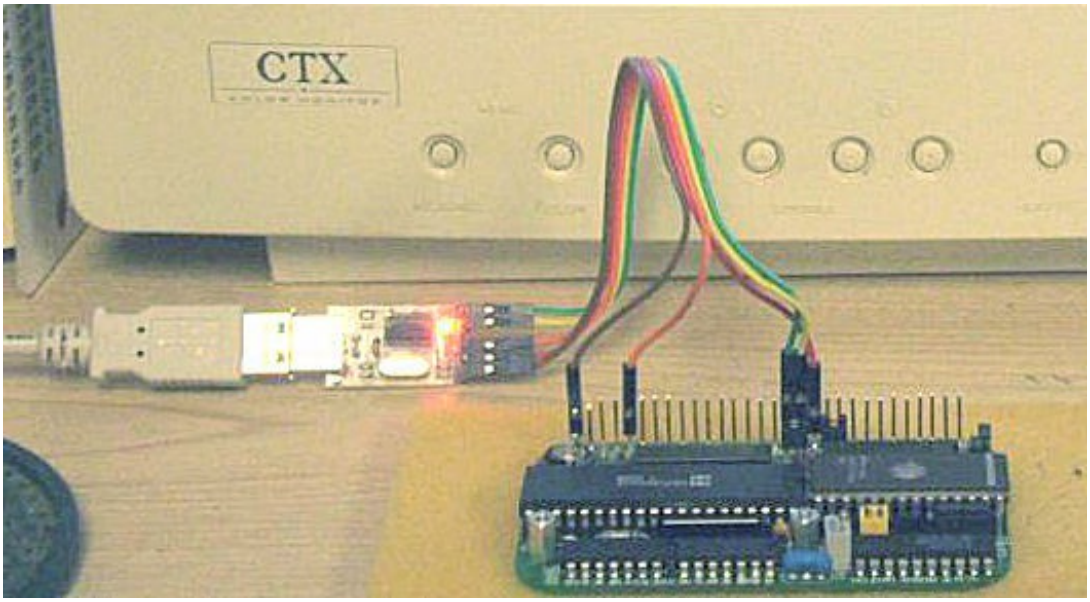
The 1802 Membership Card Starter Special



1802CPU board, with a USB-serial TTL adapter for data and power.

Thank you for your purchase of the 1802 Membership Card "Starter Special" kit. This quick-start guide will get you going. The full manual is not supplied, but can be downloaded and printed from the link below. You'll also find operating manuals for the software and other documentation there.

The "Special" comes with only the hard-to-get parts; the PC board, 1802 CPU, EPROM, RAM, and resonator. You'll need to source the rest of the parts yourself. If you're a good bargain-hunter or have a well-stocked junkbox, it's an economical way to get "into" the 1802. But buying all the parts new may cost more than the kit. Well, that's what the kit is for! :-)

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Rev. K4 -- last revised 2 July 2021

Specifications: What have we got here?

The 1802 Membership Card is a miniature version of the original Aug 1976 Popular Electronics ELF, repackaged to fit in an Altoids(tm) tin. It's built entirely with vintage parts and techniques available back then (and still available today). It has the basics of every computer; a CPU, memory, and I/O.

CPU:	RCA CDP1802ACE microprocessor (the brains of this outfit).
Clock:	4 MHz ceramic resonator (that's MHz, not GHz).
Memory:	32K RAM (and that's kilobytes, not megabytes).
	32K EPROM, with floating-point BASIC and Monitor program.
	Supercapacitor to hold data and programs in RAM without power.
I/O:	One 8-bit output port.
	One 8-bit input port.
	One 1-bit output
	Four 1-bit flag inputs, one with a pushbutton switch, one with a green LED.
	One interrupt input.
Size:	3-1/2" x 2-1/8" x 1/2" (89 x 54 x 12 mm).
Power:	3.6v to 5v DC at 5ma typical.

