ANALYZING AND LOCATING TROUBLE IN SIGNAL DISTRIBUTORS
2-WIRE AND 4-WIRE NO. 1 ELECTRONIC SWITCHING SYSTEM

CONTENTS PAGE

FIGURES PAGE

TABLES

1. GENERAL

1.01 This section provides an approach to locating and analyzing many of the malfunctions that

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can occur in the controllers and the relay contact tree of the Signal Distributor (SD).

1.02 This section is reissued to include the DR02 message for CTX-7 Issue 9 and 1E4 generic programs and to make minor corrections.

> ➧***Note:*** Effective with what would have been CTX-8 Issue 4 of No. 1 ESS, the equivalent generic program designation is 1E4.➧

2. GENERAL DESCRIPTION

2.01 The signal distributor starts an operational cycle when the ***Central Pulse Distributor (CPD),*** as instructed by ***Central Control (CC),*** transmits an enable signal over a private bus. This causes a particular signal distributor to gate the selection data from the peripheral unit address bus into its buffer register (Fig. 1). The buffer register stores this data until the selected magnetic latching relay has operated or released. When the signal distributor senses the completion of the magnetic latching relay action, it releases the established path through the relay contact tree and becomes available for a new order.

2.02 The function of the network controller in the Signal Distributor is to:

(a) Receive address information

(b) Check address information for errors

(c) Block further action if errors are found and notify CC

(d) Operate preselector relays

(e) Receive verification that the selected magnetic latching relay worked as intended.

If all circuit conditions are satisfied, the controller resets for the next cycle of operation.

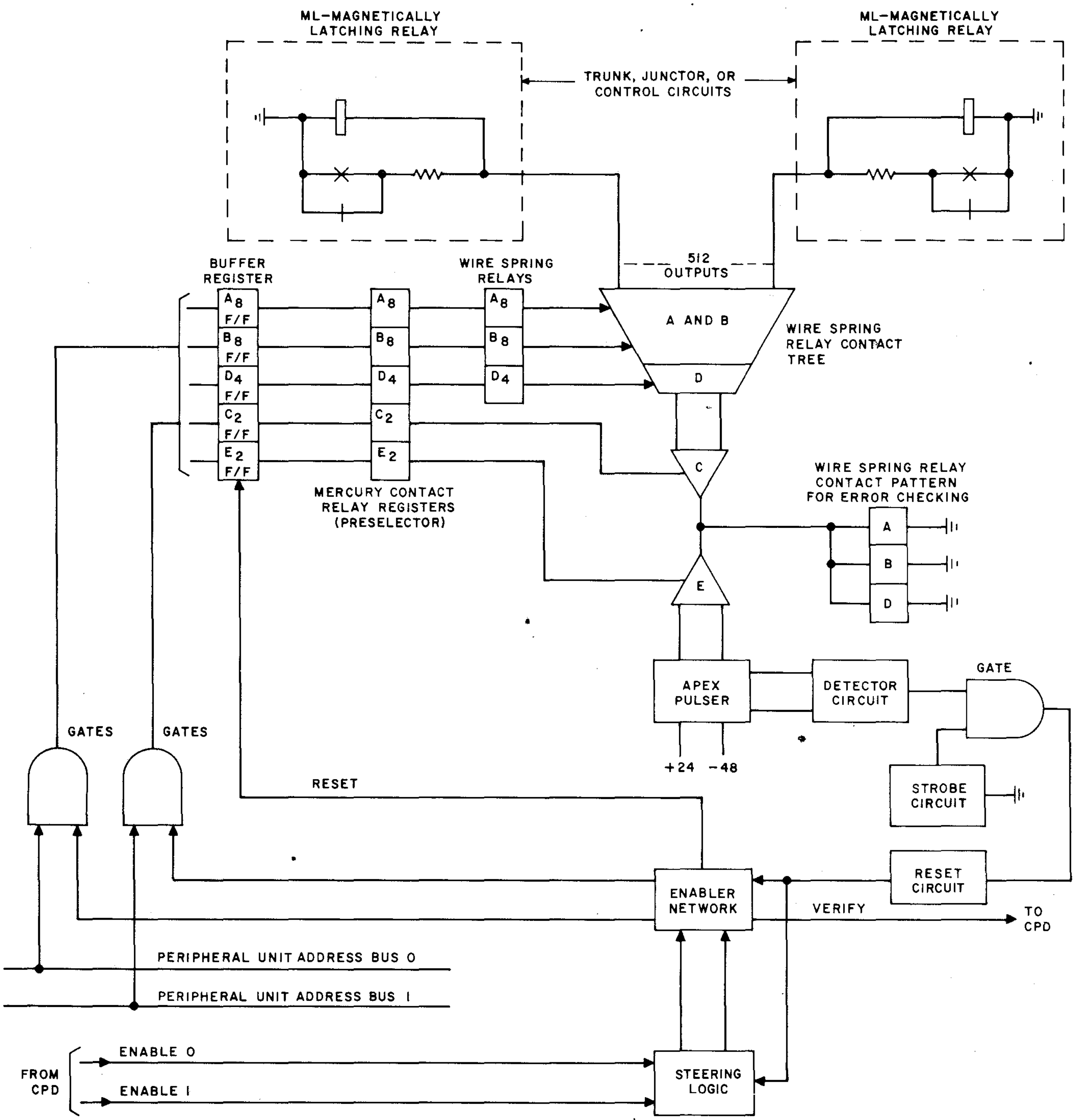


Fig. 1—Basic Signal Distributor

2.03 The relay contact tree consists of an organized system of wire-spring relays which provide a unique electrical connection called a selection path from the apex pulser to the addressed output. A typical selection path to operate or release a magnetic latching relay within a basic unit is shown in Fig. 2.

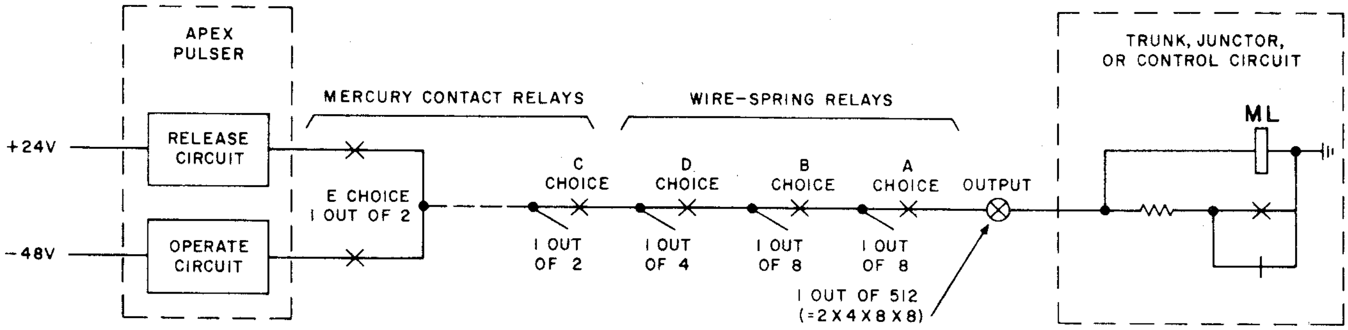


Fig. 2—Selection Path to Operate or Release a Magnetic Latching Relay

3. REFERENCE DOCUMENTS

DOCUMENT	TITLE
PD-1A028	Diagnosis Program Description
PK-1A028	Raw Data Analysis
TLM-1A216	Trouble Locating Manual for Signal Distributor
CD-1A216	Circuit Description for Signal Distributor
SD-1A216	Schematic Diagram for Signal Distributor
CD-1A247	Circuit Description for Supplementary Signal Distributor
SD-1A247	Schematic Diagram for Supplementary Signal Distributor
CD-1A113	Circuit Description for Junctor Signal Distributor
SD-1A113	Schematic Diagram for Junctor Signal Distributor
CD-1A127	Circuit Description for Universal Signal Distributor
SD-1A127	Schematic Diagram for Universal Signal Distributor
CD-1A128	Circuit Description for Miscellaneous Signal Distributors
SD-1A128	Schematic Diagram for Miscellaneous Signal Distributors
PF-1A028	Program Flowchart
IM-1A001	Input Message Manual
OM-1A001	Output Message Manual

