DATA SET 201C-L1C
TRANSMITTER-RECEIVER
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional descriptions and operating procedures for data set (DS) 201C-L1C.

1.02 When this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 DS 201C-L1C (Fig. 1) is a synchronous, serial, binary transmitter-receiver which provides half-duplex service on the switched network. This set replaces DS 201C-L1 optioned for switched network service. DS 201C-L1C is designed for switched network service and cannot be optioned for private line operation. The circuit packs used in DS 201C-L1C are not compatible with those of other DS 201C-types.

Fig. 1—Data Set 201C-L1C—Front View

1.04 The following is a technical specification summary for DS 201C-L1C.

Operation: Synchronous, binary, serial

Modulation: Differential 4-phase shift keying (PSK)

Data Rate: 2400 bps

Interface Voltages: Per Electronic Industries Association (EIA) RS-232-C

Transmitter Timing: Internal or external

Line Requirements: 2-wire switched network

Operating Modes: Simplex (1-way) or half-duplex (2-way nonsimultaneous)

Power Requirements: 105 to 129 volts, 12 watts, at 57 to 63 Hz

Ambient Temperature Range: +40 to +120°F

Relative Humidity Range: 20 to 95 percent

Dimensions: Width 10.5 inches, height 4.3 inches, depth 14 inches

Weight: 13 pounds (stand alone); 6 pounds (multiple)

Customer-Provided Equipment: Must be supplied with an interface cord terminated in a Cinch or Cannon DB-19604-432 plug wired in accordance with Table A. This interface cord should not exceed 50 feet in length.

2. PHYSICAL DESCRIPTION

2.01 The following is a description of list codes associated with DS 201C-L1C:

- List 1C—Consists of the JB-type circuit pack containing the transmitter and receiver; TP1 circuit pack (line control board); and associated customer interface circuits
- List 2—Consists of the 100A power unit
- List 3A—Consists of the M13F and M4AU telephone interface cords
- List 4—Consists of the housing required for stand-alone sets, and power cord.

2.02 The orderable list codes are as follows:

- DS 201C-L1C/2/3A for multiple data set installation in the 42A data mounting
- DS 201C-L1C/2/3A/4 for single data set installations in the 50A1 data mounting.

2.03 Diagnostic testing capabilities are provided by five pushbuttons and eight status indicators on the front panel. Removing the plastic front cover gives access to a test socket and option rocker switches.

2.04 The rear of the set (Fig. 2) has two standard 25-pin connectors for line and terminal interfacing, a 3-terminal power connector, and a fuse (spare attached).

2.05 The eight status indicators on the front panel display the internal status of the data set and the state of some of the interface leads. These status indicators consist of light emitting diodes (LEDs) that illuminate translucent designations on the data set front cover. The indicators and their functions during normal operation are as follows:

- ***ON:*** This indicator is lighted when power is supplied to the data set.
- ***TR (Terminal Ready):*** This indicator normally monitors the data terminal ready (CD) lead at the customer interface an is lighted when CD is ***on***. However, when either the remote test (RT) switch or the self test (ST) switch is pressed, the TR indicator follows the internal data terminal ready signal provided by the data set self-test circuitry.
- ***MR (Modem Ready):*** This indicator monitors the data set ready (CC) at the customer interface and is lighted when CC is ***on***. The MR indicator may be lighted in certain self-test modes even though data set ready is ***off*** at the customer interface.
- ***RS (Request to Send):*** This indicator monitors the request-to-send (BA) lead at the customer interface and is lighted when BA is on. The RS indicator is also lighted by the data set internal test circuitry. It is turned off when the receive only (RO) switch is pressed, regardless of the state of the request-to-send lead at the customer interface and the positions of the other test switches.
- ***CS (Clear to Send):*** This indicator monitors the clear-to-send (BB) lead at the customer interface and is lighted when BB is ***on*** in both normal and test modes.

TABLE A

CUSTOMER INTERFACE

PIN NO.	FUNCTION	DATA SET MNEMONIC	EIA DESIGNATION (RS-232-C)
2	Transmitted Data	SD	BA
3	Received Data	RD	BB
4	Request to Send	RS	CA
5	Clear to Send	CS	CB
6	Data Set Ready	DSR	CC
7	Signal Ground	SG	AB
8	Received Line Signal Detector	CO	CF
9	Test Voltage	+12V	---
10	Test Voltage	—12V	---
15	Transmitter Signal Element Timing	SCT	DB
16	Dibit Clock Transmitter	DCT (Non-EIA)	---
17	Receiver Signal Element Timing	SCR	DD
18	Dibit Clock Receiver* or Local Analog Loopback †	DCR (Non-EIA) LL (Non-EIA)	--- ---
19	Remote Release (+5V)	RR (Non-EIA)	---
20	Data Terminal Ready	DTR	CD
21	Ready	RDY (Non-EIA)	---
22	Ring Indicator	RI	CE
24	Transmitter Signal Element Timing (External)	SCTE	DA

* Option YT

† Option YS

- ***CO (Carrier On):*** This indicator monitors the received line signal detector (CF) lead at the customer interface and is lighted when CF is ***on*** in both normal and test modes.

