DATA SET 202R
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the description and operation of data set 202R. Other than a description of interface signals and customer options, information pertaining to the associated business machines is not given.

1.02 This section is reissued for the following reasons:

(a) To include information pertaining to remote testing capabilities of data set 202R

(b) To update Fig. 4

(c) To add illustration (Fig. 6) showing location of switches S4 and S5 on AR593 circuit pack (CP)

(d) To delete detailed information on interface leads, since this information is now contained in Section 592-025-150.

(e) To delete detailed option information, since this information is now contained in Sections 592-025-150 and 592-025-200.

1.03 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.

1.04 With the addition of a telephone set, data set 202R is suitable for switched network service at speeds up to 1200 bps. However, manual operation must be used, ie, manual answer of incoming ringing, no automatic calling unit compatibility, and manual termination of a call.

1.05 Data set 202R is compatible for use with data sets 202D and 202T over 2- and 4-wire private lines. When used on the switched network, data set 202R is compatible for use with data sets 202C, 202D, 202S, or 202R (equipped with alternate voice capability). However, manual call origination and answering must be used. In addition, the receive portion of 202R can be used in receiver-only configuration with a 202E as the distant transmitter.

Note: Data set 202R does not provide a reverse-channel feature as do certain models of 202C, 202D, 202E, 202S, and 202T.

2. PHYSICAL DESCRIPTION

2.01 Data set 202R, List 1 (Fig. 1), consists of a transmitter, a receiver, and control circuits

mounted on three plug-in type circuit boards located in an apparatus mounting. A terminal board with screw connections is attached to the rear of the mounting for connecting the telephone lines and low voltage ac power source. The overall dimensions of the List 1 data set are approximately 9 inches long, 6 inches wide, and 4 inches high. The weight is approximately 6 pounds.

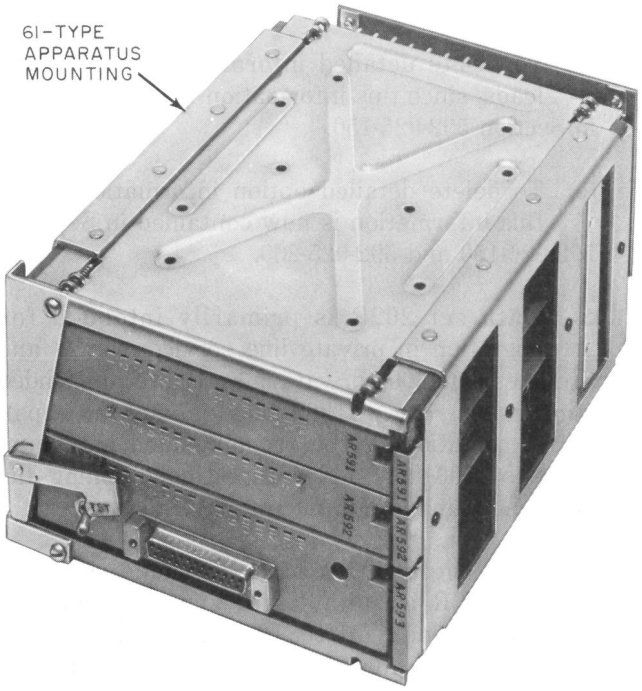

Fig. 1—Data Set 202R-L1

2.02 List 2 consists of a 2-tone gray plastic housing with a bracket to hold the equipment provided as List 1. A line cord and power transformer are also provided as part of List 2. Figure 2 shows the equipment mounted with the top removed. Figure 3 shows the data set with the cover in place. 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. Included with the data set 202R-L1/2 code is a KS-20426-L1 transformer which must be plugged into the ac power outlet. A KS-16886-L2 transformer may be substituted.

2.03 Data set 202R will operate in a temperature of +40 to +120°F and a relative humidity of 20 to 95 percent.

2.04 When 202R is to be mounted in multiple arrangements, it may be more convenient to rack-mount the List 1 data set than to cabinet-mount the L1/2 data set. The 107A brackets attach to the sides of the 61-type mounting (card nest) to permit the List 1 data set to be mounted on 19-, 23-, or 25-inch racks.

