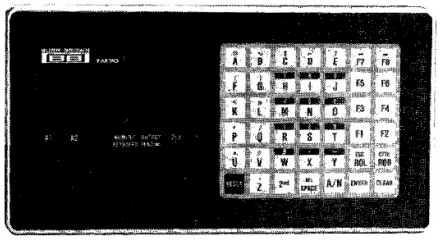
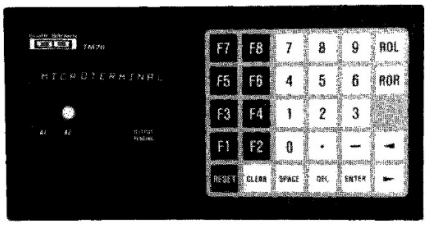
TM70 AND TM76 MICROTERMINALS USER'S GUIDE





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INTRODUCTION

If your system's data entry/control/display requirements are sophisticated but limited in volume, you don't need to buy big, expensive, and fragile CRT's or printing terminals to do the job efficiently.

The TM70 "microterminal" features a full alphanumeric keyboard and display while the TM76 has an alphanumeric display and a simplified numeric keyboard with larger keys. The TM70 and the TM76 - uniquely flexible in application versatility - are designed expressly to fill the human interface demands of widely dispersed control and communications networks - in machine and process control, energy management systems, inventory control and factory floor data collection, and information processing. Microterminals, because of their interface flexibility, appearance, size, durability, and easy installation, function equally well as consoles and control centers for instruments and small systems. They also perform as I/O terminals in diagnostic applications.

You don't need interface expertise to put microterminals to work for you...they communicate in serial ASCII with RS232C or 20mA current loop conditioning. Baud rates are 300 or 1200 bits per second.

A tough, water resistant front panel protects LED displays and indicators as well as a full alphanumeric keyboard. Tactile feedback, display blinking, and character display confirm operator entry and, because of its design simplicity, the microterminal concept doesn't require special operator skills or training. Depressing a single function key initiates preprogrammed action by the CPU. These functions may be defined in your CPU's software.

These microterminals' very compact design and simple mounting on any flat surface make them quickly adaptable to new or existing applications. All models measure only 216mm x 114mm x 15mm (8.5" x 4.5" x 0.6"). When ordered in OEM quantities the front panel can contain your corporate or system logo.

You can enter and display alphanumeric data. A 42-key keyboard (shiftable to generate 52 characters including A-Z and 0-9) allows you to receive or enter messages up to 36 characters long. A 12-character display - with horizontal scroll-left or scroll-right keyboard controls - permits review and editing of data entered before transmission in the polled mode. A 36-character message buffer is provided to hold output and input messages.

Display features include CPU control of scrolling. The keyboard can also be locked out by CPU command. Two LED indicators (A1, A2) are independently controlled by the CPU, three LED's indicate terminal status. The two independent LED's are driven by open-collector TTL signals which are also available on the back panel connector. These may be used to remotely control external equipment such as audible annunciators.

It is important to realize that while the microterminal products including the TM70 and the TM76 have many features, normal operation is very uncomplicated. Virtually untrained operators can use the microterminal products productively. Most special features are invisible to the operator. A typical application consists of a series of host-system-supplied operator prompts. To each prompt, the operator simply keys in a short number or message and pushes the ENTER key. The function message keys may be used to further simplify operator responses.

OPERATION

TM70 GENERAL DESCRIPTION

The TM70 is an alphanumeric "microterminal" which may be used as a remote or local data entry and output terminal for a host computer system. It is intended to provide a low cost, small size, alternative to a CRT terminal. It is suitable for applications with a limited amount of data interchange, as compared to applications requiring a typewriter-style keyboard and multiline display or hard copy output. The TM76 is the same as the TM70 with the exception that it features a simplified numeric-only keyboard with larger keys.

The TM70 features a dust proof front panel including 52 characters on a 42-key keyboard, 12-character alphanumeric display, two host-computer-controllable light emitting diodes (LED's), and three status LED's. The keyboard features raised embossing with tactile feedback. In addition, a 25-pin, D-style, rear panel connector features RS232C and current loop data transmit and data receive. The connector is also used to provide power, communications rate selection (300 or 1200 bps), remote reset in and reset out, and parity selection. The host-controllable LED's, labeled A1 and A2 on the front panel, are driven by open collector TTL signals which are brought out to the back panel connector.

Up to eight 4-character function messages may be defined by the host system. After definition by the host, these messages are called by the host for display by sending a 2-character code (ESC) *n* where *n* may have the values 1 through 8. Function messages may be retransmitted to the host by pressing the front panel function message keys. Thus, they may be used as extensions of the input message to the TM70 or as function messages to be transmitted by the TM70 operator to the host system.

For all following descriptions the terms input and output shall refer to input to and output from the TM70. Internal operation of the TM70 is easily conceived as a 12-character display and 36-character message buffer. The display may be filled, under operator control, with any contiguous 12-character section of the message buffer. Display contents are displayed to the operator through 12 alphanumeric LED characters. A host-sent command may be used to cause the 36-character message to continuously scroll across the display. The message buffer is handled differently in nonpolled mode than in polled mode. Nonpolled mode and polled mode operation are described in the following paragraphs.

NONPOLLED OPERATION

In nonpolled operation as each character key is pressed, it is immediately transmitted without being displayed. Therefore, it is necessary for the host to echo the key to

the terminal for display.
The ENTER key will transmit the ASCII CR (carriage return) character. Nonpolled operation is similar to the operation of a standard CRT terminal.

