DATA SET 202E-TYPE

TRANSMITTER

THEORY OF OPERATION

AND

SUPPLEMENTARY INFORMATION

1. GENERAL

1.01 This section includes a detailed description of the operation and testing of Data Set 202E-type. The information contained in this section supplements the information contained in other sections and is not required for installation, maintenance, or service of the data set under normal circumstances.

1.02 This section is reissued to provide information on new circuit boards and to provide a changed test procedure.

1.03 Data Set models 202E1, E2, E7, and E9 have a rotary dial (X option) and differ in basic features on a modular basis. Their functional equivalents in the TOUCH-TONE® dial version (W option) are 202E10, E11, E12, and E13, respectively. These sets are identical except for the dial mechanisms; therefore, information in this section will refer to the rotary dial version only.

1.04 Data Set 202E-type provides low-cost, serial transmit-only data service. These sets are compatible with existing 202 series data sets capable of speeds up to 1200 bits per second (bps) over the switched network (DDD) and up to 1800 bps on type 3002 private lines with C2 conditioning. Data Set 202E-type is designed for EIA voltage signal interface with the exception of the 202E1 which has a wiring option (Y option) for a contact interface. Data Set 202E1 is factory-wired with Z option which provides for a voltage signal interface. The maximum bit rate for Data Set 202E1 with contact interface is 600 bps.

1.05 These sets are designed on a modular basis so that the customer can be provided with

and charged for only those features required. The basic Data Set 202E-type consists of a serial modulator and a line coupler. Optional modules include a reverse-channel, automatic answer, EIA voltage interface, power rectifier, and remote test. Combinations of features can be obtained by ordering a specific model of this series according to Table A. Features can be changed in the distributing house to meet customer requirements.

1.06 The general configuration and physical dimensions of Data Set 202E-type are shown in Fig. 1.

1.07 A functional block diagram of Data Set 202E-type with associated apparatus is shown in Fig. 2. This diagram shows the function of each module and the relationship of the modules within the data set.

1.08 The basic data set accepts business machine signals, either contact closure or voltage signals, and converts these signals into mark and space frequencies in the serial modulator. The mark and space frequencies are then transmitted through the line coupler which connects the set to the telephone line, provides adjustment for modulator output level and loop current, and guarantees the polarity of line voltage to the line-powered modules. The line coupler module also provides lightning protection. The optional automatic answer feature provides timing and switching functions required to detect ringing current, to generate an answer tone, and to exchange the necessary supervisory signals with the business machine for automatic answering of data calls. The EIA interface module provides a means of accepting an EIA data terminal ready signal from the customer and of giving EIA data-set-ready and clear-to-send indications back to the customer. The reverse-channel feature permits the receiving business machine to simultaneously maintain supervision of the transmitting business machine during data transmission. The data set converts the presence or absence of the reverse-channel tone (387 Hz) into positive or negative voltages which are fed to the business machine. The remote test feature allows the data set user to have a test made of the modules in the data set. This test is made from a telephone company data test center. The power rectifier module accepts an input of 25 volts ac from an external transformer. The output of the module with respect to ground is ± 8 volts and an unregulated $+16$ volts ($+13$ to $+27$).

2. EQUIPMENT CHARACTERISTICS

2.01 The following summarizes the external and internal connections required for data set operation. Brief descriptions of the interface leads,

→ TABLE A ←

PERMISSIBLE ARRANGEMENTS FOR DATA SET 202E-TYPE

FEATURE	202E1, E10	202E2, E11	202E7, E12	202E8*	202E9, E13
Serial Modulator	BE22	BE22	BE22	BE16*	BE22
Line Coupler	BE60†	BE60†	BE60†	BE6*	BE60†
EIA Interface	—	—	BE25	BE5*	BE25
Power Rectifier	—	BE1	BE1	BE1	BE1
Automatic Answer	—	—	BE26	BE7*	BE26
Reverse-Channel	—	BE92‡	—	BE8*	BE92‡
Remote Test	—	—	BE23	BE17*	BE23

* Manufacture Discontinued
† BE27 or BE58 on older sets
‡ BE24 on older sets
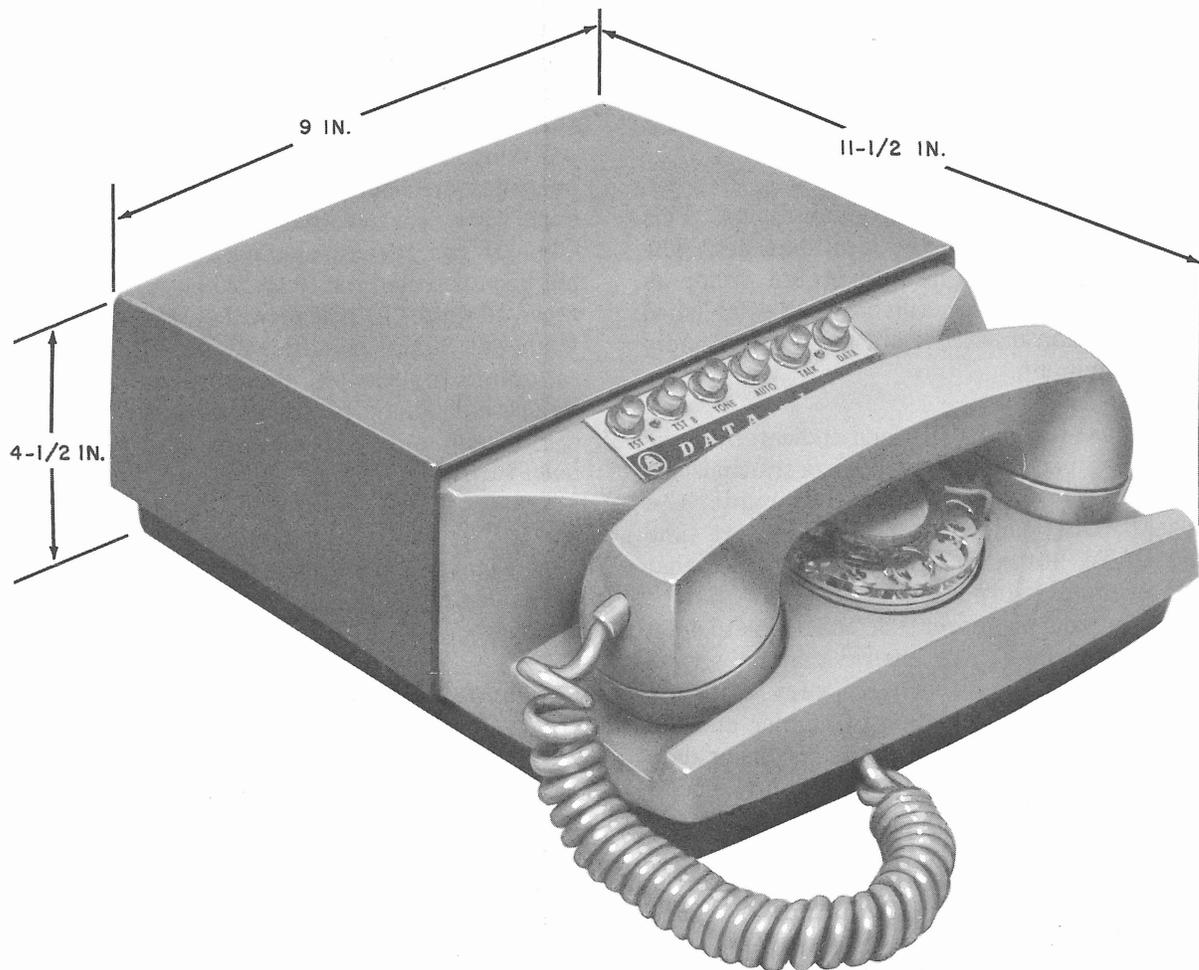
Fig. 1—Data Set 202E-Type With Rotary Dial

physical characteristics, power requirements, and optional circuits are also given.

A. Interface Leads

2.02 All interface leads for Data Set 202E-type are terminated in the equivalent of a 25-pin Cannon or Cinch DB-19604-43 receptacle mounted on the back of the data set. Pin assignments are shown in Table B.

2.03 The transmitted data (BA) lead accepts serial data from the business machine. In Data Set 202E1, this serial data can be in the form of either contact closures or EIA voltages. Signals presented to the transmitted data (BA) lead become effective as soon as the data set operator selects

the data mode of operation. This can be done by depressing the DATA button with the handset off-hook. Data Sets 202E7 and 202E9, when properly conditioned, can place the transmitted data (BA) lead in the active condition automatically.

