



Digital and Analogue Data Transmission Systems 551E-L1, A Channel Service Unit Description, Installation, and Testing

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1. Overview

1.01 The purpose of this practice is to provide information to aid technicians in understanding the AT&T 551E-L1, A extended super frame (ESF) channel service unit (CSU) and to install and test it. This practice contains the physical and functional descriptions of the CSU and procedural information to install and test it.

1.02 This practice is reissued to include an addition to switch S2 and to change 551E-L1 to 551E-L1, A. Since Issue 1 of this practice was published for a very limited distribution, Issue 2 is a general revision; therefore, revision arrows are not used.

1.03 This practice contains admonishments in the form of **CAUTIONS** which indicate the presence of a hazard which can cause personal injury or equipment damage if the hazard is not avoided.

1.04 AT&T welcomes your comments on this practice. Your comments will aid in improving the quality and usefulness of AT&T documentation. Please use the Feedback Form provided at the end of this practice or call 1-800-334-0404 or 1-919-727-6681.

1.05 Additional copies of this practice may be ordered from the AT&T Customer Information Center as follows:

- Call 1-800-432-6600
- or
- Complete Form INDI-80.80 and mail to:

AT&T Customer Information Center
Attention: Order Entry Department
2855 N. Franklin Road
P.O. Box 19901
Indianapolis, IN 46219-1999

1.06 This practice includes a Federal Communications Commission (FCC) statement as follows:

Federal Communications Commission Notification and Repair Information

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits have been designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instructions manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.07 Technical assistance for the 551E-L1, A ESF CSU can be obtained by calling the Regional Technical Assistance Center (RTAC) at **1-800-225-RTAC**. This telephone number is staffed 24 hours per day.

2. Description

A. General

2.01 The 551E-L1, A ESF CSU (Figure 1) provides an interface between the customer data terminal equipment (DTE) and a DS1 line facility (network). It provides standard D4 framing format or ESF format capability. ESF allows transmission of performance-monitoring data through the DS1 line facility without interrupting service. The CSU stores the ESF performance data in internal registers. Access to the ESF performance data is through an EIA RS-232C port on a local CSU. The RS-232C port also provides access to the remote CSU at the far end. The CSU can convert between the standard D4 framing format and the ESF format, in either transmission direction.

B. Features

2.02 Features provided by the CSU are as follows:

- Transmits selected keep-alive loopback of network signal or all 1s to the DS1 facility (network) upon loss of customer DTE signal.
- Transmits selected framed or unframed all 1s signal to the network upon loss of customer DTE signal.
- Transmits selected D4 or ESF framing format toward the customer DTE and DS1 facility (network).
- Transmits optional B7 zero suppression code toward the DS1 facility.
- Transmits optional bipolar eight zero suppression (B8ZS) line coding format toward the customer DTE and toward the DS1 facility.
- Monitors the DS1 (1.544 MHz) signal from the customer DTE for average density requirements, excessive zeros, and frame loss and displays the status of each by lighting an associated lamp on the front panel.
- Ensures that the outgoing DS1 signal meets the DS1 facility requirements.
- Monitors the DS1 signal from the network for frame/signal loss (carrier group alarm), the presence of pulses, bipolar violations, and frame loss and displays the status of each by lighting an associated lamp on the front panel.
- Stores error measurements such as errored seconds, severely errored seconds, burst errored seconds, and failed seconds in internal registers for a 24-hour period in 15-minute increments.
- Provides optional fault-locating capability to aid in testing the DS1 line facility.

- Provides test jacks for accessing the customer DTE and the DS1 facility (network). These jacks can be used to manually loop the CSU and aid in testing.
- Activates or deactivates the remote test relay upon receipt of in-band looping codes or by application or removal of DC voltage over a dedicated pair of wires from the serving central office.
- Can be powered from a local -48 V DC power source (class 2 power).

C. Physical and Functional Descriptions

2.03 The 551E-L1, A CSU is housed in a steel chassis with an aluminum cover and has a front panel and a rear panel. It weighs approximately 6.5 lbs and has external dimensions of 1.75 inches (44.5 millimeters) high, 17.5 inches (444.5 millimeters) wide, and 10.25 inches (260.4 millimeters) deep.

2.04 The CSU can be installed in a cabinet, in a 19- or 23-inch rack, or can be mounted on a desk top. It will operate in an ambient temperature range of +32°F to +131°F and at a relative humidity of up to 95 percent.

2.05 The front panel contains 12 miniature test jacks and 12 lamps (Figure 2). The miniature jacks provide test and monitoring access to the transmit and receive paths for both the data terminal equipment and the network. The 6 DTE jacks provide an interface at the customer equipment side of the CSU and the 6 NTE jacks provide an interface at the DS1 line facility side. The 12 lamps are divided into 5 categories: CSU FAIL, DTE, LOOPBACK, NTE, and POWER.

2.06 The jacks used for testing and monitoring are described as follows:

- **DTE Jacks:**
 - **EQ IN** - Provides access to the output DS1 signal toward the customer DTE from the CSU while breaking the path at the CSU. It allows for sending signals to the customer DTE or providing a loopback (EQ IN and EQ OUT) toward the customer DTE.
 - **EQ OUT** - Provides access to the incoming DS1 signal from the customer DTE to the CSU while breaking the path. It allows for receiving signals from the customer DTE or providing a loopback (EQ OUT and EQ IN) toward the customer DTE.
 - **EQ MON** - Provides access for monitoring the DS1 signal from the customer DTE to the CSU without breaking the path.
 - **SM MON** - Provides access for monitoring the DS1 signal from the DS1 line facility to the CSU without breaking the path.

- **SM IN** - Provides access to the DS1 signal toward the DS1 line facility from the customer DTE while breaking the path from the customer DTE. It allows for sending signals to the DS1 line facility or providing a loopback (**SM IN** and **SM OUT**) toward the DS1 line facility.
- **SM OUT** - Provides access to the DS1 signal from the DS1 line facility to the CSU while breaking the path to the customer DTE. It allows for receiving signals from the DS1 line facility or providing a loopback (**SM OUT** and **SM IN**) toward the DS1 line facility.

