

**DATA SET 202S**  
**TRANSMITTER-RECEIVER**  
**SUPPLEMENTARY INFORMATION**

	PAGE		PAGE
1. GENERAL . . . . .	2	C. Telephone Interface . . . . .	15
2. CODES . . . . .	2	FUNCTIONAL OPERATION . . . . .	16
3. EQUIPMENT CHARACTERISTICS . . . . .	2	A. Transmitter . . . . .	16
PHYSICAL . . . . .	2	B. Receiver . . . . .	16
A. Data Sets 202S-L1 and -L1A . . . . .	2	C. Reverse Channel . . . . .	17
B. Data Sets 202S-L1/2 and -L1A/2 . . . . .	3	D. Line Control . . . . .	18
C. Data Sets 202S-L1/3, -L1A/3A, and -L1/3A . . . . .	4	OPERATION WITH CUSTOMER-PROVIDED EQUIPMENT . . . . .	18
D. Data Sets 202S-L1/2/3, -L1A/2/3A, and -L1/2/3A . . . . .	6	A. Call Setup . . . . .	18
POWER . . . . .	6	B. Call Termination . . . . .	20
ENVIRONMENT . . . . .	7	5. CAPABILITIES . . . . .	20
OPTIONS . . . . .	7	APPLICATIONS . . . . .	20
A. Timing Options . . . . .	9	SERVICE VARIATIONS . . . . .	20
B. Service Features . . . . .	11	PERFORMANCE . . . . .	21
C. Other Operational Options . . . . .	11	6. MAINTENANCE . . . . .	21
4. DESCRIPTION . . . . .	12	TEST BUTTONS . . . . .	21
INTERFACE . . . . .	12	A. Local Self Test . . . . .	21
A. Signal/Circuit Characteristics . . . . .	12	B. Analog Loop-Back Test . . . . .	21
B. Customer Interface . . . . .	12	C. Remote Test . . . . .	23
		TROUBLESHOOTING . . . . .	25

**NOTICE**

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CONTENTS	PAGE
<b>7. REFERENCES</b> . . . . .	<b>27</b>

## 1. GENERAL

**1.01** This section provides detailed information on 202S data service which may be necessary for application and maintenance beyond that covered in the standard 592-028- series. The standard practices provide information to the extent of what is normally expected. This practice gives greater detail on characteristics and functions so the reader can gain the comprehensive knowledge required for decisions about out-of-the-ordinary situations which may arise in providing 202S data service.

**1.02** Whenever this section is reissued, the reason for reissue will be given in this paragraph.

**1.03** Data set (DS) 202S is designed for use on 2-wire switched network circuits. It is a nonsynchronous, binary, frequency-shift-keying transceiver intended for half-duplex operation at up to 1200 bits per second (bps) on the direct distance dialing (DDD) network. An optional reverse channel allows a simultaneous signal at speeds up to 5 bps in the opposite direction from the primary channel signal. The set is capable of manual or automatic answer and is compatible with 801-type automatic calling units (ACUs). It has provisions for both local and remote testing. The local tests consist of a self test and an analog loop-back test. The remote test allows a data test center (DTC) to access and test the data set. Figure 1 shows the data set with a 2565HK key telephone set. The telephone is required if manual calling and/or answer is needed.

## 2. CODES

**2.01** The list code designations for ordering DS 202S-type are as follows:

**DS 202S-L1A:** A printed circuit pack (CP) assembly, shown in Fig. 2, which may be installed in either a single set housing (47A1 data mounting) or a multiple set data mounting (coded 40A1).

**DS 202S-L1A/2:** The data set CP in an extruded aluminum housing with front and rear covers, interface assembly (Fig. 3),

power cord and transformer, and M13F telephone interface cord. The equipment code for the added hardware is the 47A1 data mounting.

**DS 202S-L1A/2/3A:** The data set CP with the single set housing with the reverse channel JY2 CP.

**DS202S-L1A/3A:** The basic data set CP with reverse channel JY2 CP for installation in one of the two data mountings.

**2.02** DS 202S-L1 and the JY1 CP (specified with /3) are manufacture discontinued (MD). For field conversion of 202S service, the JY2 CP can be used on DS 202S-L1. The MD JY1 CP will not operate properly with DS 202S-L1A.

**2.03** The discontinued -L1 and JY1 CPs are replaced with -L1A and JY2, which provide the following additional features:

- Independent operation of reverse channel—ability to receive a signal on the reverse channel regardless of the state of the request-to-send circuit
- A ring memory circuit to make DS 202S fully compatible with DS 202C
- An option to control the state of the data-set-ready interface lead during the analog loop-back test
- The use of the telephone set for voice communication without interfering with the data set when in the analog loop-back test
- Testing of reverse channel in analog loop-back mode.

## 3. EQUIPMENT CHARACTERISTICS

**3.01** The physical, power, environmental, and option characteristics of DS 202S are covered in this part.

### PHYSICAL

#### A. Data Sets 202S-L1 and -L1A

**3.02** The basic data set code is a circuit pack assembly measuring 1.5 inches high, 5.6



Fig. 1—Data Set 202S With 2565HK Telephone Set

inches wide, 10.4 inches long, and weighing 1.5 pounds (Fig. 2). Three switches are provided on the front faceplate to select the analog loop-back mode (AL), local self test mode (LT), or remote test mode (RT). The faceplate also contains seven indicators (light emitting diodes) to indicate the status of various interface leads and operating modes of the data set (Table A). All interconnections to the CP are made via a connector at the rear of the board.

**3.03** The two miniature rocker switch assemblies S2 and S3 allow the telco employee to select options and set transmit signal levels. Switch S3 is closest to the faceplate and is used to set the transmit signal level and the reverse channel option. Switch S2 is closer to the rear of the board and is used to set the remaining options.

#### B. Data Sets 202S-L1/2 and -L1A/2

**3.04** Data set codes 202S-L1/2 and -L1A/2 specify the basic CP assembly installed in the 47A1 data mounting. The data set measures 2.2 inches high, 5.8 inches wide, 10.8 inches long, and weighs 2.3 pounds (3.2 with KS-21239 transformer).

**3.05** The mounting consists of an aluminum extruded shell with card guides for the data set assembly, an interface assembly with connectors and power cord (Fig. 3), a KS-21239-L4 transformer (-L1 is MD) and M13F line cord. The top surface of the aluminum housing is depressed to allow for nesting of several housings, or for nesting of the associated telephone as shown in Fig. 1. Front and rear covers are of molded plastic with reverse sides painted black. They are retained in the housing by integral molded hooks. Covers are removed by depressing the top to disengage the top hooks and rotating the cover downward. A tab is provided at the bottom to prevent lateral movement of the cover relative to the extruded housing. The covers are installed by engaging the bottom hooks in their dents, taking care to ensure that the lateral alignment tab is engaged in its slot, and rotating the cover closed. The front cover displays the appearance of the 2-letter abbreviation when one or more of the seven status indicators are *on*, and a continuous black opaque surface when the indicators are *off*.

**3.06** The data set CP may be secured to the housing by a retaining screw under the left

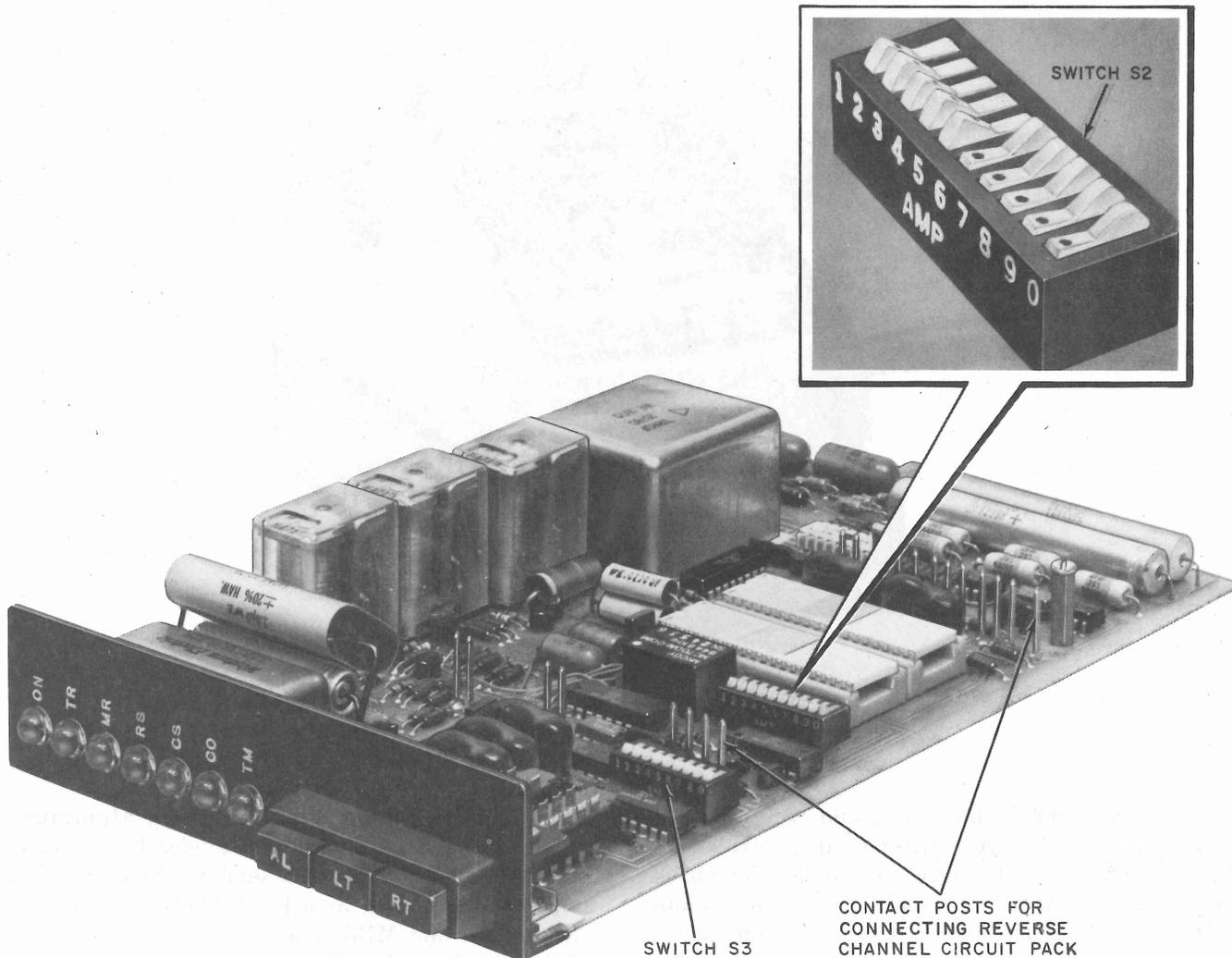


Fig. 2—Data Set 202S-L1 (L1A is Similar)

front side. This screw has been deleted from late production of -L1 sets and all -L1A sets. When installing the data set CP in the housing, ensure that the contacts at the rear of the CP are firmly seated in the connector at the rear of the housing. Later production models of the data set have a wire handle over the test buttons. When rotated outward, this handle can be used to remove the CP from the housing.

**3.07** All interconnections to the data set are via two interface connectors at the rear (Fig. 4). The customer interface connector is the standard 25-pin KS-19087-L6 that is designed to mate with the customer-supplied Cinch or Cannon DB19604-432 plug equipped with a DB51226-1 hood, or its

equivalent KS-19088-L2 plug with a KS-19196-L2 hood, also available from Cinch. The telephone interface plug is a KS-19088-L22 which connects to the telephone set via the M13F cord. The telephone set is required if manual calling and/or answer is needed.

