

**DATA SET 202R**  
**TRANSMITTER-RECEIVER**  
**THEORY OF OPERATION**  
**AND SUPPLEMENTARY INFORMATION**

CONTENTS	PAGE	1. GENERAL
<b>1. GENERAL</b> . . . . .	<b>1</b>	<b>1.01</b> This section contains detailed description, operation, and testing information for data set 202R. The information contained herein supplements the information contained in other sections and is not required for installation, maintenance, or service of the data set under normal circumstances.
<b>2. EQUIPMENT CHARACTERISTICS</b> . . . . .	<b>2</b>	<b>1.02</b> This section is reissued for the following reasons:
<b>A. Physical Characteristics</b> . . . . .	<b>2</b>	(a) To update Fig. 4 and 11
<b>B. Interface</b> . . . . .	<b>3</b>	(b) To update Table A
<b>C. Power Requirements</b> . . . . .	<b>6</b>	(c) To add Fig. 12, showing switches S4 and S5
<b>D. Options</b> . . . . .	<b>6</b>	(d) To expand information regarding remote testing for 2- and 4-wire facilities.
<b>3. APPLICATIONS</b> . . . . .	<b>9</b>	<b>1.03</b> Data set 202R is primarily intended for operation in private line service over 2- and 4-wire lines. On 3002 private lines, the recommended maximum bit rate is 1200 bits per second (bps). With C1 conditioning the recommended maximum bit rate is 1400 bps, and with C2 conditioning the recommended maximum bit rate is 1800 bps.
<b>PRIVATE LINE</b> . . . . .	<b>9</b>	<b>1.04</b> With the addition of a telephone set, data set 202R is suitable for switched network service with completely manual operation. Incoming calls must be answered and terminated manually. Data set 202R is not compatible with data auxiliary set (DAS) 801 (automatic calling unit). When used for switched network service, data set 202R has a maximum recommended bit rate of 1200 bps.
<b>A. 2-Wire Point-to-Point</b> . . . . .	<b>9</b>	<b>1.05</b> Data set 202R is compatible for use with DAS 828A-type. This DAS provides standard,
<b>B. 4-Wire Point-to-Point</b> . . . . .	<b>10</b>	
<b>C. 4-Wire Multipoint</b> . . . . .	<b>10</b>	
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prewired, tested station arrangements for terminating 4-wire private line voiceband data channels. DAS 828A can be used with or without alternate voice. For information concerning the use of DAS 828A, refer to Section 598-080-100.

**1.06** Data set 202R can provide 1-way, 2-way nonsimultaneous (on 2-wire lines), or 2-way simultaneous (on 4-wire lines) transmission for point-to-point or multipoint applications. The data set places no restrictions as to the code used or the number of consecutive 1s and 0s. No timing is provided by the data set.

**1.07** The interface signals exchanged between the data terminal and the data set are in bipolar voltage form and conform to the Electronic Industries Association (EIA) Standard RS-232-C with the following exceptions.

- (a) In 2-wire operation, the received line signal detector (carrier detector) circuit responds to signals from the local or remote transmitter.
- (b) In 2-wire operation, the data set always provides local copy on the received data circuit.

**1.08** Data set 202R uses frequency shift-keying (FSK) modulation. A negative voltage on the transmitted data lead is interpreted as a mark and is transmitted as a tone of approximately 1300 Hz. A positive voltage is interpreted as a space and is transmitted as a tone of approximately 2100 Hz. In the receiver, tones above 1700 Hz are converted to positive voltages (space) and tones below 1700 Hz are converted to negative voltages (mark). The output level of the data set is adjustable from 0 to  $-13$  dBm. The receive sensitivity is at least  $-42$  dBm.

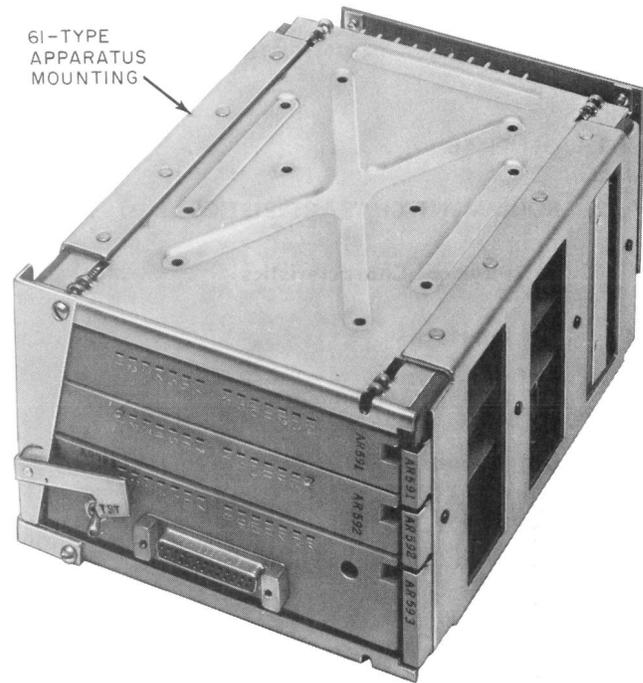
## 2. EQUIPMENT CHARACTERISTICS

**2.01** The following is a description of the data set physical characteristics, interface, power requirements, and data set options.

### A. Physical Characteristics

**2.02** Data set 202R, List 1 (Fig. 1), is the basic data set which is physically contained on three AR-type circuit packs (CPs) which are plugged into a 61-type apparatus mounting. These CPs are coded AR591, AR592, and AR593. A terminal

board, TB1, with screw terminals is attached to the rear of the mounting for the connection of the telephone lines and low-voltage ac power. The customer interface connection is made to the faceplate of the AR593 CP. The List 1 sets are for mounting in multiple arrangements as described in 3.17 through 3.22.



**Fig. 1—Data Set 202R-L1**

**2.03** Data set 202R, List 2, provides a 2-tone gray plastic housing in addition to the equipment provided as List 1. Refer to Fig. 2 for a picture of data set 202R-L1/2. Also included as part of List 2 is a D10P-61 cord (for connecting to the data line and to ac power) and a power transformer. The customer connector is located at the rear of the housing next to the test switch. The test switch must be manually operated when remote testing is required and manually released at the conclusion of the test.

**2.04** The overall dimensions of the List 1 data set are 9 inches long, 6 inches wide, and 4 inches high. The weight is approximately 6 pounds. The overall dimensions of data set 202R-L1/2 are 11 inches wide, 5-1/2 inches high, and 10-1/4 inches deep. The weight is approximately 8 pounds.

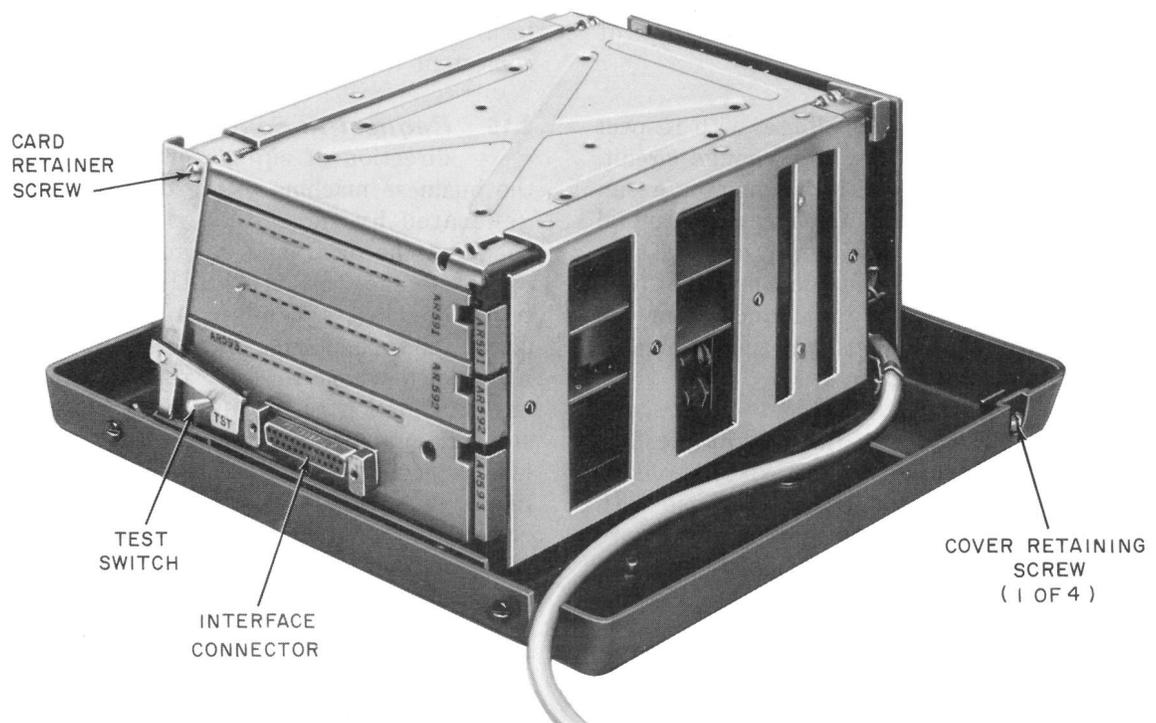


Fig. 2—Data Set 202R-L1/2 Rear View With Cover Removed

## B. Interface

**2.05** The interface is the point of connection between the data set and the data terminal. The data set is equipped with a 25-pin connector designated KS-19087. The user must supply the cable and plug necessary for connecting the data terminal equipment to the data set. The connector cable must be terminated in a Cinch or Cannon DB-19604-432 plug with a Cinch DB-51226-1 hood assembly (or equivalent). This type plug provides a reliable low-resistance contact. The hood assembly protects the connections, anchors the cable to the plug, provides a grip for easy insertion or removal, and provides a positive screw-in locking arrangement to prevent the connector from being pulled out inadvertently.

**2.06** For the transmitted and received data circuits, the signal is considered to be in the marking condition when the voltage on the circuit is more negative than  $-3$  volts with respect to signal ground. The signal is considered to be in the spacing condition when the voltage is more positive than  $+3$  volts with respect to signal ground. When no

voltage is applied to the transmitted data circuit, the circuit is held marking.

**2.07** For all control circuits, the control function is considered *on* when the voltage on the circuit is more positive than  $+3$  volts with respect to signal ground. The control function is considered *off* when the voltage on the circuit is more negative than  $-3$  volts with respect to signal ground.

**2.08** The terminating impedance of the receiving end of the interchange circuits has a dc resistance of not less than 3000 ohms nor more than 7000 ohms over the range of voltages for which the signal is defined. When the interface plug is disconnected, the interface voltage on terminator circuits is less than  $\pm 2$  volts.

**2.09** The operation of the circuitry that receives signals from an interchange circuit is dependent only on the signal voltage and conforms to EIA Specification RS-232-C regarding the rise and fall time. For the control circuits, the time required for the signal to pass through the transition region ( $-3$  volts to  $+3$  volts) during a change in state does not exceed 1 ms. For the transmitted and

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received data circuits, the rise and fall times do not exceed 4 percent of the nominal duration of the signal element.

**2.10** The open circuit driver voltage, with respect to signal ground on any interchange circuit, does not exceed  $\pm 25$  volts. The terminator on an interchange circuit will withstand any input signal within the  $\pm 25$  volt limit. The output of the driver circuits is not less than  $\pm 5$  volts or more than  $\pm 15$  volts when the terminating impedance is in the proper range (3000 to 7000 ohms) and the terminator open circuit voltage is zero.

