

## 551A-TYPE CHANNEL SERVICE UNIT DESCRIPTION

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**1. GENERAL**

**1.01** This section contains a physical and functional description of a 551A-type channel service unit (CSU) and auxiliary circuitry. This section does not contain a description of customer provided equipment (CPE) used with the CSU.

**1.02** Whenever this section is reissued, the reason(s) for reissue will be given in this paragraph. The contents of this section were formerly contained in Section 595-105-100.

**1.03** The CSU, Fig. 1, is located on customer premises and provides the customer with a transmit and receive pair using the standard T1 bipolar signal format. The customer's data signal must satisfy the pulse density and zero sequence constraints dictated by the T1 facilities. Circuitry is provided to monitor the customer's data input and, if necessary, add pulses (all 1s) to meet the requirements of the T1 facilities.

**1.04** The CSU provides the following features:

- Bipolar return-to-zero balanced to ground zero dc component interface between the CPE equipment and the 1.544-Mb/s digital line
- Monitors the input data and, when necessary, adds pulses (ones)

- Removes bipolar violations
- Regeneration of the transmitted data and termination of the T1 line or T1 repeatered loop
- A fault locating jack to aid in testing repeaters on the T1 line
- An order wire jack for communication with the T1 test bay
- Jacks for manually looping the CSU and aiding in maintenance testing
- Dc activated remote loopback relay.

**1.05** The 551A-type CSU consists of a chassis, a 4019DA or 4019DL signal monitor, a 206- or 236-type T1 office repeater, a 598-type fault locating filter (optional), and a remote loopback relay. The CSU also contains jacks for use during testing of the signal monitor or office repeater.

**1.06** The 4019DA or 4019DL signal monitor receives the signal from the CPE, monitors the pulse density of the data stream, and provides visual indications when the number of pulses (ones) in the data stream falls below the T1 line requirements.

**1.07** The 206- or 236-type repeater interfaces with the T1 line and provides regeneration of received data. The 598-type fault locating filter is necessary if the repeater is to be tested remotely from a T1 test bay.

**1.08** The remote test relay is used to loop the transmit and receive leads at the customer interface, so that the line can be tested remotely from a T1 test bay.

**1.09** The CSU is normally line powered from the central office (CO). For cases where the line is too long to be powered from the CO, provision is made

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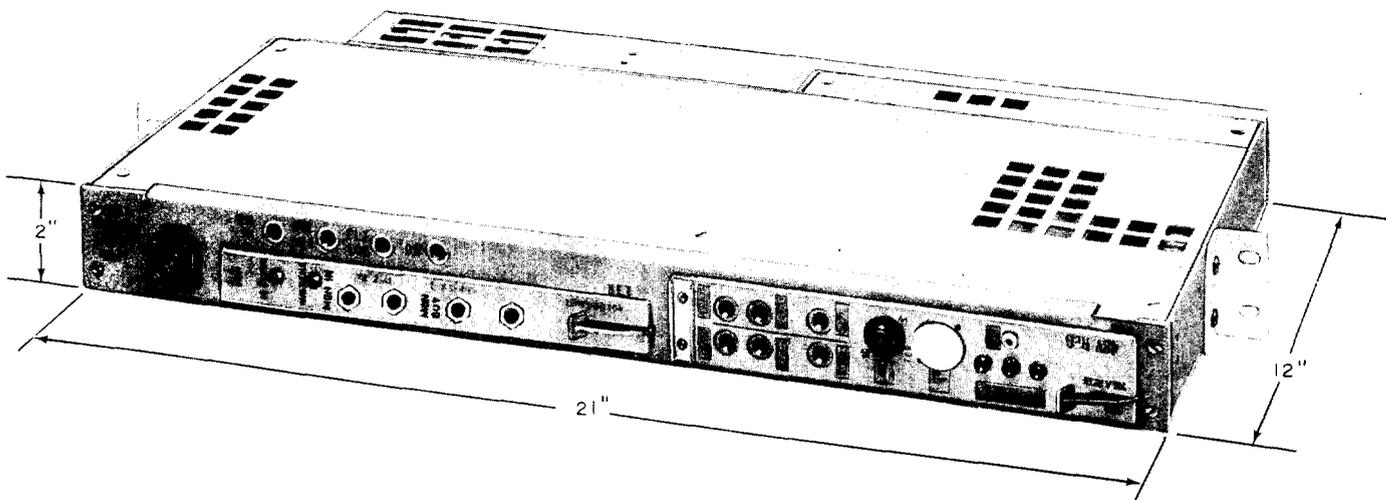


