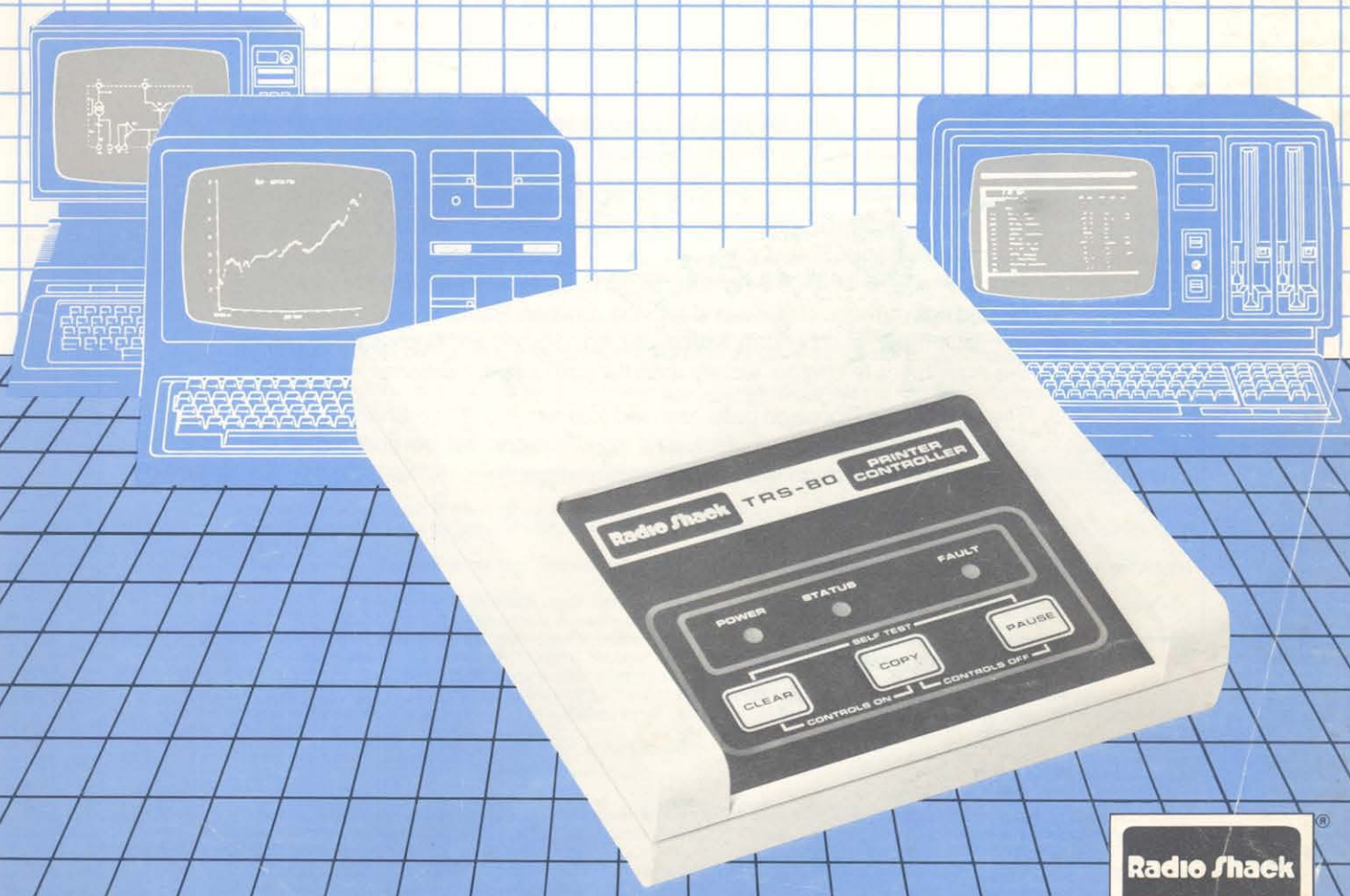
TRS-80®

PTC-64 Printer Controller

OPERATION MANUAL

Catalog Number 26-1269



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TRS-80® PTC-64 Printer Controller

Radio Shack®
A DIVISION OF TANDY CORPORATION
FORT WORTH, TEXAS 76102

10 9 8 7 6 5 4 3

Contents

Introduction

Congratulations for selecting the TRS-80® PTC-64 Printer Controller!

The PTC-64 is a programmable, intelligent print buffer (a device for storing information temporarily) equipped with 64K of RAM and a Z-80 microprocessor.

The PTC-64 increases the efficiency of any system by assuming control of all printing operations and returning control of the computer to you very quickly.

Its unique features include:

- Compact size and ease of operation.
- 62K of RAM for text storage.
- 16 special characters that can be user-defined.
- Functions can be activated from the panel Keys (hardware) or through BASIC commands (software).
- Programmable functions with the option for Downloading Special Drivers.

Ordinarily, when you execute a program that outputs to the printer or perform any printing function, your computer is forced to slow down its rate of operation to compensate for the printer's mechanical limitations. Your system then becomes "tied-up" and cannot be used efficiently until printing is finished.

The PTC-64, on the other hand, accepts information from the computer as fast as it can be sent and stores it. This means, simply, that you can start using the computer for other functions much sooner, whether it is creating or editing a document, or loading and running a program.

Furthermore, you can choose whether to begin printing immediately (even as the Printer Controller is receiving data) or later, at your convenience. It is also possible to print up to 100 consecutive copies of the data in the buffer. The PTC-64 will retain information as long as it is connected to a power source.

1/ Description of the PTC-64 Printer Controller

Open the package and take out the PTC-64. Do not throw away the packing material or the box. They may be useful if you ever need to transport the Printer Controller or send it through the mail.

The PTC-64 package includes:

- A PTC-64 Printer Controller.
- An AC adapter.
- This operation manual.

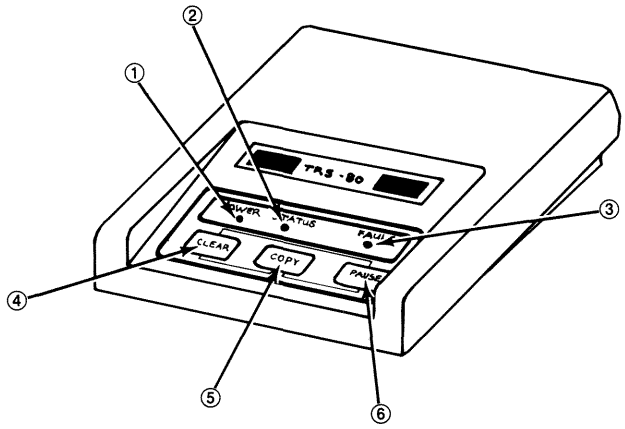


Figure 1. PTC-64 (Front View)

① **POWER Lamp** This lamp will be ON whenever the Printer Controller is powered up.

