BT

HOLMES ENGINEERING

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SPRINTER II™

Installation and operating instructions

Introduction:

Congratulations! You have purchased the best, easiest to install speed-up product on the market today! Please take your time in reading the following instructions, and when you install your *SPRINTER* in your computer. If you follow the instructions TO THE LETTER, you should have your *SPRINTER* "up and running" in less than an hour. If you decide to skip through the instructions, or rush through the installation, we wish you good luck--you will need it!!!

The photographs which show how to install the *SPRINTER* are grouped together at the end of this manual. Please remove them from the manual and refer to them often.

PART ONE : OPENING YOUR TRS-80

Unplug the power, cassette, video and expansion connectors from your keyboard unit.

The TRS-80 keyboard unit is held together by six screws. Turn the keyboard unit over (so the keys are face down) and remove the six screws with a phillips screwdriver. Note where the longer screws go so you can put them back correctly.

Hold the keyboard case together and turn it right side up. Remove the top of the case and set it aside.

The TRS-80 contains two large circuit boards, the keyboard and the main logic board, connected together by a white 20-conductor ribbon cable. THIS CABLE IS FRAGILE AND SHOULD NOT BE TWISTED OR SUBJECTED TO STRESS! Carefully lift the two boards out of the case bottom and lay them on a soft towel. Set the case aside.

Spread the two circuit boards out on the towel (see photo 1). Several white spacers will fall out from between the two boards; save these for later.

PART TWO : INSTALLING THE SPRINTER

In the next step, you will be handling a static-sensitive component. PLEASE follow the instructions exactly as outlined to avoid static damage to your Z-80 microprocessor!

If you don't have an IC removal tool (who does?), obtain a small screwdriver or similar flat-bladed object. IMPORTANT : TOUCH THE TRS-80 CIRCUIT BOARD WITH ONE HAND WHILE PERFORMING THE NEXT STEP WITH THE OTHER HAND! Insert the screwdriver under one end of Z-40 and pry it up slightly. Now insert the screwdriver under the other end of Z-40 and pry it up. Repeat the process until Z-40 is lifted out of its socket.

If you have purchased a Z-80A or Z-80B microprocessor to use with your *SPRINTER*, place the Z-80 you just removed from the socket in some type of low-static material (aluminum foil works well) and set it aside. Place the Z-80 you are going to use in the empty socket on the *SPRINTER* board. Make sure that pin one and the notch at the end of the Z-80 are at the same end as the paint mark on the *SPRINTER* socket!

Bend capacitor C57 (next to S2, the RESET switch) down flat against the circuit board. Be careful not to twist C57 as you bend it or you will short the leads together. Bend C23, C38, C47 and C56 down against the board.

The *SPRINTER* has 40 small pins attached to it which allow it to be plugged into the socket at Z-40. Set the *SPRINTER* pins on socket Z-40, so the notch in one corner of the *SPRINTER* board clears the reset switch. (If you have an INTERNAL MEMORY shipped before 12/81, you may need to trim or file off the portion which says HOLMES ENGINEERING SLC UTAH USA where it interferes with the *SPRINTER*.) The Z-80 should now be facing the same direction as it was before you removed it from its socket. Now look between the *SPRINTER* and TRS-80 main board (a flashlight may help), and make sure that the *SPRINTER* pins are in their correct places in socket Z-40. Check both ends of Z-40.

When you are satisfied that the pins are properly lined up, place one hand on the back side of the TRS-80 board directly under socket Z-40, and use the other hand to press the *SPRINTER* into the socket; it is a tight fit, so press hard! The black plastic on the pins should be touching the socket when the *SPRINTER* is properly installed.

You are now ready to attach the four *SPRINTER* wires to the TRS-80 circuit board. You may solder these if you do not wish to use the solderless connectors we provide, but please cut the connectors off and strip the wires if you decide to solder them.

A strip of double-sided tape is provided for you to use to anchor the solderless clips to the TRS-80 circuit board after they are connected. Cut the tape into four squares. Stick one of the squares between R48 and Z39 on the TRS-80 circuit board (see photo 3). Stick the second square next to pin 8 of Z54 (see photo 2). Stick the third square between Z41 and the hole next to it (don't cover the hole with the tape!) (see photo 4). Stick the fourth square between Z56 and Z41, on top of resistors R52-R56 (see photo 4).

Now connect the BLUE *SPRINTER* wire to pin 8 of Z54 (see photo 2). Push the clip onto the IC pin, just as you would push a paper clip onto a piece of paper (see fig. 1). Remove the paper from the tape square you placed next to Z54 and stick the BLUE wire down into the tape so it is secure.

Next, connect the RED *SPRINTER* wire to R48, at the end closest to the hole in the circuit board (see photo 3). Press the RED wire into the double-sided tape so it is secure.

Connect the ORANGE *SPRINTER* wire to pin 1 of Z56 on the TRS-80 circuit board (see photo 4). Press the ORANGE wire into the double-sided tape so the connector is secure.

Finally, connect the YELLOW *SPRINTER* wire to pin 1 of Z41 on the TRS-80 circuit board (see photo 4). It doesn't matter if this connector also touches pin 2 of Z41; pins 1 and 2 are connected together. This wire must clear the hole close to Z41; the solderless clip is formed at an angle to allow you to attach it to Z41 and clear the hole in the TRS-80 circuit board. Stick the YELLOW wire to the double-sided tape so it clears the hole in the circuit board.

Now run the YELLOW and ORANGE wires between the two rows of IC's on the TRS-80 circuit board so they will be out of your way when you are ready to close the case.

PART THREE : TESTING THE SPRINTER

Look under your TRS-80 main circuit board and see if any wires which may be present there have been forced onto the sharp pins on the back of the board. Lift the wires away from the board to avoid possible shorted connections.

Connect the power cord to your TRS-80; make sure you plug it into the jack closest to the power switch! Now connect the video cord to the center jack on your computer.

Turn on the power. If you don't IMMEDIATELY get the MEMORY SIZE? (or MEM SIZE?) prompt, TURN YOUR SYSTEM OFF! Double check everything and go to the TROUBLESHOOTING section of this manual. If you do get the correct prompt, you are ready for the big moment!

Press ENTER in response to the MEMORY SIZE? prompt. You should get the usual response from your system. Once you are in LEVEL II BASIC, enter the command OUT 254,8. Your system should respond with READY. Next, enter the command OUT 254,0. If your system is still running OK, go to the OPERATING INSTRUCTIONS section and start trying out all the "speeds" available with the *SPRINTER*. If your system will not run at all speeds listed, go to the TROUBLESHOOTING or HIGH SPEED MODIFICATIONS section of this manual.

Once you have done whatever is necessary to get your system to run at the speed you desire, you are ready to try out the printer portion of your *SPRINTER*. If you are making your own printer cable, refer to the TECHNICAL SPECIFICATIONS section of the manual, and prepare your printer cable. For most of the common printers, such as the MX-80, if you make sure you match pin 1 of the *SPRINTER* connector with pin 1 of your printer connector, the remaining connections should be correct.

Testing printer operation is very simple. Just connect the printer cable to the *SPRINTER* (make sure you get pin 1 of the connector in the right place!), turn on the printer, and LPRINT or LLIST something according to the rules specified in the LEVEL II BASIC manual or your printer manual.

If both the speed-up and printer functions operate correctly, you are ready to put your TRS-80 back together!

PART FOUR : RE-ASSEMBLING YOUR COMPUTER

All TRS-80's are not created equal! There are variations in both electrical and mechanical characteristics from one TRS-80 to the next. Some TRS-80's will easily go back together with the *SPRINTER* installed, while others may require that a small portion of the case be cut away.

Examine the bottom half of your TRS-80 case. You will notice that there is an unused "post" formed in the case bottom which presses on Z48 when the case is closed. This "post" serves no function and can cause the main TRS-80 board to bend. There is no harm in this, but you may wish to trim away this unused "post" so it does not push against the *SPRINTER*.

If you have a *SPRINTER* with a printer port, you may wish to cut the thin strip of plastic on the top half of the case, running across the expansion opening. Or, you may wish to just file this down a little so the *SPRINTER* board will be "clamped" between this strip of plastic and the case bottom. These modifications may once again prevent the main TRS-80 board from being bent when the case is closed.

Once you have decided what to do about the above mentioned case modifications, disconnect all cables from your computer. Fold the two boards back together just as they were when you removed them from the case, and place them in the case bottom. REMEMBER NOT TO STRAIN THE WHITE RIBBON CONNECTOR! Make sure the *SPRINTER* wires are out of the way so they don't get pinched or broken.

Carefully lift the keyboard up and work the main board down over the posts in the case bottom. It is usually easier to put the board over the taller posts first, then over the smaller posts.

Place the white spacers over the posts so they are between the main board and the keyboard. If you can't remember exactly where they went, place them in positions which best support the keyboard.

Place the keyboard on the posts. Place the case top over the keyboard, being careful to get the power-on LED properly inserted in the hole in the case top. Turn the keyboard unit over and install the six screws which hold the case together. If you have forgotten where they go, place the shortest screws closest to the front of the keyboard, the longest screws in the back, and the remaining screws in the middle holes.

You're finished! You should now connect your entire system, including an expansion interface and peripherals you may

use. Run any tests you may have to determine if there are any problems, or you may run this simple test as a general system checkout:

```
10 PRINT MEM;:IF MEM <100 THEN RUN ELSE GOSUB 10
```

This one-line test continually calls itself as a subroutine with no return, decreasing memory size by 5 bytes every time the line executes. When memory size is less than 100 bytes, line 10 starts over again to avoid an OM ERROR. If your TRS-80 is functioning properly, the memory size will continuously print on the screen. If you have any problems, your system will usually "freeze up" or print unusual numbers or characters on the screen. Run the test at all speeds.

Well, you did it! It wasn't so bad, was it?

* * HIGH-SPEED MODIFICATIONS * *

There are literally hundreds of different TRS-80's! We have tested the *SPRINTER* on many known marginal systems, and in all cases we were able to make the systmes run at 5.3 MHz with wait states. We did this by using a Z-80B processor, and by performing the following simple modifications:

(1) Locate Z-69 on the TRS-80 main board. This is a 74LS74 I.C. Referring to photo A, locate the trace which connects to pin 5 of Z-69 and "loops" out under a resistor.

(2) Using a sharp knife, cut the trace connecting to pin 5 of Z-69. There is a similar trace next to the one connecting to pin 5; make sure you don't cut it instead!

(3) Because the 74LS74 has internal pull-up resistors, it is not necessary to connect the 74LS74 input to anything; it can be left unconnected. This is in contrast to normal practice for TTL gates, which do not have internal pull-up resistors. However, if you are good at soldering, you may wish to add a wire from pin 13 to pin 12 of Z-69, so you won't lay awake at night worrying about a "floating" node.

(4) If you have a "G" version board (identified by the number 17000696 etched on the back of the board), and you have the 2-chip ROM set, you will probably need to add 1K 1/4 watt resistors at R-61 and R-68. You can either "tack" the 1K resistors to R-61 and R-68, or replace R-61 and R-68 with 1K resistors. Without these resistors, your ROM's will "turn off" too slow to run at high speed. (If you can't solder the resistors in, contact us and we will furnish you with "solderless" resistors using the same solderless clips we use on the wires.)

(5) NOTE: IT IS NOT NECESSARY TO COMPLETE THIS STEP UNLESS YOU ARE HAVING PROBLEMS RUNNING AT HIGH SPEED. The TRS-80 RAM and ROM chips have their outputs tied together. In some cases, the ROM's can "load" the RAM outputs and cause poor performance, especially at high speeds. System performmance can be enhanced by soldering a 1K 1/4 watt resistor from pin 14 to pin 9 of each RAM chip (Z-13 through Z-20) on the back side of the p.c. board. You will need GOOD soldering skills to do this; make sure you remove te RAM chips from their sockets before doing any soldering. In addition, it may help to add a 1K resistor from pins 3,4,5,6,7,10,11,12,and 13 of any RAM chip to +5 volts (pin 9); for example, one resistor from Z-13 pin 3 to pin 9, the next from Z-14 pin 4 to pin 9, and so on. This reduces the negative "undershoot" at the RAM address inputs (caused by the use of 74LS157 multiplexer chips in the TRS-80.) NONE OF THESE MODIFICATIONS WILL AFFECT THE NORMAL OPERATION OF YOUR TRS-80.

* * OPERATING INSTRUCTIONS * *

Operating Characteristics

The *SPRINTER* allows you to select one of sixteen speed options via a software command. Like most speed-up "mods", the *SPRINTER* is controlled by sending a number to output port 254. For example, the command OUT 254,5 issued from BASIC will cause the *SPRINTER* to double the clock speed of the TRS-80. The speed options are listed in Table 1.

The *SPRINTER* will add one "wait state" to every memory cycle if the "wait" function is activated. This will allow virtually all TRS-80's to run at 5.3 MHz if a Z-80B microprocessor is installed and proper modifications are made to the TRS-80 memory circuits. The net system "speed" at 5.3 MHz with wait states is approximately 2.7 times "normal speed". This 10% "loss" in system throughput is due to the extra clock cycle which the wait state adds to every memory access. Without the wait states you would not be able to run at 5.3 MHz at all unless you added an expensive TTL delay line, and even then you may have problems. The wait state function is controlled by data bit D3 when the command is sent to output port 254. If D3 is "1", the wait state circuit is activated and a wait state is added to EVERY memory access regardless of the clock speed. If D3 is "0", the wait state circuit is turned off. Even the most marginal TRS-80 should be able to run at 3.55 MHz with wait states added.

What does a "wait state" do? Simply put, it adds a little time to the memory access cycle. This allows more time for memory to respond to a read or write command without requiring the CPU to run at a slower speed. It is the equivalent of having a fast clock for the CPU and a "slower" clock for the rest of the computer!

The *SPRINTER I* also provides a standard Centronics compatible parallel printer port (not present on the *SPRINTER IL*). It is exactly like the parallel printer port available on the expansion interface, and is directly usable with the popular printers on the market today such as the MX-80™ and others. We use a special connector on the *SPRINTER* instead of a standard edge connector, so it won't interfere with use of the TRS-80 expansion connector. Astute observers will notice that the *SPRINTER* uses the same printer connector as the TRS-80 Model II uses! The Model II cable will work with the *SPRINTER*, though at $39.95 it is a

bit expensive. If you wish to use a standard printer cable, you can attach the *SPRINTER* connector a few inches above the existing edge card connector. Make certain you get pin 1 of the connector on line 1 of the cable. Some cables are put together without regard for the numbers marked on the connectors (?), so be careful. NOTE: The *SPRINTER* does not switch to normal speed for printer operation.

When the TRS-80 is turned on, and whenever the Z-80 is given a RESET command (this is system reset, NOT the NMI signal generated by the reset switch at the back of the keyboard unit), the *SPRINTER* is also reset to "normal" (1.77 MHz) clock speed. The RESET switch by the expansion connector will NOT switch the *SPRINTER* to normal speed when pressed. Whenever the cassette relay driver is activated, the *SPRINTER* is forced to run at normal speed only during the time the cassette is on. This allows normal cassette load and save operations without the need to switch to normal speed first. This feature is especially useful when using machine language editor/assemblers which will not allow you to issue a software command to switch the *SPRINTER* to normal speed. Whenever the disk controller is addressed, the *SPRINTER* switches to normal speed to allow normal TRS-80 disk access (this feature is defeatable for use with 8" double density systems).

Command Table

Shown below is a table of the software commands which tell the *SPRINTER* which clock speed to send to the TRS-80. These commands are issued from BASIC, though machine language commands which send the correct data to PORT 254 work just as well. All frequencies are approximate; the exact frequency in each case is an integer sub-multiple of the 10.6445 MHz TRS-80 system clock, obtained by multiplying 10.6445 MHz by the CLOCK DIVISION RATIO listed in the table. The column marked % SPEED CHANGE gives the amount of increase (+) or decrease (-) in clock frequency compared to the 1.77 MHz "normal" clock speed of the TRS-80. The column marked WAIT STATE indicates whether or not that command will add a wait state to every memory access.

COMMAND	CLOCK DIVISION RATIO	CLOCK FREQUENCY	WAIT STATE?	% SPEED CHANGE
OUT 254,0	1/6	1.77 MHz	NO	0%
OUT 254,1	1/7	1.52 MHz	NO	-14%
OUT 254,2	1/8	1.33 MHz	NO	-25%
OUT 254,3	1/9	1.19 MHz	NO	-33%
OUT 254,4*	1/2	5.32 MHz	NO	+200%
OUT 254,5	1/3	3.55 MHz	NO	+100%
OUT 254,6	1/4	2.66 MHz	NO	+50%
OUT 254,7	1/5	2.13 MHz	NO	+23%
OUT 254,8	1/6	1.77 MHz	YES	0%
OUT 254,9	1/7	1.52 MHz	YES	-14%
OUT 254,10	1/8	1.33 MHz	YES	-25%
OUT 254,11	1/9	1.19 MHz	YES	-33%
OUT 254,12	1/2	5.32 MHz	YES	+200%
OUT 254,13	1/3	3.55 MHz	YES	+100%
OUT 254,14	1/4	2.66 MHz	YES	+50%
OUT 254,15	1/5	2.13 MHz	YES	+23%

* The OUT 254,4 command will usually cause an unmodified TRS-80 to "crash" because the RAM and ROM in the system cannot respond to the CPU running at 5.3 MHz. It is provided for those who wish to extensively modify their TRS-80.

* * * TROUBLESHOOTING * * *

This section describes common problems and solutions. If your system has a problem which can't be solved using the information in this section, contact your dealer or HOLMES ENGINEERING for assistance.

Each symptom is identified by the symbol:***. Possible causes and solutions follow the symptom statement.

*** SCREEN IS BLANK; LED ON KEYBOARD NOT LIT. You may have the Z-80 installed backwards in the socket. If you removed the RAM chips from their sockets, you may have installed one backwards. A power supply is shorted or overloaded.

*** SCREEN FILLS WITH "GARBAGE" AND WON'T RESET. You may not be getting a clock signal to the CPU. Check the ORANGE wire to make sure it is properly connected to Z-56 pin 1. Make sure the pins on the *SPRINTER* are properly inserted in the socket at Z- ___ ?

*** MEMORY SIZE (or MEM SIZE) FLASHES ON THE SCREEN, OR DISPLAY SCROLLS ERROR MESSAGES, OR RANDOM CHARACTERS APPEAR AFTER MEMORY SIZE. SOME KEYS MAY NOT FUNCTION. One or more connections broken in the flat white cable connecting the keyboard to the main board. Find the broken connections with an ohm-meter and bridge them with stranded wires, or send your keyboard to HOLMES ENGINEERING for repair.

TECHNICAL INFORMATION

Printer connection

The *SPRINTER I* provides a Centronics compatible parallel printer port at address 37E8H, which operates exactly like the port on an expansion interface. The connector pins on the *SPRINTER* board are numbered from 1 to 34, corresponding to conductors 1 to 34 of the printer cable, and wired exactly like pins 1 to 34 of the expansion interface. SOME PRINTER CONNECTORS ARE NOT NUMBERED THIS WAY! If you are using a standard "DB" type printer connector (such as the MX-80 uses), the numbers molded on the DB connector MAY NOT match the numbers on the SPRINTER pins, though the connections will be correct if you match pin 1 on the connectors with line 1 on the cable, and crimp the connectors on. If you are using a "special" printer connector, here is the *SPRINTER I* pinout:

pin 1 = DATA STROBE	pin 13 = DATA 6	pin 25 = UNIT SELECT
pin 2 = GND	pin 14 = GND	pin 26 = N/C
pin 3 = DATA 1	pin 15 = DATA 7	pin 27 = GND
pin 4 = GND	pin 16 = GND	pin 28 = FAULT
pin 5 = DATA 2	pin 17 = DATA 8	pin 29 = N/C
pin 6 = GND	pin 18 = GND	pin 30 = N/C
pin 7 = DATA 3	pin 19 = N/C	pin 31 = GND
pin 8 = GND	pin 20 = GND	pin 32 = N/C
pin 9 = DATA 4	pin 21 = BUSY	pin 33 = GND
pin 10 = GND	pin 22 = GND	pin 34 = GND
pin 11 = DATA 5	pin 23 = OUT OF PAPER	
pin 12 = GND	pin 24 = GND	

Modifications

These modifications are suggested only for those who are skilled at soldering and working with hardware. Performing any these modifications will NOT void your warranty, but it WILL void your 30-day return privelage.

DISABLING AUTOMATIC SWITCHING TO NORMAL SPEED DURING CASSETTE OPERATIONS. The yellow wire (connecting to Z-41 pin 1) controls this function. When a cassette save or load occurs, Z-41 pin 1 goes high, causing the *SPRINTER* to switch to "normal" 1.77 MHz clock speed. If this wire is grounded, the *SPRINTER* will remain in high speed mode during cassette save and load.

DISABLING AUTOMATIC SWITCHING TO NORMAL SPEED DURING DISK OPERATIONS. The *SPRINTER* switches to "normal" 1.77 MHz clock speed whenever the TRS-80 addresses the disk controller at 37ECH. For double-density operation of 8" disks, or for experimental operation of other configurations, it is desireable to have the *SPRINTER* remain in high-speed mode during disk operations. This requires a hardware modification to the *SPRINTER*:

(1) On the top side of the *SPRINTER* board, cut the trace at pin 9 of U-10.

(2) Connect a 4.7K 1/4 watt resistor from pin 9 to pin 16 of U-10.

(3) If you wish to make this modification "switchable", connect a SPST switch from pin 9 of U-10 to pin 9 of U-4 (leave the 4.7k resistor in place). Closing the switch will restore the auto-slowdown feature; opening the switch will defeat it.

***** SYSTEM "FREEZES", "DIES", OR DISPLAYS RANDOM CHARACTERS WHEN SWITCHED TO HIGH-SPEED MODE. At least one component in your system cannot run at high speed. You must have GOOD, 200 nanosecond RAM chips in your system to run at high speed. Radio Shack used a lot of 400 nsec. RAM, especially in the older systems; Motorola chips are especially reluctant to run at high speed. Once you have made sure you have good RAM chips, try the high-speed modifications listed later in this manual. If that doesn't help, try the following procedure:

(1) Turn your computer off, wait ten seconds, then turn it on. Type 'OUT 254,3' ,ENTER. If the problem persists, you have an installation error or a defective *SPRINTER*.

(2) Next, type 'OUT 254,15' ,ENTER. If the problem still exists, you have a very marginal Z-80 which will have to be replaced with a Z-80A or Z-80B.

(3) Enter the 'OUT 254,X' command, with 'X' being the numbers 15,7,14,6,13,5,12 IN ORDER. If your system runs fine at one speed, then dies at the next speed, you have reached the limit of your system at the previous working speed. You may need to install a Z-80B, or, if you are using a Z-80B, you may need to perform the high-speed modification or "fine-tune" your system. See the HIGH SPEED MODIFICATION section.

(4) If you are using an expansion interface or other device connected to the expansion connector, remove it and run the keyboard unit alone. If the keyboard runs OK by itself, you will have ot contact us for assistance in determining what you can do to your system can drive external devices

***** SCREEN FILLS WITH "AS" PATTERN WHEN OUT 254,4 COMMAND IS EXECUTED. This is normal for a standard TRS-80. It just can't run at 5.3 MHz without WAIT states; the RAM circuits can't respond fast enough.

***** WILL NOT SWITCH SPEEDS. Check the BLUE and YELLOW wires. If either of these wires is not properly connected, the *SPRINTER* will be locked in the normal speed mode.

***** ERRORS DURING DISK OPERATIONS. Check the RED wire, which is part of the decoding signal for the disk address.

***** PRINTER DOESN'T WORK. Check the printer cable wiring; make sure it is plugged onto the *SPRINTER* correctly. Make sure the RED wire is properly connected to R-48.

***** EXPANSION INTERFACE AND/OR RAM IN INTERFACE WON'T RUN AT HIGH SPEED; RAM IN INTERFACE "DISAPPEARS" AT HIGH SPEED and /or DISK ERRORS WHILE RUNNING AT HIGH SPEED. You may have an interface with a built-in delay line for the memory circuits, or your interface may not be capable of high-speed operation, especially if you have an RS-232 board in it. Contact HOLMES ENGINEERING, giving us the serial number of your interface, and we will recommend solutions; or send your interface plus $25.00 to HOLMES ENGINEERING for modification (include all cables and power supply).

***** WON'T RUN AT HIGH SPEED WITH ANYTHING CONNECTED TO EXPANSION CONNECTOR. The buffers in your TRS-80 are "weak", or they are poorly decouupled (especially on D level boards). You can replace all address and data buffers with 74367's (NOT 74LS367!), and you may need to add resistors and capacitors at various places to clean up your TRS-80.

***** RUNS OK AT HIGH SPEED WHEN COOL, BUT FAILS WHEN HOT. If you are using the Z-80 which came with your system, you should replace it with a faster Z-80; it is slowing down when it gets warm. If you are using a fast Z-80, you have another heat-sensitive component in your system, probably a RAM chip.

* * WARRANTY * *

HOLMES ENGINEERING guarantees the SPRINTER to be free from defects in material and workmanship for a period of one year from date of purchase under normal use and operation. This warranty does not include the cost of any inconvenience, liability loss or damage to the customer or any other party caused or alleged to be caused by installation or failure of the SPRINTER, nor does it cover damage caused by misuse, abuse or alteration. Returned SPRINTER boards must be returned pre-paid to HOLMES ENGINEERING, to be repaired or replaced at HOLMES option at no charge within the warranty period. There are no other warranties granted, expressed or implied.

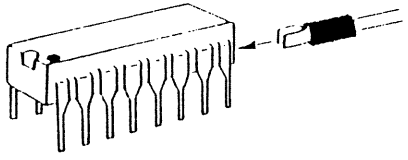


FIGURE 1
"SOLDERLESS" CLIP

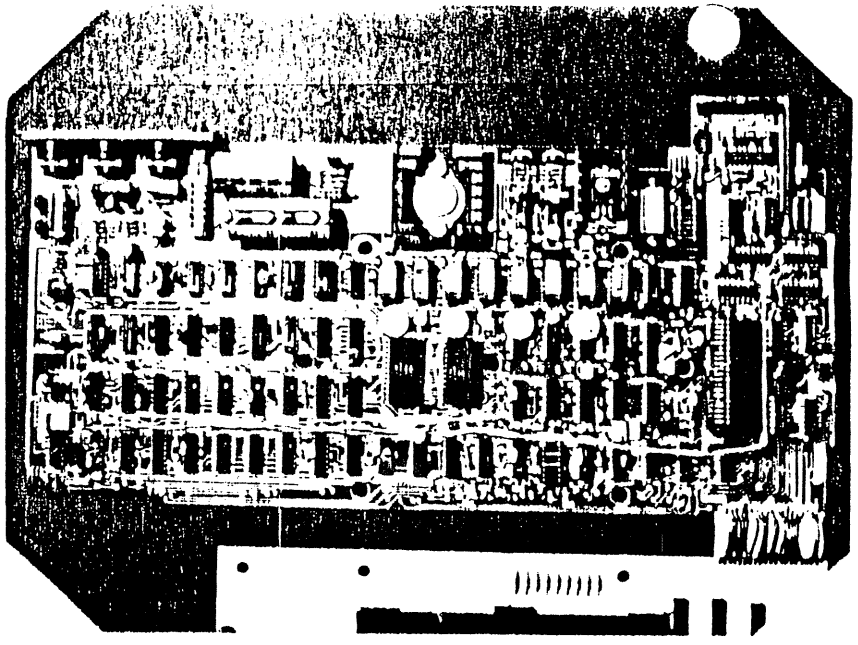


PHOTO 1
MAIN BOARD WITH
SPRINTER INSTALLED

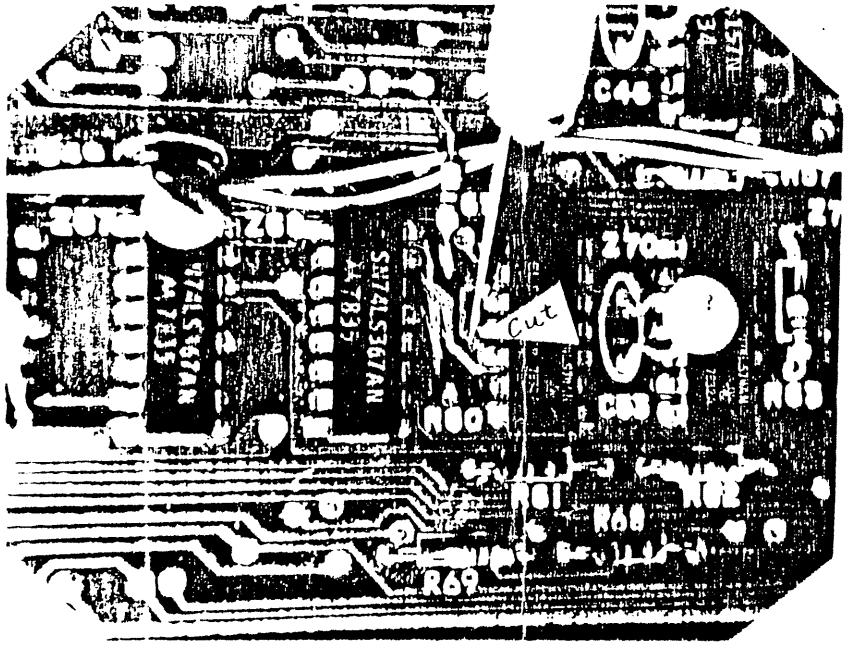


PHOTO A
CUTTING THE TRACE AT Z-69 PIN 5
(R60 has been moved for clarity)

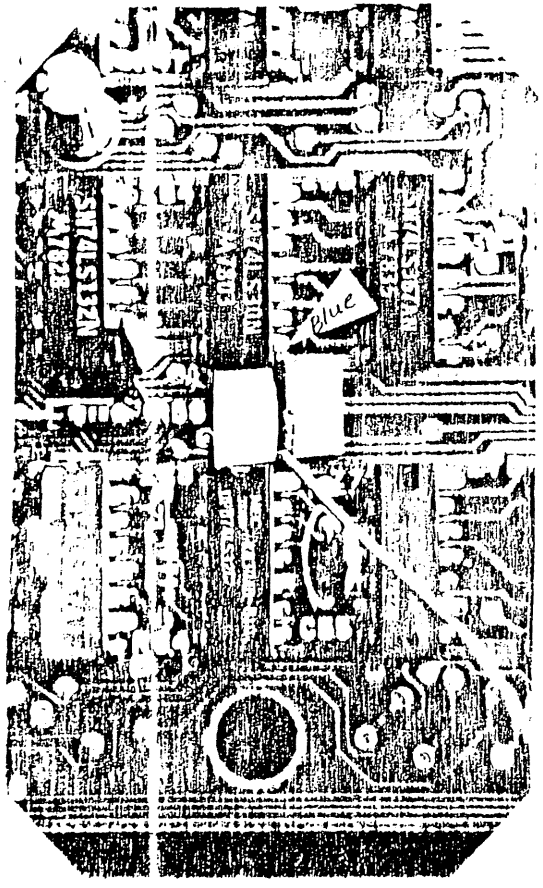


PHOTO 2
ATTACHING THE BLUE
WIRE TO Z-54 PIN 8

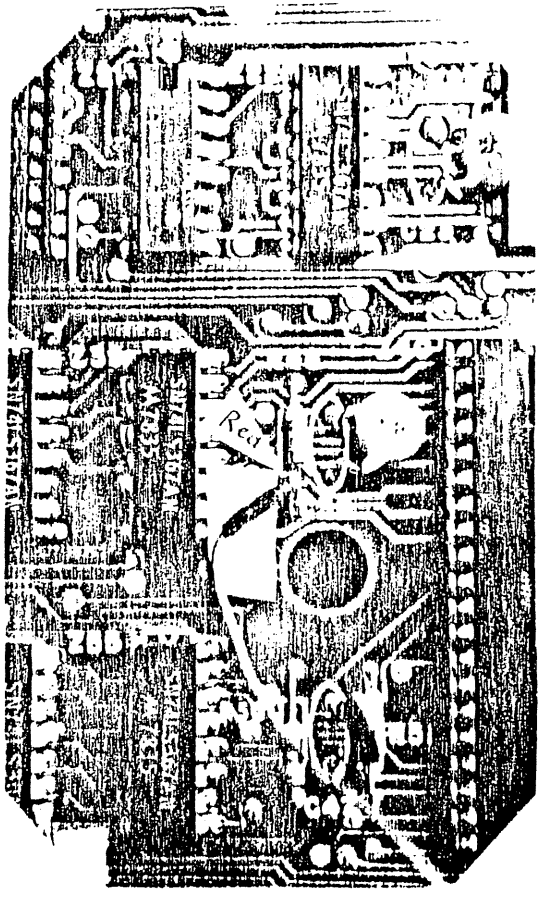


PHOTO 3
ATTACHING THE RED
WIRE TO R-48

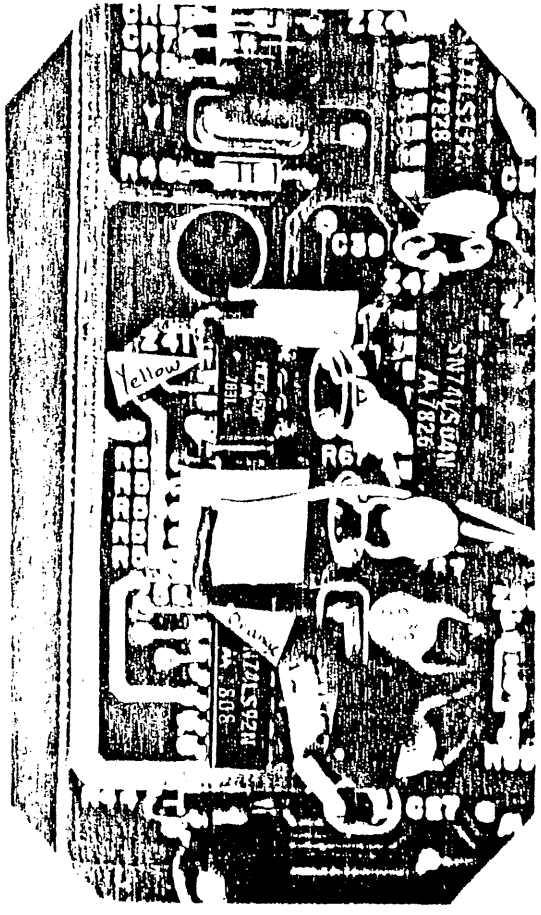
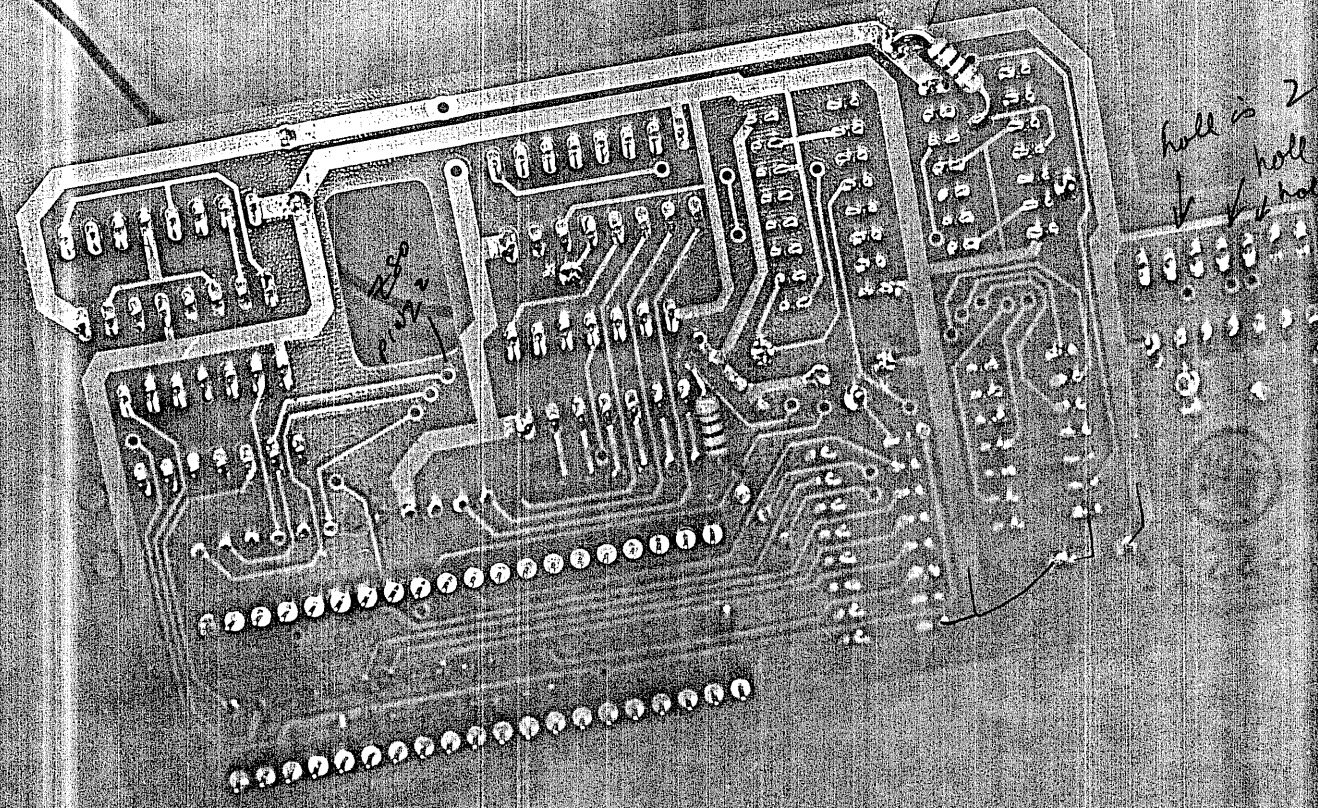
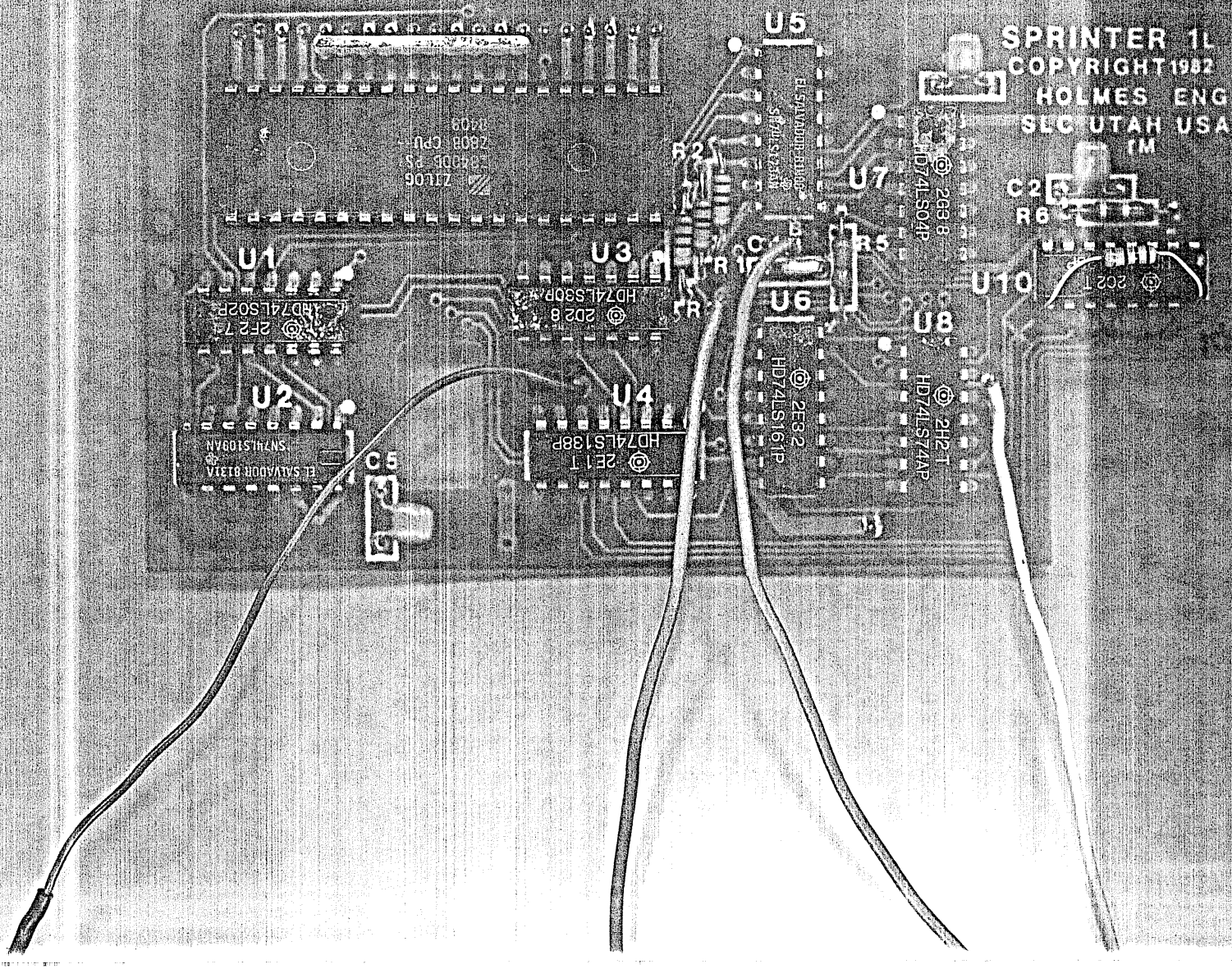


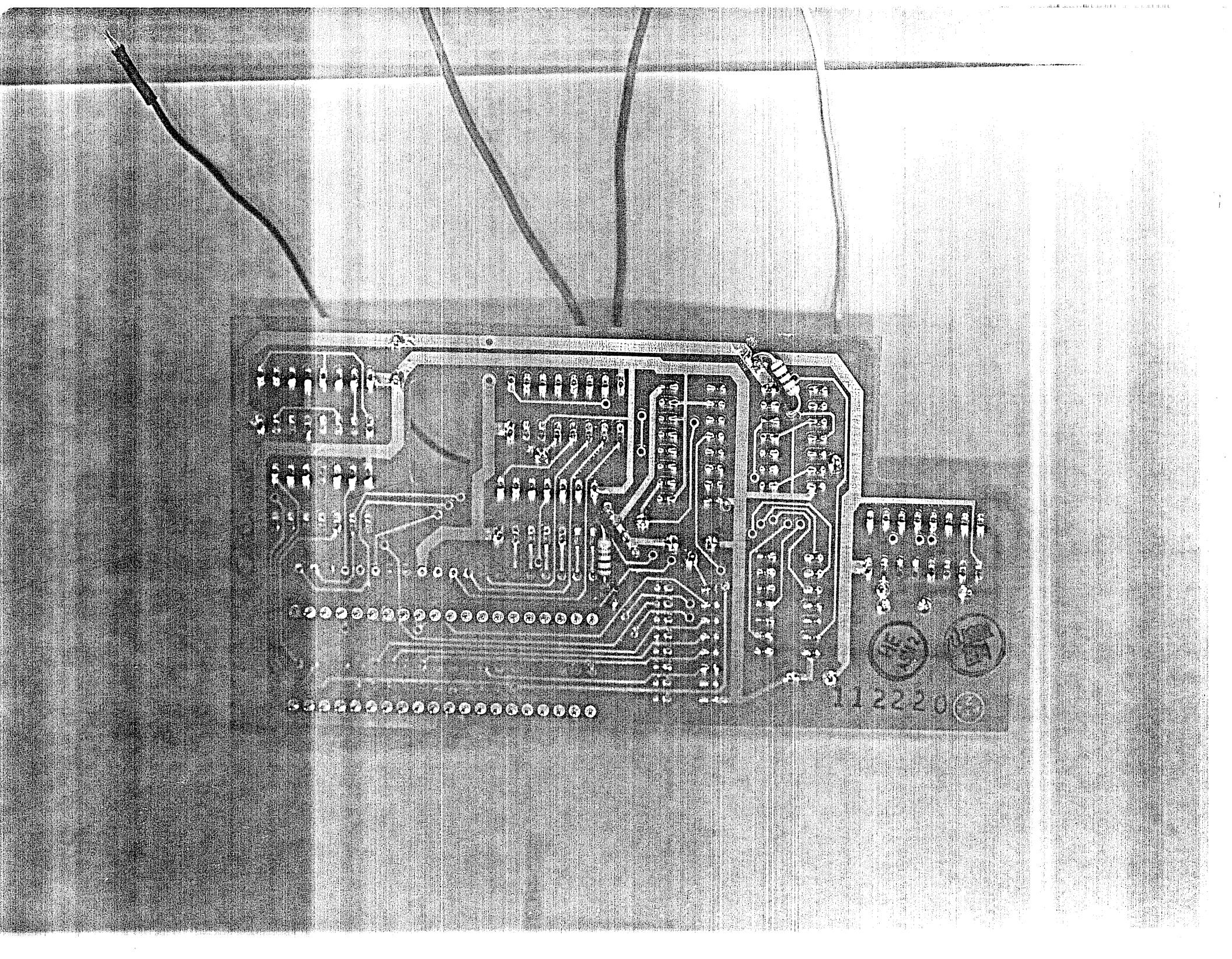
PHOTO 4
ATTACHING THE YELLOW
WIRE TO Z-41 PIN 1

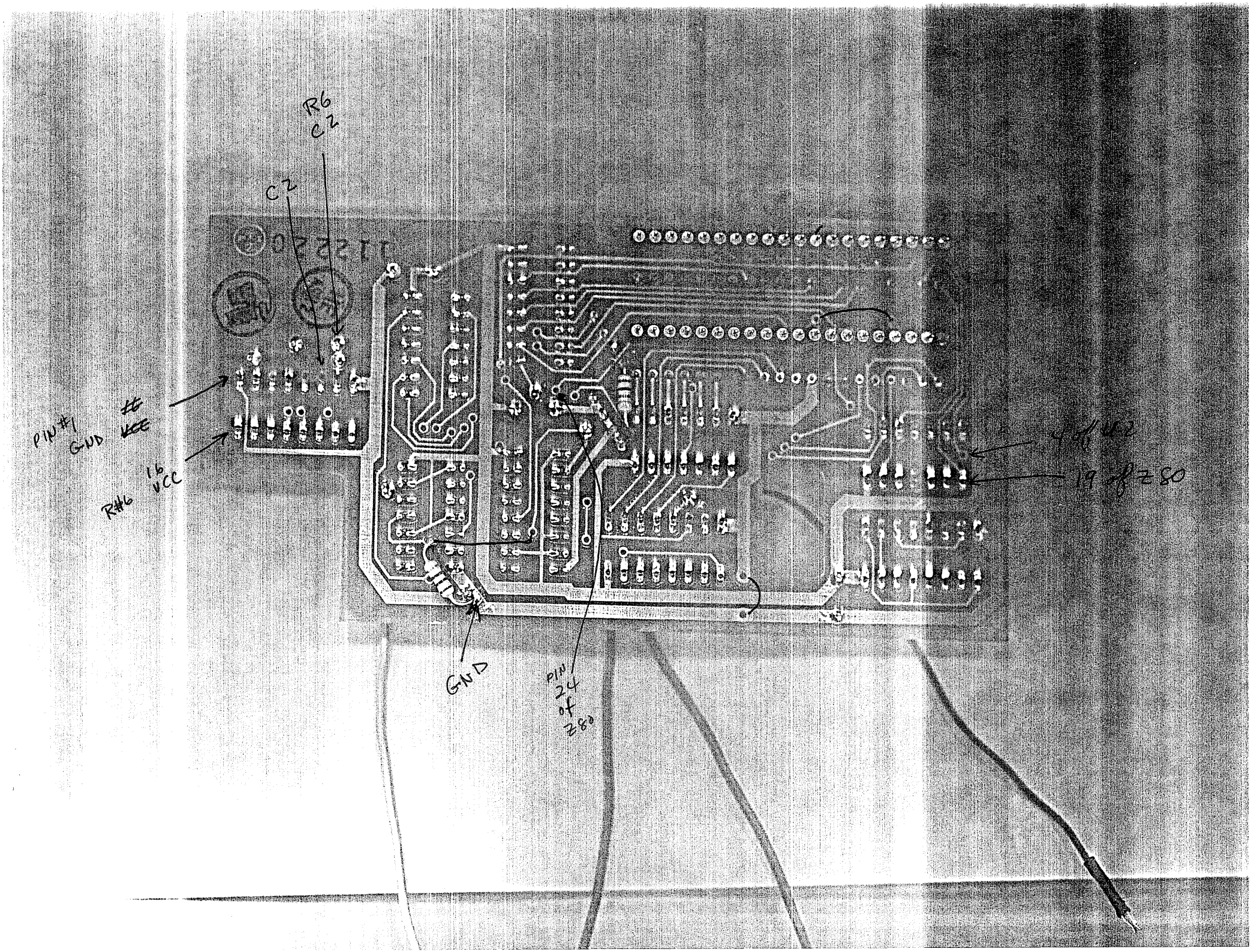
ATTACHING THE ORANGE
WIRE TO Z-56 PIN 1


1K (2 places)
hole is 21 of Z80B
hole is pin 22 of Z80B
hole is pin 11 of U4

SPRINTER 1L
COPYRIGHT 1982
HOLMES ENG
SLC UTAH USA
ZILOG
Z80B CPU
U1
U2
U3
U4
U5
U7
HD74LS138P
HD74LS161P
HD74LS74AP
HD74LS02P
HD74LS04P
SN74LS100AN
EL SALVADOR 8138A
EL SALVADOR 8100A
EL SALVADOR 8102A


SPRINTER 1L
COPYRIGHT 1982
HOLMES ENG
SLC UTAH USA
U1
U2
U3
U4
U5
U6
U7
U8
U10
C2
C5
R2
R5
R6


112220


R6
C2
C2
PIN#1
GND
16
VCC
R#6
GND
PIN
24
of
Z80
40 of U2
19 of Z80