Caveatron SV Bill of Materials Hardware Revision: C

Date: 2024-09-07

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Main Processor	1	PJRC Electronics	Teensy 4.1	Teensy 4.1	PJRC Store	

Notes: *The main system processor.* Available from multiple vendors. Versions with and without the pins pre-installed are available (link above is with pins). Either of the versions (with or without Ethernet) are fine.

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Touchscreen LCD	1	BuyDisplay	N/A	LCD 3.5" 320x480 TFT Display Module, OPTL Touch Screen w/Breakout Board Options: -Capacitive touch panel -16-bit 8080 40-pin header -3.3V supply -No font chip	<u>BuyDisplay</u>	Workspace Social Vibra Supplied Social Vibra Supplied Social Vibra Supplied Social Vibra Supplied Social Vibra Social

Notes: The display and user interface. Note that this is the capacitive touchscreen version unlike the resistive version used previously.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Laser Rangefinder	1	JRT Meter Tech., Co, Ltd.	Unknown	40m – 60m Laser Distance Sensor Module	Egismos (HEX) Ebay (ASCII) Alibaba (HEX) Alibaba (HEX) Alibaba (probably HEX) Availability changes frequently. Sites linked above has availability as of the date of this BOM	
				ats of this module including those nink any variant of this style shou		EX-based commands both of which are
Font/Graphics IC	1	Winbond	W25Q128JVSIM	W25Q128 SPI flash memory IC, 128 Mbit, quad 8-SOIC	<u>Digikey</u> and many other	

Notes: Contains the fonts and graphics used for the GUI. You must use the 128Mbit 8-SOIC package version – other sizes may not work. It is soldered to the pad location on the underside of the Teensy 4.1 that is directly under the micro-SD slot and farther from the edge (adjacent to the cross row of pins).

source

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Compass Module Optional but HIGHLY RECOMMENDED	1	Witmotion	RM3100	WitMotion High-Precision RM3100 Military-grade Magnetometer Sensor	Amazon or Witmotion	

Notes: *Used to determine the azimuth angle of the Caveatron.* This is the best currently available low-cost magnetometer module option. This magnetometer has proven more accurate, reliable and with less drift than another other tested. It is optional since the Pololu IMU module below also includes a magnetometer but the Pololu magnetometer is much more noisy and less accurate, so it is highly recommended that you use this module.

IMU Module Required for accelerometer but magnetometer portion can be used instead of RM3100 (not as good as RM3100)	1	Pololu	MinIMU-9 v5 (#2738)	MinIMU-9 v5 Gyro, Accelerometer, Compass (LSM6DS33, and LIS3MDL Carrier)	<u>Pololu</u>	
(not as good as RM3100)						

Notes: *Used to determine orientation of the Caveatron and measure inclination.*

Item	Qty	Manufacture r	Mfr. P/N	Description	Suggested Vendor Link	Photo			
Battery Charger Module	1	Unknown	TP5000	Lithium Ion 3.7V Charger Module	Amazon	DI 4482. F IN-O SANYA SANYA BA			
solder bridge is	Notes: <i>Battery charging module.</i> There are several sources for this module and at least 2 variants. Be sure to get the variant with the 4 power pins all on the same side. A solder bridge is required to make it functional and a 0.2 ohm resistor can be added to increase the charge current above 1 Amp. These are usually on a red PCB but can also be green from other sources.								
10k resistor	2	Various	Various	SMD resistor, 10k-ohm, 1%, 1206 package	<u>Digikey</u>				
				l d <i>for IMU power input</i> . Avail	able from numer	ous manufacturers and vendors - the above is only 1 example. 1/4 watt or			
	e this ca	arries no significar	t current.						
3.3k resistor	1	Various	Various	SMD resistor, 3.3k-ohm, 1%, 1206 package	<u>Digikey</u>				
Notes: Resistor			ge divider. A	vailable from numerous manu	facturers and ver	ndors - the above is only 1 example. 1/4 watt or less is fine since this			

