HCT Series
Protocol Analyzers

HCT-6000
HCT-6000A
User Guide

CTC UNION TECHNOLOGIES CO., LTD

CTC UNION TECHNOLOGIES CO., LTD.
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WARNING:

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to be within the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference including but not limited to:

- Reorientation or relocation of receiving antenna.
- Moving of equipment away from the receiver.
- Plugging of equipment into an outlet and circuit different from that which powers the receiver.

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1.0 *HCT-6000* INTRODUCTION

The contents of this operation manual have been prepared and arranged to provide a complete understanding of the functions and operation of the ***HCT-6000*** and ***HCT-6000A*** models, which throughout this document shall be referred to as only the ***HCT-6000***. It is assumed that the user is familiar with contemporary communication technology. This understanding should include terminals and communication devices as well as their settings and use of industry standard protocols. For details regarding generic standards, please refer to publications that include the standards from such organizations as the International Telecommunication Union (ITU) (formerly known as Consultative Committee for International Telegraph and Telephone (CCITT)), the Institute of Electrical and Electronics Engineers (IEEE), the Electronics Industry Association (EIA), and the International Standards Organization (ISO).

The ***HCT-6000***, notebook sized communications tester, is a WAN (Wide Area Network) protocol analyzer and BERT (Bit Error Rate Test) tester that provides ASYNC, SYNC(BSC), HDLC, SDLC, X.25, DDCMP, and FRAME RELAY (optional TCP/IP, SLIP, and PPP) protocol communications. The analyzer is suitable for equipment installations, on-line or off-line diagnostics, debugging, line testing, and interface development. The ***HCT-6000*** provides functions for both monitoring and simulating a working model. The ***HCT-6000*** features microprocessor based circuitry, a large backlit LCD display, internal rechargeable batteries, and a user friendly, easy to follow menu system, in a portable, self contained, light weight unit.

1.1 GENERAL FUNCTIONAL SPECIFICATIONS

1.1.1 PROTOCOL ANALYSIS

The ***HCT-6000*** is capable of performing protocol analysis for ASYNC, SYNC, HDLC, SDLC(NRZI), SDLC, DDCMP, X.25 (Frame and Packet), and FRAME RELAY, as well as options for testing TCP/IP, SLIP, PPP, and detailed testing of FRAME RELAY.

1.1.2 AUTO CONFIGURATION

The ***HCT-6000*** provides the ability to analyze line data to automatically detect and set communication protocol type, data RATE, data CODE, data FORMAT, parity and synchronous PATTERN.

1.1.3 BERT/BLERT : Bit/block Error Rate Test

a. Transmit/ Receive Patterns :
   Includes Mark, Space, ALT, FOX, 63, 511, 2047. The 2Mbps BERT also includes 2^{15}-1, 2^{20}-1, 2^{23}-1, and QRSS.
b. Data Block Size :
   Under CCITT specifications, 63, 511, 1000, 2047 bits.
c. Error Rate Test :
   Contains a bit COUNTER, bit ERROR numbers, a block COUNTER, block ERROR numbers, error SECONDS, forced ERRORS, and bit error rate as a calculation of TOTAL NO. OF RECEIVED ERROR BITS ÷ TOTAL NO. OF RECEIVED BITS.

1.1.4 INTERNAL TIMERS & COUNTERS

The ***HCT-6000*** contains five registers for Timers (in milliseconds) and five registers for Counters (in units) for program start/stop.

1.1.5 HARD COPY PRINT

A standard CENTRONICS INTERFACE with Female DSUB-25 connector is provided for printing CAPTURED data, PROGRAMMING, SETUP configuration information, and BERT results.

1.1.6 TERMINAL EMULATION

The ***HCT-6000*** provides a complete setup of all communication parameters, Baud rate, data bits, stop bits, parity bit, etc., including Half duplex (local echo) and Full Duplex (remote echo) modes and in either DCE (data communication equipment, such as modems) or DTE (data terminal equipment, terminals) configurations.

1.1.7 STATUS LED's

Red LED's function to show external power attachment, battery low condition, type of interface selected, DCE or DTE emulation, and the availability of power to the external interface. Dual color green and red LED's display, in real-time, the status of all signal lines of the interface port whenever the ***HCT-6000*** is powered on.

1.1.8 DATA LINE MONITOR

Simulation : DCE or DTE, Data and Status, Frame and Packet. Record data in real-time into capture memory.

Monitor : DTE only, DCE only, or DTE/DCE at the same time.

Protocols : SDLC, SDLC(NRZI), HDLC, SYNC(BSC), ASYNC, DDCMP, X.25, FRAME RELAY.

1.1.9 POWER SUPPLY

a. Rechargeable Nickel-Cadmium battery for main system.
b. Ni-Cad (or Ni-MH) battery backup for memory.
c. AC adapter included (500mA, 9Vdc) and Car (cigarette lighter) charger available.
d. Operation time : up to 1 hour on battery.
e. Data retention : more than 1 month of non-operation.

1.1.10 BASIC INTERFACES

COMMUNICATION : V.24/RS232, V.35, or RS-449. (switch selectable)
note: G.703 available with optional external adapter and set to RS-449 mode.
PRINTING : CENTRONICS Parallel port.
REMOTE : Serial port used for remote control.

1.1.11 SUPPORTED INTERFACE STANDARDS

V.35 to G.703, RS-449 to G.703, RS422, X.20/X.21, RS485, RS449, RS-530, RS232, CURRENT LOOP.
TTL interface.

1.1.12 DATA BITS

ASYNC	5,6,7,8 bits.
SYNC	6,8 bits.
HDLC/SDLC	8 bits.
X.25	8 bits.
DDCMP	8 bits.
FRAME RELAY	8 bits.
PPP/SLIP	8 bits.

1.1.13 BCC / Error Checking

ASYNC	LRC, CRC-16, NONE.
SYNC	CRC-16, LRC, CRC-CCITT, NONE.
HDLC	CRC-CCITT
SDLC	CRC-CCITT
X.25	CRC-CCITT
Frame Relay	CRC-CCITT

1.1.14 DATA CODES

ASCII, EBCDIC, HEX, IPARS, TRANSCODE, EBCD.

1.1.15 SUPPORTED BAUD RATES

ASYNC : 50, 75, 110, 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3200, 3600, 4800, 7200, 9600, 12k, 14.4k, 16k, 19.2k, 28.8k, 38.4k, 48k, 57.6k, 64k, 72k, 115.2k, 128kbps.

SYNC : 150, 200, 300, 600, 1200, 1800, 2000, 2400, 3200, 3600, 4800, 7200, 9600, 12k, 14.4k, 16k, 19.2k, 28.8k, 38.4k, 48k, 57.6k, 64k, 72k, 115.2k, 128kbps.

1.1.16 PARITY BIT

NONE, ODD, EVEN.

1.1.17 STOP BIT

1, 1.5, or 2.

1.1.18 TX CLOCK

SYNC DTE or DCE.

1.1.19 Xon/Xoff

ASYNC,SYNC Enable or Disable.

1.1.20 Flow Control

ASYNC,SYNC Disable or CTS ON.

1.1.21 Print Interval

ASYNC,SYNC Disable, 5,10,15,30, or 60 minutes.

1.1.22 Print On Error

ASYNC,SYNC Disable or Enable.

1.1.23 Test Duration

10e3 to 10e8 bits, 1 to 60 minutes, or continuous

1.1.24 Tx Bit Count

0 to 999999999, 1.0e9 to 9.9999e12

1.1.25 Rx Bit Count

0 to 999999999, 1.0e9 to 9.9999e12

1.1.26 Tx Block Count

0 to 999999999, 1.0e9 to 9.9999e11

1.1.27 Rx Block Count

0 to 999999999, 1.0e9 to 9.9999e11

1.1.28 Rx Bit Error Count

0 to 999999999, 1.0e9 to 9.9999e12

1.1.29 Rx Block Error Count

0 to 999999999, 1.0e9 to 9.9999e11

1.1.30 Rx Bit Error Rate

0 to 1.0e-13

1.1.31 Error Seconds

0 to 99999999

1.1.32 Forced Error Bit Count

0 to 999999

1.2 2M BERT SPECIFICATIONS

1.2.0 128K BERT vs. 2M BERT

Under 2M BERT mode (not available in the ***HCT-6000A***), the ***HCT-6000*** includes additional features and functions beyond those of 128K BERT mode. The following will note those specific differences.

1.2.1 Test Patterns

The transmit patterns under 2M BERT include 63/127/511/2047, MARK (all 1's), SPACE (all 0's), ALT(0101), 2e15-1, 2e20-1, 2e23-1, and QRSS. In SYNC mode only.

1.2.2 Test Speeds

The speeds available under 2M BERT are 48k, N64 values of 64k, 128k, 192k, 256k, 320k, 384k, 448k, 512k, 576k, 640k, 704k, 768k, 832k, 896k, 960k, 1024k, 1088k, 1152k, 1216k, 1280k, 1344k, 1408k, 1472k, 1536k, 1544k, 1600k, 1664k, 1728k, 1792k, 1856k, 1920k, 1984k, 2048k, plus N56 values of 56k, 112k, 168k, 224k, 280k, 336k, 392k, 448k, 504k, 560k, 616k, 672k, 728k, 784k, 840k, 896k, 952k, 1008k, 1064k, 1120k, 1176k, 1232k, 1288k, 1344k, 1400k, 1456k, 1512k, 1568k, 1624k, 1680k, 1736k, and 1792kbps.

1.2.3 Tx Clock

The Tx Clock may be set to internal or external. The polarity may also be inverted. (refer to table below)

1.2.4 Rx Clock

The Rx Clock may be set to DPLL (digital phase-locked loop) or external. The polarity of the external clock may also be inverted. (refer to table)

MODE	Clock Source Selection		TX	RX	TX Clock Source	RX Clock Source
DTE	TX Clock	Internal	TD		XTC(internal)	
		External	TD		TC	
	RX Clock	DPLL		RD		from RD
		External		RD		RC
DCE	TX Clock	Internal	RD		TC or RC(internal)	
		External	RD		XTC	
	RX Clock	DPLL		TD		from TD
		External		TD		XTC

Figure 1-1 : **2M BERT Clock Selection Table**

1.2.5 Tx Error Rate

The ***HCT-6000*** has the ability to inject bit errors randomly at a predefined rate. The Tx Error rate may be set to single, 10e-1, 10e-2, 10e-3, 10e-4, 10e-5, 10e-6, or 10e-7. When running BERT, the error injection may be toggled on or off by using function key F4. When set to "Single", errors are injected only manually (Forced Errors).

1.3 EXTERIOR and ACCESSORIES

1.3.1 CHASSIS FIGURE

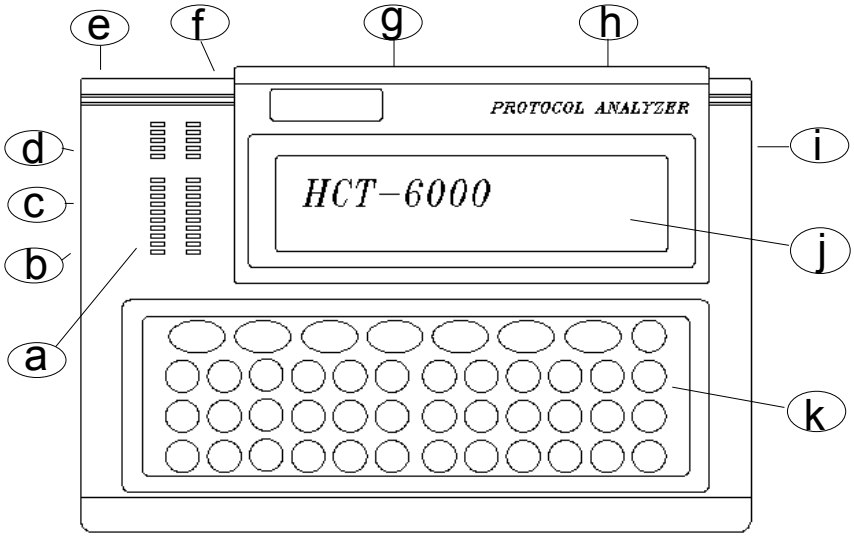

Figure 1-2 : **CHASSIS** (top view.)

a. **Status LED's**
The LED's give a quick indication of the high or low state for the data and handshaking lines. A red LED indicates a space or digital zero, a green LED indicates a mark or digital one, and an unlit LED indicates an open or unknown state. Flashing or flickering LED's show voltage transitions on handshaking lines or data transmissions on the transmit / receive lines.

HCT-6000 LED indicators

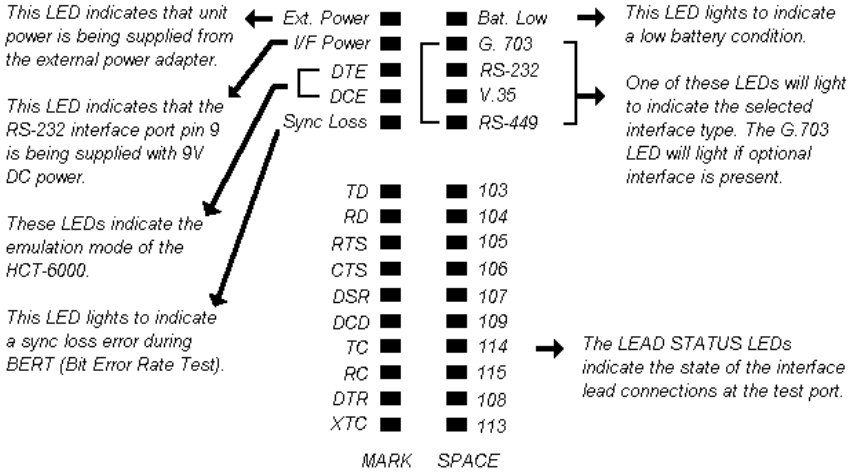

Figure 1-3 : **LED Indicators**

b. **POWER Switch**

This slide switch turns on and off power to the unit from the internal batteries or external DC power adapter.

c. **Backlight switch**

This slide switch turns the LCD backlight on and off. The backlight function provides the ability to view the LCD in low ambient light conditions.

d. **Interface Selector**

This three position slide switch selects the type of interface, RS-232, V.35, or RS-449, seen at the test port. The selected interface type is indicated on the LED display.

e. **DC 9V In**
This connector attaches the external power to the unit.

f. **DB25 Test Port**
This 25 pin male connector is the communications port for all testing and emulation. The interface type is selected by the INTERFACE SELECTOR switch and indicated on the LED display. Adapter cables are provided for attaching the ***HCT-6000*** to the appropriate interface type. This serial port also provides two way communication with a PC, when used in conjunction with the PC software and interconnecting cable, for uploading and downloading configuration data, capture memory, and program data

g. **DB9 Remote Control Port**
This 9 pin male connector is the serial port for remote control functions from a terminal or PC.

h. **DB25 Printer Port**
This 25 pin female connector provides a CENTRONICS compatible interface for hard copy printing.

i. **Contrast Control**
This thumb wheel control provides a variable adjustment of the contrast for the LCD display.

j. **Display**

A 5.5" x 1.5" (140x40mm) LIQUID CRYSTAL DISPLAY (LCD) graphics array is incorporated for displaying all operational menus, data/messages and DCE and DTE real time communications. Text is displayed on a total of eight (8) lines with up to thirty-two (32) characters per line.

k. **Keyboard**

The ***HCT-6000***'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.

l. **Bottom Panel Access**

The ***HCT-6000*** has a removable bottom access panel. First, make sure the external power is disconnected from the ***HCT-6000***. Also, be sure the power switch for the unit is in the **OFF** position. On the bottom of the unit you will note one (1) Philips head screw, locking the removable cover. Remove this screw and panel to gain access to the rechargeable battery and the firmware EPROM.

To facilitate updates or additional options (such as TCP/IP, SLIP, PPP protocols) the EPROM is mounted on a "TEXT-TOOL" socket. Before removing the EPROM, take note of its orientation. (The half-moon groove in the EPROM faces the set screw.) The set screw only needs to be turned 90 degrees counter-clockwise with a thin, flat blade screwdriver to release the IC. Lift the IC straight up, taking care not to bend any of the legs. Check the new IC's legs to be sure they are straight before proceeding. Place the new IC in the socket and tighten the set screw by turning clockwise. **DO NOT OVERTIGHTEN!** Replace the panel cover and locking screw.

1.3.2 STANDARD ACCESSORIES

a. **Voltage Adapter / Charger** : 120VAC/60Hz input, DC 9V 500mA output, UL/CSA, CE approved (220-240VAC input adapters available upon request.)

b. **Cables**

1. Extension cable (H6-Ext)(H6-530)
   25 conductor Round, 1 to 1, 2 ft. (100cm)
   DSUB-25(Female) <--- TO ---> DSUB-25(Male)
2. Gender Changer
   DSUB25(Male) <--- TO ---> DSUB25(Male)
3. Communications cable RS232(H6-232D)
   Multiple conductor Round, 2 ft. (100cm)
   DSUB-25(Female) <---TO---> DSUB-25(Female)
4. V.35 cable (H6-V35)
   Multiple conductor Round Cable, 2 ft (100cm)
   DSUB-25(Female)<--TO--->M-34 BLOCK(Male)
5. Printer cable (H6-PRN)
   Multiple conductor Round Cable, 5 ft (150cm)
   DSUB-25(Male)<--TO-->C-36(Centronics)(Male)
6. Remote cable (H6-RM/PC)
   Multiple conductor Round Cable, 4 ft. (120cm)
   DSUB-9(Female) <--- TO ---> DSUB-25(Female)
7. Parallel cable (H6-PARA)
   Multiple conductor Round Cable, 4 ft. (120cm)
   DSUB-25(Male) <--- TO ---> DSUB-25(Male)

c. **Y-stub cable connector box.**
   [2 x DSUB-25(Male) + 2 x DSUB-25(Female)]
   [all internally wired one-to-one]

d. **Operation Manual.**

e. **Nylon hand carry bag.**

f. **Software diskette** (3.5").

1.3.3 OPTIONAL CABLE ACCESSORIES

1. RS-449 cables (H6-449)
   Multiple conductor Round Cable, 2 ft. (100cm)
   DSUB-25(Female)<--- TO --->DSUB-37(Male)
   DSUB-25(Female)<--- TO --->DSUB-37(Female)

2. X.21 cables (H6-X21) or X.21 cable BOX
   Multiple conductor Round Cable, 2 ft. (100cm)
   DSUB-25(Female)<--- TO --->DSUB-15(Male)
   DSUB-25(Female)<--- TO --->DSUB-15(Female)

Note: Set I/F Select switch on the ***HCT-6000*** to RS-449 position when using X.21 cable or optional X.21 cable BOX (See Appendix B).

3. G.703 cable set
   BNC Cable / E1
   Bantam Cable / T1
   RJ-45 (UTP) Cable

1.3.4 OPTIONAL G.703 INTERFACE

The G.703 FE1 or FT1 Access Units are optional external interfaces which connect to the ***HCT-6000's*** communication port via the extension cable. **The interface select switch should be set to the RS-449 position**. When the G.703 interface is attached, the ***HCT-6000*** will sense its presence and the G.703 indicator LED will light on the ***HCT-6000*** panel. The G.703 I/F provides both BNC and RJ-45 connections. For a complete description and operating instructions, please refer to the documentation that comes with the optional interface.

1.4 COMMUNICATION INTERFACE PORTS

1.4.1 DEFINITION

The ***HCT-6000*** provides a slide switch to select a V.24/RS232, V.35 or RS-449 communications port.

When viewing the unit from behind, pin one(1) of the communications connector is located in the upper-left hand position of the M/DB25 connector.

1.4.2 HCT-6000 PORT PIN ASSIGNMENT

a. **V.24/RS-232 INTERFACE PIN ASSIGNMENT**

PIN	CIRCUIT	FUNCTION	DTE ⇐ ⇒ DCE	EIA
1	FGND	Protective gnd		AA
2	TD	Transmit data	⇒	BA
3	RD	Receive data	⇐	BB
4	RTS	Request to send	⇒	CA
5	CTS	Clear to send	⇐	CB
6	DSR	Data set ready	⇐	CC
7	GND	Signal ground		AB
8	DCD	Carrier detect	⇐	CF
9	+9V	+9V output		
15	TC	Transmit clock	⇐	DB
17	RC	Receive clock	⇐	DD
20	DTR	Data term ready	⇒	CD
24	XTC	DTE xmit clock	⇒	DA

Figure 1-4 : **RS232,** unit pin assignment

b. **V.35 INTERFACE PIN ASSIGNMENT**

PIN	CIRCUIT	FUNCTION	DTE ⇔ DCE	CCITT
1	FGND	Protective gnd		101
2	TD(A)	Xmit data A	⇒	103
3	RD(A)	Receive data A	⇐	104
4	RTS	Request to send	⇒	105
5	CTS	Clear to send	⇐	106
6	DSR	Data set ready	⇐	107
7	GND	Signal ground		102
8	DCD	Data carrier detect	⇐	109
9	RC(B)	Receive clock B	⇐	115
11	XTC(B)	DTE Xmit clock B	⇒	113
12	TC(B)	Xmit clock B	⇐	114
14	TD(B)	Xmit data B	⇒	103
15	TC(A)	Xmit clock A	⇐	114
16	RD(B)	Receive data B	⇐	104
17	RC(A)	Receive clock A	⇐	115
20	DTR	Data terminal ready	⇒	108
24	XTC(A)	DTE Xmit clock A	⇒	113

Figure 1-5 : **V.35** unit pin assignment

c. **RS-449/RS-530 INTERFACE PIN ASSIGNMENT**

PIN	CIRCUIT	FUNCTION	DTE⇔DCE	CCITT
1	FGND	Protective gnd		101
2	SD(A)	Xmit data A	⇒	103
3	RD(A)	Receive data A	⇐	104
4	RS(A)	Request to send A	⇒	105
5	CS(A)	Clear to send A	⇐	106
6	DM(A)	Data set ready A	⇐	107
7	GND	Signal ground		102
8	RR(A)	Data carrier detect A	⇐	109
9	RT(B)	Receive clock B	⇐	115
10	RR(B)	Data carrier detect B	⇐	109
11	TT(B)	DTE Xmit clock B	⇒	113
12	ST(B)	Xmit data B	⇐	114
13	CS(B)	Clear to send B	⇐	106
14	SD(B)	Xmit data B	⇒	103
15	ST(A)	Xmit clock A	⇐	114
16	RD(B)	Receive data B	⇐	104
17	RT(A)	Receive clock A	⇐	115
19	RS(B)	Request to send B	⇒	105
20	TR(A)	Data terminal ready A	⇒	108
22	DM(B)	Data set ready B	⇐	107
23	TR(B)	Data terminal ready B	⇒	108
24	TT(A)	DTE Xmit clock A	⇒	113

Figure 1-6 : **RS-449/RS-530** unit pin assignment

d. **X.21 INTERFACE PIN ASSIGNMENT**

PIN	CIRCUIT	FUNCTION	DTE ⇔ DCE	CCITT
1	FGND	Protective gnd		101
2	T(A)	Xmit data A	⇒	103
3	R(A)	Receive data A	⇐	104
4	C(A)	Request to send A	⇒	105
7	GND	Signal ground		102
8	I(A)	Data carrier detect A	⇐	109
9	S(B)	Receive clock B	⇐	115
10	I(B)	Data carrier detect B	⇒	109
14	T(B)	Xmit data B	⇒	103
16	R(B)	Receive data B	⇐	104
17	S(A)	Receive clock A	⇐	115
19	C(B)	Request to send B	⇒	105

Figure 1-7 : **X.21** unit pin assignment

c. **PRINTER PORT PIN ASSIGNMENT**

Pin	Signal	Description
1	/STROBE	/STROBE pulse sent with data out.
2 3 4 5 6 7 8 9	DATA 1 DATA 2 DATA 3 DATA 4 DATA 5 DATA 6 DATA 7 DATA 8	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.
10	/ACK	An 8μs pulse on this line indicates that the printer received a data byte and it can receive another.
11	BUSY	A HIGH signal received indicates that the printer is busy because: 1) Buffer is full 2) Printer is initializing 3) Printer is deselected 4) During printer fault
12	PE	This line goes high when paper empty.
13	SLCT	This signal received from printer goes high when printer is selected (or low when deselected).
14	/AUTO FEED	When this line is low, the printer performs an automatic line feed after each line.
15	/FAULT	This line goes low when the printer is out of paper, deselected, or in a fault state.
16	/INIT	A low on this line initializes the printer.
17	/SLCTIN	This line is fixed low, so the printer overrides DC3 (deselect) codes.
18-25	GND	

Figure 1-8 : **PRINTER PORT** pin assignment

2.0 KEYBOARD OVERVIEW

2.0.1 : INTRODUCTION

The ***HCT-6000***'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 ***HCT-6000*** 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.