2.05 All interface leads for data set 202R are terminated in a 25-pin connector mounted on AR593 CP. This connector is designated KS-19087. The customer's data equipment must be equipped with a cable terminated in a Cinch or Cannon DB-19604-432 plug with a Cinch DB-51226-1 hood assembly (or equivalent).

2.06 Low voltage ac power to the data set is supplied by a KS-16886-L2 or a KS-20426-L1 transformer (when available). The KS-20426-L1 transformer plugs into a standard 115-Vac outlet and is clamped into the outlet. The KS-16886-L2 transformer mounts apart from the ac outlet and is equipped with a cord for connection to the outlet. Both transformers provide 24 Vac to the data set power rectifier. The KS-20426-L1 transformer provides a frame ground to the data set by means of a ground wire in the power cord. The KS-16886-L2 transformer does not provide the ground path; this frame ground must be provided separately.

2.07 Options are added and removed by means of screw switches shown in Fig. 4. The 2- or 4-wire option is controlled by a slide switch shown also in Fig. 4. Detailed information on adding and removing options is contained in Section 592-025-200.

3. FUNCTIONAL DESCRIPTION

3.01 This part contains a brief functional description of the transmitter, receiver, and control circuits. The interface leads are also described here and a brief description of data set options is provided.

3.02 Data set 202R provides for the transmission and reception of digital data. Positive and negative voltages from the business machine are converted to mark and space tones. A negative voltage at the interface is interpreted as a mark and is transmitted as a tone of approximately 1300 Hz. A positive voltage at the interface is interpreted as a space and is transmitted as a tone of approximately 2100 Hz. In the receiver, tones

