

CONVERT YOUR TRS-80 TO UPPER/LOWER CASE
by Donald L. Stoner, W6TNS/7 and Richard Barker, WA7DLE
THE PERIPHERAL PEOPLE
Post Office Box 524
Mercer Island, Wa. 98040

Radio Shack didn't overlook much when they designed the TRS-80 system. It is unquestionably the most popular computer of all time, with sales are well into six figures.

At the time the TRS-80 was being developed, graphics was the big "buzz word" in the hobby computer industry. Graphics helped in the transition from video games to hobby computers for the American public. The marketing people at Tandy were probably so insistant on having better graphics that they overlooked one of the most important markets for the TRS-80..... word processing.

If you are frugal, and have a bit of electronic knowledge, you can build up a word processor for around \$1000. The basic TRS-80 costs \$600 and the careful shopper can find plenty of Selectrics for less than \$400.

It's impossible to have an effective word processor without an upper/lower case capability, however. An early brochure on the TRS-80 mentioned that you could have upper and lower case in your TRS-80, but you would have to give up the graphics capability. Repeated inquires to Tandy Corp. by the author (some of them rather heated) failed to reveal exactly how this could be done.

As it turns out, you can easily have keyboard selection of case without giving up graphics. The information which follows tells you how. I call it a "convertable conversion". It is simple to install but, more important, can be removed in a matter of minutes in case you need warranty repairs to your keyboard. No holes are drilled in the case or circuit board.

Materials Required-- Besides the usual tools and soldering iron, you will need the following components. All these materials are available from your friendly Radio Shack store. Their part numbers are shown in parenthesis. You will also need a little electronic knowledge to complete the conversion. If you are a little weak in this area, consult a friend you consider knowledgeable in electronics. He can be very helpful if you get in trouble!

short lengths of kynar wire (278-503)
one type 2102 IC (276-2501)
one type 7486 IC (276-1827)
one 4.7K, 1/4 watt resistor (271-030)
one DPDT toggle switch (275-614)
five 6" lengths of hookup wire (see Figure 2)

The switch is required in case you want to return the circuit to its original configuration. This is necessary if you own (or plan to purchase) any machine language programs such as MicroChess 1.5. Without the switch, the alpha characters in MicroChess (and similar programs) appear as wierd control characters. However, the switch is normally left in the conversion position and does not affect basic programs.

Conversion Procedure-- Ready for the big step? Start by forgetting you paid more than \$600 for the TRS-80 and plunge ahead.

1. Disconnect your keyboard and lay it face down on a bath towel, to prevent scratching.
2. Remove the six screws. Note there are three different types. Be sure to get them back in the correct holes when reassembling.
3. Carefully turn the case over and remove the top cover. Lift out

the keyboard assembly from the posts and remove the plastic spacers. Remove the second circuit board and set the bottom case section aside. Do not flex the copper cable (which connects the two boards) excessively. The two boards do not disconnect from each other.

4. Set the two boards down, component side up (with the keyboard to the rear), on your work towel. The values marked on the main board should read correctly (not upside down).

5. Observe the lower left area of the main circuit board (not the one with the keys). Locate IC chips z60 and z61. You will be "piggybacking" a new IC on the top of each one of these chips. If you do not know how, learn to read the pin numbers of these integrated circuits. Pin 1 is the reference pin and is located at the upper left hand corner of the chip, nearest the z-number printed on the circuit board. There is also a dot indentation in the plastic body of the chip nearest pin 1. The pins are numbered successively from pin 1 down one side and up the other. Thus the highest numbered pin (usually 14 or 16) is opposite pin 1. Note that z60 (marked 74LS367) and z61 (marked 2102) are both 16 pin chips. Also locate z30. You are actually going to do a coronary bypass by cutting a circuit board trace near this chip and another circuit trace on the bottom of the board.

Still game? It is not too late to put everything back together, get some orange model airplane cement (butyl acetate), touch up the warranty paint seal and Radio Shack will be none the wiser! Proceed, you say? Stout fellow!

6. First, we are going to stack the new 2102 chip on top of z61, which also happens to be a 2102. First, however, bend up pins 11 and 12 of the new 2102 (let's call it z61P, for piggyback) at right angles so they cannot touch pins 11 or 12 of z61.

