### 1.9.6 Lower Case Mod

I'm aware of two lower-case kits that came out for the early System 80's.

One kit was from Personal Micro Computers Inc., California, the folk selling the System 80 equivalent (PMC 80) in the U.S. The characters produced with this kit were clear, but lacked descenders which made g, j, p, q and y look a bit strange.

The lower case Mod that I'm most familiar with was the one developed and sold by Micro-80. This replaced the character generator chip with an EPROM chip. I installed this in my own machine. Even upper case letters were clearer than the original System 80 font, true descenders were present and there was even a set of playing cards symbols! It was an easy mod to fit, and was the first time I'd actually modified my own machine. What a thrill!
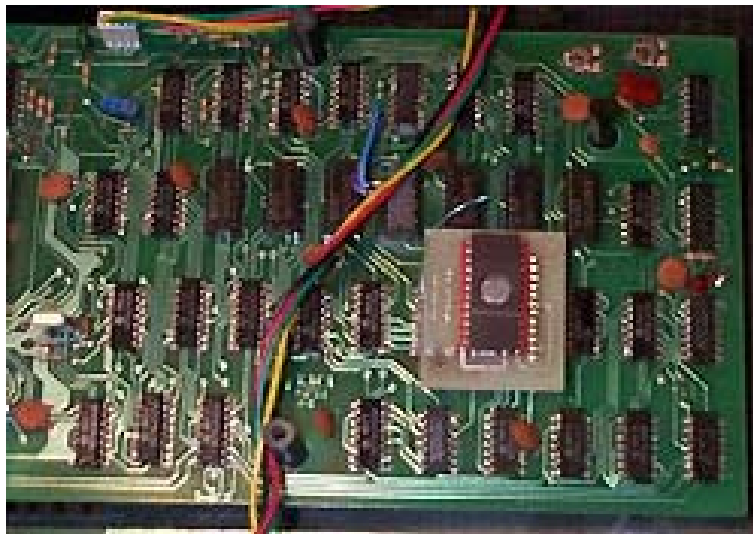
1.9.7 Sound Mod

This was the second modification made to my own machine by someone else though, not by me! Pre "blue-label" System 80 owners could not hear TRS 80 sound routines, even if a switch was fitted that "swapped" the two cassette ports. One reason was that bit 2 of port "FF" had to be set (i.e. B2=1) each time output data was fed to port FF to allow the data path through relay 2 contacts. This was solved by fitting a switch which "drove" relay two on permanently after loading the program.

Here is a drawing of the modification, taken from page 13, issue 19 (June 1981) of Micro-80. The diagram was designed to be used in conjunction with the Main Board Schematic in the Dick Smith System 80 Technical Manual.