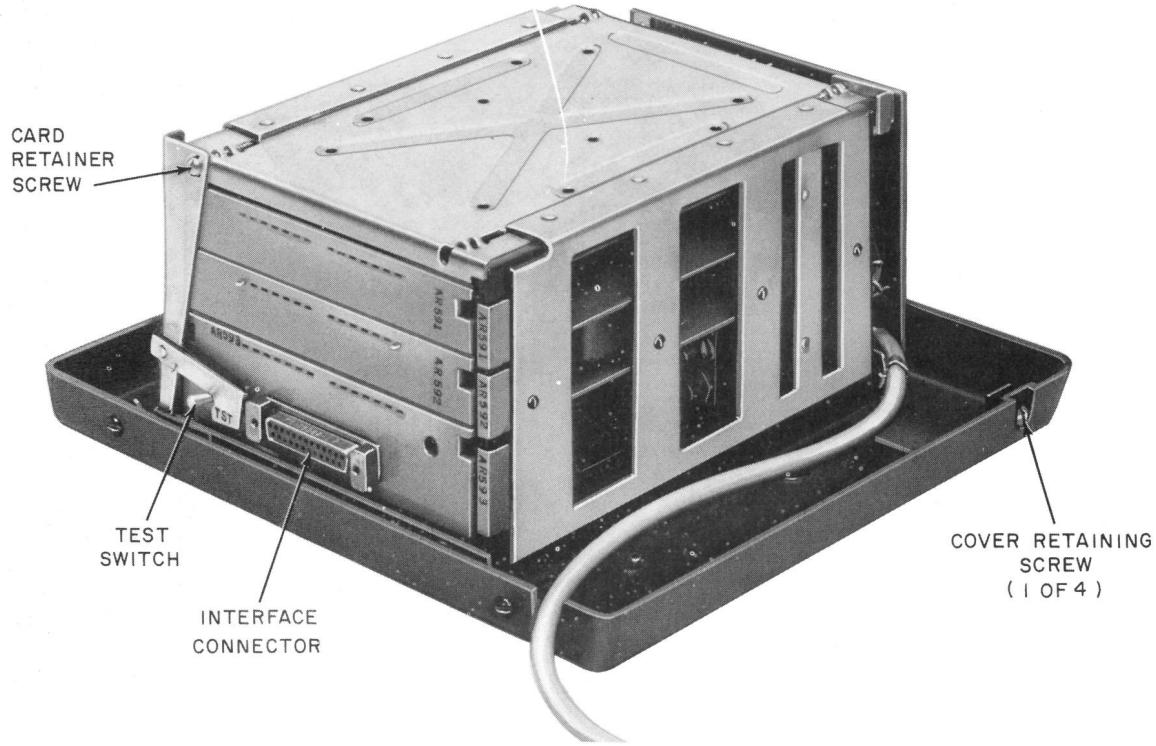

Fig. 2—Data Set 202R-L1/2 Rear View With Cover Removed

Fig. 3—Data Set 202R-L1/2 Front View

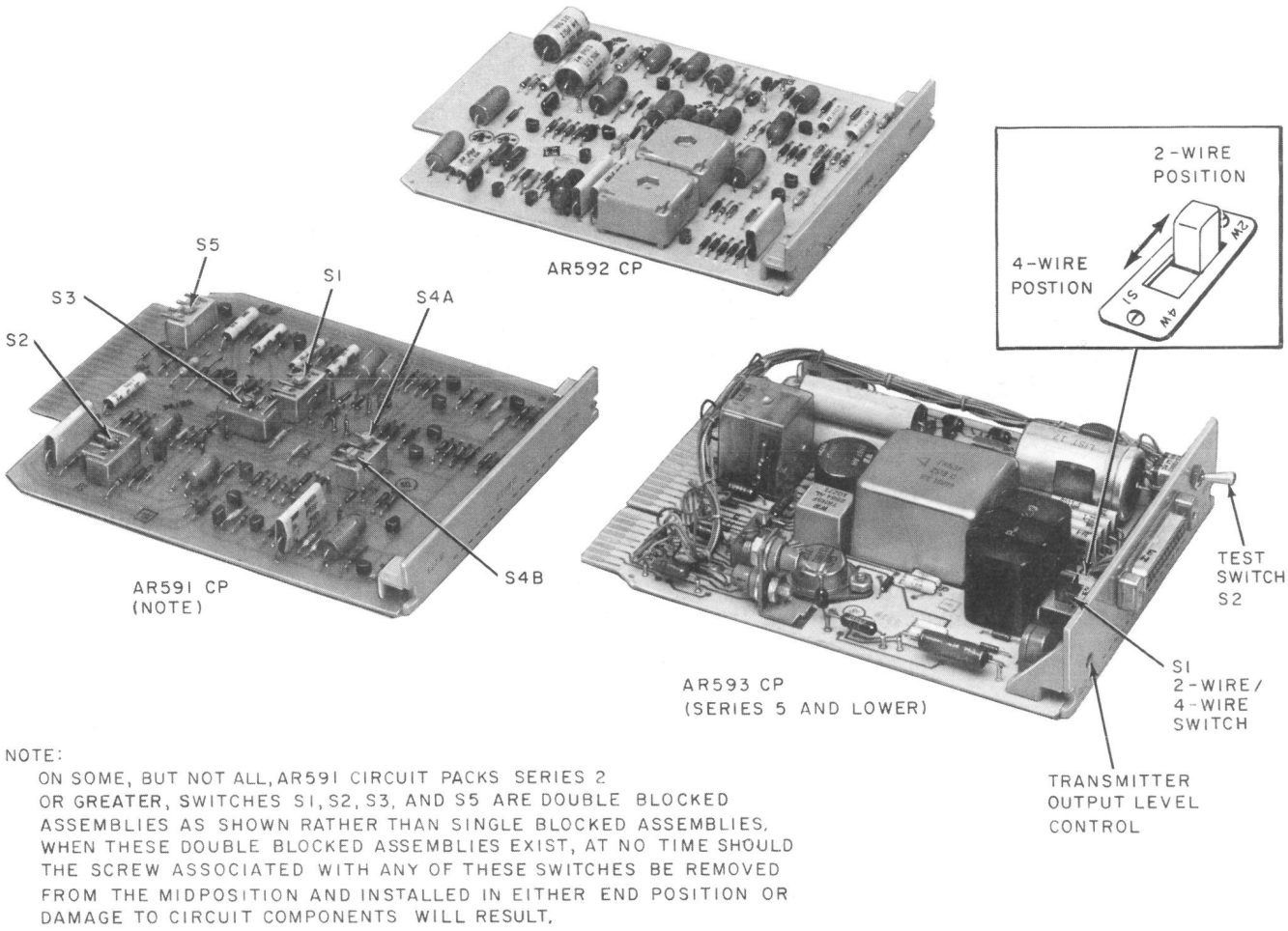

Fig. 4—Data Set 202R Circuit Packs

above 1700 Hz are converted to positive voltages (space), and tones below 1700 Hz are converted to negative voltages (mark).

A. Transmitter

3.03 Refer to Fig. 5 for a block diagram of data set 202R. The digital data from the business machine is in the form of positive and negative voltages. In response to the positive and negative voltages on the transmit data lead, the frequency-shift keyer changes the reactance in the oscillator to produce the mark and space frequencies.

3.04 The output of the modulator is approximately 2100 Hz in response to a positive voltage on the transmit data lead and approximately 1300 Hz in response to a negative voltage. These tones are transformer coupled to the telephone line. The purpose of the oscillator control is to keep the modulator turned off when the request-to-send lead is turned off.

Note: The control functions will be explained in Part E (Interface Leads).

B. Receiver

3.05 Refer to Fig. 5 for a block diagram of the data set receiver. The frequency-shift-keyed (FSK) signal received from the line is first passed through a bandpass filter which passes both the mark and space frequencies but excludes out-of-band noise and distortion. The signal goes through a limiter which converts the input to a corresponding square-wave output. The full-wave rectifier