- ***MC (Modem Check):*** During normal operation, this indicator is used to monitor the receive signal element timing (DD) lead. It is used as a no-clock indicator and lights whenever the receive signal element timing signal is not present. The MC indicator normally gives an inverse CO indication; that is, when the CO indicator is off, MC is lighted. During self tests, the MC indicator is used to signal errors and excessive internal data set distortion. In the self test mode, an error on received data causes the MC indicator to blink for 60 ms.

- ***TM (Test Mode):*** This indicator lights whenever any of the test switches (AL, DL, ST, or RT) is pressed or the data set is in the analog loopback mode, initiated by use of the LL (pin 18) customer interface lead. When TM is off, this indicates that the data

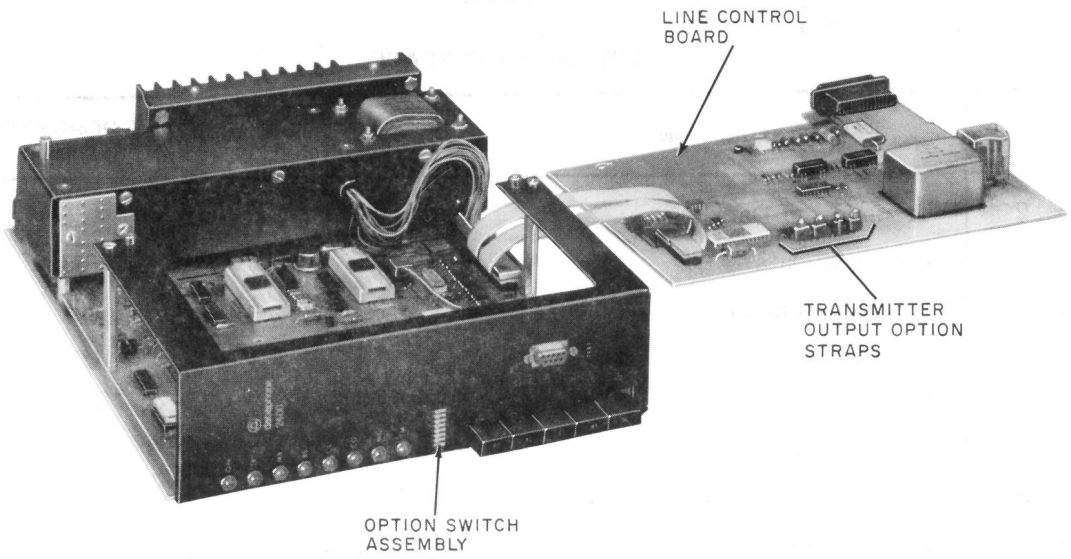

Fig. 2—Data Set 201C-L1C—Rear View

set is in the data mode and not in any self test mode.

2.06 There are five switches on the front panel of the data set which allow local and remote testing of the data set. These switches are of the push-to-operate and push-to-release types, and condition the data set as follows:

- ***RO (Receive Only):*** Operating the RO switch turns off the request-to-send signal to the transmitter and thus allows the data set to operate only in the receive mode, regardless of any other test switches and customer interface control signals. When the RO switch is pressed, the RS and CS indicators are off.

- ***AL (Analog Loopback):*** Operating the AL switch conditions the data set for full-duplex operation and loops the transmitter output back to the receiver input. Pressing the AL switch also turns both data set ready (CC) ***off*** at the customer interface and data terminal ready (CD) ***off*** at the line control circuit, causing any ongoing call in the data mode to be terminated. This also prevents the data set from automatically answering any incoming calls. Manual call answering and origination (talk mode only), and any ongoing calls in the talk mode are not affected. The TM indicator lights when the AL switch is pressed.

- ***ST (Self Test):*** Operating the ST switch disconnects transmitted data (BA) from the customer interface and internally connects a 15-bit word generator to the transmitted data circuit. The ST switch also connects a 15-bit word comparator to the receive data (BB) circuit, clamps receive data at the customer interface to steady mark, and clamps data set ready to ***off.*** It also conditions data terminal ready to ***on*** internal to the data set. If the RO switch is not pressed, request-to-send is conditioned to ***on.*** Operating the ST switch causes the MR and TM indicators to light. The ST switch enables the transmitter external timing (DA) circuitry to offset the transmitter signaling rate to 2400.26 bps or 2402.1 bps, depending on the position of the DL switch.