### C. Data Sets 202S-L1/3, -L1A/3A, and -L1/3A

**3.08** The reverse channel CP adds a /3 or /3A to the data set list code (Fig. 5). The board assembly measures 1 inch high, 3.4 inches wide, and 7.5 inches long. It includes filters, switching circuits, and demodulator circuits needed to perform the reverse channel function. Interconnection between the data set and reverse channel is

SCREW SWITCH FOR GROUNDING OPTION  
 ZG=SI CLOSED, AA CONNECTED TO AB  
 ZH=SI OPEN, AA NOT CONNECTED TO AB

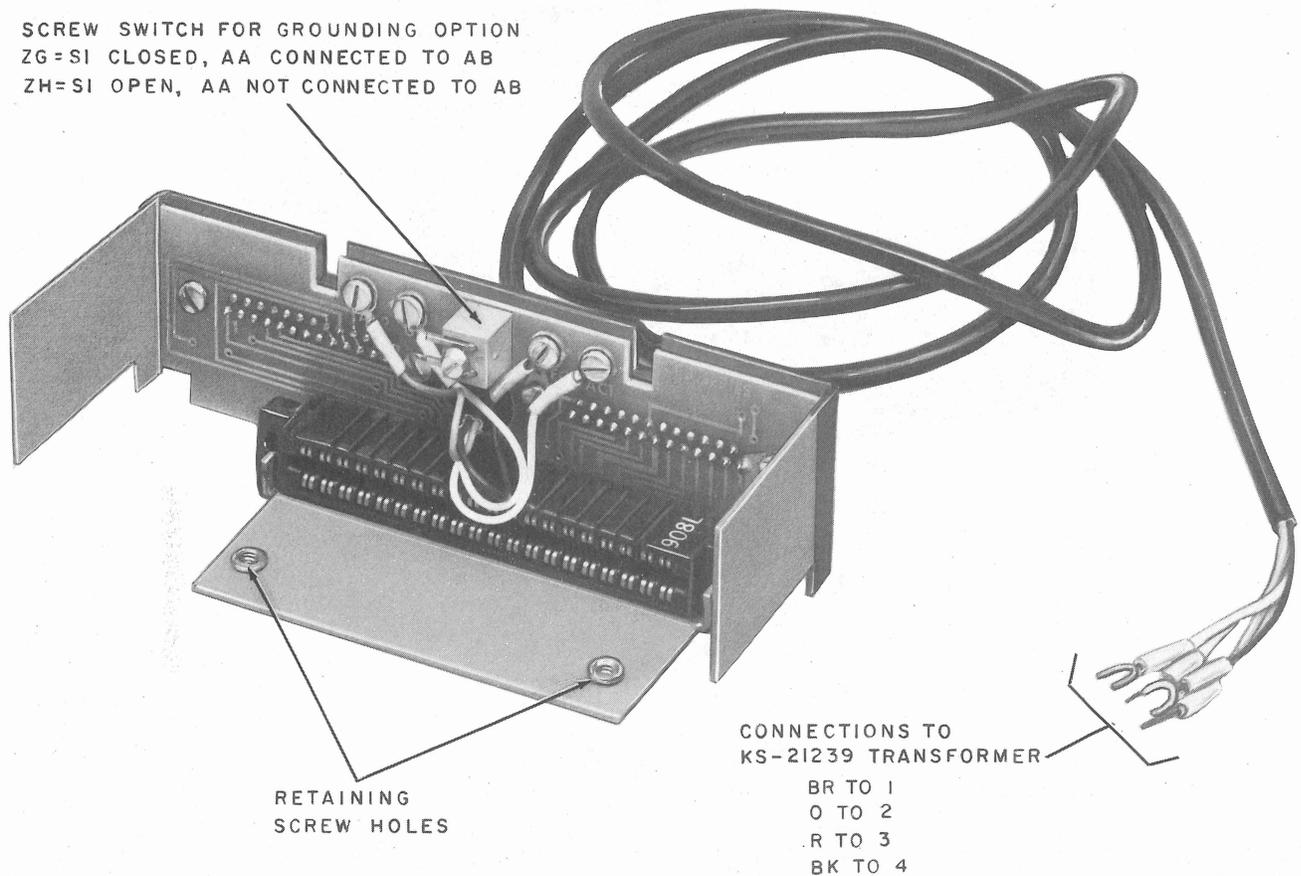


Fig. 3—Interface Assembly of 47A1 Data Mounting

TABLE A  
 STATUS INDICATORS

INDICATOR	DESCRIPTION
ON	This indicator is lighted when power is applied to the data set.
TR (Terminal Ready)	This indicator is lighted when the data-terminal-ready lead is <i>on</i> .
MR (Modem Ready)	This indicator is lighted when the data-set-ready lead is <i>on</i> .
RS (Request-to-Send)	This indicator is lighted when the request-to-send lead is <i>on</i> .
CS (Clear-to-Send)	This indicator is lighted when the clear-to-send lead is <i>on</i> .
CO (Carrier On)	This indicator is lighted when the received line signal detector lead is <i>on</i> .
TM (Test Mode)	This indicator is lighted when any of the three test switches are depressed. It goes off if an error is detected in the local self test mode.

*Note:* All indicators are lighted when the RT or LT keys are depressed.

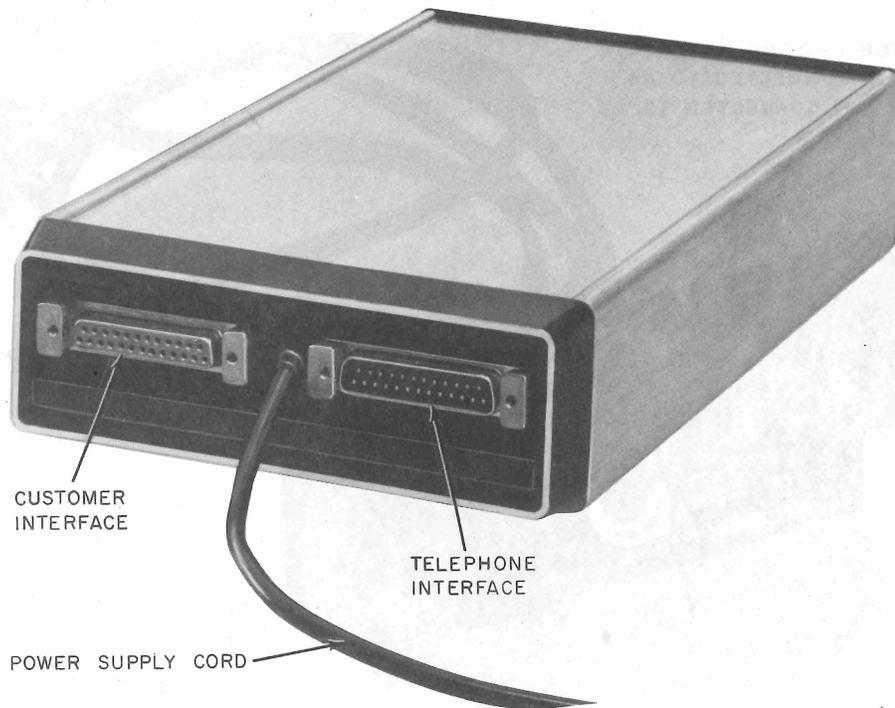


Fig. 4—Data Set 202S—Rear View

accomplished by 20 post and receptacle pairs. Four screws provide positive attachment of the CP to the data set. The screws are stored in threaded eyelets on the front edge of the CP.

**3.09** When installed, the reverse channel CP makes option switches S2 and S3 inaccessible; therefore, it must be removed to set the transmit level and customer options. The reverse channel local copy option is selected by proper positioning of the jumper plug on the reverse channel CP as shown in Fig. 5. If option D is installed (reverse channel OUT), the reverse channel CP must be removed.

**D. Data Sets 202S-L1/2/3, -L1A/2/3A, and -L1/2/3A**

**3.10** These list codes are the basic data set equipped with reverse channel and enclosed in the housing.

**POWER**

**3.11** The individually housed data set is powered by low voltage alternating current supplied by a KS-21239-L1 (MD) or -L4 transformer. The -L4 transformer has a higher volt-amp and ambient

temperature rating. The self-protecting transformer plugs directly into a commercial source of nonswitched power, 105 to 129 Vac at  $60 \pm 3$  Hz. A 3-wire U-blade ground pin receptacle is required. The transformer is equipped with a tab which should be secured to the outlet (when allowed by local electrical codes) to prevent inadvertent removal of power from the data set. Twenty-four Vac, center-tapped, and frame ground are brought out on four screw terminals to which the data set power cord is attached. The remainder of the power supply is integrated with the data set circuit board assembly. The power required per set is approximately 8 watts. About 1.7 watts of this is dissipated in the wall transformer. For air conditioning loading considerations, each data set dissipates about 27 BTU/hr.

**3.12** In the event of a short circuit condition occurring on the secondary, a thermal cutout in the primary opens within 7 minutes (ON indicator of data set goes off). The thermostat should reset in about 50 minutes and remain so if the secondary fault condition has been cleared.

**3.13** If commercial ac power is not available, dc voltage of  $\pm 15 \pm 1.5$  volts may be connected

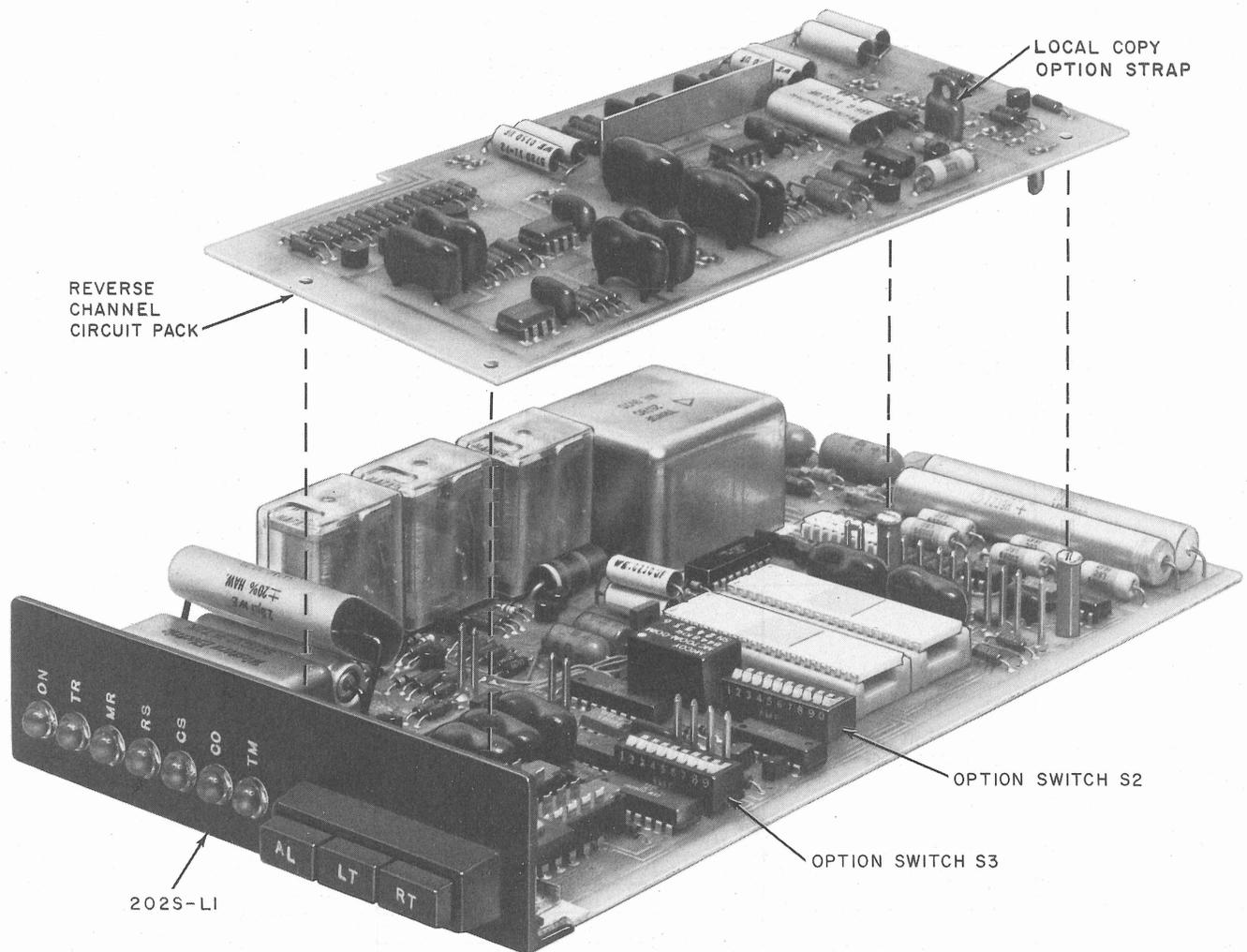


Fig. 5—Data Set 202S-L1/3 (L1A/3A is Similar)

to AC1, AC2, and GND inputs of the 47A1 data mounting in place of the power cord. Screw terminal AC1 is positive and AC2 is negative. The maximum current drain is 260 mA from the positive supply and 210 mA from the negative supply.