POLLED OPERATION

In multidrop mode, as each key is pressed, it is entered into the buffer and the display and not transmitted. The host cannot echo characters in this mode. When the ENTER key is pressed, the buffer is made ready for transmission, as indicated by the OUTPUT PENDING status LED. When the host sends the polling command ('Request Buffer') while OUTPUT PENDING is on, the TM70 will begin to transmit the buffer to the host. The buffer is prefixed by its 2-digit address to verify the source of the message.

In the event there was an error in the transmission (wrong address, parity error, etc.), the buffer can be requested again by the "Retransmit Buffer" command. If the "Request Buffer" command had been sent again, a null message would be transmitted to indicate no new data had been entered. This distinguishes between repeated data and new data.

When the host sends messages or commands to the TM70, they must be prefixed by two ASCII digits in the range 00 to 15. Address 00 is a special case which is accepted by all terminals addressed from 01 to 15. This allows a single message to be received by all terminals on the multidrop line at the same time.

The 20mA current loops should be used in polled operation. See page 7 for suggested connections. A number of microterminals may be connected to a single communications port using the current loops. The number may be limited to less than 15 by electrical considerations on some circuits. At 10mA the forward drop across the output optical coupler transistor is 1.3V. Fifteen of these total 19.5VDC. If the host current source comes from +12VDC, this obviously won't work. If -12VDC is available, 15 units can be connected as shown in Figure 5.

TM76 GENERAL DESCRIPTION

The TM76 is intended for those applications where an alphanumeric display terminal with numeric and function key data input is adequate. The TM76 keyboard has the advantage that it is less complicated for the untrained or inexperienced operator.

The TM76 is functionally identical to the TM70 except for the keyboard functions. The TM76 has larger, but fewer keys than the TM70. The TM76 offers a numeric (0-9) keyboard with function keys. Keyboard functions of the TM70 which do not appear on the TM76 are not available. The numeric keyboard and 2nd lights are unnecessary and have been deleted. Figures 1 and 2 show the front panels of the TM70 and TM76.

The keys of the TM76 are 38% larger and placed on 0.65-inch centers as compared to the 0.5-inch centers of the TM70. This is the same spacing as used on touch tone telephones and allows operators with gloved hands to easily use the keyboard. As can be seen from Figures 1 and 2, the keyboard appears much larger and easier to use. For a description of the TM76 key functions, refer to those same keys described for TM70 in the Detailed Key Descriptions section.

All matters concerning control features, communications protocol, and product specifications not related to the keyboard are as for TM70.

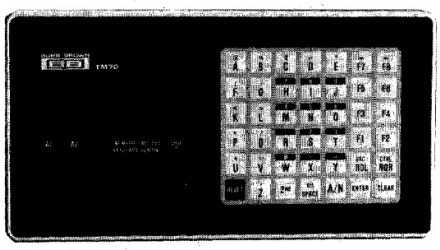


FIGURE 1. TM70 Front Panel.

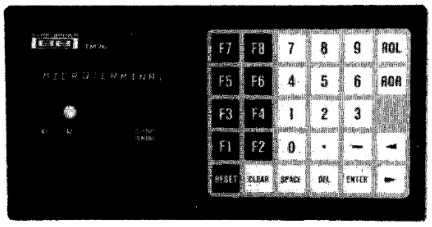


FIGURE 2. TM76 Front Panel.

SELF-TEST MODE

The TM70 has provision for performing a self-test diagnostic routine. Self test is entered by holding down any key while RESET is pressed and released. The message 'RAM␣ROM␣I/O␣' is put in the display buffer and the write/read memory test is performed. If the memory test passes, a '+' is put after 'RAM'; if there was a failure, a '—' is put in the display.

Similarly, a program ROM checksum is calculated and compared with a ROM stored checksum. The same pass/fail indicator is displayed. The I/O is tested by a write/read cycle to the internal I/O device, and a rotating test is performed on the Status LED's.

This sequence is then repeated until RESET is pressed and released while no other key is pressed. This will allow the TM70 to perform a normal power-up. The TM70 is off-line and will not receive or transmit while in self-test mode.

Self test can be accomplished only if the back panel connector reset jumper is connected between pins 19 and 21.

OPERATING INSTRUCTIONS

READY CONDITION

When power is applied to the TM70, the display will show

the ready indicator, which is a ^ in the left-most character position. In addition, pressing RESET and CLEAR will cause the ready condition to be entered. Note that in some installations the RESET key may be disabled when the unit is installed.

RECEIVING AN INPUT MESSAGE

When the TM70 receives an input message, it will appear in the display from left-to-right until the 12-character display is filled. After 12 characters the message will scroll to the left as each character is received. The internal message buffer holds up to 36 characters. For input messages larger than 36 characters, only the first 36 characters are retained. The host system must terminate each input message with a carriage return (CR). The carriage return is not displayed in any way. When the carriage return is received, the display will be reloaded with the first 12 characters of the message. In most installations this will appear to happen instantaneously. When an input message has been received, it may be examined by using the message control keys ROL, ROR, ◄, and ►. These cause a message up to 36 characters in length to move left and right in the 12-character display. Their functions are further described in the detailed key descriptions.

Receipt of another character after (CR) causes the display and message buffers to be cleared except for the characters of the new message. Also, if a character key is pressed to start an output message, the display and message buffer are cleared of the preceding input message. During normal operation an input message replaces any previous output message. The host may clear the display and message buffer by sending a message consisting of a single blank and a carriage return.

