SCANNERS

DESCRIPTION AND THEORY

NO. 1 AND NO. 1A ELECTRONIC SWITCHING SYSTEMS

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1. GENERAL

1.01 This section describes the functions and theory of operation of scanner utilized in the 2-wire and 4-wire No. 1 and No. 1A Electronic Switching System (ESS). This section covers the following types of scanners:

(a) Ferreed switch line scanners

(b) Remreed switch line scanners

(c) Universal trunk scanners

(d) Miniature universal trunk scanners

(e) Junctor scanners

(f) Master scanners

(g) Combined miscellaneous trunk master scanner.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 Scanners detect the status of customer lines, trunks, and various diagnostic points by using current sensitive devices called ferrod sensors. Scanners are controlled by the central processor and transmit information to the central processor.

1.04 A scanner consists of a ferrod sensor matrix and a controller which is duplicated for reliability. Groups of 16 ferrod sensors are scanned (interrogated) simultaneously at specified intervals of time for information the system desires. For example, a subscriber line ferrod is scanned every 200 milliseconds for originations; a dial pulse receiver ferrod is scanned every 10 milliseconds for dial pulses; and trunk ferrods are scanned every 100 milliseconds for call supervision.

ABBREVIATION

1.05 The following abbreviations are used in this section:

ASWS	All-seems-well scanner
CMT	Combined miscellaneous trunk frame
CPD	Central pulse distributor
EV	Enable-verify
MUT	Miniature universal trunk frame
PBX	Private business exchange
PPI	Processor peripheral interface
PU	Peripheral unit
SP	Signal Processor

2. APPARATUS ELEMENTS

FERROD SENSOR

2.01 The ferrod sensor is the basic unit of all scanners used by No. 1 and No. 1A ESS. The ferrod sensor can be considered a 2-winding transformer whose coupling (the ability to induce a signal from the primary winding to the secondary winding) is controlled by the current in its control winding.

2.02 The ferrod sensor operates on electromagnetic principles and consists of a pair of control windings wound around a ferrite rod (Fig. 1A). A single-turn interrogate winding and a single-turn readout winding are threaded through two holes in the center of the ferrite rod. The control windings are connected in series with the circuit to be sensed or supervised.

2.03 The magnetic coupling between the interrogate and readout windings is determined by the magnetic state of the ferrite rod. When current flows in the control windings, the ferrite rod is in a saturated magnetic condition. When no current flows in the control windings, the ferrite rod is in a nonsaturated magnetic condition. Some ferrods are scanned to detect a change from the nonsaturated to the saturated state; others are scanned to detect a change from the saturated to the nonsaturated state.

2.04 The magnetic state of the ferrite rod is sensed by pulsing the interrogate winding. The positive half-cycle of the interrogate pulse changes the magnetic state of the ferrite rod when the control windings are not energized. The negative half-cycle of the interrogate pulse is used to reset the ferrite rod to its original state. When the ferrite rod is saturated (current in control windings), the magnetic coupling between the interrogate and readout windings is greatly reduced. Therefore, a pulse applied to the interrogate winding induces practically no signal in the readout winding (less than 20 millivolts), and the readout is said to be 0. When the ferrite rod is not saturated (no current in control windings), the magnetic coupling between the interrogate and readout windings is maximum. Therefore, a pulse applied to the interrogate windings induces a significant signal in the readout winding (approximately 220 millivolts), and the readout is said to be 1.

2.05 The change in the magnetic state of the ferrite rod when the interrogate winding is pulsed is represented by the curve in Fig. 1B. If the current in the control windings is 5.5 milliamperes or less, the interrogate pulse induces a signal in the readout winding. This value (5.5 milliamperes) is called the nonoperate current. If the control winding current is 10 milliamperes or more, the interrogate pulse does not induce a significant signal in the readout winding. This value (10 milliamperes) is called the operate current. Note that there is approximately a 2 to 1 ratio between the operate and nonoperate currents.

TYPES OF FERROD SENSORS

2.06 Five types of ferrods are used in the following scanner circuits:

- Ferreed switch line scanners
- Ferreed switch unversal trunk scanners
- Junctor scanners
- Master scanners.

Uses and differences in the characteristics of these types are shown in Table A.

A. Type 1—Loop-Start Line Ferrods

2.07 The type 1 ferrods (Fig. 2A) are used in ferreed switch line scanners to recognize the initial request for service from ordinary customer lines which operate on a loop-start basis. In loop-start operation, a call is originated by closing the tip and ring loop through the customer telephone set. A contact protection network is connected across the control windings of the ferrod to protect the ferrod cutoff contacts.

B. Type 2—Loop-Start, Ground-Start, or No-Test Vertical Line Ferrods

2.08 The type 2 ferrods (Fig. 2B) are used in ferreed switch line scanners to recognize initial requests for service. By means of optional wiring, the type 2 ferrod can be adapted to loop-start operation for ordinary customer lines, as mentioned in 2.07, to ground-start operation for PBX and coin lines (Fig. 3), or to no-test vertical operation (Fig. 4). In ground-start operation, a call is originated by grounding one side of the line at the PBX or coin station.

C. Type 3—Junctor and Trunk Ferrods

2.09 The type 3 ferrods (Fig. 5) are used in series with the talking battery feed inductors in ferreed switch junctor circuits to supervise either side of line-to-line connections. Type 3 ferrods are

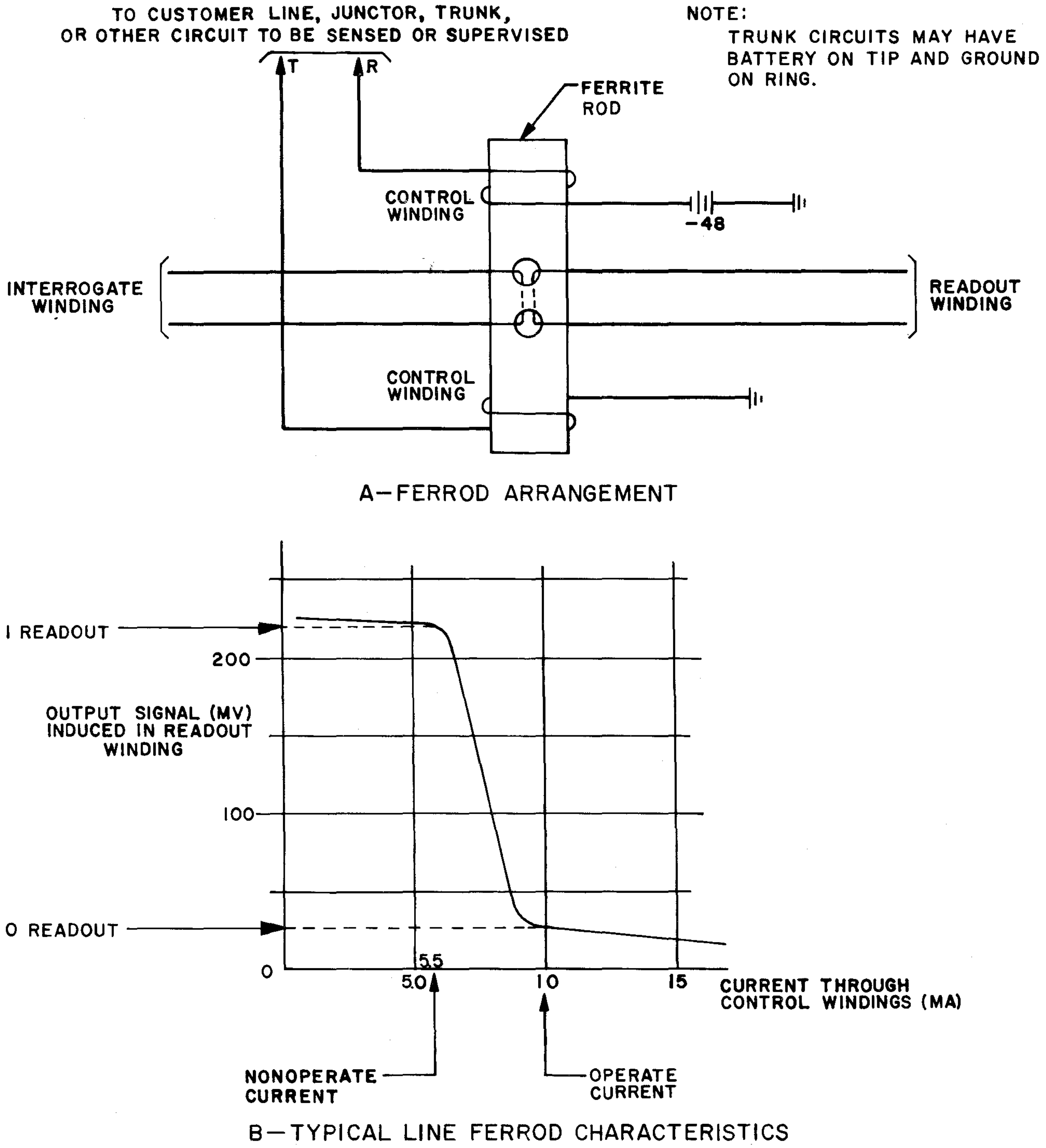


Fig. 1—Typical Ferrod Arrangement and Operating Curve

TABLE A

OPERATING CHARACTERISTICS OF TYPE 1 THROUGH 5 FERRODS

TYPE OF FERROD	TYPE OF FERROD ASSY	USED IN	MAX REST† EXT TO FERROD	MIN EXT LEAK-AGE REST†	REST† PER CONTROL WINDING ± 10%	NON-OPERATE CURRENT (1 READOUT) (ma)	OPERATE CURRENT (0 READOUT) (ma)
Type 1	1B*	Line Scanners (Loop-Start)	2800	10,000	660	5.5	10.0
Type 2		Line Scanners (Loop-Start, Ground Start, or No-Test Vertical	1800**	10,000	660	5.5	10.0
Type 3	1C	Junctor and Universal Trunk Scanners	1900	10,000	19	9.0	18.0
Type 4	1D	Universal Trunk and Master Scanners	10,700	30,000	35	1.8	3.9
Type 5	1E	Master Scanners	10,700	30,000	35	1.8	3.9

* Each 1B ferrod sensor assembly holds one type 1 and one type 2 ferrod. Both ferrods are arranged for loop-start use. The type 2 ferrod can be converted to ground-start use by changing wire straps on the equipment side of the assembly.

** The ground-start ferrod operates with a ground potential of ±10 volts.

† All resistances are in ohms.

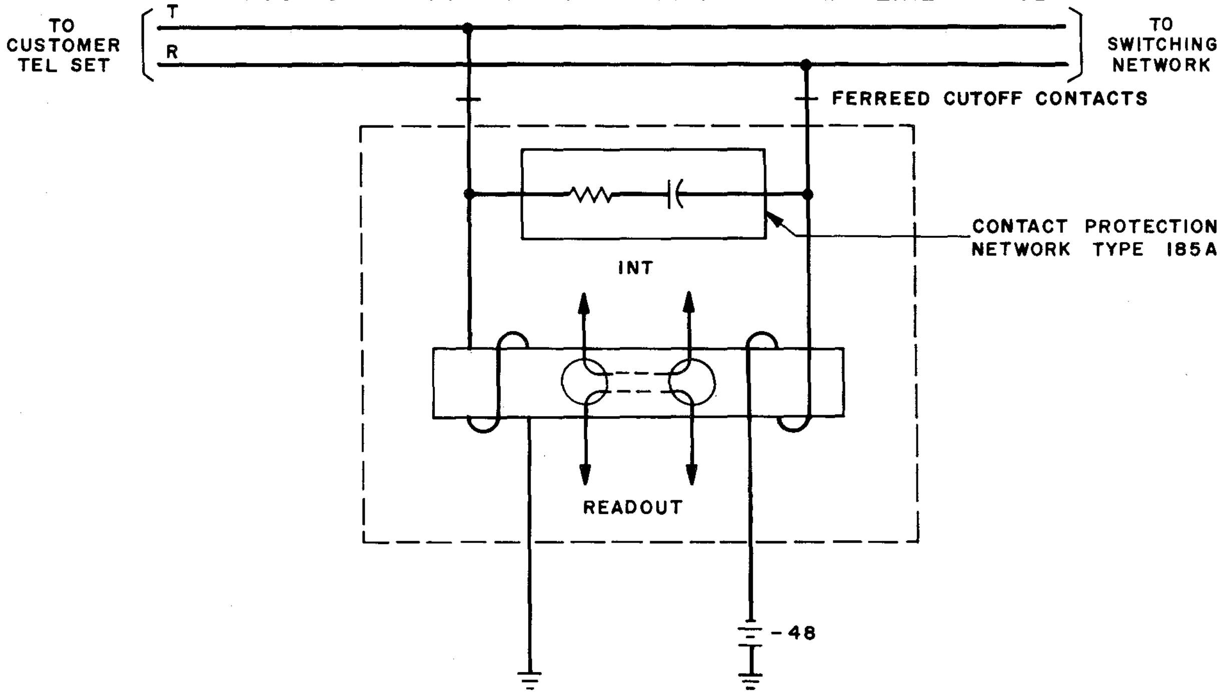
also used in ferreed switch trunk scanners to supervise the local customer side of line-to-trunk and trunk-to-line connections (Fig. 6).

D. Type 4—Distant Side of Trunk Cicuit Ferrods

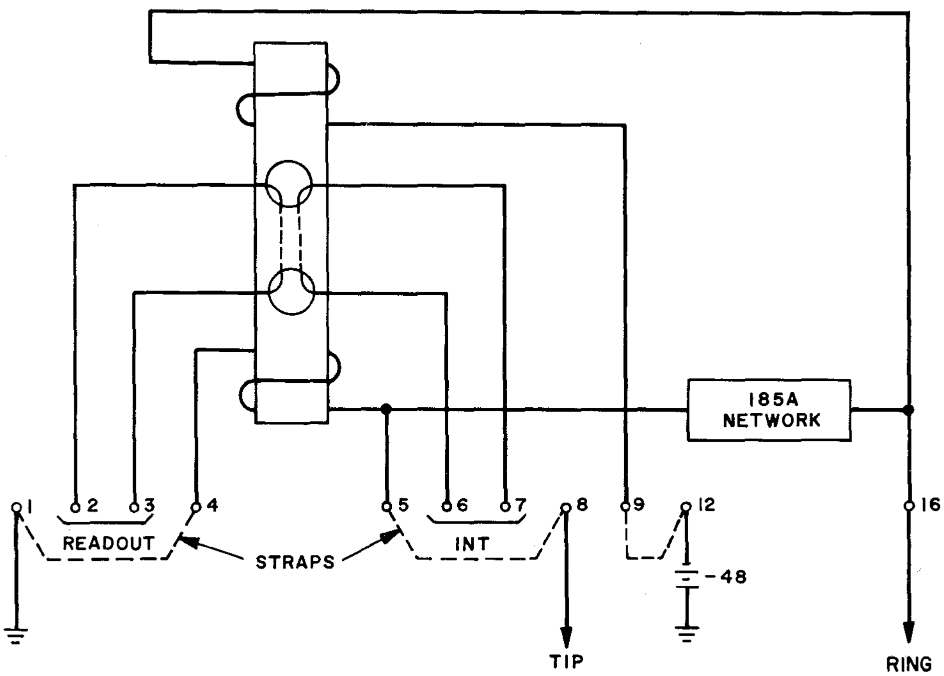
2.10 The distant office side of interoffice trunk connections is supervised by type 4 ferrods (Fig. 6). The sensitivity of the type 4 ferrod is improved by the addition of a metal bar which connects both ends of the ferrite rode, thereby providing a magnetic return path. Trunk ferrods have provisions for optional wiring of the control windings to suit the requirements of the equipment at the distant end of the trunk.

2.11 In the circuit shown in Fig. 5, a transmission path is provided between two lines; in Fig. 6, a transmission path is provided between a line and a trunk. At the same time, each line or trunk has a separate dc circuit for supervisory purposes and for supplying talking battery. These circuit arrangements are similar to the methods used to split supervision in other dial central office systems.

LOOP START WIRING USING TYPE I OR TYPE 2 LINE FERROD



A–TYPE I LINE FERROD

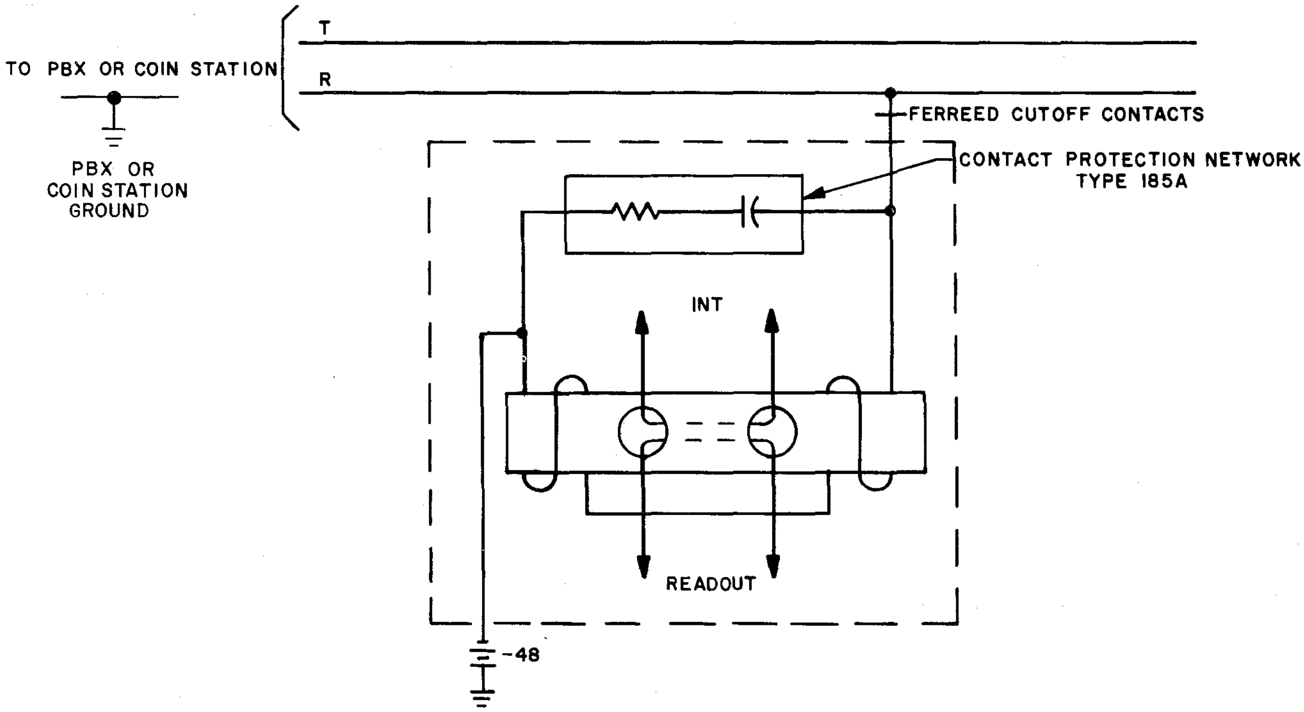


NOTE
STRAPS INDICATE WIRING OPTION AT EQUIPMENT END (FRONT) OF TYPE 1B FERROD ASSEMBLY FOR LOOP-START OPERATION.

