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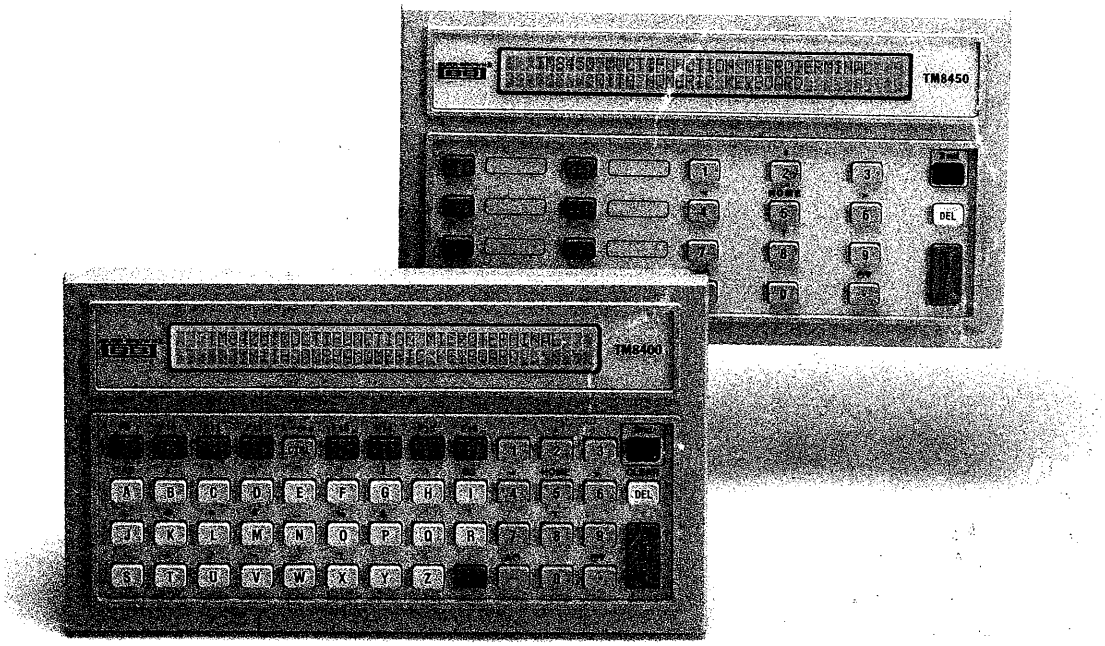
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TM8400/TM8450

Microterminals



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TM8400 Microterminal User's Guide

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Preface

This document has been prepared as a guide and reference for the installation, setup and operation of the TM8400 Microterminal and its options. To assure a successful installation, please read Chapter 2 thoroughly before beginning to install your terminal.

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 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 your TM8400, application assistance is available by calling (602) 746-1111 between 8 AM and 5 PM Mountain Standard Time.

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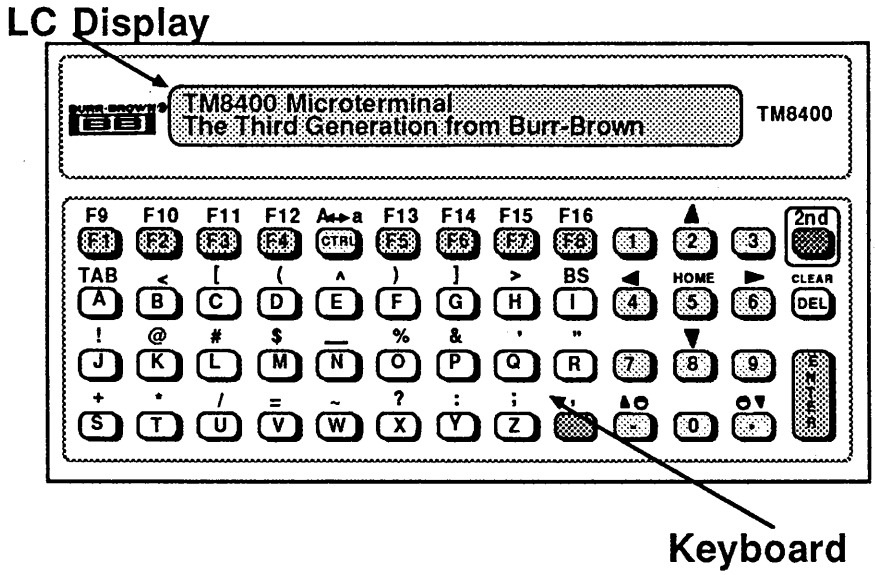
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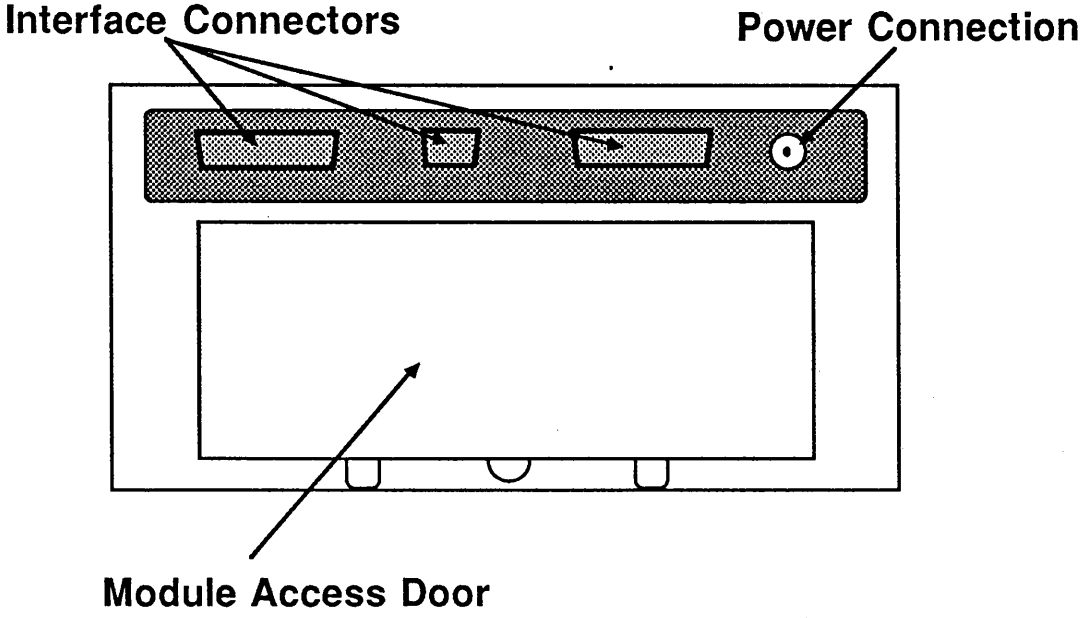
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Chapter 1

About The TM8400

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About the TM8400

The TM8400 is a compact data entry/display terminal with the versatility to meet the varied needs of industrial data collection. It may be used in applications requiring simple keyboard entry or those requiring a complex, multifunction workstation.

As with any computer terminal, the primary function of the TM8400 is to interface a human operator with a computer system. The base unit of the terminal contains the display, keyboard, and terminal electronics.

The TM8400's liquid crystal display can show two lines of 40 characters. For ease of viewing in low light areas, the display is illuminated with a soft, white electroluminescent backlight which may be controlled either from the keyboard or from the host computer. Display attributes include protected line and character flashing. Contrast and viewing angle are electronically adjustable from the keyboard.

The keyboard of the TM8400 contains 51 key locations and is capable of entering the entire ASCII character set. The unique design of this keyboard features plastic keycaps retained in a removable bezel over a sealed elastomer (silicon rubber) base. The logical layout of the keyboard is totally definable by the application programmer. The removable bezel allows keys to be physically rearranged in any sequence.

To provide audible feedback to the operator, the TM8400 features a two-tone beeper. In extremely noisy environments, an external annunciator can be triggered by a special digital output signal from the terminal which is activated whenever the beeper sounds.

Various communications interfaces and options are selected by easily installed **modules.**

There are three types of modules available for the TM8400- **Communication, Peripheral,** and **Auxiliary**. Locations inside the back of the terminal will accept one module of each type.

Communication modules select the host communications interface to the terminal and are required for operation. Any one of the family of Burr-Brown TM841X modules may be used.

Peripheral modules are used to interface scanning input devices to the terminal. These types of devices provide an alternative to manual keyboard entry of data. Any one of the family of Burr-Brown TM842X peripheral modules may be used providing a choice of several types of barcode scanners as well as magnetic stripe input.

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Auxiliary modules provide for the connection of secondary input/output devices to the TM8400. Modules in Burr-Brown's TM843X family allow the connection of printers, RS-232 serial devices, counters and digital I/O.

Modules installed in the auxiliary slot may carry their own EPROM operating instructions, allowing future modules, as well as those designed by users or third parties, to work with the existing firmware in the terminal.

The TM8400 features a choice of three **Operating Modes.** The operating mode selected depends on the application and host computer software. The protocol for sending and receiving data is different for each of these modes. The operating mode also affects the behavior of several command or *Escape Sequences* sent to the terminal. The operating mode is selected in SETUP.

Monitor Mode operation is described in Chapter 9. This mode allows the TM8400 to serve as a monitor on the host serial line for trouble-shooting communications.

Character Mode operation is described in Chapter 10. In this mode, input and output to the terminal is *character* oriented; characters are transmitted as soon as a key is pressed and displayed as soon as they are received. When in character mode, the TM8400 uses a 1920 character *virtual* screen to hold display data. This may be either 24 lines of 80 characters or 48 lines of 40 characters.

Block Mode operation is described in Chapter 11. In this mode, input and output to the terminal is line oriented; message lines are transmitted as a whole when the **ENTER** key is pressed and displayed only after the entire line and its terminator has been received. When in block mode, the *virtual* screen is used to retain the last 24 or 48 displayed lines for operator review. **Multidrop** operation, in which a number of terminals are connected to the same communications line, is possible in block mode by selecting an address other than "00" in SETUP. A multidropped terminal will display only message lines which are prefixed by its address and will transmit messages only when "polled" (see **p** command in Chapter 4).

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Chapter 2

Installation

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Installation

There are four basic steps involved in installing the TM8400:

Unpacking
Module Installation
Mounting
Power and Interface connections

Unpacking

The TM8400 base unit, modules and accessories are shipped in separate boxes. These boxes should be retained and used if there is ever a need to ship the units. Special care should be taken with the option modules. These modules are shipped in special antistatic plastic boxes with a small sheet of *Silver Saver* paper. This packaging protects the module and its elastomeric connectors. To insure proper operation of the TM8400, it is important to always store unused modules in their original boxes to prevent static damage to components and oxidation of connector surfaces.

Inspect all received parts for damage and report problems to the carrier. Do not attempt to use a TM8400 with a damaged case or display.

As with all electronic equipment, it is important to avoid static discharge to modules, electronic components, and interface connectors. It is good practice to touch a grounded metal surface before making connections to the TM8400 or handling its option modules.

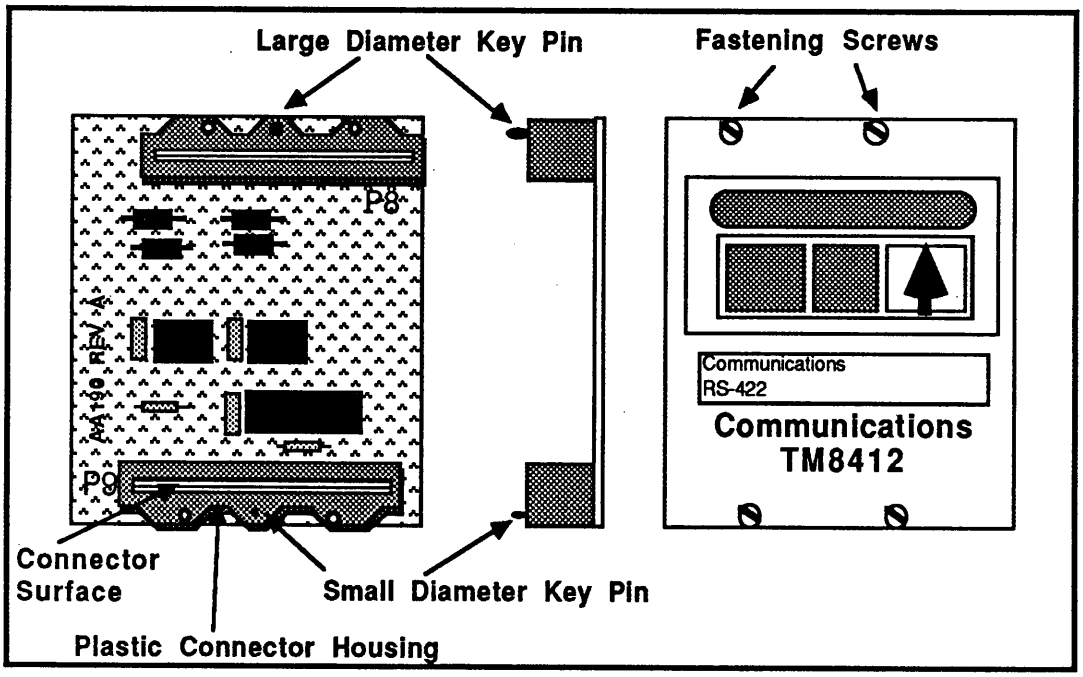
Module Installation

TM8400 option modules are actually small printed circuit boards with the electronic components necessary to add a particular capability to the terminal.

Before attempting to install the module, hold it by the edges and inspect it to identify the following features with the aid of the diagram below:

- Plastic connector housing
- Elastomer connector surface
- Large and small diameter key pins
- Captive fastening screws
- Graphic label

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Modules are installed by engaging the key pins in their corresponding holes on the terminal's main printed circuit board and then tightening the four fastening screws to secure the module in place. The size and location of key pins on each module are designed to prevent a module from being placed in the terminal upside down, or in the wrong location. A graphic label on each module also shows the proper location and orientation as well as the terminal's display indication when the module is properly installed.

Always use the following procedure when installing option modules. **Check that power is disconnected before proceeding.**

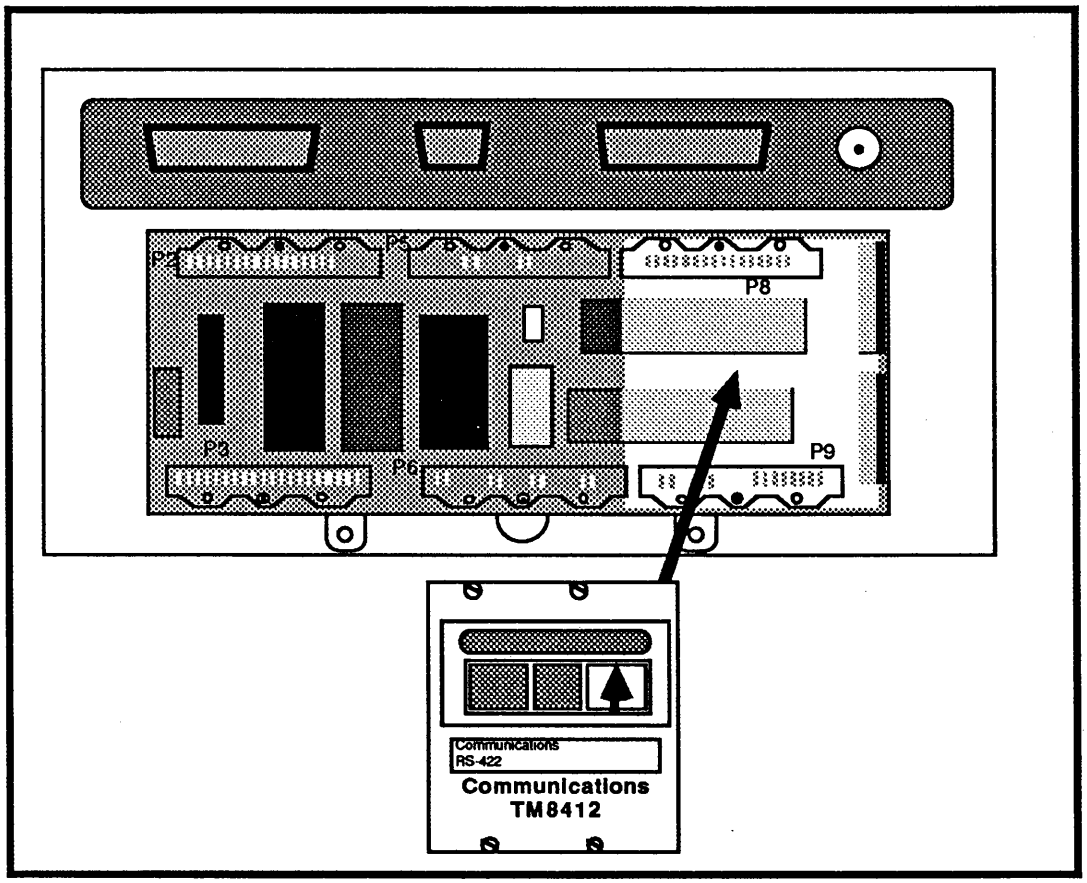
1) Determine the correct location. A communications module cannot be installed in a location designed for a peripheral module and vice versa. Place the terminal with its keyboard face down on a flat surface. Remove the module access door by removing the two screws which secure it in place. Retain the door and screws for later replacement.

Inside the terminal, you will see an electronic printed circuit board. If you look closely, you will see white outlines printed on this board in the shape of the module connector housings. Within each of these outlines are three holes, two threaded screw holes and a center key hole. Note that the key holes have larger and smaller diameters, corresponding to the key pins on the modules themselves.

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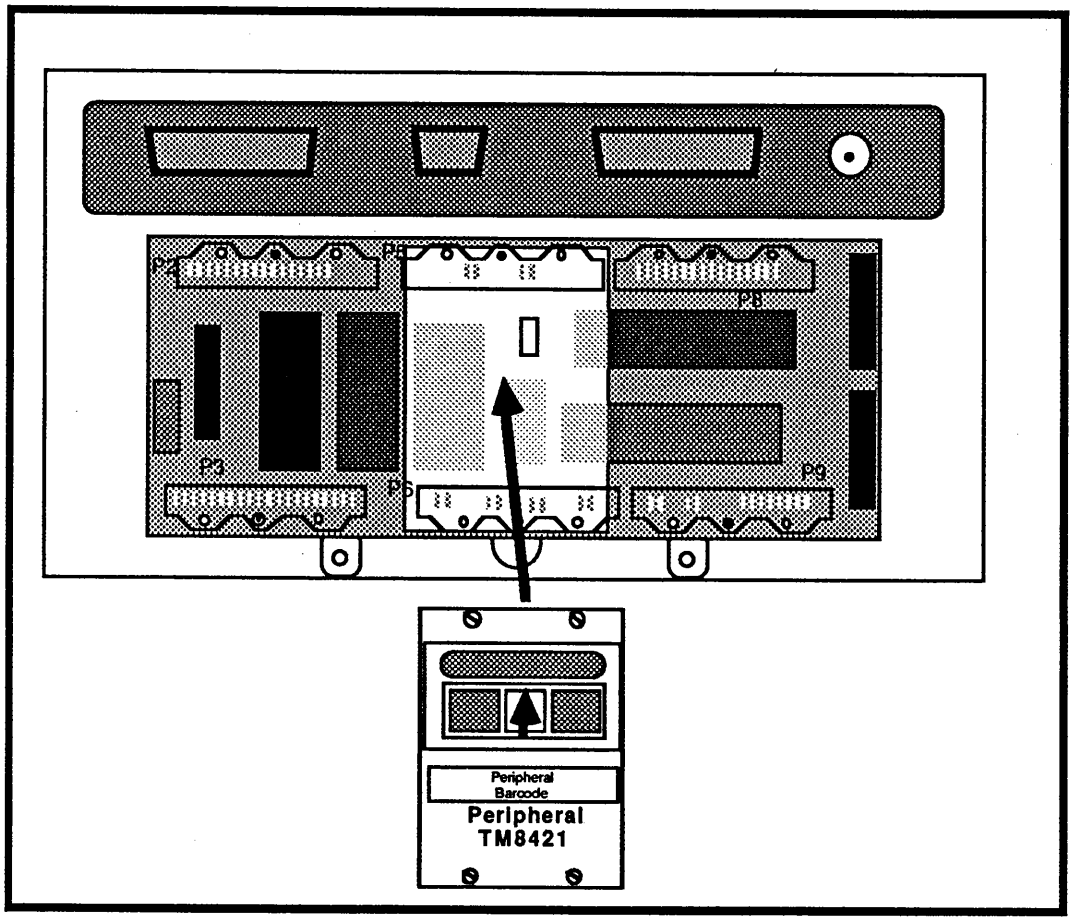
The following diagrams indicate the proper locations for the various modules.