Fig. 1—551A Channel Service Unit—Front View

to power the CSU and a portion of the T1 line from the customer end using locally provided power supplies.

**1.10** The CSU is intended to be installed on a 23-inch relay rack or in a KS-20018-type cabinet. The rear cover of the CSU must be removed in order to gain access to the strapping, power, and line terminals on the rear of the CSU.

## 2. PHYSICAL DESCRIPTION

**2.01** This part contains a physical description of a 551A-type CSU and items that comprise a CSU.

**2.02** A 551A-type CSU consists of an aluminum chassis, including top and rear cover, that houses two plug-in circuit modules, a remote test relay, a fault locating filter (optional), and miscellaneous circuitry (Fig. 2).

**2.03** The CSU weighs approximately 7-1/2 pounds and has external dimensions of approximately 2 inches high, 21 inches wide, and 12 inches deep.

**2.04** The CSU is designed to operate over a temperature range of +40 to +120°F with a relative humidity of less than 95 percent.

**2.05** The front of the CSU chassis contains a fuse holder (-48V) and four 239AM-type jacks (SM

IN, SM OUT, FLT LOC, and OW). Four pin jacks (MON IN and MON OUT) are equipped on the 4019DL. The fuse holder contains a 70G (1/2 amp) fuse that is used when the CSU and T1 line is powered by a -48V power supply from the CSU end. The SM IN and SM OUT jacks provide access to the CSU transmit input and receive output. The FLT LOC jack allows connection to the fault locating lines, and the OW jack allows connection to the order wire lines. The faceplate of the signal monitor circuit module contains two light-emitting diodes (LEDs) for visual monitoring purposes. The MON IN and MON OUT jacks provide a high impedance test access of the DS1 line towards CPE.

**2.06** The rear of the CSU contains the following connectors and connection terminals.

**Note:** The numbers preceding the descriptions below correspond to the numbers in Fig. 3.

- (1) A 15-pin KS-19087-L1 customer interface connector (J3) that connects to the CPE via a customer-provided cord.
- (2) A P-3304-SCC plug (P8) that mates with an S-3304-ABT jack (J8) located on the rear cover.
- (3) A 7-station terminal block (TB3) that connects the fault locate pair to the fault locate (FLT LOC) jack. The terminal block also connects the