COMPOSING AN OUTPUT MESSAGE

As each character key is pressed, the displayed message grows from left to right. After 12 keys have been pressed, the message scrolls to the left. All characters are retained until 36 characters have been pressed. If more than 36 characters are pressed, only the first 36 are retained. The message may be edited by pressing CLEAR and inputting the message again or by using the delete key, DEL. Note that upper labels are entered by first pressing 2nd, prior to each upper label. When the operator wishes to end the message, it is only necessary to press ENTER. When the ENTER key is pressed at the end of the line, the next character entered will cause the message and display buffers to be cleared except for the first character of the new line.

FUNCTION KEYS

The host system may define up to eight 4-character function messages to be stored in TM70 random access memory. The operator may send these to the host by pressing the F1 through F8 keys. When F1 through F8 are pressed prior to being defined by the host, &z (z = 1 through 8) is transmitted. Function messages may not be defined from the keyboard.

NONDISPLAYABLE CHARACTERS AND MISCELLANEOUS INFORMATION

When nondisplayable ASCII characters are sent to the TM70, they are not shown on the display. However, function messages may contain nondisplayable characters, which will be transmitted correctly but displayed as ⊞ when buffered in multidrop mode. This applies to all 128 characters of the ASCII set.

The decimal point takes a full character position.

DETAILED KEY DESCRIPTIONS

ALPHABET AND SPECIAL CHARACTER KEYS [ ][A][B] etc.

These keys are used for data input from the keyboard. To enter the upper character, press the 2nd key prior to each upper character. Characters enter the display in the left-most position. After 12 characters have been pressed, previous characters move one character position to the left when a new character is entered.

ALPHABET AND NUMERIC KEYS [X][Y] etc.

These keys are used to enter characters from the keyboard. The upper characters are entered by pressing 2nd prior to each upper character. This is called the Alpha mode. An alternate mode is called Numeric mode. In this mode these upper characters may be entered by only pressing the key. In the Numeric mode pressing 2nd first will cause the lower character to be entered. The keyboard is put in Numeric mode by pressing the A N key. The Numeric Keyboard LED is on while the keyboard is in Numeric mode. To exit Numeric mode press A N again. Alpha mode is the power-up and Reset mode.

FUNCTION MESSAGE KEYS [F1][F2] etc.

These keys are used to input function messages from the keyboard. The function message may be one of the default strings &z or it may be a RAM based user defined string. When no user specified string definition has been provided, the two characters of the default string appear. For a user defined value, the one to four characters of the string definition appear in the display. The z denotes 1 through 8 for function messages 1 through 8.

All function messages are transmitted to the TM70 on the communications line as (ESC)z. For output, the default string will be transmitted unless the host has defined the function message. In this case the message will be transmitted as defined.

The eight function messages are put in the buffer by pressing the F1 through F8 keys or by the host transmitting (ESC)z.

When no message has been defined by the host, default strings appear in the display as &z. The z will be 1 through 8 for a total of eight values.

FUNCTION MESSAGE AND DISPLAY CONTROL KEYS [◄F7][►F8] etc.

These keys, when used as function message keys, are the same as the previously defined function keys. When used

with the 2nd key, they move the display buffer to the right-most 12 characters (➡), or to the left-most 12 characters (⬅), of the message buffer.

DISPLAY CONTROL AND TERMINAL CONTROL KEYS [ESC ROL] [CTRL ROR]

ROL/ROR

Pressing ROL will cause the message to move one character position to the left or until the last character of the message being examined is in the right-most position of the display. Pressing ROR causes the message to move one character to the right or until the first character of the message under examination is in the left-most display position. When held down, ROL and ROR auto-repeat.

ESCAPE

When ROL is prefixed by 2nd, the ASCII control code (ESC) is produced. In multidrop mode this is displayed as #.

CONTROL

When ROR is prefixed by 2nd, the next alphabetic character is converted to the corresponding ASCII control code which in multidrop mode is displayed as #.

RESET [RESET]

The RESET key allows the TM70 operator to initialize the internal functions. Pressing RESET is equivalent to turning on the power. Pressing RESET will cause RAM based message definitions to be initialized to the power-up default strings. The ready indicator (^) will be displayed in the left-most display position. This key may be disabled at installation. RESET is also used to enter self-test mode, see page 2.

SECOND KEY [2nd]

The second key, 2nd, is used to enable the upper labels of those keys having upper labels. For example, the key sequence [2nd] [U] [U] causes +U to be transmitted. When the keyboard is in Alpha mode as indicated by the Numeric Keyboard status LED being off, [2nd] [2 @] causes 2 to be transmitted. Pressing 2nd prior to a key which has no upper label causes the lower label to be transmitted and the internal 2nd mode cleared, as indicated by the '2nd' LED going off.

SPACE AND DELETE [DEL SPACE]

Space causes a space to be transmitted.The action of the DEL key depends on the mode. In normal mode the DEL key causes the ASCII DEL character to be transmitted when it is pressed. If the host echos the DEL back to the TM70, the last character in the buffer will be deleted. In multidrop mode the DEL key will delete the last character held in the buffer if there is one.

ALPHA/NUMERIC KEY [A/N]

Pressing the A/N key causes the keyboard to enter the Numeric mode. The upper white on black labels become lower labels not requiring the 2nd key before entry. The lower labels become upper labels and require the use of the second key for entry. The front panel Numeric LED comes on to indicate the keyboard is in Numeric mode. Press A/N to return to Alpha mode. Alpha mode is also the power-up and reset mode.