Parts List

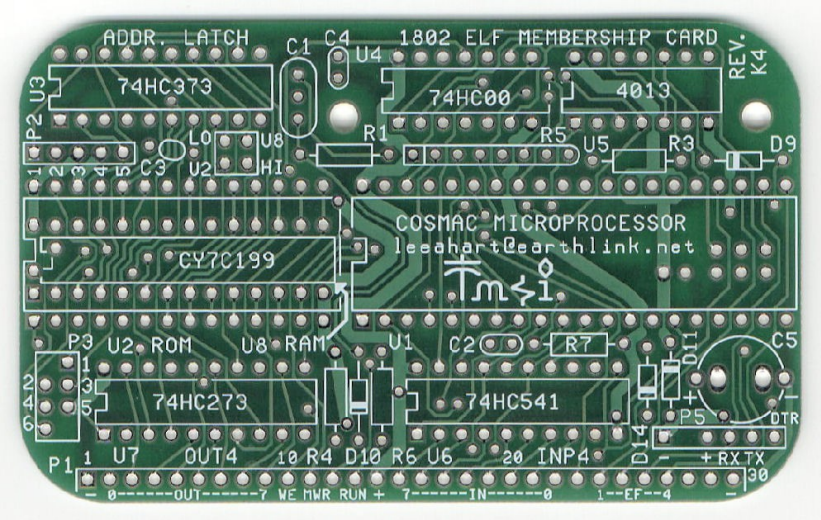
Here are the parts supplied with the "Starter Special" kit:

Quantity	Identifier	Description	Source for replacement parts
( ) 1	C1	ceramic resonator, 4 MHz (tan, marked Z4.00M)	Mouser 81-CSTS0400MG03
( ) 1	U1	CDP1802ACE microprocessor	eBay or TMSI (me)
( ) 1	U2	27C256 32k EPROM, programmed with MCSMP20A	TMSI (That's My Self and I)
( ) 1	U8	32k RAM, Cypress CY7C199	Jameco 242376
( ) 1	PCB	Membership Card (rev.K4)	TMSI (me again)

Here are the parts you'll need to get:

Quantity	Identifier	Description	Source for replacement parts
( ) 3	C2, C3, C4	capacitor, 0.1uF X7R ceramic	Jameco 1570161
( ) 1	C5	supercapacitor, 0.33F, 5.5vdc	Mouser 504-KR-5R5H334-R
( ) 4	D9,D10,D14	diode, 1N4148 (smaller red glass tube)	Jameco 36038
( ) 1	D11	diode, 1N4734A 5.6v zener (larger red glass tube)	Jameco 36118
( ) 8	Jumper	shorting jumpers for P1, P2, P3, and P6 headers	Mouser 737-MSB-G
( ) 1	P1, P2, P5	header, 40-pin, with 0.025" square pins on 0.1" centers (cut to make P1=30-pin, P2=5-pin, and P5=6-pin headers)	Jameco 2168211
( ) 1	P3, P6	header, 6x2 pin, with 0.025" square pins on 0.1" centers (cut to make P3=4x2, and P6=2x2 pin headers)	Jameco 203810
( ) 1	R1	resistor, 10meg 1/4w (brown-black-blue-gold)	Jameco 691817
( ) 2	R3, R6	resistor, 100k 1/4w (brown-black-yellow-gold)	Jameco 691340
( ) 1	R7	resistor, 3.3k 1/4w (orange-orange-red-gold)	Jameco 690988
( ) 1	R4	resistor, 1 meg 1/4w (brown-black-green-gold)	Jameco 691585
( ) 1	R5	SIP resistor, 7x100k 8-pin bussed, Bourns 4608X-AP1-104LF	Mouser 652-4608X-AP1-104LF
( ) 1	U1 socket	40-pin, ultra-low height, Mill-Max 115-43-640-41-003000	Mouser 575-115436403
( ) 1	U2 socket	28-pin, very-low height, Mill-Max 115-43-628-41-001000	Mouser 575-115436281
( ) 1	U3	74HC373 or 74HCT373 octal latch	Jameco 45831
( ) 1	U4	74HC00 quad 2-input NAND gate	Jameco 45161
( ) 1	U5	4013 dual D flip-flop	Jameco 893443
( ) 1	U6	74HC541 or 74HCT541 octal buffer	Jameco 46050
( ) 1	U7	74HC273 or 74HCT273 octal D flip-flop	Jameco 45743