2.0.2 : KEYBOARD FIGURE

Figure 2-1 : **KEYBOARD**

2.1 KEY FUNCTIONS

2.1.1 : MENU FUNCTION KEYS.

F1 **---- Configuration Setup**

Setup parameters such as Baud Rate, Parity bit, Stop, etc.

F2 **---- Monitor**

Programmable monitor functions.

F3 **---- Emulate**

Programmable emulation functions.

F4 **---- Examine Data**

On screen examination of captured data, file data, and Timer/Counter.

F5 **---- 128K BERT (Bit Error Rate Test)**

Useful for checking transmission line quality.

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Selects the second menu set of functions.

F1 **---- 2M BERT**

Supports up to 2048kbps BERT.

F2 **---- Async Terminal**

Emulates an Asynchronous terminal.

F3 **---- Configure Scan**

When connected to an ASYNC communication line, the scan can automatically configure the communication PROTOCOL, BAUD RATE, DATA BIT, PARITY, and STOP BIT, and then transmit the information onto the line.

F4 **---- File Manager**

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.

F5 **---- System Reset**

Used to restore all internal settings to the factory defaults and clear all data files.

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Selects the third menu set of functions.

F1 **---- Self Test**

Calls up the menu for testing the *HCT-6000* unit.

F2 **---- Miscellaneous**

Includes setups for external interface power, key sound, printer, and clock.

F3 **---- Up/Down Load to PC**

Selects the upload or download function when connected to a PC.

F4 **---- Diagnostic**

Provides a means to test the V.24, V.35, and RS-449 interface drivers and receivers.

F5 **---- Online Monitor (DOS)**

Enters monitor mode, executes programmable monitor functions and transfers the captured data to MS-DOS application, HCT-PC/Online Monitor.

MORE **Next Page**

Selects the fourth menu set of functions.

F1**---- Online Monitor (WIN)**

Enters monitor mode, executes programmable monitor functions and transfers the captured data to Windows application, HCT-PC/Online Monitor.

F2 **---- Review BERT Result**

Reviews 128K BERT or 2M BERT testing result.

MORE **Next Page**

Returns to the first menu set of functions.

2.1.2: 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

2.1.3: 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).

2.1.4: CURSOR KEYS DETAILS

Maneuvering through the ***HCT-6000's*** sub-windows is accomplished through the use of the blue cursor movement keys. Please follow the next example which demonstrates both cursor and sub-window functions.

Power on the ***HCT-6000*** and press any key to erase the power on logo and display the first menu. Press the "***MORE***" key to display the second function menu and then press ***F2*** to select Async Terminal.

When the TERMINAL SETUP screen is displayed, press the "**DOWN**" arrow key repeatedly. Note that when you reach the bottom, the screen will scroll up to display additional parameters. Press the "**UP**" arrow key repeatedly until it reaches the top parameter and then press the "**DOWN**" arrow key to the SPEED parameter. To select from the available parameter settings, press the right arrow key. The sub-window will appear with a selection list. The current setting will be shown in reverse text.

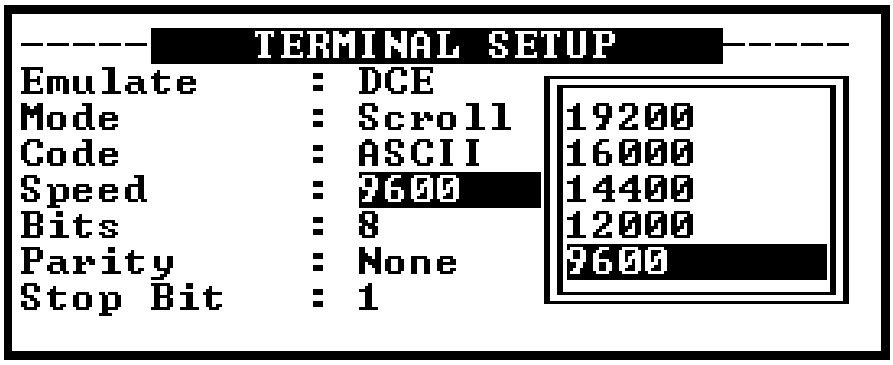

Figure 2-2 : **SUB-WINDOW**

You may press "***ESC***" at any time to exit the sub-window however, whatever setting has been hi-lighted will become the new setting. To change the setting, use the up/down arrow keys to browse the available settings and press "***ENTER***" or "***ESC***" to make the change. Note: the "***PgUp/PgDn***", "***HOME***", and "***END***" keys have no function in the sub-window and are used when viewing captured data.

The conventions for keyboard operation using the sub-window are the same through out every menu in the ***HCT-6000***.

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3.0 INTRODUCTION and INITIAL POWER ON

3.0.1 Introduction

a. Set the proper communications interface type.
   1. Slide the three position I/F select switch to select either V.24/RS232, V.35, or RS-449.
   2. Attach the appropriate cable to the communications interface port.

b. If AC power is available, connect the AC adapter to the DC power input jack located on the back side of the unit. Plug the AC adapter into a power outlet that provides the proper AC voltage.

c. The unit can be operated from the internal battery if AC power is not readily available. However, ensure that the unit has been connected to the power adapter and that the internal battery has fully charged. (This could take up to six hours.)

3.0.2 Initial Power ON

a. Slide the **POWER** switch to **ON**;

Figure 3-1 : **LOGO SCREEN**

b. Adjust the display contrast with the thumb wheel CONTRAST control, located on the right side of the unit.

c. Press any key and the following will be displayed;

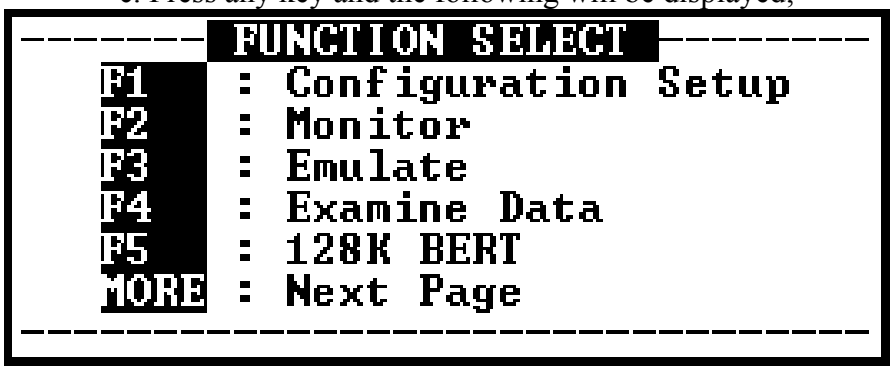


Figure 3-2 : **FIRST MENU DISPLAY**

d. Press the ***MORE*** key to display the second menu of functions;

Figure 3-3 : **SECOND MENU DISPLAY**

e. Press the ***MORE*** key to display the third menu of functions.

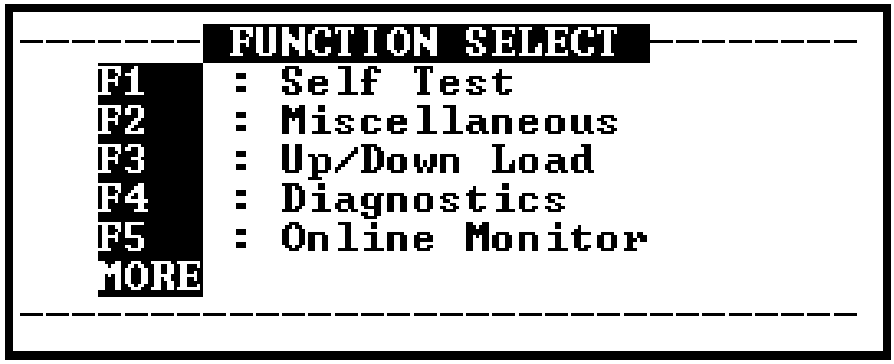


Figure 3-4 : **THIRD MENU DISPLAY**

f. Press ***MORE*** again and display reverts back to the first menu of functions.

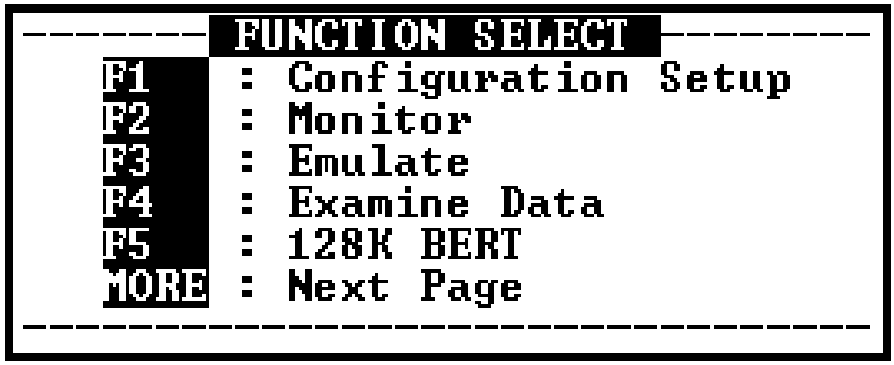


Figure 3-5 : **FIRST MENU DISPLAY (again)**

3.1 CONNECTION EXAMPLES

LINE TESTING

Figure 3-6 : **LINE TESTING**

HIGH SPEED BERT with G.703/T1 PACK

Figure 3-7 : **2M BERT TEST**

BERT with G.703/FE1-A PACK

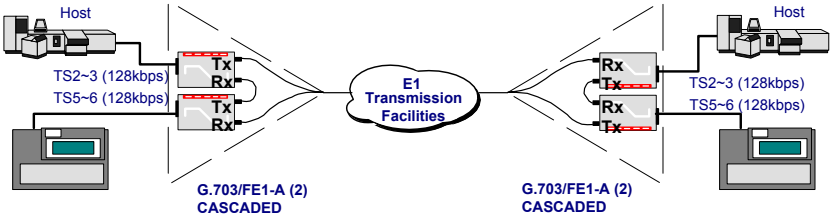


Figure 3-8 : **BERT TEST with Cascaded G.703/FE1-A**

LINK TESTING

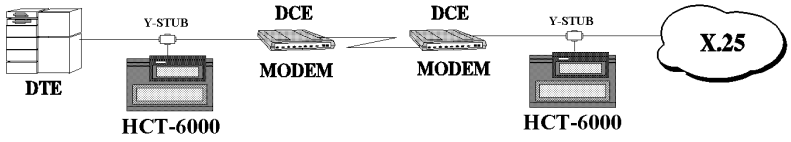


Figure 3-9 : **LINK TESTING**

HCT-6000 AS DTE

Figure 3-10 : ***HCT-6000*** **AS DTE**

HCT-6000 AS DCE

Figure 3-11 : ***HCT-6000*** **AS DCE**

LOOP BACK TEST

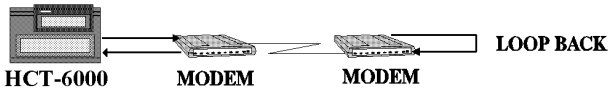


Figure 3-12 : **LOOP BACK TEST**

AUTO DETECTING

Figure 3-13 : **AUTO DETECTING**

AUTO SCANNING

Figure 3-14 : **AUTO SCANNING**

4.0 INTRODUCTION

The ***HCT-6000*** and ***HCT-6000A*** protocol analyzers provide V.24/RS232, RS-449 and V.35 interfaces to communicate with a variety of devices. They can serve as an on-line data collector, analyzer, simulator, monitor, data server for printer, and as an instrument to estimate the quality of communications. The ***HCT-6000*** can automatically check the type of communication under Auto-configuration mode and can be linked to a personal computer. (***HCT-PC*** Software is provided.)

4.0.1 : Normal operation flow chart

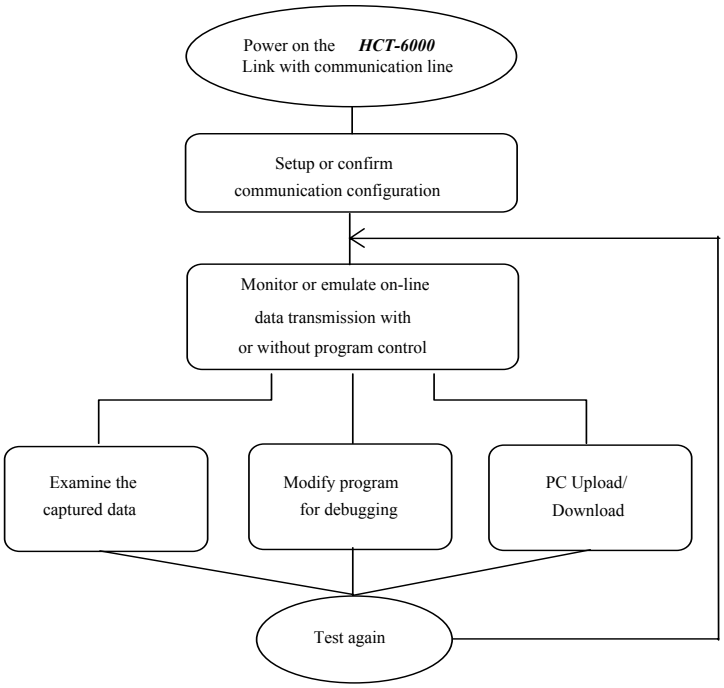


Figure 4-1 : **NORMAL OPERATION FLOW CHART**

4.0.2 : Operational menu chart

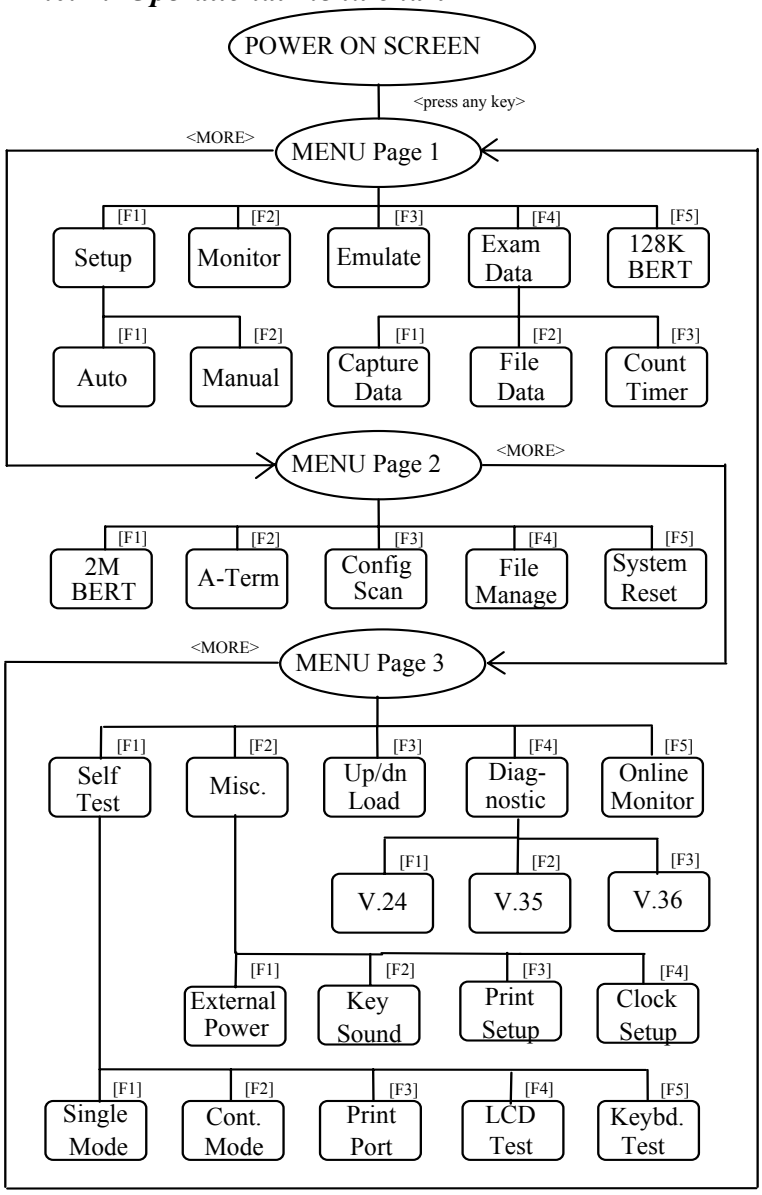


Figure 4-2 : **OPERATIONAL MENU CHART**

4.1 COMMUNICATIONS SETTINGS

4.1.1 : Setup

From the PAGE 1 MENU, press ***F1*** - SETUP. The following screen will appear;

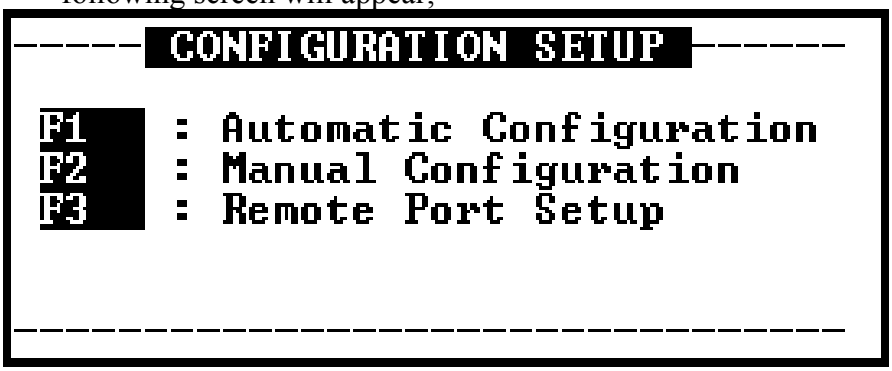


Figure 4-3 : **Configuration Setup Screen**

The ***HCT-6000*** has the ability to automatically configure itself by analyzing incoming data. Use the "Auto Configuration" function to auto scan the communication protocol and parameter settings. Use the "Manual Configuration" function to setup exact parameters. Use the "Remote Port Setup" function to setup the speed of the remote control port.

4.2 AUTO CONFIGURATION

4.2.1 : Connection

First Connect the communication port to a data line and start communication activity.

4.2.2 : Operation

PRESS the " ***F1*** " key and wait a moment. There must be constant data received on the interface. Depending upon the baud rate and code, proper determination of the configuration could take several minutes.

The ***HCT-6000*** will display the parameters on the LCD as in the example in this figure.

Figure 4-4 : **Auto Configuration Screen** (during scan)

4.2.3 : Auto-Configuration requirements

The ***HCT-6000*** requires enough characters in the data flow to completely identify the type of transmission. The minimum requirements are a continuous 10 - 50 character data flow where there is at least one "0 followed by 1 " and a "1 followed by 0" code sequence present. In asynchronous transmissions, there must be at least two "FF" idle characters between data strings. When identifying synchronous transmissions, the TC (transmission clock) and/or ETC (end of transmission character) have to be present to supply the clock. Both data and idle characters must be present. In Bit Orient Protocols (B.O.P), there must be at least one good FCS and the frame size must be less than 255 characters in length.

At this point, if ***RUN*** is pressed on the keyboard, the ***HCT-6000*** will directly enter Monitor Mode Display. Bi-directional data flow will be displayed on the LCD. DTE and DCE data will be displayed on alternate lines.

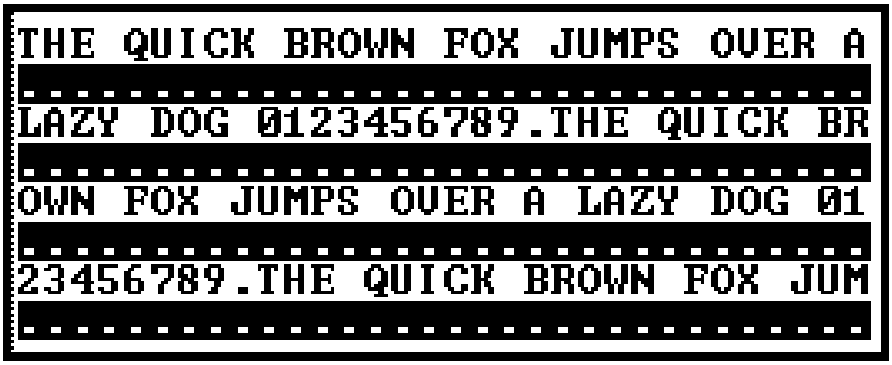


Figure 4-5 : **Monitor Mode Display**

NOTES:

Please note that in the previous figure, DTE is displayed on ODD numbered lines in normal character attributes (black on white) while DCE is displayed on EVEN lines in reverse characters (white on black).

If the criteria for Automatic Configuration cannot be met or if you already know the settings for the communication parameters, press the ***F2*** key from the Configuration Setup menu to perform MANUAL CONFIGURATION.

4.3 MANUAL CONFIGURATION

a. Connect the communication port
b. Press ***F1*** key to reach the Configuration Setup Menu.
c. Press ***F2*** key to perform Manual Configuration.
d: Review the Keyboard instructions in ***Chapter II***, 2.1.4, or follow the example below.

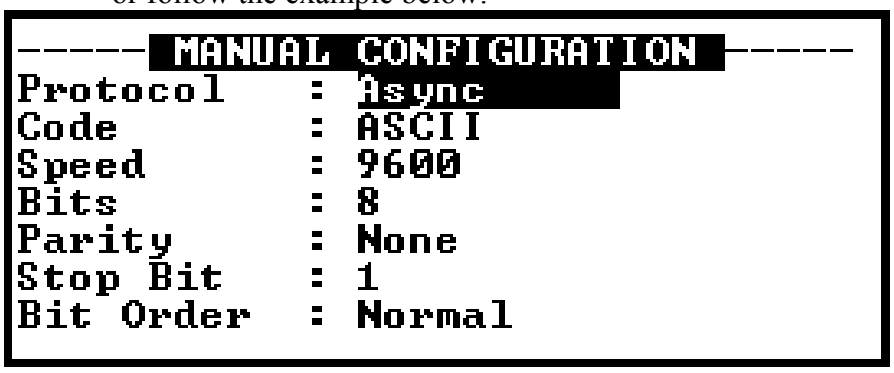


Figure 4-6 : **Manual Configuration Screen**

1. Use the down ⇩ arrow key to see the additional parameter settings.

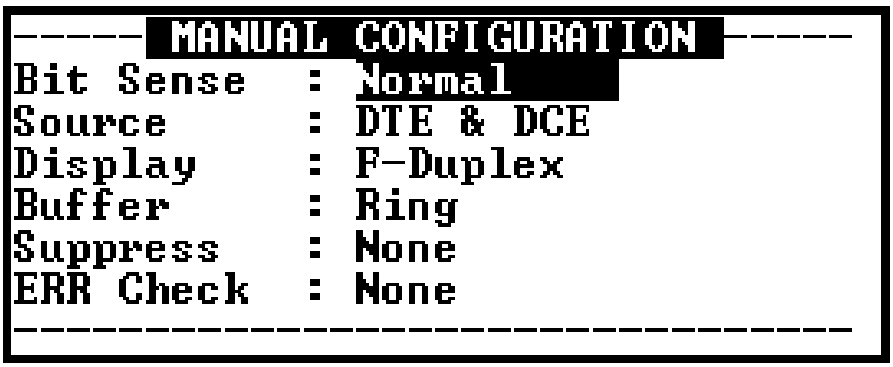


Figure 4-7 : **Manual Configuration Screen**

2. Use the ⇨ arrow key to enter the edit SUB-WINDOW and select the parameter setting.

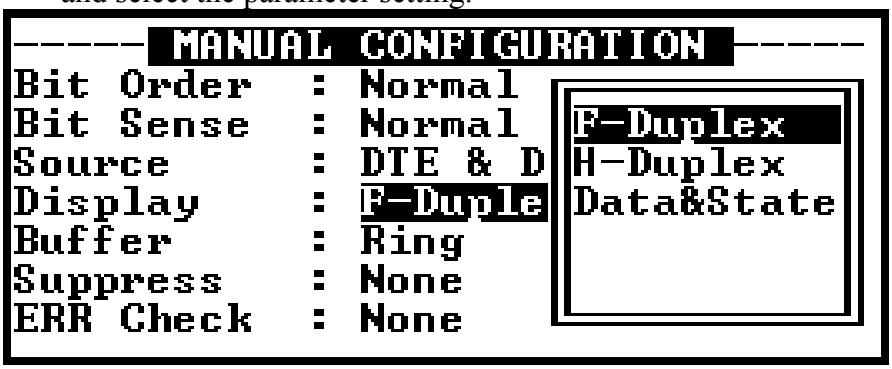


Figure 4-8 : **Editor Sub-Window**

3: Use the ⇧⇩ arrow keys to select from the allowable parameters within the Sub-Window.