ENTER KEY [ENTER]

ENTER is used to terminate an output message with a carriage return in normal mode and to enable transmission with a trailing carriage return in multidrop mode. See also the sections on Polled and Nonpolled Operation.

CLEAR [CLEAR]

Pressing CLEAR causes the message buffer and display to be cleared. The Numeric Keyboard LED goes off meaning the terminal is in Alpha mode. A1, A2 LED's and defined function messages are unaffected. RESET has the same function as CLEAR, but in addition clears A1, A2 LED's and defined function messages. The ready indicator (^) is displayed in the left-most display position in response to pressing clear.

APPLICATIONS

COMMUNICATIONS PROTOCOL

CHARACTER CODES

The TM70 sends and receives 7-bit, asynchronous ASCII character codes with a start bit, one parity bit, and two stop bits. One, one and one-half, or two stop bits will be accepted for input. When parity is disabled, a mark or space, as determined by P1 jumpers, is inserted for the parity bit. Parity may be even or odd and is selected by jumpers on P1. Characters with parity errors are displayed as #. These jumpers also select the data receive and transmit rate. This rate may be 300 or 1200 bps. P1 jumpers are described in the Installation section.

Examples of compatible host to TM70 connections:

Host	TM70
1. 7 bits + 2 stop bits	7 bits + mark + 2 stop bits
2. 7 bits + parity + 1 stop bit	7 bits + parity + 2 stop bits
3. 7 bits + parity + 2 stop bits	7 bits + parity + 2 stop bits
4. 7 bits + mark space + 1 or 2 stop bits	7 bits + mark space + 2 stop bits

Remember that since communications are asynchronous and the standby state is the marking state, extra stop bits and marking bits are always acceptable. The TM70 does not test for bit 8 mark or space on input.

CARRIAGE RETURN

For an input message, the TM70 requires that the message of up to 36 characters in length be terminated by a carriage return. Carriage return is not counted as one of the input characters.

FUNCTION MESSAGES

Function messages of up to four characters in length may be defined by sending (ESC) D z(MESSAGE)(CR). The

z represents the function message number 1 through 8. Defined messages may be deleted by sending a new definition or (ESC) D z(CR). (ESC) D 0(CR) deletes all function message definitions.

To call a function message, the host sends (ESC) z within a normal message or merely (ESC) z (CR). This causes the function message to be entered into the 36-character message buffer. The display buffer shows the defined function message when a definition is present in RAM. The defined function message is transmitted on output. When no message has been defined, &z is shown in the display. &z is also transmitted in an output message when no function message has been defined.

COMMAND DESCRIPTIONS

The TM70 accepts nine different types of Escape (ESC) sequences which serve as special commands to the TM70. These commands consist of character strings starting with the ASCII control character (ESC) and terminated with a carriage return (CR). Intervening characters form the particular command.

(ESC) A (CR)

The A command polls the TM70 for any new output message which has been entered from the TM70 keyboard. This command may be used only once per message.

(ESC) B (CR)

The B command polls the TM70 for any new or old message in its output buffer. It may be used to cause the TM70 to transmit one entered message any number of times.

(ESC) Dz (MESSAGE) (CR)

The D command used with a message is used to define function messages in the TM70's RAM. The z must be any number character from 1 through 8 for function messages 1 through 8. When the MESSAGE is not included in the escape sequence, the z function message definition is deleted. If z equals 0, all function message definitions are deleted. When function messages are deleted from RAM, they assume the default values &z.

(ESC) En (CR)

This command is used to set the A1 LED on or off. If n = 1, the LED is turned on. It is turned off for n = 0. The back panel A1 TTL output is pulled low when the LED is on.

(ESC) Fn (CR)

This command serves for A2 as the previous E command does for A1.

(ESC) Gn (CR)

When n = 1 the display continuously scrolls through the message buffer. Scrolling is stopped with n = 0.

(ESC) Jn (CR)

When n = 1 the TM70 keyboard is locked out. The keyboard is enabled if n = 0.

INPUT MESSAGE SUMMARY

Host CPU to TM.

(MESSAGE) (CR)	; input message
(ESC) A (CR)	; request buffer
(ESC) B (CR)	; retransmit buffer
(ESC) Dz (MESSAGE) (CR)	; define function message
(ESC) Dz (CR)	; delete function message
ESC) D0 (CR)	; delete all function messages
(ESC) En (CR)	; output to A1 LED
(ESC) Fn (CR)	; output to A2 LED
(ESC) Gn (CR)	; set scroll mode
(ESC) Jn (CR)	; set keyboard lockout

NOTE: Parenthesis are not actually encoded. Shown for copy clarity only. No imbedded blanks allowed. Lower case letters represent variables.

OUTPUT MESSAGE SUMMARY

TM to Host CPU.

(Character)	; response to pressing a key in non-polled mode.
(MESSAGE) (CR)	; response to ENTER key, (ESC) A (CR), or (ESC) B (CR).
(CR)	; response to (ESC) A (CR), when output buffer is empty or has previously been accessed with (ESC) A (CR). (ESC) B (CR) may be used to obtain previously transmitted messages. If the buffer has been cleared or reset, (CR) is transmitted in response to (ESC) B (CR).

NOTES:

1. z = function message number 1 through 8.
2. n = control character, 0 = off, 1 = on.
3. In polled mode all messages, commands, and replies will have a 2-digit address prefix (see Polled Operation section).

INSTALLATION

The TM70 is connected to a flat panel surface using six, 4-40, 7/16-inch machine screws using the mechanical dimensions given in the Specifications section. A connector cutout should be provided as indicated.

