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Inside the TRS-II

This month, we have a nice round of programs, my favorite being "Phone Words", a program that I've "run" on pencil and paper for years to help provide mnemonic assistance (which I sorely need) for telephone number recall. "Save" is a program which will "CSAVE" a BASIC program as if it were a SYSTEM tape. There are three advantages (in decreasing order of importance). One, when you reload your program, the SYSTEM loader will check the data coming in. If there's an error, the "C" appears on the screen to let you know it happened. Two, you can save a BASIC program which has already been merged with a machine level program. Three, you can save a program with a file name, and that file name must be used when loading, providing a limited degree of software security. For a 16 K system, set MEM to 32464, type SYSTEM and load it (filename is SAVE). Execute it by typing SYSTEM, then /32484. For a 32 K system, set MEM to 48848 and execute at 48868.

I'd like to devote the remaining yellow pages to a dissertation on the new, big TRS-80. I realize that all those reading this are model I owners, but the information is interesting anyway, and it's not the stuff you'll find in ad brochures. Also I must apologize for occasionally dropping into technical jargon - English is sort of a second language for me.

In our recent travels through the bitstream of reality, an engineer friend and I were present at a TRS-80 model II Unpacking (the capital "U" signifying that we didn't stop at the cardboard shipping container). After the preliminary procedure of tearing it out of the box and throwing the manual in a corner, we proceeded to plug it in and turn it on. It responded by commencing to operate - there oughta be a law against it being so easy. The first order of business was to back up the system disk - not an easy matter when there is only one drive, and the disk can hold up to 500 K bytes! Perseverence won out, however (hint - the password is still "PASSWORD" - it's in the manual, but not easy to find).

After proving that it worked, the next step was obvious - tear it apart. We broke the "DO NOT BREAK SEAL OR WARRANTY IS VOID" seal with a little ceremony, picked up a hammer and cold chisel, and proceeded with surgery. Removing the upper case half was fairly easy, though putting it back was a four-handed operation. (for those of you doing likewise, make sure the ridge under the top front of the cover goes in front of the metal tabs sticking up from the chassis.) The scene inside was (from left to right at the programmer's position) power supply, CRT monitor, computer cage and disk drive. We didn't check out much detail on the power supply, CRT or disk drive as they were common to all computers and we were mainly interested in What Hath Tandy Wrought.

Disclaimer: all the information I am relating here was obtained by surgery. We have not (as yet) asked Ft. Worth for information on the beast, preferring instead to act like pernicious little CIA types, thereby boosting our (already inflated) ego.

The computer section is a caged bus affair. The mother board has 8 slots, a ground plane on the daughter board side, and connecting traces

on the circuit side. Those traces carrying signals are about .010" (presumably for low crosstalk), and those carrying power are thicker (obviously for low voltage drop). There are several pins dedicated to ground - we counted seven and that might not be all. The bus distributes regulated power, unlike S-100 systems. This is generally considered to be superior design (it's definitely better for cooling purposes, and is also less expensive to manufacture). The card sockets have gold plated fingers as do the card edge connectors. This is definitely good engineering practice, and is decidedly more expensive to manufacture.

On to the daughter boards. There are four of them - CPU, memory, disk controller and video controller. They look a great deal like S-100 cards, being basically 5" by 10", with an offset card edge connector of .125" centers (80 pins instead of 100). As mentioned, they do not have onboard power regulation. The most striking departure from normal practice occurs at the pinout of these cards. The bus is rationally laid out! The data lines are all in order - the address lines too - likewise the CPU control lines - noisy lines are separated from quiet lines. At last someone has come out with a thinkum box that was designed from the ground up!

The CPU card:

Here we have, as promised, a Z-80A running at 4MHz. The basic oscillator is 8 MHz, and is run through a divide-by-two flip-flop before becoming the system clock. This assures a symmetrical square wave. In addition to the Z-80, there is a Zilog DMA, CTC, and SIO (pinout option 0). These are (respectively):

Direct Memory Access, for hauling information to and from (usually) an I/O port at Warp factor 4. Handy for disk accesses.

Counter Timer Circuit, for various system timing tasks, notably the system real time clock (time of day, as opposed to the system unreal time clock, the 4 MHz system timer).

Serial Input / Output, for talking to the serial world. This chip is essentially two completely programmable serial communications channels. There are TTL to RS-232 level shifters set up at the serial end, for the normal serial interfaces to modems and printers (the normal printer output is a Centronics type, driven from the disk controller's PIO).

All the above chips are set up on a priority interrupt basis using a lookahead circuit. Translated, this means that they can each be off in a cloud doing their own particular task, and when one has a job finished and ready to hand over to the Z-80 CPU, it generates an interrupt signal to tell the CPU to stop whatever it's doing, and accept the work. If two chips try to interrupt simultaneously, they both get their turn, but the chip with the higher priority goes first.

The DMA chip has the additional ability to completely disconnect the Z-80 chip from the bus and "take over". It can be thought of as a computer chip itself, one which is designed to move things fast without much thinking. When working in this mode, it operates on a bus request/bus grant daisy chain, and the "tail" of the chain is pinned out to the bus.

Another big chip on the CPU card is a memory chip with a 500 byte program to start up the system, clear the screen, test some memory and if everything is copacetic, sign on with "INSERT DISKETTE". It then sets up the disk drive to input data and disconnects itself. This allows the entire 64K of memory to be used by the operating system and user programs, a very handy provision.