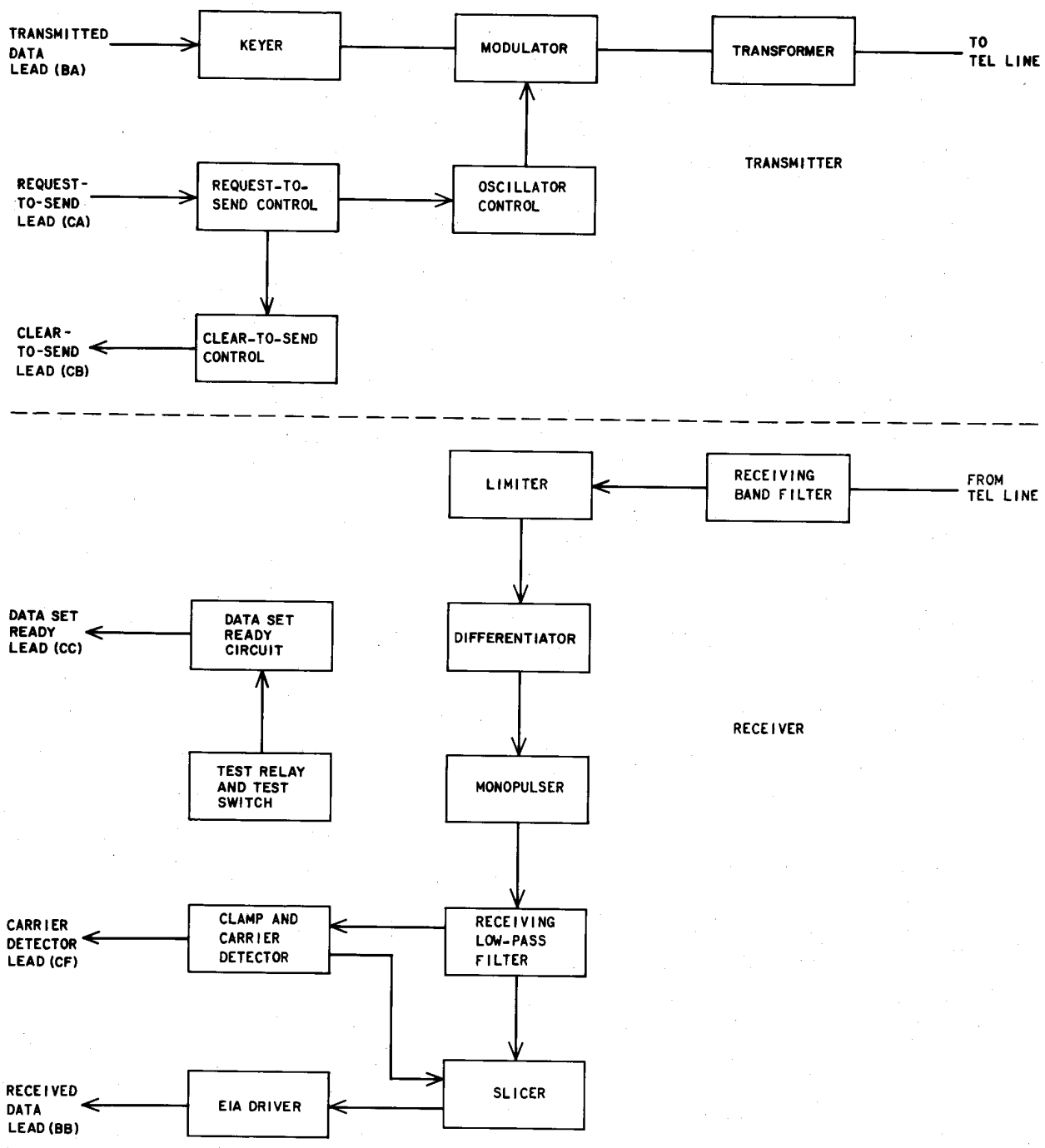

Fig. 5—Data Set 202R Block Diagram

differentiator provides an output pulse for every transition of the square wave. Each pulse from the differentiator triggers the monopulser which in turn puts out a pulse of fixed interval and constant voltage.

3.06 This pulse train enters a low-pass filter which averages the pulses over an interval roughly corresponding to the highest bit rate to be passed (approximately 0.5 ms). The output voltage on this filter is proportional to the input

pulse train density, ie, few pulses during every bit interval result in a low (or marking) voltage output while many pulses during every bit interval result in a high (or spacing) voltage. A slicer circuit with a threshold set at about 1700 Hz "decides" if this filter output voltage is marking or spacing and emits a corresponding rectangular marking or spacing pulse. In this manner, the originating business machine pulse train is recovered and the transmission process is completed. An Electronic Industries Association (EIA) driver circuit driven by this pulse train raises the mark or space indication to a level which will meet EIA specifications.

C. ▶Remote Testing Capabilities With 2-Wire Facility

3.07 Data sets used on 2-wire facilities can be remotely tested by checking the mark and space frequencies, receiver bandwidth, receiver slicing frequency, and receiver sensitivity. Also, a dynamic test can be performed. To check the mark frequency, the data test center (DTC) transmits a tone of about 1300 Hz to the data set. The data set will transmit an interrupted 1300-Hz tone back to the DTC. The mark frequency of the data set can be determined by using either the zero-beat or the period-averaging method. The zero-beat method uses an oscillator at the DTC to beat against an incoming data set frequency. Amplitude nulled (zero) beats can be audibly detected if the line signal is monitored. Thus, by changing the oscillator frequency to detect as few-zero beats as possible, an estimate of the incoming data set frequency can be achieved. The space frequency of 2100 Hz can be measured in a similar manner.

3.08 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.

3.09 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.

3.10 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.

3.11 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.

