BTM10-E1 E1 Transmission Analyzer

E1 Telecom/Datacom Analyzer

Portable Analyzer series

CTC union Technologies Co., L

Table of Contents

Chapter 6: BERT Analysis

Chapter 7: Alarms Setting

Chapter 8: Signal Result

Chapter 9: Signaling Setup

Chapter 10: Signaling Display

Chapter 11: User Program Pattern

Chapter 12: Time Slot Setting

Chapter 13: External Drop and Insert

Chapter 14: Time Slot Map Data

Chapter 15: VF Access

E1 Brief History

E1 technology has its roots in the original AT&T T1 public telephone networks. The AT&T T1 carrier used PCM (Pulse Code Modulation) and time-division multiplexing over wire pairs with digital repeaters spaced 6000 feet apart. The 24 speech channels we encoded on the 1.544 Mbps bit stream. Seven bits were used for encoding each sample. The system was designed to transmit voice frequencies up to 4 kHz, and therefore required sampling at 8000 samples per second. Each frame was 125 usec. There are a total of 1 bits in each frame, giving 193 x 8000 = 1.544 Mbps.

When T1 facilities were first introduced by AT&T, they wer installed mainly in the public telephone network to implement connections between switching offices. The T1 carrier has become s successful that individual users of telecommunications can now leas T1 facilities from a variety of common carriers and are routinely use to implement communication links where high data rates are require

The CCITT has made two recommendations for PCM transmission which can be achieved over most telephone wire pairs, one for the T1 carrier speed of 1.544 Mbps and one for E1 transmission at 2.048 Mbps,. The CCITT recommendation for 1.54 Mbps differs slightly from the North American standard set by AT& It employs a 193 bit frame with 8 bits per channel, and the frame alignment bit is the first bit, not the 193rd as in the AT&T standard. Sixteen frames of 256 bits each are grouped together to form one multi-frame. There are thirty-two 8-bit time slots in each frame, giv 30 speech channels of 64 Kbps each, one synchronization channel, and one signaling channel. 64 Kbps x 32 channels = 2.048 Mbps.

Figure 1-1 shows the CCITT 2.048 Mbps recommendation, which most of the world outside North America uses for PCM transmission.

The E1 frame structure:

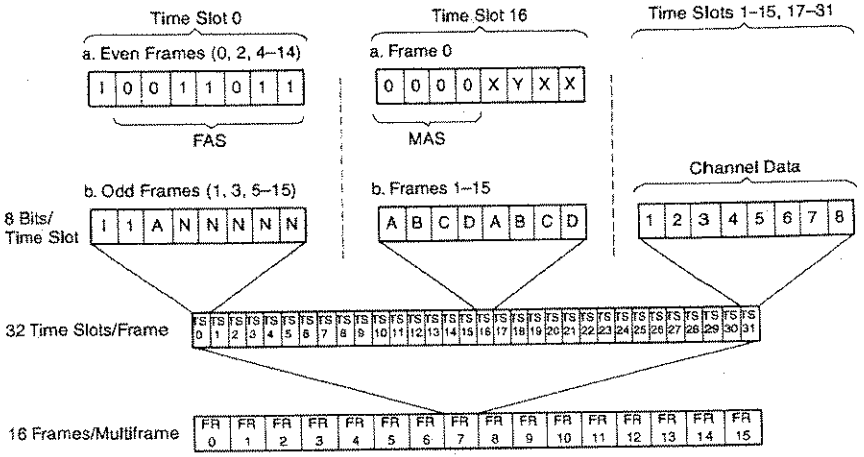


Figure 1-1 E1 Frame Structure

Technical Standards

E1 transmission technology is defined by a number of technology standards. The following standards cover many of the important aspects of E1 transmission technology:

ITU G.703 Physical/Electrical characteristics of interfaces
ITU G.704 Synchronous frame structures
ITU G.706 Frame alignment and CRC
ITU G.821 Error performance of an international connection
ITU M.550/M.2100 Bringing an international connection into service
ITU Q.400 to Q.490 Specs for R2 Signaling Systems
ITU Q.700 Series SS7 Sppecification
ITU Q.921 and Q.931 ISDN Layer 2 and 3 protocol

Pulse Code Modulation

To transmit voice in a digital medium, such as a 2.048 Mbp line, the analog voice signal must first be encoded into a binary format. The conversion is achieved via Pulse Code Modulation. Fo voice signals a maximum frequency of 4000 Hz provides adequate clarity while conserving transmission bandwidth. The Nyquist theorem requires that a signals maximum frequency be samples at t times to reproduce the signal without loss of information. Therefor the analog signal is sampled at 8000 samples/second.

The analog signal is first run through a compander (compression circuit) to raise the analog signals to their maximum level. Then the level at each of the samples is converted to an 8-bit word code. Referring to Figure 1-2 below, a 1 KHz sine wave is sampled at 8 KHz (8 samples per cycle) and yields a discrete 8-bit value at each sample point. The 8-bit words occurring at 8000 time per second form a 64 Kbps data bit stream.

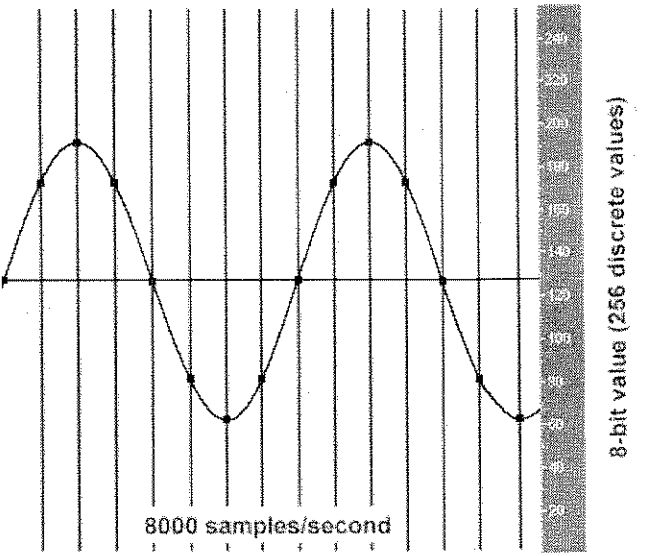


Figure 1-2 PCM Sampling Example

Line Coding

There are two common types of line coding defined for use in an E1 network: AMI and HDB3

AMI

AMI (Alternate Mark Inversion) is the simplest of the two line coding formats and is used to represent successive ones in a bit stream with alternating positive and negative pulses. A zero bit will not generate any pulse. AMI is not used in most E1 transmissions because of synchronization loss during long strings of data zeros.

HDB3

HDB3 coding was adopted to eliminate the synchronization problems occurring with AMI. In the HDB3 format, a string of four consecutive zeros is replaced with a substitute string containing an intentional BPV (Bi-Polar Violation). The receiving equipment then reads the code and reconstructs the original data. HDB3 code provides high pulse density so that receiving equipment is always able to maintain synchronization with the received signal.

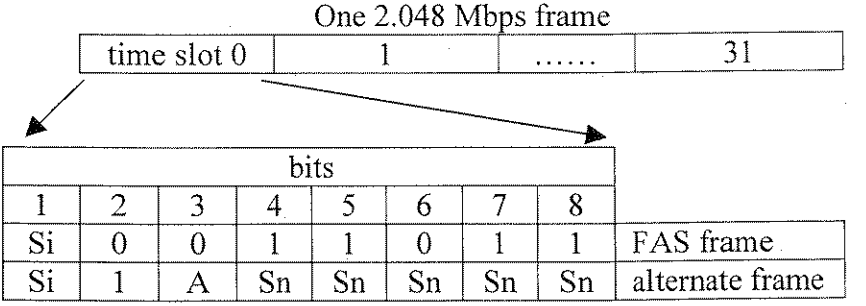
Framing

Framing is necessary so that receiving equipment is able to identify and extract the individual channels. E1 transmissions utilize two major types of framing: Frame Alignment Signal (FAS) and Multi-frame Alignment Signal (MFAS).

FAS

The 2.048 Mbps frame consists of 32 individual time slots numbered 0 to 31. Each time slot consists of a 64 Kbps channel of data.

Time slot zero of every other frame is reserved for the FAS pattern. Alternate frames contain the FAS Distant Alarm indication bit. Dat may be placed in the remaining 31 time slots. PCM-31 uses FAS.



bits								
1	2	3	4	5	6	7	8	
Si	0	0	1	1	0	1	1	FAS frame
Si	1	A	Sn	Sn	Sn	Sn	Sn	alternate frame

Figure 1-3 The FAS Frame Format

Sn: bit reserved for national use
Si: bit reserved for international use
A: remote FAS Distant Alarm bit
0011011: frame alignment signal pattern

MFAS

MFAS (Multi-Frame Alignment Signal) framing provides Channel Associated Signaling (CAS) to transmit ABCD bit supervision information for each channel. The MFAS method uses 32 time slot frame format, including time slot 0 for FAS and time s 16 for MFAS and CAS signaling. It takes 16 frames to make up a Multi-Frame. When the MFAS frame is transmitted, the individual FAS frames and framing information remains intact. Time slot 16 the first frame contains the MFAS framing information. Time slot of the remaining 15 frames of the Multi-Frame contain the ABCD bits. Refer to Figure 1-4 for the MFAS frame format.

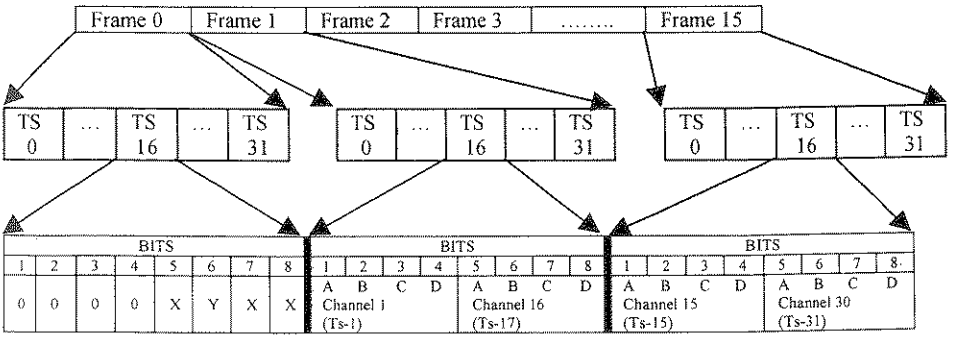


Figure 1-4 The MFAS Frame Format

Frame 0 Time Slot 16: bits 0000XYXX
X=spare bits (equals 1 if not used)
Y=MFAS Remote Alarm (equals 1 if sync is lost)

notes:
1) Frames are transmitted with 30 voice channels on TS1-15,17-31.
2) TS16 contains ABCD bits for signaling (CASS).
3) MFAS framing still includes the original FAS frames and framing information.

CRC-4

A Cyclic Redundancy Check-4 (CRC-4) is used in E1 transmission to identify possible bit errors. CRC-4 allows detection of errors within the 2.048 Mbps signal while in service.

CRC-4 is based upon simple mathematical calculations performed on each sub multi-frame of data. The equipment which originates the E1 data calculates the CRC-4 bits for one sub multi-frame and inserts them into the CRC-4 positions of the next sub multi-frame. The receiving equipment then performs the reverse mathematical calculations on the sub multi-frame, examines the CRC-4 bits received in the next sub multi-frame, and then compares the received CRC-4 bits to the calculated value. If the values do not compare, a CRC-4 error is reported.

CRC-4 Notes:
1) A CRC-4 error does not necessarily indicate a single bit error. Multiple bit errors within the same sub multi-frame will only gener a single CRC-4 error for the block.
2) There is a remote possibility that the calculated and transmitted CRC-4 bits compare even though an error has occurred.

Table 1-1. ITU-T CEPT Frame Format Timeslot 0 Bit Allocations

SMF	Frame #	Time Slot 0 Bits 1 to 8 of each frame							
		1	2	3	4	5	6	7	8
I	0	C1/Si	0	0	1	1	0	1	1
	1	O/Si	1	A	SA4	SA5	SA6	SA7	SA8
	2	C2/Si	0	0	1	1	0	1	1
	3	O/Si	1	A	SA4	SA5	SA6	SA7	SA8
	4	C3/Si	0	0	1	1	0	1	1
	5	1/Si	1	A	SA4	SA5	SA6	SA7	SA8
	6	C4/Si	0	0	1	1	0	1	1
	7	O/Si	1	A	SA4	SA5	SA6	SA7	SA8
II	8	C1/Si	0	0	1	1	0	1	1
	9	1/Si	1	A	SA4	SA5	SA6	SA7	SA8
	10	C2/Si	0	0	1	1	0	1	1
	11	1/Si	1	A	SA4	SA5	SA6	SA7	SA8
	12	C3/Si	0	0	1	1	0	1	1
	13	E/Si	1	A	SA4	SA5	SA6	SA7	SA8
	14	C4/Si	0	0	1	1	0	1	1
	15	E/Si	1	A	SA4	SA5	SA6	SA7	SA8

Notes:

1. SMF indicates the sub-multi-frame. This partitioning is used in the CRC-4 calculation.
2. Si bits are International Spare Bits.
3. A bit is used to indicate a remote alarm condition (active high).
4. SA4 to SA8 are spare bits that may be recommended by ITU-T for use in specific point-point applications (e.g., transcoder equipment conforming to Recommendation G.761).
5. SA4 to SA8 where these are not used should be set to 1 on links crossing an internationa border.
6. E bit is used to indicate a CRC-4 error. The normal state is both bits set to 1, when a CR error is detected one of the E bits is set to 0.
7. C1 to C4 bits are used to carry the CRC-4 code.
8. Timeslot 0 that contains the 0011011 sequence is defined as the FAS word and Timeslot does not contain the FAS is the Not-Word.

Table 1-2. IRSM CEPT Frame Format Timeslot 0 Bit Allocations

SMF	Frame	Time Slot 0 Bits 1 to 8 of each frame							
	#	1	2	3	4	5	6	7	8
I	0	C1/Si	0	0	1	1	0	1	1
	1	O/Si	1	A	D	E0	E1	E16	E17
	2	C2/Si	0	0	1	1	0	1	1
	3	O/Si	1	A	D	E0	E1	E16	E17
	4	C3/Si	0	0	1	1	0	1	1
	5	1/Si	1	A	D	E0	E1	E16	E17
	6	C4/Si	0	0	1	1	0	1	1
	7	O/Si	1	A	D	E0	E1	E16	E17
II	8	C1/Si	0	0	1	1	0	1	1
	9	1/Si	1	A	D	E0	E1	E16	E17
	10	C2/Si	0	0	1	1	0	1	1
	11	1/Si	1	A	D	E0	E1	E16	E17
	12	C3/Si	0	0	1	1	0	1	1
	13	E/Si	1	A	D	E0	E1	E16	E17
	14	C4/Si	0	0	1	1	0	1	1
	15	E/Si	1	A	D	E0	E1	E16	E17

Notes:

1. SMF indicates the sub-multi-frame. This partitioning is used in the CRC-4 calculation.
2. Si bits are International Spare Bits.
3. NA bit is used to indicate a remote alarm condition (active high).
4. Ei are per channel control bits.
5. E bit is used to indicate a CRC-4 error. The normal state is both bits set to 1, when a CRC-4 error is detected one of the E bits is set to 0.
6. C1 to C4 bits are used to carry the CRC-4 code.
7. Timeslot 0 that contains the 0011011 sequence is defined as the FAS word and Timeslot 0 that does not contain the FAS is the Not-Word.
8. D bits are a 4Kbit/s data link.
9. Bit 2 of the Not-Word is defined as the alternate framing bit.

Table 1-3. CEPT (ITU-T and IRSM) Frame Format Timeslot 16 Allocations

SMF	Frame #	Time Slot 16 Bits 1 to 8 of each frame							
		1	2	3	4	5	6	7	8
I	0	0	0	0	0	X0	Y	X1	X2
	1	A1	B1	C1	D1	A17	B17	C17	D17
	2	A2	B2	C2	D2	A18	B18	C18	D18
	3	A3	B3	C3	D3	A19	B19	C19	D19
	4	A4	B4	C4	D4	A20	B20	C20	D20
	5	A5	B5	C5	D5	A21	B21	C21	D21
	6	A6	B6	C6	D6	A22	B22	C22	D22
	7	A7	B7	C7	D7	A23	B23	C23	D23
II	8	A8	B8	C8	D8	A24	B24	C24	D24
	9	A9	B9	C9	D9	A25	B25	C25	D25
	10	A10	B10	C10	D10	A26	B26	C26	D26
	11	A11	B11	C11	D11	A27	B27	C27	D27
	12	A12	B12	C12	D12	A28	B28	C28	D28
	13	A13	B13	C13	D13	A29	B29	C29	D29
	14	A14	B14	C14	D14	A30	B30	C30	D30
	15	A15	B15	C15	D15	A31	B31	C31	D31

Notes:

1. SMF indicates the sub-multi-frame.
2. Ai-Di are the per channel signaling bits.
3. X0-X2 are the X spare bits normally set to 1.
4. Y is the Remote Multi-frame Yellow Alarm Indication bit. When Y is s to a 1 it indicates that the alarm is active.
5. The Multi-frame Alignment Sequence (MAS) is defined as the Time Sl 16 word that contains the 0000XYXX sequence.

