

**DATA SET 205B-TYPE
TRANSMITTER-RECEIVER
THEORY OF OPERATION
AND
SUPPLEMENTARY INFORMATION**

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1. GENERAL

1.01 This section provides both a detailed theory of data set operation and data set testing using complex test equipment (ie, oscilloscopes, counters, etc). The tests are designed to assist in localizing a malfunction which may not have been determined in testing with more common test sets. Testing of individual circuit packs is included in the appendix. The complete detailed circuit descriptions and schematic drawings are

provided in CD- and SD-1D085-01. Circuit sketches of the individual circuit packs are provided by SD-1D060-01 (sheets J1 through J12).

1.02 This section is reissued to provide circuit pack identification by apparatus coding (two digits prefixed by "AR"). Previous documentation for the data set identified circuit packs by the last three digits of the equipment code (six digits prefixed by "A").

1.03 The coding used in this practice when circuit packs are referenced contains the present "AR" coding, the last three digits of equipment coding for early manufactured data set reference, and the circuit pack location which is separated by a slant line. The reference AR95 (181)/019 should be interpreted as the circuit pack with apparatus code AR95, equipment coded A835181, and in data set slot location 019.

1.04 A separate code is used to establish the data set mnemonic symbols to the Electronic Industries Association (EIA) Standard RS-232-B symbols and separated by a slant line. The send data interface lead is mnemonically abbreviated SD and will meet the RS-232-B requirements of circuit BA. The coding SD/BA symbolizes both abbreviations.

1.05 The Data Set 205B is a 4-wire, full-duplex modem that uses synchronous 4-phase modulation for transmission of serial binary data at 600, 1200, and 2400 bits per second (bps). Transmission is over voice frequency circuits using an 1800-Hz carrier with the line signal spectrum essentially confined in the band extending from 600 to 3000 Hz.

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1.06 The Data Set 205B1 is the earlier private line version which is rated Manufacture Discontinued. The Data Set 205B2 contains all of the features and capabilities of the 205B1 plus the ability to operate on switched 4-wire facilities when used with an appropriate line control unit, such as Data Auxiliary Set (DAS) 804M. For the purposes of this practice, the features described are the same in both sets unless specifically noted.

1.07 Data Set 205B-type can be used as a terminal data set or as part of a regenerative repeater. Two data sets, back-to-back, are required to make one regenerator. The terminal data sets can operate independently at any of the three data rates in each direction of transmission under control of customer interface control signals.

1.08 For 4-wire switched network operation, Data Set 205B2 can be operated with a DAS 804M or a 5A-type Data Mounting Unit. The DAS 804M is intended for single data set installations. It contains a 4-wire line control circuit and a telephone unit in a medium-sized data set housing. The 5A-type Data Mounting is intended for multiple data installations. It contains line control circuitry for up to six associated data sets. Both line control circuits provide automatic answering, answer-tone generation, line transfer, and disconnection from the data mode. A DAS 801C4 [automatic calling unit (ACU)] can also be used with either of the above arrangements.

1.09 The data set transmitter accepts serial binary data at the selected data rate, synchronous with a bit rate timing signal, and produces the phase-modulated line signal. Transmitter timing can be provided internally or derived from a customer-supplied external source. The internally generated timing is accurate to within 0.0005 percent. Customer-provided timing must be accurate to at least 0.01 percent.

1.10 The modulation technique of the Data Set 205B transmitter is basically the same as that employed in the Data Set 201B transmitter. However, the method of recovering the clock signals in the receiver is different. In the Data Set 205B receiver, the recovered clock is derived by phase-correcting a stable timing wave to coincide with the demodulated data crossings. Accurate

timing signals in the receiver allow it to maintain synchronization with an associated transmitter. The transmitter is internally timed or has equally accurate external timing for a minimum of 6 seconds in the absence of data transitions or in the event of circuit interruption.

1.11 The data set can be operated in the switched or continuous carrier mode. In the switched mode, the carrier is controlled by the status of the request-to-send (RS/CA) interface lead. When RS/CA is switched ON, a synchronizing pattern is transmitted for an interval of time to allow far-end receiver synchronization before the data set provides clear-to-send (CS/CB). More detail is provided in Part 4 of this section.

1.12 Data, clock, and control signals are interchanged through the 25-pin CUSTOMER connector. Pin selection is in accordance with EIA Standard RS-232-B where applicable. Connector pin numbers and circuit functions are defined in Part 6 of this section. In addition to the signals that conform to RS-232-B, speed selection and remote test control are available at this interface. The ON-OFF control signals on pins 13 and 14 and pins 18 and 23 select the speed of the data set transmitter and receiver, respectively. Each pair of speed select leads provides four modes of operation: 600, 1200, 2400 bps, or the regenerate mode. Remote test can be controlled by pin 25 in addition to control from the data set LINE—TEST key, or the line control unit, if used. All data and clock signals, except serial clock transmit external (SCTE/DA), used for external transmitter timing, meet the electrical requirements of Military Standard 188B (hereafter abbreviated as MIL. STD 188B). The SCTE/DA lead and all control leads meet the electrical requirements of EIA Standard RS-232-B. The connector is a 25-pin receptacle. The customer must supply the mating plug (Cinch or Cannon DB-19604-432), hood (Cinch or Cannon DB-51226-1), and cabling.

1.13 The Data Set 205B-type can be powered either by a DAS 819A-type or by a customer-provided dc supply. The DAS 819A operates on 117 (± 10 percent) volts, 60 (± 0.8) Hz. It will not operate on 50-Hz power. The customer can supply dc power directly to the data set by means of a 40-inch power cord (supplied with the data set) which mates with the data set power

plug and is terminated in spade lugs. The customer must provide plus and minus 18.75 volts dc with respect to signal ground (SG/AB).

1.14 The DAS 819A1 can power one Data Set 205B, and the 819A2 can power two data sets or one regenerative repeater. If an 819A-type power supply is required, it must be ordered in addition to the Data Set 205B. For further information, refer to the section entitled Data Auxiliary Set 819A, Identification and Operation (598-040-100).

1.15 The Data Set 205B, the DAS 804M, and the DAS 819A-type are designed to operate over an ambient room temperature range of +50 to +120°F and a relative humidity range of 20 to 95 percent.

1.16 The data set and power supplies are designed to mount in a 23-inch relay rack. The Data Set 205B is 12 inches high, 9 inches deep, and 23 inches wide. The DAS 819A-type is 6 inches high, 9 inches deep, and 23 inches wide. The DAS 804M is designed for a table or some suitable location for customer access and control. The unit is 3-1/2 inches high, 9 inches deep, and 9 inches wide.

2. SYSTEM CONFIGURATION AND OPERATION

2.01 The Data Set 205B can be used in point-to-point private line or 4-wire switched network configurations (Fig. 1). More elaborate system configurations can be developed from these basic types.

A. Point-to-Point Private Line

2.02 In this configuration the data set is connected directly to the telephone line. Normally, the continuous carrier mode would be used. In this mode, an internally generated pattern is transmitted when request-to-send (RS/CA) is OFF to keep the far-end receiver synchronized to the transmitter. The customer places RS/CA ON during the time he is transmitting data. The switched carrier mode can be used for private line applications, such as multiparty configurations.

2.03 For private line connections that are too long to be equalized from end-to-end as required, one or more regenerative repeaters may be placed at intermediate points in the connection. A connection between locations on different continents may be an example of such a situation. The over-all error rate will be the sum of the individual regenerator link error rates.

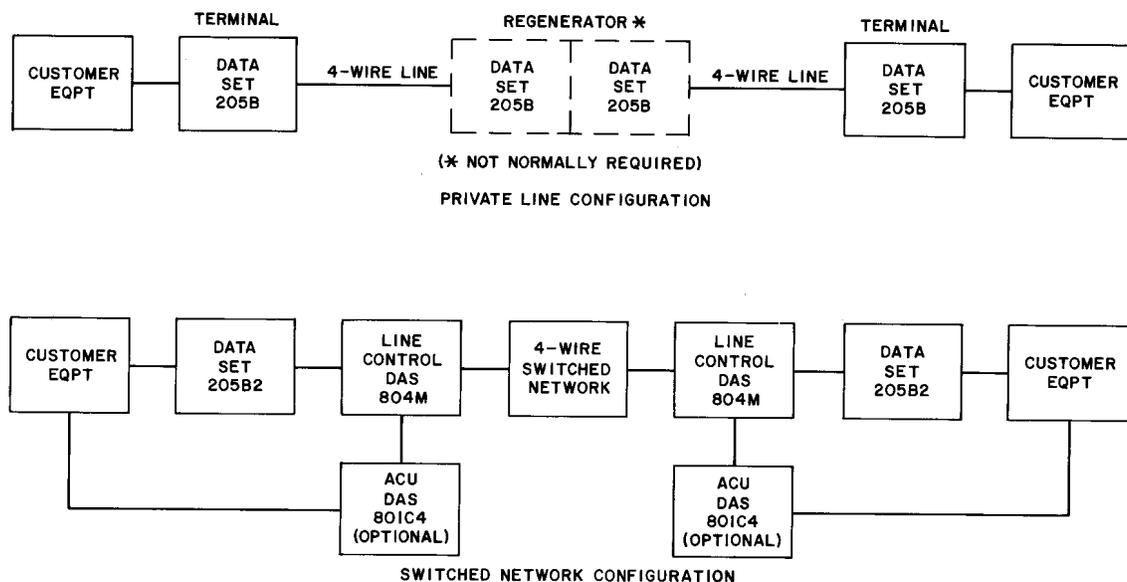


Fig. 1. — System Configurations

B. Switched Network Operation (205B2 Only)

2.04 The Data Set 205B2 will operate on a 4-wire switched network when used in conjunction with a line control unit, such as the DAS 804M. In addition, a DAS 801C4 may be used to provide automatic calling. Figure 2 is a time-sequenced diagram that shows the procedure for originating a call to a called station by using the switched carrier automatic answer mode.

Automatic Answer

2.05 An idle station will detect the presence of ringing and give an indication to the business machine on the ring indicator (RI/CE) lead. To answer the call, the business machine must give an indication to the data station on the data terminal ready (DTR/CD) lead. Upon automatically answering, the line control circuit holds the transmitting pair quiet for 1.1 seconds and then applies a 2025-Hz tone for at least 0.5 second. After the tone is transmitted, the transmission line is transferred to the data set, and an indication is given to the business machine on the DTR/CD lead. At this time request-to-send (RS/CA) can be initiated by the business machine. The set will indicate clear-to-send (CS/CB) to the business machine after a 2.5 second timed interval if the switched carrier automatic answer mode is used.

Automatic Calling

2.06 A data station that is idle is placed off-hook by the automatic calling unit (ACU). The ACU proceeds to dial the far-end station. When the far-end station automatically answers, it will transmit 2025-Hz tone back for at least 0.5 second. The end of the 2025-Hz tone transmission is detected by the ACU, and an indication is given to the associated line control circuit. This indication places the data set on-line, and the business machine is given a data set ready (DSR/CC) indication. At this time, request-to-send (RS/CA) can be initiated by the business machine. The set will indicate clear-to-send (CS/CB) to the business machine after a 2.5-second timed interval if the switched carrier automatic answer mode is used.

Manual Calling

2.07 An idle data station is placed off-hook by an attendant. The attendant proceeds to dial the connection in the normal manner. The far-end data station will automatically answer and transmit 2025-Hz tone back for at least 0.5 second. Upon hearing this tone, the attendant pushes the DATA button on the line control unit. This action places the data set on-line and gives the business machine a data set ready (DSR/CC) indication. For operation at 2400 bps and using the continuous carrier automatic answer mode, the attendant should push the DATA button within 2 seconds of hearing the 2025-Hz tone from the far end to guarantee that the near-end data set receiver is in synchronism before data transmission begins. After DSR/CC is received by the business machine, request-to-send (RS/CA) can be initiated.

Remote Release

2.08 At the termination of data transmission, the business machines at both ends of the connection shall operate the data terminal ready (DTR/CD) lead to cause the data stations to go on-hook and resume an idle state.

3. SUMMARY OF CONNECTORS AND OPTION STRAPPING

3.01 The following summary describes both external and internal connections required for data set operation. Option strapping is included for reference convenience. Detailed strapping requirements are included in later descriptions.

3.02 Interface Connectors of Data Set 205B1:

(a) **Data, Clock, and Control Interface — CUSTOMER Connector:**

A 25-pin connector allows the interchange of clock, data, and control signals between the data set and customer equipment (Part 6) or between halves of a regenerative repeater (Part 7).

(b) **Power Supply Connector:**

The data set accepts dc supply voltages through a 6-pin connector. Power may be supplied by a DAS 819A-type or by a customer-provided supply. A 40-inch cord is provided for connection to the customer supply (see 1.13 through 1.16).

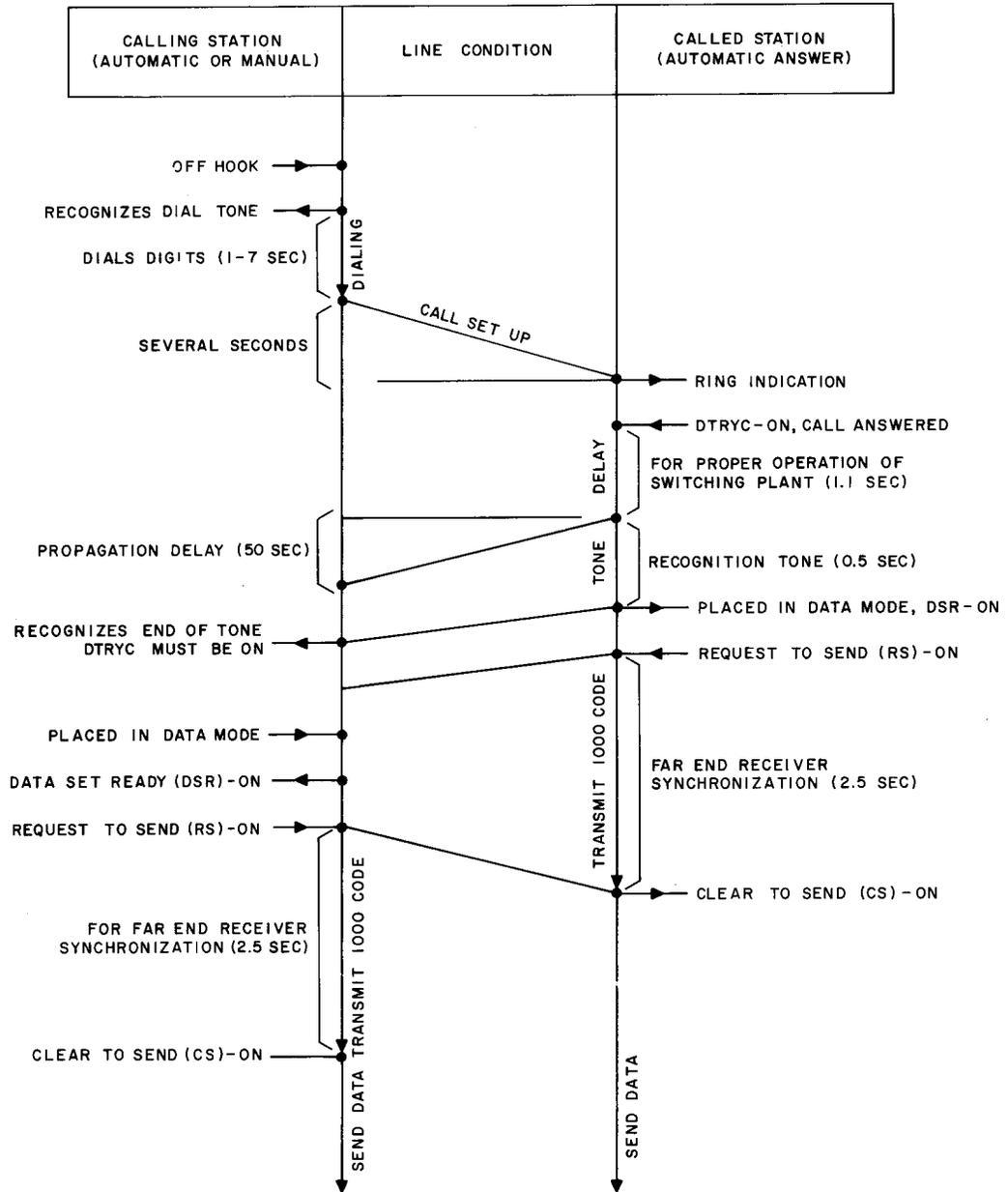


Fig. 2 — Sequence Diagram for Switched Operation (Data Set 205B2 Only)

(c) **Telephone Line Connector:**

- (1) **Data Set 205B1:** Four screw-type terminals connect the 4-wire telephone facility to the data set.
- (2) **Data Set 205B2:** For use with a line control unit, such as the DAS 804M, a 25-pin CONTROL connector is provided to allow interchange of the telephone line and certain control signals between the data set and the line control unit. Four screw-type terminals are also available to connect the 4-wire telephone facility to the data set for use on private lines where a line control unit is not required. For operation without the line control unit, the CONTROL connector can be used to initiate remote test and to indicate remote test and local test conditions (Part 8).

3.03 Data Set Internal Connections and Strapping:

(a) **Continuous or Switched Carrier Modes:**

- (1) **Data Set 205B1:** A cable from the 4B1 Data Unit is connected to 25-pin connectors P1 or P2. The choice of P1 or P2 will select the switched carrier or continuous carrier mode, respectively (Part 4).
- (2) **Data Set 205B2:** A 4-position rotary switch is located on the data set to allow the selection of the following modes: continuous carrier (CC), switched carrier (SC), continuous carrier automatic answer (CCA), and switched carrier automatic answer (SCA). The CC and SC positions correspond to the selection of P2 or P1 with the Data Set 205B1 (Part 4).

- (b) **Ground Straps E1 and E2:** A strap is provided between terminals E1 and E2 to connect signal ground (SG/AB) to frame ground (FG/AA). This strap should remain intact for all data set testing and normal operation. In some applications, the customer may require a common grounding point in the equipment. For these applications, the strap between E1 and E2 should be cut and proper grounding provided for the data set through leads available on the CUSTOMER connector (Part 10).

- (c) **Data Set or Customer-Supplied Transmitter Timing:** On AR95(181)/019, terminals 3 and 4 should be strapped for internal transmitter timing. The strap is removed for customer-supplied transmitter timing (Part 4).

- (d) **Remote Test Controlled Through CUSTOMER Connector:** Terminals 1 and 2 on AR95(181)/019 are strapped if customer does not provide the remote test (RMT) interface signal. The strap is removed if customer supplies remote test signal (Part 6).

- (e) **Transmitter Output Power:** Transmitter output power is set on AR90(182)/044 as indicated in the following chart:

OUTPUT POWER (DBM)	STRAP TERMINALS
0	1 to 4
-3	1 to 3
-6	1 to 2
-9	No Strap

- (f) **Receiver Input Sensitivity:** Receiver input sensitivity is set on AR88(178)/017 as indicated in the following chart:

INPUT SENSITIVITY (DBM)	INSERTED LOSS (DB)	STRAP TERMINALS
+5 to -23	15	4 to 5
0 to -28	10	3 to 5
-5 to -33	5	2 to 5
-10 to -38	0	1 to 5

4. DATA SET TRANSMITTER

4.01 Incoming serial data bits are applied to the transmitter through the send data (SD/BA) circuit. The data transitions are synchronous with the positive-going transitions of the transmitter clock (SCT/DB). The SD/BA signals are used to control the 4-phase modulation of the carrier. The modulation rate is 1200 baud regardless of the data rate.

4.02 Carrier Control: For Data Sets 205B1 and 205B2, a continuous carrier and a switched carrier mode can be selected. These modes are used on private line arrangements

where a line control circuit is not used. The Data Set 205B2 has two additional modes, continuous carrier automatic answer and switched carrier automatic answer, that are used when the set is operated with a line control unit, such as the DAS 804M.

A. Continuous Carrier Mode

4.03 The Data Set 205B1 is placed in the continuous carrier mode by plugging the connector cord from the 4B1 Data Unit into the 25-pin CONTINUOUS CARRIER receptacle P2. In this mode, if request-to-send (RS/CA) is OFF, an idle code will be transmitted. The idle code is a repeated 1000 transmitted at the selected bit rate. If RS/CA is ON, the transmitted signal is controlled by send data (SD/BA). The Data Set 205B2 is placed in this mode by operation of the rotary switch to the CC position.

4.04 After the transition of RS/CA from OFF to ON, the data set responds with clear-to-send (CS/CB) in the following time intervals:

BIT RATE	INTERVAL
2400 bps	0.415 (± 0.415) msec
1200 bps	0.415 (± 0.415) msec
600 bps	0.830 (± 0.830) msec

When RS/CA is switched from ON to OFF, the data set will take an interval of time to clear the data before returning to the idle code. However, the CS/CB lead switches OFF before the data has cleared. These times are listed as follows:

BIT RATE	DATA REMAINS ON LINE	CLEAR-TO-SEND TO OFF
2400 bps	2.5 (± 0.83) msec	0.415 (± 0.415) msec
1200 bps	5.0 (± 1.66) msec	0.415 (± 0.415) msec
600 bps	10.0 (± 3.32) msec	0.830 (± 0.830) msec

4.05 Continuous Carrier Automatic Answer (205B2 Only): The Data Set 205B2 is placed in this mode by operation of the rotary switch to the CCA position. In this mode, the transmitter will be turned off if the data terminal is idle. During this time, the data set ready (DSR/CC) lead on the CUSTOMER connector is

held OFF. If the line control unit establishes a telephone connection and places the data set on-line, the DSR/CC lead is placed ON and the data set transmitter is turned on at that time. The DSR/CC and the transmitter remain on as long as the data set is on-line. During this time, the transmitter operation is identical to the continuous carrier operation as described in 4.03 and 4.04.

B. Switched Carrier Mode

4.06 The carrier of Data Set 205B1 is controlled by request-to-send (RS/CA) when the connector cord from the 4B1 Data Unit is plugged into the 25-pin SWITCHED CARRIER receptacle P1. The Data Set 205B2 is placed in this mode by operation of the rotary switch to the SC position. In this mode, if RS/CA is OFF, carrier is not transmitted. If RS/CA is ON, the transmitted signal is controlled by send data (SD/BA) after an initial synchronization interval.

4.07 After the transition of RS/CA from OFF to ON, the data set will transmit the 1000 code at the selected bit rate for the following times before a clear-to-send (CS/CB) ON signal is given:

BIT RATE	INTERVAL OF 1000 CODE
2400 bps	640.00 (+0, -1.66) msec
1200 bps	1280.00 (+0, -3.32) msec
600 bps	2560.00 (+0, -6.64) msec

When RS/CA is switched from ON to OFF, the data set will take an interval of time to clear the data before the carrier is removed. However, CS/CB will be changed to OFF earlier. These times are:

BIT RATE	DATA REMAINS ON LINE	CLEAR-TO-SEND TO OFF
2400 bps	2.5 (± 0.83) msec	0.83 (± 0.83) msec
1200 bps	5.0 (± 1.66) msec	1.66 (± 1.66) msec
600 bps	10.0 (± 3.32) msec	3.33 (± 3.33) msec

C. Switched Carrier Automatic Answer Mode (205B2 Only)

4.08 The Data Set 205B2 is placed in this mode by operation of the rotary switch to the SCA position. In this mode, the transmitter will be turned off if the data terminal is idle. During this time, the data set ready (DSR/CC) lead on the CUSTOMER connector is held OFF. If the line control unit establishes a telephone connection and places the data set on-line, the DSR/CC lead is placed ON. If request-to-send (RS/CA) is OFF at this time, carrier is not transmitted. Presuming that DSR/CC is ON, if RS/CA is placed ON, the transmitted signal is controlled by send data (SD/BA) after an initial synchronization interval. After the transition of RS/CA from OFF to ON, the data set will transmit the 1000 code for 2560.00 (+0, -6.64) msec regardless of the selected bit speed. When RS/CA is switched from ON to OFF, the data set will take an interval of time to clear the data before the carrier is removed. However, clear-to-send (CS/CB) will be changed to OFF earlier. Regardless of the selected bit speed, data remains on-line 10.0 (± 3.32) msec, and CS/CB goes OFF 3.33 (± 3.33) msec.

4.09 Transmitter Output Power and Impedance: The transmitter output impedance is 600 ohms. The output power corresponds to the power that would be measured across a 600-ohm termination when using a random input data signal. The transmitter output power is set by a strap connection on AR90(182)/044 in accordance with the following table:

OUTPUT POWER (DBM)	STRAP TERMINAL
0 (± 1.5 dB)	1 to 4
-3 (± 1.5 dB)	1 to 3
-6 (± 1.5 dB)	1 to 2
-9 (± 1.5 dB)	No Strap

4.10 Transmitter Timing: Transmitter timing may be derived from either the internal crystal oscillator or a customer-supplied external source.

(a) **Internal Timing:** In this mode, a strap must be connected from terminals 3 to 4 on AR95(181)/019. This strap grounds the external clock (SCTE/DA) input to prevent

false timing corrections due to noise. The internal oscillator of the data set has a long term accuracy of ± 0.0005 percent.

(b) **Customer-Supplied Timing:** In this mode, the strap from terminals 3 to 4 is removed on AR95(181)/019. A bit rate clock (or send data SD/BA) applied to the serial clock transmit external (SCTE/DA) input by the customer is used to phase-correct the internal transmitter clock. This external timing must be accurate to at least ± 0.01 percent (Part 5). Receiver timing holdover will be diminished in accordance with the accuracy of the external timing source.

4.11 Transmitter Speed Select: The data set transmitter can operate at 2400, 1200, 600 bps, or in the regenerative mode. In all cases, the dibit rate remains fixed at 1200 per second. At 2400 bits per second, the send data (SD/BA) is examined in pairs to form dibits. The dibit is transmitted on-line as one of four phases of the transmitter carrier with respect to the phase of the previous dibit. The input to phase encoding used is:

A BIT	B BIT	PHASE SHIFT
0	0	-135°
0	1	- 45°
1	1	+ 45°
1	0	+135°

4.12 The A bit is defined as the bit sampled during the positive half-cycle of the 1200-Hz dibit clock and the B bit as that sampled during the negative half-cycle. The phase shift referred to in the table is the head-to-head or epoch angle of the carrier of succeeding pulses. Figure 3 shows the line spectrum for the transmission of repeated dibits.

4.13 For operation at 1200 bps, each bit of SD/BA corresponds to a data set dibit with the B bit always 0. A 1 is encoded as 10 and a 0 is encoded as 00; therefore, with 1200-bps operation, only two of the four dibits are transmitted. This causes the transmitted spectrum to be more concentrated about the 1800-Hz carrier for 1200-bps transmission than for 2400-bps transmission, resulting in improved data set performance at the lower speed.

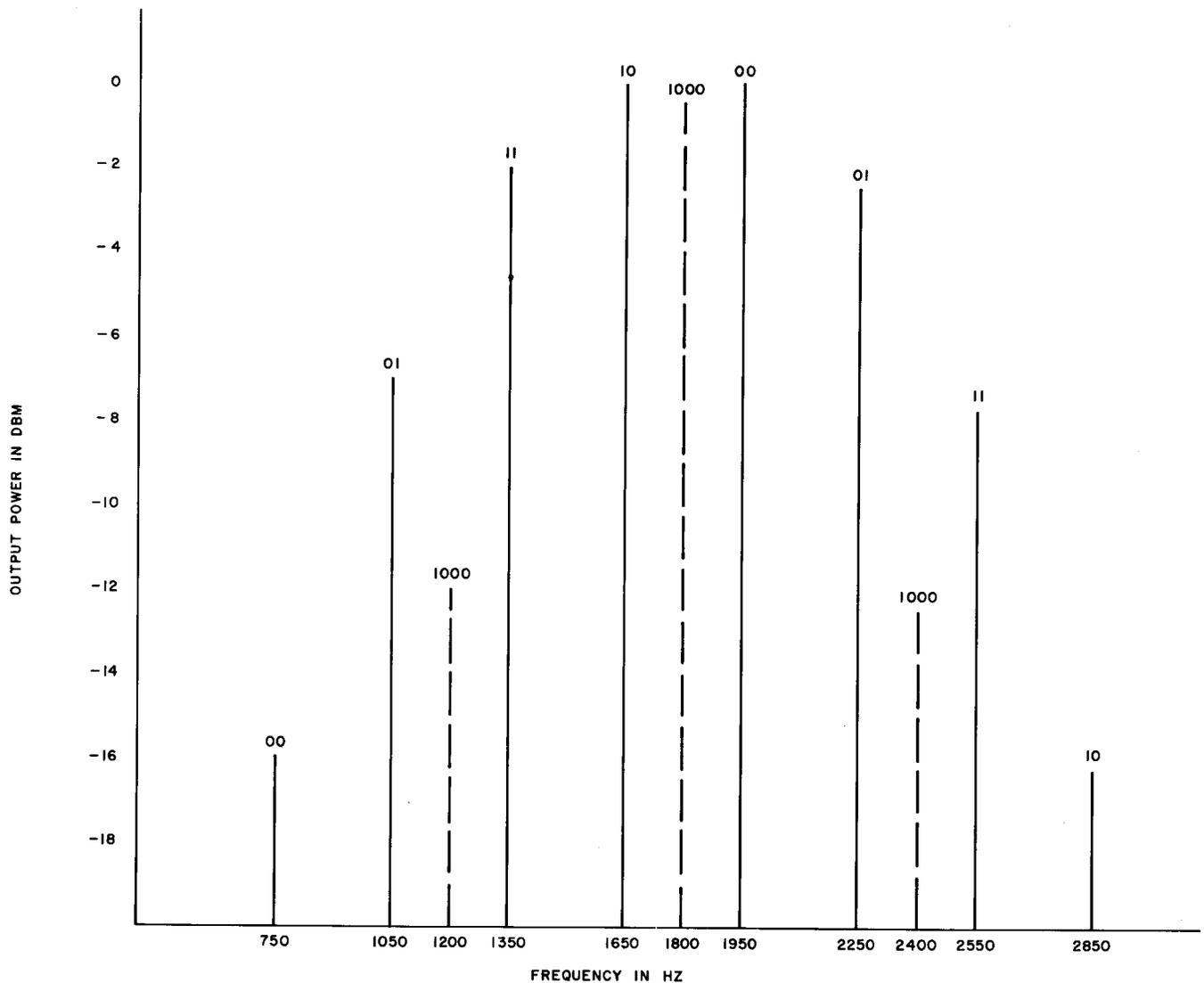


Fig. 3 — Output Spectrum for Repeated Dibit Codes at 2400 bps

4.14 For operation at 600 bps, each bit on the SD/BA lead corresponds to two dibits. A 1 is transmitted as 1010 and a 0 is transmitted as 0000. A further transmission advantage is gained at 600 bps, with respect to 2400 bps, than was gained at 1200 bps.

4.15 In the regenerative repeater configuration, the data set transmitter samples the SD/BA at 2400 bps but is timed to maintain the same dibit encoding through the regenerative repeater. This is necessary for the regeneration of the 1200- and 600-bps line signals to avoid possible transposition of the A and B bits.

5. DATA SET RECEIVER

5.01 The data set receiver demodulates the received line signal and recovers the timing wave to deliver serial data (RD/BB) and a synchronous clock (SCR/DD) to the connecting data equipment.

5.02 *Receiver Input Impedance and Sensitivity:* Receiver input impedance is 600 ohms. The receiver has an AGC circuit with a 30-dB dynamic range and an input sensitivity of $-39 (\pm 1)$ dBm. In the event that the received signal is sufficiently greater than the basic receiver sensi-

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tivity, loss pads of 5, 10, or 15 dB may be set to reduce receiver sensitivity to noise or speech interference. Loss pads are set by an internal strap connection on AR88(178)/017. The loss to be inserted will depend on the received signal power as given in the following table:

NOMINAL RECEIVED POWER (DBM)	PAD LOSS (DB)	STRAP TERMINALS	AGC SENSITIVITY (DBM)
-30 to -38	0	1 to 5	-10 to -38
-25 to -30	5	2 to 5	- 5 to -33
-20 to -25	10	3 to 5	0 to -28
+ 5 to -20	15	4 to 5	+ 5 to -23

5.03 Receiver Speed Select: The data set receiver can operate at 2400, 1200, 600 bps, or in the regenerate mode. The data is received in dibits and delivered serially to the customer along with a synchronous clock.

5.04 At 2400 bps, each received dibit contains two bits of information. The data is delivered in serial form on the RD/BB lead along with a 2400-Hz recovered clock on SCR/DD.

5.05 Operation is similar at 1200 bps to that at 2400 bps; however, only the A bit of every dibit is examined and delivered to the customer along with a 1200-Hz recovered timing wave.

5.06 Operation at 600 bps is identical to that at 1200 bps with the period of all timing waves doubled.

5.07 In the regenerator mode, the operation of the data set receiver is independent of the rate of the transmitter in the terminal data set. A regenerator receiver always operates at 2400 bps, but a 1200-Hz timing wave is delivered on SCR/DD to maintain the dibit encoding through the regenerator.

5.08 Receiver Synchronization: Receiver timing is derived by phase-correcting a timing wave generated by the internal oscillator to coincide with the zero crossings of the received data. Therefore, zero crossings are required to achieve and maintain receiver synchronization. All transitions of input data for data rates of 1200 and 600 bps cause zero crossings. However, at 2400 bps, data is examined in dibits and only a change

in dibit causes a zero crossing. Therefore, dotting code (alternate 1—0), as well as steady mark or space, does not give timing information at 2400 bps.

5.09 Receiver synchronization is performed by noting if incoming zero crossings occur before or after the crossings of the recovered clock. If 14 consecutive incoming zero crossings are sufficiently ahead or behind the receiver clock, the clock is advanced or retarded by 17.2 μ sec for 1200 and 2400 bps, and 34.4 μ sec for 600-bps operation.

5.10 The maximum time required to achieve receiver synchronization on the 1000 code is a function of the data rate timing accuracy and transmission impairments. For private line with C2 conditioning, the following lock-in times can be achieved:

BIT RATE	MAXIMUM TIME FOR SYNC RECOVERY ON 1000 CODE
2400 bps	0.6 sec
1200 bps	1.2 sec
600 bps	2.4 sec

5.11 The receiver clock accuracy is fixed at ± 0.0005 percent by the data set internal crystal oscillator. The minimum crossing rate necessary to hold the receiver clock in synchronization therefore depends primarily on the accuracy of the transmitter timing source.

TRANSMITTER TIMING ACCURACY	MINIMUM CROSSING RATE (CROSSINGS/SECOND)
$\pm 0.0005\%$	10
$\pm 0.0010\%$	14
$\pm 0.0050\%$	46
$\pm 0.0100\%$	90

5.12 After a dropout period, the receiver clock restoral time will depend on the crossing rate of the received data. To ensure remote receiver clock restoral after dropout, the local customer should provide a send data (SD/BA) crossing rate that exceeds the minimum values given.

6. DATA, CLOCK, AND CONTROL INTERFACE SIGNALS THROUGH CUSTOMER CONNECTOR

6.01 CUSTOMER Connector Characteristics:

The CUSTOMER connector (J61) is a 25-pin receptacle. The mating plug (Cinch or Cannon DB-19604-432), locking hood (Cinch or Cannon DB-51226-1), and the connecting cable must be supplied by the customer. The CUSTOMER connector is wired as shown in the following chart. Figure 4 shows the interface connections for the Data Set 205B.

PIN NUMBER	CIRCUIT
1	Frame Ground (FG/AA)
2	Send Data (SD/BA)
3	Receive Data (RD/BB)
4	Request to Send (RS/CA)
5	Clear to Send (CS/CB)
6	Data Set Ready (DSR/CC)
7	Signal Ground (SG/AB)
8	Data Carrier Detect (COO/CF)
9	+18I (681-ohm series resistance)
10	-18I (681-ohm series resistance)
13	Speed A Transmit (SAT)
14	Speed B Transmit (SBT)
15	Serial Clock Transmit (SCT/DB)
16	Dibit Clock Transmit (DTI)
17	Serial Clock Receive (SCR/DD)
18	Speed A Receive (SAR)
20	*Data Terminal Ready (DTRYC/CD)
22	*Ring Indicator (RI/CE)
23	Speed B Receive (SBR)
24	Serial Clock Transmit External (SCTE/DA)
25	Remote Test (RMT)

* These leads are not provided in the Data Set 205B1 and are functional in the Data Set 205B2 only when the set is used in conjunction with a line control unit.