#### ENVIRONMENT

**3.14** DS 202S operates in an ambient temperature between 40 and 120°F. Under no condition shall condensation be allowed to form on the circuit packs.

#### OPTIONS

**3.15** DS 202S is provided with optional features which must be specified by the customer when data service is ordered. Table B provides a

summary of these options. Several of the options listed depend on a different option in the distant data set(s). For example, the clear-to-send interval in the local data set depends on the fast carrier detection (carrier acquisition and receive line signal detector acquisition) time in the distant set. Therefore, care must be taken in choosing the option to be compatible with the distant data set.

**3.16** Many of the options available on DS 202S but not recommended for switched network service, particularly timing options, are present due to the utilization of circuitry designed for and used in private line service.

**3.17** The recommended options given in Table C are engineered to maximize protection against interfering phenomena. Other option

TABLE B

## OPTIONS

FEATURE	OPTION	DESCRIPTION		PROVIDE
		Without Reverse Channel	With Reverse Channel	
Transmit Line Signal Level	ZK	0	-1	One Per Set
	ZL	-1	-2	
	ZM	-2	-3	
	ZN	-3	-4	
	ZO	-4	-5	
	ZP	-5	-6	
	ZQ*	-6	-7	
	ZR	-7	-8	
	ZS	-8	-9	
	ZT	-9	-10	
	ZU	-10	-11	
	ZV	-11	-12	
	ZW	-12	-13	
Reverse Channel §	ZC†	In		One Per Set
	ZD*	Out (Remove CP)		
Soft Turnoff and Squelch Intervals		Soft Turnoff	Squelch	One Per Set
	Z	0	0	
	Y	8 ms	0	
	X	24 ms	0	
	W	0	9 ms	
	V	0	156 ms	
	T	8 ms	9 ms	
	S	8 ms	156 ms	
R*	24 ms	156 ms		
Fast Carrier Detection ‡	Q	In (7 ms)		One Per Set
	N*	Out (23 ms)		
Clear-to-Send Interval	M	7 ms		One Per Set
	K	30 ms		
	J	60 ms		
	G*	180 ms		
Automatic Answer	B*	In		One Per Set
	A	Out		
Transmit Only (202S-L1A Only)	YG	In		One Per Set
	YH*	Out		
Local Copy on Primary Channel	ZA	In		One Per Set
	ZB*	Out		
Clamp (202S-L1 Only)	F*	In		Must Be Provided
Condition of CC (DSR) During Analog Loop-Back (202S-L1A Only)	YI	On		One Per Set
	YJ*	Off		
Local Copy on Reverse Channel	ZE	In		One per JY1 or JY2 CP §
	ZF*	Out		
Grounding Option	ZG*	Signal Ground Connected to Frame Ground		One Per 47A1 Data Mounting
	ZH	Signal Ground Not Connected to Frame Ground		

\* Factory furnished

† Factory furnished instead of option ZD when reverse channel is installed.

‡ Same as carrier acquisition timing in earlier model DS 202-types

§ DS 202S-L1A operates with JY2 only.

combinations are possible which may optimize the start-up time and turnaround time for a particular system, taking into account the calling pattern and terminal insensitivity to various kinds of interfering phenomena (noise hits, echoes, etc). When the recommended options are not used and customer-engineered options are installed, the customer is responsible for the system startup periods. Telco is responsible for the steady state performance of the system after the startup period.

**3.18** The option label affixed to the bottom of the list 2 housing should note the options installed. If the label is absent or is desired on the side (as in the case of a wall mounted set), it can be ordered by specifying E-6573.

**3.19** The transmit line signal level is a telco option determined by measuring the loss of the local loop using the procedure detailed in the Installation and Connection Section. The balance of the features itemized in Table B can be considered optional customer features and services and are described below.

#### A. Timing Options

##### 3.20 *Squelch Interval* (Receiver Squelch or Received Data Squelch):

(a) When a station that has been transmitting in half-duplex operation on 2-wire facilities turns its request-to-send circuit **off**, the telephone line may reflect signals (echoes) back to the transmitting station for a period of up to the round-trip delay of the circuit (maximum round-trip delay within continental United States is less than 100 ms). The squelch option prevents the demodulator (receiver) of the transmitting station from delivering these reflections as data to the received data circuit.

(b) DS 202S provides for either 156-ms, 9-ms, or no squelch options. The 156-ms option is recommended for switched network service. The 9-ms option may be used in customer-engineered applications less than 50 miles in transmission length. On these facilities the duration of echoes should be less than 9 ms. On facilities of greater distance, the 9-ms option should be used only if the data terminal is able to ignore echoes, (eg,

TABLE C

RECOMMENDED CUSTOMER OPTIONS

OPTION	202S	202C, 202D*, OR 202R
Squelch Interval	156 ms	In
Clear-to-Send Interval	180 ms	200 ms
Fast Carrier Detection	Out (normal)	40 ms
Soft Turnoff Interval	24 ms	In
Clamp	In	In
Reverse Channel	Optional	Optional†
Automatic Calling Unit	Optional	Optional†
Automatic Answer	Optional	Optional†
Local Copy	Optional	Always Provided

\* 202D used with 804A.

† Not available with DS 202R.

by using a start-of-message code). The no squelch option may be used on customer-engineered applications if the customer-provided equipment (CPE) is able to ignore echoes.

(c) If the CPE is unable to ignore echoes, it is impractical to attempt to optimize the turnaround time by using the 9-ms or no squelch option in conjunction with the 60-, 30-, or 8-ms clear-to-send delay options, because the propagation time, and therefore, echo delay is widely variable. Propagation time may vary significantly for two calls between the same points because of the alternate routing capability and the mix of facilities in the DDD network. It is impractical to optimize the turnaround time for switched network service, even if the data terminal can ignore echoes, because echo suppressors may be employed in the connection. The turnaround time of an echo suppressor may be as long as 100 ms. The customer can optimize the turnaround time of his system by using the 9-ms or no squelch option in conjunction with the 60-, 30-, or 8-ms clear-to-send delay only if his terminal can ignore echoes, has provisions to keep echo suppressors disabled (eg, using the reverse channel of the data set), and the data sets have compatible options.

### 3.21 *Clear-to-Send Interval* (Clear-to-Send Delay):

The **on** condition of the clear-to-send circuit from the data set is a response to an **on** condition on the request-to-send circuit delayed by a time interval which permits the data set to establish operations with the distant data set. Intervals of 180, 60, 30, and 8 ms are provided. The interval chosen must be compatible with the distant data set squelch interval, fast carrier detection timing, and soft turn-off option.

(a) **180 ms.** This option is recommended for switched network service and required when the distant data set has the 156 ms squelch option installed. The 180-ms delay ensures that the echo suppressors are turned around before data is transmitted.

(b) **60, 30, and 8 ms.** These options are for use with private line service requiring fast startup and should not be installed in a DS 202S.

### 3.22 *Fast Carrier Detection* (Fast Carrier Detector Acquisition Timing, Carrier Acquisition

Timing, Receive Line Signal Detector Acquisition Timing, Fast Mode Carrier Detector):

(a) **IN (Fast Mode—7 ms):** With this option, the carrier detector is in the fast mode, and the received line signal detector circuit turns **on** in approximately 7 ms if the carrier frequency is between 1185 and 1325 Hz (mark). It turns **off** in approximately 6 ms for carrier frequencies between 860 and 940 Hz (soft turn-off). If the carrier frequencies are outside of these limits for the fast mode but are within the limits for the normal mode, the normal mode response times apply. This option must be used when the distant data set uses the 8-ms clear-to-send delay.

(b) **OUT (Normal Mode—23 ms):** With this option, the carrier detector is in the normal mode, and the received line signal detector circuit turns **on** in approximately 23 ms if the carrier frequency is between 1075 and 2325 Hz. It turns **off** in approximately 10 ms if the carrier frequency is less than 1050 Hz or greater than 2350 Hz. This option is compatible with the clear-to-send delay options in data sets 202C, 202D, 202E, and 202R, and is recommended when the distant data set has either the 180-, 60-, or 30-ms clear-to-send delay.

### 3.23 *Soft Turn-Off* (Soft Turn-Off Interval, Soft Carrier Turn-Off):

(a) **IN (8 or 24 ms):** When the CPE turns request-to-send **off** at the end of a message, transients occur which may cause spurious spacing signals to be received at a distant station. With the soft turn-off option, the data set transmits a 900-Hz tone for a period of either 8 or 24 ms after the request-to-send circuit is turned **off**. This option should be used in conjunction with the received data clamp option and results in a steady mark on the received data circuit of the distant data set. The 8-ms option should be used when the distant data set is a 202S and has the fast mode carrier detection option. The 24-ms option should be used when the distant data set is a 202C, 202D, 202R, 202S, or 202T with the normal mode carrier detection option. The soft turn-off option influences the clear-to-send delay option needed at the distant data set.

(b) **OUT (Quick Turn-Off):** With this option, the carrier is turned **off** in less than 1 ms

after the request-to-send circuit is turned *off*. The quick turn-off option may be used in customer-engineered applications where the distant data set is insensitive to spurious signals at the end of transmission.

## B. Service Features

**3.24 Automatic Calling:** Call origination may be performed with unattended automatic CPE by using an optional data auxiliary set (DAS) 801-type automatic calling unit (ACU). The 801A ACU used for dial pulse signaling is described in AT&T publication PUB 41601. The 801C ACU used for Touch-Tone® signaling is described in AT&T publication PUB 41602.

**3.25 Automatic Answer:** The automatic answer option allows the CPE to receive calls while unattended, provided the data-terminal-ready circuit is *on*.

**3.26 Transmit Only** (202S-L1A only): This feature is not offered as a customer option at this time.

**3.27 Local Copy on Primary Channel:** With this option IN, the receiver continuously monitors the transmitted line signals while the data set is in the data mode and provides a local copy on the received data circuit. The local copy signal is delayed less than 2 ms by the data set. The IN or OUT status of this option requires opposite switch setting for contact 1 of S2 between models L1 and L1A.

**3.28 Reverse Channel:** An optional up to 5 baud reverse channel is available. This feature may be used to provide a break feature, circuit assurance, or a feedback signal for error detection and retransmission systems. The reverse channel may also be used to hold echo suppressors disabled. The secondary request-to-send circuit and the secondary line received signal detector circuit are used for the transmission and reception of reverse channel data, respectively. The JY2 CP provides this feature (list 3A) for DS 202S-L1/2 or 202S-L1A/2. The JY1 CP (MD) can be used in DS 202S-L1 or -L1/2 *only*. For JY1, the request-to-send circuit must be *on* to permit reception of a signal on the secondary received line signal detector circuit (*dependent* operation). The reverse channel is in the transmit mode when the request-to-send circuit is *off*. For JY2, the customer can receive reverse

channel signals *independently* of the status of the request-to-send circuit. However, the reverse channel transmitter is inhibited when the request-to-send circuit is *on* to prevent simultaneous transmission of data on both channels in the same direction. The receive level sensitivity of JY2 is  $-45 \pm 1.5$  dBm which is 3 dB more sensitive than JY1. This increase provides more margin for transmission loss at the carrier frequency of 387 Hz. If option ZD is installed (reverse channel OUT), the reverse channel CP must be removed.