This page left blank intentionally.

2.1 Introduction

The **BTM10** series analyzer is a compact, notebook sized PCM measuring instrument designed for field use in analysis and maintenance of E1 (2.048Mbps) or T1 (1.544Mbps) lines. The **BTM10** performs Frame Analysis, Drop and Insert 64Kbps voice or n*64Kbps data into any time slot. The **BTM10** series analyzer also provides a variety of E1/T1 line statuses, transmission performance testing (BERT) and monitoring. On the E1/T1 line, the **BTM10** serie product may be used as a generator or receiver.

2.2 Functions

- E1/T1 BERT Analysis: E1/T1 frame, code, CRC, and BPV performance analysis and generator.
- Alarm and Looping Setting: Manual or automatic alarm and loop setting.
- VF Access: Drop and Insert 64K voice; Low Frequency Generator (transmit VF Frequency from 60 to 3950 Hz (+3 to -20dBm)
- Pulse Shape: E1/T1 pulse shape analysis.
- Signal Result: E1/T1 PCM level meter and frequency analysis.
- Signaling Setting: ABCD bit setting.
- Signaling Display: Display all channels of ABCD bits.
- BERT on Data Port: Data port BERT performance analysis.
- Examine Analysis: off-line analysis of E1/T1 BERT performance.
- External Drop and Insert: Acts as a Fractional E1/T1 converter.
- User Programmable Pattern Setting: There is a 32 bits programmable pattern, which can be inserted onto the E1/T1 line and drop for analysis.
- Timeslot Setting: Drop and Insert n*64K data onto E1/T1 line.
- Timeslot Mapping Data: Analyze any channel data of two frames.

2.3 General Specifications

2.3.1 E1 Specifications:

1. Receiver Interface of E1/CEPT

- Line Code: HDB3/AMI
- Pulse characteristics: meets ITU G.703
- Jitter Tolerance: meets ITU G.823
- Input Port Type:
  Coaxial pair: BNC (unbalanced)
  Symmetrical pair: Bantam or DB15 (balanced)
- Input mode (with AGC):
  Termination:
    Coaxial Pair Impedance: 75 ohm resistive (unbalanced)
    Symmetrical Pair Impedance: 120 ohm resistive (balanced)
    Return Loss: > 18 dB
    Receive Sensitivity: +3 dB to -40 dB
  Bridge Mode:
    Impedance: > 1000 ohm
    Receive Sensitivity: +3dB to -30 dB
  DSX-MONitor Mode:
    Coaxial Pair Impedance: 75 ohm resistive (unbalanced)
    Symmetrical Pair Impedance: 120 ohm resistive (balanced)
    Receive Sensitivity: +6dBdsx to -30dBdsx
- Receive Timing Range: 2.048MHz ± 4000Hz

2. Transmitter Interface of E1/CEPT

- Bit Rate: 2048K bit/s ± 10ppm.
- Line Code: HDB3/AMI
- Pulse characteristics: meets ITU G.703
- Pulse Amplitude: Nominal 2.37V for Coaxial Pair 75 ohm
  Nominal 3.00V for Symmetrical Pair 120 ohm
- Zero Amplitude: ± 0.1 V max.
- Jitter Tolerance: meets ITU G.823

- Output Port Type:
  Coaxial pair: BNC (unbalanced)
  Symmetrical pair: Bantam or DB15 (balanced)
- TX Clock Source:
  Internal Timing: 2.048 MHz ± 10 ppm.
  External Timing:
  Recovery from RX Timing (Loop Timing)
  Data Port Timing

3. E1/CEPT Frame Structure

- FAS
- FAS+CRC4
- FAS+CAS
- FAS+CRC4+CAS
- Unframed

4. Line Build Out:

- 0 dB
- -7.5 dB
- -15 dB
- -22.5 dB

  (Accuracy: ± 1dB)

2.3.2 T1 Specifications:

1. Receiver Interface of T1/DS1

- Line Code: B8ZS/AMI
- Pulse characteristics: meets ITU G.703
- Jitter Tolerance: meets ITU G.823
- Input Port Type:
  Symmetrical pair: Bantam or DB15 (balanced), and BNC
- Input mode (with AGC):
  Termination:
  Symmetrical Pair Impedance: 100 ohm ± 5% resistive (balanced)
  Return Loss: > 18 dB
  Receive Sensitivity: +6 dB to -36 dB
  Bridge Mode:
  Impedance: > 1000 ohm
  Receive Sensitivity: +6 dB to -30 dB
  DSX-MONitor Mode:
  Symmetrical Pair Impedance: 100 ohm ± 5% resistive (balanced)
  Receive Sensitivity: up to -30dBdsx
- Receive Timing Range: 1.544MHz ± 4000Hz

2. Transmitter Interface of T1/DS1

- Bit Rate: 1544K bit/s ± 10ppm; plus 50ppm or minus 50ppm manually
- Line Code: B8ZS/AMI
- Pulse characteristics: meets ITU G.703
- Pulse Amplitude: Nominal 3.00V for Symmetrical Pair 100 ohm
- Zero Amplitude: ± 0.1 V max.
- Jitter Tolerance: meets ITU G.823
- Output Port Type:
  Symmetrical pair: Bantam, DB15 (balanced), or BNC

- TX Clock Source:
  Internal Timing: 1.544MHz ± 10ppm; ± 50ppm manually
  External Timing
  Recovery from RX Timing (Loop Timing)
  Data Port Timing

3. T1/DS1 Frame Structure

- D4 (SF)
- ESF
- ESF+CRC6
- SLC-96
- T1DM
- Unframed

4. Line Build Out:

- 0 dB
- -7.5 dB
- -15 dB
- -22.5 dB

(Accuracy: ± 1 dB)

2.3.3 BERT Test:

1. BERT Patterns

63, 127, 2^9-1 (511), 2^{11}-1 (2047), 2^{15}-1, 2^{20}-1, QRSS, 2^{23}-1, ALL ONEs (Mark), ALL ZEROs (Space), ALT (0101..), 3 in 24, 1 in 1 1 in 8, 1 in 4, User Programmable

2. BERT Display Format

- Normal
- ITU G.821

3. BERT Transmit Error Rate

- Force Single Error: Logic (Bit), Frame, CRC, and BPV (Bipolar Violation)
- Force 10^{-3} to 10^{-7} Error Rate: Logic (Bit), Frame, CRC, and BPV

4. Performance Analysis:

- Logic, Frame, CRC, BPV, E-bit Errors
- Receive Counter
- Error Seconds
- Error Free Seconds
- Error Rate
- Available Seconds
- Degraded Minutes
- Severely Error Seconds
- G.821 Error Seconds
- Unavailable Seconds
- LOF (Loss of Frame) Events
- COFA (Change of Frame Alignment) Events
- Severely Error Frame Count

5. BERT Test on Data Port

- Data rates for 56Kbps multiples; n*56Kbps (n=1~24)
- Data rates for 64Kbps multiples; n*64Kbps (n=1~24 for T1) (n=1~32 for E1)

2.3.4 Analyzer Mode:

1. Channel Map Screen

2. Line Attenuation

3. Slip Measure

4. Signaling: [ABCD]

5. General Status:

- Signal Present
- B8ZS/HDB3
- Pattern Sync
- Frame Sync
- Looping

6. Results:

- Bit Errors
- BPV Errors
- Frame Errors
- CRC Errors
- G.821 Analysis

7. Alarm/Warning

- Signal Loss (Pulses)
- Frame Loss
- Pattern Loss
- Excess Zero Error
- One Density
- AIS
- SLIP
- Yellow Alarm (T1)
- RAI(E1)
- MRAI(E1)

8. Print out of test results

2.3.5 Other Features:

1. Pulse Wave Analyzer (option)
Built-in PUB CB119, ANSI T1.403(T1), and ITU G.703(E1)

2. In-Band and Out-of-Band Loop Control
- Line Loop (LLB)
- Pay Load Loop (PLB)
- Loop Up
- Loop Down

3. Large LCD display
- 32 Characters x 8 Lines
- Text / Graphic mode

4. Result Report
- Internal Memory storage of test result.
- Direct display on LCD screen
- Print out via Parallel Printer port
- Print out via RS-232 Series Port (option)

5. Portable for field use

6. Upgradeable for advance features

7. Rechargeable Battery with battery low indicator

8. Temp. Range
0 °C to 50 °C (operating)
-20 °C to 60 °C (storage)

9. Humidity: up to 95%

10. Power Source
AC-110V / DC9V/600mA adapter

11. Dimension

173 mm(L) x 235 mm(L) x 54 mm (H)

12. Weight

under 1.95 kg net weight

2.3.6 Interface Port Description:

- DB15 (Male): E1/T1 TX and RX Port
- BNC * 2: E1/T1 TX and RX Ports
- Bantam * 2: E1/T1 TX and RX Ports
- Bantam * 1: External Clock In
- HD26 (Female): Data Port (RS-449/530,V.35, X.21 interface)
- DB15 (Female): Printer Port
- DB9 (Male): Remote Control Port / Serial RS-232 Printer Port (option)
- RJ-45/RJ-11: Voice In/Out
- Slide Switch: E1/T1 Monitor Mode / Terminal Mode selectio
- Slide Switch: External (Reference) Clock Setting: TTL/PCM
- Power Switch: Power ON/OFF
- Mini-Phone Jack: DC9V IN

2.4 Status LEDs

The **BTM10**'s LEDs on the top panel indicate the following:

	SYSTEM	INTERFACE	
Ext. Power	Red LED	Green LED	Bridge
Bat. Low	Red	Green	Terminal
DTE	Red	Green	DSX-MON
DCE	Red	Green	E1
DATACOM	Red	Green	T1

	RECEIVE STATUS		
Signal Present	Green LED	Red LED	One Den
Frame Sync	Green	Red	AIS
Pattern Sync	Green	Red	SLIP
B8ZS/HDB3	Green	Red	Yellow
Loop Up	Green	Red	RAI
Signal Loss	Red LED	Red	MRAI
Frame Loss	Red	Red	Errors
Pattern Loss	Red	Red	Freeze
Power Loss	Red	Red	History
Excess Zero	Red	Red	Ins Err

And their detailed descriptions are as follows:

1) SYSTEM

Ext. Power (External Power):
When the external power adapter is plugged into the **BTM10**, this LED will light.

Bat. Low (Battery Low):
When the power of the built-in battery is weak, and is in need of a recharge, this LED will light.

DTE:
Data port is working in DTE mode.
DCE:
Data port is working in DCE mode.
DATACOM:
Data port is under use, such as with "Ext. Drop and Insert" or "BERT on data port" functions.

2) INTERFACE

Bridge:
BTM10 E1/T1 RX port is in bridge mode. Impedance is greater than 1K Ohm.
Terminal:
BTM10 E1/T1 RX port is in terminal mode. Impedance is 75, 100, or 120 ohms.
DSX-MON:
BTM10 E1/T1 RX port is in DSX-MONitor mode and the impedance is 75, 100, or 120 ohms.
E1:
BTM10 is working as an E1 analyzer.
T1:
BTM10 is working as a T1 analyzer.

3) RECEIVED STATUS

Following LEDs will light depending on the current E1/T1 RX port status and may change every second.

Signal Present:
BTM10 E1/T1 RX is receiving available PCM analog signal.
Frame Sync:
Remains lit if not receiving loss of frame alignment status.

Pattern Sync:
Lights if E1/T1 RX has received correct pattern, which matches for 32 consecutive bit positions.

B8ZS/HDB3:
Lights if one or more B8ZS/HDB3 substitution patterns have been detected on the E1/T1 RX port.

Loop Up:
Reports detection of an in-band loop back code and takes immediate loop back action.

Signal Loss:
Indicates E1/T1 RX input signal amplitude remained below available PCM analog signal threshold for more than 1 ms.

Frame Loss:
Lights if receipt of loss of frame alignment. In E1 CRC enabled mode, lights when 3 consecutive FAS or 915 CRC errors are received. In E1 CRC disabled mode, lights when 3 consecutive FAS errors only are received.

Pattern Loss:
Lights if E1/T1 RX port has received 6 or more bits out of 64 in error.

Power Loss: (not ready)
BTM10 has been powered off during testing.

Excess Zero:
It lights if one or more long string of zeros are detected on E1/T1 RX port. A long string of zeros is 10 consecutive zeros in E1 mode or 16 consecutive zeros in T1 mode.

One Den(One Density):

This is the criteria for detection and clearance of Receive Loss of Signal (RLOS) per ITU G.775 and ANSI T1.231.

In E1 mode, will light upon reception of 32 consecutive zeros, and is cleared upon reception of 192 bits in which no interval of 32 consecutive zeros appear, where the 192-bit window begins with reception of a pulse.

In T1 mode, will light if 100 consecutive zeros are received, and is cleared if received data sustains an average pulse density of 12.5%(24 or more ones) over a period of 192 bits starting with the receipt of a pulse, and no reoccurrence of 100 consecutive zeros.

AIS: (Receive Alarm Indication Signal)

The criteria for detection and clearance of RAIS is per ITU G.775 and ANSI T1.231.

In E1 mode, will light if 2 consecutive double frames (500us) each contain 2 or less zeros out of 512 bits and FAS alignment is loss. RAIS will turn off if 2 consecutive double frames each containing 3 or more zeros out of 512 bits is received or if FAS alignment is recovered.

In T1 mode, will light if data received for a period of 3 ms contains or less zeros out of 4632 bits and frame alignment is loss. RAIS wil turn off if data received for a period of 3 ms contains 5 or more zer out of 4632 bits or if frame alignment is recovered.

SLIP:

Lights if a slip error is received.

Yellow:

In T1 mode, will light when receiving a Yellow Alarm or a Multi-frame Yellow Alarm.

RAI: (Receive Remote Alarm)

Will light for 4 frames if 2 consecutive NFAS frames each contain TS0 bit 3 = 1. It will turn off for 4 frames if 2 consecutive NFAS frames each contain TS0 bit 3 = 0.

MRAI: (Receive Multi-frame Remote Alarm)
Will light for 2 multi-frames if frame 0 has 2 consecutive multi-frames each containing TS16 bit 6 = 1. It will turn off for 2 multi-frames if frame 0 contains TS016 bit 6 = 0.

Errors:
Will light under any of the following error conditions.

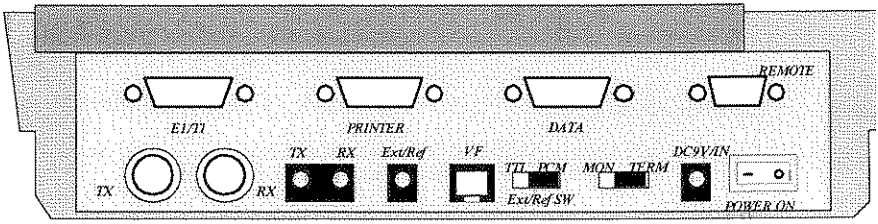
1) Frame Error (Ft/Fs/T1DM/FPS/FAS pattern error)
2) MFAS pattern error
3) CRC6/CRC4 Block Error.
4) CAS pattern error
5) Loss of T1/FAS alignment.
6) Loss of MFAS Alignment
7) Loss of CAS Alignment
8) Receive Pulse Density Violation according to ANSI T1.403 sliding windows criteria.
9) Receive TS16 Alarm Indication Signal (E1 CAS mode only). Criteria for detection and clearance of RMAIS are per ITU G.775.
10) Severely erred frame. Criteria for detection and clearance of SEF are per ANSI T1.231.

Freeze: (not ready)
It will light if the LEDs' status is frozen.

History: (not ready)
Lights when there is an error indication on history.

Ins Err: (not ready)
Lights when the **BTM10** is forcing an error rate of logic, frame, BPV, or LCV.

2.5 Rear Panel



The **BTM10** Rear Panel

Descriptions:

POWER ON:
Power on switch.

DC9V/IN:
This port is used to plug in the DC9V/1.5A adapter. It may be used to power the unit when in use or to recharge the built-in battery wh battery power is low.

TX(BNC):
This port is the E1/T1 TX port, BNC type. If the E1/T1 TX (Banta port is used, this port will be disable.

RX(BNC):
This port is the E1/T1 RX port, BNC type. If the E1/T1 RX (Bantam) port is used, this port will be disable.

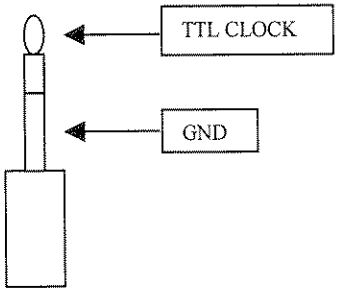
TX/RX(Bantam):
This port is the E1/T1 TX and RX port, Bantam type.

E1/T1(DB15):
This port is the E1/T1 TX and RX port, DB15 type.