6.02 Electrical Characteristics of Drivers and Terminators:

With one exception, the electrical characteristics of the interface circuits available on the CUSTOMER connector meet EIA RS-232-B specifications. Interface circuits SD/BA, RD/BB, SCT/DB, and SCR/DD also meet the intent of MIL. STD 188B which is more stringent regarding rise times. The exception is the data carrier detector (COO/CF) circuit

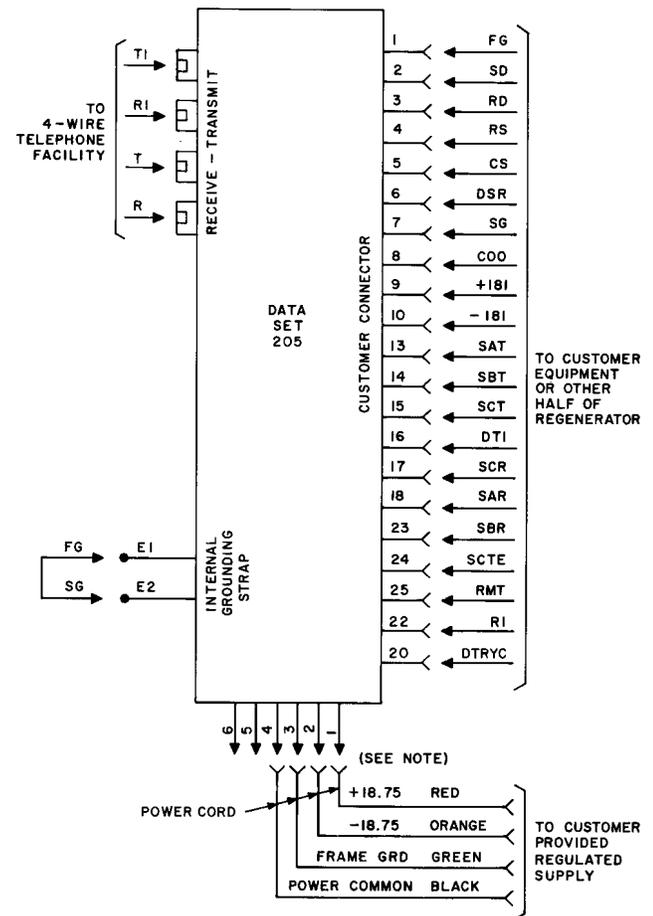
which is a line energy detector that operates on received power regardless of its nature and not on the data carrier exclusively.

A. MIL. STD 188B Driver

6.03 This driver is used for the following circuits:

- Receive data (DR/BB)
- Serial clock transmit (SCT/DB)
- Serial clock receive (SCR/DD).

It delivers an open circuit output voltage of 6.2V (± 5 percent), positive and negative, through less than 100 ohms source impedance. The rise and fall times of the output wave shape are approximately 11 microseconds, that is, 5.5 percent of the half-period of a 2400-Hz square wave.



NOTE:
WHEN AN 819A-TYPE DATA AUXILIARY UNIT IS PROVIDED, THE POWER CORD FURNISHED WITH THE DATA SET IS NOT USED. THE CORD PROVIDED WITH THE 819A CONNECTS DIRECTLY TO THE DATA SET DC POWER CONNECTOR. (+18V. IS PLACED ON PIN 6 AND -18V IS PLACED ON PIN 5 PINS 1 AND 2 ARE UNUSED).

Fig. 4 — Interface Connections

B. MIL. STD 188B Terminator

6.04 This terminator is used for the send data (SD/BA) circuit. The terminator can assume one of two states. A voltage greater than +0.5V will cause it to assume one state, and a voltage of less than -0.5V will cause it to assume the other. The two levels are balanced (with respect to 0 volts) to within 10 percent of each other. The terminator has an input resistance in excess of 5000 ohms and a shunt capacitance of less than 1000 pf.

C. EIA RS-232-B Driver

6.05 This driver is used for the following circuits:

- Clear-to-send (CS/CB)
- Data set ready (DSR/CC)
- Data carrier detector (COO/CF)
- Dibit clock transmit (DTI)
- Ring indicator (RI/CE).

The driver will deliver a +6.8 (±1.2) volt ON signal or a -6.8 (±1.2) volt OFF signal to a 3000-ohm or greater resistive load.

D. EIA RS-232-B Terminator

6.06 This terminator is used for the following circuits:

- Data terminal ready (DTR/CD)
- Request-to-send (RS/CA)
- Speed A transmit (SAT)
- Speed B transmit (SBT)
- Speed A receive (SAR)
- Speed B receive (SBR)
- Serial clock transmit external (SCTE/DA)
- Remote test (RMT).

6.07 The EIA terminators recognize a minimum of +3.0 volts to a maximum of +25 volts dc as an ON signal and a minimum of -3.0 volts to a maximum of -25 volts dc as an OFF signal without regard to rise or fall time of transitions. Shunt capacitance to signal ground of the customer equipment and cabling, measured at the interface, shall not exceed 2500 pf. Input resistance to the terminators is approximately 3000 ohms except for SCTE/DA which is 30,000 ohms. The reasons for this are:

(a) A high input resistance on SCTE/DA allows up to ten externally timed data sets to be driven from the SCT/DB output of one internally timed data set.

(b) When using send data (SD/BA) as the external timing source, a high SCTE/DA input resistance prevents loading the MIL. STD 188B terminator used for SD/BA.

6.08 EIA Standards: In this practice, all references to a ONE, MARK, or OFF state will be in accordance with the EIA definition as follows:

Binary State	ONE	ZERO
Signal Condition	MARK	SPACE
Control Function	OFF	ON
Voltage Level	NEGATIVE	POSITIVE

6.09 Description of Signals on CUSTOMER Connector:

(a) **Send Data (SD/BA) — MIL. STD 188B Terminator:** Serial data to be transmitted is presented to the data set on the SD/BA circuit synchronous with SCT/DB. Transitions of SD/BA must occur within ±160 microseconds of each positive transition of SCT/DB.

(b) **Receive Data (RD/BB) — MIL. STD 188B Driver:** Serial data obtained from demodulating the received line signal is delivered to the interface on the RD/BB lead. Transitions of RD/BB are coincident with positive transitions of SCR/DD. The RD/BB lead is clamped at the negative voltage level whenever the received input power is below the receiver sensitivity.

(c) **Serial Clock Transmit (SCT/DB) — MIL. STD 188B Driver:** SCT/DB is a square-wave clock provided by the data set at the selected data rate for use by the customer in synchronizing send data (SD/BA) with the transmitter timing. When external transmitter timing is used, jitter will be present in the SCT/DB signal due to discrete phase corrections made in the transmitter timing circuit. Each correction advances or delays a positive transition of SCT/DB by 8.7 microseconds. Once initial phase synchronization has been obtained, the correction rate is determined by the

frequencies of the internal oscillator and external timing source. The maximum correction rates for maintenance of synchronization after initial phase synchronization has been obtained are listed as follows. These rates are given as a function of the external timing accuracy.

EXTERNAL CLOCK ACCURACY	MAXIMUM SCT/DB CORRECTIONS/SECOND
$\pm 0.01\%$	12.2
$\pm 0.001\%$	1.7
$\pm 0.0005\%$	1.2

(d) **Serial Clock Receive (SCR/DD) — MIL.**

STD 188B Driver: When the set is used as a data terminal, SCR/DD is a square-wave clock at the selected bit rate. Positive transitions of SCR/DD are coincident with the transitions of received data. When used as a regenerative repeater, SCR/DD is a 1200-Hz square wave with the positive transition coincident with the received dibit. Jitter will be present in the SCR/DD signal due to discrete phase corrections made in the receiver timing circuit. At 2400, 1200 bps, or in the regenerate mode, corrections never occur more often than once every 11.7 milliseconds (every 28 cycles of a 2400-Hz clock) and are such that each correction advances or delays a positive transition of SCR/DD by 17.4 microseconds (1/24 of a 2400-Hz clock period). These times are doubled for 600-Hz operation. After initial phase synchronization is obtained, additional corrections will be necessary as SCR/DD drifts out of phase with the incoming data signal. The number of corrections required per second depends on the accuracy of the transmitter clock. The receiver clock accuracy is at least ± 0.0005 percent. Using internal timing, the transmitter accuracy will also be within ± 0.0005 percent, and a maximum of 0.6 SCR/DD corrections will occur per second. This rate is increased when using a less accurate external timing source.

EXTERNAL CLOCK ACCURACY	MAXIMUM SCR/DD CORRECTIONS/SECOND
$\pm 0.01\%$	6.2
$\pm 0.001\%$	0.9
$\pm 0.0005\%$	0.6

(e) **Serial Clock Transmit External (SCTE/DA) — EIA Terminator:** The data set may be synchronized to an external source by using the SCTE/DA circuit. For a terminal data set, the input may be either a square wave at the bit rate or send data (SD/BA). For the regenerator configuration, SCTE/DA must be connected to the 1200-Hz recovered dibit clock. The required minimum frequency accuracy of the external source is ± 0.01 percent; however, the receiver timing holdover is diminished in accordance with the accuracy of the external timing source. The transmitter can be initially synchronized with SCTE/DA by application of a square-wave source or an SD/BA dotting code (alternate 0 — 1) for at least 80 msec. After the transmitter is synchronized, it is necessary to ensure at least 13 positive transitions of SCTE/DA per second to maintain synchronization.

(f) **Dibit Clock Transmit (DTI) — EIA**

Driver: A 1200-Hz square-wave clock is provided on the CUSTOMER connector and is intended to be used for test purposes only.

(g) **Data Set Ready (DSR/CC) — EIA Driver:**

(1) **Data-Only Operation:** An ON indication is given if the data set is not in a test mode and power is supplied to the set. An OFF indication will be given if the data set is in a test mode.

(2) **Alternate Voice Operation:** An ON indication is given when the data station is in the data mode. An OFF indication is given at all other times provided that power is supplied to the data set.

(h) **Request-to-Send (RS/CA) — EIA Terminator:**

The RS/CA circuit is used differently in the switched carrier and the continuous carrier modes:

(1) **Continuous Carrier (CC and CCA):** If RS/CA is OFF, a repeated 1000 code is transmitted at the selected bit rate. If RS/CA is ON, signals on the SD/BA lead are transmitted on line. See Part 4 for switching times.

(2) **Switched Carrier (SC and SCA):** If RS/CA is OFF, the carrier is OFF. If RS/CA is ON, the 1000 code is transmitted for a period of time before the customer is clear-to-send (CS/CB). When using the switched carrier modes, if RS/CA is brought up coincident with or after DSR/CC is placed ON, the timed transmission of 1000 code prior to CS/CB will allow sufficient time for far-end receiver synchronization before data transmission begins. The continuous carrier modes do not provide a time interval of 1000 code between RS/CA and CS/CB. Consequently, the customer should wait for at least 2.5 seconds after DSR/CC goes ON before attempting to transmit data in this mode to allow for far-end receiver synchronization.

(i) **Clear-to-Send (CS/CB) — EIA Driver:**

The CS/CB circuit provides an indication to the customer when the data system is prepared to transmit data on the SD/BA lead. Clear-to-send is OFF if RS/CA is OFF. The interval between RS/CA and CS/CB is a function of the bit rate and the carrier mode.

(1) **Continuous Carrier and Continuous Carrier Automatic Answer:** After RS/CA comes ON, CS/CB will come ON in the following time intervals:

DATA RATE	TIME INTERVAL
2400 bps	0.415 (± 0.415) msec
1200 bps	0.415 (± 0.415) msec
600 bps	0.830 (± 0.830) msec

(2) **Switched Carrier:** After RS/CA comes ON, CS/CB will come ON in the following time intervals:

DATA RATE	TIME INTERVAL
2400 bps	640.00 (+0, -1.66) msec
1200 bps	1280.00 (+0, -3.32) msec
600 bps	2560.00 (+0, -6.64) msec

(3) **Switched Carrier Automatic Answer:** After RS/CA is placed ON, CS/CB will come ON in 2560.00 (+0, -6.64) μ sec regardless of the bit rate.

(j) **Data Carrier Detector (COO/CF) — EIA**

Driver: An ON condition of COO/CF indicates that telephone line power is being detected in the data set receiver. Line noise or speech, as well as carrier, can operate this circuit. An OFF condition indicates that line power is not being detected. When COO/CF is in the OFF condition, the received data (RD/BB) lead is held at the negative voltage level. Sensitivity of the COO/CF circuit is $-39 (\pm 1)$ dBm with random signal input. This threshold can be raised 5, 10, or 15 dB by inserting the receiver loss pads.

(k) **Speed A Transmit (SAT), Speed B Transmit (SBT) — EIA Terminators:** Control signals on SAT and SBT select the data rate of the transmitter. The possible combinations are as follows:

DATA RATE	SAT	SBT
2400 bps	ON	ON
1200 bps	OFF	ON
600 bps	ON	OFF
Regenerate	OFF	OFF

(l) **Speed A Receive (SAR), Speed B Receive (SBR) — EIA Terminators:** Control Signals on SAR and SBR select the data rate of the receiver. The possible combinations are as follows:

DATA RATE	SAR	SBR
2400 bps	ON	ON
1200 bps	OFF	ON
600 bps	ON	OFF
Regenerate	OFF	OFF

(m) **Data Terminal Ready (DTRYC/CD) —**

EIA Terminator (205B2 Only): This lead is used only when the Data Set 205B2 is operated in conjunction with a line control unit, such as the DAS 804M. The purpose of the DTRYC/CD lead is to provide the customer with control over whether the data terminal should be placed, held, or dropped from the data mode. If DTRYC/CD is OFF, an idle data set will not answer an incoming call and cannot be placed in the data mode. In this manner, the DTRYC/CD can be used to keep from

answering an incoming call until the terminal equipment is properly prepared. During data transmission, DTRYC/CD must be held ON. At the end of transmission, the DTRYC/CD must be placed OFF to cause the data set to go on-hook (hang up) directly from the data mode.

(n) **Ring Indicator (RI/CE) — EIA Driver (205B2 Only):** The RI/CE lead is normally held OFF. When ringing is detected by the data terminal, the RI/CE lead is placed ON for the duration of the incoming ring signal. The RI/CE indication can be used to prepare or check the status of the terminal equipment before the incoming call is answered.

(o) **Remote Test (RMT) — EIA Terminator:**

If terminals 1 and 2 on AR95(181)/019 are not strapped, remote test can be controlled by the remote test lead. The RMT lead should be held OFF when not testing. When instructed by the attendant of a 904-type Data Test Center, the RMT lead should be ON to place the data set in the test configuration. During the test, all interface circuits through the CUSTOMER connector are disconnected except RMT, DSR/CC, SG/AB, FG/AA, -18I, +18I, and DTI. DSR/CC is held OFF. The data set can also be placed in the remote test condition by a key on the data set or from the line control circuit if provided.

(p) **+18I, -18I:** The power supply voltages are available through 681-ohm resistors on the CUSTOMER connector. These voltages may be used to supply ON and OFF signals to other interface leads; however, they should not be used to supply power to any customer equipment.

(q) **Signal Ground (SG/AB):** All data set operating voltages are with respect to signal ground. SG/AB can be connected to frame ground (FG/AA) either internally or externally.

7. REGENERATOR CONFIGURATION

7.01 Two Data Set 205Bs are required for one regenerative repeater. The data sets are connected back-to-back such that the receiver of one supplies send data for the transmitter of the

other. All data line signals are regenerated and retransmitted as 2400-bps signals. However, 1200-Hz recovered clock is interchanged to maintain the dibit encoding. In this manner, the line signal for any of the three data rates is regenerated independent of the speed.

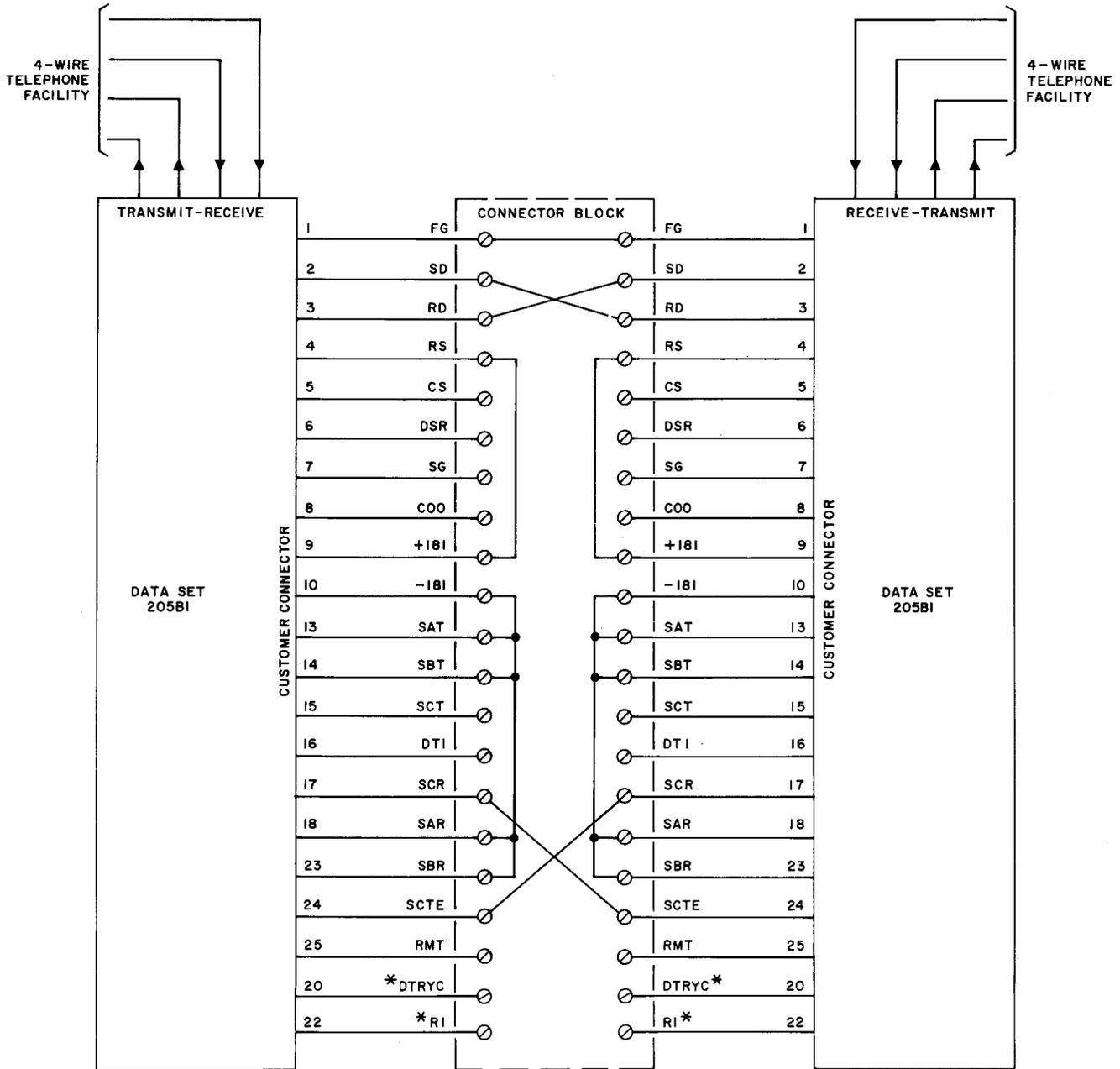
7.02 The recommended regenerator configuration is given as follows. Figure 5 shows the wiring of the CUSTOMER connector.

- (a) Switched carrier operation.
- (b) Ground strap E1 to E2 connected.
- (c) Terminals 3 and 4 of AR95(181)/019 are not strapped to allow external data set timing.
- (d) Terminals 1 and 2 of AR95(181)/019 strapped — remote test controlled by 4B1 Data Unit.
- (e) Transmitter output power and receiver sensitivity adjusted as required.
- (f) Distance between halves of regenerators should not exceed 50 feet.

8. LOCAL AND REMOTE TESTS

8.01 The Data Set 205B has provision for both a local and remote test. The local test mode is intended to allow testing of the set with 900-type portable data test equipment. The remote test mode allows the set to be tested from a 904-type Data Test Center via the telephone line.

- (a) **LOCAL TEST:** The local test mode can only be initiated by a key located on the data set. For normal operation of the set, this key is in the LINE position. During the test, the data set transmit pair is looped back to the receive pair through a 12-dB pad. The telephone line pairs are terminated with 600-ohm resistors and are not connected to the data set. In the local test mode, DSR/CC is held OFF. Also, a lamp on the line control unit indicates that the set is in a test condition. A Data Set 205B2 used without the line control unit will also give a local and remote test indication as a closure between pins 3 and 4 of the control connector.



- NOTE:
- (A) CONDITION FOR SWITCHED CARRIER OPTION.
 - (B) STRAP E1 TO E2.
 - (C) REMOVE STRAP BETWEEN SCREW TERMINALS 3 AND 4 ON BOARD O19 (EXTERNAL TIMING).
 - (D) STRAP SCREW TERMINALS 1 AND 2 ON BOARD O19 (NO RMT ON INTERFACE).
 - * FOR DATA SET 205B2 ONLY.

Fig. 5 — Regenerative Repeater Interconnections

(b) **REMOTE TEST:** The remote test condition can be initiated in several ways:

- (1) Control of RMT lead (pin 25) of CUSTOMER connector. Normally, the customer prefers not to exercise remote test control in this manner and a strapping option is provided for this purpose.
- (2) Operating the test key located on the data set to REMOTE TEST position. For normal operation of the data set, this key is in the LINE position.
- (3) Operation of a test key located on an associated line control unit.
- (4) A Data Set 205B2 used without a line control unit can also be placed in the remote test condition by placing a contact closure between pin 13 and ground (pin 16) on the CONTROL connector for the duration of the test.

8.02 In the remote test condition, the data set is configured as a regenerative repeater. The remote data test center can check such properties of the data set as error performance, clock accuracy, control lead operation and timing, and operation of the line control unit.

8.03 During the test, the data set will hold DSR/CC OFF. Also, a lamp on the line control unit indicates that the set is in a test condition. A Data Set 205B2 used without the line control unit will give a remote test indication as a closure between pin 1 and ground (pin 16) in addition to the local and remote test indication between pins 3 and 4 of the CONTROL connector. The closure on pin 1 may be used to hold the condition on pin 13 to maintain the set in the remote test condition.

9. TRANSMISSION REQUIREMENTS

9.01 Error Performance: The Data Set 205B1 is designed to operate at a long time error rate of less than one error in 10^5 bits when transmitting random data at 2400 bps on private line facilities that meet C2 conditioning as defined in Section 314-410-500.

10. DATA SET GROUNDING

10.01 Frame ground and signal ground are normally connected at one location, E1 to E2, in the data set. Some applications may require that this grounding be established in the customer equipment. In these instances, the E1 to E2 strap is broken, and FG/AA and SG/AB are connected in the customer equipment through the leads in the CUSTOMER connector. When grounding is provided in this manner, the resistance of the SG/AB — FG/AA path must be low enough that a short to SG/AB from the ac supply will cause the fuse in the ac supply to open.

10.02 When the E1 to E2 strap is present, ac power supply and grounding arrangements for the customer's data equipment and the data set must be such that the difference in ground potential between the two does not exceed ± 2.0 volts peak when measured on an oscilloscope with a bandwidth of at least one megacycle.

11. DATA SET TESTING

11.01 The following test procedures do not cover all trouble possibilities. The tests are designed to indicate which circuit pack (or packs) should be replaced as a logical choice to repair a trouble condition by using an oscilloscope.

11.02 It is recommended that the tests be performed in numerical sequence if the type of trouble is unknown. If trouble or an abnormal condition still exists after replacement of the suggested circuit packs, the preceding test must be made until the circuit pack causing the trouble condition is replaced.

11.03 The following test equipment is required to perform the tests:

- 1 — 901B-2 Data Test Set
- 1 — 902B Data Test Set
- 2 — 903B Data Test Sets
- 1 — KS-14510 volt-ohm-milliammeter
- 1 — Oscilloscope, Tektronix® 533 with CA plug-in unit (or equivalent)
- 12 — Test Probes — double end — WECO 735A (to mate with test points on data set circuit pack assemblies)

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- 6 — Test probes — scope probe end adapter — WECO 729A, or use Mueller "Micro-Gater" clips (34C), or equivalent, to make up test probes.

A. Data Set Preparation and Arrangement of External Test Equipment

11.04 Prepare the Data Set 205B as follows:

- (a) In the following order, disconnect the DC POWER cord, the CUSTOMER cord, and the 4B1 Data Unit cord from their respective connectors on the data set.
- (b) Check that terminal E1 is strapped to E2 on the data set.
- (c) Carefully remove and check circuit pack AR95(181)/019. Strap terminal 1 to 2 and terminal 3 to 4 (if not strapped). The straps ground both RMT and SCTE/DA interface signal leads.
- (d) Operate the 4B1 LINE — LOCAL TEST key to LOCAL TEST position.

Note: The following conditions up to 11.05 test the functions associated with the CONTROL connector and apply to Data Set 205B2 only. For testing Data Set 205B1, proceed to 11.05.

- (e) For Data Set 205B2 only, make the following connections:
 - Open shorting clips 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 20, 23, and 24 on the 901B-2 test set cover.
 - Connect the 901B-2 test set cover to the CUSTOMER connector with the supplied W25A cord.
 - Connect the female connector on the 901B-2 test set cover to the CONTROL connector by using the M25A cord. Only the 901B-2 cover is used for this part of the tests.
 - Connect the DC POWER cord.

Caution: Be very careful to ensure that terminals TST 2 and TST 20 are not connected to any other terminal during the following tests. The terminals supply unprotected -18 Vdc and $+18$ Vdc, respectively.

- (f) Measure the -18 Vdc and $+18$ Vdc power supply voltages as they appear on the CONTROL connector by using the following test sequence:

- (1) Condition the KS-14510 test meter to measure 60 Vdc full scale. Connect the negative test lead to TST 2 and the positive test lead to TST 16.
- (2) The test meter should indicate -18.0 (± 2.2) Vdc.
- (3) Disconnect the meter test leads.
- (4) Connect the positive test lead to TST 20 and the negative test lead to TST 16.
- (5) The test meter should indicate $+18.0$ (± 2.2) Vdc.
- (6) Disconnect the meter test leads.
- (g) Check the RI/CE and DTRYC/CD circuits. Using two of the four wires attached to the 901B-2 test set cover, connect EQ 21 to EQ 20 and TST 24 to TST 16.
 - (1) Condition the KS-14510 test meter to the 12 Vdc scale.
 - (2) Connect the positive test lead to TST 19 and the negative test lead to TST 16.
 - (3) The test meter should indicate $+6.5$ (± 1.3) Vdc.
 - (4) Disconnect the meter test leads.
 - (5) Remove the connections between TST 24 and TST 16.
 - (6) Connect the positive test lead to TST 16 and the negative test lead to TST 19.
 - (7) The test meter should indicate -7.0 (± 1.3) Vdc.
 - (8) Disconnect the meter test leads.
 - (9) Remove the connections between EQ 21 and EQ 20.

(h) Check the remote test feature as follows:

- (1) Momentarily connect TST 13 to TST 16. Relays K2 and K3 should not operate.
- (2) Operate the LINE — LOCAL TEST key to LINE position.
- (3) Connect TST 13 to TST 16.
- (4) Relays K2 and K3 should operate.
- (5) Condition the KS-14510 test meter to measure continuity. A resistance of less than 2 ohms should be measured between TST 1 and TST 16 when relays K2 and K3 are operated.
- (6) A resistance of less than 2 ohms should be measured between TST 3 and TST 4 when relays K2 and K3 are operated.
- (7) If the conditions for (1) through (6) are not met, replace the data set. If the conditions are met, remove the connections between TST 13 and TST 16.

(i) Check the RS/CA and DSR/CC functions as follows:

- (1) Connect TST 15 to TST 16 and operate the data set rotary switch to CCA position.
- (2) Condition the KS-14510 test meter to measure on the 12 Vdc scale.
- (3) Connect the positive meter lead to EQ 6 and the negative meter lead to TST 16.
- (4) The test meter should indicate +7.0 (± 1.3) Vdc.
- (5) Disconnect the meter test leads.
- (6) Remove the connection between TST 15 and TST 16.
- (7) Connect the negative meter lead to EQ 6 and the positive meter lead to TST 16.
- (8) The test meter should indicate -6.5 (± 1.3) Vdc.
- (9) Disconnect the meter test leads.

(10) If the requirements of (4) and (8) are not met, replace the data set. If the requirements are met, proceed with the following steps.

(11) Operate the LINE — LOCAL TEST key to LOCAL TEST position.

(12) Disconnect the DC POWER cord, the W25A cord connecting the 901B-2 test set cover to the data set, and the M25A cord connecting the CONTROL connector to the 901B-2 test set.

(13) Restore all open shorting clips on the test set cover to the closed position in preparation for subsequent testing.

11.05 Connect and prepare the 901B-2 Data Test Set as follows:

(a) Position both A TEST and B TEST switches to OFF.

(b) Connect the 901B-2 test set cord to the interface adapter (part of the 901B-2 test set cover). Connect the interface adapter to the data set CUSTOMER connector using the W25A cord provided. Set SELECTOR switch to 3.

(c) Make the following arrangements on the interface adapter:

- Open shorting clips 13, 14, 18, 20, 22, 23, 24, and 25.
- Strap 9 to 19, EQ 13 to EQ 18, EQ 14 to EQ 23, and EQ 14 to TST 20.
- Speed selection is determined by interface adapter connections shown in Table A.

TABLE A

DATA SET SPEED	EQ 13 TO	ATT-UNATT SWITCH TO
2400	9	UNATT
1200	10	UNATT
600	9	ATT
REGEN	10	ATT

(d) Connect the DC POWER cord to the data set.

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11.06 To measure the interface voltages, dc measurements are made between terminals A and C on the 901B-2 test set. Terminal C is always at ground potential. The ac measurements are made between terminals B and C.

11.07 Measure the DSR/CC interface voltage. Condition the data set for switched carrier operation. Set the 901B-2 A TEST switch to position 1 and B TEST switch to OFF. Position the LINE — LOCAL TEST key in LOCAL TEST position. Proceed as follows:

- (a) With the equipment prepared as above, the DSR/CC voltage measured between 901B-2 test set terminals A and C (ground) should be $-6.5 (\pm 1.3)$ Vdc. Remove the test meter probes.
- (b) Operate the LINE — LOCAL TEST key to LINE position.
- (c) The DSR/CC voltage measured between terminals A and C should be $+7.0 (\pm 1.3)$ Vdc.
- (d) Repeat (a) through (c) with the data set conditioned for continuous carrier operation.

11.08 After the requirements of 11.07 have been met, condition the data set for switched carrier operation. Operate LINE — LOCAL TEST key to LOCAL TEST position. Connect EQ 13 to 9 and position ATT-UNATT switch (on the 901B-2 test set) to UNATT.

Note: The data set is now prepared to operate at 2400 bps. For alternate speed selection, refer to Table A.

11.09 Measure for the dc and ac interface voltage requirements listed in Table B. If any measurement exceeds the listed tolerance, refer to the appropriate test section by using Table C for the same A TEST and B TEST switch positions. It is recommended that all dc voltage measurements be obtained first, then repeat the procedures to obtain ac voltage indications.

Note: Remove test meter leads and observe polarity before each measurement.

11.10 Measure for the dc and ac interface voltage requirements listed in Table D. Connect the data set for continuous carrier operation. Refer to Table A for connections required to obtain the desired speed selection. The signal on the SD/BA lead is the 01 code of DTI. If any measurement exceeds the listed tolerances, refer to the appropriate test section by using Table C for the same A TEST and B TEST switch positions.

11.11 The numbers in Table C indicate a specific group of oscilloscope tests to be used for many combinations of A TEST and B TEST switch positions. The table can be used to rapidly troubleshoot a voltage requirement failure resulting from Table B and/or Table D tests.

B. Data Set Test Setup

11.12 Prepare the data set for testing as follows:

- (a) In the following order, disconnect the DC POWER cord and the CUSTOMER cord from their respective connectors on the data set.
- (b) Check that terminal E1 is strapped to E2 on the data set.
- (c) Carefully remove and check AR95(181)/019. Strap terminal 1 to 2 and terminal 3 to 4 (if not so strapped). The straps ground both RMT and SCTE/DA interface signal leads.
- (d) Condition the data set for continuous carrier operation.
- (e) Operate the LINE — LOCAL TEST key to LOCAL TEST position.

11.13 Connect and prepare the 901B-2 Data Test Set as follows:

- (a) Position both A TEST and B TEST switches to OFF.
- (b) Connect the 901B-2 test set cord to the interface adapter (part of the 901B-2 test set cover). Connect the interface adapter to the data set CUSTOMER connector by using the W25A cord provided. Set SELECTOR switch to 3.

TABLE B
INTERFACE REQUIREMENTS: SWITCHED CARRIER

LEAD TESTED	A TEST POSITION	B TEST POSITION	RS LEAD CONDITION	SD LEAD CODE*	TEST METER INDICATION	
					DC READING	AC READING
SCT	23	8	OFF	01	0.0 (± 0.7)	6.8 (± 1.6)
DTI	22	8	OFF	01	0.0 ($+1.5$) (-0.7)	7.5 (± 2.1)
CS	21	8	OFF	01	-6.5 (± 1.3)	0
CS	21	5	ON	01	+7.0 (± 1.3)	0
RD	20	8	OFF	01	-6.1 (± 0.7)	0
RD	20	5	ON	01	0.0 (± 0.7)	6.8 (± 1.6)
RD	20	4	ON	00	+6.1 (± 0.7)	0
RD	20	3	ON	11	-6.1 (± 0.7)	0
SCR	19	8	OFF	01	0.0 (± 0.7)	6.8 (± 1.6)
COO	17	8	OFF	01	-6.5 (± 1.3)	0
COO	17	5	ON	01	+7.0 (± 1.3)	0

* With 900-type test equipment, the 01 code which appears on the DTI lead is connected to the SD lead for the test indicated.

TABLE C
OSCILLOSCOPE TESTS

B TEST POSITION	A TEST POSITION					
	23	22	21	20	19	17
8	2, 3	2	4	5, 8	3, 8	7
5			4	5, 8		7
4				5, 8		
3				5, 8		
Remote Test	9		9	9	9	9

TABLE D

INTERFACE REQUIREMENTS: CONTINUOUS CARRIER

LEAD TESTED	A TEST POSITION	B TEST POSITION	RS LEAD CONDITION	RATE (BPS)	TEST METER INDICATION	
					DC READING	AC READING
SCT	23	8	OFF	2400	0.0 (± 0.7)	6.8 (± 1.6)
RD	20	8	OFF	2400	+3.4 (± 0.7)	5.0 (± 1.6)
RD	20	5	ON	2400	0.0 (± 0.7)	6.8 (± 1.6)
RD	20	8	OFF	600	+3.4 (± 0.7)	5.0 (± 1.6)
RD	20	5	ON	600	+6.1 (± 0.7)	0.0
RD	20	8	OFF	1200	+3.4 (± 0.7)	5.0 (± 1.6)
RD	20	5	ON	1200	+6.1 (± 0.7)	0.0
SCR	19	8	OFF	2400	0.0 (± 0.7)	6.8 (± 1.6)

(c) Make the following arrangements on the interface adapter:

- Open shorting clips 13, 14, 18, 20, 22, 23, 24, and 25.
- Strap 9 to 19, EQ 13 to EQ 18, EQ 14 to EQ 23, and EQ 14 to TST 20.
- Speed selection is determined by connections shown in Table A.

(d) Set the 903B test set switches as follows:

- BIT RATE to EXT CLOCK
- RANDOM-DOT to RANDOM
- TRIGGER to + (plus)

Note: In the following connections, strap red to red and black to black.

(e) Connect the EXT CLOCK terminals of the 903B test set to the TRANSMIT CLOCK terminals of the 901B-2.

(f) Connect the ac power cord of the 903B test set to an ac voltage source and the DC POWER cord to the data set.