2.04 The signal ground (AB) lead is used as common reference for all interface signals.

2.05 Signals on the data set ready (CC) lead are generated by the local data set to indicate that it is ready to operate. The OFF condition indicates one of the following:

(a) Any abnormal or test condition which disables or impairs the service furnished.

(b) The communication channel is switched to the talk mode.

(c) The local data set is not connected to a communications channel (ie, the handset is on-hook).

The ON condition appears at all other times. This lead indicates the status of the local data set. The ON condition should not be interpreted either as an indication that communication has been established to a remote station or as the status of any remote station or equipment.

2.06 The clear-to-send (CB) lead indicates to the business machine when valid data transmission is possible. When a manual call is made, the clear-to-send (CB) lead will turn ON a short time after the DATA button is depressed, provided that the data terminal ready (CD) lead is ON. Before the DATA button is depressed, the clear-to-send (CB) lead is held OFF. To ensure that only valid data will be received, it is necessary to allow sufficient time for the detection of carrier and the removal of the hold condition at the receiving data set before transmitting data. The clear-to-send (CB) circuit performs this timing. With automatic answering, this circuit remains in the OFF state for approximately 325 milliseconds (msec) after transmission of the answer tone. Once this time has elapsed, the clear-to-send (CB) lead assumes the ON state. The business machine should transmit data only if the clear-to-send (CB) lead is ON. At all other times, the business machine should hold the transmitted data (BA) lead in the marking condition. The business machine ignores any signals from the supervisory received data (SBB) lead when the clear-to-send (CB) lead is OFF.

2.07 The data terminal ready (CD) lead accepts signals from the business machine to control the connection of the data set to the telephone line. The presence of an OFF signal on this lead will permit only the establishment of a line connection with the data set in the talk mode. The data terminal ready (CD) lead must be ON before the data set will enter the data mode and transmission of data can begin. An OFF signal on this lead of 50 msec or longer will terminate the call immediately.

2.08 The supervisory received data (SBB) lead ("reverse channel") delivers received supervisory information to the transmitting business machine while normal data is being transmitted over the transmitted data (BA) lead. The supervisory received data (SBB) lead will be held OFF when the supervisory tone of 387 Hz is not detected in the data set. After the 387-Hz signal from the receiving data set reverse-channel transmitter has been detected for a period of 40 to 70 msec, the supervisory received data (SBB) lead will be turned ON. If the reverse-channel supervisory tone has not been detected for 70 to 120 msec, the supervisory received data (SBB) lead will be turned OFF. With Data Set 202E9 conditioned for either manual or automatic operation, the business machine will ignore indications on the supervisory received data (SBB) lead until the clear-to-send (CB) lead has been turned ON.

2.09 The positive power (+P) and negative power (−P) leads are for test purposes only. These leads should not be used by the business machine.

B. Physical Characteristics

2.10 Data Set 202E-type is electrically connected to the telephone line. This set has an integral telephone set with either a rotary or TOUCH-TONE dial. The overall dimensions of the data set are approximately 9 inches wide, 4-1/2 inches high, and 11-1/2 inches deep. It weighs up to 7-3/4 pounds excluding the power transformer. Data Set 202E-type is designed to operate in an ambient temperature range of 40 to 120°F and a relative humidity range of 20 to 95 percent.

Note: A sudden drop in temperature or rise in humidity such that condensation occurs in the data set circuitry can cause faulty operation.

C. Power Requirements

2.11 Data Set 202E-type is connected to the telephone line through a D4BJ-61 cord. The cord also contains the leads which provide power from the external transformer to the data set. The data sets equipped with the power rectifier module are shipped with a KS-16886-L2 transformer and require an available source of 117 volts at 60 Hz.

D. Optional Circuits

2.12 Figure 3 is a block diagram of a basic Data Set 202E-type with common equipment. Optional circuits can be added or removed according
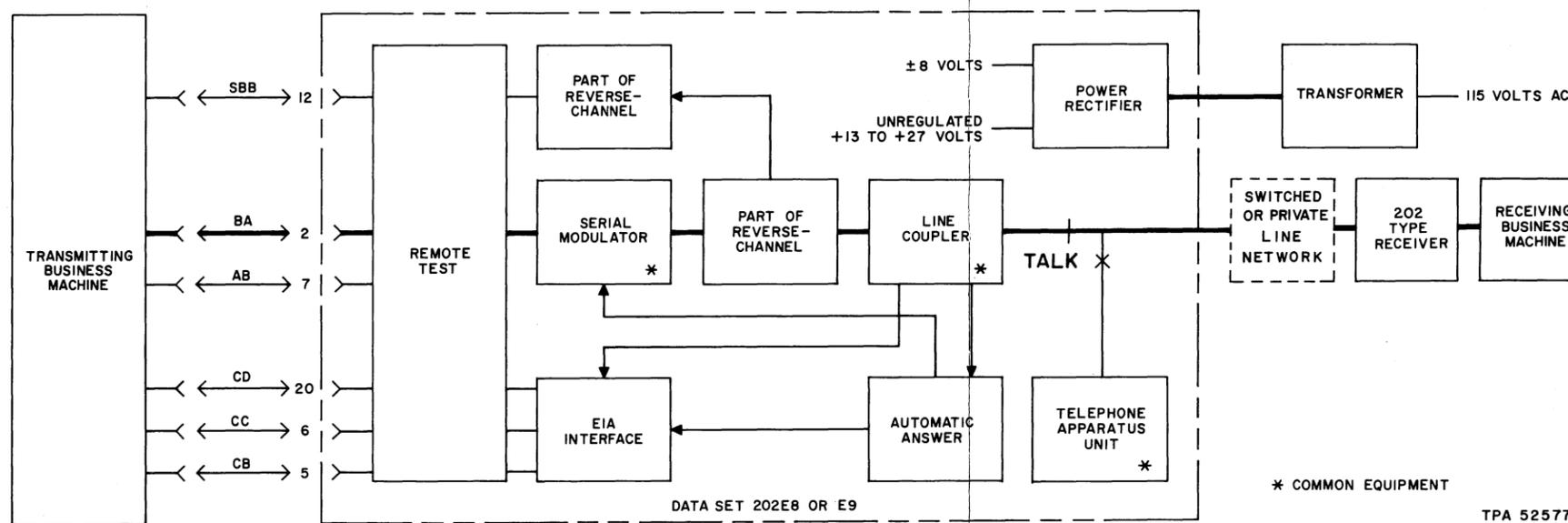
Fig. 2—Data Set 202E-Type, Functional Block Diagram

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→ TABLE B ←

INTERFACE LEADS

CONNECTOR J1 TERMINAL NUMBER	EIA DESIGNATION	FUNCTION DESIGNATION	DATA SET 202
7	AB	Signal Ground (SG)	E1, E2, E7, E8, E9 E10, E11, E12, E13
2	BA	Transmitted Data (TD)	E1, E2, E7, E8, E9 E10, E11, E12, E13
12	SBB	Supervisory Received Data (SRD)	E2, E8, E9, E11, E13
9		+P (Test Voltage)	E2, E7, E8, E9, E11, E12, E13
10		—P (Test Voltage)	E2, E7, E8, E9, E11 E12, E13
20	CD	Data Terminal Ready (DTR)	E7, E8, E9, E12, E13
6	CC	Data Set Ready (DSR)	E7, E8, E9, E12, E13
5	CB	Clear to Send (CS)	E7, E8, E9, E12, E13

to Table C to make a required model of data set. Refer to Fig. 4 and Table D for the locations of circuit packs in the data set. To convert from one data set to another, connections should be made as indicated for the given model of data set. Added leads should be removed on the given model to reduce the set to basic wiring per Fig. 3. Wiring should then be added as indicated in Table C for the required model of data set.

2.13 Table C wiring is available in cable form as listed for the following data sets:

202E1—P-42W342

202E2—P-42W343

202E7—P-42W344

202E9—P-42W345

Wire-wrap connections are used to connect leads to terminals on circuit boards. Addition or replacement of a circuit board will require that the old wrapped connections be cut back or that new wires be added. The connections should be soldered only in emergency situations. In such cases, one of the two posts for each terminal should be reserved exclusively for wrapped connections. Once a post has been used for a soldered connection, however, it cannot be used for a wrapped connection. The terminal numbers given are for circuit packs of Data Sets 202E1, E2, E7, and E9. Data Set 202E8 cannot be converted to any other model.