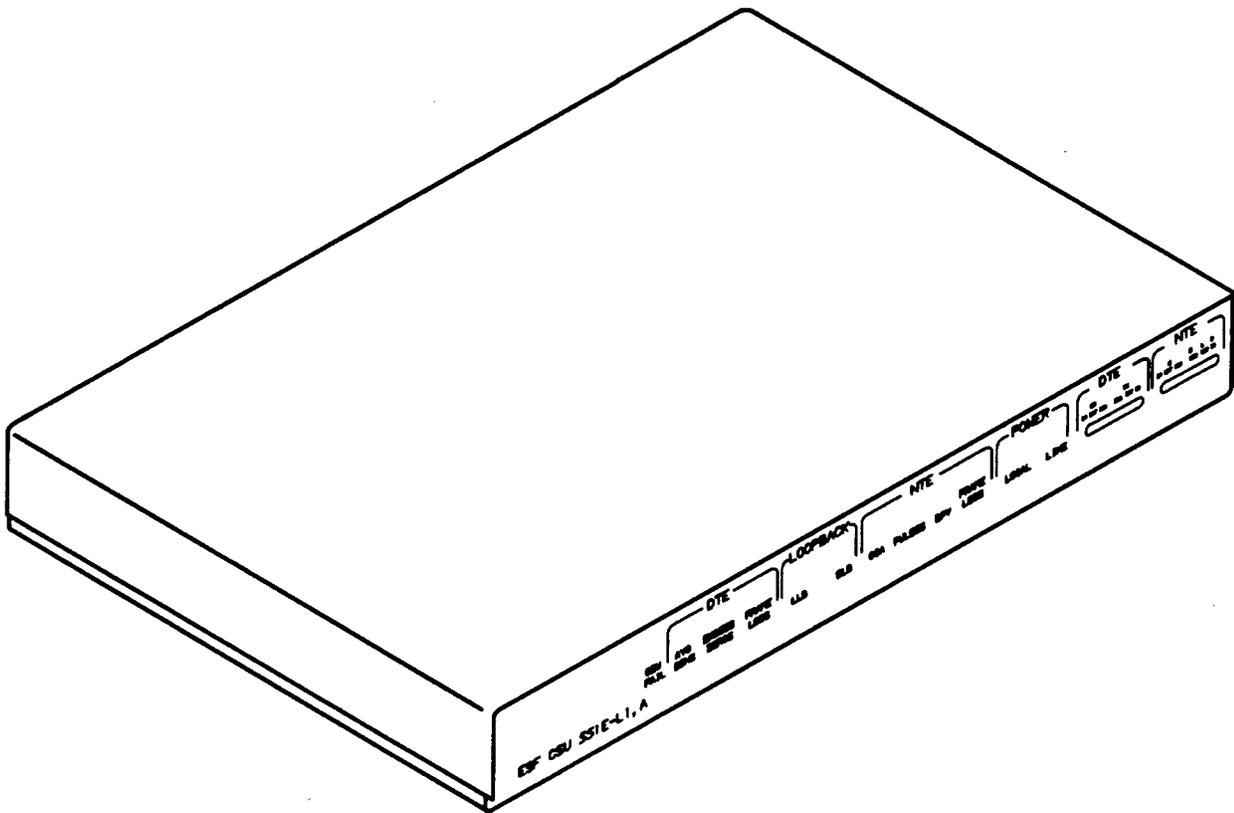


Figure 1. 551E-L1, A ESF Channel Service Unit (CSU)

- **NTE Jacks:**
 - **X IN** - Provides access to the customer DTE side of the CSU while breaking the path between the DS1 line facility and the CSU. It allows for sending test signals to the customer DTE side of the CSU or providing a loopback (**X IN** and **X OUT**) toward the customer DTE.
 - **X OUT** - Provides access to the incoming DS1 signal from the customer DTE side of the CSU while breaking the path between DS1 line facility and the CSU (isolates the DS1 line facility). It allows for receiving test signals from the customer DTE or providing a loopback (**X OUT** and **X IN**) toward the customer DTE.
 - **X MON** - Provides access for monitoring the DS1 signal from the customer DTE without breaking the path to the DS1 line facility.
 - **R MON** - Provides access for monitoring the DS1 signal from the DS1 line facility without breaking the path to the customer DTE side of the CSU.
 - **L IN** - Provides access to the DS1 line facility while breaking the path between the DS1 line facility and CSU. It allows for sending test signals to the DS1 line facility or providing a loopback (**L IN** and **R OUT**) toward the DS1 line facility.
 - **R OUT** - Provides access to the incoming DS1 signal from the DS1 line facility while breaking the path between the DS1 line facility and the customer DTE side of the CSU. It allows for test receiving signals from the DS1 line facility or providing a loopback (**R OUT** and **L IN**) toward the DS1 line facility.

2.07 The lamps are described as follows:

- **CSU FAIL Lamp** - Lights continuously if the CSU detects a failure during a self-test after a power-up. Note, that the lamp lights momentarily during the self-test as part of that test.
- **DTE Lamps:**
 - **AVG DENS** - Lights if the average density of the transmitted DS1 signal from the customer DTE falls below the requirements of AT&T Technical Reference TR62411. The lamp lights for a minimum of 150 milliseconds. This applies only to the alternate mark inversion (AMI) line coding option.
 - **EXCESS ZEROS** - Lights if the maximum allowable string of consecutive zeros is detected in the DS1 signal from the customer DTE. This can be set for 16 (AT&T TR62411) or 80 (FCC part 68). The lamp lights for a minimum of 150 milliseconds. This applies only to the AMI line coding option.
 - **FRAME LOSS** - Lights if an out-of-frame event occurs on the DS1 line from the customer DTE. The lamp lights for a minimum of 150 milliseconds.

- **LOOPBACK Lamps:**
 - **LLB** - Lights if the remote test relay is activated (causing a line loopback) upon receipt of an inband looping code or by DC voltage applied to the dedicated pair of wires.
 - **DLB** - Lights if DLB is activated. The DLB loopback is activated upon receipt of the DLB activation message received over the DS1 4-kb/s data link from the central office or from the DLB activation performed at a personal computer connected to the local CSU. The loopback can also occur at a remote CSU by DLB activation from a personal computer connected to a local CSU. (The DLB activation command is also carried over the DS1 4-kb/s data link to the remote CSU.)

- **NTE Lamps:**
 - **CGA** - Lights if carrier group alarm occurs due to frame loss or signal loss.
 - **PULSES** - Lights as long as there are pulses present on the incoming DS1 signal from the network.
 - **BPV** - Lights if excessive bipolar violations occur on the incoming DS1 signal from the network. This lamp lights for a minimum of 150 milliseconds.
 - **FRAME LOSS** - Lights if an out-of-frame event occurs on the DS1 line from the network. This lamp lights for a minimum of 150 milliseconds.

- **POWER Lamps:**
 - **LOCAL** - Indicates that the CSU is being powered by the local -48 V DC power source.
 - **LINE** - Indicates that the CSU critical circuitry is being powered.

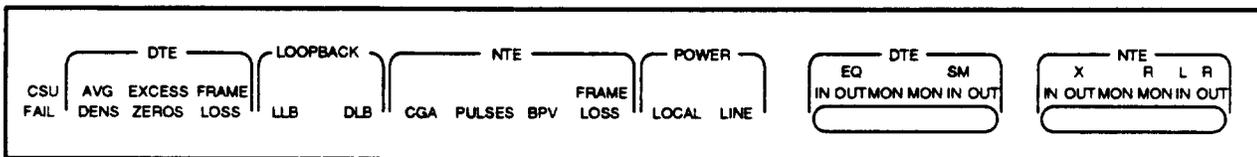


Figure 2. 551E-L1, A ESF CSU Front Panel

2.08 On the rear panel of the 551E-L1, A (Figure 3), there are four external connectors, -48 V DC power spade-lug terminals, and a **CUSTOMER LOOPBACK** switch. The **CUSTOMER LOOPBACK** switch (S3) is a slide switch which causes customer data sent from the DTE to be looped back to the DTE when placed into the **ON** position. An **ER** stamped on the rear panel represents extended range (ER). ER allows for cable losses of up to 27 dB toward the network.

