Sweeney memory 9

July 14, 1979

Dear Bob,

I was very glad to hear from you again. It's really too bad about the new delay in the keyboard. I, for one, have given up waiting and purchased a TRS-80 with the money set aside for the keyboard expansion. Don't scratch me off the ARCADIAN list, however, because I intend to get the two of them talking to each other, thus getting most of the effect of the keyboard expansion right now. I'll let you know more on this project when I get it working.

For the moment, I want to talk about my memory expansion for the Bally. Enclosed is a schematic for the main logic components. I assembled it with wire-wrap on a $4\frac{1}{4}$" by $4\frac{1}{2}$" Vector board, mounted in a Radio Shack instrument cabinet. Actually, the mechanical problems of getting the signals out of the Bally, and of arranging the power supplies and cabinet were more formidable than any of the electronic or logic problems, save one.

As drawn, the schematic provides for up to 8 kilobytes of additional memory. At this moment, I have 3 K installed, and the last 32 addresses at the top of the space are decoded to provide I/O & other special purposes.

Electrically, the design is straight-forward. In the Bally, the control lines are bufferred, but not the address and data busses; so, I included buffering for them. the address bus is set up for uni-directional operation, even though the Bally, by use of the $\overline{\text{Busreq}}$ signal, could be made to receive addresses (perhaps for DMA to the memory). The bi-directional data bus is brought out of the Hi-Z state only when the proper address is present on the bus simultaneously with the $\overline{\text{memreq}}$ signal. The choices for the bus drivers were totally governed by availability. I would rather have used 74LS244's for the address bus, but they were out of stock at two different mail-order houses, so I went with the 81LS95's, which are a Radio Shack part. A single 74LS245 would be preferrable for the data bus, but I haven't found anyone who actually has it. Hamilton-Avnet quoted 26 weeks delivery on it last Fall. I mention this because I think this kind of problem is still around.

The six switches depicted are a six-fold dip-switch. These are organized as three pairs. One of each pair is closed to determine whether a particular bit in the expander's address is hi or lo. The whole set allows the expander to be set at any 8K boundary. I use the one immediately above the Bally's memory (24K). The starting address (decimal) is 24576.

In operation, the three most signifigant address bits are transmitted through the dip swithches to the 3-in NAND. If this gate's output is low, then an address somewhere in the expander is being requested. If, in addition, a memory operation is being performed ($\overline{\text{memreq}}$ low), then the 74LS138, and the data bus circuitry is enabled. The three next-most-signifigant address lines feed into the '138. They have eight possible combinations, and each one chooses one on the eight outputs of the '138. The chosen output line corresponds to 1K of possible addresses, and is set up to activate one of the pairs of 2114's (each with 1K of 4-bit words). Meanwhile, the ten address lines not yet spoken for are attached to each of the 2114's. Only the one selected by the '138 will respond.

The data bus logic also determines whether the expander has been selected. It then examines the $\overline{rd}$ and $\overline{wr}$ lines, and sets up the data bus drivers to operate in the proper direction. In addition, it provides a $\overline{\text{write enable}}$ signal to all of the 2114's if a write operation is in progress; again, only the 2114's selected by the '138 respond. Finally, the data bus logic generates a $\overline{busoff}$ signall, which turns off the data bus driving circuit which interfaces the Z-80 to the multiplexed bus in the Bally. Since I could not locate any data on the DP8304 while I was building this device, I had no idea whether or not it needed to be turned off this way. I still think that the shematic makes it look as if the dp8304 is not activated if the address is not between 4000 and 4FFFor 5FFF. However, I can assure you that this thing does not work with the $\overline{busoff}$ omitted, and has never failed since I tried this signal in desperation.

As the schematic suggests, more 2114's are added, in pairs, by replicating the circuit surrounding each of the pairs depicted. The only change is the attachment of each successive pair to a different output from the '138.

Mechanically, the only thing of note is the actual cable which connects the Bally expansion connector to this circuit. It is an AP products 50 contact card-edge jumper, #924066-36-R (about $8.50) . This has a card-edge connector which mates with the Bally. However, the body of the connector is too bulky, and some of it has to be trimmed off to make it fitt into the hole around the expansion connector. The "ears" also have to be trimmed or removed to allow game handles numer two and four to fit in next to it. However, the plastic which must be removed is very thick, there is no question of taking enough off to impair operation, and it cust easily with a small saw. The connector is attached to a 50-conductor ribbon cable, 36" long. In my expander, I took three 24 pin dip plugs and soldered the wires onto them, 20,20, and 10. The cable is too wide to fit 24 wires into a solder-type plug; you could do this if you use insulation-

displacement plugs. On the expander board, the 24 pin plugs go into 24 pin sockets, which then form the source of connections to the buffers, etc.