3. THEORY OF OPERATION

3.01 The following is a description of the functions and interrelationship of the basic circuits of Data Set 202E-type. Each data set will be referenced to its associated functional diagram which shows interconnection between the circuit boards and the locations of apparatus keys.

DATA SET 202E1

3.02 The serial modulator and line-coupler modules contained in Data Set 202E1 are common to all Data Sets 202E-type. Refer to Fig. 5 for the block diagram showing external and internal connections of Data Set 202E1.

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3.03 The talk circuits include the telephone handset and those parts of Fig. 5 designated apparatus unit. With the TALK button on the data set depressed, the apparatus unit and handset are connected to the telephone line. The line coupler and serial modulator are then disconnected. This permits the data set to be used as an ordinary telephone with which calls can be originated and received. The data set can be placed in the data mode by depressing the DATA button. The DATA button is not connected to the circuit but is designed to release all other buttons mechanically on the upstroke which places the set in the data mode.

3.04 Data in the form of contact closures or EIA voltages is accepted by the data set and is converted to frequency-shift signals by the serial modulator. With voltage interface (Z option), data is applied to the serial modulator on pins 3 and 4 and is converted to mark and space frequencies of 1300 Hz and 2100 Hz, respectively. With contact interface (Data Set 202E1, Y option), data is applied to the serial modulator on pins 6 and 7 and is converted to mark and space frequencies of 1375 Hz and 2025 Hz, respectively. With voltage interface, a signal (more negative than -5 volts) applied to pin 4 will cause marking frequency, and a signal (more positive than $+5$ volts) applied to pin 4 will cause spacing frequency. With contact keying, a contact closure between interface terminals 2 and 7 generates a marking frequency. A spacing frequency is generated whenever terminals 2 and 7 are open. Data output to the line coupler is through pins 9 and 1.

3.05 Data in the form of mark and space frequencies is accepted from the serial modulator to line coupler pins 4, 6, 9, and 10. The input circuit of pins 4 and 6 contains a resistor network which is used to reduce the variation of customer loop plus central office resistance from the range of 385 to 1900 ohms to the range of 1100 to 1950 ohms. The resistance of this network is varied by adjusting screw terminals A, B, C, and D on line couplers BE27 or BE58 or screw terminals A and B on the BE60 module. The input circuit of pins 9 and 10 contains a resistor network which is used to adjust the output power level of the data set and to maintain the output impedance within the range of 814 to 1220 ohms. The resistance of this network is varied by adjusting screw terminals E, F, G, and H if BE27 or BE58 are used or by adjusting a potentiometer on BE60. For the adjustment of these resistance networks, refer to the section entitled Data Set 202E-Type Transmitter, Installation and Connections (592-018-200). Table B in that section shows the adjustment for a nominal level and an optional level for either BE27 or BE58. The nominal level is to be used in the majority of cases when loop loss is related to loop resistance. If the loop impedance causes a significant deviation in the received power level (ie, too high results in crosstalk or too low results in low signal-to-noise ratio), it may be necessary to adjust for an optional level. If the data set is equipped with BE60 line coupler, separate instructions concerning its adjustment are also contained in Section 592-018-200.

3.06 The diode network in the line coupler serves as a polarity guard which guarantees the polarity of the line voltage applied to the line-powered modules. The zener diode provides lightning protection. Data output to the line is through pins 2 and 11 of the line coupler module.

DATA SET 202E2

3.07 This set includes a supervisory data receiver (reverse-channel) and a power-rectifier module in addition to common equipment. This arrangement permits reception of supervisory signals transmitted from a 202-type Data Set at the receiving business machine. The reverse-channel module detects a 387-Hz signal, which has an amplitude greater than -45 dBm, and converts the presence or absence of the tone into standard EIA voltage signals.

3.08 The reverse-channel module contains a composite filter network consisting of Z1, L1, L2, C1, and C2 (Fig. 6). This filter prevents the 387-Hz tone from feeding into the serial modulator and routes the signals to the tuned amplifier. The filter also prevents the 387-Hz components of the modulator output from reaching the tuned amplifier and causing false indications. The dc continuity through the filter is maintained to provide line power to the serial modulator and to provide a low-impedance path for data from the serial modulator to the line. Transistors Q1, Q2, and Q3 form a tuned amplifier which provides the required gain at 387 Hz to operate transistor switch Q4. When the reverse-channel tone is of sufficient amplitude, transistor switch Q4 is turned ON which allows the signal to reach the detector circuit consisting of Q5. Transistors Q6 and Q7 make up a slicer circuit whose purpose it is to
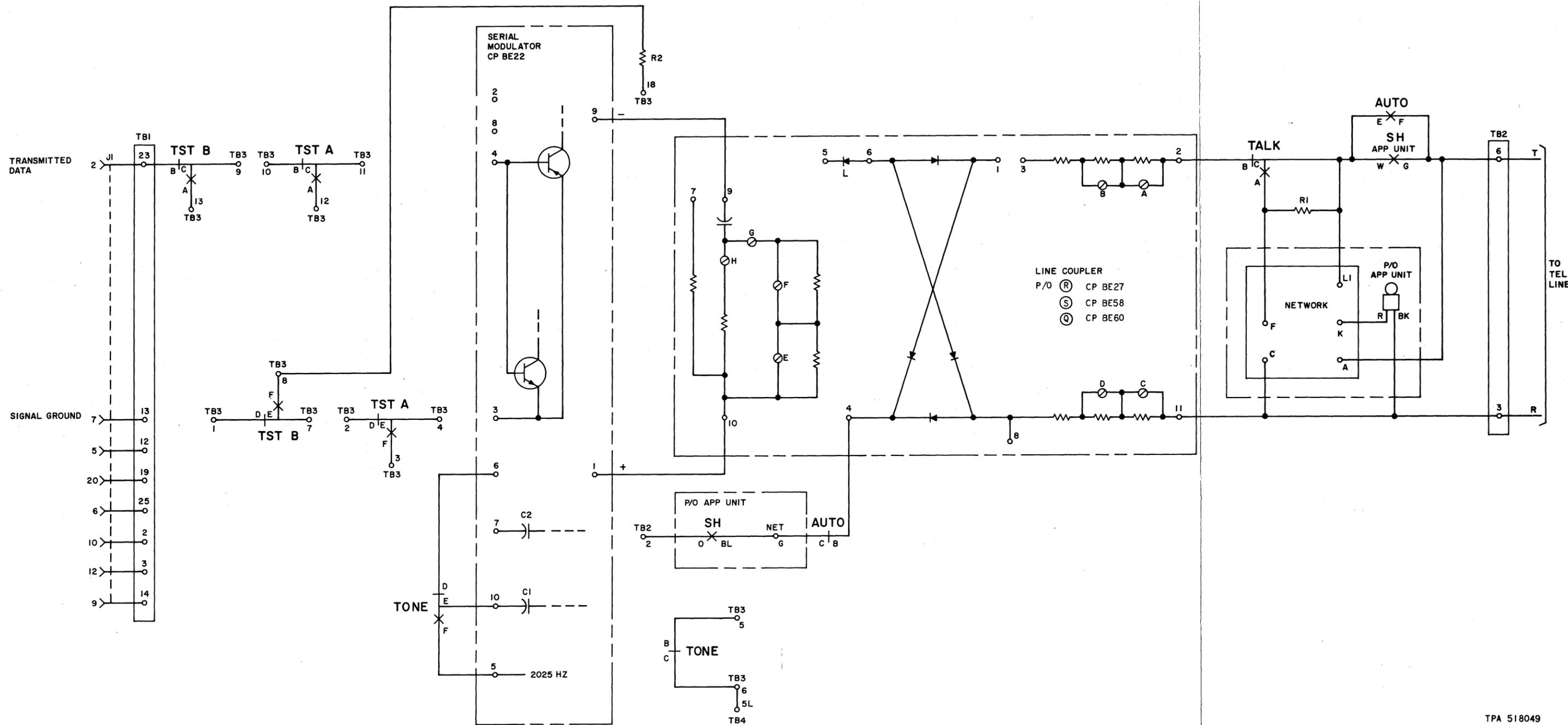
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Fig. 3—Common Equipment Circuit