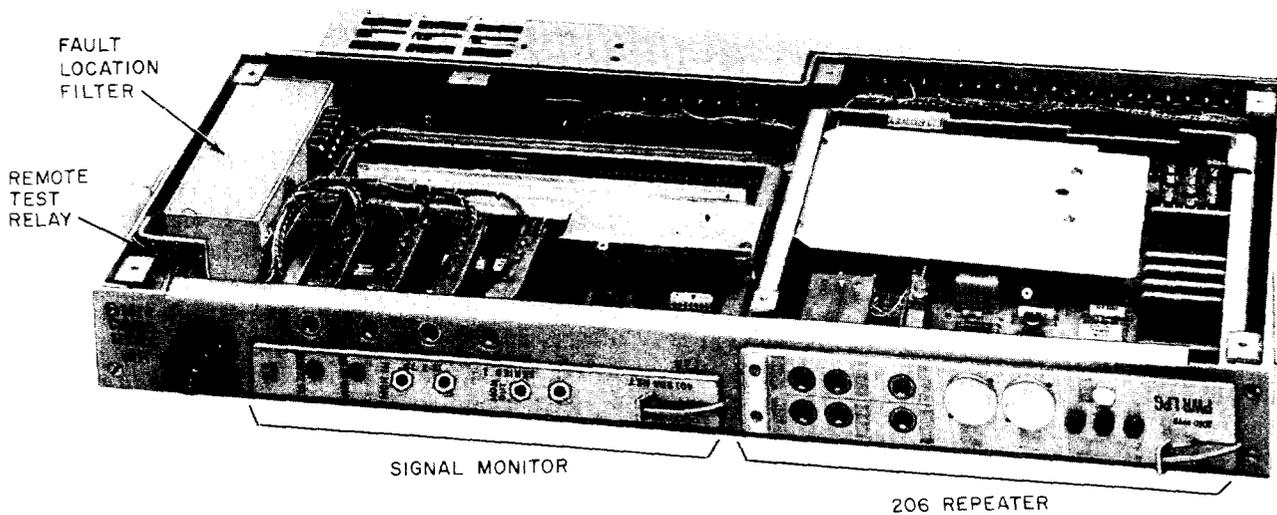


Fig. 2—551A CSU—Cover Removed

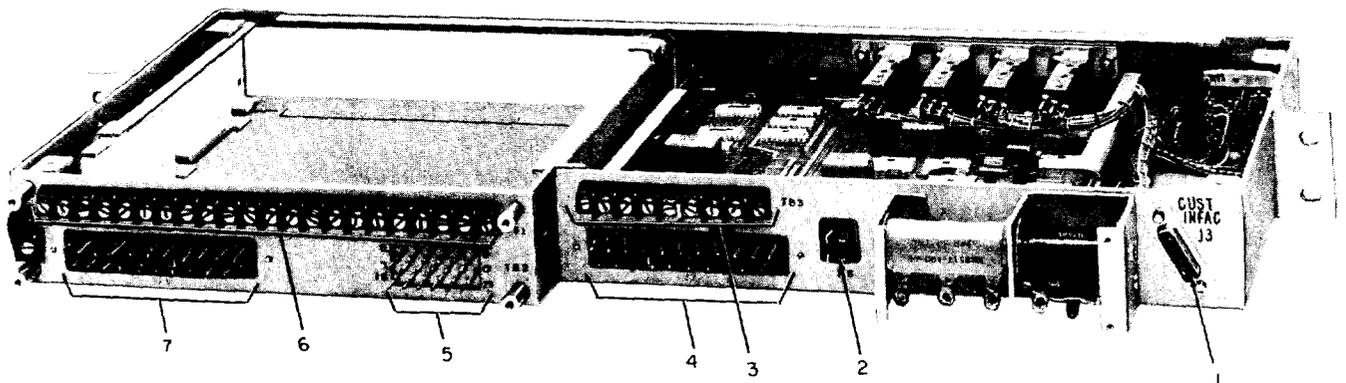


Fig. 3—551A CSU—Rear View With Covers Removed

598-type fault locate filter (optional) to the FLT LOC jack and to the 206- or 236-type repeater.

- (4) A 21-pin 902A jack (J2) that provides connection to the 4019DA or 4019DL network.
- (5) A 24-pin wire-wrap terminal board (TB2) that is used to make option connections concerning powering arrangements.
- (6) A 20-station terminal board (TB1) that connects the T1 line to the 206- or 236-type re-

peater and connects the signal monitor to the signal monitor out (SM OUT) and signal monitor in (SM IN) jacks. The terminal board also connects the remote test relay to the remote test pair and the order wire to order wire pair. Fuse alarm leads have also been provided to give a visual and/or audible indication when the 48V fuse is blown.

- (7) A 21-pin 902A jack (J1) that provides connection to the 206- or 236-type repeater.

**2.07** The rear cover on the CSU contains an interlock that disconnects station power from the

CSU when the cover is removed. Aluminum angle brackets are attached to the sides of the CSU chassis so that the CSU can be installed in a 23-inch relay rack or in a KS-20018-type cabinet.

