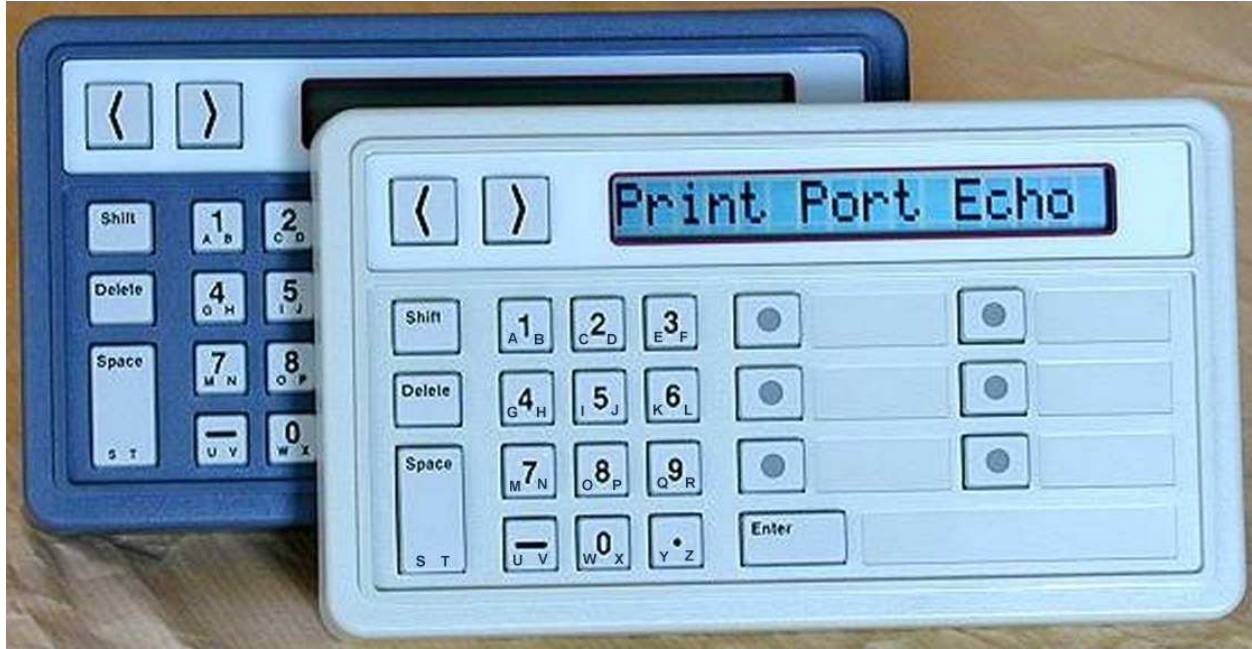


CTM200 Series OEM Microterminals

This manual describes the installation and programming of the
CTM200 series Microterminals.

855M543
Revision D



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Revision History

CTM200 Series OEM Microterminals

<u>Version</u>	<u>Date</u>	<u>Revision</u>
A	10/1990	Original document number MA51545 by fmr. Burr-Brown Corp.
B	4/1991	Added LED display on various models
C	6/2002	Corrected various typo errors
D	10/2009	Release version 3.0 firmware on redesigned hardware/ μ processor; release manual as PN 855M543

PREFACE

This document has been prepared as a guide and reference for people using the CTM200 series Microterminals. To assure a successful installation, please read INSTALLATION, page 2, thoroughly before beginning to install your terminal. In this manual, “microterminal” and “terminal” are interchangeable.

The following conventions are used in this manual for the representation of command formats, comments and examples:

- ASCII control characters are represented by placing the character mnemonic in angle brackets. For example, the Line Feed character is represented as <LF>. In sending data to the terminal, the actual ASCII character value of 00001010 (binary), would be sent, not “<LF>”.
- The character codes for ASCII characters are given as decimal numbers, often enclosed in parentheses following the mnemonic, as in <LF> (010).

If you encounter problems or questions while installing or operating these terminals, application assistance is available from Intelligent Instrumentation or your local Intelligent Instrumentation representative.

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This equipment generates and uses radio frequency energy, and may cause interference to radio or television reception.

Per FCC rules, Part 15, Subpart J, operation of this equipment is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by other incidental or restricted radiation devices, industrial, scientific or medical equipment, or from any authorized radio user.

The operator of a computing device may be required to stop operating his device upon a finding that the device is causing harmful interference and it is in the public interest to stop operation until the interference problem has been corrected.

The user of this equipment is responsible for any interference to radio or television reception caused by the equipment. It is the responsibility of the user to correct such interference.

European CE Certification

European CE certification is as described on the Declaration of Conformity that ships with each CTM200 series terminal.

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ABOUT THE CTM200 SERIES TERMINALS

Introduction

The CTM200 series terminals are compact, rugged, industrial data entry and display terminals. They are intended for use as operator panels and as service/setup panels in microprocessor based equipment. The CTM200 terminals have three families from which to choose: the CTM200, basic terminal models, the CTM250, advanced terminal models with LCD display, and the CTM280, advanced terminal models with LED display.

The CTM200 series of terminals is available in the following models:

- CTM200 – LCD terminal with RS-232
- CTM250 – LCD terminal with RS-232, auxiliary port
- CTM280 – LED terminal with RS-232, auxiliary port

CTM200/250 Base Features

- A large 16 character liquid crystal display
- The sealed keyboard has 24 keys. By using the SHIFT key, the six function keys are mapped to give access to 18 functions. See Programmable Function Keys on page 43.
- A signal for an external beeper.
- Runs on standard +5 VDC.

CTM250 Extended Features

- An auxiliary digital I/O port that can be configured as one of the following:
 - Digital I/O with 8 TTL inputs and 8 TTL outputs
 - Parallel Printer Port
 - Serial Port
- An internal beeper
- Backlighting (LEDs), for the function keys.
- Voltage regulator to handle +7.5 to +12 VDC power input.

CTM280 Extended Features

The CTM280 terminals are identical to the CTM250 terminals with the following exceptions:

- 1x16 LED display
- Adjustable brightness levels (5 levels).
- Extended temperature operation (-20C to 50C)
- Power requirement up to 400mA, depending on display brightness
- 7.5 to 12 VDC supply voltage range

INSTALLATION

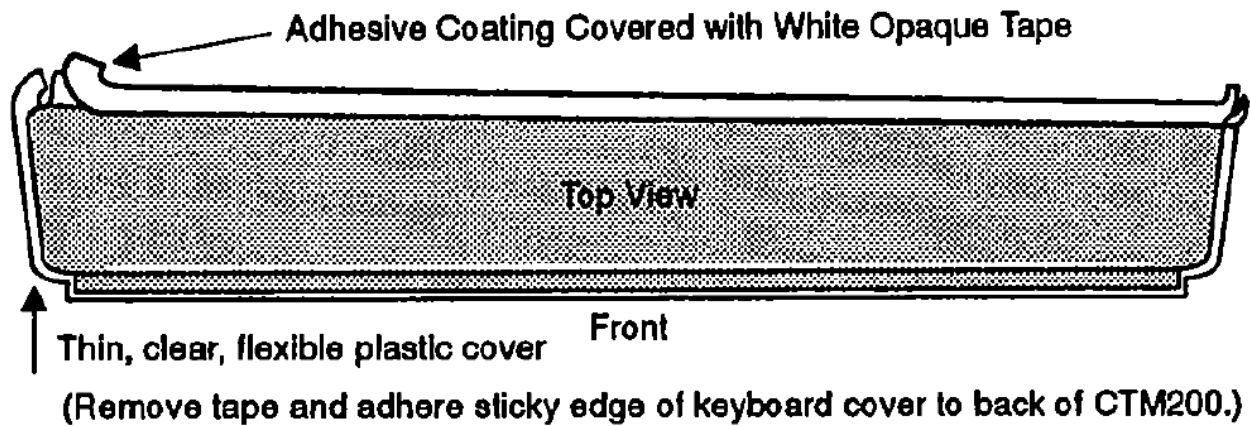
Unpacking

These terminals are shipped complete in one package. Inspect all received parts for damage and report problems to the freight carrier. Do not attempt to use a terminal with a damaged case or display.

As with all electronic equipment, it is important to avoid electrostatic discharge to electronic components and connectors. It is good practice to touch a grounded metal surface before making connections to these terminals.