TABLE C
DATA SET 202E-TYPE CONVERSION

202E1*

REMOVE FROM	REMOVE TO	ADD FROM	ADD TO	REMARKS
		1(BE27)	3(BE27)	
		10(BE27)	5(BE27)	
		5(BE27)	4(BE27)	
		9(BE27)	7(BE27)	
		7(BE27)	6(BE27)	
		9(TB3)	10(TB3)	
		12(TB3)	8(TB3)	
		7(TB3)	2(TB3)	
		13(TB1)	1(TB3)	
		13(TB3)	4(TB2)	
		13(TB3)	3(TB3)	
12(TB3)	10(BE22)	11(TB3)	4(BE22)	EIA Input Z Option
5(BE22)	10(BE22)	4(TB3)	3(BE22)	EIA Input Z Option
4(BE22)	7(BE22)	3(BE22)	6(BE22)	EIA Input Z Option
		2(BE22)	8(BE22)	EIA Input Z Option
		9(BE22)	18(TB3)	EIA Input Z Option
4(TB3)	3(BE22)	12(TB3)	10(BE22)	Contact Input Y Option
11(TB3)	4(BE22)	4(BE22)	7(BE22)	Contact Input Y Option
2(BE22)	8(BE22)	5(BE22)	10(BE22)	Contact Input Y Option
18(TB3)	9(BE22)			Contact Input Y Option

*Block AUTO key.

202E2*

ADD FROM	ADD TO
1(BE27)	3(BE27)
5(BE27)	4(BE27)
4(BE27)	10(BE24)
6(BE27)	26(BE24)
22(BE24)	7(BE27)
7(BE27)	9(BE27)
21(BE24)	10(BE27)
2(BE22)	8(BE22)
11(TB3)	4(BE22)
9(TB3)	10(TB3)
12(TB3)	9(BE24)
4(TB3)	12(TB3)
2(TB3)	3(TB1)
8(BE24)	10(BE1)
1(BE24)	4(BE1)
2(BE1)	4(TB2)
5(BE1)	5(TB2)
7(BE1)	1(TB3)
7(BE1)	13(TB1)
6(BE1)	2(TB1)
8(BE1)	14(TB1)
7(TB3)	3(BE22)
3(BE22)	6(BE22)

*Block TST B key and AUTO key.

202E7

ADD FROM	ADD TO
1(BE1)	6(BE25)
1(BE1)	11(TB3)
2(BE1)	4(TB2)
4(BE1)	4(BE23)
4(BE1)	1(BE25)
5(BE1)	5(TB2)
6(BE1)	2(TB1)
6(BE1)	8(BE23)
7(BE1)	3(BE22)
7(BE1)	10(BE25)
8(BE1)	14(TB1)
10(BE1)	3(BE23)
10(BE1)	13(BE23)
1(BE22)	3(BE26)
2(BE22)	8(BE22)
3(BE22)	13(TB1)
4(BE22)	10(BE23)
5(BE22)	28(BE26)
6(BE22)	30(BE26)
9(BE22)	2(BE26)
10(BE22)	25(BE26)
2(BE23)	3(TB3)
5(BE23)	5(BE25)
6(BE23)	2(BE25)
7(BE23)	25(TB1)
9(BE23)	9(TB3)
11(TB1)	19(TB1)
12(BE23)	9(BE25)
13(BE23)	4(BE25)
15(BE23)	12(TB1)
16(BE23)	17(TB3)
17(BE23)	(A)NET.
19(BE23)	5LG(TB4)
20(BE23)	12(TB3)
3(BE25)	27(BE26)
7(BE25)	1(BE27)
7(BE25)	1(BE26)
8(BE25)	3(BE27)
10(BE25)	23(BE26)
4(BE26)	4(BE27)
5(BE26)	17(BE26)
6(BE26)	22(BE26)
6(BE26)	2(TB2)
8(BE26)	24(BE26)
9(BE26)	8(BE27)
14(BE26)	6(BE27)
14(BE26)	16(BE26)
16(BE26)	29(BE26)
22(BE26)	5(BE27)
26(BE26)	5(TB3)
3(BE23)	4(TB3)
2(BE26)	18(BE26)
3(BE26)	22(BE26)
4(TB3)	6(TB3)
7(TB3)	12(TB3)
8(TB3)	11(TB3)

202E9*

| ADD FROM	ADD TO
1(BE1)	6(BE25)
1(BE1)	11(TB3)
2(BE1)	4(TB2)
4(BE1)	4(BE23)
4(BE1)	1(BE25)
5(BE1)	5(TB2)
6(BE1)	2(TB1)
6(BE1)	8(BE23)
7(BE1)	3(BE22)
7(BE1)	10(BE25)
8(BE1)	14(TB1)
10(BE1)	3(BE23)
10(BE1)	13(BE23)
1(BE22)	3(BE26)
2(BE22)	8(BE22)
3(BE22)	13(TB1)
4(BE22)	10(BE23)
5(BE22)	28(BE26)
6(BE22)	30(BE26)
9(BE22)	2(BE26)
10(BE22)	25(BE26)
2(BE23)	3(TB3)
5(BE23)	5(BE25)
6(BE23)	2(BE25)
7(BE23)	25(TB1)
9(BE23)	9(TB3)
11(BE23)	19(TB1)
12(BE23)	9(BE25)
13(BE23)	4(BE25)
15(BE23)	12(TB1)
16(BE23)	17(TB3)
17(BE23)	(A)NET.
19(BE23)	5LG(TB4)
20(BE23)	12(TB3)
3(BE25)	27(BE26)
7(BE25)	1(BE27)
7(BE25)	1(BE26)
8(BE25)	3(BE27)
10(BE25)	23(BE26)
4(BE26)	4(BE27)
5(BE26)	17(BE26)
6(BE26)	22(BE26)
6(BE26)	2(TB2)
8(BE26)	24(BE26)
9(BE26)	8(BE27)
14(BE26)	6(BE27)
14(BE26)	16(BE26)
16(BE26)	29(BE26)
22(BE26)	5(BE27)
26(BE26)	5(TB3)
1(BE22)	21(BE92)
9(BE22)	22(BE92)
3(BE23)	8(BE92)
4(BE23)	1(BE92)
8(BE92)	6(TB3)
9(BE92)	4(TB3)
10(BE92)	22(BE26)
26(BE92)	18(BE26)
3(TB1)	2(TB3)

*Block TST B key.
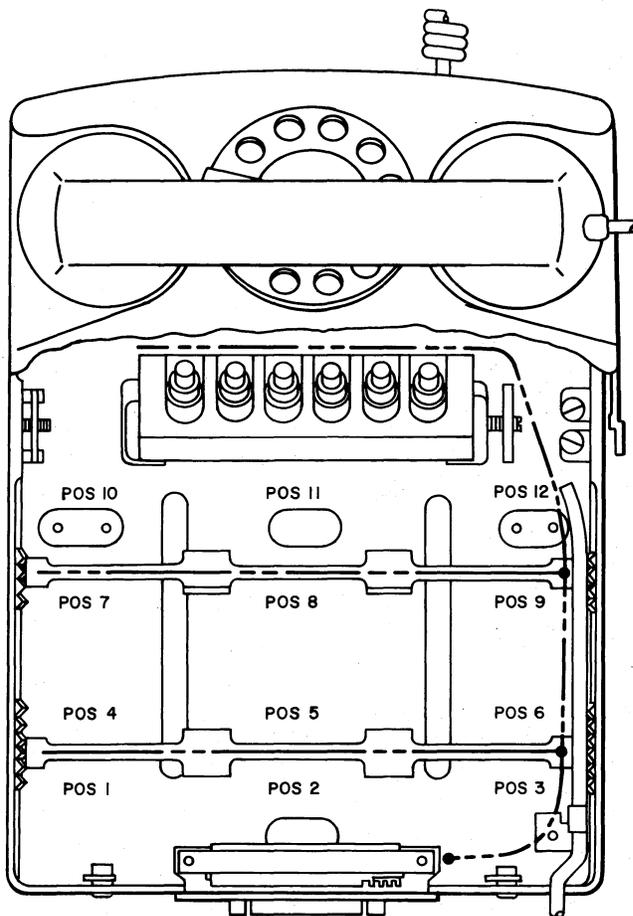
Fig. 4—Circuit Pack Locations

cause sharp transitions of the output voltage and to prevent long time constants involved in the change from one voltage state to the other from reaching the EIA interface. Transistor Q8 and associated circuitry make up a driver amplifier which increases the voltage output of the rectifier to agree with EIA standards. The output of the reverse-channel module is connected to the business machine through the unoperated TST A button and the supervisory received data (SBB) lead.