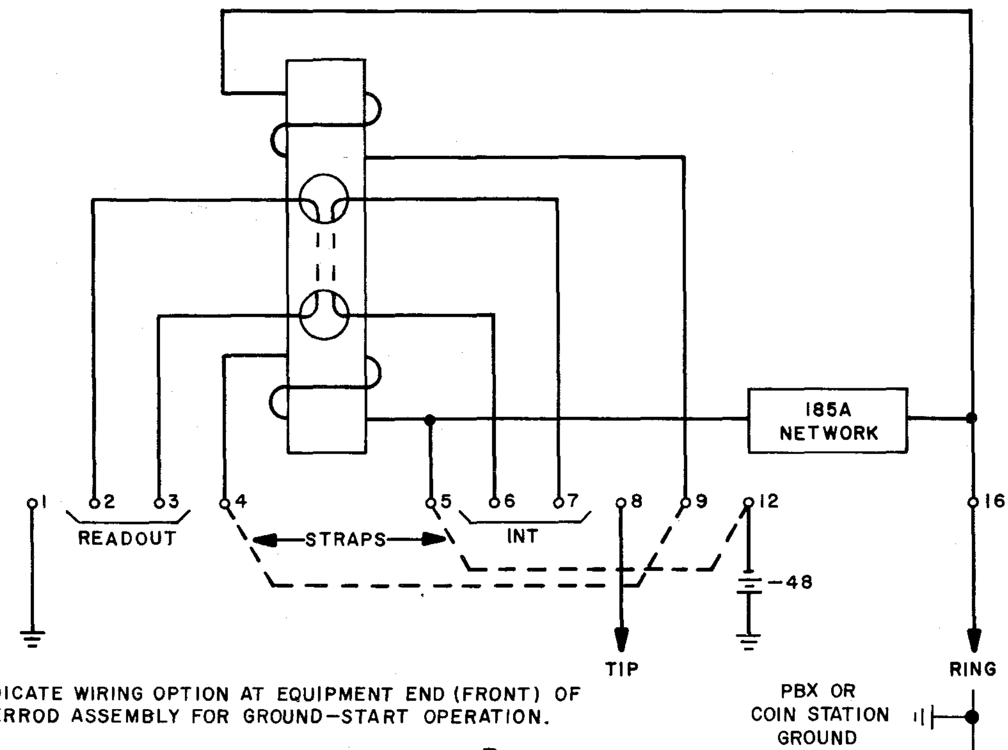
B–TYPE 2 LINE FERROD

Fig. 2—Type 1 and 2 Line Ferrods Used for Loop-Start Operation

GROUND START WIRING USING TYPE 2 LINE FERROD



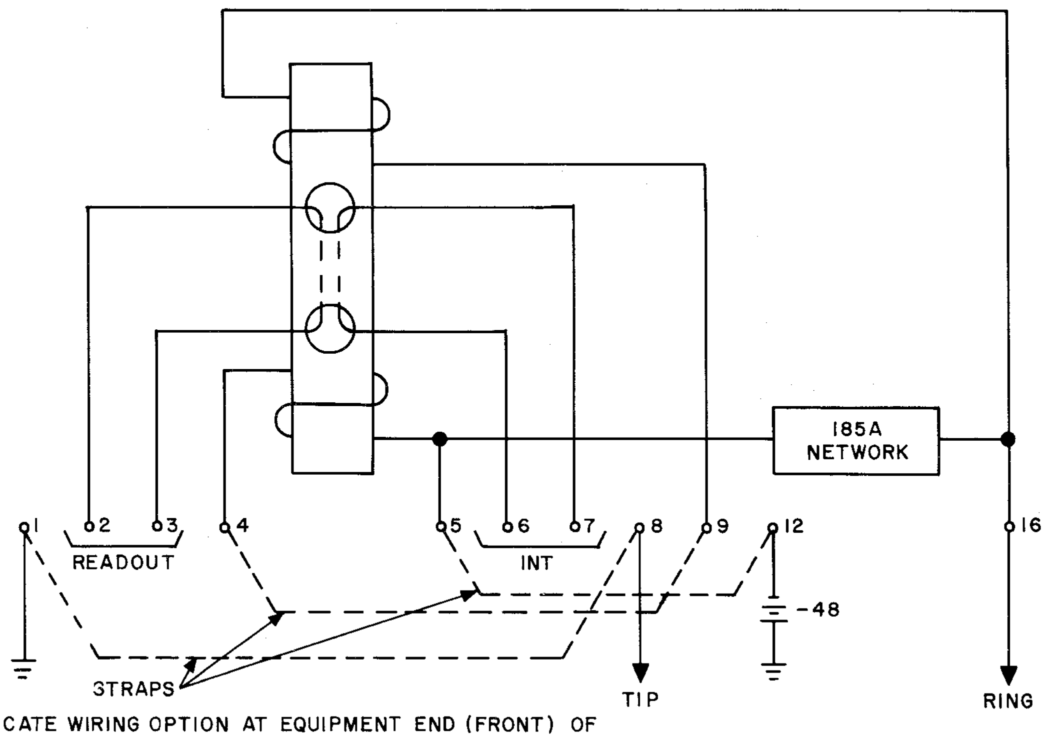
A



NOTE:
STRAPS INDICATE WIRING OPTION AT EQUIPMENT END (FRONT) OF TYPE 1B FERROD ASSEMBLY FOR GROUND-START OPERATION.

B

Fig. 3—Type 2 Line Ferrods Wired for Ground-Start Operation



NOTE:
STRAPS INDICATE WIRING OPTION AT EQUIPMENT END (FRONT) OF TYPE 1B FERROD ASSEMBLY FOR SPECIAL LOOP START FOR NO-TEST VERTICAL OPERATION

Fig. 4—Type 2 Line Ferrods Wired for No-Test Vertical Operation

E. Type 5—Master Scanner Ferrods

2.12 The type 5 ferrods are used in the master scanners for administrative and diagnostic scanning functions. They are used with trunk switching networks, with maintenance test circuits, and with various faulty-circuit detection scan points.

2.13 Three types of ferrods are used in the following scanner circuits:

- Remreed switch line scanners
- Miniature universal trunk scanner
- Combined miscellaneous trunk master scanner.

Uses and differences in the characteristics of these types are shown in Table B.

F. 2A Line Ferrod

2.14 The 2A ferrods are used in remreed switch line scanners to recognize the initial request

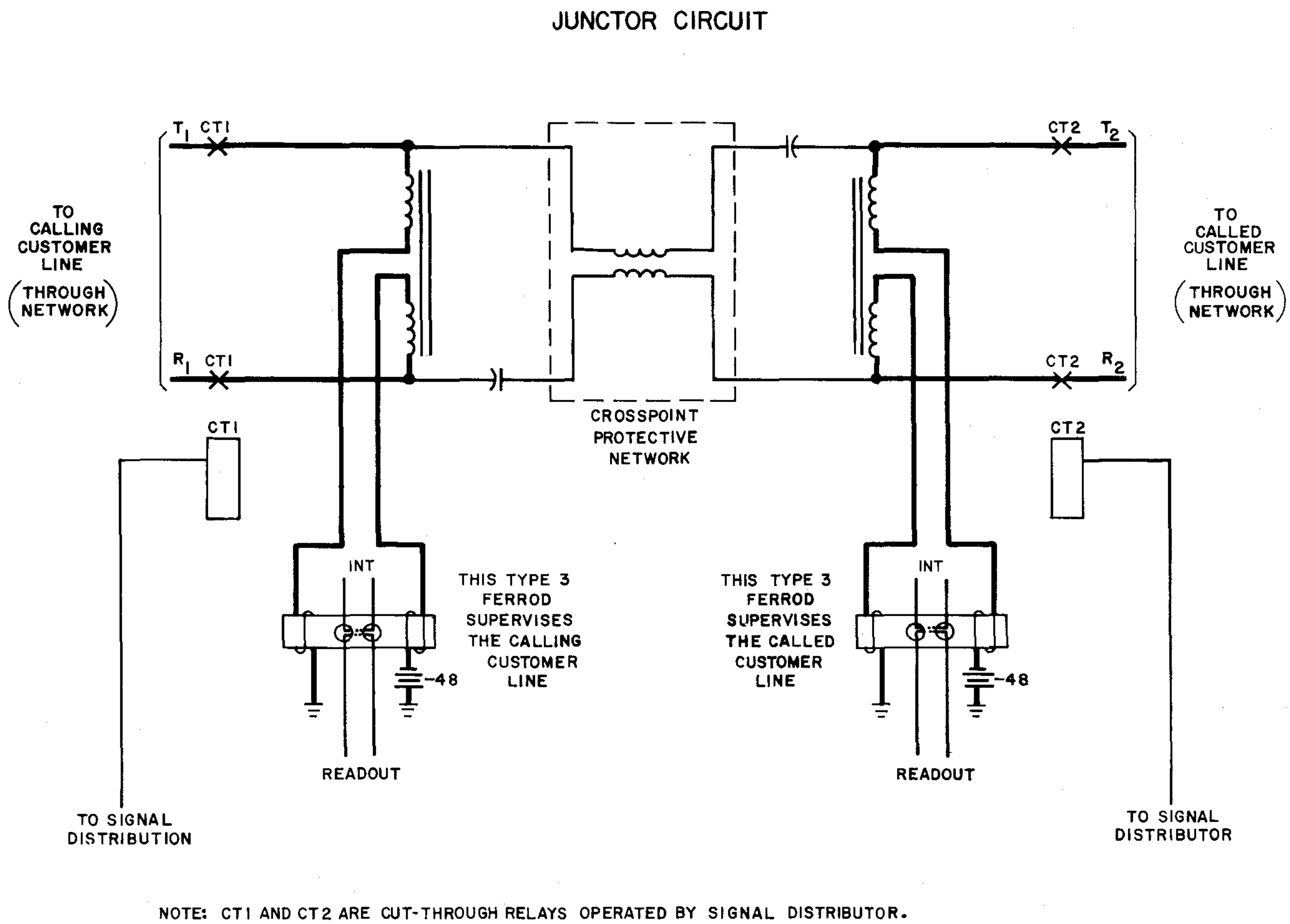


Fig. 5—Junctor Supervision Using Type 3 Ferrods

for service from customer lines which operate on a loop-start basis. The miniature 2A ferrod is mounted in the switch package for the 12A or 13A Remreed line switch (Fig. 7). By means of optional wiring, the 2A ferrod can be adapted to loop-start operation for ordinary customer lines or to ground-start operation for PBX and coin lines or to no-test vertical using the type 23A apparatus (Fig. 8). In ground-start operation, a call is originated by grounding one side of the line at the PBX or coin station.

G. 2B Ferrod

2.15 The 2B ferrod is used in the miniature universal trunk scanner and the combined miscellaneous trunk master scanner to supervise the local customer side of the line-to-trunk and trunk-to-line connections.

H. 2C Ferrod

2.16 The 2C ferrod is used in the miniature universal trunk scanner and the combined miscellaneous trunk master scanner to supervise the distant side of the trunk circuit. It is used in the master scanner for directed scan point supervision.

3. METHOD OF OPERATION

GENERAL

3.01 Scanners receive address information from and send answer information to central control via the communication bus circuits for peripheral units. In the larger 2-wire No. 1 ESS offices, some of the scanner functions may be controlled by signal processors instead of the central

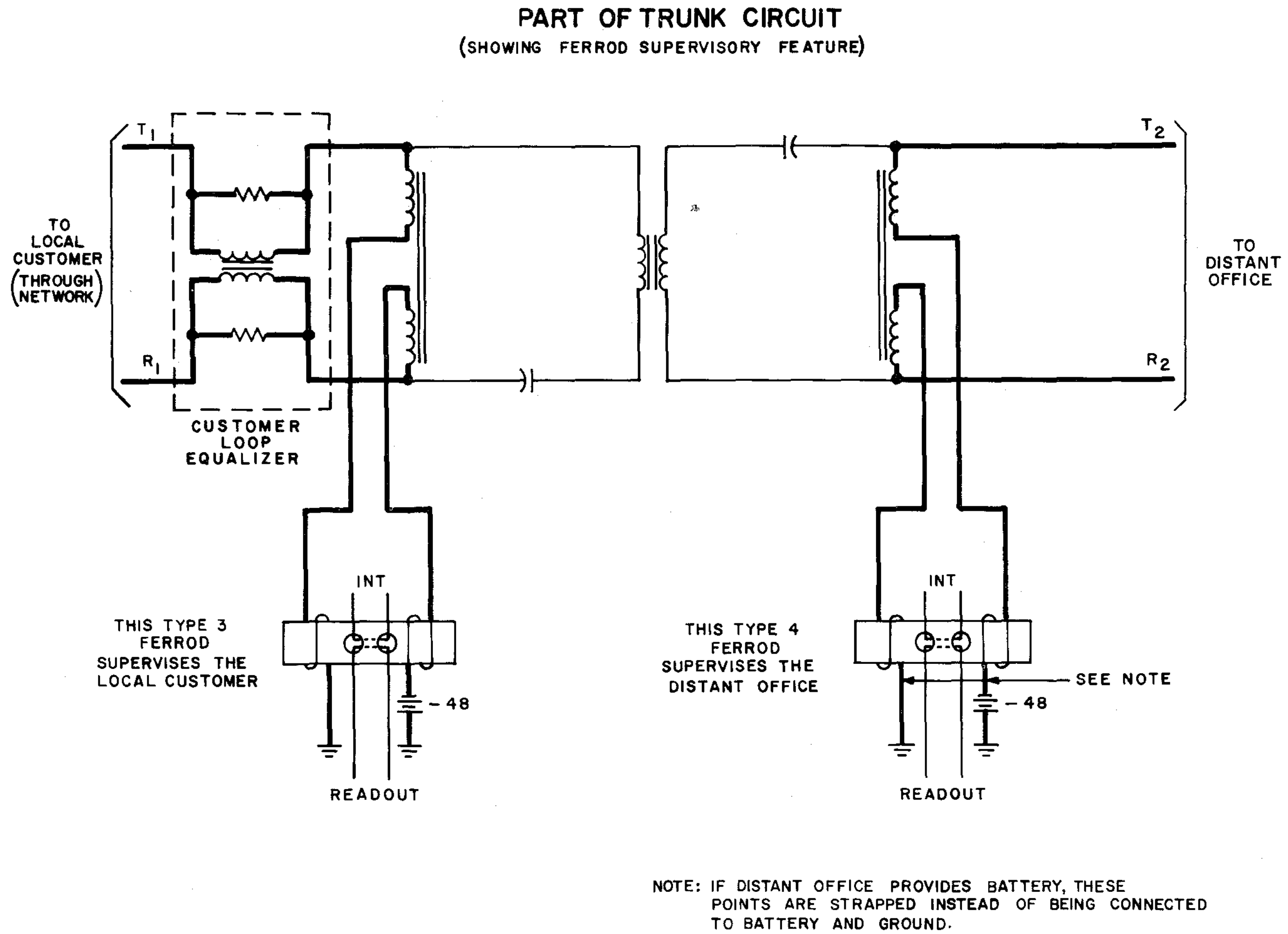


Fig. 6—Trunk Supervision Using Types 3 and 4 Ferrods

control. The main inputs and outputs of a scanner circuit are shown in Fig. 9.

3.02 There may be as many as 150 scanner units in a large central office. When a scanner operation is required, the central processor sends a scanner enable signal via a central pulse distributor to a particular scanner unit. The selected scanner unit sends back an enable-verify signal. Scanner address information is transmitted to the scanner during the enable signal interval.

3.03 Ferrod sensors are organized into rows of 32 or 64. Associated with each row are 16 individual ferrod sensors, making totals of 512 or 1024 scan points, respectively. In the ferrod sensor matrix, 16 points are scanned (interrogated) simultaneously. At each point, the presence or absence of current flow is sensed and the scanner transmits a 16-bit answer. When the scanner responds properly by translating an address into one and only one set of scan points, an all-seems-well signal is also returned. The presence or absence of the all-seems-well signal determines whether the system uses the scanner answer or switches into a diagnostics mode of operation.

CONTROLLER FOR TYPE 1 THROUGH 5 FERRODS

3.04 The controller basically consists of input circuitry (address register), a core matrix, and output circuitry. The input circuitry transforms the short duration address information into signals which can operate the core matrix. The core matrix consists of an array of 8 by 8 square-loop ferrite

TABLE B

OPERATING CHARACTERISTICS OF MINIATURE TYPE FERRODS

TYPE OF FERROD	USED IN	MAX REST† EXT TO FERROD	MIN EXT LEAKAGE REST†	REST† PER CONTROL WINDING ±10%	NON-OPERATE CURRENT (1 READOUT) (ma)	OPERATE CURRENT (0 READOUT) (ma)
2A	Line Scanner (Loop-Start)	2800	10000	685	5.5	10
	(Ground-Start or No-Test Vertical)	1800*	10000	685	5.5	10
2B	Miniature Universal Trunk Scanner (Line Side of Trunk)	1900	10000	19	9.0	18.0
	Combined Miscellaneous Trunk Master Scanner (Line Side of Trunk)					
	Combined Miscellaneous Trunk Master Scanner (Trunk Side & Directed Scan Points)	6200		40	3.0	6.0

* The ground-start ferrod operates with a ground potential of ±10 volts.

† All Resistances are in ohms.

cores. The output circuitry converts the ferrod outputs into usable signals.

CONTROLLER FOR TYPE 2A, B AND C FERRODS

3.05 The controller basically consists of the input circuitry (address register), output circuitry and access circuitry. The input circuitry transforms the short duration address information into signals that can operate the access circuitry. The access circuitry includes 64 transformers, one for each row of ferrods. The output circuitry converts the ferrod outputs into usable signals.

FERROD MATRIX USING TYPE 1 THROUGH 5 FERRODS

3.06 The ferrod matrix consists of an extension of 16 ferrods connected to each core in the core matrix (Fig. 10). When a core is addressed, it produces an interrogate pulse for a row of 16 ferrods.

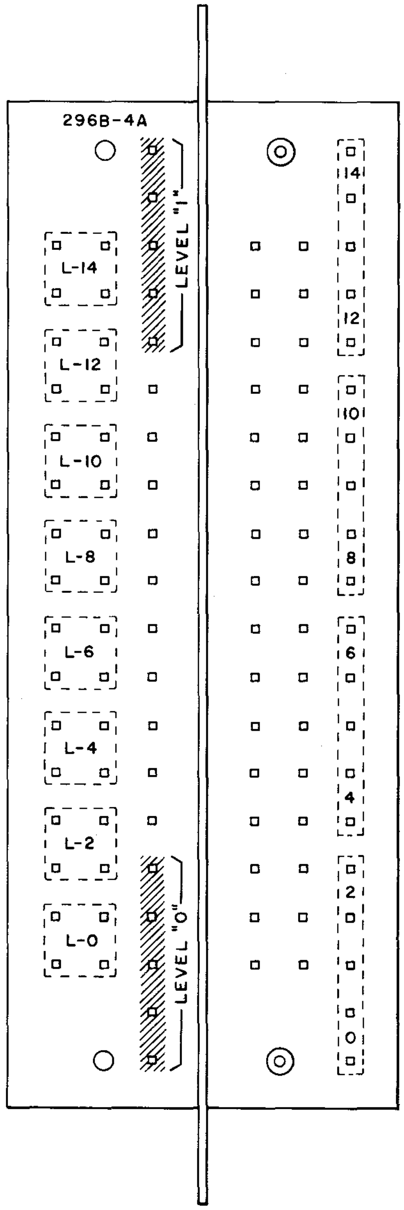
FERROD MATRIX USING TYPE 2A, B, AND C FERRODS

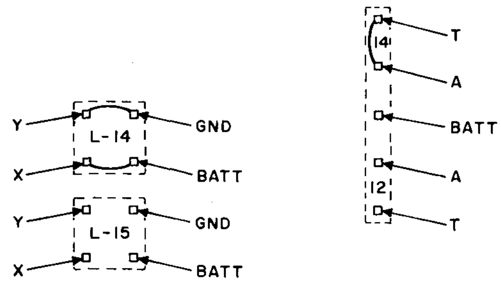
A. Line Scanner

3.07 The ferrods, one per subscriber line, are arranged in two 32 by 16 matrices. A row of 16 ferrods is contained in a switch package. There is a particular scanner address associated with each row of 16 ferrods. The tip and ring terminals of the ferrod control winding are connected to the subscriber line through normally closed remreed cutoff contacts in the line switching circuit.

B. Miniature Universal Trunk Frame

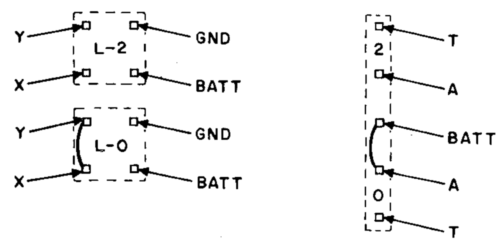
3.08 The ferrods, two per trunk, are mounted on plug-in printed circuit boards (Fig. 11). They are arranged in two 32 by 16 matrices.





