AUTOMATIC IDENTIFIED OUTWARD DIALING
CENTRAL OFFICE ARRANGEMENTS FOR PRIVATE BRANCH EXCHANGE
GENERAL DESCRIPTIVE INFORMATION

CONTENTS PAGE

1. INTRODUCTION

GENERAL

1.01 Automatic identified outward dialing (AIOD) provides the PBX centrex system with an automatic means for identification of a station or attendant making a direct dialed outward call requiring automatic message accounting (AMA). The AIOD system stores in memory the 4-digit number of the calling station or attendant for later use by the AMA facility.

1.02 Prior to PBX AIOD, station identification for any centrex PBX outward charge call required operator identification at a centralized automatic message accounting (CAMA) office.

1.03 The PBX-ANI method used to determine the identity of a PBX station or attendant originating a call into a local central office is to identify, at the PBX, both the station making the call and the PBX trunk being used. This identification information is in the form of a 4-digit trunk number and a 4-digit station number. The station number and trunk number are forwarded to the central office where they are stored until required for charging. Identification and storage of the station number is performed for every central office call regardless of whether or not the call is a charge call. The station number remains in storage in the central office until requested by the AMA or ANI (LAMA or CAMA) facility or, should the AMA or ANI facility not request the station number, it will remain in storage until it is updated by new information identifying another call on this trunk.

1.04 Figure 1 shows a block diagram of PBX-AIOD facility for both conventional centrex PBXs and the No. 101 ESS PBX.

1.05 Both the 701B and 757A centrex PBX use PBX-ANI equipment for station identification on calls to a central office. The No. 101 ESS system is designed to provide station identification when handling this type of call.

1.06 With PBX AIOD, a centrex PBX customer dialing a central office access code is identified by the last four digits of his in-dial directory number and the 4-digit number assigned to identify the PBX trunk seized for the call. The identification process for a conventional PBX is performed by PBX ANI and, upon completion of the process, the two 4-digit numbers are temporarily stored in the PBX-ANI station and trunk number memories to await transmission over a data trunk to the PBX-AIOD station identification (SI) frame in the connecting central office. For more detail on ANI in a conventional PBX, refer to Section 981-601-100.

1.07 The No. 101 ESS PBX has ANI features designed within it and uses these facilities to identify, process, and store its station identification numbers in memory with the 4-digit trunk number as an address tag. For further detail on ANI in the No. 101 ESS PBX, refer to Section 966-300-100.

1.08 The SI frame is a receiving, processing, and storage system designed to handle a maximum of 60 data trunks. This system is capable of handling identifications for a maximum of 1800 PBX trunks distributed over a maximum of 60 PBXs.

1.09 Upon completion of the identification process and temporary storage by a PBX-ANI installation, a bid signal is sent by the PBX-ANI equipment over its data trunk to the SI frame which returns a transmit signal to indicate its readiness to receive, process, and store the identification information. PBX ANI then transmits its stored identification information over the data trunk. All data trunk transmission is in two-out-of-five code using frequency shift keying (FSK).

1.10 The PBX trunk numbers are the numbers assigned by the central office to the PBX trunks used by the PBX for the outgoing call. The 4-digit numbers are determined by the trunk central office equipment location when the serving central office is a No. 1 LAMA or No. 5 crossbar (transverter) office or is an assigned number from a special AIOD number network when the serving central office is a step-by-step, panel, or No. 1 crossbar office equipped with ANI-B. Step-by-step offices equipped with ANI-C use the number assigned to the connector that is used for the PBX trunk.

1.11 The 4-digit trunk number is used by the SI frame to address a specific memory location in its station identification store into which the 4-digit station number is stored. The memory location also stores the number of the data trunk used in transmitting the information from the PBX-ANI equipment. The 4-digit station number remains in storage until called for by the AMA or ANI equipment via the AIOD translator and translator connector. This request is initiated only if the stored station identification number is needed by the AMA or CAMA facilities for billing.

CAPACITY

1.12 The station identification store (SIS) provides storage for station identification for 1800 PBX trunks.

1.13 One PBX-AIOD SI frame with an associated AIOD translator and translator connector can provide service to a maximum of two separate switching facilities as follows:

(a) A maximum of two ANI-B identifier groups with a maximum of ten ANI-B outpulsers per group.

(b) A maximum of two AMA transverter groups with a maximum of ten transverters per group.

(c) A maximum of two ANI transverter groups with a maximum of two transverters per group.

(d) A combination of one AMA or ANI transverter group and one ANI outpulser group.

(e) One outpulser ANI-C group.

1.14 The PBX-AIOD SI frame can accept data from 60 PBXs with each PBX identified by the same or different office indexes up to a maximum of 30 office indexes per No. 5 crossbar transverter group, nine office indexes per ANI-B outpulser group, or 1 office index per ANI-C outpulser group.

FEATURES

SI Frame Solid State and Magnetic Circuitry

1.15 The PBX-AIOD station identification frame uses solid state devices such as transistors, diodes, and magnetic devices.

1.16 For the most part, solid state and magnetic devices are mounted on circuit boards and modules.

SI Frame Program

1.17 The PBX-AIOD station identification frame uses a central control circuit with a wired program.

Alternate Treatment For New PBX Trunk Assignment

1.18 When a PBX trunk is reassigned at the central office and the number has not been changed at the PBX, the PBX-AIOD SI frame can be programmed to substitute the old number for the new to properly identify the station.

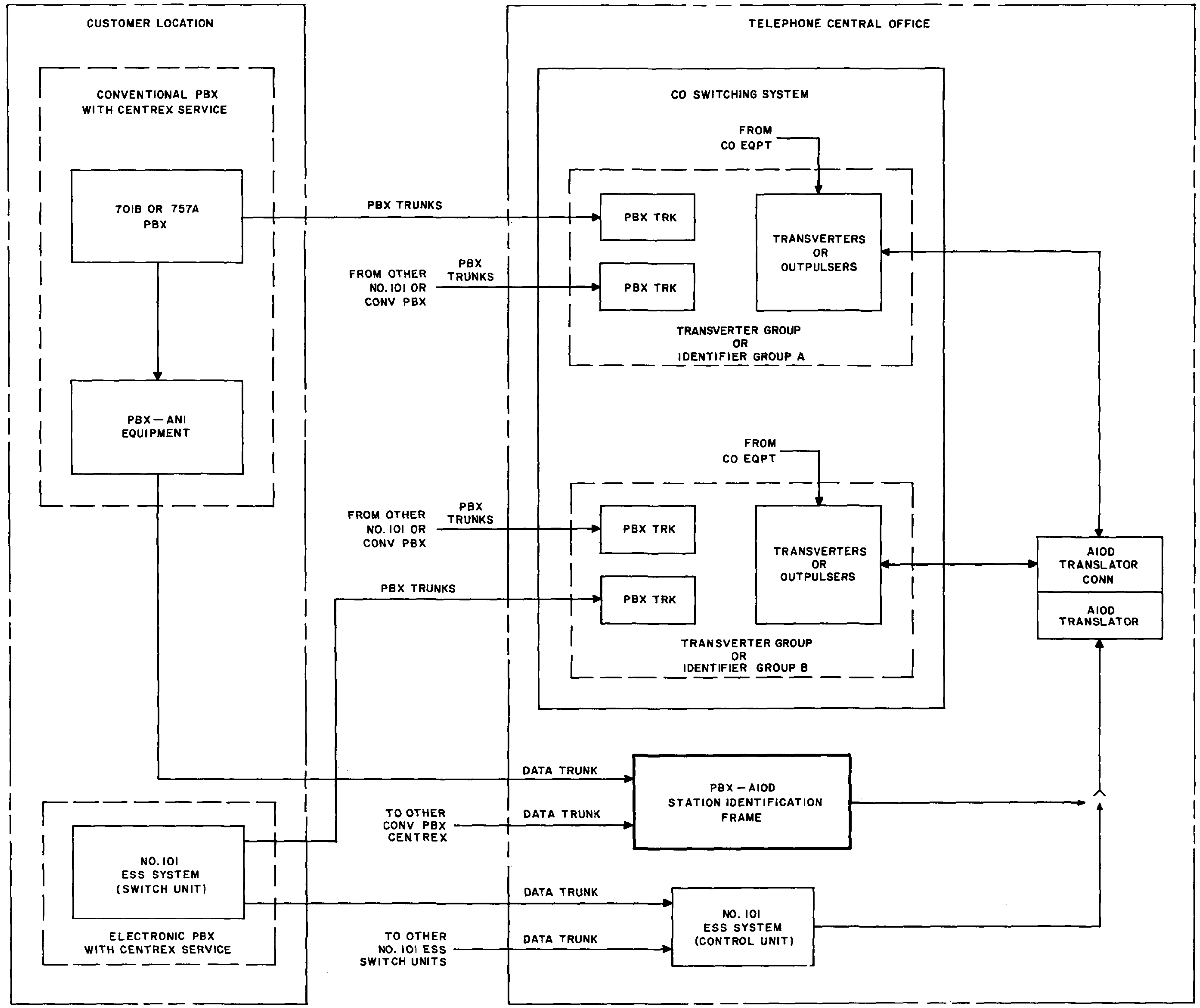

Fig. 1 — PBX AIOD Facility — Block Diagram

Alternate Billing Arrangement

1.19 Failure to provide a station number by the PBX AIOD results in alternate billing. In a transverter type office, the listed number of the PBX is obtained from the regular AMA translator. In outpulser type offices, a CAMA operator is called in to identifiy the calling PBX station.

Automatic Error Detecting and Encoding

1.20 The PBX-AIOD station identification frame has an automatic error detecting and encoding facility which continuously monitors its operation. An error will cause circuit status information to be collected and printed by a tape printer in the form of an error message. The error message information is used in association with a trouble location manual to determine the trouble area and the necessary corrective measure.

PBX Trunk Number Assignment

1.21 The PBX trunk numbers are 4-digit numbers which are assigned to the PBX trunks at the central office. Numbers are assigned in order to associate each call over a PBX trunk with the PBX-ANI information received from a PBX over the data trunk.