4: Finally use the ***ENTER*** key to accept the parameter and exit the Editor Sub-Window.

5. Continue to set the proper parameters for protocol, code, speed, bits, parity, etc.

6. After the communication parameters are set, the ***HCT-6000*** can be placed directly into MONITOR by pressing the ***RUN*** key.

Notes on ***HCT-6000*** Manual Configuration of Tx Clock:

1) The transmitting clock of RD is RC.
2) If the transmitting clock of TD is TC, you must set "Tx Clock:" to DCE.
3) If the transmitting clock of TD is XTC, you must set "Tx Clock :" to DTE.
4) The clock source table is as follows:

Manual Config.	Clock Source					
Tx Clock:	Monitor		Emulate DTE		Emulate DCE	
	TD	RD	TD	RD	TD	RD
DCE	**TC**	**RC**	**TC**	**RC**	**TC=RC***	**TC=RC***
DTE	**XTC**	**RC**	**XTC***	**RC**	**XTC**	**TC=RC***

Figure 4-9 : **Tx Clock Source Table**

*denotes that clock is issued from the ***HCT-6000***

4.4 MONITOR MODE

4.4.1 : Operation

In **MONITOR** mode, the ***HCT-6000*** will receive both DTE and DCE traffic and analyze. The ***HCT-6000*** provides an editor to enter a user written procedure which can execute program steps in **MONITOR** mode for capturing and inspecting data. For detailed information and examples, see ***CHAPTER V***, ***Examples of Application***. Programs are written using a set of commands. A total of 31 procedure blocks (LABEL (n)) can be written with each block consisting of up to 255 procedures.

4.4.2: Monitoring On-line

Enter menu page 1, then PRESS ***F2***

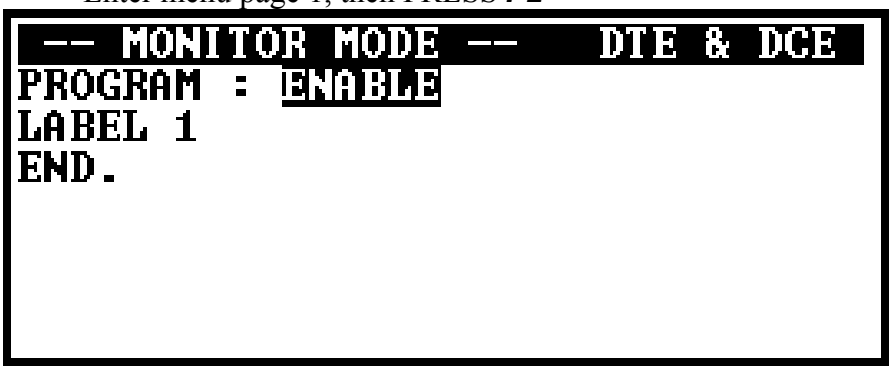


Figure 4-10 : **Monitor Mode Screen**

Monitor Mode supports these data rates :
ASYNC : 50bps to 128kbps.
SYNC/BSC, HDLC, SDLC, X.25, DDCMP, Frame Relay : 150bps to 128kbps.

NOTES :

The monitoring data format and the contents to be displayed can all be adjusted to your requirements by setting the MONITOR Source, Display, and Buffer Type in the Manual Configuration Setup.

Source : DTE, DCE, Both DTE and DCE.
Display :Full Duplex, Half duplex, Data & State, Frame/Packet
Buffer Type : Fixed, Ring
Codes : ASCII, EBCDIC, Hex, IPARS, Transcode, EBCD.

4.4.3: Terminal Emulation

From Menu Page 1 press the ***F3*** - Emulate key. The Emulate screen will be displayed.

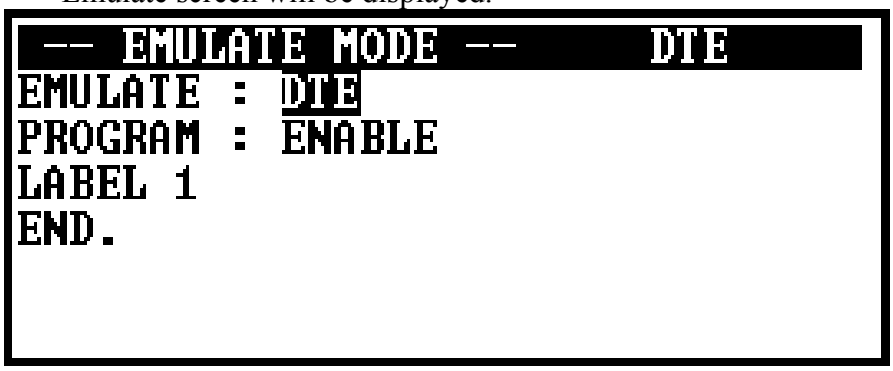


Figure 4-11 : **Emulate Mode display**

When in **EMULATE** mode, the ***HCT-6000*** can emulate a DTE or DCE terminator and analyze both DTE and DCE traffic. For detailed information and examples, see ***CHAPTER V***, ***Examples of Application***. Programs are written using a set of commands. A total of 31 procedure blocks (LABEL (n)) can be written with each block consisting of up to 255 procedures.

The EMULATE and MONITOR functions of the ***HCT-6000*** are two of the most powerful. They are useful in diagnosing many communication problems as well as aiding in debugging new communication devices at both the software and hardware levels. This makes the ***HCT-6000*** an invaluable tool in supporting communication networks and in new product development. Please refer to the examples of application in ***CHAPTER V***.

4.4.4: Captured data

Definition :

During real time monitoring, data is stored into the capture buffer. The data stored in this buffer can then be analyzed and/or printed. In auto-configuration mode, there will be a slight delay from the time of receipt of data and display of data. The ***HCT-6000*** must compare the transmission with internal tables to determine and verify the proper protocol.

In manual-configuration mode, following the pressing of the ***RUN*** key, the ***HCT-6000*** will wait for data, sense it and pass directly to the capture memory and display. The data captured includes the transmitted data (full or half duplex), handshaking lines state, and frame/packet (if applicable).

Please refer to page *IV-4* for instructions on running Auto Configuration mode or page *IV-7* for Manual Configuration mode.

4.4.5 : Examine Captured data

From the PAGE 1 Menu, PRESS ***F4*** Exam data.

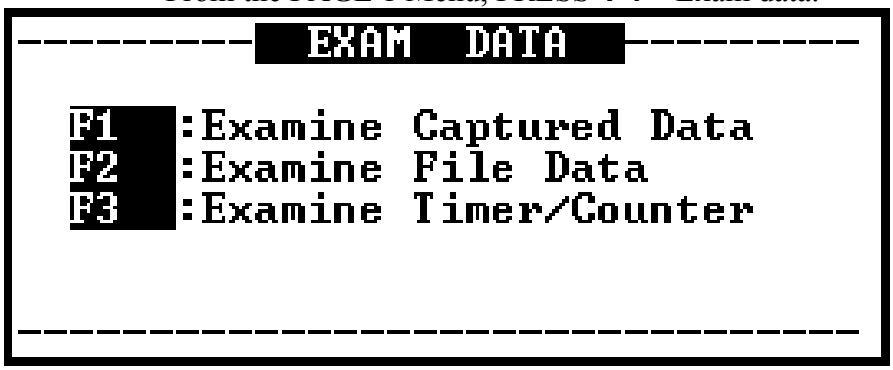


Figure 4-12 : **Examine Data menu**

4.4.5.1. Display Captured Data

Press ***F1*** and the below menu will be displayed on the LCD.

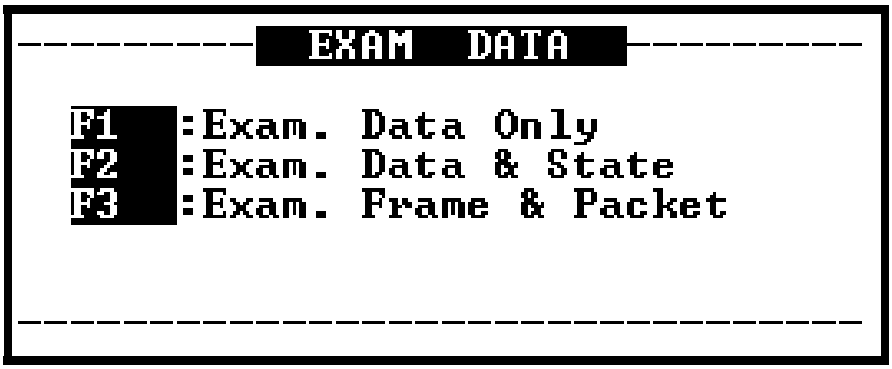


Figure 4-13 : **Choose Display Type**

Press ***F1*** to display the data only. Refer to this figure.

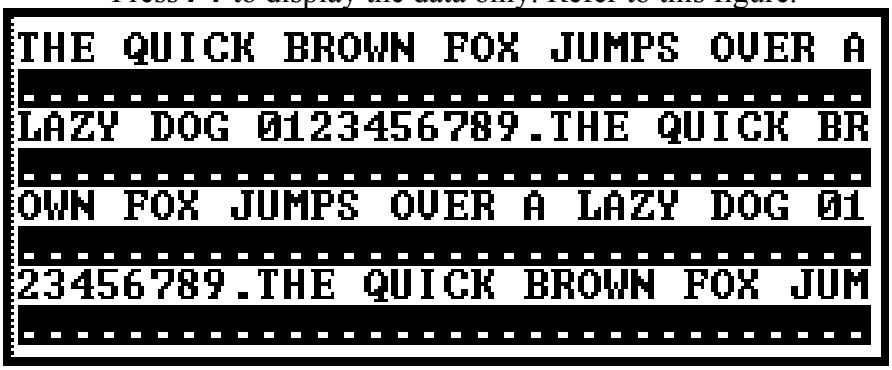


Figure 4-14 : **Data Only Display**

The DTE data is displayed in normal characters (black on white) while DCE data is displayed on alternate rows, in reverse characters (white on black). If the ***HEX*** key is pressed at this point, the data will be displayed in hex format. Pressing ***HEX*** again will revert display back to alphabetical mode.

Press ***F2*** to display data and state. Refer to the next figure.

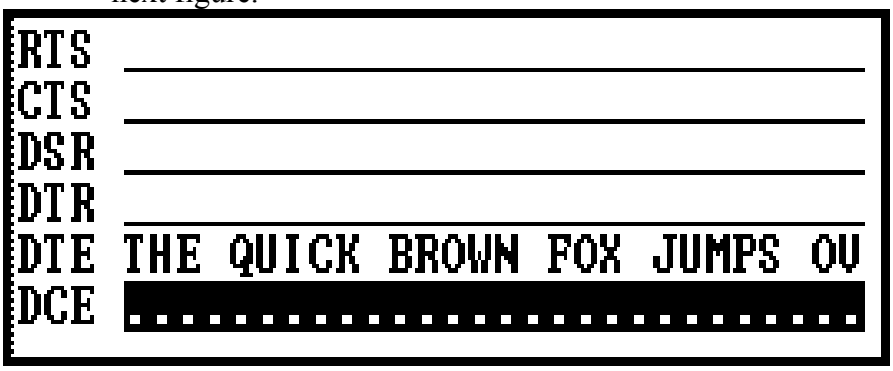


Figure 4-15 : **Data & State Display**

Use the ***PgDn*** and ***PgUp*** keys to browse through the capture buffer. To view selected data types, press the ***MORE*** key. The sub-window will appear allowing selection of the following display options.

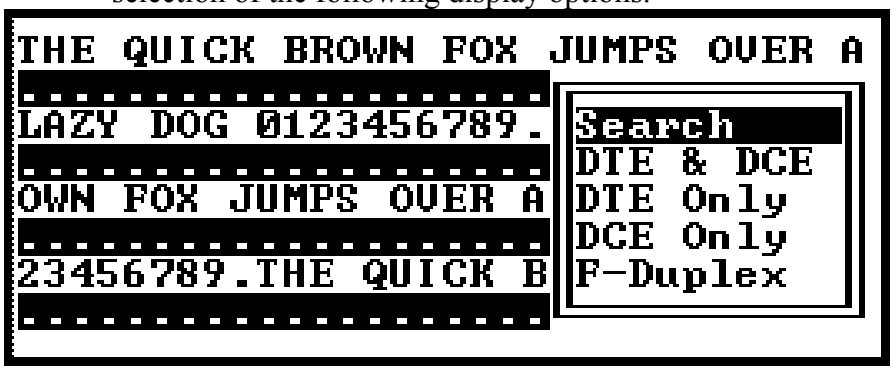


Figure 4-16 : **Data Display Options**

4.4.5.2 Display options

a. DTE & DCE

Data without packet and shown directly on the LCD.

b. FRAME

Displays the packet contents.*

c. FRAME & DATA

Displays the complete packet with the frame contents and complete data in the packet, one packet at a time.*

d. STATE & DATA

The first four rows of the display show the signal state for RTS, CTS, DSR, and DTR. Rows five and six display the DTE and DCE data.

*note: " FRAME " and " FRAME & DATA " display functions are applicable only for HDLC, SDLC, X.25, DDCMP, FRAME RELAY, and TCP/IP protocols.

e. DCE only
Only displays DCE data.

f. DTE only
Only displays DTE data.

g. Half duplex
DTE uses normal characters while DCE uses reverse characters. Both DTE and DCE data are displayed on the same line.

h. Full duplex
DTE uses normal characters while DCE uses reverse characters. Both DTE and DCE data are displayed on alternating lines.

4.4.5.3 Search Data

Press ***ENTER*** on the item Search in the MORE Sub-Window. Use the ***PgUp*** and ***PgDn*** keys to select DTE Data, DCE Data, Parity Err, or Frame Err. Press ***RUN***.

The ***HCT-6000*** starts to search from the beginning of data, character by character. If no match is found, the LCD will display the " **DATA NOT FOUND** " message. Otherwise, the display will start from the first matched data.

4.4.5.4 Print Data

Under any " EXAM DATA " display mode, with a printer connected to the ***HCT-6000's*** printer port, press the ***PRINT*** key. The stored data in the capture buffer will be printed.

4.4.5.5 Examine Frame & State

From the Examine Captured Data menu, select ***F3*** to examine Frame & Packet.

Figure 4-17 : **Examine Frame & Packet**

Note: The Examine Frame & Packet menu is only available if the protocol is set to HDLC, SDLC, X.25, DDCMP, FRAME RELAY, or optional TCP/IP or Frame Relay.

With regards to the FCS field, the following descriptions apply.
FCS=G : The frame's CRC check is OK.
FCS=B : The frame's CRC check is BAD.
FCS=A : The frame was aborted.
FCS=E : The length field is not allowed.

4.4.6 : Examine File data

From the ***F4*** Exam Data menu, press ***F2***, the following will be displayed.

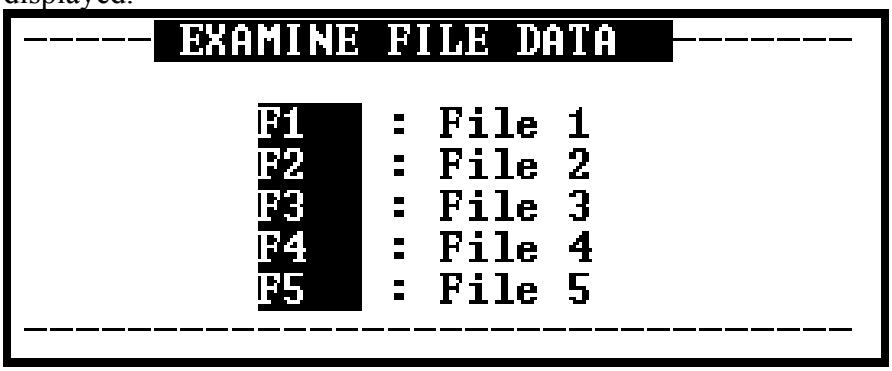


Figure 4-18 : **Examine File Menu**

Select the file you wish to view using the appropriate function key. If no captured data was saved into the internal file, then the message " **THERE IS NO DATA** " will be displayed. If there is data, it will be displayed through the same function menu as in figure 4-12.

4.4.7 : Examine Timer/Counter

From the ***F4*** Exam Data menu press ***F3***, the contents of the five (5) each timers and (5) counters can be viewed and printed.

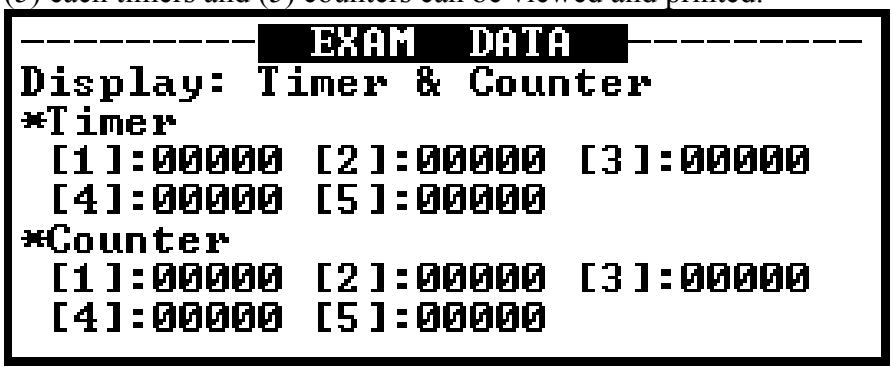


Figure 4-19 : **Timer and Counter Display**

The display will show the values as in the above format. The counter values are in units while the timer values indicate milli-seconds (1/1000 sec). One thousand (1000) milli-seconds are equal to one (1) second.

4.5 128K BERT SETUP

4.5.1 : Setup

From the **FUNCTION SELECT** Screen, press the ***F5*** key. The following screen will be displayed.

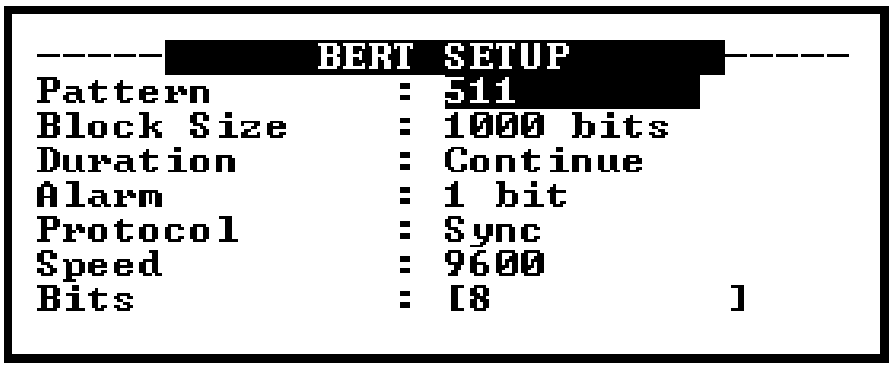


Figure 4-20 **128K BERT SETUP Screen**

Using the "⇩" arrow key, further menu items will scroll up the screen. Move the arrow down to the last menu item. The screen should look as follows.

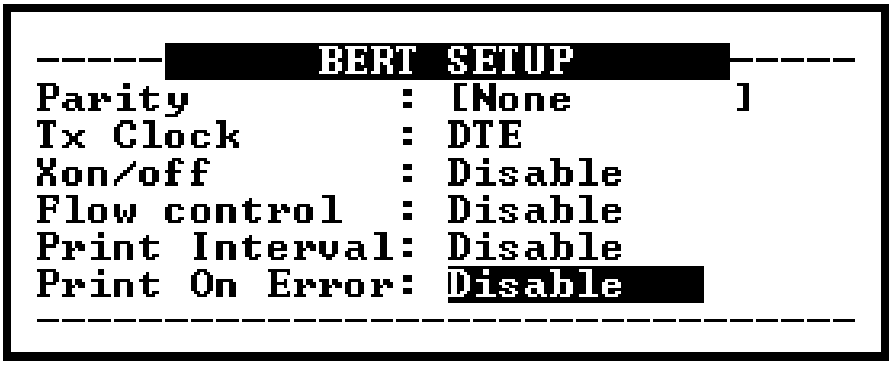


Figure 4-21 **BERT SETUP Screen (cont.)**

Return the cursor to the top of the screen (to the "Pattern" parameter setting) by using the "⇧" arrow key.

4.5.2 : Pattern Parameter Setting

Use the "⇨" arrow key to open the sub-window which displays the available data patterns for BERT . Use the "⇧" and "⇩" arrow keys to browse the available patterns. They include 63, 511, 2047, "Fox" (ASCII), Space (all zeros), Mark (all ones), and Alt (alternate ones and zeros). Hi-light the appropriate pattern and press ***ENTER*** or ***ESC***.

4.5.3 : Block Size Setting

Hi-light the parameter setting for Block Size and press the "⇨" arrow key to open the sub-window. Set the block size to either the pattern size or to 1000 bits. Press ***ENTER*** or ***ESC***.

4.5.4 : Duration Setting

Follow the same keystroke procedures and set the Duration to bit counts of 10^3, 10^4, 10^5, 10^6, 10^7, 10^8 bits, or to minutes duration of 1, 5, 10, 15, 30, 60 minutes or set to run continuously.

4.5.5 : Alarm Setting

The alarm settings may be disabled or set to trigger after 1, 10, 100, or 1000 bits in error.

4.5.6 : Protocol Setting

The ***HCT-6000*** supports both ASYNC and SYNC protocols. Select the protocol for your application.

4.5.7 : Speed Setting

Refer the page ***I-5*** for a complete listing of available baud rates for both ASYNC and SYNC. Select the appropriate speed for you application.

4.5.8 : Bits Setting

When using ASYNC protocol, the ***HCT-6000*** supports 5, 6, 7, or 8 bits. Only 8 bits are supported in SYNC mode. When choosing SYNC protocol, 8 bits will automatically be set.

4.5.9 : Parity Setting

When using ASYNC protocol, the ***HCT-6000*** supports a parity setting of ODD, EVEN or NONE. No Parity bits are supported in SYNC mode. When choosing SYNC protocol, no parity bits will apply.

4.5.10 : Stop Bits Setting

Stop bits only apply when using ASYNC protocol settings. The stop bits may be set to 1, 1.5, or 2.

4.5.11 : Tx Clock Setting

The Tx Clock only applies when using SYNC protocol settings. The Tx Clock may be set to DCE or DTE. When set to DCE, the TD rate is set according to the received TC (is dependent on an external source). When set to DTE, the ***HCT-6000***'s TD rate is set according to the outgoing XTC (which is based upon an internal clock). RD is always synchronized by external RC.

4.5.12 : Xon/off Setting

The ***HCT-6000*** allows enabling or disabling transmission of software flow control. Set according to your application.

4.5.13 : Flow control Setting

The ***HCT-6000*** allows enabling or disabling transmission of hardware flow control. Set as required by your application.

4.5.14 : Print Interval Setting

Automatic printout can be enabled at intervals of 5, 10, 15, 30, or 60 minutes.

4.5.15 : Print On Error Setting

By enabling this parameter, the ***HCT-6000*** will print whenever an error condition occurs.

4.5.16 : Display Setting

When the Normal mode is selected, the ***HCT-6000*** shows both transmitted and received results. When the Tx Simplex mode is selected, the display shows transmitted status only. When the Rx Simplex mode is selected, the display shows received results only.

4.6 RUNNING 128K BERT

4.6.1 : Start Bit Error Rate Testing

After all parameters are set and connections made, BERT testing is started by pressing the ***RUN*** key. The following screen will be displayed.

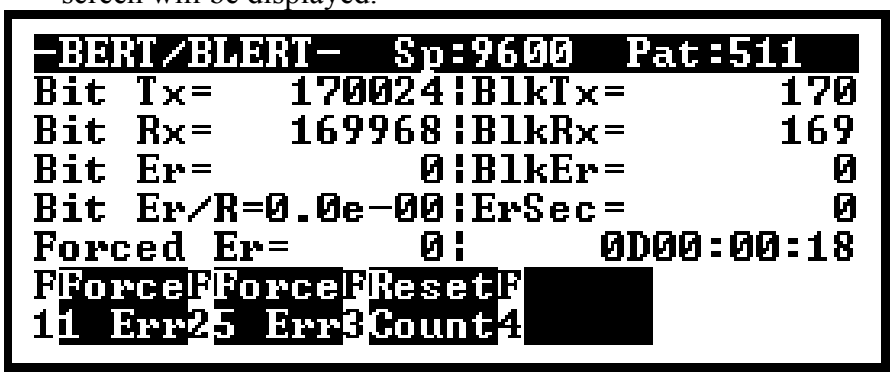


Figure 4-22 : **BERT Running**

While BERT is running the following function keys are in effect:

F1 Forces a single bit error.

