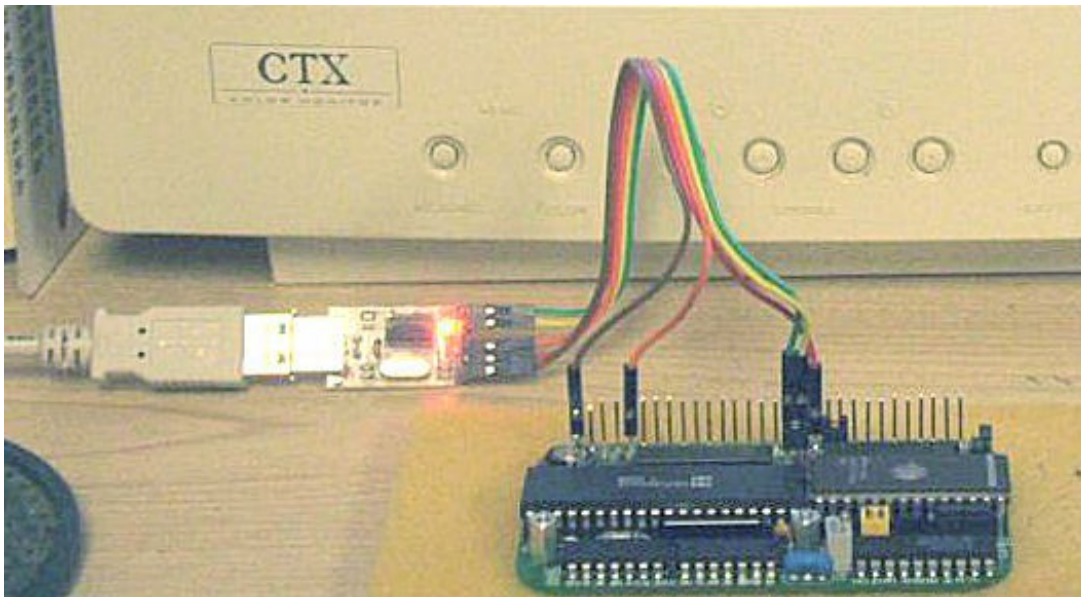


# The 1802 Membership Card Starter Special



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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<http://www.sunrise-ev.com/1802.htm>

Rev. K3 -- last revised 1 Feb 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: Voltage: 3.3v to 5v DC.  
Current: 5ma typical, depending on supply voltage and clock speed.

## Parts List

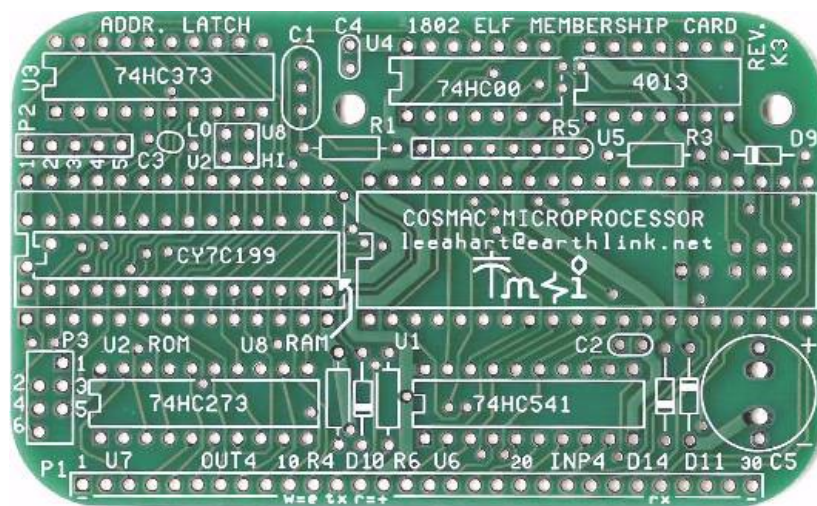
Here are the parts supplied with the "Starter Special" kit:

<u>Quantity</u>	<u>Identifier</u>	<u>Description</u>	<u>Source for replacement parts</u>
( ) 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.K3)	TMSI (me again)

Here are the parts you'll need to get:

<u>Quantity</u>	<u>Identifier</u>	<u>Description</u>	<u>Source for replacement parts</u>
( ) 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
( ) 1	P1	header, 30-pin, with 0.025" square pins on 0.1" centers	Jameco 103342
( ) 1	P2	header, 5-pin, with 0.025" square pins on 0.1" centers	Jameco 2076789
( ) 1	P3	header, 4x2 pin, with 0.025" square pins on 0.1" centers	Jameco 109517
( ) 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	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, very-low height, Mill-Max 115-43-640-41-001000	Mouser 575-115436401
( ) 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's no one "best" way to assemble the board. Here are some hints, suggestions, and strategies. I suggest you read this 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 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 cheap 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 under U2. Solder it in, or use socket pins (digikey.com #ED-5037-ND) so U2 fits on top.