**2.11** Data set 202R is provided with eight interface leads for connection to the customer data equipment and two additional leads for use with installation or maintenance test equipment. Figure 3 shows a simplified block diagram illustrating the interface leads (circuits).

**2.12 Protective Ground (AA)—Circuit 1:** Protective ground is connected to signal ground on TB1 terminal 13. This connection can be removed on customer's request, but removal is not recommended.

**2.13 Transmitted Data (BA)—Circuit 2:** The direction of signals on this circuit is from the business machine to the data set. Signals are generated by the data terminal and are sent to the data set transmitter for transmission to remote data terminal equipment. The data terminal should not transmit data unless an *on* condition is present on the clear-to-send and data-set-ready interface leads. The transmitting data terminal equipment should hold the transmitted data in the marking condition when no data is to be transmitted. With no signal applied to the transmitted data circuit and with the request-to-send and data-set-ready circuit *on*, the marking frequency will be transmitted. However, to prevent noise from falsely operating the transmitted data circuit, either a positive signal (space) or a negative signal (mark) should be applied to the circuit.

**2.14 Received Data (BB)—Circuit 3:** The direction of signals on this circuit is from the data set to the business machine. Signals are generated by the data set receiver by demodulating the signals received from the remote data set. Also, in half-duplex service, the received data circuit follows the transmitted data circuit delayed by less than 2 ms and may be used to monitor the

transmitted data for local copy. The provision for local copy does not conform to RS-232-C but is consistent with previous 202-type data sets.

**2.15 Request-to-Send (CA)—Circuit 4:** The direction of signals on this circuit is from the business machine to the data set. Signals are generated by the data terminal equipment to condition the local data set to transmit. With the data-set-ready circuit *on*, the carrier signal is transmitted in less than 1 ms after the request-to-send circuit is turned *on*. The *on* condition must be maintained whenever the data terminal equipment has information ready for transmission. The data set transmits all signals on the transmitted data lead as long as the *on* condition is maintained on request-to-send and data-set-ready. The request-to-send circuit must not be turned off for at least 1 ms after the end of the last bit that is applied to the transmitted data circuit. This is to ensure that the last bit clears the modulator before carrier is turned *off*. If local copy is being received on 2-wire circuits from the demodulator of the set that is transmitting and the squelch option is installed, it is necessary to delay the *off* signal on the request-to-send circuit 2 ms after the last bit is applied to the transmitted data circuit. This is to allow the last bit to clear the local demodulator before the squelch circuit clamps the received data circuit when request-to-send is turned *off*.

**2.16** In half-duplex service, the *off* condition holds the data set in the receive data condition, and the *on* condition holds the data set in the transmit data condition. These conditions are established without regard to signals on the transmitted and received data circuits. For data terminals designed for receive-only service, an option is provided to inhibit the transmission of carrier at all times. Data terminal equipment designed for either transmit-only or for full-duplex service may hold request-to-send in the *on* condition at all times or use the continuous carrier option of the data set. (Refer to 2.26 through 2.39 for description of options.)

**2.17 Clear-to-Send (CB)—Circuit 5:** The direction of signals on this lead is from the data set to the data terminal. Signals on this circuit are generated by the data set to indicate to the data terminal whether or not the data set is ready to transmit data. The *on* condition is a response to an *on* condition on the request-to-send circuit delayed by 200 ( $\pm 25$ ), 60 ( $\pm 10$ ), or 30 ( $\pm 5$ ) ms

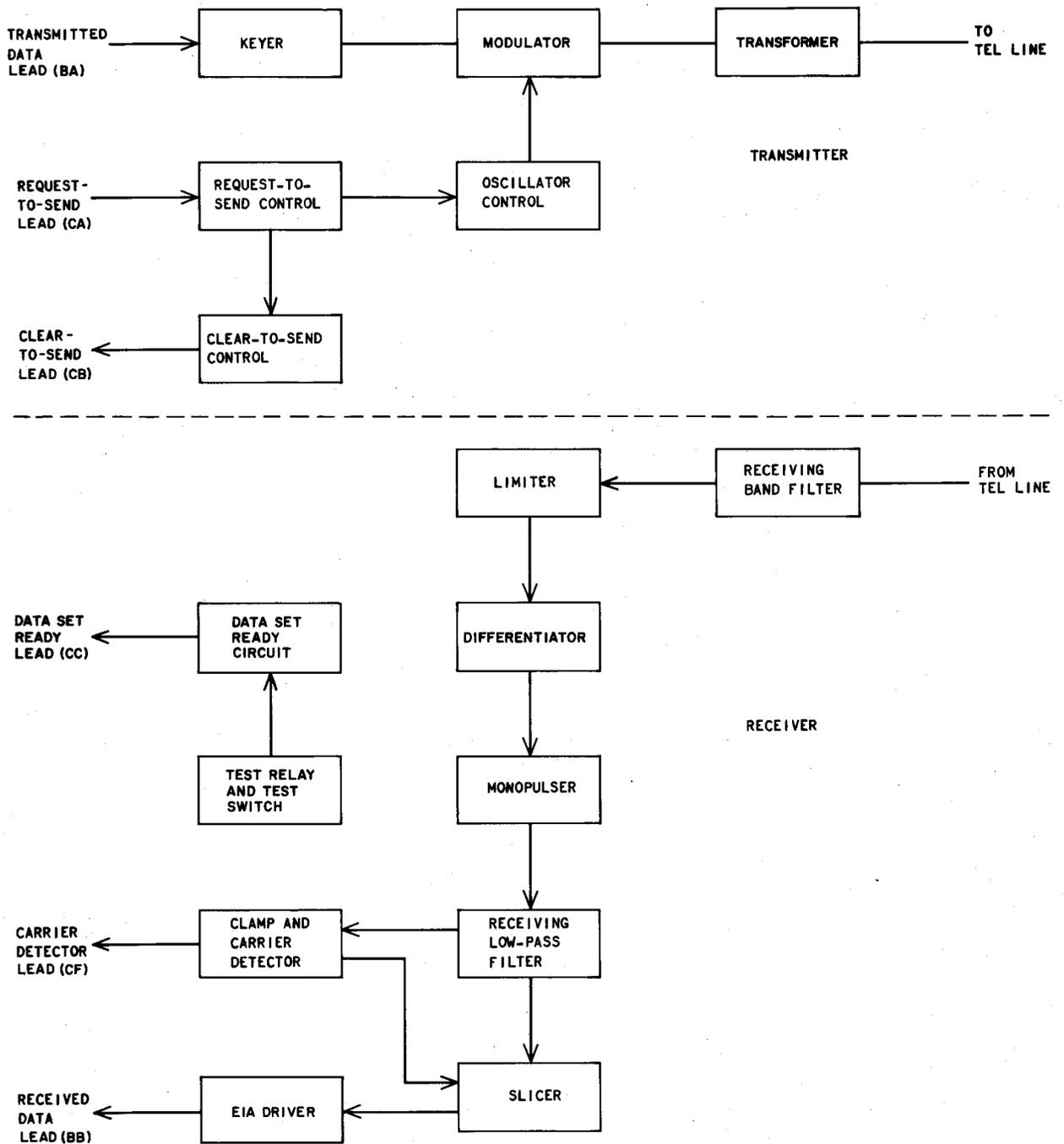


Fig. 3—Data Set 202R Block Diagram

(depending on which option is selected). The *on* condition on clear-to-send is an indication to the data terminal equipment that signals presented on the transmitted data circuit will be transmitted to the communication channel. The *off* condition is an indication to the data terminal that it should

not place data on the transmitted data circuit. When request-to-send is turned off, clear-to-send turns off in 1 ( $\pm 0.5$ ) ms.

**2.18 Data-Set-Ready (CC)—Circuit 6:** The direction of signals on this circuit is from

the data set to the data terminal. Signals are used to indicate the status of the local data set. The **on** condition indicates that the local data set is capable of transmitting and receiving data signals and is not in a test, talk, or dial mode. The **off** condition appears at all other times and is an indication that the data terminal equipment is to disregard signals appearing on any other interchange circuits. The **on** condition of the data-set-ready circuit should not be interpreted as an indication that a communication channel has been established or the status of any remote station equipment.

**2.19 Signal Ground (AB)—Circuit 7:** This circuit establishes the common ground reference potential for all interchange circuits except protective (frame) ground. It is normally connected to the frame ground circuit to minimize the introduction of longitudinal power line noise into electronic circuitry through the power transformer. Depending on local procedures and conditions, this connection may be removed by the installer.

**2.20 Received Line Signal Detector (CF)—Circuit 8:** The direction of signals on this circuit is from the data set to the data terminal. The **on** condition indicates that the data carrier is being received and has been received for at least 40 ( $\pm 10$ ) ms [or optionally 20 ( $\pm 5$ ) ms]. This circuit will not normally turn on in the presence of noise, out-of-band signals, voice, or other non-FSK signals. When the data carrier is lost due to an end of transmission or to a line interruption, the **off** condition follows after a 15 ( $\pm 3$ ) ms time delay. The **off** condition on this circuit causes the received data circuit to be clamped to the mark condition. An option is provided to remove this clamp. In half-duplex service, the received line signal detector responds to carrier signals from either the local or remote transmitting data set. With the squelch circuit installed, the received line signal detector circuit is clamped **off** for nominally 110 ms after the request-to-send circuit turns **off**.

**2.21 Positive Voltage:** The +8 volts on this lead is only for test purposes by telephone company (telco) personnel. The business machine should have no connections to this circuit.

**2.22 Negative Voltage:** The -8 volts on this lead is for test purposes by telco personnel. The business machine should have no connections to this circuit.

### C. Power Requirements

**2.23** Electric power to the data set is fed through an external transformer which reduces the 105 to 129 Vac to approximately 24 Vac. This low-voltage power is fed to the power rectifier in the data set. Data set 202R consumes approximately 15 watts of 117-Vac power.

**2.24** The power transformer provided as part of List 2 is either a KS-20426-L1 or a KS-16886-L2. The KS-20426-L1 transformer requires a 3-wire, U-shaped grounding pin, ac receptacle. The transformer mounts at the ac outlet and must be secured in place with the clip provided with the transformer. Data set frame ground is established through the grounding pin of the transformer.

