DATA SET 201CR-L1C
TRANSMITTER-RECEIVER
SINGLE SET
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains the physical and functional descriptions and operation procedures for data set (DS) 201CR-L1C. Data set 201CR-L1C is the registered version of DS 201C-L1C and meets all requirements of the FCC Registration Program. The registration number for DS 201CR-L1C is AS593M-70105-DM-E.

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

1.03 Data set 201CR-L1C (Fig. 1) is a synchronous, serial, binary transmitter-receiver for use on the 2-wire switched network at a data rate of 2400 bps. Data set 201CR-L1C is similar in construction and circuitry to DS 201C-L1C.

Fig. 1—Data Set 201CR-L1C—Front View

1.04 The following rules apply to the registration program.

- Registered versions of Bell System data sets include an "R" in the data set code.
- Bell System switched network data sets not having an "R" in the data set code are "grandfathered."
- "Grandfathered" DS 201C-type may be connected in registered arrangements provided

the transmit line signal level is set to -4 dBm and the interface with the switched network is made with the proper cord and jack as shown in the connection diagrams in Section 592-036-200.

- Data set 201CR-L1C may be connected in "grandfathered" arrangements provided the transmit line signal level is adjusted so that the level of the signal reaching the serving central office does not exceed -12 dBm.

- Connection to the telephone line in registered arrangements must be made with the proper cord to the proper data jack as shown in the connection diagrams in Section 592-036-200.

- In arrangements of one to five data sets, a mixture of "new-family" data sets may be used. "New-family" data sets are 103JR, 113CR, 113DR, 201CR, 202SR, 208BR, and 212AR.

1.05 The following is a technical specification summary for DS 201CR-L1C.

Operation: Synchronous, binary, serial

Modulation: Differential 4-phase shift keying (PSK)

Data Rate: 2400 bps

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 Interface: Electronic Industries Association (EIA) Standard RS-232-C. Customer-provided equipment (CPE) must connect to data set via an interface cable terminated with a 25-pin Cinch or Cannon DB-19604-432 (male) plug with a Cinch DB-51226-1, hood (or equivalents). The interface cable should not exceed 50 feet in length.

2. PHYSICAL DESCRIPTION

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

- List 1C—Consists of two circuit packs (JB4B and TP1B)

- List 2—Consists of a 100B power unit

- List 3A—Consists of an M13F telephone interface cord

- List 4—Consists of a stand-alone enclosure for the list 1C and list 2 components, a KS-14532-L24 power cord, and an M4AU telephone interface cord. The enclosure and the power cord are also orderable as a 50A1 data mounting.

2.02 The orderable list codes are as follows:

- Data set 201CR-L1C/2/3A for multiple data set installation in the 42A-type data mounting

- Data set 201CR-L1C/2/3A/4 for single data set installations.

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

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

2.05 The eight status indicators on the front panel of the data set 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 are as follows.

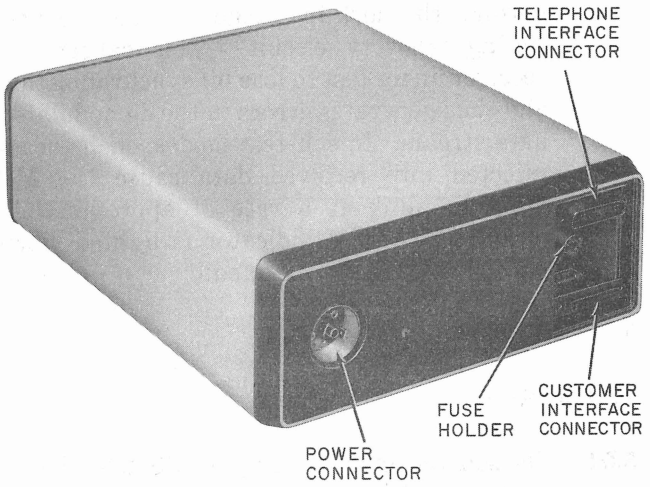

Fig. 2—Data Set 201CR-L1C—Rear View

- ***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 and is lighted when CD is ***on.*** However, when either the remote test (RT) switch or the self test (ST) switch is operated, 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) lead at the customer interface and is lighted when CC is ***on.*** The MR indicator may be lighted in certain self-test modes even though CC is ***off*** at the customer interface.