1.22 In central offices using the ANI-B system, the 4-digits assigned to a PBX trunk are derived from the special AIOD number network; in the ANI-C system the four digits are determined from the regular number network. In No. 1 crossbar LAMA and No. 5 crossbar CAMA or ANI offices, the line link frame location of the PBX trunk is translated in the AIOD translator to a 3-digit number and the thousands digit is assigned in the AIOD translator.

1.23 All PBX trunk number assignments at the central office must be in one or two thousands number series.

1.24 Since the station identification store in the station identification frame has 1800 trunk addressed storage locations arranged in two blocks of 900 numbers each (A000-A899 and B000-B899), the assignment of the thousands digit permits each of two transverter groups to have 900 PBX trunks.

1.25 If a transverter type office requires more than 900 storage locations, the second block of 900 numbers may be used.

1.26 Where one of these transverter type offices shares the station identification store with an ANI-B or ANI-C system, trunk number assignment must be coordinated to prevent conflicts.

2. SYSTEM ELEMENTS

General

2.01 Figure 2 shows a simplified block diagram of the PBX-AIOD SI frame and interface equipment. The PBX-AIOD frame occupies one prewired 11-foot 6-inch high, 4-foot length framework in the central office and is capable of receiving station identification information over data trunks. The output of SI frame is interfaced to the central office equipment by AIOD interface equipment which performs the preference and control of data to and from the central office equipment and number translation when needed.

2.02 The SI frame is composed of five major circuits with a sixth circuit providing the fuse alarm and miscellaneous functions. The five major circuits are: (1) digit register connector circuit, (2) digit register circuit, (3) station identification store circuit, (4) station identification store control circuit, and (5) station identification test circuit.

2.03 The combination of these six circuits provides the facilities for storing the station identification numbers received from remote PBX. The SI frame is a sequential, clock-timed system performing both a write-in and readout function. The station number digits when received over a data trunk are written into memory. Following a central office request for the data, the stored station number digits are read out of memory and sent to the central office equipment along with a 2-digit office index.

Digit Register Connector

2.04 The digit register connector circuit provides the means of automatically connecting a data trunk from a PBX to one of two digit

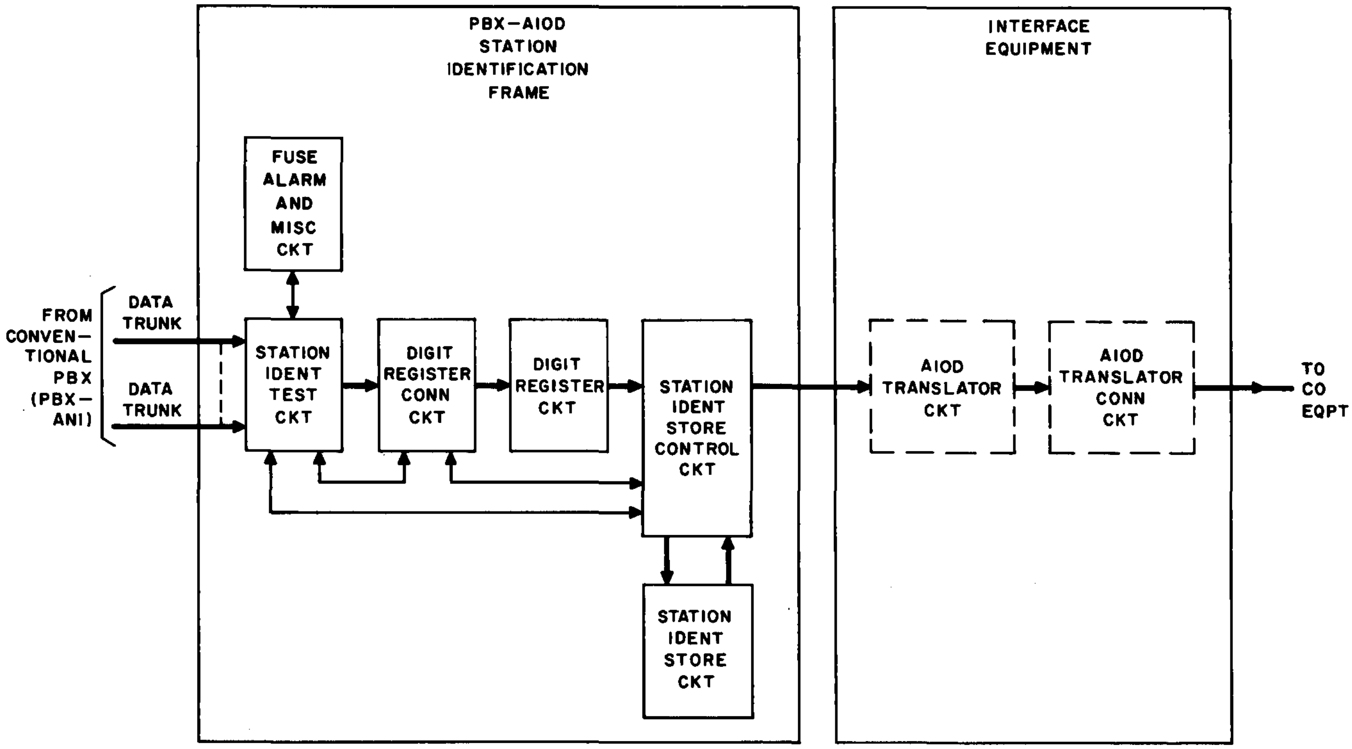

Fig. 2 — PBX-AIOD Station Identification Frame — Block Diagram

registers. The digit register connector provides a metallic switched path for a maximum of 60 data trunks. This circuit scans all of the data trunks for PBX service requests and, in the absence of a request, completes the scan in less than 1 millisecond. When a request is recognized, the digit register connector circuit connects the data trunk to one of the two digit registers and returns a transmit signal to the PBX-ANI equipment over the trunk. The scan stop and transmit signal takes approximately 65 milliseconds after which the scan is continued. A similar scan stop occurs on a second request. If a third request is detected while both digit registers are busy handling PBX data, the scan stops and waits for the release of one of the two digit registers. This release occurs when all the PBX data has been received by one of the digit registers which requires a maximum of 190 milliseconds.

2.05 The digit register connector circuit is made up of four subcircuits: trunk scanner circuit, digit register preference and selection circuit, connector switch selection circuit, and connector switch network.

2.06 The trunk scanner uses an 8 by 8 core matrix to scan 64 ferrods. Each data trunk has one ferrod sensor. Thus, 60 of the ferrod detectors are used for detecting service requests over data trunks, the remaining four being used for circuit administration and testing. A nonenergized ferrod indicates a service request by its associated data trunk. The digit register preference and selection circuit selects an idle digit register to be used by the data trunk providing the request, and also alternates digit registers on successive calls.

2.07 Connection of the data trunk to the selected digit register is made by the closure of ferreed switch contacts in the connector switch network. The ferreed switches are of the 2-wire type built up to 4 by 8 switch matrices. Associated with each switch matrix are two one-by-eight bipolar ferreed switches which provide a ferrod cutoff function for the trunk scanner.

2.08 The connector switch selection circuit consists of a relay tree arranged for selection of ferreed crosspoints in the connector switch network.

2.09 The digit register preference and selection circuit controls the connection of all data trunks to the digit registers through the connector switch network.

Digit Register Circuit

2.10 The two digit registers within the digit register circuit can be simultaneously connected to serve data trunks, thus providing for operation under a heavy load condition.

2.11 The frequency shift signals that are transmitted over the data trunk from the PBX-ANI equipment must be converted from frequency shift form to a form usable by the data processing SI frame. This is done by the selected digit register.

2.12 The received frequency shift message consists of 41 bits; a start bit, 20 bits for the trunk number, and 20 bits for the station number. The transmission rate is 735 bits per second. A "1" bit is transmitted as 1850 cps and a "0" is transmitted as 1150 cps over the data trunk. The selected digit register converts the received frequency shift signals into DC logical "1" marks and "0" spaces and then transforms each digit from serial to parallel form. Each digit is then checked for a valid two-out-of-five code.

2.13 Since the station identification store circuit is arranged in two 900-word groups, each group being addressed by the thousands digit of the PBX-AIOD trunk number, the thousands digit is converted by a cross-connecting arrangement to a logical "1" or "0" depending upon in which of two thousands groups the trunk number lies. The logical "1" and "0" arrangement for the thousands digit determines which one of the two areas of the station identification store the remaining hundreds, tens, and units digits of the trunk number will be steered. These remaining digits then determine the actual storage location within the 900-word group.

2.14 After the digit register circuit receives the single bit for the number thousands digit, the remaining two-out-of-five coded digits from the digit register connector undergo a least significant bit dropping process, dropping the "0" bit from the two-out-of-five code of each digit. Thus the PBX trunk number which was originally composed of 20 bits is composed of 13 bits. Four out of five bits were dropped from the trunk number thousands digit and the "0" bit was dropped from each of the hundreds, tens, and units digit. The 4-digit station number, received over the data trunk in two-out-of-five code, also has the least significant bit ("0" bit) of each digit dropped in the digit register circuit. Thus the PBX station number which was originally composed of 20 bits is composed of 16 bits.

2.15 This bit format of 13 bits for PBX-AIOD trunk number and 16 bits for the station number is transferred a digit at a time to the station identification store control circuit.

Station Identification Store Circuit

2.16 The station identification store circuit uses the 6A memory which contains electrically alterable ferrite sheets. The memory uses coincident current word selection, with the access, read, and write circuitry provided by circuits in the station identification store circuit. This memory has a capacity of 2048 word locations of 24 bits each, but only 1920 word locations of the memory are connected to access circuitry since the address bits are in two-out-of-five code and will not perfectly map into all 2048 memory locations.

2.17 Functionally, the 6A memory contains 64 Y planes, 32 X planes, and 24 Z or bit planes. Only 30 X planes are connected to access circuitry because only 1920 word locations of the memory are used.

2.18 The selected thousands bit and the 1, 2, 4, and 7 bits of the hundreds, tens, and units digits of the trunk number are translated to develop 1-out-of-30 X plane currents and 1-out-of-64 Y plane currents.

2.19 A set of 24 inhibit windings, one per Z or bit plane, are provided to permit cancellation of X and Y write currents in a given Z or bit plane. If the write current is canceled, a "0" is written into the bit position of the word selected by the X and Y write currents; otherwise a "1" is written into the bit position.

