

COSMAC "ELF"  
Parts Supplier List

Paul Schmidt  
March 12, 2017

ID	Qty	Description	MFR	Mfr PN	Supplier	Supplier PN	Note
-	2	Wooden strips used for support rails, 6.5" x 0.75" x 0.375"					
-	10	Sheet metal screws, #4 x 3/8"	hardware				
-	1	Perforated phenolic board, 4.5" x 6.5", 0.1" x 0.1" grid, 0.042" holes	Vector	64P44XXXP	Digikey	V1043-ND	
-	1	Switch support panel, 5.5"x2", 3/32" ~ 1/8" thick, black w/ letters	see notes				1
-	1	Heatsink, 1.6" x 0.7", 1/8" thick aluminum	see notes				2
-	1	Bolt & nut, 4-40 x 3/8" (for IC13 & heatsink)	hardware				
-	1	Power jack support panel, 5.5" x 0.625", 1/16" thick	hardware				3
J1	1	Power jack, barrel type, panel mount, 1.35mm ID, 3.5mm OD	MPD	EJ501C	Digikey	EJ501C-ND	4
-	1	AC power supply (wall-wart type), 90~260VAC input,	CUI	SW16-9-N-P7	Digikey	102-3614-ND	4
		9V regulated output, 670mA (6W) max, cable with barrel plug					
		on end, having 3.5mm barrel OD, 1.35mm ID, 9.5mm length,					
		positive center					
J2	1	Audio output jack, 1/8" (3.5mm) stereo phone type, panel mount	generic				5, 27
-	6	14 pin DIP socket, 0.5" wire wrap, gold sockets, 0.3" row spacing	Assmann	AR14-HZW/TN	Digikey	AE10047-ND	6
-	3	16 pin DIP socket, 0.5" wire wrap, gold sockets, 0.3" row spacing	Assmann	AR16-HZW/TN	Digikey	AE10048-ND	6
-	2	22 pin DIP socket, 0.5" wire wrap, gold sockets, 0.4" row spacing	Mill-Max	123-43-422-41-001000	Digikey	ED80173-ND	6
-	1	40 pin DIP socket, 0.5" wire wrap, gold sockets, 0.6" row spacing	Assmann	AR40-HZW/TN	Digikey	AE10053-ND	6
SET		Pin labels for IC sockets, 14, 16, 22, 40 pin sizes (optional)	see notes				29
-	2	14 pin DIP socket, PC pins, gold sockets, 0.3" row spacing	Mill-Max	110-93-314-41-001000	Digikey	ED3314-ND	7
-	42	Single point wire wrap pin	Vector	T44/C	Digikey	V1071-ND	9
-	LOT	Wire wrap wire, 30 AWG, Kynar insulation, Black	OK/Jonard	R30BLK-0100	Digikey	K394-ND	8
-	LOT	Wire wrap wire, 30 AWG, Kynar insulation, White	OK/Jonard	R30W-0100	Digikey	K397-ND	8
-	LOT	Wire wrap wire, 30 AWG, Kynar insulation, Red	OK/Jonard	R30R-0100	Digikey	K395-ND	8
-	LOT	Wire wrap wire, 30 AWG, Kynar insulation, Blue	OK/Jonard	R30B-0100	Digikey	K325-ND	8
SW1	1	Pushbutton switch, SPDT, momentary	C&K	8121SDZGE	Digikey	CKN1623-ND	10
-	1	Cap for pushbutton, red, 0.375" diameter	C&K	752703000	Digikey	CKN1105-ND	10
SW2~12	11	Toggle switch, SPDT, maintained	C&K	7101SYZGE	Digikey	CKN1022-ND	10
-	8	Color cap for switches SW2, SW4 ~ SW7, SW9 ~ SW11, white	C&K	896801000	Digikey	CKN1203-ND	10
-	3	Color cap for switches SW3, SW8, SW12, red	C&K	896803000	Digikey	CKN1205-ND	10
C1, C2	2	Ceramic disk capacitor, 33pF, 50V	Valuepro	CD33/50-R	Jameco	332217	11
C3,C4,C5	3	Electrolytic capacitor, 10uF, 35V, axial leads	Illinois Cap	106TTA035MSD	Digikey	1572-1035-1-ND	12
-	?	Power supply decoupling capacitor, 0.1uF, disk or axial, generic					13
R1	1	Resistor, carbon film, 5%, 1/4W, 0.25" long, axial leads, 1M	Valuepro	CF1/4W106JRC	Jameco	691817	11, 14
R2~10	9	Resistor, carbon film, 5%, 1/4W, 0.25" long, axial leads, 47k	Valuepro	CF1/4W473JRC	Jameco	691260	14