STRAPPING FOR LOOP-START

FIG. A



STRAPPING FOR GROUND-START

FIG. B

Fig. 7—Remreed Switch Package (Front View)

C. Combined Miscellaneous Trunk Frame

3.09 The ferrods are mounted on plug-in printed circuit boards, 16 per board, and arranged in two 32 by 16 matrices. The number of scan points depends on the type of trunk circuit to be used. Scan points and rate of scan are provided as per SD-1A272 (assignment for master scanners).

SCANNER OPERATION USING TYPE 1 THROUGH 5 FERRODS

3.10 The basic operation of 1024-point scanner unit is illustrated by a simplified diagram in Fig. 12.

3.11 All scanners are addressed on the same bus system, but only one scanner receives an

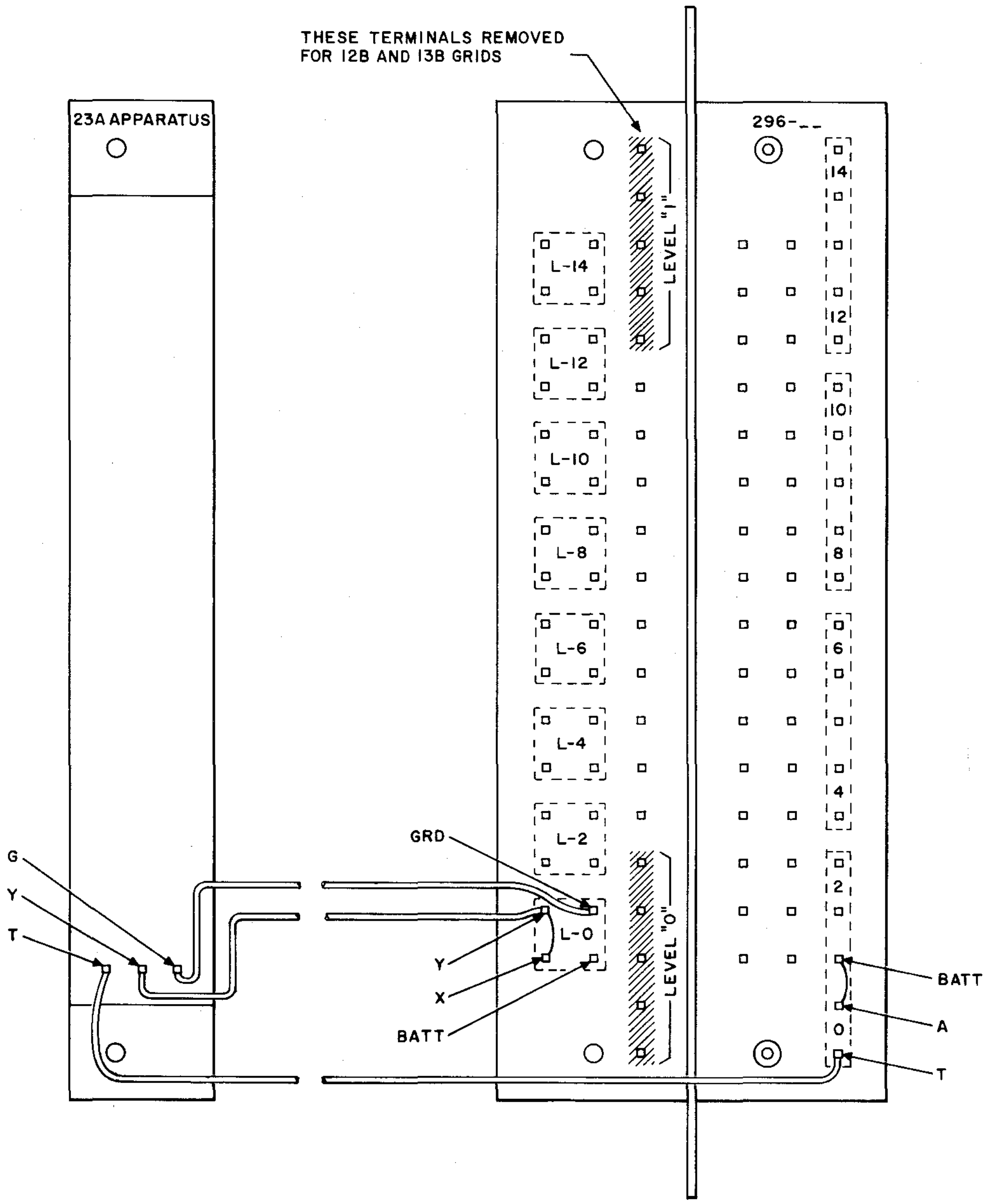


Fig. 8—Strapping for No-Test Vertical Type 23A Apparatus (Remreed)

enable signal. In a 1024-point scanner, the address has 16 bits in a 1/8 and 1/8 code. Only the two core drivers whose inputs are both 1 generate pulse outputs that select a particular row and column in the core matrix. Only the core at the intersection of the selected row and column receives a drive in both the X and Y leads. This combined drive is sufficient to overcome the dc bias and to switch the magnetic state of the core. The switching of the core induces a pulse in the associated interrogate loop. A similar interrogate loop is associated with each of the 64 cores of the matrix. Only one interrogate loop is pulsed for each address.

3.12 Each interrogate loop passes through 16 ferrods in series; therefore, pulsing one interrogate loop results in the readout of 16 bits. The presence or absence of current in the control winding of each ferrod determines whether the corresponding readout bit is 0 or 1. In this manner, 16 scan points are observed at the same time.

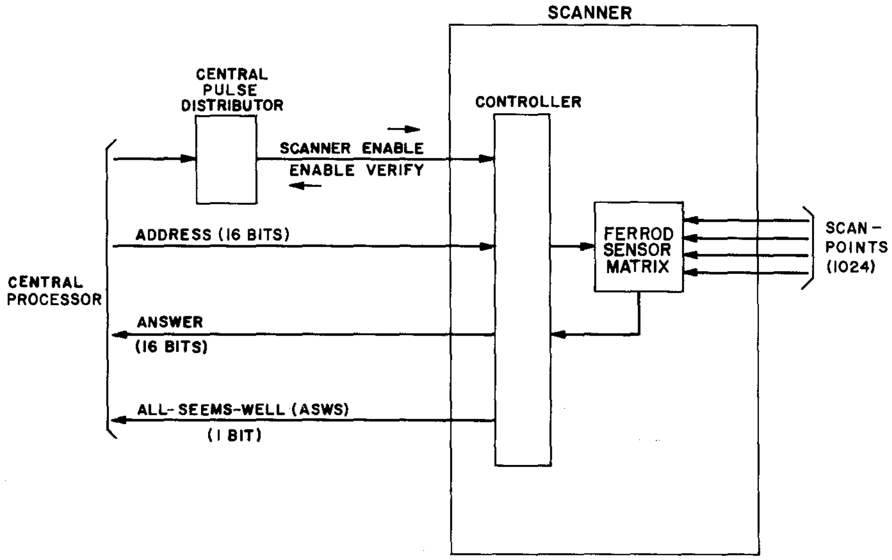


Fig. 9—Main Inputs and Outputs for Scanners

SCANNER OPERATION USING TYPE 2A, B, AND C FERRODS

3.13 Scanners are considered peripheral units (PUs). All PUs are addressed simultaneously from the control processor over the PU address bus. The particular PU that is to reply is selected by an enabling signal from the central pulse distributor (CPD).

3.14 All signaling to and from the scanner, except the control of the ferrod sensors, is done with a 0.5 USEC pulse on duplicated peripheral address buses. Each controller of the scanner must be able to operate from either bus with the selection being made by the enabling pulse via the CPD. The addressed controller replies simultaneously on both PU buses.

3.15 Associated with each controller are two enabling pairs that determine from which bus to accept addresses. The answer bus contains 16 pairs for ferrod outputs and a seventeenth pair for the ASWS signal.

3.16 An address bus to the scanner is divided into two groups; the least significant (LS) group and the most significant (MS) group. Both groups contain eight pairs of wires for a 1/8 and 1/8 selection. The scanner uses an additional pair of wires of the address bus for maintenance test orders.

3.17 To operate a controller, an enabling pulse is sent. This gates on the address registers, permitting the address to be received. At 1 to 3 USEC after the start of the enabling pulse, the perviously enabled pair is pulsed for 1 USEC by the controller. This sends to the CPD the enable-verify. A valid address results in a pulse on only one pair of wires in each of the LS and MS group of inputs. The PU bus circuit receives the address pulse and stores them in the address register and the access circuitry. The register and access circuitry translates LS and MS address inputs so that one of 64 rows of 16 ferrods is selected and interrogated. The output of the 16 ferrods is detected by the detector circuit and stored in the scanner answer register. If there is current in the control windings of the ferrod, the output circuitry will produce no pulse (0). If there is no current in the control winding of the ferrod, the output circuitry produces a pulse (1). The result of the interrogation (16 outputs) is transmitted simultaneously on both scanner-answer buses.

3.18 The maximum operate time of the scanner is 2.2 USEC. A scanner may be addressed at a minimum of 7 USEC intervals.

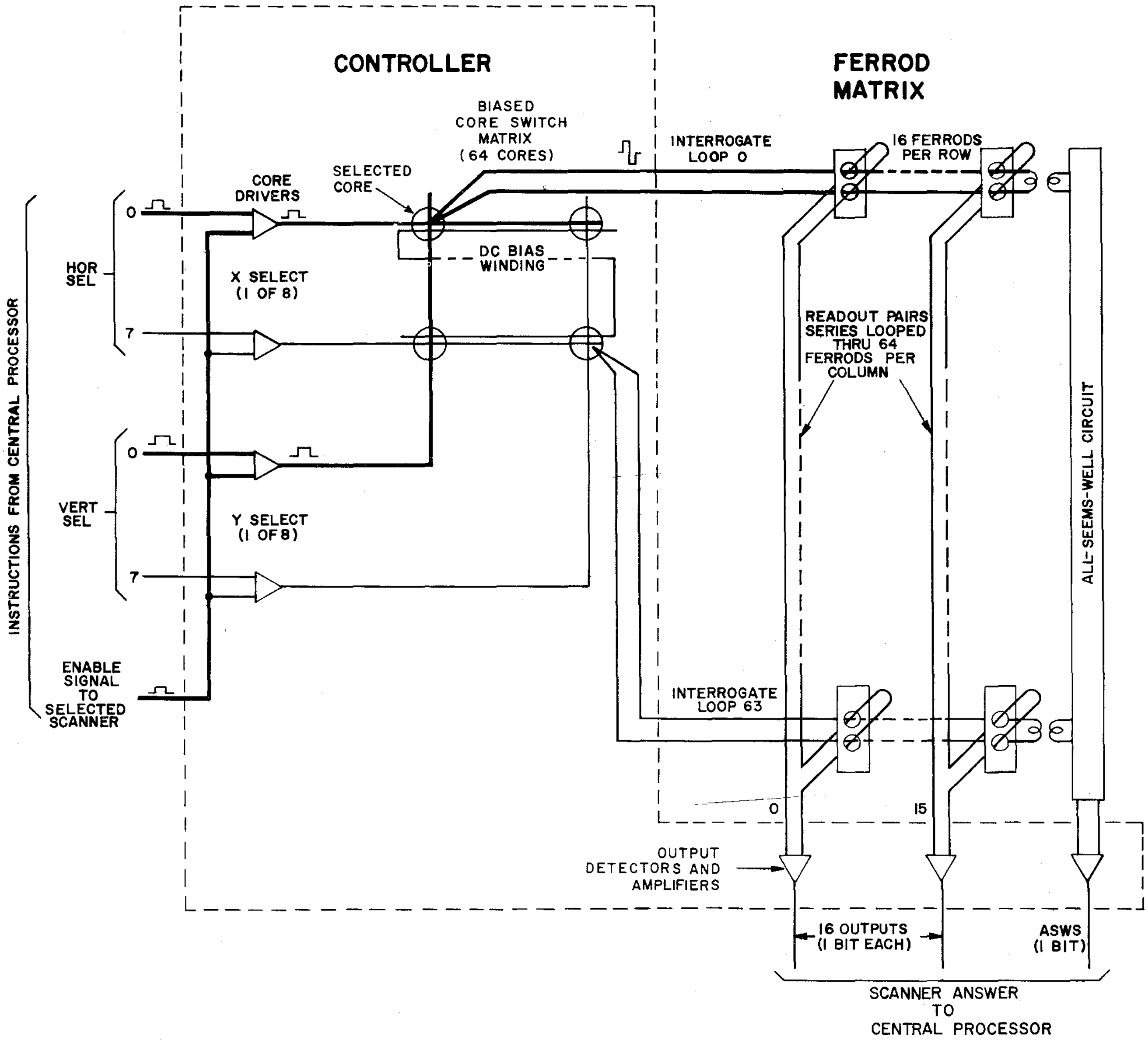


Fig. 10—Scheme for Coincident Current Selection of One Group of 16 Scan Points

4. DUPLICATION AND INTERCONNECTIONS USING TYPE 1 THROUGH 5 FERRODS

4.01 Thus far, only operation without duplication has been considered. Actually, the scanner access and output circuitry is duplicated; whereas, the ferrod matrix is not duplicated. Communication between the scanners and the central processor is by means of a bus system common to all scanners and other peripheral units. The peripheral unit address bus system is duplicated and designated as buses 0 and 1. Each bus consists of 38 pairs of leads that are used on a time-shared basis by scanners, signal distributors, network controllers, and other units. The scanner units tap off 17 pairs of leads for a 1024-point unit.

4.02 Each scanner is equipped with two controllers (Fig. 12), either of which can receive data from the peripheral unit address bus 0 or bus 1. The selection of peripheral unit address bus and the controller is determined by a scanner enabling signal (pulse combination) that is sent via the central pulse distributor.

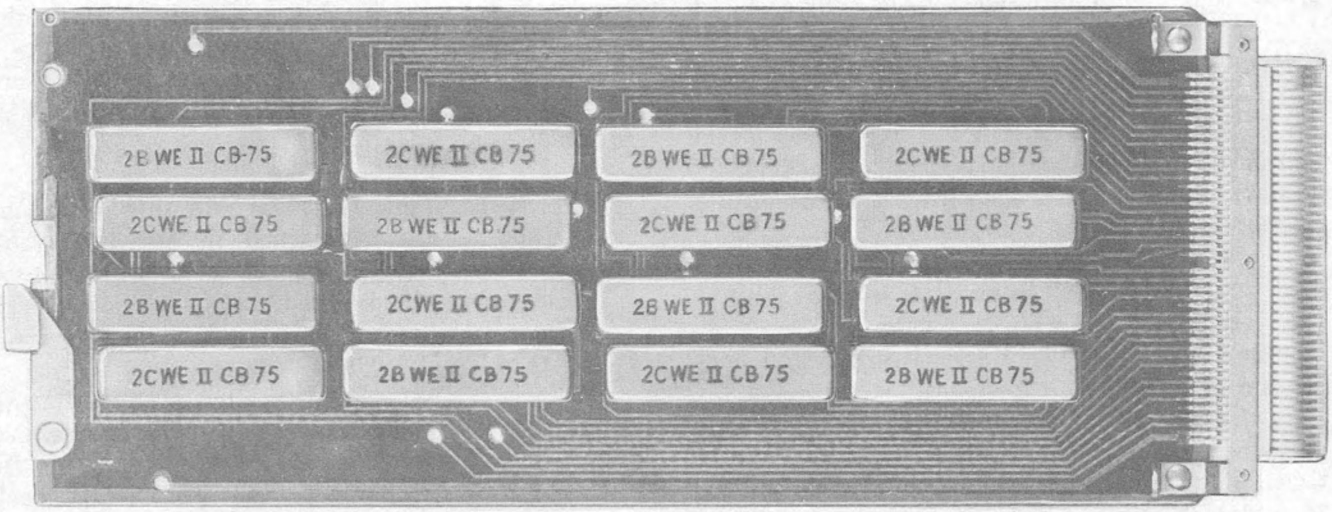


Fig. 11—Plug-In Ferrod Circuit Pack

4.03 Four enable pairs are assigned to each scanner to select the bus and controller to be used. The communication route for a scanner is selected as follows:

ENABLE SIGNAL	COMMUNICATION ROUTE
EN00	Controller 0 from address bus 0
EN01	Controller 0 from address bus 1
EN10	Controller 1 from address bus 0
EN11	Controller 1 from address bus 1

An enable-verify (EV) signal is returned via the pair used for the enable (EN) signal. The addressed scanner replies with an identical set of 16 outputs on both peripheral unit answer buses 0 and 1.

4.04 Access to the 64 interrogate loops is through either of two 8 by 8 biased core matrixes in either controller 0 to 1. Each interrogate loop sends a signal to the all-seems-well circuit (Fig. 13). This results in an all-seems-well bit if one and only one interrogate loop is pulsed at a particular time. The all-seems-well signal bit is transmitted to central control as the 17th bit of the scanner answer to indicate that the scanner has functioned properly. A malfunction in the access circuitry, core matrix, interrogate portion of the ferrod matrix, or the all-seems-well output circuitry will cause a failure of the all-seems-well signal.

4.05 The all-seems-well circuit associated with the core interrogate loops includes output detectors (Fig. 10, 12, and 13). The output detectors are duplicated; one group of 16 detectors is associated with each controller. When one controller is enabled, the associated group of detectors supplies the all-seems-well output to both answer buses 0 and 1.

4.06 In each address bus, one pair of leads is used for a maintenance test order (Fig. 12). This order is scheduled periodically by the stored program as a routine test for detecting troubles in the output detectors of a scanner controller. The scanner is enabled in the usual manner, and a maintenance test pulse is then applied to the 17th bus pair. The result should be 16 pulses (ones) and no all-seems-well signal pulse on either of the two scanner answer buses. The program is thus able to recognize whether a particular readout detector has failed. It is also possible to force an all 0 readout from a scanner by sending it an enable signal and an incomplete address; that is, an address with only one bit equal to 1.

5. MODES OF OPERATION

5.01 Either of the following control modes can be established in a scanner under program control:

(a) ***Normal:*** In this mode, either controller can be used to interrogate the ferrods. When one controller is operating the ferrod matrix, the other controller is considered to be ready-standby.

(b) ***Marked-in Trouble:*** In this mode, one controller is recorded in the temporary memory as being out of service and is not used to interrogate the ferrod matrix for normal call actions.

5.02 The system can determine at any time in what mode a scanner is operating by reading, via the master scanner, the three scan points (S, F, and T) associated with the operation of each controller.

5.03 Extra care should be taken before removing power on frames (Fig. 14) with scanners. Details on proper procedures should be consulted in the CD and SD drawings associated with these circuits.