② **STATUS Lamp** This lamp reflects the various conditions of the buffer:

- When the buffer is *empty,* it is *OFF.*
- When the buffer is *active* (either printing, receiving data, or both), it will be *green.*
- When the amount of memory remaining is *less than 4K,* the Lamp will turn *yellow.*
- When the buffer is completely *full,* the Lamp will turn *red.*

③ **FAULT Lamp** Whenever there is a printer problem (for instance, when the printer is *OFF-LINE* and you're attempting to print) this lamp will turn on and a *beeper* will sound eight times. The Printer Controller will not print or accept data until the fault condition is solved. Then it will continue printing where it left off.

④ **CLEAR Key** This key serves a dual purpose:

- When the Controller is *inactive* (STATUS Lamp is *OFF*), it marks the buffer memory to indicate the starting point for printing and clears any previous buffer contents.
- When the Controller is *active* (STATUS Lamp is lit any color), it simply aborts any printing in progress. The information in the buffer remains intact. To initiate printing again, you must press the COPY key. Printing will then start from the beginning (if CLEAR was pressed to mark the starting point). To erase the information, press CLEAR a second time instead of COPY.

⑤ **COPY Key** If the starting point has been set (see CLEAR key), the PTC-64 will print one copy of the stored information every time you press the COPY key. However, if the text exceeds the buffer size, the COPY key will be ignored.

For printing multiple copies, you may also "stack" up to 100 COPY requests by pressing the COPY key repeatedly. This means that you may wait for 100 copies to print at one time. Pressing the COPY key any more than the allowed 100 times will be ignored until at least one duplicate has been printed. If you press the CLEAR key, printing will cease. You may start over simply by pressing the COPY key again.

Note: If you send text from your computer while extra copies are being printed, that text will also be printed. Therefore, do not send any data to the PTC-64 until all copies have been printed.

⑥ **PAUSE Key** Pressing this key will temporarily interrupt any printing. Pressing this key a second time will resume printing. If you press PAUSE before sending any information to the PTC-64, printing will not start until you press this key again.

There are three other functions that can be activated by using the three keys on the front panel:

- **Controls OFF** When you press the COPY and PAUSE keys together, the PTC-64 Control Sequences — special operations to control printing functions (see section 4) — are automatically disabled.
- **Controls ON** When you press the CLEAR and COPY keys together, the PTC-64 Control Sequences are re-enabled. (The PTC-64 powers up with the Control Sequences enabled.)

  Note: There will be a long beep after Controls ON/OFF to indicate the mode change.
- **SELF-TEST** When you press the CLEAR and PAUSE keys together, the Printer Controller automatically performs a self-test, and, if everything is working properly, prints the message shown in the next section under Self-Test.

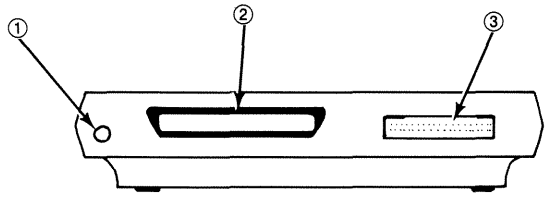


Figure 2. PTC-64 (Rear View)

① **AC Power Jack** Connect the AC adapter plug into this Jack. Use only the adapter supplied with the Printer Controller (11VAC @ 600ma).

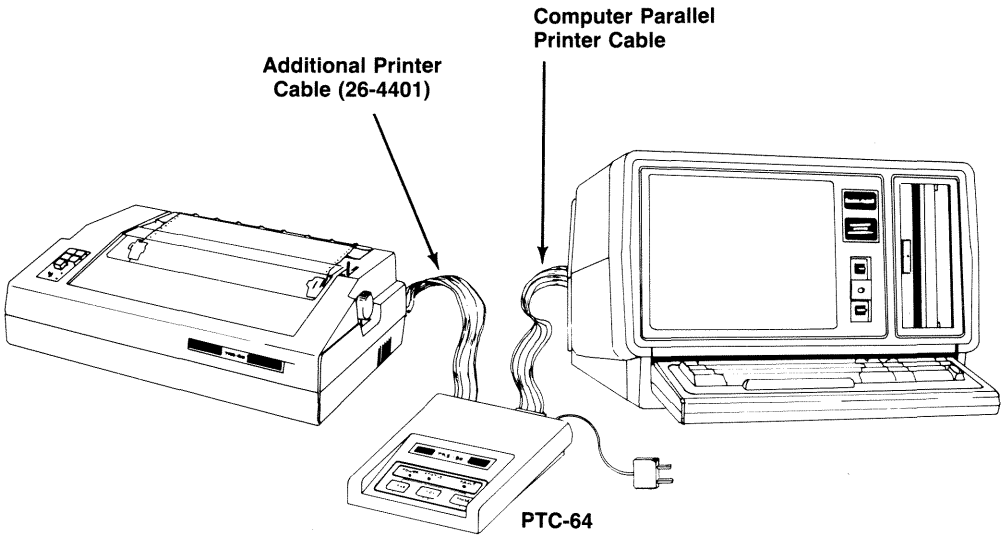
② **Computer Input Connector** Connect your computer's parallel interface cable to this connector.

③ **Printer Output Connector** You will need to connect an additional cable (26-4401) to this connector to link the Printer Controller to your printer.

2/ Setting Up the PTC-64 Printer Controller

Before connecting the PTC-64 to your system, observe the following precautions:

- Do not connect the PTC-64 to the same outlet as noise-generating equipment (air conditioners, copy machines, etc.).
- Select a flat, sturdy work surface where you have easy access to the keys.



Connecting the PTC-64 to Your System

1. Turn all equipment OFF (your computer and any peripherals, including the printer).
2. Connect the computer's parallel printer cable to the PTC-64's Computer Input Connector. Note that the cable can only be inserted in one way. If it seems unusually difficult to insert the cable, turn it over and try again.
3. Connect the additional printer cable (26-4401) to the PTC-64's Printer Output Connector and to the parallel input connector of the printer.
4. Connect the AC adapter plug to the AC Jack on the rear panel of the Printer Controller and then plug it into a wall outlet or into an approved power strip such as ***Radio Shack's Automatic Power Controller*** (26-1429).

   Note: If you use a **SW-302 Parallel Printer Selector** (26-1498), you may connect the PTC-64 in one of two ways:

   (1) Between the Printer and the Selector — In this way, two computers may use the PTC-64 simply by flipping the switch on the selector.
   (2) Between the Selector and the Computer — In this way, the PTC-64 can only be used by the Computer that's directly connected to it.

Power Up Sequence

The Power Up Sequence may vary according to your system. For specific power up instructions consult your computer's owner's manual.

Important Note: Do not turn the printer or computer off while the PTC-64 is connected to them. Otherwise invalid data may be sent to the printer.

Buffer Verification Test

Upon power-up, the Printer Controller automatically performs a *Buffer verification test.* This is indicated by the FAULT Lamp which turns ON for a short period of time. The Lamp will go OFF if the Buffer Verification test passes.