**3.29 Local Copy of the Reverse Channel:** With this option IN, the local copy of the reverse channel transmitted signal is provided. The local copy signal is delayed less than 50 ms.

## C. Other Operational Options

**3.30 Clamp** (Received Data Clamp): The clamp circuit clamps to mark the received data circuit when the received line signal detector is *off*. The clamp function must always be IN for DS 202S-L1 (not to be considered an option). DS 202S-L1A has this function permanently wired in.

**3.31 Condition of CC (DSR) During Analog Loop-Back:** This option is available on DS 202S-L1A only. With the ON setting, the data set ready circuit turns *on* during the analog loop-back test mode when the data terminal ready circuit is turned *on*. This permits testing with the customer terminal. With the OFF setting, the data set ready circuit is clamped *off* during the analog loop-back mode as it is with DS 202S-L1.

**3.32 Grounding:** The signal ground circuit on the interface is the common reference potential for all other circuits on the interface. Protective and signal ground are normally cross-connected together by means of a screw switch on the interface circuit, located at the inside rear of the housing (Fig. 3) as provided from the factory. This arrangement is intended to provide additional margin to longitudinal power line noise. The screw switch may, however, be opened at the request of the customer with due consideration given to possible noise conditions, ground potential differences, safety conditions, local electrical codes, and the data terminal manufacturer's recommendations.

4. DESCRIPTION

4.01 This part covers the descriptive operation of interface signals, operation of data set circuitry, and operation with external equipment.

INTERFACE

A. Signal/Circuit Characteristics

4.02 The interface signals follow the recommendations of Electronic Industries Association (EIA) Standard RS-232-C.

*Signal State*

4.03 The transmitted and received data signals are considered in the marking condition when the voltage on the circuit is more negative than -3 volts with respect to signal ground, and in the spacing condition when the voltage on the circuit is more positive than +3 volts with respect to signal ground.

4.04 All control functions are considered *on* when the voltage on the circuit is more positive than +3 volts with respect to signal ground, and are considered *off* when the voltage on the circuit is more negative than -3 volts with respect to signal ground. The request-to-send (CA), data terminal ready (CD), and secondary request-to-send (SCA) control circuits are "fail safe" in that a power-off condition or a disconnection of the interconnecting cable is interpreted as an *off* condition by the data set.

4.05 The data and control circuit interface functions are defined below:

VOLTAGE	Negative	Positive
BINARY STATE	One	Zero
SIGNAL CONDITION	Mark	Space
CONTROL FUNCTION	Off	On

*Impedance of Terminator*

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

*Rise and Fall Time*

4.07 The operation of the circuitry that receives signals from an interchange circuit is dependent only on the signal voltage. The operation of the circuits that transmit signals to an interchange circuit conforms to EIA standard RS-232-C with regard to rise and fall time. For control interchange circuits, the time required for the signal to pass through the transition region (-3 to +3 volts) during a change in state does not exceed 1 ms. For the received data circuit, the rise and fall time does not exceed 15 microseconds through the 6-volt range (-3 to +3volts) in which the signal condition is not defined.

*Open Circuit Voltage*

4.08 The open circuit driver voltage with respect to signal ground on any interchange circuit does not exceed  $\pm 18$  volts. The driver design is such that when the terminating impedance is in the proper range (3000 to 7000 ohms) and the terminator open circuit voltage is 0, the potential at the point of interface is between +5 and +15 volts or -5 and -15 volts. The terminator on an interchange circuit is designed to withstand any input signal within the  $\pm 25$  volt limit.

B. Customer Interface

4.09 The customer interface shown in Table D provides access to circuits for conditioning signals for and from the DDD network. Lead numbers correspond to pin assignments on the 25-pin KS-19087-L6 connector on the rear of the data set. The interface conforms to EIA Standard RS-232-C. No contact interfaces are provided as with DS 202C or 202D. The SCA lead is provided on pin 19 to agree with the assignment in EIA Standard RS-232-C and is also provided on pin 11 to be consistent with the interface provided by DS 202C and 202D. A description of operation of each associated circuit and the signals appearing on them follows.

4.10 The following signals supplied *by* the CPE are received by terminators in the data set.

● *Transmitted Data* (BA)—Pin 2:

- (a) Signals on this lead are generated by the transmitting data terminal and are transferred to the modulator of the data set for transmission

TABLE D  
CUSTOMER INTERFACE

LEAD NO.	FUNCTION	EIA DESIGNATION (RS-232-C)
1	Protective Ground	AA
2	Transmitted Data	BA
3	Received Data	BB
4	Request-to-Send	CA
5	Clear-to-Send	CB
6	Data Set Ready	CC
7	Signal Ground	AB
8	Received Line Signal Detector	CF
9	Positive 14 Volts	—
10	Negative 14 Volts	—
11&19	Secondary Request-to-Send	SCA
12	Secondary Received Line Signal Detector	SCF
20	Data Terminal Ready	CD
22	Ring Indicator	CE

to the remote terminal equipment. A positive signal is a binary "0" or space, and a negative signal is a binary "1" or mark.

(b) The CPE should not transmit data unless an *on* condition is present on the clear-to-send (CB) and data set ready (CC) interface circuits (except for analog loop-back test described later).

(c) The transmitting data terminal should hold BA in the marking condition when no data is to be transmitted. With 0 volts on the BA circuit and the CB and CC circuits *on*, the BA circuit is in an indeterminate state and either a marking or spacing data signal will be transmitted.

• *Request-to-Send* (CA)—Pin 4:

(a) Signals on this lead are generated by the data terminal to condition the local data set to transmit data. With data set ready (CC) *on*, the carrier signal is transmitted in less than 1 ms after request-to-send (CA) turns *on*. The

*on* condition must be maintained whenever the customer equipment has information ready for transmission. The data set transmits all signals on the transmitted data (BA) circuit while the *on* condition is maintained on the CA and CC leads.

(b) If local copy is being received from the demodulator of the set that is transmitting and a squelch option is installed, it is necessary to delay the *off* signal on the CA lead 2 ms after the last bit is applied to the BA lead. This is to allow the last bit to clear the local demodulator before the squelch circuit clamps the received data (BB) signal when CA is turned *off*.

(c) In half-duplex operation, the *off* condition of CA 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

BA and BB leads. CPE designed for either transmit-only or duplex operation may continuously hold CA in the **on** condition.

(d) With the list 3A reverse channel (JY2 CP); a signal may be received on the reverse channel regardless of the state of the local CA circuit. This type of operation has been called independent operation. For the list 3 reverse channel (JY1 CP), the local CA circuit must be **on** to receive on the reverse channel (dependent operation). Some data systems require independent operation.

● **Data Terminal Ready (CD)**—Pin 20:

(a) Signals on this lead control the connection of the data set to the telephone line. The **on** condition permits the data set to be connected to the communication channel upon auto answer or talk-to-data transfer. When the station is arranged for automatic answer, the data set goes off-hook in response to a ringing signal when circuit CD is turned **on**. CD must be held **on** or turned **on** before transferring to the data mode for stations optioned for manual answer.

(b) When the data set is in the data mode, the turning **off** of the CD circuit removes the data set from the communication channel by causing the data set to go on-hook.

(c) The **off** condition does not disable the operation of the ring indicator (CE) circuit.

● **Secondary Request-to-Send (SCA)**—Pins 11 and 19: This circuit is available on data sets equipped with reverse channel and is used to provide communication from the receiving data set to the transmitting data set simultaneously with the normal data channel. For the JY1 CP, the data set must have the CA circuit in the **off** condition to receive the reverse channel signal. For JY2 CP, the reverse channel can receive independent of the state of CA. SCA appears on two pins of the interface connector to conform with both EIA Standard RS-232-C and the interface of older data sets 202-type.

● **Received Data (BB)**—Pin 3: Signals on this lead are generated by the receiving data set in response to data signals received from the distant data set. With the local copy option installed (option ZA) in half-duplex operation, the BB signal follows the transmitted data (BA) signal delayed by less than 2 ms, and may be used to monitor transmitted signals.

● **Clear-to-Send (CB)**—Pin 5: The **on** condition of the CB lead is a response to an **on** condition on the request-to-send (CA) circuit, delayed by 180, 60, 30, or 8 ms, depending on the clear-to-send interval option selected (M, K, J, and G, respectively). The **on** state of CB indicates to the CPE that signals presented on the transmitted data (BA) lead will be transmitted to the communication channel. The **off** condition is an indication to the CPE that it should not transfer data on the BA lead. When CA is turned **off**, CB is turned **off** in less than 1 ms.

● **Data Set Ready (CC)**—Pin 6:

(a) An **on** condition on the CC lead is a response to an **on** condition of data terminal ready (CD). Signals on CC indicate the mode of the data set. The **on** condition indicates that the data set is in the data mode and is capable of transmitting and receiving data signals. The **on** condition is required in conjunction with an **on** condition on the request-to-send (CA) and clear-to-send (CB) leads when transmitting data. The **off** condition indicates that the data set is in talk mode call setup, on-hook, or possibly the test mode. The **on** condition of this circuit alone should not be interpreted that a communication channel has been established to a remote data station or used to determine the status of any remote terminal equipment.

(b) For DS 202S-L1A, an option is available which affects the status of CC during analog loop-back test. With option YI, CC turns **on** during the analog loop-back test mode when the CD circuit is turned **on**. This permits testing with the CPE. With option YJ (CC **off** during analog loop-back), the CC circuit is clamped **off** during the analog loop-back mode, as it is with DS 202S-L1.

4.11 Drivers in the data set supply the following signals to CPE.

- **Received Line Signal Detector (CF)**—Pin 8:

- An **on** condition on the CF lead indicates that the data carrier is being received and has been received for at least 7 (option Q) or 23 (option N) ms. This circuit normally does not turn **on** in the presence of noise, out-of-band signals, or other non-FSK signals even when the fast mode carrier detection option (Q) is selected.
- When the data carrier is lost due to an end of transmission or to a telephone line interruption, the **off** condition follows after a 10-ms time delay. The **off** condition on CF causes the received data (BB) circuit to be clamped to the mark condition.
- The CF circuit responds to carrier signals from either the near or distant transmitting data set when optioned for local copy of the primary channel (option ZA). The CF circuit is **off** during the squelch interval when a squelch option is employed.

- **Secondary Received Line Signal Detector (SCF)**—Pin 12: This lead, provided only on data sets equipped with reverse channel, signals the data set transmitting on the primary channel of conditions at the receiving data set simultaneously with the transmission on the primary data channel. With the local copy option for the reverse channel (option ZE), circuit SCF responds to reverse channel carrier from either the local or remote data set.

- **Ring Indicator (CE)**—Pin 22: The CE circuit permits automatic answering (option B) of incoming calls. The **on** condition of this lead indicates that a ringing signal is being received. The **off** condition is maintained at all other times. Operation of this circuit is not disabled by an **off** condition on data terminal ready (CD). The CE circuit turns **on** and **off** with the ring and silent intervals of the ringing sequence.

4.12 The following pins are also part of the customer interface.

- **Protective Ground (AA)**—Pin 1: Lead 1 (AA) is electrically bonded to the equipment

frame. It is further connected to external grounds through the power cord. This protective ground interface circuit is not provided in multiple data set arrangements.

- **Signal Ground (AB)**—Pin 7: Lead 7 (AB) establishes the common ground reference potential for all interface circuits except protective or frame ground (AA). It is normally connected to AA 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 opened by the telco employee.
- **+14 Volts**—Pins 9 and 10: The +14 and -14 supply voltages are used for test purposes. The CPE must not be connected to these pins.

### C. Telephone Interface

4.13 The telephone interface shown in Table E provides access to the data set line control. Lead numbers correspond to pin assignments on the 25-pin KS-19088-L22 plug on the rear of the data set. The M13F cord is provided to connect the data set to the telephone set. A functional description of the active assignments and signals appearing on these leads follows.