11.14 Information Note: The 901B-2 test set performs the following functions:

- (a) SELECTOR switch in position 3 prepares the A TEST and B TEST switches to control the data set.
- (b) A TEST switch connects various interface leads to test terminals on the 901B-2 test set. See Table E.
- (c) B TEST switch is used in conjunction with A TEST switch and in a similar manner. See Table F.
- (d) The ATT-UNATT switch is used as one of two control inputs for speed selection as shown in Table A.

11.15 Signal grounds are available at the following locations:

- (a) TP12 on 008
- (b) TP1 on 012
- (c) TP1 on 014
- (d) TP5 on 017
- (e) TP4 on 021
- (f) TP3 on 044
- (g) TP4 on 047
- (h) TP4 on 059.

TABLE E
A TEST SWITCH

A TEST POSITION	CONNECTS		
	INTERFACE LEAD		901B A TERM. TO
	RS TO	SD TO	
1			DSR
2			RD
3			SCT
4			CS
5			COO
6	+18I	-18I	RD
7	+18I	+18I	RD
8	+18I	DTI	RD
9	+18I		SCR
10	+18I		CS
11	+18I		COO
12	+18I		
13	+18I		
14	+18I		SCR
15	+18I		
16	+18I		
17			COO
18			
19			SCR
20			RD
21			CS
22			DTI
23			SCT
OFF			

Note: Blank spaces indicate no connections.

11.16 At the conclusion of the required tests, perform the following steps:

- (1) Disconnect ac power from the 903B test set and the DC POWER connector from the data set.
- (2) Remove all test equipment connections.

- (3) Remove the strap between terminals E1 and E2 if required to do so by service order.
- (4) Verify that original options are replaced in the data set.
- (5) Operate and lock the LINE — LOCAL TEST key in LINE position.
- (6) Condition the data set for either switched or continuous carrier operation, whichever satisfies the original option.
- (7) Connect DC POWER connector to the data set.
- (8) Call the data test center for a final check before releasing the data set to customer service.

TABLE F
B TEST SWITCH

B TEST POSITION	CONNECTS		
	INTERFACE LEAD		901B A TERM. TO
	RS TO	SD TO	
1			-18I
2			+18I
3	+18I	-18I	
4	+18I	+18I	
5	+18I	DTI	
6	GRD	DTI	
7	GRD	DTI	
8	GRD	DTI	
9	GRD	DTI	
10	+18I	+18I	
11	GRD	+18I	
OFF			

Note: Blank spaces indicate no connections.

TEST 1 — CLOCK CIRCUIT

11.17 The clock circuit consists of a 65A oscillator and associated countdown circuits. The clock circuit components generate square-wave signals at frequencies required by both transmitter and receiver sections of the data set. Waveforms shown in Fig. 6 and Fig. 7 represent normal operation of the clock circuits and are keyed to the respective test points on the functional schematic shown in Fig. 8. Replace the suggested circuit packs if the proper result for each test is not obtained.

CONDITIONS: None

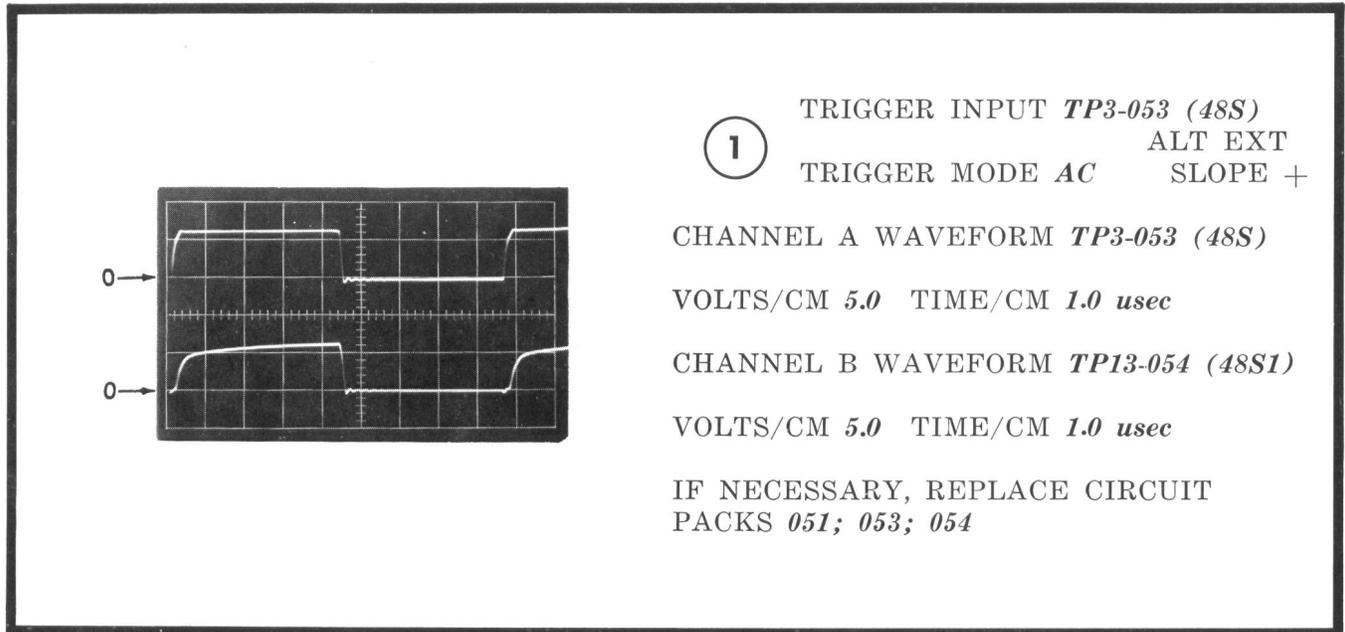
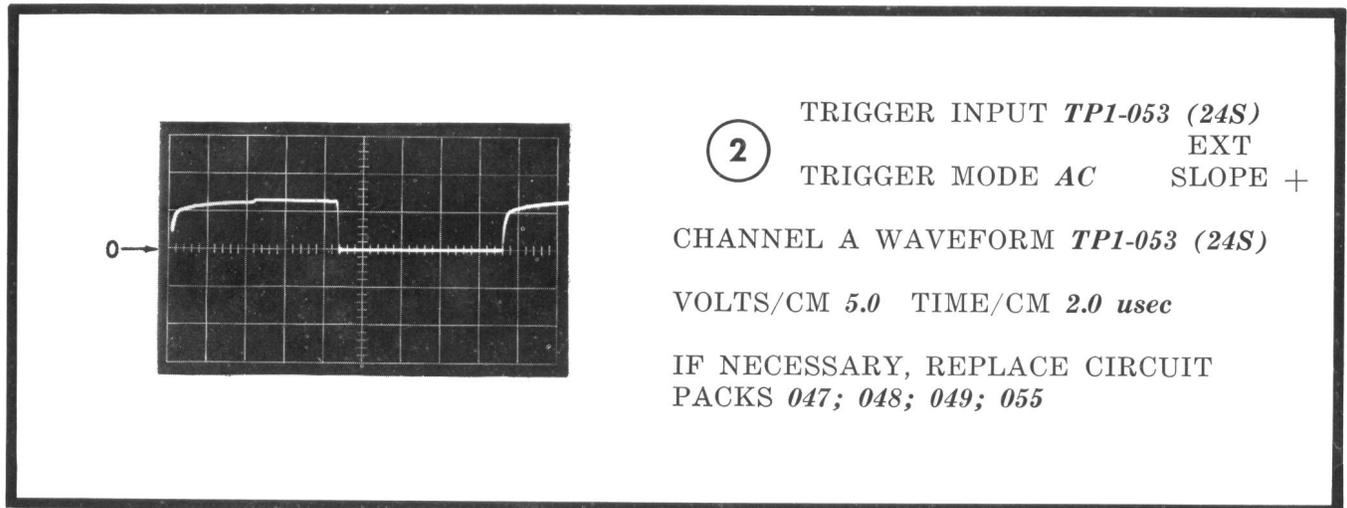


Fig. 6 — Clock Circuit Waveforms

CONDITIONS: None



CONDITIONS: 600 bps (ATT/UNATT switch on 901B-2 to ATT position)

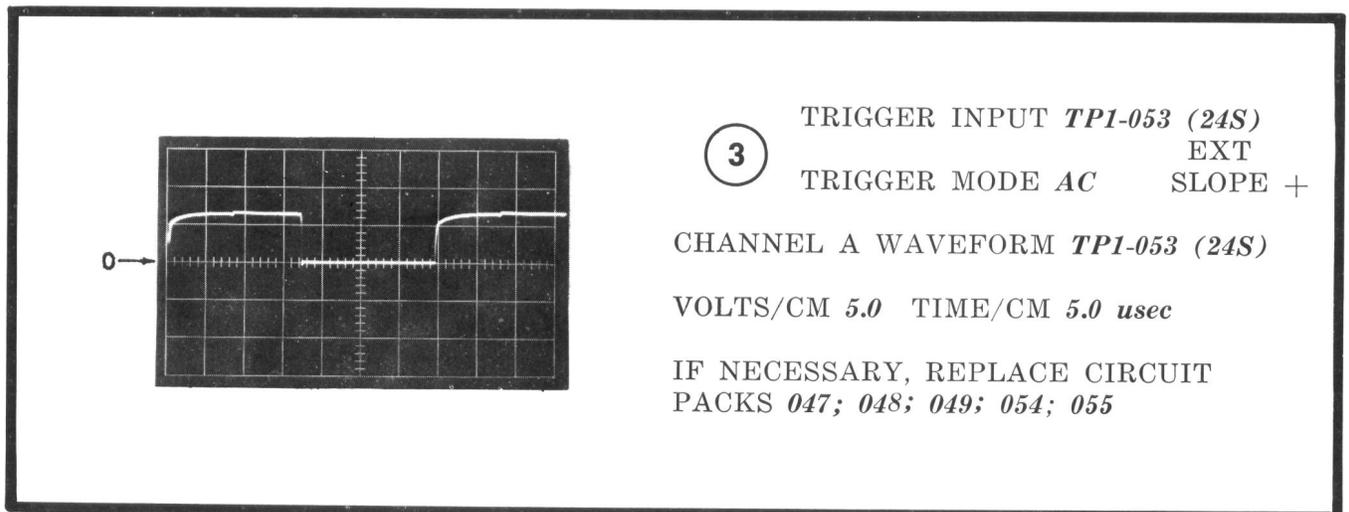


Fig. 7 — Clock Circuit Waveforms

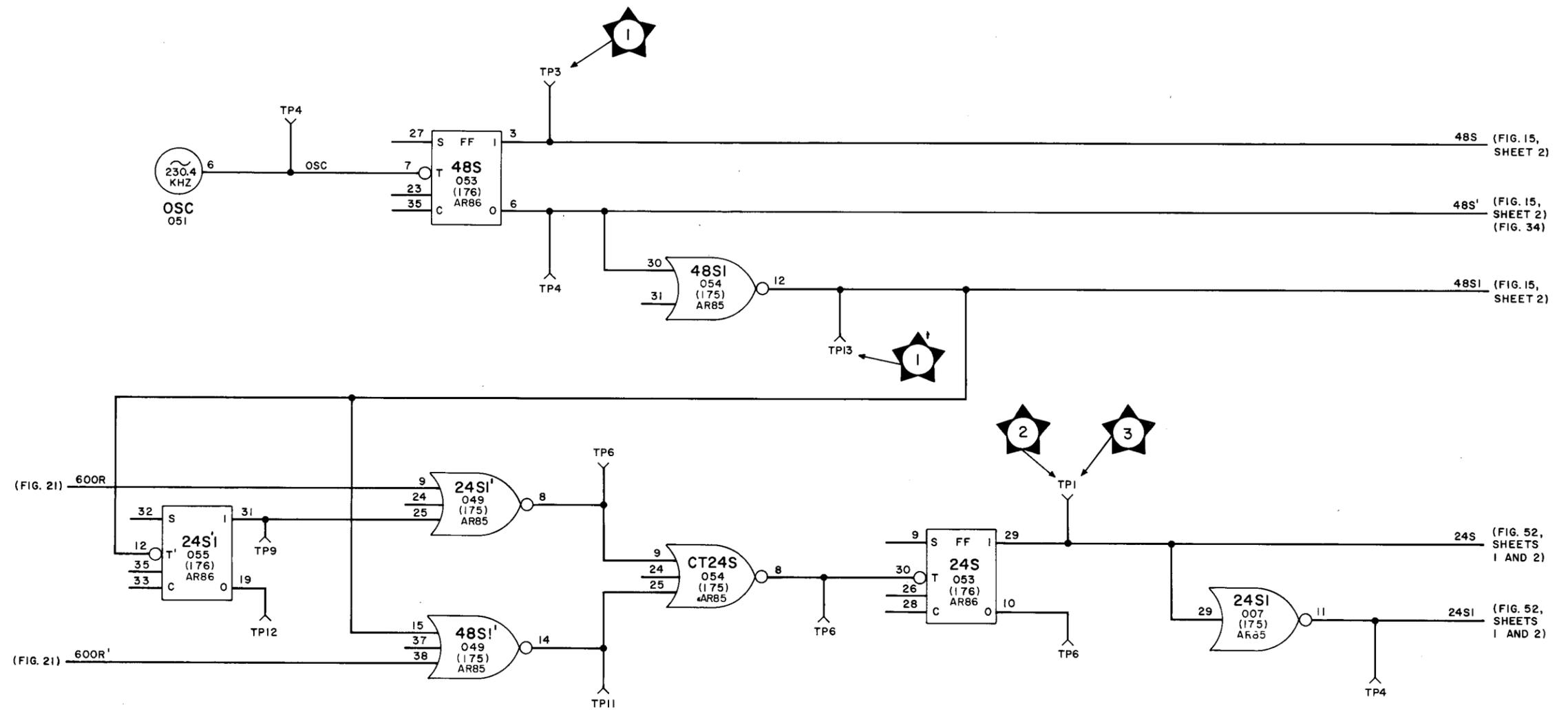


Fig. 8 — Clock Circuits, Functional Schematic

TEST 2 — TRANSMITTER TIMING

11.18 The transmitter timing circuits generate the timing signals required by the data transmitter circuits. Input signals from the clock circuits are divided by complementary flip-flop chains to provide the required pulse train frequencies for the various operational modes of the data transmitter and associated circuits. When an external timing source is used, add-delete count correction circuits adjust the transmitter operation to allow the transmitter timing to phase-lock with the external signal source.

11.19 An oscilloscope is required to perform tests 4 and 5 (Fig. 9) which are keyed to the functional schematic shown in Fig. 15. Test 6 is keyed to sheet 2 of the functional schematic.

11.20 Waveforms shown in Fig. 10 through Fig. 14 are keyed to the functional schematic shown in Fig. 15 (sheet 2). The waveforms illustrate normal operation of the flip-flop circuits when the data set is in LOCAL TEST condition.

TRIGGER switch + *INT AUTO*

④ VOLTS/CM 5.0 TIME/CM 1.0 msec

Instructions: Connect CHAN A probe to TP5-059 (SCTE').

Indication: Observe +6.2 (± 1.1) Vdc with no pulses.

IF NECESSARY, REPLACE CIRCUIT
PACK 059

TRIGGER switch + *INT AUTO*

⑤ VOLTS/CM 0.5 TIME/CM 1.0 msec

Instructions: Connect CHAN A probe to TP11-039 (CLDT'); then to TP14-039 (SE).

Indication: Each test point should measure less than +0.5 Vdc.

IF NECESSARY, REPLACE CIRCUIT
PACKS 008; 039; 050

Fig. 9 — Transmitter Timing Tests

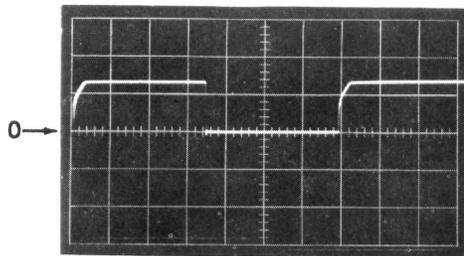
TRIGGER switch + *INT AUTO*
 6 VOLTS/CM 0.05 TIME/CM 1.0 msec

Instructions: Connect CHAN A probe to the following test points on circuit pack 043: TP7 (TAD); TP10 (TDL); TP13 (TAS); and TP14 (TDS).

Indication: Each test point should measure less than +0.5 Vdc.

IF NECESSARY, REPLACE CIRCUIT PACKS 042; 043

CONDITIONS: None



7 TRIGGER INPUT *TP4-042 (12ST')*
 EXT SLOPE +
 TRIGGER MODE *AC*

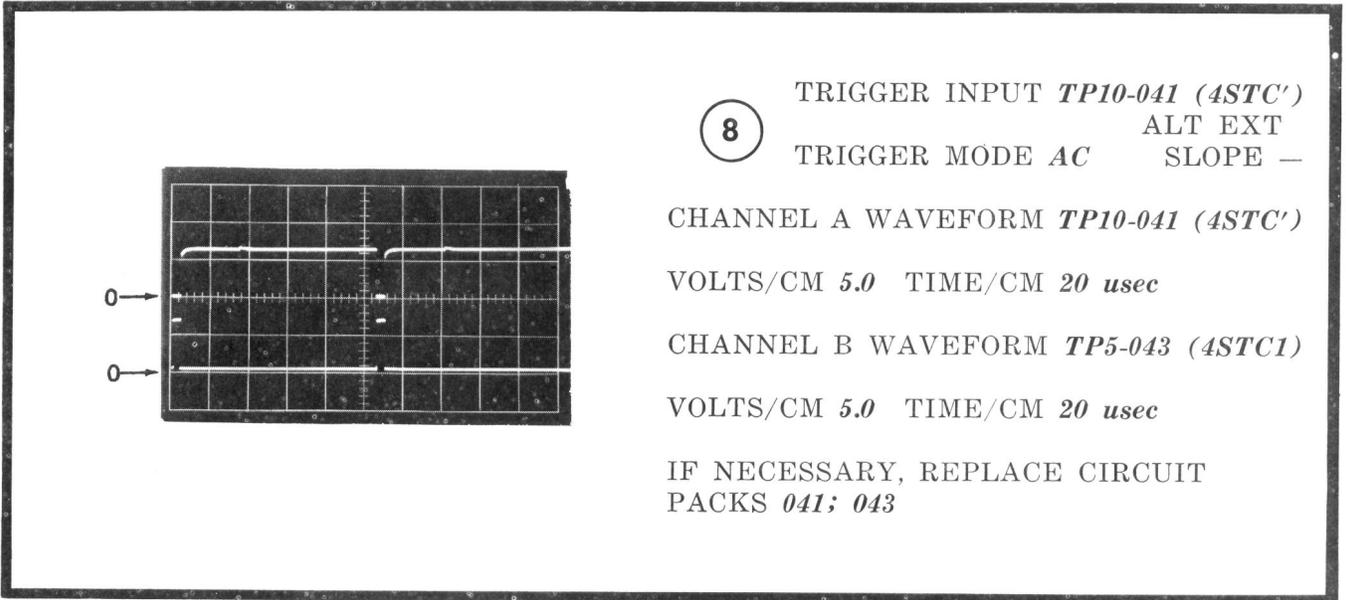
CHANNEL A WAVEFORM *TP4-042 (12ST')*

VOLTS/CM 5.0 TIME/CM 5.0 usec

IF NECESSARY, REPLACE CIRCUIT PACKS 042; 043

Fig. 10 — Transmitter Timing Tests

CONDITIONS: None



CONDITIONS: None

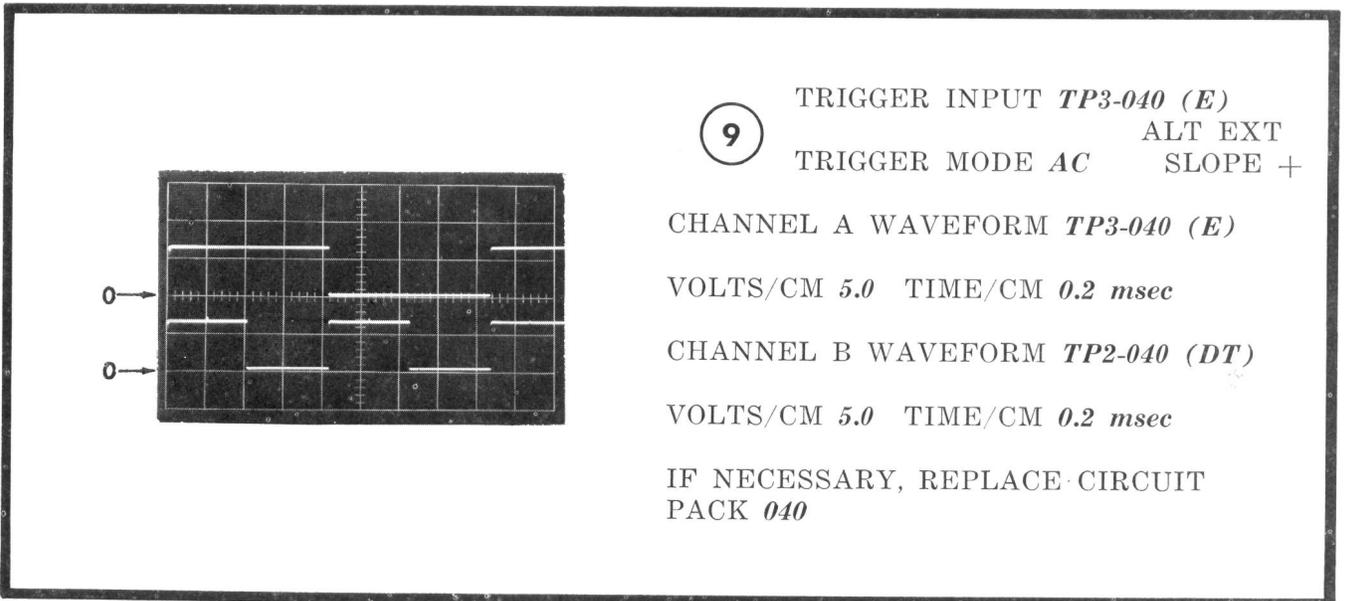
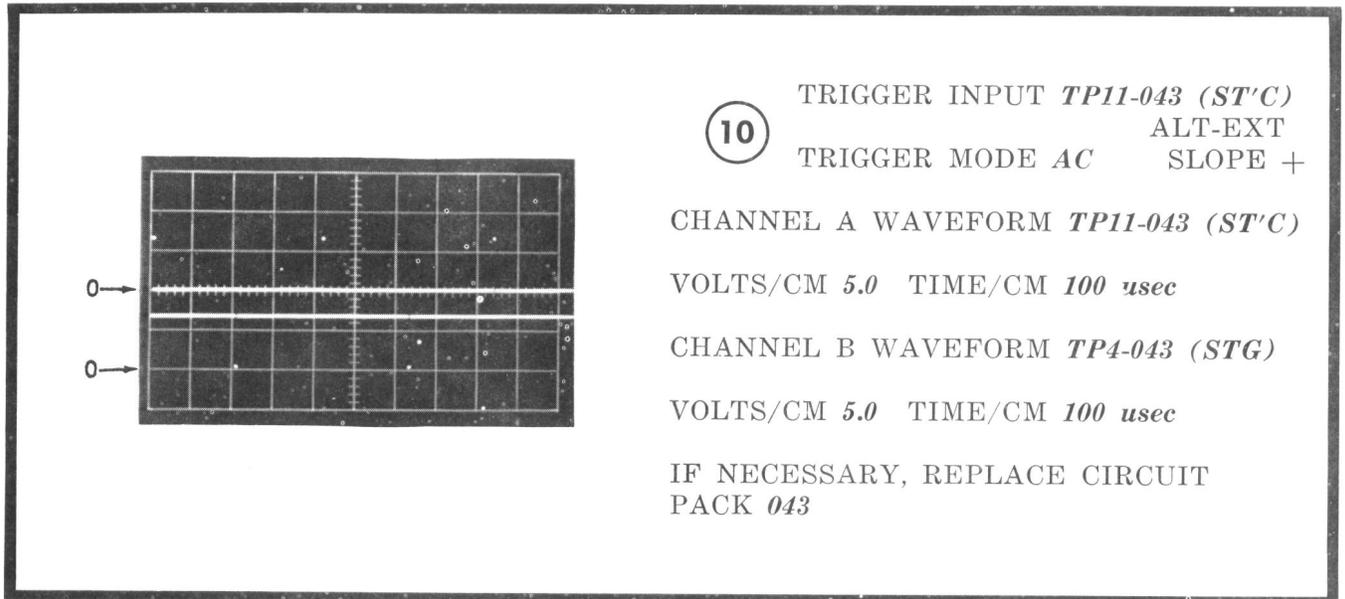


Fig. 11 — Transmitter Timing Tests

CONDITIONS: None



CONDITIONS: None

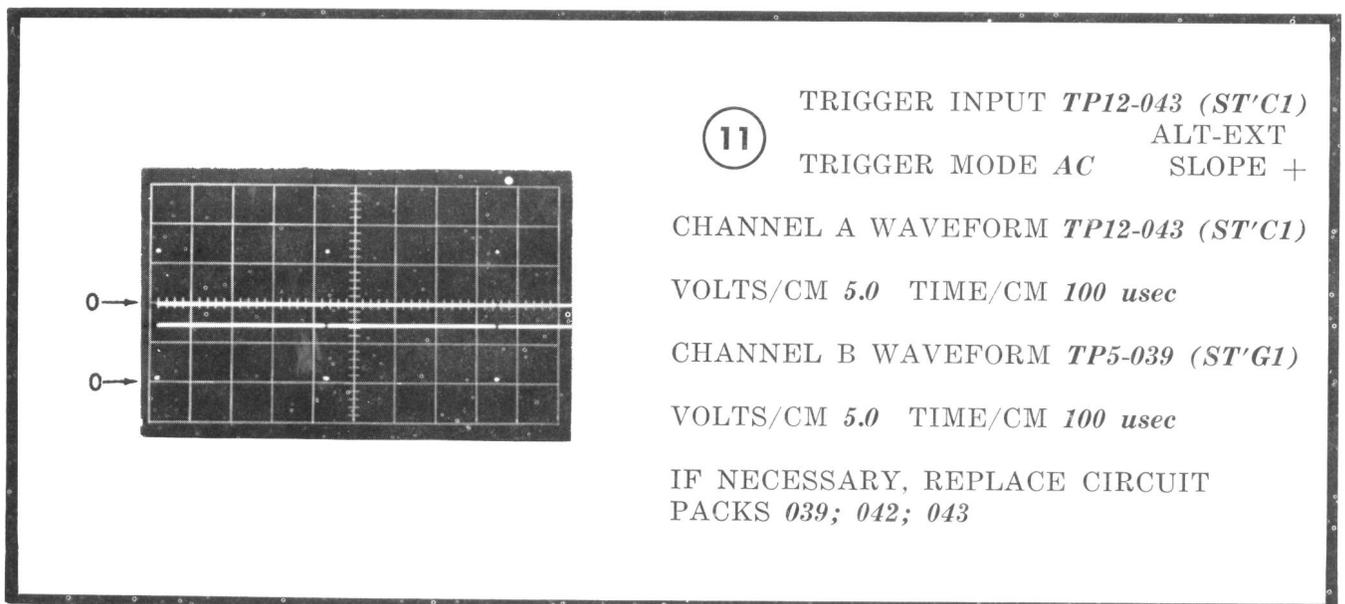
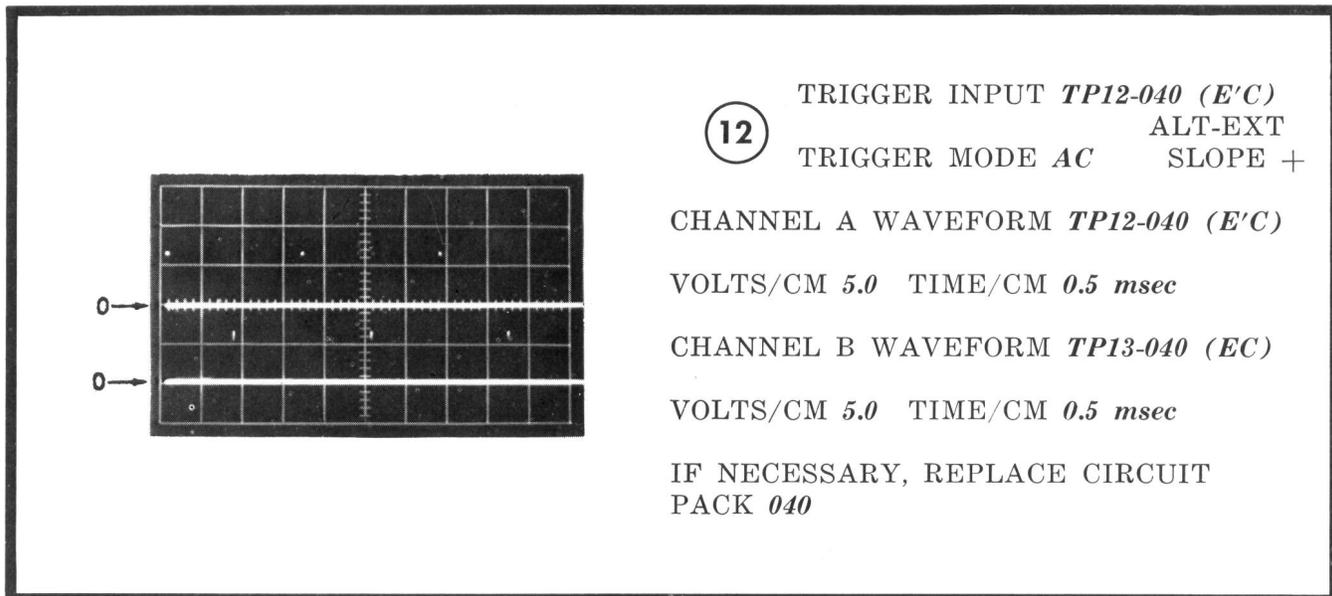


Fig. 12 — Transmitter Timing Tests

CONDITIONS: None



CONDITIONS: None

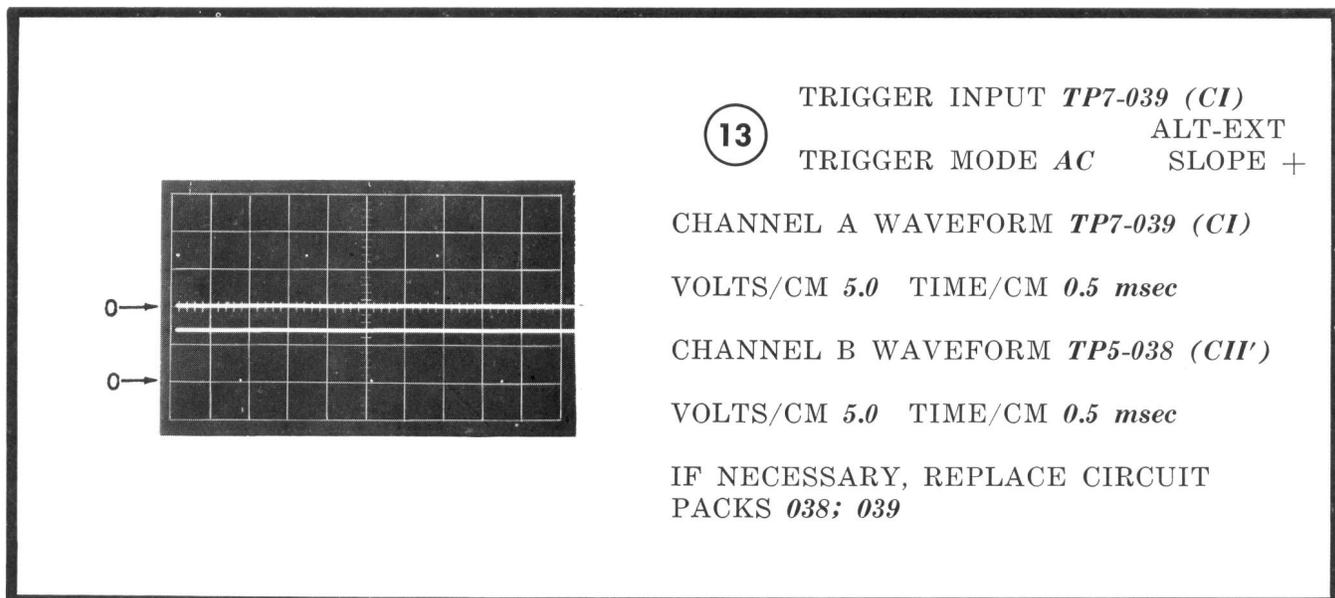
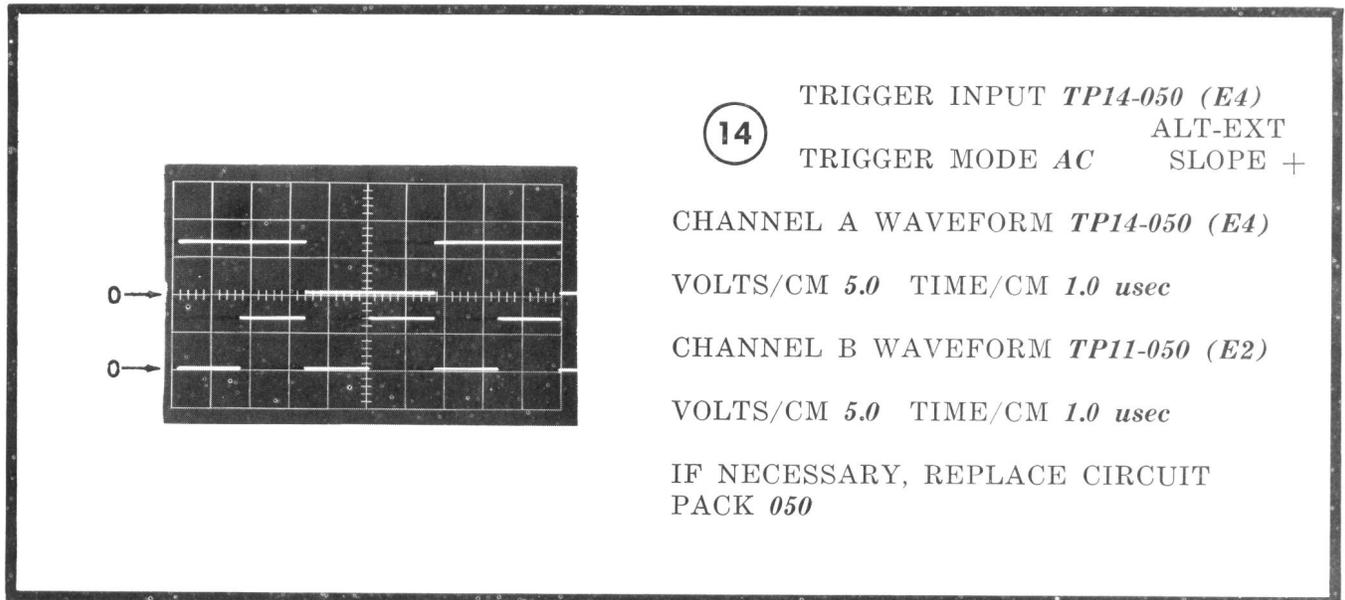