TMA013 keyboard cover

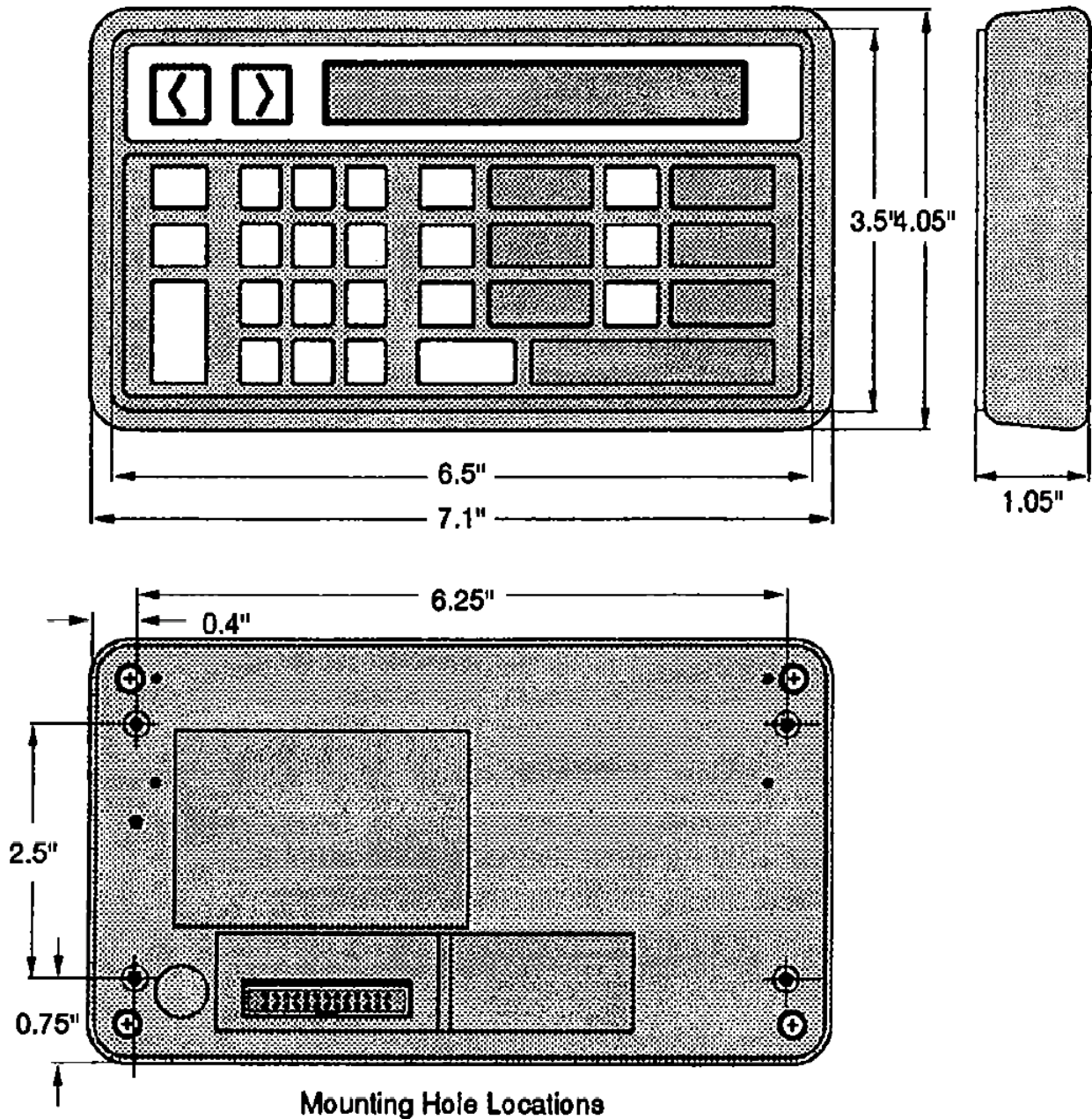
Figure 1. CTM200 series Keyboard Cover



Mounting

The CTM200 series can be surface mounted on the face of a panel or recess mounted from the rear using the TMA022 mounting brackets. Physical dimensions and mounting locations are given in the following figure.

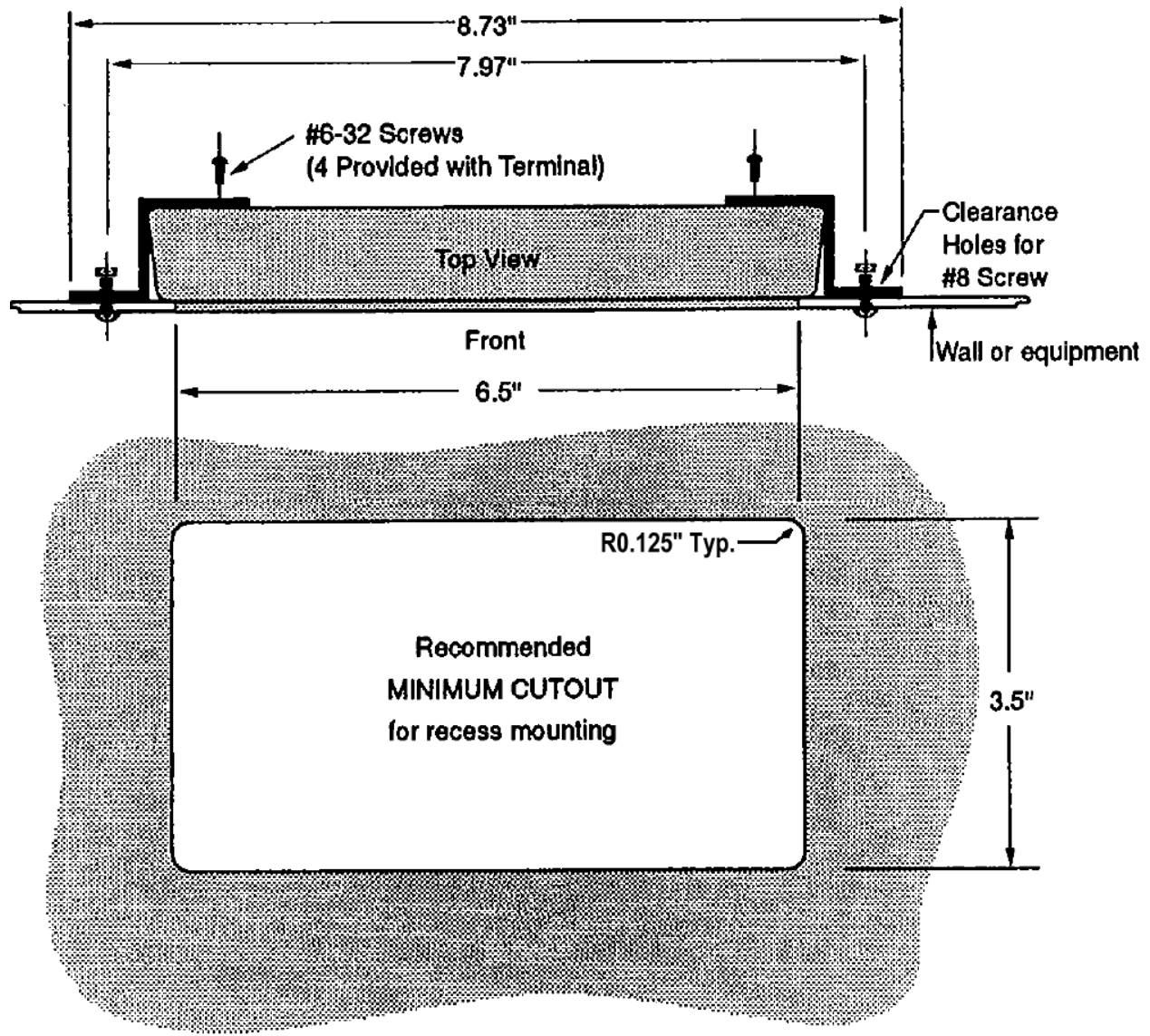
Figure 2. CTM200 series mechanical dimensions



TMA022 mounting bracket

The CTM200 series can be recess mounted behind a panel as shown in Figure 3. The TMA022 mounting kit provides the necessary brackets. The four #6-32 screws are provided with the terminal. The user must provide the hardware for fastening the brackets to the panel.

Figure 3. Recess mounting



Power and Interface Connections

The CTM200 terminal requires +5VDC power to operate. Power should be supplied through pin 2 of the single 26 pin host power/communications connector, labeled “Main Port” shown in graphic on page 5. The connector pinout is given on page 6, Main Port Connector Pinout. The CTM200 terminal requires a well-regulated +5 VDC power supply with a maximum ripple of 150 millivolts peak to peak. The maximum power supply current required by the terminal is 400 mA@9VDC for the CTM250. Full specifications for all signals are given on page 52.

The CTM250/280 terminals have a DC power connector and two 26 pin interface connectors, one for host communications and one for auxiliary functions. The DC power connector is a barrel type with center positive. It is compatible with Switchcraft P/N 760. The LPP001 power

supply may be used to provide 12VDC to the DC power connector. DC power (+5 to +12 VDC) may be applied to the DC power connector or to either 26 pin interface connector.

These units have an internal voltage regulator connected to pin 4 of the host interface port and the auxiliary interface port. The terminal can also be powered by well-regulated +5VDC on pin 2. The power supply must be well-regulated to ensure proper operation of the terminal and protection of the electronics, as the internal voltage regulator is bypassed. If you are applying a higher voltage, wire the power to pin 4 only. In this configuration, the internal regulator will operate from your input voltage, +7.5 to +12 VDC. See model Specifications, page 52, for voltage range and current requirements.

The host communications and auxiliary port connectors in the terminal are 26 pin ribbon cable connectors with a polarizing tab (3M #3593-6002). The mating connector is a 26 pin ribbon cable socket which is not supplied with the terminal (3M #3399-6600).