- **Telephone Set Tip and Ring (T, R)**—Pins 7 and 8: Data set or telephone set signals are transmitted or received through these pins. The telephone set ringer may also be connected across these leads.
- **Telephone Set Tip and Ring (T1, R1)**—Pins 21 and 22: A tip and ring pair associated with one line button of a standard 6-button key telephone set is connected to these pins. The telephone set provides voice communication over the line and terminates the line during manual origination and answering of a data call.
- **Talk-Data and Ground (TD, TDG)**—Pins 5 and 25: The A and A1 leads associated with the line button are connected to these pins. Operation of the data (hold) button of the telephone controls the TD and TDG leads to put the data set in the data mode in the manual mode of operation.

TABLE E  
TELEPHONE INTERFACE

LEAD NO.	DESIGNATION	DESCRIPTION
1	L	Tel set line lamp control from data set
4	LG	Tel set line lamp ground from data set
5	TD	Talk/data control from tel set
7	T	Telephone line tip lead
8	R	Telephone line ring lead
12	RD	Common ringer control contact to ground
14	C	Data mode contact closure to ground from set to ACU
16	D1	Data mode contact closure to ground from ACU to data set
21	T1	Tel set tip lead
22	R1	Tel set ring lead
23 & 24	A & A1	A lead control: Used to provide an indication to ACU or KTU when the line is in use
25	TDG	Talk/data control ground lead

- **Lamp and Ground (L, LG)**—Pins 1 and 4: The telephone set L and LG leads associated with the line button are connected to the data set L and LG pins to light the line button lamp when ringing voltage is detected on the line and when the data set is in the data mode. For DS 202S-L1A, the lamp is also lighted in the talk mode for the *called* data set.
- **Data Mode Control (D1)**—Pin 16: This terminal is used by an ACU to put the data set in the data mode.
- **Data Mode Indicator (C)**—Pin 14: This terminal is used by an ACU to detect when the data set is in the data mode.
- **A Lead Control (A, A1)**—Pins 23 and 24: These leads are used by an ACU or a key telephone unit (KTU) to detect when the telephone line is in use in either the data or talk mode.
- **Common Ringer Control (RD)**—Pin 12: This lead is provided to operate a common ringer for two or more data sets.

#### FUNCTIONAL OPERATION

**4.14** A block diagram of the data set showing transmitter and receiver functions for both the primary and optional reverse channels as well as part of the customer and telephone interface is shown in Fig. 6.

##### A. Transmitter

**4.15** An 844.8-kHz square wave signal from a crystal-controlled oscillator is used by the transmitter to control transmitted carrier modulation, clear-to-send timing, soft turn-off, and reverse channel carrier generation. In order for the transmitter to operate, the CA, CC, and CD leads must be positive. The modulator generates a frequency-shift-keyed (FSK) signal consisting of 1200 Hz for a mark and 2200 Hz for a space in response to negative and positive voltages, respectively, on the BA lead.

##### B. Receiver

**4.16** The carrier detector responds to valid incoming line signals, provided the CA lead is negative. The amplitude detector portion of the carrier

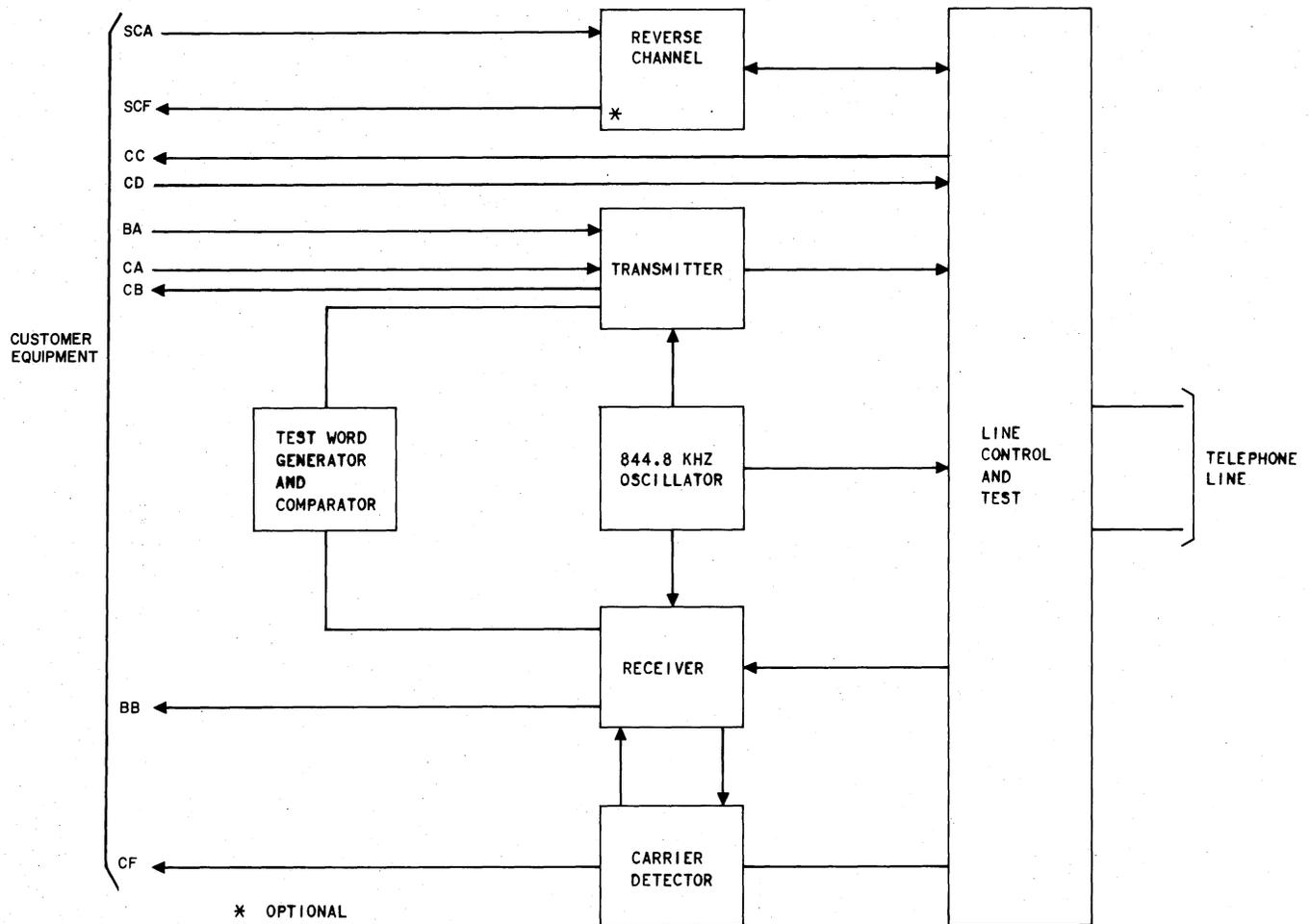


Fig. 6—Block Diagram of Data Set 202S

detector turns *on* if the received line signal is greater than  $-42$  dBm. With the amplitude detector *on*, the carrier frequency detector turns *on* if the frequency of the incoming line signal is within the limits determined by the carrier detection option. The normal response time is 23 ms if the carrier frequency is between 1075 and 2325 Hz. The fast response time is 7 ms if the carrier frequency is between 1185 and 1325 Hz and the fast carrier detection option is installed. If the carrier frequency is outside the limits of the fast response option but within the limits of the normal response option, the normal time applies.

**4.17** The receiver performs compromise equalization to correct for the average slope distortion and envelope delay distortion encountered on switched facilities.

### C. Reverse Channel

**4.18** The reverse channel provides a 387-Hz, on-off amplitude modulated signal at a maximum of 5 bps. For JY1 (specified by adding /3 to the data set code), the CA circuit must be *on* for the reverse channel to be in the receive mode. For JY2 (specified by adding /3A to the data set code), the reverse channel operation is independent of the CA circuit status. However, for both JY1 and JY2 CPs, the reverse channel transmitter is inhibited when the CA circuit is *on* to prevent simultaneous transmission of data on both channels in the same direction. The receive level sensitivity of JY2 is  $-45 \pm 1.5$  dBm, which is 3 dB more sensitive than that of JY1. This increase provides more margin for transmission loss at the carrier frequency of 387 Hz.

**D. Line Control**

**4.19** DS 202S can be installed with a 565HK, 2565HK, or equivalent-type key telephone set (ordered separately). Figure 7 shows the functional interface between the telephone set and the data set line control. Adapter KS-21253-L3 may be used to interconnect up to five data sets and associated lines through a single telephone set.

**OPERATION WITH CUSTOMER-PROVIDED EQUIPMENT****A. Call Setup**

**4.20** The ring detector circuit produces a positive voltage on the CE circuit whenever ringing voltage is present on the line. Simultaneously, the lamp under the line key on the associated telephone set flashes during ringing with the lamp lit when ringing is heard.

**4.21** In manual operation, the calling and called attendants establish voice contact in the normal manner. The *called* attendant should always enter the data mode first. The calling attendant should wait until answer tone ceases before entering the data mode (except under the conditions described in 4.23 and 4.24). The CD circuit must be held on by the CPE prior to depressing the data button. The answer sequence consisting of approximately 1.3 seconds of silence for proper call billing and 1.9 seconds of 2017-Hz tone for echo suppressor disabling is generated before the CC circuit is turned *on*. On DS 202S-L1, the lamp under the line key, which is extinguished in the talk mode, lights when the data set is in the data mode. On DS 202S-L1A, the lamp under the line key is lighted during the talk mode also for the *called* data set. For the *calling* data set, the lamp is off in the talk mode. The telephone handset may be placed on-hook while in the data mode. If loop current is interrupted for more than 10 ms during the data mode, the call will be terminated. The data set is now in the data mode and can be used for data transmission as a transmitter or receiver under the control of the CA circuit.

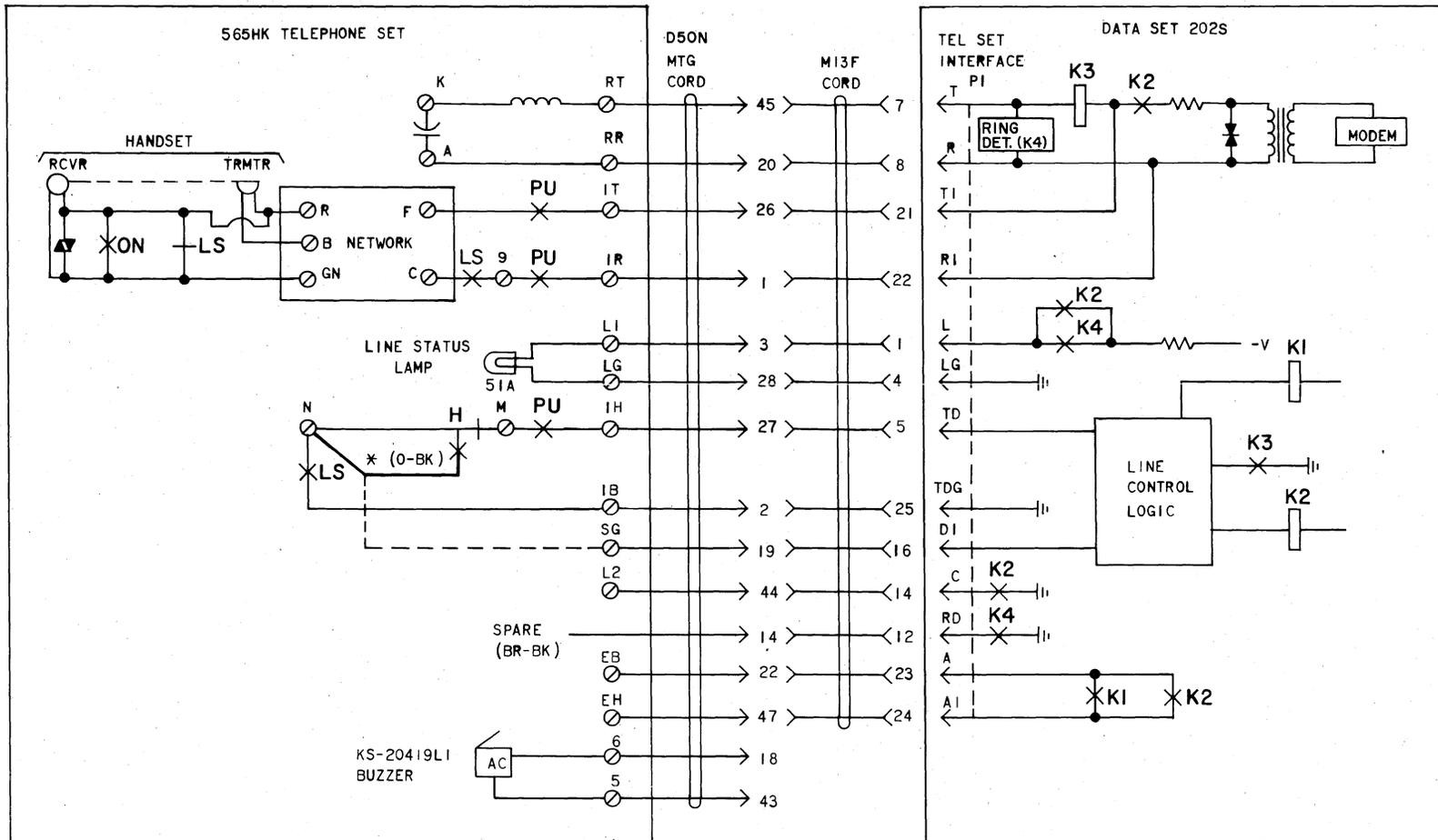
**4.22** If the call is answered automatically, the calling party will hear the high-pitched answer tone after the call is answered. Upon hearing this tone, the attendant momentarily depresses the nonlocking data button on the telephone set to transfer to the data mode and then places the handset on-hook. Again, both data terminals must