If a Buffer error exists, however, the FAULT Lamp begins flashing and a message such as:

```
Buffer memory error detected...Wrote, Read: AA,AE
```

will be printed. The letters at the end will vary according to the Buffer error encountered. Should this ever occur, disconnect the Printer Controller from your system and take it to a Radio Shack Service Center. The unit will be repaired and returned to you as soon as possible.

After the Fault message has been printed, RAM Verification can be repeated simply by pressing and holding the CLEAR Key until the FAULT Lamp turns ON.

Self-Test

To ensure that the PTC-64 is in perfect working order, we recommend that you perform the Self-Test before printing any text or programs. To execute the Self-Test, just press the CLEAR and PAUSE keys at the same time.

First, the LEDs are tested. The STATUS Lamp will blink *Green,* then *Yellow,* and finally *Red.* Then the FAULT Lamp will blink three times. Finally, the PTC-64 Beeper will sound three times and the following message will be printed:

```
Radio Shack Printer Controller v.r
0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ
```

Verify that the message is printed correctly and that the LEDs blink as described. If not, disconnect the Printer Controller and take it to a Radio Shack Repair Center. (The letters v.r. stand for the version and release of your unit.)

Note: When executing the Self-Test, do not send data from the computer — it will not be printed. Wait until the Self-Test message has been printed.

3/ Using the PTC-64

The specific steps for executing any printing operation will vary according to the computer system and program you are using. However, the general steps for using the Printer Controller are:

1. Press the CLEAR Key to mark the beginning of memory for printing later (if you plan to print more than one copy).
2. If you do not wish to begin printing immediately, press the PAUSE key. Otherwise, skip this step. (If the text is larger than buffer size, the PTC-64 will have to start printing before all of the data can be accepted and you regain control of the computer.)
3. Run the program or send the text from your computer to the printer in the usual way. That is, do the printing operation just as if the PCT-64 was not even connected to your system.
4. If you pressed the PAUSE Key (step 2), press the PAUSE key again to begin printing when you are ready. Otherwise, skip this step.
5. Press the COPY key for additional copies of the information in the buffer.

Hints and Tips...

- The Printer Controller can only hold 62K bytes in storage. If the text to be printed exceeds this space, you must initiate printing immediately. That is, you must skip step 2 (above) all together. Otherwise, this may send a printer fault to the computer, causing it to abort the listing.
- You may print as many duplicates of the data in the Printer Controller as you wish. Just remember that when the power is disconnected, the information in the buffer memory will be lost. Also, if you've pressed COPY several times before any printing (to get consecutive copies) and then press CLEAR, printing will stop entirely. To re-start printing, you must press COPY again the desired number of times.

Once the information has been received by the Printer Controller, you may start using all the functions of your computer.

For example, if you are using a word processing package, you may edit or create a new document, or, if programming, you may load, create, or run another program while the buffer is being printed.

4/ PTC-64 Control Sequences

The PTC-64 offers several ***Control Sequences*** that permit a variety of printing control operations. These Control Sequences can be sent in the BASIC immediate mode or included in any program.

The general format for the Control Codes is:

```
LPRINT CHR$(n1); CHR$(n2);
```

where ***n1*** and ***n2*** are the **ASCII** values for a particular Control Sequence. ***n1*** is **27,** which informs the Printer Controller that a special sequence follows.

Note: If a semicolon is not included at the end of a Control Sequence, the printer will execute a carriage return. Depending on your purpose, this may or may not be desirable.

The Control Sequences can be turned OFF by pressing the COPY and PAUSE keys together (or by using the sequence 27 36 described below). While the PTC-64 Control Sequences are OFF, the buffer will pass all sequences through to the printer. To re-enable them, press the CLEAR and COPY keys together, turn power OFF, or perform the Self-Test. Just remember that all information in the buffer is erased when you turn the power OFF or execute the self-test. Also, if you perform the Self-Test, a message will be printed.

The following is a list of all permissible Control Sequences and a brief description of each. Be aware that these are exclusively PTC-64 Control Codes. Your printer may recognize many others.

BEEPER

Causes the Printer Controller to sound beeper for 1/2 second.

27	42	(Dec.)
1B	2A	(Hex.)

For example, `LPRINT CHR$(27); CHR$(42);` will sound the beeper.

CLEAR

This sequence has the same functions as the CLEAR key (see pg. 3).

27	33	(Dec.)
1B	21	(Hex.)

For example, when active, `LPRINT CHR$(27); CHR$(33);` will stop any printing. When inactive, `LPRINT CHR$(27); CHR$(33);` will clear the buffer and reset the start point for multiple copies.

COPY

Same function as the Copy key (see pg. 4).

27	34	(Dec.)
1B	22	(Hex.)

For example, `LPRINT CHR$(27); CHR$(34);` will produce a copy of any information in the buffer from the starting point where CLEAR was pressed.

DOWNLOAD

Download special drivers.

27	35	(Dec.)
1B	23	(Hex.)

This sequence causes the PTC-64 to wait for a new program to be sent from the computer. The program sent should be in TRSDOS load file format (see **Appendix C/ Downloading Special Drivers** for details).

IGNORE

Same function as pressing the Copy and Pause keys together.

27	36	(Dec.)
1B	24	(Hex.)

This sequence should be used before downloading carriage positioning and other special printer codes. Otherwise, the printer codes might be misinterpreted as PTC-64 Control Sequences. All Keys on the Printer Controller will still be operative. To re-enable Control Sequences, you must press the CLEAR and COPY keys down together, turn the power OFF, or execute the self-test (by pressing the CLEAR and PAUSE keys down together).

For example, after sending `LPRINT CHR$(27); CHR$(36);` all control sequences will simply be ignored by the PTC-64 and passed on to the printer.

Note: If you experience any difficulty while printing (particularly graphics), disable the PTC-64 Control Sequences by sending the IGNORE sequence or pressing the COPY and PAUSE keys together.

PAUSE

Pause output to printer.

27	37	(Dec.)
1B	25	(Hex.)

This sequence is similar to the PAUSE key with the exception that you may only stop printing by using this sequence. To resume printing you must press the PAUSE key on the Printer Controller.

For example, `LPRINT CHR$(27); CHR$(37);` will interrupt any printing in progress or stop the PTC-64 from printing until the PAUSE key is pressed.

REDEFINE

Redefine Special Character.

27	39	(Dec.)
1B	27	(Hex.)

This sequence allows you to redefine special characters in the decimal range of 144 to 159. When redefining a special character, the old character gets erased (see **Appendix A/ Special Characters** for instructions on redefining special characters).

TRANSLATE

Translate Character Mode.

27	38	(Dec.)
1B	26	(Hex.)

With this sequence, the PTC-64 can translate single byte data into special pre-defined characters. There are 16 default characters defined in the Printer Controller (see **Appendix A/ Special Characters** for a complete list). They are accessed by specifying a decimal value in the 144 to 159 range. This feature requires a Radio Shack printer with Bit Image capability.

For example, `LPRINT CHR$(27); CHR$(38); CHR$(144);` will cause the special character identified by 144 to be printed.