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R13	1	Resistor, carbon film, 5%, 1/4W, 0.25" long, axial leads, 10k	Valuepro	CF1/4W103JRC	Jameco	691104	27, 14
R11	1	Resistor, carbon film, 5%, 1/4W, 0.25" long, axial leads, 470 Ohm	Valuepro	CF1/4W471JRC	Jameco	690785	14
R12	1	Potentiometer, trimmer, 1/2W, 25 turn, 1M	Bourns	3299W-1-105LF	Digikey	3299W-105LF-ND	15
D1~6	5	General purpose 'signal' diode, silicon, 100V, 200mA	Fairchild	1N4148	Digikey	1N4148FS-ND	16
D7	1	LED, red, diffused, T-1 3/4 case (5mm dia, round, domed), 10mA	Dialight	5219240F	Digikey	350-2676-ND	17
D8, D9	2	General purpose 'power' diode, silicon, 400V, 1A	Fairchild	1N4004	Digikey	1N4004FSCT-ND	16
X1	1	"Façade" crystal, nominally 1MHz, nominally 5/8" ~ 3/4" wide		see note			18
X2	1	Hybrid oscillator, 1MHz TTL output	ECS	ECS-100A-010	Digikey	X101-ND	
X3	1	Ceramic resonator, 1.8MHz (2.0MHz part number shown)	ECS	ZTT-2.00MG	Digikey	XC1806-ND	19
Jumper	1	3 pin SIP header	3M	961103-6404-AR	Digikey	3M9448-ND	20
Jumper	1	Shunt jumper	3M	969102-0000-DA	Digikey	3M9580-ND	20
IC1, IC2	2	256 x 4 static RAM IC	generic	2101 / 5101	Jameco	42198	21
IC4	1	Microprocessor IC	RCA/Harris	1802 (CDP1802ACE)	eBay		22
IC3	1	Dual Flip-Flop, D-type, CMOS, IC (4013)	Texas Instr	CD4013BE	Digikey	296-2033-5-ND	23
IC8,IC10	2	Quad bilateral switch, CMOS, IC (4016)	Texas Instr	CD4016BE	Digikey	296-2036-5-ND	23
IC5	1	Triple 3-input NAND gate, CMOS, IC (4023)	Texas Instr	CD4023BE	Digikey	296-2041-5-ND	23
IC9	1	Hex inverting buffer, CMOS, IC (4049)	Texas Instr	CD4049UBE	Digikey	296-2055-5-ND	23, 24
IC6,IC7	2	Hex non-inverting buffer, CMOS, IC (4050)	Texas Instr	CD4050BE	Digikey	296-2056-5-ND	23, 24
IC14	1	Hex Schmitt-trigger inverter, CMOS, IC (40106 or 4584 or 74C14)	Texas Instr	CD40106BE	Digikey	296-3503-5-ND	25
IC13	1	5V linear regulator IC, 1.5A, TO-220 package (7805 or LM340-5)	Texas Instr	LM340T-5.0	Digikey	296-39011-5-ND	28
IC11,IC12	2	Hexadecimal LED display with integral TTL logic circuit	Texas Instr	TIL311	Jotrin	JT17011317-1	26
-	16"	Solid tinned wire, 22 AWG or similar (for power bus bar)	Alpha	298 SV005	Digikey	298 SV005-ND	30

### NOTES

- 1 If home made, drill according to drawing, paint black, use white transfer lettering according to drawing. Preferably, use provided Front Panel Express file and order online; file includes all information for manufacturing.
- 2 Aluminum sheet in the required thickness is commonly available through hardware stores and online. Alternately, a piece of suitable aluminum can be cut from scrap metal pieces. Although the appearance will differ from what is desired, a commercially manufactured heatsink of the approximate dimensions can be purchased.
- 3 Aluminum sheet in the required thickness is commonly available through hardware stores and online. This panel may be drilled to receive only the J1 power jack, or it may also be drilled to receive the optional J2 audio jack.
- 4 A specific power supply is indicated here, but any suitable power supply can be used. The circuit as described requires a 9V regulated supply, and a recommended capacity of 6W (which is 670mA @ 9V). The power supply connector (plug) must match the power supply jack (J1) in regard to barrel size. The circuit as shown on the schematic has a positive center pin for J1, but if a different power supply is used, take care to assure that the polarity is known and wiring to J1 is correct for polarity.