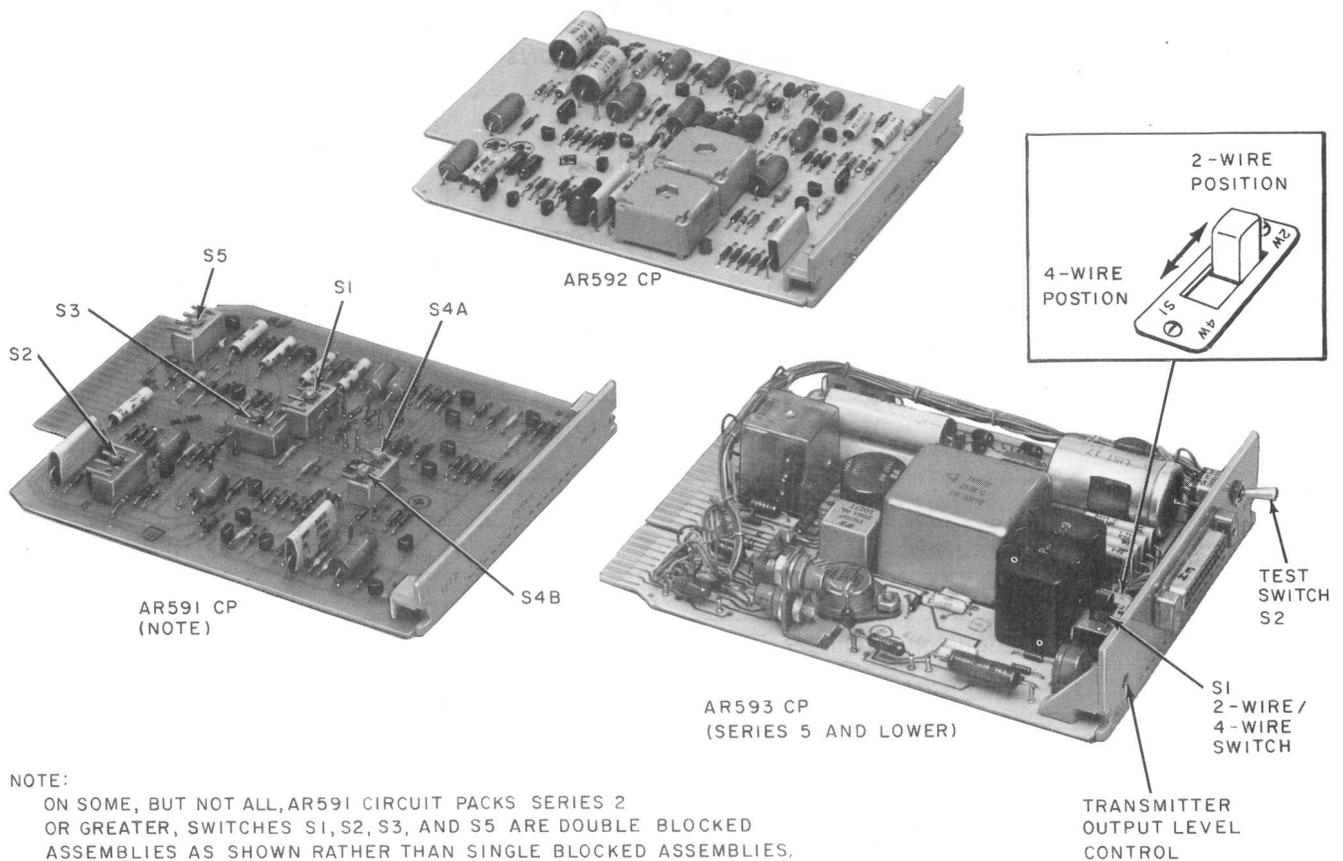
**2.25** The KS-16886-L2 transformer requires a 2-wire ac receptacle. Power to the transformer is fed through a 2-conductor cord. The transformer must be mounted near the ac outlet and is connected to the data set power rectifier through the D10P cord. The KS-16886-L2 transformer does not provide a protective ground path. This ground must be provided separately.

### D. Options

**2.26** Data set 202R is provided with a number of features or options which may be requested by the user. Some of these features are customer-requested options and some are telco engineering options. All options are controlled by switches on AR591 and AR593 CPs (Fig. 4). The screw switches are closed by turning the screw clockwise and are opened by turning the screw counterclockwise. Refer to Table A for a summary of options and option designations. The use of data set 202R on the switched network will be discussed in Part 3 (Applications).

#### 2-Wire—4-Wire

**2.27** The 2-wire—4-wire option is selected by a slide switch on AR593 CP. The 2-wire option is used in private line facilities and Dataphone service where half-duplex operation is desired. The 4-wire option is used in point-to-point and multipoint private line facilities where full-duplex operation is required.



## NOTE:

ON SOME, BUT NOT ALL, AR591 CIRCUIT PACKS SERIES 2 OR GREATER, SWITCHES S1, S2, S3, AND S5 ARE DOUBLE BLOCKED ASSEMBLIES AS SHOWN RATHER THAN SINGLE BLOCKED ASSEMBLIES. WHEN THESE DOUBLE BLOCKED ASSEMBLIES EXIST, AT NO TIME SHOULD THE SCREW ASSOCIATED WITH ANY OF THESE SWITCHES BE REMOVED FROM THE MIDPOSITION AND INSTALLED IN EITHER END POSITION OR DAMAGE TO CIRCUIT COMPONENTS WILL RESULT.

Fig. 4—Data Set 202R Circuit Packs

### Carrier Control

**2.28** With the carrier controlled by the customer's request-to-send lead (option X), the data set can transmit when request-to-send is **on** and the data set is conditioned to receive when request-to-send is **off**. With the continuous carrier option (option W), the request-to-send lead is bypassed and is held **on** by circuitry within the data set. The continuous carrier option is used on 4-wire systems or on 2-wire systems arranged to transmit only. For receive-only service, a "no carrier" option (option V) inhibits the transmitter from sending carrier.

**2.29** Option X (carrier controlled by the customer's request-to-send lead) is installed by closing switch S3B and opening switch S3A. Option W

(continuous carrier) is installed by closing switch S3A and opening switch S3B. Option V (no carrier) is installed by opening switch S3A and S3B.

### Carrier Turn-Off

**2.30** When a business machine turns request-to-send **off** at the conclusion of a transmitted message, transients occur which may cause spurious spacing signals to be received at the distant stations. With the soft carrier turn-off (option S), the data set transmits a 900-Hz carrier (which is outside the data band) for a period of between 20 and 45 ms after the request-to-send lead is turned **off**. This allows the remote data carrier detector circuits to turn off and does not cause nonvalid data to appear on the remote received data lead. This option is used in all applications except where fast

◆ TABLE A ◆  
DATA SET 202R OPTIONS

REQUIRES	OPTION DESIG.	DESCRIPTION OF OPTION		CLOSE SWITCH	OPEN SWITCH	CIRCUIT PACK
One per station	Y	4-wire	Slide switch on AR593 CP	S1 to "4-wire"	—	AR593 CP
	Z	2-wire		S1 to "2-wire"	—	
One per station	X	Data set carrier controlled by customer request-to-send		S3B	S3A	AR593 CP
	W	Continuous carrier (4-wire point-to-point or 2-wire transmit-only service)		S3A	S3B	
	V	No carrier (receive-only service)		—	S3A, S3B	
One per station	T	Fast turn-off of carrier		—	S2	AR591 CP
	S	Soft turn-off of carrier		S2	—	
One per station	R	Squelch of carrier detector		S3	—	
	Q	No squelch of carrier detector		—	S3	
One per station	N	20-ms carrier acquisition timer		S1	—	
	M	40-ms carrier acquisition timer		—	S1	
One per station	K	Carrier detector "OFF" clamps received data lead		S5	—	
	J	No clamp of received data lead		—	S5	
One per station	G	200-ms clear-to-send timer		—	S4A, S4B	
	F	60-ms clear-to-send timer		S4A	S4B	
	E	30-ms clear-to-send timer		S4B	S4A	

turnaround response of the data set is required on duplex multipoint systems, in which case the fast turn-off (option T) is used.

**2.31** Option S (soft turn-off of carrier) is installed by closing switch S2 on AR591 CP. Option T (fast turn-off of carrier) is installed by opening switch S2.

**Received Data Squelch (Squelch of Carrier Detector)**

**2.32** When a 2-wire station that has been transmitting has its request-to-send lead turned *off*, the telephone line may reflect signals (echoes) back to the station for a period up to the round-trip delay of the circuit (typically 1 ms per

100 miles each way). To prevent the receiver of the station that has been transmitting from detecting these reflections as valid data, the demodulator is squelched against all signals for a period of 110 ms (option R) after the request-to-send lead is turned *off*. This option is recommended for Dataphone® service and 2-wire private line applications. If the business machine is able to ignore the echoes (eg, by using a start-of-message code), then the "no squelch" option (option Q) can be used. In 4-wire operation, echoes are not encountered and, therefore, the "no squelch" option should be used.

**2.33** Option R (squelch of carrier detector) is installed by closing switch S3 on AR591 CP. Option Q (no squelch) is installed by opening switch S3.

### Carrier Detector Acquisition Timing

**2.34** The carrier detector circuitry requires a signal in the data band for either 40 ( $\pm 5$ ) or 20 ( $\pm 5$ ) ms before the received line signal detector turns *on*. The 40-ms acquisition timing (option M) is used when the remote data set has either the 200- or the 60-ms clear-to-send timing option (refer to 2.38). The 20-ms acquisition timing (option N) is used when the remote data set has the 30-ms clear-to-send timing option. However, with option N, the carrier detector is more susceptible to noise or voice signals unclamping the received line signal detector and received data circuits.

**2.35** An exception to the option settings specified in 2.34 occurs in the multipoint private line arrangements where a master station transmits continuous carrier (request-to-send is *on* at all times). In this instance, since the associated remote stations are all receiving continuous carrier, the 40-ms acquisition timing is used independent of the choice of clear-to-send timing at the master station.

**2.36** To install option M (40-ms timer), open switch S1 on AR591 CP. To install option N (20-ms timer), close switch S1.

### Carrier Detector Clamp

**2.37** The carrier detector clamp (option K) holds the received data circuit in the "mark" condition whenever the received line signal detector is *off* (refer to 2.34). If desired by the customer, the clamp of received data circuit may be disabled and the no clamp of received data option (option J) may be used. With the no-clamp option, telephone line noise may cause spurious space indications on the received data circuit even if the received line signal detector is *off*.

**2.38** Option K (carrier detector clamp) is installed by closing switch S5 on AR591 CP. Option J (no clamp) is installed by opening switch S5.

### Clear-to-Send Timing

**2.39** The *on* condition of the clear-to-send circuit from the data set is a response to an *on* condition on request-to-send delayed by a time interval which permits the data set to establish operation with the remote terminal. The data set provides three clear-to-send timing options: 200

( $\pm 25$ ) ms, 60 ( $\pm 10$ ) ms, and 30 ( $\pm 5$ ) ms. The 200-ms timing option (option G) is required when the remote data set has the received data squelch installed (refer to 2.32) to assure that the receiver clamp has been released before data is sent. The 60-ms timing option (option F) is recommended for 4-wire multipoint systems. It may also be used on 2-wire applications when the received data squelch is disabled. However, when used in this way, the remote data terminal should be able to ignore line reflections (refer to 2.32). The 30-ms timing option is recommended for 4-wire multipoint systems requiring fast start-up of the data set.

**2.40** Option G (200-ms timer) is installed by opening switch S4A and S4B on AR591 CP. Option F (60-ms timer) is installed by closing switch S4A and opening switch S4B. Option E (30-ms timer) is installed by closing switch S4B and opening switch S4A.

## 3. APPLICATIONS

**3.01** This part contains a description of the various applications in which a data set 202R can be used. These applications are as follows:

- 2-wire point-to-point private line
- 4-wire point-to-point private line
- 4-wire multipoint private line
- Switched network service.

The connection diagrams for these applications are contained in Section 592-025-200.

### PRIVATE LINE

**3.02** In private line operation, the line facilities are dedicated between data set locations. With power applied, the data set is in either the data or test mode of operation. In the data mode (data-set-ready *on*), the transmission of data may be initiated by data terminal control of the request-to-send interface circuit or by using the continuous carrier option of the data set.

#### A. 2-Wire Point-to-Point

**3.03** With 2-wire point-to-point service, the data set may be operated either half-duplex (alternately in each direction) or simplex (receive

only or transmit only). However, it should be noted that no reverse channel is available for circuit assurance or error control.

**3.04** In half-duplex operation, the request-to-send circuit is turned *on* by the station desiring to transmit. After a delay of nominally 200, 60, or 30 ms (depending on which clear-to-send timing option is selected), the clear-to-send circuit turns *on*, indicating that the data terminal may begin transmission. It is recommended that for half-duplex (2-wire) operation the 200-ms clear-to-send timing option (option G) and the squelch installed option (option R) be used. This is to prevent the demodulator of the station that has been transmitting from recovering line reflections when the station turns its request-to-send circuit *off*.