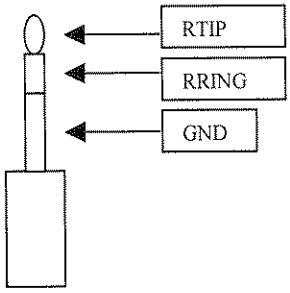
DB15 Pin Assignment:
Pin 1: TTIP (E1/T1 TX)
Pin 2: GND
Pin 3: RTIP (E1/T1 RX)
Pin 4: GND
Pin 9: TRING (E1/T1 TX)
Pin 11 RRING (E1/T1 RX)

Ext/Ref:
This port is the external/reference clock input. The reference clock input may be either a TTL or PCM signal. If switch Ext/Ref SW is turned to the TTL side, the Ext/Ref port is configured in TTL mode. If switch Ext/Ref SW is turned to the PCM side, the Ext/Ref port is configured in E1/T1 PCM signal mode.

Bantam pin assignment(TTL):



Bantam pin assignment (E1/T1 PCM):



VF:

This port (RJ-45) is the voice frequency port. It can be connected to a telephone handset directly and is used for insert and drop 64K voice on E1/T1 line.

RJ-45 pin assignment:
Pin 1: N.C.
Pin 2: Voice Ground
Pin 3: MIC+ / input
Pin 4: RCVR+ / output
Pin 5: RCVR- / output
Pin 6: MIC- / input
Pin 7: Voice Ground
Pin 8: N.C.

RJ-11 pin assignment:
Pin 1: MIC+ / input
Pin 2: RCVR+ / output
Pin 3: RCVR- / output
Pin 4: MIC- / input

Ext/Ref SW:

If this switch is slid to the TTL side, then the Ext/Ref port is configured for TTL mode. If the switch is slid to the PCM side, the the Ext/Ref port is configured for E1/T1 PCM signal mode.

MON TERM switch:

If this slide switch is set to the MON(monitor) side, then the E1/T1 Rx port will be configured for DSX-MONitor mode. If the switch is set to the TERM(terminal) side, then the E1/T1 RX port will be configured for terminal 75,100, or 120 ohm mode. If the applicatio uses E1/T1 RX bridge mode, then this switch should be set to TER side also.

Printer:

This printer port can be adapted to connect to any Centronics standard interface by the use of the **BTM-PRN** adapter cable. The DB15 pin assignment is as follows:

Pin	Signal	Description
1	/STROBE	/STROBE pulse sent with data out.
2	DATA 1	These signals represent information for the 1st to 8th bits of parallel data. Each signal is at HIGH level when data is logical 1 and LOW when it is logical 0.
3	DATA 2	
4	DATA 3	
5	DATA 4	
6	DATA 5	
7	DATA 6	
8	DATA 7	
9	DATA 8	
10	GND	
11	BUSY	A High signal received indicates that the printer cannot receive data. The signal goes HIGH in the following cases: During data entry During printing When off-line During printer error
12	GND	
13	GND	
14	--	+5V supplied to printer through 10K ohm resistor.
15	GND	

Data:

This is the data port. It can be configured as RS-232, V.35, or RS-449/530/X.21 interface type via a combination of **BTM10** configuration setup and adapter cable. In addition, the adapter cable can support external drop, insert, and BERT on the data port.

DB26 Pin Assignment:			
Pin 1	FGND	Pin 14	CTS(B)
Pin 2	TD(A)	Pin 15	TC(A)
Pin 3	RD(A)	Pin 16	XTC(B)
Pin 4	RTS(A)	Pin 17	RC(A)
Pin 5	CTS(A)	Pin 18	XRC(B)
Pin 6	DSR(A)	Pin 19	N.C.
Pin 7	GND	Pin 20	DTR(A)
Pin 8	DCD(A)	Pin 21	RD(B)
Pin 9	XRC(A)	Pin 22	DSR(B)
Pin 10	N.C.	Pin 23	TC(B)
Pin 11	TD(B)	Pin 24	XTC(A)
Pin 12	DTR(B)	Pin 25	RC(B)
Pin 13	RTS(B)	Pin 26	DCD(B)

Remote:

The remote control port is an RS-232 serial port, based upon the 9 pin standard.

DB9 Pin Assignment:	
Pin 1	DCD
Pin 2	RD
Pin 3	TD
Pin 4	DTR
Pin 5	GND
Pin 6	DSR
Pin 7	RTS
Pin 8	CTS
Pin 9	N.C.

2.6 Cable Accessories

2.6.1 Standard Cables:

1. BTMC-1 * 3 pcs
   Bantam (Male) – Bantam (Male), E1 120Ω, 3m length
2. BTMC-6 * 2 pcs
   BNC (Male) – BNC (Male), 3 m length
3. BTMC-PRINT * 1 pcs
   DB15 (Male) – C36 (Male), 1.5 m length

2.6.2 Optional Cables:

1. BTMC-2 * 2 pcs
   Bantam (Male) – Simens (Male), E1 120Ω, 3 m length
2. BTMC-3 * 2 pcs
   Simens (Male) – MIPS, E1 120Ω, 3 m length
3. BTMC-4 * 2 pcs
   Bantam (Male) – MIPS, E1 120Ω, 3 m length
4. BTMC-5 * 2 pcs
   Bantam (Male) – BNC (Male), E1 120Ω, 3 m length
5. BTMC-530 * 1 pcs
   HD26 (Male) – DB25 (Male), 1m length
6. BTMC-449* 1 pcs
   HD26 (Male) – DB37 (Male), 1m length
7. BTMC-V35 * 1 pcs
   HD26 (Male) – MB34 (Male), 1m length
8. BTMC-X21 * 1 pcs
   HD26 (Male) – DB15 (Male), 1m length
9. BTMC-RM/PC * 1 pcs
   DB9 (Female) – DB25 (Female), 1.5 m length
10. BTMC-RM/MD * 1 pcs
    DB9 (Female) – DB25 (Female), 1.5 m length

This page left blank intentionally.

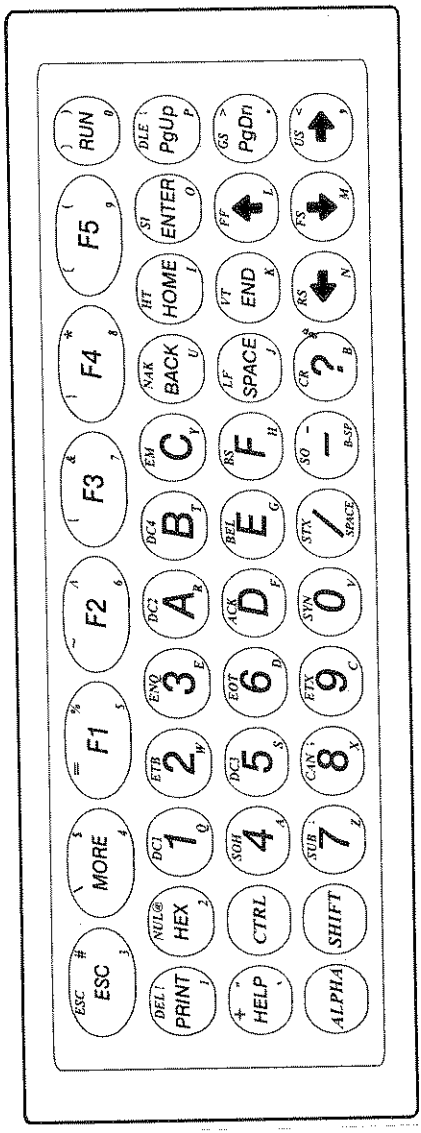
3.1 Introduction

The **BTM10**'s keyboard combines the latest in membrane switch technology to provide a full ASCII keyboard with special functions and cursor movement keys. The keyboard is dust and moisture proof to provide long life use. Key lettering colors are grouped for easy identification and selection when entering data in different keyboard modes. The blue lettered keys contain the FUNCTION (***F1-F5***) keys. The magenta colored keys are used to enter control codes. The black lettered keys are for hexadecimal data entry while the red lettered keys are for QWERTY mode entry.

When the **BTM10** is powered on, the keyboard is in hexadecimal mode. In this mode, the center functions of the keys are active (for example the large black hexadecimal digits). To enter any of the characters, shown in white, in the upper-right hand corner of some keys, press and hold ***SHIFT*** (white lettered) and press the appropriate key. To enter any of the control characters such as DC1, ETB, ENQ, etc., shown in magenta in the upper-left corner of the keys, press and hold the ***CTRL*** (magenta colored) key and press the appropriate key.

To switch to the QWERTY mode, press the ***ALPHA*** (red colored) key. The QWERTY keys are shown in red and are located in the lower-right hand corner of the keys. The ***ALPHA*** key toggles the keyboard between hexadecimal and QWERTY modes. When in QWERTY mode, to enter a lowercase character, press and hold ***SHIFT*** and press the selected alphabet key.

3.2 Keyboard Figure



Keyboard Figure

3.3 Key Functions

3.3.1 Menu Function Keys:

F1 **---- Configuration Setup**
Setup parameters such as framing, code, line interface, TX timing, etc.

F2 **---- BERT Analysis**
Run and examine BERT results.

F3 **---- Alarm Settings**
Choose AIS, RAI, or MRAI alarm generation.

F4 **---- Reset System**
Used to restore all internal settings to the factory defaults and clear all data files.

F5 **---- Back light On/Off**
Toggle LCD back light on or off.

MORE **Next Page**
Selects the second menu set of functions.

F1 **---- VF Access**
Setup channel, TX frequency and level for voice.

F2 **---- Pulse Shape**
Display a graphic representation of the interface pulse wave shape.

F3 **---- Signal Result**
Displays a numeric readout of signal strength in decibels (dB) and peak-to-peak voltage as well as the actual frequency in hertz.

F4 **---- Signaling Setup**
Used to set the ABCD bits for selected timeslots.

F5 **---- Signaling Display**
A visual display of the ABCD bits for all timeslots.

MORE **Next Page**
Selects the third menu set of functions.

F1 ---- **BERT on data port[N/A]**
(reserved for future function)
F2 ---- **Remote Port Setup[N/A]**
(reserved for future function)
F3 ---- **Examine Analysis**
Brief display of errors.
F4 ---- **Ext. Drop and Insert**
Calls up the Drop/Insert setup
F5 ---- **User Program Pattern**
Used to enter the user programmable pattern.
MORE **Next Page**
Selects the fourth menu set of functions.

F1 ---- **Time Slot Setting**
Use this display to setup the used and unused time slots
F2 ---- **Time Slot Map Data**
Used to display the FAS and NFAS data for all time slots
F3 ---- **File Management**
Control the management of (load, save, delete, etc.) a maximum of five data save files which are held in the internal battery backed-up RAM.
F4 ---- **Miscellaneous**
Calls up a menu to setup key sound, printer, and clock as well as to display the **BTM10**'s hardware and firmware version information.
F5 ---- **Self Test**
Provides a means to test the internal RAM and ROM, the data port, the printer port, the LCD, keyboard, as well as VF tests.
MORE **Next Page**
Selects the fifth menu set of functions.

F1 **---- SLIP Measure function**

Use this display to setup the used and unused time slots
Returns to the first menu set of functions.

MORE **Next Page**

Returns to the first menu page of functions

3.3.2 Other Function Keys:

ESC
ESCAPE or go back to previous menu.

RUN
Begin to EXECUTE (terminal or user program).

HEX
Toggle the display of screen data between HEXIDECIMAL and ALPHANUMERIC modes.

PRINT
Print the current data in storage.

⇦ ⇨
Move the CURSOR to the LEFT or RIGHT.

⇧ ⇩
Move the CURSOR UP or DOWN.

PgUp
During data display, Jump "UP" to the previous page.

PgDn
During data display, Jump "DOWN" to the next page.

HOME
Move the CURSOR to the HOME position.

END
Move the CURSOR to the END position.

HELP
Displays an OPERATION Message if available.

SPACE INSERT A SPACE

BACK BACKSPACE, CLEAR a CHARACTER

3.3.3 Special Keys:

CTRL

Use this key to generate special characters such as DC1, DC2, DC3. Press and hold the CTRL key and any of the "magenta" characters. (magenta characters are shown in the upper left of each key).

ALPHA

Use this key to toggle between the "QWERTY" keys (red characters in lower right of keys) and the large black alpha-numeric keys

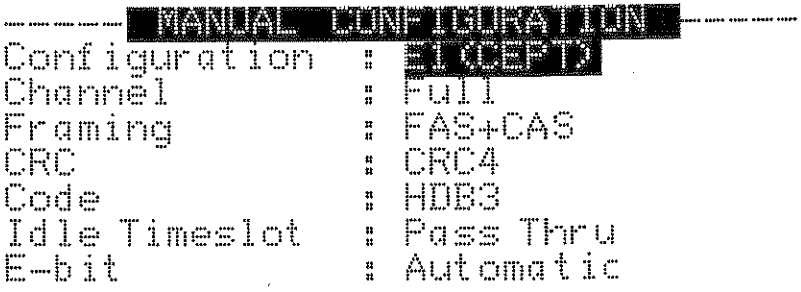
SHIFT

Use this key to enter lower case alpha characters and the special symbols in "white" (shown in the upper right corner of key).

3.3.4 Cursor Keys Details:

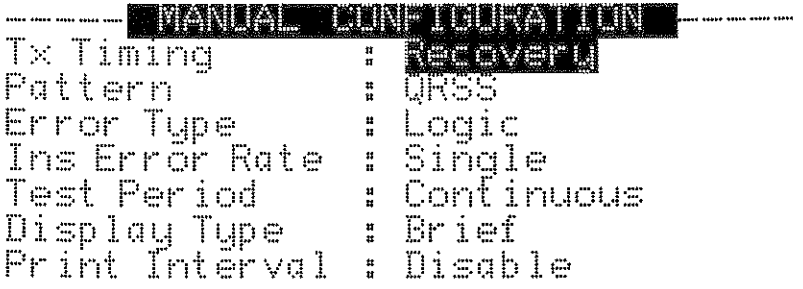
Maneuvering through the **BTM10**'s menu system is accomplished through the use of the function and blue cursor movement keys. Please follow the next example which demonstra both the function and cursor key operations.

Power on the **BTM10** and wait for the first menu. Press th ***F1*** key to display the manual configuration function menu.



Parameter Setting Screen

Note that the parameter for "Configuration" is "E1(CEPT)". This is the default setting (for E1 or E1/T1 units) and is in inverse text, which indicates the current cursor position. For a T1 only unit, the default would of course be "T1(DS1)". Press the blue down arrow key repeatedly. Note that when you reach the bottom, the screen will scroll up to display additional parameters. To toggle/select from the available parameters for any of the configuration settings, press the right arrow key. The current setting will be shown in reverse text.



Parameter Setting Screen

For example, after viewing all the available settings under manual configuration, use the up arrow key until reaching the "Tx Timing" setting. Repeated pressing of the right arrow key will display the available parameters for the "Tx Timing" setting, "Recovery, External, Data Port, 2048+50ppm, 2048-50ppm" and then back to "Internal." Use the up and down arrow keys to move to the other settings, then use the right or left arrow key to view and set their respective parameters. **Note:** Press the ***PgDn*** (page down) or ***PgUp*** (page up) key to see next page or previous page of settings. Pressing the ***HOME*** key will move the cursor to the top page and top parameter. Press ***END*** key will move the cursor to the last page and bottom parameter.

Pressing the ***ESC*** key will exit the "Manual Configuration" menu.

4.1 BTM10 Power Up

When the **BTM10** is powered on, a quick screen will flash announcing the **BTM10** model and displaying the firmware version number.

```
BTM-10 E1 PROTOCOL ANALYZER

                Version: 2.05-06
```

Following the quick screen will be the first of four menu pages.