- ***RS (Request to Send):*** This indicator monitors the request-to-send (CA) lead at the customer interface and is lighted when CA is ***on.*** The RS indicator is also lighted by the data set internal test circuitry. The RS indicator is turned off when the receive only (RO) switch is operated, regardless of the state of CA at the customer interface and the positions of the other test switches.

- ***CS (Clear to Send):*** This indicator monitors the clear-to-send (CB) lead at the customer interface and is lighted when CB is ***on*** in both normal and test modes.

- ***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 monitors the receive signal element timing (DD) lead. The MC indicator is used as a no-clock indicator and is lighted 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, the MC indicator is lighted. During self tests, the MC indicator signals 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 operated or the data set is in the analog loopback mode, initiated by use of the LL (pin 18) customer interface lead. When the TM indicator is off, the data set is in the data mode.

2.06 The five switches on the front panel of the data set enable local and remote testing of the data set. These switches are the depress-to-operate and depress-to-release type, and condition the data set as follows.

- ***RO (Receive Only):*** Operating the RO switch turns off request to send (CA) to the transmitter and thus enables 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 operated, 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. Operating the AL switch also turns 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 is lighted when the AL switch is operated.

- ***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 received data (BB) circuit, clamps received data (BB) at the customer interface to steady mark, clamps data set ready (CC) to ***off,*** and conditions data terminal ready (CD) to ***on*** internal to the data set. If the RO switch is not operated, request to send (CA) is conditioned to ***on.*** The MR and TM indicators are lighted when the ST switch is operated. The ST switch enables the transmitter external timing circuitry to adjust 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 data test center (DTC). When used in conjunction with the AL switch, the RT switch conditions the data set for the receiver margin self test. The RT switch enables the transmitter external timing circuitry to adjust the transmitter signaling rate to 2400.26 bps or 2402.1 bps, depending on the position of the DL switch. The TM indicator is lighted when the RT switch is operated.

- ***DL (Disturb Lock):*** The DL switch of DS 201CR-L1C does not perform a digital loopback function as it does in DS 201C-L1, since the DS 201CR-L1C does not have 4-wire full-duplex operation capabilities. In DS 201CR-L1C, the DL switch determines the transmitter signaling rate in self-test modes of operation when either the RT or ST switch is operated. In self-test modes with the DL switch released, the transmitter signaling rate is adjusted to 2400.26 bps, well within the capture range of the receiver timing recovery circuit. In self-test modes with the DL switch operated, the transmitter signaling rate is adjusted to 2402.1 bps, beyond the lock-in range of the receiver 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, 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 operated.

3. FUNCTIONAL DESCRIPTION

TEST MODES

3.01 The self-test circuitry enables DS 201CR-L1C to be tested in analog loopback, end-to-end, and remote test modes.

A. Manual Analog Loopback Test

3.02 This test mode is entered by operating the AL 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 customer-provided equipment (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

3.03 This test mode is entered if the CPE provides an ***on*** indication on EIA interface pin 18. Also, the data set must be optioned for electrically activated analog loopback and must not be in any other self-test mode. This test mode is inhibited if the AL, ST, or RT switch is operated. Electrically activated analog loopback conditions the data set for full-duplex operation, terminates any existing 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 CPE equipment.

C. Analog Loopback Self Test

3.04 This test mode is entered by operating 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 the

transmitter input transmitted data to a 15-bit word generator and connects the transmitter external timing input to a circuit that offsets the transmitter bit rate from 2400 bps to 2400.26 bps. The ST switch also enables a test word comparator in the receiver circuitry and allows the MC indicator to light each time an error is detected in received data.

3.05 With the RO switch released, operating 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 received data is presented to the test word comparator. Errors in received data cause the MC indicator to blink momentarily for periods of 50 ms or to remain lighted continuously.

3.06 If the RO switch is operated 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.

3.07 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 also operating the DL 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

3.08 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 distant DS 201C through a telephone channel and that both data sets be in the data mode. The distant data set may be a DS 201CR-L1C, DS 201C-L1C, or 201C-L1.