**3.05** Figure 5 shows the signals on the interface circuits of the local and remote data sets when the transmitting (local) data set (A) turns request-to-send *off* and enters the receive mode and the remote data set (B) enters the transmit mode. The request-to-send circuit of data set (A) is turned *off* at least 2 ms after the last bit of the end-of-message (EOM) code to allow the last bit to clear the demodulator for local copy. When the request-to-send circuit is turned *off*, the received line signal detector and received data circuits are clamped off for nominally 110 ms by the received data squelch option plus the 40 ( $\pm 10$ ) ms required to unclamp the received line signal detector. With data set (B) in the receive mode, its receive line signal detector turns *off* approximately 15 ms after the removal of line signal.

**3.06** If the local data set is able to ignore the line reflections, for example, by using a start-of-message (SOM) code to unblind the receiving data terminal at the beginning of a message, then the squelch option is removed and the shorter clear-to-send timing options (60 or 30 ms) are used. However, when line reflections are present, the received line signal detector circuit of both the local and remote data sets may be *on* all the time. This will occur when the data terminal of the remote data set turns request-to-send *on* before the received line signal detector (of the remote data set) turns *off*. In this case, the transmitted message (from the local to the remote data set) should be longer than the round-trip propagation delay so the echoes of the local start code are not interpreted as a start code from the remote data set.

**Note:** The maximum round-trip delay within the continental USA is less than 100 ms.

**3.07** If the data terminal of the remote data set turns request-to-send *on* after the received line signal detector turns *off*, then the received line signal detector of the local data set will be *off*, clamping the received data circuit in the mark condition for the remainder of the squelch interval. If the data terminal ignores clear-to-send and provides its own timing, a leader of at least 10 ms is transmitted before the SOM character to permit stabilization of any companders that may be present in the circuit.

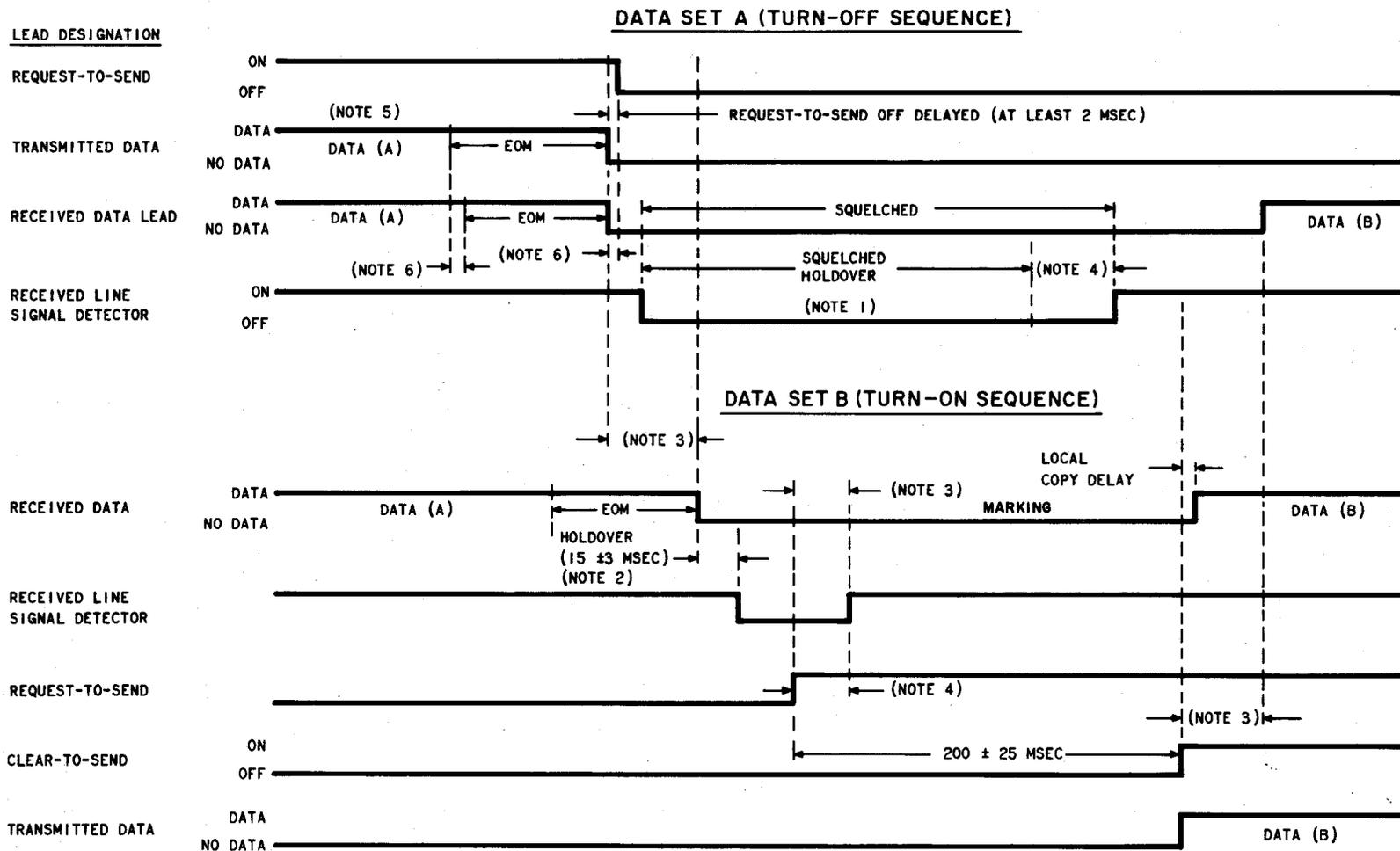
#### B. 4-Wire Point-to-Point

**3.08** In 4-wire point-to-point operation, simultaneous transmission in both directions is possible. It is recommended that continuous carrier option (option W) be used so that the clear-to-send circuit is always *on*, eliminating any start-up time. If the continuous carrier is not used, then carrier is transmitted only when the request-to-send circuit is turned *on*. In this case, the 60-ms clear-to-send timing option (option F) and the 40-ms receive carrier acquisition timing option (option M) is used to provide maximum noise protection and to assure that the receiver clamp has been released before data is sent.

#### C. 4-Wire Multipoint

**3.09** In multipoint, 4-wire private line service, there are two common bridging techniques that may be employed. In each case, the bridge itself is arranged so an input from any station on the bridge is transmitted to all other stations connected to the bridge but is not transmitted back to itself.

**3.10** Figure 6 shows one multipoint private line arrangement that may be used where all transmissions are between a master station and associated remote stations (remote stations cannot intercommunicate directly). This system permits the master station to keep its request-to-send circuit *on* at all times (or use continuous carrier option of the data set), thereby reducing the turnaround time. However, for the remote stations, the turnaround time is controlled by the time required to remove the receiver clamp at the master station (approximately 40 ms when the 60-ms clear-to-send timing option is used or 20 ms when the 30-ms



**NOTES:**

1. RECEIVED DATA SQUELCH TIME PLUS RECEIVED LINE SIGNAL DETECTOR UNCLAMP TIME (150 ± 10).
2. SPURIOUS SPACES ON RECEIVED DATA CIRCUIT DURING HOLDOVER OF RECEIVE LINE SIGNAL DETECTOR.
3. PROPAGATION DELAY (LESS THAN 50 MSEC).
4. CARRIER DETECTOR ACQUISITION TIME.
5. DATA - REPRESENTS ACTUAL INFORMATION FROM AND TO THE LINE. NO DATA LACK OF LINE SIGNAL.
6. LOCAL COPY DELAY.

**Fig. 5—Turnaround Sequence for 2-Wire Half-Duplex Operation With 200-Millisecond Clear-to-Send Delay and Squelch Installed**

clear-to-send timing option is used). Refer to Fig. 7 for a turnaround sequence for a 4-wire multipoint arrangement.

**3.11** Figure 8 shows another private line arrangement which permits any station to transmit and receive from any other station nonsimultaneously. Where the customer desires to obtain local copy through the receive leg, a "talk-back" feature may be added to the bridge. When the "talk-back" feature is provided, the squelch installed option (option R) is employed to prevent line reflections from being interpreted as valid data after the request-to-send circuit is turned *off*. With the squelch installed option, the remote data sets use the 200-ms clear-to-send timing option (option G) as discussed in 3.04. If the "talk-back" feature is not employed, the remote data sets use the 60- or 30-ms clear-to-send timing option (option F or E).

**3.12** When the "talk-back" feature is not provided, it is possible for any two stations to transmit and receive simultaneously. However, a disadvantage of this system is that all the stations not engaged in the communication receive an unintelligible combination of both transmitted signals.

**3.13** For both multipoint arrangements previously described, if turnaround time is critical, an option is provided (option J) to remove the received data clamp. With this option, the data terminal should use a multibit SOM sequence to protect the system against noise and should transmit the carrier

for at least 10 ms before the start character to permit stabilization of any companders that may be present in the circuits.

**SWITCHED NETWORK SERVICE**

**3.14** For switched network service, a telephone with an exclusion key is provided in addition to data set 202R. The recommended telephone sets are as follows:

- 511F, desk telephone, rotary dial
- 558F, wall telephone, rotary dial
- 2511F, desk telephone, Touch-Tone® dial
- 2558D, wall telephone, Touch-Tone dial.

Any of these telephones may also be used for 2-wire private line service with direct distance dialing (DDD) backup. Such an arrangement does not permit voice communication over private line facilities. However, the telephone set can be used for voice communication on the DDD network even while the data set is in use on the private line facilities. With these arrangements, only manual origination, answering, and termination of Dataphone calls are possible.

**3.15** To enter the data mode, the data set attendant must lift the exclusion key on the telephone set and keep the handset off-hook.