Appendix A/ Special Characters

The PTC-64 provides 16 special characters upon power-up. To use them, you must first send the **TRANSLATE** control sequence (27 38). This sequence is used initially to enable the special characters. Any time after this, you can specify any number in the 144 to 159 range for selecting a particular special character.

When using the special characters, it is necessary to use a printer with *Bit Image capabilities*. You can use any of the following TRS-80 printers: LP7, or 8, DMP 100, 110, 120, 200, 400, 420, 500, or 2100, and the CGP-220. (If you do not have a graphics printer, special characters will print as X X X X X.)

The following is a list of the default special characters:

Decimal Value	Hex. Value	Special Character
144	90	
145	91	
146	92	(double width)
147	93	
148	94	
149	95	
150	96	
151	97	
152	98	
153	99	
154	9A	
155	9B	
156	9C	
157	9D	
158	9E	
159	9F	(double width)

For example, `LPRINT CHR$(27); CHR$(38);` enables the 16 special characters. Later on, if you specify `CHR$(144)`, ∝ will be printed. But if you specify `LPRINT CHR$(157)`, ϰ will be printed. You may specify any other number for selecting the desired special character. It is only necessary to send the **TRANSLATE** sequence once. From that point on, any of the special characters may be chosen.

Note: Double width characters occupy the space of two normal special characters.

Redefining Special Characters

The PTC-64 offers the option of redefining special characters to let you create your own symbols.

You may redefine any of the default special characters — those in the 144 to 159 range. When you do so, the old character(s) will be erased. However, if you turn the power OFF, or perform the self-test, the original 16 special characters will be re-established.

The general format for character redefinition from BASIC is:

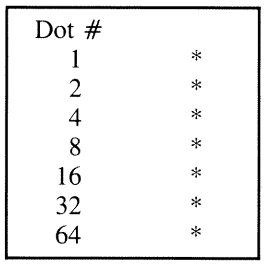
```
LPRINT CHR$(27); CHR$(39); CHR$(n1);
CHR$(n2),,,CHR$(nX);
```

- the first two bytes (27 39) are the **REDEFINE** Control Sequence
- ***n1*** is the character to be redefined (144-159)
- ***n2*** through ***nX*** are the bytes of information for specifying the dots to be printed (more on this later).

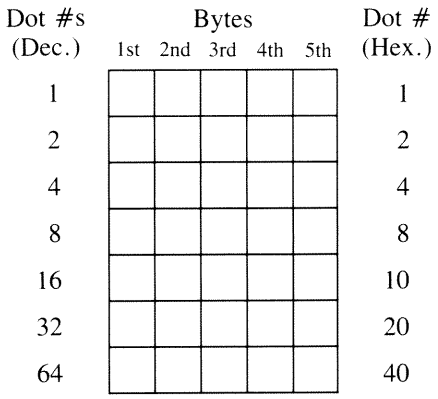
A maximum of 24 bytes of information can be sent. However, if less than 24 bytes are used, `CHR$(127)` must be the last byte sent.

When the **REDEFINE** sequence is sent, the Printer Controller automatically enters the **Graphics Mode.** If you want to use alpha-numeric characters, send `CHR$(30)` as the first character. This turns the Graphics Mode off and you may then use regular characters for redefinition (this will be explained in detail).

Redefining a special character consists primarily of telling the Printer exactly what dots to print. To understand how this is done, you should first be aware that the dot matrix Print Head consists of a vertical arrangement of "dots." Furthermore, each dot has its own "dot number" (see illustration below).



Another important thing you should know, is that most characters are formed in a 5x7 grid. In other words, each character is made up of dots arranged in a space of 5 columns by 7 rows. Every dot in the grid is addressed by a Dot # according to its position within each column. The Dot #s correspond exactly to the Print Head dot arrangement. You may think of the vertical columns as bytes of information making up a character. See the illustration below.



To tell the printer which dots to print, you should add up all the Dot #s in each column of the grid that you wish printed and then add 128 to their sum. The resulting number is then sent to the Printer Controller. This constitutes one byte of information. By successively repeating this process, you can create your own special characters.

The general procedure to redefine special characters is:

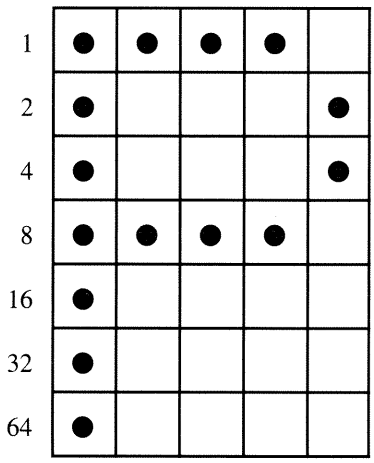
1. Send the **REDEFINE** sequence (27 39).

2. Select the special character to be redefined (in the 144 to 159 range).

3. Tell the printer which dots to print. This step will be explained in detail with a specific example.

Suppose you wish to redefine special character 144 and make it a "P." The procedure below illustrates how this is done:

On a 5x7 grid draw dots in all the desired squares to produce a letter "P" (see illustration below).



You'll notice that in the first column every square has a dot. According to the procedure above, we should add all the Dot #s and then add 128 to their sum:

$1+2+4+8+16+32+64=127$ and $127+128=255$

At this point, the control sequence for redefining character 144 should look like:

```
LPRINT CHR$(27); CHR$(39); CHR$(144); CHR$(255);
```

In the second, third, and fourth columns, only two squares have dots, namely Dot #s 1 and 8. Continuing with the procedure, Dot #s 1 and 8 must be added to each other and then to 128:

$1+8=9$ and $9+128=137$

Now the sequence would look like:

```
LPRINT CHR$(27); CHR$(39); CHR$(144); CHR$(255);
CHR$(137); CHR$(137); CHR$(137);
```

Finally, in the fifth column, Dot #s 2 and 4 are on:

$2+4=6$ and $6+128=134$

The entire sequence to redefine special character 144 is then:

```
LPRINT CHR$(27); CHR$(39); CHR$(144); CHR$(255);
CHR$(137); CHR$(137); CHR$(137); CHR$(134);
CHR$(128); CHR$(127);
```

The last two bytes of information are there for a reason. `CHR$(128)` simply inserts a blank space after the character and `CHR$(127)` is used anytime the number of bytes sent is less than 24.

Having redefined this character, anytime `CHR$(144)` is called out the letter "P" will be printed.

You may redefine characters as often as you like using this procedure. (For additional information, consult your graphic printer's manual.)

Special Note: Characters normally occupy five horizontal dots plus a blank space. If you redefine special characters that deviate from this normal dot arrangement, the printer will be out of alignment when returning to printing normal characters. This would happen, for instance, if you redefine a character to take up to seven dots in width. To compensate for this, you should insert five blank dot spaces before or after the redefined character. In this way, the redefined character would take up twelve dot spaces (double width) and the printer would still be aligned when returning to printing normal characters.

Besides creating your own symbols, you can also redefine any special character to print a sequence of up to 23 characters. This is done in a very similar way to the one just discussed above.

