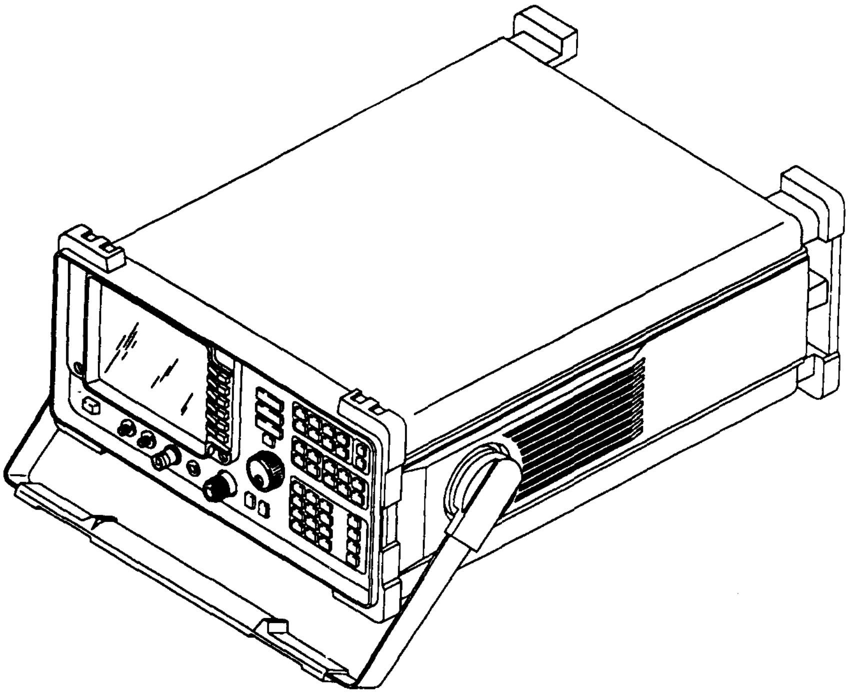
TM 11-6625-3250-40

TECHNICAL MANUAL

GENERAL SUPPORT MAINTENANCE MANUAL



EQUIPMENT DESCRIPTION PAGE 1-2

SERVICE UPON RECEIPT PAGE 2-2

SYMPTOM INDEX PAGE 2-4

MAINTENANCE PROCEDURES PAGE 2-268

SUBJECT INDEX PAGE INDEX-1

SPECTRUM ANALYZER
AN/USM-489A
(NSN 6625-01-259-1060)

WARNING This document contains technical data whose eport is restrlcted by the Arms Export Control Act (Title 22, U.S.C. Sec 2751 *et seq.)* or Executive Order 12470. Violations of these laws are subject to severe criminal penalties.

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HEADQUARTERS, DEPARTMENT OF THE ARMY
JUNE 1994

⑤ SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

① DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

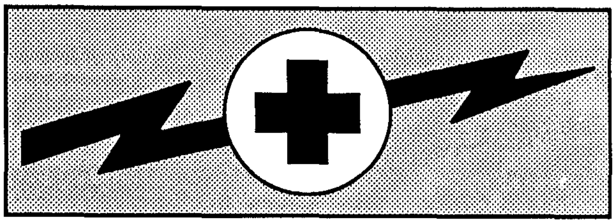
② IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

③ IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL

④ SEND FOR HELP AS SOON AS POSSIBLE

⑤ AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESPIRATION

WARNING



HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

may result if personnel fail to observe safety precautions

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When technicians are aided by operators, they must be warned about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment, after the power has been turned off, always ground every part before touching it.

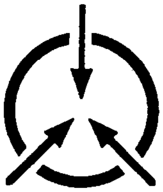
Be careful not to contact high-voltage connections of 115 or 230 volts ac input when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

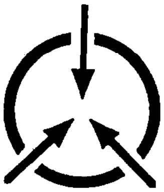
WARNING

Do not be misled by the term "LOW VOLTAGE." Potential as low as 50. volts may cause death under adverse conditions.

For Artificial Respiration refer to FM 21-11.



CAUTION



THIS EQUIPMENT CONTAINS PARTS AND ASSEMBLIES SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). USE ESD PRECAUTIONARY PROCEDURES WHEN TOUCHING, REMOVING OR INSERTING CIRCUIT CARD ASSEMBLIES.

ESD
CLASS 1

NOTE

The symbol for static sensitive devices in military inventory is as depicted in the caution block above.

GENERAL HANDLING PROCEDURES FOR ESDS ITEMS

- USE WRIST GROUND STRAPS OR MANUAL GROUNDING PROCEDURES
- KEEP ESDS ITEMS IN PROTECTIVE COVERING WHEN NOT IN USE
- GROUND ALL ELECTRICAL TOOLS AND TEST EQUIPMENT
- PERIODICALLY CHECK CONTINUITY AND RESISTANCE OF GROUNDING SYSTEM
- USE ONLY METALIZED SOLDER SUCKERS
- HANDLING ESDS ITEMS ONLY IN PROTECTED AREAS

MANUAL GROUNDING PROCEDURES

- MAKE CERTAIN EQUIPMENT IS POWERED DOWN
- TOUCH GROUND PRIOR TO REMOVING ESDS ITEMS
- TOUCH PACKAGE OF REPLACEMENT ESDS ITEM TO GROUND BEFORE OPENING
- TOUCH GROUND PRIOR TO INSERTING REPLACEMENT ESDS ITEMS

ESD PROTECTIVE PACKAGING AND LABELING

- INTIMATE COVERING OF ANTISTATIC MATERIAL WITH AN OUTER WRAP OF EITHER TYPE 1 ALUMINIZED MATERIAL OR CONDUCTIVE PLASTIC FILM OR HYBRID LAMINATED BAGS HAVING AN INTERIOR OF ANTISTATIC MATERIAL WITH AN OUTER METALIZED LAYER
- LABEL WITH SENSITIVE ELECTRONIC SYMBOL AND CAUTION NOTE

CAUTION

Devices such as CMOS, NMOS, MNOS, VMOS, HMOS, thin-film resistors PMOS, and MOSFET used in many equipments can be damaged by static voltages present in most repair facilities. Most of the components contain internal gate protection circuits that are partially effective, but sound maintenance practice and the cost of equipment failure in time and money dictate careful handling of all electrostatic sensitive components.

The following precautions should be observed when handling all electrostatic sensitive components and units containing such components.

CAUTION

Failure to observe all of these precautions can cause permanent damage to the electrostatic sensitive device. This damage can cause the device to fail immediately or at a later date when exposed to an adverse environment.

STEP 1 Turn off and/or disconnect all power and signal source and loads used with the unit.

STEP 2 Place the unit on grounded conductive work. surfaces.

STEP 3 Ground the repair operator using a conductive wrist strap or other device using a 1-M series resistor to protect the operator.

STEP 4 Ground any tools (including soldering equipment) that will contact the unit. Contact with the operator's hand provides a sufficient ground for tools that are-otherwise electrically isolated.

STEP 5 All electrostatic sensitive replacement components are shipped in conductive foam or tubes and must be stored in the original shipping container until installed.

STEP 6 When these devices and assemblies are removed from the unit, they should be placed in the conductive work surface or in conductive containers.

STEP 7 When not being worked on, wrap disconnected circuit boards in aluminum foil or in plastic bags that have been coated or impregnated with a conductive material.

STEP 8 Do not handle these device unnecessarily or remove from their packages until actually used or tested.

Technical Manual

No. 11-6625-3250-40

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 23 June 1994

GENERAL SUPPORT MAINTENANCE MANUAL FOR SPECTRUM ANALYZER AN/USM-489A (NSN 6625-01-259-1060)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, U.S. Army Missile Command, ATTN: AMSMI-MMC-LE-FP, Redstone Arsenal, AL 35898-5238. A reply will be furnished to you.

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

HOW TO USE THIS MANUAL

This manual tells about the AN/USM-489A Spectrum Analyzer and contains instructions about how to use it during maintenance on other electronic equipment.

The technical manual for the electronic equipment being maintained will tell where to make certain connections and when to use various accessories which are part of the AN/USM-489A.

When first receiving the AN/USM-489A, start at the front of the manual and go all the way through to the back. Become familiar with every part of the manual and the AN/USM-489A.

This manual has an edge index which will help find specific information in a hurry. Simply spread the pages on the right edge of the manual until the printed blocks can be seen. Open the manual where the block on the edge of the page lines up with the selected topic printed on the front cover block.

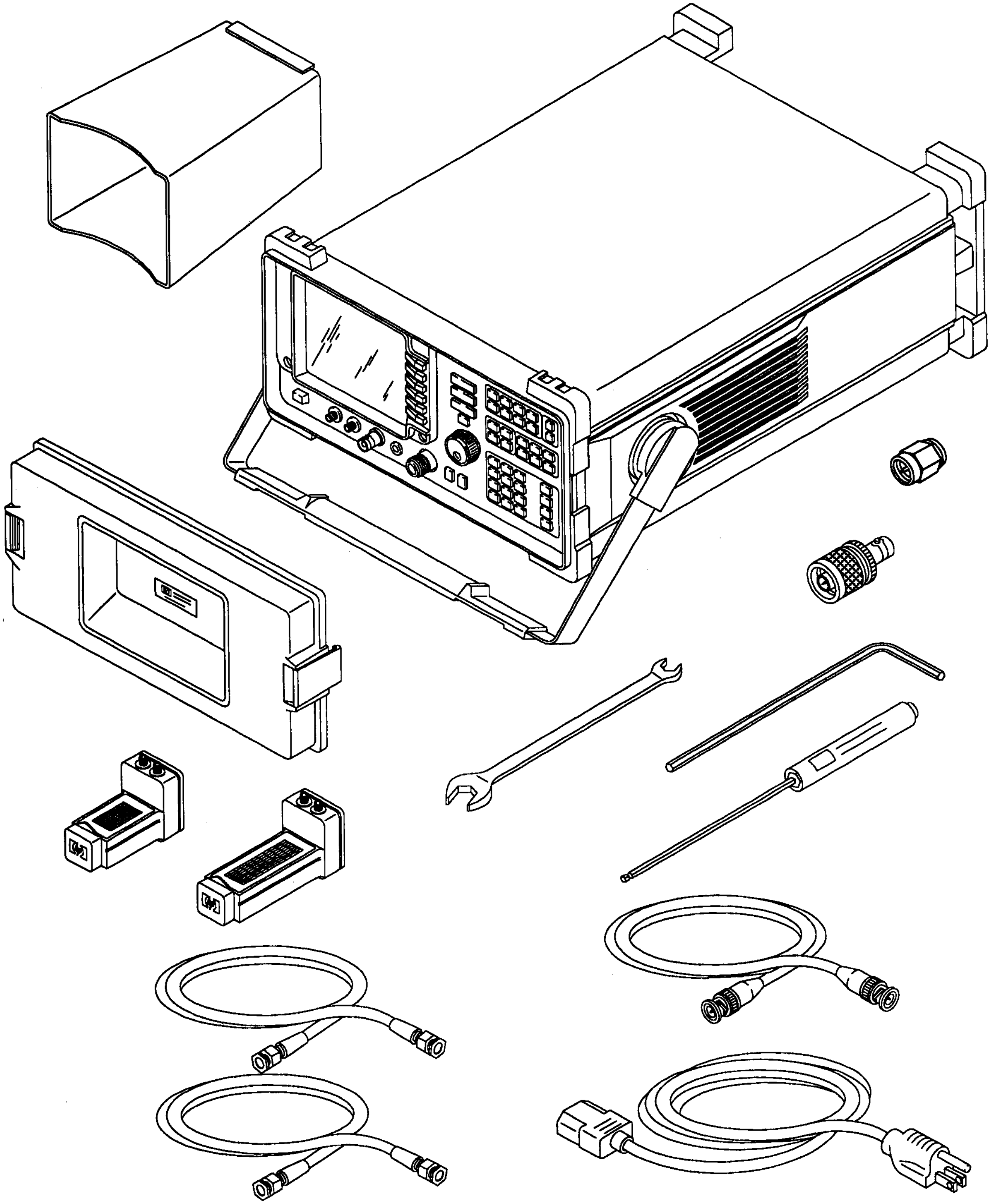


Figure 1-1. Spectrum Analyzer AN/USM-489A.

CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

1-1. SCOPE.

a. *Type of Manual:* General Support Maintenance Manual.

b. Equipment Name and Model Number: Spectrum Analyzer AN/USM-489A (Hewlett-Packard model number 8562A).

c. Purpose of Equipment: The Spectrum Analyzer is designed to measure signals from -119.9 dBm to +30 dBm over a frequency range of 10 kHz to 22 GHz. Two external mixers (supplied) increase frequency range to 40 GHz.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS.

Refer to the latest issue of DA Pam 25-30 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS.

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750 as contained in the Maintenance Management Update. Air Force personnel will use AFR 66-1 for maintenance reporting and TO-00-35D54 for unsatisfactory equipment reporting. Navy personnel will report maintenance performed utilizing the Maintenance Data Collection Subsystem (MDCS) IAW OPNAVINST 4790.2, Vol 3 and unsatisfactory material/conditions (UR submissions) IAW OPNAVINST 4790.2, Vol 2, chapter 17.

b. Report of Item and Packaging Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/SECNAVINST 4355.18/AFR 400-54/MCO 4430.3J.

c. Transportation Discrepancy Report (TDR)(SF 361). Fill out and forward Transportation Discrepancy Report (TDR)(SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 4500.15.

1-4. DESTRUCTION OF ARMY ELECTRONICS MATERIEL TO PREVENT ENEMY USE.

Destruction of Army materiel to prevent enemy use is described in TM 750-244-2.

1-5. NOMENCLATURE CROSS-REFERENCE LIST.

Common names will be used when the Spectrum Analyzer AN/US M-489A is mentioned in this manual.

NOTE

Official nomenclature must be used when filling out report forms or looking up technical manuals.

Common Name	***Official Nomenclature***
Analyzer	Spectrum Analyzer AN/USM-489A
Spectrum Analyzer	Spectrum Analyzer AN/USM-489A
AN/USM-489A	Spectrum Analyzer AN/USM-489A

1-6. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR'S).

If your Spectrum Analyzer AN/USM-489A needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF368 (Product Quality Deficiency Report). Mail it to us at: Commander, US Army Missile Command, ATTN: AMSMI-RD-QA-CF, Redstone Arsenal, AL 35898-5290. We'll send you a reply.

1-7. WARRANTY INFORMATION.

The Spectrum Analyzer is warranted by Hewlett-Packard Company for one year. Warranty starts on the date of shipment to the original buyer. Report all defects in material or workmanship to your supervisor who will take appropriate action.

Section II. EQUIPMENT DESCRIPTION

1-8. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

a. CHARACTERISTICS.

- Small physical size.
- Lightweight.
- Portable.
- Designed for bench top use.

b. CAPABILITIES AND FEATURES.

-119.9 dBm to +30 dBm signal range.

10 kHz to 22 GHz frequency range

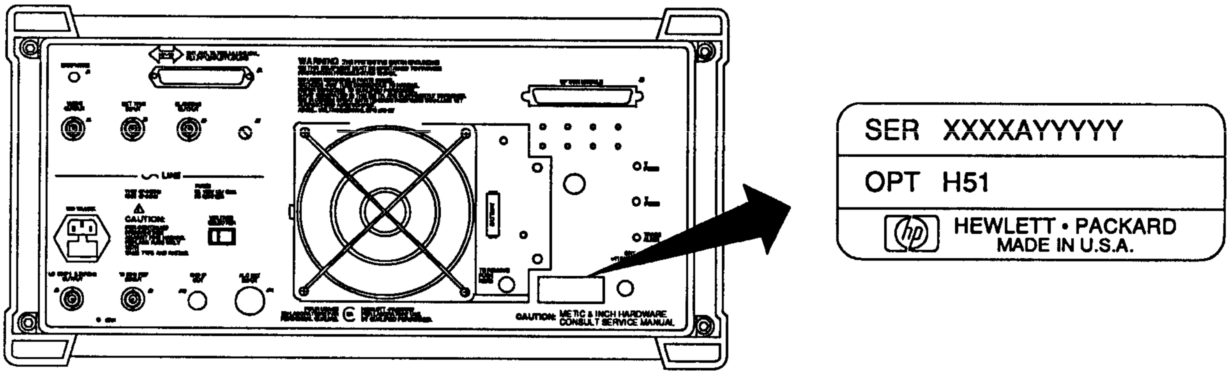
18 GHz to 40 GHz frequency range using external mixers (supplied).

Pushbutton control allows for easy operation of equipment.

- CRT Screen on front panel for constant measurement and equipment status.
- Built-in fault analysis programs with extensive self-adjustment routines.
- Battery backup for saving traces, setups, and configurations.
- Programmed interface for remote operation.

1-9. DIFFERENCE BETWEEN MODELS.

There are 25 different AN/USM-489A versions fielded at this time. While there are no operational differences between versions, there are internal differences that are maintenance significant. The different versions are identified using the manufacturers five-digit serial number prefix. Location and form of the manufacturers serial number prefix is shown below, along with all of the serial number prefixes cross-referenced to the assembly or assemblies that caused the change. Chapter 2 contains the specific details for all configurations.



AN/USM-489A Serial Prefix	"X" Indicates Assembly Part Number Change																		
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19
2929A																			
2950A					X														
2952A																			
3006A														X					
3017A															X				
3027A				X															
3029A															X				
3040A			X																
3043A																			
3051A																			
3115A		X	X																
3119A						X											X	X	
3120A															X				
3121A			X																
3129A		X																	
3133A																			
3136A														X					
3137A															X				
3148A																	X		
3204A	X		X																
3127A															X				
3226A																	X		
3236A		X																	
3306A					X														

1-10. EQUIPMENT DATA.

WEIGHTS AND DIMENSIONS

Net Weight	44lb(19kg)
Depth	18.00 in. (460.5 mm)
Width	14.00 in. (373mm)
Height	8.00 in. (200mm)

POWER REQUIREMENTS

115 Vac Operation:

Voltage	90 to 140 Vac
Current	3.2 amps rms maximum
Frequency	47 to 440 Hz
Power	180 watts maximum

230 Vac Operation:

Voltage	180 to 250 Vac
Current	1.8 amps rms maximum
Frequency	47 to 66 Hz
Power	180 watts maximum

Fuse Rating:

115 Vac operation	5.0 amp, 125 volt
230 Vac operation	5.0 amp, 250 volt

ENVIRONMENTAL

Operating temperature range	-10 to +55°C
Storage temperature range	-62 to +85°C

Relative humidity:

+ 40°C (for five days)	95% maximum

Rain Resistance..	Drip-roof at 16 liters/hour/squarefoot
Operating altitude	0 to 15,000 feet (4,500 m)
Storage altitude	0 to 50,000 feet (15,000m)
Vibration (operating)	5 to 55 Hza to 0.020 in. peak-to-peak excursion
Shock (non-operating)	30g, 11 ms (half-sine)

PERFORMANCE

Frequency:

Range:

Internal Mixing	10 kHz to 22 GHz
Harmonic Mixing Mode (N*) 1-	10 kHz to 2.9GHz
Harmonic Mixing Mode (N*) 1-	2.75 GHz to 6.46 GHz
Harmonic Mixing Mode (N*) 2-	5.86 GHz to 13.O GHZ
Harmonic Mixing Mode(N*)3-	12.4 GHz to 19.7 GHz
Harmonic Mixing Mode(N*)4-	19.1 GHz to 22. 0 GHz
External Mixing	18 GHz to 40.0 GHz
Harmonic Mixing Mode (N*) 6- (using 11970K)	18.0 to 26.5 GHz
Harmonic Mixing Mode (N*) 8- (using 11970A)	26.5 to 40.0 GHz

PERFORMANCE—Continued

Readout Accuracy (START, CENTER, STOP or MARKER) .... $< \pm (f_r \times f_{ra} + 5\%$ of $f_s + 15\%$ of $r_b + 250$ Hz$)^{**}$

Count Marker:

Resolution .... Selectable from 10 Hz to 1 MHz
Accuracy (S/NR ≥25 dB) .... $< \pm (m_f \times f_{ra} + 50$ Hz x N* + 1 LSD$)^{**}$
Delta Frequency Count Accuracy (S/NR ≥ 25 dB) .... $< \pm (d_f \times f_{ra} + 100$ Hz x N* + 2 LSD$)^{**}$

Frequency Reference Accuracy (includes aging, temperature drift, and settability) .... $\pm 4 \times 10^{-6}$ per year

Stability:

Residual FM (zero span) .... < 50 Hz x N* peak-to-peak in 20 ms
Spectral Purity/Noise Sidebands:

9 kHz offset .... < – 70 dBc
Drift

≤100 kHz SPAN .... < 50 Hz X N* per minute of sweep time
101 kHz to ≤1 MHz SPAN .... < 2 kHz X N* per minute of sweep time

Span:

Range:

Internal Mixing 0 Hz, 2.5 kHz x N* to 19.25 GHz (over the 10-division CRT horizontal axis, variable in approximately 1% increments, or in a 1, 2, 5 sequence)
External Mixing .... Minimum span = 2.5 kHz x N*

Accuracy (spans ≥10 kHz) .... < ± 5%

Resolution Bandwidths (–3 dB)

Range .... 100 Hz to 1 MHz (selectable in a 1, 3, 10 sequence) and 2 MHz
Accuracy:

1 and 2 MHz RES BW .... < ± 25%
300 kHz to 300 Hz RES BW .... < ± 10%
100 Hz RES BW .... < ± 30%

Selectivity (60 dB/3 dB bandwidth ratio) .... < 15:1
Bandwidth Shape .... Synchronously tuned, 4-pole filters

Amplitude/Measurement Range:

Video Bandwidth .... 1 Hz to 3 MHz in a 1, 3, 10 sequence
Maximum Safe Input Power

Average Continuous Power (input attenuation ≥10 dB) .... + 30 dBm (1 watt)
Peak Pulse Power (input attenuation ≥30 dB) .... + 50 dBm (100 watts) for < 10 µs and < 1% duty cycle
DC .... 0 volts

Gain Compression:

10 MHz to 2.9 GHz (≤–5 dBm at input mixer) .... < 1.0 dB
2.9 GHz to 22 GHz (≤–3 dBm at input mixer) .... < 1.0 dB

---

* N is harmonic mixing mode. The desired 1st Local Oscillator (LO) harmonic is always higher than the tuned frequency by the 1st Intermediate Frequency (IF) frequency (3.9107 for the 10 kHz to 2.9 GHz band, and 310.7 MHz for all other bands).

** d_f=delta frequency, f_r=frequency readout, f_{ra}=frequency reference accuracy, f_s=frequency span, m_f=marker frequency, r_b=resolution bandwidth

PERFORMANCE—Continued

Displayed Average Noise Level (no signal at input, 100 Hz RES BW, and 0 dB input attenuation):

10 kHz	< – 90 dBm
100 kHz	< – 100 dBm
1 MHz to 2.9 GHz	< – 120 dBm
2.9 GHz to 6.46 GHz	< – 121 dBm
6.46 GHz to 13.0 GHz	< – 110 dBm
13.0 GHz to 19.7 GHz	< – 105 dBm
19.7 GHz to 22.0 GHz	< – 100 dBm

Spurious Responses (all input-related spurious responses, with ≤–40 dBm mixer level***):

10 MHz to 6.46 GHz	< – 60 dBc

Second Harmonic Distortion:

10 MHz to 2.9 GHz	< – 72 dBc, – 40 dBm mixer level***
2.75 GHz to 22.0 GHz	< – 100 dBc, – 10 dBm mixer level***

Third Order Intermodulation Distortion (two –30 dBm input signals at the input mixer***):

10 MHz to 2.9 GHz	< – 70 dBc
2.75 GHz to 6.5 GHz	< – 75 dBc

Image, Multiple, and Out-of-Band Responses:

10 MHz to 18 GHz	< – 70 dBc
10 MHz to 22 GHz	< – 60 dBc

Residual Responses (no signal at input, 0 dB input attenuation):

200 kHz to 6.46 GHz	< – 90 dBm
6.46 GHz to 33 GHz	< – 70 dBm

Amplitude Measurement/Display Range:

Amplitude Scale	10 vertical CRT divisions, with reference level (0 dB) at top graticule line

Calibration:

Log (display expanded from reference level):

90 dB	10 dB/DIV
50 dB (digital display mode,≥30 ms sweep only)	5 dB/DIV
20 dB	2 dB/DIV
10 dB (digital display mode,≥30 ms sweep only)	1 dB/DIV

Linear	10% of reference level per div (when calibrated in voltage)

Reference Level Range:

Log (adjustable in 0.1 dB steps):

10 kHz to 2.9 GHz	– 120 dBm to + 30 dBm
2.75 GHz to 6.46 GHz	– 120 dBm to + 30 dBm
5.86 GHz to 13.0 GHz	– 115 dBm to + 30 dBm
12.4 GHz to 19.7 GHz	– 105 dBm to + 30 dBm
19.1 GHz to 22.0 GHz	– 100 dBm to + 30 dBm

Linear (settable in 1% steps):

10 kHz to 2.9 GHz	2.2 µV to 7.07 V
2.75 GHz to 6.46 GHz	2.2 µV to 7.07 V
5.86 GHz to 13.0 GHz	4.0 µV to 7.07 V
12.4 GHz to 19.7 GHz	12.6 µV to 7.07 V
19.1 GHz to 22.0 GHz	22.0 µV to 7.07 V

*** Mixer level = input level – input attenuation

PERFORMANCE—Continued

Amplitude Accuracy/Reference Level Uncertainty:

Frequency Response (10 dB input attenuation), referenced to CAL OUTPUT (300 MHz):

10 kHz to 19.7 GHz .... < ± 6.1 dB

Calibrator Uncertainty (−10 dBm, 300 MHz) .... < ± 0.3 dB

Input Attenuator Switching Uncertainty (0 to 70 dB, referenced to 10 dB input attenuation):

10 kHz to 22.0 GHz .... < ± 1.8 dB/10 dB step, 3.5 dB max.

IF Gain Uncertainty (0 dBm to −80 dBm reference level, 10 dB input attenuation) .... < ± 1.0 dB

Resolution Bandwidth Switching Uncertainty (referenced to 300 kHz RES BW) .... < ± 0.5 dB

IF Alignment Uncertainty (when using 100 Hz and 300 Hz RES BW):

100 Hz RES BW .... < ± 2.0 dB

300 Hz RES BW .... < ± 0.5 dB

Pulse Digitization Uncertainty (pulse response mode, PRF>720/sweep time):

Log:

RES BW ≤1 MHz .... < 1.25 dB peak-to-peak

RES BW 2 MHz .... < 3 dB peak-to-peak

Linear:

RES BW ≤1 MHz .... < 4% of reference level peak-to-peak

RES BW of 2 MHz .... < 12% of reference level peak-to-peak

Marker (measured at 300 MHz) .... < ± 3.3 dB

Radio Frequency (RF) Input VSWR (at tuned frequency with >10 dB input attenuation):

10 MHz to 2.9 GHz .... < 1.5:1

2.9 GHz to 19.4 GHz .... < 2.3:1

Amplitude Accuracy/Scale Fidelity:

Log (from reference level to a maximum of ±1.5 dB over 0 to 90 dB range) .... < ± 0.4 dB/4 dB

Linear .... < ± 3% of reference level

Sweep:

Time:

Range:

Span = 0 .... 50 µs to < 30 ms (analog display)

Span = 0 .... 30 ms to 60 s (digital display)

Span ≥ 2.5 kHz x N* .... 50 ms to 100 s (digital display)

Accuracy (Span = 0):

30 ms ≤sweep time ≤60 seconds .... < ± 1%

Sweep time <30 ms .... < ± 15%

Sweep Trigger .... Free Run, Single, Line, Video, External

Demodulation (typical):

Type .... AM and FM

Audio Output .... Internal speaker and phone jack with volume control

Marker Pulse Time .... 100 ms to 60 sec

---

* N is harmonic mixing mode. The desired 1st LO harmonic is always higher than the tuned frequency by the 1st IF frequency (3.9107 for the 10 kHz to 2.9 GHz band, and 310.7 MHz for all other bands).

PERFORMANCE—Continued

Front Panel Connectors:

1st LO OUTPUT:

Connector	SMA female
Impedance	50 Ω
Frequency Range (typical)	3.0000 GHz to 6.8107 GHz
Amplitude	+ 16.5 dBm ± 2.0 dB (20°C to 30°C)

IF INPUT:

Connector type	SMA female
Impedance	50 Ω
Frequency (typical)	310.7 MHz
Noise Figure (typical)	7 dB
1 dB Gain Compression Level (typ, 0 dBm reference level, 30 dB conversion loss)	– 23 dBm
Input level for full-screen deflection (external mixing mode, 0 dBm reference level, 30 dB conversion loss)	– 30 dBm ± 1.5 dB

CAL OUTPUT:

Connector	BNC female
Impedance	50 Ω
Frequency	300 MHz ± (300 Hz x f_{ra})**
Amplitude	– 10 dBm + 0.3 dB

PROBE POWER:

Voltage (typical)	+ 15 Vdc, –12.6 Vdc
Current (typical)	150 mA max., each

INPUT 50Ω:

Connector type	Precision Type N female
Input level	+ 30 dBm, 1 watt, 0 Vdc
Impedance	50 Ω

Rear Panel Connectors:

EARPHONE:

Connector	1/8 inch miniature monophonic jack
Power Output	0.25 watts into 4 Ω

HP-IB:

Connector	IEEE 488 bus connector
Interface Functions	SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP1, DC1, DT0, C1, C28, E1

VIDEO OUTPUT:

Connector	BNC female, rear panel
Impedance (DC coupled)	50 Ω
Amplitude (typical into 50 Ω load)	0 to + 1 volt full-scale
Scale (typical)	Linear or Log 100 dB/V

EXT TRIG INPUT:

Connector	BNC female, rear panel
Impedance	10 kΩ
Trigger Level	Rising edge of TTL Level

** d_f=delta frequency, f_r=frequency readout, f_{ra}=frequency reference accuracy, f_s=frequency span, m_f=marker frequency, r_b=resolution bandwidth

PERFORMANCE—Continued

Rear Panel Connectors – Continued:

BLANKING OUTPUT:

Connector	BNC female, rear panel
Amplitude (typical):	
during SWEEP	Low TTL Level (sink 150 mA max.)
during RETRACE	High TTL Level (source 0.5 mA max.)
Maximum input (typical, high TTL state)	+40 V

LO SWP|0.5 V/GHz OUTPUT:

Connector	BNC female, rear panel
Impedance (DC coupled)	2 kΩ
LO SWP OUTPUT (typical, no load)	0 to +10 V
0.5 V/GHz OUTPUT (typical, no load)	0.5 V/GHz of tuned frequency

10 MHz REF IN/OUT:

Connector	BNC female, rear panel
Impedance	50 Ω
Output Amplitude (typical)	0 dBm
Input Amplitude (typical)	– 2 to + 10 dBm
Frequency	10 MHz ± (10 MHz x f_{ra})**

** d_f=delta frequency, f_r=frequency readout, f_{ra}=frequency reference accuracy, f_s=frequency span, m_f=marker frequency, r_b=resolution bandwidth

1-11. SAFETY, CARE, AND HANDLING.

Observe all WARNINGS, CAUTIONS, and NOTES in this manual. This equipment can be extremely dangerous if these instructions are not followed.

Section III. PRINCIPLES OF OPERATION

1-12. GENERAL FUNCTIONAL DESCRIPTION.

The AN/USM-489A Spectrum Analyzer is a (Figure 1-1) is a complete, self-contained device capable of measuring signals from -119.9 to +30 dBm at from 10 kHz to 22 GHz. Frequency range is increased to 40 GHz by use of external mixers (supplied). It is functionally organized into six groups, and physically organized into 19 assemblies.

The six functional groups are as follows (fig. 1-2):

- RF Section
- Synthesizer Section
- IF Section
- ADC/interface Section
- Controller Section
- Display/Power Supply Section

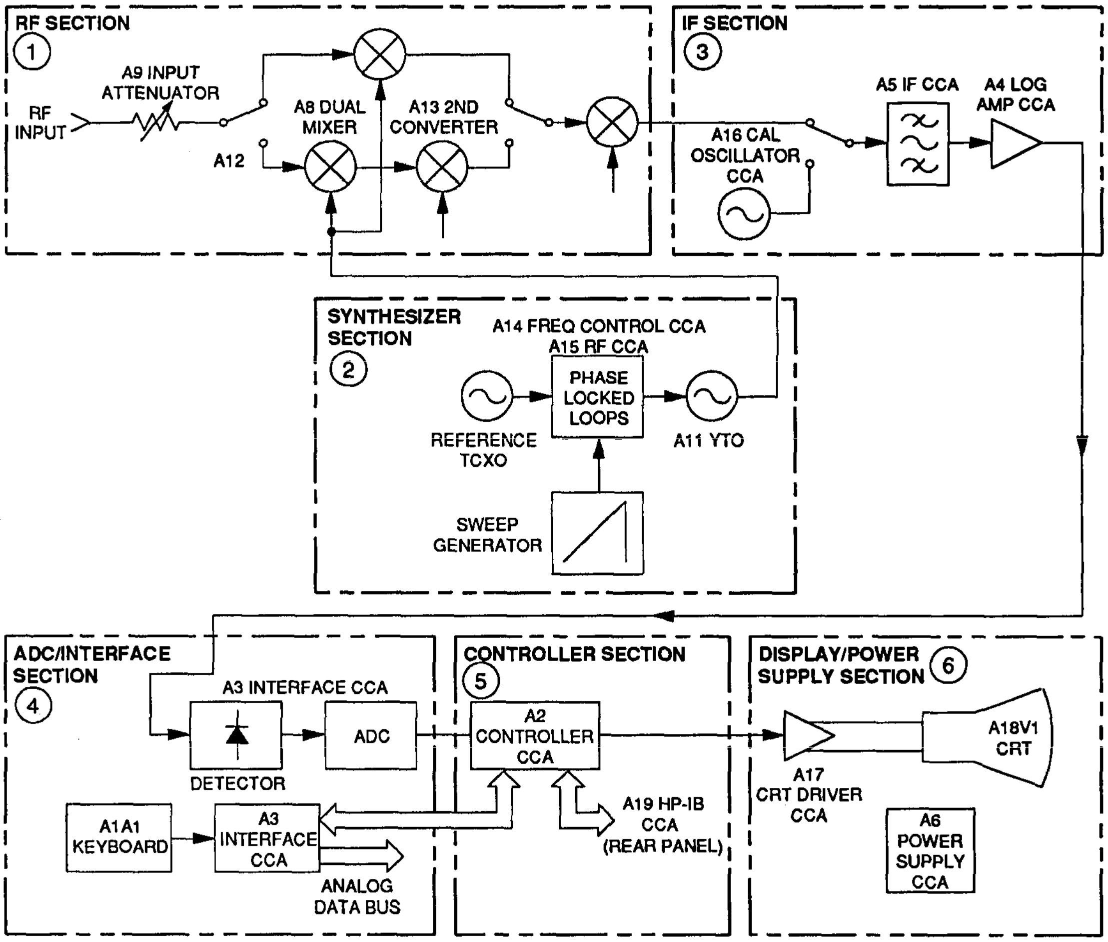


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Figure 1-2. AN/ US M-489A Functional Sections

Operationally, each functional group (fig. 1-2) consist of Circuit Card Assemblies (CCAS) and microwave components.

1 The RF Section converts all input signals (10 kHz to 22 GHz) to a fixed Intermediate Frequency (IF) of 10.7 MHz. This IF signal is routed to the IF Section for processing. Reference and control signals are provided by the Synthesizer and Controller Sections, respectively. Internal or External mixing depends on the input frequency (two external mixers are supplied). Routing of the input signal depends on the input frequency, mixer (internal or external), and connector (INPUTor IF INPUT) used.

2 The Synthesizer Section generates the necessary reference signals used by the Spectrum Analyzer. Control signals are provided by the Controller Section. All reference signals are phased locked to the internal 10 MHz Temperature Controlled Crystal Oscillator (TCXO), or external reference (if connected).

3 The IF Section processes the 10.7 MHz IF signal from the RF Section. Control signals are provided by the Controller Section. The incoming IF signal is filtered and amplified, and the detected video output is routed to the ADC/interface Section for measurement. If selected, demodulated audio (AM or FM) is amplified and routed to the speaker. The CAL oscillator provides a 10.7 MHz signal for automatic IF adjustments.

4 The ADC/interface Section links the Controller Section with the operator and all the other sections in the Spectrum Analyzer.

5 The Controller Section provides overall control of the internal circuitry in the Spectrum Analyzer. Data and control signals are sent to/received from all the other sections as required to perform all Spectrum Analyzer functions. Also contains the circuits that allow the Spectrum Analyzer to be operated remotely using an external controller connected to the rear panel Hewlett-Packard Interface Bus (HPIB) connector.

6 The Display/Power Supply Section provides the Spectrum Analyzer with a visual display, and the necessary internal power required for normal operation.

1-13. DETAILED FUNCTIONAL DESCRIPTION.

The following is a detailed functional description of all AN/US M-489A functional groups. The simplified block diagram (fig. FO-4) and functional block diagram (fig. FO-5) shows the CCAS and components, and how they relate to the higher functional groups. In addition, detailed functional block diagrams are provided for each functional group (referenced below).

a. RF Section. The RF Section (fig. FO-24) converts all input signals to a fixed IF of 10.7 MHz. The RF Section's microcircuits are controlled by signals from the A14 Frequency Control CCA and A15 RF CCA. Five frequency bands cover the input range as follows:

Band 0	10 kHz to 2.9 GHz
Band 1	2.75 GHz to 6.3 GHz
Band 2	5.86 to 13.0 GHz
Band 3	12.4 GHz to 19.7GHz
Band 4	19.1 GHz to 22.0 GHz

Band 0 (low band) uses triple conversion to produce the final 10.7 MHz IF. The A8 Dual Mixer up-converts the RF input to a first IF of 3.9107 GHz. The A13 Second Converter down-converts the 3.9107 GHz IF to an IF of 310.7 MHz. A third conversion on the A15 RFCCA down-converts the second IF to the final 10.7 MHz third IF.

Bands 1 through 4 (high bands) use double conversion. A8 Dual Mixer down-converts the RF input to a first IF of 310.7 MHz. Although this IF passes through A13 Second Converter, it bypasses the second mixer. The second and final conversion occurs in the third converter where the second IF is down-converted to produce the final 10.7 MHz IF.

The RF Section consists of the following assemblies:

- A7 LO Distribution Amplifier (LODA) Assembly
- A8 Dual Mixer Assembly
- A9 Input Attenuator Assembly
- A10 YIG-Tuned Filter (YTF) Assembly
- A11 YIG-Tuned Oscillator (YTO) Assembly
- A12 RF Switch Assembly
- A13 Second Converter Assembly
- A14 Frequency Control CCA (also in Synthesizer Section)
- A15 RF CCA (also in Synthesizer Section)
- FL1, 2, and 3 Low Pass Filters

A7 LO DIstribution Amplifler (non-repairable). The A7 LODA levels the output of the A11 YTO and distributes the power to the front-panel 1ST LO OUTPUT, A8 Dual Mixer, and A15U1OO Sampler. The leveling circuitry is provided by the A14 Frequency Control CCA.

NOTE

YTO unlock errors may occur if the power delivered to the A15U100 Sampler is less than -9.5 dBm. Frequency response will be degraded in both internal and external mixing modes if output power is low or unleveled.

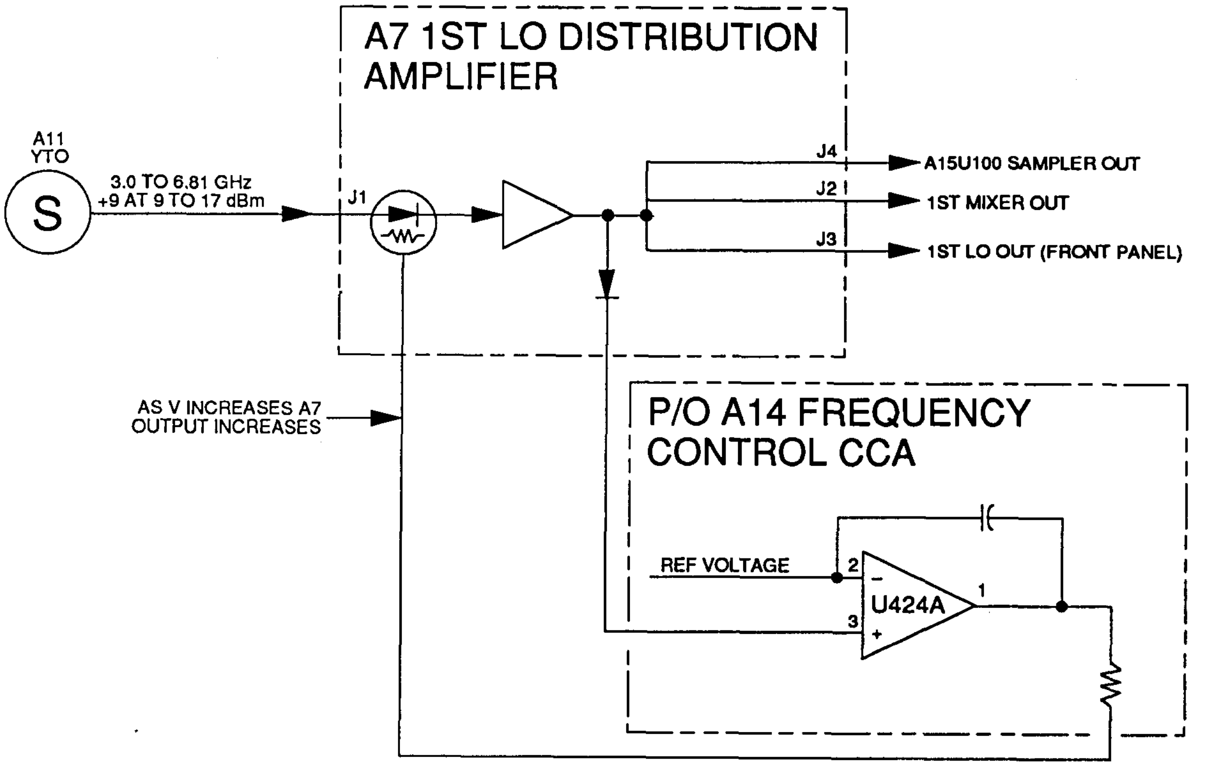

Figure 1-3. A7 LO Distribution Amplifier Drive

A8 ***Dual Mixer (non-repairable).*** The A8 Dual Mixer Assembly contains two separate mixers; one for low band and one for high band. The low-band mixer is de-coupled and contains a limiter. The high-band mixer uses ac coupling. A PIN diode switch (controlled by the A14 Frequency Control CCA) directs the 1st LO to the appropriate mixer.

A9 ***Input Attenuator (non-repairable).*** The attenuator is a **50Ω** precision, coaxial step attenuator. Attenuation in 10 dB steps from 0 dB to 70 dB is accomplished by switching the signal path through one or more of four resistive pads. The attenuator automatically sets to 70 dB when the AN/USM-489A turns off, providing ESD protection.

A1O Y/G-Tuned Filter (non-repairable). The YTF is a tracking preselector that performs as a tunable bandpass filter for high band signals. Coarse frequency control originates from slope and offset Digital-to-Analog Converters (DACs) located on the A14 Frequency Control CCA. Slope and offset DAC values are loaded into EEROM for each of the four high bands.

Fine frequency control originates from a preselector peak DAC located on the A3 Interface CCA. Values for the preselector peak DAC are interpolated approximately every 17 MHz based upon data taken during the YTF and Frequency Response adjustment.

The preselector's bandwidth varies from 25 MHz, at 2.75 GHz, to approximately 40 MHz, at 22 GHz.

A12 ***RF Switch (non-repairable).*** The A12 RF Switch is a latching switch, meaning that current flows only during the switching period. The switch directs the RF input to either the low-band or high-band paths,

A13 ***2nd Converter (non-repairable).*** In low band, the A13 2nd Converter down-converts the 3.9107 GHz 1st IF to a 310.7 MHz 2nd IF. In high band, it passes the 310.7 MHz 1st IF from the A8 Dual Mixer to the A15 RF CCA. The converter generates a 3.6 GHz second LO by multiplying a 600 MHz reference. Bandpass filters remove unwanted harmonics of the 600 MHz driving signal. First IF and 2nd LO signals are filtered by cavity filters.

A14 ***Frequency Control CCA (limited repair).*** The A14 Frequency Control CCA (fig. FO-26 and FO-27) provides a different high-band bias for each band. This bias minimizes second- and third-order distortion and conversion loss. The AN/USM-489A stores the bias values in Electrically Erasable Read Only Memory (EEROM). The circuits contained on the A14 Frequency Control CCA are the A7 LODA Drive (circuit Z), Band-Switch Driver Control Latch (circuit AA), and YTF Driver circuits.

The YTF driver circuit consists of Sweep + Tune Multiplier (circuit Q), Frequency Analog Voltage (FAV) Generator (circuit R), YTF Gain and Offset (circuit S), and YTF Drive (circuit T) circuits. The FAV Generator generates the 0.5 V/GHz signal. The YTF driver circuitry can be half-split by checking the rear-panel's 0.5 V/GHz output.

The Sweep + Tune Multiplier (circuit Q) takes tune information (YTO start frequency) and sweep (based on LO span) and multiplies it so that it is correct for the appropriate YTF band.

The FAV Generator's (circuit R) sample-and-hold switch, A14U415B and A14C31 , hold the YTF steady during retraces between multiband sweeps. Switch A14U415C and A14R94 provide the YTF dehysteresis pulse. In high band, amplifier A14U402A provides an offset voltage to account for the 310.7 MHz offset (A14U415A open) between the desired harmonic of the YTO frequency and the center frequency. In low band, switch A14U415A is closed to account for the 3.9107 GHz 1st IF offset between the YTO frequency and the center frequency. This signal is 0.5 V/GHz of tuned frequency and is available at the rear panel.

A15 ***RF CCA.*** The A15 RF CCA (fig. FO-29 and FO-30) contains the Third Converter which down-converts the IF to 10.7 MHz. A PIN-diode switch selects the LO signal used. For normal operation, a 300 MHz LO signal is used. The signal is derived from the Reference Phase-Locked Loop. During signal identification (SIG ID ON), the 298 MHz SIG ID Oscillator is fed to the double balanced mixer on alternate sweeps. The A15 RF CCA also contains the 10 MHz Reference.

The Third Converter consists of the Second IF Distribution (circuit A), A15U801 Second IF Amplifier (circuit B), Double Balanced Mixer (circuit C), 10.7 MHz Bandpass Filter (circuit D), and Flatness Compensation Amplifiers (circuit E), and Flatness Compensation Control (circuit G). The Second IF Distribution switches between two possible Second IF inputs: the internally generated Second IF, or the external mixing IF INPUT. A variable dc bias can be applied to the IF INPUT for external mixers which require such bias. The selected input is fed to the A15U801 Second IF Amplifier.

The A15U801 Second IF Amplifier (circuit B) is a microcircuit consisting of two stages of gain and two stages of SAW filters for image frequency rejection that amplifies and filters the second IF. A factory select attenuator (A15U802) ensures that the gain provided by the Second IF Amplifier is 12 dB ±2 dB.

The external mixing input from the front-panel's IF INPUT connector is also directed through the Second IF Amplifier. A dc bias is placed onto the IF INPUT line for biasing external mixers.

The 10.7 MHz Bandpass Filter (circuit C) provides a broadband termination to the mixer while filtering out unwanted mixer products.

The Flatness Compensation Amplifiers (circuit E) amplify the output of the double-balanced mixer. The amplifier's variable gain (8 to 32 dB) compensates for flatness variations within a band. Band conversion loss is compensated by step gain amplifiers in the IF Section. Each Flatness Compensation Amplifier consists of three fixed-gain stages and two stages of variable attenuation. This provides an overall adjustable gain of 8 to 32 dB. This gain is adjusted during an analyzer sweep to compensate for front-end conversion-loss versus frequency.

Control for the amplifiers originates from two DACs on the A3 Interface CCA. DACs eliminate the need for potentiometers. DAC values are interpolated approximately every 17 MHz based on data obtained during the YTF and Frequency Response adjustment. The A15 RF CCA flatness-compensation control circuitry converts the RF GAIN voltage, from A3, into two currents: RF GAIN 1 and RF GAIN 2. These currents drive PIN diodes in the Flatness Compensation Amplifiers.

The Flatness Compensation Control (circuit G) consists of a buffer amp (A15U901B) and two identical voltage-to-current converters (A15U901A and A15U901C). The thermistor A15RT901 in the buffer amp provides temperature compensation for the PIN diodes in the attenuator stages. The gain of the Flatness Compensation Amplifiers is driven to a minimum by the REDIR line going low during Automatic IF adjustment.

The SIG ID Oscillator (circuit F) provides a shifted third LO (298 MHz) to distinguish true signals from false signals (such as image or multiple responses). When the AN/USM-489A is set to SIG ID ON, the SIG ID Oscillator turns on during alternate sweeps.

The 10 MHz Reference (circuit K) consists of 10 MHz TCXO and distribution amplifier. The TCXO is turned off when using an EXTernal 10 MHz reference. When set to EXTernal frequency reference, line receiver A15U304B is disabled and A15U304A is on. In INTernal frequency reference, A15U304A is disabled and A15U304B is turned on.

b. *Synthesizer Section.* The Synthesizer Section (fig. 1-4) generates the necessary reference signals used by the Spectrum Analyzer.

The Synthesizer Section consists of the following assemblies:

- A7 LODA Assembly
- A11 YTO Assembly
- A14 Frequency Control CCA (also in RF Section)
- A15 RF CCA (also in RF Section)

The AN/USM-489A employs lock-and-roll tuning to sweep the first LO (A11 YTO). This applies to all frequency spans and involves phase-locking the instrument to the start frequency during the retrace of the sweep, The 1st LO is then unlocked, and, when a trigger signal is detected, the 1st LO sweeps (rolls).

When there is a considerable delay between the end of one sweep and the beginning of the next, the actual 1st LO start frequency may differ from the locked start frequency. This start frequency drift will be most noticeable in a 1.01 MHz LO span (the narrowest FM coil span), but is not noticeable in either Free Run or Line Trigger modes.

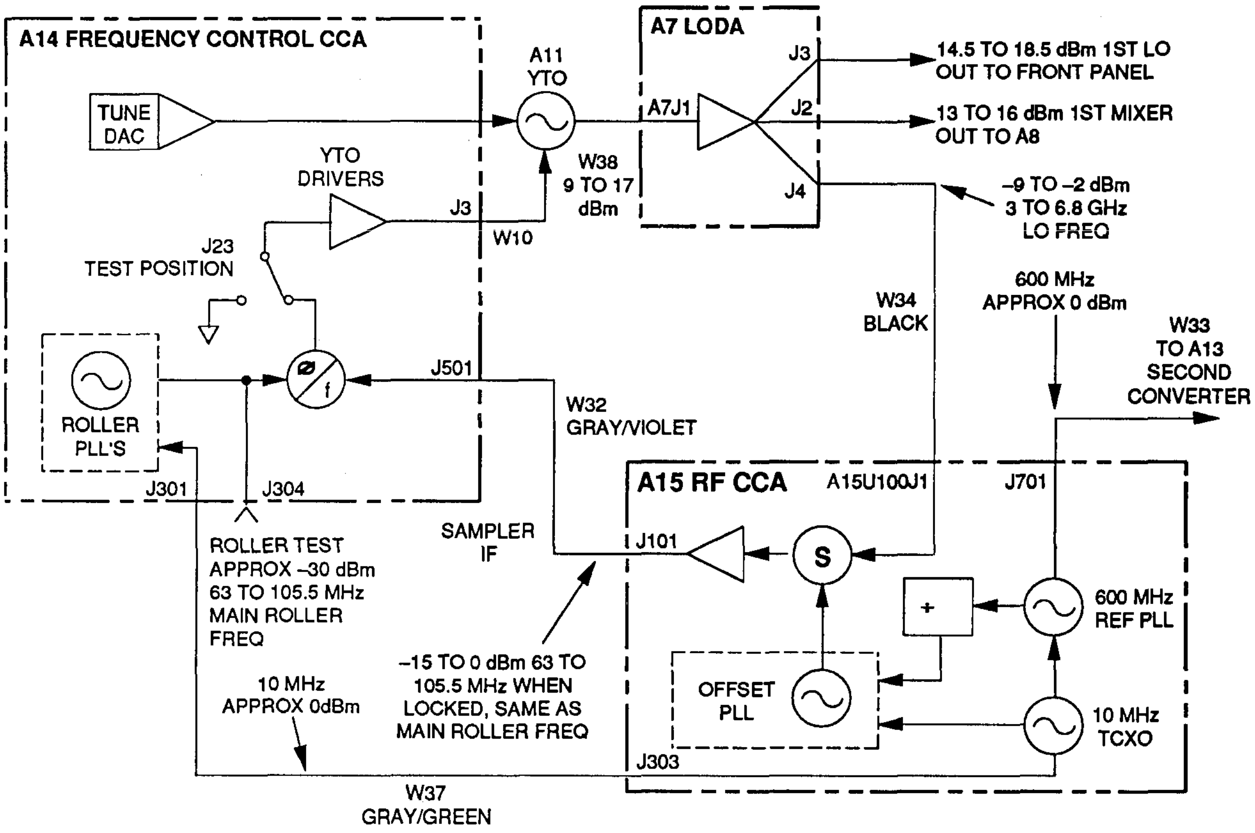

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Figure 1-4. Synthesizer Section Functional Block Diagram

The sweep ramp, generated on the A14 Frequency Control CCA , is applied to either A11 YTO's main coil, A11 YTO's FM coil, Roller Oscillator's Main Roller Phase Locked Loop (PLL), or Roller Oscillator's Offset Roller PLL depending on the desired first-LO's span. Due to harmonic mixing, this is not necessarily the same as the span setting of the instrument. The frequency/span relationships are as follows:

A11 YTO Spanwidth	Sweep Applied To
20.1 MHz to 3.8107 GHz	A11 YTO's Main coil
1.01 MHz to 20.0 MHz	A11 YTO's FM coil
100 kHz to 1 MHz	Roller Oscillator PLL's Main Roller Osc
10 kHz to 100 kHz	Roller Oscillator PLL's Offset Roller Osc

- For YTO Main coil spans, the YTO is locked at the beginning of the sweep and the sweep ramp is summed into the Main Coil Tune Driver.
- In YTO FM Coil spans, the YTO loop is locked and then opened while the sweep ramp is summed into the FM coil. FM spans are adjusted by changing the sensitivity of the FM coil driver.

- Sweeping the Roller Oscillator's Offset Roller Oscillator PLL results in sweeping the YTO'S FM coil. There is a one-to-one relationship between the roller-oscillator's frequency span and the first-LO's span.
- In LO spans <100 kHz, the Roller Oscillator PLL's Offset Roller Oscillator is swept. The Main Roller PLL remains locked to the Offset Roller's frequency divided by 100. In a 100 kHz span, the Offset Roller PLL rolls 10 MHz while the Main Roller PLL rolls 100 kHz. The YTO is locked to the Main Roller PLL and also rolls 100 kHz.
- The switching network, A14U116A, B, C and A14Q101 (fig. FO-27, Sheet 12, circuit AM) determines the Main Roller PLL's voltage source. When the oscillator is locked, A14U116A is closed to apply the PLL error voltage to the oscillator. When the oscillator is swept, A14U116A opens and A14U116C closes applying the span ramp to the oscillator. A14U116B also closes providing the same impedance to ground as during the lock mode.
- When the sweep ramp is applied to one of the PLLs, the AN/USM-489A must prevent this loop from trying to compensate for changes in the output frequency. To accomplish this, the analyzer breaks the PLL by switching the output of the PLL's phase detector to ground.

Phase Locked Loops. The All YTO (1st LO) is a YIG-Tuned Oscillator which tunes from 3.0 to 6.81 GHz. A11 is phase-locked to the AN/USM-489A's internal 10 MHz standard (on A15) by the following four phase-locked loops (PLL).

YTO PLL	located on the A7 LODA, A11 YTO, and A14 Frequency Control CCA
Roller Oscillator PLL	located on the A14 Frequency Control CCA
Offset PLL (Sampling Oscillator PLL)	located on the A15 RF CCA
Reference PLL	located on the A15 RF CCA

The Reference PLL supplies reference frequencies for the instrument. The three remaining PLLs tune and phase-lock the LO through its frequency range. To tune the LO to a particular frequency, the instrument's controller must set the programmable feedback dividers (N) and reference dividers (R) contained in each PLL.

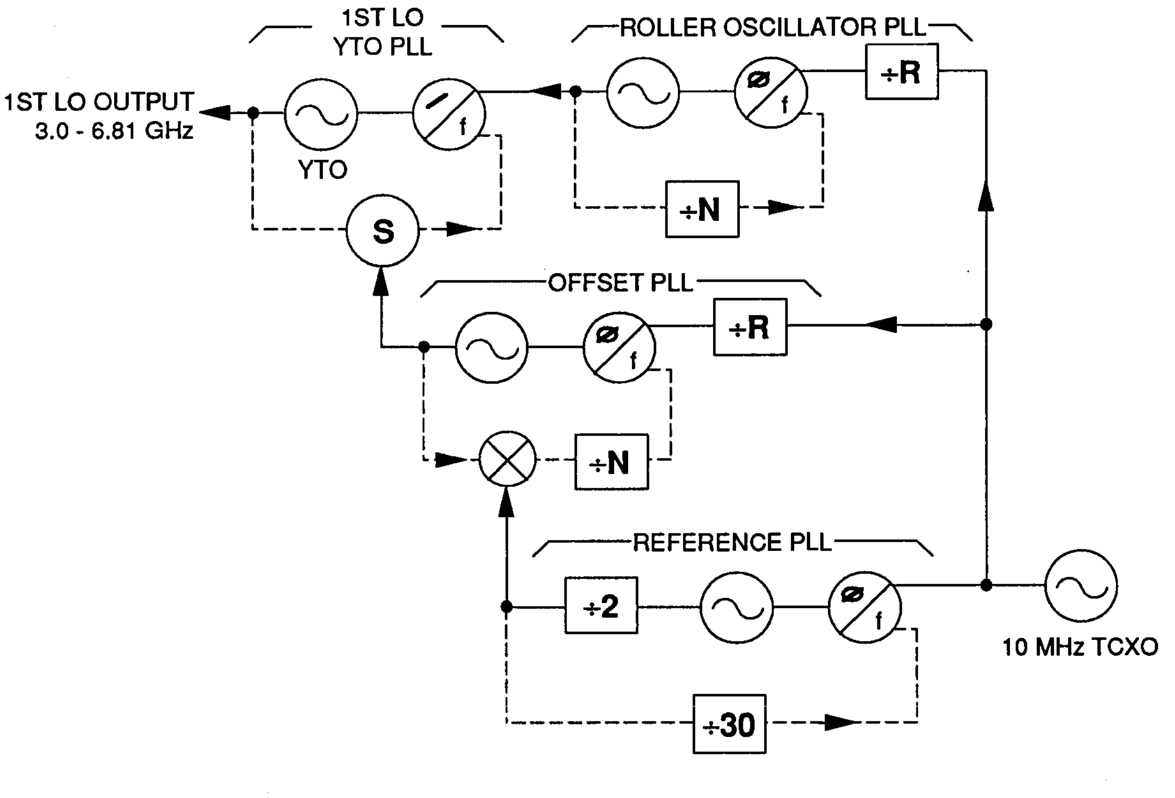

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Figure 1-5. Synthesizer Section Phase Locked Loops

YTO PLL (fig. 1-6. FO-266. and FO-27. The YTO PLL's oscillator produces the first LO (3.0 to 6.81 GHz). The oscillator's output is sampled by the output of the Offset PLL (Sampling Oscillator), and the resulting frequency is phase-locked to the output of the Roller Oscillator PLL Main Oscillator.

For LO spans of 1.01 MHz and above, either the FM or Main Coil of the YTO is swept directly. For LO spans of 1 MHz and below, the Roller PLL's Main Oscillator is swept. The Sampling Oscillator remains fixed-tuned during all sweeps.

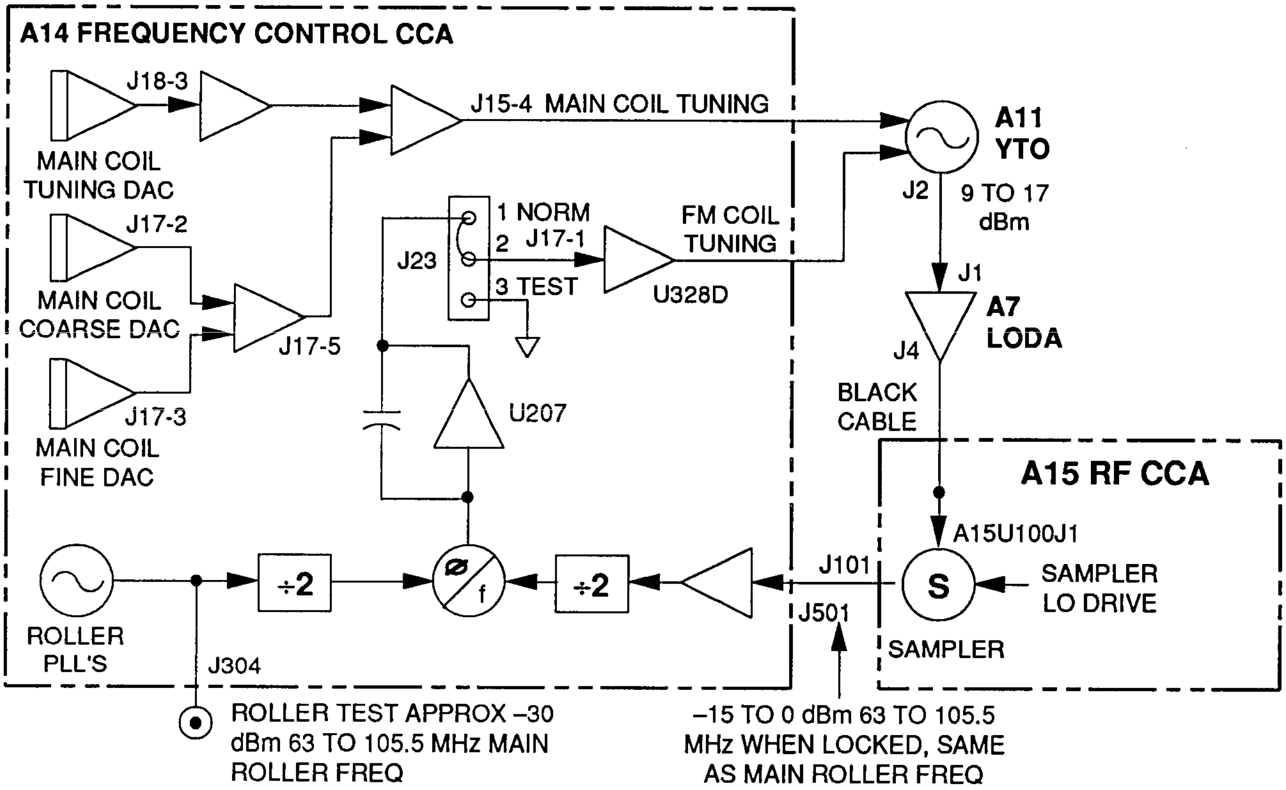

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Figure 1-6. YTO Phase Locked Loop

The output of All YTO feeds through the A7 LODA to the A15U100 Sampler. The Offset PLL's Sampling Oscillator, which drives the sampler, oscillates between 280 and 298 MHz. The sampler generates harmonics of the Sampling Oscillator and one of these harmonics mixes with the YTO frequency to generate the Sampler IF frequency. As a result, the frequency of the Sampler IF (between 63 and 105.5 MHz) is determined by the following equation:

$$F_{IF} = F_{YTO} - (N \text{ X } F_{SAMP})$$

Where:

FIF is the Sampler IF

FYTO is the YTO's frequency

N is the desired Sampling Oscillator harmonic

FSAMP is the Sampling Oscillator frequency

Notice that FIF can be positive or negative depending upon whether the Sampling Oscillator harmonic used is below or above the YTO frequency. The actual Sampler IF is always positive, but the sign is carried along as a “book keeping” function which determines which way to sweep the Roller Oscillator (up or down) and what polarity the YTO error voltage should have (positive or negative) to maintain lock.

If the Main Roller Oscillator frequency is positive, the Sampler IF is also positive. A negative Main Roller frequency indicates that the Sampler IF is negative.

Notice that the polarity of the YTO loop error voltage (YTO LOOP ERROR) out of the YTO Loop (circuit AB) phase/frequency detector changes as a function of the polarity of the Sampler IF. That is, for positive Sampler IF’s, an increasing YTO frequency results in an increasing YTO LOOP ERROR signal. For negative Sampler IF’s, a decreasing YTO frequency results in a decreasing YTO LOOP ERROR signal. This implies that to maintain lock in both cases, the sense of YTO LOOP ERROR must be reversed such that, with a negative Sampler IF, an increasing YTO LOOP ERROR results in an increasing YTO frequency. This is accomplished with an error-sign amplifier. This amplifier can be firmware-controlled to operate as either an inverting or non-inverting amplifier. Digital control line ERRSGN controls the polarity of this amplifier. When ERRSGN is high, the amplifier has a positive polarity.

In Roller Spans (LO Spans <1 MHz) the YTO remains locked to the sweeping Roller Oscillator PLL’s oscillator. Thus, the Sampler IF must always equal the Main Roller Oscillator frequency (conditions for lock). Since the YTO must always sweep up in frequency, for negative Sampler IF’s, the Main Roller Oscillator must sweep from a higher frequency to a lower frequency. This is necessary since an increasing YTO frequency decreases the Sampler IF for negative Sampler IF’s. The opposite is true for positive Sampler IF’s, so in these cases, the Main Roller Oscillator sweeps more conventionally from a lower frequency to a higher frequency. This implies that the sense of the span ramp sweeping the Roller Oscillator PLL must change between negative and positive Sampler IF'S. This is accomplished by controlling the polarity of the Voltage Controlled Oscillator (VCO) Sweep Driver. The polarity is controlled by VCOSGN. When VCOSGN is high, the VCO Sweep Driver has positive polarity.

The Main and Offset Roller Oscillators have opposite sense with respect to the VCO span ramp (VCO RAMP). A positive going ramp moves the Main Roller Oscillator lower in frequency (Main Roller spans) while a positive-going ramp moves the Offset Roller Oscillator higher in frequency (Offset Roller spans). Thus the polarity of the VCO Sweep Driver depends on whether a Main Roller or Offset Roller LO span is selected.

The following summarizes the amplifier polarities for the various combinations of Sampler IF polarities and LO spans.

Item Swept	Sampler IF Polarity	YTO Error Sign Amplifier Polarity	VCO Sweep Driver Amp Polarity	ERRSGN (A14U313 pin 12) fig. FO-27 circuit G	VCOSGN (A14U425 pin 12) fig. FO-27 circuit
Roller’s Offset Oscillator	Positive	Positive	Negative	TTL High	TTL Low
	Negative	Negative	Negative	TTL Low	TTL High
Roller’s Main Oscillator	Positive	Positive	Positive	TTL High	TTL High
	Negative	Negative	Negative	TTL Low	TTL Low
FM/Main YTO coils	Positive	Positive	Does not apply	TTL High	Does not apply
	Negative	Negative	Does not apply	TTL Low	Does not apply

The YTO Main Coil Filter (circuit E) is used to improve residual FM in FM spans. Transistors A14Q304 and A14Q305 switch the filter (capacitor A14C36 and resistor A14R48) into the circuit, Transistor A14Q303 and A14U333 keep A14C36 charged during main spans so the frequency does not jump when A14C36 is switch in.

The A11 YTO has an initial pretune accuracy of ±20 MHz. However, when the Roller Oscillator frequency is <73 MHz, this is changed to +30/-10 MHz. If the Roller Oscillator is 93 MHz, the accuracy is changed to +10/-30 MHz. This is done by changing the Main Coil Coarse DAC (circuit 1) to keep the Sampler IF within the acquisition range of the YTO Loop. When dealing with the Sampler IF and an unlocked YTO, the same frequency differences apply to the Sampler IF.

Roller Oscillator PLL (fig. 1-7. FO-26. and FO-27). The Roller Oscillator PLL's output serves as the reference frequency for the YTO PLL. It provides the 25 Hz start-frequency resolution for the 1st LO, and is the means by which the 1st LO is swept in LO spans of 1 MHz or less (Roller spans). A one-to-one relationship in frequency tracking exists between the Roller Oscillator PLL and the YTO. For example, a change of 1 MHz in the Roller Oscillator PLL will produce a 1 MHz change in the YTO frequency.

The Roller Oscillator PLL actually contains three PLLs that collectively produce an output of 63 MHz to 105.5 MHz. The three PLLs are as follows:

- Offset Roller Oscillator PLL (not the same as A15 RF CCA Offset PLL)
- Transfer Roller Oscillator PLL
- Main Roller Oscillator PLL

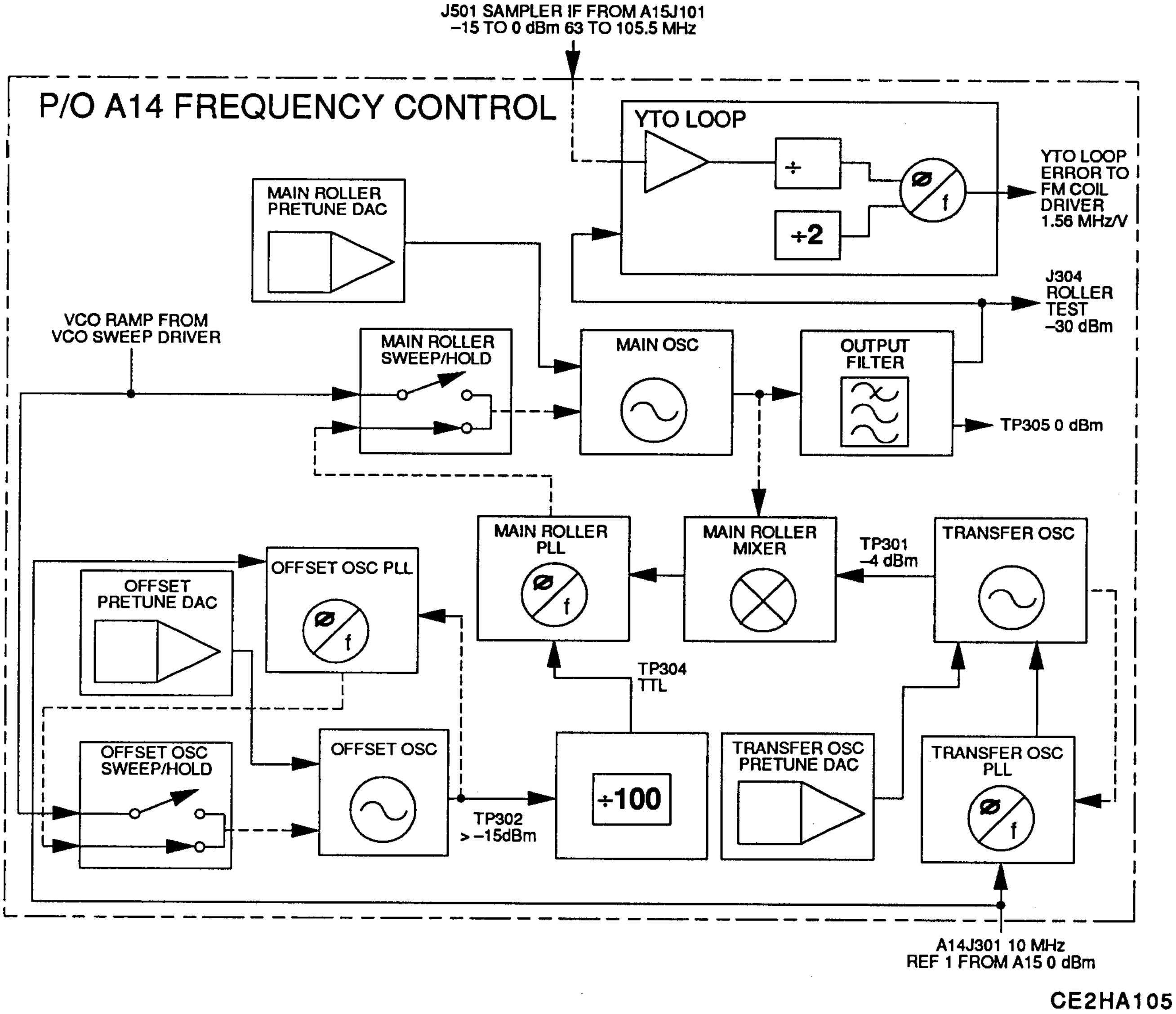


Figure 1-7. A14 Frequency Control CCA Simplified Diagram

These three PLLs operate together to produce an output frequency in the range of 63 MHz to 105.5 MHz selectable in 25 Hz increments. The output frequency can be swept (increasing or decreasing) over a selectable 2.5 kHz to 1 MHz range.

During the LO ADJUST sequence performed at power-on, pretune-DAC-values for Roller Oscillator frequencies, spaced 2 MHz apart, are determined and stored, Pretune-DAC-values for frequencies locked during instrument operation are interpolated from these calibration values. Tuning sensitivities for the Main and Offset Rollers are determined and used to adjust the Roller Span Attenuator DACA14U114B to improve span accuracy.

Offset Roller Oscillator PLL. The Offset Roller Oscillator PLL provides a synthesized frequency in the range of 189 MHz to 204 MHz in 2.5 kHz steps. This frequency is divided by 100 to provide a 1.89 MHz to 2.04 MHz signal with 25 Hz resolution to the Main Roller Oscillator PLL, yielding an effective frequency resolution on the YTO of 25 Hz. This circuit is swept in LO spans <100 kHz.

Transfer Roller Oscillator PLL. The Transfer Roller Oscillator PLL provides a synthesized signal from 61 MHz to 103.5 MHz in 50 kHz steps. This signal mixes with the Main Roller Oscillator PLL’s output, producing the roller IF at approximately 2 MHz. The roller IF is compared to the Offset Roller Oscillator’s divided output to phase-lock the main-roller oscillator.

Main Roller Oscillator PLL. The Main Roller Oscillator PLL provides an output signal in the range of 63 MHz to 105.5 MHz. This signal is the reference to the YTO PLL. The Sampler IF signal from the A15 RF CCA is compared to this signal in the YTO Loop providing an error voltage to phase-lock the YTO.

The Main Roller Oscillator PLL’s sample-and-hold function is performed digitally using two DACS, Coarse Adjust and Fine Adjust. When the Main Roller Oscillator is locked after retrace and before the start of a Main Roller span, these DACS are adjusted to zero. When the PLL error voltage is zero it provides no frequency correction and can thus be disconnected without affecting the Main Roller frequency. The span ramp is then applied to sweep the Main Roller over the desired range.

The Main Roller Oscillator PLL is sometimes swept backwards (higher frequency to lower frequency) because of the way in which the Sampler IF signal is produced. Switches A14U324A and A14U318C (fig. FO-27, Sheet 3, circuit H)) can change the polarity of A14U404B. This allows the Roller Oscillator to sweep backwards when the YTO is locked to a lower sideband of a Sampling Oscillator’s comb tooth. The YTO always sweeps forward (lower frequency to higher frequency), but the Roller Oscillator sometimes sweeps backwards (higher frequency to lower frequency).

Offset PLL Sampling Oscillator) (fig. 1-8. FO-29, and FO-30). The 280 MHz to 298 MHz output of the Offset PLL is used to sample the YTO PLL’s feedback path. By changing the values placed in the Offset loops programmed dividers, the YTO frequency can be changed.

The Offset PLL drives the A15U100 Sampler. The Offset PLL’s sampling oscillator tunes to one of fifteen discrete frequencies between 280 MHz and 298 MHz. The oscillator’s output is mixed (A15U400) with 300 MHz from the Reference PLL, producing a 2 MHz to 20 MHz IF signal.

The 2 MHz to 20 MHz signal is divided down to 2 MHz or 2.5 MHz and compared in the phase/frequency detector with the divided-down 10 MHz from the Reference PLL. The phase/frequency detector drives a voltage-to-current (V/I) diode switch which drives the loop integrator. Loop bandwidth switches vary the loop bandwidth to minimize noise sidebands. The sampling oscillator must produce low noise because the A15U100 Sampler multiplies noise by a factor of approximately 24.

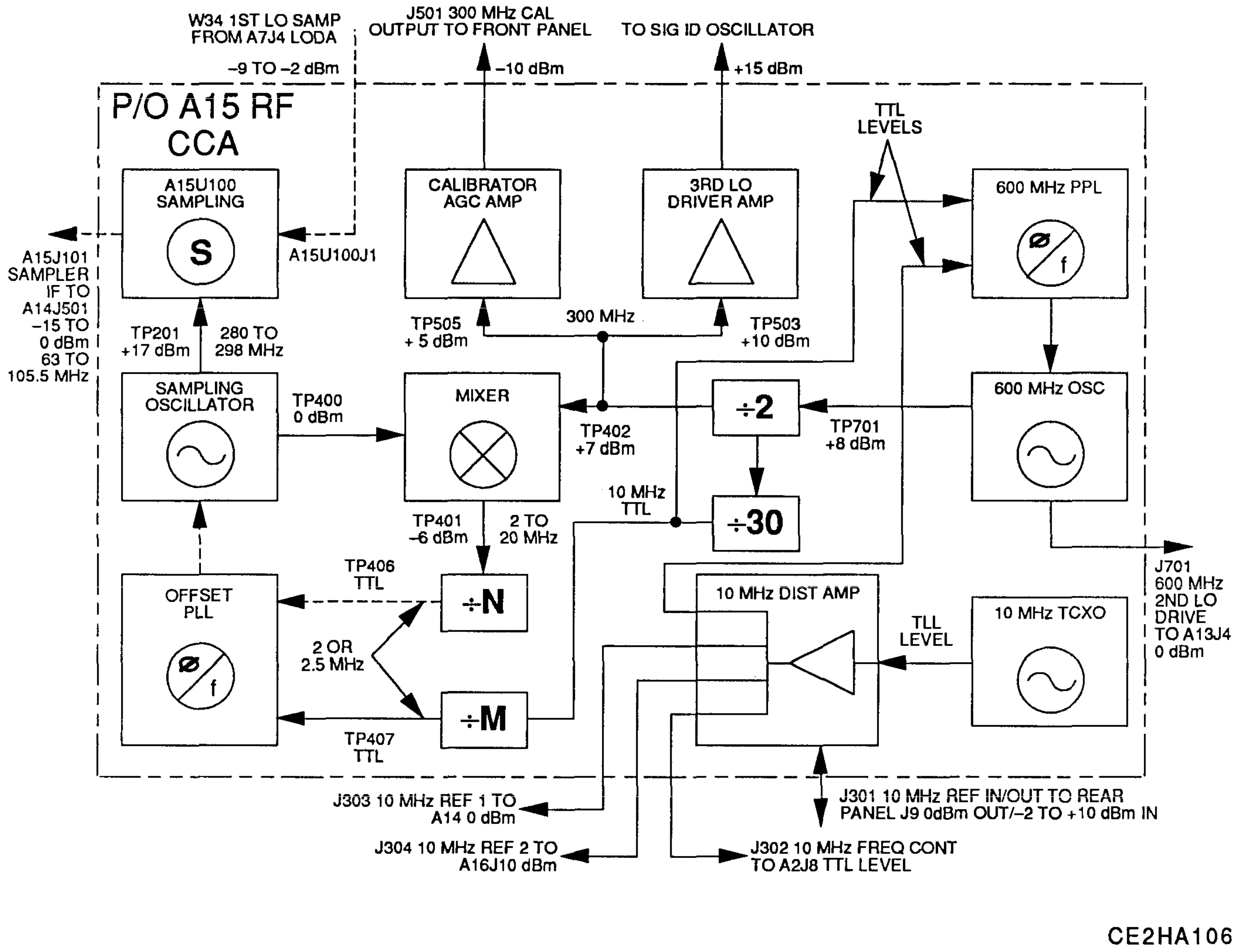


Figure 1-8. A15 IF CCA Simplified Diagram

Reference PLL. The 600 MHz Reference PLL provides the 600 MHz Second LO, 300 MHz for the third LO, and reference for the Sampling Oscillator A15U100. The PLL is locked to the 10 MHz TCXO (temperature-compensated crystal oscillator), but can also be locked to an external frequency reference. The TCXO also supplies the reference for the Roller Oscillators, the frequency counter on the A2 Controller CCA, and the A6 CAL Oscillator CCA.

The Reference PLL's 600 MHz output is generated by a 600 MHz Surface Acoustical Wave Resonator (SAWR) VCO. The SAWR provides a high Q feedback path in the oscillator ensuring good phase noise. If the oscillator is off-frequency, the phase-lock circuitry is probably at fault. Transistor A15Q703 provides active bias for oscillator transistor A15Q701. Transistor A15Q704 provides active bias for 600 MHz buffer amplifier A15Q702.

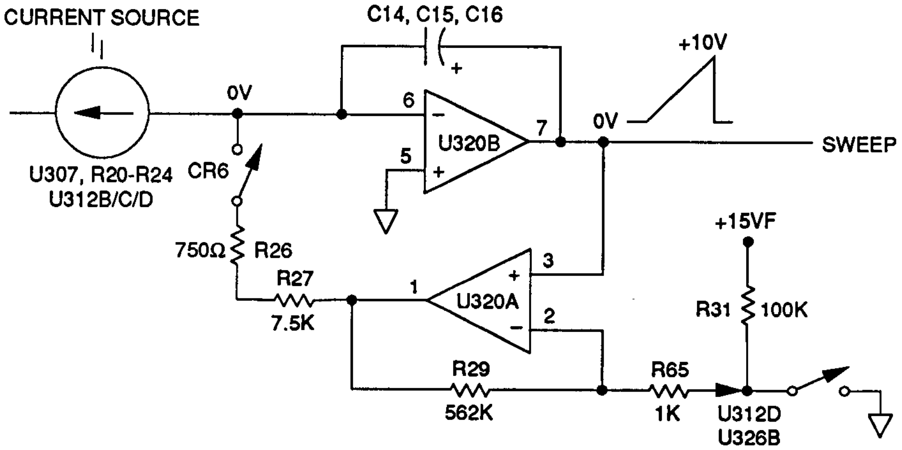
The outputs of Phase/Frequency Detector are low-pass filtered to reduce the 10 MHz component of the signal. The filtered signals are then integrated by A15U506 and the result is fed to the tune line of the 600 MHz oscillator.

The 300 MHz CAL OUTPUT signal comes from the divided down 600 MHz which is passed through a leveling loop. The 300 MHz signal passes through a low-pass filter for reducing higher harmonics. These harmonics can fool the detector. The 300 MHz signal passes through a variable attenuator controlled by PIN diode A15CR503 which is controlled by the feedback loop. Diode A15CR504 is the detector diode (the same type as A15CR505). Diode A15CR504 provides temperature compensation between the reference voltage and the detected RF voltage.

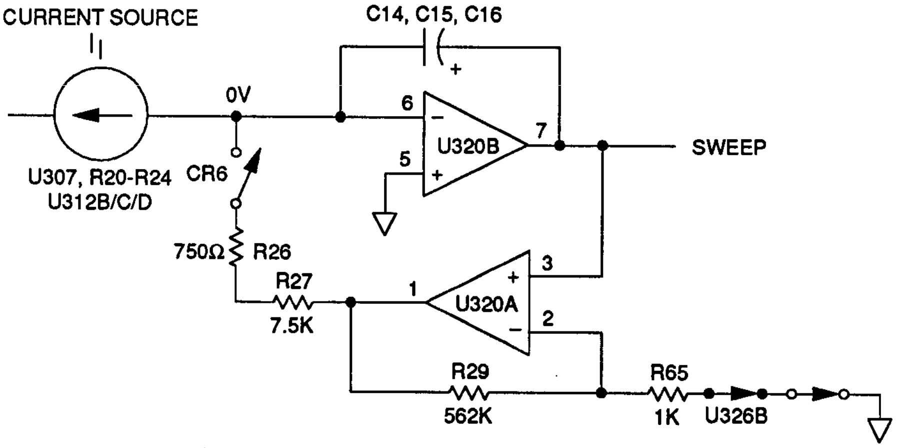
Third LO Driver Amplifier (fig. FO-29 and FO-30. circuit V). The Third LO Driver Amplifier amplifies the 300 MHz from the 600 MHz phase-lock loop to a sufficient level to drive the LO port of the Double Balanced Mixer. During the SIG ID operation, diodes turn off the 3rd LO Driver Amplifier in order to minimize the amount of 300 MHz going to the double- balanced mixer.

Sampler and Sampler IF (fig. FO-29 and FO-30. circuits Z and Y). The A15U100 Sampler creates and mixes harmonics of the sampling oscillator with the first LO. The resulting sampler IF (63 MHz to 105 MHz) is used to phase-lock the YTO. The Sampler IF filters unwanted products from A15U100's output and amplifies the IF to a level sufficient to drive the YTO loop. When the IF is between 78 and 87 MHz, PIN diodes switch a 120 MHz notch filter in the sampler IF section.

*Sweep Generator Circuit (fig. 1-9. FO-26. and FO-27. circuit K)*The Sweep Generator operates by feeding a constant current from DAC A14U307 into an integrator, A14U320B. This current is scaled by resistors A14R20 through A14R24 and A14U312B/C/D. The capacitors used in the integrator depend on the sweep-time range; smaller-value capacitors provide faster sweep times.



DURING SWEEP



DURING RETRACE

CE2HA107

Figure 1-9. Sweep Generator

The integration is initiated by HSCAN going high. This opens A14U312A which places the output of A14U320A near -15 V dc, turning A14CR6 off and allowing the output of integrator A14U320B to ramp from 0 V to +10 V dc. The analyzer's ADC (via the scan ramp attenuator A14U320B pin 7) monitors the scan ramp at A14U325A pin 1. When the ramp reaches +10 V (for single-band sweeps), HSCAN is brought low and the integration ends. During normal non-fast-zero spans (sweep times >30 ins), comparators A14U319A and B are high. This turns on diodes A14CR1, A14CR2, A14CR3, and A14CR4, Note that the integrating current (maximum value 236 uA) actually flows backwards through diodes A14CR3 and A14CR4.

During retrace, HSCAN is low, closing A14U306B and A14U312A. The output of A14U320A tries to go high, turning A14CR6 on and sourcing current through A14R26. This current discharges the capacitors in the integrator, forcing A14U320B pin 7 toward O V dc. Ultimately, the output of A14U320B will be brought and held to 0 V by A14U320A supplying a current equal to that which is sunk by the current source.

A7 ***LODA (non-repairable).*** The A7 LODA distributes the first LO to the front-panel 1ST LO OUTPUT connector, the A8 Dual Mixer, and A15U100 Sampler.

A11 YTO (non-repairable). A11 is a YIG-Tuned Oscillator, where Yttrium-Iron-Garnet (YIG) is a ferro-magnetic material which is polished into a small sphere and precisely oriented in a magnetic field. Changes in this magnetic field alter the frequency generated by the YTO. Current control of the magnetic field surrounding the YIG sphere tunes the oscillator to the desired frequency.

Typically, when PLL's malfunction, they are either locked at the wrong frequency or unlocked.

PLL Locked at Wrong Frequency. The following information is provided to illustrate what happens when a PLL locks-up at the wrong frequency (fig. 1-10).

- Any frequency errors at reference (1) will be multiplied by N/M on the PLL's output.
- A sampler reference-frequency error (2) will be multiplied by its harmonic on the PLL's output.
- A mixer reference-frequency error (3) produces the identical error on the PLL's output.
- Incorrect divide numbers and data controlling the dividers cause incorrect input or output frequencies (4).

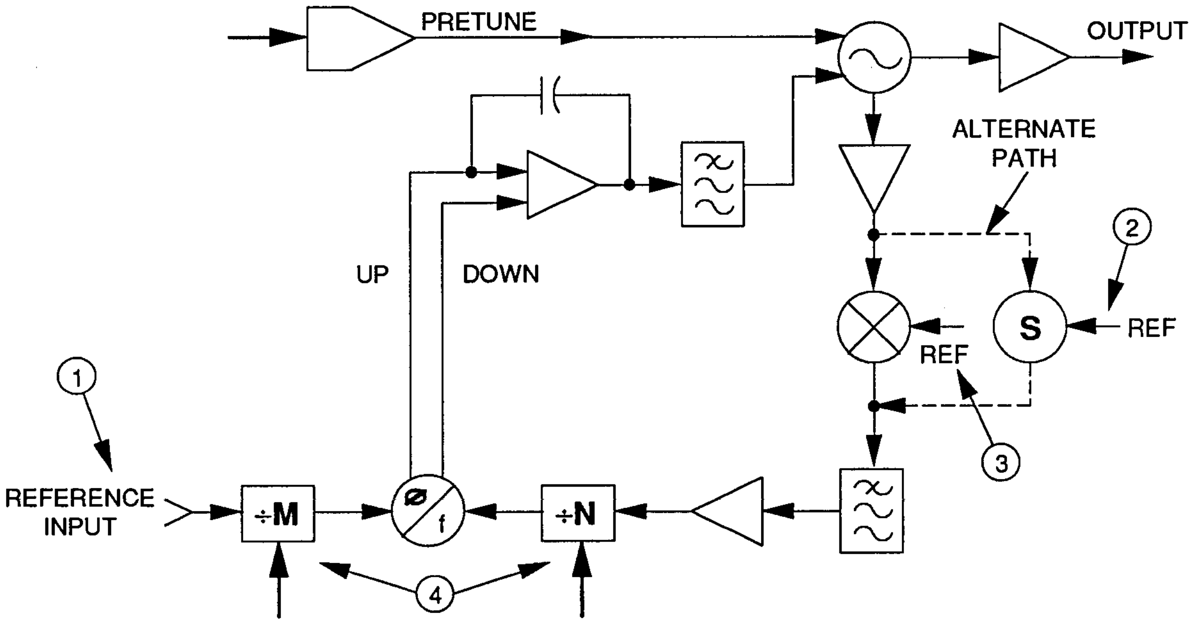


Figure 1-10. Phase Locked Loops at Wrong Frequency

PLL Unlocked. The following information is provided to illustrate what happens when a PLL is unlocked (fig. 1-11). An unlocked PLL can be caused by problems inside or outside the PLL. This type of problem is best solved by working backward from the oscillator.

The loop integrator's output voltage (1) should be attempting to tune the oscillator to the correct frequency.

This voltage should increase as the frequency increases on the YTO PLL, Reference PLL, and Sampler PLL.

This voltage should increase as the frequency decreases on the Main Roller PLL, Offset Roller PLL, and Transfer Roller PLL.

If the integrator's output voltage (1) changes properly, the problem is external to the PLL (for example, the pretune DAC could be faulty).

If the integrator's output voltage appears incorrect, the pulses out of the phase detector (2) should be attempting to tune the oscillator in the correct direction.

If the phase detector's output is bad, suspect the inputs to the detector (3). One input should be higher in frequency than the other; this should match the phase detector outputs.

Confirm proper power levels for the signals at the input to the "N" dividers (4), the reference input (5), and the loop's feedback path (6).

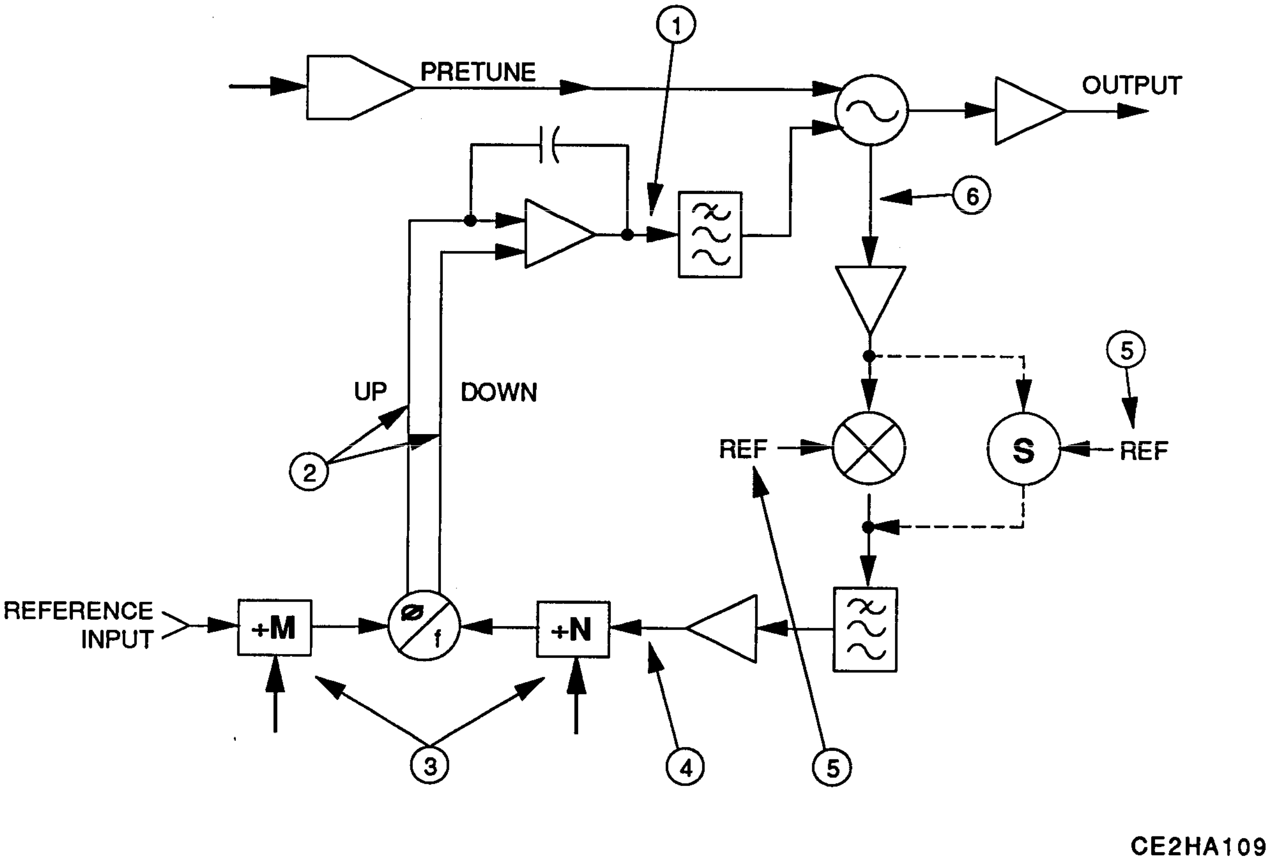


Figure 1-11. Phase Locked Loops Unlocked

c. IF Section. The IF Section (fig. 1-12) processes the 10.7 MHz output of the RF Section and sends the detected video (A15J601) to the ADC/interface Section.

The IF Section consists of the following assemblies:

- A3 Interface CCA (also in the ADC/interface section)
- A4 Log Amplifier CCA
- A5 IF CCA
- A16 Calibration Oscillator CCA

The AN/USM-489A uses trace-data manipulation to generate the 5 dB/DIV scale from the 10 dB/DIV scale. The A3 Interface CCA amplifies and offsets the 10 dB/DIV video to generate the 2 dB/DIV scale. The 1 dB/DIV scale is generated from the 2 dB/DIV scale through trace data manipulation.

The first 50 dB of IF gain (log and linear mode) is achieved using the A5 IF CCA liner step-gain amplifiers. The A4 Log Amplifier CCA's video-offset circuit provides the remaining 60 dB of log mode IF gain and the assembly's linear amplifiers 40 dB of linear mode gain. In Bands 2, 3 and 4, some of the IF gain in the A5 IF CCA is used to compensate for conversion loss in the RF section. This results in a reduced reference level range in Bands 2, 3, and 4. IF gain steps of less than 10 dB (regardless of the reference level) are accomplished on the A5 IF CCA.

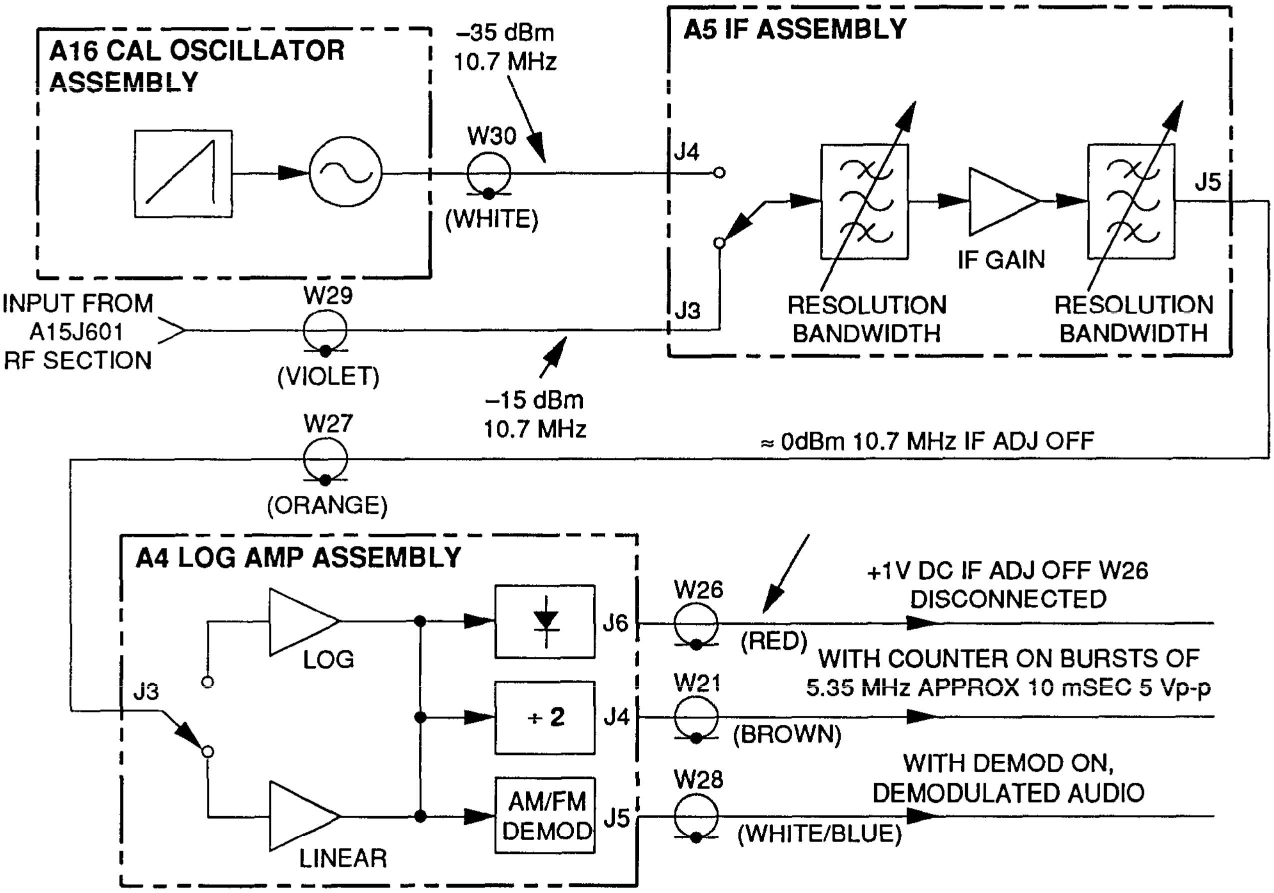


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Figure 1-12. IF Section Block Diagram

A4 *LOG Amplifier CCA (limited repair).* The A4 LOG Amplifier CCA (fig. FO-15 and FO-16) has separate log and linear amplifier paths. After log or linear amplification the signal path consists of a Detector, Buffer Amplifier, Video Offset and Video Buffer Amplifier Other auxiliary functions include the Frequency Counter Prescaler/Conditioner and the AM/FM Demodulator.

The A4 Log Amplifier CCA performs several functions, The main signal path consists of either the 90 dB log amplifier or the 40 dB linear amplifier, detector, buffer amplifier, video offset, and video buffer amplifier. Other functions include the Frequency Counter Prescaler/Conditioner and the AM/FM Demodulator.

The Detector (circuit O) is essentially a full wave rectifier. The Detector linearity is factory adjusted and should not be readjusted. The Buffer Amplifier provides gain and does the differential-to-single-ended conversion. The Video Offset provides *60* dB of apparent IF gain in log mode and also removes offsets from the video amplifiers. The Video Buffer Amplifier is a unity gain buffer. The Frequency Counter Prescaler/Conditioner divides the IF frequency by two and converts the signal to HCT levels.

The Log amplifier (circuits B through H, J, and K) contains nine gain-limiting stages providing *90* dB of gain. Factory adjustment of each stage optimizes log fidelity. These adjustments should not be readjusted. The linear amplifier provides 0 dB to *40* dB of IF gain in 10 dB steps.

The Log Amplifiers cannot be repaired because of the factory-only log-fidelity adjustments.

The Linear Amplifier (circuit N) chain is made up of two common emitter gain stages, a 180° splitter, and four buffer stages. The common emitter stages have programmable gains. The gain of these stages is selected by using switches to change the emitter load. The gains can be selected by setting the AN/ US M-489A's Reference Level.

The Buffer Amplifier (circuit P) is a differential input/single-ended output video amplifier with a gain of 6. The Buffer Amplifier includes two input buffers and a discrete operational amplifier.

The Video Offset (circuit Q) provides a programmable offset of 300 mV to +900 mV in *5* mV steps.

The Video Buffer Amplifier (circuit R) is a discrete operational amplifier. (Resistors A4R616 and A4R618 provide the feed back.) It has unity gain when loaded by the A3 Interface CCA.

The Frequency Counter Prescaler/Conditioner (circuit T) converts the IF signal to TTL levels and then divides the frequency by two. The circuit consists of an input attenuator, 50 dB integrated amplifier, line receiver, and frequency divider. The integrated amplifier and line receiver turn on only when the AN/ US M-489A is counting.

The AM/FM Demodulator (circuit S) on the A4 Log CCA produces a low level audio signal. This audio signal is amplified by the A16 CAL Oscillator CCA. The FM demodulator demodulates narrow-band FM (5 kHz deviation) signals. The detector also demodulates AM signals.

A5 *IF CCA.* The A5 IF CCA (fig. FO-18 and FO-19) has four crystal filter poles, four LC filter poles, and step gain amplifiers. The crystal filters provide resolution bandwidths of 100 Hz to 10 kHz. The LC filters provide resolution bandwidths of 30 kHz to 2 MHz. All filter stages are in series. PIN diode switches bypass unwanted stages.

An Automatic IF Adjustment, in analyzer firmware, sets center frequency and 3 dB bandwidth of all filter poles through varactor and PIN diodes. The firmware also controls crystal-pole symmetry and the step gain amplification.

Input Switch. The Input Switch (circuit A) connects the IF to either the A16 Calibration Oscillator CA or the 10.7 MHz IF output from the A15 RF CCA. The Automatic IF Adjustment uses the A16 Calibration Oscillator CCA at instrument turn-on and between sweeps to align the IF filters and step gain amplifiers. During sweeps the Input Switch selects the 10.7 MHz IF output from A15.

LC filters. The LC filters (circuits E, F, N, and O) are variable-bandwidth filters that provide resolution bandwidths from 30 kHz to 1 MHz. The Automatic IF Adjustment sets the bandwidths and center frequencies of each filter stage.

Crystal *Filters.* The crystal filters (circuits C, D, K, L) are variable-bandwidth filters that provide resolution bandwidths from 100 Hz to 10 kHz. The Automatic IF Adjustment sets the filter's bandwidths, symmetry, and center frequency.

Step Gain Amplifiers. *The* step gain amplifiers (circuits B, H, and I) consist of the First Step gain Stage, Second Step gain Stage, and Third Step gain Stage. These amplifiers provide gain when the analyzer's reference level is changed. The amplifiers also provide gain range to compensate for variations in the IF filter gains, which change with bandwidth and environmental conditions, and band conversion loss in the front end. Fixed gain amplifiers shift the signal levels to lower the noise figure of the IF chain.

Attenuators. The assembly has two variable attenuators. The Fine Attenuator (circuit J) provides the O.1dB reference level steps. The Reference 15 dB Attenuator (circuit G) provides a reference for automatic adjustment of the Step gain amplifiers and the A4 Log Amp CCA. The Reference 15 dB Attenuator also provides gain for changes in analyzer reference level.

Various buffer amplifiers provide a high-input impedance to prevent loading of the previous filter pole and a low-output impedance to drive the next filter pole.

Control. Digital control signals from the W2 Control Cable, the ‘analog bus”, drives the control circuitry (circuit P). At the beginning of each sweep the analog bus sets each control line for instrument operation. At the end of each sweep the analog bus sets each control line for the next portion of the Automatic IF Adjustment routine. IF adjustments continuously remove the effects of component drift as the analyzer temperature changes.

The assembly contains a reference limiting amplifier. This amplifier provides a known amount of limiting for the Automatic IF Adjustment routines. (Limiting occurs only during the Automatic IF Adjustment routine s.) The LC34_Short switches are open during sweeps. The current in the reference limiter is increased during sweeps to prevent limiting.

A16 *Calibration Oscillator (non-repairable).* The A16 Calibration Oscillator (fig. FO-32) supplies the stimulus signal for Automatic IF adjustments normally, the oscillator operates only during retrace (for a few milliseconds) to adjust part of the IF. (A11 IF parameters will be re-adjusted approximately every five minutes.) With continuous IF adjust ON, a group of IF parameters are adjusted during each retrace period (non-disruptive). If continuous IF adjust is OFF, the most recent IF calibration data will be used.

The IF parameters adjusted include step gains, log amplifier gain and offset, bandwidth centering, 3 dB bandwidth, bandwidth amplitude, and crystal-filter symmetry.

The A16 Calibration Oscillator's output has three forms (all -35 dBm):

- 10.7 MHz
- 9.9 to 11.5 MHz in 100 kHz steps
- Frequency sweeps from 20 kHz to 700 Hz centered at 10.7 MHz (lasting 5 to 60 ms respectively)

The purpose of these signals is:

- Adjust gains, log amps, and video slopes and offsets.
- Adjust 3 dB bandwidth and center frequencies of LC resolution (Bandwidth) BW filters (30 kHz through 1 MHz).
- Adjust 3 dB bandwidth, symmetry, and gain of the crystal resolution BW filters (100 Hz through 10 kHz).

The Low Pass Filter filters the square wave output of the variable gain amplifier so that harmonics do not subtly degrade the performance of the IF ADJUST process.

The A16 Calibration Oscillator uses a phase-locked-loop. The oscillator is locked to the AN/USM-489A's 10 MHz reference. The Reference Divider divides the reference and presents a 100 kHz logic signal to the Phase Detector. The Divide by N divides the oscillator output of 9.9 MHz to 11.5 MHz (by 99 to 115) resulting in a 100 kHz output to the phase detector. When the A16 Calibration Oscillator PLL is locked, equal width, narrow positive and negative pulses occur at the phase detector's output.

The Loop Integrator low-pass filters the pulses and inverts the result.

A properly operating sweep generator generates a series of negatively-going parabolas. Before the sweep, switches turn on shorting the output is at zero volts, These switches open to start the sweep.

Automatic IF Adjustment. The AN/USM-489A performs an automatic adjustment of the IF Section whenever needed. The A16 Calibration Oscillator provides a stimulus signal which is routed through the lF during the retrace period. The A3 Interface CCA measures the response using its ADC (Analog to Digital Converter). The AN/USM-489A turns the A16 Calibration Oscillator CCA off during a sweep.

When IF ADJ is ON, the AN/USM-489A readjusts part of the IF circuitry during each retrace period to completely readjust the IF every 5 minutes.

Automatic IF adjustment is performed upon the following conditions:

- Power on: (unless STOP ALIGN key is pressed). The IF parameter variables are initialized to values loaded in Program ROM and all possible IF adjustments are made. If STOP ALIGN key is pressed, the adjustment is halted.
- REALIGN LO & IF key pressed: All possible IF adjustments (and LO adjustments) are made with the most recent IF parameter variables used as the starting point.
- FULL IF ADJ key pressed: All possible IF adjustments are made with the most recent IF parameter variables used as the starting point. (FULL IF ADJ is located in the ADJUST menu under AMPLITUDE.)
- ADJ CURR STATE key selected: All amplitude data and some resolution bandwidths are adjusted. The bandwidths adjusted are a function of the currently-selected RES BW setting.
- Between sweeps: IF ADJ must be selected ON. When IF ADJ is OFF, an “A” is displayed along the left side of the graticule. Earlier versions of firmware automatically turn IF ADJ to OFF when in zero span. This theoretically prevents the detected video from the IF adjustment routine from being seen at the VIDEO OUTPUT.

The following IF parameters are adjusted in the sequence listed:

- Linear Scale Video Offset Amplitude.
- Log Scale Video Offset Amplitude:
  - Wide-Band and Narrow-Band modes.
  - 0 to 60 dB range in 10 dB steps.
  - 10 dB/DIV and 2 dB/DIV modes.
- Step Gains Amplitude (A5 iF CCA):
  - First Step Gain for 16 different DAC settings.
  - Second Step Gain for 16 different DAC settings.
  - Third Step Gain for 0, 15, and 30 dB attenuation relative to maximum gain.
  - Fine Attenuator for 32 evenly-spaced DAC settings.
- Log Amplifier Slopes Amplitude:
  - Wide-Band and Narrow-Band modes.
  - 10dB/DiV and 2 dB/DIV (log expand) modes.
- Linear Scale Gains Amplitude (On A4 Log Amp CCA).
- Peak Detector Offsets Amplitude (both Positive and Negative Peak Detectors with respect to normal sample path used by Auto IF Adjust).
- LC Bandwidths:
  - 300 kHz Resolution Bandwidth (RBW) center frequency, bandwidth, and gain.
  - 1 MHz RBW center frequency, bandwidth, and gain.
  - 100 kHz RBW center frequency, bandwidth, and gain.
  - 30 kHz RBW center frequency, bandwidth, and gain.

- Crystal Bandwidths:

  A16 Calibration Oscillator's sweep rate is measured against the 100 kHz RES BW filter's edge. This result is used in compensating the sweeps used for adjusting the crystal bandwidths.

  10 kHz RBW (Center frequency of LC tank that loads the crystal, Symmetry adjustment to cancel crystal's case capacitance, Bandwidth).

  3 kHz RBW center frequency of LC tank and bandwidth.

  1 kHz RBW bandwidth.

  300 Hz RBW bandwidth.

  100 Hz RBW bandwidth (all four poles adjusted simultaneously).

  Gain of all RBW's relative to the 300 kHz RES BW.

- 2 MHz RBW.

For the Automatic IF Adjustment routine to work, the AN/USM-489A must provide the following basic functions:

- Power Supplies.
- Control Signals.
- ADC.
- 10 MHz Frequency Reference to A16 CAL Oscillator.
- A15 RF CCA isolation from the RF signal during IF adjustment. A15 RF CCA isolation is a function of the REDIR signal in A15's Flatness Compensation Control block.

The references against which the Automatic IF Adjustment routine aligns are:

- 10 MHz reference (A15).
- Linear Scale Fidelity, especially the 10 dB gain stage in A4's Linear Amplifier block.
- 15 dB Reference Attenuator (A5).
- A16 Calibration Oscillator output power.

d. *ADC/interface Section.* The ADC/interface Section provides the link between the Controller Section and the rest of the spectrum analyzer. It controls the RF, Synthesizer, and IF sections through address and data lines on the Analog Bus. Analog signals from these sections are monitored by the ADC/interface Section's Analog to Digital Converter (A DC) circuit.

The ADC/interface Section consists of the following assemblies:

- A3 Interface CCA (also in the IF section).
- A1 Front Panel Assembly (A1A1 Keyboard and A1A2 Rotary Pulse Generator (RPG).

A3 *Interface CCA (fig. FO-12).* The A3 Interface CCA includes log expand, video filter, peak detector, track-and-hold, real-time DACs, RF gain DACs, +10 V reference, and ADC circuitry. The assembly's digital section includes ADC Algorithmic State Machine (ASM), trigger, keyboard interface, RPG interface, and analog bus interface circuitry.

ADC. The AN/USM-489A uses a successive-approximation type of ADC (circuit A). The ADC ASM controls the interface between the Start/Stop Control and the ADC itself, switching between positive and negative peak detectors when the NORMAL ("Rosenfell") detector mode is selected, and switching the Ramp Counter into the ADC for comparison to the analog sweep ramp.

Log Expand/Video Functions. The A3 Interface CCA performs log expand and offset functions. The Log Expand/Log Offset Amplifier (circuit X) provides a 2 dB/Div log scale. The 5 dB/Div scale is derived by multiplying the digitized 10 dB/Div trace data by two in the CPU. The 1 dB/Div scale is similarly derived by multiplying the 2 dB/Div trace data by two.

The AN/USM-489A uses two types of video filters (circuits V and W). An RC low-pass circuit provides 300 Hz to 3 MHz video bandwidths. Video bandwidths of 1 Hz to 100 Hz are filtered digitally by the CPU. When a digital filter is selected, a "D" appears along the left edge of the CRT, indicating that something other than the normal detector mode is being used. Digitally filtered bandwidths use a sample detector.

After filtering, the video is sent to the Positive and Negative Peak Detectors (circuits Y and Z). These detectors are designed for optimum pulse response. The Positive Peak Detector resets at the end of each horizontal "bucket" (there are 601 such buckets across the screen). The Negative Peak Detector resets at the end of every other bucket. When reset, the output of the peak detector equals its input.

Triggering. The AN/USM-489A has five trigger (circuit H) modes: free run, single, external, video, and line. The Free Run and Single trigger signal comes from the 1 MHz ADC clock. The line trigger signal comes from the A6 Power Supply. Video triggering originates from A3 Interface CCA's video filter buffer circuit. External triggering requires a TTL logic high level received from a rear-panel BNC connector. A DAC in the trigger circuit sets the video trigger level.

The ADC clock provides synchronization in FREE RUN and SINGLE triggering. LINE triggering synchronization originates on the A6 Power Supply. The trigger Multiplexer (MUX) selects between FREE RUN, VIDEO, LINE, and EXTERNAL trigger sources. The trigger signal sets the output of the HSCAN latch high. HBADC_CLKO provides the trigger signal for FREE RUN. The VIDEO TRIG signal must be at least 25 mV (0.25 divisions) peak-to-peak to trigger in video trigger mode.

Keyboard Interface (circuit G). A pressed key results in a Iow on a keyboard sense line. This sets the output of NAND gate A3U607 high, generating KBD_IRQ (fig. FO-13, sheet 4). The CPU determines the key pressed by setting only one keyboard scan line (LKSCNO through LKSCN5) low through A3U602 and reading the keyboard sense lines.

RPG Interface (circuit J). The RPG Interface circuit latches the RPG direction from the two RPG outputs. Counterclockwise RPG rotation produces low-going pulses which result in a high output. A3U612A provides the edge to trigger one-shot A3U423B, which generates a 90 ms pulse. This pulse gates A3U61OA for counting of RPG pulses by A3U606. Gates A3U610D and A3U614D prevent retriggering of A3U423B until its 90 ms pulse has timed out.

Preselector Peaking Control (Real Time DAC) circuit L). The AN/USM-489A uses a real-time DAC (R/T DAC1) to peak the preselector.

Band Fatness Control (RF Gain DACs). RF Gain DACs (circuit M) control the A15 RF CCA's flatness compensation amplifiers. The RF Gain DACs are arranged so that the output of one DAC is the voltage reference for the other DAC. This results in an RF GAIN voltage which is exponentially proportional to the DAC settings. Each DAC is set to the same value. The A15 RF CCA converts the RF GAIN signal to a current for driving the PIN diode attenuators in the Flatness Compensation Amplifiers. The exponentially-varying voltage compensates for the nonlinear resistance-versus-current characteristic of the PIN diodes.

Video Circuits. Voltages supplied to the A3 Interface CCA's Variable Gain Amplifier (circuit Q) correspond to on-screen signal levels. (One volt corresponds to the top of the screen and zero volts corresponds to the bottom of the screen.) This is true for both log and linear settings except when the analyzer is in 1 dB/div or 2 dB/div. In these cases the log expand amplifier is selected, and 1 V corresponds to top-screen and 0.8 or 0.9 V corresponds to bottom-screen. The analyzer can be set to zero span at the peak of a signal to generate a constant dc voltage in the video circuits during sweeps.

Log Offset/ Log Exnand (circuit x). The log scales are modified using a combination of amplification and digital trace manipulation. The video input to the A3 Interface CCA is either 10 dB/Div or linear. To obtain the 5 dB/Div scale, the CPU manipulates the trace data from the 10 dB/Div scale. To obtain the 2 dB/Div scale, the video signal is amplified and offset so that top-screen in 10 dB/Div corresponds to top-screen in 2 dB/Div. To obtain the 1 dB/Div scale, the CPU manipulates trace data from the 2 dB/Div scale.

In 2 dB/Div, Log Offset/Log Expand amplifies the top 20 dB of the display. This is done by offsetting the video signal by -0.8 V-and providing a gain of 5 to the top 0.2 V of the video signal, The -0,8 V offset is accomplished by sinking 2 mA through A3R114 by current source A3U105/A3Q1O1.

Video Filter (circuit V). The AN/USM-489A uses digital filtering for 1 Hz to 100 Hz video bandwidths. An RC low-pass filter is used for 300 Hz to 3 MHz video bandwidths. Various series resistances and shunt capacitances switch into the video filter to change its cutoff frequency.

Video Filter Buffer Amplifier (circuit W). The video filter buffer amplifier provides outputs for video trigger, positive and negative peak detectors, and the analog zero-span (sweeps <30 ms). The zero-span video output is terminated in 500 ohms on the A2 Controller CCA. The amplifier is a high-input-impedance buffer amplifier with a terminated gain of one.

Positive/Negative Peak Detectors (Circuits Y and Z). The following information pertains to the positive peak detector and is applicable to troubleshooting the negative peak detector.

The positive peak detector consists of an input amplifier followed by detector diodes and hold capacitor. An output amplifier buffers the hold capacitor. Both the input and output amplifiers have a gain of one. Each amplifier has local feedback.

ADC MUX The ADC MUX (circuit Q) switches various inputs into the video path for conversion by the ADC. The scan ramp input is used during non-zero-span sweeps. Other signals are used only during diagnostic and auto adjust routines.

Variable Gain Amplifier (VGA). The VGA (circuit AA) provides adjustable gain in the video path. Its nominal gain of 7 can be adjusted ±10%. There is no easy way to change the DAC settings from the front panel.

ADC Circuits. The ADC consists of a 12-bit DAC, 12-bit Successive Approximation Register (SAR), data multiplexer, and data latches. The ADC Algorithmic State Machine (ASM) (circuit F) controls the ADC. Eight inputs are controlled by the ADC MUX (circuit AA). These include a positive peak detector, negative peak detector, sampled video, scan ramp, YTO error voltage, FC MUX voltages, CAL Oscillator tune voltage, and offset lock error voltage. A MUX on the A14 Frequency Control CCA selects which voltage is sent to the ADC-MUX on the FC MUX signal line.

During NORMAL detector mode sweeps, when noise is detected by the Rosenfell detector, the ADCASM automatically switches between POS PEAK and NEG PEAK.

ADC Control Signals. The ADC requires two signals from the A2 Controller CCA: HBADC CLKO and HBKT_PULSE. HBKT_PULSE is used only in zero span.

ADC Start/Stop Control. The ADC Start/Stop Control (circuit B) determines the start time of all ADC conversions. Multiplexer A3U509 chooses the source of the start signal. Both HSTART_SRC and HBUCKET tell the ASM to start a conversion.

ADC (curcuit A). When the SAR is started, the SAR successively toggles bits from high to low starting with the most significant bit. The digital result is then converted to an analog current in a DAC and compared with the SAMPLED VIDEO. If the DAC current is too high, the output will be high, telling the SAR that the “guess” was high and that the bit just toggled should be set low. It then moves on to the next most significant bit until all 12 bits have been "guessed" at. Each "guess" takes 1us (one cycle of HBADC_CLKO), or 12 us to complete a conversion. When the conversion is completed, the bits are written to the data bus.

Ramp Counter. The Ramp Counter (circuit D) is used for non-zero-span sweeps and for zero-span sweep times greater than 60 seconds. The analog sweep ramp is compared to the digital ramp counter. When the analog sweep ramp exceeds the DAC output generated for that ramp counter setting, HRAMP_COMP toggles high, indicating the end of a bucket. The ramp counter counts horizontal buckets. There are 600 buckets per sweep, so the ramp (bucket) counter counts from O to 600. The ramp counter is incremented by HRST_PK_ENA.

Analog Bus Timing. Analog Bus Timing (ABT) (circuit P) generates the strobes for the A4 Log Amplifier, A5 IF, A14 Frequency Control, and A15 Reassemblies. The A14 Frequency Control CCA also requires a qualifier for its strobe LVFC_ENABLE. A3 Interface CCA components provide a 2 us delay between the time HANA_BUS goes high and the enable line to the demultiplexer goes low.

Interface Strobe Select. Interface strobe select (circuit K) generates the various strobes used by circuits on the A3 Interface CCA.

e. *Controller Section.* The Controller Section (Fig. FO-8, FO-9, and FO-10) provides overall control of the AN/USM-489's circuitry.

The Controller Section consists of the following assemblies:

- A2 Controller CCA.
- A19 HP-IB CCA.

A2 Controller CCA. The A2 Controller CCA contains the CPU, RAM, ROM, the Display ASM and Line Generators, CRT blanking, focus, intensity control, HP-IB Interface, Frequency Counter, Display RAM, Option Module interface, and EEROM.

RAM (circuit S). Four of the eight RAM IC's are battery-backed. The battery-backed RAM stores trace information (two Display Memory RAMs) and AN/USM-489A state information (two program RAMs). A total of eight traces and ten states may be stored. Typical battery life is ten years with the lithium battery and two years with the optional silver-oxide battery. Trace and state information may be retained for up to 30 minutes with a dead battery and power turned off. This is due to the RAM's very low data retention current.

STATE storage is in two of the six Program RAMs and TRACE storage is in the two Display RAMs. With low battery voltage, it is normal for STATES and TRACES to be retained if the power is off for less than one minute. If the power is left off for more than thirty minutes with low battery voltage, the stored STATES and TRACES will be lost.

EEPROM (circuit U). The EEPROM stores important amplitude-related correction data. This includes data for mixer-bias DACs, YTF Slope and Offset DACs, RF Gain DACs (flatness correction), and a Preselector Peak DAC. The AN/USM-489A serial number, model number, and installed options are also stored in EEROM.

Firmware. The AN/USM-489A firmware reads the model number and installed options from the EEROM to determine how to respond to certain keystrokes.

Much of the miscellaneous digital control is performed by the display ASM and character ROM. It also converts the 16 bit CPU data bus to an 8-bit data bus for the rest of the AN/USM-489A.

Line Generators (circuits D and I). The line generators convert the digital display information to an analog output suitable to drive the A17 CRT Display Driver CCA. These circuits change the digital words into vectors, or lines, which move the beam of the CRT. The vectors are each 6 us long (width of the INTEGRATE pulse) followed by a 1 us SAMPLE pulse. When characters of text are being drawn, the vectors are 3 us long.

The Output function circuits contains the absolute value circuits which determine the intensity of vectors drawn on the display. The vector length is approximated by the sum of the X length and Y length. The voltage corresponding to the X length, /~X, is converted to current. (If the voltage is negative, it is amplified by 2, converted to current, and added to the current already existing.) This effectively turns both negative and positive voltages into positive currents, hence absolute value.

Frequency Count Marker. The Frequency Count Marker function works by dividing the 10.7 MHz IF signal by two (prescaling) and counting the divided-down signal using the Frequency Counter. The prescaler is on the A4 Log Amplifier CCA.

Frequency Counter (circuit Y). The Frequency Counter counts the frequency of the last IF and provides accurate signals timing for digital zero-spans. The circuit also provides timing signals to the A3 Interface CCA's Analog to Digital Converter (ADC). The nominal input frequency is 5.35 MHz (10.7 MHz divided by 2). The circuit's frequency reference is the A15 RF CCA's 10 MHz TCXO.

A19 *HP-IB CCA.* The A19 HP-IB CCA is a mechanical interface between the standard HP-IB connector and the connector on the A2 Controller CCA.

f. Display /Power Supply Section, The Display/Power Supply Section (fig. 1-13) provides the all internal operating voltages for the instrument and CRT display capabilities.

WARNING

When troubleshooting the power supply, use an isolation transformer and connect A6TP101 to A6TP301.

The Display/Power Supply Section consists of the following assemblies:

- A6 Power Supply CCA (includes A6A1 High Voltage Module)
- A17 CRT Driver CCA
- A18 CRT Assembly

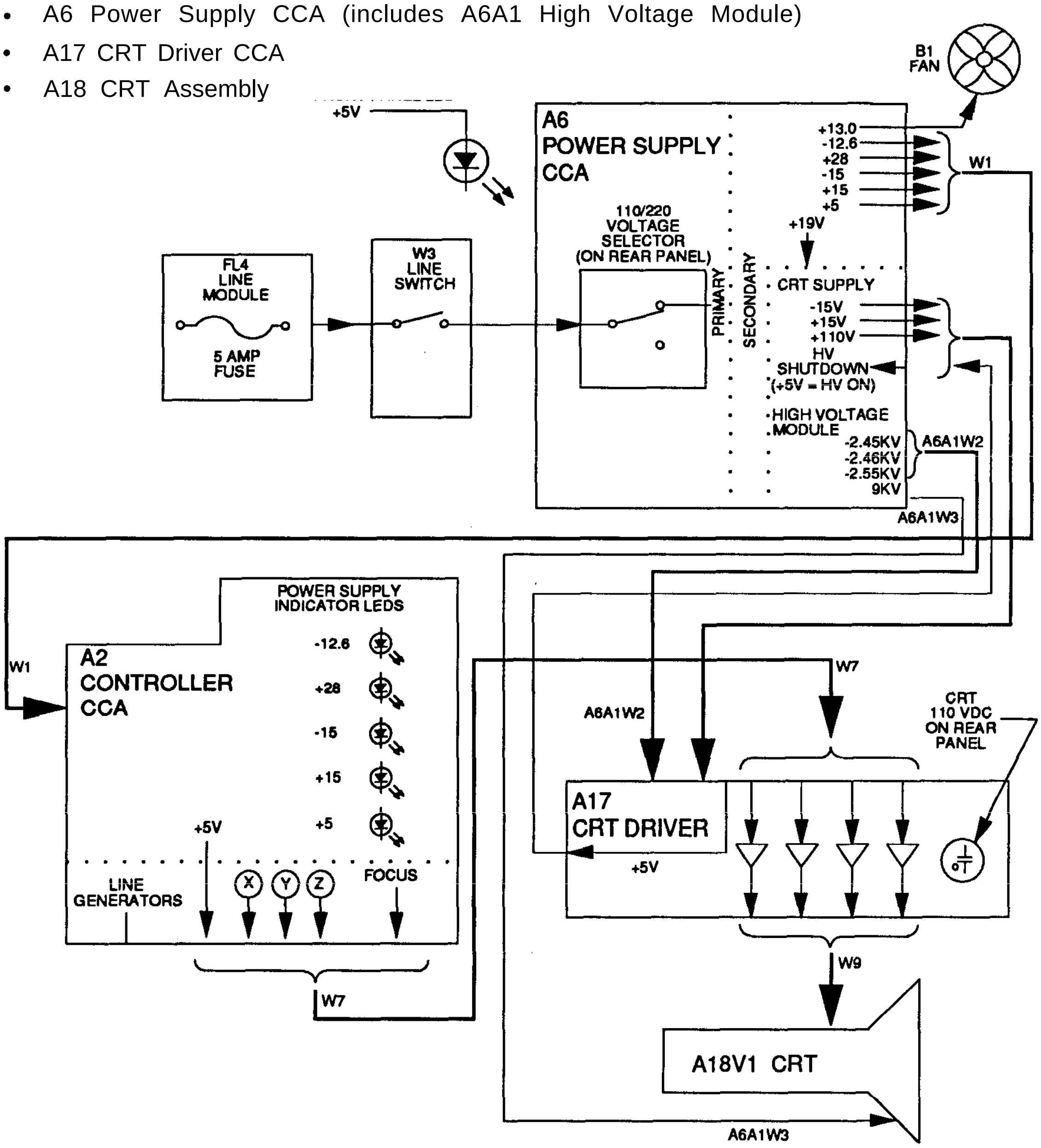


Figure 1-13. Display/Power Supply Section

A6 Power Supply. The A6 Power Supply (fig. FO-21) is a switching supply operating at 40 kHz for the low voltages and 30 kHz for the CRT supplies (cathode, filament, +110 V dc, and post accelerator). The A6A1 High Voltage Module contains the high-voltage transformer and post-accelerator multiplier. Power is distributed through the A17 CRT Driver CCA to the rest of the assemblies. The A6A1 High Voltage Module supplies CRT cathode and filament voltages to the A17 CRT Driver CCA.

The speed of the AN/USM-489A's fan is variable. A thermistor on the A6 Power Supply senses the temperature and adjusts the fan speed accordingly. This allows the AN/USM-489A to run quietly in most room-temperature environments and faster (louder) only when necessary.

A17 CRT *Driver CCA (non-repairable).* The A2 Controller CCA's Line Generators drive the A17 CRT Driver CCA (fig. FO-34). The A17 CRT Driver CCA contains X and Y Deflection Amplifiers, focus and intensity grid amplifiers, and miscellaneous CRT bias circuitry. The high voltage is supplied by the A6A1 High Voltage Module.

The AN/USM-489A uses a vector display. The graticule lines, traces, and characters are composed of a series of straight lines ("vectors") placed end-to-end.

In fast-analog zero-span mode (sweep times ≤ 30 ms), the A3 Interface CCA and the A14 Frequency Control provide input to the A17 CRT Driver CCA. The graticule and annotation is still digitally drawn.

The CRT Power Supply is a separate switching power supply which provides the +110 V dc for the A17 CRT Driver CCA from a winding on the A6A1 High Voltage Module. The CRT Power Supply operates at approximately 30 kHz.

Buck *Regulator Control.* The Buck Regulator and Buck Regulator Control circuitry permit the power supply to start up at low line voltages at low temperatures. At low line voltages the Buck Regulator will turn on and draw current through the thermistors in the Input Rectifier. This warms up the thermistors, thereby decreasing their resistance and increasing the control voltage. The Buck Regulator Control signal modulates the Buck Regulator and provides a synchronized signal to the DC-DC Converter Control circuitry. The Buck Regulator Control has two feedback paths. The first is the output of the Buck Regulator, which provides coarse regulation. The second is the Feedback Circuit which samples and compares the +5 V dc output of the Output Rectifier.

Thermal shutdown occurs when a thermistor, mounted on the main heatsink, reaches a temperature of 100^o C. When this occurs, an increase in voltage inhibits pulses to the Buck Regulator.

Power Up. The Power Up circuitry generates the Power-up Signal, which tells the microprocessor that the power supplies are up and stable. The Power-up Signal will go high when the +5 V dc Power Supply exceeds +4.99 V dc, and is set low if the voltage drops below +4.895 V dc. Once the Power-up Signal is set low, it will stay low for:

as long as the voltage remains below +4.895 V dc.

a minimum of 50 ms (even if the +5 V dc Power Supply exceeds +4.99 V dc before 50 ms have elapsed) before returning high.

CHAPTER 2
MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT

2-1. COMMON TOOLS AND EQUIPMENT.

Common tools and equipment required for general support maintenance of Spectrum Analyzer AN/USM-489A/U are listed in the Maintenance Allocation Chart (MAC), TM 11-6625-3250-12, Appendix B.

2-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

Special tools, TMDE, and support equipment required for general support maintenance are listed in the Maintenance Allocation Chart (MAC), TM 11-6625-3250-12, Appendix B. Special tools are listed and illustrated in Repair Parts and Special Tools List, TM 11-6625-3250-24P.

2-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List, TM11-6625-3250-24P.

Section II. SERVICE UPON RECEIPT

2-4. SERVICE UPON RECEIPT OF MATERIAL.

WARNING

The AN/USM-489A weighs approximately 44 lbs. Always use two persons when lifting the unit.

a. Unpacking. Special design reusable packing material inside this shipping carton provides maximum protection for Spectrum Analyzer. Avoid damaging carton and packing material during equipment unpacking. Use the following steps for unpacking Spectrum Analyzer:

- Cut and remove paper sealing tape on carton top and open carton.
- Remove packing foam.
- Remove inner packing container by either turning shipping carton upside down or lifting inner container up and out.
- Cut and remove protective aluminum foil from inner packing container.
- Cut and remove paper sealing tape on carton top and open carton.
- Grasp Spectrum Analyzer firmly, and while restraining packing carton, lift up and out of packing carton.
- Place Spectrum Analyzer on a suitable flat, clean, and dry surface.
- Remove protective plastic bag.
- Place desiccant bags back inside protective plastic bag, and place plastic bag inside of shipping carton.
- Return shipping carton to supply system.

b. Checking Unpacked Equipment.

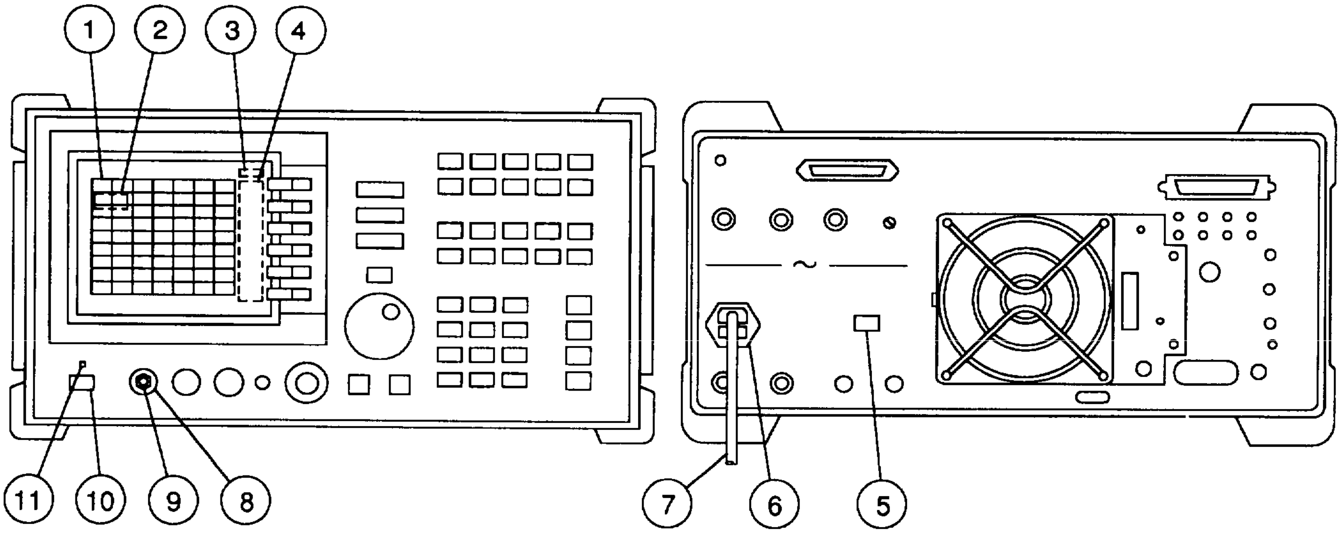
- Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy (ROD).
- Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA Pam 738-750.
- Check to see whether the equipment has been modified.

2-5. PRELIMINARY SERVICING AND ADJUSTMENT OF EQUIPMENT.

a. Verify that LINE switch (10) is set to OFF, and that the 50Ω Termination (9) is connected to the 1st LO OUTPUT (8) connector.

b. Verify VOLTAGE SELECTION switch (5) on rear panel indicates line voltage available in your area. if not correct, change to correct line voltage value.

c. Connect power cable (7) to AC POWER connector (6) on rear panel.



d. Set LINE switch (10) from OFF to ON. Verify that the LINE Indicator (11) lights. After approximately five seconds, verify the CRT Screen (1) increases in intensity.

e. The Spectrum Analyzer will perform an internal alignment routine for approximately 30 seconds. During alignment, the ACTIVE FUNCTION (2) area displays “LO ADJUST STATUS:” then “IF ADJUST STATUS:” with the current adjustment status, and the KEY MENU (4) area displays “STOP REALIGN”. After the alignment is complete, the ACTIVE FUNCTION (2) area displays “HP 8562A COPYRIGHT 19xx, 19xx Hewlett-Packard Co. Rev: xxxxxxx”, the MENU TITLE (3) annotation displays PRESET, and the KEY MENU (4) area displays the PRESET choices.

f. Complete performance tests (para 2-18).

Section III. TROUBLESHOOTING

SYMPTOM INDEX

2-6. GENERAL.

Troubleshooting at the intermediate general support maintenance level requires you to locate any malfunction as quickly as possible. The amount of troubleshooting you can do is based on what the Maintenance Allocation Chart says you can fix. Because of this, the only trouble symptoms you will find here are those that could be caused by faulty items you can fix.

NOTE

- Before using the troubleshooting table, check your work order and talk to unit maintenance, if possible, for a description of the symptoms and the steps that have been taken to correct them.
- Check all forms and tags attached to, or accompanying, the equipment to determine the reason for removal from service.

2-7. TROUBLESHOOTING GUIDELINES.

The following is a list of aids that you can use when troubleshooting the Spectrum Analyzer:

a. The Spectrum Analyzer has built-in self tests and diagnostics that are used in troubleshooting. A self-test and adjustment is automatically initiated at power-up, and the adjustment can be initiated manually from the front panel or remotely over HP-IB bus. See paragraph 2-10 for information on diagnostics.

b. Refer to the principles of operation, Chapter 1, Section III as required. This provides circuit theory of the section you are troubleshooting with references to the functional and schematic diagrams.

c. Various types of diagrams are used in troubleshooting the AN/USM-489A. Power levels and voltages shown on block diagrams and schematics are provided as a troubleshooting aid only, and should not be used for making adjustments. Symbols used in the block and schematic diagrams are provided in figure 2-1. The following diagrams are provided:

- Spectrum Analyzer assembly and cable locator diagrams are provided on figures FO-1 and FO-2.
- Spectrum Analyzer wiring and block diagrams are provided in figures FO-3 through FO-5.
- Assembly schematic, functional block, and component locator diagrams for all assemblies/circuits/sections are located on figures FO-6 thru FO-35.

d. Circuit cooler spray (Appendix B, item 4) can be used in isolating problems. The most generally used method is to spray suspected circuits/components to see if the malfunction can be temporarily fixed. This method will not work all the time, but it can be a great timesaver. It is especially helpful on intermittent problems that get worse with a rise in temperature. However, use this spray sparingly. Overspraying operational amplifiers, for example, can create a feedback path around the amplifier that will be detrimental to circuit operation.

e. Many problems on Spectrum Analyzers that have been in service for awhile are caused by corrosion. Sometimes removing and reseating the affected plug-in assembly or cable will correct a malfunction. Cleaning connector pins and/or switch contacts with alcohol (Appendix B, item 2) will repair many types of digital and analog circuit malfunctions.

f. For microcircuit and connector orientation, pin one is identified by a square solder pad on printed circuit board. For diodes and transistors, the square solder pad indicates the cathode or emitter.

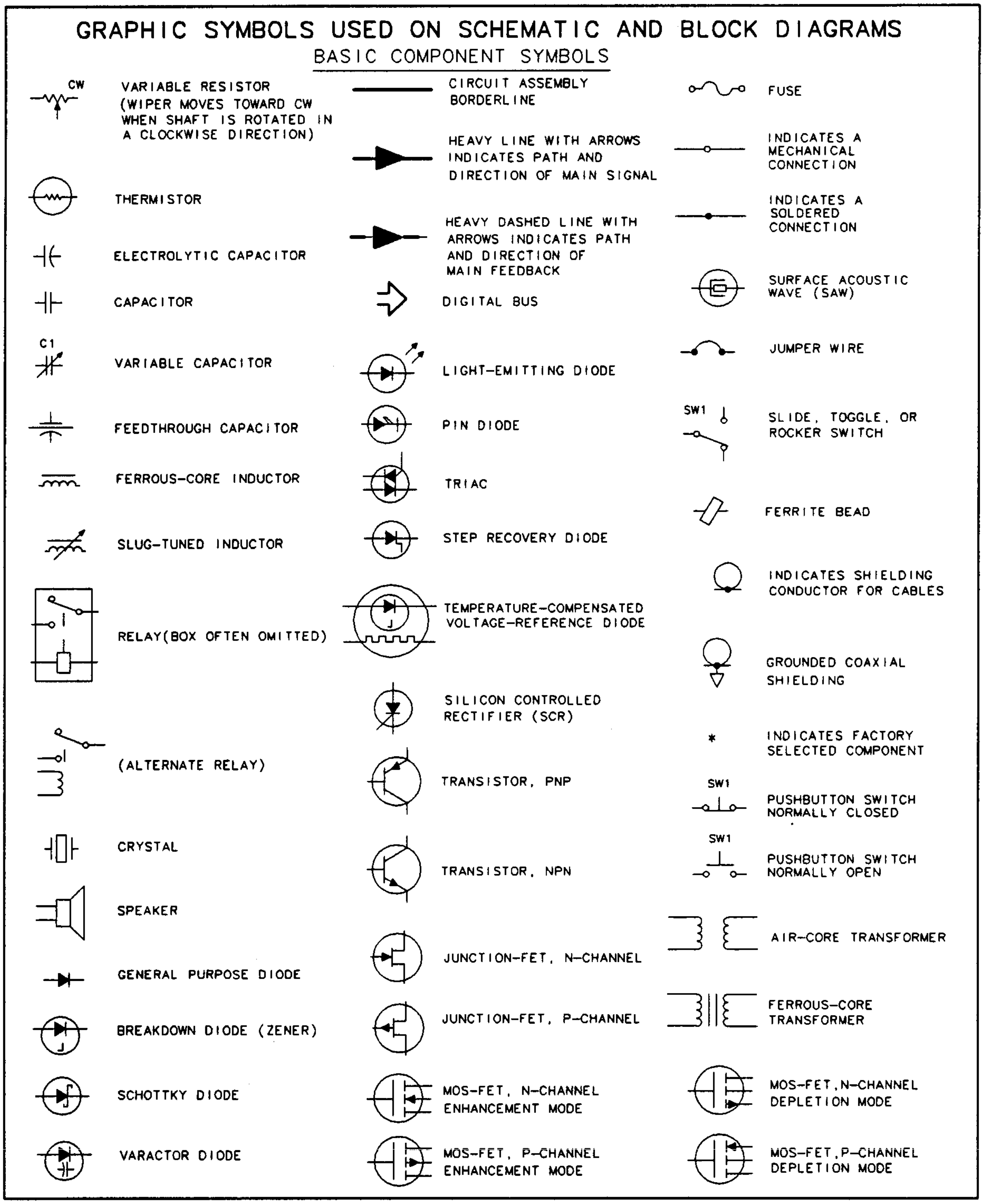


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Figure 2-1. Graphic Symbols (1 of 2)

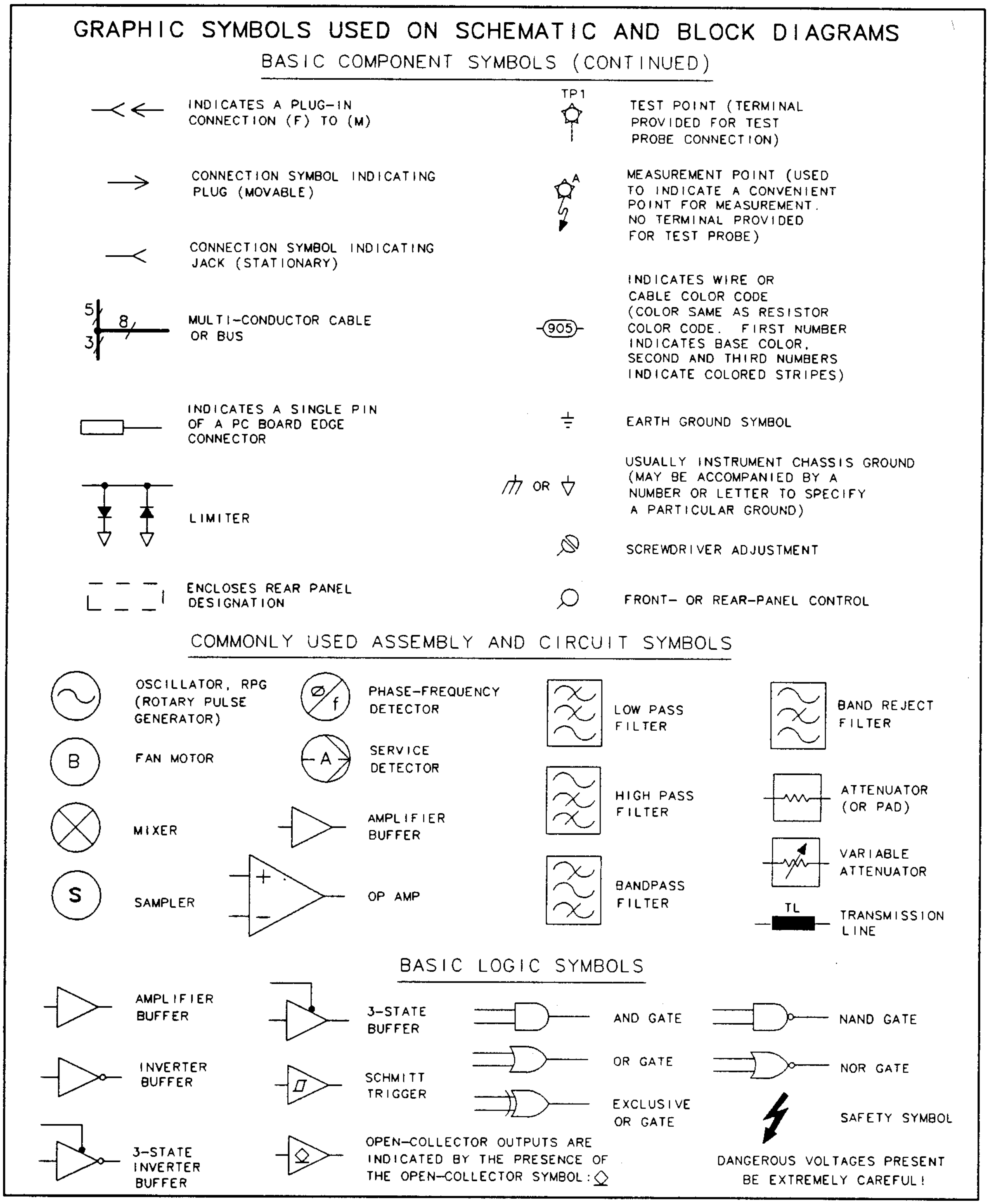

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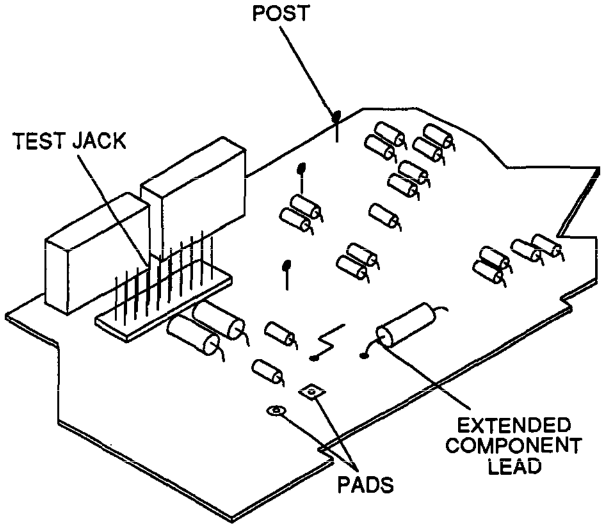
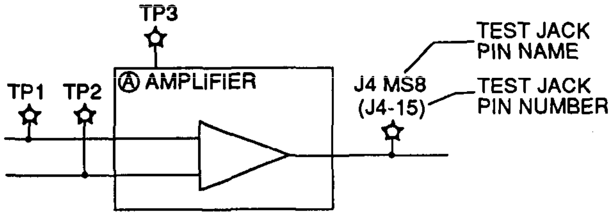
Figure 2-1. Graphic Symbols (2 of 2)

g. The CCAs in the Spectrum Analyzer contain four types of test points (TPs). The following figure illustrates each type of test point as seen on both the block/schematic diagrams and CCA. The name of each test point is etched on the CCA and indicated on the component locator diagrams.