Fig. 13 — Transmitter Timing Tests

CONDITIONS: None



CONDITIONS: None

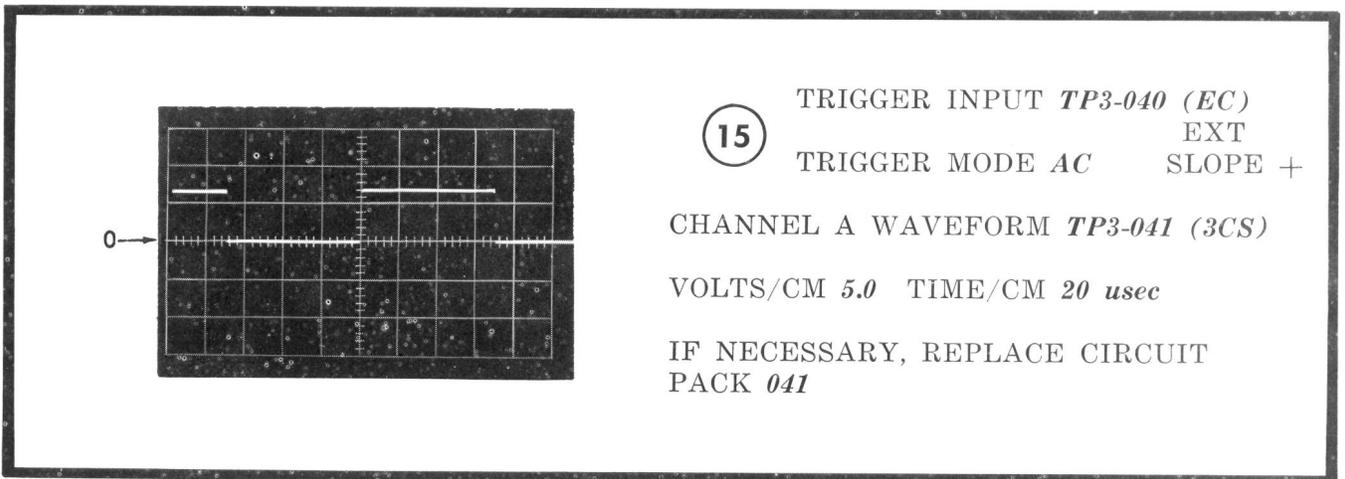


Fig. 14 — Transmitter Timing Tests

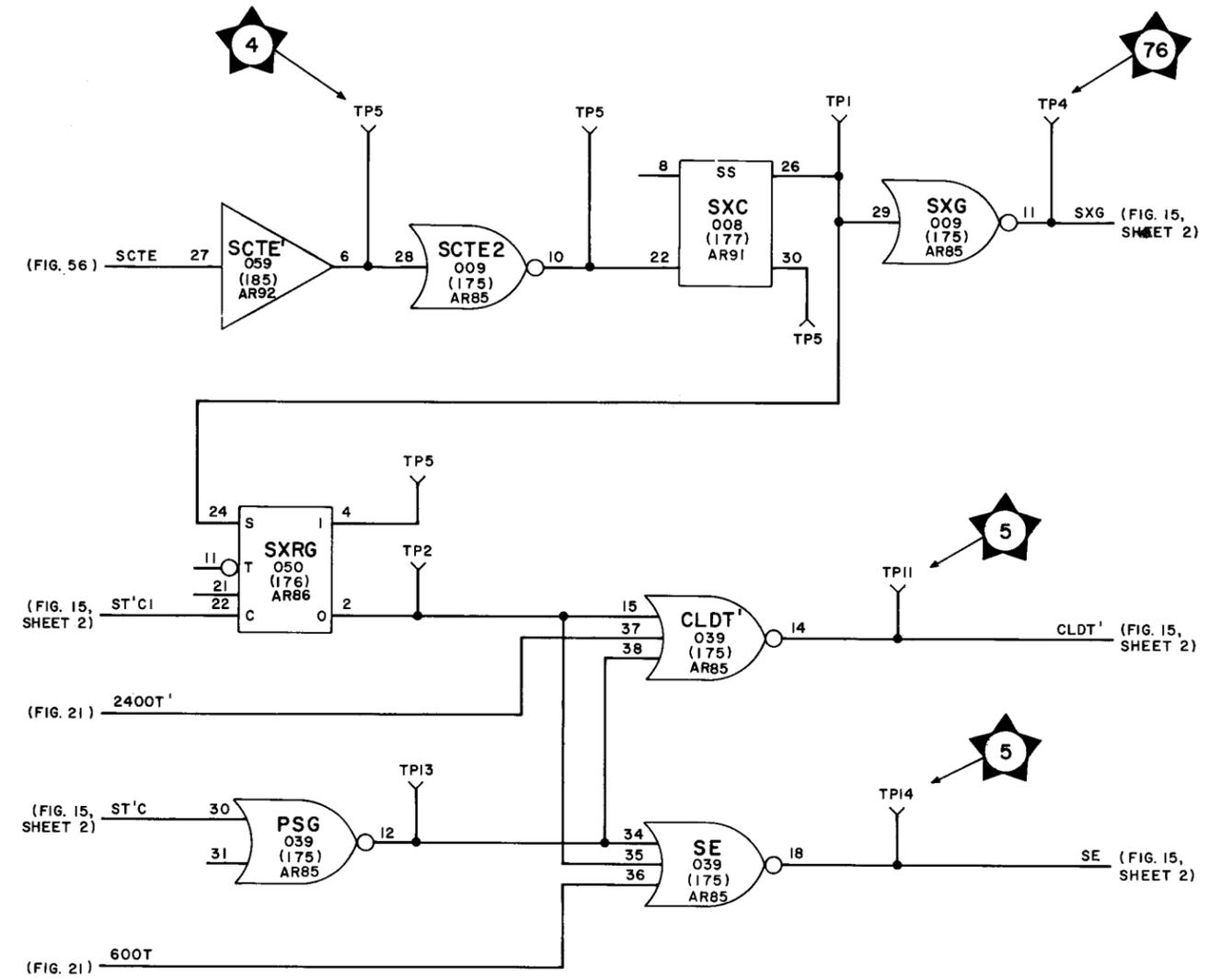


Fig. 15—Transmitter Timing Functional Schematic (Sheet 1 of 2)

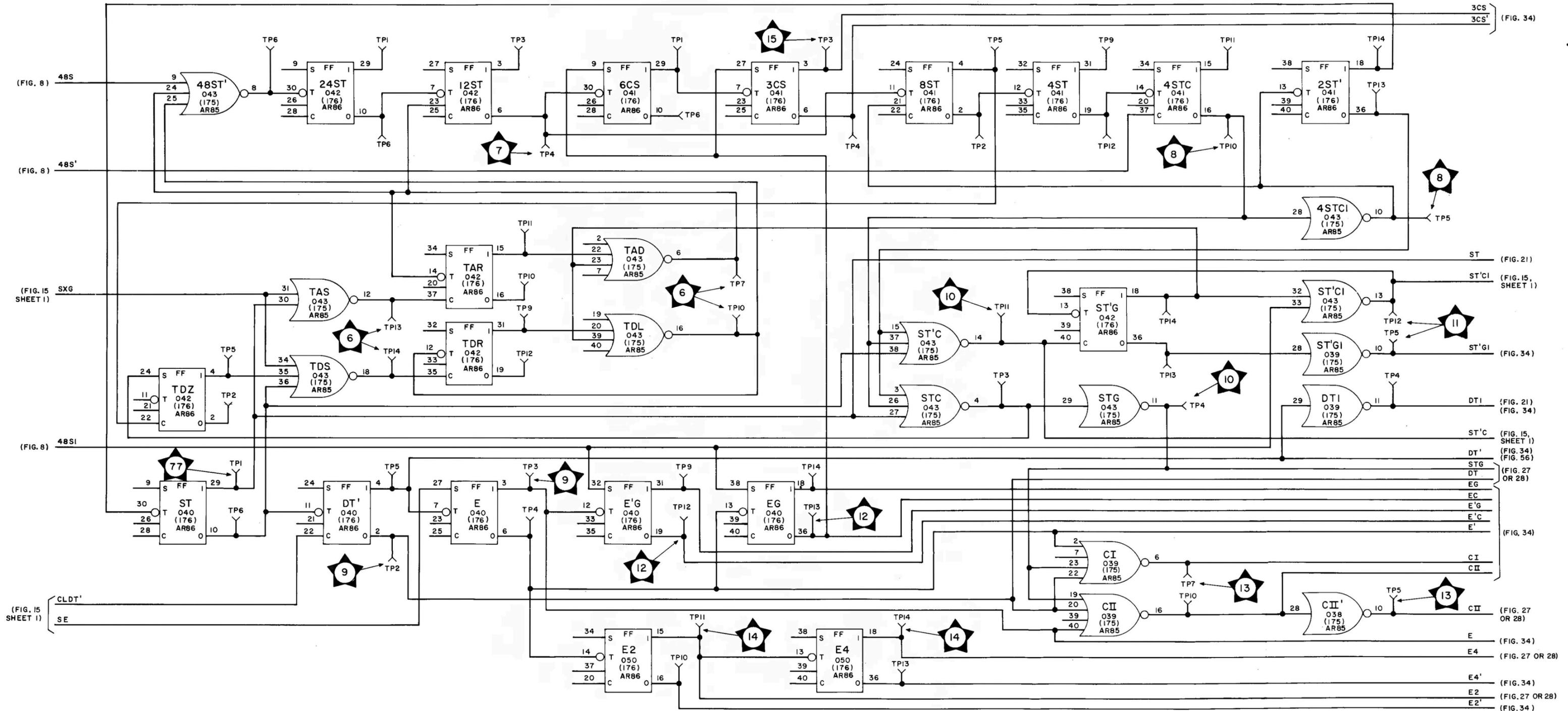


Fig. 15 — Transmitter Timing Functional Schematic (Sheet 2 of 2)

TEST 3—CLOCK SPEED SELECT CIRCUITS

11.21 The clock speed select circuits provide control signals required by the data set transmitter and receiver for various modes of operation. Voltage and waveform requirements shown in Fig. 16 through Fig. 20 are keyed to the functional schematic diagram shown in Fig. 21.

Note: Speed selection requirements noted by waveform CONDITIONS must be accomplished by using the ATT-UNATT switch on the 901B-2 test set together with proper connections on the interface adapter. Follow keyed instructions carefully when using the speed selection chart given in Table A or Fig. 21.



Requirements for the star test points are contained in Fig. 21.

CONDITIONS: 600 bps

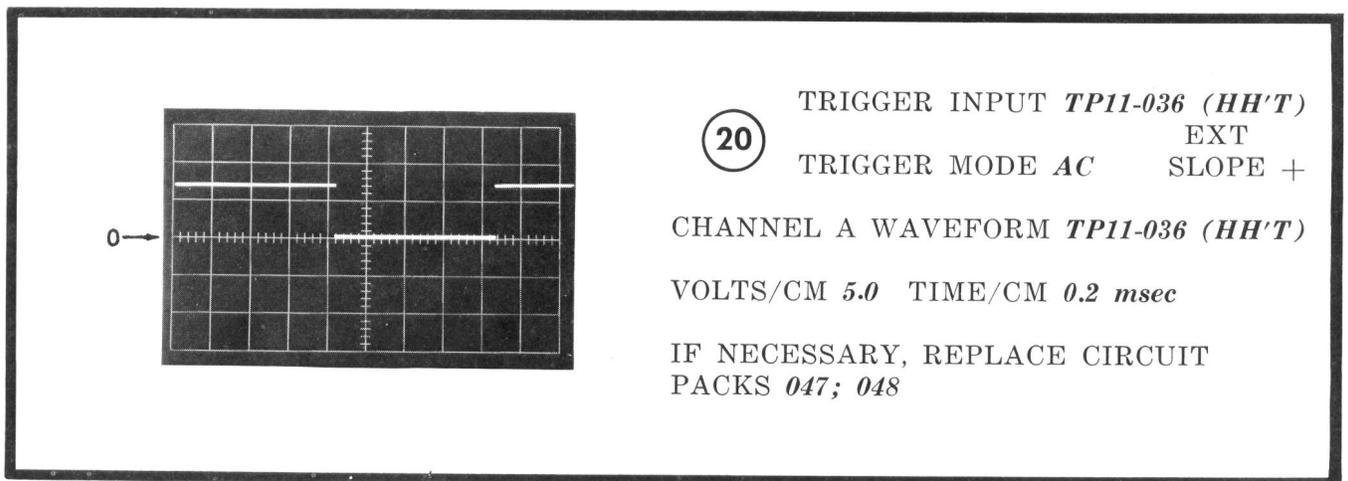
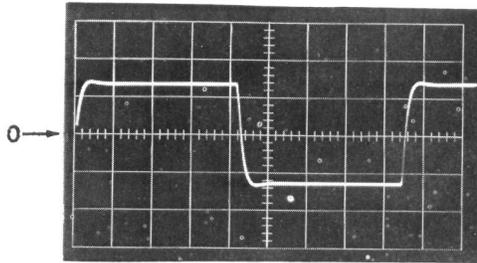


Fig. 16 — Speed Select Tests

CONDITIONS: 2400 bps



21

TRIGGER INPUT *TP10-060 (SCT)*

EXT

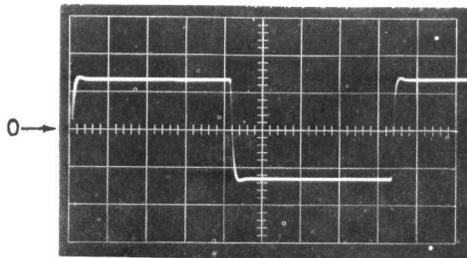
TRIGGER MODE *AC* SLOPE +

CHANNEL A WAVEFORM *TP10-060 (SCT)*

VOLTS/CM *5.0* TIME/CM *50 usec*

IF NECESSARY, REPLACE CIRCUIT
PACKS *058; 060*

CONDITIONS: 1200 bps



22

TRIGGER INPUT *TP10-060 (SCT)*

EXT

TRIGGER MODE *AC* SLOPE +

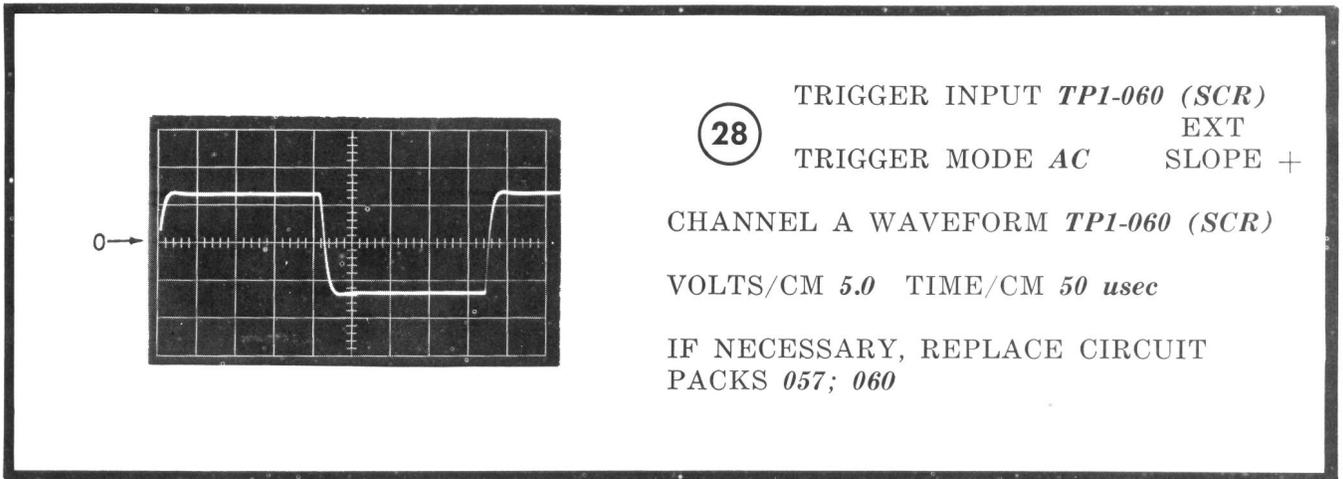
CHANNEL A WAVEFORM *TP10-060 (SCT)*

VOLTS/CM *5.0* TIME/CM *0.1 msec*

IF NECESSARY, REPLACE CIRCUIT
PACKS *058; 060*

Fig. 17 — Speed Select Tests

CONDITIONS: 2400 bps



CONDITIONS: 1200 bps

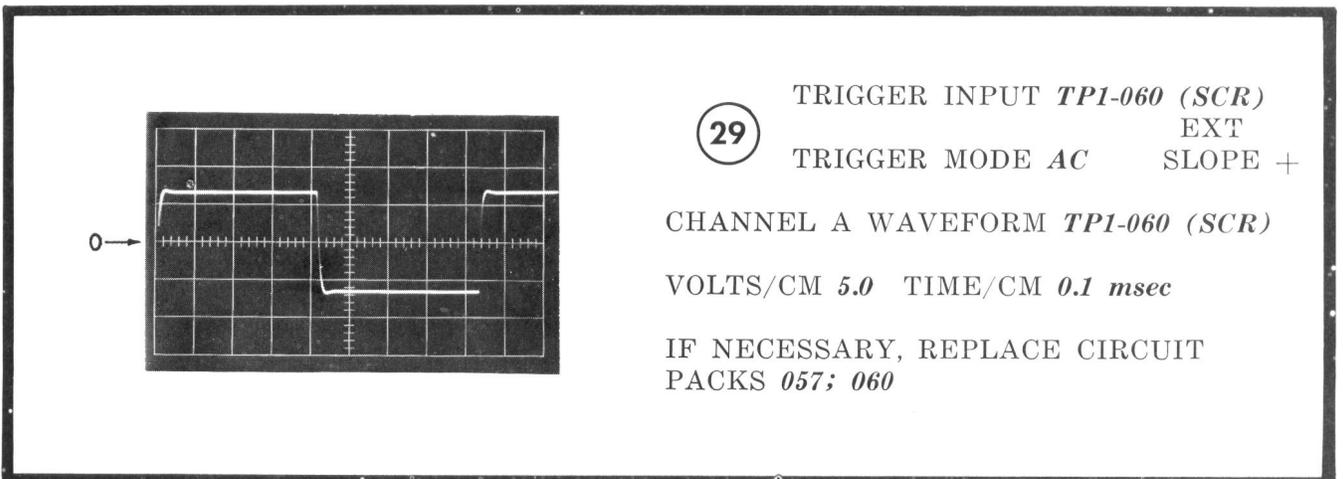
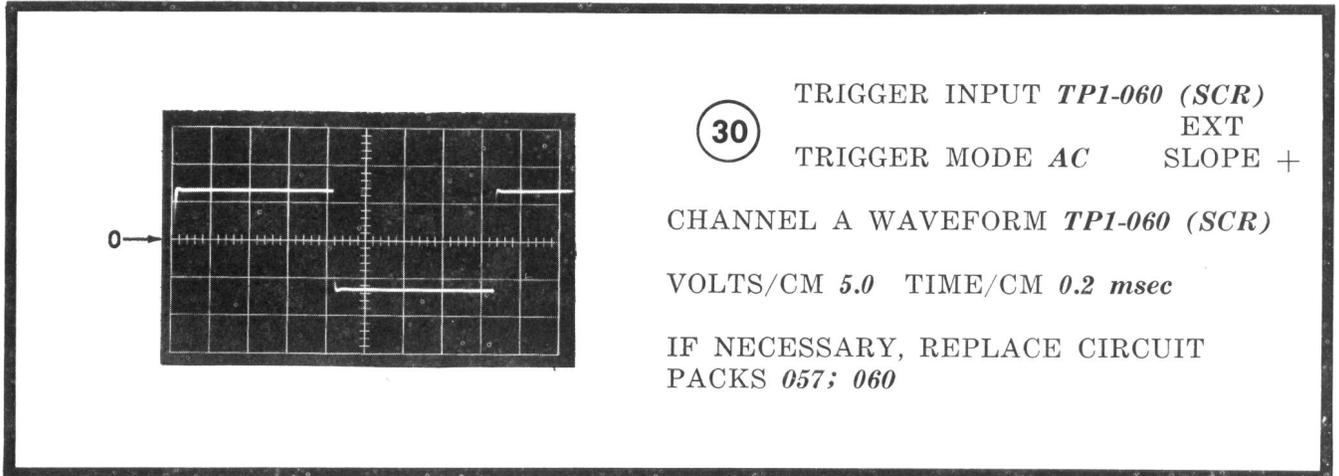


Fig. 19 — Speed Select Tests

CONDITIONS: 600 bps



CONDITIONS: Regenerate

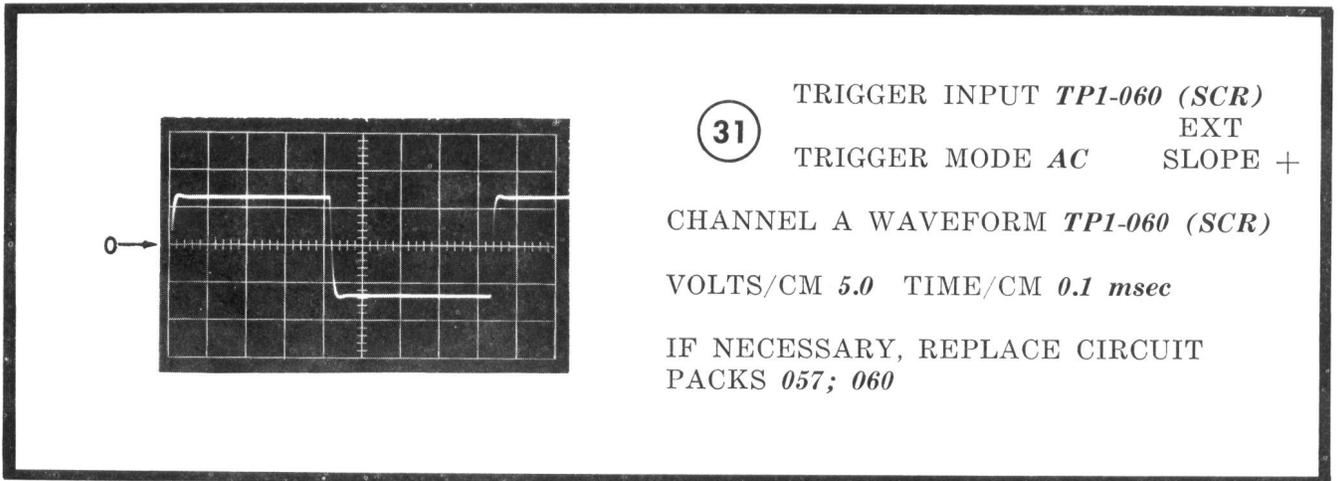
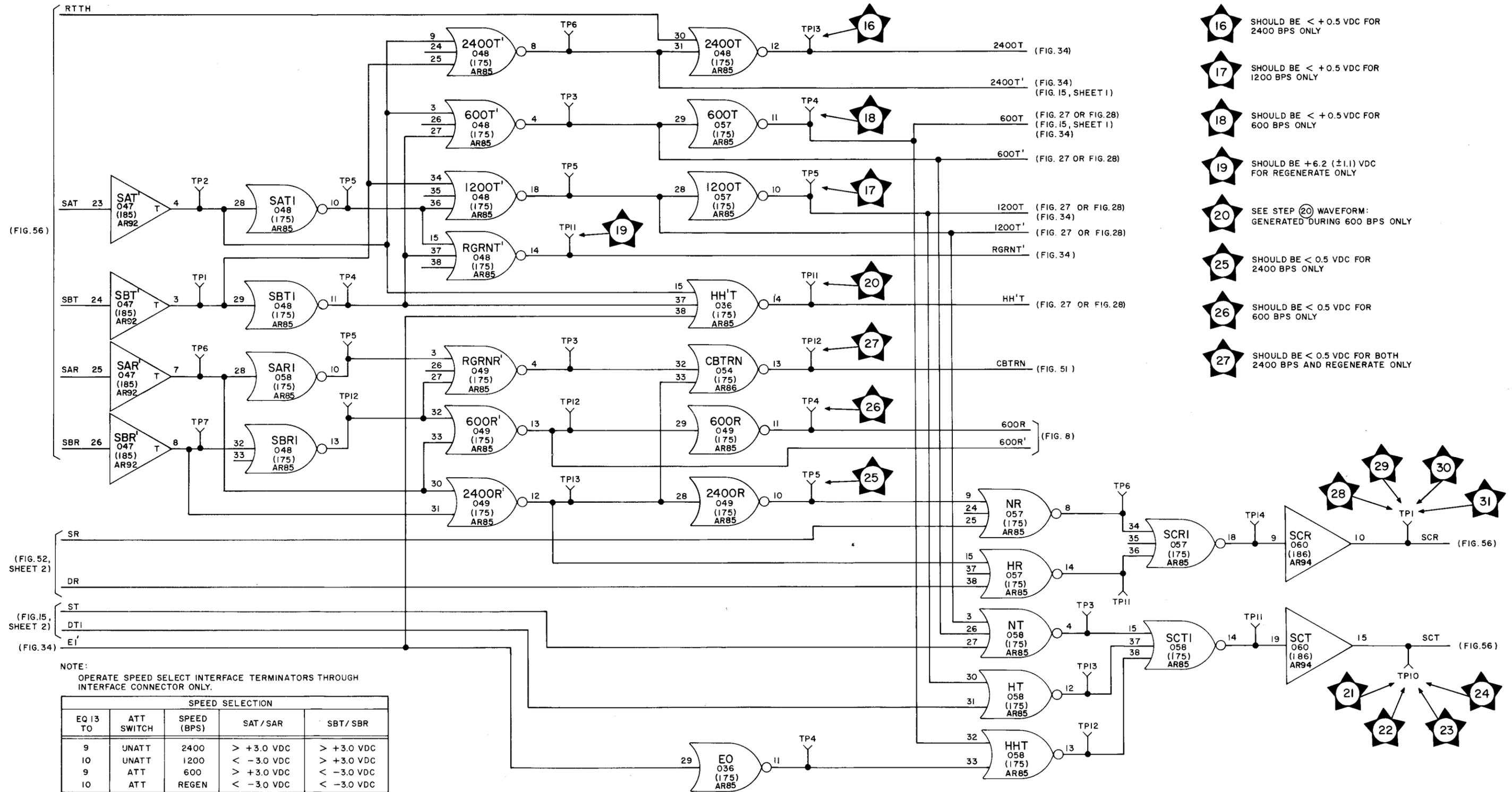


Fig. 20 — Speed Select Tests



- 16** SHOULD BE < +0.5 VDC FOR 2400 BPS ONLY
- 17** SHOULD BE < +0.5 VDC FOR 1200 BPS ONLY
- 18** SHOULD BE < +0.5 VDC FOR 600 BPS ONLY
- 19** SHOULD BE +6.2 (±1.1) VDC FOR REGENERATE ONLY
- 20** SEE STEP 20 WAVEFORM: GENERATED DURING 600 BPS ONLY
- 25** SHOULD BE < 0.5 VDC FOR 2400 BPS ONLY
- 26** SHOULD BE < 0.5 VDC FOR 600 BPS ONLY
- 27** SHOULD BE < 0.5 VDC FOR BOTH 2400 BPS AND REGENERATE ONLY

Fig. 21 — Speed Select Circuits, Functional Schematic

TEST 4 — TRANSMITTER CONTROL TIMING

11.22 The transmitter control timing circuits provide transmitter timing functions when keyed by request-to-send (RS/CA) signal through the CUSTOMER connector. The timing circuits generate a clear-to-send (CS/CB) signal to notify customer equipment that the send data (SD/BA) lead is available and the data set will accept and process customer equipment signals.

11.23 Voltage and waveform requirements shown in Fig. 22 through Fig. 26 are keyed to the functional schematic shown in Fig. 27. Tests suffixed by the letter A are for Data Set 205B2 and are keyed to Fig. 28.

Note: Speed selection requirements noted by waveform CONDITIONS must be accomplished by using the ATT-UNATT switch on the 901B-2 test set and proper connections on the interface adapter. Follow keyed instructions carefully when using speed selection chart given in Table A or Fig. 21.

CONDITIONS: CONTINUOUS CARRIER (Waveform independent of speed)

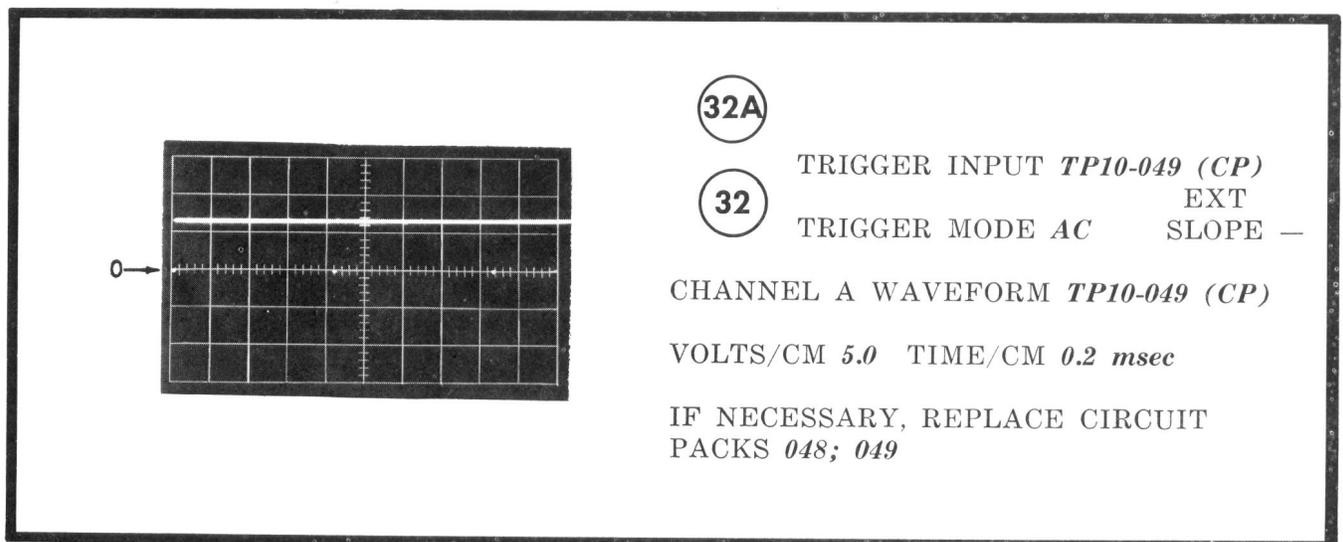
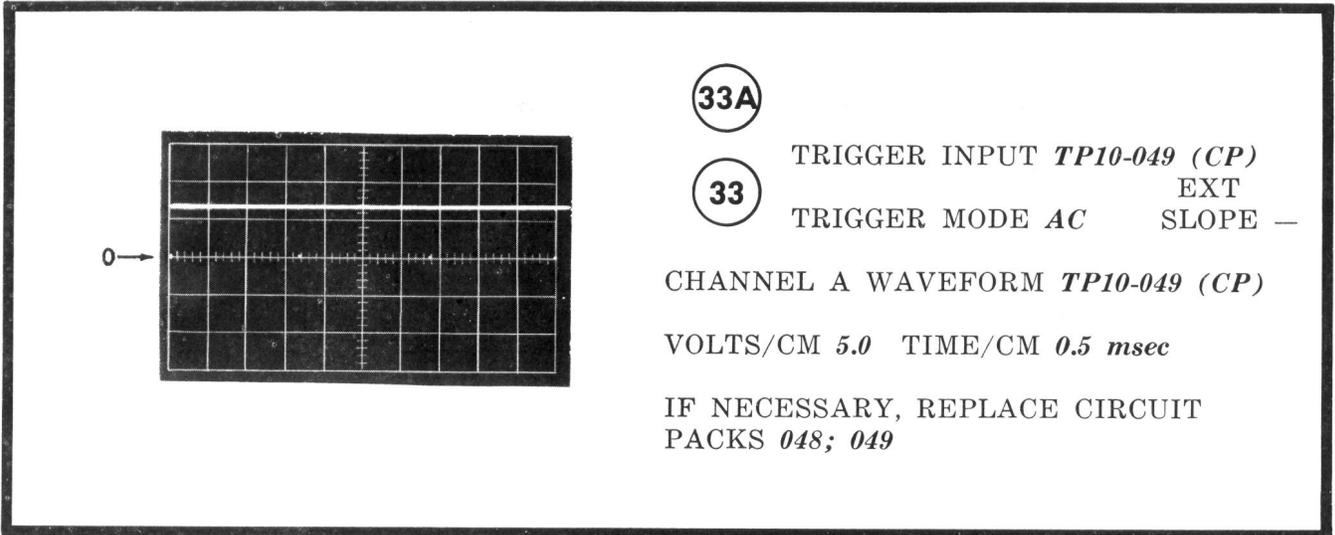


Fig. 22 — Control Timing Tests

CONDITIONS: SWITCHED CARRIER at 2400 bps



CONDITIONS: SWITCHED CARRIER at 1200 bps

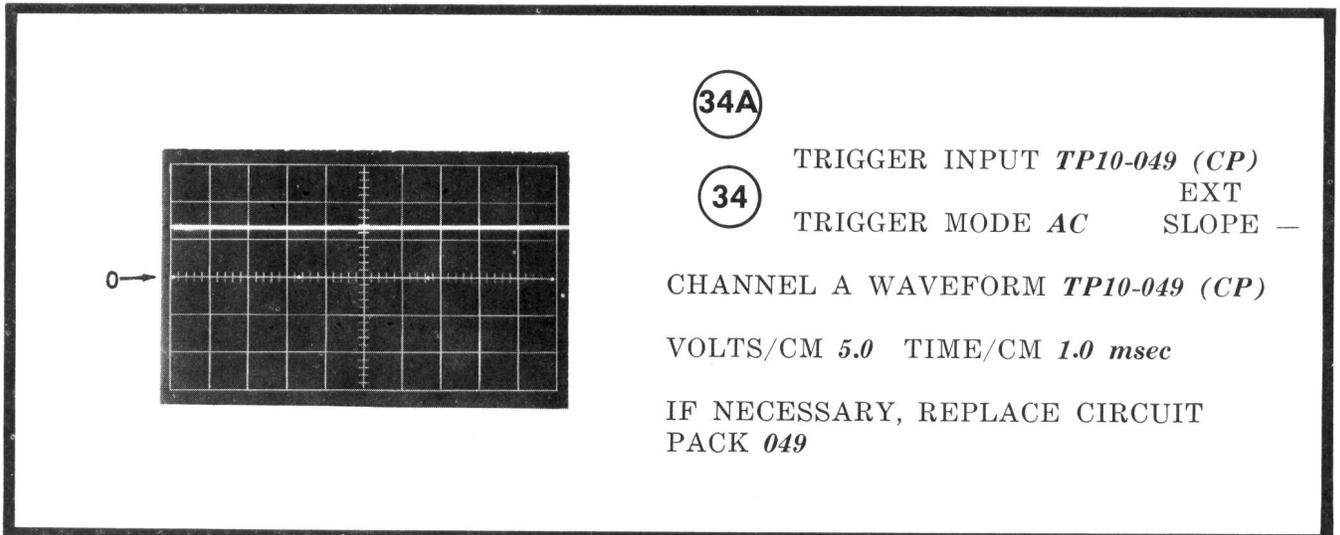


Fig. 23 — Control Timing Tests

CONDITIONS: For 205B1 and 205B2, SWITCHED CARRIER at 600 bps. For 205B2 only, SWITCHED CARRIER AUTOMATIC at all bit speeds.