Figure 4. Connector pinout diagram

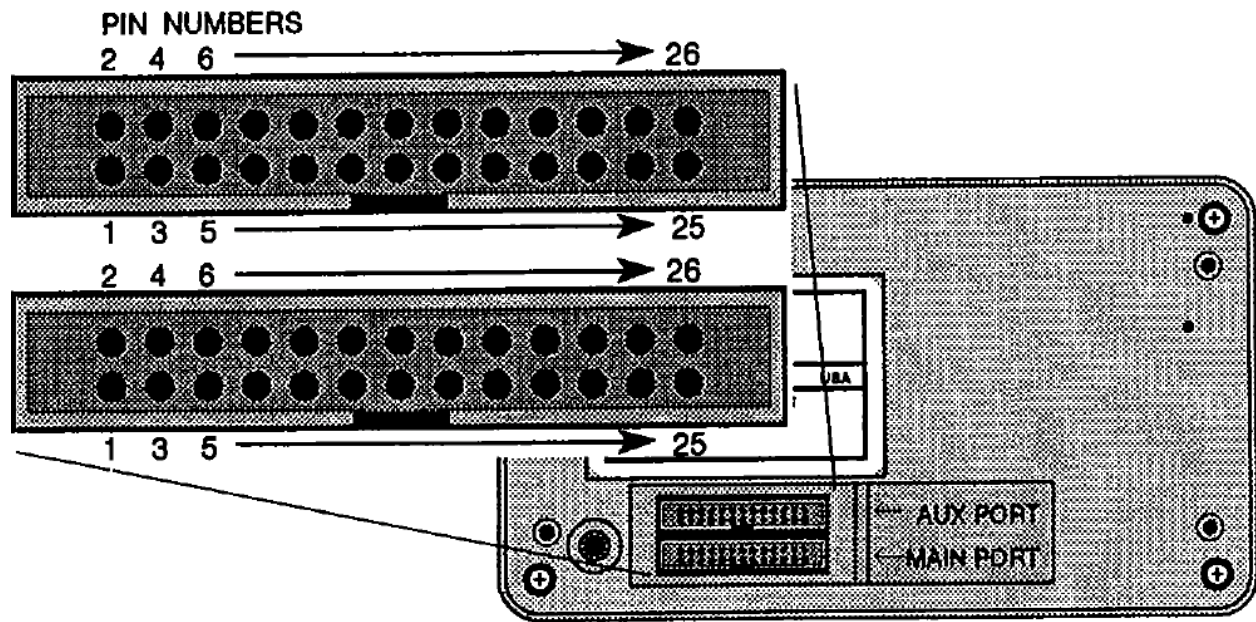


Table 1. Main Port Connector Pinout

Pin	CTM200 RS-232	CTM250/280 RS-232
1	Ground	Ground
2	+5 VDC	+5 VDC
3	TX (data)	TX (data)
4	+5 VDC	+7.5 to +12 VDC
5	RX (data)	RX (data)
6	Unused	Unused
7	Unused	Unused
8	Unused	Unused
9	Unused	Unused
10	Unused	Unused
11	Unused	Unused
12	Unused	Unused
13	Signal Ground	Signal Ground
14	Unused	Unused
15	Unused	Unused
16	Unused	Unused
17	Unused	Unused
18	Unused	Unused
19	Unused	Unused
20	Unused	Unused
21	Unused	Unused
22	Unused	Unused
23	Ground	Ground
24	Beep+ (+5 VDC)	Beep+ (+5 VDC)
25	Beep-	Beep-
26	Ground	Ground

Table 2. Auxiliary Port Connector Pinout

Pin	Configured as Digital I/O	Configured as Printer Port
1	Ground	Ground
2	+5 VDC	+5 VDC
3	AUX TX (data)	AUX TX (data)
4	7.5 to 12 VDC	+7.5 to +12 VDC
5	AUX RX (data)	AUX RX (data)
6	Digital Output #1	Data #1
7	Digital Output #2	Data #2
8	Digital Output #3	Data #3
9	Digital Output #4	Data #4
10	Digital Output #5	Data #5
11	Digital Output #6	Data #6
12	Digital Output #7	Data #7
13	Signal Ground	Signal Ground
14	Digital Output #8	Strobe
15	Digital Input #1	Busy
16	Digital Input #2	Unused
17	Digital Input #3	Unused
18	Digital Input #4	Unused
19	Digital Input #5	Unused
20	Digital Input #6	Unused
21	Digital Input #7	Unused
22	Digital Input #8	Unused
23	Ground	Ground
24	Beep+ (+5 VDC)	Beep+ (+5 VDC)
25	Beep-	Beep-
26	Ground	Ground

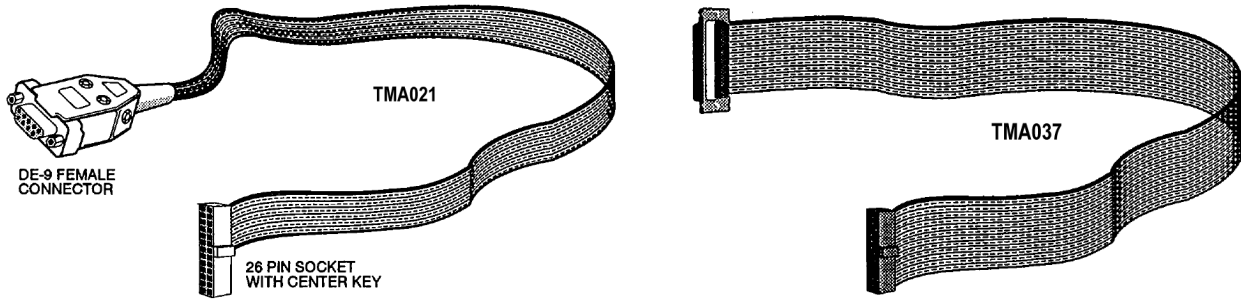
RS-232 Conversion Cables/Connectors

Intelligent Instrumentation offers the following cables to allow interfacing with the DB type connectors:

- TMA021 converts the 26 pin ribbon to a DE-9 connector
- TMA037 converts the 26 pin ribbon to a DB-25 connector

The cables look similar to those shown in Figure 5.

Figure 5. Ribbon to Dsub cables



Descriptions of each cable follow:

TMA021 Cable

The TMA021 illustrated above converts the 26 pin ribbon cable to a DE-9 female connector.

Table 3. Connector Pinout for TMA021

DE-9	RS-232 Signal	26 Pin Ribbon
1	Ground	1
2	TX (data)	3
3	RX (data)	5
4	Unused: B' (RX+)	7
5	Unused: A' (RX-)	9
6	Unused	-
7	Unused	-
8	+5 VDC	2
9	Vin (7.5 to 12 VDC)	4

TMA037 Cable

The TMA037 cable has a DTE pinout with a pin 2 Transmit Data, a pin 3 Receive Data and a pin 7 Signal Ground. This cable passes the signals straight through.

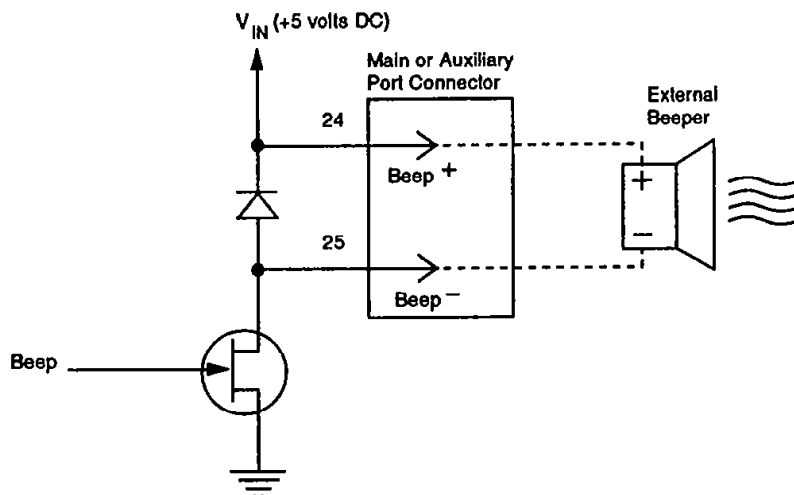
Table 4. Connector Pinout for TMA037

DB-25	RS-232 Signal	26 Pin Ribbon
1	Ground	1
2	TX (data)	3
3	RX (data)	5
4	Unused: B' (RX+)	7
5	Unused: A' (RX-)	9
6	Unused	-
7	Signal Ground	13
14	+5 VDC	2
15	Vin (7.5 to 12 VDC)	4

If a custom cable is fabricated for the CTM200/250 RS-232 interface, it is important to conform to the RS-232 standard that the length of the cable be less than 50 feet.

Connecting an External Beeper

Figure 6. External beeper connection schematic



An external beeper may be connected to either the main or auxiliary port connector. A DC operated audio alarm, such as Mallory #SC628 or Floyd Bell #XC-V09-212-S, is recommended. Up to 50mA drive current may be supplied by the terminal. The figure above shows the drive circuit and beeper connection.