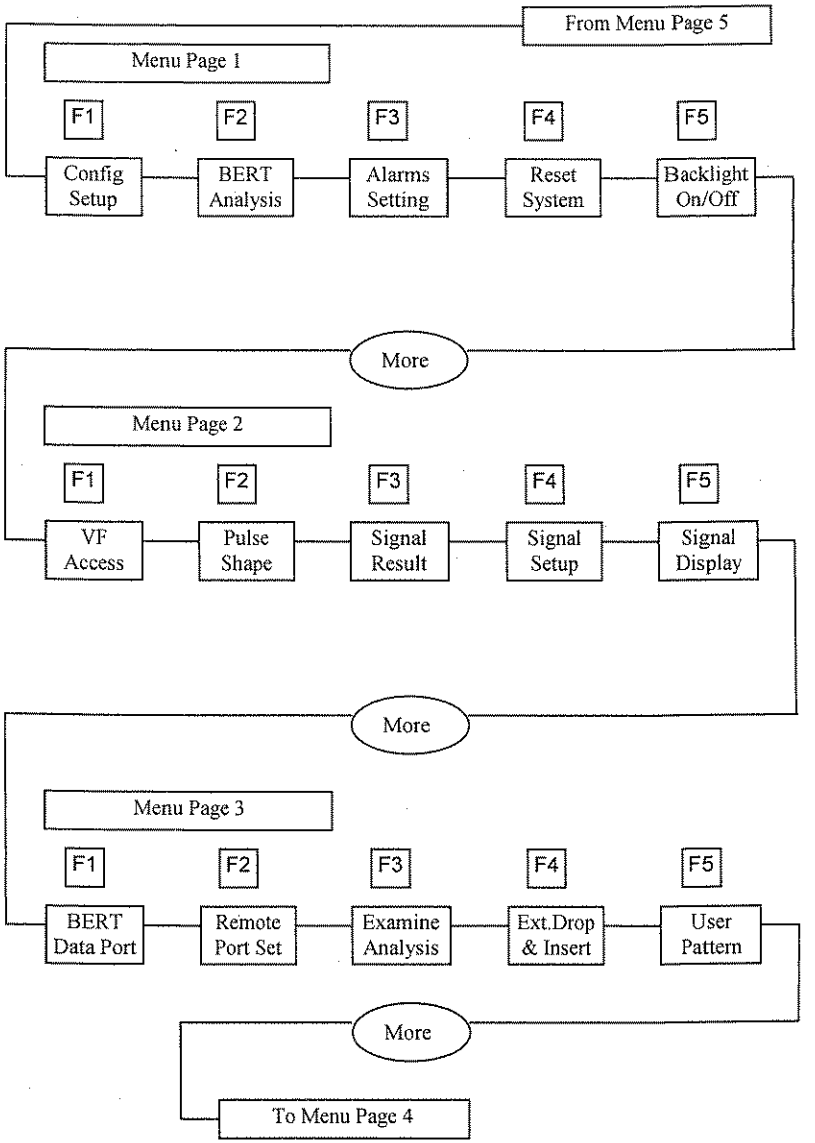

```
: Configuration Setup
: BERT Analysis
: Alarms Setting
: Reset System
: Backlight On/Off
: Next Page
Please select one function or
press 'MORE' to see next page.
```

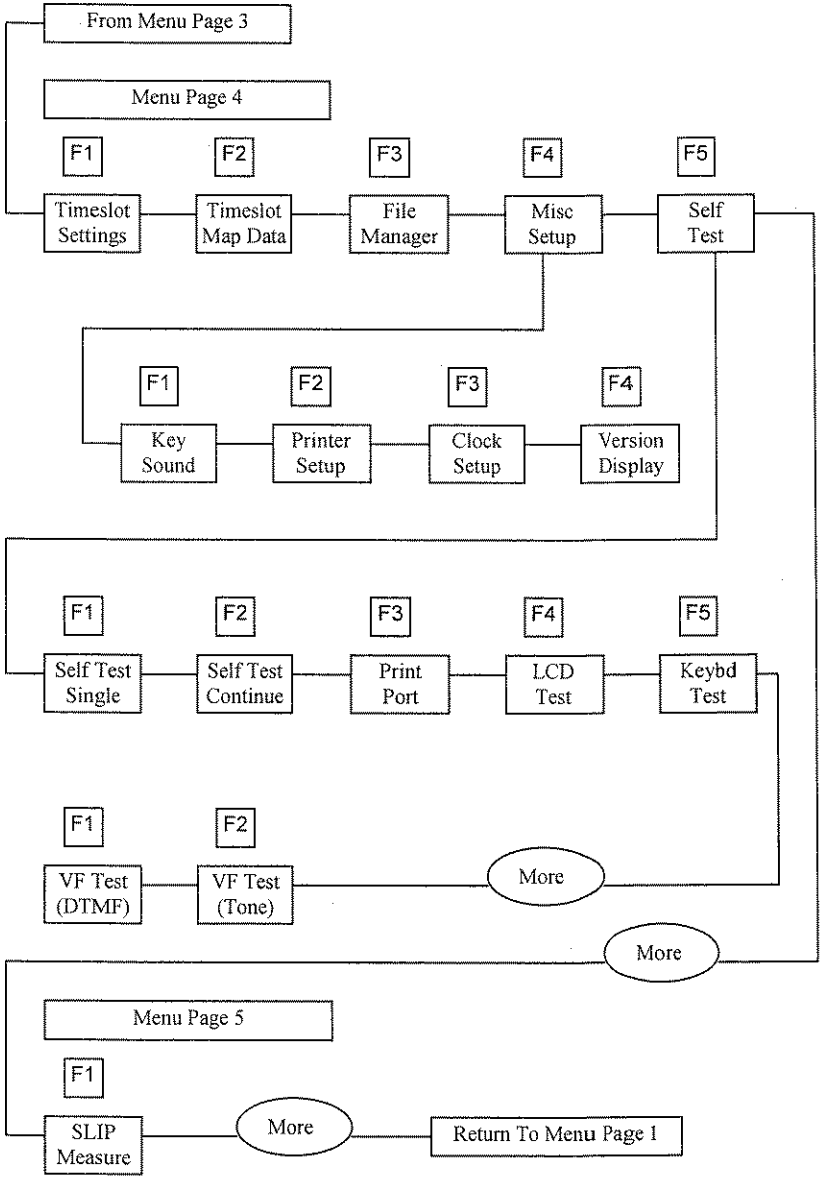
Press the ***MORE*** key to scan through all of the top level me pages. Press one of the function keys, ***F1*** to ***F5***, to select any of the functions from the menu page. You will then enter the next level of nested function, change parameters for specific settings or execute into a selected function, depending upon your location in the **BTM** menu system. Pressing the ***ESC*** key will "back out" one level in th menu system or will quit the current running status. Refer to Chapt for keyboard operation details.

4.2 BTM10 Menu System

The following page shows a graphic overview of the **BTM1** menu system and operation flow.

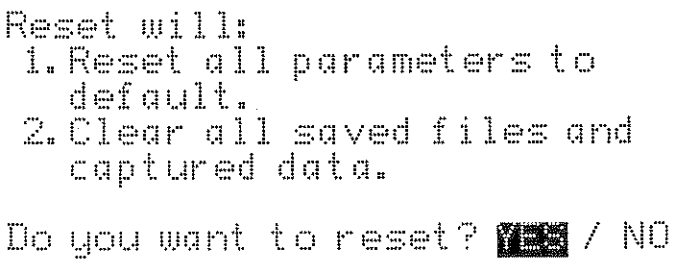
BTM10 Menu System Flow Block Diagram




From Menu Page 3
Menu Page 4
F1
Timeslot Settings
F2
Timeslot Map Data
F3
File Manager
F4
Misc Setup
F5
Self Test
F1
Key Sound
F2
Printer Setup
F3
Clock Setup
F4
Version Display
F1
Self Test Single
F2
Self Test Continue
F3
Print Port
F4
LCD Test
F5
Keybd Test
F1
VF Test (DTMF)
F2
VF Test (Tone)
More
More
Menu Page 5
F1
SLIP Measure
More
Return To Menu Page 1

4.3 System Reset

When you first receive your **BTM10**, it is advisable to do a "**System Reset**" to clear the internal buffers and to initialize the unit to a known state. This is also the quickest way to clear user files, etc. or to revive the unit should it become "hung" due to a user error or unknown bug in the **BTM10** firmware. To enter the reset function, press the ***F4*** key from the first menu page, toggle the left arrow key to "Yes" and press ***ENTER*** twice. All the parameters will be set to the default settings. It is also useful to reset the unit if you get the **BTM10** into an unknown state or receive an unfamiliar status.



System Reset Screen

4.4 Back light Toggle

The back light on the **BTM10**'s LCD may be toggled on or off by directly pressing the ***F5*** key from the first menu page.

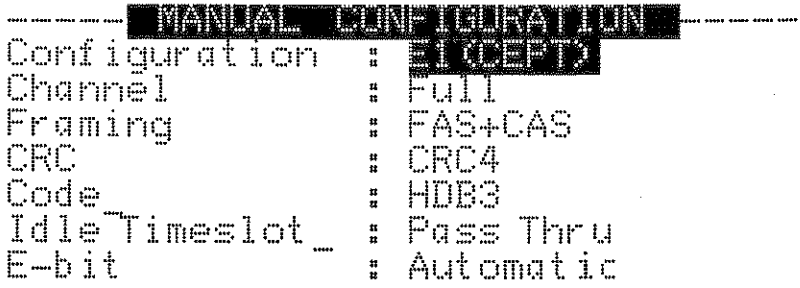
4.5 Examine Analysis

All of the test results of BERT analysis are stored in memory and can be reviewed and/or printed out by entering the "**Examine Analysis**" function. via the ***F3*** key on the main menu page 3.

For more information about BERT analysis, please refer to Chapter 6.

5.1 Configuration Setup

While your **BTM10** is located on the first menu page, press th ***F1*** key to enter the configuration setup screen. The screen displays th configuration settings and the current parameters, similar to the display below:



Configuration Setup Screen

These are main settings of the **BTM10** and will effect associated operations. The inverted cursor block is located on the firs parameter, E1 (CEPT). You can move the cursor up and down by pressing the up and down arrow keys. You may change the current parameter, where the cursor is located, by pressing the right or left arrow key. Press the ***PgDn*** (page down) or ***PgUp*** (page up) key to see next page or previous page of settings. Pressing the ***HOME*** key will move the cursor to the top page and top parameter. Press ***END*** key will move the cursor to the last page and bottom parameter.

5.2 Configuration Setting Parameter Details

The available settings and meanings of each in the "Manual Configuration" functions are as follows:

Setting	Parameter Description
Configuration:	**E1(CEPT)**; **BTM10** is configured to E1 mode **T1(DS1)**; **BTM10** is configured to T1 mode T1 not available on E1 only model. E1 not available on T1 only model. Please contact with your agent if you want to add a mode feature.
Channel:	**Full**; The **BTM10** may use any of the following combinations: 1) PCM31 (FAS, and TS1 to TS 31 are used) 2) PCM31+CRC (FAS, CRC4 enable, and TS1 to TS31 are used) 3) PCM30 (FAS, CAS enable, TS1 to TS15 and TS17 to TS31 are used) 4) PCM30+CRC (FAS, CRC4 enable, CAS enable, TS1 to TS15, and TS17 to TS31 are used) or 5) Unframe mode(TS1 to TS31 are used) **n*64K**; The **BTM10** may use any of the following combinations: 1) FAS + Timeslot sets available ones, 2) FAS + CRC + Timeslot sets available ones, 3) FAS + CAS + Timeslot sets available ones, 4) FAS + CAS + CRC + Timeslot sets available ones, or 5) Unframe mode(TS1 to TS31 are used)

Framing:	**FAS only**; Frame mode only **FAS+CAS**; Frame mode plus CAS function **Unframed**; Unframe mode is selected
CRC:	**CRC4**; In E1 mode, it sets CRC4 enable on. It is not available if using unframe mode. **NO**; This disables CRC4 or CRC6. **CRC6**; In T1 mode, it sets to CRC6 enable on. It is not available if using unframe mode.
Code:	**HDB3**; In E1 mode, it sets the E1 PCM code t HDB3 encoding mode. **AMI**; It sets the PCM code to normal AMI encoding mode. **B8ZS**; In T1 mode, it sets the T1 PCM code to B8ZS encoding mode.
Line Interface:	**TERM 75**; Sets **BTM10** to E1 75 ohm termin mode on TX or RX port. (The switch on rear panel must be set to TERM position) **TERM 100**; Sets **BTM10** to T1 100 ohm terminal mode on TX or RX port. (The switch on rear panel must be set to TERM position) **TERM 120**; Sets **BTM10** to E1 120 ohm terminal mode on TX or RX port. (The switch on rear panel must be set to TERM position) **Bridge**; Sets **BTM10** to bridge mode. The RX impedance will be greater than 1000 ohms. (The switch on rear panel must be set t TERM position) **DSXMON 75**; Sets **BTM10** to E1 75 ohm DSX-MONitor mode on RX port. (The switch on rear panel must be set to MON position) **DSXMON 100**; Sets **BTM10** to E1 100 ohm DSX-MONitor mode on RX port. (The switch on rear panel must be set to MON position) **DSXMON 120**; Sets **BTM10** to E1 120 ohm DSX-MONitor mode on RX port.

LBO:
0 dB; TX Line Build Out is set to 0 dB
-7.5dB; TX Line Build Out is set to -7.5 dB
-15dB; TX Line Build Out is set to -15 dB
-22.5dB; TX Line Build Out is set to -22.5 dB

Tx Timing: (E1/T1 TX PCM clock source)
Internal; from **BTM10** internal, 2048K bps on E1, 1544k bps on T1.
Recovery; from E1/T1 RX port recovered clock
External; from E1/T1 Ext/Ref clock
Data Port; from data port clock
2048+50ppm; from **BTM10** internal, 2048K plus 50 PPM offset on E1 mode
2048-50ppm; from **BTM10** internal, 2048K minus 50 PPM offset on E1 mode
1544+50ppm; from **BTM10** internal, 1544K plus 50 PPM offset on T1 mode
1544-50ppm; from **BTM10** internal, 1544K minus 50 PPM offset on T1 mode

Pattern: (**BTM10** will transmit and analyze this pattern onto E1/T1 frame.)

63; Pseudo random pattern: 2e6-1
127; Pseudo random pattern: 2e7-1
511; Pseudo random pattern: 2e9-1(O.153)
2047; Pseudo random pattern: 2e11-1 (O.152 AND O.153)
2e15-1; Pseudo random pattern: 2e15-1(O.151)
2e20-1; Pseudo random pattern: 2e20-1(O.153)
QRSS; Pseudo random pattern: 2e20-1 (O.151 QRSS)
2e23-1; Pseudo random pattern: 2e23-1 (O.151)
All One; Repetitive pattern: all ones (11111...)
All Zero; Repetitive pattern: all zeros (00000...)
ALT(0101); Repetitive pattern: alternating ones and zeros (10101010...)
3 in 24; Repetitive pattern: 3 in 24

1 in 16; Repetitive pattern: 1 in 16
1 in 8; Repetitive pattern: 1 in 8
1 in 4; Repetitive pattern: 1 in 4
User Prog.; User programmable repetitive pattern. The length of this pattern may be set from 1 to 32 bits. Please refer to Chapter 11 for details.

Error Type:
Logic; Force TX error type: Logic bit
Frame; Force TX error type: Framing bit
CRC; Force TX error type: CRC4/CRC6
BPV; Force TX error type: BPV

Ins Error Rate:
Single; Will force a single error when you pres the Force Error Key.
1e-3; Will force errors continuously at transmi rate of 1e-3.
1e-4; Will force errors continuously at transmi rate of 1e-4.
1e-5; Will force errors continuously at transmi rate of 1e-5.
1e-6; Will force errors continuously at transmi rate of 1e-6.
1e-7; Will force errors continuously at transmi rate of 1e-7.

Test Period:
Continuous; The BERT test will run forever.
1 Minute; BERT will run for one minute.
15 Minutes; BERT will run for fifteen minute
30 Minutes; BERT will run for half an hour.
1 Hour; BERT will run for an hour.
24 Hours; BERT will run for one day.

Display Type:
Brief; Upon entering BERT function, the screen will show in "brief" mode.
Logical; Upon entering BERT function, the screen will show in "logic" mode.
Frame; Upon entering BERT function, the screen will show in "frame" mode.

	CRC; Upon entering BERT function, the screen will show in "CRC" mode.
	BPV; Upon entering BERT function, the screen will show in "BPV" mode.
Print Interval:	**Disable**; The printer will not print out results automatically.
	5 Min; The printer will print out test results every five minutes.
	10 Min; The printer will print out test results every ten minutes.
	15 Min; The printer will print out test results every fifteen minutes.
	30 Min; The printer will print out test results every half an hour.
	60 Min; The printer will print out test results every one hour.
Print On Error:	**Disable**; The printer will not print out current test results while errors are received.
	Enable; The printer will print out current test results while errors are received.

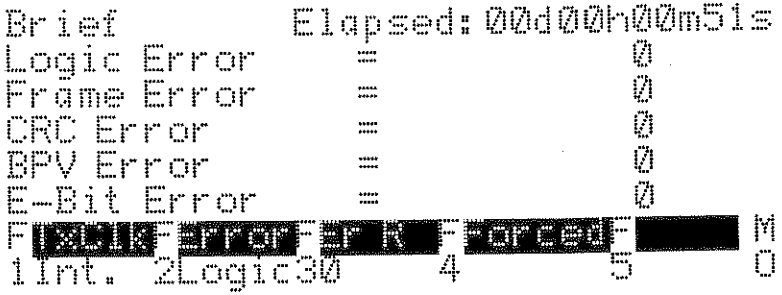
When you press the ***RUN*** key while in configuration setup, the **BTM10** will enter and run the BERT analysis function. Please refer to Chapter 6 for more information on the BERT analysis function.

6.1 Introduction

When the screen of the **BTM10** is on the first main menu page, pressing the ***F2*** key will enter and run the BERT analysis function. Alternately, you may also enter this function by pressing the ***RUN*** key while located within the Configuration Setup.

The BERT function will analyze E1/T1 line performance in common display mode or ITU-G.821 mode, and will generate standard E1/T1 line code.