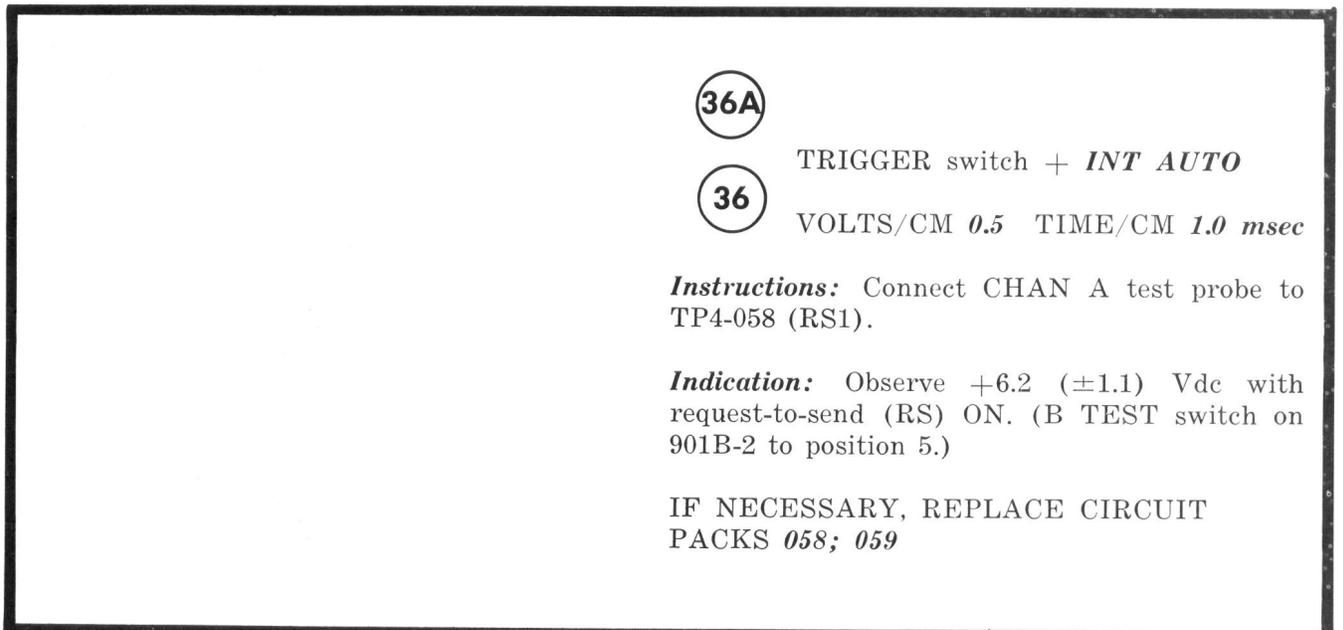
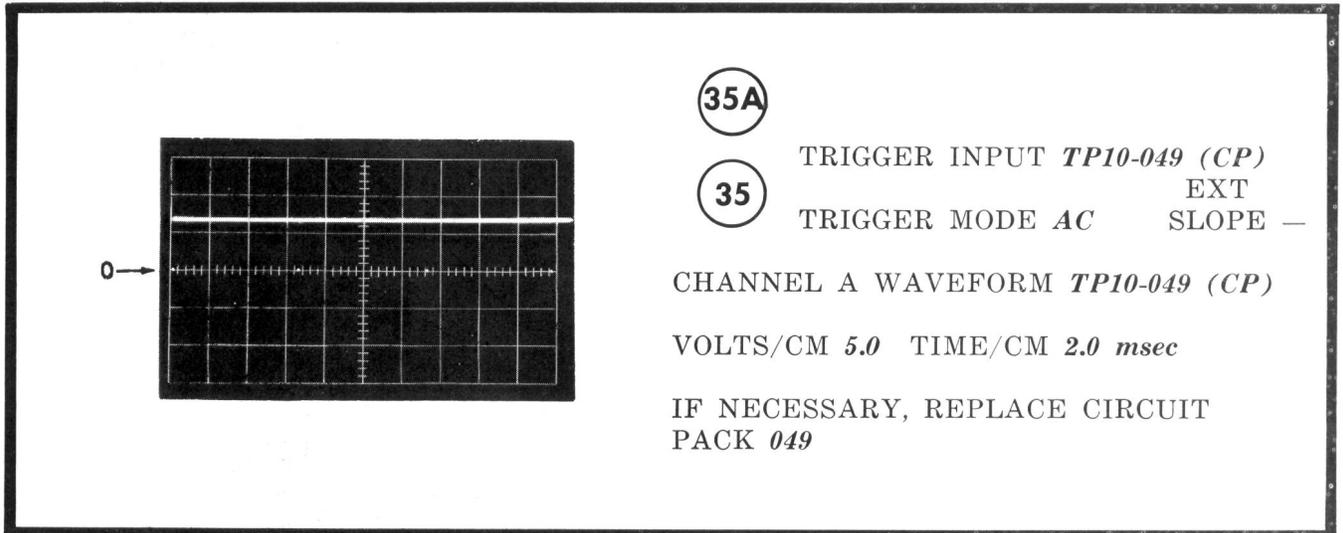
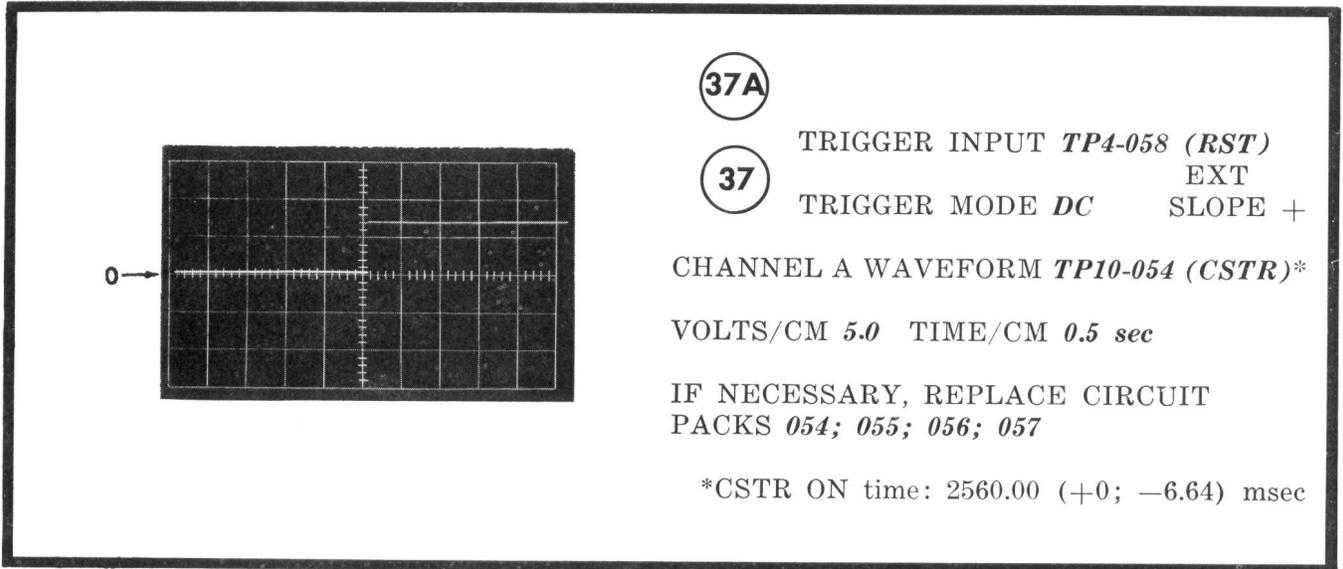


Fig. 24 — Control Timing Tests

CONDITIONS: SWITCHED CARRIER at 600 bps; TRIGGER set on rise of RS; operate 901B-2 B TEST switch from position 6 to 5.



CONDITIONS: SWITCHED CARRIER at 600 bps; TRIGGER set on fall of RS1; operate 901B-2 B TEST switch from position 5 to 6.

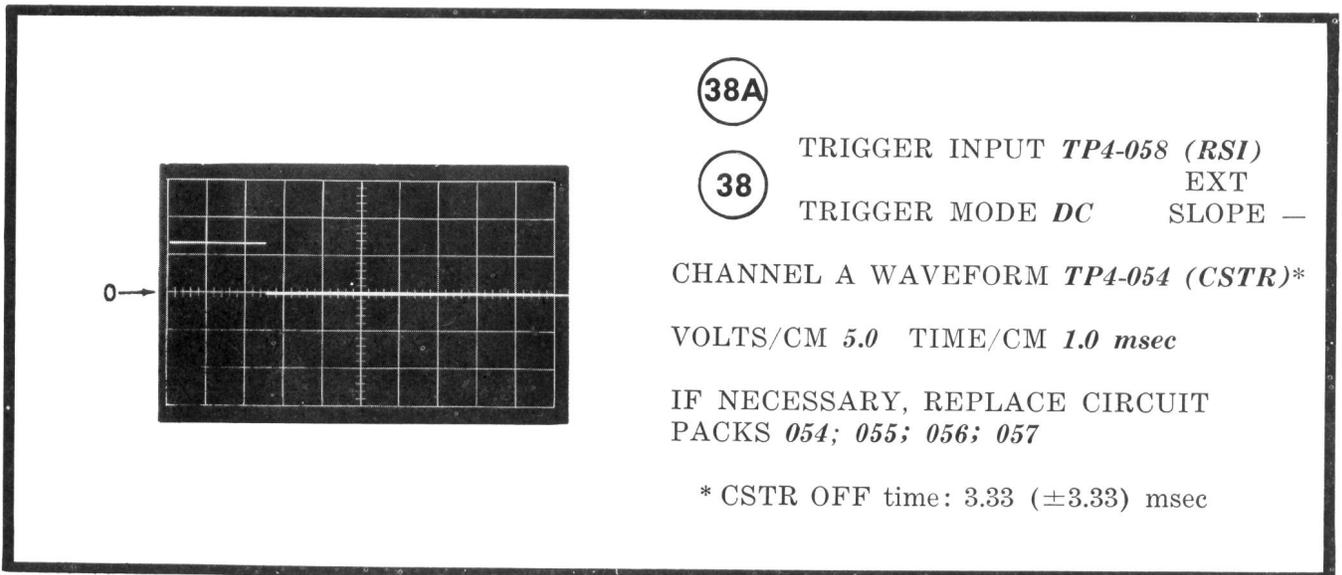


Fig. 25 — Control Timing Tests

CONDITIONS: CONTINUOUS CARRIER at 600 bps; TRIGGER set on rise of RS1; operate 901B-2 B TEST switch from position 6 to position 5 (to cause RS to switch).

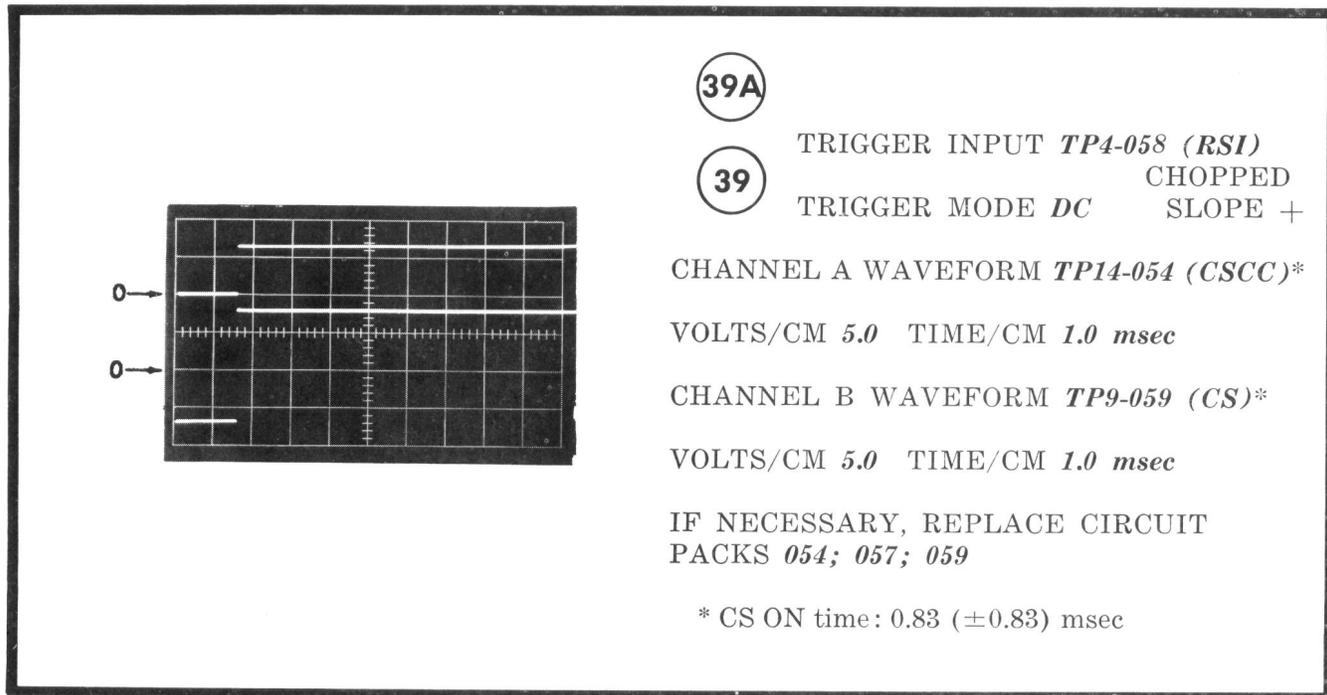


Fig. 26 — Control Timing Test

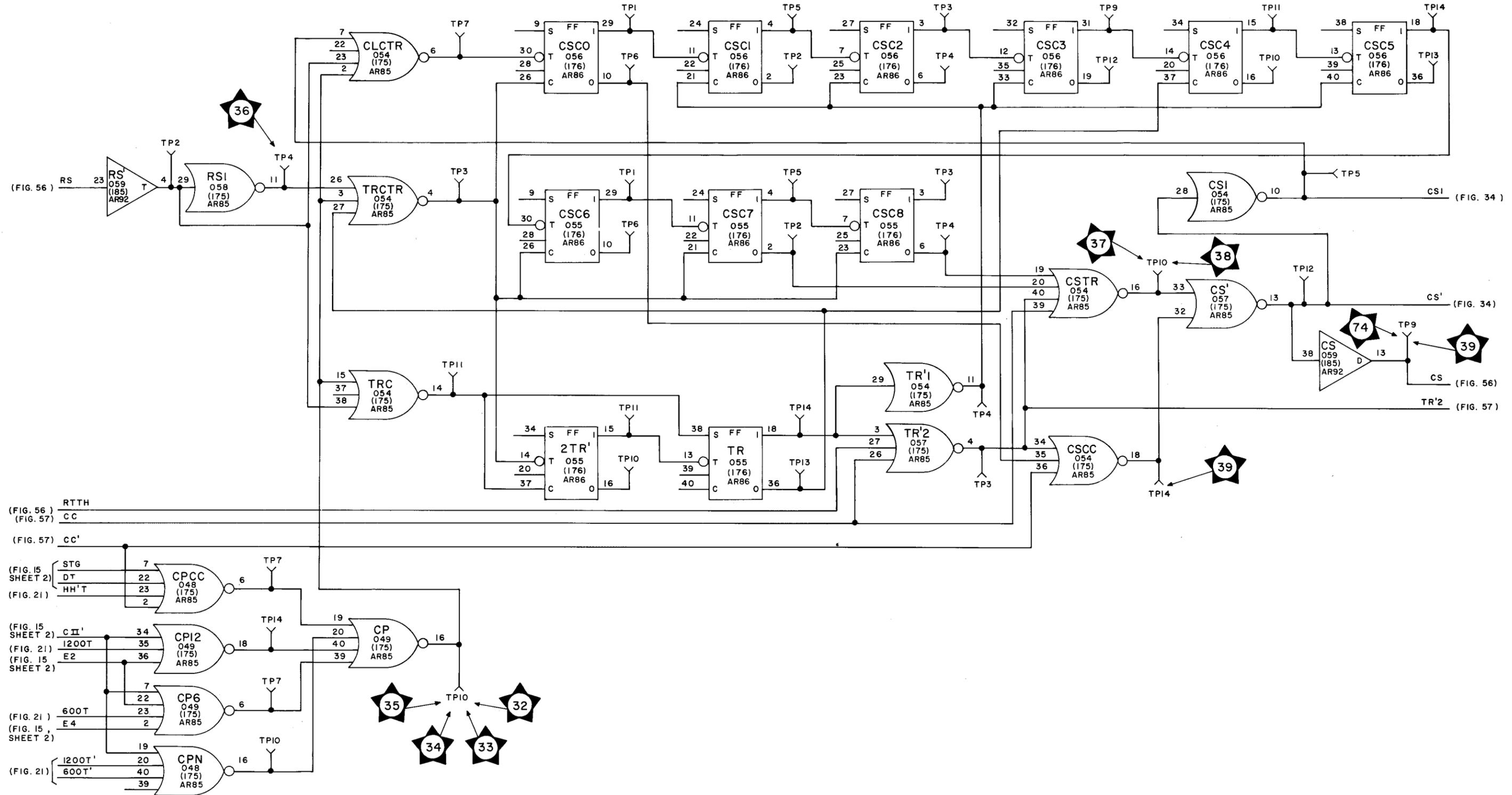


Fig. 27 — Control Timing Circuits, Functional Schematic for Data Set 205B1

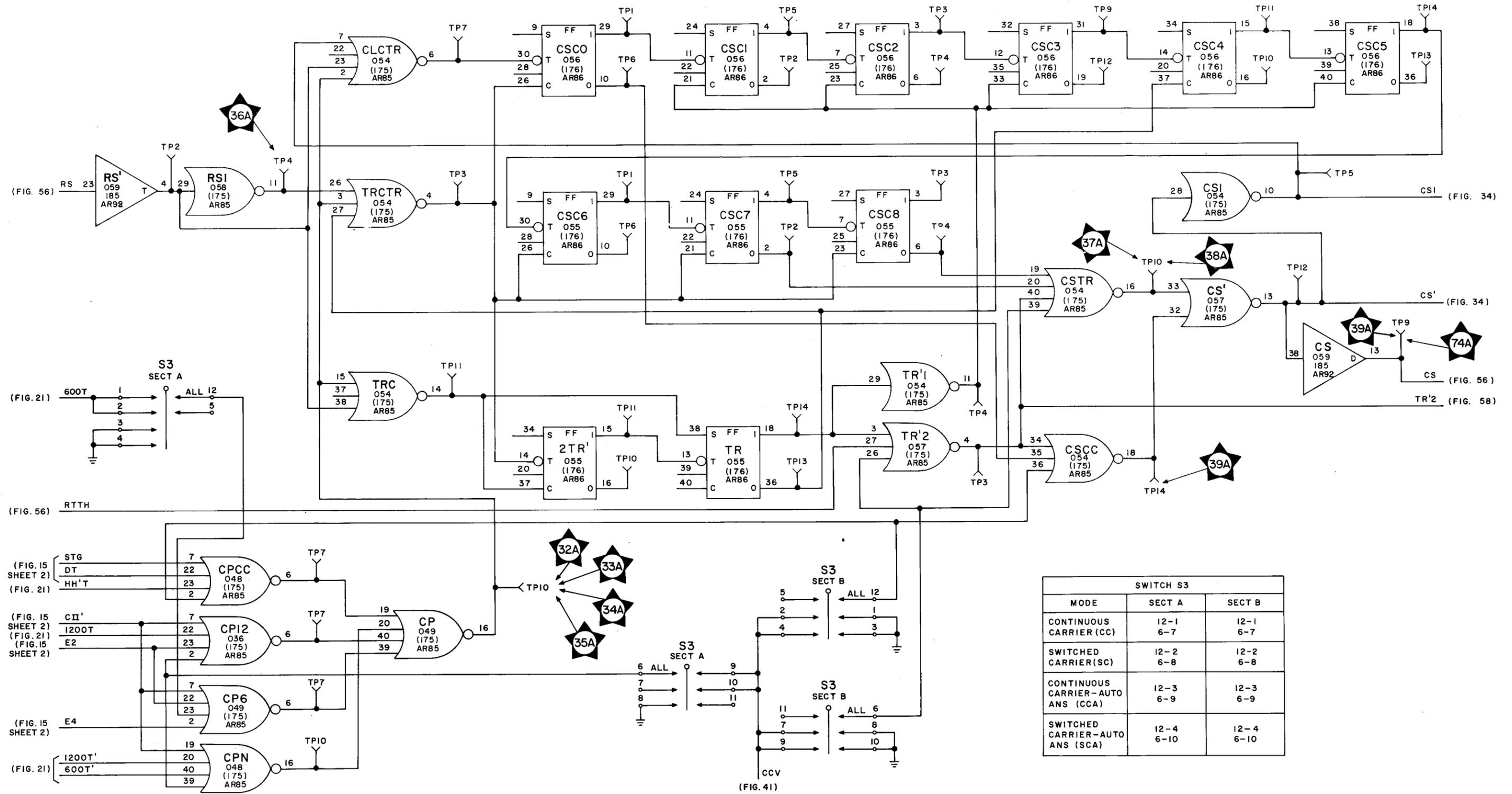


Fig. 28—Control Timing Circuits, Functional Schematic for Data Set 205B2

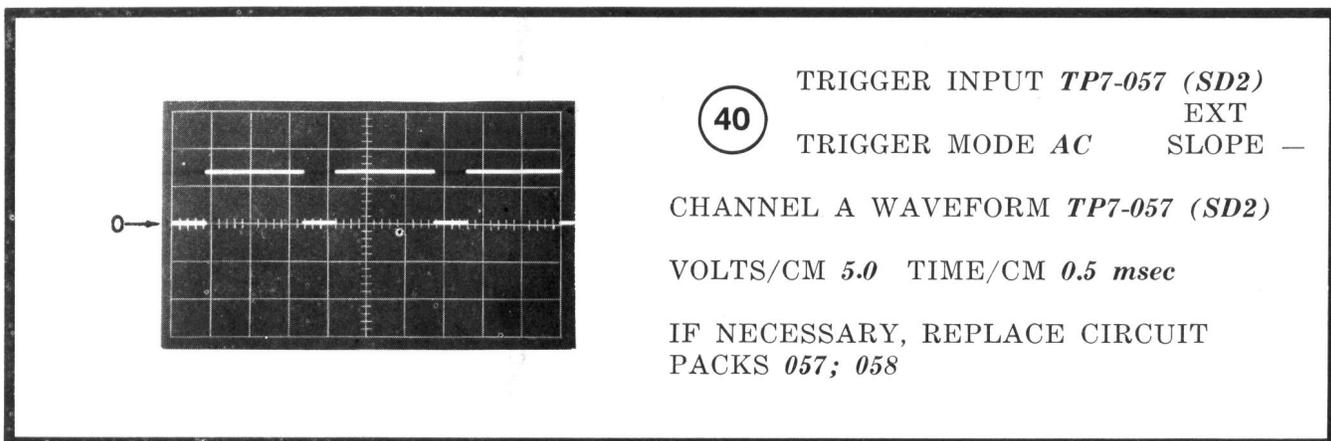
TEST 5 — DATA TRANSMITTER

11.24 The data transmitter encodes serial binary data as a band-limited signal suitable for transmission over telephone lines.

11.25 Waveform requirements shown in Fig. 29 through Fig. 33 are keyed to the functional schematic shown in Fig. 34. The waveforms are examples of normal operation for various modes in which the transmitter may be used.

Note: Speed selection requirements noted by waveform CONDITIONS must be accomplished by using the ATT-UNATT switch on the 901B-2 test set and proper connections on the interface adapter. Follow keyed instructions carefully when using speed selection chart given in Table A or Fig. 21.

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is OFF; 901B-2 B TEST switch to position 6.



CONDITIONS: CONTINUOUS CARRIER at 1200 bps; RS is OFF; 901B-2 B TEST switch to position 6.

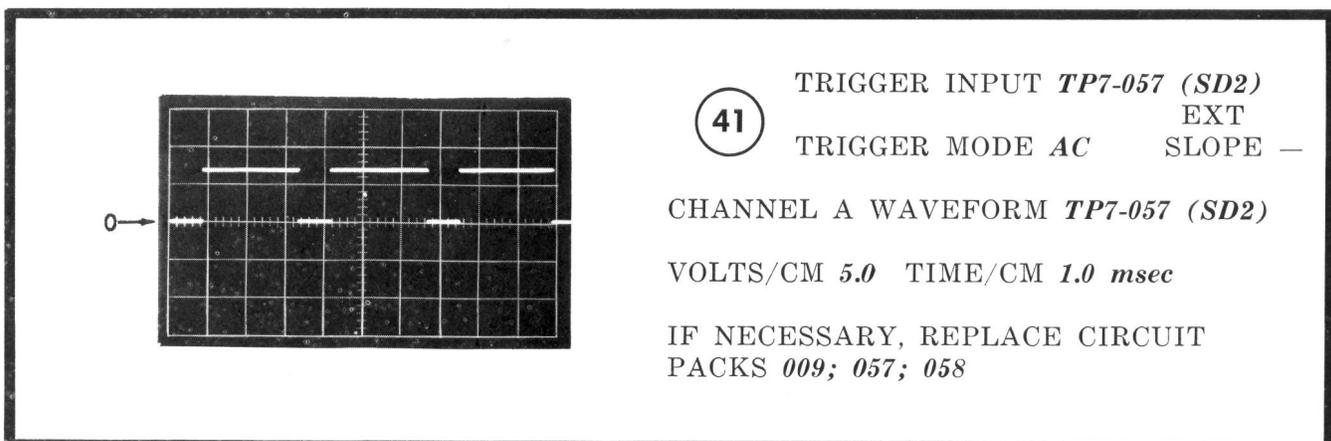
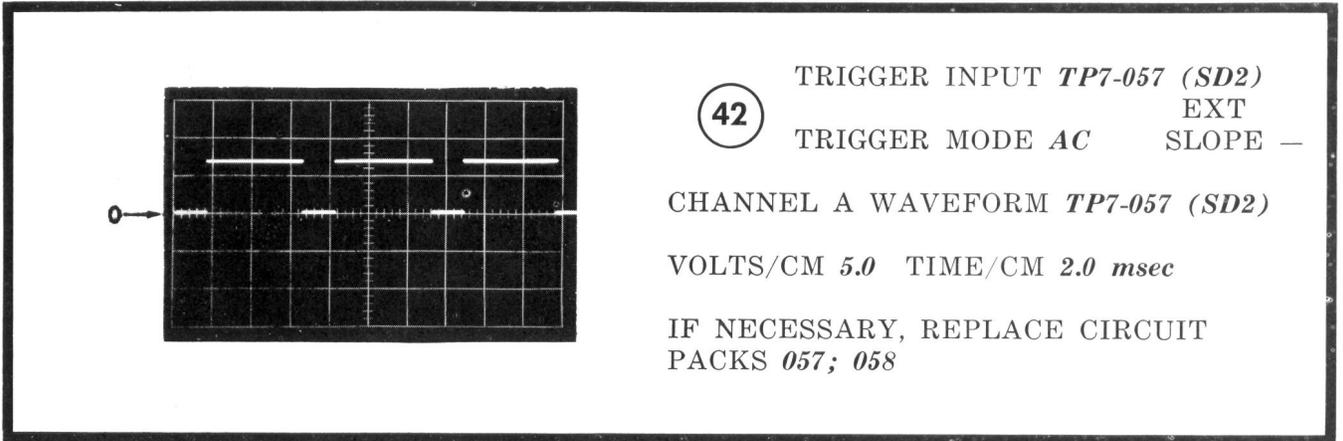


Fig. 29 — Data Transmitter Tests

CONDITIONS: CONTINUOUS CARRIER at 600 bps; RS is OFF; 901B-2 B TEST switch to position 6.



CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is the 01 code; 901B-2 B TEST switch in position 5.

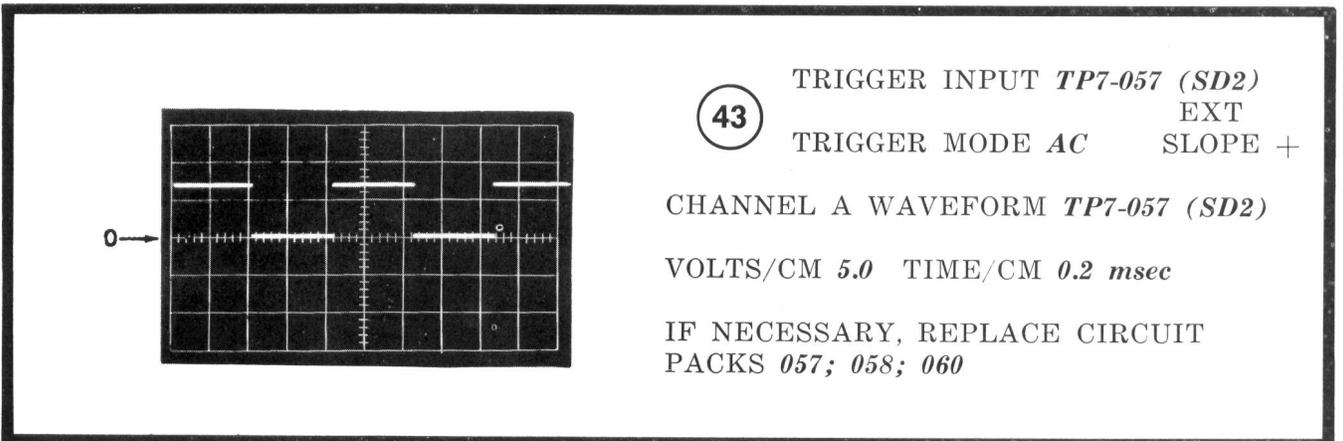
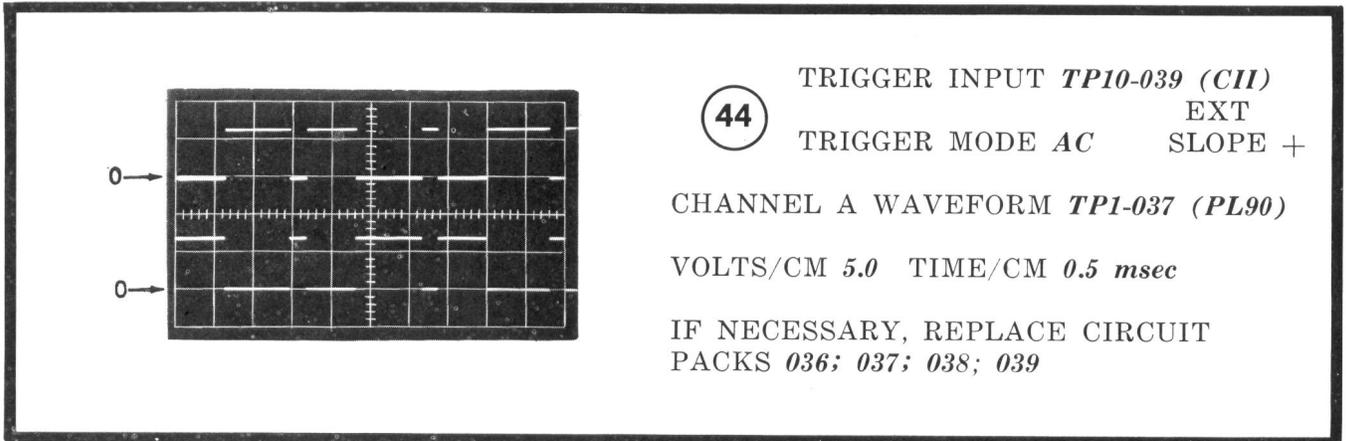


Fig. 30 — Data Transmitter Tests

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is the 00 code; 901B-2 B TEST switch in position 4; either waveform is correct.



CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is the 11 code; 901B-2 B TEST switch in position 3; either waveform is correct.

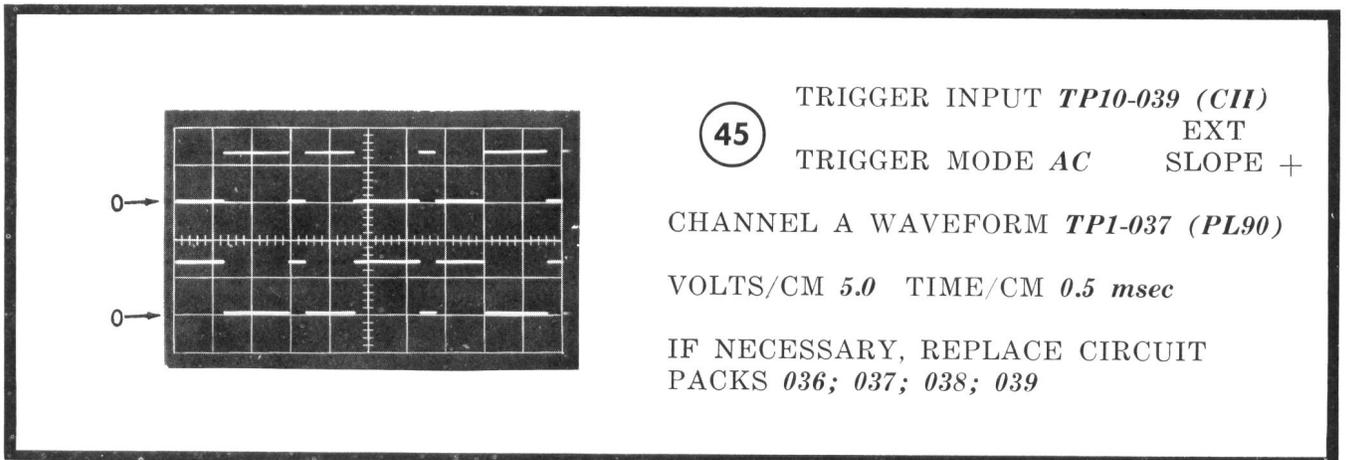
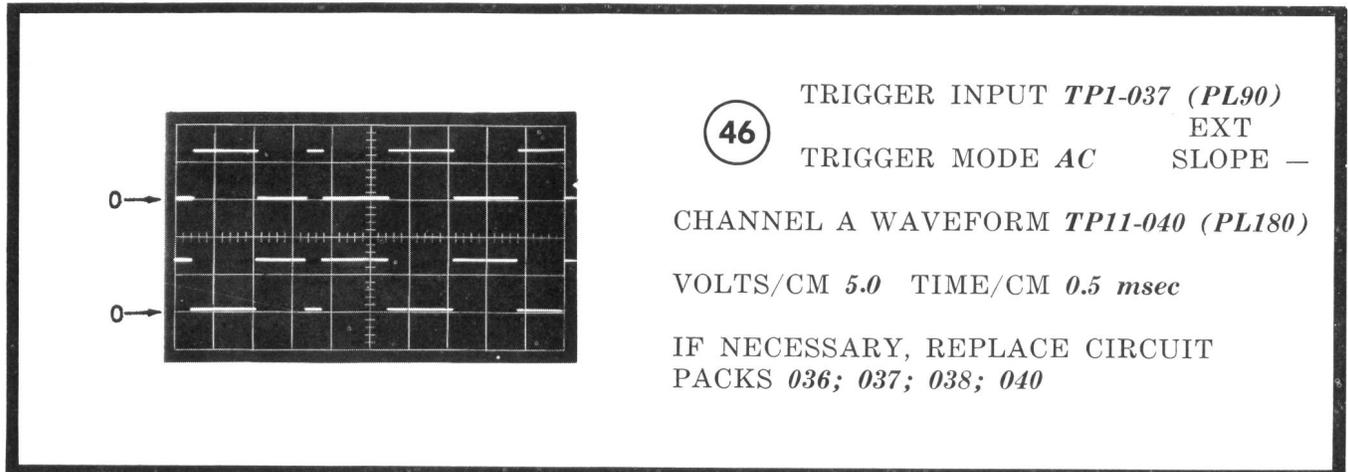


Fig. 31 — Data Transmitter Tests

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is the 01 code; 901B-2 B TEST switch in position 5; either waveform is correct.



CONDITIONS: Same as 46, plus ground TP11-040 (PL180) and TP1-037 (PL90). After checking waveforms, remove both grounds.