Communication



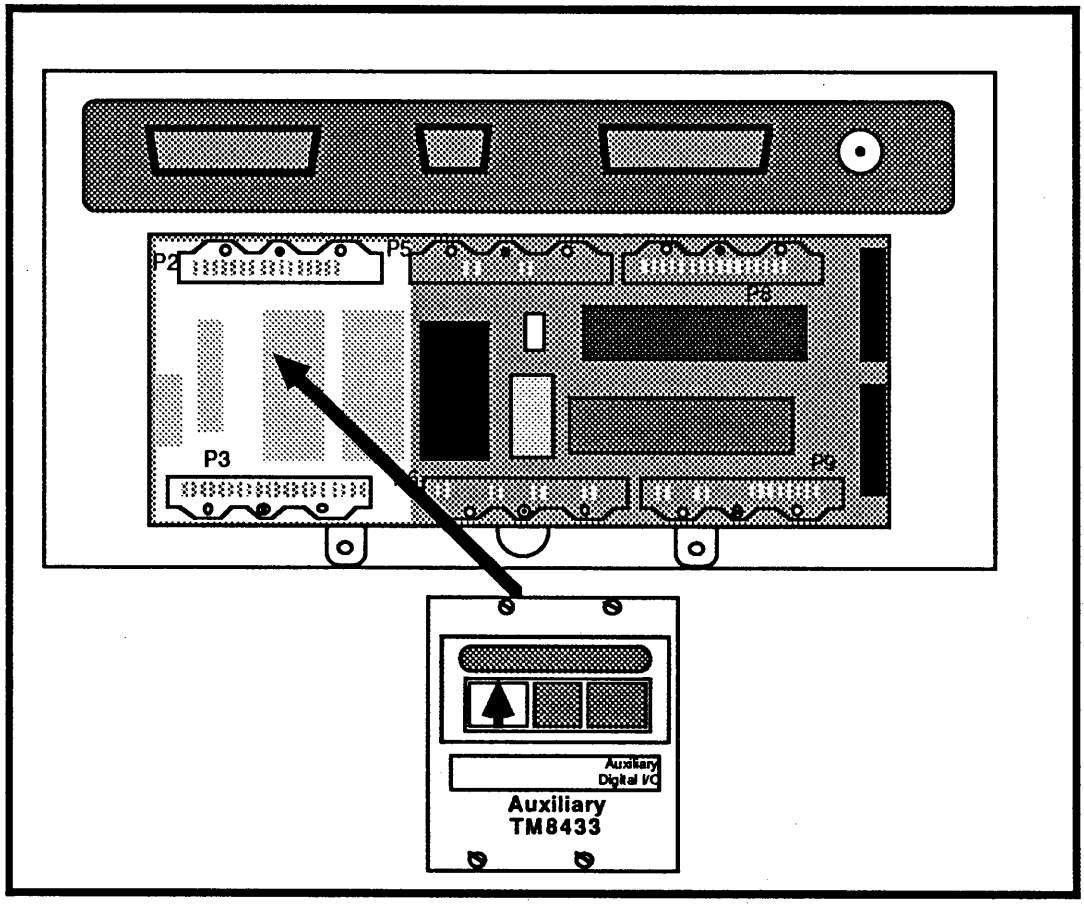
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Peripheral



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Auxiliary



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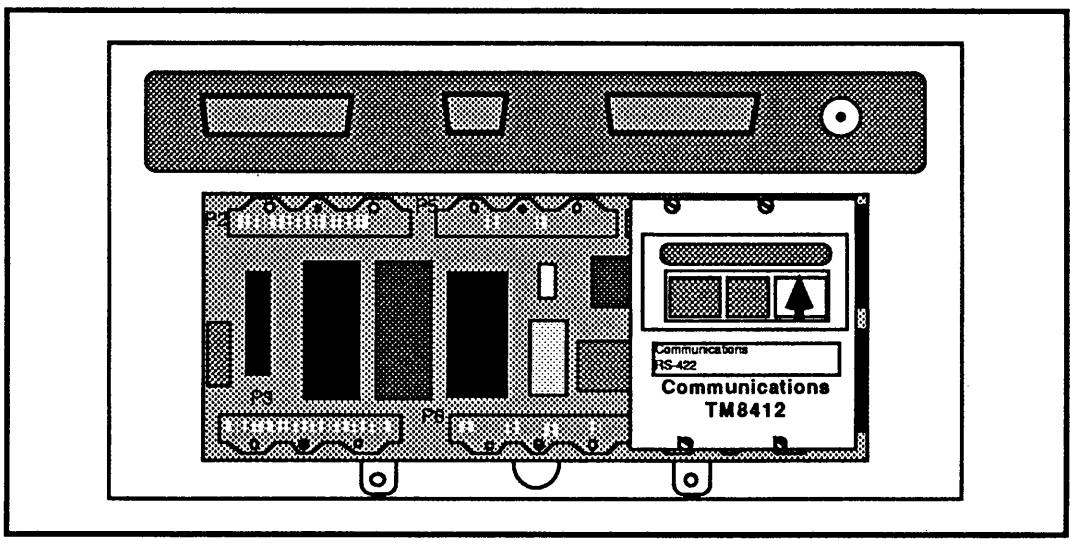
2) Handle the module properly. The module may be handled by grasping the edges of its printed circuit board, or the heads of the fastening screws. Note that the fastening screws are *captive*, or retained by the connector housing. You should not attempt to remove the screws completely from this housing while installing or removing modules. Again, be certain to touch a grounded metal surface before handling the module to make sure you do not discharge static electricity.

3) Place the module carefully in its location. Lower the module into its proper location, making sure that the arrow printed on the module's graphic label is pointing upward toward the row of interface connectors on the back of the terminal. Move the module gently from side to side until the key pins engage in their corresponding holes on the printed circuit board.

4) Tighten the fastening screws. Use a small size screwdriver to avoid slipping off the screw heads and also to prevent overtightening. Give each screw a few turns to seat the module and then go back and tighten each screw until moderate resistance is felt. **Do not overtighten.**

5) Don't force it!! Modules should install easily. If you encounter resistance, **STOP,** remove the module, check the orientation and location and begin again.

A properly installed module should look like this in the back of the terminal:

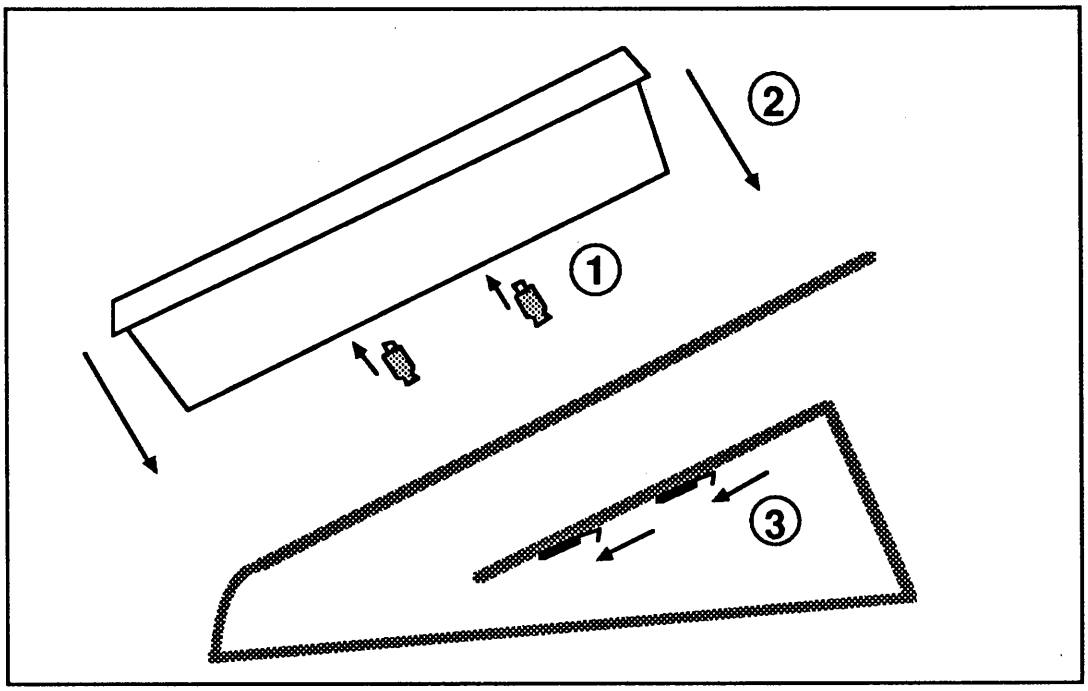


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Mounting

The TM8400 may be placed on a desktop using the TM8440 stand or mounted on a wall or panel. The optional TM8442 mounting kit allows for recess mounting through panel cutouts.

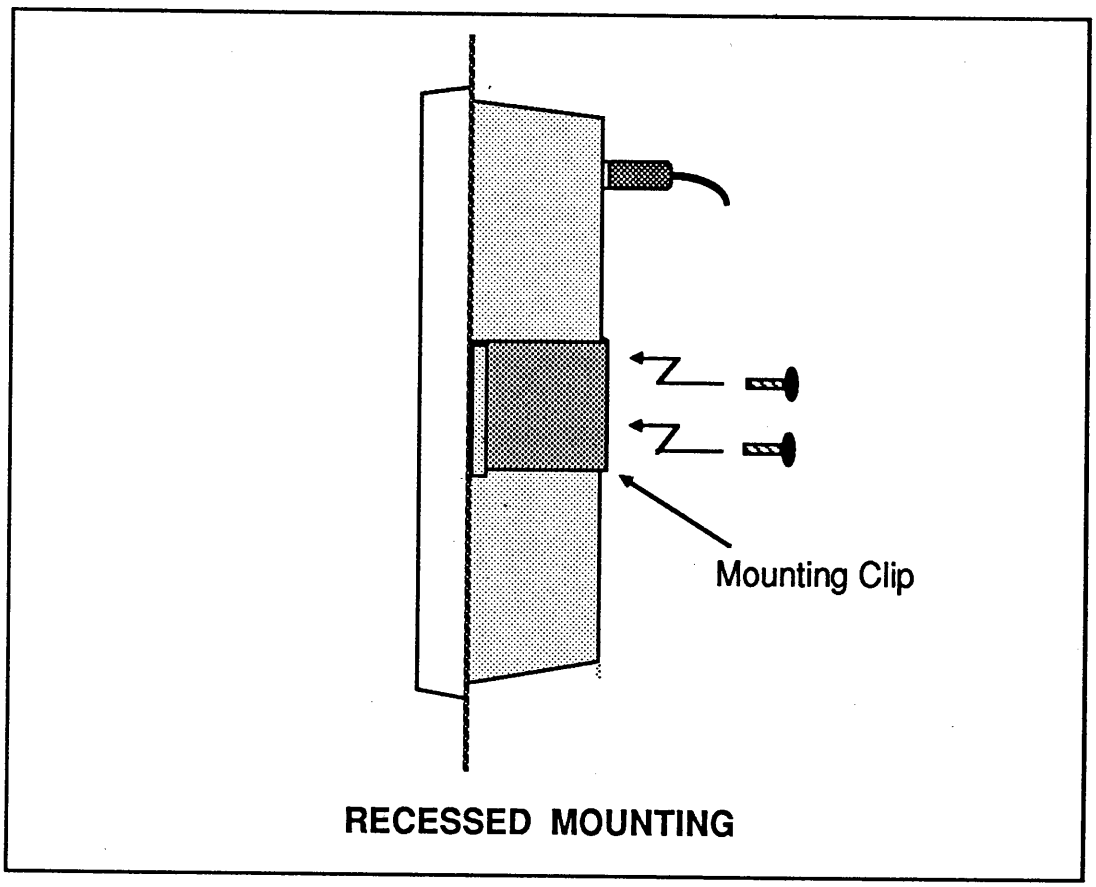
To install the terminal in its stand, (1) screw the four threaded mounting studs in to the brass inserts on either side of the module access door. (2) Lower the terminal onto the stand, engaging the mounting studs in the holes provided. (3) Secure the terminal by latching the four mounting clips.



Desktop Mounting with TM8440 Stand

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The TM8442 mounting kit contains two spring clips which allow the TM8400 to be recessed in an equipment panel up to .25" in thickness. To mount the terminal, prepare a cutout in the panel with dimensions as indicated below. Insert the TM8400 case through the front of the panel. While holding the terminal in place, attach the spring clips to the back case of the terminal with screws provided.

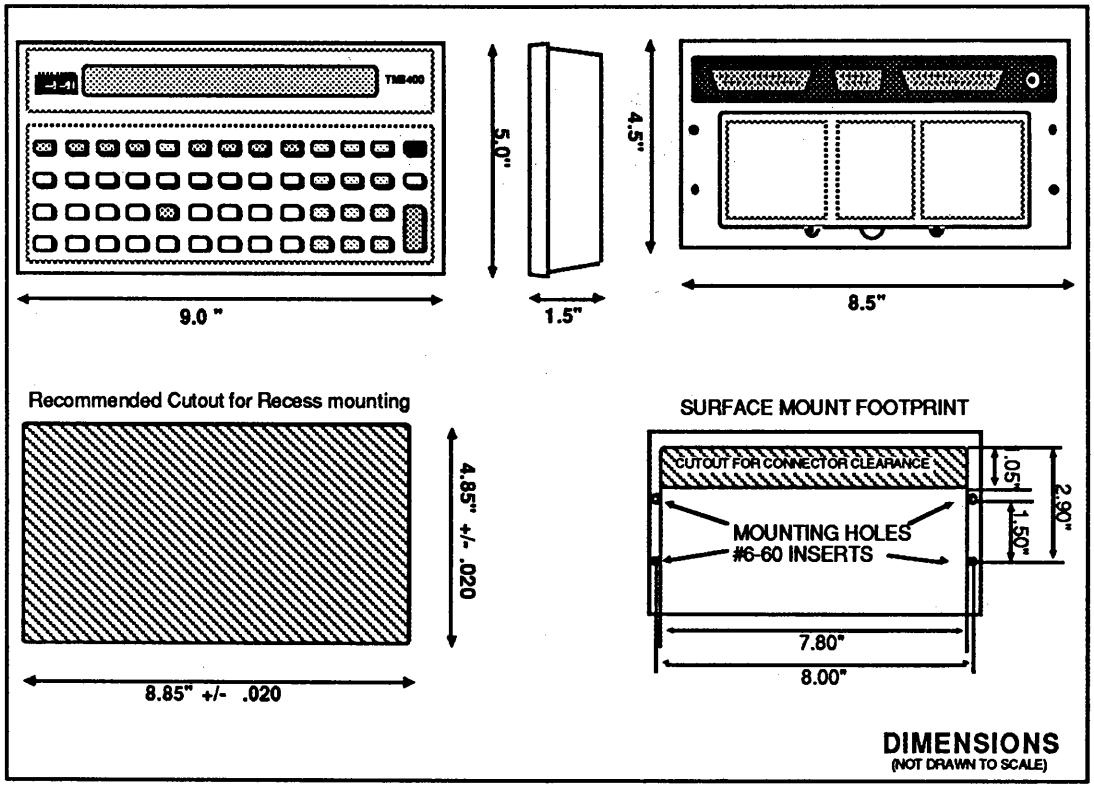


RECESSED MOUNTING

The TM8400 may also be surface mounted on a wall or other flat surface providing only a small cutout for power and interface connectors.

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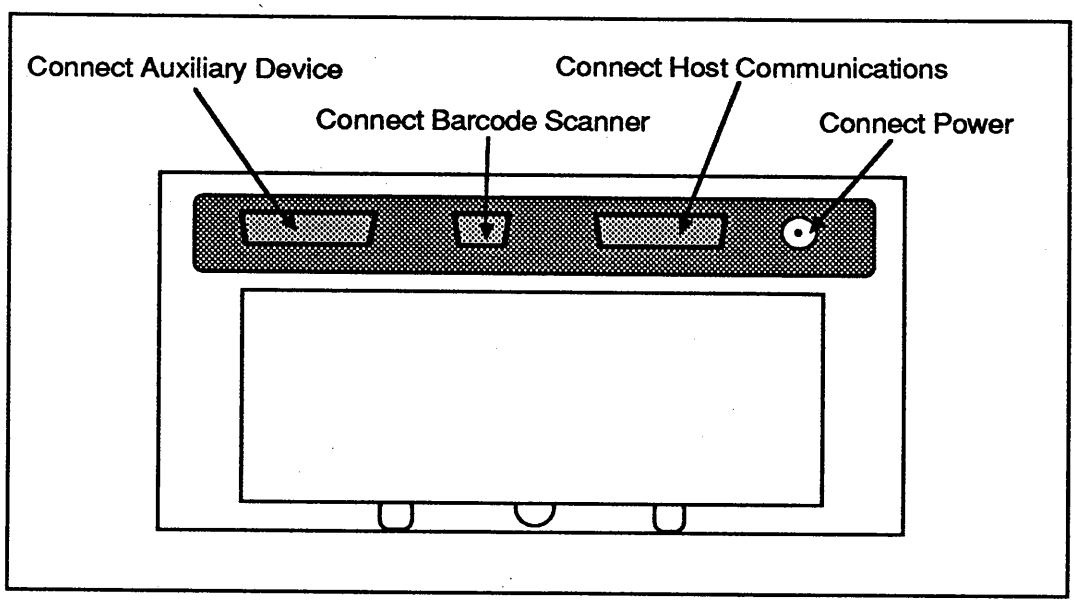
The diagram below gives mechanical dimensions of the TM8400 case, recommended recess mount cutout, and the surface mounting footprint.



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Power and Interface Connections

There is a row of four interface connectors on the back of the TM8400 case. The diagram below indicates the proper connection to each of these locations.



It is recommended that power be supplied to the unit by the TM8441 power pack. For connecting power from other sources, a barrel-type mating connector is provided with the unit. The connector should be wired so that the center is positive and the outside is ground. External DC power should range between 7.5 and 9 volts. The maximum current draw of the terminal is 500 mA.

For compatibility with previous systems, power may also be connected to special pins on the host communications connector. Power connected at this point may be either 5 VDC or 7.5-9 VDC as indicated below.

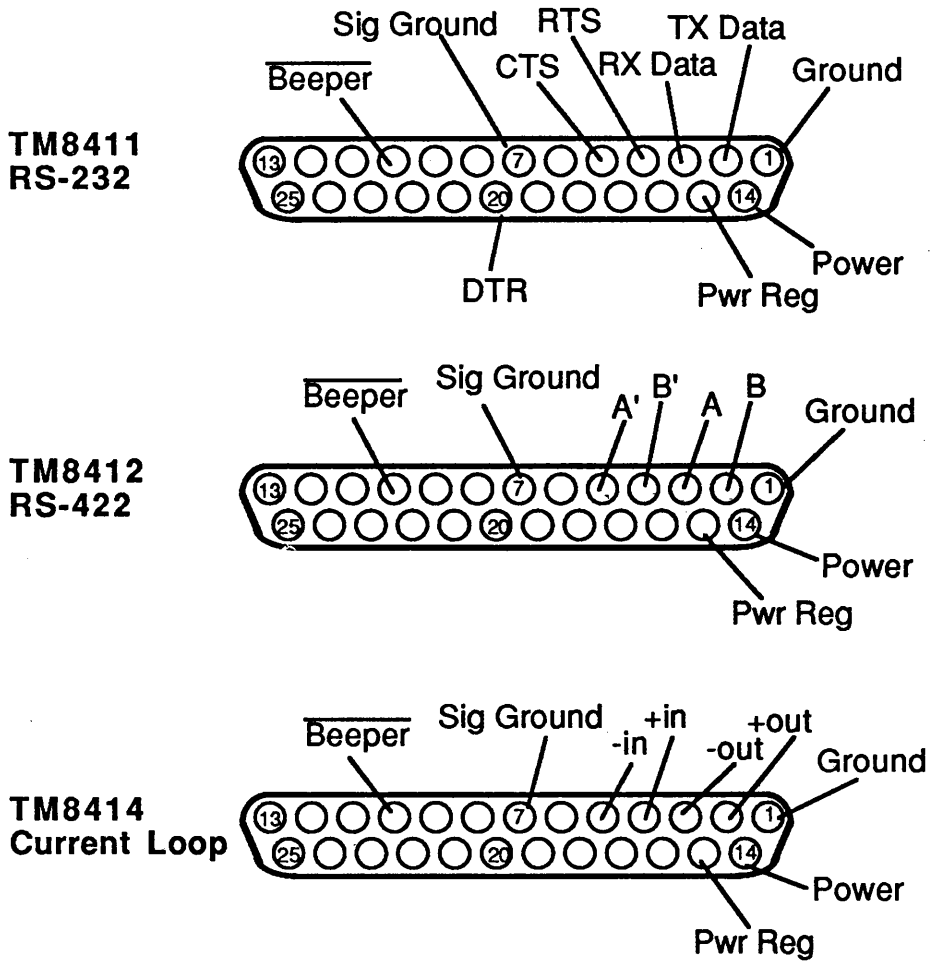
Power	Connection
5 VDC	Jumper pins 14 and 15, connecting +V to these pins. Connect supply return to pin 1.
7.5-9 VDC	Connect +V to pin 15. Connect supply return to pin 1.

Power connection through the host interface is not recommended for new installations.

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The Host interface is connected through a female DB-25 connector. The pinout of this connector is dependent on the communication module installed in the unit. Pinouts and full signal specifications for these communications interfaces are given in the appendix.

Please note that there are three non-standard signals present on this connector: pins 14 and 15 are connected to the unit's power regulator, and pin 10 is an active low digital output signal which is activated when the internal beeper is sounded. Care should be taken that these signals are not accidentally connected to communications circuits of the host system.



Host Interface Connections

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To connect a barcode wand or slot scanner to the terminal, simply plug the latching DE-9P connector into the peripheral interface. This interface is associated with a peripheral module which must be installed for operation of this feature.

Connection of Auxiliary interfaces to the male DB-25 connector is dependent on the particular auxiliary module installed. Prewired cables are available from Burr-Brown for the Printer module. The Serial I/O module may use a standard 25 conductor ribbon cable. Digital I/O and custom interfaces should be connected with the aid of the auxiliary module specifications provided in the appendix.

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Chapter 3

Setup

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Setup

Communications and operating parameters of the TM8400 are selected interactively from the keyboard and stored in the unit's non-volatile battery-backed RAM so they may be recalled automatically the next time the terminal powers up.

Setup selections are made in a special *Setup* mode which prompts the operator through the various categories and choices using the display and function keys. After the initial setting of parameters, Setup need only be entered when an option is to be changed.

With the exception of communications-related parameters, many of the terminal's operating characteristics can also be altered by commands from the host computer.

In order to guard against accidental changes by untrained operators, the Setup mode is entered with a multiple key sequence keyed in after the terminal's power-up self-test routine. Since the keyboard of the TM8400 is redefinable, some care should be taken that the keys used by the Setup routine are defined and accessible if it is desired to change the terminal's parameters.