Power-Up Self Test

These terminals provide a built-in self-test, activated when power is applied. The CPU, display, internal beeper, RAM, ROM, and nonvolatile storage (EEPROM), are tested. The test sequence is:

1. CPU test
2. ROM test
3. RAM test
4. Internal I/O test
5. Beep (only in the CTM250/280)
6. Turn all display dots on, then off
7. Display start-up message
8. Load operating parameters from EEPROM and test
9. Enter SETUP, immediately after power up, by pressing and releasing the Shift key, then the Enter key

NOTE: SETUP is described in Manual Setup Mode, page 11.

After self-test, the message “Vx.yy Test OK” appears for a few seconds indicating a successful self-test. In the message, the “x” represents an ASCII digit indicating the firmware version, and the “yy” represents two ASCII digits indicating the revision level of the firmware in the terminal. A cursor then appears in the left hand side of the display to indicate that the terminal is ready for operation. If an error condition is detected during self-test, the cursor will not appear and the display will be blank. If an EEPROM error is detected at any time, the message “EEPROM Error” will appear on the display. If any error is detected, the terminal will not function or respond to inputs.

MANUAL SETUP MODE

Communications and operating parameters of the CTM200 series may be selected interactively through the keyboard. Operating parameters may also be selected through commands from the host. Selections are stored in the unit's nonvolatile EEPROM, and are recalled automatically the next time the terminal powers up.

Setup selections are made in a special **SETUP** mode, which prompts the operator through various categories and choices. After the initial setting of parameters, **SETUP** need only be entered when an option is to be changed. In order to guard against accidental changes by untrained operators, the manual **SETUP** mode can be disabled during **SETUP** or via a host command. See the host **k** command, page 29.

Placing Terminal in SETUP Mode

1. Apply power
2. Press and release the Shift key, then the Enter key

NOTE: If the setup mode has not been entered before the self-test has completed, the terminal will go to a ready condition. The terminal is in ready condition when the startup message showing the firmware revision is cleared from the display. At that point, attempting to enter the **SETUP** mode is no longer allowed.

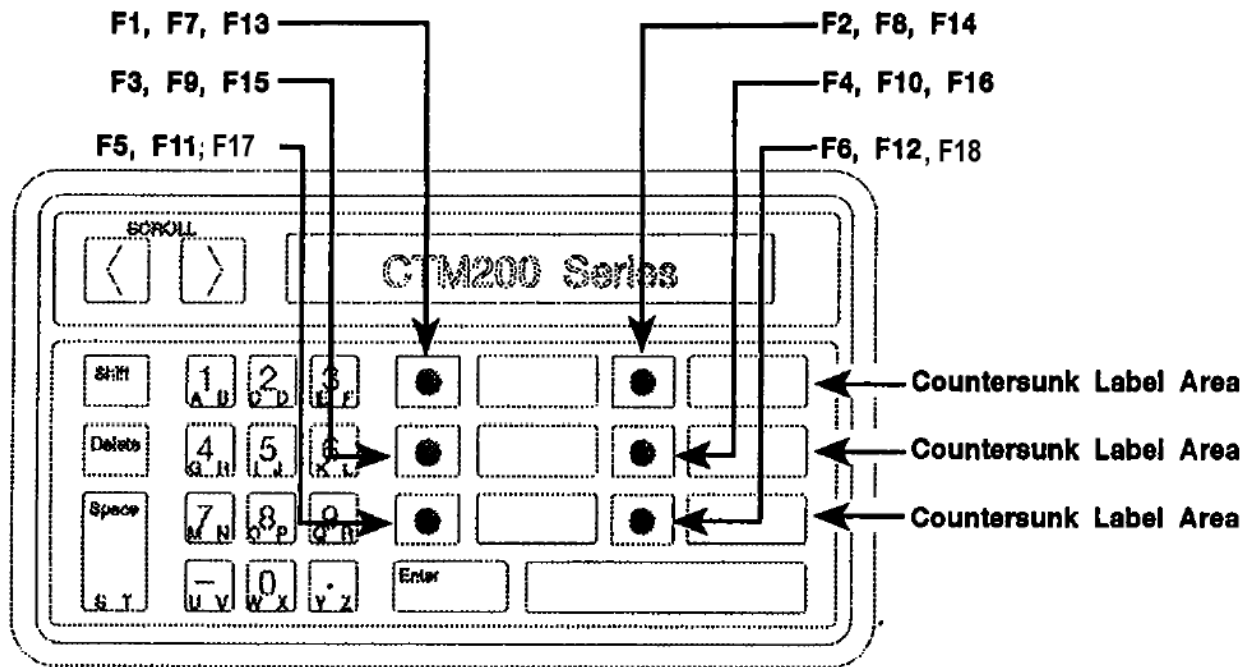
SETUP

Communications and operating parameters are selected interactively from the keyboard and stored in the unit's nonvolatile EEPROM. This allows the parameters to be recalled automatically the next time the unit is powered up. Additional information about communications, including handshake, is available under Character Mode Operation, page 16. Additional information is available about the keyboard setup under Keyboard, page 42. The Display section, page 40, offers more information about display setup.

Table 5. Key Operation During SETUP

Key	Action
F1	(NEXT) Displays the next SETUP category and its currently-selected option.
F2	(PREV) Displays the previous SETUP category and its currently-selected option.
F3	(SEL) Selects and displays the next option for the current category. Used to step through the choices in any particular category.
F6	(EXIT) Leaves SETUP mode and begins normal operation. EXIT leaves selected options in volatile memory and does not automatically save them to EEPROM before exiting.
F7 (Shift+F1)	LED display self test (CTM280 only).
F8 (Shift+F2)	(SAVE) Saves the current configuration in EEPROM but does not exit SETUP.

Figure 7. Terminal front



SETUP Category Description

The available categories for manual SETUP are shown exactly as they appear on the display. The abbreviated or condensed spelling in some cases is due to the limitations of a 16 character displays.

NOTE: All options selected are stored in nonvolatile EEPROM when F8 (SAVE) is pressed.

Standard CTM200 series Options

Host Port Data Rate (Host Baud)

300
600
1200
2400
4800
9600 (Factory Default)
19200

Host Port Data Format (Host DF)

7 EVEN
7 ODD
7 SPACE
7 MARK
8 EVEN
8 ODD
8 NONE (Factory Default)

Host Port Stop Bits (Host SBits)

1 (Factory Default)
2

Host Port Handshake Mode (Host HS)

NONE (Factory Default)
XON/XOFF

Keyboard Enable (Keyboard)

OFF
ON (Factory Default)

Keyboard Repeat Enable (Keyrepeat)

OFF
ON (Factory Default)

Keyboard Click Enable (Keyclick)

OFF
ON (Factory Default)

Keyboard Setup Enable (Setup Key)

OFF
ON (Factory Default)

CAUTION: If this option is set to OFF, entry into manual setup mode will be denied. To turn it back on, you can send the 'k' command. See HOST COMMANDS on page 18.

Keyboard Enter Key (Enter Key)

CR (Factory Default)
LF
CR/LF

NOTE: The ENTER key is also called the *line terminator*. <LF> and <CR> is/are the character(s) transmitted when the ENTER key is pressed by the operator.

Display Flashing Enable (Flashing)

OFF (Factory Default)
ON

Display Cursor Enable (Cursor)

OFF
ON (Factory Default)

Display Autowrap (Autowrap)

OFF (Factory Default)
ON

Display Local Enable (Local Echo)

OFF
ON (Factory Default)

Display Newline (Newline)

OFF (Factory Default)
ON

NOTE: If Newline is set to ON and the characters <CR> or <LF> are received from the host, those characters will be expanded to <CR><LF>

Transmit Delay Time (Tx Delay)

0mS (Factory Default)
50mS
100mS
250mS
500mS
1S

CTM250/280 series Options

Auxiliary Port Enable (Aux Port)

OFF (Factory Default)

PASS
ECHO

Auxiliary Port Data Rate (Aux Baud)

300
600
1200
2400
4800
9600 (Factory Default)
19200

Auxiliary Port Data Format (Aux DF)

7 EVEN
7 ODD
7 SPACE
7 MARK
8 EVEN
8 ODD
8 NONE (Factory Default)

Auxiliary Port Stop Bits (Aux SBits)

1 (Factory Default)
2

Auxiliary Port Handshake Mode (Aux HS)

NONE (Factory Default)
XON/XOFF

Printer Port Enable (Print Port)

OFF (Factory Default)
PASS
ECHO

CHARACTER MODE OPERATION

Summary

These terminals operate much like a simple, conversational mode CRT terminal with a one-line, 80-character display. All input and output is character-oriented. Characters from the host are displayed upon receipt. Characters entered from the keyboard are transmitted when the key is pressed. When the ENTER key is pressed, the selected line terminator is transmitted to the host.

Function keys can be associated with strings of characters that are sent to the host when the keys are pressed. When a function key is pressed and an ASCII <RS>(030) character defines the last character of the function key message, the selected line terminator is transmitted as the last character(s) of the function message. It may be necessary to consult the host computer's control character chart to determine what key or key combination generates an ASCII decimal value of 030 (when programming the function key message).