3.09 The 25-volt ac power taken from the transformer is rectified by a full-wave bridge in circuit pack BE1. The dc voltage is taken through a voltage regulator which holds the voltage at the desired level of +8 Vdc and −8 Vdc. The power rectifier also has a +Ec voltage tap, which provides a source of unregulated 13 to 27 volts dc, and two additional taps (pins 10 and 9 of J1) which supply auxiliary voltages to be used when needed by telephone company test equipment.

DATA SET 202E7

3.10 This set includes automatic answer, EIA interface, power rectifier, and remote test modules in addition to common equipment. With the automatic answer module, the data set can detect ringing, answer the call, transmit the answer tone, connect the modulator to the line, and transmit data-set-ready and clear-to-send indications to the business machine.

→ TABLE D ←

DATA SET	BOARD MOUNTING POSITION											
	1	2	3	4	5	6	7	8	9	10	11	12
202E1	BE60†	—	BE22	—	—	—	—	—	—	—	—	—
202E2	BE60†	BE1	BE22	—	—	—	BE92‡			—	—	—
202E7	BE60†	BE1	BE22	BE25	BE23		—	—	—	BE26		
202E8*	BE6	BE1	BE16	BE5	BE17		BE8			BE7		
202E9	BE60†	BE1	BE22	BE25	BE23		BE92‡			BE26		

*Manufacture Discontinued
†BE27 or BE58 on older sets
‡BE24 on older sets

3.11 In the automatic answer module, ringing current from the central office is rectified by a full-wave bridge rectifier CR1 in the ring detector circuit (Fig. 7). Rectifier CR1, transistors Q1 and Q2, and relay R make up the ring detector circuit. Transistors Q1 and Q2 act as switches which control current through relay R. When relay R operates, it provides a dc path for central office current to flow so that the call can be answered. This current operates the H relay, thus providing current to transistor switch Q7 which connects the serial modulator to the line. The R relay also controls transistors Q3 and Q4 which make up a flip-flop circuit which controls the transmission of answer tone. Transistors Q5 and Q6 and the B relay make up a circuit which holds the call on-line. The B relay also connects the business machine to the input of the serial modulator and supplies a contact closure to the timing circuits in the EIA interface module which provides data-set-ready and clear-to-send indications back to the business machine.

3.12 The EIA interface module is made up of timing circuits, relay driver, and C relay. Transistors Q1 to Q6 make up the timing circuit which is used to supply the business machine at the proper time with data-set-ready and clear-to-send voltage indications of at least ±5 Vdc under the control of relay contact closures in the automatic answering circuit. If the automatic answering circuit does not complete its answer sequence, the data-set-ready (CC) and clear-to-send (CB) interface leads will supply at least -5.0 volts dc to the business machine. The operation of the B relay does not guarantee the completion of the answer sequence in the automatic answering circuit; therefore, the $+5.0$ volt dc clear-to-send indication necessary to begin data transmission is supplied after a delay of 325 (±125) msec after the B relay operates. This insures that the circuits are prepared for data transmission when clear-to-send is given.

3.13 Transistor Q7 and its associated circuits make up the relay driver. The C relay contact closure is caused by the data-terminal-ready indication from the business machine. Operation of the C relay connects the line coupler to the tip and ring terminals.

3.14 Depression of the TST A button operates the TR relay in the remote test module. Data Set 202E7 can enter the test mode only when the clear-to-send (CB) and data-set-ready (CC) leads

are OFF. These control leads will normally be OFF when the data set is in the talk mode. Operation of the TR relay supplies current to light the test lamp under the TST A button, isolates the business machine from the data set, and conditions the data set for automatic answer.

DATA SET 202E8 (MANUFACTURE DISCONTINUED)

3.15 This set combines the features of Data Sets 202E2 and 202E7. Data Set 202E8 is functionally the same as the 202E9; however, Data Set 202E8 cannot be converted to any other data set. Therefore, the conversion methods described in 2.12 do not apply. As shown in Fig. 8, the circuit pack codes and associated terminal numbers in the 202E8 are different from the other data sets.
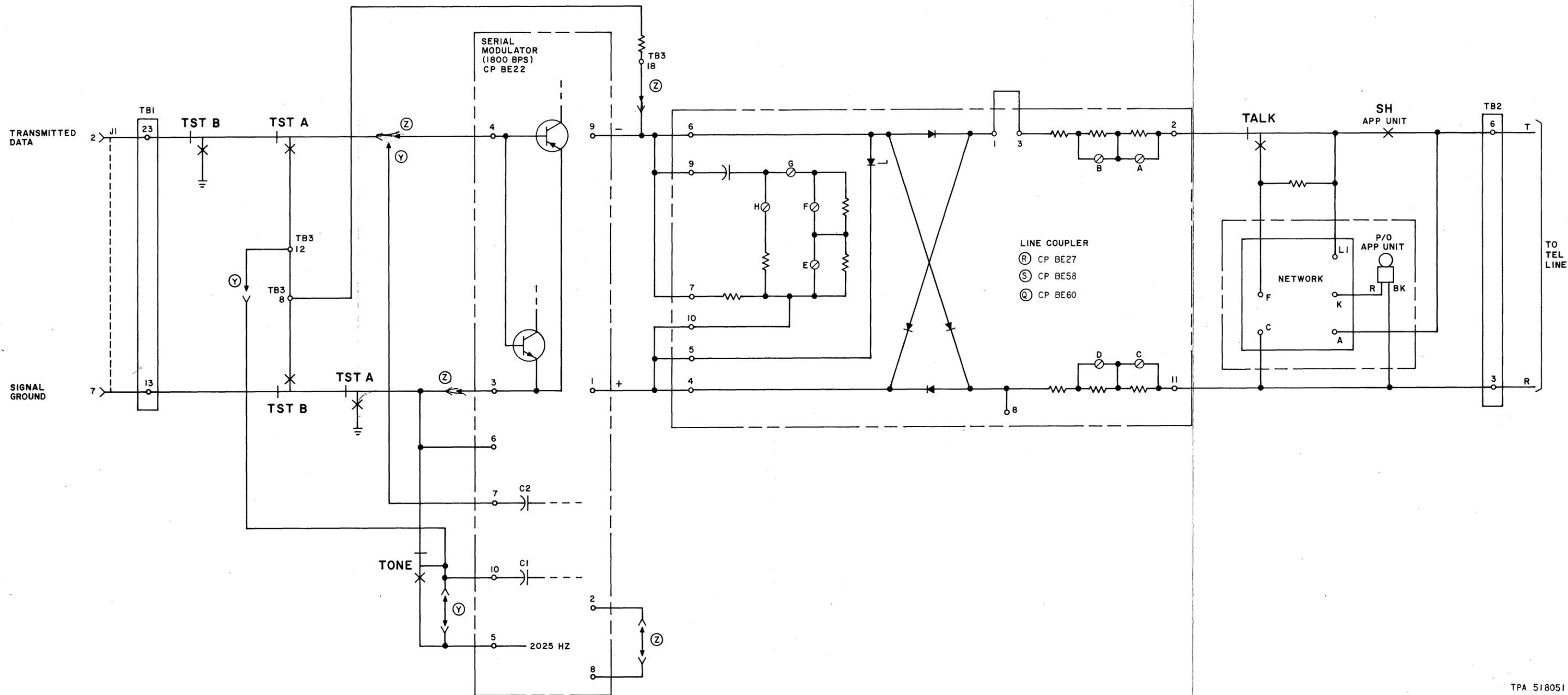
DATA SET 202E9

3.16 Data Set 202E9 (Fig. 9) consists of a Data Set 202E7 with the addition of the reverse-channel module. The description of modules in Data Set 202E9 is the same as that in the 202E2 and 202E7 with the following exception. In the remote test circuit, the reverse-channel output of the 202E9 is connected to the input of the modulator, thereby allowing the reverse-channel signal to key the modulator. This allows the data test center to control the remote testing of Data Set 202E9.