Prompts for the Setup mode are displayed in English, French, or German. The choice of the prompt language is actually the first category presented in Setup mode.

Placing the terminal in SETUP mode

1) Apply power to the terminal.

2) Wait for beep tone and Self-Test message:

TM8400 Vxx.xx Self Test Ok

3) Wait for module identification message:

Communication	**Peripheral**	**Auxiliary**
RS-422	**Barcode**	**None**

4) Press **2nd** key, followed by **CTRL.**

You have five seconds to press these keys after the module identification message appears. If no key is pressed, the terminal will begin normal operation. Note that if the keyboard layout has been redefined, the Setup function may have been moved to another key.

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Several keys are used by the terminal operator when in Setup mode:

NEXT (F1) — Displays the next Setup category and its currently selected option on the top line of the display

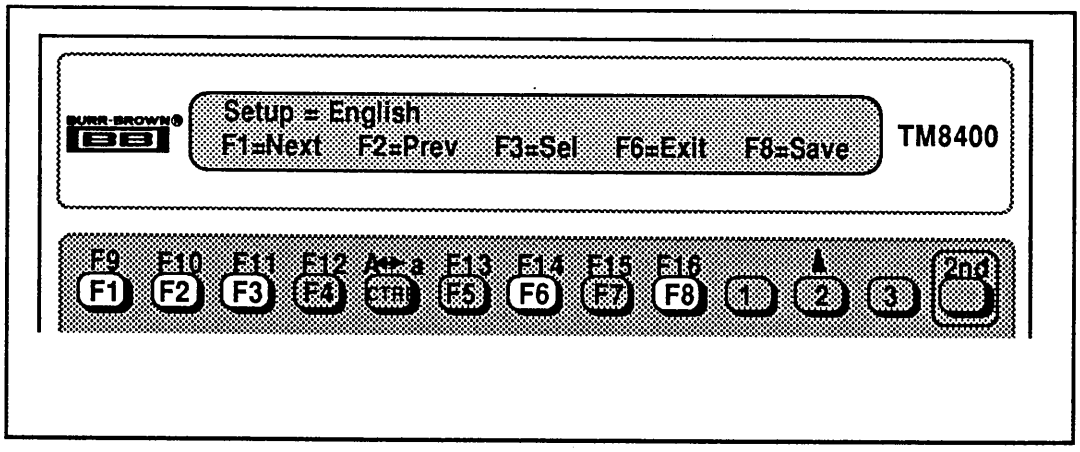
PREV (F2) — Displays the previous Setup category and its currently selected option on the top line of the display

SEL (F3) — Selects and displays the next option for the current category. Used to step through the choices in any particular category

EXIT (F6) — Leave Setup and begin normal operation. Exit leaves selected options in volatile memory and does not save them in battery-backed RAM

SAVE (F8) — Saves the current configuration in battery-backed RAM but does not Exit

These keys and their functions are displayed on the protected bottom line of the display. The category and currently selected option are shown on the first line of the display. For example:



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Following is a listing of the Setup categories and the available options. Note that some selections are not required for certain terminal modes and will not be prompted for. Only English prompts are shown.

Setup =

English
Deutsch
Francais

This category selects the language in which all subsequent prompts will be displayed

Terminal Mode =

Monitor
Block
Character

This category selects the terminal's operating mode as described later in this user's guide. Block mode must be selected for multidrop applications or when buffering of input and output messages is desired.

Address =

00 (non-polled)
01
02
•
•
30
31
32

This category selects the terminal's optional multidrop address and is displayed only if block mode was previously selected. If any address other than "00" is selected, the terminal operates in polled mode, transmitting data only when requested by the host computer (see poll command).

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Baud Rate =

300
600
1200
2400
4800
9600
19200

This category selects the communications speed for transmitting and receiving on the host interface. The baud rate must be set to match that of the host computer.

Data Format =

7 bits odd parity
7 bits even parity
7 bits mark parity
7 bits space parity
8 bits no parity

This category selects the communications word length and parity. The data format selected must be compatible with that used on the host computer. The parity bit is ignored if mark or space parity is selected. All formats generate one stop bit.

Line Terminator =

ETX
CR
LF
CRLF

This category selects the line or message terminator. In block mode operation, this character (sequence) defines the end of a received message block and is appended to any message transmitted from the terminal. In character mode, the line terminator is the character (sequence) which is transmitted when the ENTER key is depressed.

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Handshaking =

None (Data Leads Only)
Modem Control
XON/XOFF

This category determines whether flow control handshaking is used by the terminal on its host interface. When **None** is selected, only the TX data and RX data lines are used. When **Modem Control** is selected, the terminal asserts RTS and DTR and responds to CTS. The selection in this category is ignored on communications modules which do not have these signal lines. When **XON/XOFF** is selected, the ASCII <DC1> and <DC3> control characters are used to control transmission in both directions. The **XON/XOFF** choice will appear only when **Character** mode operation has been selected.

Turnaround Delay =

0	**mS**
10	**mS**
20	**mS**
30	**mS**
40	**mS**
50	**mS**
100	**mS**
250	**mS**
500	**mS**
1	**S**

This category selects the communications turnaround delay used in block mode operation. Turnaround delay is the length of time the terminal will wait between a request to transmit data (such as the **poll** or **echo** commands) and the actual transmission of that data.

Backlight =

Off
On
Auto On/Off

This category controls the operation of the display backlight. When **Auto On/Off** is selected, the backlight will automatically turn off after 10 minutes of inactivity. The light will then come back on with any input from the keyboard, peripheral, or auxiliary input.

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Input Display = **Free Format**
One message per line

This category controls the display of input messages in block mode. When **Free Format** is selected, each new message is displayed beginning at the present cursor position. **One message per line** causes the terminal to begin a new line with each message received.

Auto Wrap = **Off**
On

The **Auto Wrap** setting controls the movement of the display cursor after it reaches the rightmost position of the virtual display. When **Auto Wrap** is **On**, the cursor will automatically move to the first position of the next line. When set to **Off**, the cursor will remain at the right boundary of the display until a <CR> or other cursor movement character is received.

Newline = **No**
Yes

The **Newline** setting determines how the display will handle the <CR> and <LF> control characters. When set to **Yes**, a received <CR> or <LF> is expanded to a <CRLF> sequence, causing the display cursor to move to the first position of the next line.

Display Width = **40**
80

This category determines the width of the terminal's virtual display. When set to **80**, the display window will scroll horizontally as well as vertically.

Local Echo = **Off**
On

This category determines whether characters entered from the keyboard, peripheral or auxiliary input are written to the display before being transmitted. This selection is made only in character mode.

Key Repeat = **Off**
On

This category determines whether data entry keys will repeat if held down.

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Key Click = **Off**
On

When **Key Click** is set to **On**, the beeper is sounded to provide audible feedback for each key depression.

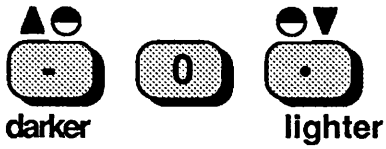
Peripheral mode = **Off**
Auto
Manual

This category determines the operation of the optional peripheral scanner. When set to **Auto**, each code scanned is automatically transmitted when the terminal is in block mode, or automatically terminated in character mode. Setting the mode to **Off** disables the scanner.

Symbology = **3 of 9**
Full ASCII 3 of 9
2 of 5
Interleaved 2 of 5
EAN/UPC
Auto Discriminate

This category selects the barcode symbology which can be read when a barcode scanner is used. When set to **Auto Discriminate**, the terminal will automatically identify and decode all symbologies (with the exception of Full ASCII 3 of 9). When any individual code is selected, the terminal will read only that code.

In addition to setting these parameters, the contrast or viewing angle of the LCD display is also adjustable from the keyboard. Two special symbols are located on the keyboard to indicate the functions *+view* (lighter) and *-view* (darker).



To adjust the view angle, press the maroon **2nd** key and then hold down the appropriate view key until the display is easily readable.

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Chapter 4

Host Commands

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Host Commands

In addition to sending text messages to the TM8400, 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.

<ESC><command letter>**[**<parameters>**]**<terminator>

In order to give the host computer full control over the terminal's extended capabilities, the TM8400 uses a different set of command sequences than previous models of Burr-Brown terminals. To maintain compatibility with existing applications, however, the TM8400 will respond to a limited number of TM7x command sequences. These compatibility sequences are listed in the appendix. It is recommended that new applications utilize the newer TM8400 sequences only.

	Command Letter	Description
COMMUNICATION		
	p	Poll terminal for output
	r	Retransmit last data
	e	Echo message from host
	o	Clear output and Tx Buffers
	u	Restore output buffer cleared with **o**
	t	Set turnaround delay
KEYBOARD		
	k	Set keyboard parameters
	l	Redefine keyboard layout
	m	Define function message
DISPLAY		
	d	Set display characteristics
	f	Set display format
	i	Insert function message in output stream
	w	Write to protected line
MODULE AND MISCELLANEOUS		
	s	Set peripheral scanner characteristics
	a	Auxiliary module request
	b	Backup parameters in non-volatile RAM
	c	Configuration Request

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All command sequences must be properly terminated to be executed by the terminal. The ASCII control character <STX>(002) can be used to terminate commands in both block and character modes. In Block mode, the selected line terminator (<ETX>, <CR>, <LF> or <CRLF>) may also be used provided the command is at the end of a transmitted line. Using the <STX> terminator allows multiple commands to be imbedded, along with text, in a line sent to the terminal.

When the terminal receives commands containing errors or invalid parameters, valid command characters at the beginning of the command are processed; remaining characters from the first invalid character to the terminator are ignored. Commands which allow several parameters may be terminated prematurely without affecting the unspecified parameters.

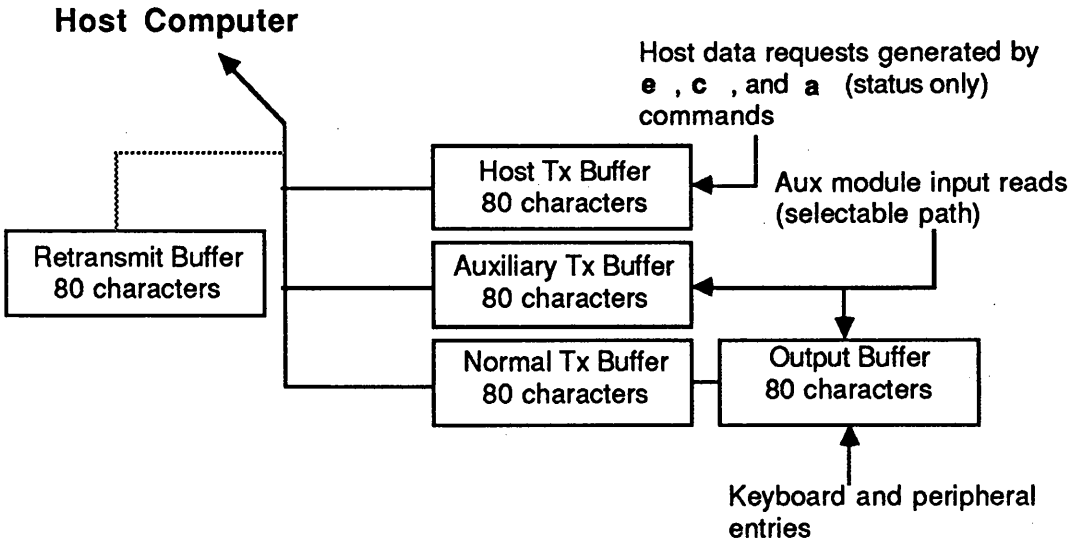
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Communications Commands

Certain communications commands cause the terminal to transmit data back to the host. Since input to the terminal may also occur simultaneously from a number of sources, a system of buffers or temporary storage locations is used to assure that all data is transmitted to the host in the proper sequence without being lost or overwritten.

Four buffers are used for transmitting. The normal buffer is for operator entered data. Another buffer is used for auxiliary module data, which must be explicitly requested by host command. A special buffer is used for host data such as that requested by the *echo* command or status request commands. The final buffer is the retransmit buffer, which always contains the last data transmitted.

If several pieces of data are awaiting transmission to the host, the buffers have the following priority order: *host , auxiliary module, normal .*



Exactly when data is transmitted in response to a host command or as a result of operator input is dependent on the terminal mode. In character mode, data is placed in a transmit buffer and transmitted immediately. When the terminal is in block mode, data is transmitted immediately only if the terminal's multidrop address is set to "00"(non-polled). If the terminal is multidropped, data is not sent until a *poll* or *retransmit* command is addressed to the terminal.

A programmable *turnaround delay* (see t command) can be set to delay the response to any request for transmission.

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p
The *poll* command causes the contents of the highest priority Tx buffer to be transmitted to the host. If all buffers are empty, the line terminator alone is sent.

Modes: *Block*

<ESC>p<terminator>

r
The *retransmit* command causes retransmission of the last data sent by the terminal. Since a separate buffer is used to hold the last data transmitted, the *retransmit* command may be used repeatedly and will not be affected by any action of the terminal operator.

Modes: *Block, Character*

<ESC>r<terminator>

e
The *echo* command allows the host computer to verify communications to and from the TM8400. The host transmits a text string, embedded in the command, to the terminal, and the terminal sends back the string.

Modes: *Block, Character*

<ESC>e<text>**<**terminator**>**

The text string may be from 0 to 80 characters in length. The terminal will respond to this command with:

<text><line terminator>

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o

The *clear output* command allows the host computer to clear the **output buffer** and the **normal Tx buffer.** Any data which has been entered into the output buffer is saved so that the host may recall it later if desired. Any partial (unterminated) output message in the display is erased. If the normal transmit buffer is pending transmission, this condition is also cleared. **Any data in the normal Tx buffer will be lost.**

In block mode operation, normal text messages from the host are discarded while the operator is entering an output message into the terminal. The clear output command gives the host the capability to clear this condition and *break through.* The **u** command may be used later to restore the output buffer after the host message has been displayed.

Modes: *Block*

<ESC>o<terminator>

u

The *undelete output* command allows the host to recall and display the contents of the last output buffer deleted by an **o** command. The recalled contents are appended to any current contents of the output buffer.

Modes: *Block*

<ESC>u<terminator>

Example:

Host issues priority message, clearing any possible output message:

<ESC>o<STX>Emergency Message!!<BEL><BEL><CR>

Host issues new prompt and restores partial operator entry (if any):

New Prompt <ESC>u<CR>

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t

The *set turnaround delay* command allows the host computer to specify the minimum time which must elapse between a command which causes the terminal to transmit data immediately and the actual transmission of that data. This is necessary only for host systems which require time to prepare to read input after sending output to the terminal.

Modes: *Block*

<ESC>t<delay**><**terminator**>**

The delay should be specifed as a single ASCII digit 0-9. Values are:

0	0	mS
1	10	mS
2	20	mS
3	30	mS
4	40	mS
5	50	mS
6	100	mS
7	250	mS
8	500	mS
9	1	S

Example:

Set turnaround delay to 40 mS:

<ESC>t4<STX>

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Keyboard Commands

The keyboard on the TM8400 is flexible in that it allows redefinition of any key, as well as a physical layout change. The keyboard may include up to 16 programmable function keys. The corresponding function messages are organized as two banks of 16 messages which may be up to 40 characters long. It is possible to selectively enable and disable the keyboard, key repeat and audible key click.

k

The *keyboard* command allows the keyboard operating characteristics to be specified. Any of the parameters may be modified without altering the settings of the others.

Modes: *Block, Character*

<ESC>k<keyboard><function bank><key repeat><keyclick><terminator>

values for *keyboard* are

0	no change
1	OFF
2	ON

values for *function bank* are

0	no change
1	F1 thru F16 (Lower Bank)
2	F17 thru F32 (Upper Bank)

This parameter selects which bank of function messages in the terminal's memory is accessed by the keys F1 through F16. When the upper bank is selected, key F1 will access message F17, key F2 will access message F18, etc.

values for *key repeat* are

0	no change
1	OFF
2	ON

values for *keyclick* are

0	no change
1	OFF
2	ON

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Example:

Select the upper function bank leaving all other parameters unchanged:

<ESC>k0200<STX>
or simply
<ESC>k02<STX>

l (lower case "L")
The *keyboard layout* command allows modification of the keyboard layout. Please refer to the **Keyboard** section of this manual for key and location codes.

Modes: *Block, Character*

<ESC>l0<location><normal code><shifted code><terminator>

(command letter is lower case "L" followed by digit "0")

The *location* value should be two ASCII decimal digits indicating the physical position of the key being defined. (00-55)

The *normal code* value should be three ASCII decimal digits for the key value when it alone is pressed. (000-255)

The *shifted code* should be three ASCII decimal digits for the key value when it is preceded by the 2nd key. (000-255)

A special version of this command will restore the default keyboard layout.

<ESC>l1<terminator>

Example:

Define key location 38 to have "space" as its normal function and "chgcase" as its shifted function

<ESC>l038032132<STX>

m
The *define function message* command allows the host computer to redefine function messages. Text stored as a function message will be entered into the terminal when the corresponding key is pressed as if the operator had typed the individual characters.

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Two ASCII control characters can be embedded in function messages for special functions. A function message which ends with <RS> (030) is equivalent to a message typed on the keyboard followed by depression of the *ENTER* key. Ending a function message with <EOT> (004) has a similiar effect in block mode except that the normal line terminator is suppressed on transmssion. (The <EOT> would be transmitted in character mode.)

The default values for all function messages which are not defined by the host are literally the legends printed on the keys - "F1", "F2", etc.

Modes: *Block, Character*

<ESC>m<number><text><terminator>

Values for *number* are

01 - 16 for F1 - F16 (lower bank)
17 - 32 for F1 - F16 (upper bank)

Text should be a string of 0 to 40 characters.

Example:

Define a message on function F1 which is transmitted immediately on depression of the F1 key:

<ESC>m01Call a Plumber!<RS><STX>

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Display Commands

d

The *display characteristics* command allows the host computer to modify the operation of the display. Display **flash**ing may be enabled or disabled. All characters sent to the display from any source while flashing is enabled will be set to flash. These characters will continue to flash even after flashing is disabled. The display may also be set to have either a two line window or a one line window with a **prot**ected bottom **line**. The **cursor** may be turned on or off, the virtual display **width** may be set to 40 or 80 characters, and the **auto wrap** setting may be modified.

Modes: *Block, Character*

<ESC>d<flash><prot line><cursor><auto wrap><width><terminator>

Values for *flash* are:

0	no change
1	OFF
2	ON

Values for *prot line* are:

0	no change
1	OFF (two line window)
2	ON (one line window)

Values for *cursor* are:

0	no change
1	OFF
2	ON

Values for *auto wrap* are:

0	no change
1	OFF
2	ON

Values for *width* are:

0	no change
1	40 characters wide
2	80 characters wide

Example:

Enable the protected line and turn off the cursor:

<ESC>d02100<STX>

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f

The *display format* command allows the host computer to specify the format of the display. **Output display** may be disabled for applications such as password security. When disabled, only information received from the host computer will be displayed. The **backlight** parameter allows the host to control the operation of the display backlight. The **local echo** setting determines if keys are displayed before transmission in character mode. The **newline** setting affects the treatment of the ASCII <CR>(013) and <LF>(010) characters. When disabled, <CR> moves the cursor to the beginning of the current display line, and <LF> moves the cursor to the same column on the next line. When enabled, both characters are treated as a <CRLF> sequence. The **input display** setting specifies how input messages are displayed in block mode. When *free format* is selected, the host controls the placement of messages in the display; otherwise, the terminal will add a <CRLF> sequence to the beginning of every message received before displaying it. This results in one message per line.

Modes: *Block,Character*

<ESC>f<output display>**<**backlight**>**<local echo>**<**newline**>**
<input display>**<**terminator**>**

Values for *output display* are:

0	no change
1	OFF
2	ON

Values for *backlight* are:

0	no change
1	OFF
2	ON
3	Auto ON/OFF (10 min timeout)

Values for *local echo* are:

0	no change
1	OFF
2	ON

Values for *newline* are:

0	no change
1	NO
2	YES

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Values for *input display* are:

0	no change
1	free format
2	one message per line

Example:

Turn on the display backlight:

<ESC>f02000<STX>

i

The host may specify a function message to be inserted in the output stream using the *insert message* command. In block mode, the message will be appended to the output buffer; in character mode, it will be transmitted.

Modes: *Block, Character*

<ESC>i<number><terminator>

Values for *number* are:

01 - 16 for F1 - F16 first bank
17 - 32 for F1 - F16 second bank

Examples:

The **i** command presents many interesting possibilities to the creative programmer.

1) After storing a terminal-specific operator prompt in F1 on all terminals, prompt any operator with the general command:

<ESC>I01<STX>

2) Define function F9 to be <RS> for use as a "remote ENTER":

<ESC>m09<RS><STX>	Define the message
<ESC>I09<STX>	Remote ENTER

3) Return the display window to home without operator action by simulating keyboard input.

<ESC>m10<Space><DEL><STX>	Define some arbitrary message
<ESC>I10<STX>	Home the window

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w

The *write protected line* command is used to write messages to the terminal's protected bottom line. Since these messages are stored in a special buffer, the display does not have to be configured with the protected line before using this command; however, the contents of the protected line buffer are not displayed until it is. Text strings of less than 40 characters are padded with trailing blanks.

Modes: *Block,Character*

<ESC>w<text><terminator>

Text may be a string of 0 to 40 characters.

Example:

Write a message to the protected line:

<ESC>wHere are some instructions<STX>

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Peripheral Module Commands

s

The *scanner* command allows the host to specify the operating characteristics of the barcode or magnetic stripe scanner.