FIG 1
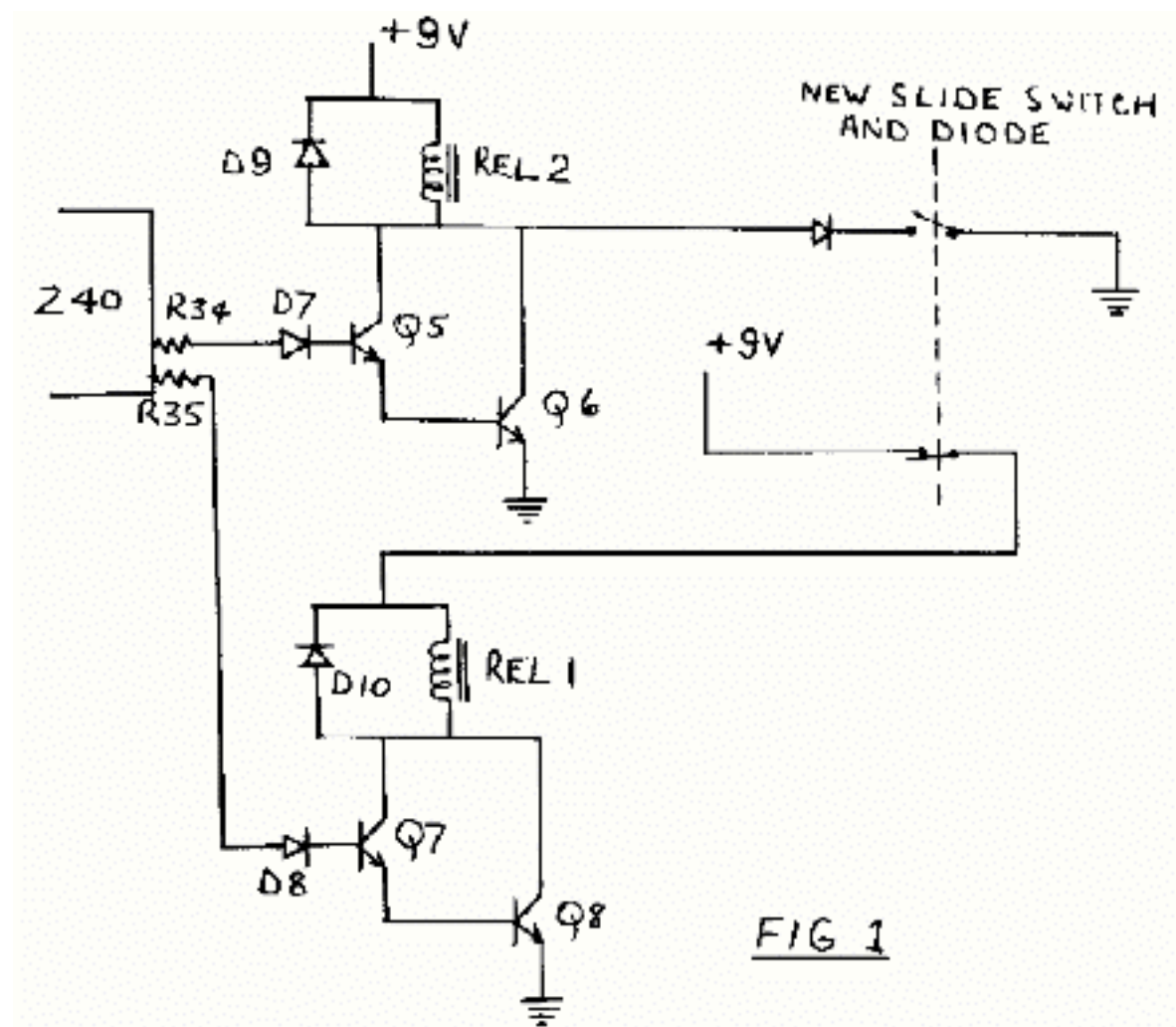
1.9.8 Memory Upgrade

The System 80 came with 16k of memory. Indeed, most cassette programs were written assuming this amount but who wants 16k when you could get up to 48k, and hence be able to type more text in SCRIPSIT and load all those monitor programs which let you do all kinds of things (like copy tapes etc.).

Memory expansion could be achieved by buying a standard expansion interface of course, but these were expensive. A quick and easy solution was to "piggy-back" new RAM chips on the existing ones, as shown in the photo opposite! This worked a treat and with careful soldering, owners could soon have a beast of a machine with 48k on-board (whoo-hoo!). This was how my own machine's memory was upgraded.
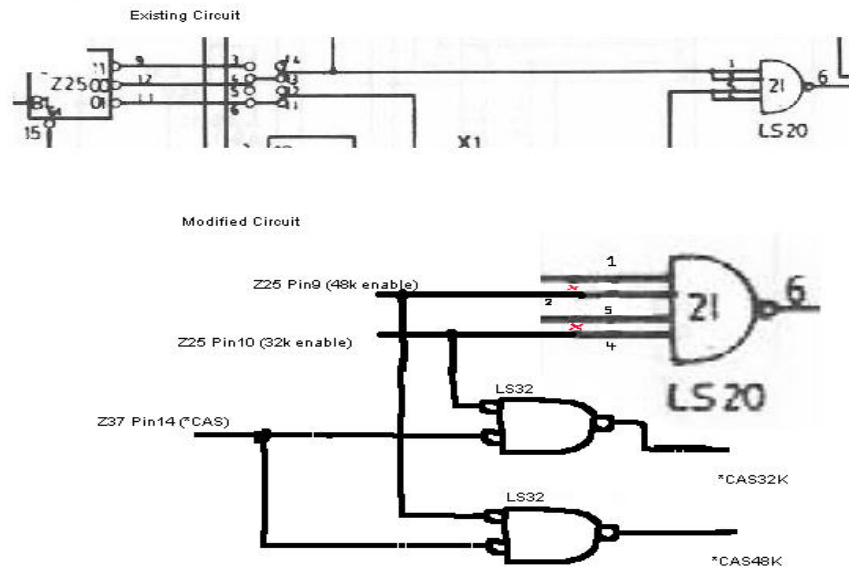
There are several ways to increase the memory of a System 80, each with their own pros and cons.

Piggyback Method.

Get hold of 8 (for 32k) or 16 (for 48k) 4116 memory chips. Bend pin 15 horizontally on each of the chips and "piggyback" them to the existing memory chips (soldering each of the legs very carefully). Refer to the diagram below, and main CPU board schematics in the System 80 technical manual.

Z25 (Ls139) uses A14 and A15 to divide the memory map into 4 areas, providing active low enables for each. Normally only the ROM (00) and first 16k bank (01) enables are used.