The general format for the redefinition sequence to accomplish this is:

```
LPRINT CHR$(27); CHR$(39); CHR$(n1); CHR$(30);
CHR$(n2),,,CHR$(nX); CHR$(127);
```

- The first two bytes are the REDEFINE code (27 39).
- ***n1*** is the special character to be redefined.
- CHR$(30) takes the printer out from the graphics mode.
- ***n2...nX*** correspond to the ASCII numbers for the desired characters.
- The last byte (127) is used anytime less than 24 bytes are sent.

Suppose you want to redefine the special character 145 (the Delta symbol) to print "TRS-80" every time it is called out. The following sequence accomplishes this:

```
LPRINT CHR$(27); CHR$(39); CHR$(145); CHR$(30);
CHR$(84); CHR$(82); CHR$(83); CHR$(45); CHR$(56);
CHR$(48); CHR$(127);
```

In this sequence:

- CHR$(145) is the character to be redefined.
- CHR$(30) takes the printer out from the graphics mode.
- The next four bytes correspond to the ASCII numbers for the characters "TRS-80". (For a complete listing of the ASCII characters, see your printer's owner's manual.)
- The last byte (127) is used anytime the bytes sent are less than 24.

Also, the next sequence accomplishes the same with considerably less effort:

```
LPRINT CHR$(27); CHR$(39); CHR$(145); CHR$(30);
"TRS-80"; CHR$(127);
```

Having redefined this special character, any time you send LPRINT CHR$(145); the six characters "TRS-80" will be printed. Remember that you must first activate the special characters with the TRANSLATE sequence (27 38).

Appendix B/ Using PTC-64 Functions with Radio Shack Application Programs

Although the PTC-64 is primarily controlled from the front panel keys, it can become an even more useful and powerful device when used in conjunction with Radio Shack application programs that make use of special printing functions. Some of these programs include: Viscalc™, Profile II™, and Scripsit™. In this section, we'll use Model II Scripsit as an example.

Scripsit allows the use of Printer Control Codes to perform special functions such as underlining or printing special characters (the copyright, cents or summation symbols, etc.). This is what makes it possible to use the PTC-64 functions.

All you need to do is define printer control codes using the **"Print Control Code Editing"** procedure described in the ***Model II Scripsit Reference Manual*** (pg. 66). Then, when you wish to use the PTC-64 functions or special characters previously defined, just specify the appropriate Printer Control Code; the desired function will then be executed or the special character will be printed.

Using PTC-64 Special Characters

When defining a Printer Control Code you should use the Hexadecimal equivalent of the PTC-64 Special Character. Also, you should reserve a Printer Control Code solely for activating the PTC-64 special characters, the **TRANSLATE** code (1B 26 in Hex.).

We'll illustrate how this is done with a simple example:

Suppose, while typing a Scripsit file, you want to use the special symbol for ohms. Looking at the list of PTC-64 special characters, you'll find that this symbol is addressed by specifying 9F (in Hex.).

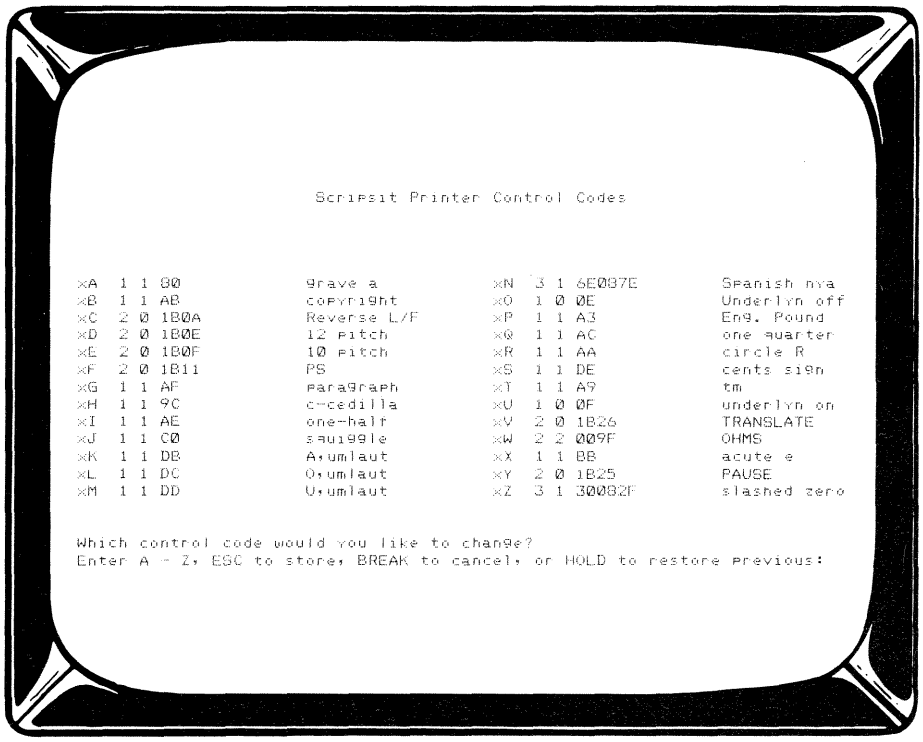
To define Printer Control Codes, you should:

1. Start up Scripsit. When the directory is displayed, type (U) to display the disk utilities menu. Type (P) to choose Print Control Editing.
2. Answer the prompt by typing the letter (from A through Z) you want to define. We'll use the letter V in this example. The cursor will move to the ASCII length column.
3. Press (2). This is the number of two-character ASCII codes for the TRANSLATE sequence (1B26).
4. Press (0), meaning this code will not be printed as a character. Rather, it only activates the PTC-64 special characters.
5. Type the ASCII code for TRANSLATE: 1B26 and press (ENTER).
6. Type a description of the key you have just defined for future reference and press (ENTER) again. For example, you can type "translate."
7. Press (ESC) to write your definition to the disk and return to the disk utilities menu.

Up to this point, you have defined a Print Control Code to activate the use of PTC-64 Special Characters. You should repeat the procedure above to define a Print Code for the special character for ohms, which is specified by 9F. This time, however, both the code length and the justification value will be 2 since this is a double-width symbol. (When

specifying the hex code, use 009F. The first two zeros are ignored by the printer but counted by Scripsit.)

Suppose that you define the letter W to be the ohms symbol. The sample screen below, shows the Printer Control Codes display with the letters V and W defined for the **TRANSLATE** Sequence and the **ohms** symbol respectively.



Having defined the two Print Control Codes, you can go into a Scripsit file and whenever the ohms symbol is desired, simply press (CTRL)(X) and (V), the Print Control Character to enable the special characters (it is only necessary to enable the special characters once). Then press the (CTRL)(X) plus (W), the Print Control Character for the ohms symbol.

For example, in the sentence:

> The greek letter omega, Ω, has come to represent resistance - a basic measurement of opposition to the flow of current in any electronic circuit.

you can send the TRANSLATE sequence anywhere before the ohms symbol is sent. Remember that nothing is printed when the TRANSLATE sequence is sent. Then to send the ohms symbol, just type (CTRL)(X) plus (W).