BACK PANEL CONNECTIONS

The front panel RESET key is disabled until RESET IN and RESET OUT are connected by a soldered jumper on the back panel mating connector. The communication rate may be set to 1200 bits per second by connecting pin 11 to the ENABLE pin. If pin 11 is left unconnected, the communication rate will be 300bps. Parity and word

format may be selected by connecting pins 9 to 10 to the ENABLE pin as indicated by the zeros in Table I. Logic one is obtained by leaving the pin unconnected. The format is 7 bits plus a mark, space or parity bit. Remember that the communications are asynchronous; therefore, it is always acceptable to have more than the required number of stop and/or marking bits.

Nonpolled operation is obtained by having $\overline{A0}$ through $\overline{A3}$ open. This represents address 0000. Polling address 01 is obtained by connecting $\overline{A0}$ to ENABLE.

Connector wiring for P1 (see Figure 3) may be accomplished with the aid of Tables I, II, III, and IV.

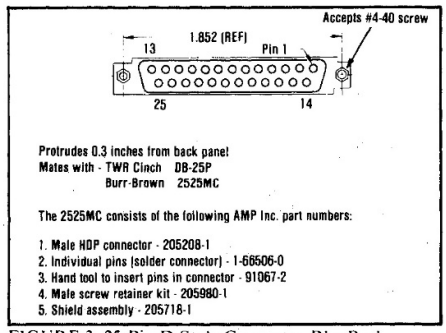


FIGURE 3. 25-Pin D Style Connector P1 - Back Panel View.

TABLE I. Setting the Parity Bit.

P1	P0	Parity Bit
0	0	Even
0	1	Odd
1	0	Space
1	1	Mark

Logic 1 is open.
Logic 0 is jumpered to ENABLE (pin 2).
Stop bits: 1, 1-1/2, or 2 bits on input
2 stop bits on output.
Parity errors displayed as ±.
Mark/space not detected on input.
Logic 1 = Mark

TABLE II. Polling Address Selection.

Polling Address	$\overline{A0}$	$\overline{A1}$	$\overline{A2}$	$\overline{A3}$
0	0	0	0	0 Nonpolled
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Logic 1 is jumpered to ENABLE (pin 12)
Logic 0 is open

TABLE III. Setting the Baud Rate.

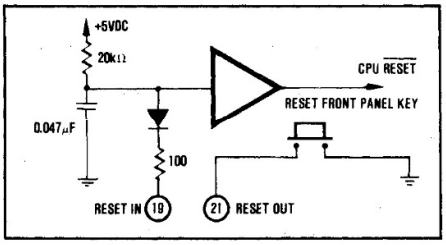
Baud Rate	B0
300	1
1200	0

TABLE IV. Listing of Connector P1 Pins.

See Note	Pin	Function	
4	1	Supply RTN	
	2	TX	RS232C
	3	RX	RS232C
5	4	REQUEST TO SEND	OUTPUT
5	5	CLEAR TO SEND	INPUT
1	6	A1 LED	
4	7	Signal Ground	
1	8	A2 LED	
	9	P0	
	10	P1	
	11	B0	
2	12	ENABLE	
	13	(NO CONNECTION)	
	14	+5VDC	
	15	-IN	20mA Current Loops
	16	+IN	20mA Current Loops
	17	-OUT	20mA Current Loops
	18	+OUT	20mA Current Loops
3	19	RESET IN	
6	20	DATA TERMINAL READY	OUTPUT
3	21	RESET OUT	
7	22	$\overline{A0}$	Polling Address
	23	$\overline{A1}$	Polling Address
	24	$\overline{A2}$	Polling Address
	25	$\overline{A3}$	Polling Address

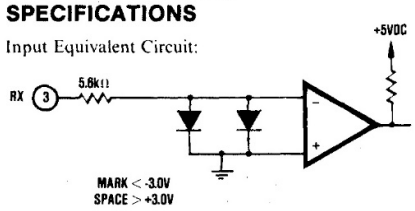
NOTES:
1. A1 and A2 are logic low (< 0.4V at 1.6mA sink) when LED is on.
2. 0 = Jumper to ENABLE (pin 12); 1 = Open, for P0, P1 and B0.
3. To enable RESET, jumper between RESET IN and RESET OUT.
4. Supply RTN and Signal RTN internally connected.
5. Pins 4 and 5 are internally connected.
6. Pin 20 is internally connected to +12V through 1500Ω.
7. Nonpolled mode is address 0000 with pins 22 through 25 open.
1 = Jumper to ENABLE. 0 = Open.

RESET IN AND RESET OUT EQUIVALENT CIRCUIT

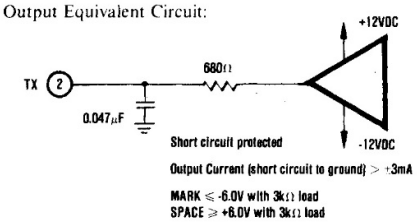


RS232C ELECTRICAL SPECIFICATIONS

Input Equivalent Circuit:



Output Equivalent Circuit:



Maximum recommended transmission distance is 15 meters (50 feet).

CURRENT LOOP COMMUNICATIONS WIRING CONNECTIONS

TM70 units may be connected to one or more hosts by using the two 20mA current loop circuits. Optical coupling devices are used to electrically isolate TM70 from these circuits. Figures 4 and 5 illustrate connections to typical host communications circuits.