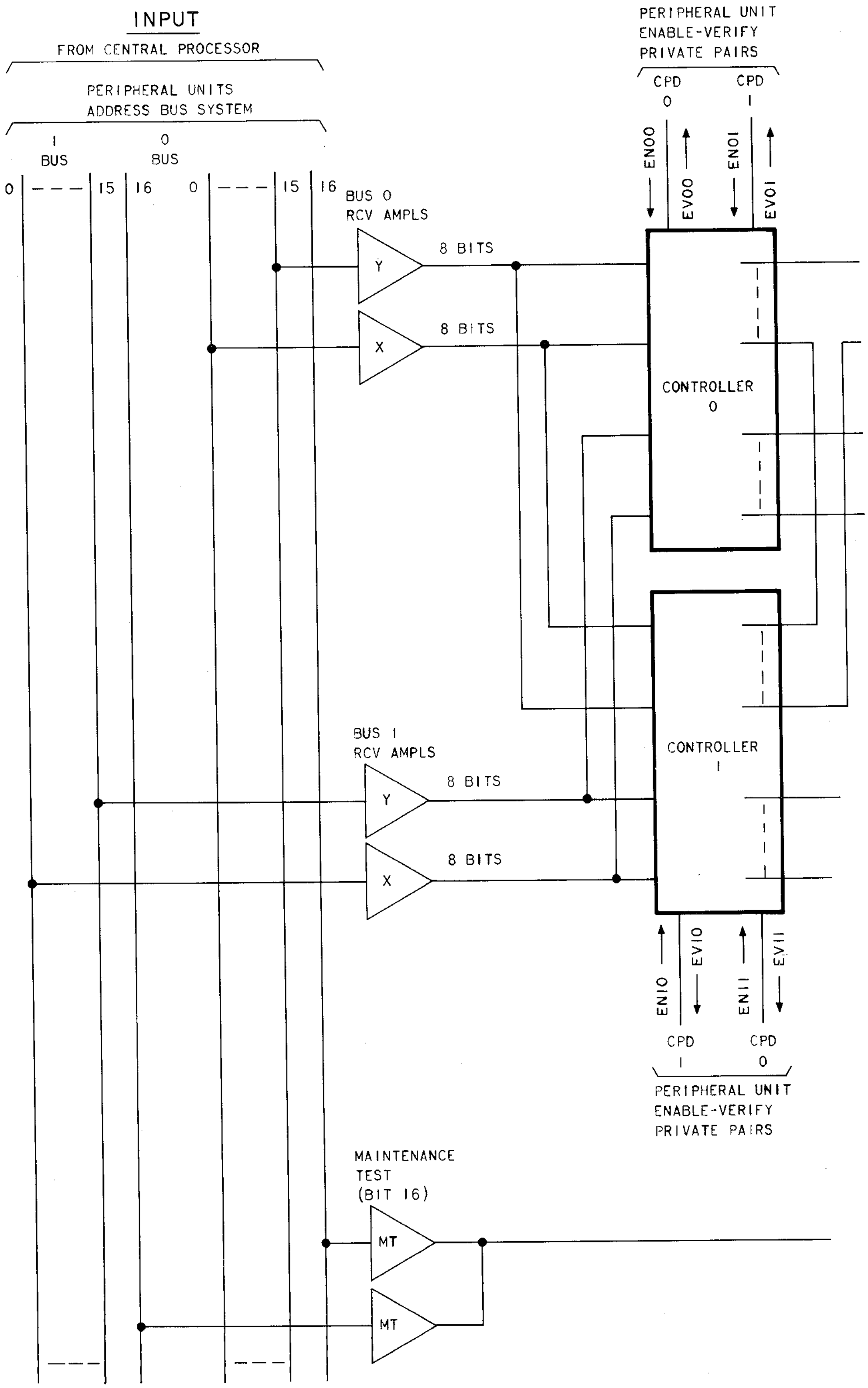
6. EQUIPMENT ARRANGEMENTS USING TYPE 1 THROUGH 5 FERRODS

TYPES OF DUAL FERROD ASSEMBLIES

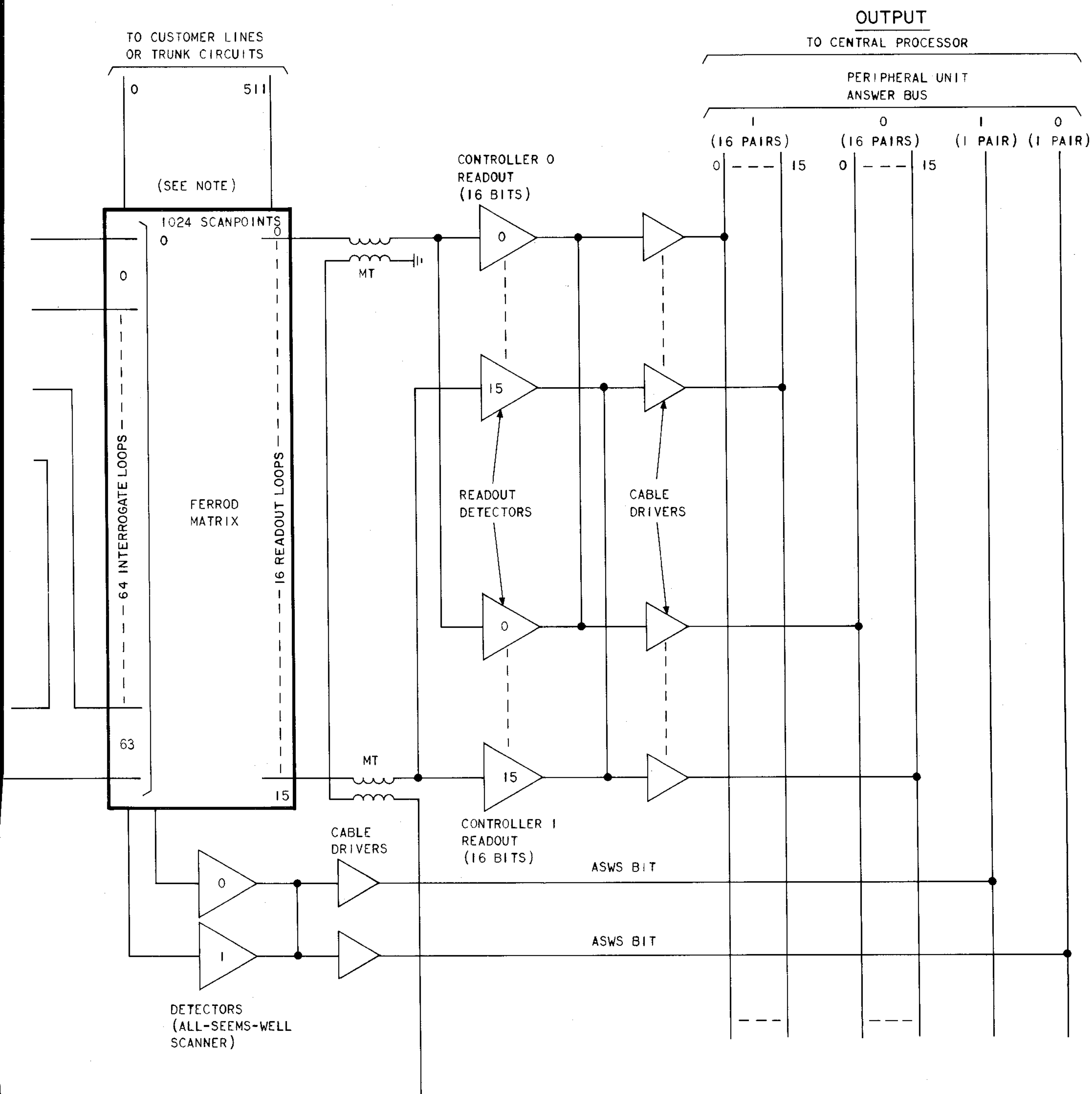
6.01 Ferrods are packaged in pairs using various combinations to make up four types of assemblies (Table A). The two ferrods are supported by a system of wire rods held together by four insulated bridges. The rods provide mechanical support and serve as terminals to make connections to the various windings.

A. Type 1B Ferrod Sensor Assembly

6.02 The type 1B assembly consists of one type 1 and one type 2 line ferrods mounted in

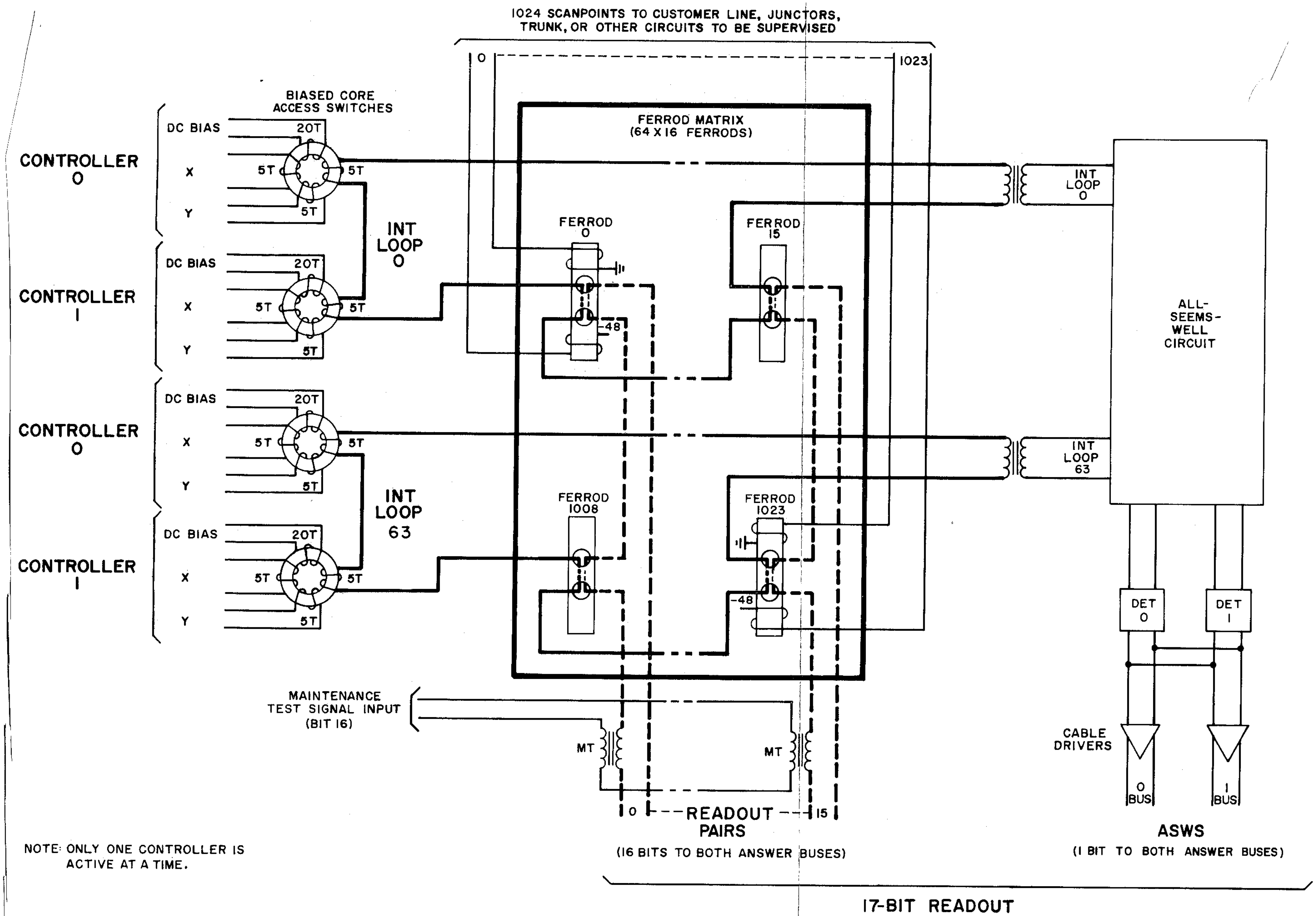


INPUT
FROM CENTRAL PROCESSOR
PERIPHERAL UNITS
ADDRESS BUS SYSTEM
1 BUS
0 BUS
0 --- 15 16 0 --- 15 16
PERIPHERAL UNIT
ENABLE-VERIFY
PRIVATE PAIRS
CPD 0
CPD 1
EN00
EV00
EN01
EV01
BUS 0
RCV AMPLS
Y
X
8 BITS
8 BITS
CONTROLLER 0
CONTROLLER 1
BUS 1
RCV AMPLS
Y
X
8 BITS
8 BITS
EN10
EV10
EN11
EV11
CPD 1
CPD 0
PERIPHERAL UNIT
ENABLE-VERIFY
PRIVATE PAIRS
MAINTENANCE
TEST
(BIT 16)
MT
MT



NOTE:
CONTROLLERS ARE FOR 1024 SCANPOINTS.
FERROD MATRIX COULD BE 512 POINT OR
1024 POINT.

Fig. 12—1024-Point Scanner, Block Diagram



NOTE: ONLY ONE CONTROLLER IS ACTIVE AT A TIME.

Fig. 13—Typical Operation of a Scanner Using Type 1 through 5 Ferrods

Fig. 14—Scanner Control Panel Using Type 1 through 5 Ferrods

the assembly shown in Fig. 15. The wiring and terminal assignments are shown in Fig. 16.

B. Type of 1C Ferrod Sensor Assembly

6.03 The type 1C assembly consists of two type 3 junctor ferrods as shown in Fig. 17. The wiring and terminal assignment are shown in Fig. 15.

C. Type 1D Ferrod Sensor Assembly

6.04 The type 1D assembly consists of two type 4 trunk ferrods as shown in Fig. 19. The wiring and terminal assignments are the same as for type 1C (Fig. 18).

D. Type 1E Ferrod Sensor Assembly

6.05 The type 1E assembly consists of two type 5 master scanner ferrods as shown in Fig. 20. The wiring and terminal assignments are shown in Fig. 21 and 22.

FERROD ARRAYS

6.06 The basic apparatus mounting for ferrods is shown in Fig. 23. This mounting contains 128 cells arranged in an 8 by 16 array. Each cell holds one assembly of two ferrods; therefore, each apparatus mounting contains 256 ferrods. The steel box and separators serve as a magnetic and fire shield between ferrod assemblies.

TYPES OF SCANNERS

6.07 The types of scanners differ mainly in the type and number of ferrods used. A scanner is made up of two or four apparatus mountings containing 512 or 1024 ferrods, respectively. One ferrod for each scan point is required. The total number of scan points required in a central office is about 1.5 times the number of lines in the office. Five types of scanners (Table C) are used in No. 1 ESS.

A. Line Scanner (4 to 1 Concentration)

6.08 Line ferrods are associated with line concentrator switches in stage 0 of line switching frames. The equipment arrangement for 4 to 1 concentration ratio is shown in Fig. 24. The home frame contains the controls for 1024 ferrods. The home frame and the mate frame each contains 512 ferrods (256-type 1B assemblies).

6.09 Each ferrod is designated by five digits based on the position of the associated line switch (see bottom of Fig. 24). From left to right, the first digit corresponds to the bay (0 or 2); the second, to the line concentrator (0 through 7); the third, to the switch number within the line concentrator (0 through 3); and remaining two, to one of 16 inputs (00 through 15) on the switch input. A group of 16 ferrods is associated with each line switch. One such group of line scanner ferrods is shown shaded in the upper left of Fig. 24.

B. Line Scanner (2 to 1 Concentration)

6.10 The equipment arrangement for 2 to 1 concentration ratio is shown in Fig. 25. Each home frame contains 512 ferrods and controls for 1024 scan points. The associated mate frame contains 512 ferrods and uses the control mounted on the home frame. Each line link network has cutoff contacts between its lines and the line scanner.

C. Junctor Scanner

6.11 Each junctor circuit has two scan points. One ferrod is used to scan the calling customer line, and the other ferrod is used to scan the called customer line (Fig. 4). The ferrods located in junctor circuits have seven digit designations (Fig. 26). These designations are based on the location designations of the associated circuits which the ferrods scan.

D. Universal Trunk Scanner

6.12 The ferrod designations (Fig. 27 and 28) are based on the frame location of the associated trunk circuits. Each trunk circuit has two supervisory scan points (Fig. 5) similar to the two scan points for each circuit in the junctor scanners.

E. Master Scanner

6.13 The master scanner equipment is shown in Fig. 29. The ferrods are designated by four digits (Fig. 30). Master scanners provide supervisory and information access for the control unit of the system. Scan points are assigned into two areas called supervisory and directed fields. Some scan points have Fixed Assignments—that is, the same location in the first master scanner (MS-00) of all No. 1 ESS Central Offices. Other scan points have Group Assignments—that is; they are assigned to adjacent positions in a given master scanner row. Non-Fixed Assignments are job-engineered for each No. 1 ESS Central Office. Assignment of master scanner points is covered in SD-1A272-01 for No. 1 and SD-6A272-01 for No. 1A ESS.

7. EQUIPMENT ARRANGEMENTS USING TYPE 2A, B AND C FERRODS

LINE SCANNER (2 to 1 CONCENTRATION)

7.01 The line ferrods are 2A miniature and are mounted on the 12A Grid switch package. Each switch package has 16 2A ferrods. The connection shown in Fig. 7 indicates that all odd numbered sensor/cutoff combinations (L1, L3, L5....L15) are wired internally in a loop-start mode. Connections from all even numbered sensory /cutoff combinations (L0, L1, L4....L14) are brought out to the front terminals where they can be strapped for loop-start, ground-start or no-test. Figure 31 shows the layout for displaying the ferrods.

LINE SCANNER (4 to 1 CONCENTRATION)

7.02 The line ferrods are 2A miniature and are mounted on the 13A grid switch package. The ferrod arrangment is the same as for the 2 to 1 concentration. Figure 32 shows the layout for displaying the ferrods.

MINIATURE UNIVERSAL TRUNK SCANNER (MUT)

7.03 The MUT uses the same scanner controller as the line scanner. The ferrods are mounted on printed circuit boards and are plugged into the MUT frame. Figure 33 shows the scanners for the MUT.

COMBINED MISCELLANEOUS TRUNK MASTER SCANNER (CMT)

7.04 The CMT uses the same scanner controller as the line scanner. The ferrods are mounted on printed circuit boards and are plugged-into the trunk interconnecting unit in the CMT.

8. SCANNER INTERFACES

8.01 Figure 34 is a block diagram depicting scanner interfaces. All signal leads from central control (CC0/CC1 for No. 1A ESS ***only***) pass through the processor peripheral interface (PPI). In most larger No. 1 ESS applications, peripheral unit signaling is accomplished via the SP and a PPI is not utilized.

8.02 Scanners are enabled by CC or SP via the CPD ***execute bus*** and addressed via the PU ***address bus.*** Figure 35 shows the sequence of events to address and receive an answer from a scanner.