Moving away from the LSI type chips, there is the usual conglomeration of fourteen and sixteen legged roaches performing the various tasks which allow the bigger chips to talk to each other and the rest of the world. The bypass capacitors used are the sealed monolithic types that have such primo characteristics and command such a primo price. The last item of mention on this board is that the drivers are hysteresis types. This makes the bus very immune to noise, and it's a quiet bus to begin with. Very conservative design.

The memory card:

There's not much to report here, except that it is dynamic and the refresh circuitry is onboard. Evidently (rumor here) if the computer is ordered with 32K, the 32K expansion will be a separate board, not extra chips. It will take up another slot in the mother board. CAUTION: If you are ordering one of these guys, get the 64K model. Don't get the 32K model. Don't even THINK of getting the 32K model. It's like buying a dairy farm with two cows.

The disk controller:

What I know about disk controllers can be engraved on the head of a pin with a cold chisel. This one works. There is a Zilog PIO chip on this board that controls some of the disk functions, as well as taking care of the Centronics port.

The video card:

Again as promised, the monitor has an 80 character by 24 line screen. The screen is memory mapped, but not in the main memory area. A bank switching arrangement is used to prevent confusion. The monitor itself is easily readable - the individual dots making up the letters and graphic characters are discernable, which is more than I can say for the Teleray that I am now typing on. The keyboard, by the way, feels much better than the original TRS-80's, and does not show any sign of bounce. I'd rate it as halfway between a Decwriter and a good IBM terminal. It is serially scanned by hardware, meaning both a flexible cable (it can be placed on the programmer's lap), and low software overhead.

Negative impressions:

I'd like to mention the things I wasn't impressed with first, as the list is short.

One, the product is the worst named item on this planet. It's worse than the Lear Seigler ADM-3 (American Dream Machine). The committee (it HAD to be a committee) that hung the TRS-80 model II monicker on this guy should be farmed out to General Mills to name new breakfast cereals.

Two, the disk drive makes this cute little GRIND GRIND sound. This is not a result of Radio Shack's engineering, nor the engineering of the drive itself. Briefly, the problem lies in the rate of stepping the leadscrew motor that moves the read/record head in and out. The rate can be set to any value by software, and can be altered by individual owners (the factory supplied software sets it to about 15 milliseconds). The optimum value will vary somewhat from machine to machine. Resetting this value does not harm the drive, nor does it shorten its life, but it is something that if done wrong will wipe out files. For assured reliability of software, leave it be.

Positive impressions:

There are all sorts of itsy bitsy details inside that if mentioned would turn this into a book - things like numerous test points, program jumpers, and chamfered edge connectors. They apply to the "invisible" part of a computer system, normally not of interest to anyone but the poor guy back at the repair center who has to fix it. The servicability of this machine is exceptionally high, and the part selection and construction practices are such that repair should seldom, if ever, be necessary. The weak link in this system is the disk drive, which will probably need attention every year or two, at an expense of around $100 per trip.

I would also like to impress upon you that this computer is FAST. Typical applications that business computers are put to involve the process of shoveling data, with little computation other than selection and sorting. For most of these applications (sorting excepted), the limitation will be disk access time. Prediction: a Winchester hard disk drive is in the works. Anything less does not exploit the power of this machine. What's a hard disk? A tad over a hundred 5" minifloppies worth of data, any byte of which can be snagged in 1/20 second.

I would also like to go on record as stating that this is the ultimate Z-80 machine. There will not be any more powerful stand-alone computers based on the Z-80 chip simply because the TRS-II has taken the Z-80 as far as it will go. The only additions this machine could use are peripherals and more (bank-switched) memory, both of which can be added to the present machine without changing its basic design.

I'm currently searching for an excuse to use company funds to buy one (what? ANOTHER computer??).

- - - see you next month,

Ralph 7/11 '79

Ralph McElroy, Publisher

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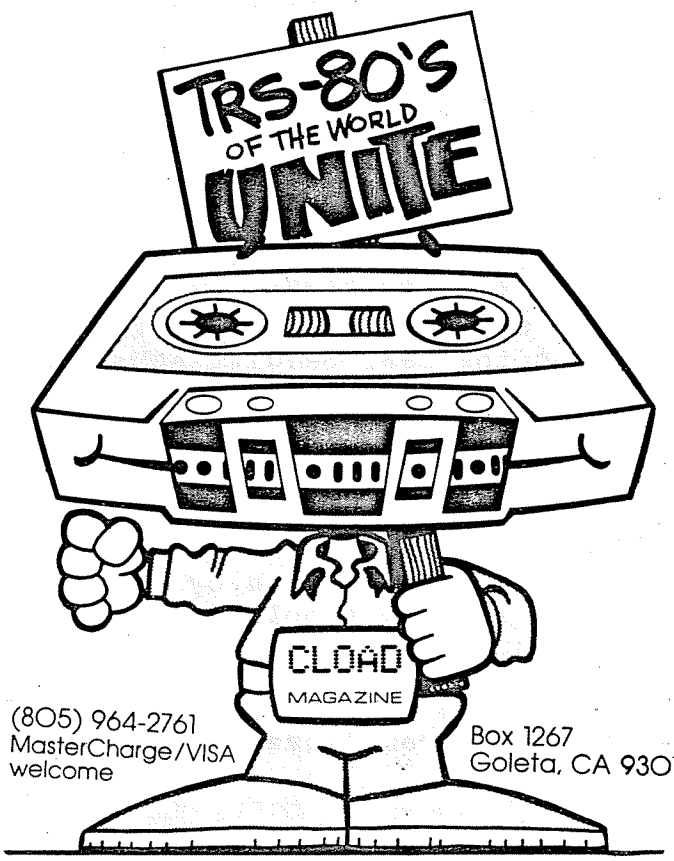

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