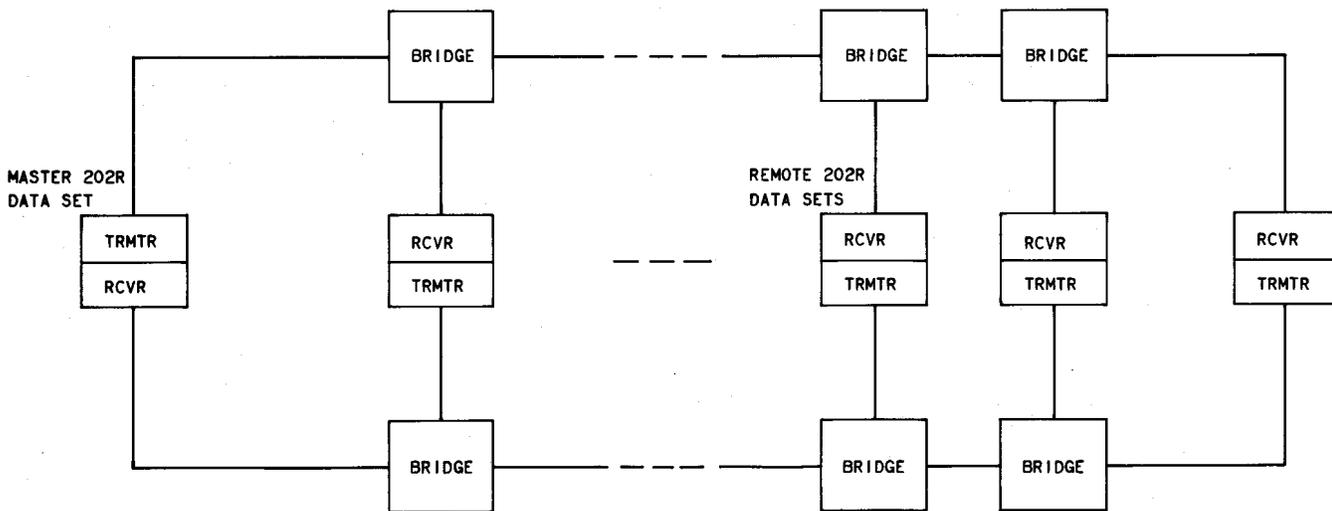
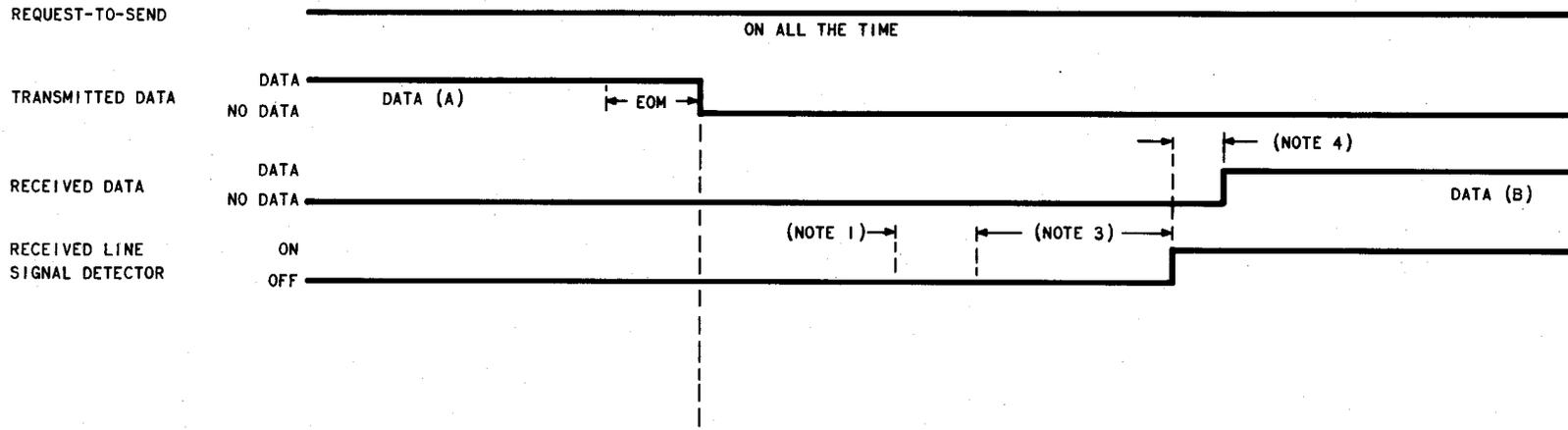
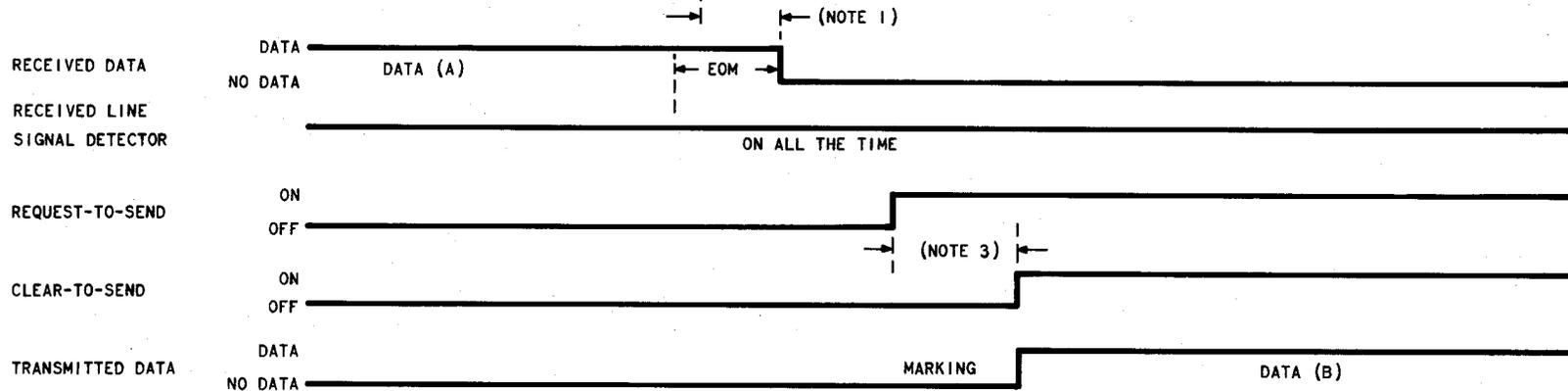


Fig. 6—Four-Wire Multipoint Private Line Service With One Master Station and Several Remote Stations

**DATA SET A (MASTER STATION - TURN-OFF SEQUENCE)**



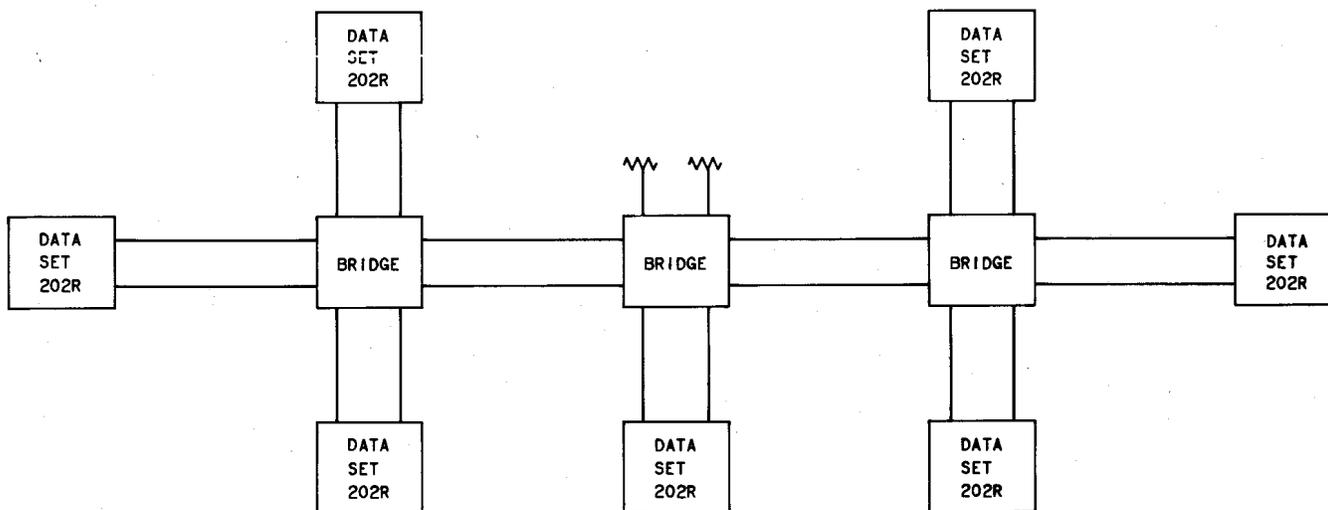
**DATA SET B (REMOTE STATION - TURN-ON SEQUENCE)**



**NOTES:**

1. PROPAGATION DELAY (LESS THAN 50 MSEC).
2. CLEAR-TO-SEND DELAY ( $60 \pm 10$  OR  $30 \pm 5$  MSEC) IN REMOTE STATION.
3. RECEIVED LINE SIGNAL DETECTOR UNCLAMP TIME ( $40 \pm 10$  OR  $20 \pm 5$  MSEC) IN MASTER STATION.
4. DIFFERENCE BETWEEN INTERVALS 2 AND 3.

**Fig. 7—Four-Wire Turnaround for Multipoint Arrangement With a Master Station and Several Remote Stations**



**Fig. 8—Four-Wire Multipoint Arrangement With Each Data Set Able to Talk With Each Other Data Set**

If the data set is being used on 2-wire private line with DDD backup, the telephone set is normally connected to the DDD network (line key rotated counterclockwise) and the data set is connected to the 2-wire private line. When the line key is turned clockwise, the data set is transferred to the DDD line as in switched network service.

**Note:** For switched network service only, the line key is disabled.

**3.16** The procedure to turn a switched network call around is the same as to turn a 2-wire half-duplex private line data set around (refer to 3.05 and Fig. 5). However, it is strongly recommended that the 200-ms clear-to-send timing option (option G) and the received data squelch option (option R) be used. The 200-ms clear-to-send timing is necessary for assuring that echo suppressors on long circuits are turned around before data is transmitted, while the squelch installed option is necessary for preventing line reflections from being demodulated as valid data.

#### MULTIPLE ARRANGEMENTS

**3.17** Data sets 202R-L1 when used with 107A brackets are suitable for mounting in multiple arrangements. Two 107A brackets must be attached to the sides of the 61B apparatus mounting of each data set 202R. This permits the data sets to be mounted on 67A, 67B, or similar brackets used in 200-type key telephone mounting arrangements.

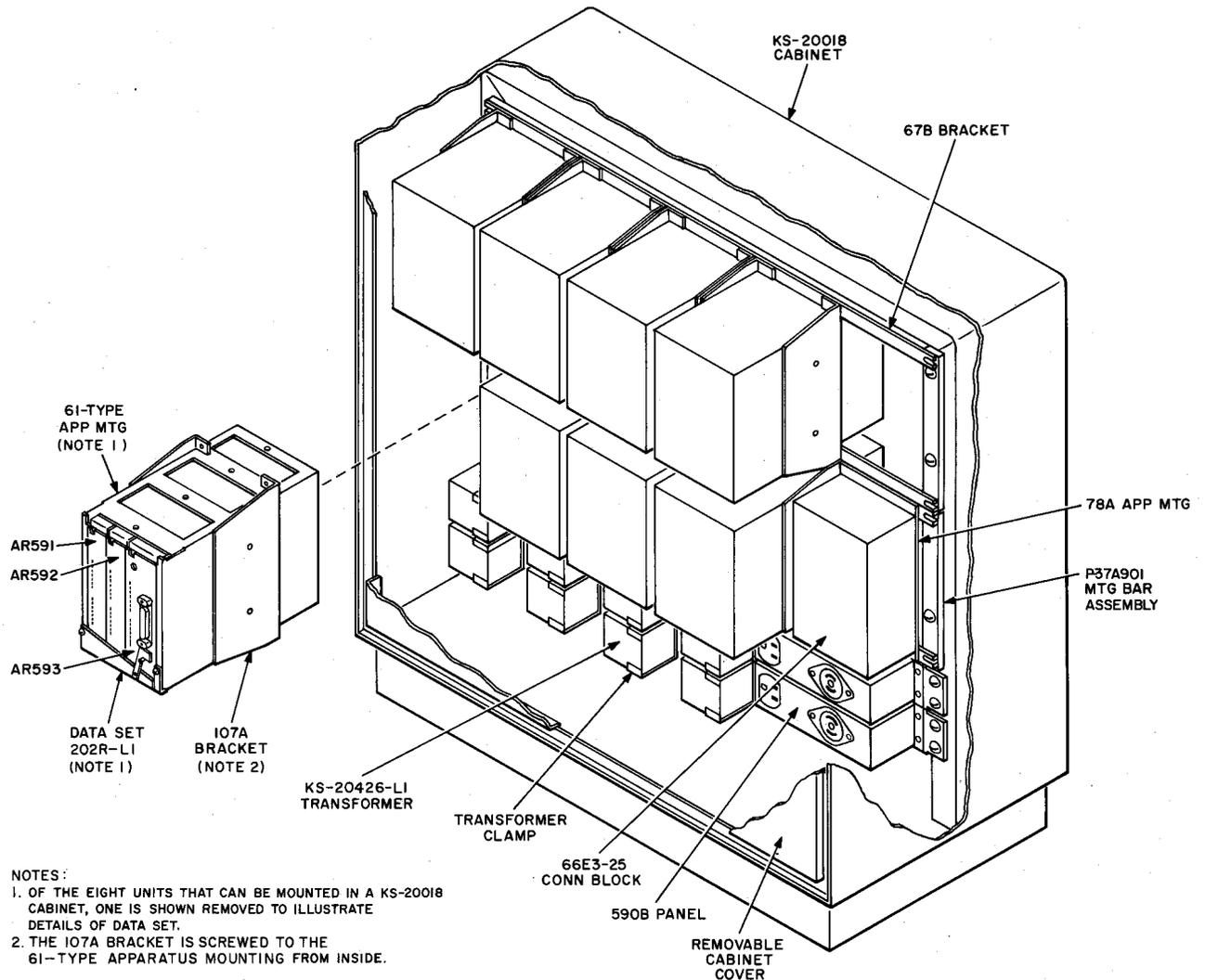
Refer to Fig. 9 for a typical mounting arrangement in a KS-20018 cabinet.

