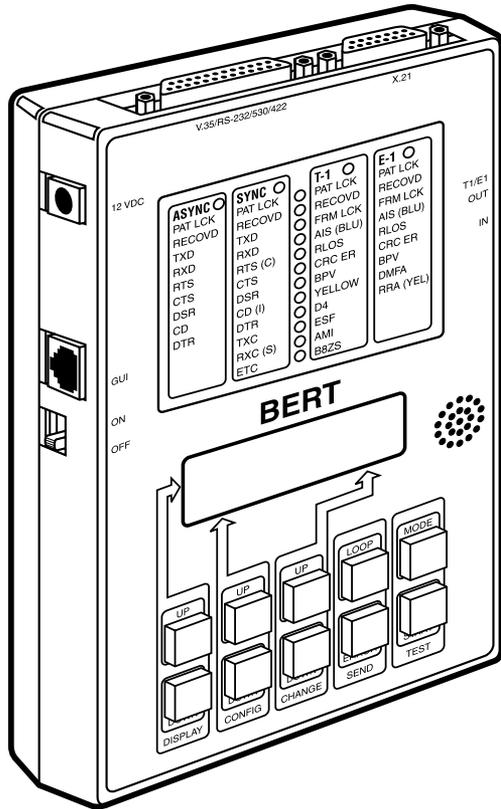# BERT Tester

**FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS**

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.

2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.

3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.

4. Todas las instrucciones de operación y uso deben ser seguidas.

5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..

6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.

7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.

8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.

9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.

10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

   A: El cable de poder o el contacto ha sido dañado; u

   B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

   C: El aparato ha sido expuesto a la lluvia; o

   D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

   E: El aparato ha sido tirado o su cubierta ha sido dañada.

TRADEMARKS USED IN THIS MANUAL

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VT100 is a trademark of Digital Equipment Corporation.

Winchester is a registered trademark of Winchester Systems, Inc.

Any other trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Important Safety Instructions

1. Do not allow anything to rest on the power cord, and do not place the product where people will walk on the power cord.

2. Do not attempt to service this product yourself, as opening or removing covers may expose you to dangerous high-voltage points or other risks. Refer all servicing to qualified service personnel.

3. Cables that work with this product include TS941, TS942, and TS943. Special cables, which may be required by the regulatory inspection authority for this installation site, are the responsibility of the customer.

4. When installed in the final configuration, the product must comply with the applicable safety standards and regulatory requirements of the country in which it is installed. If necessary, consult with the appropriate regulatory agencies and inspection authorities to ensure compliance.

5. A rare phenomenon can create voltage potential between the earth grounds of two or more buildings. If products installed in separate buildings are interconnected, the voltage potential may cause hazardous conditions. Consult a qualified electrical consultant to determine whether or not this phenomenon exists and, if necessary, implement corrective action prior to interconnecting the products.

In addition, if the equipment is to be used with telecommunications circuits, take the following precautions:

- Never install telephone wiring during a lightning storm.

- Never install telephone jacks in wet locations unless the telephone line has been disconnected at the network interface.

- Use caution when installing or modifying telephone lines.

- Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning.

- Do not use the telephone to report a gas leak in the vicinity of the leak.

Contents

Chapter   **Page**

1. Specifications

1.1 General

Buttons: Display (Up and Down), Configure (Up and Down), Change (Up and Down), Send, Loop, Test, Mode

Switches: (1) On/Off switch

Console Port: Compatible with VT100™ CRTs; RS-232 interface with speed of 9600 bps, 8 data bits, 1 stop bit, and no parity; Supports dial-in modems; Control "D" used for disconnect

Loopbacks Generated: V.54 loop (T1, E1, and synchronous modes); CSU loop (T1 only); Smart jack 1 framed loop (T1 only); Smart jack 1 unframed loop (T1 only); Smart jack 2 framed loop (T1 only); Smart jack 2 unframed loop (T1 only)

Connectors: (1) RJ-11 for GUI, (1) RJ-48C and dual Bantam for T1/E1, (1) dual BNC for E1, (1) DB25, (1) DB15, (1) 12-VDC barrel connector for power

Operating Temperature: 32 to 122°F (0 to 50°C)

Relative Humidity: Up to 95% noncondensing

Power: 6 watts, 21 BTU/hr.; 8 AA Nickel Hydride batteries;
North America: Wallmount power supply, 90 to 130 VAC, 57 to 63 Hz;
International: Switching mode inline power supply: 100 to 240 VAC, 50 to 60 Hz

Size: 5"H x 7"W x 1.6"D (12.7 x 17.8 x 4.1 cm)

Weight: 1 lb. (0.5 kg)

1.2 Asynchronous Mode

Speed: 28 standard speeds from 50 bps to 115,200 bps

Displays: See the table on the next page

Display	Function
CHAR ERRS	Displays the number of characters in error received since the last reset display command. Counts up to 999,999,999 characters in error.
CHAR RCVD	Displays the total number of characters received since the last reset display command. Counts up to 999,999,999 characters.
TEST SEC	Displays the total number of seconds that the tester has been in test since the last reset display command. Counts up to 999,999 seconds.
ERR SECS	Displays the number of seconds the tester was in test with errors occurring during those seconds since the last reset display command. Counts up to 999,999 seconds.
RT DELAY	Displays the round-trip delay of the pattern in milliseconds since the last start button command. Counts up to 999,999 seconds.
ELAPSED TIME	Displays the number of hours, minutes, and seconds that have elapsed since the start button was pressed. Maximum count of 99 hours, 59 minutes, and 59 seconds.

Pattern Generator: See the table below

Pattern Generator and Checker	Function
511	Generates and checks a 511-bit pseudo-random pattern.
2^{11} (2047)	Generates and checks a 2^{11} (2047) bit pseudo-random pattern.
Binary	Generates and checks a sequential binary pattern.
Fox Test	Generates the fox message for testing terminals (*The quick brown fox jumps over the lazy dog*).
Mark	Generates and checks a pattern of continuous marks.
Space	Generates and checks a pattern of continuous spaces.

BERT TESTER

Interface: Electrical: RS-232, RS-422/RS-530, CCITT V.35;
Mechanical: DB25 female

Indicators: See the table below

Indicator	Function
PAT LCK	**ON when the test pattern is good.**
RECOVD	**ON anytime the tester recovers synchronization.**
TXD	**ON when TX data is spacing from the tester to the DCE device.**
RXD	**ON when RX data is spacing from the DCE device to the tester.**
RTS	**ON when RTS from the tester to the DCE device is ON.**
CTS	**ON when CTS from the DCE device to the tester is ON.**
DSR	**ON when DSR from the DCE device to the tester is ON.**
CD	**ON when CD from the DCE device to the tester is ON.**
DTR	**ON when DTR from the tester to the DCE device is ON.**
TXC	**ON when the tester is accepting Transmit Clock.**
RXC (S)	**ON when receive clock (source in X.21) is present.**
ETC	**ON when the tester is providing external transmit clock.**

1.3 Synchronous Mode

Speed: 75 speeds from 1200 bps to 2.048 Mbps

Displays: See the table below and on the next two pages

Display	Function
ERRS	**Displays up to 9,999,999,999 bit errors.**
BER	**Displays bit error rate, which is the number of bits in error divided by the number of bits in scientific notation. Range is $1.00 \times 10^{e-11}$ to $9.99 \times 10^{e+11}$.**

Display	Function
TX FREQ	Measures the frequency of the transmit clock.
RX FREQ	Measures the frequency of the receive clock.
TEST SEC	Displays the total number of seconds the tester has been in test since the last reset display command. Counts up to 999,999 seconds.
ERR SECS	Displays the number of seconds the tester was in test with errors occurring during those seconds since the last reset display command. Counts up to 999,999 seconds.
SES	Displays the number of severely errored seconds that have occurred since the last reset display command. A severely errored second is any second that has a bit error rate of more than 1 error in every thousand bits (1 x 10^{e-3}). Counts up to 999,999 seconds.
DEG MIN	Displays the number of degraded minutes that have occurred since the last reset display command. A degraded minute is any minute with a bit error rate worse than 1 bit every million bits. Counts up to 999,999 seconds (11.57 days).
AVAIL	A period of available seconds begins when the bit error rate in each second is better than 1 error in every 1000 bits for a period of 10 consecutive seconds. These 10 seconds are considered to be available seconds. Each second thereafter with a bit error rate better than 1 in every 1000 bits is counted as an available second until unavailable time occurs. During available and unavailable time, seconds with a bit error rate of exactly 1 in 1000 are not counted.
B	Displays the total number of bits received since the last Start button command. Counts up to 9,999,999,999,999 seconds.
UNAVAIL	A period of unavailable seconds begins when the bit error rate in each second is worse than 1 error in every 1000 bits for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable seconds. Each second thereafter with a bit error rate worse than 1 in every 1000 bits is counted as an unavailable second until available time occurs. During available and unavailable time, seconds with a bit error rate of exactly 1 in 1000 are not counted.

Display	Function
RTS TIME	Displays the number of milliseconds that have elapsed from the tester raising RTS to receiving clear-to-send high since the last reset display command. Counts up to 9999 milliseconds (10 seconds).
BITS	Displays the number of bits received. Counts up to 9,999,999,999 bits.
RT DELAY	Displays the round-trip delay of a character in milliseconds since the last start button command. The tester pattern selection must be set to RT delay and a loopback must be in the data path for this feature to operate. Counts up to 9999 milliseconds (10 seconds).
ELAPSED TIME	Displays the number of hours, minutes, and seconds that have elapsed since the start button was pressed. Maximum count of 99 hours, 59 minutes, and 59 seconds.

Pattern Generator and Checker: See the table below and on the next page

Pattern Generator and Checker	Function
511	Generates and checks a 511-bit pseudo-random pattern.
2^{11} (2047)	Generates and checks a 2^{11} (2047) bit pseudo-random pattern.
2^{15} (32767)	Generates and checks a 2^{15} (32767) bit pseudo-random pattern.
QRSS	Generates and checks a quasi-random signal source.
2^{20} (1,048,575)	Generates and checks a 2^{20} (1,048,575) bit pseudo-random pattern.
2^{23} (8,388,607)	Generates and checks a 2^{23} (8,388,607) bit pseudo-random pattern.
1 of 8	Generates and checks a pattern of 1 bit marking and 7 bits spacing.
3 of 24	Generates and checks a pattern of 3 bits marking and 21 bits spacing.

Pattern Generator and Checker	Function
Alt	Generates and checks a pattern of even bits marking and odd bits spacing between framing bits.
Mark	Generates and checks a pattern of continuous marks.
Space	Generates and checks a pattern of continuous spaces.

Interface: Electrical: RS-232, RS-422/RS-530, CCITT V.35, X.21;
Mechanical: RS-232, RS-422/RS-530, V.35 DB25 female, X.21 DB15 female

Indicators: See the table below

Indicator	Function
PAT LCK	ON when test pattern is good.
RECOVD	ON anytime tester recovers synchronization.
TXD	ON when TX data is spacing from tester to DCE device.
RXD	ON when RX data is spacing from the DCE device to the tester.
RTS (C)	ON when RTS (control in X.21) from the tester to the DCE device is ON.
CTS	ON when CTS from the DCE device to the tester is ON.
DSR	ON when DSR from the DCE device to the tester is ON.
CD (I)	ON when CD (indicator in X.21) from the DCE device to the tester is ON.
DTR	ON when DTR from the tester to the DCE device is ON.
TXC	ON when the tester is accepting transmit clock.
RXC (S)	ON when receive clock (source in X.21) is present.
ETC	ON when the tester is providing external transmit clock.

1.4 T1 Mode

Speed: 1.544 ±50 bps

Interface Termination: 8-position RJ-45 and dual Bantam jacks in parallel; (2) BNC connectors

Displays: See the table below and on the next two pages

Display	Function
ERRS	**Displays up to 9,999,999,999 bit errors.**
BER	**Displays bit error rate, which is the number of bits in error divided by the number of bits in scientific notation. Range is $1.00 \times 10^{e-11}$ to $9.99 \times 10^{e+11}$.**
TX FREQ	**Measures the frequency of the transmit clock.**
RX FREQ	**Measures the frequency of the receive clock.**
TEST SEC	**Displays the total number of seconds the tester has been in test since the last reset display command. Counts up to 999,999 seconds.**
ERR SECS	**Displays the number of seconds the tester was in test with errors occurring during those seconds since the last reset display command. Counts up to 999,999 seconds.**
SES	**Displays the number of severely errored seconds that have occurred since the last reset display command. A severely errored second is any second that has a bit error rate of more than 1 error in every thousand bits ($1 \times 10^{e-3}$). Counts up to 999,999 seconds.**
DEG MIN	**Displays the number of degraded minutes that have occurred since the last reset display command. A degraded minute is any minute with a bit error rate worse than 1 bit every million bits. Counts up to 999,999 seconds (11.57 days).**
AVAIL	**A period of available seconds begins when the bit error rate in each second is better than 1 error in every 1000 bits for a period of 10 consecutive seconds. These 10 seconds are considered to be available seconds. Each second thereafter with a bit error rate better than 1 in every 1000 bits is counted as an available second until unavailable time occurs. During available and unavailable time, seconds with a bit error rate of exactly 1 in 1000 are not counted.**

Display	Function
UNAVAIL	A period of unavailable seconds begins when the bit error rate in each second is worse than 1 error in every 1000 bits for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable seconds. Each second thereafter with a bit error rate worse than 1 in every 1000 bits is counted as an unavailable second until available time occurs. During available and unavailable time, seconds with a bit error rate of exactly 1 in 1000 are not counted.
SLIPS	Displays the number of controlled slip events that occurred since the last start button command. Controlled slip events are the occurrence of a duplication or deletion of a T1 frame. Counts up to 999,999 controlled slip events.
RX LEVEL	Displays the receive level of the T1 signal in decibels. Range is +2 to -33 dB. The RX level measurement will vary depending on the type of T1 data being received.
FE ERRS	Displays the number of framing errors that have occurred since the last reset display command. Counts up to 999,999 FE errors.
CRC ERRS	When ESF framing is selected, displays the number of CRC (cyclic redundancy check) errors that have occurred since the last reset display command. When D4 framing is selected, the number of Fs (superframe alignment) errors displays. Counts up to 999,999 CRC or Fs errors.
BPV ERRS	Displays the number of BPV (bipolar violation) errors that have occurred since the last reset display command. Counts up to 999,999 BPV errors.
SIGNALLING BITS	Displays the A and B signalling bits in D4 and A, B, C, and D signalling bits in ESF of the selected DS0 in signal view.
DENS ERR	Displays the total number of density errors received since the last start button command. Counts 999,999 density errors. Density is checked in accordance with ANSI T1.403-1989.

Display	Function
RT DELAY	Displays the round-trip delay of the pattern in milliseconds since the last start button command. Tester pattern selection must be set to RT delay and a loopback must be in the data path for this feature to operate. Counts up to 99,999 milliseconds (100 seconds).
ELAPSED TIME	Displays the number of hours, minutes, and seconds that have elapsed since the Start button was pressed. Maximum count of 99 hours, 59 minutes, and 59 seconds.

