

**2B PROCESSOR FUNCTIONAL DESCRIPTION OF TTY FACILITIES
NO. 2B ELECTRONIC SWITCHING SYSTEM (ESS)**

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1. GENERAL

1.01 This section provides a physical and functional description of the teletypewriter (TTY) and the teletypewriter controller (TTYC) provided with the No. 2B Electronic Switching System (ESS).

1.02 There are two primary devices by which operating personnel can communicate with the No. 2B ESS. One of these devices is the 3A central control panel which is described in Section 232-309-102, and the other is the TTY. The TTY used in this system is the model 35 automatic send-receive (ASR) teletypewriter set and the Model 35 Key Send-Receiver (KSR) teletypewriter set manufactured by the Teletype Corporation, 5555 Touky Avenue, Skokie, Illinois.

1.03 The model 35 ASR TTY is an electromechanical device capable of sending and receiving messages over telephone networks. The TTY is capable of message transmission at 100 words a minute. All messages received or transmitted are typed on page size copy or continuous business forms. These messages, depending on the equipment options used, may be punched on paper tape.

1.04 Operating personnel, by typing input messages per the Input Message Manual (IM-2H200) can command and interrogate the system. The system will act upon the input messages and report the result of the action via an output message on the TTY. All output messages are defined in the Output Message Manual (OM-2H200). Programmed

diagnostic tests are performed on the system at predetermined times or whenever a failure occurs. The TTYs provide a printout of all diagnostic tests. The printout is in a coded format. By using the trouble locating manual (TLM) the code can be translated into the probable causes of the system failure. Recent changes to translation data can also be made via the TTYs.

2. PHYSICAL DESCRIPTION

2.01 The component compliment of the model 35 ASR TTY will vary. Normally, the TTY that is mounted in the maintenance center frame (Fig. 1) is a model 35 KSR and is equipped with an upper cabinet cover, a keyboard, a typing unit, a motor unit, and an electrical service unit. The TTYs which are located remotely from the maintenance center may be either the Model 35 ASR or the Model 35 KSR and will contain all the components found in the maintenance center frame mounted TTY, plus a pedestal, or lower cabinet, a tape reperfector, a transmitter distributor, and a transmitter distributor base assembly.

CABINET

2.02 The cabinet is a floor standing enclosure made up of two main parts: the pedestal, or lower cabinet, and the cover, or upper cabinet. It is designed to house the components of the TTY, and is equipped with a copyholder and line guide for short copy, and copy illuminating lamps for the typing unit and reperfector areas.

- (a) The pedestal is of sheet metal construction, and rests on two feet which extend forward to support the weight of the set. An equipment supporting pan is spot welded to the top of the pedestal. The pan contains mounting facilities for the components of the TTY.

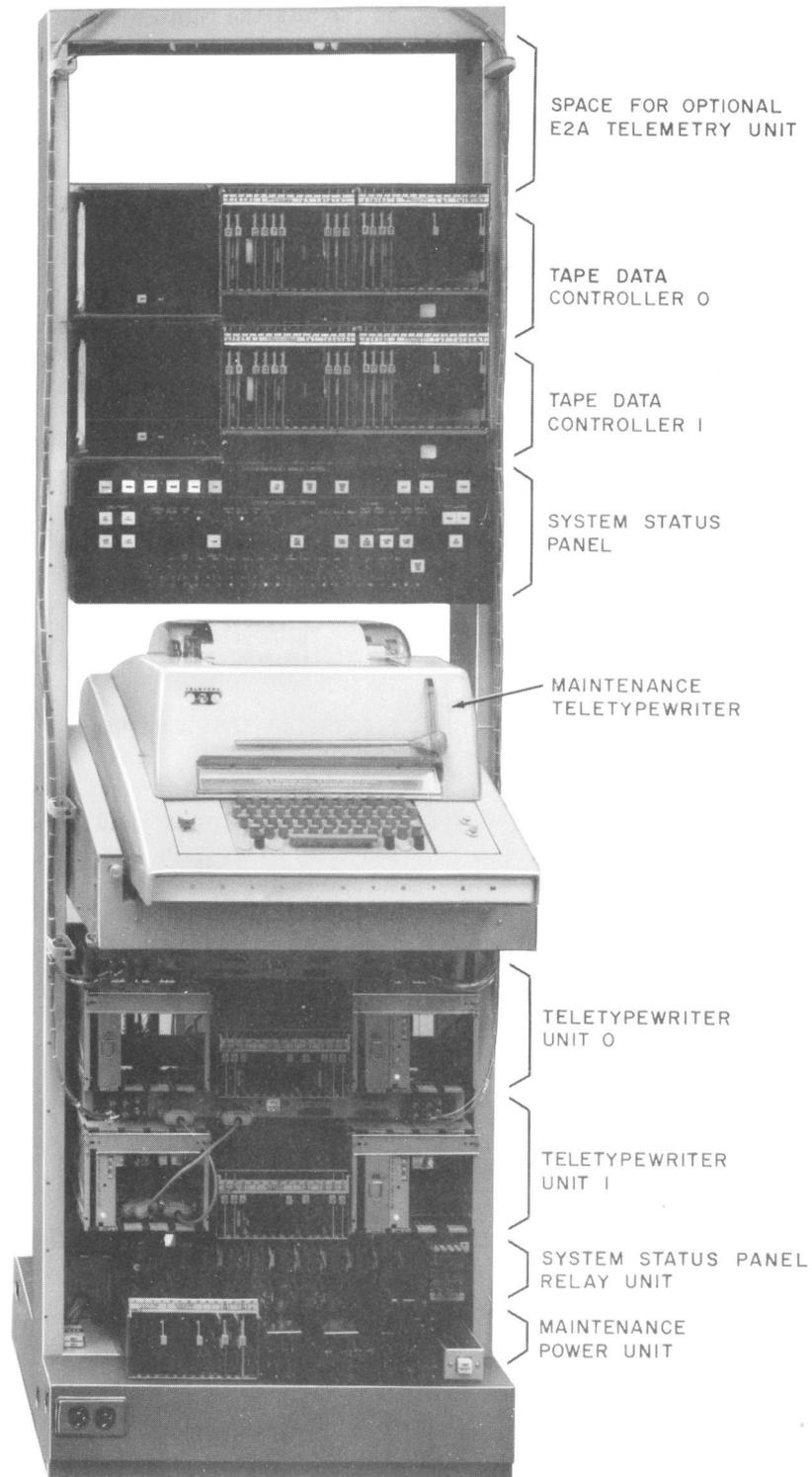


Fig. 1—Maintenance Center Frame with Local Maintenance TTY and TTY Control Logic

SECTION 232-309-107

(b) The cover is also of sheet metal construction, and consists of a lower cover and a hinged upper cover. The upper cover is hinged to the lower cover to provide access to the equipment for changing the paper supply and ink ribbons. An information and character counter window is located in the lower front of the upper cover. A clear plastic bubble is located on top of the upper cover for viewing the copy and observing operation of the typing unit. A laminated glass window, in front of the plastic bubble, enables the operator to view the copy as it is typed. The rear edge of the glass provides a paper tearing surface for removal of typed copy. A window is also located at the left front of the upper cover for viewing the perforated tape, and an adjustable metal edge is provided for tearing the tape. The approximate dimensions in inches are as follows.