Local echo is used in half-duplex environments to display each output character as it is being transmitted to the host. When local echo is OFF, only characters received from the host are displayed.

The Delete key on the terminal transmits the ASCII (127) character.

Data Buffers

Three buffers are used to accept and transmit characters: the display buffer (80 characters), the receive buffer (64 characters), and the command buffer (20 characters). The host can transmit up to 80 characters to the terminal's display buffer. Host commands may also be transmitted to the terminal. See the Host Commands, page 18. These terminals also feature a 64-character receive buffer. The receive buffer is totally transparent except for the three commands which require extra processing time:

1. Define Function Keys
2. Backup Parameters
3. Use Default/Custom parameter set

These three commands, <ESC>m, <ESC>b, and <ESC>x, write to the terminal's EEPROM and require additional time to be completed. During the required delay time, data received, up to the total of 64 characters of the receive buffer, will be stored. Characters in excess of the 64 in the buffer will be dropped.

Commands are transferred to the 20-character command buffer upon receipt. The <ESC> and the <STX> characters are not stored. The remainder of the command string must not exceed 20 characters.

When the 80-character display buffer is full and autowrap is not enabled, new characters received will write over the final character in the buffer. If autowrap is enabled, a <CR><LF> is sent to the display when the 81st character is received, clearing the display buffer and the display and returning the cursor to the left edge of the display. If newline is enabled, then the receipt of either <LF> or <CR> clears the display buffer in the same way.

Handshake Operation

When XON/XOFF is selected and the terminal buffer is nearly full, the terminal will automatically transmit an XOFF character <DC3>(019), causing the host to stop transmitting. The host must stop transmitting within 8 characters to avoid overrunning the terminal's buffer (and losing data). As soon as the characters already buffered are processed, the terminal will send an XON <DC1>(017), character to notify the host to resume transmitting. Normally, the only time the terminal's receive buffer may fill is during processing of an EEPROM command.

In a similar way, upon receipt of the XOFF character from the host, the terminal will stop transmitting within three characters. Transmission will be re-enabled upon receipt of an XON character. When an XOFF is inhibiting transmission, key presses that occur will be ignored.

HOST COMMANDS

Summary

In addition to sending text messages to the terminal, the host computer may use a set of command (or *Escape*) sequences to control the operation of the terminal. A command sequence consists of the ASCII control character <ESC>(027), followed by a command letter, parameters, and a command terminator <STX>(002). All command letters must be lower case.

Host Commands

Command Letter	Description
COMMUNICATION	
a	Asynchronous serial interface configuration
e	Echo message from host
t	Set turnaround delay
AUXILIARY	
j	Configure auxiliary port
r	Read from digital input port
u	Set pass-through mode
v	Set pass-through termination string
w	Write to digital output
KEYBOARD	
h	Control function key backlights
k	Set keyboard parameters
m	Define function key message
DISPLAY	
d	Set display characteristics
f	Set display format
i	Insert function key message into output stream
MISCELLANEOUS	
b	Backup parameters to nonvolatile EEPROM
c	Configuration request
x	Set terminal to default/custom parameter set
y	Read terminal serial number from EEPROM

Some command sequences require dummy parameters indicated by <dummy>. The number 0 (048) should be used for the dummy parameter.

Command sequence format is: <ESC><command letter>[<parameters>]<STX>

Any <ESC> sequence that is sent to the terminal that is not valid will be ignored (until the <STX> character is reached). The length of the command sequence is determined by reading from the <ESC> character to the <STX> character. Command sequences not containing all of the parameters, but still ending with the <STX> character, are valid and will be processed.

The <STX> character can be replaced either by the (002) character (Control+B), or by the currently-configured line terminator character for the terminal, <CR>, <LF>, or <CR><LF>.

a—asynchronous serial interface configuration

The a command is used to configure both the host and auxiliary asynchronous serial interfaces. The command syntax is as follows:

FORMAT

<ESC>a<PORTID><BAUD><LENGTH&PARITY><STOPBITS><HANDSHAKE><STX>

PARAMETERS

PORTID

- 0 – host
- 1 – auxiliary

BAUD

- 0 – No change
- 1 – 300
- 2 – 600
- 3 – 1200
- 4 – 2400
- 5 – 4800
- 6 – 9600
- 7 – 19200

LENGTH&PARITY

- 0 – No change
- 1 – 7 bits, even parity
- 2 – 7 bits, odd parity
- 3 – 7 bits, space parity
- 4 – 7 bits, mark parity
- 5 – 8 bits, even parity
- 6 – 8 bits, odd parity
- 7 – 8 bits, no parity

STOPBITS

- 0 – No change
- 1 – 1
- 2 – 2

HANDSHAKE

- 0 – No change
- 1 – None
- 2 – XON/XOFF

EXAMPLE

Send the following command to set the host serial port to 4800 baud, 8 bit character, no parity, one stop bit, and no handshake:

```
<ESC>a05711<STX>
```

b—backup parameters in nonvolatile EEPROM

The b command causes the terminal's current operating parameters to be saved to nonvolatile EEPROM. These parameters may have changed values under the control of other host commands. The b command will save those parameter values so they can be used as the defaults the next time the power to the terminal is applied.

This command requires additional time for processing after the command is received. **Allow 75mS for processing** of this command before sending additional commands. The command syntax is as follows:

FORMAT

<ESC>b<STX>

PARAMETERS

None

EXAMPLE

Send the following command to backup the current settings to EEPROM:

<ESC>b<STX>

c—configuration request

The c command causes the terminal to respond with a message identifying the terminal's characteristics. The command syntax is as follows:

FORMAT

<ESC>c<STX>

RESPONSE

The response to the command contains the following information:

<CLASS><VERSION><REVISION><DUMMY>

CLASS

- a – CTM200
- b – CTM250
- c – CTM280

VERSION

Two ASCII digits for the firmware version (“03”, for example, for version 3.00).

REVISION

Two ASCII digits for the firmware revision level (“00”, for example, for version 3.00).

DUMMY

Always returns “0”, for compatibility.

EXAMPLE

Send the following command to retrieve the configuration of the terminal:

<ESC>c<STX>

This may return a string of the following general form:

A03000

The “a” indicates a CTM200, the “03” indicates the firmware version, the “00” indicates the firmware revision level. The firmware version, in this example, is “3.00”.

d—set display characteristics

The d command allows the host computer to flash the display and control the cursor. Display flashing may be enabled or disabled. When this option is on, the entire display content flashes. The command syntax is as follows:

FORMAT

<ESC>d<FLASH><DUMMY><CURSOR><AUTOWRAP><STX>

PARAMETERS

FLASH

- 0 – No change
- 1 – OFF
- 2 – ON

DUMMY

- 0 – No effect

CURSOR

- 0 – No change
- 1 – OFF
- 2 – ON

AUTOWRAP

- 0 – No change
- 1 – OFF
- 2 – ON

EXAMPLE

Send the following command to turn off the cursor without affecting the current settings of autowrap or flash:

```
<ESC>d0010<STX>
```

e—echo message from host

The e command allows the host to verify communications to and from the terminal. The host transmits the echo command with a test string to the terminal and the terminal will echo back the string. The command syntax is as follows:

FORMAT

<ESC>e<STRING><STX>

PARAMETERS**STRING**

The text string to be echoed. This string may be up to 16 characters in length. The terminal will respond to the command with <STRING>

EXAMPLE

Send the following command to echo the string:

<ESC>e1234567890123456<STX>

The terminal will respond with:

1234567890123456

f—set display format

The f command allows the host to specify the format of the display. The local echo setting determines whether keys pressed by the operator are echoed to the local display before transmission to the host. The newline parameter controls whether any newline character, <CR> or <LF>, causes the display to be cleared and the cursor to be returned to the left edge position. The command syntax is as follows:

FORMAT

<ESC>f<DUMMY><DUMMY><LOCALECHO><NEWLINE><DUMMY><STX>

PARAMETERS

DUMMY

0 – No effect

DUMMY

0 – No effect

LOCALECHO

0 – No change

1 – OFF

2 – ON

NEWLINE

0 – No change

1 – OFF

2 – ON

DUMMY

0 – No effect

EXAMPLE

Send the following command to turn on local echo without affecting the newline setting:

```
<ESC>f00200<STX>
```

h—control function key backlight

The h command controls the function key backlights. The same results can be obtained by using the digital write command, w. This command provides direct compatibility with the TM2500 microterminal. The command syntax is as follows:

FORMAT

<ESC>h<LIGHT><ACTION><STX>

PARAMETERS

LIGHT

- 0 – Controls all backlights
- 1 – controls F1
- 2 – controls F2
- 3 – controls F3
- 4 – controls F4
- 5 – controls F5
- 6 – controls F6

ACTION

- 0 – OFF
- 1 – ON
- 2 – toggle state

EXAMPLE

To turn on the F1 backlight, send the following command:

```
<ESC>h11<STX>
```

To toggle the state of all six backlights, send the following command:

```
<ESC>h02<STX>
```

i—insert function key message in output stream

The *i* command causes the function key text message programmed for the indicated function key to be sent to the host. If local echo is enabled, the text will also appear on the display. The command syntax is as follows:

FORMAT

<ESC>i<NUMBER><STX>

PARAMETERS

NUMBER

01 - 18 – Function key number whose message text should be sent. Note that two digits should be passed for this parameter (01 for F1, 02 for F2, etc.)