Pattern Generator and Checker: See the table below and on the next page

Pattern Generator and Checker	Function
511	Generates and checks a 511-bit pseudo-random pattern.
2^{11} (2047)	Generates and checks a 2^{11} (2047) bit pseudo-random pattern.
2^{15} (32767)	Generates and checks a 2^{15} (32767) bit pseudo-random pattern.
QRSS	Generates and checks a quasi-random signal source.
2^{20} (1,048,575)	Generates and checks a 2^{20} (1,048,575) bit pseudo-random pattern.
2^{23} (8,388,607)	Generates and checks a 2^{23} (8,388,607) bit pseudo-random pattern.
1 of 8	Generates and checks a pattern of 1 bit marking and 7 bits spacing.
3 of 24	Generates and checks a pattern of 3 bits marking and 21 bits spacing.
Alt	Generates and checks a pattern of even bits marking and odd bits spacing between framing bits.
Mark	Generates and checks a pattern of continuous marks on all bits between framing bits.
Space	Generates and checks a pattern of continuous spaces on all bits between framing bits.

Pattern Generator and Checker	Function
T1 Daly FR	Generates and checks T1 daly framed stress pattern.
T1 Daly UF	Generates and checks T1 daly unframed stress pattern.
55 OCT FR	Generates and checks 55 octet framed stress pattern.
55 OCT UF	Generates and checks 55 octet unframed stress pattern.

Indicators: See the table below

Indicator	Function
PAT LCK	ON when test pattern is good.
RECOVD	ON anytime the tester recovers synchronization.
FRM LCK	ON when the tester is frame-locked to the T1 network.
AIS (BLU)	ON when all marks (blue alarm) are detected on the receive data interface.
RLOS	ON when receive loss of signal is detected on the receive data interface.
CRC ER	Blinks when a CRC error is detected on the receive data interface.
YELLOW	ON when the tester detects a yellow alarm on the receive data.
BPV	Blinks when a bipolar variation is detected on the receive data interface.
D4	ON when the tester is set to D4 framing mode.
ESF	ON when the tester is set to ESF framing mode.
AMI	ON when the unit is set to AMI coding.
B8ZS	ON when the unit is set to B8ZS coding.

1.5 E1 Mode

Speed: 2.048 Mbps ±50 bps with HDB3 coding

Interface Termination: 8-position RJ-45 and dual Bantam jacks in parallel; (2) BNC connectors

Displays: See the table below and on the next page

Display	Function
ERRS	Displays up to 9,999,999,999 bit errors.
BER	Displays bit error rate, which is the number of bits in error divided by the number of bits in scientific notation. Range is $1.00 \times 10^{e-11}$ to $9.99 \times 10^{e+11}$.
TX FREQ	Measures the frequency of the transmit clock.
RX FREQ	Measures the frequency of the receive clock.
TEST SEC	Displays the total number of seconds the tester has been in test since the last reset display command. Counts up to 999,999 seconds.
ERR SECS	Displays the number of seconds the tester was in test with errors occurring during those seconds since the last reset display command. Counts up to 999,999 seconds.
SES	Displays the number of severely errored seconds that have occurred since the last reset display command. A severely errored second is any second that has a bit error rate of more than 1 error in every thousand bits ($1 \times 10^{e-3}$). Counts up to 999,999 seconds.
DEG MIN	Displays the number of degraded minutes that have occurred since the last reset display command. A degraded minute is any minute with a bit error rate worse than 1 bit every million bits. Counts up to 999,999 seconds (11.57 days).
AVAIL	A period of available seconds begins when the bit error rate in each second is better than 1 error in every 1000 bits for a period of 10 consecutive seconds. These 10 seconds are considered to be available seconds. Each second thereafter with a bit error rate better than 1 in every 1000 bits is counted as an available second until unavailable time occurs. During available and unavailable time, seconds with a bit error rate of exactly 1 in 1000 are not counted.

Display	Function
UNAVAIL	**A period of unavailable seconds begins when the bit error rate in each second is worse than 1 error in every 1000 bits for a period of 10 consecutive seconds. These 10 seconds are considered to be unavailable seconds. Each second thereafter with a bit error rate worse than 1 in every 1000 bits is counted as an unavailable second until available time occurs. During available and unavailable time, seconds with a bit error rate of exactly 1 in 1000 are not counted.**

Pattern Generator and Checker: See the table below

Pattern Generator and Checker	Function
511	**Generates and checks a 511-bit pseudo-random pattern.**
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QRSS	**Generates and checks a quasi-random signal source.**
2^{20} (1,048,575)	**Generates and checks a 2^{20} (1,048, 575) bit pseudo-random pattern.**
2^{23} (8,388,607)	**Generates and checks a 2^{23} (8,388,607) bit pseudo-random pattern.**
1 of 8	**Generates and checks a pattern of 1 bit marking and 7 bits spacing.**
3 of 24	**Generates and checks a pattern of 3 bits marking and 21 bits spacing.**
Alt	**Generates and checks a pattern of even bits marking and odd bits spacing between framing bits.**
Mark	**Generates and checks a pattern of continuous marks on all bits between framing bits.**
Space	**Generates and checks a pattern of continuous spaces on all bits between framing bits.**

BERT TESTER

Indicators: See the table below

Indicator	Function
PAT LCK	**ON when the test pattern is good.**
RECOVD	**ON anytime the tester recovers synchronization.**
FRM LCK	**ON when the tester is frame-locked to the E1 network.**
AIS (BLU)	**ON when all marks (blue alarm) are detected on the receive data interface.**
RLOS	**ON when receive loss of signal is detected on the receive data interface.**
CRC ER	**ON when a CRC error is detected on the receive data interface.**
BPV	**ON when a bipolar variation is detected on the receive data interface.**
DMFA	**ON when the BERT Tester sets bit 6 in frame 0 of timeslot 16 (TS16) to 1. OFF when the BERT Tester resets bit 6 in frame 0 of timeslot 16 (TS16) to 0.**
RRA (YEL)	**ON when receive remote alarm (bit 3 in timeslot 0 in every odd-numbered frame) is set on the receive data interface.**

2. Overview

The BERT Tester is a sophisticated bit error rate tester in a compact, hand-held package. It can analyze asynchronous, synchronous, T1, Fractional T1, and Fractional E1 communications facilities and their respective NCTEs (Network Channel Terminating Equipment).

The BERT Tester includes a 130-volt power pack. It also includes a battery option, as described in **Chapter 6**.

The tester comes with RS-232, RS-422/RS-530, V.35, X.21, DS1 (T1, 1.544 Mbps) and G.703 (E1, 2.048 Mbps) interfaces. The RS-232, RS-422/530, and V.35 interfaces are provided on DB25 connectors. The X.21 interface uses a DB15 connector. The T1 and E1 interfaces are provided on RJ-45 and Bantam connectors. The tester also includes two BNC connectors for T1 and E1 interfaces.

In the T1 and E1 modes, the BERT Tester counts and displays bit errors, transmit and receive frequency, test seconds, bit error rate, and G.821 performance measurements. In the T1 mode, it also displays receive level, FE errors, CRC errors, and BPV errors. A variety of test patterns can be inserted in all or selected time slots/DS0s, contiguous or non-contiguous, making the BERT Tester ideal for fractional T1 and E1 testing.

In the asynchronous and synchronous test modes, the BERT Tester generates test data in a choice of patterns and formats. Choose from a selection of 28 asynchronous and 81 synchronous speeds. In the async mode, the tester counts and displays character errors, characters received, total test seconds, and errored seconds. In the synchronous mode, it counts and displays bit errors, bit error rate, total test seconds, and errored seconds. In the sync mode, it also displays transmit frequency, receive frequency, clear to send delay, bits received, and G.821 performance measurements (errored seconds, degraded minutes, and available and unavailable times).

The BERT Tester is extremely easy to use. It includes a 2-line by 16-character LCD display that shows selected mode, test, and operating parameters. Front-panel buttons include Display (Up and Down), Config (Up and Down), Change (Up and Down), Send, Loop, Test, and Mode. Parameters are selected by scrolling through values stored in the tester.

The BERT Tester also includes a console port that supports a command line interface, optional GUI, and dial-in modems. Each tester includes a wallmounted power pack.

The following is a sample list of some of the facilities and devices the BERT Tester can test:

- A leased line with modems on each end.

- A T1 facility with T1 CSUs on each end.

- A Fractional T1 facility.

- A DDS link with CSU/DSUs on each end.

- A satellite link with modems on each end.

- A 2.048-Mbps facility with Network Terminating Units (NTUs) on each end.

- Time-division, statistical, T1, and E1 multiplexors.

- Terminals.

Applications

Designed to fulfill the requirements of a broad range of applications, the BERT Tester may be used to test data communications equipment, networks, systems, and line facilities. The tester simulates real data passing through a data communications link and then determines the performance of a piece of equipment or that of a network. Many standard data patterns may be generated and recovered. The tester then monitors the data passing through the data communications link and indicates line quality by comparing the data that has been received with the data that was known to have been transmitted.

Typical applications include, but are not limited to, final test departments, field installations and evaluations of data communications equipment, field monitoring of data communications facilities, and field problem isolation.

You can use the BERT Tester by itself at either end of the system being tested as shown in Figure 2-1 or in pairs as illustrated in Figure 2-2.
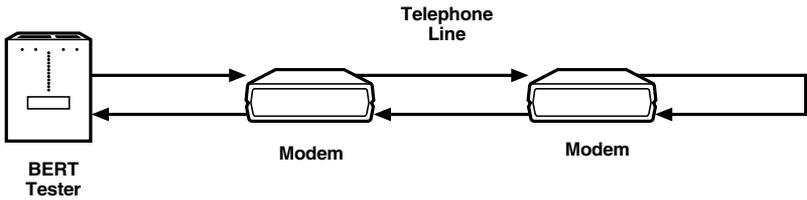
Figure 2-1. This illustration shows a single BERT Tester testing a telephone line and a pair of modems. The remote modem is in loopback.
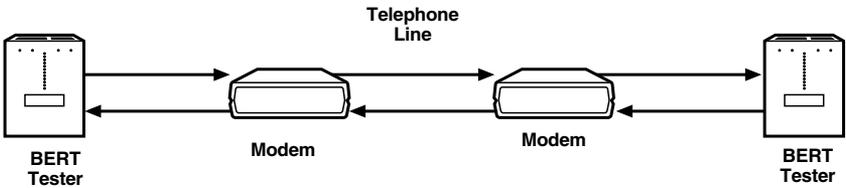
Figure 2-2. This illustration shows a pair of BERT Testers testing a telephone line and a pair of modems.

3. Configuration

3.1 General

CAUTION

The BERT Tester should be set up before installing in a network to keep disruption to the network at a minimum.

The BERT Tester is very easy to program to meet a variety of applications. Program it using buttons on the front of the tester, through the command line interface, or through the async console port (described in **Chapter 5**). This chapter describes how to configure the tester with the buttons.

The BERT Tester is shipped from the factory pre-programmed with a default configuration for all five modes (asynchronous, synchronous, T1, E1, and setup). It is also programmed to power on in T1 mode.

All of these pre-programmed configurations, as well as the power-on mode, can be changed by the following procedure.

In each of the five modes, there is a Config display labeled Save EEPROM. With the Save field displayed, pressing either the Up or Down Change button will cause the current configuration *of that mode only* to be saved to EEPROM (non-volatile memory that will retain the configuration after power is removed from the tester). In addition to saving the configuration of that mode, it will make that mode the new power-on default. This means that the last mode saved before power is removed will be the new power-on default.

3.2 Operation

The BERT Tester includes a 2-line by 16-character backlit LCD display and 16 LED indicators that show test data and selected mode, test, and operating parameters. Select parameters by scrolling through values stored in the tester.

The LCD display lights when the tester is powered on.

If you do not press a key within four minutes, the display turns off. The first key you press when the display is off lights the display and ignores the key you pressed.

All operations can be performed using only ten buttons. These are described on the next page.

Display (Up/Down): The Display Up/Down buttons move vertically through all the counter displays of a selected mode. If the desired display is passed when pressing the Up button, the Down button reverses the selection so that you don't have to scroll all the way through the choices again.

Config (Up/Down): The Config Up/Down buttons move vertically through all the configuration parameters in each mode of operation (asynchronous, synchronous, T1, E1). The configuration parameters and options for each parameter are shown on the second line of the display.

Change (Up/Down): The Change Up/Down buttons select or change the configuration options for a selected parameter. The Change Down button changes the choices for a selected parameter in the reverse direction. Change Down is especially convenient when scrolling through a change field that has many choices for a selected parameter. If you pass the desired option when you press the Up button, the Down button reverses the selection so you don't have to scroll all the way to the choices again.

Loop: The Loop button initiates a loopback command whenever you are on a loop field.

Send: The Send button inserts an error into the data stream.

Mode: The Mode button changes the mode from any point on the LCD display. You do not have to be on the mode field to change modes.

Test: The Test button resets all counters and starts a new test.

3.3 Asynchronous Mode

There are twelve parameter fields in the async mode. The following is a description of these fields.

Mode: The mode field consists of five choices: async, sync, T1, E1, and setup. The mode can be changed by pressing the Mode button until the desired mode appears or by the following procedure.

Press the Up or Down Config button until the mode field is displayed. With the mode field displayed, press the Up or Down Change button until the desired mode appears on the display. With the selected mode displayed, press the Up or Down Config button to view the options for the selected mode.

Output Data: The output data field controls the output of the BERT Tester. The two selections in this field include:

- Norm: Permits data from the pattern selection to be transmitted.

- Loop: Inserts a bidirectional loopback at the output of the BERT Tester. This means data from the BERT Tester is looped back to itself, and received data coming from the DCE is looped back to the DCE. This selection also is used to self-test the BERT Tester.

Interface: The interface field contains four interface choices, listed below.

- V.35: The V.35 interface in the async mode provides five balanced interface signals, five unbalanced interface signals, and ground. When V.35 is selected, a 25-pin male to 34-pin male Winchester® adapter cable may be used.

- RS-530: The RS-530 interface in the async mode provides seven balanced interface signals, three unbalanced signals, and ground through the DB25 pin female connector.

- RS-422: The RS-422 interface in the async mode provides seven balanced interface signals, three unbalanced signals, and ground through the DB25 pin female connector. When you select RS-422, you may use a 25-pin male to 37-pin male adapter cable.

- RS-232: The RS-232 interface in the async mode provides ten interface signals plus ground through the DB25 pin female connector.

Speed: The speed field in the async mode contains 28 speed choices. The following speeds (in bps) are available in this field:

50	600	4800	19,200
75	1000	7200	38,400
110	1200	9600	56,000
134.5	1800	12,800	57,600
150	2000	14,400	64,000
200	2400	16,000	72,000
300	3600	16,800	115,200

Pattern: In the async mode, the pattern field has seven choices, listed below. With the exception of mark and space, the patterns are inserted into characters being transmitted.

- 2^9 (511): This pattern is a 511-bit pseudo-random pattern. It is inserted in the data bits in the transmitted character between the start space and parity bit/ stop mark. The receiver checks for this pattern and will add 1 to the character error counter for each character that it receives in error.