After entering the function, the screen should show a display similar to below:

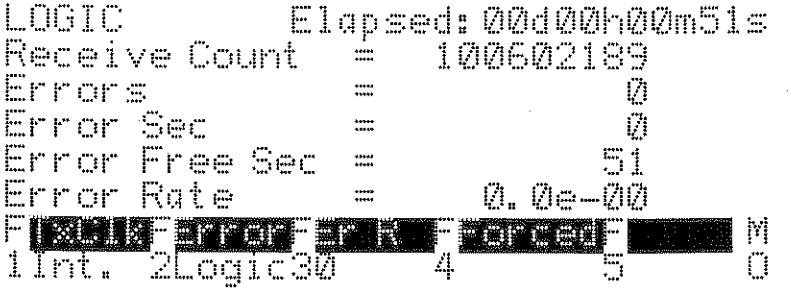


Brief Display Mode Screen

The upper-left indicator, Brief, LOGIC, FRAME, CRC, or BPV, depends upon the setting parameter for "Display Type" in the configuration setup. Please refer to Chapter 5 for details on configuration setup.

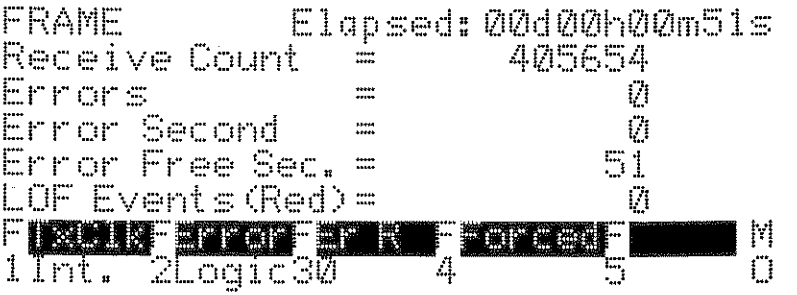
The top-right message, elapsed time, shows the duration of th current test. This analysis mode can be paused by pressing the ***RUN*** key, and continued by pressing the ***RUN*** key again. The bottom two lines show available function keys and their abbreviation. Pressing th ***MORE*** key will display additional function keys.

By simply pressing the ***PgUp*** (page up) or ***PgDn*** (page down) keys, all of the display type screens can be viewed. Examples of all the other screens are shown as follows:

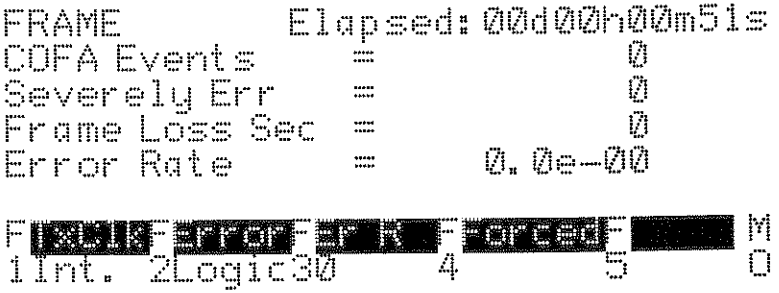


Logic Display Screen

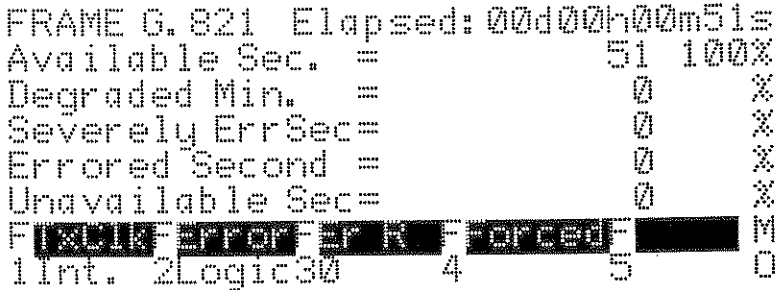
Logic G.821 Display Screen



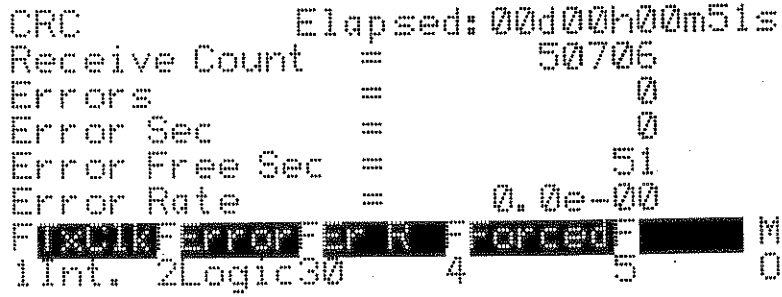
Frame Display Screen, page 1



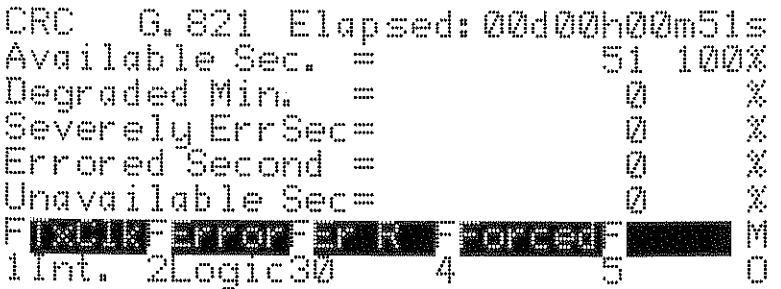
Frame Display Screen, page 2



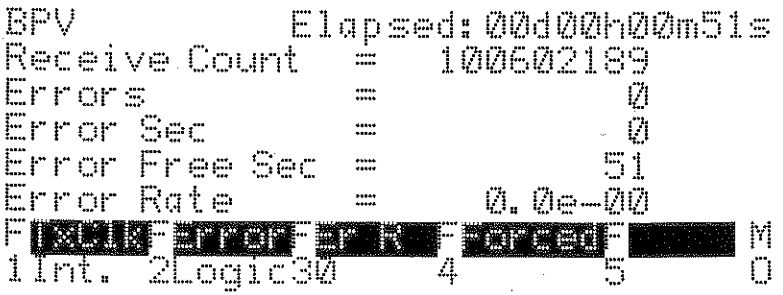
Frame G.821 Display Screen



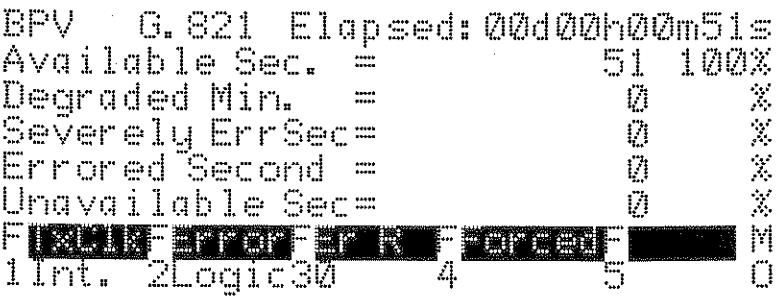
CRC Display Screen



CRC G.821 Display Screen



BPV Display Screen



BPV G.821 Display Screen

If you desire a hard copy print out of all the test results, connect the printer adapter cable from the printer port to a printer and press the ***PRINT*** key to start print out.

6.2 Performance

The **BTM10** analyzes and displays received E1/T1 frame on the LCD screen and LEDs. This section depicts all of the on screen abbreviations and meanings.

In "Brief" Format:

Logic Error	: Received Error Logic Bit Counter
Frame Error	: Received Error Framing Bit Counter
CRC Error	: Received Error CRC Counter
BPV Error	: Received Error BPV(Bipolar Violation) Counter
E-Bit Error	: Received Error Far End Block(E-bit) Counter (applicable only in E1 mode)

In "Logic" Format:

Receive Count	: Received Total Logic Bit Counter
Errors	: Received Error Logic Bit Counter
Error Sec	: Received Logic Bit Error Seconds
Error Free Sec	: Received Logic Bit Error Free Seconds
Error Rate	: Received Logic Error Rate (calculated of dividing received error logic bit counter by total received logic bit counter)

In "Logic G.821" Format:

Available Sec.	: Received G.821 Logic Bit Available Seconds
Degraded Min.	: Received G.821 Logic Bit Degraded Minutes
Severely ErrSec	: Received G.821 Logic Bit Severely Error Seconds
Erred Second	: Received G.821 Logic Bit Error Seconds
Unavailable Sec	: Received G.821 Logic Bit Unavailable Seconds

In "Frame" Format:

Receive Count	: Received Total Frame Counter
Errors	: Received Error Framing Bit Counter
Error Second	: Received Framing Bit Error Seconds
Error Free Sec.	: Received Framing Bit Error Free Seconds
LOF Events(Red)	: Received Loss of Frame Counter
COFA Events	: Received Change of Frame Alignment Counter
Severely Err	: Received Severely Error Frame Counter
Frame Loss Sec.	: Received Frame Loss Seconds
Error Rate	: Received Frame Error Rate (calculated by dividing the received error framing bit counter by the total received framing bit counter)

In "Frame G.821" Format:

Available Sec.	: Received G.821 Frame Available Seconds
Degraded Min.	: Received G.821 Frame Degraded Minutes
Severely ErrSec	: Received G.821 Frame Severely Error Seconds
Erred Second	: Received G.821 Frame Erred Seconds
Unavailable Sec	: Received G.821 Frame Unavailable Seconds

In "CRC" Format:

Receive Count	: Received Total CRC Counter
Errors	: Received Error CRC Counter
Error Sec	: Received CRC Error Seconds
Error Free Sec	: Received CRC Error Free Seconds
Error Rate	: Received CRC Error Rate (calculated of dividing received error CRC counter by total received CRC counter)

In "CRC G.821" Format:

Available Sec.	: Received G.821 CRC Available Seconds
Degraded Min.	: Received G.821 CRC Degraded Minutes
Severely ErrSec	: Received G.821 CRC Severely Error Seconds
Erred Second	: Received G.821 CRC Error Seconds
Unavailable Sec	: Received G.821 CRC Unavailable Seconds

In "BPV" Format:

Receive Count	: Received Total Logic Bit Counter
Errors	: Received Error BPV Counter
Error Sec	: Received BPV Error Seconds
Error Free Sec	: Received BPV Error Free Seconds
Error Rate	: Received BPV Error Rate (calculated by dividing received error BPV count by the total received logic bit counter)

In "BPV G.821" Format:

Available Sec.	: Received G.821 BPV Available Seconds
Degraded Min.	: Received G.821 BPV Degraded Minutes
Severely ErrSec	: Received G.821 BPV Severely Error Seconds
Erred Second	: Received G.821 BPV Error Seconds
Unavailable Sec	: Received G.821 BPV Unavailable Seconds

6.3 Function Keys

At the bottom of each display screen are two lines, with abbreviated and inverted character text indicating functions that may be applied in run mode. Under the abbreviated function is the current status. If you press any function key, the **BTM10** will take some action immediately, such as changing the E1/T1 line status, framing mode, or forcing errors. The current status will be modified if it has several selected statuses.

The function keys are in three different groups or sets of keys. Press the ***MORE*** key repeatedly to display the other function key groups.

For example:

Press "***MORE***"

Press ***MORE***

Here are the function key detailed meanings and actions.

Group 1

[F1] TxClk Transmit Clock Source

Int.	Change to internal clock source, initialize and restart test.
Recov	Change to RX recovery clock source, initialize and restart test.
Ext.	Change to external clock source, initialize and restart test.
Data	Change to data port clock source, initialize and restart test.
+50	Change to internal clock plus 50 ppm offset as clock source, initialize and restart test.
-50	Change to internal clock minus 50 ppm offset as clock source, initialize and restart test.

[F2]Error Forced Error Type

Logic Change forced error type to logic.
Frame Change forced error type to frame.
CRC Change forced error type to CRC.
BPV Change forced error type to BPV.

[F3]Er R Automatic Forced Error Rate

0 Disable automatic forced errors action.
1e-3 Automatic forced error rate is set at a rate of 1e-3.
1e-4 Automatic forced error rate is set at a rate of 1e-4.
1e-5 Automatic forced error rate is set at a rate of 1e-5.
1e-6 Automatic forced error rate is set at a rate of 1e-6.
1e-7 Automatic forced error rate is set at a rate of 1e-7.

[F4]Forced Force a Single Error

Insert a single error immediately.

Group 2

[F1]Disp. Display Format

Brief Changes the display format to brief display mode.
Logic Changes the display format to logic display mode.
Frame Changes the display format to frame display mode.
CRC Changes the display format to CRC display mode.
BPV Changes the display format to BPV display mode.

[F2]Frame Frame Type

FAS Changes the frame type to E1 FAS only mode.
F+CAS Changes the frame type to E1 FAS and CAS enabled mode.
Unfr. Changes the frame type to unframed mode.

[F3]CRC CRC Enable/Disable
CRC4 Changes the E1 CRC to CRC4 enabled mode.
NO Disables the CRC feature.
CRC6 Changes the T1 CRC to CRC6 enabled mode. (T1 only)

[F4]Code Code Format
HDB3 Changes to HDB3 coding mode. (E1 only)
AMI Changes to AMI coding mode.
B8ZS Changes to B8ZS coding mode. (T1 only)

[F5]Rmode Receive Mode
T 75 Change to 75 ohm terminal mode. (E1 only)
T 100 Change to 100 ohm terminal mode. (T1 only)
T 120 Change to 120 ohm terminal mode. (E1 only)
Bridg Change to bridge mode.
M 75 Change to DSX-MONitor 75 ohm mode.(E1 only)
M 100 Change to DSX-MONitor 100 ohm mode.(T1 only)
M 120 Change to DSX-MONitor 120 ohm mode.(E1 only)

Group 3

[F1]LBO Line Build Out Attenuation
0 Change LBO to 0 dB
-7.5 Change LBO to -7.5 dB
-15 Change LBO to -15 dB
-22.5 Change LBO to -22.5 dB

[F2]Patn Pattern
63 63
127 127
511 511
2047 2047
2e15- 2e15-1
2e20- 2e20-1

Patterns (cont.)

QRSS	QRSS
2e23-	2e23-1
All 1	All Ones
All 0	All Zeros
0101	Alternate(0101)
3in24	3 in 24
1in16	1 in 16
1 in8	1 in 8
1 in4	1 in 4
UserP	User Prog.

[F3]Durn. Test Duration

Cont.	Continuous
1 Min	1 Minute
15Min	15 Minutes
30Min	30 Minutes
60Min	1 Hour
24Hrs	24 Hours

[F4]ReSyn Re-sync framing

[F5]Reset Reset all test results and clear all of received counters and timers.

This page left blank intentionally.

7.1 Alarms Setting

To enter the "Alarms Setting" function, press the ***F3*** key fron the first menu page. Following entering the "Alarms Setting" functio you will see a screen similar to below:

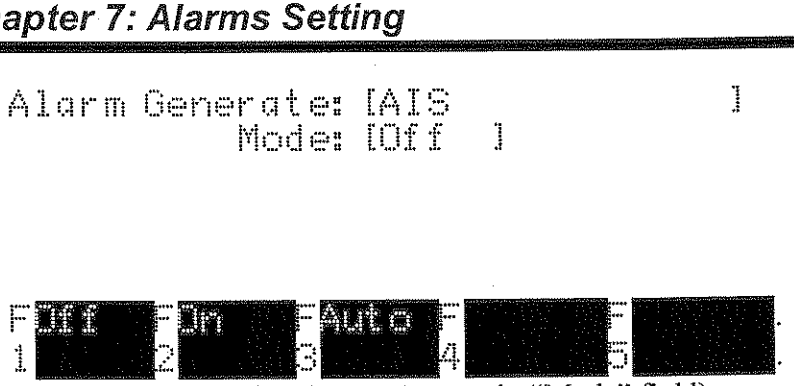
```
Alarm Generate: [AIS                ]
          Mode: [Off  ]
```

Alarms Setting Screen (cursor in "Alarm Generate" field)

The **BTM10** can generate **AIS** (Alarm Indication Signal), **Remote Alarm** (Yellow Alarm), or **Multi-frame Remote Alarm** (Multi-frame Yellow Alarm) manually or automatically. You may move the cursor up or down between the two entry fields by pressing the up or down arrow keys. When the cursor is located in the "Alarm Generation" field, you may select the type of alarm, which you require, simply by pressing the appropriate function key directly:

[F1] AIS	Alarm Indication Signal
[F2] REMOT	Remote Alarm
[F3] MULTI	Multi-frame Remote Alarm

Pressing the down arrow key will move the cursor to the "Mode" field, a second set of function keys are then active. Refer to the screen display on the next page.



Alarms Setting Screen (cursor in "Mode" field)

You may then select alarm generation off, on, or send automatically by simply pressing the function key directly:

[F1]Off	alarm generation disable
[F2]On	generate alarm manually
[F3]Auto	generate alarm automatically

AIS (Alarm Indication Signal):

When activated manually or automatically, the **BTM10** replaces all data output on the TX port with an unframed all ones signal (AIS). Automatic mode sends AIS for the duration of receive loss of signal.