Modes: *Block,Character*

<ESC>s<mode><symbology><terminator>

Values for *mode* are:

0	no change
1	OFF
2	AUTO
3	MANUAL

Values for *symbology* are:

0	no change
1	3 of 9
2	full ASCII 3 of 9
3	2 of 5
4	Interleaved 2 of 5
5	UPC/EAN
6	Codabar
7	Auto discriminate

Example:

Set peripheral scanner for **manual mode** and **full ASCII 3 of 9:**

<ESC>s32<STX>

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Auxiliary Module Commands

a

The *auxiliary module request* command is used to control the auxiliary interface. The functions and parameters are defined separately for individual modules. Future Burr-Brown and user-designed auxiliary modules will carry firmware which defines the appropriate function codes and parameters. Functions and parameters are required for request types *2* and *5* only. See chapter 8 for specific details on Auxiliary module request commands.

Modes: *Block,Character*

<ESC>a<type><ID>**[**<function><parms>**]**<terminator>

Values for *type* are:

0	input status
1	terminate input
2	input write
3	output status
4	terminate output
5	output write
6	return module name
7	poll input
8	pass through output

Values for *ID* are the module's two digit ID code 00-15. Presently defined codes are:

00	Digital I/O
01	Serial I/O
02	Printer
04	Counter
15	EPROM module

Function is a single ASCII character which is module dependent. (required only for request types 2 and 5)

Parms are any parameters required by the selected module function. (required only for request types 2 and 5)

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Request types *0* and *3* return a module status code to the host.

<status**><**line terminator**>**

Status codes are:

1	busy
0	idle
-1	invalid function
-2	invalid parameter
-3	timeout
-4	I/O error
-5	module dependent
-6	module dependent
-7	module not present
-8	I/O section not present
-9	system error

Miscellaneous Commands

b

The *backup parameters* command causes the terminal's current operating parameters to be saved in battery-backed RAM. These parameters are those selectable in the Setup mode which may have been modified by the host through the **t, k, d, f,** and **s** commands.

Modes: *Block,Character*

<ESC>b<terminator**>**

c

The *request configuration* command causes the TM8400 to answerback with a message identifying its charactersitics.

Modes: *Block, Character*

<ESC>c<terminator**>**

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The response to the **c** command contains the following information:

<class><version><revision><comm id><periph id><aux id><terminator>

class is the terminal classification (0 for TM8400)

version is two ASCII digits for the firmware version

revision is two ASCII digits for the revision level of the firmware

comm id is one ASCII digit for the ID of the communications module (0-6). Presently defined values are :

0	RS-232
1	RS-422
2	Current loop
3-6	Custom

periph id is one ASCII digit for the ID of the peripheral module (0-2), or X if no module present. Presently defined values are:

0	Barcode
1	Magstripe
2	LASER

aux id is two ASCII digits for the ID of the auxiliary module (00-15), or XX if no module is present. Presently defined values are:

00	Digital I/O
01	Serial I/O
02	Printer
04	Counter
15	EPROM module

Example:

Configuration request is sent to a TM8400 with firmware version 00, revision 01 with RS422 communication module, Barcode module and no auxiliary module.

<ESC>c<STX>

The response is:

0000110XX<CR>

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Control Character Processing:
The following table lists the response of the TM8400 to ASCII control characters with the following exceptions.

1) In monitor mode, **all** control characters are displayed by flashing the corresponding printable character.

2) In block mode, the selected line terminator (<LF>,<CR>,<CRLF>, or <ETX>) is used to define the end of a message block from the host. The line terminator is stripped off by the terminal's receiver before the message is displayed.

Character	Value	Action
<NUL>	000	Ignored
<SOH>	001	Ignored
<STX>	002	Command terminator
<ETX>	003	Ignored if not line terminator
<EOT>	004	Special function message terminator
<ENQ>	005	Ignored
<ACK>	006	Ignored
<BEL>	007	Sound low beep tone
<BS>	008	Move cursor back one location
<TAB>	009	Move cursor forward one location
<LF>	010	Move cursor down one line (see also *newline*)
<VT>	011	Move cursor up one line
<FF>	012	Clear display
<CR>	013	Move cursor to beginning of line (see also *newline*)
<SO>	014	Ignored
<SI>	015	Ignored
<DLE>	016	Ignored
<DC1>	017	Ignored
<DC2>	018	Ignored
<DC3>	019	Ignored
<DC4>	020	Ignored
<NAK>	021	Ignored
<SYN>	022	Ignored
<ETB>	023	Ignored
<CAN>	024	Clear input buffer in block mode
<EM>	025	Clear input buffer in block mode
<SUB>	026	Ignored
<ESC>	027	Command sequence introducer
<FS>	028	Ignored
<GS>	029	Ignored
<RS>	030	Special function message terminator
<US>	031	Ignored

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Chapter 5

Display

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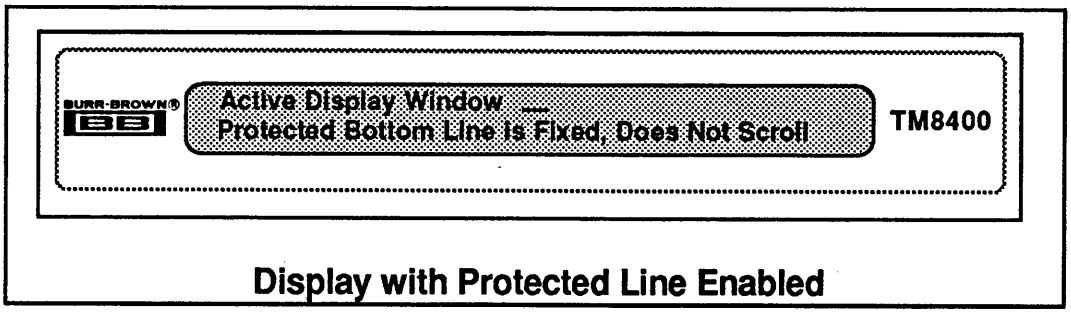
Display

The TM8400's LC display can be thought of as a window into a virtual screen of 1920 characters. The display is buffered in a circular fashion so that as the screen becomes full, new data entered at the bottom of the screen causes the screen to scroll upward. The point at which characters are entered into the display is indicated by a flashing cursor, which may or may not be visible in the window. Characters written to the display can be made to **flash** under software control.

The virtual screen may be 48 lines of 40 characters or 24 lines of 80 characters, depending on the **display width** setting . If the width is set to 80, the display window will move both horizontally and vertically . When **auto wrap** is enabled, characters which exceed the screen width will continue on the next line; otherwise, excess characters will be lost.

The size of the visible window may be one line of 40 characters or two lines by 40 characters, depending on the display mode selected. When the single line window is used, the top line is a normal display line, and the bottom line is a **protected line.**

The protected line is always 40 characters in length. This line is fixed and does not scroll. Messages are written to the protected line by the host using the **w** command. Since this line has no cursor, cursor control characters between the escape sequence and the command terminator are ignored. Characters written to the protected line will flash when flashing is enabled.



Display with Protected Line Enabled

Several other parameters affect the way data is displayed. The display of output messages may be disabled for security and password applications by setting the **Output Display** parameter to **Off.** In character mode operation, the **Local Echo** setting determines whether data entered into the terminal is displayed when it is transmitted to the host. If Local Echo is set to **Off** , the host must echo characters to the terminal for display.

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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 autowrap is disabled, the cursor will not move past the last character in the current line. This means that extra characters will replace the last display character if the number of characters between <CR>s exceeds the line length.

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

<CR> (013)	move to the beginning of the current line
<LF> (010)	move down to the next line in the current column
<TAB> (009)	move forward one location in the virtual screen
<BS> (008)	move back one location in the virtual screen
<VT> (011)	move up to the previous line in the current column
<FF> (012)	Clear the display buffer and move the cursor and the window to the beginning of the buffer. (the protected line is not affected)
<DEL> (127)	Delete the character before the cursor

When any of the above characters would cause the cursor to move before the beginning of the virtual screen, it is ignored. The cursor may, however, be made to move past the end of the virtual screen, causing the display to scroll.

The **Newline** and **Input Display** parameters affect the movement of the cursor and placement of data on the screen. When Newline is set to **On**, individual <CR> and <LF> control characters are converted to <CRLF> sequences, moving the cursor to the first position of the next line. Setting Input Display to **One Message per Line** causes the terminal to add a <CRLF> sequence to the beginning of each new message received in block mode, resulting in one message per line.

The selection of the **Line Terminator** in block mode operation can affect whether or not <CR> and <LF> characters sent from the host computer will ever reach the display. If the terminator is set to **<CR>**, any <CR> received

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will be interpreted as an end of message and stripped off. Likewise, if set to **<CRLF>**, any <CRLF> sequence received will be stripped off before reaching the display, however, individual <CR>'s not followed by a <LF> or <LF>'s not preceded by a <CR> will reach the display. Setting the line terminator to **<ETX>** is suggested when possible to avoid this problem.

Cursor Fonts

The cursor appears as one of four display fonts, depending on the current status of the keyboard.

The standard cursor is an underscore

_

When the **2nd** key has been pressed, a *shift* cursor is displayed

$_

Pressing the **CTRL** key also changes the cursor

c_

Pressing **CTRL** followed by **2nd** produces a fourth cursor font

c$

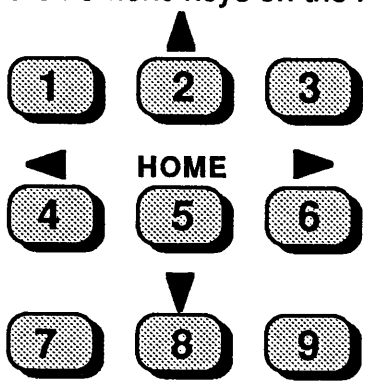
The purpose of these cursor changes is to indicate that the next key pressed will be modified by the **2nd** or **CTRL** functions.

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Movement of Display Window

The cursor and display window can be moved independently of each other. The display window can be in one of two states. When the window is *home,* the window always contains the cursor and follows it if it moves beyond the limits of the visible display. When a two line window is used, the cursor stays on the bottom line of the window, except when the window is at the top of the virtual display and the cursor is in the first line (of the virtual screen).

Several keys allow the operator to manually move the display window away from its *home* position to view other sections of the virtual screen. These keys are located above the numeric keys on the right side of the keyboard.



An attempt by the operator to move the window in any direction beyond the boundaries of the virtual screen will result in an error beep.

When the window has been moved away from *home,* it may or may not contain the cursor but does not follow it. If the display window is moved away from home and left in place, the window will track the text being viewed until it scrolls off the top of the virtual screen. New messages from the host will not be visible in the display if the window has been moved away from the cursor position.

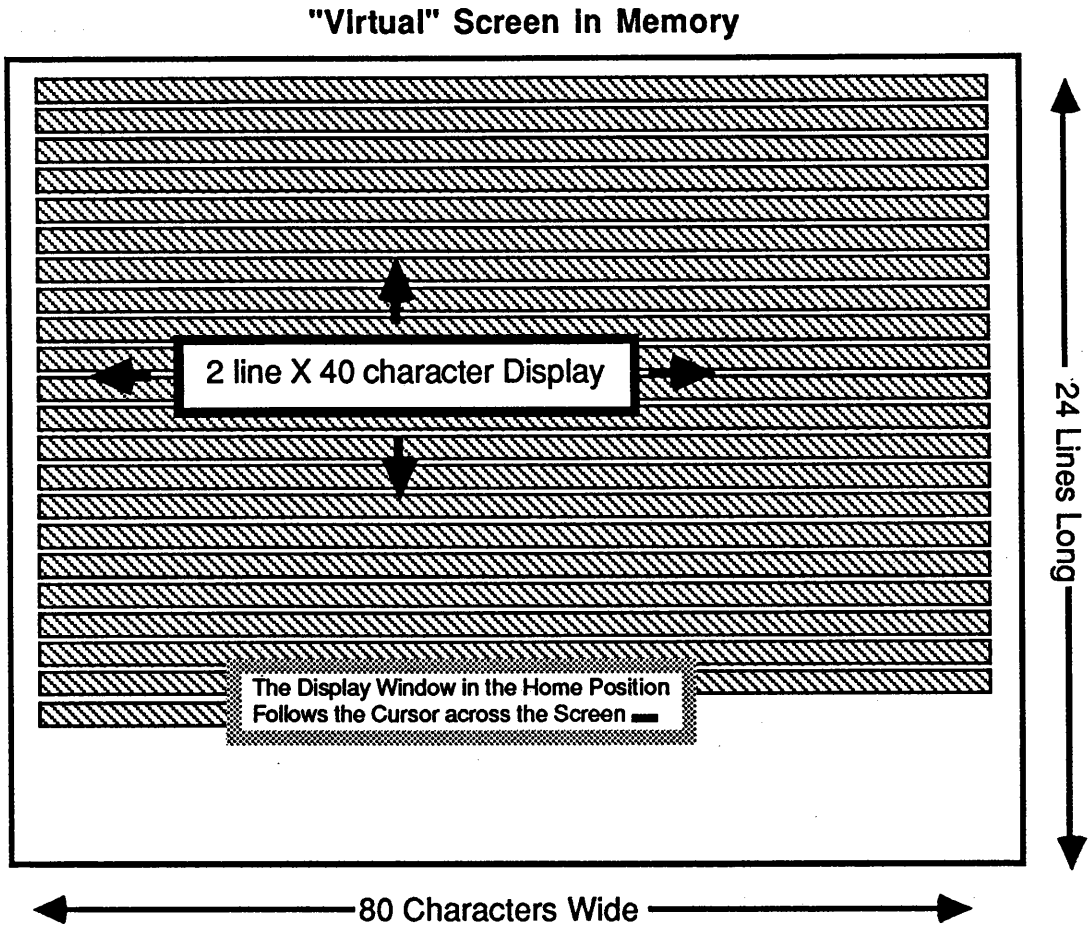
There are two ways for the operator to return the window to the *home* position so that if will again follow the cursor. Entering a new message on the keyboard or peripheral will automatically return the window to home, or , the operator may press the **HOME** key . Moving the window back with the arrow keys until the cursor is seen will not *home* the window.

To *home* the window from the host computer, a <FF> may be sent to clear the screen. The **i** command may be used to home the window without clearing the screen. This is done by simulating a keyboard entry as described in the example in chapter 4.

In interactive applications using character mode, it may be desirable to redefine the window movement keys so that they instead transmit the

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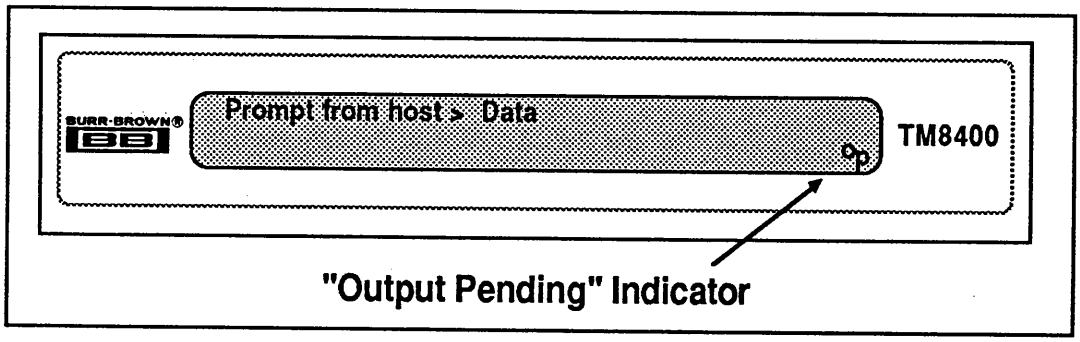
characters <VT>,<LF>,<BS>,and <TAB>. This allows the host to keep track of the position of the window by moving it only with echoed cursor controls. The window would then never leave *home* .



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Output Pending Status Indicator

In multidropped operation, an *Output Pending* condition can exist when the operator has entered data which has not yet been requested by the host. This condition is indicated by a flashing $^{o}_{p}$ in the lower right corner of the display. If this position is occupied by a character the $^{o}_{p}$ symbol will alternate with that character so that both can be seen.



Display Backlight Control

For ease of viewing in low light, the display has an electroluminescent backlight. This backlight may be switched on and off under software control. In order to extend the life of the light source, the backlight features a special **Auto On/Off** mode which will turn the light off after 10 minutes of inactivity (no input into the terminal). The display will come on again automatically with any keyboard, peripheral, or auxiliary input. The host may also retrigger the backlight using the **f** command.

Display Character Set

The following table contains the set of characters which the TM8400 will display. All of the standard printable ASCII characters with codes between 032 and 126 (decimal) may be displayed.

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Code	Graphic	Code	Graphic	Code	Graphic	Code	Graphic
032		056		080		104	
033		057		081		105	
034		058		082		106	
035		059		083		107	
036		060		084		108	
037		061		085		109	
038		062		086		110	
039		063		087		111	
040		064		088		112	
041		065		089		113	
042		066		090		114	
043		067		091		115	
044		068		092		116	
045		069		093		117	
046		070		094		118	
047		071		095		119	
048		072		096		120	
049		073		097		121	
050		074		098		122	
051		075		099		123	
052		076		100		124	
053		077		101		125	
054		078		102		126	
055		079		103		127	

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Chapter 6

Keyboard

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Keyboard

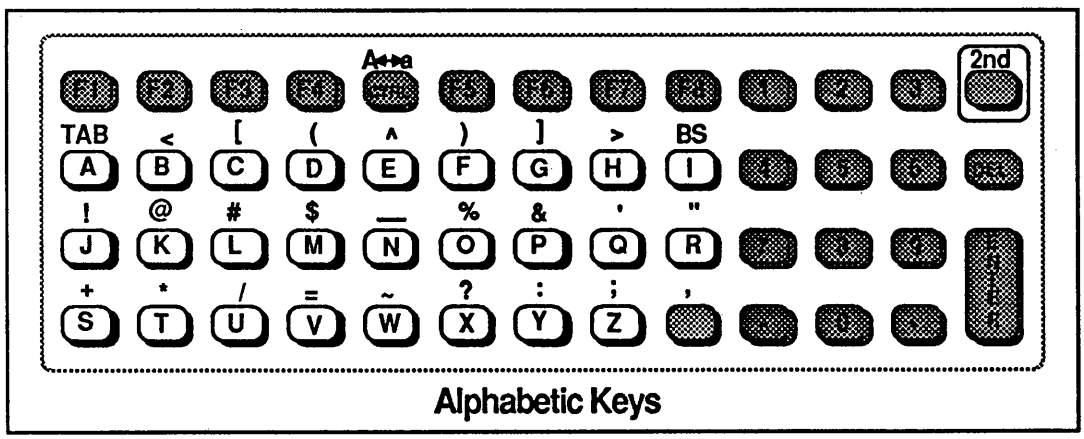
The TM8400 keyboard provides for manual data entry. There are 51 key locations on the standard keyboard (providing 102 key functions if the **2nd** key is used). All keys feature 2-key rollover as well as optional auto repeat and keyclick sound. The keyboard may be logically redefined and physically rearranged to suit many applications.

The are four general classes of key functions as listed below. All keys are shown in their default locations.

Alphabetic Keys

The alpha portion of the keyboard allows entry of alphabetic characters and special symbols. Characters printed directly on the keycap are entered by pressing the key. Characters printed above the key (shifted functions) are entered by first pressing the **2nd** key, then the desired key. For example, **2nd D** would enter the "(" character.

Alphabetic keys are normally entered as upper case. Pressing the **A↔a** key (**2nd** followed by **CTRL** on the standard keyboard) will switch the keyboard to lower case mode. Pressing this key sequence again will return to upper case mode. (Lower case mode causes the terminal to add 32 to the character code of any character between 065 ("A") and 090 ("Z") thereby generating the corresponding lower case character. Keys with codes outside this range are not affected by the case setting.)

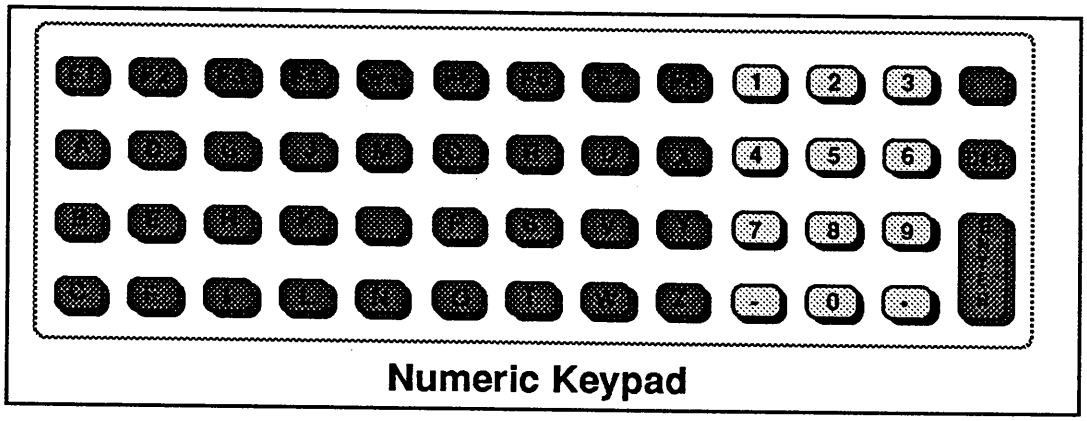


Alphabetic Keys

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Numeric Keys

The numeric keypad is separate from the alphabetic keys for ease of entering numbers. The arrangement of these keys on the standard keyboard is similar to that used on a telephone.