4. TEST PROCEDURES

4.01 The following test procedures do not cover all trouble possibilities in Data Sets 202E-type. The tests are designed to indicate which wiring board should be replaced as a logical choice to repair a trouble condition. Refer to the section entitled Data Set 202E-Type Transmitter, Test Procedures (592-018-500) for an interface test of this data set. Refer to the functional diagrams for the circuit locations of terminals and pin numbers for each type of data set. When the trouble has been localized to a particular module and that module has been replaced, the data set should be retested to verify that it is meeting requirements.

4.02 Because of the differences between models of Data Sets 202E-type, the data sets will be divided into categories of similarity, and each

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Fig. 5—Data Set 202E1, Functional Block Diagram
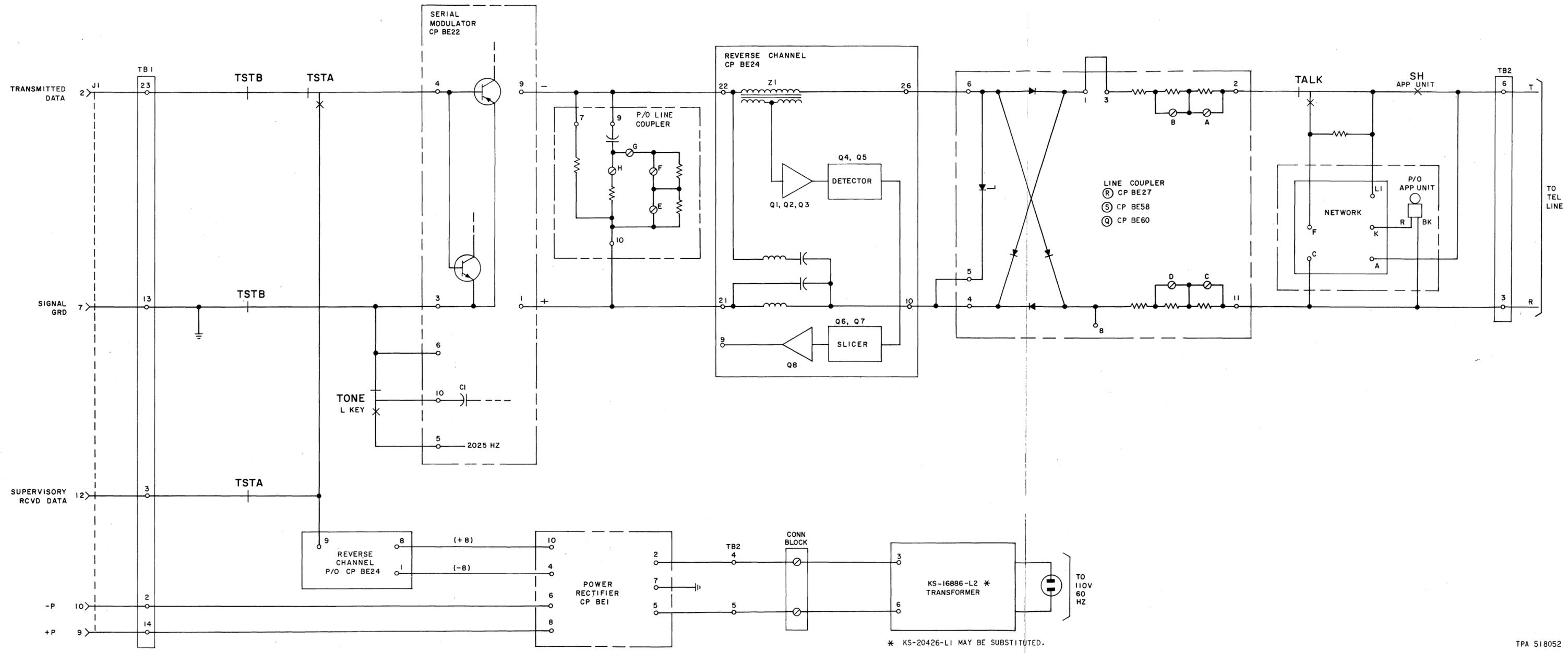
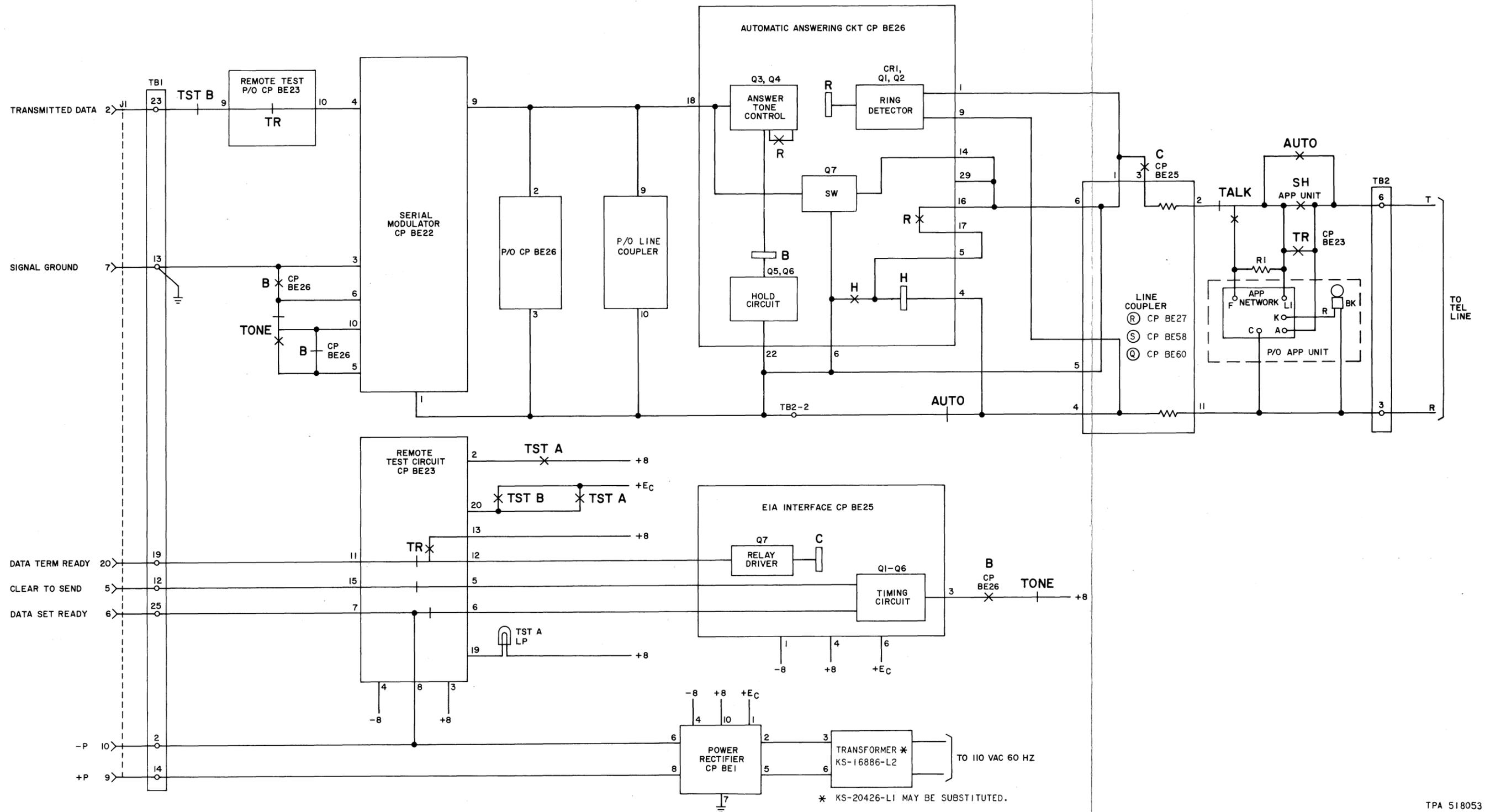Fig. 6—Data Set 202E2, Functional Block Diagram

