INTERNAL MEMORY

The INTERNAL MEMORY you have purchased is manufactured in Australia by
ASP microcomputers under licence from Holmes Engineering of Utah, USA.
In addition to this product, ASP is the sole Australian Distributor for
all products of Holmes Engineering. Currently these include a 32K
INTERNAL MEMORY, with other low cost products for the Tandy's TRS-80 on
the way.

Included with all INTERNAL MEMORIES from ASP is a Stringy Floppy Wafer
containing ASP's comprehensive machine language memory test. This progam
is also available on cassette for $9.50 including postage within Australia.
Following is a description of the operation of this program.

ASP MEMORY TEST

This test is loaded from wafer (or cassette). If starting or ending addresses
 e specified with an <ENTER> the test will cover all available memory.
Otherwise addresses must be specified in HEX (not decimal). Invalid addresses
will not be accepted. The test may be terminated or restarted as documented
on the screen. The test is designed to show most common problems first, and
more subtle ones last. The test never finishes be itself.

Generally memory chip failures will be found within a few seconds. The test
takes about 5 minutes to run all phases in a 48K system. To completely test
for all address open and short combinations, the test should be run over a 4K
boundary, then run over the full range. There are some subtle things that get
missed if you only run the test over the full range and not 4K at a time.

The following tests are performed:

FAST COMPLEMENT	This is a test of all memory starting at 4200H and testing to the top of memory (except its own loop). Pick up each byte, complement and try to store. Quickly test if properly complemented and restore original byte.
CK BIT	Fill the test area with 0FFH and check for 0FFH. Then fill the test area with 0's and test for 0's. Then re-fill with 0FFH and test just in case the bit was originally high.
ADJACENT BIT SHORTED	Sets a single bit in all bytes high. This checks if a bit is shorted to the ones on each side. The test repeats 8 times, rotating the test bit from LSB to MSB.
CHECKERBOARD	Fill memory with 0AAH, 55H pattern and check. This forms an alternating "checkerboard". Then reverse the pattern and re-check.
WALKING BIT TEST	Fill memory with one bit set for each byte. For example, byte 1 has bit 1 set, byte 2 bit 2 etc. Then memory is checked for the proper pattern. This is repeated 8 times, rotating the bit each time. Then the whole procedure is repeated rotating the opposite way.

ADDRESS SHORTED   Fills all memory with 55H then writes an 0AAH at 4200H
                           (or the lowest memory tested). It then tests the rest
                           of memory for 55H's. Then it clearsthe location of the
                           0AAH and writes it into location 1. Then it does the
                           same with location 2,4,8 etc. setting a new address bit
                           high each time and testing all of memory. If any
                           address bit is shorted to another, the test will find
                           an 0AAH in a location other than the place it was
                           written.
RANDOM NUMBERS   A random number routine generates an 8 bit number
                           pattern and writes it through all test memory. It then
                           re-inserts the same seed to the routine and test reads
                           the memory. A new seed is generated and the exercise
                           is repeated with a new pattern. This goes on 8 times.

The whole test restarts, and as described above, will not terminate by itself.
Errors are reported as they are found by the program. They are displayed with
the memory address in Hex, with what the byte should have contained, and what
it does contain, in binary.

                    INTERPRETING MEMORY TEST RESULTS

The TRS-80 and INTERNAL MEMORY use 16K Dynamic RAM IC's. These are arranged
as 16K wide by 1 bit deep. This means that in a 16K block each of the 8 chips
is responsible for 1 bit of each byte throughout the block.

So if a problem is indicated, compare the "was" and "should be" columns to
identify which bit is different (& therefore bad). Bits are counted up from
the right thus:

        Bit Number   7   6   5   4   3   2   1   0
        Sample Byte   1   0   1   1   1   0   0   1

Then identify the defective chip from this chart:

ADDRESS RANGE (hexadecimal)	BIT 0	1	2	3	4	5	6	7
4000-7FFF	M1	M2	M3	M4	M5	M6	M7	M8
8000-BFFF	M9	M10	M11	M12	M13	M14	M15	M16
C 0-FFFF	M17	M18	M19	M20	M21	M22	M23	M24

eg:

ADDRESS	SHOULD BE	WAS
A000	0110 0110	0110 1110
:	:	:
:..between 8000 & BFFF		:..bad bit 3

Solution: replace M12

ADDRESS	SHOULD BE	WAS
DBFF	1111 0000	1001 0000
:		::
:..between C000 & FFFF		::..bad bits 5 & 6

Solution: replace M22 and M23

WARRANTY

ASP MICROCOMPUTERS warrants the INTERNAL MEMORY for a period of six months
from the date of purchase. At our option we will repair or replace any
INTERNAL MEMORY which proves to be defective in materials or workmanship
within the Warranty period. This Warranty does not cover damage resulting fro
accidents or abuse of the INTERNAL MEMORY.

ASP shall not be responsible for any incidental or consequential damages. Som
States do not allow the exclusion or limitation of incidental or consequential
damages, so this limitation or exclusion may not apply to the purchaser.

This Warranty limits any implied warranty to six months from date of purchase.
Some States do not allow limitations on how long an implied warranty lasts, so
this limitation may not apply to the purchaser. This Warranty gives the
purchaser specific legal rights and the purchaser may also have other rights
which vary from State to State.

                    RETURNS

Save your INTERNAL MEMORY's packaging. If you need Warranty or other repairs
write a detailed statement of the problem exhibited and enclose it with the
INTERNAL MEMORY in its original packaging.

****

                    ASP MICROCOMPUTERS
                    797 Dandenong Road,
                    EAST MALVERN   3145
                    VICTORIA   AUSTRALIA

                    telephone: 03/211 8855

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Thank you for purchasing the INTERNAL MEMORY (TM) from HOLME ENGINEERING! The following pages describe installation and operation for bot the 32K IM-1 and the 48K IM-2 boards. Installation is accomplished withou soldering or trace-cutting, and does not require a great deal of skill o knowledge about electronics. PLEASE READ ALL OF THE INSTRUCTIONS CAREFULLY TAKE YOUR TIME AND HANDLE EVERYTHING WITH CARE, AND YOU WILL BE SURPRISED A HOW EASY IT WILL BE TO INSTALL YOUR INTERNAL MEMORY (or IM) BOARD AND HAVE I WORK THE FIRST TIME YOU TRY IT!

The IM boards can be used with a Model I TRS-80* (NOTE: TRS-80* is registered trademark of the TANDY CORP.) , LEVEL I or LEVEL II. Both the IM- and the IM-2 require that the Keyboard unit (KU) be programmed for 16K RA chips. If you have a 16K keyboard unit, read on. If your KU is presently se up for 4K RAM, and you informed us of this when you ordered, you should hav received instructions on upgrading from 4K to 16K and a set of jumper plug with your IM board. If not, you will need to contact HOLMES ENGINEERING for 16K upgrade kit.

If you ever feel "lost" or confused about some point in the instructio STOP! Go back to the point where everything is very clear and start from ther Computers do not forgive; everything must be perfect or nothing will work!

You will need to know how to handle MOS dynamic RAM's properly, how t "read" I.C. pin numbers, and how to remove I.C.'s from sockets in order t successfully install your IM. Even if you know ALL ABOUT these things, pleas read through this material anyway, just to be sure.

MOS I.C.'s, including dynamic RAM's, are VERY easily damaged by stati electricity. You can generate several thousand volts just by walking across rug, or sliding around on a plastic chair! Follow these precautions when usin MOS I.C.'s:

(1) NEVER store or transport MOS devices without wrapping them i aluminum foil, or placing them in some other conductive, anti-stati material.

(2) Do not wear nylon clothing while working with MOS devices.

(3) ALWAYS touch a socket with one hand before inserting a MOS I.C with the other hand; this will equalize the potential between the I.C. and th socket, which will prevent any static discharge between the I.C. and th socket.

(4) Hold I.C.'s by the "body"; touch the pins as little as possible.

All of the integrated circuits used in the TRS-80* and IM use the sam in-numbering scheme. Looking at the I.C. from the top (pins facing away fro you), notice that one end of the I.C. has a square or half-round notch in it and/or, a small "dimple" in one corner. (Some I.C.'s will have some type o notch in both ends; one will be more prominent than the other).

If you turn the I.C. so that the notch or dimple is facing upward, pi one of the I.C. will be in the upper left-hand corner, and the pins will b numbered counter-clockwise around the I.C. like this:

PIN 1 →

START AT PIN 1
AND COUNT IN THIS
DIRECTION

top view
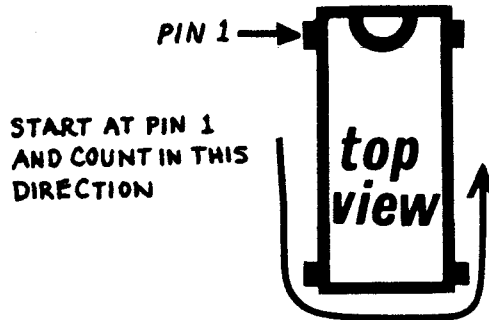
I.C. sockets have a notch of some kind at one end to indicate where pi
1 of the I.C. goes. When installing an I.C. in a socket, place the notched en
of the I.C. at the notched end of the socket (that makes sense!). In addition
the IM boards have I.C. outlines painted on the top surface; match the notc
on the I.C. with the notch painted on the board.
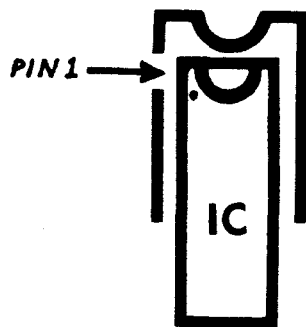
        By the way, all IC's on the TRS-80* main board are numbered from "Z1
to "Z76". The IC numbers are printed on the circuit board between adjacen
IC's in some cases. It is not usually obvious which IC belongs to whic
number! Go to one end of the row to see whether the numbers are printed to th
 eft or right of IC's in that row. Double check all numbers to preven
errors.
        When removing IC's from sockets, DO NOT try to pull the IC out wit
your fingers; it will "pop" out suddenly, bending the pins and/or stickin
them into your fingers (ouch!). If you have an I.C. removal tool, use it. I
you don't, use a small screwdriver, nail file or similar object to "pry" th
I.C. out of the socket, as shown. Pry up one end of the I.C., then pry up th
other end and lift it out.
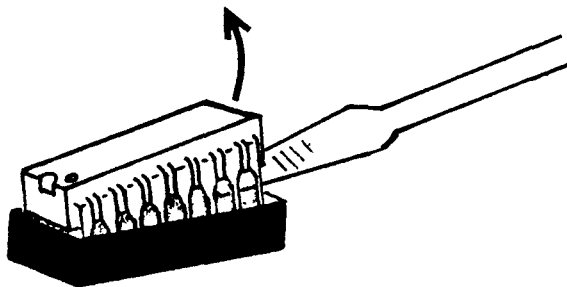
        Now you are ready to install your IM! You will need a phillips screw
driver and a soft towel.
        Remove the power supply, video and cassette cables from your keyboar
unit (KU). Also disconnect anything you may have connected to the expansio
connector at the back of the KU.
        Lay the KU face down on the towel, with the front of the KU facin
toward you.
        Loosen and remove the six black screws on the bottom of the KU. Th
screws are not all the same length; mark them in some way so you can get the
back in the correct holes when you put the case back together again.
        Hold the KU together and turn it "right side up". Very carefully lif
the top of the case off, being careful to keep everything in place.
        There are several differant versions of the TRS-80* with variou
amounts of hardware inside. Make a mental note (or better yet a drawing) o
what is inside your KU so you can put it all back together properly.

There is a flat "ribbon" cable connecting the keyboard to the mai
board. This cable is very fragile and must not be strained during the nex
steps! Excessive flexing of this cable will cause broken or intermittan
connections to the keyboard.

SPACERS

SPACER

RIBBON CABLE
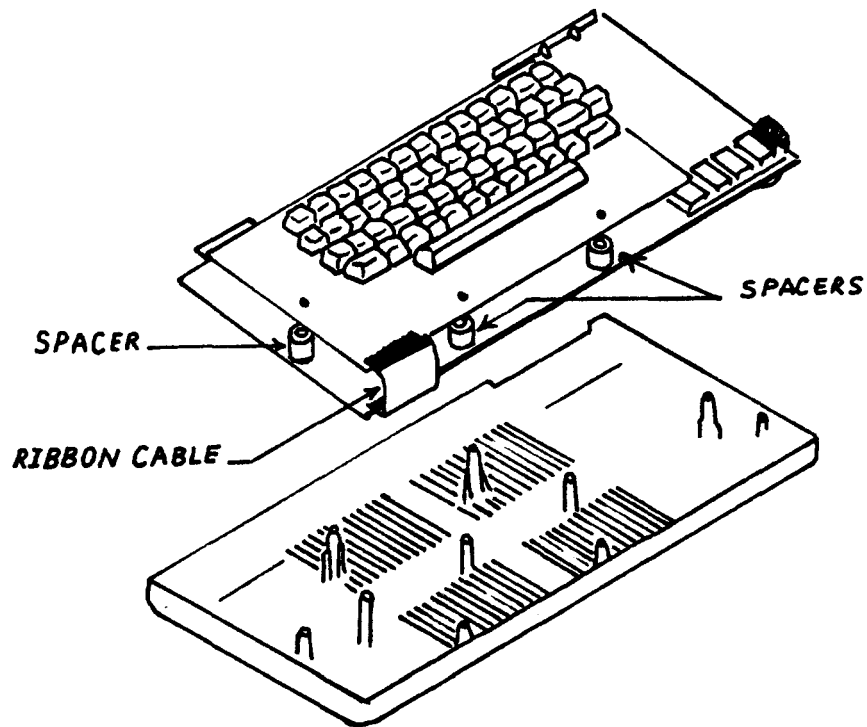
Very carefully lift up the keyboard and note that there are severa
plastic spacers holding the keyboard up off the main board. It is mos
convenient to glue these spacers to the main board; then you do not need t
keep track of where they belong! If you do not wish to glue them on, make
note of where they belong, then remove them and set them aside.

Lift both the keyboard and the main board out of the case bottom, an
set the case aside. (If you have an older style keypad in your KU, you ma
wish to tape it to the keyboard to keep it from coming loose during the nex
steps.)

Open the keyboard/main board up like a "clamshell", and lay them dow
on the towel, with the writing on the main board "right side up". Be carefu
not to break any wires which may be attached to the main board; position an
cables or "piggy-back" boards (such as the 3-chip ROM board) so they will nc
be damaged in the next steps.

Remove the RAM IC from socket Z13 on the main board (remember th
instructions for removing IC's) and plug it into socket M1 on the IM board
MAKE SURE YOU POSITION THE I.C. SO THE NOTCHED END MATCHES THE OUTLINE PRINTE
AROUND THE SOCKET ON THE IM BOARD, OR YOU MAY DAMAGE THE RAM CHIP WHEN YC
APPLY POWER LATER ON! Remove Z14 from the main board and plug it in to socke
M2 on the IM board, again matching the IC notch with the outline painted c
the IM board. In the same manner remove Z15,Z16,Z17,Z18,Z19 and Z20 from th
main board and install them in M3,M4,M5,M6,M7, and M8 on the IM board.

Install RAM I.C.'s (4116 or equivalent) in sockets M9 through M16 fc
32K RAM (IM-1 and IM-2) and in sockets m17 through m24 for 48K RAM (IM-
only). Again, match the notch at one end of the I.C.'s with the outlin
painted on the IM board around the socket. NOTE: If you purchased RAM wit
your IM, the RAM chips will already be installed in sockets M-9 through M-24.

Examine the bottom of the IM board and notice that sockets M-1 throuc
M-8 have several pins connected to them. These pins will be plugged into th
RAM sockets Z-13 through Z-20 on the TRS-80* main board, and will provide th
power, data, and most of the address connections to the IM board. THESE PIN
MUST BE PROPERLY INSERTED OR THE IM (and your TRS-80*) WILL NOT WORK! Take a

mome━ ╴ to study the pins, and see how they fit into the RAM sockets, befor
a━╴ ╴ally attempting to install the IM; installation is very simple once yo
╴╴now how it is SUPPOSED to be done! NOTE: The pins should come straight out o
the IM board. If any of the pins are bent, CAREFULLY bend them so they com
straight out of the IM board at a 90 degree angle.
    Looking at the TRS-80* main board with the writing "right side up"
position the IM board over the · RAM sockets with the "skinny end" pointing t
your left.
    Now stand the IM on end, with the end closest to M-8 resting betwee
Z-22 and Z-23 on the TRS-80* main board. You are now going to connect two o
the solderless connectors to points which will be underneath the IM board onc
it is installed in the RAM sockets.
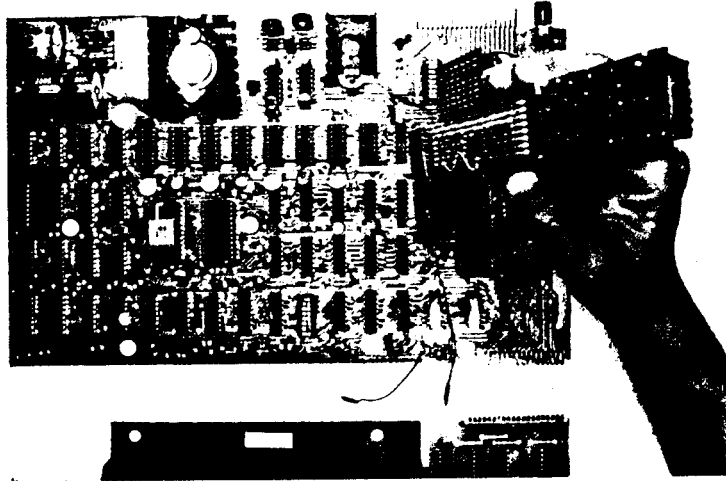
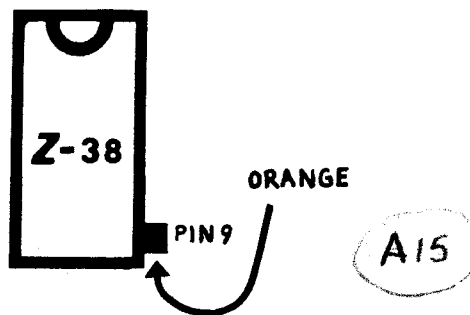   Connect the YELLOW wire to pin one of Z-21 on the TRS-80* main board
by slipping the solderless clip onto the I.C. pin as shown. You may wish t
tape or glue the wire in place to make it more secure; be careful not to ge
any glue on the I.C. pin or the connector.
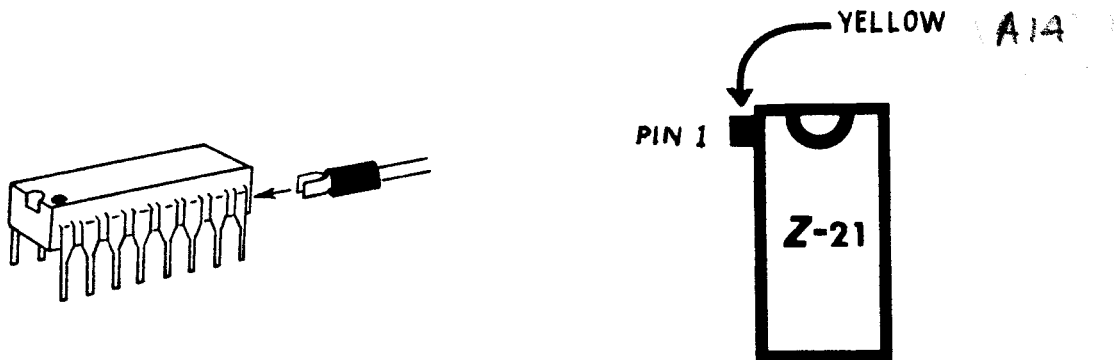
    NOTE: If you decide to solder the wires instead of using the solderles
connectors, please cut the connectors off before soldering the wires
soldering the connectors themselves may open up the connection between th
connector and the wire inside the black tubing.
    Connect the ORANGE wire to pin 9 of Z-38 on the TRS-80* main board, th
same way as you connected the yellow wire to Z-21.

```
         ┌──────┐
         │  ◯   │
         │      │
         │ Z-38 │
         │      │              ORANGE
         │      │  ▪PIN 9       ╱      ⌒⌒⌒
         └──────┘   ↖___╱      ( A 15 )
                                ⌒⌒⌒⌒
```
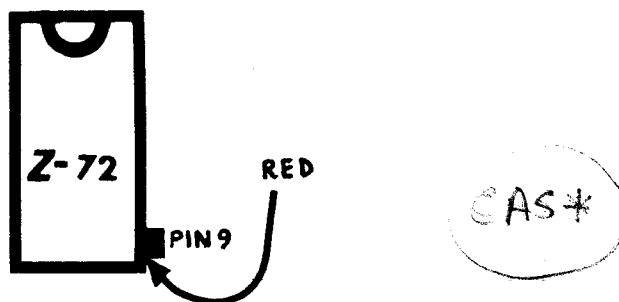
        Place the IM back on top of the RAM sockets, then look under the IM an
make sure the pins fit into the   RAM   sockets   properly. Pin 1 of M-1 (the pi
protruding from the back of the IM   board)   must be plugged into pin 1 of Z-1
on the main board, and pin 16 of M-1   must   plug into pin 16 of Z-13. Pin 1 o
M-8 must plug into pin 1 of Z-20,   and   pin 16 of M-8 must plug into pi 16 o
Z-20, etc. If you get the pins in   Z-13 and Z-20 correctly, all the other pin
should line up properly.
        Once you have the pins lined up, push gently on top of the IM board an
start its pins into the RAM sockets. It is a good idea to keep looking at th
pins under the IM board in this and the next step, to make sure none of the
ๆet bent. If any of the pins appear to bend or bow while attempting to pus
๛he IM into the RAM sockets, STOP. One of the pins may be bent or caught on
metal edge in the RAM socket. In addition, slight variations in the RAM socke
spacing may require you to reposition a pin or two to get the IM to fit int
the RAM sockets on the TRS-80¥ main board. (If you do need to reposition pin
to get the board to fit, use a long narrow object, such as a round toothpic
or Q-tip handle to push the pin until it slips into the RAM socket.) Th
sockets used in the TRS-80¥ have wide openings where the pins enter th
socket, which will allow you to move the IM board around a little whil
attempting to line up the pins. All you need to do at this point is to get th
pins into the correct socket openings; they will "bend" into position when yo
push the board into place in the next step.
   Once you are satisfied that the pins are all properly lined up, pres
the IM board firmly into place, until you "feel" the pins touch the bottom o
the RAM sockets. If you have the IM properly installed, you will be able t
tug on it (not too hard, though!) without pulling it out of the RAM sockets.
        Now connect the RED wire to Z-72 pin 9 in the same way you connecte
the YELLOW and ORANGE wires.

```
         ┌──────┐
         │  ◯   │
         │      │
         │      │
         │      │
         │ Z-72 │          RED
         │      │ ▪PIN 9    ╱        ⌒⌒⌒
         └──────┘  ↖___╱             ( AS ¥ )
                                      ⌒⌒⌒⌒
```

        With the TRS-80¥ main board positioned with the writing right side up
find the socket labeled Z-71 (it will have a "DIP shunt" plugged into it)
Look just off the lower left corner of Z-71 and find a 4.7 K ohm resisto
labeled "R62".
        Attach the blue IM wire to R62, on the wire closest to Z71, (next page

Z71

BLUE

R62

*RAM**
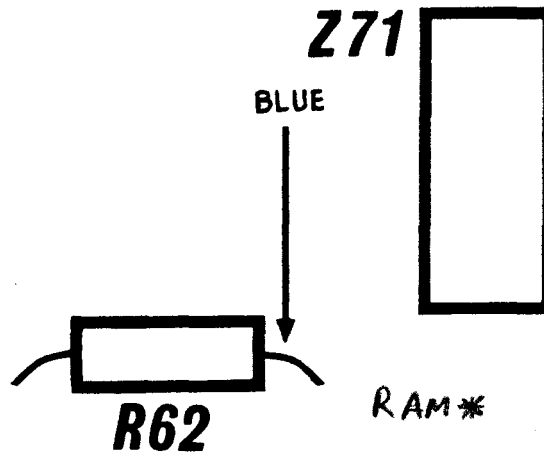
Position the wires away from the holes in the TRS-80* main board s
they will not get pinched by the cabinet posts when you put the case bac
together. Tape or glue them down if necessary to keep them out of the way.

Your INTERNAL MEMORY is now installed and connected! Double check al
connections, and check to make sure the pins have been propely installed i
the RAM sockets.
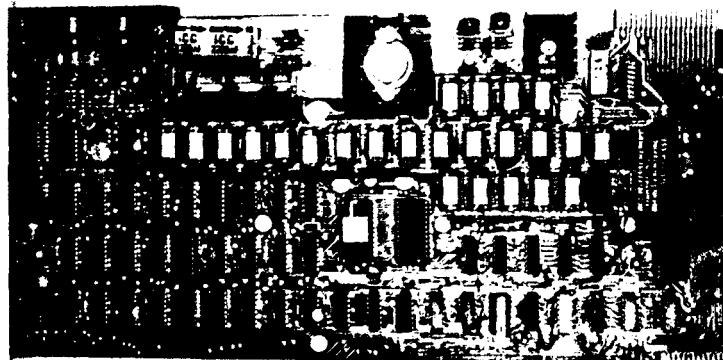
You are now ready to put your keyboard unit back together. If you wis
to check out your TRS-80/IM combination before putting it back into the case
keep in mind that the TRS-80* main board is "upside down" when it is remove
from the case and placed component side up! If you connect anything to th
expansion connector, the connector should be attached opposite to the way i
attaches when the TRS-80* is in its case. Also, make certain that you plug th
power supply into the connector closest to the power switch!

Due to the limited amount of space available inside the TRS-80* case
you may need to trim some plastic away from the cabinet supports of the cas
bottom closest to Z-21 and Z-13 to allow room for the IM board. These post
are very sturdily built and will not be weakened if they are trimmed.

As shown, remove the thin "web" from the support post on the side whic
will be next to the IM board. This is easily removed with a knife , a pair c
wire cutters, etc.. Remove enough plastic to prevent the post from rubbin
against the IM board and "popping" it out of the RAM sockets.
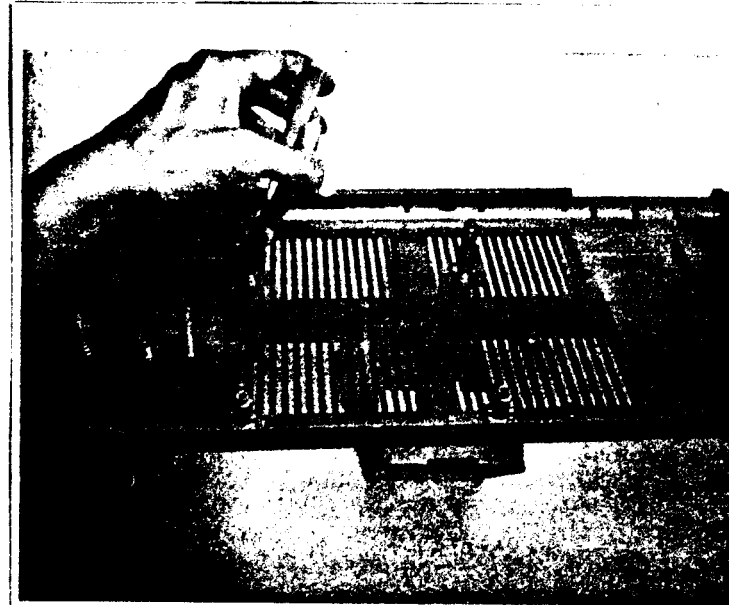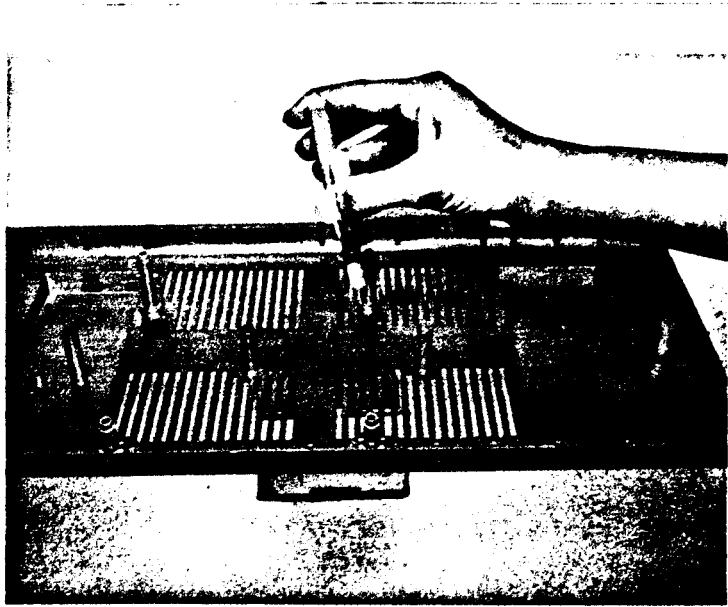
Now fold the main board and keyboard back together, just as they wer
when you removed them from the case. Place them over the cabinet support post
and into the case bottom, taking care not to pinch or break loose any wires o
cables.

If you did not glue the spacers to the main board, GENTLY lift up th
keyboard (remember that fragile ribbon connector!) and place the plasti
spacers back on the cabinet support posts. If you don't remember just wher
they go, place them in positions which best support the keyboard itself.

Now place the keyboard back on the cabinet posts, and positio
everything as it was when you first opened the case. Double check to make sur
no wires or cables have been pulled loose or pinched in the case/boar
assemblies.

Place the top of the case back on, making sure you get the LED power-o
indicator properly inserted in its mounting ring on the case top. Tape th
case together in a couple of places (or get an extra pair of hands to hold i
for the next step). Place the KU keys-down on the soft towel.

Place the screws in the holes in the case bottom, with the shortes
screws in the holes nearest the front of the case, the medium screws in th
middle holes, and the longest screws in the holes closest to the rear of th
KU. Make sure the screws are correctly threaded into the PLASTIC case, the
tighten them down GENTLY; it is hard to put the plastic back in if you stri
out the threads!

You guessed it-your INTERNAL MEMORY is installed and you are ready t
try it out! The next section tells you how to test your RAM to make sure it i
functioning correctly.

SYSTEM CHECKOUT

Connect the power supply, video and any other cables you normall connect to your TRS-80*. Wish yourself good luck, and turn on your KU. Yo should immediately see the familiar MEMORY SIZE (or MEM SIZE) question on th screen. If you get garbage, a blank screen, or a pattern of letters or @ sign and letters, TURN YOUR SYSTEM OFF AND GO TO THE THE "IN CASE OF DIFFICULTY section of this manual.

Press 'ENTER' in response to the MEMORY SIZE question; in a couple o seconds you should get the familiar >READY prompt. It will take longer for th >READY to come back with more than 16K of RAM, because the TRS-80* has t search further to find the top of RAM.

Once you get the >READY prompt, type PRINT MEM. You should get 3195 (31954) for a 32K system, or 48340 (48338) for a 48K system. (The values i paranthesis are correct for 2-chip ROM sets, which are those systems whic normally give 15570 memory size with 16K of RAM.) If you get something else go to the "IN CASE OF DIFFICULTY" section.

You are almost finished! All that remains to be done is to verify tha all memory locations are good. If you have a memory test program you ar familiar with, use it to test your INTERNAL MEMORY. If not, use the simpl program listed here. Although it can't test every memory location (you need t use some RAM to store the program!), it can test all the ADDED RAM to mak sure it can at least store and recall 1's and 0's properly.

Type in the following program, and store it on tape (or whatever yo use).

```
10 CLEAR 0:CLS:PRINT"INTERNAL MEMORY RAM TEST"
20 INPUT"ENTER START ADDRESS";A
30 IF A>32767 THEN A=A-65536
40 INPUT"ENTER END ADDRESS";B
50 IF B>32767 THEN B=B-65536
60 PRINT"TESTING...."
70 IF A<0 GOTO 160
80 IF B>0 THEN C=B ELSE C=32767
90 FOR X=A TO C
100 POKE X,0
110 IF PEEK(X)<>0 GOSUB 230
120 POKE X,255
130 IF PEEK(X)<>255 GOSUB 230
140 NEXT
150 IF B>0 GOTO 220
160 FOR X=A TO B
170 POKE X,0
180 IF PEEK(X)<>0 GOSUB 230
190 POKE X,255
200 IF PEEK(X)<>255 GOSUB 230
210 NEXT
220 CLS:PRINT"END OF TEST":PRINT E;"ERRORS DETECTED":END
230 PRINT"ERROR AT ADDRESS";X:E=E+1
240 FOR Y=0 TO 300:NEXT
250 RETURN
```

Turn off your TRS-80*, turn it back on, and answer 17800 to the MEMOR SIZE question. YOU MUST SET MEMORY SIZE BELOW THE START OR 4 BYTES ABOVE TH END OF THE BLOCK YOU WISH TO TEST or the program will crash; the TRS-80* use the top 4 bytes of RAM, starting with the address you specify when you set th memory size.

Load the program and RUN it. The first testable location is now a 17801; the first 16K of RAM ends at 32767, and is contained in RAM's M-1 thr

M-8 on the IM board. The second 16K of RAM starts at 32768 and ends at 49151 and is contained in RAM's M-9 thru M-16 on the IM board. The upper 16K (IM-only) starts at 49152 and ends at 65535, and is contained in RAM's M-17 thr M-24 on the IM board. Thus, test a 32K system from 17801 to 49151, and a 48 system from 17801 to 65535. Any failures will show on the screen. This is BASIC program, so it will take a few minutes to RUN. If you have a printer you may wish to change the PRINT statements in lines 60-230 to LPRINT, to ge a listing of the test results.

Once you have tested your new RAM , all that is left to do is use it RAM in your IM "looks" just like the RAM in an expansion interface; use i exactly the same way. The only "trick" needed to use the IM is not related t the IM at all, but is brought about by the fact that the Z-80 processor use in the TRS-80* cannot handle integers greater than 32767. Thus, in order t use PEEK and POKE commands with addresses above 32767, you must use a negativ number derived from this formula:

desired   address   -   65536   =   PEEK   or   POKE   address

This is explained in section 8 of the TRS-80* LEVEL II BASIC REFERENCE MANUAL
One final note-make sure that you allow plenty of room under you keyboard unit for air to "flow" through the case and cool the added RAM. Th keyboard unit will run fairly hot, and must have this air flow.

IN CASE OF DIFFICULTY

The following information is intended only to provide suggestions fo solving relatively simple difficulties. No attempt is made to teach how t repair the TRS-80*, as that is best covered in the well-written Technica Reference Manual available from Radio Shack.
There are several common problems which can occur when installing an I board, involving malfunctions of the TRS-80* (caused by broken wires) o malfunctions/incorrect installation of the IM or RAM chips. Answer fou questions before proceeding:
(1) Are all the RAM chips inserted with the notched end matching th outline on the IM board?
(2) Are any RAM pins bent up under the bottom of the case, preventin the pin from fitting into the socket? (Lift up each chip to check).
(3) Are the red,blue,yellow and orange wires connected to the correc points on the main board? Are they touching adjacent IC pins or PC traces?
(4) Do you have the correct type of RAM chips installed? 4K chip will not work, though they may fool the TRS-80* into thinking they will!
You must know that the TRS-80 is functioning properly before you ca look for other problems. If you can operate your TRS-80* SAFELY out of th ase, follow these steps. (Otherwise, go to the nxt paragraph). Remove the RA chips from the IM sockets, then turn on the TRS-80*. If you get a pattern o "@S's" on the display, your IM is OK and you have a problem with a RAM chip If you don't get "@S's", disconnect the four IM wires, and remove the IM fro the TRS-80* RAM sockets. If you don't get "@S's" now, you probably have problem with the TRS-80*; contact your dealer or us for assistance.
Verify that your TRS-80* is working properly by putting the origina RAM chips back in and running it as it was before you installed the IM. If i doesn't work properly, you can't go much further until it does! You need t contact your dealer or us for assistance.
Once your are sure your TRS-80 is OK, install your IM again. If i still doesn't work, read on.
The following is a list of symptoms, preceded by an arrow (-->) an printed in CAPITALS, followed by suggestions for solving the indicate problem.
-->SCREEN IS BLANK THE INSTANT THE TRS-80* IS TURNED ON. The +5 volt suppl

is current limiting. You probably have a RAM installed backwards; go to page
and check all RAM's for proper installation.

--->SCREEN SHOWS GARBAGE FOR AN INSTANT, THEN GOES BLANK OR SHOWS RANDO
CHARACTERS AT A FEW LOCATIONS. The RAM address lines are not all functionin
properly. Check for bent RAM pins, improperly installed chips in M-1 thru M-8
capacitors pushed down and shorting against PC traces on IM board.

--->SCREEN FILLS WITH BLINKING PATTERN. OF "ə9's" (OR LARGE "ə's"). A ROM o
the ROM cable is unplugged, or a wire from the ROM board to the main board i
broken loose. You will need a RS manual, or contact your dealer for help.

--->SCREEN FILLS WITH BLINKING PATTERN OF REPEATING CHARACTERS AND "ə
SIGNS. The IM board is not inserted fully into the RAM sockets on the TRS-80
main board, or one of the IM wires (usually the blue wire) is not connected o
is broken.

--->IMMEDIATELY AFTER MEMORY SIZE APPEARS, OTHER CHARACTERS APPEAR AND/O
ERROR MESSAGES SCROLL DOWN THE SCREEN. One or more connections inside th
ribbon cable connecting the keyboard to the main board are broken. Measure th
cable with an ohm meter and attach jumper wires across any open connections
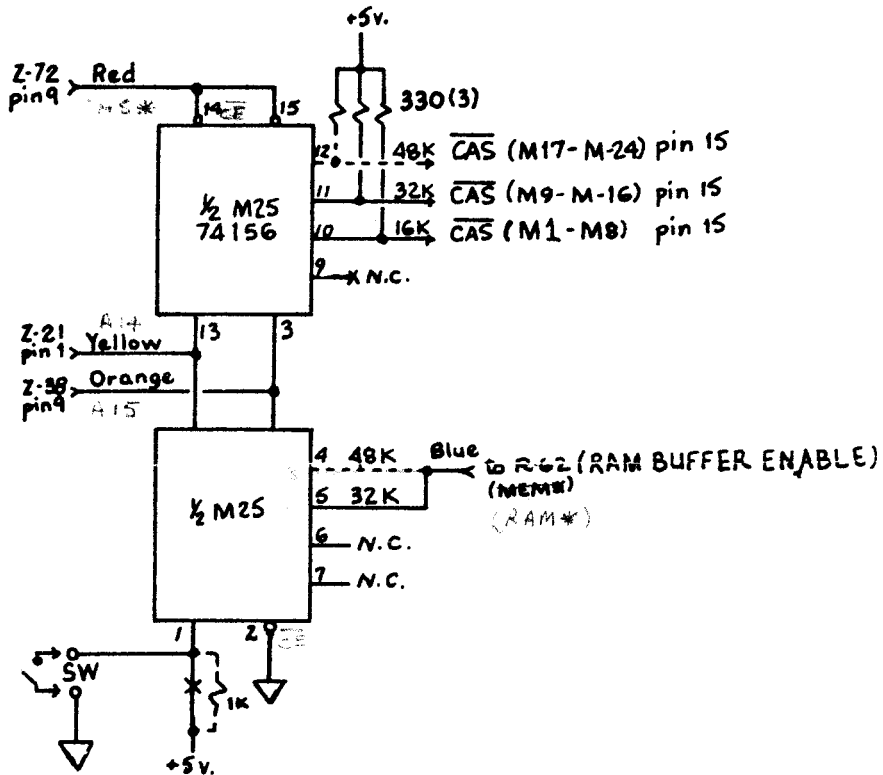flex the cable while measuring to reveal intermittant connections.

--->SCREEN FILLS WITH "GARBAGE". Make sure you have gone through the step
at the beginning of this section. You must know that your TRS-80* i
functioning properly before you can go on!

    Disconnect the blue wire from R-62 (see page 6), and turn on th
.RS-80*. If the screen fills with the "əX" pattern (where X is any character)
your problem is either a bad or improperly installed RAM. If you still ge
garbage, remove all the RAM's from the IM board and try again. "əX's" at thi
point once again point to defective/improperly installed RAM's. If you stil
get garbage, remove the IM entirely but leave the RAM sockets empty. If yo
don't get "əS's", something is wrong with your TRS-80*. If you do get "əS's"
your IM board has a problem. Contact your dealer for assistance.

--->IM WORKS, BUT NOT AT FULL CAPACITY. If the IM works at all, there ar
three problems which will keep it from functioning to capacity. (1) Defectiv
or improperly installed RAM chips. You can use your TRS-80* to test any RA
chips you may suspect. (2) Yellow or orange wires improperly installed. (3
The pins on the back of the IM may not be properly inserted into the RA
sokets. It is best to remove the IM, inspect and correct the pins, then put i
back.

--->NONE OF THE ABOVE STEPS HELP. You have exhausted the simple tests. G
over everything again, and maybe again, but stop just before you are ready t
send the IM down the garbage disposal! Contact your local dealer if possible
he can most convenienly assist you. If you purchased your IM directly fro
IOLMES ENGINEERING, call or write and we will assist you. The IM DOES work
One way or another, we will help you get it up and running.

+5v.

Z-72 Red
pin9

330(3)

½ M25
74156

12 |48K C̄A̅S̅ (M17-M24) pin 15
11 |32K C̄A̅S̅ (M9-M16) pin 15
10 |16K C̄A̅S̅ (M1-M8) pin 15
9 → N.C.

Z-21 Yellow
pin1
A-14
13

Z-28 Orange
pin4
A-15
3

½ M25

4 48K Blue to R-62 (RAM BUFFER ENABLE)
5 32K (MEM*)
6 N.C. (RAM*)
7 N.C.

SW

1K

+5v.

- PINS 1,3,4,5,6,7,8,9,10,11,12,13, & 16 OF ALL RAM CHIPS ARE BUSSED TOGETHER AND CONNECTED TO THE TRS-80 RAM SOCKETS VIA PINS ON THE IM BOARD.
- PIN 15 IS CONNECTED IN 8-CHIP BLOCKS AND DRIVEN BY THE 74156 AS SHOWN AT LEFT.
- PIN 2 (DATA IN) AND PIN 14 (DATA OUT) OF EACH RAM IS CONNECTED TO PINS 2 & 14 OF AN APPROPRIATE TRS-80 RAM SOCKET, THROUGH PINS ON THE I

TO COMPENSATE FOR MARGINAL PERFO ANCE OF TRS-80 CIRCUITS, 1K RESIST ARE CONNECTED BETWEEN PINS 5,6, 10,11,12,13 & 14, AND +5 VOLTS.

BRIEF TECHNICAL INFORMATION:

Shown above is a schematic of the address decoder section of the INTERNAL MEMORY. The top section of the 74156 I.C. (M-25 on the IM-2; M-17 on the IM-1) is used to decode and drive the CAS* signals for each 16k bank of RAM on the IM board. The bottom section of the 74156 is used to turn on the TRS-80 memory buffers for addresses above 7FFFH (32767). The TRS-80 address decoder (Z-21) handles this function for the lower 16K of RAM.

Referring to the schematic, pin 13 of the 74156 connects to address A-14, and pin 3 connects to address A-15. Both A-14 and A-15 will be low for addresses 0000H through 3FFFH; all connected outputs of the 74156 will be pulled to +5 volts by the pull-up resistors connected to them, and none of the RAM chips will be given a CAS* signal. Since the CAS* signal is used by the RAM chips as a "chip enable", none of the RAM outputs will be enabled.

When the TRS-80 selects an address between 4000H & 7FFFH, A-14 and pin 13 of the 74156 will go high; A-15 and pin 3 of the 74156 will stay low. Then, when the TRS-80 pulls CAS* low, pin 10 of the 74156 goes low, and M-1 through M-8 on the IM board are selected via the low-going CAS* signal.

When the TRS-80 selects an address between 8000H &BFFFH, A-15 and pin 3 will go high, while A-14 and pin 13 will go low. Pin 5 will go low, enabling the TRS-80 RAM buffers, and pin 11 will go low when CAS* goes low, selecting chips M-9 through M-18 on the IM board.

Finally, when the TRS-80 selects an address between C000H & FFFFH, both A-14 & A-15 go high, pins 3 & 13 go high, pin 4 enables the TRS-80 RAM buffers, and pin 12 goes low with CAS*, enabling M-17 through M-24 (on the IM-2 only).

By cutting a trace and connecting pin 1 of the 74156 through a 1k-10k resistor to +5 volts, a SPST switch may be installed at the terminals marked SW on the IM board. When this switch is open, the IM functions as described. When the switch is closed, pin 1 of the 74156 is grounded, and the section of the 74156 which drives the TRS-80 memory buffer enable is disabled. This results in only 16K of RAM in the system, which allows an expansion interface to be connected to the TRS-80/IM combination with no conflicts.

Pins 1-14 & 16 of the RAM chips connect to pins 1-14 & 16 of sockets Z-13 through Z-20 on the TRS-80 board. Pins 1, 3-13, and 16 are connected together on all RAM chips on the IM board. Pin 15 is connected together in each set of eight RAM chips in each 16K block of RAM. Pins 2 & 14 (DATA In & DATA OUT) are common to one chip in each 16K block of RAM; for example, pin 2 of M-1 is connected to pin 2 of M-9 and pin 2 of M-17 (IM-2 only).

All of the capacitors on the IM board are there to decouple noise and switching transients on the power supply lines as the RAM chips switch on and off.

TIPS FROM INTERNAL MEMORY USERS:

The first users/installers of the INTERNAL MEMORY have found that th brown ceramic disc capacitors on the TRS-80 main board around the RAM socket may touch against the bottom of the IM board and not allow the IM pins to b adequately inserted into the RAM sockets. There are many varieties o capacitors used on the TRS-80, with some varieties being 3 times larger tha others! The amount of difficulty you may encounter will depend on your TRS-80 though in any case you shouldn't have any real difficulty.

So what do you do to cure the "problem"? Bend the capacitors dow parallel to the TRS-80 board until there is enough clearance to install the I board! Don't be afraid to bend them down tightly against the main board; som of the brown coating may crumble off, especially where the wire attaches t the capacitor body, but this will cause no damage. Even if a capacitor I damaged, the IM board has enough decoupling capacitors to function with AL the TRS-80 capacitors malfunctioning! Just be certain that none of the bar capacitor wires touch any other bare wires or circuit board traces.

If you have a 3-chip ROM set (with the wide ribbon cable plugged int Z-34 and running to the small board stuck to the back of the main board), o if you have any other hardware with wires attached to the back side of th main board, you should check the back of the main board AFTER you install you INTERNAL MEMORY, AND BEFORE YOU TURN ON YOUR TRS-80 TO TRY IT OUT! You ma have pushed the sharp pins on the back of the TRS-80 board into the plasti insulation of a wire connected to the TRS-80, shorting the pin to the wire (This usually produces either a blank screen or a screen full of rando garbage on power-up, and is not covered in the TROUBLESHOOTING section--yet) Lift all the wires away from the main board to make sure none of them hav been pierced by a sharp pin.

We would appreciate hearing from you if you have any tips to pass on t other INTERNAL MEMORY users; feedback from our customers will help us t refine and improve our products to the benefit of all TRS-80 users!