- 2^{11} (2047): This pattern is a 2047-bit pseudo-random pattern. It is inserted in the data bits in the transmitted character between the start space and parity bit/stop mark. The receiver checks for this pattern and will add 1 to the character error counter for each character that it receives in error.

- Binary: The binary pattern is a counter that starts from all zeros (all data bits spacing) and counts up to all ones (all data bits marking). It is inserted in the data bits between the start space and parity bit/stop mark of the transmitted character. The receiver checks for this pattern and will add 1 to the character error counter for each character that it receives in error.

- Fox Test: The fox test generates the following message: The quick brown fox jumps over the lazy dog. It is inserted in the data bits in the transmitted character between the start space and parity bit/stop mark. This pattern is useful for testing devices such as terminals where a repetitive sentence is more easily recognizable than a complex test pattern. The fox test is not error-checked.

- Mark: The mark selection overrides the character framing and transmits continuous marks out the transmit data lead. The mark pattern is not error-checked.

- Space: The space selection overrides the character framing and transmits continuous spaces out the transmit data lead. The space pattern is not error-checked.

- RT Delay: The round trip delay selection displays the round trip delay of the special pattern in milliseconds since the last start button command. BERT Tester pattern selection must be set to RT delay and a loopback must be in the data path for this feature to operate. The maximum count is 9999 milliseconds (9.999 seconds).

Trap Error: When the selection in this field is on, the tester will halt when the first character error is received. The error free seconds display will stop counting to show when the trap occurred. In the off position, the tester will not stop on an error.

Data Bits: The data bits field selects the number of data bits in the character. There are four choices in this field: 5, 6, 7, and 8. The number of data bits does not include the start space, parity, or the stop mark.

Stop Mark: This selection adds 1, 1.5, or 2 stop marks to the character.

Parity: The parity field has four choices, listed below.

- None: When this selection is chosen, the character does not have any parity and consists of a start space, up to eight data bits, and up to two stop marks.

- Mark: This selection adds one marking parity bit to the character so the character will consist of one start space, up to eight data bits, one marking parity bit, and up to two stop marks.

- Odd: When this is selected, an odd parity bit is added to the data bits in the character. If the data bits contain an even number of marking bits, the parity bit will be mark, making the number of marks in the data bits and parity bit odd. If the data bits contain an odd number of marking bits, the parity bit will be space, leaving the total number of marks in the data bits and parity bit odd. The character will consist of one start space, up to eight data bits, an odd parity bit, and up to two stop marks.

- Even: When even parity is selected, an even parity bit is added to the data bits in the character. If the data bits contain an even number of marking bits, the parity bit will be space, leaving the number of marks in the data bits and parity bit even. If the data bits contain an odd number of marking bits, the parity bit will be even, making the total number of marks in the data bits and parity bit even. The character will consist of one start space, up to eight data bits, an odd parity bit, and up to two stop marks.

RTS: RTS (Request to Send) has three selections, listed below.

- On: With the RTS selection set to on, the BERT Tester raises the RTS control signal to the local DTE, telling it that the BERT Tester is ready to send.

- Off: With the RTS selection set to off, the BERT Tester lowers the RTS control signal to the local DTE, telling it that the BERT Tester is not ready to send.

• Auto: Setting the RTS selection to auto causes the BERT Tester to raise RTS to the local DCE. When the local DCE responds with CTS (Clear to Send) high, the BERT Tester transmits 100 characters of the selected pattern and then lowers RTS. This sequence repeats once a second.

DTR: DTR (Data Terminal Ready) has two selections, on and off. Setting DTR to the on selection raises the DTR signal to the local DCE, telling it that the BERT Tester is ready to receive. Setting DTR to the off selection lowers the DTR signal to the local DCE, telling it that the BERT Tester is not ready to receive.

Save EEPROM: With the Save field displayed in the async mode, pressing either the Up or Down Change button will cause the current configuration of the async mode to be saved to EEPROM (nonvolatile memory which will retain the configuration after power is removed from the tester).

3.3.1 TESTING AN ASYNC TERMINAL

Figure 3-1 shows a typical async terminal testing configuration.

Async terminal
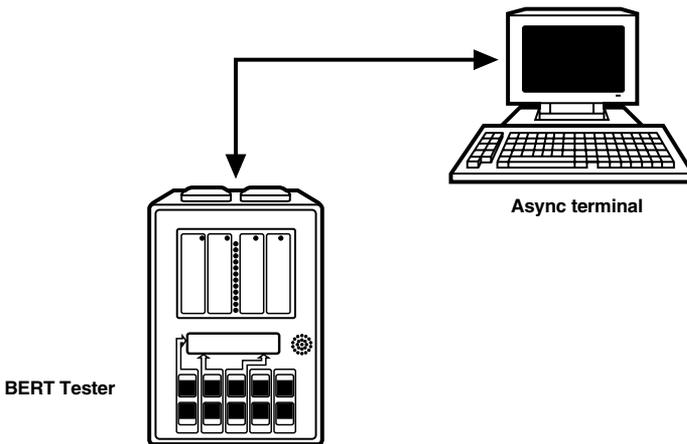
BERT Tester

Figure 3-1. Using the BERT Tester to test an async terminal.

Connections

Typically, the DB25 connector on an async terminal or CRT is a female connector and is wired as a DTE. Since the DB25 connector on the BERT Tester is also a female and wired as a DTE, a male-to-male crossover cable must be used. Attach one end of the cable to the BERT Tester and the other end to the terminal.

BERT Tester Settings

Set the BERT Tester as follows:

```
MODE: ASYNC        SPEED: 19200   DATA BITS: 8  RTS: ON
OUTPUT: NORMAL     PAT: FOX       STOP MARKS: 1 DTR: ON
INTERFACE: RS-232  TRAP ERR: OFF  PARITY: EVEN   SAVE: EEPROM
```

Results

Match the interface, speed, data bits, stop marks, and parity to the terminal's settings. Watch the terminal and a repeating The quick brown fox jumps over the lazy dog message displays on the terminal. Make sure all characters are being printed on the screen.

3.3.2 TESTING AN ASYNC MODEM

The following describes how to test an async modem. Before putting the modem on the telephone line, a quick test of the modem to determine if it is operating may help bring the application up more quickly. Figure 3-2 shows this application.
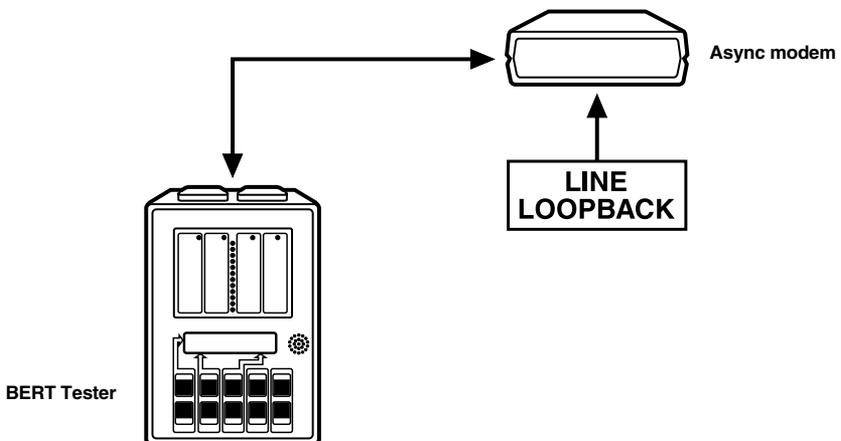
Figure 3-2. Using the BERT Tester to test an async modem.

Connections

The async modem's DB25 female connector is wired as a DCE and the DB25 female on the BERT Tester is wired as a DTE. Most DB25 male-to-male straight-through cables will work. Attach one end of the cable to the BERT Tester and the other end to the modem.

BERT Tester Settings

Set the BERT Tester as follows:

```
MODE: ASYNC        SPEED: 9600    DATA BITS: 8  RTS: ON
OUTPUT: NORMAL     PAT: 2047      STOP MARKS: 1 DTR: ON
INTERFACE: RS-232  TRAP ERR: OFF  PARITY: NONE  SAVE: EEPROM
```

Results

Make sure that the BERT Tester is programmed to match the speed, data bits, stop marks, and parity of the async modem. Put the modem in line loopback.

Press the Test button on the BERT Tester. The list below shows all the async displays and LEDs after the Test button has been pressed.

```
C ERR: 0000000000   C RCVD: 0000002244     TEST SEC: 000000   ERR SECS: 000000
                                           RT Delay: 0000 m   ELAPSD: 00:00:01
```

The LEDs that should be on include: PAT LOCK, TXD, RXD, RTS, CTS, DSR, CD, and DTR. Some of the control signal LEDs may or may not be on, depending how the modem is configured.

If the modem is operating, the displays above are typical. The character received (C RCVD) counter should add 1 to the character received counter for each character that it receives in error. The character error (C ERR) counter should have no errors. Press the Send button on the BERT Tester once and the C ERR counter will add 1 to the character error counter for each character that it receives in error. This ensures that you have a loop in the network.

3.4 Synchronous Mode

There are 11 parameter fields in the sync mode. They are described in this section.

Mode: The mode field consists of five choices: async, sync, T1, E1, and setup. The mode can be changed by pressing the Mode button until the desired mode appears or by the following procedure.

Press the Up or Down Config button until the mode field is displayed. With the mode field displayed, press the Up or Down Change button until the desired mode appears on the display. With the selected mode displayed, press the Up or Down Config button to view the options for the selected mode.

Output Data: The output data field controls the BERT Tester's output. There are five selections in this field.

- Normal: The normal selection permits data from the pattern selection to be transmitted.

- Loop: The loop selection inserts a bidirectional loopback at the BERT Tester's output. This means data from the BERT Tester is looped back to itself and received data coming from the DCE is looped back to the DCE. This selection also is used to self-test the BERT Tester.

- Invert: The invert data selection inverts the data being sent out the Transmit Data lead and inverts the incoming receiving data lead. This selection is useful when testing new equipment.

- Invert TX: The invert TX data selection inverts the data being sent on the transmit data lead only. This selection is useful when testing new equipment.

- Invert RX: The invert RX data selection inverts the incoming receive data lead only. This selection is useful when testing new equipment.

Interface: The interface field contains five interface choices, listed below.

- V.35: The V.35 interface in the sync mode provides five balanced interface signals, five unbalanced interface signals, and ground. When V.35 is selected, a 25-pin male to 34-pin male Winchester adapter cable may be used.

- RS-530: The RS-530 interface in the sync mode provides nine balanced interface signals, three unbalanced signals, and ground through the DB25 female connector.

- RS-422: The RS-422 interface in the sync mode provides nine balanced interface signals, three unbalanced signals, and ground through the DB25 female connector. When RS-422 is selected, a 25-pin male to 37-pin male adapter cable may be used.

- RS-232: The RS-232 interface in the sync mode provides twelve interface signals plus ground through the DB25 female connector.

- X.21: The X.21 interface in the sync mode provides five balanced interface signals plus ground through the DB15 female connector.

Pattern: In the sync mode, the pattern field has fifteen choices, listed below.

NOTE

When using the BERT Tester in the sync mode to check a fractional T1 channel, patterns of 2^{15} (32767), QRSS, 2^{20} (1,048,575), 2^{23} (8,388,607), 1 of 8, and 3 of 24 will cause density errors if the fractional T1 channel is not clear channel.

- 2^9 (511): This pattern is a 511-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- 2^{11} (2047): This pattern is a 2047-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- 2^{15} (32767): This pattern is a 32767-bit pseudo-random pattern. After the tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- ITU 2^{15} (32767): This pattern is an O.151 inverted 32767 bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- QRSS: This pattern is a Quasi-Random Signal Source. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- 2^{20} (1,048,575): This pattern is a 1,048,575-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- ITU 2^{20} (1,048,575): This pattern is an O.153 1,048,575 bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- 2^{23} (8,388,607): This pattern is a 8,388,607-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- ITU 2^{23} (8,388,607): This pattern is an O.151 inverted 8,388,607-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- 1 of 8: This pattern is a continuous one bit marking seven bits spacing. The receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- 3 of 24: This pattern is a continuous three bits marking 21 bits spacing. The receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error.

- Alternate: This pattern generates an alternate 1 and 0 pattern. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error. This pattern should not be used when RTS selection is auto.

- Mark: This pattern generates all marks from the BERT Tester. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error. This pattern should not be used when RTS selection is auto.

- Space: This pattern generates all spaces from the BERT Tester. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit that it receives in error. This pattern should not be used when RTS selection is auto.

- RT Delay (Round Trip Delay): This displays the round trip delay of the special pattern in milliseconds since the last start button command. BERT Tester pattern selection must be set to RT delay and a loopback must be in the data path for this feature to operate. The maximum count is 9999 milliseconds (9.999 seconds).

Loop: The only choice in the Loop field is V.54. To send a V.54 loop, press the Loop button. A V.54 loop On command will be transmitted for 4 seconds. When the loop command is sent, "ON" is displayed in the LCD window. If the BERT Tester receives a normal or inverted V.54 loop pattern, it displays "ACK" for 3 seconds and then displays "ON" until the loop is deactivated. If the loop pattern is not received back within 4 seconds, "FAIL" is displayed for 3 seconds and the loop command is terminated. When the V.54 Loop has been acknowledged and is in the On state, pressing the Loop button again will cause the BERT Tester to send a V.54 loop Off command for 4 seconds. If the tester receives the V.54 loop Off command back, "ACK" will be displayed for 3 seconds and then disappear.

The V.54 is a latching loop, so be careful when setting it since it must be turned off when the tester is finished using it.

NOTE

If a loop has already been set to On when the tester is used, the tester must go through the V.54 Loop On command sequence before it turns the loop Off.

Speed: The speed field in the sync mode can generate 81 speeds from 1200 bps to 44,736,000 bps.

The BERT Tester permits setting speeds to 44,736,000 bps with all interfaces and timing options. Be careful when selecting speed, interface, and TX Clk combinations, since not all combinations will work. For example, setting the speed to 2,000,000 bps when selecting the RS-232 interface will not work because the RS-232 interface typically will not operate above 128,000 bps.

Another combination to be careful of is setting speeds above 1,000,000 with the TX Clk option in Accept (accept transmit clock from the DCE) selected. With this combination, propagation delays through the interfaces in the BERT Tester and in the DCE accumulate may be longer than one-half bit time, which will cause failure to pattern lock or erratic performance.

The following speeds (in bps) are available in this field:

1200	38,400	192,000	560,000	952,000	1,288,000	1,856,000
2400	48,000	224,000	576,000	960,000	1,344,000	1,920,000
4800	50,000	256,000	616,000	1,000,800	1,408,000	1,984,000
7200	56,000	280,000	640,000	1,024,000	1,440,000	2,048,000
9600	57,600	288,000	672,000	1,064,000	1,472,000	4,096,000
12,800	64,000	320,000	704,000	1,088,000	1,536,000	8,192,000
14,400	72,000	336,000	728,000	1,120,800	1,544,000	16,384,000
16,000	96,000	384,000	768,000	1,152,000	1,600,000	22,384,000
19,200	112,000	392,000	784,000	1,176,000	1,664,000	34,368,000
24,000	128,000	448,000	832,000	1,216,000	1,728,000	44,736,000
28,800	144,000	504,000	840,000	1,232,000	1,792,000	
32,000	168,000	512,000	896,000	1,280,000		

TX Clock: This TX clock field has three options, listed below.