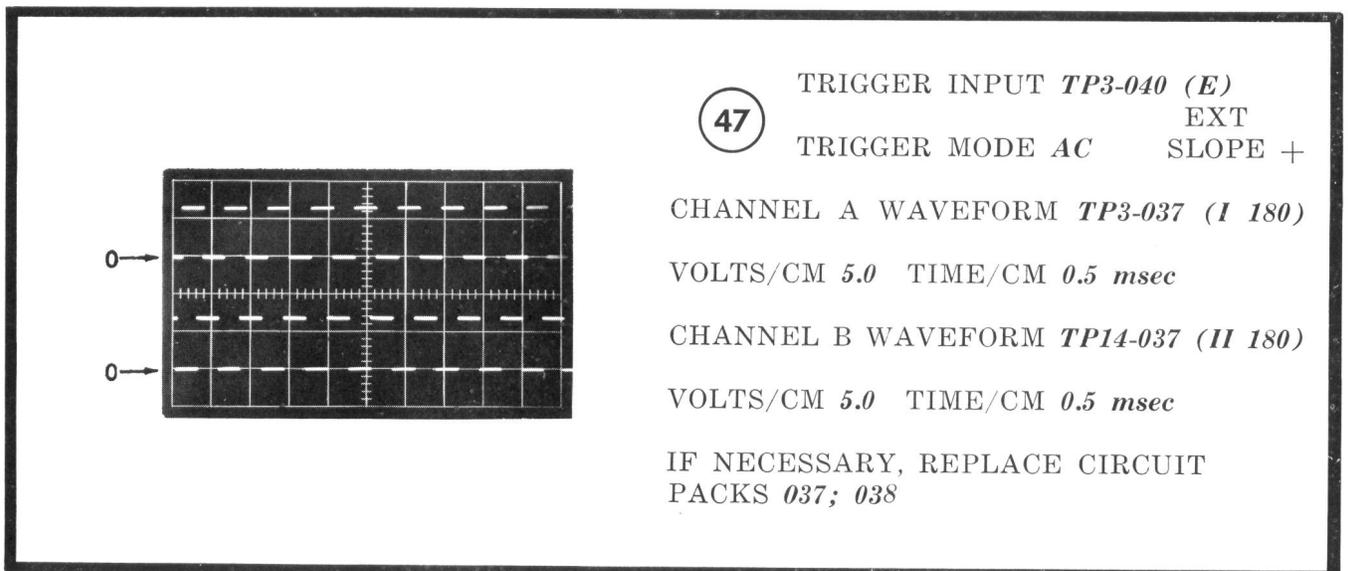
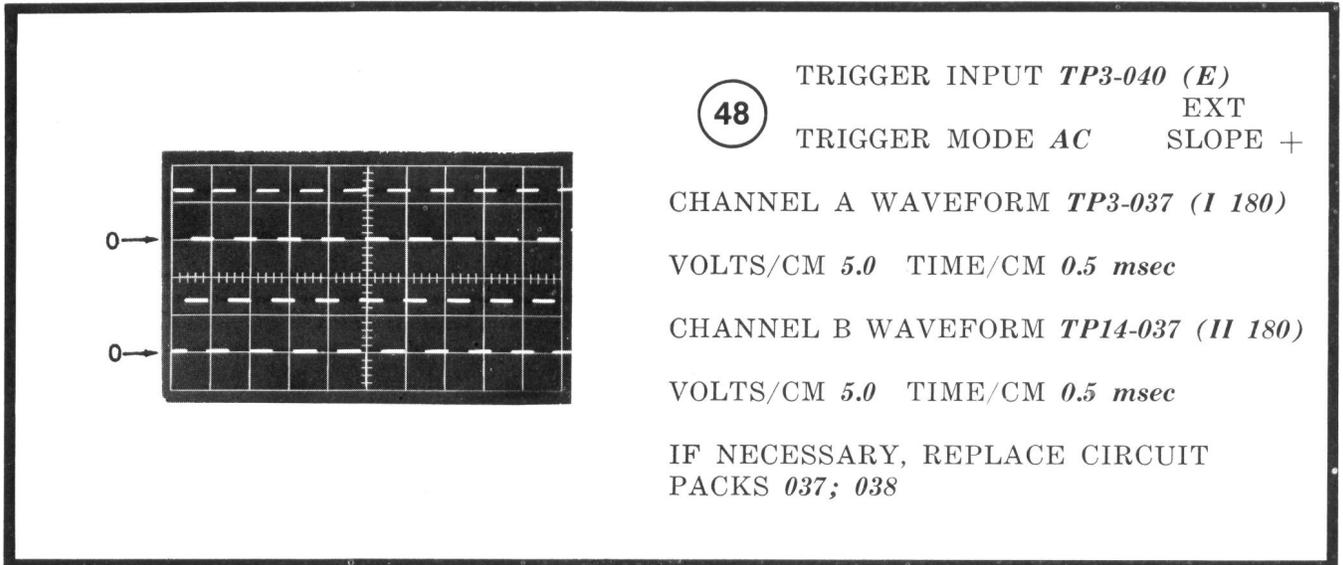


Fig. 32 — Data Transmitter Tests

CONDITIONS: Same as 47, plus ground TP10-040 (PL180') and TP6-037 (PL90'). Retain both grounds for the next waveform.



CONDITIONS: Same as 48. Adjust oscilloscope for A — B operation. After checking waveforms, remove both grounds.

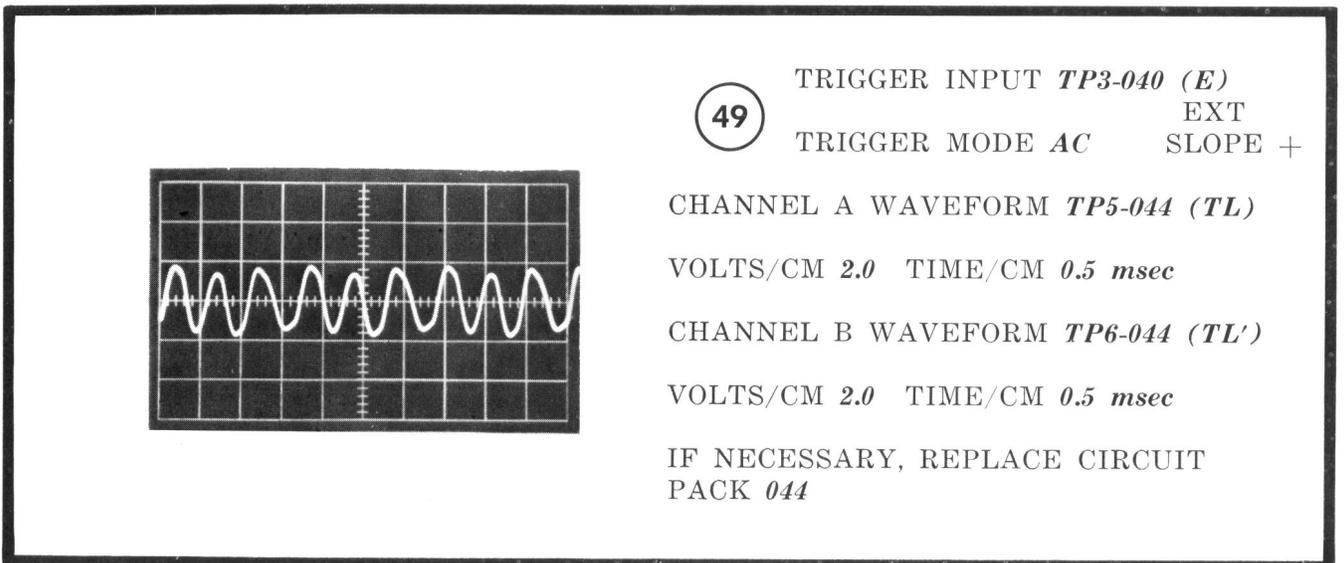


Fig. 33 — Data Transmitter Tests

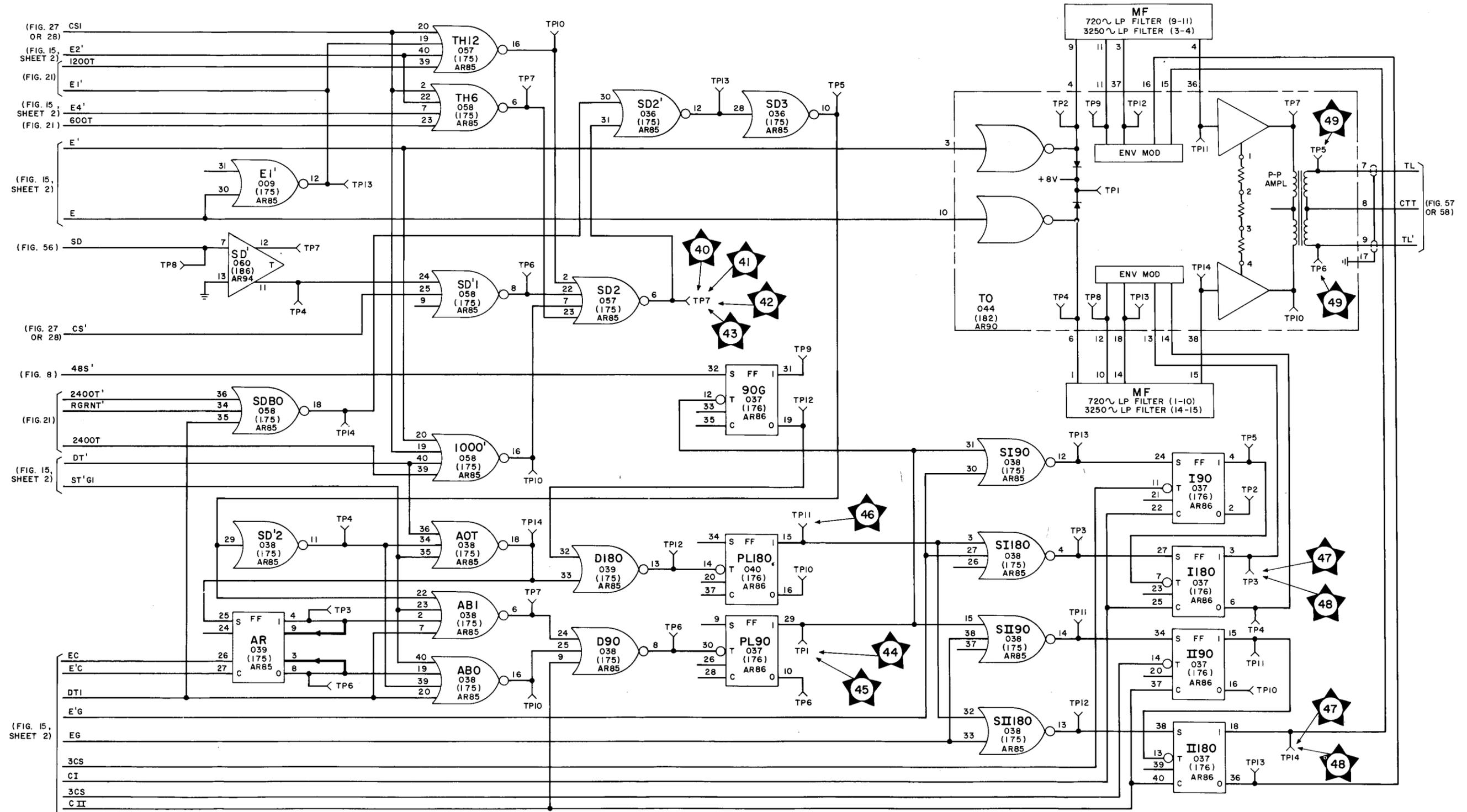


Fig. 34 — Data Transmitter, Functional Schematic

TEST 6 — TRANSMIT-RECEIVE SWITCH (TR-SW)

11.26 The transmit-receive switch controls the application of transmit line signals through an electronic switch when the carrier is controlled by request-to-send (RS/CA). The data set receiver is always connected to the receive line pair through the transmit-receive switch circuit components.

11.27 The waveform requirement shown in Steps 50 through 53 displays bandpass filter output under LOCAL TEST conditions.

Note: The waveforms shown are for 1 to 4 strapping on circuit pack 044. Other strapping will result in less amplitude.

TEST 7 — ANALOG RECEIVER

11.28 The analog receiver circuits both amplify the band-limited line signal to a fixed amplitude and convert the received signal into two parallel signals which constitute the A and B bits of received serial binary data.

11.29 Voltage and waveform requirements shown in Fig. 35 through Fig. 41 are keyed to the functional schematic shown in Fig. 42. The waveforms are examples of normal operation for various code combinations the receiver will convert.

CONDITIONS: SWITCHED CARRIER at 2400 bps; RS is ON; 901B-2 B TEST switch in position 5. Waveform disappears when B TEST switch is placed in position 8.

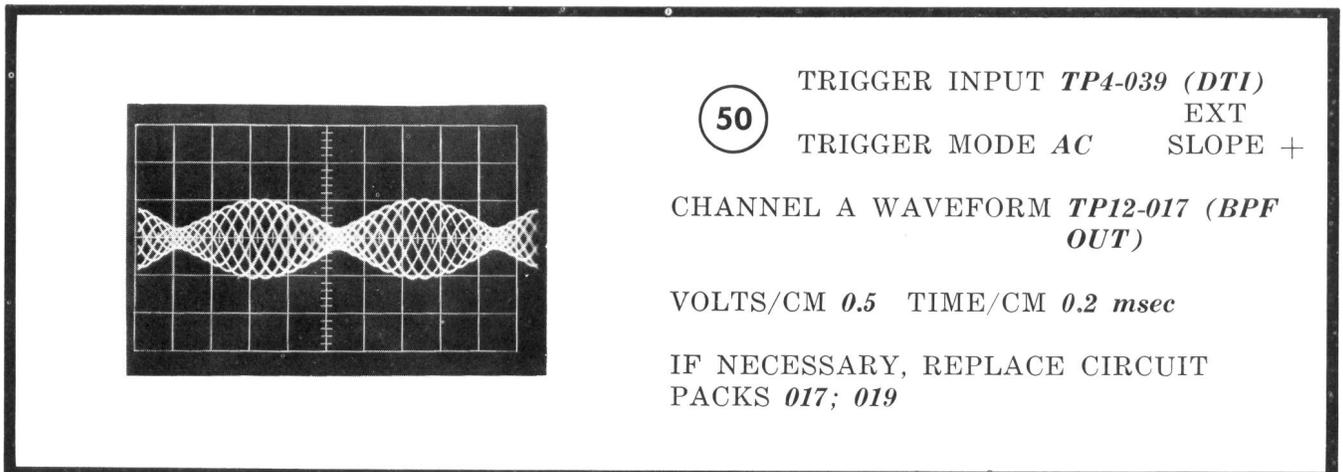
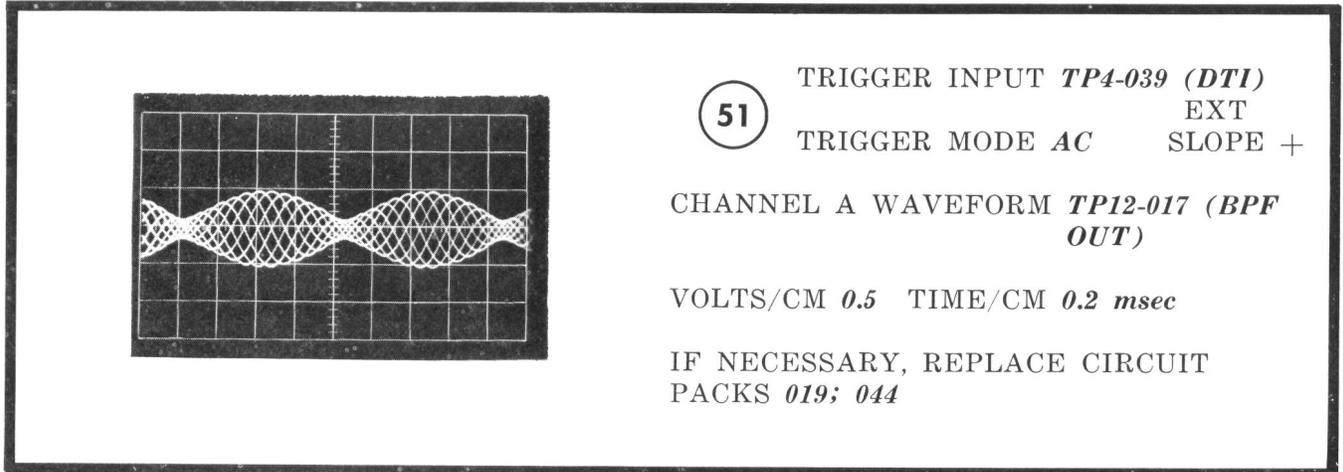


Fig. 35 — Analog Receiver Test

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is the 01 code; 901B-2 B TEST switch in position 5.



CONDITIONS: Same as 51, except 901B-2 B TEST switch to position 4 (DATA signal is the 00 code).

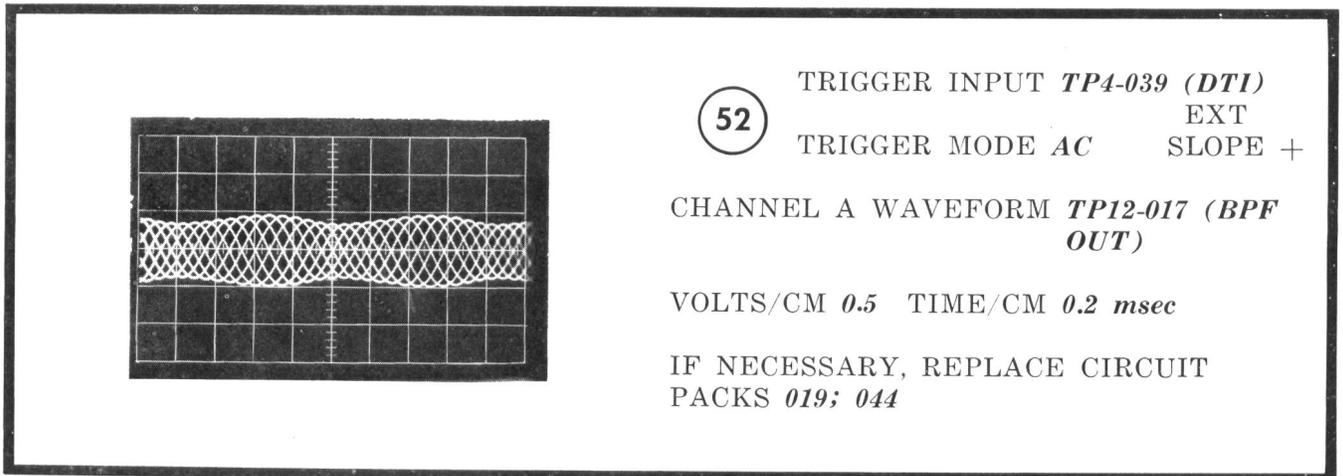
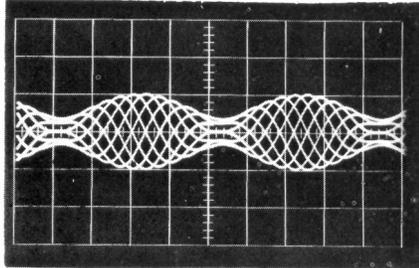


Fig. 36 — Analog Receiver Tests

CONDITIONS: Same as 51, except 902B-2 B TEST switch to position 3 (DATA signal is the 11 code).



53

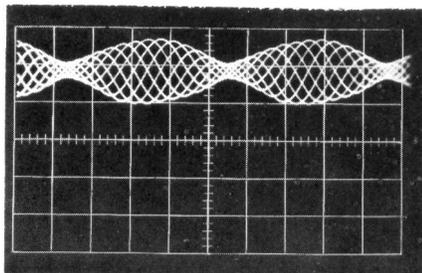
TRIGGER INPUT *TP4-039 (DTI)*
EXT
TRIGGER MODE *AC* SLOPE +

CHANNEL A WAVEFORM *TP12-017 (BPF OUT)*

VOLTS/CM *0.5* TIME/CM *0.2 msec*

IF NECESSARY, REPLACE CIRCUIT
PACKS *019; 044*

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is the 01 code; 901B-2 B TEST switch to position 5; and terminals 1 and 5 (on circuit pack 017) are strapped.



54

TRIGGER INPUT *TP4-039 (DTI)*
EXT
TRIGGER MODE *AC* SLOPE +

CHANNEL A WAVEFORM *TP13-016 (AGC OUT)*

VOLTS/CM *2.0* TIME/CM *0.2 msec*

IF NECESSARY, REPLACE CIRCUIT
PACKS *016; 017*

Fig. 37 — Analog Receiver Tests

55

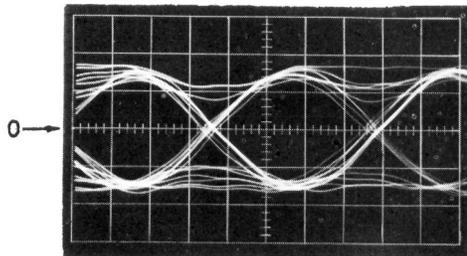
TRIGGER switch + *INT AUTO*VOLTS/CM *0.5* TIME/CM *1.0 msec*

Instructions: Connect CHAN A probe to TP10-059 (COO). With the same conditions required for 54, measure for the following indications.

Indications: LINE—LOCAL TEST key in LOCAL TEST position, measure +7.0 (± 1.3) Vdc; LINE—LOCAL TEST key in LINE position, measure -6.5 (± 1.3) Vdc.

Note: Return LINE — LOCAL TEST key to LOCAL TEST position before making the next test.

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is pseudo-random; oscilloscope adjusted for A — B operation.



56

TRIGGER INPUT *TP4-039 (DTI)*

EXT

TRIGGER MODE *AC* SLOPE +CHANNEL A WAVEFORM *TP8-012 (ADM')*VOLTS/CM *5.0* TIME/CM *0.2 msec*CHANNEL B WAVEFORM *TP14-012 (ADM)*VOLTS/CM *5.0* TIME/CM *0.2 msec*

IF NECESSARY, REPLACE CIRCUIT
PACK *012*

Test Equipment Condition: Position A TEST switch to 9 and B TEST switch to OFF. Connect 901B-2 TRANSMIT DATA and TRANSMIT CLOCK terminals to similar terminals on the 903B. Select RANDOM CODE.

Note: The waveform illustrates the 63 bit pseudo-random word. A 2047 bit word display is not shown.

Fig. 38 — Analog Receiver Tests

The following waveforms should be seen if using a single-channel oscilloscope without the differential feature to measure 56.

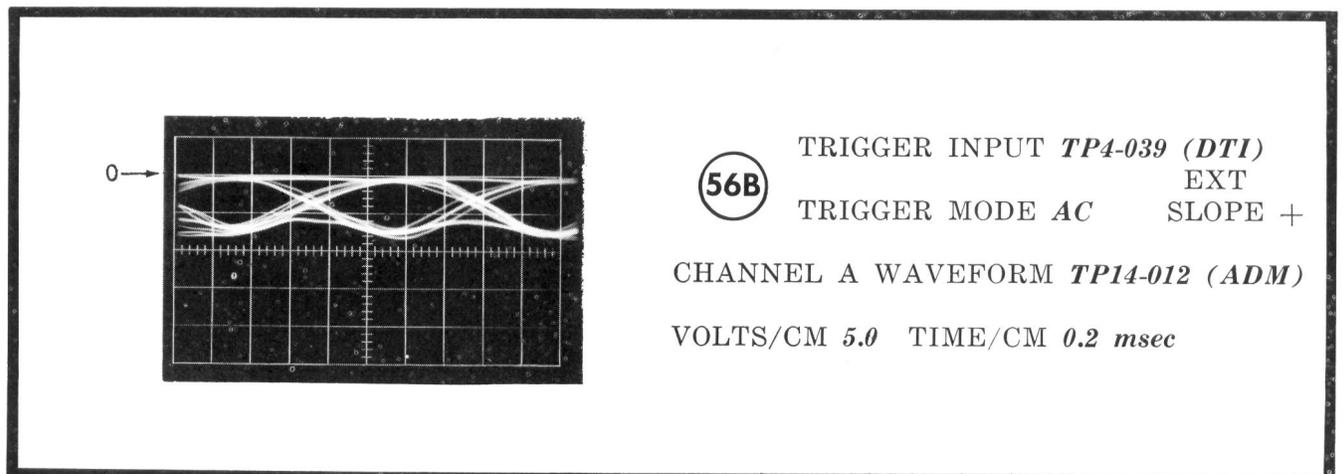
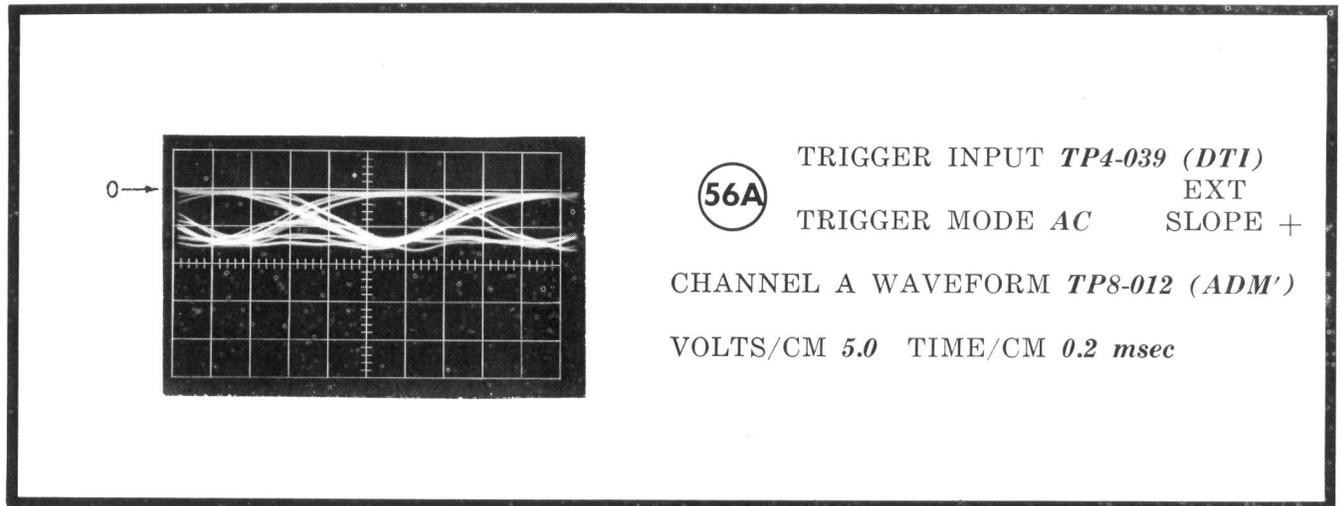


Fig. 39 — Analog Receiver Tests

The following waveforms should be seen if using a single-channel oscilloscope without the differential feature to measure 57.

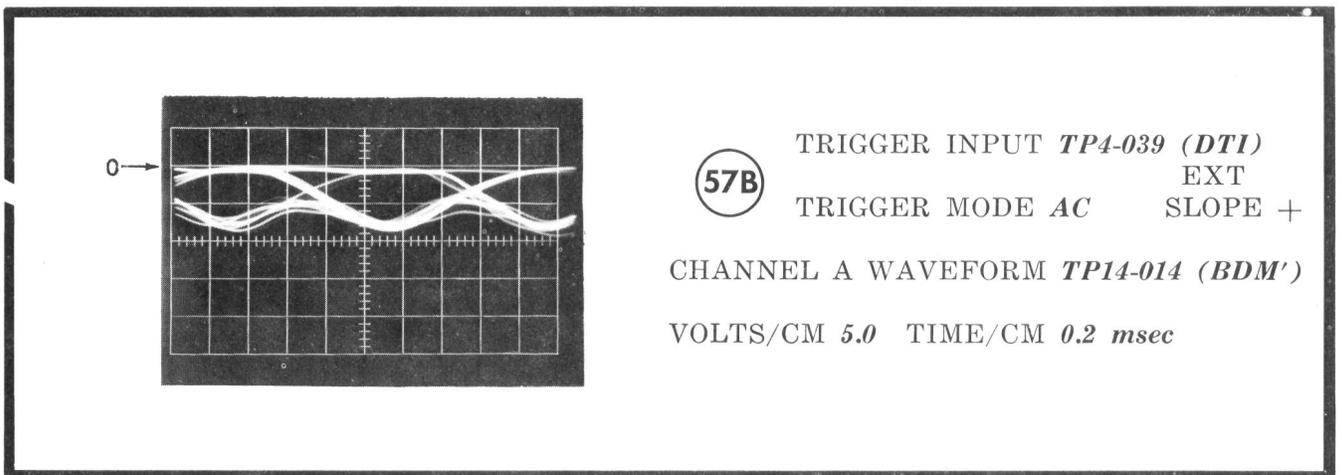
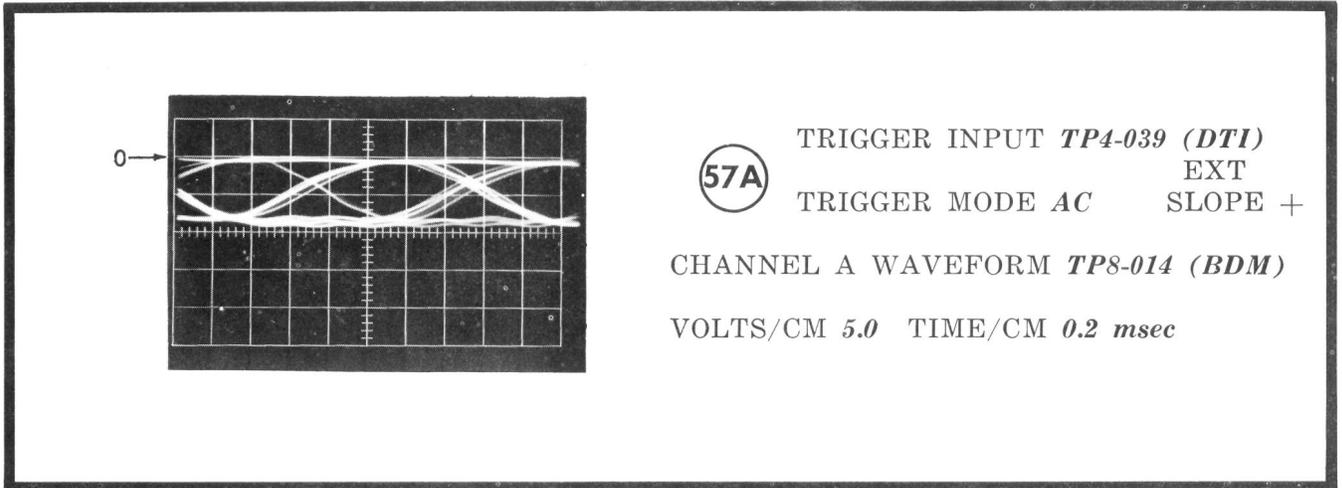


Fig. 41 — Analog Receiver Tests

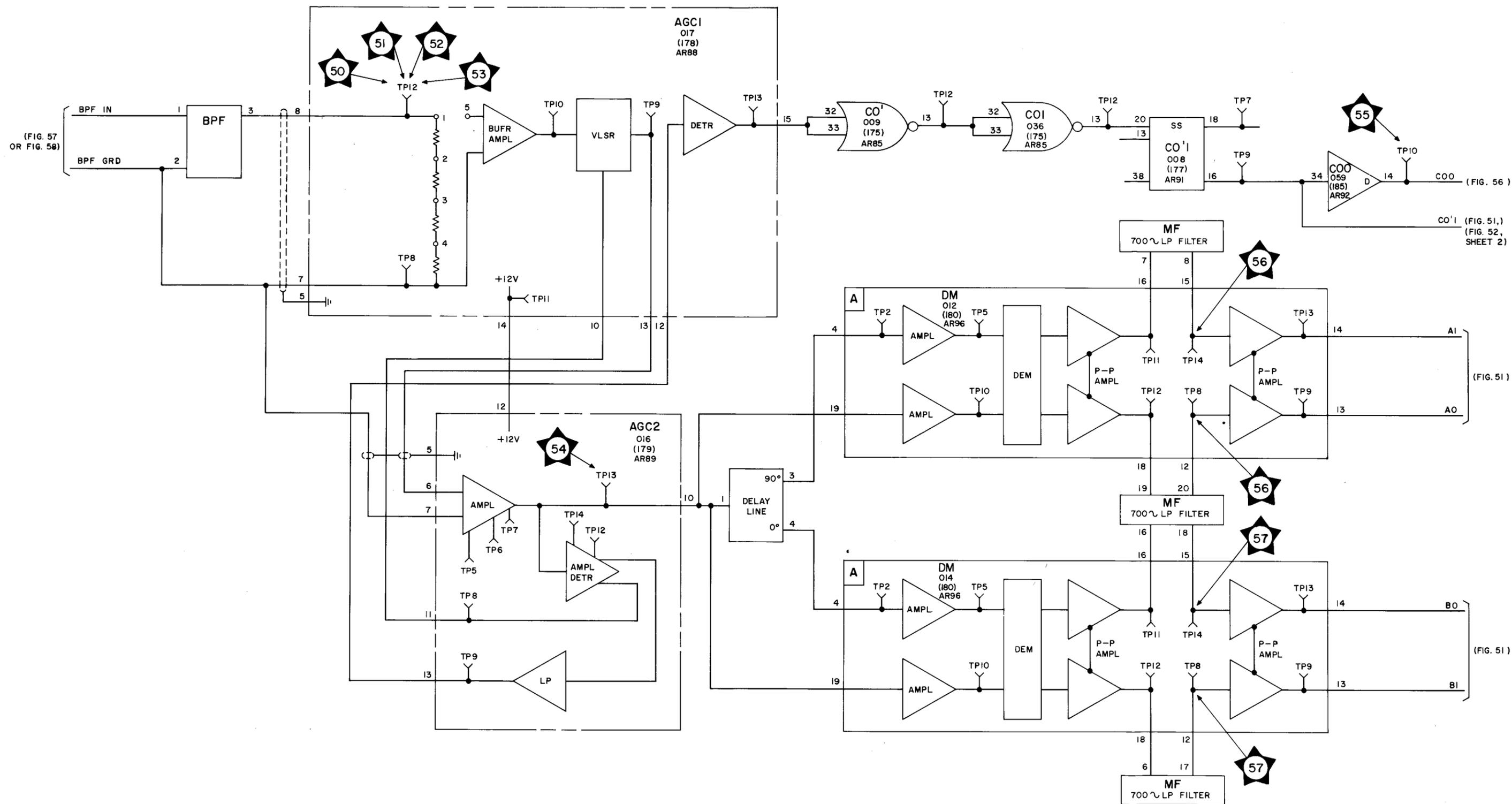


Fig. 42 — Analog Receiver, Functional Schematic

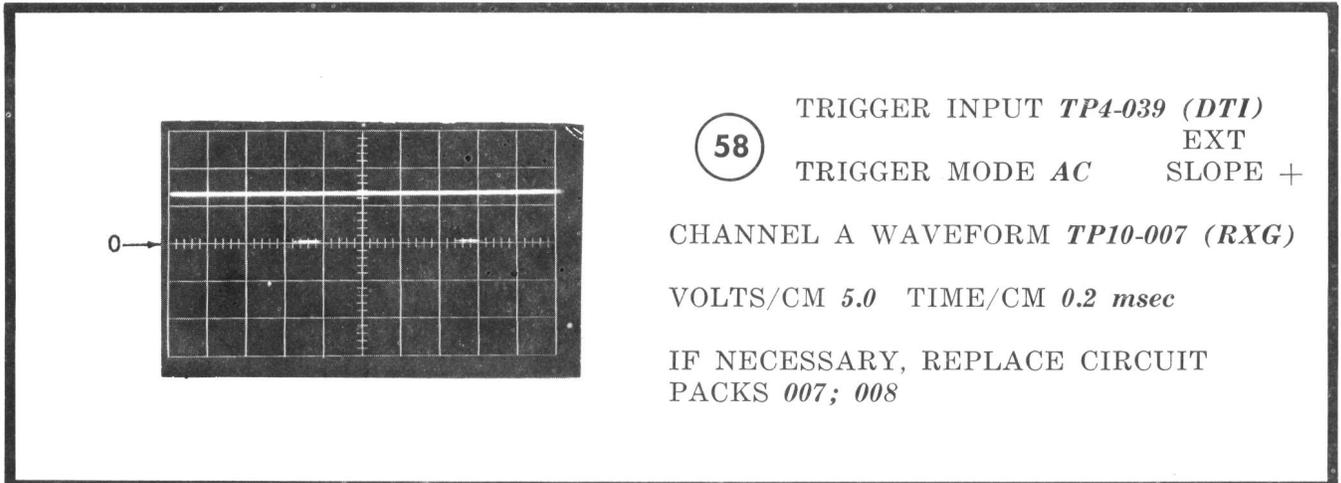
TEST 8 — DIGITAL DATA RECEIVER AND RECEIVER TIMING

Note: TEST 8 — DIGITAL DATA RECEIVER AND RECEIVER TIMING shall be tested together as a single data set function. Waveform requirements are in proper testing sequence and are keyed to appropriate functional schematics. Measure for waveform requirements in numerical sequence only.

11.30 The digital data receiver converts the demodulated data waveforms into standard logic signals. These signals are generated as a serial binary data waveform acceptable to customer equipment. The digital data receiver also generates axis-crossing pulses for timing the recovery circuit operation.

11.31 The receiver timing circuits recover synchronization timing signals required for both sampling and parallel-to-serial conversion of the received data. Voltage and waveform requirements for the tests shown in Fig. 43 through Fig. 50 are keyed to the functional schematic shown in Fig. 51 and Fig. 52.