- ***RT (Remote Test):*** Operating the RT switch conditions the data set for testing by a telephone company remote data test center (DTC). When used in conjunction with the AL switch, the RT switch conditions the data set for the local loopback receiver margin test. The RT switch enables the transmitter external timing circuitry to offset the transmitter signaling rate to 2400.26 bps or 2402.1 bps, depending on the position of

the DL switch. The TM indicator lights when the RT switch is pressed.

- ***DL (Disturb Lock):*** The DL switch of DS 201C-L1C does not perform a digital loopback function as it does in DS 201C-L1, because the DS 201C-L1C does not have 4-wire full-duplex operation capabilities. In DS 201C-L1C, the DL switch affects the transmitter signaling rate in self-test modes of operation when either the RT or ST switch is pressed. In a self test mode with the DL switch released, the transmitter signaling rate is adjusted to 2400.26 bps, well within the capture range of a DS 201C-L1C receiver timing recovery circuit. In a self test mode with the DL switch operated, the transmitter signaling rate is adjusted to 2402.1 bps, beyond the lock-in range of the timing recovery circuit. This causes the receiver under test to lose bit synchronization and thus generates errors in the demodulated data stream. In self test modes of operation, such errors injected into received data cause the MC lamp to blink at a rate of approximately 0.75 Hz. The TM indicator is lighted when the DL switch is pressed.

3. FUNCTIONAL DESCRIPTION

3.01 DS 201C-L1C consists of a transmitter, a receiver, test and control circuits, and interface circuits.

TRANSMITTER

3.02 The transmitter accepts serial binary data at 2400 bps in synchronism with positive transitions of a 2400-Hz clock provided either by the data set or by the customer-provided equipment (CPE). The transmitter groups the digital data into symbols of two bits each (dibits) and encodes this data in a differential 4-phase modulated signal suitable for transmission on switched network lines.

RECEIVER

3.03 The receiver accepts the transmitted signal from the telephone line, demodulates the analog signal to recover serial data and bit timing, and delivers the data and timing to the CPE through the EIA interface.

TEST MODES

3.04 The self test circuitry enables DS 201C-L1C to be tested in local analog loop-back, self test, end-to-end and remote test modes.

A. Manual Analog Loopback Test

3.05 This test mode is entered by pressing the AL test switch. This conditions the data set for full-duplex operation, terminates any existing call in the data mode, loops the transmitter output back to the receiver input, and turns data set ready ***on*** internal to the data set. The CPE can test the data set and EIA interface by transmitting data and examining transmitter and receiver output signals at the interface. The data set ready indication is turned ***off*** at the EIA interface.

B. Electrically Activated Analog Loopback Test

3.06 This test mode is entered if the CPE provides an ***on*** indication on the EIA interface pin 18. Also, the data set must be optioned for electrically activated loopback and must not be in any other self test mode. This test mode is inhibited if the AL, ST, or RT switch is pressed. Electrically activated analog loopback conditions the data set for full-duplex test operation, terminates any ongoing call in the data mode, and loops the transmitter output back to the receiver input. Both internal and external data set ready indications are turned ***on***. Data set and CPE interface functions can then be exercised by the data terminal equipment.

C. Analog Loopback Self Test

3.07 This test mode is entered by pressing the AL and ST switches. The AL switch performs the loopback function the same as in the manual analog loopback test. The ST switch connects transmitter input transmitted data (BA) to a 15-bit word generator and connects the transmitter external timing input (DA) to a circuit which offsets the transmitter bit rate from 2400 bps to 2400.26 bps. The ST switch also enbles a test word comparator in the receiver circuitry and allows the MC indicator to light each time an error is detected in received data (BB).

3.08 With the RO switch released, pressing the ST switch turns ***on*** request-to-send and causes the transmitter to send the standard 15-bit self test pattern. The test signal is demodulated

and reviewed data is presented to the test word comparator. Errors in received data cause the MC indicator the blink momentarily for periods of 50 ms or to remain lighted continuously.

3.09 If the RO switch is pressed in addition to the AL and ST switches, request-to-send is turned ***off,*** which causes the RS, CS, and CO indicators to go off. The absence of carrier energy causes the receiver to inhibit the dibit clock receiver (DCR) signal. The no-clock detector circuitry senses the absence of DCR and causes the MC indicator to light continuously.