- Accept: The BERT Tester accepts transmit clock from the DCE. The speed selection is ignored.

- Provide: The BERT Tester provides external transmit clock to the DCE. The clock speed is determined by the selection in the speed field.

- Accept Invert: The BERT Tester inverts transmit clock.

Trap Error: The trap error field has two choices, on and off. When the selection in this field is On, the BERT Tester will halt when the first bit error is received. The error free seconds display will stop counting to show when the trap occurred. In the Off position, the tester will not stop on an error.

RTS: RTS (Request to Send) has three selections, listed below.

- On: With the RTS selection set to on, the BERT Tester raises the RTS control signal to the local DTE, telling it that the BERT Tester is ready to send.

- Off: With the RTS selection set to off, the BERT Tester lowers the RTS control signal to the local DTE, telling it that the BERT Tester is not ready to send.

- Auto: Setting the RTS selection to auto causes the BERT Tester to raise RTS to the local DCE. When the local DCE responds with CTS (Clear to Send) high, the BERT Tester transmits 1,000 bits of the selected test pattern and then lowers RTS. This sequence repeats every second. The alternate, mark, and space selections should not be used in this mode.

DTR: DTR (Data Terminal Ready) has two selections, on and off. Setting DTR to On raises the DTR signal to the local DCE, telling it that the BERT Tester is ready to receive. Setting DTR to Off lowers the DTR signal to the local DCE, telling it that the BERT Tester is not ready to receive.

Save EEPROM: With the save field displayed in the sync mode, pressing either the Up or Down Change button will cause the current configuration of the Sync mode to be saved to EEPROM (nonvolatile memory that will retain the configuration after power is removed from the tester).

SYNC APPLICATION

The BERT Tester can support a variety of interfaces. In the example shown in Figure 3-3, the V.35 interface on the tester connects to the local T1 CSU/DSU and is used to test the complete facility.
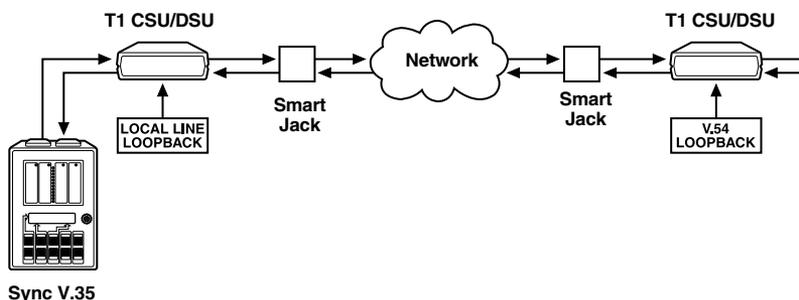
Figure 3-3. Testing a T1 facility with CSU/DSUs and V.35 interfaces.

Connections

For this test, you'll need a DB25 male to 34-pin Winchester male cable. Attach the DB25 male side to the BERT Tester connector labeled V.35, RS-232, RS-530, RS-422. Attach the 34-pin connector to the local T1 CSU/DSU.

BERT Tester Settings

Set the BERT Tester as follows:

```
MODE: SYNC         PAT: 2047      TX CLK: ACCEPT DTR: ON
OUTPUT: NORMAL     V.54 LOOP:     TRAP ERR: OFF  LDL: OFF
INTERFACE: V.35    SPEED: 1200    RTS: ON        RDL: OFF
                                                 SAVE: EEPROM
```

Results

The BERT Tester T1 TMG (timing) should be set to match the timing required for the application. Generally, the T1 CSU/DSU provides the timing. When TX Clk is set to accept, disregard the speed field.

If this is an initial install, try using the V.54 loopback at the remote first since this will check the entire facility. This loopback can be activated by the tester generating a V.54 loop command or by having someone at the remote CSU/DSU manually activating a loopback. If this test does not pass, check the local CSU/DSU first with a local line loopback and then proceed to test farther out until you find the problem.

After all parameters are set to match the network and a loopback has been activated, press the TEST button on the BERT Tester. The list below shows all the sync displays and LEDs after the TEST button has been pressed.

```
ERRS: 0000000000    TEST SEC:000000   ERR SECS: 000000   AVAIL: 000000
B: 00000000000000   TX FREQ: 1536000  SES: 000000        UNAVAIL: 000000
BER: 0.00x10e-06    RX FREQ: 1536000  DEG MINS: 000000   RTS TIME: 0000m
RT DELAY: 0000 m                                         ELAPSD: 00:00:01
```

The LEDs that should be on include PAT LOCK, TXD, RXD, RTS, CTS, DSR, CD, DTR, TXC, and RXC. Some of the control signal LEDs may or may not be on, depending how the CSU/DSU is configured.

If the facility is fully functional, the displays should match the ones shown above. Press the Send button on the BERT Tester once and the tester will add 1 to the bit error counter for each bit that it receives in error. This ensures that you have a loop in the network.

3.5 T1 Mode

This section lists the parameter fields in the T1 Mode. Since T1 always uses the DS1 interface and operates at 1,544,000 bps, no interface or speed options are available in this mode.

Mode: The mode field consists of five choices: async, sync, T1, E1, and setup. The mode can be changed by pressing the MODE button until the desired mode appears or by the following procedure.

Press the Up or Down Config button until the mode field is displayed. With the mode field displayed, press the Up or Down Change button until the desired mode appears on the display. With the selected mode displayed, press the Up or Down Config button to view the options for the selected mode.

FUNC (Function): The FUNC field consists of five choices, listed below. After the mode is selected, the function will determine how the BERT Tester will be used. The following is a description of these selections.

- Terminate: Terminate is used when the BERT Tester is used to terminate a T1 line, CSU/DSU, or mux. This selection interrupts user data and is generally used when initially installing a facility or bench testing CSU/DSUs and muxes.

- Monitor: This selection is used for monitoring a TX or RX DSX-1 signal through a DSX jack panel or DSX jacks on equipment. When the FUNC choice is Monitor, the BERT Tester amplifies the receive T1 signal 20 dB.

- Insert: Used when performing drop/insert testing.

- Drop: If monitor jacks are available, use the Monitor instead of the Drop selection for the connection.

- Insert Mon: This choice is used when performing drop/insert testing.

T1 Out: The T1 Out field controls the output of the BERT Tester. The following describes the six selections in this field.

- Norm: Permits data from the pattern selection to be transmitted.

- Loop: Inserts a bidirectional loopback at the output of the BERT Tester. This means data from the BERT Tester is looped back to itself, and Received Data coming from the DCE is looped back to the DCE. This selection also is used to self-test the BERT Tester.

- All zeros (red alarm): The all zeros selection overrides the pattern selection and transmits continuous unframed spaces. If connected to a T1 mux, this signal will cause the T1 mux to transmit a yellow alarm back to the BERT Tester.

- All ones (blue alarm): The all ones selection overrides the pattern selection and transmits continuous unframed marks, also known as the alarm indication signal (AIS). If connected to a T1 mux, this signal will cause the T1 mux to detect a blue alarm condition. When transmitting a blue alarm to some older D4 equipment, the blue alarm may be detected as a red alarm.

- Yellow alarm: The yellow alarm selection overrides the pattern selection and writes a space in bit 2 of all DS0s if D4 framing is selected. It leaves the other bits in each DS0 undisturbed. If the framing format is ESF, the yellow alarm command is transmitted through the facility data link (FDL) and does not disturb any data bits. If connected to a T1 mux, this signal will cause the T1 mux to detect a yellow alarm.

- Framed 1s: The framed 1s selection sends the selected T1 framing with all 24 DS0s marking.

Framing: The framing field has three choices (D4, ESF, and Auto). The following is a description of these selections.

- D4: This selection sets the frame to the D4 framing standard specified in AT&T® Pub. 43801. In this document, the D4 framing is referred to as 193S and consists of 12 frames 193 bits in length. A frame is made up of 24 channels (DS0s) of 8 bits each and an F bit. After the 12 frames, the frame pattern repeats. The following is a description of a D4 frame.

T1 D4 (193S) FRAME

8 x 24 = 192 bits

Frame	F	DS0-01	DS0-02	DS0-03	DS0-04	DS0-05 thru DS0-23		DS0-24
01	1	00000001	00000001	00000001	00000001	00000001	00000001	00000001
02	0	00000001	00000001	00000001	00000001	00000001	00000001	00000001
03	0	00000001	00000001	00000001	00000001	00000001	00000001	00000001
04	0	00000001	00000001	00000001	00000001	00000001	00000001	00000001
05	1	00000001	00000001	00000001	00000001	00000001	00000001	00000001
06	1	0000000A	0000000A	0000000A	0000000A	0000000A	0000000A	0000000A
07	0	00000001	00000001	00000001	00000001	00000001	00000001	00000001
08	1	00000001	00000001	00000001	00000001	00000001	00000001	00000001
09	1	00000001	00000001	00000001	00000001	00000001	00000001	00000001
10	1	00000001	00000001	00000001	00000001	00000001	00000001	00000001
11	0	00000001	00000001	00000001	00000001	00000001	00000001	00000001
12	0	0000000B	0000000B	0000000B	0000000B	0000000B	0000000B	0000000B

    T1 = 1544000 bps or 647 nanoseconds per bit
    192 (8 x 24) bits + 1 framing (F) = 193 bits per frame or 125 microseconds
    12 frames = 1 superframe or 1.5 milliseconds
    1544000/193 bits = 8000 bps per bit in each DS0
    1 DS0 = 8 bits x 8000 bps = 64000 bps - bit 8 the LSB (rightmost bit in DS0)

The F bits are used for synchronization:

    Odd bits (Ft) - 101010 - dotting pattern - frame alignment bits

    Even bits (Fs) - 001110 - sync pattern - superframe alignment bits

    A & B (robbed-bits) signalling occurs in 6th and 12th frames

• ESF: This selection sets the frame to the ESF framing standard specified in AT&T C.B #142. In this document, the ESF framing is referred to as 193E and consists of 24 frames 193 bits in length. A frame is made up of 24 channels (DS0s) of 8 bits each and an F bit. After the 24 frames, the frame pattern repeats. The following is a description of an ESF superframe.

T1 ESF (193E) SUPERFRAME

8 x 24 = 192 bits

Frame	F	DS0-01	DS0-02	DS0-03	DS0-04	DS0-05 thru DS0-23	DS0-24
01	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
02	C	00000001	00000001	00000001	00000001	00000001 00000001	00000001
03	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
04	0	00000001	00000001	00000001	00000001	00000001 00000001	00000001
05	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
06	C	0000000A	0000000A	0000000A	0000000A	0000000A 0000000A	0000000A
07	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
08	0	00000001	00000001	00000001	00000001	00000001 00000001	00000001
09	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
10	C	00000001	00000001	00000001	00000001	00000001 00000001	00000001
11	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
12	1	0000000B	0000000B	0000000B	0000000B	0000000B 0000000B	0000000B
13	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
14	C	00000001	00000001	00000001	00000001	00000001 00000001	00000001
15	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
16	0	00000001	00000001	00000001	00000001	00000001 00000001	00000001
17	D	00000001	00000001	00000001	00000001	00000001 00000001	00000001
18	C	0000000C	0000000C	0000000C	0000000C	0000000C 0000000C	0000000C

19	D	00000001	00000001	00000001	00000001	00000001	00000001	00000001
20	1	00000001	00000001	00000001	00000001	00000001	00000001	00000001
21	D	00000001	00000001	00000001	00000001	00000001	00000001	00000001
22	C	00000001	00000001	00000001	00000001	00000001	00000001	00000001
23	D	00000001	00000001	00000001	00000001	00000001	00000001	00000001
24	1	0000000D	0000000D	0000000D	0000000D	0000000D	0000000D	0000000D

T1 = 1544000 bps or 647 nanoseconds per bit
192 (8 x 24) bits + 1 framing (F) = 193 bits per frame or 125 microseconds
24 frames = 1 superframe or 3 milliseconds
1544000/193 bits = 8000 bps per bit in each DS0
1 DS0 = 8 bits x 8000 bps = 64000 bps - bit 8 the LSB (rightmost bit in DS0)

The F bits (8000 bps) are frame pattern sync (FPS), CRC6, and data link:

Frame Pattern Sync (FPS) - 001011 - 6 of 24 F bits = 2000 bps
CRC6 (cyclic redundancy check) - CCCCCC - 6 of 24 F bits = 2000 bps
CRC is performed on DS0s in the previous superframe (192 x 24)
Data Link - DDDDDDDDDDDD - 12 of 24 F bits = 4000 bps
A, B, C, & D (robbed-bits) signalling occurs in 6th, 12th, 18th, & 24th frames

- Auto: This selection automatically sets up the framing based on the receive signal. This feature is very useful when installing new T1 links to ensure that the T1 mux, T1 CSU, and T1 facility are all configured with the same framing.

Coding: The coding field has two choices, listed below.

- AMI: This selection sets the choice to AMI (alternate mark inversion). When AMI is selected, the transmit section of the network interface is set to AMI and the receive section is always set to B8ZS (AMI and B8ZS coding can both be detected in B8ZS). If B8ZS coding is detected when set to AMI, the B8ZS LED will flash to warn that there may be a mismatch in coding.

- B8ZS: This selection sets the choice to B8ZS (Binary 8 Zero Substitution) coding. With this coding choice, the transmit side of the network interface is set to B8ZS. This selection is used for clear channel, which permits 64,000 bps of all 24 DS0s to be used without violating density requirements.

CAUTION
The T1 facility must be configured with B8ZS to use this selection.

T1 LBO: The T1 LBO selection controls the output level of the T1 pulses being transmitted. The nine choices with this selection are 0 dB, -7.5 dB, -15 dB, -22.5 dB, 133 feet, 266 feet, 399 feet, 533 feet, and 655 feet. 0 through -22.5 dB are long-haul settings with the normal setting being 0 dB. 133 through 655 feet are short-haul settings. When using the short-haul settings, the setting should match the cable length between the tester and the device being tested.

T1 TMG: The T1 TMG (timing) field selects the transmit clocking option used by the BERT Tester. There are three selections in this field.

- Network: With this selection, TX data timing is locked to RX data. The slip counter is disabled in this mode.

- Internal: With this selection, TX data timing is locked to the BERT Tester's internal oscillator. The slip counter is disabled in this mode.

- Internal slips: This selection is same as Internal except the RX timing is compared to the internal oscillator. If they are not locked, the slip counter will add 1 to the slip error counter for each slip it receives in error.

Pattern: In the T1 mode, the pattern field has 25 choices. All of the patterns will add 1 to the pattern error counter for each pattern it receives in error, and only one error per second will be recorded by the errored second counter regardless of how many pattern errors occurred.

When testing for BPV errors in B8ZS format, 1 of 8 and 3 of 24 patterns will permit some BPV errors to pass through undetected because of the repetitive groups of zeros in these two patterns.