1			Description	Suggested Vendor Link	Photo
1	Dantona	L37A26-1-0- 2WX	18650 Lithium-Ion Battery Rechargeable (Secondary) 2.6Ah	<u>Digikey</u>	CEL 1850 3:0 MN EST CLIFE CEL 1850 3:0 MN EST CLIFE CEL 1850 3:0 MN EST CLIFE CEL 1850 3:0 MN PO GWIN
y system 1		,		_	le from Tenergy (PN 30011) but is not connectorized: <u>Tenergy</u>
•	1 Kun uk	1701	Cylindrical Battery - 3.7v 2200mAh	1 I WILLIAM	ICRISSS 2200min 3.70
•			<u> </u>	_ • • • • • • • • • • • • • • • • • • •	ble to obtain the higher capacity option above.
1	Pololu			<u>Pololu</u>	THE STATE OF THE S
supply fo					
1	Pololu	Uı	o/Step-Down Voltage	<u>Pololu</u>	
	y system 1 supply for 1	1 Adafruit y system battery. This optic 1 Pololu supply for Teensy. 1 Pololu	y system battery. This version comes with a 1 Adafruit 1781 y system battery. This option is a lower capa 1 Pololu 2119 5V Volt supply for Teensy. 1 Pololu 2118 Po	(Secondary) 2.6Ah y system battery. This version comes with a 2-pin JST connector. A s 1 Adafruit 1781 Lithium Ion Cylindrical Battery - 3.7v 2200mAh y system battery. This option is a lower capacity battery but might be 1 Pololu 2119 5V Step-Up/Step-Down Voltage Regulator S7V7F5	y system battery. This version comes with a 2-pin JST connector. A similar battery is availabed a Adafruit 1

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Power Switch Module	1	Pololu	2808	Mini Pushbutton Power Switch with Reverse Voltage Protection, LV	Pololu	
Notes: Turns o	on and oj	ff system power who	en pushbutton j	power switch is pressed and also con	trols timed auto p	ower-off.
2.8V Voltage Regulator USED IN PCB SV REV C.2	1	Microchip Technology	MCP1700- 2802E/TO	Linear voltage regulator IC, 2.8V, 250mA, TO92	<u>Digikey</u>	
Notes: Regula	tes batte	ry voltage to keep I	Real Time Cloc	k active when Caveatron is turned of	f. Replaces coin c	ell battery used in PCB Rev C.2.
1uF Ceramic Capacitor USED IN PCB SV REV C.2	2	TDK	FG18X7R1 E105KRT0 6	Ceramic Capacitor, 1uF, 25V, Radial leads	<u>Digikey</u> (and many others)	
Notes: Stabiliz	es outpu	ıt voltage of RTC re	egulator above.	Most any ceramic capacitor of 1 uF	will work so long	as it is rated to 6V or higher.
Piezoelectric Buzzer	1	Uxcell	A1406240 0ux0199	uxcell A14062400ux0199 5 Pcs DC 2-28V 80Db Sound Electronic Passive Buzzer Alarm Black, 22 x 4.5 mm	Amazon	
Notes: Indicat	or buzze	r.		•		

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Power Switch & Charging LED	1	Adafruit	3350	Rugged Metal Pushbutton - 16mm RGB Momentary	Adafruit Amazon	
		CIT Relay and Switch	BH16NBSBG		<u>Digikey</u>	

Notes: On/Off power switch and charge indicating ring LED. This one enables separate colors on the ring LED for indicating charging and charge complete. These can be found at other sources as well but if you buy from another source be sure to get the common anode version.