3.10 During the above tests, the transmitter external timing circuit is utilized to change the transmitter signaling rate from the normal 2400 bps to 2400.26 bps (an offset of approximately one fourth the receiver timing recovery range). This exercises the timing recovery circuitry and can detect component failures in the timing recovery even though the receiver and transmitter circuits operate from a common clock. By additionally pressing the DL test switch, the transmitter signaling rate is adjusted to 2402.1 bps, about twice the receiver timing lock-in range. In this mode, the receiver loses symbol synchronization approximately every 1.3 seconds, causing errors in received data and causing the MC indicator to light.

D. End-to-End Self Test

3.11 In the end-to-end self test mode, the data set operates half-duplex; therefore, transmitter and receiver sections are tested separately. This test requires that the data set be connected to a remote DS 201C through a telephone channel and that both data sets be in the data mode. The remote data set may be either a DS 201C-L1C or a 201C-L1.

3.12 In the transmit portion of the test, only the ST switch is pressed, causing the test word to be transmitted to the remote data set and disabling the local receiver. The distant data set is placed in the receive mode by simultaneously pressing the ST and RO switches at the distant end. Error detection is performed by observing the MC indicator at the distant end. With the local DL switch released, the local transmitter bit signaling rate is 2400.26 bps and the MC indicator at the distant end should remain off. With the local DL switch pressed, the transmitter signaling state shifts to 2402.1 bps and the MC indicator at the distant end should blink at approximately 1.3-second intervals.

3.13 In the receive mode portion of the test, the roles of the two data sets are reversed. The local RO switch is pressed and the distant RO switch is released. If the distant data set is a DS 201C-L1C, local data set performance can be checked by observing the MC indicator with the DL switch on the distant data set both released and pressed.

E. Remote Test

3.14 When the data set RT switch is pressed, the data set is conditioned for testing by a telephone company DTC. The DTC calls the data set under test, which answers automatically and goes to the data mode. The DTC then sends 2-second blocks of the 15-bit test pattern to the data set. The data set examines the data for errors and if no errors are present, transmits a 2-second block of the 15-bit test pattern back to the DTC. If any errors are detected in the data from the DTC, the data set inverts the 15-bit test pattern before transmitting to the DTC. This process continues until terminated by the DTC.

3.15 When the test is complete, the DTC sends several seconds of steady space, which terminates the call, turns off the TR indicator, and disables the automatic answer option until the RT switch is released. This allows the DTC operator to call the data station and give the results of the test.

3.16 Throughout the remote test, the transmitter of the data set under test has the signaling rate adjusted to 2400.26 bps. If the DL switch is pressed during a block transmission to the DTC, the DS 201C at the DTC loses receiver timing synchronization and indicates block errors.

INTERFACE

3.17 The customer interface is accessible through the CUST INT (lower) connector at the rear of the data set. The connector pin numbers and the corresponding lead designations are shown in Table A.

3.18 The telephone line interface is accessible through the unlabeled (top) connector at

the rear of the data set. The connector pin numbers and the corresponding lead designations are shown in Table B.

OPTIONS

3.19 DS 201C-L1C has seven options which are to be selected by the customer or the telephone company. A detailed description of these options is contained in Section 592-029-210. A summary of the options is contained in Table C.

4. OPERATION

4.01 DS 201C provides the capability for the following:

- Manual call handling
- Automatic answering and disconnect
- Use of telephone line for both voice and data transmission
- Compatibility with DAS 801-type.

4.02 ***Answering:*** Calls can be answered either manually or automatically.

(a) In manual answering, the telephone receiver is lifted from the cradle and the data set enters the talk mode. This enables the customer to speak with the calling party. When ready, the customer depresses the DATA key on the telephone, thereby initiating the answering sequence that puts the data set into the data mode. The manual answering sequence consists of a 64-ms quiet period followed by entrance into the data mode. The data terminal ready (CD) lead must be ***on*** for the answering sequence to occur.

TABLE B

TELEPHONE LINE INTERFACE

PIN NO.	DESIG-NATION	FUNCTION
1	L	Line status lamp control from data set to telephone set
2	−12V	Test voltage
3	+5V	Test voltage
4	LG	Line status lamp control ground
5	TD	Talk/data control from telephone set to data set
7	T	Telephone line tip
8	R	Telephone line ring
12	RNG	Common ringer control for multiple data sets
14	C	Data mode status from data set to ACU
16	D1	Data mode control from ACU to data set
20	+12V	Test voltage
21	T1	Telephone set tip
22	R1	Telephone set ring
23	A	Telephone line status from data set to ACU
25	TDG	Talk/data control ground