Other Sections Referenced:

040-272-701	RELAYS 286, 287, AND 288 TYPES REQUIREMENTS AND ADJUSTING PROCEDURES
100-136-301	MAGNETIC LATCHING TIMING RELAY TEST SET J94735A OPERATION
231-130-301	TRUNK AND LINE TEST PANEL AND SUPPLEMENTARY TRUNK TEST PANEL—METHOD OF OPERATION

4. TOOLS, MATERIALS, AND TEST APPARATUS

CODE OR SPEC. NO.	DESCRIPTION

TOOLS

662A	Adjuster for fixed contacts

MATERIALS

—	Bond paper
—	Trichloroethane

TEST APPARATUS

J94735A	Magnetic Latching Relay Test Set
KS-20538-L1	Volt-Ohmmeter or Equivalent
453A	Tektronix Oscilloscope or Equivalent

5. NETWORK CONTROLLER DIAGNOSTIC FAILURES

5.01 Circuit failures can be detected by TTY printouts or TBL lamps at the MCC. If detected by TBL lamps, use NETSD-TBL message to determine the failing unit. Refer to IM-1A001 Input Message Manual for complete message. The system will respond with an MA06 NTSD TBL message. Refer to OM-1A001 Output Message Manual for complete message. The controller enable word is shown in Fig. 3.

22 20	19 17	16 14	13 11	10	9 7	6 5	4 1	0
GROUP IN CPD	ROW IN CPD	COLUMN IN CPD	CPD PAIR	C P D	CC TRANSLATOR	SEE NOTE 2	STATUS BITS SEE NOTE 1	

Fig. 3—Layout of Network and SD Enable Word

Note 1: Bit 1 = 1—controller is in trouble and out of service.

Bit 2 = 1—controller is bus or CPD sensitive.

Bit 3 = 1—fault recognition is in progress on controller.

Bit 4 = 1—both controllers are faulty.

Note 2: Bits 5 and 6 indicate maintenance responses to CC:

Bit 5 = 1—look for ASW, always 0.

Bit 6 = 1—look for enable verify, normally 1.

EXAMPLE:

MA06 NTSD TBL
UTSD SEC
MEMN

00 05603502 05603500

Note 3: Member number = 00. Octal digits 05603502 represent controller 0 and octal digits 05603500 represent controller 1. Bit 1 of controller 0 word equals 1; therefore controller 0 is out of service.

5.02 Using the information obtained in 5.01, request a diagnostic using NET DGN message as per IM-1A001 Input Message Manual. The system will respond with a DR01 TBL message. Refer to OM-1A001 Output Message Manual for complete output message.

5.03 Repeat 5.02 to insure that trouble is not random. Numerous circuit failures can be the cause of network frame controllers failing a diagnostic. Refer to TLM 1A216 for UTSDs and JSDs and to TLM 1A247 for SSDs and MSDs, and if an exact match is found, replace the designated circuit packs one at a time. Repeat diagnostic each time a pack is replaced. If the same universal trouble number occurs, replace the old pack and proceed to the next pack listed. If this fails to fix the trouble, or if the original trouble did not yield an exact match, the next step will be to request a raw data printout.

5.04 Analysis of the raw data printout will be made easier if the fundamental operation of the ***Signal Distributor (SD)*** is understood.

5.05 SD diagnostic tests are predicated on sending a series of orders to the suspected controller and monitoring the internal relay operations from private master scanner points. The following paragraphs show the basic operations for the SD internal circuitry.

Steering Logic—FS4

5.06 Each controller can be enabled by either of two CPD signals. For a given controller, each enable originates from a different CPD and allows the controller to receive orders from either PU address bus (Fig. 4).

5.07 Once a controller has been properly enabled, an enable verify pulse will be sent back to the CPD, and the timing sequence to receive and carry out the order is started. Successful completion of the order results in resetting the controller via an output from the apex pulser. If the controller is not reset by completion of the order, it may be reset by a CC pulse (lead 36) sent to all controllers at the end of each cycle.

Maintenance Relays—FS5

5.08 The F, S, and T points are connected over private pairs to a master scanner. These points reflect the state of the controller, and also the source of the controller reset (Fig. 4).

5.09 In addition to the F, S, and T points, FS5 contains the maintenance relays used for changing states of a controller. This circuitry is controlled by a CC order to the mate controller, and is designed to prevent mate units from being placed in conflicting states.

Relay Contact Matrix—FS3

5.10 The peripheral order received in FS1 should have operated one X and one Y relay in FS2. In FS3 this "one and only one" concept is tested. If more than one relay is operated in either group, the R/LCKP or R/LCKS lead will be grounded and will prevent the controller from affecting an external relay.

Apex Pulser—FS6

5.11 When the relay path has been established to the output point, the apex pulser will attempt to operate or release the external relay. If the external relay functions properly, a step current will be detected, resulting in an R/LOP pulse to reset the controller.

5.12 At the MCC-TTY request raw data diagnostic as described in 5.02.

5.13 The following examples represent typical raw data failures on a UTSD. In each case, analysis of the printout will narrow the trouble possibilities to a relatively small area.

5.14 Controller diagnostic programs perform a logical sequence of tests to isolate internal circuitry problems. When analyzing raw data results, it is usually advantageous to examine the data from all preceding and succeeding tests which may have passed.