2.20 Out of the 1920 word locations that are connected to access circuitry, 1800 word locations can be addressed using the PBX trunk numbers. The trunk number addresses are divided into A000 through A899 and B000 through B899, where A and B are any two thousands digits as determined by the cross-connection arrangement discussed in 2.13.

2.21 A fourth set of windings, similar to the inhibit windings, is provided for sensing when reading out the stored information.

2.22 Three external inputs are required for station identification store circuit operation. These are (a) a command signal which specifies the type of read and/or write operation to be performed, (b) an address which selects the memory word location, and (c) data information which specifies the bit configuration of words to be written into the 6A memory.

2.23 The various commands which can be given are:

(a) ***RW command:*** A word is read out of a specified address and is set into the data register of the station identification store control circuit. That word is then automatically written back into the same memory location.

(b) ***RO command:*** A word is read out of a specified address and set into the data register. The addressed memory location is left in a cleared state.

(c) ***CO command:*** A word is read out of a specified address but is not set into the data register.

(d) ***W1 command:*** A word composed of all "1"s is written into a specified address.

(e) ***WO command:*** A word contained in the data register is written into the previously cleared address. Either the RO or CO command will clear an address and prepare it for a WO command.

Station Identification Store Control Circuit

2.24 The station identification store control circuit provides the logic to control the station identification frame in assembling and transferring its data and writing in and reading out data from the station identification store circuit.

2.25 A clock is used to develop twelve 1-microsecond timing pulse outputs which sequence and synchronize the various operations throughout the system. The twelfth timing pulse is used to generate a 96-microsecond scan cycle that provides eight 12-microsecond scanning intervals for the following functions:

(a) Scans 1 and 2 assemble the data from digit register A.

(b) Scans 3 and 4 assemble the data from digit register B.

(c) Scans 5 and 6 perform a station identification store and station identification store control circuit integrity check.

(d) Scan 7 serves test circuit requests.

(e) Scan 8 serves central office requests.

2.26 During scans 1 through 4, the PBX trunk and station numbers are transferred a digit at a time to two special storage locations in the station identification store circuit where they are assembled until the information is complete. Then the station number is transferred to the storage location in the station identification store circuit specified by the PBX trunk number address.

2.27 Also during scans 1 through 4, the data trunk number of the data trunk conveying the information from the bidding PBX is identified by a 6-bit binary code and two parity bits are added to the word to be stored. The total word length is 24 bits composed of the 16 station number bits, 6 data trunk number bits, and 2 parity bits.

2.28 Scans 5 and 6 are used to address two special storage locations in the station identification store circuit that contain test words. These words provide a means of determining the integrity of a portion of the station identification control circuit and the station identification store.

2.29 Scan 7 is allocated to handle any tests from the test circuit for routine maintenance and administration.

2.30 Scan 8 handles requests for station identification by the central office through the AIOD translator and connector. During this scan, the "0" bits in each digit of the station number are reconstructed to again form a true 2-out-of-5 code. The station number including the office index is transferred to buffer registers that control the multilead data sent to the central office equipment. The office index is derived from the six binary bits of the data trunk number stored in the 6A memory with the station number by translating the six bits to 1-out-of-64 octal code and cross connecting these to assign an office index in 1-out-of-3 tens digit and 2-out-of-5 units digit.

2.31 PBX trunk number reassignment provisions have been incorporated to permit reassigning a PBX trunk number at the central office without immediately changing the trunk number at the PBX. To do this, the old trunk location address is written into the new trunk location in the 6A memory which is then tagged to indicate that the station number should be obtained from this old trunk location.

2.32 If there is a data trunk failure, the data trunk number is stored and used to deny station identification to all calls on PBX trunks associated with this data trunk. This denial is continued for a 25-second period after the data trunk trouble has been cleared. This prevents the use of any PBX-ANI information by the central office that might be in error due to the data trunk failure until the information can be updated. If two or more data trunks fail, the station identification frame automatically is taken out of service for the duration of the trouble plus the 25-second denial period.

2.33 For reliability purposes, all timing circuits within the station identification store control circuit are duplicated. Parity checks, 2-out-of-5 checks, and data comparisons are made periodically during the processes of assembly and transfer of data within the station identification frame. Failure-to-check alarms are given and error indications are handled by the station identification test circuit for printout on its tape printer.

Station Identification Test Circuit

2.34 The station identification test circuit provides the means for performing operational on-line and off-line tests and routine maintenance on the PBX-AIOD station identification frame. The test circuit performs three basic functions: (1) Detects information errors and circuit failures and prints out an error code and status information with its tape printer. (2) Acts as an input/output buffer to check the station identification store through the station identification store control circuit. (3) Acts as a PBX simulator.

2.35 When trouble occurs with a data trunk, patching arrangements are provided to substitute PBX talking trunk conductors for the data trunk conductors. When this substitution is performed, it requires a corresponding conductor transfer at the PBX.

2.36 When E and M type signaling is used for carrier transmission between the PBX ANI and central office, a conversion is required at both the PBX ANI and again at the central office. A simplex to E and M signaling conversion is provided at the PBX-ANI central office by the PBX-AIOD signaling converter unit (J99235CK).

3. INTERFACE EQUIPMENT

General

3.01 The AIOD translator and AIOD translator connector as shown in Figure 3 form a preference and control circuit in the central office which furnishes the interface between existing central office equipment and the PBX AIOD station identification (SI) frame. The central office connecting equipment can be AMA or ANI transverters in No. 5 crossbar offices, ANI outpulsers in panel, No. 1 crossbar, and step-by-step offices, or AMA transverters in No. 1 crossbar offices. The AIOD translator and translator connector function according to the type of central office used.

3.02 It should be noted that all word transmission to and from the AIOD system, whether an SI frame or No. 101 ESS, is based on the two-out-of-five code. Also, the transverters in the transverter type office furnish to the AIOD translator and translator connector an equipment location for the PBX trunk handling the call. The AIOD translator and translator connector convert the equipment line location to a 4-digit PBX trunk number in two-out-of-five code for handling by the SI frame or No. 101 ESS. This 4-digit trunk number is used to address a memory location in the SI frame or No. 101 ESS. Station number readout and the office index readout from the SI frame is in two-out-of-five code for station number and one-out-of-three and two-out-of-five code for office index. The AIOD translator and connector convert the the two-out-of-five portion of the message into one-out-of-ten code to properly interface with the central office transverters.

3.03 When interfacing between an outpulser type office and SI frame, a number code conversion on the two-out-of-five coded station number by the AIOD translator and translator connector is not necessary because the outpulser uses the two-out-of-five code. The only conversion required is the office index from two-out-of-five to one-out-of-nine code.

3.04 In addition to number code conversion, when required, the AIOD translator connector, acting as a preference and control circuit, functions to permit only one transverter or outpulser access to the SI frame at a time and in a predetermined order. Since one AIOD translator and translator connector can serve a maximum of two separate central office number identification systems, each with a definite combination of identifiers and transverters, preference and control are required. The AIOD translator, in processing its input and output information, checks for word errors to assure proper word structure during its control, conversion, and transfer of information.

3.05 Upon receipt of the PBX station number from the AIOD translator and translator connector, the transverter or outpulser follows the normal routine in forwarding the information to the AMA facility.

3.06 Should the AIOD translator and translator connector detect a failure or error within its own circuit or within other equipment required in the identification process, the central office equipment is notified to perform an alternate billing routine. In AMA or ANI transverter type offices, alternate billing is made to the PBX listed number by using the regular AMA translator. In ANI outpulser type offices, CAMA operator identification is used as the alternate billing routine.

AIOD Translator Connector

3.07 The translator connector consists of a preference circuit and multicontact relay connectors. The preference circuit allows only one transverter or outpulser access to PBX-AIOD translator at one time and in a predetermined order, thus guarding against a double connection. The multicontact relays provide the multileads necessary between the central office switching system equipment and the PBX-AIOD translator.

AIOD Translator

3.08 The AIOD translator is composed of nine basic functional circuits. Five of these circuits as shown in Figure 3 are: (1) trunk number thousands, tens, and units digit register circuit, (2) trunk number hundreds digit register circuit, (3) trunk number hundreds, tens digit translator circuit, (4) trunk number 2/5 check circuit, and (5) trunk number sending circuit. These five circuits perform the trunk number registration, translation, checking, and transmission of the PBX trunk number to the PBX-AIOD SI frame. The four remaining circuits as shown in Figure 3 are: (1) station number register circuit, (2) station number and office index 2/5 check circuit, (3) office index sending circuit, and (4) station number sending circuit. These four circuits perform the station number registration, translation, checking, and transmission to the central office switching system via the translator connector.

Operation With Transverter

3.09 In a transverter type office, the calling number request on PBX-AIOD calls is steered to the AIOD translator connector rather than the AMA translator by assigning a specific class of service to PBX trunks. The marker converts the ring party indication to tip party on lines with this class of service, and the transverter selects the AIOD translator connector as if it were a tip translator. When the transverter