F2 Forces five(5) single bit errors.

F3 Resets the timer and all bit/block counters to zero.

ESC Exits BERT testing.

RUN Halts BERT testing. HALT will be displayed. At this point, a print out may be done by pressing the ***PRINT*** key. Pressing ***RUN*** again will restart testing.

1 Sets the RTS or CTS lead status to active (space).

2 Sets the RTS or CTS lead status to inactive (mark).

3 Sets the DTR or DSR lead status to active (space).

4 Sets the DTR or DSR lead status to inactive (mark).

4.6.2 : Communication Line Quality Test

To test and check the quality of a transmission line, the ***HCT-6000*** sends continuous data which is then looped back, received, and compared. Any discrepancies indicate that an error has occurred.

a: Available BAUD Rates for testing:
ASYNC : 50 bps - 128 Kbps,
SYNC (BSC) : 150 bps - 115.2 Kbps.

b: Available test transmission PATTERNS :
63/511/2047, MARK (all 1's), SPACE (all 0's), FOX (ASCII), and ALT (0101).

4.6.3 : Connections

There are two recommended connection methods. The first requires two ***HCT-6000***s, one connected on each side of the communication line via a "null" connection. In other words, the transmit signal from one unit is connected to the receive input of the other unit and visa versa.

The second method requires only one ***HCT-6000*** on one end of the communication line and a physical loop back at the other end. The ***HCT-6000*** can transmit the selected pattern continuously, will synchronize with the received data and count bit errors. By looping back at different points on the data link or by testing with various BAUD rates, the **BERT** test function can determine line quality, acceptable band width, or serve as an aid in trouble shooting and isolating cable/connector deficiencies.

4.6.4 : Setup

When using an ***HCT-6000*** on both sides of the communication line, set the parameters SELECT PATTERN, DATA BLOCK, SPEED, CLOCK (if sync), and ALARM TIMER to identical settings on both units. Connect the units such that the transmit pin of one unit is connected to the receive pin of the other. If using a single unit, set a loop back on the transmission cable from the receive pin to the transmit pin.

4.6.5 : Testing

To start testing, if using two units, press the ***RUN*** key at the same time on both units on each end of the communications line. Otherwise, just press ***RUN*** on the single unit.

The length of testing time is determined by the setup information. The advantage of using two units for testing is that the sending and receiving channels can be tested simultaneously since each ***HCT-6000*** contains its own transmitter and receiver.

128K BERT User's Notes:

4.7 2M BERT MODE (HIGH SPEED) SETUP

NOTE: Not available on the *HCT-6000A*.

4.7.1 : Setup

From the PAGE 2 Menu, PRESS ***F1*** 2M BERT.

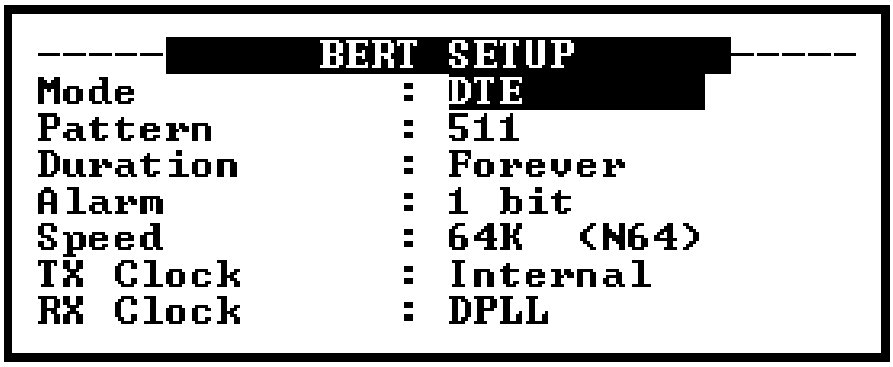


Figure 4-23 : **2M BERT SETUP**

4.7.2 : Mode Parameter Setting

Use the "⇨" arrow key to open the sub-window which displays the available modes for BERT . Use the "⇧" and "⇩" arrow keys to browse the available modes. The two modes available are DTE and DCE.

4.7.3 : Pattern Parameter Setting

Use the "⇨" arrow key to open the sub-window which displays the available data patterns for 2M BERT . Use the "⇧" and "⇩" arrow keys to browse the available patterns. The patterns include 63, 127, 511, 2047, 2e15-1, 2e20-1, ORSS, 2e23-1, Space (all zeros), Mark (all ones), Alt (alternate ones and zeros), 11001100, 3 in 24, 1 in 16, 1 in 8, and 1 in 4. Hi-light the appropriate pattern and press ***ENTER*** or ***ESC***.

4.7.4 : Duration Parameter Setting

Hi-light the parameter setting for Duration and press the "⇨" arrow key to open the sub-window. Set the duration to 1, 5, 10, 15, 30, 60 minutes or "Forever". Press ***ENTER*** or ***ESC***. NOTE: this setting is overridden by the Event Timer setting under Clock Setup. See 3.5.4

4.7.5 : Alarm Setting

The alarm settings may be disabled or set to trigger after 1, 10, 100, or 1000 bits in error.

4.7.6 : Speed Setting

The speed settings for 2M BERT include 48K and all N56 (T1) and N64 (E1) multiples up to 2048Kbps. Select the appropriate speed for you application.

4.7.7 : Tx Clock Setting

The Tx Clock may be set to Internal, Inverted Internal, External, or Inverted External. Refer to figure 1-1, page *I-9*.

4.7.8 : Rx Clock Setting

The Rx Clock may be set to DPLL (digital phase locked loop), External, or Inverted External. Refer to figure 1-1, page *I-9*.

4.7.9 : Tx Error Rate Setting

The ***HCT-6000*** allows setting of transmit error rate to Single, 10e-1, 10e-2, 10e-3, 10e-4, 10e-5, 10e-6, or 10e-7. Set according to your desired application.

4.7.10 : Flow control Setting

The ***HCT-6000*** allows enabling or disabling transmission of hardware flow control. Set as required by your application.

4.7.11 : Print Interval Setting

Automatic printout can be enabled at intervals of 5, 10, 15, 30, or 60 minutes.

4.7.12 : Print On Error Setting

By enabling this parameter, the ***HCT-6000*** will print whenever an error condition occurs.

4.7.13 : Display Setting

When the Normal mode is selected, the ***HCT-6000*** shows both transmitted and received results. When the Tx Simplex mode is selected, the display shows transmitted status only. When the Rx Simplex mode is selected, the display shows received results only.

4.8 RUNNING 2M BERT

4.8.1 Procedure

After setting up all of the 2M BERT parameters, activate BERT testing by pressing ***RUN***. The following screen will be displayed.

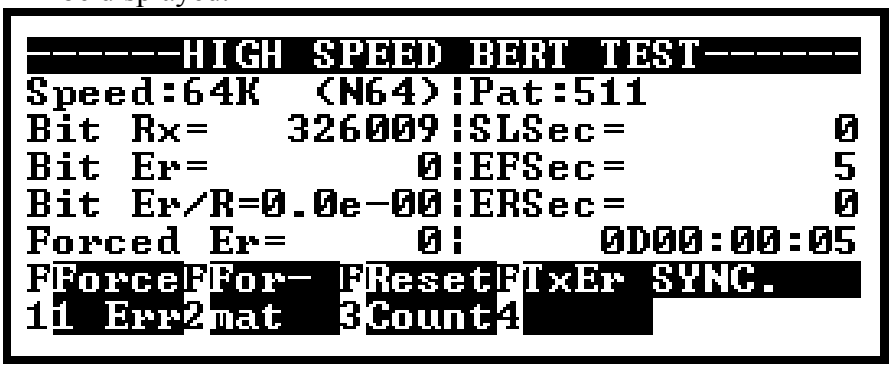


Figure 4-24 : **2M BERT while running**

Abbreviation	Definition	Range and/or note
Speed	Data rate	Parameter setting.
Pat	Pattern	Parameter setting.
Bit Rx	Received bit count	0 to 999999999, 1.0000e9 to 9.9999e14
Bit Er	Received bit error count	0 to 999999999, 1.0000e9 to 9.9999e14
Bit Er/R	Received bit error rate	0 to 1.0e-15
SLSec	Sync loss seconds	0 to 999999999
EFSec	Error free seconds	0 to 999999999
ERSec	Error seconds	0 to 999999999
Forced Er	Forced error bit count.	0 to 999999
0D00:00:05	Test duration	0 seconds to 9999 days

Figure 4-25 : **2M BERT display definitions**

High speed BERT mode offers extended patterns for testing. They included all the patterns of 128k BERT plus; 2e15-1, 2e20-1,QRSS,2e23-1, 11001100, 1 in 16 (1000000000000000), 1 in 8 (10000000), 1 in 4 (1000), and 3 in 24 (001000000000000000100010).

While High Speed BERT is running the following function keys are in effect:

F1 Forces a single bit error when pressed.
F2 Toggles the display format to G.821 analysis.
F3 Resets the timer and all bit counters to zero.
F4 Turns on/off the automatic error injection depending upon the setting of the Tx Error Rate parameter. An asterisk "*" indicated that Tx Error injection is active.
ESC Exits BERT testing.
RUN Halts BERT testing. HALT will be displayed. At this point, a print out may be done by pressing the ***PRINT*** key. Pressing ***RUN*** again will reset and restart testing. During normal running, "SYNC." will be displayed. If the connection is lost then "SYN.LOSS" will be displayed.
1 Sets the RTS or CTS lead status to active (space).
2 Sets the RTS or CTS lead status to inactive (mark).
3 Sets the DTR or DSR lead status to active (space).
4 Sets the DTR or DSR lead status to inactive (mark).

The following screen shows the G.821 display format by toggling the ***F2*** key.

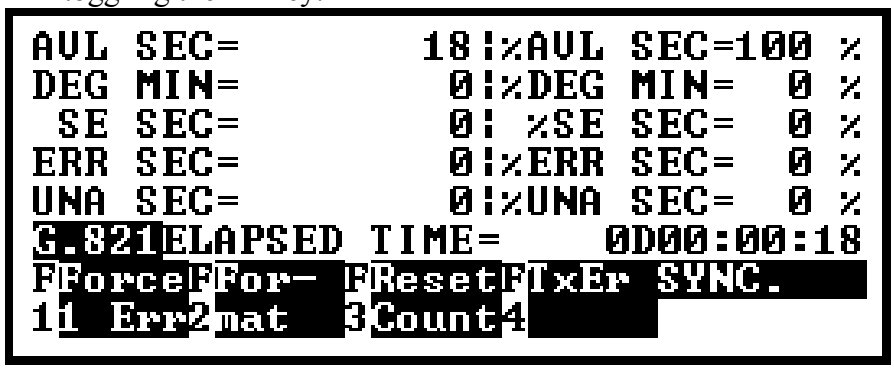


Figure 4-26 : **G.821 display format for 2M BERT.**

Abbreviation	Definition	Range and note
AVL SEC	Available Seconds	0 to 999999999
%AVL SEC	Percent of Available Seconds	0 to 100%
DEG MIN	Degraded Minutes	0 to 999999999
%DEG MIN	Percent of Degraded Minutes	0 to 100%
SE SEC	Severely Errored Seconds	0 to 999999999
%SE SEC	Percent of Severely Errored Seconds	0 to 100%
ERR SEC	G.821 Errored Seconds	0 to 999999999
%ERR SEC	Percent of G.821 Errored Seconds	0 to 100%
UNA SEC	Unavailable Seconds	0 to 999999999
%UNA SEC	Percent of Unavailable Seconds	0 to 100%
0D00:00:18	Elapsed Time	0 seconds to 9999 days

Figure 4-27 : **G.821 display definitions**

4.8.2 : Communication Line Quality Test

To test and check the quality of a transmission line, the ***HCT-6000*** sends continuous data which is then looped back, received, and compared. Any discrepancies indicate that an error has occurred.

a: Available speeds for testing:
48Kbps
N64 to 2048Kbps
N56 to 2048Kbps

b: Available test transmission PATTERNS :
63/127/511/2047, MARK (all 1's), SPACE (all 0's), ALT(0101), 2e15-1, 2e20-1, 2e23-1, and QRSS.

4.8.3 : Connections

There are two recommended connection methods. The first requires two ***HCT-6000***s, one connected on each side of the communication line via two modems or "null" connections. In this method, the transmit signal from one unit is connected to the receive input of the other unit and visa versa.

The second method requires only one ***HCT-6000*** on one end of the communication line and a physical loop back at the other end. The ***HCT-6000*** can transmit the selected pattern continuously, will synchronize with the received data and count bit errors. By looping back at different points on the data link or by testing with various BAUD rates, the BERT test function can determine line quality, acceptable bandwidth, or serve as an aid in trouble shooting and isolating cable/connector deficiencies.

4.8.4 : Two Units Setup

When using ***HCT-6000***s on both ends of the communication line, set the parameters Pattern, Duration, Speed, and Alarm to identical settings on both units. Connect the units such that the transmit pin of one unit is connected to the receive pin of the other. If using only a single ***HCT-6000*** unit, set a loop back on the transmission cable from the receive pin to the transmit pin.

4.8.5 : Testing

To start testing, if using two units, press the ***RUN*** key at the same time on both units on each end of the communications line. Otherwise, just press ***RUN*** on the single unit. The length of testing time is determined by the setup information. The advantages of using two units for testing are that the sending and receiving channels can be tested simultaneously and at longer distances (a physical loop back will double the apparent distance as the signal retraces through the cable) since each ***HCT-6000*** contains its own transmitter and receiver.

4.9 ASYNC TERMINAL EMULATION

4.9.1 : ASYNC Terminal Setup

The first step in emulating terminal equipment is to set the proper communication protocol and parameters to match the host equipment. Follow the example below which will demonstrate the ASYNC terminal emulation function.

From the PAGE 2 Menu, PRESS ***F2*** - Async-Terminal. The display will show the following.

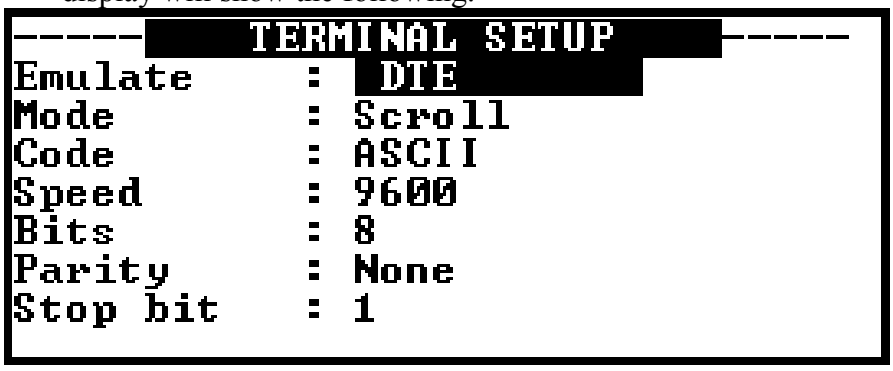


Figure 4-28 : **Terminal Setup Screen**

4.9.2 : Example for ASYNC Terminal

Manually configure for DCE, 9600 bps, 8 bits, no parity, and 1 stop bit. Exit the Config menu by pressing ***ESC*** or press ***RUN*** to enter terminal mode. Using the supplied RS-232 cable, connect the interface port on the ***HCT-6000*** to an unused COM port on any IBM compatible personal computer running the Microsoft DOS operating system.

(IBM and Microsoft are registered trademarks of their respective companies.)

Make sure that the **I/F Select** switch on the ***HCT-6000*** is set to RS-232. Since the communication port of a PC is DTE, please set the ***HCT-6000*** to emulate DCE. On the PC keyboard enter the following:

[path]\MODE COMx:9600,N,8,1 < ENTER > where path is the directory where the DOS files are located and "x" is the number of the COM port connected to the ***HCT-6000***.

next enter

CTTY COMx

Now the console input to your PC has been directed for reception from the ***HCT-6000*** on COMx. You can control the PC remotely. Try typing in a few simple DOS commands (DIR, CHDIR, etc.). To return control back to the PC keyboard, on the ***HCT-6000*** enter:

CTTY CON

Now control of the PC has been returned to the PC keyboard.

Now try sending some text messages from the PC. For example, use the DOS re-direct command;

TYPE {filename} > COMx

The data will display.

4.10 AUTO SCAN AND CONFIGURE

Auto scan is used to send out combinations of baud rate, data bit, parity, and stop bit to detect the configuration of the connected equipment.

From the PAGE 2 Menu, PRESS ***F3*** Configure Scan. The display will show:

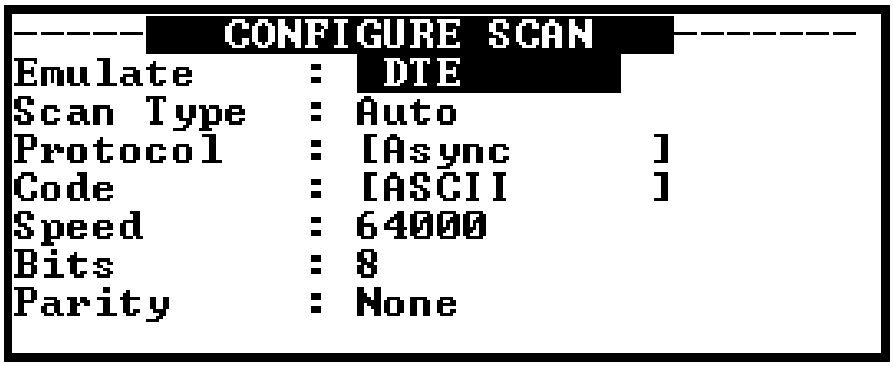


Figure 4-29 : **Configuration Scan Setup Screen**

When setting the Scan Type, choose between AUTO, STEP, or REPEAT.

a. Auto: The speed, bits, and parity will change as data is sent out automatically until ***ESC*** is pressed.

b. Step: The parameters will change and data will be sent when any key except ***ESC*** is pressed.

c. Repeat: The parameters will not change. Data will be sent when any key is pressed except ***ESC***.

After completing the parameter setup, the scanning begins when the ***RUN*** key is pressed. When the scan settings match those of the connected device, the process message will display on the target device. During the scan operation, you will observe the changing of baud rate, bits, and parity. The scan can be stopped at any time by pressing the ***ESC*** key.

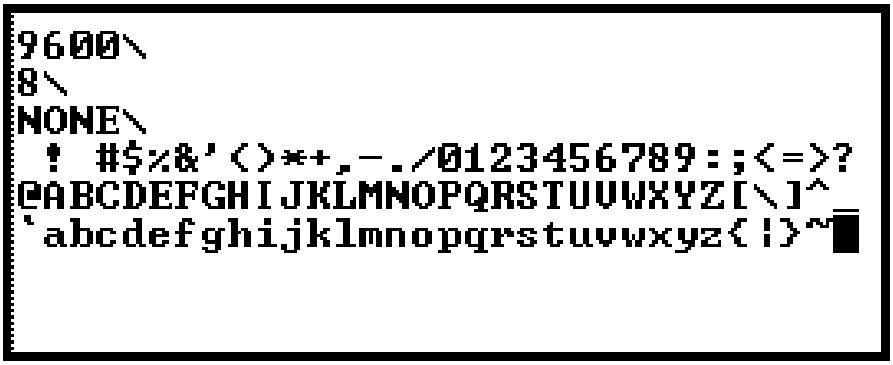


Figure 4-30 : **Process Message**

4.11 FILE MANAGEMENT

4.11.1 : Introduction

The ***HCT-6000*** includes a system for storing and retrieving configuration settings, captured data, and the monitor and emulate programs. The ***HCT-6000*** has a total of 512K bytes of battery backed-up static RAM for use by both the work buffer and filing system (1K=1024 bytes). Of the 512KB available, a maximum of 485KB may be used for file storage and/or capture buffer. There is always a minimum of 16KB for use by the work buffer. If all 485KB were used by the capture buffer, there would be 0KB available for file storage. For any files saved, the RAM they occupy will be unavailable for use by the capture buffer. If a larger capture buffer is desired, the RAM may only be freed by deleting a file. NOTE: Files are also cleared via the System Reset. (refer to section 4.12)

4.11.2 : Operation

From the PAGE 2 MENU, press ***F4***. The following will display.

Figure 4-31 : **File Manager, Opening Menu**

The item FREE, indicates the amount of memory available for file storage. It is equal to 512KB minus the capture buffer (16K minimum reserved), minus 11K overhead, minus any existing file usage. Use the SAVE command to store your temporary data into the storage RAM. Use LOAD to recall previously saved data. The CLEAR command is used to erase a file and free memory.

When pressing the ***ENTER*** key, the entry window will change to select the appropriate file.

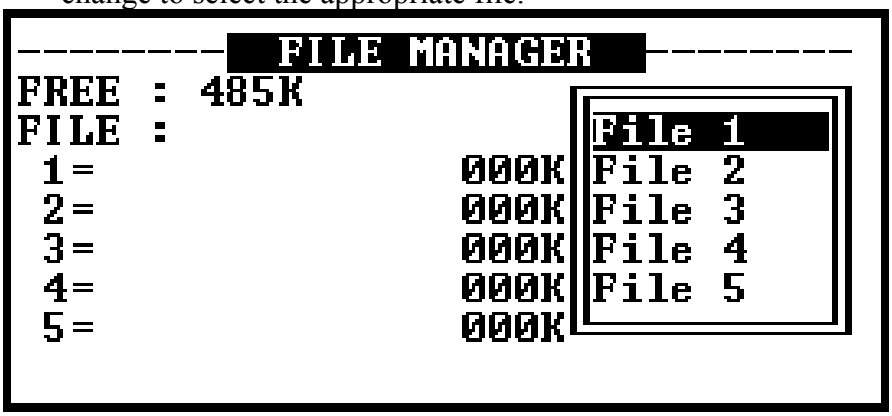


Figure 4-32 : **File Manager, File Selection**

Select the file and press ***ENTER.*** The save file menu will appear.

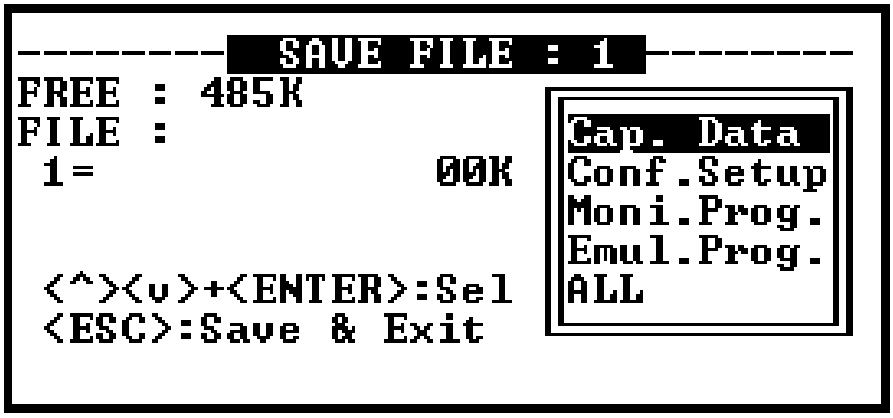


Figure 4-33 : **File Manager, Data Type Selection**

Now, using the up/down arrow keys, select the type of data to be saved in the file. Choose from Capture Data, Configuration Setup, Monitor Program, Emulation Program, or ALL. **NOTE: If you plan to use the UP/DOWN LOAD functions with the PC software, you must select "ALL" in order to maintain a compatible file structure**. The screen will look something like this:

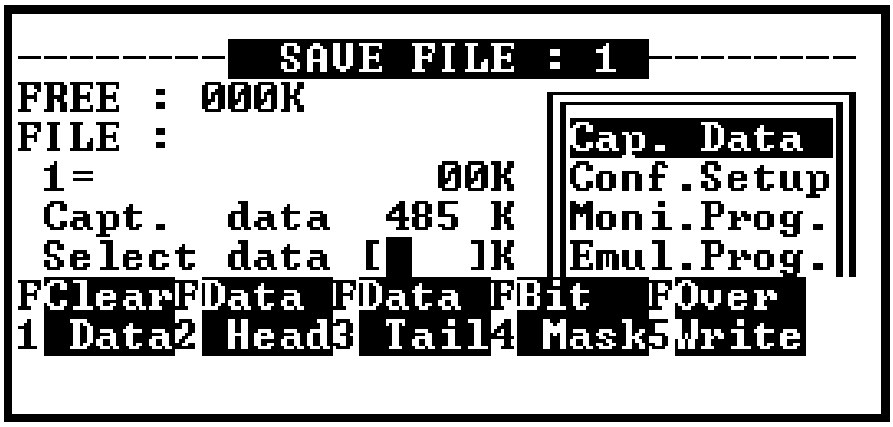


Figure 4-34 : **File Manager, Save File Screen**

In the previous figure, we have chosen to save Capture Data. The screen tells us there is 485K in the capture buffer. You are now prompted to enter the amount, in K-Bytes, of the buffer to be saved. In the select data field, ***F1*** will erase an entry, ***F2*** will go to the first character in the entry field, ***F3*** will go to the last character, while ***F4*** and ***F5*** have no function in this menu. In our example, we key-in "32" and then hit ***ENTER*** followed by ***ESC***.