Density errors will occur when using 2^{15} (32767), QRSS, 2^{20} (1,048,575), 2^{23} (8,388,607), and 3 of 24 patterns with the DS0 bandwidth set to 64,000, if the T1 facility is not clear channel.

The following is a description of the 25 pattern fields:

- 2^9 (511): This pattern is a 511-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- 2^{11} (2047): This pattern is a 2047-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- 2^{15} (32767): This pattern is a 32767-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error. If the DS0 bandwidth is set to 64,000 and the T1 facility is not clear channel, this pattern will cause density errors because of the number of consecutive zeros it generates.

- ITU 2^{15} (32767): This pattern is an O.151 inverted 32767 bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- QRSS: This pattern is a Quasi-Random Signal Source. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error. If the DS0 bandwidth is set to 64,000 and the T1 facility is not clear channel, this pattern will cause density errors because of the number of consecutive zeros it generates.

- 2^{20} (1,048,575): This pattern is a 1,048,575-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error. If the DS0 bandwidth is set to 64,000 and the T1 facility is not clear channel, this pattern will cause density errors because of the number of consecutive zeros it generates.

- ITU 2^{20} (1,048,575): This pattern is an O.153 1,048,575-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- 2^{23} (8,388,607): This pattern is a 8,388,607-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error. If the DS0 bandwidth is set to 64,000 and the T1 facility is not clear channel, this pattern will cause density errors because of the number of consecutive zeros it generates.

- ITU 2^{23} (8,388,607): This pattern is an O.151 inverted 8,388,607-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- 1 of 8: This pattern is a continuous one bit marking seven bits spacing. The receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error after synchronization.

- 3 of 24: This pattern is a continuous three bits marking 21 bits spacing. The receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error after synchronization. If the DS0 bandwidth is set to 64,000 and the T1 facility is not clear channel, this pattern will cause density errors because of the number of consecutive zeros it generates.

- Alternate: This pattern consists of even bits marking and odd bits spacing in each selected DS0. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- Mark: This pattern puts all 8 bits in each selected DS0 to marks. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- Space: This pattern puts all 8 bits in each selected DS0 to spaces. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- T1 Daly Framed: This pattern is a T1 daly framed stress pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- T1 Daly unframed: This pattern is a T1 daly unframed stress pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- 55-Octet framed: This pattern is a 55-octet framed stress pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- 55-Octet unframed: This pattern is a 55-octet unframed stress pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the the bit error counter for each bit it receives in error.

- Digital Milliwatt: This pattern inserts a 64-bit m-law digital pattern that when converted through an analog voice channel in a T1 multiplexer puts out a 1000-Hz signal at 0 dB. This pattern is then used to adjust gain on the voice channel. This test pattern is specified in AT&T Technical Publication 43801.

- Round Trip Delay: Round trip delay is used to measure the time in milliseconds for a pattern to be transmitted in a DS0(s) from the BERT Tester to the T1 network and back again. The DS0 path must have a loopback somewhere in the network, typically at the customer premise equipment.

  With Round Trip Delay selected, pressing Test will cause a pattern to be sent out the selected DS0(s) and will add 1 to the RTD counter for each bit it receives in error in the display section of the tester. The counter will count milliseconds and continue to count until the pattern sent is received. If the pattern sent is not received, the counter will lock up at 9999 milliseconds. RTD does not count bit errors and erases any error count which was in the bit error counter.

- 56K CSU loop: This pattern is used to remotely loop and test the CSU portion of a CSU/DSU on DDS or other digital networks through the interconnecting T1 path on a single DS0.

  When this pattern is selected, the BERT Tester sends a control byte with the loop command (n010 1000) followed by a byte of the 2047 test pattern. This alternating pattern will not cause a loop until at least four control bytes in a row with the loop command are sent to the CSU/DSU. Pressing Loop on this selection causes at least four control bytes of the loop command to be sent consecutively, causing a remote CSU loop. The BERT Tester then resumes sending alternate loop command bytes followed by bytes of the 2047 pattern, which the receiver checks for errors.

  If more than one DS0 is selected, a beep will occur when Loop is pressed.

- 56K DSU Loop: This pattern is used to remotely loop and test the DSU portion of a CSU/DSU on DDS or other digital networks through the interconnecting T1 path on a single DS0.

When this pattern is selected, the BERT Tester sends a control byte with the loop command (n010 1000) followed by a byte of the 2047 test pattern. This alternating pattern will not cause a loop until at least four control bytes in a row with the loop command are sent to the CSU/DSU. Pressing Loop on this selection causes at least four control bytes of the loop command to be sent consecutively causing a remote DSU loop. The BERT Tester then resumes sending alternate loop command bytes followed by bytes of the 2047 pattern which the receiver checks for errors. In addition, the pattern field will display red until a different pattern is selected.

If more than one DS0 is selected, a beep will occur when Loop is pressed.

- 56K OCU Loop: This pattern is used to remotely loop and test the OCU in a channel bank on DDS or other digital networks through the interconnecting T1 path on a single DS0.

  When this pattern is selected, the BERT Tester sends a control byte with the loop command (n010 1000) followed by a byte of the 2047 test pattern. This alternating pattern will not cause a loop until at least four control bytes in a row with the loop command are sent to the OCU. Pressing Loop on this selection causes at least four control bytes of the loop command to be sent consecutively, causing a remote OCU loop. The BERT Tester then resumes sending alternate loop command bytes followed by bytes of the 2047 pattern which the receiver checks for errors. In addition, the pattern field will display red until a different pattern is selected.

  If more than one DS0 is selected, the four consecutive bytes of loop command will not be sent, and a beep will occur when Loop is pressed.

- User: The user pattern is a repeating 3 to 32 bit pattern programmed by the user in the setup mode. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- DS0 Bandwidth: The DS0 bandwidth field has two choices, listed below.

  56,000: When 56,000 bps is selected, all 24 DS0s in the T1 frame have bit 8 marking and only allow for 56,000 bps worth of bandwidth per DS0.

  64,000: When 64,000 bps is selected, all 24 DS0s in the T1 frame have the full 64,000 bps available for data. Care should be used when selecting this option since it may violate the bit density requirements of some networks.

LP—Loops: In T1 mode, the LP selection determines the type of loopback being sent. There are nine options. To send a loop, the selected loop must be displayed

in the LP field and the Loop button must be pressed. All the loops sent are acknowledged except the loops that are activated and deactivated by FDL/ESF messages. These three unacknowledged messages are ANS CSU, ATT PAY, and ANS PAY and are just sent for a fixed period of time. When acknowledged loops are sent, the message "On" is displayed in the LCD window. The acknowledged loops are sent for up to 12.5 seconds. If the BERT Tester receives the loop pattern back, it displays "ACK" for 3 seconds and then displays "On" until the loop is deactivated. If the loop pattern is not received back within 12.5 seconds, "Fail" is displayed for 3 seconds and the loop is deactivated. All of the nine loops are latching loops, so care must be used when setting them since they must be deactivated to reset.

NOTE

To cancel a previously set loop with the tester, the tester must go through Loop Up or On commands before it turns the loop Off. The options are as follows.

The nine loops available include:

- ATT CSU: This pattern sends a CSU Loop Up command to the CSU at the other end causing a remote latching loopback if a loop command has not been previously sent. The Up Loop command is a repetitive unframed 00001 pattern sent for at least 6.5 seconds. When D4 is selected in the framing field, this pattern will comply with AT&T Technical Reference 62411. When ESF has been selected in the framing field, this pattern will comply with AT&T Technical Reference 54016. When the Up Loop is acknowledged, pressing the Loop button again will cause the tester to send a Send command. The Send command is a repetitive unframed 001 pattern sent for at least 6.5 seconds.

- ANS CSU: This pattern generates an ANSI CSU Loop activate command to the remote CSU causing a remote loopback. This loop is available in ESF only. The activate command is a repetitive 0000 1110 11111111 pattern that is inserted in the 4-kbps data link for at least 10 times. The BERT Tester sends this command for a minimum of 100 milliseconds. This command is compliant with ANSI T1.403 - 1989. When the ANSI CSU Loop is sent, pressing the Loop button again will cause the tester to send a ANSI CSU Loop deactivate command. The deactivate command is a 0011 1000 1111 1111 pattern that is also sent for a minimum of 100 milliseconds.

- ATT payload: This pattern generates request message #1 AT&T Payload Loop activate command to the remote CSU causing a remote loopback. Payload loopback can only be sent when the framing selection is set to ESF. The BERT Tester sends this command once. This command is compliant with AT&T 54016. When the AT&T Payload Loop is sent, pressing the Loop button again

will cause the tester to send a request message #2 AT&T Payload Loop deactivate command.

- ANS payload: This pattern generates an ANSI Payload Loop activate command to the remote CSU causing a remote loopback. The activate command is a repetitive 0001 0100 11111111 pattern that is inserted in the 4-kbps Data Link for at least 10 times. The BERT Tester sends this command for a minimum of 100 milliseconds. This command is compliant with ANSI T1.403 - 1989. When the ANSI Payload Loop is sent, pressing the Loop button again will cause the tester to send a ANSI Payload Loop deactivate command. The deactivate command is a 0011 0010 1111 1111 pattern that is also sent for a minimum of 100 milliseconds.

- SJ1F: This pattern sends a Smart Jack 1 Framed Loop Up command to the remote tester if a loop command has not been previously sent. The Smart Jack 1 Framed Loop Up command is a repetitive framed 1100 pattern sent for at least 6.5 seconds. When the Up Loop is acknowledged, pressing the Loop button again will cause the tester to send a Smart Jack 1 Framed Loop Down command. The Smart Jack 1 Framed Loop Down command is a repetitive framed 1110 pattern sent for at least 6.5 seconds.

- SJ1U: This pattern sends a Smart Jack 1 Unframed Loop Up command to the remote tester if a loop command has not been previously sent. The Smart Jack 1 Unframed Loop Up command is a repetitive unframed 1100 pattern sent for at least 6.5 seconds. When the Up Loop is acknowledged, pressing the Loop button again will cause the tester to send a Smart Jack 1 Unframed Loop Down command. The Smart Jack 1 Unframed Loop Down command is a repetitive unframed 1110 pattern sent for at least 6.5 seconds.

- SJ2F: This pattern sends a Smart Jack 2 Framed Loop Up command to the remote tester if a loop command has not been previously sent. The Smart Jack 2 Framed Loop Up command is a repetitive framed 11000 pattern sent for at least 6.5 seconds. When the Up Loop is acknowledged, pressing the Loop button again will cause the tester to send a Smart Jack 2 Framed Loop Down command. The Smart Jack 2 Framed Loop Down command is a repetitive framed 11100 pattern sent for at least 6.5 seconds.

- SJ2U: This pattern sends a Smart Jack 2 Unframed Loop Up command to the remote tester if a loop command has not been previously sent. The Smart Jack 2 Unframed Loop Up command is a repetitive unframed 11000 pattern sent for at least 6.5 seconds. When the Up Loop is acknowledged, pressing the Loop button again will cause the tester to send a Smart Jack 2 Unframed Loop

Down command. The Smart Jack 2 Unframed Loop Down command is a repetitive unframed 11100 pattern sent for at least 6.5 seconds.

- V54: This selection transmits a V54 Loop On in one or more DS0s to the remote CSU/DSU if a V54 loop command has not been sent previously. When the V54 Loop On is acknowledged, pressing the Loop button again will cause the tester to send a V54 Loop Down command.

Listen: The Listen field contains 24 choices (DS01through DS24). This field enables you to select the DS0 to monitor with the built-in speaker in either the RX or TX direction.

Volume: The volume setting range is 0–9. Selecting 0 will disable the volume. The lowest volume setting is 1 and the loudest is 9.

Signal View: The signal view field contains 24 choices (DS01through DS24). This field enables you to select the DS0 to view in the signalling bits display.

Signal Generate: This field permits the insertion or generation of ABCD (AB in D4) signalling bits in one or more DS0s in the T1 frames transmitted out the network side of the tester. The signalling bit combinations are inserted in DS0s that are selected.

When the framing selection is ESF, there are 17 choices in this field: Off and sixteen combinations of ABCD signalling. In ESF (24 frames), the A bit is inserted in every sixth frame and the BCD bits are inserted in the 12th, 18th, and 24th bits, respectively.

CAUTION

If the DS0 bandwidth selection is set for 64000 bps, the ABCD bits will write over data in the bit 8 position. Use the Off selection to prevent sending any signalling, or use the 56000 bps DS0 bandwidth selection which does not use bit 8 for data.

When the framing selection is D4, there are only five choices: Off and four combinations of AB bits. In D4 format (12 frames), the A bit will be inserted in every sixth frame and the B bit will be inserted in every twelfth frame in the bit 8 position.

Error Type: This field has four choices, listed below. The purpose of this option is to generate fixed errors to aid in troubleshooting equipment. When an error is inserted, a single error of the error type displayed in this field will be generated.

- Logic: The logic error inverts one bit in the data path.

- CRC: The CRC (cyclic redundancy check) error generates an error in the CRC6 portion of the facility data link of an ESF superframe.

- Frame: The frame error selection generates an FPS error when the framing is set to ESF and an FS of FT error when framing is set to D4.

- BPV: Bipolar violations are generated in the data portion (192 bits) of the T1 frame.

Error Frequency: This field has two choices, single and 1sec. Single generates a single error of the error type selected each time the Send button is pressed. 1 sec generates a single error of the error type selected every second.

Idle: The Idle character selection has 256 choices: 00 to FF hex. The idle character is inserted in all the unused DS0s (the DS0s that are not On).

DS01 through DS24: Each DS0 field has two choices, Off and On. If a DS0 selection is Off, its bandwidth is not used in the T1 frame. If a DS0 selection is On, its bandwidth is used in the T1 frame.

Save EEPROM: With the Save field displayed in the T1 mode, pressing either the Up or Down Change button will cause the current configuration of the T1 mode to be saved to EEPROM (nonvolatile memory which will retain the configuration after power is removed from the tester).

3.6 E1 Mode

This section describes the parameter fields in the E1 mode. Since E1 always uses the G.703 interface and operates at 2,048,000 bps with HDB3 coding, no interface or speed options are available in this mode. The following is a description of these fields.

Mode: The mode field consists of five choices: async, sync, T1, E1, and setup. The mode can be changed by pressing the Mode button until the desired mode appears or by the following procedure.

Press the Up or Down Config button until the mode field is displayed. With the mode field displayed, press the Up or Down Change button until the desired mode appears on the display. With the selected mode displayed, press the Up or Down Config button to view the options for the selected mode.

FUNC (Function): The FUNC field consists of six choices, listed below. After the Application (AP) is selected above, the Function will determine how the BERT Tester will be used. The following is a description of these selections.

- Terminate: Used to terminate an E1 line, CSU/DSU, or mux. This selection is interruptive to user data and is generally used when initially installing a facility or bench testing CSU/DSUs and muxes.

- Monitor: Used for monitoring a TX or RX DSX-1 or E1 DSX signal through a DSX jack panel or DSX jacks on equipment.

- Insert: Used when performing drop/insert testing.

- Drop: The drop/insert Drop selection is used in conjunction with the Insert or Insert Mon selection to drop and test 1 of the framed E1 channels.

- Insert Mon: Used when performing drop/insert testing.