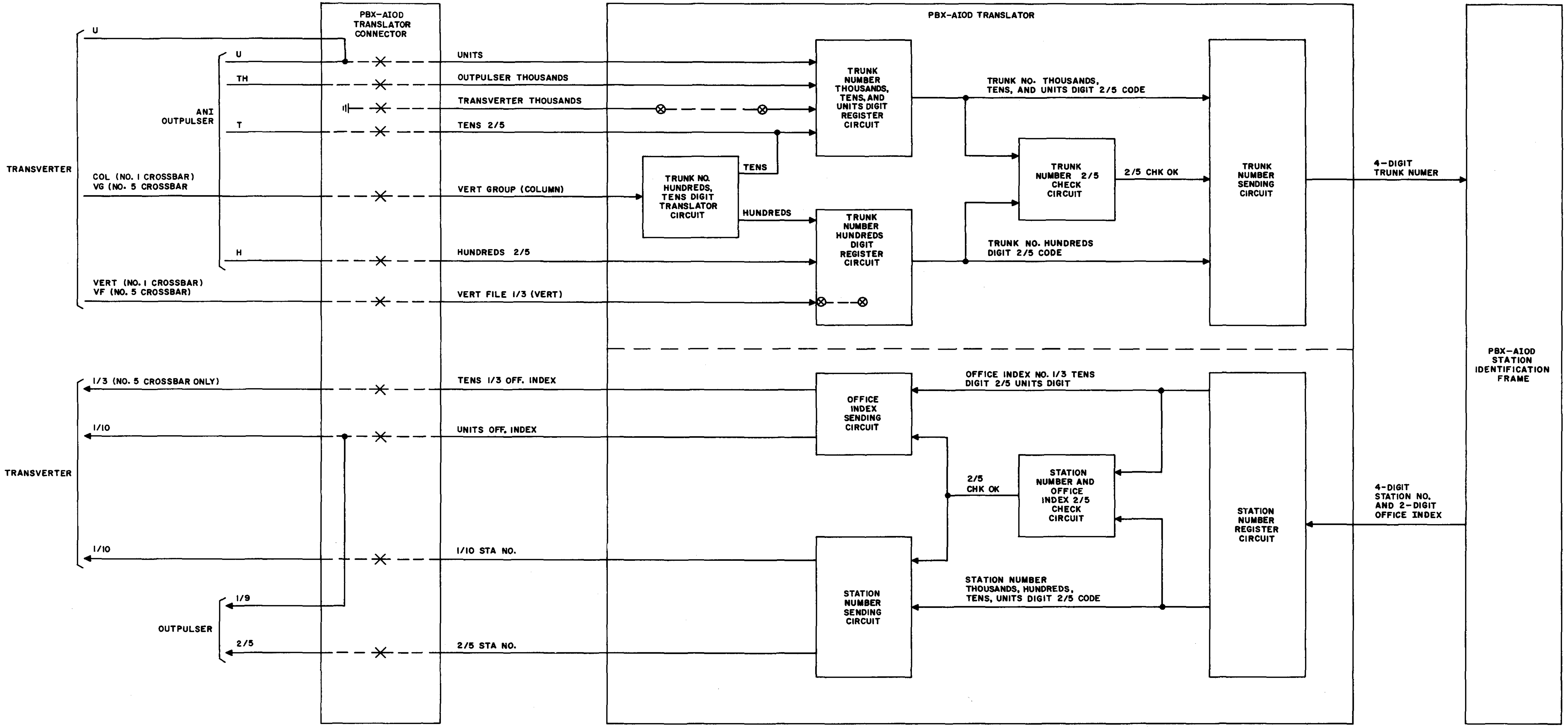

Fig. 3 — PBX-AIOD Translator and Connector — Block Diagram

selects the AIOD translator connector, it receives service on a perference basis. When the transverter receives preference in the AIOD translator connector, it is connected through to the AIOD translator.

3.10 The thousands digit of the PBX trunk number is a direct indication of the transverter group to which the PBX trunk being identified is assigned. This digit is generated by the PBX-AIOD translator connector and the cross-connecting arrangement in the PBX-AIOD translator. Since each of the two transverter groups has a distinct thousands digits, there could be a maximum of 1000 PBX trunks assigned to each transverter group.

3.11 Although each translator and its connector could handle a maximum of 2000 PBX trunks (1000 trunks from each group), the station identification store in the PBX-AIOD SI frame is designed to handle a maximum of 1800 trunks.

3.12 The hundreds digit of the PBX trunk to be identified is derived by the combination of vertical group (VG) location and vertical file (VF) location on the line link frame in a No. 5 crossbar office or the column (VG) and vertical (VF) in No. 1 crossbar offices. The VG data is translated into a more usable form in the trunk number hundreds tens digit translator circuit and combined in the trunk number hundreds digit register circuit with the VF data. The result of this combining is a trunk number hundreds digit in two-out-of-five code which is registered in the trunk number hundreds digit register circuit.

3.13 The tens digit is derived solely by the VG data. This data is translated directly into two-out-of-five code which is registered in the trunk number thousands, tens, and units digit register circuit.

3.14 The PBX trunk number units digit is actually the switch number of the horizontal group location of the PBX trunk requiring station identification. This information is received from the transverter directly in two-out-of-five code and registered in the trunk number thousands, tens, and units digit register circuit.

3.15 The PBX trunk number thousands, tens, and units digits stored on the register relays in the trunk number thousands, tens, and units digit register circuit are checked by the trunk number check circuit to ensure that only two out of five of the register relays in the trunk number hundreds digit register circuit are operated for each digit. Also, the PBX trunk number hundreds digit stored on the hundreds digit register relays in the trunk number hundreds digit register circuit is checked by the trunk number check circuit to ensure that only two out of five of the register relays are operated. A valid two-out-of-five check results in the 4-digit PBX trunk number being transmitted to the PBX-AIOD SI frame in two-out-of-five multilead form via the trunk number sending circuit.

3.16 After the SI frame receives the 4-digit PBX trunk number from the PBX-AIOD translator and retrieves the 4-digit station number associated with the PBX trunk number from its station identification store, it transmits the 4-digit station number along with a 2-digit office index to the station number register circuit of the PBX-AIOD translator.

3.17 The office index number is received and registered in the station number register circuit in a one-out-of-three and two-out-of-five code. Since the maximum number of office indexes to be handled by the PBX-AIOD SI frame is 30, the office index tens digit is in one-out-of-three code and the units digit is in two-out-of-five code. The station number thousands, hundreds, tens, and units digits are each received and registered in the station number register circuit in two-out-of-five code. The station number thousands, hundreds, tens, and units digits and the office index units digit registered on the register relays in the station number register circuit are checked by the station number and office index two-out-of-five check circuit to ensure that only two out of five register relays are operated for each digit.

3.18 When the central office is a No. 5 crossbar office, a valid two-out-of-five check results in the 2-digit office index being transmitted in two parts to the transverter via the office index sending circuit and the PBX-AIOD translator connector. The tens digit is transmitted in one-out-of-three code and the units digit in one-out-of-ten code.

3.19 When the central office is a No. 1 crossbar transverter office, a valid two-out-of-five check results in a 1-digit office index being transmitted to the transverter in one-out-of-ten code via the PBX-AIOD translator connector. The one-out-of-three office index tens digit is not connected through the PBX-AIOD translator connector. In both No. 1 and No. 5 crossbar transverter offices, the station digits are transmitted in two-out-of-five code to the transverter via the station number sending circuit and PBX-AIOD translator connector.

Operation With Outpulser

3.20 In an outpulser type office, the calling number request on PBX-AIOD calls is steered to the AIOD translator connector by assigning all PBX trunks to special number networks in the ANI-B system or by using one of the special treatment marks in the ANI-C number networks. As is true with a transverter, when an outpulser receives preference in the translator connector, it is connected through to the translator.

3.21 The PBX trunk number thousands, tens, and units digits are received and registered directly in two-out-of-five code in the trunk number thousands, tens, and units digit register circuit and the PBX trunk number hundreds digit is received and registered directly in two-out-of-five code in the trunk number hundreds digit register circuit. No PBX trunk number word translation is required on PBX-AIOD translator inputs when associated with outpulser type offices since outpulsers use the two-out-of-five code.

3.22 Transfer and checking of data through the PBX-AIOD translator, for both the PBX trunk number and station number and office index, is identical to the process for a transverter type office.

3.23 Again, no number code conversion is required for PBX-AIOD translator station number outputs as the outpulser uses the two-out-of-five code.

3.24 Since the maximum office index handling capacity of any outpulser is nine office index codes, the office index is handled on a one-out-of-nine multilead basis to the outpulser.

4. EQUIPMENT

Devices

4.01 The PBX-AIOD station identification (SI) frame (Fig. 4) is approximately 11 feet 6 inches high by 4 feet 1-1/4 inches long and uses primarily solid state and magnetic devices in the form of transistors, diodes, ferrite devices, etc.

4.02 The low power consuming solid state devices are utilized in gate circuits, flip-flop circuits, counter circuits, etc, to form the logic packages needed for digital application.

4.03 The SI frame uses both transistor resistor logic (TRL) and low level logic (LLL) to perform its switching and gating functions. All the transistors are of the silicon type with NPN type junctions with the exception of the relay drivers which are PNP type. The diodes are also of the silicon type.

4.04 The 6A memory, part of the station identification store circuit uses ferrite sheets which are mounted in four basic submodules. These ferrite sheet submodules are used to form the building blocks for the 6A memory.

4.05 The SI frame is factory wired with the system components contained on plug-in circuit packs. Connection and cross-connection facilities are provided as part of the SI frame.

Circuit Packs

4.06 A basic circuit pack is 4 inches high by 6 inches deep and includes a 28-pin connector.

4.07 The circuit packs are divided into four different types. The first type includes all logic building blocks such as LLL and TRL gates, flip-flops, and inverters; the second group includes monopulsers and timers; the third group is made up of passive components such as resistors and diodes; and the fourth group is made up of specialized circuits.

Circuit Pack Connectors

4.08 The connector which accepts the 28 pins of a circuit pack is built into the package mounting unit. The individual contact springs of