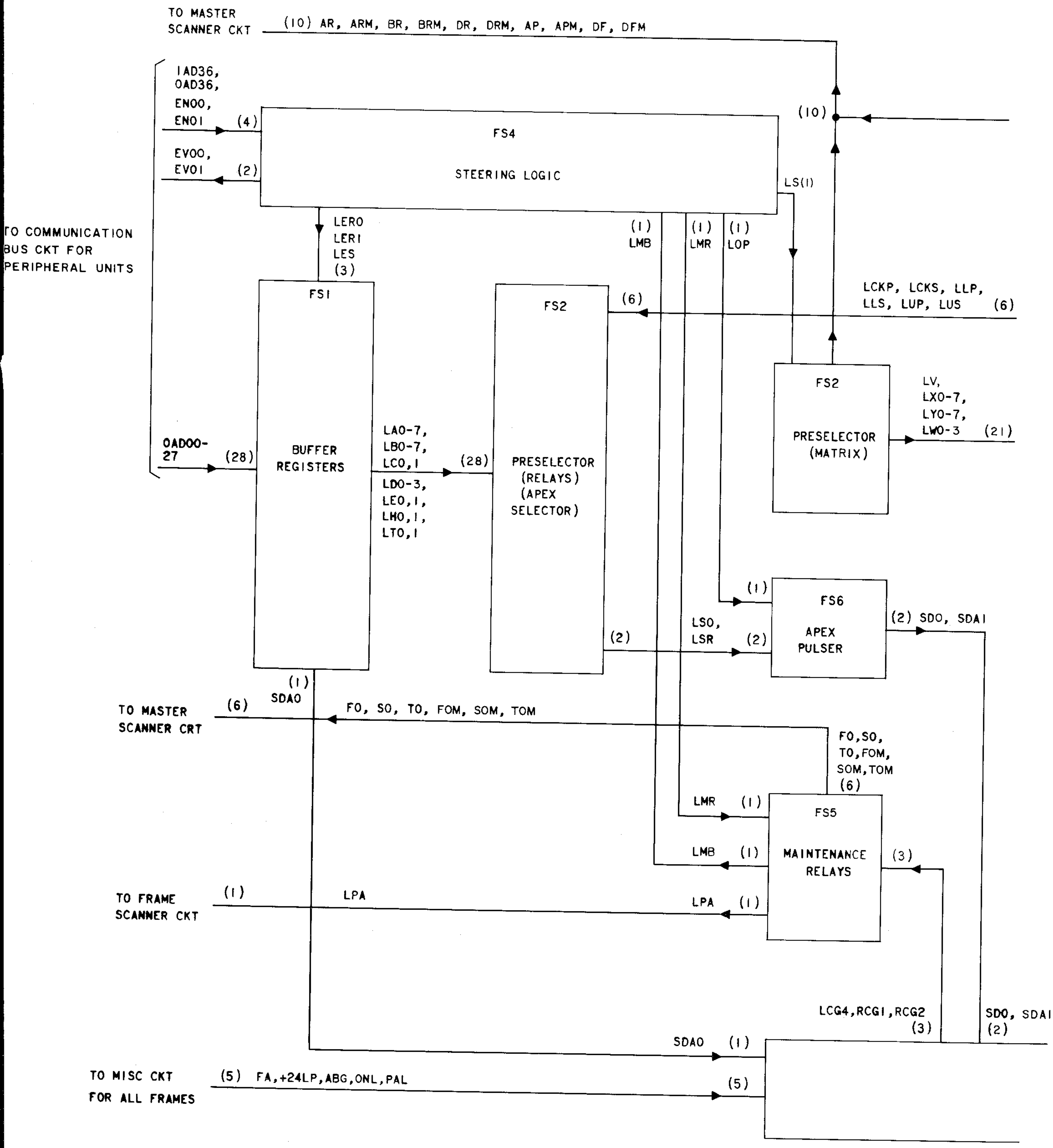
5.15 Example #1—UTSD CONTROLLER 0. Phases 2 and 3 fail identical tests using PK 1A028 and the raw data printout. The information derived is as follows:

DR02 RAW DGN RES UTSD 0 CONTR 0

PH 1 ATP

PH 2 STF	PH 3 STF
00000000	00000000
02104000	02104000
00210420	00210420
00000000	00000000
--------	--------
00000000	00000000

5.16 All failing bits refer to Note 88 ▶in PK-1A028,◀ which in turn refers to Note 87. Note 87 explains why the AP point on the diagnostic bus will read zero (saturated). This occurs when the LSO or LSR (the failure is in controller 0) relays operate. These relays operate when either the operate or release current flows.



TO MASTER SCANNER CKT
(10) AR, ARM, BR, BRM, DR, DRM, AP, APM, DF, DFM
IAD36, OAD36, EN00, EN01
(4)
EV00, EV01
(2)
FS4
STEERING LOGIC
(10)
LS(1)
TO COMMUNICATION BUS CKT FOR PERIPHERAL UNITS
LER0
LER1
LES
(3)
(1) LMB
(1) LMR
(1) LOP
FS1
FS2
(6)
LCKP, LCKS, LLP, LLS, LUP, LUS (6)
FS2
PRESELECTOR (MATRIX)
LV, LX0-7, LY0-7, LW0-3 (21)
OAD00-27
(28)
BUFFER REGISTERS
LA0-7, LB0-7, LC0,1
(28)
LD0-3, LE0,1, LH0,1, LT0,1
PRESELECTOR (RELAYS) (APEX SELECTOR)
(1)
FS6
APEX PULSER
(2) SDO, SDAI
(2)
LSO, LSR
(2)
(1) SDAO
TO MASTER SCANNER CRT
(6)
FO, SO, TO, FOM, SOM, TOM
FO,SO, TO,FOM, SOM,TOM (6)
LMR (1)
FS5
MAINTENANCE RELAYS
LMB (1)
(3)
TO FRAME SCANNER CKT
(1)
LPA
LPA (1)
LCG4,RCG1,RCG2 (3)
SDO, SDAI (2)
SDAO (1)
TO MISC CKT FOR ALL FRAMES
(5) FA,+24LP,ABG,ONL,PAL
(5)