7. Next, solder (pin for pin and don't get it reversed end for end) z61P on top of z61. Use extreme caution to get all pins (except 11 and 12, of course) securely connected. Equally important, do not get any solder bridges between pins or from one of the pins to the circuit board.

8. Connect a short direct wire from pin 5 of z60 to pin 11 of z61P. Pin 12 of z61P will be connected to the toggle switch later.

Okeh, that was the easy part. Next we have to "piggyback" the 7486 chip on top of z60. We'll call this added chip z60P. Unfortunately, z60P is a 14 pin chip, while z60 has 16 pins. Thus, we cannot make a pin-for-pin connection as we did with the 2102.

9. Bend pins 8,9,10,11,12 and 13 of z60P at right angles so that they cannot touch the pins of z60. Only pin 14 on this side of the chip will be used.

10. Bend pins 1,14 and 7 slightly so they will contact 1,16 and 8 when z60P is joined to z60.

11. Bend pins 4 and 5 of z60P away from each other so they will contact pins 4 and 6 of z60 when the two chips are joined.

12. Bend pins 2,3 and 6 of z60P at right angles so they cannot touch the pins of z60.

13. Place z60P over z60 to insure you can make the following solder connections. Looks good? Okeh, solder the connections. The first number is z60P, the second is z60.

Pin 1 to Pin 1
Pin 14 to Pin 16
Pin 7 to Pin 8
Pin 5 to Pin 6
Pin 4 to Pin 4

14. Connect the 4.7K, 1/4 watt resistor between pins 1 and 14 of z60P.

15. Connect a short direct length of Kynar wire from pin 2 to pin 6 of z60P. For the moment, leave pin 3 of z60P disconnected. It will be connected to the toggle switch later.

16. Refer to the sketch in Figure 1. Locate the area shown between z29 and z30 and cut the trace with an Xacto knife at the point shown. This point can be bridged with a short piece of bare Kynar wire if it is necessary to remove the conversion.

17. On the reverse side of the board, locate the circuit trace that goes from pin 13 of z30 to pin 4 of z60 (see Figure 1). Make a small cut in this trace that can be bridged later, if the conversion is removed.

18. The last conversion step is to connect the toggle switch. Use the 6" lengths of hookup wire to prepare the switch as shown in Figure 2. Connect the switch in the following manner:

Connect the green wire to pin 13 of z30.
 Connect the orange wire to pin 4 of z60.
 Connect the yellow wire to pin 12 of z61P.
 Connect the red wire to pin 3 of z60P.
 Connect the brown wire to pin 13 of z27.

Don't forget to include the jumper on the switch, as shown in Figure 2. Place the switch in the conversion position (with the handle toward the green wire end).

This completes the case conversion of the TRS-80. Carefully review your work to make absolutely certain there are no shorted wires or solder bridges. Check things with an ohmmeter if you have any doubt about any connection. Once you are certain all is well, reassemble everything by reversing the disassembly steps done earlier. Route the cable (with the toggle switch on the end) out the hole where the interface plug connects.

Power Up- After reconnecting everything, power up the system normally. The screen display should be the same as before with one small exception. Your cursor will no longer be a dash but, rather, will look like this . This is one of the control characters mentioned earlier. It takes some getting used to, but pretend it's a happy face!

Egad! All that work and still no lower case letters. For this, you are going to have to enter some software. If you did not purchase a software tape from The Peripheral People, use your T-Bug or DOS and enter the following machine language program. It is relocatable, depending on how much memory you have.

```

96 XX60: F5 3A 18 40 FE 01 20 06 79 C5 CD 3B 00 C1 3A 19
   XX70: 40 FE 01 28 04 F1 C3 58 04 F1 DD 6E 03 DD 66 04
128 XX80: DA 9A 04 DD 7E 05 B7 28 01 77 79 FE 80 D2 A6 04
   XX90: FE 20 DA 06 05 FE 40 DA 7D 04 FE 60 30 05 F6 20
110 XXA0: C3 7D 04 E6 9F C3 7D 04 3A 19 40 FE 01 20 14 79
   XXB0: FE 41 38 0E FE 7A 30 0A FE 5B 38 04 FE 20 38 02
   XXC0: EE 20 4F 3A 1A 40 FE 01 C2 8D 05 79 FE 0D 28 05
   XXD0: FE 0A C2 8D 05 11 00 20 1B 7A B3 20 FB 3E 0D 32
   XXE0: E8 37 11 00 20 1B 7A B3 20 FB 3E 0A 32 E8 37 11
   XXF0: 00 30 1B 7A B3 20 FB 0E 0D C9 00 00 00 00 00
  