**3.18** Five data sets may be mounted in a 7-inch mounting plate space on a 23-inch mounting frame. Four data sets will fit on a 19-inch mounting frame. A 6017AP or 6017AR key (LINE—TEST key) may be mounted to the side of the 107A bracket if required for line and local loop-around tests at each station. This will reduce by one the number of sets that will fit in the available mounting space.

**3.19** To provide line connections to the data set, it may be desired to install a 66E3 connecting block on the 67-type brackets. A 78A apparatus mounting is available for this purpose. Each connecting block may be used to distribute up to 25 telephone lines to the data set.

**3.20** To provide power to the data sets, it will be necessary to use a 590B panel to distribute the 110-Vac power. This panel consists of four duplex outlets into which the KS-20426-L1 transformers can be plugged (Fig. 9). Only one transformer will fit on each duplex outlet. The clip furnished with each transformer must be used to secure the transformer to the panel.

**3.21** If the KS-16886-L2 transformer is used, refer to Fig. 10 for a suggested mounting arrangement. Only one 590B panel is needed to distribute power and the remaining space can be



**Fig. 9—Multiple Arrangement of Data Set 202R in a KS-20018 Cabinet**

used to mount the transformers. The transformers can be mounted on 67-type brackets below the power distribution panel.

**3.22** The arrangements shown in Fig. 9 and 10 use a KS-20018 cabinet. Other cabinets which can be used are the KS-20093 and KS-20757 types. For information on these cabinets, refer to the section entitled Data Sets, Multiple Installation Information (590-010-201).

#### 4. THEORY OF OPERATION

**4.01** This part contains information pertaining to the functional description of the data set

transmitter, receiver, and control circuits. For information concerning interface leads and data set options, refer to Part 3.

**4.02** Refer to Fig. 11 for a functional block diagram of the data set. Data set 202R contains three CPs as follows:

- The power supply, modulator, and line circuits are contained on AR593.
- The demodulator is contained on AR592.
- The carrier detector and various timers are contained on AR591.

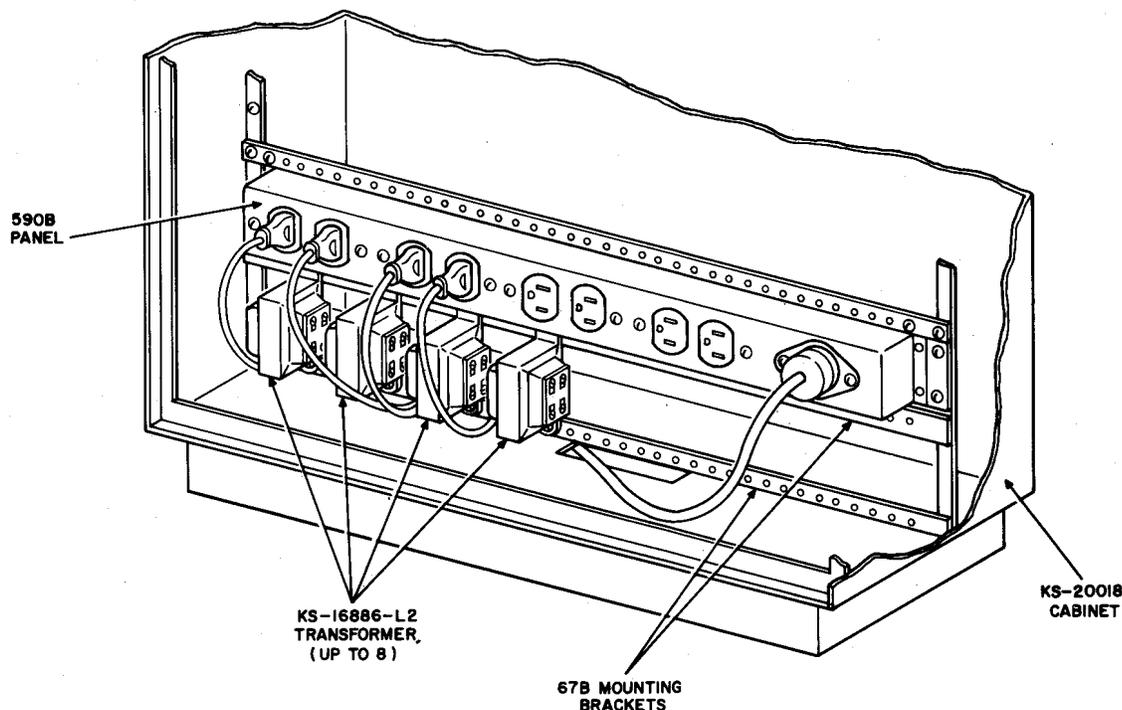


Fig. 10—KS-16886-L2 Transformer Mounted on 67-Type Brackets

**4.03** An external transformer (T1) supplies a nominal 24 Vac to the power supply on AR593 CP. The power supply provides an unregulated +16 volts and a regulated +8 and -8 volts.

#### DETAILED DESCRIPTION

**4.04** Received line signals across T and R are coupled to the demodulator (AR592 CP) via the transformer, pad, and bandpass circuit of AR593 CP. Switch S1 provides the data set with the 2-wire (half-duplex) or 4-wire (full-duplex) option. With S1 in the 4W position, the modulator output is transformer-coupled to the line across T1 and R1. When S1 is placed in the 2W position, the modulator output bridges the receiver input circuit, thus generating local copy to the receiver. The modulator output is also transformer-coupled to the line across T and R.

**4.05** The modulator, composed of a keyer and oscillator circuit, converts customer data signals appearing on pin 2 of J1 (BA) into a frequency shift-modulated signal, consisting of mark (1300-Hz) and space (2100-Hz) frequencies, suitable for transmission over the telephone line. In order to enable the modulator to send carrier, it is

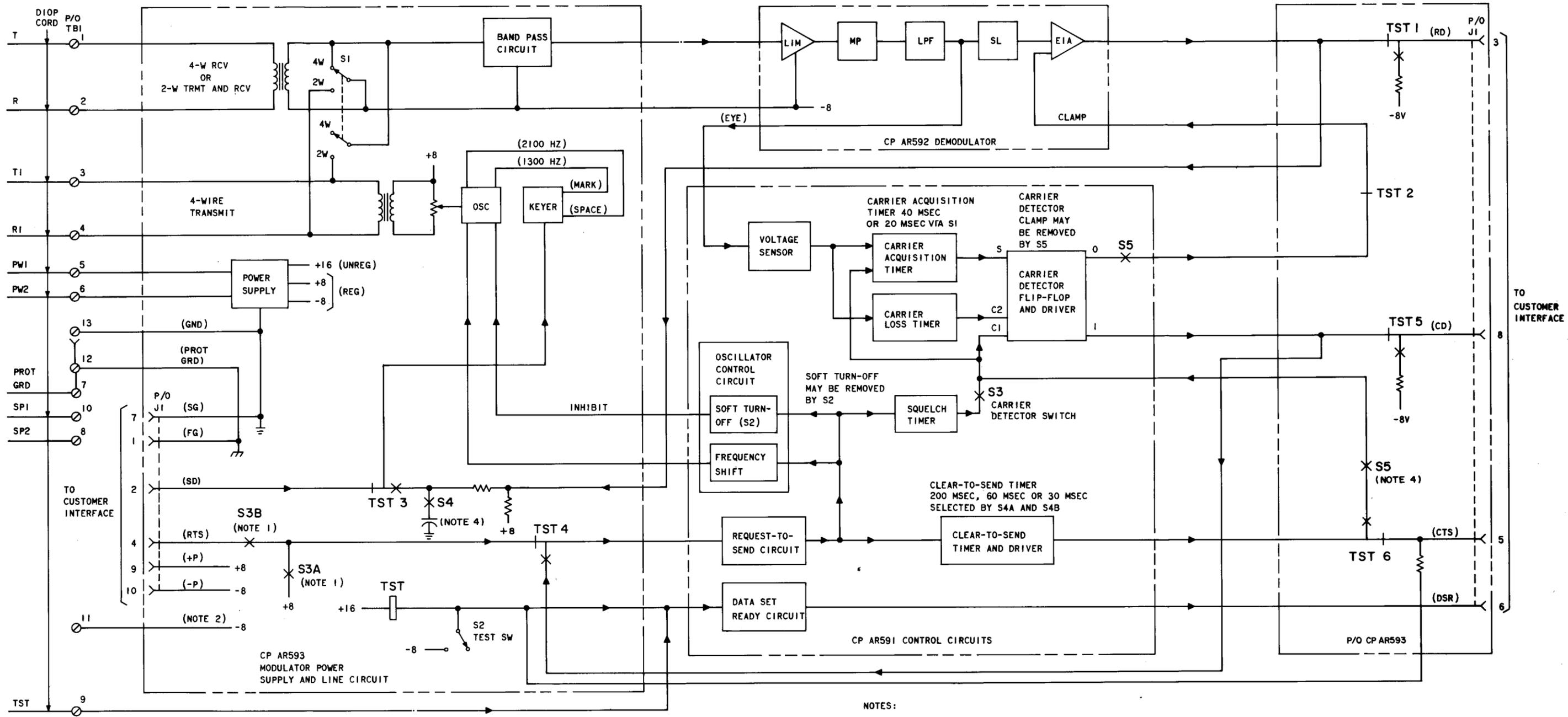
necessary to turn on the request-to-send terminating circuit of AR591 CP. Dependent upon data set options, this may be accomplished in one of two ways.

- (a) Switch S3A open, S3B closed. This option places the data set carrier under control of the customer request-to-send voltage on pin 4 of J1 (CA).
- (b) Switch S3A closed, S3B open. This option applies an internal **on** condition to the request-to-send terminating circuit. This causes continuous carrier and is associated with providing transmit-only service.

A third option, S3A and S3B open, is used for receive-only service (no carrier).

**4.06** An adjustable output level control is provided to meet switched network and private line transmit level objectives.