Using PTC-64 Functions

In the same way that special characters are defined in the Printer Control Codes, you may use the PTC-64's other functions (CLEAR, COPY, PAUSE, and Controls ON/OFF).

We'll use the **PAUSE** function as an example:

When the **PAUSE sequence** is used from a Scripsit file, printing will stop temporarily until the PAUSE key on the PTC-64 front panel is pressed.

This is a useful feature if you need to stop printing temporarily at a certain point in the file for any reason. For instance, suppose that you wish to print some text and then a large table of figures which requires you to change printer paper from 13″ to 15″.

All you have to do is define a Print Control Code for the **PAUSE** sequence (with its **Hex.** value, **1B25**) using exactly the same procedure as described in Using PTC-64 Special Characters. Then simply insert the Print Control Code at the appropriate place in your file. This will cause the printer to stop temporarily (after having printed any text previous to the PAUSE code). You'll hear a beep to announce the printer has stopped. You may then change the paper. Printing will resume only after pressing the PAUSE key on the Printer Controller.

Appendix C/ Downloading Special Drivers

The DOWNLOAD feature lets you take full advantage of your printer's capabilities by making it possible to program functions for specialized applications into the PTC-64. For instance, you can program high resolution graphics support or special fonts.

Any program sent to the Printer Controller, however, must be in ***TRSDOS load file format***. This appendix describes the downloading procedure and the required format and structure of program files.

Downloading Procedure

To download your drivers you must follow this procedure:

1. Send the **DOWNLOAD** Sequence (27 38 Dec.).
2. Send the data in **TRSDOS** load file format (more on this later).

You should be aware that Radio Shack computers do not send all data to the printer directly. Some characters such as TABs and NULLs are intercepted and not sent. Therefore, a special routine must be written to send your data to the printer port.

For Models I, III, and 4, you may send data to the port in BASIC via the OUT or POKE command, depending on which computer you are using. Refer to the table below.

For Models II, 12, and 16, you will have to create an assembly language routine to send the data to the port. For more information on the printer port, you should refer to the Technical Information section of the owner's manual for the computer you intend to use.

Computer	Command	Address
Model I	POKE	14312 (Dec.) 37E8 (Hex.)
Models II, 12, 16	OUT	225 (Dec.) E1 (Hex.)
Models II, 4	OUT	248 (Dec.) F8 (Hex.)

Remember that even though you are only downloading program data, you must still monitor the BUSY signal at the computer. See the table below for Status port address:

Computer	Command	Address	Bit
Model I	PEEK	14312 (Dec.)	7
Models II, 12, 16	IN	224 (Dec.)	7
Models III, 4	IN	248 (Dec.)	7

Important Note: You may abort downloading at any time (between sending the first and last byte of data) by pressing the CLEAR key on the PTC-64 panel. This will print the following message to the printer:

```
CLEAR key pressed, resuming monitor.
```

Program File Format

Programs sent to the PTC-64 are composed of several blocks. There are three major types of blocks:

1. **Program data blocks.** These contain the actual program data, prefixed by four bytes of header information.

2. **Comment blocks.** These contain documentation for the programmer. Comment blocks are not loaded or examined by the loader. Comment blocks are prefixed by two bytes of header information.

3. **Trailer blocks.** Each program file ends with a trailer block. It marks the end of file and tells the Printer Controller to transfer control to a specified address. Trailer blocks are always four bytes long.

The length of the blocks will vary, depending on the type of block and the amount of information in that block. The blocks must be contiguous: there can be no unused bytes after the end of one block and the beginning of the next.

The first byte in a block identifies the block type as follows:

Contents of Byte # Hex	Block Type
01	Program data
05	Comment block
02	Trailer block — jump after loading
all others ignored	

Details of Block Structure

Program data blocks consist of the following:

Byte #	Contents
1	Block Identifier (= 1)
2	Length — number of bytes of program data plus two for load address
3-4	Load address — where the following program data starts loading into RAM, LSB-MSB format.
5-end	Program data

Notes:

1. The block identifier always equals binary "1" for a program data block.

2. The length byte gives the number of bytes in the rest of the block — following the two-byte load address. This sum may range from three (two-byte addresses plus one byte of data) to 258 (two-byte addresses plus 256 bytes of data), but it must be translated into the range 0-255.

To do this, take the number of program bytes and increment by two. Note that values greater than 255 "wrap around" to 0, 1, and 2. Here is a table:

Number of bytes after the address (program data only)	Use this value for the length byte itself
1	3
2	4
3	5
...	...
253	255
254	0
255	1
256	2

3. The load address tells TRSDOS where the data in this block will be loaded into RAM. Bytes will be loaded serially starting at the load address. The load address must allow the entire block of program data to load into the PTC-64.

Comment Blocks

Comment blocks consist of the following:

Byte #	Contents
1	Block Identifier (=5)
2	Length — number of bytes in the comment
3-end	Comment

Notes:

- For comments, the block identifier always equals binary "5."
- The length byte gives the number of bytes in the comment, i.e., the number of bytes after the length byte itself. This sum ranges from 0 to 255:

Length Byte	Length of Comment
0	0
1	1
2	2
...	...
255	255

Trailer Blocks

Each program file ends with a single trailer block which tells the PTC-64 to move the program to its correct location and transfer control to the address that follows.

Trailer blocks consist of the following:

Byte #	Contents
1	Block Identifier (=2)
2	Length (=2)
3-4	Transfer address in LSB-MSB sequence

Notes:

1. For trailer blocks, the identifier must equal binary "2."
2. The transfer address is in LSB-MSB sequence.

Additional Information for Writing Your Own Drivers

If you want to write your own Printer Controller drivers, there are certain things that you must know:

1. The PTC-64 is configured to use Z-80 Mode 1 interrupts. This means that pressing a key on the front panel causes a CALL to address 0038H (if interrupts are enabled). A STROBE* from the computer will generate an NMI causing the Z-80 to perform a CALL to address 0066H. This may not be disabled. If you want to prevent the computer from sending data, turn on the FAULT bit in Port 1 (Write).

2. BUSY and BUSY* will be active for a minimum of 90 uS upon receipt of a STROBE from the computer. This may not be disabled, but may be extended by turning on the appropriate bits in Port 1 (Write).

Printer signals that need to be monitored:
(Port 1 Read)

1. BUSY and BUSY*...If BUSY = 1 and BUSY* = 0 then the printer is ready to accept data (provided there is no printer fault). (See next paragraph.) If BUSY = 0 and BUSY* = 1 then the printer cannot accept data.
2. FAULT* ...This will indicate a printer fault such as Printer Off Line or ribbon end. The printer cannot accept data in this state.
3. EMPTY ... This bit will indicate that the printer is out of paper. In some instances, this condition will also turn on the FAULT bit.
4. ACK* ... This bit indicates that the printer has received and processed the current byte.
5. PAUSE, COPY, and CLEAR ... Indicate which key is being pressed. You should look at these in your interrupt service routine to determine which key was pressed.