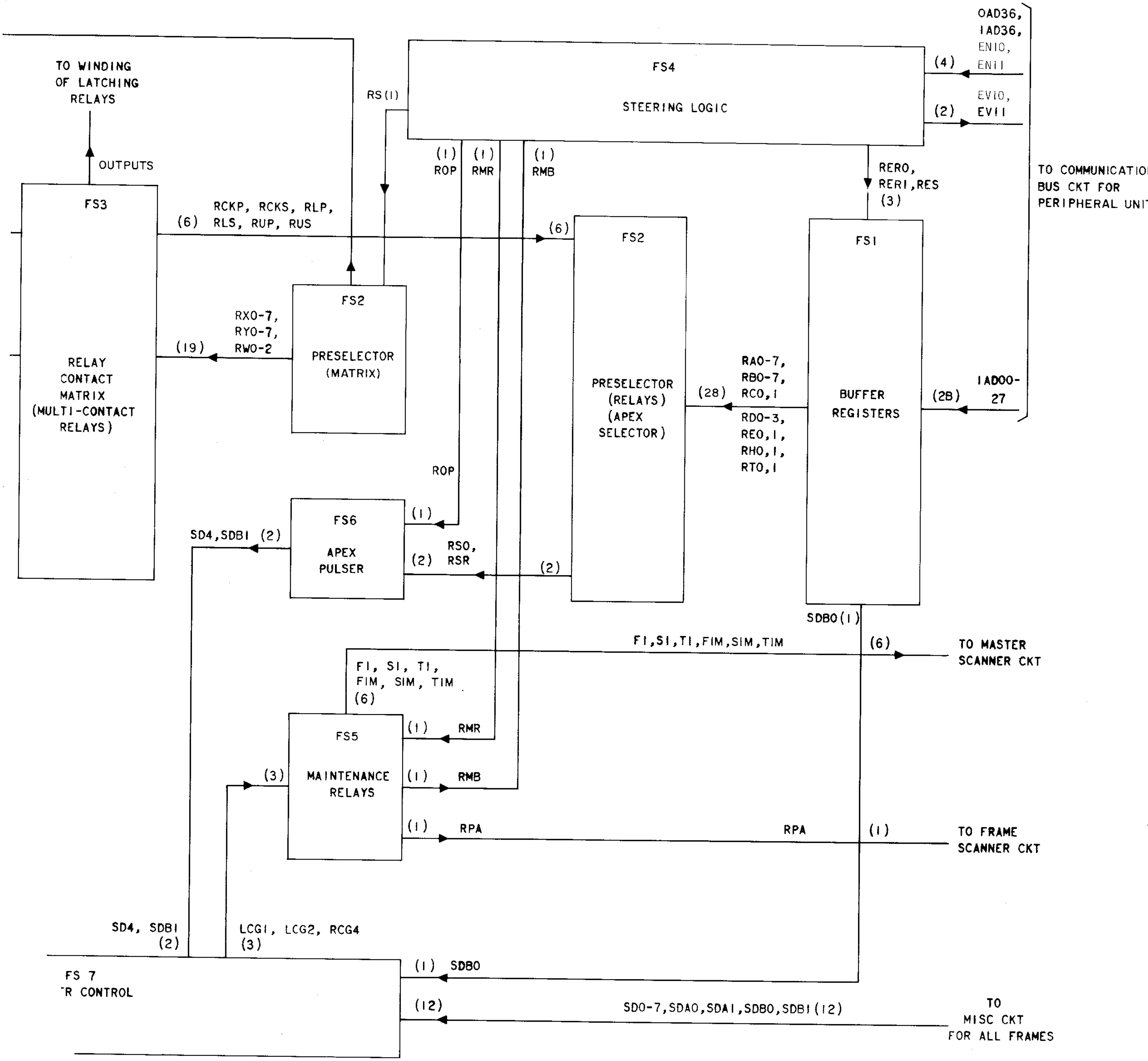


Fig. 4—Signal Distributor Block Diagram

5.17 A check of each failing bit shows the problem always to be AP = 0. For each of these test orders, a Y relay is supposed to operate without any X or W relays operating. If the controller functions properly, the operate or release potential should not be closed through. Therefore, the AP point would be unsaturated.

5.18 There are 8 LY relays (0 through 7), but only 7 bits failed in the raw data test. Checking the remaining test orders shows that bit 0 of word 3 passes. In this instance, the LY3 relay is being operated.

5.19 FS3 of SD-1A216 contains the relay matrix. If more than one relay in any group operates, a shunting ground is placed in the path of the operate or release potential.

5.20 Since the LY3 is the only relay that passes the test, it can be assumed that this relay is operating falsely on the other seven test orders, resulting in a "more than one" failure.

5.21 It would appear that the L03 relay, make contacts 3 to 10, are stuck closed. Using an ohmmeter, check contacts, change the circuit packs associated with the LY3, and inspect the wiring or use NET-ONE order (6.29) to locate the trouble.

5.22 Example #2 - UTSD CONTROLLER 0. In this case, only one failing bit is indicated in the printout:

24 DR02 RAW DGN RES UTSD 0 CONTR 0

PH 1 ATP

PH 2 STF	PH 3 STF
00000000	00000000
00000020	00000020
00000000	00000000
--------	--------
00000000	00000000

5.23 The fact that only one bit is shown as failing does not mean that all other tests passed. In this case the remainder of the tests were bypassed once a failure was encountered. The indication that the diagnostic phase has ended can be obtained from the PK sheets as shown by the notation "terminate points". In this case, phase 2 or 3 will be terminated after bit 7 if any failure occurs between bits 4 through 7.

5.24 Bit 4 indicates a DC check failure on point AR. These points can be located by using the lead index in the SD. This point tests the normal state of relays L08 through L15 through a contact of the LTA relay.

5.25 ➧For offices with CTX-7 Issue 9, IE4 or later generic programs, the DR02 message is basically the same. The differences are as follows:

- A 12-digit phase trouble number is printed
- A 12-digit universal trouble number is printed
- The word number in decimal of the failing raw data is printed
- All raw data words which contain only zeros are not printed ➧

6. RELAY TROUBLE LOCATING PROCEDURES

6.01 Using Fig. 5 flowchart with numbered Procedures listed in 6.02 through 6.29, this section can be used as a guide to locating most problems encountered in the relay section of Signal Distribution Frames.

PROCEDURE 1—ANALYZING NN10 MESSAGE FOR SD POINTS

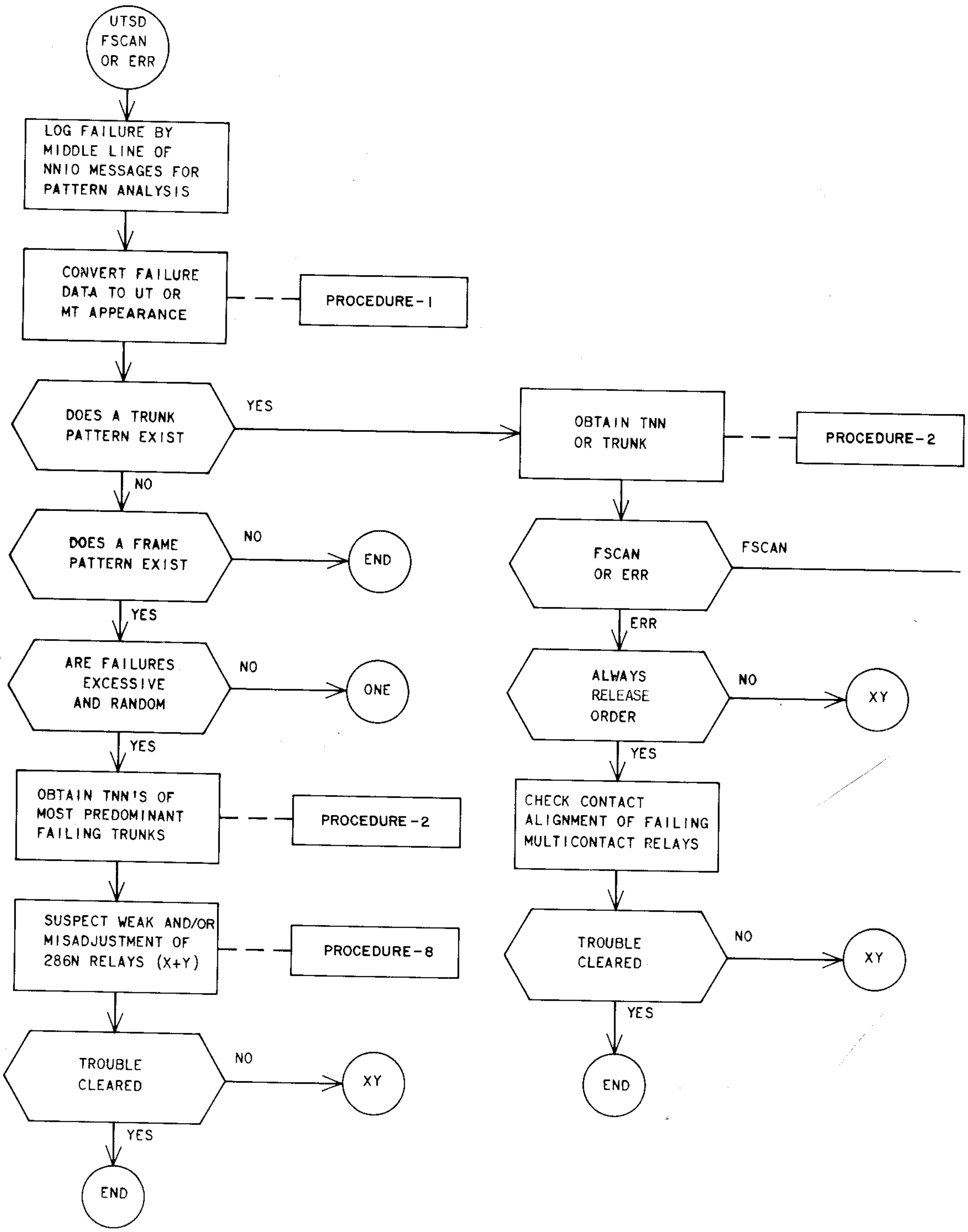
6.02 At MCC-TTY type in:

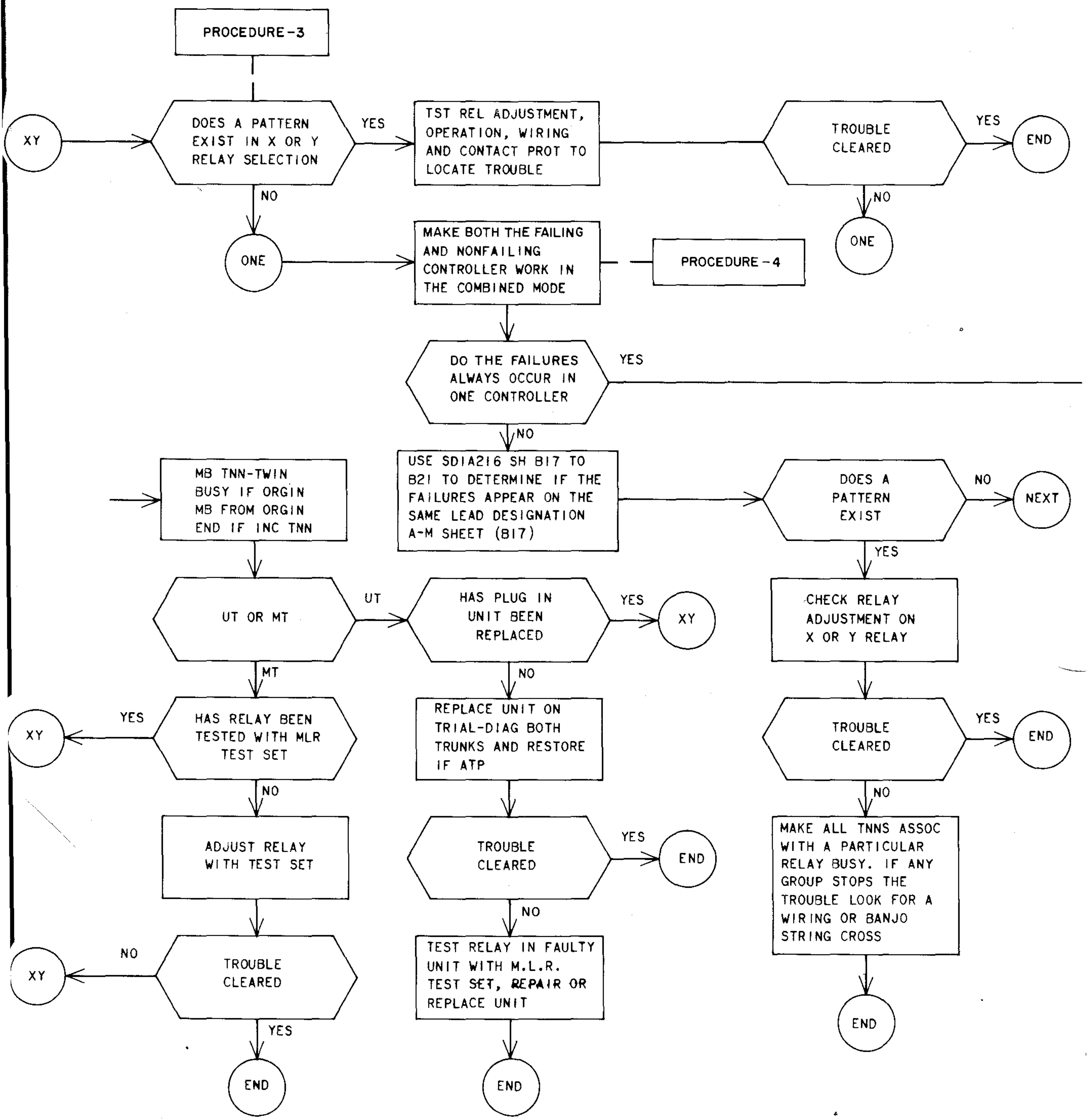
NM-SNAP-ALL0001111.

System response:

OK-followed by

NN10 message when a failing order is detected.


UTSD FSCAN OR ERR
LOG FAILURE BY MIDDLE LINE OF NNIO MESSAGES FOR PATTERN ANALYSIS
CONVERT FAILURE DATA TO UT OR MT APPEARANCE
PROCEDURE-1
DOES A TRUNK PATTERN EXIST
YES
NO
OBTAIN TNN OR TRUNK
PROCEDURE-2
DOES A FRAME PATTERN EXIST
NO
END
YES
FSCAN OR ERR
FSCAN
ERR
ARE FAILURES EXCESSIVE AND RANDOM
NO
ONE
YES
ALWAYS RELEASE ORDER
NO
XY
YES
OBTAIN TNN'S OF MOST PREDOMINANT FAILING TRUNKS
PROCEDURE-2
CHECK CONTACT ALIGNMENT OF FAILING MULTICONTACT RELAYS
SUSPECT WEAK AND/OR MISADJUSTMENT OF 286N RELAYS (X+Y)
PROCEDURE-8
TROUBLE CLEARED
NO
XY
YES
END
TROUBLE CLEARED
NO
XY
YES
END


PROCEDURE-3
XY
DOES A PATTERN EXIST IN X OR Y RELAY SELECTION
YES
TST REL ADJUSTMENT, OPERATION, WIRING AND CONTACT PROT TO LOCATE TROUBLE
TROUBLE CLEARED
YES
END
NO
ONE
NO
ONE
MAKE BOTH THE FAILING AND NONFAILING CONTROLLER WORK IN THE COMBINED MODE
PROCEDURE-4
DO THE FAILURES ALWAYS OCCUR IN ONE CONTROLLER
YES
NO
MB TNN-TWIN BUSY IF ORGIN MB FROM ORGIN END IF INC TNN
USE SD1A216 SH B17 TO B21 TO DETERMINE IF THE FAILURES APPEAR ON THE SAME LEAD DESIGNATION A-M SHEET (B17)
DOES A PATTERN EXIST
NO
NEXT
YES
UT OR MT
UT
HAS PLUG IN UNIT BEEN REPLACED
YES
XY
CHECK RELAY ADJUSTMENT ON X OR Y RELAY
MT
NO
XY
YES
HAS RELAY BEEN TESTED WITH MLR TEST SET
REPLACE UNIT ON TRIAL-DIAG BOTH TRUNKS AND RESTORE IF ATP
TROUBLE CLEARED
YES
END
NO
NO
ADJUST RELAY WITH TEST SET
TROUBLE CLEARED
YES
END
MAKE ALL TNNS ASSOC WITH A PARTICULAR RELAY BUSY. IF ANY GROUP STOPS THE TROUBLE LOOK FOR A WIRING OR BANJO STRING CROSS
NO
TEST RELAY IN FAULTY UNIT WITH M.L.R. TEST SET, REPAIR OR REPLACE UNIT
XY
NO
TROUBLE CLEARED
END
YES
END
END