- Voice Mon: Used when performing voice testing.

E1 Out: The E1 out field controls the output of the BERT Tester. The following describes the four selections in this field:

- Norm: Permits data from the pattern selection to be transmitted.

- Loop: Inserts a loopback at the output of the BERT Tester. The data from the BERT Tester is looped back to itself and TX data is still transmitted to the network from the tester.

- All zeros: Overrides the pattern selection and transmits continuous unframed spaces.

- All ones: Overrides the pattern selection and transmits continuous unframed marks.

Pattern: In the E1 mode, the pattern field has 17 choices. All of the patterns will will add 1 to the errored seconds counter for each errored second it receives whenever the pattern is received wrong, and only one error per second will be recorded by the errored second counter regardless of how many bit errors occurred.

When testing for BPV errors in B8ZS format, 1 of 8 and 3 of 24 patterns will permit some BPV errors to pass through undetected because of the repetitive groups of zeros in these two patterns.

The following is a description of the 17 pattern fields.

- 2^9 (511): This pattern is a 511-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- 2^{11} (2047): This pattern is a 2047-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- 2^{15} (32767): This pattern is a 32767-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- ITU 2^{15} (32767): This pattern is an O.151 inverted 32767-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- QRSS: This pattern is a Quasi-Random Signal Source pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- 2^{20} (1,048,575): This pattern is a 1,048,575-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- ITU 2^{20} (1,048,575): This pattern is an O.153 1,048,575-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- 2^{23} (8,388,607): This pattern is a 8,388,607-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- ITU 2^{23} (8,388,607): This pattern is an O.151 inverted 8,388,607-bit pseudo-random pattern. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- 1 of 8: This pattern is a continuous one bit marking seven bits spacing. The receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error after synchronization.

- 3 of 24: This pattern is a continuous three bits marking 21 bits spacing. The receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error after synchronization.

- Alternate: This pattern consists of the E1 frame with the even bits marking and the odd bits spacing in all timeslots that are selected. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- Mark: This pattern consists of the E1 frame with all timeslots that are selected marking. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- Space: This pattern consists of the E1 frame with all timeslots that are selected spacing. When the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- User: The user pattern is a repeating 3- to 32-bit pattern programmed by the user in the setup mode. After the BERT Tester establishes synchronization, the receiver checks for this pattern and will add 1 to the bit error counter for each bit it receives in error.

- Digital Milliwatt: This pattern inserts a 64-bit a-law digital pattern that when converted through an analog PCM voice channel in a E1 mux puts out a 1000-Hz signal at 0 dB. This pattern is then used to adjust gain on the voice channel.

- Round Trip Delay: Round trip delay is used to measure the time in milliseconds for a pattern to be transmitted in a timeslot(s) from the BERT Tester to the E1 network and back again. The timeslot path must have a loopback somewhere in the network, typically at the customer premise equipment.

  With round trip delay selected, pressing TEST will cause a pattern to be sent out the selected timeslot(s) and start incrementing the RTD counter in the display section of the tester. The counter will count milliseconds and continue to count until the pattern sent is received. If the pattern sent is not received, the counter will lock up at 9999 milliseconds. RTD does not count bit errors and erases any error count which was in the bit error counter.

E1 TMG: The E1 TMG (Timing) field selects the transmit clocking option used by the BERT Tester. There are two selections in this field.

- Internal: TX data timing is locked to the BERT Tester's internal oscillator.

- Network: TX data timing is locked to RX data.

NOTE

When the AP field is set to E1>T3 CBIT or E1>T3 M13, there is also a field for T3 TMG. When the AP field is set to E1>E1 BNC or E1>E3, there is also a field for E3 TMG.

Term: The termination field consists of two choices, listed below.

- 75 ohms: Sets the TX and RX impedance to 75 ohms.

- 120 ohms: Sets the TX and RX impedance to 120 ohms.

Loop: The only choice in the Loop field is V.54. To send a V.54 loop, press the Loop button. A V.54 Loop On command will be transmitted in all the selected timeslots for up to 4 seconds. When the loop command is sent, the message "On" is displayed in the LCD window. If the BERT Tester receives a normal or inverted V.54 loop pattern, it displays "ACK" for 3 seconds and then displays "On" until the loop is deactivated. If the loop pattern is not received back within 4 seconds, "Fail" is displayed for 3 seconds and the loop command is terminated. When the V.54 loop has been acknowledged and is in the On state, pressing the Loop button again will cause the BERT Tester to send a V.54 loop Off command for 4 seconds. If the tester receives the V.54 Loop Off command back, ACK will be displayed for 3 seconds and then disappear.

The V.54 is a latching loop, so care must be used when setting it since it must be turned off when finished using it. The selected timeslots in the BERT Tester must match the timeslot selection in the device that is attempting to be looped.

NOTE

If a loop has already been set On when the tester is used, the tester must go through the V.54 Loop On command sequence before a V.54 Loop Off command can be sent.

Framing: The framing field has two choices.

- Framed: The BERT Tester generates a framed E1 signal.

- Unframed: The BERT Tester does not generate any E1 framing.

CRC4: The CRC4 field has two choices.

- CRC4 On: The BERT Tester checks for valid CRC4 in the framing.

- CRC4 Off: The BERT Tester ignores the CRC4 in the framing.

Listen: The listen field contains 31 choices (TS01 through TS31). This field enables you to select the tester to monitor with the built-in speaker in either the RX or TX direction.

Volume: The volume setting range is 0–9. Selecting 0 will disable the volume. The lowest volume setting is 1; the loudest is 9.

DMFA: The Distant Multiframe Alarm (DMFA) field has two choices.

- DMFA Off: The BERT Tester will reset bit 6 in Frame 0 of timeslot 16 (TS16) to 0.

- DMFA On: The BERT Tester will set bit 6 in frame 0 of timeslot 16 (TS16) to 1.

RRA: The Receive Remote Alarm (RRA) field has two choices.

- RRA Off: The BERT Tester will reset bit 3 in timeslot 00 (TS00) in every odd-numbered frame to 0. The odd-numbered frames 1, 3, 5, 7, 9, 11, 13, and 15 are referred to as the non-alignment frames.

- RRA On: The BERT Tester will set bit 3 in timeslot 00 (TS00) in every odd-numbered frame to 1. The odd-numbered frames 1, 3, 5, 7, 9, 11, 13, and 15 are referred to as the non-alignment frames.

Error Type: This field has four choices, listed below. The purpose of this option is to generate fixed errors to aid in troubleshooting equipment. When an error is inserted, a single error of the error type displayed in this field will be generated.

- Logic: The logic error inverts one bit in the data path.

- CRC: The CRC (Cyclic Redundancy Check) error generates an error in the CRC4 portion of the frame byte.

- Frame: The frame error selection generates one frame error.

- BPV: The bipolar violation selection generates a BPV error.

Error Frequency: This field has two choices.

- Single: Generates a single error of the error type selected each time the Error button is pressed.

- 1 sec: Generates a single error of the error type selected every second.

Timeslot 01 through Timeslot 31: Each timeslot field contains two choices, On and Off. This field selects each timeslot to be used in the E1 frame. A timeslot's bandwidth is used in the frame when On is displayed. The E1 Frame has 32 (TS00–TS31) timeslots. Only timeslots 01 through timeslot 31 are programmable.

- On: The timeslot's bandwidth is used in the E1 frame.

- Off: The timeslot's bandwidth is not used in the E1 frame.

TS00 is used for synchronization. TS16 has an additional choice of SIG. If SIG is selected, Timeslot 16 is used for signalling and not data. TS16 must be set to SIG to transmit a Distant Multiframe Alarm (DMFA). The following is a detailed description of the E1 frame.

<div align="center">E1 Frame</div>

Frame	TS00	TS01 thru TS15	TS16	TS17 thru TS31
00	c0011011	00000000 00000000	00000000	00000000 00000000
01	01annnnn	00000000 00000000	00000000	00000000 00000000
02	c0011011	00000000 00000000	00000000	00000000 00000000
03	01annnnn	00000000 00000000	00000000	00000000 00000000
04	c0011011	00000000 00000000	00000000	00000000 00000000
05	01annnnn	00000000 00000000	00000000	00000000 00000000
06	c0011011	00000000 00000000	00000000	00000000 00000000
07	01annnnn	00000000 00000000	00000000	00000000 00000000
08	c0011011	00000000 00000000	00000000	00000000 00000000
09	11annnnn	00000000 00000000	00000000	00000000 00000000
10	c0011011	00000000 00000000	00000000	00000000 00000000
11	11annnnn	00000000 00000000	00000000	00000000 00000000
12	c0011011	00000000 00000000	00000000	00000000 00000000
13	i1annnnn	00000000 00000000	00000000	00000000 00000000

| 14 | c0011011 | 00000000 00000000 | 00000000 | 00000000 00000000 |
| 15 | i1annnnn | 00000000 00000000 | 00000000 | 00000000 00000000 |

E1 = 2048000 bps or 488 nanoseconds per bit
256 (8 x 32) bits per frame - 125 microseconds per frame
16 frames = 1 multiframe or 2 milliseconds
2048000/256 = 8000 bps per bit
1 timeslot (TS) = 8 x 8000 bps = 64000 bps

16 Frames (0–15) = CRC multiframe
Each CRC multiframe contains two 8 frame submultiframes (SMF I and SMF III)
Each SMF = 2048 (256 x 8) bits has its own CRC (cyclic redundancy check)
Each CRC multiframe contains 32 timeslots (TS00–TS31)

Bits are numbered 1 thru 256.

Bits 1 through 8 (timeslot 00) contain the following:
  bits 2–8 in frames 0, 2, 4, 6, 8, 10, 12, and 14 contain the frame alignment signal 0011011.
  bit 1 in frames 1, 3, 5, 7, 9, and 11 contain the multiframe alignment signal 001011.
  c bits are for SMF I and SMF III CRC4s. Many systems in use presently do not incorporate the CRC4 (c bits). In those cases, the cbits are set to 1.
  i bits are for international use. This bit set to 1 when not used and crossing international borders.
  n bits are spare bits reserved for national use.
  a bits are for signalling remote alarm indications (alarm = 1).

Frames 1, 3, 5, 7, 9, 11, 13, and 15 are also referred to as the non-alignment frames.

Bits 129 through 136 (timeslot 16) are used for common channel signalling or channel associated signalling.

Save EEPROM: With the Save field displayed in the E1 mode, pressing either the Up or Down Change button will cause the current configuration of the E1 mode to be saved to EEPROM (nonvolatile memory which will retain the configuration after power is removed from the tester).

3.7 Setup Mode

This section describes the parameter fields in the setup mode.

Mode: The mode field consists of five choices: async, sync, T1, E1, and setup. The mode can be changed by pressing the Mode button until the desired mode appears or by the following procedure.

Press the Up or Down Config button until the mode field is displayed. With the mode field displayed, press the Up or Down Change button until the desired mode appears on the display. With the selected mode displayed, press the Up or Down Config button to view the options for the selected mode.

Run: The Run field has two choices, listed below.

- Manual: When manual is selected, the tester can freeze all displays. When the Start button is pushed the first time in the manual mode, the tester resets all the displays and then updates the displays as events occur after the reset. When the Start button is pushed a second time, the tester freezes all the displays. Pushing the Start button again starts the cycle over again, resetting all the displays and then updating them.

- Continuous: When continuous is selected, the tester continuously sends a test pattern. When the Start button is pushed, the tester resets all the displays and continues to run.

TST Time—Hours: The choices in the test time hours are 0 through 99 hours. When the timed selection in the run field is selected, this choice will determine how many hours the test will run.

TST Time—Mins: The choices in the test time minutes are 0 through 59 minutes. When the timed selection in the run field is selected, this choice will determine how many minutes the test will run.

User Pat Len: There are 30 choices in the user pattern length field (03 through 32). This choice will determine how long the user pattern will be and how many user bits will be displayed. For example, if 13 is selected in the user pattern length field, user bits displayed will be user bit 01 through user bit 13. User bit 01 is always transmitted first.

User Bit 1 through User Bit 32: The User Bit fields selections are binary 1 or binary 0. There can be up to 32 fields displayed depending on the selection in the user pattern length. User bit 01 through user bit 03 are always displayed.

Console: The console field has two choices, VT100 or CLI. When VT100 is selected, the VT100 console is used to control the BERT Tester. When CLI is selected, the command line interface is used to control the BERT Tester.

Audible Alarm: The audible alarm field can be either on or off. When audible alarm on is selected, the tester sends a bell character to the console port and sounds an audible alarm for every errored second that occurs. When audible alarm off is selected, the audible alarm feature is disabled.

Save EEPROM: With the Save field displayed in the setup mode, pressing either the Up or Down Change button will cause the current configuration of the setup mode to be saved to EEPROM (nonvolatile memory which will retain the configuration after power is removed from the tester).

4. Interfaces and Cables

4.1 Network Interface

Choose between Bantam connectors or an RJ-48C connector for the NI (network interface) termination. Both the Bantam connectors and the RJ-48C connector are wired in parallel. The interface pins on these connectors on the right side of the BERT Tester are described in Table 4-1.

Table 4-1. RJ-48C 8-position modular connector on side of tester.

Pin Number	Direction
1	from network
2	from network
4	to network
5	to network

4.2 X.21 Interface

The DB15 female connector on the top of the tester supplies the X.21 interface. The signals on this connector appear as a DTE (terminal) to the data communications equipment (DCE). The X.21 interface connector on the top of the tester is wired as described in Table 4-2.

Table 4-2. The X.21 interface 15-pin female connector wiring on the top of the tester when X.21 is selected.

Pin Number	Signal Name	Direction
1	Shield ground	both ways
2	Transmit Data (A)	from tester
9	Transmit Data (B)	from tester
4	Receive Data (A)	to tester
11	Receive Data (B)	to tester
3	Control (A)	from tester
10	Control (B)	from tester
5	Indicator (A)	to tester
12	Indicator (B)	to tester

Table 4-2 (continued). The X.21 interface 15-pin female connector wiring on the top of the tester when X.21 is selected.

Pin Number	Signal Name	Direction
6	Signal Element (A)	to tester
13	Signal Element (B)	to tester
8	Signal Ground	both ways

4.3 RS-232/RS-530/RS-422 Interfaces

The DB25 female on the top of the tester may be used for either RS-232 or for RS-422/RS-530 interfaces. This interface will appear as a DTE (terminal) to the data communications equipment (DCE). When RS-232 is selected, the interface on the top of the tester will appear as described in Table 4-3.

Table 4-3. DB25 female connector wiring on the top of the tester when RS-232 is selected.

Pin Number	Signal Name	Direction
1	Shield	both ways
2	Transmitted Data	from tester
3	Received Data	to tester
4	Request to Send	from tester
5	Clear to Send	to tester
6	Data Set Ready	to tester
7	Signal Ground	both ways
8	Carrier	to tester
15	Transmit Sig Elem Timing	to tester
17	Receiver Sig Elem Timing	to tester
18	-10 volts	from tester
20	Data Terminal Ready	from tester
21	-10 volts	from tester
24	External Transmit Timing	from tester

When RS-530/422 interface is selected, the signals on the DB25 pin connector will also appear as a DTE (terminal) to the data communications equipment (DCE). The interface actually is wired for RS-530. A 25-pin-to-37-pin RS-422 adapter cable

(not supplied) may be used for RS-422. When RS-530 is selected, the interface on the top of the tester will appear as described in Table 4-4.