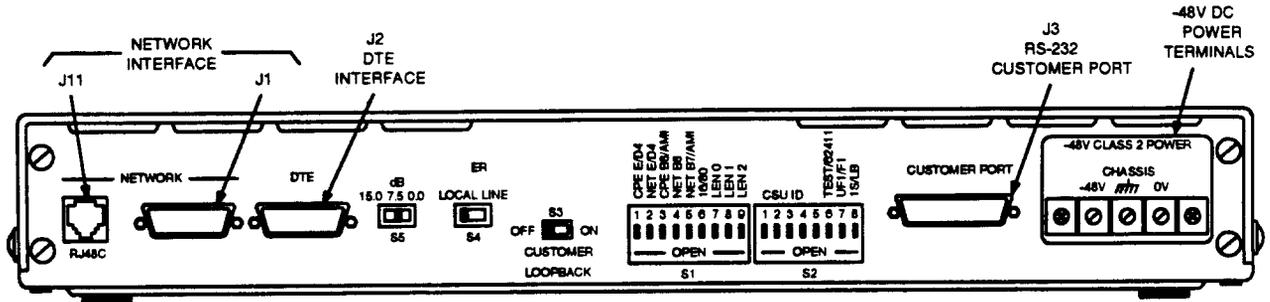


Figure 3. 551E-L1, A ESF CSU Rear Panel

2.09 The four rear panel connectors are as follows:

- **NETWORK** - J11 and J1 are two different types of connectors used to connect to the DS1 line facility (Figure 3). J11 is an 8-pin modular-type connector (RJ48C). It provides connections to the network through an M4AU data cord or equivalent. However, J11 does not provide connections for the fault-locating filter option. J1 is a 15-pin male D-type connector (KS-19088, List 15). J1 provides connections to the network and for the fault-locating filter option through a 758A cable pair with shield or equivalent and a KS-19087, List 1 connector or an equivalent connector.
- **DTE** - J2 is a 15-pin female D-type connector (KS-19087, List 1) used to connect to the customer DTE through a DS1 cable (758A cable pair with shield) and 15-pin male D-type connector (KS-19088, List 15 or equivalent).
- **CUSTOMER PORT** - J3 is a 25-pin connector (EIA RS-232C) used to connect a customer-provided AT&T 6300 Personal Computer (PC) or an equivalent to the CSU for retrieving facility performance data. See Figure 4. A customer-provided multiport manual switch can be used as shown in Figure 4.

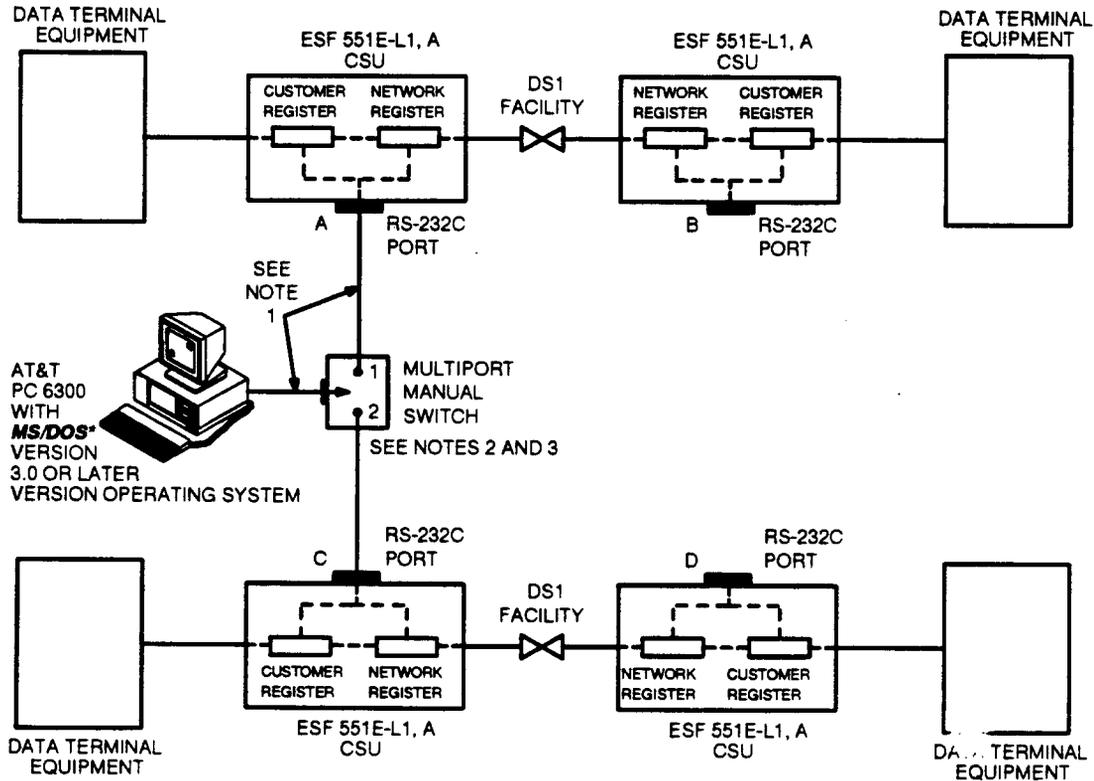
D. Performance Data Retrieval

2.10 The CSU (local and remote) stores network and customer performance data within internal registers in the CSU. By performing the proper user commands at a connected PC (Figure 4), this data can be retrieved, reviewed, and printed (if a printer is connected to the PC). Equipment and other items required in order to access the performance data are as follows:

- AT&T 6300 PC or equivalent using **MS/DOS*** Version 3.0 or later operating system software.

* Registered trademark of Microsoft Corp.

- Customer port driver software (Version 1.0 or later). For more information about the customer port driver software program and how to use it with the PC, refer to the Customer Port Driver Software User Guide.
- An EIA RS-232C noncrossover cable for connecting the associated port on the PC to the **CUSTOMER PORT** connector on the CSU.



NOTES:

1. THE RS-232C CABLE LENGTH IS LIMITED TO THE EIA STANDARD OF 50 FEET.
2. THE MULTIPOINT MANUAL SWITCH ALLOWS THE ESF DATA TO BE RETRIEVED FROM TWO DS1 LINE FACILITIES. WITH THE SWITCH SET TO THE #1 POSITION, ESF DATA FROM THE LOCAL CSU (A) AND ESF DATA FROM THE REMOTE CSU (B) CAN BE RETRIEVED. WITH IT SET TO THE #2 POSITION, ESF DATA FROM THE LOCAL CSU (C) AND ESF DATA FROM THE REMOTE CSU (D) CAN BE RETRIEVED.
3. THE MAXIMUM NUMBER OF DS1 LINE FACILITIES THAT CAN BE ACCESSED BY THE AT&T PC 6300 IS LIMITED TO THE NUMBER OF CSU RS-232C PORT CONNECTIONS MADE TO THE MULTIPOINT MANUAL SWITCH.

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Figure 4. EIA RS-232C Customer Port Application

3. Installation

A. General

3.01 This part contains the information to install the 551E-L1, A ESF CSU and to make the necessary wire connections.

3.02 The recommended order of installation for the CSU is as follows:

- (1) Set the options.
- (2) Install the CSU as required. It can be rack, cabinet, or desk-top mounted.
- (3) Make the required connections which include power-up and self-test.