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USB Jack	1	GT Contact	GT11A200-10	Micro USB-B Plastic Panel	USBFirewire.	
			(RR-11A200-10)	Mount to 6 Pin Solder Type	<u>com</u>	
						www.USBFireWire.com
						019

Notes: *USB jack for data download, battery charging, and loading of software and calibration parameters.* This is the version with the solder pins on the back side. If you prefer a USB-mini connector, that is available as part number RR-114200-10 and is an identical fit.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
USB Cap	1	GT Contact	GT1C522122 (RR-1C522122)	Seal Cap	USBFirewire. com	SBFireWire.com

Notes: Waterproof cap for USB jack. This cap works for either the mini or micro USB options.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
GPS Module OPTIONAL (OPTION 1)	1	Adafruit	746	Adafruit Ultimate GPS Breakout - 66 channel w/10 Hz updates - PA1616S	Adafruit Digikey and other sources	Ultimate GPS. PAGET AND THE PAGE OF STREET OF

Notes: *GPS module.* This component adds GPS functionality to the Caveatron for marking entrances or surface features. Data is saved with the cave survey file and includes latitude, longitude, elevation, and position accuracy. Use of this module precludes use of the Bluetooth modules below.

Bluetooth	1	Various	HM-10	HM-10 Bluetooth	<u>Amazon</u>	Taring a secretarian
Module				Serial Module		RXD
						TXD
OPTIONAL						GND VCC(2 CV CV)
(OPTION 2)						VCC(3.6V-6V)

Notes: *Bluetooth communications module.* This component is intended for future interfacing with TopoDroid or similar software running on an Android tablet but this function has not yet been added. The HM-10 is a Bluetooth 4.0 LE device so is only compatible with newer tablets and draws less power. Multiple variants and vendors are available for this component and so long as it is an HM-10 and operates on +5V, it should work. Use of this module precludes use of the GPS module above.

Bluetooth Module	1	Various	HC-05	HC-05 Bluetooth Serial Module	<u>Amazon</u>	EN VCC(3.6V-6V)
OPTIONAL				Boriar Woodale		GND TXD
(OPTION 3)						RXD STATE

Notes: *Bluetooth communications module.* This component is intended for future interfacing with TopoDroid or similar software running on an Android tablet but this function has not yet been added. The HC-05 is a Bluetooth 2.0 device so is compatible with older tablets but draws more power. Multiple variants and vendors are available for this component and so long as it is an HC-05 and operates on +5V, it should work. Use of this module precludes use of the GPS module above.

MicroSD Card	1	Various	Various	SanDisk 32GB Ultra microSDHC UHS-I Memory Card	Amazon and many other sources	SanDisk Ultra 32 _{GB} © A1
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Notes: *Storage for Caveatron data.* Numerous brands and sources available. MicroSD card must be SDHC type not larger than 32 GB (smaller capacities are fine as well). SanDisk brand is preferred as they are generally the most reliable.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Teensy USB connector	1	N/A	N/A	Micro USB Male Solder Connector	Amazon and many other sources	

Notes: For the cable to connect the exterior USB jack to the Teensy. Wires are soldered between this part and the USB jack connector pins. Note that only the D+, D-, and GND are connected on this plug. The USB power (and a second GND wire) goes from the USB jack to a plug on the main PCB.