Assembly



There is no one "best" way to assemble the board. Here are some hints, suggestions, and strategies. I suggest you read these FIRST, so you don't make any hard-to-correct mistakes!

C1 is a 4 MHz resonator with built-in capacitors. Other frequencies also work; the MCSMP20A program adapts to different clock frequencies. If you use a 2-pin resonator or crystal, add two 10-30 pf capacitors (from input-GND, and output-GND). Crystals are larger but more accurate.

C5 is a supercapacitor that can hold programs and data for days. Its value is not critical; in fact, you can use an ordinary electrolytic of just about any value to save money.

D11 is an "idiot" diode. If power is over 5.6v, or connected backwards, or is AC instead of DC, D11 shorts it out to protect the rest of the board. At worst, D11 will get hot and fail shorted; but it's cheap and easy to replace.

R5 The value is not critical; anything from 22K to 100K will work.

U1 I socket U1 and U2, but not the other ICs. I use very low height machined-pin sockets (see the parts list) for reliability and to keep the height low. You can socket the other ICs, but don't use <u>cheap</u> sockets; they are a lot less reliable than the ICs!

U2 needs to be in an IC socket. Cut out the center or use socket strips to leave room for U8.

U8 mounts <u>under</u> U2. Solder it in, or use socket pins (digikey.com #ED-5037-ND) so U2 fits on top.

Jumper Options

Install jumpers at P2, P3, and P6 to configure it for the type of memory chips at U2. The "Special" kit comes with a programmed 27C256 EPROM (addressed at 0h, so 0-32K), and a 32K RAM (addressed at 8000h, so 32-64K). See TABLE 1 on the schematic to configure it for other memories.

( ) P2: Short pins 2-3 and pins 4-5.

( ) P3: Short pins 1-3 and pins 4-6.

( ) P6: Short pins U2-LO and U8-HI. (Note: Boards before rev.K4 have etched foil jumpers that had to be cut for different configurations).

( ) I/O jumpers: There are jumpers under the 1802 to set the I/O port address. Foil is in place to set the on-board port to OUT4-7 and INP4-7. These can be cut and patched for other ports.

( ) CPU jumper: Also under the CPU is a jumper labeled "1804". There is foil to short it to use an 1802. Or, cut it to use an 1804 CPU.

Connect it Up!

The Membership Card takes very little power; 3.6 to 5vdc at a few mA to Run, or a few microamps in Standby. A battery holder with three 1.5v AA cells works nicely. Or you can use a single lithium 3.6v cell, an old 5v cellphone charger, a USB cable to a computer, or even a little solar panel.

Connector P5 on the rev.K4 board is a 6-pin header that provides power, ground, and TTL serial I/O. The pinouts match the Sparkfun #9718 FTDI 5v USB-TTL serial cable www.sparkfun.com/products/9718. Block pin 2 (the brown wire) with a toothpick or something as a key (so you can't plug it on wrong).

Short RUN to VDD (P1 pin 13-14) with a shorting jumper to "run" the 1802; or leave RUN open for "standby". Standby resets the 1802 and stops the clock; but memory and CPU register contents are maintained. You can connect a switch between RUN and VDD as your "Standby/Run" switch.

Short /WE to /MWR (P1 pins 10-11) with a shorting jumper. This enables programs to write to RAM. Opening this jumper write-protects memory.

Serial I/O

OK; so you connected power (and nothing smoked). Let's see if it works!