Note: X2 will allow you to enable the ROMS in the C000-FFFF space for testing. Z21 is a 4 input NAND gate that uses these two outputs to enable the DATA BUS buffers. Z21 can easily be modified to enable the buffers in the 8000-FFFF range by making the changes as shown. The *CAS32 and *CAS48 signals are then run to pin 15 of the piggy backed RAM chips.

Existing Circuit

Z25   X1   LS 20

Modified Circuit

Z25 Pin9 (48k enable)

Z25 Pin10 (32k enable)

Z37 Pin14 (*CAS)

LS32

LS32

LS 20

*CAS32K

*CAS48K

Alternative Method 1.

Less soldering but slightly more difficult. Get 8 x 4164 Memory chips. They must be ones that have a 7x16 matrix as opposed to an 8x8 otherwise half the address space will not refresh due to the Z80 only providing a 7 bit refresh. I understand that some of the later Z80 variants (Z80H anyone confirm this?) provide an 8 bit refresh, so if you wanted to upgrade the processor this shouldn't be a problem.

Replace the 4116's on the Motherboard with the 4164's. The +12v and -5v rails need to be disconnected from the RAM chips since the 4164's only need +5v and GND.   A14 and A15 need to be multiplexed through the spare gate of Z24, and applied to the extra address pin of the 4164 chips.   The data buffers need to be enabled for the 8000-FFFF space in the same way as for method 1 (above).

This is a much neater way of doing it, plus 4164 chips should be easier to get than 4116's these days. It also makes it easier to experiment with re-mapping the Address bus for CP/M since you have 64k of RAM available to play with.

Alternative Method 2

Use 2 x 32k static RAM chips.   The CACHE ram chips found in most modern IBM compatibles should be suitable. They have access times as low as 15ns (faster still?) and can be easily battery backed. This will allow you to experiment with VERY fast Z80 chips (assuming that you replace your system ROMs with a modern day FLASH ROM, some of which have very low access times and come in DIP packages.)

This is the least trivial but the most flexible of the options. Since with some slight modifications to the System ROMS, and a faster processor you could have several "virtual System-80/Trs80's" running in their own address spaces a'la AMIGA. Each time the processor switches tasks/memory areas, it could just save the current screen contents/pointers into the relevant bank.

1.9.9 Cassette gain control

This was another mod. common with the early machines...someway of controlling tape gain and monitoring it. It was only necessary in early models as later ones had a volume control and replay level indicator fitted, as they did the 2 missing keys above. Again, the text below is taken from the Dick Smith System 80 Technical Manual (Version 2).

The System-80 computer is fitted with an internal cassette tape deck, which provides no external user controls. The circuitry of the cassette deck and interface is such that, when correctly set up, most program tapes will load into the machine quite reliably. However pre-recorded tape cassettes vary quite widely in terms of both recorded level and signal waveform; this means that some tapes cannot be loaded satisfactorily without adjustment of relay gain.

As it happens there is an internal preset pot for adjustment of replay gain, fitted to the small PCB mounted under the internal cassette deck (VRI, at the front left-hand corner of the PCB). This pot may easily be removed and replaced by a normal l00k linear pot mounted on the rear of the case, to allow for external user adjustment. The new pot may be connected to the PCB via a single shielded cable, as shown:
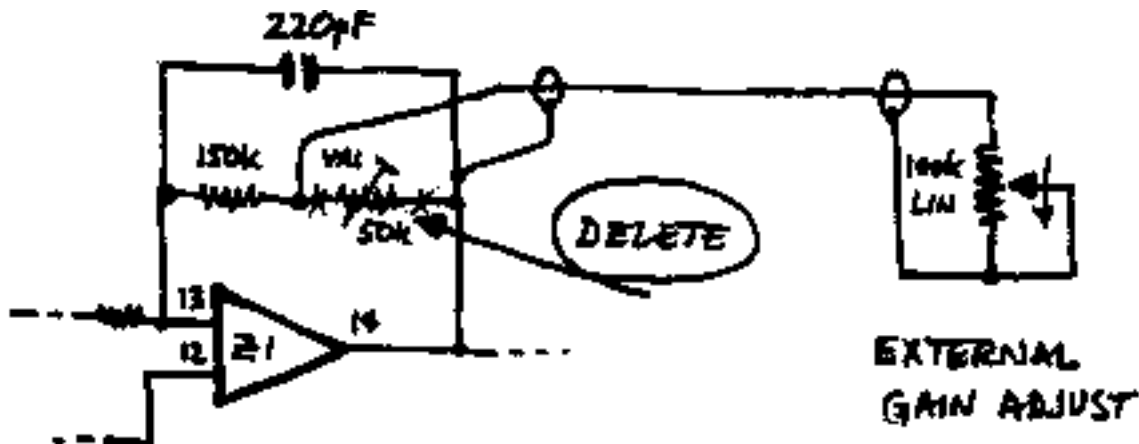

The most convenient place to mount the new pot is on the right-hand side of the lower part of the System 80's case, alongside the cassette deck. There is just enough depth here to mount a standard-sized pot, which can be fitted with a small knob for convenient adjustment. To mount the pot you will have to drill a 4 or 5mm hole at the desired position, then carefully enlarge it using a hand reamer or similar until it is just large enough to accept the pot bush. Fix it with the usual washer and nut.