B. Option Settings



CAUTION:

Always remove power to the CSU before altering any of the switch settings except for the CUSTOMER LOOPBACK switch (S3).

3.03 The five switches used to set options are **S1** (a 9-section dip switch), **S2** (an 8-section dip switch of which only sections 6, 7, and 8 are presently used), **S3** (a 2-position slide switch), **S4** (a 2-position slide switch), and **S5** (a 3-position slide switch). See Figure 3. Switch **S2** has 5 sections reserved for future applications.

3.04 To set the appropriate switches, perform the following steps.

Step	Procedure
1	If the CSU is powered, disconnect the DC power from the DC power spade-lug terminals at the rear of the CSU.
2	Remove two screws on each side of the CSU and slide the top cover backwards approximately one-half of an inch. Remove the cover by pulling upwards. This will expose the circuit board where the switches can be reached.

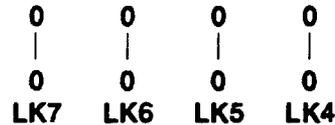
Step	Procedure
3	<p>Set the sections on S1 to select appropriate options as follows:</p> <p>CPE E/D4 For the customer DTE ESF framing format, set switch (S1-1) to OPEN. For the customer DTE D4 framing format, set switch (S1-1) to the <i>CLOSED</i> position (opposite of OPEN).</p> <p>NET E/D4 For the network ESF framing format, set switch (S1-2) to OPEN. For the network D4 framing format, set switch (S1-2) to the <i>CLOSED</i> position (opposite of OPEN).</p> <p>CPE B8/AMI For the customer DTE B8ZS line coding format, set switch (S1-3) to OPEN. For the customer DTE AMI line coding format, set switch (S1-3) to the <i>CLOSED</i> position (opposite of OPEN).</p> <p>NET B8 For the network B8ZS line coding format, set switch (S1-4) to OPEN. This will disable the S1-5 (NET B7/AMI) option. For the network B7 or AMI line coding format, set switch (S1-4) to the <i>CLOSED</i> position (opposite of OPEN). This will enable the S1-5 (NET B7/AMI) option.</p> <p>NET B7/AMI For the network B7 zero coding (D4 standard), set switch (S1-5) to OPEN. For the network AMI line coding, set switch (S1-5) to the <i>CLOSED position (opposite of OPEN)</i>.</p> <p>16/80 For zero count monitor threshold of 16, set switch (S1-6) to OPEN. For zero count monitor threshold of 80, set switch (S1-6) to the <i>CLOSED</i> position (opposite of OPEN).</p> <p>LEN0, LEN1, LEN2 Refer to the following chart to determine the settings for S1 switches 7, 8, and 9 based upon the type and length of cable used between the CSU and the customer DTE.</p>

TYPE OF CABLE	LINE LENGTH SELECTED (FEET)	SETTINGS FOR S1 SWITCHES		
		LEN2 9	LEN1 8	LEN0 7
MAT & ICOT	0 - 220	Closed	OPEN	OPEN
	220 - 440	Closed	Closed	OPEN
	440 - 655	Closed	OPEN	Closed
ABAM & PIC	0 - 133	Closed	OPEN	OPEN
	133 - 266	OPEN	Closed	Closed
	266 - 399	OPEN	Closed	OPEN
	399 - 533	OPEN	OPEN	Closed
	533 - 655	OPEN	OPEN	OPEN

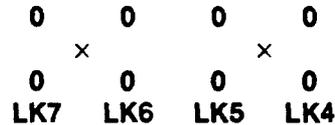
Step	Procedure
4	Set switch S2 sections 6 , 7 , and 8 to the desired position as follows: ⇒ NOTE: Disregard switch sections 1 through 5 . They are for future applications. (a) Set section 6 to the <i>CLOSED</i> (62411) position (opposite of OPEN) for pulse density enforcement in accordance with AT&T Technical Reference TR62411 or to OPEN (TEST) to disable pulse density enforcement or to perform testing without pulse density enforcement. ⇒ NOTE: Section 6 of switch S2 is provided for installation and maintenance testing from the customer side of the CSU. It should be in the <i>CLOSED</i> position for normal operation. It has no effect on B8ZS or B7 operation but disables AMI line coding including zero code suppression. (b) Set section 7 to the OPEN position if unframed all 1s are to be sent to the DS1 facility (network) or to the <i>CLOSED</i> position (opposite of OPEN) if framed all 1s are to be sent to the DS1 facility (network). (c) Set section 8 to OPEN if all 1s signal is to be sent to the network upon loss of customer DTE signal or to the <i>CLOSED</i> position (opposite of OPEN) to activate keep alive loopback of the network signal upon loss of customer DTE signal.
5	Set switch S4 to one of the following positions: <ul style="list-style-type: none">▪ Set switch S4 to LINE if the critical circuitry is to be powered by 60- or 140-mA simplex current from the DS1 line.▪ Set switch S4 to LOCAL if the critical circuitry is to be powered locally. The simplex power loop is maintained towards the DS1 facility.
6	For ALBO (artificial line buildout), set switch S5 to 0.0 dB , 7.5 dB , or 15.0 dB as required.
7	Set switch S3 to OFF for normal operation. When a customer loopback is desired for testing, set S3 to ON .
8	Strap connections are made at LK4 through LK8 (Figure 5) for the various options. Strap connections LK1 through LK3 are factory-wired. LK 4 , LK 5 , LK 6 , and LK 7 strap positions are used to reverse the transmit and receive

Step	Procedure
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paths on J11. To transmit to the network on the T and R pair and receive from the network on the T1 and R1 pair, strap LK 4, LK 5, LK 6, and LK 7 as follows:



To transmit to the network on the T1 and R1 pair and receive from the network on the T and R pair, strap two straps between LK 7 and LK 6 and two straps between LK 5 and LK 4 as follows:



- 9 If the **NETWORK** J11 connector is used to connect the DS1 line facility or if the fault-locating filter is not used, strap LK8.
- 10 Replace the top cover and tighten the two screws on each side.

STOP. YOU HAVE COMPLETED THE OPTION SETTINGS.