For detailed information on programming refer to a Z-80 Assembly language manual.

I/O Port Mapping

Port 0 (Read)

This port is the data port from the computer. This data is only guaranteed valid for 2.5uS. Therefore, it should be read early in the NMI service routine.

Port 0 (Write)

This port is the data port to the printer. It writes the data to the printer and generates a STROBE*.

Port 1 (Read)

Bit 7 — CLEAR key from front panel.	1 = key pressed
Bit 6 — COPY key from front panel.	1 = key pressed
Bit 5 — PAUSE key from front panel.	1 = key pressed
Bit 4 — BUSY* from printer	1 = Printer Busy
Bit 3 — FAULT* from printer	1 = Fault Condition
Bit 2 — BUSY from printer	0 = Printer Busy
Bit 1 — EMPTY from printer	0 = Out of Paper
Bit 0 — ACK* from printer	1 = Byte Accepted

Port 1 (Write)

Bit 7 — Status LED (see Note 1)	
Bit 6 — Status LED (see Note 1)	
Bit 5 — Piezo Buzzer	1 = ON
Bit 4 — Fault LED and to computer	0 = Fault Condition
Bit 3 — BUSY* to computer	0 = Busy
Bit 2 — BUSY to computer	1 = Busy
Bit 1 — ACK* to computer (see Note 2)	0 = Byte Accepted
Bit 0 — EMPTY to computer	1 = Out of Paper

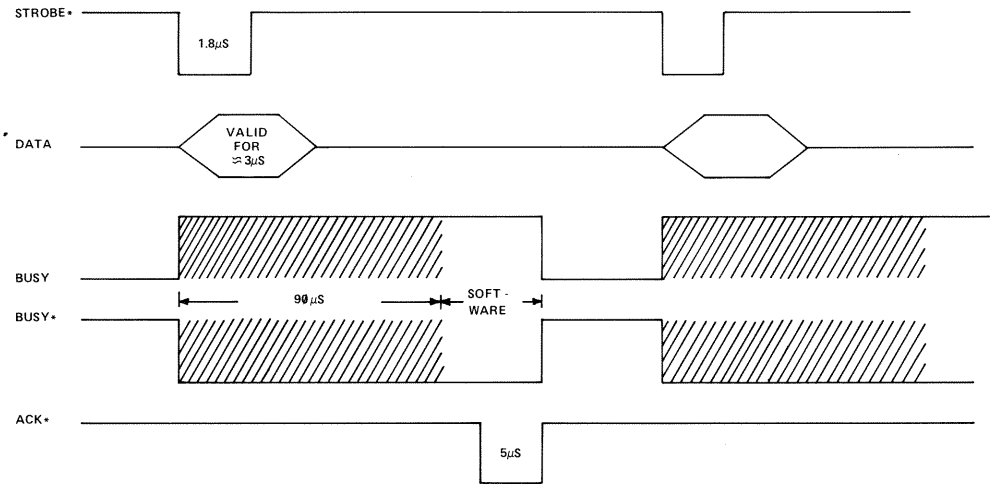
Notes:

Note 1: There are four possible states of the Status LED:

Bit 7	Bit 6	State of LED
0	0	LED OFF
0	1	LED is red
1	0	LED is green
1	1	LED is yellow/orange

Note 2: The ACK* signal to the computer is an active low pulse. This means that when a byte of data has been accepted, the signal should go to 0 for a duration of at least 5uS and then return to 1.

NMI Timing Diagram



Notice, from the timing diagram shown above, that data from the computer is only guaranteed valid for a period of approximately 3uS. Therefore, reading data from the computer Data Port must be done immediately upon entry to the NMI Service Routine.

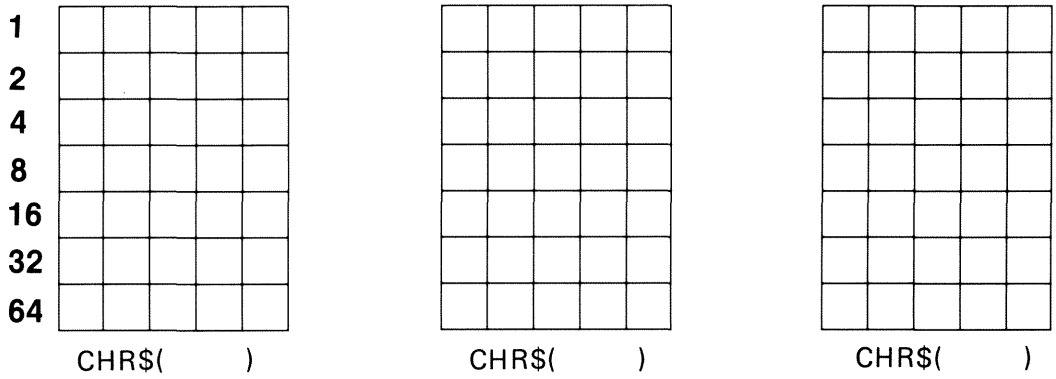
BUSY and BUSY* will be initiated in hardware for a period of 90uS. To guarantee that they stay active for the duration of the Service Routine, they should be turned on in Port 1 (Write) soon after reading the data. The ACK* signal should be turned on for a period of 5uS at the end of the Service Routine and turned off at the same time as BUSY and BUSY*. An example of a basic NMI Service Routine follows:

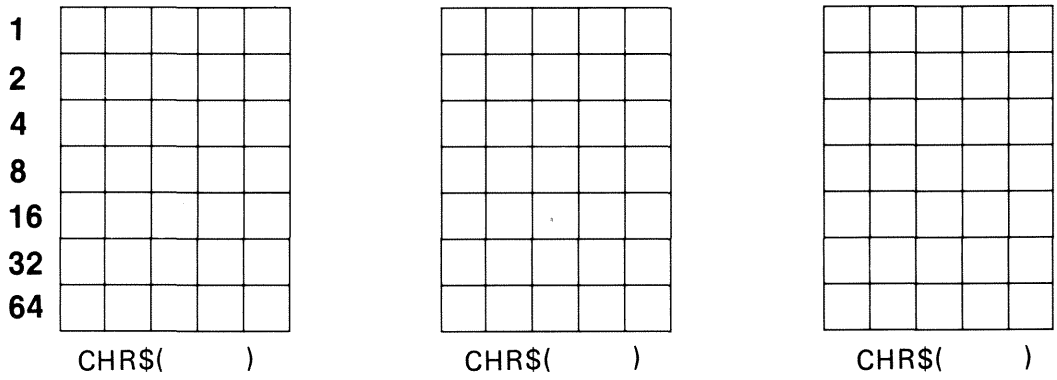
```
;    start of routine
PUSH AF
IN          A,(0)          ; GET DATA FROM PORT
PUSH        BC
PUSH        DE
PUSH        HL             ; SAVE THE OTHER REGISTERS
LD          B,A            ; SAVE THE DATA BYTE TO B
LD          A,14H          ; FAULT OFF, BUSY AND BUSY* ACTIVE
OUT         (1),A          ; SEND IT TO COMPUTER

; process data byte and store to memory

POP         HL
POP         DE
POP         BC
POP         AF             ; RESTORE STACK
RETN                       ; RETURN FROM NMI
```