LCD	1	N/A	N/A	40 pin IDE Male to Female	<u>Ebay</u>	
Connector				Extension Cable, 4" (10	-	
Cable				cm) or 6" (15 cm)	and other sources	
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Notes: Cable to connect to LCD Touchscreen from the Caveatron main board. Cables longer than 6" would take up too much space in the enclosure while those shorter than 4" are not long enough. These are available from multiple vendors. Note that some of these connectors do not include one of the middle pins, however those are fine since that pin is not used.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
JST Connector 5-pin	2 or 3	Various	JST-XH	JST 2.54mm pitch, 5 pin, male connector	Amazon, Ebay and others	
Notes: Conne	ctor for LRF	and power switch.	If you order th	nem prewired as in the photo, b		100 mm in length.
JST Connector 2-pin	3 or 4	Various	JST-XH	JST 2.54mm pitch, 2 pin, male connector	Amazon, Ebay and others	
					hem prewired as in the	photo, be sure they are at least 100 mm in length. (You
		ery if you order a b		T Comments	T	
Socket Headers 1	1 (6 pin positions needed)	Prec-Dip or others	310-87- 106-41- 001101	Socket header, 0.1" pitch, 4.2 mm insulation height, single row, 6 pins	<u>Digikey</u> and others	
						ed since the RM3100 has tall components. This header size is on one side and 2 pins on the other.
Socket Headers 2	3 (54 pin positions needed)	Prec-Dip or others	801-87- 024-10- 001101	Socket header, 0.1" pitch, 7.0 mm insulation height, single row, 24 pins	<u>Digikey</u> and others	
						Imm height to avoid interference with the display. Other Feensy and 5 pins are needed for the IMU module.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Screen Protector	1	Supershieldz	N/A	iPhone SE and iPhone 5 Screen Protector	Amazon	FUD OF ShieldZ
Notes: <i>Protecti</i> width as the 3.5	ion film 5" LCD	<i>for touchscreen</i> . N . Multiple vendors	Needs to be cu produce a sin	ut to length. Most any PET scremilar product.	een protector film for iPhone	4, 4S, 5, 5s, or SE should work as they have the same screen
Threaded Inserts for Enclosure	4	Initeq		#6-32 Threaded Heat Set Inserts for 3D Printing (Long)	<u>Ebay</u>	
Notes: Heat set	t thread	led inserts used in .	3D printed er	iclosure.		
Threaded Inserts for external mounting (Optional)	1	Initeq		#1/4-20 1/4" Threaded Heat Set Inserts for 3D Printing (Short)	<u>Ebay</u>	
Notes: Heat set handle) or mou			3D printed er	nclosure for external mounting.	This is an optional part if yo	ou plan to attach something external to the Caveatron (like a

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
LRF Window Material	1	Sibe Polymers	5064981212	Clear Acrylic Plexiglass 12" x 12" - 3/32" (.090)	Amazon	
Notes: Transp	parent a	crylic sheet for LR	F window on Ma	in Body.		
Wrist Strap Lanyard	1	Hukado	N/A	Hukado Adjustable Hand Wrist Straps Lanyard, (6 Pack) 9.5 inches Nylon Lanyard	Amazon	
Notes: Wrist	Strap. T	his wrist strap wor	ks well, but other	r options are available in various le	engths depending	on your preference.
O-Ring Seals	4 feet	The O-Ring Store	N50.103	0.103" (2.62mm) Buna-N 50 O-Ring Cord Stock, Black	O-Ring Store	The Plan St
	_	•				rred over more readily available 70 durometer since it is softer

and can make a tighter seal. Must cut to length and glue ends (this vendor also sells O-ring glue in small quantities.) Other vendors sell similar material.

RTC Battery Holder	1	MPD and others	BC501SM	Coin Cell Battery Holder - 12mm	<u>Digikey</u>	
NOT RECOMMENDED Only used with PCB SV Rev C.1				(for CR1220 batteries)	Amazon	

Notes: Holds a CR1220 battery to provide power to maintain the Real-time clock on the Teensy. The CR1220 batteries can only run the real-time clock for 6 weeks so require frequent replacement. A mod has been implemented to replace this part with a regulator and this part has been removed from PCB C.3 and C.4. Identical holders are available from many sources with differing part numbers.

Other Required Items:

Caveatron SV Rev C Printed Circuit Board

Single row male headers, 2.54 mm (0.1") pitch

Double row female headers 2x20 (for 40 pin LCD Connector), 2.54 mm (0.1") pitch

Soldering supplies
6-32 x 1/2" Flat Head Screws (4x)
4-20 x ½" thread rolling screws (3x)

4-20 x ¹/₄" thread rolling screws (10x)

2-28 x ¹/₄" thread rolling screws (15x)

PETG filament for 3D printed parts

O-Ring grease

O-Ring epoxy

Flexible waterproof epoxy sealant

Adhesive-backed foam

Tape (Kapton or cellophane)

Notes: For assembly and electrical interconnections between boards.