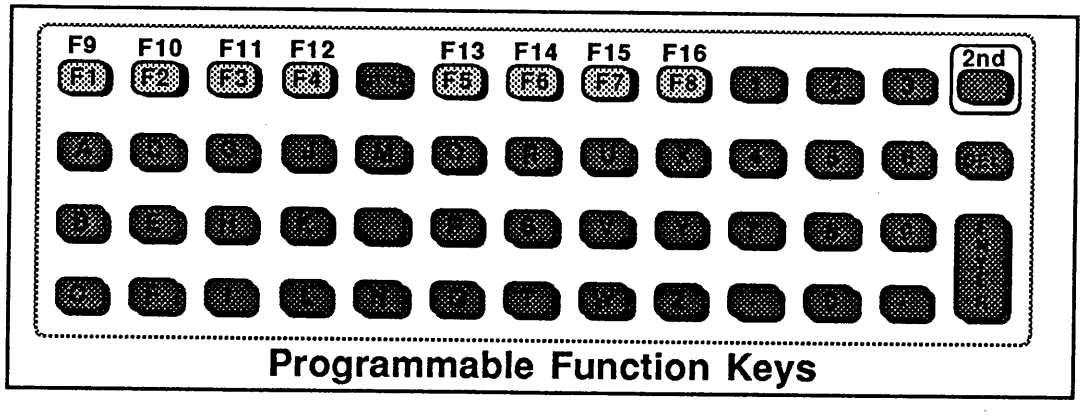


Numeric Keypad

Programmable Function Keys

Eight programmable function keys are located in a row under the display. Each of these keys may be programmed by the host to enter a message up to 40 characters in length. Functions **F1** through **F8** are entered by pressing the appropriate key. **F9** through **F16** are entered by first pressing the **2nd** key.

Internally, the TM8400 stores two sets of 16 function messages, referred to as the lower and upper function banks. The host computer may choose which bank of function messages is accessed from the keyboard by using the **k** command. If the upper bank is selected, the key functions **F1** through **F16** will enter function messages **F17** through **F32** respectively. Function messages are stored in non-volatile memory and retained when power is off.



Programmable Function Keys

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Special Function Keys

Several keys have special functions. The four directional arrows and the **HOME** function located above the numeric keys allow the operator to move the display window.

The **2nd** key selects the shifted function of the key pressed immediately following it.

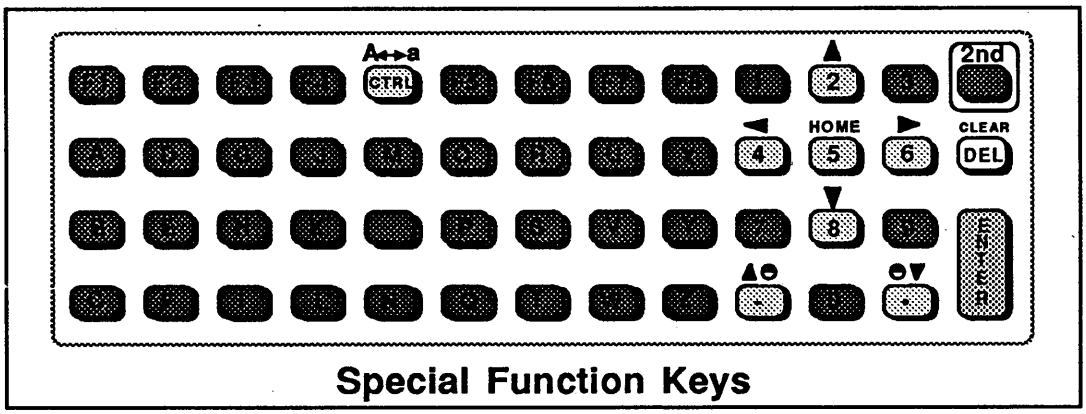
The **CTRL** key algorithmically modifies the keycode transmitted by the key following it, producing the corresponding ASCII control character. (This affects only characters with codes between 064 and 095. Control character codes are generated by subtracting 64 from the normal code.) For example, **CTRL** followed by **G** will produce the <BEL> character.

Both the **2nd** and **CTRL** keys cause the cursor to change font, indicating that the next key pressed will be modified.

The **A↔a** key switches the keyboard between upper and lower case mode for alphabetic characters.

The above special function keys are local and do not transmit characters themselves.

The **DEL** and **CLEAR** functions are local in block mode only but transmit <DEL> and <FF> respectively when in character mode. The operation of these keys is described in chapters 10 and 11.

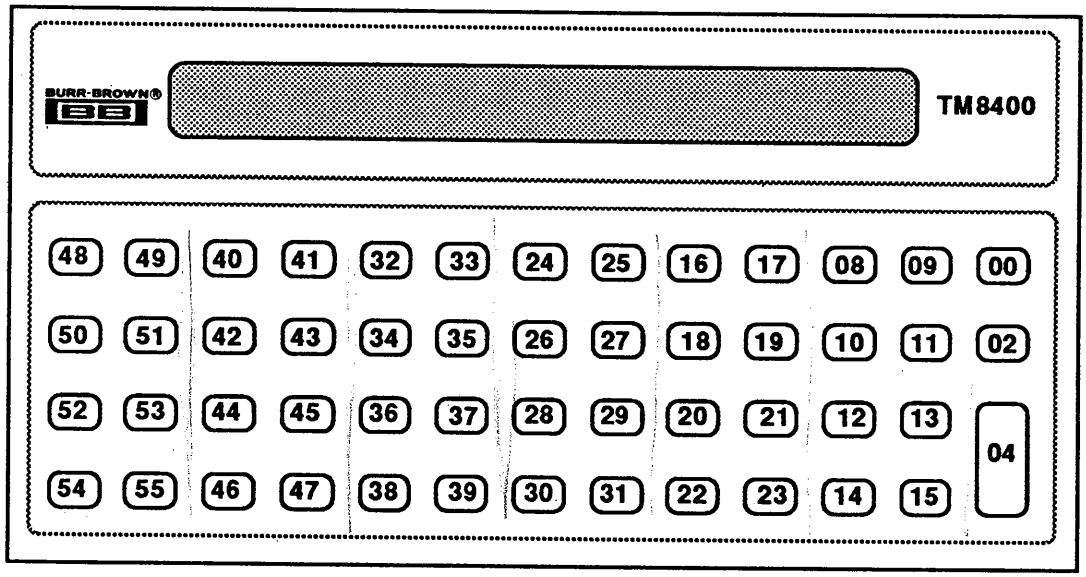


Special Function Keys

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Keyboard Redefinition

The TM8400's keyboard consists of 51 keys. Each of these key locations has a unique number between 00 and 55.



Key Location Codes

The keyboard layout may be redefined by the user to suit a particular application. It is also possible to modify the terminal's character set by assigning characters other than the default ones to keys.

Keyboard redefinition is done by using the host **l** (lower case "L") command, specifying a normal and shifted code for each location to be defined. Any individual key may be changed without affecting the others. The key definitions are stored in non-volatile memory and retained on power off.

A set of key codes has been defined. Codes 001-127 are the standard ASCII character set. Codes 128-159 designate keys requiring special action. Codes 160-255 are reserved for future use. The action taken for a particular key code never changes; however, a key code can be assigned to any physical location. For example, if the letter **D** is desired, some key must be assigned the code (068). Likewise, a key must be assigned the code (128) if keys are to have shifted functions.

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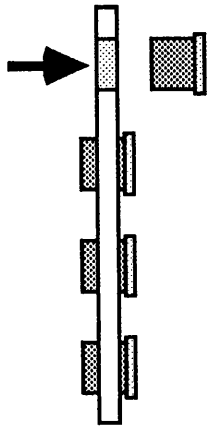
The following table lists the special action codes which may be assigned to keys. Invalid special action codes will be ignored. Assigning a key the code (000) will disable that key.

	128	shift	**144**	F1
	129	control	**145**	F2
	130	+ viewing angle	**146**	F3
	131	- viewing angle	**147**	F4
	132	chgcase/setup	**148**	F5
	133	enter	**149**	F6
	134	del	**150**	F7
	135	clear	**151**	F8
	136	*window top left	**152**	F9
	137	window home	**153**	F10
	138	*window left margin	**154**	F11
	139	*window right margin	**155**	F12
▲	**140**	window up	**156**	F13
▼	**141**	window down	**157**	F14
◄	**142**	window left	**158**	F15
►	**143**	window right	**159**	F16

* Not included in default keyboard layout. These functions may be added to the keyboard if desired. *window top left* causes the display window to move to the top left corner of the virtual display (the classical *home* position on a CRT terminal). *Window left margin* and *window right margin* are useful when the virtual display width is set to 80.

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Individual key caps may be snapped out of place by pressing from the front once the bezel is removed.



Keycap Removal

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Chapter 7

Peripheral Module Operation

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Peripheral Module Operation

The peripheral interface allows input to the TM8400 from barcode wands, slot readers and LASER scanners, as well as magnetic stripe readers. The presence of an installed peripheral module may be detected by the host computer using the **c** command to request the terminal's configuration. Peripheral module ID codes are returned as follows:

0	Barcode wand or slot reader
1	Magstripe reader
2	Barcode LASER scanner

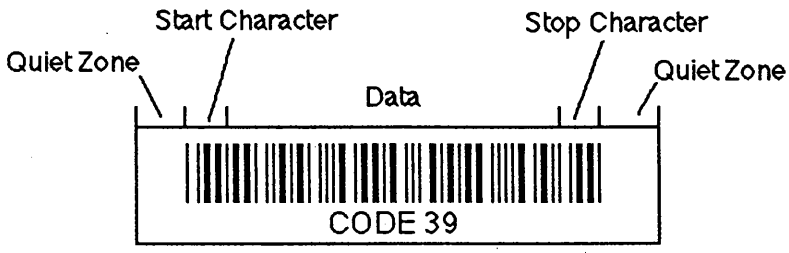
Data entered via the peripheral interface is treated in much the same way as that entered from the keyboard.

The mode of operation for the peripheral scanner may be selected as **Auto** or **Manual.** The difference between these two modes is that the terminal adds the line terminator to the scanned data in **Auto** mode, in effect **Auto**matically pressing the **ENTER** key. Note than when the terminal is in **Block** mode and **Manual** operation is selected, scanned inputs will not be transmitted to the host until the **ENTER** key is pressed. This allows a message to be composed of a number of scanned and/or keyed entries.

Peripheral mode may also be set to **Off** to disable operation. Feedback to the operator on successful reads is provided by a beep.

Barcodes

Barcoding is a method of printing information on a media in a machine readable form. The key advantages of using barcodes to represent data in industrial applications are speed of entry, low error rates, and ease of printing. A barcode symbol is a pattern of bars and spaces which represent a series of digits or alphanumeric characters.



The symbol consists of quiet zones, start and stop character patterns, and data characters.

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The quiet zones are areas 20 to 30 times the width of the widest bar which are clear of bars, printed characters, or other markings. These zones are used to indicate to the barcode decoder that the wand or scanner is about to encounter a bar code. A clear quiet zone is especially important with slot-type barcode scanners reading codes from cards and badges.

The start and stop characters are special bar/space patterns which identify the beginning and end of the barcode symbol. These patterns are generally asymmetrical so that the decoder can determine whether the character has been scanned in the forward or reverse direction. It is these predefined start and stop characters which make it possible for a barcode to be scanned in either direction while keeping data characters in the proper order.

There are quite a number of types of barcodes, or symbologies in use. These symbologies differ in the amount and type of information which can be represented in a symbol, and the way in which the information is encoded. The longest barcode which can be scanned by the TM8400 is 48 characters.

The TM8400 barcode decoder is programmed to read the following symbologies:

3 of 9	(alphanumeric)
Full ASCII 3 of 9	(all 128 ASCII characters)
2 of 5	(numeric)
Interleaved 2 of 5	(numeric)
UPC/EAN	(numeric)
includes:	
UPC - A	
UPC - E	
EAN 8	
Codabar	(numeric)

In addition, the terminal may be set to **auto**matically **discriminate** between codes (with the exception of Full ASCII 3 of 9 which must be explicitly selected). Automatic discrimination is designed as a convenience for applications where barcodes of different types are routinely encountered. The decoding algorithms will automatically identify which of the symbologies it is reading without previous selection by the operator. For applications where only one type of barcode symbology is used, a slightly better first read rate on marginal codes may be obtained by preselecting that particular code at setup.

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Full ASCII Code 3 of 9 is a variation of this code in which special two character sequences are used to represent additional symbols, lowercase alphabetics and control characters. The table below indicates which Full-ASCII character sequences should be printed to obtain these special characters. The decoder will automatically substitute the special character for the two character sequence before sending the data to the host.

Full ASCII Code 3 of 9

Char	Print As:	Char	Print As:	Char	Print As:	Char	Print As:
NUL	%U	SP	Space	@	%V	‘	%W
SOH	$A	!	/A	A	A	a	+A
STX	$B	"	/B	A	B	b	+B
ETX	$C	#	/C	C	C	c	+C
EOT	$D	$	/D	D	D	d	+D
ENQ	$E	%	/E	E	E	e	+E
ACK	$F	&	/F	F	F	f	+F
BEL	$G	'	/G	G	G	g	+G
BS	$H	(	/H	H	H	h	+H
HT	$I	)	/I	I	I	i	+I
LF	$J	*	/J	J	J	j	+J
VT	$K	+	/K	K	K	k	+K
FF	$L	,	/L	L	L	l	+L
CR	$M	-	/M	M	M	m	+M
SO	$N	.	/N	N	N	n	+N
SI	$O	/	/O	O	O	o	+O
DLE	$P	0	0	P	P	p	+P
DC1	$Q	1	1	Q	Q	q	+Q
DC2	$R	2	2	R	R	r	+R
DC3	$S	3	3	S	S	s	+S
DC4	$T	4	4	T	T	t	+T
NAK	$U	5	5	U	U	u	+U
SYN	$V	6	6	V	V	v	+V
ETB	$W	7	7	W	W	w	+W
CAN	$X	8	8	X	X	x	+X
EM	$Y	9	9	Y	Y	y	+Y
SUB	$Z	:	/Z	Z	Z	z	+Z
ESC	%A	;	%F	[	%K	{	%P
FS	%B	<	%G	\	%L	|	%Q
GS	%C	=	%H	]	%M	}	%R
RS	%D	>	%I	^	%N	~	%S
US	%E	?	%J	_	%O	DEL	%T

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Example:

To represent the message **Hello!**, the barcode would be printed as:

H+E+L+L+O/A

Special Barcode Functions Available with Full ASCII 3 of 9
The **Manual** mode of peripheral operation normally requires that the **ENTER** key be pressed after all desired codes are scanned in order to transmit the data to the host (or terminate it in character mode). When using Full ASCII 3 of 9, special barcodes can be created to perform this function automatically without touching the keyboard. This in effect allows the printed code to determine whether the decoder operates in Auto or Manual mode.

Any barcode whose last data character is the ASCII control character <NUL> will be automatically terminated and transmitted as if the terminal were in Auto mode. To terminate a barcode with <NUL>, use the Full ASCII 3 of 9 sequence **%U**, as indicated in the table above.

A special **ENTER** barcode may be created by printing a symbol with a start character followed by a stop character, with no data intervening. Wanding of this code is equivalent to pressing the ENTER key.

Below are examples of Full ASCII barcodes.



Printing Barcodes
Several factors should be kept in mind when printing barcodes to assure a high read rate.

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Print Quality is especially important when printing codes on a dot matrix printer. Barcode scanners depend on a high *contrast ratio* between the dark bars and light spaces. It is important to use a light media with 75% to 90% reflectance and a dark, well defined print. Common inking errors which cause poor read rates are *smearing, specks and voids, non-uniformity* and *edge roughness.* These errors are typically caused by worn ribbons, misadjusted print mechanisms, and incompatibility between ink and paper.

The **Resolution** of a barcode symbol is defined by the width of the smallest bar. For reliable scanning, this width can be no smaller than the aperature or *spot size* of the barcode scanner. Resolution of Burr-Brown barcode scanners ranges from 0.0060" to 0.0075".

The **Width Ratio** of wide to narrow bars should be between 2.2:1 and 3:1.

The size of the **Quiet Zone** is especially important when printing codes on badges or cards for use with a slot scanner. It is recommended that the quiet zone be greater than 30x the width of the widest bar used in the symbol.

Magnetic Stripe Decoding

Magnetic stripe encoding stores information on a small strip of magnetic material. The information is read by passing the stripe by a read head similar to that found on audio tape recorders.

The magnetic stripe decoder on the TM8400 is designed to read ABA Track 2 data encoded according to ANSI standard X4.16-1971. Up to 40 numeric characters may be encoded on a single stripe at a density of 75 bits per inch. The read range of the scanner is between 3 and 40 inches per second.

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Chapter 8

Auxiliary Module Operation

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Auxiliary Module Operation

The auxiliary interface allows the connection of a wide range of input and output devices to the TM8400. Operation is dependent on which module is installed. The host computer can determine the presence of an auxiliary module by using the **c** command. Presently defined module ID codes are:

00	Digital I/O
01	Serial I/O (RS-232)
02	Printer
04	Counter
15	Custom

Custom modules may be designed by Burr-Brown, users, or third parties. These modules carry their own operating firmware and identification, making it possible for newly designed modules to work with the original version of the TM8400.

Operation of the auxiliary interface is controlled by the host computer using the **a** command. This command is designed to allow new modules to define their own input and output operation through function codes and parameters. Input and output may be continuous or in fixed blocks as defined by the type and function codes below (independent of the terminal's operating mode).

a
The *auxiliary module request* command is used to control the auxiliary interface. There are eight types of request that can be issued to an auxiliary module. Request types *2* and *5* require additional function codes and parameters which are defined separately for individual modules.

Modes: *Block,Character*

<ESC>a<type><ID>**[**<function><parms>**]**<terminator>

Values for *type* are:

0	input status
1	terminate input
2	input read
3	output status
4	terminate output
5	output write
6	return module name
7	poll input
8	pass through output

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Values for *ID* are the module's two digit ID code 00-15. Presently defined codes are:

00	Digital I/O
01	Serial I/O
02	Printer
04	Counter
15	EPROM module

Function is a single ASCII character which is module dependent. (required only for request types 2 and 5)

Parms are any parameters required by the selected module function. (required only for request types 2 and 5)

Request Types

Request types *0* and *3* return a module status code to the host.

<status><line terminator>

Status codes are:

1	busy
0	idle
-1	invalid function
-2	invalid parameter
-3	timeout
-4	I/O error
-5	module dependent
-6	module dependent
-7	module not present
-8	I/O section not present
-9	system error

Request type *3* is generally used to check on the status of printer or serial output buffers before sending more data to the TM8400. It may also be used to determine whether a previous request resulted in an error.

Example:

Request the status of the printer module's output buffer.

<ESC>a302<STX>

If the output buffer is busy, the TM8400 would reply with:

1<CR>

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Request types *2* and *5* are used to read and write data to the auxiliary device. There are several types of functions for each request type and for each module. Following sections detail these functions.

Request types *1* and *4* are used to terminate input and output requests. This is especially necessary for continuous input requests.

Request type *6* will return the name of the installed module to the host. This is necessary primarily because all custom modules will have the same ID (15). The name string may be between 0 and 14 characters in length.

Example:

Request the name of the installed printer module:

<ESC>a602<STX>

The terminal would reply:

Printer<CR>

Request type *7* is used to make input data in the auxiliary Tx buffer ready for transmission. This request type is used when the auxiliary Tx buffer is selected as the output path and is not necessary when auxiliary module data is routed to the standard output path. At least two **a** commands are necessary to read data that is routed to the auxiliary Tx buffer. The first command would be a request type *2*, followed by a request type *7*. Note that in multidropped operation, a **p** command would also be necessary.

Request type *8* is used to pass a continuous stream of data from the host computer to the auxiliary device. The TM8400 will not interpret any commands or control sequences while in pass-through mode, with exception of <STX> which is used to terminate the mode.

When continuous pass-through mode is used with an auxiliary I/O device which is slower than the host communications, it is the responsibility of the host software to build in sufficient delays so that the 80 character auxiliary module output buffer is not overrun.

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MODULE SPECIFIC FUNCTIONS AND PARAMETERS

Digital I/O Module

The Digital I/O module provides 16 input/output lines for controlling or communicating with external devices. Functions are provided to read data, write data, and define an input tag string.

Both ports are initialized to be *latching inputs* and are then set to the directions established by DIP switches DIR0 and DIR10. The I/O may be configured as follows:

16 inputs:

Lines I/O 0 through I/O 7	Low byte
Lines I/O 10 trough I/O 17	High byte

8 inputs + 8 outputs:

Lines I/O 0 through I/O 7	Input byte
Lines I/O 10 through I/O 17	Output byte

16 outputs:

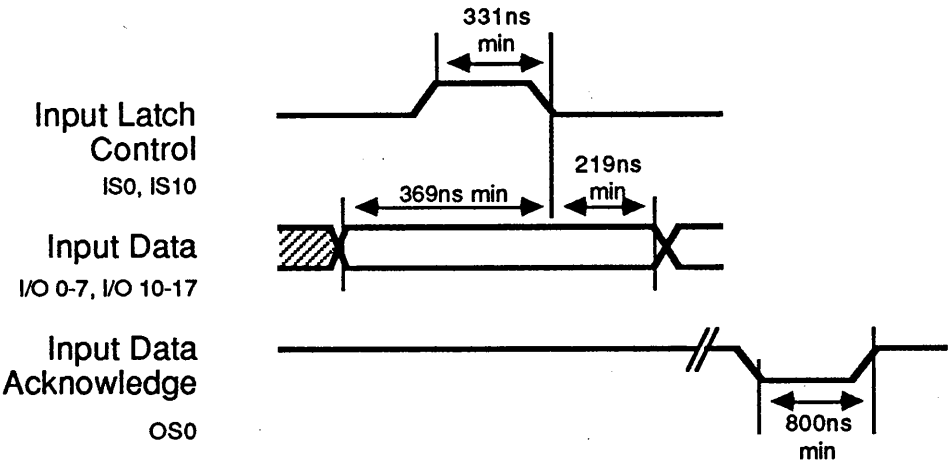
Lines I/O 0 through I/O 7	High byte
Lines I/O 10 through I/O 17	Low byte

Each set of 8 I/O lines has its own input and output strobe lines for handshaking (strobe/acknowledge) with the external device. The following timing diagram illustrates the relationship between data and control signals.