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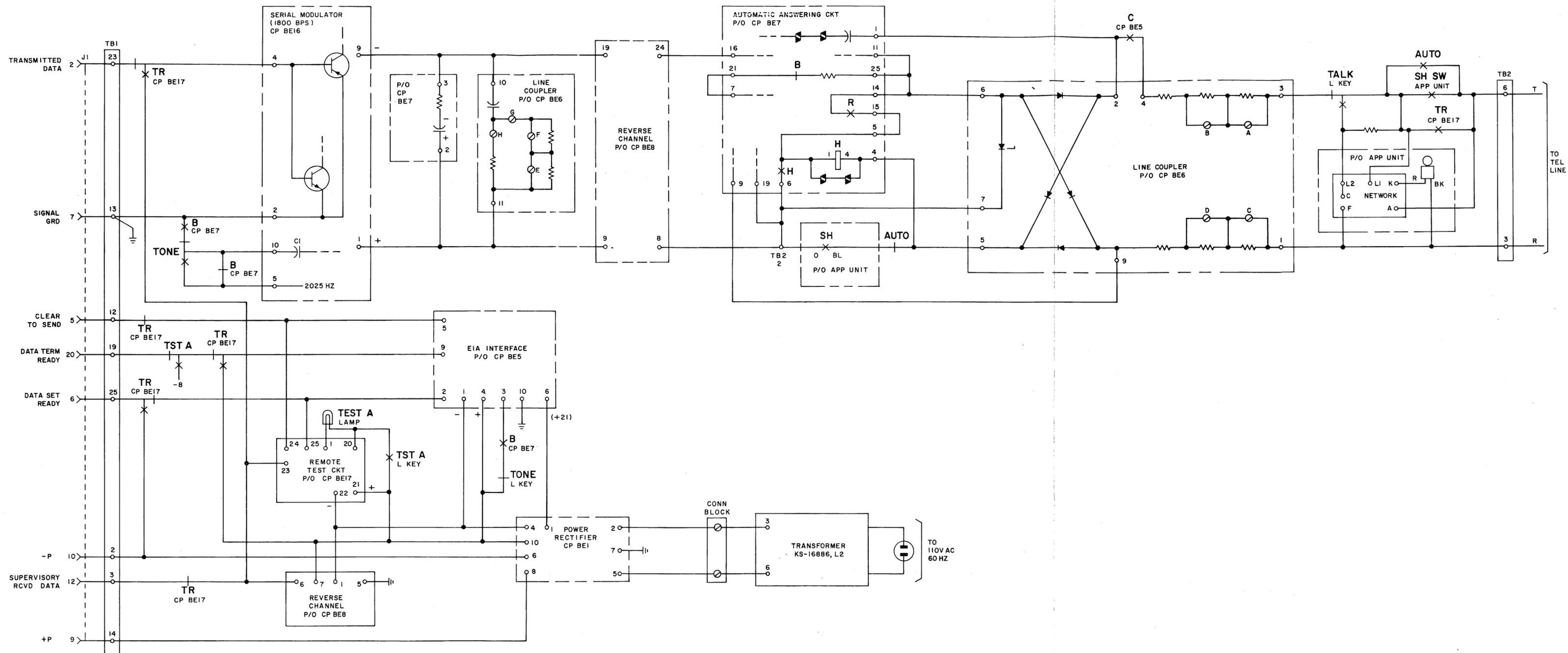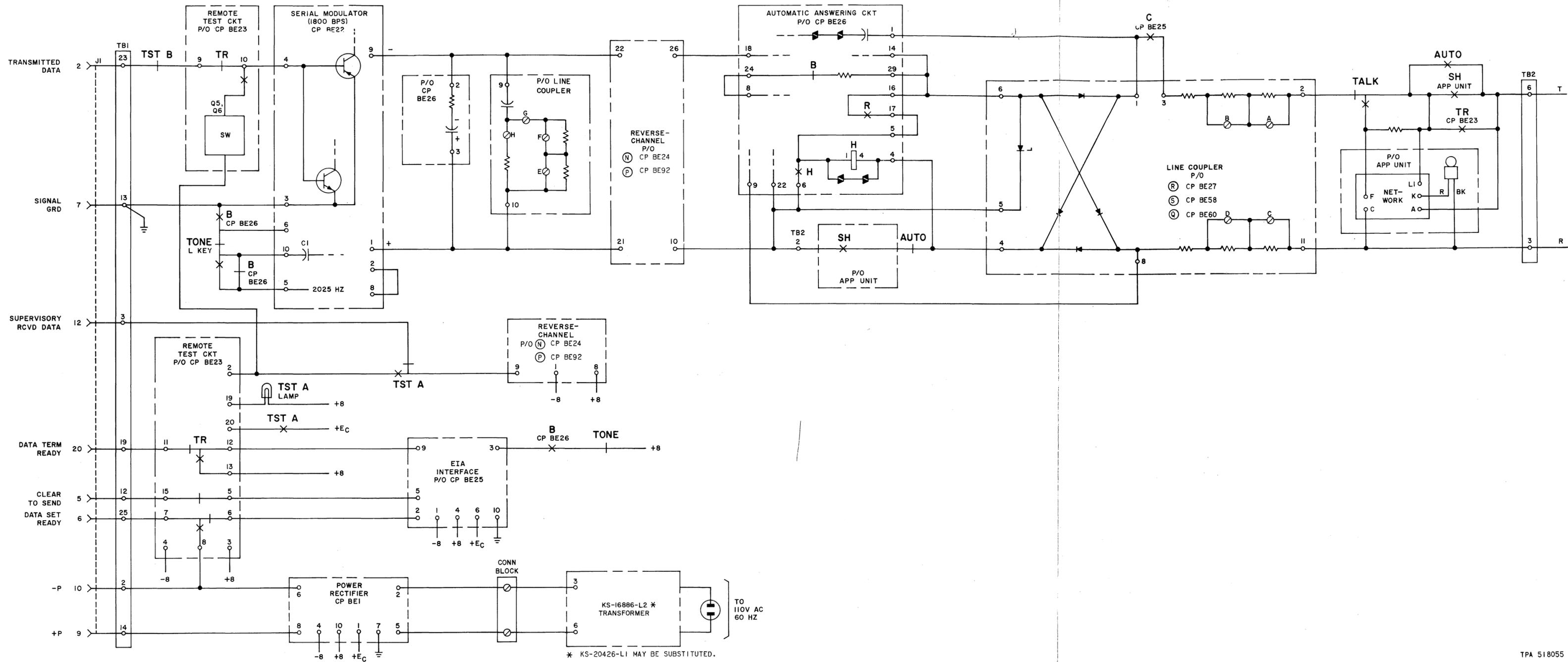**Fig. 7—Data Set 202E7, Functional Block Diagram**

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Fig. 8—Data Set 202E8, Functional Block Diagram

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Fig. 9—Data Set 202E9, Functional Block Diagram

category will be supplied with an independent test. The different categories are as follows:

- Data Sets 202E1 and 202E10
- Data Sets 202E2 and 202E11
- Data Sets 202E7 and 202E12
- Data Sets 202E9 and 202E13.

DATA SETS 202E1 AND 202E10

4.03 The following test equipment is required to perform this test:

1—914B Data Test Set

1—Frequency counter—Hewlett Packard 5321 or equivalent

4.04 Because Data Sets 202E1 and 202E10 are line powered sets, this test should be performed with the data set connected to the telephone line unless some other arrangement can be made to supply 48 volts dc to simulate line power. Dial a quiet termination. The test is performed as follows.

(1) Connect the 914B Data Test Set (DTS) to the Data Set 202E interface connector. Use interface connector A on the 914B DTS and verify that all A interface selector switches are pushed in.

(2) Insert a red pin into position 7-GRD and 2-S1 on the matrix board of the 914B DTS.

(3) Set the controls on the 914B DTS as follows:

INTERFACE MODE switch to VOLTAGE or CONTACT

S1—S8 switches to OFF

FUNCTION switch to OFF.

(4) Disregard the settings of the other switches.

(5) Remove the data set cover.

(6) Connect the counter to pin 5 of CP BE22 with ground connected to pin 3 of CP BE22. (If the data set is arranged for contact closure

interface, connect the counter to pin 8 of CP BE22 with ground to pin 3.)

(7) Apply power to the data set and to the 914B DTS.

(8) Move switch S1 to ON. Read the mark signal on the counter.

Requirement: 1300 ($+25$) Hz for EIA interface (marking, -5 volts)

Requirement: 1375 ($+25$) Hz for contact interface (marking, contact closed)

(9) Move switch S1 to OFF. Read the space signal on the counter.

Requirement: 2100 ($+25$) Hz for EIA interface (spacing, $+5$ volts)

Requirement: 2025 ($+25.0$) Hz for contact interface (spacing; contact open)

(10) If the data set fails the test, card BE22 or the line coupler (BE27, BE58, or BE60) may be defective.