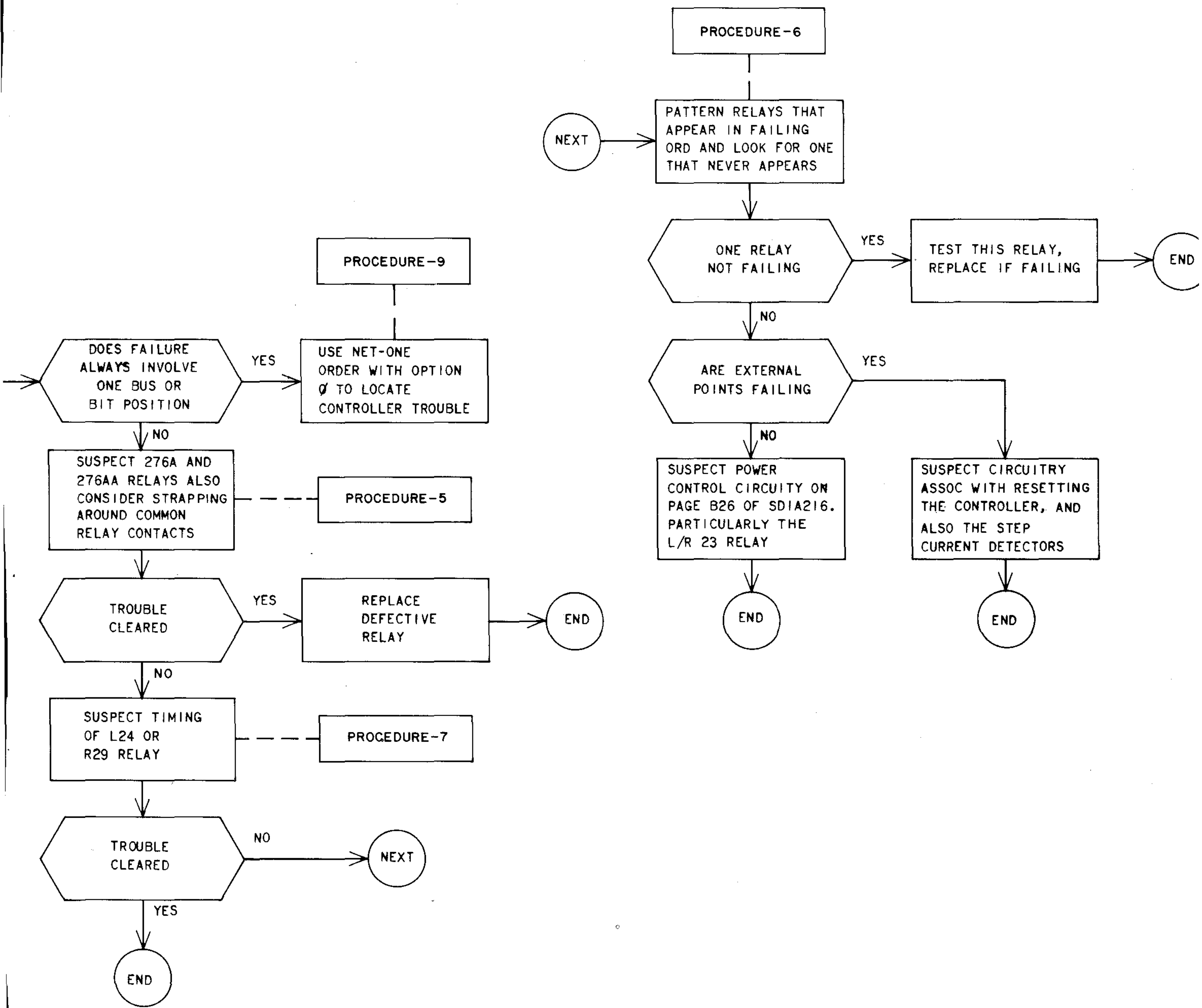


Fig. 5—Relay Trouble Location Flowchart

6.03 Analyze NN10 message as follows:

NN10 áaaa
bbb ccc
ddd eee ff & ggg s hhh i j k l m n o
ppppppp
gggg gggg gggg gggg gggg gggg gggg gggg

Variable field:

bbb = Frame type

ccc = Network or Frame no.

ppppppp = Network order in octal

gggg ---- = order as it appears on the PU bus.

6.04 Analyze ppppppp as follows: for 2-wire No. 1 ESS

Note: If bit position 0 and 1 = 11, then it is an EXTERNAL SD point (MT) (see example b).

```
Bit position =      11 ¦ 10 ¦ 9 ¦ 8    7    6    5 ¦ 4    3 ¦ 2 ¦ 1   0
                       ¦  ^ ¦ b ¦ HMP-1            ¦ VF     ¦ c ¦ r  00 = A relay
                       ¦  | ¦ a ¦                  ¦        ¦ k ¦ e  01 = B relay
                       ¦  | ¦ y ¦                  ¦        ¦ t ¦ l  10 = C relay
                          |   ^                                  a  11 = EXTERNAL SD
   (0 = operate)          |   |_(0 = bay 0)                      y       point. (see
   (1 = release)__________|     (1 = bay 2)                              example b).
```

(a) EXAMPLE: Internal SD point

ppppppp = 0000271

```
00 0¦0¦0¦0 1 0 1¦1 1¦0¦01
    ¦^¦^¦  ^    ¦ ^ ¦^¦^_B relay
     |  |  |      |  |___ckt = 0
     |  |  |      |______VF = 3
     |  |  |_____________HMP = 6 (5+1)
     |  |________________Bay = 0
     |___________________Relay failed to operate
```

(b) EXTERNAL SD point

```
bit position     11¦ 10 ¦ 9 ¦ 8    7    6    5    4    3    2 ¦ 1   0
                   ¦  ^ ¦ b ¦      EXTERNAL SD                 ¦ ^_will be 11
     0 = operate___¦__| ¦ a ¦      Point                       ¦   indicating
     1 = release          y                                        external SD
                          ^                                        point
                          |_(0 = bay 0)
                            (1 = bay 2)
```

To determine SD point: convert binary bits 2 thru 8 to octal, convert octal to decimal for SD point for bay "0", if bay is 1, add 128 to decimal number for SD point. SD points 000 through 127 appear on bay 0 and SD points 128 through 255 appear on bay 2.

Use the 1201 form (MT Frame Assignments) to locate the TNN. Use office base T drawing to locate signal distributor points.

(c) EXAMPLE:

EXTERNAL SD point

ppppppp = 0001657

```
0¦0¦1¦1 1 0 1 0 1 1¦1 1
 ¦ ¦  ¦Ø.153       ¦ └──External SD point
 │ │  107₁₀
 │ │                 SD point = 107      If bay was 1 the SD point would have
 │ └─bay 2                               been 235
 └───relay did not operate
```

6.05 Analyze ppppppp as follows: for 4-wire

```
bit position =      11 ¦ 10 ¦ 9 ¦ 8   7   6   5 ¦ 4   3   2 ¦ 1   0
                       ¦  ▲ ¦ b ¦ HMP-1         ¦   ckt     ¦ r  00 = CT relay
                          │   a                               e  01 = M relay
   ┌0 = operate┐          │   y◄─┌0 = bay 0┐                  l  10 = SL relay
   └1 = release┘──────────┘      └1 = bay 2┘                  a
                                                              y
```

6.06 Analyze ppppppp for **SUPPLEMENTARY SIGNAL DISTRIBUTOR POINTS**

```
bit position =      11 ¦ 10 ¦ 9 ¦ 8   7 ¦ 6   5   4   3   2 ¦ 1   0
                       ¦  ▲ ¦ h ¦       ¦                   ¦
                       ¦  │ ¦ a ¦ QUAD  ¦       ROW         ¦ FIELD
                       ¦  │ ¦ l ¦       ¦                   ¦
                       ¦  │ ¦ f ¦       ¦                   ¦
       ┌0 = operate┐    │
       └1 = release┘────┘
```

EXAMPLE: ppppppp = 0002023

```
0¦1¦0¦0 0¦0 0 1 0 0¦1 1
```

FIELD = 3
ROW = 4
QUAD = 0
HALF = 0
Point did not release

Using TABLE A, this SD point is No. 388. Refer to office base T drawings to find assignments.