Serial I/O uses the 1802's EF3 and Q pins. These are TTL levels, which are +3.3v to +5v idle, and 0v to +0.5v active. Most people will use some kind of PC with a "terminal" program (Hyperterm, RealTerm, TeraTerm, etc.) with a USB-to-serial adapter. The Sparkfun adapter is is recognized by most PCs and “just works”. Figuring out how to wire up, configure, and run a cheap no-name USB adapter is left as an exercise for the reader.

Or, if your PC has a real RS-232 serial port, you can use an RS-232-to-TTL converter. Real serial ports usually work better with Terminal programs.

In either case, begin with the 1802MC **not** connected to your serial adapter. Set your terminal program to full duplex, 4800 baud, 1 Start, 8 data, no parity, 1 Stop, and no hardware or software handshaking. Set the ENTER key to send only an ASCII <CR>. Short your adapter's TXD to RXD, and keep "fiddling" until you can type on the PC keyboard and see it echoed to the PC screen.

Once that works, connect your 1802MC. Apply power, set RUN high, and type ENTER <CR> as the very first key. The MCSMP20 program will use it to set the baud rate, and display its sign-on message. See the online MCSMP20 and BASIC3 manuals to use the monitor and BASIC. Also see http://www.retrotechnology.com/memship/mem_rom_serial.html for more serial I/O help.

Parallel I/O

P1 has all the 1802 control signals, its Q and EF1-EF4 lines, an 8-bit input port, and an 8-bit output port. You can use these any way you like to “power up” your projects. The INP 4 instruction reads the input port, and the OUT 4 instruction writes to the output port.

All of these can be used by machine language or BASIC3 programs. Note that the MCSMP20 monitor uses EF3 and Q for serial I/O, and sends the received characters to OUT4.

Links for more information about the 1802 and ELF computers:

http://www.sunrise-ev.com/1802.htm
My website, with ordering information, manual updates, schematics, cheat sheets, and more.

https://billr.incolor.com/elf/html/elf-1-33.htm
The Aug 1976 Popular Electronics article that introduced the Elf. Most of it applies directly.

http://datasheets.chipdb.org/RCA/MPM-201B_CDP1802_Users_Manual_Nov77.pdf
An online copy of RCA's User Manual for the 1802. "Must read" reference material!

http://www.ittybittycomputers.com/IttyBitty/ShortCor.htm
"A Short Course in Programming" by Tom Pittman. An excellent introduction to programming the 1802.

http://www.cosmacelf.com
The COSMAC ELF "fan club", with lots of information on the many commercial and hobbyist variants.

http://www.retrotechnology.com/memship/memship.html
Herb Johnson's Membership Card “home” page, with tons of history, design notes, and software.

Last Writes

I'm still learning, so please contact me with comments, corrections and any improvements you discover. My contact info is on the front page. Also watch my web pages for updates!