**4.07** Associated with the request-to-send terminating circuit is the clear-to-send timer, also located on AR591 CP. In response to a positive request-to-send voltage on pin 4 of J1, a delayed clear-to-send



NOTES:

1. S3A PROVIDES CONTINUOUS CARRIER. S3B PROVIDES CARRIER CONTROLLED BY CUSTOMER'S REQUEST-TO-SEND LEAD.
2. ON DATA SETS WITH LINE KEY, CONNECT SPI LEAD TO TBI-11.
3. KS-20426-L1 TRANSFORMER IS SHOWN. IF THE KS-16886-L2 TRANSFORMER IS USED, PW1 AND PW2 LEADS MUST BE RUN TO TERMINALS 3 AND 6 OF THE TRANSFORMER VIA THE DIOP CORD. PROTECTIVE GROUND MUST ALSO BE RUN VIA THE DIOP CORD BUT MUST BE SEPARATELY ROUTED TO POWER GROUND SINCE THE TRANSFORMER DOES NOT HAVE A PLUG TERMINAL TO POWER GROUND.
4. SWITCHES S4 AND S5 PROVIDE A DIGITAL LOOP-BACK TEST CAPABILITY ON DATA SETS EQUIPPED WITH CP AR593 SERIES 6 OR LATER.

Fig. 11—Data Set 202R Functional Block Diagram

output voltage (positive) appears on pin 5 of J1 (CB). Clear-to-send timing delays of 30, 60, or 200 ms are provided by installer option switches S4A and S4B.

**4.08** Turning off the request-to-send circuit by applying a negative voltage to the request-to-send input lead initiates the following actions:

- (a) Turns off clear-to-send within 1 ms
- (b) With S2 closed, soft turn-off of carrier via the frequency shift and oscillator control circuits of AR591 CP; with S2 open, fast turn-off of carrier
- (c) With S3 closed, squelches the carrier detector off for a timed interval; with S3 open, no squelch of carrier detector.

**4.09** The demodulator, located on AR592 CP, is of the zero-crossing type. Binary FSK signals appearing at the input with signal strength greater than  $-42$  dBm are demodulated and presented to the customer as mark (negative) and space (positive) voltages on pin 3 of J1 (BB). For an inband signal, the received data lead (BB) will respond with a negative voltage for marking ( $< 1700$  Hz) or a positive voltage for spacing ( $> 1700$  Hz). An output of the low-pass filter of the demodulator provides presence of carrier information to the carrier detector circuit of AR591 CP and is brought out on pin 20 for this purpose.

**4.10** The carrier detector circuit, located on AR591 CP, is used to detect a valid incoming signal as carrier and to protect the customer against excessive noise and out-of-band signals by providing clamping action on the receiver. If a data band signal (1100 through 2300 Hz) of sufficient strength is present on the line, the carrier detector circuit will indicate presence of carrier (positive voltage on pin 8 of J1, CF). Carrier acquisition times of 40 to 20 ms are obtainable through installer option S1. The carrier acquisition timing options, in conjunction with the clear-to-send timing options, may be utilized to provide fast turnaround of a data call for polling applications. In the event that the carrier on the line is interrupted or ceases, the carrier detector will hold over for a period of 15 ms provided by the carrier loss timer. Clamping of the received data lead by the carrier detector circuitry is made optional by S5, located on AR591 CP. When the clamp option is installed, the

receiver is subject to the acquisition and loss timing of the carrier detector. Whenever the carrier detector indicates an *off* condition, the receiver output lead will be mark-hold.

**4.11** A positive data-set-ready indication will be presented to the customer on pin 6 of J1 whenever the data set is powered and the test relay (TST) is not operated. The relay is operated to place the data set in the test mode of operation.

#### A. Remote Testing Capabilities With 2-Wire Facility

**4.12** The data set used on 2-wire facilities has a remote test feature which permits a test from a data test center (DTC) by means of tones sent over the telephone line. To check the data set, the attendant at the DTC calls the customer and asks him to place the set in the test mode by operating the test key. The DTC may now conduct tests to check the mark and space frequencies, receiver bandwidth, receiver slicing frequency, and receiver sensitivity. Also, a dynamic test can be performed.

**4.13** Operating the test switch S2 causes the data-set-ready lead (CC) to go negative and operates the TST relay on AR593 CP, thereby placing the data set in the test mode. In the operate position, the TST relay performs the following functions:

- (a) Applies a negative voltage to interface leads BB, CF, and CB via relay contacts TST1, TST5, and TEST SW S2, respectively
- (b) Removes customer input signals on interface leads BA and CA via relay contacts TST3 and TST4, respectively
- (c) Opens the clamp lead from the carrier detector to the demodulator via relay contact TST2
- (d) Loops the output of the demodulator to the input of the transmitter via relay contact TST3
- (e) Loops the output of the carrier detector to the request-to-send circuit via relay contact TST4

(f) Connects the output of the clear-to-send to circuitry internal to the carrier detector (carrier detector flip-flop) via relay contact TST6.

**4.14** In this state, the modulator of the data set is held off by the negative carrier detector output connected to the request-to-send circuit. In testing, a tone above -42 dBm and between 1100 and 1700 Hz is applied to the data set from the DTC. The data set will respond to the tone with an interrupted marking frequency tone. The generation of the tone interval is a result of the carrier detector going positive, turning on the request-to-send, thus turning on the modulator. The receiver output being connected to the send data input forces the modulator frequency to follow the state of the received data output, which in this case is mark.

**4.15** Eventually, the clear-to-send timer circuit goes positive (delayed response to request-to-send being turned on) and turns off the carrier detector circuit which turns off the request-to-send, thus inhibiting the modulator. The request-to-send going off turns off the clear-to-send circuit which clamps the carrier detector off (via carrier detector flip-flop) for the squelch timing duration. The tone from the data set remains off for the squelch and carrier detector intervals but becomes activated once again as these circuits time out and allow the receiver to detect the DTC tone, thus repeating the sequence. If the tone from the test center is increased to a frequency of between 1700 and 2300 Hz, the data set will respond with an interrupted spacing tone.

**4.16** The receiver bandwidth is measured by varying the DTC signal away from mark (1300 Hz) and space (2100 Hz). As the signal frequency is lowered below 1300 Hz, it will eventually fall outside the 202R data band and the tone from the data set will cease. The tone will also cease if the signal being sent is raised too far above 2100 Hz.

**4.17** The receiver slicing frequency is measured by varying the frequency around 1700 Hz. Below 1700 Hz, the data set will respond by transmitting a 1300-Hz tone. Above 1700 Hz, the data set will respond by transmitting a 2100-Hz tone.

**4.18** The receiver sensitivity is measured by setting the DTC oscillator near the mark or

space frequency. If the level of the signal is slowly reduced, at some point it will not be strong enough to be detected by the data set receiver and the interrupted tone will cease. It is then possible to calculate the receiver sensitivity if the loss between the DTC and data set is known.

**4.19** The dynamic test subjects the data set and transmission facilities to test data signals. This is a data station to DTC error check and does require a craft employee at the customer location. In this test, data is transmitted from one end and is compared to a similar locally generated signal at the other end. Tests are run alternately from each end except where the data set is arranged to transmit only or receive only. At the receiving end, errors in the received data are counted and it is determined whether the error rate is excessive.

**B. Remote Testing Capabilities With 4-Wire Facility**

**4.20** Data sets equipped with AR593 CP, series 5 or earlier, used on 4-wire facilities are tested as described in 4.12 through 4.19. Data sets equipped with AR593 CP, series 6 or later, contain a 4-wire testing capability which allows the DTC to transmit to the data set on one pair and receive from the data set on the other pair. The mark and space frequencies, space level, slicing frequency, and carrier detector bandwidth are tested.

**4.21** Data sets equipped with AR593 CP, series 6 or later, contain a digital loop-back testing capability provided by switches S4 and S5 as illustrated in Fig. 12. In this test, data is transmitted from the DTC to the data set, looped around at the data set customer interface, and transmitted by the data set back to the DTC. The data received at the DTC is then checked for errors. This allows the DTC to determine the error rate of the channel.

**5. TEST PROCEDURES**

**5.01** The following test procedures do not cover all trouble possibilities in data set 202R. The tests are designed to indicate which CP should be replaced as a logical choice to repair a trouble condition. Installation and maintenance tests for data set 202R are contained in Section 592-025-500.

**5.02** Tests contained in Section 592-025-500 are designed for routine installation and maintenance

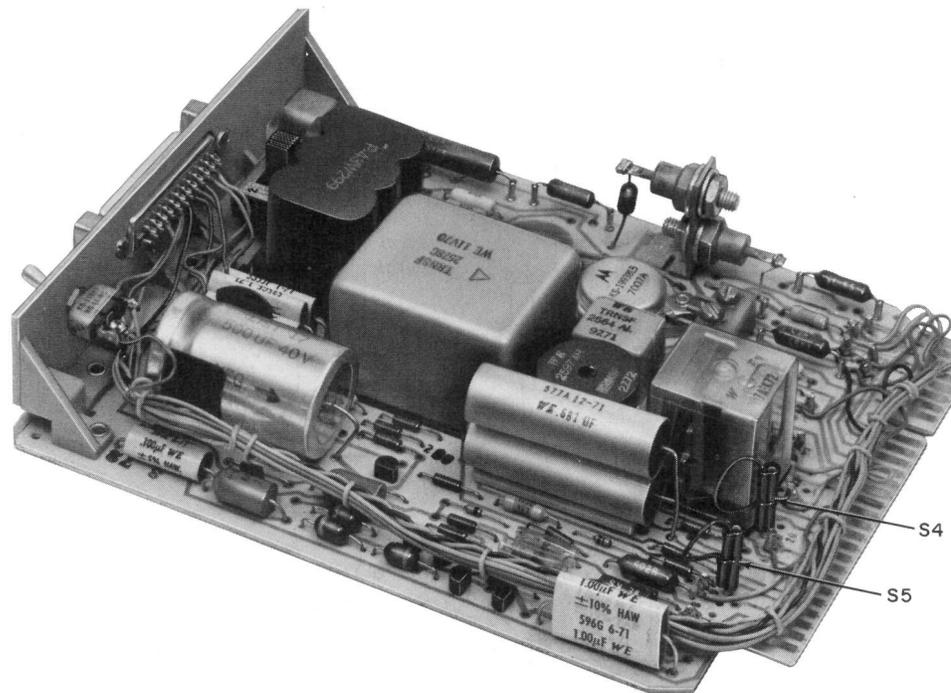


Fig. 12—AR593 Circuit Packs—Location of Switches S4 and S5

to be conducted at the customer premises. Tests contained in this section are for testing the data set only. The tests can be conducted apart from the associated equipment (telephone set, connector blocks, etc). When the trouble has been localized to a particular CP and that CP has been replaced, the data set should be retested to verify that it meets requirements.

**5.03** The following test equipment is required to perform these tests:

1—914-type data test set (DTS)

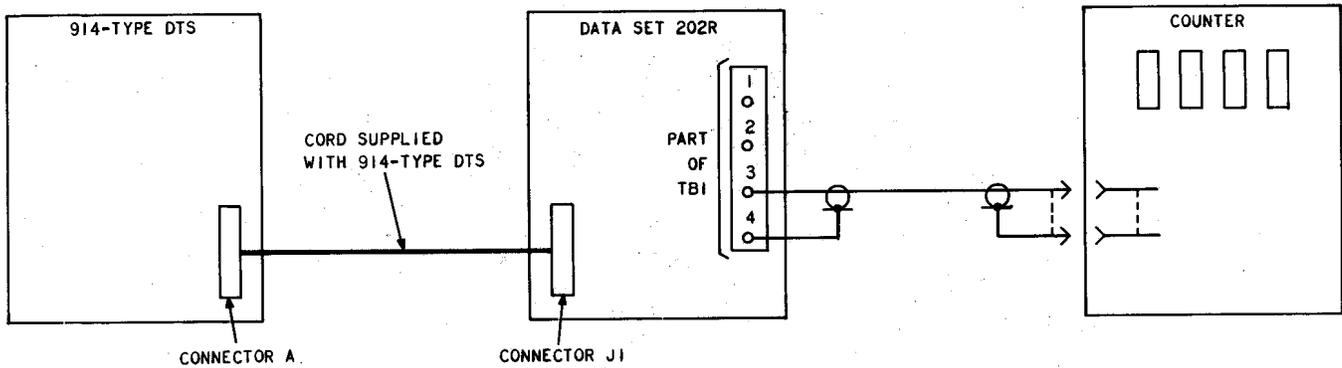
1—Hewlett Packard counter, Type 5321B (or equivalent).