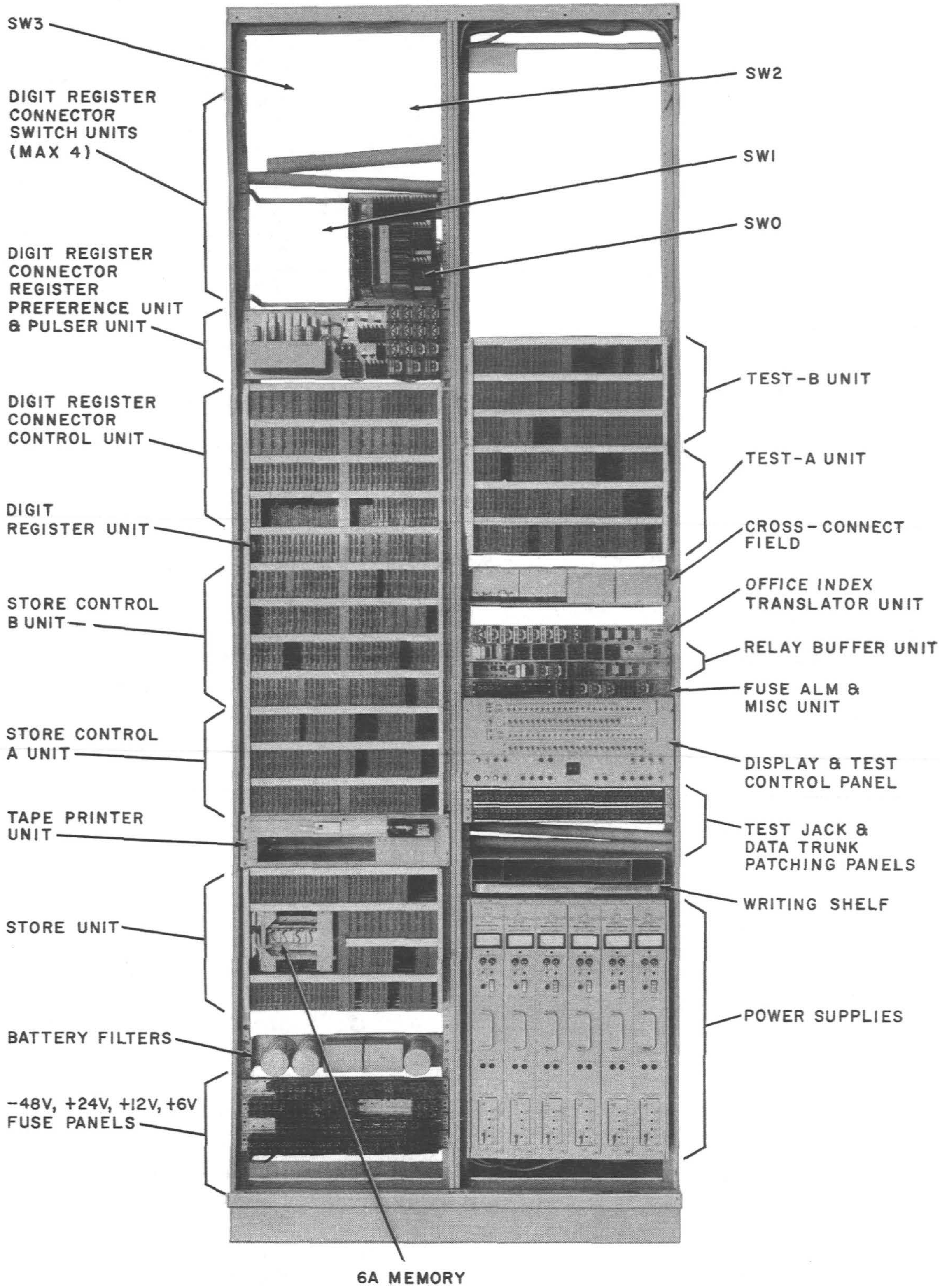

Fig. 4 — Station Identification Frame Equipment Layout

these connectors are gold plated to ensure a low resistance electrical connection.

Tray Assembly

4.09 Each tray assembly is 4 inches high by 23 inches wide and mounts a maximum of 32 circuit pack connectors. Designation strips are provided on the face of the unit for identification of the circuit packs that are housed in the tray assembly.

Station Identification Store

4.10 As shown in Figure 4, the station identification store is mounted on the left bay and consists of a 6A memory and four tray assemblies for housing the station identification store circuit packs.

Station Identification Store Control

4.11 The station identification store control consists of seven tray assemblies on the left bay for housing the station identification store control circuit packs and one 2-inch mounting plate on the right bay for mounting the office index translator unit.

Digit Register Connector

4.12 The digit reigster connector occupies the upper portion of the left bay. When fully equipped for 60 data trunks, it contains four ferreed switch units, each unit handling a maximum of 16 data trunks. Directly below the ferreed switch units is the register preference unit and pulser unit mounted on an 8-inch mounting plate. Located below the 8-inch mounting plate are four tray assemblies for housing the digit register connector circuit packs.

Digit Register

4.13 The digit register is located on the left bay and consists of one tray assembly for housing the digit register circuit packs.

Station Identification Test Circuit

4.14 The station identification test circuit is located on the right bay. This circuit consists of six tray assemblies for housing the station identification test circuit circuit packs, a 4-inch mounting plate for mounting the relay buffer unit, and the display and test control panel and the test jack and data trunk patching panels.

Fuse Alarm and Miscellaneous Circuit

4.15 The fuse alarm and miscellaneous circuit consists of a 2-inch mounting plate for mounting the alarm relays, lamps, and circuits. The plate also contains a frame line telephone jack circuit, spare jack circuit, remote control test jack for starting or advancing the central office test circuit, frame voltage test point, and ground test point.

Power Supplies

4.16 The power supplies occupy the lower portion of the right bay and consist of a pair of 6-volt, 12-volt, and 24-volt DC to DC converters.

5. CIRCUIT OPERATION

Typical Operation On PBX Data

5.01 Figure 5 shows a block diagram of the major circuits involved in processing and storing data from the PBX.

5.02 ***The trunk scanner within the digit register connector*** detects a service request over a data trunk and assigns a preference to the service request. The digit register preference and selection circuit selects and makes busy an idle digit register in the ***digit register circuit.*** If both digit registers are idle, it will select the digit register that has been idle the longest period of time.

5.03 After the selected digit register has been connected to the data trunk by the ***digit register connector,*** and it is ready to receive the PBX data, a transmit signal in the form of a simplexed battery is returned over the data trunk to the PBX-ANI equipment.

5.04 The transmit signal received at the PBX initiates the transmission of the 41-bit message over the data trunk, through the established channel in the connector switch network of

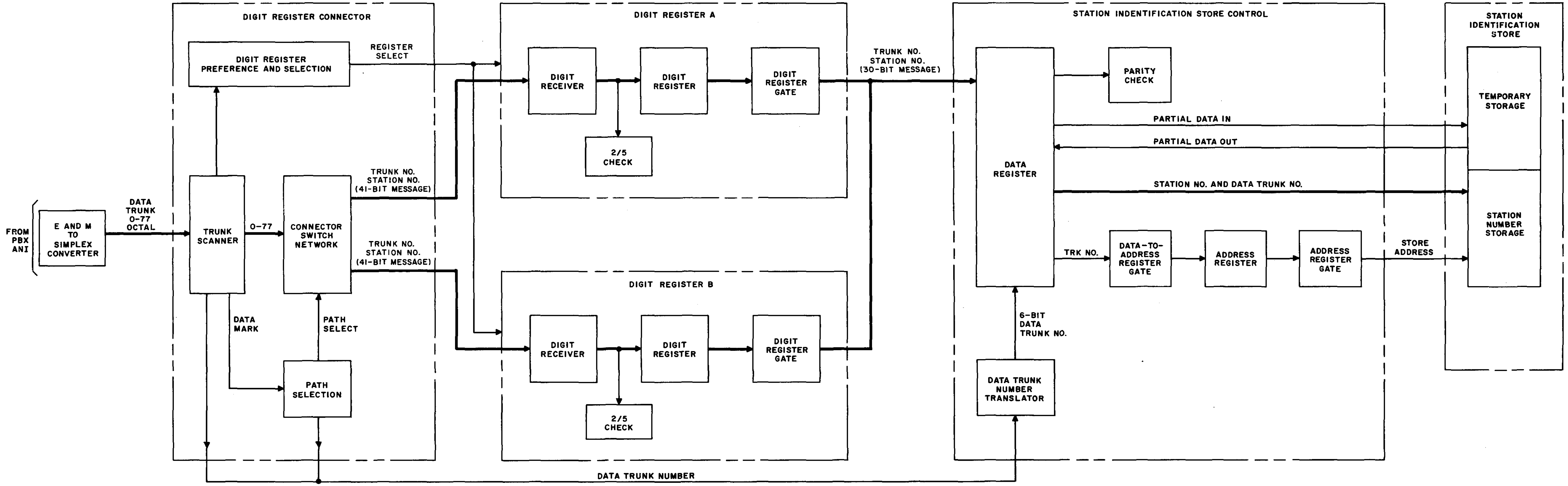

Fig. 5 — Typical Operation On PBX Data — Block Diagram

the ***digit register connector*** to the digit receiver of the ***digit register circuit.*** The channel through the connector switch network is determined by the path selection circuit.

5.05 The digit receiver accepts the 41-bit message which is in frequency shift form and converts each serial bit to a logic "1" or "0".

5.06 Each serial bit is gated into the digit register which is a 6-bit shift register. When the six stages of the shift register are full, the contents are gated out in parallel form to the data register in the ***station identification store control circuit*** and five more bits are serially shifted in. The first six bits consisted of the premessage bit and the five bits of the trunk number thousands digit. Since the remaining portion of the 41-bit message is composed of five bits per digit, a "1" bit is loaded into the 6-bit shift register prior to the gating in of the trunk number hundreds digit. This "1" bit serves to initiate parallel readout of the hundreds digit from the shift register in the same manner as the premessage bit initiated parallel readout of the thousands digit from the shift register. This "1" bit loading procedure occurs once for each digit of the message until the total message has been gated through to the data register in the ***station identification store control circuit.***

5.07 The total message takes on a slightly different format as it is gated, digit-by-digit, out of the 6-bit shift register.

(a) The trunk number thousands digit is converted by means of cross-connections to a single bit, a logic "1" or "0".

(b) The least significant bit ("0" bit) is dropped from the five bits of each succeeding digit making each digit a 4-bit code rather than a 5-bit code.

Thus the total message is a 30-bit word consisting of one premessage bit; one trunk number thousand digit bit; four trunk number hundreds, tens, and units digit bits; and four station number thousands, hundreds, tens, and units digit bits.

5.08 As each digit is registered in the digit register, it is given a two-out-of-five check before being gated into the data register after which it is stored into a temporary location in the ***station identification store.*** Prior to the gating of a new digit from the digit register into the data register, the previous digit is taken from its temporary storage location and placed back in its proper location in the data register and an odd parity check is made. The new digit is gated into the data register where it takes its place with the previous digit and the contents of the data register are again gated into the temporary storage location. This process continues until the units digit of the station number is received in the data register, at which time the trunk number portion of the word is gated from the data register into the address register. The station number portion remains in the data register.

5.09 The control circuit interrogates the trunk number translator which returns a 6-bit binary data trunk number and two parity bits. The trunk number translator generates its output from the contents of the trunk scanner and path selection in the ***digit register connector.*** This 6-bit binary information is registered in the data register, taking its place with the remaining 16 station number bits.