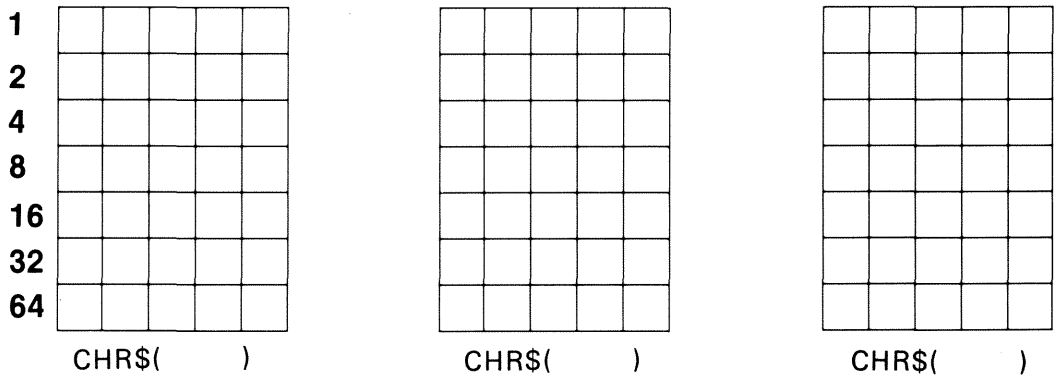
This is a very basic routine and ignores the status LEDs and piezo buzzer. Ideally, the current state of this port should be stored in RAM and the appropriate bits turned on.

Appendix D/ Character Redefinition Worksheet

This section gives you the opportunity to experiment at creating your own special characters. Use the grids below as guides to draw dots in the appropriate places and then refer to Appendix A for translating your work into PTC-64 special symbols.







1															
2															
4															
8															
16															
32															
64															

CHR$( ) CHR$( ) CHR$( )

1															
2															
4															
8															
16															
32															
64															

CHR$( ) CHR$( ) CHR$( )

1															
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16															
32															
64															

CHR$( ) CHR$( ) CHR$( )

1															
2															
4															
8															
16															
32															
64															

CHR$( ) CHR$( ) CHR$( )

Appendix E/ Specifications

Physical

Weight ..... 1.68 lbs. (.763 Kg.)

Measurements ..... Width: 6.5″ (16.51 cm)
Height: 2.38″ (6.05 cm.)
Length: 7.5″ (19.05 cm.)

Environmentals

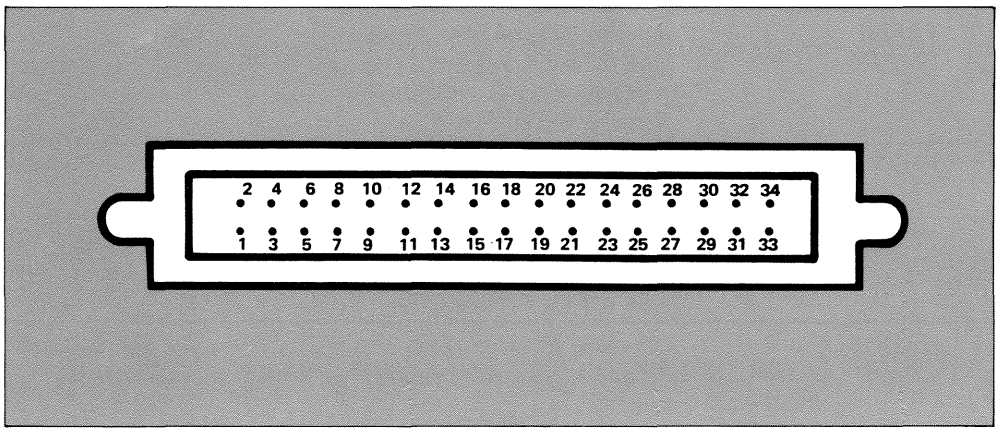
Temperature and Humidity Range .....41° F (5 C) to 104° F (40° C)

Power Requirements..... 11 VAC @ at 600mA, 60Hz

Parallel Interface Signals and Levels

The PTC-64 includes a parallel interface designed for connection to a line printer via the 34-pin connector on the back panel of the unit. Eight data bits are output in parallel and five input bits are status indicators. All levels are TTL compatible.

The connector pin-outs and signals available are listed on the next page.



To Printer

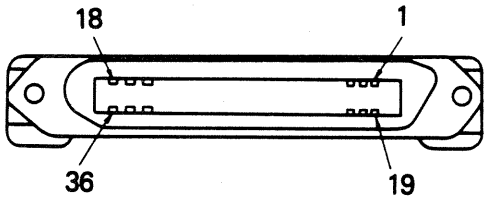
SIGNAL	FUNCTION	PIN#
STROBE*	1.8mS pulse to clock the data from PTC-64 to printer	1
DATA 0	Bit 0 (lsb) of output data byte	3
DATA 1	Bit 1 of output data byte	5
DATA 2	Bit 2 of output data byte	7
DATA 3	Bit 3 of output data byte	9
DATA 4	Bit 4 of output data byte	11
DATA 5	Bit 5 of output data byte	13
DATA 6	Bit 6 of output data byte	15
DATA 7	Bit 7(msb) of output data byte	17
ACK*	Input to PTC-64 from printer low indicates data byte received	19
BUSY	Input to PTC-64 from printer, high indicates busy	21
PAPER EMPTY	Input to PTC-64 from printer, high indicates to paper — if printer doesn't provide this, signal is forced low	23
BUSY*	Input to PTC-64 from printer of BUSY logical inverse	25
FAULT*	Input to PTC-64 from printer, low indicates fault (paper empty, light detect, deselect, etc.)	28
GROUND	Common signal ground	2,4,6,8,10 12,14,16,18, 20,22,24,27, 31,33
NC	Not connected	29,30,32,34

*These signals are active-low.

Parallel Interface

A 36-pin female connector located at the left rear of the Printer Controller provides the means for connecting it to a computer.

The pin arrangement of the connector, signal summary, and the interface timing are shown below.



Parallel Interface Connector Pin Arrangement (To Computer)

SIGNAL IN	RETURN PIN	NAME OF SIGNALS
1	19	STROBE*
2	20	DATA 0
3	21	DATA 1
4	22	DATA 2
5	23	DATA 3
6	24	DATA 4
7	25	DATA 5
8	26	DATA 6
9	27	DATA 7
10	28	ACK*
11	29	BUSY
12	—	PE (Paper out)
13	—	BUSY*
14	—	OV
15	—	NC
16	—	OV
17	—	CHASIS GROUND
18	—	5V (80mA Maximum)
30	—	OV
31	—	NC
32	—	FAULT* (Print Error Condition)
33	—	NC
34	—	NC
35	—	NC
36	—	NC

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