EXAMPLE

To send the function key message for F13 (Shift+Shift+F1), send the following command:

```
<ESC>i13<STX>
```

To send the function key message for F6, send the following command:

```
<ESC>i06<STX>
```

The default message for each function key is the function key name, so the above two commands, by default, would return:

```
F13  
F6
```

j—configure auxiliary port

The *j* command is used to configure the auxiliary serial port and to configure the parallel bits as either digital I/O or as a parallel printer port.

When defined as a printer port, the digital I/O read and write commands are disabled. When the printer port is configured for pass-through mode, characters received from the host are sent directly to the printer port. Likewise, characters received from the printer port are sent directly to the host.

When the printer port is configured for echo mode, key presses on the terminal are sent both to the printer port and to the host port (as usual).

The command syntax is as follows:

FORMAT

```
<ESC>j<PORTID><MODE><STX>
```

PARAMETERS

PORTID

- 0 – Auxiliary serial port
- 1 – Printer port

MODE

- 0 – Port off
- 1 – Pass-through mode
- 2 – Echo mode

EXAMPLE

To configure the auxiliary serial port for pass-through mode, send the following command:

```
<ESC>j01<STX>
```

To configure the digital I/O as a parallel printer port and to set the port for pass-through mode, send the following command:

```
<ESC>j11<STX>
```

To enable the port for use as digital I/O, turn the printer port mode to off.

```
<ESC>j10<STX>
```

k—set keyboard parameters

The k command allows the host to specify the keyboard parameters, such as repeat, clicks, and access to manual SETUP mode. The command syntax is as follows:

FORMAT

<ESC>k<KEYBOARD><KEYREPEAT><KEYCLICK><SETUP><ENTERKEY><STX>

PARAMETERS

KEYBOARD

- 0 – No change
- 1 – OFF
- 2 – ON

KEYREPEAT

- 0 – No change
- 1 – OFF
- 2 – ON

KEYCLICK

- 0 – No change
- 1 – OFF
- 2 – ON

SETUP

- 0 – No change
- 1 – OFF
- 2 – ON

CAUTION: When SETUP is ON, pressing the setup key (Shift+Enter), during the startup period will place the terminal in manual setup mode. When SETUP is OFF, manual SETUP mode is inaccessible (any changes to settings on the terminal must be accomplished via host commands).

ENTERKEY

- 0 – No change
- 1 – <CR>
- 2 – <LF>
- 3 – <CR><LF>

EXAMPLE

To completely disable the keypad, send the following command:

```
<ESC>k10000<STX>
```

To disable manual setup mode, while leaving other parameters unchanged, send the following command:

```
<ESC>k00010<STX>
```

m—define function key message

The m command allows a host computer to redefine the text message sent by the terminal when the operator presses a function key. When the function key is pressed, during normal operation, this message is sent to the host and, if local echo is enabled, to the display, as though the operator had typed the characters individually. Function key messages can end with a special character <RS>(030). When this character is found in the function key message, the terminal's currently-configured newline character (<LF>, <CR>, or <CR><LF>), is sent at the end of the function key message.

The m command stores the key message directly to nonvolatile EEPROM and requires additional time to complete. **Allow 75mS for processing** of this command before sending additional commands.

The command syntax is as follows:

FORMAT

<ESC>m<NUMBER><STRING><STX>

PARAMETERS

NUMBER

01 - 18 – Function key number whose message text should be set. Note that two digits should be passed for this parameter (01 for F1, 02 for F2, etc.)

STRING

The maximum text length is six characters, including the <RS> character, if used.

EXAMPLE

To set function key F1 to send the text HELLO<newline>, send the following command:

```
<ESC>m01HELLO<RS><STX>
```

The default message for each function key is the key name, F1 = "F1", F10 = "F10", etc.

r—read

The r command reads the digital input states and return 3 characters with the decimal equivalent of the 8 digital input lines (digital input #8 = MSB, digital input #1 = LSB). The command syntax is as follows:

FORMAT

<ESC>r<STX>

RESPONSE

The response to the command contains the decimal value read from the eight input lines.

<DATA>

DATA

8 bit value where each digital input bit controls a corresponding bit in the data value.

Digital Input	Mask Value
1	1
2	2
3	4
4	8
5	16
6	32
7	64
8	128

EXAMPLE

To read the digital input lines, send the following command:

<ESC>r<STX>

If digital inputs #3 and #6 are in the ON (TTL high, +5V), state, while the other inputs are in the OFF state, the result will be:

036

If digital inputs #1, #4, and #8 are ON, while the others are off, the result will be:

137

t—turnaround delay

The t command allows the host computer to specify the minimum time that must elapse between a command that causes the terminal to transmit data and the time of actual transmission of that data. This command might be necessary on host systems that require time to prepare for the reception of data from the terminal after sending commands to the terminal. The command syntax is as follows:

FORMAT

<ESC>t<DELAY><STX>

PARAMETERS**DELAY**

- 0 – No change
- 1 – 0mS
- 2 – 50mS
- 3 – 100mS
- 4 – 250mS
- 5 – 500mS
- 6 – 1S

EXAMPLE

To set the turnaround delay to 1 second, send the following command:

<ESC>t6<STX>

u—set pass-through mode

The u command will set the indicated terminal port to pass-through mode. All characters, including <ESC> and, hence, the start of a command sequence will be passed through from the host computer directly to the selected port (command strings are not interpreted when in pass-through mode). Pass-through mode ends when the three character termination string is received from the host computer by the terminal. See the v command for information on defining the termination string. The command syntax is as follows:

FORMAT

<ESC>u<PORTID><STX>

PARAMETERS

PORTID

0 – Auxiliary serial port

1 – Printer port

EXAMPLE

To configure the auxiliary serial port for pass-through mode, send the following:

<ESC>u0<STX>

v—set pass-through mode termination string

The v command sets the string that is used to terminate the pass-through mode on the terminal. The string is a three-character string that the host computer will send when it no longer wishes to have all of its data sent to the auxiliary serial port or the printer port, nor to receive all data from those ports. The default termination string is “+++” – three + characters. The command syntax is as follows:

FORMAT

<ESC>v<PORTID><TERMSTRING><STX>

PARAMETERS

PORTID

- 0 – Auxiliary serial port
- 1 – Printer port

TERMSTRING

Three-character string.

EXAMPLE

To configure the auxiliary serial port termination string for “---“, send the following:

```
<ESC>v0---<STX>
```

To configure the printer port termination string for “@@@“, send the following:

```
<ESC>v1@@@<STX>
```

w—write

The w command will write to the 8-bit digital output port. The first six digital lines are reflected in the terminal function key backlights, where digital line #1 matches F1, line #2 matches F2, etc. The command syntax is as follows:

FORMAT

<ESC>w<DATA><STX>

PARAMETERS**DATA**

Three-digit decimal value. Bit 0 of this value controls digital output #1, bit 1 controls digital output #2, etc.

Digital Output	Mask Value	Function Key
1	1	F1
2	2	F2
3	4	F3
4	8	F4
5	16	F5
6	32	F6
7	64	-
8	128	-

EXAMPLE

To turn off all of the digital output lines, send the following command:

<ESC>w000<STX>

To turn on digital outputs #1 and #8 (and to turn on the F1 backlight), send the following command:

<ESC>w129<STX>

x—select terminal parameter set

The x command is used to set the terminal to the default parameter set or to the custom parameter set, if defined in a custom build of the terminal. **Allow 75mS for processing** of this command before sending additional commands. The command syntax is as follows:

FORMAT

<ESC>x<PARAMSET><STX>

PARAMETERS**PARAMSET**

- 0 – Default parameter set
- 1 – Custom parameter set (contact the factory)

EXAMPLE

To return the terminal to the factory parameter set, send the following command:

<ESC>x0<STX>

y—read the terminal serial number from EEPROM

The y command is used to read the unique serial number of the terminal. The command syntax is as follows:

FORMAT

<ESC>y<STX>

EXAMPLE

To return the serial number of the terminal as assigned at the factory, send the following command:

<ESC>y<STX>

Control Character Processing

The following table shows how the CTM200 series terminals handle ASCII control characters:

Table 6. ASCII Control Characters

Char	Value (decimal)	Action
(NUL)	000	Ignored
(SOH)	001	Ignored
(STX)	002	Command terminator
(ETX)	003	Ignored
(EOT)	004	Special function message terminator
(ENQ)	005	Ignored
(ACK)	006	Ignored
(BEL)	007	Sound beep
(BS)	008	Move cursor back one position
(TAB)	009	Move cursor forward one position
(LF)	010	Line feed
(VT)	011	Ignored
(FF)	012	Clear display
(CR)	013	Move cursor to beginning of line
(SO)	014	Ignored
(SI)	015	Ignored
(DLE)	016	Ignored
(DC1)	017	XON
(DC2)	018	Ignored
(DC3)	019	XOFF
(DC4)	020	Ignored
(NAK)	021	Ignored
(SYN)	022	Ignored
(ETB)	023	Ignored
(CAN)	024	Ignored
(EM)	025	Ignored
(SUB)	026	Ignored
(ESC)	027	Command sequence initiator
(FS)	028	Ignored
(GS)	029	Ignored
(RS)	030	Special function message terminator
(US)	031	Ignored