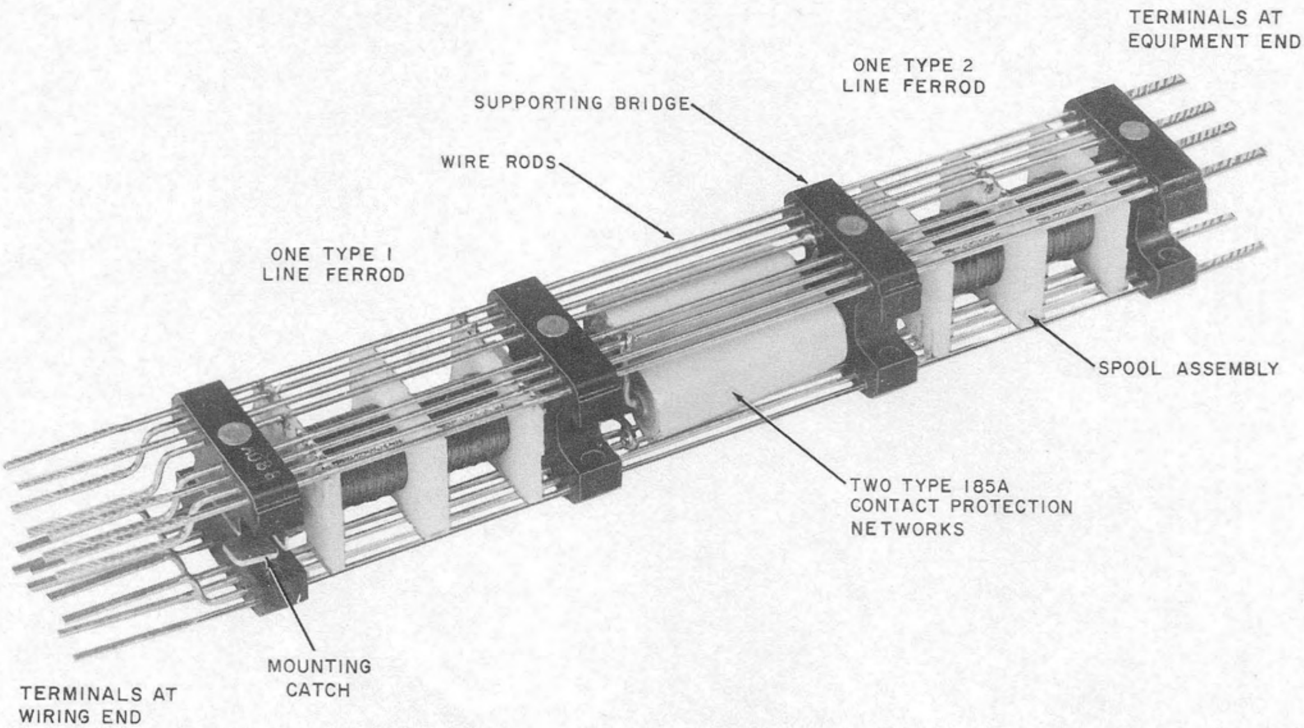
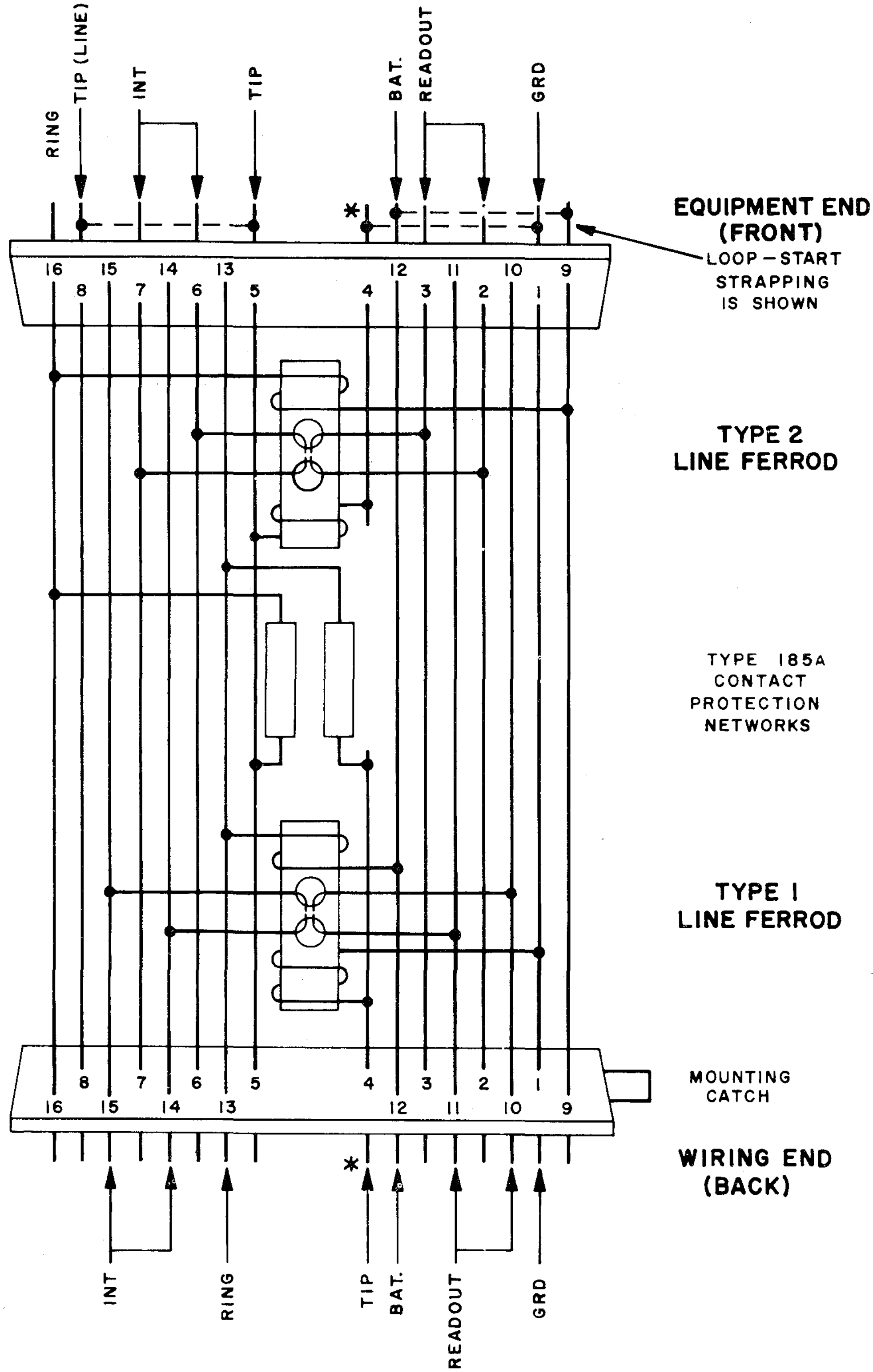