**3. FUNCTIONAL DESCRIPTION**

**3.01** This part contains a functional description of the operation of a 551A-type CSU.

**3.02** A block diagram of a 551A-type CSU is shown in Fig. 4. The bipolar signal from the CPE enters the bipolar-to-binary converter, via the SM IN jacks and remote test relay contacts, where the signal is converted to a logic level signal. This signal is used in the clock recovery and data regenerator to control the phase and frequency of an oscillator producing a 1.544-MHz clock. The clock is then used to regenerate the data signal.

**3.03** The regenerated signal is applied to the average density monitor and is also delayed by three bits and then applied to the binary-to-bipolar converter and to the 16-zero detector and indicator.

**3.04** The average density monitor determines the average "ones" density in the transmitted signal; and, if the average "ones" density falls below a prescribed value, the average density monitor causes the all 1s pulse generator to generate an all 1s signal. The all 1s signal is sent to the binary-to-bipolar converter where it is converted to bipolar format and is sent to the repeater in place of the data signal. The average density indicator illuminates for approximately one-fourth of a second each time the average density monitor triggers the all 1s generator.

**3.05** The 16-zero detector and indicator circuitry counts the number of consecutive zeros in the data stream; and, when 16 zeros are counted, the 16-zero indicator illuminates for approximately one-fourth of a second.

**3.06** The binary-to-bipolar converter converts the logic level input signals, from the 3-bit delay and all 1s generator, to bipolar format for transmission to the 206- or 236-type repeater.

**3.07** The data signal is transformer coupled to the T1 bipolar line through a 1500-foot artificial line section in the transmit section of the 206- or 236-type repeater. Jacks are provided in the repeater

transmit line, between the signal monitor circuitry and the repeater circuitry, to allow monitoring of the transmitted signal (MON), terminating the signal (X OUT), or transmitting a test signal (L IN).

**3.08** The signal received from the bipolar T1 line enters the 206- or 236-type repeater and is terminated through a 1500-foot artificial line section. The signal is reshaped and amplified by the regenerator and then transformer coupled, by the signal monitor, to the CPE through the remote test relay contacts and the SM OUT jack. Jacks are also provided in the repeater receive line to allow monitoring the regenerated signal (MON), terminating the signal (R OUT), or transmitting a test signal to the signal monitor (X IN). These jacks are connected between the repeater circuitry and the signal monitor circuitry.

**3.09** The remote test relay is energized by applying a voltage to the remote test pair at the CO. Operation of the remote test relay requires a minimum of 15 volts at 20 mA at the CSU. When the relay is energized, the transmit and receive pairs to the CPE are opened and are looped at the customer interface for remote testing from the CO. A make-and-break contact of the remote test relay also provides a status of the relay (energized or released) to the customer.

**3.10** The fault location filter is located in the CSU to allow remote testing of the repeater from the CO. The fault location jack and order wire jack are used for maintenance and communication purposes, respectively, during testing.

**3.11** The 551A-type CSU is normally line powered from the CO. In cases where the length of the local cable pair must be extended beyond the maximum length that can be powered by the CO, provision has been made to power the CSU and part of the bipolar line from the station location. Four power supplied voltages may be used at the station location, -48 Vdc, +130 Vdc, 178 Vdc (-48 and +130), and 260 Vdc (-130 and +130). Maximum use of the CO battery supplies should be made, however, before considering powering from the station location. The 551A CSU requires 140 mA power on the line. If a 236-type repeater is used, it must be a looping repeater optioned for series powering. Table A lists the different powering arrangements and the type of repeater required for each arrangement. For additional information on 206- or 236-type repeaters, refer to Section 365-200-101.

**3.12** The 551A CSU when equipped with a 4019DL network operates the same as if equipped with the 4019DA network but with the following enhancements. The 4019DL network contains a timing recovery circuit which is much more tolerant to jitter than the 4019DA network. The circuitry in the 4019DL consists of an LC timing recovery circuit and an automatic switch which contains logic gates as the switch elements (Fig. 4). During normal operation, the LC timing recovery circuit is switched into the circuit. Should the customer's signal be removed or degrade to a point where the average density monitor operates, the LC timing recovery circuit will be switched out and the crystal controlled oscillator will be switched into the circuit. This assures that the transmitted line signal is within satisfactory frequency limits for the line and also provides a clock signal if no input signal is present.