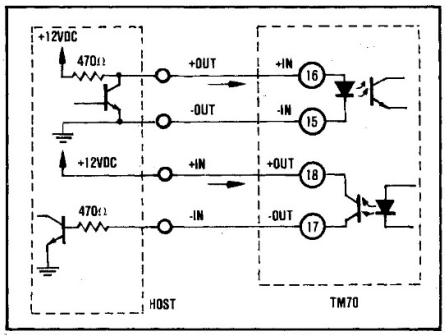


FIGURE 4. Single-drop Connection - Polled or Nonpolled Operation.

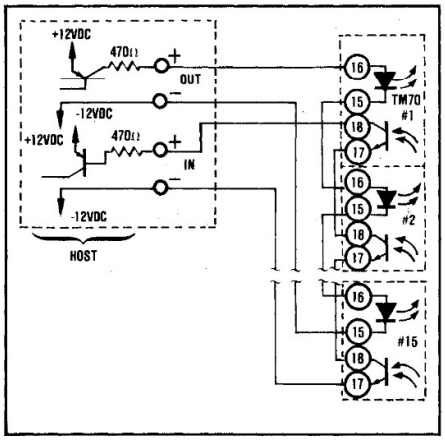


FIGURE 5. Multidrop Connection - Polled Operation.

CURRENT LOOP ELECTRICAL SPECIFICATIONS

Input Voltage Drop	≤ 1.3V at 35mA ≤ 1.2V at 20mA ≤ 1.2V at 10mA
Input Minimum Current	10mA
Input Maximum Current	35mA
Output Voltage Drop	≤ 1.3V at 10mA ≤ 1.3V at 20mA ≤ 1.4V at 35mA
Output Current Minimum	20mA

Output Voltage Drop x Output Current must be ≤ 250mV.

Output Current must be limited by the external circuit.

Maximum applied voltage is 30VDC.

Maximum recommended transmission distance is 1500 meters (5000 feet).

LOOP POWER SOURCE

A distance limitation for current loop that should be considered is the compliance of the loop power source.

The forward voltage drop across the output transistor is 1.3V maximum. The loop power source must be able to drive 1.3V plus the voltage drop produced by the resistance of the wire in the communications line.

The resistance of wire 1mm in diameter (#18AWG) is 4Ω per 100-meter loop (13Ω per 1000-foot loop). The voltage drop caused by the resistance of the wire is 0.08V per 100-meter loop (0.25V per 1000-foot loop). The resistance of wire 0.5mm in diameter (#24AWG) is 16Ω per 100-meter loop (51Ω per 1000-foot loop), so that voltage drop will increase by a factor of four. The sum of output transistor drops and wire resistance drops must be held within the compliance range of the current supplying circuit. As an example, with 10 microterminals and 1000 feet of #18AWG wire, the loop power supply must be: 10 terminals x 1.3V per terminal = 13V plus 0.25V for wiring for a total of 13.25V.

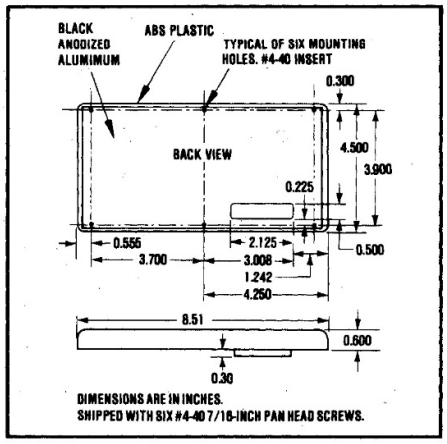
SPECIFICATIONS

DISPLAY	
Number of Characters	12, alphanumeric
Internal Buffer	36 characters
Type of Digit Display	16 segment
Character Height	3.6mm (0.14")
FUNCTION LIGHTS	
Host Controlled Lights	2
Status Lights	3/1
Type of Light	Red, LED
KEYBOARD	
Type of Keyboard	Alphanumeric/Numeric
Number of Function Keys	8
User Programmable	Yes, up to 4 characters each
MATERIALS	
Front Panel	Polycarbonate
Back Panel	Black Anodized Aluminum
Case	ABS Plastic
The front panel will be attacked by these chemicals:	Chlorinated or Fluorinated Hydrocarbons PVC Plasticizing Agents Amines

DO NOT USE FLUOROCARBONS (TMC, FREON, ETC.) TO CLEAN!

TTL OUTPUTS	
TTL Outputs	2 at 1LSTTL Load Open collector
SERIAL INTERFACE	
Conditioning	RS232C/V.24 and 20mA Current Loop
Baud Rate	300, 1200
Parity Bit	Even, Odd, Space, Mark
Number of Terminals per Serial Interface	1 to 15
Communications Delays	None - TM70/76 do not require delays between messages or commands
Maximum Transmission Distance	
RS232C/V.24	15 meters (50 feet)
20mA Current Loop	1500 meters (5000 feet)
RS232C	
Output Voltage	
Logic 1	-10VDC
Logic 0	+10VDC
Input Voltage	
Logic 1	-3VDC to +15VDC
Logic 0	+3VDC to +15VDC
20mA Current Loop	
Input	
Forward Voltage Drop	1.3V max at 30mA/1.2V max at 20mA
Output	
Saturation Voltage	1.3V max at 20mA
Breakdown Voltage	30V max
TEMPERATURE RANGE	
Operating	0°C to +60°C
Storage	0°C to +60°C
POWER SUPPLY	
Voltage	+5VDC ±5%
Current	600mA max
WEIGHT	290 grams (10 oz.)