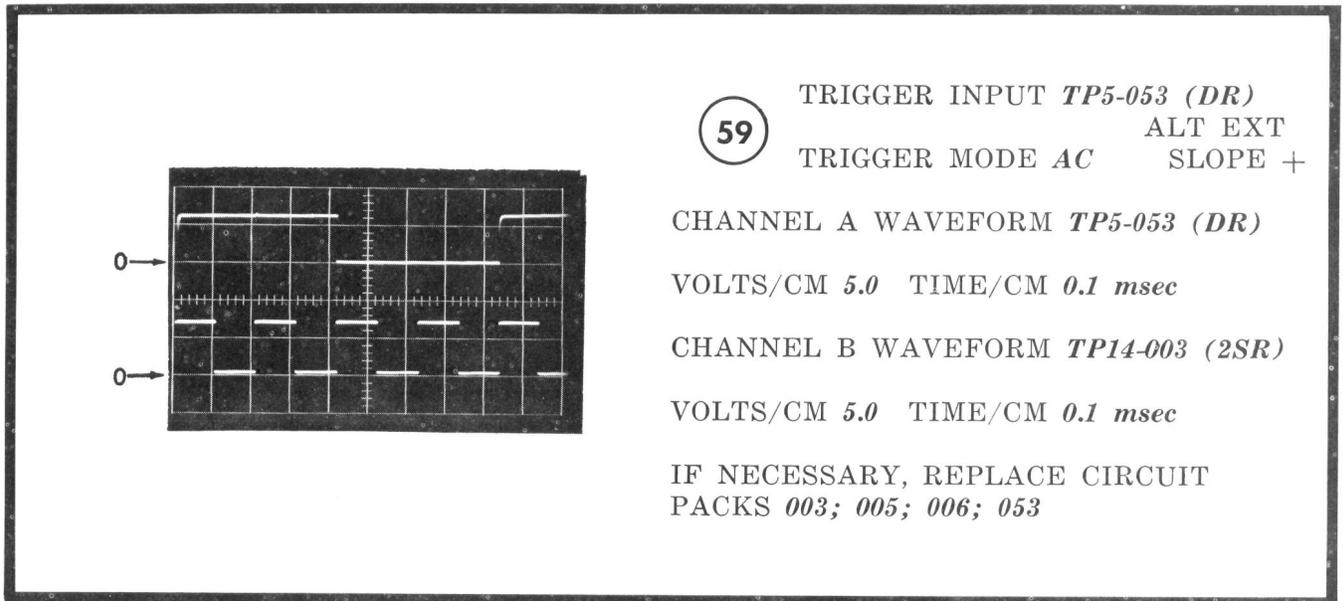
CONDITIONS: Same as 56, except do not use A — B operation.



Note: Check that waveforms similar to 58, but inverted, appear on TP2-008, TP14-008, and TP3-008 for the same condition as 58.

Fig. 43 — Digital Data Receiver and Receiver Timing Test

CONDITIONS: Same as 58, except ground TP10-006 (RDL) and TP7-006 (RAD). (Signal ground is available at the following test points: TP12-008, TP1-012, TP1-014, and TP5-017.)



CONDITIONS: Same as 59.

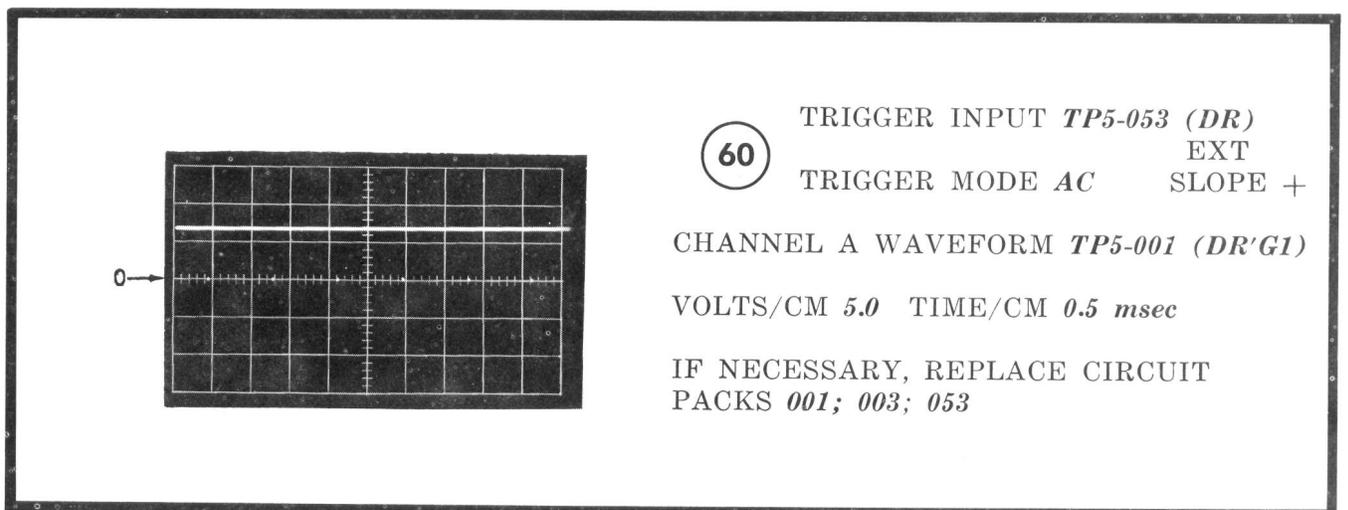
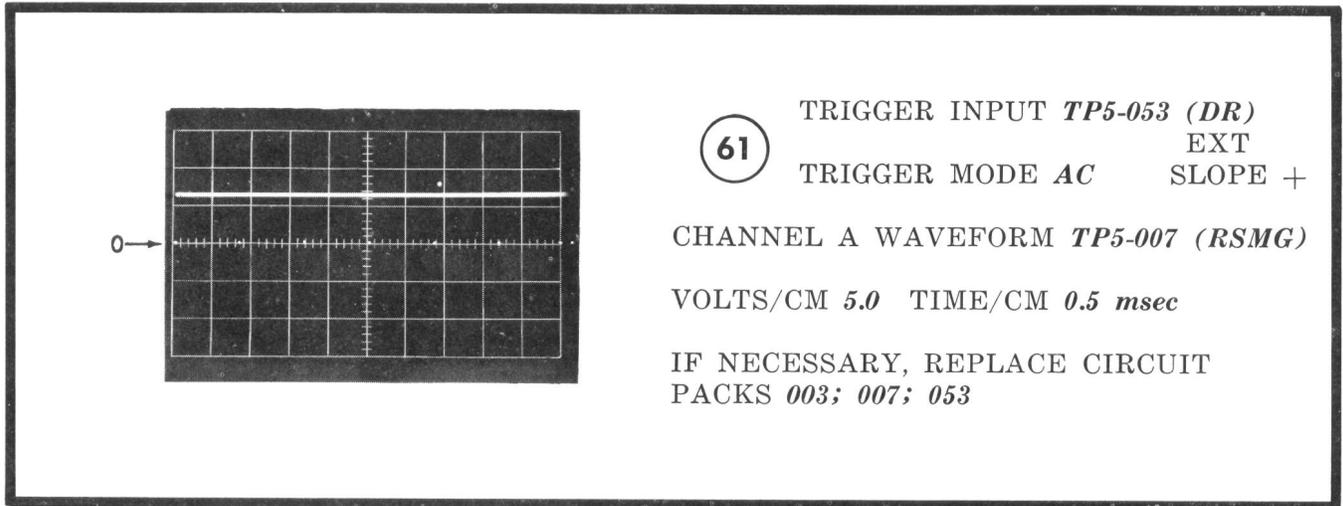


Fig. 44 — Digital Data Receiver and Receiver Timing Tests

CONDITIONS: Same as 59.



CONDITIONS: Same as 59.

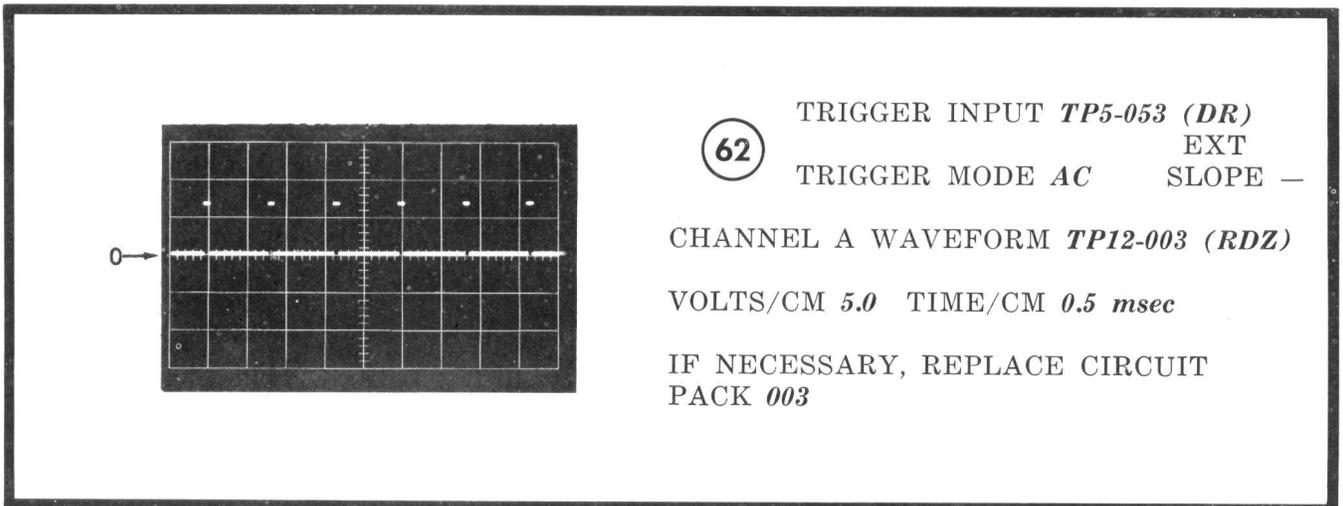
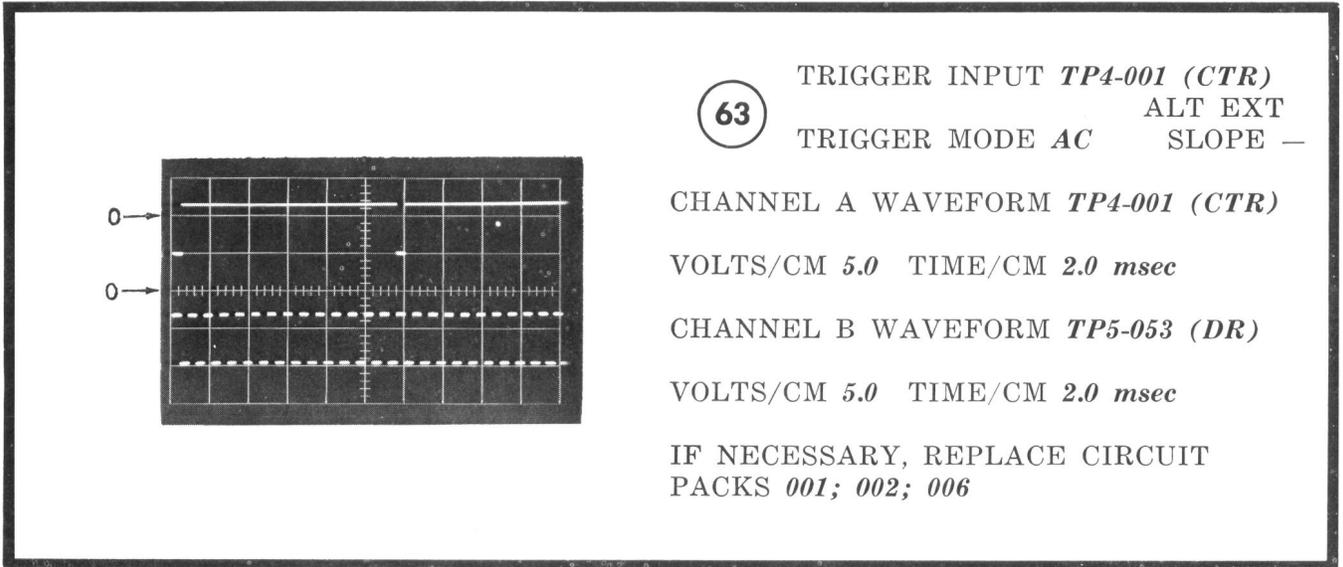


Fig. 45 — Digital Data Receiver and Receiver Timing Tests

CONDITIONS: Same as 59, except ground TP10-007 (RXG) and TP10-001 (RDS) in addition to the RDL and RAD grounds. Observe 14 cycles of DR for each cycle of CTR.



CONDITIONS: Same as 59, except remove all signal ground connections. Then ground TP4-001 (CTR) and TP10-007 (RXG).

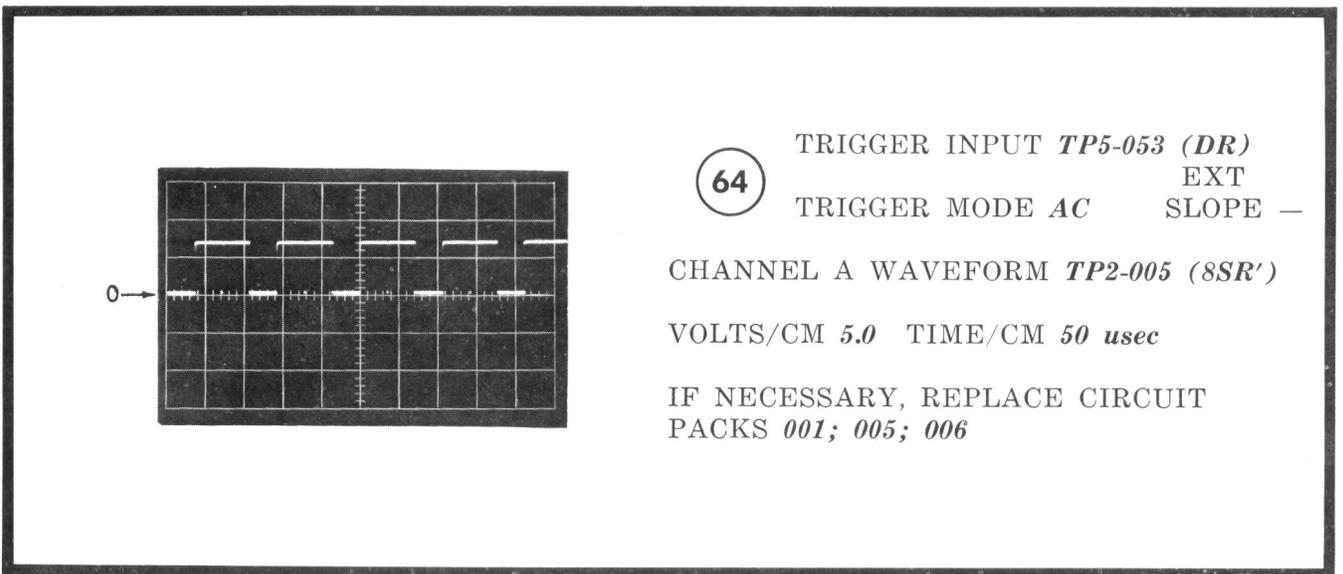
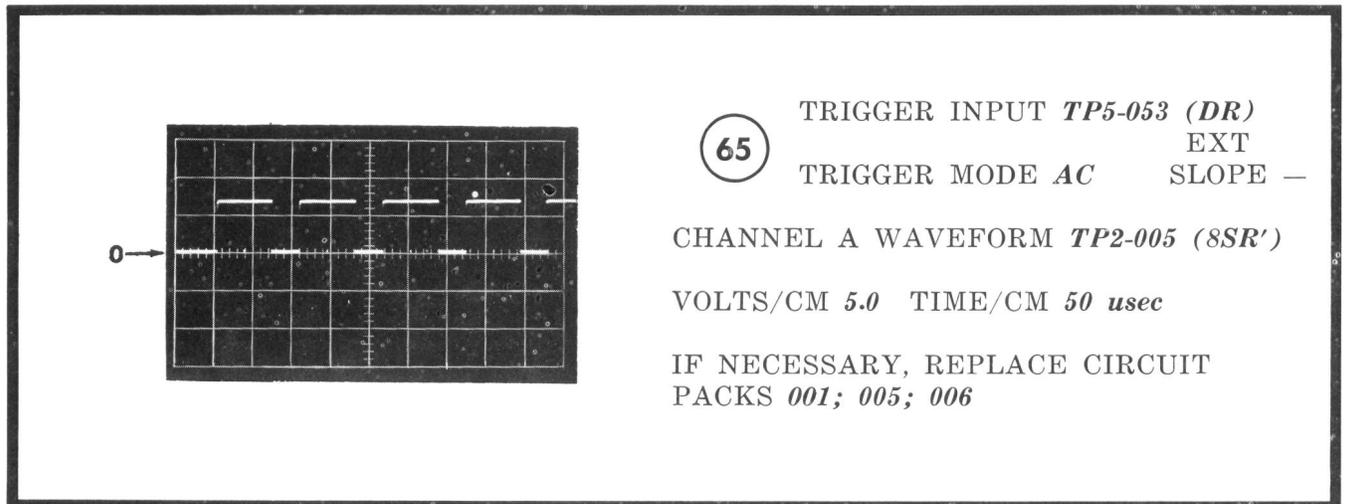


Fig. 46 — Digital Data Receiver and Receiver Timing Tests

CONDITIONS: Same as 64, except ground TP7-001 for the time required to observe the waveform.



CONDITIONS: Same as 64, except ground TP10-001 (RDS) for the time required to observe the waveform.

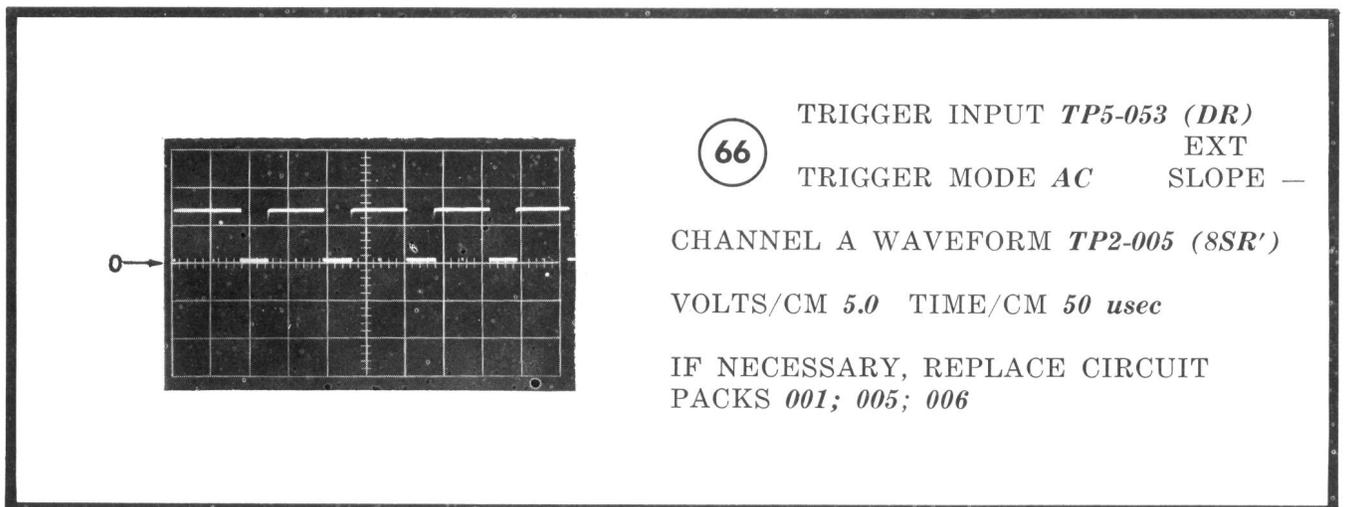
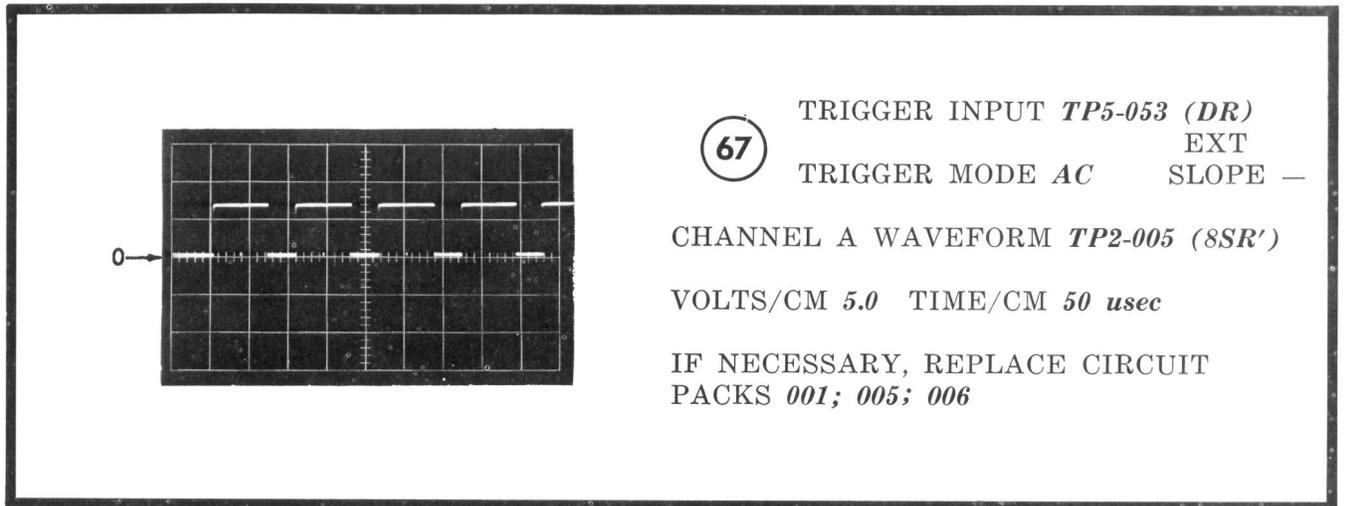


Fig. 47 — Receiver Timing Tests

CONDITIONS: Same as 64, except ground TP6-001 (TC 1) and TP11-001 (TC 2) for the time required to observe the waveform.



Note: After 67, remove all grounds [TP4-001 (CTR), TP10-007 (RXG), and others in 65, 66, and 67].

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is OFF; 901B-2 A TEST switch positioned to OFF; disconnect all leads from the 903B test set.

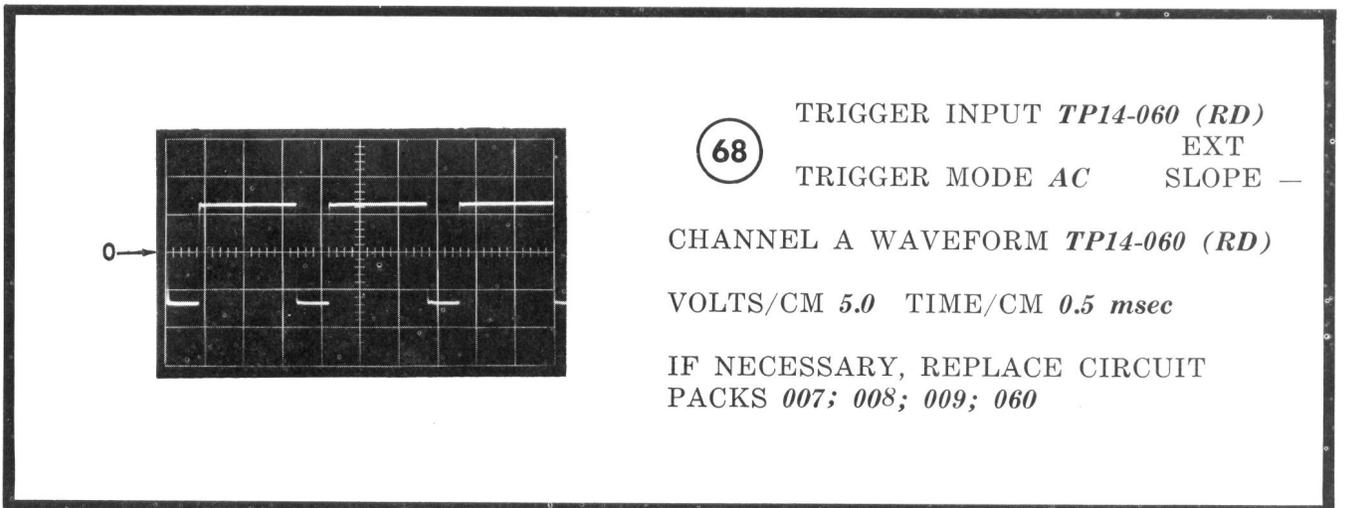
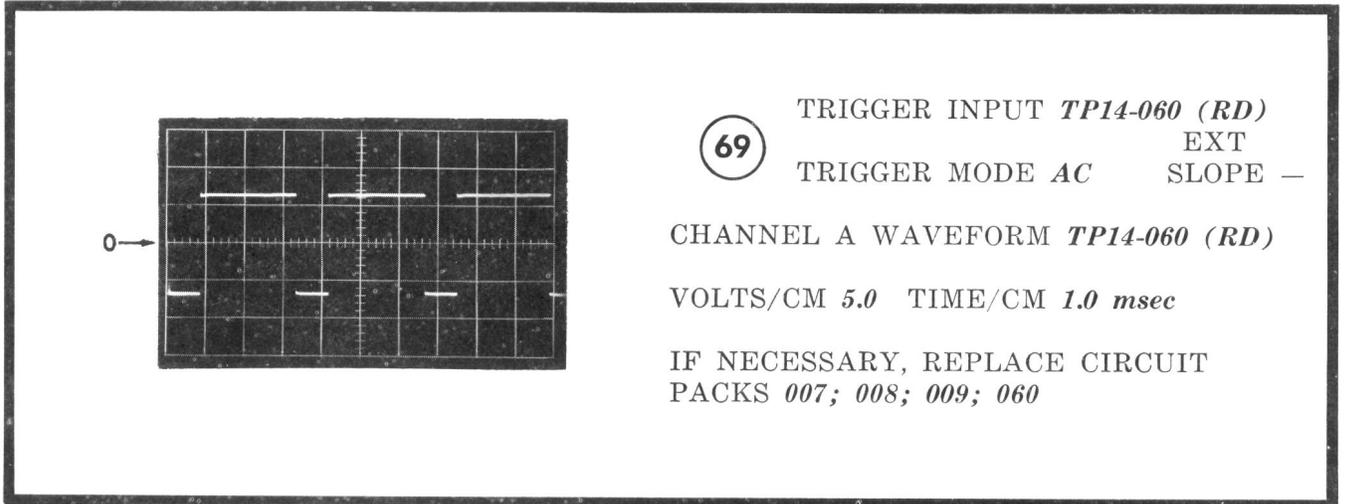


Fig. 48 — Digital Data Receiver Tests

CONDITIONS: CONTINUOUS CARRIER at 1200 bps; RS is OFF; 901B-2 B TEST switch positioned to 8.



CONDITIONS: CONTINUOUS CARRIER at 600 bps; RS is OFF; 901B-2 B TEST switch remains at 8.

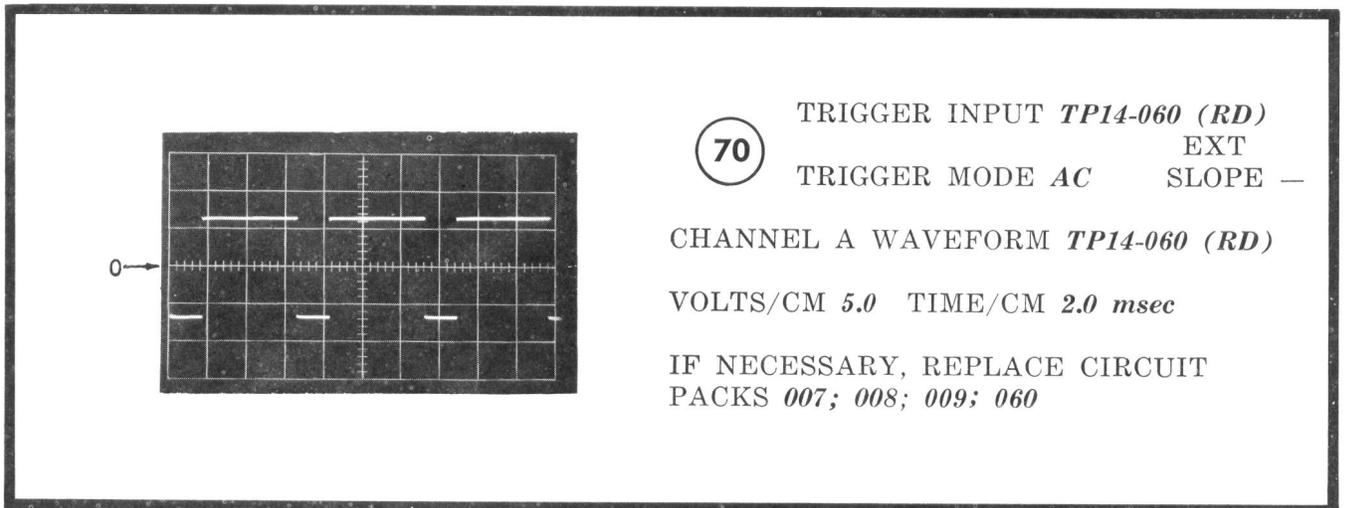


Fig. 49 — Digital Data Receiver Tests

CONDITIONS: CONTINUOUS CARRIER at 2400 bps; RS is ON; DATA signal is the 01 code; 901B-2 B TEST switch positioned to 5.

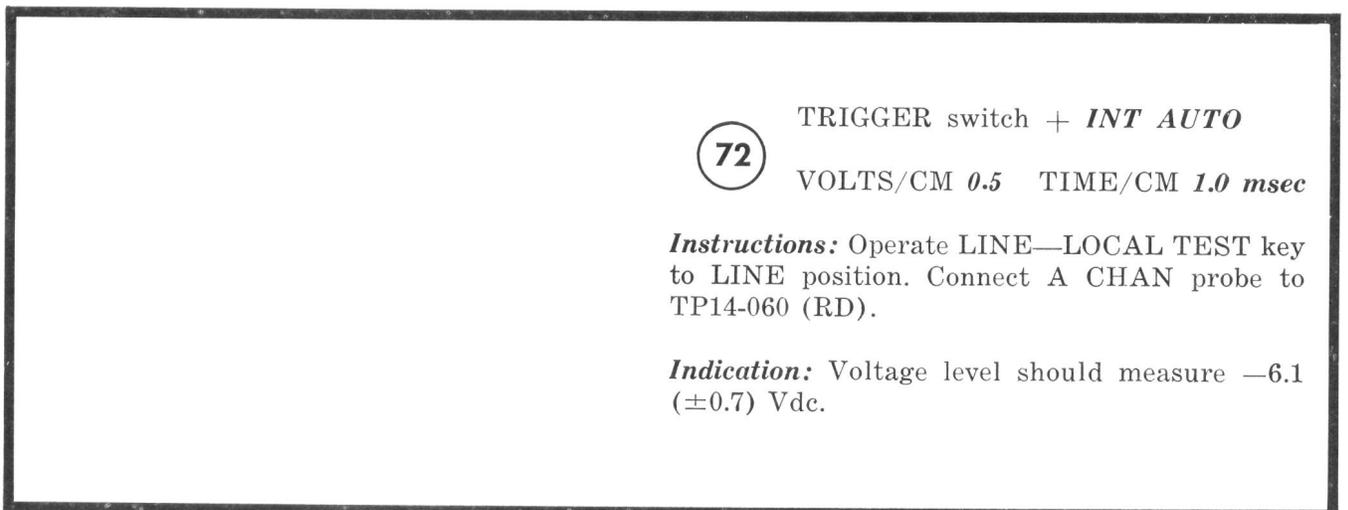
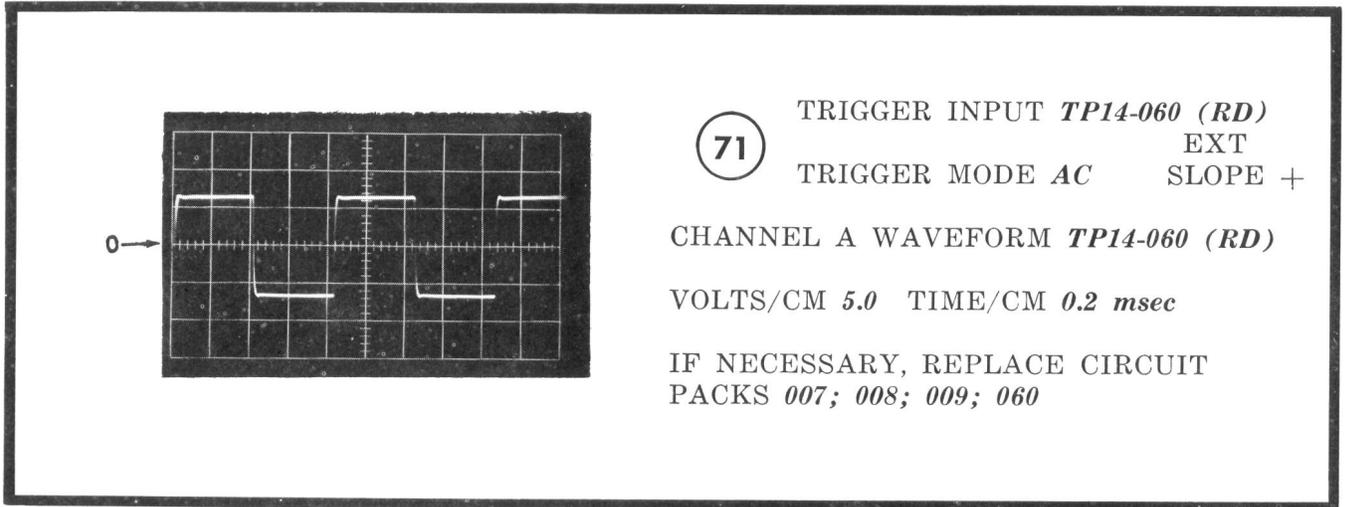