**Table 4-4. DB25 female connector wiring
on the top of the tester when RS-530 is selected.**

Pin Number	Signal Name	Direction
1	Shield	both ways
2	Transmit Data (A)	from tester
14	Transmit Data (B)	from tester
3	Receive Data (A)	to tester
16	Receive Data (B)	to tester
4	Request to Send (A)	from tester
19	Request to Send (B)	from tester
5	Clear to Send (A)	to tester
13	Clear to Send (B)	to tester
6	Data Set Ready (A)	to tester
22	Data Set Ready (B)	to tester
7	Signal Ground	both ways
8	RLSD or Carrier (A)	to tester
10	RLSD or Carrier (B)	to tester
15	Transmit Signal Elem Timing (A)	to tester
12	Transmit Signal Elem Timing (B)	to tester
17	Receiver Sig Elem Timing (A)	to tester
9	Receiver Sig Elem Timing (B)	to tester
18	-10 volts	from tester
20	Data Terminal Ready (A)	from tester
23	Data Terminal Ready (B)	from tester
21	-10 volts	from tester
24	External Transmit Timing (A)	from tester
11	External Transmit Timing (B)	from tester

4.4 CCITT V.35 Interface

When V.35 is selected, the V.35 signals will be present on the DB25 connector. The signals on this connector appear as a DTE (terminal) to the data communications equipment (DCE). This interface is wired as described in Table 4-5.

**Table 4-5. DB25 female connector wiring
on the top of the tester when V.35 is selected.**

Pin Number	Signal Name	Direction
1	Shield	both ways
2	Transmit Data (A)	from tester
14	Transmit Data (B)	from tester
3	Receive Data (A)	to tester
16	Receive Data (B)	to tester
4	Request to Send	from tester
5	Clear to Send	to tester
6	Data Set Ready	to tester
7	Signal Ground	both ways
8	RLSD or Carrier	to tester
15	Transmit Sig Elem Timing (A)	to tester
12	Transmit Sig Elem Timing (B)	to tester
17	Receive Sig Elem Timing (A)	to tester
9	Receive Sig Elem Timing (B)	to tester
18	-10 volts	from tester
20	Data Terminal Ready	from tester
21	-10 volts	from tester
24	External Transmit Timing (A)	from tester
11	External Transmit Timing (B)	from tester

4.5 Audio Out

The audio out connector is reserved for future use.

4.6 Console Interface

The console interface is a 6-position modular connector. This connector is used to connect the console or modem to the BERT Tester. This optional 6-position modular cable with the DB25 male hood is connected to the ASCII terminal. The cable and 25-pin hood are described at the end of this section. The interface pins on the 6-position modular connector are described in Table 4-6.

**Table 4-6. 6-position modular console (GUI) connector
on the left side of the tester.**

Pin Number	Signal Name	Direction
1	Receive Data	to tester
2	Ground	both ways
3	RLSD or Carrier	to tester
4	Data Terminal Ready	from tester
5	Data Set Ready	to tester
6	Transmit Data	from tester

4.7 Cables

Optional cables and hoods are available from Black Box for the BERT Tester. Refer to Table 4-7. Call Technical Support at 724-746-5500 for details.

Table 4-7. Optional cables and hoods.

Cable	Description
See Tables 4-8 and 4-9.	Cable used for connecting the tester's modular console connector to either the DB9 or DB25 hood.
See Table 4-8.	DB9 hood used for connecting to the console's DB25 connector.
See Table 4-9.	Hood used when connecting the console port to a modem.

Table 4-7 (continued). Optional cables and hoods.

Cable	Description
EVN530-0005-MM	DB25 male to DB25 male straight-through 5-ft. (1.5-m) cable used to connect the BERT Tester's DB25 female interface port (RS-232/RS-530/RS-422/V.35) to a DCE's DB25 female interface port.
EGM16E-0005-MM	DB15 male to DB15 male straight-through 5-ft. (1.5-m) cable used to connect the BERT Tester's DB15 female interface port (X.21) to a DCE's DB15 female interface port.
TS940A-R2	DB25 male to DB34 male adapter 6-ft. (1.8-m) cable used to connect the BERT Tester's DB25 female interface port (RS-530) to a DCE's DB34 female interface port (V.35).
See Table 4-11 for pinout information.	DB25 male to DB37 male adapter 6-ft. (1.8-m) cable used to connect the BERT Tester's DB25 female interface port (RS-530) to a DCE's DB37 female interface port (RS-422).
Please contact Technical Support (custom cable).	Bantam to Bantam cable used to connect Bantam connectors on the BERT Tester to Bantam connectors. This cable is used for T1 and E1 applications.
See Table 4-12. Please contact Technical Support (custom cable).	Dual Bantam to DB15 male cable used to connect dual Bantam connectors on the BERT Tester to a DB15 female interface port on a DCE. This cable is used for T1 and E1 applications.
Please contact Technical Support (custom cable).	Dual Bantam to RJ-45 cable used to connect dual Bantam connectors on the BERT Tester to an RJ-45 modular interface port on a DCE. This cable is used for T1 and E1 applications.

Table 4-7 (continued). Optional cables and hoods.

Cable	Description
Please contact Technical Support (custom cable).	Bantam to BNC cable used to connect the Bantam connector on the BERT Tester to a BNC connector on a DCE. This cable is typically used for E1 applications.

With the exception of the straight-through adapter cables, all cables and hoods are depicted in Figures 4-1 through 4-7. Tables 4-8 through 4-13 describe the pinnings.

Figure 4-1. RJ-11C 6-pin modular to modular straight-through 6-ft. (1.8-m) cable—BERT Tester console to DB9 hood when connecting to the console.
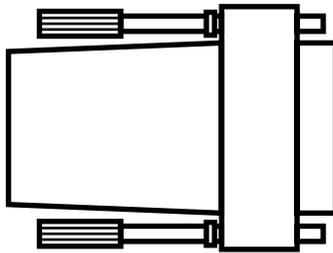
Figure 4-2. DB9 hood used to connect modular cables from the BERT Tester console port to a terminal.

Table 4-8. DB9 hood pinning.

6-Pin Modular	Signal Name	DB9 Female
1	Transmit Data	3
2	Ground	5
6	Receive Data	2
—	RTS to CTS to RLSD	1 to 7 to 8
—	DSR to DTR	6 to 4
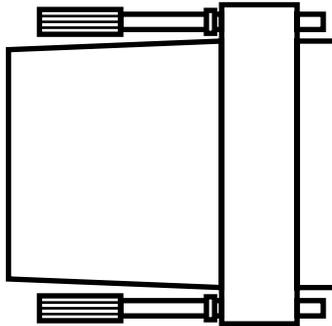
**Figure 4-3. DB25 hood used to connect modular cable
from the BERT Tester console port to a modem.**

Table 4-9. DB25 hood pinning.

6-Pin Modular	Signal Name	DB25 Male
1	Receive Data	3
2	Ground	7
3	RLSD or Carrier	8
4	Data Terminal Ready	20
5	Data Set Ready	6
6	Transmit Data	2

**Figure 4-4. DB25 male to DB34 male adapter 6-ft. (1.8-m) cable used to
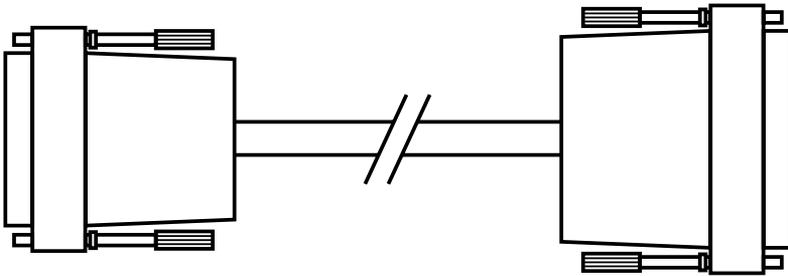connect the BERT Tester's DB25 pin female interface port (RS-530)
to the DCE's DB34 female interface port (V.35).**

Table 4-10. DB25 male to DB34 male adapter pinning.

DB25 Male	Signal Name	DB34 Male
7	Ground	B
2	Transmit Data (A)	P
14	Transmit Data (B)	S
3	Receive Data (A)	R
16	Receive Data (B)	T
6	Data Set Ready	E
8	Carrier Detect	F
24	External TXC (A)	U
11	External TXC (B)	W
15	Transmit Clock (A)	Y
12	Transmit Clock (B)	AA (a)
17	Receive Clock (A)	V
9	Receive Clock (B)	X
20	Data Terminal Ready	H
4	Request to Send	C
5	Clear to Send	D
18	-10 volts	L
21	-10 volts	N
25	Test Mode	MM (m)
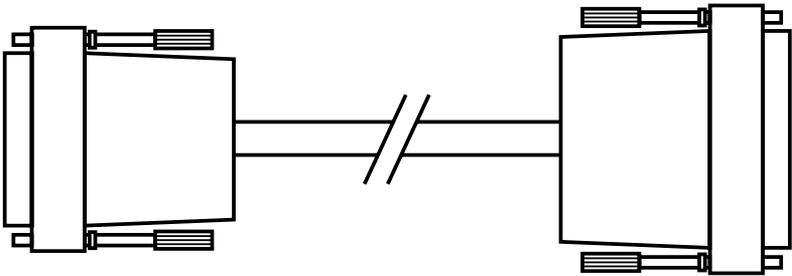
Figure 4-5. DB25 male to DB37 male adapter 6-ft. (1.8-m) cable used to connect the BERT Tester's DB25 female interface port (RS-530) to the DCE's DB37 female interface port (RS-422).

Table 4-11. DB25 male to DB37 male adapter pinning.

DB25 Male	Signal Name	DB37 Male
1	Ground	1
7	Ground	19
2	Transmit Data (A)	4
14	Transmit Data (B)	22
3	Receive Data (A)	6
16	Receive Data (B)	24
6	Data Set Ready (A)	11
22	Data Set Ready (B)	29
8	Carrier Detect (A)	13
10	Carrier Detect (B)	31
25	Test Mode	18
24	External TXC (A)	17
11	External TXC (B)	35
15	Transmit Clock (A)	5
12	Transmit Clock (B)	23
17	Receive Clock (A)	8
9	Receive Clock (B)	26
18	-10 volts	10
21	-10 volts	14
20	Data Terminal Ready (A)	12

Table 4-11 (continued). DB25 male to DB37 male adapter pinning.

DB25 Male	Signal Name	DB37 Male
23	Data Terminal Ready (B)	30
4	Request to Send (A)	7
19	Request to Send (B)	25
5	Clear to Send (A)	9
13	Clear to Send (B)	27
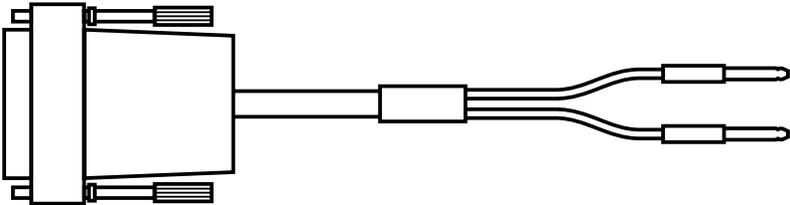
**Figure 4-6. Dual Bantam to DB15 male 6-ft. (1.8-m) adapter cable used
to connect dual Bantam connectors on the BERT Tester
to a DB15 female interface port on a DCE.**

Table 4-12. Dual Bantam to DB15 male pinning.

Dual Bantam	DB15 Male
Tip	1, 3
Ring	9, 11
Sleeve	Shield
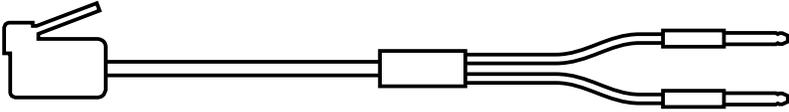
**Figure 4-7. Dual Bantam to RJ-45 6-ft. (1.8-m) adapter cable used
to connect dual Bantam connectors on the BERT Tester
to an RJ-45 modular interface port on a DCE.**

Table 4-13. DB25 male to DB37 male adapter pinning.

Dual Bantam	Signal Name	RJ-45 Male
Tip Ring	Twisted Pair	1 2
Sleeve	————	Shield
Tip Ring	Twisted Pair	4 5

5. Console Port

5.1 General

The BERT Tester console supports dial modems and VT100 terminals. The speed of the console port is 9600 bps.

5.2 Cabling a Terminal to the Console Port

To cable a terminal to the console port, an optional cable and hood are required. Call Black Box Technical Support at 724-746-5500 for details. The cable is a six-conductor straight-through RJ-11 modular cable and the hood is an RJ-11 modular to DB9 female as described in Figure 4-1. One end of the RJ-11 cable is inserted into the connector on the left side of the tester and the other end into the modular connector in the hood. Plug the hood into the DB9 connector on the VT100 terminal.

5.3 Cabling a Modem to the Console Port

To cable a modem to the console port, an optional hood and cable are required. Call Black Box Technical Support at 724-746-5500 for details. The cable is an RJ-11C six-pin modular straight-through cable (see Figure 4-1) and the hood is an RJ-11 modular to DB25 male (see Figure 4-3). Wiring diagrams appear in **Chapter 4**.

5.4 Console Port Operation

The console port and the ASCII terminal or modem must be programmed for the same speed to use the console feature. The BERT Tester's console port settings are 9600 bps, 8 data bits, 1 stop mark, and no parity.

The console is user-friendly and very simple to operate, since only a few keys are needed. Except for the two control keys, all keys are described on the bottom lines of the screens where they are used. A description of these keys appears in Table 5-1.

Table 5-1. Console keys.

Key	Description
Arrow keys	Pressing the arrow keys on all screens advances the blinking cursor to the next field.
ENTER	Pressing **Enter** causes one of two things to happen, depending on the field displayed. In the mode field, it selects and displays the next screen. In the other fields, Enter selects the next choice in the field.
BS/bs	Typing the letters BS or bs (case-insensitive) on all screens selects the previous choice in the field.
D/d	Typing the letter D or d (case-insensitive) on all screens deactivates the console.
E/e	Typing the letter E or e (case-insensitive) on all screens inserts an error into the data stream.
P/p	Typing the letter P or p (case-insensitive) on all screens enables you to change the password.
R/r	Typing the letter R or r (case-insensitive) on all screens resets all the counters being displayed.
S/s	Typing the letter S or s (case-insensitive) on all screens sends a loop command to the remote tester.
Control D	Holding the **Control** key down and then typing the letter D (or d) disconnects the modem.
Control R	Holding the **Control** key down and then pressing the R (or r) refreshes the screen.

The console is easy to use because the screen hierarchy is very flat. There is only one screen displayed for each mode. The screen hierarchy is shown in Figure 5-1.
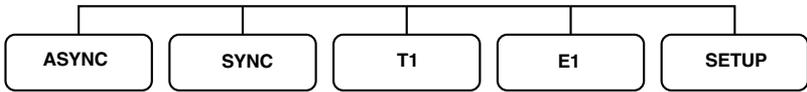
Figure 5-1. Screen hierarchy.