TEST POINTS ON CCA



TEST POINTS ON BLOCK DIAGRAM

- *Solder Pad:* Each pad test point uses a square pad and a round pad etched into the CCA. The square pad is the point being measured. The round pad supplies a grounding point for the test probe.
- *Post: Either* a square post or flat post with an eyelet. Normally used for high voltage or grounding.
- *Extended Component Lead:* Component lead free of insulation soldered into a square pad.
- *Test Jack:* A collection of test points located on a single 16-pin jack. There are over 26 test jacks used throughout the Spectrum Analyzer. The TAM uses these test jacks during diagnostic and adjustment procedures. The pins on the test jack may be manually probed, provided caution is used to prevent accidental shorting between adjacent pins. MS “measured signal, “TA “ test and adjustment Module address line, ” and OS “output signal” lines are provided. Test jack test points are identified on block/schematic diagrams by both the jack/pin number and line name.

h. Ribbon cables are used extensively in the Spectrum Analyzer, and each cable uses a different pin numbering method on the jacks (signal names remain the same but the pin numbers vary). Figure FO-3 illustrates the pin configurations of these cables. Cables W1 and W2 use two pin numbering methods on their many jacks. These methods are identified in the interconnect and block diagrams by the letters “A” and “B” next to the jack designator (e.g. J1(A)). CCA jacks connected to W1 will always be labeled J1, and jacks connected to W2 will always be labeled J2.

2-8. EQUIPMENT INSPECTION.

The following inspection procedures shall be used to locate obvious malfunctions with the Spectrum Analyzer.

a. Inspect all external surfaces of Spectrum Analyzer for physical damage, breakage, loose or dirty contacts, and missing components.

WARNING

Hazardous voltages are present when covers are removed. Where maintenance can be performed without having power applied, power should be removed.

CAUTION

Do not disconnect or remove any board assemblies in the Spectrum Analyzer unless the instrument is turned to off. Some board assemblies contain devices that can be damaged if the board is removed when the power is on. Several components, including MOS devices, can be damaged by electrostatic discharge. Use conductive foam and grounding straps when servicing is required around sensitive components. Use a grounding strap when servicing is required around sensitive components. Use care when unplugging IC's from high-grip sockets.

b. Remove the cover (para 2-39) and place CCAs in the service position (para 2-42 and 2-45) as required to gain access to components.

c. Inspect printed circuit board surfaces for discoloration, cracks, breaks, and warping,

d. Inspect printed circuit board traces for breaks, cracks, cuts, erosion, or looseness.

e. Inspect all assemblies for burnt or loose components.

f. Inspect all chassis-mounted components for looseness, breakage, loose contacts or conductors.

g. Inspect Spectrum Analyzer for disconnected, broken, cut, loose, or frayed cables or wires.

2-9. ERROR CODES.

The Spectrum Analyzer uses error codes to alert the user to both operator errors and hardware malfunctions. Error codes are displayed in the lower right-hand corner of the CRT display. The software routines that generate error codes are initiated at instrument turn-on, and continually check for error conditions during operation. Multiple error messages may exist simultaneously. See table 2-1 for more information on troubleshooting using error codes.

2-10. TEST AND ADJUSTMENT MODULE (TAM).

Diagnostics are performed using the Test and Adjustment Module (TAM) connected to the rear panel. Paragraph 2-38 provides installation instructions. Because the TAM connects directly to the Spectrum Analyzer's internal data and address bus, it controls the hardware directly through firmware control. The TAM measures voltages at key points in the circuitry, and flags a failure whenever the voltage falls outside the limits. The TAM locates the failure to a small functional area which can be examined manually. Remember when using the TAM:

- Make sure the Spectrum Analyzer's LINE is OFF when installing or removing the TAM.
- Use the HELP key (found in all menus) for useful troubleshooting information.
- Pressing the MODULE button will return to the TAM's main menu.
- Because the TAM acts as the active controller on the HP-IB bus, no other active controller should be connected to the bus.

For the TAM to function properly, certain parts of the Spectrum Analyzer must be operating properly. These include the CPU, parts of the Program ROM and Program RAM, the keyboard and keyboard interface, and the display. Even though the TAM communicates to the operator via the display, some display problems can be fault isolated using the TAM and an external printer.

The TAM uses a built-in dc voltmeter and DAC to measure voltages on any one of 26 'test connectors" located throughout the Spectrum Analyzer. One test connector on each CCA is reserved as a “revision connector. ” The TAM uses the revision connector to identify the CCA's design revision. The TAM must be plugged into the revision connector first to determine which tests to use for the CCA. If the revision connector has not been probed, a message will appear instructing you to connect the probe to the revision connector and press TEST. You can then probe the rest of the assembly's connectors.

NOTE

> If the revision of the CCA is newer than the TAM, a message will be displayed stating that the revision code for this board is not known by this module. The choices presented are to use the test for the latest known revision board, measure only voltages, or exit. In general, most points will not change from one board revision to another, so using the most current tests is still very useful. However, any failure should be verified using the troubleshooting procedures provided before doing a repair.

Many of the signals measured by the TAM are digitally controlled. If inconsistent results are obtained, or if failures appear in unrelated areas, the digital control may be at fault. Refer to the manual troubleshooting procedures for those assemblies to isolate those failures.

If the TAM seems to be giving erroneous results, its performance can be checked by placing the probe on the TAM test connector A2J11 (fig. FO-7) and executing the manual probe diagnostics. If either of the tests fail, the TAM is malfunctioning and should be serviced.

2-11. TROUBLESHOOTING TABLE.

The Troubleshooting table (table 2-1) lists common malfunctions which may be found during normal operation or maintenance of the Spectrum Analyzer or its components. You should perform the tests or inspections and corrective actions in the order listed.

WARNING

Troubleshooting and repair of the Spectrum Analyzer without the case exposes high voltage points that may, if contacted, cause personal injury. Maintenance and repair of the Spectrum Analyzer should be performed only by a skilled person who knows the hazards involved. Where maintenance can be performed without power applied, the power should be removed. When any repair is completed, make sure that all safety features are intact and functioning and that all necessary parts are connected to their grounds.

CAUTION

Use caution when probing test points or connectors during troubleshooting. Some of the transistors used in the Spectrum Analyzer contain metal containers that, if accidently shorted (to ground or other levels), can cause permanent damage. Also, when probing of the 16-pin test jacks, make sure pins are not shorted.

NOTES

- After repair of Spectrum Analyzer verify malfunction is cleared. If not, perform the proper adjustment (table 2-8).
- TTL low logic level is -0.5 to +0.8 V; TTL high logic level is +3.5 to +5.5 v.
- See figure FO-1 for assembly location diagram, and FO-2 for cable locator diagram.

Table 2-1. Troubleshooting.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

1. Blank Display (or no power up).

Perform Blank Display Test (para 2-17).

2. Keyboard/RPG Failures.

Step 1. Perform Keyboard/RPG Test(s) (para 2-12).

- Replace faulty component.

Step 2. Perform Keyboard Test (para 2-14).

- Replace faulty component.

3. Display Problems (other than blank).

Step 1. Perform appropriate Display Test(s) (para 2-14).

- Replace faulty component.

Step 2. Perform appropriate Display/Power Supply Section Test(s) (para 2-17).

- Replace faulty component.

4. Demodulator (audio) Failures.

Step 1. If problem only occurs when SPAN is not set to 0 Hz (zero span), perform Frequency Span Accuracy Performance Test (para 2-18).

If performance test fails, perform Adjust YTO (para 2-27).

If problem only occurs when SPAN is set to 0 Hz (zero span) or only for FM audio, perform Adjust Demodulator (para 2-33).

Step 2. Perform AM/FM Demodulation, Audio Amplifier, and Speaker Test (para 2-13).

- Replace faulty component.

5. Trace or State Storage Failures.

Perform State and Trace Storage Test (para 2-14).

- Replace faulty component.

6. Spectrum Analyzer Displays Error Code(s).

Step 1. Record error message, then press RECALL button, then MORE key, then RECALL ERRORS key.

Step 2. Use STEP up and down buttons to scroll through and record additional error messages.

Step 3. Press SAVE button, then SAVE STATE key, then STATE 0 key.

Step 4. Press PRESET button then REALIGN LO & IF key and wait for the sequence to finish.

Step 5. Press RECALL button, then RECALL STATE key, then RECALL 0 key.

- If identical error is displayed, locate error number below and perform as instructed.
- If error code is not displayed, unit is operational.

Table 2-1. Troubleshooting – Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

6. Spectrum Analyzer Displays Error Code(s) – Continued.

NOTE

All possible errors are arranged in numeric order. The top of each page contains a listing of errors contained on that page.

Step 6. If multiple errors are present that are of various types, perform ADC Test (para 2-12) prior to performing the individual error tests.

- Replace faulty component.

ERROR Codes 100 through 199 Displayed (HP-IB Errors).

- Troubleshoot using TM 11-6625-3250-12, Appendix F.

ERROR Codes 200 and 201 Displayed (System Errors).

200 SYSTEM - Hardware/firmware interaction.
201 SYSTEM - Hardware/firmware interaction.

Step 1. If any other errors are displayed, troubleshoot them first.

Step 2. Verify A2U306 through A2U311 (fig. FO-7) firmware is all the same revision level and fully seated.

- Replace if necessary.

Step 3. Verify A2U501 is fully seated.

- Replace faulty component/assembly.

Step 4. Perform Digital Signature Analysis (DSA) Test (para 2-14).

- Replace faulty component.

Step 5. Troubleshoot address and data lines for stuck bits using fig. FO-9/FO-10.

- Replace faulty component.

ERROR Codes 300 and 301 Displayed (YTO Loop Errors).

300 YTO UNLK - YTO (1st LO) Loop is unlocked.
301 YTO UNLK - YTO (1st LO) Loop is unlocked. Set when YTO ERR is out of range.

Perform Unlocked YTO PLL Test (para 2-15).

- Replace faulty component.

NOTE

YTO unlock errors may occur if the power delivered to A15U100 Sampler (fig. FO-30, Sheet 6, circuit Z) is less than -9.5 dBm. Frequency response will be degraded in both internal and external mixing modes if the output power is low or unleveled.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 302 through 316 Displayed (Roller PLL Errors).

NOTE

If error codes 333 and 499 are also present, perform 10 MHz Reference Test (para 2-16) prior to performing this test.

302 OFF UNLK - Offset Roller Oscillator PLL is unlocked. Offset Oscillator Pretune DAC could not be adjusted to bring OFFSENSE within proper range.

Step 1. Perform 10 MHz Reference Test (para 2-16).

- Replace faulty component.

Step 2. Perform Offset Oscillator PLL Test (para 2-15).

- Replace faulty component.

303 XFR UNLK - Transfer Roller Oscillator PLL is unlocked. Transfer Oscillator Pretune DAC could not be adjusted to bring XFRSENSE within proper range.

Step 1. Perform 10 MHz Reference Test (para 2-16).

- Replace faulty component.

Step 2. Perform Transfer Oscillator PLL Test (para 2-15).

- Replace faulty component.

304 ROL UNLK - Main Roller Oscillator PLL is unlocked. Main Roller Pretune DAC could not be adjusted to bring OFFSENSE within proper range.

Step 1. Perform 10 MHz Reference Test (para 2-16).

- Replace faulty component.

Step 2. Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

305 FREQ ACC - Unable to adjust MAINSENSE close to zero volts using Coarse Adjust

306 FREQ ACC - Unable to adjust MA INSENSE to zero volts using the Fine Adjust DAC.

Step 1. Perform Unlocked YTO PLL Test (para 2-15).

- Replace faulty component.

Step 2. Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

307 FREQ ACC - Transfer Oscillator Pretune DAC out of range. DAC set to 255 (maximum) before XFRSENSE changed polarity.

Perform Transfer Oscillator PLL Test (para 2-15).

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 302 through 316 Displayed (Roller PLL Errors) – Continued.

308 FREQ ACC - Offset Oscillator Pretune DAC not within limits at low frequency.
309 FREQ ACC - Offset Oscillator Pretune DAC not within limits at high frequency. Set if XFRSENSE is greater than +5V (should be at negative rail).

Perform Offset Oscillator PLL Test (para 2-15).

- Replace faulty component.

310 FREQ ACC - Main Roller Pretune DAC set to 255. DAC set to 255 before MAINSENSE changes to a negative polarity.
311 FREQ ACC - Main Roller Pretune DAC set to 255. DAC set to 255 before MAINSENSE changes to a negative polarity.

Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

312 FREQ ACC - Unable to adjust MAINSENSE to zero volts using Fine Adjust DAC.

Step 1. Perform Unlocked YTO PLL Test (para 2-15).

- Replace faulty component.

Step 2. Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

313 FREQ ACC - Error in LO synthesis algorithm. Set if a combination of Sampler Oscillator and Roller Oscillator frequencies could not be found to correspond to the required YTO start frequency,

Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

314 FREQ ACC - Indicates problems in the span calibration. Appears when the Main Roller Oscillator sweep sensitivity is zero.
315 FREQ ACC - Indicates problems in the span calibration. Appears when the Roller Span Attenuator DAC is out of range.

Step 1. If errors 302, 303, or 304 are also present, troubleshoot that error first.

Step 2. Perform Roller Oscillator Span Test (para 2-15).

- Replace faulty component.

Step 3. Troubleshoot around A14U114B, A14U115A, A14U116, or A14Q101 using fig. FO-27, Sheet 12, circuit AM.

- Replace faulty component.

316 FREQ ACC - Sensitivity of Main Roller Pretune DAC is zero.

Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

Table 2-1. Troubleshooting – Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 317 and 318 Displayed (YTO Loop Errors).

317 FREQ ACC - Main Coil Coarse DAC at limit. Main Coil Coarse DAC is set to one of its limits before bringing YTO ERR close enough to zero volts.
318 FREQ ACC - Main Coil Fine DAC at limit, Main Coil Fine DAC is set to one of its limits before bringing YTO ERR to zero volts.

Perform Unlocked YTO PLL Test (para 2-15).

- Replace faulty component.

NOTE

YTO unlock errors may occur if the power delivered to A15U100 Sampler (fig. FO-30, Sheet 6, circuit Z) is less than -9.5 dBm. Frequency response will be degraded in both internal and external mixing modes if the output power is low or unleveled.

ERROR Codes 321 through 329 Displayed (Roller PLL Errors).

NOTE

If error codes 333 and 499 are also present, perform 10 MHz Reference Test (para 2-16) prior to performing this test.

321 FREQ ACC - Main Roller tuning sensitivity is not greater than zero.

Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

322 FREQ ACC - Unable to adjust MAINSENSE close to zero volts using Coarse Adjust DAC.
324 FREQ ACC - Unable to adjust MAINSENSE close to zero volts using Coarse Adjust DAC.
325 FREQ ACC - Unable to adjust MAINSENSE to zero volts using the Fine Adjust DAC,
326 FREQ ACC - Fine Adjust DAC near end of range. Fine Adjust DAC value is set to less than 5 or greater than 250.

Step 1. Perform Unlocked YTO PLL Test (para 2-15).

- Replace faulty component.

Step 2. Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

327 OFF UNLK - Offset Roller Oscillator PLL is unlocked. Offset Oscillator Pretune DAC cannot be adjusted to bring OFFSENSE within proper range.

Step 1. Perform 10 MHz Reference Test (para 2-16).

- Replace faulty component.

Step 2. Perform Offset Oscillator PLL Test (para 2-15).

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 321 through 329 Displayed (Roller PLL Errors)-Continued.

328 FREQ ACC - Roller Fine Adjust DAC sensitivity less than or equal to zero.
329 FREQ ACC - Roller Coarse Adjust DAC sensitivity less than or equal to zero.

Perform Main Oscillator PLL Test (para 2-15).

- Replace faulty component.

ERROR Code 331 Displayed (YTO Loop Error).

331 FREQ ACC - Invalid YTO frequency. Firmware attempted to set YTO to a frequency outside 2.95 to 6.8107 GHz range,

Step 1. Perform Digital Signature Analysis (DSA) Test (para 2-14).

- Replace faulty component.

Step 2. Troubleshoot A2 RAM circuit using fig. FO-9/FO-10, Sheet 7, circuit S.

Replace faulty component.

ERROR Code 333 Displayed (Reference Loop Error).

NOTE

If error codes 302, 303, 304, 327 or 499 are also present, perform 10 MHz Reference Test (para 2-16) prior to performing this test.

333 600 UNLK - The 600 MHz Reference Oscillator PLL is unlocked. Set if L03ERR is outside of its limits.

Step 1. Perform 10 MHz Reference Test (para 2-16).

- Replace faulty component.

Step 2. Perform Unlocked Reference PLL Test (para 2-15).

- Replace faulty component.

ERROR Code 334 Displayed (YTO Leveling Loop Error).

NOTE

Error 334 is usually accompanied by error codes 300 and/or 301. ERR 301 YTO UNLK will be cleared once ERR 334 has been cleared.

334 LO AMPL - 1ST LO Distribution Amplifier is unleveled.

Step 1. Verify 50Ω load is connected to 1st LO OUTPUT connector.

Step 2. Perform Low and High Band Test (para 2-16).

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) – Continued.

ERROR Code 335 Displayed (Sampling Oscillator Error).

335 SMP UNLK - Sampling Oscillator PLL is unlocked. Set if OFL_ERR is outside its

Step 1. Perform 10 MHz Reference Test (para 2-16).

- Replace faulty component.

Step 2. Perform Unlocked Offset PLL Test (para 2-15).

- Replace faulty component.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors). These error codes are generated when the automatic IF adjustment routine detects a fault. This routine first adjusts amplitude parameters, then resolution bandwidths in a 300 kHz, 1 MHz, 100 kHz, 30 kHz, 10 kHz, 3 kHz, 1 kHz, 300 Hz, 100 Hz, and 2 MHz sequence. The routine will restart from the beginning if a fault is detected. Parameters adjusted after the routine begins but before the fault is detected are correct, but parameters adjusted later in the sequence are suspect. Refer to paragraph 1-13c for more information.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

400 AMPL 100- Unable to adjust amplitude of 100 Hz RES BW.
401 AMPL 300- Unable to adjust amplitude of 300 Hz RES BW.
402 AMPL 1K - Unable to adjust amplitude of 1 kHz RES BW.
403 AMPL 3K - Unable to adjust amplitude of 3 kHz RES BW.
404 AMPL 10K - Unable to adjust amplitude of 10 kHz RES BW.
405 RBW 10K - Unable to adjust 10 kHz RES BW in First XTAL Pole.
406 RBW 10K - Unable to adjust 10 kHz RES BW in Second XTAL Pole.
407 RBW 10K - Unable to adjust 10 kHz RES BW in Third XTAL Pole.
408 RBW 10K - Unable to adjust 10 kHz RES BW in Fourth XTAL Pole.
409 RBW 10K - Unable to adjust 10 kHz RES BW in First XTAL Pole.
410 RBW 10K - Unable to adjust 10 kHz RES BW in Second XTAL Pole.
411 RBW 10K - Unable to adjust 10 kHz RES BW in Third XTAL Pole.
412 RBW 10K - Unable to adjust 10 kHz REW BW in Fourth XTAL Pole.
413 RBW 10K - Unable to adjust 10 kHz RES BW in First XTAL Pole.
414 RBW 10K - Unable to adjust 10 kHz RES BW in Second XTAL Pole. .
415 RBW 10K - Unable to adjust 10 kHz RES BW in Third XTAL Pole.
416 RBW 10K - Unable to adjust 10 kHz RES BW in Fourth XTAL Pole.

Step 1. Perform Resolution Bandwidth Test (para 2-13), for the bandwidth that failed.

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except Log Amplifier Test and AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) – Continued.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors) – Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

417 RBW 3K - Unable to adjust 3 kHz RES BW in First XTAL Pole.
418 RBW 3K - Unable to adjust 3 kHz RES BW in Second XTAL Pole.
419 RBW 3K - Unable to adjust 3 kHz RES BW in Third XTAL Pole.
420 RBW 3K - Unable to adjust 3 kHz RES BW in Fourth XTAL Pole.
421 RBW 10K - Unable to adjust 10 kHz RES BW is First XTAL Pole.
422 RBW 10K - Unable to adjust 10 kHz RES BW is Second XTAL Pole.
423 RBW 10K - Unable to adjust 10 kHz RES BW is Third XTAL Pole.
424 RBW 10K - Unable to adjust 10 kHz RES BW is Fourth XTAL Pole.
425 RBW 3K - Unable to adjust 3 kHz RES BW in First XTAL Pole.
426 RBW 3K - Unable to adjust 3 kHz RES BW in Second XTAL Pole.
427 RBW 3K - Unable to adjust 3 kHz RES BW in Third XTAL Pole.
428 RBW 3K - Unable to adjust 3 kHz RES BW in Fourth XTAL Pole.
429 RBW 100 - Unable to adjust 100 Hz RES BW.
430 RBW 300 - Unable to adjust 300 Hz RES BW.
431 RBW 1K - Unable to adjust 1 kHz RES BW.
432 RBW 3K - Unable to adjust 3 kHz RES BW.
433 RBW 10K - Unable to adjust 10 kHz RES BW.
434 RBW 300-300 Hz RES BW amplitude low in First XTAL Pole.
435 RBW 300-300 Hz RES BW amplitude low in Second XTAL Pole.
436 RBW 300-300 Hz RES BW amplitude low in Third XTAL Pole.
437 RBW 300-300 Hz RES BW amplitude low in Fourth XTAL Pole.
438 RBW 1K - 1 kHz RES BW amplitude low in First XTAL Pole.
439 RBW 1K - 1 kHz RES BW amplitude low in Second XTAL Pole.
440 RBW 1K - 1 kHz RES BW amplitude low in Third XTAL Pole.
441 RBW 1K - 1 kHz RES BW amplitude low in Fourth XTAL Pole.
442 RBW 3K - 3 kHz RES BW amplitude low in First XTAL Pole.
443 RBW 3K - 3 kHz RES BW amplitude low in Second XTAL Pole.
444 RBW 3K - 3 kHz RES BW amplitude low in Third XTAL Pole.
445 RBW 3K - 3 kHz RES BW amplitude low in Fourth XTAL Pole.
446 RBW 10K - 10 kHz RES BW amplitude low in First XTAL Pole.
447 RBW 10K - 10 kHz RES BW amplitude low in Second XTAL Pole.
448 RBW 10K - 10 kHz RES BW amplitude low in Third XTAL Pole.
449 RBW 10K - 10 kHz RES BW amplitude low in Fourth XTAL Pole.

Step 1. Perform Resolution Bandwidth Test (para 2-13), for the bandwidth that failed.

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except Log Amplifier Test and AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Table 2-1. Troubleshooting-Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors)-Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

450 IF SYSTM - IF hardware failure.
451 IF SYSTM - IF hardware failure.
452 IF SYSTM - IF hardware failure.

Step 1. If any other errors are displayed, troubleshoot them first.

Step 2. Verify A2U306 through A2U311 (fig. FO-7) firmware is all the same revision level and fully seated.

- Replace if necessary.

Step 3. Verify A2U501 is fully seated.

- Replace faulty component/assembly.

Step 4. Perform Digital Signature Analysis (DSA) Test (para 2-14).

- Replace faulty component.

Step 5. Troubleshoot address and data lines for stuck bits using fig. FO-9/FO-10.

- Replace faulty component.

454 AMPL - Unable to adjust step gain amplifiers.
455 AMPL - Unable to adjust Fine Attenuator.
456 AMPL - Unable to adjust Fine Attenuator.
457 AMPL - Unable to adjust Fine Attenuator.
458 AMPL - Unable to adjust First Step Gain Stage.
459 AMPL - Unable to adjust First Step Gain Stage.
460 MPL - Unable to adjust First Step Gain Stage.
461 AMPL - Unable to adjust Second Step Gain Stage.
462 AMPL - Unable to adjust Second Step Gain Stage.
463 AMPL - Unable to adjust Third Step Gain Stage.
464 AMPL - Unable to adjust Third Step Gain Stage.
465 AMPL - Unable to adjust Third Step Gain Stage.
466 LIN AMPL - Unable to adjust linear amplifier scale.
467 AMPL - Unable to adjust step gain amplifiers.
468 AMPL - Unable to adjust Third Step Gain Stage.
469 AMPL - Unable to adjust step gain amplifiers.
470 AMPL - Unable to adjust Third Step Gain Stage.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except Log Amplifier Test and AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Table 2-1. Troubleshooting-Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

6. Spectrum Analyzer Displays Error Code(s) – Continued.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors) -Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

471 RBW30K - Unable to adjust 30 kHz RES BW in First LC Pole.
472 RBW 100K - Unable to adjust 100 kHz RES BW in First LC Pole.
473 RBW 300K - Unable to adjust 300 kHz RES BW in First LC Pole.
474 RBW 1M - Unable to adjust 1 MHz RES BW in First LC Pole.
475 RBW 30K - Unable to adjust 30 kHz RES BW in Second LC Pole.
476 RBW 100K - Unable to adjust 100 kHz RES BW in Second LC Pole.
477 RBW 300K - Unable to adjust 300 kHz RES BW in Second LC Pole.
478 RBW 1M - Unable to adjust 1 MHz RES BW in Second LC Pole.
483 RBW 10K - Unable to adjust 10 kHz RES BW.
484 RBW 3K - Unable to adjust 3 kHz RES BW.
485 RBW 1K - Unable to adjust 1 kHz RES BW.
486 RBW 300- Unable to adjust 300 Hz RES BW.
487 RBW 100- Unable to adjust 100 Hz RES BW.
488 RBW 10- Unable to adjust 10 Hz RES BW.
489 RBW 100- Unable to adjust 100 Hz RES BW.
490 RBW 100- Unable to adjust 100 Hz RES BW.
491 RBW 100- Unable to adjust 100 Hz RES BW.
492 RBW 300- Unable to adjust 300 Hz RES BW.
493 RBW 1K - Unable to adjust 1 kHz RES BW.
494 RBW 3K - Unable to adjust 3 kHz RES BW.
495 RBW 10K - Unable to adjust 10 kHz RES BW.
496 RBW 100- Unable to adjust 100 Hz RES BW.
497 RBW 100- Unable to adjust 100 Hz RES BW.
498 RBW 100- Unable to adjust 100 Hz RES BW.

Step 1. Perform Resolution Bandwidth Test (para 2-13), for the bandwidth that failed.

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except Log Amplifier Test and AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

499 CAL UNLK - A16 Cal Oscillator is unlocked. Verify the unlocked condition as follows:

Perform CAL Oscillator Test (para 2-13).

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

---

6. Spectrum Analyzer Displays Error Code(s) – Continued.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors) -Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

500 AMPL 30K - Unable to adjust amplitude of 30 kHz RES BW.
501 AMPL .1M - Unable to adjust amplitude of 100 kHz RES BW.
502 AMPL .3M - Unable to adjust amplitude of 300 kHz RES BW.
503 AMPL .1M - Unable to adjust amplitude of 1 MHz RES BW.
504 AMPL 30K - Unable to adjust amplitude of 30 kHz RES BW.
505 AMPL .1M - Unable to adjust amplitude of 100 kHz RES BW.
506 AMPL .3M - Unable to adjust amplitude of 300 kHz RES BW.
507 AMPL 1M - Unable to adjust amplitude of 1 MHz RES BW.
508 AMPL 30K - Unable to adjust amplitude of 30 kHz RES BW.
509 AMPL .1M - Unable to adjust amplitude of 100 kHz RES BW.
510 AMPL .3M - Unable to adjust amplitude of 300 kHz RES BW.
511 AMPL 1M - Unable to adjust amplitude of 1 MHz RES BW.
512 RBW 100- Unable to adjust 100 Hz RES BW.
513 RBW 300- Unable to adjust 300 Hz RES BW.
514 RBW 1K - Unable to adjust 1 kHz RES BW.
515 RBW 3K - Unable to adjust 3 kHz RES BW.
516 RBW 10K - Unable to adjust 10 kHz RES BW.
517 RBW 100- Unable to adjust 100 Hz RES BW.
518 RBW 300 - Unable to adjust 300 Hz RES BW.
519 RBW 1K - Unable to adjust 1 kHz RES BW.
520 RBW 3K - Unable to adjust 3 kHz RES BW.
521 RBW 10K - Unable to adjust 10 kHz RES BW.
522 RBW 10K - Unable to adjust symmetry of 10 kHz RES BW in First XTAL Pole.
523 RBW 10K - Unable to adjust symmetry of 10 kHz RES BW in Second XTAL Pole.
524 RBW 10K - Unable to adjust symmetry of 10 kHz RES BW in Third XTAL Pole.
525 RBW 10K - Unable to adjust symmetry of 10 kHz RES BW in Fourth XTAL Pole.

Step 1. Perform Resolution Bandwidth Test (para 2-13), for the bandwidth that failed.

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except Log Amplifier Test and AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) – Continued.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors) -Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

550 LOG AMPL - Unable to adjust amplitude of log scale.
551 AMPL - Unable to adjust step gain amplifiers.
552 LOG AMPL - Unable to adjust amplitude of log scale.
553 LOG AMPL - Unable to adjust amplitude of log scale.
554 LOG AMPL - Unable to adjust amplitude of log scale.
555 LOG AMPL - Unable to adjust amplitude of log scale.
556 LOG AMPL - Unable to adjust amplitude of log scale.
557 LOG AMPL - Unable to adjust amplitude of log scale.
558 LOG AMPL - Unable to adjust amplitude of log scale.
559 LOG AMPL - Unable to adjust amplitude of log scale.
560 LOG AMPL - Unable to adjust amplitude of log scale.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

-Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

-Replace faulty component.

561 LOG AMPL - Unable to adjust amplitude of log scale.
562 LOG AMPL - Unable to adjust amplitude of log scale.

Step 1. Perform IF Signature Test (para 2-13).

-Replace faulty component.

Step 2. Perform all A3 Interface CGA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Step 4. Troubleshoot using fig. FO-19, Sheet 2, circuit H.

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 400 through 599 Displayed (Automatic iF Errors) -Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

563 LOG AMPL - Unable to adjust amplitude of log scale.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Step 4. Troubleshoot using fig. FO-19, Sheet 3, circuit 1.

- Replace faulty component.

564 LOG AMPL - Unable to adjust amplitude of log scale.
565 LOG AMPL - Unable to adjust amplitude of log scale.
566 LOG AMPL - Unable to adjust amplitude of log scale.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

567 LOG AMPL - Unable to adjust amplitude of log scale.
568 LOG AMPL - Unable to adjust amplitude of log scale.
569 LOG AMPL - Unable to adjust amplitude of log scale.
570 LOG AMPL - Unable to adjust amplitude of log scale.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Troubleshoot using fig. FO-13, Sheet 8, circuit X.

- Replace faulty component.

Step 4. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Table 2-1. Troubleshooting–Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors) -Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

571 AMPL - Unable to adjust step gain amplifiers.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

572 AMPL 1M - Unable to adjust amplitude of 1 MHz RES BW.

Step 1. Perform 1 MHz Resolution Bandwidth Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except Log Amplifier Test and AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

573 LOG AMPL - Unable to adjust amplitude of log scale.
574 LOG AMPL - Unable to adjust amplitude of log scale.
575 LOG AMPL - Unable to adjust amplitude of log scale.
576 LOG AMPL - Unable to adjust amplitude of log scale.
577 LOG AMPL - Unable to adjust amplitude of log scale.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Step 4. Troubleshoot using fig. FO-16, Sheet 6, circuit Q.

- Replace faulty component.

Table 2-1. Troubleshooting-Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 400 through 599 Displayed (Automatic IF Errors) - Continued.

NOTE

Multiple IF Errors occur during the IF Adjust routine, perform CAL Oscillator Test (para 2-13) prior to performing this test.

581 AMPL - Unable to adjust 100 kHz and 10 kHz RES BW's.
582 AMPL - Unable to adjust 100 kHz and 10 kHz RES BW's.
583 RBW 30K - Unable to adjust 30 kHz RES BW.
584 RBW 100K - Unable to adjust 100 kHz RES BW.
585 RBW 300K - Unable to adjust 300 kHz RES BW.
586 RBW 1M - Unable to adjust 1 MHz RES BW.
587 RBW 30K - Unable to adjust 30 kHz RES BW.
588 RBW 100K - Unable to adjust 100 kHz RES BW.
589 RBW 300K - Unable to adjust 300 kHz RES BW.
590 RBW 1M - Unable to adjust 1 MHz RES BW.

Step 1. Perform Resolution Bandwidth Test (para 2-13), for the bandwidth that failed.

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except Log Amplifier Test and AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

591 LOG AMPL - Unable to adjust amplitude of log scale.
592 LOG AMPL - Unable to adjust amplitude of log scale.

Step 1. Perform IF Signature Test (para 2-13).

- Replace faulty component.

Step 2. Perform all A3 Interface CCA Video Circuits Test (para 2-12).

- Replace faulty component.

Step 3. Perform all A4 LOG Amplifier CCA Tests (para 2-13), except AM/FM Demodulation, Audio Amplifier, and Speaker Test.

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 600 through 651 Displayed (ADC Errors).

600 SYSTEM - Hardware/Firmware interaction.
601 SYSTEM - Hardware/Firmware interaction.

Step 1. If any other errors are displayed, troubleshoot them first.

Step 2. Verify A2U306 through A2U311 (fig. FO-7) firmware is all the same revision level and fully seated.

- Replace if necessary.

Step 3. Verify A2U501 is fully seated.

- Replace faulty component/assembly.

Step 4. Perform Digital Signature Analysis (DSA) Test (para 2-14).

- Replace faulty component.

Step 5. Troubleshoot address and data lines for stuck bits using fig. FO-9/FO-10.

- Replace faulty component.

650 OUTOFRG - ADC input is outside of the ADC range.
651 NO IRQ - Microprocessor is not receiving interrupt from ADC.

Perform Frequency Counter Test (para 2-14).

- Replace faulty component.

ERROR Codes 700 through 704 Displayed (EEROM Checksum Errors).

700 EEROM - Checksum error of EEROM A2U501.
701 AMPL CAL - Checksum error of frequency response correction data.
702 ELAP TIM - Checksum error of elapsed time data.
703 AMPL CAL - Checksum error of frequency response correction data. Default values being used.

Step 1. Place A2/A3 in service position (para 2-40).

Step 2. Set A2J12 (fig. FO-7) jumper to WR ENA position.

Step 3. Set LINE to on and press INT button then FLATNESS DATA key.

Step 4. Set FLATNESS to 130, then press EXIT, STORE DATA, YES, DISP and MORE keys.

Step 5. Press INTEN key, set INTENSITY to 90, then press STORE INTEN key.

Step 6. Press FOCUS key, set FOCUS to 128, then press STORE FOCUS key.

Step 7. Press SAVE button, then SAVE PRSEL PK key.

Step 8. Set LINE to OFF then ON.

If errors are still present, replace A2U501 (fig. FO-7).

704 PRESELCT - Checksum error of user preselector peak data.

Press RECALL button, then MORE, FACTORY PRESEL PK, SAVE, and SAVE PRSEL PK keys to clear error.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Codes 705 through 710 Displayed (Program ROM Checksum Errors).

NOTE

Replacement program ROMs must be the same part number as the replaced part.

705 ROM U306 - Checksum error of Program ROM A2U306.

Replace A2U306 (fig. FO-7).

706 ROM U307 - Checksum error of Program ROM A2U307.

Replace A2U307 (fig. FO-7).

707 ROM U308 - Checksum error of Program ROM A2U308.

Replace A2U308 (fig. FO-7).

708 ROM U309 - Checksum error of Program ROM A2U309.

Replace A2U309 (fig. FO-7).

709 ROM U310 - Checksum error of Program ROM A2U310.

Replace A2U310 (fig. FO-7).

710 ROM U311 - Checksum error of Program ROM A2U311.

Replace A2U311 (fig. FO-7).

ERROR Codes 711 through 716 Displayed (RAM Check Errors).

711 RAM U303 - Checksum error of System RAM A2U303.

Replace A2U303 (fig. FO-7).

712 RAM U302 - Checksum error of System RAM A2U302.

Replace A2U302 (fig. FO-7).

713 RAM U301 - Checksum error of System RAM A2U301.

Replace A2U301 (fig. FO-7).

714 RAM U300 - Checksum error of System RAM A2U300.

Replace A2U300 (fig. FO-7).

715 RAM U305 - Checksum error of System RAM A2U305.

Replace A2U305 (fig. FO-7).

716 RAM U304 - Checksum error of System RAM A2U304.

Replace A2U304 (fig. FO-7).

ERROR Code 717 Displayed (Microprocessor Error).

717 BAD uP! ! - Microprocessor not fully operational.

Perform Digital Signature Analysis (DSA) Test (para 2-14).

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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6. Spectrum Analyzer Displays Error Code(s) - Continued.

ERROR Code 718 Displayed (Battery Error).

718 BATTERY? - Non-volatile RAM not working; check battery BT1.

Perform State and Trace Storage Test (para 2-14).

- Replace faulty component.

ERROR Codes 750 through 755 Displayed (System Errors).

750 SYSTEM - Hardware/firmware interaction; check other errors.
751 SYSTEM - Hardware/firmware interaction; check other errors.
752 SYSTEM - Hardware/firmware interaction; check other errors.
753 SYSTEM - Hardware/firmware interaction; check other errors.
754 SYSTEM - Hardware/firmware interaction; check other errors.
755 SYSTEM - Hardware/firmware interaction; check other errors.

Step 1. If any other errors are displayed, troubleshoot them first.

Step 2. Verify A2U306 through A2U311 (fig. FO-7) firmware is all the same revision level and fully seated.

- Replace if necessary.

Step 3. Verify A2U501 is fully seated,

- Replace faulty component/assembly.

Step 4. Perform Digital Signature Analysis (DSA) Test (para 2-14).

- Replace faulty component.

Step 5. Perform all A3 Interface CCA Control Circuits Test (para 2-12).

- Replace faulty component.

Step 6. Troubleshoot address and data lines for stuck bits using fig. FO-9/FO-10.

- Replace faulty component.

ERROR Codes 800 through 899 Displayed (Module Errors).

Refer to the option module's manual for troubleshooting information.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
    TEST OR INSPECTION
        CORRECTIVE ACTION

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7. All other AN/USM-489A Failures.

Step 1. Set LINE to OFF.

- Disconnect all external cables except power cable.

Step 2. Connect TAM and extension cables to rear panel (para 2-38).

Step 3. Set LINE to ON and wait for internal alignment routine to finish.

- If display is blank, perform Blank Display Test (para 2-17).
- If errors are displayed, troubleshoot error code (table 2-1).
- If displayed is unreadable, troubleshoot display problems (table 2-1).

Step 4. Press PRESET button.

- If key does not function, troubleshoot keyboard/RPG failures (table 2-1).

Step 5. Press MODULE button then DIAGNOSE key. Use KNOB to select “1) Automatic Fault Isolation”.

- If knob does not function, troubleshoot keyboard/RPG failures (table 2-1).

Step 6. Press EXECUTE key and follow instructions on the screen.

Step 7. Read test results on the CRT Screen.

- If any of the tests return FAIL, perform as instructed below. For additional troubleshooting information on failed tests, press MORE INFO key and follow instructions on CRT Screen.
- If all tests pass, proceed to step 8.

Controller Check - Performs a check-sum of all ROMs, RAMs, and the ERROM. Also checks parts of the CPU.

- If test fails, follow instructions on CRT Screen.
  - Replace faulty component.

Table 2-1. Troubleshooting – Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

7. All other AN/USM-489A Failures - Continued.

ADC/interface Check -Tests ADC/interface Section. If test fails, match suspected circuit indicated on CRT screen (listed below) to the proper troubleshooting procedure (provided in paragraph 2-12 unless otherwise specified). List below is alphabetized by fault.

- *Check ADC ASM* - perform ADC ASM Test.
- *Check ADC MUX*- perform ADC MUX Test.
- *Check ADC Start/Stop Control*- perform ADC Start/Stop Control Test.
- *Check* Analog *Bus* Drivers - disconnect W2 from A3J2 (fig. FO-11) and repeat test. If test still fails, perform Analog Bus Drivers Test. If test now passes, W2 is shorted, or A4, A5, A14, or A15 CCA's bus inputs are shorted. Troubleshoot using fig. FO-3. Replace faulty component.
- *Check Analog Bus Timing* - disconnect W2 from A3J2 (fig. FO-11) and repeat test. If test still fails, perform Analog Bus Timing Test. If test now passes, W2 is shorted, orA4, A5, A14, or A15 CCA's bus inputs are shorted. Troubleshoot using fig. FO-3. Replace faulty component.
- Check *Interface Strobe Select* - perform Interface Strobe Select Test.
- *Check Keyboard Interface* - perform Keyboard Interface Test.
- *Check Negative Peak Detector* - perform Positive/Negative Peak Detectors Test.
- *Check Peak Detector Reset* - perform Peak Detector Reset Test.
- *Check Positive Peak Detector*- perform Positive/Negative Peak Detectors Test.
- *Check Ramp Counter*- perform Ramp Counter Test.
- *Check Real Time DAC*- perform Preselector Peaking Control (Real Time DAC) Test.
- *Check RF Gain DACs* - perform Band Flatness Control (RF Gain DACs) Test.
- *Check Rosenfell Detector* - perform Rosenfell Detector Test.
- *Check RPG Interface* - perform RPG Interface Test.
- *Check Track and Ho/d* - perform Track and Hold Test.
- *Check Trigger*- perform Triggering Test.
- *Check Variable Gain Amplifier (VGA)* - troubleshoot using fig. FO-13, Sheet 11, circuit AB. Replace faulty component.
- *Check Video Filter*- perform Video Filter Test.
- *Check Video Filter Buffer Amplifier* - troubleshoot using fig. FO-13, Sheet 9, circuit W, Replace faulty component.
- *Check Video MUX*- perform Video MUX Test.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

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7. All other AN/USM-489A Failures - Continued.

IF/LOG Check - Tests IF Section. If test fails, match suspected circuit indicated on CRT screen (listed below) to the proper troubleshooting procedure (provided in paragraph 2-13 unless otherwise specified). List below is alphabetized by fault.

- *Check* A16 Cal *Oscillator* - perform all A16 TAM Tests.
- *Check Input Switch on A5 IF Assembly* - perform all *A5* TAM Tests.
- *Check Linear Amplifiers on A4 Log Amplifier* - perform Linear Amplifiers Test.
- *Check Log Expand on A3 Interface Assembly* - perform Log Offset/Log Expand Test (para 2-12).
- *Check Step Gains on A5 IF Assembly* - perform Step Gains Test.
- *Check Video Offsets on A4 Log Amplifier Assembly* - perform Video Offset Test.
- *Check VIDEO OUT of A4 Log Amplifier Assembly* - perform Video Output Test.

LO Control Check -Tests Synthesizer Section. If test fails, match suspected circuit indicated on CRT screen (listed below) to the proper troubleshooting procedure (provided in paragraph 2-15 unless otherwise specified). List below is alphabetized by fault.

- *Check the YTO Loop* - perform Unlocked YTO PLL test.
- *Check 1st LO* - perform Confirming Faulty Synthesizer Section Test.
- *Check 1st Lo Pretune Frequency and Amplitude* - perform Unlocked YTO PLL.
- *Check 3rd LO Drive* - perform Third LO Driver Amplifier Test.
- *Check 10 MHz Reference to Phase Frequency Detector* - perform Unlocked Reference PLL Test.
- *Check for 10 MHz Signal at Other Input to Phase/Frequency Detector*- perform Unlocked Reference PLL Test.
- *Check A3 ADC MUX Function Block* - perform Confirming Faulty Synthesizer Section Test.
- *Check A14 Frequency Control Assembly* - perform Confirming Faulty Synthesizer Section Test.
- *Check A14J301 10 MHz REF Input* - perform Confirming Faulty Synthesizer Section Test.
- Check A15 Reassembly - perform Confirming a Faulty Synthesizer Section Test.
- *Check Current Source U307* - perform First-LO Span Test (All Spans).
- *Check FM Loop Sense* - perform Unlocked YTO PLL Test.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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7. All other AN/USM-489A Failures - Continued.

LO Control Check -Continued.

- *Check YTF Gain and Offset DACs* - perform YTF Driver Circuit Test (para 2-16).
- Check Level *at Amplifier Input* - perform Third LO Driver Amplifier Test.
- *Check Levels into Mixer U400* - perform Unlocked Offset PLL Test.
- Check *Loop References* - perform Unlocked Offset PLL Test.
- *Check Main Coil Tune DAC* - perform Unlocked YTO PLL Test.
- *Check Main Coil Coarse and Fine DACs* - perform Unlocked YTO PLL Test.
- *Check Main Roller Mixer-* perform Main Oscillator PLL Test.
- *Check Main Roller Oscillator and Output Buffer Amp* - perform Main Oscillator PLL Test.
- *Check Main Roller PLL* - perform Main Oscillator PLL Test.
- *Check Main Roller Pretune DA C-* perform Main Oscillator PLL Test.
- *Check Main Roller Sweep/Hold Switches* - perform Roller Oscillator Span Test (LO Spans ≤ 1 MHz).
- *Check Offset Oscillator and Buffer Amp* - perform Offset Oscillator PLL Test.
- *Check Offset Oscillator PLL* - perform Offset Oscillator PLL Test.
- *Check Offset Oscillator PLL Pre-Scaler* - perform Offset Oscillator PLL Test.
- *Check Offset Oscillator Pretune Circuitry* - perform Offset Oscillator PLL Test.
- *Check Offset Span Accuracy* - perform Roller Oscillator Span Test (LO Spans ≤ 1 MHz).
- *Check Offset Oscillator Sweep/Hold* - perform Offset Oscillator PLL Test.
- *Check Phase/Frequency Detector* - perform Unlocked Reference PLL Test.
- *Check Path to Phase/Frequency Detector* - perform Unlocked Offset PLL Test.
- *Check Roller Oscillator* - perform Unlocked YTO PLL Test.
- *Check Sampler Drive Output of A7 LODA* - perform Unlocked YTO PLL Test.
- *Check Sampler IF-* perform Unlocked YTO PLL Test.
- *Check Sampler/Sampler IF Operation* - perform Sampler and Sampler IF Test.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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7. All other AN/USM-489A Failures - Continued.

LO Control Check - Continued.

- Check *Span Attenuator*- perform First-LO Span Test. (All Spans).
- *Check Sweep Generator*- perform First-LO Span Test. (All Spans). If pass troubleshoot using fig. FO-27, Sheet 4, circuit K. Replace faulty component.
- *Check Sweep + Tune Multiplier* - perform YTF Driver Circuit Test (para 2-16)
- *Check the 600 MHz Reference Loop Amplifier* - perform Unlocked Reference PLL Test.
- *Check the YTO Loop* - perform Unlocked YTO PLL Test.
- *Check Transfer Oscillator* - perform Transfer Oscillator PLL Test.
- *Check Transfer Oscillator PLL* - perform Transfer Oscillator PLL Test.
- *Check Transfer Oscillator Pre-Scaler* - perform Transfer Oscillator PLL Test.
- *Check Transfer Oscillator Pretune DAC*- perform Transfer Oscillator PLL Test.
- *Check YTF Gain and Offset DACs* - perform Transfer Oscillator PLL Test.
- *Check YTO FM Coil Driver* - perform YTO FM Coil Span Test (1.01 MHz to 20 MHz).
- *Check YTO FM Coil Driver and Main Loop Error Voltage Driver* - perform Unlocked YTO PLL Test.

RF Low Band Check - Tests the RF Section to 300 MHz. If test fails, match suspected circuit indicated on CRT screen (listed below) to the proper troubleshooting procedure (provided in paragraph 2-16 unless otherwise specified). List below is alphabetized by fault.

- *Check 2nd IF Amplifier* - perform Third Converter Test.
- *Check 2nd IF Distribution* - perform Third Converter Test.
- *Check 10.7 MHz IF Out of Double Balanced Mixer* - perform Third Converter Test.
- *Check 300 MHz CAL OUTPUT*- perform Adjust Calibrator Amplitude (para 2-31).
- *Check A7 LO Distribution Amplifier* - perform A7 LODA (LO Distribution Amplifier) Test.
- *Check A8 Dual Mixer* - perform A8 Dual Band Mixer Test.
- *Check A9 Input Attenuator* - perform A9 Input Attenuator Test.
- *Check A12 RF Switch* - perform A12 RF Switch Test.
- *Check A13 Second Converter*- perform A13 Second Converter Test.
- *Check A13J2 INT 2nd IF*- perform A13 Second Converter Test.

Table 2-1. Troubleshooting-Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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7. All other AN/USM-489A Failures - Continued.

RF Low Band Check -Continued.

- *Check A14 Latch* - perform Control Latch for Band-Switch Driver Test.
- *Check A15 Control Latches* - perform Control Latches Test.
- *Check A15J601 10.7 MHz* - perform Confirming a Faulty Third Converter Test.
- *Check External 10 MHz Reference Operation* - perform 10 MHz Reference Test.
- *Check Gain of Flatness Compensation Amplifier* - perform Third Converter Test.
- *Check High-Band Bias* - perform High-Band Bias Test.
- *Check INT 10 MHz Reference Operation* - perform 10 MHz Reference Test.
- *Check* LO *Feedthrough* - perform Low Band (1 kHz to 2.9 GHz) Test.
- *Check LO Power*- perform Low and High Band Test.
- *Check P/N Switch* - perform PIN Switch Test.
- *Check P/N Switches in SIG ID Oscillator* - perform SIG ID Oscillator Test.
- *Check Second Converter Control* - perform A13 Second Converter Test.
- *Check* S/G *ID Oscillator* - perform Adjust SIG ID Oscillator Test.
- *Check* S/G *ID Oscillator Operation* - perform SIG ID Oscillator Test.
- *Check Third Converter*- perform Low and High Band Test.

Step 8. Press EXIT key. Use KNOB to select “3) RF Path Fault Isolation”.

Step 9. Press EXECUTE key and follow instructions on the screen (requires connecting a signal generator).

Step 10. Read test results on the CRT Screen.

- If any of the tests return FAIL, perform as instructed below. For additional troubleshooting information on failed tests, press MORE INFO key and follow instructions on CRT Screen.

RF Path Fault isolation - Tests the RF Section to 20 GHz. If test fails, match suspected circuit indicated on CRT screen (previously listed under RF Low Band Check) to the proper troubleshooting procedure (provided in paragraph 2-16 unless otherwise specified). List is alphabetized by fault.

NOTE

RF Path Fault Isolation will not be able to locate slight problems in frequency response because the tolerances of the measurements are too coarse, Perform Flatness Performance Test (para 2-18) to locate slight problems in frequency response.

Table 2-1. Troubleshooting – Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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7. All other AN/USM-489A Failures - Continued.

Step 11. If all tests pass, complete performance tests (para 2-18).

NOTE

Complete as many performance tests as possible to assist in locating malfunction.

- If any tests fails, troubleshoot using table 2-1.
- If all tests pass, and a malfunction still exists, proceed to step 12.
- If all tests pass, and a malfunction does not exist, unit is operational.

Step 12. Complete the following TAM Tests.

A2 TAM Tests (para 2-14).

- If tests fail, perform as instructed.

A3 TAM Tests (para 2-12).

- If tests fail, perform as instructed.

A4 TAM Tests (para 2-13).

- If tests fail, perform as instructed.

A5 TAM Tests (para 2-13).

- If tests fail, perform as instructed.

A14 TAM Tests (para 2-15).

- If tests fail, perform as instructed.

A15 TAM Tests (para 2-15).

- If tests fail, perform as instructed.

A16 TAM Tests (para 2-13).

- If tests fail, perform as instructed.

A17 TAM Tests (para 2-17).

- If tests fail, perform as instructed.

8. 10 MHz Reference Output Accuracy Test Failure.

Step 1. Adjust 10 MHz Frequency Reference (para 2-32).

Step 2. If adjustment fails to correct malfunction, perform 10 MHz Reference Test (para 2-16).

- Replace Faulty Component.

Table 2-1. Troubleshooting-Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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9. Calibrator Accuracy Test Failure.

Step 1. Adjust Calibrator Amplitude (para 2-31).

Step 2. Using an active probe and another spectrum analyzer, verify A15TP505 is ≈ 300 MHz at more than +2 dBm.

- If incorrect, perform Unlocked Reference PLL Test (para 2-15).

Step 3. Short A15CR503 and verify CAL Output signal is -10 dBm.

- If less than -10 dBm, troubleshoot around A15Q505 using fig. FO-30, Sheet 5 circuit W. Replace faulty component.
- If greater than -10 dBm, troubleshoot around A15CR503 and A15CR504 using fig. FO-30, Sheet 5 circuit W. Replace faulty component.

Step 4. Verify voltage at A15J502 pin 14 is ≈ +0.3 Vdc and that voltage changes with adjustment of A15R561.

- If incorrect, troubleshoot using fig. FO-30, Sheet 5 circuit W. Replace faulty component.

Step 5. Verify voltage at A15U507A pin 3 is +1.7 Vdc.

- If incorrect, troubleshoot using fig. FO-30, Sheet 2 circuit A (10V REF). Replace faulty component.

Step 6. Verify voltage at A15U507B pin 5 changes between +1.3 V and -0.6 V while adjusting A15R561.

Verify voltage at A15U507B pin 7 measures ≈ +9 Vdc at one limit of A15R561, and –12 Vdc at other limit.

- If incorrect, troubleshoot using fig. FO-30, Sheet 5 circuit W. Replace faulty component.

10. Displayed Average Noise Test Failure.

Step 1. Adjust 1st LO Distribution Amplifier (para 2-28).

Step 2. If adjustment fails to correct malfunction, perform Adjust Dual Band Mixer Bias (para 2-29).

Step 3. If adjustment fails to correct malfunction, perform Adjust YTF and Frequency Response (para 2-30).

Step 4. If adjustment fails to correct malfunction, perform all A14 TAM Tests and A15 TAM Tests (para 2-15).

- If any tests fail, perform as instructed.

Step 5. Analyze what frequencies are affected.

- If 1 kHz to 2.9 GHz, perform Low Band (1 kHz TO 2.9 GHz) Test (para 2-16).
- If 2.75 GHz to 22 GHz, perform High Band Test (para 2-16).
- If 1 kHz to 22 GHz, perform Low and High Band (2.75 GHz to 22 GHz) Test (para 2-16).
  - Replace Faulty Component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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10. Displayed Average Noise Test Failure - Continued.

Step 6. Perform all A5 TAM Tests (para 2-13).

- If any tests fail, perform as instructed.

Step 7. Perform IF Signature Test (para 2-13).

- Replace Faulty Component.

11. Resolution Bandwidth Switching and IF Alignment Uncertainty Test Failure.

Step 1. Adjust IF Bandpass (para 2-24).

Step 2. If adjustment fails to correct malfunction, perform Adjust IF Amplitude (para 2-25).

Step 3. If adjustment fails to correct malfunction, perform all A5 TAM Tests (para 2-13).

- If any tests fail, perform as instructed.

Step 4. Perform all A5 IF Filter CCA Tests (para 2-13).

- Replace Faulty Component.

12. Resolution Bandwidth Accuracy and Selectivity Test Failure.

step 1. Adjust IF Bandpass (para 2-24).

Step 2. If adjustment fails to correct malfunction, perform all A5 TAM Tests (para 2-13).

- If any tests fail, perform as instructed.

Step 3. Perform all A5 IF Filter CCA Tests (para 2-13).

- Replace Faulty Component.

13. Input Attenuator Accuracy Test Failure.

Perform all A9 Input Attenuator Tests (para 2-16).

- Replace Faulty Component.

14. IF Gain Uncertainty Test Failure.

Step 1. Adjust IF Amplitude (para 2-25).

Step 2. If adjustment fails, analyze failure.

- If failure occurs in first 50 dB of IF gain (REFLVLS of 0 dBm to -50 dBm with 10 dB ATTEN), problem is on the A5 IF CCA. Perform all A5 TAM Tests (para 2-13).
  - If any tests fail, perform as instructed.
  - If tests pass, perform all A5 IF Filter CCA Tests (para 2-13).
- If failure occurs in next 60 dB of IF gain (REF LVLs of -60 dBm to -110 dBm, 10 dB ATTEN), problem is on the A4 Log Amplifier CCA. Proceed to step 2.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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14. IF Gain Uncertainty Test Failure -Continued.

Step 3. Place A2/A3/A4/A5 in service position (para 2-42).

Step 4. Set LINE to ON, and press PRESET button. Wait for adjustment routine to finish.

Step 5. Set SPAN WIDTH to O Hz, CENTER FREQ to 1 GHz, and REF LVL to -50 dBm.

Step 6. Disconnect W27 (ORN) from A5J5, and connect W27 to a signal generator.

Step 7. Set signal generator Amplitude to +10 dBm and Frequency to 10.7 MHz.

Step 8. Simultaneously decrease signal generator's output level and AN/ US M-489A REF LVL in 10 dB steps, and verify signal displayed on the CRT remains at the reference level for each step.

- If incorrect, perform all A4 LOG Amplifiers Tests (para 2-13) except Linear Amplifiers Test.
  - Replace Faulty Component.

Step 9. Repeat step 8 until REF LVL is 110 dBm.

Step 10. Press AMPLITUDE button then LINEAR key.

Step 11. Repeat steps 7 through 9.

- If incorrect, perform all A4 LOG Amplifiers Tests (para 2-13) except Log Amplifier Test.
  - Replace Faulty Component.

15. Scale Fidelity Test Failure.

Analyze failure.

- If failure occurs only in 1 dB/div or 2 dB/div scales, problem is on the A5 IF CCA. Perform all A5 TAM Tests (para 2-13).
  - If any tests fail, perform as instructed.
  - If tests pass, perform all A5 IF Filter CCA Tests (para 2-13).
- If failure occurs in Linear, 5 dB/div, or 10 dB/div scales, problem is on the A4 Log Amplifier CCA. Perform all A4 TAM Tests (para 2-13).
  - If any tests fail, perform as instructed.
  - If tests pass, perform all A4 Log Amplifier CCA Tests (para 2-13).

16. Residual FM Test Failure.

Step 1. Adjust 10 MHz Frequency Reference (para 2-32).

Step 2. If adjustment fails to correct malfunction, perform Unlocked Reference PLL Test (para 2-15).

- If test fails, perform as instructed.

Step 3. If test fails to correct malfunction, perform Low and High Band Test (para 2-16).

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

17. Noise Sidebands Test Failure.

Step 1. Adjust 10 MHz Frequency Reference (para 2-32).

Step 2. If adjustment fails to correct malfunction, perform Adjust YTO (para 2-27).

Step 3. If adjustment fails to correct malfunction, analyze frequency of noise sidebands. Troubleshoot using the following information.

NOTE

Verify that all shields are in place and properly secured, and that all cables are properly connected.

- If noise is 40/80 kHz, suspect A6 Power Supply CCA. Troubleshoot using fig. FO-22.
- If noise is from one of the PLL's, troubleshoot using fig. FO-27 and FO-30.

- Replace faulty component.

18. Image, Multiple, and Out-of-Band Responses Test Failure.

Step 1. Adjust 1st LO Distribution Amplifier (para 2-28).

Step 2. If adjustment fails to correct malfunction, perform Adjust Dual Band Mixer Bias (para 2-29).

Step 3. If adjustments fail to correct malfunction, analyze failure and troubleshoot using fig. FO-24.

- Replace faulty component.

19. Frequency Readout and Frequency Count Marker Accuracy Test Failure.

Step 1. Adjust 10 MHz Frequency Reference (para 2-32).

Step 2. If adjustment fails to correct malfunction, perform Frequency Count Marker Tests (para 2-14).

- If test fails, perform as instructed.

Step 3. Troubleshoot using fig., FO-16, Sheet 6, circuit T.

- Replace faulty component.

20. Pulse Digitization Uncertainty Test Failure.

Step 1. Perform all A3 Interface CCA ADC Circuits Tests (para 2-12).

- If test fails, perform as instructed.

Step 2. Troubleshoot using fig., FO-30, Sheet 2, circuits A, B, and E.

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

21. Second Harmonic Distortion Test Failure.

Step 1. Adjust Dual Band Mixer Bias (para 2-29).

Step 2. If adjustment fails to correct malfunction, perform A8 Dual Band Mixer Test (para 2-16).

- If test fails, perform as instructed.

Step 3. If test fails to correct malfunction, analyze failure and troubleshoot using fig. FO-24.

- Replace faulty component.

22. Flatness Test Failure.

Step 1. Adjust YTF and Frequency Response (para 2-30).

Step 2. If adjustment fails to correct malfunction, perform Band Flatness Control (RF Gain DACs) Tests (para 2-12).

- If test fails, perform as instructed.

Step 3. If test fails to correct malfunction, troubleshoot using fig. FO-30, Sheets 2 and 3, circuits 2 and 3.

- Replace faulty component.

23. Frequency Span Accuracy Test Failure.

Step 1. Adjust YTO (para 2-27).

Step 2. If adjustment fails to correct malfunction, perform Adjust Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).

Step 3. If adjustment fails to correct malfunction, perform Frequency Span Test Tests (para 2-15).

- If test fails, perform as instructed.

Step 4. Perform Analog Zero-Span Tests (para 2-14).

- If test fails, perform as instructed.

Step 5. If test fails to correct malfunction, analyze failure and troubleshoot using fig. FO-27, Sheets 4 and 5, circuits K, L, and M.

- Replace faulty component.

24. Third Order Inter modulation Distortion Test Failure.

Step 1. Adjust Dual Band Mixer Bias (para 2-29).

Step 2. If adjustment fails to correct malfunction, perform all A8 Dual Band Mixer Tests (para 2-16).

- If test fails, perform as instructed.

Step 3. If test fails to correct malfunction, perform A13 Second Converter Test (para 2-16).

- If test fails, perform as instructed.

Step 4. If test fails to correct malfunction, perform Confirming Faulty Third Converter Test (para 2-16).

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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25. Gain Compression Test Failure.

Step 1. Adjust Dual Band Mixer Bias (para 2-29).

Step 2. If adjustment fails to correct malfunction, perform all A8 Dual Band Mixer Tests (para 2-16).

- If test fails, perform as instructed.

Step 3. If test fails to correct malfunction, perform A7 LODA Test (para 2-16).

- If test fails, perform as instructed.

Step 4. If test fails to correct malfunction, perform A7 LODA Drive Tests (para 2-16).

- Replace faulty component.

26. 1st LO Output Amplitude Test Failure.

Step 1. Adjust 1st LO Distribution Amplifier (para 2-28).

Step 2. If adjustment fails to correct malfunction, perform Adjust YTO (para 2-27).

Step 3. If test fails to correct malfunction, perform A7 LODA Test (para 2-16).

- If test fails, perform as instructed.

Step 4. If test fails to correct malfunction, perform A7 LODA Drive Tests (para 2-16).

- If test fails, perform as instructed.

Step 5. If test fails to correct malfunction, perform all A8 Dual Band Mixer Tests (para 2-16).

- If test fails, perform as instructed.

Step 6. If test fails to correct malfunction, perform Low and High Band Test (para 2-16).

- Replace faulty component.

27. Sweep Time Accuracy Test Failure.

Step 1. Adjust Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).

Step 2. If adjustment fails to correct malfunction, analyze failure and troubleshoot using fig. FO-27, Sheets 4 and 5, circuits K, L, and M.

- Replace faulty component.

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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28. Residual Responses Test Failure.

Analyze frequency of residual response. Troubleshoot using the following information.

NOTE

Verify that all shields are in place and properly secured, and that all cables are properly connected.

- If noise is 40/80 kHz, suspect A6 Power Supply CCA. Troubleshoot using fig. FO-22.
- If noise is from one of the PLL's, troubleshoot using fig. FO-27 and FO-30.

  \- Replace faulty component.

29. IF Input Amplitude Accuracy Test Failure.

Step 1. Adjust IF Amplitude (para 2-25).

Step 2. If adjustment fails to correct malfunction, perform Adjust External Mixer Bias (para 2-34).

Step 3. If adjustment fails to correct malfunction, perform Adjust External Mixer Amplitude (para 2-35).

Step 4. If adjustment fails to correct malfunction, perform all A5 TAM Tests (para 2-13).

- If any tests fail, perform as instructed.

Step 5. Perform IF Signature Test (para 2-13).

- If any tests fail, perform as instructed.

Step 6. Perform all A16 TAM Tests (para 2-13).

- Replace faulty component.

30. RF Input VSWR Test Failure.

Step 1. Perform A9 Input Attenuator Test (para 2-16).

- If test passes, repeat RF Input VSWR Test (para 2-18).
- If test fails, perform as instructed.

Step 2. If RF Input VSWR Test fails again, replace A9 (para 2-59) and W41 (fig. FO-2).

31. Frequency Drift Test Failure.

Step 1. Perform 10 MHz Reference Test (para 2-16).

- If test passes, repeat Frequency Drift Test (para 2-18).
- If test fails, perform as instructed.

Step 2. If Frequency Drift Test fails again, replace A15U302 (fig. FO-28).

Table 2-1. Troubleshooting - Continued.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

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32. Marker Amplitude Accuracy Test Failure.

Step 1. Adjust IF Amplitude (para 2-25).

Step 2. if adjustment fails to correct malfunction, perform all A3 interface CCA ADC Circuits Test (para 2-12).

- Replace faulty component.

33. 11970A Mixer Test Faliure.

Inspect connectors.

- if not damaged, replace Mixer.
- if damaged, replace connectors (para 2-76).

34. 11970K Mixer Test Failure.

inspect connectors.

- if not damaged, replace Mixer.
- If damaged, replace connectors (para 2-76).

2-12. ADC/INTERFACE SECTION TEST

DESCRIPTION

This test is used to isolate malfunctions in the Al Al Keyboard Assembly, A1A2 Rotary Pulse Generator (RPG), and A3 Interface CCA to the malfunctioning component or assembly.

NOTE

> Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

1. Troubleshooting the ADC/interface Section consists of performing up to eight individual test procedures, some of which contain subtests.

   - If the specific test (or subtest) is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph. Table 2-2 contains a complete list of ADC/interface Section Tests/Subtests.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate test in Table 2-2.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented in Table 2-2.

Table 2-2. ADC/interface Section Tests

Test Name	Subtest Name	Page
A3 TAM Tests	A3J400	2-46
	A3J105	2-47
Keyboard/RPG Test	Keyboard Interface Test	2-48
	RPG Interface Test	2-50
Triggering Test	None	2-52
Preselector Peaking Control (Real Time DAC) Test	None	2-54
Band Flatness Control (RF GAIN DAC) Test	None	2-55
A3 Interface CCA Video Circuits Test		2-57
	Log Offset/Log Expand Test	2-60
	Video MUX Test	2-61
	Video Filter Test	2-63
	Positive/Negative Peak Detectors Test	2-65
	Peak Detector Reset Test	2-67
	Rosenfell Detector Test	2-69
	ADC MUX Test	2-71
	Track and Hold Test	2-74
A3 Interface CCA ADC Circuits Test		2-75
	ADC Start/Stop Control Test	2-77
	ADC ASM Test	2-79
	ADC Test	2-80
	Ramp Counter Test	2-82
A3 Interface CCA Control Circuits Test		2-84
	Analog Bus Drivers Test	2-85
	Analog Bus Timing Test	2-87
	Interface Strobe Select Test	2-89

2-12. AD C/INTERFACE SECTION TEST - A3 TAM TESTS.

A3 TAM TESTS

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A3 Interface CCA using the TAM.

---

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.

A3J400 Test.

2. On AN/USM-489A,

   Connect TAM probe cable to A3J400 (fig. FO-11),

   Set LINE to ON,
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “2) Manual Probe Troubleshooting”.
   - Press EXECUTE key.
3. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:
- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-13).

- If all tests return OK, proceed to step 4.

Failed Test	FO-13 Circuit(s)	FO-13 Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS2	N/A	N/A
Trigger	H	MS8	Triggering Test	2-52
ADC Start/Stop Control	B	MS7	ADC Start/Stop Control Test	2-77
Video Trigger DAC	H	MS1	Triggering Test	2-52
Real Time DAC #1	L	MS3	Preselector Peaking Control (Real Time DAC) Test	2-54
RF Gain DACs	M	MS6	Band Flatness Control (RF Gain DACs)	2-55

2-12. *ADC/INTERFACE SECTION TEST - A3 TAM TESTS - A3J105 Test.*

A3J105 Test.

4. On AN/USM-489A,
   - Connect TAM probe cable to A3J105 (fig. FO-11).
   - Press the TEST key.
5. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-13).

If all tests return OK, proceed to step 6.

Failed Test	FO-13 Circuit(s)	FO-13 Signal(s)	Test/Subtest to Perform	Page
Video Input to Interface	T	MS1	Video Output Test (A4)	2-114
Video to Rear Panel	T	MS2	Troubleshoot using FO-13, Sheet 8	N/A
Video MUX	T	MS3	Video MUX Test	2-61
Log Offset/Log Expand	X	MS1, MS3	Log Offset/Log Expand Test	2-60
Video Filter Buffer Amplifier	U,V, W	MS3, MS5 0S1	Troubleshoot using FO-13, Sheets 8 and 9	N/A
Video Peak Detectors	Y,Z	MS5, MS6	Positive/Negative Peak Detectors Test	2-65
ADC MUX	AA	MS6	ADC MUX Test	2-71
Variable Gain Amplifier	AB	MS6, MS7	Troubleshoot using FO-13, Sheet 11	N/A
Track and Hold	AC	MS7, MS8	Track and Hold Test	2-74

6. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - KEYBOARD/RPG TEST.

KEYBOARD/RPG TEST.

DESCRIPTION

This test is used to isolate front panel interface malfunctions in the Al Al Keyboard Assembly, A1A2 Rotary Pulse Generator (RPG), and A3 Interface CCA to the malfunctioning component or assembly.

---

1. Troubleshooting keyboard/RPG malfunctions consists of performing up to two individual test procedures.
   - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented,

Keyboard Interface Test.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 4, circuit G as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

2-12. *ADC/INTERFACE SECTION TEST - KEYBOARD/RPG TEST - Keyboard Interface Test - Continued.*

2. Exercise the keyboard and RPG to determine extent of malfunction.
   - If all keys and RPG are malfunctioning, check A1A1W1.
   - If an entire row or column of keys malfunction (see following table), and RPG functions properly, check A1A1W1.

COL/ROW	LKSNS0	LKSNS1	LKSNS2	LKSNS3	LKSNS4	LKSNS5	LKSNS6	LKSNS7
LKSCN0	DEMOD	SAVE	RECALL	GHz	MHz	kHz	Hz	PRESET
LKSCN1	FREQ COUNTER	TRIG	DISP	9	6	3	BK SP	up arrow
LKSCN2	PEAK SEARCH	BW	TRACE	8	5	2	•	down arrow
LKSCN3	MKR OFF	AUTO COUPLE	MKR->	7	4	1	0	HOLD
LKSCN4	SWEEP	SK1	SK2	SK3	SK4	SK5	SK6	MKR ON
LKSCN5	INT	EXT	MODULE	•	°	FRE-QUENCY	SPAN	AMPLI-TUDE

3. Using a logic probe, verify that A3U607 pins 1-6, 11, and 12 (LKSNS lines) are high when no key is pressed.
   - If incorrect (low), disconnect A1A1W1 at A3J602 and recheck A3U607. If still low, suspect A3U604 and A3U607. Troubleshoot using fig. FO-13, Sheet 4, circuit G. Replace faulty component.
4. Verify that A3U607 pin 8 is TTL high when each key is pressed and held.
   - If incorrect, suspect A3U607. Troubleshoot using fig. FO-13, Sheet 4, circuit G. Replace faulty component.
5. Verify that A3J602 pins 1 - 6 are TTL low with no key pressed.
   - If incorrect (high), suspect A3U602 and A3U604. Troubleshoot using fig. FO-13, Sheet 4, circuit G. Replace faulty component.
6. Using an oscilloscope (200 usec/div), verify that a pulse is present at A3U602 pins 2, 5, 6, 15, 16, and 19 when a key is pressed.
   - If incorrect, suspect A3U604 and A3U602. Troubleshoot using fig. FO-13, Sheet 4, circuit G. Replace faulty component.
7. Using a logic probe, verify that only one input to A3U607 (pin 1 -6, 11, or 12) goes low when a key is pressed.
   - If incorrect, suspect A1A1 keyboard assembly and A1A1W1. Troubleshoot using fig. FO-6. Replace faulty component.
8. Verify that A3U602 pin 9 pulses low when a key is pressed.
   - If incorrect, suspect A1A1 keyboard assembly and A1 A1W1. Troubleshoot using fig. FO-6. Replace faulty component.
9. Troubleshoot A3 Interface CCA LWRCLK and LSCAN_KBD signals using fig. FO-13.
10. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - KEYBOARD/RPG TEST - RPG Interface Test.

RPG interface Test.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig, FO-13, Sheet 5, circuit J as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Using a logic probe, verify that pulses are present at A3U401 pin 2 and A3U608 pin 12 when RPG is rotated.
   - If incorrect at both points, check power and ground on A1A1W1 and A1A2W1. If cables are not malfunctioning, suspect A1A2 RPG, Troubleshoot using fig. FO-6. Replace faulty component.
   - If incorrect at only one point, check A1A1W1 and A1A2W1. If cables are not open/shorted, suspect A1A2 RPG. Troubleshoot using fig. FO-6. Replace faulty component.
3. On AN/USM-489A,
   - Set LINE to OFF.
   - Disconnect A1A1W1 at A3J602.
   - Jumper A3U608 pin 12 to A3U608 pin 14.
   - Jumper A3U401 pin 2 to A3U511 pin 11.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Using an oscilloscope, verify that narrow, low-going pulses ≈ every 90 ms are present at A3U608 pins 9 and 13, A3U612 pin 5, and A3U505 pin 13.
   - Verify that narrow, high-going pulses ≈ every 90 ms are present at A3U608 pin 5.
4. Analyze test results.
   - If A3U608 pin 5 and A3U505 pin 13 are correct, but A3U608 pin 13 is incorrect, perform Controller Section Tests (para 2-14).
   - If any other measurement(s) are incorrect, troubleshoot using fig. FO-13. Replace faulty component.

2-12. ADC/INTERFACE SECTION TEST - KEYBOARD/RPG TEST - RPG Interface Test - Continued.

On AN/USM-489A,

- Verify that a 7.8 kHz square wave is present at A3U610 pin 3.
- Verify that narrow, high-going pulses ≈ every 90 ms are present at A3U606 pin 2.
- Verify frequencies at A3U606 using the following table.

A3U606 pin	Nominal Frequency
3	3900 Hz
4	1950 Hz
5	975 Hz
6	488 Hz
11	244 Hz
10	122 Hz
9	61 Hz

6. Analyze test results.
   - If all checks are correct, but RPG is malfunctioning, suspect A1A2 RPG or A1A1 Keyboard Assembly. Troubleshoot using fig. FO-6. Replace faulty component.
   - If reading(s) are incorrect, troubleshoot using fig. FO-13. Replace faulty component.
7. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect jumpers, test cables, and equipment.
   - Reconnect A1A1W1 to A3J602.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-72. *ADC/INTERFACE SECTION TEST - TRIGGERING TEST.*

TRIGGERING TEST.

DESCRIPTION

This test is used to isolate trigger circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 4, circuit H as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Using an oscilloscope, verify that A3U613 is receiving trigger source (TRIG_ SOURCE) information for each trigger mode in the following table.

Trigger Mode	TRIG_SOURCEO A3U613 pin 14	TRIG_SOURCE1 A3U613 pin 2	MUX Input A3U613 pin
FREE RUN	L	L	6
VIDEO	H	L	5
LINE	H	H	3
EXTERNAL	L	H	4

   - If incorrect, verify that the appropriate trigger signal is present at corresponding MUX input (refer to previous table). If the corresponding MUX input is incorrect, troubleshoot using fig. FO-13. Replace faulty component.
3. Verify that selected MUX input signal is present at A3U613 pin 7.
   - If incorrect, suspect A3U613. Troubleshoot using fig. FO-13, Sheet 4, circuit H. Replace faulty component.
4. On AN/USM-489A,
   - Connect digital multimeter positive lead to A3J400 pin 1 and negative lead to A3TP4.
   - Press TRIG button.
   - Press VIDEO key.

2-12. ADC/INTERFACE SECTION TEST - TRIGGERING TEST - Continued.

5. Press STEP down arrow key and verify that digital multi meter reading decreases by 1 Vdc and position of video trigger level on the screen decreases by one division for each key press.
   - If incorrect, proceed to step 6.
   - If correct, troubleshoot malfunction using fig. FO-13. Replace faulty component.
6. Verify A3U409 pin 4 is -10 Vdc.
   - If incorrect, troubleshoot using fig. FO-13, sheet 11, circuit AD. Replace faulty component.
7. Verify pulses are present at A3U409 pins 15 and 16 when adjusting video trigger level using front panel knob.
   - If incorrect, perform Interface Strobe Select Test (para 2-12).
8. Verify pulses are present at A3U409 pin 6.
   - If incorrect, troubleshoot using fig. FO-13, sheet 4, circuit H. Replace faulty component.

   Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
9. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. *ADC/INTERFACE SECTION TEST- PRESELECT OR PEAKING CONTROL (REAL TIME DAC) TEST.*

PRESELECTOR PEAKING CONTROL (REAL TIME DAC) TEST.

DESCRIPTION

This test is used to isolate real time DAC circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 6, circuit L as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect digital multimeter positive lead to A3J400 pin 3 and negative lead to A3TP4.
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Press MARKER ON button.
   - Press INT button.
   - Press PRESEL MAN ADJ key.
2. Using the front panel knob, change PRESELECTOR TUNE value from 0 to 255. Verify digital multi meter reading increases from 0 Vdc (0) to ≈+10 Vdc (255).
   - If incorrect, proceed to step 3.
   - If correct, real time DACs are functioning normally.
3. On AN/USM-489A,
   - Press TRIG button.
   - Press SINGLE key.
4. Verify that A3U409 pin 18 is at – 10 Vdc.
   - If incorrect, troubleshoot using fig, FO-13, sheet 11, circuit AD. Replace faulty component.
5. Verify that pulses are present at A3U409 pin 6 when adjusting PRESELECTOR TUNE value using front panel knob.
   - If incorrect, troubleshoot using fig. FO-13, sheet 6, circuit L. Replace faulty component.

2-12. ADC/INTERFACE SECTION TEST - PRESELECTOR PEAKING CONTROL (REAL TIME DAC) TEST - Continued.

6. Verify that A3U409 pin 15 is a TTL high.
   - If incorrect, perform Interface Strobe Select Test para 2-12).
7. Verify that pulses are present at A3U409 pin 16.
   - If incorrect, perform Interface Strobe Select Test para 2-12).
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component
8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

BAND FLATNESS CONTROL (RF GAIN DACs) TEST.

DESCRIPTION

This test is used to isolate RF gain DAC circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 6, circuit M as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A21A3 in service position (para 2-40).
   - Move WR PROT/WR ENA jumper on AZ Controller CCA to WR ENA position (fig. FO-7).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press INT button.
   - Press FLATNESS key.
   - Press NEXT BAND key until “FLATNESS BAND # 0“ is displayed.
   - Press STEP up arrow button until “DATA @ 300 MHz” is displayed.

2-12. ADC/INTERFACE SECTION TEST - BAND FLATNESS CONTROL (RF GAIN DACs) TEST - Continued.

2. Connect digital multimeter positive lead to A3J400 pin 13 and negative lead to A3TP4.
3. Using the front panel knob, change RF Gain DAC value (number below "DATA @ 300 MHz") from 0 to 255. Verify digital multimeter reading increases from 0 Vdc (0) to between +3.5 Vdc and +5.0 Vdc (255).
   - If incorrect, proceed to step 4.
   - If correct, real time DACs are functioning normally.
4. On AN/USM-489A,
   - Press PRESET button.
   - Press TRIG button.
   - Press SINGLE key.
   - Press INT button.
   - Press FLATNESS key.
   - Press NEXT BAND key until "FLATNESS BAND # 0" is displayed.
   - Press STEP up/down arrow buttons until "DATA @ 300 MHz" is displayed.
5. Verify that A3U417 pin 4 is at -10 Vdc.
   - If incorrect, troubleshoot using fig. FO-13, sheet 11, circuit AD. Replace faulty component.
6. Verify that pulses are present at A3U417 pin 16.
   - If incorrect, perform Interface Strobe Select Test (para 2-12).
7. Verify that pulses are present at A3U417 pin 15 when turning front panel knob.
   - If incorrect, perform Interface Strobe Select Test (para 2-12).

6\. Verify that pulses are present at A3U417 pin 6 when turning front panel knob.
   - If incorrect, troubleshoot using fig. FO-13, sheet 6, circuit M. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

9\. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Move WR PROT/ WR ENA jumper on A2 Controller CCA in the WR PROT position.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST.

A3 INTERFACE CCA VIDEO CIRCUITS TEST.

DESCRIPTION

This test is used to isolate video circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheets 7- 11, circuits R - AB as required for schematic diagrams.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Disconnect W26 (RED) from A3J101.
   - Disconnect W20 (BLUE) from A2J4.
   - Connect W26 (RED) to A2J4.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 20 ms.
   - Set RES BW to 1 MHz.
   - Set LOG/div to 10 dB/div.
2. Observe CRT screen.
   - If a trace is displayed, proceed to step 4.
   - If a trace is absent, proceed to step 3.
3. Connect an oscilloscope to the rear-panel BLANKING OUTPUT and verify a TTL signal that is low during 20 ms sweep.
   - If correct, perform IF Section Tests (para 2-13).
   - If incorrect (always TTL high or low), perform Triggering Test (para 2-12).

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Continued.

4. On AN/USM-489A,
   - Reconnect W26 (RED) to A3J101.
   - Reconnect W20 (BLUE) to A2J4.
5. Analyze malfunction.
   - If video filters appear to be faulty, perform Video Filter Test (para 2-12).
   - If peak detectors appear to be faulty, perform Positive/Negative Peak Detectors Test (para 2-12).
   - If unit functions in 5 dB/div and 10 dB/div but not in 1 dB/div or 2 dB/div, perform Log Offset/Log Expand Test (para 2-12).
   - If problem involves on-screen amplitude errors which appear to originate in the video chain, proceed to step 6.
6. On AN/USM-489A,
   - Connect CAL OUTPUT connector to INPUT 50t2 connector using supplied BNC cable and adapter.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to O Hz.
   - Set REF LVL to -10 dBm.
7. Using an oscilloscope, verify A3TP9 is ≈ +1 Vdc.
   - If incorrect, perform IF Section Test (para 2-13).
8. Change REF LVL from -10 dBm to +3o dBm in 10 dB steps. Verify the voltage displayed on the oscilloscope (at all TPs in following table) changes by ≈ 100 mV per 10 dB step.

Test Point	Voltage at +30 dBm	Test to Perform if Incorrect
A3TP9	≈+0.6 Vdc	IF Section Test (para 2-13).
A3TP14	N/A	Video MUX Test (para 2-12).
A3TP15	NIA	Video Filter Test (para 2-12).
A3TP17	NIA	Troubleshoot Video Filter Buffer Amplifier using fig. FO-13, Sheet 9, Circuit W.

NOTE

The on-screen amplitude level will probably not change as expected, since the video chain is assumed to be faulty.

   - If incorrect, perform test indicated.
9. Connect oscilloscope to A3TP6.
10. On AN/USM-489A,
    - Set SWEEP TIME to 50 s.
    - Press TRACE button.
    - Press MORE key.
    - Set DETECTOR MODES to DETECTOR SAMPLE.

2-12. *ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Continued.*

11. Change REF LVL from -10 dBm to +30 dBm in 10 dB steps. Verify the voltage displayed on the oscilloscope changes by ≈ 100 mV per 10 dB step. Record voltage at each REF LVL setting.

    - If incorrect, perform ADC MUX Test (para 2-12).

12. Connect oscilloscope to A3TP8.
13. Change REF LVL from - 10 dBm to +30 dBm in 10 dB steps. Verify the voltage displayed on the oscilloscope is the same as recorded values in step 11.

    - If incorrect, suspect A3U110. Troubleshoot using fig. FO-13, Sheet 11, circuit AB. Replace faulty component.

14. Connect oscilloscope to A3TP7.
15. Change REF LVL from -10 dBm to 0 dBm and verify voltage changes from ≈ 700 mV to ≈620 mV.

    - If incorrect, troubleshoot Variable Gain Amplifier (VGA) circuit using fig. FO-13, Sheet 11, circuit AB.

    Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

16. On AN/USM-489A,

    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Log Offset/Log Expand Test.

Log Offset/Log Expand Test.

DESCRIPTION

This test is used to isolate log offset/log expand circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 8, circuit X as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Disconnect W26 (RED) from A3J101.
   - Connect function generator output to A3J101.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Press SPAN button.
   - Press ZERO SPAN key.
   - Set SWEEP TIME to 50 ms.
2. Set function generator controls as follows:

   Output .... Sine wave
   Amplitude .... 1 V pk-to-pk
   DC Offset .... +500 mV
   Frequency .... 50 Hz

   Adjust amplitude and offset until sine wave fills the entire CRT graticule area.
3. Using an oscilloscope, measure and record function generator's peak-to-peak voltage for 10 dB/div.
4. On AN/USM-489A, set dB/DIV to 2 dB.
5. Readjust function generator amplitude and offset until sine wave again fills the entire CRT graticule area.
6. Using an oscilloscope, measure and record function generator's peak-to-peak voltage for 2 dB/div.

2-12. *ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Log Offset/Log Expand Test - Continued.*

7. Verify ratio of voltage recorded in step 3 to the voltage recorded in step 6 is 5 ±3%.
   - If incorrect, troubleshoot Log Offset/Log Expand circuit using fig. FO-13, Sheet 8, circuit X. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W26 (RED) at A3J101.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

Video MUX Test.

DESCRIPTION

This test is used to isolate video multiplexer circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 8, circuit U as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SWEEP TIME to 20 ms.
   - Set SPAN WIDTH to 0 Hz.

2-12. *ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Video MUX Test - Continued.*

2. Verify a TTL high on A3U104 pin 2, and a TTL low on A3U104 pins 7,10, and 15.
3. On AN/USM-489A, set dB/DIV to 2 dB/div, and verify a TTL high on A3U104 pin 10, and a TTL low on A3U104 pins 2, 7, and 15.
   - If steps 2 and 3 are incorrect, proceed to step 4.
   - If steps 2 and 3 are correct, proceed to step 5.
4. Verify a pulse is present when switching between 10 dB/div and 2 dB/div at A3U104 pins 9, 4, and 12.
   - If incorrect, perform Analog Bus Timing Test (para 2-12) and (if necessary) Analog Bus Drivers Test (para 2-12).
5. Verify A3U109A/C/D outputs (pins 1, 8, and 14) are high when noninverting inputs (pins 3, 10, and 12) are greater than the threshold voltage of +2.4 Vdc (see fig. FO-13).
   - If incorrect, troubleshoot using fig. FO-13, Sheet 8, circuit U. Replace faulty component.
6. On AN/USM-489A, set REF LVL to 0 dBm.
7. Verify voltage at A3TP14 changes from 0.9 Vdc to 0.5 Vdc while switching from 10 dB/div to 2 dB/div.
   - If incorrect, suspect A3Q220 or A3Q221. Troubleshoot using fig. FO-13, Sheet 8, circuit U. Replace faulty component.
8. - If Video MUX still appears faulty lift A3CR109's cathode and perform steps 1 through 7 again.
   - If test now passes, troubleshoot around A3CR109 using FO-13.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
9. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. *ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Video Filter Test.*

Video Filter Test.

DESCRIPTION

This test is used to isolate video filter circuit malfunctions in the A3 interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 8, circuit V as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set START FREQ to -10 MHz (will indicate –0 Hz).
   - Set STOP FREQ to 500 MHz.
   - Set SWP TIME to MAN.
2. On AN/USM-489A,
   - Step VIDEO BW from 3 MHz to 10 kHz (using STEP up/down arrow buttons).
   - Verify peak-to-peak deviation of noise decreases with each step (wait for sweep to complete).
   - Step VIDEO BW from 10 kHz to 1 Hz.
   - Verify amplitude of the LO feedthrough (0 Hz) decreases with each step (wait for sweep to complete).
     - If incorrect troubleshoot using fig. FO-13, Sheet 8, circuit V. Replace faulty component.

2-12. *ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Video Filter Test - Continued.*

3. Verify latch output settings of A3U102 in the following table for each selected video bandwidth.

Video BW	In=Pin 3 Out=Pin 2	In=Pin 4 Out=Pin 5	In=Pin 6 Out= Pin 7	In=Pin 11 Out=Pin 10	In=Pin 13 Out=Pin 12	In=Pin 14 Out=Pin 15
300 Hz	H	L	L	L	L	L
1 kHz	L	L	L	L	L	H
3 kHz	L	H	L	L	L	L
10 kHz	L	L	L	L	H	L
30 kHz	H	L	H	L	L	L
100 kHz	L	L	H	L	L	H
300 kHz	L	H	H	L	L	L
1 MHz	L	L	H	L	H	L
3 MHz	L	L	L	H	L	L

- If incorrect, proceed to step 4.
- If correct, proceed to step 5.

4. Connect oscilloscope external trigger at A3U102 pin 9, and monitor A3U102 pin 1 and latch inputs (from previous table) each selected video bandwidth.
   - If inputs are incorrect, perform Analog Bus Timing Test (para 2-12) and (if necessary) Analog Bus Drivers Test (para 2-12).
   - If ‘inputs are correct and outputs are incorrect, suspect A3U102. Troubleshoot using fig. FO-13, Sheet 8, circuit V. Replace faulty component.
5. Verify that A3U111A pin 1, A3U111B pin 7, and A3U107A/B/C/D (pins 1, 7, 8, and 14) are high with noninverting inputs (pins 3, 5, 10, and 12) greater than +1.4 Vdc.
   - If incorrect, suspect corresponding component. Troubleshoot using fig. FO-13, Sheet 8, circuit V. Replace faulty component.
   - If a voltage drop is noticed across these components, suspect A3CR109 or A3Q317B. Troubleshoot using fig. FO-13, Sheet 8, circuit V. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

6, On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Positive/Negative Peak Detectors Test.

Positive/Negative Peak Detectors Test.

DESCRIPTION

This test is used to isolate positive and negative peak detector circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheets 9 and 10, circuits Y and Z as required for schematic diagrams.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 500 MHz.
2. On AN/USM-489A,
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR NORMAL key.
   - Verify peak-to-peak deviation of noise is approximately two divisions.
   - Record amplitude levels (top and bottom) of displayed noise.
   - Press DETECTOR POS PEAK key.
   - Verify noise is about one-third division peak-to-peak, and that noise is no higher than top noise level previously recorded.
   - Press DETECTOR NEG PEAK key.
   - Verify noise is about one-third division peak-to-peak, and that noise is no lower than bottom noise level previously recorded.
   - Press DETECTOR SAMPLER key.
   - Verify noise is between top and bottom of noise levels previously recorded.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Positive/Negative Peak Detectors Test - Continued.

3. Analyze test results.
   - If results in step 2 are correct, positive and negative peak detectors are functioning normally.
   - If results in step 2 are incorrect, proceed to step 4.
4. On AN/USM-489A,
   - Connect CAL OUTPUT connector to INPUT **50Ω** connector using BNC cable and adapter supplied.
   - Press DETECTOR POS PEAK key.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 5 s.
5. Connect oscilloscope channel A to A3TP17 and channel B to A3TP16.
6. On AN/USM-489A, change REF LVL from -10 dBm to +30 dBm using STEP up/down arrow buttons and verify A3TP17 and A3TP16 change from ≈ 1 Vdc to ≈ 0.6 Vdc in 100 mV steps.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 9, circuit Y. Replace faulty component.
7. Verify negative TTL level pulses occurring every 130 us at ≈ 250 ns wide are present at A3C216.
   - If incorrect, perform Peak Detector Reset Test (para 2-12).
8. Verify positive-going pulses from -12.7 V to -1.35 V at A3Q207 gate.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 9, circuit Y. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
9. Additional troubleshooting hints are as follows:
   - Peak detector can be made into a unity gain amplifier by shorting cathode of A3CR203 to anode of A3CR204. If peak detector functions normally as a unity gain amplifier, suspect A3Q208, A3CR203 or A3CR204. Troubleshoot using fig. FO-13, Sheet 9, circuit Y. Replace faulty component.
   - Entire detector range can be checked by substituting a 0 to 1 volt dc source at A3J101.
10. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST – A3 INTERFACE CCA VIDEO CIRCUITS TEST - **Peak Detector** ***Reset Test.***

Peak Detector Reset Test.

DESCRIPTION

This test is used to isolate peak detector reset circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-1 1 as required for component location information.
- See fig. FO-13, Sheet 7, circuit R as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On ANIUSM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 5 s.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR POS PEAK key.
2. Using an oscilloscope,
   - Verify that A3U526 pin 11 has 18 us wide pulses every 128 µs.
   - Verify that A3U408 pin 5 has a 16.7 ms period square wave (2 x sweep time/600).
   - Verify A3U422 pin 4 has a 200 ns low-going pulses every 128 µs.
   - Verify A3U422 pin 12 has a 200 ns low-going pulses every 128 µs.
3. Analyze test results.
   - If results in step 2 are correct, proceed to step 4.
   - If results in step 2 are incorrect, troubleshoot using fig. FO-13, Sheet 7, circuit R. Replace faulty component.
4. On AN/USM-489A, press DETECTOR NORMAL key.

*2-12. **ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Peak Detector Reset Test - Continued.***

5. Verify that A3U422 pin 12 has two pulses spaced ≈ 40 us apart, and then a single pulse ≈ 88 µs from the second pulse.

   - If incorrect, troubleshoot using fig. FO-13, Sheet 7, circuit R. Replace faulty component.

6. Verify signals/levels at A3U408 using the following table.

Detector Mode	A3U408 pin 3	A3U408 pin 9
NORMAL	≈ 40 us pulse every 128 us	≈ 40 us pulse every 128 us
SAMPLE	H	H
NEG PEAK	L	H
POS PEAK	H	L

   - If incorrect, troubleshoot using fig. FO-13, Sheet 7, circuit R. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

7. On AN/USM-489A,

   - Set LINE to OFF,
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Rosenfell Detector Test.

Rosenfell Detector Test.

DESCRIPTION

This test is used to isolate rosenfell detector circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 7, circuit S as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 5 s.
2. Using an oscilloscope,
   - Verify A3U422 pin 4 has a 200 ns low-going pulses every 128 µs.
   - Verify A3U422 pin 12 has a 200 ns low-going pulses every 128 µs.
   - If results are incorrect, troubleshoot Peak Detector Reset circuit using fig. FO-13, Sheet 7, circuit R. Replace faulty component.
3. Using an oscilloscope,
   - Verify A3U423 pin 4 has 3.3 µs low-going pulses every 90 µs.
   - Verify A3U610 pin 6 has two 3 us low-going pulses spaced ≈ 40 µs apart, and then a third 3 µs low-going pulse 90 µs from the second pulse.
   - If incorrect, troubleshoot circuit using fig. FO-13, Sheet 7, circuit S. Replace faulty component.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Rosenfell Detector Test - Continued.

4. Reduce VIDEO BW from 1 MHz to 1 kHz using the STEP up/down arrow buttons while monitoring the following points. As VIDEO BW is decreased:
   - Verify A3U610 pin 6 increasingly shows a low logic level and the AN/USM-489A CRT screen displays a nearly flat line at 1 kHz.
   - Verify A3U416 pin 4 is mostly high at 1 MHz VIDEO BW and mostly low at 1 kHz VIDEO BW.
   - Verify A3U416 pin 9 is mostly high at 1 MHz VIDEO BW and mostly low at 1 kHz VIDEO BW.
     - If incorrect, troubleshoot circuit using fig, FO-13, Sheet 7, circuit S. Replace faulty component.
     - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
5. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - ADC MUX Test.

ADC MUX Test.

DESCRIPTION

This test is used to isolate ADC multiplexer circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 11, circuit AA as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LEVEL to -10 dBm.
   - Set SWEEP TIME to 50 s.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR SAMPLE key.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - ADC MUX Test - Continued.

2. Using an oscilloscope, verify the following logic levels at A3U108 and A3TP6.

Detector Mode	A3U108 pin 1	A3U108 pin 15	A3U108 pin 16	A3TP6 (same as)
SAMPLE	H	L	H	A3U108 pin 7
POS PEAK	H	L	L	A3U108 pin 5
NEG PEAK	L	H	L	A3U108 pin 6

- If A3U108 pins 1, 15, and 16 are incorrect, perform ADC ASM Test (para 2-12). If test passes troubleshoot VGA/ADC MUX Control using fig. FO-13, Sheet 7, circuit Q. Replace faulty component.
- If A3TP6 incorrect, suspect A3U108. Troubleshoot using fig, FO-13, Sheet 11, circuit AA. Replace faulty component.

3. Using an oscilloscope, verify A3J2 pin 42 is 0 V during a sweep and positive during retrace
   - If incorrect (constant dc voltage), perform Synthesizer Section Test (para 2-15).
4. On AN/USM-489A,
   - Set SPAN WIDTH to 1 MHz.
   - Set SWEEP TIME to 50 ms.
   - Press TRIG button.
5. Using an oscilloscope, verify A3J2 pin 45 (ground to A3TP4) is 0 to 10 V ramp.
6. On AN/USM-489A, press LINE key.
7. Verify 0 to 10 V ramp is still displayed on oscilloscope.
   - If incorrect for step 5 and correct for step 6, perform all A3 Interface Control Circuits Tests (para 2-12).
   - If correct for steps 5 and 7, proceed to step 9.
   - If incorrect for steps 5 and 7, proceed to step 8.
8. Verify A3J400 pin 15 is a TTL signal, high during 50 ms sweep time and low during retrace.
   - if correct, perform Synthesizer Section Test (para 2-15).
   - If incorrect, proceed to step 10.
9. Verify A3U108 pin 8 is a 0 to 10 V ramp.
   - If incorrect, suspect A3U108. Troubleshoot using fig. FO-13, Sheet 11, circuit AA. Replace faulty component.
10. On AN/USM-489A,
    - Press FREE RUN key.
    - Set SWEEP TIME to 100 ms.
    - Press AMPLITUDE button.
    - Press MORE key.
    - Press IF ADJUST key.
    - Set IF ADJ to ON.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - ADC MUX Test - Continued.

11. Verify A3J401 pin 25 has a signal greater than 10 V peak-to-peak during part of retrace period.
    - If incorrect (constant dc voltage during the sweep and all retrace period), perform IF Section Test (para 2-13).
    - If correct, troubleshoot malfunction using fig. FO-13, Sheet 11, circuit AA. Replace faulty component.
12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Track and Hold Test.

Track and Hold Test.

DESCRIPTION

This test is used to isolate track and hold circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 11, circuit AC as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR SAMPLE key.
   - Set REF LEVEL to -70 dBm.
   - Set LOG dB/DIV to 2 dB/DIV.
   - Set SWEEP TIME to 50 us.
   - Disconnect all front panel cables.
   - Verify full scale display of sampled noise on CRT screen.
2. Connect oscilloscope channel A input to A3TP10 and external trigger to A3U506 pin 16.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA VIDEO CIRCUITS TEST - Track and Hold Test - Continued.

3. Verify oscilloscope displays random noise with an average level of ≈ 4 V with a flat spot in its response while A3U506 pin 16 is high.
   - If incorrect, suspect A3U114. Troubleshoot using fig. FO-13, Sheet 11, circuit AC. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
4. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover,

A3 INTERFACE CCA ADC CIRCUITS TEST.

DESCRIPTION

This test is used to isolate ADC circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheets 2 and 3, circuits A, B, D, and F as required for schematic diagrams.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

Prior to troubleshooting the A3 Interface CCA ADC circuits, perform the following steps to determine if A2 Controller CCA signals are being provided to the A3 Interface CCA.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Disconnect W22 (BLK) from A2J8 (fig. FO-7).
   - Connect W22 to oscilloscope input.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA ADC CIRCUITS TEST-Continued.

2. Verify oscilloscope displays a ≈ 10 MHz TTL signal.
   - If incorrect, perform 10 MHz Reference Test (para 2-16).
3. On AN/USM-489A,
   - Set LINE to OFF.
   - Reconnect W22 (BLK) to A2J8.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
4. Using an oscilloscope, verify A3J401 pin 20 has TTL level pulses.
   - If incorrect, proceed to step 6.
5. Verify A3J401 pin 23 has a 1 MHz TTL clock signal.
   - If incorrect, proceed to step 6.
   - If correct, proceed to A3 Interface Control Circuits Test (para 2-12).
6. Verify A2U5 pin 3 (fig. FO-7) has TTL level pulses.
   - If incorrect, perform Frequency Counter Test (para 2-14).
7. Verify A2U5 pin 7 has a 1 MHz TTL clock signal.
   - If incorrect, perform Controller Section Test (para 2-14).
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA ADC CIRCUITS TEST - ADC Start/Stop Control Test.

ADC Start/Stop Control Test.

DESCRIPTION

This test is used to isolate ADC start/stop control circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-1 1 as required for component location information.
- See fig. FO-13, Sheet 2, circuit B as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 60 s.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR SAMPLE key.
2. Using a logic probe, verify A3U509 pin 2 is TTL high and A3U509 pin 14 is TTL low.
   - If incorrect, troubleshoot ADC Registers circuit using fig. FO-13, Sheet 3, circuit E. Replace faulty component.
3. On AN/USM-489A, press DETECTOR NORMAL key.
4. Verify A3U509 pins 2 and 14 are TTL low.
   - If incorrect, troubleshoot ADC Registers circuit using fig. FO-13, Sheet 3, circuit E. Replace faulty component.
5. On AN/USM-489A,
   - Press DETECTOR SAMPLE key.
   - Set SPAN WIDTH to 1 MHz.
6. Verify A3U509 pins 2 and 14 are TTL high.
   - If incorrect, troubleshoot ADC Registers circuit using fig. FO-13, Sheet 3, circuit E. Replace faulty component.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA ADC CIRCUITS TEST - ADC Start/Stop Control Test - Continued.

7. On AN/USM-489A,
   - Press PRESET button.
   - Press REALIGN LO & IF key.
   - During realignment, verify A3U509 pin 2 is TTL low and pin 14 is TTL high.
     - If incorrect, troubleshoot ADC Registers circuit using fig. FO-13, Sheet 3, circuit E. Replace faulty component.
8. On AN/USM-489A,
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 400 ms.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR SAMPLE key.
9. Using an oscilloscope, verify A3U509 pins 7 and 9 have identical 15 µs pulses with a 667 µs period present during sweep and absent during retrace.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 2, circuit B. Replace faulty component.
10. On AN/USM-489A, press DETECTOR NORMAL key.
11. Verify A3U509 pin 9 has pulses every 130 µs, and A3U509 pin 7 has pulses every 333 us (pulse widths may be changing).
    - If incorrect, troubleshoot using fig. FO-13, Sheet 2, circuit B. Replace faulty component.
    - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA ADC CIRCUITS TEST - ADC ASM Test - Continued.

ADC ASM Test.

DESCRIPTION

This test is used to isolate ADC ASM circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 3, circuit F as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 60 s.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR SAMPLE key.
2. Connect oscilloscope channel A to A3U504 pin 4 and channel B to A3U506 pin 16.
3. Verify signal at A3U504 pin 4 goes TTL high, causing A3U506 pin 16 to go TTL high ≈ 15 µs later for ≈ 18 µs.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 3, circuit F. Replace faulty component.
4. Move oscilloscope channel B to A3U506 pin 15.
5. Verify signal at A3U504 pin 4 goes TTL high, causing A3U506 pin 15 to go TTL high ≈ 19 µs later for ≈ 31 µs.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 3, circuit F. Replace faulty component.
6. Connect oscilloscope channel A to A3U506 pin 15 and channel B to A3U504 pin 15.
7. Verify signal at A3U506 pin 15 goes TTL high, causing A3U504 pin 15 to go TTL low ≈ 12 µs later.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 3, circuit F. Replace faulty component.
8. Connect oscilloscope channel A to A3U504 pin 15 and channel B to A3U506 pin 19.

2-12. ADC/INTERFACE SECTION TEST -A3 INTERFACE CCA ADC CIRCUITS TEST - ADC ASM Test - Continued.

9. Verify signal at A3U504 pin 15 goes TTL low, causing A3U506 pin 19 to go TTL low ≈ 2 us later.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 3, circuit F. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.
10. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

ADC Test.

DESCRIPTION

This test is used to isolate ADC circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 2, circuit A as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields,

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 60 s.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR SAMPLE key.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA ADC CIRCUITS TEST - ADC Test - Continued.

2. Connect oscilloscope external trigger to A3U506 pin 15 and channel A input to A3U513 pin 5. Verify signal starts high then switched low (may stay low or return high 1 us later).

3. Repeat with channel A input at A3U513 pins 6-9, and 16-20.

   - If step 2 and 3 results incorrect, perform ADC ASM Test (para 2-12), If test passes, suspect A3U513. Troubleshoot using fig. FO-13, Sheet 2, circuit A. Replace faulty component.

4. Connect oscilloscope external trigger to A3U506 pin 15 and channel A input to A3U512 pin 7. Verify signal toggles back and forth during a conversion.

   - If incorrect, suspect A3U512 or A3CR502. Troubleshoot using fig. FO-13, Sheet 2, circuit A. Replace faulty component.

NOTE

A3U512 pin 2 is at a virtual ground (currents are being summed at this node), so voltage levels at this point are difficult to interpret.

   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

5. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA ADC CIRCUITS TEST - Ramp Counter Test.

Ramp Counter Test.

DESCRIPTION

This test is used to isolate ramp counter circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 3, circuit D as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to 1 MHz.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR SAMPLE key.
   - Set SWEEP TIME to 100 ms.
2. Connect oscilloscope to A3U525 pin 3.
3. Verify oscilloscope displays a 333 usec period square wave.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 3, circuit D. Replace faulty component.
4. On AN/USM-489A, press STEP up arrow button.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA ADC CIRCUITS TEST - Ramp Counter Test - Continued.

5. Repeat steps 3 and 4 using the following table.

Sweep Time	Square wave period
200 ms	666 µs
500 ms	1.6 ms
1 see	3.3 ms
2 sec	6.6 ms
5 sec	16.6 ms
10 sec	33.3 ms
20 sec	66.6 ms
50 sec	166.6 ms

- If readings are incorrect, troubleshoot using fig. FO-13, Sheet 3, circuit D. Replace faulty component.
- Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

6. Troubleshooting hints:

- Any SWEEP TIME from 100 ms and 60 sec can be selected. Correct period is calculated as follows:

$$\text{period (in see)} = \frac{2 \text{ x sweep time}}{600}$$

For example, for a 6 sec SWEEP TIME, period is $\frac{2 \text{ x } 6}{600}$ or 20 ms.

- The ramp (bucket) counter will be odd every other bucket.

7. On AN/USM-489A,

- Set LINE to OFF.
- Remove power cable.
- Disconnect test cables and equipment.
- Replace circuit card shields (if removed).
- Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST- A3 INTERFACE CCA CONTROL CIRCUITS TEST.

A3 INTERFACE CCA CONTROL CIRCUITS TEST.

DESCRIPTION

This test is used to isolate control circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheets 5 and 6, circuits K, N, and P as required for schematic diagrams,
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

Prior to troubleshooting the A3 Interface CCA control circuits, perform the following steps to determine if A3 Interface CCA control circuits are malfunctioning.

1. On AN/USM-489A,
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press AMPLITUDE button.
   - Press ATTEN key.
   - Set ATTEN to 70 dB and verify a click is heard.
   - Verify CRT screen displays “RF ATT 70 dB”,
   - Set ATTEN to 10 dB and verify a click is heard.
   - Verify CRT screen displays “RF ATT 10 dB”.
2. Analyze results.
   - If clicks were heard, control circuits are functioning properly.
   - If no clicks were heard, but RF ATT displayed on CRT was correct, control circuits are malfunctioning. Proceed with Analog Bus Drivers Test.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA CONTROL CIRCUITS TEST - Analog Bus Drivers Test.

Analog Bus Drivers Test.

DESCRIPTION

This test is used to isolate analog bus driver circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 6, circuit N as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to O Hz.
   - Set TRIGGER to SINGLE.
2. Connect an oscilloscope to A3U401 pin 3.
3. On AN/USM-489A,
   - Press INT button.
   - Set SIG ID to ON and verify oscilloscope displays a pulse.
   - Set SIG ID to OFF and verify oscilloscope displays a pulse.
     - If incorrect, troubleshoot using fig. FO-13, Sheet 6, circuits P and N. Replace faulty component.
4. Repeat steps 2 and 3 using the following table.

Oscilloscope	Button	Key	Toggle Between
A3U401 pin 5	AMPLITUDE	ATTEN	10 dB and 20d B
A3U401 pin 7	AMPLITUDE	REF LVL	-10 dB and -20 dB
A3U401 pin 9	AMPLITUDE	LINEAR	LOG dB/div

- If incorrect, troubleshoot using fig. FO-13, Sheet 6, circuits P and N. Replace faulty component.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA CONTROL CIRCUITS TEST - Analog Bus Drivers Test - Continued.

5. On AN/USM-489A,
   - Set LINE to OFF.
   - Jumper A3TP1 to A3TP2 to A3U406 pin 20.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Set TRIGGER to SINGLE.
6. Using a logic probe, verify the following lines are TTL high:
   - Address lines A0-A7 at A3U406 pins 2, 5, 6, 9, 12, 15, 16, and 19.
   - Data lines Do-D7 at A3U405 pins 2, 5, 6, 9, 12, 15, 16, and 19.
     - If incorrect, proceed to step 7.
     - If correct, circuit is functioning normally.
7. On AN/USM-489A,
   - Set LINE to OFF.
   - Disconnect W2 from A3J2.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
8. Using a logic probe, verify the following lines are TTL high:
   - Address lines A0-A7 at A3U406 pins 2, 5, 6, 9, 12, 15, 16, and 19.
   - Data lines Do-D7 at A3U405 pins 2, 5, 6, 9, 12, 15, 16, and 19.
     - If correct, suspect W2 or stuck line on A4 Log Amplifier CCA, A5 IF Filter CCA, A14 Frequency Control CCA, or A15 RF CCA. Troubleshoot using fig. FO-3. Replace faulty component.
     - If incorrect, proceed to step 9.
9. Check corresponding inputs of A3U405 or A3U406 (pins 3, 4, 7, 8, 13, 14, 17, or 18).
   - If corresponding A3U405 input is stuck low, suspect A3U600. Troubleshoot using fig. FO-13, Sheet 6, circuit O. Replace faulty component.
   - If corresponding A3U406 input is stuck low, suspect A3W1 or A2 Controller CCA. Troubleshoot using fig. FO-3. Replace faulty component.
   - If corresponding A3U405/A3U406 input is high or toggling, suspect a A3U405 or A3U406. Troubleshoot using fig. FO-13, Sheet 6, circuit N. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA CONTROL CIRCUITS TEST - Analog Bus Drivers Test - Continued.

10. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Remove jumpers.
    - Reconnect W2 to A3J2.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

Analog Bus Timing Test.

DESCRIPTION

This test is used to isolate analog bus timing circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 6, circuit P as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card-shields.

1. On AN/USM-489A,
    - Place A2/A3 in service position (para 2-40).
    - Connect power cable to the rear panel.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
    - Set CENTER FREQ to 300 MHz
    - Set SPAN WIDTH to 100 MHz.
2. Connect oscilloscope channel A to A3U400 pin 3 and channel B to A3U407 pin 1.
3. Verify signal at A3U400 pin 3 goes TTL high, causing A3U407 pin 1 to go TTL **low** ≈ 2 **µs** later.
    - If A3U400 pin 3 is absent, proceed to step 4.
    - If A3U407 pin 1 is not delayed 2 **µs,** proceed to step 5.
    - If correct, proceed to step 6.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA CONTROL CIRCUITS TEST - Analog Bus Timing Test - Continued.

4. Verify pulses are present at A3U505 pin 2 and A3U505 pin 5.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 6. Replace faulty component.
5. Verify 1 MHz signal at A3U414 pin 1.
   - If correct, suspect A3U414 or A3U400. Troubleshoot using fig. FO-13, Sheet 6, circuit P. Replace faulty component.
   - If incorrect, troubleshoot using fig. FO-13, Sheet 6, circuit P. Replace faulty component.
6. On AN/USM-489A,
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Set TRIGGER to SINGLE.
7. Connect an oscilloscope to A3U401 pin 3.
8. On AN/USM-489A,
   - Press INT button.
   - Set SIG ID to ON and verify oscilloscope displays a pulse.
   - Set SIG ID to OFF and verify oscilloscope displays a pulse.
     - If incorrect, troubleshoot using fig. FO-13, Sheet 6, circuits P and N. Replace faulty component.
9. Repeat steps 9 and 10 using the following table.

Oscilloscope	Button	Key	Toggle Between
A3U401 pin 5	AMPLITUDE	ATTEN	10 dB and 20 dB
A3U401 pin 7	AMPLITUDE	REF LVL	-10 dB and -20 dB
A3U401 pin 9	AMPLITUDE	LINEAR	LOG dB/div

   - If incorrect, troubleshoot using fig, FO-13, Sheet 6, circuits P and N. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

10. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3 and cover.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA CONTROL CIRCUITS TEST - Interface Strobe Select Test.

Interface Strobe Select Test.

DESCRIPTION

This test is used to isolate interface strobe select circuit malfunctions in the A3 Interface CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-11 as required for component location information.
- See fig. FO-13, Sheet 5, circuit K as required for schematic diagram.
- See paragraph 2-41 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Connect oscilloscope channel A input to A3U410 pin 15 and channel B to A3U410 pin 1.
3. Verify as A3U410 pin 15 strobes TTL low that A3U410 pin 1 strobes low.
4. Move oscilloscope channel B to A3U410 pin 2.
5. Verify as A3U410 pin 15 strobes TTL low that A3U410 pin 2 strobes low.
6. Move oscilloscope channel B to A3U410 pin 3.
7. Verify as A3U410 pin 15 strobes TTL low that A3U410 pin 3 strobes low.
8. Repeat steps 2 through 7 to verify levels in the following table.

Oscilloscope Channel A Connect		Oscilloscope Channel B		
		A3U410 pin 1	A3U410 pin 2	A3U410 pin 3
A3U410 pin 15	strobes L	strobes L	strobes L	strobes L
A3U410 pin 13	strobes L	strobes L	strobes H	strobes L
A3U410 pin 12	strobes L	strobes H	strobes H	strobes L
A3U410 pin 11	strobes L	strobes L	strobes L	strobes H
A3U410 pin 7	strobes L	strobes H	strobes H	strobes H

- If incorrect, troubleshoot using fig. FO-13, Sheet 5, circuit K. Replace faulty component.

2-12. ADC/INTERFACE SECTION TEST - A3 INTERFACE CCA CONTROL CIRCUITS TEST - Interface Strobe Select Test - Continued.

9. Repeat steps *2* through *7* to verify A3U500 levels in the following table.

Oscilloscope Channel A Connect		**Oscilloscope Channel B**		
		A3U500 pin 1	**A3U500 pin 2**	**A3U500 pin 3**
Pin 15	strobes L	strobes L	strobes L	strobes L
Pin 14	strobes L	strobes H	strobes L	strobes L
Pin 13	strobes L	strobes L	strobes H	strobes L
Pin 12	strobes L	strobes H	strobes H	strobes L
Pin 11	strobes H	strobes L	strobes L	strobes H
Pin 10	strobes H	strobes H	strobes L	strobes H
Pin 9	strobes L	strobes L	strobes H	strobes H
Pin 7	strobes L	strobes H	strobes H	strobes H

- If incorrect, troubleshoot using fig. FO-13, Sheet 5, circuit K. Replace faulty component.
- Troubleshoot remaining problems using fig. FO-13. Replace faulty component.

10. On AN/USM-489A,

- Set LINE to OFF.
- Remove power cable.
- Disconnect test cables and equipment.
- Replace circuit card shields (if removed).
- Reinstall A2/A3 and cover.

2-13. IF SECTION TEST

DESCRIPTION

This test is used to isolate malfunctions in the A4 Log Amplifier CCA, A5 IF Filter CCA, and A16 CAL Oscillator CCA to the malfunctioning component or assembly.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

1. Troubleshooting the IF Section consists of performing up to six individual test procedures, some of which contain subtests.
   - If the specific test (or subtest) is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph. Table 2-3 contains a complete list of IF Section Tests /Subtests.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate test in Table 2-3.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented in Table 2-3.

NOTE

Because A16 CAL Oscillator CCA is such an integral part of the IF Section, always check first before checking the remaining IF Section assemblies.

Table 2-3. IF Section Tests

Test Name	Subtest Name	Page
A16 TAM Tests	A16J4	2-92
	Cal Oscillator Test	2-93
A4 TAM Tests	A4J8	2-97
	A4J 7	2-98
	A4J9	2-99
A5 TAM Tests		2-99
	A5J 8	2-100
	A5J 7	2-102
	A5J 6	2-101
	IF Filter Test	2-104
A4 Log Amplifier CCA Tests		2-105
	Log Amplifier Test	2-106
	Linear Amplifiers Test	2-107
	Detector Test	2-109
	Buffer Amplifier Test	2-111
	Video Offset Test	2-112
	Video Output Test	2-114
	AM/FM Demodulation, Audio Amplifier, and Speaker Test	2-115
A5 IF Filter CCA Tests		2-117
	IF Signature Test	2-119
	Resolution BW Test	2-128
	Step Gains Test	2-133

2-13. IF SECTION TEST- A16 TAM TESTS.

A16 TAM TESTS.

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A16 CAL Oscillator CCA using the TAM.

NOTES

- See fig. FO-31 as required for component location information.
- See fig. FO-32 as required for functional block diagram.
- See paragraph 2-49 (as required) for procedure on removing circuit card shields.

A16J4 Test.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Place A16 in service position (para 2-48).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.
   - Connect TAM probe cable to A16J4 (fig. FO-31).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “2) Manual Probe Troubleshooting”.
   - Press EXECUTE key.

2-13. IF SECTION TEST- A16 TAM TESTS - A16J4 Test- Continued.

2. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table,

NOTE

For additional troubleshooting information on failed tests:
- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-32).

   - If all tests return OK, proceed to step 3.

Failed Test	Circuit(s)	Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS8	N/A	N/A
Cal Osc Sweep Gen Hardware	L	MS1 , MS2	CAL Oscillator Test	2-93
Cal Osc Tune Line Test	A	MS3	CAL Oscillator Test	2-93
Cal Osc ALC Test	C	MS4	CAL Oscillator Test	2-93
Cal Osc Sweep Gen Output	L	MS6	CAL Oscillator Test	2-93

3. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A16.
   - Reinstall A2/A3/A4/A5 and cover.

CAL Oscillator Test.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.
   - Disconnect W30 (WHT) from A5J4 (fig. FO-17).
   - Connect W30 to another spectrum analyzer input.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “4) Cal Osc Troubleshooting Mode".
   - Press EXECUTE key.

2-13. IF SECTION TEST - A16 TAM TESTS - CAL Oscillator Test - Continued.

2. Set spectrum analyzer (connected to W30) as follows:

   Span .... 5 MHz
   Reference level .... -30 dBm
   Center Frequency .... 10.7 MHz

3. On AN/USM-489A,
   - Press STOP key (if displayed).
   - Use KNOB to select "1) Fixed tuned to 11.5 MHz".
   - Press EXECUTE key.
4. Verify signal measured on spectrum analyzer is 11.5 MHz at ≈ **–35** dBm.
5. Repeat steps 3 and 4 at 10.7 MHz and 9.9 MHz.
   - If output level is incorrect (low), perform Adjust IF Amplitude (para 2-25). If adjustment fails, proceed to step 14.
   - If 11.5 MHz, 10.7 MHz, and/or 9.9 MHz frequencies are incorrect, proceed to step 6.
   - If 11.5 MHz, 10.7 MHz, and 9.9 MHz output level and frequencies are correct, proceed to step 17.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Place A16 in service position (para 2-48).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select "4) Cal Osc Troubleshooting Mode".
   - Press EXECUTE key.
   - Use KNOB to select "2) Fixed tuned to 11.5 MHz".
   - Press EXECUTE key.
7. Using an oscilloscope, verify A16U13 pin 9 (fig. FO-31) is 100 kHz.
   - If incorrect, proceed to step 8.
   - If correct, proceed to step 9.
8. Verify A16J1 center pin is 10 MHz.
   - If incorrect, perform 10 MHz Reference Test (para 2-16).
   - If correct, replace A16 Cal Oscillator CCA (para 2-64).
9. Verify that frequencies at A16U4 pin 15 and A16U13 pin 9 are identical.
   - If incorrect, replace A16 Cal Oscillator CCA (para 2-64).
10. Verify that frequency at A16U4 pin 3 is 11.5 MHz.
    - If incorrect, replace A16 Cal Oscillator CCA (para 2-64).

2-13. IF SECTION TEST - A16 TAM TESTS - CAL Oscillator Test - Continued.

11. On AN/USM-489A,
    - Press STOP key.
    - Use KNOB to select "2) Fixed tuned to 10.7 MHz".
    - Press EXECUTE key.
12. Verify that frequency at A16U4 pin 3 is 10.7 MHz.
    - If incorrect, replace A16 Cal Oscillator CCA (para 2-64).
13. Repeat steps 11 and 12 for 9.9 MHz.
14. On AN/USM-489A,
    - Press EXIT key.
    - Press RETURN key.
    - Press EXIT MODULE key.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press AMPLITUDE button.
    - Press MORE key.
    - Press IF ADJUST key.
    - Rotate A16R32 fully clockwise.
15. Pressing FULL IF ADJ key and verify signal level on spectrum analyzer (connected to W30) is above (more positive) –34.55 dBm.
    - If incorrect, replace A16 Cal Oscillator CCA (para 2-64).
16. Rotate A16R32 fully counterclockwise and verify signal level on spectrum analyzer (connected to W30) is below (more negative) –36.25 dBm.
    - If incorrect, replace A16 Cal Oscillator CCA (para 2-64).
    - If correct, perform all A5 TAM Test (para 2-13).
17. On AN/USM-489A,
    - Press STOP key.
    - Use KNOB to select "4) Sweep width 20 kHz".
    - Press EXECUTE key.
18. Reduce span of spectrum analyzer (connected to W30).
19. Verify that displayed 10.7 MHz signal is sweeping 20 kHz.
20. Repeat steps 17 through 19 at 10 kHz, 4 kHz, 2 kHz, and .7 kHz
    - If incorrect, proceed to step 21.
    - If correct, A16 CAL Oscillator CCA is functioning normally.

2-13. IF SECTION TEST - A16 TAM TESTS - CAL Oscillator Test - Continued.

21. On AN/USM-489A,
    - Set LINE to OFF.
    - Place A16 in service position (para 2-48).
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press PRESET button.
    - Press MODULE button.
    - Press DIAGNOSE key.
    - Use KNOB to select “4) Cal Osc Troubleshooting Mode”.
    - Press EXECUTE key.
    - Use KNOB to select “4) Sweep width 20 kHz”.
    - Press EXECUTE key.
22. Using an oscilloscope, verify that A16U10 pin 8 is a series of negative-going parabolas (“U” shaped) with frequency and amplitude depending on the sweep width chosen. Use the following table (sweep width/sweep time columns) to determine if all sweep width waveforms are correct.

Sweep Width	Sweep Time (Signal Width)	RES BW Adjusted	A16U9 pin 16	A16U7 pin 1	A16U7 pin 16
20 kHz	5 ms	10 kHz	+5 V	0 V	0 V
10 kHz	10ms	3 kHz	+5 V	0 V	+5 V
4 kHz	30 ms	1 kHz	+5 V	+5 V	0 V
2 kHz	15ms	300 Hz	+5 v	+5 V	+5 V
700 Hz	60 ms	100 Hz	0 V	+5 V	+5 V

    - If incorrect, proceed to step 23.
    - If correct, replace A16 CAL Oscillator CCA (para 2-64).
23. Select malfunctioning sweep width and measure levels at A16U9 and A16U7 from the table above.
    - If incorrect, perform Controller Section Test (para 2-14).
    - If correct, replace A16 CAL Oscillator CCA (para 2-64).
24. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Reconnect W30 to A5J4.
    - Disconnect test cables and equipment.
    - Replace circuit card shields (if removed).
    - Reinstall A16.
    - Reinstall A2/A3/A4/A5 and cover.

2-13. IF SECTION TEST- A4 TAM TESTS.

A4 TAM TESTS.

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A4 Log Amplifier CCA using the TAM.

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1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.

A4J8 Test.

2. On AN/USM-489A,
   - Connect TAM probe cable to A4J8 (fig. FO-14).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “2) Manual Probe Troubleshooting”.
   - Press EXECUTE key.
3. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

> For additional troubleshooting information on failed tests:
> - Use KNOB to select failed test.
> - Press MORE INFO key.
> - Follow instructions on CRT Screen (fig. FO-16).

   - If all tests return OK, proceed to step 4.

NOTE

> A4 TAM Tests each cascaded log amplifier by calculating the bias currents into each stage. This locates dead stages, but might not report a slightly degraded stage. See Log Amplifier Test (para 2-13) for more detailed troubleshooting.

2-13. IF SECTION TEST - A4 TAM TESTS - A4J8 Test - Continued.

Failed Test	FO-16 Circuit(s)	FO-16 Signal(s)	Test/Subtest to Perform	Page
Revision	NIA	MS5	N/A	N/A
Voltage Reference	L	MS6, MS7 MS8	Troubleshoot using fig. FO-16, Sheet 4	N/A
7th Log Amplifier Stage	H	MS1, MS2	Log Amplifier Test	2-106
8th Log Amplifier Stage	J	MS1 , MS3	Log Amplifier Test	2-106
9th Log Amplifier Stage	K	MS1, MS4	Log Amplifier Test	2-106

A4J7 Test.

4. On AN/USM-489A,
   - Connect TAM probe cable to A4J7.
   - Press the TEST key.
5. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-16).

- If all tests return OK, proceed to step 6.

NOTE

A4 TAM Tests each cascaded log amplifier by calculating the bias currents into each stage. This locates dead stages, but might not report a slightly degraded stage. See Log Amplifier Test (para 2-13) for more detailed troubleshooting.

Failed Test	FO-16 Circuit(s)	FO-16 Signal(s)	Test/Subtest to Perform	Page
Input Converter	A	MS1	Log Amplifier Test	2-106
Positive 15 V Supply	U	MS5	Troubleshoot using fig. FO-16, Sheet 6	N/A
Ist Log Amplifier Stage	B	MS2	Log Amplifier Test	2-106
2nd Log Amplifier Stage	C	MS3	Log Amplifier Test	2-106
3rd Log Amplifier Stage	D	MS4	Log Amplifier Test	2-106
4th Log Amplifier Stage	E	MS7	Log Amplifier Test	2-106
5th Log Amplifier Stage	F	MS8	Log Amplifier Test	2-106
6th Log Amplifier Stage	G	MS6	Log Amplifier Test	2-106

2-13. IF SECTION TEST- A4 TAM TESTS - A4J9 Test.

A4J9 Test.

6. On AN/USM-489A,
   - Connect TAM probe cable to A4J9.
   - Press the TEST key.
7. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:
- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-16).

- If all tests return OK, proceed to step 8.

Failed Test	FO-16 Circuit(s)	FO-16 Signal(s)	Test/Subtest to Perform	Page
Linear Amp Stage 1 Output	N	MS1	Linear Amplifiers Test	2-107
Linear Amp Stage 2 Output	N	MS2	Linear Amplifiers Test	2-107
Detector Bias Test	O	MS5	Detector Test	2-109
Detector Buffer Test	O	MS6	Detector Test	2-109
Video Offset/Buffer Test	P,Q,R	MS8	Buffer Amplifier Test	2-111
			Video Offset Test	2-112
			Video Output Test	2-114

8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3/A4/A5 and cover.

A5 TAM TESTS.

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A5 IF Filter CCA using the TAM.

---

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.

2-13. IF SECTION TEST- A5 TAM TESTS - A5J8 Test.

A5J8 *Test.*

2. On AN/USM-489A,
   - Connect TAM probe cable to A5J8 (fig. FO-17).
   - On AN/USM-489A,
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “2) Manual Probe Troubleshooting”.
   - Press EXECUTE key.
3. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-19).

   - If all tests return OK, proceed to step 4.

NOTE

A5 TAM Tests each IF chain stage by calculating the bias currents into each stage. This locates dead stages, but might not report a slightly degraded stage. See IF Signature Test (para 2-13) for more detailed troubleshooting.

Failed Test	FO-19 ICircuit (s)	FO-19 Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS8	N/A	N/A
4th XTAL Pole Stage	L	MS1, MS2 MS3	IF Signature Test	2-119
Post Amplifier Stage 1	M	MS2, MS3 MS4	Troubleshoot using fig. FO-19, Sheet 4	N/A
Post Amplifier Stage 3	M	MS3, MS4 MS5	Troubleshoot using fig. FO-19, Sheet 4	N/A
3rd LC Pole Stage	N	MS5, MS6 MS7	IF Signature Test	2-119
4th LC Pole Stage	O	MS6, MS7	IF Signature Test	2-119

2-13. IF SECTION TEST - A5 TAM TESTS - A5J6 Test.

A5J6 Test.

4. On AN/USM-489A,

- Connect TAM probe cable to A5J6.
- Press the TEST key.

5. Read test results on the CRT Screen.

- If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-19).

- If all tests return OK, proceed to step 6.

NOTE

A5 TAM Tests each IF chain stage by calculating the bias currents into each stage. This locates dead stages, but might not report a slightly degraded stage. See IF Signature Test (para 2-13) for more detailed troubleshooting.

Failed Test	FO-19 Circuit(s)	FO-19 Signal(s)	Test/Subtest to Perform	Page
1st Step Gain Stage 1	B	MS1, MS2 MS8	IF Signature Test	2-119
1st Step Gain Stage 2	H	MS1, MS2 MS3	IF Signature Test	2-119
1st XTAL Pole Stage	c	MS2, MS3 MS4	IF Signature Test	2-119
2nd XTAL Pole Stage	D	MS3, MS4 MS5	IF Signature Test	2-119
1st LC Pole Stage 1	E	MS4, MS5 MS6	IF Signature Test	2-119
1st LC Pole Stage 2	E	MS5, MS6 MS7	IF Signature Test	2-119

2-13. IF SECTION TEST - AS TAM TESTS - A5J7 Test.

A5J7 Test.

6. On AN/USM-489A,
   - Connect TAM probe cable to A5J7.
   - Press the TEST key.
7. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-19).

- If all tests return OK, proceed to step 8.

NOTE

A5 TAM Tests each IF chain stage by calculating the bias currents into each stage. This locates dead stages, but might not report a slightly degraded stage. See IF Signature Test (para 2-13) for more detailed troubleshooting.

Failed Test	FO-19 Circuit(s)	FO-19 Signal(s)	Test/Subtest to Perform	Page
Ref 15 dB Attenuator Stage	G	MS1, MS2 MS3	IF Signature Test	2-119
2nd Step Gain Stage	H	MS2, MS3 MS4	IF Signature Test	2-119
2nd/3rd Step Gain Stage	H, I	MS3, MS4 MS5	IF Signature Test	2-119
3rd Step Gain Stage	I	MS4, MS5 MS6	IF Signature Test	2-119
Fine Atten/3rd XTL Pole	J, K	MS5, MS6 MS7	IF Signature Test	2-119
3rd XTAL Pole Stage	K	MS6, MS7 MS6	IF Signature Test	2-119

2-13. IF SECTION TEST- AS TAM TESTS - A5J9 Test.

A5J9 Test.

8. On AN/USM-489A,

- Connect TAM probe cable to A5J9.
- Press the TEST key.

9. Read test results on the CRT Screen.

- If any of the tests return FAIL, perform as instructed in the following able.

NOTE

> For additional troubleshooting information on failed tests:
>
> - Use KNOB to select failed test.
> - Press MORE INFO key.
> - Follow instructions on CRT Screen (fig. FO-19).
> - IFDAC1=A5U812, IFDAC2=A5U813, IFDAC3=A5U809, IFDAC4=A5U807, IFDAC5=A5U810, IFDAC6=A5U806.

- If all tests return OK, proceed to step 10.

Failed Test	lCircuit(s)	lSignal(s)	Test/Subtest to Perform	Page
IFDAC Channels 'A'	S	MS 1	Troubleshoot using fig. FO-19, Sheet 6	N/A
IFDAC Channels 'B'	S	MS3	Troubleshoot using fig. FO-19, Sheet 6	N/A
IFDAC Channels 'C'	S	MS4	Troubleshoot using fig. FO-19, Sheet 6	N/A
IFDAC Channels 'D'	S	MS2	Troubleshoot using fig. FO-19, Sheet 6	N/A
Latched IF Control Lines	S	MS5	Troubleshoot using fig. FO-19, Sheet 6	N/A
Negative 15 V Supply	R	MS6	Troubleshoot using fig. FO-19, Sheet 5	N/A
Five Volt Supply	R	MS7	Troubleshoot using fig. FO-19, Sheet 5	N/A
Ten Volt Reference	R	MS8	Troubleshoot using fig. FO-19, Sheet 5	N/A

10. On AN/USM-489A,

- Set LINE to OFF.
- Remove power cable.
- Disconnect test cables and equipment.
- Reinstall A2/A3/A4/A5 and cover.

2-13. IF SECTION TEST - A5 TAM TESTS - IF Filter Test.

IF Filter Test.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A5J5 (fig. FO-17).
   - Connect A5J5 to another spectrum analyzer input.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select "4) Cal Osc Troubleshooting Mode".
   - Press EXECUTE key.
   - Use KNOB to select "2) Fixed tuned to 10.7 MHz".
   - Press EXECUTE key.
2. Set spectrum analyzer (connected to A5J5) as follows:

   Span ....5 MHz

   Reference level ....+l0 dBm

   Center Frequency ....10.7 MHz
3. Verify signal measured on spectrum analyzer is 10.7 MHz at ≈ +10 dBm.
   - If incorrect, perform CAL Oscillator Test (para 2-13). If test passes, perform IF Signature Test (para 2-13).
   - If correct, and all other A5 TAM Tests passed, A5 IF Filter CCA is functioning normally.
4. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3/A4/A5 and cover.

2-13. IF SECTION TEST- A4 LOG AMPLIFIER CCA TESTS.

A4 *LOG AMPLIFIER CCA TESTS.*

DESCRIPTION

This test is used to isolate malfunctions in the A4 Log Amplifier CCA to the malfunctioning component or assembly.

CAUTION

Use an active probe and another spectrum analyzer when troubleshooting the A4 Log Amplifier CCA. If the spectrum analyzer has a dc coupled input, set the active probe for an ac coupled output or use a dc blocking capacitor between active probe and spectrum analyzer input.

NOTES

- Only the following A4 Log Amplifier CCA circuits are repairable: Input Converter (A), Control (M), Linear Amplifiers (N), Buffer Amplifier (P), Video Offset (Q), Video Buffer Amplifier (R), AM/FM Demodulation (S), Frequency Counter Prescaler/Conditioner (T), and Power Supply (U). All other circuits are non-repairable.
- Schematic diagrams are provided for the non-repairable circuits ONLY to assist in determining if the A4 Log Amplifier CCA is malfunctioning.
- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for component location information.
- See fig. FO-16 as required for schematic diagrams.

1. Troubleshooting A4 Log Amplifier CCA malfunctions consists of performing up to seven individual test procedures.
   - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented.

2-13. IF SECTION TEST- A4 LOG AMPLIFIER CCA TESTS - Log Amplifier Test.

Log Amplifler Test.

DESCRIPTION

This test is used to isolate log amplifier chain and log wide/narrow filter malfunctions in the A4 Log Amplifier CCA to the malfunctioning component or assembly. Log circuits cannot be repaired because of factory-only log-fidelity adjustments.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for component location information.
- See fig. FO-16, Sheets 2-4, circuits B - K as required for schematic diagrams.
- See paragraph 2-43 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A4J3.
   - Connect a signal generator to A4J3.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set SWEEP to SINGLE.
2. Set signal generator controls as follows:

   Frequency .... 10.7 MHz

   Output Level .... +10 dBm
3. Using an active probe and another spectrum analyzer (in linear mode), verify signal levels at A4TP405 and A4TP406 are ≈ 1 Vrms. Leave probe connected to A4TP406.
   - If correct, proceed to step 5.
4. Using an active probe and another spectrum analyzer (in log mode), verify signal levels at A4TP102 and A4TP103 are 10.7 MHz at ≈ +7 dBm.
   - If correct, replace A4 Log Amplifier CCA (para 2-55).
   - If incorrect, troubleshoot using fig. FO-16, Sheet 2, circuit A. Replace faulty component.
5. Set signal generator controls as follows:

   Output Level .... -10 dBm

   Step Level .... 10 dB
6. Adjust reference level of spectrum analyzer to place signal at top graticule line.

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - Log Amplifier Test - Continued.

7. Reduce signal generator output level in 10 dB steps while reading signal amplitude displayed on spectrum analyzer.
8. Verify signal level drops by one division for each 10 dB step.
   - If incorrect, replace A4 Log Amplifier CCA (para 2-55).
9. Repeat steps 7 and 8 until displayed signal is at noise floor.
10. On AN/USM-489A,
    - Set RES BW to 100 kHz.
11. Repeat Steps 2 through 10.
    - If incorrect, replace A4 Log Amplifier CCA (para 2-55).
    - Troubleshoot remaining problems using fig. FO-16.
12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W27 at A4J3.
    - Reinstall A2/A3/A4/A5 and cover.

Linear Amplifiers Test.

DESCRIPTION

This test is used to isolate linear amplifier circuit malfunctions in the A4 Log Amplifier CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for component location information.
- See fig. FO-16, Sheet 5, circuit N as required for schematic diagrams.
- See paragraph 2-43 (as required) for procedure on removing circuit card shields.

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - Linear Amplifiers Test - Continued.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A4J3.
   - Connect a signal generator to A4J3.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 1 GHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -50 dBm.
2. Set signal generator controls as follows:

Frequency	10.7 MHz
Output Level	+6 dBm
Step Size	10 dBm

3. Decrease signal generator output level and AN/USM-489A REF LVL in 10 dB steps.
4. At each step, verify signal displayed on AN/USM-489A remains within 1 division of REF LVL.
5. Repeat steps 3 and 4 until AN/USM-489A REF LVL is -110 dBm.
6. On AN/USM-489A,
   - Press SWEEP button.
   - Press SINGLE key.
   - Press AMPLITUDE button.
   - Press LINEAR key.
7. Set signal generator amplitude to -30 dBm.
8. Using an active probe and another spectrum analyzer, verify gain from A4TP101 to A4TP703 is ≈ 4 dB.
9. Verify gain from A4TP101 to A4TP704 is ≈ 4 dB.
10. Decrease signal generator output level 10 dB.
11. Verify levels at A4TP703 and A4TP704 decrease by 10 dB.
12. Repeat steps 10 and 11 until signal generator output level is -90 dBm.
    - If results of steps 4, 8, 9, and 11 are correct, Linear Amplifiers are functioning normally.
    - If results of steps 4, 8, 9, and 11 are incorrect, proceed to step 13.
13. Set signal generator amplitude to -50 dBm.
14. Using an active probe and another spectrum analyzer, verify gain from A4TP101 to A4TP701 is ≈ 1 dB.
15. Set signal generator amplitude to -80 dBm.

2-13. IF SECTION TEST- A4 LOG AMPLIFIER CCA TESTS - Linear Amplifiers Test - Continued.

16. Verify level at A4TP701 decrease by 20 dB.

    - If steps 14 and 16 are incorrect, troubleshoot first gain stage of linear amplifiers circuit using fig. FO-16, Sheet 5, circuit N. Replace faulty component.

17. Set signal generator amplitude to -50 dBm.

18. Using an active probe and another spectrum analyzer, verify gain from A4TP701 to A4TP702 is ≈ 2.5 dB.

19. Set signal generator amplitude to -60 dBm.

20. Verify level at A4TP702 decrease by 10 dB.

21. Set signal generator amplitude to -70 dBm.

22. Verify level at A4TP702 decrease by 10 dB.

    - If steps 18, 20, and 22 are incorrect, troubleshoot second gain stage of linear amplifiers circuit using fig. FO-16, Sheet 5, circuit N. Replace faulty component.
    - Troubleshoot remaining problems using fig. FO-16.

23. On AN/USM-489A,

    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W27 at A4J3.
    - Reinstall A2/A3/A4/A5 and cover.

Detector Test.

DESCRIPTION

This test is used to isolate detector circuit malfunctions in the A4 Log Amplifier CCA to the malfunctioning component or assembly. Detector circuit cannot be repaired because of factory-only linearity adjustments.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for component location information.
- See fig. FO-16, Sheet 5, circuit O as required for schematic diagrams.
- See paragraph 2-43 (as required) for procedure on removing circuit card shields.