```

The "XX" is the location. It should be 7F, BF or FF for 16K, 32K or 48K, respectively. Don't forget to protect your memory at 32605, 48991 or 65375 or your programs will go crashing into this routine with disastrous results. Incidentally don't forget to also save the routine on tape or disc. It can get a bit messy having to enter the machine code each time you want to use the upper-lower case conversion.

Testing- To see if all your hard work and electronic expertise paid off, type and enter the following patch to the start of the routine:

POKE16414,96:POKE16415,XXX:POKE16422,167:POKE16423,XXX.

The XXX's are the starting address and are the decimal equivalent of 7F, BF or FF for 16, 32 and 48K, respectively. This patch will be required at

191 255

U/A ON 4019,1 0FF 4019,0 (16409) | ECHO ON 4018,1 0FF 4018,0 (16408)

the start of any program which requires upper and lower case. Next, type and enter:

```
&H4019,1
```

Presto!! The screen should show READY in lower case letters. Besides this, the first thing you will probably notice is that the letter a is setting above the base line of the words. Early TRS-80's had a Motorola character generator ROM with an error in the font for this letter. In later units, this ROM error was corrected. You will also find that the "tails" on letters such as p, q, y and so on, don't extend below the baseline. This is because the character generator is only a 5 X 7 matrix. There simply are not enough dots available to print the "tails" below the baseline. The letters could be shifted electronically but, this is hardly worth the complication, trouble and expense (translation-I don't know how). Once you get used to the shifted letters, you won't notice them anyway.

You can get back to upper case only by typing:

```
poke &h4019,0
```

The two poke statements can be built into your programs. For example:

```
INPUT"WOULD YOU LIKE UPPER AND LOWER CASE";A$
IF LEFT$(A$,1)="Y" THEN POKE &H4019,1 ELSE POKE &H4019,0
```

It is interesting that an unmodified TRS-80 does have upper and lower case printing capability. Naturally, this is only apparent with a printer having a lower case capability. However, LPRINT produces upper case printing all the time unless you use the shift key when writing the program. Unfortunately, pressing the shift will cause lower case letters to be printed, which is just the opposite of what you want. The program which accompanies this article has provision for reversing the case out the printer port. The case reversal to the printer is made automatically when you use the above poke statement. Naturally, when you poke back to zero, the normal unshifted upper case printing occurs.

* The accompanying program also has provision for inserting an automatic line feed with each carriage return. If you have a Teletype, or similar machine which requires this, simply POKE &H401A,1 to turn it on and &H401A,0 to turn it off. The program will even add a carriage return after a line feed as required by some printers.

Finally, the program has an echo routine. To the best of my knowledge, this is the first time this feature has been offered to TRS-80 owners. This is extremely handy for a couple of reasons. Let's say you have a number of PRINT statements that must be changed to LPRINT before the printer will work. You can type POKE &H4018,1 just before these statements. Any subsequent print statements will echo on the screen and printout without adding L ahead of each.

The echo is also handy to turn your printer into a typewriter. By entering the echo poke statement, anything you type on the keyboard will echo on the printer. When you want to turn off this feature, simply type POKE &H4018,0

These features are all incorporated in the "ELECTRIC SECRETARY" word processing program which was used to type this manuscript. It is available from The Peripheral People for \$50.00 postage paid on a customer supplied DOS formatted disk for the TRS-80. The "ELECTRIC SECRETARY" can also be supplied on cassette for the same price, for customer transfer to a disk. Note, however, it is a disk based system only. Because of the self contained hyphenating dictionary (and other features) a cassette based system is not fast enough. A complete conversion kit of parts, including a machine language program tape, is also available from The Peripheral People (Box 524, Mercer Island Wa. 98040) for \$20.00 postage paid.