My expander is mounted in an instrument cabinet from Radio Shack (now discontinued). However, any enclosure in which the board can be well mounted will do. I mounted the boards in U-grooves bent from sheet aluminum, and bolted to the floor and ceiling of the enclosure. It is also important to provide strain relief for the connector cable, I did this by doubling up a foot or so of the 36" inside the box, and then strapping it to one wall.

The Power Supply is built around a calculator-power pack obtained from California Digital. This unit delivers approximately 8 volts filtered DC. With the additional filtering, I feel sure it will deliver 1.5 amps at 7.5 volts. I know it delivers 1 amp. The most amazing thing about this power unit, which includes primary and secondary fuses , is its price of $6 or so. The output of the power pack is further filtered, and then regulated.

One final word on the memory chips themselves. In the schematic, they are listed as 2114's, but this was for convenience. Actually, some form of low power 2114 is needed to keep the power requirements within reason. I have ordered my 3K as 1K each, on three occassions. Consequently, I have three different sets of chips; all are satisfactory. I have Hitachi 2114's, National 2114-3L's, and NEC 2114-1's. Since the Bally clock is less than 2 MegaHertz, any 2114 with a 500 nanosecond or faster access time should work. Also, the price of these chips has recently decreased from $8 to $6.50 each, which is very pleasing.

Well, that's all I have to say for the moment. Enclosed is a list of the more critical parts, and a diagram of the edge connector. I hope this is of some use. I'll be waiting to hear from you.