If we had chosen to save ALL data, we would arrow key down to ALL, press ***ENTER***, key-in "32" in the select data, press ***ENTER*** and then ***ESC***. If, for example, you only desire to save 12K of the total 485K captured buffer, you would key-in "12" and then press ***ENTER*** followed by ***ESC***.

When data has been captured, and you want to capture more, the data in the buffer will be over-written. Therefore, you must use the save function or you will loose the previous data. After saving the data, you can return to the monitor or emulate function and capture more data. You can actually access a total of six sets of data, one set for each of the available files plus the buffer itself.

To save configuration parameters and/or monitor/emulate programs, complete parameter or program entry, then enter the file manager to save.

NOTE: After storing captured data, the capture buffer is cleared, the data cannot be LOADed back into the capture buffer. If you try to Examine the captured data after saving to a file, no data will be found. To view the stored data use the EXAM FILE DATA function (see 4.4.6).

4.12 SYSTEM RESET

4.12.1 : Definition

System Reset is used to restore all the factory default parameters from the system ROM to the internal RAM. All captured data, programs, timers, counters, and stored files will be cleared.

4.12.2 : Operation

From the PAGE 2 Menu, PRESS ***F5*** - System Reset. The display will show:

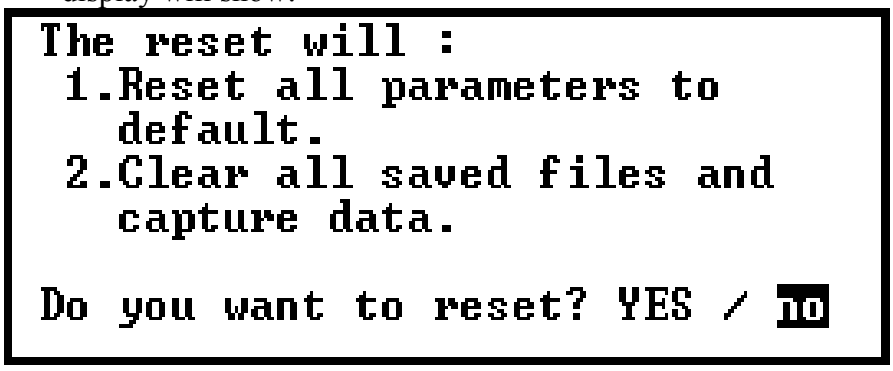


Figure 4-35 : **Reset Screen**

Pressing the ***ENTER*** key will return you to the first MENU page. To do a System Reset, press the left arrow key to select "YES" and then press ***ENTER***. You will be prompted one more time with the "Are you sure ?" message. Press ***ESC*** to exit or ***ENTER*** to initiate the reset procedure.

4.13 SELF TEST

4.13.0 Description

The tests performed by the ***HCT-6000*** are selected from the menu 3 page, ***F1***. 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 the 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 ***HCT-6000***'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 Port Test. ***F4*** selects the LIQUID CRYSTAL DISPLAY (LCD) for testing, while ***F5*** will test the tactile membrane KEYBOARD.

4.13.1 Self Test Single Mode

From the Page 3 MENU, select ***F1***, Self Test.

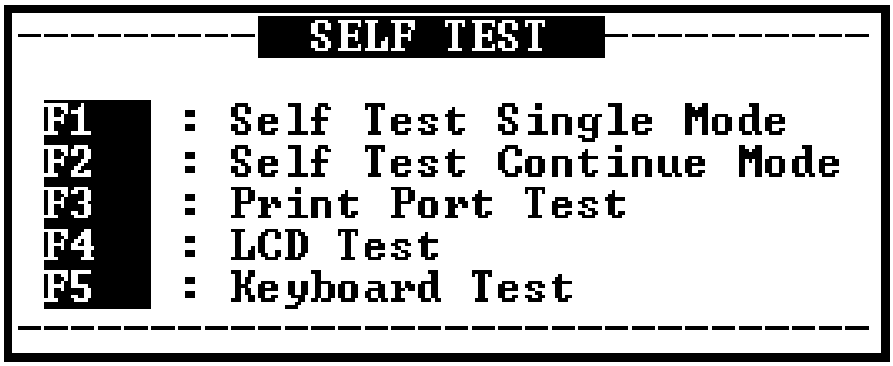


Figure 4-36 : **Self Test Main Menu**

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

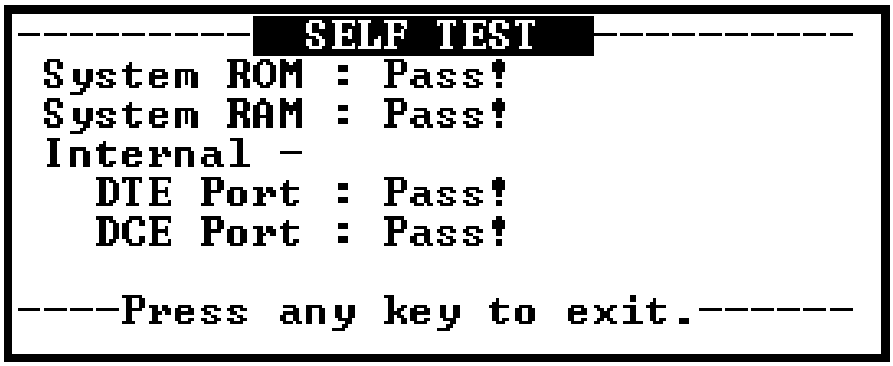


Figure 4-37 : **Self Test Single Pass**

4.13.2 : 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.

4.13.3 : 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.

4.13.4 : 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.

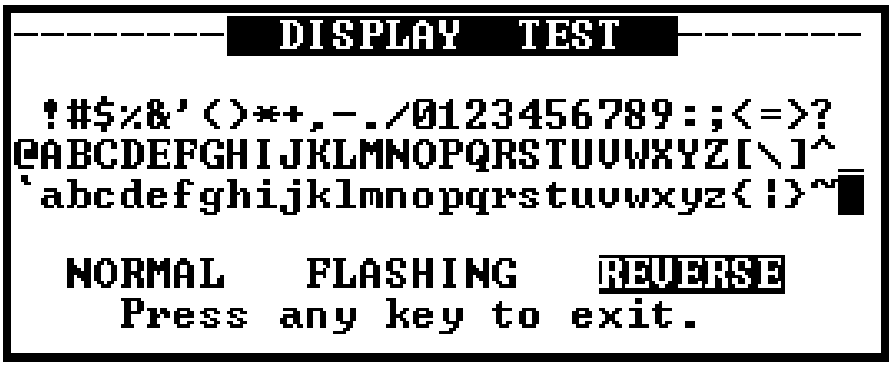


Figure 4-38 : **Display Test Screen**

4.13.5 : Keyboard Test

F5 **Keyboard Test** will bring up the last test in the Self Test menu. The display should resemble the following figure.

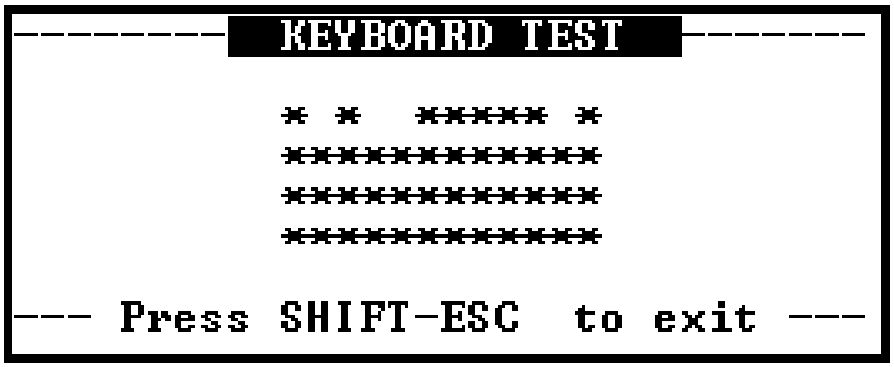


Figure 4-39 : **Keyboard Test Screen**

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 at any time, Press ***SHIFT*** and ***ESC*** .

4.14 MISCELLANEOUS

From the Page 3 Menu, select function ***F2*** **Miscellaneous**. The following will be displayed.

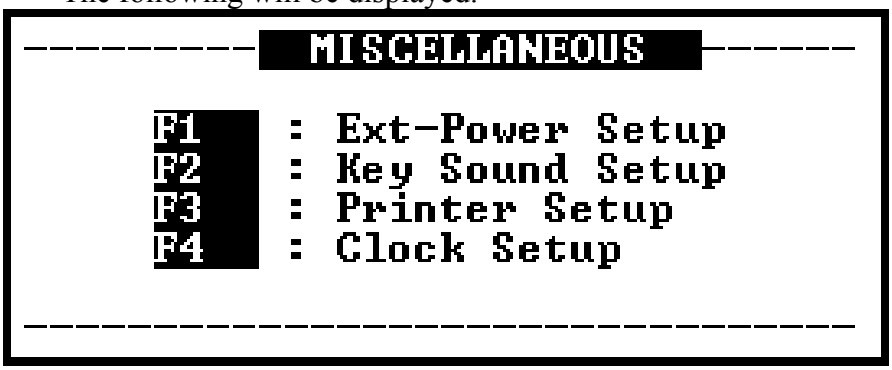


Figure 4-40 : **MISCELLANEOUS MENU**

4.14.1 : External Power Function (I/F Power)

From the Miscellaneous Menu Select ***F1*** **Ext-Power Setup**.

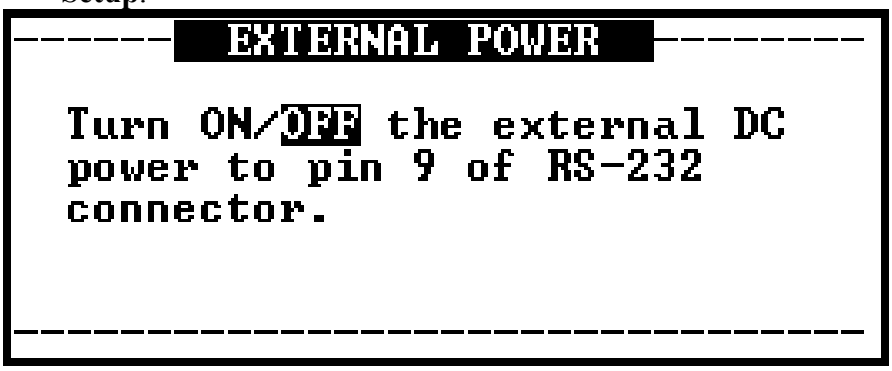


Figure 4-41 : **External Power Setup**

THIS FUNCTION IS ONLY FOR THE RS-232 INTERFACE MODE.

Using the LEFT arrow key, toggle to ON and then press the ***ESC*** key. This will supply external power to the RS-232 I/F (interface) pin 9. The Status LED will light to indicate power is present at the interface. The default setting is OFF.

4.14.2 : Key Sound Setup

The beep sound when a key is depressed can be turned OFF or ON. From the Miscellaneous Menu press the ***F2*** key. The following will display.

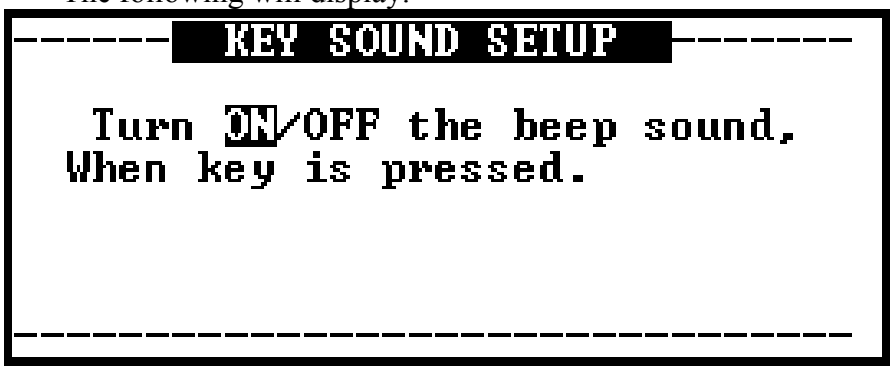


Figure 4-42 : **Key Sound Setup**

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

4.14.3 : Print function setting

The mode of printing may be selected between normal or condensed print. From the Miscellaneous Menu press the ***F3*** key. The following will be displayed.

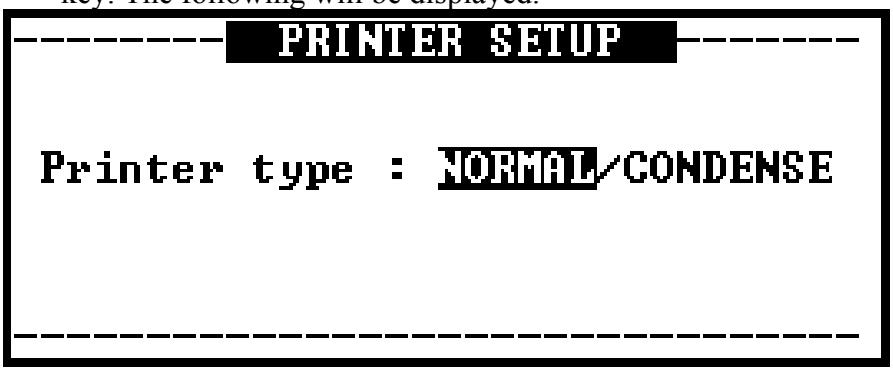


Figure 4-43 : **Printer Setup Screen**

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

4.14.4 : Clock Setup

The internal clock of the ***HCT-6000*** may be set through this menu. From the Miscellaneous Menu press the ***F4*** key. The following will be displayed.

```
Current Date: 96-10-29
        Time: 14:43:55
Setting Date: 96-10-29(yy-mm-dd)
        Time: 14:43:40(hh:mm:ss)
  Event Time: 11:11:11(hh:mm:ss)
* Press <ENTER> to confirm every
  item.
* Press <ESC> to exit.
```

Figure 4-44 : **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" message will be displayed. By confirming this function, when the current time equals the event time, any process you may be running, such as an emulation program, will stop automatically.

4.15 UP/DOWN LOAD

4.15.1 : Upload/Download Setup

An application program is provided with the ***HCT-6000*** to run on a PC. This program facilitates the transfer of data between the PC and ***HCT-6000*** and for viewing, on the PC, of files which have been up-loaded from the ***HCT-6000***. Please refer to *Chapter VI*, ***HCT-PC*** Program for the PC software usage. To initiate file/data transfer on the ***HCT-6000***, from the third MENU page press ***F3***. The Up/Down Load function will be displayed.

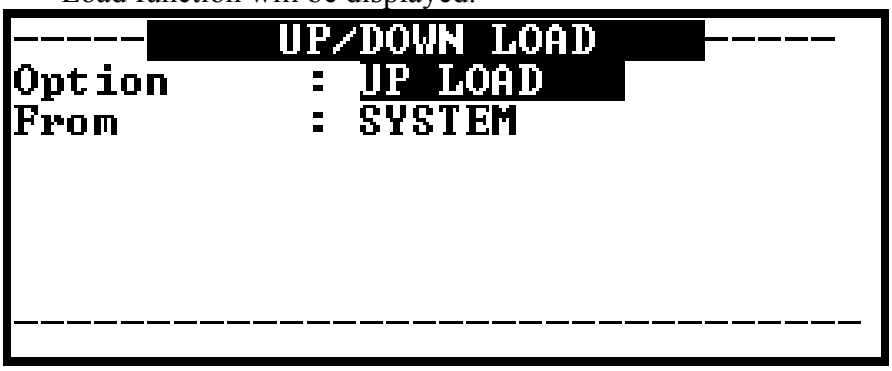


Figure 4-45 : **Up/Down Load Screen**

Select between the UP/LOAD and DOWN/LOAD options and then select From (To) options. The data that can be saved and retrieved from the PC includes the five (5) user saved files, system data, and the configuration and the buffer containing the captured data.

4.16 DIAGNOSTICS

4.16.0 : Diagnostic Operation

From the third page menu, press the ***F4*** key to enter the Diagnostics Menu.

The **DIAGNOSTICS** run the EXTERNAL subset of tests. You will need to prepare a number of golden pin wire jumpers or loop-back connectors first.

After keying in ***F4*** from the third page menu, the **DIAGNOSTICS** test menu will appear.

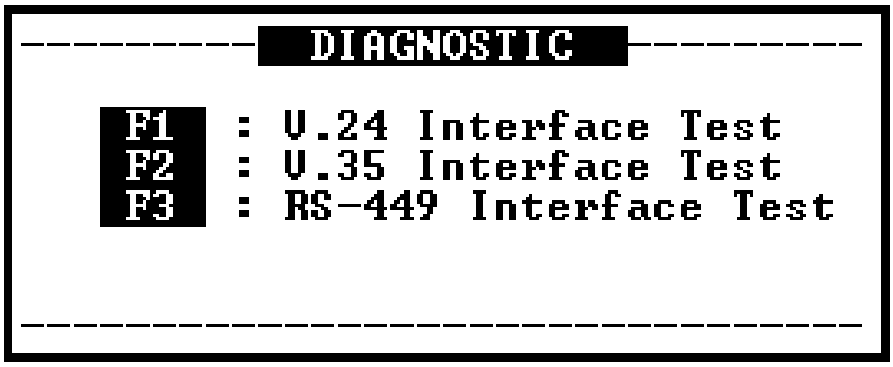


Figure 4-46 : **Diagnostics Test Menu**

4.16.1 : V.24/RS232 Interface Test

From the DIAGNOSTIC Menu, press ***F1.*** The following screen will display.

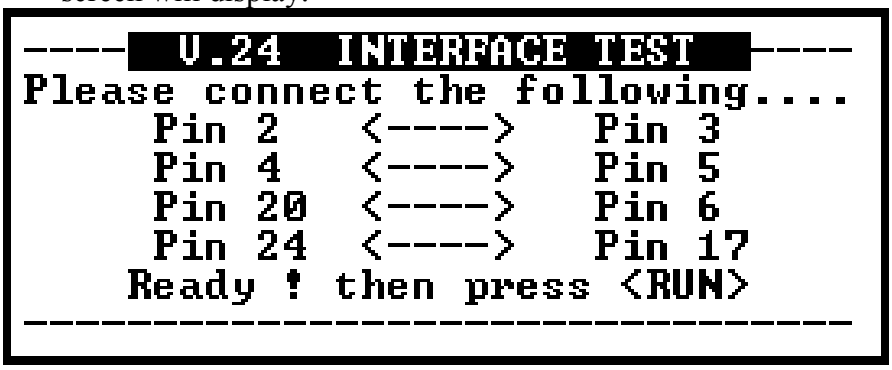


Figure 4-47 : **V.24/RS232 I/F Test**

Refer to the instruction on the LCD. Short or tie the relevant pins of the connector together. Press ***RUN*** key to start the test.

4.16.2 : V.35 Interface Test

From the DIAGNOSTIC Menu, press ***F2.*** The following screen will display.

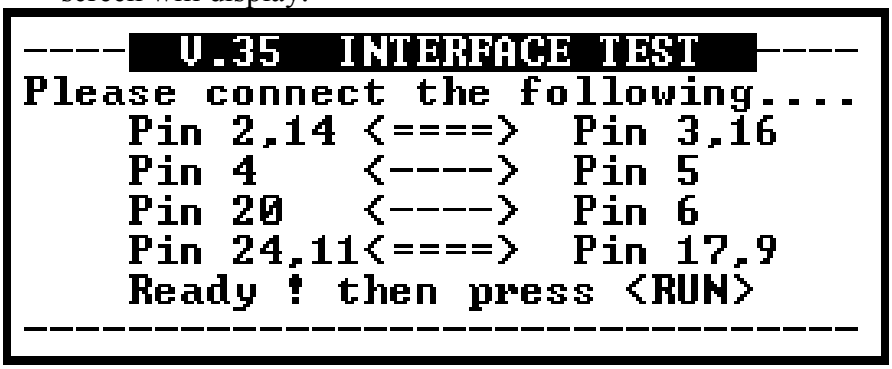


Figure 4-48 : **V.35 I/F Test**

Refer to the instruction on the LCD. Short or tie the relevant pins of the connector together. Press **RUN** key to start the test.

4.16.3 : RS449 Interface Test

From the DIAGNOSTIC Menu, press ***F3.*** The following screen will display.

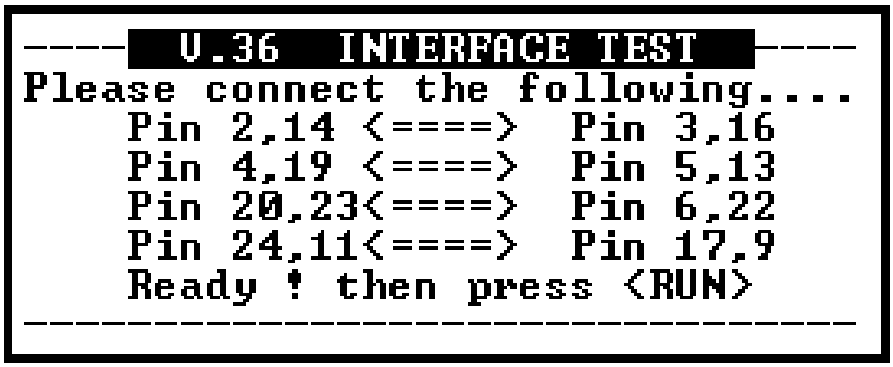


Figure 4-49 : **RS449 I/F Test**

Refer to the instruction on the LCD. Short or tie the relevant pins of the connector together. Press **RUN** key to start the test.

4.17 ON-LINE MONITOR

4.17.1 Setup

From the third page menu, press ***F5***. The On-line Monitor menu will be displayed.

```
Online Monitor program is the
same as Monitor program. Please
work with HCT-PC software via
both printer ports and LapLink
cable.
```

Figure 4-50 : **On-line Monitor Screen**

Using the On-line Monitor function, the ***HCT-6000*** can decode and store on-line traffic on a PC. When operating in this configuration, the printer port of the ***HCT-6000*** is connected to the printer port of the PC with the special parallel link cable as shown below.

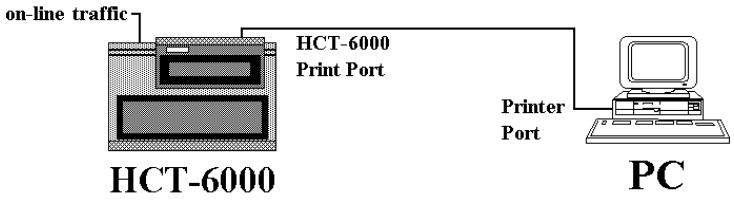


Figure 4-51 : **Parallel Connection Diagram**

4.17.2 Operation

The three functions of the On-line Monitor are:

1. Decode and display on-line traffic.
2. Store captured data in PC hard disk.
3. Examine captured and stored data.

Please refer to *Chapter VI* for more detail on running the ***HCT-PC*** software on a PC and the On-line Monitor function.