For Word Mode read, IS0 and IS10 may be tied together. For Word Mode Write, waiting for OS10 guarantees completion.

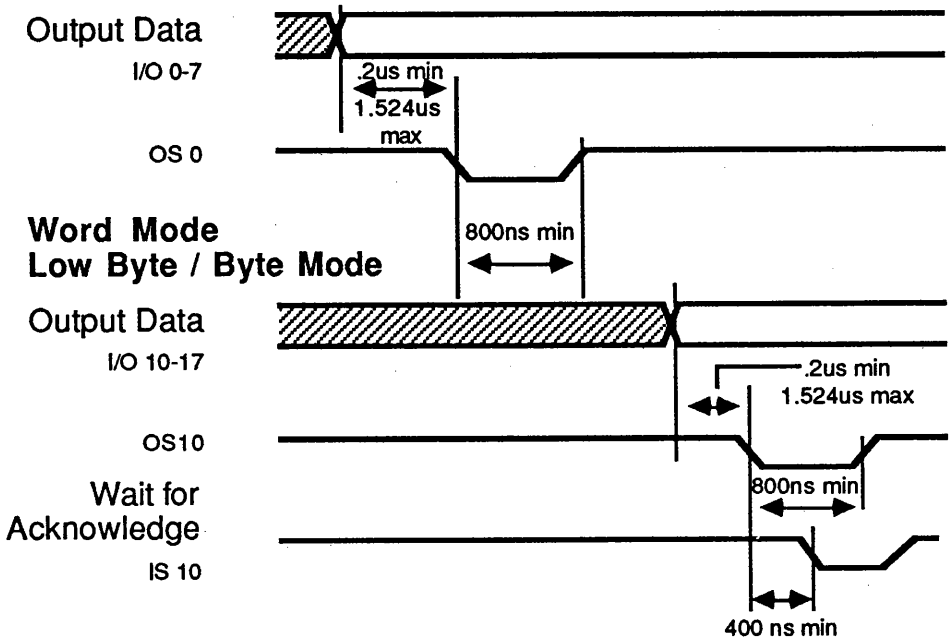
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Read Data
Word, Byte Mode



Write Data

Word Mode High Byte



Word Mode
Low Byte / Byte Mode

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Read Function

The **r**ead function and its parameters are used with request type *2* of the **a** command to read bytes or words of data from the digital I/O module. The format of the **a** command with the **r** function is:

<ESC>a200r<type><path><mode><length><timeout><STX>

Values for *type* are:

0	Read and acknowledge (byte)
1	Wait for strobe, read and acknowledge (byte)
2	Read and acknowledge (word)
3	Wait for strobe, read and acknowledge (word)

The *type* parameter specifies whether data is to be read as bytes (8 input lines) or words (16 input lines), and whether or not the terminal will wait for the Input Strobe before reading the data.

Values for *path* are:

0	Standard output path
1	Auxiliary Tx Buffer
2	Standard output path with line terminator

The *path* parameter specifies the path by which the input data will be sent to the host. Data is returned as an ASCII representation of the hexadecimal value of the input lines - "00 - FF" for bytes and "0000 - FFFF" for words. Data sent to the standard output path will be treated in the same way as keyboard or peripheral input, depending on the terminal mode. It is often useful to define an input *tag* (see below) so that the host can distinguish auxiliary module data from keyboard data. Data sent to the auxiliary Tx buffer must be explicitly requested by the host using the **a** command request type *7.*

Values for *mode* are:

0	One read
1	Continuous
2	One read with beep
3	Continuous with beep

Modes 1 and 3 will send a continuous stream of data to the host until terminated by an **a** command request type 1. Modes 2 and 3 provide audible indication that data is being read by sounding the unit's beeper.

Values for *length* are:

01-40	for bytes
01-20	for words

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The *length* parameter specifies the number of bytes or words to be read. In continuous mode, *length* should be set to the minimum number of bytes or words expected to be read at a time.

Values for *timeout* are the period in seconds (000-255) the terminal should wait to read *length* bytes or words of data. A value of "000" disables the timeout.

Tag Function

The **t**ag function defines a string of characters (up to 16) which will be prefixed to data read from the digital I/O module before it is sent to the host. This is helpful in distinguishing auxiliary module data from keyboard data coming to the host along the standard output path. Once defined, the tag is retained in the TM8400's nonvolatile memory. The **t** function is used with request type *2* of the **a** command and has the following format:

<ESC>a200t<string>**<STX>**

The string may be from 0 to 16 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 16 character tag. The default tag is null.

Digital I/O Module Read Example:

Define an input tag string to be <LF>DIO:

<ESC>a200t^010DIO<STX>

Read a single 16 bit word which will be strobed into the digital I/O module, add the line terminator and send it to the standard output path. Beep on read. Timeout will be 15 seconds.

<ESC>a200r32201015<STX>

The response from the TM8400 might be

<LF>DIOAA55<CR>

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Write Function

The **w**rite function is used to write data to output lines of the digital I/O module. This function is used with request type *5* of the **a** command and has the following format.

<ESC>a500w<type><timeout><string>**<STX>**

Values for *type* are:

0	write and strobe (byte)
1	write and strobe, then wait for acknowledge (byte)
2	write and strobe (word)
3	write and strobe, then wait for acknowledge (word)

The *type* parameter specifies whether data is written in bytes (8 output lines) or words (16 output lines), and whether or not the terminal will wait for acknowlegement before strobing the next byte or word.

The *timeout* parameter is the period in seconds (000-255) which the terminal should wait to complete this request. Setting this parameter to 000 disables the timeout.

The *string* parameter is the actual data being written to the outputs. The string may be up to 40 bytes, specified as "00-FF" or 20 words, specified as "0000-FFFF"

Digital I/O Output Example:

Write the following series of 16 bit words to the digital I/O module, handshaking with external device. 5555 0000 AAAA FFFF Timeout is disabled.

<ESC>a500w300055550000AAAAFFFF<STX>

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Serial I/O Module

The Serial I/O module provides a second serial communications interface to the TM8400. Functions are provided to **c**onfigure the interface, **r**ead data, **w**rite data, define **p**refix and **s**uffix strings for both input and output, and define an input **t**ag string. In addition, data can be continuously passed through to the serial module's output from the host using the **a** command request type *8*.

Configuration

The **c**onfiguration function is used to set the communication parameters of the auxiliary serial interface. This configuration is retained in the TM8400's nonvolatile memory. This function is used with the **a** command request type *2* and has the following format:

<ESC>a201c<baudrate><word length><parity><stop bits><handshake>**<STX>**

Values for *baud rate* are:

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

Values for *word length* are:

0	no change
1	7 bits
2	8 bits

Values for *parity* are:

0	no change
1	none
2	odd
3	even
4	mark
5	space

Values for *stop bits* are:

0	no change
1	1
2	2

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Values for *handshake* are:

0	no change
1	RTS/CTS
2	XON/XOFF

If XON/XOFF handshaking is chosen, the CTS line on the auxiliary interface must still be asserted for the TM8400 to transmit. This can be done most easily by tying the RTS and CTS lines together.

The default configuration of the auxiliary serial interface is 300 baud, 7 bits, space parity, 1 stop bit and RTS/CTS.

Serial I/O Configuration Example:

Set the serial port for 9600 baud, 8 bits, no parity, 1 stop bit, XON/XOFF.

<ESC>a201c62112<STX>

Prefix and Suffix Functions

Prefix and suffix character strings add a great deal of utility to the serial interface. These strings may be defined independently for input and output and are retained in the TM8400's nonvolatile memory.

The output prefix and suffix strings are added to messages transmitted by the TM8400 from the serial interface. These strings are especially useful for sending necessary control sequences to auxiliary devices. To define the output prefix and suffix strings, the **p**refix and **s**uffix functions are used with the **a** command request type *5* and have the following format:

<ESC>a501p<string>**<STX>**	Prefix
<ESC>a501s<string>**<STX>**	Suffix

The *string* may be from 0 to 16 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 16 character prefix or suffix. The default prefix is a string of zero length. The default suffix is <CR>.

The **w**rite function allows the host to specify that either or both of these strings be added to an output message.

The input prefix and suffix strings are used for communication synchronization or read control. The **r**ead function allows the host to command the TM8400 to "look for" the prefix and suffix to mark the beginning and end of an input string on the serial interface. The input prefix and suffix are stripped off by the TM8400 and are never transmitted to the

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host. To define the input prefix and suffix strings, the **p**refix and **s**uffix functions are used with the **a** command request type *2* and have the following format:

<ESC>a201p<string>**<STX>**	Prefix
<ESC>a201s<string>**<STX>**	Suffix

The *string* may be from 0 to 16 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 16 character prefix or suffix.

Read Function

The **r**ead function and its parameters are used with request type *2* of the **a** command to read either a defined block or a continuous stream of characters from the auxiliary interface. The format of the **a** command with the **r** function is:

<ESC>a201r<type>**<path>**<mode>**<length>**<end input>**<timeout>**
<STX>

Values for *type* are:

0	string only
1	prefix + string
2	string + suffix
3	prefix + string+ suffix

The *type* parameter specifies whether the TM8400 will look for the defined input prefix and suffix to define the beginning and end of the input string.

Values for *path* are:

0	Standard output path
1	Auxiliary Tx Buffer
2	Standard output path with line terminator

The *path* parameter specifies the path by which the input data will be sent to the host. Data sent directly to the Tx Buffer will never appear in the terminal's display.

Values for *mode* are:

0	One read
1	Continuous
2	One read with beep
3	Continuous read with beep

Mode 1 will send a continuous stream of data to the host until terminated by an **a** command request type 1.

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Values for *length* are:
01-80
The *length* parameter specifies the maximum number of characters to input for each read. A read will be terminated before *length* characters are input by encountering the *input suffix* or *End input* character defined below.

End input is the decimal code ("000"-"255") of the ASCII character which signals the end of the input string. This character will be replaced by the standard line terminator when the string is transmitted to the host. This parameter performs a function similar to that of the input suffix.

Values for *timeout* are the period in seconds (000-255) the terminal should wait to read the requested character string. A value of "000" disables the timeout.

Tag Function

The tag function defines a string of characters (up to 16) which will be prefixed to data read from the serial I/O module before it is sent to the host. This is helpful in distinguishing auxiliary module data from keyboard data coming to the host along the standard output path. Once defined, the tag is retained in the TM8400's nonvolatile memory. The **t** function is used with request type *2* of the **a** command and has the following format:

<ESC>a201t<string>**<STX>**

The string may be from 0 to 16 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 16 character tag. The default tag is none.

Serial I/O input example:

Read a string of data which must begin with <ESC> and end with <EOT>. Tag the data with "S!" before sending it to the host.

<ESC>a201p^027<STX> Define <ESC> as input prefix

<ESC>a201tS!<STX> Define "S!" as the tag

<ESC>a201r12080004000<STX> Request the read

Assuming the terminal saw the following data on its auxiliary serial input:
Some Junk<ESC>This is what we want<EOT>more junk

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The host would receive the following from the TM8400:
S!This is what we want<CR>

Write Function

The **w**rite function is used to send lines of data to the auxiliary serial interface. This command is used with request type *5* of the **a** command and has the following format:

<ESC>a501w<type><timeout><string>**<STX>**

Values for *type* are:

0	String only
1	Prefix+string
2	String+suffix
3	Prefix+string+suffix

Values for *timeout* are the period in seconds (000-255) the terminal should wait to write the requested character string. A value of "000" disables the timeout.

The *string* may be from 0 to 80 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 80 character string.

Serial I/O Output Example:

Send the string "This is a test" terminated by <CRLF>:

<ESC>a501s^013^010<STX> Define output suffix

<ESC>a501w2000This is a test<STX> Send the string

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Printer Module

The Printer module provides a parallel printer interface to the TM8400. Functions are provided to **w**rite data and define **p**refix and **s**uffix strings for output. In addition, data can be continously passed through to the printer module's output from the host using the **a** command request type *8*.

Prefix and Suffix Functions

Prefix and suffix character strings add a great deal of utility to the printer interface. These strings are retained in the TM8400's nonvolatile memory.

The output prefix and suffix strings are added to messages transmitted by the TM8400 from the printer interface. These strings are especially useful for sending necessary control sequences to auxiliary devices. To define the output prefix and suffix strings, the **p**refix and **s**uffix functions are used with the **a** command request type *5* and have the following format:

<ESC>a502p<string>**<STX>**	Prefix
<ESC>a502s<string>**<STX>**	Suffix

The *string* may be from 0 to 16 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 16 character prefix or suffix. The default prefix is none. The default suffix is <CR>.

The **w**rite function allows the host to specify that either or both of these strings be added to an output message.

Write Function

The **w**rite function is used to send lines of data to the printer interface. This command is used with request type *5* of the **a** command and has the following format:

<ESC>a502w<type>**<timeout>**<string>**<STX>**

Values for *type* are:

0	String only
1	Prefix+string
2	String+suffix
3	Prefix+string+suffix

Values for *timeout* are the period in seconds (000-255) the terminal should wait to write the requested character string. A value of "000" disables the timeout.

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The *string* may be from 0 to 80 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 80 character string.

Printer Output Example:

Send the string "This is a test" terminated by <CRLF>:

<ESC>a502s^013^010<STX>	Define output suffix
<ESC>a502w2000This is a test<STX>	Send the string

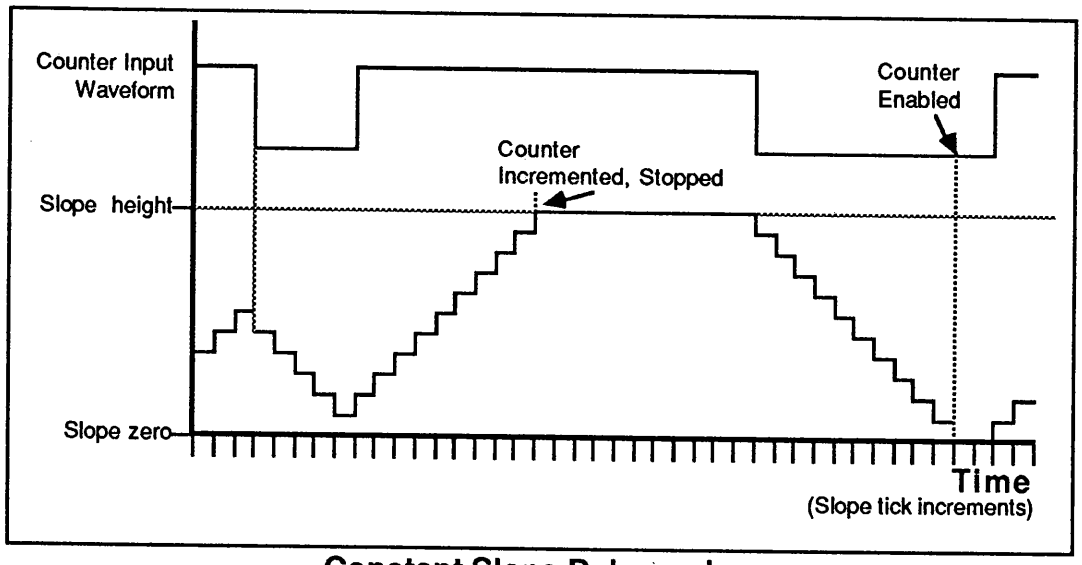
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Pulse Counter Module

The pulse counter module provides the ability to count cycles on up to eight digital input lines or channels. The counter module consists of 8 TTL compatible inputs. A fixed sampling rate of 250 Hz (once every 4 mS) is used. The minimum pulse width which can be reliably detected is 5 mS; the maximum frequency is inverse of twice this time, or 100 Hz.

The **input polarity** is settable for each counter. The counter can be triggered on a positive or negative edge of the input signal.

Debouncing or filtering is provided for each channel using a programmable time constant. The time constant or slope height is settable from 0mS to approximately 1 second. Constant slope filtering is used for input debouncing. The slope is incremented when the selected polarity is applied to the line. When the opposite polarity is applied, the slope is decremented. When the slope height is reached, the slope remains at that value and the counter is incremented, then stopped until the slope reaches zero signifying the end of the count pulse.



Constant Slope Debouncing

Each counter channel has a status byte indicating running, overflow and reset conditions. This status is returned along with the value of the counter when a channel is read.

All channels provide 16-bit accumulation with overflow, providing a range of 0 to 131071.

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Functions are provided to set **p**olarity, specify **f**iltering, define a **t**ag string, **i**nitialize, **d**isable, **e**nable, **r**ead or **c**lear a counter channel. The **i, d, e, r,** and **c** functions generate replies back to the host through the selected output path; the function is performed **before** the counter is read for the reply (important to note when using functions which reset the counter value) All functions may affect all counters or an individual one.

The counter module is an input-only device. Auxiliary module request types 0,1,2,6 and 7 are valid for use in the **a** command. The Module ID is **04**, the name string is "**Counter**".

Set Polarity Function
The set **p**olarity function is used to specify positive or negative edge triggering for the specified counter(s). This function is used with the **a** command request type *2* and has the following format:

<ESC>a204p<n>**<STX>**

Values for *n* are:

0	All counters
1	Channel 1
2	Channel 2
:	
.	
8	Channel 8

Values for *polarity* are:

0	Negative edge triggered
1	Positive edge triggered

This function should be issued only after power up or the integrity of the counter value cannot be guaranteed. Polarity settings are stored in non-volatile memory.

Set Polarity Example:

Set all channels to be triggered on a positive edge of the input signal.

<ESC>a204p01<STX>

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Specify Filtering Function

The specify filtering function is used to set the slope height, or time constant, for the associated digital filter(s) of the specified counter(s). This function is used with the **a** command request type *2* and has the following format:

<ESC>a204f<n><slope height><STX>

Values for *n* are:

0	All counters
1	Channel 1
2	Channel 2
:	
.	
8	Channel 8

Slope height is a number from "000" to "255" representing the time constant in 4 mS increments. The slope height for each counter is stored in non-volatile memory. This function should only be used immediately after power-up.

Digital Filtering Example:

Set the debounce time constant for counter channel 1 to be 100mS.

<ESC>a204f1025<STX>

Tag Function

The **t**ag function defines a string of characters (up to 16) which will be prefixed to data read from the counter module before it is sent to the host. This is helpful in distinguishing auxiliary module data from keyboard data coming to the host along the standard output path. Once defined, the tag is retained in the TM8400's nonvolatile memory. The **t** function is used with request type *2* of the **a** command and has the following format:

<ESC>a204t<string>**<STX>**

The string may be from 0 to 16 characters in length. ASCII control characters should be specified as **^xxx** where **xxx** is the decimal value of the character. The **^xxx** sequence counts as 1 character in the 16 character tag. The default tag is null.

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Initialize Counter Function

The **i**nitialize function is used to initialize all counters after a power-up occurs. Following this command, the status is set to "0" and the count is set to "0000". The **i** function generates a reply to the host with the status and counter value for the counter(s) requested. This function is used with request type *2* of the **a** command and has the following format:

<ESC>a204i<n><path><mode>**<STX>**

The value for *n* must be "0" for this function.

Values for *path* are:

0	Standard output path
1	Auxiliary Tx buffer
2	Standard output path with terminator

The *path* parameter specifies the path by which the counter data will be sent to the host. The format of the data is described below:

Values for *mode* are:

0	One read
1	Continuous
2	One read with beep
3	Continuous read with beep

For continuous reads, one reply is generated per second. Continuous mode is not useful with the **i** function since the counter(s) would be initialized before each read is performed. (the return value would always be "0000")

The reply sent to the host consists of the following:

<status><value>[<status><value>...]<line terminator>

Status codes are:

0	stopped, no overflow
1	stopped, overflow set
2	running, no overflow
3	running, overflow set
4	uninitialized

The counter *value* will be the ASCII representation of the hexadecimal value of the counter channel. (Always "0000" for **i** function)

Since *n* is "0" eight sets of status and value codes are returned, a total of 40 characters. Channel 1 values are transmitted first, channel 8 last.

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The **i** function must be used before any of the counters can be enabled. A status code of "4" in any reply indicates that a power reset has occurred.

Disable Function

The **d**isable function is used to disable, or stop, one or all counters. Following this command, the status is set to "0" or "1". The counter value is unaffected. The **d** function generates a reply to the host with the status and counter value for the counter(s) requested. This function is used with request type *2* of the **a** command and has the following format:

<ESC>a204d<n><path><mode>**<STX>**

Values for *n* are:

0	All counters
1	Channel 1
2	Channel 2
:	
.	
8	Channel 8

Values for *path* are:

0	Standard output path
1	Auxiliary Tx buffer
2	Standard output path with terminator

The *path* parameter specifies the path by which the counter data will be sent to the host. The format of the data is described below:

Values for *mode* are:

0	One read
1	Continuous
2	One read with beep
3	Continuous read with beep

Note that for continuous reads, a reply is generated once per second. Continuous mode is not useful with the **d** function since the counter(s) will be disabled.

The reply sent to the host consists of the following:

<status><value>[<status><value>...]<line terminator>

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Status codes are:

0	stopped, no overflow
1	stopped, overflow set
2	running, no overflow
3	running, overflow set
4	uninitialized

The counter *value* will be the ASCII representation of the hexadecimal value of the counter channel - "0000" - "FFFF"

When *n* is "0" eight sets of status and value codes are returned, a total of 40 characters. Channel 1 values are transmitted first, channel 8 last. When *n* is "1" through "8", only one set of values is returned, for the channel requested.