3.09 In the transmit portion of the test, only the ST switch is operated, causing the test word to be transmitted to the distant data set and disabling the local receiver. The distant data set is placed in the receive mode by simultaneously operating 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 distant MC indicator should remain off. With the local DL switch operated, the transmitter signaling rate shifts to 2402.1 bps and the distant MC indicator should blink at approximately 1.3-second intervals.

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

E. Remote Test From Data Test Center

3.11 When the RT switch is operated, 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 sequence continues until terminated by the DTC.

3.12 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 to call the data station and give the results of the test.

3.13 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 operated during a block transmission to the DTC, the data set at the DTC loses receiver timing synchronization and indicates block errors.

INTERFACE

3.14 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.

3.15 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

3.16 Data set 201CR-L1C has seven options that are selected by the customer or the telephone company. A detailed description of these options is contained in Section 592-036-200. A summary of the options is contained in Table C.

4. OPERATION

4.01 Data set 201CR-L1C provides the capability for the following:

- Manual call handling

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

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

- 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. Data terminal ready (CD) must be ***on*** for the answering sequence to occur.

(b) In automatic answering, the data set answers an incoming call automatically if data terminal ready (CD) 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 can be originated either manually or automatically by an ACU. Data terminal ready (CD) 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

TABLE C

DATA SET 201CR-L1C OPTIONS

OPTION			LINE CONTROL BOARD (TP1B)									PROVIDE
DESCRIPTION		DESIG	STRAP IN (VERTICAL)						STRAP OUT (HORIZONTAL)			
Transmit Line Signal Level †	- 4 dBm	ZE*							1, 2, 4, 8			One Per Station
	- 5 dBm	ZF	1						2, 4, 8			
	- 6 dBm	ZG	2						1, 4, 8			
	- 7 dBm	ZH	1, 2						4, 8			
	- 8 dBm	ZI	4						1, 2, 8			
	- 9 dBm	ZJ	1, 4						2, 8			
	- 10 dBm	ZK	2, 4						1, 8			
	- 11 dBm	ZL	1, 2, 4						8			
	- 12 dBm	ZM	8						1, 2, 4			
	- 13 dBm	ZN	1, 8						2, 4			
	- 14 dBm	ZO	2, 8						1, 4			
	- 15 dBm	ZP	1, 2, 8						4			
			SWITCH SETTING								DIGITAL BOARD (JB4B)	PROVIDE
			1	2	3	4	5	6	7	8		
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	Signal Ground Connected to Frame Ground	YK*									Install E1-E2	One Per Station
	Signal Ground Not Connected to Frame Ground	YL									Remove E1-E2	
Function of EIA Interface Pin 18	Initiates Analog Loopback	YS				X					Install E3-E4	One Per Station
	Provides Dibit Clock Receiver	YT*				O					Install E4-E5	
Continuous Receiver Bit Clock	In	YO							O			One Per Station
	Out	YP*							X			
Satellite	In	YQ*			X							One Per Station
	Out	YR			O							

* Factory-furnished

† Use option ZE for all data sets in registered installations. For "grandfathered" installations, select the appropriate transmit line signal level for each data set so that the level of the signal reaching the serving central office does not exceed -12 dBm.

X = Closed (switch contacts are closed when rocker is down on side adjacent to numbers).

O = Open

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. Depressing 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 (CD) to ***off.*** Data set ready (CC) goes ***off*** about 25 ms later and the call is ended 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 concerning DS 201CR-L1C and auxiliary apparatus is contained in the following publications:

SECTION	TITLE
502-500-120	Telephone Sets—540, 560, 1560, and 2560 Series—Common Installation and Maintenance Information
590-010-200	Data Sets and Data Access Arrangements—General Installation and Connection Information
590-101-103	Jacks for Registered Data Equipment
592-036-200	Data Set 201CR-L1C—Transmitter-Receiver— Single Set—Installation and Connections
592-036-500	Data Set 201CR-L1C—Transmitter-Receiver—Single Set—Test Procedures Using 914-Type Data Test Set
598-088-200	Data Auxiliary Set 801CR-L1/2—Installation and Connections

5.02 Detailed information concerning DS 201CR-L1C is contained in CD- and SD-10288-02.