C. Mounting the CSU

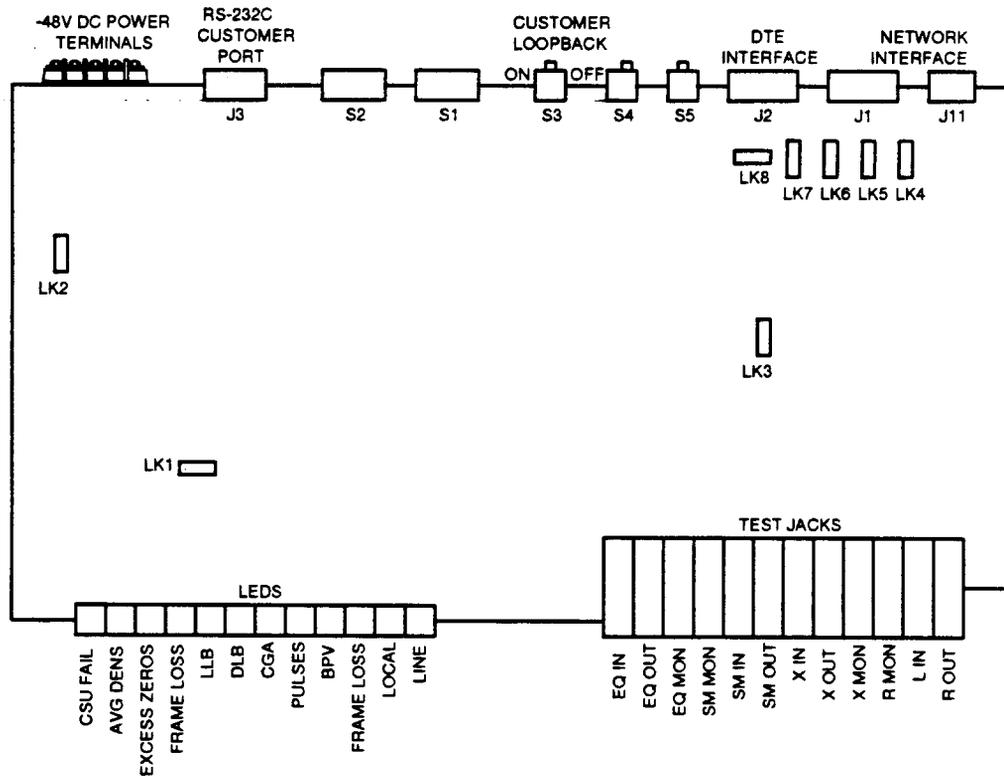
3.05 The CSU can be rack, cabinet, or desk-top mounted as follows:

- **Rack Mounting**

The 551E-L1, A CSU can be installed in either a 19- or a 23-inch rack. Determine the rack position to which the CSU is to be mounted (front or mid-rack) and mount the appropriate external brackets (provided with the CSU) to the side of the CSU. Mount the CSU in the rack by aligning the side brackets with the screw holes in the racks. Secure the CSU using the proper size of screws.

- **Cabinet Shelf or Desk-Top Mounting**

Four rubber studs are attached to the underside of the CSU for cabinet-shelf or desk-top mounting. No installation is required other than positioning the CSU on the proper shelf or desk top.



NOTE:
LK1-LK8 STRAPS ARE FACTORY SET. IF THE J1 NETWORK INTERFACE CONNECTOR IS TO BE USED WITH THE FAULT LOCATING FILTER CONNECTION, LK8 STRAP MUST BE REMOVED.

Figure 5. 551E-L1, A ESF CSU Option Switch and Strap Positions

D. Connections

3.06 The 551E-L1, A CSU external connections are made with male and female 15-pin, D-type connectors, an 8-pin modular telephone jack, and -48 V DC power spade-lug terminals (Figures 3 and 6).

3.07 The customer DTE interface connection is made at the rear of the CSU at the J2 (DTE) 15-pin female D-type connector. The customer DTE cable (758A twisted cable pair with shield or equivalent) should be equipped with a KS-19088, List 15 or equivalent connector having a right-angle hood and sliding lock assembly. This will allow the connector to mate and lock with the DTE connector. The maximum allowable

cable distance between the customer DTE and the CSU is 655 feet. The J2 pin assignments and lead designations for the connector are as follows:

<u>J2 (DTE) PINS</u>	<u>DESIGNATION</u>
1	T Receive from Customer DTE
9	R Receive from Customer DTE
2	Shield Ground
3	T1 Transmit to Customer DTE
11	R1 Transmit to Customer DTE
4	Shield Ground.

3.08 The DS1 line facility network interface connection is made at the rear of the CSU at either the **NETWORK J1** connector or the **NETWORK J11 (RJ48C)** connector. The J1 15-pin male D-type connector must be used if fault locating is desired. If the J1 connector is used and the fault-locating filter is not used, **LK8** must be strapped. See Figure 5 for **LK8** location. J1 connects to a 15-pin female connector (KS-19087, List 1 or equivalent) through a 758A twisted cable pair with shield or equivalent from the DS1 line facility. Extended range (ER) is provided which allows cable losses of up to 27 dB toward the network.

3.09 The J11 8-pin modular connector (RJ48C) can be used if a modular connection is desired without fault-locating filter capability. **LK8** must be strapped. Connection to J11 is through an RJ48C 8-pin plug and M4AU data cord or equivalent.

3.10 The pin assignments and lead designations for J1 and J11 connectors are as follows:

<u>NETWORK J1 PINS</u>	<u>DESIGNATION</u>
1	T Transmit to DS1 Network
9	R Transmit to DS1 Network
2	Shield Ground
3	T1 Receive from DS1 Network
11	R1 Receive from DS1 Network
4	Shield Ground
5	Fault-Locating Filter
6	Fault-Locating Filter
7	+ DC Power for LLB (Line Loopback)
8	- DC Power for LLB (Line Loopback)

<u>NETWORK J11 PINS</u>	<u>DESIGNATION</u>
2	T Transmit to DS1 Network
1	R Transmit to DS1 Network
8	Shield Ground
5	T1 Receive from DS1 Network
4	R1 Receive from DS1 Network
7	Shield Ground.

3.11 The EIA RS-232C connection to a PC 6300 or equivalent personal computer is made at the rear of the CSU at J3 (**CUSTOMER PORT**) 25-pin female D-type connector. The maximum cable distance for this connection is the EIA standard of 50 feet. The pin assignments and lead designations for the J3 connector are as follows:

<u>CUSTOMER PORT J3 PINS</u>	<u>DESIGNATION</u>
1	Frame Ground
2	Receive
3	Transmit
5	Tied To 6 & 20
6	Tied To 5 & 20
20	Tied To 5 & 6
7	Ground

3.12 To power up the CSU, connect the -48 V DC power lead to the - **48V terminal** and the battery return lead to the **0V terminal** at the rear of the CSU (Figure 3). When the CSU is powered, the CSU goes through a self-test for 4 seconds (the CSU **FAIL** lamp is lighted). The CSU **FAIL** lamp extinguishes after 4 seconds if the test is successful.

4. Test Procedures

A. General

4.01 This part describes the test procedures that can be used after the CSU is installed and the options are set or when trouble clearing is required.

4.02 There are three types of loopback tests that can be performed on the CSU. Before any of the tests can be performed, the DS1 line facility must be installed and tested. The loopback tests are as follows:

- Customer Loopback
- Line Loopback
- CSU Loopback.

4.03 Since the CSU and line loopback tests use DS1 facility test sets, these two loopback tests are not intended as a requirement for the customer.

B. Customer Loopback

4.04 The customer loopback test is performed at the customer premises CSU. A loopback occurs when the **CUSTOMER LOOPBACK** switch (S3) is set to the **ON** position. Any data sent from the customer DTE to the CSU is looped and sent back to the customer DTE.

C. Line Loopback Test

4.05 The line loopback test is performed at the central office and at the customer premises CSU. Therefore, technicians are required at each location to perform some of the steps or verifications. The test checks the regenerator circuitry of the CSU and the DS1 line facility by remotely looping the transmit pair to the receive pair at the CSU. Once the loopback is made, test signals are transmitted to the CSU from the central office. The loopback can be performed by operating the remote test relay or by manually patching the **R OUT** jack to the **L IN** jack on the CSU (Figure 7). The manual loopback is also called regenerator loopback test. The remote test relay can be activated/deactivated by codes sent through the DS1 line facility or by DC voltage (5V DC @ 20 mA) applied to a dedicated pair of wires from the central office.