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - Detector Test - Continued.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A4J3.
   - Connect a signal generator to A4J3 (set to OFF).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set SWEEP to SINGLE.
2. Verify voltages at A4TP505 and A4TP506 are +2 to +3 Vdc, and are within 30 mV of each other.
   - If incorrect, replace A4 Log Amplifier CCA (para 2-55).
3. Set signal generator controls as follows:

   Frequency ....10.7 MHz
   Output Level .... +10 dBm
   Step Size .... 10 dBm
4. Connect oscilloscope at A4TP505.
5. Decrease signal generator output 10 dB and verify voltage at A4TP505 decreases by ≈ 8 to 9 mV.
6. Repeat step 5 until signal generator output level is -50 dBm.
   - If correct, detector is functioning normally.
   - If incorrect, replace A4 Log Amplifier CCA (para 2-55).
7. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W27 at A4J3.
   - Reinstall A2/A3/A4/A5 and cover.

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - Buffer Amplifier Test.

Buffer Amplifier Test.

DESCRIPTION

This test is used to isolate buffer amplifier circuit malfunctions in the A4 Log Amplifier CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for component location information.
- See fig. FO-16, Sheet 6, circuit P as required for schematic diagrams.
- See paragraph 2-43 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A4J3.
   - Connect a signal generator to A4J3 (set to OFF).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set SWEEP to SINGLE.
2. Verify voltage at A4TP507 is less than +200 mVdc.
   - If correct, replace A4 Log Amplifier CCA (para 2-55).
3. The voltage at A4TP507 should measure less than +200 mVdc.
   - If incorrect, perform Detector Test (para 2-13). If test passes, proceed to step 4.
4. Jumper A4TP505 to A4TP506.
5. Set signal generator controls as follows:

   Frequency ....10.7 MHz
   Output Level ....+10 dBm
   Step Size ....10 dBm
6. Decrease signal generator output 10 dB and verify voltage at A4TP507 decreases by 100 mV.
7. Repeat step 6 until signal generator output level is -50 dBm.
   - If correct, buffer amplifier is functioning normally.
   - If incorrect, troubleshoot using fig. FO-16, Sheet 6, circuit P. Replace faulty component.

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - Buffer Amplifier Test - Continued.

8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Remove jumper.
   - Reconnect W27 at A4J3.
   - Reinstall A2/A3/A4/A5 and cover.

Video Offset Test.

DESCRIPTION

This test is used to isolate video offset circuit malfunctions in the A4 Log Amplifier CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for component location information.
- See fig. FO-16, Sheet 6, circuit Q as required for schematic diagrams.
- See paragraph 2-43 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A4J3.
   - Connect a signal generator to A4J3.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 1 GHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -50 dBm.
2. Set signal generator controls as follows:

Frequency	10.7 MHz
Output Level	+10 dBm
Step Size	10 dBm

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - Video Offset Test - Continued.

3. Decrease signal generator output level and AN/USM-489A REF LVL in 10 dB steps.
4. At each step, verify signal displayed on AN/USM-489A remains close to REF LVL.
5. Repeat steps 3 and 4 until AN/USM-489A REF LVL is -110 dBm.
   - If correct, video offset is functioning normally.
   - If incorrect, proceed to step 6.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Disconnect signal generator.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set SWEEP to SINGLE.
7. Connect digital multi meter (-) lead to A4TP507 and (+) lead to A4TP601. Verify voltage reading is ≈ -90 mV.
   - If incorrect, proceed to step 8.
   - If correct, troubleshoot using fig. FO-16, Sheet 6, circuit Q around A4U603A. Replace faulty component.

a. Connect digital multi meter (+) lead to A4U602 pin 2 and (–) lead to A4TP507. Verify voltage reading is ≈ –54 mV.

   - If correct, troubleshoot using fig. FO-16, Sheet 6, circuit Q around A4U603B and A4Q601. Replace faulty component.
   - If incorrect, troubleshoot using fig. FO-16, Sheets 5 and 6, circuits M and Q around A4U602, A4U603A and A4U601. Replace faulty component.

9. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W27 at A4J3.
   - Reinstall A2/A3/A4/A5 and cover.

2-13. IF SECTION TEST- A4 LOG AMPLIFIER CCA TESTS - Video Output Test.

Video Output Test.

DESCRIPTION

This test is used to isolate video buffer amplifier circuit malfunctions in the A4 Log Amplifier CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for component location information.
- See fig. FO-16, Sheet 6, circuit R as required for schematic diagrams.
- See paragraph 2-43 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Disconnect W26 (RED) from A4J6.
   - Connect an oscilloscope to A4J6.
   - Connect CAL OUTPUT connector to **INPUT 50Ω** connector using BNC cable and adapter supplied.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -10 dBm.
2. Set oscilloscope controls as follows:

   Amplitude scale . . . .0 to +1 V

   Coupling ....dc

   Sweep time ....5 ms/div
3. Verify oscilloscope displays a flat line at ≈ +1 Vdc.
   - If incorrect, troubleshoot using fig. FO-16, Sheet 6, circuit R. Replace faulty component.
4. Disconnect BNC cable from **IN** connector.
5. Verify noise on oscilloscope is ≈ +200 mV to +400 mV.
   - If incorrect, troubleshoot using fig. FO-16, Sheet 6, circuit R. Replace faulty component.

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - Video Output Test - Continued.

6. On AN/USM-489A. decrease REF LVL in 10 dB steps from -10 dBm to -70 dBm and verify noise displayed on oscilloscope increases in 100 mV increments.
   - If incorrect, perform Step Gains Test (para 2-13). If test passes, perform Video Offset Test (para 2-13).
   - Troubleshoot remaining problems using fig. FO-16. Replace faulty component.
7. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W26 at A4J6.
   - Reinstall A2/A3/A4/A5 and cover.

AM/FM Demodulation, Audio Amplifier, and Speaker Test.

DESCRIPTION

This test is used to isolate AM/FM demodulation and audio (to speaker) malfunctions in the A4 Log Amplifier CCA or A16 CAL Oscillator CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-14 as required for A4 Log Amplifier CCA component location information.
- See fig. FO-16, Sheet 6, circuit S as required for A4 Log Amplifier CCA schematic diagrams.
- See fig. FO-31 as required for A16 CAL Oscillator CCA component location information.
- See fig. FO-32 as required for A16 CAL Oscillator CCA functional block diagram.
- See paragraphs 2-43 and 2-49 (as required) for procedure on removing circuit card shields.

2-13. IF SECTION TEST- A4 LOG AMPLIFIER CCA TESTS - AM/FM Demodulation, Audio Amplifier, and Speaker Test - Continued.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 100 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 50 ms.
   - Set REF LVL to 0 dBm.
   - Press LINEAR key.
   - Set RES BW to 10 kHz.
2. Connect signal generator to AN/USM-489A INPUT connector and set as follows:

Frequency	100 MHz
Amplitude	–6 dBm
Modulation Type	80% AM
Modulation Frequency	400 Hz

3. On AN/USM-489A,
   - Adjust REF LVL and CENTER FREQ to display 400 Hz modulation frequency eight divisions peak-to-peak.
   - Press DEMOD button.
   - Press AM DEMOD ON key.
   - Set SWEEP TIME to 5 s.
   - Press DEMOD button.
   - Press MORE key.
   - Press VOLUME key,
4. Vary volume setting using the control knob and verify 16 audio levels of speaker output ≈ 3 dB apart. Note that clipping is normal on highest settings.
   - If incorrect, proceed to step 5.
   - If correct, demodulation and audio circuits are functioning normally.
5. Disconnect W28 (WHT/BLU) at A4J5 (fig. FO-14).
6. Connect oscilloscope to A4J5 and verify signal is 190 mVrms ±25%.
   - If incorrect, troubleshoot using fig. FO-16, Sheet 6, circuit S. Replace faulty component.
   - If correct, check W28 and SP1 speaker (and cable). If good, replace A16 CAL Oscillator CCA (para 2-64).

2-13. IF SECTION TEST - A4 LOG AMPLIFIER CCA TESTS - AM/FM Demodulation, Audio Amplifier, and Speaker Test - Continued.

7. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Reconnect W28 to A4J5.
   - Disconnect test cables and equipment.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3/A4/A5 and cover.

A5 IF FILTER CCA TESTS.

DESCRIPTION

This test is used to isolate malfunctions in the A5 IF Filter CCA to the malfunctioning component or assembly.

CAUTION

Use an active probe and another spectrum analyzer when troubleshooting the A5 IF Filter CCA. If the spectrum analyzer has a dc coupled input, set the active probe for an ac coupled output or use a dc blocking capacitor between active probe and spectrum analyzer input.

CAUTION

Do not short control voltages to ground. These voltages are not short-circuit protected. DACs damages by shorting these voltages might not fail until several weeks after shorted condition occurred.

CAUTION

Do not short power supply voltages to ground as power-supply current limiting cannot protect resistors in series with power supply.

CAUTION

Do not short transistor cases to ground or other points when making measurements as some transistors have collectors connected to the case.

2-13. IF SECTION TEST- A5 IF FILTER CCA TESTS.

NOTES

- Do not make measurements using transistor cases as electrical connection from case to collector is not reliable.
- Refer to Chapter 1 for circuit principles of operation,
- See fig. FO-17 as required for component location information.
- See fig. FO-19 as required for schematic diagrams.
- See paragraph 2-44 (as required) for procedure on removing circuit card shields.

1. Troubleshooting A5 IF Filter CCA malfunctions consists of performing up to three individual test procedures.
   - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test.

IF Signature Test.

DESCRIPTION

This test is used to isolate malfunctions in the A5 IF Filter CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-17 as required for component location information.
- See fig. FO-19, Sheets 1-6 as required for schematic diagrams.
- See paragraph 2-44 (as required) for procedure on removing circuit card shields.

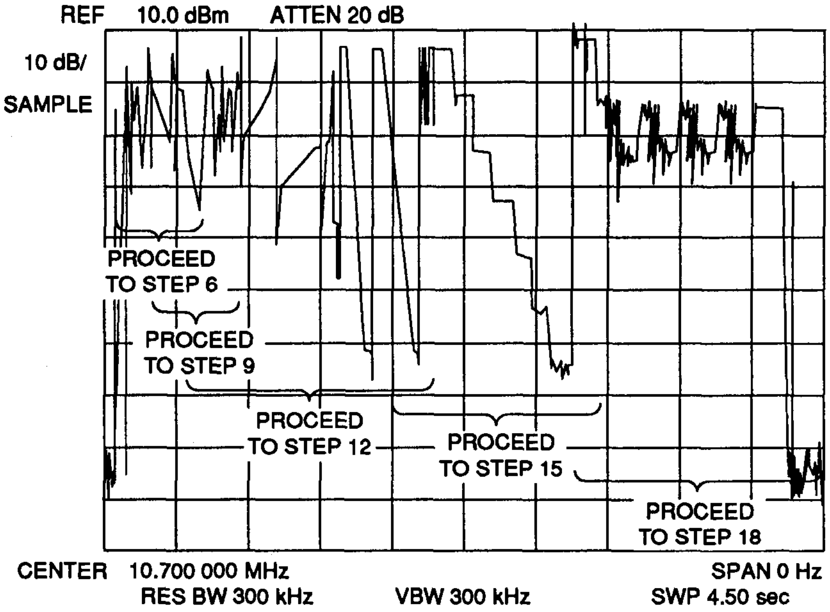
1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42),
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A5J5.
   - Connect a power splitter (source) to A5J5.
   - Connect a power splitter (output) to W27.
   - Connect a power splitter (output) to another spectrum analyzer.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 2 MHz.
   - Set TRIG to SINGLE.
   - Press AMPLITUDE button.
   - Press MORE key.
   - Press IF ADJUST key.
2. Set spectrum analyzer (connected to power splitter) controls as follows:

Reference Level	+1 0 dBm
Center Frequency	10.7 MHz
Span	0 Hz
Resolution Bandwidth	300 kHz
Video Bandwidth	300 kHz
Sweep Time	4.5 s
Sweep	Single
Detector Mode	Sample

3. At the same time, press ADJ CURR IF STATE key on AN/USM-489A and SINGLE on spectrum analyzer (connected to power splitter).

2-13. *IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.*

4. Verify IF signature displayed on spectrum analyzer resembles the waveform shown below.



- If incorrect, repeat step 4.

5. Compare IF signature displayed on spectrum analyzer to above figure.

- If they do not closely resemble each other, locate the incorrect area(s) and proceed to step number indicated.
- If they match each other, A5 IF Filter CCA is functioning properly.

6. Set spectrum analyzer (connected to power splitter) controls as follows:

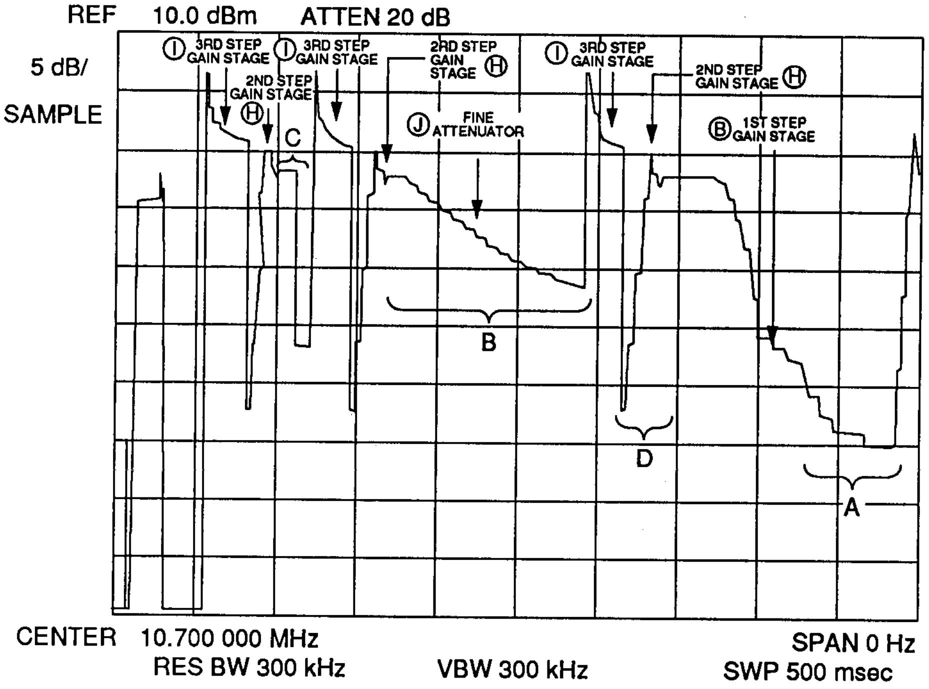
Sweep Time ....05 s
Video Bandwidth ....300 Hz
dB/div ....5 dB

7. At the same time, press ADJ CURR IF STATE key on AN/USM-489A and SINGLE on spectrum analyzer (connected to power splitter).

- If necessary, repeat until IF signature displayed on spectrum analyzer resembles the waveform shown below.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.

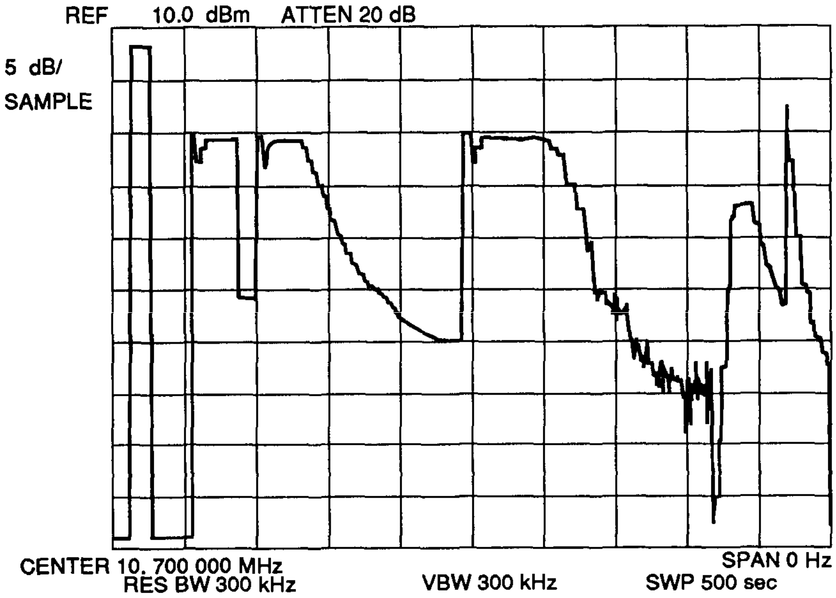
8. Compare IF signature displayed on spectrum analyzer to figure below.



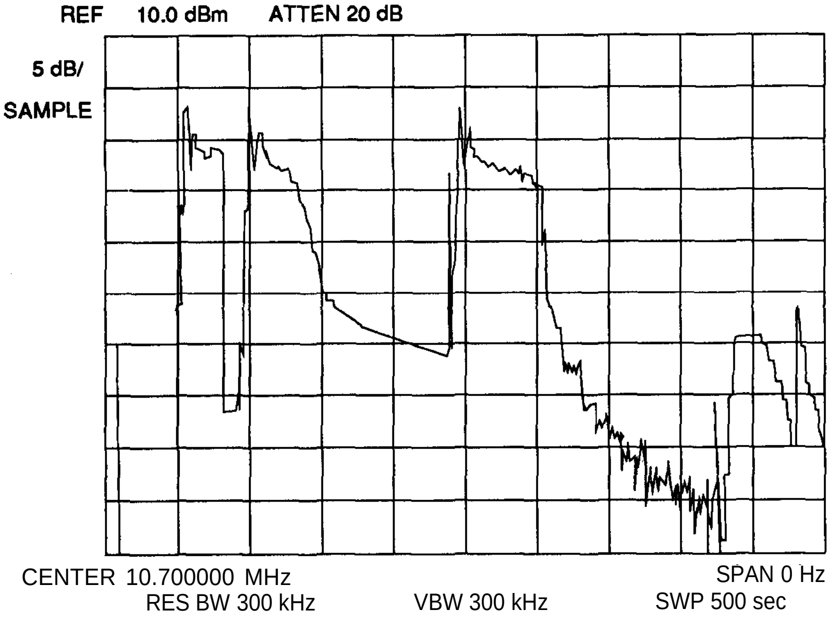
- If they do not closely resemble each other, locate the incorrect area(s) and troubleshoot circuit(s) indicated using fig. FO-19. Replace faulty component.
- If region A is noisy, troubleshoot first LC pole using fig. FO-19, Sheet 2, circuit E. Replace faulty component.
- If region B is flat, troubleshoot third step gain stage, fine attenuator, then fourth LC pole output amplifier using fig. FO-19, Sheets 3 and 4, circuits 1, J, and O. Replace faulty component.
- If region C has no 15 dB step, troubleshoot reference 15-d B attenuator using fig. FO-19, Sheet 2, circuit G. Replace faulty component.
- If region D is flat, troubleshoot second step gain stage using fig. FO-19, Sheet 2, circuit H. Replace faulty component.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.

- If region B amplitude varies more than 12 dB as shown below, troubleshoot third step gain stage using fig. FO-19, Sheet 3, circuit I. Replace faulty component.

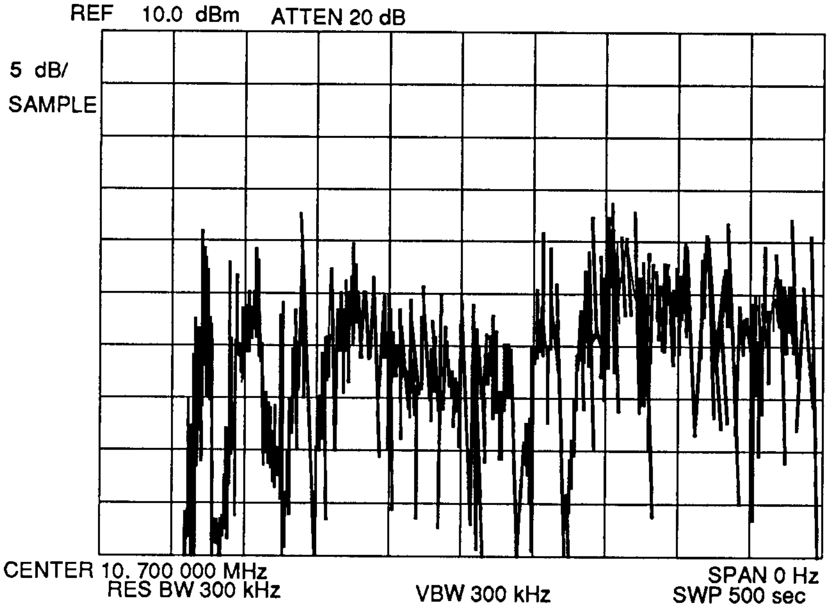


- If region B amplitude is kinked as shown below, troubleshoot fourth LC pole output amplifier using fig. FO-19, Sheet 4, circuit O. Replace faulty component.

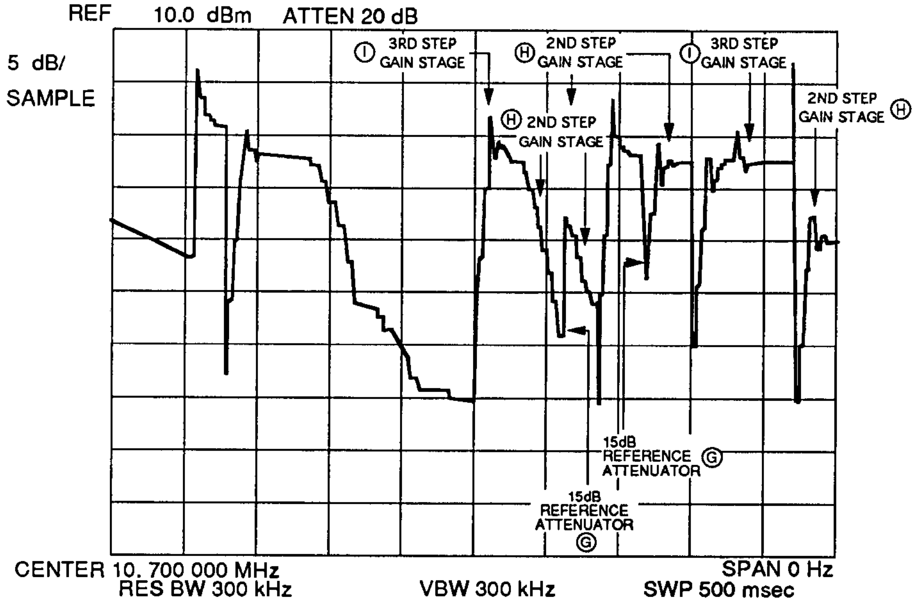


2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.

- If entire signature is noisy as shown below, troubleshoot first step gain stage, or a break in signal path in input switch, first crystal pole, or second crystal pole using fig. FO-19, Sheet 1, circuits B, A, C, or D. Replace faulty component.



- If correct shape but noisy as shown below, troubleshoot second crystal pole output amplifier using fig. FO-19, Sheet 1, circuit D. Replace faulty component.



2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.

9. Set spectrum analyzer (connected to power splitter) controls as follows:

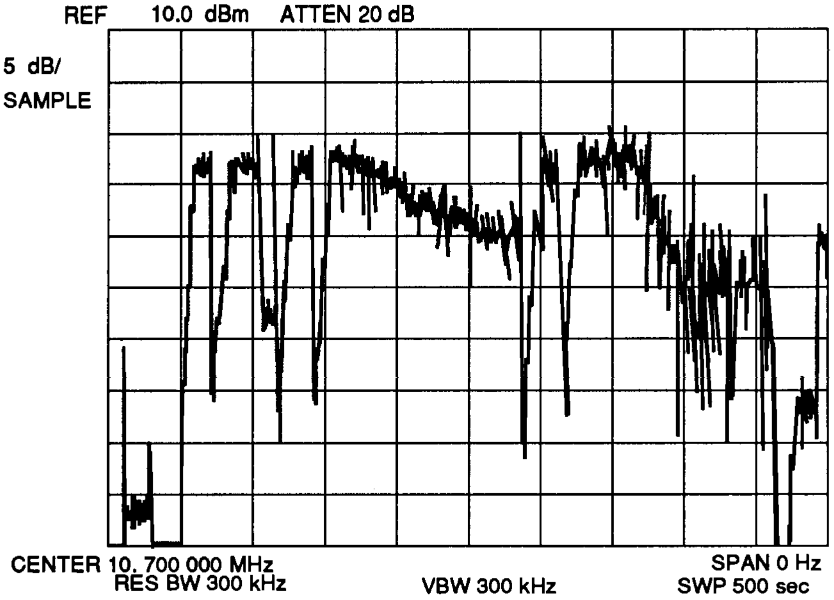
   Sweep Time ....0.5 s

   Video Bandwidth ....300 kHz

   dB/div ....5 dB

10. Press ADJ CURR IF STATE key on AN/USM-489A then quickly press SINGLE on spectrum analyzer (connected to power splitter).

    - If necessary, repeat until IF signature displayed on spectrum analyzer resembles the waveform shown below.



11. Compare IF signature displayed on spectrum analyzer to figure below.

    - If they do not closely resemble each other, locate the incorrect area(s) and troubleshoot circuit(s) indicated using fig, FO-19. Replace faulty component.

12. Set spectrum analyzer (connected to power splitter) controls as follows:

    Sweep Time ....1.4 s

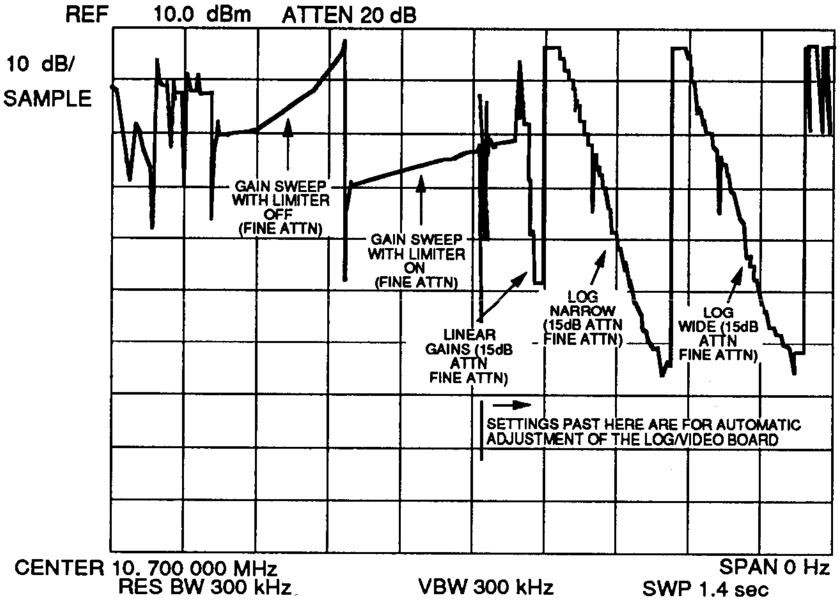
    Video Bandwidth ....300 kHz

    dB/div ....10 dB

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.

13. At the same time, press ADJ CURR IF STATE key on AN/USM-489A and SINGLE on spectrum analyzer (connected to power splitter).

    - If necessary, repeat until IF signature displayed on spectrum analyzer resembles the waveform shown below.



14. Compare IF signature displayed on spectrum analyzer to figure below.

    - If they do not closely resemble each other, locate the incorrect area(s) and troubleshoot circuit(s) indicated using fig. FO-19. Replace faulty component.

15. Set spectrum analyzer (connected to power splitter) controls as follows:

    Sweep Time .... 1.4 s

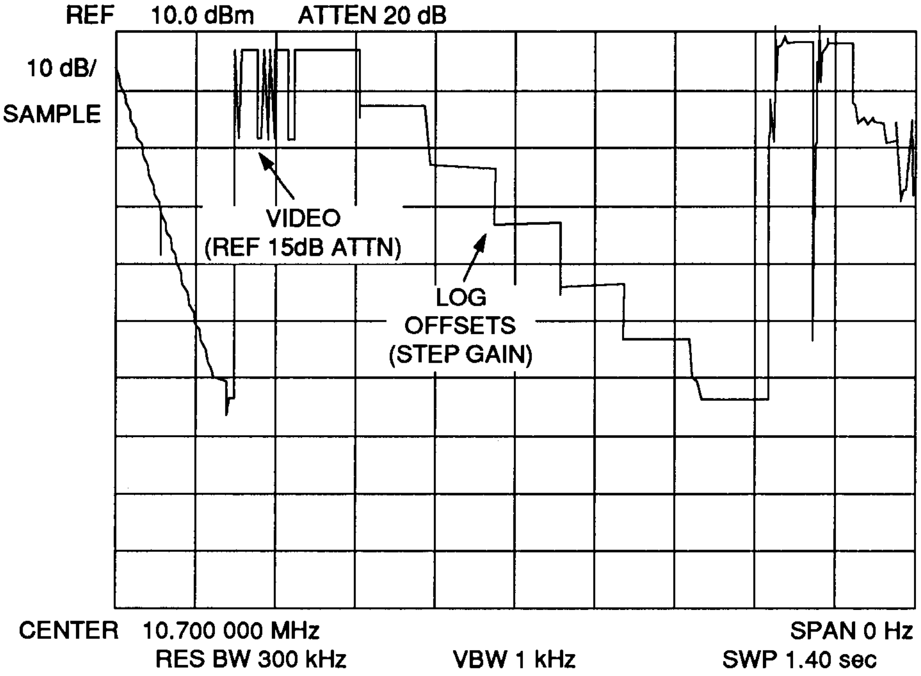
    Video Bandwidth .... 1 kHz

    dB/div .... 10 dB

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.

16. At the same time, press ADJ CURR IF STATE key on AN/USM-489A and SINGLE on spectrum analyzer (connected to power splitter).

    - If necessary, repeat until IF signature displayed on spectrum analyzer resembles the waveform shown below.



17. Compare IF signature displayed on spectrum analyzer to figure below.

    - If they do not closely resemble each other, locate the incorrect area(s) and troubleshoot circuit(s) indicated using fig. FO-19. Replace faulty component.

18. Set spectrum analyzer (connected to power splitter) controls as follows:

    Sweep Time 2.0s

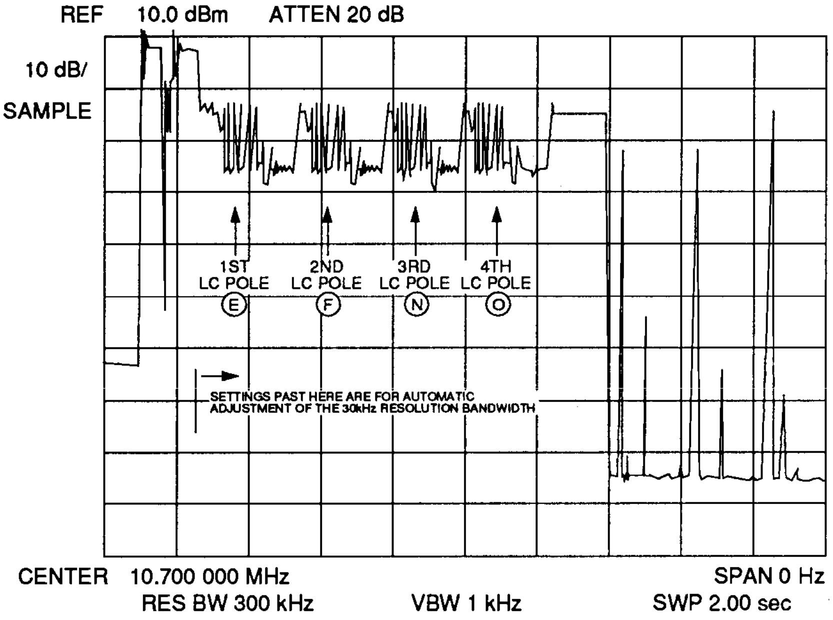
    Video Bandwidth ....1 kHz

    dB/div ....10 dB

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - IF Signature Test - Continued.

19. At the same time. press ADJ CURR IF STATE key on AN/USM-489A and SINGLE on spectrum analyzer (connected to power splitter).

    - If necessary, repeat until IF signature displayed on spectrum analyzer resembles the waveform shown below.



20. Compare IF signature displayed on spectrum analyzer to figure below.

    - If they do not closely resemble each other, locate the incorrect area(s) and troubleshoot circuit(s) indicated using fig. FO-19. Replace faulty component.
    - Troubleshoot remaining problems using fig. FO-19. Replace faulty component.

21. On AN/USM-489A,

    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W27 to A5J5.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3/A4/A5 and cover.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - Resolution Bandwidth Test.

Resolution Bandwidth Test.

DESCRIPTION

This test is used to isolate resolution bandwidth malfunctions in the A5 IF Filter CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-17 as required for component location information.
- See fig. FO-19, Sheets 1-6 as required for schematic diagrams.
- See paragraph 2-44 (as required) for procedure on removing circuit card shields.

1. Troubleshooting resolution bandwidth malfunctions consists of performing up to five individual test procedures.
   - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented.
2. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

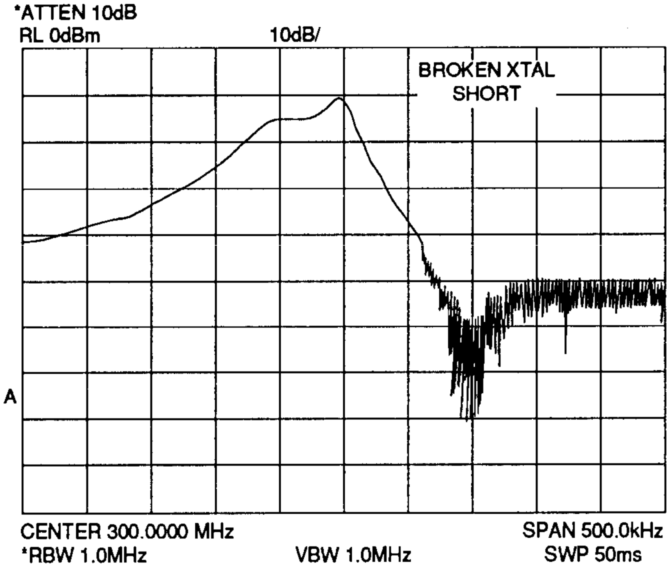
1. MHz Resolution Bandwidth Test

1. On AN/USM-489A,
   - Connect CAL OUTPUT connector to **INPUT 50Ω** connector using BNC cable and adapter supplied.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 500 kHz.
   - Set RES BW 1 MHz.

2-13. IF SECTION TEST – A5 IF FILTER CCA TESTS - Resolution Bandwidth Test - 1 MHz Resolution Bandwidth Test - Continued.

2. Verify trace flatness is within 2.5 dB.

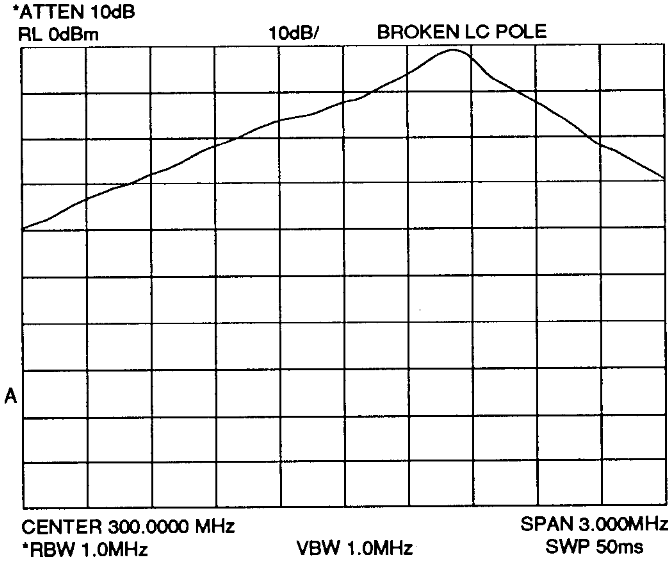
   - If correct, 1 MHz resolution bandwidth is functioning normally.
   - If display is as shown below, suspect one of the crystal pole shorting switches (A5CR200, A5CR207, A5CR500 or A5CR507). Troubleshoot using fig. FO-19, Sheets 1 and 3, circuits C,



   - If incorrect, proceed to step 3.

3. On AN/USM-489A, set SPAN WIDTH to 3 MHz.

   - If display is as shown below, suspect one of the LC pole circuits. Perform IF Signature Test (para 2-13).



2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - Resolution Bandwidth Test - 1 MHz Resolution Bandwidth Test - Continued.

4. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Replace circuit card shields (if removed).
    - Reinstall A2/A3/A4/A5 and cover.

100 kHz Resolution Bandwidth Test

1. On AN/USM-489A,
    - Connect CAL OUTPUT connector to **INPUT 50Ω** connector using BNC cable and adapter supplied.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 500 kHz.
    - Set RES BW 100 kHz.
    - Set LOG dB/div to 1 dB.
    - Set REF LVL to place signal peak on top graticule line.
    - Press PEAK SEARCH button.
    - Press MARKER DELTA key.
    - Use front panel knob to position marker until delta MKR reads -3 dB ±0.1 dB.
    - Press MARKER DELTA key.
    - Use front panel knob to position marker to the other side of signal until delta MKR reads -3 dB +0.1 dB.
2. Verify delta MKR frequency is between 90 kHz and 100 kHz.
    - If correct, 100 kHz RES BW is working properly.
3. Perform CAL Oscillator Test (para 2-13).
    - If test passes, perform IF Signature Test (para 2-13).
4. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.

30 kHz Resolution Bandwith Test

1. On AN/USM-489A,
    - Connect CAL OUTPUT connector to **INPUT 50Ω** connector using BNC cable and adapter supplied.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 1 MHz.
    - Set RES BW 30 kHz.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - Resolution Bandwidth Test - 30 kHz Resolution Bandwidth Test - Continued.

2. Measure 3 dB and 60 dB bandwidth of 300 MHz signal.

3. Calculate shape factor as follows: $\frac{\text{60 dB bandwidth}}{\text{3 dB bandwidth}}$

   - If $\geq$ 15:1, suspect one of the LC pole circuits. Perform IF Signature Test (para 2-13).
   - Troubleshoot remaining problems using fig. FO-19. Replace faulty component.

NOTE

> If one of the LC poles malfunctions, shape factor may be the only indication of failure. Take several signatures to examine LC pole adjustments. If one of four sections of the waveform is consistently longer than all others, the corresponding LC pole is faulty.

4. Troubleshooting hints:

   - If experiencing IF gain compression, suspect A5Q301, A5Q303, A5Q700, and A5Q701. If source on any transistor indicates less than zero volts, replace component.
   - If bandwidth is too wide, check for contamination on printed-circuit board.

5. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.

3 kHz and 10 kHz Resolution Bandwidth Test

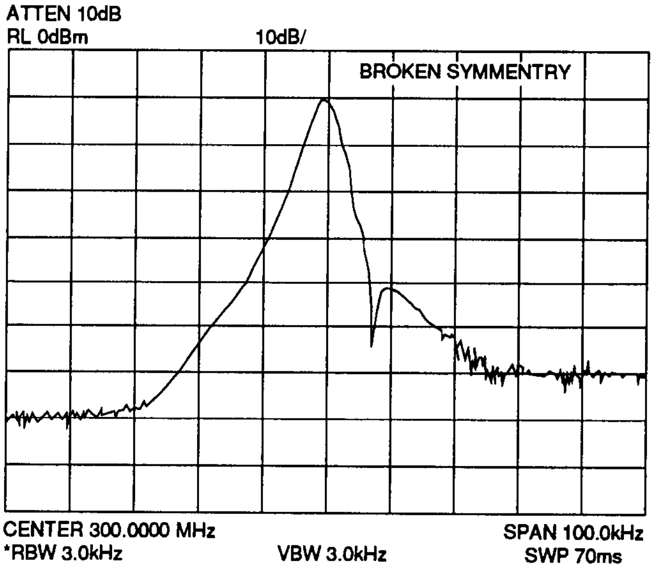
1. On AN/IUSM-489A,

   - Connect CAL OUTPUT connector to **INPUT 50Ω** connector using BNC cable and adapter supplied.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 100 kHz.
   - Set RES BW 3 kHz.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - Resolution Bandwidth Test - 3 kHz and 10 kHz Resolution Bandwidth Test - Continued.

2. If display is as shown below, suspect one of the crystal pole symmetry circuits (A5CR201, A5CR208, A5CR501 or A5CR508). Troubleshoot using fig. FO-19, Sheets 1 and 3, circuits C, D, K, and L. Replace faulty component.

   - If display is not as shown below, perform CAL Oscillator Test (para 2-13).
   - Troubleshoot remaining problems using fig. FO-19. Replace faulty component.



3. Troubleshooting hints:

   - If experiencing IF gain compression, suspect A5Q202, A5Q203, A5Q501, and A5Q503. If source on any transistor indicates less than zero volts, replace component.
   - If bandwidth is too narrow, check for contamination on printed-circuit board.

4. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Replace circuit card shields (if removed),
   - Reinstall A2/A3/A4/A5 and cover.

100 Hz Resolution Bandwidth Test

1. On AN/USM-489A,

   - Verify all A5 shields are installed.
   - Disconnect W29 (VIO) from A5J3.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 10 kHz.
   - Press MARKER ON button.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - Resolution Bandwidth Test - 100 Hz Resolution Bandwidth Test - Continued.

2. If marker amplitude is more positive than –90 dBm, suspect a failure in the LC34_SHORT signal path. Troubleshoot using fig. FO-19, Sheet 4, circuit M. Replace faulty component.

   - If marker amplitude is more negative than -90 dBm, perform CAL Oscillator Test (para 2-13).

3. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Reconnect W29 (VIO) at A5J3.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3/A4/A5 and cover.

Step Gains Test.

DESCRIPTION

This test is used to isolate step gain stage malfunctions in the A5 IF Filter CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-17 as required for component location information.
- See fig. FO-19, Sheets 1-3, circuits B, H, and I as required for schematic diagrams.
- See paragraph 2-44 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,

   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Connect power cable to the rear panel.
   - Disconnect W27 (ORN) from A5J5.
   - Connect spectrum analyzer to A5J3.
   - Disconnect W29 (VIO) from A5J3.
   - Connect signal generator to A5J3.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 1 GHz.
   - Set SPAN WIDTH to 0 Hz.
   - Press MARKER ON button.

2-13. IF SECTION TEST - A5 IF FILTER CCA TESTS - Step Gains Test - Continued.

2. Set signal generator controls as follows:

   Frequency ....2.0 s

   Output Level ....–5 dBm

   Step Size ....10 dB

3. Set spectrum analyzer (connected to A5J3) controls as follows:

   Center Frequency ....10.7 MHz

   Reference Level ....+10 dBm

4. Decrease signal generator output and AN/USM-489 REF LVL by 10 dB.

5. Verify signal displayed on spectrum analyzer (connected to A5J3) is ≈ **+10** dBm.

   - If incorrect, troubleshoot step gain stages using fig. FO-19, Sheets 1-3, circuits B, H, and I. Replace faulty component.

6. Repeat steps 3 and 4 until signal generator output is –55 dBm.

   - If correct, repeat steps 2 through 6 decreasing signal generator output and AN/USM-489REF LVL by 2 dB.

7. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Reconnect W27 (ORN) at A5J5.
   - Reconnect W29 (VIO) at A5J3.
   - Replace circuit card shields (if removed).
   - Reinstall A2/A3/A4/A5 and cover.

2-14. CONTROLLER SECTION TEST

DESCRIPTION

This test is used to isolate malfunctions in the A2 Controller Assembly to the malfunctioning component or assembly. Note that presence of a display (graticule and annotation) verifies that most of A2 Controller Assembly is operating properly.

NOTES

- Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.
- When measuring voltages or waveforms, make ground connections to A2TP3. Metal standoffs are not grounded and should not be used when making measurements.

1. Troubleshooting the Controller Section consists of performing up to eight individual test procedures, some of which contain sub-tests.
   - If the specific test (or subtest) is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph. Table 2-4 contains a complete list of Controller Section Tests/Subtests.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate test in Table 2-4.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order” presented in Table 2-4.

Table 2-4. Controller Section Tests

Test Name	Subtest Name	Page
A2 TAM Tests	A2J11	2-136
	A2J202	2-137
	A2J201	2-137
Digital Signature Analysis (DSA) Test	None	2-138
Display Tests	Line Generators Test	2-140
	Blanking Test	2-142
	Display Jumbled or Trace Off Screen Test	2-144
	Brightness Test	2-147
	Bad Characters or Graticule Test	2-148
	Long Lines Dimmer Than Short Lines Test	2-149
Analog Zero-Span Test	None	2-152
Frequency-Count Marker Test		2-154
	Frequency Counter Test	2-155
State and Trace Storage Test	None	2-156
Keyboard Test	None	2-157

2-14. CONTROLLER SECTION TEST - A2 TAM TESTS.

A2 TAM TESTS.

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A2 Controller CCA using the TAM.

---

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.

A2J11 Test.

2. On AN/USM-489A,
   - Connect TAM probe cable to A2J11 (fig. FO-7).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “2) Manual Probe Troubleshooting”.
   - Press EXECUTE key.
3. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-9/10).

- If all tests return OK, proceed to step 4.

Failed Test	FO-9/10 Circuit(s)	FO-9/10 Signal(s)	Test/Subtest to Perform	Page
ADC/MUX Test	P	MS1, MS3-MS6 MS8	Replace TAM and repeat test. If it fails again perform Digital Signature Analysis (DSA) Test.	2-138
DAC Test	P	MS2, MS7 OS1	Replace TAM and repeat test. If it fails again perform Digital Signature Analysis (DSA) Test.	2-138

2-14. CONTROLLER SECTION TEST - A2 TAM TESTS - A2J202 Test.

A2J202 Test.

4. On AN/USM-489A,
   - Connect TAM probe cable to A2J202.
   - Press the TEST key.
5. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-9/10).

- If all tests return OK, proceed to step 6.

Failed Test	FO-9/10 Circuit(s)	FO-9/10 Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS1	N/A	N/A
X, Y, & Z Output Offset	G,H,M	MS3, MS4	Long Lines Dimmer Than Short Lines Test	2-149
		MS7	Line Generators Test	2-140
X Output Amplifier	H	MS7	Analog Zero-Span Test	2-152
Y Output Amplifier	G	MS3	Analog Zero-Span Test	2-152
Blanking Test	J	MS8	Blanking Test	2-142
Focus DAC Test	N	MS2	Troubleshoot using fig. FO-9/10 Sheet 3 circuit N.	N/A

A2J201 Test.

6. On AN/USM-489A,
   - Connect TAM probe cable to A2J201.
   - Press the TEST key.
7. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-9/10).

- If all tests return OK, proceed to step 8.

2-14. CONTROLLER SECTION TEST - A2 TAM TESTS - A2J201 Test - Continued.

Failed Test	FO-9/10 Circuit(s)	FO-9/10 Signal(s)	Test/Subtest to Perform	Page
10 Volt Reference Test	A	MS4	Troubleshoot using fig. FO-9/10 Sheet 3 circuit A.	N/A
Switch Drive Test		MS3	Display Jumbled or Trace Off Screen Test	2-144
Buffered X & Y DAC Outputs	D, I	MS2, MS7	Line Generators Test Display Jumbled or Trace Off Screen Test	2-140 2-144
X Line Gen Test	D	MS6	Line Generators Test	2-140
Y Line Gen Test	I	MS1	Line Generators Test	2-140
Intensity Offset Output	M	MS8	Brightness Test	2-147

8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

DIGITAL SIGNATURE ANALYSIS (DSA) TEST.

DESCRIPTION

This test is used to isolate digital malfunctions in A2 Controller CCA to the malfunctioning component or assembly. Microprocessor (A2U1) is placed in a simplified known state (places a one-word instruction, MOVE QUICK, (0111 XX10 XXXX XXX0) on the data bus) then cycles through its address range continually reading the instruction.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheets 4-8, circuits P - V as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheets 4-7, circuits P - V as required for schematic diagram (serial prefix 3115A to 3306A).

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Move A2J13 (DSA) jumper to E5/E6 position.
   - Remove A2U300 16 pin jumper.
   - Set LINE to ON (ignore speaker).

2-14. CONTROLLER SECTION TEST - DIGITAL SIGNATURE ANALYSIS (DSA) - Continued.

2. Using an oscilloscope, verify A2U1 pins 6-8, 29-48, 50-52 are toggling at TTL levels.
3. Using an oscilloscope, measure and record frequency of address line A1 (A2U1 pin 29).
4. Measure and record frequency of address line A2 (A2U1 pin 30).
5. Verify frequency at A2 is one-half that of Al.
6. Repeat steps 2 through 5 checking all 23 address lines. At each line, verify frequency is one-half frequency of previous line.

Address Line	A2U1 pin	Address Line	A2U1 pin	Address Line	A2U1 pin
A1	29	A2	30	A3	31
A4	32	A5	33	A6	34
A7	35	A8	36	A9	37
A10	38	A11	39	A12	40
A13	41	A14	42	A15	43
A16	44	A17	45	A18	46
A19	47	A20	48	A21	50
A22	51	A23	52		

- If results of steps 2 and 5 are correct, troubleshoot non-microprocessor malfunctions using fig. FO-9/10, circuits P - V.
- If results of steps 2 and 5 are incorrect, replace A2U1 (fig. FO-7).

7. On AN/USM-489A,
   - Set LINE to OFF.
   - Move A2J13 (DSA) jumper to E6/E7 position.
   - Replace A2U300 16 pin jumper.
   - Reinstall A2/A3 and cover.

2-14. CONTROLLER SECTION TEST- DISPLAY TESTS.

DISPLAY TESTS.

DESCRIPTION

This test is used to isolate display malfunctions in A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheets 2 and 3, circuits D, I, J, and M as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheets 2 and 3, circuits D, I, J, and M as required for schematic diagram (serial prefix 31 15A to 3306A).

1. Troubleshooting display malfunctions consists of performing up to six individual test procedures.
   - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented.

Line Generators Test.

DESCRIPTION

This test is used to isolate line generator circuit malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 2, circuits D and I as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig, FO-10, Sheet 2, circuits D and I as required for schematic diagram (serial prefix 3115A to 3306A).

2-14. CONTROLLER SECTION TEST - DISPLAY TESTS - Line Generators Test - Continued.

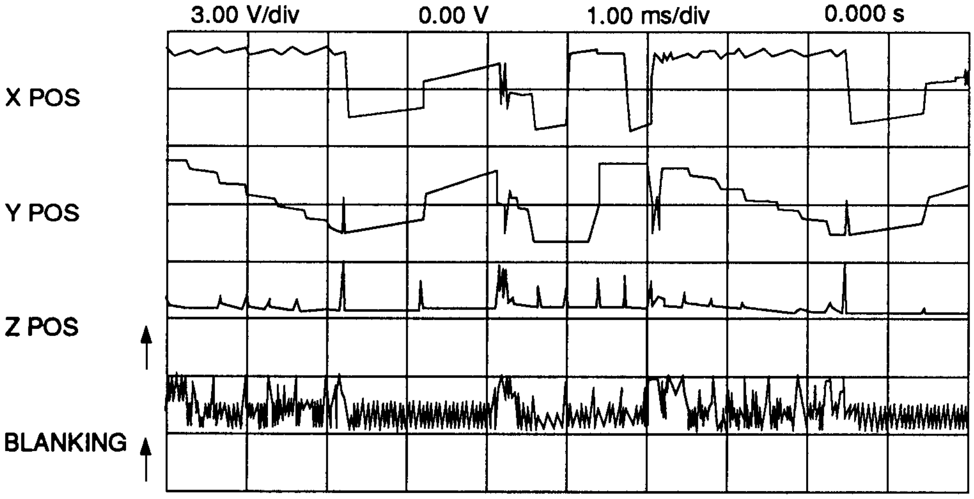
1. On AN/USM-489A,
    - Place A2/A3 in service position (para 2-40).
    - Connect power cable to the rear panel.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
    - Press RECALL button.
    - Press MORE key (bottom soft key if display blank).
    - Press CRT ADJ PATTERN key (third soft key from top if display blank).
2. Connect oscilloscope external trigger to A2U207 pin 8.
3. Set oscilloscope controls as follows:

Amplitude scale	3 V/div
Sweep time	1 ms/div
Triggering	External

4. Verify signals at following test points are as shown below:
    - X POS (circuit G) at A2J202 pin 14.
    - Y POS (circuit H) at A2J202 pin 3.
    - Z OUT (circuit M) at A2J201 pin 3.
    - BLANKING (circuit J) at A2J202 pin 15.

NOTE

It is normal for waveforms displayed on an analog scope to show considerably more spikes due to wider displayed bandwidth.



2-14. CONTROLLER SECTION TEST - DISPLAY TESTS - Line Generators Test - Continued.

5. If any waveform is incorrect, troubleshoot circuit indicated using fig. FO-9/10 sheets 2 and 3. Replace faulty component.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

Blanking Test.

DESCRIPTION

This test is used to isolate blanking circuit malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 2, circuit J as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 2, circuit J as required for schematic diagram (serial prefix 3115A to 3306A).

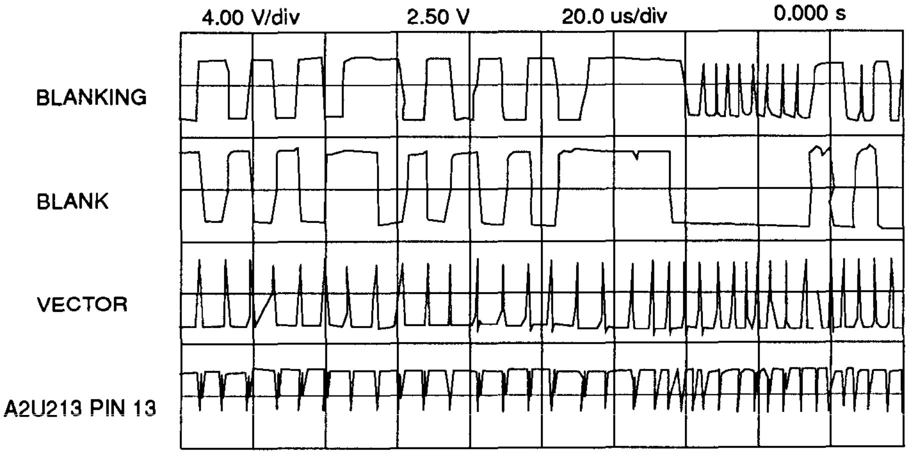
1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Using a logic probe, verify A2U206 pin 6 is TTL high.
3. Connect oscilloscope external trigger to A2U207 pin 8.
4. Set oscilloscope controls as follows:

Amplitude Scale	4 V/div
Amplitude Offset	+2.5V
Sweep Time	20 µs/div
Triggering	External

2-14. CONTROLLER SECTION TEST- DISPLAY TESTS - Blanking Test - Continued.

5. Verify signals at following test points are as shown below:

   - BLANKING at A2J202 pin 15.
   - BLANK at A2U214 pin 12.
   - VECTOR at A2U214 pin 11.
   - A2U213 pin 13.



6. If any waveform is incorrect, troubleshoot using fig. FO-9/10 sheet 2 circuit J. Replace faulty component. When troubleshooting:

   - Waveforms shown above must match timing of vectors being drawn. A2U215B is used to adjust leading edge and A2U215A is used to adjust trailing edge.
   - The first six horizontal divisions show line drawing mode where VECTOR pulses are 6 µs apart. Remaining divisions shows character mode (VECTOR pulses 3 us apart).
   - BLANK pulses are synchronized to VECTOR pulses by A2U214B.
   - A2U213 shows the double pulses which delay the leading and trailing edges of the blanking pulses.
   - To expand BLANKING and A2U213 pin 13 waveforms to display how rising edges of A2U213 pin 13 determine transitions of BLANKING pulses, set oscilloscope Sweep Time to 2 µs/div and Delay from Trigger to 96 us.

7. If all steps are correct and problem remains, replace A17 CRT Driver CCA (para 2-65).
8. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

2-14. *CONTROLLER SECTION TEST - DISPLAY TESTS - Display Jumbled or Trace Off Screen Test.*

Display Jumbled or Trace Off Screen Test.

DESCRIPTION

This test is used to isolate line generator display malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

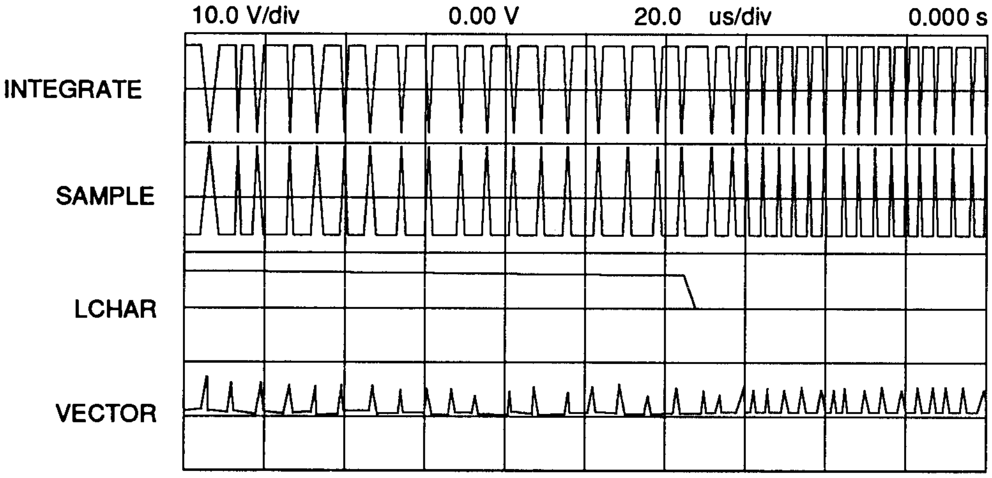
- Procedure is used to test either X or Y line generator circuits. References in parentheses are Y line generator.
- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 2, circuits D and I as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 2, circuits D and I as required for schematic diagram (serial prefix 3115A to 3306A).

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Verify voltage at A2U202B pin 7 is +10.0 Vdc.
   - If incorrect, troubleshoot using fig. FO-9/10, Sheet 1, circuit A. Replace faulty component.
3. Perform Line Generators Test (para 2-14).
   - If X POS and/or Y POS waveforms look different from those shown, proceed to step 4.
   - If X POS and/or Y POS waveforms are correct, proceed to step 9.
4. Using an oscilloscope, verify waveform at A2R208 (A2R217) looks like X POS (Y POS) with amplitude from 0 V to +5 V.
   - If incorrect, proceed to step 5.
   - If correct, proceed to step 9.
5. Connect oscilloscope external trigger to A2U207 pin 8.
6. Set oscilloscope controls as follows:

Amplitude Scale	10 V/div
Sweep Time	20 µs/div
Triggering	External

2-14. CONTROLLER SECTION TEST - DISPLAY TESTS - Display Jumbled or Trace Off Screen Test - Continued.

7. Verify signals at following test points are as shown below:
   - INTEGRATE at A2Q202 collector.
   - SAMPLE at A2Q201 collector.
   - LCHAR at A2U207 pin 9.
   - VECTOR at A2U213 pin 9.

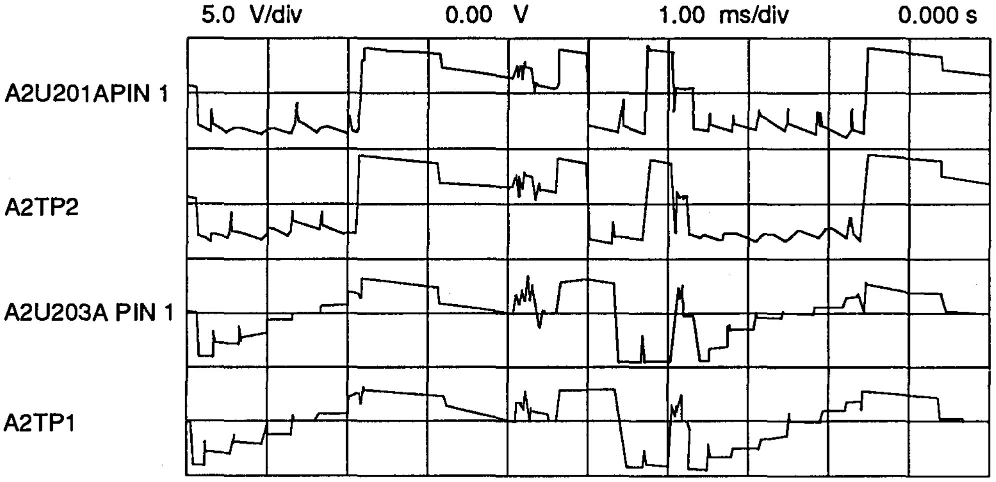


8. If any waveform is incorrect, troubleshoot using fig. FO-9/10 sheet 2 circuit L. Replace faulty component. When troubleshooting:
   - INTEGRATE and SAMPLE waveforms are replicas of VECTOR except for polarity and amplitude.
   - LCHAR is low when characters are drawn.
9. Jumper A2J201 pin 13 to A2TP3.
10. Connect oscilloscope external trigger to A2U207 pin 8.
11. Set oscilloscope controls as follows:

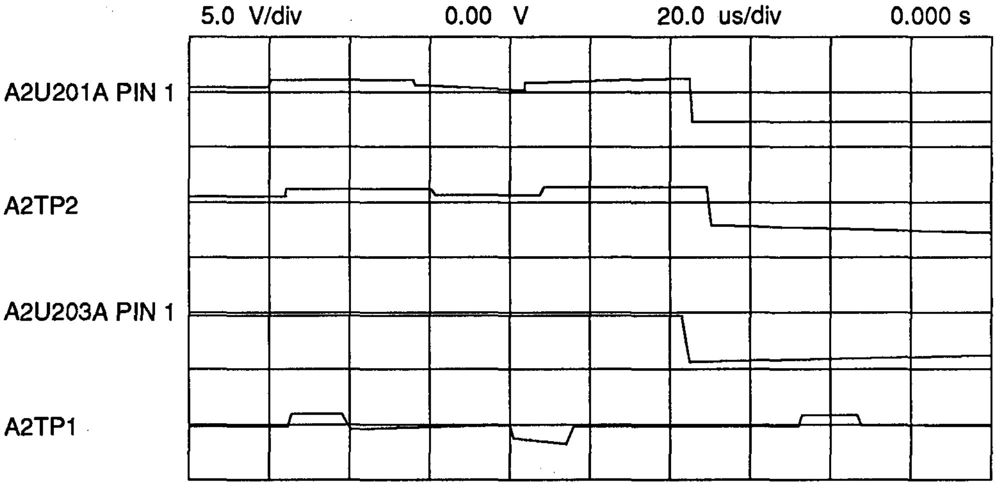
Amplitude Scale	5 V/div
Sweep Time	1 ms/div
Coupling	AC
Triggering	External

2-14. CONTROLLER SECTION TEST - DISPLAY TESTS - Display Jumbled or Trace Off Screen Test - Continued.

12. Verify signals at following test points are as shown below:
    - A2U201 pin 1 (X Line Generator).
    - A2TP2 (X Line Generator).
    - A2U203 pin 1 (Y Line Generator).
    - A2TP1 (Y Line Generator).



13. If any waveform is incorrect, troubleshoot using fig. FO-9/10, sheet 2, circuit D or I. Replace faulty component. When troubleshooting:
    - To expand waveforms to display relative timing, set oscilloscope Sweep Time to 20 μs/div. Traces at A2TP2 and A2TP1 should be delayed 5 ms from A2U201 and A2U203 as shown.



2-14. CONTROLLER SECTION TEST - DISPLAY TESTS - Display Jumbled or Trace Off Screen Test - Continued.

- Whenever there is a pulse on A2TP1 or A2TP2, the appropriate integrator (A2U201B or A2U203B) generates a ramp (output vector) which feeds back to A2U201A (A2U203A) and shows on its output.
- Troubleshoot remaining problems using fig. FO-9/10. Replace faulty component.

14. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Remove jumper.
    - Disconnect test cables and equipment.
    - Reinstall A2/A3 and cover.

Brightness Test.

DESCRIPTION

This test is used to isolate display intensity malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 3, circuit M as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 3, circuit M as required for schematic diagram (serial prefix 3115A to 3306A).

1. On AN/USM-489A,
    - Place A2/A3 in service position (para 2-40).
    - Connect power cable to the rear panel.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
2. Perform Long Lines Dimmer Than Short Lines Test (para 2-14).
    - If test passes, proceed to step 3.
3. Temporarily short A2U207 pin 2 to pin 7 and verify display brightens.
    - If incorrect, troubleshoot A2U207B using fig. FO-9/10, sheet 3, circuit M. Replace faulty component.

2-14. *CONTROLLER SECTION TEST - DISPLAY TESTS - Brightness Test - Continued.*

4. Temporarily short A2U207 pin 2 to pin 3 and verify display brightens.
   - If incorrect, troubleshoot A2U207A using fig. FO-9/10, sheet 3, circuit M. Replace faulty component.
5. On AN/USM-489A,
   - Press DISPLAY button.
   - Press MORE key.
   - Press INTEN key.
6. Verify intensity changes using the front panel knob.
   - If incorrect, troubleshoot A2U212A using fig. FO-9/10, sheet 3, circuit M. Replace faulty component, Note amplitude of waveform at A2U211A pin 1 should increase or decrease with intensity changes.
7. On AN/USM-469A, set INTEN to 90.
8. Temporarily short A2J201 pin 1 to A2TP3 and verify A2U211 pin 7 is 4.2 Vdc.
   - If incorrect, troubleshoot A2U211C using fig. FO-9/10, sheet 3, circuit M. Replace faulty component.
   - If correct, perform Intensity Test (para 2-17).
9. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

Bad Characters or Graticule Test.

DESCRIPTION

This test is used to isolate character/graticule display malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 2, circuits D and I as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 2, circuits D and I as required for schematic diagram (serial prefix 3115A to 3306A).

2-14. CONTROLLER SECTION TEST - DISPLAY TESTS - Bad Characters or Graticule Test - Continued.

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Perform steps 1 through 10 in Display Jumbled or Trace Off Screen Test (para 2-14). In step 7, verify LCAR signal is as shown.
   - If incorrect, perform as instructed.
   - If correct, proceed to step 3.
3. If displayed characters are incorrect but graticule is correct, or if characters are correct but graticule is incorrect, troubleshoot A2U207D and A2U207C using fig. FO-9/10, sheet 2, circuits D and 1. Replace faulty component.
4. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

Long Lines Dimmer Than Short Lines Test.

DESCRIPTION

This test is used to isolate display graticule intensity malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig, FO-9, Sheet 3, circuit M as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 3, circuit M as required for schematic diagram (serial prefix 3115A to 3306A).

2-14. *CONTROLLER SECTION TEST - DISPLAY TESTS - Long Lines Dimmer Than Short Lines Test - Continued.*

1. *On AN/USM-489A,*
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Jumper A2J201 pin 13 to A2TP3.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
2. Connect oscilloscope channel A to A2J201 pin 2, channel B to A2U210 pin 14, and external trigger to A2U207 pin 8.
3. Set oscilloscope controls as follows:

   Amplitude scale ....10 V/div

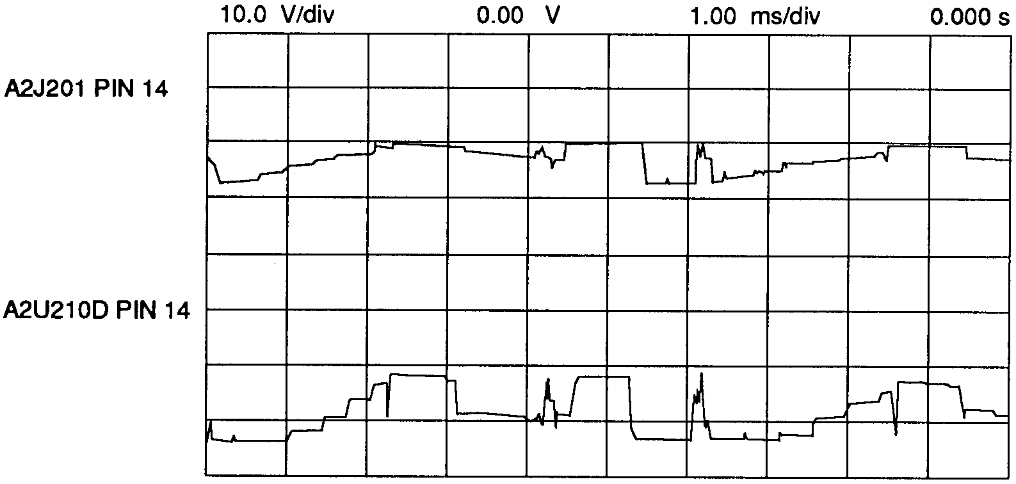
   Sweep time ....1 ms/div

   Triggering ....External
4. Verify signals are as shown below:

   - If waveform at A2J201 pin 2 is incorrect, troubleshoot using fig. FO-9/10, sheet 2, circuit D. Replace faulty component.
   - If waveform at A2U210D pin 14 is incorrect, troubleshoot using fig. FO-9/10, sheet 3, circuit M. Replace faulty component.
5. On AN/USM-469A,
   - Remove jumper from A2J201 pin 13 to A2TP3.
   - Jumper from A2J201 pin 1 to A2TP3.
6. Connect oscilloscope channel A to A2J201 pin 14.

2-14. CONTROLLER SECTION TEST- DISPLAY TESTS - Long Lines Dimmer Than Short Lines Test - Continued.

7. Verify signals are as shown below:



- If waveform at A2J201 pin 14 is incorrect, troubleshoot using fig. FO-9/10, sheet 2, circuit 1. Replace faulty component.
- If waveform at A2U210D pin 14 is incorrect, troubleshoot using fig. FO-9/10, sheet 3, circuit M. Replace faulty component.
- Troubleshoot remaining problems using fig. FO-9/10. Replace faulty component.

8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Remove jumper.
   - Disconnect test cables and equipment.
   - Reinstall A21A3 and cover.

2-14. CONTROLLER SECTION TEST- ANALOG ZERO-SPAN TEST.

ANALOG ZERO-SPAN TEST.

DESCRIPTION

This test is used to isolate zero-span malfunctions in A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheets 2 and 3, circuits F and M as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheets 2 and 3, circuits F and M as required for schematic diagram (serial prefix 3115A to 3306A).

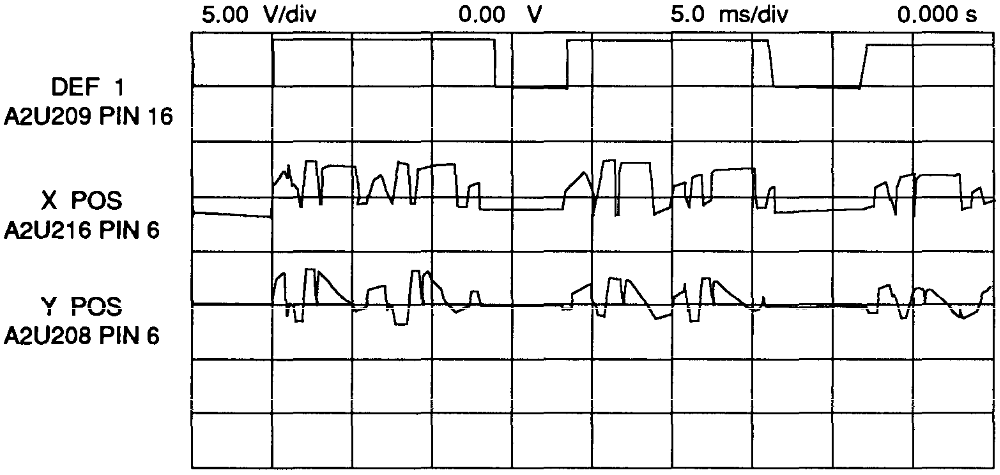
1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear pane
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 1 ms.
   - Press RECALL button.
   - Press MORE key.
   - Press CRT ADJ PATTERN key.
2. Connect oscilloscope channel A to A2J201 pin 14, channel B to A2U210 pin 14, and external trigger to A2U207 pin 8.
3. Set oscilloscope controls as follows:

   Amplitude scale ....10 V/div
   Sweep time ....1 ms/div
   Triggering ....External

4. Verify waveforms are as shown in step 7 of Long Lines Dimmer Than Short Lines Test (para 2-14), except that untriggered trace should show at left edge of the screen.
   - If incorrect, troubleshoot using fig. FO-9/10, sheet 3, circuit M. Replace faulty component.

2-14. CONTROLLER SECTION TEST- ANALOG ZERO-SPAN TEST– Continued.

5. Troubleshoot other malfunctions using fig. FO-9/10, sheet 2, circuit F. Replace faulty component. Troubleshooting hints:
   - In these settings, Line DEF1 (A2U209 pin 16) causes switching between line generators and analog inputs (sweep and video).
   - Sweep input from A2J1 pin 41 is from 0 V to +10 V.
   - Video In goes from about 0 V to 1 V for bottom to top screen.
   - Apply a dc voltage (0 to 1 V) to A2J4 (Video In) to test circuit.
   - There is no synchronization between DEF1 (A2U209 pin 16) and the video patterns X POS (A2U216 pin 6) and Y POS (A2U208 pin 6) when DEF1 is TTL high as shown below. Y POS level is Video In level when DEF1 is low.



6. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

2-14. CONTROLLER SECTION TEST - FREQUENCY COUNT MARKER TEST.

FREQUENCY COUNT MARKER TEST.

DESCRIPTION

This test is used to isolate weather frequency count marker malfunctions are on the problem is on A4 Log Amplifier CCA or A2 Controller CCA.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig, FO-2 as required for cable location information.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 9, circuit Y as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 8, circuit Z as required for schematic diagram (serial prefix 3115A to 3306A).
- See paragraph 2-43 (as required) for procedure on removing circuit card shields.

1. On AM/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Disconnect W21 (BRN) from A2J7.
   - Connect signal generator to A2J7.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 1 MHz.
2. Set signal generator controls as follows:

   Amplitude ....+10 dBm
   Frequency ....5.35 MHz
3. On AN/USM-489A, press FREQ COUNT button and verify CNT value displayed is ≈ 300 MHz.
   - If CNT reads all asterisks, perform Frequency Counter Test below.
   - If correct, perform all A4 TAM Tests (para 2-13).
4. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W21 to A2J7.
   - Reinstall A2/A3 and cover.

2-14. CONTROLLER SECTION TEST - FREQUENCY COUNT MARKER TEST- Frequency Counter Test.

Frequency Counter Test.

DESCRIPTION

This test is used to isolate frequency counter malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- .See fig. FO-2 as required for cable location information.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 9, circuit Y as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 8, circuit Z as required for schematic diagram (serial prefix 3115A to 3306A).

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Disconnect W22 (BLK) from A2J8.
   - Connect W22 to oscilloscope.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
2. Verify oscilloscope displays a 10 MHz, TTL-level signal.
   - If correct, proceed to step 3.
   - If incorrect, proceed to step 5.
3. On AN/USM-489A,
   - Reconnect W22 to A2J8.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 20 ms.

2-14. CONTROLLER SECTION TEST- FREQUENCY COUNT MARKER TEST- Frequency Counter Test - Continued.

4. Verify signal at A2J2 pin 21 is toggling.

   - If incorrect, troubleshoot using fig. FO-9, Sheet 9, circuit Y or fig. FO-10, Sheet 8, circuit Z and following table. Replace faulty component.

COUNTER RES (FREQ COUNT)	Gate Time* (A2U511 pin 3 high state)	A2TP16	A2TP15*
10Hz	200 ms	2 MHz	4.18 kHz
100 Hz	20 ms	2 MHz	418 Hz
1 kHz	2 ms	2 MHz	41.8 Hz
10 kHz	2 ms	2 MHz	41.8Hz
100 kHz	2 ms	2 MHz	41.8Hz
1 MHz	2 ms	2 MHz	41.8Hz

* A2TP15 = (FREQ COUNT input x Gate Time)/256

5. Verify A15J302 (fig. FO-28) is a 10 MHz signal.

   - If incorrect, perform 10 MHz Reference Test (para 2-16).
   - If correct, troubleshoot using fig. FO-9, Sheet 9, circuit Y or fig. FO-10, Sheet 8, circuit Z and above table. Replace faulty component.

6. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W22 to A2J8.
   - Reinstall A2/A3 and cover.

STATE AND TRACE STORAGE TEST.

DESCRIPTION

This test is used to isolate storage (instrument state or trace) malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheet 8, circuit V as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheet 8, circuit W as required for schematic diagram (serial prefix 3115A to 3306A).

2-14. CONTROLLER SECTION TEST - STATE AND TRACE STORAGE TEST - Continued.

1. On AN/USM-489A,
   - Set LINE to OFF.
   - Place A2/A3 in service position (para 2-40).
   - Disconnect W6 from A2J10.
2. Verify voltage at W6 is ≥ 3.5 Vdc.
   - If incorrect, replace BT1 Battery (para 2-70).
3. On AN/USM-489A, reconnect W6 at A2J10 and wait 5 minutes.
4. Verify voltage at A2U101 pin 28 and A2U102 pin 28 is ≥ 2.0 Vdc.
   - If incorrect, troubleshoot using fig. FO-9, Sheet 8, circuit V or fig. FO-10, Sheet 8, circuit W. Replace faulty component.
   - If correct, suspect troubleshoot using fig. FO-9/10, Sheet 7, circuit S. Replace faulty component.
5. On AN/USM-489A,
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

KEYBOARD TEST.

DESCRIPTION

This test is used to isolate front panel interface malfunctions in the A2 Controller CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 as required for component location information.
- See fig. FO-9, Sheets 4 and 5, circuits P and Q as required for schematic diagram (serial prefix 2929A to 3051A).
- See fig. FO-10, Sheets 4 and 5, circuits P and Q as required for schematic diagram (serial prefix 3115A to 3306A).

1. On AN/USM-489A,
   - Place A2/A3 in service position (para 2-40).
   - Connect power cable to the rear panel.
   - Connect rear panel J3 (HP-IB) to a controller.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.

   Press PRESET button.

2-14. CONTROLLER SECTION TEST - KEYBOARD TEST - Continued.

2. Enter and execute the following BASIC program.

```
10 OUTPUT 718; “IP; SP 1 MHz;“
20 WAIT 2 ! Wait 2 seconds
30 OUTPUT 718; “AT 70 DB;“
40 WAIT 2 ! Wait 2 seconds
50 OUTPUT 718; “AT 30 DB; “
60 WAIT 2 ! Wait 2 seconds
70 0UTPUT 718; ”AT 10 DB;”
80 END
```

3. Verify when program executes, three or four clicks are heard, display shows in RMT mode, and ATTEN cycles to 70 dB, 30 dB, and 10 dB.
   - If any response, perform Keyboard/RPG Test (para 2-12).
   - If no response over HP-IB, troubleshoot using fig. FO-9, Sheet 11, circuit AA or fig. FO-10, Sheet 9, circuit AB. If correct, troubleshoot A19 HP-IB CCA using fig. FO-35.
4. Using a logic probe, verify A2U2 pin 2 has pulses while pressing a key and rotating front panel knob.
   - If always low, troubleshoot using fig. FO-9/10, Sheets 4 and 5, circuits P and Q. Replace faulty component.
   - If always high, perform Keyboard/RPG Test (para 2-12).
   - Troubleshoot remaining problems using fig. FO-9/10. Replace faulty component.
5. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A2/A3 and cover.

2-15. SYNTHESIZER SECTION TEST

DESCRIPTION

This test is used to isolate malfunctions in the A7 LO Distribution Amplifier, All YIG-Tuned Oscillator (YTO), and portions of A14 Frequency Control CCA and A15 RF CCA to the malfunctioning component or assembly.

CAUTION

Use an active probe and another spectrum analyzer when troubleshooting the Synthesizer Section. If the spectrum analyzer has a dc coupled input, set the active probe for an ac coupled output or use a dc blocking capacitor between active probe and spectrum analyzer input.

CAUTION

Many Synthesizer Section components are extremely sensitive to Electrostatic Discharge (ESD). Refer to page C for more information.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

1. Troubleshooting the Synthesizer Section consists of performing up to ten individual test procedures, some of which contain sub-tests.

   - If the specific test (or subtest) is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph. Table 2-5 contains a complete list of Synthesizer Section Tests/Subtests.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate test in Table 2-5.
   - If a specific test was not provided and the symptoms are not obvious, perform Confirming Faulty Synthesizer Section Test.

Table 2-5. Synthesizer Section Tests

Test Name	Subtest Name	Page
A14 TAM Tests	A14J302	2-160
	A14J15	2-161
	A14J16	2-162
	A14J17	2-162
	A14J18	2-163
	A14J19	2-163
	A14J303	2-164
A15 TAM Tests	A15J901	2-165
	A15J200	2-166
	A15J400	2-167
	A15J502	2-167
	A15J602	2-168

2-15. SYNTHESIZER SECTION TEST- Continued.

Table 2-5. Synthesizer Section Tests - Continued

Test Name	Subtest Name	Page
Confirming Faulty Synthesizer Section Test	None	2-169
Frequency Span Accuracy Test		2-174
	YTO Main Coil Span Test (LO Spans >20MHz)	2-175
	YTO FM Coil Span Test (LO Spans 1.01 MHz to 20 MHz) Test	2-176
	Roller Oscillator Span Test (LO Spans $\leq$ 1 MHz)	2-178
First LO Span Test (All Spans)	None	2-182
Unlocked YTO PLL Test	None	2-185
Unlocked Roller Oscillator PLL Test		2-190
	Offset Oscillator PLL Test	2-191
	Transfer Oscillator PLL Test	2-194
	Main Oscillator PLL Test	2-196
Unlocked Offset PLL Test	None	2-199
Unlocked Reference PLL Test		2-202
	Third LO Driver Amplifier Test	2-204
Sampler and Sampler IF Test	None	2-205

A14 TAM TESTS.

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A14 Frequency Control CCA using the TAM.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.

A14J302 Test.

2. On AN/USM-489A,
   - Connect TAM probe cable to A14J302 (fig. FO-25).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “2) Manual Probe Troubleshooting”.
   - Press EXECUTE key.

2-15. SYNTHESIZER SECTION TEST - A14 TAM TESTS - A14J302 Test - Continued.

3. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-27).

- If all tests return OK, proceed to step 4.

Failed Test	Circuit(s)	Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS7	N/A	N/A
XFER Osc Bias	AI	MS1	Transfer Oscillator PLL Test	2-194
XFER Pretune DAC	AK	MS6	Transfer Oscillator PLL Test	2-194
Offset Osc Bias	AE	MS2	Offset Oscillator PLL Test	2-191
Offset Pretune DAC	AF	MS8	Offset Oscillator PLL Test	2-191
Offset Amp Bias	AE	MS5	Offset Oscillator PLL Test	2-191

A14J15 Test.

4. On AN/USM-489A,
   - Connect TAM probe cable to A14J15 (fig. FO-25).
   - Press the TEST key.
5. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-27).

- If all tests return OK, proceed to step 6.

Failed Test	FO-27 Circuit (s)	FO-27 Signal(s)	Test/Subtest to Perform	Page
Sweep Generator	K	MS8	First LO Span Test (All Spans) Troubleshoot using fig. FO-27, Sheet 4	2-182 N/A
Span Attenuator DAC	M	MS7	First LO Span Test (All Spans)	2-182
Span Attenuator Switches	M	MS7	First LO Span Test (All Spans)	2-182
Sweep + Tune Mult Input Amp	Q	MS1, OS1	YTF Driver Circuit Test	2-229
Sweep + Tune Mult Input Switches	Q	MS1 , MS3	YTF Driver Circuit Test	2-229
VCO Sweep Driver	H	MS6,0S1	Roller Oscillator Span Test (LO Spans ≤ 1 MHz)	2-178

2-15. SYNTHESIZER SECTION TEST - A14 TAM TESTS – A14J16 Test.

A14J16 Test.

6. On AN/USM-489A,
   - Connect TAM probe cable to A14J16 (fig. FO-25).
   - Press the TEST key.
7. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

> For additional troubleshooting information on failed tests:
> - Use KNOB to select failed test.
> - Press MORE INFO key.
> - Follow instructions on CRT Screen (fig. FO-27).

- If all tests return OK, proceed to step 8.

Failed Test	FO-27 Circuit (s)	FO-27 Signal(s)	Test/Subtest to Perform	Page
FAV Generator	R	MS4	YTF Driver Circuit Test	2-229
			Troubleshoot using fig. FO-27, Sheet 6	N/A
FAV Gen 0.5 V/GHz Output	x	MS5	YTF Driver Circuit Test	2-229
			Troubleshoot using fig. FO-27, Sheet 6	N/A
YTF Offset DAC	s	MS6	YTF Driver Circuit Test	2-229
YTF Gain and Offset Input	s	MS2	YTF Driver Circuit Test	2-229
YTF Gain DAC	s	MS 1	YTF Driver Circuit Test	2-229
YTF Drive		MS3	YTF Driver Circuit Test	2-229
Band Switch Driver	AA	MS8	Control Latch for Band Switch Driver Test	2-229
			Troubleshoot using fig. FO-27, Sheet 8	N/A

A14J17 Test.

8. On AN/USM-489A,
   - Connect TAM probe cable to A14J17 (fig. FO-25).
   - Press the TEST key.
9. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

> For additional troubleshooting information on failed tests:
> - Use KNOB to select failed test.
> - Press MORE INFO key.
> - Follow instructions on CRT Screen (fig. FO-27).

- If all tests return OK, proceed to step 10.

2-15. SYNTHESIZER SECTION TEST - A14 TAM TEST S- A14J17 Test-Continued.

Failed Test	FO-27 Circuit(s)	FO-27 Signal(s)	Test/Subtest to Perform	Page
Main Coil Course DAC	I	MS3	Troubleshoot using fig. FO-27, Sheet 3	N/A
Main Coil Fine DAC	I	MS2	Troubleshoot using fig. FO-27, Sheet 3	N/A
Main Coil DACs Output	I	MS5	Troubleshoot using fig. FO-27, Sheet 3	N/A
YTO Loop Phase Detector	AB	MS1	Unlocked YTO PLL Test	2-185
Main Loop Error Volt DVR	O	MS4	Unlocked YTO PLL Test	2-185
Option Drive	N/A	MS8	N/A	N/A
Option Drive Switch	N/A	MS7	N/A	N/A
Option Drive DAC	U	MS6	Troubleshoot using fig. FO-27, Sheet 7	N/A

A14J18 Test.

10. On AN/USM-489A,

- Connect TAM probe cable to A14J18 (fig. FO-25).
- Press the TEST key.

11. Read test results on the CRT Screen.

- If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-27).

- If all tests return OK, proceed to step 12.

Failed Test	FO-27 Circuit(s)	FO-27 Signal(s)	Test/Subtest to Perform	Page
+10 V Reference	A	MS1, MS2	Troubleshoot using fig. FO-27, Sheet 2	N/A
LODA Drive	Z	MS5, MS6 MS7, MS8	A7 LODA Drive Test	2-226

A14J19 Test

12. On AN/USM-489A,

- Connect TAM probe cable to A14J19 (fig. FO-25).
- Press the TEST key.

2-15. SYNTHESIZER SECTION TEST - A14 TAM TESTS - A14J19 *Test* - Continued.

13. Read test results on the CRT Screen.
    - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-27).

- If all tests return OK, proceed to step 14.

Failed Test	FO-27 Circuit(s)	FO-27 Signal(s)	Test/Subtest to Perform	Page
Second Conv PIN Switch	Y	MS8	A13 Second Converter Test	2-223
Second Conv Mixer Bias	Y	MS1l	A13 Second Converter Test	2-223
Second Conv Drain Bias	N/A	MS3	N/A	N/A
Second Conv Doubler Bias	N/A	MS4	N/A	N/A
Second Conv Driver Bias	N/A	MS5	N/A	N/A
First Mixer Drive Switch	W	MS7	PIN Switch Test	2-215
First Mixer Drive DAC	W	MS6	High Band Bias Test	2-216

A14J303 Test.

14. On AN/USM-489A,
    - Connect TAM probe cable to A14J303 (fig. FO-25).
    - Press the TEST key.
15. Read test results on the CRT Screen.
    - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-27).

- If all tests return OK, proceed to step 16.

Failed Test	FO-27 Circuit (s)	FO-27 Signal(s)	Test/Subtest to Perform	Page
XFER Amp Bias	AP	MS3	Main Oscillator PLL Test	2-196
Main Amp Bias	AP	MS4	Main Oscillator PLL Test	2-196
Out Amp Bias	AO	MS1	Main Oscillator PLL Test	2-196
Main Osc Bias	AO	MS2	Main Oscillator PLL Test	2-196
Main Pretune DAC	AN	MS7	Main Oscillator PLL Test	2-196
Course Adj DAC	**AM**	MS8	Main Oscillator PLL Test	2-196
Fine Adj DAC	AM	MS6	Main Oscillator PLL Test	2-196
Span Multiplier DAC	AM	MS5	Main Oscillator PLL Test	2-196

2-15. SYNTHESIZER SECTION TEST- A14 TAM TESTS - A14J303 Test - Continued.

16. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

A15 TAM TESTS.

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A15 RF CCA using the TAM.

NOTE

The TAM tests A5 RF CCA circuitry by digitally controlling hardware and monitoring control lines to verify they are responding properly, and is unable to test signal path. It may be necessary to verify RF levels manually using fig. FO-30 to ensure proper operation.

1. On AN/USM-489A,
    - Place A14/A15 in service position (para 2-45).
    - Connect TAM and extension cables to rear panel (para 2-38).
    - Connect power cable to the rear panel.

A15J901 Test.

2. On AN/USM-489A,
    - Connect TAM probe cable to A15J901 (fig. FO-28).
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
    - Press MODULE button.
    - Press DIAGNOSE key.
    - Use KNOB to select “2) Manual Probe Troubleshooting”.
    - Press EXECUTE key.

2-15. SYNTHESIZER SECTION TEST- A15 TAM TESTS - A15J901 Test - Continued.

3. Read test results on the CRT Screen.

   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-30).

   - If all tests return OK, proceed to step 4.

Failed Test	FO-30 Circuit(s)	FO-30 Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS4, MS3	N/A	N/A
External Mixer Switch	I	MS1, MS8	Troubleshoot using fig. FO-28, Sheet 3	N/A
Signal ID Switch	I	MS5, MS6	Troubleshoot using fig. FO-28, Sheet 3	N/A
Ten Volt Reference	A	MS4	Troubleshoot using fig. FO-28, Sheet 2	N/A
External Mixer Bias	A	MS7	Third Converter Test Troubleshoot using fig. FO-28, Sheet 2	2-235 N/A
RF Gain Test	G	MS2	Band Flatness Control Test	2-55

A15J200 Test.

4. On AN/USM-489A,

   - Connect TAM probe cable to A15J200 (fig. FO-28).
   - Press the TEST key.

5. Read test results on the CRT Screen.

   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-30).

   - If all tests return OK, proceed to step 6.

Failed Test	FO-30 Circuit(s)	FO-30 Signal(s)	Test/Subtest to Perform	Page
Positive 15 Volt Supply	N	MS1	Troubleshoot using fig. FO-28, Sheet 4	N/A
Sampler Drive Buffer Bias	AD	MS2	Unlocked Offset PLL Test	2-199
Sampling Oscillator Bias	AC	MS3	Unlocked Offset PLL Test	2-199
Offset Lock Drive Buffer	AG	MS4	Unlocked Offset PLL Test	2-199
OFL Error Voltage	AB	MS6	Unlocked Offset PLL Test	2-199
Phase Detector Bias Adjust	AE	MS8	Unlocked Offset PLL Test	2-199

2-15. SYNTHESIZER SECTION TEST- A15 TAM TESTS - A15J400 Test.

A15J400 Test.

6. On AN/USM-489A,
   - Connect TAM probe cable to A15J400 (fig. FO-28).
   - Press the TEST key.
7. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-30).

- If all tests return OK, proceed to step 8.

Failed Test	FO-30 Circuit(s)	FO-30 Signal(s)	Test/Subtest to Perform	Page
Positive 15 Volt Supply	N	MS2	Troubleshoot using fig. FO-28, Sheet 4	N/A
Offset Lock RF Buffer	AH	MS4	Offset Oscillator PLL Test	2-191
IF AMP/Limiter Bias	A K	MS6	Offset Oscillator PLL Test	2-191
Offset Lock Loop Buffer D	AM	MS7	Offset Oscillator PLL Test	2-191
Offset Lock Loop Buffer C	AM	MS8	Offset Oscillator PLL Test	2-191
Sampler Bias Test	Z	MS3	Sampler and Sampler IF Test	2-191

A15J502 Test.

8. On AN/USM-489A,
   - Connect TAM probe cable to A15J502 (fig. FO-28).
   - Press the TEST key.
9. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-30).

- If all tests return OK, proceed to step 10.

2-15. SYNTHESIZER SECTION TEST - A15 TAM TESTS - A15J502 Test - Continued.

Failed Test	FO-30 Circuit(s)	FO-30 Signal(s)	Test/Subtest to Perform	Page
Positive 15 Volt Supply	N	MS2	Troubleshoot using fig. FO-28, Sheet 4	N/A
Third LO Tune Voltage	P	MS3	Unlocked Reference PLL Test	2-202
Offset Lock Loop Buffer	T	MS4	Unlocked Reference PLL Test	2-202
600 MHz Oscillator Bias	R	MS5	Unlocked Reference PLL Test	2-202
Calibrator AGC Amp Bias	W	MS6	Unlocked Reference PLL Test	2-202
Calibrator Ampl Adj	W	MS7	Unlocked Reference PLL Test	2-202
3rd LO Driver Amp	V	MS1, MS8	Third LO Driver Amplifier Test	2-204

A15J602 Test.

10. On AN/USM-489A,
    - Connect TAM probe cable to A15J602 (fig. FO-28).
    - Press the TEST key.

11, Read test results on the CRT Screen.
- If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:
- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-30).

- If all tests return OK, proceed to step 12.

Failed Test	FO-30 Circuit(s)	FO-30 Signal(s)	Test/Subtest to Perform	Page
Positive 15 Volt Supply	N	MS8	Troubleshoot using fig. FO-28, Sheet 4	N/A
Flatness Compensation 3	E	MS2	Third Converter Test	2-235
Flatness Compensation 2	E	MS5	Third Converter Test	2-235
Flatness Compensation 1	E	MS6	Third Converter Test	2-235
SIG ID Collector Bias	F	MS7	SIG ID Oscillator Test	2-239
RF Gain Control Test	E	MS1, MS3	Third Converter Test	2-235

12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

2-15. SYNTHESIZER SECTION TEST - CONFIRMING FAULTY SYNTHESIZER SECTION TEST.

CONFIRMING FAULTY SYNTHESIZER SECTION TEST.

DESCRIPTION

This test is used to determine if the synthesizer section is malfunctioning.

NOTES

- If multiple failures appear in unrelated areas, suspect control circuitry malfunction. Troubleshoot using fig, FO-30, Sheet 3, circuit H before proceeding with this test.
- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7/A11), FO-25 (A14), or FO-28 (A15) as required for component location information.
- See fig. FO-27 (A14), or FO-30 (A15) as required for schematic diagrams.
- See paragraphs 2-46 and 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear pane
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 389.5 MHz.
   - Set CF STEP to 7.5 MHz.
   - Set SPAN WIDTH to 0 Hz.
2. Connect digital multi meter (+) lead to A15J200 pin 13 and (-) lead to A15J502 pin 6.

2-15. SYNTHESIZER SECTION TEST - CONFIRMING FAULTY SYNTHESIZER SECTION TEST - Continued.

3. On AN/USM-489A, press STEP up/down arrow buttons and tune CENTER FREQ to values listed in the following table. At each step verify digital multi meter reads from ≈ +1.5 Vdc to +6 Vdc and that as frequency is increased, reading also increases.

CENTER FREQ (MHz)	Sampling Oscillator's Frequency (MHz)
389.5	280.0
427.0	282.5
449.5	284.0
464.5	285.0
4795	286.0
502.0	287.5
5095	288.0
539.5	290.0
569.5	292.0
5770	292.5
599.5	294.0
614.5	295.0
629.5	296.0
652.0	297.5
659.5	298.0

- If correct and a Sampling Oscillator Error (ERR 335) is displayed, perform all A3 Interface CCA ADC Circuits Test (para 2-12).
- If correct and a Sampling Oscillator Error (ERR 335) is not displayed, proceed to step 4.
- If incorrect, perform Unlocked Offset PLL Test (para 2-15).

4. On AN/USM-489A,
   - Disconnect W37 (GRY/GRN) from A14J301.
   - Connect another spectrum analyzer to W37.

5. Set spectrum analyzer (connected to W37) controls as follows:

Center Frequency ....10 MHz

Span ....2 MHz

6. Verify amplitude of 10 MHz signal displayed on spectrum analyzer is ≈ -1 dBm.
   - If incorrect, perform 10 MHz Reference Test (para 2-16).

7, On AN/USM-489A,
   - Reconnect W37 to A14J301.
   - Connect the CAL OUTPUT connector to IN **PUT 50Ω** connector using BNC cable and adapter provided.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 100 MHz.

8. On AN/USM-489A, verify CAL signal is present at ≈ -10 dBm in amplitude, ≈ ±20 MHz from center frequency.
   - If no signal is displayed and ERR 334 LO AMPL is not present, perform A7 LODA Test (para 2-16).
   - If no signal is displayed and ERR 334 LO AMPL is present, proceed to step 9.
   - If correct, proceed to step 15.

2-15. SYNTHESIZER SECTION TEST - CONFIRMING FAULTY SYNTHESIZER SECTION TEST - Continued.

9. Zero power meter for 18 GHz.
10. On AN/USM-489A,
    - Set LINE to OFF.
    - Set jumper A14J23 to TEST position.
    - Disconnect W38 from A11J2 (fig. FO-23).
    - Connect power meter directly to A11J2.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press PRESET button.
    - Press EXT button.
    - Set HARMONIC LOCK to 6.
    - Set SPAN WIDTH to 0 Hz.
    - Set CENTER FREQ to 18 GHz.
    - Set CF STEP to 1.2 GHz.
11. Verify power meter reads between +9 and +13 dBm.
    - If incorrect, replace A11 YTO (para 2-61).
12. On AN/USM-489A, press STEP up arrow button.
13. Repeat steps 11 and 12 until CENTER FREQ is 40 GHz.
14. On AN/USM-489A,
    - Set LINE to OFF.
    - Set jumper A14J23 to NORM position.
    - Reconnect W38 to A11J2.
15. On AN/USM-489A,
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 100 MHz.
    - Press RECALL button.
    - Press MORE key.
    - Press FREQ DIAGNOSE key.
    - Press MAIN ROLLER key.
16. On AN/USM-489A, record displayed Main-Roller Oscillator's frequency.
17. On AN/USM-489A,
    - Disconnect W32 (GRY/VIO) from A14J501.
    - Connect signal generator to A14J501.
    - Connect digital multi meter (+) lead to A14J17 pin 1 and (-) lead to A14J17 pin 6.

2-15. SYNTHESIZER SECTION TEST - CONFIRMING FAULTY SYNTHESIZER SECTION TEST - Continued.

18. Set signal generator controls as follows:

    Output Level ....0 dBm
    Frequency ....Frequency recorded instep 16

19. Decrease signal generator frequency by 1 MHz and verify digital multimeter reads ≈ +8.2 Vdc.
20. Increase signal generator frequency by 2 MHz and verify digital multi meter reads ≈ -8.2 Vdc.
    - If steps 19 or 20 are incorrect, perform Unlocked YTO PLL Test (para 2-15).
21. On AN/USM-489A,
    - Set LINE to OFF.
    - Reconnect W32 to A14J501.
    - Disconnect W34 (BLK) from A15U100J1.
    - Disconnect W32 (GRY/VIO) from A15J101.
    - Connect frequency counter to A15J101.
    - Connect synthesized sweeper to A15U100J1 using a high-frequency test cable.
    - Connect AN/USM-489A 10 MHz REF lN/OUT connector to synthesized sweeper FREQUENCY STANDARD EXT input connector.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press PRESET button.
    - Set SPAN WIDTH to 0 Hz.
    - Set CF STEP to 7.5 MHz.
22. On AN/USM-489A, set CENTER FREQ to 389.5 MHz.
23. Set synthesized sweeper controls as follows:

    Frequency ....4300.2 MHz CW
    Reference ....EXT REF
    Power Level ....5 dBm
    FREQ STEP ....7.5 MHz

24, Verify frequency counter reads 100.2 MHz (sampler IF) to 100 kHz resolution.
    - If incorrect, perform Sampler and Sampler IF Test (para 2-15).
    - If correct, but YTO unlocks only with certain center frequency and span combinations, proceed to step 26.
    - If correct with no other problems, synthesizer section is functioning properly.

2-15. SYNTHESIZER SECTION TEST - CONFIRMING FAULTY SYNTHESIZER SECTION TEST – Continued.

25. Repeat steps 22 through 24 for all AN/USM-489A CENTER FREQ and synthesized sweeper frequencies listed in the following table.

AN/USM-489A CENTER FREQ (MHz)	Synthesized Sweeper CW Frequency (MHz)	Frequency of Offset PLL's Sampling Oscillator (MHz)
389.5	4300.2	280.0
427.0	4337.7	282.5
449.5	4360.2	284.0
464.5	4375.2	285.0
479.5	4390.2	286.0
502.0	4412.7	287.5
509.5	4420.2	288.0
539.5	4450.2	290.0
569.5	4480.2	292.0
577.0	4487.7	292.5
599.5	4510.2	294.0
614.5	4525.2	295.0
629.5	4540.2	296.0
652.0	4562.7	297.5
659.5	4570.2	298.0

26. On AN/USM-489A,
    - Set LINE to OFF.
    - Reconnect W34 to a power meter.
    - Reconnect W32 to A15J101.
    - Verify 50 ohm load is connected to 1ST LO OUTPUT connector.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
    - Set SPAN and CENTER FREQ to generate unlock condition.
    - Set TRIGGER to SINGLE.
    - Set jumper A14J23 to TEST position.
27. Verify power meter reads more positive than -6.5 dBm.
    - If incorrect, suspect W34, A7 LODA (perform A7 LODA Test, para 2-16), or A11 YTO (perform Low and High Band Test, para 2-16). Replace faulty component.
28. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W34 to A15U101J1.
    - Move jumper A14J23 to NORM position.
    - Reinstall A14/A15 and cover.

2-15. SYNTHESIZER SECTION TEST - FREQUENCY SPAN ACCURACY TESTS.

FREQUENCY SPAN ACCURACY TESTS.

DESCRIPTION

This test is used to isolate frequency span accuracy malfunctions in the Synthesizer Section to the malfunctioning component or assembly.

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1. Troubleshooting frequency span accuracy malfunctions consists of performing up to three individual subtest procedures.
   - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, proceed to step 2.
2. Perform Adjust YTO (para 2-27).
3. On AN/USM-489A,
   - Press PRESET button.
   - Press REALIGN LO IF key.
4. Repeat Frequency Span Accuracy Performance Test (para 2-18) and record all AN/USM-489A SPAN and CENTER FREQ failures.
   - If none, malfunction is cleared.
5. Determine harmonic-mixing number of failed CENTER FREQs using the following table.

Center Frequency	Harmonic Mixing Number
1 kHz to 2.9 GHz	1
2.75 GHz to 6.46 GHz	1
5.86 GHz to 13.0 GHz	2
12.4 GHz to 19.7 GHz	3
19.1 GHz to 22.0 GHz	4

6. Calculate first-LO spans for all failed performance test CENTER FREQs and SPANS using the following formula:

$$\text{First LO Span} = \frac{\text{Span}}{\text{Harmonic Mixing Number}}$$

For example, if performance test failed with SPAN at 10 kHz, and CENTER FREQ at 1.5 GHz (1). then first-LO span is 10 kHz divided by 1 or 10 kHz.

2-15. SYNTHESIZER SECTION TEST- FREQUENCY SPAN ACCURACY TESTS - Continued.

7. Analyze what first-LO spans caused performance test failure.

   - If problem is only with first-LO spans ≤1 MHz, perform Roller Oscillator Span Test (LO Spans ≤1 MHz) (para 2-15).
   - If problem is only with first-LO spans 1.01 MHz to 20 MHz, perform YTO FM Coil Span Test (LO Spans 1.01 MHz to 20 MHz) (para 2-15).
   - If problem is only with first-LO spans ≥20 MHz, perform YTO Main Coil Span Test (LO Spans ≥20 MHz) (para 2-15).
   - If problem is with more than one first-LO span, perform First-LO Span Test (All Spans) (para 2-15).

8. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.

YTO Main Coil Span Test (LO Spans ≥20 MHz).

DESCRIPTION

This test is used to isolate first LO Span ≥20 MHz malfunctions in the synthesizer section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-25 as required for component location information.
- See fig. FO-27, sheets 2 and 3, circuits C and G as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,

   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

2. If not already completed, perform Adjust YTO (para 2-27).

   - If adjustments cannot be performed, proceed to step 3.

2-15. SYNTHESIZER SECTION TEST - FREQUENCY SPAN ACCURACY TESTS - YTO Main Coil Span Test (LO Spans ≥20 MHz) - Continued.

3. On AN/USM-489A,
   - Set START FREQ to 10 MHz.
   - Set STOP FREQ to 2.9 GHz.
4. Using an oscilloscope, verify a ≈ -1.2 V to -4.8 V ramp is at A14U331 pin 2.
   - If incorrect, troubleshoot using fig. FO-27, Sheet 3, circuit G. Replace faulty component.
5. Verify A14J18 pin 3 is -2.49 V.
   - If incorrect, troubleshoot using fig. FO-27, Sheet 2, circuit C. Replace faulty component.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

YTO FM Coil Span Test (LO Spans 1.01 MHz to 20 MHz).

DESCRIPTION

This test is used to isolate first LO Span 1.01 MHz to 20 MHz malfunctions in the synthesizer section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7/A11) or FO-25 (A14) as required for component location information.
- See fig. FO-27, Sheets 3-5, circuits G, H, K, M, and N as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

2-15. SYNTHESIZER SECTION TEST - FREQUENCY SPAN ACCURACY TESTS - YTO FM Coil Span Test (LO Spans 1.01 MHz to 20 MHz) - Continued.

2. If not already completed, perform Adjust YTO (para 2-27).
   - If adjustments cannot be performed, proceed to step 3.
3. On AN/USM-489A,
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 20 MHz.
   - Set SWEEP TIME to 50 ms.
4. Using an oscilloscope, verify a ≈ 0 V to –10 V ramp is at A14J15 pin 14.
   - If incorrect, troubleshoot using fig. FO-27, Sheets 3-5, circuits G, K, and M. Replace faulty component.
5. Verify a ≈ 0 V to +5 V sweep ramp at A14U405 pin 6.
   - If incorrect, perform First-LO Span Test (All Spans) (para 2-15).
6. Verify state of switches in the following table.

fig. FO-27		Switch	Switch State	SW Control Line (Pin #)	Control Line State (TTL)
Sht	Ckt				
3	G	A14U318A	Open	1	High
3	H	A14U318C	Open	9	High
3	G	A14U318D	Closed	16	Low
3	H	A14U324A	Closed	1	High
3	G	A14U324D	Closed	8	High
3	G	A14U324C	Open	9	Low

   - If incorrect, troubleshoot using fig. FO-27, Sheet 3, circuits G and H. Replace faulty component.
7. On AN/USM-489A,
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set TRIG to SINGLE.
   - Press SAVE button.
   - Press SAVE STATE key.
   - Press STATE 0 key.
   - Remove jumper at A14J23.
8. Connect dc power supply set at 0 Vdc to A14J23 pin 2 (middle pin) and pin 3 (ground).
9. Connect frequency counter to AN/USM-489A front panel 1ST LO OUTPUT connector.
10. Record reading on frequency counter (1st LO frequency).
11. Set dc power supply output to +10 Vdc.
12. Verify frequency counter reading increases ≈ +15.6 MHz from reading in step 10.
   - If incorrect, proceed to step 13.
   - If correct, YTO FM Coil Driver is functioning normally.
13. Verify voltage at A14U332 pin 2 is ≈ 2 Vdc. Record if correct or incorrect.

2-15. SYNTHESIZER SECTION TEST - FREQUENCY SPAN ACCURACY TESTS - YTO FM Coil Span Test (LO Spans 1.01 MHz to 20 MHz) - Continued.

14. On AN/USM-489A,
    - Set LINE to OFF.
    - Disconnect W10 from A14J3.
    - Short A14J3 pins 9 and 10.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press RECALL button.
    - Press RECALL STATE key.
    - Press STATE 0 key.
15. Verify voltage at A14U332 pin 2 is ≈ 2 Vdc.
    - If voltage at A14U332 pin 2 is correct in step 15 but incorrect in step 13, replace All YTO (para 2-61).
    - If voltage at A14U332 pin 2 is incorrect in both step 15 and 13, troubleshoot using fig. FO-27, Sheet 5, circuit N. Replace faulty component.
16. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W10 at A14J3.
    - Remove short at A14J3 pins 9 and 10.
    - Install jumper at A14J23.
    - Reinstall A14/A15 and cover.

Roller Oscillator Span Test (LO Spans ≤1 MHz).

DESCRIPTION

This test is used to isolate first LO Span ≤1 MHz malfunctions in the synthesizer section to the malfunctioning component or assembly.

NOTES

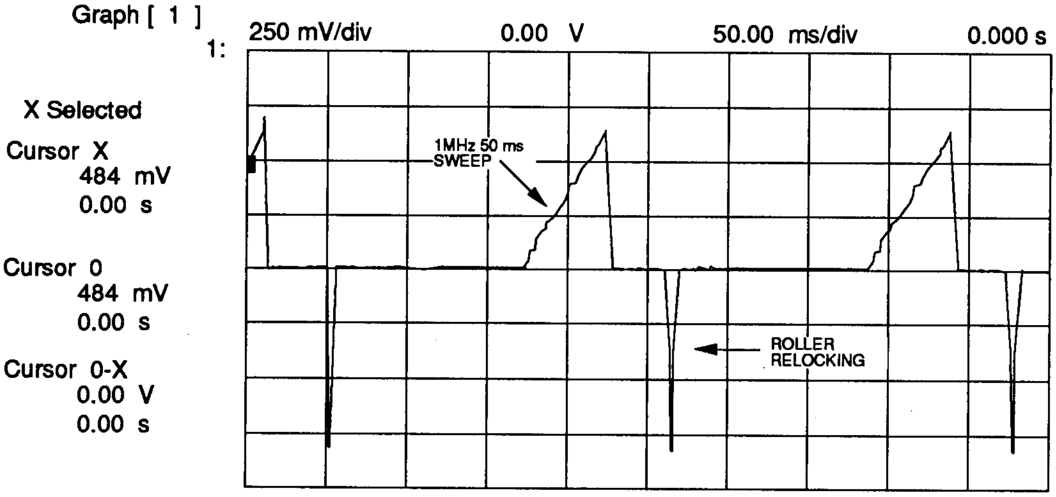
- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-25 as required for component location information.
- See fig. FO-27 Sheets 3, 10, and 12, circuits G, H, AD, AE, and AM as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

2-15. SYNTHESIZER SECTION TEST- FREQUENCY SPA N ACCURACY TESTS - Roller Oscillator Span Test (LO Spans ≤1 MHz) - Continued.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 1 MHz.
   - Set RES BW to 10 kHz.
   - Set VIDEO BW to 10 kHz.
   - Set SWEEP TIME to 50 ms.
   - Connect oscilloscope to A14J17 pin 1.
2. Set oscilloscope controls as follows:

   Amplitude Scale ....250 mV/div

   Sweep Time ....50 ms/div
3. Verify oscilloscope display is as shown below.



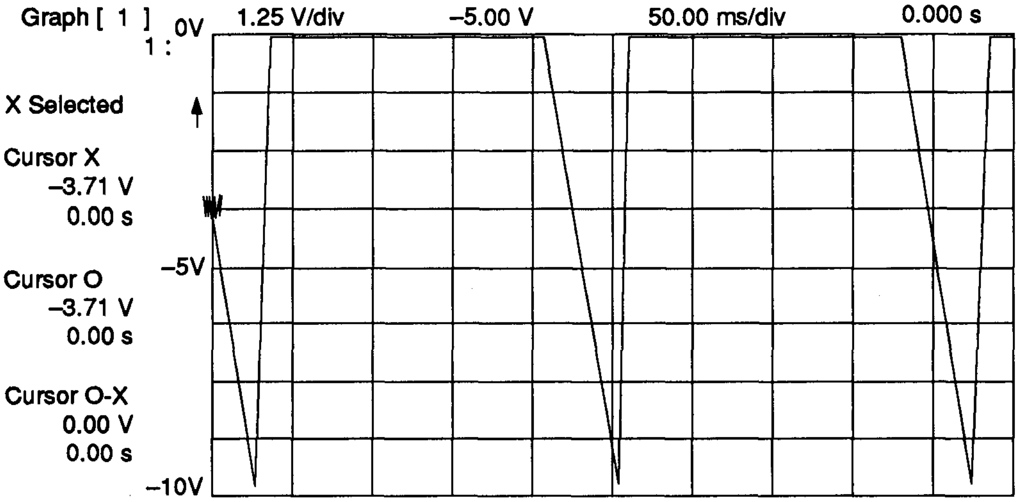
- If incorrect, proceed to step 4.
- If correct, proceed to step 8.

4. Connect oscilloscope to A14J15 pin 14.

2-15. SYNTHESIZER SECTION TEST- FREQUENCY SPAN ACCURACYTESTS- Roller Oscillator Span Test (LO Spans ≤*1* MHz) - Continued.

5. Set oscilloscope amplitude scale to 1.25 V/div, and verify oscilloscope displays a 0 V to -10 V sweep of 50 ms duration as shown below.

Source [Chan 1] [- Slope]   Auto Scale [Enabled]
Level [Adjust] -2.500 V   On Event 00001
Probe [1:1]   Coupling [dc] [1 **MΩ**]



- If incorrect, perform First-LO Span Test (All Spans) (para 2-15).

6. Verify A14J15 pin 13 is a 0 V to -10 V sweep ramp.

- If incorrect, troubleshoot using fig. FO-27, Sheets 3, circuit H. Replace faulty component.

7. Verify state of switches in the following table.

fig. FO-27		Switch	Switch State	SW Control Line (Pin #)	Control Line State (TTL)
Sht	Ckt				
3	G	A14U318A	Open	1	High
3	H	A14U318C	Open	9	High
3	G	A14U318D	Open	16	High
3	H	A14U324A	Closed	1	High
3	G	A14U324D	Closed	8	High
3	G	A14U324C	Closed	9	High

- If incorrect, troubleshoot using fig. FO-27, Sheet 3, circuits G and H. Replace faulty component.

8. On AN/USM-489A,

- Set START FREQ to 678.8 MHz.
- Set STOP FREQ to 679.8 MHz.

2-15. SYNTHESIZER SECTION TEST - FREQUENCYS PAN ACCURACY TESTS - Roller Oscillator Span Test (LO Spans £ 1 MHz) - Continued.

9. Verify A14J15 pin 13 is a 0 V to +10 V sweep ramp.

   - If incorrect, troubleshoot using fig. FO-27, Sheets 3, circuit H using the information in the following table.

fig. FO-27		Switch	Switch State	SW Control Line (Pin #)	Control Line State (TTL)
Sht	Ckt				
3	H	A14U318C	Closed	9	Low
3	H	A14U324A	Open	1	Low

10. On AN/USM-489A,

    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 1 MHz.

11. Using an active probe and another spectrum analyzer, verify A14J304 is sweeping from 94.2 to 95.2 MHz.

12. If LO spans ≤100 kHz are malfunctioning, troubleshoot Offset Oscillator circuits as follows:

    - if the sweep ramp is correct at A14J15 pin 13 (step 9), but Roller Oscillator is not sweeping properly in LO spans <100 kHz, troubleshoot Offset Oscillator Sweep/Hold circuit using fig. FO-27, Sheet 10, circuit AD. Replace faulty component.
    - If Offset Oscillator Sweep/Hold circuit is operating properly, replace A14A101 Offset Oscillator. See fig. FO-27, Sheet 10, circuit AE.

13. If all LO spans <1 MHz are malfunctioning, troubleshoot Main Roller Sweep/Hold switches using fig. FO-27, Sheet 12, circuit AM. Replace faulty component.

14. If LO spans are still faulty, perform Unlocked Roller Oscillator PLL Test (para 2-15).

15. On AN/USM-489A,

    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

2-15. SYNTHESIZER SECTION TEST - FIRST-LO SPAN TEST (ALL SPANS).

FIRST-LO SPAN TEST (ALL SPANS).

DESCRIPTION

This test is used to isolate first LO span accuracy malfunctions in the Synthesizer Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-25 as required for component location information.
- See fig. FO-27 Sheets 3, 4, and 5, circuits G, K, L, and M as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 1 MHz.
   - Set RES BW to 1 MHz.
   - Set VIDEO BW to 1 MHz.
   - Set SWEEP TIME to 50 ms.
2. Verify A14J15 pin 15 has a 0 V to +10 V ramp of 50 ms duration.
   - If incorrect, troubleshoot using fig. FO-27, Sheet 3, circuit K. Replace faulty component.
3. Verify A14J15 pin 14 has a 0 V to -10 V ramp signal.
   - If correct, and experiencing single-band sweep LO span malfunctions, troubleshoot using fig. FO-27, Sheet 3, circuit G. Replace faulty component.
   - If correct, and experiencing multiband sweep LO span malfunctions proceed to step 14.
   - If incorrect, proceed to step 4.

2-15. SYNTHESIZER SECTION TEST - FIRST-LO SPAN TEST (ALL SPANS) - Continued.

4. On AN/USM-489A, set SPAN setting to value indicated and verify correct signal at the point specified in the following table.

AN/USM-489A SPAN	Measure At	Correct Signal	If incorrect, Troubleshoot Using
1 MHz	A14U325 pin 1	0 V to +10 V ramp	fig. FO-27, Sheet 4, circuit L
1 MHz	A14U323 pin 6	0 V to -10 V ramp	fig. FO-27, Sheet 5, circuit M
500 kHz	A14U323 pin 6	0 V to –5 V ramp	fig. FO-27, Sheet 5, circuit M
200 kHz	A14U323 pin 6	0 V to –2 V ramp	fig. FO-27, Sheet 5, circuit M

- If incorrect, troubleshoot using figure and circuit provided. Replace faulty component.

5. On AN/USM-489A,

- Set START FREQ to 2.75 GHz.
- Set STOP FREQ to 6.4 GHz.
- Set SWEEP TIME to 80 ms.

6. Verify A14J15 pin 14 has a 0 V to -9 V ramp.

- If incorrect, troubleshoot using fig. FO-27, Sheet 5, circuit M using the information in the following table.

fig. FO-27		Switch	Switch State	SW Control Line (Pin #)	Control Line State (TTL)
Sht	Ckt				
5	M	A14U317A	Open	1	High
5	M	A14U317B	Open	8	High
5	M	A14U317C	Closed	9	Low
5	M	A14U317D	Open	16	High

7. On AN/USM-489A, set SPAN WIDTH to 365 MHz.
8. Verify A14J15 pin 14 has a 0 V to -900 mV ramp.

- If incorrect, troubleshoot using fig. FO-27, Sheet 5, circuit M using the information in the following table.

fig. FO-27		Switch	Switch State	SW Control Line (Pin #)	Control Line State (TTL)
Sht	Ckt				
5	M	A14U317B	Closed	8	Low
5	M	A14U317C	Open	9	High

9. On AN/USM-489A, set SPAN WIDTH to 36.5 MHz.
10. Verify A14J15 pin 14 has a 0 V to -90 mV ramp.

- If incorrect, troubleshoot using fig. FO-27, Sheet 5, circuit M using the information in the following table.

fig. FO-27		Switch	Switch State	SW Control Line (Pin #)	Control Line State (TTL)
Sht	Ckt				
5	M	A14U317A	Closed	1	Low
5	M	A14U317B	Open	8	High

2-15. SYNTHESIZER SECTION TEST - FIRST-LO SPAN TEST (ALL SPANS)-Continued.

11. On AN/USM-489A,
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 1 MHz.
    - Set SWEEP TIME to 50 ms.
12. On AN/USM-489A, set SWEEP TIME setting to value indicated and verify correct level at the point specified in the following table.

AN/USM-489A SWEEP TIME	Measure At	Correct level	If Incorrect, Troubleshoot Using
50 ms	A14J18 pin 4	≈ -8.45 Vdc	fig. FO-27, Sheet 4, circuit K
100 ms	A14J18 pin 4	≈ -4.21 Vdc	fig. FO-27, Sheet 4, circuit K
200 ms	A14J18 pin 4	≈ -2.1 Vdc	fig. FO-27, Sheet 4, circuit K

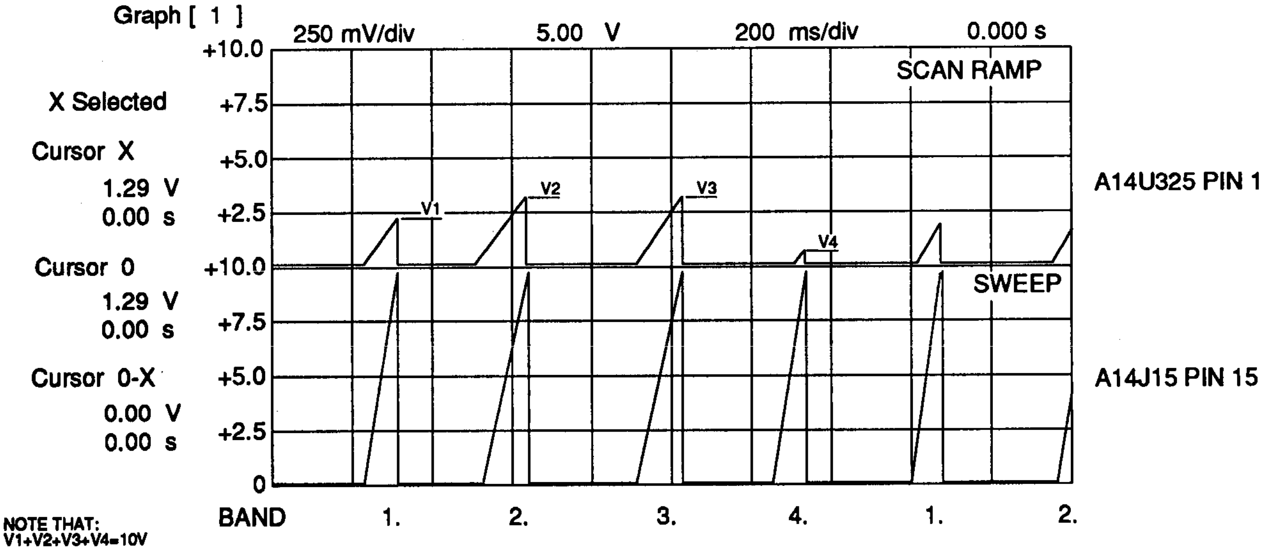
- If incorrect, troubleshoot using figure and circuit provided. Replace faulty component.

13. On AN/USM-489A, set SWEEP TIME setting to value indicated and verify correct logic levels at the points specified in the following table.

SWEEP TIME	fig. FO-27		A14U312B	A14U312C	A14U312D	A14U319A	A14U319B
	Sht	Ckt	Pin 8	Pin 9	Pin 18	Pin 1	Pin 7
200 ms	4	K	High (Open)	High (Open)	Low (Closed)	High	High
2 s	4	K	High (Open)	High (Open)	High (Open)	High	High
20 s	4	K	Low (Closed)	Low (Closed)	High (Open)	High	High

- If incorrect, troubleshoot using fig. FO-27, Sheet 4, circuit K. Replace faulty component.

14. On AN/USM-489A, press PRESET button.
15. Connect oscilloscope channel A to A14U325A pin 1 and channel B to A14J15 pin 15.
16. Verify oscilloscope display is as shown below.



2-15. SYNTHESIZER SECTION TEST - FIRST-LO SPAN TEST (ALL SPANS) - Continued.

- If incorrect, troubleshoot using fig. FO-27, Sheet 4, circuits K and L. Replace faulty component.
- Troubleshoot remaining problems using fig. FO-27. Replace faulty component.

17. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

UNLOCKED YTO PLL TEST.

DESCRIPTION

This test is used to isolate YIG-tuned Oscillator phase-lock-loop malfunctions (error 301) in the Synthesizer Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7/A11), FO-25 (A14), or FO-28 (A15) as required for component location information.
- See fig. FO-27 (A14), or FO-30 (A15) as required for schematic diagrams.
- See paragraph 2-46 and 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
    - Place A14/A15 in service position (para 2-45).
    - Connect power cable to the rear panel.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Verify error code 301 is displayed (may also have other errors).
    - Press PRESET button.
    - Set SPAN WIDTH to 0 Hz.
    - Move A14J23 jumper to TEST position.
    - Verify error code 301 is no longer displayed.
    - Press RECALL button.
    - Press MORE key.
    - Press FREQ DIAGNOSE key.
    - Press LO FREQ key.
    - Record displayed LO FREQ value.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED YTO PLL TEST - Continued.

2. Connect AN/USM-489A 1st LO OUTPUT connector to a frequency counter.
3. Record frequency counter reading (to same resolution as recorded in step 1).
4. Calculate YTO frequency-error as follows.

   YTO Frequency Error = LO FREQ (step 3)-1st LO Frequency (step 1)

   Record results as YTO Frequency Error (in MHz).
5. On AN/USM-489A,
   - Press MAIN ROLLER key.
   - Record displayed MAIN ROLLER value.
6. Analyze results:
   - If YTO Frequency Error (step 4) is greater than 30 MHz, proceed to step 7.
   - If YTO Frequency Error (step 4) is less than 10 MHz, proceed to step 9.
   - If YTO Frequency Error (step 4) is between 10 MHz and 30 MHz, proceed to step 11.
7. Adjust YTO (para 2-27).
   - If YTO's main coil cannot be adjusted, proceed to step 22.
8. Perform A14 TAM Tests for A14J17 and A14J18.
   - If test fails, troubleshoot using the information provided.
   - If correct, proceed to step 13.
9. Verify the frequency at A14J304 equals frequency recorded in step 5.
   - If incorrect, perform Unlocked Roller Oscillator PLL Test (para 2-15).
10. Perform Sampler and Sampler IF Test (para 2-15).
    - If test fails, perform as instructed.
    - If test passes, proceed to step 30.
11. Match frequency recorded in step 7 in first column of following table to locate corresponding YTO Frequency Error.

MAIN ROLLER Frequency (step 7)	YTO Frequency Error (step 6)	A14U328B Gain
-104 to -93 MHz	-10 to +30 MHz	–1
-93 to -73 MHz	-20 to +20 MHz	-1
-73 to -65 MHz	-30 to +10 MHz	-1
+65 to +73 MHz	-10 to +30 MHz	+1
+73 to +93 MHz	-20 to +20 MHz	+1
+93 to +104 MHz	-30 to + 10 MHz	+1

12. Verify YTO Frequency Error calculated in step 4 is within range of YTO Frequency Error listed in above table.
    - If incorrect, proceed to step 7.
    - If correct, proceed to step 9.
13. Using another spectrum analyzer, verify AN/USM-489A 1ST LO OUTPUT connector measures between +14.5 and +18.5 dBm in amplitude at from 3 to 6.81 GHz.
    - If incorrect, perform Adjust 1st LO Distribution Amplifier (para 2-28).

2-15. *SYNTHESIZER SECTION TEST - UNLOCKED YTO PLL TEST - Continued.*

14. On AN/USM-489A,
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 0 Hz.
    - Connect another spectrum analyzer to A14J304.
15. Verify signal on spectrum analyzer (connected to A14J304) measures ≈ -30 dBm at 94.7 MHz.
    - If incorrect, perform Unlocked Roller Oscillator PLL Test (para 2-15).
    - If correct, but problem exists only at a particular CENTER FREQ and SPAN setting, proceed to step 16.
    - If correct, and problem does not exists at a particular CENTER FREQ and SPAN setting, proceed to step 18.
16. On AN/USM-489A,
    - Set CENTER FREQ to problem setting.
    - Set SPAN WIDTH to problem setting.
    - Press RECALL button.
    - Press MORE key.
    - Press FREQ DIAGNOSE key.
    - Press MAIN ROLLER key.
    - Record displayed MAIN ROLLER value.
17. Verify signal on spectrum analyzer (connected to A14J304) measures ≈ -30 dBm at recorded frequency in step 16.
    - If incorrect, perform Unlocked Roller Oscillator PLL Test (para 2-15).
18. On AN/USM-489A,
    - Move A14J23 jumper to TEST position.
    - Set CENTER FREQ to 2.9 GHz.
    - Set SPAN WIDTH to 0 Hz.
    - Disconnect W34 (BLK) at A15U100J1.
    - Connect W34 to another spectrum analyzer.
19. Verify spectrum analyzer (connected to W34) reads greater (more positive) than –9 dBm at from 3.0 to 6.81 GHz.
    - If incorrect, perform A7 LODA Test (para 2-16).
20. On AN/USM-489A,
    - Reconnect W34 at A15U100J1.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 0 Hz.
    - Disconnect W32 (GRY/VIO) from A15J101.
    - Connect A15J101 to another spectrum analyzer.
21. Verify spectrum analyzer (connected to A15J101) reads between 74 MHz and 114 MHz at -15 dBm to +2 dBm.
    - If incorrect, perform Unlocked Offset PLL Test (para 2-15).

2-15. SYNTHESIZER SECTION TEST - UNLOCKED YTO PLL TEST - Continued.

22. On AN/USM-489A,
    - Move A14J23 jumper to NORMAL position.
    - Reconnect W32 at A15J101.
    - Disconnect W32 (GRY/VIO) from A14J501,
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 0 Hz.
    - Connect a signal generator to A14J501.
    - Connect an oscilloscope to A14J17 pin 1 (ground at pin 6).
23. Set signal generator controls as follows:

Frequency	84 MHz
Frequency Step	1 MHz
Amplitude	0 dBm

24. Increase signal generator frequency in 1 MHz steps to 104 MHz while observing oscilloscope display. Verify voltage changes from +8.2 Vdc (at 88 MHz) to -8.2 Vdc (at 104 MHz) ±1 V. Record results.
25. Set signal generator controls as follows:

Frequency	84 MHz
Amplitude	-15 dBm

26. Repeat step 24.
    - If correct, proceed to step 29.
    - If correct at 0 dBm but incorrect at -15 dBm , suspect A14U201 or A14U202. Troubleshoot using fig, FO-27, Sheet 9, circuit AB. Replace faulty component.
    - If incorrect at both levels, proceed to step 27.
27. Set signal generator frequency to 80 MHz.
28. Using an active probe and another spectrum analyzer, verify that:
    - A14U203 pin 2 is ≈ 0 dBm (ECL levels).
    - 47.35 MHz, and A14U205 pin 2 is 40 MHz at ≈ 0 dBm.
        - If incorrect, troubleshoot using fig. FO-27, Sheet 9, circuit AB. Replace faulty component.
29. On AN/USM-489A, reconnect W32 to A14J501.
30. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove A14J23 jumper.
    - Connect a dc power supply (set to 0 Vdc) to A14J23 pin 2 (ground to pin 3).
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 0 Hz.
31. Set dc power supply to +7.5 Vdc.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED YTO PLL TEST – Continued.

32. Verify nominal test-point voltages at points listed in following table.

Measurement Point	Reading (at +7.5 Vdc)	Reading (at -7.5 Vdc)
A14U405 pin 6	+2.8 Vdc	-2.8 Vdc
A14U332 pin 2	+1.36 Vdc	-1.36 Vdc
A14J17 pin 4	>+12 Vdc	<-12 Vdc

33. Set dc power supply to -7.5 Vdc.
34. Repeat step 32.
    - If incorrect, troubleshoot using fig. FO-27, Sheet 5, circuits N and O. Replace faulty component.
35. On AN/USM-489A,
    - Set CENTER FREQ to 678.8 MHz.
    - Set SPAN WIDTH to 0 Hz.
36. Verify nominal test-point voltages at points listed in following table.

Measurement Point	Reading (at -7.5 Vdc)	Reading (at +7.5 Vdc)
A14U405 pin 6	+2.8 Vdc	-2.8 Vdc
A14U332 pin 2	+1.36 Vdc	-1.36 Vdc
A14J17 pin 4	>+12 Vdc	<-12 Vdc

37. Set dc power supply to +7.5 Vdc.
38. Repeat step 36.
    - If incorrect, troubleshoot using fig. FO-27, Sheet 5, circuits N and O. Replace faulty component.
39. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14J23 jumper.
    - Reinstall A14/A15 and cover.

2-15. SYNTHESIZER SECTION TEST- UNLOCKED ROLLER OSCILLATOR PLL TESTS.

UNLOCKED ROLLER OSCILLATOR PLL TEST.

DESCRIPTION

This test is used to isolate roller oscillator phase-lock-loop malfunctions (error 301) in the Synthesizer Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-25 as required for component location information.
- See fig. FO-27 Sheet 8, circuit AG as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Connect another spectrum analyzer to A14J304.
2. Verify spectrum analyzer (connected to A14J304) displays a 94.7 MHz signal.
   - If 94.7 MHz is present and stable, Roller Oscillator PLLs are probably locked.
   - If 94.7 MHz is off-frequency or unstable, and no error message is displayed, proceed to step 3.
   - If 94.7 MHz is off-frequency or unstable, and an error message is displayed, see Error Messages in table 2-1 for troubleshooting information.

NOTE

An unstable signal at A14J304 does not always indicate that Main Roller Oscillator is unlocked, as the Main Roller Oscillator tracks frequency movements of the other two Roller PLLs (Offset and Transfer).

3. Troubleshoot A14U305, A14U328, and A14U326D using fig. FO-27, Sheet 8, circuit AG.
   - If fault is located, replace faulty component.
   - If no fault is located, perform Offset Oscillator PLL Test (para 2-15), Transfer Oscillator PLL Test (para 2-15), and if necessary Main Oscillator PLL Test (para 2-15).

2-15. SYNTHESIZER SECTION TEST - UNLOCKED ROLLER OSCILLATOR PLL TESTS - Continued.

4. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

Offset Oscillator PLL Test.

DESCRIPTION

This test is used to isolate offset oscillator phase-locked-loop malfunctions in the synthesizer section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-25 as required for component location information.
- See fig. FO-27 Sheets 2, 8, and 10, circuits B, AB, AC, AD, and AG as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Using an active probe and another spectrum analyzer, verify:
   - A14TP302 is at 189 MHz to 204 MHz at –15 dBm.
   - A14U102 pin 2 is 189 MHz to 204 MHz at greater than (more positive) –3 dBm.
3. Using an oscilloscope, verify:
   - A14J302 pin 5 is between +2 and +4 Vdc.
   - A14J302 pin 2 is between +7 and +8 Vdc.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED ROLLER OSCILLATOR PLL TESTS - Offset Oscillator PLL Test - Continued.

4. Analyze the results of steps 2 and 3.
   - If incorrect, proceed to step 5.
   - If correct, proceed to step 24.
5. On AN/USM-489A,
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
6. Using an active probe and another spectrum analyzer, verify A14TP302 is 200 MHz +10 MHz.
   - If incorrect, proceed to step 7.
   - If correct, proceed to step 11.
7. Short A14U416 pin 14 to ground (A14U416 pin 15),
8. Using an active probe and another spectrum analyzer, verify A14TP302 is 200 MHz ±1 MHz.
   - If incorrect, record frequency and proceed to step 9.
   - If correct, troubleshoot A14U416D using fig. FO-27, Sheet 10, circuit AD. Replace faulty component.
9. Using an oscilloscope, verify voltage at A14J302 pin 15 is from -5.25 V to -3.5 Vdc.
   - If incorrect, troubleshoot A14U126B, A14U119B, and A14U302 using fig. FO-27, Sheets 2 and 10, circuits B and AB. Replace faulty component.

NOTE

If Transfer Roller Oscillator is locked, A14U302 is not at fault as it decodes a single address for both Offset Oscillator Pretune DAC and Transfer Oscillator Pretune DAC.

10. Remove short at A14U416 pin 14.
11. Connect a frequency counter to A14U101 pin 3 using a x 10 oscilloscope probe.
12. Set frequency counter to high-input impedance function.
13. Verify frequency counter reads the frequency recorded in step 10 divided by 128.
14. Verify that A14U101 pin 1 is TTL high.
15. Verify amplitude of signal at A14U110 pin 3 measures greater than 1 V p-p.
    - If steps 13 through 15 are incorrect, troubleshoot around A14U101 using fig. FO-27, Sheet 10, circuit AC. Replace faulty component.
16. Verify A14U110 pins 18 and 15 have narrow (<1µs) pulses 400 µs apart.
    - If incorrect, troubleshoot around A14U110 using fig. FO-27, Sheet 10, circuit AC. Replace faulty component.
17. Temporarily short A14A101 pin 14 to pin 20 and verify voltage at A14U11 1 pin 1 is greater than +9 Vdc.

2-15. SAYNTHESIZER SECTION TEST - UNLOCKED ROLLER OSCILLATOR PLL TESTS - Offset Oscillator PLL Test - Continued.

Temporarily short A14A101 pin 14 to pin 16 and verify voltage at A14U111 pin 1 is less than -9 Vdc.

- If readings in steps 17 or 18 are incorrect, troubleshoot around A14U110/A14U111 using fig. FO-27, Sheet 10, circuit AC. Replace faulty component.

NOTE

Under some unlocked conditions, error voltage at A14U111 pin 1 may oscillate wildly do to conduction of A14VR308 and A14VR309 which short out A14R336 to improve lock time.

19. Verify voltage at A14U112 pin 5 is approximately same as A14U112 pin 3.
20. Verify A14U112 pin 8 is TTL low.

- If readings in steps 19 or 20 are incorrect, troubleshoot around A14U112 using fig. FO-27, Sheet 10, circuit AD. Replace faulty component.

21. On AN/USM-489A, set SPAN WIDTH to 100 kHz.
22. Connect oscilloscope external trigger to A14U112 pin 8, channel A to A14U112 pin 3, and channel B to A14U112 pin 5.
23. Verify pulses are at A14U112 pin 5 and A14U112 pin 3.

- If readings in steps 22 or 23 are incorrect, troubleshoot around A14U112 using fig. FO-27, Sheet 10, circuit AD. Replace faulty component.

If errors 302 or 327 are displayed, and Offset Oscillator PLL Test passes, troubleshoot A14U305, A14U328, and A14U326D using fig. FO-27, Sheet 8, circuit AG.

- If malfunction is located, replace faulty component.
- If malfunction is not located, perform all A3 Interface CCA ADC Circuit Test and A3 Interface CCA Control Circuits Test (para 2-12).

25. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED ROLLER OSCILLATOR PLL TESTS - Transfer Oscillator PLL Test.

Transfer Oscillator PLL Test.

DESCRIPTION

This test is used to isolate transfer oscillator phase-locked-loop malfunctions in the synthesizer section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-25 as required for component location information.
- See fig. FO-27 Sheets 2, 8, and 11, circuits B, AG, AH, Al, AK, and AN as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields,

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Using an active probe and another spectrum analyzer, verify A14TP301 is a swept signal from ≈ 65 MHz to 110 MHz at ≈ **−4** dBm.
   - If output contains noise sidebands, phase noise, or jitter, troubleshoot A14Q102 and A14Q103, and A14Q104 using fig. FO-27, Sheet 11, circuits AK and AN. Replace faulty component.
3. Using an oscilloscope, verify voltage at A14J302 pin 1 is +7.5 Vdc ±1 V.
   - If incorrect, suspect A14A102. Troubleshoot using fig. FO-27, Sheet 11, circuit Al. Replace faulty component.
4. On AN/USM-489A,
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
5. Using an active probe and another spectrum analyzer, verify A14TP301 is from 94.7 MHz to 98.7 MHz.
   - If incorrect, proceed to step 6.
   - If correct, proceed to step 19.
6. Short A14A102 pin 12 to ground (A14A102 pin 16).

2-15. SYNTHESIZER SECTION TEST - UNLOCKED ROLLER OSCILLATOR PLL TESTS - Transfer Oscillator PLL Test - Continued.

7. Using an active probe and another spectrum analyzer, verify A14TP301 is from 95.7 MHz to 97.7 MHz.
   - If incorrect, record frequency and proceed to step 8.
   - If correct, troubleshoot using fig. FO-27, Sheet 11, circuit AH. Replace faulty component.
8. Using an oscilloscope, verify voltage at A14J302 pin 13 is +13.6 Vdc ±1.8 V.
   - If incorrect, troubleshoot A14U119A, A14U122A, A14Q102, A14Q103, and A14U302 using fig. FO-27, Sheets 2 and 11, circuits B and AK. Replace faulty component.

NOTE

> If Offset Oscillator is locked, A14U302 is not at fault as it decodes a single address for both Offset Oscillator Pretune DAC and Transfer Oscillator Pretune DAC.

   - If correct, suspect A14A102. Troubleshoot using fig. FO-27, Sheet 11, circuit AI. Replace faulty component. If A14A102 good, proceed to step 9.
9. On AN/USM-489A,
   - Remove short at A14A102 pin 12.
   - Set CENTER FREQ to 87.3 MHz.
   - Set SPAN WIDTH to 0 Hz.
10. Connect a frequency counter to A14U127 pin 3 using a x 10 oscilloscope probe.
11. Set frequency counter to high-input impedance function.
12. Verify frequency counter reads the frequency recorded in step 7 divided by 32.
13. Verify that A14U127 pin 1 is TTL high.
14. Verify amplitude of signal at A14U127 pin 3 measures greater than 1 V p-p.
    - If steps 12 through 14 are incorrect, troubleshoot around A14U127 using fig. FO-27, Sheet 11, circuit AH. Replace faulty component.
15. On AN/USM-489A,
    - Set CENTER FREQ to 200 MHz.
    - Set SPAN WIDTH to 0 Hz.
16. Verify A14U124 pins 18 and 15 have narrow (<1µs) pulses 20 µs apart.
    - If incorrect, troubleshoot around A14U124 using fig. FO-27, Sheet 11, circuit AH. Replace faulty component.
17. Temporarily short A14U126 pin 3 to ground and verify voltage at A14U126 pin 1 is less than (more negative) than -9.5 Vdc.
18. Temporarily short A14U126 pin 2 to ground and verify voltage at A14U126 pin 1 is greater than +9.5 Vdc.
    - If readings in steps 17 or 18 are incorrect, troubleshoot around A14U124/A14U126 using fig. FO-27, Sheet 11, circuit AH. Replace faulty component.

2-15. SYNTHESIZER SECTION TEST- UNLOCKED ROLLER OSCILLATOR PLL TESTS - Transfer Oscillator PLL Test - Continued.

19. If error 303 is displayed, and Transfer Oscillator PLL Test passed, troubleshoot A14U305, A14U328, and A14U326D using fig. FO-27, Sheet 8, circuit AG.
    - If malfunction is located, replace faulty component.
    - if malfunction is not located, perform all A3 Interface CCA ADC Circuit Tests and A3 interface CCA Control Circuits Tests (para 2-12).
20. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment,
    - Reinstall A14/A15 and cover.

Main Oscillator PLL Test.

DESCRIPTION

This test is used to isolate main oscillator phase-locked-loop malfunctions in the synthesizer section to the malfunctioning component or assembly.

NOTES

- Before proceeding with Main Oscillator PLL Test, perform Offset Oscillator PLL Test and Transfer Oscillator PLL Test (if not already performed) to confirm loops are locked.
- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-25 as required for component location information.
- See fig. FO-27 Sheets 8, 11 and 12, circuits AG, AI, AJ, AL, AO, AN, and AP as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
    - Place A14/A15 in service position (para 2-45).
    - Connect power cable to the rear panel.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED ROLLER OSCILLATOR PLL TESTS - Main Oscillator PLL Test - Continued.