Host Command SETUP Example

All host command letters must be entered in lower case. The lines below are sample commands that set the keyboard to turn the keyrepeat OFF, display an underscore cursor in the terminal

display window, and program the F1 key to send the message “WAIT”, the F2 key to send the message “READY”, and the F3 key to send “END”. The last command line, using the backup command, instructs the terminal to backup the current parameter settings, including those immediately above. Since the backup command writes these parameter settings to the terminal EEPROM, they will be in force the next time the terminal is powered up. Please note that all other keyboard and display parameters are to set to 0, for no change, in the command strings below:

```
<ESC>k01000<STX>  
<ESC>d0020<STX>  
<ESC>m01WAIT<STX>  
<ESC>m02READY<STX>  
<ESC>m03END<STX>  
<ESC>b<STX>
```

DISPLAY

Summary

These terminals feature a 16 character liquid crystal or light emitting diode display. The display window of 16 characters can be moved left and right through the 80 character display buffer using the left and right arrow keys on the terminal. Characters are added to the screen from left to right. If more than 15 characters are transmitted to the display buffer, the display moves with the data showing the last 15 characters transmitted. The point at which characters are entered to the display is indicated by a cursor. The display can be made to flash under software control.

Local echo may be used to display characters entered to the terminal as they are transmitted to the host. The display of an output message entered from the keyboard can be disabled for security and password applications under software control.

Cursor Control

Characters are always entered into the display at the current cursor position. If a character is present at this location, it will be replaced by the new character.

When the 80-character display buffer is full, the cursor will not move past the last character in the line. This means that extra characters will replace the last display character as they arrive, unless display autowrap is enabled.

Several ASCII control characters are provided to control the position of the display cursor:

When a character would cause the cursor to move before the beginning of a line - to the left of position 0 - that character is ignored. When a new line of information is transmitted to the terminal, a prefix of <CR><LF> or <FF> will ensure that the data is written at the start of the screen and that the display buffer will be clear.

Table 7. Display Response

Char	Value (decimal)	Action
(BS)	008	Move cursor back one position
(TAB)	009	Move cursor forward one position
(LF)	010	Line feed
(FF)	012	Clear display
(CR)	013	Move cursor to beginning of line

Cursor Fonts

The cursor appears in one of three ways under software control:

- No cursor
- Underscore:
- Shift-underscore: s
- Shift-shift-underscore: ss

Movement of Display Window

The left arrow and right arrow keys move the 16-character display window through the 80-character display buffer. An attempt by the operator to move the display window left or right beyond the display buffer limit will result in an error beep, if the beeper option is installed. Depressing any other key returns the window to its position before it was moved.

Adjusting the LED Display Brightness

CTM280 only: The LED display brightness may be adjusted through the terminal keypad. To increase the brightness, press and release the shift key twice, then the right arrow key. To decrease brightness, press and release the shift key twice, then the left arrow key. If brightness is adjusted during manual SETUP mode, saving the settings will save the brightness setting as well.

Terminal Display Character Generation

When the host post data format is set to 7 bit mode, character codes 0-127 can be sent from the host. When the data format is set to 8 bit mode, extended character generation is possible by sending ASCII codes 128-255.

The terminal display used by the CTM280 supports the characters generated by ASCII codes 0-127 only.

KEYBOARD

Data may be entered into these terminals through the keyboard. There are 24 key locations. The keyboard also features auto-repeat and keyclick sound (CTM250/280 only). When a key is pressed, the character appears in the display (assuming that localecho is enabled), beginning at the leftmost position, with following characters appearing to the right.

Key Placement

There are three general classes of key functions used on the keyboard:

1. Control keys
2. Alphanumeric keys
3. Programmable function keys

Control Keys

These keys control the operation of the display and other operating parameters of the terminal. The left and right arrow keys move the display manually (scroll through the display buffer, showing 16 characters of the buffer at a time on the display itself).

On beeper-equipped terminals (CTM250, CTM280), the Shift key can be used in combination with the arrow keys to adjust the beeper tone. Press Shift+right to increase the frequency of the terminal beep sound. Press Shift+left to decrease the frequency.

On LED-equipped terminals (CTM280) the Shift key can be used in combination with the arrow keys to adjust the brightness of the LED display. Press Shift+Shift+right to increase brightness; press Shift+Shift+left to decrease brightness.

Table 8. Display Control Keys

Key Name	Keys	Action
Left Arrow	<	Moves window left in buffer
Right Arrow	>	Moves window right in buffer
Shift	Shift	Change from unshifted mode to Shift mode, or from Shift mode to Shift+Shift mode or from Shift+Shift mode to unshifted mode
Delete	Delete	Moves cursor back and erases character. Sends key (127) to the host.
Beep Frequency Up	Shift+>	Increases the beep tone frequency of the terminal.
Beep Frequency Down	Shift+<	Decreases the beep tone frequency of the terminal.
Brightness Up	Shift+Shift+>	Increase brightness on LED-based terminal displays
Brightness Down	Shift+Shift+<	Decrease brightness on LED-based terminal displays

Alphanumeric Keys

The numeric keypad arrangement is similar to that used on a telephone. The keys are used to enter the digits 0 through 9, as well as “.” (decimal point), and “-” (minus sign). The Enter key sends the character for which the terminal is presently configured to use as a newline character, <CR>, <LF>, or <CR><LF>.

The Shift key can be used to generate alphabetic keys. To generate the letter “A”, press and release the Shift key once, followed by the 1 key (Shift+1). To transmit the letter “B”, press and release the Shift key twice, followed by the 1 key (Shift+Shift+1).

Programmable Function Keys

The six function keys are arranged on a block on the right half of the terminal. The keys themselves are unmarked so that the user can easily assign a function to each of them and identify the function with a label in the adjacent label area. The label area to the right of each function key is countersunk so that the label edges are protected and resistant to peeling.

Each programmable function key may be programmed by the host to generate a message up to six characters in length. Function messages are stored in nonvolatile EEPROM and retained when power is off. The default characters for each function key are “F1” through “F18” for the corresponding function keys F1 through F18 (Shift+Shift+F6).

To access the function keys F7 through F18, you must use the Shift key. For example, access F7 by pressing and releasing the Shift key once, followed by the F1 key (Shift+F1). F13 is Shift+Shift+F1.

User Labels

Each function key features a countersunk label area to the right of it. The function key label size is 26.1mm x 10.1mm, 1.030" x .400". A label area for product name, logo, etc. has been provided to the right of the Enter key. This label area measures 62.6mm x 10.1mm, 2.400" x .400".

Adjusting the Terminal Beeper Tone

The terminal beeper tone may be controlled at the terminal by pressing the Shift key followed by the ">" (right arrow), key to increase the frequency and by pressing the Shift key followed by the "<" (left arrow), key to decrease the frequency (lower tone). While in manual setup mode, pressing the F8 key after setting the desired tone will save the tone setting in nonvolatile EEPROM. The host cannot control the tone.

AUXILIARY PORT OPERATION

Outline of Uses

The auxiliary port may be used for the following purposes:

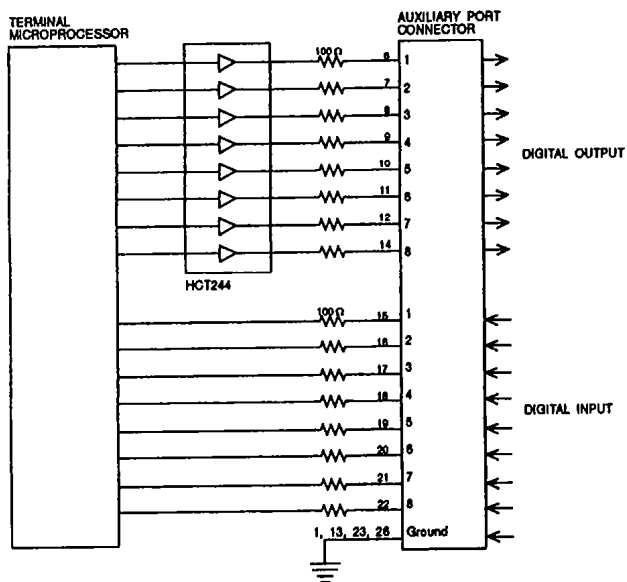
- Use as a digital I/O port
- Use as a serial port
- Use as a parallel port

Digital I/O Port

The digital I/O port consists of 8 inputs and 8 outputs. The digital inputs may be used to read the state of any TTL or CMOS signal. Possible applications include reading switch positions, machine state, and door latch positions. The digital outputs may be used to provide control of external devices such as lights, alarms, and door latches. In most cases, an intermediate relay or transistor circuit must be added to drive such external devices.

To use the digital I/O port, the auxiliary parallel port must be configured first as digital I/O with the j command (by setting the Printer Port to Off). Then, the r command can be used to read the digital inputs and the w command can be used to write the digital outputs.