Programming Statement List

Function/ Command	Statement Structure		
SIMULATE	DTE , DCE		
PROGRAM	DISABLE , ENABLE , DELETE		
Ins. Label			
Del. Label			
LABEL (nn)	Insert Label , Delete Line , Insert line, Start , Stop , Inc Counter , If , When , Beep, Reset , Goto Label , Send , Set Lead , Wait		
Start	Display , Timer (n) , Capture		
Stop	Display , Timer (n) , Capture , Test		
Increment Counter (n)			
If	Counter (n)	> = (nnnnn)	Then goto Label(n)
	Lead	RTS	On/Off
		CTS	On/Off
		DSR	On/Off
		DTR	On/Off
When	String	DTE=(..) DCE=(..)	Then goto Label(n)
	Error	DTE	(FCS)
		DCE	(Abort)
			(Parity)
			(Frame)
			(BCC)
	Lead	RTS	On/Off
		CTS	On/Off
		DSR	On/Off
		DTR	On/Off
	Timer(n)	>=(nnnn)	

Programming Statement List (cont.)

Function Command	Statement Structure		
	Keyboard key	=(.)	
Beep			
Reset	Counter(n), Timer(n)		
Send	Keyboard Character		
	String	("fox")	
		(00-FFh)	
		(20-FFh)	
Goto Label	(n)		
Set Lead	RTS	On/Off	
	CTS	On/Off	
	DSR	On/Off	
	DTR	On/Off	
Wait	(nnnnn)		

Program Function/Command Definitions

Beep

Used to sound an audible "beep" upon statement execution.

Del. Label

The Del. Label function is used to remove an entire procedure under a program label. The actual label will still remain.

Del. Line

The Del. Line function is used to remove a program line.

Goto Label

Use the Goto Label [n]statement to execute an unconditional program branch.

If

Use the if statement to create a conditional branch to a label, based upon a counter value or the state of a handshaking lead (RTS,CTS,DSR,DTR).

Inc. Count

Place an Inc. Count statement within a program and select one of five(5) counter registers. The counter contents (x) will become (x+1). You may use the counters in loop routines. (See also If Count.)

Label

Labels are used within the user program to facilitate conditional branches in the program execution or to provide the ability to loop routines. Labels always have an associated number attached. When a new label is inserted into the user's program, the next incremental number is assigned. Labels can only be inserted at the end statement of the program. A new label cannot be inserted between previously written statements. Therefore, it is important to either first write a program down on paper or to insert extra labels into the program as it is written. When the cursor is moved to “Label” line, you can create a procedure block if none exists or edit the existing procedure.

When using the Del. Label function, any procedure contained within the label will be deleted. The label, however, remains, and a new procedure block can be entered at that label.

Program

Choose one of three choices; Disable, Enable, or Delete.

Program Disable : Disable all of the procedure blocks and the procedures in each block.

Program Enable : Enable all the procedures.

Program Delete : Clears all the procedures and starts a new procedure block.

Reset

The Reset statement is used to clear any of the specific counters or timers.

Send

The Send statement is used to output a keyboard character or to send a string (text, 00-FFh, or 20-7Fh). The text defaults to the standard "fox" pattern or may be any string the user desires.

Set Lead

The Set Lead statement is used within a program to change the state of a handshaking lead (RTS,CTS,DSR,DTR) during program execution. This is very useful in emulating hardware handshaking with your program.

Start

Use the Start command to control the display, a timer(n) register, or to initiate a capture operation, from within a program.

Stop

Use the Stop command on the display, a timer(n), on a capture operation, or to stop the entire user test procedure.

Wait

The Wait[xxxxx] statement is used within a program to pause execution. The Wait unit value is entered in milli-seconds or .001 sec.

When

Create conditions based upon a string from DCE or DTE, an error (in parity, framing, BCC, or FCS), a lead (RTS,CTS,DSR,DTR), a timer(n), or a keyboard action. Program can branch to a Label or additional When statements may be embedded.

5.0 INTRODUCTION

In this chapter, examples of applying the ***HCT-6000***'s internal program language are shown. There are examples for both ASYNC and SYNC transmissions. We hope these simple examples will inspire the user in writing his or her own routines, as the real power of the ***HCT-6000*** can then be fully realized. You do not have to be a programming genius to write your own routines. All of the language commands are selected from the windowed selection area on the display. It is assumed however, that you do have a good understanding of the communication protocol with which you plan to evaluate. The ***HCT-6000*** can then serve as a portable communications analyzer with functions that were previously available only in large and expensive "test bench" systems.

5.1 ASYNC APPLICATION

SIMULATION MODE

5.1.1 : Example 1; On an ASYNC line, capture data after a parity error occurs.

```
* Program Start *
Label 1
Stop Capture                        ; note 1
Reset Timer 1
Label 2
When Error DTE Parity
   or When Error DCE Parity
        Then Goto Label [3]         ; note 2
Label 3
Start Capture
Start Timer 1
When Timer 1 >= [1000]              ; note 3
        Then Goto Label [1]
* End *
```

note 1: At program start, the default for both Capture and Display is **ON**. Therefore, if the program is to do a conditional Capture, the program should begin with the "Stop Capture" statement. Capture will the be turned **OFF**.

note 2: Between any two program "Label" segments, there can be a maximum of 5 condition statements.

note 3: The units of the Timer are in " ms " (milli-seconds or 1/1000 of a second). Therefore 1000 units are equal to 1 second. The maximum value in units for Timer is 65535 or about 65.5 seconds.

5.1.2 : Start to monitor and capture data after DTE and DCE have finished handshaking,

```
* Program Start *
Label 1
Stop Display
Stop Capture                ;Display and capture turned OFF
Label 2
When Lead DTR is ON         ;Monitor the logic state of DTR.
        Then Goto Label [3]
Label 3
When Lead DSR is ON         ;Monitor the logic state of DSR.
        Then Goto Label [5]
Label 4
When Lead RTS is ON         ;Monitor the logic state of RTS.
        Then Goto Label [5]
Label 5
When Lead CTS is ON         ;Monitor the logic state of CTS.
        Then Goto Label [6]
Label 6                             ;Handshaking completed.
Start Display
Start Capture               ;Display and Capture are ON
* End *
```

5.1.3 : Capture data between fixed start and end "Patterns"

During on-line operation, a user wants to find some fixed data or data string which starts with "pattern 1" and ends with "pattern 2". The pattern can be one to sixteen characters in length and can be any character from hex 00 to FF.

```
* Program Start *
Label 1
Stop Capture                    ;Capture turned OFF
Label 2
When String DTE = [ Pattern 1 ]
        Then Goto Label [3]
Label 3
Start Capture
When String DTE = [ Pattern 2 ]
        Then Goto Label [4]
Label 4
Stop Capture
* End *
```

EMULATE MODE

5.1.4 : Emulate handshaking

This program demonstrates emulating handshaking between DTE and DCE and then sends out a Test Pattern to DCE. If failed, then two warning beep tones are generated.

```
EMULATE: DTE
PROGRAM: Enable
* Program Start *
Label 1
Reset Timer 1
Reset Timer 2                    ;Reset two timers.
Set Lead DTR ON                  ;emulate handshaking
Start Timer 1
When Lead DSR Turn ON
   or When Timer 1 >= [ 10000 ]  ;10 Second time out.
        Then Goto Label [2]
Label 2
If Lead DSR is OFF
        Then Goto Label [5]
Set Lead RTS ON.
Start Timer 2
When Lead CTS Turn ON.
   or When Timer 2 >= [ 10000 ]
        Then Goto Label [3]
Label 3
If Lead CTS is OFF
        Then Goto Label [5]
Send String Text [ Test Pattern ]
```

(continued on next page)

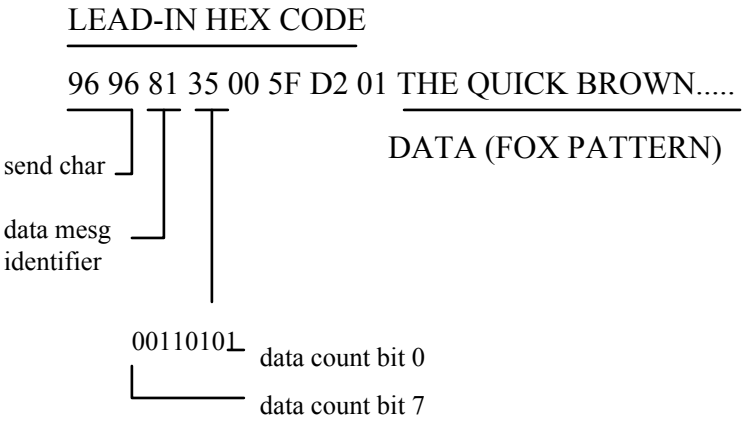
```
(continued)
When String DTE = [ Last character of test pattern ]; note 1
        Then Goto Label [4]
Label 4
Set Lead RTS OFF
Set Lead DTR OFF
Stop Test
Label 5                          ;on error routine
Beep
Beep
* End *
```

note 1 : Because the instruction execution speed is faster than the data transmission speed, the "When String DTE =[Last character of test pattern] statement must be included to avoid an early program jump to the next instruction. The conditional statement will ensure that all test data has been sent. Be very careful to include this statement to avoid a program jump before data transmission has been completed.

5.1.5 : Emulate DCE with the DDCMP Protocol, then send one FOX pattern to DTE.

EMULATE : DCE
PROGRAM : Enable
* Program Start *
Send String Text [96 96 81 35 00 5F D2 01 THE QUICK BROWN FOX ..... 6 7 8 9.] ; note 1
* End *

note 1 :



5.1.6 : Emulate a DCE device, receive data sent from DTE.

Upon data error, send an error message to DTE, count the number of error occurrences. If the error count exceeds 10, then generate a Beep tone and stop execution.

```
EMULATE : DCE
PROGRAM : Enable
* Program Start *
Label 1
Reset Counter
Label 2
When Error DTE Parity
   or When Error DTE Framing
   or When Error DTE BCC
         Then Goto Label [3]
Label 3
Send String Text [ error message ]
Wait [ 200 ]
Inc. counter 1
If Counter 1 >= [ 10 ]
         Then Goto Label [ 4 ]
Goto Label [ 2 ]
Label 4
Beep
Beep
* End *
```

5.1.7 : Send one message while continuing to receive data.

The ***HCT-6000*** will send a test pattern through the communication line. At the same time, it will continue to receive data from the line.

```
LABEL 1:
Send [ Testing Pattern ]
END
```

NOTES

5.2 X.25 APPLICATION

5.2.1 : Programming examples for X.25 protocol.

The X.25 protocol is the CCITT definition for attachment to a packet-switched data network. The following program is an example of a terminal simulation for X.25 protocol.

MANUAL CONFIGURATION

Protocol : X. 25
Code : ASCII
Speed : 9600
Bits : 8
Parity : None
Source : DTE & DCE
Display : Frame/Pack
Buffer : Ring
Suppress : None
TX Clock: DCE
ERR Check : CRC-CCITT

*** EMULATE MODE *** DTE

EMULATE : DTE
PROGRAM : ENABLE
LABEL 1
Set Lead RTS ON
Set Lead DTR ON
Wait [50]
Send String Text [01 43]
(continued on next page)

```
When String DCE= [03 3F]
        Then Goto Label 2
LABEL 2
Send String Text [03 73]
Wait [100]
LABEL 3
Send String Text [01 00 10 01 FB 00 00]
When String DCE= [03 20 10 01 FF]
        Then Goto Label  4
LABEL  4
Wait [100]
Send String Text [01 22 10 01 0B 09 12 34 56 00 00 00]
When String DCE= [03 42 10 01 0F]
        Then Goto Label  5
LABEL  5
Send string Text [03 41]
LABEL  6
Wait [l00]
Send String Text [01 44 10 01 00]
When String DCE= [03 64 10 01 21]
        Then Goto Label  7
LABEL  7
Wait [100]
Send String Text [01 66 10 01 02 31 31 31 31 31]
When String DCE= [03 06 10 01 41]
        Then Goto Label 8
LABEL 8
Wait [100]
Send String Text [01 08 10 01 04 32 32 32 32 32]
```

(continued on next page)

```
When String DCE= [03 28 10 01 61]
        Then Goto Label 9
LABEL 9
Wait [100]
Send String Text [01 2A 10 01 06 33 33 33 33 33]
When String DCE= [03 4A 10 01 01]
        Then Goto Label 10
LABEL 10
Wait [100]
Send String Text [01 4C 10 01 08 34 34 34 34 34]
When String DCE= [03 6C 10 01 21]
        Then Goto Label 11
LABEL 11
Wait [100]
Send String Text [01 6E 10 01 0A 35 35 35 35 35]
When String DCE= [03 0E 10 01 41]
        Then Goto Label 12
LABEL 12
Wait [100]
Send String Text [01 00 10 01 FF 36 36 36 36 36]
When String DCE= [03 20 10 01 61]
        Then Goto Label 13
LABEL 13
Wait [100]
Send String Text [01 22 10 01 0E 37 37 37 37 37]
When String DCE= [03 42 10 01 01]
Then Goto Label 6
*End*
```

The following program is an example of DCE simulation for the X.25 protocol.

MANUAL CONFIGURATION

Protocol : X. 25
Code : ASCII
Speed : 9600
Bits : 8
Parity : None
Source : DTE & DCE
Display : Frame/Pack
Buffer : Ring
Suppress : None
TX Clock: DCE
ERR Check : CRC-CCITT

*** EMULATE MODE *** DCE

EMULATE : DCE
PROGRAM : ENABLE
LABEL 1
If Lead RTS is ON
    Then Goto Label 2
LABEL 2
Set Lead CTS ON
If DTR is ON
    Then Goto Label 3
LABEL 3
Set Lead DSR ON
(continued on next page)

(continued)
Wait [50]
Send String Text [03 43]
Wait [100]
Goto Label 4
LABEL 4
Send String Text [03 3F]
When String DTE=[01 00 10 01 FB 00 00]
    Then Goto Label 5
LABEL 5
Wait [100]
Send String Text [03 20 10 01 FF]
When String DTE=[01 22 10 01 0B 09 12 34 56 00 00 00]
    Then Goto Label 6
LABEL 6
Wait [100]
Send String Text [03 42 10 01 0F]
When String DTE=[01 44 10 01 00]
    Then Goto Label 7
LABEL 7
Wait [100]
Send String Text [03 64 10 01 21]
When String DTE=[01 66 10 01 02 31 31 31 31 31]
    Then Goto Label 8
LABEL 8
Wait [100]
Send String Text [03 06 10 01 41]
When String DTE=[01 08 10 01 04 32 32 32 32 32]
    Then Goto Label 9
LABEL 9
Wait [100]
(continued on next page)

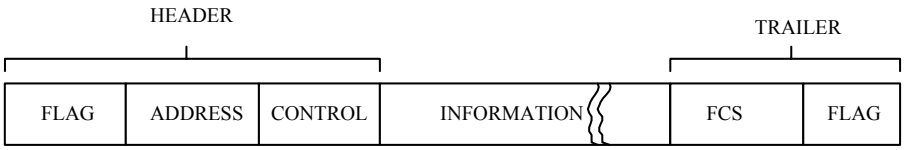
```
(continued)
Send String Text [03 28 10 01 61]
When String DTE=[01 2A 10 01 06 33 33 33 33 33]
        Then Goto Label 10
LABEL 10
Wait [100]
Send String Text [03 4A 10 01 01]
When String DTE=[01 4C 10 01 08 34 34 34 34 34]
        Then Goto Label 11
LABEL 11
Wait [100]
Send String Text [03 6C 10 01 21]
When String DTE=[01 6E 10 01 0A 35 35 35 35 35]
        Then Goto Label 12
LABEL 12
Wait [100]
Send String Text [03 0E 10 01 41]
When String DTE=[01 00 10 01 FF 36 36 36 36 36]
        Then Goto Label 13
LABEL 13
Wait [100]
Send String Text [03 20 10 01 61]
When String DTE=[01 22 10 01 0E 37 37 37 37 37]
        Then Goto Label 14
LABEL 14
Wait [100]
Send String Text [03 42 10 01 01]
When String DTE=[01 44 10 01 00]
        Then Goto Label 7
END.
```

The following program demonstrates the MONITOR mode for X.25 and tests response time.

```
   MONITOR MODE
PROGRAM: ENABLE
LABEL 1
STOP Capture
Reset TIMER 1
LABEL 2
WHEN String DTE= [01 22 10 01 0B 09 12 34 56 00 00 00]
        Then Goto Label [3]
LABEL 3
Start timer 1
WHEN String DCE= [03 42 10 01 0F]
        Then Goto Label [4]
WHEN timer 1 >=1000
        Then Goto Label [1]
LABEL 4
Stop timer 1
Stop test
*End*
```

5.3 SDLC APPLICATION

SDLC or Synchronous Data Link Control is a protocol developed by IBM in the early 1970's for use in SNA. At the time IBM developed SDLC, the predominant data link configuration consisted of a single primary station (typically a host computer or communications controller) connected to multiple secondary stations (typically terminals), using multipoint, half-duplex physical circuit. IBM's SDLC is a functional subset of HDLC and is compatible with the normal mode of HDLC. Refer to 5.4 for HDLC.



The three formats defined for the control field are used to perform;

- Numbered information transfer (I-format)
- Numbered supervisory functions (S-format)
- Unnumbered control functions (U-format).

CONTROL FIELD BITS

BIT ORDER	1	2	3	4	5	6	7	8
I frame format	0	N(S)			P/F	N(R)		
S frame format	1	0	S	S	P/F	N(R)		
U frame format	1	1	M	M	P/F	M	M	M

N(S) = Send sequence number
N(R) = Receive sequence number
P/F = Poll/Final bit
S = Supervisory bits
M = Modifier bits

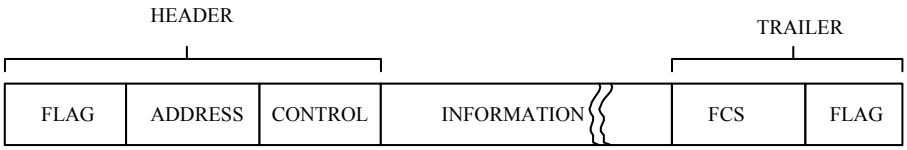
5.3.1 : Programming example for SDLC protocol.

```
EMULATE : DCE
PROGRAM : ENABLE
Label 1
Send String Text [01 01]              ;RR
Wait [100]
Send String Text [01 05]              ;RNR
Wait [100]
Send String Text [01 09]              ;REJ
Wait [100]
Send String Text [01 00 A B C D]      ;data
Wait [100]
```

notes:

5.4 HDLC APPLICATION

HDLC or High-Level Data Link is the ISO definition for a data link layer protocol specification for the wide area networking environment. The following defines the HDLC tranmission frame.



The example given in 5.3 for SDLC is also applicable for HDLC.

notes:

5.5 DDCMP APPLICATION

Developed by DIGITAL EQUIPMENT CORPORATION, DDCMP (DIGITAL Data Communication Message Protocol) is another protocol for wide area networking similar to HDLC. The following examples are for ASYNC mode.

(1) DATA MESSAGES

SYN	SYN	SOH	COUNT FLAGS	RESP	NUM	ADDR	BLKCK 1	DATA	BLKCK2
FF	FF	81	05 00	11	22	01	E1 14	41 42 43 44 45	91 ED

(2) CONTROL MESSAGES

a> ACK -- Acknowledge Message

SYN	SYN	ENQ	ACK FLAGS	RESP	FILL	ADDR	BLKCK3
FF	FF	05	01 00	01	00	01	

b> NAK -- Negative Acknowledge Message

SYN	SYN	ENQ	NAK FLAGS	RESP	FILL	ADDR	BLKCK3
FF	FF	05	02 03	22	00	01	

c> REP -- Reply to Message number

SYN	SYN	ENQ	REP FLAGS	FILL	NUM	ADDR	BLKCK3
FF	FF	05	03 80	00	12	01	

d> STRT -- Start Message

SYN	SYN	ENQ	STRT FLAGS	FILL	FILL	ADDR	BLKCK 3
FF	FF	05	06 40	00	00	01	

e> Stack -- Start Acknowledge Message

SYN	SYN	ENQ	STRT FLAGS	FILL	FILL	ADDR	BLKCK3
FF	FF	05	07 C0	00	00	01	

(3) Maintenance Message

SYN	SYN	DLE	COUNT FLAGS	FILL	FILL	ADDR	BLKCK1	DATA	BLKCK2
FF	FF	90	03 C0	00	00	01		31 32 33	

EXAMPLES OF DDCMP PROGRAMS

5.5.1 : Programming example DDCMP ASYN Emulate Mode for display status

```
EMULATE: DCE
PROGRAM: ENABLE
LABEL 1
Send String Text [ff ff 81 05 00 11 22 01 41 42 43 44 45] ;data msg.
Wait [100]
Send String Text [ff ff 05 01 00 01 00 01]          ;acknowledge
Wait [100]
Send String Text [ff ff 05 02 03 22 00 01]          ;negative ACK
Wait [100]
Send String Text [ff ff 05 03 80 00 12 01]          ;REP
Wait [100]
Send String Text [ff ff 05 06 40 00 00 01]          ;start msg. STRT
Wait [100]
Send String Text [ff ff 05 07 C0 00 00 01]          ;start ACK
Wait [100]
Send String Text [ff ff 90 03 C0 00 00 01 31 32 33] ;maint. msg.
*End*
```

After Executing ***RUN*** ,the display will look something like this on the ***HCT-6000's*** LCD.

Type	Flag	Rp	Nm	Add	Data	BCS
DATA	??	11	22	01	ABCDE	G
ACK	??	01	00	01	.....	G
NAK	??	22	00	01	.....	G
REP	S	00	12	01	.....	G
STRT	Q	00	00	01	.....	G
STCK	SQ	00	00	01	.....	G
MATN	SQ	00	00	01	123	G

5.5.2 : Programming example DDCMP ASYN Emulate Mode.

When "1" is pressed, send "TEST 1" string. When "2" is pressed, TEST 2" string is sent.

```
EMULATE : DTE
PROGRAM : ENABLE
LABEL 1
When Keyboard Key = [1]
        Then Goto Label [2]
When Keyboard Key = [2]
        Then Goto Label [3]
LABEL 2
Send String Text [ff ff 81 05 00 11 22 01 TEST 1]
Goto Label [1]
LABEL 3
Send String Text [ff ff 81 05 00 12 23 01 TEST 2]
Goto Label [1]
END.
```

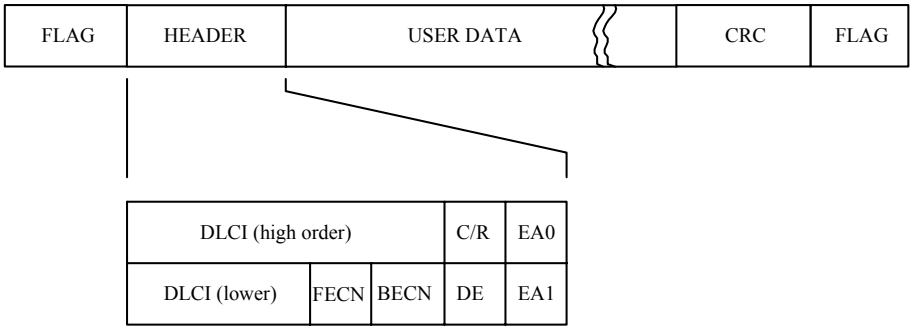
5.5.3 : Programming example, Start-up sequence with errors.

```
EMULATE: DTE
PROGRAM: ENABLE
LABEL 1
Start Timer 1
Reset Timer 1
Send String Text [ff ff 05 06 C0 00 00 01]
When String DCE = [ff ff 05 06 C0 00 00 01]
        Then Goto Label [2]
When Timer 1 >= [1000]
        Then Goto Label [1]
LABEL 2
Reset Timer 1
Send String Text [ff ff 05 07 C0 00 00 01]
Send String DCE = [ff ff 05 01 00 00 00 01]
        Then Goto Label [3]
When Timer 1 > = [1000]
        Then Goto Label [2]
LABEL 3
END.
```

5.6 FRAME RELAY APPLICATION

Frame relay is one of two new frame-mode services associated with ISDN (Integrated Services Digital Networks), the other being frame switching. The major difference between the two modes is the error and flow control procedures of frame switching. The procedures associated with frame services are defined in CCITT recommendation I.122/Q.922. Detailed analysis is beyond the scope of this manual.

With frame relay, multiplexing of multiple virtual circuits and routing are performed at the data link layer, resulting in lower processing overheads per packet and higher bit rates. Subsequently, although defined for use with ISDN, frame relay is also finding widespread use in private networks.