Fig. 50 — Digital Data Receiver Tests

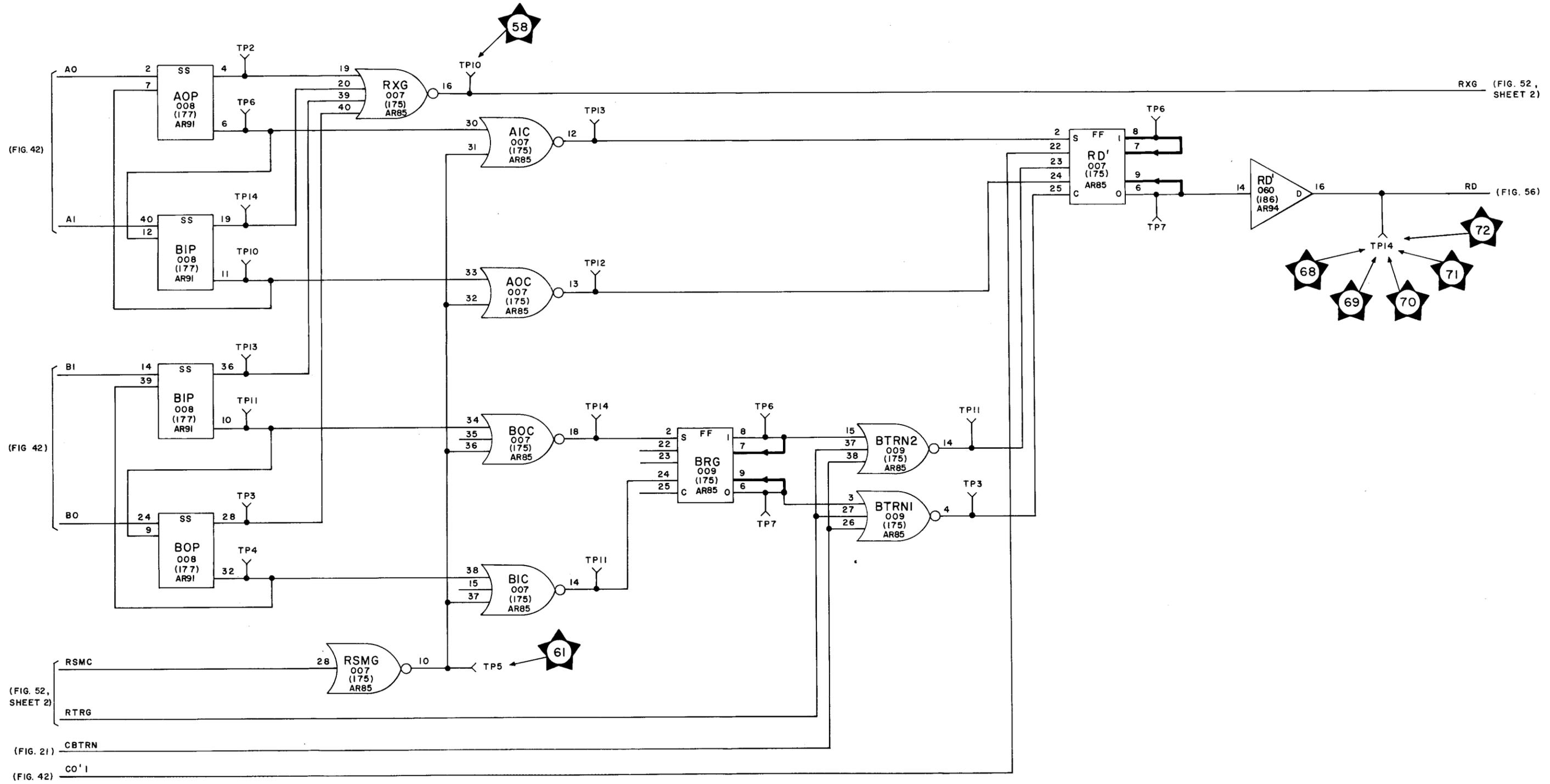


Fig. 51 — Digital Data Receiver, Functional Schematic

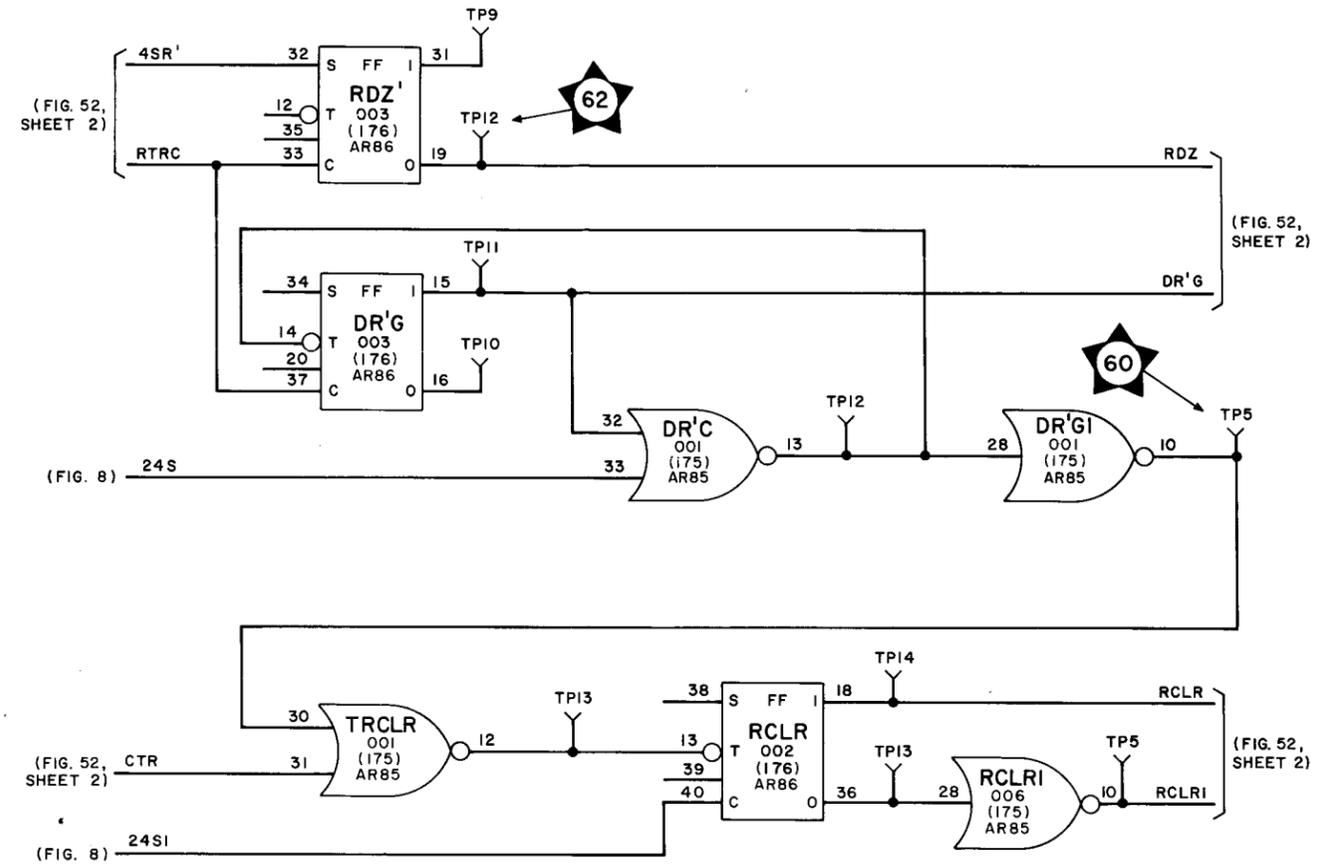


Fig. 52 — Receiver Timing, Functional Schematic (Sheet 1 of 2)

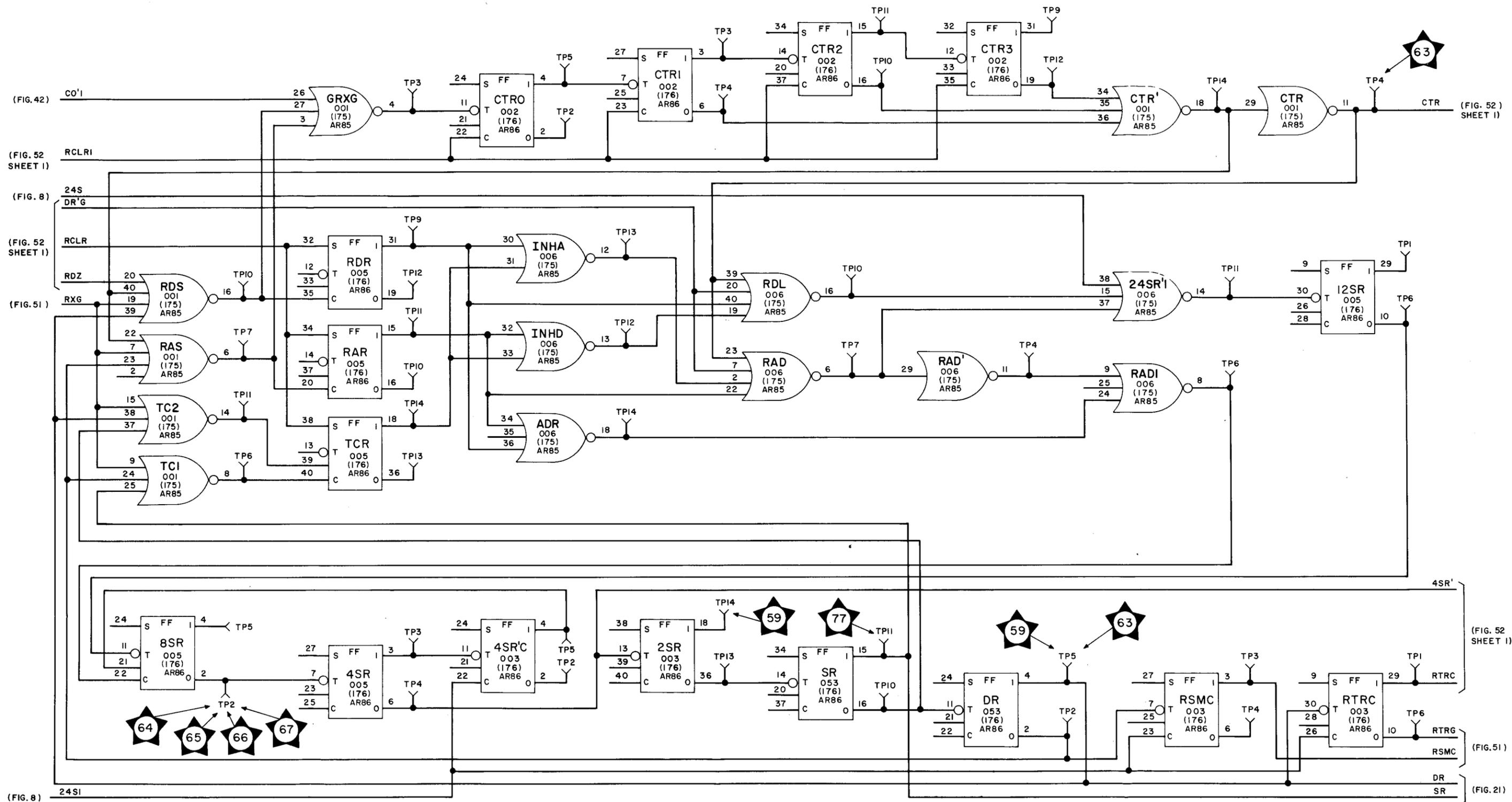


Fig. 52—Receiver Timing, Functional Schematic (Sheet 2 of 2)

TEST 9—REMOTE TEST

11.32 The data set may be tested remotely by a 904-type Data Test Center. Data set functions can be transferred from LINE condition to REMOTE TEST by (1) operating the LINE—LOCAL TEST key switch on the data set, or (2) a customer-originated signal on the RMT interface lead. During REMOTE TEST operation, circuits within the data set generate the required control signals for the various operational modes for both transmitter and receiver sections.

11.33 Waveforms and voltage requirements for REMOTE TEST operation, shown in Fig. 53 through Fig. 55, are keyed to the functional schematic shown in Fig. 56.

Note: Test 74 is keyed to Fig. 27 and Fig. 56. Test 74A is keyed to Fig. 28 and Fig. 56. Test 76 is keyed to Fig. 15, sheet 1. Test 77 is keyed to Fig. 15, sheet 2, and Fig. 52, sheet 2. Figure 57 shows the 205B1 line circuit connection provided by the 4B1 Data Unit connection cord which permits switched carrier or continuous carrier operation. Figure 58 shows similar operational connections for Data Set 205B2.

73 Relay K2 should operate when the LINE—REMOTE TEST key is positioned to REMOTE TEST. If this requirement is met, return the key to the original position (LOCAL TEST).

CONDITIONS: CONTINUOUS CARRIER; Ground TP11-039 (CLDT'), TP14-039 (SE), TP11-036 (HH'T); [Strap TP14-050 (E4) to TP12-009 (CO').] Operate LINE—REMOTE TEST key to REMOTE TEST position.

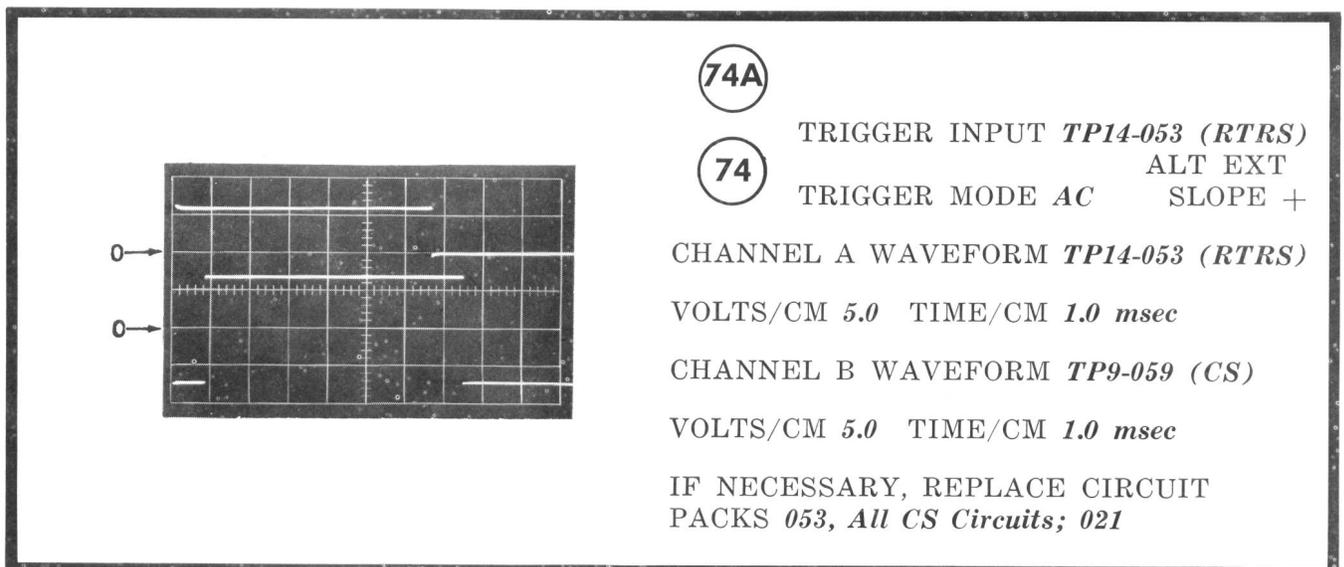
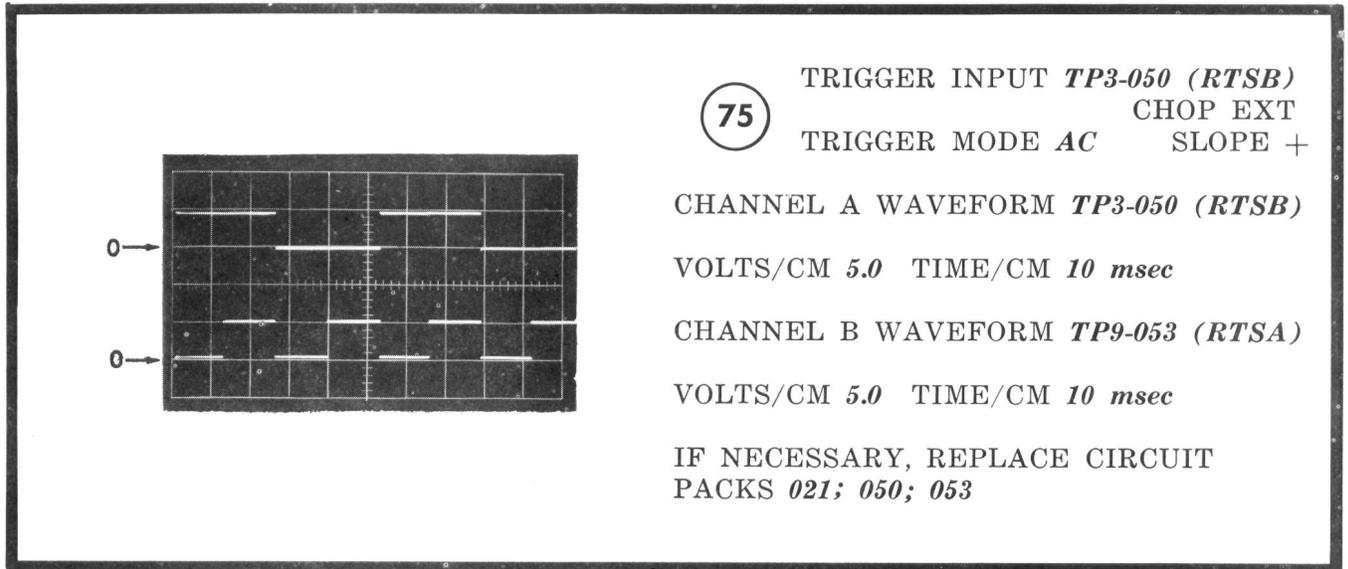


Fig. 53—Remote Test Circuit Tests

CONDITIONS: Same as 74, except DO NOT ground TP11-039 (CLDT'), TP14-039 (SE), and TP11-036 (HH'T).



CONDITIONS: Same as 75. Test point indicated on Fig. 15, sheet 1.

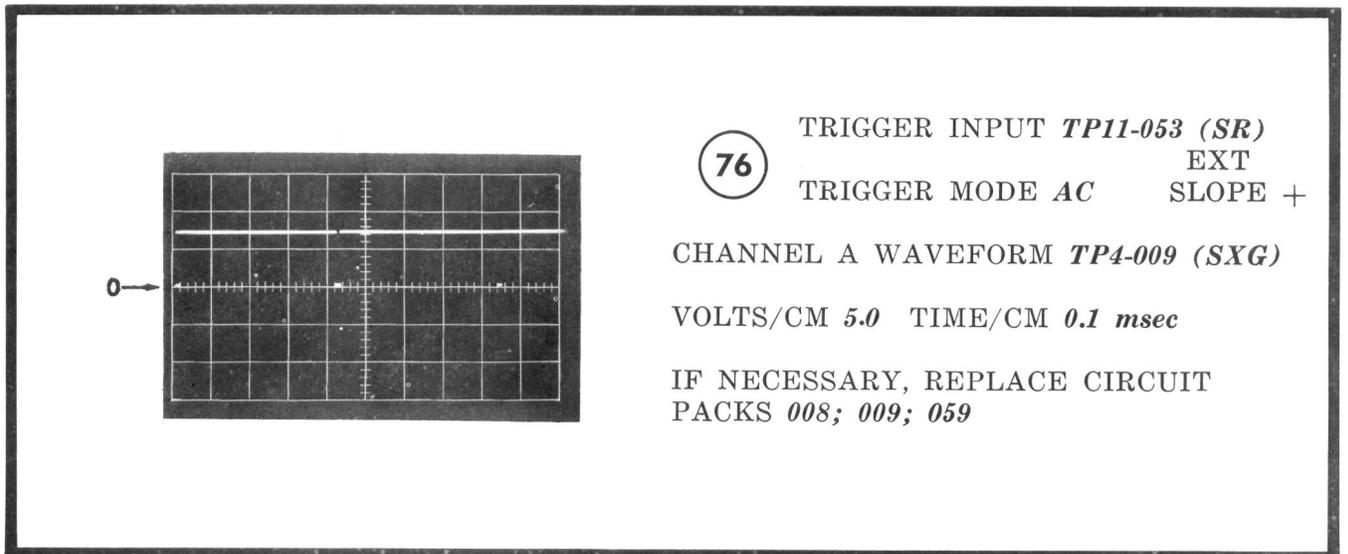
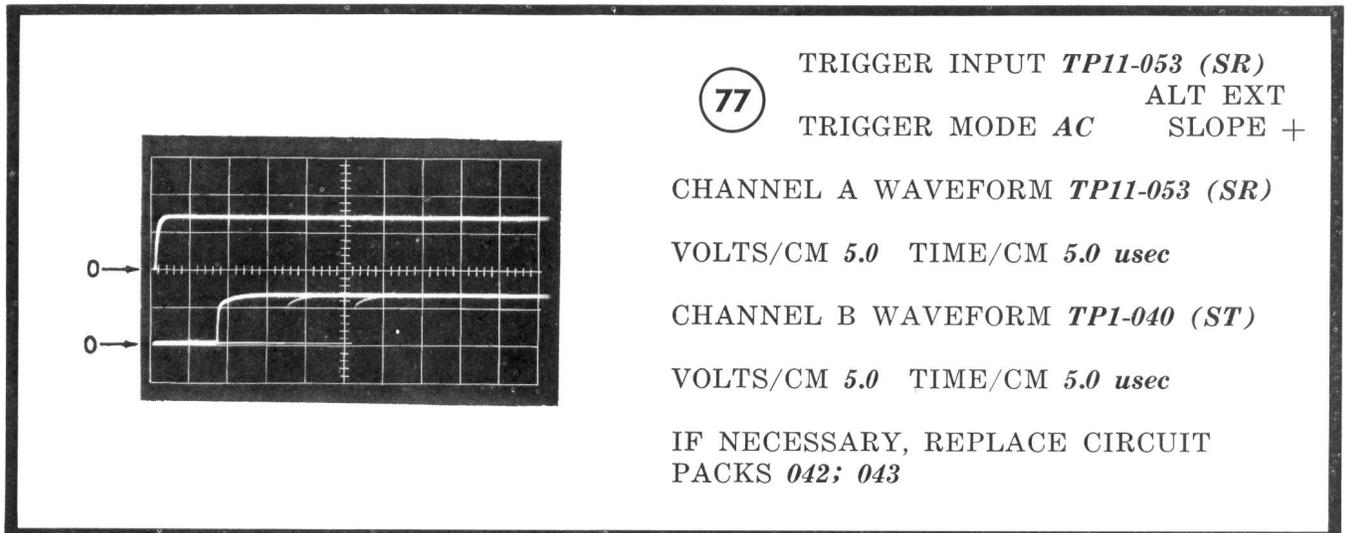


Fig. 54 — Remote Test Circuit Tests

CONDITIONS: Same as 75. The positive transition of ST should be within $+0, -35 \mu\text{sec}$ of the positive transition of SR. See sheet 2 of both Fig. 15 and Fig. 52 for test point locations.



Note: Remove the strap between TP12-009 (CO') and TP14-050 (E2). Remove all test equipment connections. Restore original options.

CONDITIONS: Perform the following tests with a KS-14510 volt-ohm-milliammeter conditioned to measure on the 12 Vdc scale.

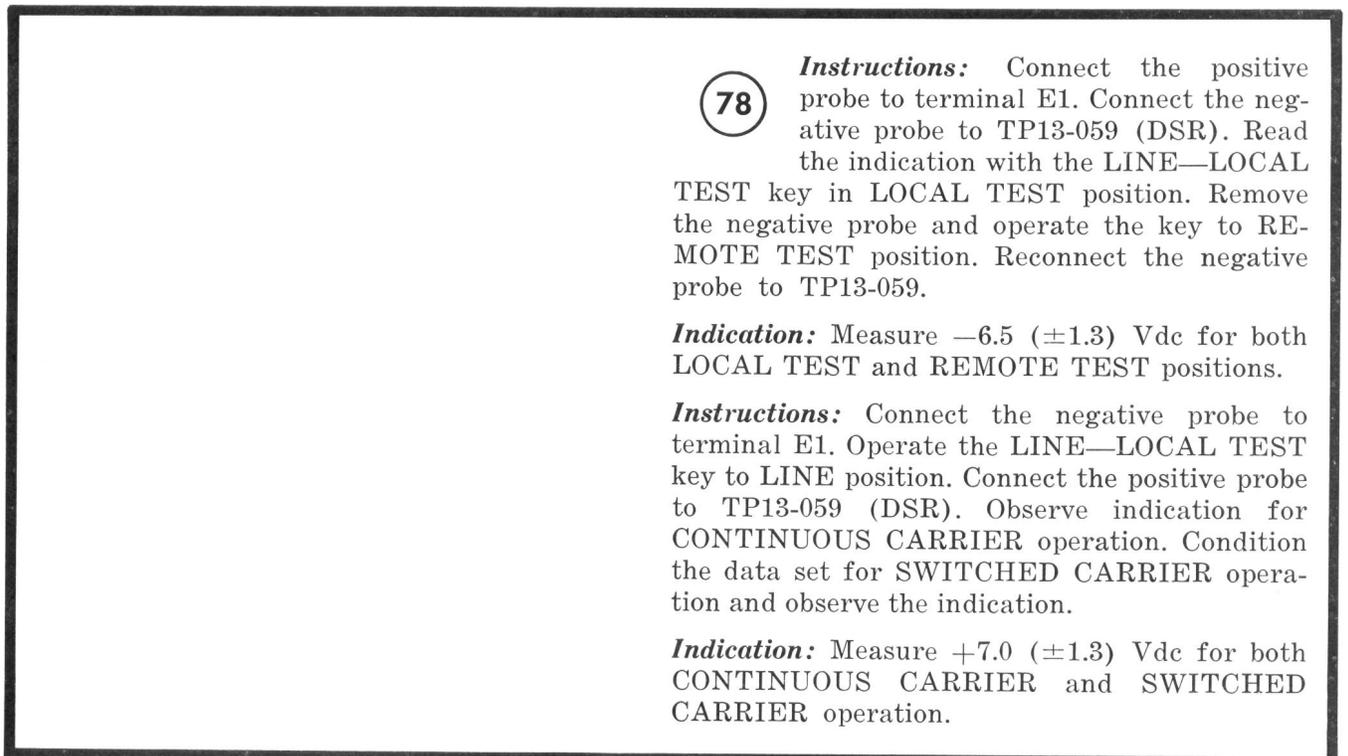


Fig. 55 — Remote Test Circuit Tests

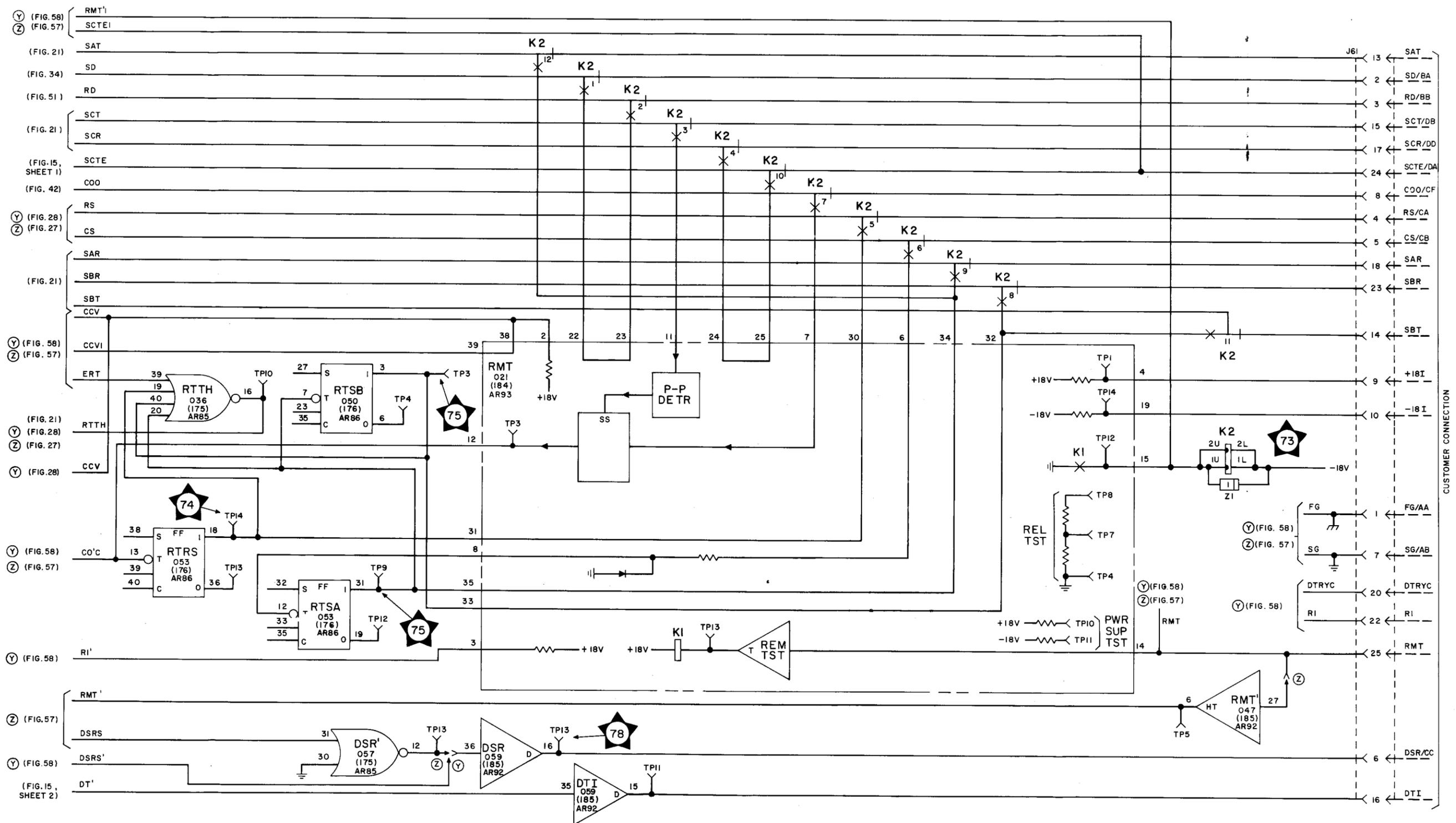


Fig. 56— Interface Connections and Remote Test, Functional Schematic

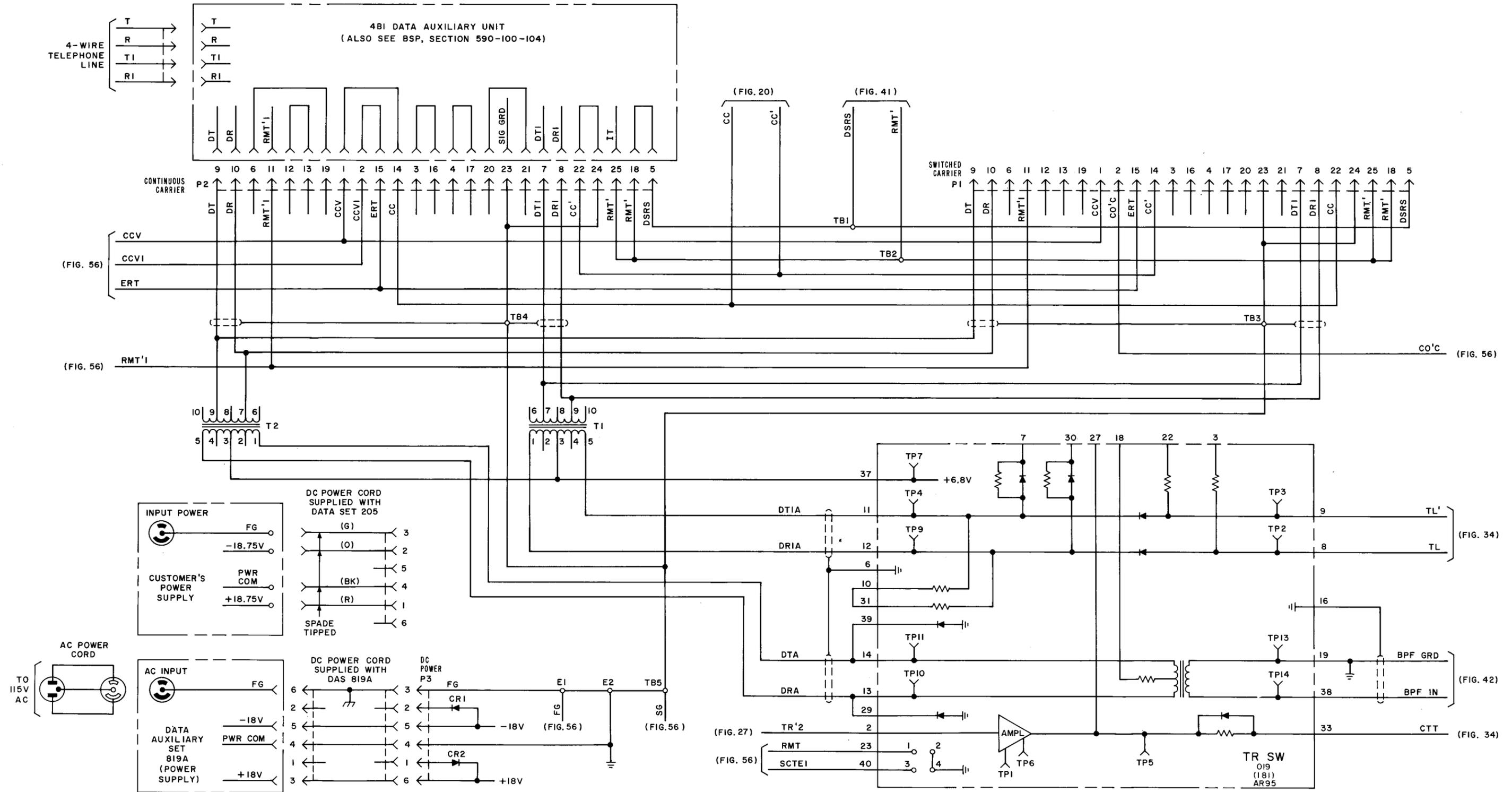


Fig. 57—Line Connector, TR Switch and Power Supply, Functional Schematic for Data Set 205B1

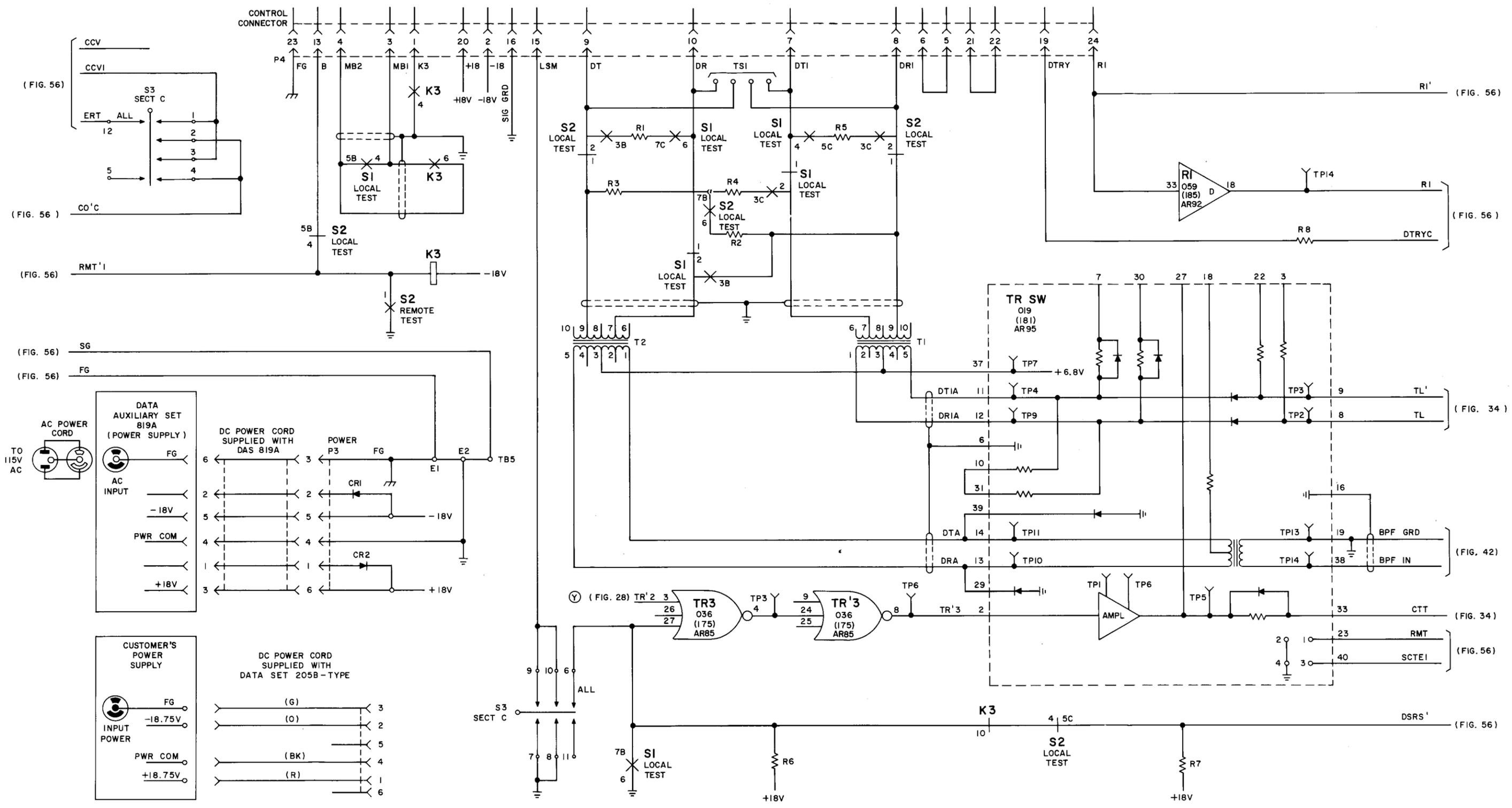


Fig. 58—Line Connector, TR Switch and Power Supply, Functional Schematic for Data Set 205B2