- 5 Audio output jack is optional, and the original ELF did not have one.
- 6 IC socket model numbers shown here are suggestions only; any similar sockets may be used. Gold plated contact points for IC pins are preferable.
- 7 Two 14 pin IC sockets are used on the optional secondary "clock board"; one socket is for IC14 which is used for the slow speed clock and as a buffer for the audio output, the other socket is for the primary hybrid oscillator X2. If using the authentic original ELF crystal oscillator, which is not shown on the schematic (but is shown as a 'façade' on the layout drawing), then these sockets may not be required. The socket model shown here is a suggestion only, as any similar socket can be used.
- 8 Part numbers shown are for 100 foot rolls, although much less wire is required for the ELF. Use any equivalent wire wrap wire on hand. With the four colors listed, use BLACK for 'circuit ground', RED for 5V/V+, WHITE for control circuits/signals, BLUE for address & data signals.
- 9 This part is used to provide wire-wrappable pins for discrete components that do not fit into IC sockets. Each part is a single pin that is pressed into a hole in the Vectorbord using a small screwdriver or a similar tool, and the lead of the component is soldered to the "U" shaped top of the pin, and then the bottom of the pin can be wire wrapped normally. This part number is for a bag of 100 pins.
- 10 The original ELF article did not specify which models of switch to use. The switches specified here are high quality models that match the photos of the original ELF as pictured in the article. However, these are expensive switches and lower cost "hobby" grade switches can be used instead. If trying for a high quality build, it is recommended to use the models specified here.
- 11 The circuit as described on the schematic does not actually use these parts; they are there as a 'façade' to match the appearance of the original ELF. However, these part values are appropriate if the builder wishes to construct the CPU oscillator according to the original ELF article. The crystal X1 is wired across IC4 pins 1 & 39. Capacitor C1 is wired from IC4 pin 1 to circuit ground. Capacitor C2 is wired from IC4 pin 39 to circuit ground. Resistor R1 is wired in parallel with X1 (across IC4 pins 1 & 39). The X2 & X3 circuits shown on the schematic would not be used if the X1 circuit described here is used.
- 12 Any equivalent capacitor of the same values and configuration will work. C5 is only required for the optional audio output.
- 13 The original ELF article did not call for power supply decoupling capacitors, and the ELF build that is the basis for this parts list did not use them. Using a star-topology power supply wiring scheme will help provide a cleaner power feed to the IC's (each IC's power pins are wired back to the supply 'rails' at voltage regulator IC13, instead of being daisy-chained as a single wire from IC13 that serves all IC's. If the builder wishes to add decoupling capacitors, they should be soldered to the IC socket pins used for V+ and circuit ground.
- 14 Any generic 1/4W carbon resistor with axial leads and a body about 1/4" long will work. 5% tolerance or better is preferable.
- 15 Optional. Used only if slow speed clock is included in the build. Any equivalent trim potentiometer will work. Multi-turn preferred.
- 16 The 1N4148 is also called the 1N914. For all diodes except the LED, the Fairchild brand is given for reference only; these are all generic parts.
- 17 Any generic red diffused LED with a T-1 3/4 (5mm round, with domed top) case/body. LED rated for 10mA will give best light with R11.
- 18 This part is intended to be a 'façade' part, used for appearance only, to match the original ELF. To appear correct, a large-body crystal must be used, and also the frequency should be 1MHz. Large-body crystals with a low frequency such as 1MHz are no longer made. Accordingly, the ELF circuit described replaces the original crystal circuit with a hybrid oscillator device having a frequency of 1MHz (X2). For the façade part X1, the builder can use any old crystal that may be on hand, as long as it has the correct appearance; remove any outer wrapping and leave just the bare metal can. However, if the builder does have an appropriate size and frequency of crystal, the original ELF oscillator circuit may be built according to note 11 above. If the builder chooses to use the original ELF crystal oscillator circuit with a modern sized crystal, a good choice is the Digikey part number X066B-ND (ECS # ECS-10-13-1H).