2. Using an active probe and another spectrum analyzer, verify A14J304 is ≈ 94.73 MHz at greater than (less negative) -33 dBm, and A14TP305 is ≈ 0 dBm.
   - If incorrect, proceed to step 3.
   - If correct, proceed to step 4.
3. Using an oscilloscope, verify voltage at A14J303 pin 1 is between +3 Vdc and +6 Vdc, and at A14J303 pin 2 is +7.8 Vdc ±1 V.
   - If incorrect, troubleshoot using fig. FO-27, Sheet 12, circuit AO. Replace faulty component.
4. On AN/USM-489A,
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
5. Verify voltage at A14A103 pin 14 is +12.6 Vdc ±1.4 V.
   - If incorrect, troubleshoot using fig. FO-27, Sheets 11 and 12, circuits AO and AN. Replace faulty component.
6. Short A14A103 pin 12 to ground (A14A103 pin 16).
7. Using a frequency counter and x 10 oscilloscope probe, verify A14C345 (lead closest to A14U117) is from 93.7 MHz to 95.7 Hz.
   - If incorrect, suspect A14A103. Troubleshoot using fig. FO-27, Sheet 12, circuit AO. Replace faulty component.
8. Remove short from A14A103 pin 12.
9. Using an oscilloscope and x 10 probe, verify A14U109 pin 1 is ≈ 2 MHz at 50 mV.
   - If incorrect, proceed to step 10.
   - If correct, proceed to step 14.
10. Using an active probe and another spectrum analyzer, verify A14U117 pin 1 is ≈ –13 dBm.
    - If incorrect, proceed to step 11.
    - If correct, troubleshoot around A14U117 using fig. FO-27, Sheet 12, circuit AP. Replace faulty component.
11. Using an oscilloscope, verify A14J303 pin 3 is from +2 Vdc to +4 Vdc.
    - If incorrect, troubleshoot around A14U123 using fig. FO-27, Sheet 12, circuit AP. Replace faulty component.
    - If correct, proceed to step 12.
12. Using an oscilloscope, verify A14U424B pin 7 is ≈ -14 Vdc.
    - If incorrect, troubleshoot around A14CR302/CR303 using fig. FO-27, Sheet 11, circuit Al. Replace faulty component.
13. Verify A14U424B pin 5 is ≈ 0 Vdc.
    - If incorrect, troubleshoot around A14U401 and A14U303 using fig. FO-27, Sheet 8, circuit AG. Replace faulty component.
14. Verify A14U109 pin 7 is ≈ 100 mV p-p at 2 MHz.
    - If incorrect, troubleshoot around A14U109 using fig. FO-27, Sheet 12, circuit AL. Replace faulty component.

2-15. SYNTHESIZER SECTION TEST- UNLOCKED ROLLER OSCILLATOR PLL TESTS - Main Oscillator PLL Test - Continued.

15. Verify A14U106 pin 7 is a square wave with lower limit between 0 V and +0.5 V and upper limit between +3 V and +5 V.

    - If incorrect, troubleshoot around A14U106 using fig. FO-27, Sheet 12, circuit AL. Replace faulty component.

16. Verify A14U105 pin 1 has a similar waveform as step 17, but may be different in amplitude.

    - If incorrect, troubleshoot around A14U103 and A14U104 using fig. FO-27, Sheet 12, circuit AJ. Replace faulty component.

17, Verify A14U105 pins 2 and 13 have narrow (<0.1 µs) pulses 0.5 µs apart.

    - If incorrect, troubleshoot around A14U105 using fig. FO-27, Sheet 12, circuit AL. Replace faulty component.

18. Temporarily short A14U115B pin 5 to ground and verify voltage at A14U115B pin 7 is less than (more negative) than -9.1 Vdc.

19. Temporarily short A14U115B pin 6 to ground and verify voltage at A14U115B pin 7 is greater than +9.1 Vdc.

    - If readings in steps 18 or 19 are incorrect, troubleshoot around A14U1 15 using fig. FO-27, Sheet 12, circuit AL. Replace faulty component.

20. If error 304 is displayed, and Transfer Oscillator PLL Test passed, troubleshoot A14U305, A14U328, and A14U326D using fig. FO-27, Sheet 8, circuit AG.

    - If malfunction is located, replace faulty component.
    - If malfunction is not located, perform all A3 Interface CCA ADC Circuit Tests and A3 Interface CCA Control Circuit Tests (para 2-12).

21. On AN/USM-489A,

    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED OFFSET PLL TESTS - Continued.

UNLOCKED OFFSET PLL TEST.

DESCRIPTION

This test is used to isolate sampling oscillator phase-lock-loop malfunctions in the Synthesizer Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-28 as required for component location information.
- See fig. FO-30 Sheets 6 and 7, circuits AB, AC, AD, AG, Al, AJ, AK, AL, AM, AN, and AO as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Using an active probe and another spectrum analyzer, verify A15TP404 is ≈ 300 MHz at ≈ +5 dBm, and A15TP408 is ≈ 10 MHz at TTL-levels.
   - If incorrect, perform Unlocked Reference PLL Test (para 2-15).
3. On AN/USM-489A,
   - Short A15X201 pin 1 to A15X201 pin 5 (unlocks PLL).
   - Connect a dc power supply to A15J200 pin 16 and ground to pin 12.
   - Connect an active probe and another spectrum analyzer to A15TP201.
4. Adjust dc power supply output until frequency on spectrum analyzer (connected to A15TP201) is 280 MHz.
5. Verify dc power supply output voltage is between +2 Vdc and +8 Vdc.
   - If incorrect, perform Adjust Sampling Oscillator (para 2-26).
6. Using an active probe and another spectrum analyzer, verify A15TP402 is ≈ 300 MHz at +7 dBm.
   - If incorrect, troubleshoot using fig. FO-30, Sheet 7, circuit AM. Replace faulty component.
7. Using an active probe and another spectrum analyzer, verify A15TP400 is ≈ 280 MHz at 0 dBm.
   - If incorrect, proceed to step 8.
   - If correct, proceed to step 9.

2-15. SYNTHESIZER SECTION TEST- UNLOCKED OFF SET PLL TESTS - Continued.

8. Using an active probe and another spectrum analyzer, verify points in following table.

Meas Point	Reading	If incorrect, troubleshoot using
A15TP200	≈ +3 dBm @ ≈ 280 MHz	fig. FO-30, Sheet 6, circuit AC
A15TP201	≈ +10 dBm @ ≈ 280 MHz	fig. FO-30, Sheet 6, circuit AD
A15TP202	≈ +4 dBm @≈ 80 MHz	fig. FO-30, Sheet 6, circuit AG

- If incorrect, perform as instructed.

9. Using an active probe and another spectrum analyzer, verify points in following table.

Meas Point	Reading	If incorrect, troubleshoot using
A15TP401	≈ –6 dBm @ ≈ 20 MHz	fig. FO-30, Sheet 6, circuit Al
A15U401 pin 2	≈ –6 dBm @ ≈ 20 MHz	fig. FO-30, Sheet 6, circuit AJ

- If incorrect, perform as instructed.

10. Using an oscilloscope, verify A15TP405 is a 20 MHz square-wave signal at +0.6 V to +2.2 V.
    - If incorrect, troubleshoot using fig. FO-30, Sheet 7, circuit AK. Replace faulty component.
11. On AN/USM-489A,
    - Set CENTER FREQ to 369.3 MHz.
    - Set SPAN WIDTH to 0 Hz.
12. Using an oscilloscope, verify A15TP406 and A15TP407 both have a 2.5 MHz TTL-level signal.
    - If incorrect, troubleshoot using information from following table and fig. FO-30, Sheet 7, circuits AL and AN, Replace faulty component.

Sampling (oscillator Freq. (MHz)	CENTER FREQ. * (MHz)	Divide Ratios		A15TP406 A15TP407 TTL Level (MHz)	N Control Lines TTL Level A15U403			M Control Lines TTL Level A15U404	
		N	M		pin 3	pin 4	pin 5	pin 3 & 4	pin 5
280.0	389.5	8	4	2.5	high	high	high	high	low
282.5	427.0	7	4	2.5	low	high	high	high	low
284.0	449.5	8	5	2.0	high	high	high	low	high
285.0	464.5	6	4	2.5	high	low	high	high	low
286.0	479.5	7	5	2.0	low	high	high	low	high
287.5	502.0	5	4	2.5	low	low	high	high	low
288.0	509.5	6	5	2.0	high	low	high	low	high
290.0	539.5	5	5	2.0	low	low	high	low	high
292.0	569.5	4	5	2.0	high	high	low	low	high
292.5	577.0	3	4	2.5	low	high	low	high	low
294.0	599.5	3	5	2.0	low	high	low	low	high
295.0	614.5	2	4	2.5	high	low	low	high	low
296,0	629.5	2	5	2.0	high	low	low	low	high
297.5	652.0	1	4	2.5 •	low	low	low	high	low
298.0	659.5	1	5	2.0	low-	low	low	low	high

*Set Sampling Oscillator to a desired frequency by setting AN/USM-489A SPAN WIDTH to 0 Hz and CENTER FREQ to value listed above.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED OFFSET PLL TESTS - Continued.

13. On AN/USM-489A,
    - Set LINE to OFF.
    - Disconnect dc power supply from A15J200 pin 16.
    - Unsoldering one end of A15R436 (locks loop's phase/frequency detector).
    - Short A15TP406 to A15TP407.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press PRESET button.
    - Set CENTER FREQ to 369.3 MHz.
    - Set SPAN WIDTH to 0 Hz.
14. Using an oscilloscope, verify A15U406 pin 5 is normally low pulsing high and A15U406 pin 8 is normally high pulsing low (narrow pulses).
    - If incorrect, troubleshoot using fig. FO-30, Sheet 7, circuit AO. Replace faulty component.
15. Using an at-coupled oscilloscope, verify cathode of A15CR401 is a ≈ 5 mV p-p sawtooth waveform.
    - If incorrect, troubleshoot using fig. FO-30, Sheet 7, circuit AP. Replace faulty component.
16. On AN/USM-489A, short A15C441.
17. Verify voltage at A15J200 pin 15 is +1.8 Vdc.
    - If incorrect, adjust A15R453 for +1.8 Vdc.
18. Verify voltage at A15U408 pin 2 is +1.8 Vdc.
    - If incorrect, suspect A15U408. Troubleshoot using fig. FO-30, Sheet 6, circuit AB. Replace faulty component.
19. Verify voltages at A15U408 pin 6 and A15J200 pin 16 are ≈ 2 Vdc.
    - If incorrect, troubleshoot using fig. FO-30, Sheet 6, circuits AB and AC. Replace faulty component.
    - If correct, troubleshoot remaining problems using fig. FO-30. Replace faulty component.
20. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Remove short from A15X201 pin 1.
    - Remove short from A15C441.
    - Resolder A15R436.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

2-15. SYNTHESIZER SECTION TEST- UNLOCKED REFERENCE PLL TESTS.

UNLOCKED REFERENCE PLL TEST.

DESCRIPTION

This test is used to isolate reference oscillator phase-lock-loop malfunctions in the Synthesizer Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-28 as required for component location information.
- See fig, FO-30 Sheets 3, 4 and 5, circuits M, O, P, Q, R, S, U, X as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Using an active probe and another spectrum analyzer, verify A15J701 is a 600 MHz signal at ≈ 0 dBm.
   - If 600 MHz is present and stable, reference PLLs are probably locked.
   - If 600 MHz is off-frequency, unstable, or less than -3 dBm, proceed to step 3.
3. Verify cathodes of A15CR701 and A15CR702 are between 0 V and 18 V.
   - If incorrect, troubleshoot using fig. FO-30, Sheet 4, circuits P and Q. Replace faulty component.
4. Temporarily place a 100-ohm resistor across A15U701 pins 1 and 2, and verify A15J701 has a 600 MHz signal.
   - If incorrect, suspect A15U701. Troubleshoot using fig. FO-30, Sheet 4, circuit Q. Replace faulty component.
5. Verify voltage at A15J502 pin 3 (ground at A15J502 pin 6) is between 0 Vdc and 5.75 Vdc.
   - If incorrect, troubleshoot using fig. FO-30, Sheet 4, circuit P. Replace faulty component.
6. On AN/USM-489A,
   - Disconnect W22 (GRY) from A15J301.
   - Connect a frequency counter to A15J301.
   - Wait 5 minutes.

2-15. SYNTHESIZER SECTION TEST- UNLOCKED REFERENCE PLL TESTS - Continued.

7. Verify frequency counter reads 10 MHz ±40 Hz.

   - If incorrect, perform 10 MHz Reference Test (para 2-16).

8. On AN/USM-489A,

   - Disconnect frequency counter.
   - Reconnect W22 to A15J301.

9. Using an oscilloscope, verify points in following table.

Meas Point	Reading	If incorrect, troubleshoot using
A15U504 pin 3	≈10 MHz @ TTL levels	fig. FO-30, Sheet 3, circuit M
A15U504 pin 11	≈ 10 MHz @ TTL levels	fig. FO-30, Sheet 5, circuit X
A15U503 pin 3	≈ 10 MHz @ ECL levels	fig. FO-30, Sheet 5, circuit X

   - If incorrect, perform as instructed.

10. Using an active probe and another spectrum analyzer, verify points in following table.

Meas Point	Reading	If incorrect, troubleshoot using
A15TP506	50 MHz @ ≥+3 dBm	fig. FO-30, Sheet 5, circuit X
A15U502 pin 15	300 MHz @ ≥+3 dBm	fig. FO-30, Sheet 5, circuit U
A15TP503	300 MHz @ ≈ +8 dBm	fig. FO-30, Sheet 5, circuit U
A15TP502	300 MHz @ ≈ +3 dBm	fig. FO-30, Sheet 5, circuit S
A15TP701	600 MHz @ ≈ 0 dBm	fig. FO-30, Sheet 5, circuit R

   - If incorrect, perform as instructed.

11. Connect an oscilloscope channel A to A15U504 pin 5 and channel B to A15U504 pin 9.
12. Verify oscilloscope displays stable, narrow (≈ 20 us wide), positive-going TTL pulses at 10 MHz on both channels.

   - If incorrect, suspect A15U504. Troubleshoot using fig. FO-30, Sheet 4, circuit O. Replace faulty component.

13. On AN/USM-489A,

   - Press FREQUENCY button.
   - Press MORE key.
   - Set 10 MHz to EXT.
   - Verify rear panel 10 MHz REF IN/OUT connector is not connected.

14. Verify voltage at A15J502 pin 3 is ≈ -6 Vdc.
15. On AN/USM-489A,

   - Set 10 MHz to INT.
   - Remove A15C519 from A15X501.

16. Verify voltage at A15J502 pin 3 is ≈ +7 Vdc.
17. Verify voltage at A15J502 pin 3 is between 0 V and +5.75 Vdc.

   - If steps 15 through 17 are incorrect, troubleshoot using fig, FO-30, Sheet 4, circuit P. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-30. Replace faulty component.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED REFERENCE PLL TESTS - Continued.

18. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

Third LO Driver Amplifier Test.

DESCRIPTION

This test is used to isolate third local oscillator driver amplifier malfunctions in the synthesizer section to the malfunctioning component or assembly.

NOTES

- Before proceeding with Main Oscillator PLL Test, perform Offset Oscillator PLL Test and Transfer Oscillator PLL Test to confirm loops are locked.
- Refer to Chapter 1 for circuit principles of operation.
- See fig, FO-28 as required for component location information.
- See fig. FO-30 Sheets 2 and 5, circuits F and V as required for schematic diagrams.
- See paragraph 2-46 and 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
    - Place A14/A15 in service position (para 2-45).
    - Connect power cable to the rear panel.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
2. Using an active probe and another spectrum analyzer, verify points in following table.

Mess Point	Reading	If incorrect,
A15TP602	300 MHz @ ≥+7 dBm	Proceed to step 3
A15TP504	300 MHz @ ≥+11 dBm	Proceed to step 4

    - If incorrect, perform as instructed.
3. Verify cathodes at A15CR603 and A15CR605 are ≈ +10 Vdc.
    - If incorrect, troubleshoot using fig. FO-30, Sheet 2, circuit F. Replace faulty component.

2-15. SYNTHESIZER SECTION TEST - UNLOCKED REFERENCE PLL TESTS -
Third LO Driver Amplifier Test - Continued.

4. Using an active probe and another spectrum analyzer, verify A15TP503 is ≈10 MHz at ≈ + 10 dBm.

   Ž If incorrect, perform Unlocked Reference PLL Test (para 2-15).

   Ž If correct, troubleshoot using fig. FO-30, Sheet 5, circuit V. Replace faulty component.

5. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

SAMPLER AND SAMPLER IF TEST.

DESCRIPTION

This test is used to isolate sampler malfunctions in the Synthesizer Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-28 as required for component location information.
- See fig. FO-30 Sheet 6, circuit Y, AC, and AD as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Disconnect W32 (GRY/VIO) from A15J101.
   - Connect power splitter input to A15J101.
   - Connect power splitter output to W32.
   - Connect power splitter output to another spectrum analyzer.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.

2-15. SYNTHESIZER SECTION TEST - SAMPLER AND SAMPLER IF TEST - Continued.

2. Verify spectrum analyzer (connected to power splitter) displays a 94.7 MHz signal at greater than (more positive). Record reading.

   - If incorrect, proceed to step 3.
   - If correct, proceed to step 6.

3. On AN/USM-489A,

   - Disconnect W36 (BLK) from A15U100J1.
   - Connect signal generator to A15U100J1.

4. Set signal generator controls as follows:

   Frequency ....4.2107 GHz
   Amplitude ....–5 dBm

5. Verify spectrum analyzer (connected to power splitter) displays a 94.7 MHz signal at ≈ 0 dBm.

6. Using an active probe and another spectrum analyzer, verify points in following table.

Meas Point	Reading	If incorrect, troubleshoot using
A15TP101	94.7 MHz @ ≈ -10 dBm	Proceed to step 7
A15TP201	294 MHz @ ≈ +10 dBm	fig. FO-30, Sheet 6, circuits AC and AD

   - If incorrect, perform as instructed.
   - If correct, and reading recorded in step 2 was incorrect, proceed to step 9.

7. Using an oscilloscope, verify points in following table.

Meas Point	Reading
A15J400 pin 1	+1.0 Vdc to +2.4 Vdc with <0.5 V p-p variation
A15J400 pin 3	-1.0 Vdc to –2.4 Vdc with <0.5 V p-p variation

   - If incorrect, perform Adjust Sampler Oscillator (para 2-26).

8. Repeat step 6.

   - If adjustment failed to correct A15TP101 reading, and A15TP201 is correct, replace A15U100.

9. Perform steps 2 and 4 (if not already performed).

10. Using an active probe and another spectrum analyzer, verify signal at A15U103 pin 1 is ≈ 94.7 MHz at ≈ -14 dBm.

   - If correct, and reading recorded in step 4 was incorrect, suspect A15U103. Troubleshoot using fig. FO-30, Sheet 6, circuit Y. Replace faulty component.
   - If incorrect, troubleshoot using information in the following table and fig. FO-30, Sheet 6, circuit Y. Replace faulty component.

CENTER FREQ	A15U104 pin 3	A15U104 pin 6	A15CR101	A15CR102	A15CR103
300 MHz	TTL low	-15 Vdc	reverse-biased	reverse-biased	reverse-biased
89.3 MHz	TTL high	> + 7 V	forward (≈7mA)	forward (≈7mA)	forward (≈7mA)

   - Troubleshoot remaining problems using fig. FO-30. Replace faulty component.

2-15. SYNTHESIZER SECTION TEST- SAMPLER AND SAMPLER IF TEST - Continued.

11. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W36 to A1U100J1.
    - Reconnect W32 to A15J101.
    - Reinstall A14/A15 and cover.

2-16. RF SECTION TEST

DESCRIPTION

This test is used to isolate RF related malfunctions in the A7 LO Distribution Amplifier, A8 Dual Mixer, A9 Input Attenuator, A10 YIG-Tuned Filter, All YIG-Tuned Oscillator (YTO), A12 RF Switch, A13 Second Converter, and portions of A14 Frequency Control CCA and A15 RF CCA to the malfunctioning component or assembly.

CAUTION

Use an active probe and another spectrum analyzer when troubleshooting the RF Section. If the spectrum analyzer has a dc coupled input, set the active probe for an ac coupled output or use a dc blocking capacitor between active probe and spectrum analyzer input.

CAUTION

Many RF Section components are extremely sensitive to Electrostatic Discharge (ESD). Refer to page C for more information.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

1. Troubleshooting the RF Section consists of performing up to twelve individual test procedures, some of which contain sub-tests.

   - If the specific test (or subtest) is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph. Table 2-6 contains a complete list of RF Section Tests/Subtests.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate test in Table 2-6.
   - If a specific test was not provided and the symptoms are not obvious. perform all tests in the order' presented in Table 2-6.

Table 2-6. RF Section Tests

Test Name	Subtest Name	Page
A14 TAM Tests	A14J302	2-160
	A14J15	2-161
	A14J16	2-162
	A14J17	2-162
	A14J18	2-163
	A14J19	2-163
	A14J303	2-164
A15 TAM Tests	A15J901	2-165
	A15J200	2-166
	A15J400	2-167
	A15J502	2-167
	A15J602	2-168

2-16. RF SECTION TEST - Continued.

Table 2-6. RF Section Tests – Continued

Test Name	Subtest Name	Page
Low Band (1 kHz to 2.9 GHz) Test	None	2-209
High Band (2.75 to 22 GHz) Test	None	2-210
Low and High Band Test	None	2-211
A7 LODA (Lo Distribution Amplifier) Test	None	2-213
A8 Dual Mixer Test	PIN Switch Test	2-215
	High Band Bias Test	2-216
A9 Input Attenuator Test	None	2-218
A12 RF Switch Test	None	2-220
A13 Second Converter Test	None	2-223
A14 Frequency Control CCA Test	A7 LODA Drive Test	2-226
	Control Latch for Band-Switch Driver Test	2-228
	YTF Driver Circuit Test	2-229
A15 RF CCA Test	Confirming Faulty Third Converter Test	2-233
	Third Converter Test	2-235
	Control Latches Test	2-237
	SIG ID Oscillator Test	2-239
	10 MHz Reference Test	2-241

LOW BAND (1 KHZ TO 2.9 GHZ) TEST.

DESCRIPTION

This test is used to isolate 1 kHz to 2.9 GHz RF malfunctions in the RF Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-23 as required for component location information.
- See fig. FO-24 as required for functional block diagram.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Verify front panel **INPUT 50Ω** connector is not connected.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 0 Hz.
   - Set SPAN WIDTH to 1 MHz.
   - Set INPUT ATTEN to 0 dB.
   - Press MARKER ON button.

2-16. RF SECTION TEST- LOW BAND (1 KHZ TO 2.9 GHZ) TEST- Continued.

2. Verify LO feedthrough amplitude on CRT display is between -10 and -30 dBm.
   - If correct, but signals are low, troubleshoot signal path up to A8 Dual Mixer using fig. FO-24. Replace faulty component,
   - If amplitude is higher than -5 dBm (clipped at top of CRT screen), and signals are low in amplitude, suspect A8 Dual Mixer. Troubleshoot using fig. FO-24. Replace faulty component.
3. Perform Control Latch for Band-Switch Driver Test (para 2-16).
   - If test fails, perform as instructed.
4. Verify voltage at A14J12 pin 1 is between -150 mVdc and -900 mVdc.
   - If incorrect, perform A13 Second Converter Test (para 2-16).
5. Troubleshoot remaining low band problems using fig. FO-24. Replace faulty component.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

HIGH BAND (2. 75 GHZ TO 22 GHZ) TEST.

DESCRIPTION

This test is used to isolate 2.75 kHz to 22 GHz RF malfunctions in the RF Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-23 as required for component location information.
- See fig, FO-24 as required for functional block diagram.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Perform PIN Switch Test (para 2-16).
   - If test fails, perform as instructed.

2-16. RF SECTION TEST- HIGH BAND (2.75 GHZ TO 22 GHZ) TEST- Continued.

3. Perform High Band Bias Test (para 2-16).
   - If test fails, perform as instructed.
4. Perform Control Latch for Band-Switch Driver Test (para 2-16).
   - If test fails, perform as instructed.
5. Troubleshoot remaining low band problems using fig. FO-24. Replace faulty component.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

LOW AND HIGH BAND TEST.

DESCRIPTION

This test is used to isolate 1 kHz to 22 GHz RF malfunctions in the RF Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7 - A13), or FO-28 (A15) as required for component location information.
- See fig. FO-24 as required for A7 - A13 functional block diagram.
- See fig. FO-30 (A15) as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press REALIGN LO IF button.
   - If error message 334 is displayed, proceed to step 8.
   - If any other error message is displayed, troubleshoot using Table 2-1.

2-16. RF SECTION TEST - LOW AND HIGH BAND TEST- Continued.

2. Adjust External Mixer Amplitude (para 2-35).
   - If adjustment cannot be completed, proceed to step 3.
   - If adjustment can be completed, proceed to step 6.
3. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Disconnect W35 (WHT/RED) from A15J801.
   - Connect a signal generator to A15J801.
4. Set signal generator controls as follows:

   Frequency ....310.7 MHz
   Amplitude ....-28 dBm
5. On AN/USM-489A, verify a flat line is displayed within 2 dB of the reference level.
   - If correct, perform Confirming Faulty Third Converter Test (para 2-16).
   - If incorrect, reconnect W35 to A15J801 and proceed to step 6.
6. Perform 1st LO Output Amplitude Performance Test (para 2-18).
   - If performance test fails, proceed to step 7.
   - If performance test passes, proceed to step 11.
7. Adjust 1st LO Distribution Amplifier (para 2-28).
   - If adjustment cannot be completed, proceed to step 8.
   - If adjustment can be completed, proceed to step 11.
8. On AN/USM-489A,
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Place A14J23 jumper in TEST position.
   - Disconnect W38 from A11J2.
   - Connect another spectrum analyzer to A11J2.
9. Verify spectrum analyzer (connected to A11J2) reads between +9 dBm and +13 dBm at from 3.0 GHz to 6.81 GHz.
   - If correct, and error 334 is displayed, perform A7 LODA Test (para 2-16).
10. On AN/USM-489A,
    - Place A14J23 jumper in NORM position.
    - Reconnect W38 to A11J2.
11. Troubleshoot remaining low band problems using fig. FO-24. Replace faulty component.
12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

2-16. RF SECTION TEST - A7 LODA (LO DISTRIBUTION AMPLIFIER) TEST.

A7 LODA (LO DISTRIBUTION AMPLIFIER) TEST.

DESCRIPTION

This test is used to isolate local oscillator distribution amplifier malfunctions in the RF Section to the malfunctioning component or assembly.

CAUTION

Do not connect or disconnect W12 with AN/USM-489A LINE switch set to ON. Failure to set LINE to OFF before disconnecting W12 will destroy the A7 LODA Assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7 - A13), or FO-25 (A14) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27 (A14) as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
    - Place A14/A15 in service position (para 2-45).
    - Connect power cable to the rear panel.
    - Set LINE to OFF.
    - Disconnect W12 from A14J10.
    - Jumper between A14J10 pin 5 and A14J19 pin 6.
    - Jumper between A14J18 pin 13 and A14J18 pin 1.
    - Connect a digital multimeter (+) lead to A14J18 pin 14 and (-) lead to A14J18 pin 6.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press PRESET button.
2. Verify digital multi meter reading is more negative than -14 Vdc.
3. On AN/USM-489A, move jumper from A14J18 pin 1 to A14J18 pin 2.
4. Verify digital multi meter reading is more positive than +14 Vdc.
    - If steps 2 or 4 incorrect, perform LODA Drive Test (para 2-16).

2-16. RF SECTION TEST - A7 LODA (LO DISTRIBUTION AMPLIFIER) TEST - Continued.

5. Connect digital multi meter (+) lead to A14J10 pin 1 and verify reading is ≈ +5 Vdc.
   - If incorrect, perform LODA Drive Test (para 2-16).
6. Connect digital multi meter (+) lead to A14J18 pin 15 and verify reading is within 5% of GATE BIAS voltage listed on A7 LODA's label.
   - If incorrect, proceed to step 7.
   - If correct, proceed to step 8.
7. Rotate A14R628 fully CW and CCW while monitoring digital multi meter, and verify reading varies between 0 Vdc and -2 Vdc.
   - If correct, adjust A14R628 to within 1%. of GATE BIAS voltage listed on A7 LODA'S label.
   - If incorrect, perform LODA Drive Test (para 2-16).
8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove jumper from A14J10 pin 5 and A14J19 pin 6.
   - Reconnect W12 to A14J10.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
9. Verify digital multi meter reading is within 5% of GATE BIAS voltage listed on A7 LODA's label.
   - If incorrect, replace A7 LODA (para 2-57).
10. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Remove jumper from A14J18.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

A8 DUAL BAND MIXER TEST.

DESCRIPTION

This test is used to isolate A8 Dual Mixer Assembly malfunctions in the RF Section to the malfunctioning component or assembly.

---

1. Troubleshooting A8 Dual Mixer Assembly malfunctions consist of performing up to two individual test procedures.
   - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented.

2-16. RF SECTION TEST - A8 DUAL BAND MIXER TEST - PIN Switch Test.

PIN Switch Test.

DESCRIPTION

This test is used to determine if the A8 Dual Mixer Assembly is receiving proper switching information from the A14 Frequency Control CCA.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-25 as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27, Sheet 7, circuit W as required for schematic diagrams.
- See paragraph 2-46 and 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Connect a digital multimeter (+) lead to A14J19 pin 14 and (-) lead to A14J19 pin 6.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press CENTER FREQ to 1 GHz.
2. Verify digital multi meter reading is between +10 Vdc and +13 Vdc.
3. On AN/USM-489A, set CENTER FREQ to 4 GHz.
4. Verify digital multi meter reading is between -10 Vdc and –13 Vdc.
   - If steps 2 and 4 are correct, perform High Band Bias Test (para 2-16).
   - If steps 2 and 4 are incorrect, proceed to step 5.
5. On AN/USM-489A,
   - Disconnect W15 from A14J11.
   - Press CENTER FREQ to 1 GHz.
6. Verify digital multi meter reading is between +14 Vdc and +15 Vdc.
7. On AN/USM-489A, set CENTER FREQ to 4 GHz.

2-16. RF SECTION TEST - A8 DUAL BAND MIXER TEST – PIN Switch Test - Continued.

8. Verify digital multi meter reading is between -14 Vdc and -15 Vdc.
   - If steps 6 and 8 are correct, perform High Band Bias Test (para 2-16).
   - If steps 6 and 8 are incorrect, troubleshoot using fig. FO-27, Sheet 7, circuit W. Replace faulty component.
9. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

High Band Bias Test.

DESCRIPTION

This test is used to determine if the A8 Dual Mixer Assembly is receiving proper bias from the A14 Frequency Control CCA.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7 - A13), or FO-25 (A14) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27 Sheet 7, circuit W as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Connect a digital multimeter (+) lead to A14J19 pin 13 and (-) lead to A14J19 pin 6.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set SPAN WIDTH to 0 Hz.
2. On AN/USM-489A, set CENTER FREQ to 5 GHz.
3. Record digital multi meter reading (to mV resolution) as 5 GHz Band 1.

2-16. RF SECTION TEST - A8 DUAL BAND MIXER TEST - High Band Bias Test - Continued.

4. Repeat steps 2 and 3 for following AN/USM-489A CENTER FREQ's:

NOTE

To avoid errors or confusion, blank spaces are provided to record the numerous readings required for future calculations. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

AN/USM-489A CENTER FREQ	Digital Multi meter Reading (to mV resolution)	A8 Dual Mixer Assembly Label Voltage
5 GHz	**Band 1 ____________ Vdc**	**1 _______________ Vdc**
10 GHz	**Band 2 ____________ Vdc**	**2 _______________ Vdc**
15 GHz	**Band 3 ____________ Vdc**	**3 _______________ Vdc**
20 GHz	**Band 4 ____________ Vdc**	**4 _______________ Vdc**

5. Record mixer-bias voltages printed on A8 Dual Mixer Assembly's label for each band.
6. Verify each digital multi meter reading recorded in step 3 is within 50 mV of mixer-bias voltages printed on A8 Dual Mixer label.
   - If incorrect, perform Adjust Dual Band Mixer Bias (para 2-29), then proceed to step 7.
   - If correct, proceed to step 7.
7. On AN/USM-489A,
   - Move A2J12 jumper to WR ENA position.
   - Set CENTER FREQ to 5 GHz.
   - Set SPAN WIDTH to 10 MHz.
   - Set LOG DB/DIV to 2 dB/DIV.
   - Press INT button.
   - Press MIXER BIAS key.
   - Record MIXER BIAS DAC setting.
   - Set MIXER BIAS DAC to 0.
   - Connect a signal generator to front panel INPUT 50 Ω connector.
8. Set signal generator controls as follows:

   Frequency .... 5 GHz
   Amplitude .... 0 dBm

9. Using the front panel knob, step DAC value from 0 to 255. While changing value verify:
   - Voltage reading on digital multi meter increases as DAC is stepped from 0 to 255.
   - Signal displayed on CRT exhibits a peak (sometimes two peaks) as DAC is stepped through its range.

2-16. RF SECTION TEST - A8 DUAL BAND MIXER TEST - High Band Bias Test - Continued.

10. Analyze results of step 9.
    - If incorrect, proceed to step 11.
    - If correct, troubleshoot mixer malfunctions using fig. FO-24. Replace faulty component.
11. On AN/USM-489A, disconnect W15 from A14J11.
12. Repeat step 9.
    - If correct, replace A8 Dual Mixer Assembly (para 2-58).
    - If incorrect, troubleshoot using fig. FO-27, Sheet 7, circuit W. Replace faulty component.
13. On AN/USM-489A,
    - Reset DAC value recorded in step 7.
    - Set LINE to OFF.
    - Remove power cable.
    - Move A2J12 jumper to WR PROT position.
    - Disconnect test cables and equipment.
    - Reconnect W15 to A14J11.
    - Reinstall A14/A15 and cover.

A9 INPUT ATTENUATOR TEST.

DESCRIPTION

This test is used to isolate A9 Input Attenuator Assembly malfunctions in the RF Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for component location information.
- See fig. FO-23 (A7 - A13), or FO-25 (A14) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27 Sheet 7, circuit V as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

2-16. RF SECTION TEST- A9 INPUT ATTENUATOR TEST - Continued.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Perform Input Attenuator Accuracy Performance Test (para 2-18).
   - If step-to-step error is ≈ 10 dB or more, proceed to step 3.
   - If correct, malfunction is cleared.
3. On AN/USM-489A,
   - Press AMPLITUDE button.
   - Press ATTEN key.
   - Set ATTEN to 0 dB.
4. Using a logic probe, verify A14U420 TTL levels are as follows for 0 dB ATTEN setting:

ATTEN Setting (dB)	A14U420 pin 3	414U420 pin 4	A14U420 pin 5	A14U420 pin 6	A14U420 pin 10	A14U420 pin 11	A14U420 pin 12	A14U420 pin 13
0	high	low	high	low	low	high	low	high
10	high	low	high	low	low	high	high	low
20	high	low	low	high	low	high	low	high
30	high	low	low	high	low	high	high	low
40	high	low	low	high	high	low	low	high
50	high	low	low	high	high	low	high	low
60	low	high	low	high	high	low	low	high
70	low	high	low	high	high	low	high	low

5. On AN/USM-489A, press STEP up arrow button and verify a click is heard.
6. Repeat steps 4 and 5 until RF ATT is at 70 dB.
   - If steps 4 through 6 are incorrect, proceed to step 7.
   - If steps 4 through 6 are correct, check W11. If good, suspect A9 Input Attenuator Assembly. Troubleshoot malfunction using fig. FO-24. Replace faulty component.
7. On AN/USM-489A,
   - Set ATTEN to 0 dB.
   - Disconnect W11 from A14J6.

2-16. RF SECTION TEST - A9 INPUT ATTENUATOR TEST - Continued.

8. Using a logic probe, verify A14U420 TTL levels are as follows for each ATTEN setting:

ATTEN Setting (dB)	A14U420 pin 3	A14U420 pin 4	A14U420 pin 5	A14U420 pin 6	A14U420 pin 10	A14U420 pin 11	A14U420 pin 12	A14U420 pin 13
0	high	low	high	low	low	high	low	high
10	high	low	high	low	low	high	low	low
20	high	low	low	low	low	high	low	high
30	high	low	low	low	low	high	low	low
40	high	low	low	low	low	low	low	high
50	high	low	low	low	low	low	low	low
60	low	low	low	low	low	low	low	high
70	low	low	low	low	low	low	low	low

- if incorrect, troubleshoot using fig. FO-27, Sheet 7, circuit V. Replace faulty component.
- if correct, check W11. If good, suspect A9 Input Attenuator Assembly. Troubleshoot malfunction using fig. FO-24. Replace faulty component.

9. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W11 to A14J6.
   - Reinstall A14/A15 and cover.

A12 RF SWITCH TEST.

DESCRIPTION

This test is used to isolate A12 RF Switch malfunctions in the RF Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7 - A13), or FO-25 (A14) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27, Sheet 8, circuit AA as required for schematic diagrams.
- See paragraph 2-46 and 2-47 (as required) for procedure on removing circuit card shields.

2-16. RF SECTION TEST - A12 RF SWITCH TEST - Continued.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Connect a digital multimeter to A14J16 pin 15 and ground.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
2. On AN/USM-489A, set CENTER FREQ to 3 GHz and verify a click is heard and that digital multi meter reads ≈ +5.6 Vdc.
3. On AN/USM-489A, set CENTER FREQ to 300 MHz and verify a click is heard and that digital multi meter reads ≈ +5.6 Vdc.
   - If steps 2 and 3 correct, proceed to step 6.
   - If a click is heard in steps 2 and 3, and voltage at one setting is greater than +5.6 Vdc, troubleshoot using fig. FO-27, Sheet 8, circuit AA. Replace faulty component.
   - If a click is heard, and voltage at one setting is less than +5.6 Vdc, proceed to step 4.
   - If a buzzing sound was heard, and voltage at setting where switch buzzes is less than +5.6 Vdc, troubleshoot using fig. FO-27, Sheet 8, circuit AA. Replace faulty component.
   - If a buzzing sound was heard, and voltage at setting where switch buzzes is greater than +5.6 Vdc, proceed to step 4.
   - If no sound was heard, proceed to step 4.
4. On AN/USM-489A,
   - Disconnect W14 from A14J8.
   - Set CENTER FREQ to 300 MHz.
5. On AN/USM-489A, set CENTER FREQ between 3 GHz and 300 MHz and verify digital multimeter reads ≈ 0.2 Vdc at each setting.
   - If correct, replace A12 RF Switch Assembly (para 2-62).
   - If incorrect, reconnect W14 to A14J18 and perform Control Latch for Band Switch Driver test (para 2-16). If test passes, troubleshoot using fig. FO-27, Sheet 8, circuit AA. Replace faulty component.
6. On AN/USM-489A,
   - Disconnect W44 from FL1 and A12J2.
   - Connect another spectrum analyzer to A12J2.
   - Connect CAL OUTPUT connector to INPUT 50 Ω connector using BNC cable and adapter supplied.
   - Set CENTER FREQ to 300 MHz.
   - Set INPUT ATTEN to 0 dB.

2-16. RF SECTION TEST - A12 RF SWITCH TEST - Continued.

7. Verify signal on spectrum analyzer (connected to A12J2) measures between -8 dBm and -12 dBm at 300 MHz.
8. On AN/USM-489A, set CENTER FREQ to 3 GHz and verify signal on spectrum analyzer (connected to A12J2) disappears.
   - If steps 7 and 8 incorrect, replace A12 RF Switch Assembly (para 2-62).
9. On AN/USM-489A,
   - Disconnect W46 from A10J1 and A12J1.
   - Connect another spectrum analyzer to A12J1.
   - Set CENTER FREQ to 3 GHz.
   - Set INPUT ATTEN to 0 dB.
10. On AN/USM-489A, set CENTER FREQ to 300 MHz and verify signal on spectrum analyzer (connected to A12J1) disappears.
    - If steps 9 and 10 incorrect, replace A12 RF Switch Assembly (para 2-62).
    - Troubleshoot remaining problems using fig. FO-24. Replace faulty component.
11. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W44 to FL1 and A12J2.
    - Reconnect W46 to A10J1 and A12J1.
    - Reinstall A14/A15 and cover.

2-16. RF SECTION TEST - A13 SECOND CONVERTER TEST.

A13 SECOND CONVERTER TEST.

DESCRIPTION

This test is used to isolate A13 second converter malfunctions in the RF Section to the malfunctioning component or assembly.

CAUTION

A13 2nd Converter Assembly is extremely sensitive to Electrostatic Discharge (ESD). Refer to page C for more information.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7 - A13), FO-25 (A14), or FO-28 (A15) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27 Sheet 7, circuit Y as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Disconnect W35 (RED/WHT) from A13J2.
   - Connect another spectrum analyzer to A13J2.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set ATTEN to 0 dB.
   - Connect CAL OUTPUT connector to INPUT 50 Ω connector using BNC cable and adapter supplied.
2. Verify spectrum analyzer (connected to A13J2) displays a 310.7 MHz signal at ≈ –28 dBm.
   - If correct, A13 2nd Converter Assembly is functioning normally. Troubleshoot malfunction using fig. FO-24. Replace faulty component.

2-16. RF SECTION TEST - A13 SECOND CONVERTER TEST - Continued.

3. On AN/USM-489A,
   - Reconnect W35 to A13J2.
   - Disconnect W33 (GRY/BRN) from A13J4.
   - Connect another spectrum analyzer to W33.
4. Verify spectrum analyzer (connected to W33) displays a 600 MHz signal at ≈ -5 dBm.
   - If incorrect, perform Unlocked Reference PLL Test (para 2-15).
5. Connect digital multi meter (+) lead to A14J19 pin 15 and (-) lead to A14J19 pin 6, and verify +14.0 Vdc and +15.0 Vdc reading.
   - If incorrect, proceed to step 6.
   - If correct, proceed to step 9.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Disconnect W13 from A14J12.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 10 MHz.
7. Verify digital multimeter reading is +15 Vdc ±0.2 V.
   - If incorrect, troubleshoot using fig. FO-27, Sheet 7, circuit Y. Replace faulty component.
8. On AN/USM-489A,
   - Set LINE to OFF.
   - Reconnect W13 to A14J12.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
9. Move digital multimeter (+) lead to A14J19 pin 1 and verify reading is between -150 mVdc and -900 mVdc.
   - If incorrect, replace A13 Second Converter (para 2-63).
10. Set AN/USM-489A CENTER FREQ to 3 GHz.
11. Move digital multimeter (+) lead to A14J19 pin 15 and verify reading is between -2.0 Vdc and -3.5 Vdc.
    - If incorrect, proceed to step 12.
    - If correct, replace A13 Second Converter (para 2-63).

2-16. RF SECTION TEST- A13 SECOND CONVERTER TEST- Continued.

12. On AN/USM-489A,
    - Set LINE to OFF.
    - Disconnect W13 from A14J12.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
    - Press PRESET button.
    - Set CENTER FREQ to 3 GHz.
    - Set SPAN WIDTH to 0 Hz.
13. Verify digital multi meter reading is -15 Vdc +0.2 V.
    - If incorrect, troubleshoot using fig. FO-27, Sheet 7, circuit Y. Replace faulty component.
    - If correct, replace A13 Second Converter Assembly (para 2-63).
14. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W13 to A14J12.
    - Reinstall A14/A15 and cover.

A14 FREQUENCY CONTROL CCA TEST.

DESCRIPTION

This test is used to isolate A14 Frequency Control CCA malfunctions in the RF Section to the malfunctioning component or assembly.

---

1. Troubleshooting A14 Frequency Control CCA malfunctions consists of Performing up to three individual test procedures.
    - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
    - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
    - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented.

2-16. RF SECTION TEST - A14 FREQUENCY CONTROL CCA TEST - A7 LODA Drive Test.

A7 LODA Drive Test.

DESCRIPTION

This test is used to isolate local oscillator distribution amplifier malfunctions in the A14 Frequency Control CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7 - A13), or FO-25 (A14) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27 Sheet 8, circuit Z as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Disconnect W36 (BLK) from A7J4.
   - Connect another spectrum analyzer to A7J4.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 2 MHz.
   - Set TRIGGER to SINGLE.
2. Verify signal displayed on spectrum analyzer (connected to A7J4) is between -2 dBm and -9 dBm at from 3.0 GHz to 6.81 GHz.
   - If output power is low, proceed to step 7.
   - If output power is high, proceed to step 8.
   - If output power is correct, proceed to step 3.
3. On AN/USM-489A,
   - Reconnect W36 to A7J4.
   - Disconnect W39 from A7J2.
   - Connect another spectrum analyzer to A7J2.

2-16. RF SECTION TEST - A14 FREQUENCY CONTROL CCA TEST - A7 LODA Drive Test - Continued.

4. Verify signal displayed on spectrum analyzer (connected to A7J2) is between 13 dBm and 16 dBmat from 3.0 GHz to 6.81 GHz.
   - If output power is low, proceed to step 7.
   - If output power is high, proceed to step 8.
   - If output power is correct, proceed to step 5.
5. On AN/USM-489A,
   - Reconnect W39 to A7J2.
   - Remove **50Ω** load from front panel 1st LO OUTPUT connector.
   - Connect another spectrum analyzer to 1st LO OUTPUT connector.
6. Verify signal displayed on spectrum analyzer (connected to 1st LO OUTPUT connector) is between 14.5 dBm and 18.5 dBm at from 3.0 GHz to 6.81 GHz.
   - If output power is low, proceed to step 7.
   - If output power is high, proceed to step 8.
   - If output power is correct, proceed to step 10.
7. Verify voltage at A14J18 pin 14 is greater than 0 Vdc.
   - If correct, proceed to step 10.
   - If incorrect, proceed to step 9.
8. Verify voltage at A14J18 pin 14 is more negative than -10 Vdc.
   - If correct, proceed to step 10.
   - If incorrect, proceed to step 9.
9. Verify voltages at A14J18 pins 5 and 13 is between -0.1 Vdc and -0.25 Vdc.
   - If correct, troubleshoot around A14U424A using fig. FO-27, Sheet 8, circuit Z, Replace faulty component.
   - If incorrect, proceed to step 10.
10. On AN/USM-489A,
    - Disconnect W38 from A11J2.
    - Connect another spectrum analyzer to A11J2.
11. Verify signal displayed on spectrum analyzer (connected to A11J2) is between 13 dBm and 17 dBm at from 3.0 GHz to 6.81 GHz.
    - If incorrect, perform Confirming Faulty Synthesizer Section Test (para 2-15).
    - If correct, perform A7 LODA Test (para 2-16).
12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reconnect W38 to A11J2.
    - Reinstall A14/A15 and cover.

2-16. RF SECTION TEST - A14 FREQUENCY CONTROL CCA TEST- Control Latch for Band-Switch Driver Test.

Control Latch for Band-Switch Driver Test.

DESCRIPTION

This test is used to isolate band switching malfunctions in the A14 Frequency Control CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-25 as required for component location information.
- See fig. FO-27 Sheet 6, circuit P as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Connect digital multimeter (+) lead to A14U417 pin 5 and (-) lead to A14J18 pin 6.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
2. Verify digital multimeter reading is ≈ 0 Vdc (TTL low).
   - If incorrect, troubleshoot using fig. FO-27, Sheet 6, circuit P. Replace faulty component.
3. On AN/USM-489A, set CENTER FREQ to 3 GHz.
4. Verify digital multi meter reading is ≈ +5 Vdc (TTL high).
   - If incorrect, troubleshoot using fig. FO-27, Sheet 6, circuit P. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-27. Replace faulty component.
5. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

2-16. RF SECTION TEST - A14 FREQUENCY CONTROL CCA TEST - YTF Driver Circuit Test.

YTF Driver Circuit Test.

DESCRIPTION

This test is used to isolate YIG-tuned filter driver malfunctions in the A14 Frequency Control CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-23 (A7 - A13), or FO-25 (A14) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-27, Sheets 4 and 6, circuits K, R, S, and T as required for schematic diagrams.
- See paragraph 2-46 (as required) for procedure on removing circuit card shields.

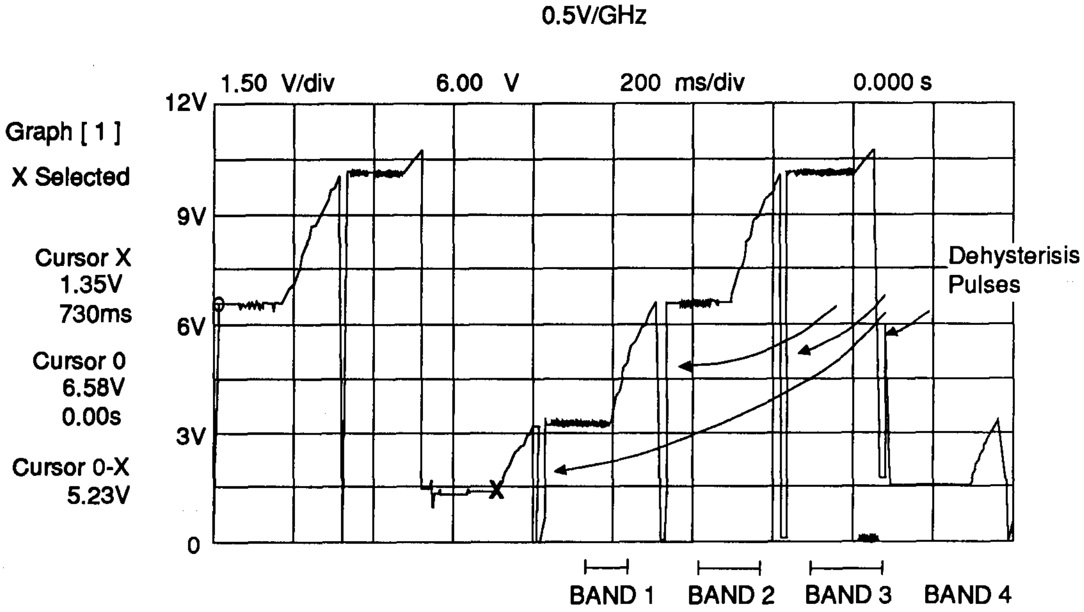
1. On AN/USM-489A,
   - Place A14/A15 in service position (para 2-45).
   - Connect power cable to the rear panel.
   - Connect rear-panel LO SWP 10.5 V/GHz OUTPUT connector to an oscilloscope.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Set START FREQ to 2.75 GHz.
   - Set STOP FREQ to 22 GHz.
   - Press SWEEP button.
   - Press PNL OUTPUT key.
   - Press .5 V/GHz (FAV) key.
2. Set oscilloscope controls as follows:

Amplitude Scale . . . .1.5 V/div

Sweep Time ....200 ms/div

2-16. RF SECTION TEST- A14 FREQUENCY CONTROL CCA TEST - YTF Driver Circult Test - Continued.

3. Verify waveform displayed on oscilloscope is as follows:



- If correct, YTF driver is functioning normally. Troubleshoot remaining problems using fig. FO-27. Replace faulty component.
- If incorrect, proceed to step 4.

4. On AN/USM-489A,
   - Set START FREQ to 8 GHz.
   - Set STOP FREQ to 10 GHz.
   - Connect an oscilloscope to A14J15 pin 1.

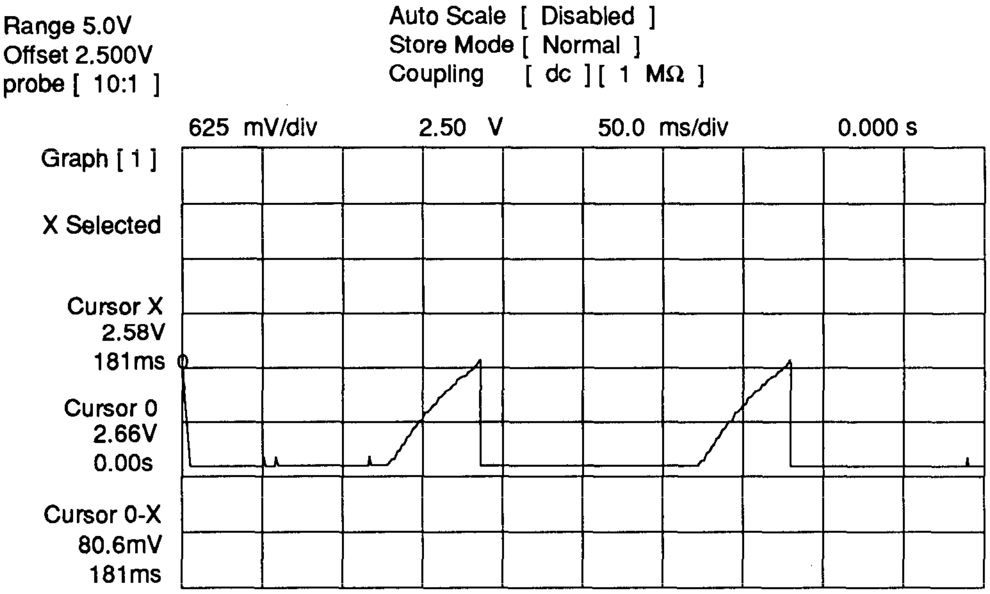
5. Set oscilloscope controls as follows:

Volts/DIV . . . . 625 MV/DIV

Sweep . . . . 50 MS/DIV

2-16. RF SECTION TEST - A14 FREQUENCY CONTROL CCA TEST - YTF Driver Circuit Test - Continued.

6. Verify waveform displayed on oscilloscope is as follows:



Range 5.0V
Offset 2.500V
probe [10:1]

Auto Scale [Disabled]
Store Mode [Normal]
Coupling [dc] [1 MΩ]

625 mV/div 2.50 V 50.0 ms/div 0.000 s

Graph [1]

X Selected

Cursor X
2.58V
181ms

Cursor 0
2.66V
0.00s

Cursor 0-X
80.6mV
181ms

- If in correct, confirm operation of Main Coil Tune DAC and Sweep Generator by performing Unlocked YTO PLL Test. If test passes, troubleshoot using fig. FO-27, Sheet 4, circuit K. Replace faulty component.

7. On AN/USM-489A,
   - Set CENTER FREQ to 5 GHz.
   - Set SPAN WIDTH to 0 Hz.
   - Connect a digital multimeter to A14J16 pin 3.
8. Verify digital multi meter reads -1.33 Vdc ±0.2 Vdc.
   - If incorrect, troubleshoot using fig. FO-27, Sheet 6, circuit Q and information in the following table. Replace faulty component.

AN/USM-489A CENTER FREQ	Multi meter Reading (Vdc)	A14U416A pin 1 State/TTL Level	A14U416B pin 8 State/TTL Level	A14U416C State/TTL Level	Sweep+Tune Multiplier Gain
5 GHz	-1.33 ±0.2 V	Open/high	Closed/low	Closed/low	x I
10 GHz	–2.5 ±0.2 V	Open/high	Closed/low	Open/high	x2
15 GHz	-3.82 ±0.2 V	Closed/low	Open/high	Open/high	x3
20 GHz	-5.07 ±0.2 V	Open/high	Open/high	Open/high	x4

9. Repeat steps 7 and 8 for all AN/USM-489A CENTER FREQ settings.

2-16. RF SECTION TEST - A14 FREQUENCY CONTROL CCA TEST- YTF Driver Circuit Test - Continued.

10. On AN/USM-489A,
    - Set A2J12 (fig. FO-7) jumper to WR ENA position.
    - Set CENTER FREQ to 5 GHz.
    - Set SPAN WIDTH to 0 Hz.
    - Press INT button.
    - Press PRESEL ADJ key.
    - Press PRESEL OFFSET key.
    - Record PRESEL OFFSET DAC value,
    - Connect a digital multi meter to A14J16 pin 13.
11. Using the front panel knob, step DAC value from 0 to 255. While changing value verify readings change from 0 V (0) to -10 V (255).
    - If incorrect, troubleshoot using fig. FO-27, Sheet 6, circuits R and S. Replace faulty component.
12. On AN/USM-489A,
    - Set PRESEL OFFSET DAC to value recorded in step 10.
    - Set A14J14 jumper to OPT position.
    - Connect a digital multi meter to A14J16 pin 1.
    - Press PRESEL SLOPE key.
    - Record PRESEL SLOPE DAC value.
13. Using the front panel knob, step DAC value from 0 to 255. While changing value verify readings change from 0 V (0) to -10 V (255).
    - If incorrect, troubleshoot using fig. FO-27, Sheet 6, circuit S. Replace faulty component.
14. On AN/USM-489A,
    - Set PRESEL SLOPE DAC to value recorded in step 12.
    - Set A14J14 jumper to NORM position.
    - Connect a digital multi meter to A14J16 pin 3.
    - Set CENTER FREQ to 3 GHz.
    - Set SPAN WIDTH to 0 Hz.
    - Set CF STEP to 1 GHz.
    - Press CENTER FREQ button.
15. Record digital multi meter reading.
16. On AN/USM-489A, press STEP up arrow button (increase CENTER FREQ by 1 GHz) and verify digital multimeter reading changes by ≈ 266 mV.
    - If incorrect, troubleshoot using fig. FO-27, Sheet 6, circuits S and T. Replace faulty component.
17. Repeat step 16 until CENTER FREQ is 22 GHz.
    - Troubleshoot remaining problems using fig. FO-27. Replace faulty component.

2-16. RF SECTION TEST - A14 FREQUENCY CONTROL CCA TEST - YTF Driver Circuit Test - Continued.

18. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Set A2J12 jumper to WR Proposition.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

A15 RF CCA TEST.

DESCRIPTION

This test is used to isolate A15 RF CCA malfunctions in the RF Section to the malfunctioning component or assembly.

---

1. Troubleshooting A15 RF CCA malfunctions consists of performing up to five individual test procedures.
    - If the specific subtest is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph.
    - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
    - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented.

Confirming Faulty Third Converter Test.

DESCRIPTION

This test is used to isolate third converter malfunctions in the A15 RF CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-23 (A7 - A13), or FO-28 (A15) as required for component location information.
- See fig. FO-24 as required for functional block diagram.
- See fig. FO-30 as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

2-16. RF SECTION TEST - A15 RF CCA TEST - Confirming Faulty Third Converter Test – Continued.

1. On AN/USM-489A,
   - Place A14/A15 in service position (2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. If not already completed, perform IF Input Amplitude Accuracy Performance Test (para 2-18).
   - If performance test fails, proceed to step 3.
   - If performance test passes, proceed to step 7.
3. Adjust External Mixer Amplitude (para 2-35).
   - If adjustment can be completed, proceed to step 7.
   - If adjustment cannot be completed, proceed to step 4.
4. On AN/USM-489A,
   - Disconnect W35 (WHT/RED) from A15J801.
   - Connect signal generator to A15J801.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
5. Set signal generator controls as follows:

   Frequency .... 310.7 MHz CW
   Power ....-28 dBm
6. On AN/USM-489A, verify a flat line is displayed on CRT screen within 2 dB of reference level.
   - If correct, troubleshoot A7 through A13 using fig, FO-24. Replace faulty component. Additional information can be found in the following tests:

     A7 LODA Test (para 2-16).

     A8 Dual Mixer Tests (para 2-16).

     A9 Input Attenuator Test (para 2-16).

     A12 RF Switch Test (para 2-16).

     A13 Second Converter Test (para 2-16).
   - If correct, perform Third Converter Test (para 2-16).

2-16. RF SECTION TEST- A15 RF CCA TEST - Confirming Faulty Third Converter Test - Continued.

7. On AN/USM-489A,
   - Disconnect W29 (VIO) from A15J601.
   - Connect another spectrum analyzer to A15J601.
   - Connect front panel CAL OUTPUT connector to INPUT 50 Ω connector using BNC cable and adapter provided.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set ATTEN to 0 dB.
   - Set TRIGGER to SINGLE.
8. Verify signal on spectrum analyzer (connected to A15J601) is 10.7 MHz at ≈ **–5** dBm.
   - If incorrect, perform Third Converter Test (para 2-16).
   - If correct, A15 RF CCA Third Converter circuitry is functioning normally. Troubleshoot remaining problem using fig. FO-30. Replace faulty component.
9. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reconnect W29 to A15J601.
   - Reinstall A14/A15 and cover.

Third Converter Test.

DESCRIPTION

This test is used to isolate third converter malfunctions in the A15 RF CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-28 as required for component location information.
- See fig. FO-30 Sheets 2 and 3, circuits A, B, C, D, E, and G as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

2-16. RF SECTION TEST - A15 RF CCA TEST - Third Converter Test - Continued.

1. On AN/USM-489A,
   - Place A14/A15 in service position (2-45).
   - Connect power cable to the rear panel,
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Verify A15CR802 is forward biased (<1 V across) and A15CR801 (>5V across) is reverse biased.
   - If incorrect, troubleshoot using fig. FO-30, Sheet 2, circuit A. Replace faulty component.
3. On AN/USM-489A,
   - Disconnect W35 (WHT/RED) from A15J801.
   - Connect signal generator to A15J801.
4. Set signal generator controls as follows:

   Frequency ....310.7 MHz CW

   Output ....-30 dBm
5. Using an active probe and another spectrum analyzer, verify points in following table.

Meas Point	Reading	If incorrect, troubleshoot using
A15TP601	310.7 MHZ @ -18 dBm ±2 dB	fig. FO-30, Sheet 2, circuit B
A15TP602	300 MHz @ > +7 dBm	Third LO Driver Amplifier Test, (para 2-15)
A15TP603	10.7 MHz @ ≈ -24 dBm	fig. FO-30, Sheet 2, circuit C

   - If incorrect, perform as instructed.
6. On AN/USM-489A,
   - Move A2J12 (fig. FO-7) jumper to WR ENA position.
   - Connect an active probe and another spectrum analyzer to A15TP603.
7. Adjust signal generator output until spectrum analyzer (connected to A15TP603) 10.7 MHz signal level is -40 dBm.
8. On AN/USM-489A,
   - Set TRIGGER to SINGLE
   - Press INT button.
   - Press FLATNESS key.
   - Record FLATNESS DATA value.
   - Set FLATNESS to 255 (sets maximum gain).
   - Connect an active probe and another spectrum analyzer to A15J601.
9. Verify 10.7 MHz signal displayed on spectrum analyzer (connected to A15J601) is ≈ -10 dBm.
10. On AN/USM-489A, set FLATNESS to 0 (sets minimum gain).

2-16. RF SECTION TEST- A15 RF CCA TEST- Third Converter Test – Continued.

11. Verify 10.7 MHz signal displayed on spectrum analyzer (connected to A15J601) is less than -32 dBm.

    - If steps 9 or 11 are incorrect, proceed to step 12.
    - If steps 9 or 11 are correct, third converter circuitry is functioning normally.

12. Verify gain stages, attenuator stages, and flatness compensation control circuitry are properly biased and functioning using fig. FO-30, Sheets 2 and 3, circuits B, C, D, E, and G and information in the following table.

FLATNESS SETTING	Gain set to	A15J901 pin 2 voltage	A15R606 voltage drop = current	A15R614 voltage drop = current
0	minimum	≈ 0 Vdc	≈0Vdc 0Vdc = 0 ma	≈0Vdc 0Vdc = 0ma
255	maximum	≈ 4 Vdc	≈1Vdc 1Vdc = 7 ma	≈11 Vdc = 7 ma

    - Replace faulty component.

13. On AN/USM-489A,

    - Set FLATNESS DATA to value recorded in step 8.
    - Set LINE to OFF.
    - Remove power cable.
    - Move A2J12 jumper to WR PROT position.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

Control Latches Test.

DESCRIPTION

This test is used to isolate PIN switch driver control latch malfunctions in the A15 RF CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-28 as required for component location information.
- See fig. FO-30, Sheet 3, circuit H as required for schematic diagrams.
- See paragraphs 2-46 and 2-47 (as required) for procedure on removing circuit card shields.

2-16. RF SECTION TEST - A15 RF CCA TEST - Control Latches Test - Continued.

1. On AN/USM-489A,
   - Place A14/A15 in service position (2-45).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press EXT button.
   - Connect digital multimeter (+) lead to A15J901 pin 15 and (-) lead to A15J901 pin 6.
2. Verify digital multi meter reads ≈ +5 Vdc (TTL high).
   - If incorrect, troubleshoot using fig. FO-30, Sheet 3, circuit H. Replace faulty component.
3. On AN/USM-489A, press INT button.
4. Verify digital multi meter reads ≈ 0 Vdc (TTL low).
   - If incorrect, troubleshoot using fig. FO-30, Sheet 3, circuit H. Replace faulty component.
5. Connect digital multi meter (+) lead to A15J901 pin 13.
6. On AN/USM-489A,
   - Press SIG ID ON key.
   - Set TRIGGER to SINGLE,
7. Verify digital multi meter reading toggles between TTL high and low levels when AN/USM-489A SINGLE key is pressed.
   - If incorrect, troubleshoot using fig. FO-30, Sheet 3, circuit H. Replace faulty component.
8. Connect an oscilloscope to A15U902 pin 7 with ground lead to A15J901 pin 6.
9. Set oscilloscope controls as follows:

   Amplitude Scale ....2 V/div

   Sweep Time ....20 ms/div
10. On AN/USM-489A,
    - Press PRESET button.
    - Set SPAN WIDTH to 1 MHz.
11. Verify waveform on oscilloscope is TTL high during part of retrace period and TTL low during sweep (≈ 50 ms).
    - If incorrect, troubleshoot using fig. FO-30, Sheet 3, circuit H. Replace faulty component.
    - Troubleshoot remaining problems using fig. FO-30. Replace faulty component.
12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A14/A15 and cover.

2-16. RF SECTION TEST - A15 RF CCA TEST - SIG ID Oscillator Test.

SIG ID Oscillator Test.

DESCRIPTION

This test is used to isolate signal identification oscillator malfunctions in the A15 RF CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-28 as required for component location information.
- See fig. FO-30 Sheet 2, circuit F as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

1. On AN/USM-489A,
   - Place A14/A15 in service position (2-45).
   - Connect power cable to the rear panel.
   - Connect an active probe and spectrum analyzer to A15TP602.
   - Connect a digital multi meter to A15J901 pin 13.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press INT button.
   - Set SIG ID to ON.
   - Set TRIGGER to SINGLE.
2. Set spectrum analyzer (connected to A15TP602) controls as follows:

Center Frequency	300 MHz
Span	10 MHz
Reference Level	+10 dBm

2-16. RF SECTION TEST - A15 RF CCA TEST - SIG ID Oscillator Test - Continued.

3. Verify spectrum analyzer (connected to A15TP602) and digital multi meter readings alternate to indications in the following table for each press of AN/USM-489A SINGLE key.

State	SIG ID Oscillator	A15TP602 signal	A15J901 pin 13 voltage (TTL level)
1	ON	298 MHz ±50 kHz (≥ +1 dBm)	≈ 0 V (low)
2	OFF	300 MHz (≥ +7 dBm)	≈ 5 5 V (high)

- If state 1 signal incorrect, perform Adjust SIG ID Oscillator (para 2-37). If adjustment cannot be completed, proceed to step 6.
- If state 2 signal incorrect, perform Third LO Driver Amplifier Test (para 2-15).
- If state 1 or 2 voltage incorrect, perform Control Latches Test (para 2-16).
- If voltage correct, but states did not change, proceed to step 4.

4. On AN/USM-489A, press SINGLE until A15J901 pin 13 is TTL low.
5. Verify diode states/bias voltages in following table:

Component	State	Voltage/Reading
A15CR501	forward biased	<1 V across component
A15CR502	forward biased	<1 V across component
A15CR603	forward biased	<1 V across component
A15CR604	forward biased	<1 V across component
A15CR605	reverse biased	≈ 6 V across component
A15R622/R623	biasing A15Q604 on	-5 Vdc at junction

- If incorrect, troubleshoot using fig. FO-30, Sheet 2, circuit F. Replace faulty component.

6. Place a 100 Ω resistor across A15U602 pins 1 and 2.
   - If signal at A15TP602 is now 298 MHz ± 50 kHz (≥ +1 dBm), replace A15U601.
   - Troubleshoot remaining problems using fig. FO-30. Replace faulty component.
7. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Remove 100Ω resistor.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

2-16. RF SECTION TEST- A15 RF CCA TEST- 10 MHz Reference Test.

10 MHz Reference Test.

DESCRIPTION

This test is used to isolate 10 MHz reference malfunctions in the A15 RF CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-28 as required for component location information.
- See fig. FO-30 Sheet 3, circuit M as required for schematic diagrams.
- See paragraph 2-47 (as required) for procedure on removing circuit card shields.

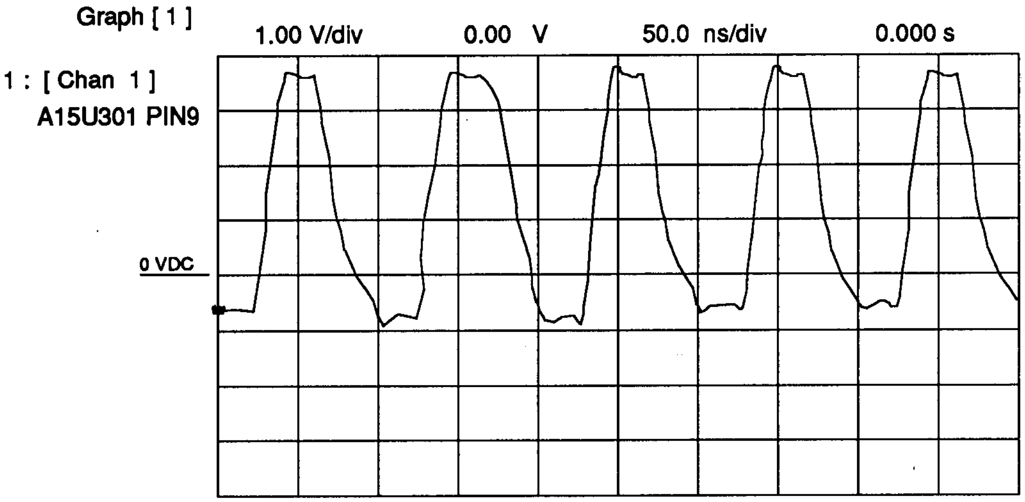
1. On AN/USM-489A,
   - Place A14/A15 in service position (2-45).
   - . Connect power cable to the rear panel.
   - Set LINE to ON.
   - Press PRESET button.
2. Using another spectrum analyzer, verify points in following table.

Disconnect	Connect Spectrum Analyzer to	Correct Reading
W37 (GRY/GRN)	A15J303	10 MHz @ ≥–10 dBm
W17 (GRY/YEL)	A15J304	10 MHz @ ≥–10 dBm
W31 (GRY)	A15J301	10 MHz @ ≥–2 dBm

- If incorrect, proceed to step 3.
- If correct, proceed to step 4.

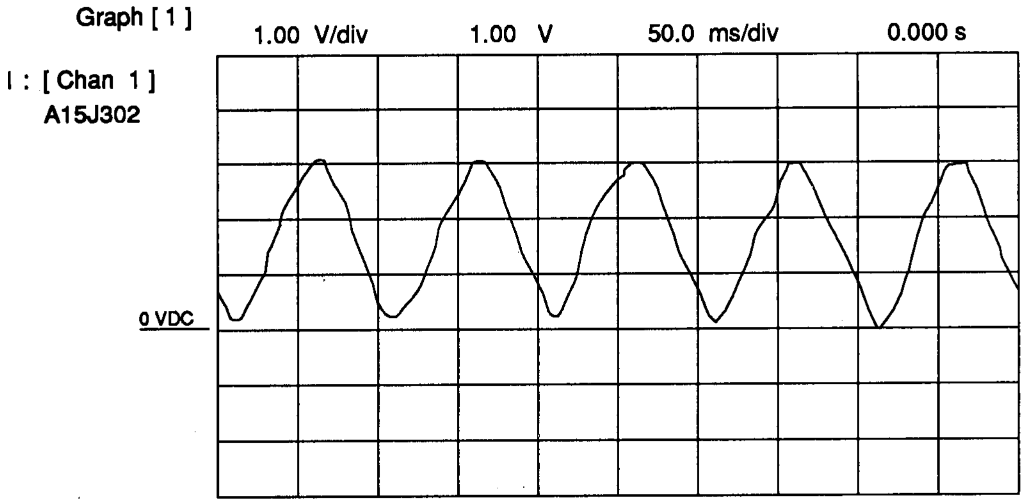
2-16. RF SECTION TEST - A15 RF CCA TEST - 10 MHz Reference Test - Continued.

3. Using an oscilloscope, verify A15U301 pin 9 has a 10 MHz 4 V p-p waveform as shown below.



- If correct, troubleshoot using fig. FO-30, Sheet 3, circuit M. Replace faulty component.

4. Using an oscilloscope, verify A15J302 has a 10 MHz 3 V p-p waveform as shown below.



- If incorrect, troubleshoot using fig. FO-30, Sheet 3, circuit M. Replace faulty component.

5. Using a frequency counter, verify signal at A15J301 is 10 MHz ±40 Hz.
   - If incorrect, adjust A15R306 to bring signal into specification.

2-16. RF SECTION TEST- A15 RF CCA TEST- 10 MHz Reference Test - Continued.

6. On AN/USM-489A,

   - Press FREQUENCY button.
   - Press MORE key.
   - Set 10 MHz to EXT.
   - Connect signal generator to rear panel 10 MHz REF IN/OUT connector.

7. Set signal generator controls as follows:

   Frequency .... 10 MHz
   Output .... –2 dBm

8. Repeat steps 2 and 3.

   - If correct using external reference (step 8) and incorrect using internal reference, proceed to step 9.
   - If incorrect using both references, troubleshoot using fig. FO-30, Sheet 3, circuit M.

9. On AN/USM-489A,

   - Disconnect signal generator from rear panel 10 MHz REF IN/OUT connector.
   - Press FREQUENCY button.
   - Press MORE key.
   - Set 10 MHz to INT.

10. Using an oscilloscope, verify points in following table.

Meas Point	Reading	If incorrect, troubleshoot using
A15U305 pin 3	+12 Vdc	fig. FO-30, Sheet 3, circuit J
A15U303 pin 5	10 MHz sine wave, ≥1 V p-p	Replace A15U302

   - If incorrect, perform as instructed.
   - Troubleshoot remaining problems using fig. FO-30. Replace faulty component.

11. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

2-17. DISPLAY/POWER SUPPLY SECTION TEST

DESCRIPTION

This test is used to isolate malfunctions in the A6 Power Supply CCA, A6A1 High Voltage Module, A17 CRT Driver CCA, and A18 CRT Assembly to the malfunctioning component or assembly.

WARNING

Both the A6 Power Supply CCA and A6A1 High Voltage Module contain lethal voltages with lethal currents in all areas. Use extreme care when servicing these assemblies. Always disconnect power cord from the rear panel before servicing these assemblies. Failure to follow this precaution can represent a shock hazard which may result in personal injury.

WARNING

Voltage potential at A6A1W3 is +9 kV. Always disconnect cables from CRT with caution! If A6A1W3 must be disconnected, remove rear panel power cord first. Failure to discharge A6A1W3 may result in severe electrical shock to personnel and damage to the instrument.

WARNING

Do not discharge the CRT second anode directly to ground with A6A1W3 cable connected, or damage to the A17 CRT Driver CCA can result. Always discharge through-a high resistance (such as a high voltage probe).

WARNING

Always use an isolation transformer when troubleshooting either A6 Power Supply CCA or A6A1 High Voltage Module. When using an isolation transformer, connect a jumper between A6TP101 and A6TP301. This connects the circuit common to earth ground. Remove this jumper when the isolation transformer is not used.

NOTES

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - Continued.

1. Troubleshooting the Display/Power Supply Section consists of performing up to six individual test procedures, some of which contain sub-tests.

   - If the specific test (or subtest) is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided in this paragraph. Table 2-7 contains a complete list of Display/Power Supply Section Tests/Subtests.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate test in Table 2-7.
   - If a specific test was not provided and the symptoms are not obvious, perform all tests in the order presented in Table 2-7.

Table 2-7. Display/Power Supply Section Tests

Test Name	Subtest Name	Page
A17 TAM Test	A17J4	2-245
Blank Display Test	None	2-247
Display Distortion Test	None	2-249
Focus Test	None	2-251
Intensity Test	None	2-254
A6 Power Supply CCA Tests		2-257
	Dead Power Supply Test	2-258
	Line Fuse Blowing Test	2-261
	Supply Restarting Every 1.5 Seconds (Kick Start) Test	2-262
	Low Voltage Supplies Test	2-263
	High Voltage Supplies Test	2-265
	CRT Supply Dropping Out Test	2-266

A17 TAM TESTS.

DESCRIPTION

These tests are used to fault isolate suspected circuits that need to be manually checked in the A17 CRT Driver CCA using the TAM.

---

1. On AN/USM-489A,

   - Place A2/A3 in service position (para 2-40).
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect power cable to the rear panel.
   - Connect TAM probe cable to A2J202 (fig. FO-7).
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press MODULE button.
   - Press DIAGNOSE key.
   - Use KNOB to select “2) Manual Probe Troubleshooting”.
   - Press EXECUTE key.
   - Connect TAM probe cable to A2J201.
   - Press TEST key.

2-17. DISPLAY/POWER SUPPLY SECTION TEST- A17 TAM TESTS - A17J4 Test.

A17J4 Test.

2. On AN/USM-489A,
   - Connect TAM probe cable to A17J4 (fig. FO-33).
   - Press TEST key.
3. Read test results on the CRT Screen.
   - If any of the tests return FAIL, perform as instructed in the following table.

NOTE

For additional troubleshooting information on failed tests:

- Use KNOB to select failed test.
- Press MORE INFO key.
- Follow instructions on CRT Screen (fig. FO-27).

AN/USM-489A Serial Prefix 2929A to 3115A Failed Test	FO-34 Circuit(s)	FO-34 Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS5	N/A	N/A
X-Deflection Amplifier	H	MS2, MS3	Display Distortion Test	2-249
Constant Current Source	J	MS1	Replace A17 CRT Driver CCA (para 2-65)	N/A
Focus Amplifier Bias	C, D	MS4	Focus Test	2-251
Intensity Amplifier Bias	A	MS6	Intensity Test	2-254
Intensity Input	A	MS7	Intensity Test	2-254
Intensity Offset	A	MS7	Intensity Test	2-254
Blanking Control	A	MS8	Blanking Test	2-142

AN/USM-489A Serial Prefix 3119A to 3306A Failed Test	FO-34 Circuit(s)	FO-34 Signal(s)	Test/Subtest to Perform	Page
Revision	N/A	MS5	N/A	N/A
Int Input Amp Gain	A	MS7	Intensity Test	2-254
Int Input Amp Offset	A	MS7	Intensity Test	2-254
Constant Current Source	J	MS1	Replace A17 CRT Driver CCA (para 2-65)	N/A
Blanking Control	A	MS8	Blanking Test	2-142

4. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Reinstall A14/A15 and cover.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - BLANK DISPLAY TEST.

BLANK DISPLAY TEST.

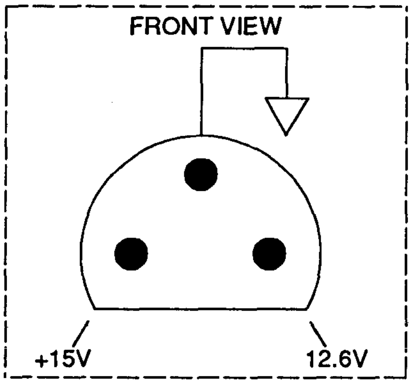
DESCRIPTION

This test is used to isolate blank display malfunctions in the Display/Power Supply Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 (A2), FO-20 (A6), and FO-33 (A17) as required for component location information.

1. On AN/USM-489A,
   - Place A2/A3 in service position (2-40).
   - Connect power cable to the rear panel.
   - Verify A2 Controller CCA, A17 CRT Driver CCA, W1, W7, and W8 are properly installed and connected.
   - Set LINE to ON.
   - Press PRESET button.
2. Perform checks in the following table to determine if A6 Power Supply CCA is functioning:

Check	If incorrect, troubleshoot using
Verify front panel LINE LED is ON	Perform Dead Power Supply Test (para 2-17).
Check front-panel PROBE POWER jack voltages 	Perform Low Voltage Supplies Test (para 2-17).
Verify fan is operating	Perform Low Voltage Supplies Test (para 2-17).
Verify rear panel CRT +110 VDC LED is ON	CRT Supply Dropping Out Test (para 2-17).
Verify five A2 power LEDs (A2U19) are ON	Perform Low Voltage Supplies Test (para 2-17).

- If incorrect, perform as instructed.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - BLANK DISPLAY TEST-Continued.

3. On AN/USM-489A,
   - Press FREQUENCY button.
   - Press 1 button then GHz button.
   - Allow AN/USM-489A 1 minute to warm-up.
4. While observing CRT display, set LINE to OFF.
   - If a green flash appears, proceed to step 6.
   - If a green flash does not appear, proceed to step 5.
5. Perform High Voltage Supplies Test (para 2-17).
   - If test fails, replace A6A1 High Voltage Module (para 2-56).
   - If test passes, proceed to step 6.
6. On AN/USM-489A,
   - Set LINE to OFF.
   - Connect TAM and extension cables to rear panel (para 2-38).
   - Connect an HP Think jet printer to AN/USM-489A Rear Panel. Set printer's address to value required by TAM (usually 1 unless previously changed).
   - Set LINE to ON.
   - Connect the TAM's probe cable to A2J11.
   - Press MODULE button
   - Press SOFT KEY #3 (from top)
   - Press STEP down button
7. On AN/USM-469A, press SOFT KEY #1 and verify A2CR6 blinks approximately ten times.
   - If incorrect, perform Digital Signature Analysis (DSA) Test (para 2-14).
8. On AN/USM-489A,
   - Move TAM probe cable to A2J202.
   - Press SOFT KEY #1 and wait five seconds.
   - Press SOFT KEY #4 to print results.
   - If any test fails, see A2 TAM Tests (para 2-14) for troubleshooting information.

NOTE

To obtain more information in steps 8 through 10, press STEP down button one less time than the test number. For example, press it twice for the third test on the list. Press SOFT KEY #3, then SOFT KEY #4, and when the printout is complete, press SOFT KEY #6.

9. On AN/USM-489A,
   - Move TAM probe cable to A2J201.
   - Press SOFT KEY #1 and wait five seconds.
   - Press SOFT KEY #4 to print results.
   - If any test fails, see A2 TAM Tests (para 2-14) for troubleshooting information.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - BLANK DISPLAY TEST - Continued.

10. On AN/USM-489A,
    - Move TAM probe cable to A17J4 (fig. FO-33).
    - Press SOFT KEY #1 and wait five seconds.
    - Press SOFT KEY #4 to print results.
    - If any test fails, see A17 TAM Tests (para 2-17) for troubleshooting information.
11. If all tests pass, replace A18V1 (para 2-67).
12. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A2/A3 and cover.

DISPLAY DISTORTION TEST.

DESCRIPTION

This test is used to isolate vector display distortion malfunctions in the Display/Power Supply Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-33 as required for component location information.
- See fig. FO-34 as required for functional block diagrams.

1. On AN/USM-489A,
    - Place A2/A3 in service position (2-40).
    - Connect power cable to the rear panel.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish.
    - Press PRESET button.
    - Press RECALL button.
    - Press MORE key.
    - Press CRT ADJ PATTERN key.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - DISPLAY DISTORTION TEST - Continued.

2. Verify CRT ADJ PATTERN is not distorted (all lines that make up grid and characters are meeting properly, and in focus).
   - If incorrect, proceed to step 3.
   - If correct, display operating properly. Perform Display Jumbled or Trace Off Screen Test (para 2-14).
3. Adjust Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).
   - If A2RXX adjustments cannot be completed, perform all Display Tests (para 2-14).
   - If A17RXX adjustments cannot be completed, proceed to step 4.
   - If distortion confined to one axis (vertical or horizontal only), replace A17 CRT Driver CCA (para 2-65).
4. On AN/USM-489A,
   - Set LINE to OFF.
   - Place A17 in service position (para 2-50) and remove safety shield.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

WARNING

A17 CRT Driver CCA contains lethal voltages with lethal currents. Use extreme care when servicing this assembly. Always disconnect power cord from rear panel before servicing this assembly. Failure to follow this precaution can represent a shock hazard which may result in personal injury.

5. Connect oscilloscope channel A to A17TP11 and channel B to A17TP14.
6. For serial prefixes 2929A to 3115A, verify 50 Vp-p ac component of each waveform are mirror images of each other with dc average of 50 V.

   For serial prefixes 3119A to 3306A, verify 50 Vp-p to 100 Vp-p ac component of each waveform are mirror images of each other with dc average of 55 V.
   - If incorrect, replace A17 CRT Driver CCA (para 2-65).
7. Adjust A17R25 (serial prefixes 2929A to 3115A) or A17R57 (serial prefixes 3119A to 3306A) and verify dc component of both waveforms changes in opposite directions.
   - If incorrect, replace A17 CRT Driver CCA (para 2-65).
8. Adjust A17R19 (serial prefixes 2929A to 3115A) or A17R55 (serial prefixes 3119A to 3306A) and verify ac component of both waveforms changes the same amount.
   - If incorrect, replace A17 CRT Driver CCA (para 2-65).
9. Connect oscilloscope channel A to A17TP12 and channel B to A17TP13.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - DISPLAY DISTORTION TEST - Continued.

10. For serial prefixes 2929A to 3115A, verify 50 Vp-p ac component of each waveform are mirror images of each other with dc average of 50 V.

    For serial prefixes 3119A to 3306A, verify 50 Vp-p to 100 Vp-p ac component of each waveform are mirror images of each other with dc average of 55 V.

    - If incorrect, replace A17 CRT Driver CCA (para 2-65).

11. Adjust A17R26 (serial prefixes 2929A to 31 15A) or A17R77 (serial prefixes 3119A to 3306A) and verify dc component of both waveforms changes in opposite directions.

    - If incorrect, replace A17 CRT Driver CCA (para 2-65).

12. Adjust A17R20 (serial prefixes 2929A to 3115A) or A17R75 (serial prefixes 3119A to 3306A) and verify ac component of both waveforms changes the same amount.

    - If incorrect, replace A17 CRT Driver CCA (para 2-65).

13. Verify base of A17Q18 (serial prefixes 2929A to 3115A) or A17Q102 (serial prefixes 3119A to 3306A) is -10.3 V ±0.3 V.

    - If incorrect, replace A17 CRT Driver CCA (para 2-65).

14. If steps 6 through 13 are correct, check cables to CRT.

    - If cables good, replace A18V1 CRT (para 2-67).

15. On AN/USM-489A,

    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A17 and safety shield.
    - Reinstall A2/A3 and cover.

FOCUS TEST.

DESCRIPTION

This test is used to isolate display focus malfunctions in the Display/Power Supply Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 (A2) and FO-33 (A17) as required for component location information.
- See fig. FO-9/10, Sheet 3, circuit N as required for schematic diagrams.
- See fig. fig. FO-34 as required for functional block diagrams.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - FOCUS TEST - Continued.

1. On AN/USM-489A,
   - Place A2/A3 in service position (2-40).
   - Connect power cable to the rear panel.
   - Connect digital multimeter (+) lead to A2J202, pin 2 (fig. FO-7) and (-) lead to A2J202 pin 6.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press DISPLAY button.
   - Press MORE key.
   - Press FOCUS key.
2. Using front panel knob, change FOCUS from 0 to 255 and verify digital multimeter reads ≈ 0 Vdc (0) and ≈ -10 Vdc (255).
   - If incorrect, troubleshoot using fig. FO-9/10, Sheet 3, circuit N. Replace faulty component.
3. Adjust Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above) steps 1 through 8.
   - If focus of some areas of CRT screen are worse than others, proceed to step 8.
   - If no part of CRT screen can be brought to sharp focus, proceed to step 4.

NOTE

CRTs have some normal focus variation across their face.

4. On AN/USM-489A,
   - Set LINE to OFF.
   - Connect ground lead of high-voltage probe to the chassis.
   - Place A17 in service position (para 2-50) and remove safety shield.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

WARNING

A17 CRT Driver CCA contains lethal voltages with lethal currents. Use extreme care when servicing this assembly. Always disconnect power cord from rear panel before servicing this assembly. Failure to follow this precaution can represent a shock hazard which may result in personal injury.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - FOCUS TEST - Continued.

NOTE

The following measurements should be made with a high-voltage probe. When using a high-voltage probe, connect ground lead securely to the AN/USM-489A chassis.

5. Verify nominal voltage at A17J7 pin 10 is -1700 Vdc (serial prefix 2929A to 3115A) or ≈ –1600 Vdc (serial prefix 3115A to 3306A).

6. Adjust A17R58 (serial prefix 2929A to 3115A) or A17R34 (serial prefix 3115A to 3306A) and verify voltage at A17J7 pin 10 varies by 150 V.

   - If steps 5 and 6 are correct, replace A18V1 CRT (para 2-67).

7. Verify voltage at A17TP16 is -2450 V ±250 V.

   - If incorrect, perform High Voltages Supplies Test (para 2-17).

8. Connect oscilloscope probe to A17TP9 (serial prefixes 2929A to 3115A) or A17TP17 (serial prefixes 3119A to 3306A).

9. On AN/USM-489A,

   - Press DISPLAY button.
   - Press MORE key.
   - Press FOCUS key.

10. Using front panel knob, change FOCUS from 0 to 255 and verify dc level of signal on oscilloscope changes by from 10 to 32 Vdc.

    - If incorrect, replace A17 CRT Driver (para 2-65).

11. On AN/USM-489A, press INTEN key.

12. Using front panel knob, change INTEN from 0 to 255 and adjust A17R50 (serial prefix 2929A to 3115A) or A17R21 (serial prefix 3115A to 3306A) fully CW and CCW. and verify ac level of signal on oscilloscope changes by from 10 to 25 Vp-p.

    - If incorrect, replace A17 CRT Driver (para 2-65).

13. On AN/USM-489A,

    - Set INTEN to 0.
    - Set A17R50 (serial prefix 2929A to 3115A) or A17R26 (serial prefix 3115A to 3306A) fully CCW.

14. Verify ac component of signal on oscilloscope is ≈ 20 Vp-p (serial prefix 2929A to 3115A) or ≈ 40 Vp-p (serial prefix 3115A to 3306A).

    - If incorrect, replace A17 CRT Driver (para 2-65).
    - If all steps correct, replace A18V1 CRT (para 2-67).

15. On AN/USM-489A,

    - Set LINE to OFF.
    - Remove power cable.
    - Disconnect test cables and equipment.
    - Reinstall A17 and safety shield.
    - Reinstall A2/A3 and cover.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - INTENSITY TEST.

INTENSITY TEST.

DESCRIPTION

This test is used to isolate display intensity malfunctions in the Display/Power Supply Section to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-7 (A2) and FO-33 (A17) as required for component location information.
- See fig. FO-34 as required for functional block diagrams.

1. On AN/USM-489A,
   - Place A2/A3 in service position (2-40).
   - Connect power cable to the rear panel.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
   - Press DISPLAY button.
   - Press MORE key.
   - Press INTEN key.
2. Using front panel knob, change INTEN from 0 to 255 and verify CRT screen intensity changes from dim, but readable, to bright.
   - If incorrect, perform Brightness Test (para 2-14), If test passes, proceed to step 3.
3. Adjust Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above) and verify A17R55 (serial prefix 2929A to 3115A) or A17R11 (serial prefix 3115A to 3306A) functions properly.
   - If incorrect, proceed to step 4.
4. On AN/USM-489A,
   - Set LINE to OFF.
   - Place A17 in service position (para 2-50) and remove safety shield.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - INTENSITY TEST - Continued.

WARNING

A17 CRT Driver CCA contains lethal voltages with lethal currents. Use extreme care when servicing this assembly. Always disconnect power cord from rear panel before servicing this assembly. Failure to follow this precaution can represent a shock hazard which may result in personal injury.

5. Using an oscilloscope, verify that A17TP2 has TTL level blanking pulses ≈ 1 µs wide and 4 µs to 7 us apart.
   - If incorrect, perform Blanking Test (para 2-14).
6. Verify A17TP10 varies when changing INTEN using front panel knob, and is ≈ 40 Vp-p (serial prefix 2929A to 3115A) or = 55 Vp-p (serial prefix 3115A to 3306A) with INTEN at 255.
   - If incorrect, proceed to step 7.
   - If correct, proceed to step 9.
7. While changing INTEN from 0 to 255 using front panel knob, verify A17TP4 varies up to ≈ 4 Vp-p.
   - If incorrect, perform Brightness Test (para 2-14).
8. While changing INTEN from 0 to 255 using front panel knob, verify A17TP1 varies up to ≈ 12 Vp-p.
   - If incorrect, replace A17 CRT Driver CCA (para 2-65).
9. Connect ground lead of high-voltage probe to the chassis.

NOTE

The following measurements should be made with a high-voltage probe. When using a high-voltage probe, connect ground lead securely to the AN/USM-489A chassis.

10. Using a high-voltage probe, verify A17J7 pin 4 is –2450 V ± 250 V, and that A17J7 pin 6 is 30 V to 100 V more negative than A17J7 pin 4.
    - If incorrect, proceed to step 13.
    - If correct, proceed to step 11.
11. On AN/USM-489A, set LINE to OFF.
12. Using an ohmmeter, check A17CR13.
    - If good, replace A18V1 CRT (para 2-67).
    - If not good, replace A17 CRT Driver CCA (para 2-65).

2-17. DISPLAY/POWER SUPPLY SECTION TEST - INTENSITY TEST-Continued.

CAUTION

Be careful not to bend pins when connecting W8 to A18V1.

13. On AN/USM-489A,
    - Set LINE to OFF.
    - Disconnect W8 from base of A18V1 CRT.
    - Set LINE to ON.
    - Wait for internal alignment routine to finish (ignore errors).
14. Using a high-voltage probe, verify A17J7 pin 4 is -2450 V ± 250 V, and that A17J7 pin 6 is 30 V to 100 V more negative than A17J7 pin 4.
    - If incorrect, perform CRT Supply Dropping Out Test (para 2-1 7).
    - If correct, replace A18V1 CRT (para 2-67).
15. On AN/USM-489A,
    - Set LINE to OFF.
    - Remove power cable,
    - Disconnect test cables and equipment.
    - Reinstall A17 and safety shield.
    - Reinstall A2/A3 and cover.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST.

A6 POWER SUPPLY CCA TEST

DESCRIPTION

This test is used to isolate malfunctions in the A6 Power Supply CCA and A6A1 High Voltage Module, to the malfunctioning component or assembly.

WARNING

Both the A6 Power Supply CCA and A6A1 High Voltage Module contain lethal voltages with lethal currents in all areas. Use extreme care when servicing these assemblies. Always disconnect power cord from the rear panel before servicing these assemblies. Failure to follow this precaution can represent a shock hazard which may result in personal injury.

WARNING

Voltage potential at A6A1W3 is +9 kV. Always disconnect cables from CRT with caution! If A6A1W3 must be disconnected, remove rear panel power cord first. Failure to discharge A6A1W3 may result in severe electrical shock to personnel and damage to the instrument.

WARNING

Do not discharge the CRT second anode directly to ground with A6A1W3 cable connected, or damage to the A17 CRT Driver CCA can result. Always discharge through a high resistance (such as a high voltage probe).

WARNING

Always use an isolation transformer when troubleshooting either A6 Power Supply CCA or A6A1 High Voltage Module. When using an isolation transformer, connect a jumper between A6TP101 and A6TP301. This connects the circuit common to earth ground. Remove this jumper when the isolation transformer is not used.

NOTE

Perform this procedure only when instructed from table 2-1 or another troubleshooting test. Do not perform this or any other troubleshooting test as a separate procedure unless otherwise instructed, as certain conditions have been established and/or tested prior to performing this test.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - Continued.

1. Troubleshooting the A6 Power Supply CCA consists of performing up to six individual sub-tests.
   - If the specific test (or subtest) is specified by the TAM, Table 2-1, or another troubleshooting test, proceed to the individual procedure provided.
   - If a specific test was not provided, but the symptoms are obvious, perform the appropriate subtest.
   - If a specific test was not provided and the symptoms are not obvious, perform all subtests in the order provided.

Dead Power Supply Test.

DESCRIPTION

This test is used to isolate power supply malfunctions in the A6 Power Supply CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-20 as required for component location information.
- See fig. FO-22, Sheets 1 and 2, circuits A, B, C, G, H, and L as required for schematic diagrams.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Remove A6 Cover (para 2-56).
   - Connect power cable to an isolation transformer and to the rear panel.
   - Connect a jumper between A6TP101 and A6TP301.
   - Connect digital multimeter (-) lead to A6TP301.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

2-17. DISPLAY/POWER SUPPLY SECTION TEST- A6 POWER SUPPLY CCA TEST - Dead Power Supply Test Continued.

2. Using a digital multimeter, measure points in the following table:

Measure	Digital Multi meter Reading	If incorrect, troubleshoot using/perform
A6TP308	+5 Vdc	Low Voltage Supplies Test (Para 2-17)
A6TP302	+15 Vdc	Low Voltage Supplies Test (para 2-17)
A6TP303	-15 Vdc	Low Voltage Supplies Test (para 2-17)
A6TP304	+28 Vdc	Low Voltage Supplies Test (para 2-17)
A6TP305	-12.6 Vdc	Low Voltage Supplies Test (para 2-17)
A6TP108	215 Vdc to +350 Vdc	fig. FO-22, Sheet 1, circuits A and B
A6TP206	≈14 Vdc	Proceed to step 3.

- If incorrect, perform as instructed.

3. Using an oscilloscope, verify A6TP210 has pulses 200 ms wide with an amplitude of 14.7 V.

- If no pulses are present, troubleshoot using fig. FO-22, Sheet 1, circuit L. Replace faulty component.
- If pulses are low in amplitude (≈ 1 V), suspect A6Q201. Troubleshoot using fig. FO-22, Sheet 1, circuit G. Replace faulty component.

4. Using an oscilloscope, verify A6TP206 has pulses 200 ms wide with an amplitude of ≈ 14 V.

- If incorrect, troubleshoot using fig. FO-22, Sheet 2, circuit H. Replace faulty component.

NOTE

The remaining steps in this procedure are performed using an external power supply connected to the A6 assembly WITHOUT AC power connected.

5. On AN/USM-489A,

- Set LINE to OFF.
- Disconnect power cable.
- Connect positive output of a current-limited dc power supply to cathode of A6CR201 and ground to A6TP201.
- Connect a jumper from positive output of dc power supply to end of A6R202 physically nearest A6U211.
- Connect a jumper from positive output of dc power supply to end of A6C207 physically nearest A6C209.

6. Set dc power supply controls as follows:

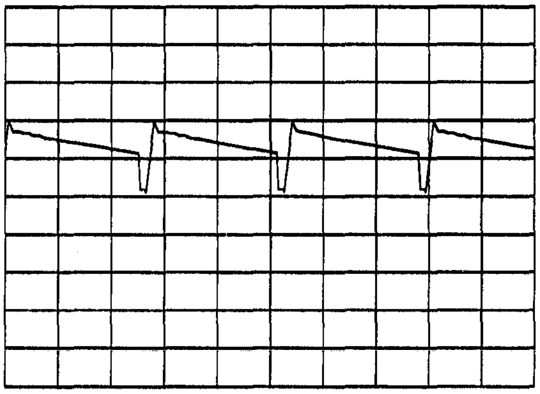
Current Limit .... 500 mA
Voltage .... 12 Vdc

7. Verify current draw on dc power supply does not exceed ≈ 50 mA.

- If incorrect, check A6CR201. If good, troubleshoot using fig. FO-22, Sheet 1, circuit G. Replace faulty component.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - Deed Power Supply Test Continued.

8. Using an oscilloscope, measure points In the following table:

Measure	Correct Reading	
A6TP204	80 kHz sawtooth (4 Vp-p)	**fig. FO-22, Sheet 2, circuit H**
A6TP203	40 kHz square (12 Vp-p)	**Measure A6TP105 and A6TP106**
A6TP207	41 kHz square (12 Vp-p)	**Measure A6TP105 and A6TP106**
A6TP105	12 Vp-p sawtooth flattened at bottom	**Replace A6Q103**
A6TP106	12 Vp-p sawtooth flattened at bottom	**Replace A6Q104**
A6TP202	30 kHz pulses (12 Vp-p)	**fig. FO-22, Sheet 2, circuit H**
A6TP103	See waveform below 	**If A6TP202 check good, suspect A6Q102 or A6CR106. See fig. FO-22, Sheet 1, circuit C.**

- If incorrect, perform as instructed, Replace faulty component.
- Troubleshoot remaining problems using fig. FO-20. Replace faulty component.

9. On AN/USM-489A,
   - Disconnect test cables and equipment.
   - Remove Jumpers.
   - Reinstall A6 cover.
   - Reinstall A2/A3/A4/A5 and cover.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - Line Fuse Blowing Test.

Line Fuse Blowing Test.

DESCRIPTION

This test is used to isolate power supply malfunctions in the A6 Power Supply CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-20 as required for component location information.
- See fig. FO-22, Sheet 1, circuits B, C, and D as required for schematic diagrams.

1. Place A2/A3/A4/A5 in service position (para 2-42).
2. Analyze malfunction.
   - If fuse blows with LINE switch OFF, troubleshoot FL4 and W3 using fig. FO-3. Replace faulty component.
   - If fuse blows when LINE is set to ON, proceed to step 3.
3. On AN/USM-489A,
   - Remove A6 Cover (para 2-56).
   - Unsolder and lift drain of A6Q102 from A6TP108.
   - Connect power cable to an isolation transformer and to the rear panel.
   - Connect a jumper between A6TP101 and A6TP301.
   - Connect digital multimeter (-) lead to A6TP301.
   - Set LINE to ON.
4. Verify condition of fuse.
   - If open, suspect A6U102. Troubleshoot using fig. FO-22, Sheet 1, circuit B. Replace faulty component.
5. Verify A6TP108 is between +215 Vdc and +350 Vdc.
   - If correct, proceed to step 6.
   - If incorrect, troubleshoot using fig. FO-22, Sheet 1, circuit B. Replace faulty component.
6. On AN/USM-489A, set LINE to OFF and check A6Q102.
   - If shorted, A6Q103, A6Q104, A6CR106, and A6CR108 are also probably shorted. Troubleshoot using fig. FO-22, Sheet 1, circuits C and D. Replace faulty component.
   - If good, proceed to step 7.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - Line Fuse Blowing Test Continued.

7. Verify resistance between A6TP102 (+) and A6TP101 (-) is more than 1 **kΩ.**
   - If incorrect, suspect A6Q103 or A6Q104. Troubleshoot using fig. FO-22, Sheet 1, circuit D. Replace faulty component.
   - If correct, troubleshoot using fig. FO-22, Sheet 1, circuit C. Replace faulty component.
8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Remove jumpers.
   - Reinstall A6 cover.
   - Reinstall A2/A3/A4/A5 and cover.

Supply Restarting Every 1.5 Seconds (Kick Start) Test.

DESCRIPTION

This test is used to isolate power supply malfunctions in the A6 Power Supply CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-20 as required for component location information.
- See fig. FO-22, Sheet 1, circuits E, F, G, and L as required for schematic diagrams,

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Remove A6 Cover (para 2-56).
   - Connect power cable to an isolation transformer and to the rear panel.
   - Connect a jumper between A6TP101 and A6TP301.
   - Connect digital multimeter (-) lead to A6TP301.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.
2. Connect oscilloscope channel A to A6TP208 and channel B to A6TP206.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - Supply Restarting Every 1.5 Seconds (Kick Start) Test Continued.

3. Observe signals on oscilloscope.
   - If signal at A6TP208 goes high before signal at A6TP206 goes low, troubleshoot overcurrent condition using fig. FO-22, Sheet 1, circuits E and F. Replace faulty component.
   - Troubleshoot all other malfunctions using fig. FO-22, Sheet 1, circuits L and G. Replace faulty component.
4. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Remove jumpers.
   - Reinstall A6 cover.
   - Reinstall A2/A3/A4/A5 and cover.

Low Voltage Supplies Test.

DESCRIPTION

This test is used to isolate low voltage power supply malfunctions in the A6 Power Supply CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-20 as required for component location information.
- See fig. FO-22, Sheets 1 and 2 as required for schematic diagrams.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Remove A6 Cover (para 2-56).
   - Connect power cable to an isolation transformer and to the rear panel.
   - Connect a jumper between A6TP101 and A6TP301.
   - Connect digital multi meter (-) lead to A6TP301.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - Low Voltage Supplies Test Continued.

2. Using a digital multimeter, measure points in the following table:

Measure	Digital Multi meter Reading	If incorrect, troubleshoot using/perform
A6TP302	+15 Vdc	Proceed to step 4
A6TP303	-15 Vdc	Proceed to step 4
A6TP304	+28 Vdc	Proceed to step 4
A6TP305	-12.6 Vdc	Proceed to step 4
A6TP308	+5 Vdc	Proceed to step 4

- If incorrect, perform as instructed.
- If correct, proceed to step 3.

3. Verify A2U19 (fig, FO-7) LEDs are lit.
   - if incorrect, check W1.
4. Disconnect W1 from A6J1 and repeat step 2 (voltages will now be approximate).
   - If now correct, suspect a short in one of the other assemblies connected to W1. Troubleshoot using fig. FO-3. Replace faulty component.
   - If still incorrect, troubleshoot using fig. FO-22, Sheet 1. Replace faulty component.
   - If only A6TP308 incorrect, proceed to step 5.
5. Using a digital multimeter, measure points in the following table:

Measure	Digital Multimeter Reading	If incorrect, troubleshoot using/perform
A6U305 pin 5	+5 Vdc	fig. FO-22, Sheet 2, circuit J
A6U306 pin 7	-7.5 Vdc	fig. FO-22, Sheet 2, circuit J
A6U306 pin 14	+7.5 Vdc	fig. FO-22, Sheet 2, circuit J
A6U306 pin 1	+13 Vdc	fig. FO-22, Sheet 2, circuit J
A6U302 pin 7	TTL high	fig. FO-22, Sheet 2, circuit J

- If incorrect, perform as instructed.
- Troubleshoot remaining problems using fig. FO-22. Replace faulty component.

6. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Remove jumpers.
   - Reinstall A6 cover.
   - Reinstall A2/A3/A4/A5 and cover.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - High Voltage Supplies Test.

High Voltage Supplies Test.

DESCRIPTION

This test is used to isolate high voltage power supply malfunctions in the A6 Power Supply CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-20 as required for component location information.
- See fig. FO-22 Sheet 2, circuit K as required for schematic diagrams.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Remove A6 Cover (para 2-56).
   - Connect power cable to an isolation transformer and to the rear panel.
   - Connect a jumper between A6TP101 and A6TP301.
   - Connect digital multimeter (+) lead to A6TP405 and (-) lead to A6TP401 .
   - Set LINE to ON,
   - Wait for internal alignment routine to finish.
   - Press PRESET button.

2 Verify digital multimeter reads ≈ +110 Vdc and AN/USM-489A rear panel CRT +110 V DC ON indicator is lit.

   - If incorrect, perform Adjust High Voltage Power Supply (para 2-21). If adjustment fails, proceed to step 3.

3. Verify A6U401 pin 10 is ≈ +5 Vdc.
   - If incorrect, check W6.
4. Connect an oscilloscope to A6TP402 with probe's negative lead to A6TP401.
5. Set oscilloscope controls as follows:

   Sweep time .... 10 µs/div

   Vertical Scale .... 10 V/div

6. Verify oscilloscope displays a nearly-sinusoidal waveform at greater than 30 Vp-p, with an ≈ +18 Vdc offset.
   - If a dc voltage near 0 Vdc with narrow, positive- and negative-going pulses are displayed, replace A6A1 High Voltage Module (para 2-56).
   - If adc voltage near +18 Vdc with narrow, positive- and negative-going pulses are displayed, proceed to step 7.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - High Voltage Supplies Test Continued.

7. Using an oscilloscope, verify A6TP403 is a sawtooth waveform with a 1.8 V amplitude.
   - If incorrect, replace A6A1 High Voltage Module (para 2-56).
   - If waveform has pulses similar to A6TP402, troubleshoot using fig. FO-22, Sheet 2, circuit K. Replace faulty component.
   - Troubleshoot remaining problems using fig. FO-22. Replace faulty component.
8. On AN/USM-489A,
   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Remove jumpers.
   - Reinstall A6 cover.
   - Reinstall A2/A3/A4/A5 and cover.

CRT Supply Dropping Out Test.

DESCRIPTION

This test is used to isolate CRT power supply malfunctions in the A6 Power Supply CCA to the malfunctioning component or assembly.

NOTES

- Refer to Chapter 1 for circuit principles of operation.
- See fig. FO-2 as required for cable location information.
- See fig. FO-20 as required for component location information.
- See fig. FO-22 Sheet 2, circuit K as required for schematic diagrams.

1. On AN/USM-489A,
   - Place A2/A3/A4/A5 in service position (para 2-42).
   - Remove A6 Cover (para 2-56).
   - Connect power cable to an isolation transformer and to the rear panel.
   - Connect a jumper between A6TP101 and A6TP301.
   - Connect digital multimeter (+) lead to A6TP405 and (-) lead to A6TP401.
   - Connect an IC clip to A6U401, and connect a jumper between A6U401 pin 10 and A6TP308.
   - Disconnect W8 from A6J4.
   - Set LINE to ON.
   - Wait for internal alignment routine to finish (ignore errors).
   - Press PRESET button.

2-17. DISPLAY/POWER SUPPLY SECTION TEST - A6 POWER SUPPLY CCA TEST - CRT Supply Dropping Out Test Continued.

2. Verify digital multimeter reads ≈ +110 Vdc.

   - If correct, replace A17 CRT Driver CCA (para 2-65).
   - If incorrect, proceed to step 3.

3. Using an oscilloscope, verify A6U401 pin 8 for a 30 kHz flat-topped sawtooth signal at ≈ 5 Vp-p.

   - If incorrect, suspect A6U402A. Troubleshoot using fig. FO-22, Sheet 2, circuit K. Replace faulty component.

4. Using an oscilloscope, verify base of A6Q401 has 30 kHz pulses.

   - If incorrect, and step 2 reading was incorrect, suspect A6CR401 through A6CR404. Troubleshoot using fig. FO-22, Sheet 2, circuit K. Replace faulty component.

5. On AN/USM-489A,

   - Set LINE to OFF.
   - Remove power cable.
   - Disconnect test cables and equipment.
   - Remove jumpers.
   - Reinstall A6 cover.
   - Reinstall A2/A3/A4/A5 and cover.

Section IV. MAINTENANCE PROCEDURES

2-18. PERFORMANCE TEST.

DESCRIPTION

This procedure covers:

- 10 MHz Reference Output Accuracy Test
- Calibrator Accuracy Test
- Displayed Average Noise Test
- Resolution Bandwidth Switching and IF Alignment Uncertainty Test
- Resolution Bandwidth Accuracy and Selectivity Test
- Input Attenuator Accuracy Test
- IF Gain Uncertainty Test
- Scale Fidelity Test
- Residual FM Test
- Noise Sidebands Test
- Image, Multiple, and Out-of-Band Responses Test
- Frequency Readout and Frequency Count Marker Accuracy Test
- Pulse Digitization Uncertainty Test
- Second Harmonic Distortion Test
- Flatness Test
- Frequency Span Accuracy Test
- Third Order Intermodulation Distortion Test
- Gain Compression Test
- 1st LO Output Amplitude Test
- Sweep Time Accuracy Test
- Residual Responses Test
- IF Input Amplitude Accuracy Test
- RF Input VSWR Test
- Frequency Drift Test
- Marker Amplitude Accuracy Test
- 11970A Mixer Test
- 11970K Mixer Test

NOTE

Unless otherwise specified:

- Performance test procedure steps should be done in the order given.
- Keep test equipment interconnecting cables as short as possible.
- Allow a 30 minute warm-up period when performing the first performance test to allow the Spectrum Analyzer to stabilize.
- Allow the Spectrum Analyzer 5 minutes to stabilize if turned off less than five minutes during performance tests.
- The initialized setup of Spectrum Analyzer controls and indicators is to be performed prior to each performance test.
- Pushbutton controls are referred to as “BUTTONS”, and the six display softkeys are referred to as “KEYS” in these procedures.

INITIALIZED SETUP.

1. Initialization of Spectrum Analyzer controls and indicators is accomplished by pressing the PRESET button.
2. Initialized state of Spectrum Analyzer should be as follows:

NOTE

Refer to Section I in TM-11-6625-3250-12 for location of controls and indicators.

CRT SCREEN DISPLAY:

ATTEN annotation	10 dB
RL annotation	0 dBm
MENU TITLE annotation	PRESET
KEY MENU area	RECALL PWR ON/LAST STATE/REALIGN LO & IF/HP-IB ADDRESS
ACTIVE FUNCTION area	HP 8562A COPYRIGHT 19xx,19xx Hewlett-Packard Co. Rev: xxxxxxx
CENTER annotation	12.38 GHz
SPAN annotation	19.25 GHz
RBW annotation	1.0 MHz
VBW annotation	1.0 MHZ
SWP annotation	400 ms
10 dB/ annotation	10 dB/division

NOTE

Press the button, followed by the desired key to display the following default value(s). Pressing a key or button may change the default state (e.g., from AUTO to MANUAL, from OFF to ON, etc).

FREQUENCY button:

CENTER FREQ	12.38 GHz
START FREQ	2.75 GHz
STOP FREQ	22.00 GHz
Center Freq STEP I (mode)	1.93 GHz [AUTO
FREQ OFFSET	0 Hz, OFF (unbold)
10 MHz	INTERNAL

SPAN button:

SPAN WIDTH	19.25 GHz
SWEEP TIME I (mode)	400 ms I AUTO

AMPLITUDE button:

REFerence LEVEL	0 dBm
Input Attenuation I (mode)	10 dB I AUTO
Vertical Scale	LOG 10 dB/DIV
REF LVL OFFSET	0 dB (OFF) (unbold)
MAX MXR LEVEL	-10 dBm
Automatic IF ADJUST	ON
UNITS I (mode)	dBm I AUTO

FREQ COUNT button:

FREQ COUNTer	OFF
COUNTER REsolution	10 kHz

INITIALIZED SETUP - Continued.

Demodulation button:

AM Demodulation	OFF
FM Demodulation	OFF
Demodulation TIME	1 second
VOLUME	0
SQUELCH (mode)	OFF
AGC	OFF

INTernal mixer button:

Internal Mixer	mode selected
SIGnal identification	OFF

EXTernal mixer button:

FULL BAND	K
LOCK HARMONIC	6
Band LOCK	OFF
SIGNAL identification	OFF

Marker buttons:

Marker mode	OFF
MKR NOISE	OFF
SIGnal TRK	OFF
PEAK EXCURSION	6 dB
PEAK THRESHOLD	-120 dBm

SWEEP button:

Continuous mode	ON
SWEEP TIME I (mode)	400 ms I AUTO

AUTO COUPle button:

MAX MXR LEVEL	-10 dBm
VBW:RBW ratio	1
RBW:SPAN ratio	0.011

BW (bandwidth) button:

Resolution BW I (mode)	1 MHz I AUTO
VIDEO BW I (mode)	1 MHz I AUTO
VID AVG I (mode)	100 I OFF

TRACE button:

TRACE A	CLEAR-WRITE
TRACE B	BLANK
A - B - > A	OFF
A - B + Display Line -> A	OFF
DETECTOR MODES	NORMAL
FFT	OFF

TRIGger button:

Continuous mode	ON
Source	FREE RUN
VIDEO TRIG LEVEL	0 dBm

DISPLAY button:

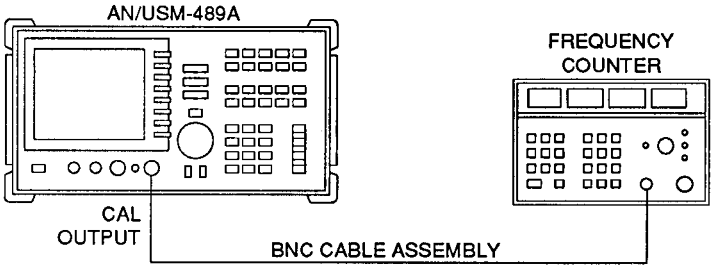
DISPLAY LINE I (mode)	0 dBm I OFF
THRESHLD I (mode)	-90 dBm I OFF
GRATicule	ON
ANNOTation	ON
FREQUENCY DISPLAY OFF	not selected

10 MHz REFERENCE OUTPUT ACCURACY TEST.

1. Connect test equipment as shown (to the <500 MHz input).

NOTE

> The AN/USM-489A must be allowed to warm up for at least ten minutes with 10 MHz key set to INT. If the AN/USM-489A has warmed UP, but 10 MHz key has been set to EXT, wait at least five minutes after pressing PRESET before proceeding.



2. Set frequency counter controls as follows:
   - Sample rate to midrange.
   - Configure counter to measure frequency at 300 MHz.
   - Resolution to 1 Hz.
   - Input impedance to 50 Ω.
3. On AN/USM-489A, press PRESET button.
4. After frequency counter settles (two or three gate times), verify display reads from 299.998800 MHz to 300.001200 MHz
5. Disconnect test equipment.

CALIBRATOR ACCURACY TEST.

1. Zero power meter and power sensor.
2. Connect power sensor using type N (f) to BNC (m) adapter directly to the AN/USM-489A CAL OUTPUT connector.
3. Set power meter CAL Factor to power sensor's 300 MHz setting.
4. Verify power meter reads from -10.3 dBm to -9.7 dBm.
5. Disconnect test equipment.

DISPLAYED AVERAGE NOISE TEST.

1. On AN/USM-489A, connect CAL OUTPUT connector to **INPUT 50Ω** connector using the supplied adapter and BNC cable.
2. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 2.5 kHz.
   - Set REF LVL to -10 dBm.
   - Set ATTEN to 0 dB.
   - Set RES BW to 100 Hz.
   - Set VIDEO BW to 30 Hz.
   - Press MARKER ON button.
   - Press PEAK SEARCH button.
   - Press AMPLITUDE key.
   - Press MORE key.
   - Press REF LVL CAL key.
3. On AN/USM-489A, use the KNOB or STEP buttons to adjust the REF LVL CAL number until the MKR amplitude is -10.00 dBm ±0.17 dB.

NOTE

After the REF LVL CAL number has changed, wait for sweep to finish before reading MKR amplitude.

4. Disconnect cable and connect a **50Ω** Termination to AN/USM-489A INPUT 5**0Ω** connector.
5. On AN/USM-489A,
   - Set REF LVL to -50 dBm.
   - Set SPAN WIDTH to 0 Hz.
   - Set CENTER FREQ to 10 kHz.
   - Set VIDE0 BW to 1 Hz.
   - Press TRIG button.
   - Press SINGLE key (wait for sweep to finish).
   - Press SINGLE key.
   - Press MARKER ON button.
6. Verify the MKR amplitude is more negative than -90 dBm.
7. On AN/USM-489A,
   - Set CENTER FREQ to 99 kHz.
   - Press TRIG button.
   - Press SINGLE key.
8. Verify the MKR amplitude is more negative than -100 dBm.

DISPLAYED AVERAGE NOISE TEST - Continued.

9. On AN/USM-489A,
   - Set START FREQ to 1 MHz.
   - Set STOP FREQ to 2.9 GHz.
10. On AN/USM-489A,
    - Press MARKER OFF button.
    - Set RES BW to 1 MHz.
    - Set VIDEO BW to 10 kHz.
    - Press TRIG button.
    - Press SINGLE key.
    - Press SINGLE key (wait for sweep to finish).
    - Press MARKER ON button.
    - Set MKRNOISE key to ON.
    - Rotate front-panel knob until marker is on highest level.
    - Press MARKER MKR-> button.
    - Press MARKER->CF key.
    - Press SPAN button.
    - Press ZERO SPAN key.
    - Press MARKER OFF button.
    - Set RES BW to 100 Hz.
    - Set VIDEO BW to 1 Hz.
    - Press TRIG button.
    - Press SINGLE key.
    - Press MARKER ON button.
11. Verify the MKR amplitude is more negative than -121 dBm.
12. On the AN/USM-489A, set START FREQ and STOP FREQ to the values shown in the following table, repeat step 10, then verify the MKR amplitude is more negative than the specified level.

START FREQ	STOP FREQ	MKR AMPLITUDE
2.9 GHz	6.46 GHz	-121 dBm
6.46 GHz	13.0 GHz	-110 dBm
13.0 GHz	19.7 GHz	-105 dBm
19.7 GHz	22.0 GHz	-100 dBm

13. Disconnect test equipment.

RESOLUTION BANDWIDTH SWITCHING AND IF ALIGNMENT UNCERTAINTY TEST.

---

1. On AN/USM-489A, connect CAL OUTPUT connector to INPUT 50Ω connector using the supplied adapter and BNC cable.
2. On the AN/USM-489A,
   - Press PRESET button.
   - Press AMPLITUDE button.
   - Press MORE key.
   - Press IF ADJUST key.
   - Press FULL IF ADJ key.
   - Wait for IF ADJUST STATUS message to disappear.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 1 MHz.
   - Set REF LVL to –5 dBm.
   - Set dB/DIV to 1 dB.
   - Set RES BW to 300 kHz.
   - Press TRIGGER button.
   - Press SINGLE button.
   - Press AMPLITUDE button.
   - Press MORE key.
   - Press IF ADJUST key.
   - Set IF ADJ key to OFF.
   - Press TRIG button.
   - Press SINGLE key.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.
3. On AN/USM-489A,
   - Set SPAN WIDTH to 10 MHz.
   - Set RES BW to 2 MHz.
   - Press AMPLITUDE button.
   - Press MORE key.
   - Press IF ADJUST key.
   - Press ADJ CURR IF STATE key.
   - Wait for IF ADJUST STATUS message to disappear.
   - Press TRIG button.
   - Press SINGLE key.
   - Press PEAK SEARCH button.
4. Verify Δ MKR amplitude is 0 dB ±0.5 dB.

RESOLUTION BANDWIDTH SWITCHING AND IF ALIGNMENT UNCERTAINTY TEST - Continued.

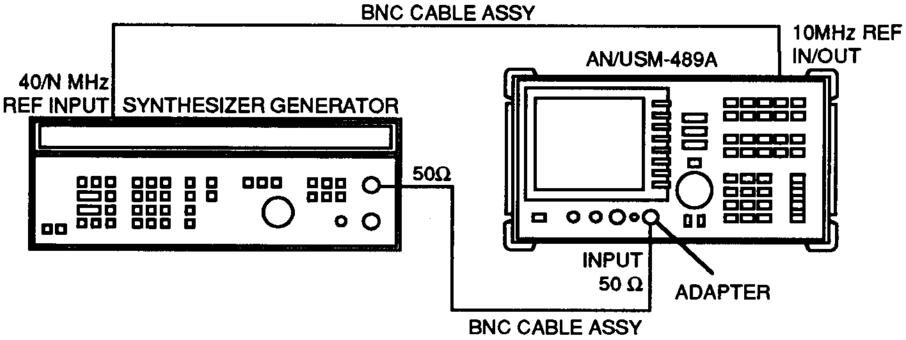
5. Repeat steps 3 and 4 for each set of SPAN WIDTH and RES BW settings shown below, and verify the A MKR reading is 0 dB, within the limits shown.

SPAN WIDTH	RES BW	Tolerance (dB)
10 MHz	2 MHz	±0.5 dB
5 MHz	1 MHz	±0.5 dB
500 kHz	100 kHz	±0.5 dB
100 kHz	30 kHz	±0.5 dB
50 kHz	10 kHz	±0.5 dB
10 kHz	3 kHz	±0.5 dB
10 kHz	1 kHz	±0.5 dB
10 kHz	300 Hz	±1.0 dB
10 kHz	100 Hz	±2.5 dB

6. Disconnect test equipment.

RESOLUTION BANDWIDTH ACCURACY AND SELECTIVITY TEST.

1. Connect test equipment as shown (AN/USM-489A provides frequency reference for synthesizer generator).



2. Set synthesizer generator controls as follows:
   - FREQUENCY to 40 MHz.
   - FREQUENCY INCREMENT to 10 kHz.
   - AMPLITUDE to -3 dBm.
   - AMPLITUDE INCREMENT to 1 dB.
3. On AN/USM-489A.
   - Press PRESET button.
   - Press AMPLITUDE button.
   - Press MORE key.
   - Press IF ADJUST key.
   - Set IF ADJ key to OFF.
   - Set CENTER FREQ to 40 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set LOG dB/DIV to 1 dB.
   - Set SWEEP TIME to 50 ms.
4. Using synthesizer generator AMPLITUDE INCREMENT key, adjust output amplitude to place the signal displayed on the AN/USM-489A two to three divisions below the top graticule line.
5. Set synthesizer generator AMPLITUDE INCREMENT to 3 dB.

RESOLUTION BANDWIDTH ACCURACY AND SELECTIVITY TEST - Continued.

6. On AN/USM-489A,
   - Set RES BW to 2 MHz.
   - Set VIDEO BW to 300 Hz.
   - Press AMPLITUDE button.
   - Press MORE key.
   - Press IF ADJUST key.
   - Press ADJ CURR IF STATE key.
   - Wait for IF ADJUST STATUS message to disappear.
   - Press SPAN button.
   - Press ZERO SPAN key.
   - Press MARKER ON button.

7, Set synthesizer generator FREQUENCY INCREMENT to 10 kHz. Use FREQUENCY INCREMENT key to adjust output frequency to peak the signal amplitude displayed on the AN/USM-489A.

NOTE

Several minor peaks might be observed when searching for peak signal amplitude for 2 MHz RES BW setting. Be sure the peak found is the one with the highest amplitude.

8. On synthesizer generator, press AMPLITUDE INCREMENT (DOWN ARROW) button.
9. On AN/USM-489A, press MARKER DELTA key.
10. On synthesizer generator, press AMPLITUDE INCREMENT (UP ARROW) button.
11. Increase synthesizer generator output frequency until the AN/USM-489A Δ MKR reads 0 dB ±0.02 dB.
12. Record synthesizer generator frequency as the upper 3 dB frequency for current RES BW setting.
13. Decrease synthesizer generator frequency until the peak of the signal is found. Decrease frequency further until AN/USM-489A Δ MKR again reads 0 dB ±0.02 dB.
14. Record the synthesizer generator frequency as lower 3 dB frequency for current RES BW setting.
15. Subtract recorded lower 3 dB frequency from recorded upper 3 dB frequency, and verify results are from 1.5 MHZ to 2.5 MHz.
16. Record result as actual 3 dB bandwidth for the current RES BW setting (will be used in a later calculation).
17. Set synthesizer generator frequency to 40 MHz.
18. On AN/USM-489A, press MARKER OFF button.

RESOLUTION BANDWIDTH ACCURACY AND SELECTIVITY TEST - Continued.

19. Repeat steps 6 through 18 for all AN/USM-489A RES BW and VIDEO BW settings and synthesizer generator FREQUENCY INCREMENT settings listed in the following table. Verify results are within specified limits.

NOTES

- To avoid errors or confusion, blank spaces are provided to record the numerous readings required for future calculations, Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.
- Tune synthesizer generator frequency slowly when VIDEO BW is set to 1 Hz.

AN/USM-489A			synhesizer generator		3 dB Bandwidth		
RES BW	VIDEO BW	FREQ INCR	Upper 3 dB	Lower 3 dB	Min	Actual	Max
2 MHz	300 Hz	10 kHz			1.5 MHz		2.5 MHz
1 MHz	300 Hz	10 kHz			750 kHz		1.25 MHz
300 kHz	300 Hz	1 kHz			270 kHz		330 kHz
100 kHz	300 Hz	500 Hz			90 kHz		110 kHz
30 kHz	300 Hz	100 Hz			27 kHz		33 kHz
10 kHz	1 Hz	50 Hz			9 kHz		11 kHz
3 kHz	1 Hz	10 Hz			2.7 kHz		3.3 kHz
1 kHz	1 Hz	5 Hz			900 Hz		1.1 kHz
300 Hz	1 Hz	1 Hz			270 Hz		330 Hz
100 Hz	1 Hz	1 Hz			70 Hz		130 Hz

20. Set synthesizer generator as follows:
    - FREQUENCY to 40 MHz.
    - FREQUENCY INCREMENT to 10 kHz.
    - AMPLITUDE to -3 dBm.
    - AMPLITUDE INCREMENT to 60 dB.
21. On AN/USM-489A,
    - Set RES BW to 2 MHz.
    - Set VIDEO BW to 300 Hz.
    - Press AMPLITUDE button.
    - Set LOG dB/DIV to 10 dB.
    - Press MORE key.
    - Press IF ADJUST key.
    - Press ADJ CURR IF STATE key.
    - Wait for IF ADJUST STATUS message to disappear.
    - Press MARKER ON button.

RESOLUTION BANDWIDTH ACCURACY AND SELECTIVITY TEST - Continued.

22. Set synthesizer generator FREQUENCY INCREMENT to 10 kHz. Use FREQUENCY INCREMENT key to adjust output frequency to peak the signal amplitude displayed on the AN/USM-489A.

NOTE

Several minor peaks might be observed when searching for peak signal amplitude for 2 MHz RES BW setting. Be sure the peak found is the one with the highest amplitude.

23. On synthesizer generator, press AMPLITUDE INCREMENT (DOWN ARROW) button.
24. On AN/USM-489A, press MARKER DELTA.
25. On the synthesizer generator, press AMPLITUDE INCREMENT (UP ARROW) button.
26. Increase synthesizer generator output frequency until the AN/USM-489A Δ MKR reads 0 dB ±0.2 dB.
27. Record synthesizer generator frequency as the upper 60 dB frequency for current RES BW setting.
28. Decrease synthesizer generator frequency until the peak of the signal is found. Decrease frequency further until AN/USM-489A Δ MKR again reads 0 dB ±0.2 dB.
29. Record the synthesizer generator frequency as lower 60 dB frequency for current RES BW setting.
30. Subtract recorded lower 60 dB frequency from recorded upper 60 dB frequency, record result as 60 dB bandwidth for the current RES BW setting.
31. Divide the 60 dB bandwidth by the 3 dB bandwidth (calculated in step 16) and verify the calculated actual shape factor is less than 15.
32. Set synthesizer generator frequency to 40 MHz.
33. On AN/USM-489A, press MARKER OFF button.

RESOLUTION BANDWIDTH ACCURACY AND SELECTIVITY TEST - Continued.

34. Repeat steps 21 through 33 for all AN/USM-489A RES BW and VIDEO BW settings and synthesizer generator FREQUENCY increment settings listed in the following table.

NOTES

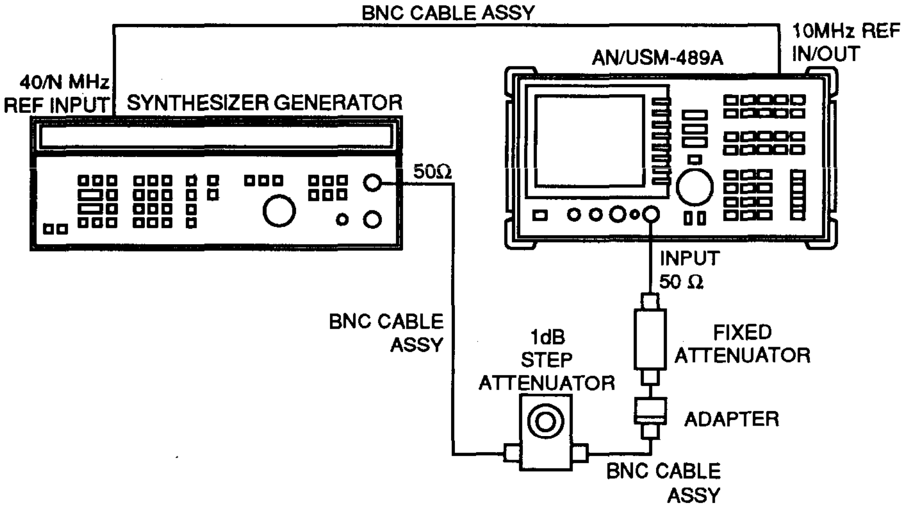
- To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual, It is recommended that a copy of this page be used to record necessary readings.
- Tune synthesizer generator frequency slowly when VIDEO BW is set to 1 Hz.

AN/USM-489A		Synthesizer Generator			60 dB Bandwidth	3 dB Bandwidth	Shape Factor
RES BW	VIDEO BW	FREQ INCR	Upper 60 dB	Lower 60 dB			
2 MHz	300 Hz	10 kHz					
1 MHz	300 Hz	10 kHz					
300 kHz	300 Hz	1 kHz					
100 kHz	300 Hz	1 kHZ					
30 kHz	300 Hz	100 Hz				— . —	
10 kHz	1 Hz	100 Hz					
3 kHz	1 Hz	10 Hz					
1 kHz	1 Hz	10 Hz					
300 Hz	1 Hz	1 Hz					
100 Hz	1 Hz	1 Hz				— —	

35. Disconnect test equipment.

INPUT ATTENUATOR ACCURACY TEST.

1. Connect test equipment as shown using a 20 dB attenuator (AN/USM-489A provides frequency reference for synthesizer generator).



2. Set synthesizer generator controls as follows:
   - FREQUENCY to 50 MHz.
   - AMPLITUDE to -50 dBm.
   - AMPLITUDE INCREMENT to 10 dB.
   - OUTPUT impedance to **50Ω.**
3. On AN/USM-489A,
   - Press PRESET button.
   - Press REALIGN LO & IF key.
   - Wait for ADJUST STATUS message to disappear.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK.
   - Set CENTER FREQ to 50 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -70 dBm.
   - Set dB/DIV to 1 dB.
   - Set RES BW to 3 kHz.
   - Set VIDEO BW to 1 Hz.
4. Set 1 dB step attenuator to 0 dB.
5. Adjust 1 dB step attenuator to place peak of the signal two to three divisions below the top graticule line.

INPUT ATTENUATOR ACCURACY TEST - Continued.

6. On AN/USM-489A,
   - Press TRIG button.
   - Press SINGLE key.
   - Press SINGLE key.
   - Wait for a new sweep to finish.
   - Press MARKER ON button.
   - Press MARKER DELTA key.
7. Set synthesizer generator output to –40 dBm using the AMPLITUDE increment button.
8. On AN/USM-489A,
   - Press AMPLITUDE button.
   - Set ATTEN to 20 dB.
   - Set REF LVL to -60 dBm,
   - Press TRIG button.
   - Press SINGLE key.
   - Wait for a sweep to finish.
9. Record ΔMKR amplitude reading for AN/USM-489A ATTEN setting of 20 dB.
10. Calculate the Cumulative Switching Uncertainty as follows:
    - Subtract the Δ MKR reading from the Ideal Δ MKR reading shown in following table for AN/USM-489A ATTEN setting of 20 dB, and verify the result is 0 dB ±3.5 dB.
    - For example, if the Δ MKR reading for AN/USM-489A ATTEN 20 dB setting was 10.1, then calculated CSU for 20 dB would be 10.0 - 10.1 = -0.1.
    - Record difference as Cumulative Switching Uncertainty (CSU) for AN/USM-489A ATTEN setting of 20 dB.
11. Repeat steps 7 through 10 for all synthesizer generator AMPLITUDE settings and AN/USM-489A ATTEN and REF LVL settings listed in the following table.
12. Calculate the Incremental Switching Uncertainty (ISU) as follows:
    - For AN/USM-489A ATTEN settings from 20 through 70 dB, subtract the previous CSU from the current CSU, and verify the result is 0 dB ±1.8 dB.
    - For example, if the calculated CSU for AN/USM-489A ATTEN 20 dB setting was -0.1, then ISU for 20 dB would be -0.1 - 0.0 = -0.1.
    - For AN/USM-489A ATTEN setting of 0 dB, CSU = ISU. Verify CSU is 0 dB ±1.8 dB.

INPUT ATTENUATOR ACCURACY TEST - Continued.

NOTE

To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

Synthesizer Amplitude (dBm)	AN/USM-489A ATTEN (dB)	REF LVL (dBm)	Ideal Δ MKR (dB)	Actual Δ MKR (dB)	Cumulative Switching Uncert (dB)	Incremental Switching Uncert (dB)
–50	10	–70	0 (Ref)	0 (Ref)	0 (Ref)	0 (Ref)
–40	20	–60	+10.0	______	______	______
–30	30	–50	+20.0	______	______	______
–20	40	–40	+30.0	______	______	______
–10	50	–30	+40.0	______	______	______
0	60	–20	+50.0	______	______	______
+10	70	–10	+60.0	______	______	______
–60	0	–80	–10.0	______	______	______

13. Set synthesizer generator control as follows:
    - FREQUENCY to 50 MHz.
    - AMPLITUDE to +10 dBm.
    - AMPLITUDE INCREMENT to 5 dB.
    - OUTPUT impedance to 50Ω.
14. On AN/USM-489A,
    - Press PRESET button.
    - Press REALIGN LO & IF key.
    - Wait for ADJUST STATUS message to disappear.
    - Set CENTER FREQ to 50 MHz.
    - Set SPAN WIDTH to 0 Hz.
    - Set REF LVL to -10 dBm.
    - Set dB/DI V to 1 dB.
    - Set ATTEN to 0 dB.
    - Set RES BW to 1 kHz.
    - Set VIDEO BW to 1 Hz.
15. Replace 20 dB fixed attenuator with a 10 dB fixed attenuator, and set 1 dB step attenuator to 5 dB.
16. Adjust 1 dB step attenuator to place peak of the signal two to three divisions below the top graticule line.

INPUT ATTENUATOR ACCURACY TEST - Continued.

17. On AN/USM-489A,
    - Press MARKER ON button.
    - Press MARKER DELTA key.
18. Set synthesizer generator output to +5 dBm using the AMPLITUDE increment button.
19. On AN/USM-489A, set REF LVL to -15 dBm.
20. Record ΔMKR amplitude reading for AN/USM-489A REF LVL setting of -15 dBm.
21. Calculate the IF Gain Deviation as follows:
    - Subtract the Ideal Δ MKR reading from the Actual Δ MKR reading shown in following table for AN/USM-489A REF LVL setting of -15 dBm.
    - Record difference as IF Gain Deviation for AN/USM-489A REF LVL setting of -15 dBm (note the sign). These values will be used in a later step.
    - For example, for the AN/USM-489A REF LVL -15 dBm setting, if Actual ΔMKR was -5.02 dB, then IF Gain Deviation = (-5.02) - (-5 dB) = -0.02 dB.
22. Repeat steps 18 through 21 for all synthesizer generator AMPLITUDE settings and AN/USM-489A REF LVL settings listed in the following table.

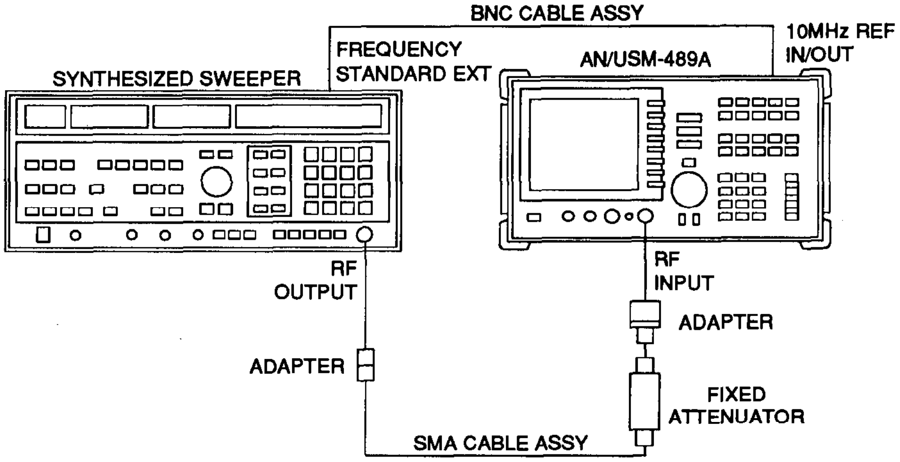
NOTE

To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

Synthesizer Generator Amplitude (dBm)	AN/USM-489A REF LVL (dBm)	Actual Δ MKR Reading (dB)	Ideal Δ MKR Reading (dB)	IF Gain Deviation (dB)
+10	-10	0 (Ref)	00 (Ref)	0 (Ref)
+5	-15		-5	
0	-20		-10	
-5	-25		-15	
-10	-30		–20	
-15	-35		-25	
-20	-40		-30	
-25	-45		-35	
-30	-50		-40	
-35	-55		-45	
-40	-60		-50	
-45	-65		-55	
-50	-70		-60	
-55	-75		-65	
-60	-80		-70	
-65	-85		-75	
-70	-90		-80	
-75	-95		-85	
-80	-100		-90	

INPUT ATTENUATOR ACCURACY TEST - Continued.

23. Connect test equipment as shown using a 10 dB attenuator (AN/USM-489A provides frequency reference for synthesized sweeper).



24. On AN/USM-489A,
    - Set CENTER FREQ to 22 GHz.
    - Set REF LVL to -10 dBm.
    - Set ATTEN to 10 dB.
    - Press MARKER OFF button.
25. Set synthesized sweeper controls as follows:
    - Press PRESET button.
    - CW frequency to 22 GHz.
    - Power level to 0 dBm.
26. On AN/USM-489A,
    - Press PEAK SEARCH button.
    - Press INT button.
    - Press PRESEL AUTO PK key.
    - Wait for PEAKING message to disappear.
27. Adjust synthesized sweeper power level for an AN/USM-489A MKR amplitude reading of -13 dBm ±0.05 dB.
28. On AN/USM-489A,
    - Press MARKER ON button.
    - Press MARKER DELTA key.
    - Press AMPLITUDE button.
    - Set ATTEN to 20 dB.
    - Wait for a new sweep to finish.
29. Record the AN/USM-489A MKR amplitude reading as the A MKR Reading for 20 dB.

INPUT ATTENUATOR ACCURACY TEST - Continued.

30. Repeat steps 28 and 29 for all AN/USM-489A ATTEN settings listed in the following table.

NOTE

> To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

AN/U ATTEN (dB)	M-489A Δ MKR Reading	IF Gain Correction (dB)	Cumulative Switching Uncertainty (dB)	Incremental Switching Uncertainty (dB)
10	0 (Ref)	0 (Ref)	0 (Ref)	0 (Ref)
20		[(-50)-(-40)]		
30		[(-60)-(-40)]		
40		[(-70)-(-40)]		
50		[(-80)-(-40)]		
60		[(-90)-(-40)]		
70		[(-100)-(-40)]		
0		[(-30)-(-40)]		

31. Calculate and record IF GAIN CORRECTION factors for each AN/USM-489A ATTEN setting as follows:

    - For each IF GAIN CORRECTION entry there is a pair of numbers in parentheses. These numbers represent AN/USM-489A REF LVL settings recorded in step 21.
    - Look up the IF GAIN DEVIATION values recorded in step 21 that correspond to these REF LVL settings. Substitute the recorded values for the numbers in parentheses in the IF GAIN CORRECTION column, then calculate the IF GAIN CORRECTION value.
    - For example, when calculating IF GAIN CORRECTION value for 20 dB ATTEN, find the IF GAIN DEVIATION value recorded in step 21 for the -50 and -40 dBm REF LVL settings. If the recorded IF GAIN DEVIATION for -50 dBm REF LVL was +0.2 dB, and for the -40 dBm REF LVL was -0.3 dB, then IF GAIN CORRECTION for the 20 dB ATTEN setting would then be (+0.2) - (-0.3) = +0.5 dB.

32. Calculate the Cumulative Switching Uncertainty for each AN/USM-489A ATTEN setting as follows:

    - Subtract the calculated IF GAIN CORRECTION from the Δ MKR reading, and verify the result is 0 dB ±3.5 dB.
    - For example, if the IF GAIN CORRECTION for AN/USM-489A ATTEN 20 dB setting was +0.02, and ΔMKR reading for ATTEN 20 dB setting was +0.01, then calculated CSU for 20 dB would be (+0.02) - (+0.01) = +0.01.
    - Record difference as Cumulative Switching Uncertainty (CSU) for each AN/USM-489A ATTEN settings in the previous table.

33. Calculate the Incremental Switching Uncertainty (ISU) for each AN/USM-489A ATTEN setting as follows:

    - For AN/USM-489A ATTEN settings from 20 through 70 dB, subtract the previous CSU from the current CSU, and verify the result is 0 dB ±1.8 dB.
    - For example, if the calculated CSU for AN/USM-489A ATTEN 20 dB setting was +0.01, then ISU for 20 dB would be (+0.01) - (0.0) = +0.01.
    - For AN/USM-489A ATTEN setting of 0 dB, CSU = ISU. Verify CSU is 0 dB ±1.8 dB.

34. Disconnect test equipment.

IF GAIN UNCERTAINTY TEST.

1. Connect the equipment as shown. The AN/USM-489A Spectrum Analyzer provides the frequency reference for the synthesizer generator.

2. Set synthesizer generator controls as follows:
   - FREQUENCY to 50 MHz.
   - AMPLITUDE to +10 dB.
   - AMPLITUDE INCREMENT to 10 dB.
   - OUTPUT IMPEDANCE to **50Ω.**
3. On AN/USM-489A,
   - Press PRESET button.
   - Press REALIGN LO & IF key.
   - Set CENTER FREQ to 50 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set dB/DIV to 1 dB.
   - Set RES BW to 10 kHz.
   - Set VIDE0 BW to 1 Hz.
4. Set step attenuator to 0 dB.
5. On AN/USM-489A, press MARKER ON button.
6. Adjust the step attenuator to place the signal 2 or 3 dB (two to three divisions) below the top graticule line.
7. On AN/USM-489A,
   - Press TRIG button.
   - Press SINGLE key.
   - Press MARKER ON button.
   - Press MARKER DELTA key.