5.4.1 ACTIVATING THE CONSOLE

To activate the console, you must enter a password. The default password when shipped from the factory is the Enter key. Pressing **Enter** will activate the console and bring up the T1 menu.

5.4.2 DISPLAYING SCREENS FOR EACH MODE

To display any of the five screens listed in Figure 5-1, push the Mode button on the LCD display until the desired screen appears.

5.4.3 CHANGING THE PASSWORD

To change the password, type P on any screen. The following prompt will appear:

Enter New Password:

Type the new password, then press **Enter**. The tester will then ask you to verify your entry:

Re-Enter Password: For Verification

Again, type the new password, followed by **Enter**.

If you enter an invalid password, the following message appears:

Press any key to exit or P to re-enter.

5.4.4 DEACTIVATING THE CONSOLE

To deactivate the console, type D on any screen. The console will be deactivated and the password will be required to activate the console again.

5.5 T1 Menu

The T1 menu is the first screen displayed (see Figure 5-2). The blinking cursor will be positioned on the mode field under Configuration. Use the space bar to advance the cursor to the next field and the **Enter** key to change any of the configuration selections.

```
                              BERT TESTER

DISPLAYS                                                      REL 1.2
ERRS: 000000000    TEST SEC: 000000    CRC ERRS: 000000   ERR SECS: 000000
BER: 0.00 x 10e-06  SLIPS: 000000       BPV ERRS: 000000   SES: 000000
TX FREQ: 1544000   SIG: A* B* C* D*    FE ERRS: 000000    DEG MINS: 000000
RX FREQ: 1544000   dB LVL: 0 dB        DENSITY: 000000    AVAIL: 000000
RX LVL: 6.3 V      RT DELAY: 0000 m    UNAVAIL: 000000    ELAPSD: 00:00:01


LEDS (*=LED ON)
PAT LOCK  RECOV   FRAME LOCK  AIS     RLOS *  CRC         BPV  YEL


CONFIGURATION
MODE: T1          LP: ATT CSU         DS01: ON     DS09: ON     DS17: ON
FUNC: TERMINATE   LISTEN: 01          DS02: ON     DS10: ON     DS18: ON
T1 OUT: Normal    VOLUME: 7           DS03: ON     DS11: ON     DS19: ON
FRAMNG: ESF       SIG VIEW: 01        DS04: ON     DS12: ON     DS20: ON
CODING: B8ZS      SIG GEN: OFF        DS05: ON     DS13: ON     DS21: ON
T1 LBO: 0 dB      ERR TYPE: LOGIC     DS06: ON     DS14: ON     DS22: ON
T1 TMG: INTERNAL  ERR FREQ: SINGLE    DS07: ON     DS15: ON     DS23: ON
PAT: QRSS         IDLE: FE            DS08: ON     DS16: ON     DS24: ON
DS0 BW: 64000


RUN/RESET=[R]       SEND LOOP=[S]                     INSERT ERROR=[E]
CURSOR=[SPACE/b]                                      CHANGE=[ENTER/BS]
```

Figure 5-2. T1 menu.

NOTE

By pressing Enter on the mode field, you change the mode and cause the screen for that mode to appear.

To reset the displays at the top of the screen, simply type the letter R. To insert an error, type the letter E. See **Chapter 2** for a detailed description of each of the displays and LEDs. See **Chapter 3** for a detailed description of each of the configuration parameters.

To send a loop, select the loopback type by advancing to the LP Type field and pressing the **Enter** key until the desired loopback type appears. Go to the loop field and select **Send On**. With the LP type and loop fields programmed, type the letter S to send the loop.

5.6 E1 Menu

The E1 menu is displayed in Figure 5-3. The blinking cursor will be positioned on the mode field under Configuration. Use the space bar to advance the cursor to the next field and the Enter key to change any of the configuration selections. By pressing **Enter** on the mode field, you change the mode and cause the screen for that mode to appear.

```
                              BERT TESTER

DISPLAYS                                                          REL. 1.2
ERRS: 000000000   TEST SEC: 000000   CRC ERR: 000000   ERR SECS: 000000
BER: 0.00 x 10e-06  SES: 000000      BPV ERR: 000000   AVAIL: 000000
TX FREQ: 2048000  DEG MINS: 000000   FE ERRS: 000000   UNAVAIL: 000000
RX FREQ: 2048000  RTD: 0000 m        SLIPS: 000000     ELAPSD: 00:00:01


LEDS (*=LED ON)
PAT LOCK     RECOV     FRAME LOCK AIS        RLOS* CRC    BFV   DMFA  RRA


CONFIGURATION
MODE: E1          VOLUME: 0          TS06: ON     TS16: ON     TS26: ON
FUNC: TERMINATE   DMFA: OFF          TS07: ON     TS17: ON     TS27: ON
E1 OUT: Normal    RRA: OFF           TS08: ON     TS18: ON     TS28: ON
PAT: ITU 2¹⁵      ERR TYPE: LOGIC    TS09: ON     TS19: ON     TS29: ON
E1 TMG INTERNAL   ERR FREQ: SINGLE   TS10: ON     TS20: ON     TS30: ON
TERM: 75 OHM      TS01: ON           TS11:ON      TS21: OFF    TS31: ON
V54 LP:           TS02: ON           TS12: ON     TS22: ON     SAVE: EEPROM
FRAMNG: FRAMED    TS03: ON           TS13: ON     TS23: ON
CRC4: ON          TS04: ON           TS14: ON     TS24: ON
LISTEN: 01        TS05: ON           TS15: ON     TS25: ON


RUN/RESET=[R]       SEND LOOP=[S]                  INSERT ERROR=[E]
CURSOR=[SPACE/b]                                   CHANGE=[ENTER/BS]
```

Figure 5-3. E1 menu.

To reset the displays at the top of the screen, simply type the letter R. To insert an error, type the letter E. Refer to **Chapter 2** for a detailed description of each of the displays and LEDs. Refer to **Chapter 3** for a detailed description of each of the configuration parameters.

To send a loop, select the loopback type by advancing to the LP type field and pressing the Enter key until the desired loopback type appears. Go to the loop field and select **Send On**. With the LP type and loop fields programmed, type the letter S to send the loop.

5.7 Async Menu

The Async menu is displayed in Figure 5-4. The blinking cursor will be positioned on the mode field under Configuration. Use the space bar to advance the cursor to the next field and the Enter key to change any of the configuration selections.

```
                            BERT TESTER


DISPLAYS
C ERR: 000000000    C RCVD: 0000001692    TEST SEC: 000000    ERR SECS: 000000
                                          RT Delay: 000000    ELAPSD: 00:00:01


LEDS (*=LED ON)
PAT LOCK      RECOV      TXD:        RXD      RTS    CTS    DSR    CD    DTR*


CONFIGURATION
MODE: ASYNC       SPEED: 9600       DATA BITS: 8      RTS: ON
OUTPUT: NORMAL    PAT: 2047         STOP MARKS: 1     DTR: ON
INTERFACE: RS232  TRAP ERR: OFF     PARITY: NONE      SAVE: EEPROM



RUN/RESET=[R]        SEND LOOP=[S]                      INSERT ERROR=[E]
CURSOR=[SPACE/b]                                        CHANGE=[ENTER/BS]
```

Figure 5-4. Async menu.

NOTE

By pressing Enter in the mode field, you change the mode and cause the screen for that mode to appear.

Under the LEDs section of this screen, the asterisk (*) and T are used as indicators. When an LED is On, the asterisk will be present. When an LED is Off, the asterisk will not be present. If either the TXD LED or RXD LED is On, the asterisk indicates all 0s. If either the TXD LED or RXD LED is Off, then all 1s are being detected. If any combination of ones and zeros occur within the second, the display will indicate T for transition.

To reset the displays at the top of the screen, simply type the letter R. To insert an error, type the letter E. Refer to **Chapter 2** for a detailed description of each of the displays and LEDs. Refer to **Chapter 3** for a detailed description of each of the configuration parameters.

To send a loop, select the loopback type by advancing to the LP type field and pressing the **Enter** key until the desired loopback type appears. Go to the loop field and select **Send On**. With the LP type and loop fields programmed, type the letter S to send the loop.

5.8 Sync Menu

The Sync menu is displayed in Figure 5-5. The blinking cursor will be positioned on the mode field under Configuration. Use the space bar to advance the cursor to the next field and the **Enter** key to change any of the configuration selections.

```
                              BERT TESTER


DISPLAYS
ERRS: 000000000    TEST SEC: 000000    ERR SECS: 000000    AVAIL: 000000
B: 000000000000    TX FREQ: 1536000    SES: 000000         UNAVAIL: 000000
BER: 0.00 x 10e-06 RX FREQ: 1536000    DEG MINS: 000000     RTS TIME: 0000 m
                                                           ELAPSD: 00:00:01zx


LEDS (*=LED ON)
PAT LOCK   RECOV TXD:   RXD    RTS    CTS    DSR    CD    DTR*  LDL  RDL


CONFIGURATION
MODE: SYNC         PAT: 2047           TX CLK: ACCEPT      DTR: ON
OUTPUT: NORMAL     V.54 LOOP:          TRAP ERR: OFF       LDL: OFF
INTERFACE: V.35    SPEED: 1200         RTS: ON             SAVE: EEPROM


RUN/RESET=[R]          SEND LOOP=[S]                       INSERT ERROR=[E]
CURSOR=[SPACE/b]                                           CHANGE=[ENTER/BS]
```

Figure 5-5. Sync menu.

NOTE

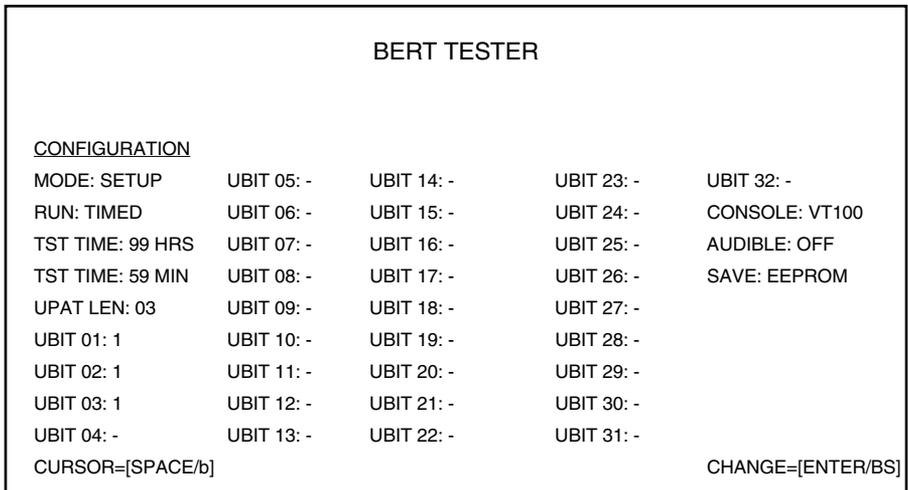**By pressing Enter on the mode field, you change the mode and cause the screen for that mode to appear.**

Under the LEDs section of this screen, the asterisk (*) and T are used as indicators. When an LED is On, the asterisk will be present. When an LED is Off, the asterisk will not be present. If either the TXD LED or RXD LED is On, the asterisk indicates all 0s. If either the TXD LED or RXD LED is Off, then all 1s are being detected. If any combination of ones and zeros occur within the second, the display will indicate "T" for transition.

To reset the displays at the top of the screen, simply type the letter R. To insert an error, type the letter E. Refer to **Chapter 2** for a detailed description of each of the displays and LEDs. Refer to **Chapter 3** for a detailed description of each of the configuration parameters.

To send a loop, select the loopback type by advancing to the LP type field and pressing the **Enter** key until the desired loopback type appears. Go to the loop field and select **Send On**. With the LP type and loop fields programmed, type the letter S to send the loop.

5.9 Setup Menu

The setup menu is displayed in Figure 5-6. The blinking cursor will be positioned on the mode field under Configuration. Use the space bar to advance the cursor to the next field and the Enter key to change any of the configuration selections.

```
                              BERT TESTER


CONFIGURATION
MODE: SETUP       UBIT 05: -     UBIT 14: -     UBIT 23: -     UBIT 32: -
RUN: TIMED        UBIT 06: -     UBIT 15: -     UBIT 24: -     CONSOLE: VT100
TST TIME: 99 HRS  UBIT 07: -     UBIT 16: -     UBIT 25: -     AUDIBLE: OFF
TST TIME: 59 MIN  UBIT 08: -     UBIT 17: -     UBIT 26: -     SAVE: EEPROM
UPAT LEN: 03      UBIT 09: -     UBIT 18: -     UBIT 27: -
UBIT 01: 1        UBIT 10: -     UBIT 19: -     UBIT 28: -
UBIT 02: 1        UBIT 11: -     UBIT 20: -     UBIT 29: -
UBIT 03: 1        UBIT 12: -     UBIT 21: -     UBIT 30: -
UBIT 04: -        UBIT 13: -     UBIT 22: -     UBIT 31: -
CURSOR=[SPACE/b]                                CHANGE=[ENTER/BS]
```

Figure 5-6. Setup menu.

NOTE

By pressing Enter on the mode field, you change the mode and cause the screen for that mode to appear.

Refer to **Chapter 3** for a detailed description of each of the configuration parameters.

6. Battery Power

The BERT Tester is equipped with a battery option. Eight rechargeable nickel metal hydride batteries power the tester. These state-of-the-art batteries do not require discharging before recharging, which means you do not have to wait for the battery to run down before recharging. The batteries do not retain memory; you can recharge them anytime. In addition, they are non-toxic to the environment.

An On/Off switch (located below the console port on the left side of the tester) is used to select the battery options.

- Put the switch in the Off position to charge the batteries. The AC adapter must be plugged into the wall when this selection is made. The tester requires 14 hours in the Off position to charge the batteries for a period of 5 hours.

- Putting the switch in the On position provides battery power for the tester. If the AC adapter is not plugged into the wall, the tester runs on the batteries. The batteries have a charge life of 5 hours.

NOTE

If the AC adapter is plugged into the wall when the switch is in the On position, the tester runs on AC power and simultaneously charges the batteries. Charge time takes considerably longer than in the Off position.

We recommend replacing the batteries once a year to protect the tester from being damaged by battery erosion.

7. Troubleshooting

7.1 Calling Black Box

If you determine that your BERT Tester is malfunctioning, do not attempt to alter or repair the tester. It contains no user-serviceable parts. Contact Black Box at 724-746-5500.

Before you do, make a record of the history of the problem. We will be able to provide more efficient and accurate assistance if you have a complete description, including:

- the nature and duration of the problem.

- when the problem occurs.

- the components involved in the problem.

- any particular application that, when used, appears to create the problem or make it worse.

7.2 Shipping and Packaging

If you need to transport or ship your BERT Tester:

- Package it carefully. We recommend that you use the original container.

- If you are shipping the BERT Tester for repair, make sure you include everything that came in the original package. Before you ship, contact Black Box to get a Return Authorization (RA) number.

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