- 19 Ideally a 1.8MHz resonator should be used, but these are not always readily available. A part number for a 2MHz resonator is shown. This part is only required if the 'slow clock' option with R12 and IC14 is desired.
- 20 An SPDT switch can be used in place of this 2 position jumper. The 3M part numbers are given for reference, but this is very generic.
- 21 The original ELF used the 2101 RAM parts; but these are hard to obtain as new parts. Jameco sells the CMOS version (5101) which is function & pin compatible; a true drop-in replacement. The 5101 part is recommended. Be aware that some parts sold are faulty.
- 22 The 1802 was originally an RCA part. The 1802 was then made by Harris, under the longer part number shown, but they sold the business to Intersil, who still makes the part. Regular distributors may not be willing to sell these in small quantities. However, sellers on eBay always seem to have these, especially the Harris versions. The Intersil part number is CDP1802A (or CDP1802A/3).
- 23 These are generic CMOS logic parts. Texas Instruments numbers are given for reference.
- 24 Watch out for the unusual power pinouts on these IC's!
- 25 Generic CMOS logic part with three different part numbers for the same thing. 40106 is preferred, the obsolete 4584 is good if it is on hand, and although the 74C14 is in a different logic family, it is equivalent. All three parts have the same function and pinout. Digikey still sells the 4584 version as catalog number BU4584B-ND (Rohm # BY4584B). This Schmitt-trigger type of inverter MUST be used in the oscillator circuit with X3; a regular inverter will not work. If neither the slow rate clock nor the audio output are desired, this IC is not required.
- 26 This type of integrated hexadecimal LED display is iconic to the ELF, and the ELF cannot be built with the correct appearance and functionality without it. The distinguishing characteristics are the 'dot-matrix' look of the hexadecimal readout, and the integrated logic circuit that implements a strobed data latch and a decoder to convert the 4-bit binary input to the correct LED pattern for each displayed character 0 ~ 9 and A ~ F. The original ELF could be built using either the Texas Instruments # TIL311 version or the Hewlett Packard # 5082-7340 version (these are almost identical in appearance, and identical in function, although they differ in their pinouts). This parts list favors the TIL311 since it is the easier of the two versions to obtain. The TIL311 was reportedly available with an alternate part number, DIS1417, but this has not been confirmed. The TIL311 can be obtained as used parts from eBay sellers, and Jotrin Electronics ([www.jotrin.com](http://www.jotrin.com)) sells new TIL311 parts for approximately \$10 each, plus express postage from China. Jameco also sells the TIL311, their # 32951, but their price is about 2.5 times the Jotrin price; however postage is much less than Jotrin's. Sellers such as Freelance Electronics sell the 5082-7340 for approximately \$20 each.
- 27 Only required if the optional audio output is desired.
- 28 7805 and LM340-5 are two part numbers for the same part. Some actual parts will have both part numbers marked on them. The original ELF magazine article recommended the LM309K voltage regulator IC (now obsolete), but the original ELF as pictured in the same article used the 7805/LM340-5 part instead. The LM309K part is much larger and would not fit the ELF properly, so the fact that the article specified this part is considered to be an error.
- 29 Pin labels are highly recommended for wire wrap work. These are small labels that affix to the bottom of the Vectorbord, under each IC socket, to identify the pin numbers when viewed upside down/reversed when viewing the board from the bottom during wire wrapping. These can be purchased, or they can be home made on a laser or inkjet printer using regular paper; PDF files of the label design are part of the set of documents of which this parts list is part. These label designs were done in Front Panel Designer, the free software that is normally used for designing control panels to be made by Front Panel Express.

- 30 Optional. Used for +5V and 0V (ground) bus between toggle switches, and near IC13 to act as power bus to support 'star' wiring of 5V power to all IC's and other components. Use actual commercially available bus bar, or strip insulation from regular 22 AWG solid tinned hookup wire. 'Star' wiring topology is recommended especially if decoupling capacitors will not be used; run a dedicated wire from the power supply pin(s) on each IC to the associated +5V or 0V power bus bar located at IC13 - these bus bars are solid wires soldered to the IC pins. This is generic, but the part number provided is for the Alpha brand of 22 AWG solid, tinned copper bus bar (no insulation), in a 100' roll.