IF GAIN UNCERTAINTY TEST - Continued.

8. On synthesizer generator,
   - Press AMPLITUDE button.
   - Press AMPLITUDE INCREMENT (DOWN ARROW) button.
9. On AN/USM-489A,
   - Set REF LVL to -10 dBm.
   - Press TRIG button.
   - Press SINGLE key.
10. Verify AN/USM-489A Δ MKR amplitude reading is -10 dBm ±1 dB.
11. Repeat steps 8 through 10 for all AN/USM-489A REF LVL and synthesizer Amplitude settings listed in the following table. At each setting, verify Δ MKR reading is within specified limits

AN/USM-489A REF LVL (dBm)	Synthesizer Amplitude (dBm)	ΔMKR Reading
-10	0	-10 dBm ±1 dB
-20	-10	-20 dBm ±1 dB
-30	-20	-30 dBm ±1 dB
-40	-30	-40 dBm ±1 dB
-50	-40	-50 dBm ±1 dB
-60	-50	-60 dBm ±1 dB
-70	-60	-70 dBm ±1 dB
-80	-70	-80 dBm ±1 dB

12. Set synthesizer generator controls as follows:
   - AMPLITUDE to + 10 dBm.
   - AMPLITUDE INCREMENT to 1 dB.
13. On AN/USM-489A,
   - Press MARKER ON button.
   - Press MARKER NORMAL key.
   - Set REF LVL to 0 dBm.
   - Set dB/DIV to 1 dB.
   - Press TRIG button.
   - Press CONT key.
14. Adjust 1 dB step attenuator to place peak of the signal two to three divisions below the top graticule line,

IF GAIN UNCERTAINTY TEST - Continued.

15. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
    - Press SINGLE key.
    - Press MARKER ON button.
    - Press MARKER DELTA key.
16. Set synthesizer generator controls as follows:
    - Press AMPLITUDE button.
    - Press AMPLITUDE INCREMENT (DOWN ARROW) button.
17. On AN/USM-489A,
    - Set REF LVL to -1 dBm.
    - Press TRIG button.
    - Press SINGLE key.
18. Verify AN/USM-489A Δ MKR amplitude reading is -1 dBm ±1 dB.
19. Repeat steps 16 through 18 for all AN/USM-489A REF LVL and synthesizer Amplitude settings listed in the following table. At each setting, verify Δ MKR reading is within specified limits.

AN/USM-489A REF LVL (dBm)	Synthesizer Amplitude (dBm)	Δ MKR Reading
-1	+9	−1 dBm ± 1 dB
-2	+8	−2 dBm ± 1 dB
-3	+7	−3 dBm ± 1 dB
-4	+6	−4 dBm ± 1 dB
-5	+5	−5 dBm ± 1 dB
-6	+4	−6 dBm ± 1 dB
-7	+3	−7 dBm ± 1 dB
-8	+2	−8 dBm ± 1 dB
-9	+1	−9 dBm ± 1 dB
-10	0	−10 dBm ± 1 dB
-11	-1	−11 dBm ± 1 dB
-12	-2	−12 dBm ± 1 dB

20. Set synthesizer generator controls as follows:
    - AMPLITUDE to + 10 dBm.
    - AMPLITUDE INCREMENT to 10 dB.

IF GAIN UNCERTAINTY TEST - Continued.

21. On AN/USM-489A,
    - Press MARKER ON button.
    - Press MARKER NORMAL key.
    - Set REF LVL to 0 dBm.
    - Press LINEAR key.
    - Press MORE key.
    - Press UNITS key.
    - Press dBm key.
    - Press TRIG button.
    - Press CONT key.
22. Adjust 1 dB step attenuator to place peak of the signal two to three divisions below the top graticule line.
23. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
    - Press SINGLE key.
    - Press MARKER ON button.
    - Press MARKER DELTA key.
24. Set synthesizer generator controls as follows:
    - Press AMPLITUDE button.
    - Press AMPLITUDE INCREMENT (DOWN ARROW) button.
25. On AN/USM-489A,
    - Set REF LVL to -10 dBm.
    - Press TRIG button.
    - Press SINGLE key.
26. Verify AN/USM-489A ΔMKR amplitude reading is -10 dBm ±1 dB.

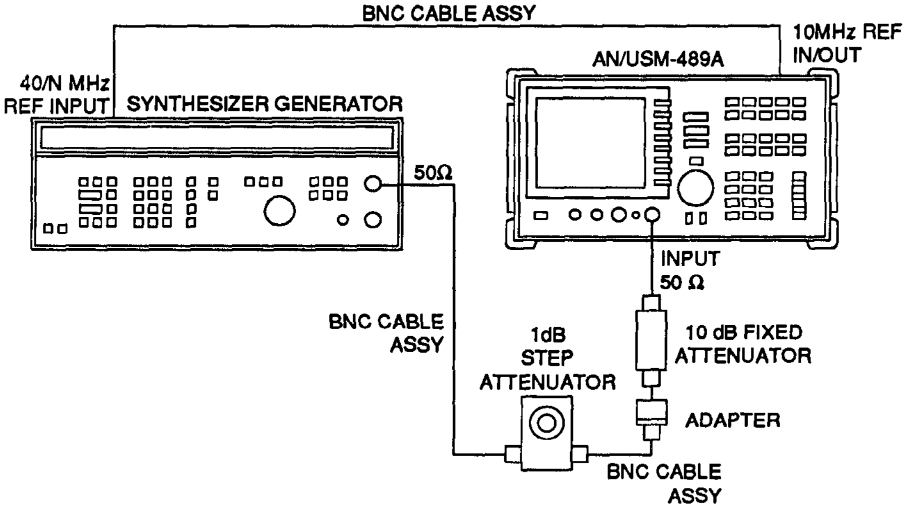
27, Repeat steps 24 through 26 for all AN/USM-489A REF LVL and synthesizer Amplitude settings listed in the following table. At each setting, verify ΔMKR reading is within specified limits.

AN/USM-489A REF LVL (dBm)	Synthesizer Amplitude (dBm)	Δ MKR Reading
-10	0	−10 dBm ± 1 dB
-20	-10	−20 dBm ± 1 dB
-30	-20	−30 dBm ± 1 dB
-40	-30	−40 dBm ± 1 dB
-50	-40	−50 dBm ± 1 dB
-60	-50	−60 dBm ± 1 dB
-70	-60	−70 dBm ± 1 dB
-80	-70	−80 dBm ± 1 dB

28. Disconnect test equipment.

SCALE FIDELITY TEST.

1. Connect the equipment as shown. The AN/USM-489A Spectrum Analyzer provides frequency reference for synthesizer generator.



2. Set synthesizer generator controls as follows:
   - FREQUENCY to 50 MHz.
   - AMPLITUDE to +10 dB.
   - AMPLITUDE INCREMENT to 0.05 dB.
   - OUTPUT IMPEDANCE to **50Ω.**
3. On AN/USM-489A,
   - Press PRESET button.
   - Press REALIGN LO & IF key.
   - Set CENTER FREQ to 50 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -10 dBm.
   - Set ATTEN to 0 dB.
   - Set RES BW to 10 kHz.
   - Set VIDEO BW to 30 Hz.
4. Set step attenuator to 0 dB.
5. On AN/USM-489A, press MARKER ON button.
6. Adjust step attenuator until AN/USM-489A MKR amplitude reads between -10 dBm and -11 dBm.
7. Set synthesizer generator controls as follows:
   - Press AMPLITUDE button.
   - Press AMPLITUDE INCREMENT (DOWN ARROW) and (UP ARROW) buttons until AN/USM-489A MKR reads exactly -10.00 dBm.
   - Set AMPLITUDE INCREMENT to 4 dB.
   - Press AMPLITUDE button.

SCALE FIDELITY TEST - Continued.

8. On AN/USM-489A,
   - Press TRIG button.
   - Press SINGLE key.
   - Press SINGLE key.
   - Press MARKER ON button.
   - Press MARKER DELTA key.
9. On synthesizer generator, press AMPLITUDE INCREMENT (DOWN ARROW) button.
10. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
11. Verify AN/USM-489A MKR amplitude reads from -4.4 dBm to –3.6 dBm.
12. Repeat steps 9 through 11 for all synthesizer Amplitude settings listed in the following table. At each setting, verify MKR reading is within specified limits.

Synthesizer Amplitude (dBm)	dB from AN/USM-489A REF LVL (nominal)	MKR Reading
+6	-4	-4.4 dBm to -3.6 dBm
+2	-8	-8.8 dBm to -7.2 dBm
-2	-12	-13.2 dBm to -10.8 dBm
-6	-16	–17.5 dBm to -14.5 dBm
-10	-20	–21.5 dBm to -18.5 dBm
-14	-24	–25.05 dBm to -22.5 dBm
–18	-28	-29.5 dBm to -26.5 dBm
-22	–32	-33.5 dBm to -30.5 dBm
-26	–36	–37.5 dBm to -34.5 dBm
-30	–40	-41.5 dBm to -38.5 dBm
–34	-44	-45.5 dBm to –42.5 dBm
-38	–48	-49.5 dBm to -46.5 dBm
-42	–52	-53.5 dBm to -50.5 dBm
-46	–56	-57.5 dBm to -54.5 dBm
-50	–60	-61.5 dBm to -58.5 dBm
–54	-64	-65.5 dBm to -62.5 dBm
-58	–68	-69.5 dBm to -66.5 dBm
–62	-72	–73.5 dBm to -70.5 dBm
-66	-76	-77.5 dBm to -74.5 dBm
-70	–80	-81.5 dBm to -78.5 dBm
-74	-84	-85.5 dBm to –82.5 dBm
-78	-88	-89.5 dBm to -86.5 dBm

SCALE FIDELITY TEST - Continued.

13. Set synthesizer generator controls as follows:
    - Press AMPLITUDE button.
    - Set AMPLITUDE INCREMENT to 2 dB.
    - Press AMPLITUDE INCREMENT (DOWN ARROW) button.
14. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
15. Verify AN/USM-489A Δ MKR amplitude reads from -91.5 dBm to -88.5 dBm.
16. On AN/USM-489A,
    - Press TRIG button.
    - Press CONT key.
    - Set dB/DIV to 2 dB.
17. Set synthesizer generator controls as follows:
    - AMPLITUDE to +10 dBm.
    - AMPLITUDE INCREMENT to 0.01 dB.
18. On AN/USM-489A,
    - Set REF LVL to -10 dBm.
    - Press MARKER ON button.
    - Press MARKER NORMAL key.
19. Adjust step attenuator until AN/USM-489A MKR amplitude reads between -10 dBm and -11 dBm.
20. Set synthesizer generator controls as follows:
    - Press AMPLITUDE button.
    - Press AMPLITUDE INCREMENT (DOWN ARROW) and (UP ARROW) buttons until AN/USM-489A MKR reads exactly -10.00 dBm.
    - Set AMPLITUDE INCREMENT to 4 dB.
    - Press AMPLITUDE button.
21. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
    - Press SINGLE key.
    - Press MARKER ON button.
    - Press MARKER DELTA key.
22. On synthesizer generator, press AMPLITUDE INCREMENT (DOWN ARROW) button.
23. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
24. Verify AN/USM-489A Δ MKR amplitude reads from -4.4 dBm to -3.6 dBm.

SCALE FIDELITY TEST - Continued.

25. Repeat steps 22 through 24 for all synthesizer Amplitude settings listed in the following table. At each setting, verify ΔMKR reading is within specified limits.

Synthesizer Amplitude (dBm)	dB from AN/USM-489A REF LVL (nominal)	Δ MKR Reading
+6	-4	-4.4 dBm to -3.6 dBm
+2	-8	-8.8 dBm to -7.2 dBm
-2	-12	-13.2 dBm to -10.8 dBm
-6	-16	-17.5 dBm to -14.5 dBm

26. Set synthesizer generator controls as follows:
    - Press AMPLITUDE button.
    - Set AMPLITUDE INCREMENT to 2 dB.
    - Press AMPLITUDE INCREMENT (DOWN ARROW) button.
27. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
28. Verify AN/USM-489AA Δ MKR amplitude reads from -19.5 dBm to -16.5 dBm.
29. On AN/USM-489A,
    - Press TRIG button.
    - Press CONT key.
    - Press AMPLITUDE button.
    - Press LINEAR key.
    - Press MORE key.
    - Press UNITS key.
    - Press dBm key.
30. Set synthesizer generator controls as follows:
    - AMPLITUDE to +10 dBm.
    - AMPLITUDE INCREMENT to 0.01 dB.
31. On AN/USM-489A,
    - Set REF LVL to -10 dBm.
    - Press MARKER ON button.
    - Press MARKER NORMAL key.
32. Adjust step attenuator until AN/USM-489A MKR amplitude reads between –10 dBm and -11 dBm.

SCALE FIDELITY TEST - Continued.

33. Set synthesizer generator controls as follows:
    - Press AMPLITUDE button.
    - Press AMPLITUDE INCREMENT (DOWN ARROW) and (UP ARROW) buttons until AN/USM-489A MKR reads exactly -10.00 dBm.
    - Set AMPLITUDE INCREMENT to 2 dB.
    - Press AMPLITUDE button.
34. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
    - Press SINGLE key.
    - Press MARKER ON button.
    - Press MARKER DELTA key.
35. On synthesizer generator, press AMPLITUDE INCREMENT (DOWN ARROW) button.

38. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.

37. Verify AN/USM-489A ΔMKR amplitude reads from -2.33 dBm to –1.68 dBm.

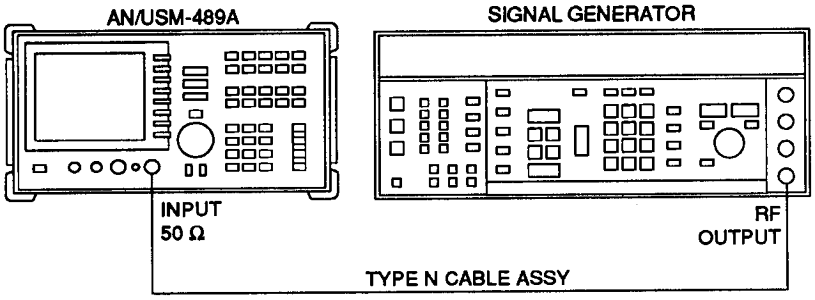
38. Repeat steps 35 through 37 for all synthesizer Amplitude settings listed in the following table. At each setting, verify ΔMKR reading is within specified limits.

Synthesizer Amplitude (dBm)	dB from AN/USM-489A REF LVL (nominal)	Δ MKR Reading
+8	2	-2.33 dBm to -1.68 dBm
+6	4	-4.42 dBm to –3.60 dBm
+4	6	-6.54 dBm to -5.50 dBm
+2	8	-8.68 dBm to -7.37 dBm
0	10	-10.87 dBm to -9.21 dBm
- 2	12	-13.10 dBm to -11.02 dBm
- 4	14	-15.42 dBm to -12.78 dBm
- 6	16	-17.82 dBm to -14.49 dBm
- 8	18	-20.36 dBm to -16.14 dBm

39. Disconnect test equipment.

RESIDUAL FM TEST.

1. Connect the equipment as shown.



2. Set signal generator controls as follows:
   - FREQUENCY to 2000 MHz.
   - CW OUTPUT to -10 dBm.
3. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 2.0 GHz.
   - Set SPAN WIDTH to 1 MHz.
   - Set REF LVL to -10 dBm.
   - Set dB/DIV to 1 dB.
   - Set RES BW to 3 kHz.
   - Press PEAK SEARCH button.
   - Set SIG TRK key to ON.
   - Set SPAN WIDTH to 10 kHz.
   - Set RES BW to 1 kHz.
   - Press MARKER ON button.
   - Set SIG TRK key to OFF.
   - Press PEAK SEARCH button.
   - Press MKR-> button.
   - Press MARKER -> CF key.
   - Press MARKER -> REF LVL key.
   - Press MARKER OFF button.
   - Press TRIG button.
   - Press SINGLE key.
   - Press SINGLE key.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.

RESIDUAL FM TEST - Continued.

4. On AN/USM-489A,
   - Rotate knob counterclockwise until the ΔMKR reads -1 dB ±0.1 dB.
   - Press MARKER DELTA.
   - Rotate knob counterclockwise until the ΔMKR reads -4 dB ±0.1 dB.
5. Divide displayed ΔMKR frequency (in Hz) by displayed ΔMKR amplitude (in dB). and record value (in Hz/d B) as slope of the RES BW filter is.

   For example if ΔMKR frequency is 380 Hz and Δ MKR amplitude is 3.92 dB. slope would be:

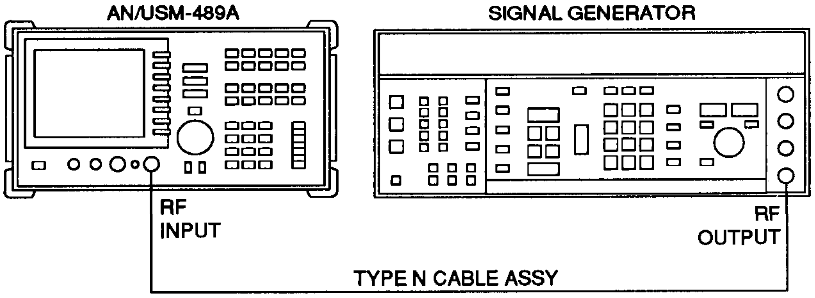
   $$\frac{380\text{ Hz}}{3.92\text{ dB}} = 97\text{ Hz/d B}$$
6. On AN/USM-489A,
   - Press MARKER OFF button.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.
   - Rotate knob counterclockwise until ΔMKR reads -3 dB ±0.1 dB.
   - Press MKR -> button.
   - Press MARKER NORMAL key.
   - Press MARKER -> CF.
   - Press SPAN button.
   - Press ZERO SPAN key.
   - Set SWEEP TIME to 100 ms.
   - Press TRIG button.
   - Press SINGLE key.
7. On AN/USM-489A, verify displayed trace is ≈ 3 divisions below top graticule line.
   - If incorrect, press CONT key, press FREQUENCY button, and use knob to place the displayed trace about 3 divisions below top graticule line. Press TRIG button then SINGLE key and continue with next step.
   - If correct, continue with next step.
8. On AN/USM-489A,
   - Press MARKER ON button.
   - Locate horizontal division with greatest amplitude deviation, and rotate knob to position the marker at highest point within that same horizontal division.
   - Press MARKER DELTA key.
   - Rotate knob to position marker at the lowest point within that same horizontal division.
9. Record absolute value of Δ MKR amplitude.
10. Calculate Residual FM as follows:

    Multiplying slope calculated in step 5 by deviation recorded in step 9 and verify result is <50 Hz.

    For example if slope (step 5) is 97 Hz/d B and deviation (step 9) is 0.12 dB, then Residual FM would be 97 Hz/dB x 0.12 dB = 11.64 Hz.
11. Disconnect test equipment.

NOISE SIDEBANDS TEST.

1. Connect the equipment as shown.



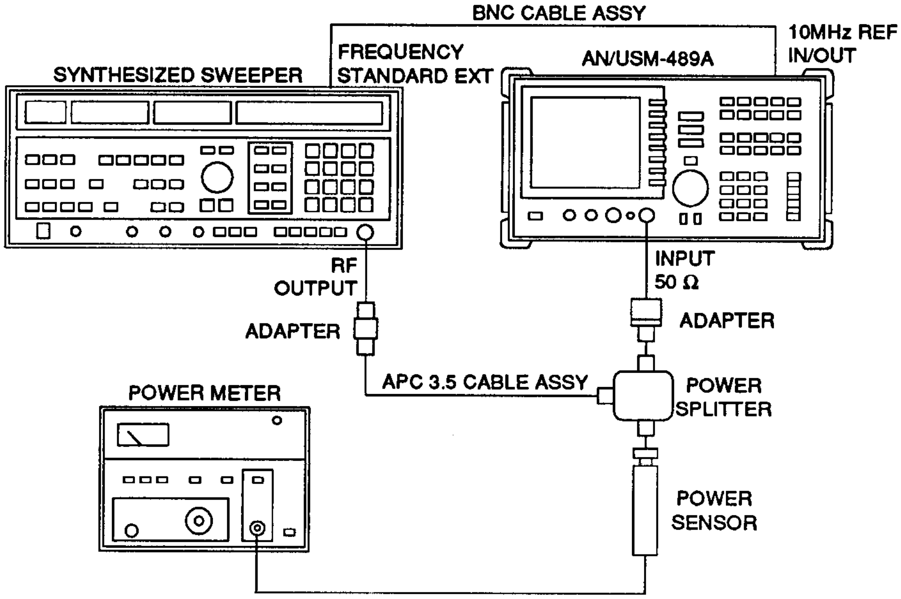
2. Set signal generator controls as follows:
   - FREQUENCY to 2000 MHz.
   - CW OUTPUT to -10 dBm.
3. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 2.0 GHz.
   - Set SPAN WIDTH to 1 MHz.
   - Set REF LEVEL to -10 dBm.
   - Set ATTEN to 0 dBm.
   - Press PEAK SEARCH button.
   - Set SIG TRK key to ON.
   - Set SPAN WIDTH to 10 kHz.
   - Wait for the completion of two sweeps.
   - Press MARKER ON button.
   - Set SIG TRK key to OFF.
   - Set RES BW to 300 Hz.
   - Set VIDEO BW to 1 Hz.
   - Set SPAN WIDTH to 0 Hz.
4. Adjust signal generator amplitude until AN/USM-489A signal peak is equal to top graticule line.

NOISE SIDEBANDS TEST - Continued.

5. On AN/USM-489A,
   - Press TRIG button.
   - Press SINGLE key.
   - Press SINGLE key.
   - Wait for the completion of sweep.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.
   - Press FREQUENCY button.
   - Set CF STEP to 9 kHz.
   - Press CENTER FREQ key.
   - Press UP ARROW button.
   - Press TRIG button.
   - Press SINGLE key.
   - Wait for the completion of sweep.
6. Verify Δ MKR amplitude reads more negative than -70.0 dBc.
7. On AN/USM-489A,
   - Press FREQUENCY button.
   - Press DOWN ARROW button.
   - Press DOWN ARROW button.
   - Press TRIG button.
   - Press SINGLE key.
   - Wait for the completion of sweep.
8. Verify Δ MKR amplitude reads more negative than -70.0 dBc.
9. Disconnect test equipment.

IMAGE, MULTIPLE, AND OUT-OF-BAND RESPONSES TEST.

1. Zero power meter and power sensor.
2. Connect the equipment as shown. The AN/USM-489A provides the frequency reference for the synthesized sweeper.



3. Set synthesized sweeper controls as follows:
   - Press INSTR PRESET button.
   - Set CW FREQUENCY to 2 GHz.
   - Set POWER LEVEL to -10 dBm.
   - Set rear panel FREQUENCY STANDARD SWITCH to EXT.
4. On AN/USM-489A,
   - Press PRESET button.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK key.
   - Set CENTER FREQ 2 GHz.
   - Set SPAN WIDTH 10 kHz.
   - Set REF LVL to -10 dBm.
   - Set ATTEN to 0 dB.
   - Set RES BW to 1 kHz.
5. Enter power sensor’s 2 GHz calibration factor into power meter.
6. Adjust synthesized sweeper power level for a power meter reading of –10 dB ±0.1 dB.

IMAGE, MULTIPLE, AND OUT-OF-BAND RESPONSES TEST - Continued.

7. On AN/USM-489A,
   - Press PEAK SEARCH button.
   - Press MKR -> button.
   - Press MARKER -> REF LVL key.
   - Press TRIG button.
   - Press SINGLE key.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.
8. Set synthesized sweeper to 1978.6 MHz.
9. Enter power sensor's calibration factor into power meter for current synthesized sweeper CW frequency.
10. Adjust synthesized sweeper power level for a power meter reading of -10 dBm ±0.1 dB.
11. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
    - Wait for completion of sweep.
    - Press PEAK SEARCH button.
12. Verify Δ MKR amplitude is more negative than -70 dBc.
13. Repeat steps 8 through 12 for all AN/USM-489A Center Frequency settings and Sweeper CW frequency settings listed in the following table. At each setting, verify Δ MKR reading is within specified limits.

Band	AN/USM-489A Center Freq GHz	Synthesized Sweeper CW (MHz)	Maximum Δ MKR amplitude
0	2.0	1978.6*	-70 dBc
	2.0	2021.4*	-70 dBc
	2.0	1378.6*	-70 dBc
	2.0	2621.4*	-70 dBc
	2.0	9821.6***	-70 dBc
	2.0	1810.7**	-70 dBc
	2.0	7910.7***	-70 dBc
	2.0	289.3**	-70 dBc

* Image response
** Multiple response
*** Out-of-Band response

14. On AN/USM-489A,
    - Press MARKER OFF button.
    - Press TRIG button.
    - Press CONT key.
    - Set CENTER FREQ 4 GHz.
15. Set synthesized sweeper CW frequency to AN/USM-489A CENTER FREQ.

IMAGE, MULTIPLE, AND OUT-OF-BAND RESPONSES TEST - Continued.

16. Enter power sensor's calibration factor into power meter for current synthesized sweeper CW frequency.

17. On AN/USM-489A,
    - Press PEAK SEARCH button.
    - Press INT button.
    - Press PRESEL AUTO PK key.
    - Wait for PEAKING message to disappear.
    - Press MARKER OFF button.

18. Adjust synthesized sweeper power level for a power meter reading of -10 dBm ±0.1 dB.

19. On AN/USM-489A,
    - Press PEAK SEARCH button.
    - Press MKR -> button.
    - Press MARKER -> REF LVL key.
    - Press TRIG button.
    - Press SINGLE key.
    - Press PEAK SEARCH button.
    - Press MARKER DELTA key.

20. Set synthesized sweeper to 3978.6 MHz.

21. Enter power sensor's calibration factor into power meter for current synthesized sweeper CW frequency.

22. Adjust synthesized sweeper power level for a power meter reading of -10 dBm ±0.1 dB.

23. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
    - Wait for completion of sweep.
    - Press PEAK SEARCH button.

24. Verify Δ MKR amplitude is more negative than -70 dBc.

25. Repeat steps 20 through 24 for all AN/USM-489A Sweeper CW frequency settings listed in the following table for Band 1. At each setting, verify ΔMKR reading is within specified limits.

IMAGE, MULTIPLE, AND OUT-OF-BAND RESPONSES TEST - Continued.

26. Repeat steps 14 through 25 for AN/USM-489A Band 2, 3, and 4 settings listed in the following table.

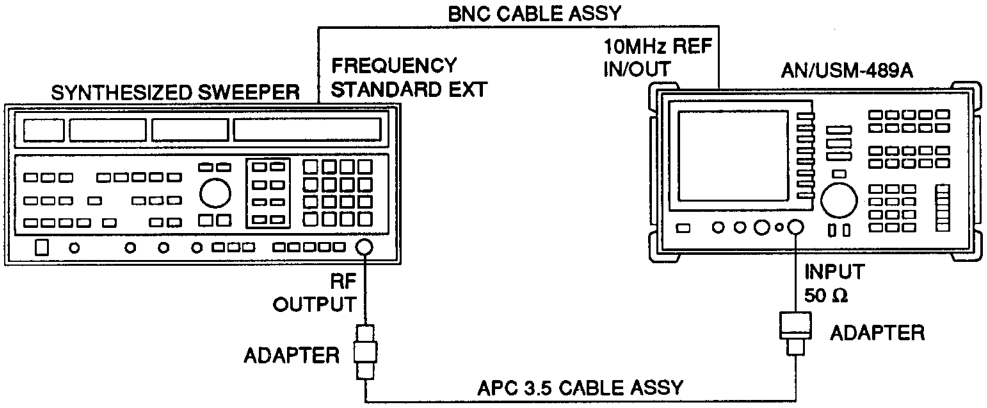
Band	AN/USM-489A Center Freq G Hz	Synthesized Sweeper CW (MHz)	Maximum Δ MKR amplitude
1	4.0	3978.6*	-70 dBc
	4.0	4021.4*	-70 dBc
	4.0	3378.6*	-70 dBc
	4.0	4621.4*	-70 dBc
	4.0	289.3***	-70 dBc
	4.0	3721.4**	-70 dBc
2	9.0	8978.6*	-70 dBc
	9.0	9021.4*	-70 dBc
	9.0	8378.6*	-70 dBc
	9.0	9621.4*	-70 dBc
	9.0	269.3***	-70 dBc
	9.0	9921.4**	-70 dBc
3	15.0	14978.6*	-70 dBc
	15.0	15021.4*	-70 dBc
	15.0	15621.4*	-70 dBc
	15.0	14378.6*	-70 dBc
	15.0	289.3***	-70 dBc
	15.0	14721.4**	-70 dBc
4	21.0	20978.6*	-60 dBc
	21.0	21021.4*	-60 dBc
	21.0	20378.6*	-60 dBc
	21.0	21621.4*	-60 dBc
	21.0	289.3***	-60 dBc
	21.0	21921.4**	-60 dBc

*	Image response
**	Multiple response
***	Out-of-Band response

27. Disconnect test equipment.

FREQUENCY READOUT AND FREQUENCY COUNT MARKER ACCURACY TEST.

1. Connect equipment as shown. The AN/USM-489A provides frequency reference for synthesized sweeper.



2. Set synthesized sweeper controls as follows:
   - Press INSTR PRESET button.
   - Set CW FREQUENCY to 1.5 GHz.
   - Set POWER LEVEL to -10 dBm.
   - Set rear panel FREQUENCY STANDARD switch to EXT.
3. On AN/USM-489A,
   - Press PRESET key.
   - Set CENTER FREQ to 1.5 GHz.
   - Set SPAN WIDTH to 1 MHz.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK key.
   - Press PEAK SEARCH button.
4. Verify the MKR frequency is from 1.499948 GHz to 1.500051 GHz.
5. Repeat steps 3 and 4 for all Sweeper frequency settings and AN/USM-489A Frequency/Span combinations listed in the following table. At each setting, verify MKR reading is within specified limits.

Sweeper CW (GHz)	AN/USM-489A Span	Center Freq	AN/USM-489A Marker Reading
1.5	1 MHz	1.5 GHz	1.499948 to 1.500051 GHz
1.5	10 MHz	1.5 GHz	1.49948 to 1.50051 GHz
1.5	20 MHz	1.5 GHz	1.49895 to 1.50104 GHz
1.5	50 MHz	1.5 GHz	1.49745 to 1.50254 GHz
1.5	100 MHz	1.5 GHz	1.4948 to 1.5052 GHz
1.5	1 GHz	1.5 GHz	1.450 to 1.550 GHz

FREQUENCY READOUT AND FREQUENCY COUNT MARKER ACCURACY TEST - Continued.

6. On AN/USM-489A,
   - Press MARKER OFF button.
   - Set CENTER FREQ 4 GHz.
7. Set synthesized sweeper CW frequency to AN/USM-489A CENTER FREQ.
8. On AN/USM-489A,
   - Press PEAK SEARCH button.
   - Press INT button.
   - Press PRESEL AUTO PK key.
   - Wait for PEAKING message to disappear.
   - Press MARKER OFF button.
9. On AN/USM-489A,
   - Set SPAN WIDTH to 1 MHz.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK key.
   - Press PEAK SEARCH button.
10. Verify the MKR frequency is from 3.999948 GHz to 4.000051 GHz.
11. Repeat steps 9 and 10 for all AN/USM-489A Span settings listed in the following table for 4.0 GHz. At each setting, verify MKR reading is within specified limits.
12. Repeat steps 6 through 11 Sweeper/AN/USM-489A frequency settings of 9.0 GHz, 16.0, and 21.0 GHz listed in following table.

Sweeper CW (GHz)	AN/USM Span	-489A Center Freq	AN/USM-489A Marker Reading
4.0	1 MHz	4.0 GHz	3.999948 to 4.000051 GHz
4.0	10 MHz	4.0 GHz	3.99948 to 4.00051 GHz
4.0	20 MHz	4.0 GHz	3.99895 to 4.00104 GHz
4.0	50 MHz	4.0 GHz	3.99745 to 4.00254 GHz
4.0	100 MHz	4.0 GHz	3.9948 to 4.0051 GHz
4.0	1 GHz	4.0 GHz	3.950 to 4.050 GHz
9.0	1 MHz	9.0 GHz	8.999948 to 9.000051 GHz
9.0	10 MHz	9.0 GHz	8.99948 to 9.00051 GHz
9.0	20 MHz	9.0 GHz	8.99895 to 9.00104 GHz
9.0	50 MHz	9.0 GHz	8.99745 to 9.00254 GHz
9.0	100 MHz	9.0 GHz	8.9948 to 9.0051 GHz
9.0	1 GHz	9.0 GHz	8.950 to 9.050 GHz
16.0	1 MHz	16.0 GHz	15.999948 to 16.000051 GHz
16.0	10 MHz	16.0 GHz	15.99948 to 16.00051 GHz
16.0	20 MHz	16.0 GHz	15.99895 to 16.00104 GHz
16.0	50 MHz	16.0 GHz	15.99745 to 16.00254 GHz
16.0	100 MHz	16.0 GHz	15.9948 to 16.0051 GHz
16.0	1 GHz	16.0 GHz	15.950 to 16.050 GHz
21.0	1 MHz	21.0 GHZ	20.999948 to 21.000051 GHz
21.0	10 MHz	21.0 GHz	20.99948 to 21.00051 GHz
21.0	20 MHz	21.0 GHz	20.99895 to 21.00104 GHz
21.0	50 MHz	21.0 GHz	20.99745 to 21.00254 GHz
21.0	100 MHz	21.0 GHz	20.9948 to 21.0051 GHz
21.0	1 GHz	21.0 GHz	20.950 to 21.050 GHz

FREQUENCY READOUT AND FREQUENCY COUNT MARKER ACCURACY TEST – Continued.

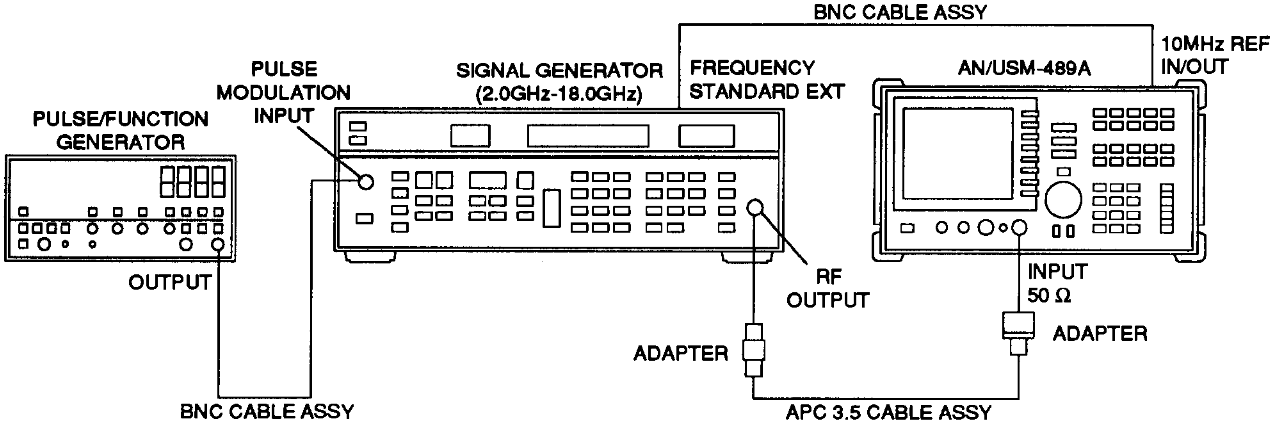
13. On AN/USM-489A,
    - Press SPAN WIDTH 1 MHz.
    - Press FREQ COUNT button.
    - Set COUNTER RES to10 Hz.
14. Set synthesized sweeper CW FREQUENCY to 1.5 GHz.
15. On AN/USM-489A,
    - Set CENTER FREQ to 1.5 GHz.
    - Press PEAK SEARCH button.
16. Verify MKR frequency is from 1.49999994 GHz to 1.50000006 GHz.
17. Repeat steps 14 through 16 for all Sweeper/AN/USM-489A frequency settings listed in the following table. At each setting, verify MKR reading is within specified limits.

Synthesized Sweeper CW (GHz)	AN/USM-489A Frequency	AN/USM-489A Marker Frequency
1.5	1.5	1.49999994 to 1.50000006 GHz
4.0	4.0	3.99999994 to 4.00000006 GHz
9.0	9.0	8.99999989 to 9.00000011 GHz
16.0	16.0	15.99999984 to 16.00000016 GHz
21.0	21.0	20.99999979 to 21.00000021 GHz

18. Disconnect test equipment.

PULSE DIGITIZATION UNCERTAINTY TEST.

1. Connect equipment as shown. The AN/USM-489A provides frequency reference for signal generator.



2. Set signal generator controls as follows:
   - Press INSTR PRESET button.
   - Set FREQUENCY to 2500 MHz.
   - Set MODULATION to PULSE.
   - Set POWER LEVEL to -15 dBm.
   - Set RF to ON.
   - Set LEVELING to INT.
   - Set rear panel FREQUENCY STANDARD SWITCH to EXT.
3. Set Pulse/Function Generator controls as follows:
   - Set FUNCTION to PULSE.
   - Set WIDTH to 200 ns.
   - Set AMPLITUDE to 5.0 V.
   - Set OFFSET to 0.0 V.
   - Set MODE to NORM.
   - Set CTRL to OFF.

PULSE DIGITIZATION UNCERTAINTY TEST – Continued.

4. On AN/USM-489A,
   - Press PRESET button.
   - Press TRACE button.
   - Press MORE key.
   - Press DETECTOR MODES key.
   - Press DETECTOR POS PEAK key.
   - Set CENTER FREQ to 2500 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEPTIME to 50 ms.
   - Set REF LVL to -10 dBm.
   - Set dB/DIV to 5 dB.
   - Set RES BW to 1 MHz.
   - Set VIDEO BW to 3 MHz.
5. Set Pulse/Function Generator FREQ to 144 kHz using RANGE switch.
6. On AN/USM-489A,
   - Press TRIG button.
   - Press SINGLE key.
   - Press SINGLE key.
   - Press PEAK SEARCH button.
   - Record Marker Amplitude reading as MAX level for 144 kHz PRF.
7. On AN/USM-489A,
   - Press MARKER ON button.
   - Rotate knob until marker it is at lowest point on the trace.
   - Record Marker Amplitude reading as MIN level for 144 kHz PRF.
8. Set Pulse/Function Generator FREQ to 14.4 kHz using RANGE switch.
9. On AN/USM-489A
   - Press TRIG button.
   - Press SINGLE key.
   - Press SINGLE key.
   - Press PEAK SEARCH button.
   - Record Marker Amplitude reading as MAX level for 14.4 kHz PRF.
10. On AN/USM-489A,
    - Press MARKER ON button.
    - Rotate knob until marker it is at lowest point on the trace.
    - Record Marker Amplitude reading as MIN level for 14.4 kHz PRF.

PULSE DIGITIZATION UNCERTAINTY TEST - Continued.

11. Calculate Pulse Digitization Uncertainty (PDU) (dB) as follows:
    - Subtract lowest recorded MIN Marker Amplitude reading (step 7 or 10) from highest recorded MAX Marker Amplitude reading (step 6 or 9).
    - Verify result is < 1.25 dB.
12. On AN/USM-489A, set RES BW to 2 MHz.
13. Repeat steps 5 through 10.
14. Calculate PDU (dB) as follows:
    - Subtract lowest recorded MIN Marker Amplitude reading (step 7 or 10) from highest recorded MAX Marker Amplitude reading (step 6 or 9).
    - Verify result is < 3 dB.
15. On AN/USM-489A,
    - Set RES BW to 1 MHz.
    - Press AMPLITUDE button.
    - Press LINEAR key.
16. Repeat steps 5 through 10.
17. Calculate PDU (%) as follows:
    - $$\text{PDU} = 100 \times \left(\frac{\text{highest recorded MAX Marker Amplitude reading (step 6 or 9)}}{\text{lowest recorded MIN Marker Amplitude reading (step 7 or 10)}} - 1 \right)$$
    - Verify result is < 4%.
18. On AN/USM-489A, set RES BW to 2 MHz.
19. Repeat steps 5 through 10.
20. Calculate PDU (%) as follows:
    - $$\text{PDU} = 100 \times \left(\frac{\text{highest recorded MAX Marker Amplitude reading (step 6 or 9)}}{\text{lowest recorded MIN Marker Amplitude reading (step 7 or 10)}} - 1 \right)$$
    - Verify result is < 12%.

NOTE

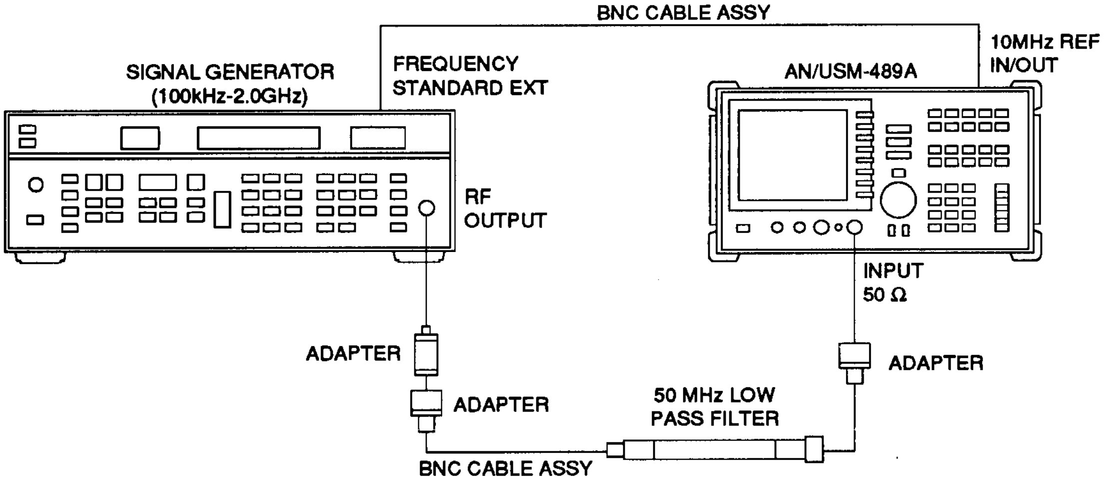
To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

		Marker Amplitude Reading					
		144 kHz PRF		14.4 kHz PRF			
RES BW	Scale	Max	Min	Max	Min	PDU	Spec
1 MHz	5 dB/DIV	_____dBm	_____dBm	_____dBm	_____dBm	______dB	1.25 dB
2 MHz	5 dB/DIV	_____dBm	_____dBm	_____dBm	_____dBm	______dB	3 dB
1 MHz	Linear	______mV	______mV	______mV	______mV	______%	4%
2 MHz	Linear	______mV	______mV	______mV	______mV	______%	12%

21. Disconnect test equipment.

SECOND HARMONIC DISTORTION TEST.

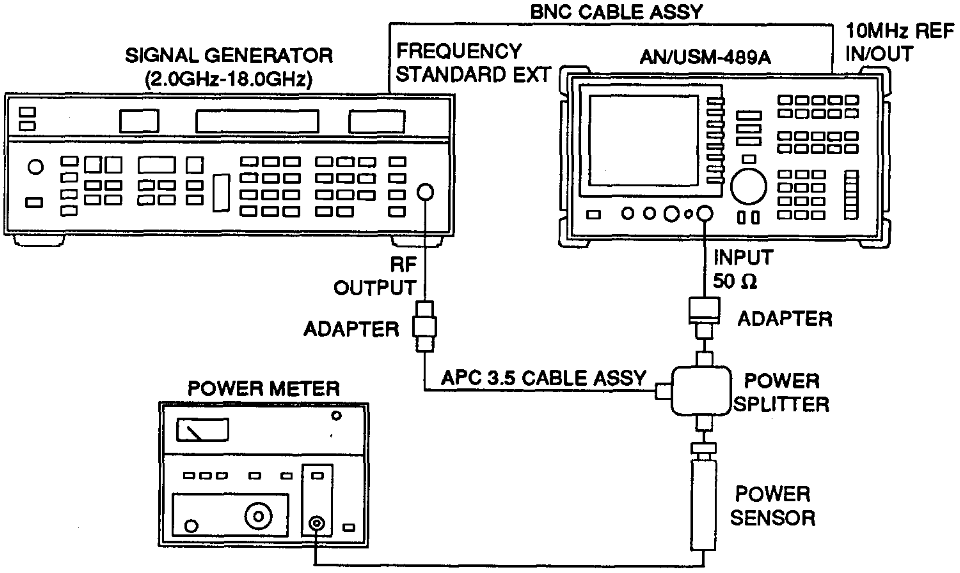
1. Connect equipment as shown. The AN/USM-489A provides frequency reference for signal generator.



2. Set signal generator controls as follows:
   - Press PRESET button.
   - Set FREQUENCY to 40 MHz.
   - Set POWER LEVEL to -30 dBm.
   - Set rear panel FREQUENCY STANDARD SWITCH to EXT.
3. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 40 MHz.
   - Set SPAN WIDTH to 10 kHz.
   - Set REF LVL to -30 dBm.
   - Press PEAK SEARCH key.
4. Adjust signal generator power level for an AN/USM-489A MKR amplitude reading of -30 dBm ±0.1 dB.

SECOND HARMONIC DISTORTION TEST - Continued.

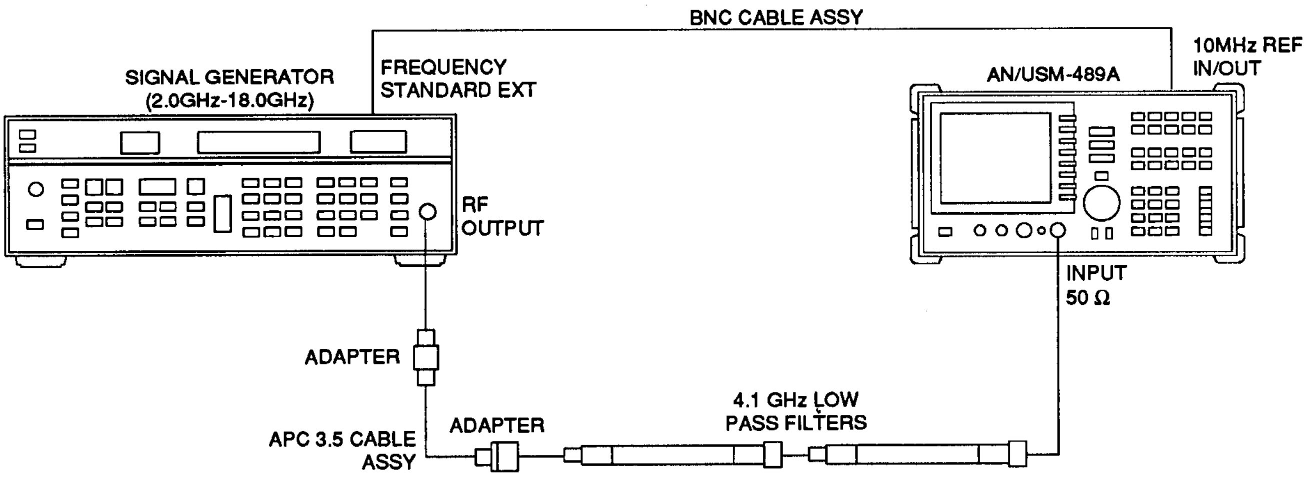
5. On AN/USM-489A,
   - Press TRIG button.
   - Press SINGLE key.
   - Press PEAK SEARCH button.
   - Press MKR -> button.
   - Press MARKER -> CF STEP key.
   - Press MARKER DELTA key.
   - Press FREQUENCY button.
   - Press (UP ARROW) button.
   - Press TRIG button.
   - Press SINGLE key.
   - Wait for AN/USM-489A to complete a new sweep.
   - Press PEAK SEARCH button.
6. Verify Δ MKR reads more negative than -72 dB (<72 dBc).
7. Zero power meter and power sensor combination. Enter power sensor's 3 GHz calibration factor into power meter.
8. Connect equipment as shown. The AN/USM-489A provides frequency reference for signal generator.



9. On AN/USM-489A,
   - Set CENTER FREQ to 2.95 GHz.
   - Set CF STEP to 2.95 GHz.
   - Set REF LVL to 0 dBm.
10. Set signal generator controls as follows:
    - Set FREQUENCY to 2.95 GHz.
    - Set POWER LEVEL to 0 dBm.

SECOND HARMONIC DISTORTION TEST - Continued.

11. On AN/USM-489A,
    - Press TRIG button.
    - Press CONT key.
    - Press MARKER OFF button.
    - Press PEAK SEARCH key.
    - Press INT button.
    - Press PRESEL AUTO PK key.
    - Wait for PEAKING message to disappear.
12. Adjust signal generator power level for an AN/USM-489A MKR reading of -5 dBm ±0.1 dBm.
13. Set power meter controls as follows:
    - Press dB REF button to set a reference level.
    - Enter power sensor's 6 GHz calibration factor.
14. Set signal generator FREQUENCY to 5.9 GHz.
15. On AN/USM-489A,
    - Press FREQUENCY button.
    - Press (UP ARROW) button.
    - Press PEAK SEARCH button.
    - Press INT button.
    - Press PRESEL AUTO PK key.
    - Wait for PEAKING message to disappear.
16. Adjust signal generator power level for an AN/USM-489A MKR reading of -5 dBm ±0.1 dBm.
17. Record power meter reading as the Frequency Response Error.
18. Connect equipment as shown. The AN/USM-489A provides frequency reference for signal generator.

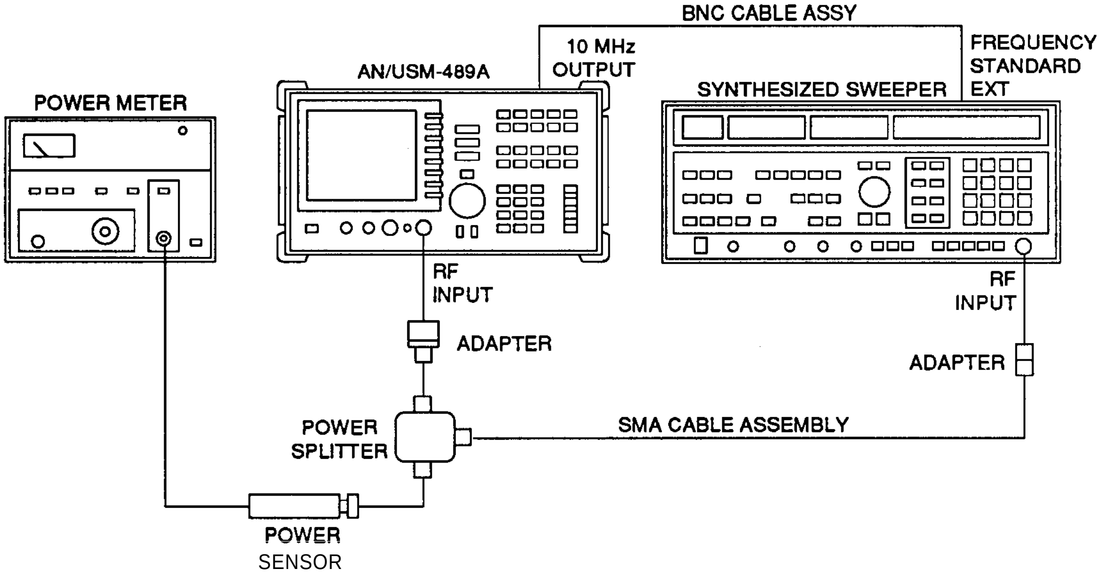


SECOND HARMONIC DISTORTION TEST - Continued.

19. Set signal generator controls as follows:
    - Set FREQUENCY to 2.95 GHz.
    - Set POWER LEVEL to -5 dBm.
20. On AN/USM-489A,
    - Press FREQUENCY button.
    - Press (DOWN ARROW) button.
    - Press PEAK SEARCH button.
    - Press INT button.
    - Press PRESEL AUTO PK key.
    - Wait for PEAKING message to disappear.
21. Adjust signal generator power level for an AN/USM-489A MKR amplitude reading of 0 dBm ±0.1 dBm.
22. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.
    - Press SINGLE key.
    - Press PEAK SEARCH button.
    - Press MARKER DELTA key.
    - Press FREQUENCY button.
    - Press (UP ARROW) button.
    - Set REF LVL to -30 dBm.
    - Press TRIG button.
    - Press SINGLE key.
    - Press PEAK SEARCH button.
    - Press INT button.
    - Press PRESEL AUTO PK key.
    - Wait for PEAKING message to disappear.
    - Wait for completion of a new sweep.
    - Press PEAK SEARCH button.
23. Record the Δ MKR Amplitude reading.
24. Algebraically add Frequency Response Error (recorded in step 17) to the Δ MKR Amplitude reading (recorded in step 23) and verify result is more negative than -100 dBc.
25. Disconnect test equipment.

FLATNESS TEST.

1. Zero power meter and power sensor.
2. Connect equipment as shown. The AN/USM-489A provides frequency reference for synthesized sweeper.



Set synthesized sweeper controls as follows:

- Press PRESET button.
- Set CW FREQUENCY to 300 MHz.
- Set FREQUENCY STEP to 100 MHz.
- Set POWER LEVEL to 0 dBm.
- Set RF to ON.
- Set PEAK to ON.
- Set MODULATION to OFF.
- Set MARKERS to OFF.
- Set rear panel FREQUENCY STANDARD SWITCH to EXT.

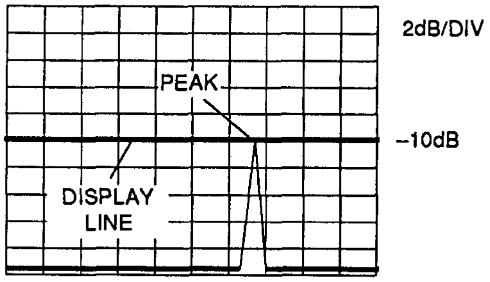
4. On AN/USM-489A,
   - Press PRESET button.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRSEL PK key.
   - Set START FREQ to 10 MHz.
   - Set STOP FREQ to 2.9 GHz.
   - Set dB/DIV to 2 dB/DIV.
   - Press DISPLAY button.
   - Set DISPLAY LINE to -10 dBm.
   - Press PEAK SEARCH button.

FLATNESS TEST - Continued.

5. Adjust synthesized sweeper POWER LEVEL for a AN/USM-489A MKR amplitude reading of -10 dBm ±0.05 dBm.
6. Set power meter controls as follows:
   - Enter power sensor's 300 MHz calibration factor.
   - Press dB REF button to set a reference level.
7. Set synthesized sweeper CW FREQUENCY to 50 MHz.
8. Set power meter power calibration factor to power sensor's 50 MHz setting (or appropriate calibration factor if available).
9. On AN/USM-489A, press PEAK SEARCH button.
10. Adjust synthesized sweeper POWER LEVEL for an AN/USM-489A MKR amplitude reading of -10 dBm ±0.05 dBm.
11. Verify the absolute value of the power meter reading is ±6.1 dB.
12. For 50 MHz only, record power meter reading (used in a later step).
13. Repeat steps 7 through 11 for all Sweeper frequency settings and power sensor calibration factor settings listed in the following table. At each setting, verify absolute value of the power meter reading is ±6.1 db.

NOTE

Due to span accuracy limitations, the 2800 and 2900 MHz signals might not be visible. on screen. If this is the case, adjust the synthesized sweeper CW FREQUENCY for a signal displayed within 0.2 divisions of rightmost vertical graticule line as shown.



FLATNESS TEST - Continued.

Sweeper Frequency (MHz)	Sensors CAL Factor FREQ (G Hz)	Absolute Power Meter Reading
50	.05	± 6.1 dB
100	.05	± 6.1 db
200	.05	± 6.1 db
300	.05	± 6.1 db
400	.05	± 6.1 db
500	.05	± 6.1 db
600	.05	± 6.1 db
700	.05	± 6.1 db
800	.05	± 6.1 db
900	.05	± 6.1 db
1000	.05	± 6.1 db
1100	2.0	± 6.1 db
1200	2.0	± 6.1 db
1300	2.0	± 6.1 db
1400	2.0	± 6.1 db
1500	2.0	± 6.1 db
1600	2.0	± 6.1 db
1700	2.0	± 6.1 db
1800	2.0	± 6.1 db
1900	2.0	± 6.1 db
2000	2.0	± 6.1 db
2100	2.0	± 6.1 db
2200	2.0	± 6.1 db
2300	2.0	± 6.1 db
2400	2.0	± 6.1 db
2500	3.0	± 6.1 db
2600	3.0	± 6.1 db
2700	3,0	± 6.1 db
2800	3.0	± 6.1 db
2900	3.0	± 6.1 db

14. On AN/USM-489A,
    - Set START FREQ to 2.75 GHz.
    - Set STOP FREQ to 6.46 GHz.
15. Set synthesized sweeper CW FREQUENCY to 2.8 GHz.
16. Set power meter power calibration factor to power sensor's 3.0 GHz setting.
17. On AN/USM-489A, press PEAK SEARCH button.
18. Adjust synthesized sweeper POWER LEVEL for an AN/USM-489A MKR amplitude reading of -10 dBm ±0.05 dBm.
19. Verify the absolute value of the power meter reading is ±6.1 dB.

FLATNESS TEST - Continued.

20. Repeat steps 15 through 19 for all Sweeper frequency settings and power sensor calibration factor settings listed in the following table. At each setting, verify absolute value of the power meter reading is ±6.1 dB.

NOTE

Due to span accuracy limitations, the 6.3 and 6.4 GHz signals might not be visible on screen. If this is the case, adjust the synthesized sweeper CW FREQUENCY for a signal displayed within 0.2 divisions of rightmost vertical graticule line as shown previously.

Sweeper Frequency	Sensors CAL Factor FREQ (G Hz)	Absolute Power Meter Reading
2.80	3.0	± 6.1 dB
2.90	3.0	± 6.1 db
3.0	3.0	± 6.1 db
3.1	3.0	± 6.1 db
3.2	3.0	± 6.1 db
3.3	3.0	± 6.1 db
3.4	3.0	± 6.1 db
3.5	4.0	± 6.1 db
3.6	4.0	± 6.1 db
3.7	4.0	± 6.1 db
3.8	4.0	± 6.1 db
3.9	4.0	± 6.1 db
4.0	4.0	± 6.1 db
4.1	4.0	± 6.1 db
4.2	4.0	± 6.1 db
4.3	4.0	± 6.1 db
4.4	4.0	± 6.1 db
4.5	5.0	± 6.1 db
4.6	5.0	± 6.1 db
4.7	5.0	± 6.1 db
4.8	5.0	± 6.1 db
4.9	5.0	± 6.1 db
5.0	5.0	± 6.1 db
5.1	5.0	± 6.1 db
5.2	5.0	± 6.1 db
5.3	5.0	± 6.1 db
5.4	5.0	± 6.1 db
5.5	6.0	± 6.1 db
5.6	6.0	± 6.1 db
5.7	6.0	± 6.1 db
5.8	6.0	± 6.1 db
5.9	6.0	± 6.1 db
6.0	6.0	± 6.1 db
6.1	6.0	± 6.1 db
6.2	6.0	± 6.1 db
6.3	6.0	± 6.1 db
6.4	6.0	± 6.1 db

21. On AN/USM-489A,

- Set START FREQ to 5.86 GHz.
- Set STOP FREQ to 13.0 GHz.

22. Set synthesized sweeper CW FREQUENCY to 6 GHz.

FLATNESS TEST – Continued.

23. Set power meter Power calibration factor to power sensor's 6.0 GHz setting.
24. On AN/USM-489A, press PEAK SEARCH button.
25. Adjust synthesized sweeper POWER LEVEL for an AN/USM-489A MKR amplitude reading of -10 dBm ±0.05 dBm.
26. Verify the absolute value of the power meter reading is ±6.1 dB.
27. Repeat steps 22 through 26 for all Sweeper frequency settings and power sensor calibration factor settings listed in the following table. At each setting, verify absolute value of the power meter reading is ±6.1 dB.

NOTE

Due to span accuracy limitations, the 12.8 and 13.0 GHz signals might not be visible on screen. If this is the case, adjust the synthesized sweeper CW FREQUENCY for a signal displayed within 0.2 divisions of rightmost vertical graticule line as shown previously.

Sweeper Frequency (GHz)	Sensors CAL Factor FREQ (GHz)	Absolute Power Meter Reading
6.0	6.0	± 6.1 dB
6.2	6.0	± 6.1 db
6.4	6.0	± 6.1 db
6.6	7.0	± 6.1 db
6.8	7.0	± 6.1 db
7.0	7.0	± 6.1 db
7.2	7.0	± 6.1 db
7.4	7.0	± 6.1 db
7.6	8.0	± 6.1 db
7.8	8.0	± 6.1 db
8.0	8.0	± 6.1 db
8.2	8.0	± 6.1 db
8.4	8.0	± 6.1 db
8.6	9.0	± 6.1 db
8.8	9.0	± 6.1 db
9.0	9.0	± 6.1 db
9.2	9.0	± 6.1 db
9.4	9.0	± 6.1 db
9.6	10.0	± 6.1 db
9.8	10.0	± 6.1 db
10.0	10.0	± 6.1 db
10.2	10.0	± 6.1 db
10.4	10.0	± 6.1 db
10.6	11.0	± 6.1 db
10.8	11.0	± 6.1 db
11.0	11.0	± 6.1 db
11.2	11.0	± 6.1 db
11.4	11.0	± 6.1 db
11.6	12.0	± 6.1 db
11.8	12.0	± 6.1 db
12.0	12.0	± 6.1 db
12.2	12.0	± 6.1 db
12.4	12.0	± 6.1 db
12.6	13.0	± 6.1 db
12.8	13.0	± 6.1 db
13.0	13.0	± 6.1 db

FLATNESS TEST - Continued.

28. On AN/USM-489A,
    - Set START FREQ to 12.4 GHz.
    - Set STOP FREQ to 19.7 GHz.
29. Set synthesized sweeper CW FREQUENCY to 12.5 GHz.
30. Set power meter Power calibration factor to power sensor's 13.0 GHz setting.
31. On AN/USM-489A, press PEAK SEARCH button.
32. Adjust synthesized sweeper POWER LEVEL for an AN/USM-489A MKR amplitude reading of -10 dBm ±0.05 dBm.
33. Verify the absolute value of the power meter reading is ±6.1 dB.
34. Repeat steps 29 through 33 for all Sweeper frequency settings and power sensor calibration factor settings listed in the following table. At each setting, verify absolute value of the power meter reading is ±6.1 dB.

NOTE

Due to span accuracy limitations, the 19.5 and 19.7 GHz signals might not be visible on screen. If this is the case, adjust the synthesized sweeper CW FREQUENCY for a signal displayed within 0.2 divisions of rightmost vertical graticule line as shown previously.

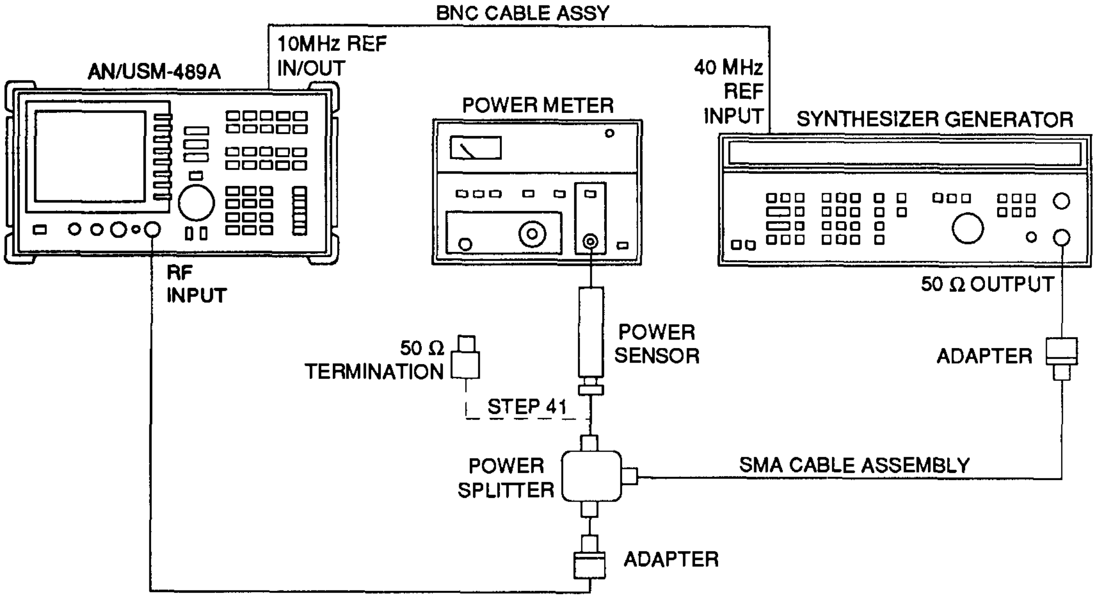
Sweeper Frequency (G Hz)	Sensors CAL Factor FREQ (GHz)	Absolute Power Meter Reading
12.5	13.0	[illegible]
12.7	13.0	± 6.1 db
12.9	13.0	± 6.1 db
13.1	13.0	± 6.1 db
13.3	13.0	± 6.1 db
13.5	13.0	± 6.1 db
13.7	14.0	± 6.1 db
13.9	14.0	± 6.1 db
14.1	14.0	± 6.1 db
14.3	14.0	± 6.1 db
14.5	14.0	± 6.1 db
14.7	15.0	± 6.1 db
15.1	15.0	± 6.1 db
15.3	15.0	± 6.1 db
15.5	15.0	± 6.1 db
15.7	16.0	± 6.1 db
15.9	16.0	± 6.1 db
16.1	16.0	± 6.1 db
16.3	16.0	± 6.1 db
16.5	16.0	± 6.1 db
16.7	17.0	± 6.1 db
16.9	17.0	± 6.1 db
17.1	17.0	± 6.1 db
17.3	17.0	± 6.1 db
17.5	17.0	± 6.1 db
17.7	18.0	± 6.1 db
17.9	18.0	± 6.1 db
18.1	18.0	± 6.1 db
18.3	18.0	± 6.1 db
18.5	18.0	± 6.1 db
18.7	19.0	± 6.1 db
18.9	19.0	± 6.1 db
19.1	19.0	± 6.1 db
19.3	19.0	± 6.1 db
19.5	19.0	± 6.1 db
19.7	20.0	± 6.1 db

FLATNESS TEST - Continued.

35. On AN/USM-489A,

- Set SPAN WIDTH to 10 kHz.
- Set CENTER FREQ to 50 MHz.
- Set RES BW to 1 kHz.
- Press MARKER OFF button.

36. **Connect equipment as shown. The AN/USM-489A provides frequency reference for synthesizer generator.**



37. Set synthesizer generator controls as follows:

- FREQUENCY to 50 MHz.
- AMPLITUDE to -4 dBm.
- AMPTD INCR to 0.01 dB.

38. Set power meter Power calibration factor to power sensor’s 50 MHz setting.

39. Adjust synthesizer generator output AMPLITUDE until power meter display reads same value as recorded in step 12.

40. Record synthesizer generator amplitude for 50 MHz.

41. Replace power sensor with 50 Ohm termination as shown.

42. On AN/USM-489A,

- Press MARKER ON button.
- Press MARKER DELTA key.

43. On AN/USM-489A, set CENTER FREQ to 50 MHz.

FLATNESS TEST - Continued.

44. Set synthesizer generator controls as follows:
    - FREQUENCY to 50 MHz.
    - Adjust AMPLITUDE until AN/USM-489A Δ MKR amplitude reads 0.00 ±0.05 dB.
    - Record synthesizer generator AMPLITUDE setting at current FREQUENCY.
45. Repeat steps 43 and 44 for all synthesizer generator and AN/USM-489A CENTER FREQ settings listed in the following table.

NOTE

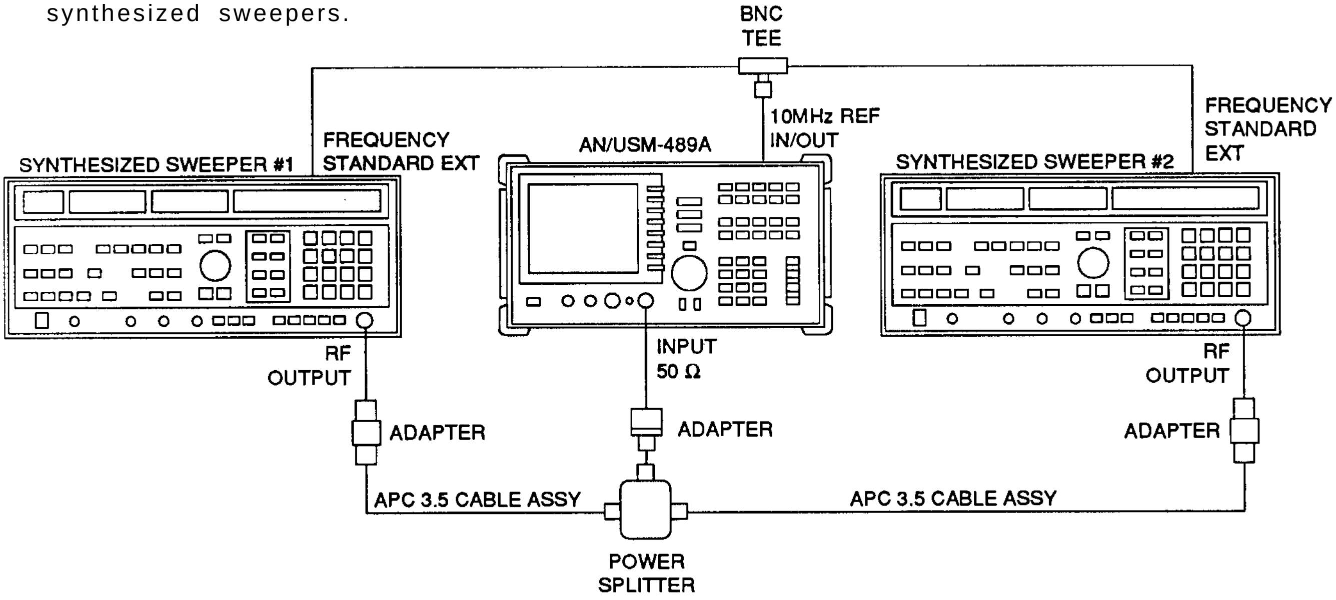
To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

Synthesizer Generator Frequency	AN/USM-489A CENTER FREQ	(Step 44) Synthesizer Amplitude (dBm)	(Step 46) Response Relative to 50 MHz	(Step 47) Response Relative to 300 MHz
50 MHz	50 MHz	______	0 (Ref)	______
20 MHz	20 MHz	______	______	______
10 MHz	10 MHz	______	______	______
1 MHz	1 MHz	______	______	______
100 kHz	100 kHz	______	______	______
10 kHz	10 kHz	______	______	______

46. For each frequency in previous table, subtract synthesizer generator amplitude reading (recorded in step 40) from the synthesizer generator Amplitude (recorded in step 44), and record the result as the Response Relative to 50 MHz.
47. For each frequency in previous table, add the negative of the power meter reading for 50 MHz (recorded in step 12) to the Response Relative to 50 MHz (calculated in step 46). Verify the absolute value of the result (Response Relative to 300 MHz) is ±6.1 dB.
48. Disconnect test equipment.

FREQUENCY SPAN ACCURACY TEST.

1. Connect equipment as shown. The AN/USM-489A provides frequency reference for both synthesized sweepers.



2. Set synthesized sweeper #1 controls as follows:
   - Press PRESET button.
   - POWER LEVEL to -5 dBm.
   - Rear panel FREQUENCY STANDARD SWITCH to EXT.
3. Set synthesized sweeper #2 controls as follows:
   - Press PRESET button.
   - POWER LEVEL to 10 dBm.
   - Rear panel FREQUENCY STANDARD SWITCH to EXT.
4. On AN/USM-489A,
   - Press PRESET button.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK key.
5. Set synthesized sweeper #1 CW FREQUENCY to 1.499996 GHz.
6. Set synthesized sweeper #2 CW FREQUENCY to 1.500004 GHz.
7. On AN/USM-489A,
   - Set CENTER FREQ to 1.5 GHz.
   - Set SPAN WIDTH to 10 kHz.
   - Press TRIG button.
   - Press SINGLE key.
   - Press SINGLE key.
   - Press MARKER OFF button.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.
   - Press NEXT PEAK key.
   - Verify active and anchor markers are on peaks of signals near second and tenth vertical graticule lines.

FREQUENCY SPAN ACCURACY TEST - Continued.

8. Verify AN/USM-489A Δ MKR frequency reading is from 7.60 kHz to 8.40 kHz.
9. Repeat steps 5 through 8 for all synthesizer generator CW frequencies and AN/USM-489A center frequency and span settings listed in the following table. At each setting verify the Δ MKR frequency reading is within specified limits.

Sweeper #1 Frequency	Sweeper #2 Frequency (GHz)	AN/USM-489A		Actual Δ MKR Reading
		Center Freq	Span Setting	
1.499996	1.500004	1.5 GHz	10 kHz	7.60 kHz to -8.40 kHz
1.499992	1.500008	1.5 GHz	20 kHz	15.2 kHz to 16.8 kHz
1.499980	1.500020	1.5 GHz	50 kHz	38.0 kHz to 42.0 kHz
1.499960	1.500040	1.5 GHz	100 kHz	76.0 kHz to 84.0 kHz
1.499960	1.500040	1.5 GHz	101 kHz	76.0 kHz to 84.0 kHz
1.499920	1.500080	1.5 GHz	200 kHz	152 kHz to 168 kHz
1.499800	1.500200	1.5 GHz	500 kHz	380 kHz to 420 kHz
1.499600	1.500400	1.5 GHz	1.0 MHz	760 kHz to 840 kHz
1.499600	1.500400	1.5 GHz	1.01 Mhz	760 kHz to 840 kHz
1.499200	1.500800	1.5 GHz	2.0 MHz	1.52 MHz to 1.68 MHz
1.498000	1.502000	1.5 GHz	5.0 MHz	3.80 MHz to 4.20 MHz
1.496	1.504	1.5 GHz	10.0 MHz	7.60 MHz to 8.40 MHz
1.492	1.508	1.5 GHz	20.0 MHz	15.2 MHz to 16.8 MHz
1.480	1.520	1.5 GHz	50.0 MHz	38 MHz to 42.0 MHz
1.460	1.540	1.5 GHz	100 MHz	76 MHz to 84.0 MHz
1.420	1.580	1.5 GHz	200 MHz	152 MHz to 168.0 MHz
1.300	1.700	1.5 GHz	500 MHz	380 MHz to 420 MHz
1.100	1.900	1.5 GHz	1.0 GHz	760 MHz to 840 MHz
0.700	2.300	1.5 GHz	2.0 GHz	1.52 GHz to 1.68 GHz
8.999996	9.000004	* 9.0 GHz	10 kHz	7.6 kHz to 8.4 MHz
8.992	9.008	9.0 GHz	20 MHz	15.2 MHz to 16.8 MHz
8.98	9.020	9.0 GHz	50 MHz	38.0 MHz to 42.0 MHz
7.0	11.0	9.0 GHz	5 GHz	3.8 GHz to 4.2 GHz
15.999996	16.000004	* 16.0 GHz	10 kHz	7.6 kHz to 8.4 kHz
15.98	16.02	16.0 GHz	50 MHz	38.0 MHz to 42 MHz
15.96	16.04	16.0 GHz	100 MHz	76.0 MHz to 84.0 MHz
14.0	18.0	16.0 GHz	5 GHz	3.8 GHz to 4.2 GHz
20.499996	20.500004	* 20.5 GHz	10 kHz	7.6 kHz to 8.4 kHz
20.48	20.52	20.5 GHz	50 MHz	38 MHz to 42 MHz
20.46	20.54	*12.40 GHz	100 MHz	76.0 MHz to 84.0 MHz
3.0	21.0	12.40 GHz	19.25 GHz	17.1 GHz to 18.9 GHz

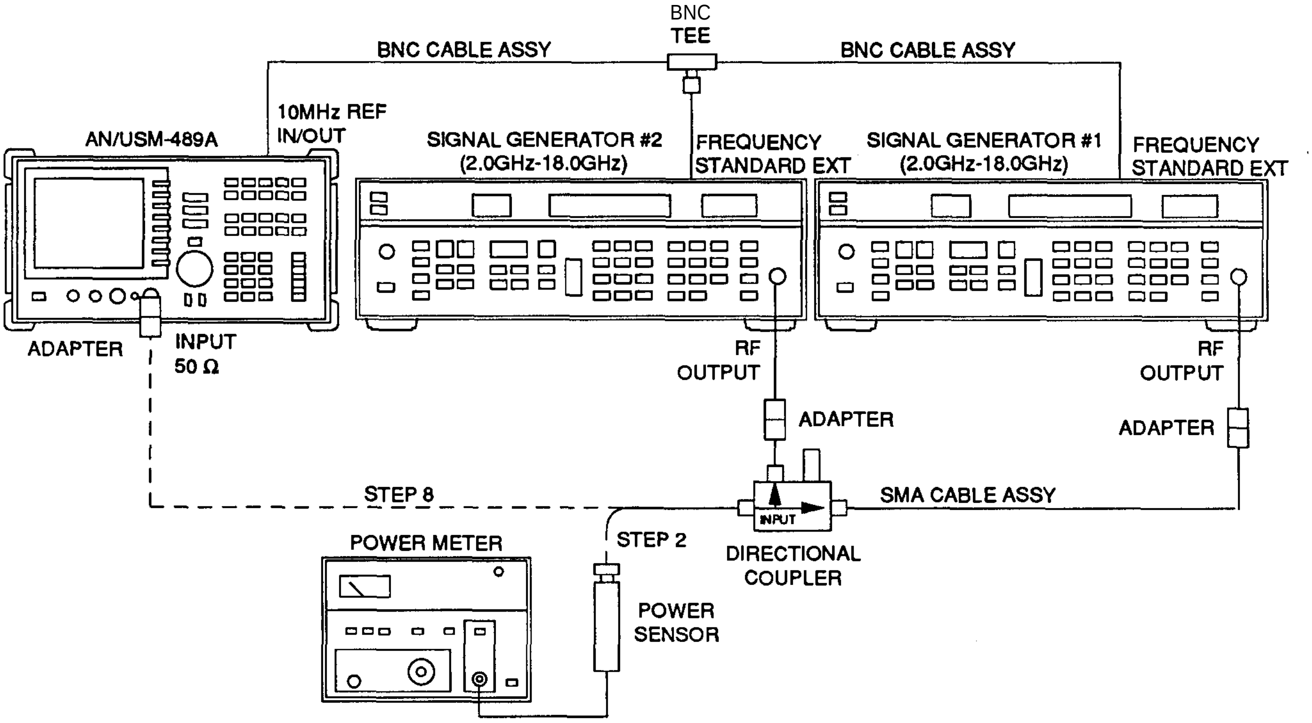
* When changing AN/USM-489A CENTER FREQ, perform the following steps:

- Set synthesized sweeper #1 CW FREQUENCY to AN/USM-489A CENTER FREQ.
- On AN/USM-489A,
  - Press TRIG button.
  - Press CONT key.
  - Press PEAK SEARCH button.
  - Press INT button.
  - Press PRESEL AUTO PK key.
  - Wait for PEAKING message to disappear.
  - Press TRIG button.
  - Press SINGLE key.
- Proceed with steps 5 through 8.

10. Disconnect test equipment.

THIRD ORDER INTERMODULATION DISTORTION TEST.

1. Zero power meter and power sensor.
2. Connect equipment as shown with power sensor at output of Directional Coupler. AN/USM-489A provides frequency reference for both Signal Generators.



3. Set signal generator #1 controls as follows:
   - Set POWER LEVEL to -20 dBm.
   - Set FREQUENCY to 2.800 GHz.
   - Set MODULATION to OFF.
   - Set RF to OFF.
   - Set rear panel FREQUENCY STANDARD SWITCH to EXT.
4. Set signal generator #2 controls as follows:
   - Set POWER LEVEL to -20 dBm.
   - Set FREQUENCY to 2.80005 GHz.
   - Set MODULATION to OFF.
   - Set RF to OFF.
   - Set rear panel FREQUENCY STANDARD SWITCH to EXT.

THIRD ORDER INTERMODULATION DISTORTION TEST - Continued.

5. On AN/USM-489A,
   - Press PRESET button.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK key.
   - Set CENTER FREQ to 2.8 GHz.
   - Set CF STEP to 50 kHz.
   - Set SPAN WIDTH to 10 kHz.
   - Set REF LVL to -20 dBm.
   - Set RES BW to 1 kHz.
   - Set VIDEO BW to 100 Hz.
6. Set power meter calibration factor to power sensor's 3 GHz setting.
7. Set signal generator #1 controls as follows:
   - Set RF OUTPUT to ON.
   - Adjust POWER LEVEL for a -20 dBm ±0.1 dBm reading on power meter display.
8. Disconnect power sensor from Directional Coupler and connect Directional Coupler directly to AN/USM-489A **INPUT 50Ω** using an adapter. Do not use a cable.
9. On AN/USM-489A,
   - Press PEAK SEARCH button.
   - Press MKR -> button.
   - Press MARKER -> REF LVL key.
   - Wait for completion of a new sweep.
   - Press MARKER DELTA key.
   - Press FREQUENCY button.
   - Press (UP ARROW) button.
10. Set signal generator #2, set RF OUTPUT to ON.
11. On AN/USM-489A, press PEAK SEARCH button.
12. Adjust signal generator #2 POWER LEVEL for an AN/USM-489A Δ MKR reading of 0.0 dB ±0.17 dB.
13. On AN/USM-489A,
    - Press MARKER OFF button.
    - Press PEAK SEARCH button.
    - Press MARKER DELTA key.
    - Press FREQUENCY button.
    - Press (UP ARROW) button.
    - Wait for a new sweep to finish.
    - Press PEAK SEARCH button.
14. Verify AN/USM-489A Δ MKR reading (Upper Product Suppression) is more negative than -70 dB.

THIRD ORDER INTERMODULATION DISTORTION TEST - Continued.

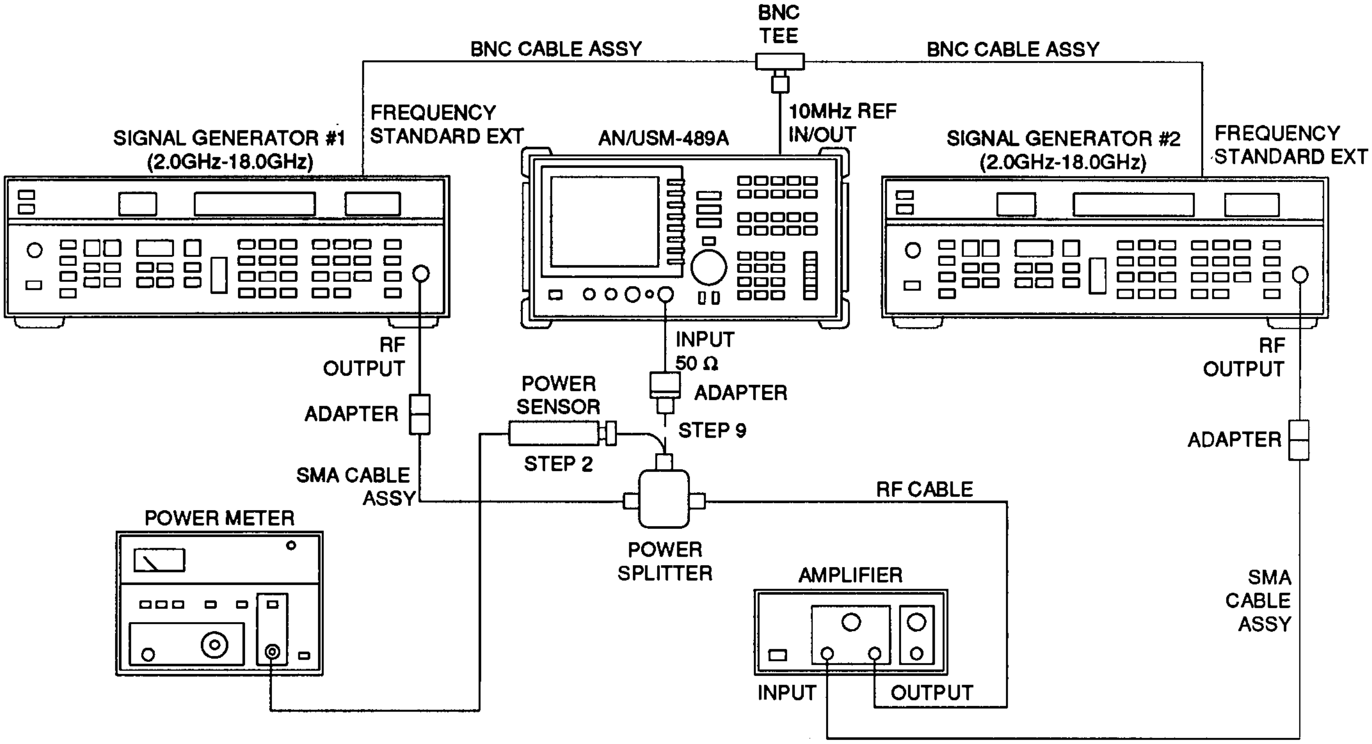
15. On AN/USM-489A,
    - Press FREQUENCY button.
    - Press (DOWN ARROW) button three times.
    - Wait for completion of a new sweep.
    - Press PEAK SEARCH button.
16. Verify AN/USM-489A Δ MKR reading (Lower Product Suppression) is more negative than -70 dB.
17. Disconnect directional coupler from AN/USM-489A, and reconnect to power sensor.
18. Set signal generator #2 controls as follows:
    - Set RF OUTPUT to OFF.
    - Set FREQUENCY to 4.0001 GHz.
19. Set signal generator #1 FREQUENCY to 4.0 GHz.
20. Set power meter calibration factor to power sensor's 4 GHz setting.
21. Adjust signal generator #1 POWER LEVEL for a –20 dBm ±0.1 dBm reading on power meter.
22. Disconnect power sensor from Directional Coupler and connect Directional Coupler directly to AN/USM-489A **INPUT 50Ω** using an adapter. Do not use a cable.
23. On AN/USM-489A,
    - Set CENTER FREQ to 4.0 GHz.
    - Set CF STEP to 100 kHz.
    - Press MARKER OFF button.
    - Set REF LVL to -20 dBm.
    - Press PEAK SEARCH button.
    - Press INT button.
    - Press PRESEL AUTO PK button.
    - Wait for PEAKING message to disappear.
    - Press PEAK SEARCH button.
    - Press MKR –> button.
    - Press MARKER -> REF LVL key.
    - Wait for completion of a new sweep.
    - Press MARKER DELTA key.
    - Press FREQUENCY button.
    - Press (UP ARROW) key.
24. Set signal generator #2 RF OUTPUT to ON.
25. On AN/USM-489A, press PEAK SEARCH button.
26. Adjust signal generator #2, POWER LEVEL for an AN/USM-489A Δ MKR reading of 0.0 dB ±0.17 dB.

THIRD ORDER INTERMODULATION DISTORTION TEST - Continued.

27. On AN/USM-489A,
    - Press FREQUENCY button.
    - Press (UP ARROW) button.
    - Wait for completion of a new sweep.
    - Press PEAK SEARCH button.
28. Verify AN/USM-489A Δ MKR reading (Upper Product Suppression) is more negative than -75 dB.
29. On AN/USM-489A,
    - Press FREQUENCY button.
    - Press (DOWN ARROW) button three times.
    - Wait for completion of a new sweep.
    - Press PEAK SEARCH button.
30. Verify AN/USM-489A Δ MKR reading (Lower Product Suppression) is more negative than -75 dB.
31. Disconnect test equipment.

GAIN COMPRESSION TEST.

1. Zero power meter and power sensor.
2. Connect equipment as shown with power sensor at output of power splitter. AN/USM-489A provides frequency reference for both Signal Generators.



3. Set signal generator #1 controls as follows:
   - FREQUENCY to 2.0 GHz.
   - POWER LEVEL to -24 dBm.
   - RF OUTPUT to ON.
   - Rear panel FREQUENCY STANDARD SWITCH to EXT.
4. Set signal generator #2 controls as follows:
   - FREQUENCY to 2.003 GHz.
   - POWER LEVEL to +8 dBm.
   - RF OUTPUT to ON.
   - Rear panel FREQUENCY STANDARD SWITCH to EXT.

GAIN COMPRESSION TEST - Continued.

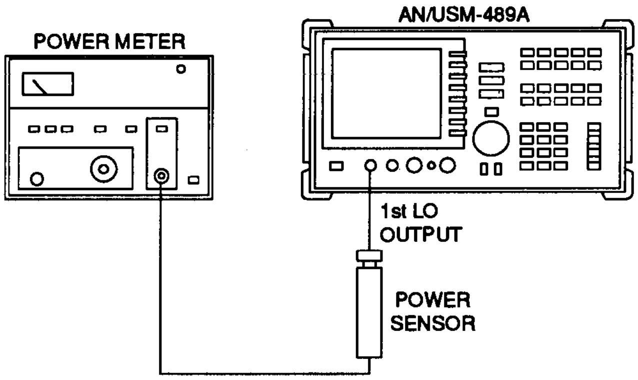
5. On AN/USM-489A,
   - Press PRESET button.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK key.
   - Set CENTER FREQ to 2.0 GHz.
   - Set REF LVL to -30 dBm.
   - Set SPAN WIDTH 10 MHz.
   - Set RES BW to 300 kHz.
   - Set LOG dB/DIV to 1 dB.
6. Set power meter's calibration factor to power sensor's 2 GHz setting.
7. Adjust Amplifier Output Power Level for a +5 dBm ±0.1 dB reading on power meter.
8. Set signal generator #2 POWER LEVEL to -80 dBm.
9. Disconnect power sensor from power splitter and reconnect to AN/USM-489A **INPUT 50Ω** using an adapter. Do not use a cable.
10. Adjust signal generator #1 POWER LEVEL for a signal one division below AN/USM-489A top graticule.
11. On AN/USM-489A
    - Press PEAK SEARCH button.
    - Press MARKER DELTA key.
12. Set signal generator #2 POWER LEVEL to +8 dBm.
13. Verify Δ MKR amplitude is more positive than -1.0 dB.
14. Set signal generator #1 FREQUENCY to 4.0 GHz.
15. Set signal generator #2 controls as follows:
    - FREQUENCY to 4.003 GHz.
    - RF OUTPUT to OFF.
16. On AN/USM-489A,
    - Set CENTER FREQ to 4.0 GHz.
    - Set MARKER to OFF.
17. Set power meter's calibration factor to power sensor's 4 GHz setting.
18. Disconnect power splitter from AN/USM-489A, and reconnect to power sensor.
19. Set signal generator #2 RF OUTPUT to ON.
20. Adjust Amplifier Output Power Level for a +7 dBm ±0.1 dB reading on power meter.
21. Set signal generator #2 POWER LEVEL to -80 dBm.
22. Disconnect power sensor from power splitter and reconnect to AN/USM-489A **INPUT 50Ω** using an adapter. Do not use a cable.

GAIN COMPRESSION TEST - Continued.

23. Adjust signal generator #1 POWER LEVEL for a signal one division below AN/USM-489A top graticule.
24. On AN/USM-489A,
    - Press PEAK SEARCH button.
    - Press INT key.
    - Press PRESEL AUTO PK key.
    - Wait for PEAKING message to disappear.
    - Press PEAK SEARCH button.
    - Press MARKER DELTA key.
25. Set signal generator #2 POWER LEVEL to +8 dBm.
26. Verify ΔMKR amplitude is more positive than -1.0 dB.
27. Set signal generator #1 FREQUENCY to 7.0 GHz.
28. Set signal generator #2 controls as follows:
    - Set FREQUENCY to 7.003 GHz.
    - RF OUTPUT to OFF.
29. On AN/USM-489A, set CENTER FREQ to 7.0 GHz.
30. Set power meter's calibration factor to power sensor's 7 GHz setting.
31. Repeat steps 18 through 26.
32. Disconnect test equipment.

1ST LO OUTPUT AMPLITUDE TEST.

1. Zero power meter and power sensor.
2. Connect equipment as shown (remove **50Ω** Termination).



3. On AN/USM-489A,
   - Press PRESET button.
   - Press SPAN button.
   - Press ZERO SPAN key.
   - Press EXT button.
   - Set LOCK HARMONIC to #6.
   - CENTER FREQ to 18 GHz (ignore .00000750 extension).
   - CF STEP to 1200 MHz.
   - SPAN WIDTH to 0 Hz.
4. Set power meter calibration factor to power sensor's 3 GHz setting.
5. Verify power meter reading is from +14.5 to +18.5 dB.
6. On AN/USM-489A,
   - Press FREQUENCY button.
   - Press (UP ARROW) button.

1ST LO OUTPUT AMPLITUDE TEST - Continued.

7. Repeat steps 4 through 6 for all AN/USM-489A CENTER FREQ (w/corresponding 1st LO settings) and power sensor calibration factor settings listed in the following table.

Center Freq(n=6)	1ST LO Freq* (GHz)	CAL Factor Frequency	Power Meter Reading
18	3.0	3.0	+14.5 dBm to +18.5 dBm
19.2	3.2	3.0	+14.5 dBm to +18.5 dBm
20.4	3.4	3.0	+14.5 dBm to +18.5 dBm
21.6	3.6	4.0	+14.5 dBm to +18.5 dBm
22.8	3.8	4.0	+14.5 dBm to +18.5 dBm
24.0	4.0	4.0	+14.5 dBm to +18.5 dBm
25.2	4.2	4.0	+14.5 dBm to +18.5 dBm
26.4	4.4	4.0	+14.5 dBm to +18.5 dBm
27.6	4.6	5.0	+14.5 dBm to +18.5 dBm
28.8	4.8	5.0	+14.5 dBm to +18.5 dBm
30.0	5.0	5.0	+14.5 dBm to +18.5 dBm
31.2	5.2	5.0	+14.5 dBm to +18.5 dBm
32.4	5.4	5.0	+14.5 dBm to +18.5 dBm
33.6	5.6	6.0	+14.5 dBm to +18.5 dBm
34.8	5.8	6.0	+14.5 dBm to +18.5 dBm
36.0	6.0	6.0	+14.5 dBm to +18.5 dBm
37.2	6.2	6.0	+14.5 dBm to +18.5 dBm
38.4	6.4	6.0	+14.5 dBm to +18.5 dBm
39.6	6.6	7.0	+14.5 dBm to +18.5 dBm
**39.99992	6.7	7.0	+14.5 dBm to +18.5 dBm

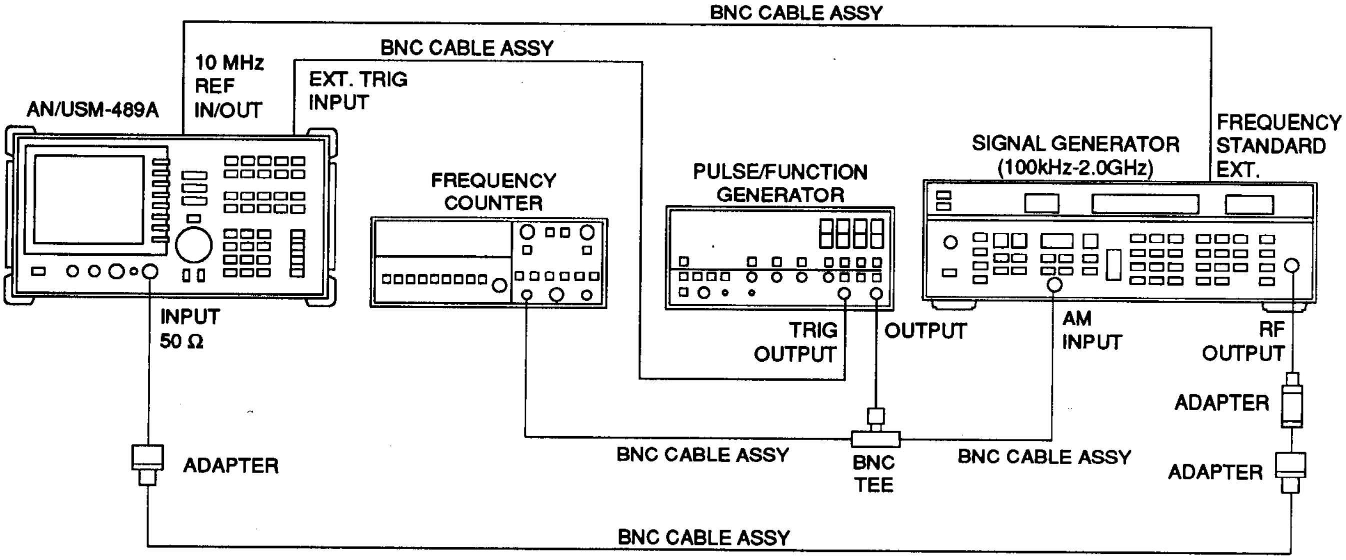
* Nominal. Actual 1st LO freqency is within 60 MHz of this frequency.

**May display 40 GHz.

8. Disconnect test equipment, and replace **50Ω** Termination on AN/USM-489A 1st LO Output connector.

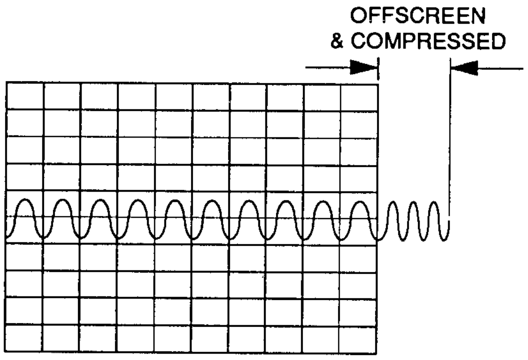
SWEEP TIME ACCURACY TEST.

1. Connect equipment as shown.



2. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set SWEEP TIME to 50 µs.
   - Press AMPLITUDE button.
   - Press LINEAR key.
3. Set frequency counter controls as follows:
   - Measurement to FREQUENCY (≈200 kHz).
   - RESOLUTION to 1 Hz.
   - GATE TIME control to minimum.
   - LEVEL/SENSITIVITY control to midrange.
4. Set Pulse/Function Generator controls as follows:
   - FREQUENCY to 200 kHz.
   - DUTY CYCLE to 50%.
   - AMPLITUDE to 500 mV.
   - OFFSET to 0 V.
   - FUNCTION to TRIANGLE.

SWEEP TIME ACCURACY TEST - Continued.



5. Set signal generator controls as follows:
   - Press PRESET.
   - FREQUENCY to 300 MHz.
   - POWER LEVEL to -5 dBm.
   - MODULATION to AM.
6. On AN/USM-489A,
   - Press TRIG button.
   - Press EXTERNAL key.
   - Ignore portion of waveform off screen.
7. Set Pulse/Function Generator controls as follows:
   - FREQUENCY to 200 kHz.
   - Fine adjust FREQUENCY for 10 cycles evenly spaced relative to the vertical graticule lines on AN/USM-489A display.
   - For example, if the peak of the first cycle is 0.2 divisions to the right of the first graticule line, the peak of the tenth cycle should be adjusted 0.2 divisions to the right of the tenth graticule line.
8. Using frequency displayed on frequency counter, calculate the measured sweep time as follows:

$$\text{Measured Sweep Time} = \frac{10}{\text{Frequency Counter Reading in Hz}}$$

9. Verify calculated Measured Sweep Time is from 42.5 **µsec** to 57.5 **µsec.**
10. Repeat steps 7 through 9 for AN/USM-489A SWEEP TIME settings listed in the following table. At each setting, verify calculated Measured Sweep Time is within specified limits.

Initial Pulse/ Function Gen Setting	AN/USM-489A Sweep Time Setting	Measured Sweep Time
200 kHz	50 µs	42.5 µs to 57.5 µs
100 kHz	100 µs	85 µs to 115 µs
50 kHz	200 µs	170 µs to 230 µs
20 kHz	500 µs	425 µs to 575 µs
10 kHz	1 ms	850 µs to 1.15 ms to 1.15 ms
5 kHz	2 ms	1.7 ms to 2.3 ms
2 kHz	5 ms	4.25 ms to 5.75 ms
1 kHz	10 ms	8.5 ms to 11.5 ms
500 Hz	20 ms	17.0 ms to 23.0 ms

11. Disconnect all cables from AN/USM-489A except power cable. Connect a BNC cable from the rear panel AN/USM-489A BLANKING OUTPUT connector to frequency counter channel A input.
12. On AN/USM-489A,
    - Press TRIG button.
    - Press FREE RUN key.
    - Set SWEEP TIME to 30 ms.

SWEEP TIME ACCURACY TEST - Continued.

13. Set frequency counter controls as follows:
    - Measurement to TIME INTERVAL A to B.
    - Select COMM A.
    - Channel A slope to negative.
    - Channel B slope to positive.
    - A and B SENSITIVITY controls to minimum.
    - Adjust SENSITIVITY of channels A and B to gate (trigger) frequency counter.
14. On AN/USM-489A, set SWEEP TIME to 30 ms.
15. Wait for frequency counter display to settle (usually about three sweeps), and verify reading is from 29.7 ms to 30.3 ms.

NOTE

It might be necessary to readjust the SENSITIVITY controls slightly for a stable display.

AN/USM-489A Sweep Time Setting	Measured Sweep Time
30 ms	29.7 ms to 30.3 ms
50 ms	49.5 ms to 50.5 ms
100 ms	99.0 ms to 101.0 ms
200 ms	198.0 ms to 202.0 ms
500 ms	495.0 ms to 505.0 ms
1 s	990.0 ms to 1010.0 ms
2 s	1.98s to 2.02s
5 s	4.95s to 5.05s
10s	9.9s to 10.1s
20 s	19.8s to 20.2s
50 s	49.5 s to 50.5s
60 s	59.4s to 60.6s

16. Disconnect test equipment.

RESIDUAL RESPONSES TEST.

1. On AN/USM-489A,
    - Connect CAL OUTPUT and INPUT **50Ω** connectors using supplied BNC cable and adapter.
    - Press PRESET button.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 10 kHz.
    - Set RES BW to 300 Hz.
    - Set REF LVL to -10 dBm.
    - Set ATTEN to 0 dB.
    - Press PEAK SEARCH button.
    - Press AMPLITUDE button.
    - Press MORE key.
    - Press REF LVL CAL key.
    - Rotate knob until MKR amplitude reads -10.00 dBm ±0.17 dB.
    - Press STORE REF LVL CAL key.
2. On AN/USM-489A,
    - Remove BNC cable and adapter from INPUT **50Ω.**
    - Install Type N-to-APC 3.5 adapter and 50 ohm termination on INPUT **50Ω** connector.
    - Press PRESET button.
    - Set CENTER FREQ to 15.2 MHz.
    - Set SPAN WIDTH to 30 MHz.
    - Set CF STEP to 28.5 MHz.
    - Set REF LVL to -50 dBm.
    - Set ATTEN to 0 dB.
    - Set RES BW to 10 kHz.
    - Press TRIG button.
    - Press SINGLE key.
    - Press DISPLAY button.
    - Set DISPLAY LINE to -90 dBm.
3. On AN/USM-489A,
    - Press TRIG button.
    - Press SINGLE key.

RESIDUAL RESPONSES TEST - Continued.

4. Verify noise level is at least 6 dB (**≈1/2** graticule) below display line.
   - If incorrect, reduce SPAN WIDTH and RES BW to reduce noise level. If SPAN is reduced, CF STEP must also be reduced to not more than 95% of SPAN WIDTH. For example, if SPAN WIDTH is reduced to 20 MHz, CF STEP cannot be set to any value higher than 19 MHz.
   - If a residual is suspected, press SINGLE key again. A residual response will persist, but a noise peak will not. Record frequency and amplitude of any responses above display line.
   - If a response is marginal, verify response amplitude as follows:

     Press SAVE button.

     Press SAVE STATE key.

     Press STATE 0 key.

     Press MARKER ON.

     Rotate knob to place marker on peak of response in question.

     Press MKR -> button.

     Press MARKER -> CF key.

     Press SPAN button.

     Press (DOWN ARROW) button 4 times.

     Press TRIG button.

     Press CONT key.

     Press BW button.

     Set RES BW key to AUTO.

     Press SPAN button.

     Reduce SPAN using (DOWN ARROW) button until a RES BW of 300 Hz is reached.

     If response is a synthesis-related residual, it might disappear as SPAN is reduced. If correct, measure amplitude with narrowest span possible at 300 Hz RES BW.

     Record the frequency and amplitude of any residual response above the display line.

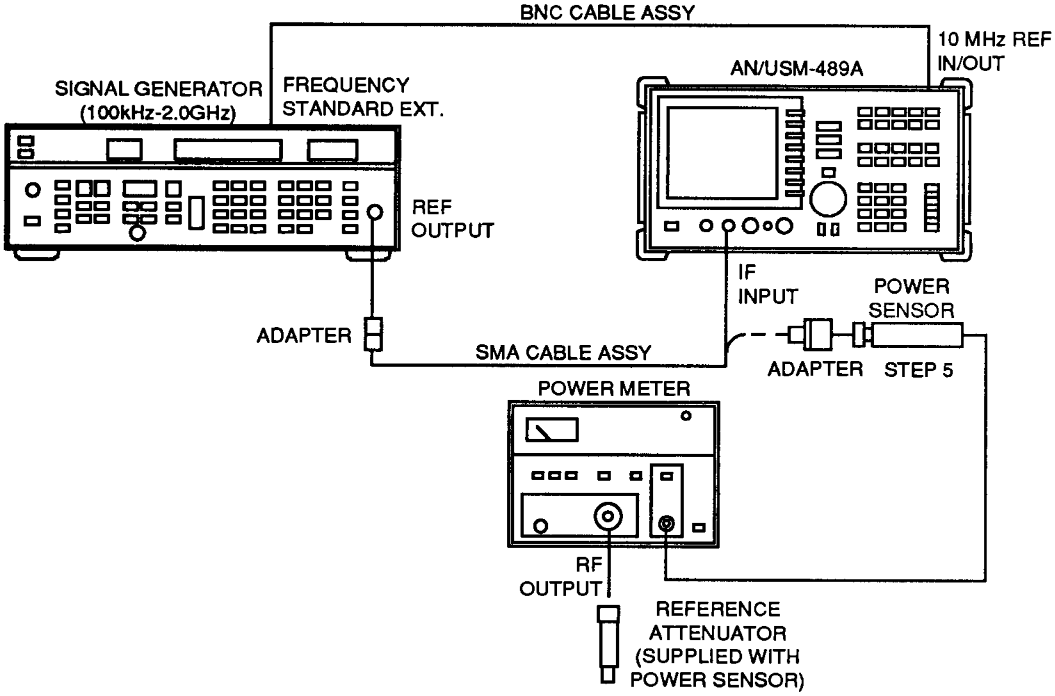
     Press RECALL button.

     Press RECALL STATE key.

     Press STATE 0 key.
5. On AN/USM-489A,
   - Press FREQUENCY button.
   - Press CENTER FREQ key.
   - Press (UP ARROW) button.
6. Repeat steps 3 through 5 checking for residuals up to 6.46 GHz.
7. On AN/USM-489A,
   - Set CENTER FREQ to 6.51 GHz.
   - Press DISPLAY button.
   - Set DISPLAY LINE to -70 dBm.
8. Repeat steps 3 through 5 checking for residuals up to 22.0 GHz.
9. Disconnect test equipment.

IF INPUT AMPLITUDE ACCURACY TEST.

1. Connect equipment as shown. AN/USM-489A Spectrum Analyzer provides frequency reference for signal generator.



2. On AN/USM-489A,
   - Press PRESET button.
   - Set LOG dB/DIV to 1 dB.
   - Press MARKER ON button.
   - Press SPAN button.
   - Press ZERO SPAN key.
   - Press EXT button.
   - Press AMPTD CORRECT key.
   - Press CNV LOSS VS FREQ key.

IF INPUT AMPLITUDE ACCURACY TEST - Continued.

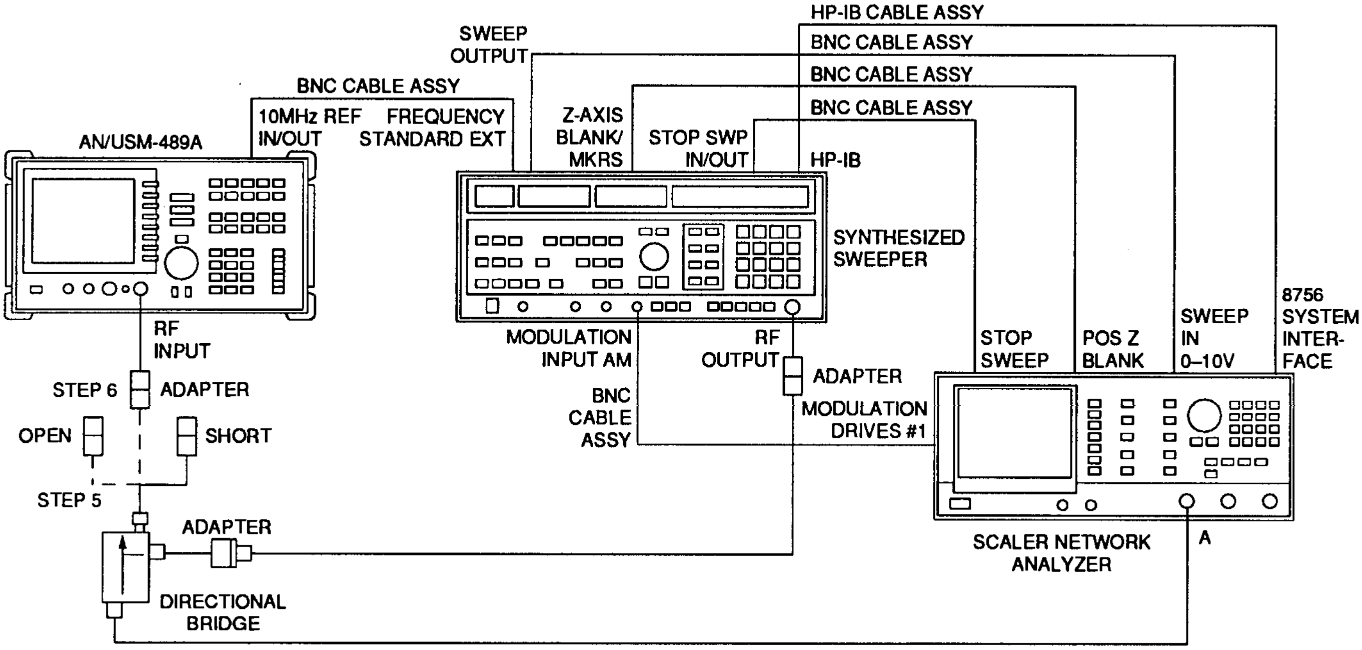
3. On AN/USM-489A, press (UP/DOWN ARROW) buttons to step through conversion losses for all frequencies (displayed in active function block).
   - If all conversion losses are 30.0 dB, proceed to step 4.
   - If all conversion losses are not 30.0 dB, proceed as follows:
     - Press (UP/DOWN ARROW) buttons until CONV LOSS @ 18 GHz is displayed.
     - Record conversion loss.
     - Enter a conversion loss of 30 dB.
     - Press (UP ARROW) button.
     - Repeat until all CONV LOSS @ frequencies listed in following table are set to 30 dB.

Frequency (G Hz)	Conversion Loss (dB)
18	________
20	________
22	________
24	________
26	________
27	________

4. Set signal generator controls as follows:
   - Press PRESET button.
   - Set FREQUENCY to 310.7 MHz.
   - Set POWER LEVEL to -30 dBm.
   - Adjust POWER LEVEL until MKR amplitude reads 0 dBm ±0.05 dB.
5. Set power meter controls as follows:
   - Zero power meter and power sensor combination using reference attenuator.
   - Set power meters calibration factor to power sensor's 50 MHz setting.
6. Disconnect APC 3.5 cable from AN/USM-489A IF INPUT, and reconnect cable through an adapter, to power sensor.
7. Verify power displayed on power meter reads -30 dBm ±1.5 dB. Record power meter reading as IF INPUT Amplitude.
8. Disconnect test equipment.
9. If conversion loss frequencies were changed in step 2, proceed as follows:
   - Press (UP/DOWN ARROW) buttons until CONV LOSS @ 18 GHz is displayed.
   - Record conversion loss.
   - Interconversion loss recorded in step 2 for 18 GHz.
   - Press (UP ARROW) button.
   - Repeat until all CONV LOSS @ frequencies are set to recorded values.

RF INPUT VSWR TEST.

1. Connect equipment as shown with coaxial short connected to directional bridge test port. Set switch on the directional bridge to correspond with scaler network analyzer.



2. Set scaler network analyzer controls as follows:
   - Press PRESET button.
   - CHANNEL 1 to ON.
   - CH 2 to OFF.
   - SCALE to 5 dB/DIV.
   - MEAS to A.
   - DISPLAY to MEAS-MEM (not to MEAS->MEM).
   - SYSTEM DETECTION MODE to DC.
   - SYSTEM #TRACE POINTS to 1601.
3. Set synthesized sweeper controls as follows:
   - START FREQ to 10 MHz.
   - STOP FREQ to 2.9 GHz.
   - POWER LEVEL to -10 dBm.
   - SWEEP to CONT.
   - Rear panel FREQUENCY STANDARD SWITCH to EXT.
4. Connect coaxial short to the directional bridge test port.

RF INPUT VSWR TEST – Continued.

5. Set scaler network analyzer controls as follows:
   - Press CAL button.
   - Press SHORT OPEN key.
   - Press STORE SHORT key.
   - Replace coaxial short with coaxial open.
   - Press STORE OPEN key.
   - Press SYSTEM button.
   - Set ADPT NM to ON.
   - Press CURSOR button.
   - Press CURSOR FMT SWR key.
6. Connect directional bridge test port to AN/USM-489A RF INPUT using an adapter.
7. Set synthesized sweeper controls as follows:
   - Press SINGLE button.
   - Set FREQ STEP to 200 MHz.
8. On AN/USM-489A,
   - Press PRESET button.
   - Press RECALL button.
   - Press MORE key.
   - Press FACTORY PRESEL PK key.
   - Set SPAN WIDTH to 0 Hz.
   - Set CF STEP to 200 MHz.
9. On AN/USM-489A, set CENTER FREQ to 10 MHz.
10. Set synthesized sweeper controls as follows:
    - Press CW button.
    - FREQUENCY to 10 MHz.
11. Verify scaler network analyzer cursor value at 10 MHz reads less than 1.5.
12. On AN/USM-489A, set CENTER FREQ to 100 MHz.
13. Set synthesized sweeper CW FREQUENCY to 100 MHz.
14. Verify scaler network analyzer cursor value at 10 MHz reads less than 1.5.

RF INPUT VSWR TEST - Continued.

15. Repeat steps 12 through 14 for AN/USM-489A CENTER FREQUENCIES and synthesized sweeper CW FREQUENCIES listed in the following table. Frequencies can be changed using ARROW buttons. At each setting, verify the scaler network analyzer readings at the frequency being tested are within specified limits.

AN/USM-489A Center Freq (GHz)	Synthesized Sweeper (G Hz)	Scaler Network Analyzer Cursor Reading (SWR)
0.100	0.100	1.5
0.300	0.300	1.5
0.500	0.500	1.5
0.700	0.700	1.5
0.9	0.9	1.5
1.1	1.1	1.5
1.3	1.3	1.5
1.5	1.5	1.5
1.7	1.7	1.5
1.9	1.9	1.5
2.1	2.1	1.5
2.3	2.3	1.5
2.5	2.5	1.5
2.7	2.7	1.5
2.9	2.9	1.5

16. Repeat steps 3 through 6, setting synthesized sweeper START FREQ to 2.7 GHz and STOP FREQ to 6.0 GHz.

17. On AN/USM-489A,
    - Set CENTER FREQ to 3 GHz.
    - Set CF STEP to 300 MHz.

18. Set synthesized sweeper controls as follows:
    - CW FREQUENCY to 3 GHz.
    - FREQ STEP to 300 MHz.

19. On AN/USM-489A,
    - Press INT button.
    - Press PRESEL AUTO PK key.
    - Press FREQUENCY button.

20. Verify scaler network analyzer cursor value at 3.0 GHz reads less than 2.3.

21. On AN/USM-489A, press (UP ARROW) button to increment center frequency.

22. On synthesized sweeper, press (UP ARROW) button to increment CW frequency.

23. Verify scaler network analyzer cursor value at 3.3 GHz reads less than 2.3.

24. Repeat steps 21 through 23 for AN/USM-489A Band 1 CENTER FREQUENCIES and synthesized sweeper CW FREQUENCIES listed in the following table. At each setting, verify the scaler network analyzer readings at the frequency being tested are within specified limits.

RF INPUT VSWR TEST - Continued.

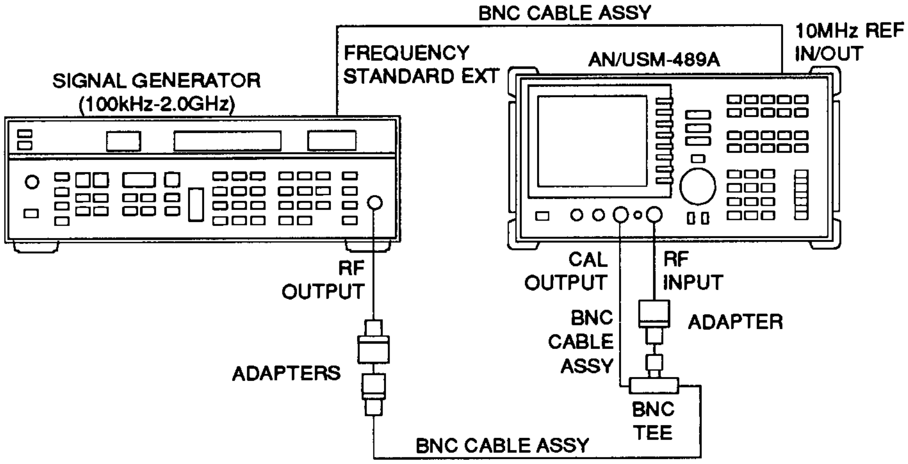
25. Repeat steps 16 through 24 for AN/USM-489A Band 2 and 3 CENTER FREQUENCIES and synthesized sweeper CW FREQUENCIES listed in the following table. At each setting, verify the scaler network analyzer readings at the frequency being tested are within specified limits.

AN/USM CENTER FREQ (GHz)	-489A CF STEP (MHz)	Synthesized CW FREQ (G Hz)	Sweeper FREQ STEP (MHz)	Scaler ANA Cursor Rdg (SWR)
BAND 1				
3.0	300	3.0	300	2.3
3.3	300	3.3	300	2.3
3.6	300	3.6	300	2.3
3.9	300	3.9	300	2.3
4.2	300	4.2	300	2.3
4.5	300	4.5	300	2.3
4.8	300	4.8	300	2.3
5.1	300	5.1	300	2.3
5.4	300	5.4	300	2.3
5.7	300	5.7	300	2.3
6.0	300	6.0	300	2.3
BAND 2				
6.1	600	6.1	600	2.3
6.7	600	6.7	600	2.3
7.3	600	7.3	600	2.3
7.9	600	7.9	600	2.3
8.5	600	8.5	600	2.3
9.1	600	9.1	600	2.3
9.7	600	9.7	600	2.3
10.3	600	10.3	600	2.3
10.9	600	10.9	600	2.3
11.5	600	11.5	600	2.3
12.1	600	12.1	600	2.3
12.7	600	12.7	600	2.3
BAND 3				
13.3	600	13.3	600	2.3
13.9	600	3.9	600	2.3
14.5	600	4.5	600	2.3
15.1	600	5.1	600	2.3
15.7	600	5.7	600	2.3
16.3	600	16.3	600	2.3
16.9	600	16.9	600	2.3
17.5	600	7.5	600	2.3
18.1	600	18.1	600	2.3
18.7	600	18.7	600	2.3
19.3	600	19.3	600	2.3

26. Disconnect test equipment.

FREQUENCY DRIFT TEST.

1. Connect equipment as shown. AN/USM-489A provides frequency reference for signal generator.



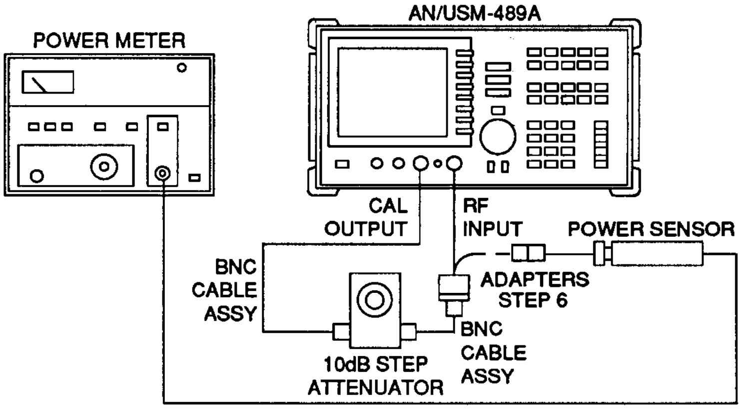
2. Set signal generator controls as follows:
   - FREQUENCY to 300.001500 MHz.
   - POWER LEVEL to –15 dBm.
   - RF OUTPUT to OFF.
3. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 2.5 kHz.
   - Set RES BW to 100 Hz.
   - Set REF LVL to –8 dBm.
   - Set LOG dB/DIV to 2 dB.
4. On AN/USM-489A,
   - Press PEAK SEARCH button.
   - Press MARKER —>CF key.
   - Wait for completion of sweep.
   - Press FREQUENCY button.
   - Press (UP ARROW) button three times.
   - Verify signal is about two divisions from leftmost graticule line.
5. Set signal generator RF OUTPUT to ON.

FREQUENCY DRIFT TEST - Continued.

6. On AN/USM-469A,
   - Press TRIG button.
   - Press SINGLE key.
   - Press wait for completion of sweep.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.
   - Press NEXT PEAK key.
7. Record Δ MKR frequency reading as Δ F1 Span.
8. On AN/USM-489A
   - Set SWEEP TIME to 100 sec.
   - Press SINGLE key.
   - Wait for completion of sweep (will take 100 seconds).
   - Press MARKER OFF button.
   - Press PEAK SEARCH button.
   - Press MARKER DELTA key.
   - Press NEXT PEAK key.
9. Record Δ MKR frequency reading as Δ F2 Span.
10. Subtract Δ F2 frequency (recorded in step 9) from Δ F1 frequency (recorded in step 7). Verify absolute value of result is < 50 Hz.
11. Set signal generator controls as follows:
    - FREQUENCY to 300.060600 MHz.
    - RF OUTPUT to OFF.
12. On AN/USM-489A,
    - Press PRESET button.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 101 kHz.
    - Set RES BW to 1 kHz.
    - Set REF LVL to -8 dBm.
    - Set LOG dB/DIV to 2 dB.
13. Repeat steps 4 through 9.
14. Subtract Δ F2 frequency (recorded in step 9) from Δ F1 frequency (recorded in step 7). Verify absolute value of result is < 2 kHz.
15. Disconnect test equipment.

MARKER AMPLITUDE ACCURACY TEST.

1. On AN/USM-489A,
   - Connect CAL OUTPUT and RF INPUT connectors using supplied BNC cable and adapter.
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -10 dBm.
   - Set RES BW to 300 kHz.
   - Press MARKER ON button.
   - Press AMPLITUDE button.
   - Press MORE key.
   - Press REF LVL CAL key.
   - Rotate knob until MKR amplitude reads -10 dBm ±0.17 dB.
   - Press STORE REF LVL key.
   - Disconnect BNC cable and adapter from CAL OUTPUT and RF INPUT connectors.
2. Set power meter controls as follows:
   - Zero power meter and power sensor combination.
   - Set power meters calibration factor to power sensor's 300 MHz setting.
3. Connect equipment as shown with power sensor connected to end of BNC cable through two adapters.



4. Set 10 dB step attenuator to 0 dB.
5. Record power meter reading (Ideal MKR for 0 dB).
6. Disconnect power sensor from BNC cable and connect BNC cable through Type N to BNC adapter to AN/USM-489A RF INPUT.

MARKER AMPLITUDE ACCURACY TEST - Continued.

7. On AN/USM-489A,
   - Press PRESET button.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set RES BW to 300 kHz.
   - Set VIDEO BW to 1 Hz.
   - Press MARKER ON button.
8. Record MKR amplitude reading as Actual Marker reading.
9. Set 10 dB step attenuator to 60 dB.
10. Set AN/USM-489A REF LVL to the values listed in the following table. At each setting, record the MKR amplitude reading (Actual MKR for 60 dB at selected REF LVL).

NOTE

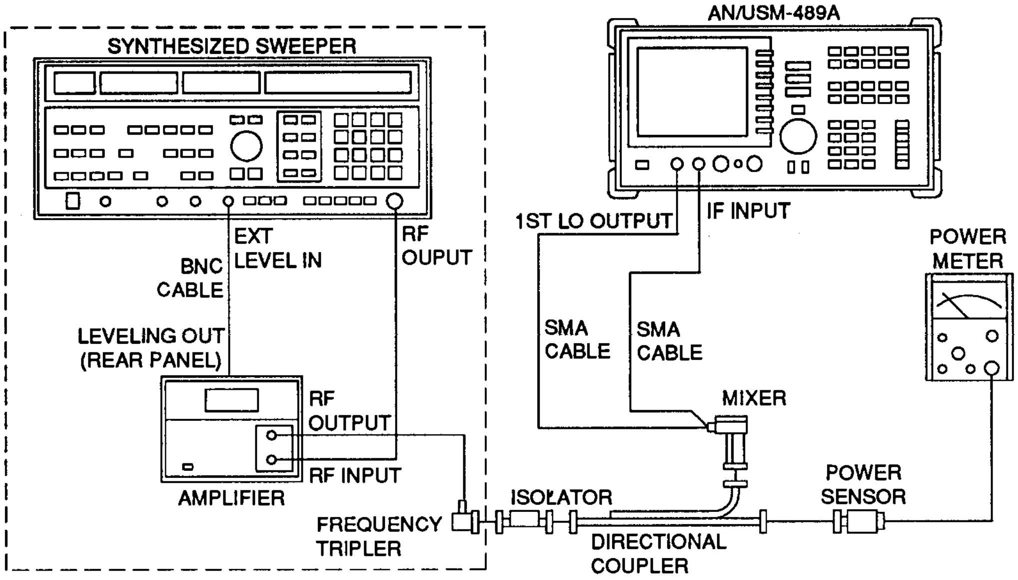
To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

Step Atten (dB)	AN/USM-489A Ref Level (dBm)	Mkr Reading		Marker Error	
		Actual (dBm)	Ideal (dBm)	Actual (dB)	Spec (dB)
0	0	______	______	______	±3.3
60	-10	______	______	______	±3.3
60	-40	______	______	______	±3.3
60	-50	______	______	______	±3.3

11. Calculate Ideal Marker Reading as follows:
    - 0 dB: Enter power level (recorded in step 5) as IDEAL MKR Reading for 0 dB Step Atten.
    - 60 dB: Subtract the actual attenuation for 60 dB setting of step attenuator (from 10 dB step attenuator calibration sheet), from power level recorded in step 5. Record this value as IDEAL MKR Reading for 60 dB Step Atten.
12. Calculate Marker Error as follows:
    - For each row in previous table, subtract ACTUAL MKR Reading from IDEAL MKR Reading.
    - Verify result (ACTUAL MKR ERROR) is 0 dB ±3.3 dB.
13. Disconnect test equipment.

11970A MIXER TEST.

1. Zero power meter and power sensor, then connect test equipment as shown below.



CAUTION

Make sure Microwave Amplifier is set for external leveling before applying power. Failure to set amplifier for external leveling may allow amplifier output to rise about +20 dBm, which is high enough to damage Frequency Tripler.

2. Set power meter Cal Factor to 100 percent.
3. Set synthesized sweeper controls as follows:
   - Press INSTR PRESET button.
   - CW FREQUENCY to 8.833333 GHz (after tripler will equal 26.5 GHz).
   - STEP FREQ to 166.666667 MHz (after tripler will equal 500 MHz).
   - POWER LEVEL to -3 dBm (as read on power meter).

11970A MIXER TEST - Continued.

4. On AN/USM-489A,
   - Press PRESET button.
   - Press EXT button.
   - Set FULL BAND to A.
   - Set CENTER FREQ to 26.5 GHz.
   - CF STEP to 500 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -15 dBm.
   - Set LOG dB/DIV to 2 dB.
   - Set RES BW to 1 MHz.
   - Press EXT button.
   - Press AMPTD CORRECT key.
   - Press CNV LOSS VS FREQ key.
5. On AN/USM-489A, press (UP/DOWN ARROW) buttons to step through conversion losses for all frequencies (displayed in active function block).
   - If all conversion losses are 30.0 dB, proceed to step 6.
   - If all conversion losses are not 30.0 dB, proceed as follows:
     - Press (UP/DOWN ARROW) buttons until CONV LOSS @ 27 GHz is displayed.
     - Record conversion loss.
     - Enter a conversion loss of 30 dB.
     - Press (UP ARROW) button.
     - Repeat until all CONV LOSS @ frequencies listed in following table are set to 30 dB.

Frequency	Conversion Loss (dB)
27	________
29	________
31	________
33	________
35	________
37	________
39	________
40	________

11970A MIXER TEST - Continued.

6. On AN/USM-489A,
   - Press PEAK SEARCH.
   - Record the following information.

     Center Frequency (M_f) is provided.

     - Marker Amplitude (M_a).
     - Power Meter Reading (PM_r).

     Power Sensor Cal Factor in % or Correction Factor in dB (PSC_f).

     Directional Coupler Coupling Factor (DCC_f) provided on Directional Coupler calibration sheet.

NOTE

For purposes of this measurement, Directional Coupler coupling factor is defined as ratio of power at output flange to power at coupled flange (provided on Directional Coupler calibration sheet).

7. Calculate conversion loss of mixer using one of following equations:

   When using Power Meter Cal Factor in %:

   Conversion Loss = (PM_r) -10 [log (PSC_f Cal Factor)] - (Ma) - (DCC_f)

   When using Power Meter Correction Factor in dB:

   Conversion Loss = (PM_r) + (PSC_f Correction Factor) - (M_a) - (DCC_f)

   For example:

   M_a = -39.78 dBm

   PM_r =-10.03 dBm,

   PSC_f Cal Factor = 94.8%, (or PSC_f Correction Factor = 0.92 dB),

   DCC_f = 8.93 dB

   then:

   Conversion Loss = (-10.03) - 10 [log(.948)] -(–39.78 dBm) –8.93 dB = 21.05 dB

   OR

   Conversion Loss = (-10.03 dBm) +.92 dB - (–39.78d Bm) -8.93 dB =21.7 dB

8. Add 30 dB to the result and record as conversion loss for frequency being tested.
9. On synthesized sweeper, press (UP ARROW) button.
10. On AN/USM-489A,
    - Press FREQUENCY button.
    - Press (UP ARROW) button.
11. Repeat steps 6 through 10 for AN/USM-489A CENTER FREQUENCIES and synthesized sweeper CW FREQUENCIES listed in the following table.

11970A MIXER TEST - Continued.

12. Subtract maximum and minimum conversion losses recorded from 26.5 GHz to 40 GHz, and verify result is < 3.8 dB.

NOTE

To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

AN/USM-489P CENTER FREQ (G Hz)	Sweeper FREQUENCY (G Hz)	Marker Amplitude (dBm) (M_a)	Power Meter Readings (dBm) (PM_r)	Pwr Sensor Cal Factor (% or dB) (PSC_f)	Dir Coupler Coupling Fat (dB) (DCC_f)	Conversion Loss (dB)
26.5	8.833333					
27.0	9.0					
27.5	9.166666					
28.0	9.333333					
28.5	9.5					
29.0	9.666666					
29.5	9.833333					
30.0	10.0					
30.5	10.166666					
31.0	10.333333					
31.5	10.5					
32.0	10.666666					
32.5	10.833333					
33.0	11.0					
33.5	11.166666					
34.0	11.333333					
34.5	11.5					
35.0	11.666666					
35.5	11.833333					
38.0	12.0					
36.5	12.166666					
37.0	12.333333					
37.5	12.5					
38.0	12.666666					
38.5	12.833333					
39.0	13.0					
39.5	13.166666					
40.0	13.333333					

Frequency Response = __ __ _dB

11970A MIXER TEST - Continued.

13. On AN/USM-489A,
    - Press PRESET button.
    - Press EXT button.
    - Set FULL BAND to A.
    - Set LOCK HARMONIC to 8.
    - Set SPAN WIDTH to 30 MHz.
    - Set VIDEO BW to 100 Hz.
    - Set RES BW to 100 kHz.
    - Set CENTER FREQ to 26.5 GHz.
14. Set power meter CAL FACTOR to the power sensor's 26.5 GHz setting.
15. Set synthesized sweeper controls as follows:
    - Press INSTR PRESET button.
    - CW FREQUENCY to 8.833333 GHz (after tripler will equal 26.5 GHz).
    - POWER LEVEL to -3 dBm (as read on power meter).
16. Record power meter reading as Actual Power Reading,
17. Calculate Corrected Power Reading as follows:

    Corrected Power Reading = Power Meter Reading - Directional Coupler Coupling Factor (from calibration sheet).

    For example:

    (-10.03 dBm) -20.82 dB =-30.85 dBm
18. Record result as Corrected Power Reading.
19. On AN/USM-489A,
    - Press PEAK SEARCH button.
    - Press MKR—> button.
    - Press MARKER—>REF LVL key.
    - Wait three sweeps.
    - Record the marker amplitude as Signal MKR Amplitude.
20. On AN/USM-489A,
    - Rotate knob to move marker a minimum of three divisions from signal.
    - Record marker amplitude as Noise MKR Amplitude.
21. Calculate Average Noise Level as follows:

    Average Noise Level = Corrected Power Reading (step 18) - Signal MKR Amplitude (step 19) + Noise MKR Amplitude (step 20) - 20 (20 = bandwidth correction factor).

    Where Bandwidth Correction Factor = 10log(100 kHz/1 kHz).

    For example:

    Average Noise Level = (-30.85 dBm) - (-22.0 dBm) + (-82.9 dBm) -20 dB = -111.75 dBm
22. Verify calculated average noise level is more negative than -110 dBm.

11970A MIXER TEST - Continued.

23. Repeat steps 13 through 22 using AN/USM-489A CENTER FREQ, synthesizer sweeper FREQUENCY, and power sensor calibration factor settings listed in the following table.

NOTE

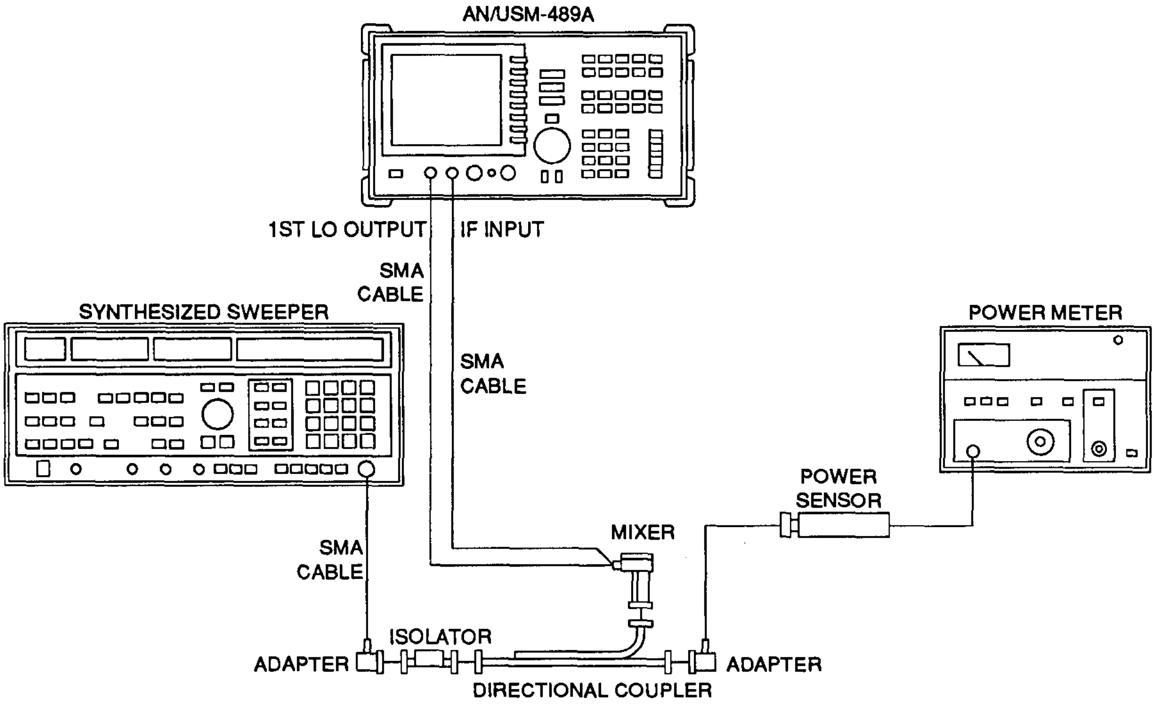
To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

AN/USM-489A CENTER FREQ (GHz)	Sweeper FREQ (GHz)	Pwr Sensor Cal Factor	Actual Power Reading (dBm)	Dir Coupler correction Factor (dB)	Corrected Power Reading (dBm)	Signal MKR Amplitude (dBm)	Noise Marker Amplitude (dBm)	Average Noise Level (dBm)
26.5	8.833333	26.5						
33.0	11.0	33.0						
40.0	13.333333	40.0						

24. Disconnect test equipment.
25. If conversion loss frequencies were changed in step 5, proceed as follows:
    - Press (UP/DOWN ARROW) buttons until CONV LOSS @ 18 GHz is displayed.
    - Record conversion loss.
    - Enter conversion loss recorded in step 2 for 18 GHz.
    - Press (UP ARROW) button.
    - Repeat until all CONV LOSS @ frequencies are set to recorded values.

11970K MIXER TEST.

1. Zero power meter and power sensor, then connect test equipment as shown below.



2. Set power meter Cal Factor to 100 percent.
3. Set synthesized sweeper controls as follows:
   - Press INSTR PRESET button.
   - CW FREQUENCY to 18.0 GHz.
   - STEP FREQ to 500 MHz.
   - POWER LEVEL to -10 dBm (as read on power meter).
4. On AN/USM-489A,
   - Press PRESET button.
   - Press EXT button.
   - Set FULL BAND to K.
   - Set CENTER FREQ to 18 GHz.
   - CF STEP to 500 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Set REF LVL to -15 dBm.
   - Set LOG dB/DIV to 2 dB.
   - Set RES BW to 1 MHz.
   - Press EXT button.
   - Press AMPTD CORRECT key.
   - Press CNV LOSS VS FREQ key.

11970K MIXER TEST - Continued.

5. On AN/USM-489A, press (UP/DOWN ARROW) buttons to step through conversion losses for all frequencies (displayed in active function block).
   - If all conversion losses are 30.0 dB, proceed to step 6.
   - If all conversion losses are not 30.0 dB, proceed as follows:
     - Press (UP/DOWN ARROW) buttons until CONV LOSS @ 18 GHz is displayed.
     - Record conversion loss.
     - Enter a conversion loss of 30 dB.
     - Press (UP ARROW) button.
     - Repeat until all CONV LOSS @ frequencies listed in following table are set to 30 dB.

Frequency (GHz)	Conversion Loss (dB)
18	____________
20	____________
22	____________
24	____________
26	____________
27	____________

6. On AN/USM-489A,
   - Press PEAK SEARCH.
   - Record the following information.
     - Center Frequency **(M_f)** is provided.
     - Marker Amplitude **(M_a)**.
     - Power Meter Reading **(PM_r)**.
     - Power Sensor Cal Factor in % or Correction Factor in dB **(PSC_f)**.
     - Directional Coupler Coupling Factor **(DCC_f)** provided on Directional Coupler calibration sheet.

NOTE

For purposes of this measurement, Directional Coupler coupling factor is defined as ratio of power at output flange to power at coupled flange (provided on Directional Coupler calibration sheet).

11970K MIXER TEST - Continued.

7. Calculate conversion loss of mixer using one of following equations:

When using Power Meter Cal Factor In %:

Conversion Loss = (PM_r) -10 [log $(PSC_f$ Cal Factor)] - (M_a) - (DCC_f)

When using Power Meter Correction Factor In dB:

Conversion Loss = (PM_r) + $(PSC_f$ Correction Factor) - (M_a) - (DCC_f)

For example:

M_a = -39.78 dBm

PM_r = -10.03 dBm,

PSC_f Cal Factor = 94.8%, (or PSC_f Correction Factor = 0.92 dB),

DCC_f = 8.93 dB

then:

Conversion Loss = (-10.03) - 10[log(.948)] -(-39 .78 dBm) -8.93 dB = 21.05 dB

OR

Conversion Loss = (-10.03 dBm) + .92 dB - (-39.78 dBm) -8.93 dB = 21.7 dB

8. Add 30 dB to the result and record as conversion loss for frequency being tested.

9. On synthesized sweeper, press (UP ARROW) button.

O. On AN/USM-489A,

- Press FREQUENCY button.
- Press (UP ARROW) button.

1. Repeat steps 6 through 10 for AN/USM-489A CENTER FREQUENCIES and synthesized sweeper CW FREQUENCIES listed in the following table.

11970K MIXER TEST - Continued.

12. Subtract maximum and minimum conversion losses recorded from 18 GHz to 26.5 GHz, and verify result is < 3.8 dB.

NOTE

To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

AN/USM-4891 CENTER FREQ (GHz)	Sweeper FREQUENCY (GHz)	Marker Amplitude (dBm) (M_a)	Power Meter Readings (dBm) (PM_r)	Pwr Sensor Cal Factor (% or dB) (PSC_f)	Dir Coupler Coupling Fact (dB) (DCC_f)	Conversion Loss (dB)
18.0	18.0					
18.5	18.5					
19.0	19.0					
19.5	19.5					
20.0	20.0					
20.5	20.5					
21.0	21.0					
21.5	21.5					
22.0	22.0					
22.5	22.5					
23.0	23.0					
23.5	23.5					
24.0	24.0					
24.5	24.5					
25.0	25.0					
25.5	25.5					
26.0	26.0					
26.5	26.5					

Frequency Response . .-—-------dB

11970K MIXER TEST - Continued.

13. On AN/USM-489A,

    - Press PRESET button.
    - Press EXT button.
    - Set FULL BAND to K.
    - Set LOCK HARMONIC to 6.
    - Set SPAN WIDTH to 30 MHz.
    - Set VIDEO BW to 100 Hz.
    - Set RES BW to 100 kHz.
    - Set CENTER FREQ to 18.015 GHz.

14. Set power meter CAL FACTOR to the power sensor's 18 GHz setting.

15. Set synthesized sweeper controls as follows:

    - Press INSTR PRESET button.
    - CW FREQUENCY to 18.105 GHz.
    - POWER LEVEL to -10 dBm (as read on power meter).

16. Record power meter reading as Actual Power Reading.

17. Calculate Corrected Power Reading as follows:

    Corrected Power Reading = Power Meter Reading – Directional Coupler Coupling Factor (from calibration sheet).

    For example:

    (-10.03 dBm) -20.82 dB = -30.85 dBm

18. Record result as Corrected Power Reading.

19. On AN/USM-489A,

    - Press PEAK SEARCH button.
    - Press MKR—> button.
    - Press MARKER—>REF LVL key.
    - Wait three sweeps.
    - Record the marker amplitude as Signal MKR Amplitude.

20. On AN/USM-489A,

    - Rotate knob to move marker a minimum of three divisions from signal.
    - Record marker amplitude as Noise MKR Amplitude.

21. Calculate Average Noise Level as follows:

    Average Noise Level = Corrected Power Reading (step 18) - Signal MKR Amplitude (step 19) + Noise MKR Amplitude (step 20) – 20 (20 = bandwidth correction factor).

    Where Bandwidth Correction Factor = 10log(100 kHz/1 kHz).

    For example:

    Average Noise Level = (-30.85 dBm) - (-22.0 dBm) + (-82.9 dBm) -20 dB = -111.75 dBm

22. Verify calculated average noise level is more negative than -110 dBm.

11970K MIXER TEST - Continued.

23. Repeat steps 13 through 22 using AN/USM-489A CENTER FREQ, .synthesizer sweeper FREQUENCY, and power sensor calibration factor settings listed in the following table.