TABLE C

DATA SET 201C-L1C OPTIONS

FEATURE		OPTION	LINE CONTROL BOARD (TP1) STRAP IN (VERTICAL	LINE CONTROL BOARD (TP1) STRAP OUT (HORIZONTAL)	PROVIDE
Transmit Line Signal Level	0 dBm	ZA		1, 2, 4, 8	One Per Station
	−1 dBm	ZB	1	2, 4, 8	
	−2 dBm	ZC	2	1, 4, 8	
	−3 dBm	ZD	1, 2	4, 8	
	−4 dBm	ZE	4	1, 2, 8	
	−5 dBm	ZF	1, 4	2, 8	
	−6 dBm	ZG	2, 4	1, 8	
	−7 dBm	ZH	1, 2, 4	8	
	−8 dBm	ZI	8	1, 2, 4	
	−9 dBm	ZJ*	1, 8	2, 4	
	−10 dBm	ZK	2, 8	1, 4	
	−11 dBm	ZL	1, 2, 8	4	
	−12 dBm	ZM	4, 8	1, 2	
	−13 dBm	ZN	1, 4, 8	2	
	−14 dBm	ZO	2, 4, 8	1	
	−15 dBm	ZP	1, 2, 4, 8		

FEATURE		OPTION	SWITCH SETTING 1	2	3	4	5	6	7	8	DIGITAL BOARD (JB4)	PROVIDE
Transmitter Timing	INTERNAL	YC*					X					One Per Station
	EXTERNAL	YD					O					
Automatic Answer	RDY & DTR CONTROLLED OR NOT PROVIDED	YE								O		One Per Station
	DTR CONTROLLED ONLY	YF*								X		
Grounding Option	SIGNAL GRD CONNECTED TO FRAME GRD	YK*									Install E1-E1	
	SIGNAL GRD NOT CONNECTED TO FRAME GRD	YL									Remove E1-E2	
Function of EIA Interface Pin 18	INITIATES LOCAL ANALOG LOOPBACK	YS				X					Install E3-E4	One Per Station
	PROVIDES RECEIVE SYMBOL CLOCK	YT*				O					Install E4-E5	
Cont Receiver Bit Clock	IN	YO							O			One Per Station
	OUT	YP*							X			
Satellite Option	IN	YQ*			X							One Per Station
	OUT	YR			O							

* Factory-furnished option

X - Closed

O = Open

(b) In automatic answering, the data set answers an incoming call automatically if data terminal ready (CB) is ***on*** and the automatic answer option is installed, or the ready lead is ***on*** or connected to the remote release lead. The automatic answering sequence consists initially of a 1.7-second quiet period during which no signal is transmitted from the data set. This is followed by a 1.7-second period of 2025-Hz answer tone that is used to signal the distant automatic calling unit (ACU) to switch the distant data set into the data mode. A 64-ms quiet period then occurs, followed by entrance into the data mode.

4.03 ***Calling:*** Calls may be originated either manually or automatically by an ACU. The data terminal ready (CD) lead must be ***on*** before the data set enters the data mode.

(a) In manual calling, the data set starts in the talk mode and does not enter the data mode until the DATA key on the telephone is depressed. After the DATA key is depressed, the data set goes through the same sequence as described for manual answering.

Note: In manual calling, neither end transmits an answer tone. Both ends should depress the DATA key at about the same time.

(b) In automatic calling by an ACU, the ACU responds to the 2025-Hz answer tone from the distant end, bypasses the quiet and answer-tone periods of the manual answering sequence, and puts the data set directly into the data mode.

4.04 ***Hanging Up:*** The call may be ended manually or automatically.

(a) In manual operation, the call is ended by lifting the handset, depressing the LINE key on the telephone, and then hanging up. Pressing the AL switch on the data set while in the data mode also ends the call.

(b) In automatic operation, the call is ended by switching data terminal ready to ***off***. The data set ready (CC) lead goes ***off*** about 25 ms later and the call is terminated about 12 ms after data terminal ready goes ***off***. It is recommended that the CPE hold data terminal ready ***off*** at least until data set ready goes ***off*** before turning data terminal ready ***on*** again.

5. REFERENCES

5.01 Additional information covering DS 201C-L1C and auxiliary equipment is contained in the following publications.

SECTION	TITLE
502-500-120	Telephone Sets—540, 560, 1560, and 2560 Series—Common Installation and Maintenance Information
592-029-210	Data Set 201C-L1C Transmitter-Receiver—Installation and Connections
592-029-510	Data Set 201C-L1C Transmitter-Receiver—Test Procedures
598-012-202	Data Auxiliary Set 801C L1/2—Installation and Connection