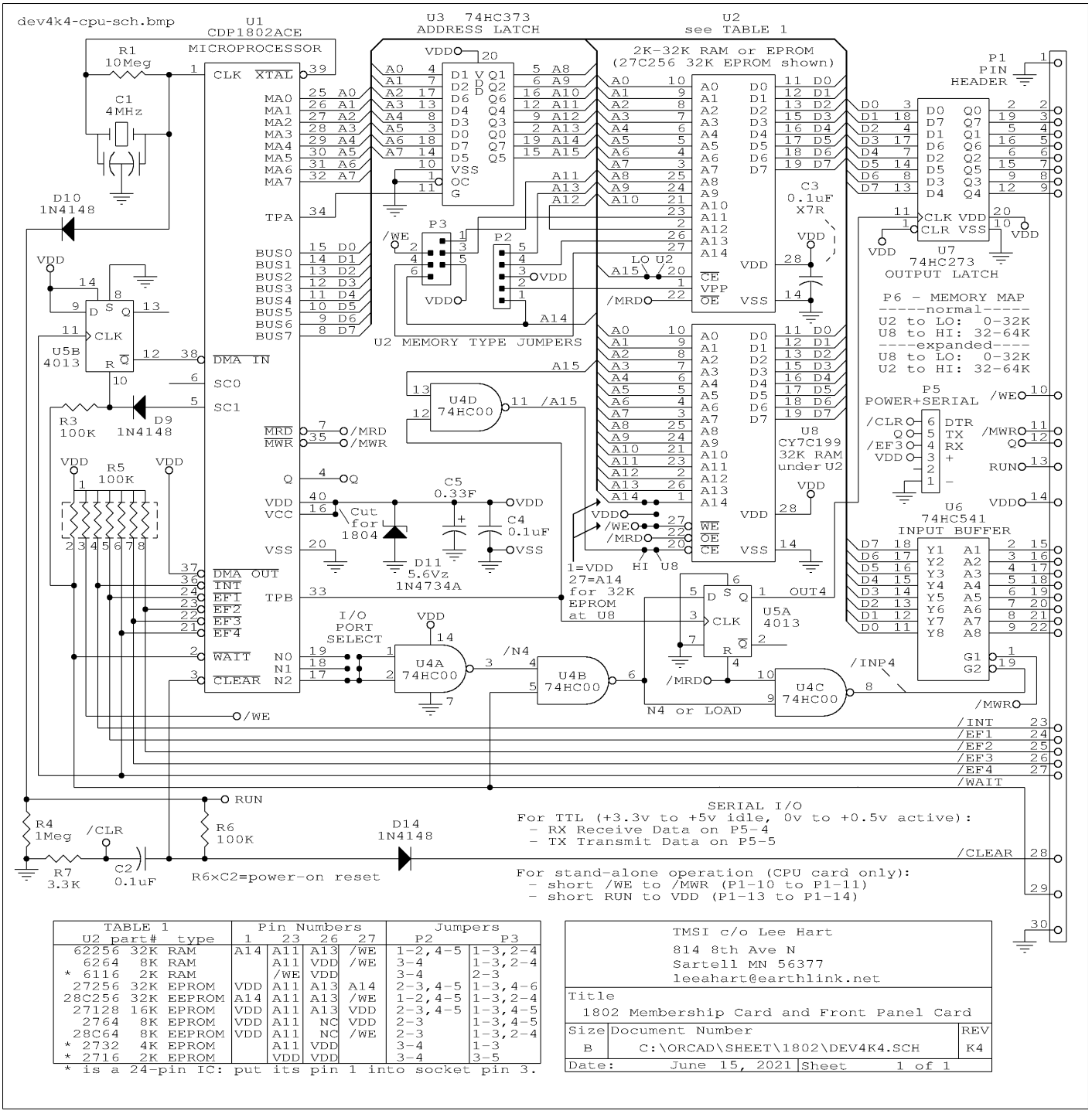


TABLE 1 U2 part#	type	Pin Numbers 1	23	26	27	Jumpers P2	P3
62256	32K RAM	A14	A11	A13	/WE	1-2,4-5	1-3,2-4
6264	8K RAM		A11	VDD	/WE	3-4	1-3,2-4
* 6116	2K RAM		/WE	VDD		3-4	2-3
27256	32K EPROM	VDD	A11	A13	A14	2-3,4-5	1-3,4-6
28C256	32K EEPROM	A14	A11	A13	/WE	1-2,4-5	1-3,2-4
27128	16K EPROM	VDD	A11	A13	VDD	2-3,4-5	1-3,4-5
2764	8K EPROM	VDD	A11	NC	VDD	2-3	1-3,4-5
28C64	8K EEPROM	VDD	A11	NC	/WE	2-3	1-3,2-4
* 2732	4K EPROM		A11	VDD		3-4	1-3
* 2716	2K EPROM		VDD	VDD		3-4	3-5

* is a 24-pin IC: put its pin 1 into socket pin 3.

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