NOTE

To avoid errors or confusion, blank spaces are provided to record the numerous readings required for calculating test results. Do not write in this manual. It is recommended that a copy of this page be used to record necessary readings.

AN/USM-489A CENTER FREQ (G Hz)	Sweeper FREQ (GHz)	Pwr Sensor Cal Factor	Actual Power Reading (dBm)	Dir Coupler Correction Factor (dB)	Corrected Power Reading (dBm)	Signal MKR Amplitude (dBm)	Noise Marker Amplitude (dBm)	Average Noise Level (dBm)
18.105	18.105	18.105						
22.0	22.0	22.0						
26.485	26.485	26.465						

24. Disconnect test equipment.

25. If conversion loss frequencies were changed in step 5, proceed as follows:

- Press (UP/DOWN ARROW) buttons until CONV LOSS @ 18 GHz is displayed.
- Record conversion loss.
- Enter conversion loss recorded in step 2 for 18 GHz.
- Press (UP ARROW) button.
- Repeat until all CONV LOSS @ frequencies are set to recorded values.

2-19. ADJUSTMENTS.

DESCRIPTION

The adjustment procedures cover:

- Adjust High-Voltage Power Supply (para 2-21).
- Adjust Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).
- Adjust IF Bandpass (para 2-24).
- Adjust IF Amplitude (para 2-25).
- Adjust Sampling Oscillator (para 2-26).
- Adjust YTO (para 2-27).
- Adjust 1st LO Distribution Amplifier (para 2-28).
- Adjust Dual Band Mixer Bias (para 2-29).
- Adjust YTF and Frequency Response (para 2-30).
- Adjust Calibrator Amplitude (para 2-31).
- Adjust 10 MHz Frequency Reference (para 2-32).
- Adjust Demodulator (para 2-33).
- Adjust External Mixer Bias (para 2-34).
- Adjust External Mixer Amplitude (para 2-35).
- Adjust Second IF Gain (para 2-36).
- Adjust SIG ID Oscillator (para 2-37).

NOTES

- If “consult service manual” message is displayed during adjustment, see paragraph 2-11 for troubleshooting information.
- Specific adjustments may be necessary after repair/replacement of specific assemblies in the AN/USM-489A or failure of a performance test. Adjustment is not required if malfunction has been cleared after repair.
- Never perform all adjustments from para 2-21 thru 2-37 at one time.
- Certain adjustments are performed using a Test and Adjustment Module (TAM) connected to J3 on the rear panel (para 2-38). During the procedure, instructions and indicators are presented on the screen. Any differences or unexplained situations are documented in this manual.
- Do not adjust components unless instructed to do so in the procedures, as many are factory adjustable only.
- The adjustment needed after repair/replacement of specific assemblies are as shown in table 2-8.
- All indications and waveforms are referenced to chassis ground unless otherwise specified.
- All voltages specified as DC unless otherwise specified.
- TTL low logic level is -0.5 to +0.8 V and TTL high logic level is +3.5 to +5.5 V.
- When using any source, use **50Ω** impedance.

2-19. ADJUSTMENTS - Continued.

- Assembly and cable location diagram is figure FO-1. Individual circuit card component locator diagrams are on the following figures:
  - Figure FO-7. A2 Controller CCA
  - Figure FO-11. A3 Interface CCA
  - Figure FO-14. A4 Log Amplifier CCA
  - Figure FO-17. A5 IF (Intermediate Frequency) Filter CCA
  - Figure FO-20. A6 Power Supply CCA
  - Figure FO-23. A7 LODA Assembly, A8 Dual Mixer, A10 YTF, A11 YTO, and A13 2nd Converter
  - Figure FO-25. A14 Frequency Control CCA
  - Figure FO-28. A15 RF (Radio Frequency) CCA
  - Figure FO-31. A16 CAL Oscillator CCA
  - Figure FO-33. A17 CRT Driver CCA
  - Figure FO-35. A19 HP-IB CCA
- After adjust procedure is completed remove power and install cover (para 2-39).

Table 2-8. Post Repair/Replace Adjustments.

Repaired/Replaced Assembly	Adjust
A1 Front Panel Assembly	None
A1A1 Keyboard CCA	None
A1A2 Rotary Pulse Generator	None
A2 Controller CCA	Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above). YTF and Frequency Response (para 2-30) only if A2U501 was replaced.
A3 Interface CCA	Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above). YTF and Frequency Response (para 2-30).
A4 Log Amplifier CCA	Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above). Demodulator (para 2-33).
A5 IF CCA	IF Bandpass (para 2-24). IF Amplitude (para 2-25).
A6 Power Supply	High Voltage Power Supply (para 2-21). Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).
A6A1 HV Module	High Voltage Power Supply (para 2-21). Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).
A7 1ST LO Distribution Amp Assy	First LO Distribution Amplifier (para 2-28). YTF and Frequency Response (para 2-30).
A8 Dual Band Mixer Assembly	Dual Band Mixer Bias (para 2-29). YTF and Frequency Response (para 2-30).
A9 Input Attenuator Assembly	YTF and Frequency Response (para 2-30).

Table 2-8. Post Repair/Replace Adjustments - Continued.

Repaired/Replaced Assembly	Adjust
A10 YTF Assembly	YTF and Frequency Response (para 2-30).
A11 YTO Assembly	YTO (para 2-27).
A12 RF Switch Assembly	YTF and Frequency Response (para 2-30).
A13 2nd Converter Assembly	YTF and Frequency Response (para 2-30).
A14 Frequency Control CCA	Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above). YTO (para 2-27). 1st LO Distribution Amplifier (para 2-28). Dual Band Mixer Bias (para 2-29). YTF and Frequency Response (para 2-30).
A15 RF CCA	10 MHz Frequency Reference (para 2-32). Calibrator Amplitude (para 2-31). External Mixer Bias (para 2-34). Sampling Oscillator (para 2-26). SIG ID Oscillator (para 2-37). External Mixer Amplitude (para 2-35). YTF and Frequency Response (para 2-30).
A15U801 2nd IF Amplifier Assembly	Second IF Gain (para 2-36).
A15U100 Sampler Assembly	Sampling Oscillator (para 2-26).
A16 Cal Oscillator CCA	IF Amplitude (para 2-25).
A17 CRT Driver CCA	Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).
A18CRT Assembly	Display (para 2-22 for units prefixed up to 3115A, para 2-23 for units prefixed 3119A and above).
A19 HP-IB CCA	None

2-20. INITIAL SETUP

1. Remove cover and feet (para 2-39).
2. Perform turn-on procedures TM 11-6625-3250-12, paragraph 2-6.

WARNING

Dangerous voltages are present with the case removed. Where maintenance can be performed without power applied, the power should be removed.

3. On AN/USM-489A, press PRESET key.

2-21. ADJUST HIGH-VOLTAGE POWER SUPPLY.

WARNING

The following procedure probes voltage that, if contacted, could cause personal injury or death.

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Disconnect power cable.
   - Place A2/A3/A4/A5 CCAs in service position (para 2-42).

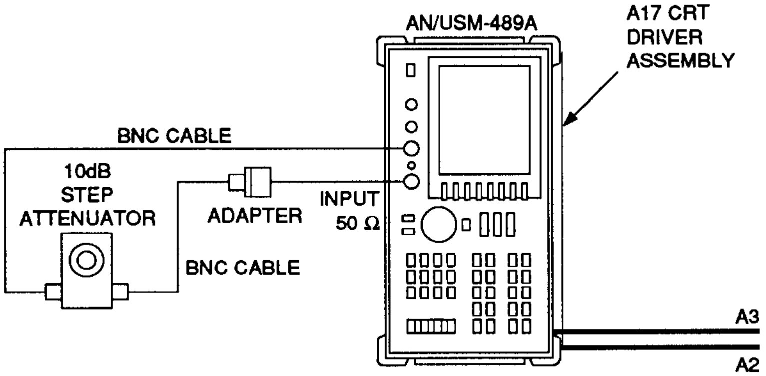
WARNING

After disconnecting the ac line power cord, allow at least 30 seconds for capacitors in the high-voltage supply to discharge before removing the protective cover from the A6 Power Supply.

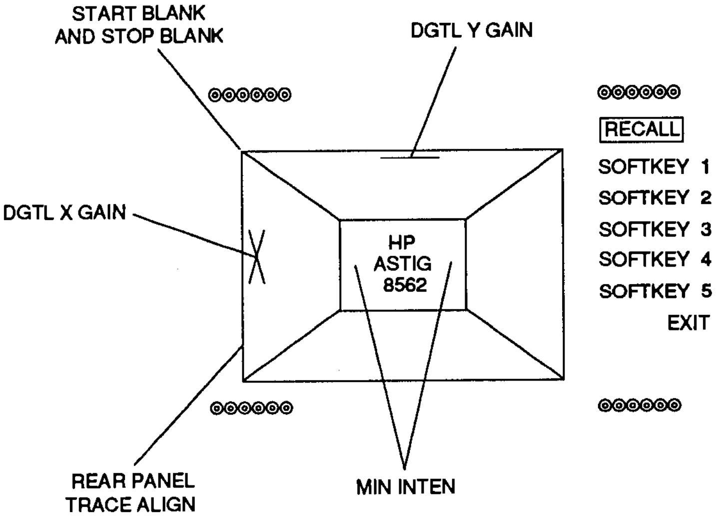
   - Remove Power Supply Cover (para 2-56).
3. Set digital multimeter controls as follows:
   - Connect (+) lead to A6TP405 (fig. FO-20) and (-) lead to A6TP401.
   - FUNCTION to DC VOLTS.
   - RANGE to 1000 VOLTS.
4. On AN/USM-489A,
   - Reconnect power cable.
   - Set LINE switch to ON.
   - Note voltage marked on the A6A1 HV Module label (fig. FO-1).
5. Note value of inductor A6L401 (located next to main transformer A6T103).
   - If A6L401 is 10 mH, adjust A6R410 (HV ADJ) to 2 volts above voltage marked on A6A1 HV Module label.
   - If A6L401 is 20 mH, adjust A6R410 (HV ADJ) equal to voltage marked on A6A1 HV Module label ± 0.5 Vdc.
6. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Disconnect power cable.
   - Wait at least 30 seconds.
   - Disconnect digital multimeter test leads.
   - Install Power Supply Cover.
   - Place A2/A3/A4/A5 CCAs in normal position.

2-22. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX UP TO 3115A).

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A2/A3 CCA's in service position (para 2-40).
3. Connect test equipment as shown.



4. On AN/USM-489A,
   - Set A17R62 (PATN) (fig. FO-33) to midrange.
   - Set LINE switch to ON.
   - Adjust A17R55 (MIN INT) until a trace appears on CRT.
   - Adjust A17R58 (FOCUS) for best possible overall focus.
   - Press DISPLAY button.
   - Press MORE key.
   - Set INTEN to 255.
   - Set FOCUS to 128.
   - Press RECALL button.
   - Press MORE key.
   - Press CRT ADJ PATTERN key.
   - Use figure to locate display adjust points.



5. On AN/USM-489A,
   - Adjust rear-panel TRACE ALIGN until leftmost line is parallel with CRT bezel.
   - Adjust rear-panel X POSN and A17R19 (X GAIN) until leftmost "@" characters and softkey labels appear just inside left and right edges of CRT bezel.
   - Adjust rear-panel Y POSN and A17R20 (Y GAIN) until softkey labels align with their appropriate softkeys.

2-22. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX UP TO 3115A) - Continued.

6. On AN/USM-489A,
   - Adjust A17R63 (ASTIG) for smallest round dot possible.
   - Adjust A17R58 (FOCUS) for best focus of test pattern's outside box and "@" characters.
   - Adjust A17R55 (MIN INT) until two dots just barely disappear.
   - Press EXIT key.
   - Press DISPLAY button.
   - Press MORE key.
   - Press GRAT OFF key.
7. On AN/USM-489A,
   - Adjust A17R55 (MIN INT) until horizontal line at bottom of display disappears.
   - Set INTEN to 1.
   - Adjust A17R55 (MIN INT) until display is dim but still readable.
   - Set INTEN to 255.
   - Repeat step until no horizontal line appears along bottom with INTEN set to 255, and display is dim but readable with INTEN set to 1.
8. On AN/USM-489A,
   - Set INTEN to 90.
   - Press STORE INTEN.
   - Set GRAT key to ON.
   - Adjust A17R63 ASTIG for best focus of outside graticule lines.
   - Adjust A17R51 DYN FOCUS for best overall focus.
9. On AN/USM-489A,
   - Press RECALL button.
   - Press MORE key.
   - Press CRT ADJ PATTERN key.
   - Fold up A3 Interface CCA.
   - Adjust A2R206 (DGTL X GAIN) (fig FO-7) until two vertical lines near left edge of display appear to be one single line.
   - Adjust A2R215 (DGTL Y GAIN) until two horizontal lines near top edge of display appear to be one single line.
   - Adjust A2R262 (STOP BLANK) and A2R263 (START BLANK) for sharpest corners of outer box in test pattern. The intensity of the corners should be the same as the middle of the lines.
   - Press EXIT key.
   - If necessary, readjust A2R262 (STOP BLANK) and A2R263 (START BLANK) for best-looking intersection of graticule lines. Most notable along center vertical and center horizontal graticule lines.

2-22. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX UP TO 3115A) - Continued.

10. On AN/USM-489A,
    - Set A2R218 (VIDEO OFFSET) to midrange.
    - Set A2R268 (VIDEO GAIN) to midrange.
11. Set 10 dB step attenuator to 20 dB.
12. On AN/USM-489A,
    - Press PRESET button.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 0 Hz.
    - Set REF LVL to -40 dBm.
    - Set RES BW to 1 kHz.
    - Set VIDEO BW to 300 Hz.
    - Press MARKER ON button.
    - Press MKR—> button.
    - Press MARKER—> REF LVL key.
    - Set SWEEP TIME to 10 ms.

13, On AN/USM-489A,
- Adjust A2R209 SWEEP OFFSET to place the beginning of the trace at the leftmost vertical graticule line and adjust A2R271 SWEEP GAIN to place the end of the trace at the tenth vertical graticule line (one division from the right edge of the graticule).
- Press SAVE button.
- Press SAVE STATE key.
- Press STATE 0 key.
- Press Set REF LVL to +30 dBm.
- Press SAVE button.
- Press SAVE STATE key.
- Press STATE 1 key.
- Set SWEEP TIME to 50 ms.
- Press SAVE button.
- Press SAVE STATE key.
- Press STATE 2 key.
- Press RECALL button.
- Press RECALL STATE key.

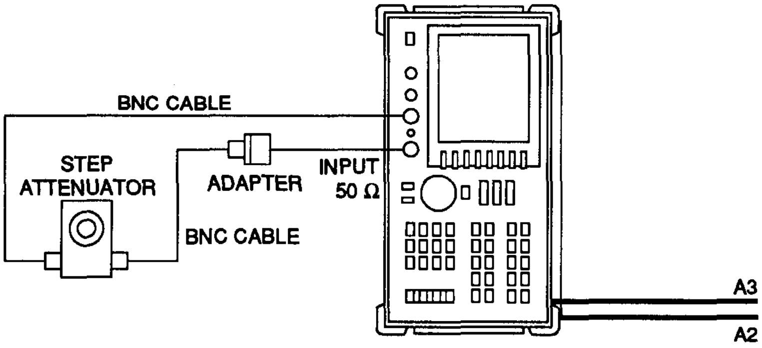
2-22. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX UP TO 3115A) - Continued.

14. On AN/USM-489A,
    - Note vertical position of trace.
    - Press STATE 2 key.
    - Note vertical position of trace.
    - Press STATE 1 key.
    - Adjust A2R218 (VIDEO OFFSET) to position trace halfway between original position and new position.
    - Press STATE 0 key.
    - Adjust A2R268 (VIDEO GAIN) to position trace halfway between original position and top horizontal graticule line.
    - Repeat step until the vertical positions of trace in STATE 1 and STATE 2 coincide, and trace aligns with top horizontal graticule in STATE 0.
15. On AN/USM-489A,
    - Press STATE 0 key.
    - Adjust A2R271 (SWEEP GAIN) to place end of trace at rightmost vertical graticule line.
16. On AN/USM-489A,
    - Set LINE switch to OFF.
    - Disconnect test equipment.

2-23. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX 3119A AND ABOVE).

---

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
    - Set LINE switch to OFF.
    - Place A2/A3 CCA's in service position (para 2-40).
3. Connect test equipment as shown.

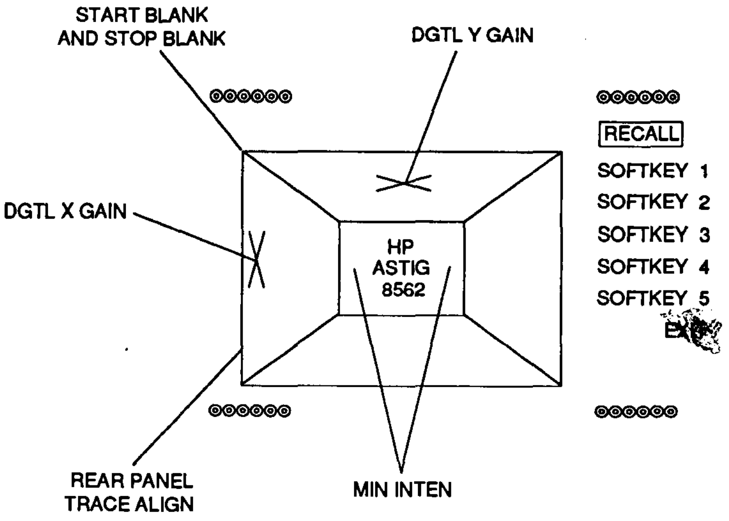


2-23. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX 3119A AND ABOVE) - Continued.

4. On AN/USM-489A,
   - Set A17R55 (X GAIN) (fig. FO-33) to midrange.
   - Set A17R75 (Y GAIN) to midrange.
   - Set A17R92 (DDD) to midrange.
   - Set A17R93 (ASTIG) to midrange.
   - Set A2R206 (DGTL X GAIN) (fig. FO-7) to midrange.
   - Set A2R215 (DGTL Y GAIN) to midrange.
   - Set A2R262 (STOP BLANK) to midrange.
   - Set A2R263 (START BLANK) to midrange.
   - Set (A17R57) rear-panel X POSN to midrange.
   - Set (A17R77) rear-panel Y POSN to midrange.
   - Set (A17R90) rear-panel TRACE ALIGN to midrange.
   - Set A17R21 (Z FOCUS) fully counterclockwise.
   - Set A17R26 (X FOCUS) fully counterclockwise.
   - Set A17R11 (CUTOFF) fully counterclockwise.
   - Set A17R4Z (GAIN) fully clockwise.
   - Set LINE switch to ON.
   - Wait three minutes.
   - Adjust A17R11 (CUTOFF) until display is visible.
   - Adjust A17R34 (COURSE FOCUS) for best possible focus.
5. On AN/USM-489A,
   - Press PRESET button.
   - Press DISPLAY button.
   - Press MORE key.
   - Set INTEN to 255.
   - Press STORE INTEN key.
   - Set FOCUS to 127.
   - Press STORE FOCUS key.
   - Press GRAT OFF key.
   - Adjust A17R11 (CUTOFF) until line at bottom of trace just disappears.

2-23. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX 3119A AND ABOVE) - Continued.

6. On AN/USM-489A,
   - Set GRAT key to ON.
   - Set INTEN to 80.
   - Press STORE INTEN key.
   - Press RECALL key.
   - Press MORE key.
   - Press CRT ADJ PATTERN key.
   - Fold up A3 Interface CCA.
   - Use figure to locate display adjust points.
   - Adjust A2R206 (DGTL X GAIN) until two vertical lines near left edge of display appear to be one single line.
   - Adjust A2R215 (DGTL Y GAIN) until two horizontal lines near top of display appear to be one single line.
   - Adjust A2R262 (STOP BLANK) and A2R263 (START BLANK) for sharpest corners of outer box in test pattern. The intensity of the corners should be the same as the middle of the lines.



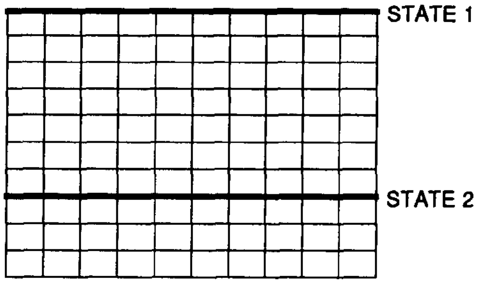
   - Adjust (A17R90) rear-panel TRACE ALIGN until leftmost line of test pattern is parallel with CRT bezel.
   - Adjust (A17R57) rear-panel X POSN and A17R55 X GAIN until leftmost '@" characters and softkey labels appear just inside left and right edges of CRT bezel.
   - Adjust (A17R77) rear-panel Y POSN and A17R75 Y GAIN until softkey labels align with their appropriate softkeys.
   - Press PRESET button.
   - If necessary, readjust A2R262 (STOP BLANK) and A2R263 (START BLANK) for best - looking intersection of graticule lines. Most notable along center vertical and center horizontal graticule lines.
7. On AN/USM-489A,
   - Set REF LVL to -70 dBm.
   - Set LOG dB/DIV to 1 dB.
   - Verify screen fills with noise floor.
   - Press TRIG button.
   - Press SINGLE key.
   - Press DISPLAY button.
   - Press MORE key.
   - Set INTEN to 0.
   - Adjust A17R4 (Z GAIN) until display is just visible.
   - Press PRESET key.
   - Press RECALL button.
   - Press MORE key.
   - Press CRT ADJ PATTERN key.

2-23. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX 3119A AND ABOVE) - Continued.

8. On AN/USM-489A,
   - Adjust A17R93 (ASTIG) for smallest round dot possible.
   - Adjust A17R34 (COURSE FOCUS) and A17R92 (DDD) for best focus at center screen.
   - Adjust A17R21 (Z FOCUS) for best focus of outside box.
   - Adjust A17R26 (X FOCUS) for best focus of "@" characters at corners.
   - Repeat step to obtain best overall focus quality.
9. On AN/USM-489A,
   - Set A2R209 (SWEEP OFFSET) to midrange.
   - Set A2R218 VIDEO OFFSET to midrange.
   - Set A2R268 VIDEO GAIN to midrange.
   - Set A2R271 SWEEP GAIN to midrange.
10. Set 10 dB step attenuator to 30 dB.
11. On AN/USM-489A,
    - Press PRESET button.
    - Set CENTER FREQ to 300 MHz.
    - Set SPAN WIDTH to 0 Hz.
    - Set REF LVL to -40 dBm.
    - Set RES BW to 1 kHz.
    - Set VIDEO BW to 300 Hz.
    - Set Sweep time to 50 ms.
    - Press MARKER ON button.
    - Press MKR—> button.
    - Press MARKER—> REF LVL key.
    - If marker is not at top graticule, press MARKER-> REF LVL key again.

2-23. ADJUST DISPLAY (UNITS WITH SERIAL PREFIX 3119A AND ABOVE) - Continued.

12. On AN/USM-489A,
    - Press SAVE button.
    - Press SAVE STATE key.
    - Press STATE 0 key.
    - Set SWEEP TIME to 10 ms.
    - Press SAVE button.
    - Press SAVE STATE key.
    - Press STATE 1 key.
    - Adjust A2R209 (SWEEP OFFSET) to place beginning of trace at leftmost vertical graticule line and adjust A2R271 (SWEEP GAIN) to place end of trace at tenth vertical graticule line (one division from right edge).
    - Press AMPLITUDE and press the UP key seven times.
    - Press SAVE button.
    - Press SAVE STATE key.
    - Press STATE 2 key.
    - Set sweep time to 50 ms.
    - Press SAVE button.
    - Press SAVE STATE key.
    - Press STATE 3 key.
    - Press RECALL button.
    - Press RECALL STATE key.
    - Press STATE 1 key.
13. On AN/USM-489A,
    - Switch between recall STATE1 and STATE2.
    - Adjust A2R268 and A2R218 so that in STATE1 trace is lined up with the top graticule and in STATE2 the trace is lined up with eight graticule (as shown).
    - Repeat until they align to within ±0.2 divisions.



14. On AN/USM-489A,
    - Press STATE 2 key.
    - Adjust A2R209 and A2R271 until start of sweep is aligned to leftmost vertical graticule line and stop sweep is aligned with right most vertical graticule line.
    - Note trace location.
    - Press STATE3 key and verify trace moves less than ±0.1 division.
    - Press STATE0 key and note trace location.
    - Press STATE1 key and verify trace moves less than ±0.1 division.
15. On AN/USM-489A,
    - Set LINE switch to OFF.
    - Disconnect test equipment.

2-24. ADJUST IF BANDPASS.

---

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A2/A3/A4/A5 CCA's in service position (para 2-42).
   - Connect TAM and extension cable (para 2-38).
   - Set LINE switch to ON
   - Press MODULE button
   - Press ADJUST key.
   - Rotate knob to select IF Bandpass LC Poles Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- References to "LC CTRF" indicate "LC CTR".
- A5 component locator diagram is provided in fig. FO-17.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

3 . If adjustment is successful (ADJUST menu displayed), proceed to step 4.

If there is insufficient range in an LC CTR adjustment, reselect value of the associated fixed capacitor as follows:

- Set LINE switch to OFF.
- Connect digital multimeter to test point indicated in the following table that corresponds with failed adjustment.

Test Point	LC CTR Adjustment	FSV Capacitor
A5TP5	A5L300 LC CTR 1	A5C326
A5TP6	A5L301 LC CTR 2	A5C327
A5TP1	A5L700 LC CTR 3	A5C717
A5TP2	A5L701 LC CTR 4	A5C718

2-24. ADJUST ADJUST IF BANDPASS - Continued.

- Using fig. FO-17, locate corresponding FSV Capacitor and remove appropriate shield (para 2-44).
- Center the appropriate LC CTR adjustment.
- Set LINE switch to ON.
- Press PRESET button.
- Wait for status message to disappear.
- Press AMPLITUDE button.
- Press MORE key.
- Press IF ADJUST key.
- Press ADJ CURR IF STATE.
- Wait for IF ADJUST STATUS message to dissapear.
- Record digital multimeter reading.
- Note current FSV Capacitor value.
- Set LINE switch to OFF.
- Install new FSV capacitor value based on digital multimeter reading and currently loaded capacitor as shown in following table.
- Set LINE switch to ON.
- Press MODULE button.
- Press ADJUST key.

DVM Reading (V)	Currently Loaded FSV Capacitor Value (pF)*						
	6.8	8.2	10	12	15	18	20
0 to 1.5	•	•	•	•	•	•	•
1.5 to 2.5	18	18	•	•	•	•	•
2.5 to 3.5	15	15	18	18	•	•	•
3.5 to 4.5	10	12	15	15	18	•	•
4.5 to 5.5	8.2	10	12	15	18	•	•
5.5 to 6.5	no change	no change	no change	no change	no change	no change	no change
6.5 to 7.5	no change	no change	no change	no change	no change	no change	no change
7.5 to 8.5	•	6.8	8.2	10	12	15	18
8.5 to 9.5	•	•	6.8	8.2	12	15	18
9.5 to 10	•	•	6.8	8.2	10	12	15

*A bullet (•) indicates a condition that should not exist (proceed to para 2-16).
All capacitances are in pF.

2-24. ADJUST IF BANDPASS - Continued.

4. On AN/USM-489A,

- Rotate knob to select IF Bandpass Crystal Poles Adjustment.
- Press EXECUTE key.
- Follow displayed instructions.

NOTES

- References to "XTAL CTRF" indicate "XTAL CTR".
- A5 component locator diagram is provided in fig. FO-17.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

5. If adjustment is successful (Adjustment displayed), proceed to step 6.

If there is insufficient range in an XTAL CTR adjustment, reselect value of the associated fixed capacitor as follows:

- Set LINE switch to OFF.
- Connect digital multimeter to test point indicated in the following table that corresponds with failed adjustment.

Test Point	XTAL CTR Adjustment	FSV Capacitor
A5TP7	A5T200 XTAL CTR 1	A5C204
A5TP8	A5T202 XTAL CTR 2	A5C216
A5TP3	A5T500 XTAL CTR 3	A5C205
A5TP4	A5T502 XTAL CTR 4	A5C516

- Using fig. FO-17, locate corresponding FSV Capacitor and remove appropriate shield (para 2-44).
- Center the appropriate LC CTR adjustment.
- Set LINE switch to ON.
- Press PRESET button.
- Wait for status message to disappear.
- Press AMPLITUDE button.
- Press MORE key.
- Press IF ADJUST key.
- Press ADJ CURR IF STATE.
- Wait for IF ADJUST STATUS message to disappear.
- Record digital multi meter reading.
- Note current FSV Capacitor value.
- Set LINE switch to OFF.
- Install new FSV capacitor value based on digital multimeter reading and currently loaded capacitor as shown in following table.
- Set LINE switch to ON.
- Press MODULE button.
- Press ADJUST key.

2-24. ADJUST IF BANDPASS - Continued.

DVM Reading (V)	Currently Loaded Capacitor Value (pF)*					
	15	18	20	22	24	27
0 to 1.5	•	•	•	•	•	•
1.5 to 2.5	27	•	•	•	•	•
2.5 to 3.5	22	27	27	•	•	•
3.5 to 4.5	18	22	24	27	27	•
4.5 to 5.5	18	20	22	24	27	•
5.5 to 6.5	no change	no change	no change	no change	no change	no change
6.5 to 7.5	no change	no change	no change	no change	no change	no change
7.5 to 8.5	•		18	18	22	24
8.5 to 9.5	•	15	15	18	20	24
9.5 to 10	•	•	15	18	20	24

*A bullet (*) indicates a condition that should not exist (proceed to para 2-16).
All capacitances are in pF.

6. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Install Shields (if removed).
   - Remove TAM.
   - Place A2/A3/A4/A5 CCA's in normal position.

2-25. ADJUST IF AMPLITUDE.

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A2/A3/A4/A5 CCA's in service position (para 2-42).
   - Connect TAM and extension cable (para 2-38).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select IF Amplitude Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- A5 component locator diagram is provided in fig. FO-17.
- A16 component locator diagram is provided in fig. FO-31.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

2-25. ADJUST IF AMPLITUDE - Continued.

3. When “To alter stored EEPROM data... ” message is displayed:
   - Press CONTINUE key to store new adjustment data, and continue to follow displayed instructions.
   - Press EXIT key to abort adjustment.
4. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Disconnect BNC cable.
   - Place A2/A3/A4/A5 CCA's in normal position.
   - Remove TAM.

2-26. ADJUST SAMPLING OSCILLATOR.

---

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA’s in service position (para 2-45).
   - Connect TAM (para 2-38).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select Sampling Oscillator Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- A15 component locator diagram is provided in fig. FO-28.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.
- When using the source, impedance is **50Ω.**

2-26. ADJUST SAMPLING OSCILLATOR - Continued.

3. If there is insufficient range in a VCO RANGE adjustment, perform Coarse Tune Adjustment as follows:
   - Set LINE switch to OFF.
   - Remove shield (para 2-47) to access A15Z200.
   - Using a soldering iron, remove any existing shorts from exposed center conductor of A15Z200 and ground.
   - Set Power Supply controls as follows:
     - Output to -21 Vdc.
     - Connect (+) lead to A15X201 pin 1.
     - Connect (-) lead to A15X201 pin 4.
   - Set frequency counter controls as follows:

     Sample Rate fully CCW.

     Impedance to **50Ω.**

     Frequency range to <500 MHz.

     Resolution to 100 kHz.

     Connect Active Probe to A15TP201.
   - On AN/USM-489A,

     Set LINE switch to ON.

     Press PRESET button.

     Set CENTER FREQ to 661 MHz.

     Set SPAN WIDTH to 0 Hz.
   - Starting at end of A15Z200 nearest A15X201, short center conductor to ground hole using lead of a **1MΩ** resistor until counter reads 298 MHz ± 4 MHz. Note ground hole.
   - Set LINE switch to OFF.
   - Solder lead to ground hole and center conductor, and cut away resistor.
   - Disconnect test equipment.
   - Install shield.
   - Repeat step 2.
4. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in normal position.
   - Remove TAM.

2-27. ADJUST YTO.

---

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in service position (para 2-45).
   - Connect TAM (para 2-38).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select YTO Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- A14 component locator diagram is provided in fig. FO-25.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

3. On ANIUSM-489A,
   - Set LINE switch to OFF.
   - Disconnect BNC cable.
   - Place A14/A15 CCA's in normal position.
   - Remove TAM.

2-28. ADJUST 1st LO DISTRIBUTION AMPLIFIER.

1. Perform initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in service position (para 2-45).
   - Connect TAM and extension cable (para 2-38).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select LO Distribution Amplifier Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- A14 component locator diagram is provided in fig. FO-25.
- 1st LO Distribution Amplifier (A7) assembly locator diagram is provided in fig. FO-23.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.
- If "consult service manual" message is displayed, see paragraph 2-11 for troubleshooting information.

3. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in normal position.
   - Replace **50Ω** Termination.
   - Remove TAM.

2-29. ADJUST DUAL BAND MIXER BIAS.

---

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in service position (para 2-45).
   - Connect TAM (para 2-38).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select Dual Band Mixer Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

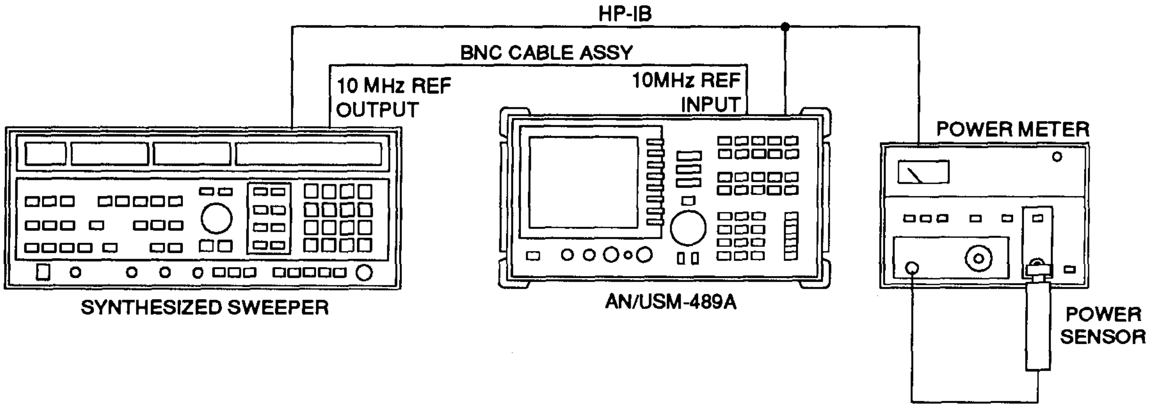
NOTES

- A14 component locator diagram is provided in fig. FO-25.
- Dual Mixer (A8) assembly locator diagram is provided in fig. FO-23.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

3. When "To alter stored EEPROM data... " message is displayed:
   - Press CONTINUE key to store new adjustment data, and continue to follow displayed instructions.
   - Press EXIT key to abort adjustment.
4. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in normal position.
   - Remove TAM.

2-30. ADJUST YTF AND FREQUENCY RESPONSE.

1. Perform initial Setup procedure (para 2-20).
2. Connect test equipment as shown.



3. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Connect TAM (para 2-38).
   - Place A14/A15 CCA's in service position (para 2-45).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press CONFIG key.
   - Press VERIFY key.
4. On AN/USM-489A, verify that (as a minimum) Source and Pwr Mtr have "YES" displayed under found.
   - If correct, proceed to step 5.
   - If incorrect, proceed as follows:
     - Rotate knob to select source.
     - Press CHANGE EQUIP key.
     - Rotate knob to select source connected.
     - Press SELECT key.
     - Rotate knob to select Pwr Mtr.
     - Rotate knob to select power meter connected.
     - Press SELECT key.
     - Press STORE CONFIG key.

2-30. ADJUST YTF AND FREQUENCY RESPONSE - Continued.

5. On AN/USM-489A,
   - Rotate knob to select Pwr Mtr.
   - Press CHANGE EQUIP key.
   - Press SENSOR UTILITY key.
   - Verify power sensor(s) being used for this adjustment procedure are displayed.
   - Rotate knob to select sensor.
   - Press VIEW key.
   - Verify power sensor calibration data is correct (from Sensor calibration label).
   - If all sensor data is correct, proceed to step 6.
   - If incorrect, proceed as follows:
     - Press RETURN key.
     - If adding a new power sensor data file, press ADD key and follow displayed instructions.
     - If changing calibration data on an existing file, rotate knob to select sensor and press EDIT key and follow displayed instructions.
     - If deleting an existing power sensor data file, press PURGE key and follow displayed instructions.
     - Press RETURN key until CONFIG Menu is displayed.
     - Press STORE CONFIG key.
6. On AN/USM-489A,
   - Press RETURN key until Module Menu is displayed.
   - Press ADJUST key.
   - Rotate knob to select Low Band Flatness Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- A15 component locator diagram is provided in fig. FO-28.
- When “zero and calibrate” power meter is displayed, it is referring to zeroing power sensor to power meter, and entering the power sensor’s calibration factor.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

7. On AN/USM-489A,
   - Rotate knob to select High Band Flatness & YTF Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.
8. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA’s in normal position.
   - Remove TAM.

2-31. ADJUST CALIBRATOR AMPLITUDE.

---

1. Perform Initial Setup procedure (para 2-20).
   - Set LINE switch to OFF.
   - Connect TAM (para 2-38).
   - Place A14/A15 CCA's in service position (para 2-45).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select Calibrator Amplitude Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

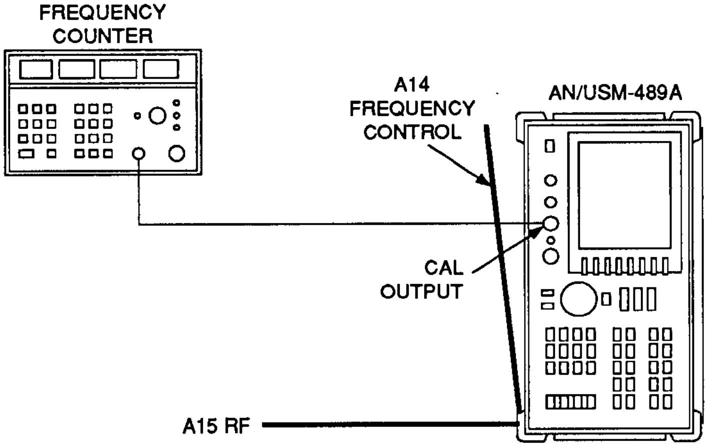
- A15 component locator diagram is provided in fig. FO-28.
- When "zero and calibrate" power meter is displayed, it is referring to zeroing power sensor to power meter, and entering the power sensor's calibration factor.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in normal position.
   - Remove TAM.

2-32. ADJUST 10 MHZ FREQUENCY REFERENCE.

---

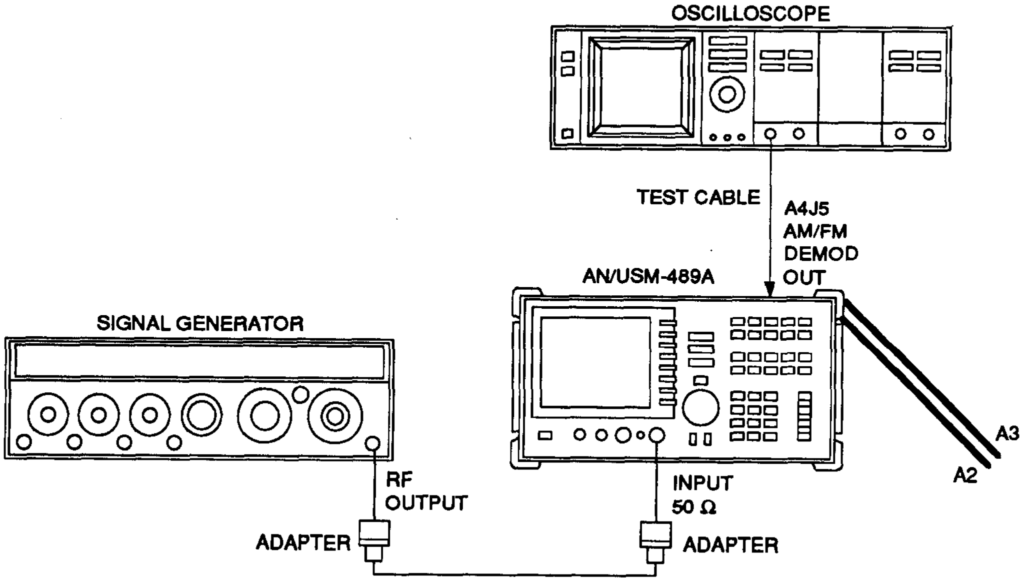
1. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA in service position (para 2-45).
   - Connect test equipment as shown using frequency counter <500 MHz input.



   - Set LINE switch to ON.
   - Press PRESET button.
   - Press FREQUENCY button.
   - Press MORE key.
   - Set 10 MHz key to INT.
   - Allow 30 minute warm-up.
2. Set frequency counter controls as follows:
   - Sample Rate to midrange.
   - Resolution to 1 Hz.
   - Input Impedance to **50Ω.**
3. On AN/USM-489A,
   - Remove screw-cap from A15U302 (fig. FO-28).
   - Adjust for a FREQUENCY Counter indication of 300.000000 MHz ± 30 Hz.
   - Set LINE switch to OFF.
   - Disconnect test equipment.
   - Place A15 CCA in normal position.

2-33. ADJUST DEMODULATOR.

1. On AN/USM-48914,
   - Set LINE switch to OFF.
   - Place A2/A3 CCA's in service position (para 2-40).
   - Connect TAM and extension cable (para 2-38).
   - Disconnect W28 (WHT/BLU) from A4J5 (fig FO-14).
   - Connect test equipment as shown.



   - Set LINE switch ON.
2. Set signal generator controls as follows:
   - FREQUENCY to 100.000 MHz.
   - OUTPUT LEVEL to -10 dBm.
   - RF OUTPUT to ON.
   - AM to OFF.
   - FM to INT.
   - MODULATION FREQUENCY to 1000 Hz.
   - PEAK Deviation to 5 kHz.
   - Set FM to OFF.

2-33. ADJUST DEMODULATOR - Continued.

3. Set oscilloscope controls as follows:
   - CH 1 to VOLTS/DIV 50 mV.
   - COUPLING to AC.
   - SECS/DIV to 1.00 ms/DIV.
   - TRIGGER to INT.
   - HF REJ to ON.
   - TRIGGER COUPLING to AC.
4. On AN/USM-489A,
   - Press PRESET button.
   - CENTER FREQ to 100 MHz.
   - SPAN WIDTH to 5 MHz.
   - REF LVL to -10 dBm.
   - RES BW to 100 kHz.
   - Press PEAK SEARCH button.
   - Press MARKER -> CF key.
   - Press SPAN button.
   - Press ZERO SPAN key.
   - Press DEMOD button.
   - Set FM DEMOD to ON.
   - Press TRIG button.
   - Press SINGLE key.
5. Set signal generator FM to ON.
6. Verify a 1 kHz sine wave is shown on oscilloscope.
   - Adjust A4C853 (fig. FO-14) (DEMOD) for a maximum peak-to-peak response on oscilloscope.
7. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Disconnect test equipment.
   - Reconnect W28 to A4J5.
   - Place A2/A3 CCA’s in normal position.

2-34. ADJUST EXTERNAL MIXER BIAS.

---

1. Perform initial Setup procedure (para 2-20).
   - Set LINE switch to OFF.
   - Connect TAM (para 2-38).
   - Place A14/A15 CCA's in service position (para 2-45).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select External Mixer Bias Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- A15 component locator diagram is provided in fig. FO-28.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Place A14/A15 CCA's in normal position.
   - Remove TAM.

2-35. ADJUST EXTERNAL MIXER AMPLITUDE.

---

1. Perform Initial Setup procedure (para 2-20).
   - Set LINE switch to OFF.
   - Connect TAM (para 2-38).
   - Set LINE switch to ON.
   - Press MODULE button.
   - Press ADJUST key.
   - Rotate knob to select External Mixer Amplitude Adjustment.
   - Press EXECUTE key.
   - Follow displayed instructions.

NOTES

- When “zero and calibrate” power meter is displayed, it is referring to zeroing power sensor to power meter, and entering the power sensor’s calibration factor.
- At beginning of procedure, press HELP key for additional information.
- At anytime during procedure, press EXIT key to abort.

2. When “To alter stored EEPROM data... ” message is displayed:
   - Press CONTINUE key to store new adjustment data, and continue to follow displayed instructions.
   - Press EXIT key to abort adjustment.
3. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Remove TAM.

2-36. ADJUST SECOND IF GAIN.

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Disconnect power cable.
   - Place A14/A15 CCA’s in service position (para 2-45).
   - Remove middle shield (para 2-47) to access A15U801.
   - Record gain printed on A15A1 (A15U801) label (fig. FO-28).
   - Select a value for A15U802 from following table based on gain of A15A1 (A15U801).

A15A1 (A15U801) Gain Range (dB)	A15U802 Value (dB)
13.1 to 14.2	1
14.3 to 15.2	2
15.3 to 16.2	3
16.3 to 17.2	4
17.3 to 18.2	5
18.3 to 19.2	6
19.3 t0 20.2	7

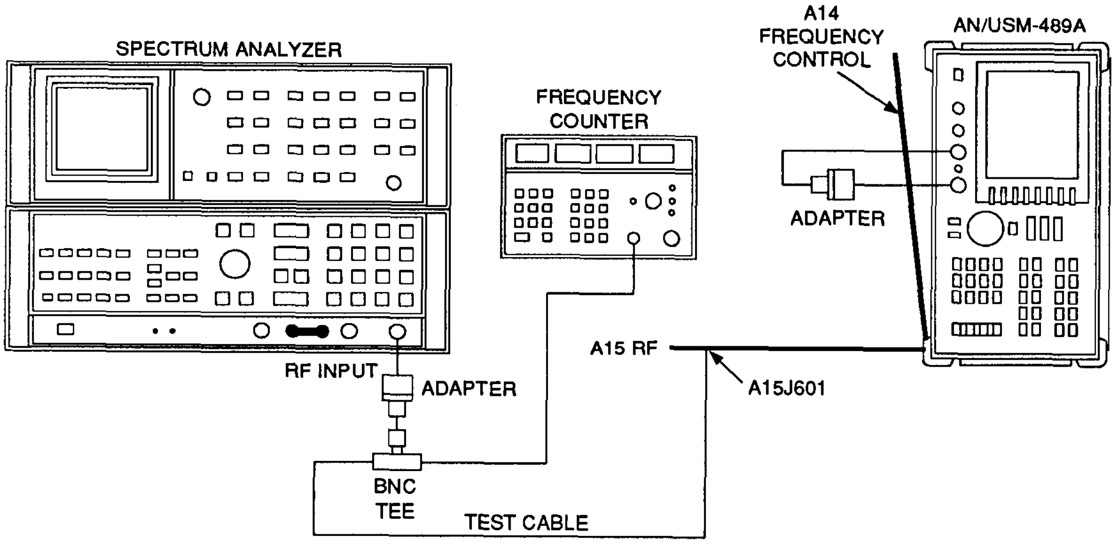
3. On AN/USM-489A,
   - Install shield.
   - Adjust External Mixer Amplitude (para 2-35).

NOTE

If the Second IF input Switch was repaired, there might be insufficient range in the External Mixer Amplitude Adjustment. If this is the case, select a new value for A15U802. Greater attenuation values of A15U802 will lower the signal amplitude, and lower attenuation values will increase the signal amplitude.

2-37. ADJUST SIG ID OSCILLATOR.

1. Perform Initial Setup procedure (para 2-20).
2. On AN/USM-489A,
   - Set LINE switch to OFF.
   - Disconnect power cable.
   - Place A14/A15 CCA's in service position (para 2-45).
   - Connect test equipment as shown. Disconnect cable W29 (VIO) from A15J601 (10.7 MHz IF out) (fig. FO-28) and connect SMB end the test cable to A15J601.



3. On AN/USM-489A,
   - Reconnect power cable.
   - Set LINE switch ON.
   - Set CENTER FREQ to 300 MHz.
   - Set SPAN WIDTH to 0 Hz.
   - Press INT button.
   - Set SIG ID key to ON.
   - Press TRIG button.
   - Press SINGLE button.
4. Set spectrum analyzer controls as follows:
   - CENTER FREQUENCY to 10.7 MHz.
   - FREQUENCY SPAN to 200 kHz.

2-37. ADJUST SIG ID OSCILLATOR - Continued.

5. Set frequency counter controls as follows:
   - Frequency to 10 MHz.
   - Input Impedance to **50Ω.**

NOTE

> If no signal is displayed on Spectrum Analyzer, adjust A15C629 (fig. FO-28) (ID SIG) until a signal is displayed.

6. Rotate A15C629 (ID SIG) slightly while observing spectrum analyzer display.
   - If the frequency of displayed signal does not change, press AN/USM-489A TRIG button and SINGLE key.
7. While observing spectrum analyzer display.
   - Adjust A15C629 for highest obtainable frequency with <3 dB decrease in amplitude from maximum.
   - Record frequency counter reading as F_{3} dB high (1 kHz resolution).
   - Adjust A15C629 for lowest obtainable frequency with <3 dB decrease in amplitude from maximum.
   - Record frequency counter reading as F_{3} dB low (1 kHz resolution).
   - Subtract F_{3} dB low from F_{3} dB high and divide results by four.
   - Add F OFFSET to F_{3} dB low and record result as F_{SIG}
8. On AN/USM-489A,
   - Adjust A15C629 for a frequency counter reading of F_{SIG}
   - Verify final adjusted frequency is 10.7 MHz ±50 kHz.

NOTE

> If 298 MHz SIG ID oscillator is severely mistuned, it might be necessary to widen span on spectrum analyzer to see shifted sweep.

2-38. INSTALL TEST AND ADJUSTMENT MODULE (TAM).

DESCRIPTION

This procedure covers: Install. Remove.

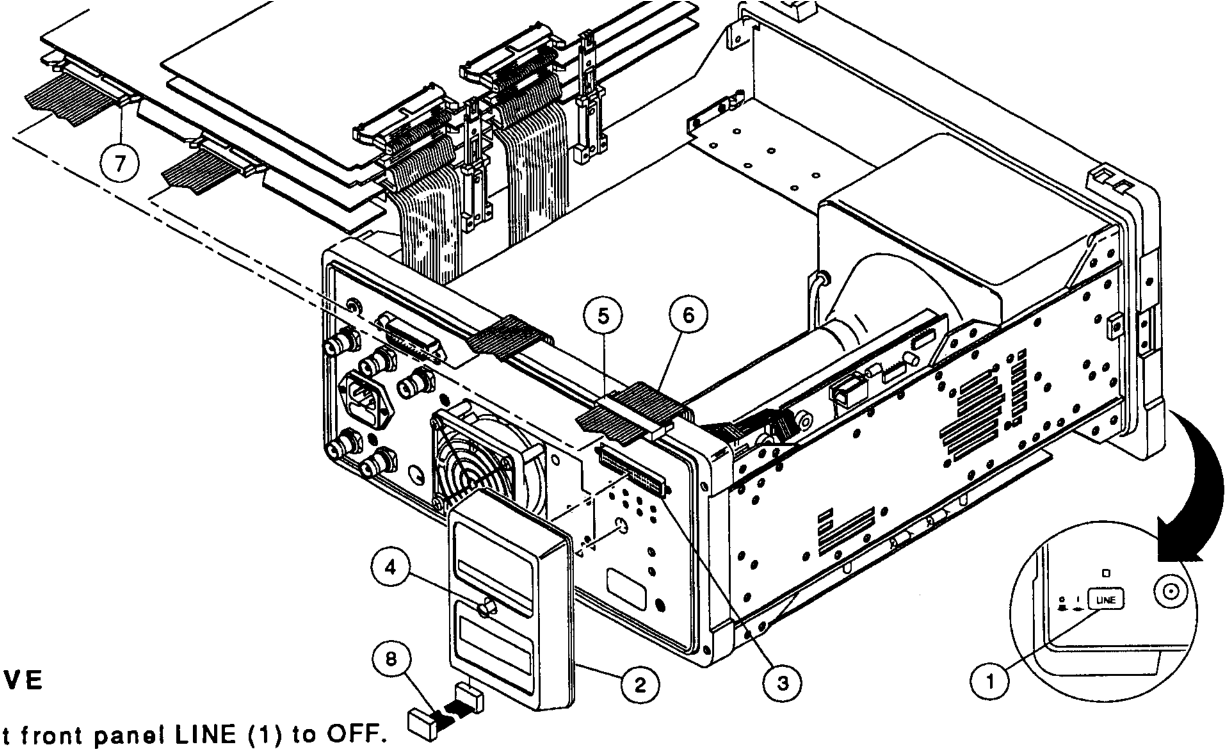
INITIAL SETUP

CAUTION

Always remove power from the AN/USM-489A before connecting the TAM to the rear panel. Failure to set LINE to OFF before connecting may permanently damage the TAM.

INSTALL

1. Set front panel LINE (1) to OFF.
2. Plug Test and Adjustment Module (2) into rear panel Option Module connector J3 (3) and lock into place with 1/4 turn fastener (4).
   - If A2/A3 or A2/A3/A4/A5 in service positions, connect TAM's 50 pin extension cable (5) to W4 (6) and A2J6 (7).
3. Install 16 pin cable (8) into bottom of TAM (2). Other end used to connect to various CCA test connectors.



REMOVE

1. **Set front panel LINE (1) to OFF.**
2. Disconnect 16 pin measurement cable (8), and if installed, TAM's 50 pin extension cable (5).
3. Turn 1/4 turn fastener (4) and remove TAM (2).

END OF TASK

2-39. REPLACE EQUIPMENT COVER AND FEET.

DESCRIPTION

This procedure covers: Remove. Install.

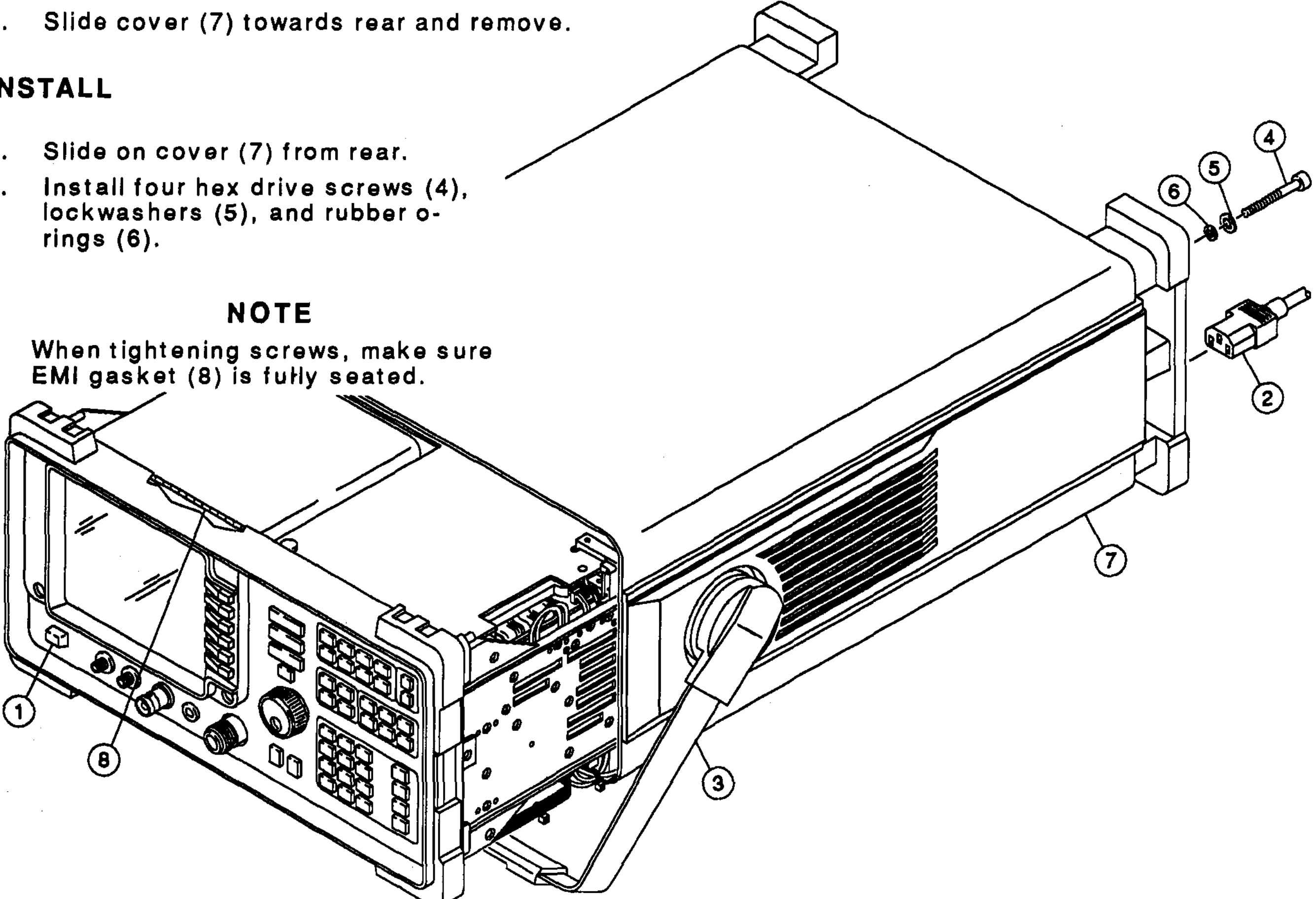
INITIAL SETUP

WARNING

Hazardous voltages are present when covers are removed. Where maintenance can be performed without having power applied, disconnect power cord from ac source.

REMOVE

1. Set LINE (1) to OFF.
2. Disconnect power cable (2).
3. Rotate handle (3) away from front panel.
4. Remove four hex drive screws (4), lockwashers (5), and rubber O-rings (6).
5. Slide cover (7) towards rear and remove.



INSTALL

1. Slide on cover (7) from rear.
2. Install four hex drive screws (4), lockwashers (5), and rubber o-rings (6).

NOTE

When tightening screws, make sure EMI gasket (8) is fully seated.

END OF TASK

2-40. A2/A3 SERVICE POSITION.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Remove equipment cover feet and feet (para 2-39).

REMOVE

1. Remove three screws marked “2” (1).
2. Remove two screws marked “4” (2).
3. Remove three screws marked ’3” (3).
4. Disconnect 50 pin cable W4 (4) from A2J6.
5. Fold open A2 Controller CCA (5) and A3 Interface CCA (6) together.

NOTE

Make sure cables are free when opening.

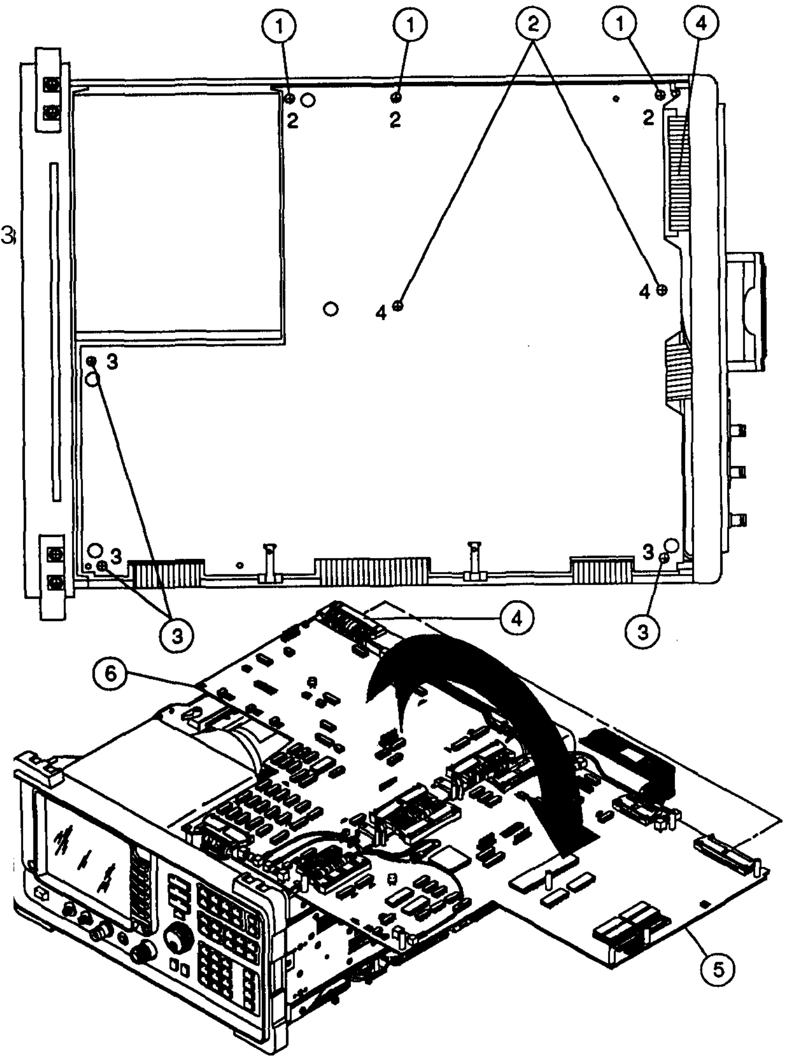
INSTALL

1. Fold in A3 Interface CCA (6) and A2 Controller CCA (5) as a unit.

NOTE

Make sure cables fold into proper locations.

2. Connect 50 pin cable W4 (4) to A2J6.
3. Install two screws in hole “4” (2).
4. Install three screws in hole “3” (3).
5. Install three screws in hole “2” (1).



NOTE

FOLLOW-ON PROCEDURES

Install equipment cover feet and feet (para 2-39).

END OF TASK

2-41. REPLACE A3 SHIELD.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Place A2/A3 in service position (para 2-40).

REMOVE

1. Loosen twelve screws (1).

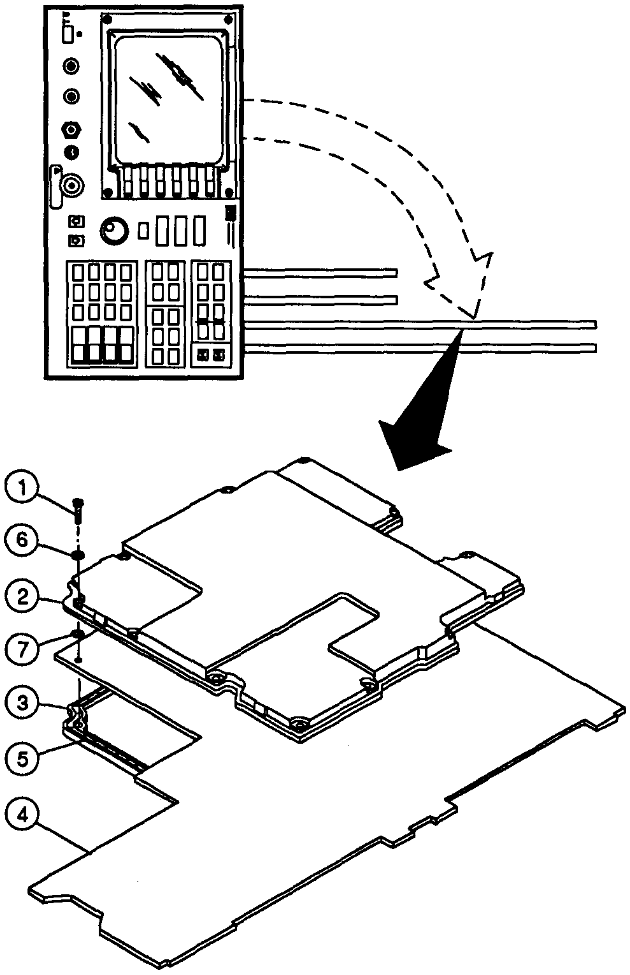
NOTE

Screws are phillips head on older units and Torx on newer units.

2. Remove top shield (2), and bottom shield (3) from A3 Interface CCA (4).

INSTALL

1. Make sure EMI gasket (5) is in place on bottom shield (3).
2. Make sure twelve screws (1), lockwashers (6), and O-rings (7) are in place.
3. Install top shield (2), and bottom shield (3) to A3 Interface CCA (4).
4. Tighten twelve screws (1).



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3 in normal position (para 2-40).

END OF TASK

2-42. A2/A3/A4/A5 SERVICE POSITION.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Place A2/A3 in service position (para 2-40).

REMOVE

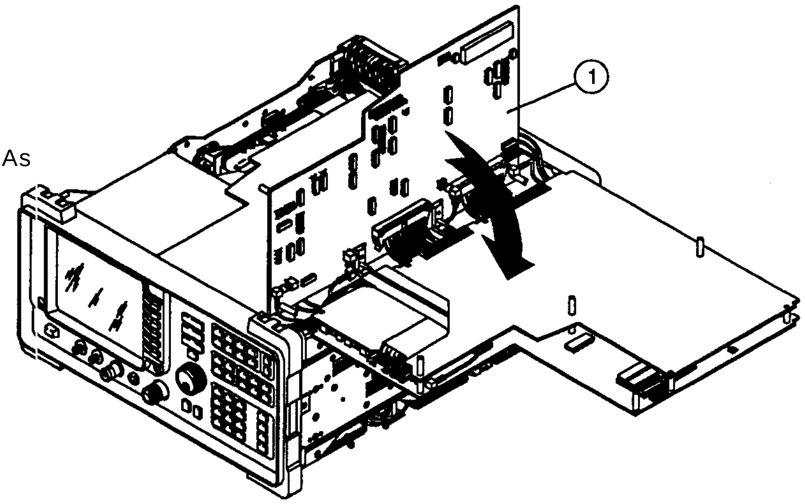
1. Fold open A5 IF CCA (1), and A4 Log Amplifier CCA (2) together.
2. Pull retainer clip (3) to separate CCAs (if required).

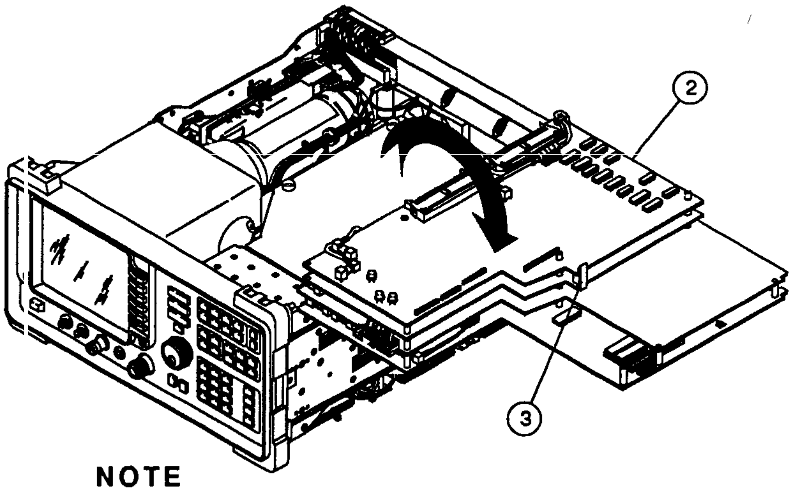
INSTALL

1. Lock A5 IF CCA (1) and A4 Log Amplifier CCA (2) together using retainer clip (3).
2. Fold in A5 IF CCA (1) and A4 Log Amplifier CCA (2) as a unit.

NOTE

Make sure cables fold in to proper locations.





NOTE

FOLLOW-ON PROCEDURES

Place A2/A3 in normal position (para 2-40).

END OF TASK

2-43. REPLACE A4 SHIELDS.

DESCRIPTION

This procedure covers: Remove. install.

INITIAL SETUP

NOTES

- Perform steps 1 and 2 to remove small shield.
- Perform steps 3 and 4 to remove large shield.

PRELIMINARY PROCEDURES

Place A2/A3/A4/A5 in service position (para 2-42).

REMOVE

1. Loosen nine screws (1).

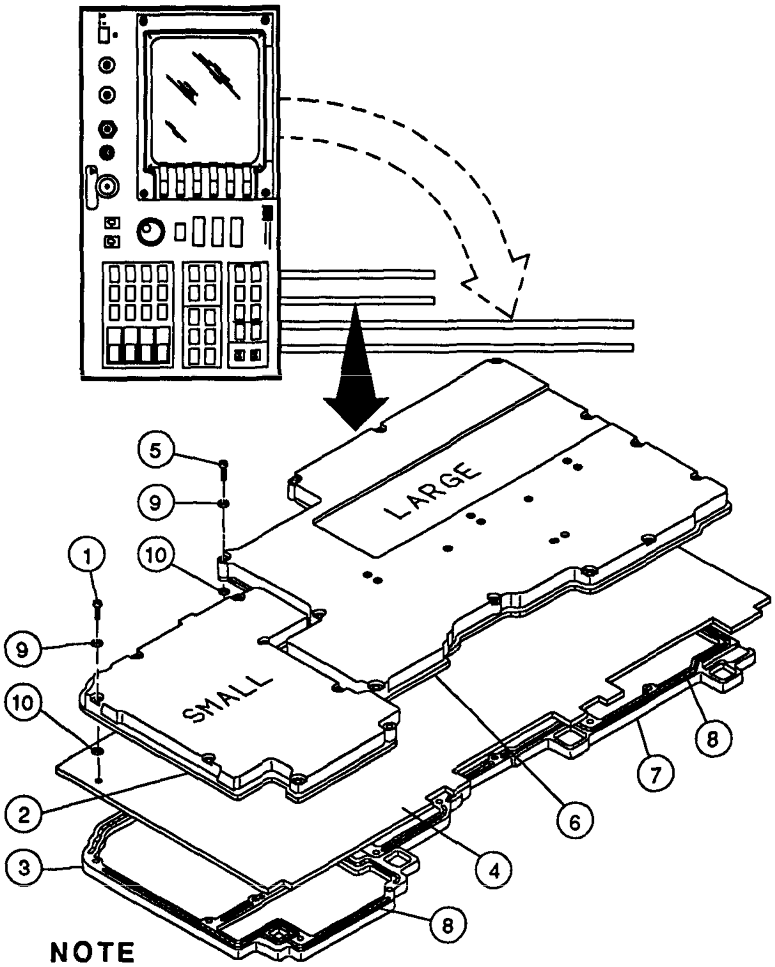
NOTE

Screws are philllps head on older units and Torx on newer units.

2. Remove small top shield (2), and bottom shield (3) from A4 Log Amplifier CCA (4).
3. Loosen fifteen screws (5).
4. Remove large top shield (6), and bottom shield (7) from A4 Log Amplifier CCA (4).

INSTALL

1. Make sure EMI gasket (8) is in place on bottom shield (3 and 7).
2. Make sure screws (1 and 5), lockwashers (9), and O-rings (10) are in place.
3. Install top shield (2 and 6), and bottom shield (3 and 7) to A4 Log Amplifier CCA (4).
4. Tighten screws (1 and 5).



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-44. REPLACE A5 SHIELDS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTES

- Perform steps 1 and 2 to remove small shield.
- Perform steps 3 and 4 to remove large shield.

PRELIMINARY PROCEDURES

Place A2/A3/A4/A5 in service position (para 2-42).

REMOVE

1. Loosen seven screws (1).

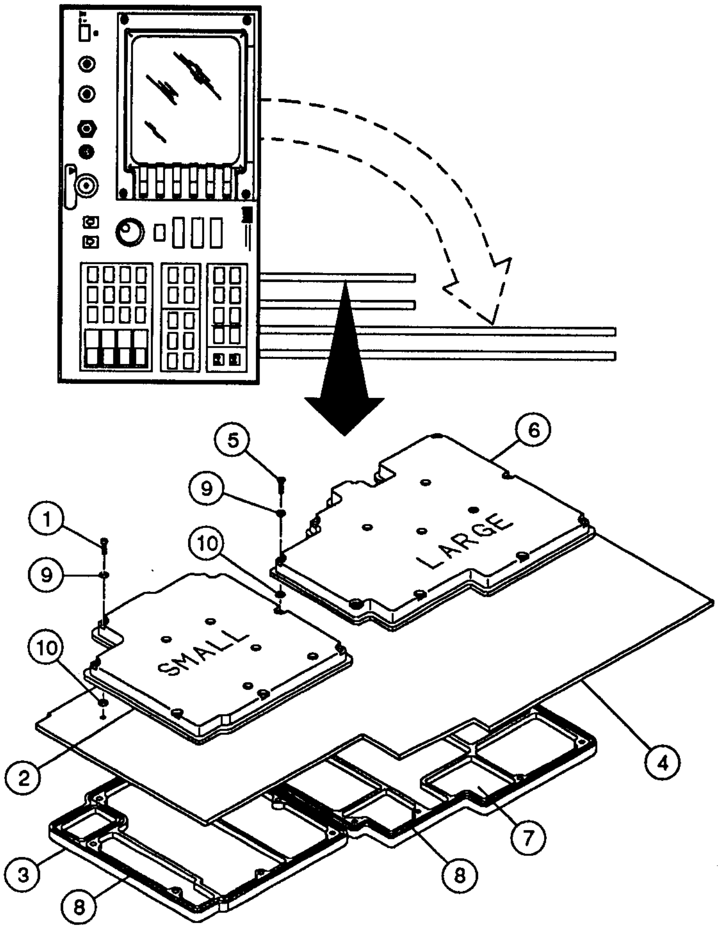
NOTE

Screws are phillips head on older units and Torx on newer units.

2. Remove small top shield (2), and bottom shield (3) from A5 IF CCA (4).
3. Loosen nine screws (5).
4. Remove large top shield (6), and bottom shield (7) from A5 IF CCA (4).

INSTALL

1. Make sure EMI gasket (8) is in place on bottom shields (3 and 7).
2. Make sure screws (1 and 5), lockwashers (9), and O-rings (10) are in place.
3. Install top shield (2 and 6), and bottom shield (3 and 7) to A5 IF CCA (4).
4. Tighten screws (1 and 5).



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para

END OF TASK

2-45. A14/A15 SERVICE POSITION.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Remove equipment cover feet and feet (para 2-39).

REMOVE

1. Remove eight screws marked “1” (1).
2. Fold open A15 RF CCA (2) and A14 Frequency Control CCA (3) together.

NOTE

Make sure cables are free when opening.

3. Pull retainer clip (4) to separate CCAs (if required).

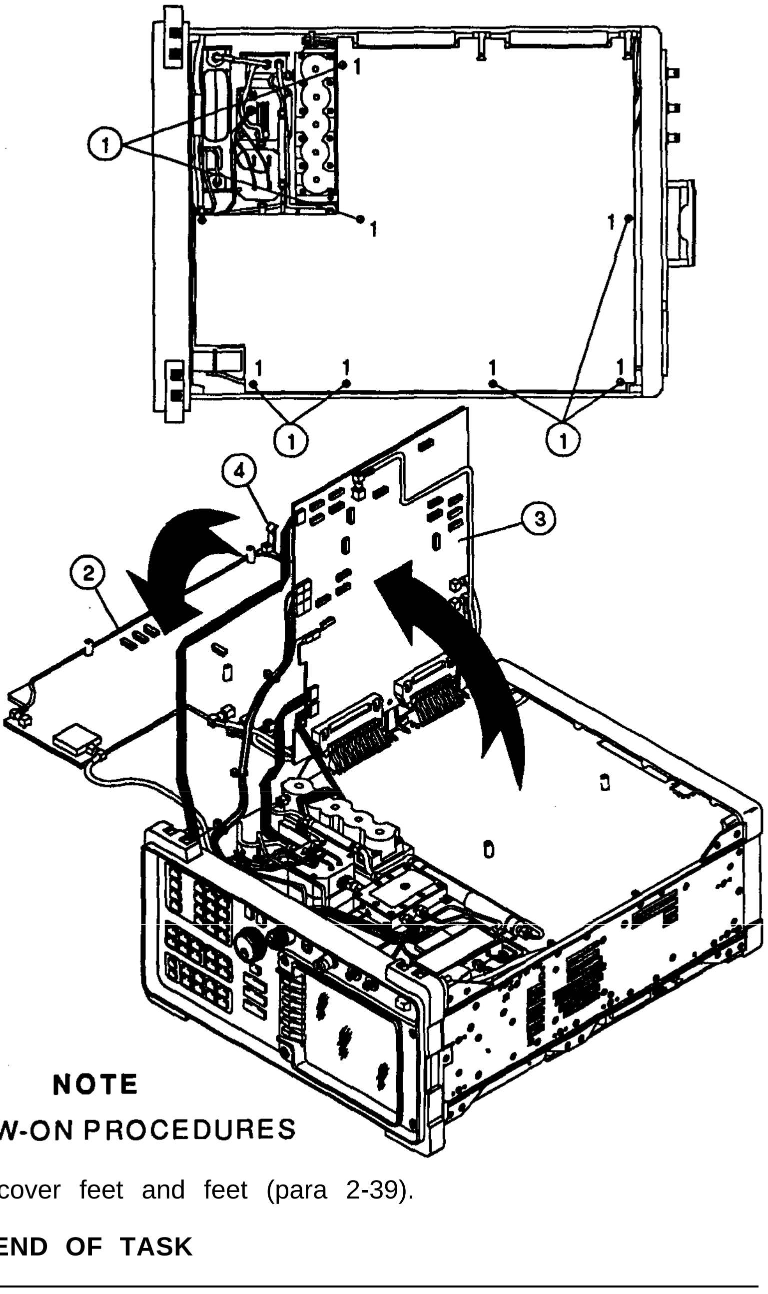
INSTALL

1. Lock A15 RF CCA (2) and A14 Frequency Control CCA (3) together using retainer clip (4).
2. Fold in A15 RF CCA (2) and A14 Frequency Control CCA (3) as a unit.

NOTE

Make sure cables fold into proper locations.

3. Install eight screws marked “1” (1).



NOTE

FOLLOW-ON PROCEDURES

Install equipment cover feet and feet (para 2-39).

END OF TASK

2-46. REPLACE A14 SHIELD.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Place A14/A15 in service position (para 2-45).

REMOVE

1. Loosen thirteen screws (1).

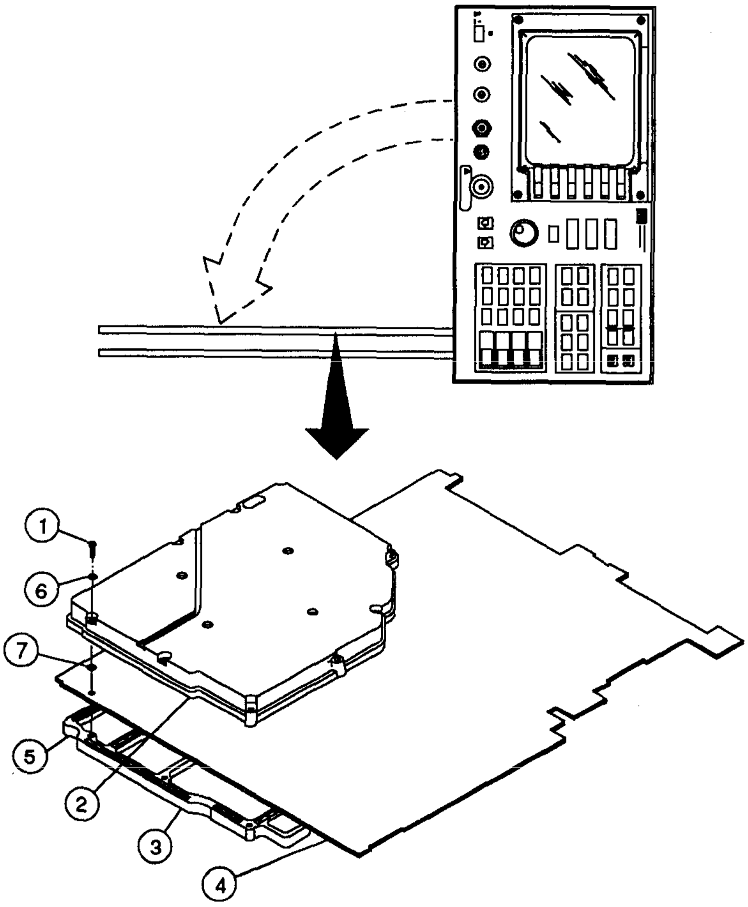
   NOTE

   Screws are phillips head on older units and Torx on newer units.

2. Remove top shield (2), and bottom shield (3) from A14 Frequency Control CCA (4).

INSTALL

1. Make sure EMI gasket (5) is in place on bottom shield (3).
2. Make sure thirteen screws (1), lockwashers (6), and O-rings (7) are in place.
3. Install top shield (2), and bottom shield (3) A14 Frequency Control CCA (4).
4. Tighten thirteen screws (1).



NOTE

FOLLOW-ON PROCEDURES

Place A14/A15 in normal position (para 2-45).

END OF TASK

2-47. REPLACE A15 SHIELDS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTES

- Perform steps 1 through 3 to remove rear shield.
- Perform steps 4 and 5 to remove front shield.
- Perform steps 6 and 7 to remove middle shield.

PRELIMINARY PROCEDURES

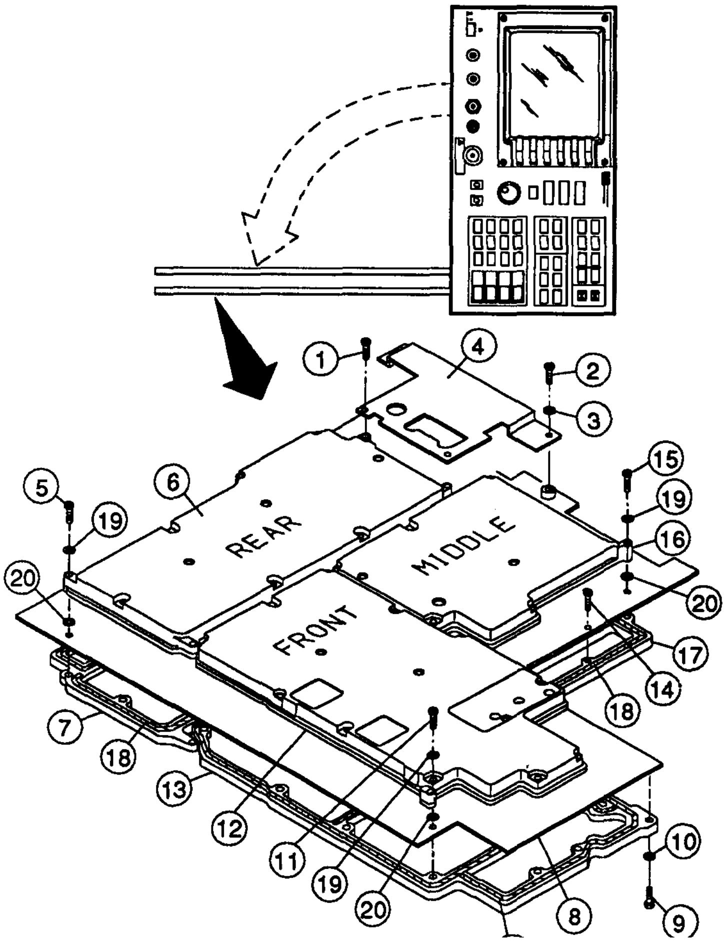
Place A14/A15 in service position (para 2-45).

REMOVE

1. Remove two screws (1).
2. Remove two screws (2) and lockwashers (3), and remove bracket (4).
3. Loosen ten screws (5) and remove rear top shield (6), and bottom shield (7) from A15 RF CCA (8).
4. Remove two screws (9), and two lockwashers (10).
5. Loosen fourteen screws (11), and remove front top shield (12) and bottom shield (13) from A15 RF CCA (8).
6. Remove one screw (14).
7. Loosen seven screws (15), and remove middle top shield (16), and bottom shield (17) from A15 RF CCA (8).

INSTALL

1. Make sure EMI gasket (18) is in place on bottom shields (7, 13, and 17).
2. Make sure screws (5, 11, and 15), lockwashers (19), and O-rings (20) are in place.
3. Install top shield (6, 12, and 16), and bottom shield (7, 13, and 17) to A15 RF CCA (8).
4. Tighten screws (5, 11, and 15).
5. Install bracket (4). using two screws (2), and lockwashers (3).
6. Install two screws (9), and lockwashers (10)
7. Install two screws (1).



NOTE

FOLLOW-ON PROCEDURES

Place A14/A15 in normal position (para 2-45).

END OF TASK

2-48. A16 SERVICE POSITION.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Place A2/A3/A4/A5 in service position (para 2-42).

REMOVE

1. Remove two flat head screws (1) from holes marked “6” on left side frame (2), and remove two card holders (3).
2. Remove two flat head screws (4) from holes marked “5” on left side frame (2)
3. Lift A16 Cal Oscillator CCA (5) up and install to left side frame (2) using two flat head screws (4) into holes marked “6A”.

NOTE

Make sure cables are free when lifting.

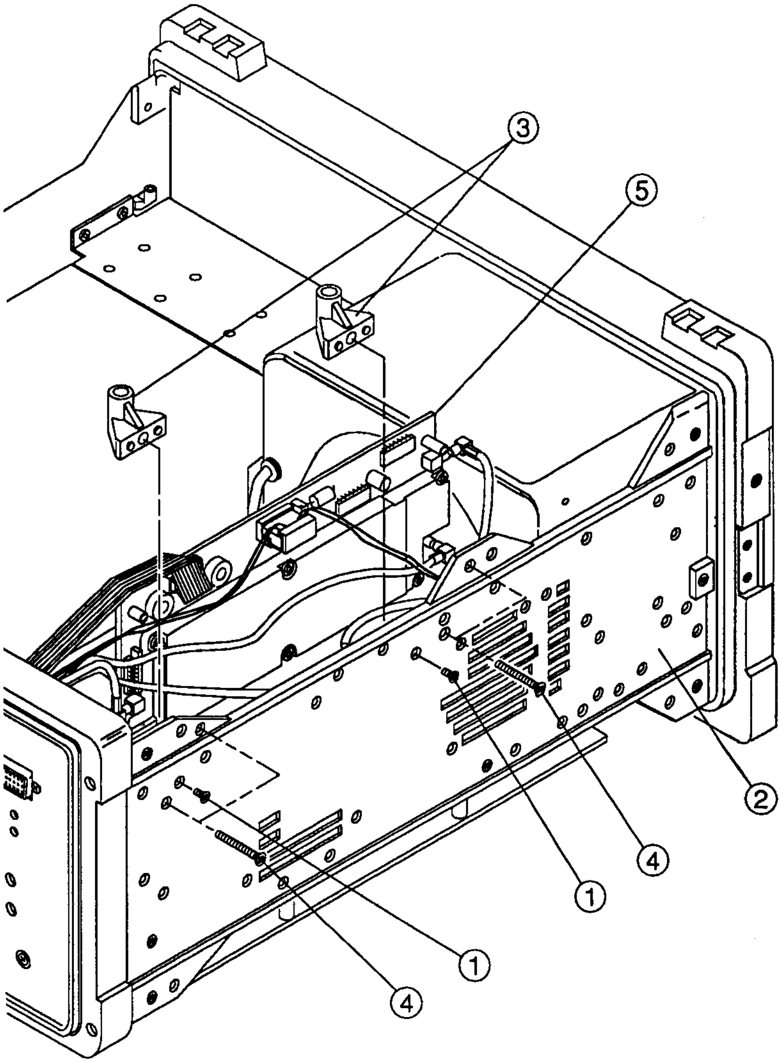
INSTALL

1. Remove two flat head screws (4) from holes marked “6A” on left side frame (2).
2. Lower A16 Cal Oscillator CCA (5) to proper position, and install two flat head screws (4) into holes marked “5” on left side frame (2).

NOTE

Make sure cables fold into proper locations.

3. Install two card holders (3) using two flat head screws (1) into holes marked “6” on left side frame (2).



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-49. REPLACE A16 SHIELD.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Place A16 in service position (para 2-48).

REMOVE

1. Loosen six screws (1).

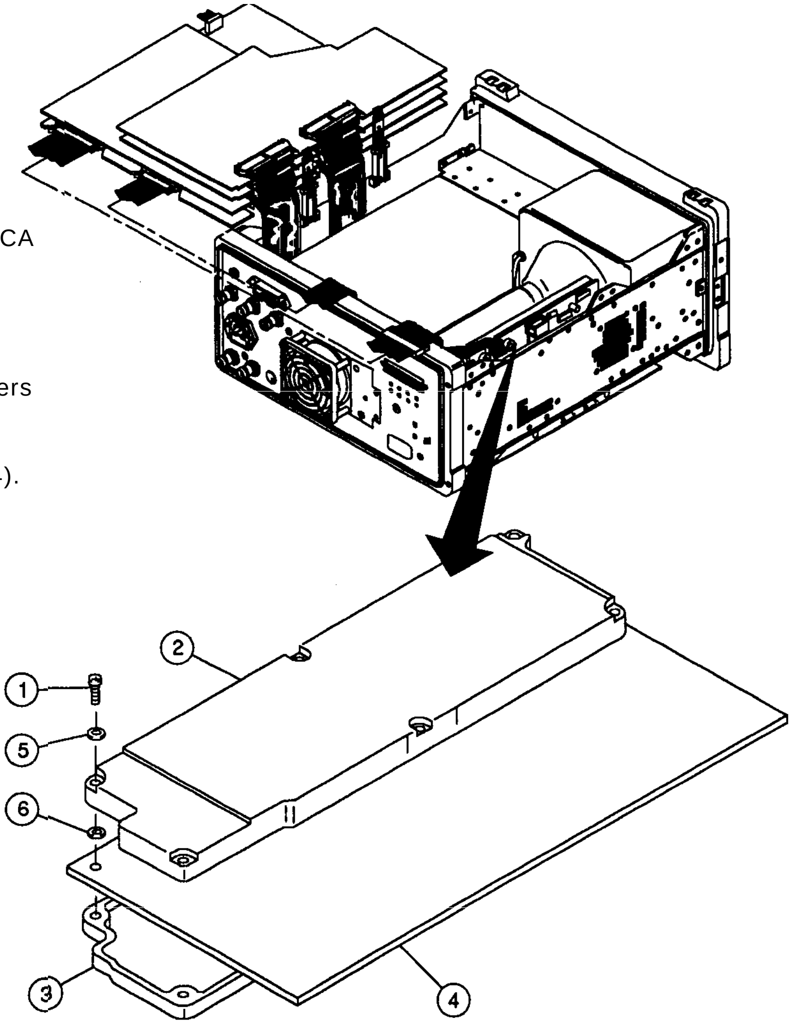
NOTE

Screws are phillips head on older units and Torx on newer units.

2. Remove top shield (2), and bottom shield (3) from A16 CAL Oscillator CCA (4).

INSTALL

1. Make sure six screws (1), lockwashers (5), and O-rings (6) are in place.
2. Install top shield (2), and bottom shield (3) A16 CAL Oscillator CCA (4).
3. Tighten six screws (1).



NOTE

FOLLOW-ON PROCEDURES

Place A16 in normal position (para 2-48).

END OF TASK

2-50. A17 SERVICE POSITION.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

- Place A2/A3/A4/A5 in service position (para 2-42).
- Perform steps 1 and 2 of A16 Service Position (para 2-48).

REMOVE

1. Move A16 away from chassis to access A17 CRT Driver (3).
2. Remove A17 CRT Driver CCA (3) from chassis and reposition A16 in its proper place.
3. Lift A17 CRT Driver CCA (3) up and install to left side frame (2) using two flat head screws (1) into holes marked “6B”.

NOTE

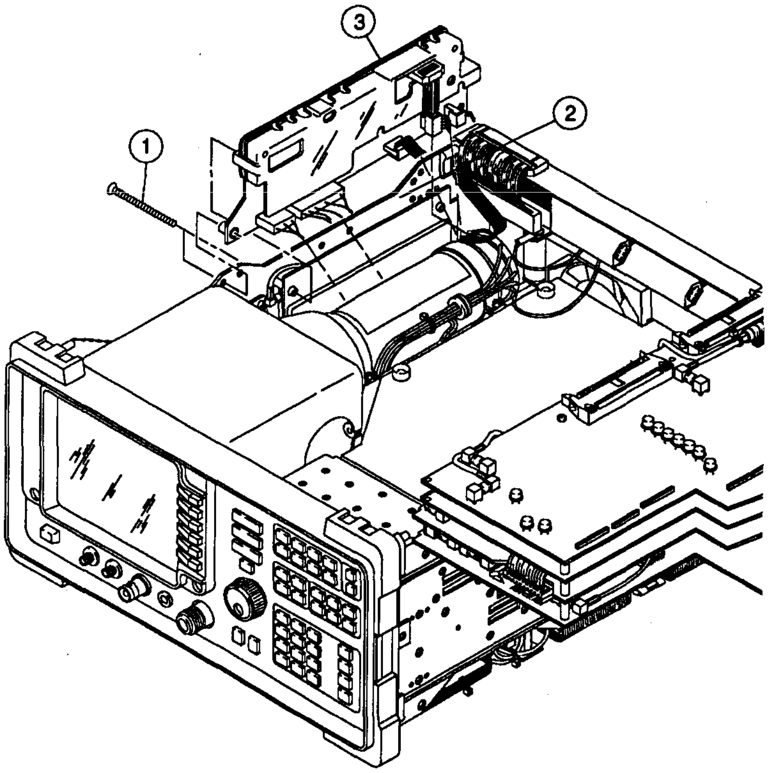
Make sure cables are free when lifting.

INSTALL

1. Remove two flat head screws (1) from holes marked “6B” on left side frame (2).
2. Lower A17 CRT Driver CCA (3) to proper position, and install two flat head screws (1) into holes marked “5” on left side frame (2).

NOTE

Make sure cables fold in to proper locations.



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-51. REPLACE AI FRONT PANEL ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

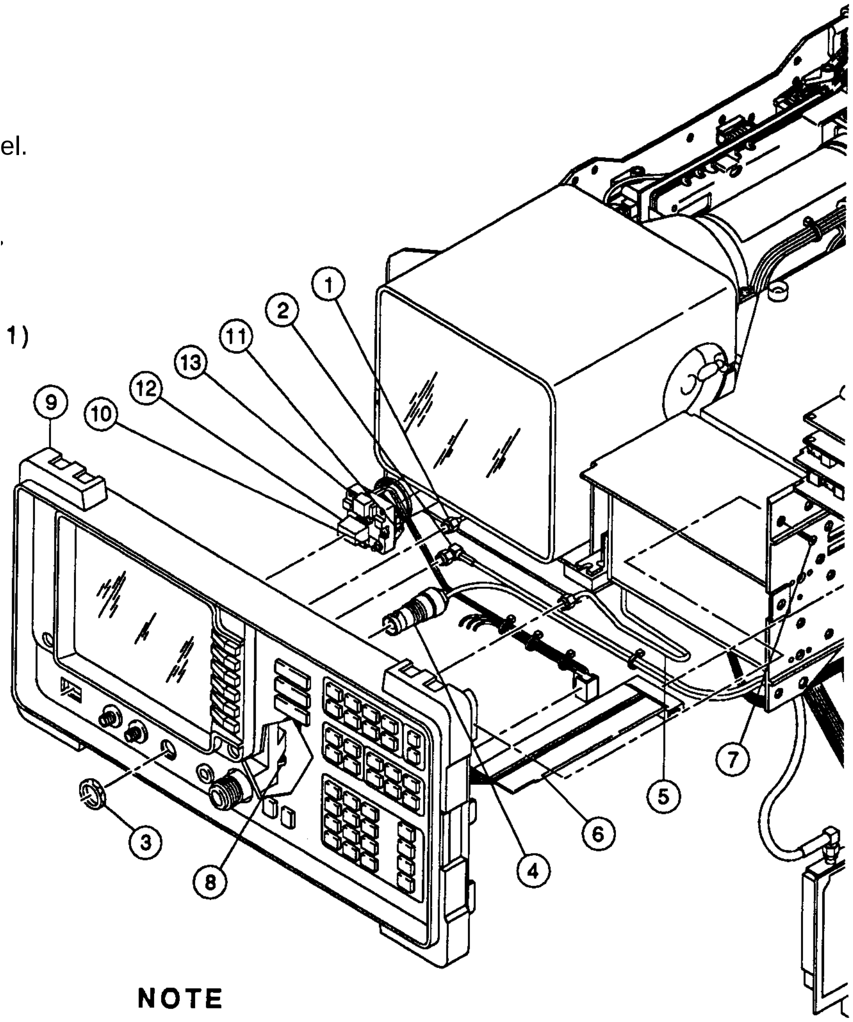
NOTE

PRELIMINARY PROCEDURES

- Place A2/A3/A4/A5 in service position (para 2-42).
- Place A14/A15 in service position (para 2-45).

REMOVE

1. Disconnect following cables:
   - W42 (1) from J4.
   - W36 (2) from J3.
   - nut (3) then W40 (4) from panel.
   - W41 (5) from J1.
   - A1A1W1 (6) from A3J602,
2. Remove six flat head screws (7).,
3. Loosen screw (8) and pull front panel (9) towards front ≈ 2 in.
4. Remove screw (10) ground lug (1 1) and remove W3 (12) from front panel (9).
5. Remove A1W1 (13) from W3 (12).
6. Remove front panel (9).



INSTALL

1. Install A1W1 (13) in W3 (12).
2. Install screw (10), ground lug (11), and W3 (12) to front panel (9).
3. Install front panel (9).
4. Tighten screw (8), and install six flat head screws (7).
5. Reconnect following cables:
   - A1A1W1 (6) to A3J602.
   - W41 (5) to J1.
   - W40 (4) to panel with nut (3).
   - W36 (2) to J3.
   - W42 (1) to J4.

NOTE

FOLLOW-ON PROCEDURES

- Place A14/A15 in normal position (para 2-45).
- Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-52. REPLACE A1A1 KEYBOARD CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Remove Front Panel (para 2-51).

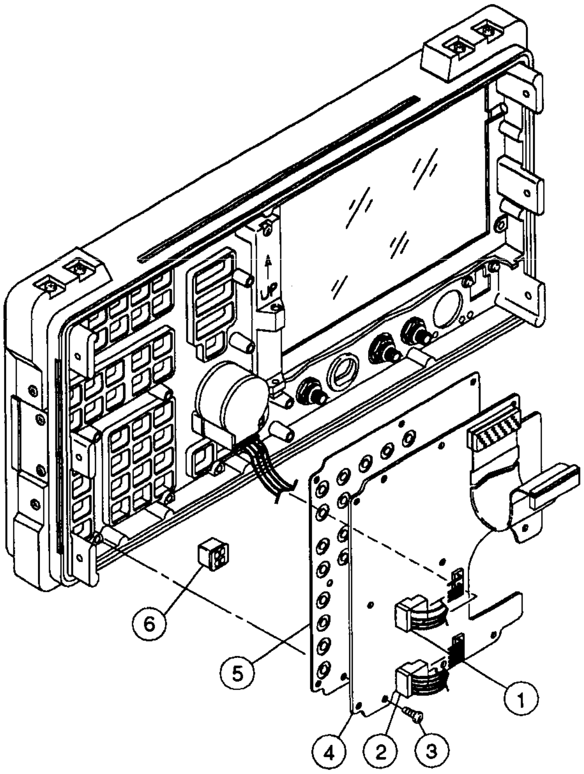
REMOVE

1. Disconnect A1A2W1 (1) from A1A1J2 and A1W1 (2) from A1A1J3.
2. Remove nine Torx screws (3).
3. Remove A1A1 Keyboard CCA (4) and rubber pad (5).

NOTE

On AN/USM-489A with serial prefixes 2929A to 3148A, keys (6) are separate.

On AN/USM-489A with serial prefixes 3204A to 3306A, keys are part of rubber pad.



INSTALL

1. On AN/USM-489A's with serial prefixes 2929A to 3148A, make sure keys (6) are in place on front panel.
2. Install rubber pad (5) and Keyboard CCA (4).
3. Install nine Torx screws (3).
4. Connect A1A2W1 (1) to A1A1J2 and A1W1 (2) to A1A1J3.

NOTE

FOLLOW-ON PROCEDURES

Install Front Panel (para 2-51).

END OF TASK

2-53. REPLACE A1A2 RPG ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

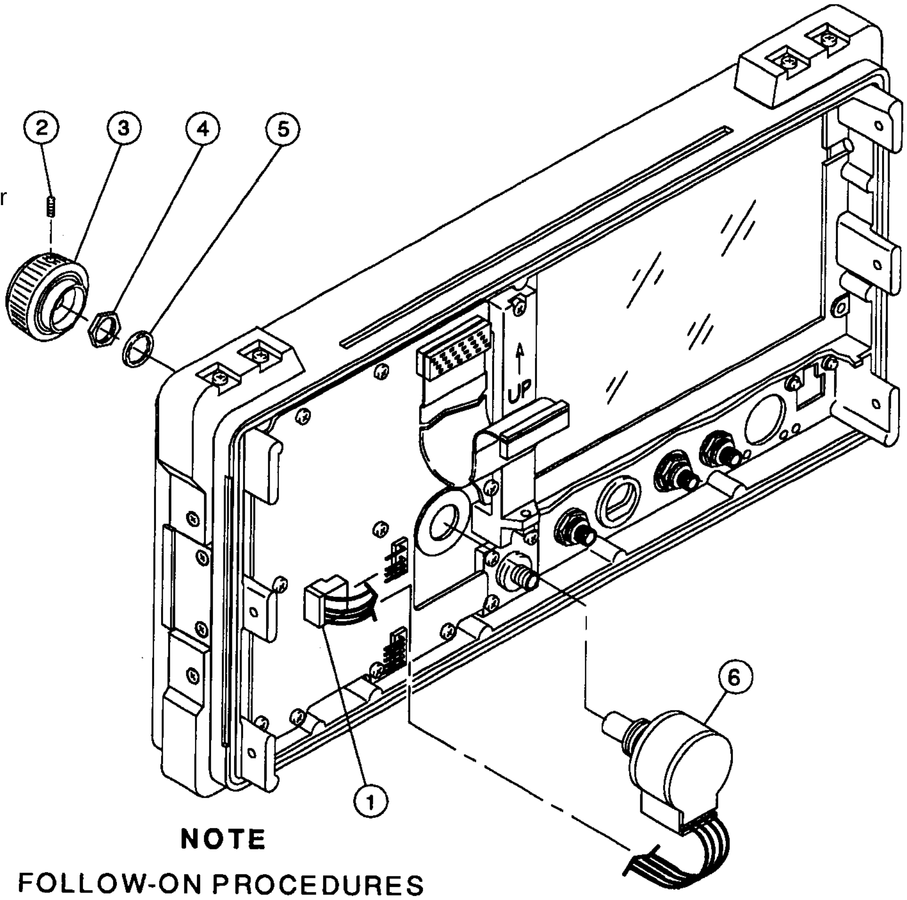
Remove Front Panel (para 2-51).

REMOVE

1. Disconnect A1A2W1 (1) from A1A1J2.
2. Loosen set screws (2) and remove knob (3).
3. Remove nut (4) and lockwasher (5).
4. Remove RPG assembly (6).

INSTALL

1. Install RPG assembly (6) in front panel.
2. Install nut (4) and lockwasher (5).
3. Install knob (3) on RPG shaft and tighten set screws (2).
4. Connect A1A2W1 (1) to A1A1J2.



NOTE

FOLLOW-ON PROCEDURES

Install Front Panel (para 2-51).

END OF TASK

2-54. REPLACE LINE SWITCH.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

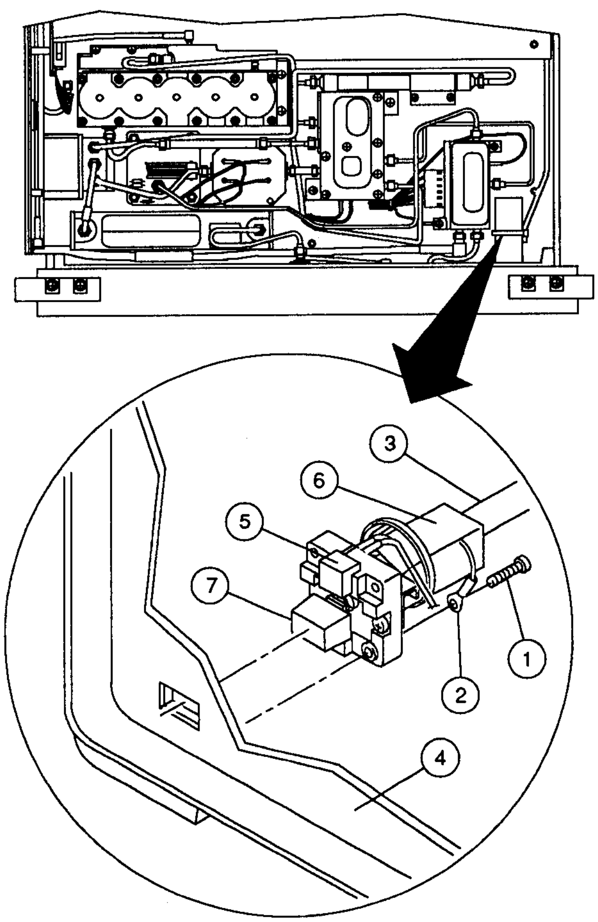
Position A14/A15 in service position (para 2-51).

REMOVE

1. Remove screw (1) ground lug (2) and W3 (3) with switch from front panel (4).
2. Cut cable tie (5) and remove heats Shrink (6) from switch.
3. Tag and unsolder four wires, and remove line switch (7).

INSTALL

1. Slide new heats Shrink (Appendix B item 6) over cable.
2. Resolder four wires to line switch (7).
3. Install new cable tie (Appendix B item 7).
4. Install screw (1), ground lug (2), and W3 (3) with switch to front panel (4).



NOTE

FOLLOW-ON PROCEDURES

Install Front Panel (para 2-51).

END OF TASK

2-55. REPLACE A4 LOG AMPLIFIER CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

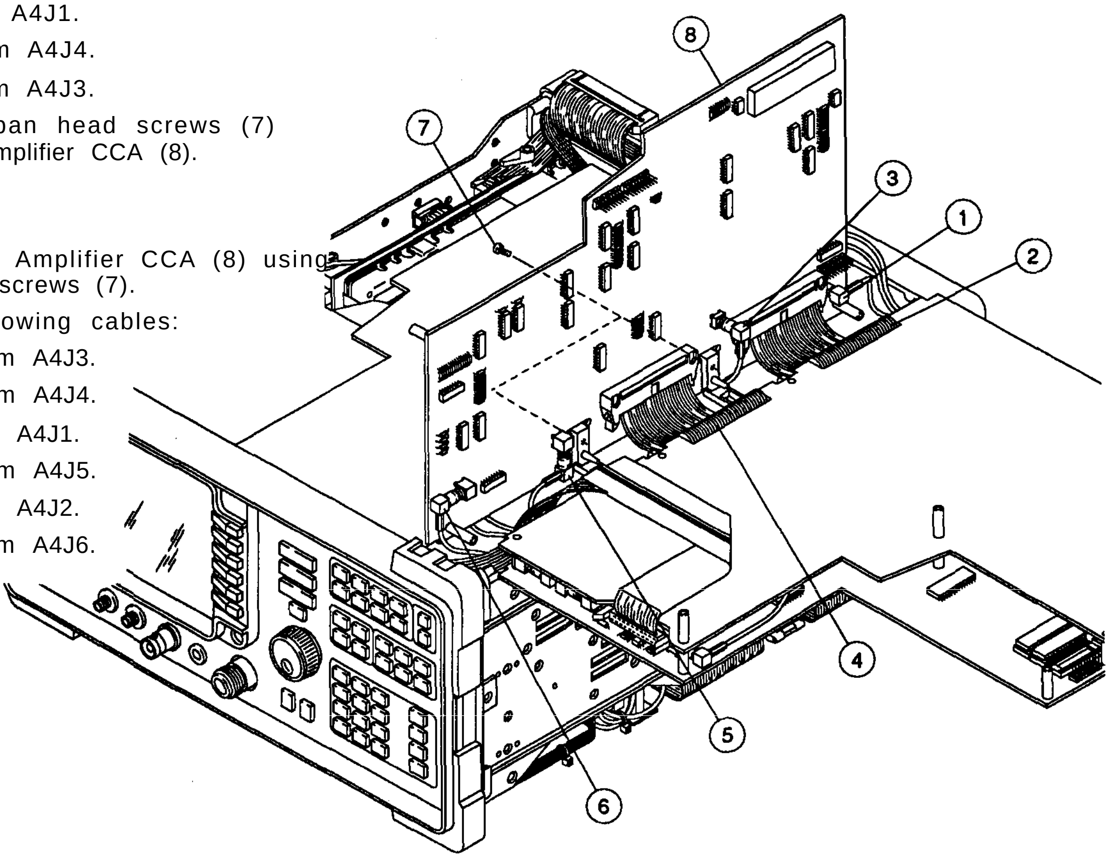
Place A2/A3/A4/A5 in service position (para 2-42).

REMOVE

1. Disconnect following cables:
   - W26 (1) from A4J6.
   - W2 (2) from A4J2.
   - W28 (3) from A4J5.
   - W1 (4) from A4J1.
   - W21 (5) from A4J4.
   - W27 (6) from A4J3.
2. Remove two pan head screws (7) and A4 Log Amplifier CCA (8).

INSTALL

1. Install A4 Log Amplifier CCA (8) using two pan head screws (7).
2. Reconnect following cables:
   W27 (6) from A4J3.
   W21 (5) from A4J4.
   W1 (4) from A4J1.
   W28 (3) from A4J5.
   W2 (2) from A4J2.
   W26 (1) from A4J6.



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-56. REPLACE A6A1 HIGH VOLTAGE MODULE.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

WARNING

Voltage potential at A6A1W3 is +9 kV. Always disconnect cables from CRT with caution! Do not discharge the CRT second anode directly to ground with A6A1W3 cable connected, or damage to the A17 CRT Driver CCA can result. Always discharge through a high resistance (such as a high voltage probe). Failure to discharge A6A1W3 may result in severe electrical shock to personnel and damage to the instrument.

NOTE

PRELIMINARY PROCEDURES

- Place A2/A3/A4/A5 in service position (para 2-42).
- If only removing the power supply cover, perform remove step 1.
- If removing A6A1 High Voltage Module, remove A17 CRT Driver CCA (para 2-65).

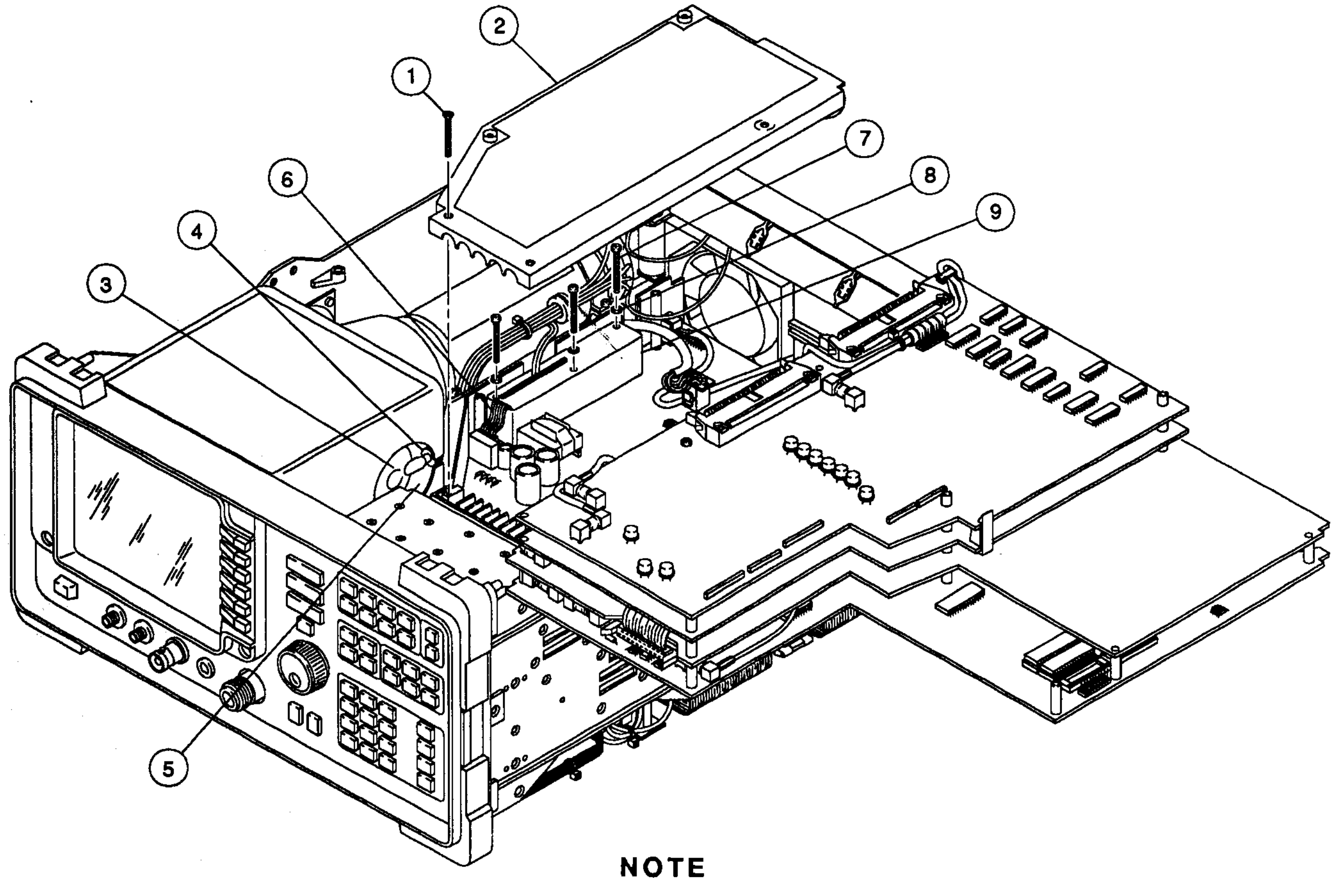
REMOVE

1. Remove three screws (1) then remove A6 power supply cover (2).
2. Discharge CRT anode (3) using a high voltage probe, then disconnect A6A1W3 (3) and grommet (4) from CRT (5).
3. Disconnect A6A1W1 (6) from A6J5.
4. Remove three screws (7), three flat washers (8), cut cable tie, and remove High Voltage Module A6A1 (9).

INSTALL

1. Install High Voltage Module A6A1 (9) using three screws (7) and three flat washers (8).
2. Reconnect following cables:
   - A6A1W1 (6) to A6J5.
   - A6W1W3 (3) and grommet (4) to CRT (5).
   - Replace cable tie (appendix B item 7).
3. Install A6 power supply cover (2) using three screws (1).

2-56. REPLACE A6A1 HIGH VOLTAGE MODULE - Continued



NOTE

FOLLOW-ON PROCEDURES

- Install A17 CRT Driver CCA (para 2-65).
- Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-57. REPLACE A7 LO DISTRIBUTION AMPLIFIER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

CAUTION

Do not bend, twist, or otherwise damage semi-rigid cables in following procedure.

NOTE

PRELIMINARY PROCEDURES

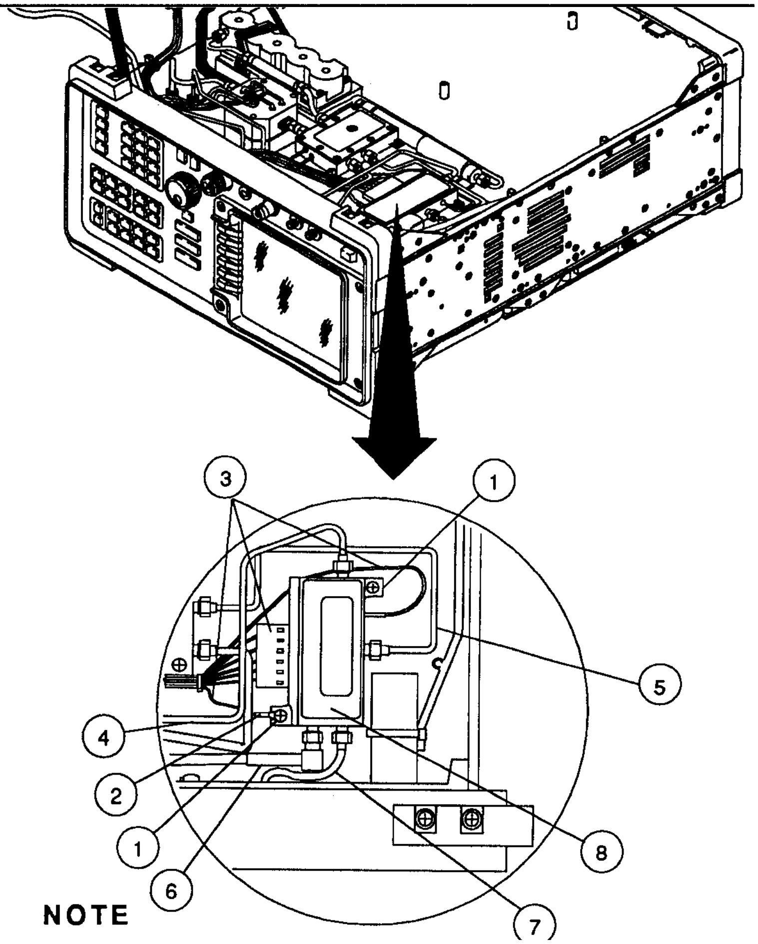
Place A14/A15 in service position (para 2-45).

REMOVE

1. Remove two pan head screws (1) one terminal lug (2) and
2. Disconnect following cables:
   - W12 (3) from pin and connector.
   - W38 (4) from A7J1.
   - W39 (5) from A7J2
   - W34 (6) from A7J4.
   - W42 (7) from A7J3.
3. Remove 1st Lo Distribution Amplifier A7 (8).

INSTALL

1. Position A7 in place and reconnect following cables:
   - W42 (7) to A7J3.
   - W34 (6) to A7J4.
   - W39 (5) to A7J2
   - W38 (4) to A7J1.
   - W12 (3) to pin and connector.
2. Install terminal lug (2) and two pan head screws (1).



NOTE

FOLLOW-ON PROCEDURES

Place A14/A15 in normal position (para 2-45).

END OF TASK

2-58. REPLACE A8 DUAL MIXER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

CAUTION

Do not bend, twist, or otherwise damage semi-rigid cables in following procedure.

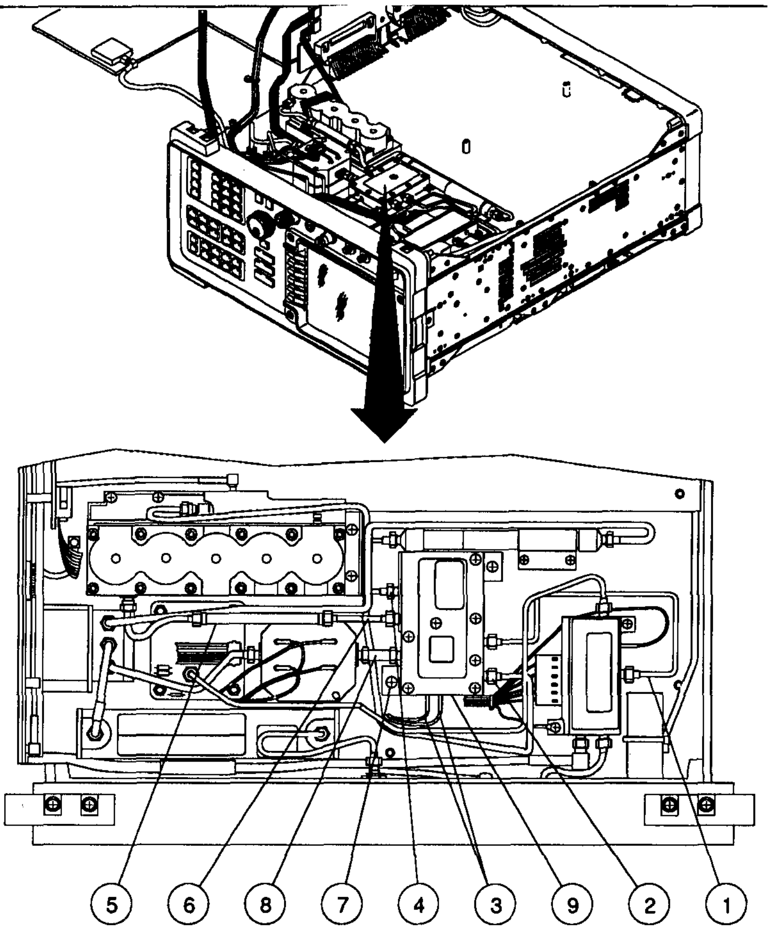
NOTE

PRELIMINARY PROCEDURES

Place A14/A15 in service position (para 2-45).

REMOVE

1. Disconnect following cables:
   - W39 (1) from A8J4.
   - W48 (2) from A8J5.
   - Tag and disconnect two single conductor wires W15 (3).
   - W45 (4) from A8J1 and FL1J2.
   - FL2 (5) from A8J2 and A13J1 (serial prefix 2929A to 3043A).
   - W56 (6) from A8J2 and FL2 (serial prefix 3051A to 3306A).
2. Remove two pan head screws (7).
3. Disconnect W47 (8) from A8J3 and remove Dual Mixer A8 (9).



INSTALL

1. Install Dual Mixer A8 (9) and connect W47 (8) to A8J3.
2. Install two pan head screws (7).
3. Reconnect following cables:
   - W56 (6) to A8J2 and FL2 (serial prefix 3051A to 3306A).
   - FL2 (5) to A8J2 and A13J1 (serial prefix 2929A to 3043A).
   - W45 (4) to A8J1 and FL1J2.
   - Two single conductor wires W15 (3).
   - W48 (2) to A8J5.
   - W39 (1)to A8J4.

NOTE

FOLLOW-ON PROCEDURES

Place A14/A15 in normal position (para 2-45).

END OF TASK

2-59. REPLACE A9 INPUT ATTENUATOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

Do not bend, twist, or otherwise damage semi-rigid cables in following procedure.

NOTE

PRELIMINARY PROCEDURES

Remove equipment cover feet and feet (para 2-39).

REMOVE

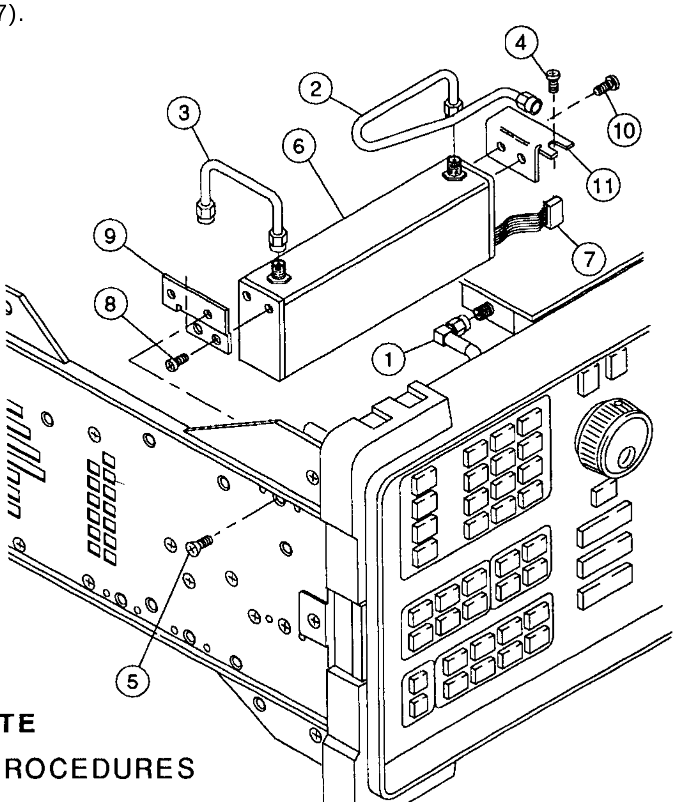
1. Disconnect following cables:
   - W34 (1) from A15A2J1.
   - W41 (2) from A9J1 and J1.
   - W43 (3) from A9J2 and A12J3.
2. Remove one pan head screw (4) and two flat head screws (5) (serial prefix 3051A to 3306A).

   Remove one flat head screw (5) (serial prefix 2929A to 3043A).
3. Lift A9 Attenuator enough to disconnect W11 (7).
4. Remove two pan head screws (8) and outside
5. Remove two pan head screws (10) and inside mounting bracket (11).
6. Remove two pan head screws (10) and inside mounting bracket (11).

INSTALL

1. Install inside mounting bracket (11) using two pan head screws (10).
2. Install outside mounting bracket (9) using two pan head screws (8).
3. Position A9 Attenuator (6) and connect W11 (7).
4. Install one pan head screw (4) and two flat head screws (5) (serial prefix 3051A to 3306A).

   Install one flat head screw (5) (serial prefix 2929A to 3043A).
5. Reconnect following cables:
   - W43 (3) from A9J2 and A12J3.
   - W41 (2) from A9J1 and J1.
   - W34 (1) from A15A2J1.



NOTE

FOLLOW-ON PROCEDURES

Install equipment cover feet amd feet (para 2-39)

END OF TASK

2-60. REPLACE A10 YIG-TUNED FILTER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

CAUTION

Do not bend, twist, or otherwise damage semi-rigid cables in following procedure.

NOTE

PRELIMINARY PROCEDURES

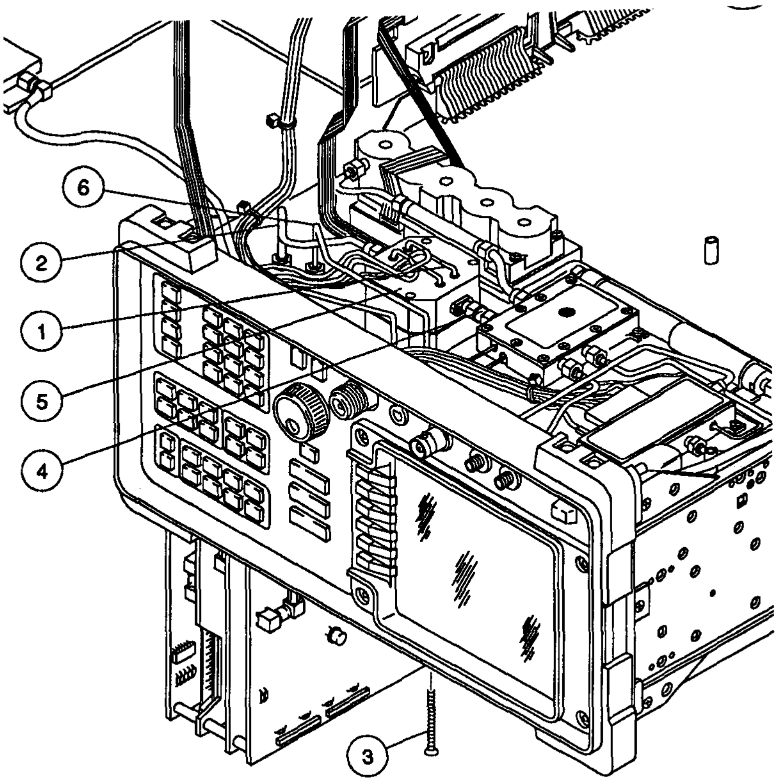
- Place A2/A3/A4/A5 in service position (para 2-42).
- Place A14/A15 in service position (para 2-45).

REMOVE

1. Tag and disconnect four single conductor wires W16 (1).
2. Remove W46 (2) from A10J1 and A12J1.
3. Remove four flat head screws (3).
4. Disconnect W38 (6) from A11J2.
5. Disconnect W47 (4) from A10J2 and remove A10 YTF (5).

INSTALL

1. Connect W47 (4) to A10J2 (do not tighten).
2. Install A10 YTF (5) using four flat head screws (3).
3. Tighten W47 (4).
4. Reconnect W38 (6) to A11J2.
5. Install W46 (2) to A10J1 and A12J1.
6. Connect four single conductor wires W16 (1).



NOTE

FOLLOW-ON PROCEDURES

- Place A2/A3/A4/A5 in normal position (para 2-42).
- Place A14/A15 in normal position (para 2-45).

END OF TASK

2-61. REPLACE A11 YIG-TUNED OSCILLATOR ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

CAUTION

Do not bend, twist, or otherwise damage semi-rigid cables in following procedure.

NOTE

PRELIMINARY PROCEDURES

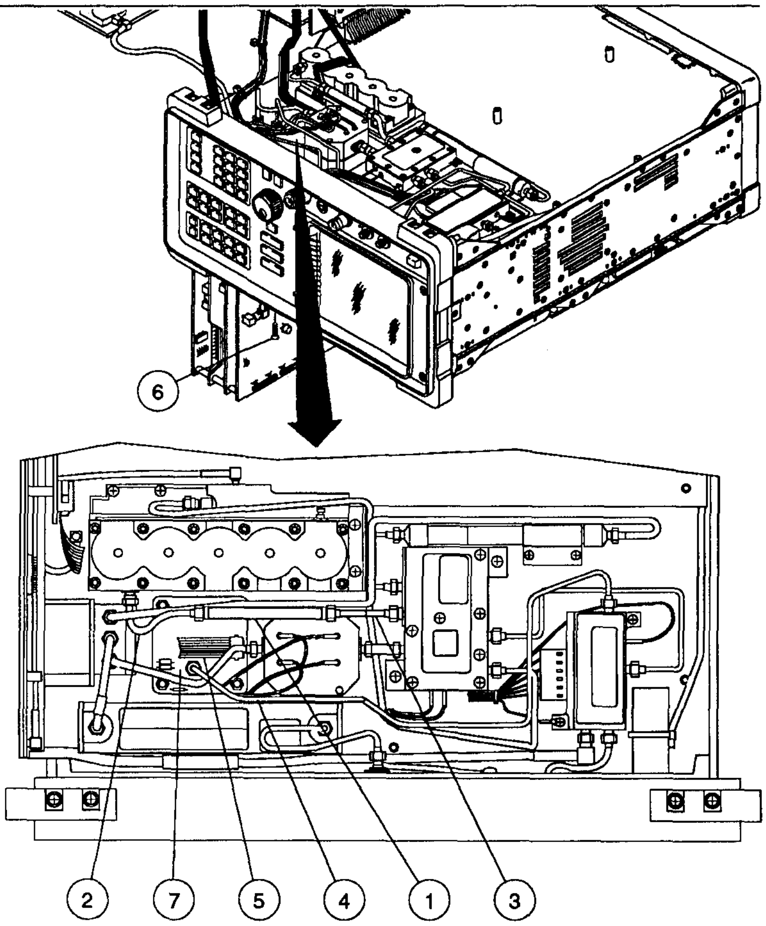
Place A14/A15 in service position (para 2-45).

REMOVE

1. Disconnect following cables:
   - FL2 (1) from A8J2 and A13J1 (serial prefix 2929A to 3043A).
   - W57 (2) from A13J1 and W56 (3) from A8J2 (serial prefix 3051A to 3306A).
   - W38 (4) from A11J2 and A7J1.
   - W10 (5) from A11J1.
2. Remove four flat head screws (6) and All YTO (7).

INSTALL

1. Install All YTO (7) using four flat head screws (6).
2. Reconnect following cables:
   - W10 (5) from A11J1.
   - W38 (4) from All J2 and A7J1.
   - W57 (2) from A13J1 and W56 (3) from A8J2 (serial prefix 3051A to 3306A).
   - FL2 (1) from A8J2 and A13J1 (serial prefix 2929A to 3043A).



NOTE

FOLLOW-ON PROCEDURES

Place A14/A15 in normal position (para 2-45).

END OF TASK

2-62. REPLACE A12 RF SWITCH ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

CAUTION

Do not bend, twist, or otherwise damage semi-rigid cables in following procedure.

NOTE

PRELIMINARY PROCEDURES

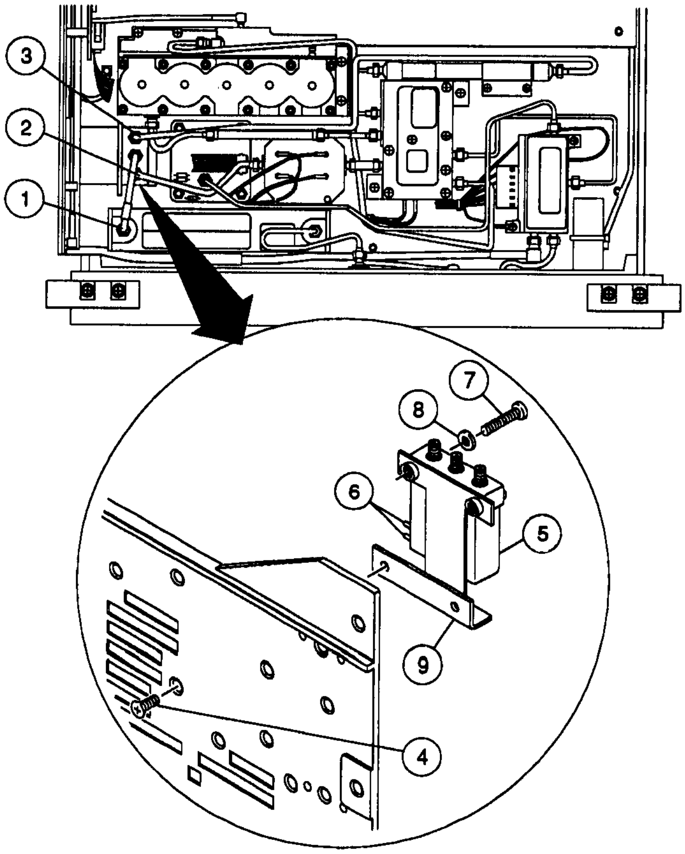
Place A14/A15 in service position (para 2-45).

REMOVE

1. Disconnect following cables:
   - W43 (1) from A12J3 and A9J2.
   - W46 (2) from A12J1 and A10J1.
   - W44 (3) from A10 J3.
2. Remove two flat head screws (4).
3. Lift A12 RF Switch (5) high enough to tag and unsolder two wires (6).
4. Remove A12 RF Switch (5) and bracket.
5. Remove two Torx pan head screws (7) two flat washers (8) to remove mounting bracket (9).

INSTALL

1. Install mounting bracket (9) using two Torx pan head screws (7) two flat washers (8).
2. Solder two wires (6) to A12 RF Switch (5).
3. Install A12 RF Switch (5) using two flat head screws (4).
4. Connect W44 (3) to A10 J3. Install W46 (2) to A12J1 and A10J1. Install W43 (1) to A12J3 and A9J2.
5. Reconnect following cables:
   - W44 (3) from A10 J3.
   - W46 (2) from A12J1 and A10J1.
   - W43 (1) from A12J3 and A9J2.



NOTE

FOLLOW-ON PROCEDURES

Place A14/A15 in normal position (para 2-45).

END OF TASK

2-63. REPLACE A13 2nd CONVERTER ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

CAUTION

Do not bend, twist, or otherwise damage semi-rigid cables in following procedure.

NOTE

PRELIMINARY PROCEDURES

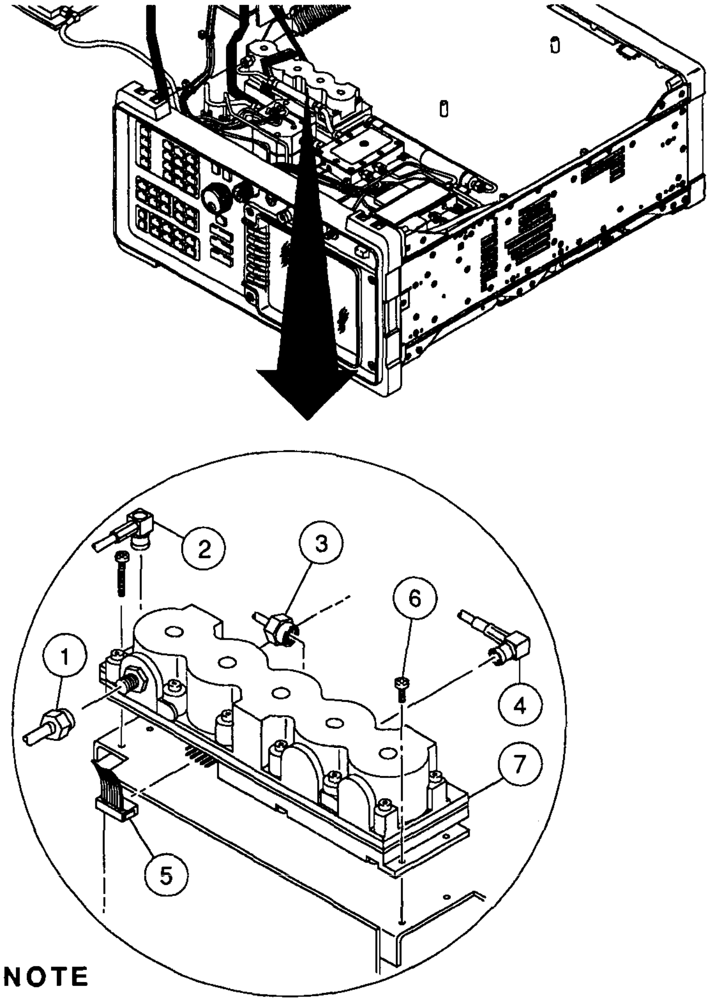
Place A14/A15 in service position (para 2-45).

REMOVE

1. Disconnect following cables:
   - FL2 (5) from A13J1 (serial prefix 2929A to 3043A).
   - W57 (1) from A13J1 (serial prefix 3051A to 3306A).
   - W35 (2) from A13J2.
   - W48 (3) from A13J3.
   - W33 (4) from A13J4.
   - W13 (5) from connector.
2. Remove four pan head screws (6) and A13 2nd Converter (7).

INSTALL

1. Install A13 2nd Converter (7) using four pan head screws (6).
2. Disconnect following cables:
   - W13 (5) from connector.
   - W33 (4) from A13J4.
   - W48 (3) from A13J3.
   - W35 (2) from A13J2.
   - W57 (1) from A13J1 (serial prefix 3051A to 3306A).
   - FL2 (5) from A13J1 (serial prefix 2929A to 3043A).



NOTE

FOLLOW-ON PROCEDURES

Place A14/A15 in normal position (para 2-45).

END OF TASK

2-64. REPLACE A16 CAL OSCILLATOR CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

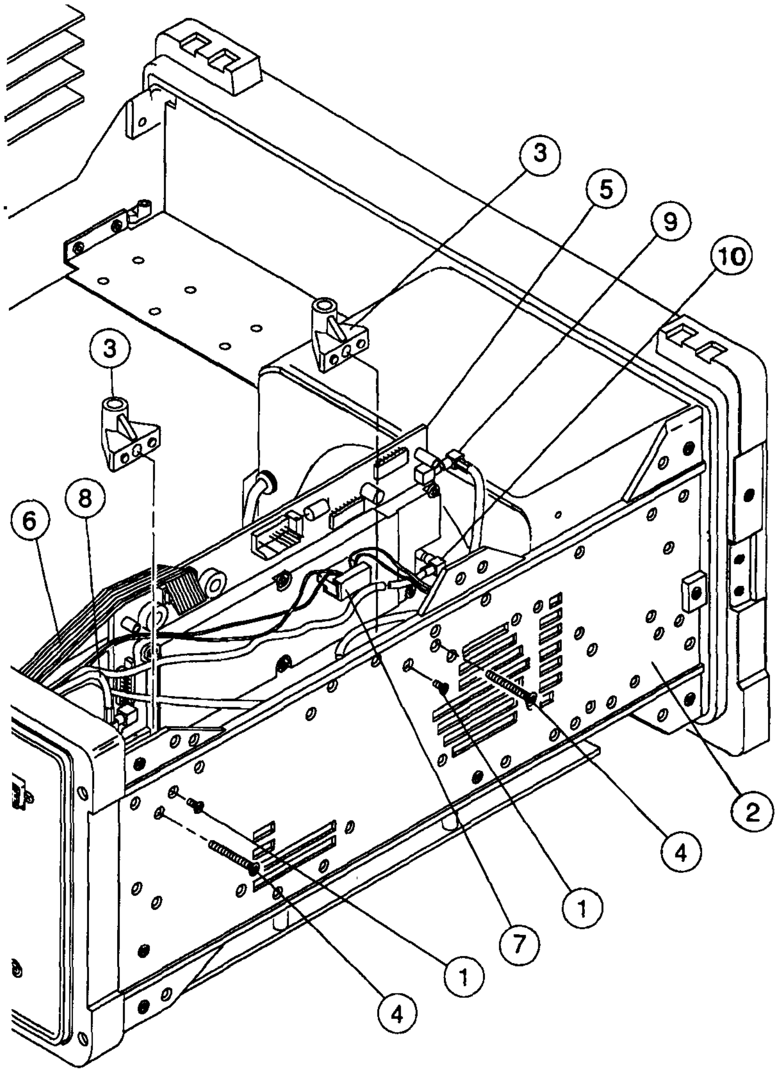
Place A2/A3/A4/A5 in service position (para 2-42).

REMOVE

1. Remove two flat head screws (1) from holes marked “6” on left side frame (2) and remove two card holders (3).
2. Remove two flat head screws (4) from holes marked “5” on left side frame (2).
3. Lift A16 Cal Oscillator CCA (5) and disconnect following cables:
   - W7 (6) from A16J3.
   - W5 (7) from A16J102.
   - W30 (8) from A16J2.
   - W28 (9) from A16J101.
   - W17 (10) from A16J1.
4. Remove A16 Cal Oscillator CCA (5).

INSTALL

1. Position A16 Cal Oscillator CCA (5) and reconnect following cables:
   - W7 (6) from A16J3.
   - W5 (7) from A16J102.
   - W30 (8) from A16J2.
   - W28 (9) from A16J101.
   - W17 (10) from A16J1.
2. Lower A16 Cal Oscillator CCA (5) to proper position, and install two flat head screws (4) into holes marked “5” on left side frame (2).
3. Install two card holders (3) using two flat head screws (1) into holes marked “6” on left side frame (2).



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-65. REPLACE A17 CRT DRIVER CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

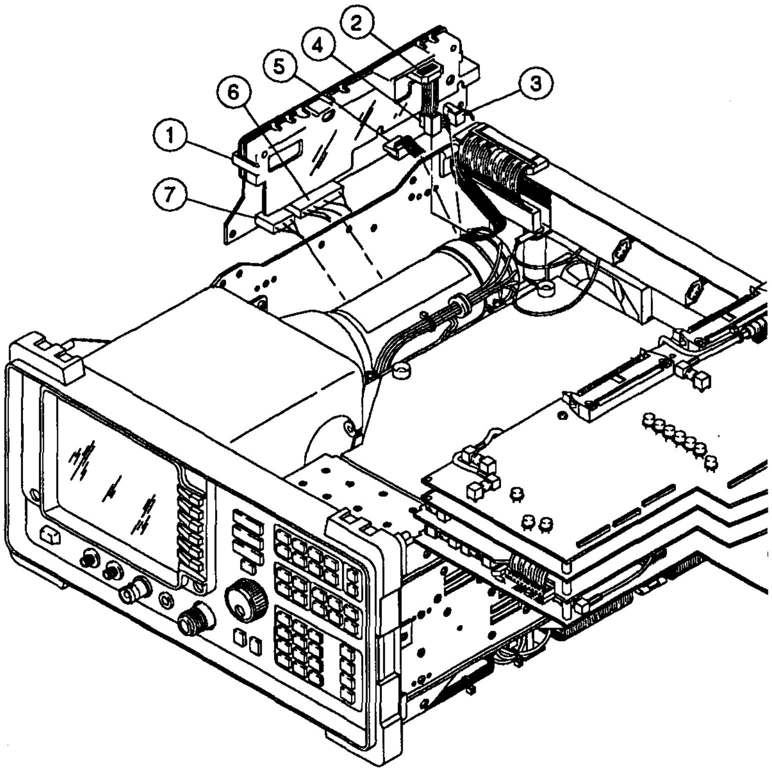
Remove A16 CAL Oscillator (para 2-64).

REMOVE

1. Lift A17 CRT Driver CCA (1) and disconnect following cables:
    - W7 (2) from A17J1.
    - A18W1 (3) from A17J5.
    - W9 (4) from A17J3.
    - W8 (5) from A17J2.
    - W9 (6) from A17J7.
    - A6A1W2 (7) from A17J6.
2. Remove A17 CRT Driver CCA (1).

INSTALL

1. Position A17 CRT Driver CCA (1) and reconnect following cables:
    - A6A1W2 (7) from A17J6.
    - W9 (6) from A17J7.
    - W8 (5) from A17J2.
    - W9 (4) from A17J3.
    - A18W1 (3) from A17J5.
    - W7 (2) from A17J1.
2. Install A17 CRT Driver CCA (1) (secured during A16 Cal Oscillator reinstallation).



NOTE

FOLLOW-ON PROCEDURES

Install A16 CAL Oscillator (para 2-64).