provide an *on* condition to the CD circuit to prepare the data sets for data transmission and to hold the connection. If the call is originated by an 801-type ACU, the ACU detects the answer tone and places the data set in the data mode.

**4.23** Previous data sets 202-type recommended that the called set enter the data mode first and transmit the answer tone to disable echo suppressors. The calling set is placed in the data mode at the end of the answer tone, and does not transmit the tone. However, DS 202S-L1 transmits the answer tone whenever it enters the data mode except when operated by an ACU. To avoid interpreting the 2017-Hz tone as data signals after entering the data mode, 2 ms of continuous or additive marking (1200 Hz) must be received before the demodulator is enabled. This first mark feature prevents detection of the 2017-Hz tone as a space signal.

**4.24** Since previous data sets 202-type do not have the first mark feature, a problem may occur when DS 202S-L1 with manual call origination calls one of these sets. In this case, since the calling 202S-L1 generates answer tone, spurious space signals may occur on the BB circuit of the older 202 from the DS 202S-L1 2017-tone after these data sets have entered the data mode. ***If DS 202S-L1 calls DS 202C, 202D with DAS 804, or 202R with manual answer, it is recommended that the attendants agree that the 202S-L1 enter the data mode first to avoid the spurious space signal.*** If DS 202S-L1 calls DS 202C or 202D with automatic answer, the attendant should enter the data mode at the beginning of the answer tone. A spurious space signal is most likely to be detected by the called set because it usually automatically enters the data mode before the tone from DS 202S-L1 ends. The note on Fig. 7 provides a modification to the tel set which will prevent the calling 202S-L1 from sending answer tone. ***This modification should not be made if DS 202S-L1 is used to answer calls manually. If manual answer is desired, use DS 202S-L1A or unmodified DS 202S-L1.*** DS 202S-L1A has a ring memory circuit which prevents it from sending answer tone when it is the calling set in the same manner as DS 202C.

**4.25** If echo suppressors are in the circuit, they are disabled during the call setup procedure by the 2017-Hz answer tone. Echo suppressors will become enabled again if there is a period as



\* IF 202S-LI WILL BE CALLING A 202C AND WILL NEVER BE USED TO ANSWER CALLS MANUALLY, IT IS RECOMMENDED THAT THE O-BK LEAD OF THE HOLD KEY (EITHER TAPED & STORED OR CONNECTED TO TERMINAL N) BE CONNECTED TO EITHER OF THE TWO S6 SCREW TERMINALS. THIS MODIFICATION PREVENTS THE 202S-LI FROM SENDING ANSWER TONE WHEN IT IS MANUALLY PLACED IN THE DATA MODE.

Fig. 7—Interface Between Telephone Set and Data Set Line Control

## SECTION 592-028-150

long as 100 ms without any signal on the line. This last requirement must be met by the CPE, and may be accomplished using the reverse channel by ensuring that either the reverse channel transmitter or the primary channel transmitter is on at all times after echo suppressors are disabled. If the distant data terminal is able to ignore echoes and the reverse channel is used to keep echo suppressors disabled, then the no squelch option and the shorter clear-to-send delays may be used.

### B. Call Termination

**4.26** Switched network connections must be terminated by taking positive action at both data stations. A call may be terminated manually by lifting the handset, depressing the key on the telephone set corresponding to the line with which the data set is associated (to go to talk mode), and then replacing the handset on-hook.

**4.27** With unattended call termination, the call is terminated by turning off the CD circuit for at least 50 ms. The lamp under the line button extinguishes and the CC circuit goes to an *off* condition.

## 5. CAPABILITIES

**5.01** The scope of capabilities included in this part covers application, service variations, and performance to be expected.

**5.02** DS 202S is line signal compatible with all switched network data sets 202-type: 202C, 202D with DAS 804, 202E, and 202R (manual operation, no reverse channel). However, when DS 202S-L1 manually originates calls to some manual or automatic answer DS 202C or 202D with DAS 804, a spurious space signal may be detected by the called data set during call setup. The Installation and Connection practice recommends a procedure for coping with this problem. Except for the elimination of the contact interface arrangement, DS 202S provides an interface to the CPE identical to former 202-type sets.

### APPLICATIONS

**5.03** DS 202C provides a significant amount of the present Bell System 1200-bps service over the switched telephone network. The replacing DS 202S is designed to be line compatible with the 202C. DS 202C should continue to be employed

for 1200-bps switched network service whenever possible. Systems requiring contact customer interface operation must use DS 202C. To minimize customer confusion, new systems and additions to existing systems should be provided so that a mix of DSs 202C and 202S is avoided whenever possible.

### SERVICE VARIATIONS

**5.04** A DS 202S multiple installation may be configured in one of two ways.

- Up to five stand-alone (individually housed) sets may be connected to a key telephone set (565HK or 2565HK). A KS-21253-L3 adapter is used to interconnect each of the sets to one of the line keys on the telephone set.

- A maximum of 24 data sets may be installed in a single cabinet in installations using three 40A1 data mountings. Each 40A1 data mounting can house up to eight sets, and a maximum of three mountings may be installed in one of the available cabinets. The data mounting provides power, access to the service line for testing, and the necessary hardware to rack-mount the data set. See the section entitled Data Station Using Data Set 202S—Description and Operation (592-860-100) for a more detailed description.

**5.05** The appearance of the ring indication signal from each data set on screw terminals of the KS-21253-L3 adapter makes other arrangements possible. For example, in such a multiple data set arrangement it is likely that the sets will be in an automatic answering mode. Under normal operation, the customer may prefer not to hear the buzzing or ringing. The factory-provided connections among screws 1 through 5 can be broken and left broken if no audible indication is ever desired. This assumes that the telephone set would be used very infrequently and only to originate calls. The customer may desire to be alerted on one or more lines on a selective basis. An externally mounted key strip (eg, KS-19504-L1 switch) can be used to pick which lines result in an audible ringing upon detection of ringing by the data set(s) on the selected line(s). It is expected that such an arrangement would find application in an automatic answering collection of data sets, to be used under trouble conditions to intercept incoming calls.

## PERFORMANCE

**5.06** The operating bit rate of the data set is a function of both the data set design and the network over which the data set operates. The recommended maximum bit rate for DS 202S on the switched network is 1200 bps. This limit is a statistically derived value based on the overall distribution of network connections. Although on selected connections it may be possible to operate at speeds in excess of 1200 bps, no performance statement can be made at higher speeds.

**5.07** Expected performance over the switched network is comparable to that of DS 202C, 202D, and 202R. Figures 8 and 9 show bit and block error rates for data sets 202-type based on a 1969-70 Connection Survey conducted by the Bell Telephone Laboratories. The performance data was obtained using DS 202D. However, the performance of DS 202S is comparable to that of DS 202D. It is expected to have better than a  $10^{-2}$  1000-bit block error rate on approximately 90 percent of all connections. A bit error rate of  $10^{-5}$  will be obtained on approximately 82 percent of switched connections.

## 6. MAINTENANCE

**6.01** This part covers detailed operation of the data set test buttons utilized in the standard practices. The troubleshooting information provides data on recurring problems beyond the scope of the maintenance-test practices which may aid in clearing some trouble reports.

## TEST BUTTONS

**6.02** DS 202S has test capabilities which can be used by a customer to expedite isolation of service problems to either the data set, transmission facilities, or CPE (data terminal). These test features may be used either prior to calling the telco Repair Service or when the telco test center requests assistance with certain remote tests. The use of the test buttons and status lamps on the data set is described in this part. Before proceeding with testing, the terminal equipment associated with the data set under test should be in the idle mode so that data transmission is not interrupted.

### A. Local Self-Test

**6.03** The local self-test is initiated by holding the nonlocking LT button depressed. It must be manually depressed for the test duration. The transmitter output is connected to the receiver input and the data set is conditioned to operate with built-in test word generator and comparator circuits (Fig. 10). Control signals request-to-send (CA) and data terminal ready (CD) are clamped **on** internal to the data set. The data set is inhibited from making or answering a data call. All output circuits at the customer interface are clamped **off**. A repeating 63-bit pseudo-random word (identical to the test word in the 903- and 914-types data test set) is generated at 1547 bps and sent to the transmitter, where it is modulated and transmitted through the level adjust and equalizing networks to the receiver. In the receiver the word is demodulated and compared to the original word. If all lamps stay lighted while the LT button is depressed, the data set is probably operating satisfactorily. If the TM lamp turns off before the LT button is released (hold approximately 15 seconds), the test should be repeated. A properly operating set should pass four of five trials. One failure could be due to power line hits or switch bounce. The passing of this test does not guarantee that the set is operating properly, because the interface terminators and drivers are not utilized. The AL test checks these circuits.