Fig. 15—Type 1B Ferrod Sensor Assembly



* NO. 4 WIRE ROD IS CUT BETWEEN THE FRONT AND BACK FERROD UNIT

Fig. 16—Wiring Arrangement of Type 1B Ferrod Sensor Assembly

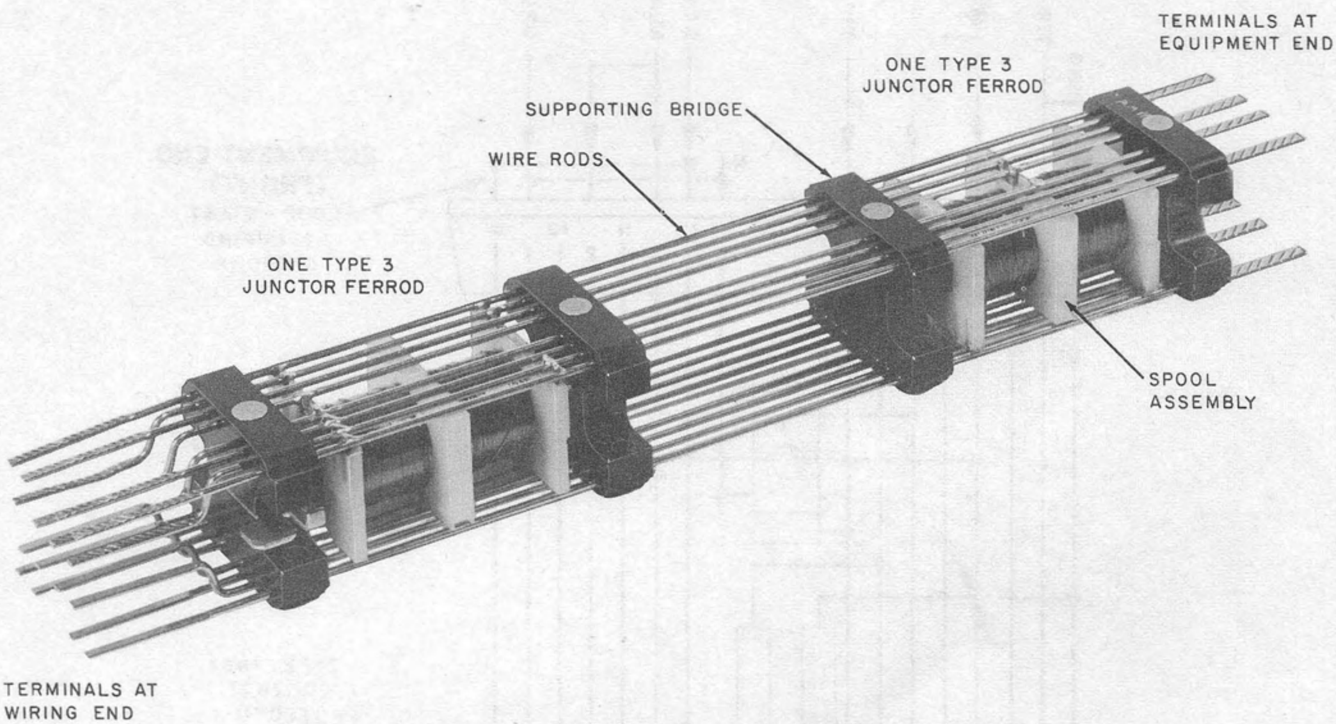


Fig. 17—Type 1C Ferrod Sensor Assembly

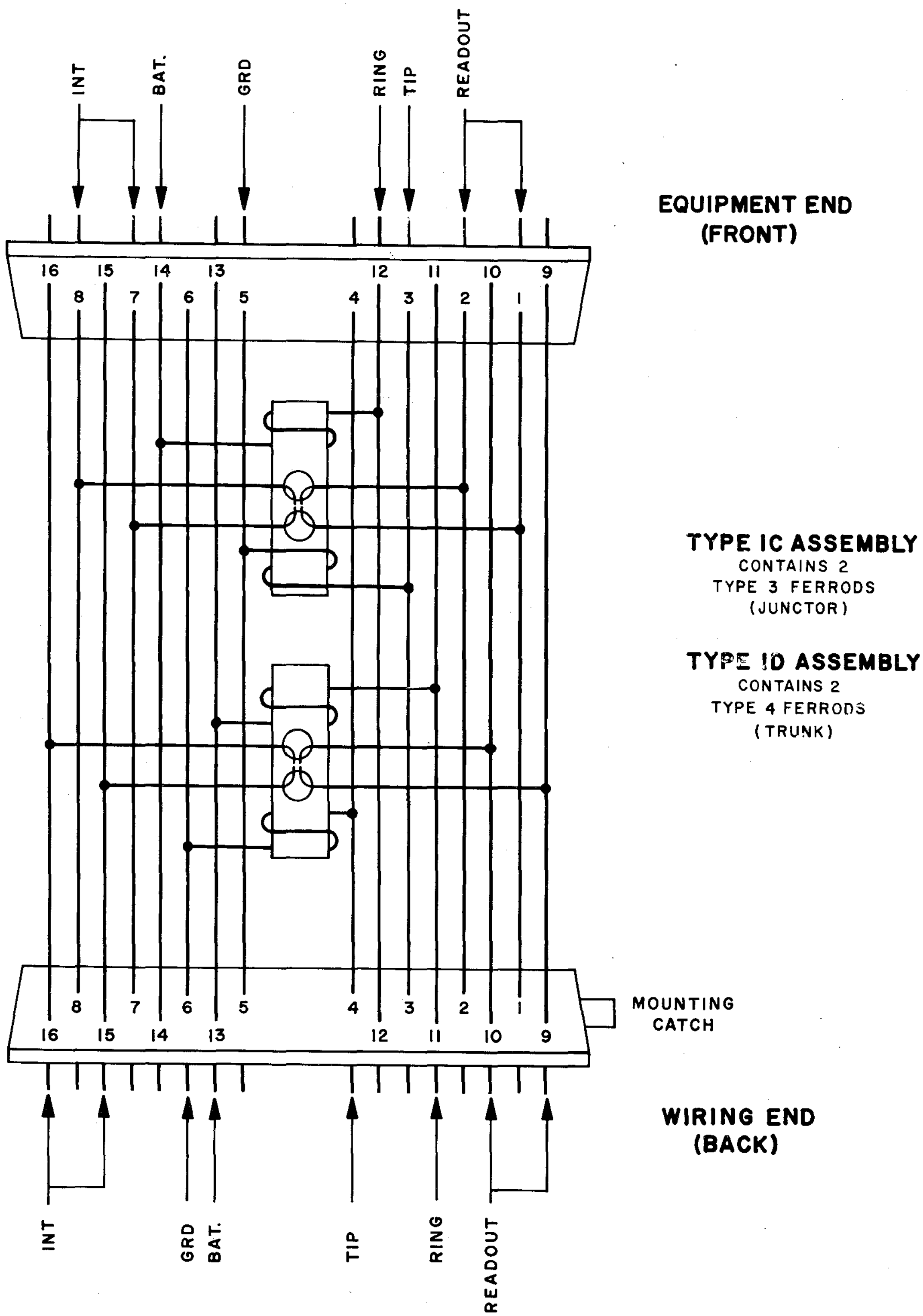


Fig. 18—Wiring Arrangements of Type 1C or 1D Ferrod Assembly

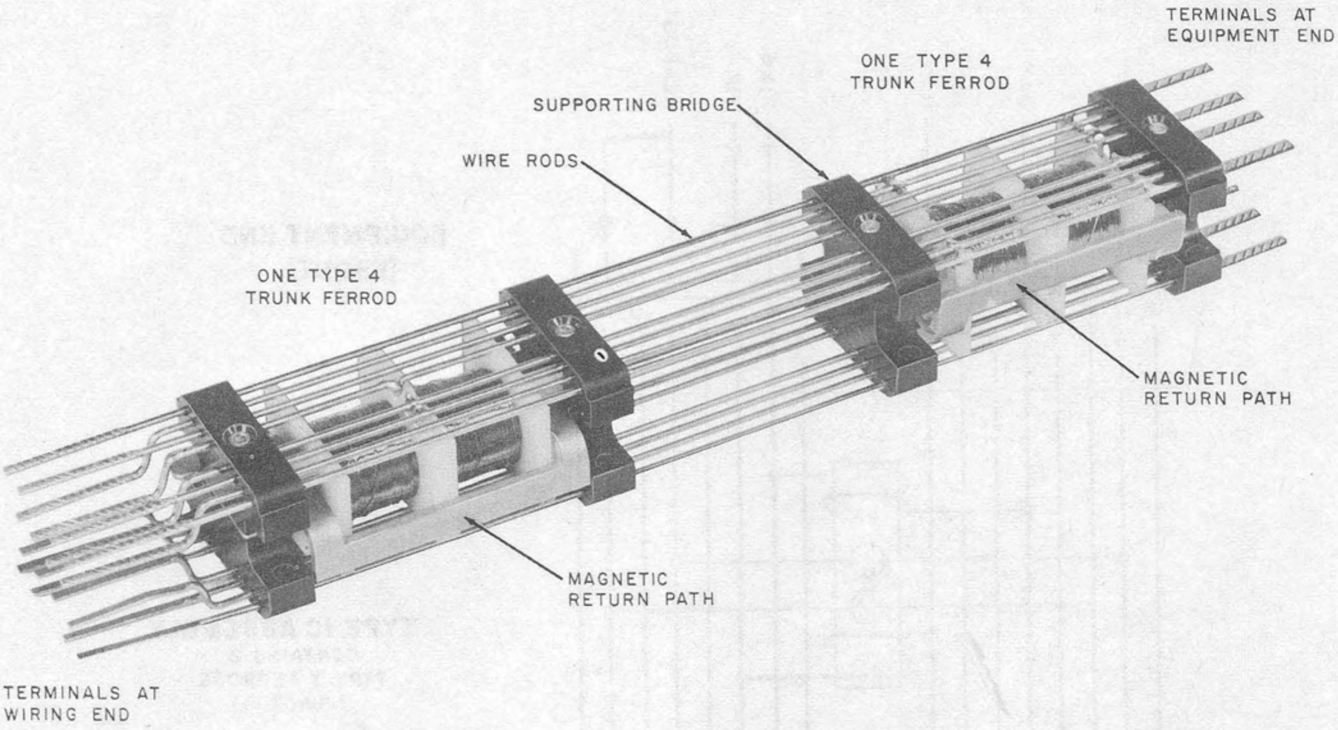


Fig. 19—Type 1D Ferrod Assembly

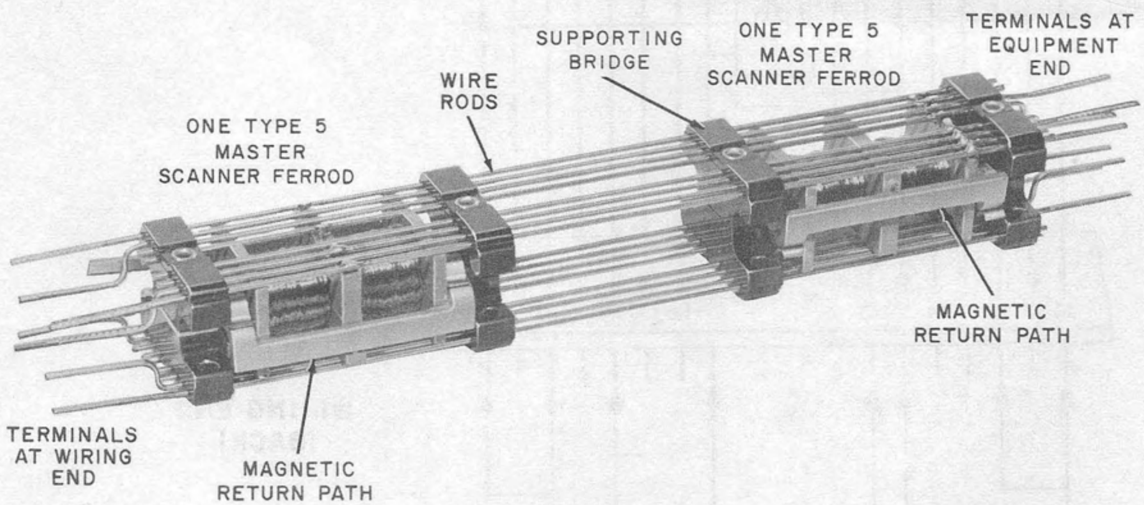


Fig. 20—Type 1E Ferrod Assembly

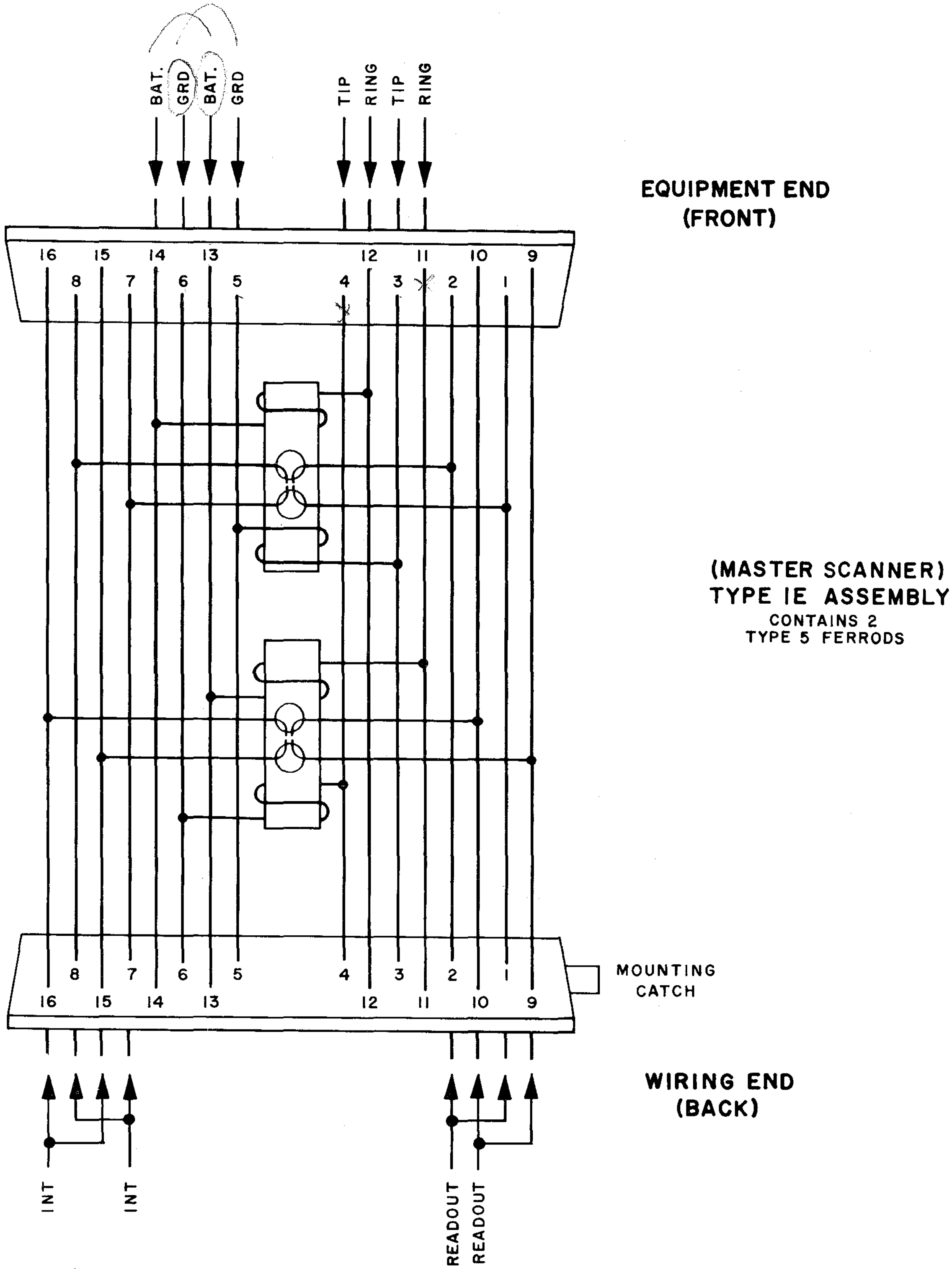


Fig. 21—Wiring Arrangements of Type 1E Ferrod Sensor Assembly

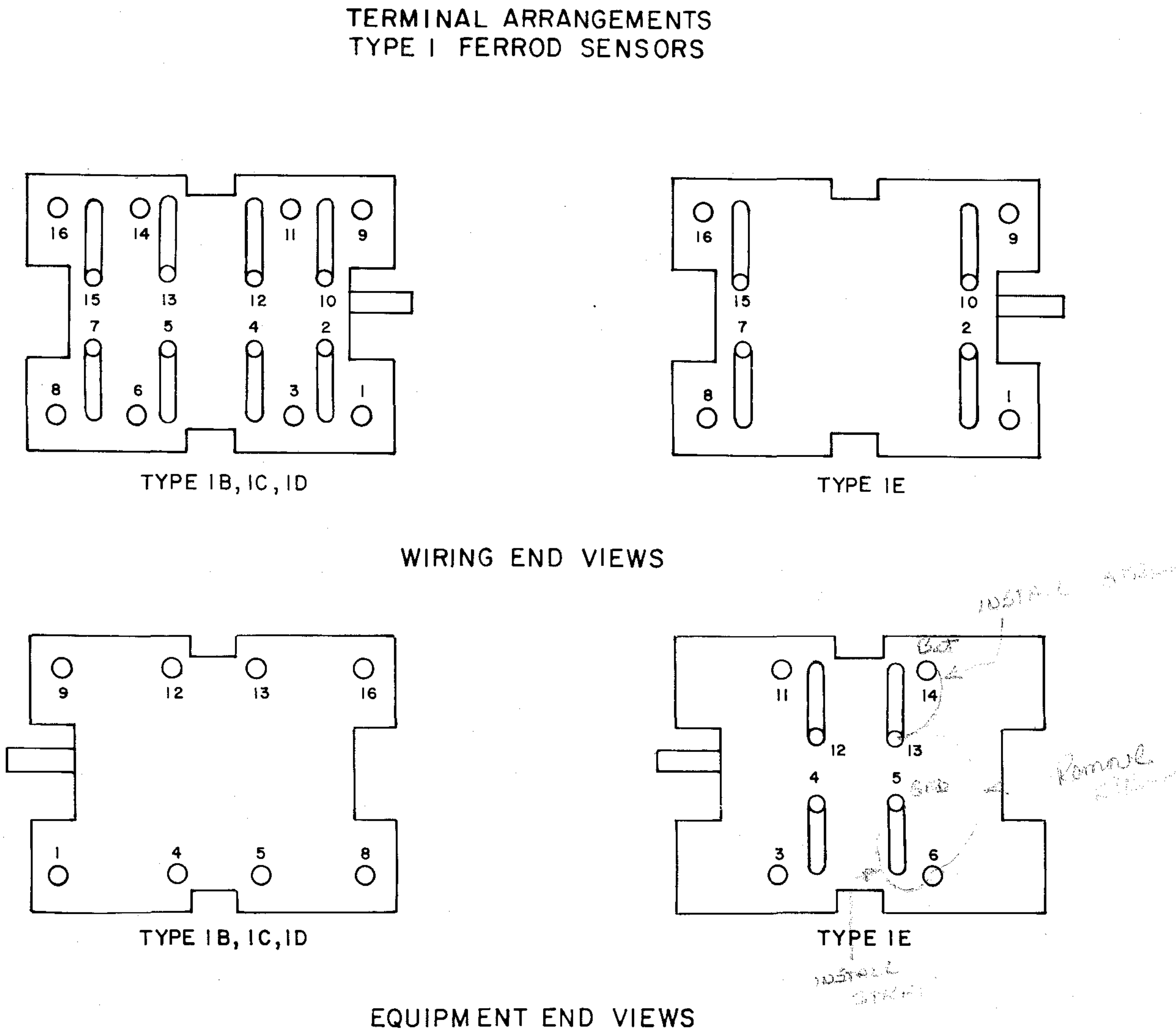


Fig. 22—Ferrod Assemblies Terminal Arrangement

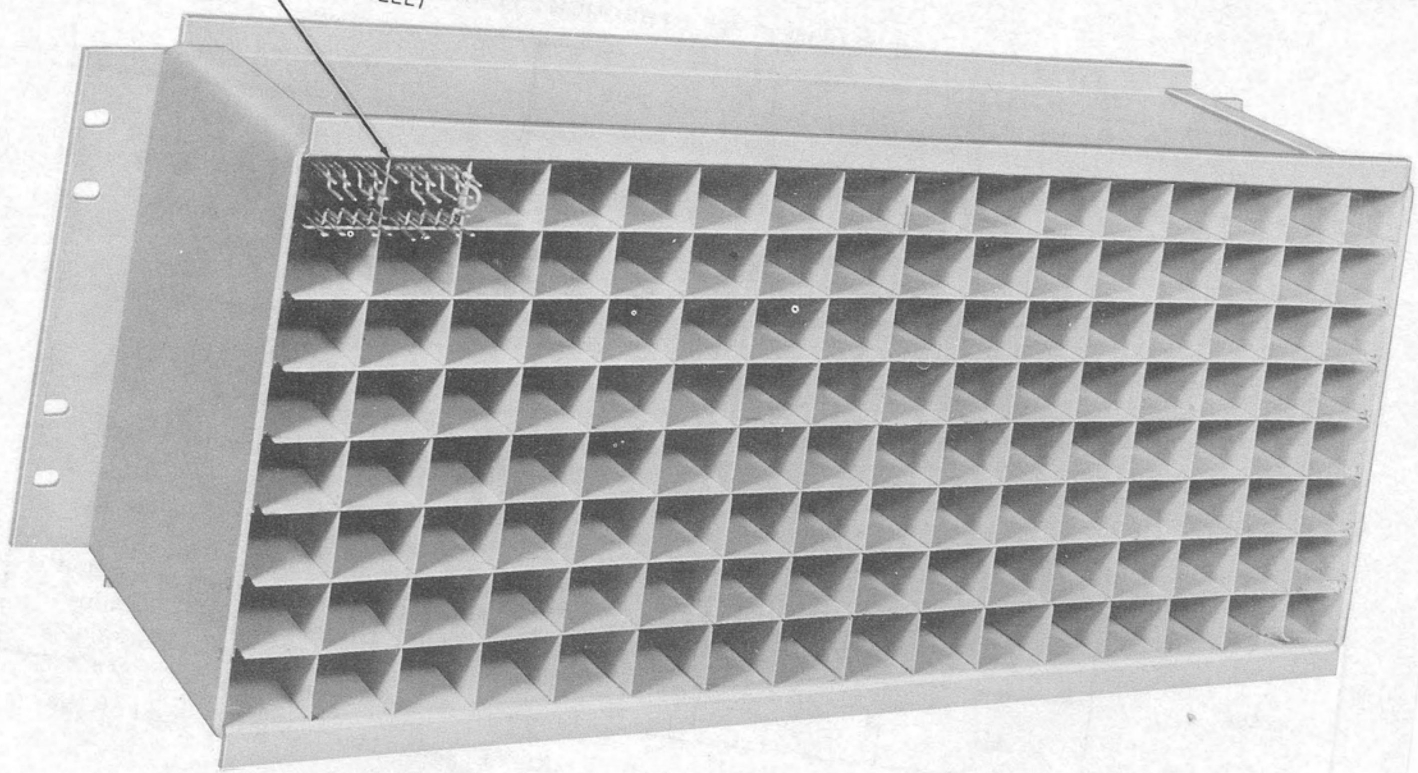


Fig. 23—Apparatus Mounting Unit for 256 Type 1 through 5 Ferrods—Pre-Assembled Front View

TABLE C

TYPES OF SCANNERS USING TYPE 1 THROUGH 5 FERRODS

TYPE OF SCANNER	FERROD SENSOR ASSEMBLY	MATRIX SIZE	LOCATION	FUNCTION
Line (4 to 1)	1B	16 by 32 (512)	Line Switching Frame (4 to 1), home and mate	Detection of call origination by customer (off-hook)
Line (2 to 1)		16 by 32 (512)	*Line Switching Frame (2 to 1)	
Junctor	1C	16 by 32 (512)	*Junctor Frame	Supervision of intraoffice calls
Universal Trunk	1C and 1D	16 by 32 (512)	*Universal Trunk Frame	Supervision of interoffice calls
Master	1D	16 by 32 (512)	Master Scanner Frame	Monitoring of points within the electronic central office for various purposes such as routine tests, trouble diagnosis, administration, and other requirements.
	1E	16 by 64 (1024)		

* For each pair of mate and home frames, the control for both 512-point matrixes are located on the home frame.

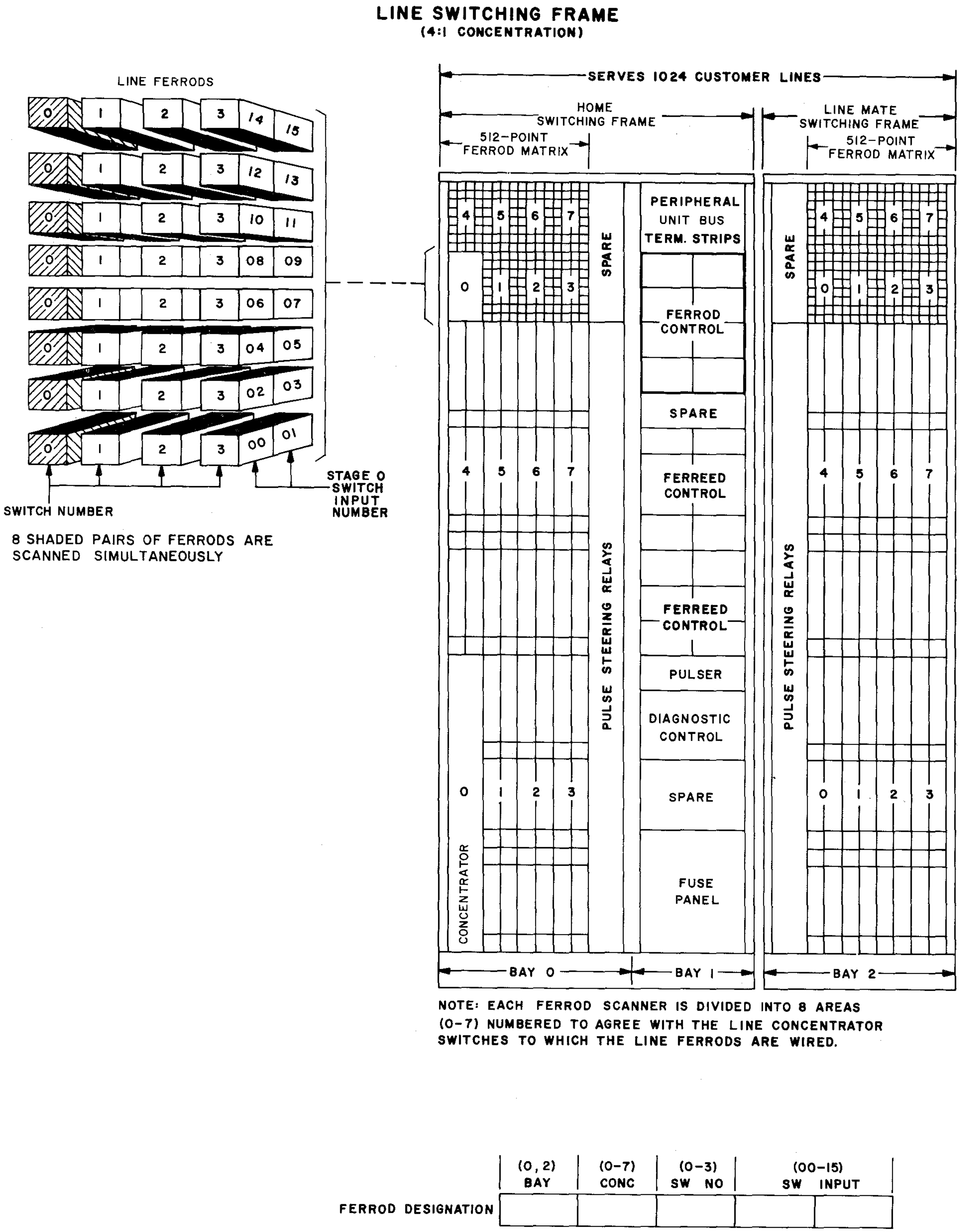
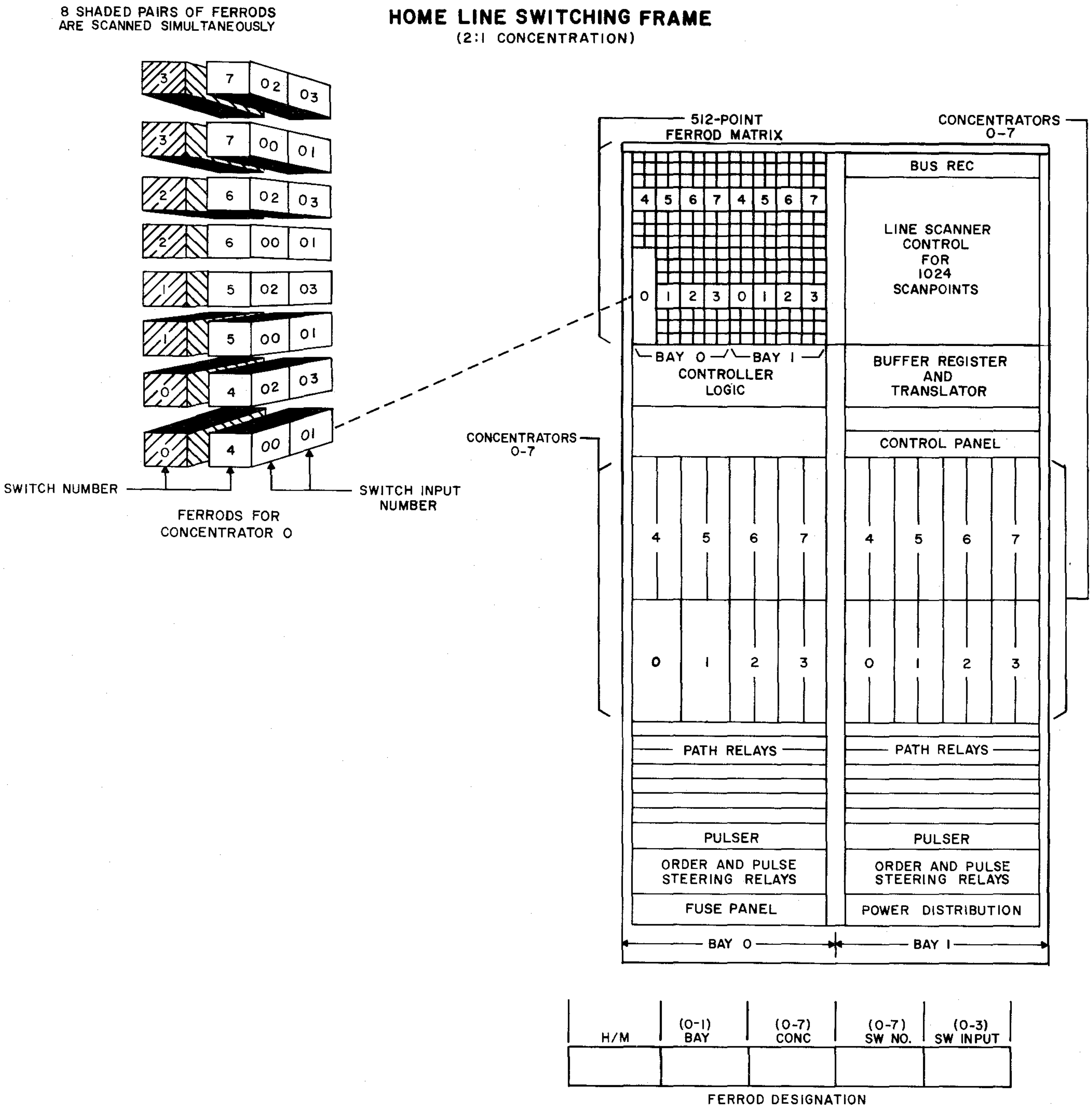


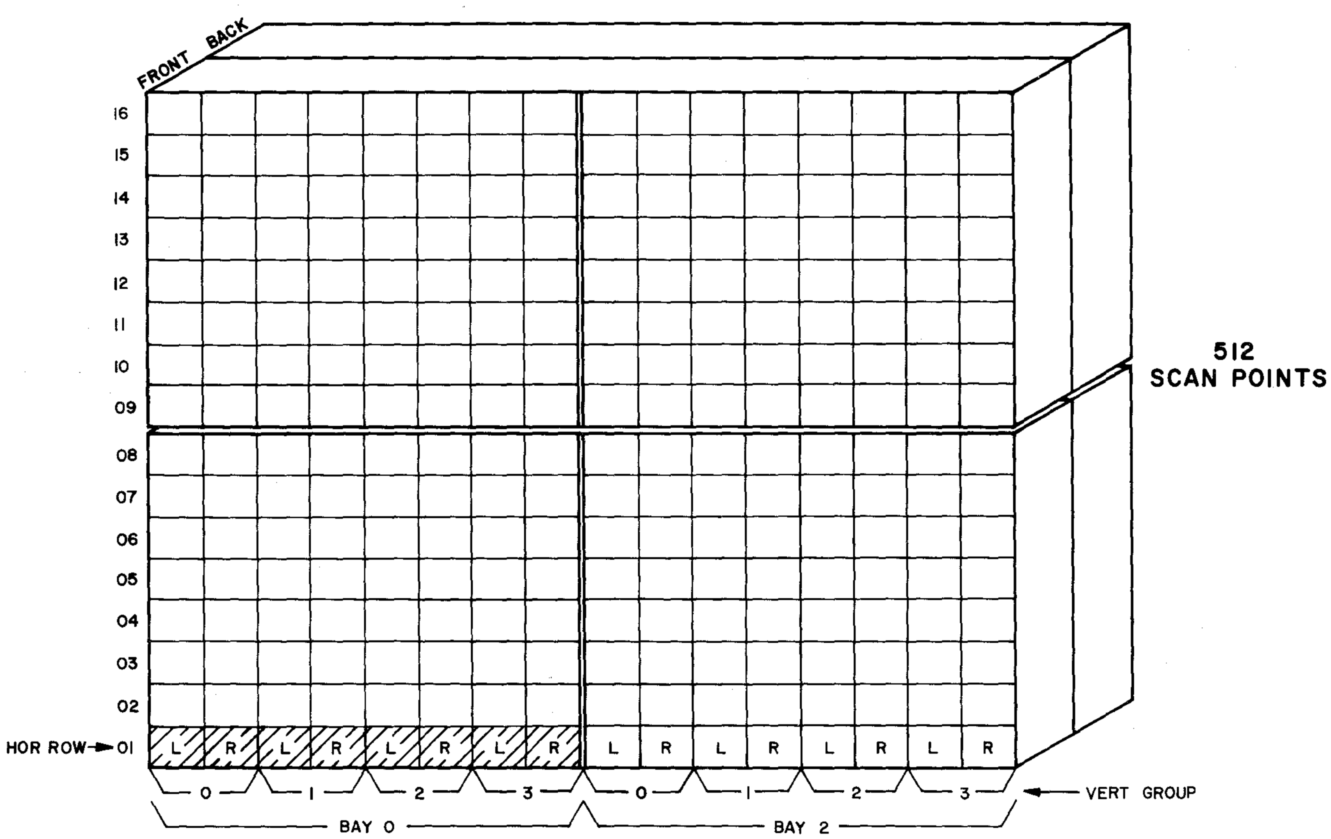
Fig. 24—Line Scanner with 4 to 1 Concentration (Ferreed)



NOTE:

THE MATE FRAME IS IDENTICAL TO THE HOME FRAME EXCEPT THAT IT DOES NOT CONTAIN SCANNER CONTROL CIRCUITS.