PROCEDURE 2 CONVERTING UT APPEARANCE TO TNN

6.07 At MCC-TTY type in:

VFY-UTCN-12bb c ddd.

bb = UT Frame no. from NN10 message

```
c = bay (0=bay 0, 1=bay 2) from NN10 message
ddd = CKT no. (from Fig. 6)
System response:
TR11 ⱥⱥa b ¢¢c d  ɇɇe ƒf gh ij
ⱥⱥa b ¢¢c = trunk circuit no. specified in input message.
        d = 0-not a trunk circuit
          = 1-valid trunk circuit
      ɇɇe = program index
  ƒf gh ij = TNN of trunk
```

PROCEDURE 3—ANALYZING ppppppp OF NN10 MESSAGE FOR X AND Y PATTERN

6.08 As in Table B, the second and third least significant digit is the NN10 message which can be translated into the X and Y relay selection. Bit 2 of the order designates which digit represents each relay.

Example:

(a) ppppppp = 0002044

(a) Bit 2 = 1 (bits 3-5 = X relay, bits 6-8 = Y relay)

(a) Bit 9 = 0 = left half

(a) Bits 3-5 = 4 = LX4 relay operated

(a) Bits 6-8 = 0 = LY0 relay operated

(b) ppppppp = 0002040

(b) Bit 2 = 0 (bits 3-5 = Y relay, bits 6-8 = X relay

(b) Bit 9 = 0 = left half

(b) Bits 3-5 = 4 = LY4 relay operated

(b) Bits 6-8 = 0 = LX0 relay operated

HALF	FIELD	QUADRANT	ROW 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
		2	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
		3	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
	1	0	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
		1	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
		2	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
		3	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
	2	0	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
		1	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
		2	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
		3	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
	3	0	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415
		1	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447
		2	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479
		3	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511

Table A

SUPPLEMENTARY SIGNAL DISTRIBUTOR POINTS

HALF	FIELD	QUADRANT	ROW 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	0	0	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543
		1	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575
		2	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607
		3	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639
	1	0	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671
		1	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703
		2	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735
		3	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767
	2	0	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799
		1	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831
		2	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863
		3	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895
	3	0	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927
		1	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959
		2	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991
		3	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023

MTG. PLT.	120	121	122	123	124	125	126	127
15	112	113	114	115	116	117	118	119
	104	105	106	107	108	109	110	111
	096	097	098	099	100	101	102	103
	088	089	090	091	092	093	094	095
	080	081	082	083	084	085	086	087
10	072	073	074	075	076	077	078	079
	064	065	066	067	068	069	070	071
	056	057	058	059	060	061	062	063
	048	049	050	051	052	053	054	055
	040	041	042	043	044	045	046	047
05	032	033	034	035	036	037	038	039
	024	025	026	027	028	029	030	031
	016	017	018	019	020	021	022	023
	008	009	010	011	012	013	014	015
01	000	001	002	003	004	005	006	007
CKT	0	1	0	1	0	1	0	1
	VF 0		VF 1		VF 2		VF 3	

Fig. 6—Circuit Location for UTs

TABLE B
PPPPPPP OF NN10 MESSAGE

BIT	PURPOSE
0-1	Selects L/RW0 through L/RW3 relays. L/RW3 is used for external points.
2	Selects circuit within PLUG-IN-UNIT.
3-5	X or Y relay selection Bit 2 = 0 = Y relay selection Bit 2 = 1 = X relay selection
6-8	X or Y relay selection Bit 2 = 0 = X relay selection Bit 2 = 1 = Y relay selection
9	Left or right half Bit 9 = 0 = bay 0 Bit 9 = 1 = bay 2
10	Operate or release Bit 10 = 0 = operate Bit 10 = 1 = release

PROCEDURE 4—RUNNING CONTROLLER IN COMBINED MODE

6.09 Run each controller in the combined mode. This procedure will determine whether the failure is associated with a relay path or the internal controller circuitry.

Example: If controller 1 fails only to points in bay 2 when running in either the normal or combined mode, the trouble would most likely be with the right half relay tree (R relays), since the controller can crossfire without trouble to the left relay tree (L relays). To further isolate trouble, run controller 0 in the combined mode. If failures occur in the right half while controller 0 is running combined, the trouble will be proven into the right relay tree. If the failure does not occur with controller 0 combined, the RX and RY relays (the relay tree) can be eliminated, since these relays operate properly from one controller. In this case, the trouble area to suspect would be the R00 through R25 relays.

PROCEDURE 5—STRAPPING AROUND SUSPECTED RELAY CONTACTS

6.10 If failing orders always show the L19 relay, rather than the L18 relay, the trouble might be caused by the L18 relay failing to restore properly after completing an order. If the next order requires the operation of the L19 relay, the pulse path would be open and thus fail.

6.11 Figure 7 shows where strap would be applied, for test purposes.

WARNING: Before applying any external strap, be sure to study SD 1A216-01 and CD 1A216 carefully for possible side effects.

6.12 276A AND 276AA RELAYS

(a) These relays are used to reset the controller (L/R 29 etc), and if they occasionally stick, will cause random failures.

PROCEDURE 6—TESTING TIMING OF L29 OR R29 RELAY

6.13 At the UT Frame, connect trace lead of oscilloscope to pin 1 of the LC0 or RC0 relay (depending on the relay to be timed). Normally this relay should never operate. If it does, connect the oscilloscope to pin 8 break of the L29 or R29 relay.

(a) Connect sync lead of the oscilloscope to the active enable.

(b) Set timing on the oscilloscope at 5 ms.

(c) The waveform shown in Fig. 8 should be observed.

(d) The pulse observed should occur between 17-18 msec. If the timing is 19 msec or more, the relay should be replaced.

(e) Check the timing on the new relay after it is installed.

Note: Several new relays have been found to be troublesome.