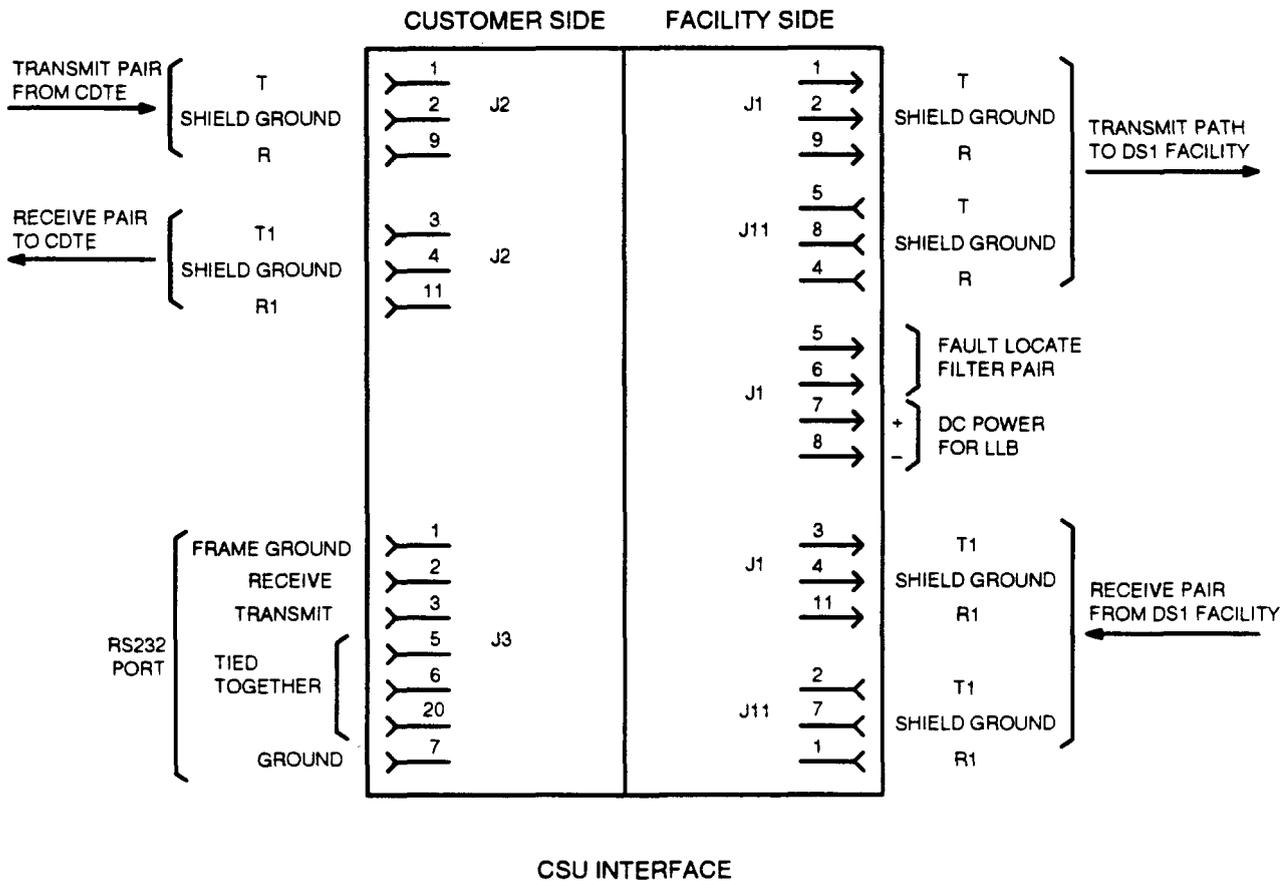


Figure 6. 551E-L1, A ESF CSU Block Diagram of Pin Assignments

4.06 The following equipment is required to perform the test:

- HP 3787B test set or equivalent for use at the central office
- Two 3P7C cords for use at the central office
- One patch cord terminated on each end with miniature telephone jacks for use at the CSU if a manual loopback is to be made (not required if activation of the remote test relay can be done).

4.07 Perform the following steps to run the Line Loopback Test:

Step	Procedure
1	Establish voice contact between the central office and the customer premises CSU. All steps of this procedure apply to the central office technician except when the steps specify an action at the customer premises CSU.
2	Make test set connections as shown in Figure 7.
3	At the customer premises CSU verify or set switch S2 rocker positions (Figure 3) 8 (1S/LB) to the OPEN (1s) position and 7 (UF1/F1) to the OPEN (UF1) position. Disconnect the customer DTE cable connector from connector (J2) at the rear of the CSU. The DTE alarm lamps AVG DENS , EXCESS ZEROS , and FRAME LOSS on the CSU and the ALARMS AIS lamp on the test set at the central office should light.
4	Perform the line loopback by one of the following methods: <ul style="list-style-type: none"> ▪ Activate the RT relay by applying a DC voltage to the remote test pair of wires (Figure 7). ▪ Connect a patch cord between R OUT and L IN jacks at the customer premises CSU to activate a manual line loopback (Figures 2 and 7). ▪ Send an inband loop-up code using the HP 3787B test set (Figure 8) by performing the following steps: <ol style="list-style-type: none"> (a) Power up the HP 3787B test set and allow from 12 to 15 seconds for the initialization and self-test processes to finish. The INDEX page is then displayed with the cursor positioned on Page 1 of Normal Operation. See the bottom portion of Figure 8.

Step	Procedure
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- (b) Press the **PAGE** or the **INDEX** button. The **Normal Operation Receiving** page should appear in the display. The **Normal Operation Transmitting** page may appear first. If so, move the cursor (using the cursor positioning buttons) to the **Transmitting** field and press the **NEXT** or the **PREV** button to select the **Receiving** page. The **Receiving** page should have the following information displayed in the corresponding fields:

FIELDS	SETUP INFORMATION
Code	AMI
Frame	ESF
Select	DS1
Pattern	20 Stage PRBS 14-0 Limit On

If any field is different than what is shown above, move the cursor to the appropriate field and press the **NEXT** or the **PREV** button until the correct information is displayed.

- (c) Set the **Results** field to display **Error Seconds** and the **Gating Interval** to display **15** by performing the following steps:
- (1) Move the cursor to just past the **DS1** in the **Results** field. Press the **NEXT** or the **PREV** button to select the **Logic** field. Set the **Logic** field to display **Async Err Sec**.
 - (2) Move the cursor to the **Elapsed Time** field. Press the **NEXT** or the **PREV** button to select **Gating**.
 - (3) Move the cursor to the right and press the **NEXT** or the **PREV** button to select **Interval**.
 - (4) Move the cursor to the right to the **Days** field and press the **NEXT** or the **PREV** button to select **00**.
 - (5) Move the cursor to the right to the hours, minutes, and seconds field and press the **NEXT** or the **PREV** button to select **00:15:00**.
- (d) Move the cursor to the **Receiving** field and press the **NEXT** or the **PREV** button. The **Transmitting** page is then displayed.