<u>Height</u>	<u>Width</u>	<u>Depth</u>	<u>Weight</u>
38 1/2	40	24	225 lbs.

TYPING UNIT

2.03 The typing unit (Fig. 2) is mounted centrally on the keyboard in front of the motor unit

and gear assembly. The component parts of the typing unit are suspended between and mounted on the left, the right, and the front plate assemblies.

KEYBOARD

2.04 The keyboard (Fig. 3) mounts on the cradle assembly of the cabinet pan, and provides support for the motor unit, typing unit, reperforator, and gear assembly of the TTY. The front of the keyboard extends forward beyond the edge of the cabinet pedestal to place the typing keys in a convenient operating position. The keys are positioned in a four row arrangement with most punctuation marks and control symbols indicated as upper keytop characters.

MOTOR UNIT

2.05 The motor unit (Fig. 2) is a 1/20 horsepower synchronous motor cradled in a mounting bracket assembly. The motor assembly is located in the right rear corner of the keyboard base.

ELECTRICAL SERVICE UNIT

2.06 The electrical service unit (Fig. 2) is mounted on the cabinet pan directly behind the typing unit. It consists of a main chassis and a number of mounting plate assemblies. Each mounting plate assembly consists of a functional group of components. The assemblies mount on the chassis and are interconnected, as required, with strapping.

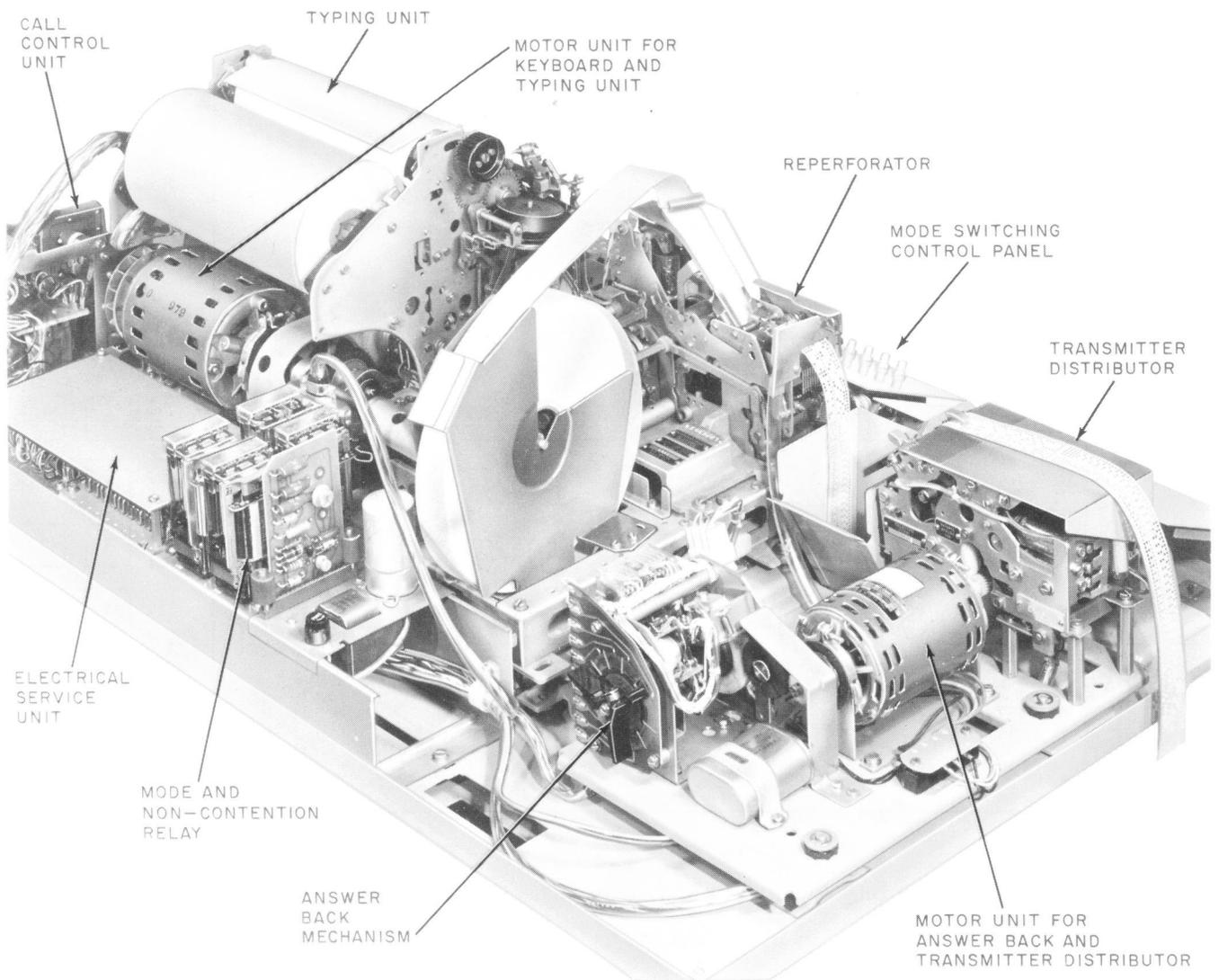


Fig. 2—35 Automatic Send-Receive Set Components (Switched Network)