TRS-80 UPPER/LOWER CASE CONVERSION INSTRUCTIONS

Materials Required- Besides the usual tools and soldering iron, you will need the following components. All these materials are available from your friendly Radio Shack store. Their part numbers are shown in parenthesis. You will also need a little electronic knowledge to complete the conversion. If you are a little weak in this area, consult a friend you consider knowledgeable in electronics. He can be very helpful if you get in trouble!

- short lengths of kynar wire (278-503)
- one type 2102 IC (276-2501)
- one type 7486 IC (276-1827)
- one 4.7K, 1/4 watt resistor (271-030)
- one DPDT toggle switch (275-614)
- five 6" lengths of hookup wire (see Figure 2)

The switch is required in case you want to return the circuit to its original configuration. This is necessary if you own (or plan to purchase) any machine language programs such as MicroChess 1.5. Without the switch, the alpha characters in MicroChess (and similar programs) appear as wierd control characters. However, the switch is normally left in the conversion position and does not affect basic programs.

Conversion Procedure- Ready for the big step? Start by forgetting you paid more than \$600 for the TRS-80 and plunge ahead.

1. Disconnect your keyboard and lay it face down on a bath towel, to prevent scratching.

2. Remove the six screws. Note there are three different types. Be sure to get them back in the correct holes when reassembling.

3. Carefully turn the case over and remove the top cover. Lift out the keyboard assembly from the posts and remove the plastic spacers. Remove the second circuit board and set the bottom case section aside. Do not flex the copper cable (which connects the two boards) excessively. The two boards do not disconnect from each other.

4. Set the two boards down, component side up (with the keyboard to the rear), on your work towel. The values marked on the main board should read correctly (not upside down).

5. Observe the lower left area of the main circuit board (not the one with the keys). Locate IC chips z60 and z61. You will be "piggybacking" a new IC on the top of each one of these chips. If you do not know how, learn to read the pin numbers of these integrated circuits. Pin 1 is the reference pin and is located at the upper left hand corner of the chip, nearest the z-number printed on the circuit board. There is also a dot indentation in the plastic body of the chip nearest pin 1. The pins are numbered successively from pin 1 down one side and up the other. Thus the highest numbered pin (usually 14 or 16) is opposite pin 1. Note that z60 (marked 74LS367) and z61 (marked 2102) are both 16 pin chips. Also locate z30. You are actually going to do a coronary bypass by cutting a circuit board trace near this chip and another circuit trace on the bottom of the board.

Still game? It is not too late to put everything back together, get some orange model airplane cement (butyl acetate), touch up the warranty paint seal and Radio Shack will be none the wiser! Proceed, you say? Stout fellow!

6. First, we are going to stack the new 2102 chip on top of z61, which also happens to be a 2102. First, however, bend up pins 11 and 12 of the new 2102 (let's call it z61P, for piggyback) at right angles so they cannot touch pins 11 or 12 of z61.

7. Next, solder (pin for pin and don't get it reversed end for end) z61P on top of z61. Use extreme caution to get all pins (except 11 and 12, of course) securely connected. Equally important, do not get any solder bridges between pins or from one of the pins to the circuit board.

8. Connect a short direct wire from pin 5 of z60 to pin 11 of z61P. Pin 12 of z61P will be connected to the toggle switch later.

Okeh, that was the easy part. Next we have to "piggyback" the 7486 chip on top of z60. We'll call this added chip z60P. Unfortunately, z60P is a 14 pin chip, while z60 has 16 pins. Thus, we cannot make a pin-for-pin connection as we did with the 2102.

9. Bend pins 8,9,10,11,12 and 13 of z60P at right angles so that they

cannot touch the pins of z60. Only pin 14 on this side of the chip will be used.

10. Bend pins 1,14 and 7 slightly so they will contact 1,16 and 8 when z60P is joined to z60.

11. Bend pins 4 and 5 of z60P away from each other so they will contact pins 4 and 6 of z60 when the two chips are joined.