#### 4. OPTIONS

**4.01** The 551A-type CSU options are described below. The options provide for installation of the 598-type fault location filter in the CSU and various powering arrangements.

- Option M—Provides a resistor to terminate the fault location pair.
- Option N—Provides for an improved grounding arrangement for line powered CSU applications
- Option R—Used to connect the CSU and the fault locate pair to the 598-type fault location filter when the filter is installed in the CSU.
- Option S—Terminates the wire pair from the CSU and the fault locate pair that normally connect to the 598-type fault location filter when the 598-type fault location filter is not installed in the CSU.
- Option T—Connects the supply to the CSU circuitry when a -48 Vdc station supply has to be used at the station location.
- Options V, W, and X—Connect the supply to the CSU circuitry when a +130 Vdc station supply has to be used at the station location.
- Options T and X—Connect the +130 Vdc supply and the -48 Vdc supply to the CSU cir-

cuitry when a 178-Vdc station supply has to be used at the station location.

- Options W, X, and Y—Connect the +130 Vdc supply and the -130 Vdc supply to the CSU circuitry when a 260-Vdc station supply has to be used at the station location.
- Option Z—Is factory-provided and is used when the CSU power is supplied over the T1 line from the CO.

#### 5. REFERENCES

**5.01** This part provides a list of documents containing additional information concerning the 551A-type CSU.

**5.02** For detailed information concerning the 551A-type CSU, refer to the following circuit descriptions (CDs) and schematic drawings (SDs):

DRAWING	TITLE
CD- & SD-1D248-01	551A-L1 Channel Service Unit
CD- & SD-3C367-01	236-Type Repeaters
CD- & SD-97095-01	206A Through 206G Office Repeaters
CD- & SD-97095-02	206H, J, K, L, M, and N Office Repeaters

**5.03** The following Bell System Practices contain information concerning the 551A-type CSU:

SECTION	TITLE
365-200-101	Digital Transmission Systems, T1 Digital Line, Repeater Description
595-105-180	551A Channel Service Unit For 4-Wire Digital Data Transmission, Summarizing Specification
314-646-200	551A-Type Channel Service Unit, Installation and Connections
314-646-300	551A-Type Channel Service Unit, Maintenance
314-646-500	551A-Type Channel Service Unit, Test Procedures