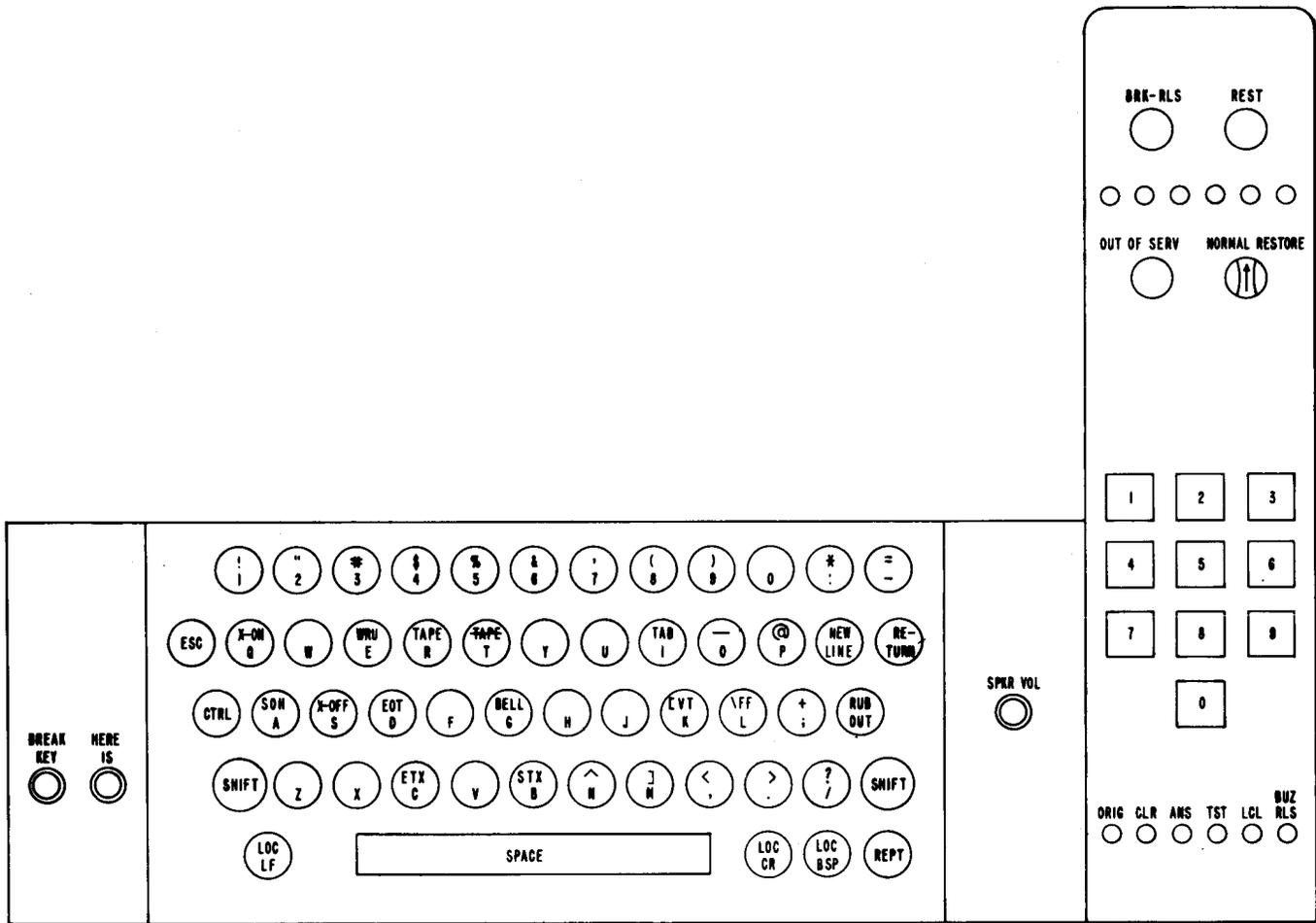


Fig. 3—Typical Keyboard for 35 Automatic Send-Receive Sets—Front View

REPERFORATOR

2.07 The reperformator (Fig. 2) is located at the left front corner of the keyboard. The reperformator consists of a base that provides a mounting foundation for the component parts of the reperformator. The approximate dimensions in inches of the reperformator are as follows:

Height	Width	Depth	Weight
9 1/2	11	12 13/16	7 1/2 lbs.

TRANSMITTER DISTRIBUTOR

2.08 The transmitter distributor unit (Fig. 2) consists of two main assemblies, (a) the base assembly, and (b) the transmitter distributor.

- (a) The transmitter distributor base assembly is located to the left of the keyboard in the cabinet. It consists of a sheet metal mounting plate, a motor, electrical terminal board and connector facilities, and mounting parts for the transmitter distributor unit. An answer-back feature is provided on sets used in switched network systems. The answer-back assembly is located at the rear of the transmitter distributor base assembly. Its main components are a coded message drum, a main shaft, and a distributor assembly. The answer-back receives its motive power from the motor via the

intermediate gear assembly on the transmitter distributor base. The base assembly is secured to the cabinet pan by four studs with flexible rubber mounts for vibration isolation.

(b) The transmitter distributor (Fig. 2) is located at the front of its base assembly, and is supported by three mounting studs. The unit receives its motive power from the motor mounted at the rear of the base. The transmitter distributor consists basically of a sensing mechanism to read perforated tape, and a distributing mechanism to transmit coded messages over signal lines. A control lever is located near the right rear corner to manually operate the mechanism while loading and positioning the tape into the reading head.

3. FUNCTIONAL DESCRIPTION

3.01 The TTYs communicate with the system via dedicated TTY channels. There are seven TTY channels available to the No. 2B ESS. One channel is designated as a maintenance channel while the remaining six can be used for purposes designated by the operating company. One or more channels may be used as backup for any other channel.

TTY CHANNELS

A. Maintenance TTY Channel

3.02 The *maintenance channel* is the basic communication link between operating personnel and the system (Fig. 4). This channel has two TTYCs connected in a mate operation arrangement which act as a buffer and a conversion unit between the TTY and the system. If one of the TTYCs is taken out of service, the channel is still operational.

3.03 The local maintenance (LM) TTY and the remote maintenance (RM) TTY are part of the maintenance channel and operate in a mate arrangement described in 4.07. They receive messages simultaneously. The LM TTY is permanently mounted in the maintenance center frame (Fig. 1) while the RM TTY is located at some remote attended point. When the No. 2B ESS office is left unattended for any length of time, the LM TTY can be turned off via a type-in leaving the RM TTY connected to the maintenance channel. The LM TTY is returned to service by a second type-in from the RM TTY. A No. 2B ESS TTY

diagnostic program is capable of disconnecting either or both maintenance TTYs. In the event of a maintenance channel equipment failure, the diagnostic program will cause a sequence of LM and RM TTY tests and TTYC tests in an attempt to find the trouble. If either TTY fails the diagnostic, the program will disconnect it from the maintenance channel and send an out-of-service message to the remaining maintenance TTY.

B. Nonmaintenance TTY Channels

3.04 Six nonmaintenance TTY channels are provided for use in a variety of administrative tasks. Channels 2 through 7 each have one TTYC (Fig. 4). For procedural purposes, when referring to the nonmaintenance channels, the words TTYC and channel are synonymous. If a nonmaintenance TTYC is removed from service, the channel is removed from service. Normally, the six nonmaintenance TTY channels are used for the functions given in 3.05 through 3.09.

3.05 The *traffic TTY channel* reports certain traffic overflow conditions and the traffic data accumulated by the system. The traffic TTY can be used to interrogate the system for the contents of specific traffic registers. The No. 2B ESS is programmed to identify various blocks of traffic registers and to print out the contents periodically in a summarized form on the traffic TTY. (Local records are necessary to identify these specific registers.) The traffic TTY may be located at any point local or remote from the No. 2B ESS office.

3.06 The *service order TTY channel* provides an input for service order information. This information is used to make changes to customer lines and services. A service order TTY is normally located in the office service center. The service order TTY can be used off-line to produce a punched tape for subsequent transmission into the system. Typing procedures for the service order TTY are described in other practices and are not included in this section.

3.07 The *local test desk TTY channel* is used by the system to transmit and receive information to and from a local or remote local test bureau. The local test desk TTY supplements the line test facilities provided by the local test desk. Maintenance personnel can initiate automatic line insulation tests and pressurized cable contactor