Step	Procedure
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The **Transmitting** page should have the following information in the corresponding fields:

FIELDS	SETUP INFORMATION
Code	AMI
Frame	ESF
DS1 Clock	INT
Transmit	DS1
Alarms	None
Loopback	Off
Pattern	20 Stage PRBS 14-0 Limit On
Error	No Error Add

If any field is different than what is shown above, move the cursor to the appropriate field and press the **NEXT** or the **PREV** button until the correct information is displayed.

- (e) Move the cursor to the Loopback field and press the **NEXT** or **PREV** button until **Fixed** is displayed.
- (f) Press the **EXEC** button to send the loop-up code to the CSU. After approximately 5 seconds, the **LOOPED** lamp lights on the CSU.

- 5 Press the **START/STOP** button to start the test. The green lamp above the button should light indicating that the test is in progress. The test should run for 15 minutes.
- 6 Verify that all **ALARMS** lamps on the test set are extinguished.
- 7 Observe the **Results** field. If the error-seconds count exceeds 30 for the 15-minute interval, the test fails.
- 8 Remove the loopback by one of the following methods depending upon how it was made:
 - Remove the DC voltage that was applied to the remote test pair of wires.
 - Remove the patch cord between **R OUT** and **L IN** jacks on the CSU at the customer premises.
 - Send an inband loop-down code to the CSU from the test set as follows:

Step	Procedure
	<p>(a) Move the cursor to the Receiving page and press the NEXT or the PREV button to display the Transmitting page.</p> <p>(b) Press the EXEC button to send the loop-down code which releases the loopback. Allow approximately 5 seconds for it to finish. The code conditions the CSU to send an all ones pattern signal towards the central office.</p>
9	Verify that the test set ALARMS AIS lamp is lighted.
10	At the customer premises CSU reconnect the customer DTE cable connector to DTE (J2) on the rear of the CSU, and reset rockers 7 and 8 on switch S2 (Figure 3) to their original positions.
11	Verify that the test set ALARMS AIS lamp is extinguished.
12	Remove all test connections.

STOP. YOU HAVE COMPLETED THE LINE LOOPBACK TEST.

D. CSU Loopback Test

4.08 The CSU loopback test is a test of the CSU at the customer premises and the DS1 line facility. It is made by manually looping the transmit pair to the receive pair at the customer premises CSU and transmitting test signals from the central office. Although the test is performed at the central office, some of the steps or verifications are done at the customer premises CSU. Refer to Figure 7 for making the loopback connection.

4.09 The following equipment is required to perform the CSU loopback test:

- HP 3787B test set or equivalent for use at the central office
- Two 3P7C cords for use at the central office
- One patch cord terminated on each end with miniature telephone jacks for use at the customer premises.

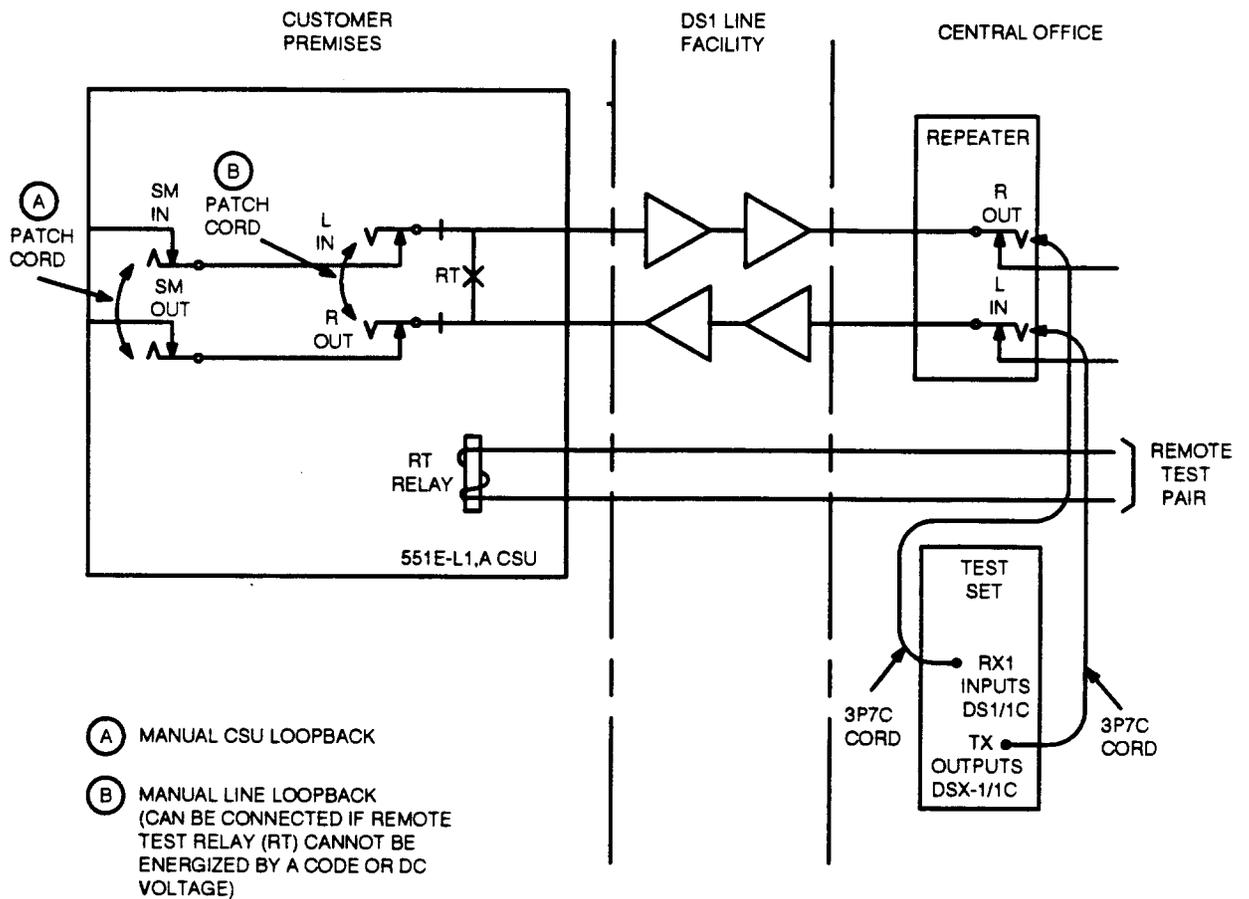


Figure 7. Line and CSU Loopback Tests Connections

4.10 Perform the following steps to run the CSU Loopback Test:

Step	Procedure
1	Establish voice contact between the central office and the customer premises CSU.
2	Make test set connections as shown in Figure 7.

Step Procedure

- 3 At the customer premises CSU verify or set the following rocker positions on the S2 switch (Figure 3):
- 8 (1S/LB) to the OPEN (1S) position
 - 7 (UF1/F1) to the OPEN (UF1) position
 - 6 (TEST/62411) to the OPEN (TEST) position.