**5.04** In this test, the DS lamps of the 914-type DTS are used to indicate the presence of positive interface voltages. If the lamp lights dimly, or if there is doubt that the interface lead meets voltage requirements, measure the voltage on that lead using the meter in the 914-type DTS as described in the following procedure.

- (1) Set the VERTICAL MONITOR switch to the position of the lead being monitored.
- (2) Set the RANGE switch to DCV-10.
- (3) Set the FUNCTION switch to VOLTS INT.
- (4) There should be at least +5 volts on any control interface lead in the *on* condition.

**5.05** To perform the following test, remove the data set cover and remove AR591 and AR593 CPs. Open all option switches by turning counterclockwise and set the 2-wire/4-wire switch to the 4W position. Insert the cards back into the data set. Connect the G-W and W-G leads of the D10P cord to terminals 4 and 3 on the power transformer. Insulate the other spade tips to avoid short circuits.

- (1) Set up the equipment as shown in Fig. 13. Apply power to the data set and to the 914-type DTS.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	ST6	
GRD	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	GRD
SD	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	SD
RD	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	RD
SI	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	SI
DS1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS1
DS2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS2
S2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	S2
DS3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS3
TP1	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	TP1
TP2	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	TP2
S3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	S3
DS4	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS4
DS5	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS5
S4	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	S4
SCT	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	SCT
S5	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	S5
SCR	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	SCR
DS6	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS6
S6	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	S6
DS7	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS7
DS8	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	DS8
S7	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	S7
TP3	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	TP3
S8	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	S8

NOTES:

1. SET SWITCHES ON 914-TYPE DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
VERTICAL MONITOR	10
COUNTER	INTERVAL-X10
FUNCTION	VOLT INT
RANGE	DCV - 10
METER-POLARITY	REV

2. 914-TYPE DTS INDICATOR LAMPS CORRESPOND TO THE FOLLOWING INTERFACE LEADS:

LAMP	FUNCTION
DS1	RECEIVED DATA
DS2	CLEAR TO SEND
DS3	DATA SET READY
DS4	CARRIER DETECTOR

3. 914-TYPE DTS SWITCHES CORRESPOND TO THE FOLLOWING INTERFACE LEADS:

SWITCH	FUNCTION
S1	SEND DATA
S2	REQUEST TO SEND

Fig. 13—Test Equipment Setup

- (2) The meter should indicate  $-8 (\pm 1.0)$  volts. If it does not, check the ac power source and the data set power transformer.
- (3) Move the FUNCTION switch to OFF. Move the meter POLARITY switch to NOR and move the VERTICAL MONITOR switch to 9.
- (4) Move the FUNCTION switch to VOLTS INT. The meter should indicate  $+8 (\pm 1.0)$  volts. If the power supply voltages are incorrect and the trouble is not in the ac source, replace AR593 CP. Move the FUNCTION switch to OFF.
- (5) Verify that the DS3 lamp is lighted. This indicates that the data-set-ready lead is *on*. If the DS3 lamp is not lighted, verify that the TST switch on the data set is in the line position (away from red dot and flag in place). If the TST switch is in the correct position, replace AR591 CP. If the DS3 lamp remains unlighted, replace AR593 CP.
- (6) Raise the metal flag and move the TST switch to the test position (toward red dot). The DS3 lamp should extinguish. Move the VERTICAL MONITOR switch to 6, move the POLARITY switch to REV, and move the FUNCTION switch to VOLTS INT.
- (7) The meter should indicate a voltage more negative than  $-5$  volts (data-set-ready is *off*). If the voltage is incorrect, replace AR593 CP. If the voltage is still incorrect, replace AR591 CP.
- (8) Move the TST switch to line position (away from red dot). Remove AR593 CP and close option switch S3A. Insert the card into the data set.
- (9) Verify that the DS2 lamp is lighted. This indicates that the clear-to-send lead is *on*. If the DS2 lamp is not lighted, replace AR591 CP. If the DS2 lamp is still not lighted, replace AR593 CP.
- (10) Remove AR593 CP, open switch S3A, and close S3B. Move the VERTICAL MONITOR switch to 5 and move the FUNCTION switch to VOLTS INT.
- (11) The meter should indicate more negative than  $-5$  volts (clear-to-send is *off*). If the voltage is incorrect, replace AR591 CP.
- (12) Move the FUNCTION switch to OFF. Zero the counter on the 914-type DTS by pressing the RESET button.
- (13) Move the S2 switch to ON. This switch controls the request-to-send lead. The DS2 lamp will light indicating that the clear-to-send circuit is *on*. The counter will indicate the interval between request-to-send *on* and clear-to-send *on*.
- Requirement:** 17 to 23 on counter.
- Note:** Because the COUNTER switch is set to INTERVAL X10 ms, the actual interval requirement is 170 to 230 ms.
- (14) On the 914-type DTS, move the S2 switch to OFF. Remove AR591 CP and close option switch S4A. Insert the card back into the data set.
- (15) On the 914-type DTS, move the COUNTER switch to INTERVAL X1 and move the S2 switch to ON. Zero the counter by pressing the RESET button.
- (16) The counter will indicate the interval between request-to-send *on* and clear-to-send *on*.
- Requirement:** 60 ( $\pm 10$ ) ms.
- (17) On the 914-type DTS, move switch S2 to OFF. Remove AR591 CP, close switch S4B, and open switch S4A. Insert the card back into the data set.
- (18) Zero the counter by pressing the RESET button. Move switch S2 to ON and measure the interval between request-to-send *on* and clear-to-send *on*.
- Requirement:** 30 ( $\pm 5$ ) ms.
- (19) If the clear-to-send lead fails to come *on* (DS2 unlighted) or if the time intervals are incorrect, replace AR591 CP.

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(20) Refer to the electronic counter. This is monitoring the data set transmit pair. Measure the frequency of the mark signal.

**Requirement:** 1297 to 1317 Hz.

(21) On the 914-type DTS, move switch S1 to ON. This will cause the data set to send a spacing signal. Measure the frequency on the counter.

**Requirement:** 2080 to 2105 Hz.

(22) Remove AR593 CP and move the 2W/4W switch to the 2W position. Move the electronic counter input from TB1-3 and TB1-4 to TB1-1 and TB1-2.

(23) Verify that the data set is sending the spacing signal on the 2-wire transmit pair.

**Requirement:** 2080 to 2105 Hz.

(24) Disconnect the electronic counter from TB1 and connect a 600-ohm resistor between TB1-1 and TB1-2. Connect the 914-type DTS meter INPUT terminals across the resistor and move the RANGE switch to dB-0.

(25) Move the FUNCTION switch to VOLT/OHM EXT and monitor the data set transmit level. Vary this transmit level by means of the potentiometer accessible through the hole in AR593 CP. The level should be adjustable from -1 to -14 dBm.

(26) If the transmit level is incorrect or not adjustable through the specified range, replace AR593 CP.

(27) Set the potentiometer to obtain the minimum level. Verify that the DS1 lamp is lighted on the 914-type DTS. This indicates that the transmitted data has been demodulated and a space (+V) indication is on the received data lead.

(28) Move FUNCTION switch to OFF. Move meter RANGE switch to DCV-10 and VERTICAL MONITOR switch to 3.

(29) On the 914-type DTS, move the S1 switch to OFF and move the FUNCTION switch to VOLT INT. The data set is now transmitting

a marking tone which is demodulated and appears as a negative voltage on the received data lead.

**Requirement:** More negative than -5 volts.

(30) If the received data circuit indications are not as specified in (27) and (29) above, replace AR592 CP.

(31) Move the FUNCTION switch to OFF. Remove the AR591 CP and close option switch S5. Insert the CP back into the data set.

(32) Move the S1 switch to **on** and verify that the DS1 lamp lights (data set is transmitting and receiving a space signal). Turn RS **off** by moving the S2 switch to OFF. Verify that the DS1 lamp extinguishes when the RS circuit is **off**.

(33) Steps (34) to (37) below check that the **off** condition on carrier detector will clamp the received data to mark-hold.

(34) On the 914-type DTS, move switch S1 to OFF and move the matrix pin from TP2-5 to TP2-3.

(35) Zero the counter by pressing the RESET button. Move switch S1 to ON.

**Requirement:** DS1 lamp remains extinguished.

(36) Move switch S1 to ON. The DS1 and DS4 lamps will illuminate and the counter will indicate the carrier detector clamp interval.

**Requirement:** 40 ( $\pm$ 10.0) ms.

(37) If the requirement of (36) is not met, replace AR591 CP and retest. If the requirement is still not met, replace AR592 CP.

(38) On the 914-type DTS, move the pin from matrix position TP2-3 to TP2-8. Leave the pin in TP1-4.

(39) Move the S2 switch to OFF and zero the counter on the 914-type DTS by pressing the RESET button.

(40) Move the S2 switch to ON and measure the time it takes for the carrier detector to come on.

**Requirement:** 40 ( $\pm 10.0$ ) ms.

(41) Turn the S2 switch to OFF. Remove AR591 CP and close option switch S1. Insert the CP into the data set.

(42) Zero the counter on the 914-type DTS by pressing the RESET button. Move switch S2 to ON and measure the time it takes for the carrier detector to come on.

**Requirement:** 20 ( $\pm 5.0$ ) ms.

(43) On the 914-type DTS, move the TP1 FIRST switch to -/CLOSE. Zero the counter and move the S2 switch to OFF.

(44) Measure the time it takes for the carrier detector to indicate loss of carrier.

**Requirement:** 15 ( $\pm 2.5$ ) ms.

(45) If the carrier detector fails to meet the requirements specified in (40), (42), and (44) above, replace AR591 CP.

(46) Disconnect the test equipment and power connections from the data set.

(47) Unless the data set is to be used in a specific installation, remove the AR591 and AR593 CPs. Set the option switches as shown in Table B.

**Note:** These are the same as the factory-installed options.

(48) Install the CPs in the data set and replace the data set cover.

**6. REFERENCES**

**6.01** The following BSPs contain additional information concerning data set 202R:

SECTION	TITLE
590-002-108	Data Set 202R—Reference Guide
591-025-500	Data Set 202R Transmitter-Receiver—Test Procedures
592-025-100	Data Set 202R Transmitter-Receiver—Description and Operation
592-025-180	Data Set 202R Transmitter-Receiver—Summarizing Specification

**TABLE B  
FACTORY-INSTALLED OPTIONS**

CIRCUIT PACK	CLOSE SWITCH	OPEN SWITCH	OPTION
AR591	—	S1	M
	S2	—	S
	—	S3	Q
	—	S4A	G
	—	S4B	
—	S5	—	K
AR593	Slide Switch to "4-Wire" position.		4-Wire
	S3B	S3A	X

**SECTION 592-025-150**

<b>SECTION</b>	<b>TITLE</b>	<b>6.02</b>
592-025-200	Data Set 202R Transmitter-Receiver—Installation and Connections	The following documents contain additional information concerning data set 202R: (a) SD- and CD-1D224-01 (b) Technical Reference, Data Set 202R (c) Manufacturing Testing Requirements, X-17814.
592-025-300	Data Set 202R Transmitter-Receiver—Maintenance.	