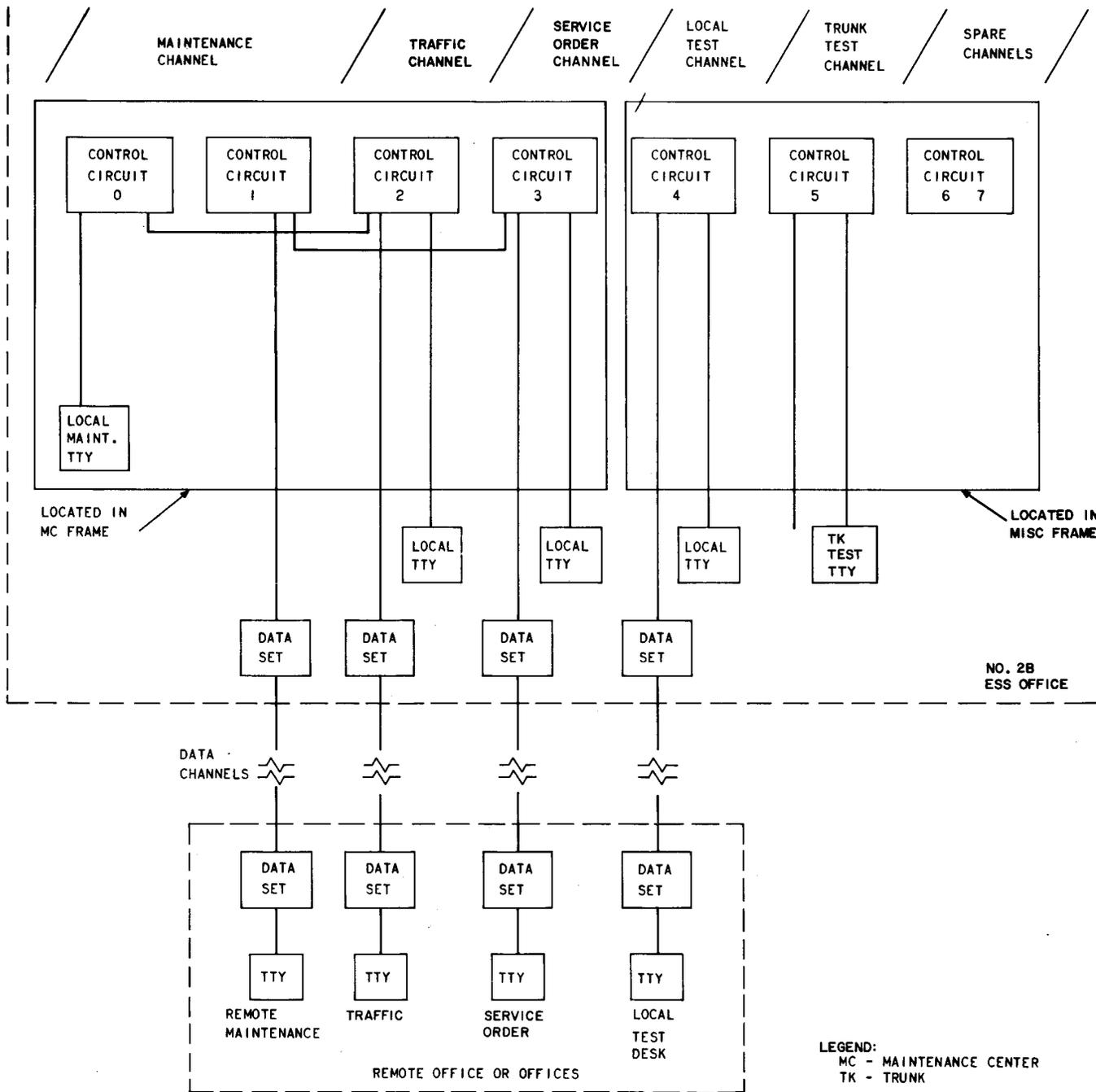


Fig. 4—Block Diagram of TTY Facilities

pair tests and place lines in the high and dry state from the TTY on this channel. The results of the automatic line insulation tests and of the cable contactor tests are printed out as these tests are performed.

3.08 The *trunk test TTY channel* is used to transmit and receive information pertaining to trunk and service circuit tests. It supplements the trunk test facilities provided by the trunk test panel by printing routine automatic operational and transmission test information. The trunk test TTY, via the proper input message, can initiate operational and transmission trunk tests and service circuit operational tests.

3.09 *TTY channels 6 and 7* are not presently used. These are spare channels and may be assigned, if required, in the future.

C. Local TTYs

3.10 Local TTYs operate on a simple 20 ma dc loop. The loop resistance must not be great enough to degrade the 20 ma loop current requirement. TTYs on this loop are always located in the same building as the No. 2B ESS. If two or more local TTYs are operated on the same channel they are connected in series.

D. Remote TTYs

3.11 Remote operation is required when the dc loop resistance degrades the loop current below 20 ma. The remote TTYs may be located either in the No. 2B ESS central office or at some remote location beyond the immediate circuitry of the central office. For remote operation, a 108-type data set must be used in conjunction with the normal TTY facilities. This data set converts the dc TTY signals to ac tones. This shift in frequency (dc current pulses to ac tones) allows transmission over great distances without degrading the 20 ma dc loop current.

CABINET

3.12 The function of the cabinet is to house the component parts of the teletypewriter.

TYPING UNIT

3.13 The typing unit (Fig. 2) incorporates the necessary electrical and mechanical elements

to receive and type messages. The typing unit receives coded signals (electrical impulses) from the keyboard and the TTYC. These coded signals are applied to a two coil magnet which is associated with a selecting mechanism. This selecting mechanism interprets the signals and controls the mechanical action involved in typing a character or performing a function. Typing is produced by type pallets which are arranged in a type box. In operation the type box moves across the paper and presents the proper type pallets to the printing hammer while the platen remains stationary. The pallets are driven forward against the inked ribbon and paper to print characters.

KEYBOARD

3.14 The keyboard (Fig. 3) provides a means of transmitting coded electrical impulses. The electrical impulses are converted into mechanical motions by the typing unit and the reperforator where they enable the typing unit and reperforator to monitor the input from the keyboard. When a key on the keyboard is depressed, a 12-bit binary data word or control word is generated. Each word is transmitted serially between the TTY and the TTYC. Each bit of each word is characterized as a current pulse (logic one), or the absence of a current pulse (logic zero). The data being transmitted utilizes only 8 bits of the 12-bit transmission pattern (Fig. 5). The first bit is always a space (logic zero). The next 8 bits (1 through 8) are data control bits which define the character or function. Bit 10 is a parity bit. All TTY devices are equipped for even parity. Bits 11 and 12 are stop bits and are always logic ones. It takes 100 ms to transmit each 12-bit word.

MOTOR UNIT

3.15 The motor unit is shown in Fig. 2. The function of the motor unit is to supply the motive forces for the keyboard, typing unit, and reperforator mechanisms. The motor unit requires 115 volts ac, single phase, 60-Hz power for its operation.

ELECTRICAL SERVICE UNIT

3.16 The electrical service unit serves as an area of concentration for the wiring of the various units of the TTYs. The components of the electrical service unit will vary, depending on the number and complexity of the functions performed by the

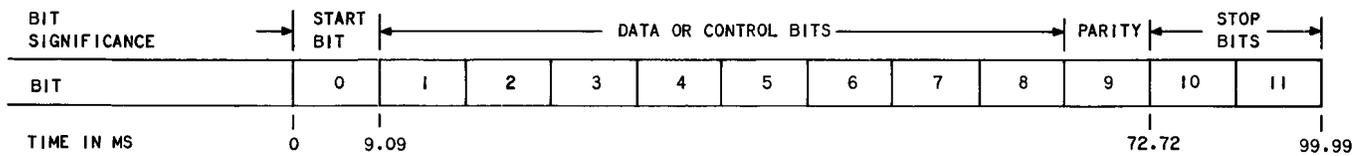


Fig. 5—TTY Signal Format

TTY. A typical electrical service unit is shown in Fig. 6.