Enable Function

The **e**nable function is used to enable, or start, one or all counters. Following this command, the status is set to "2". The counter value is unaffected. The **e** function generates a reply to the host with the status and counter value for the counter(s) requested. This function is used with request type *2* of the **a** command and has the following format:

<ESC>a204e<n><path><mode>**<STX>**

Values for *n* are:

0	All counters
1	Channel 1
2	Channel 2
:	
8	Channel 8

Values for *path* are:

0	Standard output path
1	Auxiliary Tx buffer
2	Standard output path with terminator

The *path* parameter specifies the path by which the counter data will be sent to the host. The format of the data is described below:

Values for *mode* are:

0	One read
1	Continuous
2	One read with beep
3	Continuous read with beep

Note that for continuous reads, a reply is generated once per second.

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The reply sent to the host consists of the following:

<status><value>[<status><value>...]<line terminator>

Status codes are:

0	stopped, no overflow
1	stopped, overflow set
2	running, no overflow
3	running, overflow set
4	uninitialized

The counter *value* will be the ASCII representation of the hexadecimal value of the counter channel - "0000" - "FFFF".

When *n* is "0" eight sets of status and value codes are returned, a total of 40 characters. Channel 1 values are transmitted first, channel 8 last. When *n* is "1" through "8", only one set of values is returned, for the channel requested.

The **e** function is useful for resetting the overflow for a counter. A counter need not be stopped to use this function.

Read Function

The read function is used to read one or all of the counters. The status and counter value are unaffected. The **r** function generates a reply to the host with the status and counter value for the counter(s) requested. This function is used with request type *2* of the **a** command and has the following format:

<ESC>a204r<n><path><mode>**<STX>**

Values for *n* are:

0	All counters
1	Channel 1
2	Channel 2
:	
.	
8	Channel 8

Values for *path* are:

0	Standard output path
1	Auxiliary Tx buffer
2	Standard output path with terminator

The *path* parameter specifies the path by which the counter data will be sent to the host. The format of the data is described on the next page:

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Values for *mode* are:

0	One read
1	Continuous
2	One read with beep
3	Continuous read with beep

Note that for continuous reads, a reply is generated once per second.

The reply sent to the host consists of the following:

<status><value>[<status><value>...]<line terminator>

Status codes are:

0	stopped, no overflow
1	stopped, overflow set
2	running, no overflow
3	running, overflow set
4	uninitialized

The counter *value* will be the ASCII representation of the hexadecimal value of the counter channel - "0000" - "FFFF".

When *n* is "0" eight sets of status and value codes are returned, a total of 40 characters. Channel 1 values are transmitted first, channel 8 last. When *n* is "1" through "8", only one set of values is returned, for the channel requested.

Clear Function

The **c**lear function is used to reset one or all counters. The status is set to "0" and the count is set to "0000". The **c** function generates a reply to the host with the status and counter value for the counter(s) requested. This function is used with request type *2* of the **a** command and has the following format:

<ESC>a204c<n><path><mode><STX>

Values for *n* are:

0	All counters
1	Channel 1
2	Channel 2
:	
.	
8	Channel 8

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Values for *path* are:

0	Standard output path
1	Auxiliary Tx buffer
2	Standard output path with terminator

The *path* parameter specifies the path by which the counter data will be sent to the host. The format of the data is described below:

Values for *mode* are:

0	One read
1	Continuous
2	One read with beep
3	Continuous read with beep

Note that for continuous reads, a reply is generated once per second. Continuous mode is not useful with the **c** function since the counter value is cleared before the channel is read.

The reply sent to the host consists of the following:

<status><value>[<status><value>...]<line terminator>

Status codes are:

0	stopped, no overflow
1	stopped, overflow set
2	running, no overflow
3	running, overflow set
4	uninitialized

The counter *value* will be the ASCII representation of the hexadecimal value of the counter channel. (Always "0000" for **c** function)

When *n* is "0" eight sets of status and value codes are returned, a total of 40 characters. Channel 1 values are transmitted first, channel 8 last. When *n* is "1" through "8", only one set of values is returned, for the channel requested.

Counter Module Example:

Initialize all counter channels after power-up. Send the reply to the standard output path with a terminator.

<ESC>a204i020<STX> command

0000000000000000000000000000000000000000<CR> reply

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Read and stop counter 3 using the **d** function. The count on this channel has reached 100.

<ESC>a204d320<STX> command

20064<CR> reply

Read channel 2 continuously (once per second).

<ESC>a204r221<STX> command

20040<CR> reply
20045<CR>
2004A<CR>
:
.
2FFFF<CR>
30005<CR>
:

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Chapter 9

Monitor Mode

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Monitor Mode Operation

While in monitor mode, the TM8400 functions as a simple serial data analyzer. The operator controls a 2 line by 40 character display window into a 48 line by 40 character receive buffer. The display shows all incoming characters, including ASCII <NUL>s. Commands and control characters are not executed by the terminal while in monitor mode. All control characters (ASCII 000-031) are displayed by flashing the corresponding displayable character. For example, an ASCII <LF> would be displayed as a flashing **J**. Before running, the operator can enter a string of characters which will be transmitted to the host immediately after the display is enabled and running. When halted, the window movement keys are used to review the received data.

The protected line of the display is used as a menu line when appropriate. The following keys are used for operator control:

RUN (F1)	Remove menu line, display instructions, clear display, enable receiving, and send TX string, if any.
TXENTRY (F2)	Allow input of a transmit string of up to 40 characters in length. Then run.
REVIEW (F3)	Remove menu line, and enable arrow keys to move display window.
HALT (F8)	End current mode and display menu line.

Run Mode

In run mode, the TM8400 continuously displays all data detected on the host communications line. To start, press **F1**. TheTM8400 will display an instruction line for one second

Press F8 to halt and return to menu

and then clear its display and begin running. The display width is fixed at 40 characters and auto wrap is enabled . The last 48 display lines of data are retained in a circular fashion. All characters are displayed; control characters are displayed by flashing the corresponding printable character. Communications and parity errors are displayed as E. The only key on the keyboard which has any function in run mode is **F8** which is used to halt.

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TxEntry

When testing communications, it is often necessary for the terminal device to send a string of data to the host to initiate the test. A transmit string or Tx Entry of up to 40 characters may be entered into the terminal. This string will be transmitted one time, immediately before entering run mode. The Tx Entry is sent exactly as keyed in; there is no terminator added. Control characters may be entered using the **CTRL** key. Type the transmit string from the keyboard, pressing **ENTER** when complete. The TM8400 will then automatically enter run mode as described above. The TxEntry is not retained and must be reentered each time the terminal is placed in Run mode.

Review

Review allows the operator to examine the previous 48 display lines of incoming data after the monitor has been halted. The up_arrow and down_arrow keys move the display window through the stored data. This buffer is cleared each time the terminal is placed in Run mode.

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Chapter 10

Character Mode

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Character Mode Operation

In character mode, the TM8400 operates like a simple CRT terminal with a virtual screen size of 24 lines by 80 characters or 48 lines by 40 characters. All input and output is character oriented. Characters from the host computer are displayed immediately upon receipt; characters entered from the keyboard are transmitted to the host on keystroke. Character mode does not support multidropped operation.

The important options in this mode are the line terminator, newline setting, local echo, and the peripheral mode.

The line terminator is transmitted by the terminal whenever the **ENTER** key is pressed, or an ASCII <RS> is found at the end of a function message. If the peripheral module is in AUTO mode, the line terminator will be appended to any scanned input message. In MANUAL mode, the line terminator will be generated only for a scanned message of zero length (such as a barcode consisting of only a start and stop character.)

When the terminal is set for newline operation, received <CR> or <LF> characters are expanded to <CRLF> sequences .

Local echo is used in half-duplex environments to display output before transmission to the host. When local echo is set to **Off**, only characters received from the host are displayed.

Several keys have special functions in character mode. The **DEL** key causes transmission of the ASCII <DEL> (127). The **CLEAR** key causes transmission of the ASCII <FF> (012). The **ENTER** key causes the transmission of the selected line terminator.

XON/XOFF Handshaking

The TM8400 will perform bidirectional flow control handshaking on both the Host and Auxiliary serial communications ports using the **XON/XOFF** protocol.

XON/XOFF handshaking is available only in **character mode** on the host communications port.

This type of flow control synchronization is especially useful when passing data through the TM8400 between a host and auxiliary device operating at different baud rates. Handshaking may be active on both ports simultaneously.

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Receiver - As the TM8400 receives characters on either communications port, the characters are buffered until they can be processed by the terminal. When one of these buffers becomes full, the TM8400 will generate the XOFF character <DC3> (019) to cause the host or auxiliary device (whichever the case may be) to stop transmitting. The other device must stop transmitting within four (4) characters after receiving the XOFF to avoid overrunning the TM8400's buffer. As soon as the characters in the buffer are processed and the buffer becomes empty, the TM8400 will generate the XON character <DC1> (017) to cause the other device to resume its transmission.

The receive buffer on the host port can hold a maximum of 256 characters. The auxiliary port receive buffer can hold 64 characters.

Transmitter - The TM8400 will respond to XON/XOFF control generated by another device. When the XOFF character is received on either port, the TM8400 will disable transmission on that port. If the TM8400 is transmitting at the time, it will stop within three(3) characters. Transmission will be reenabled upon receipt of the XON character.

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Chapter 11

Block Mode

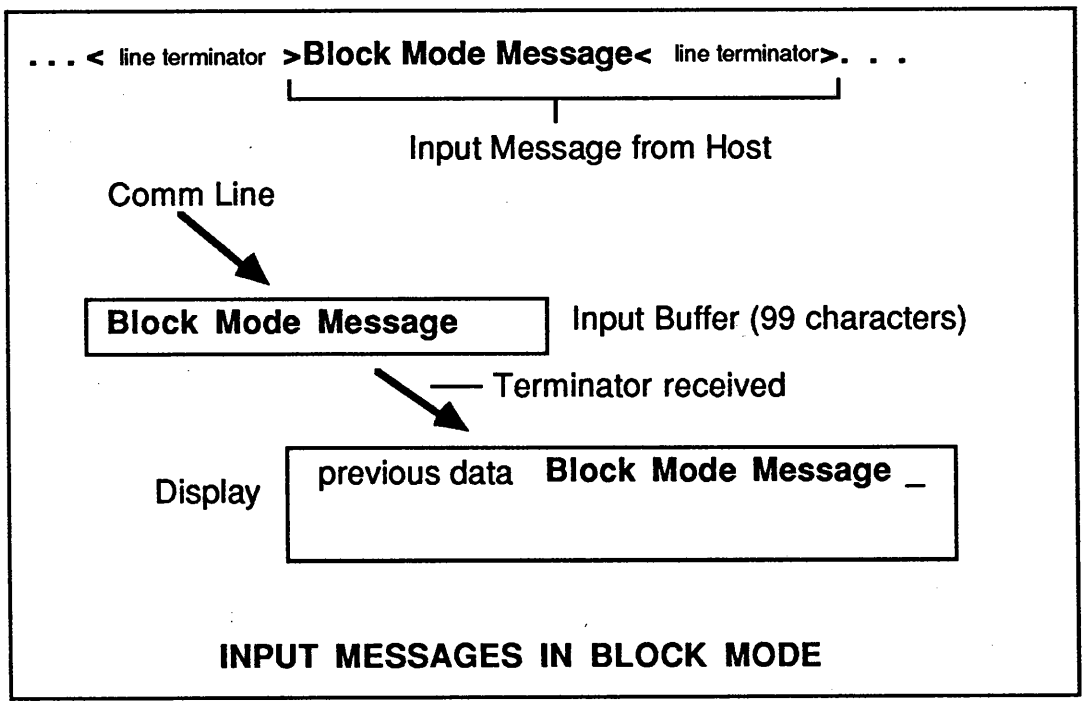
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Block Mode Operation

In block mode, the TM8400 buffers input and output message lines so that it displays or transmits whole messages at a time. This mode of operation is well suited for prompt/response transaction systems and, more importantly, it allows for multidropped operation.

Block Mode Input

As messages are received from the host computer, they are buffered by the terminal until the **line terminator** is received. The complete message is then sent to the display. Note in the illustration below that the line terminator is not considered part of the message and is not sent to the display. This is especially important to remember when using <CR> or <CRLF> as the line terminator.



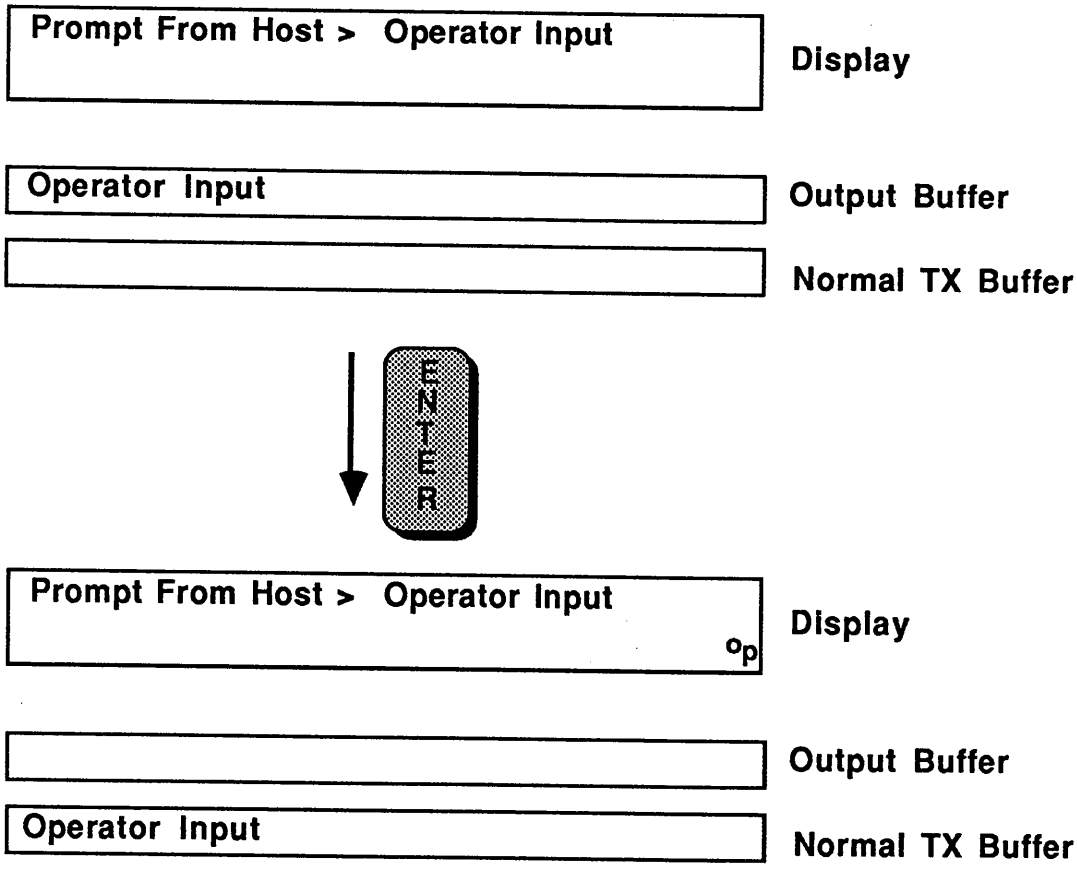
INPUT MESSAGES IN BLOCK MODE

The maximum number of characters which the terminal can receive in one message is 99. Additional characters are ignored until the terminator is received.

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Block Mode Output

As an operator begins to key in a message in block mode, the terminal accumulates it in the *output* buffer. By pressing the **ENTER** key, the operator places the message in the *transmit* buffer where it is ready* to be sent to the host. The operator may enter a maximum of 80 characters for output. Characters which exceed this length are ignored and an error beep is sounded. If a function key is pressed and the length of its message would cause the output message to exceed the length of its buffer, the function message will be ignored (none of it will be placed in the buffer) and an error beep is sounded.



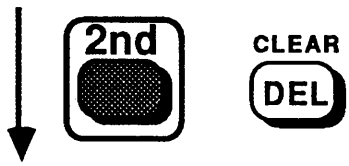
While a message is being entered by the operator, the display is *reserved* for the output message only. Text messages received from the host while an output message is being composed are ignored. Priority messages should be prefaced with the **o** command so that they will *break through* to the display.

*messages are not always immediately sent in block mode. The host may prevent transmission by handshaking on the CTS control line. In multidropped operation, no message is sent until specifically requested by the host. A pending Tx buffer is indicated by the flashing $^{o}_{p}$ in the lower right corner of the display.

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When composing a block mode output message, the **DEL** and **CLEAR** keys affect only the output message being composed. Any previous contents of the display, or messages in the Tx buffer waiting to be transmitted to the host are not affected.

Previous Prompt > Previous Input Host Prompt > Operator Input o_p	Display
Operator Input	Output Buffer
Previous Input	Normal TX Buffer



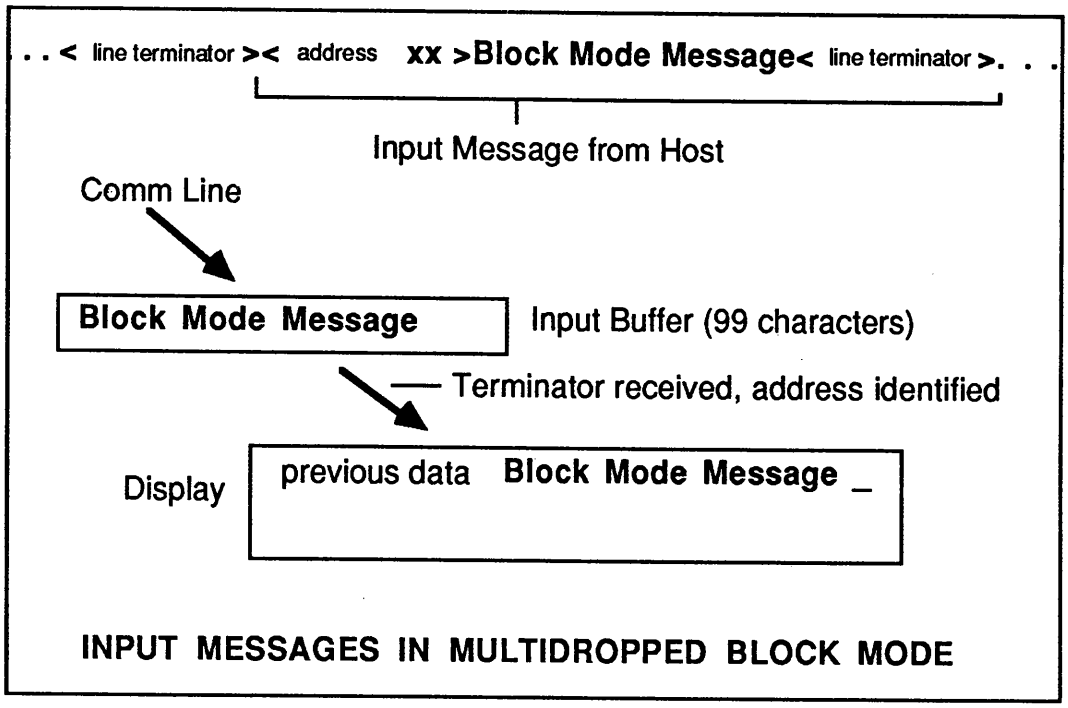
Previous Prompt > Previous Input Host Prompt > o_p	Display
	Output Buffer
Previous Input	Normal TX Buffer

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Multidropped (polled) **Input**
In polled operation, each terminal on a multidrop line is given a unique ID, or address, selected in Setup. Selecting any address other than **00** places the terminal in polled mode. **All** messages sent to the terminal must be prefixed with two ASCII digits representing the terminal's address. For example:

03Hello Dave<CR>

would be received and displayed only by a terminal with address **03.** Any other terminals on the same line would ignore the message. In multidrop operation, the input message block is handled slightly differently than it is in normal (or nonpolled) block mode.



INPUT MESSAGES IN MULTIDROPPED BLOCK MODE

After a line terminator is received, the message in the input buffer is checked to see that the first two characters are the terminal's multidrop address. If not, the contents of the input buffer are discarded. Receipt of the line terminator serves to resynchronize communications.

Note that in a continuous stream of data coming from the host, the multidrop address characters must **immediately** follow the previous line terminator. Any intervening characters will cause the terminals on the line to not recognize their addresses. For example, if the selected line terminator is <CR> and the host computer ends a message with <CRLF>, the terminal would attempt to interpret the <LF> as part of its multidrop address.

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Multidropped Output

In multidrop operation the TM8400 will not transmit output messages to the host until they are requested with the **p** command.

When an output message is waiting to be sent to the host in multidrop operation, an *output pending* indicator °$_p$ will be displayed in the lower right corner of the display. The operator may not place another output message in the *transmit* buffer until the host requests the previous one. This is to prevent data from being lost by being overwritten. An error beep will sound if the **ENTER** key is pressed while the terminal is in the *output pending* condition.

Note that there are actually several Tx buffers which hold data waiting to be transmitted to the host. The content of these buffers and the priority in which they are sent to the host is described in chapter 4.

All messages sent by the terminal in response to the **p** command are prefixed with the the terminal's multidropped address. For example:

03This is the output message<CR>

Options

The important options to select in Block mode are the line terminator, address, newline setting, input display setting, and peripheral mode.

The line terminator is used by the host to terminate a line or block of data. A line may contain a mixture of text and commands. The line terminator is not sent to the display and will not affect the position of the cursor. Under normal circumstances, data sent by the terminal is also terminated by this terminator.

If the address is set to **00** , the TM8400 operates in its' normal or non-polled block. Addresses from **01** through **32** place the terminal in multidrop operaton.

The newline setting determines the operation of the <LF> character and <CR> characters. When set for newline operation, both <CR> and <LF> are expanded to <CRLF> sequences, causing the display cursor to move to the first position of the next line.

As described earlier, the input display setting affects how messages are placed in the display. When set for free format, all input messages are displayed starting at the current cursor position. The host controls the format of display by embedding cursor control characters in the message.