MECHANICAL DIMENSIONS



OPTIONS

None

ACCESSORIES

25-pin Mating Connector - 2525MC

ORDERING INFORMATION

TM70 is the full part number for the TM70
TM76 is the full part number for the TM76

APPENDIX

AMERICAN NATIONAL STANDARD CODE FOR INFORMATION INTERCHANGE

This coded character set is to be used for the general interchange of information among information processing systems, communications systems, and associated equipment.

B_{its} b7 b6 b5					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4	b3	b2	b1	COLUMN → / ROW ↓	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	iy	y
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11	VT	ESC	+	;	K	[	k	{
1	1	0	0	12	FF	FS	,	<	L	\	l	|
1	1	0	1	13	CR	GS	-	=	M	]	m	}
1	1	1	0	14	SO	RS	.	>	N	^	n	~
1	1	1	1	15	SI	US	/	?	O	—	o	DEL

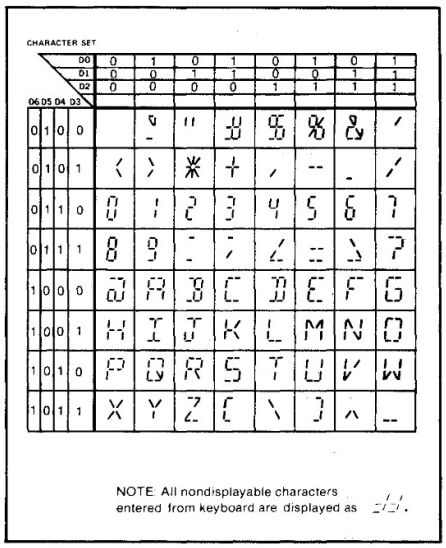
Control CTRL characters, i.e., CTRLX is CAN, etc.

DECIMAL EQUIVALENTS OF ASCII CHARACTERS

Decimal Code	ASCII Graphic	Decimal Code	ASCII Graphic	Decimal Code	ASCII Graphic	Decimal Code	ASCII Graphic	Decimal Code	ASCII Graphic	Decimal Code	ASCII Graphic
000	NUL	022	SYN	044	,	066	B	088	X	110	n
001	SOH	023	ETB	045	-	067	C	089	Y	111	o
002	STX	024	CAN	046	.	068	D	090	Z	112	p
003	ETX	025	EM	047	/	069	E	091	[	113	q
004	EOT	026	SUB	048	0	070	F	092	\	114	r
005	ENQ	027	ES	049	1	071	G	093	]	115	s
006	ACK	028	FS	050	2	072	H	094	^	116	t
007	BEL	029	GS	051	3	073	I	095	—	117	u
008	BS	030	RS	052	4	074	J	096	`	118	v
009	HT	031	US	053	5	075	K	097	a	119	w
010	LF	032	SP	054	6	076	L	098	b	120	x
011	VT	033	!	055	7	077	M	099	c	121	y
012	FF	034	"	056	8	078	N	100	d	122	z
013	CR	035	#	057	9	079	O	101	e	123	{
014	SO	036	$	058	:	080	P	102	f	124	|
015	SI	037	%	059	;	081	Q	103	g	125	}
016	DLE	038	&	060	<	082	R	104	h	126	~
017	DC1	039	'	061	=	083	S	105	i	127	DEL
018	DC2	040	(	062	>	084	T	106	j		
019	DC3	041	)	063	?	085	U	107	k		
020	DC4	042	*	064	@	086	V	108	l		
021	NAK	043	+	065	A	087	W	109	m		

LF = Line Feed, FF = Form Feed, CR = Carriage Return, DEL = Rubout.

DISPLAYABLE CHARACTERS



COMMUNICATIONS CHECKOUT PROGRAMS

The following programs are provided as examples of short programs written in high level languages which might be used to verify that a TM70 is properly connected to a computer communications port. They are not intended as full applications programs, although they might be used as seeds for the development of a particular application. The BASIC programs were tested at 300 baud. Depending upon the speed of the particular BASIC installation, the programs may or may not be able to keep up at 1200 baud. This is due to the fact that the polling program inputs and outputs one character per statement. The nonpolled BASIC program should work at the higher data rate since it receives and then echoes character-by-character as the operator presses each TM70 key. The third program is written in FORTRAN. It reads and writes entire character lines and works at higher data rates. However, it uses calls to two system programs that are available on many Digital Equipment Corporation PDP 11/34 RSX-11M systems. They are GETADR and WTQIO. GETADR finds the addresses of LINE and POL variables. WTQIO sends the polling command and reads the command immediately.

It is not intended that these programs will work in systems other than the ones for which they were written. However, programs of similar brevity should be possible with any computer system. The nonportability of the programs is due to their use of various system features. The BASIC programs use a terminal driver called AT: to initialize the communications port. The FORTRAN program uses calls to system-supplied subroutines GETADR and WTQIO.

CHARACTER ECHO FROM BASIC

```
10  OPEN "O" #1, "AT:" 'SET UP UART; AT: MUST BE LOADED FROM SYSTEM LEVEL
20  REM FILE "TM70S" USED TO VERIFY COMMUNICATIONS CONNECTION TO TM70
30  REM NONPOLLED OPERATION IS ASSUMED
40  REM
50  REM ..... MAIN PROGRAM .....
60  REM
70  REM LOOP UNTIL A CHARACTER COMES IN AND THEN ECHO THE CHARACTER
80  REM SUBTRACT 128 SINCE TM70 SETS BIT 8
90  IF(INP(229) AND 1) <> 1 THEN GOTO 150
100 C = INP(224) -128
110 OUT 224,C
120 REM DELAY TIL CHARACTER IS TRANSMITTED
130 FOR J = 1 TO 20
140 NEXT J
150 GOTO 90
160 STOP
170 END
```

The numbers 224 and 229 are I/O addresses for the communications port.