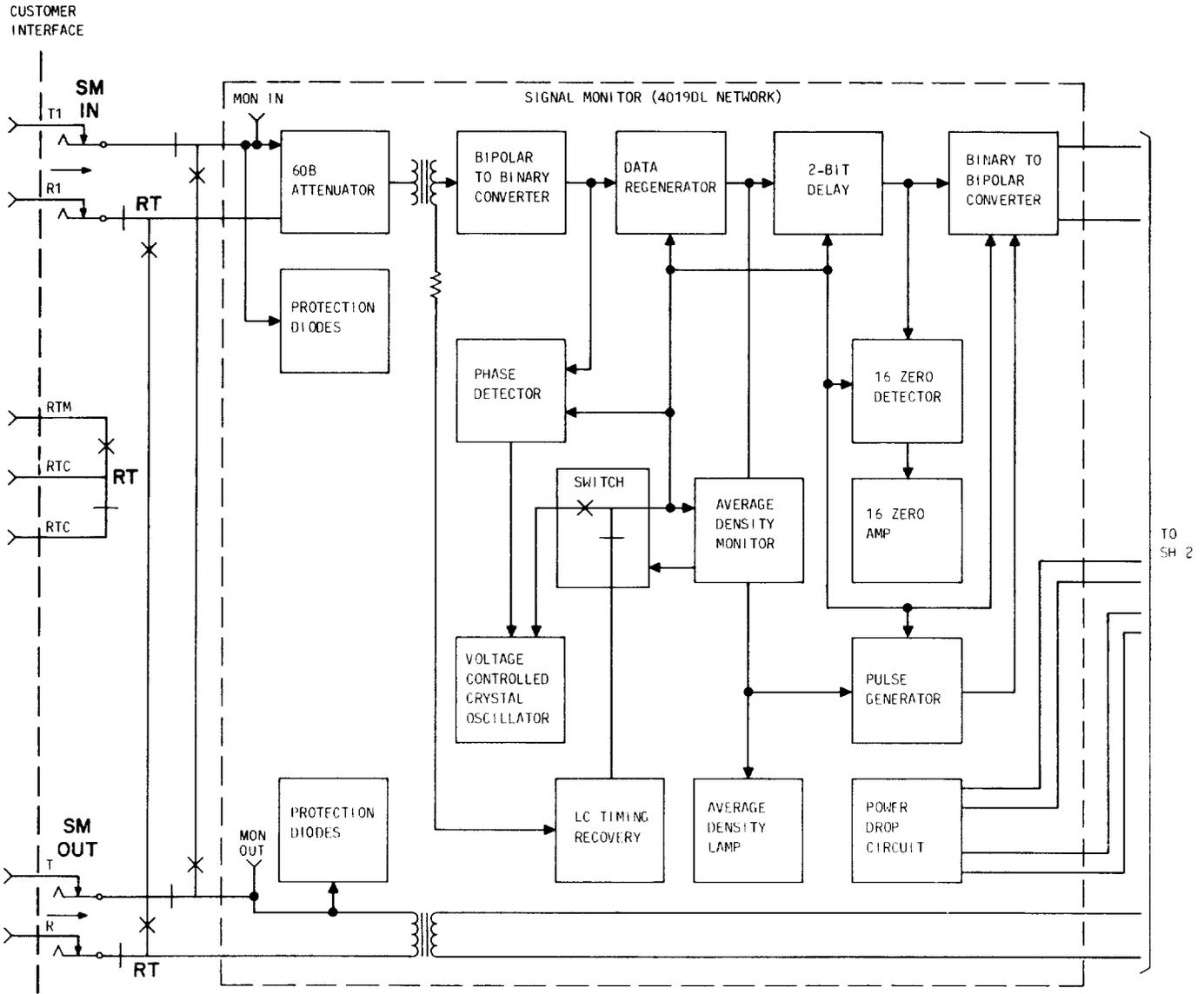


Fig. 4—551A Line Powered CSU—Block Diagram (Sheet 1 of 2)