Figure 8. Digital I/O diagram



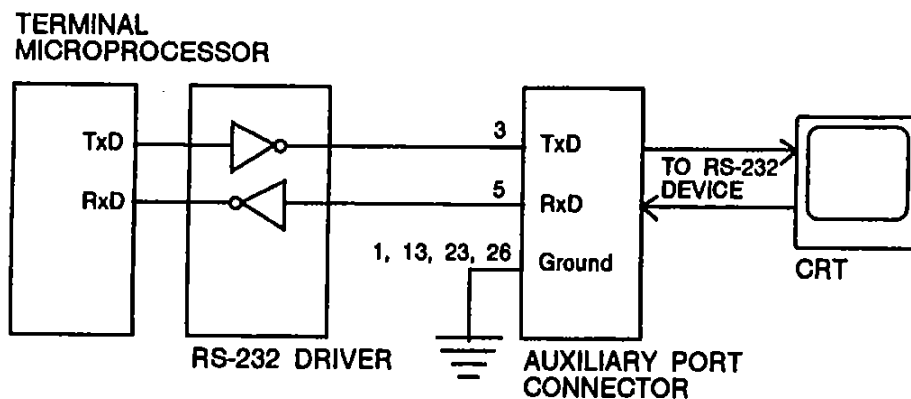
Serial Pass-through

The RS-232 serial auxiliary port is a TxD and RxD pair that may be used to communicate with devices such as electronic scales, CRTs, or a second terminal. When the terminal is placed in serial pass-through mode, it behaves as if the host and auxiliary RS-232 wires were connected and the terminal is transparent. All keys and display functions are disabled on the terminal. All data and control characters, including <ESC> and XON/XOFF flow control characters, are simply passed through the terminal from host to auxiliary port and vice versa. It is recommended that the host and auxiliary baud rates be set to the same value. This common baud rate will minimize the possibility of data loss.

The following steps should be performed to use the auxiliary port in serial pass-through mode:

1. Configure auxiliary port to enable the serial port at time of initialization:
<ESC>j01<STX>
2. Set to serial pass-through mode.
<ESC>u0<STX>
3. Transmit/receive data from the device.
4. Send pass-through mode termination string (default: +++), to end pass-through mode and return the terminal to normal operations. The pass-through mode termination string can be changed with the v command.

Figure 9. Serial pass-through diagram



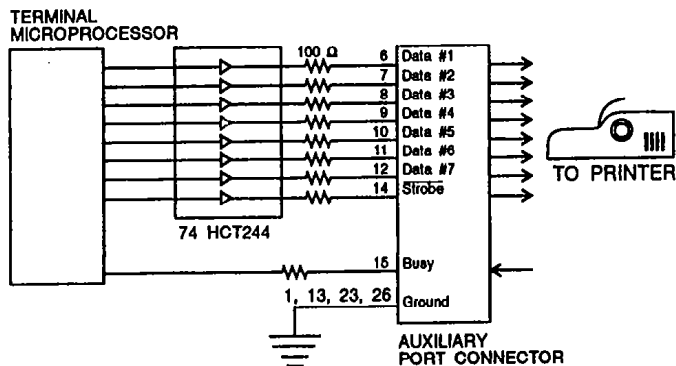
Serial Echo

The RS-232 serial auxiliary port may also be placed in echo mode. In this mode, all keystrokes that cause a character to be transmitted to the host will also be transmitted to the auxiliary port. The following command should be used to enter serial echo mode:

<ESC>j02<STX>

Parallel Printer Pass-through

Figure 10. Printer configuration diagram



The parallel printer port is implemented as a subset of the Centronics printer interface. Seven data bits, a data strobe, and printer busy signals are supported. All other printer outputs are ignored. Unused printer inputs, if present, maybe need to be tied to appropriate levels for proper operation.

Use the `j` command to configure the auxiliary port for pass-through mode to a parallel printer. Use commands `u` and `v` to complete the programming. Use the `u` command to set the port to pass-through mode, and the `v` command to set the termination string (default: +++).

1. Configure the auxiliary port at time of initialization to enable the parallel printer:
`<ESC>j11<STX>`
2. Set to printer pass-through mode:
`<ESC>u1<STX>`
3. Send data to printer. All data will be printed until the pass-through mode termination string is received from the host. All keyboard, display, and command processing is disabled during pass-through operation.
4. Send pass-through mode termination string to end pass-through mode and return the terminal to normal operation. The termination string can be changed using the `v` command.

The Centronics 36-pin D-type connector pin-out that would be used to connect the auxiliary port to a standard parallel printer follows:

Table 9. Connector Pinout for Parallel Adapter Cable

Pin	Signal
1	Strobe/
2	Data 1
3	Data 2
4	Data 3
5	Data 4
6	Data 5
7	Data 6
8	Data 7
9	Ground (Data 8)
10	Unused
11	Busy
12	Unused
13	Unused
14	Unused
15	Unused
16	Unused
17	Unused
18	Unused
19	Ground
20	Ground
21	Ground
22	Ground
23	Ground
24	Ground
25	Ground
26	Ground
27	Ground
28	Ground
29	Ground
30	Unused
31	Unused
32	Unused
33	Unused
34	Unused
35	Unused
36	Unused

Parallel Printer Echo

The parallel printer port may also be placed in echo mode. All keystrokes that cause a character to be transmitted to the host port will also be transmitted to the parallel printer port. The following command should be used to enter parallel printer echo mode:

`<ESC>j12<STX>`

ASCII TABLE

Table 10. ASCII Character Codes

Dec	Hex	Char
000	00	NUL
001	01	SOH
002	02	STX
003	03	EXT
004	04	EOT
005	05	ENQ
006	06	ACK
007	07	BEL
008	08	BS
009	09	HT
010	0A	LF
011	0B	VT
012	0C	FF
013	0D	CR
014	0E	SO
015	0F	SI
016	10	DLE
017	11	DC1
018	12	DC2
019	13	DC3
020	14	DC4
021	15	NAK
022	16	SYN
023	17	ETB
024	18	CAN
025	19	EM
026	1A	SUB
027	1B	ESC
028	1C	FS
029	1D	GS
030	1E	RS
031	1F	US
032	20	SPACE
033	21	!
034	22	"
035	23	#
036	24	\$
037	25	%
038	26	&
039	27	' (APOSTROPHE)
040	28	(

041	29)
042	2A	*
043	2B	+
044	2C	, (COMMA)
045	2D	- (MINUS)
046	2E	. (PERIOD)
047	2F	/
048	30	0
049	31	1
050	32	2
051	33	3
052	34	4
053	35	5
054	36	6
055	37	7
056	38	8
057	39	9
058	3A	:
059	3B	;
060	3C	<
061	3D	=
062	3E	>
063	3F	?
064	40	@
065	41	A
066	42	B
067	43	C
068	44	D
069	45	E
070	46	F
071	47	G
072	48	H
073	49	I
074	4A	J
075	4B	K
076	4C	L
077	4D	M
078	4E	N
079	4F	O
080	50	P
081	51	Q
082	52	R
083	53	S
084	54	T
085	55	U
086	56	V
087	57	W
088	58	X

089	59	Y
090	5A	Z
091	5B	[
092	5C	\
093	5D]
094	5E	^
095	5F	_ (UNDERSCORE)
096	60	`
097	61	a
098	62	b
099	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	(PIPE)
125	7D	}
126	7E	~
127	7F	DEL

SPECIFICATIONS

Display		
Type	Liquid crystal 5 x 7 dot matrix with cursor	
Number of characters	16	
Character height	9.66mm, .380"	
Display buffer	80 characters	
Attributes	Display flash, display blank	
Cursor types	Underscore, none	
Keyboard		
Type	Silicone rubber elastomer	
Number of keys	24	
Service life	1 million operations	
Programmable function keys	6, with 6 characters per key in normal, single shift, and double shift for up to 18 function combinations	
Communications Interface		
CTM200/250	RS-232 (recommend 50' maximum distance)	
Code	ASCII	
Baud rate	300, 600, 1200, 2400, 4800, 9600, 19200	
Protocol	Character mode, XON/XOFF optional	
I/O connector	26 pin ribbon cable connector (3M #3593-6002), mates with 26 pin ribbon cable socket (3M #3399-6600)	
Power connector	Switchcraft P/N 760	
Power Requirements	Voltage	Current
CTM200	+5 VDC \pm 5%	450 mA max
CTM250	+5 VDC \pm 5%, +7.5 VDC to +12 VDC	400 mA max @9V
Physical		
Size	104.2mm x 180.4mm x 26.9mm, 4.102" x 7.102" x 1.060"	
Weight	266g, 10.5oz	
Case material	ABS plastic	
Environmental		
Operating temperature	0° to +50°C (CTM200/250)	-20° to +50°C (CTM280)
Storage temperature	-20° to +70°C	
Relative humidity	5% to 95% (non-condensing)	
Sealing at IP42*	Resists dust, liquid	
Sealing at IP54*	Resists dust, liquid with TMA013 cover, recess mounted	

* International Protection Degree