Note: that it will be necessary to position the hole for the pot on the midline between the inner surface of the bottom of the case and the top of the moulding, to allow it to fit in place.

1.9.10 Level Indicator

To allow convenient setting of optimum gain for different tapes, it is possible to provide the System-80 with a simple replay volume indicator. This can be done easily and at low cost by using the following circuit, which converts the existing "cassette recorder" pilot LED into a volume indicator:
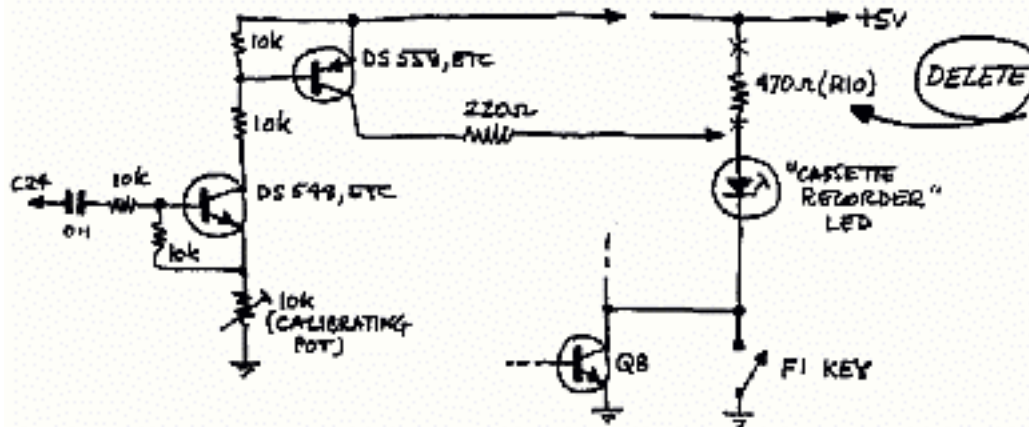
As you can see, the additional circuitry required is quite simple and involves only two low-cost transistors, four resistors, a capacitor and a preset pot for calibration. Basically, the circuit detects the positive peaks of the replay signal and amplifies them to modulate the current drawn by the LED. The l0k pot may be set so that full LED brightness is achieved only when the positive peaks of the replay reach an amplitude sufficient to ensure reliable loading.

RI0, the existing resistor in series with the LED, is mounted at the top right-hand corner of the keyboard PCB looking from the front of the machine. Removing this resistor provides two of the four connections required for the new circuitry. The earth connection can be made to the centre pin of the external cassette socket, at the rear of the machine, while the audio signal connection may be taken from the left-hand side of capacitor C24. This capacitor is at the extreme right-hand side of the interface PCB, just in front and to the right of the internal deck relay RLYI.

The two transistors and their associated wiring can easily be mounted on a small piece of utility PCB or similar.   This can be attached to the rear of the keyboard PCB, immediately behind the original location of RI0, supported by two short lengths of tinned copper wire in the holes previously used for the +5V and LED connections.

To set up the l0k preset pot, you ideally need an oscilloscope. This should be connected between either side of C24 and earth, to monitor the replay signal. Then insert a known good program tape in the cassette deck, set the deck for PLAY, and depress the FI button. The replay gain control (VRI or the replacement l00k pot at the rear, if fitted) should then be adjusted to give a signal amplitude whose positive peaks are as close as possible to 3V. Note that this is not 3V peak to peak -- it is the amplitude of the positive peaks alone.

Now turn the l0k calibrating pot to maximum resistance, and slowly turn it back until the LED just reaches its maximum brightness. This completes your setting up.

Note that the LED indicator and replay volume control both operate in the "manual" cassette mode, with the FI button depressed, as well as in auto mode. So manual mode may now be used to find the optimum gain setting for unknown tapes. Having done this, the tape can then be rewound and loaded normally via the CLOAD or SYSTEM commands.

The addition of an external gain control and simple LED level indicator generally make it possible to load just about all program tapes, both BASIC and machine language, using the System-80's internal deck. However it should be noted that there are still occasional tapes which will not load reliably at any gain setting, due to their severe waveform degradation. With such tapes, no simple techniques will allow normal loading; it is usually necessary to analyse the replay waveform with an oscilloscope, and process the signal in some suitable fashion to restore its integrity -- if this is possible.