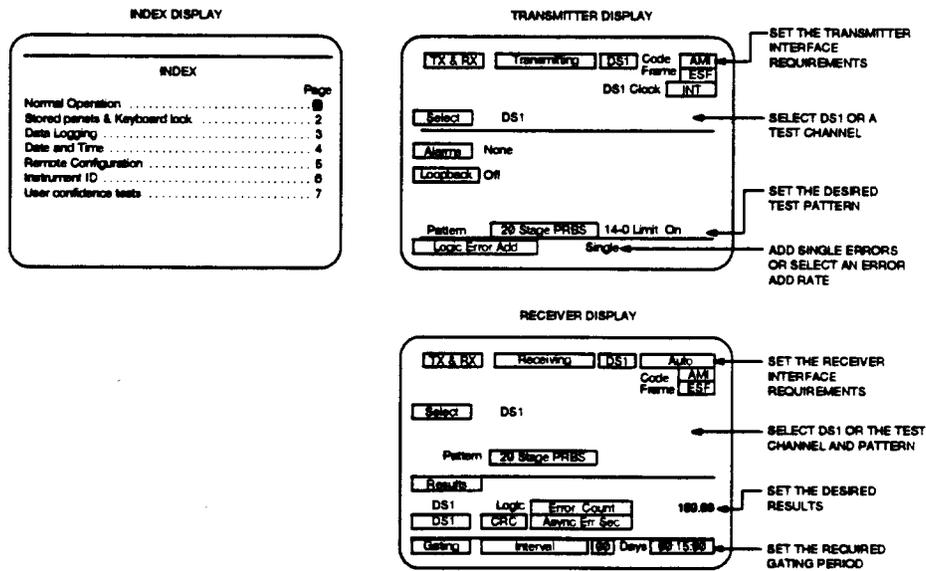
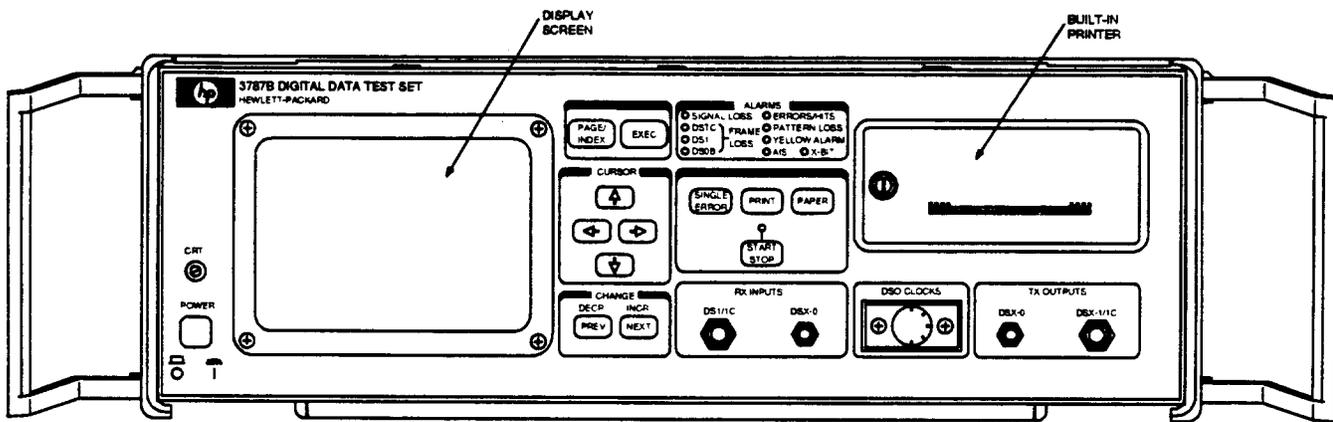


Figure 8. HP 3787B Digital Data Test Set

Step	Procedure
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- | | |
|---|--|
| 4 | <p>Prepare the HP 3787B test set (Figure 8) as follows:</p> <p>(a) Power up the HP 3787B test set and allow from 12 to 15 seconds for the initialization and self-test processes to finish. The INDEX page is then displayed with the cursor positioned on Page 1 for Normal Operation. See the bottom portion of Figure 8.</p> <p>(b) Press the PAGE or the INDEX button. The Normal Operation Receiving page should appear in the display. The Normal Operation Transmitting page may appear first. If so, move the cursor (using the cursor-positioning buttons) to the Transmitting field and press the NEXT or the PREV button to select the Receiving page. The Receiving page should have the following information displayed in the corresponding fields:</p> |
|---|--|

FIELDS	SETUP INFORMATION
Code	AMI
Frame	ESF
Select	DS1
Pattern	20 Stage PRBS 14-0 Limit On

If any field is different than what is shown above, move the cursor to the appropriate field and press the **NEXT** or the **PREV** button until the correct information is displayed.

- (c) Set the **Results** field to display **Error Seconds** by moving the cursor just past the **DS1** in the **Results** field. Press the **NEXT** or the **PREV** button to select the **Logic** field. Set the **Logic** field to display **Async Err Sec**.
- (d) Set the **Gating Interval** field to display **15** by moving the cursor to the **Elapsed Time** field. Press the **NEXT** or the **PREV** button to select **Gating**. Move the cursor to the right and press the **NEXT** or the **PREV** button to select **Interval**. Move the cursor to the right to the **Days** field and press **NEXT** or the **PREV** button to select **00**. Move the cursor to the hours, minutes, and seconds field and press the **NEXT** or the **PREV** button to select **00:15:00**.

Step	Procedure
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- (e) Move the cursor to the **Receiving** field and press the **NEXT** or the **PREV** button. The **Transmitting** page is then displayed. The **Transmitting** page should have the following information in the corresponding fields:

FIELDS	SETUP INFORMATION
Code	AMI
Frame	ESF
DS1 Clock	INT
Transmit	DS1
Alarms	None
Loopback	Off
Pattern	20 Stage PRBS 14-0 Limit On
Error	No Error Add

If any field is different than what is shown above, move the cursor to the appropriate field and press the **NEXT** or the **PREV** button until the correct information is displayed.

- 5 Have the technician at the customer premises CSU disconnect the customer DTE cable from the **DTE (J2)** connector at the rear of the CSU. The **ALARMS AIS** lamp on the test set and the **DTE** alarm lamps **AVG DENS**, **EXCESS**, and **FRAME LOSS** on the customer premises CSU should light.
- 6 Have the technician at the customer premises CSU connect the **SM OUT** jack to the **SM IN** jack on the front panel of the CSU using the patch cord. See Figures 2 and 7.
- 7 Press the **START/STOP** button to start the test. The green lamp above the button should light indicating that the test is in progress. The test should run for 15 minutes.
- 8 Verify that no bit errors are accumulating at the test set.
- 9 Remove the loopback connection at the CSU. The test set should be receiving an AIS signal again.
- 10 If the test fails or if the AIS signal is not present at the test set, have the technician at the customer premises CSU connect the **R OUT** jack to the **L IN** jack. Repeat Steps 6, 7, and 8. If the test fails again, the trouble is in the line. Continue with Step 11.

Step	Procedure
11	Have the technician at the CSU remove the loopback connection between the R OUT jack and the L IN jack.
12	Reconnect the customer interface connector DTE (J2) on the rear of the CSU, and reset rockers 6, 7, and 8 on switch S2 (Figure 3) to their original positions.
13	Verify that all ALARMS lamps on the test set are extinguished.
14	Remove all test set connections at the central office.

STOP. YOU HAVE COMPLETED THE CSU LOOPBACK TEST.