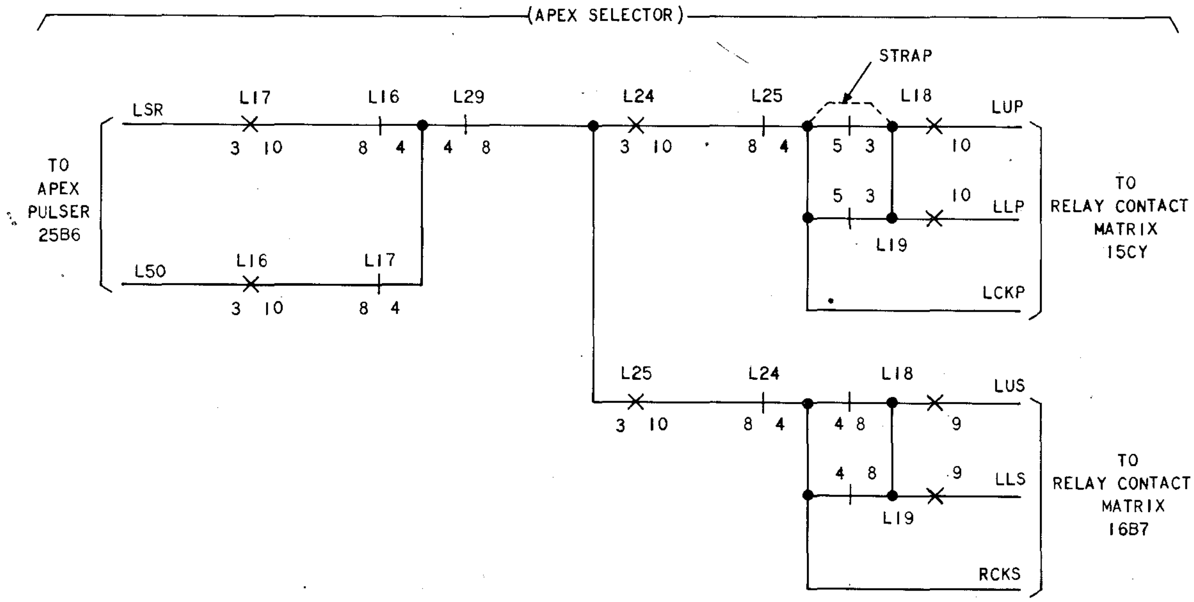


Fig. 7—Apex Selector

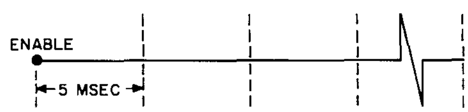


Fig. 8—Timing Pulse

PROCEDURE 7—ANALYZING NN10 MESSAGE PU BUS

6.14 Analyze NN10 message as follows:

NN10 daaa

gggg gggg gggg gggg gggg gggg gggg gggg gggg

Using Table C determine L or R relays that are operating.

6.15 Fault could be relay that never appears in failure message. By keeping a stroke record of the L or R relays (313A) appearing in NN10 messages, sticky relays can be elected. If one relay never appears in the NN10 message, it could be this relay is sticking.

Example: If random failures are being received which never involve the R08 relay, this relay should be suspected. If this relay is occasionally sticking, it would cause a "more than one" failure on any subsequent order. However, if the next order involves the R08 relay, it will pass because this relay's contacts are already closed.

PROCEDURE 8—LOCATING X AND Y RELAY TROUBLE

CAUTION: This procedure should be used only during periods of light traffic.

6.16 At the TLTP make most predominant TNN TWIN BUSY.

System response:

TN06 TNN
TN06 TNN

6.17 At UT frame—Remove the trunk pack in question. Reinsert trunk pack using the 169A trunk pack adapter.

6.18 At the MCC-TTY type in:

NET-ONE-aaa bbc de fffffff ggggggg hhhhhhhh.

Variable e in NET-ONE message = 0

Variable gggggggg is the same as variable ppppppp in NN10 message or word 4 of MN01 message (6.30).

6.19 At the UT frame determine which 286N relays are pulsing by observation.

WARNING: These relays CANNOT be removed from service. DO NOT interfere with their normal operation.

6.20 Using Table D, determine where the sync lead of the oscilloscope should be attached for the 286N relays determined in 6.19. Attach sync lead to the designated pin of the circuit pack. Only one lead is needed. If there are excessive extraneous pulses, use other relay circuit packs for sync pulse.

6.21 Attach oscilloscope trace lead on the battery side of relay winding of the relay determined from ppppppp in the NN10 message.

6.22 Adjust oscilloscope so entire pulse can be seen clearly. The operate pulse (-48V) and the release pulse (+24V) will be seen superimposed. The pulses should appear to be uniform and clean on the oscilloscope (no nipples, spikes, variation in length, etc).

6.23 If pulses appear distorted, look for the following conditions on 286N relays in the path set up by the NET-ONE message:

(a) Foreign elements in contacts

(b) Excessive spacing between fixed and moving contacts (compare with other relays in the tree)

(c) Vertical alignment of contacts not uniform from top to bottom (compare with other relays in the tree).

Clean contacts with bond paper saturated with trichloroethane. ***DO NOT*** BURNISH THESE CONTACTS.

6.24 Test and adjust 286N relays as per Section 040-272-701. Special attention should be given to the problem of sticking armatures on 286N relays, a condition which frequently causes relay chatter well beyond the 4 ms allowed tolerance.

6.25 Remove all oscilloscope leads. At the MCC, abort the NET-ONE message by depressing PROGRAM CONTROL KEY 20.

6.26 At the UT frame, remove the 169A Adapter. Reinsert the trunk pack.

6.27 At the TLTP make both TNN's idle. Call through on both TNNs.

6.28 Start with 6.16 on next trouble. It is possible that some of the existing NN10 messages may now be clear due to adjustments already accomplished.

PROCEDURE 9—CONSTRUCTING A NET-ONE MESSAGE

6.29 This message will allow a single order to be repeatedly sent to the signal distributor frame. Refer to IM-1A001 for the complete message structure.

6.30 This example of a NET-ONE message is constructed in long binary as taken from raw data failure (Fig. 9). This failure is on a UTSD controller 0 and bit 0 failed:

ffffffff of NET-ONE message = 00000400 for long binary

gggggggg of NET-ONE message are bits 0 through 22 of the order as it goes out on the bus (Fig. 9) = 01200400

hhhhhhhh of NET-ONE message are bits 23 through 35 of the order as it goes out on the bus (Fig. 9) = 00000012

The message would be as follows:

NET-ONE USD00000 00000200 00500200 00000012.

TABLE C

ORDER ON PU BUS

BIT	RELAY OPERATED 1ST	RELAY OPERATED 2ND	BIT	RELAY OPERATED 1ST	RELAY OPERATED 2ND
0	L/R 0	L/R Y0	15	L/R 15	L/R X7
1	L/R 1	L/R Y1	16	L/R 16	
2	L/R 2	L/R Y2	17	L/R 17	
3	L/R 3	L/R Y3	18	L/R 18	
4	L/R 4	L/R Y4	19	L/R 19	
5	L/R 5	L/R Y5	20	L/R 20	L/R W0
6	L/R 6	L/R Y6	21	L/R 21	L/R W1
7	L/R 7	L/R Y7	22	L/R 22	L/R W2
8	L/R 8	L/R X0	23	L/R 23	
9	L/R 9	L/R X1	24	L/R 24	
10	L/R 10	L/R X2	25	L/R 25	
11	L/R 11	L/R X3	26	L/R 26	
12	L/R 12	L/R X4	27	L/R 27	
13	L/R 13	L/R X5			
14	L/R 14	L/R X6			

TABLE D

SYNC LEADS FOR UTSD TREE RELAYS

RELAY	CKT-PKT	PIN	RELAY	CKT-PKT	PIN
LW0	120-16	2	RW0	120-44	2
LW1	120-16	1	RW1	120-44	1
LW2	120-16	0	RW2	120-44	0
LX0	120-04	2	RX0	120-30	2
LX1	120-04	1	RX1	120-30	1
LX2	120-04	0	RX2	120-30	0
LX3	120-04	26	RX3	120-30	26
LX4	120-08	2	RX4	120-32	2
LX5	120-08	1	RX5	120-32	1
LX6	120-08	0	RX6	120-32	0
LX7	120-08	26	RX7	120-32	26
LY0	120-12	2	RY0	120-34	2
LY1	120-12	1	RY1	120-34	1
LY2	120-12	0	RY2	120-34	0
LY3	120-12	26	RY3	120-34	26
LY4	120-14	2	RY4	120-40	2
LY5	120-14	1	RY5	120-40	1
LY6	120-14	0	RY6	120-40	0
LY7	120-14	26	RY7	120-40	26

	BIT	CAUSE OF FAILURE	ORDERS AS THEY GO OUT ON THE BUS																																		
			35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IX	0	DR = I XO ENERGIZED NO Y OR W										X		X						X		X								X								
	1	AP = O XI ENERGIZED NO Y OR W										X		X						X		X							X									
	2	AR = O										X		X						X		X							X									
	3	BR = I										X		X						X		X							X									

Fig. 9—Raw Data Failure