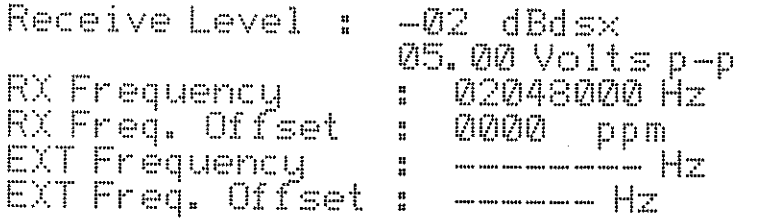
Remote Alarm (RAI, Yellow Alarm):

Manual mode sends remote alarm immediately. Automatic mode sends remote alarm for the duration of a receive loss of frame alignment.

Multi-frame Remote Alarm (MRAI, Multi-frame Yellow Alarm):

Manual mode sends multi-frame alarm immediately. Automatic mode sends multi-frame remote alarm for the duration of receive loss of multi-frame alignment.

This function allows the user to verify the received E1/T1 PCM signal. The "Signal Result" function is entered by pressing the ***F3*** key from the second menu page. When you enter this function, th E1/T1 RX port signal results will be displayed as follows:



Signal Result Screen display

Receive Level:

The current RX port signal level is measured in dBdsx, and calculated in peak-to-peak voltage.

Rx frequency:

The current RX port signal frequency is shown, measured in Hertz.

Rx Freq. Offset:

The current RX port signal frequency is compared with the internal clock frequency, and shown with the offset in ppm.

EXT Frequency:

The current Ext/Ref port signal frequency is shown, measure in Hz.

EXT Freq. Offset:

The current Ext/Ref port signal frequency is compared with the Rx port signal frequency, and shown with the offset in Hz.

Press the ***ESC*** key to exit this function.

This page left blank intentionally.

When you set the **BTM10** to CAS framing mode, signaling i enabled. To enter the signaling setup function, press the ***F4*** key fron the second menu set pages. If the **BTM10** is not in CAS mode, it wi change to CAS mode automatically. After you enter this function, y will see a screen similar to that below:

Signaling Setup Screen

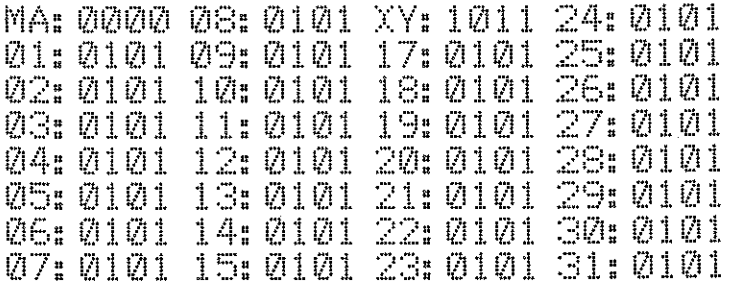
The screen shows which TX time slot is under setup, and its current ABCD bits. The flashing cursor is under the ABCD bit field and can be moved to A, B, C, or D locations by pressing the right or left arrow keys, or by pressing the ***F3*** Select Bit key. The function k definitions are as follows:

[**F1**] DecTS; Will decrement to the next time slot selection.
[**F2**] Inc TS; Will increment to the previous time slot selection.
[**F3**] Sel Bit; Will select on of the ABCD bits.
[**F4**] Set Bit; Will set the selected ABCD bit to "one".
[**F5**] Reset Bit; Will clear the selected ABCD bit to "zero".

To exit the "Signaling Setup" function, press the ***ESC*** key.

This page left blank intentionally.

To enter the "Signaling Display" function, press the ***F4*** key from the second menu set page. After you enter this function, you w see a screen similar to that below:



Signaling Display Screen

The screen shows every RX time slot's signaling A,B,C, an bits. The actual location of the bits is in time slot 16 during E1 CA framing mode. If the **BTM10** are not in CAS mode, it will be chan to CAS mode automatically.

The first time slot 16 of the first frame of multi-frame conta the multi-frame alignment and XYXX bits. They are shown in the and **XY** fields.

To exit the "Signaling Display" function, press the ***ESC*** ke

This page left blank intentionally.

To enter the "User Program Pattern" function, press the ***F5*** key from the third menu selection page. When you enter the functio you will see a screen similar to that below:

```
User programmable pattern:
Size [08] bits
Pattern(in binary) (left first)
00000001.........................

Press "1","0", or "-"(not used)
Press "ESC" key to exit.
```

User Program Pattern Screen

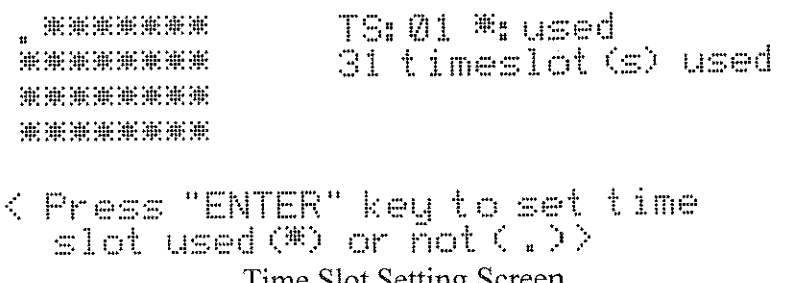
The user programmable pattern can be sent and analyzed or E1/T1 TX and RX ports while doing BERT analysis. Please refer t Chapter 6, BERT Analysis, for more details of the BERT function.

The left bit of the programmable pattern will be sent or received first, MSB first. Just enter the programmable pattern. You may enter "1" to set the current flashing bit in the pattern or you m enter "0" to clear the current flash bit to zero. If you want to move position of flash cursor, just press "Right" or "Left" arrow key. Th total repetitive pattern length will be counted automatically and sh as a number size in bit, on line two of the display. The maximum pattern length is 32 bits. Press the "-" key to delete the bit at the cu position, the current bit symbol will change to "." and the length o pattern will decrease by one bit. The minimum length of the programmable repetitive pattern is one bit.

To exit the "User Programmable Pattern" function, press th ***ESC*** key.

This page left blank intentionally.

To enter the "Time Slot Setting" function, press the ***F1*** key from the fourth menu set page. After you enter this function, you wil see a screen similar to that below:



Time Slot Setting Screen

There are 32 dot (.) or star (*) symbols on left side of the screen. Each one represents the status of one time slot. There are 32 time slots in an E1 frame. They may be set to used (shown as "*") o not (shown as ".").

There is a flashing cursor at any location of the time slot ma You may press the "Right Arrow", "Left Arrow", "Up Arrow", or "Down Arrow" key to move the flashing cursor's position.

If you want to change the time slot status, used or unused, a you have to do is press the ***ENTER*** key. The current used status, st symbol, will be changed to unused status, dot symbol, or vice versa

If the **BTM10** is set to **E1 unframe** mode, all of the 32 timeslots can be set to used or not. If the mode is set to **E1 frame** mode, only **TS1 to TS31** can be set. If the mode is set to **E1 frame and CAS** mode, only **TS1 to TS15 and TS17 to TS31** are settable

When performing BERT analysis, you may insert and drop a test pattern into used time slots if you set channel to n*64K mode. For more information on changing setup parameters, please refer to Chapter 5, Configuration Setup.

You may enter "External Drop and Insert" and run this function directly by pressing the ***RUN*** key at this stage. For more information, please refer to chapter 13, External Drop and Insert.

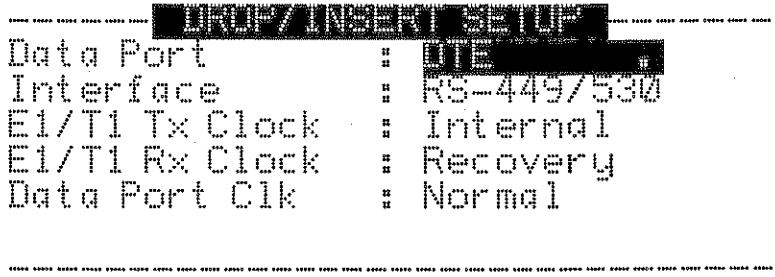
To exit the "Time Slot Setting" function, press the ***ESC*** key.

13.1 Introduction

The "External Drop and Insert" function lets the data stream on the data port drop and insert into the E1/T1 port. The E1/T1 framing configuration is based on the setting of "Configuration Setup". The available time slots are assigned by the function of "Tim Slot Setting". For more information, please refer to Chapter 5 Configuration Setup and Chapter 12 Time Slot Setting.

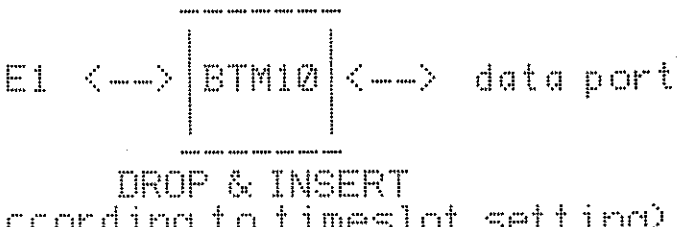
13.2 Parameter Setting

The "External Drop and Insert" function may be entered by pressing the ***F4*** key from the third menu page. After you enter this function, you will see a screen similar to that below:



Drop and Insert Setup Screen

After you set the parameters by using standard menu key operations, press the ***RUN*** key to activate this function. You will receive a screen similar to the screen on the following page:



Drop and Insert Screen

To exit the "External Drop and Insert" function, press the ***ESC*** key. The available settings and parameters for each are shown and explained in the following table:

Items	Selected parameters	Definition		
Data Port	(1) DTE	The data port is configured in DTE mode. This data port can be connected to another DCE instrument, such as a modem		
	(2) DCE	The data port is configured in DCE mode. This data port can be connected to another DTE instrument, such as a PC.		
Inter-face	(1) RS-232	The data port is set to RS-232.		
	(2) V.35	The data port is set to V.35.		
	(3) RS-449/530	The data port is set to RS-449 or RS-530.		
Idle Code	(1) 7EH	The unused time slots will be set to code 7E (hexadecimal).		
	(2) FFH	The unused time slots will be filled with code FF (hexadecimal).		
E1/T1 Tx Clock		E1/T1 TX port clock source	Data port RX/clock source (DTE mode)	Data port TX/clock source (DCE mode)
	(1) Internal	Internal OSC. (default)	RD(I/P)/XTC(O/P)	TD(I/P)/TC(O/P)
	(2) Recovery	Recovery from E1/T1 RX port	RD(I/P)/XTC(O/P)	TD(I/P)/TC(O/P)
	(3) External	Ext/Ref Port	RD(I/P)/XTC(O/P)	TD(I/P)/TC(O/P)
	(4) Data Port	Extract from Data Port	RD(I/P)/TC(I/P)	TD(I/P)/XTC(O/P)
E1/T1 Rx Clock		E1/T1 Rx port clock source	Data port TX clock source (DTE mode)	Data port TX clock source (DCE mode)
	(1) Internal	Internal OSC.	TD(O/P)/XRC(O/P)	RD(O/P)/RC(O/P)
	(2) Recovery	Recovery from E1/T1 RX port (default)	TD(O/P)/XRC(O/P)	RD(O/P)/RC(O/P)
	(3) External	Ext/Ref Port	TD(O/P)/XRC(O/P)	RD(O/P)/RC(O/P)
	(4) Data Port	Extract from Data port	TD(O/P)/RC(I/P)	RD(O/P)/XRC(I/P)
Data Port Clk	(1) Normal	The clock polarity of data port is normal.		
	(2) Inverted	The clock polarity of data port is inverted.		

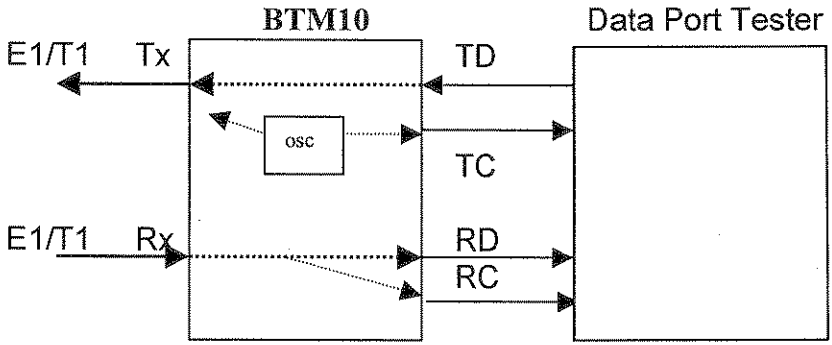
External Drop and Insert setting parameters table

13.3 Examples

1) **BTM10** Configuration:
Configuration: E1(CEPT)
Channel: Full
Framing: Unframe

BTM10 Ext. Drop and Insert Configuration:
Data Port : DCE
Interface : RS-449/530
Idle Code : 7EH
E1/T1 Tx Clock : Internal
E1/T1 Rx Clock : Recovery
Data Port Clk : Normal

Data Port Tester Configuration:
Mode : DTE
Speed: 2048K
Tx Clock: External
Rx Clock: DPLL (or External)



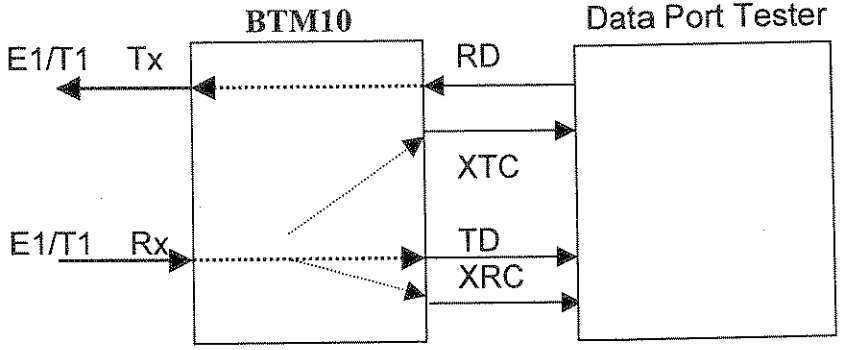
2) BTM10 Configuration:
Configuration: E1(CEPT)
Channel: n*64K
Framing: FAS+CAS
BTM10 Ext. Drop and Insert Configuration:
Data Port : DTE
Interface : RS-449/530
Idle Code : 7EH
E1/T1 Tx Clock : Recovery
E1/T1 Rx Clock : Recovery
Data Port Clk : Normal

```
. ********          TS: 00 . : unused
**********          30 timeslot (s) used
. ********
**********

< Press "ENTER" key to set time
  slot used (*) or not ( . )>
```

Time Slot Setting Screen

Data Port Tester Configuration:
Mode : DCE
Speed: 1920K
Tx Clock: External
Rx Clock: DPLL



The **BTM10** has the ability to display two frames of E1 32 time slot data in real-time. One frame is FAS, the other is NFAS. From the forth menu page, press the ***F2*** key "Time Slot Map Data". The screen will display similar to the following:

```
FAS: TS0 : 9B AA AA AA AA AA AA AA
     TS8 : AA AA AA AA AA AA AA AA
     TS16: 55 AA AA AA AA AA AA AA
     TS24: AA AA AA AA AA AA AA AA
NFAS: TS0 : 5F AA AA AA AA AA AA AA
     TS8 : AA AA AA AA AA AA AA AA
     TS16: 55 AA AA AA AA AA AA AA
     TS24: AA AA AA AA AA AA AA AA
```

Time Slot Map Data Screen

For readability, the screen will pause for 0.5 second and then the data will be refreshed.

To exit the "Time Slot Map Data" function, press the ***ESC*** key.

This page left blank intentionally.

Chapter 15: VF Access

The "VF Access" function is used to place and monitor an audio frequency (from 60 to 3950 Hz) onto the selected time slot. To enter the "VF Access" function, press the ***F1*** key from the second menu selection page. When you enter the function, you will see a screen similar to that below:

VF Access Setup Screen

Depending upon the VF access setting, the **BTM10** will generate a low frequency (audio sine wave) and insert it into an E1/T 64K channel. The **BTM10** is also able to monitor the low frequency on the same E1/T1 64K channel and output the audio to its built-in speaker.

Standard editing functions apply, the up and down arrow key will move between settings, the right and left arrow keys will modify the setting parameters. Additionally, the function keys may be used a different functions are applied to each particular setting. The meanin and available settings for this configuration function are as follows:

Setting Item	Selected parameters	Definition
Channel	From TS1 to TS31	Generate VF onto specific channel and monitor voice on the same channel.
Frequency	From 60 to 3950 Hz	Generate a specific voice frequency from 60 to 3950 Hz with a resolution of 1 Hz.
Level	From –55 to 0 dBm0	Generate the specific voice frequency at a level from –55 to 0 dBm0 with a resolution of 5 dB.
Speaker	(1)Off	The monitor speaker is turned off.
	(2)Loud	The monitor speaker is turned on and loud.
	(3)Soft	The monitor speaker is turned on and soft.

This page left blank intentionally.