## Jumper Options

Install jumpers at P2 and P3 to configure it for the type of memory chips at U2 and/or U8. The "Special" kit comes with a programmed 27C256 EPROM (addressed at 0-32K), and 32K RAM (addressed at 32-64K).

- ( ) P2: Short pins 2-3 and pins 4-5.
- ( ) P3: Short pins 1-3 and pins 4-6.
- ( ) Address jumpers: There is already foil in place to connect U2-LO and U8-HI. These only need to be changed if you use different memory chips, or want RAM low and EPROM high.
- ( ) 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.

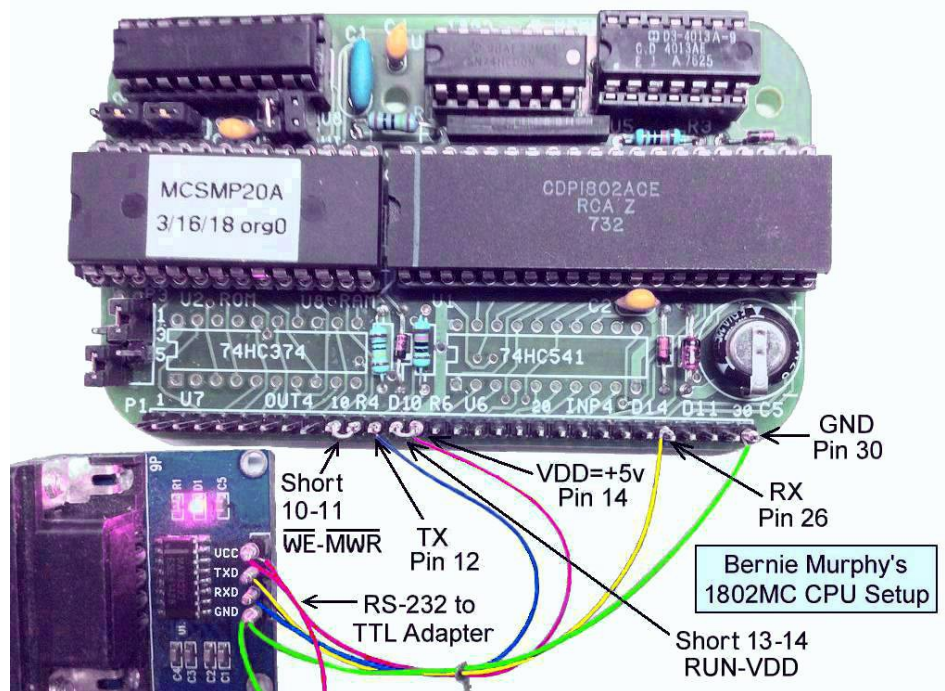
## Connect it Up!

The Membership Card takes very little power; 3.3 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.

Connect RUN (P1 pin 13) to VDD (P1 pin 14) to "run" the 1802. Leave RUN open for "standby". In Standby, power consumption falls to a few microamps, the 1802 is reset, and the clock is stopped; but memory and CPU register contents are maintained. You can connect a switch between RUN and VDD as your "Standby/Run" switch.

The silkscreen for P1 labels the pins you need to use to connect power, ground, and serial data:

- + Positive power (VDD: P1 pin 14).
- Negative power (GND: P1 pin 30).
- W=E Short /WE to /MWR (P1 pins 10-11) to enable writing to RAM.
- R=+ Short RUN to VDD (P1 pins 13-14) for RUN mode. Open this connection for STANDBY.
- RX Serial input (EF3: P1 pin 26). Connect it to your terminal's TTL-level serial TXD output.
- TX Serial output (Q: P1 pin 12). Connect it to your terminal's TTL-level serial RXD input.



Here's a photo of Bernie Murphy's assembled card. It provides an example of the connections to an RS-232 to TTL adapter wired directly to P1. The power supply (not shown) connects to the red and green wires running off the bottom of the photo. He also left off U6 and U7 (the I/O ports) as they are not needed for serial operation.

If your adapter has a TTL-level DTR or RTS output that is high when your terminal program is "on-line" or "connects", and is low when it goes "off-line" or "disconnects", you can connect it to RUN (P1 pin 13) instead of VDD. This allows you to RESET the 1802MC by switching your terminal "off-line" or "disconnect"; and to RUN the 1802MC by switching it "on-line" or "connect".

## 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 the PC's RS-232 port, or a USB port with a USB-to-serial adapter.

If your PC has a real RS-232 serial port, you need an RS-232-to-TTL converter (like Bernie Murphy's above). Real serial ports usually work well with Terminal programs.

If your PC only has USB ports, you need a USB-to-serial TTL adapter (like the one pictured on the first page). These things can be a nightmare to get working! They come with no documentation, so you have to figure out where to get and how to install the needed driver. There are instructions for installing one of these gadgets at <http://www.sunrise-ev.com/photos/6502/badge-manual.pdf> In either case, begin with the 1802MC **not** connected to your serial adapter. Set your terminal program to full duplex, 9600 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 the adapter's TXD to RXD, and keep "fiddling" until you can type on the PC keyboard and see it echoed to the PC screen.