REPERFORATOR

3.17 Teletypewriters that are equipped with a typing reperforator also print messages on perforated tape. Chad from the punched tape is diverted from the punch head to a chad container located below the cabinet panel assembly. The reperforator operates in response to line signals or signals generated by keyboard operation. The selection of the operating mode is controlled by a mode switch located to the left of the keyboard. The reperforator is shown on Fig. 2.

TRANSMITTER DISTRIBUTOR

3.18 The transmitter distributor provides a means of sensing intelligence stored on paper tape. It transmits this intelligence, in the form of electrical pulses, to receiving stations (TTYs). Sensing fingers that rest on the tape sense perforations in the tape and generate electrical pulses. These pulses are coded using the same format as those that are generated by the keyboard (3.14). The function of the transmitter distributor base assembly is to provide a mounting platform for the transmitter distributor and a motor. In some TTYs an answer-back assembly is also mounted on the base assembly.

3.19 The motor that is mounted on the transmitter distributor base assembly furnishes driving power for the transmitter distributor and the answer-back assembly. The motor is controlled by the mode switch. In switched network systems the motor may be controlled remotely or by operation of the proper pushbuttons on the mode switching control panel.

3.20 The answer-back assembly is designed to distribute, upon receipt of a WRU (who are you) or HERE IS signal, a predetermined sequence

of characters which serves to identify the station. A maximum of 20 characters may be transmitted. The character sequence is determined by the manner in which the message drum is coded by the customer. The transmitter distributor, its base assembly, motor, and the answer-back assembly are shown in Fig. 2.

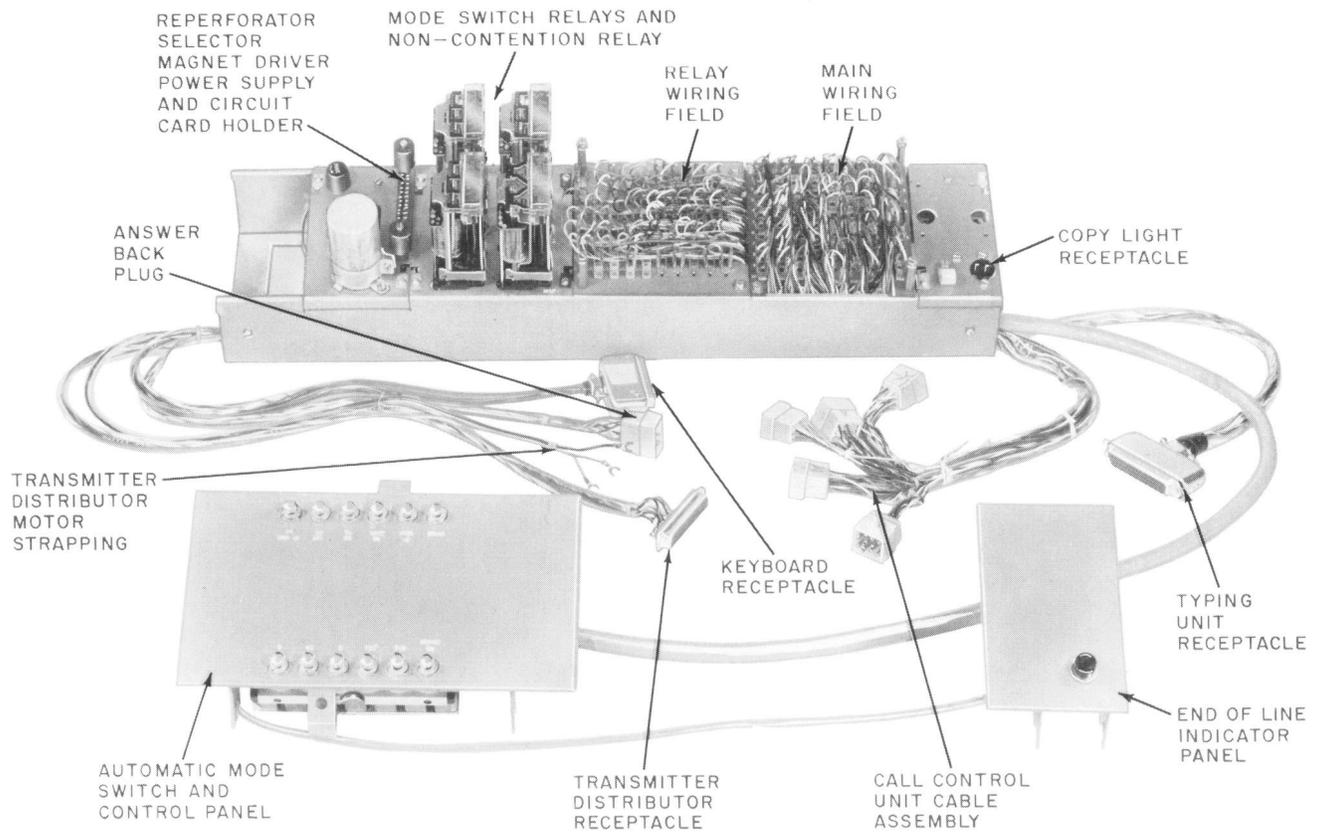
4. TTY CONTROLLER (TTYC)

4.01 In the No. 2B ESS, information is transferred serially at a 6.7 MHz rate from the 3A central control (3A CC) to the TTY requiring the information via the TTYC. To permit communication with the TTYs which send and receive serial information, a control circuit is interposed between the 3A CC and the TTYs. The TTYC accepts serial information from the 3A CC and transmits it serially to the TTYs. Conversely, the TTYC receives serial information from the TTYs and converts it to a serial form acceptable to the 3A CC.

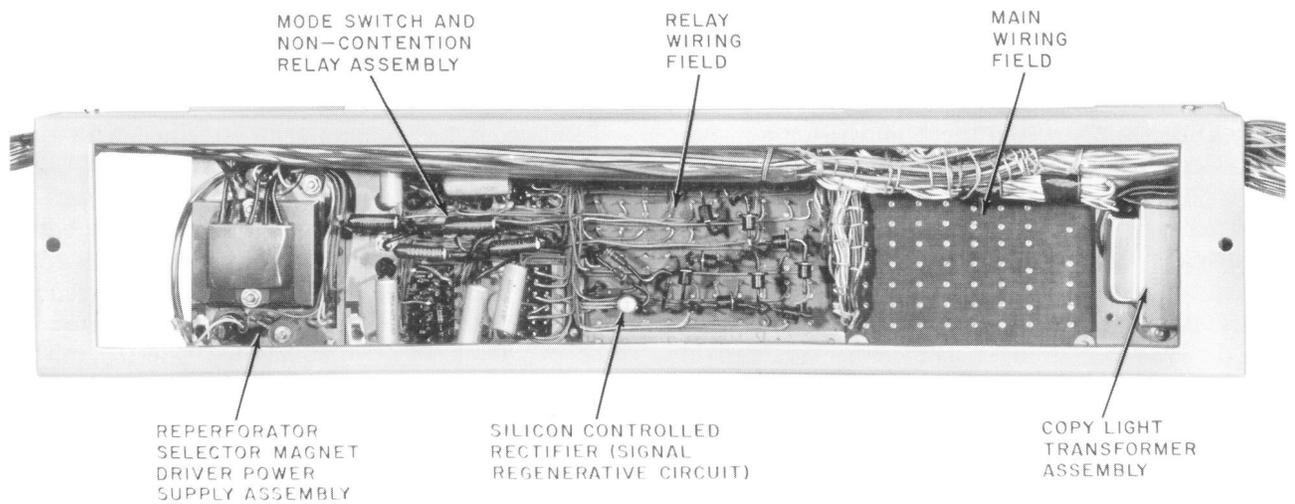
TTY CONTROLLER—PHYSICAL DESCRIPTION

4.02 The TTYC units are mounted below the TTY in the maintenance center frame (Fig. 1). Each TTYC unit contains two independent TTYCs except for power. The power supply which is mounted between the two TTYCs is common to both TTY controllers. As shown on Fig. 7, two 58C apparatus mountings, one on each end of an 8-inch mounting plate, provide space for four 108-type circuit packs or four AR17 circuit packs or any combination of the two per channel. Circuit packs or data sets need to be provided for only the TTY ports being utilized. The unit is wired so that either a 108-type circuit pack or an AR17 circuit pack may be inserted into the same position.