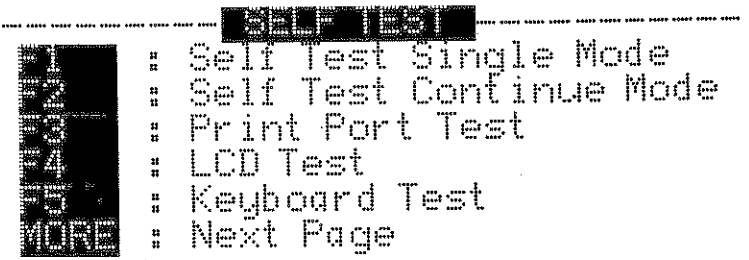
16.1 Description

The diagnostic self tests performed by the **BTM10** are selecte from the fourth menu page by the ***F5*** key. From the Self Test menu, ***F1*** and ***F2*** select the **SINGLE MODE** and **CONTINUOUS MODE** respectively. The same tests are available under both **SINGLE MODE** and **CONTINUOUS MODE**. The difference between the two modes is that in **SINGLE MODE**, the tests are run for one pass only. In **CONTINUOUS MODE**, the tests are run repeatedly until a key is pressed when the "press any key to exit." message is displayed the unit is powered off, or the battery becomes too low for the unit to function properly.

The tests confirm proper operation of the **BTM10**'s Central Processing Unit (CPU), the Read Only Memory (ROM), and the Random Access Memory (RAM) as well as internal loop-back tests for the communications interface. Selecting ***F3***, runs the Printer Por Test. The ***F4*** key selects the Liquid Crystal Display (LCD) for testin while ***F5*** will test the tactile membrane Keyboard. Press the ***MORE*** key to see another menu screen page. ***F1*** selects VF DTMF test. ***F2*** selects the VF Tone test.

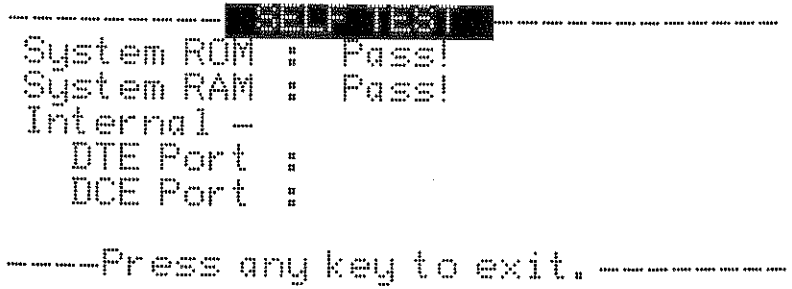
16.2 Self Test Single Mode

From the Page 4 MENU, select ***F5***, Self Test.



Self Test Screen

Selecting ***F1*** from the Self Test Menu will run the internal test routines for one pass. The resultant display will look like this.



Self Test Single results Screen

16.3 Self Test Continuous Mode

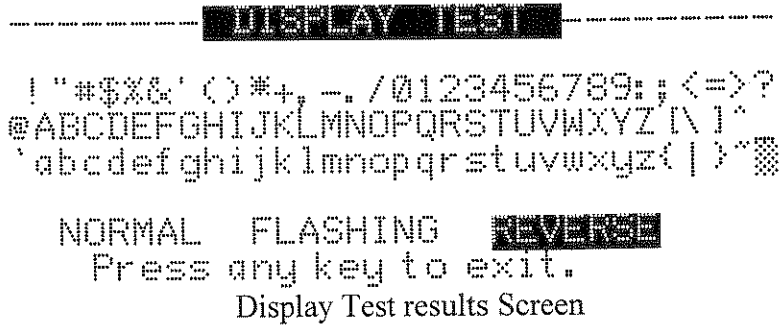
Selecting ***F2*** **Self Test Continue Mode**, from the Self Test Menu, will run the internal tests continuously, non-stop. In continuous mode, the display test is added to the test routine.

16.4 Print Port Test

Selecting ***F3*** **Print Port Test**, will print an ASCII CODE pattern of printable characters (20H---7FH) to any attached printer. If no printer is attached to the parallel port, a PRINTER BUSY message will be displayed on the LCD screen.

16.5 LCD Test

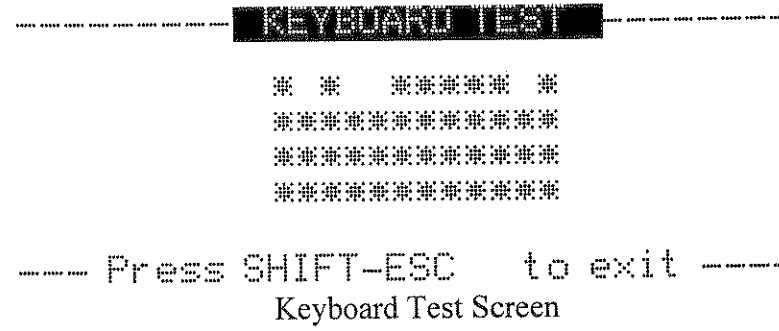
Selecting ***F4* LCD Test**, will test the LCD display in the following manner. All pixels will light ON and then OFF. Then the Display will show the character set with NORMAL, FLASHING, and REVERSE video attributes.



Display Test results Screen

16.6 Keyboard Test

***F5* Keyboard Test** will bring up the keyboard test from the Self Test menu. The display should resemble the following:



Keyboard Test Screen

The relative key positions will be shown on the LCD. With every press of a key on the keyboard, the relative position markers will change to a square box, indicating proper operation of the key.

To EXIT the test at any time, press ***SHIFT*** and ***ESC***.

16.7 VF Test (DTMF)

Pressing ***MORE*** from the first self test menu page will display the second test menu page as follows:

Self Test, second menu screen

Please add a loop back cable between Tx and Rx.

Pressing the ***F1*** key will enter the VF (DTMF) test.

```
A-Law DTMFSpeaker  louder. 1234567
890**ABCSpeaker  soft. 12345678 90*
*ABCSpeaker  off. 123456789 0**AB
```

VF Test (DTMF) screen results

16.8 VF Test (Tone)

Please add a loop back cable between Tx and Rx.

Pressing the ***F2*** key will enter the VF (Tone) test.

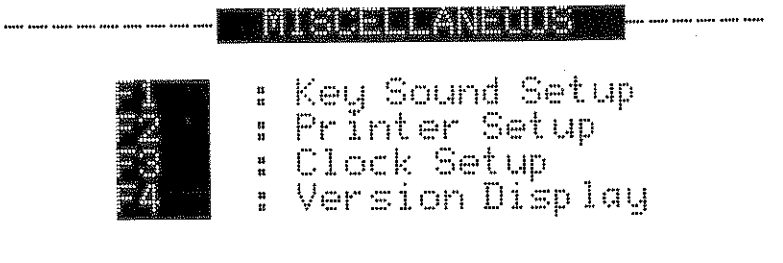
```
Tone is sending. Please loopback.
Speaker is louder.
Speaker is soft.
Speaker is off.
Frequency scanning.
```

VF Test (Tone) screen results

Press ***ESC*** to exit tests.

17.1 Description

From the Page 4 Menu, select function ***F4*** **Miscellaneous**. Th following will be displayed:



Miscellaneous Screen

The following sections will define the four miscellaneous functions.

17.2 Key Sound Setup

The beep sound when a key is depressed can be turned OFF c ON. From the Miscellaneous Menu press the ***F1*** key. The following will be displayed:

Key Sound Setup Screen

Toggle between ON and OFF, using left and right arrow key to enable or disable the Beep sound and then press the ***ESC*** key.

17.3 Print function setting

The mode of printing may be selected between normal or condensed print. From the Miscellaneous Menu press the ***F2*** key. The following will be displayed.

Printer Setup Screen

Toggle between NORMAL and CONDENSE, using the left and right arrow keys, to enable or disable condensed printing and then press the ***ESC*** key.

17.4 Clock Setup

The internal clock of the **BTM10** may be set through this menu. From the Miscellaneous Menu press the ***F3*** key. The following will be displayed:

```
Current Date:  98-08-24
        Time:  14:39:53
Setting Date:  98-08-24 (yy-mm-dd)
        Time:  14:37:07 (hh:mm:ss)
  Event Time:  00:00:00 (hh:mm:ss)
* Press <ENTER> to confirm every
  item.
* Press <ESC> to exit.
```

Clock Setup Screen

From the cursor position, either change the entry or press ***ENTER*** to accept the current value. Only the fields for setting date & time and the event time may be edited. Press ***ESC*** anytime to exit. In order for changes to be saved, you must press ***ENTER*** on all of the remaining fields.

After completing all of the entry fields, the "**Press <F1> key to confirm this function**" message will be displayed. By confirming this function, when the current time equals the event time, any proces you may be running, such as an emulation program, will stop automatically.

17.5 Version Display

The version level of the **BTM10** may be displayed through th function. Press the ***F4*** key from the miscellaneous menu, a similar screen will be displayed:

```
Firmware version: 2.05-03
Hardware version: L2.3 + L3.2
     press any key to exit
```

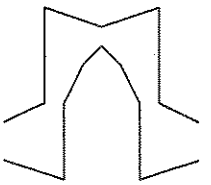
Version Display Screen

Press any key to exit back to the miscellaneous menu. Press the ***ESC*** key to exit the miscellaneous menu.

This page left blank intentionally.

18.1 Introduction

The **BTM10** has the ability to analysis the incoming E1/T1 pulse shape. According to the specification of ITU-G.703, the **BTM1** will draw the incoming pulse shape in graphics on the LCD and do a pulse shape analysis. The **BTM10** will show a "Good!" comment when the pulse shape meets the standards, otherwise it will issue a "Not Good!" comment. After you enter this function, you should see screen similar to the following:



Pulse Shape Display Screen

If the received frequency is not the same as standard E1/T1 o the signal level is too small, the **BTM10** will not accept the signal fo analysis. The function may also be unavailable if the incoming pulse has few or is without continuous ones. Make sure there are enough continuous pulses (ones) on incoming E1/T1 RX port. The recommend received testing pattern is all ones.

If the power of the built-in battery is weak, the LED may indicate a battery low condition. In this case the test result may also b incorrect. Please recharge battery or test while the external power adapter is plugged into **BTM10**.

18.2 Function Keys

There are four functions, which you may select, shown on the right side of screen. The meaning of each function is shown in the following table:

Function	Meaning
[F2] Re-Trigr	Re-Sync and re-trigger measurement.
[F3] Print out	Print out the current pulse shape.
[F4] Mask on	Show both pulse shape and ITU-G.703 mask.
[F5] Mask off	Show only the pulse shape.

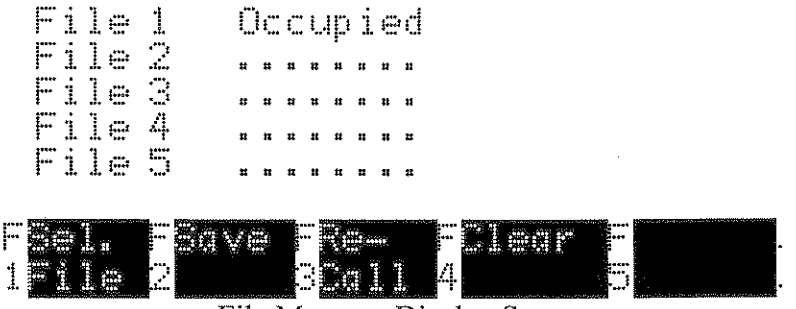
Note:

You may also press the left or right arrow keys to move the mask slightly left or right.

To exit this function, press the ***ESC*** key.

19.1 Introduction

The **BTM10** is capable of storing configuration and BERT results into its internal memory. You may recall this data from memory at a later date. There are five locations where the data can be stored. This function is useful for retaining different field test and analysis results. The results will remain in memory even after you tur the unit power off. To enter this function, press the ***F3*** key from the fourth menu page. A screen will be displayed similar to the following



File Manager Display Screen

19.2 Operation

There will be a flashing cursor at the beginning of one of the five file locations. The cursor position indicates the selected file. You may then take one of the following actions, **Save**, **Recall**, or **Clear**, simply by pressing the appropriate function key. If a file location is occupied with previously saved data, its line will show the "Occupied" message. Empty file locations will show as a dotted line

If a file location is "Occupied", the only operations allowed are to **Recall** or **Clear**. The **Recall** operation will restore the selected file location's contents into the **BTM10**'s working memory. The **Clear** operation will erase the file location contents, freeing it for further **Saves**.

If the file location is empty, you may only do a **Save** operation, as there is already no data to **Clear** or **Recall**. The **Save** will immediately place the working memory contents and place them into the selected file location for later **Recall** or **Clear**.

The meaning of each function is shown in the following table:

Function	Meaning
[F1] Sel. File	Moves the flashing cursor to the next file location.
[F2] Save	Saves current configuration parameter and BERT test results to the location indicated by the flashing cursor.
[F3] Re-call	Recalls the stored data from internal file memory location indicated by the flashing cursor.
[F4] Clear	Clears the file data from the location indicated by the flashing cursor.

Note:

You may also use the left and right arrow keys to move flashing cursor's position.

To exit this function, press the ***ESC*** key.

20.1 Introduction

When the E1/T1 RX port recovered clock is different from Ext/Ref port recovery clock, the frame timing may become misaligne or may "Slip". The **BTM10** is able to measure the differences in the clocks whether due to faster or slower recovered clocks or due to jitt (short term variations of the digital signal from their ideal positions i time) from the clock. There are three Slip parameters that can be measured by the **BTM10**; uncontrolled Slip, frame Slip and timing Slip. The function is entered by pressing the ***F1*** key from the fifth menu page. A screen similar to the following will be displayed:

SLIP Measurement Display Screen

Uncontrolled SLIP:

This is the count of uncontrolled SLIP. It indicates that the E1/T1 RX port has received signal with underrun or overflow causec by jitter or out of tolerance clock from the **BTM10**'s default. The result is an uncontrolled jitter data slip. This value is the sum total of all uncontrolled SLIPs.

Frame SLIP:

This is the count of controlled +/- 1 frame SLIP. It indicates that the E1/T1 RX port recovered clock is different from Ext/Ref po recovery clock and that the BTM10's receiver caused a whole frame of data to slip. The value shown is the sum of the total frame SLIPs.

Timing SLIP:

This is the count of timing SLIP (or frequency SLIP). It indicates that the E1/T1 RX port recovered clock is difference from the Ext/Ref port recovery clock. This value is total difference in timing measured in Hertz.

20.2 Operation

Press the ***F1*** key from the fifth menu page, measurement will start and continue. If you want to clear the counters, simply press the ***RUN*** key again.

If the E1/T1 RX port has no any incoming signal, all of the counters will show the "....." message. The **BTM10** takes these measurements from the E1/T1 RX port signal.

If the Ext/Ref port does not have any incoming signal, the counters of frame SLIP and timing SLIP will show the "no ext clk" message. This shows that these two measurements are dependant upon the difference between the Ext/Ref port signal and E1/T1 RX port signal. If the Ext/Ref port is set to TTL mode, it will always show these two measurements.

To exit this function, press the ***ESC*** key.

21.1 Introduction

The actual function of the REMOTE CONTROL utility is to provide the PC with a terminal emulation ability. Therefore, the remote functions could also be run from a stand alone termina or by using a different terminal emulation program on your PC.

The remote PC can control the **BTM10** by direct connection or via dial-up MODEM as displayed in the following figures.

Direct Connection

Dial-up MODEM Connection

Direct connection is made between the PC's communication port, COM1:, COM2:, COM3:, or COM4:, and the male DB9 Remote Control port connector on the **BTM10** with the supplied Remote cable. When using a dial-up connection, a null cable (***Appendix B***) must be used on the **BTM10** side.

When using REMOTE CONTROL, the following functions of the BTM10 may be controlled remotely:

1. Configuration Setup.
2. BERT Test and Analysis.
3. Reset System.

21.2 Remote Port Setup

You can enter this setup menu by pressing the **F2** key from main menu page 3, and the screen will show as following:

Remote Port Setup Display Screen

Press the Right Arrow or Left Arrow key will change the remote port baud rate. The available remote port baud rate are 300, 600, 1200, 2400, 4800, 9600, and 38400 bps.

21.3 Operation

The actual function of the ***REMOTE CONTROL*** Operation of REMOTE CONTROL involves simply connecting the **BTM10** as shown in figure 22-1 or 22-2. The remote PC must set its RTS (signal 105) and DTR (signal 108) to active (space, 0), and use the same baud rate to control **BTM10**.

When powered on, the **BTM10** will initialize and check for an active connection on its Remote Port. After **BTM10** initials MODEM, simply press the space bar twice on the PC and the terminal will display the remote screen.

```
*BTM-10 MAIN MENU*
1)CONFIG. SETUP
2)BERT ANALYSIS
3)RESET SYSTEM
0)EXIT
*SELECT 0-3
```

Remoted PC Display Screen
(Main Menu)

To exit, press the zero key on PC. The **BTM10** w disable CTS/DSR and DTR, wait 2 seconds and then exit. If yc are using modem connections, they will automatically hang u when DTR drops.

Press "1" key will enter Configuration Setup function. Or press "2" key will enter BERT Analysis function, and so o After entering sub-function, you may type in command whi shows on remoted PC screen, **BTM10** will do such action a send "OK" message to remoted PC. Error command will g "ERROR COMMAND, TRY AGAIN!" message from **BTM10**.