END OF TASK

2-66. REPLACE A18 CRT ASSEMBLY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

WARNING

Voltage potential at A6A1W3 is +9 kV. Always disconnect cables from CRT with caution! Do not discharge the CRT second anode directly to ground with A6A1W3 cable connected, or damage to the A17 CRT Driver CCA can result. Always discharge through a high resistance (such as a high voltage probe). Failure to discharge A6A1W3 may result in severe electrical shock to personnel and damage to the instrument.

NOTE

PRELIMINARY PROCEDURES

Remove A1 Front Panel Assembly (para 2-51).

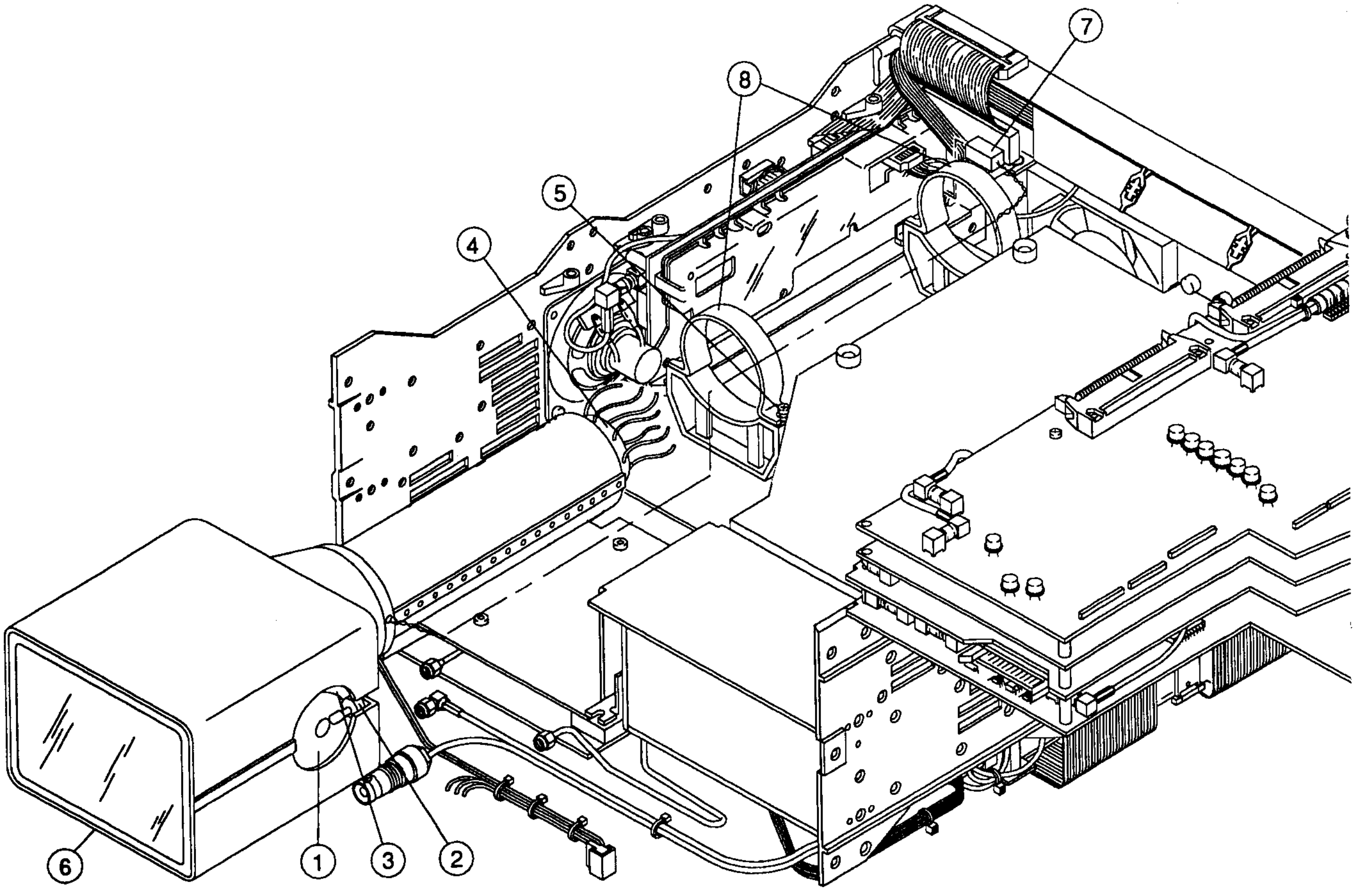
REMOVE

1. Discharge CRT anode (1) using a high voltage probe, then disconnect A6A1W3 (1) and grommet (2) from CRT (3).
2. Disconnect W9 (4) from rear of CRT (3).
3. Loosen four screws (5) and slide A18 CRT Assembly (6) forward ≈ 2 in.
4. Disconnect A18W1 (7) from A17J5.
5. Remove A18 CRT Assembly (6) by sliding forward out of clamps (8).

INSTALL

1. Slide A18 CRT Assembly (6) fully into clamps (8).
2. Reconnect A18W1 (7) to A17J5.
3. Align CRT (horizontally) and tighten four screws (5).
4. Reconnect W9 (4) to rear of CRT (3).
5. Reconnect A6A1W3 (1) and grommet (2) to CRT (3).

2-66. REPLACE A18 CRT ASSEMBLY - Continued.



NOTE

FOLLOW-ON PROCEDURES

Install A1 Front Panel Assembly (para 2-51).

END OF TASK

2-67. REPLACE A18V1 CRT.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Remove A18 CRT Assembly (para 2-66).

REMOVE

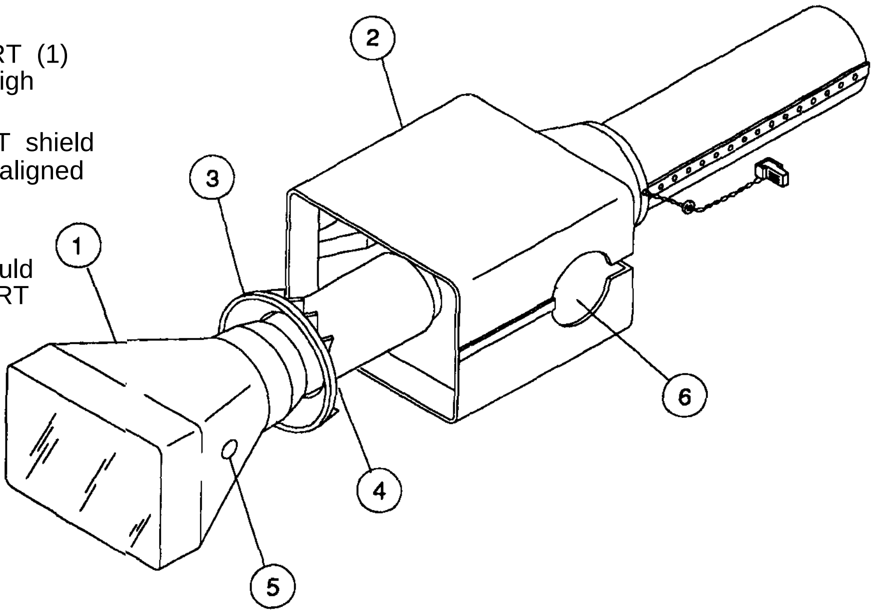
1. Separate A18V1 CRT (1) from shield (2) by carefully pushing on rear of A18V1 CRT(1).
2. Remove spacer (3).

INSTALL

1. Install spacer (3) on A18V1 CRT (1) with notch (4) aligned to the high voltage hook up (5).
2. Install CRT A18V1 (1) into CRT shield (2) with high voltage hook up aligned with access hole (6).

NOTE

The face of CRT A18V1 (1) should be flush with the front of the CRT shield (2).



NOTE

FOLLOW-ON PROCEDURES

Install A18 CRT Assembly (para 2-66).

END OF TASK

2-68. REPLACE A18L1 COIL.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

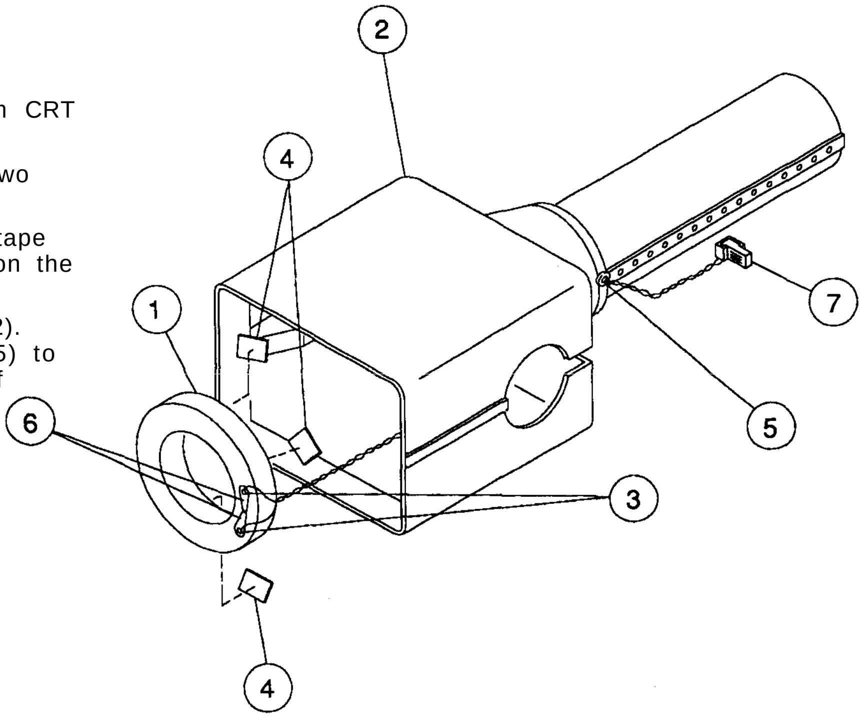
Remove A18V1 CRT (para 2-67).

REMOVE

1. Pry Coil (1) loose from CRT shield (2).
2. Tag and unsolder two wires (3).
3. Remove A18L1 Coil (1).

INSTALL

1. Remove all old two-way tape from CRT shield (2).
2. Position A18L1 Coil and solder two wires (3).
3. Install three pieces of two-way tape (4) (Appendix B, item 8) evenly on the back side of coil (1).
4. Install Coil (1) into CRT shield (2). While inserting, align contacts (5) to grommet (6) and pull slack out of A18W1 (7).



NOTE

FOLLOW-ON PROCEDURES

Install A18V1 CRT (para 2-67).

END OF TASK

2-69. REPLACE A19 HP-IB CCA.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

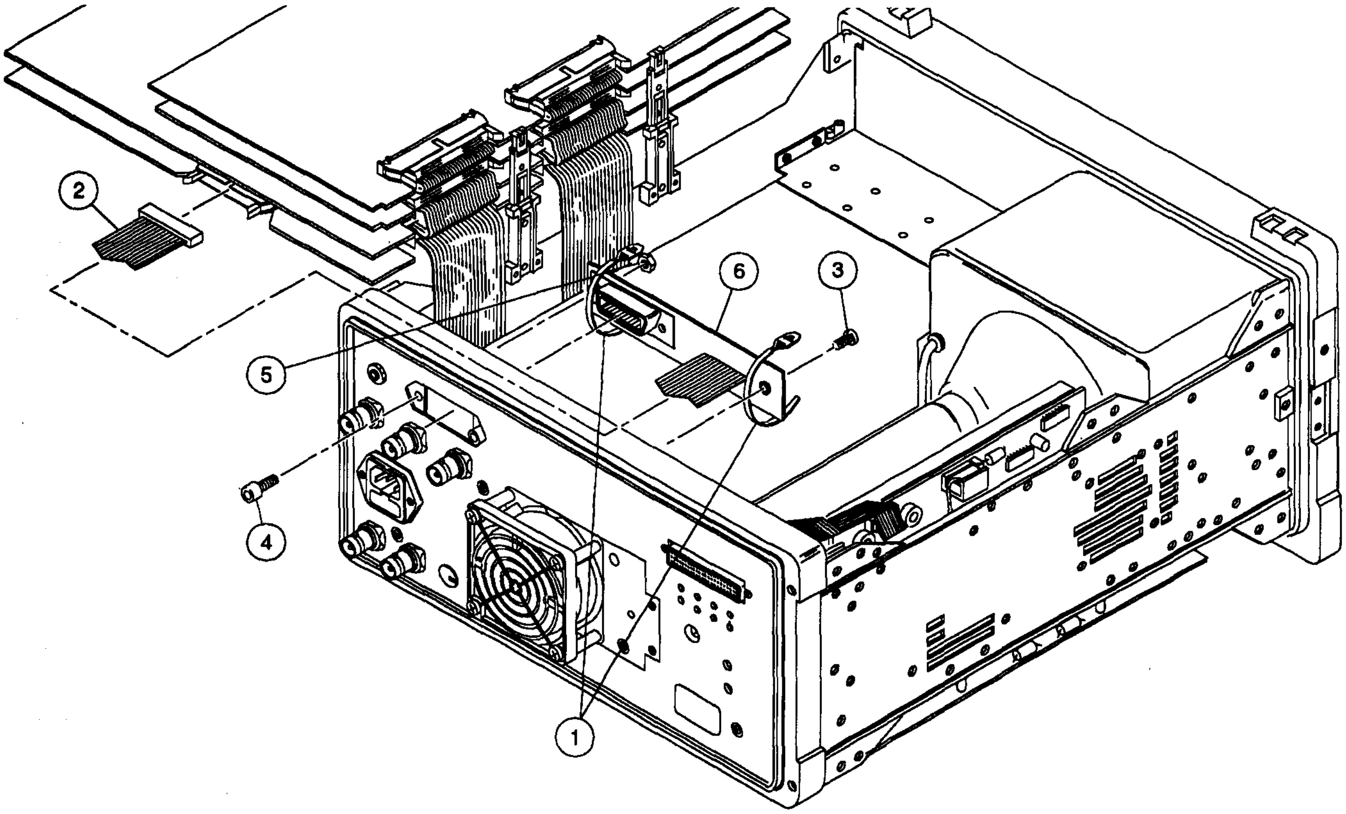
Place A2/A3/A4/A5 in service position (para 2-42).

REMOVE

1. Undo two cable ties (1) and move harness out of way.
2. Disconnect cable A19W1 (2) from A2J5.
3. Remove pan head screw (3) two standoffs (4) and two nuts (5).
4. Remove A19 HP-IB CCA (6).

INSTALL

1. Install A19 HP-IB CCA (6) using pan head screw (3) two standoffs (4) and two nuts (5).
2. Connect cable A19W1 (2) to A2J5.
3. Install harness using two cable ties (1).



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-70. REPLACE BT1 BATTERY.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

WARNING

User data stored in RAM will be lost when battery is removed. Make sure all data is available for re-entry.

REMOVE

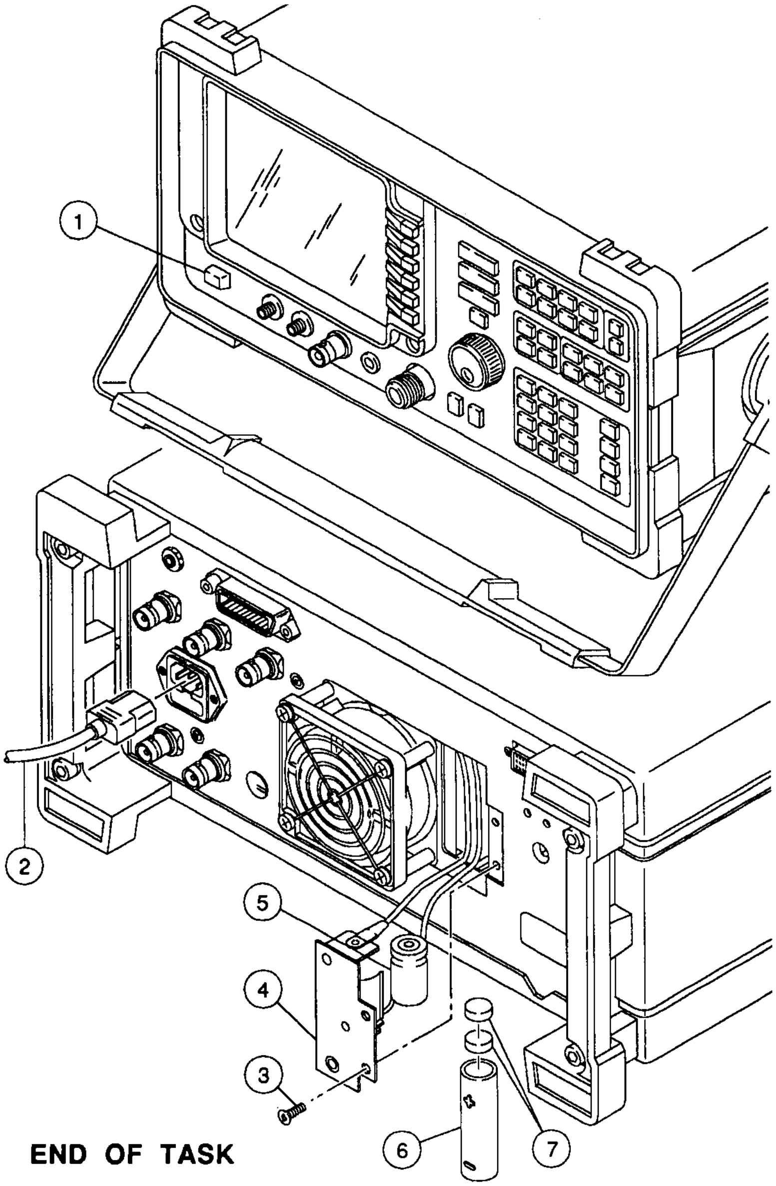
1. Set LINE (1) to OFF.
2. Disconnect power cable (2).
3. Remove two flat head screws (3).
4. Remove battery holder (4).
5. For AN/USM-489As with serial prefix 3121A to 3306A, remove battery (5) from battery holder (4).

   For AN/USM-489As with serial prefix 2929A to 3120A, remove battery adapter (6) and two batteries (7).

INSTALL

1. For AN/USM-489As with serial prefix 3121A to 3306A, install battery (5) into battery holder (4).

   For AN/USM-489As with serial prefix 2929A to 3120A, install two batteries (7) into battery adapter (6). Install battery adapter (6) into battery holder (4).
2. Install battery holder (4).
3. Install two flat head screws (3).



END OF TASK

2-71. REPLACE LS1 SPEAKER.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

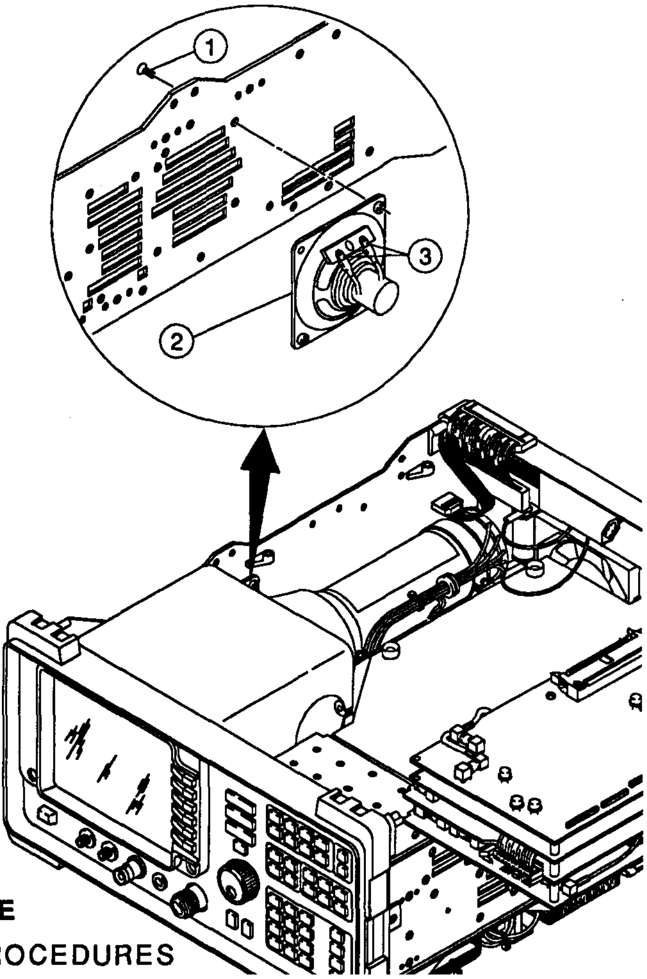
- Remove A17 CRT Driver CCA (para 2-65).
- Remove A16 Cal Oscillator CCA (para 2-64).

REMOVE

1. Remove two screws (1).
2. Lift up speaker (2) high enough to access wires.
3. Tag and unsolder two wires W5 (3) and remove speaker (2).

INSTALL

1. Position speaker and solder two wires W5 (3).
2. Install speaker using two screws (1).



NOTE

FOLLOW-ON PROCEDURES

- Install A16 Cal Oscillator CCA (para 2-64).
- Install A17 CRT Driver CCA (para 2-65).

END OF TASK

2-72. REPLACE FL1/FL2 LINE FILTERS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Place A14/A15 in service position (para 2-45).

REMOVE FL1

1. Disconnect W45 (1) from FL1J2 and A8J1.
2. Remove two pan head screws (2) and mounting bracket (3).
3. Disconnect W44 (4) at FL1J1, and remove FL1 (5).

INSTALL FL1

1. Connect W44 (4) to FL1J1.
2. Install FL1 (5) using mounting bracket (3) and two pan head screws (2).
3. Connect W45 (1) to FL1J2 and A8J1.

REMOVE FL2

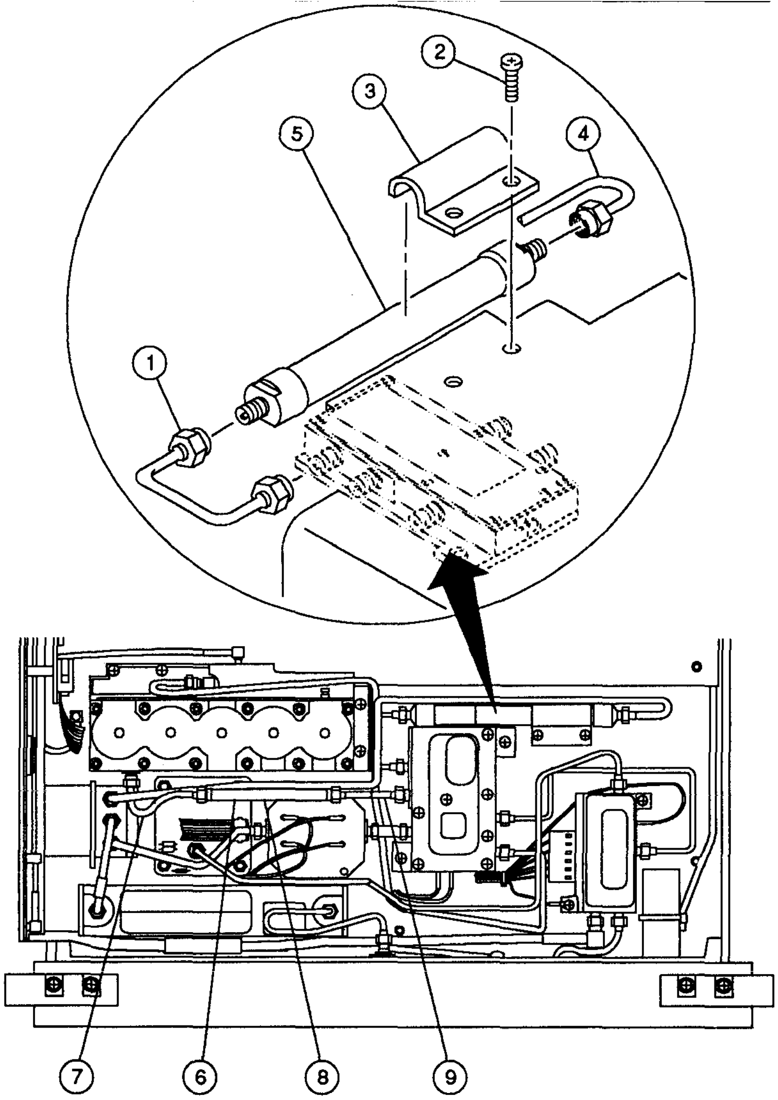
1. On AN/USM-489A with serial prefixes 2929A to 3043A, remove FL2 (6) from A8J2 and A13J1.

   On AN/USM-489A with serial prefixes 3051A to 3306A, remove W57 (7) from A13J1 and FL2 (8) and W56 (9) from A8J2 and FL2 (8).

INSTALL FL2

1. On AN/USM-489A with serial prefixes 2929A to 3043A, install FL2 (6) to A8J2 and A13J1.

   On AN/USM-489A with serial prefixes 3051A to 3306A, install W57 (7) to A13J1 and FL2 (8) and W56 (9) to A8J2 and FL2 (8).



NOTE

FOLLOW-ON PROCEDURES

- Place A14/A15 in normal position (para 2-45).

2-73. REPLACE REAR PANEL.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Place A2/A3/A4/A5 in service position (para 2-42).

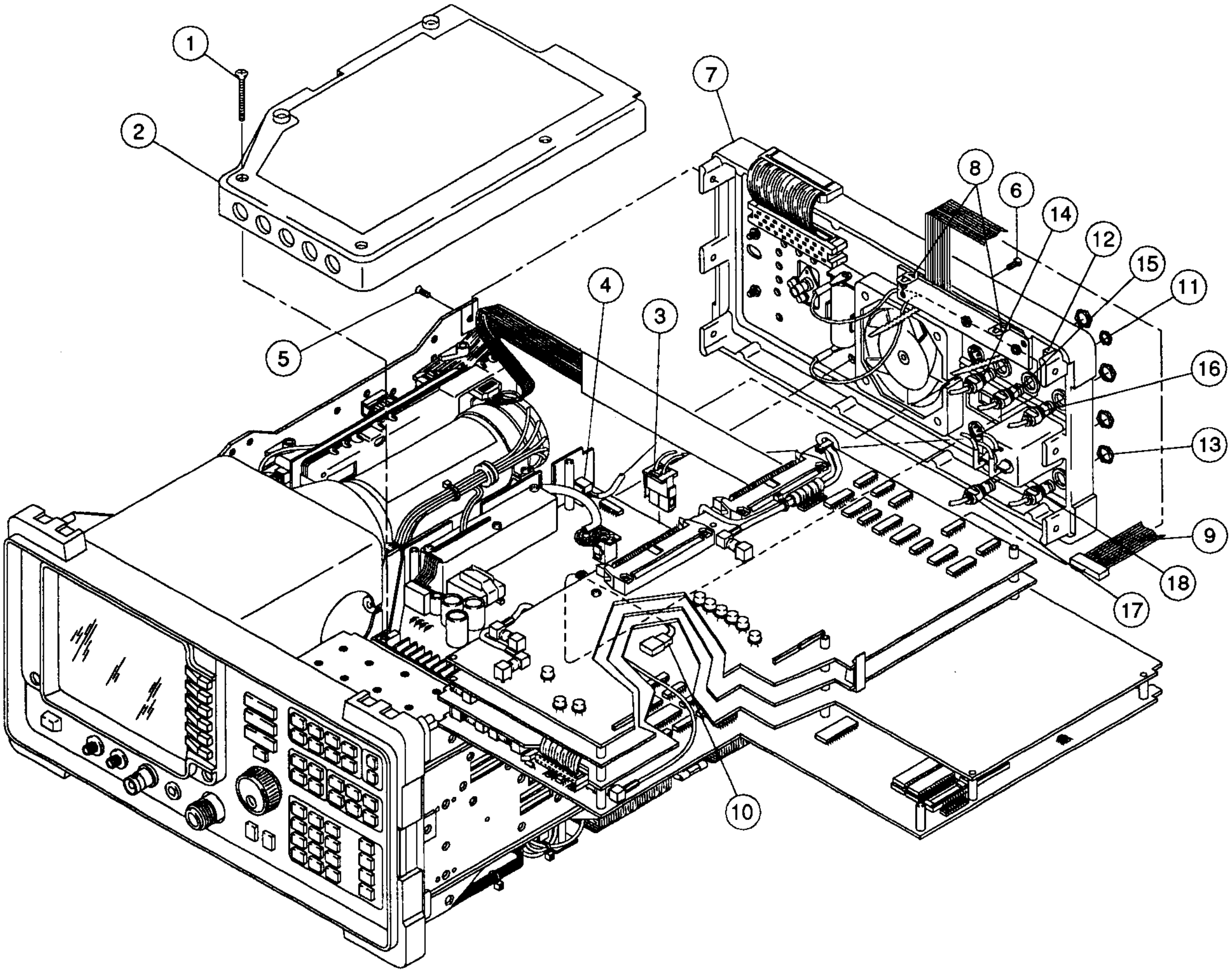
REMOVE

1. Remove three flat head screws (1) and power supply cover (2).
2. Disconnect two conductor cable (3) from A6J101.
3. Disconnect two conductor cable (4) from A6J3.
4. Remove six flat head screws (5) and four pan head screws (6).
5. Pull rear panel (7) to rear ≈ 2 in.
6. Uncouple cable ties (8).
7. Disconnect A19W1 (9) from A2J5. Disconnect W6 (10) from A2J10.
8. Remove nut (11) and W5 (12) from rear panel (7) J1.
9. Remove five nuts (13) and remove the following cables from the rear panel (7):
   - W25 (14) YEL from J6.
   - W23 (15) WHT/ORN from J5.
   - W24 (16) GRN from J4.
   - W31 (17) GRY from J9.
   - W18 (18) WHT/VIO from J8.

INSTALL

1. Position rear panel and install the following cables to the rear panel (7) using five nuts (13):
   - W25 (14) YEL from J6.
   - W23 (15) WHT/ORN from J5.
   - W24 (16) GRN from J4.
   - W31 (17) GRY from J9.
   - W18 (18) WHT/VIO from J8.
2. Install W5 (12) to the rear panel (7) J1 using nut (11).
3. Connect A19W1 (9) to A2J5.
4. Connect W6 (10) to A2J10.
5. Re-couple cable ties (8).
6. Install rear panel (7) in place using six flat head screws (5) and four pan head screws (6).
7. Connect two conductor cable (3) from A6J101.
8. Connect two conductor cable (4) from A6J3.
9. Install power supply cover (2) using three flat head screws (1).

2-73. REPLACE REAR PANEL - Continued.



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-74. REPLACE B1 FAN.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

WARNING

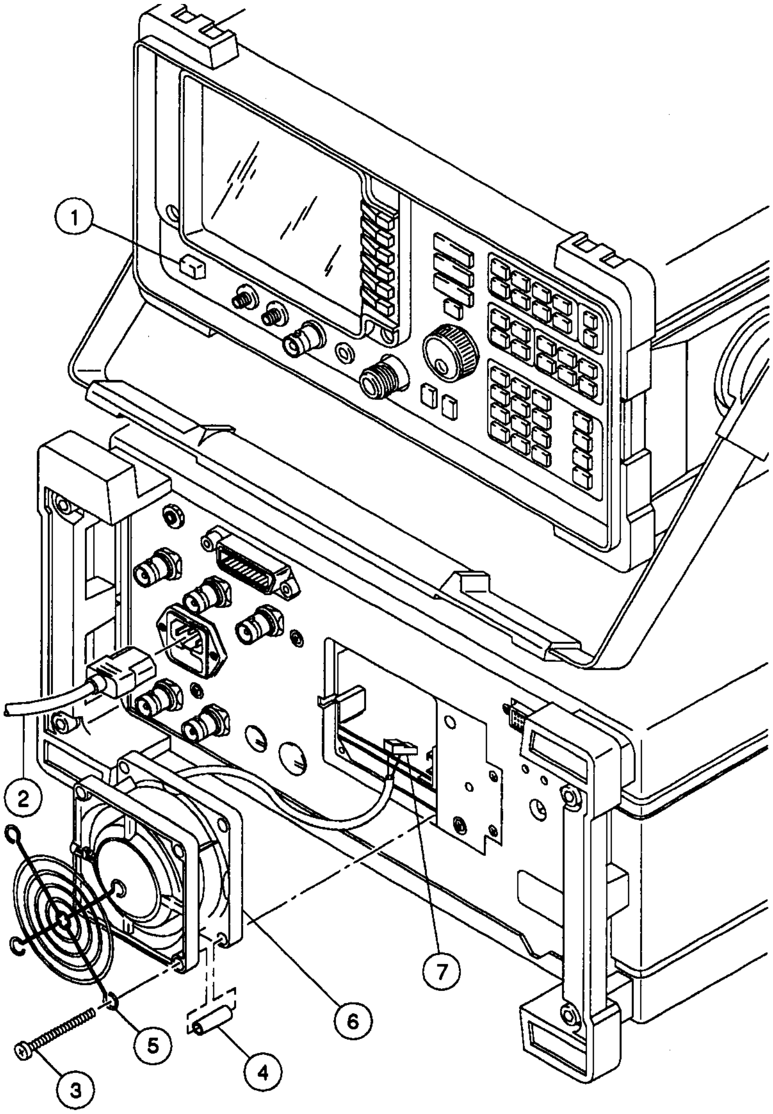
Hazardous voltages are present when covers are removed. Where maintenance can be performed without having power applied, disconnect power cord from ac source.

REMOVE

1. Set LINE (1) to OFF.
2. Disconnect power cable (2).
3. Remove four pan head screws (3) and four standoffs (4).
4. Remove finger guard (5) and fan (6).
5. Disconnect 2-pin cable (7) A6J3.

INSTALL

1. Connect 2-pin cable (7) to A6J3.
2. Install fan (6) and finger guard (5).
3. Install four pan head screws (3) and four standoffs (4).



END OF TASK

2-75. REPLACE FL4 LINE FILTER.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

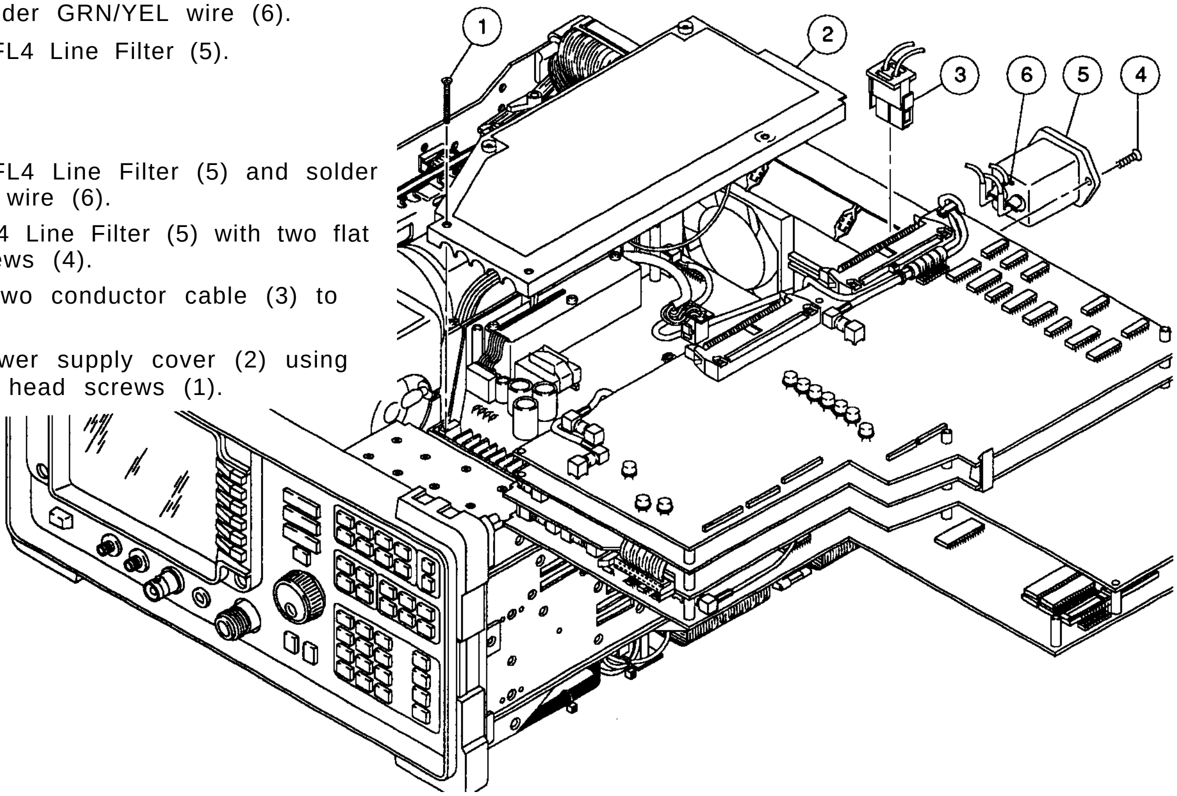
Place A2/A3/A4/A5 in service position (para 2-42).

REMOVE

1. Remove three flat head screws (1) and power supply cover (2).
2. Disconnect two conductor cable (3) from A6J101.
3. Remove two flat head screws (4).
4. Pull FL4 Line Filter (5) out, then tag and unsolder GRN/YEL wire (6).
5. Remove FL4 Line Filter (5).

INSTALL

1. Position FL4 Line Filter (5) and solder GRN/YEL wire (6).
2. Install FL4 Line Filter (5) with two flat head screws (4).
3. Connect two conductor cable (3) to A6J101.
4. Install power supply cover (2) using three flat head screws (1).



NOTE

FOLLOW-ON PROCEDURES

Place A2/A3/A4/A5 in normal position (para 2-42).

END OF TASK

2-76. REPLACE MIXER CONNECTORS.

DESCRIPTION

This procedure covers: Remove. Install.

INITIAL SETUP

NOTE

PRELIMINARY PROCEDURES

Disconnect all cables from mixer.

REMOVE

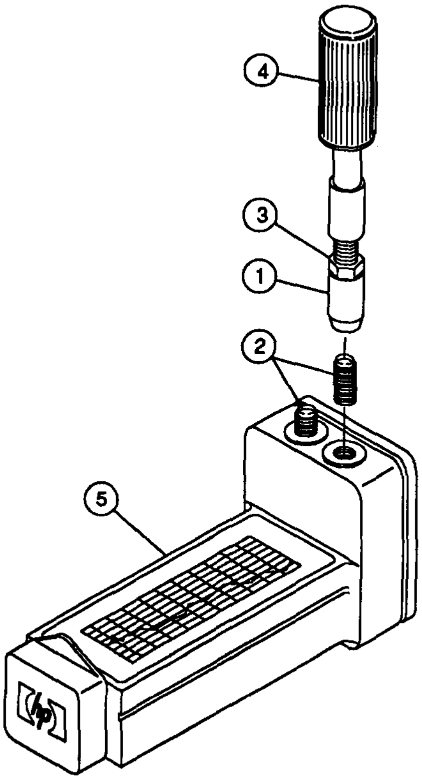
1. Thread collar (1) of insertion tool over SMA connector (2).
2. Loosen nut (3) and tighten down handle (4). Retighten nut (3).
3. Remove SMA connector (2) from Mixer (5) by turning handle (4) counterclockwise.

NOTE

Connector can be removed with pliers if tool fails to remove.

INSTALL

1. Thread NEW SMA connector half way into collar (1).
2. Loosen nut (3) and tighten down handle (4). Retighten nut (3).
3. Thread SMA connector (2) into Mixer (5) connector (2) and tighten with handle (4).



END OF TASK

Section V. PREPARATION FOR STORAGE OR SHIPMENT

2-77. PACKAGING.

Package Spectrum Analyzer in original shipping container. When using packing materials other than the original, use the following guidelines:

- Wrap Spectrum Analyzer in plastic packing material.
- Use double-wall cardboard shipping container.
- Protect all sides with shock-absorbing material to prevent Spectrum Analyzer movement within the container.
- Seal the shipping container with approved sealing tape.
- Mark "FRAGILE" on all sides, top, and bottom of shipping container.

2-78. TYPES OF STORAGE.

- Short-Term (administrative) = 1 to 45 days.
- Intermediate = 46 to 180 days.
- Long term = over 180 days. After long term storage, perform turn-on procedure (TM 11-6625-3231-12, para 2-6). If this procedure fails, perform troubleshooting procedures (table 2-1).

2-79. ENVIRONMENT.

The Spectrum Analyzer should be stored in a clean, dry environment. In high humidity environments, protect the Spectrum Analyzer from temperature variations that could cause internal condensation. The following environmental conditions apply to both shipping and storage:

Temperature	– 62° C to +85° C
Relative Humidity (sea level)	0 to 95% at +40° C (up to five days)
Altitude	0 to 50,000 feet (15,000 meters)
Shock	0 to 30g

APPENDIX A

REFERENCES

A-1. SCOPE.

This appendix lists all forms, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

A-2. FORMS.

Equipment Inspection and Maintenance Worksheet	DA Form 2404
Product Quality Deficiency Report	Form SF 368
Recommended Changes to Equipment Technical Manuals	DA Form 2028-2
Recommended Changes to Publications and Blank Forms	DA Form 2028
Report of Discrepancy (ROD)	Form SF 364
Transportation Discrepancy Report (TDR)	Form SF 361

A-3. TECHNICAL MANUALS.

Operator's and Unit Maintenance Manual for Spectrum Analyzer AN/USM-489A	TM 11-6625-3250-12
Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command)	TM 750-244-2
Unit, Direct Support, and General Support Repair Parts and Special Tools List, for Spectrum Analyzer AN/USM-489A	TM 11-6625-3250-24P

A-4. MISCELLANEOUS.

Abbreviations for Use on Drawings, Specifications, Standards and in Technical Documents	MIL-STD-12
Calibration and Requirements for the Maintenance of Army Materiel	TB 43-180
Common Table of Allowances	CTA 50-970
Consolidated Index of Army Publications and Blank Forms	DA Pam 25-30
First Aid for Soldiers	FM 21-11
Safety Precautions for Maintenance of Electrical/Electronic Equipment	TB 385-4
The Army Maintenance Management System (TAMMS)	DA Pam 738-750

APPENDIX B

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

B-1. SCOPE.

This appendix lists expendable supplies you will need for maintenance on Spectrum Analyzer AN/USM-489A. These items are authorized to you by CTA 50-970, Expendable items (Except Medical, Class V, Repair Parts, and Heraldic Items).

B-2. EXPLANATION OF COLUMNS.

a. Column (1)—Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., “Use cleaning compound, item 5, App. B“).

b. Column (2)—Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew.
O - Unit Maintenance.
H - General Support Maintenance.

c. Column (3)—National Stock Number. This column indicates the national stock number assigned to the item and will be used for requisitioning purposes.

d. Column (4)—Description. This column indicates the federal item name and if required, a minimum description to identify the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

e. Column (5)—Unit of Measure (U/M). This column indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e. g., EA, IN, PR). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	C	8305-00-267-3015	Cloth, Cheesecloth, Cotton, Listless, CCC-C-440, Type Il, Class 2(81349)	YD
2	O	6810-00-753-4993	Alcohol, isopropyl, 8OZ Can, MIL-A-10428, Grade A(81349)	CN
3	C	7930-00-068-1669	Detergent, Mild, Liquid	OZ
4	H	6850-00-405-9388	Circuit Cooler, 1202 Can (21267)	OZ
5	H	6850-00-927-9461	Silicone Heat Sink Compound, 5oz Tube (71984)	OZ
6	H	5970-00-018-7723	Tubing, Insulating, Heat Shrink (0.125 I.D.)	EA
7	H	5975-01-184-1697	Strap, tiedown, Elec (36956)	EA
8	H	7510-00-165-6560	Tape, Adhesive, 2-way with pad	IN

INDEX

INDEX — Continued

INDEX — Continued

INDEX — Continued

INDEX — Continued

INDEX — Continued

INDEX — Continued

INDEX — Continued

INDEX — Continued

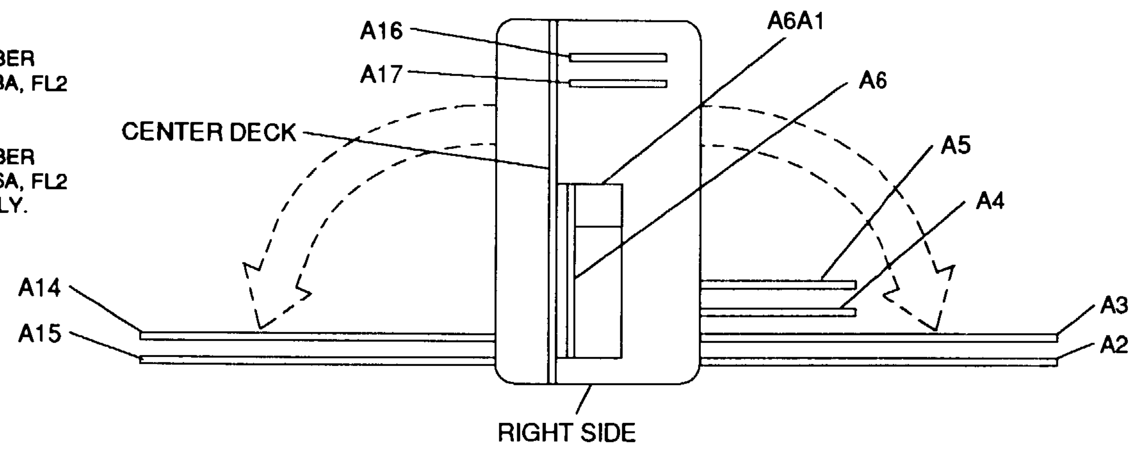
INDEX — Continued

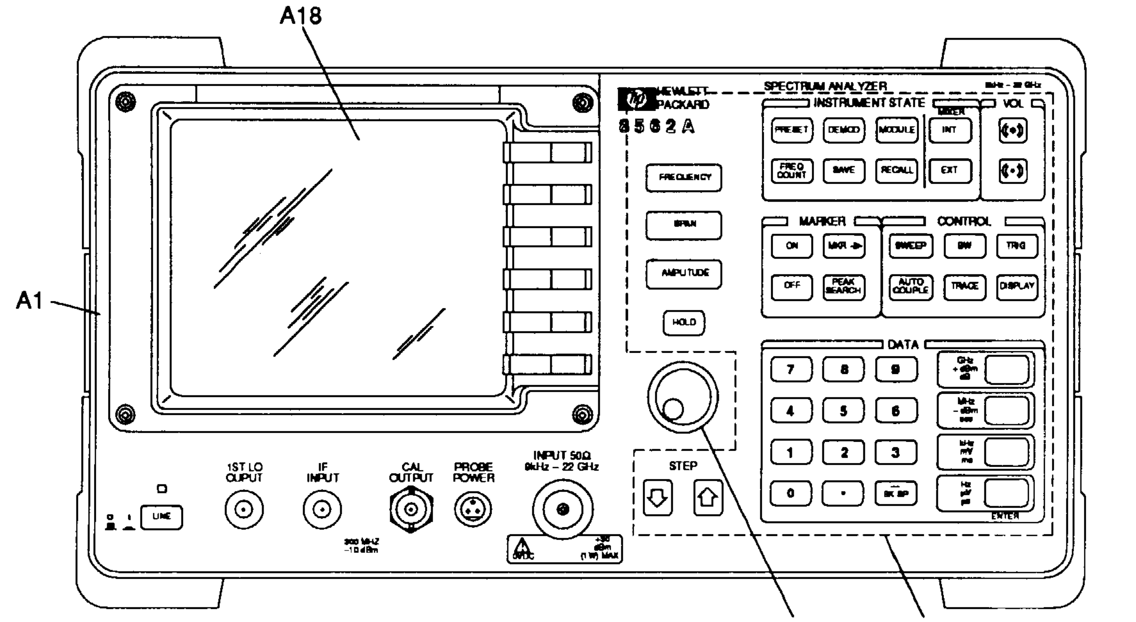
INDEX — Continued

NOTES:

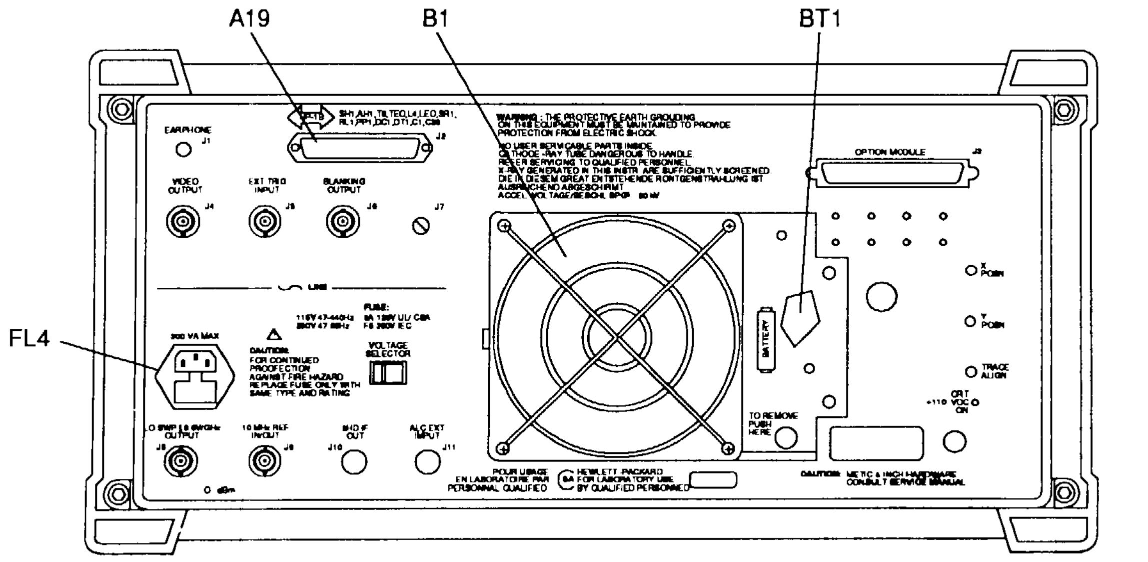
1. FOR AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3043A, FL2 IS A SEMI-RIGID CABLE.

   FOR AN/USM-489A SERIAL NUMBER PREFIXES 3051A THROUGH 3306A, FL2 IS A LOW PASS FILTER ASSEMBLY.

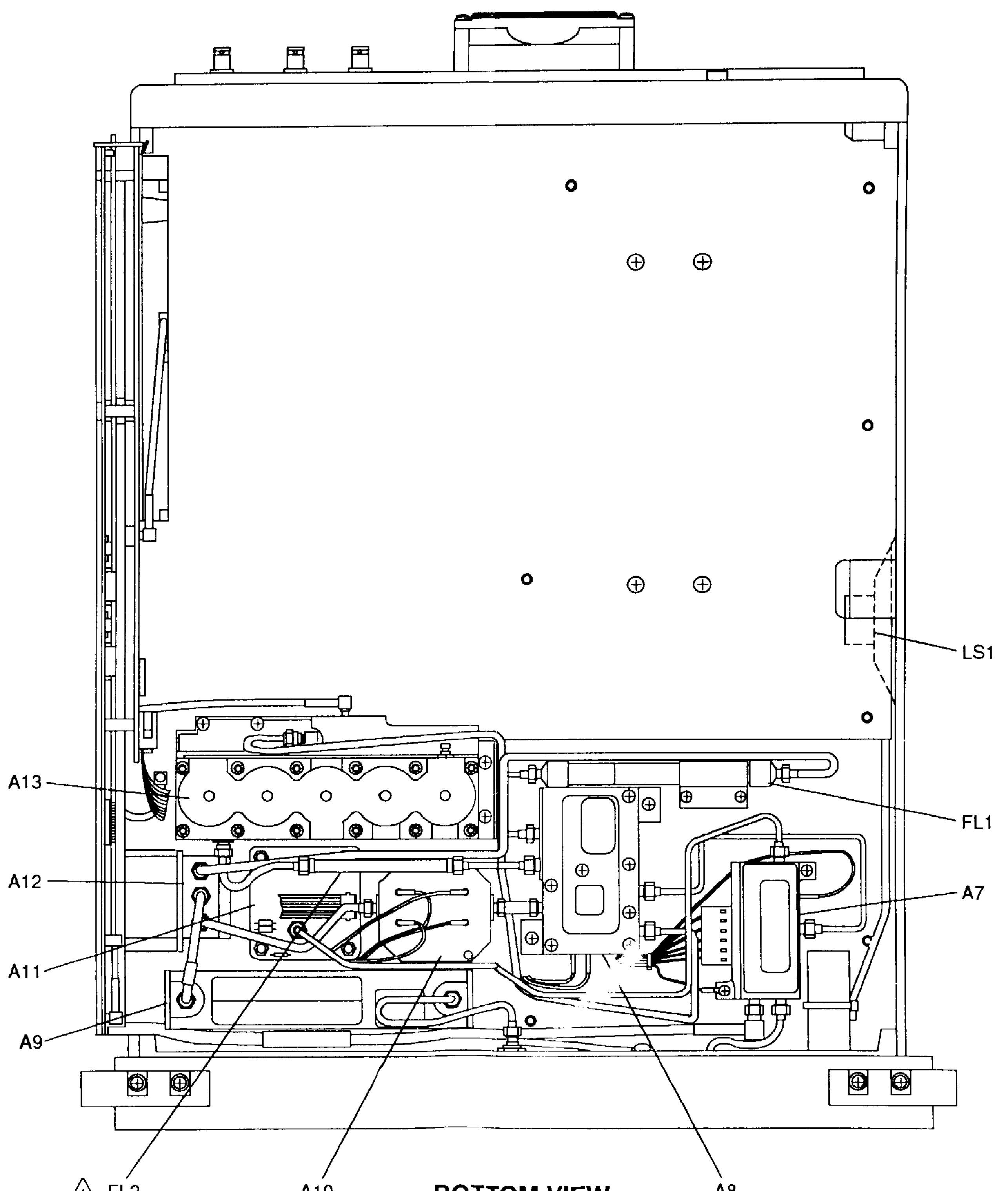




FRONT VIEW



REAR VIEW



BOTTOM VIEW (SERVICE POSITION)

CE2HA001

Figure FO-1. AN/USM-489A Assembly Locator Diagram.

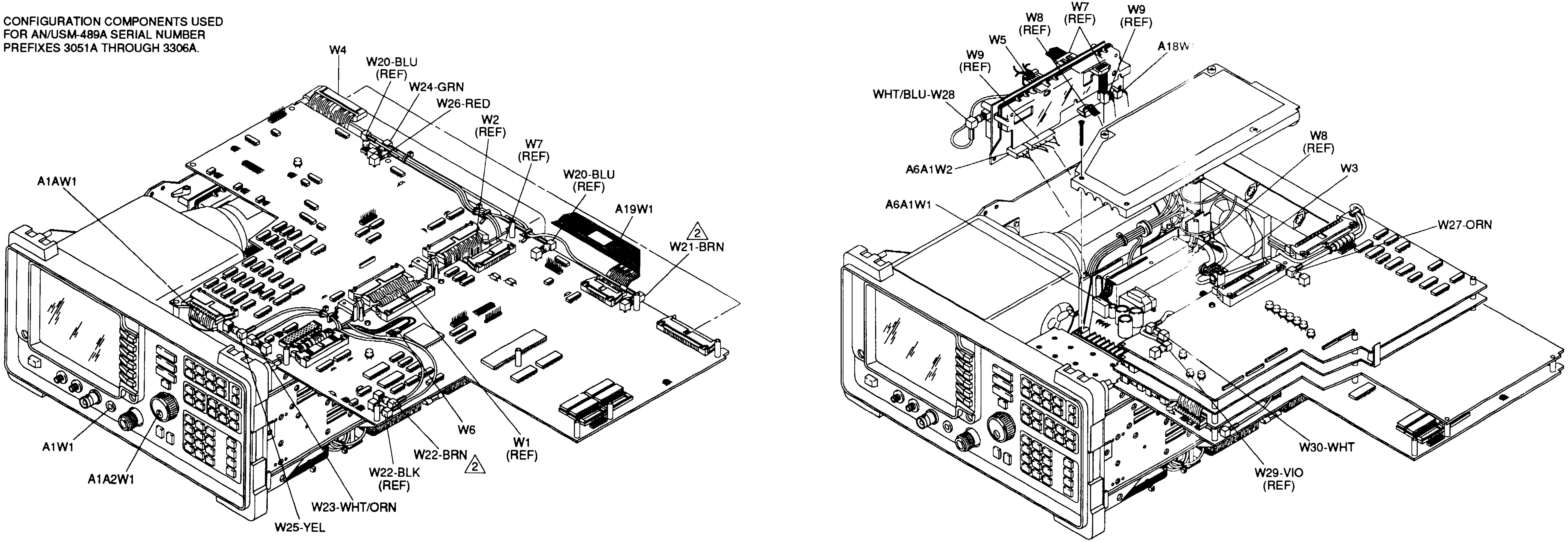
NOTES:

△1 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3051A.

△2 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 3115A THROUGH 3306A.

△3 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3043A.

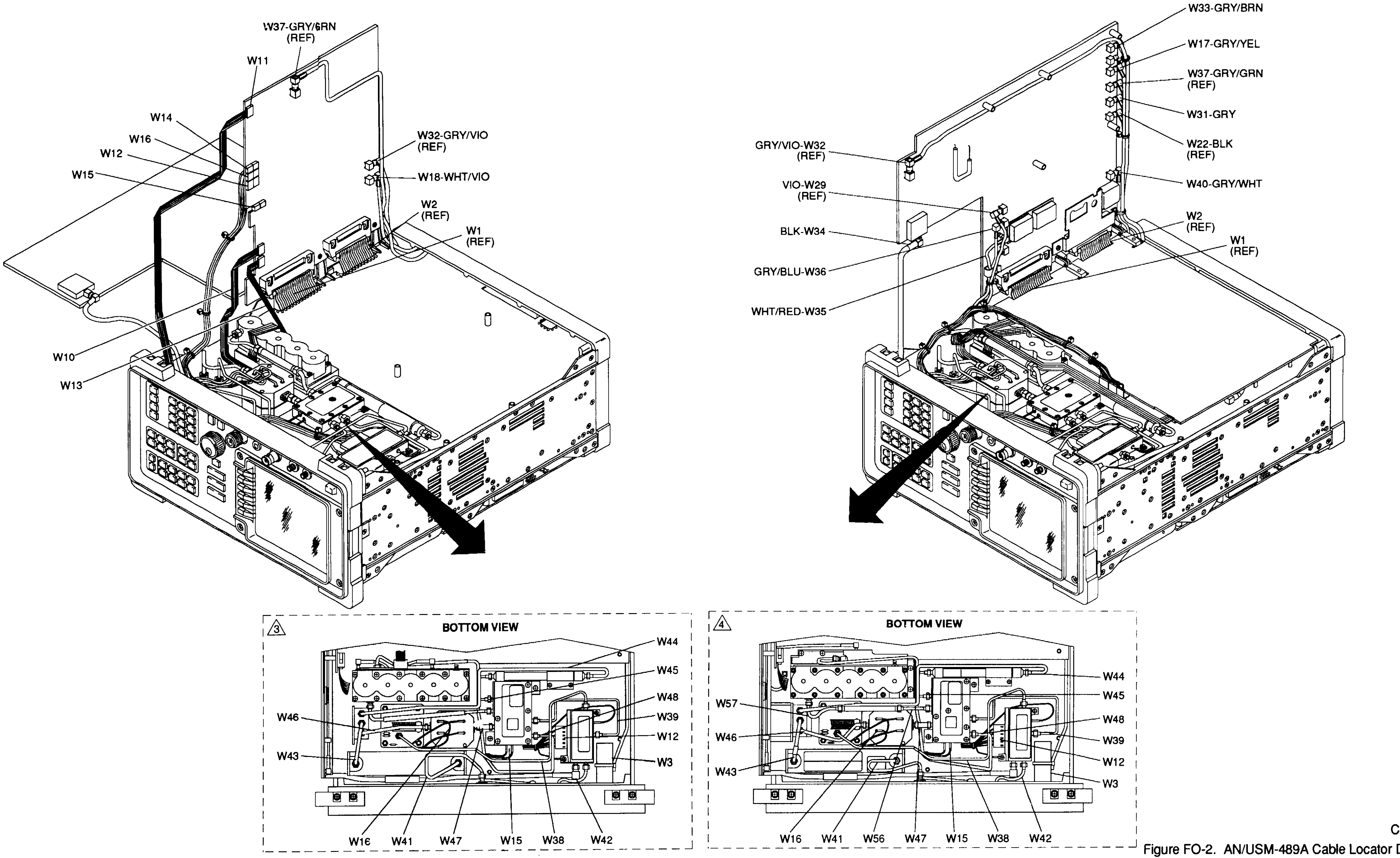
△4 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 3051A THROUGH 3306A.



CE2HA002

Figure FO-2. AN/USM-489A Cable Locator Diagram (Sheet 1 of 2).

SEE SHEET 1 FOR NOTES

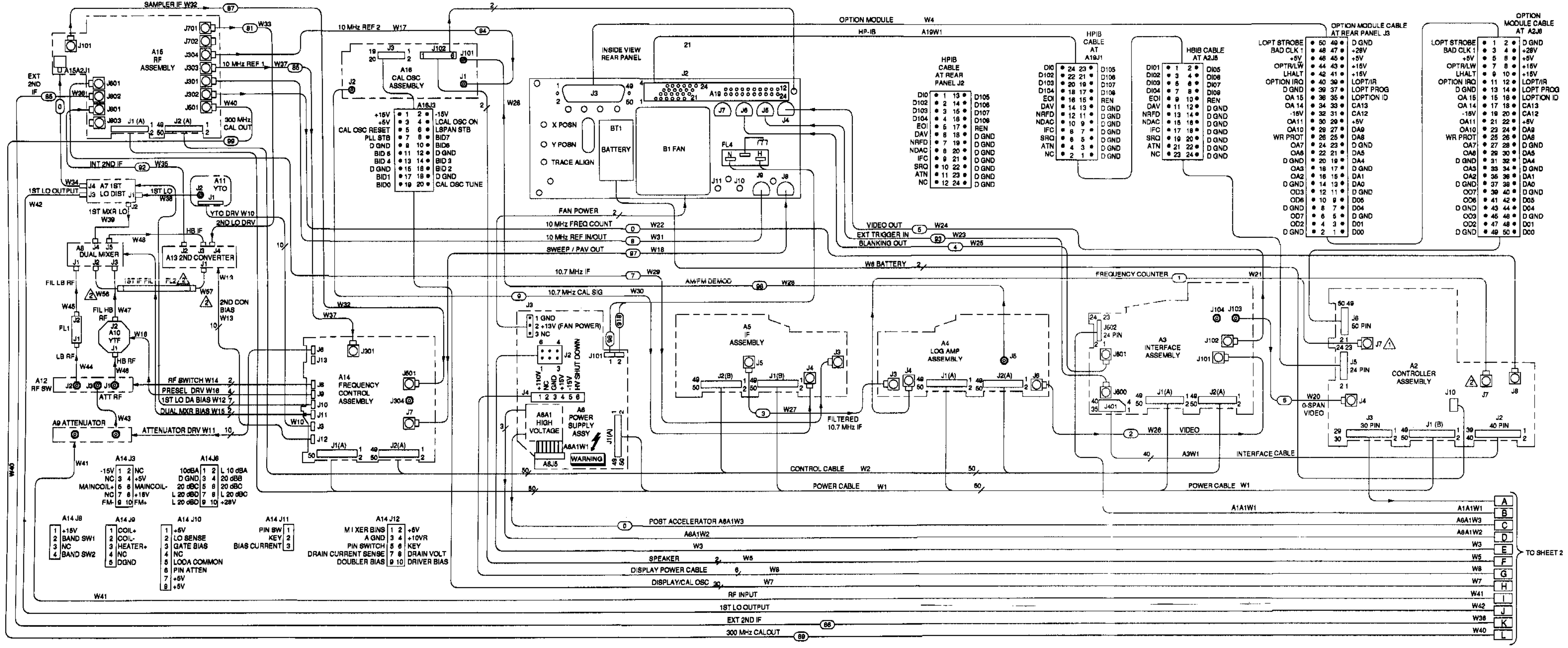


CE2HA003

Figure FO-2. AN/USM-489A Cable Locator Diagram
(Sheet 2 of 2).

NOTES:

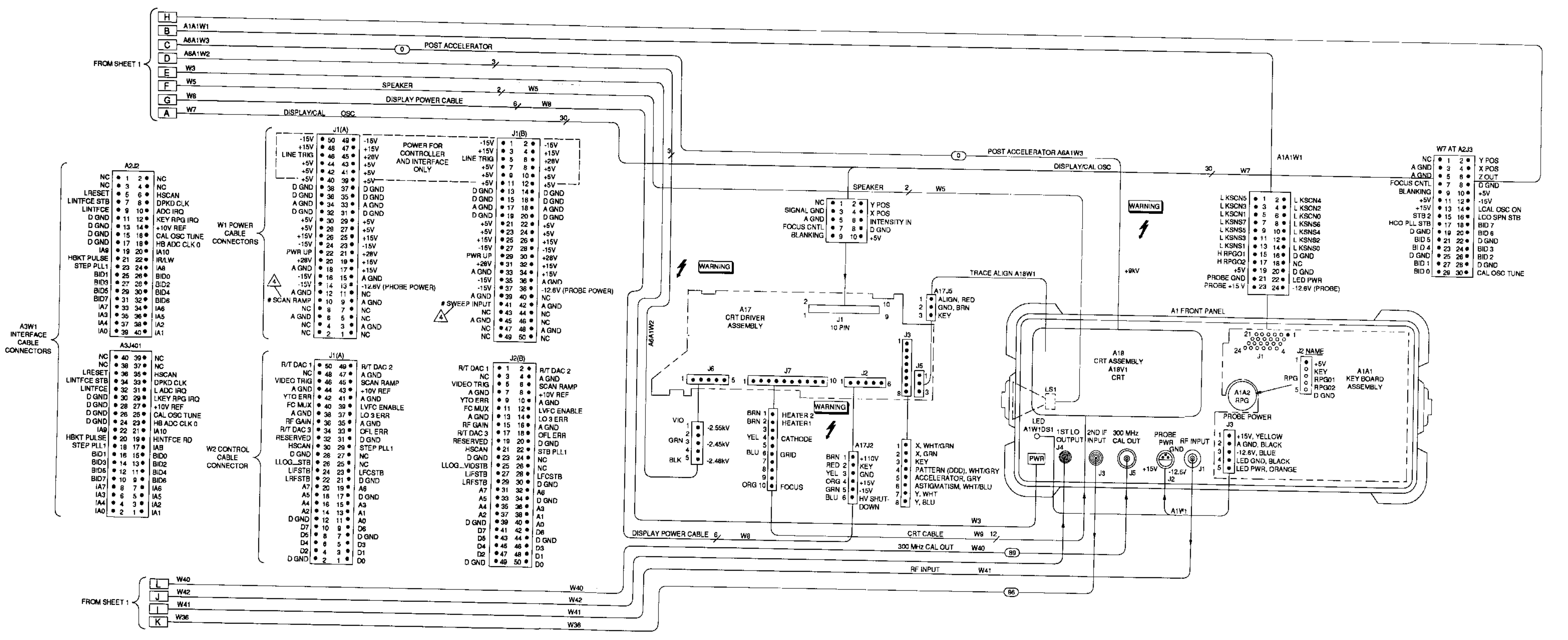
- △1 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3051A.
- △2 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 3115A THROUGH 3306A.
- 3. CABLES WITH -(XX)- INDICATE CABLE COLOR USING STANDARD COLOR CODE.
- △4 SCAN RAMP/SWEEP INPUT FOR A2 CONTROLLER AND A3 INTERFACE CCA ONLY.



CE2HA004

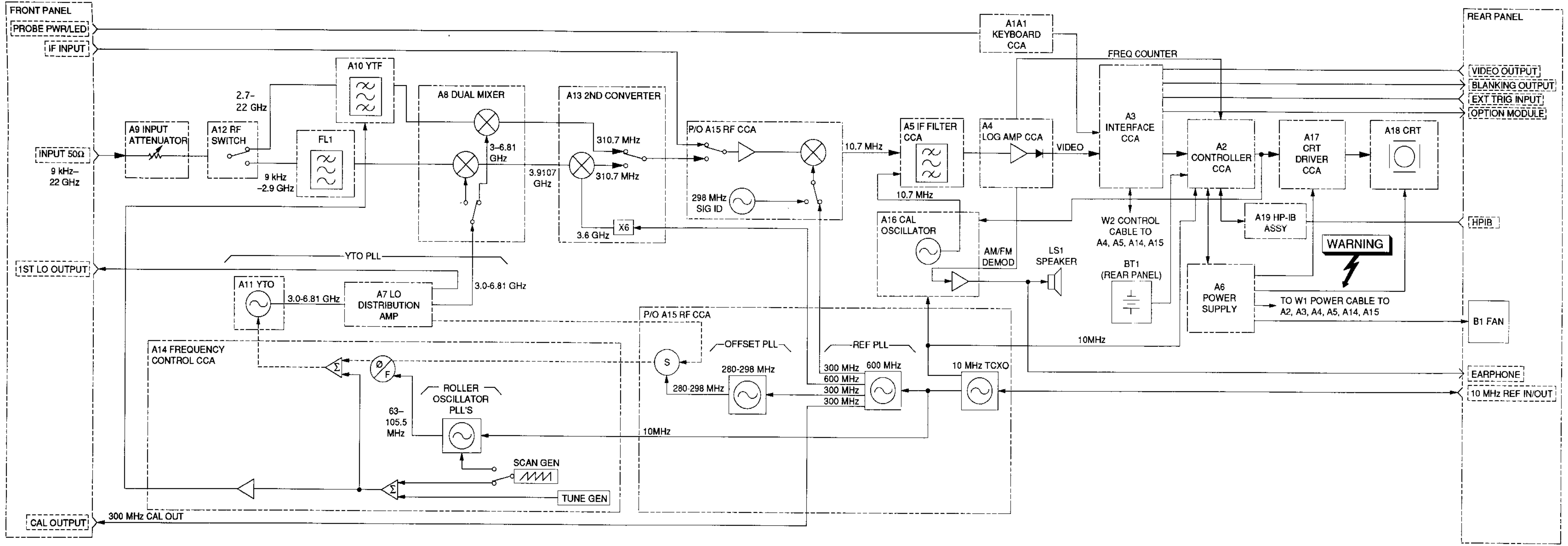
Figure FO-3. AN/USM-489A Wiring Diagram (Sheet 1 of 2).

SEE SHEET 1 FOR NOTES.



CE2HA005

Figure FO-3. AN/USM-489A Wiring Diagram
(Sheet 2 of 2).



CE2HA006

Figure FO-4. AN/USM-489A Simplified Block Diagram .

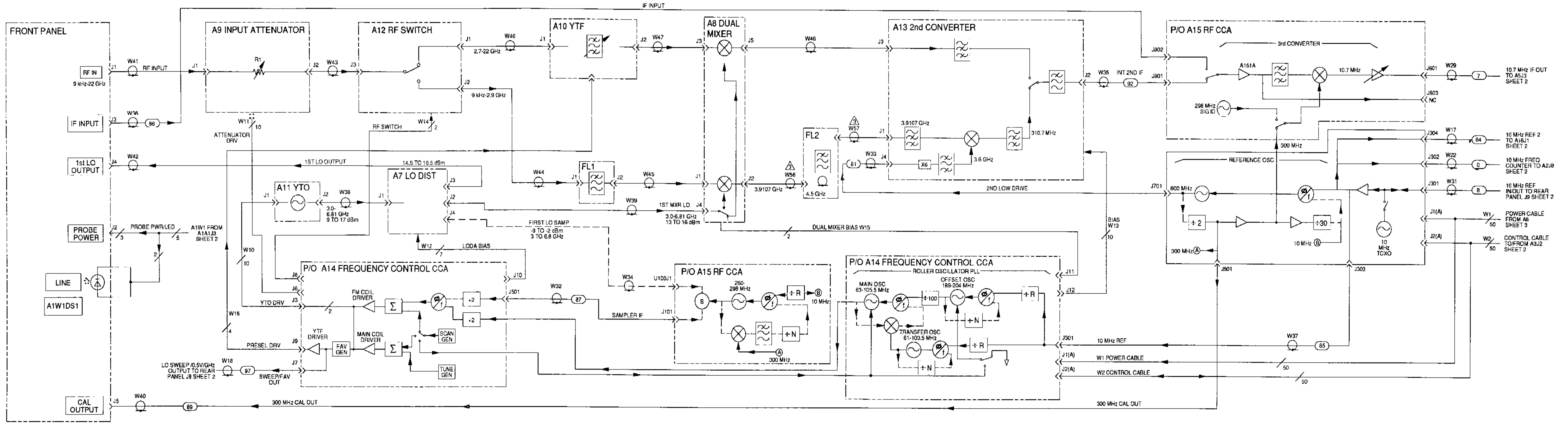
NOTES:

△1 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3115A.

△2 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 3119A THROUGH 3226A.

△3 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 3151A THROUGH 3306A.

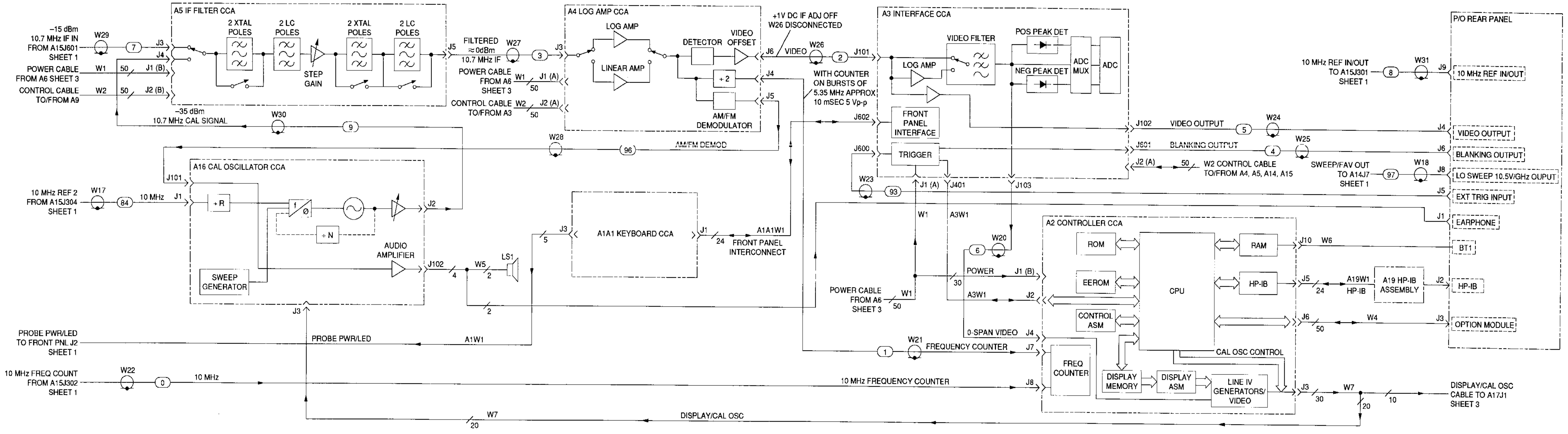
4. CABLES WITH -(XX)- INDICATE CABLE COLOR USING STANDARD COLOR CODE.



CE2HA007

Figure FO-5. AN/USM-489A Functional Block Diagram (Sheet 1 of 3).

SEE SHEET 1 FOR NOTES



CE2HA008

Figure FO-5. AN/USM-489A Functional Block Diagram (Sheet 2 of 3).

CE2HA009

Figure FO-5. AN/USM-489A Functional Block Diagram (Sheet 3 of 3).

NOTES:

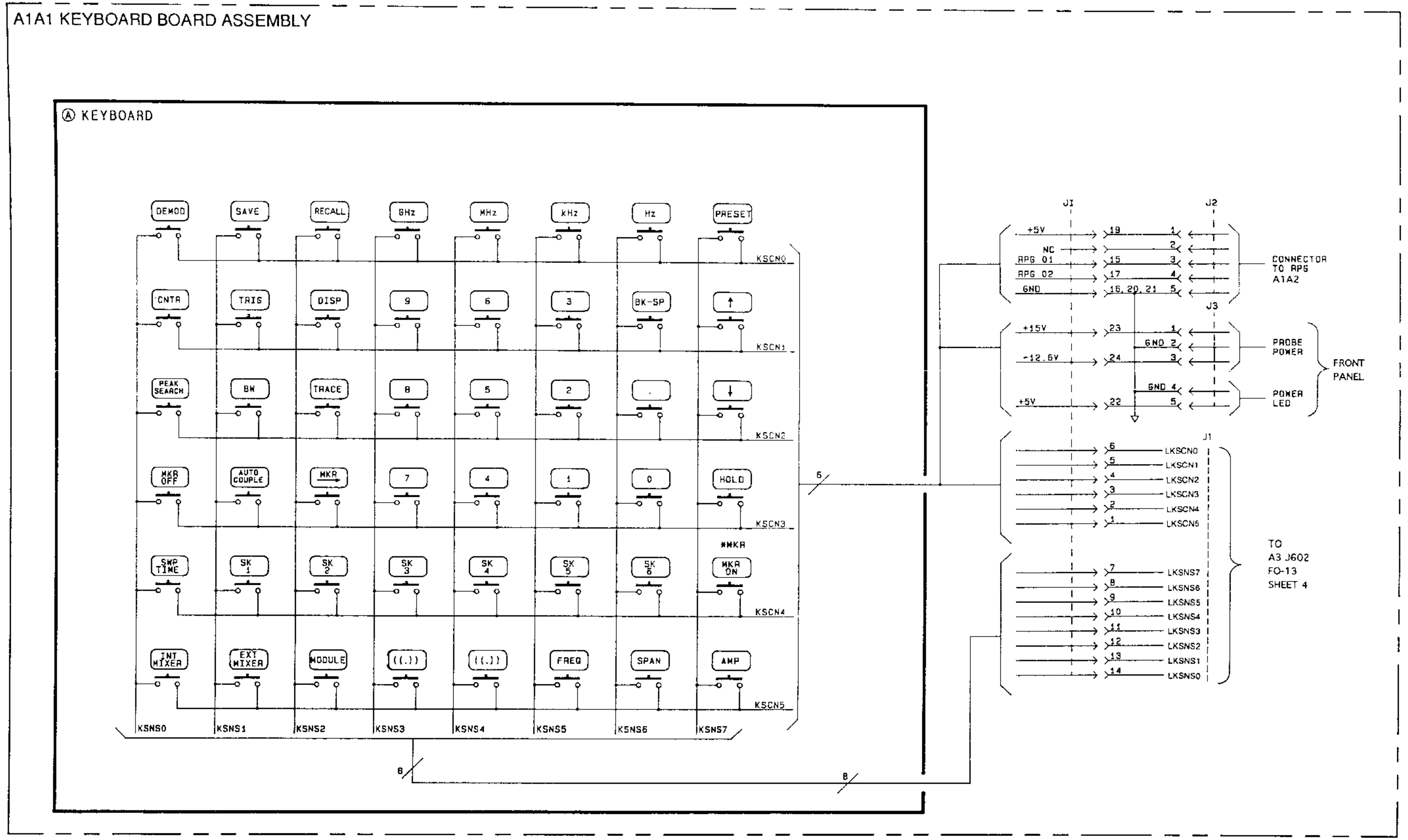
1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A1A1.

2. UNLESS OTHERWISE INDICATED:
RESISTANCE IS IN OHMS (Ω).
CAPACITANCE IS IN MICROFARADS (µF).
INDUCTANCE IS IN MICROHENRIES (µH).

3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A1A1 CIRCUIT CARD ASSEMBLIES AND AN/USM-489 PREFIXES:

HP PART NUMBER	SERIAL PREFIX	
	FROM	TO
08562-60031	2929A	3148A
08562-60140	3204A	3306A

4. REFER TO FIGURE FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.



CE2HA010

Figure FO-6. A1 Front Panel Assembly Schematic Diagram.

NOTES:

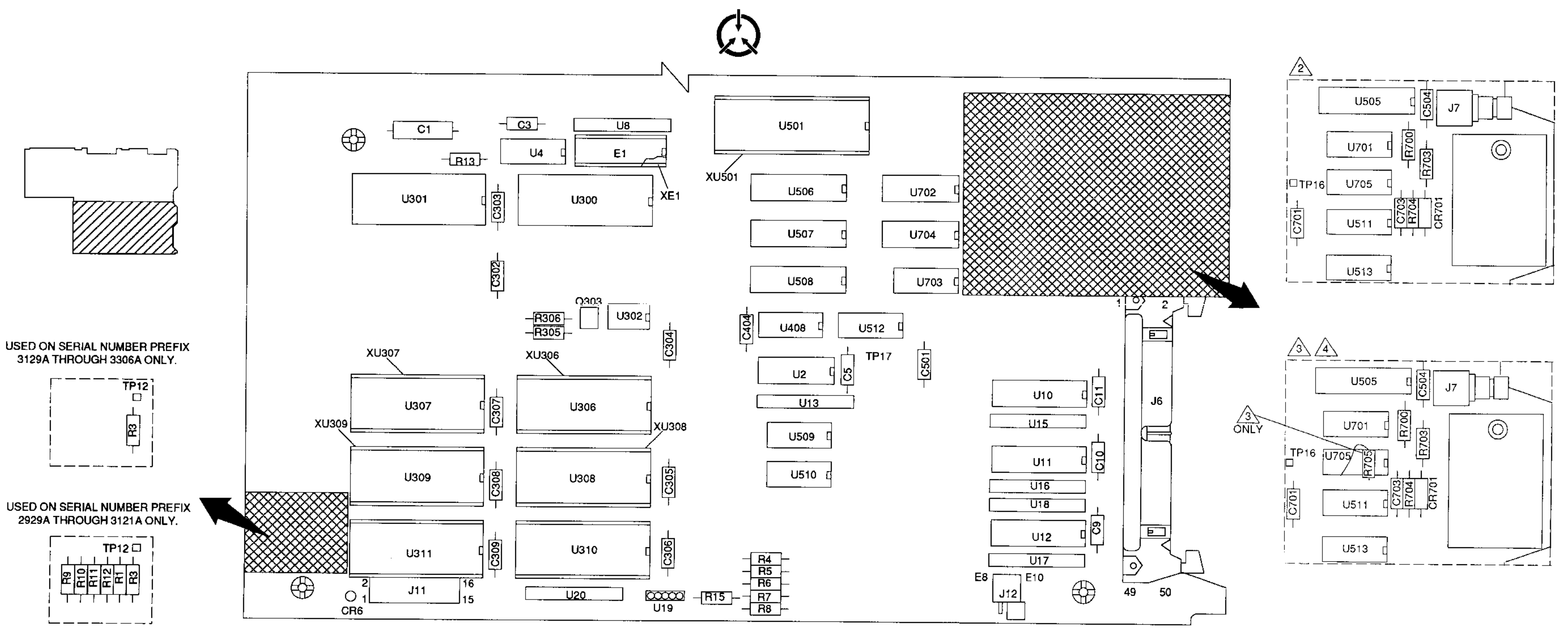
1. ⊡ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIODES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (⊚ ROUND PAD = TP GROUND)

△2 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60110 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3051A).

△3 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60124 (AN/USM-489A SERIAL NUMBER PREFIXES 3115A THROUGH 3121A).

△4 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60151 AND 80562-60173 (AN/USM-489A SERIAL NUMBER PREFIXES 3129A THROUGH 3306A).

5. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A2 FOR COMPLETE REFERENCE DESIGNATOR.



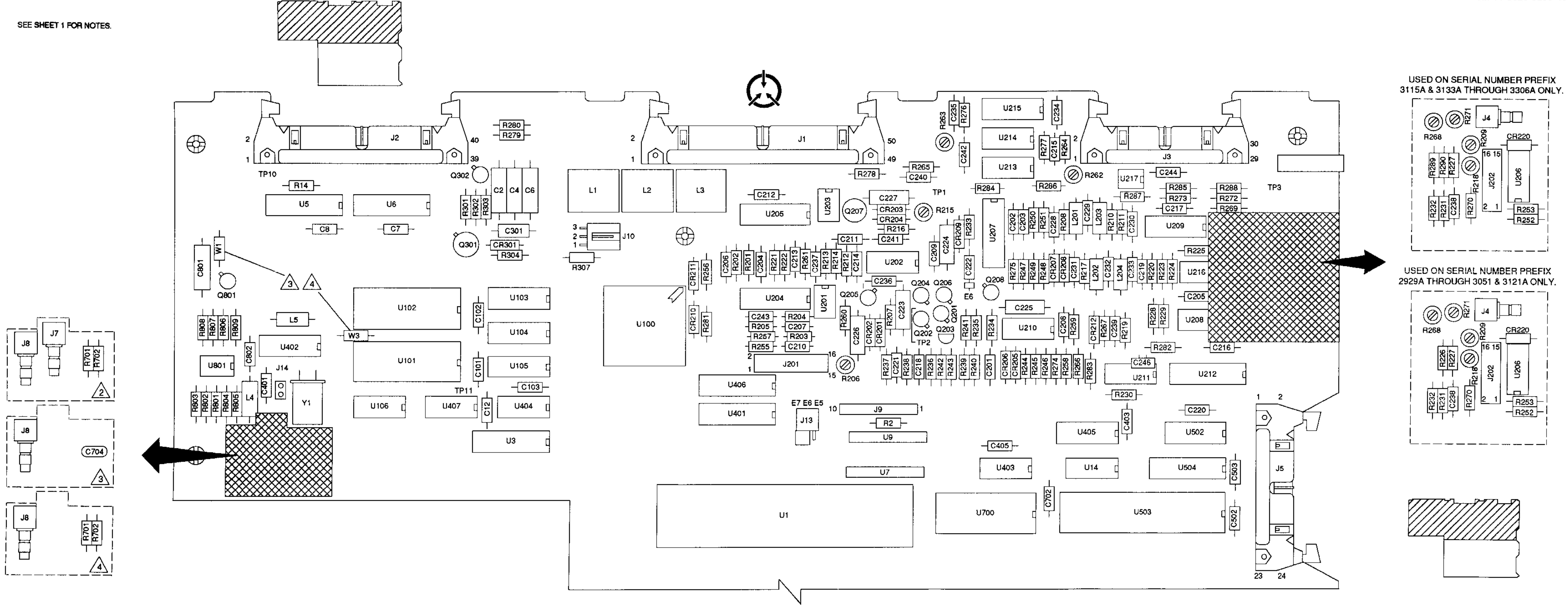
CE2HA011

Figure FO-7. A2 Controller CCA Component Locator Diagram (Sheet 1 of 2).

SEE SHEET 1 FOR NOTES.

USED ON SERIAL NUMBER PREFIX 3115A & 3133A THROUGH 3306A ONLY.

USED ON SERIAL NUMBER PREFIX 2929A THROUGH 3051 & 3121A ONLY.

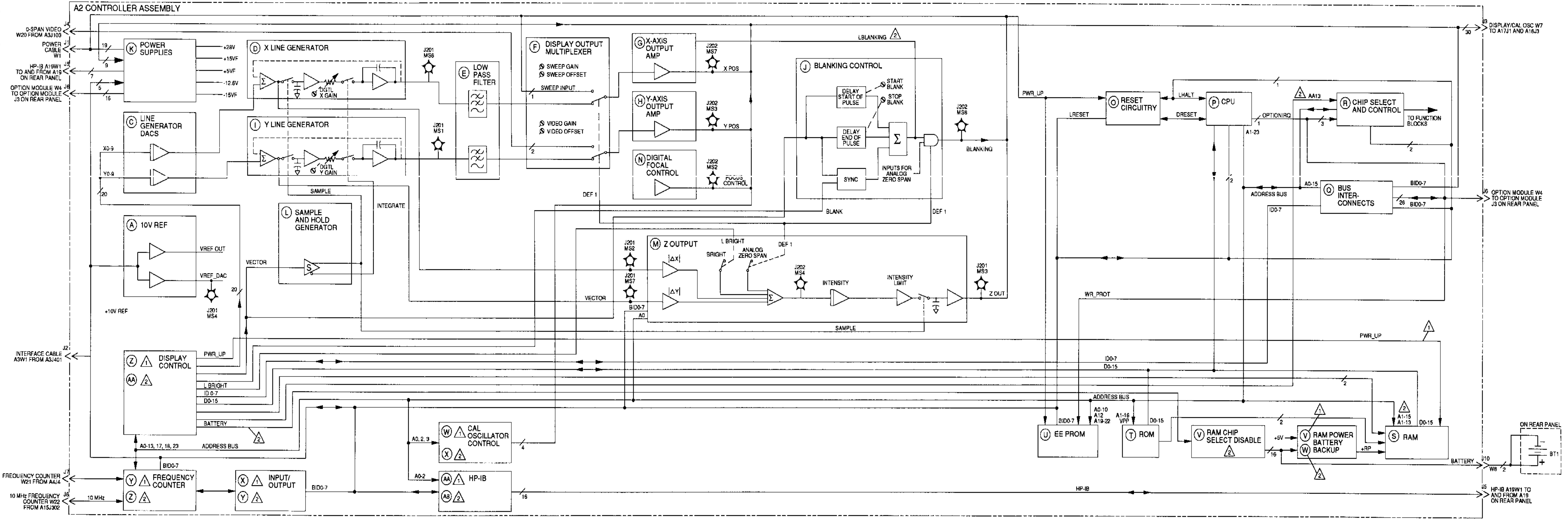


CE2HA012

Figure FO-7. A2 Controller CCA Component Locator Diagram (Sheet 2 of 2).

NOTES:

- ⚠1 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3051A.
- ⚠2 CONFIGURATION COMPONENTS USED FOR AN/USM-489A SERIAL NUMBER PREFIXES 3115A THROUGH 3306A.



CE2HA013

Figure FO-8. A2 Controller CCA Functional Block Diagram.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A2 FOR COMPLETE REFERENCE DESIGNATOR.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω).
   CAPACITANCE IS IN MICROFARADS (μF).
   INDUCTANCE IS IN MICROHENRIES (μH).
   $\bigtriangledown_A$ = ANALOG GROUND.
   $\bigtriangledown_D$ = DIGITAL GROUND.
3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A2 CIRCUIT CARD ASSEMBLY AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	SERIAL PREFIX TO
08562-60110	2929A	3051A

4. BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.
5. REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

⚠6 COMPONENT(S) NOT USED.

J1 POWER BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	−15V	W1	K
2	−15V	W1	K
3	+15V	W1	K
4	+15V	W1	K
5	LINE TRIG	NC	
6	+28V	W1	K
7	+5V	W1	K
8	+5V	W1	K
9	+5V	W1	K
10	+5V	W1	K
11	+5V	W1	K
12	+5V	W1	K
13	DGND	W1	K
14	DGND	W1	K
15	DGND	W1	K
16	DGND	W1	K
17	AGND	W1	K
18	AGND	W1	K
19	DGND	W1	K
20	DGND	W1	K
21	+5V	NC	
22	+5V	NC	
23	+5V	NC	
24	+5V	NC	
25	+15V	NC	
26	+15V	NC	
27	−15V	NC	
28	−15V	NC	
29	PWR_UP	W1	O
30	+28V	NC	
31	+28V	NC	
32	+15V	NC	
33	AGND	W1	
34	+15V	NC	
35	−15V	NC	
36	AGND	NC	
37	−15V	NC	
38	−12.6V(PROBE)	W1	K
39	AGND	NC	
40	NC	W1	
41	SWEEP INPUT	W1	F
42	AGND	NC	
43	NC	W1	
44	NC	W1	
45	AGND	NC	
46	NC	W1	
47	NC	W1	
48	AGND	NC	
49	NC	W1	
50	NC	W1	

J2 INTERFACE

PIN	SIGNAL	TO/FROM	BLOCK
1	NC	A3W1	
2	NC	A3W1	
3	NC	A3W1	
4	NC	A3W1	
5	LRESET	A3W1	O
6	HSCAN	A3W1	J
7	LINTFCE_STB	A3W1	R
8	DPKD_CLK	A3W1	Z
9	LINTFCE	A3W1	R
10	ADCIRQ	A3W1	P
11	DGND	A3W1	K
12	KEYRPGIRG	A3W1	P
13	DGND	A3W1	K
14	+10VREF	A3W1	A
15	DGND	A3W1	K
16	CALOSCTUNE	A3W1	K
17	DGND	A3W1	K
18	HBADC_CLK0	A3W1	Q
19	IA9	A3W1	Q
20	IA10	A3W1	Q
21	HBKT_PULSE	A3W1	Q
22	IR/LW	A3W1	Q
23	STEP_PLL1	A3W1	J
24	IA8	A3W1	Q
25	BID1	A3W1	Q
26	BID0	A3W1	Q
27	BID3	A3W1	Q
28	BID2	A3W1	Q
29	BID5	A3W1	Q
30	BID4	A3W1	Q
31	BID7	A3W1	Q
32	BID6	A3W1	Q
33	IA7	A3W1	Q
34	IA6	A3W1	Q
35	IA3	A3W1	Q
36	IA5	A3W1	Q
37	IA4	A3W1	Q
38	IA2	A3W1	Q
39	IA0	A3W1	Q
40	IA1	A3W1	Q

J3 CAL OSC/DISP DRVR BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	NC	W7	
2	Y POS	W7	H
3	AGND	W7	K
4	X POS	W7	G
5	AGND	W7	K
6	ZOUT	W7	M
7	FOCUS_CNTL	W7	N
8	DGND	W7	K
9	BLANKING	W7	J
10	+5V	W7	K
11	+5V	W7	K
12	−15V	W7	K
13	+15V	W7	K
14	LCALOSCON	W7	W
15	STB2	W7	W
16	LCO_SPN_STB	W7	W
17	HCO_PLL_STB	W7	W
18	BID7	W7	Q
19	DGND	W7	K
20	BID6	W7	Q
21	BID5	W7	Q
22	DGND	W7	K
23	BID4	W7	Q
24	BID3	W7	Q
25	DGND	W7	K
26	BID2	W7	Q
27	BID1	W7	Q
28	DGND	W7	K
29	BID0	W7	Q
30	CALOSCTUNE	W7	K

J5 HP-IB

PIN	SIGNAL	TO/FROM	BLOCK
1	DIO1	A19W1	AA
2	DIO5	A19W1	AA
3	DIO2	A19W1	AA
4	DIO6	A19W1	AA
5	DIO3	A19W1	AA
6	DIO7	A19W1	AA
7	DIO4	A19W1	AA
8	DIO8	A19W1	AA
9	EOI	A19W1	AA
10	REN	A19W1	AA
11	DAV	A19W1	AA
12	DGND	A19W1	K
13	NRFD	A19W1	AA
14	DGND	A19W1	K
15	NDAC	A19W1	AA
16	DGND	A19W1	K
17	IFC	A19W1	AA
18	DGND	A19W1	K
19	SRQ	A19W1	AA
20	DGND	A19W1	K
21	ATN	A19W1	AA
22	DGND	A19W1	K
23	NC	A19W1	AA
24	DGND	A19W1	K

J6 OPTION MODULE BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	LOPT STROBE	W4	R
2	DGND	W4	K
3	BADC_CLK1	W4	Q
4	+28V	W4	K
5	+5V	W4	K
6	+5V	W4	K
7	OPTR/LW	W4	Q
8	+15V	W4	K
9	LHALT	W4	O
10	+15V	W4	K
11	OPTIONIRQ	W4	P
12	LOPT/IR	W4	R
13	DGND	W4	K
14	LOPTPROG	W4	R
15	OA15	W4	Q
16	LOPTION_ID	W4	Q
17	OA14	W4	Q
18	OA13	W4	Q
19	−15V	W4	K
20	OA12	W4	Q
21	OA11	W4	Q
22	+5V	W4	K
23	OA10	W4	Q
24	OA9	W4	Q
25	WR_PROT	W4	U
26	OA8	W4	Q
27	OA7	W4	Q
28	DGND	W4	K
29	OA6	W4	Q
30	OA5	W4	Q
31	DGND	W4	K
32	OA4	W4	Q
33	OA3	W4	Q
34	DGND	W4	K
35	OA2	W4	Q
36	OA1	W4	Q
37	DGND	W4	K
38	OA0	W4	Q
39	OD7	W4	Q
40	DGND	W4	K
41	OD6	W4	Q
42	OD5	W4	Q
43	DGND	W4	K
44	OD4	W4	Q
45	OD3	W4	Q
46	DGND	W4	K
47	OD2	W4	Q
48	OD1	W4	Q
49	DGND	W4	K
50	OD0	W4	Q

J9 TEST POINTS

PIN	SIGNAL	TO/FROM	BLOCK
1	DGND		K
2	DRESET		O
3	A20		P
4	DSPLY CLK		Z
5	R/LW		P
6	A19		P
7	LDTACK		P
8	LAS		P
9	CPU CLK		P
10	DGND		K

J10 BATTERY

PIN	SIGNAL	TO/FROM	BLOCK
1	BATTRY	W6	V
2	NC	W6	V
3	BATGND	W6	V

J11 TEST & ADJUSTMENT

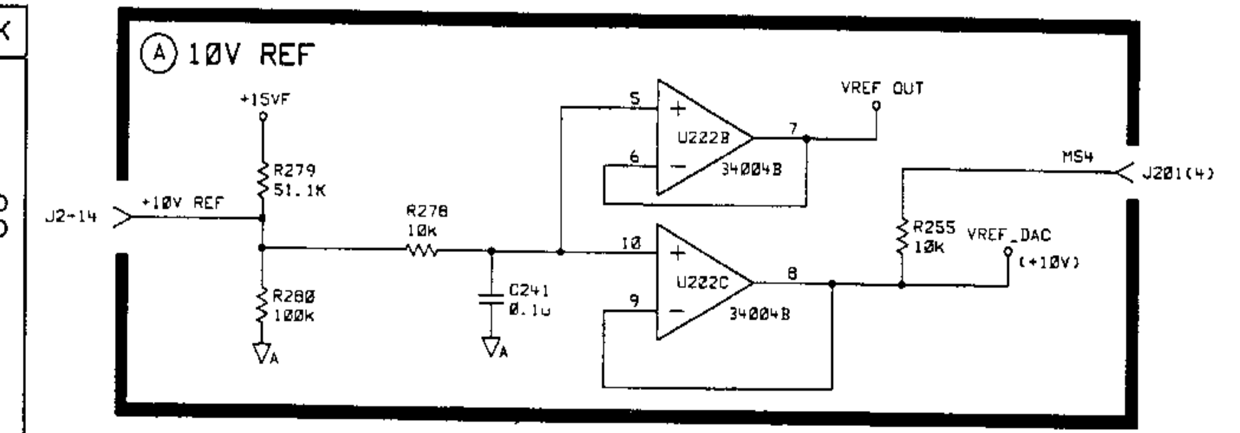
PIN	SIGNAL	TO/FROM	BLOCK
1	MS1	NC	B
2	MS2		B
3	MS3		B
4	MS4		B
5	MS5		B
6	GND		B
7	A0		NC
8	A1		NC
9	KEY		NC
10	A2		B
11	A3		NC
12	A4		NC
13	MS6		B
14	MS7		B
15	MS8		B
16	OS1		B

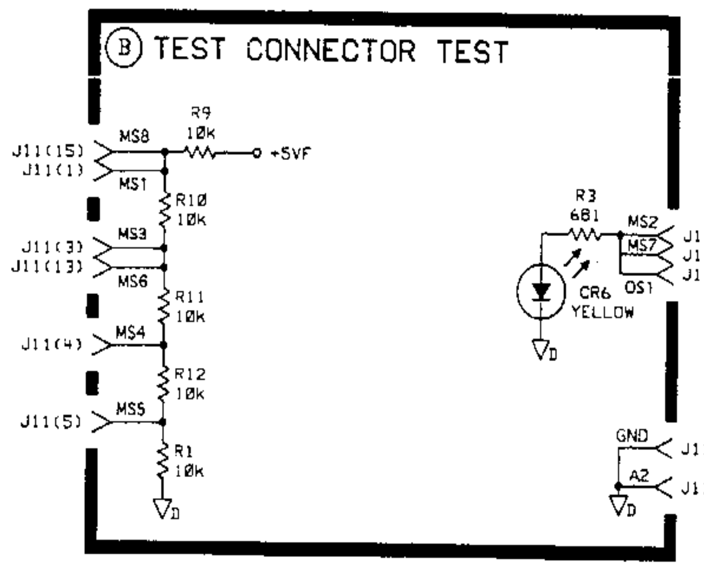
J201 TEST & ADJUSTMENT

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1	NC	I
2	MS2		D
3	MS3		M
4	MS4		A
5	MS5		NC
6	GND		AGND
7	A0		NC
8	A1		AGND
9	KEY		NC
10	A2		NC
11	A3		NC
12	A4		NC
13	MS6		D
14	MS7		I
15	MS8		L
16	OS1		NC

J202 TEST & ADJUSTMENT

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1	NC	K
2	MS2		N
3	MS3		H
4	MS4		M
5	MS5		NC
6	GND		AGND
7	A0		DGND
8	A1		NC
9	KEY		NC
10	A2		NC
11	A3		NC
12	A4		NC
13	MS6		NC
14	MS7		G
15	MS8		J
16	OS1		NC





CE2HA014

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 1 of 11).

SEE SHEET 1 FOR NOTES

CE2HA015

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 2 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA016

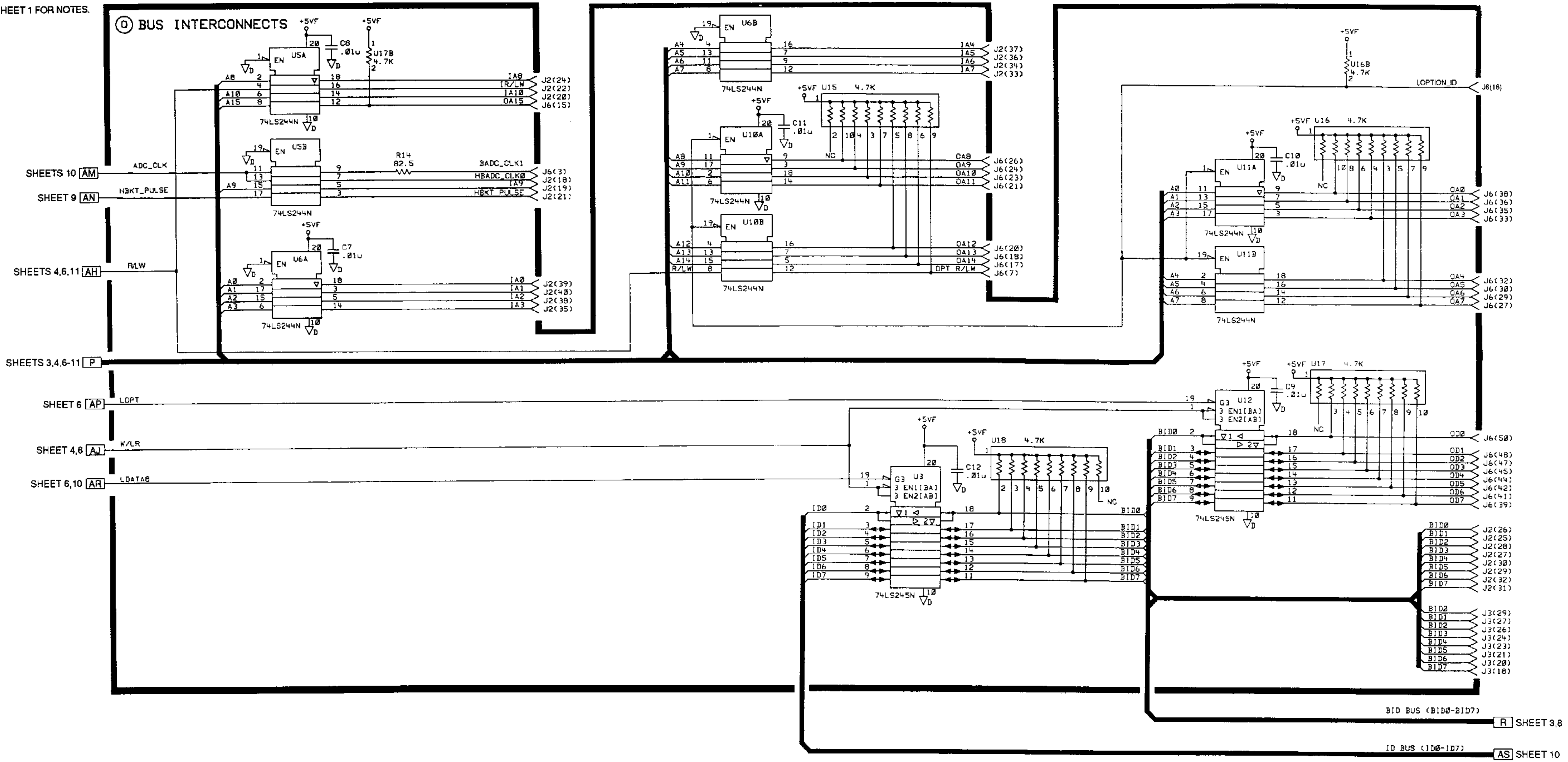
Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 3 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA017

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 4 of 11).

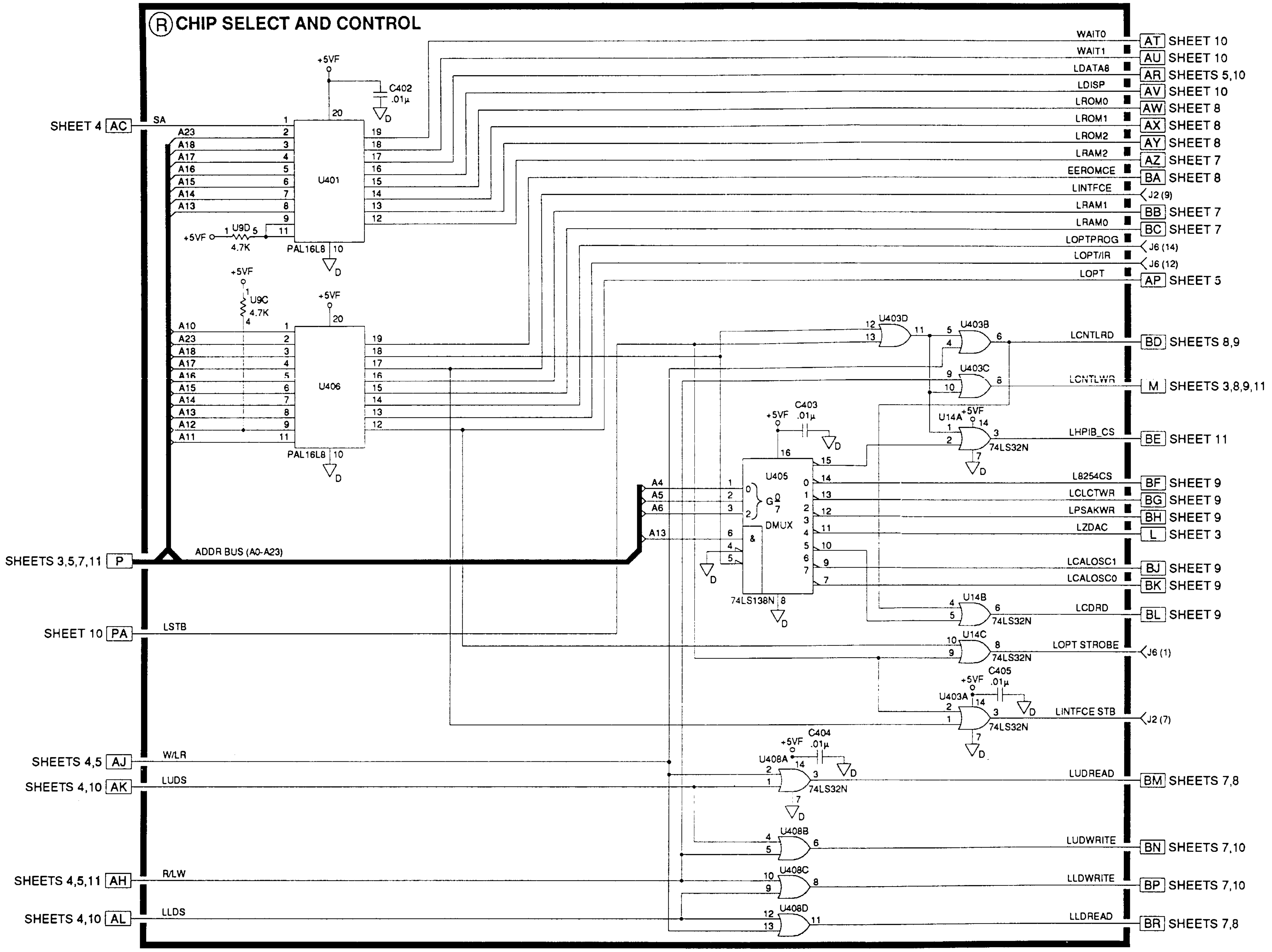
SEE SHEET 1 FOR NOTES.



CE2HA018

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 5 of 11).

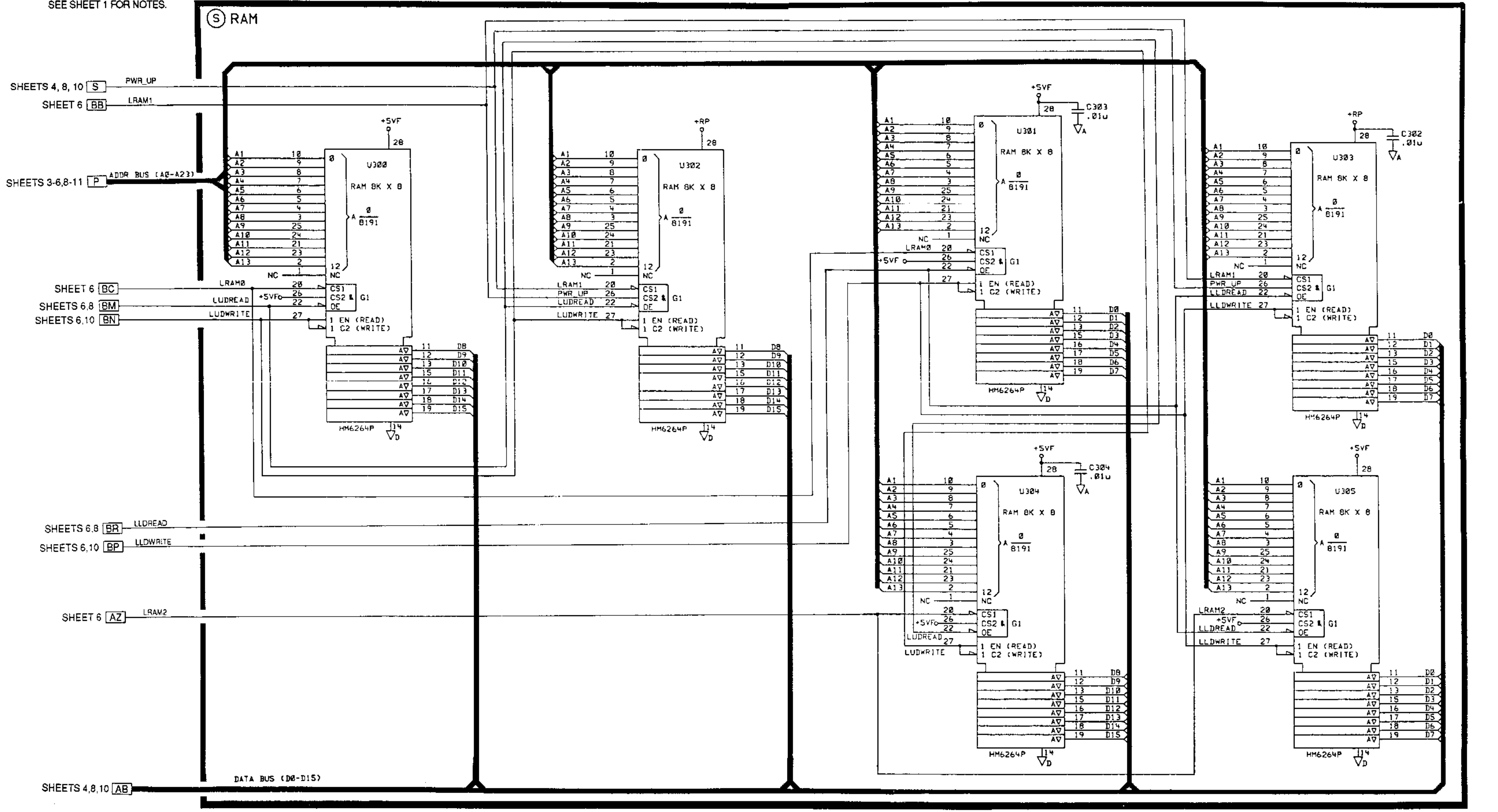
SEE SHEET 1 FOR NOTES.



CE2HA019

Figure FO-9. A2 Controller CCA Schematic Diagram-Serial Prefix 2929A through 3051A (Sheet 6 of 11).

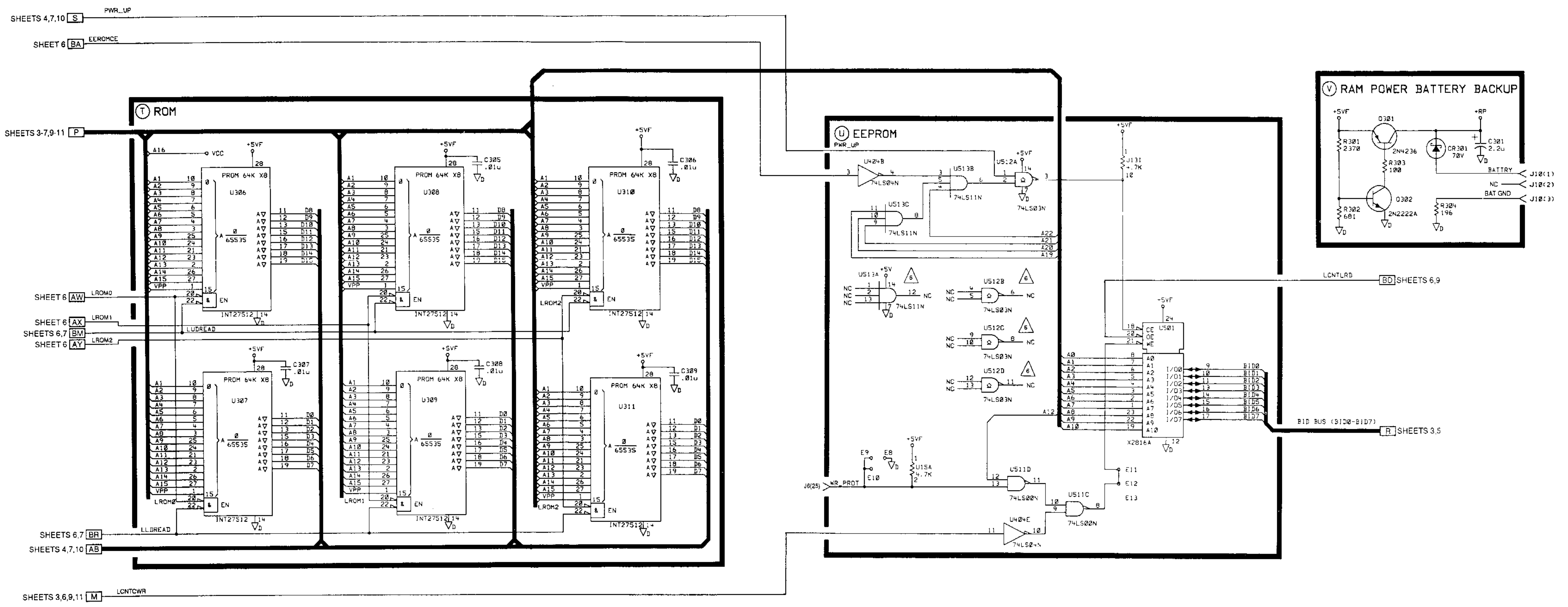
SEE SHEET 1 FOR NOTES.



CE2HA020

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 7 of 11).

SEE SHEET 1 FOR NOTES.



CE2HA021

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 8 of 11).

SEE SHEET 1 FOR NOTES

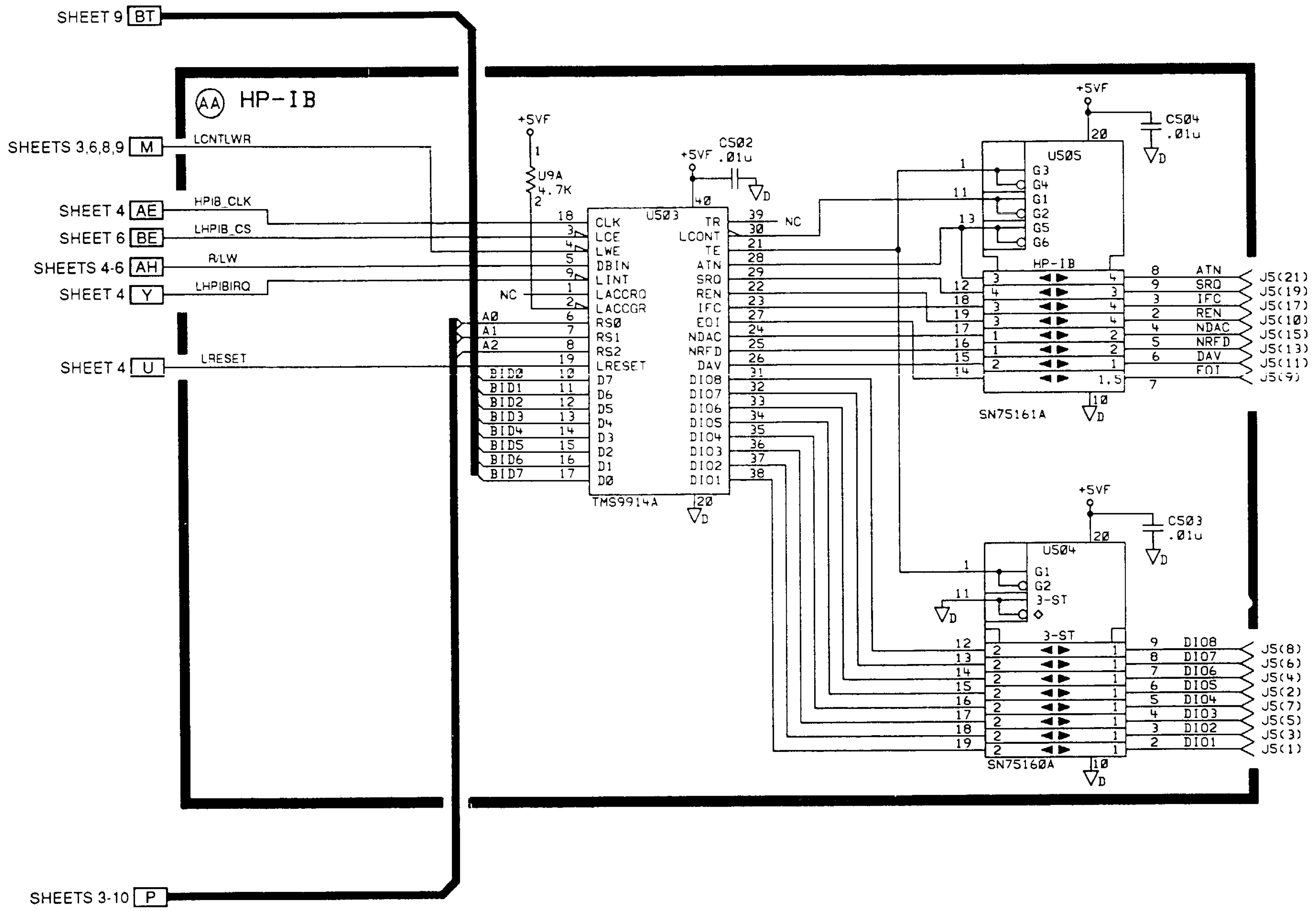
CE2HA022

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 9 of 11).

SEE SHEET 1 FOR NOTES.

Figure FO-9. A2 Controller CCA Schematic Diagram - Serial Prefix 2929A through 3051A (Sheet 10 of 11).

SEE SHEET 1 FOR NOTES.



CE2HA024

Figure FO-9. A2 Controller CCA Schematic Diagram-Serial Prefix 2929A through 3051A (Sheet 11 of 11).

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A2 FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS (Ω).
CAPACITANCE IS IN MICROFARADS (μF).
INDUCTANCE IS IN MICROHENRIES (μH).
∇_A = ANALOG GROUND.
∇_D = DIGITAL GROUND.

3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A2 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	TO
08562-60124	3115A	3121A
08562-60151	3129A	3226A
08562-60173	3236A	3306A

4. BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.

5. REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

△6 JUMPER SHOWN IN NON DSA POSITION.

△7 COMPONENT(S) NOT USED.

△8 COMPONENT(S) NOT LOADED.

△9 JUMPER SHOWN IN WRITE PROTECT POSITION.

△10 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A2 CIRCUIT CARD ASSEMBLY WITH HP P/N 08562-60124.

△11 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A2 CIRCUIT CARD ASSEMBLY WITH HP P/N 08562-60151 AND 08562-60173.

12 DIFFERENCE BETWEEN 08562-60151 AND 08562-60173 IS ONLY TRACE WIDTH ON THE PRINTED WIRING BOARD.

△13 CONFIGURATION OR VALUE FOR CIRCUIT CARDS 08562-60151 WITH PREFIX PRIOR TO 3129A.

△14 CONFIGURATION OR VALUE FOR CIRCUIT CARD 08562-60151 AND 08562-60173 AT AND AFTER PREFIX 3129A.

J1 POWER BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	−15V	W1	K
2	−15V	W1	K
3	+15V	W1	K
4	+15V	W1	K
5	LINE TRIG	NC	
6	+28V	W1	K
7	+5V	W1	K
8	+5V	W1	K
9	+5V	W1	K
10	+5V	W1	K
11	+5V	W1	K
12	+5V	W1	K
13	DGND	W1	K
14	DGND	W1	K
15	DGND	W1	K
16	DGND	W1	K
17	AGND	W1	K
18	AGND	W1	K
19	DGND	W1	K
20	DGND	W1	K
21	+5V	NC	
22	+5V	NC	
23	+5V	NC	
24	+5V	NC	
25	+15V	NC	
26	+15V	NC	
27	−15V	NC	
28	−15V	NC	
29	PWR_UP	W1	O
30	+28V	NC	
31	+28V	NC	
32	+15V	NC	
33	AGND	NC	
34	+15V	NC	
35	−15V	NC	
36	AGND	NC	
37	−15V	NC	
38	−12.6V(PROBE)	W1	K
39	AGND	NC	
40	NC	W1	
41	SWEEP INPUT	W1	F
42	AGND (NC)	NC	
43	NC	W1	
44	NC	W1	
45	AGND	NC	
46	NC	W1	
47	NC	W1	
48	AGND	NC	
49	NC	W1	
50	NC	W1	

J2 INTERFACE

PIN	SIGNAL	TO/FROM	BLOCK
1	NC	A3W1	
2	NC	A3W1	
3	NC	A3W1	
4	NC	A3W1	
5	LRESET	A3W1	O
6	HSCAN	A3W1	J
7	LINTFCESTB	A3W1	R
8	DPKD CLK	A3W1	AA
9	LINTFCE	A3W1	R
10	ADCIRQ	A3W1	P
11	DGND	A3W1	K
12	KEYRPGIRG	A3W1	P
13	DGND	A3W1	K
14	+10VREF	A3W1	A
15	DGND	A3W1	K
16	CALOSCTUNE	A3W1	K
17	DGND	A3W1	K
18	HBADC CLK0	A3W1	Q
19	IA9	A3W1	Q
20	IA10	A3W1	Q
21	HBKT PULSE	A3W1	Q
22	IR/LW	A3W1	Q
23	STEP_PLL1	A3W1	J
24	IA8	A3W1	Q
25	BID1	A3W1	Q
26	BID0	A3W1	Q
27	BID3	A3W1	Q
28	BID2	A3W1	Q
29	BID5	A3W1	Q
30	BID4	A3W1	Q
31	BID7	A3W1	Q
32	BID6	A3W1	Q
33	IA7	A3W1	Q
34	IA6	A3W1	Q
35	IA3	A3W1	Q
36	IA5	A3W1	Q
37	IA4	A3W1	Q
38	IA2	A3W1	Q
39	IA0	A3W1	Q
40	IA1	A3W1	Q

J3 CAL OSC/DISPLAY DRIVER BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	NC	W7	
2	YPOS	W7	H
3	AGND	W7	K
4	XPOS	W7	G
5	AGND	W7	K
6	ZOUT	W7	M
7	FOCUS CNTL	W7	M
8	DGND	W7	K
9	BLANKING	W7	J
10	+5VF	W7	K
11	+5VF	W7	K
12	−15VF	W7	K
13	+15VF	W7	K
14	LCALOSCON	W7	X
15	STB2	W7	X
16	LOC SPN STB	W7	X
17	HCO PLL STB	W7	X
18	BID7	W7	Q
19	DGND	W7	K
20	BID6	W7	Q
21	BID5	W7	Q
22	DGND	W7	K
23	BID4	W7	Q
24	BID3	W7	Q
25	DGND	W7	K
26	BID2	W7	Q
27	BID1	W7	Q
28	DGND	W7	K
29	BID0	W7	Q
30	CALOSCTUNE	W7	K

J5 HP-IB

PIN	SIGNAL	TO/FROM	BLOCK
1	D101	A19W1	AB
2	D105	A19W1	AB
3	D102	A19W1	AB
4	D106	A19W1	AB
5	D103	A19W1	AB
6	D107	A19W1	AB
7	D104	A19W1	AB
8	D108	A19W1	AB
9	EOI	A19W1	AB
10	REN	A19W1	AB
11	DAV	A19W1	AB
12	DGND	A19W1	K
13	NRFD	A19W1	AB
14	DGND	A19W1	K
15	NDAC	A19W1	AB
16	DGND	A19W1	K
17	IFC	A19W1	AB
18	DGND	A19W1	K
19	SRQ	A19W1	AB
20	DGND	A19W1	K
21	ATN	A19W1	AB
22	DGND	A19W1	K
23	NC	A19W1	
24	DGND	A19W1	K

J6 OPTION MODULE BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	LOPT STROBE	W4	R
2	DGND	W4	K
3	BADC CLK1	W4	Q
4	+28V	W4	K
5	+5VF	W4	K
6	+5VF	W4	K
7	OPTR/LW	W4	Q
8	+15VF	W4	K
9	LHALT	W4	O
10	+15VF	W4	K
11	OPTIONIRQ	W4	P
12	LOPTI/O	W4	R
13	DGND	W4	K
14	LOPTPROG	W4	R
15	OA15	W4	Q
16	LOPTION ID	W4	Q
17	OA14	W4	Q
18	OA13	W4	Q
19	−15VF	W4	K
20	OA12	W4	Q
21	OA11	W4	Q
22	+5VF	W4	K
23	OA10	W4	Q
24	OA9	W4	Q
25	WR PROT	W4	U
26	OA8	W4	Q
27	OA7	W4	Q
28	DGND	W4	K
29	OA6	W4	O
30	OA5	W4	Q
31	DGND	W4	K
32	OA4	W4	Q
33	OA3	W4	Q
34	DGND	W4	K
35	OA2	W4	Q
36	OA1	W4	Q
37	DGND	W4	K
38	OA0	W4	Q
39	OD7	W4	Q
40	DGND	W4	K
41	OD6	W4	Q
42	OD5	W4	Q
43	DGND	W4	K
44	OD4	W4	Q
45	OD3	W4	Q
46	DGND	W4	K
47	OD2	W4	Q
48	OD1	W4	Q
49	DGND	W4	K
50	OD0	W4	Q

J9 TEST POINTS

PIN	SIGNAL	TO/FROM	BLOCK
1	DGND		K
2	DRESET		O
3	A20		P
4	DSPLY CLK		AA
5	LW/R		P
6	A19		P
7	LDTACK		P
8	LAS		P
9	CPU CLK		P
10	DGND		K

J10 BATTERY

PIN	SIGNAL	TO/FROM	BLOCK
1	BATTRY	W6	W
2	NC	W6	W
3	BATGND	W6	W

J11 TEST & ADJUSTMENT

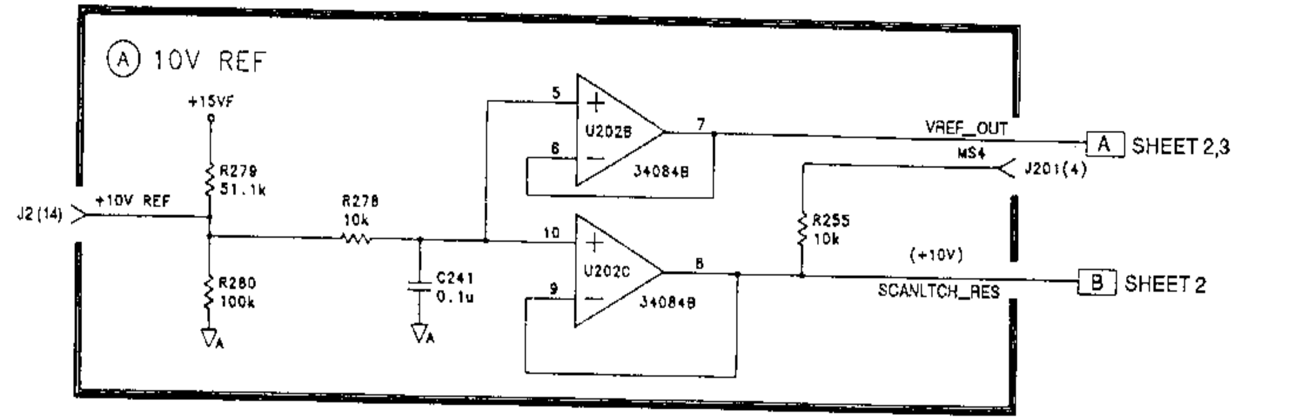
PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		B
2	MS2		B
3	MS3		B
4	MS4		B
5	MS5	NC	B
6	DGND		B
7	A0	NC	
8	A1 (DGND)		B
9	KEY	NC	
10	A3 (DGND)		B
11	A3	NC	
12	A4	NC	
13	MS6		B
14	MS7		B
15	MS8		B
16	OS1	NC	B

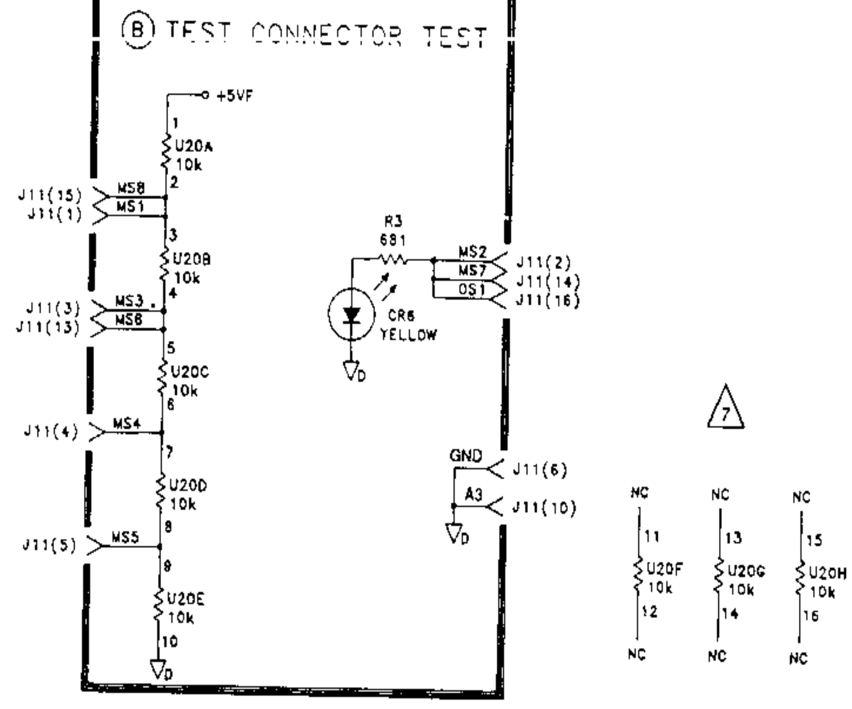
J201 TEST & ADJUSTMENT

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		I
2	MS2		D
3	MS3		M
4	MS4		A
5	MS5	NC	
6	AGND		K
7	A0	NC	
8	A1 (DGND)		K
9	KEY	NC	
10	A2	NC	
11	A3	NC	
12	A4	NC	
13	MS6		D
14	MS7		I
15	MS8		L
16	OS1	NC	

J202 TEST & ADJUSTMENT

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		K
2	MS2		N
3	MS3		H
4	MS4		M
5	MS5	NC	
6	AGND		K
7	A0 (DGND)		K
8	A1	NC	
9	KEY	NC	
10	A2	NC	
11	A3	NC	
12	A4	NC	
13	MS6	NC	
14	MS7		G
15	MS8		J
16	OS1	NC	





CE2HA025

Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 1 of 9).

CE2HA026

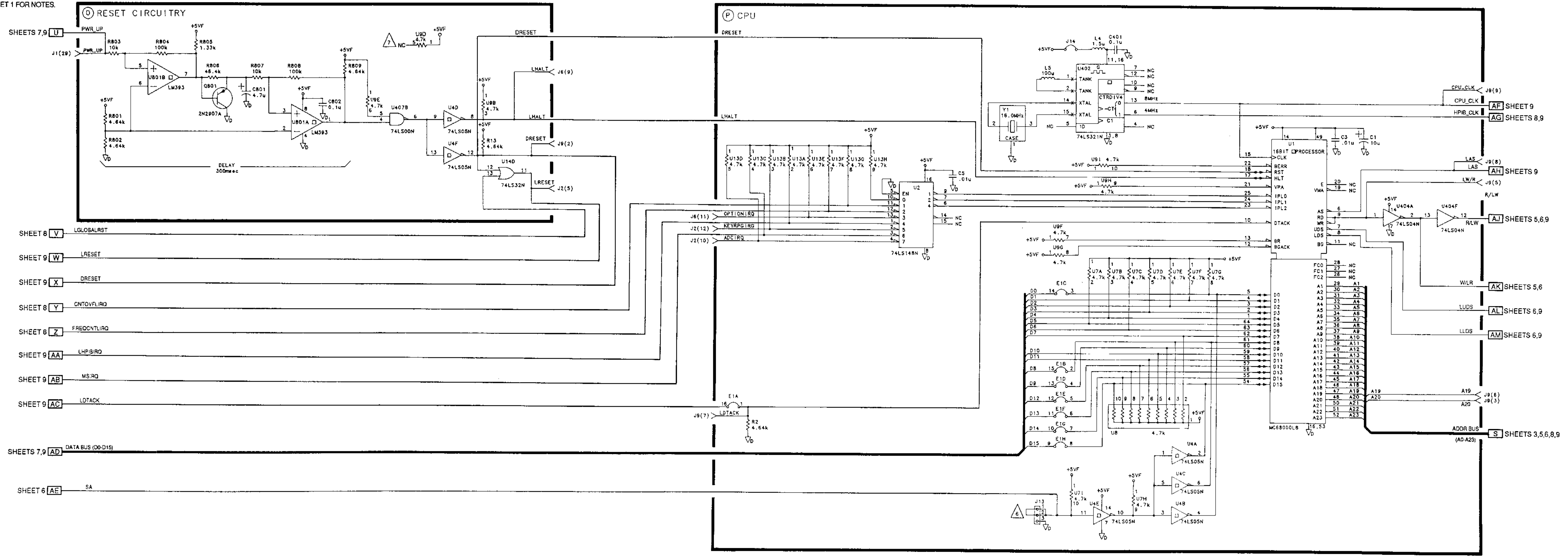
Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 2 of 9).

SEE SHEET 1 FOR NOTES.

CE2HA027

Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 3 of 9).

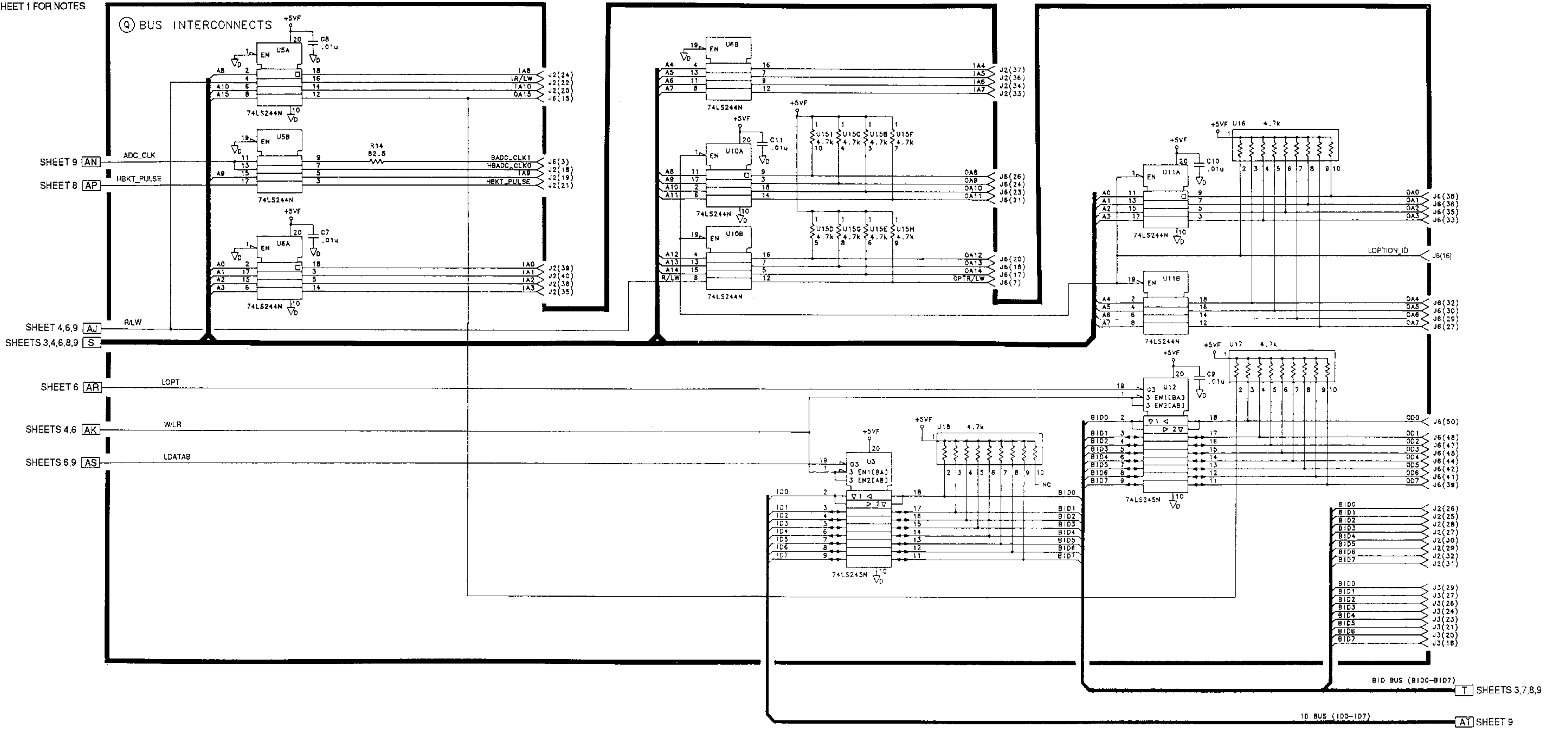
SEE SHEET 1 FOR NOTES.



CE2HA028

Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 4 of 9).

SEE SHEET 1 FOR NOTES.

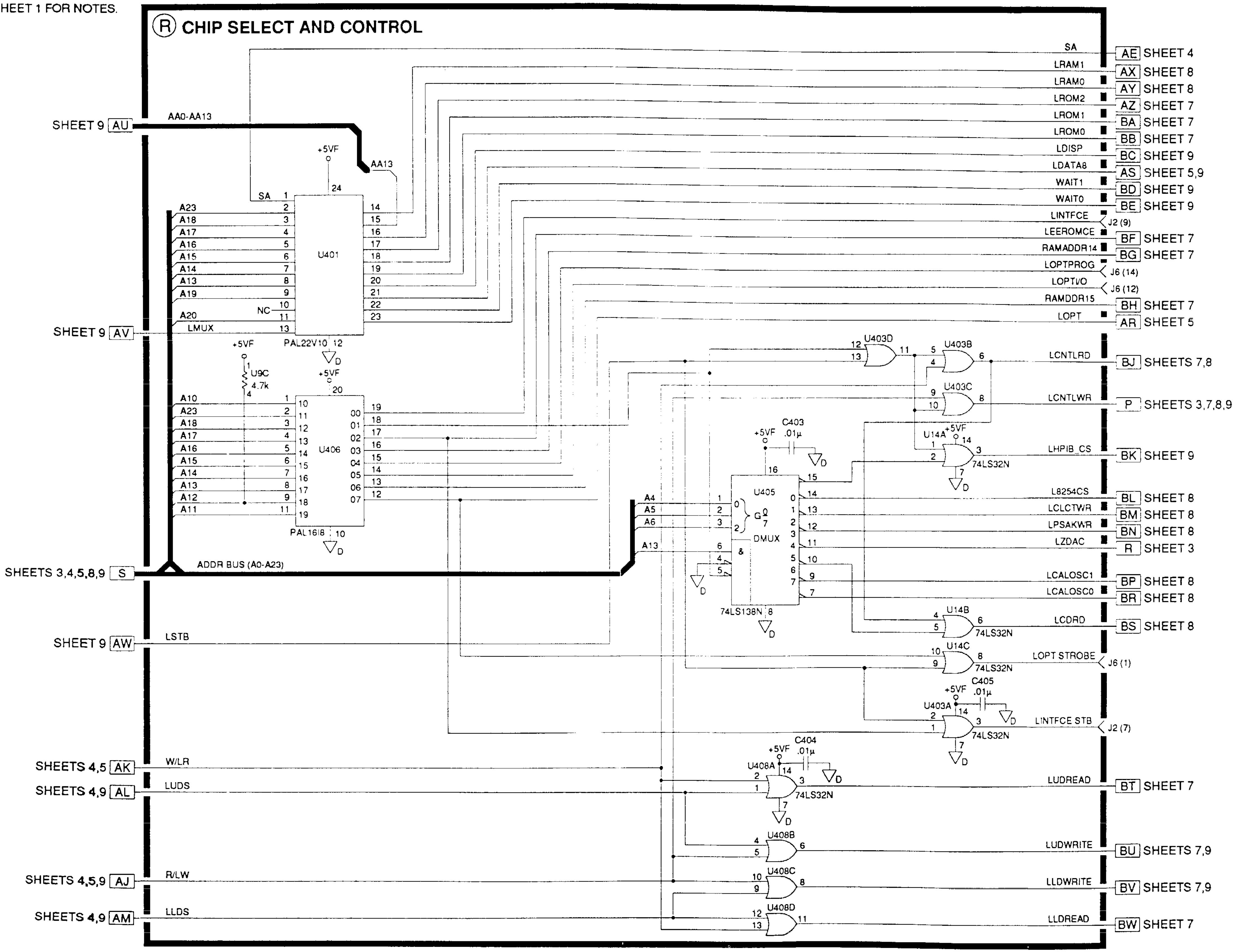


CE2HA029

Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 5 of 9).

FP-57/FP-58 Blank)

SEE SHEET 1 FOR NOTES.



CE2HA030

Figure FO-10. A2 Controller CCA Schematic Diagram-Serial Prefix 3115A through 3306A (Sheet 6 of 9).

SEE SHEET 1 FOR NOTES.

CE2HA031

Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 7 of 9).

CE2HA032

Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 8 of 9).

SEE SHEET 1 FOR NOTES.

CE2HA033

Figure FO-10. A2 Controller CCA Schematic Diagram - Serial Prefix 3115A through 3306A (Sheet 9 of 9).

NOTES:

1. ▣ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIODES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (⊙ ROUND PAD = TP GROUND)

△2 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60097 AND 08562-60138 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3051A).

△3 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60142, 08562-60149, AND 08562-60144 (AN/USM-489A SERIAL NUMBER PREFIXES 3115A THROUGH 3306A).

△4 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60097, 08562-60138, AND 08562-60142 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3120A).

△5 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60149, AND 08562-60144 (AN/USM-489A SERIAL NUMBER PREFIXES 3121A THROUGH 3306A).

△6 — – – — LINE INDICATES SHIELD.

7. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A3 FOR COMPLETE REFERENCE DESIGNATOR.