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When set for one message per line, the terminal prefixes a <CRLF> sequence to each message before displaying it.

When the peripheral module is set for AUTO operation, an **ENTER** operation will be automatically performed after each message is scanned. When in MANUAL operation, each message scanned will be appended to the *output message* buffer. An **ENTER** operation is performed only for scanned messages of zero length in MANUAL operation.

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Appendix

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Appendix
SPECIFICATIONS

DISPLAY

Type	Liquid Crystal Dot Matrix
Number of Lines	2
Characters/Line	40
Matrix Size	5 x 7 with Cursor
Character Height	.190"
Virtual Screen	1920 characters
Attributes	Character flash
	Line protect
Status Indicators	4 cursor fonts
	"output pending" $^{o}_{p}$ symbol

BACKLIGHTING

Type	Electroluminescent
Color	White
Brightness	50 cd/m^2 (typ @ 25C)
Switching	On/Off/Timeout

KEYBOARD

Type	Sealed Elastomeric
Number of Keys	51
Keycaps	ABS Plastic
Keycap Size	.425" x .275"
	(Double-size ENTER)
Key Spacing	.60" h/v centers
Actuation Force	80g
Travel	.06"
Layout	User Definable
Service Life	5 million operations

PROGRAMMABLE FUNCTIONS

Memories	2 banks of 16
Storage Capacity	40 characters/memory
Keyboard Locations	16

ELECTRONICS

Technology	CMOS
CPU	6303
ROM	32K
Volatile RAM	8K
Battery-backed RAM	2K (10 yr backup)

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INTERFACE

Electrical	Selected by Comm. module
Transmission	Serial Asynchronous
Code	ASCII
Baud Rate	300-19,200
Protocol	Character mode (XON/XOFF) Block mode Multidrop block mode Monitor mode
Max Block Length	99 chars (input) 80 chars (output)
Max. Multidrop	32 units/line
Connector Type	DB-25S (host) DE-9P (peripheral) DB-25P (auxiliary)

PROGRAMMING

Retention	Battery-backed RAM

PARAMETERS

Method	Interactive (keyboard)/host	
Prompt Languages	English, French, German	
Options:		
Language	Terminal mode	Address
Baud Rate	Data Format	Line Terminator
Handshaking	Turnaround Delay	Backlight
Display Format	Local Echo	Autowrap
Newline	Display Width	Key Repeat
Key Click	Peripheral mode	Symbology

FUNCTION KEYS

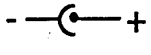
Method	Host (comm line)

KEYBOARD LAYOUT

Method	Host (comm line)

POWER SUPPLY

Type	External
Voltage	7.5-9.0 VDC
Current	100mA (base unit) 500mA max.
Connector	Barrel-type Compatible with Switchcraft P/N 760



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PHYSICAL

Size	9.00" x 5.00"x1.50"
Weight	approx. 1.7 lb
Case Material	NORYL

ENVIRONMENTAL

Operating Temp.	0C to + 50C
Storage Temp.	-10C to +60C
Relative Humidity	5% to 95% (non-condensing)

SEALING

Keyboard/Display	Resists Dust, liquid
Case	Resists Dust

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OPTION MODULE SPECIFICATIONS

COMMUNICATIONS

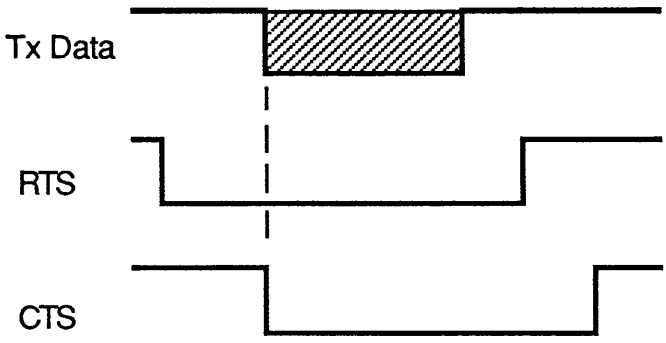
Connector	DB-25S	
TM8411	RS-232-C	
Distance	50 ft.	
Modem Control	RTS, CTS, DTR	
Logic Levels:		
Receive	Logic 1	-3V to -15V
	Logic 0	+3V to +15V
Transmit	Logic 1	≤-6V with 3KΩ load
	Logic 0	≥+6V with 3KΩ load

Pinout:

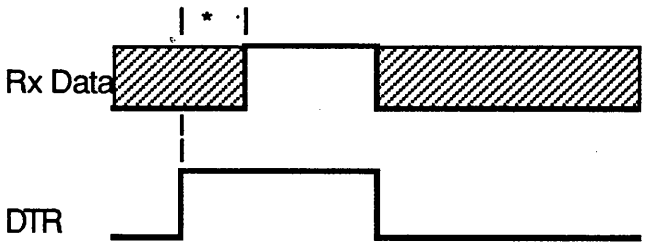
1 Ground	**8** N/C	**15** Pwr Reg	**22** N/C
2 TX Data	**9** N/C	**16** N/C	**23** N/C
3 RX Data	**10** Beeper/	**17** N/C	**24** N/C
4 RTS	**11** N/C	**18** N/C	**25** N/C
5 CTS	**12** N/C	**19** N/C	
6 N/C	**13** N/C	**20** DTR	
7 Sig. Gnd	**14** Power	**21** N/C	

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Modem Control Handshaking with the RS-232 Interface:



RTS/CTS/Tx Timing



DTR Timing
* = 4 character margin

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TM8412

Distance		RS-422 4000 ft	
Receiver:			
Differential Input Voltage		$0.2V < \Delta V_{in} < 6V$	
Input Impedance		12000 Ω min.	
Logic Levels:			
	Logic 1	A' - high	B' - low
	Logic 0	A' - low	B' - high
Transmitter:			
Differential Output Voltage (open circuit)		5V max	
Differential Output Voltage (full load, $R_L = 100\Omega$)		2V min	
Output Current (active, $R_L = 100\Omega$)		20mA	
Output Current (inactive, power off)		±100µA	
Logic Levels:			
	Logic 1	A - high	B - low
	Logic 0	A - low	B - high
Common Mode:			
Input Voltage		-0.75V to +7V	
Output Voltage		-0.3V to +3.5V	

Pinout:

1 Ground	**8** N/C	**15** Pwr Reg	**22** N/C
2 B	**9** N/C	**16** N/C	**23** N/C
3 A	**10** Beeper/	**17** N/C	**24** N/C
4 B'	**11** N/C	**18** N/C	**25** N/C
5 A'	**12** N/C	**19** N/C	
6 N/C	**13** N/C	**20** N/C	
7 Sig. Gnd	**14** Power	**21** N/C	

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TM8414	Current Loop(passive)
Distance	1000 ft
(@ 20Kbaud)	
Receive Loop:	
Mark State Input Current	12-24mA
Mark State Input Voltage	2.75V max
(@I_{MI} = 20mA)	
Space State Input Current	0-3mA
Space State Input Voltage	2.2V max
(@I_{SI} - 2 mA)	
Transmit Loop:	
Mark State Output Current	12-24mA
Mark State Output Voltage	2.7V max
(@I_{MO} = 20mA)	
Space State Output Current	2.0mA max
(@V_{SO} = 27V)	

****Maximum Open Circuit Voltage is 27V**

Pinout:

1 Ground	**8** N/C	**15** Pwr Reg	**22** N/C
2 +Out	**9** N/C	**16** N/C	**23** N/C
3 - Out	**10** Beeper/	**17** N/C	**24** N/C
4 +In	**11** N/C	**18** N/C	**25** N/C
5 - In	**12** N/C	**19** N/C	
6 N/C	**13** N/C	**20** N/C	
7 Sig. Gnd	**14** Power	**21** N/C	

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PERIPHERAL	
Connector	DE-9P
Decoder	
Barcode Symbologies	3 of 9 Full ASCII 3 of 9 2 of 5 Interleaved 2 of 5 Codabar UPC - A UPC - E EAN
Magnetic Stripe	ABA Track 2
Modes	Auto Tx Manual Tx (concatenate) Disable
TM8421	Barcode Wand
Wand Type	Digital
Resolution	0.006 inches
Depth of Field	0.075 inches
Light Source	660nm visible red LED
Scan Angle	0-45 degrees from normal
Case	Stainless Steel
Tip	Replaceable
Cable	Coiled, strain-relieved 72" extended
TM8423	Barcode Slot Reader
Type	Digital
Resolution	0.0075 inches
Aperture	6 x 20 mil diamond-shape
Light Source	660nm visible Red LED
Amb. Light Rejection	Direct sunlight at any illumination angle
Slot width	0.125"
Slot depth	0.80" (nominal)
Optical Center Line	0.50" from bottom
Case	Cast metal, sealed (IP66/67)
Dimensions	5.0" x 2.05" x 1.10"
Cord	48" straight
Cord Exit	Bottom

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TM8424	Magnetic Stripe Reader
Card Standard	ANSI X4.13-1971
Encoding Standard	ANSI X4.16-1971
Read Track	Track 2 ABA
Density	75BPI
Capacity	40 numeric characters
Read Speed	3-40 IPS
Slot Width	0.10"

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AUXILIARY

Connector		DB-25P	
TM8431 (Preliminary)		Printer Port	
Interface		Parallel - Centronics type	
Pinout:			
1 Strobe/	**8** DATA 7	**15** Fault/	**22** N/C
2 DATA 1	**9** DATA 8	**16** N/C	**23** N/C
3 DATA 2	**10** ACK	**17** Sig Gnd	**24** N/C
4 DATA 3	**11** BUSY	**18** Sig Gnd	**25** N/C
5 DATA 4	**12** N/C	**19** N/C	
6 DATA 5	**13** N/C	**20** N/C	
7 DATA 6	**14** Sig Gnd	**21** N/C	

TM8432 (Preliminary)		Serial RS-232
Distance	15 ft.	
Modem Control	RTS, CTS, DTR, DCD	
Logic Levels:		
Receive	Logic 1	-3V to -15V
	Logic 0	+3V to +15V
Transmit	Logic 1	-5V with 3KΩ load
	Logic 0	+5V with 3KΩ load

Pinout:

1 Gnd	**8** DCD	**15** N/C	**22** N/C
2 TX Data	**9** N/C	**16** N/C	**23** N/C
3 RX Data	**10** N/C	**17** N/C	**24** N/C
4 RTS	**11** N/C	**18** N/C	**25** N/C
5 CTS	**12** N/C	**19** N/C	
6 N/C	**13** N/C	**20** DTR	
7 Sig Gnd	**14** N/C	**21** N/C	

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TM8433
(Preliminary)
Number of Lines

Digital I/O

16 I/O, input and output strobes

Configuration

Jumper Selectable -
16 bit input
16 bit output
8 bit input/ 8 bit output

Compatibility

TTL

Pinout:

1 I/O 0	**8** I/O 7	**15** I/O 16	**22** IS 0
2 I/O 1	**9** I/O 10	**16** I/O 17	**23** OS10
3 I/O 2	**10** I/O 11	**17** Gnd	**24** IS 10
4 I/O 3	**11** I/O 12	**18** Gnd	**25** N/C
5 I/O 4	**12** I/O 13	**19** Gnd	
6 I/O 5	**13** I/O 14	**20** Gnd	
7 I/O 6	**14** I/O 15	**21** OS 0	

TM8434
(Preliminary)

Pulse Counter

Number of Channels	8
Compatibility	TTL
Minimum Pulse Width	5 mS
Max Frequency	100 Hz
Max Accumulation	65535

Pinout:

1 CI0	**8** N/C	**15** CI3	**22** Ground
2 CI2	**9** Ground	**16** CI5	**23** Ground
3 CI4	**10** Ground	**17** CI7	**24** N/C
4 CI6	**11** OS0	**18** N/C	**25** N/C
5 N/C	**12** N/C	**19** N/C	
6 N/C	**13** N/C	**20** N/C	
7 N/C	**14** CI1	**21** N/C	

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TM7x Compatibility Commands

Command	Comments
<ESC>A	Poll command
<ESC>B	Retransmit command
<ESC>T	Clear output and transmit buffers
<ESC>Jn	Lock keyboard
<ESC>Un	Keyclick
<ESC>Dzz<text>	Define function key F1-F8 and 2nd F1-F8 zz = (01 - 08, 21 - 28) no access to upper bank of functions
<ESC>In	Display blanking no access to other characteristics
<ESC>Vn	Auto/Manual Peripheral mode

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Command Sequence Summary

Poll Command*
<ESC>p<terminator>
Retransmit Command*
<ESC>r<terminator>
Echo Command*
<ESC>e<text><terminator>
Clear Output Buffer
<ESC>o<terminator>
Undelete Output Buffer
<ESC>u<terminator>
Set Turnaround Delay
<ESC>t<delay><terminator>
Keyboard Characteristics
<ESC>k<keyboard><function bank><key repeat><keyclick><terminator>
Keyboard Layout
<ESC>l0<location><normal code><shifted code><terminator>
<ESC>l1<terminator> (restore default layout)
Define Function Message
<ESC>m<number><text><terminator>
Display Characteristics
<ESC>d<flash><prot line><cursor><auto wrap><width><terminator>
Display Format
<ESC>f<output display><backlite><local echo><newline><input display><terminator>
Insert Message
<ESC>i<number><terminator>
Write to Protected Line
<ESC>w<text><terminator>
Scanner Characteristics
<ESC>s<mode><symbology><terminator>
Auxiliary Module Request**
<ESC>a<type><ID>[<function><parms>]<terminator
Backup Parameters
<ESC>b<terminator>
Request Configuration*
<ESC>c<terminator>

*** will cause a reply message from the TM8400**
**** may cause a reply message (depending on request type)**

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Sending Control Sequences

When composing messages on the TM8400 keyboard , it is possible to enter the entire 128 character ASCII set by using combinations of the **CTRL** and **2nd** keys. The ASCII character table contained at the end of this appendix shows the simple relationship between the ASCII control characters and the corresponding printable characters. The control characters are shown in the first and second columns (from the left) of the chart. The corresponding printable character appears in the same row on the chart, four columns to the right. For example, the printable character corresponding to <NUL> is "@"; the corresponding printable character to <DC3> is "S".

Pressing the **CTRL** key, followed by the key for the corresponding printable character will generate the control character. If the printable character is a *shifted* character (above the key) then the **2nd** key must also be pressed. When both the **CTRL** and **2nd** keys are used, the **CTRL** key should always be pressed first.

Example

To send the ASCII character <ESC>, we find in the chart that the corresponding printable character is "[". Since "[" is a shifted character, we must use both the **CTRL** and **2nd** keys to generate this code.



Note that since the keyboard on the TM8400 is redefinable, a key can always be defined to send any character without the need for a multiple key sequence.

Example

To change key 50 (the "A" key on the default keyboard) to transmit <ESC> as its normal code, the host computer would use the **I** command as follows:

<ESC>I05027<STX>

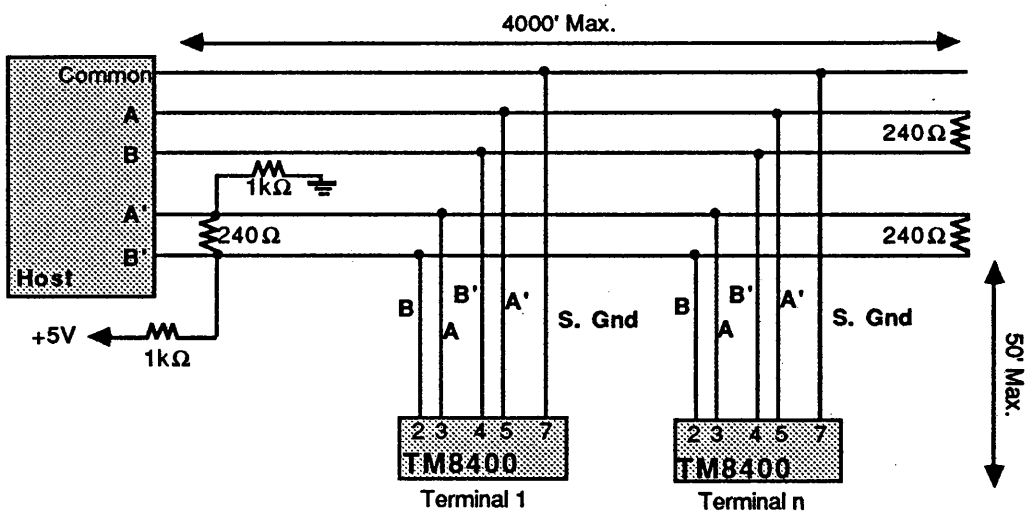
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RS422 Connections

When using the TM8412 (RS422) communications module, up to 32 terminals may be connected to a single communications line as indicated below.

It is important that the length of the main cable be less than 4000 feet for reliable communications. Short *stub* lines to each terminal should be kept to 50 feet or less.

RS422 is a balanced line interface and requires the main line to be terminated at the furthest point from the host system. The recommended value for most installations is 240Ω . In addition, the signal ground should be connected to the common of the host interface to obtain a reliable reference.



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Decimal Equivalents of ASCII Characters

Dec[Hex] Graphic	Dec[Hex] Graphic	Dec[Hex] Graphic	Dec[Hex] Graphic	Dec[Hex] Graphic	Dec[Hex] Graphic	Dec[Hex] Graphic	Dec[Hex] Graphic
000[00] NUL	016[10] DLE	032[20] SPACE	048[30] 0	064[40] @	080[50] P	096[60] `	112[70] p
001[01] SOH	017[11] DC1	033[21] !	049[31] 1	065[41] A	081[51] Q	097[61] a	113[71] q
002[02] STX	018[12] DC2	034[22] "	050[32] 2	066[42] B	082[52] R	098[62] b	114[72] r
003[03] ETX	019[13] DC3	035[23] #	051[33] 3	067[43] C	083[53] S	099[63] c	115[73] s
004[04] EOT	020[14] DC4	036[24] $	052[34] 4	068[44] D	084[54] T	100[64] d	116[74] t
005[05] ENQ	021[15] NAK	037[25] %	052[35] 5	069[45] E	085[55] U	101[65] e	117[75] u
006[06] ACK	022[16] SYN	038[26] &	053[36] 6	070[46] F	086[56] V	102[66] f	118[76] v
007[07] BEL	023[17] ETB	039[27] '	054[37] 7	071[47] G	087[57] W	103[67] g	119[77] w
008[08] BS	024[18] CAN	040[28] (	055[38] 8	072[48] H	088[58] X	104[68] h	120[78] x
009[09] HT	025[19] EM	041[29])	056[39] 9	073[49] I	089[59] y	105[69] i	121[79] y
010[0A] LF	026[1A] SUB	042[2A] *	057[3A] :	074[4A] J	090[5A] Z	106[6A] j	122[7A] z
011[0B] VT	027[1B] ESC	043[2B] +	058[3B] ;	074[4B] K	091[5B] [	107[6B] k	123[7B] {
012[0C] FF	028[1C] FS	044[2C] ,	059[3C] <	075[4C] L	092[5C] \	108[6C] l	124[7C] |
013[0D] CR	029[1D] GS	045[2D] -	060[3D] =	076[4D] M	093[5D]]	109[6D] m	125[7D] }
014[0E] SO	030[1E] RS	046[2E] .	061[3E] >	077[4E] N	094[5E] ^	110[6E] n	126[7E] ~
015[0F] S1	031[1F] US	047[2F] /	062[3F] ?	078[4F] O	095[5F] _	111[6F] o	127[7F] DEL

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TM8450 User's Guide Addendum

to Manual MA51309

Description

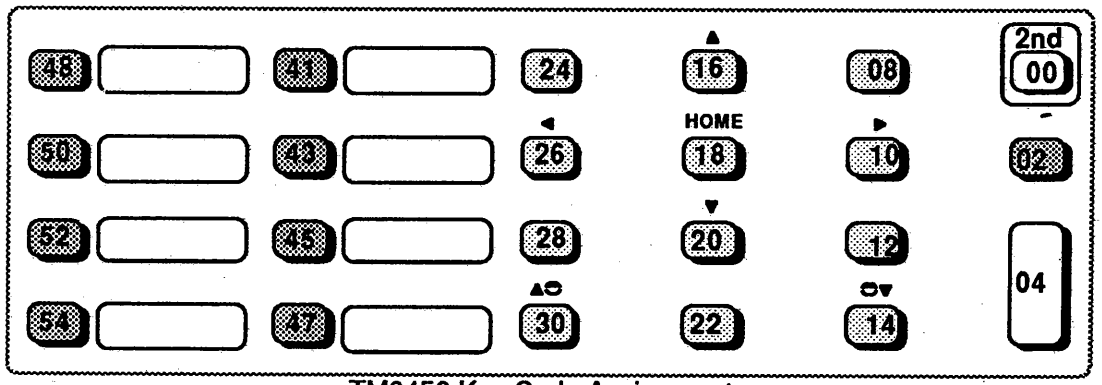
The TM8450 multifunction terminal features a numeric input keyboard with simplified layout and wide key spacing for industrial applications. The keyboard is populated with 23 of the possible 51 TM8000 series key positions and contains function keys F1-F8 (F9-F16 with 2nd), Digits 0-9, ., -, and the functions 2nd, Delete and Enter. Spaces are provided next to each of the function keys to accept a standard sized label which may be supplied by the user. The terminal hardware is identical to the TM8400 in all other respects.

Keyboard Characters

There are a number of keyboard functions available on the TM8450 which are not indicated on the keyboard overlay. These are as follows:

Space	2nd, 0
Setup	2nd, Enter
Clear	2nd, Del
F9-F16	2nd, F1-F8

As with the TM8400, the TM8450's keyboard is redefinable by the user. The diagram below indicates the key position assignments of the various keys.



TM8450 Key Code Assignments

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