### B. Analog Loop-Back Test

**6.04** In the analog loop-back test, the output of the transmitter is connected to the input of the receiver to permit testing of the data set and other terminal equipment by the CPE or test set(s). The line is disconnected from the data set as shown in Fig. 10. To enter the analog loop-back test, depress the locking AL button. On DS 202S-L1, the data set ready (CC) circuit turns **off**, but the other interface circuits perform as in normal operation. EIA RS-232-C presently requires CC to be **off** when in the test mode. It also recommends that the data terminal ignore all other interface circuits when CC is **off**. Terminals following this recommendation cannot perform this test. On DS 202S-L1A, the CC circuit can be **on** (optional). The data terminal ready (CD) and request-to-send (CA) circuits must be turned **on** by the CPE for testing to begin. The power ON and the test mode (TM) lamps should be lighted. DS 202S-L1 cycles through the answer tone sequence consisting

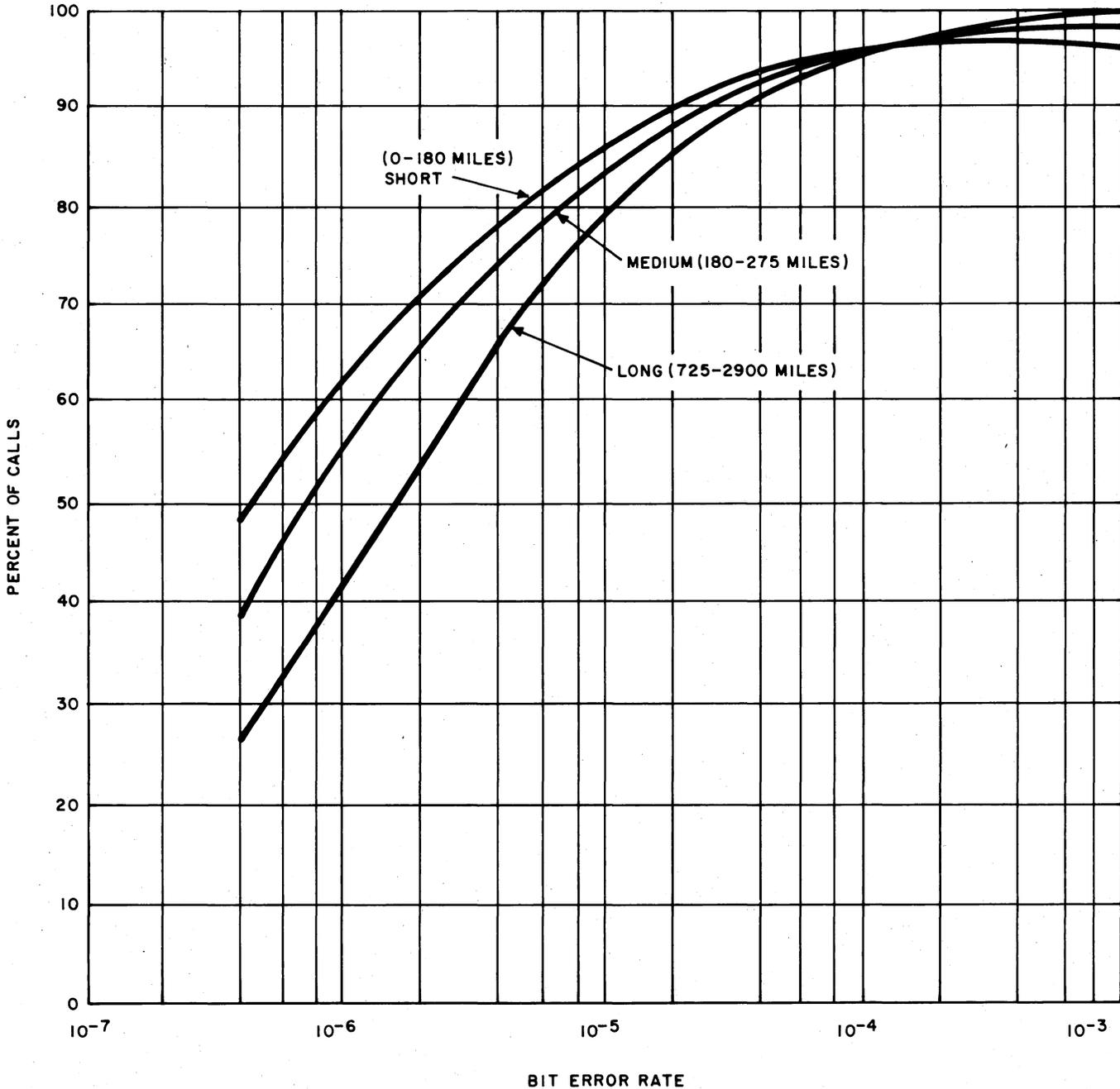


Fig. 8—Switched Telecommunication Network Bit Error Rate Distribution by Mileage Strata at 1200 BPS

of a nominal 1.3-second quiet interval followed by the transmission of 1.9 seconds of answer tone each time the analog loop-back mode is entered. For DS 202S-L1A, the answer tone interval is eliminated.

**6.05** On DS 202S-L1, if the telephone handset is placed off-hook while in the analog loop-back test mode, the clear-to-send circuit (CB) turns *off*.

If the test procedure does not require this circuit to be *on*, the test may continue. However, should the attendant hang up the phone, the data set reinitiates the answer sequence which interferes with the test. For DS 202S-L1A, this interaction between the telephone set and data set is eliminated.

**6.06** On DS 202S-L1/2/3, if the reverse channel local copy option is IN, the signal applied

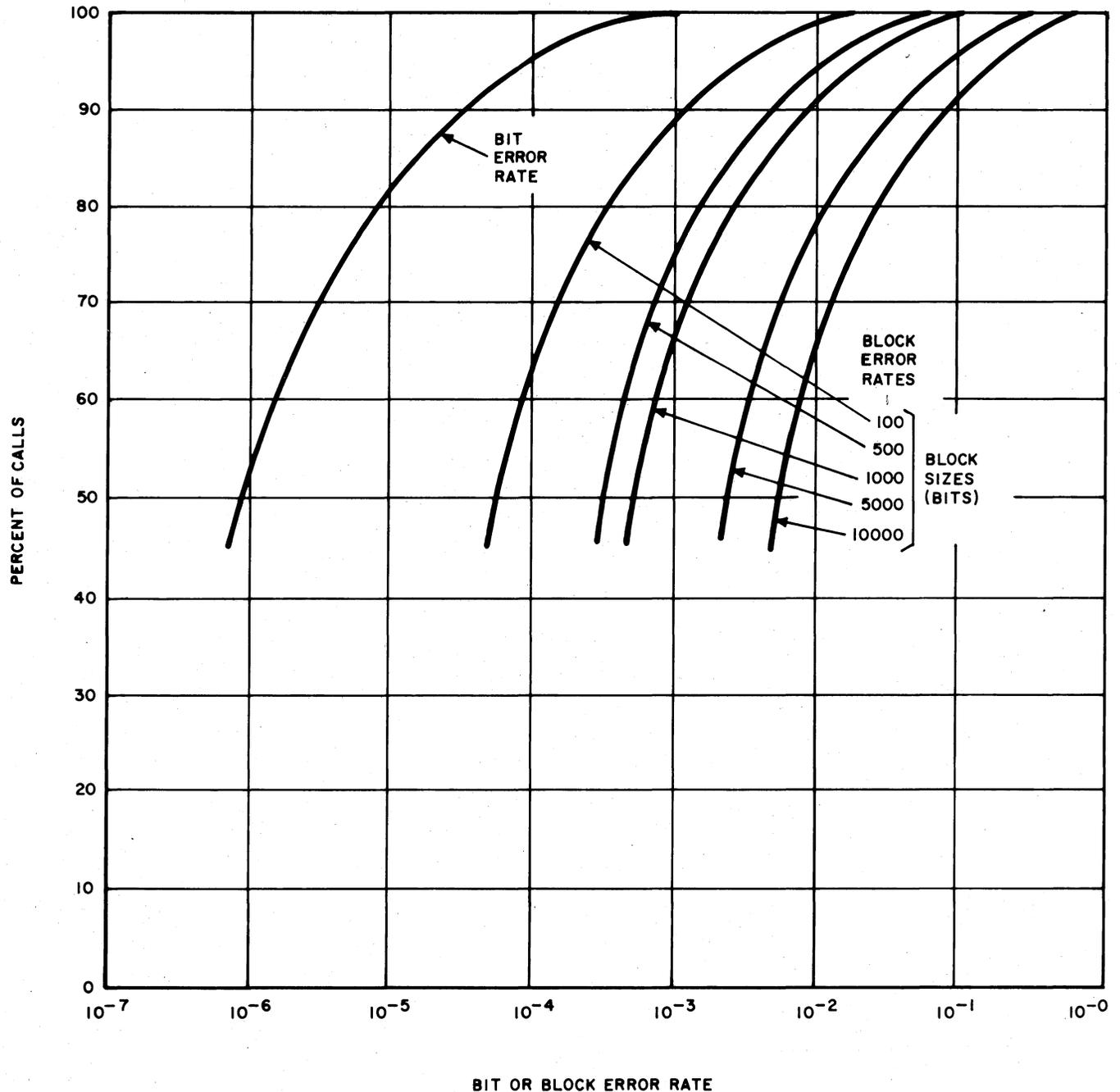


Fig. 9—Switched Telecommunication Network Bit and Block Error Rate Distribution at 1200 BPS

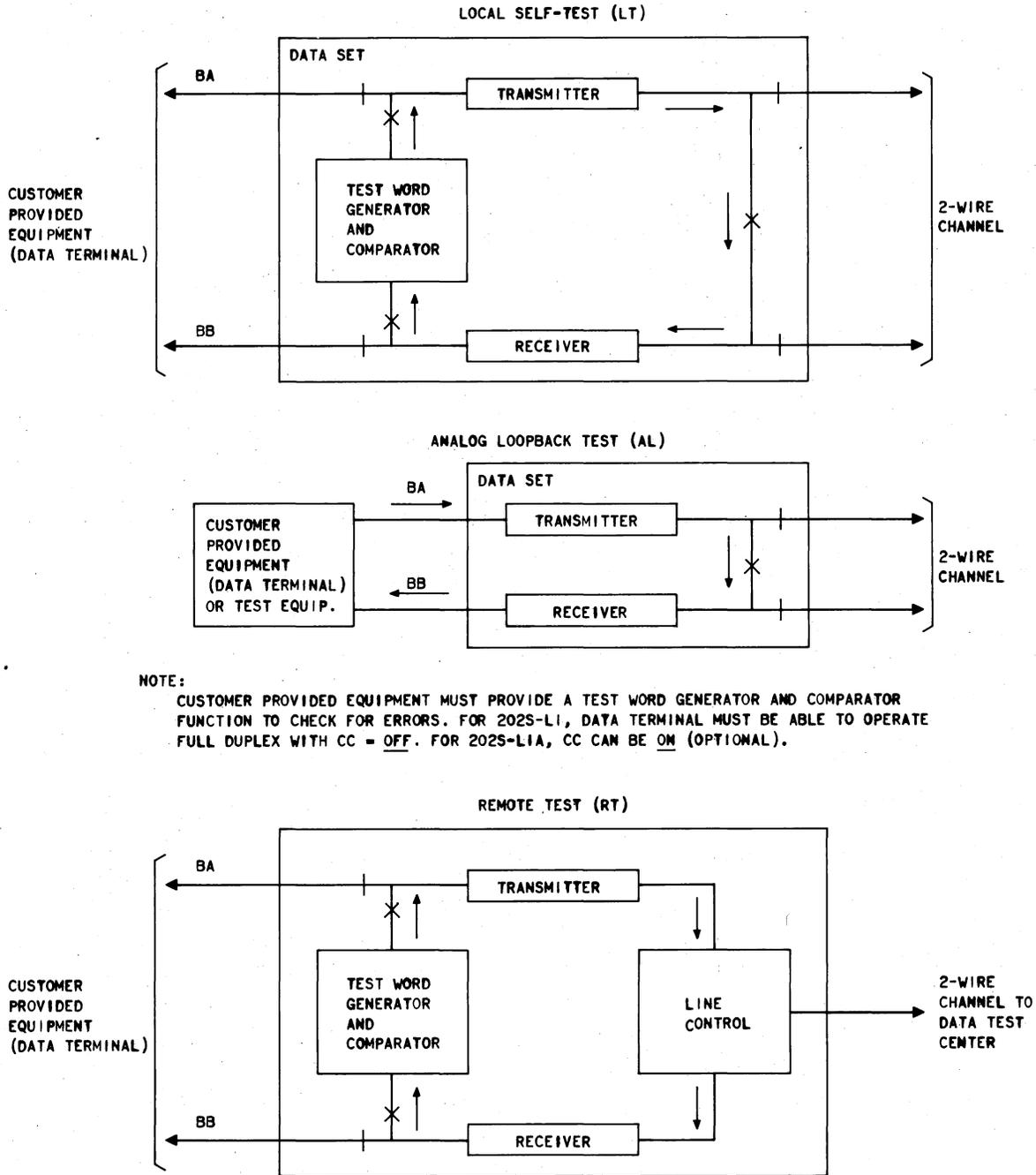
to the secondary request-to-send (SCA) circuit can be monitored on the secondary received line signal detector (SCF) circuit. On DS 202S-L1A/2/3A the reverse channel circuit is normally looped back for testing during the AL mode.