Fig. 25—Line Scanner With 2 to 1 Concentration (Ferreed)

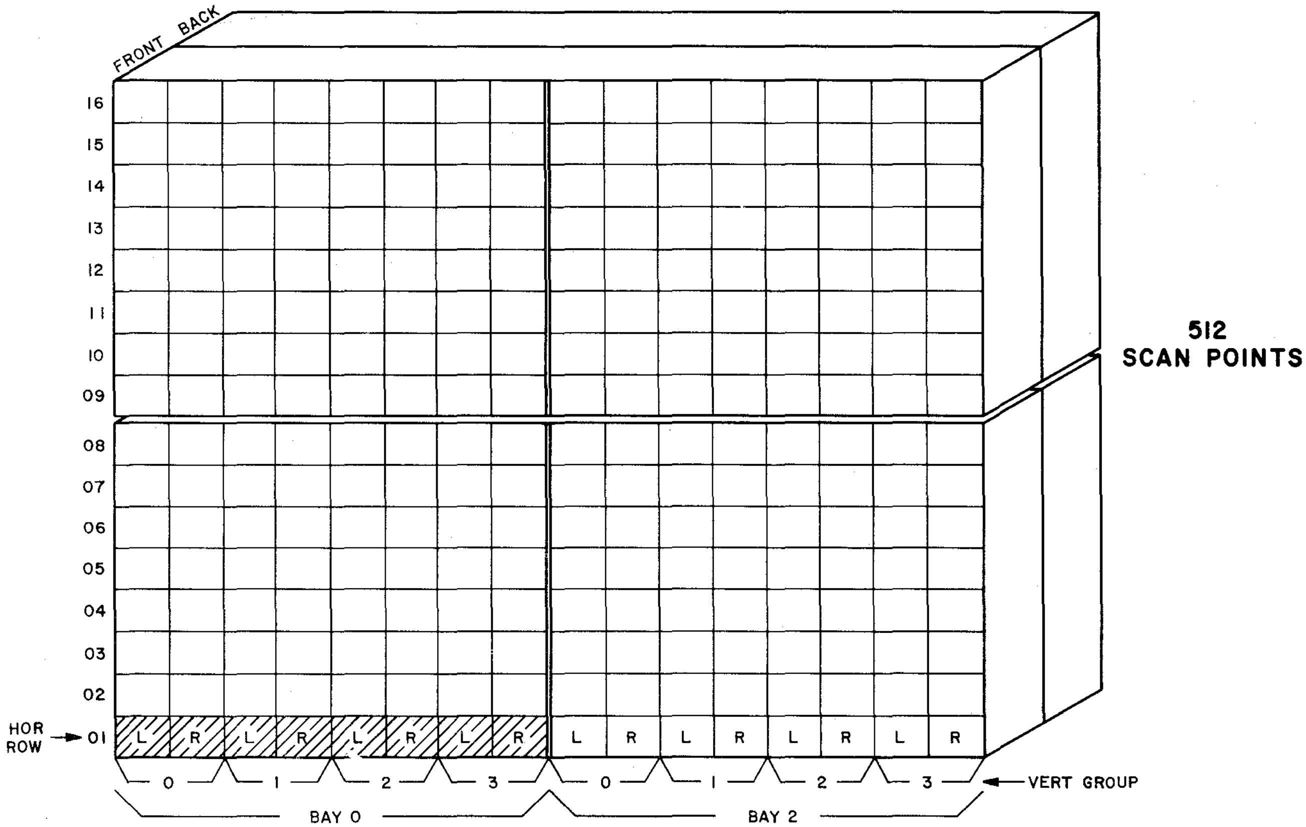


8 SHADED PAIRS OF FERRODS ARE SCANNED SIMULTANEOUSLY

L=TYPE IC R=TYPE IC

	H/M	(0,2) BAY	(01-16) HOR ROW		(0-3) VERT GRP	FRONT (0) OR BACK (1)	LEFT (L) OR RIGHT (R)
FERROD DESIGNATION							

Fig. 26—Ferrod Designations in Junctor Scanner



8 SHADED PAIRS OF FERRODS ARE SCANNED SIMULTANEOUSLY

L=TYPE 1C R=TYPE 1D

	H/M	(0,2) BAY	(01-16) HOR ROW		(0-3) VERT GRP	FRONT (0) OR BACK (1)	LEFT (L) OR RIGHT (R)
FERROD DESIGNATION							

Fig. 27—Ferrod Designations in Universal Trunk Scanner

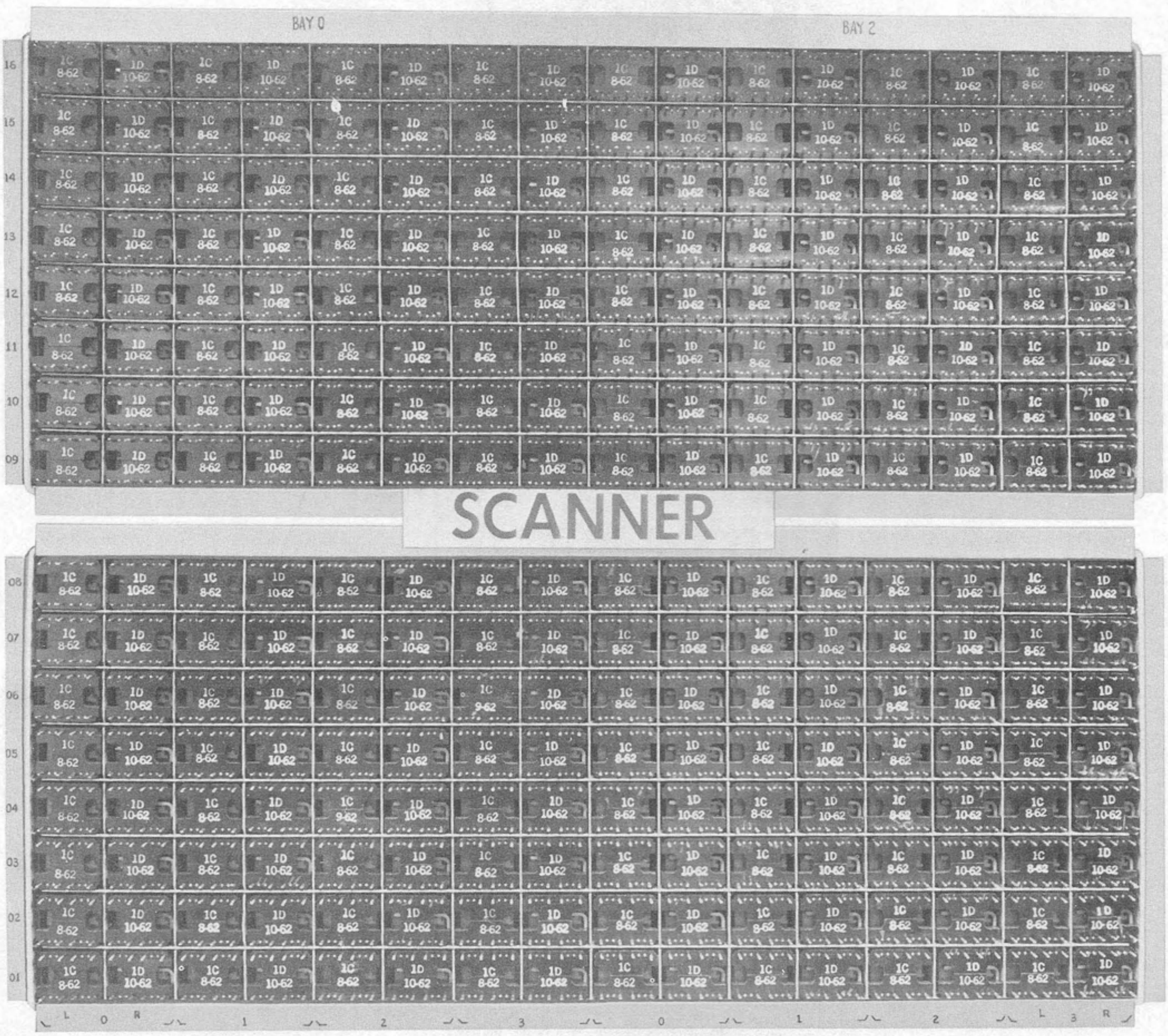


Fig. 28—Universal Trunk Frame Ferrod Matrix

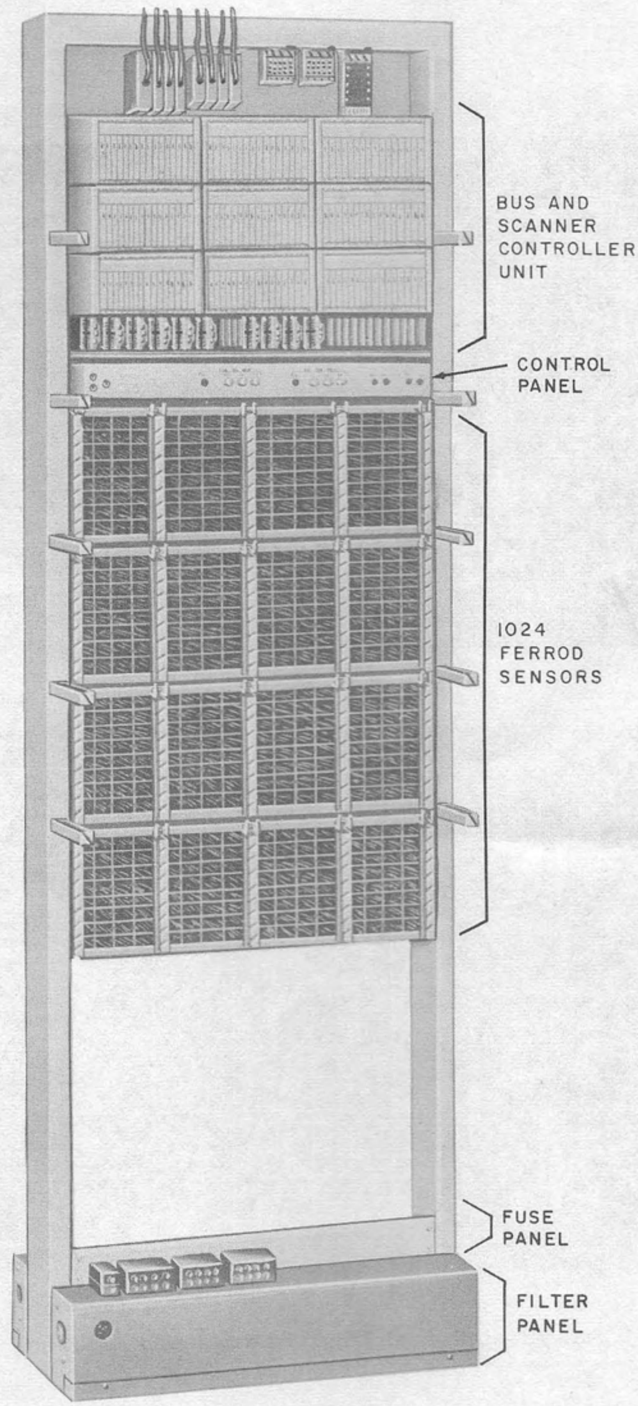


Fig. 29—Master Scanner Using Type 1 through 5 Ferrods

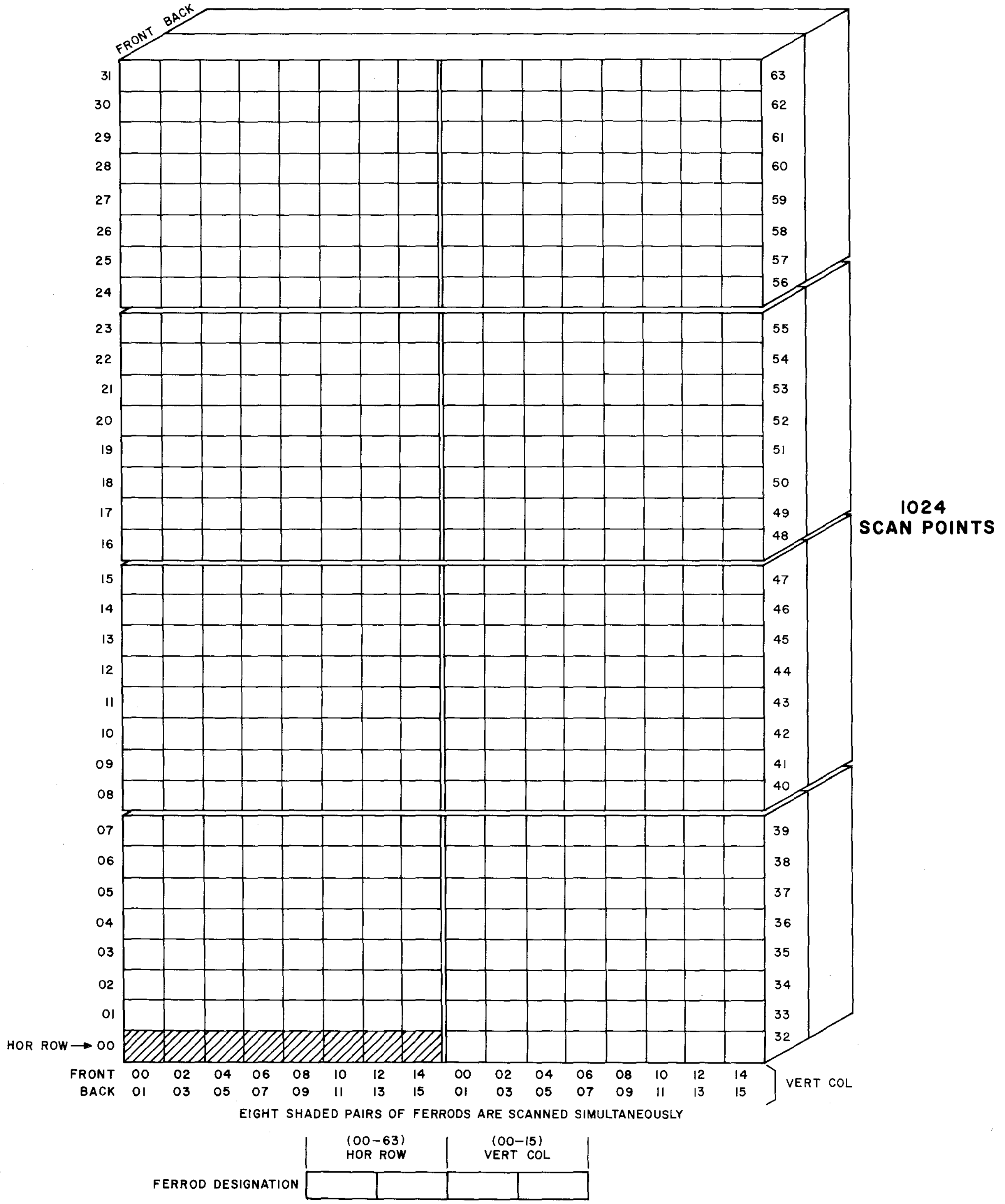
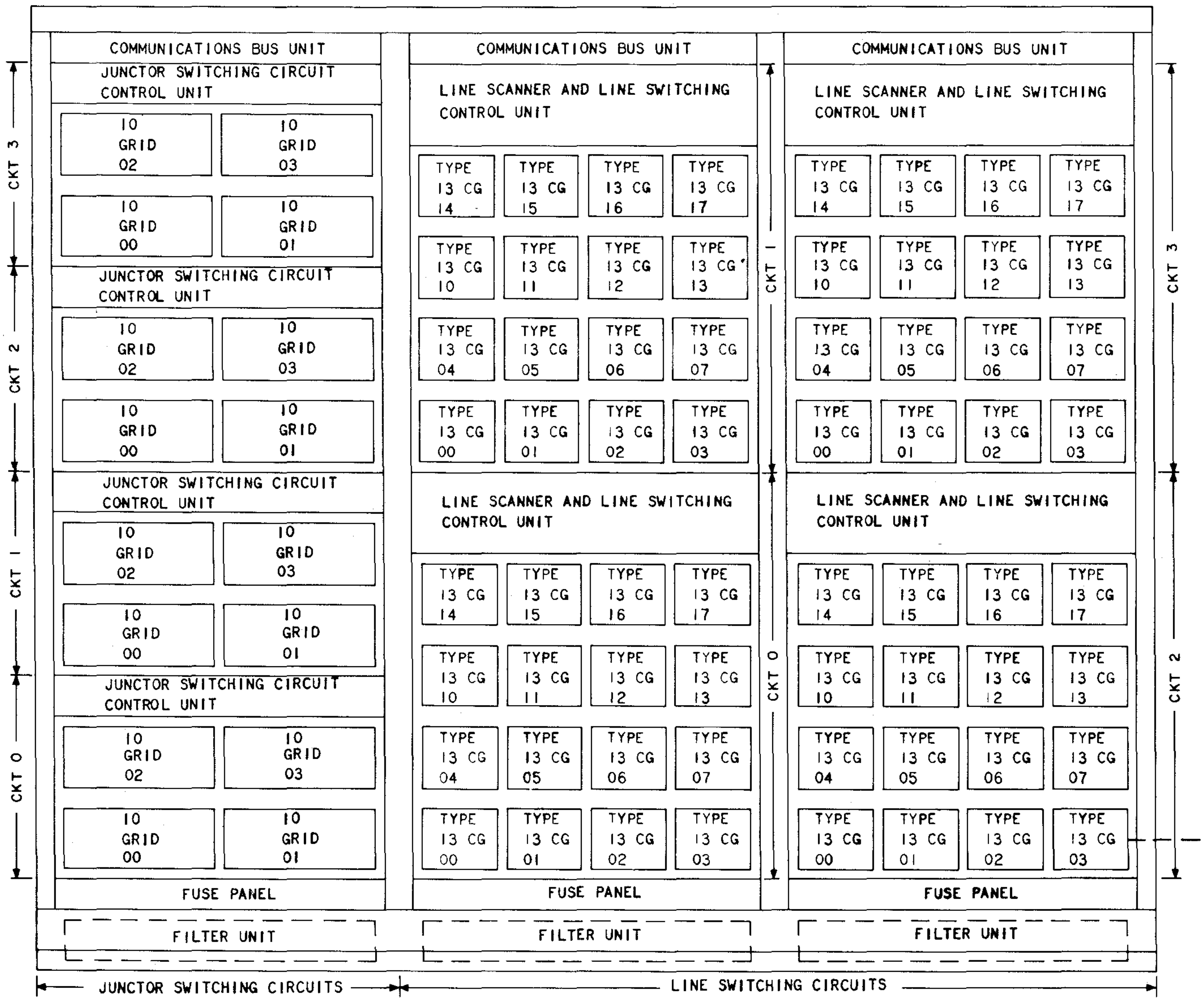