DLCI - Data Link Connection Identifier
C/R - Command/Response bit
FECN - Forward Explicit Congestion Notification
BECN - Backward Explicit Congestion Notification
DE - Discard Eligibility bit
EA - Extended Address bit

5.6.1 : Programming example for Frame Relay protocol.

MANUAL CONFIGURATION

Protocol : FRAME_REL.
Code : EBCDIC
Speed : 9600
Bits : 8
Parity : None
Source : DTE & DCE
Display : Frame/Pack
Buffer : Ring
Suppress : None
Tx Clock : DCE
ERR Check : CRC-CCITT
Mode : Normal

EMULATE : DTE
PROGRAM : ENABLE
Label 1
Send String Text [00 11 C1 C2 C3 C4 C5 C6 C7 C8 C9 D1 D2 D3 D4 D5 D6]
END.

View of LCD display after running sample program.

5.7 TCP/IP APPLICATIONS

Transmission Control Protocol/Internet Protocol (TCP/IP) provides connectivity for computers with widely different operating systems. It uses a set of networking protocols originally developed by the US Department of Defense (DOD) in the mid-1970's.

The TCP/IP protocol suite was first developed to be the networking protocol of the Internet. TCP/IP comes as a built in part of many versions of UNIX and has become synonymous with UNIX networking. It has also been implemented on all operating systems, including DOS, Macintosh, and VMS.

The DOD model of the TCP/IP protocol suite consists of four layers.

DO) Layer	Description
Process/Application	Interface to user. Provides specific applications between two hosts.
Host-to-Host	Maintains data integrity and sets up reliable end-to-end communication between systems. Ensures error-free delivery of data units, in proper sequence, and with no loss or duplication.
Internet	Routes packets between different hosts or networks.
Network Access	Defines physical interconnection between hosts.

Table 5-1 : **DOD Layers**

The specifications for each protocol within the TCP/IP suite are defined with one or more "Requests for Comments" (RFC). Electronic copies of all RFCs may be obtained by anonymous FTP from ds.internic.net and other servers throughout the Internet.

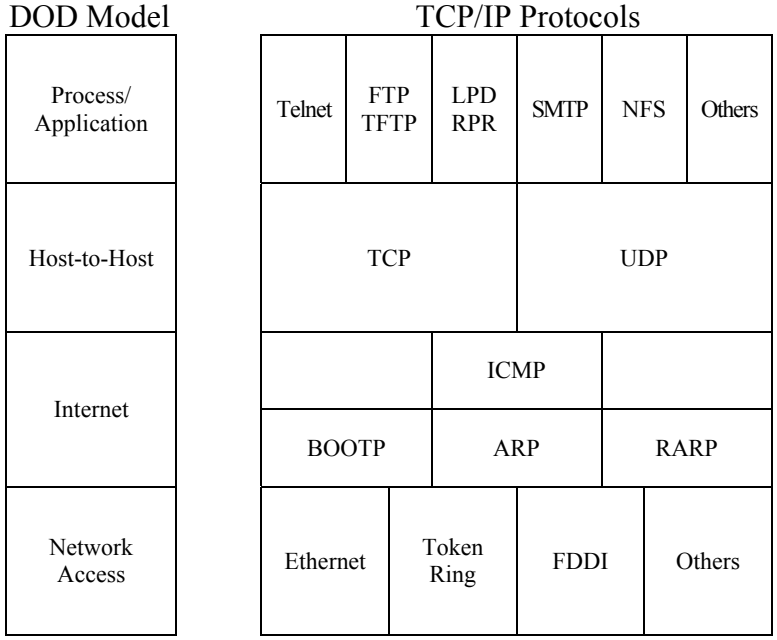


Figure V-1 : **TCP/IP protocols and DOD model relationship**

TCP/IP applications usually include a client and a server program. The server program is often referred to as a *daemon*. Telnet (terminal emulation), File Transfer Protocol (FTP), Network File System (NFS), Simple Mail Transfer Protocol (SMTP), Line Printer Daemon (LPD), Remote Printing (RPR), and Simple Network Management Protocol (SNMP) are all examples of TCP/IP applications.

The Host-to-Host layer of the TCP/IP protocol suite consists of the Transmission Control Protocol (TCP) and the User Datagram Protocol (UDP).

TCP provides a reliable, virtual circuit connection. TCP connections begin with a client requesting a virtual connection from a remote host. No communication is possible until the remote host responds. Whenever a message is sent to a host, an acknowledgment packet is returned. Periodically, packets may be exchanged just to make sure the connection has not been lost. Each host will notify the other when the connection is to be closed.

UDP protocol can be compared to your postal service. To send data to a remote host, the data is simply transmitted. No acknowledgment is expected. The UDP protocol provides a faster transport than TCP at the expense of ensuring reliable delivery.

Protocols	Description
Internet Protocol (IP)	Provides datagram service between hosts. Responsible for packet routing, fragmentation, and reassembly.
Internet Control Message Protocol (ICMP)	Used to send error and control messages to hosts and routers.
Address resolution Protocol (ARP)	Used to translate a remote host's software address to a MAC address.
Reverse Address Resolution Protocol (RARP)	Used by diskless workstations to translate their MAC addresses to a software address.
BootP	Used by diskless workstations to discover their IP address, the address of a server host, and the name of a file to be loaded and executed at boot time.

The primary purpose of the Internet layer protocols is to route packets between different hosts. Connecting different local area networks together can create a complicated maze. The hosts may be located on different networks separated by several routers.

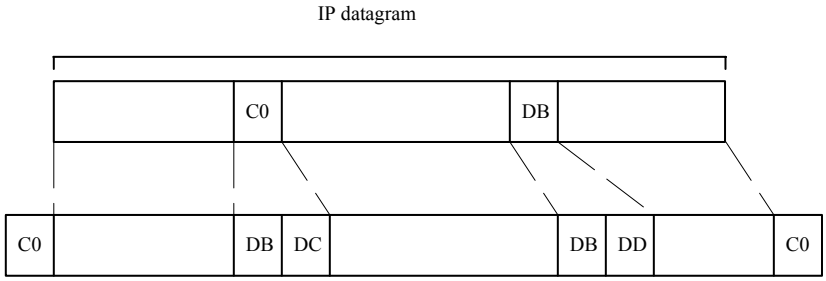
The Network Access layer defines the physical connection between hosts on the network. Specifications for the network interface boards, cabling, and network topology are defined at this layer. The Network Access protocol encapsulates the packet within a frame that is transmitted across the network. When the frame reaches its destination, data is passed up through the four layers. Each layer strips off the appropriate header, processes the data, and passes the remaining data to the next layer until it reaches the application.

The ***HCT-6000*** is capable of analyzing IP encapsulated with SLIP, asynchronous PPP or synchronous PPP.

Serial Line IP (SLIP) is a simple form of encapsulation for IP datagrams on serial lines. The following rules apply to SLIP framing:

1. The IP datagram is terminated by the special character END (0xc0). Most implementations transmit an END character at the beginning of the datagram as well.
2. If a byte of the IP datagram equals the END character, a two-byte sequence 0xdb, 0xdc is transmitted instead.
3. If a byte of the IP datagram equals the SLIP ESC character (0xdb), the two-byte sequence 0xdb, 0xdd is transmitted instead.

The following is a framing example in which the IP datagram includes both an ESC and END characters.



SLIP encapsulation

5.7.1 : Programming example for SLIP protocol.

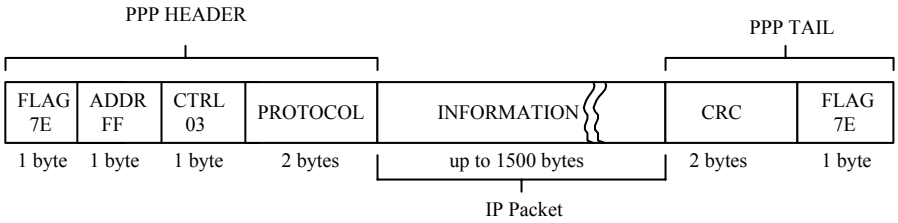
MANUAL CONFIGURATION (note: Auto Config. will not detect TCP/IP)

Protocol : SLIP
Code : ASCII
Speed : 9600
Stop Bit : 1
Bit Sense : Normal
Source : DTE & DCE
Display : Frame/Pack
Buffer : Ring
Suppress : None

EMULATE : DCE
PROGRAM : ENABLE
Label 1
Send String Text [45 00 00 2C 12 34 00 00 80 06 00 00 12 34 56 78 90 12 34 56 12 34 56 78 00 00 00 01 00 00 00 01 50 00 00 04 12 34 00 00 41 42 43 44 45]
END.

Point-to-Point Protocol (PPP) corrects all the deficiencies in SLIP. PPP consists of three components.

1. A way to encapsulate IP datagrams on a serial link. PPP supports either an asynchronous link with 8 bits of data and no parity or bit-oriented synchronous links.
2. A link control protocol (LCP) to establish, configure, and test the data-link connection.
3. A family of network protocols (NCP) specific to different network layer protocols.



Format of PPP frames

The two protocol bytes identify the frame type as follows.

1. 0021 Internet Protocol (IP datagram)
2. C021 Link Control Protocol
3. 8021 Network Control Protocol
4. 0041 Cisco Systems Protocol
5. 8041 Cisco Systems Control Protocol
6. 80FD Compression Control Protocol
7. C023 Password Authentication Protocol

PPP also uses two byte escape sequences when flag characters are in the information field. On a synchronous link, this is done by the hardware using a technique called bit stuffing. On asynchronous links, a special byte 0x7D is used and is handled by the software. Bit stuffing and escape flag bytes are handled automatically by the ***HCT-6000***.

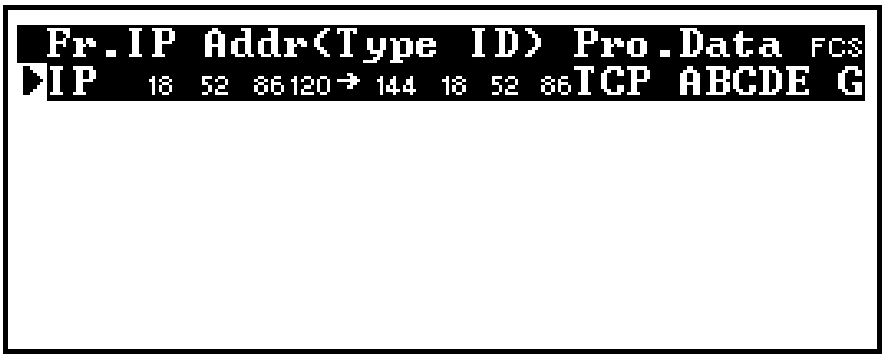
5.7.2 : Programming examples for PPP protocol.

MANUAL CONFIGURATION (note: Auto Config. will not detect TCP/IP)

Protocol : PPP (Async)
Code : ASCII
Speed : 9600
Stop Bit : 1
Bit Sense : Normal
Source : DTE & DCE
Display : Frame/Pack
Buffer : Ring
Suppress : None

Example #1. Send IP datagram, data=ABCDE

EMULATE : DCE
PROGRAM : ENABLE
Label 1
Send String Text [FF 03 00 21 45 00 00 2C 12 34 00 00 80 06 00 00 12 34 56 78 90 12 34 56 12 34 56 78 00 00 00 01 00 00 00 01 50 00 00 04 12 34 00 00 41 42 43 44 45]
END.



HCT-6000 **Screen Results**

Example #2. Send link control protocol

EMULATE : DCE
PROGRAM : ENABLE
Label 1
Send String Text [FF 03 C0 21 02 01 00 0C 01 04 05 DC 07 02 08 02]
END.

HCT-6000 **Screen Results**

Example #3. Send network control protocol

EMULATE : DCE
PROGRAM : ENABLE
Label 1
Send String Text [FF 03 80 21 03 01 00 0A 03 06 A8 5F 64 E9]
END.

HCT-6000 **Screen Results**

note: The following packets are available in the ***HCT-6000*** PPP protocol.

LCP	FF 03	C0 21	Packet Type	ID	Length	- - - -
	2	2	1	1	2	bytes
LCP		C0 21	Packet Type	ID	Length	- - - -
		2	1	1	2	bytes
NCP	FF 03	80 21	Packet Type	ID	Length	- - - -
	2	2	1	1	2	bytes
NCP		80 21	Packet Type	ID	Length	- - - -
		2	1	1	2	bytes
IP	FF 03	00 21	IP DATAGRAM - - - -			
	2	2	bytes			
IP		00 21	IP DATAGRAM - - - -			
		2	bytes			
IP		21	IP DATAGRAM - - - -			
		1	byte			

LCD display packet type abbreviations.

LCD Abbrev.	Meaning
????	unknown
Conf.-Req	Configure-Request
Conf.-Ack	Configure-Ack
Conf.-Nak	Configure-Nak
Conf.-Rej	Configure-Reject
Term.-Req	Terminate-Request
Term.-Ack	Terminate-Ack
Code -Rej	Code-Reject
Prot.-Rej	Protocol-Reject
Echo -Req	Echo-Request
Echo -Rep	Echo-Reply
Disc.-Req	Discard-Request
Identific	Identification
Time-Rema	Time-Remaining
Reset-Req	Reset-Request
Reset-Rep	Reset-Reply

CHAPTER VI : HCT-PC UTILITY PROGRAM

6.0 INTRODUCTION

The application program, ***HCT-PC***, for the ***HCT-6000*** is an easy to use, menu-driven program which runs on any **IBM PC, PC/AT ®**[1] or compatible computer, running **MS-DOS ®**[2]. The ***HCT-PC*** utility program facilitates the remote control functions, the uploading, downloading, viewing and analyzing of files and programs, and the on-line monitoring functions for the ***HCT-6000.***

This chapter will explain in detail the three major functions of the ***HCT-PC*** software program:

1. General terminal functions for ***REMOTE CONTROL***.
2. Up/Download functions for ***UP/DOWNLOAD***.
3. On-line Monitor functions for ***ONLINE***.

The hardware and software requirements for ***HCT-PC*** are as follows:

1. One ***HCT-6000***.
2. One 80X86 class PC.
3. Recommend 8MB PC memory.
4. Hard disk storage based upon capacity of data to be stored.
5. MS-DOS operating system version 3.3 or above.
6. ***HCT-PC*** program copied to PC hard disk.
7. Remote Cable (refer to ***Appendix, B-5***).
8. Parallel Cable (refer to ***Appendix, B-8***).
9. Pair of modems and null-modem cables (Optional).

1. IBM and IBM PC are registered trademarks of International Business Machines Corp.
2. MS-DOS is a registered trademark of Microsoft Corp.

6.1 *HCT-PC* Program Operation

First install the application from the program diskette to your PC's hard drive. From your computer's hard drive prompt:

c:\>**md hct6000** ;create a directory for program files
c:\>**cd hct6000** ;change directory
c:\hct6000>**copy a:*.*** ;copy all files from diskette
to run the application:
c:\hct6000>**hct-pc**

6.2 *REMOTE CONTROL* Function - F1

6.2.1 Connection Method

The remote PC can control the ***HCT-6000*** by direct connection or via dial-up MODEM as displayed in the following figures.

Figure 6-1 : **Direct Connection**

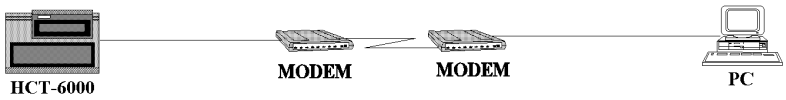


Figure 6-2 : **Dial-up MODEM Connection**

Direct connection is made between the PC's communication port, COM1:, COM2:, COM3:, or COM4:, and the DB9 Remote Control port connector on the ***HCT-6000*** with the supplied Remote cable. When using a dial-up connection, a null cable (***Appendix B-9***) must be used on the ***HCT-6000*** side.

When using ***REMOTE CONTROL***, the following functions of the ***HCT-6000*** may be controlled remotely:

1. Start Emulation program.
2. Start Monitor program.
3. Start 128K BERT testing.
4. Start 2M BERT testing.

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 terminal or by using a different terminal emulation program on your PC.

Operation of ***REMOTE CONTROL*** involves simply connecting the ***HCT-6000*** as shown in **figure 6-1** or **6-2**. When powered on, the ***HCT-6000*** will initialize and check for an active connection on its Remote Port. In this mode, the key beep feature will be disabled. At this point, simply press the space bar twice on the PC and the terminal will display the remote screen.

To exit, press the zero key on PC. The ***HCT-6000*** will disable CTS/DSR and DTR, wait 2 seconds and then exit. If you are using modem connections, they will automatically hang up when DTR drops.

6.3 *UP/DOWNLOAD* Function

6.3.1 Connection Method

The connection for ***UP/DOWNLOAD*** is made by connecting the ***HCT-6000's*** communications interface port to your PC's COM1 or COM2 port.

6.3.2 Operation

Selecting F2 from the ***HCT-PC*** startup menu will place the PC in the ***UP/DOWNLOAD*** functional mode.

All the operations in ***UP/DOWNLOAD*** are carried out via a very user friendly pull-down menu system. The screen display consists of three distinct areas, a command line along the top, a data area below that, and a status/help/prompt line at the bottom.

All commands are executed by single "FUNCTION KEY" key strokes, by highlighting options with the up/down/left/right cursor movement keys followed by "ENTER", or by "ALT" key combinations. The 'ESC' key is used to gracefully back-out of any menu.

6.3.3 Functional Description

UP/DOWNLOAD has 7 basic functions

< F1 > File :	Files handling
< F2 > Display :	Data examination
< F3 > Analysis :	Data analysis
< F4 > Search :	Date string search
< F5 > Parameter :	Protocol status
< F6 > Print :	Hard copy utility
< F7 > Mode :	Hex/Text toggle key

6.3.3 Functional Description (continued)

After starting ***UP/DOWNLOAD***, press <ENTER> to bypass the startup logo. The command line at the top of the screen should display the seven functions.

The first action in running the program is to determine which file operation must be performed. Press <F1> and the file pull-down menu will appear.

Select File	[Alt-A] choose a file for display
Upload	[Alt-U]..utility to save ***HCT-6000*** data to PC
Download	[Alt-D] utility to restore data from PC to ***HCT-6000***
Directory	[Alt-E] lists files in the PC directory, uses DOS wildcards
DOS Shell	[Alt-S] temporarily suspends ***UP/DOWNLOAD*** operation, enters DOS
Exit	[Alt-X] leave the ***UP/DOWNLOAD*** program

Before display, analysis, search, parameter, print, or mode can be performed, a file must first be "selected" for opening. The directory command can be used to display the filenames on the disk and in the directory from which ***UP/DOWNLOAD*** is run. If you are just starting ***UP/DOWNLOAD*** for the first time, you will not have any data files to display. You will need to use ***File/Upload*** to upload data from the ***HCT-6000*** for later analysis.

6.3.4 Upload Procedure

1. Connect ***HCT-6000*** communication interface port to any COM port on the PC.
2. Start ***HCT-PC*** software on the PC.
3. Select ***UP/DOWNLOAD*** (F2) from the top menu line.
4. On the PC, Press <ENTER> to exit start-up logo screen.
5. On the PC, Press <F1> for file functions.
6. On the PC, Select the Upload option and press <ENTER>.
7. On the PC, Select the appropriate COM port and press <ENTER>.
8. At the prompt, Enter any legal filename using DOS conventions and press <ENTER>.
9. On the ***HCT-6000***, press in order:
   MORE, MORE,MORE,F3, and then **RUN**

   Data will be transferred from the ***HCT-6000*** to the PC and written to a disk file. Upon successful transfer, the ***HCT-6000*** will display the message "UPLOAD COMPLETE!".

6.3.5 Download Procedure

NOTE: In order for data to be properly restored to the ***HCT-6000***, the original file saved to the ***HCT-6000***'s internal memory must have been saved with the "ALL" option.

With the same connections made as in the upload procedure;
1. Start ***HCT-PC*** software on the PC.
2. Select ***UP/DOWNLOAD*** (F2) from the top menu line.
3. On the PC, Press <ENTER> to exit start-up logo screen.
4. On the PC, press <F1> for file functions.
5. On the PC, select the Download option and press <ENTER>.

6.3.5 Download Procedure (continued)

6. On the PC, Select the appropriate COM port and press <ENTER>.
7. At the prompt, Enter the filename of the data stored on disk and press <ENTER>.
8. On the ***HCT-6000***, press in order;

MORE, MORE, F3, ⇨ ⇩ ENTER, RUN

Data transfer will commence and will be completed when the ***HCT-6000*** displays the message "DOWNLOAD COMPLETE!"

Descriptions of the remaining functions in ***UP/DOWNLOAD***.

<F3> Data analysis will give a quantitative break down of data types (XON, XOFF, ACK, NAK, PARITY, etc.) for both DTE and DCE.

<F4> The search function is used to locate a hex string forwards or backwards for DTE or DCE.

<F5> Parameter function gives a listing of transmission protocol type along with the parameter settings for baud, data bits, stop bits, and parity settings.

<F6> The print function allows printing of the displayed screen, all data, or selected data. Data is selected for printing by using the page up/down keys.

<F7> While displaying data, <F7> toggles the data display mode between hexadecimal and ASCII.

To exit ***UP/DOWNLOAD***, pull down the File menu by pressing <F1> and select the exit ***UP/DOWNLOAD*** option or press <ALT> X.

6.4 *ON-LINE MONITOR* FUNCTION

6.4.1 Overview of ON-LINE MONITOR F3

When using the on-line monitor function for the ***HCT-6000***, on-line traffic can be decoded by and stored on the PC.

6.4.2 Connection Method

The PC monitors the ***HCT-6000*** via a parallel connection between the PC and the ***HCT-6000***. A special parallel cable (refer to ***Appendix B-8***) is provided for the ***ON-LINE MONITOR*** function. Connect the cable between the ***HCT-6000's*** printer port and LPT1: or LPT2: on the PC.

6.4.3 Operation

Selecting F3 from the ***HCT-PC*** startup menu will place the PC in the ***ON-LINE MONITOR*** functional mode. The ***HCT-6000*** will link to the PC for real-time online analysis of online traffic. The ***ONLINE MONITOR*** provides the following functions:

1. Decode and display on-line traffic.
2. Store captured data to PC hard disk.
3. Examine the captured data.

6.5 EXIT PROGRAM

To exit the ***HCT-PC*** program, use ALT-X or the right arrow key to highlight Exit and press Enter. Confirm with "y" and the ***HCT-PC*** program will terminate and return to DOS.

ASCII Character Code Table

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
0	00000000	00	NU	NUL	Null
1	00000001	01	SH	SOH	Start Of Header
2	00000010	02	SX	STX	Start Of Text
3	00000011	03	EX	ETX	End Of Text
4	00000100	04	ET	EOT	End Of Transmission
5	00000101	05	EQ	ENQ	Inquiry
6	00000110	06	AK	AC K	Acknowledge
7	00000111	07	BL	BEL	Bell
8	00001000	08	BS	BS	Back Space
9	00001001	09	HT	HT	Horizontal Tab
10	00001010	0A	LF	LF	Line Feed
11	00001011	0B	VT	VT	Vertical Tab
12	00001100	0C	FF	FF	Form Feed
13	00001101	0D	CR	CR	Carriage Return
14	00001110	0E	SO	SO	Shift Out
15	00001111	0F	SI	SI	Shift In
16	00010000	10	DL	DLE	Data Link Escape
17	00010001	11	D1	DC1	Device Control 1
18	00010010	12	D2	DC2	Device Control 2
19	00010011	13	D3	DC3	Device Control 3
20	00010100	14	D4	DC4	Device Control 4
21	00010101	15	NK	NAK	Neg Acknowledge
22	00010110	16	SY	SYN	Synchronous Idle
23	00010111	17	EB	ETB	End of Trans Block
24	00011000	18	CN	CAN	Cancel
25	00011001	19	EM	EM	End of Medium
25	00011010	1A	SB	SUB	Substitute
26	00011011	1B	EC	ESC	Escape
28	00011100	1C	FS	FS	File Separator
29	00011101	1D	GS	GS	Group Separator
30	00011110	1E	RS	RS	Record Separator
31	00011111	1F	US	US	Unit Separator

ASCII Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
32	00100000	20	SP	Space	
33	00100001	21	!		
34	00100010	22	"		
35	00100011	23	#		
36	00100100	24	$		
37	00100101	25	%		
38	00100110	26	&		
39	00100111	27	'		
40	00101000	28	(		
41	00101001	29	)		
42	00101010	2A	*		
43	00101011	2B	+		
44	00101100	2C	,		
45	00101101	2D	-		
46	00101110	2E	.		
47	00101111	2F	/		
48	00110000	30	0		
49	00110001	31	1		
50	00110010	32	2		
51	00110011	33	3		
52	00110100	34	4		
53	00110101	35	5		
54	00110110	36	6		
55	00110111	37	7		
56	00111000	38	8		
57	00111001	39	9		
58	00111010	3A	:		
59	00111011	3B	;		
60	00111100	3C	<		
61	00111101	3D	=		
62	00111110	3E	>		
63	00111111	3F	?		