(11) At the completion of the test, disconnect the test equipment and restore the data set to normal.

DATA SETS 202E2 AND 202E11

4.05 This test consists of checking the mark and space frequencies and reverse-channel receiver. The following test equipment is required:

1—914B Data Test Set

1—Frequency counter, Hewlett Packard 5321 or equivalent

1—Transmission Test Set TTS 4AN equipped with TTS 4XV or TTS 4XDV cover (variable frequency oscillator).

4.06 The test is performed as follows.

(1) Connect the 914B DTS to the Data Set 202E interface connector. Use connector A on the 914B DTS and verify that all A interface selector switches are pushed in. Connect the data set to a telephone line and dial a quiet

termination. The data set must be in the data mode.

(2) Insert a red pin into positions 7-GRD, 2-S1, and 12-DS1 on the matrix board of the 914B DTS.

(3) Set the controls on the 914B DTS as follows:

INTERFACE MODE switch to VOLTAGE

S1—S8 switches to OFF

FUNCTION switch to OFF.

(4) Disregard the settings of the other switches.

(5) Remove the data set rear cover.

(6) Connect the counter to pin 5 of CP BE22 with ground to pin 3 of CP BE22.

(7) Apply power to the data set and to the 914B DTS.

(8) Read the mark signal on the counter.

Requirement: 1275 to 1325 Hz

(9) Move switch S1 to ON. The mark signal should change to space. Measure the space signal on the counter.

Requirement: 2075 to 2125 Hz

(10) Connect the TTS 4 cover to the line using the LINE terminals.

(11) Plug the connector at the end of the cable in the cover into the connector on the TTS 4AN marked EXT FREQ.

(12) On the TTS 4AN, move the SEND FREQ switch to EXT.

(13) On the TTS 4AN cover, set the VFO control to 387 Hz.

(14) On the TTS 4AN, set the SEND LEVEL switch to −20. Set the FUNCTION switch to SEND REC, the LINE switch to SEND, the SEND IMP switch to 900Ω.

(15) On the TTS 4AN, move the POWER switch to ON. The DS1 lamp on the 914B DTS should light. This indicates that the reverse-channel detector has recognized the 387-Hz tone.

(16) If the data set fails the test, the serial modulator circuit board or the reverse-channel circuit board may be defective.

(17) At the completion of the test, disconnect the test equipment and restore the data set to normal.

DATA SETS 202E7 AND 202E12

4.07 This test consists of checking the mark and space frequencies and the automatic answer unit. The following test equipment is required:

1—914B Data Test Set

1—Frequency counter, Hewlett Packard 5321 or equivalent.

4.08 Because the automatic answer unit is line powered, this test should be performed with the data set connected to the telephone line. The test is performed as follows.

(1) Connect the 914B DTS to the Data Set 202E interface connector. Use connector A on the 914B DTS and verify that all A interface selector switches are pushed in.

(2) Insert red pins into positions 7-GRD, 2-S1, 5-DS1, 6-DS2, and 20-S2 on the matrix board of the 914B DTS.

(3) Set the controls on the 914B DTS as follows:

INTERFACE MODE switch to VOLTAGE

S1—S8 switches to OFF

FUNCTION switch to OFF.

(4) Disregard the settings for the other switches.

(5) Remove the data set rear cover.

(6) Connect the counter to pin 5 of CP BE22 with ground to pin 3 of CP BE22.

(7) Apply power to the data set and to the 914B DTS. Move switch S2 to ON. On the Data Set 202E, press the AUTO button.

(8) Dial the number associated with the data set by using a nearby telephone set. The data set will answer automatically. When ringing stops, lamps DS1 and DS2 will light. Lamp DS1 is associated with clear-to-send and lamp DS2 is associated with the data-set-ready lead.

(9) The data set will go to the data mode and transmit a mark signal. Measure the mark frequency on the counter.

Requirement: 1275 to 1325 Hz

(10) On the 914B DTS, move switch S1 to ON. The data set will transmit a space signal. Measure the space frequency on the counter.

Requirement: 2075 to 2125 Hz

(11) If the data set fails to answer correctly or if clear-to-send and data set ready do not go positive when specified, the automatic answer circuit board may be defective. If the mark and space tones are not as specified, the serial modulator circuit board may be defective.

(12) At the completion of the test, disconnect the test equipment and restore the data set to normal.

DATA SETS 202E9 AND 202E13

4.09 This test consists of checking the mark and space frequencies, the reverse-channel receiver, and the automatic answer unit. The following test equipment is required:

1—914B Data Test Set

1—Frequency counter, Hewlett Packard 5321 or equivalent

1—Transmission Test Set TTS 4AN equipped with TTS 4XV or 4XDV cover (variable frequency oscillator).

4.10 Because the automatic answer unit is line powered, the test must be performed with the data set connected to the telephone line. The test is performed as follows.

(1) Connect the 914B DTS to the Data Set 202E interface connector. Use connector A on the 914B DTS and verify that all A interface selector switches are pushed in.

(2) Insert red pins into positions 7-GRD, 2-S1, 5-DS1, 6-DS2, 12-DS3, and 20-S2 on the matrix board of the 914B DTS.

(3) Set the controls on the 914B DTS as follows:

INTERFACE MODE switch to VOLTAGE

S1—S8 switches to OFF

FUNCTION switch to OFF.

(4) Disregard the settings of the other switches.

(5) Remove the data set cover. Connect the counter to pin 5 of CP BE22 with ground connected to pin 3 of CP BE22.

(6) Apply power to the data set and to the 914B DTS. Move switch S2 to ON. On the Data Set 202E, press the AUTO button.

(7) Dial the number associated with the data set by using a nearby telephone set. The data set will answer automatically. When ringing stops, lamps DS1 and DS2 will light. Lamp DS1 is associated with clear-to-send and lamp DS2 is associated with the data-set-ready lead.

(8) The data set will go to the data mode and transmit a mark signal. Measure the mark frequency on the counter.

Requirement: 1275 to 1325 Hz

(9) On the 914B DTS, move switch S1 to ON. The data set will transmit a space signal. Measure the space frequency on the counter.

Requirement: 2075 to 2125 Hz

(10) Connect the TTS 4 cover to the line using the LINE terminals.

(11) Plug the connector at the end of the cable in the cover into the connector on the TTS 4AN marked EXT FREQ.

(12) On the TTS 4AN, move the SEND FREQ switch to EXT.

(13) On the TTS 4AN cover, set the VFO control to 387 Hz.

(14) On the TTS 4AN, set the SEND LEVEL switch to −20. Set the FUNCTION switch to SEND REC, the LINE switch to SEND, the SEND IMP switch to 900Ω.

(15) Move the TTS 4AN POWER switch to ON. The DS3 lamp on the 914B DTS should light. This indicates that the reverse-channel detector has recognized the 387-Hz tone.

(16) If the data set fails to answer automatically or if clear-to-send and data set ready do not go positive when specified, the automatic answer circuit board may be defective. If the mark and space frequencies are not correct, the serial modulator or the line coupler may be defective. If the reverse-channel indication (supervisory received data—lead 20) is not as specified, the reverse-channel circuit board may be defective. If the circuit boards are not available, return the data set for repair.

(17) Upon completion of the test, disconnect the test equipment and restore the data set to normal.

4.11 All models of Data Set 202E-type are provided with a 2025-Hz tone for disabling echo suppressors. The data set should be tested for proper operation of this tone as follows.

(1) Disconnect test equipment from the interface of the data set.

(2) Dial a quiet termination.

(3) Connect the counter to pin 8 of CP BE22 with ground to pin 10.

(4) With the data set TONE button pressed in, read the tone frequency on the counter.

   Requirement: 2025 (±15.0) Hz

(5) If the data set fails the specified requirements, card CP BE22 may be defective.

(6) Upon completion of the test, disconnect the test equipment and restore the data set to normal.

5.   REFERENCE INFORMATION

5.01   The following is a list of reference information relative to Data Set 202E-type:

● Bell System Practices

   592-018-100, Description and Operation

   592-018-200, Installation

   592-018-300, Maintenance

   592-018-500, Test Procedures

   668-102-513, Data Test Center—904A- and 904C-Types, Test Procedures

● Technical Reference, Data Set 202E Series

● Bell System Repair Specification No. 480.068.