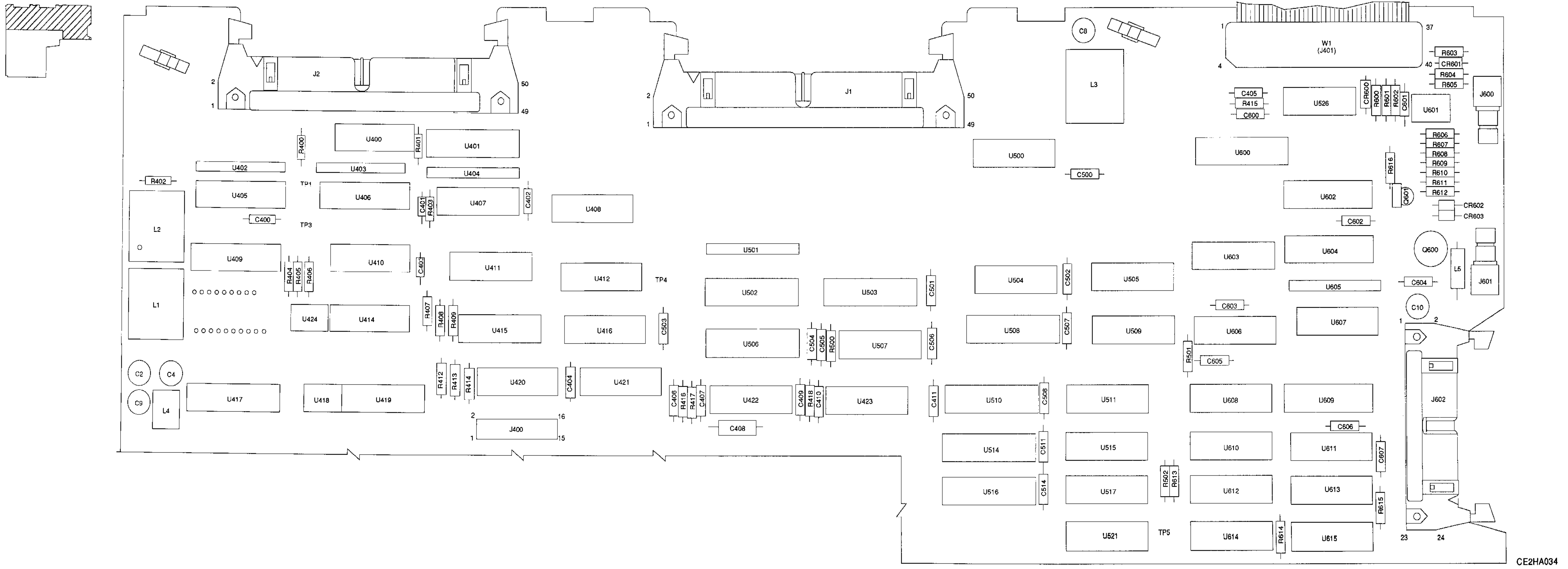
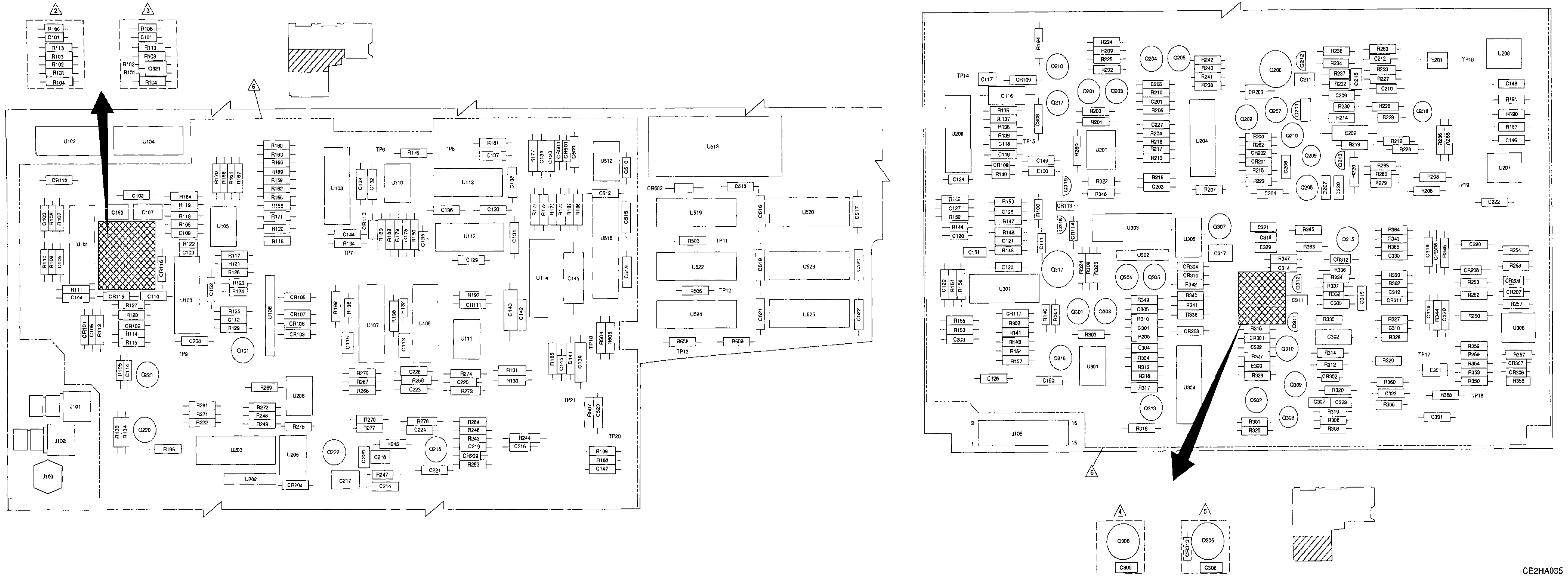


Figure FO-11. A3 Interface CCA Component Locator Diagram (Sheet 1 of 2).

SEE SHEET 1 FOR NOTES.



CE2HA035

Figure FO-11. A3 Interface CCA Component Locator Diagram (Sheet 2 of 2).

CE2HA036

Figure FO-12. A3 Interface CCA Functional Block Diagram.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A3 FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS (Ω).
CAPACITANCE IS IN MICROFARADS (μF).
INDUCTANCE IS IN MICROHENRIES (μH).
∇_A = ANALOG GROUND.
∇_D = DIGITAL GROUND.

3. MNEMONIC TABLE

MNEMONIC	DESCRIPTION
MS	MEASURED SIGNAL
TA	TAM ADDRESS LINE

4. THIS SCHEMATIC IS USED FOR THE FOLLOWING A3 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	TO
08562-60097	2929A	3029A
08562-60138	3040A	3051A
08562-60142	3115A	3120A
08562-60149	3121A	3148A
08562-60144	3204A	3306A

5. PINS CONNECTED TO EMBEDDED POWER/GROUND NETS:
U102 8 (DGND), 16(+5V)
U104 8(DGND), 16(+5V)
U108 3(−15VF), 13(+15VF), 14(AGND)
U112 1(DGND), 3(−15VF), 13(+15VF)
U113 1(DGND), 3(−15VF), 13(+15VF)
U12 7(DGND), 14(+5V)
U205 4(−15VF), 7(+15VF)
U305 4(−15VF), 7(+15VF)
U400 7(DGND), 14(+5V)
U401 10(DCOM), 20(+5V)
U405 10(DCOM), 20(+5V)
U406 10(DGND), 20(+5V)
U407 8(DGND), 16(+5V)
U409 1(AGND), 5 (DGND), 17(+5V)
U410 8(DGND), 16(+5V)
U411 8(DGND), 16(+5V)
U412 7(DGND), 14(+5V)
U413 1(AGND), 5(DGND), 17(+5V)
U414 8(DGND), 16(+5V)
U415 7(DCOM), 14(+5V)
U416 7(DGND), 14(+5V)
U417 1(AGND), 5(AGND), 5(DGND), 17(+15V)
U420 8(DGND), 16(+5V)
U421 8(DGND), 16(+5V)
U422 8(DGND), 16(+5V)
U423 8(DGND), 16(+5V)
U500 8(DGND), 16(+5V)
U502 10(DGND), 20(+5V)
U503 10(DGND), 20(+5V)
U504 8(DGND), 16(+5V)
U505 7(DGND), 14(+5V)
U506 10(DGND), 20(+5V)

(CONTINUED)
5. PINS CONNECTED TO EMBEDDED POWER/GROUND NETS:
U507 8(DGND), 16(+5V)
U508 10(DGND), 20(+5V)
U509 8(DGND), 16(+5V)
U510 10(DGND), 20(+5V)
U511 7(DGND), 14(+5V)
U512 1(DGND), 4(−15V), 8(+15V)
U513 12(DGND), 24(+5V)
U514 10(DGND), 20(+5V)
U515 7(DGND), 14(+5V)
U516 10(DGND), 20(+5V)
U517 7(DGND), 14(+5V)
U518 13(AGND), 17(−15V), 20(+15V)
U519 8(DGND), 16(+5V)
U520 8(DGND), 16(+5V)
U521 7(DGND), 14(+5V)
U522 8(DGND), 16(+5V)
U523 8(DGND), 16(+5V)
U524 8(DGND), 16(+5V)
U525 8(DGND), 16(+5V)
U600 10(DGND), 20(+5V)
U602 10(DGND), 20(+5V)
U603 10(DGND), 20(+5V)
U604 10(DGND), 20(+5V)
U606 8(DGND), 14(+5V)
U607 8(DGND), 14(+5V)
U608 7(DGND), 14(+5V)
U609 10(DGND), 20(+5V)
U610 7(DGND), 14(+5V)
U611 8(DGND), 16(+5V)
U612 7(DGND), 14(+5V)
U613 8(DGND), 16(+5V)
U614 7(DGND), 14(+5V)
U615 7(DGND), 14(+5V)

6. BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.

7. REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

△8 COMPONENT(S) NOT USED.

△9 CONFIGURATION(S)/VALUE(S) SHOWN ARE FOR A3 CIRCUIT CARD ASSEMBLY HP P/N 08562-60097.

△10 CONFIGURATION(S)/VALUE(S) SHOWN ARE FOR A3 CIRCUIT CARD ASSEMBLY HP P/N 08562-60138.

△11 CONFIGURATION(S)/VALUE(S) SHOWN ARE FOR A3 CIRCUIT CARD ASSEMBLY HP P/N 08562-60142.

△12 CONFIGURATION(S)/VALUE(S) SHOWN ARE FOR A3 CIRCUIT CARD ASSEMBLY HP P/N 08562-60149.

△13 CONFIGURATION(S)/VALUE(S) SHOWN ARE FOR A3 CIRCUIT CARD ASSEMBLY HP P/N 08562-60144.

△14 CAPACITANCE FORMED BY P.C. BOARD.

J1 POWER BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	NC	W1	
2	NC	W1	
3	AGND	W1	C
4	NC	W1	
5	NC	W1	
6	AGND	W1	C
7	NC	W1	
8	NC	W1	
9	AGND	W1	C
10	SCAN RAMP	W1	AA
11	NC	W1	
12	AGND	W1	C
13	−12.6V (PROBE)	W1	C
14	−15V	W1	C
15	AGND	W1	C
16	−15V	W1	C
17	+15V	W1	C
18	AGND	W1	C
19	+15V	W1	C
20	+28V	W1	C
21	+28V	W1	C
22	PWR UP	W1	NC
23	−15V	W1	C
24	−15V	W1	C
25	+15V	W1	C
26	+15V	W1	C
27	+5V	W1	C
28	+5V	W1	C
29	+5V	W1	C
30	+5V	W1	C
31	DGND	W1	C
32	DGND	W1	C
33	AGND	W1	C
34	AGND	W1	C
35	DGND	W1	C
36	DGND	W1	C
37	DGND	W1	C
38	DGND	W1	C
39	+5V	W1	C
40	+5V	W1	C
41	+5V	W1	C
42	+5V	W1	C
43	+5V	W1	C
44	+5V	W1	C
45	+28V	W1	C
46	LINE TRIG	W1	H
47	+15V	W1	C
48	+15V	W1	C
49	−15V	W1	C
50	−15V	W1	C

J2 ANALOG BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	D0	W3	N
2	DGND	W3	C
3	D1	W3	N
4	D2	W3	N
5	D3	W3	N
6	D4	W3	N
7	DGND	W3	C
8	D5	W3	N
9	D6	W3	N
10	D7	W3	N
11	A0	W3	N
12	DGND	W3	C
13	A1	W3	N
14	A2	W3	N
15	A3	W3	N
16	A4	W3	N
17	DGND	W3	C
18	A5	W3	N
19	A6	W3	N
20	A7	W3	N
21	DGND	W3	C
22	LRF STB	W3	N
23	LFC STB	W3	N
24	LIF STB	W3	N
25	NC	W3	
26	LLOG STB	W3	N
27	NC	W3	
28	DGND	W3	C
29	STEP PLL1	W3	K
30	HSCAN	W3	H
31	DGND	W3	C
32	RESERVED	W3	
33	OFL ERR	W3	AA
34	R/T DAC3	W3	L
35	AGND	W3	C
36	RF GAIN	W3	M
37	LO3 ERR	W3	NC
38	AGND	W3	C
39	LVFC ENABLE	W3	P
40	FC MUX	W3	AA
41	AGND	W3	C
42	YTO ERR	W3	AA
43	+10V REF	W3	AD
44	AGND	W3	C
45	SCAN RAMP	W3	AA, C
46	VIDEO TRIG	W3	H
47	AGND	W3	C
48	NC	W3	
49	R/T DAC2	W3	L
50	R/T DAC1	W3	L

J105 TEST & ADJ

PIN	SIGNAL	BLOCK
1	MS1	T
2	MS2	T
3	MS3	U
4	MS4	NC
5	MS5	W
6	AGND	C
7	TA0 (AGND)	C
8	TA1	NC
9	KEY	NC
10	TA2	NC
11	TA3 (AGND)	C
12	TA4	NC
13	MS6	AB
14	MS7	AB
15	MS8	AC
16	OS1	U

J400 TEST & ADJ

PIN	SIGNAL	BLOCK
1	MS1	H
2	MS2	C
3	MS3	L
4	MS4	L
5	MS5	L
6	DGND	C
7	TA0 (NC)	
8	TA1 (DGND)	C
9	N.C. KEY	
10	TA2 (NC)	
11	TA3 (DGND)	C
12	TA4 (NC)	
13	MS6	M
14	MS7	B
15	MS8	H
16	OS1 (OPEN)	

J401 CONTROLLER BUS

PIN	SIGNAL	TO/FROM	BLOCK
1	IA1	A2J2-40	K
2	IA0	A2J2-39	K
3	IA2	A2J2-38	K
4	IA4	A2J2-37	K
5	IA5	A2J2-36	K
6	IA3	A2J2-35	K
7	IA6	A2J2-34	K
8	IA7	A2J2-33	K
9	BID6	A2J2-32	O
10	BID7	A2J2-31	O
11	BID4	A2J2-30	O
12	BID5	A2J2-29	O
13	BID2	A2J2-28	O
14	BID3	A2J2-27	O
15	BID0	A2J2-26	O
16	BID1	A2J2-25	O
17	IA8	A2J2-24	K
18	STEP PLL1	A2J2-23	K
19	HINTFCE RD	A2J2-22	K
20	HBKT PULSE	A2J2-21	B
21	IA10	A2J2-20	K
22	IA9	A2J2-19	K
23	HBADC CLK0	A2J2-18	F
24	DGND	A2J2-17	C
25	CAL OSCTUNE	A2J2-16	AA
26	DGND	A2J2-15	C
27	+10VREF	A2J2-14	AD
28	DGND	A2J2-13	C
29	LKEYRPGIRQ	A2J2-12	G
30	DGND	A2J2-11	C
31	LADC IRQ	A2J2-10	B
32	LINTFCE	A2J2-9	K
33	DPKD CLK	A2J2-8	B
34	LINTFCE STB	A2J2-7	K
35	HSCAN	A2J2-6	H
36	LRESET	A2J2-5	F
37	NC	A2J2-4	
38	NC	A2J2-3	
39	NC	A2J2-2	
40	NC	A2J2-1	

J602 KEYBOARD/RPG

PIN	SIGNAL	TO/FROM	BLOCK
1	LKSCN5	A1A1J1-1	G
2	LKSCN4	A1A1J1-2	G
3	LKSCN3	A1A1J1-3	G
4	LKSCN2	A1A1J1-4	G
5	LKSCN1	A1A1J1-5	G
6	LKSCN0	A1A1J1-6	G
7	LKSNS7	A1A1J1-7	G
8	LKSNS6	A1A1J1-8	G
9	LKSNS5	A1A1J1-9	G
10	LKSNS4	A1A1J1-10	G
11	LKSNS3	A1A1J1-11	G
12	LKSNS2	A1A1J1-12	G
13	LKSNS1	A1A1J1-13	G
14	LKSNS0	A1A1J1-14	G
15	HRPG01	A1A1J1-15	G
16	DGND	A1A1J1-16	C
17	HRPG02	A1A1J1-17	J
18	NC	A1A1J1-18	J
19	+5V	A1A1J1-19	C
20	DGND	A1A1J1-20	C
21	PROBE GND	A1A1J1-21	NC
22	LED PWR	A1A1J1-22	G
23	PROBE +15VF	A1A1J1-23	C
24	PROBE −12.6V	A1A1J1-24	C

CE2HA037

Figure FO-13. A3 Interface CCA Schematic Diagram
(Sheet 1 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA038

Figure FO-13. A3 Interface CCA Schematic Diagram (Sheet 2 of 11).

SEE SHEET 1 FOR NOTES.

Figure FO-13. A3 Interface CCA Schematic Diagram (Sheet 3 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA040

Figure FO-13. A3 Interface CCA Schematic Diagram (Sheet 4 of 11).

SEE SHEET 1 FOR NOTES.

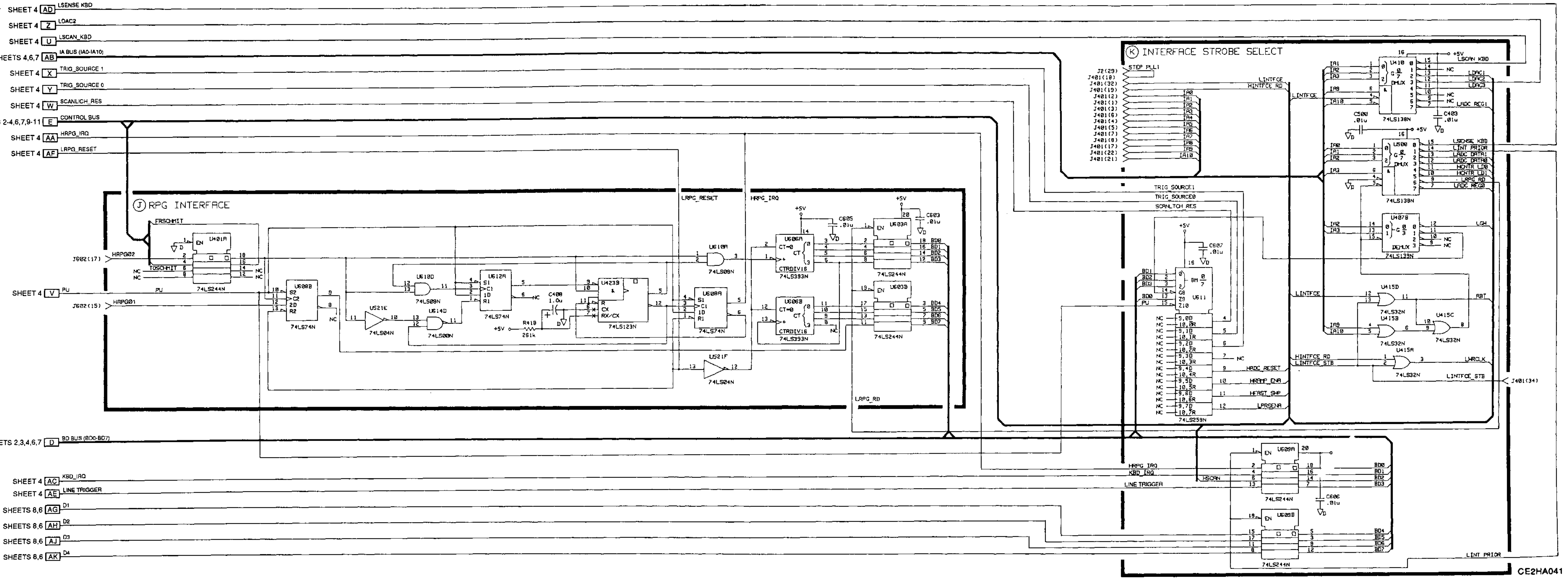


Figure FO-13. A3 Interface CCA Schematic Diagram (Sheet 5 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA042

Figure FO-13. A3 Interface CCA Schematic Diagram (Sheet 6 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA043

Figure FO-13. A3 Interface CCA Schematic Diagram
(Sheet 7 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA044

Figure FO-13. A3 Interface CCA Schematic Diagram (Sheet 8 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA045

Figure FO-13. A3 Interface CCA Schematic Diagram
(Sheet 9 of 11).

SEE SHEET 1 FOR NOTES.

CE2HA046

Figure FO-13. A3 Interface CCA Schematic Diagram
(Sheet 10 of 11).

CE2HA047

Figure FO-13. A3 Interface CCA Schematic Diagram (Sheet 11 of 11).

NOTES:

1. ▣ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIODES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (◎ ROUND PAD = TP GROUND)

2. CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60109 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3017A).

3. CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60133 (AN/USM-489A SERIAL NUMBER PREFIXES 3029A THROUGH 3306A).

4. — - - — LINE INDICATES SHIELD.

5. SHADED AREA IS NON-REPAIRABLE.

6. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A4 FOR COMPLETE REFERENCE DESIGNATOR.

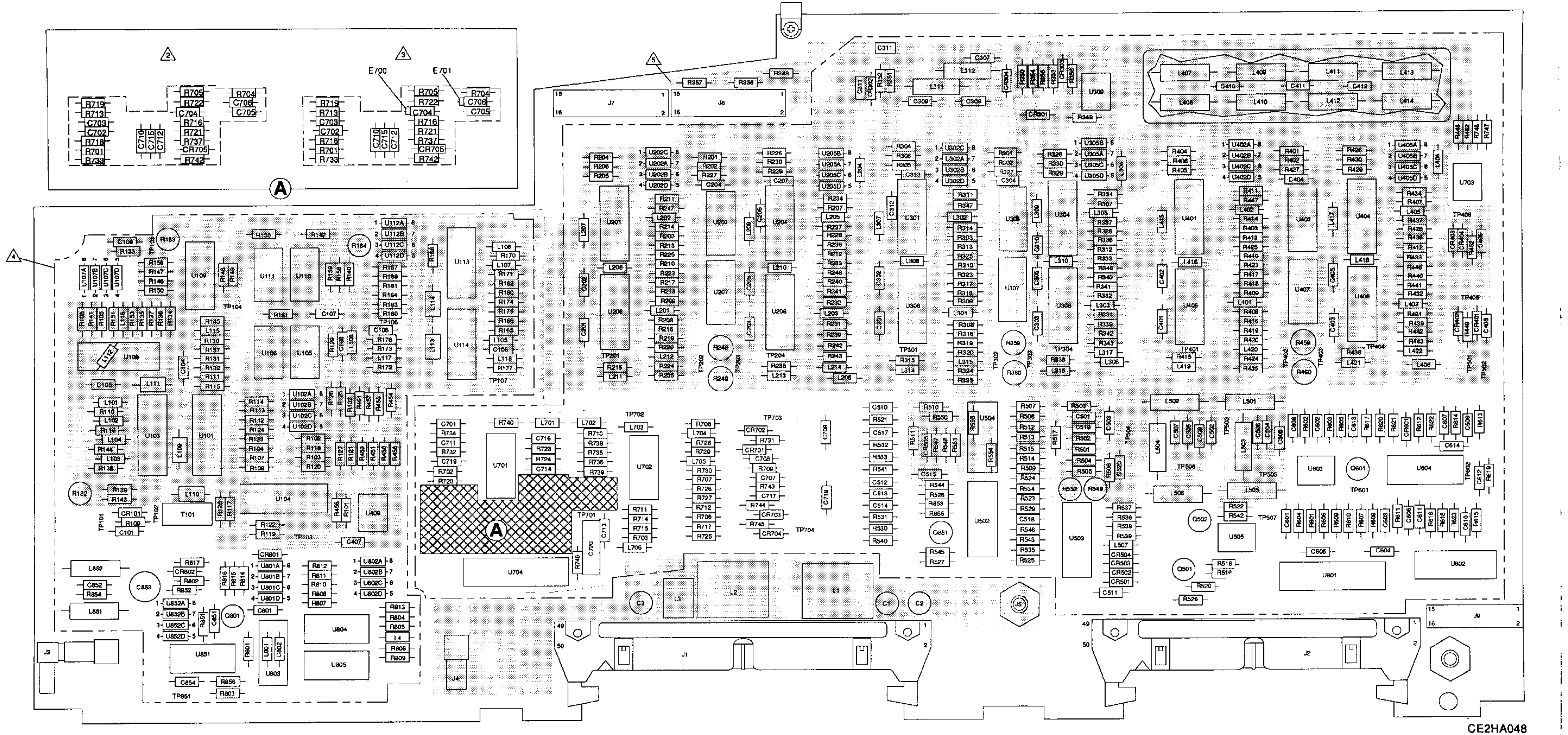
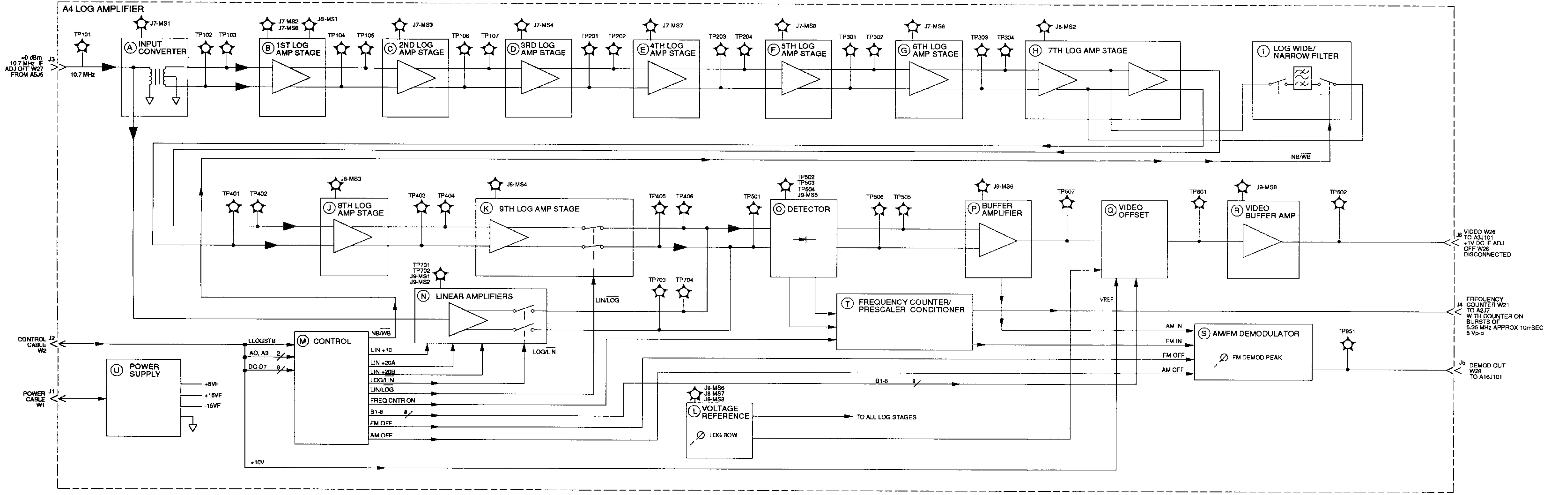


Figure FO-14. A4 Log Amplifier CCA Component Locator Diagram.



CE2HA049

Figure FO-15. A4 Log Amplifier CCA Functional Block Diagram.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A4 FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω).
   CAPACITANCE IS IN MICROFARADS (µF).
   INDUCTANCE IS IN MICROHENRIES (µH).
   ▽A = ANALOG GROUND.
   ▽D = DIGITAL GROUND.

3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A4 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	TO
08562-60109	2929A	3017A
08562-60133	3029A	3306A

4. BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.

△5 CAPACITANCE FORMED BY P.C. BOARD.

6. # INDICATES FACTORY SELECTED VALUES.

△7 ON HP P/N 08562-60133 CIRCUIT CARD ASSEMBLIES, THESE COMPONENTS ARE SINGLE 4 CAPACITOR ARRAYS (BELOW 3137A) OR INDIVIDUAL COMPONENTS (3137A AND ABOVE).

△8 REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

△9 NONREPAIRABLE CIRCUITS ARE SHOWN ONLY TO ASSIST IN TROUBLESHOOTING REPAIRABLE CIRCUITS.

△10 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A4 CIRCUIT CARD ASSEMBLY HP P/N 08562-60109.

△11 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A4 CIRCUIT CARD ASSEMBLY HP P/N 08562-60133.

J1 POWER

PIN	SIGNAL	TO/FROM	BLOCK
1	NC		
2	NC		
3	AGND	A6J1-3	U
4	NC		
5	NC		
6	AGND	A6J1-8	U
7	NC		
8	NC		
9	AGND	A6J1-9	U
10	SCAN RAMP		
11	NC		
12	AGND	A6J1-12	U
13	−12.6V (PROBE)	NC	
14	−15V	A6J1-14	U
15	AGND	A6J1-15	U
16	−15V	A6J1-16	U
17	+15V	A6J1-17	U
18	AGND	A6J1-18	U
19	+15V	A6J1-19	U
20	+28V	NC	
21	+28V	NC	
22	PWR UP	NC	
23	−15V	A6J1-23	U
24	−15V	A6J1-24	U
25	+15V	A6J1-25	U
26	+15V	A6J1-26	U
27	+5V	A6J1-27	U
28	+5V	A6J1-28	U
29	+5V	A6J1-29	U
30	+5V	A6J1-30	U
31	DGND	A6J1-31	U
32	DGND	A6J1-32	U
33	AGND	A6J1-33	U
34	AGND	A6J1-34	U
35	DGND	A6J1-35	U
36	DGND	A6J1-36	U
37	DGND	A6J1-37	U
38	DGND	A6J1-38	U
39	+5V	NC	
40	+5V	NC	
41	+5V	NC	
42	+5V	NC	
43	+5V	NC	
44	+5V	NC	
45	+28V	NC	
46	LINE TRIG	NC	
47	+15V	NC	
48	+15V	NC	
49	−15V	NC	
50	−15V	NC	

J2 CONTROL

PIN	SIGNAL	TO/FROM	BLOCK
1	D0	A3J2-1	M
2	DGND		U
3	D1	A3J2-3	M
4	D2	A3J2-4	M
5	D3	A3J2-5	M
6	D4	A3J2-6	M
7	DGND		U
8	D5	A3J2-8	M
9	D6	A3J2-9	M
10	D7	A3J2-10	M
11	A0	A3J2-11	M
12	DGND		U
13	A1	NC	
14	A2	NC	
15	A3	A3J2-15	M
16	A4	NC	
17	DGND		U
18	A5	NC	
19	A6	NC	
20	A7	NC	
21	DGND		U
22	LRF_STB	NC	
23	LFC_STB	NC	
24	LIF_STB	NC	
25	NC		
26	LLOG_STB	A3J2-26	M
27	NC		
28	DGND		U
29	STEP PLL1	NC	
30	HSCAN	NC	
31	DGND		U
32	RESERVED	NC	
33	OFL ERR	NC	
34	R/T DAC3	NC	
35	AGND		U
36	RF GAIN	NC	
37	LO 3 ERR	NC	
38	AGND		U
39	LVFC ENABLE	NC	
40	FC MUX	NC	
41	AGND		U
42	YTO ERR	NC	
43	+10V REF	A3J2-43	Q
44	AGND		U
45	SCAN RAMP	NC	
46	VIDEO TRIG	NC	
47	AGND		
48	NC		
49	R/T DAC2	NC	
50	R/T DAC1	NC	

J7 TEST

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		A
2	MS2		B
3	MS3		C
4	MS4		D
5	MS5		I
6	GND		U
7	AGND		U
8	TA1 (NC)		
9	N.C. KEY		
10	AGND		U
11	AGND		U
12	TA4 (NC)		
13	MS6		G
14	MS7		E
15	MS8		F
16	OPEN		

J8 TEST

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		B
2	MS2		H
3	MS3		J
4	MS4		K
5	MS5		I
6	AGND		U
7	TA0 (NC)		
8	TA1 (NC)		
9	N.C. KEY		
10	AGND		U
11	AGND		U
12	TA4 (NC)		
13	MS6		L
14	MS7		L
15	MS8		L
16	OPEN (NC)		

J9 TEST

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		N
2	MS2		N
3	MS3 (NC)		
4	MS4 (NC)		
5	MS5		O
6	AGND		U
7	AGND		U
8	AGND		U
9	N.C. KEY		
10	TA2 (NC)		
11	AGND		U
12	TA4 (NC)		
13	MS6		P
14	MS7 (NC)		
15	MS8		R
16	OPEN (NC)		

CE2HA050

Figure FO-16. A4 Log Amplifier CCA Schematic Diagram (Sheet 1 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA051

Figure FO-16. A4 Log Amplifier CCA Schematic Diagram (Sheet 2 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA052

Figure FO-16. A4 Log Amplifier CCA Schematic Diagram (Sheet 3 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA053

Figure FO-16. A4 Log Amplifier CCA Schematic Diagram
(Sheet 4 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA054

Figure FO-16. A4 Log Amplifier CCA Schematic Diagram (Sheet 5 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA055

Figure FO-16. A4 Log Amplifier CCA Schematic Diagram
(Sheet 6 of 6).

NOTES:

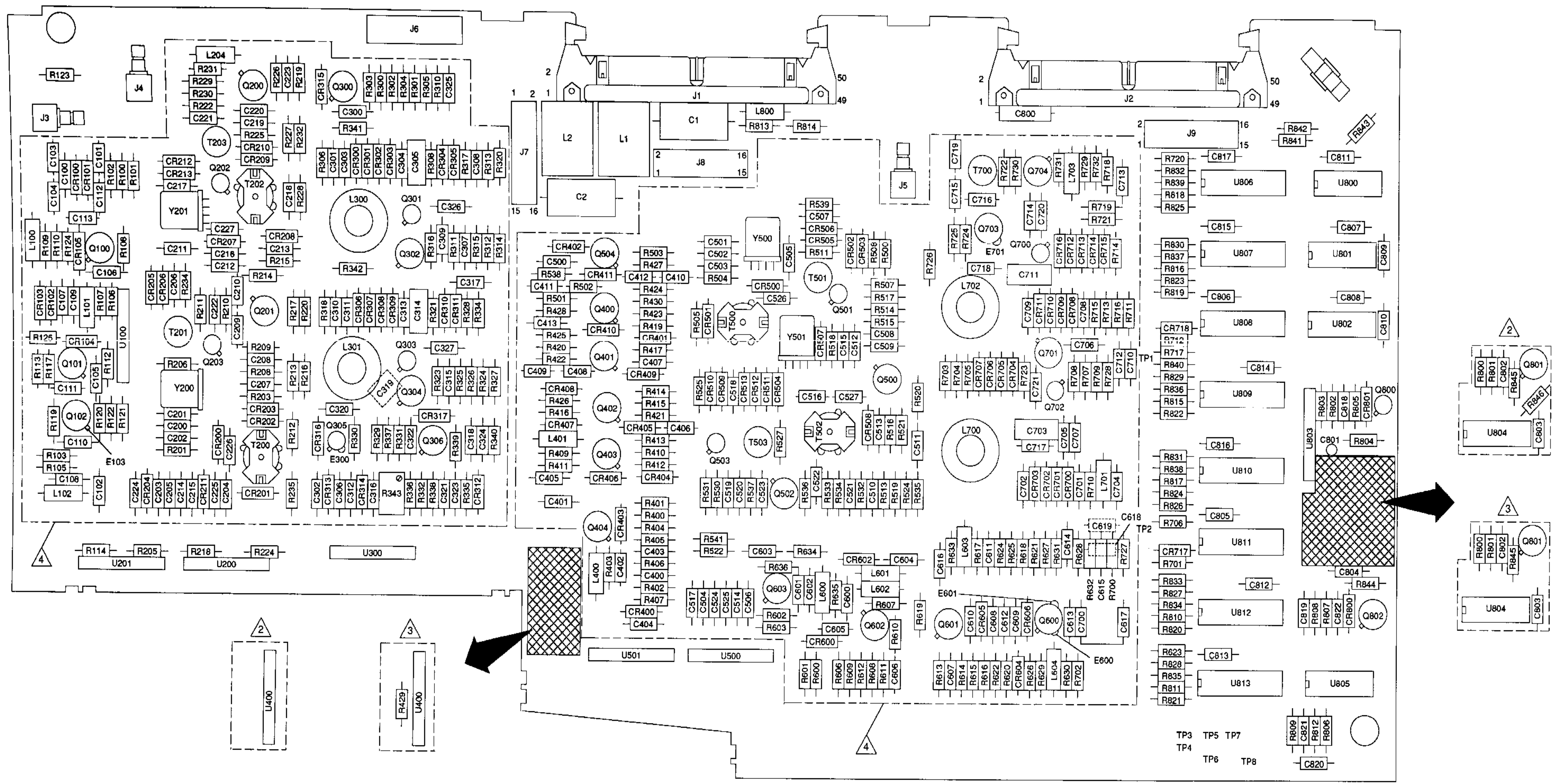
1. ⊡ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIODES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (◎ ROUND PAD = TP GROUND)

△2 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60082 (AN/USM-489A SERIAL NUMBER PREFIX 2929A.

△3 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60120 AND 08562-60174 (AN/USM-489A SERIAL NUMBER PREFIXES 2950A THROUGH 3306A).

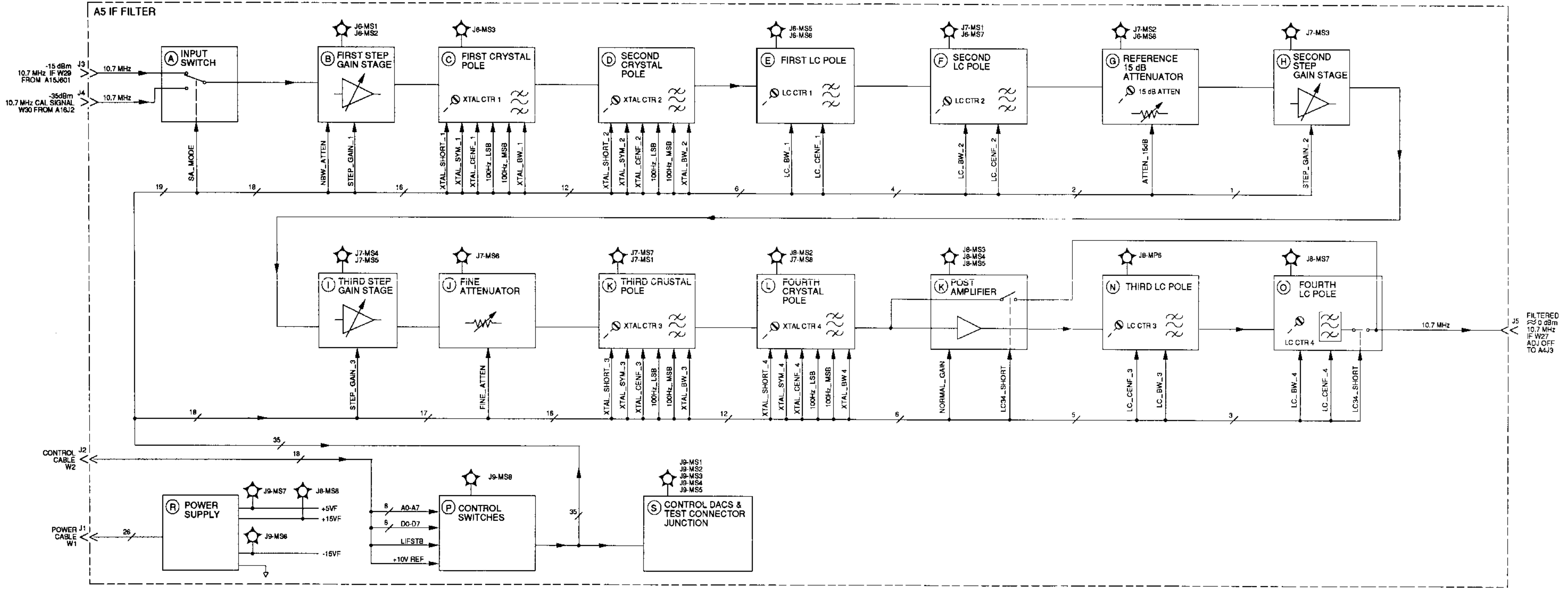
△4 — - - — LINE INDICATES SHIELD.

5. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A5 FOR COMPLETE REFERENCE DESIGNATOR.



CE2HA056

Figure FO-17. A5 IF (Intermediate Frequency) Filter CCA Component Locator Diagram.



CE2HA057

Figure FO-18. A5 IF (Intermediate Frequency) Filter CCA Functional Block Diagram.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A5 FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω).
   CAPACITANCE IS IN MICROFARADS (μF).
   INDUCTANCE IS IN MICROHENRIES (μH).
   $\bigtriangledown_A$ = ANALOG GROUND.
   $\bigtriangledown_D$ = DIGITAL GROUND.

3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A5 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	TO
08562-60082	2929A	2929A
08562-60120	2950A	3236A
08562-60174	3306A	3306A

△4 FACTORY SELECT PART. NOMINAL VALUE SHOWN.

△5 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A5 CIRCUIT CARD ASSEMBLIES HP P/N 08562-60120 WITH SERIAL PREFIX BELOW 3204A.

△6 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A5 CIRCUIT CARD ASSEMBLIES HP P/N 08562-60120 WITH SERIAL PREFIX OF 3204A AND ABOVE.

△7 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A5 CIRCUIT CARD ASSEMBLY HP P/N 08562-60174.

△8 BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.

△9 REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

△10 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A5 CIRCUIT CARD ASSEMBLY HP P/N 08562-60120.

△11 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A5 CIRCUIT CARD ASSEMBLY HP P/N 08562-60082.

CE2HA058

Figure FO-19. A5 IF (Intermediate Frequency) Filter CCA Schematic Diagram (Sheet 1 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA059

Figure FO-19. A5 IF (Intermediate Frequency) Filter CCA Schematic Diagram (Sheet 2 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA060

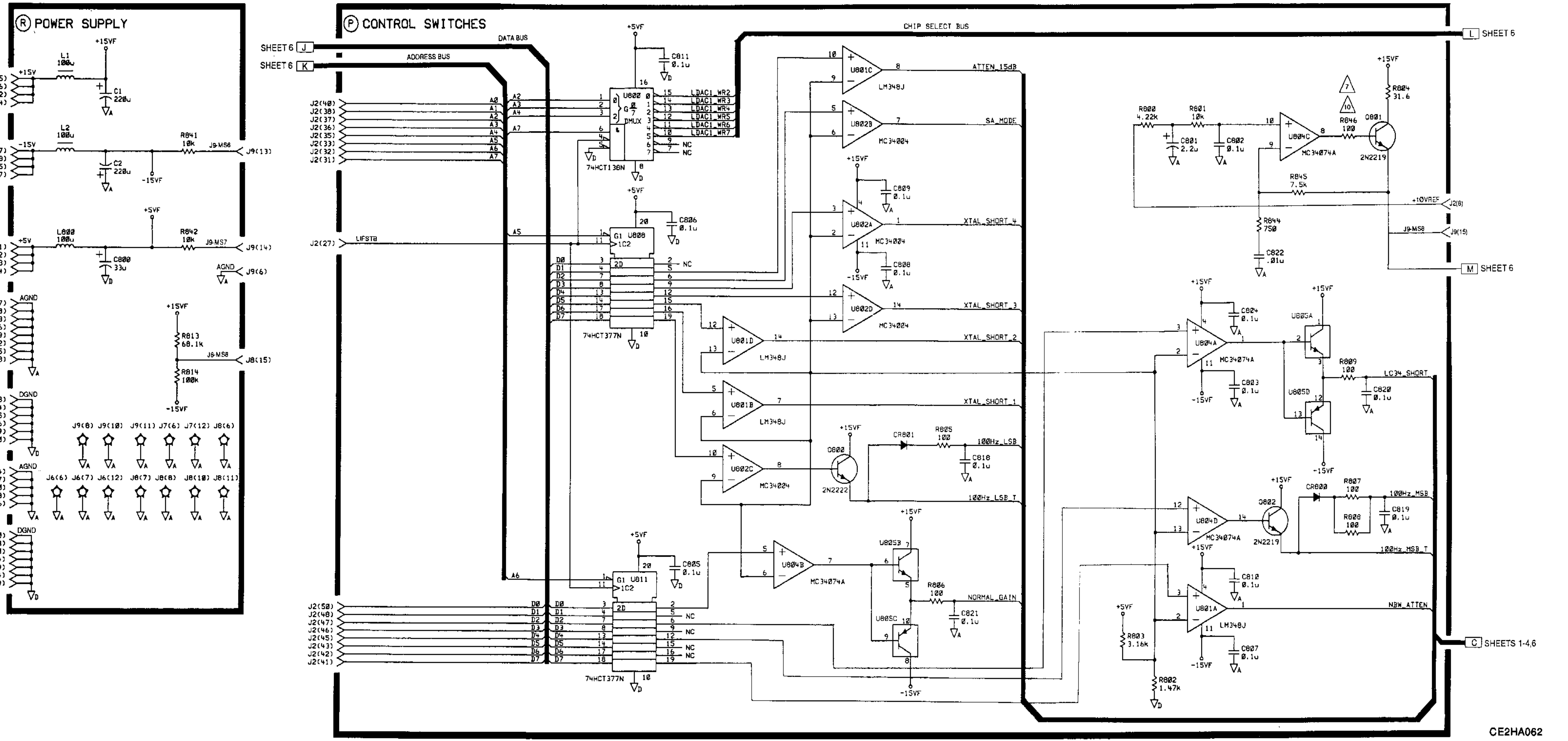
Figure FO-19. A5 IF (Intermediate Frequency) Filter CCA Schematic Diagram (Sheet 3 of 6).

SEE SHEET 1 FOR NOTES.

CE2HA061

Figure FO-19. A5 IF (Intermediate Frequency) Filter CCA Schematic Diagram (Sheet 4 of 6).

SEE SHEET 1 FOR NOTES.



CE2HA062

Figure FO-19. A5 IF (Intermediate Frequency) Filter CCA Schematic Diagram (Sheet 5 of 6).

SEE SHEET 1 FOR NOTES.

J1 POWER

PIN	SIGNAL	TO/FROM	BLOCK
1	−15V	NC	
2	−15V	NC	
3	+15V	NC	
4	+15V	NC	
5	LINE TRIG	NC	
6	+28V	NC	
7	+5V	NC	
8	+5V	NC	
9	+5V	NC	
10	+5V	NC	
11	+5V	NC	
12	+5V	NC	
13	DGND	A6J1-38	R
14	DGND	A6J1-37	R
15	DGND	A6J1-36	R
16	DGND	A6J1-35	R
17	AGND	A6J1-34	R
18	AGND	A6J1-33	R
19	DGND	A6J1-32	R
20	DGND	A6J1-31	R
21	+5V	A6J1-30	R
22	+5V	A6J1-29	R
23	+5V	A6J1-28	R
24	+5V	A6J1-27	R
25	+15V	A6J1-26	R
26	+15V	A6J1-25	R
27	−15V	A6J1-24	R
28	−15V	A6J1-23	R
29	PWR UP	NC	
30	+28V	NC	
31	+28V	NC	
32	+15V	A6J1-19	R
33	AGND	A6J1-18	R
34	+15V	A6J1-17	R
35	−15V	A6J1-16	R
36	AGND	A6J1-15	R
37	−15V	A6J1-14	R
38	−12.6V(PROBE)		
39	AGND	A6J1-12	R
40	NC		
41	SWEEP INPUT	NC	
42	AGND	A6J1-9	R
43	NC		
44	NC		
45	AGND	A6J1-6	R
46	NC		
47	NC		
48	AGND	A6J1-3	R
49	NC		
50	NC		

J2 CONTROL

PIN	SIGNAL	TO/FROM	BLOCK
1	R/TDAC1	NC	
2	R/TDAC2	NC	
3	NC		
4	AGND		R
5	VIDEOTRIG	NC	
6	SCANRAMP	NC	
7	AGND		R
8	+10V REF	A3J2-43	P
9	YTO ERR	NC	
10	AGND		R
11	FC MUX	NC	R
12	LVFC ENABLE		
13	AGND		
14	LO3 ERR	NC	
15	RF GAIN	NC	
16	AGND		R
17	R/TDAC3	NC	
18	OFL ERR	NC	
19	RESERVED	NC	
20	DGND		R
21	HSCAN	NC	
22	STEP PLL1	NC	
23	DGND		R
24	NC		
25	LLOG/VIDSTB	NC	
26	NC		
27	LIFSTB	A3J2-24	P
28	LFCSTB	NC	
29	LRFSTB	NC	
30	DGND		R
31	A7	A3J2-20	P
32	A6	A3J2-19	P
33	A5	A3J2-18	P
34	DGND		R
35	A4	A3J2-16	P
36	A3	A3J2-15	P
37	A2	A3J2-14	P
38	A1	A3J2-13	P
39	DGND		R
40	A0	A3J2-11	P
41	D7	A3J2-10	P
42	D6	A3J2-9	P
43	D5	A3J2-8	P
44	DGND		R
45	D4	A3J2-6	P
46	D3	A3J2-5	P
47	D2	A3J2-4	P
48	D1	A3J2-3	P
49	DGND		R
50	D0	A3J2-1	P

J6 TEST

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		B
2	MS2		B
3	MS3		C
4	MS4		D
5	MS5		E
6	AGND		R
7	AGND		R
8	TA1	NC	
9	KEY	NC	
10	TA2	NC	
11	TA3	NC	
12	AGND		R
13	MS6		E
14	MS7		F
15	MS8		G
16	OS1 (NC)		

J7 TEST

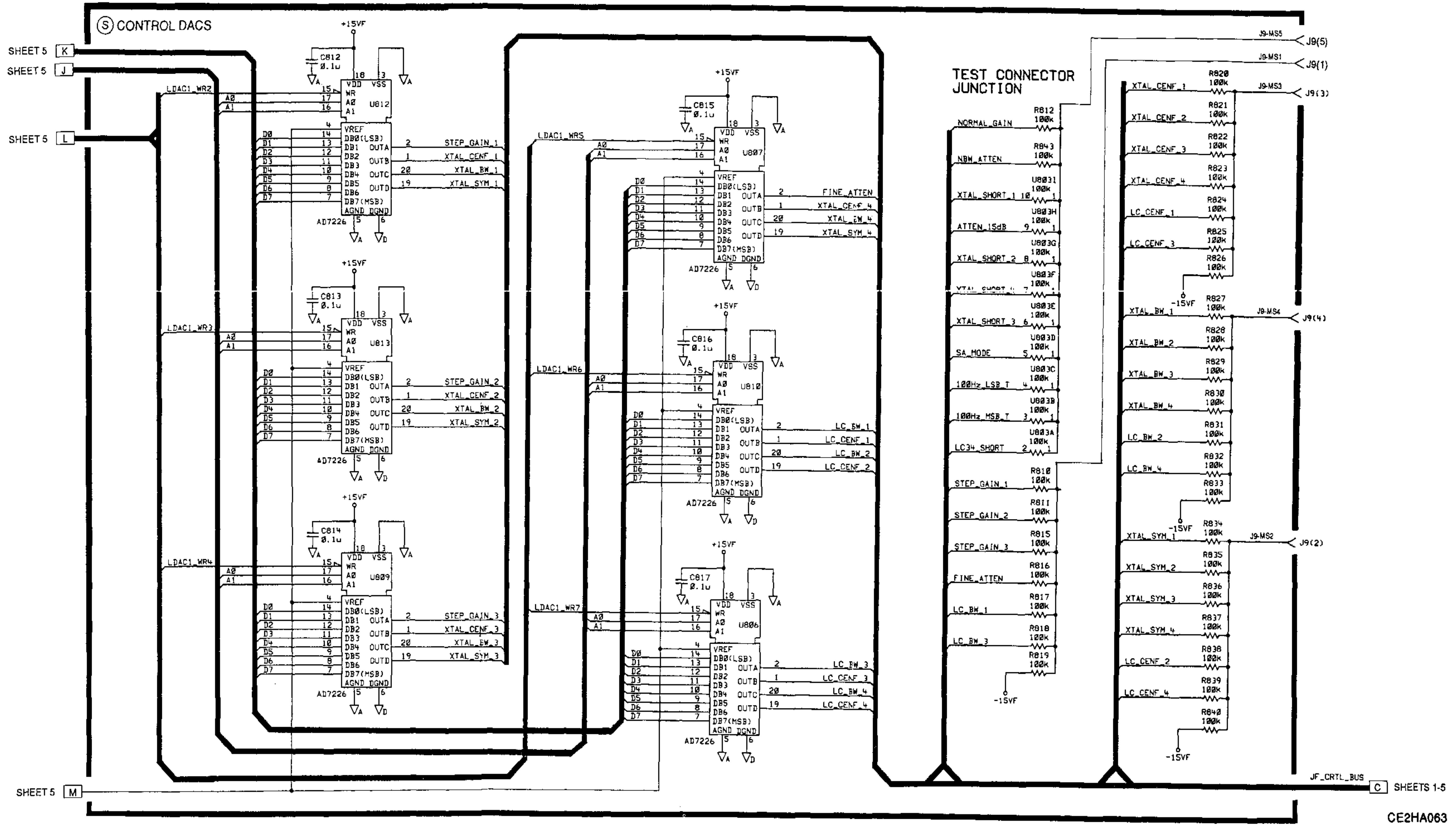
PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		F
2	MS2		G
3	MS3		H
4	MS4		I
5	MS5		I
6	AGND		R
7	TA0		
8	TA1 (NC)		
9	KEY (NC)		
10	TA2 (NC)		
11	TA3 (NC)		
12	AGND		R
13	MS6		J
14	MS7		K
15	MS8		L
16	OS1 (NC)		

J8 TEST

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		K
2	MS2		L
3	MS3		M
4	MS4		M
5	MS5		M
6	AGND		R
7	AGND	G	R
8	AGND	G	R
9	KEY (NC)		
10	AGND	G	R
11	AGND	G	R
12	TA4 (NC)		
13	MS6		N
14	MS7		O
15	MS8		R
16	OS1 (NC)		

J9 TEST

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		S
2	MS2		S
3	MS3		S
4	MS4		S
5	MS5		S
6	AGND		R
7	TA0 (NC)		
8	AGND		R
9	KEY (NC)		
10	AGND		R
11	AGND		R
12	TA4 (NC)		
13	MS6		R
14	MS7		R
15	MS8		P
16	OS1 (NC)		



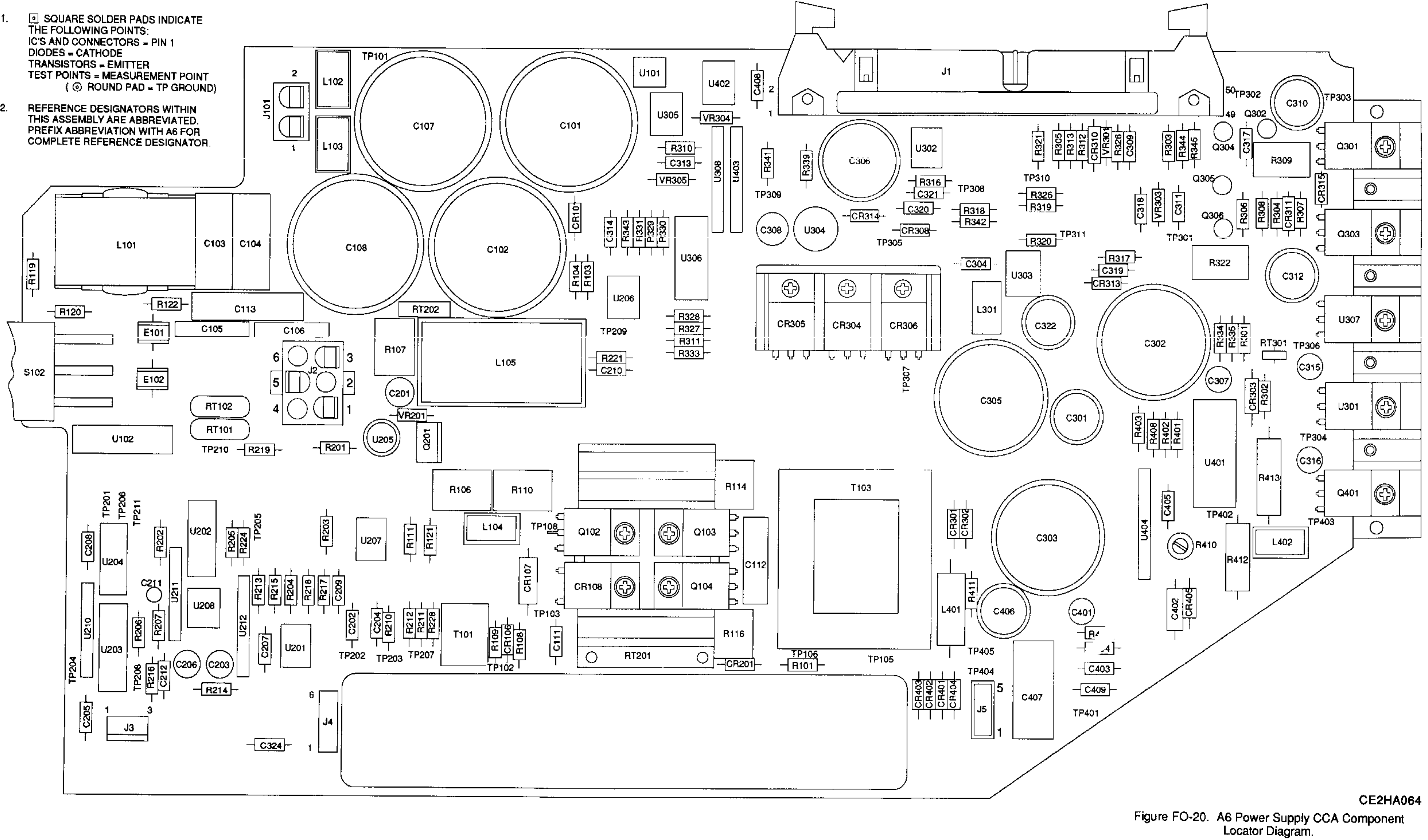
CE2HA063

Figure FO-19. A5 IF (Intermediate Frequency) Filter CCA Schematic Diagram (Sheet 6 of 6).

NOTES:

1. ☐ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIOCES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (◎ ROUND PAD = TP GROUND)

2. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A6 FOR COMPLETE REFERENCE DESIGNATOR.



CE2HA064

Figure FO-20. A6 Power Supply CCA Component Locator Diagram.

NOTES:

1. CABLES WITH -(XX)- INDICATE CABLE COLOR USING STANDARD COLOR CODE.

WARNING

CIRCUIT COMMON NOT EARTH GROUND NODES MAY BE AT A LETHAL POTENTIAL WITH RESPECT TO EARTH GROUND. CIRCUIT DOES NOT EQUAL EARTH.

LINE TO OUTPUT SAFETY ISOLATION PROVIDED BY T103, U101, U206

CE2HA065

Figure FO-21. A6 Power Supply CCA Functional Block Diagram.

WARNING

LINE TO OUTPUT SAFETY
ISOLATION PROVIDED BY T103
AND U101.

CIRCUIT COMMON NOT EARTH
GROUND NODES MAY BE AT A
LETHAL POTENTIAL WITH
RESPECT TO EARTH GROUND.
CIRCUIT ⏚ ≠ ⏚ EARTH.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A6 FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω).
   CAPACITANCE IS IN MICROFARADS (μF).
   INDUCTANCE IS IN MICROHENRIES (μH).

   ⏚ EARTH GROUND.

   ▽ CHASSIS GROUND.

3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A6 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	TO
08562-60094	2929A	3306A

4. MNEMONIC TABLE:

MNEMONIC	DESCRIPTION
PWR UP	POWER UP

△5 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A6 CIRCUIT CARD ASSEMBLY HP P/N 08562-60094 WITH SERIAL PREFIX BELOW 3204A.

△6 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A6 CIRCUIT CARD ASSEMBLY HP P/N 08562-60094 WITH SERIAL PREFIX OF 3204A AND ABOVE.

△7 BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.

△8 REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

J1 POWER

PIN	SIGNAL	TO/FROM	BLOCK
1	NC		
2	NC		
3	A GND	W1	F
4	NC		
5	NC		
6	A GND	W1	F
7	NC		
8	NC		
9	A GND	W1	F
10	SCAN RAMP	NC	
11	NC		
12	A GND	W1	F
13	−12.6V(PROBE)	W1	F
14	−15V	W1	F
15	A GND	W1	F
16	−15V	W1	F
17	+15V	W1	F
18	A GND	W1	F
19	+15V	W1	F
20	+28V	W1	F
21	+28V	W1	F
22	PWR UP	W1	M
23	−15V	W1	F
24	−15V	W1	F
25	+15V	W1	F
26	+15V	W1	F
27	+5V	W1	E
28	+5V	W1	E
29	+5V	W1	E
30	+5V	W1	E
31	D GND	W1	F
32	D GND	W1	F
33	A GND	W1	F
34	A GND	W1	F
35	D GND	W1	F
36	D GND	W1	F
37	D GND	W1	F
38	D GND	W1	F
39	+5V	W1	E
40	+5V	W1	E
41	+5V	W1	E
42	+5V	W1	E
43	+5V	W1	E
44	+5V	W1	E
45	+28V	W1	F
46	LINE TRIG	W1	A
47	+15V	W1	F
48	+15V	W1	F
49	−15V	W1	F
50	−15V	W1	F

J3 FAN

PIN	SIGNAL	TO/FROM	BLOCK
1	GND	B1	F
2	FAN PWR	B1	F
3	KEY		

J4 DISPLAY

PIN	SIGNAL	TO/FROM	BLOCK
1	+110V	A17J2-1	K
2	NC		
3	GND	A17J2-3	F
4	+15V	A17J2-4	F
5	−15V	A17J2-5	F
6	HV SHUT DOWN	A17J2-6	K

CE2HA066

Figure FO-22. A6 Power Supply CCA Schematic Diagram (Sheet 1 of 2).

WARNING

CIRCUIT COMMON NOT EARTH GROUND
NODES MAY BE AT A LETHAL POTENTIAL
WITH RESPECT TO EARTH GROUND.
CIRCUIT ⏚ ≠ ⏚ EARTH

WARNING

LINE TO OUTPUT SAFETY
ISOLATION PROVIDED BY
U206

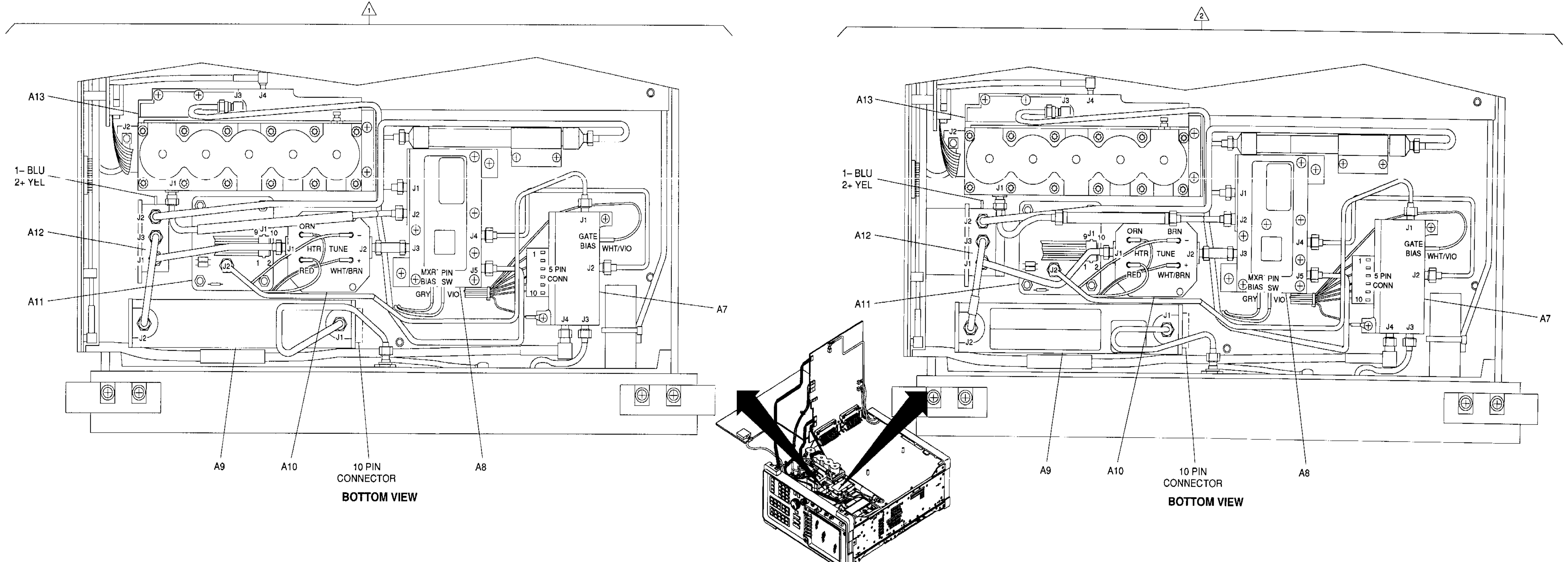
CE2HA067

Figure FO-22. A6 Power Supply CCA Schematic Diagram (Sheet 2 of 2).

NOTES:

△1 AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3043A.

△2 AN/USM-489A SERIAL NUMBER PREFIXES 3051A THROUGH 3306A.



CE2HA068

Figure FO-23. A7 through A13 RF Section Component Locator Diagram.

SEE SHEET 1 FOR NOTES.

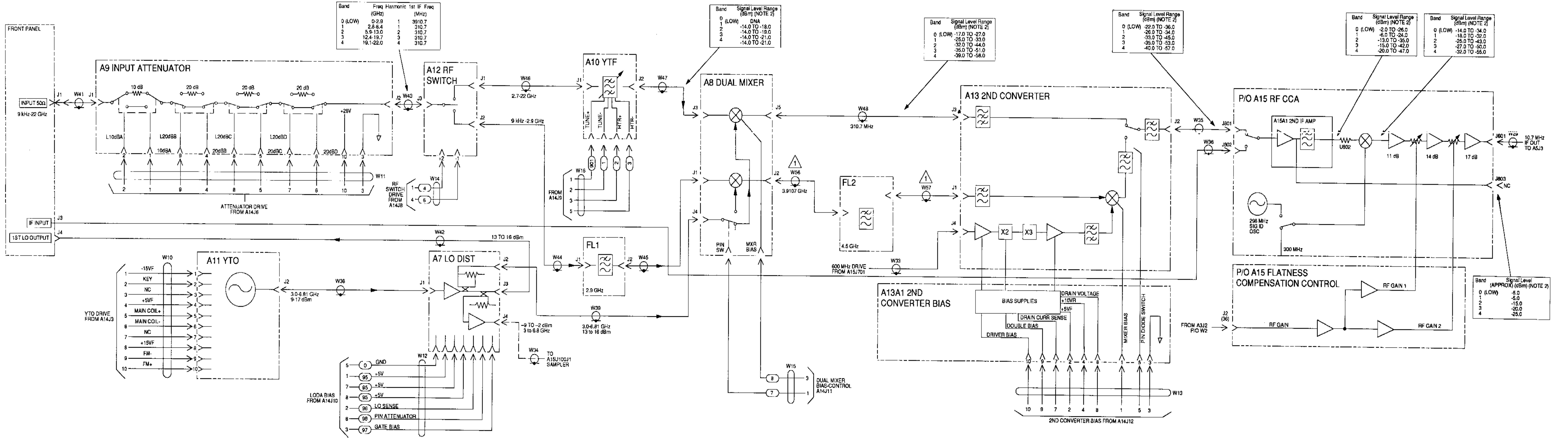
NOTES:

1. USED ON SERIAL NUMBER PREFIXES 2929A THROUGH 3306A.

2.

MNEMONIC TABLE

MNEMONIC	DESCRIPTION
TUNE+, TUNE–	YTF TUNE SIGNAL
HTR+, HTR–	YTF HEATER POWER
MAIN COIL+, MAIN COIL–	YTO MAIN COIL TUNE SIGNAL
FM+, FM–	YTO FM COIL TUNE SIGNAL
LO SENSE	LO AMPLITUDE SENSE VOLTAGE
LEVEL ADJUST	LO AMPLITUDE ADJUSTMENT VOLTAGE (PIN ATTEN)
GATE BIAS	LODA GATE BIAS VOLTAGE
XMX	EXTERNAL MIXER; +12V=EXT. MIX; –12V=INT MIX
SID	SIG ID OSCILLATOR ON. +12V=SIG ID OFF; –8V=SIG ID ON
PIN SW	PIN DIODE SWITCH CONTROL FOR DUAL MIXER LO SIGNAL
MIXER BIAS	BIAS SIGNAL FOR DUAL MIXER
PIN DIODE SWITCH	PIN DIODE SWITCH CONTROL FOR 2ND CONV. IF OUTPUT.
MIXER BIAS	DETECTED VOLTAGE ON 2ND CONVERTER MIXER DIODE
RFGAIN	VOLTAGE TO CONTROL GAIN OF FLATNESS COMP. AMPS.
RFGAIN1 & RFGAIN2	CURRENTS TO DRIVE PIN DIODES IN FLATNESS COMP AMPS
L10dBA, L20dBB, L20dBC, L20dBD	CONTROL LINES TO SET ATTENUATOR SECTIONS A, B, C, AND D TO ATTENUATE POSITION (ACTIVE LOW)
10dBA, 20dBB, 20dBC, 20dBD	CONTROL LINES TO SET ATTENUATOR SECTIONS A, B, C, AND D TO ATTENUATE POSITION (ACTIVE HIGH)



Band	Freq (GHz)	Harmonic	1st IF Freq (MHz)
0 (LOW)	0-2.9	1	3910.7
1	2.8-6.4	1	310.7
2	5.9-13.0	2	310.7
3	12.4-19.7	3	310.7
4	19.1-22.0	4	310.7

Band	Signal Level Range (dBm) (NOTE 2)
0 (LOW)	DNA
1	-14.0 TO -18.0
2	-14.0 TO -19.0
3	-14.0 TO -21.0
4	-14.0 TO -21.0

Band	Signal Level Range (dBm) (NOTE 2)
0 (LOW)	-17.0 TO -27.0
1	-25.0 TO -33.0
2	-32.0 TO -44.0
3	-35.0 TO -51.0
4	-39.0 TO -56.0

Band	Signal Level Range (dBm) (NOTE 2)
0 (LOW)	-22.0 TO -36.0
1	-26.0 TO -34.0
2	-33.0 TO -45.0
3	-35.0 TO -53.0
4	-40.0 TO -57.0

Band	Signal Level Range (dBm) (NOTE 2)
0 (LOW)	-2.0 TO -26.0
1	-6.0 TO -24.0
2	-13.0 TO -35.0
3	-15.0 TO -42.0
4	-20.0 TO -47.0

Band	Signal Level Range (dBm) (NOTE 2)
0 (LOW)	-14.0 TO -34.0
1	-18.0 TO -32.0
2	-25.0 TO -43.0
3	-27.0 TO -50.0
4	-32.0 TO -55.0

Band	Signal Level (APPROX) (dBm) (NOTE 2)
0 (LOW)	-5.0
1	-5.0
2	-15.0
3	-20.0
4	-25.0

CE2HA069

Figure FO-24. A7 through A13 RF Section Functional Block Diagram.

NOTES:

1. ⊡ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIODES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (◎ ROUND PAD = TP GROUND)

⚠2 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60055 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 2952A).

⚠3 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60123, AND 08562-60153 (AN/USM-489A SERIAL NUMBER PREFIXES 3006A THROUGH 3306A).

⚠4 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60055, AND 08562-60123 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3133A).

⚠5 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60153 (AN/USM-489A SERIAL NUMBER PREFIXES 3136A THROUGH 3306A).

⚠6 — — — — LINE INDICATES SHIELD.

7. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A14 FOR COMPLETE REFERENCE DESIGNATOR.

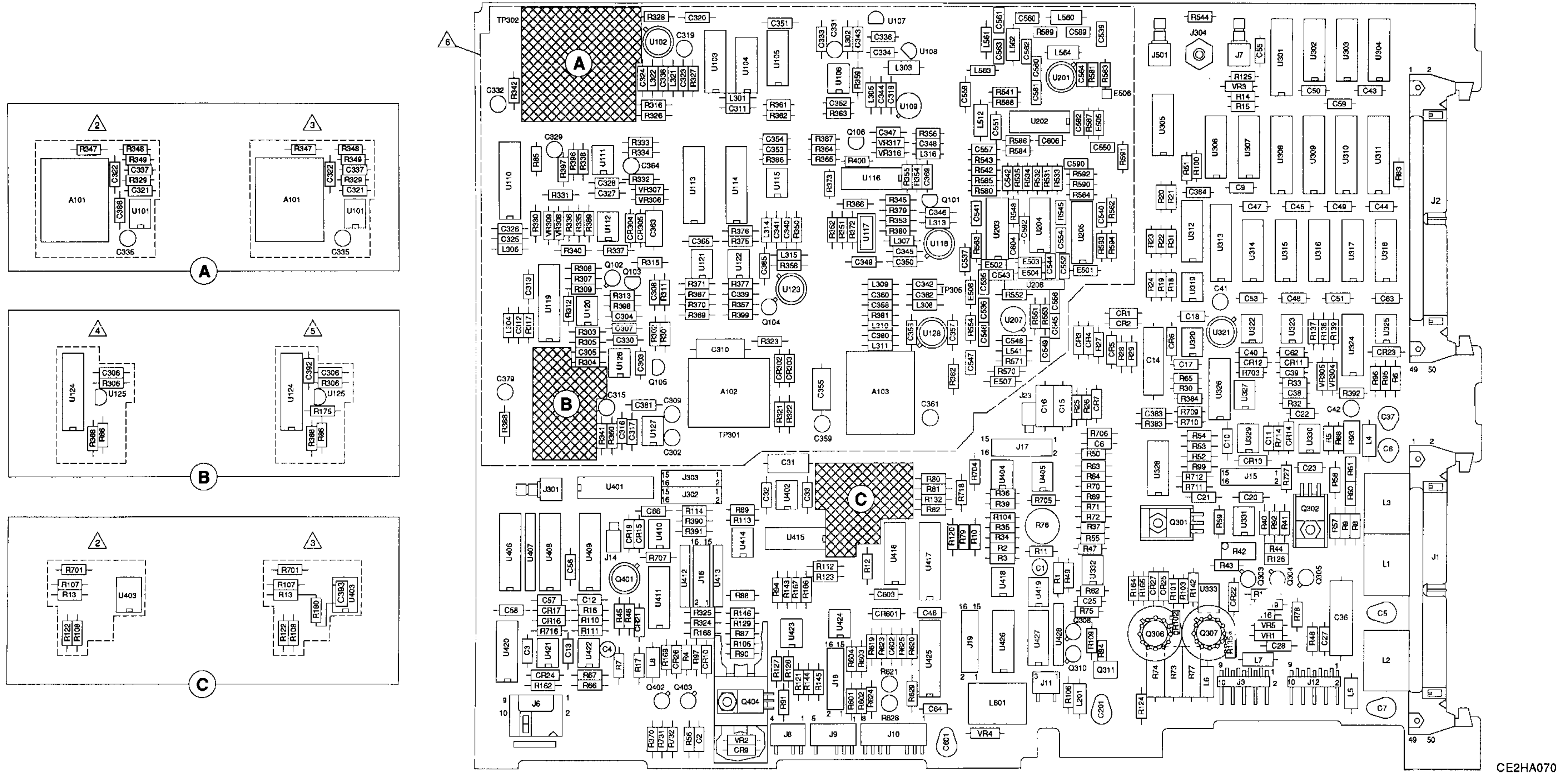


Figure FO-25. A14 Frequency Control CCA Component Locator Diagram.

CE2HA071

Figure FO-26. A14 Frequency Control CCA Functional Block Diagram.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A14 FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS (Ω).
CAPACITANCE IS IN MICROFARADS (μF).
INDUCTANCE IS IN MICROHENRIES (μH).
∇_A = ANALOG GROUND.
∇_D = DIGITAL GROUND.

3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A14 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	TO
08562-60055	2929A	2952A
08562-60123	3006A	3133A
08562-60153	3136A	3306A

4. BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.

5. REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

△6 COMPONENT(S) NOT USED.

△7 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A14 CIRCUIT CARD ASSEMBLY HP P/N 08562-60055.

△8 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A14 CIRCUIT CARD ASSEMBLY HP P/N 08562-60123.

△9 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A14 CIRCUIT CARD ASSEMBLY HP P/N 08562-60153.

J1 POWER

PIN	SIGNAL	TO/FROM	BLOCK
1	NC	W1	
2	NC	W1	
3	AGND	W1	F
4	NC	W1	
5	NC	W1	
6	AGND	W1	F
7	NC	W1	
8	NC	W1	
9	AGND	W1	F
10	SCAN RAMP	NC	
11	NC	W1	
12	AGND	W1	F
13	−12.6V(PROBE)	NC	
14	−15V	W1	F
15	AGND	W1	F
16	−15V	W1	F
17	+15V	W1	F
18	AGND	W1	F
19	+15V	W1	F
20	+28V	W1	F
21	+28V	W1	F
22	PWRUP	NC	
23	−15V	W1	F
24	−15V	W1	F
25	+15V	W1	F
26	+15V	W1	F
27	+5V	W1	F
28	+5V	W1	F
29	+5V	W1	F
30	+5V	W1	F
31	+5V	W1	F
32	+5V	W1	F
33	AGND	W1	F
34	AGND	W1	F
35	+5V	W1	F
36	+5V	W1	F
37	+5V	W1	F
38	+5V	W1	F
39	+5V	NC	
40	+5V	NC	
41	+5V	NC	
42	+5V	NC	
43	+5V	NC	
44	+5V	NC	
45	+28V	NC	
46	LINE TRIG	NC	
47	+15V	NC	
48	+15V	NC	
49	−15V	NC	
50	−15V	NC	

J2 CONTROL

PIN	SIGNAL	TO/FROM	BLOCK
1	D0	W2	K
2	DGND	W2	F
3	D1	W2	K
4	D2	W2	K
5	D3	W2	K
6	D4	W2	K
7	DGND	W2	F
8	D5	W2	K
9	D6	W2	K
10	D7	W2	K
11	A0	W2	B
12	DGND	W2	F
13	A1	W2	B
14	A2	W2	B
15	A3	W2	B
16	A4	W2	B
17	DGND	W2	F
18	A5	W2	B
19	A6	W2	NC
20	A7	W2	B
21	DGND	W2	F
22	LRFSTB	NC	
23	LFCSTB	W2	B
24	LIFSTB	NC	
25	NC	W2	
26	LLOG STB	NC	
27	NC	W2	AG
28	DGND	W2	F
29	STEP PLL1	NC	
30	HSCAN	W2	K
31	DGND	W2	F
32	RESERVED	NC	
33	OFL ERR	NC	
34	R/T DAC3	NC	
35	AGND	W2	F
36	RF GAIN	NC	
37	L03ERR	W2	AG
38	AGND	W2	F
39	LVFC ENABLE	W2	K
40	FCMUX	W2	AG
41	AGND	W2	F
42	YTO ERR	W2	O
43	+10V REF	NC	
44	AGND	W2	F
45	SCAN RAMP	W2	L
46	VIDEO TRIG	NC	
47	AGND	W2	F
48	NC	W2	
49	R/T DAC2	NC	
50	R/T DAC3	NC	S

J3 EYO

PIN	SIGNAL	TO/FROM	BLOCK
1	−15VF		N
2	KEY		N
3	NC		N
4	+5VF		N
5	MAINCOIL+		E
6	MAINCOIL−		E
7	NC		N
8	+15VF		N
9	FM−		N
10	FM+		N

J6 ATTENUATOR

PIN	SIGNAL	TO/FROM	BLOCK
1	10 dB A		V
2	L 10dB A		V
3	DGND		V
4	20dB B		V
5	20dB C		V
6	20dB D		V
7	L 20dB D		V
8	L 20dB C		V
9	L 20dB B		V
10	+28V		V

J8 BAND SWITCH

PIN	SIGNAL	TO/FROM	BLOCK
1	BAND SW 2		AA
2	+15V		AA
3	KEY		AA
4	BAND SW 1		AA

J9 YTF

PIN	SIGNAL	TO/FROM	BLOCK
1	TUNE +		T
2	TUNE −		T
3	HEATER+		T
4	KEY		T
5	HEATER −		T

J10 LODA

PIN	SIGNAL	TO/FROM	BLOCK
1	+5VF2		Z
2	LOSENSE		Z
3	GATEBIAS		Z
4	KEY		Z
5	LODA COMMON		Z
6	PIN ATTEN		Z
7	+5VF2		Z
3	+5VF2		Z

J11 DUAL MIXER

PIN	SIGNAL	TO/FROM	BLOCK
1	PIN SW		W
2	KEY		W
3	MIXER BIAS		W

J12 2ND CONVERTER

PIN	SIGNAL	TO/FROM	BLOCK
1	MIXER BIAS		Y
2	+5VF		Y
3	AGND		Y
4	+10VR		Y
5	PIN SWITCH		Y
6	KEY		Y
7	DRAIN CURRENT SENSE		Y
8	DRAIN VOLT		Y
9	DOUBLER BIAS		Y
10	DRIVER BIAS		Y

J15 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		Q
2	NC		
3	MS3		Q
4	MS4		J
5	NC		
6	AGND		F
7	DGND		F
8	NC		
9	NC		
10	NC		
11	DGND		F
12	DGND		F
13	MS6		H
14	MS7		G
15	MS8		K
16	NC		G
17	NC		
18	NC		
19	NC		
20	NC		

J16 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		S
2	MS2		S
3	MS3		T
4	MS4		
5	MS5		R
6	AGND		F
7	NC		
8	NC		
9	NC		
10	NC		
11	DGND		F
12	DGND		F
13	MS6		S
14	MS3		Q
15	MS8		AA
16	NC		
17	NC		
18	NC		
19	NC		
20	NC		

J17 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		N
2	MS2		I
3	MS3		I
4	MS4		O
5	MS5		I
6	AGND		F
7	DGND		F
8	DGND		F
9	NC		
10	DGND		F
11	NC		
12	DGND		F
13	MS6		U
14	MS7		U
15	MS8		U
16	NC		
17	NC		
18	DGND		F
19	NC		
20	NC		

J18 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		A
2	MS2		A
3	MS3		C
4	MS4		K
5	MS5		Z
6	AGND		F
7	NC		
8	DGND		F
9	NC		
10	DGND		F
11	NC		
12	DGND		F
13	MS8		Z
14	MS7		Z
15	MS6		Z
16	NC		
17	NC		
18	NC		
19	NC		
20	NC		

J19 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		Y
2	MS2		Y
3	MS3		Y
4	MS4		Y
5	MS5		Y
6	AGND		F
7	DGND		F
8	NC		
9	NC		
10	DGND		F
11	NC		
12	DGND		F
13	MS6		W
14	MS7		W
15	MS8		Y

J107 TEST CONNECTORS

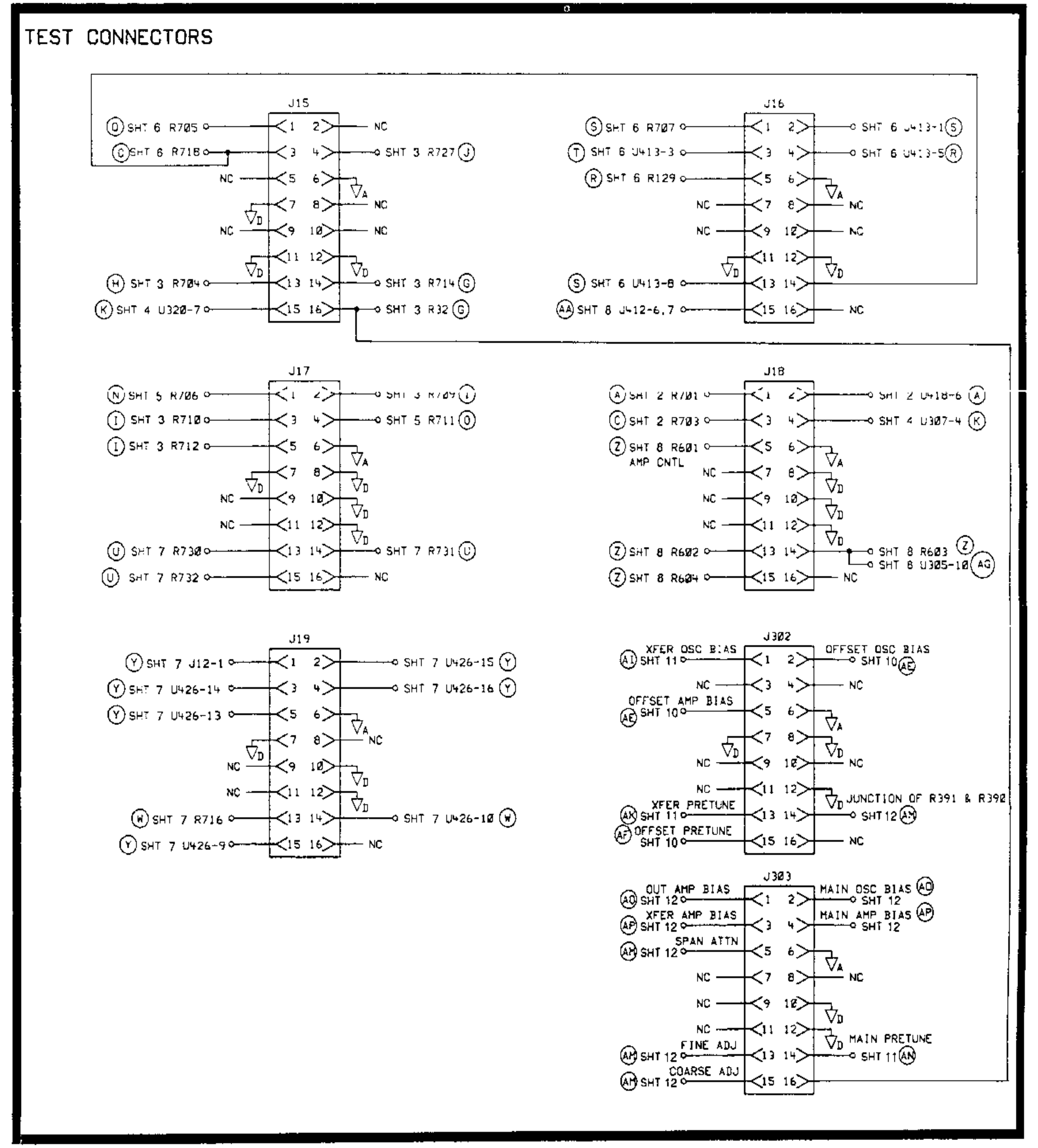
PIN	SIGNAL	TO/FROM	BLOCK
1	NC		
2	NC		
3	NC		
4	NC		
5	NC		
6	NC		
7	NC		
8	NC		
9	NC		
10	NC		
11	NC		
12	NC		
13	NC		
14	NC		
15	NC		
16	NC		
17	NC		
18	NC		AM

J302 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		AI
2	MS2		AE
3	NC		
4	NC		
5	MS5		AE
6	AGND		F
7	DGND		F
8	DGND		F
9	NC		
10	NC		
11	NC		
12	DGND		F
13	MS6		AK
14	NC		AP
15	MS8		AF
16	NC		G

J303 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS2		AO
2	MS1		AO
3	MS3		AP
4	MS4		AP
5	MS5		AM
6	AGND		F
7	NC		
8	NC		
9	NC		
10	DGND		F
11	NC		
12	DGND		F
13	MS6		AM
14	MS7		AN
15	MS8		AM
16	NC		G



CE2HA072

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 1 of 12).

SEE SHEET 1 FOR NOTES.

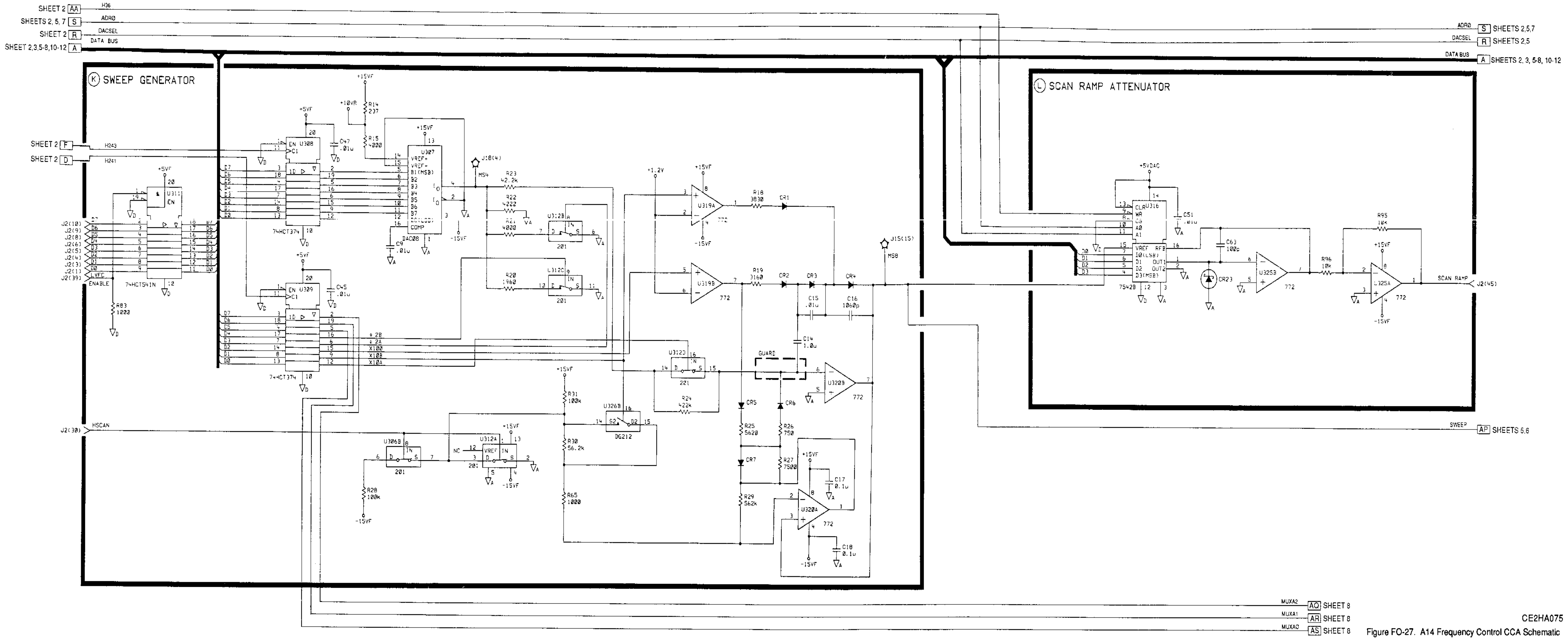
CE2HA073

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 2 of 12).

CE2HA074

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 3 of 12).

SEE SHEET 1 FOR NOTES.



CE2HA075

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 4 of 12).

SEE SHEET 1 FOR NOTES.

CE2HA076

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 5 of 12).

SEE SHEET 1 FOR NOTES.

CE2HA077

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 6 of 12).

SEE SHEET 1 FOR NOTES.

CE2HA078

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 7 of 12).

SEE SHEET 1 FOR NOTES.

CE2HA079

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 8 of 12).

SEE SHEET 1 FOR NOTES.

CE2HA080

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 9 of 12).

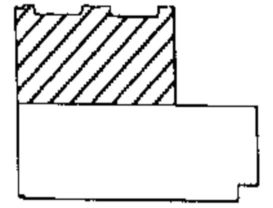
CE2HA081

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 10 of 12).

SEE SHEET 1 FOR NOTES.

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 11 of 12).

Figure FO-27. A14 Frequency Control CCA Schematic Diagram (Sheet 12 of 12).



NOTES:

1. ⊡ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIODES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (⊙ ROUND PAD = TP GROUND)

△2 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60103, AND 08562-60122 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3027A).

△3 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60118, 08562-60146, 08562-60157, AND 08562-60169 (AN/USM-489A SERIAL NUMBER PREFIXES 3029A THROUGH 3306A).

△4 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60103, 08562-60122, 08562-60118, AND 08562-60146 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3136A).

△5 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60157, AND 08562-60169 (AN/USM-489A SERIAL NUMBER PREFIXES 3137A THROUGH 3306A).

△6 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60103, 08562-60122, AND 08562-60118 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3119A).

△7 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60146, 08562-60157, AND 08562-60169 (AN/USM-489A SERIAL NUMBER PREFIXES 3120A THROUGH 3306A).

△8 — - - — LINE INDICATES SHIELD.

9. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A15 FOR COMPLETE REFERENCE DESIGNATOR.

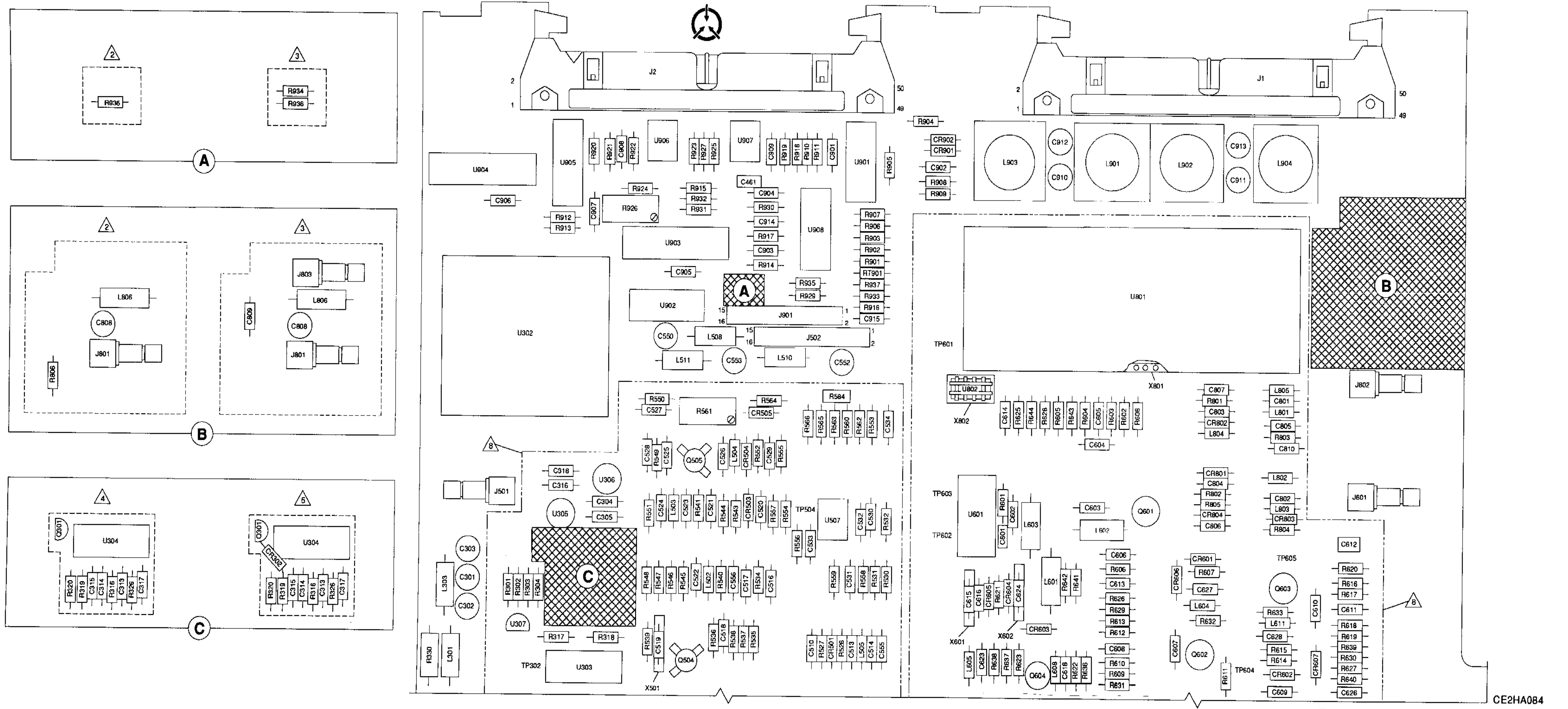


Figure FO-28. A15 RF (Radio Frequency) CCA Component Locator Diagram (Sheet 1 of 3).

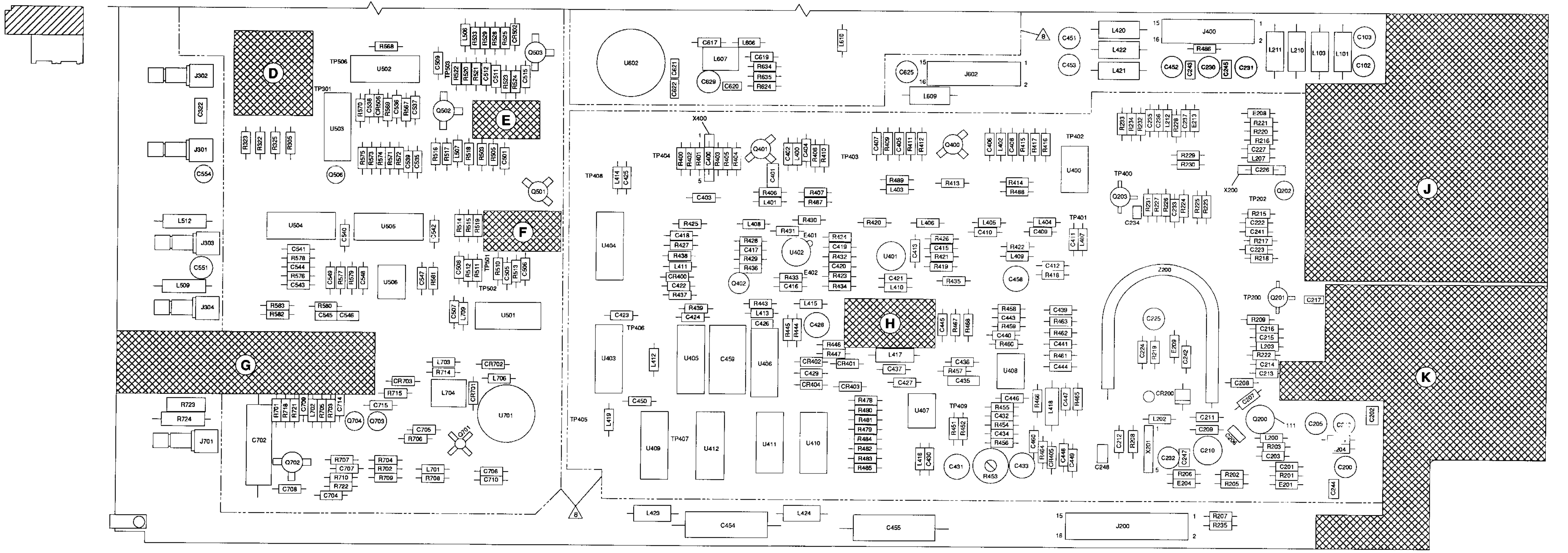
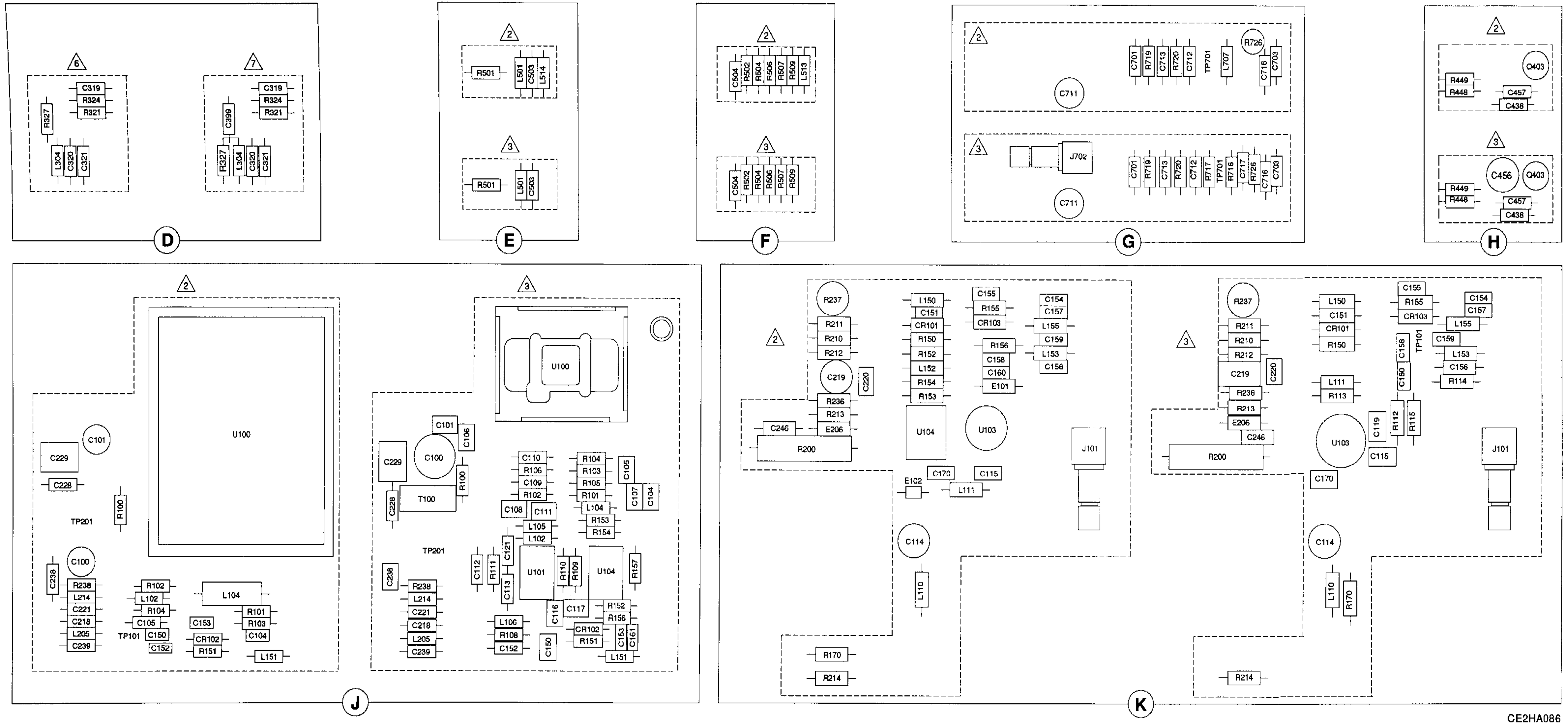


Figure FO-28. A15 RF (Radio Frequency) CCA Component Locator Diagram (Sheet 2 of 3).

CE2HA085

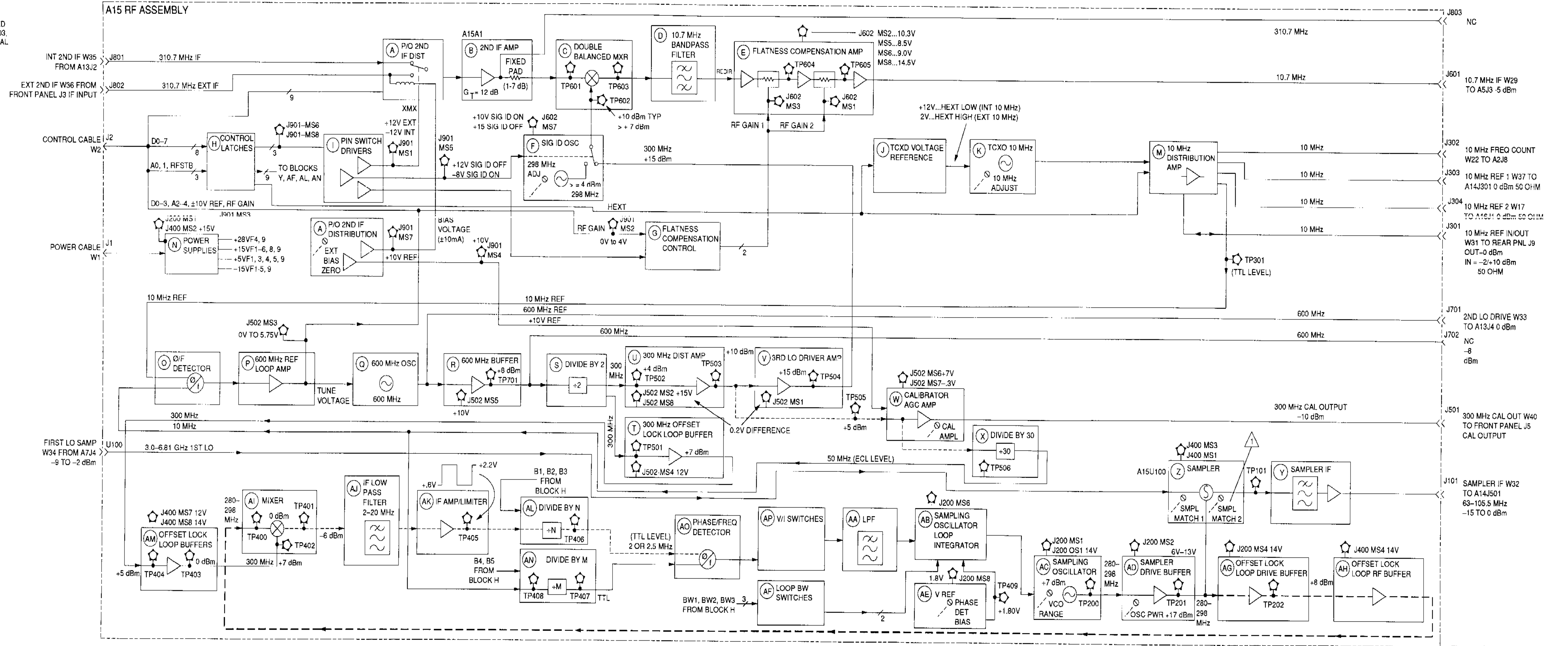


CE2HA086

Figure FO-28. A15 RF (Radio Frequency) CCA Component Locator Diagram (Sheet 3 of 3).

NOTES:

1. CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60103, AND 08562-60122 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3027A).



CE2HA087

Figure FO-29. A15 RF (Radio Frequency) CCA Functional Block Diagram.

NOTES:

1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A15 FOR COMPLETE REFERENCE DESIGNATOR.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS (Ω).
   CAPACITANCE IS IN MICROFARADS (μF).
   INDUCTANCE IS IN MICROHENRIES (μH).
   ▽A = ANALOG GROUND.
   ▽D = DIGITAL GROUND.

3. THIS SCHEMATIC IS USED FOR THE FOLLOWING A15 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART	SERIAL PREFIX	
NUMBER	FROM	TO
~~08562-60103~~	~~3020A~~	~~3006A~~
08562-60122	3017A	3027A
08562-60118	3029A	3119A
08562-60146	3120A	3136A
08562-60157	3137A	3204A
08562-60169	3217A	3306A

4. BLOCK NUMBERS FOR CIRCUITS ARE SHOWN IN THE UPPER LEFT CORNER OF THE CIRCUIT BOX.

5. REFER TO FIGURE FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.

△6 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A15 CIRCUIT CARD ASSEMBLY HP P/N 08562-60103.

△7 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A15 CIRCUIT CARD ASSEMBLY HP P/N 08562-60122.

△8 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A15 CIRCUIT CARD ASSEMBLY HP P/N 08562-60118.

△9 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A15 CIRCUIT CARD ASSEMBLY HP P/N 08562-60146.

△10 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A15 CIRCUIT CARD ASSEMBLY HP P/N 08562-60157.

△11 COMPONENT(S)/VALUE(S) SHOWN ARE ONLY USED ON A15 CIRCUIT CARD ASSEMBLY HP P/N 08562-60169.

△12 COMPONENT(S) NOT USED.

△13 FACTORY SELECT COMPONENT WITH VALUES FROM 1.0 TO 4.7 PF. NOMINAL VALUE IS SHOWN.

J1

PIN	SIGNAL	TO/FROM	BLOCK
1	NC	W1	
2	NC	W1	
3	AGND	W1	N
4	NC	W1	
5	NC	W1	
6	AGND	W1	N
7	NC	W1	
8	NC	W1	
9	AGND	W1	N
10	SCAN RAMP	NC	
11	NC	W1	
12	AGND	W1	
13	−12.6V(PROBE)	NC	
14	−15V	W1	N
15	AGND	W1	N
16	−15V	W1	N
17	+15V	W1	N
18	AGND	W1	
19	+15V	W1	N
20	+28V	W1	N
21	+28V	W1	N
22	PWR UP	NC	
23	−15V	W1	N
24	−15V	W1	N
25	+15V	W1	N
26	+15V	W1	N
27	+5V	W1	N
28	+5V	W1	N
29	+5V	W1	N
30	+5V	W1	N
31	DGND	W1	H
32	DGND	W1	N
33	AGND	W1	N
34	AGND	W1	H
35	DGND	W1	H
36	DGND	W1	H
37	DGND	W1	H
38	DGND	W1	
39	+5V	NC	
40	+5V	NC	
41	+5V	NC	
42	+5V	NC	
43	+5V	NC	
44	+5V	NC	
45	+28V	NC	
46	LINE TRIG	NC	
47	+15V	NC	
48	+15V	NC	
49	−15V	NC	
50	−15V	NC	

J2

PIN	SIGNAL	TO/FROM	BLOCK
1	D0	W2	A, H
2	DGND	W2	H
3	D1	W2	A, H
4	D2	W2	A, H
5	D3	W2	A, H
6	D4	W2	A, H
7	DGND	W2	H
8	D5	W2	H
9	D6	W2	H
10	D7	W2	H
11	A0	W2	H
12	DGND	W2	H
13	A1	W2	H
14	A2	W2	A
15	A3	W2	A
16	A4	W2	A
17	DGND	W2	H
18	A5	NC	
19	A6	NC	
20	A7	NC	
21	DGND	W2	H
22	LRFSTB	W2	A
23	LFCSTB	NC	
24	LIFSTB	NC	
25	NC	W2	
26	LLOG STB	NC	
27	NC	W2	
28	DGND	W2	H
29	STEP PLL1	NC	
30	HSCAN	NC	
31	DGND	W2	H
32	RESERVED	NC	
33	OFL ERR	W2	AB
34	R/T DAC3	NC	
35	AGND	W2	H
36	RFGAIN	W2	G
37	LO 3 ERR	W2	P
38	AGND	W2	
39	LVFC ENABLE	NC	H
40	FC MUX	NC	
41	AGND	W2	H
42	YTO ERR	NC	
43	+10V REF	W2	A
44	AGND	W2	H
45	SCAN RAMP	NC	
46	VIDEO TRIG	NC	
47	AGND	W2	H
48	NC	W2	
49	R/T DAC2	NC	
50	R/T DAC1	NC	

J200 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		N
2	MS2		AD
3	MS3		AC
4	MS4		AG
5	NC		
6	AGND		N
7	NC		
8	A1		N
9	NC		
10	A2		N
11	A3		N
12	A4		N
13	MS6		AB
14	NC		
15	MS8		AE
16	OS1		AC

J400 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		Z
2	MS2		N
3	MS3		Z
4	MS4		AH
5	NC		
6	AGND		N
7	A0		N
8	NC		
9	NC		
10	A2		N
11	A3		N
12	A4		N
13	MS6		AK
14	MS7		AM
15	MS8		AM

J502 TEST CONNECTORS

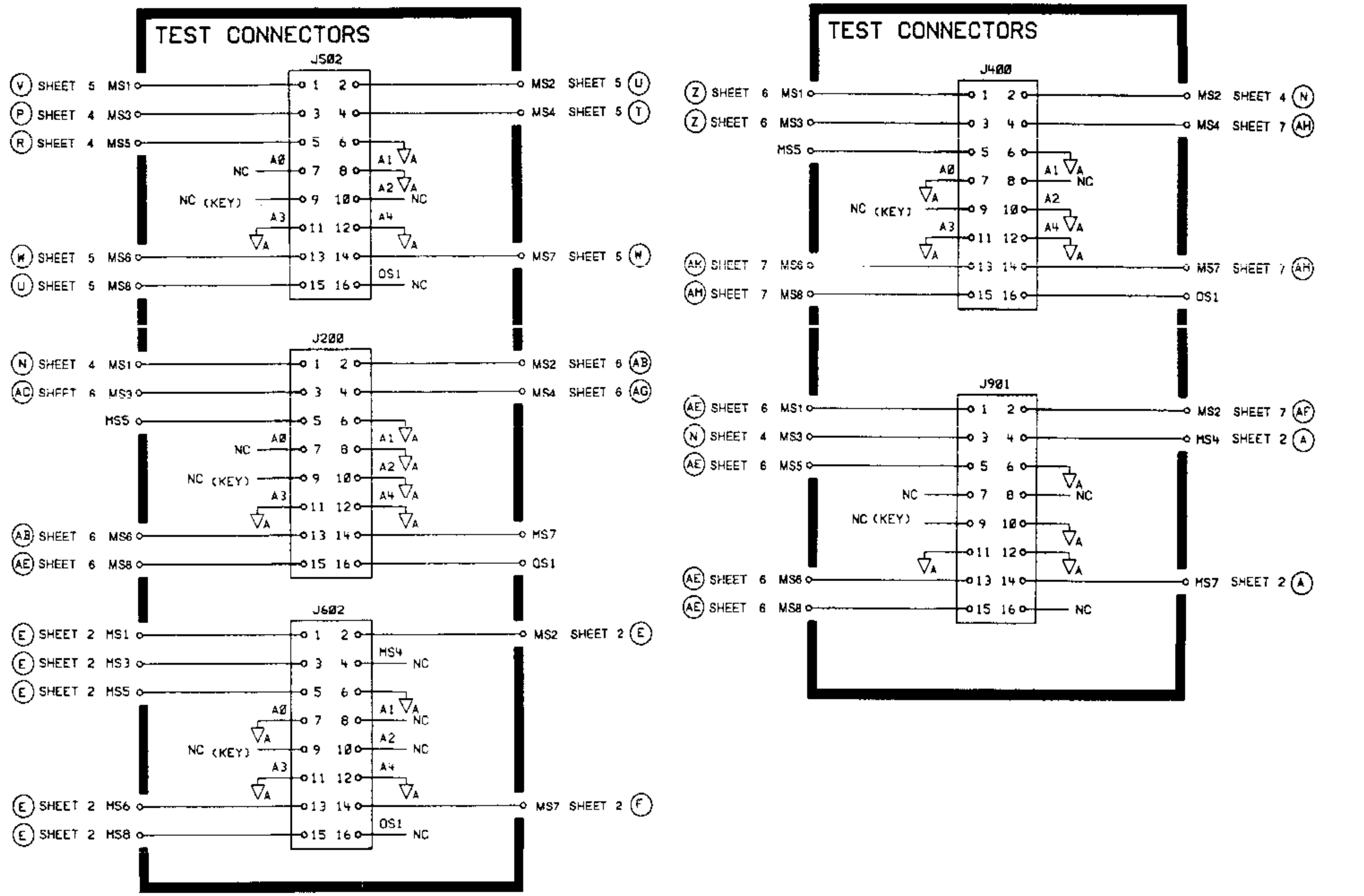
PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		V
2	MS2		U
3	MS3		P
4	MS4		T
5	MS5		R
6	AGND		N
7	NC		
8	A1		N
9	NC		
10	NC		
11	A3		N
12	A4		N
13	MS6		W
14	MS7		W
15	MS8		U

J602 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		E
2	MS2		E
3	MS3		E
4	NC		
5	MS5		E
6	AGND		N
7	A0		N
8	AGND		N
9	NC		
10	NC		
11	A3		N
12	A4		N
13	MS6		E
14	MS7		F
15	MS8		E

J901 TEST CONNECTORS

PIN	SIGNAL	TO/FROM	BLOCK
1	MS1		I
2	MS2		G
3	MS3		N
4	MS4		A
5	MS5		I
6	AGND		N
7	NC		
8	NC		
9	NC		
10	AGND		N
11	AGND		N
12	AGND		N
13	MS6		I
14	MS7		A
15	MS8		I



CE2HA088

Figure FO-30. A15 RF (Radio Frequency) CCA Schematic Diagram (Sheet 1 of 7).

SEE SHEET 1 FOR NOTES.

CE2HA089

Figure FO-30. A15 RF (Radio Frequency) CCA Schematic Diagram (Sheet 2 of 7).

SEE SHEET 1 FOR NOTES

CE2HA09

Figure FO-30. A15 RF (Radio Frequency) CCA
Schematic Diagram (Sheet 3 of 7).

SEE SHEET 1 FOR NOTES

CE2HA091

Figure FO-30. A15 RF (Radio Frequency) CCA Schematic Diagram (Sheet 4 of 7).

SEE SHEET 1 FOR NOTES.

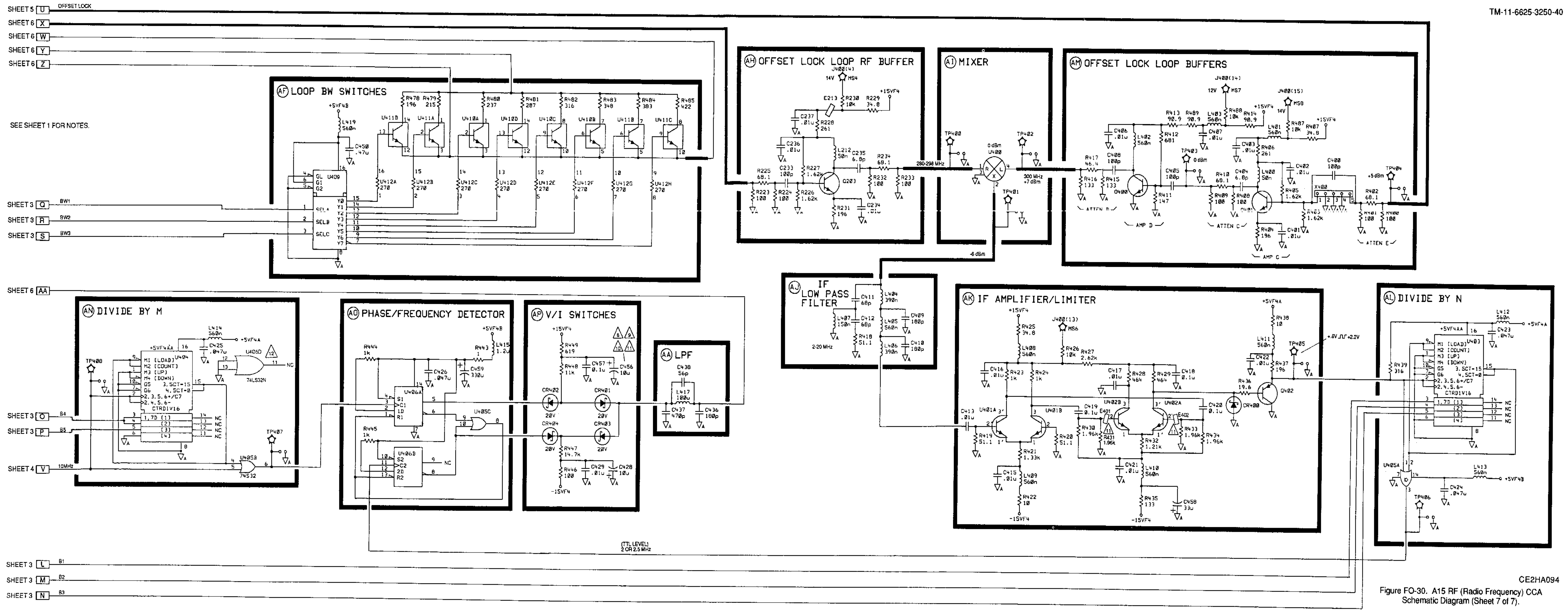
CE2HA092

Figure FO-30. A15 RF (Radio Frequency) CCA
Schematic Diagram (Sheet 5 of 7).

SEE SHEET 1 FOR NOTES.

CE2HA093

Figure FO-30. A15 RF (Radio Frequency) CCA Schematic Diagram (Sheet 6 of 7).



CE2HA094

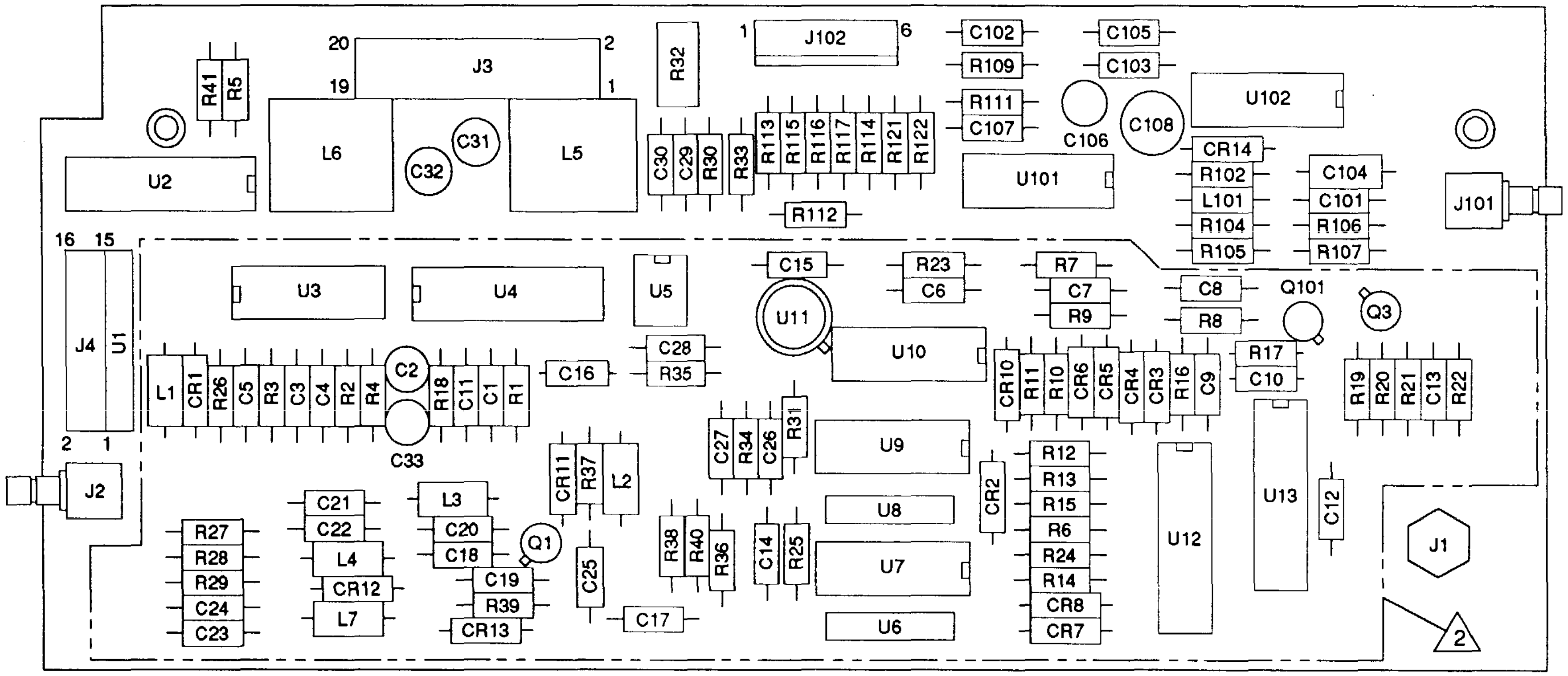
Figure FO-30. A15 RF (Radio Frequency) CCA Schematic Diagram (Sheet 7 of 7).

NOTES:

1. ⊡ SQUARE SOLDER PADS INDICATE
THE FOLLOWING POINTS:
IC'S AND CONNECTORS = PIN 1
DIODES = CATHODE
TRANSISTORS = EMITTER
TEST POINTS = MEASUREMENT POINT
(◎ ROUND PAD = TP GROUND)

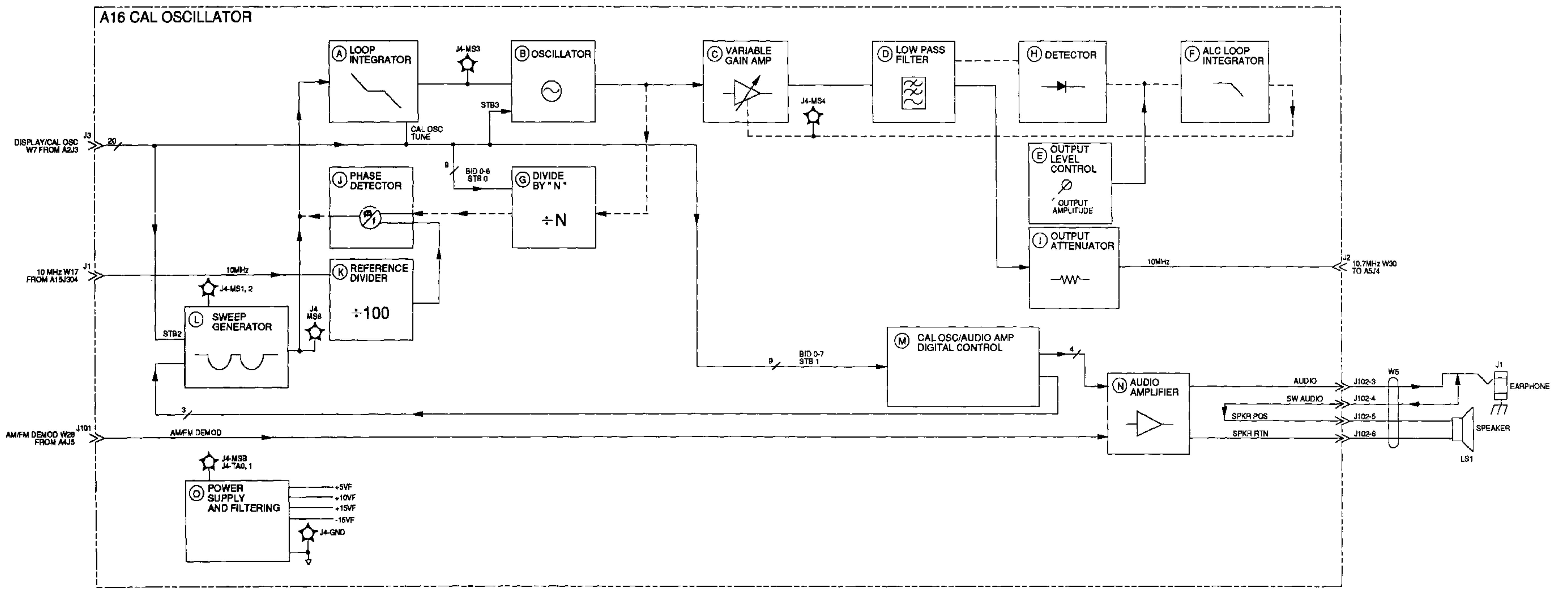
2. ———— LINE INDICATES SHIELD.

3. REFERENCE DESIGNATORS WITHIN
THIS ASSEMBLY ARE ABBREVIATED.
PREFIX ABBREVIATION WITH A16 FOR
COMPLETE REFERENCE DESIGNATOR.



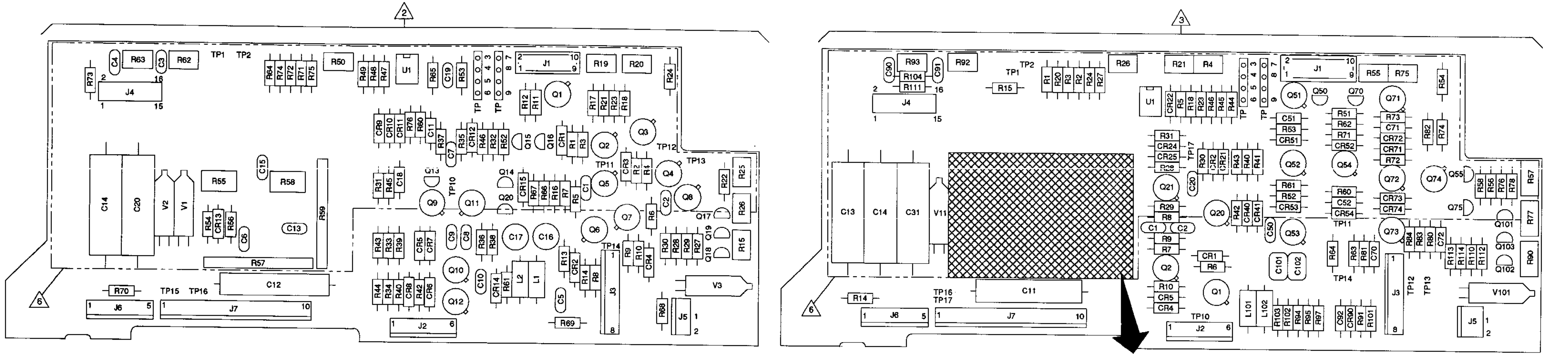
CE2HA095

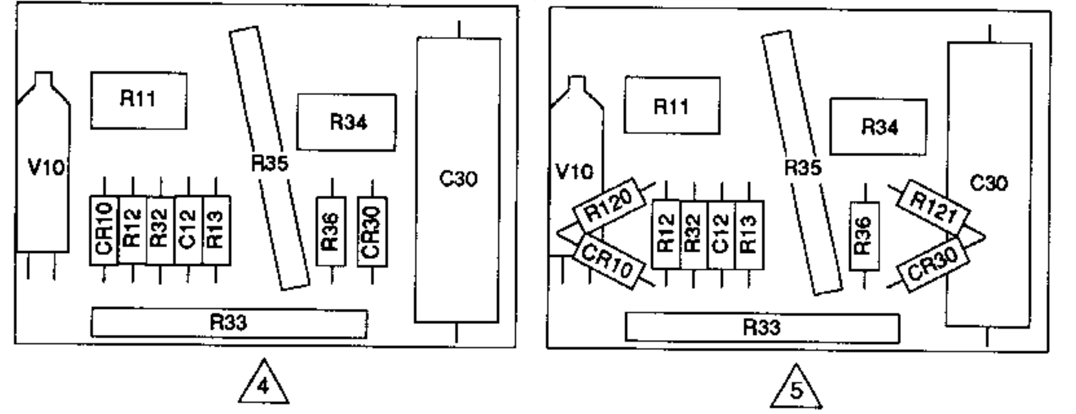
Figure FO-31. A16 CAL Oscillator CCA Component Locator Diagram.



CE2HA096

Figure FO-32. A16 CAL Oscillator CCA Functional Block Diagram.





NOTES:

1. ⊡ SQUARE SOLDER PADS INDICATE THE FOLLOWING POINTS:
   IC'S AND CONNECTORS = PIN 1
   DIODES = CATHODE
   TRANSISTORS = EMITTER
   TEST POINTS = MEASUREMENT POINT
   (◎ ROUND PAD = TP GROUND)

△2 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60039 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3115A).

△3 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60112, 08562-60165, AND 08562-60166 (AN/USM-489A SERIAL NUMBER PREFIXES 3119A THROUGH 3306A).

△4 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60112 (AN/USM-489A SERIAL NUMBER PREFIXES 3119A THROUGH 3147A).

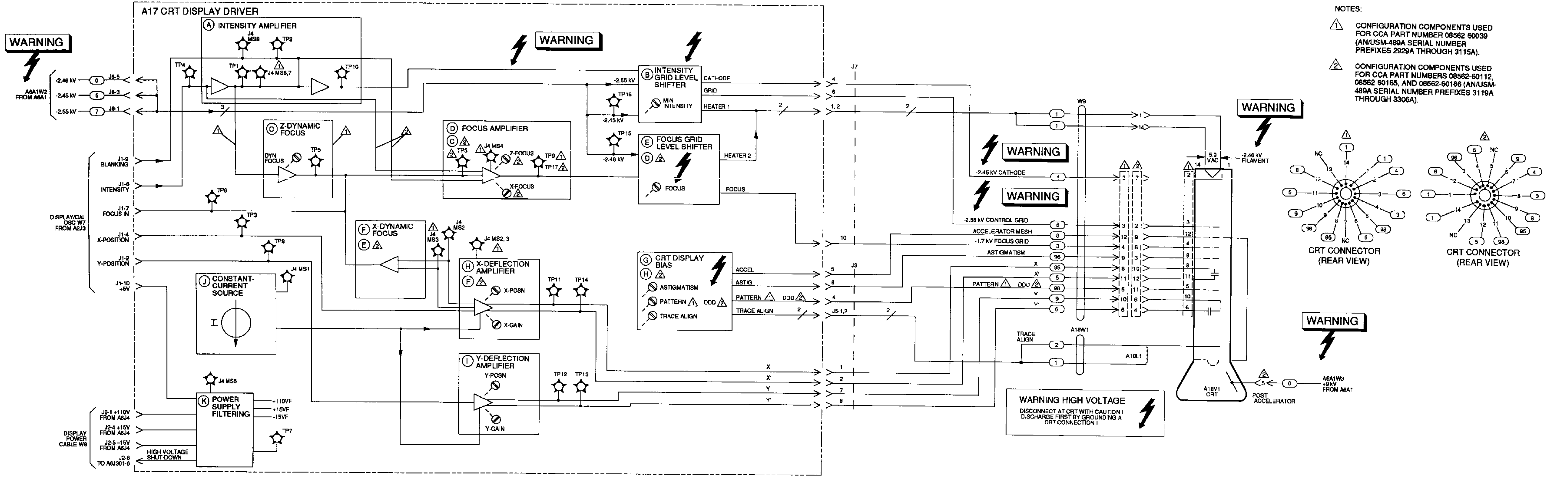
△5 CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60165, AND 08562-60166 (AN/USM-489A SERIAL NUMBER PREFIXES 3148A THROUGH 3306A).

△6 — - - — LINE INDICATES SHIELD.

7. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A17 FOR COMPLETE REFERENCE DESIGNATOR.

CE2HA097

Figure FO-33. A17 CRT Driver CCA Component Locator Diagram.



NOTES:

1. CONFIGURATION COMPONENTS USED FOR CCA PART NUMBER 08562-60039 (AN/USM-489A SERIAL NUMBER PREFIXES 2929A THROUGH 3115A).

2. CONFIGURATION COMPONENTS USED FOR CCA PART NUMBERS 08562-60112, 08562-60165, AND 08562-60166 (AN/USM-489A SERIAL NUMBER PREFIXES 3119A THROUGH 3306A).

CE2HA098

Figure FO-34. A17 CRT Driver CCA Functional Block Diagram.

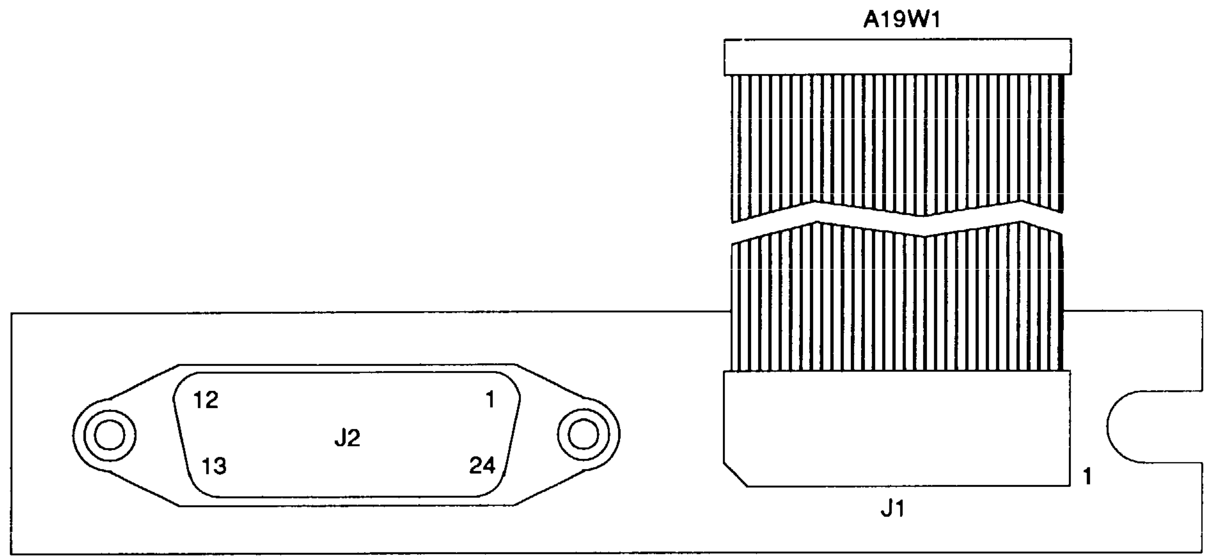
NOTES:

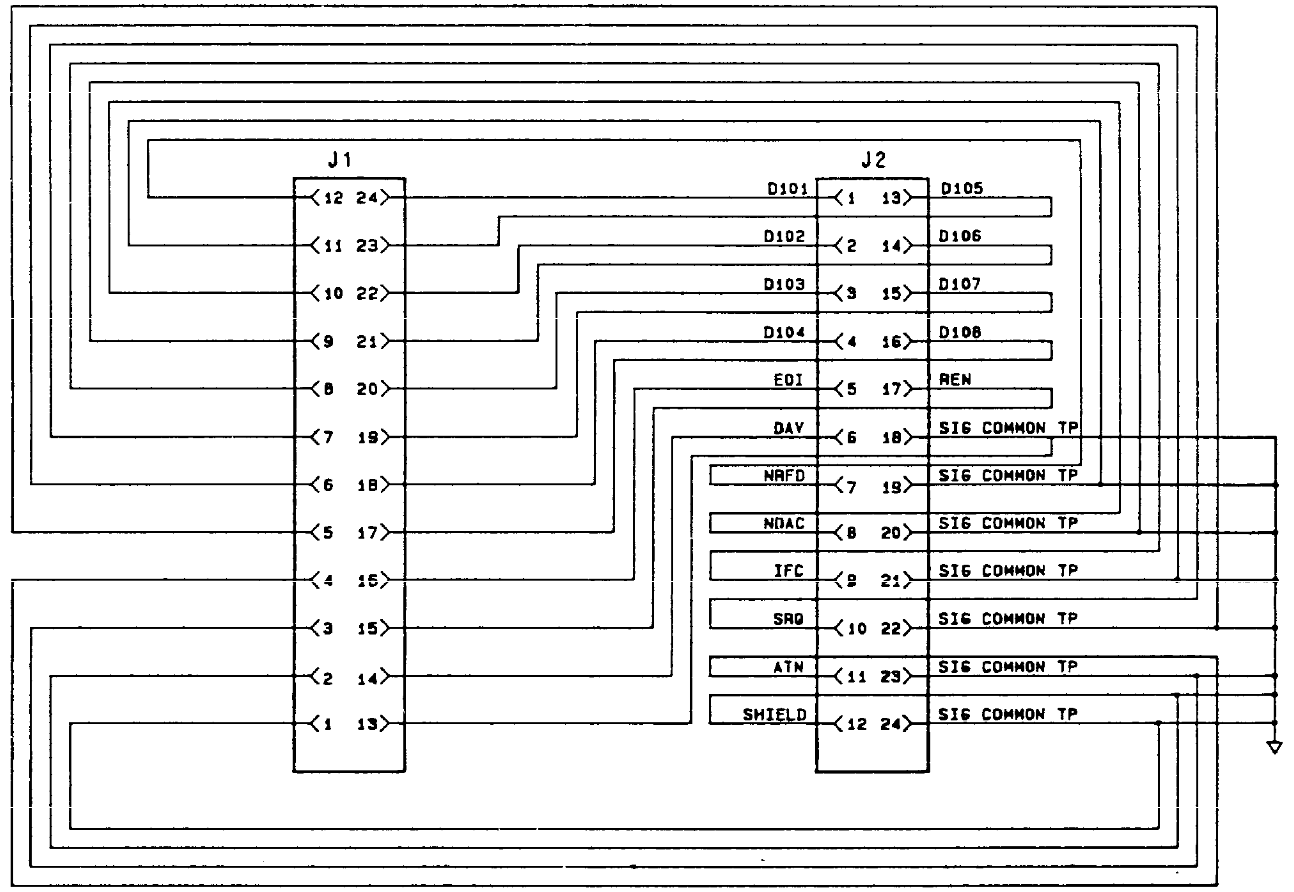
1. REFERENCE DESIGNATORS WITHIN THIS ASSEMBLY ARE ABBREVIATED. PREFIX ABBREVIATION WITH A19 FOR COMPLETE REFERENCE DESIGNATOR.

2. THIS SCHEMATIC IS USED FOR THE FOLLOWING A19 CIRCUIT CARD ASSEMBLIES AND AN/USM-489A PREFIXES:

HP PART NUMBER	SERIAL PREFIX FROM	TO
08562-60042	2929A	3306A

3. REFER TO FO-3 FOR CONNECTOR INTERCONNECTION INFORMATION.





CE2HA099

Fgure FO-35. A19 HP-IB CCA Component Locator/Schematic Diagram.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

Milton H. Hamilton

MILTON H. HAMILTON
Administrative Assistant to the
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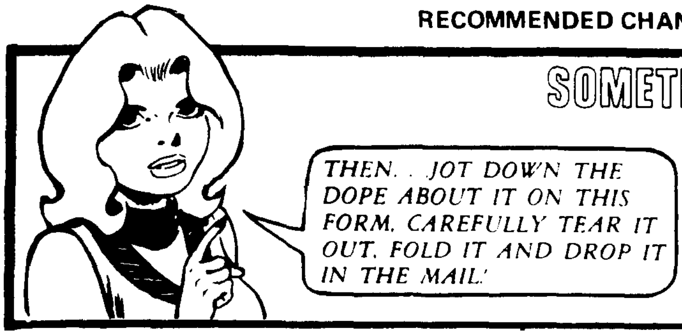

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9-19		9-5		"B" Ready Relay K11 is shown with two #9 contacts. That contact which is wired to pin 8 of relay K16 should be changed to contact #10.
21-2	step 1C		21-2	Reads: Multimeter B indicates 600 K ohms to 9000 K ohms. Change to read: Multimeter B indicates 600 K ohms minimum. Reason: Circuit being checked could measure infinity. Multimeter can read above 9000 K ohms and still be correct.

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All comments will be appreciated, and will be given immediate attention. Handwritten comments are acceptable.

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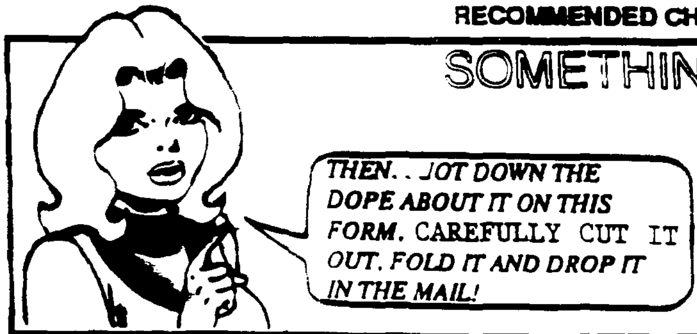

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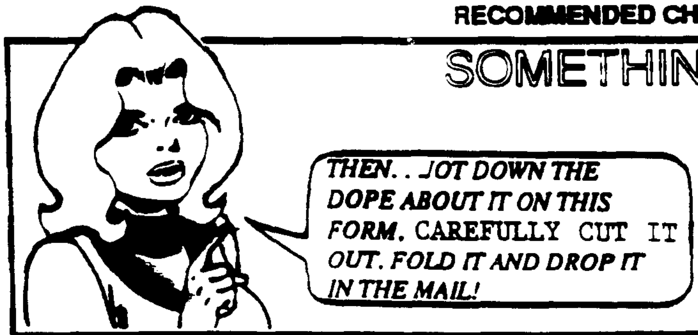

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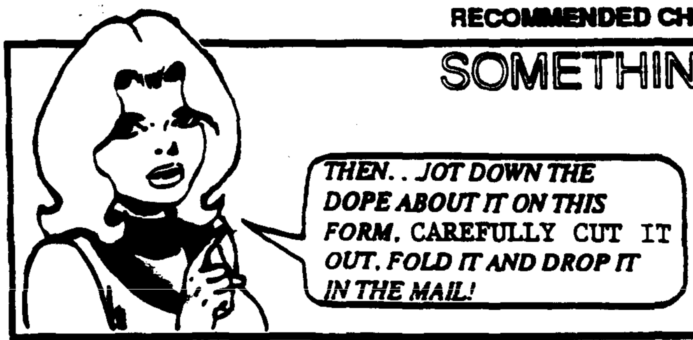

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