5.10 The address register addresses the memory location in the ***station identification store*** with the trunk number registered in the register. A write command is given to the store which writes in the station number, data trunk number, and parity bits to the addressed location in the ***station identification store*** and the data, address, and digit registers are reset.

5.11 The station identification frame is now ready to process data on a new PBX request for service.

Typical Operation On Central Office Request

5.12 Figure 6 shows a block diagram of the major circuits involved in processing and transferring data to the central office.

5.13 The translator gate, part of the ***station identification store control circuit,*** detects a request for a station number associated with a PBX trunk. Information in the form of a two-out-of-five trunk number is received by the translator gate via the AIOD translator and connector and transferred to the address register via the translator to address register gate circuit. The thousands digit is converted to a logic "1" or "0" and the least significant bit is dropped from the remaining digits resulting in the address register receiving a 13-bit word.

5.14 The address register, via the address register gate, addresses the memory location with its registered trunk number. The station number and data trunk number stored in that memory location are gated out to the data register. The parity check circuit is used to compute parity over each of the four station number digits in the data register. The result of this parity check determines whether a logic "1" or "0" was dropped as the least significant bit of each digit during the data assembly process. The parity check circuit will reconstruct the missing bits and gate them through the data to buffer register gate circuit along with the station number and the data trunk number digits from the data register to the buffer register. In the buffer register the least significant bits are registered in their proper slot with their respective station number digits.

5.15 The six binary bits representing the data trunk number are transferred from the buffer register to the office index translator where a relay tree establishes a one-out-of-sixty octal output. The output of this tree is brought to a cross-connect field where the 60 leads can be cross connected to any of 30 office index leads. These 30 office index leads are further translated by a diode matrix to the required one-out-of-three tens and two-out-of-five units digit code.

5.16 The 20 bits registered in the buffer register, representing the 4-digit station number, and the eight bits from the office index translator are applied directly to the AIOD translator for AMA billing by the AMA equipment.

Operation of Station Identification Test Circuit

5.17 The ***station identification test circuit*** is functionally subdivided into three operational areas: error detecting and encoding, input/output checking, and PBX simulation.

Error Detecting and Encoding

5.18 Error detecting and encoding performed by the ***station identification test circuit*** provides the means for monitoring information being processed by the ***digit register connector, station identification store control, and the fuse alarm and miscellaneous circuit.*** Errors and circuit failures are printed out in code on paper tape by the tape printer. This code is then translated into a probable equipment trouble area by reference to a trouble locating manual. The coded tape printout is divided into two sequences: sequence 1 consists of a space character, 2-digit error code, dash and 44 bits of status information separated by dashes into groups of 4 bits ended by a final space character; sequence 2 consists of the space character, the 2-digit error code, and a final space character.

5.19 Figure 7 shows a block diagram of the ***station identification test circuit.*** The circuits shown make up the error detecting and encoding portion of the test circuit.

5.20 The error encoder circuit receives error signals in the event of an error or failure within the ***digit register connector (DRC), station identification store control (SIS CTL),*** or ***fuse alarm and miscellaneous circuit (FA and MC).*** Each error signal is then encoded into a discrete error code by a diode matrix, part of the error encoder. The error code is then transferred into the error code register for registration and an error indication is sent to the sequence and gate encoder.

5.21 The normal test (NT) key at the control panel, through the test mode control circuit, controls the error output gates of the central register. When the NT key is operated to the NORM position, the error output gates of the central register are enabled allowing status information to be shifted into the error code register. When the NT key is operated to the TEST position, the error output gates are disabled.

5.22 The discrete error code from the error encoder is registered in the error code register flip-flops. The registered error code information is then gated into the print mode encoder and printer timing circuit.

5.23 The error indication from the error encoder is coincident with the error code received by the error code register. It primes the sequence and gate encoder to set up the print sequence (sequence 1 or sequence 2), and enables the connector status gates and control status

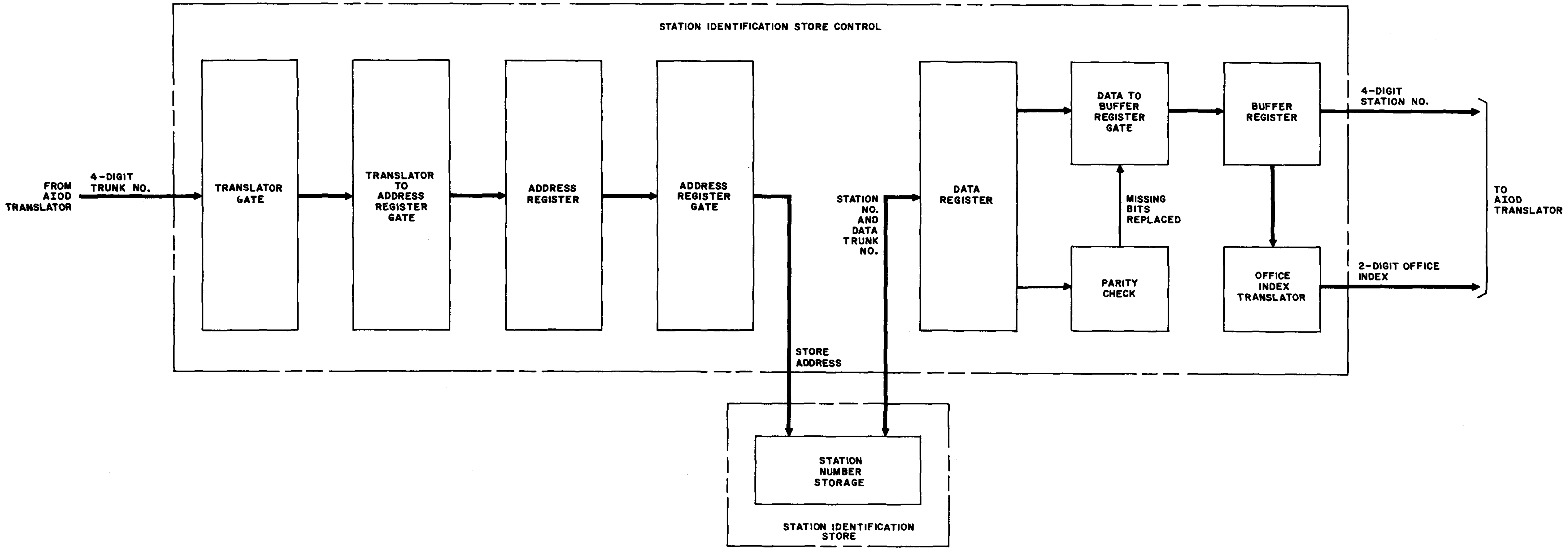

Fig. 6 — Typical Operation On Central Office Request — Block Diagram

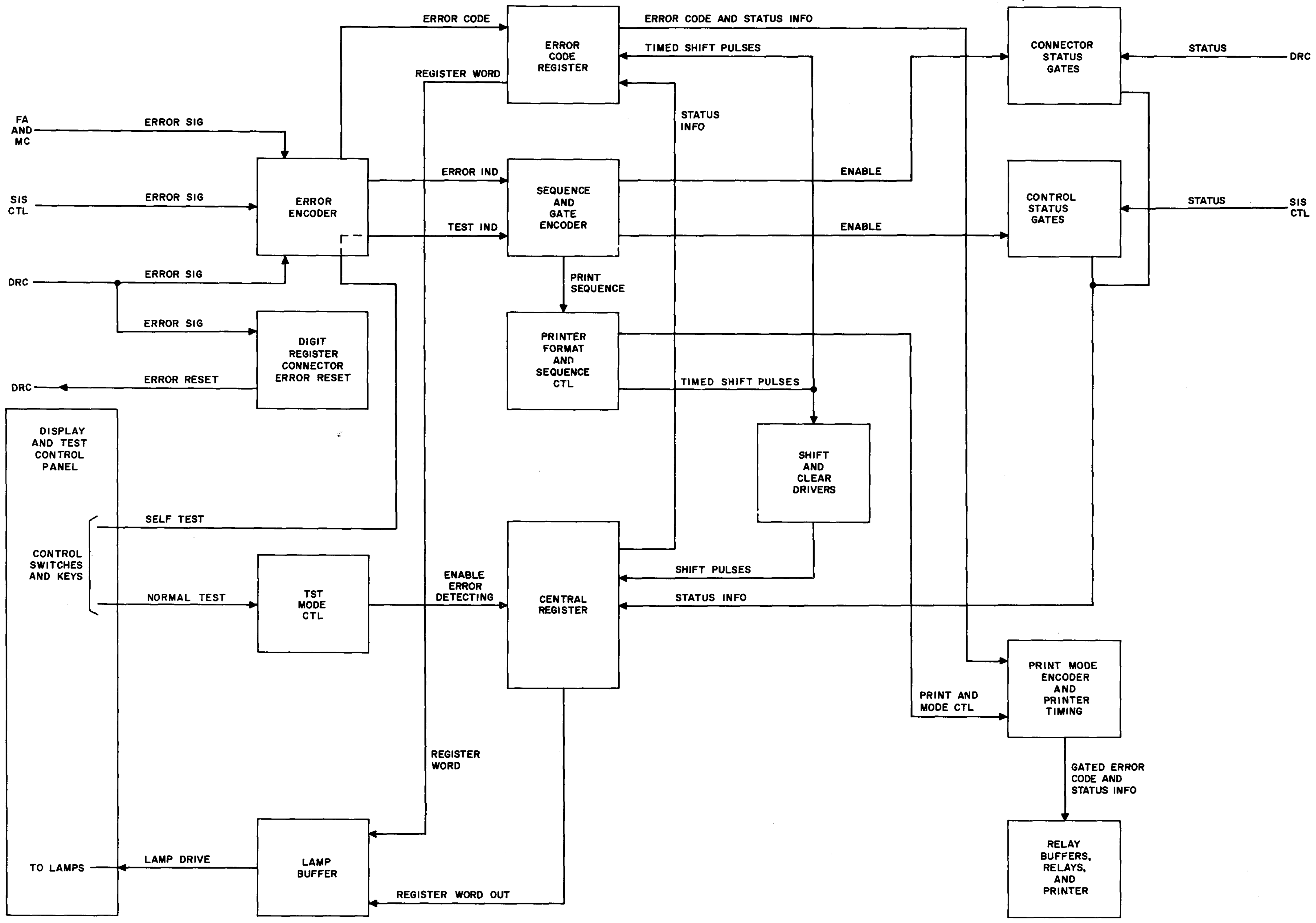

Fig. 7 — Error Detecting and Encoding In the Station Identification Test Circuit — Block Diagram

gates if a sequence 1 type printout is required. The sequence and gate encoder also generates an alarm signal to the major alarm circuit for transfer of a major alarm to the fuse alarm and miscellaneous circuit.