4.03 An 80A apparatus housing is mounted between the two 58C apparatus housings. It provides space for six controller logic circuit



TOP VIEW



BOTTOM VIEW

Fig. 6—Typical Electrical Service Unit for 35 ASR Set

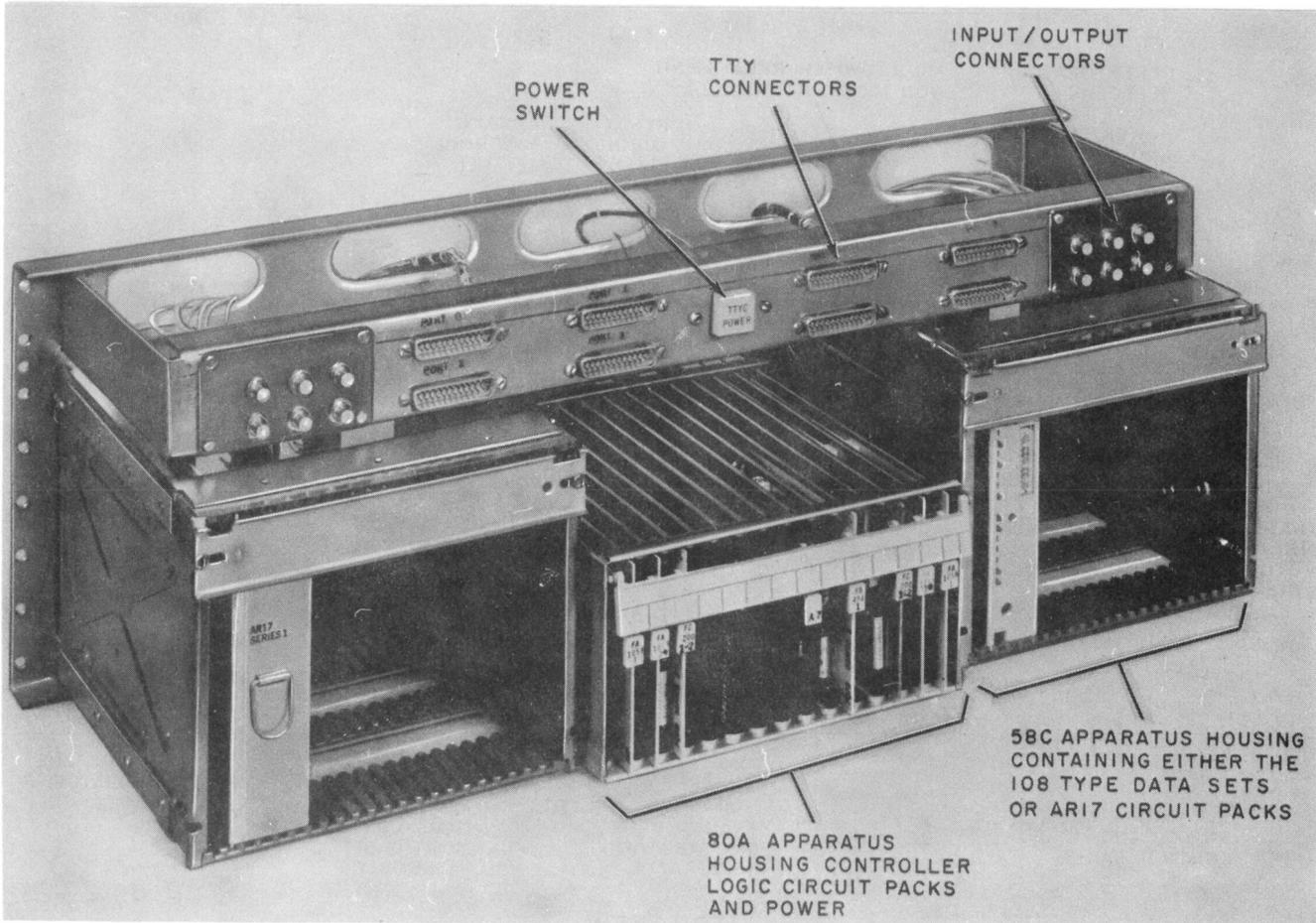


Fig. 7—Teletypewriter Controller (TTYC)

packs (three per channel), and two power supply circuit packs.

4.04 Directly above the three apparatus housings is a connector plate assembly. This connector plate assembly contains the connectors required to interface with the 3A CC and the TTYs. Six coaxial cable connectors are mounted on each end of this connector plate to provide the unit with the necessary three inputs per channel from the 3A CC. The remaining eight connectors provide an interface with the TTYs. A pushbutton type switch for applying power to the TTYC is mounted in the center of the connector plate. The pushbutton is lit when the TTYC power is on.

TTY CONTROLLER—FUNCTIONAL DESCRIPTION

4.05 Fig. 8 is a simplified block diagram of the TTYC. Individual circuit packs are shown

but circuit pack descriptions are not provided. The function of the left and right controllers is identical, therefore, a single description applies to both. The TTYC contains circuits that interface with the 3A CC and the TTYs.

4.06 The TTYC provides the interface between the 3A CC and the system TTYs. Each TTYC connects the 3A CC to a TTY port connector which in turn connects to a maximum of four TTY ports. Each TTYC unit has a DC-to-DC converter which has sufficient capacity to power both controllers. The DC-to-DC power converters require $-48V$ and $+24V$ power from the office power supply. The TTYCs employ plug-in circuit packs, therefore, only one TTYC may be equipped if desired. The same philosophy is applied to the port interface circuit packs (AR17 and 108E data sets). Only the TTY ports being utilized need be equipped with these circuit packs. The TTYC also has coaxial