D. Remote Testing Capabilities With 4-Wire Facility

3.12 Data sets equipped with AR593 CP, series 5 or earlier, used on 4-wire facilities are tested as described in 3.07 through 3.11. 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; however, the DTC can test using the beat-frequency detection method instead of the zero-beat or period-averaging methods. This allows for a faster and more accurate test.

3.13 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. 6. 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.◀

E. Interface Leads

3.14 Data set 202R is provided with eight interface leads for connection to the customer's data equipment. These leads and their corresponding pin numbers are shown in Table A. ▶A detailed description of the interface leads is contained in Section 592-025-150.◀

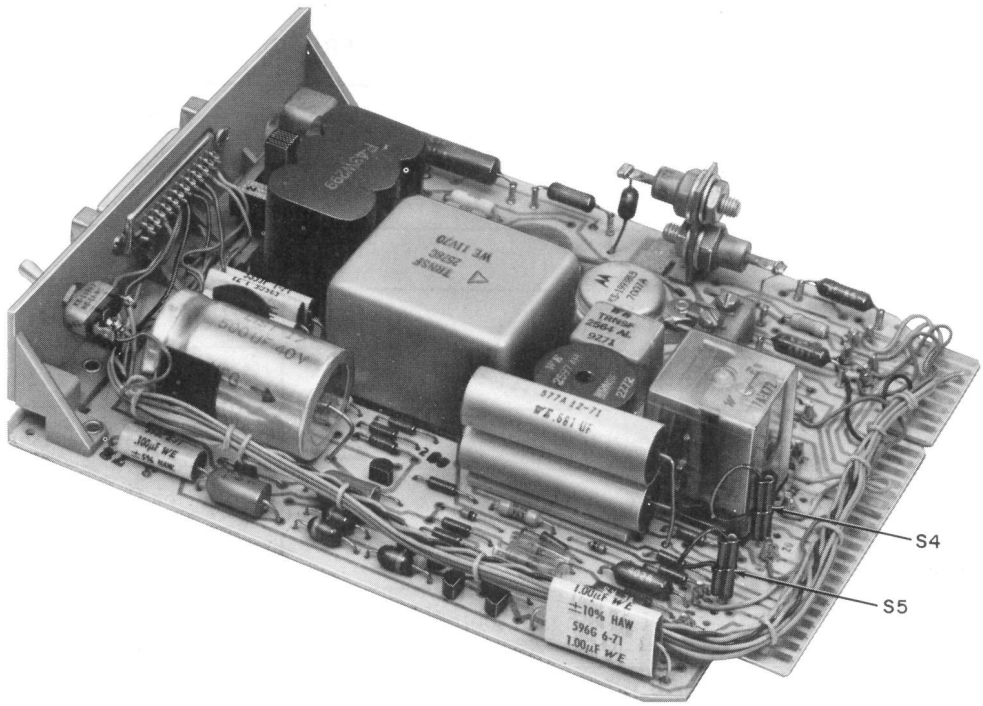

Fig. 6—AR593 Circuit Packs—Location of Switches S4 and S5

F. Options

3.15 Data set 202R is provided with a number of features or options which may be requested by the user. Some of these are customer options and others are telephone company (telco) engineering options. All options are provided by way of screw switches on the AR593 and AR591 cards. A summary of these options is contained in Table B. A detailed description of the options is contained in Sections 592-025-150 and 592-025-200.

4. OPERATION

4.01 This part contains information concerning the manual operation of data set 202R. The data set alone has only two modes of operation: data mode and test mode. A telephone set with exclusion key provides a talk mode for Dataphone® service.

4.02 In private line applications, when the data set is not in the test mode it is in the data mode. A test switch is provided at the back of the data set to permit the telco to evaluate the condition of the data set from a DTC.

4.03 Proceed as follows for conducting a loop-back test.

(a) When the user suspects that the data set is operating in a faulty manner, it will be necessary to call the repair service.

(b) The data station will be contacted by the DTC and will be told when to enter the test mode.