5.24 The enabled connector status gates and control status gates load status information from the DRC and SIS CTL, respectively, into the central register. These status gates are enabled for sequence 1 type printout to load the shift register of the central register with status information.

5.25 As the error code information from the error code register is gated into the print mode encoder and printer timing circuit, the status information in the central register is shifted out and into the error code register where it takes its place to be shifted, along with the error code information, to the print mode encoder and printer timing circuit.

5.26 The print sequence, established by the sequence and gate encoder, is used by the printer format and sequence control to provide the timed shift pulses for the error code register and the central register. The printer format and sequence control also generates print and mode control signals to the print mode encoder and printer timing circuit.

5.27 Error code and status information forwarded from the error code register are gated by the print mode encoder and printer timing circuit to the relay buffers, relays, and printer circuit. The print mode encoder and printer timing circuit also controls the print mode for the output format of space, dash, error code, and the binary status bits.

5.28 The relay buffers, relays, and printer circuit converts transistor resistor logic (TRL) pulses from the print mode encoder into the voltages necessary to operate the tape printer.

Input/Output Checking of SIS

5.29 This function of the station identification test circuit provides the means for testing three operating modes of the ***station identification store:*** read-write (RW), read-only (RO), and write-only (WO). These modes are controlled from the display and test control panel and use parts of the central register as address and data register.

5.30 Mode RW leaves the controls of the SIS memory location, specified by the address register, unchanged. Information read from the SIS store location and addressed by the switches on the display and test control panel is registered in the data register portion of the central register.

5.31 Mode RO provides a destructive readout from the SIS location addressed by the switches on the display and test control panel.

5.32 Mode WO provides a repetitive write-in to the SIS location addressed by the switches on the display and test control panel. This repetitive write-in occurs every 96 microseconds.

5.33 Figure 8 shows a block diagram of part of the station identification test circuit. The circuits shown make up the portion of the test circuit used for input/output checking of the ***station identification store.***

5.34 The display and test control panel, in conjunction with the input/output checking of the ***station identification store,*** provides keys, lamps, and switches which are used to establish the test mode, to write the test data into an addressed position of the ***station identification store,*** and to read out the same data.

5.35 The three possible test modes and test signal are received by the test mode control circuit from the display and test control panel keys. The test mode control circuit enables the central register for input/output testing and the control status gates for 2-way transfer of data information between the central register and the ***station identification control circuit.***

5.36 The central register is used as a data and address register to provide data and address information to and from the SIS circuit through the SIS control circuit. The central register displays its data and address word by lamps on the display and test control panel.

5.37 The lamp buffer converts the TRL information from the central register into the voltages necessary to light the lamps on the display and test control panel.

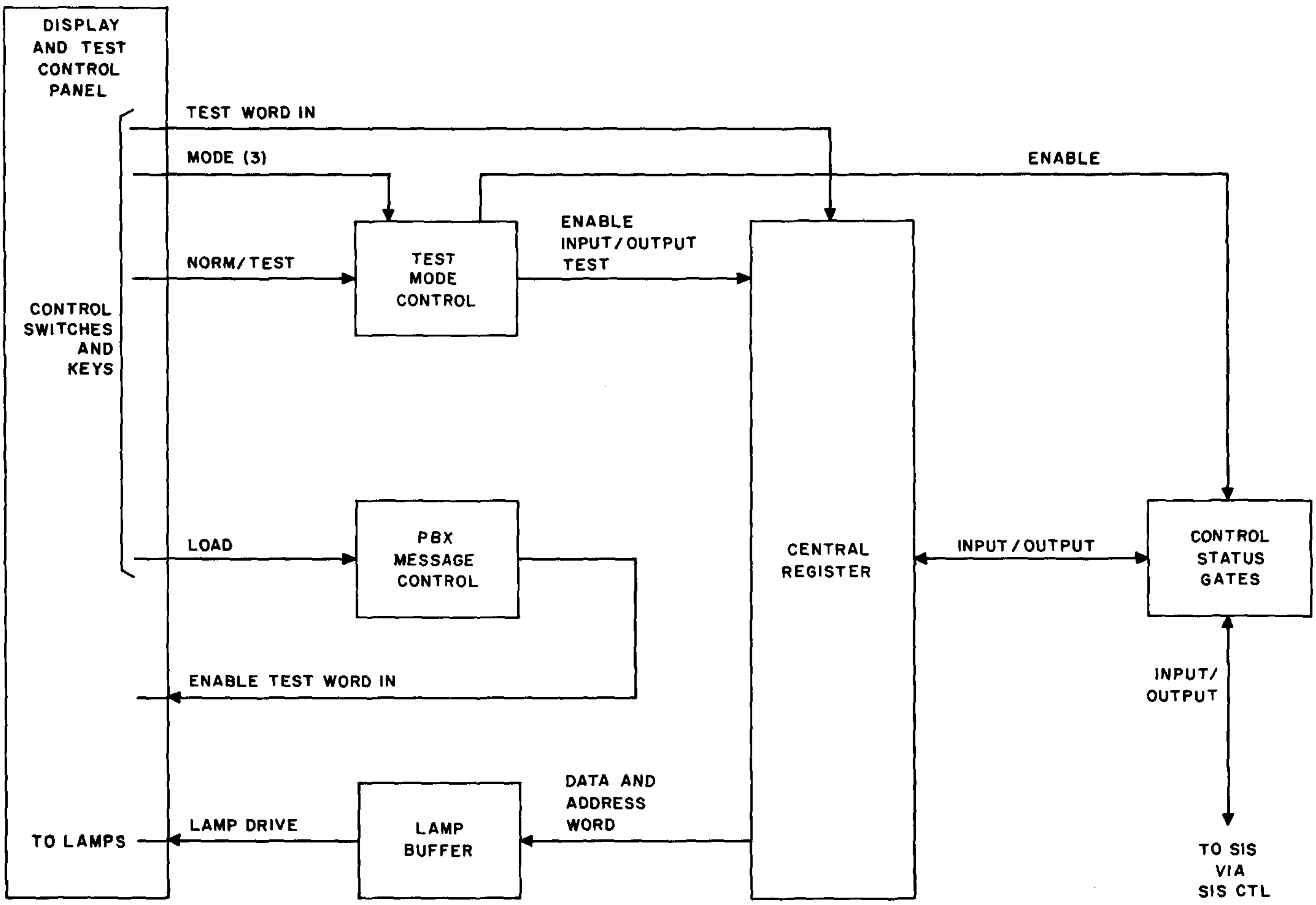

Fig. 8 — Input/Output Checking Of SIS In Station Identification Test Circuit — Block Diagram

5.38 The load (LD) key on the display and test control panel is operated whenever the central register is to be loaded with the simulated word to implement any one of the three modes of testing.

PBX Simulation

5.39 The display and test control panel provides a means of simulating a PBX making a bid for service over a data trunk and transmission of trunk and station identifying information into the system. Provisions are made for selecting a particular ***digit register connector*** appearance or for bypassing the ***digit register connector*** and processing straight into the digit register. Display and test control panel switches allow continuous or single transmission of a PBX message.

5.40 Figure 9 shows a block diagram of part of the ***station identification test circuit.*** The circuits shown comprise the PBX simulation portion of the test circuit.

5.41 For use with the PBX simulation tests, the display and test control panel provides keys, jacks and lamps, and switches which are used to set the test mode via the test mode control and to load the central register with test words for single or continuous transmission to the digit register connector. The central register is primed to act as a PBX message register to shift out the test word entered at the display and test control panel. The test word is loaded into the central register in parallel form and shifted out in serial form through the data transmitter.