Fig. 30—Ferrod Designations in Master Scanner



LEGEND
CG - CONCENTRATOR GRID
SW - SWITCH

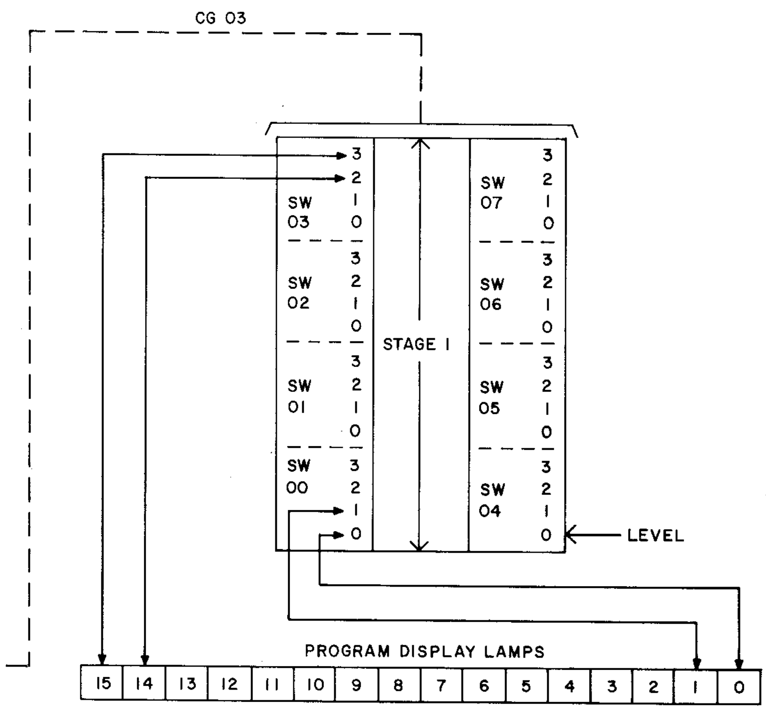
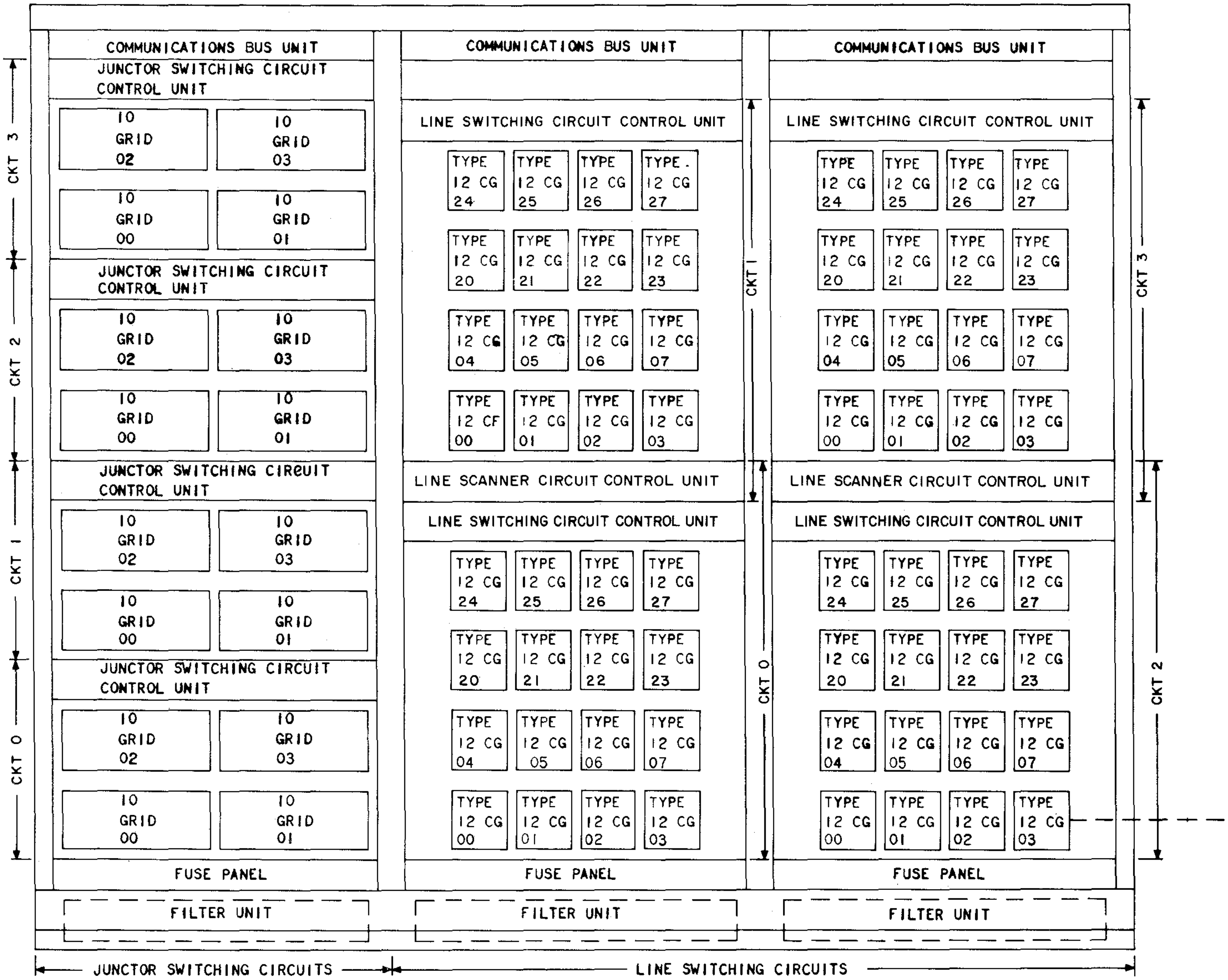


Fig. 31—Display of Ferrod States—Remreed Line Scanner—2 to 1 Concentration



LEGEND
CG - CONCENTRATOR GRID
SW - SWITCH

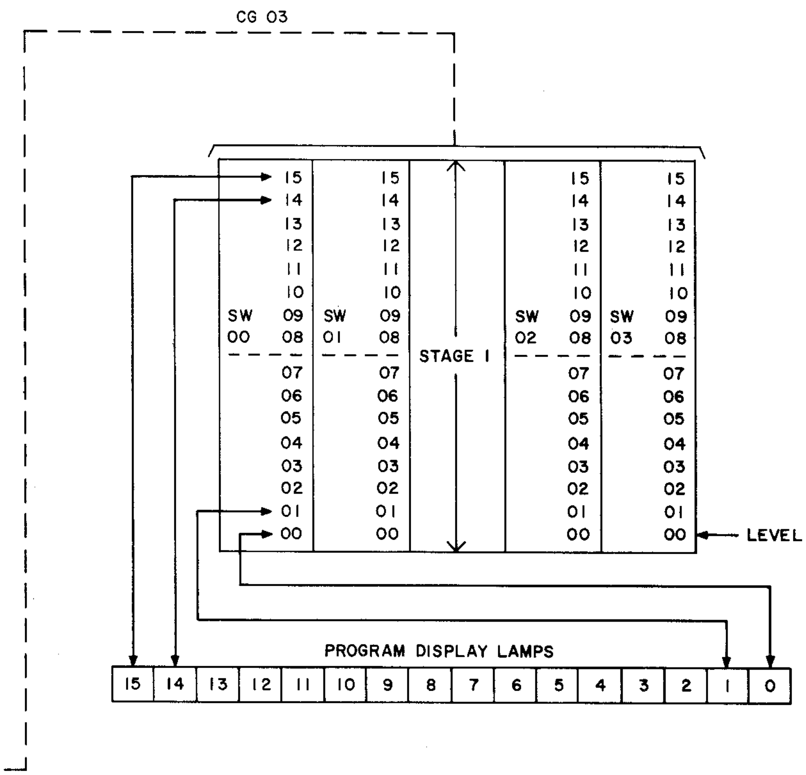


Fig. 32—Display of Ferrod States—Remreed Line Scanner—4 to 1 Concentration

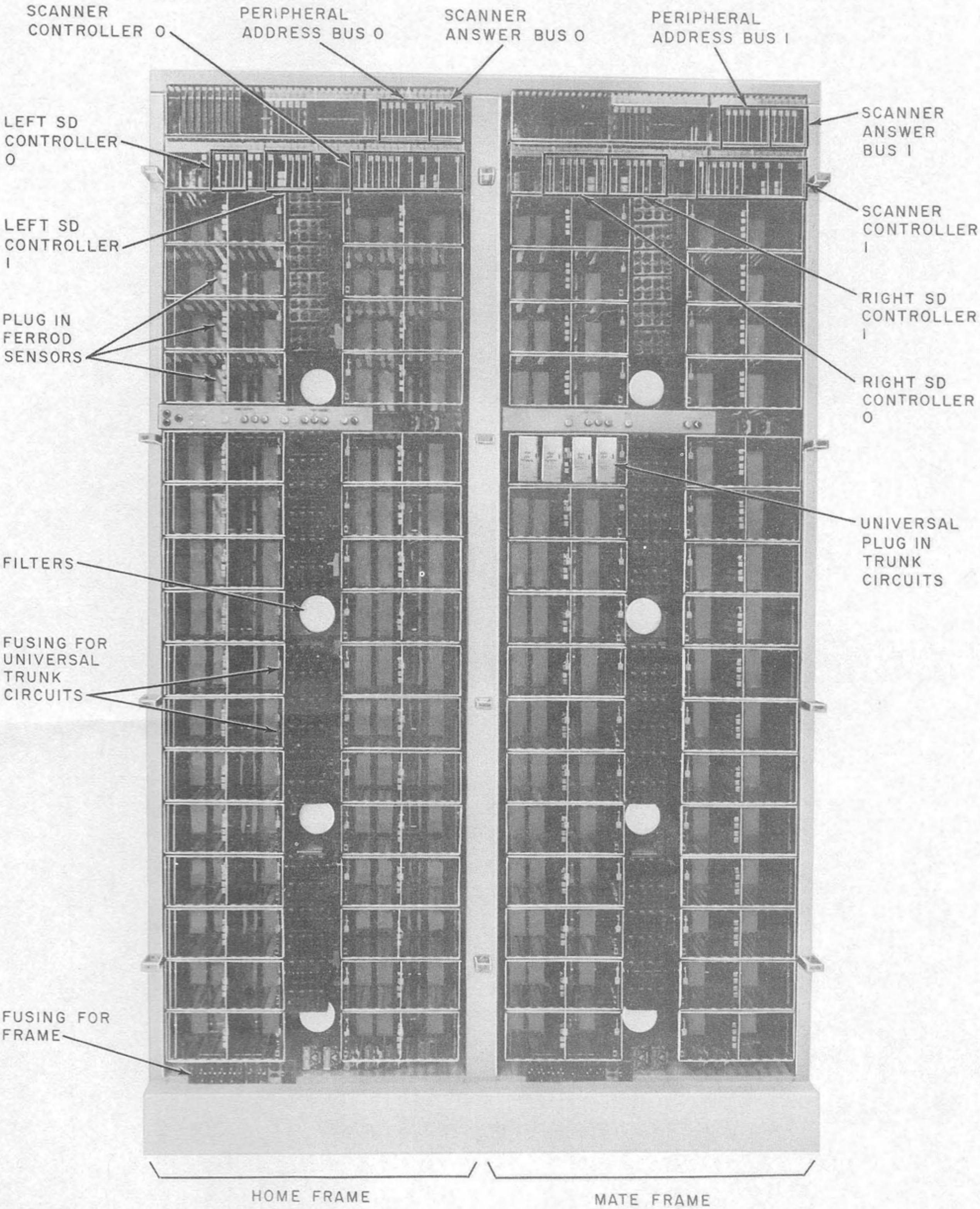
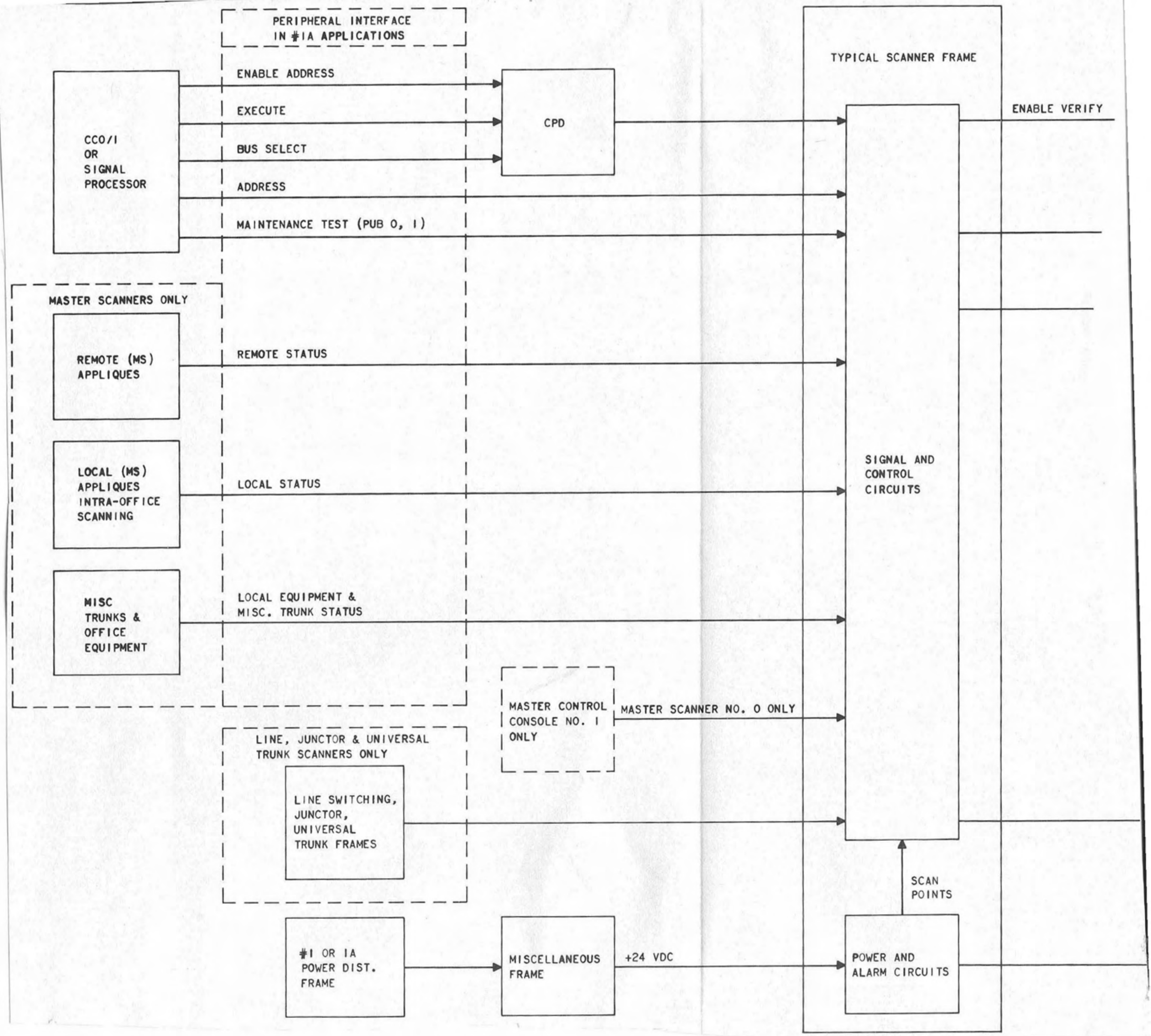


Fig. 33—Miniature Universal Trunk Frame



PERIPHERAL INTERFACE
IN #IA APPLICATIONS
TYPICAL SCANNER FRAME
ENABLE ADDRESS
EXECUTE
BUS SELECT
ADDRESS
MAINTENANCE TEST (PUB 0, 1)
CCO/I
OR
SIGNAL
PROCESSOR
CPD
ENABLE VERIFY
MASTER SCANNERS ONLY
REMOTE (MS)
APPLIQUES
REMOTE STATUS
LOCAL (MS)
APPLIQUES
INTRA-OFFICE
SCANNING
LOCAL STATUS
SIGNAL AND
CONTROL
CIRCUITS
MISC
TRUNKS &
OFFICE
EQUIPMENT
LOCAL EQUIPMENT &
MISC. TRUNK STATUS
MASTER CONTROL
CONSOLE NO. 1
ONLY
MASTER SCANNER NO. 0 ONLY
LINE, JUNCTOR & UNIVERSAL
TRUNK SCANNERS ONLY
LINE SWITCHING,
JUNCTOR,
UNIVERSAL
TRUNK FRAMES
SCAN
POINTS
#1 OR 1A
POWER DIST.
FRAME
MISCELLANEOUS
FRAME
+24 VDC
POWER AND
ALARM CIRCUITS

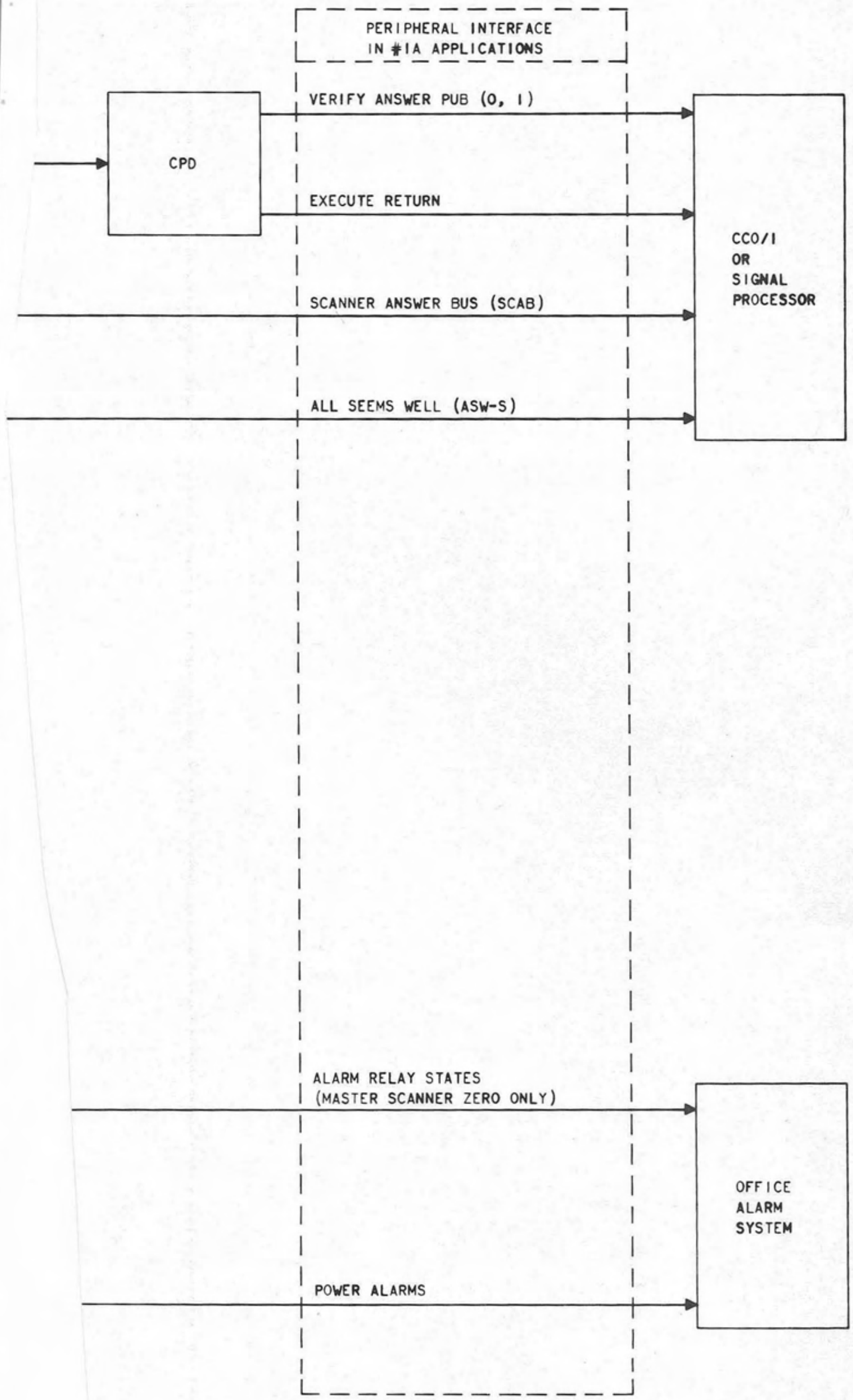


Fig. 34—No. 1 and No. 1A ESS Master Scanner Interfaces

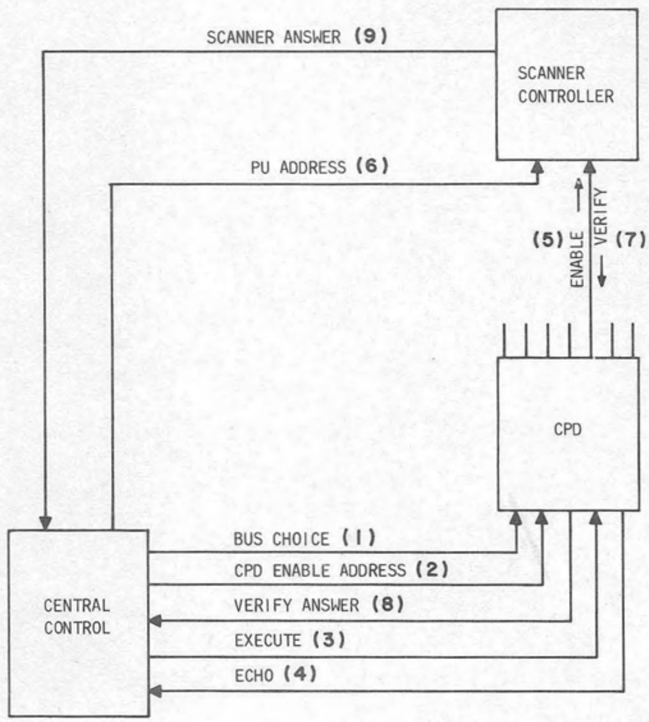


Fig. 35—Scanner Enable and Address Sequence