(c) To enter the test mode, raise the metal flag labeled TST (at the rear of the data set). This will expose the red dot. Move the toggle switch toward the red dot.

(d) Upon completion of the test, the data station will be notified of the test results.

(e) Move the toggle switch to the left and the metal flag will reposition itself.

The purpose of the metal flag is to prevent the toggle switch from accidentally being moved to the test position. When not in the test mode,

TABLE A

DATA SET 202R INTERFACE

PIN NO.	EIA RS-232-C NOMENCLATURE	DATA SET 202R LEAD DESIGNATION
1	Protective Ground (AA)	Frame Ground (FG)
2	Transmitted Data (BA)	Send Data (SD)
3	Received Data (BB)	Receive Data (RD)
4	Request-to-Send (CA)	Request-to-Send (RTS)
5	Clear-to-Send (CB)	Clear-to-Send (CTS)
6	Data Set Ready (CC)	Data Set Ready (DSR)
7	Signal Ground (AB)	Signal Ground (SG)
8	Received Line Signal Detector (CF)	Data Carrier Detector (CD)
9	(Reserved for Data Set Testing)	+P
10	(Reserved for Data Set Testing)	−P
11-25		Not used

the test switch must be in the left (data) position or the data set will not go to the data mode.

4.04 If the data set is to be used on Dataphone service, it must be used with a telephone set equipped with an exclusion key. Calls must be originated, answered, and terminated manually. To enter the data mode, the data station attendant must raise the exclusion key and leave the handset off the switchhook during data transmission.

5. REFERENCES

5.01 The following BSPs contain information pertaining to data set 202R:

SECTION	TITLE
502-501-102	502-, 510-, 511-, 515-, 555-, and 558-Type Telephone Sets
502-503-102	2502-, 2510-, 2511-, 2515-, 2555-, and 2558-Type Telephone Sets
590-002-108	Data Set 202R—Reference Guide
592-025-150	Data Set 202R Transmitter-Receiver—Theory of Operation and Supplementary Information
592-025-180	Data Set 202R Transmitter-Receiver—Summarizing Specification—Data Systems Station
592-025-200	Data Set 202R Transmitter-Receiver—Installation and Connections

→ TABLE B ←

DATA SET 202R OPTIONS

REQUIRES	OPTION DESIG.	DESCRIPTION OF OPTION		CLOSE SWITCH	OPEN SWITCH	CIRCUIT PACK
One per station	Z	2-wire	Jumpers S4 and S5 and slide switch S1 (See *Note*)	S1 to "2-wire" S4, S5 *Note*	—	AR593
	Y	4-wire		S1 to "4-wire"	S4, S5 *Note*	
One per station	X	Data set carrier under control of customer request-to-send lead		S3B	S3A	
	W	Continuous carrier (4-wire point-to-point or 2-wire transmit-only service)		S3A	S3B	
	V	No carrier (receive-only service)		—	S3A, S3B	
	T	Fast carrier turn-off		—	S2	AR591
	S	Soft carrier turn-off		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	

Note: AR593 CPs, series 6 and later, contain jumpers which are used as switches S4 and S5. The "open switch" condition is obtained by plugging one end of the jumper into the other end of the same jumper. The "closed switch" condition is obtained by plugging the jumper into two adjacent posts on the circuit board. The "open switch" condition allows digital loop-back test. To perform the "beeper" 4-wire loop-back test, close switches S4 and S5. All data sets with AR593, series 6 and later, are factory furnished in the "open switch" condition.

SECTION	TITLE	SECTION	TITLE
592-025-300	Data Set 202R Transmitter-Receiver—Maintenance	668-102-517	Data Test Center 904A- and 904C-Types Test Procedure—Data Set 202R—Loop-Back Test.
592-025-500	Data Set 202R Transmitter-Receiver—Test Procedures		

5.02 Detailed information concerning data set 202R is also contained in CD- and SD-1D224-01.