When that works, connect it to your 1802MC. Apply power, set RUN high, and type ENTER <CR> as the very first key. The MCSMP20 monitor program should 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](http://www.retrotechnology.com/memship/mem_rom_serial.html) for more serial I/O help.

## 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.

<http://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](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!

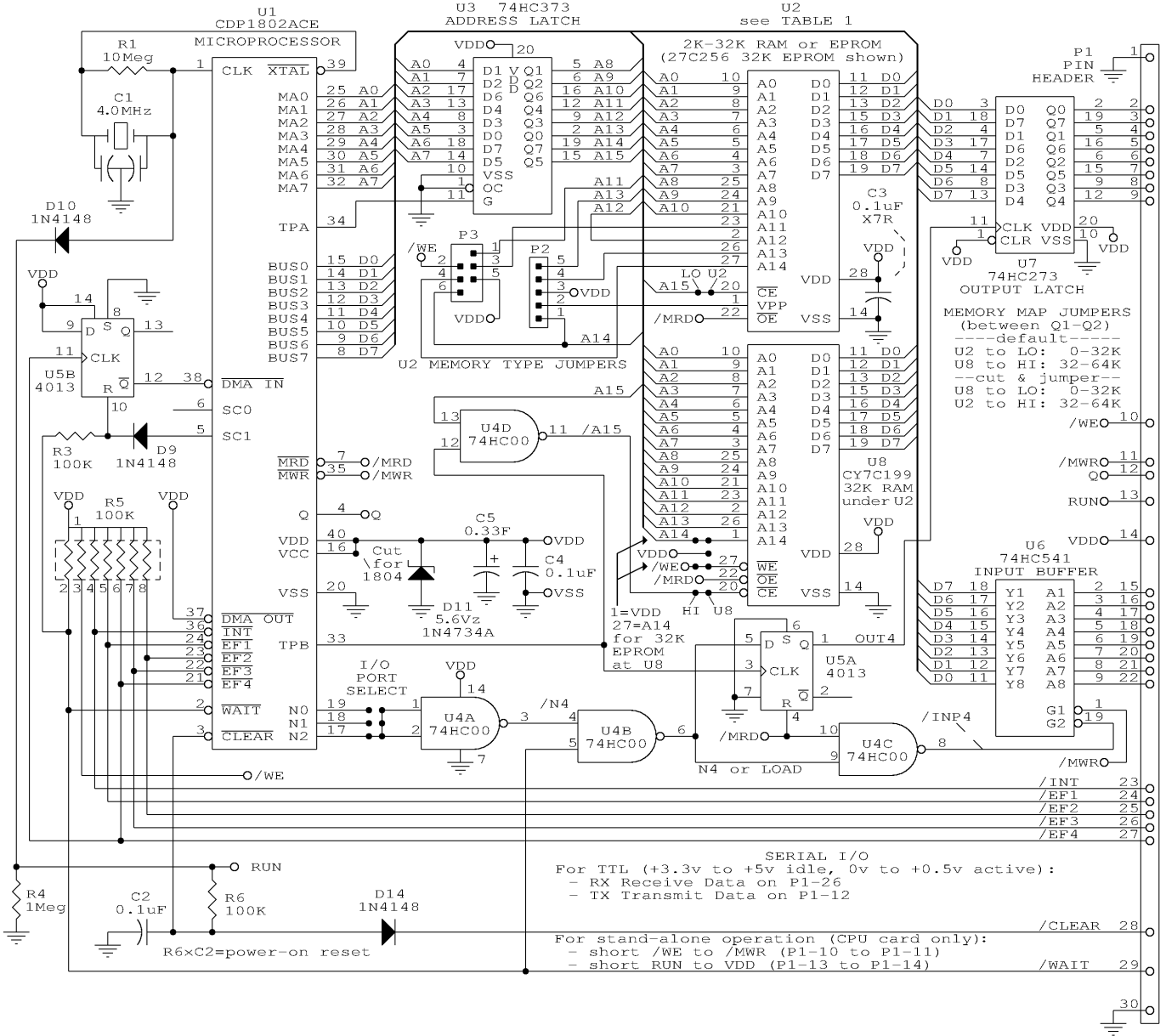


TABLE 1		Pin Numbers				Jumpers	
U2 part#	type	1	23	26	27	p2	p3
62256	32K RAM	A14	A11	A13	/WE	1-2, 4-5	1-3, 2-4
6264	8K RAM	A11	VDD	/WE		3-4	1-3, 2-4
* 6116	2K RAM	/WE	VDD			3-4	2-3
27256	32K EPROM	VDD	A11	A14		2-3, 4-5	1-3, 4-6
28C256	32K EEPROM	A14	A11	A13	/WE	1-2, 4-5	1-3, 2-4
27128	16K EPROM	VDD	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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Title  
 1802 Membership Card

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