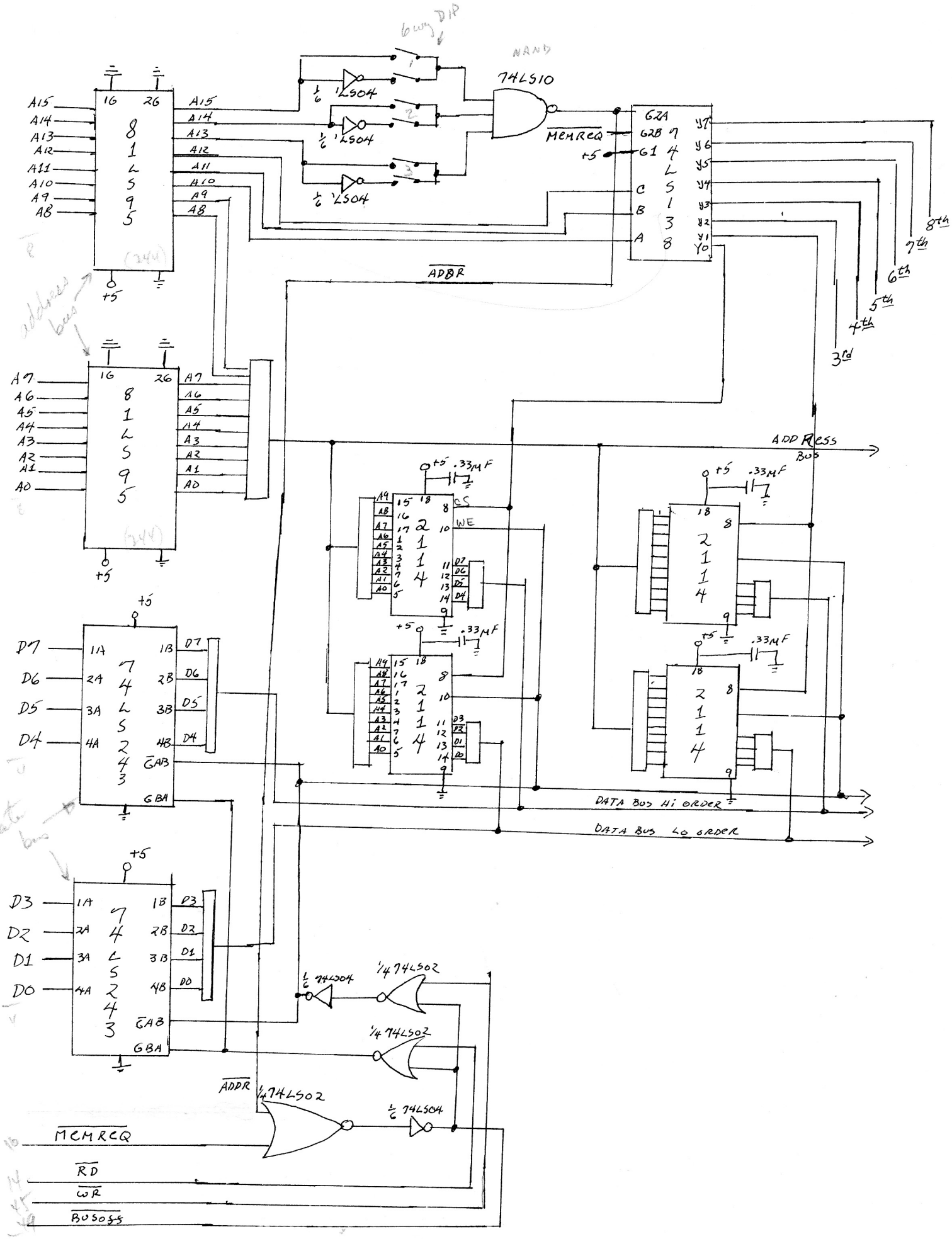
Sincerely,

John Sweeney

P. S.

The Hackers' Guide says that the "get character from tape" routine is accessible through a transfer vector at 201A. This is very valuable, but incomplete; does anyone know of the existence and location of a "put character onto tape" routine?

Memory Expander for Bally home computer John Sweeney 1979



Power suppy: 7V DC @ 1,4 amps — California Digital

7805 +5V regulator — Digi-Key

10,000 microfarad 20V electrolytic capacitor — Digi-Key

.01 microfarad capacitor — Radio Shack

SPST switch — "

200 ohm, ¼watt resistor — "

LED (red) — "

Wire-Wrap boards: 8½" by 4½" Vector boards (cut into two pieces, one for the power supply, and one for the memory)

Connector: AP products #924066-36-R 50 contact card-edge jumper.

(wired into) three 24-pin dip plugs with covers.

Sockets: all gold, three-level, wire-wrap

- 3 24pin
- 2 20 pin
- 2 18 pin for each 1K of memory
- 1 16 pin
- 6 14 pin

2 .33 microfarad capacitors per each 1K of memory

Integrated circuits:

2x 81LS95

2x 74LS243

1x 74LS02

1x 74LS04

1x 74LS10

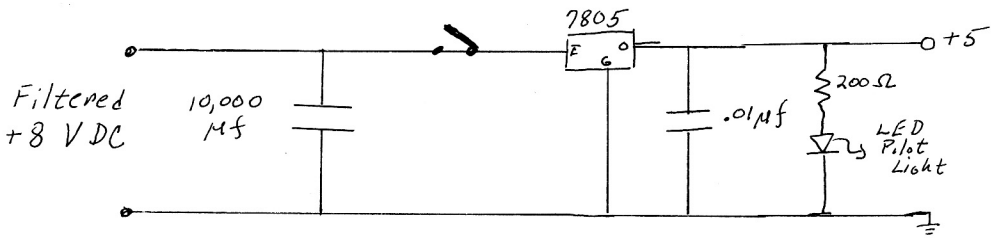
1x 74LS138

2x 2114-type memory (500 ns, Or faster) per 1K memory

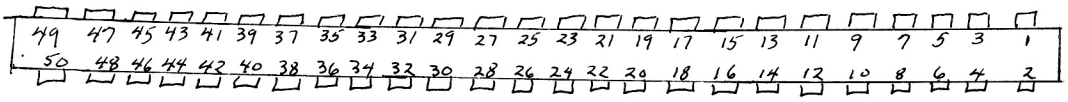
1x 6 position dip swithch

The sockets and integrated circuits are available in many places(see the back pages of Byte or Kilobaud). Where available at retail in a store, they are usually twice the price of a mail order.

Power Supply: schematic



Bally expansion connector: layout



as viewed from the rear of the Bally

Bally Expansion Connector: number		functions number	
2	vidout	1	ground
4	ground	3	vidin
6	clock	5	7 MHz
8	audin	7	px
10	vert dr.	9	$\overline{\text{M1}}$
12	hor dr	11	$\overline{\text{reset}}$
14	$\overline{\text{rd}}$	13	$\overline{\text{iorq}}$
16	$\overline{\text{memreq}}$	15	A7
18	A6	17	A5
20	A4	19	A2
22	A3	21	A12
24	A15	23	A11
26	A13	25	A10
28	A14	27	A9
30	A8	29	$\overline{\text{RFSH}}$
32	$\overline{\text{int}}$	31	D4
34	D3	33	D5
36	A1	35	D6
38	A0	37	D2
40	D7	39	D0
42	D1	41	$\overline{\text{nmi}}$
44	busack	43	$\overline{\text{busreq}}$
46	$\overline{\text{wait}}$	45	$\overline{\text{wr}}$
48	$\overline{\text{halt}}$	47	casen
50	sysen	49	$\overline{\text{busoff}}$