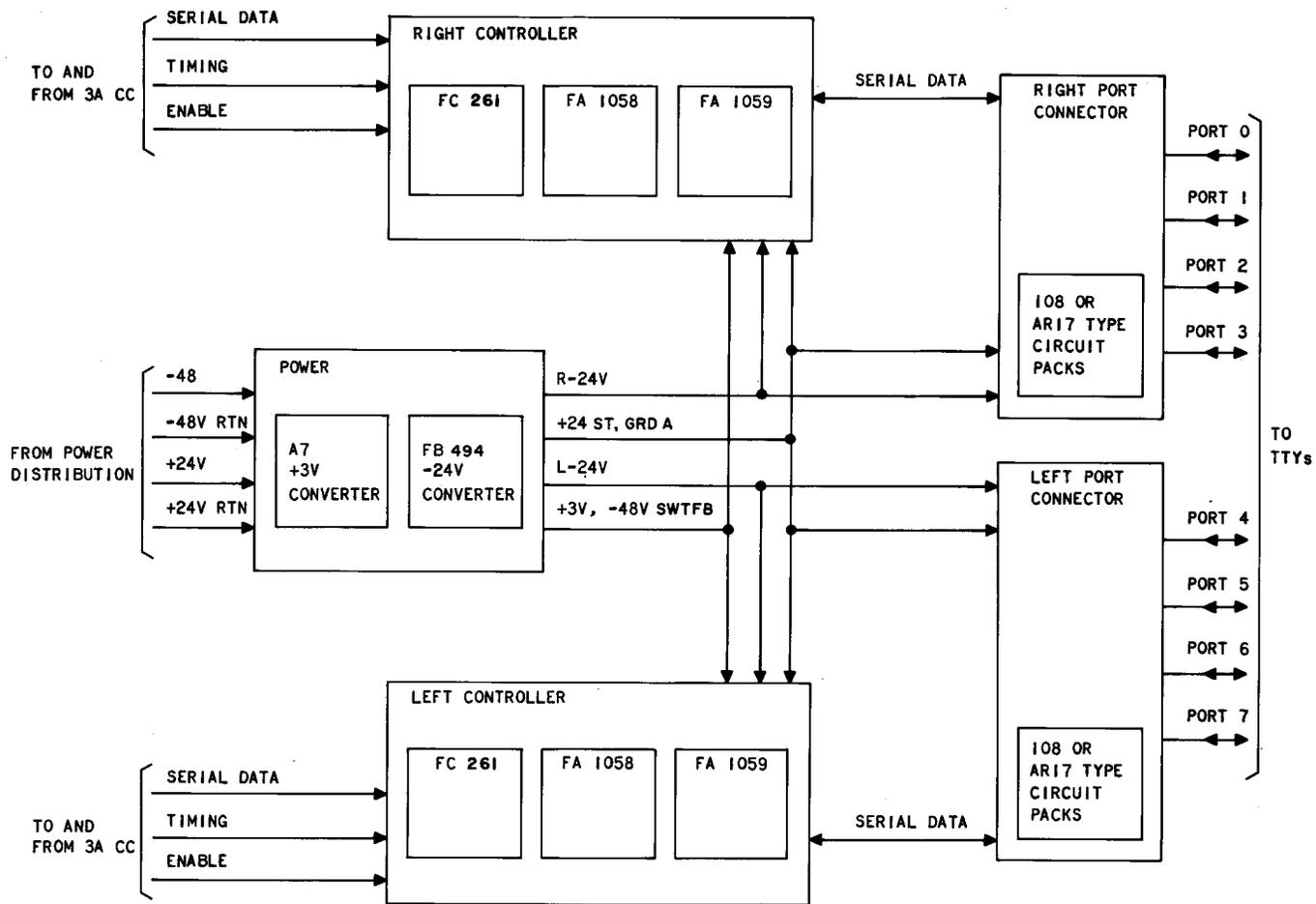


Fig. 8—TTYC Simplified Block Diagram

connectors for the I/O and interrupt connections to the 3A CC.

4.07 Data that is transmitted to the local maintenance TTY is also transmitted to the remote maintenance TTY via the mate operation of the TTYCs. Conversely, the same principle applies to data transmitted to the remote maintenance TTY. This is accomplished through a cross coupling, (mate operation), of TTYC-0 and TTYC-1 (Fig. 10). The local maintenance TTY is connected to port 0 of TTYC-0 and the remote maintenance TTY is connected to port 0 of TTYC-1. Receive only TTYs are connected to port 1 of TTYCs 0 and 1. Port 2 of TTYC-0 is cross coupled to port 3 of TTYC-1. Port 3 of TTYC-0 is cross coupled to port 2 of TTYC-1. If any TTYC is removed from service, the 2B processor can communicate with the local maintenance TTY or the remote maintenance TTY via the in service TTYC and the cross coupling.

5. MESSAGE CONTROL

3A CC to TTYC COMMUNICATIONS

5.01 The input/output (I/O) section of the 3A CC is structured around 6.7 mHz, serial, bipolar, data communication. The 3A CC sends a 21-bit message to a TTYC and remains active waiting for a response. While in the active waiting state the 3A CC continues to send data (all zeros). The TTYC may derive bit timing for a return message from this continuing input. A time-out mechanism (3A CC software) can terminate the I/O operation if a response is not received in a specified time.

5.02 The 3A CC I/O message to the TTYC (Fig. 9A) consists of a 3-bit start code and two 8-bit data fields with a parity bit for each data field. Since the TTYs function with an 8-bit ASCII format (Fig. 9B), only the low data field is