12. Bend pins 2,3 and 6 of z60P at right angles so they cannot touch the pins of z60.

13. Place z60P over z60 to insure you can make the following solder connections. Looks good? Okeh, solder the connections. The first number is z60P, the second is z60.

Pin 1 to Pin 1
Pin 14 to Pin 16
Pin 7 to Pin 8
Pin 5 to Pin 6
Pin 4 to Pin 4

14. Connect the 4.7K, 1/4 watt resistor between pins 1 and 14 of z60P.

15. Connect a short direct length of Kynar wire from pin 2 to pin 6 of z60P. For the moment, leave pin 3 of z60P disconnected. It will be connected to the toggle switch later.

16. Refer to the sketch in Figure 1. Locate the area shown between z29 and z30 and cut the trace with an Xacto knife at the point shown. This point can be bridged with a short piece of bare Kynar wire if it is necessary to remove the conversion.

17. On the reverse side of the board, locate the circuit trace that goes from pin 13 of z30 to pin 4 of z60 (see Figure 1). Make a small cut in this trace that can be bridged later, if the conversion is removed.

18. The last conversion step is to connect the toggle switch. Use the 6" lengths of hookup wire to prepare the switch as shown in Figure 2. Connect the switch in the following manner:

Connect the green wire to pin 13 of z30.
Connect the orange wire to pin 4 of z60.
Connect the yellow wire to pin 12 of z61P.
Connect the red wire to pin 3 of z60P.
Connect the brown wire to pin 13 of z27.

Don't forget to include the jumper on the switch, as shown in Figure 2. Place the switch in the conversion position (with the handle toward the green wire end).

This completes the case conversion of the TRS-80. Carefully review your work to make absolutely certain there are no shorted wires or solder bridges. Check things with an ohmmeter if you have any doubt about any connection. Once you are certain all is well, reassemble everything by reversing the disassembly steps done earlier. Route the cable (with the toggle switch on the end) out the hole where the interface plug connects.

Power Up- After reconnecting everything, power up the system normally. The screen display should be the same as before with one small exception. Your cursor will no longer be a dash but, rather, will look like this . This is one of the control characters mentioned earlier. It takes some getting used to, but pretend it's a happy face!