ASCII Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
64	01000000	40	@		
65	01000001	41	A		
66	01000010	42	B		
67	01000011	43	C		
68	01000100	44	D		
69	01000101	45	E		
70	01000110	46	F		
71	01000111	47	G		
72	01001000	48	H		
73	01001001	49	I		
74	01001010	4A	J		
75	01001011	4B	K		
76	01001100	4C	L		
77	01001101	4D	M		
78	01001110	4E	N		
79	01001111	4F	O		
80	01010000	50	P		
81	01010001	51	Q		
82	01010010	52	R		
83	01010011	53	S		
84	01010100	54	T		
85	01010101	55	U		
86	01010110	56	V		
87	01010111	57	W		
88	01011000	58	X		
89	01011001	59	Y		
90	01011010	5A	Z		
91	01011011	5B	[		
92	01011100	5C	\		
93	01011101	5D	]		
94	01011110	5E	^		
95	01011111	5F	_		

ASCII Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
96	01100000	60	`		
97	01100001	61	a		
98	01100010	62	b		
99	01100011	63	c		
100	01100100	64	d		
101	01100101	65	e		
102	01100110	66	f		
103	01100111	67	g		
104	01101000	68	h		
105	01101001	69	i		
106	01101010	6A	j		
107	01101011	6B	k		
108	01101100	6C	I		
109	01101101	6D	m		
110	01101110	6E	n		
111	01101111	6F	o		
112	01110000	70	p		
113	01110001	71	q		
114	01110010	72	r		
115	01110011	73	s		
116	01110100	74	t		
117	01110101	75	u		
118	01110110	76	v		
119	01110111	77	w		
120	01111000	78	x		
121	01111001	79	y		
122	01111010	7A	z		
123	01111011	7B	{		
124	01111100	7C	|		
125	01111101	7D	}		
126	01111110	7E	~		
127	01111111	7F	■	DEL	Delete

EBCDIC Character Code Table

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
0	00000000	00	NU	NUL	NuII
1	00000001	01	SH	SOH	Start Of Header
2	00000010	02	SX	STX	Start Of Text
3	00000011	03	EX	ETX	End Of Text
4	00000100	04	PF	PF	Punch Off
5	00000101	05	HT	HT	Horizontal Tab
6	00000110	06	LC	LC	Lower Case
7	00000111	07	DL	DEL	Delete
8	00001000	08	(HEX)		
9	00001001	09	RF	RLF	
10	00001010	OA	SM	SMM	Start Manual Msg
11	00001011	OB	VT	VT	Vertical Tab
12	00001100	OC	FF	FF	Form Feed
13	00001101	OD	CR	CR	Carriage Return
14	00001110	OE	SO	SO	Shift Out
15	00001111	OF	SI	SI	Shift In
16	00010000	10	DL	DLE	Data Link Escape
17	00010001	11	D1	DC1	Device Control 1
18	00010010	12	D2	DC2	Device Control 2
19	00010011	13	D3	DC3	Device Control 3
20	00010100	14	RE	RES	Restore
21	00010101	15	NL	NL	New Line
22	00010110	16	BS	BS	Back Space
23	00010111	17	IL	IL	Idle
24	00011000	18	CN	CAN	Cancel
25	00011001	19	EM	EM	End of Medium
26	00011010	1A	CC	CC	Cursor Control
27	00011011	1B	C1	CU1	
28	00011100	1C	FS	IFS	Info File Sep.
29	00011101	1D	GS	IGS	Info Group Sep.
30	00011110	1E	RS	IRS	Info Record Sep.
31	00011111	1F	US	IUS	Info Unit Sep.

EBCDIC Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
32	00100000	20	DS	DS	Digit Select
33	00100001	21	SS	SOS	Start of Significance
34	00100010	22	FS	FS	Field Separator
35	00100011	23	(HEX)		
36	00100100	24	BP	BYP	Bypass
37	00100101	25	LF	LF	Line Feed
38	00100110	26	EB	ETB	End of Trans Block
39	00100111	27	EC	ESC	Escape
40	00101000	28	(HEX)		
41	00101001	29	(HEX)		
42	00101010	2A	SM	SM	Set Mode
43	00101011	2B	C2	CU2	
44	00101100	2C	(HEX)		
45	00101101	2D	EQ	ENQ	Inquiry
46	00101110	2E	AK	ACK	Acknowledge
47	00101111	2F	BL	BEL	Bell
48	00110000	30	(HEX)		
49	00110001	31	(HEX)		
50	00110010	32	SY	SYN	Synchronous Idle
51	00110011	33	(HEX)		
52	00110100	34	PN	PN	Punch On
53	00110101	35	RS	RS	Reader Stop
54	00110110	36	UC	UC	Upper Case
55	00110111	37	ET	EOT	End of Transmission
56	00111000	38	(HEX)		
57	00111001	39	(HEX)		
58	00111010	3A	(HEX)		
59	00111011	3B	C3	CU3	
60	00111100	3C	D4	DC4	Device Control 4
61	00111101	3D	NK	NAK	Negative Acknowledge
62	00111110	3E	(HEX)		
63	00111111	3F	SB	SUB	Substitute

EBCDIC Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
64	01000000	40	SP	Space	
65	01000001	41	(HEX)		
66	01000010	42	(HEX)		
67	01000011	43	(HEX)		
68	01000100	44	(HEX)		
69	01000101	45	(HEX/		
70	01000110	46	(HEX)		
71	01000111	47	(HEX)		
72	01001000	48	(HEX)		
73	01001001	49	(HEX)		
74	01001010	4A			
75	01001011	4B			
76	01001100	4C	<		
77	01001101	4D	(		
78	01001110	4E	+		
79	01001111	4F	!		
80	01010000	50	&		
81	01010001	51	(HEX)		
82	01010010	52	(HEX)		
83	01010011	53	(HEX)		
84	01010100	54	(HEX)		
85	01010101	55	(HEX)		
86	01010110	56	(HEX)		
87	01010111	57	(HEX)		
88	01011000	58	(HEX)		
89	01011001	59	(HEX)		
90	01011010	5A	!		
91	01011011	5B	$		
92	01011100	5C	*		
93	01011101	5D	)		
94	01011110	5E	;		
95	01011111	5F			

EBCDIC Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
96	01100000	60	-		
97	01100001	61	/		
98	01100010	62	(HEX)		
99	01100011	63	(HEX)		
100	01100100	64	(HEX)		
101	01100101	65	(HEX)		
102	01100110	66	(HEX)		
103	01100111	67	(HEX)		
104	01101000	68	(HEX)		
105	01101001	69	(HEX)		
106	01101010	6A			
107	01101011	6B			
108	01101100	6C	%		
109	01101101	6D	-		
110	01101110	6E	>		
111	01101111	6F	?		
112	01110000	70	(HEX)		
113	01110001	71	(HEX)		
114	01110010	72	(HEX)		
115	01110011	73	(HEX)		
116	01110100	74	(HEX)		
117	01110101	75	(HEX)		
118	01110110	76	(HEX)		
119	01110111	77	(HEX)		
120	01111000	78	(HEX)		
121	01111001	79			
122	01111010	7A	:		
123	01111011	7B	#		
124	01111100	7C	@		
125	01111101	7D	,		
126	01111110	7E	=		
127	01111111	7F	"		

EBCDIC Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
128	10000000	80	(HEX)		
129	10000001	81	a		
130	10000010	82	b		
131	10000011	83	c		
132	10000100	84	d		
133	10000101	85	e		
134	10000110	86	f		
135	10000111	87	g		
136	10001000	88	h		
137	10001001	89	i		
138	10001010	8A	(HEX)		
139	10001011	8B	(HEX)		
140	10001100	8C	(HEX)		
141	10001101	8D	(HEX)		
142	10001110	8E	(HEX)		
143	10001111	8F	(HEX)		
144	10010000	90	(HEX)		
145	10010001	91	j		
146	10010010	92	k		
147	10010011	93	l		
148	10010100	94	m		
149	10010101	95	n		
150	10010110	96	o		
151	10010111	97	p		
152	10011000	98	q		
153	10011001	99	r		
154	10011010	9A	(HEX)		
155	10011011	9B	(HEX)		
156	10011100	9C	(HEX)		
157	10011101	9D	(HEX)		
158	10011110	9E	(HEX)		
159	10011111	9F	(HEX)		

EBCDIC Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
160	10100000	A0	(HEX)		
161	10100001	A1			
162	10100010	A2	s		
163	10100011	A3	t		
164	10100100	A4	u		
165	10100101	A5	v		
166	10100110	A6	w		
167	10100111	A7	x		
168	10101000	A8	y		
169	10101001	A9	z		
170	10101010	AA	(HEX)		
171	10101011	AB	(HEX)		
172	10101100	AC	(HEX)		
173	10101101	AD	(HEX)		
174	10101110	AE	(HEX)		
175	10101111	AF	(HEX)		
176	10110000	B0	(HEX)		
177	10110001	B1	(HEX)		
178	10110010	B2	(HEX)		
179	10110011	B3	(HEX)		
180	10110100	B4	(HEX)		
181	10110101	B5	(HEX)		
182	10110110	B6	(HEX)		
183	10110111	B7	(HEX)		
184	10111000	B8	(HEX)		
185	10111001	B9	(HEX)		
186	10111010	BA	(HEX)		
187	10111011	BB	(HEX)		
188	10111100	BC	(HEX)		
189	10111101	BD	(HEX)		
190	10111110	BE	(HEX)		
191	10111111	BF	(HEX)		

EBCDIC Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
192	11000000	C0		Space	
193	11000001	C1	A		
194	11000010	C2	B		
195	11000011	C3	C		
196	11000100	C4	D		
197	11000101	C5	E		
198	11000110	C6	F		
199	11000111	C7	G		
200	11001000	C8	H		
201	11001001	C9	I		
202	11001010	CA	(HEX)		
203	11001011	CB	(HEX)		
204	11001100	CC			
205	11001101	CD	(HEX)		
206	11001110	CE	Y		
207	11001111	CF	(HEX)		
208	11010000	D0			
209	11010001	D1	J		
210	11010010	D2	K		
211	11010011	D3	L		
212	11010100	D4	M		
213	11010101	D5	N		
214	11010110	D6	O		
215	11010111	D7	P		
216	11011000	D8	Q		
217	11011001	D9	R		
218	11011010	DA	(HEX)		
219	11011011	DB	(HEX)		
220	11011100	DC	(HEX)		
221	11011101	DD	(HEX)		
222	11011110	DE	(HEX)		
223	11011111	DF	(HEX)		

EBCDIC Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	MNEMONIC	DESCRIPTION
224	11100000	E0	\		
225	11100001	E1	(HEX)		
226	11100010	E2	S		
227	11100011	E3	T		
228	11100100	E4	U		
229	11100101	E5	V		
230	11100110	E6	W		
231	11100111	E7	X		
232	11101000	E8	Y		
233	11101001	E9	Z		
234	11101010	EA	(HEX)		
235	11101011	EB	(HEX)		
236	11101100	EC	(HEX)		
237	11101101	ED	(HEX)		
238	11101110	EE	(HEX)		
239	11101111	EF	(HEX)		
240	11110000	F0	0		
241	11110001	F1	1		
242	11110010	F2	2		
243	11110011	F3	3		
244	11110100	F4	4		
245	11110101	F5	5		
246	11110110	F6	6.		
247	11110111	F7	7		
248	11111000	F8	8		
249	11111001	F9	9		
250	11111010	FA	|		
251	11111011	FB	(HEX)		
252	11111100	FC	(HEX)		
253	11111101	FD	(HEX)		
254	11111110	FE	(HEX)		
255	11111111	FF	(HEX)		

IPARS Character Code Table

DEC	BINARY	HEX	DISPLAY	DESCRIPTION
0	000000	00	(HEX)	
1	000001	01	1	
2	000010	02	2	
3	000011	03	3	
4	000100	04	4	
5	000101	05	5	
6	000110	06	6	
7	000111	07	7	
8	001000	08	8	
9	001001	09	9	
10	001010	0A	0	
11	001011	0B	*	
12	001100	0C	CR	Carriage Return
13	001101	0D	EI	End of Medium, Incomplete
14	001110	0E	=	Sense
15	001111	0F	(HEX)	Go Ahead
16	010000	10	(HEX)	Write
17	010001	11	/	
18	010010	12	S	
19	010011	13	T	
20	010100	14	U	
21	010101	15	V	
22	010110	16	W	
23	010111	17	X	
24	011000	18	Y	
25	011001	19	Z	
26	011010	1A	-	
27	011011	1B	#	
28	011100	1C	Sp	Space
29	011101	1D	EC	End of Medium, Complete
30	011110	1E	[	Start
31	011111	1F		

IPARS Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	DESCRIPTION
32	100000	20	@	
33	100001	21	J	
34	100010	22	K	
35	100011	23	L	
36	100100	24	M	
37	100101	25	N	
38	100110	26	O	
39	100111	27	P	
40	101000	28	Q	
41	101001	29	R	
42	101010	2A	:	UMSG
43	101011	2B	<	
44	101100	2C	+	
45	101101	2D	EU	End of Medium, Unsolicited
46	101110	2E	)	
47	101111	2F	(	
48	110000	30	$	
49	110001	31	A	
50	110010	32	B	
51	110011	33	C	
52	110100	34	D	
53	110101	35	E	
54	110110	36	F	
55	110111	37	G	
56	111000	38	H	
57	111001	39	I	
58	111010	3A	?	
59	111011	3B	*	
60	111100	3C	%	
61	111101	3D	EP	End of Medium, Pushbutton
62	111110	3E	S2	Sync 2
63	111111	3F	S1	Sync 1, Reset

TRANSCODE Character Code Table

DEC	BINARY	HEX	DISPLAY	DESCRIPTION
0	000000	00	SH	
1	000001	01	A	
2	000010	02	B	
3	000011	03	C	
4	000100	04	D	
5	000101	05	E	
6	000110	06	F	
7	000111	07	G	
8	001000	08	H	
9	001001	09	I	
10	001010	0A	SX	
11	001011	0B	.	
12	001100	0C	<	
13	001101	0D	BL	
14	001110	0E	SB	
15	001111	0F	EB	
16	010000	10	&	
17	010001	11	J	
18	010010	12	K	
19	010011	13	L	
20	010100	14	M	
21	010101	15	N	
22	010110	16	O	
23	010111	17	P	
24	011000	18	Q	
25	011001	19	R	
26	O11010	1A	SP	Space
27	011011	1B	$	
28	011100	1C	*	
29	011101	1D	US	
30	011110	1E	ET	
31	011111	1F	DL	

TRANSCODE Character Code Table (Cont.)

DEC	BINARY	HEX	DISPLAY	DESCRIPTION
32	100000	20	-	
33	100001	21	/	
34	100010	22	S	
35	100011	23	T	
36	100100	24	U	
37	100101	25	V	
38	100110	26	W	
39	100111	27	X	
40	101000	28	Y	
41	101001	29	Z	
42	101010	2A	EC	
43	101011	2B	,	
44	101100	2C	%	
45	l01101	2D	EQ	
46	101110	2E	EX	
47	101111	2F	HT	
48	110000	30	0	
49	110001	31	1	
50	110010	32	2	
51	110011	33	3	
52	110100	34	4	
53	110101	35	5	
54	110110	36	6	
55	110111	37	7	
56	111000	38	8	
57	111001	39	9	
58	111010	3A	SY	
59	111011	3B	#	
60	111100	3C	@	
61	111101	3D	NK	
62	111110	3E	EM	
63	111111	3F		

EBCD Character Code Table

DEC	BINARY	HEX	UNSHIFTED (LETTERS)	SHIFTED (FIGURES)
0	000000	00	SP	SP
1	000001	01	-	-
2	000010	02	@	(HEX)
3	000011	03	&	+
4	000100	04	8	*
5	000101	05	q	Q
6	000110	06	y	Y
7	000111	07	h	H
8	001000	08	4	:
9	001001	09	m	M
10	001010	0A	u	U
11	001011	0B	d	D
12	001100	0C	(HEX)PN	(HEX)PN
13	001101	0D	(HEX)RES	(HEX)RES
14	001110	0E	(HEX)BYP	(HEX)BYP
15	001111	0F	(HEX)PF	(HEX)PF
16	010000	10	2	<
17	010001	11	k	K
18	010010	12	s	S
19	010011	13	b	B
20	010100	14	0	)
21	010101	15	VT	VT
22	010110	16	FF	FF
23	010111	17	(HEX)	(HEX)
24	011000	18	6	,
25	011001	19	o	O
26	011010	1A	w	W
27	011011	1B	f	F
28	011100	1C	SO(ShiftOut)	SO(ShiftOut)
29	011101	1D	BS	BS
30	011110	1E	EB	EB
31	011111	1F	SI(ShiftIn)	SI(ShiftIn)

EBCD Character Code Table (Cont.)

DEC	BINARY	HEX	UNSHIFTED (LETTERS)	SHIFTED (FIGURES)
32	100000	20	1	=
33	100001	21	j	J
34	100010	22	/	?
35	100011	23	a	A
36	100100	24	9	(
37	100101	25	r	R
38	100110	26	z	Z
39	100111	27	i	I
40	101000	28	5	%
41	101001	29	n	N
42	101010	2A	v	V
43	101001	2B	e	E
44	101100	2C	RS	RS
45	101101	2D	CR	CR
46	101110	2E	LF	LF
47	101111	2F	HT	HT
48	110000	30	3	:
49	110001	31	l	L
50	110010	32	t	T
51	110011	33	c	C
52	110100	34	#	"
53	110101	35	$	|
54	110110	36	,	,
55	110111	37	.	
56	111000	38	>	>
57	111001	39	p	P
58	111010	3A	x	X
59	111011	3B	g	G
60	111100	3C	ET	ET
61	111101	3D	(HEX)	(HEX)
62	111110	3E	ESC	ESC
63	111111	3F	DEL	DEL

Extension Cable, 25 conductor round, 1 to 1, 60cm.

Female DB25 PIN		Male DB25 PIN
1	<═══════>	1
2	<═══════>	2
3	<═══════>	3
4	<═══════>	4
5	<═══════>	5
6	<═══════>	6
7	<═══════>	7
8	<═══════>	8
9	<═══════>	9
10	<═══════>	10
11	<═══════>	11
12	<═══════>	12
13	<═══════>	13
14	<═══════>	14
15	<═══════>	15
16	<═══════>	16
17	<═══════>	17
18	<═══════>	18
19	<═══════>	19
20	<═══════>	20
21	<═══════>	21
22	<═══════>	22
23	<═══════>	23
24	<═══════>	24
25	<═══════>	25

Communications Cable, **RS232/RS530**,
multi-conductor round, 60cm.

Female DB25 PIN		Female DB25 PIN
1	<═══════════>	1
2	<═══════════>	2
3	<═══════════>	3
4	<═══════════>	4
5	<═══════════>	5
6	<═══════════>	6
7	<═══════════>	7
8	<═══════════>	8
9	<═══════════>	9
15	<═══════════>	15
17	<═══════════>	17
20	<═══════════>	20
24	<═══════════>	24

V.35 Cable,
multi-conductor round, 60cm.

Female DB25 PIN		Male M-34 BLOCK PIN
2	<═══════>	P
14	<═══════>	S
3	<═══════>	R
16	<═══════>	T
4	<═══════>	C
5	<═══════>	D
6	<═══════>	E
20	<═══════>	H
8	<═══════>	F
24	<═══════>	U
11	<═══════>	W
15	<═══════>	Y
12	<═══════>	AA
17	<═══════>	V
9	<═══════>	X
1	<═══════>	A
7	<═══════>	B
22	<═══════>	J

NOTE: TWISTED PAIRS;
P,S
R,T
U,W
Y,AA
V,X

Printer Cable,
multi-conductor round, 150cm.

Male DB25 PIN		Male C-36 (CENTRONIC) PIN
1	<═══════>	1
2	<═══════>	2
3	<═══════>	3
4	<═══════>	4
5	<═══════>	5
6	<═══════>	6
7	<═══════>	7
8	<═══════>	8
9	<═══════>	9
10	<═══════>	10
11	<═══════>	11
12	<═══════>	12
13	<═══════>	13
14	<═══════>	14
15	<═══════>	32
16	<═══════>	31
17	<═══════>	36
18	<═══════>	19,20
19	<═══════>	21,22
20	<═══════>	23,24
21	<═══════>	25,26
22	<═══════>	27,28
23	<═══════>	33
24	<═══════>	29
25	<═══════>	30

Remote Cable
multi-conductor round, 120cm.

Female DB9 PIN		Female DB25 PIN
2	<═══════>	3
3	<═══════>	2
4	<═══════>	20
5	<═══════>	7
6	<═══════>	6
7	<═══════>	4
8	<═══════>	5
9	<═══════>	22

RS-449 Cables, (optional)
multi-conductor round, 60cm.

Female DB25 PIN		Male(or Female) DB37 PIN
1	<═══════>	1
7	<═══════>	19
(the following are all twisted pairs)		
2	<═══════>	4
14	<═══════>	22
3	<═══════>	6
16	<═══════>	24
4	<═══════>	7
19	<═══════>	25
5	<═══════>	9
13	<═══════>	27
6	<═══════>	11
22	<═══════>	29
20	<═══════>	12
23	<═══════>	30
8	<═══════>	13
10	<═══════>	31
24	<═══════>	17
11	<═══════>	35
15	<═══════>	5
12	<═══════>	23
17	<═══════>	8
9	<═══════>	26

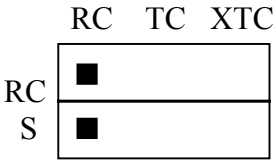
X.21 Cables, (optional)
multi-conductor round, 60cm.

Female DB25 PIN		Male(or Female) DB15 PIN
1	<═══════════>	1
7	<═══════════>	8
(the following are all twisted pairs)		
2	<═══════════>	2
14	<═══════════>	9
3	<═══════════>	4
16	<═══════════>	11
4	<═══════════>	3
19	<═══════════>	10
8	<═══════════>	5
10	<═══════════>	12
17	<═══════════>	6
9	<═══════════>	13

X.21 Cable Box, (optional)

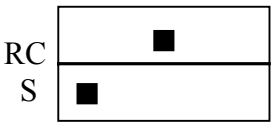
Setting of X.21 Cable Box's two 3 position selector switches for connecting of RC and S pins (DB15 side) to RC,TC or XTC pins (DB25side):

1)



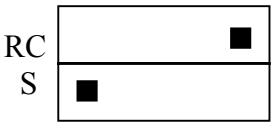
denotes DB25 RC ——— X.21 S

2)



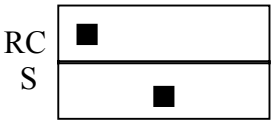
denotes DB25 RC ——— X.21 S
DB25 TC ———

3)



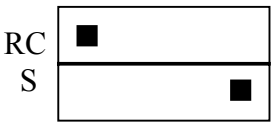
denotes DB25 RC ——— X.21 S
DB25 XTC ———

4)



denotes DB25 TC ——— X.21 S

5)



denotes DB25 XTC ——— X.21 S

Parallel Cable, (*HCT-PC*)
multi-conductor round, 120cm.

Male DB25 PIN		Male DB25 PIN
1	<═══════>	1
2	<═══════>	15
3	<═══════>	13
4	<═══════>	12
5	<═══════>	10
6	<═══════>	11
7	<═══════>	7
8	<═══════>	8
9	<═══════>	9
10	<═══════>	5
11	<═══════>	6
12	<═══════>	4
13	<═══════>	3
14	<═══════>	14
15	<═══════>	2
16	<═══════>	16
17	<═══════>	17
18	<═══════>	18
19	<═══════>	19
20	<═══════>	20
21	<═══════>	21
22	<═══════>	22
23	<═══════>	23
24	<═══════>	24
25	<═══════>	25

Remote Modem Cable
multi-conductor round, 120cm.

Female DB9 PIN		Male DB25 PIN
2	<═══════>	2
3	<═══════>	3
4	<═══════>	6
5	<═══════>	7
6	<═══════>	20
7	<═══════>	5
8	<═══════>	4

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