POLLING TM70 FROM BASIC

```
10  OPEN "O", #1, "AT:" SET UP THE UART; AT: MUST BE LOADED AT SYSTEM LEVEL
20  REM FILE "TM70P" USED TO VERIFY COMMUNICATIONS CONNECTION TO TM70
30  REM POLLED OPERATION ASSUMED
40  DIM C(36)
50  REM
60  REM ..... MAIN PROGRAM .....
70  REM
80  REM POLL FOR INPUT
90  GOSUB 380
100 REM GET INPUT LINE
110 GOSUB 270
120 REM PRINT INPUT LINE, BUT SUPPRESS ADDRESS AND CARRIAGE RETURN
130 FOR J = 3 TO I
140 PRINT CHR$ (C(J));
150 NEXT J
160 REM PRINT CARRIAGE RETURN IF MORE THAN ADDRESS HAS BEEN RECEIVED
170 IF(I>3) THEN PRINT CHR$(13)
180 GOTO 90
190 STOP
200 END
210 REM
220 REM ..... LINE INPUT ROUTINE .....
230 REM
240 REM TEST INPUT STATUS AND LOOP TIL A CHARACTER IS RECEIVED
250 REM SUBTRACT 128 SINCE TM70 SETS BIT 8
260 REM RETURN WHEN CARRIAGE RETURN IS FOUND
270 I = 1
280 IF(INP(229) AND 1) <> 1 THEN GOTO 320
290 C(I) = INP(224) -128
300 IF(C(I) = 13) THEN GOTO 330
310 I = I + 1
320 GOTO 280
330 RETURN
340 REM
350 REM ..... POLLING ROUTINE .....
360 REM
370 REM TRANSMIT THE SEQUENCE 01(ESC)A(CR) TO POLL TM70
380 OUT 224,48 : GOSUB 440
390 OUT 224,49 : GOSUB 440
400 OUT 224,27 : GOSUB 440
410 OUT 224,65 : GOSUB 440
420 OUT 224,13 : GOSUB 440
430 RETURN
440 REM
450 REM ..... DELAY TIL CHARACTER IS TRANSMITTED .....
460 REM
470 FOR K = 1 TO 20
480 NEXT K
490 RETURN
```

Note that the 01(ESC)A(CR) sequence is accomplished by outputting 48, 49, 27, 65, 13 to the I O address 224. These numbers are merely the decimal equivalents of the ASCII binary values of the corresponding characters of the tables on page 7. For example, 0 is given as $0110000 = 2^5 + 2^4 = 32 + 16 = 48$.

The numbers 224 and 229 are I O addresses of the communications port.

POLLING TM70 FROM FORTRAN

This program was run on DEC's FORTRAN IV under RSX11M version 3.2. The program continuously polls a TM70 addressed as unit 1. Any new message from the terminal will be printed on the console until the message STOP is received. This ends the program. The TM70 is connected to the host computer as terminal 17 (TT17:). It uses the system supplied subroutine GETADR to obtain the address of the LINE and POL variables. The system supplied subroutine WTQIO sends the polling message and receives the response immediately.

```
      PROGRAM TMDEMO
      INTEGER PARAMS(6),TEMP(2)
      LOGICAL*1 LINE(80),POL(5)
      DATA PARAMS(2) 80 ,PARAMS(3) 0 ,PARAMS(5) 5 ,PARAMS(6) 0
      DATA POL(1) '0' ,POL(2) '1' ,POL(3) 27 ,POL(4) 'A' ,POL(5) 13
      CALL GET ADR(TEMP,LINE,POL)
      PARAMS(1)=TEMP(1)
      PARAMS(4)=TEMP(2)
C     ASSIGN TERMINAL 17 AS LOGICAL DEVICE 6
      CALL ASSIGN(6,'TT17:')
      WRITE(5,100)
100   FORMAT('POLLING TERMINAL 1')
C     MAIN PROGRAM - POLL TIL "STOP" IS RECEIVED
200   LINE(3)=' '
      CALL WTQIO('4400,6,3,,,PARAMS)
      IF (LINE(3).EQ.' ') GOTO 200
      WRITE(5,260) LINE
260   FORMAT(',80A1)
      IF (LINE(3) .NE.'S') GOTO 200
      IF (LINE(4) .NE.'T') GOTO 200
      IF (LINE(5) .NE.'O') GOTO 200
      IF (LINE(6) .NE.'P') GOTO 200
      STOP
      END
```

MICROTERMINAL OPTION CONNECTION SUMMARY

The RS232C and 20mA current loop pin connections are contained in the rear panel DB-25 connector. All options are selected by interconnecting pins on the same connector. The option selections are summarized below. The DB-25 connector pinout is shown in Table IV on page 6. All other tables referred to below are also on page 6.

Parity

Parity selection (pins 9 and 10) is shown in Table I. With both parity pins open, the microterminal will operate with Mark parity.

Baud Rate

Baud rate selection (pin 11) is shown in Table III. With pin 11 open, the microterminal will operate at 300 baud.

Polling Address

Polling address selection (pins 22, 23, 24, and 25) is shown in Table II. With all polling address pins open, the microterminal will operate in the nonpolled mode.