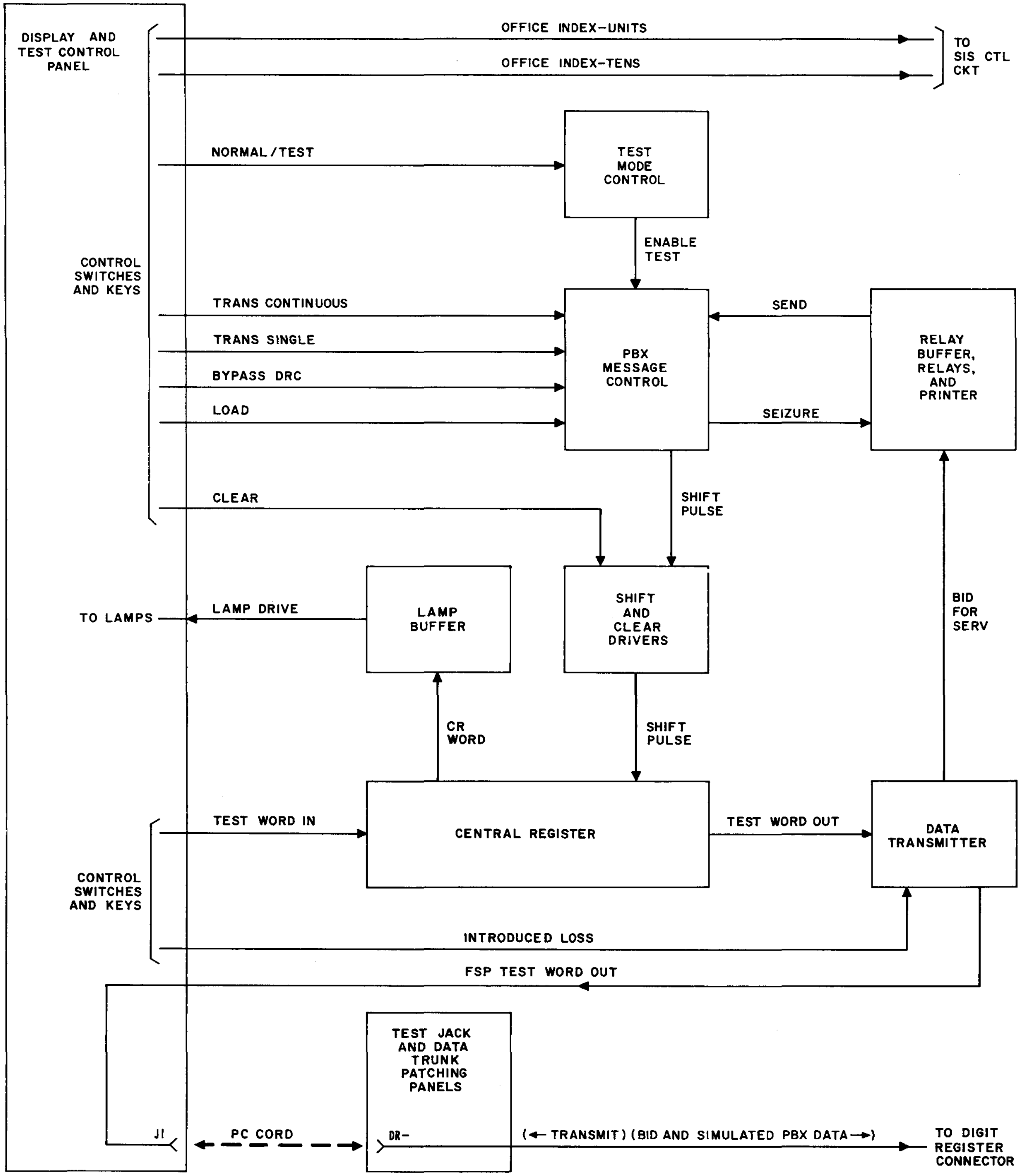

Fig. 9 — PBX Simulation Testing With the Station Identification Test Circuit — Block Diagram

5.42 The lamp buffer consists of lamp drivers which drive the display and test control panel lamps displaying the test word loaded into the central register.

5.43 The data transmitter consists of a data modulator and wave shaper which are used to simulate a PBX-ANI data transmitter and data trunk connecting to the ***digit register connector*** via the jacks on the test jack and data trunk patching panel.

5.44 The test jack and data trunk patching panel consists of jacks and lamps. There are 64 digit register connector (DR-) jacks, 64 data trunk or signal converter (DT-) jacks and 64 spare (S) jacks for patching into a PBX trunk if necessary, for use as a data trunk. The 64 lamps, one per spare jack, indicate when a spare jack is in use.

5.45 The test requirements established on the display and test control panel switches are controlled by the PBX message control circuit. A crystal oscillator controlled counter transmits 735 pps shift pulses to the shift and clear drivers which, in turn, provide the timing of the shift pulses to the central register.

5.46 When the digit register connector receives a bid for service (simplex ground) via the data transmitter and patch cord (PC), it returns a transmit command (simplexed battery) via the patch cord and data transmitter to generate a send signal from the relay buffer, relays and printer circuit. The send signal to the PBX message control enables the shift pulses from the PBX message control to, in turn, shift out the test data from the central register. This test data in the form of a PBX-ANI message is transmitted to the digit register connector from the data transmitter via the patch cord connection between J1 jack on the display and test control panel and a DR- jack on the test jack and data trunk patching panels.

6. MAINTENANCE

General

6.01 The PBX-AIOD station identification test circuit detects malfunctions within the SI frame, on the data trunk, and trouble conditions from PBX ANI. These trouble conditions are automatically printed out as a trouble report on a paper tape. The printed report is cross referenced in a trouble locating manual where corrective measures are outlined. (Reference TLM-1C005-01.)

Display and Test Control Panel

6.02 The display and test control panel, part of the station identification test circuit, is shown in Figure 10. From this panel, the input/output checking and PBX simulation can be performed and the results observed on the panel lamps.

Test and Data Trunk Jacks

6.03 The test and patch jacks, part of the station identification test circuit, are shown in Figure 11. There are three separate groups of jacks provided: the DR jacks which provide jack appearances for the digit register connector inputs, the DT jacks which provide jack appearances for the data trunks, and the S jacks and associated SL lamps which provide jack appearances for PBX trunks if required to substitute for a faulty data trunk.

6.04 The DR jacks and DT jacks allow for alternate assignment of both PBX data channels and digit register connector data channels during a PBX simulation test.

Trouble Location Manual

6.05 The primary maintenance tool to be used in locating troubles and performing tests is the trouble location manual TLM 1C005-01.

6.06 The TLM includes general testing procedures and outlines display and test control panel operation, PBX simulation tests, station identification store input/output testing, and AIOD initialization procedures.

6.07 One area of the TLM is dedicated to the conversion of the coded printer format that is printed out in the event of a circuit malfunction. This conversion section is listed in error code order, and upon matching the printer output with an error code in the TLM, a suggested corrective maintenance procedure is outlined.

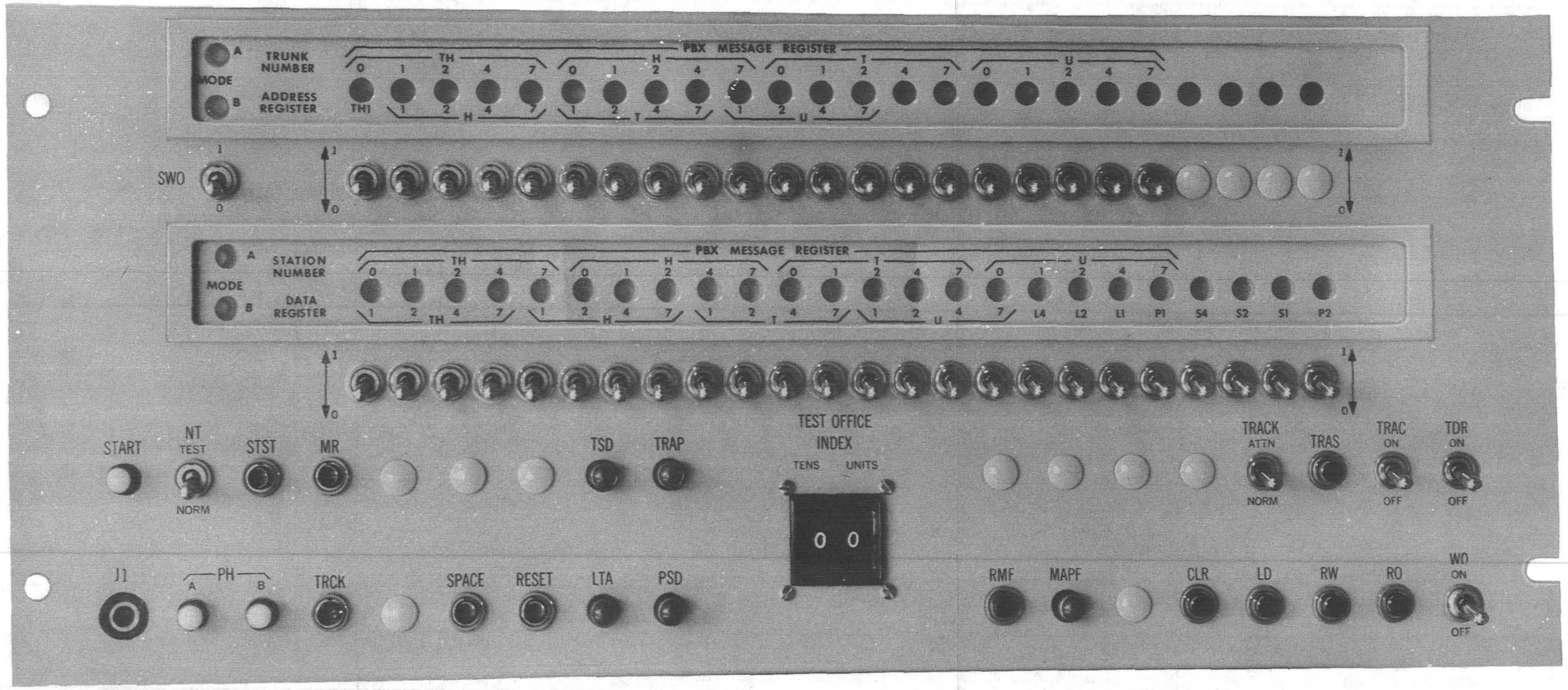

Fig. 10 — Station Identification Test Circuit Control Panel

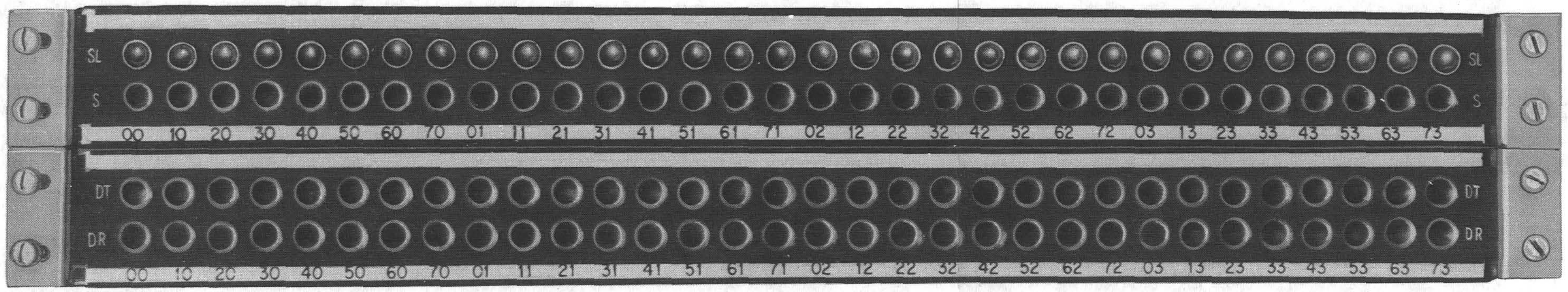

Fig. 11 — Test Jack and Data Trunk Patching Panels

6.08 Recommended special tools are specified in the TLM as an additional aid to the craftsmen in locating troubles.

6.09 For further maintenance information, refer to the following sections:

(a) Section 201-830-201 — PBX-AIOD General Maintenance Procedures

(b) Section 201-830-501 — Alarms, Operational Tests — Automatic Identified Outward Dialing Equipment — PBX Systems

(c) Section 030-342-301 — KS-19717, L1 Tape Printer, Operations and Maintenance