Press "0" will escape current sub-function and return to ma menu.

```
*CONFIG SETUP*'
CF1,CF2,CH1~3,CO1,CO2,CR1,CR2,
EB1~5,ET1~4,FM1~7,ID1~4,IE1~6,
LB1~4,LI1~6,PA1~9,PAA~K,TT1~4
*COMMAND/0/SPACE?
```

Remoted PC Display Screen
(Configuration Setup)

```
*BERT ANALYSIS*
CO1,CO2,CR1,CR2,ET1~4,FM1~7,
FR1,IE1~6,LB1~4,LI1~6,PA1~9,
PAA~K,RS1,RT1,SH1~6,TT1~4
*COMMAND/0/SPACE?
```

Remoted PC Display Screen
(BERT Analysis)

```
*RESET SYSTEM*
*YES/0/SPACE?
```

Remoted PC Display Screen
(Reset System)

21.4 Commands

21.4.1 Main Menu Setup Command List:

<Space> : Shows current page again.
<0> : Initials MODEM, exit remote control functiom.
<1> : Enter Configuration Setup.
<2> : Enter BERT Analysis.

21.4.2 Configuration Setup Command List:

<Space> : Shows current page again.
<0> : Escapes to main menu.
<CF1> : Sets to E1 configuration mode.
<CF2> : Sets to T1 configuration mode.

<CH1> : Sets to Full channel mode.
<CH2> : Sets to N*64K channel mode.
<CH3> : Sets to N*56K channel mode. (T1)
<CO1> : Sets code to HDB3 mode (E1) or B8ZS mode (T1)
<CO2> : Sets code to AMI mode.
<CR1> : Sets CRC enable.
<CR2> : Sets CRC disable.
<EB1> : Sets E-bit to Automatic mode. (E1)
<EB2> : Sets E-bit to Manual 11 mode. (E1)
<EB3> : Sets E-bit to Manual 10 mode. (E1)
<EB4> : Sets E-bit to Manual 01 mode. (E1)
<EB5> : Sets E-bit to Manual 00 mode. (E1)
<ET1> : Sets error type to Logic.
<ET2> : Sets error type to Frame.
<ET3> : Sets error type to CRC.
<ET4> : Sets error type to BPV.
<FM1> : Sets to FAS only mode (E1) or ESF mode (T1).
<FM2> : Sets to FAS+CAS mode (E1) or ESF+T1DM mod
(T1).
<FM3> : Sets to Unframe mode (E1) or SF mode (T1).
<FM4> : Sets to SF+T1DM mode (T1).
<FM5> : Sets to SLC-96 mode (T1).
<FM6> : Sets to SLC-96+T1DM mode (T1).
<FM7> : Sets to Unframe mode (T1).
<ID1> : Sets idle timeslots to Fill 7EH mode.
<ID2> : Sets idle timeslots to Fill 7FH mode.
<ID3> : Sets idle timeslots to Fill FFH mode.
<ID4> : Sets idle timeslots to Pass Thru mode.
<IE1> : Sets insert error rate to Single.
<IE2> : Sets insert error rate to 1e-3.
<IE3> : Sets insert error rate to 1e-4.
<IE4> : Sets insert error rate to 1e-5.
<IE5> : Sets insert error rate to 1e-6.
<IE6> : Sets insert error rate to 1e-7.

<LB1> : Sets LBO to 0dB.
<LB2> : Sets LBO to -7.5dB.
<LB3> : Sets LBO to -15dB.
<LB4> : Sets LBO to -22.5dB.
<LI1> : Sets line interface to Terminal 75 ohm(E1)
or Terminal 100 ohm(T1).
<LI2> : Sets line interface to Terminal 120 ohm(E1)
or Bridge 100 ohm(T1).
<LI3> : Sets line interface to Bridge 75 ohm(E1)
or Monitor 100 ohm(T1).
<LI4> : Sets line interface to Bridge 120 ohm(E1).
<LI5> : Sets line interface to Monitor 75 ohm(E1).
<LI6> : Sets line interface to Monitor 120 ohm(E1).
<PA1> : Sets pattern to 63.
<PA2> : Sets pattern to 127.
<PA3> : Sets pattern to 511.
<PA4> : Sets pattern to 2047.
<PA5> : Sets pattern to 2e15s.
<PA6> : Sets pattern to 2e15n.
<PA7> : Sets pattern to 2e20s.
<PA8> : Sets pattern to 2e20n.
<PA9> : Sets pattern to QRSS.
<PAA> : Sets pattern to 2e23s.
<PAB> : Sets pattern to 2e23n.
<PAC> : Sets pattern to All 1.
<PAD> : Sets pattern to All 0.
<PAE> : Sets pattern to 0101.
<PAF> : Sets pattern to 3in24.
<PAG> : Sets pattern to 1in16.
<PAH> : Sets pattern to 1 in8.
<PAI> : Sets pattern to 1 in4.
<PAJ> : Sets pattern to UserP.
<PAK> : Sets pattern to LIVE.

<TT1> : Sets Tx Timing to Internal mode.
<TT2> : Sets Tx Timing to Recovery mode.
<TT3> : Sets Tx Timing to External mode.
<TT4> : Sets Tx Timing to Data Port mode.

21.4.3 BERT Analysis Command List:

<Space> : Shows current page again.
<0> : Escapes to main menu.
<CO1> : Sets code to HDB3 mode (E1) or B8ZS mode (T1
<CO2> : Sets code to AMI mode.
<CR1> : Sets CRC enable.
<CR2> : Sets CRC disable.
<ET1> : Sets error type to Logic.
<ET2> : Sets error type to Frame.
<ET3> : Sets error type to CRC.
<ET4> : Sets error type to BPV.
<FM1> : Sets to FAS only mode (E1) or ESF mode (T1).
<FM2> : Sets to FAS+CAS mode (E1) or ESF+T1DM mo
(T1).
<FM3> : Sets to Unframe mode (E1) or SF mode (T1).
<FM4> : Sets to SF+T1DM mode (T1).
<FM5> : Sets to SLC-96 mode (T1).
<FM6> : Sets to SLC-96+T1DM mode (T1).
<FM7> : Sets to Unframe mode (T1).
<FR1> : Force one error.
<IE1> : Sets insert error rate to Single.
<IE2> : Sets insert error rate to 1e-3.
<IE3> : Sets insert error rate to 1e-4.
<IE4> : Sets insert error rate to 1e-5.
<IE5> : Sets insert error rate to 1e-6.
<IE6> : Sets insert error rate to 1e-7.
<LB1> : Sets LBO to 0dB.
<LB2> : Sets LBO to -7.5dB.

<LB3> : Sets LBO to -15dB.
<LB4> : Sets LBO to -22.5dB.
<LI1> : Sets line interface to Terminal 75 ohm(E1)
or Terminal 100 ohm(T1).
<LI2> : Sets line interface to Terminal 120 ohm(E1)
or Bridge 100 ohm(T1).
<LI3> : Sets line interface to Bridge 75 ohm(E1)
or Monitor 100 ohm(T1).
<LI4> : Sets line interface to Bridge 120 ohm(E1).
<LI5> : Sets line interface to Monitor 75 ohm(E1).
<LI6> : Sets line interface to Monitor 120 ohm(E1).
<PA1> : Sets pattern to 63.
<PA2> : Sets pattern to 127.
<PA3> : Sets pattern to 511.
<PA4> : Sets pattern to 2047.
<PA5> : Sets pattern to 2e15s.
<PA6> : Sets pattern to 2e15n.
<PA7> : Sets pattern to 2e20s.
<PA8> : Sets pattern to 2e20n.
<PA9> : Sets pattern to QRSS.
<PAA> : Sets pattern to 2e23s.
<PAB> : Sets pattern to 2e23n.
<PAC> : Sets pattern to All 1.
<PAD> : Sets pattern to All 0.
<PAE> : Sets pattern to 0101.
<PAF> : Sets pattern to 3in24.
<PAG> : Sets pattern to 1in16.
<PAH> : Sets pattern to 1 in8.
<PAI> : Sets pattern to 1 in4.
<PAJ> : Sets pattern to UserP.
<PAK> : Sets pattern to LIVE.
<RS1> : ReSync E1/T1 RX.
<RT1> : Reset test result.
<SH1> : Show current configuration settings
<SH2> : Show BRIEF testing result.

<SH3> : Show LOGIC testing result.
<SH4> : Show FRAME testing result.
<SH5> : Show CRC testing result.
<SH6> : Show BPV testing result.
<TT1> : Sets Tx Timing to Internal mode.
<TT2> : Sets Tx Timing to Recovery mode.
<TT3> : Sets Tx Timing to External mode.
<TT4> : Sets Tx Timing to Data Port mode.

21.4.4 System Reset Command List:

<Space> : Shows current page again.
<0> : Escapes to main menu.
<YES> : Reset BTM10 system.

Appendix A: Acronyms and Abbreviations

ADC	Analog to Digital Converter
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
ALBO	Automatic Line Build Out
ALOS	Analog Loss of Signal
AMI	Alternate Mark Inversion
ANSI	American National Standards Institute
B8ZS	Binary with 8 Zero Substitution
BER	Bit Error Rate
BERR	Bit Error Counter
BFA	Basic Frame Alignment
BOP	Bit-Oriented Protocol
BPV	Bipolar Violation
CAS	Channel Associated Signaling
ITU-T	International Telegraph and Telephone Consultative Committee
CCS	Common Channel Signaling
CERR	CRC Errors
CGA	Carrier Group Alarm
CI	Customer Installation
COFA	Change of Frame Alignment
CRC	Cyclic Redundancy Check
CSU	Channel Service Unit
DAC	Digital to Analog Converter
DCS	Digital Cross-Connect System
DDS	Digital Data System
DMI	Digital Multiplexed Interface
DPLL	Digital Phase Locked Loop
DS1	Digital Signal Level 1
DSU	Data Service Unit
ESF	Extended Superframe
EXZ	Excessive Zeros
FAS	Frame Alignment Sequence (E1 Format)
FCC	Federal Communications Committee
FCS	Frame Check Sequence

FDL	Facility Data Link
FEBE	Far End Block Error
FERR	Framing Bit Error
FPS	Frame Pattern Sequence (EFS Format)
HCDS	High-Capacity Digital Service
HDB3	High-Density Bipolar of order 3
ICOT	Intercity and Outstate Trunk
IDLC	Integrated Digital Loop Carrier
ISDN	Integrated Service Digital Network
JAT	Jitter Attenuator
JCLK	Jitter Attenuated Clock
JTAG	Joint Test Action Group
LBO	Line Build Out
LCV	Line Code Violation
LEC	Local Exchange Carrier
LIU	Line Interface Unit
LOAS	Loss of Analog Signal
LOF	Loss of Frame
LOS	Loss of Signal -DS1
LSB	Least Significant Bit
MAIS	Multiframe AIS
MART	Maximum Average Reframe Time
MAS	Multiframe Alignment Sequence (CAS Format)
MAT	Metropolitan Area Trunk
MERR	MFAS Error
MFAS	Multiframe Alignment Sequence (CRC4 format)
MOP	Message-Oriented Protocol
MOS	Message Oriented Signaling
MSB	Most Significant Bit
MVIP	Multi-Vendor Integration Protocol
MYEL	Multiframe Yellow Alarm
NI	Network Interface
NRZ	Non-Return to Zero
OOF	Out of Frame
PDV	Pulse Density Violation

PIC	Polyethylene-insulated Cable
PLCC	Plastic Leaded Chip Carrier
PLL	Phase Locked Loop
PM	Performance Monitoring
PRBS	Pseudo-Random Bit Sequence
PRI	Primary Rate Interface
PRM	Performance Report Message
RAI	Remote Alarm Indication
RBOP	Bit-Oriented Protocol Detector
RBS	Robbed Bit Signaling
RCVR	Receiver
RDL1	Receive Data Link 1
RDL2	Receive Data Link 2
RDL3	External Receive Data Link
RFRAME	Receive Framer
RJAT	Receive Jitter Attenuator
RLIU	Receive Line Interface Unit
RMAIS	Receive Multiframe AIS
RPDV	Receive Pulse Density Violation
RPLL	Receive Phase Locked Loop
RSB	Receive System Bus
RSBI	Receive System Bus Interface
RSIG	Receive Signaling Buffer
RSLIP	Receive Slip Buffer
RXCLK	Receive Clock
RZCS	AMI/HDB3/B8ZS Line Decoder
QRSS	Quasi-Random Signal Source
SEF	Severely Errored Framing Event
SERR	CAS Error
SF	Super Frame
SLC	Subscriber Loop Carrier
TAP	Test Access Port
TBOP	Bit Oriented Protocol Formatter
TDL1	Transmit Data Link 1
TDL2	Transmit Data Link 2

TDL3	External Transmit Data Link
TDM	Time Division Multiplexed
TSB	Transmit System Bus
TSBI	Transmit System Bus Interface
TJAT	Transmit Jitter Attenuator
TLIU	Transmit Line Interface Unit
TLOS	Transmit Loss of Signal
TSB	Transmit System Bus
TSIC	Time Slot Inter-Change
TSIG	Transmit Signaling Buffer
TSLIP	Transmit Slip Buffer
TZCS	AMI/HDB3/B8ZS Line Encoder
UI	Unit Interval
UMC	Unassigned Mux Code
UNICODE	Universal Trunk Out Of Service Code
UTP	Unshielded Twisted Pair
VCO	Voltage Controlled Oscillator
VCXO	Voltage Controlled Crystal Oscillator
VGA	Variable Gain Amplifier
XMTR	Digital Transmitter
YEL	Yellow Alarm
ZCS	Zero Code Suppression

BTMC-530:

HD26(MALE)	PIN#	<->	PIN# DB25(MALE)
TD(A)	2	<->	2
TD(B)	11	<->	14
RD(A)	3	<->	3
RD(B)	21	<->	16
RTS(A)	4	<->	4
RTS(B)	13	<->	19
CTS(A)	5	<->	5
CTS(B)	14	<->	13
DSR(A)	6	<->	6
DSR(B)	22	<->	22
DTR(A)	20	<->	20
DTR(B)	12	<->	23
DCD(A)	8	<->	8
DCD(B)	26	<->	10
TC(A)	15	<->	15
TC(B)	23	<->	12
RC(A)	17	<->	17
RC(B)	25	<->	9
XTC(A)	24	<->	24
XTC(B)	16	<->	11
XRC(A)	9	<->	21
XRC(B)	18	<->	18
GND	7	<->	7
FGND	1	<->	1

Note: The (A)(B) of the same name must be a twisted pair

BTMC-449:

HD26(MALE)	PIN#	<->	PIN#	DB36(MALE)
TD(A)	2	<->	4	SD(A)
TD(B)	11	<->	22	SD(B)
RD(A)	3	<->	6	RD(A)
RD(B)	21	<->	24	RD(B)
RTS(A)	4	<->	7	RS(A)
RTS(B)	13	<->	25	RS(B)
CTS(A)	5	<->	9	CS(A)
CTS(B)	14	<->	27	CS(B)
DSR(A)	6	<->	11	DM(A)
DSR(B)	22	<->	29	DM(B)
DTR(A)	20	<->	12	TR(A)
DTR(B)	12	<->	30	TR(B)
DCD(A)	8	<->	13	RR(A)
DCD(B)	26	<->	31	RR(B)
TC(A)	15	<->	5	ST(A)
TC(B)	23	<->	23	ST(B)
RC(A)	17	<->	8	RT(A)
RC(B)	25	<->	26	RT(B)
XTC(A)	24	<->	17	TT(A)
XTC(B)	16	<->	35	TT(B)
XRC(A)	9	<->	14	RL
XRC(B)	18	<->	10	LL
GND	7	<->	19,37,20,	SG,SC,RC
FGND	1	<->	1	

Note: The (A)(B) of the same name must be a twisted pair.

BTMC-V35:

HD26(MALE)	PIN#	<->	PIN# MB34(MALE)
TD(A)	2	<->	P
TD(B)	11	<->	S
RD(A)	3	<->	R
RD(B)	21	<->	T
RTS(A)	4	<->	C
CTS(A)	5	<->	D
DSR(A)	6	<->	E
DTR(A)	20	<->	H
DCD(A)	8	<->	F
TC(A)	15	<->	Y
TC(B)	23	<->	AA
RC(A)	17	<->	V
RC(B)	25	<->	X
XTC(A)	24	<->	U
XTC(B)	16	<->	W
XRC(A)	9	<->	Z
XRC(B)	18	<->	BB
GND	7	<->	B
FGND	1	<->	A

Note: The (A)(B) of the same name must be a twisted pair

BTMC-X21:

HD26(MALE)	PIN#	<->	PIN#	DB15(MALE)
TD(A)	2	<->	2	T(A)
TD(B)	11	<->	9	T(B)
RD(A)	3	<->	4	R(A)
RD(B)	21	<->	11	R(B)
RTS(A)	4	<->	3	C(A)
RTS(B)	13	<->	10	C(B)
DCD(A)	8	<->	5	I(A)
DCD(B)	26	<->	12	I(B)
RC(A)	17	<->	6	S(A)
RC(B)	25	<->	13	S(B)
XTC(A)	24	<->	7	
XTC(B)	16	<->	14	
GND	7	<->	8	Ground
FGND	1	<->	1	Shield

Note: The (A)(B) of the same name must be a twisted pair.

NOTES: