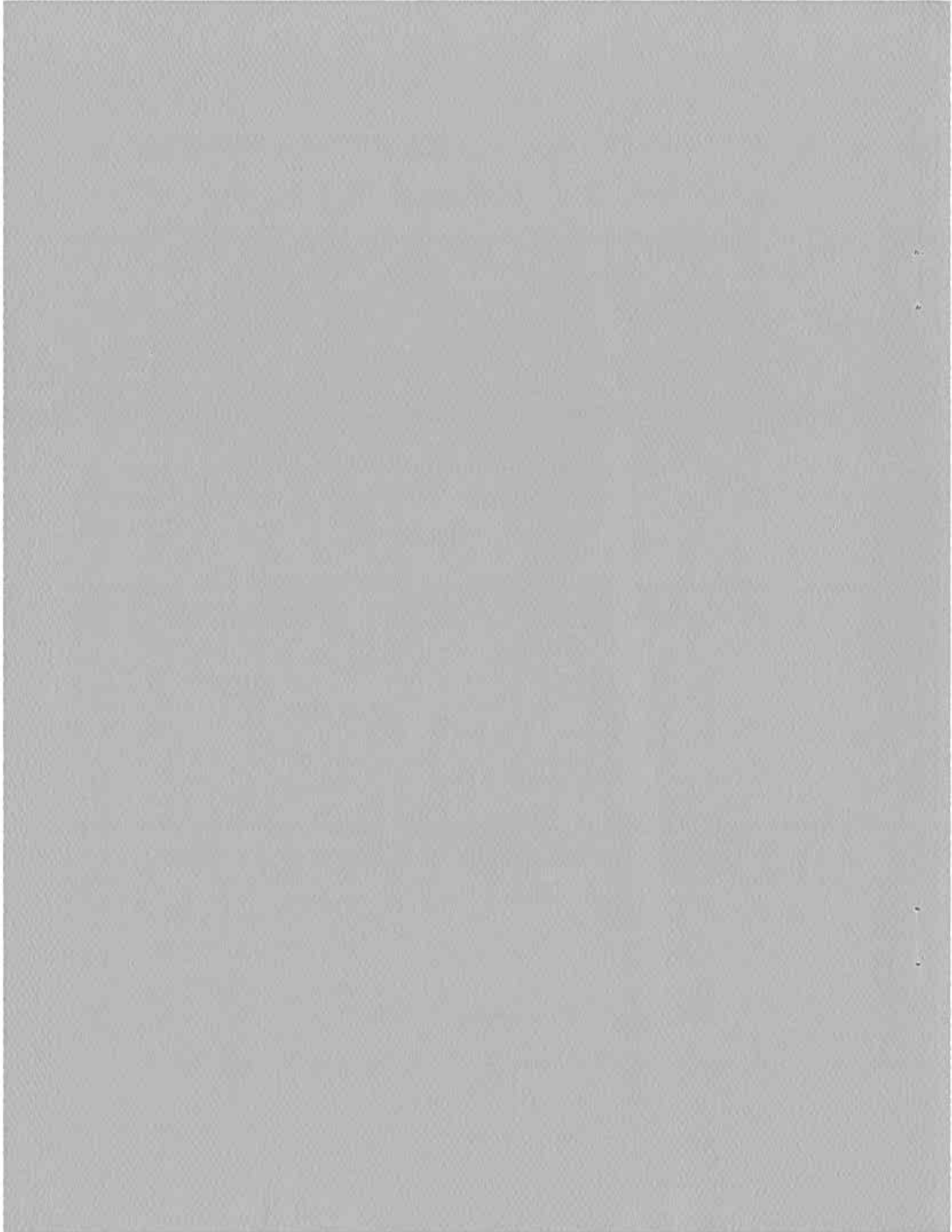The WORD PROCESSING LOWERKIT   (tm)
----

lowercase generator system for the
      TRS-80 Color Computer*

designed by Dennis Bathory Kitsz
      Roxbury, Vermont 05669

manufactured and distributed by MSB Electronics
      Drawer 766, Barre, Vermont 05641

* TRS-80 is a trademark of Tandy Corporation

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**************************************
*** ATTENTION!  READ THIS FIRST! ***
**************************************
```

DO   NOT   OPEN   THE   PLASTIC   BAG !!!
───

Read this booklet first. If at any time you
decide that the Word Processing Lowerkit is not
for you, for any reason, you may return it for a
full refund. However, if you open the plastic bag
containing your Lowerkit and then wish to return
it (unless it is defective), there is a $15
checkout and restocking fee.

Defective Lowerkits will be exchanged at no
charge; write your distributor for a postpaid
return envelope.

    >>>>> Warranty and Disclaimer <<<<<

Your Word Processing Lowerkit is warranted to be
free from manufacturing defects for a period of
six months from the date of purchase, when
installed and used according to instructions in an
otherwise unmodified TRS-80 Color Computer. The
user alone determines applicability and
appropriateness of the Word Processing Lowerkit
for the user's computer system, and by this
purchase agrees to hold the manufacturer and
distributor harmless for any damages,
consequential or otherwise, arising from use of
the Word Processing Lowerkit.

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-- Lowerkit Warranty Registration Form --
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Name _____

Address _____

City _____ State _____

Zip _____-_____ Serial Number _____

Date Purchased _____ Purchased From:

_____



Comments or Product Suggestions:

_____

_____

_____
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Contents

What is the Lowerkit?

The Word Processing Lowerkit is a true
lowercase character generator designed for the
TRS-80 Color Computer, providing a 7x12 matrix
character set with descenders. The Lowerkit is
necessary because (unlike the Model I or many
other personal computers) the Color Computer uses
a "black box" video display generator (VDG). This
single integrated circuit has a set of 64
characters built into it which cannot be changed.
The reason for choosing this circuit for the
inexpensive Color Computer was its simplicity --
this single device (a Motorola MCM6847) creates
characters, manages all modes of high-resolution
graphics, produces color combinations, and
develops all the synchronization signals necessary
for television input. One of its few drawbacks is
the limited 64-character set, with inverted
characters selected for "lowercase".

The Lowerkit changes this. It makes use
of an interesting option provided by the VDG, but
not implemented within the Color Computer: the
connection of an external character generator.
Together with a few additional integrated
circuits, the Lowerkit can provide a full
128-character ASCII character set in a 7x12 dot
matrix. The large 7x12 matrix allows descenders
on lowercase characters, and detailed special
symbols.

The Lowerkit is provided with a Model I
style character generator -- upper and lowercase,
numbers and symbols, plus special characters which
can be used by POKEing the screen (explained
later). Alternate characters sets (European,
Hebrew, Arabic, Kata Kana, Greek, Cyrillic, etc.)
are available, and you can create your own
character sets which MSB Electronics will "burn"
into a character generator memory.

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Before Beginning the Installation
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         Yes, before you start we have to remind
you that installation of your Lowerkit may void
the Radio Shack limited warranty on the Color
Computer. Likewise, we cannot be responsible for
consequential damages of any kind or extent which
may be caused by or arise out of the installation
or use of the Lowerkit. When you put it in, you
are on your own. If that scares you, then don't
open the plastic bag containing the Lowerkit; just
send this complete package back for a full
refund.

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Tools You Will Need
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● For the Assembled and Tested Version:
    * Phillips screwdriver to open the case.
    * Wire snips or small scissors to clip
        plastic clamps.
    * Nail file or flat blade to lift the VDG.

● Disable Switch Option uses above tools plus:
    * Drill and 1/4" bit for switch hole.
    * Pliers for tightening the mounting nut.

● Kit Version uses the above tools plus:
    * Soldering iron and solder.

● For VDG Removal, if necessary, use:
    * Desoldering braid.
    * 40-pin socket for installation in place of
        the VDG.

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Opening Your Color Computer
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Find a comfortable area in which to work.
Unplug the computer now. Cover a tabletop with a
towel or other soft material, flip the computer
face down on the towel, and examine the back.
There are a dozen round holes in the bottom. Most
of these contains Phillips screws.

Slide a Phillips screwdriver into each
hole, and turn out the screw. If the screwdriver
plays aimlessly, that hole probably doesn't have a
screw in it; mark the empty holes. There's one
last screw under the "Warning" label. Punching
through it voids the warranty, but you'll have to
do that in order to open the computer.

Now that all the screws are out, grab the
computer by its sides, squeezing it together.
Flip it on its back, with the keyboard facing you.
Slide your fingernails under the ridge between the
top and bottom, and pop the cover up. Swing it
back and off.

In front of you will be the keyboard on
support posts, the power supply to the left under
an insulating cardboard, some miscellaneous
circuitry, and a large metal plate on the right.
Under this plate -- a radio-frequency interference
shield -- lies the heart of the computer. Examine
the shield. It might be held in place by a pair
of white plastic grips. If it is, snip these and
pull them out. They are needed only for extra
strength during shipping.

Put your thumbs under the sides of the
metal cover, and push up slowly and firmly. Work
your way around the cover until it is free, and
set it aside.

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Locating the Socketed VDG
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        The characters on your present Color
Computer video display are created by the internal
character generator of the MC6847 Video Display
Generator (VDG). The Lowerkit replaces part of
the activity of the VDG, but to do so, it must
intercept some of its connections. Therefore, the
VDG must be removed from its socket.

        Once you have lifted the metal RF shield,
you will be presented with the heart of the
computer. With the keyboard facing you, the VDG
is the 40-pin integrated circuit at the back left,
parallel to the back of the computer. It is
marked MC6847. See Photo 1.
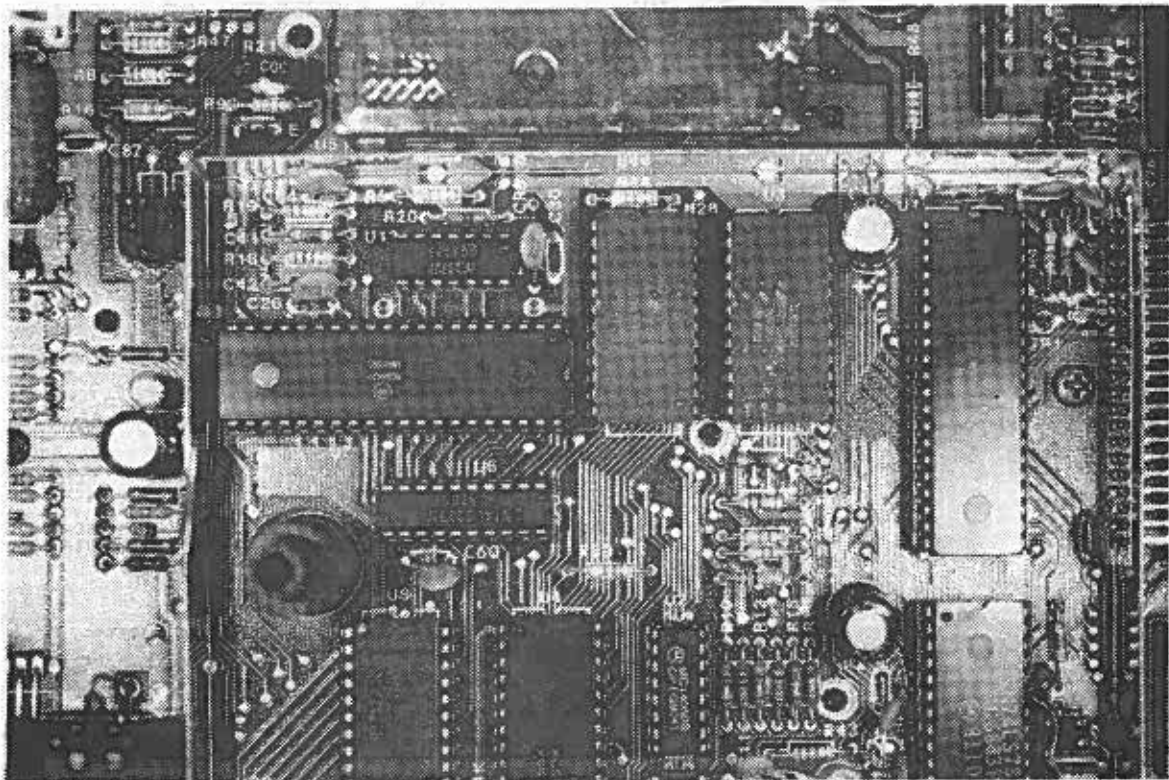
What to do if It's Soldered in Place

This might be a disappointment if you've gotten this far. On the first four or five thousand Color Computers, the MC6847 VDG was soldered right to the board -- no socket! In order to use the Lowerkit, the VDG must come out. Your options are:

● Send the computer and Lowerkit to MSB Electronics, together with $25, and we will install it for you within three days; or

● Remove the VDG yourself.

D A N G E R !

Electrocution and/or destruction of the computer is possible if placement of the wires to or from the power supply is not correctly made. Be certain to mark the location of each of the primary power supply wires (green, white and black) at their connection points within the computer.

You must be confident of your de-soldering abilities if you choose to do it yourself. We cannot be responsible for damage which arises from trying to remove the VDG. This is a difficult chore; we don't recommend it (Even we don't enjoy doing it!), but if you want to go ahead, follow these steps:

1. Remove the paper insulator and the three screws which hold the power supply in place. Unplug each wire leading to and from the power supply, carefully marking its color and location. Lift out the power supply and set it aside.

2. Unplug the keyboard by holding the cable firmly and lifting the keyboard straight toward you.

3.   Remove the screws holding the main circuit board in place. There are two behind the cartridge connector, two near the power switch, and seven more scattered around the board. When all are removed, the circuit board will lift easily up and out.

4.   Locate the position of all the rivets holding the bottom plate to the printed circuit board. Using a hard pencil eraser, push each rivet from the top of the board. Use firm but gentle pressure until all rivets are partly free, then repeat until all are free. Set aside the bottom.

5.   Using desoldering braid (sold by Radio Shack and others), heat each pin of the VDG protruding through the bottom of the board. The desoldering braid will suck up the solder. Hold onto the VDG as you do this; if it gets too hot to hold, stop working until it cools off. Eventually, all the solder will be removed from the VDG and circuit board.

6.   With the edge of your fingernail, push lightly each pin of the VDG to assure it is free. Lift out the VDG, noting its position (notch to the right). Set it on a piece of aluminum foil or special non-static, black shipping foam.

7.   Insert a 40-pin socket into the holes, with its notch pointing to the right. Solder each of the 40 pins, being very careful not to splash any solder or cause hairs of solder to join adjacent pins together.

8.   Replace the bottom. Push in the rivets. Reinsert the board. Replace the screws. Reattach the keyboard. Set in the power supply. Attach its wires. Replace the power supply screws and insulator. Temporarily insert the VDG in the socket. Place on the RF shield. Set the cover on. Plug the computer in. Check that operation is normal. If not, recheck all your work.

9.   Remove the cover and the RF shield.

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Removing the Socketed VDG
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It's now time to install the Lowerkit
board. The first step is to remove the VDG from
its socket.

Slide a flat nailfile underneath the VDG,
between it and its socket. Push the file straight
in -- not at an angle. Turn it clockwise about 10
degrees, then counterclockwise. Lift up about 20
degrees. The VDG should begin to loosen from its
socket. Now push down on the end you just lifted
-- that's right, push it back in. The opposite
end should lift up just a bit. Repeat this entire
procedure a few times. Eventually the VDG should
loosen enough to lift the nailfile and remove the
VDG entirely. Never exert much pressure; it will
eventually loosen.

Check this integrated circuit for bent
pins, and carefully straighten any that need it.

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```
Installing the Lowerkit Board
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Open the Lowerkit package. Slide out the
board and pull off the foam backing. Out of the
bottom of the board protrude 40 pins. Orient the
board so the 40 pins are directly over the VDG
socket, and so the hole in the board slips easily
over the Color Computer's plastic support post.
Make sure you're not too far left or right. Shine
a bright light into the computer so you can be
sure the Lowerkit pins are aiming straight for the
socket.

Push the Lowerkit into the VDG socket
(Photo 2) with thumbs and knuckles. It must go in
absolutely straight.

Replacing the VDG

Pick up the VDG, and orient it in the same
direction it came out of the computer -- with the
notch pointing to the right. Set it into the
socket on the Lowerkit, making sure all the pins
line up precisely, and that none are likely to
bend underneath. Press it in place.

The electronic modifications are now
complete, unless you have requested the
Lowerkit-disable (Option #1) or additional
character sets (Option #2). If you requested
these options, please turn now to the appropriate
section in this documentation.

Replace the RF shield, which will still
fit in place, though it will ride about 1/8 inch
higher than before. A few pieces of tape will
secure it if you don't think it's tight enough.

Reinstall the cover.
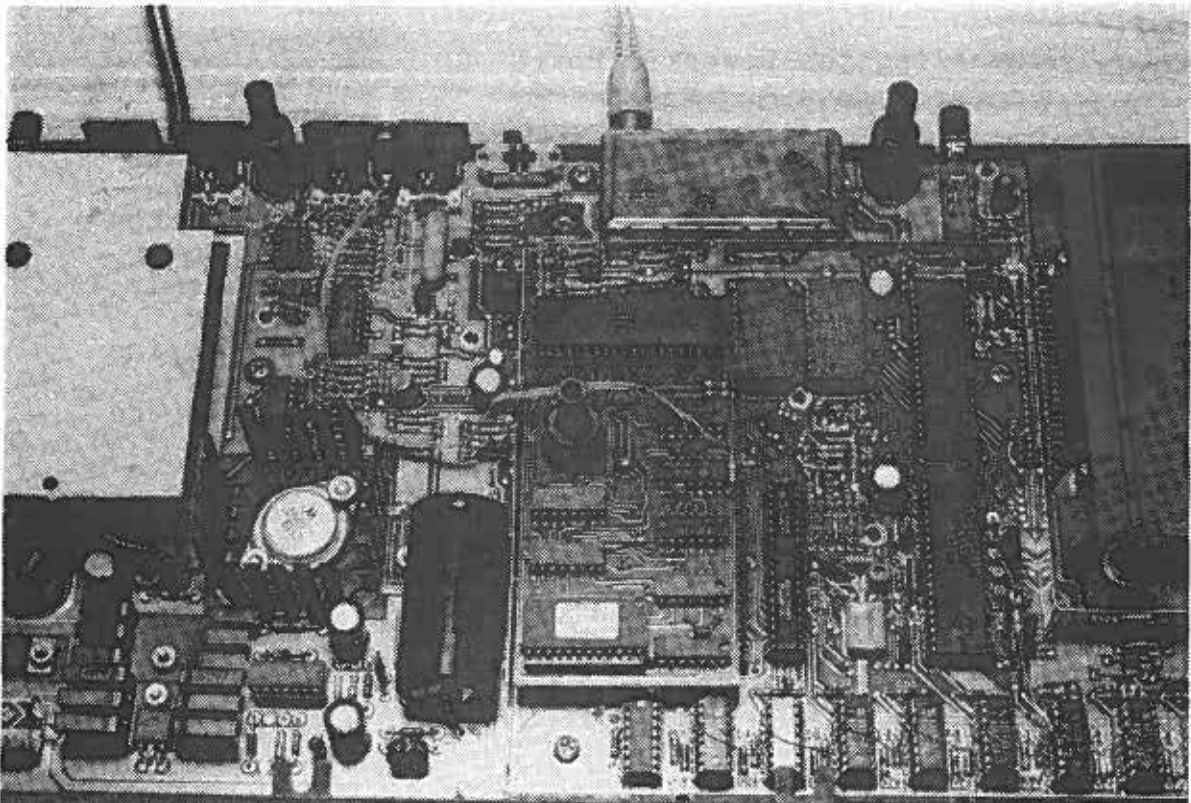
Testing the Installation

       Plug in the computer and restore the
power. Your "Color Basic" or "Extended Color
Basic" message should appear in the new Lowerkit
uppercase characters. They will be larger and
more dramatic than your original set. Now enter
this program:

```
10        FOR X = 0 TO 255
20        PRINT CHR$(X);
30        NEXT
```

Run it. The whole printable character set,
including graphics, will appear on the screen.
Lower case is now true lower case, not reverse
characters.

       But there are a few hidden characters as
well. Try this program:

```
10        FOR X = 1024 TO 1024+255
20        POKE X,Y
30        Y = Y + 1
40        NEXT
50        GOTO 50
```

If you have elected the stock character option, a
set of "gaming" or control characters will appear
along with the regular set. Otherwise, your
special characters will appear on the screen in
these locations.

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What to Do . . . .
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```

. . . if the screen is blank.

Make sure the VDG is fully it its
socket in the Lowerkit. Also, check for
proper insertion of the Lowerkit itself
in its socket. The pins should be
fully inserted, and not bent out the
side or under. These pins are very
strong, so bent pins should not be a
problem, but make sure anyway. Also,
check that the pins are not pushed in
the socket one position to the right.
The socket has 40 pins, and the Lowerkit
has 40 pins. They match.

. . . if only old characters appear.

If you have the switch option, make sure
you have switched the new character set
"in". If neither position has any ef-
fect, check that you have not broken any
wires leading to the switch, either at
the switch or on the board. Note that a
jumper resistor must be soldered to the
74LS125 between pins 1 and 14. If you
do not have the switch option, make sure
a small wire jumper is in place, found
between the 74LS04 and the 74LS125.

. . . if there is garbage on the screen.

Check that the VDG is fully inserted in
its new socket, and that the character
generator is also in its socket. The
notches or dots on both these ICs point
to the right (with the keyboard facing
you).

. . . if the wrong characters appear.

You may have ordered a special character
set, or the character generator may have
some pins bent underneath or out of the
socket.

. . . if the screen is black with white,
     evenly spaced vertical lines.

The character generator is out of its
socket, pins are bent underneath, or
slipping out the side. It may also be
inserted backwards, or an end lifted.
If you have the zero-insertion-force
socket option, make sure the handle is
pushed down.

If problems persist, call MSB Electronics
or return your Lowerkit immediately for a
replacement. Lowerkit KIT builders should refer
to return/repair instructions.

Maintenance, Upgrading, Repairs

No maintenance is needed for your Word
Processing Lowerkit, since the hardware has been
designed for consistent and reliable operation.

From time to time, other versions of the
Lowerkit incorporating additional features may be
offered. If new features are added, Lowerkit
owners will be given upgrade options at very low
cost. Please inquire if you see any new features
announced.

During the warranty period for the Word
Processing Lowerkit, repairs will be made at no
charge. Write or call for a repair authorization
card, and provide a complete description of the
problems encountered. This will give us the
opportunity to assist you if the problem is (for
example) merely one of incorrect installation.
Pack the Lowerkit carefully -- pins bent by the
user or due to improper packing are not covered by
the warranty -- and insure it for $100. Work will
be done promptly and the Lowerkit returned
postpaid.

If the Lowerkit is outside of warranty,
repair charges will be made at $30 per hour, plus
parts and postage. Note: we do NOT charge a full
hour if the work doesn't take a full hour. If the
work takes 10 minutes, you pay $5. And we don't
charge you for opening the package.

Kit versions are provided with a similar
warranty (subject to the requirements in the
assembly booklet). Any units which do not work
when assembled will be repaired and returned for
$7.50 plus parts, postpaid. Be sure to return the
kit registration only after your Lowerkit is
assembled and working to provide warranty
protection for your Lowerkit.

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          -----------------------------
          -- Replacement Parts List --
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              Available from MSB Electronics.
                Add $1 for postage/handling.


74LS04           .50          74LS125         .50
74LS73           .50          74LS93          .75
75LS86           .50          74LS157        1.00
2716 (GEN40)   15.00          Resistors       .15
24-pin socket   1.00          Capacitors      .15
40-pin socket   1.50          ZIF socket     9.00
PC board       20.00          SPST switch    1.50
Header (40)     2.50          Documentation  2.50

Complete kit of parts,                       45.00
(saves $5.65 over individual parts)

Character generator development software
     (CHARIT), including 10% discount on
     character generators programmed by MSB
     from CHARIT tapes,                       20.00

Character generators programmed from CHARIT
     software,                                22.50

Character generators programmed from user
     tapes (other than from CHARIT),          25.00

Programming of user-supplied ROMs (type
     2716-1 or 27A16 only!),                  15.00

       >>>>> Character generators <<<<<
                 $15.00 each
     (*allow 2 weeks additional for delivery)

ASCII/Greek, GEN10           ASCII/Arabic, GEN60*
ASCII/Kata Kana, GEN20       ASCII/Hebrew, GEN70*
Kata Kana/ASCII, GEN30       ASCII/French, GEN80
ASCII/gaming, GEN40          ASCII/European, GEN90
ASCII/Cyrillic, GEN50*       ASCII/Math, GEN25*
ASCII/APL, GEN15*
```

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Option    :   Additional Character Sets
----------------------------------------
```

Additional character sets are available
from MSB Electronics. These are:

* ASCII upper/lower and gaming
    characters (standard).
* ASCII shifted with Greek.
* ASCII shifted with Kata Kana.
* Kata Kana shifted with ASCII
    (Kata Kana occupies
    normal ASCII positions).
* ASCII shifted with Cyrillic.
* ASCII shifted with Arabic.
* ASCII shifted with Hebrew.
* ASCII with French characters.
* ASCII shifted with European
    character variants.
* ASCII shifted with math symbols
    and operators.

Special character sets of any kind may be
obtained. MSB Electronics can create your special
character set in this format (7 x 12 matrix):

```
Ø X X X X X X X        =        Byte 1
Ø X X X X X X X        =        Byte 2
Ø X X X X X X X        =        Byte 3
Ø X X X X X X X        =        Byte 4
Ø X X X X X X X        =        Byte 5
Ø X X X X X X X        =        Byte 6
Ø X X X X X X X        =        Byte 7
Ø X X X X X X X        =        Byte 8
Ø X X X X X X X        =        Byte 9
Ø X X X X X X X        =        Byte 10
Ø X X X X X X X        =        Byte 11
Ø X X X X X X X        =        Byte 12
1 1 1 1 1 1 1 1        =        Byte 13
1 1 1 1 1 1 1 1        =        Byte 14
1 1 1 1 1 1 1 1        =        Byte 15
1 1 1 1 1 1 1 1        =        Byte 16
```

An audio cassette may be sent in the standard
telephone communications format 300 baud, 8-bit
word, one start bit, one stop bit, parity
disabled. Please include a 10-second starting
tone, and make at least 3 copies on the tape.

ROM characters memory map must be in this format:

Bytes 000-1FF   Special Characters (hex 00-1F)
Bytes 200-3FF   Numbers & Symbols (hex 20-3F)
Bytes 400-5FF   ASCII Uppercase (hex 40-5F)
Bytes 600-7FF   ASCII Lowercase (hex 60-7F)

Note: Complete software for the Color Computer or
the TRS-80 Model I is available to create full
character sets. The "standard" character set is
installed in the software for you to modify.

Character preparation example ...

Character desired: A, uppercase,
                                with underscore
Hex value desired: 41
ROM map position required: 410-41F
Byte pattern resultant:

        0 0 0 0 1 0 0 0   =   08
        0 0 0 1 0 1 0 0   =   14
        0 0 1 0 0 0 1 0   =   22
        0 1 0 0 0 0 0 1   =   41
        0 1 0 0 0 0 0 1   =   41
        0 1 1 1 1 1 1 1   =   7F
        0 1 0 0 0 0 0 1   =   41
        0 1 0 0 0 0 0 1   =   41
        0 1 0 0 0 0 0 1   =   41
        0 0 0 0 0 0 0 0   =   00
        0 1 1 1 1 1 1 1   =   7F
        0 0 0 0 0 0 0 0   =   00
        bytes 13-16   always FF

Therefore, the following byte stream must be
recorded on cassette as bytes 410 to 41F in order
to produce the "A" character with underscore:

08 14 22 41 41 7F 41 41 41 00 7F 00 FF FF FF FF

```
------------------------------------------
2716 Character Generator Information
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```

The 2716 character generator must have an access
time of 350 nS or better (2716-1 or 27A16). The
pinout is used in the following fashion:

```
         1 - ASCII bit 3        24 - Vcc, +5 volts
         2 - ASCII bit 2        23 - ASCII bit 4
         3 - ASCII bit 1        22 - ASCII bit 5
         4 - ASCII bit 0        21 - Vpp (to Vcc)
         5 - Screen Row Select 3   20 - Chip Select
         6 - Screen Row Select 2   19 - ASCII bit 6
         7 - Screen Row Select 1   18 - Output Enable
         8 - Screen Row Select 0   17 - Column 0 (NC)
         9 - Dot Column 1        16 - Dot Column 7
        10 - Dot Column 2        15 - Dot Column 6
        11 - Dot Column 3        14 - Dot Column 5
        12 - Ground              13 - Dot Column 4
```

***** PARTS PROVIDED WITH THE LOWERKIT >KIT< VERSION *****

```
1 __ 74LS04 integrated circuit, 14 pins
1 __ 74LS125 integrated circuit, 14 pins
1 __ 74LS73 integrated circuit, 14 pins
1 __ 74LS93 integrated circuit, 14 pins
1 __ 74LS86 integrated circuit, 14 pins
2 __ 74LS157 integrated circuits, 16 pins
1 __ 2716-1 integrated circuit, 24 pins
       (GEN40, unless otherwise requested)
3 __ 1,000 ohm resistors, 1/4 watt, 5 percent
       (brown-black-red-gold)
1 __ 470 ohm resistor, 1/4 watt, 5 percent
       (yellow-purple-brown-gold) * OR *
       510 ohm  resistor, 1/4 watt, 5 percent
       (green-brown-brown-gold)
3 __ 0.1 or 0.01 mF disc capacitors (marked
       0.1, 0.01, 104, 103, 104K, or 103K)
1 __ 24-pin socket, low-profile type
       (Zero Insertion Force if requested)
1 __ 40-pin socket, low-profile type
2 __ 20-pin header strips (or total equivalent
       of 40 header pins)
1 __ double-sided printed circuit board
1 __ single-pole, single-throw switch
       (supplied if disable option requested)
```

```
====================================================================
           ASSEMBLING THE LOWERKIT PRINTED CIRCUIT BOARD
====================================================================
```

Check off each assembly step as you complete it.

( ) Do NOT remove the GEN40 character generator from its packing
material until you are instructed to do so.

( ) Orient the printed circuit board with the message "C1981 D.KITSZ
Rev. B" at the top, furthest away from you. This is the component side
of the board. All components, with one exception, will be mounted on
this side; this is referred to as the "top" or "component" of the board.
The other side of the printed circuit board is referred to as the
"bottom" or "solder side" of the board.

( ) Note that just below the copyright message are four rows of parallel
holes with 20 holes per row. Below these holes and to the right are 10
rows of parallel holes (each row contains seven holes) that extend to
the bottom right of the board. Five integrated circuits will be
inserted into these holes.

( ) Note: When describing integrated circuits, a notch or dot will be
mentioned. Each integrated circuit will have a notch or dot at one end.
Some will have a dot at both ends, but only one notch. Some will have a
dot at both ends but no notch, but one dot will be smaller; this is the
correct dot.

( ) Pick up the 74LS04 integrated circuit. Orient it so the dot or
notch is nearest the right edge of the printed circuit board.

( ) Insert the 74LS04 into the the first pair of the 10 rows of parallel
holes noted above. Be sure the notch or dot is pointed to the edge of
the board. You may have to bend the pins very slightly to insert it.

( ) Turn the board over while holding the integrated circuit firmly in
place. Bend over two diagonally opposite pins to hold the integrated
circuit in place.

( ) Solder all 14 pins of the 74LS04 from the solder side of the board.
Solder need not flow through to the top, because holes are plated
through the board to make the electrical connection.

( ) Pick up the 74LS125 integrated circuit and insert it, with the notch
or dot toward the edge of the board, in the next set of holes toward the
bottom of the printed circuit board.

( ) Hold, flip, bend, and solder the 74LS125 as described above.

( ) Pick up the 74LS73 integrated circuit and insert it, with the notch
or dot toward the edge of the board, in the next set of holes toward the
bottom of the printed circuit board.

( ) Hold, flip, bend, and solder the 74LS73 as described above.

( ) Pick up the 74LS93 integrated circuit and insert it, with the notch or dot toward the edge of the board, in the next set of holes toward the bottom of the printed circuit board.

( ) Hold, flip, bend, and solder the 74LS93 as described above.

( ) Pick up the 74LS86 integrated circuit and insert it, with the notch or dot toward the edge of the printed circuit board, in the last set of holes in the row.

( ) Hold, flip, bend, and solder the 74LS86 as described above.

( ) Note the four rows of parallel holes just below the large post hole in the printed circuit board. Two integrated circuits will be soldered in these holes.

( ) Pick up a 74LS157 integrated circuit and insert it, with the notch or dot to the right (the same direction as the other ICs) and insert it in the set of holes below the post hole.

( ) Hold, flip, bend, and solder the 74LS157 as described above.

( ) Pick up the other 74LS157 and insert it in the next set of holes toward the bottom of the printed circuit board, with the notch or hole in the same direction as the first one.

( ) Hold, flip, bend, and solder the second 74LS157 as described above.

( ) Take a break.

( ) Find the two parallel rows of 12 holes nearest you, running left to right at the bottom of the board, below the 74LS157 integrated circuits.

( ) Locate the 24-pin socket. Mount it with the notch to the right (same as the ICs), in the parallel set of holes.

( ) While gently holding the socket in place, turn the board over and solder all 24 pins.

( ) At this time locate the four resistors and the three capacitors. The three capacitors will be mounted first; the values are identical and they are interchangeable. The capacitors may be marked 0.1, 0.01, 103, or 104.

( ) Note: You may wish to refer to the diagram on the next page when mounting these resistors and capacitors.

( ) Find the first hole diagonally to the upper right of the top 74LS157. There is a second hole about 1/4 inch to the right. Insert one capacitor in this pair of holes.

( ) While holding the capacitor in place, flip the board over.

( ) Solder both leads of the capacitor.

( ) Find the pair of holes between the 74LS125 and the 74LS73.

( ) Insert a second capacitor, flip the board, and solder both leads.

( ) Find the pair of holes between the 74LS93 and the 74LS86.

( ) Insert the last capacitor, flip the board, and solder both leads.

( ) Clip off the excess from the six wires; leave only about 1/16 inch protruding from the bottom of the board.

( ) Find the four holes on the right side of the board above the rightmost end of the 74LS04.

( ) Insert a 1,000-ohm resistor (brown-black-red-gold) in the topmost pair, flip the board, and solder both leads.

( ) Insert a 1,000-ohm resistor (brown-black-red-gold) in the bottom pair, flip the board, and solder both leads.

( ) Clip off the excess from the four wires.

( ) Find the hole to the top right of the bottom 74LS157. Find a second hole about 1/2 inch to its right. (You may need to refer to the diagram to be sure).

( ) Insert a 470-ohm (yellow-purple-brown-gold) or 510-ohm (green-brown-brown-gold) resistor in these holes, flip the board, and solder both leads.

( ) Clip off the excess from these two wires.

( ) Find the hole immediately to the bottom right of the 74LS125. Find a pair of holes to the top right of the 74LS125.

( ) Insert a 1,000-ohm resistor (brown-black-red-gold) in the rightmost of the pair of holes, and its other end into the lower hole.

( ) Flip the board, solder both leads, and clip off the excess.

( ) Locate the two 20 pin standoff strips. Note: These are the only parts that mount from the solder side of the printed circuit board. Also note that one side of each strip has a metal collar and slightly larger pins.

( ) Find the four rows of 20 parallel holes just below the copyright message at the top of the board.

( ) From the solder side of the board, insert one standoff strip in the second row of holes from the top of the printed circuit board. Insert the strip so that the larger pins go into the printed circuit board.

( ) Holding the strip so that the collars are flush with the solder side
of the printed circuit board, solder the end pins from the component
side of the printed circuit board. This will hold the strip in place.
Make sure that the header is perfectly vertical; reheat the solder if
necessary to assure that the strip is correctly positioned.

( ) Solder the remaining 18 pins of that strip.

( ) Insert the other standoff in the bottom set of 20 parallel holes
(fourth row from the top). This should also be inserted from the solder
side of the board.

( ) Solder the end pins, then the remaining 18 pins of the strip as
described above.

( ) With nail clippers or fine wire cutters, from the top (component)
side of the printed circuit board, cut the two end protruding pins in
the second row of 20 parallel holes as close as possible to the printed
circuit board. You will be inserting a socket over this row of pins.
If, when you attempt to insert the socket, it will not fit fairly flush
with the board, then remove the socket and clip the remaining 18 pins
from the pin strips.

( ) Locate the 40 pin socket. Insert it in the remaining 40 holes on
the component side of the printed circuit board (first and third rows).
Press carefully until it is almost flush with the surface of the board.
It should slide between some of the protruding pins; if not, see the
step above.

( ) Hold the socket in place and parallel to the printed circuit board.
Turn the board over and bend two diagonally opposite pins to hold the
socket in place.

( ) Solder all 40 pins of this socket.

( ) With your hand, touch a grounded object, such as a cold water pipe
or large metallic object.

( ) While holding the grounded object, remove the GEN40 from its
protective carrier. Insert it with the notch to the right of the
printed circuit board (the same direction as the notch on the socket and
the notches on all the other integrated circuits). Be sure that all
pins of the GEN40 go into the socket and that none get bent underneath
or off to the side of the socket.

( ) If your lowerkit was ordered without the restore switch option,
install a jumper as indicated on the next page.

( ) Double-check that all solder connections are complete, and that
there are no unsoldered or shorted connections.

( ) Look again at the two neighboring holes above the 74LS125.

( ) Find a second hole about 3/4 inch to the left.

* If you are going to use the Lowerkit without a disable switch:

( ) Install a jumper wire between these two holes, and solder it in place.

* If you are going to use the Lowerkit with a disable switch:

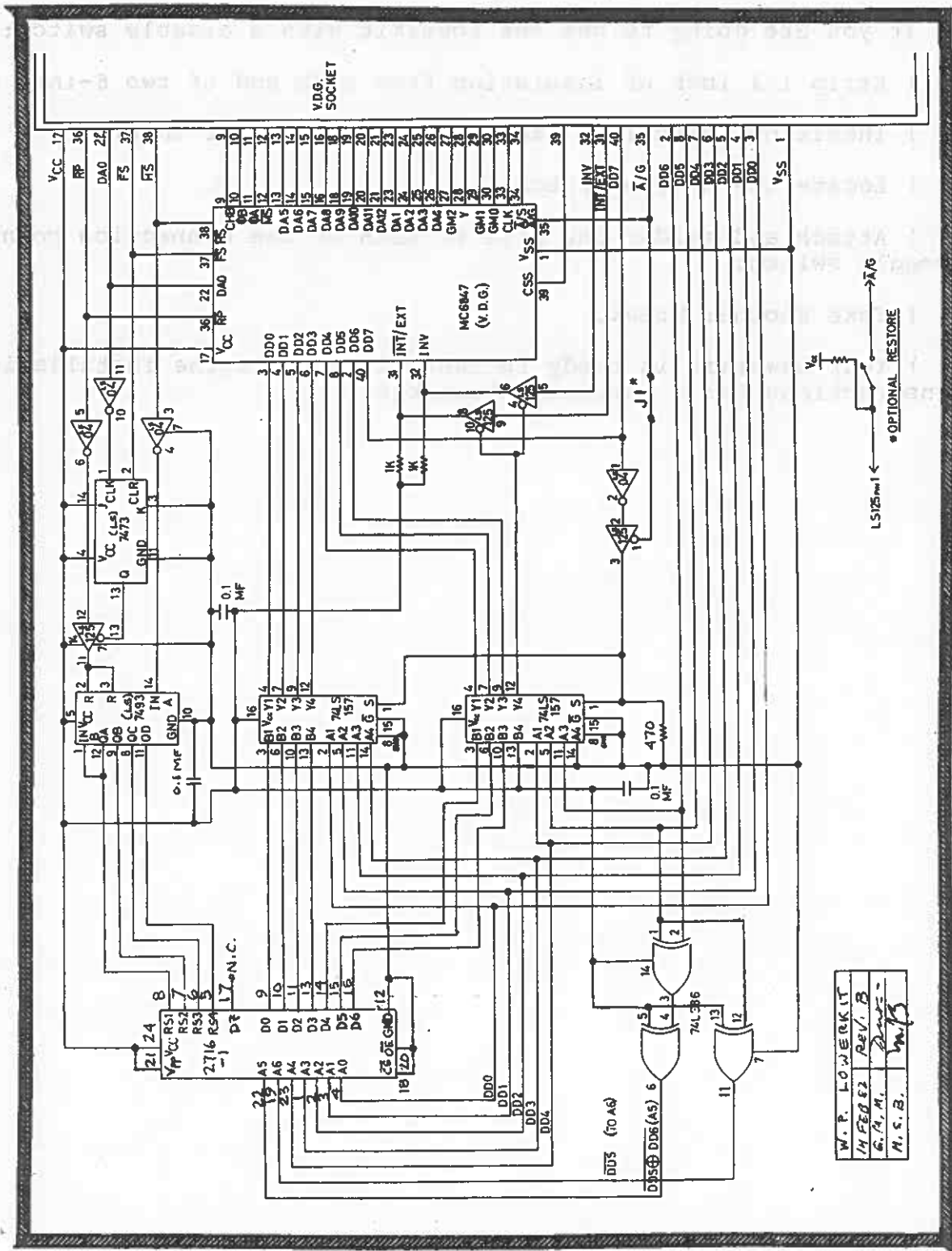( ) Strip 1/4 inch of insulation from each end of two 6-inch wires.

( ) Insert one wire into each hole and solder it in place.
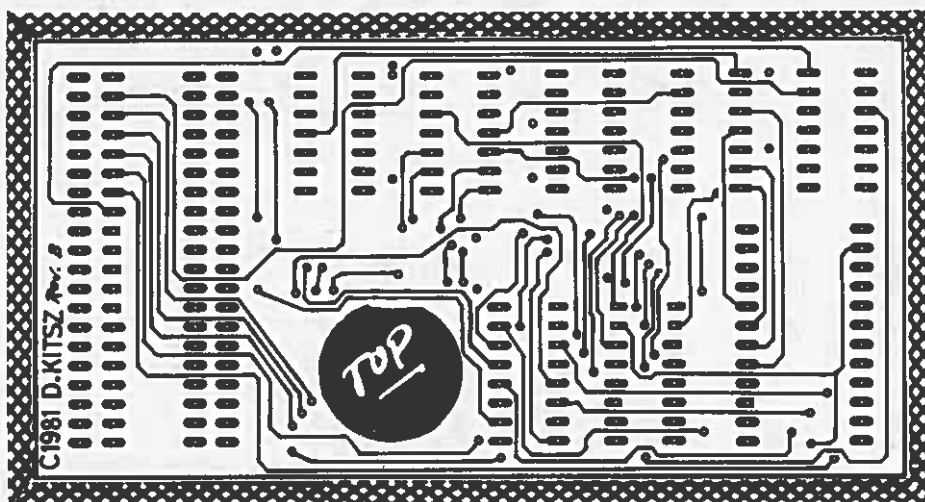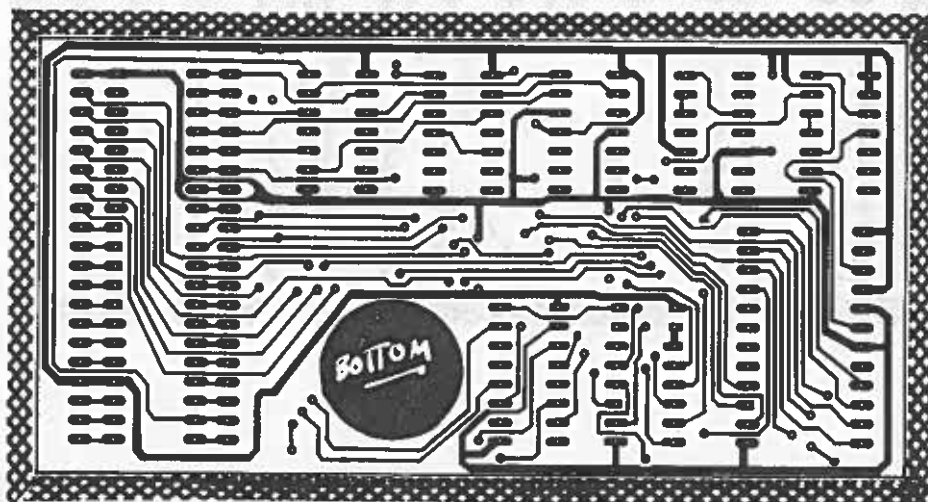
( ) Locate the toggle switch.

( ) Attach and solder one wire to each of the connection points on the toggle switch.

( ) Take another break.

( ) Your Lowerkit is ready to install; turn to the installation instructions for a completed Lowerkit.
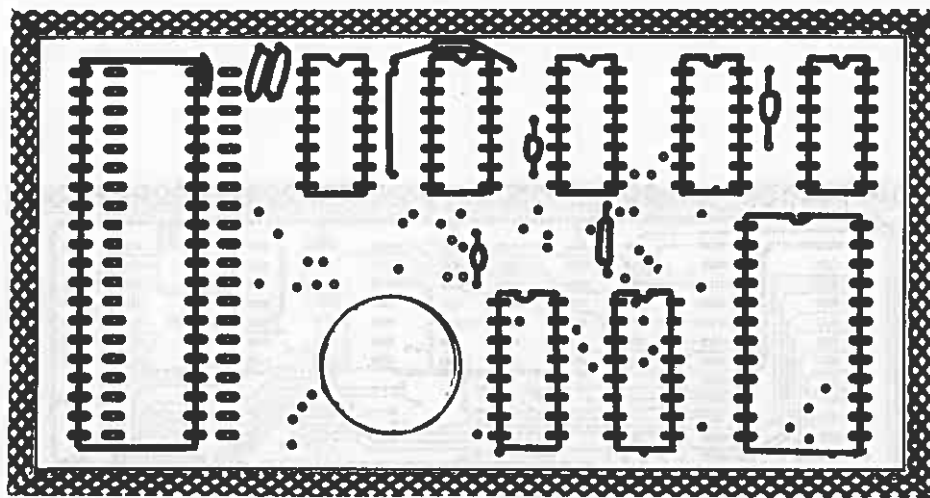
***** LOWERKIT PRINTED CIRCUIT BOARD ETCHING GUIDES *****

These guides are provided for troubleshooting only. Use
of these guides for commercial production is prohibited.

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THE WORD PROCESSING LOWERKIT (tm)
FOR THE TRS-80 COLOR COMPUTER

Designed by Dennis Bathory Kitsz,
monthly "80 Applications" columnist

DESCRIPTION OF THE WORD PROCESSING LOWERKIT

The Word Processing Lowerkit has been designed to meet the needs of Color Computer users with serious applications. It is intended to set the standard for lowercase on the Color Computer.

The Word Processing Lowerkit is a piggyback board designed to press in place, without soldering, inside the TRS-80 Color Computer. It is a 2¼"x 4½" board; the standard version fits snugly inside the metal shield.

The purpose of the Lowerkit is to display true upper and lower case characters in place of the unattractive normal/reverse caps display now used by the computer. As an added feature, the Lowerkit uses a 7 x 12 dot matrix for display (rather than the built-in 5 x 7 matrix) for large, clear letters. These letters look very well balanced on the computer's short 32 character line.

All characters have descenders where necessary (comma, semicolon, lowercase letters, g, j, p, q, y). The character set in the standard generator is fully compatible with the normal Color Computer character set, with the exception that lowercase letters are correctly displayed. The standard character set (GEN 40) includes a set of 32 gaming characters that are available with the Poke Command.

SPECIFICATIONS

7 LSTTL integrated circuits, one character generator
Double-sided expoxy glass PC board with sockets for the
  VDG and character generator plus standoffs to insert
  in the Color Computer socket
OPTIONAL CHARACTER GENERATORS AVAILABLE:
  ASCII Shifted with Greek
  ASCII Shifted with Kata Kana
  ASCII Shifted with APL character set
  Kata Kana shifted with ASCII
  ASCII Shifted with Cyrillic
  ASCII Shifted with Arabic
  ASCII Shifted with Hebrew
  ASCII Shifted with French characters
  ASCII Shifted with European character variants
  ASCII Shifted with Math symbols and operators
  Custom Generators made to user specifications

COMPLETE LOWERKIT PACKAGES AND OPTIONS

The Lowerkit consists of an assembled and tested, ready-to-mount circuit board, complete documentation (including schematics and installation instructions). No soldering is required to use the standard version. In summary, to install the Lowerkit: the computer is opened, the RF shield lifted off, the VDG removed from its socket, the Lowerkit pressed in place, the VDG pressed into the Lowerkit, the RF shield replaced, and cover re-installed.

RESTORE SWITCH OPTION

The original Color Computer display may be restored by flipping a switch; because the original display is no match for the Lowerkit display, it is offered only as an option.

INSTALLATION IN EARLIER MACHINES

In some early runs of the Color Computer, the Video Display Generator is soldered to the board, rather than socketed. If a Lowerkit purchaser finds his computer is from this early run, the options are: the user may desolder the 40-pin VDG and put a socket in place (not recommended for average users); the user may return the sealed plastic package containing the Lowerkit board for full refund; or the user may request installation of the Lowerkit.

Installation support can be provided by MSB Electronics (Drawer 766, Barre, Vermont, 05641). Forty-eight hour maximum turnaround time is promised by MSB. The fee for this installation is $25.00.

KIT OPTION

MSB Electronics is also making available a printed circuit board and complete kit of parts for hobbyists, at a lower price than the finished package. The PC board with construction information and documentation will be $20.00, the character generator $15.00, the set of LSTTL integrated circuits $15.00, sockets and standoff hardware $15.00. The complete kit including instructions and documentation will be $45.00.

Users of the Lowerkit are welcome to contact either MSB Electronics or Dennis Kitsz by telephone for answers to any questions about operation and installation.

ORDERING INFORMATION

Word Processing Lowerkit, complete ---------- $79.95

Word Processing Lowerkit, kit of parts ------ $45.00

PC Board and Documentation Only ------------- $20.00

Character Generator ------------------------- $15.00

LSTTL Integrated Circuits ------------------- $15.00

Hardware ------------------------------------ $15.00

Add $2.50 for Shipping and Handling (Blue Label UPS
shipping will be used if available in your area)

To order: Send name and complete address (for UPS delivery) to:

MSB ELECTRONICS
P.O. DRAWER 766
BARRE, VT 05641

802-476-7311

We accept VISA and MASTERCARD. If personal checks are sent please
allow two weeks delivery for clearance.