**6.07** The data set is returned to normal operation by releasing the AL button. The CS, MR,

and TM lamps should be off after the AL switch is released.

#### C. Remote Test

**6.07** When the locking RT button is depressed, the data set is conditioned for automatic answer. After this operation, a test can be conducted



NOTE:  
 CUSTOMER PROVIDED EQUIPMENT MUST PROVIDE A TEST WORD GENERATOR AND COMPARATOR FUNCTION TO CHECK FOR ERRORS. FOR 202S-L1, DATA TERMINAL MUST BE ABLE TO OPERATE FULL DUPLEX WITH CC = OFF. FOR 202S-L1A, CC CAN BE ON (OPTIONAL).

Fig. 10—Functional Operation of Test Buttons

by the customer or a data test center. Figure 10 shows the functional condition of the data set in this test mode.

- The *customer* can utilize the RT mode to determine if a connection can be established to a distant data set. Any convenient

telephone handset may be used in performing this test. However, if the telephone handset of the calling data set is used, the entire telephone connection can be tested. The data set automatically answers an incoming call and goes through the call setup procedure. The data set trips ringing, goes through a

quiet interval of 1.3 seconds, transmits answer tone for 1.9 seconds and then transmits a random data signal. The customer can monitor this sequence with the telephone set to determine if the data set and the link from the data set to the calling station are in working order. On data sets with reverse channel, a low frequency beeping tone is also heard. If the above sequence does not occur, the customer should report the problem to telco. It should be noted that during this test, noise or speech picked up by the mouthpiece of the telephone handset may cause the distant data set to transmit a steady tone instead of random data.

- The *data test center* (DTC) causes the data set to transmit a 63-bit word compatible with 914-type or equivalent DTS at 1547 bps. This tests the transmitter of the data set and the telephone line. The 63-bit word is also looped back internally to the data set under test and processed by the receiver as in local self test. If the data set is operating properly, the transmitter continues to transmit the 63-bit word. If the data set detects an error in the looped-back word, the DTC receives constant spacing. The DTC may cause the data set to send constant spacing in a properly operating set by applying signals such as dial pulse, Touch-Tone® signals, or other tones to the line with auxiliary equipment. The amplitude and frequency of the constant spacing may be measured. If the data set is equipped with reverse channel, the reverse channel transmitter sends an on-off signal at 4.3 bps simultaneously with the line signal of the 63-bit word. While transmitting spacing after an error is detected, the reverse channel transmitter is off and the reverse channel receiver is on. Application of a 387-Hz tone to the line at the DTC switches the data set output from constant spacing to constant marking. At the completion of the test, the RT switch must be released to return the data set to the normal mode.

## TROUBLESHOOTING

- 6.08** It is recommended that DS 202S service be maintained on a set change-out basis when trouble is isolated to the data set. It is imperative

that the defective (or suspected defective) data set be tagged with the symptoms and/or reason for change-out to aid in troubleshooting analysis and repair.

- 6.09** A regional field support team has been established at Bell Laboratories to assist in solving technical and application-related problems encountered in providing DS 202S service. In the event that a problem which requires further technical assistance is encountered, normal DATEC escalation steps (locally established routine) should be followed. The 195 DATEC Control Center will provide immediate on-line contact with the assigned Bell Laboratories field support team member. Following resolution, if the problem appears to be of a recurring nature or of common interest, the 195 DATEC Control Center may issue advisories to all areas. This procedure will assist in providing minimum down-time and trouble-free service to the customer.

- 6.10** This part provides information on problem/resolution situations which have occurred to date and may be of aid in clearing trouble reports.

### *Option Setting Confusion*

- 6.11** The Installation and Connections practice pictures option switch S3 in its intended position and tabularly presents various settings for this switch. For a limited production run, a number of DS 202S were manufactured with switch S3 in the opposite direction from that intended. Figure 11A shows the AMP rocker switch in its normal configuration when viewed from the faceplate end of DS 202S. Operating the rocker toward the number gives a contact closure. Figure 11B shows a substitute AMP rocker switch that mechanically operates in reverse of the normally specified switch (Fig. 11A). In Fig. 11B operating the rocker toward the number still gives a contact closure; however, the switch is being operated in reverse of Fig. 11A. Optioning a 202S with this reversed switch is confusing and leads to field errors. Comparing two data sets 202S in order to see if they are optioned the same leads to the same confusion.

### *Reverse Channel OUT*

- 6.12** The procedure for removing reverse channel service involves changing an option switch

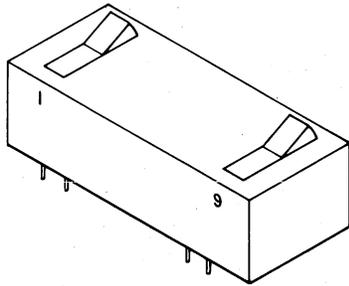


FIG. 11A

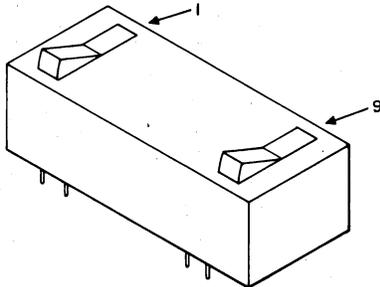


FIG. 11B

## NOTE:

REGARDLESS OF PLACEMENT OF SWITCH ASSEMBLY, SWITCH POSITION IS CLOSED WHEN ROCKER IS DOWN ON SIDE ADJACENT TO NUMBERS.

**Fig. 11—Confusion in Setting Options Because of Switch S3 Reversed**

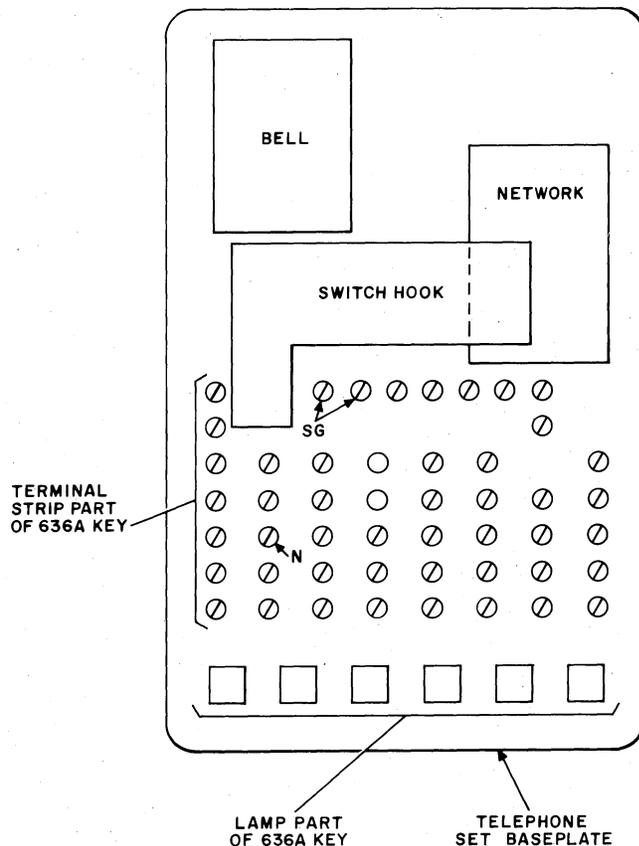
setting *and* physical removal of the reverse channel CP. Telco personnel have spent significant time troubleshooting DS 202S-L1/2/3 service after installing option ZD (reverse channel OUT). If option ZD is desired, the reverse channel CP (coded JY1 or JY2) must also be removed.

### **Lack of Ring Memory—DS 202S-L1**

**6.13** DS 202S-L1 does not contain a ring memory feature as does DS 202C. As a result, 202S-L1 sends answer tone whether it is a calling or called set except when a call is originated by an ACU. DS 202C only sends answer tone when it is the called set. A called 202C will generate spurious data hits on the receive-data lead if the 202C is in the data mode before a calling 202S-L1 finishes sending answer tone. These hits appear as a steady space that lasts from the time data-set-ready goes *on* in DS 202C until the end of the 202S-L1 answer tone, and a few transitions occur as answer tone goes off.

**6.14** Data sets 202S-L1 that are configured for manual calling and automatic answering of data calls or manual answering of non-data calls should have their associated 565HK or 2565HK telephone sets modified to disable the answer tone on manual talk-to-data transfers. The modification does not affect the performance or operation of the data set in automatic calling and answering configuration. A modified installation cannot be used to answer data calls manually. Therefore, in applications where manual call origination and manual answering of data calls are both required, data sets 202S-L1A or 202C should be used (unless the CPE can tolerate possible data hits). The following modification is *not* recommended on DS 202S-L1 that never originates calls manually.

- (1) Disconnect 565HK or 2565HK telephone set from DS 202S-L1 and telephone line.
- (2) Remove telephone set cover and move rotary or Touch-Tone dial for easy access to the key terminal board below the dial.
- (3) Locate the O-BK lead to the hold key. This lead is normally taped and stored or is connected, for storage purposes, to terminal N on the key terminal board (Fig. 12).
- (4) Connect this lead to an SG screw terminal on the key terminal board. There are two SG terminals and either one may be used. There should also be a BR-Y lead on SG that goes to pin 19 of the telephone set 50-pin connector at the end of the mounting cord.
- (5) Reassemble the telephone set, and connect the telephone set, telephone line, and data set per Installation and Connections section.
- (6) To verify modification:
  - (a) Check that all data set test buttons are released and customer is disconnected.
  - (b) Apply a positive voltage to pin 20 of the customer interface using a 914B or C test set. TR lamp should light on data set.
  - (c) Call any telephone set from modified set.
  - (d) Answer call at telephone set, then push data (hold) key on modified set.



**Fig. 12—Location of SG and N Terminals in 565 and 2565HK Telephone Sets**

- (e) The data set should immediately go to data mode (MR lamp lights) and no answer tone should be heard at the called telephone set.
- (f) Return to talk at modified set and hang up at both ends.
- (g) Push in RT button on DS 202S-L1.
- (h) Call DS 202S-L1 from any telephone set and verify that set answers automatically and sends the answer tone/data sequence that is normal for a 202S-L1 in remote test mode.
- (i) Release RT, return to talk mode, and hang up at both ends.
- (j) If DS 202S-L1 is optioned for automatic answer, call it from another telephone set

and verify that it does answer automatically and sends answer tone. After answer tone ends, the line should be quiet.

- (k) Assuming successful operation, disconnect the call and restore the station to service.

**6.15** An unavoidable consequence of this modification is that an idle data set can be put into the data mode merely by pushing the data button on the telephone. For this to happen, the TR lamp must be lighted and the line button must be depressed. This mode may be cleared by simply going into the talk mode and hanging up. The set will also clear if the central office sends a loop interrupt. To avoid this problem, leave the line (talk) button in the up position when not in use.

## 7. REFERENCES

**7.01** The following BSPs provide additional information:

SECTION	TITLE
314-205-501	Data System-DATAPHONE® Service Direct Distance Dialing Network Test Requirements for Subscriber, Foreign Exchanges, and Remote Exchange Lines
590-010-200	Data Sets and Data Access Arrangements—General Installation and Connection Information
592-028-ZZZ	Data Set 202S Transmitter-Receiver
668-102-519	Data Test Center 904A-and 904C-Types—Test Procedure For Data Set 202S
999-100-141	Data Station 202S—How to Operate Manual

**SECTION 592-028-150**

**7.02** The following additional documents may be of maintenance aid:

	<b>NUMBER</b>	<b>TITLE</b>
	E.L. 2648	
SD-&CD-1D238-01		Data Systems Station—Data Set 202S-Type and 40A1 Data Mounting
	GL:74-05-153	
AT&TCo Pub. 41212		
	GL:74-04-194	