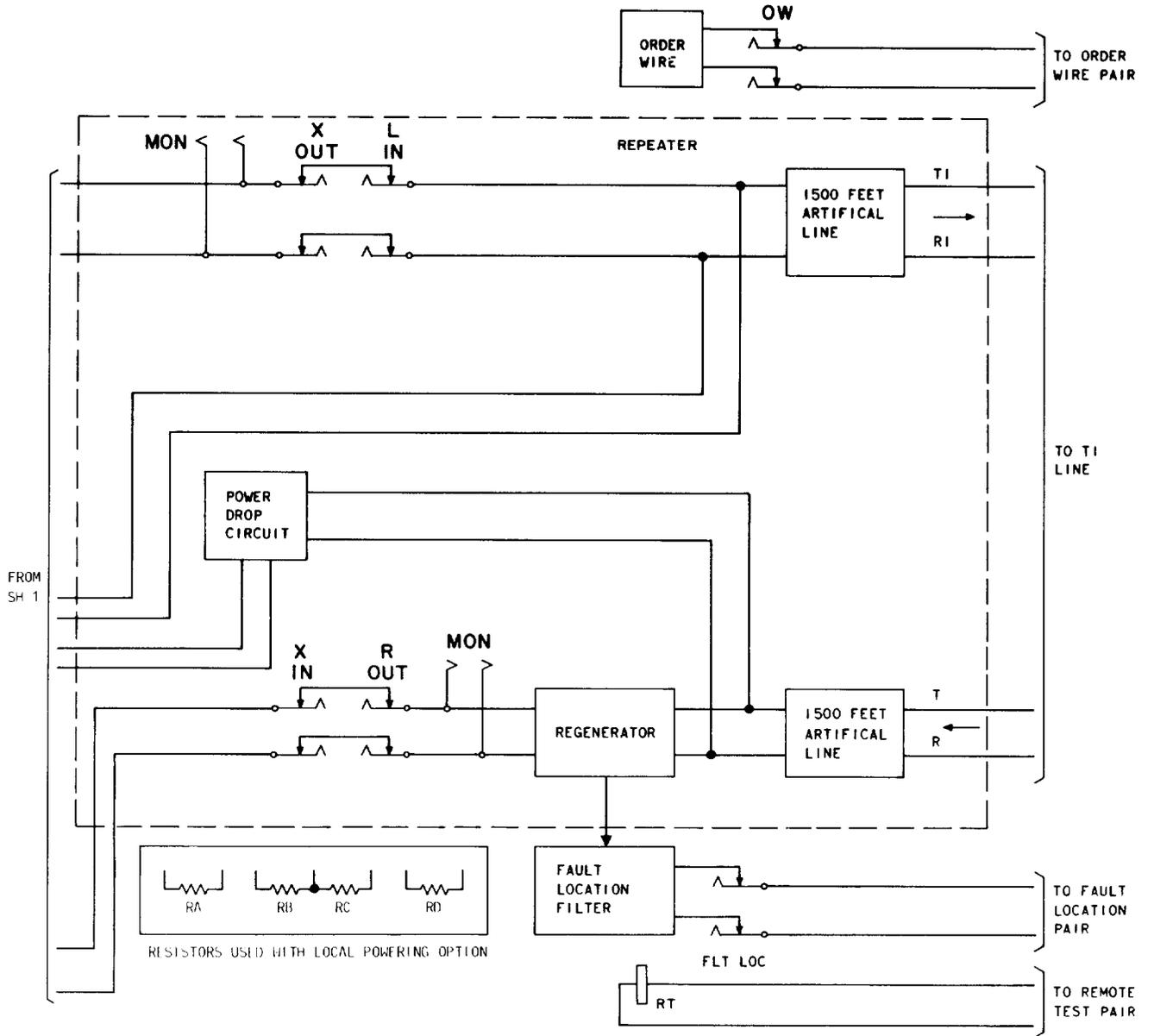


Fig. 4—551A Line Powered CSU—Block Diagram (Sheet 2 of 2)

TABLE A

## T1 REPEATER REQUIRED IN CSU FOR DIFFERENT SPAN LINE VOLTAGES

T1 REPEATER	MODE OF OPERATION (NOTE)	BATTERY ASSIGNMENT		TOTAL SPAN LINE VOLTAGE
		CENTRAL OFFICE	STATION	
206D or 206K	Looping	-48 +130 +130, -48 +130, -130		48 130 178 260
206A or 206H	Powering	-48 +130 +130, -48 +130, -130	-48 -48 -48 -48	96 178 226 308
206B or 206J	Powering	+130 +130, -48 +130, -130 +130 +130, -48 +130, -130 +130 +130, -48 +130, -130	+130 +130 +130 +130, -48 +130, -48 +130, -48 +130, -130 +130, -130 +130, -130	260 308 390 308 356 438 390 438 520
236AA	Looping	-48 +130 +130, -48 +130, -130		48 130 178 260
236AA	Powering	-48 +130 +130, -48 +130, -130 -48 +130 +130, -48 +130, -130 -48 +130 +130, -48 +130, -130 -48 +130 +130, -48 +130, -130	-48 -48 -48 -48 +130 +130 +130 +130 +130, -48 +130, -48 +130, -48 +130, -48 +130, -130 +130, -130 +130, -130	96 178 226 308 178 260 308 390 226 308 356 438 308 390 438 520
236AB	Looping	-48 +130 +130, -48 +130, -130		48 130 178 260
206A or 206H	Looping	-48 +130 +130, -48 +130, -130		48 130 178 260
206B or 206J	Looping	130 130, -48 130, -130		130 178 260

**Note:** When a repeater is used in a looping mode, power for the line is provided by the remote end of the system. When a powering repeater is used, line power is provided by the local end of the system. In either case, the local repeater can be powered in series with the line repeater or separately from a local -48 volt source and can be selected by options contained on the repeater.