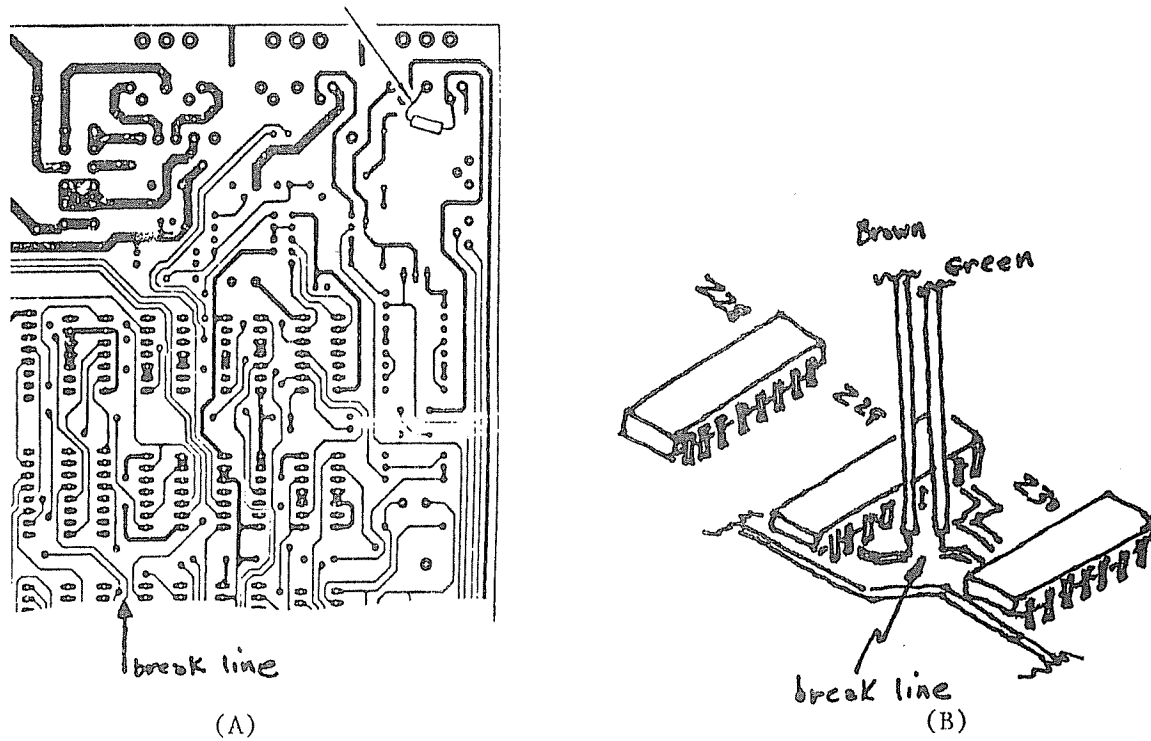


Figure 1- It is necessary to cut the circuit board in two places as shown here (circuit board drawing courtesy of Radio Shack)

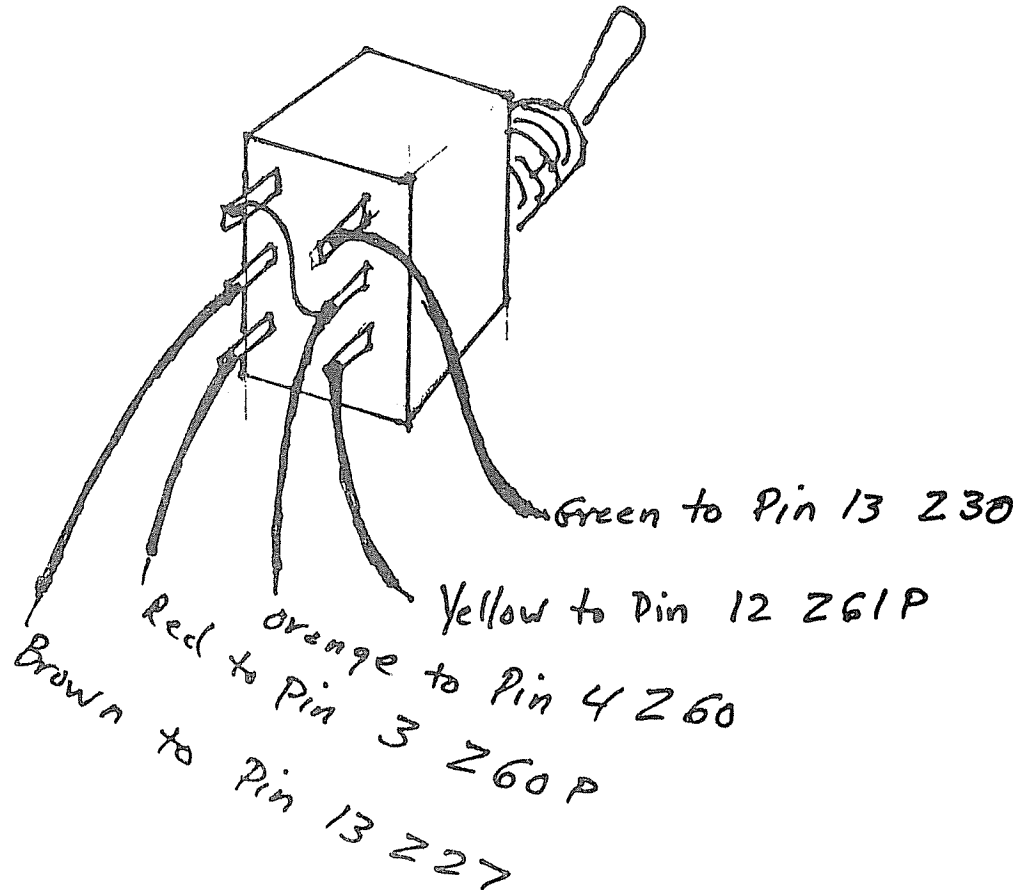


Figure 2- Pre-wire the switch as shown here. Don't forget to add the jumper.

Figure 3- Circuit diagram of the converted Upper/Lower case TRS-80. (circuit diagram courtesy of Radio Shack)