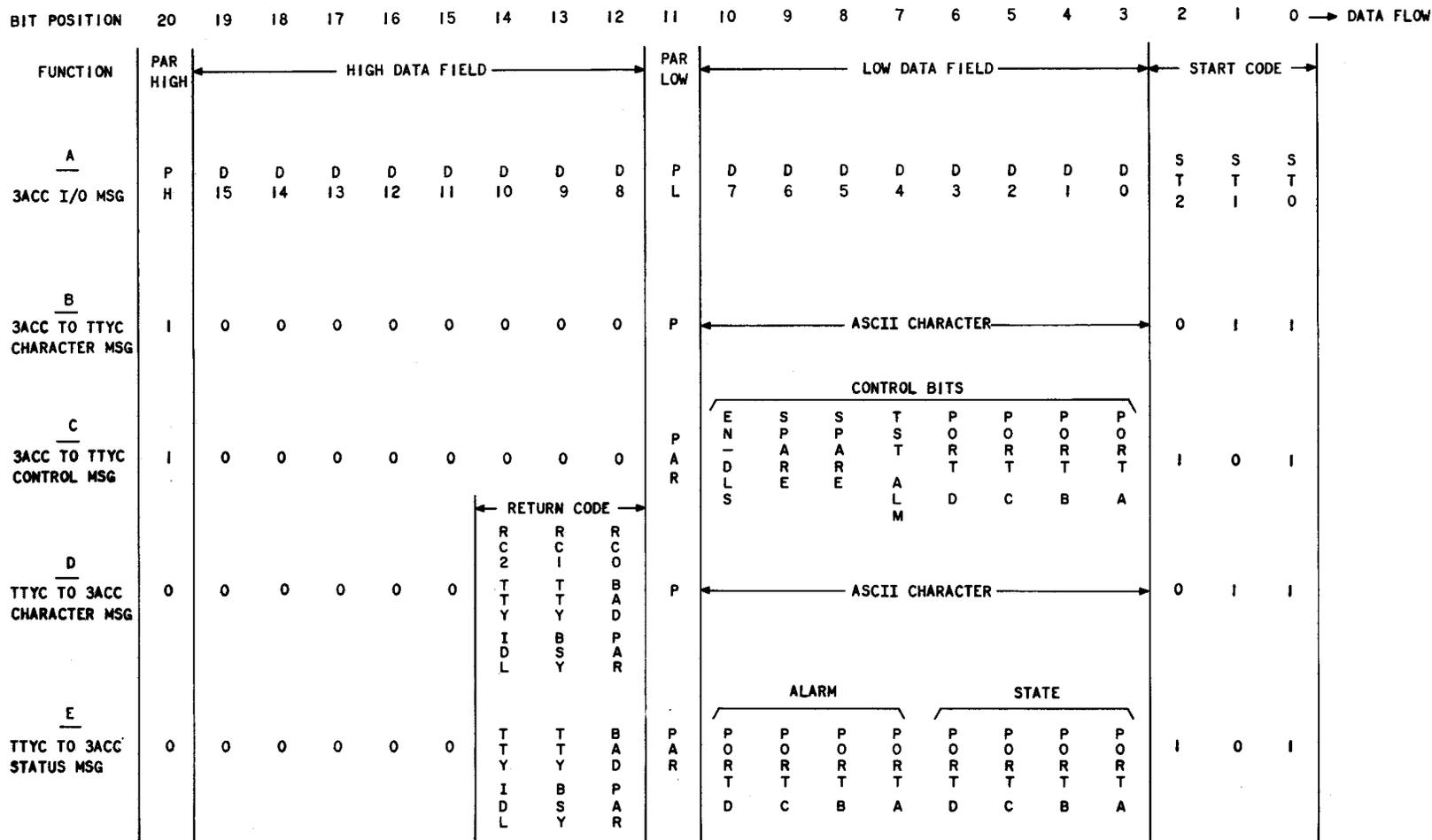


Fig. 9—Message Formats

required to transmit a character from the 3A CC. The high data field is all zeros. Two start codes are used. The start code for a normal TTY function is 011, and the start code for a maintenance function is 101. The data field following the start code is interpreted as an ASCII character by the TTYC. Figure 9B shows the message format used to transmit a TTY character from the 3A CC to the TTYC.

5.03 The TTYC interprets the data field following a maintenance start code as a control message. The interpretation of this data field is shown in Fig. 9C. Bit 10 is used to enable or disable the functions defined in bits three through six. If bit 10 is a zero the function is disabled. If data bit 10 is a one the function is enabled. Data bits three through six control the state of each TTY port. Data bit 7 controls a maintenance state that simulates an alarm on all ports.

5.04 The TTYC sends two types of messages (character, and status) to the 3A CC.

The normal start code is always used with the character message, while the status message uses the maintenance start code. The formats for these messages are shown in Fig. 9D and 9E, respectively. Each of these messages contain a 1-out-of-3 bit return code. The return code informs the processor that

- a) RC0—incoming message had bad parity
- b) RC1—the TTY is busy
- c) RC2—the TTY is idle.

A single bit for each of these functions eliminates the need of a high parity bit.

5.05 If the TTYC receives a bad parity message it takes no action except to send the appropriate status message to the 3A CC. Otherwise, on receipt of a message, the TTYC always sends a character to the 3A CC if one is ready. If no character is ready, the appropriate status message is sent.

TTY TO TTYC COMMUNICATIONS

5.06 Characters are exchanged between the TTY and the TTYC by an 11-bit serial message. The 8-bit ASCII character is sandwiched between a start bit and 2-stop bits (Fig. 5). Timing is provided in the TTYC to function at a 100 word per minute transmission rate.

INTERRUPTS

5.07 The timed interrupt used by call processing for input and output functions occurs every 25 ms. The interrupt stops the main program and performs those tasks required during the interrupt period. There are 13 tasks that are performed during timed interrupts. All the tasks need to be performed more often than can be executed by the main program loop, although few tasks are performed every 25 ms interrupt. The TTY interrupts are one of the tasks performed every 25 ms. If more than one TTY channel is used, the interrupts can be multiplied to all of the TTYCs. The normal response of the 3A CC to the TTY interrupt is to poll the TTYC with a control message. The TTYC having a character ready will return it to the 3A CC. Those with no character ready will return a status message. In the case of head-on-tail inputs from the TTY, at least one character time (100 usec) is available for the 3A CC to receive the character.

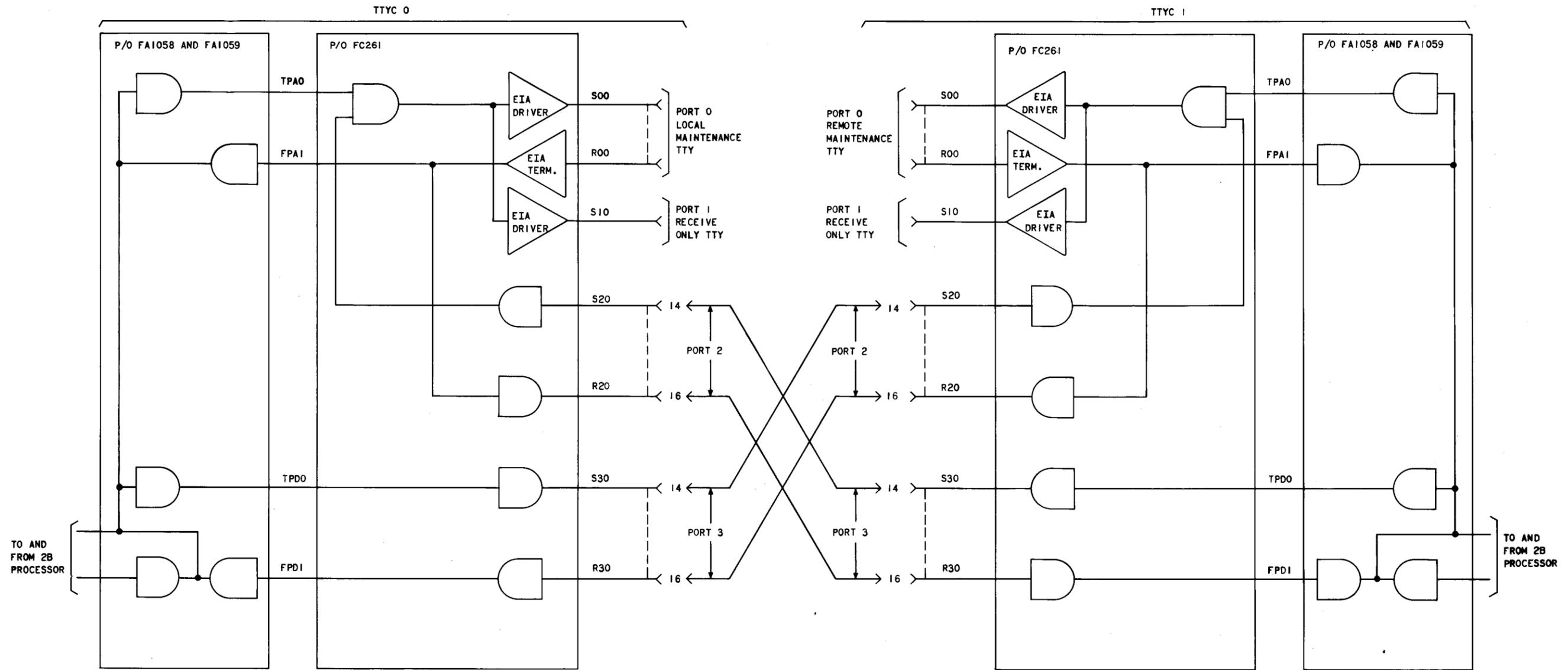


Fig. 10—TTYC Arranged for Mate Operation