Caveatron SV Bill of Materials Hardware Revision: C

Date: 2024-01-02

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 ma	in systen	n <i>processor</i> . Availa	ble from multiple	e vendors. Versions with	and without the pins pr	re-installed are available (link above is with pins).

Touchscreen	1	BuyDisplay	N/A	LCD 3.5" 320x480	BuyDisplay	31711100000000000000000
LCD	1	BuyDisplay	IN/A	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	виуызріау	Workspace Social Vibra Support State Time Off Open Address Staff Time Off Open Address St

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	Unknown	40m – 60m Laser Distance	<u>Ebay</u>	
		Tech., Co, Ltd.		Sensor Module	<u>Ebay</u>	
OPTION 1					<u>Ebay</u>	
					<u>Alibaba</u>	
					<u>Alibaba</u>	
					<u>Alibaba</u>	
					A 21 1 21.	
					Availability	
					changes	
					frequently. Sites	
					linked above has	
					availability as of	
					the date of this	
					BOM	
· ·				nts of this module including those		X-based commands both of which are

supported by the Caveatron. Based on the datasheets I have reviewed I think any variant of this style should work.

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Font/Graphics IC	1	Winbond	W25Q128JVSIM	W25Q128 SPI flash memory IC, 128 Mbit, quad 8-SOIC	Digikey and many other	
					source	
						- Pro-

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 closest to the edge.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Compass Module OPTIONAL BUT HIGHLY RECOMMENED	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.

		1	1			
IMU Module	1	Pololu	MinIMU-9 v5 (#2738)	MinIMU-9 v5 Gyro, Accelerometer, Compass (LSM6DS33, and LIS3MDL	Pololu	
				Carrier)		

Notes: *Used to determine orientation of the Caveatron and measure inclination.* Note that the AltIMU-10 v5 does not fit on the current PCB. The MinIMU-9 v3 and v4 are still supported by the code and electronics but are no longer available.

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	D14492. FEIN-ON SANYAF ON BH					
solder bridge is	Notes: Battery charging module. 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, Digikey										
				1%, 1206 package							
		tery monitor volta arries no significar		d for IMU power input. Avail	able from numero	ous manufacturers and vendors - the above is only 1 example. ¹ / ₄ watt or					
3.3k resistor	1	Various	Various	SMD resistor, 3.3k-ohm, 1%, 1206 package	Digikey						
Notes: Resistor	r for bat	ı tery monitor volta	ge divider. A	vailable from numerous manu	facturers and ven	ndors - the above is only 1 example. 1/4 watt or less is fine since this					

carries no significant current.

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Battery Pack OPTION 1	1	Dantona	L37A26-1-0- 2WX	18650 Lithium-Ion Battery Rechargeable (Secondary) 2.6Ah	<u>Digikey</u>	PAN STAR TO ANY SEX OF THE STAR SEX OF THE S
						le from Tenergy (PN 30011) but is not connectorized: <u>Tenergy</u>
Battery Pack OPTION 2	1	Adafruit	1781	Lithium Ion Cylindrical Battery - 3.7v 2200mAh	<u>Adafruit</u>	ICRI9650 2200 APN 3.70
					•	ble to obtain the higher capacity option above.
Voltage Regulator – 5V	1	Pololu		V Step-Up/Step-Down tage Regulator S7V7F5	<u>Pololu</u>	
Notes: Power s	upply fo	or Teensy.				
LRF Voltage Regulator	1	Pololu		ololu Adjustable Step- p/Step-Down Voltage Regulator S7V8A	<u>Pololu</u>	
Notes: Power s	upply fo	or Laser Rangefind	er. Output needs	to be set to 3.0V.		

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	<u>Pololu</u>	
Notes: Turns o	on and o	ff system power whe	en pushbutton j	power switch is pressed and also con	trols timed auto p	oower-off.
RTC Battery Holder	1	MPD and others	BC501SM	Coin Cell Battery Holder - 12mm (for CR1220 batteries)	<u>Digikey</u> <u>Amazon</u>	
				ntain the Real-time clock on the Teen all have nearly identical dimensions		ers are available from many sources with differing part
Piezoelectric Buzzer	ose i na	Uxcell	A1406240 Oux0199	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 6V RGB Momentary	Adafruit Amazon	

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.

		•	,	U		
USB Jack	1	GT Contact	GT114200-10	Mini USB-B C2 size Plastic	USBFirewire.	
			(RR-114200-10)	Panel Mount	<u>com</u>	
						WAY TWA LUSTSTEP WITH A COMP
						GEO

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 inside. If you prefer a USB-micro connector, that is available as part number RR-11A200-10 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.	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	O 43.3V DER Breakout v3 O FIX O 4TX O PA1616S O GND O PVIN O 4PPS

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	Amazon	Train (exceptions
Module				Serial Module		RXD
						TXD
OPTIONAL						GND WEST SWEET
(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.

1	Various	HC-05	HC-05 Bluetooth	<u>Amazon</u>	EN
			Serial Module		— VCC(3.6V-6V)
					P GND
					TXD
					RXD
	1	1 Various	1 Various HC-05		

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 32GB MSSU © 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 Connector Cable	1	N/A	N/A	40 pin IDE Male to Female Extension Cable, 4" (10 cm) or 6" (15 cm)	Ebay or Amazon	
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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	e sure they are at least	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					
		USB data, USB poerry if you order a b			hem prewired as in the	photo, be sure they are at least 100 mm in length. (You				
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	Digikey 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	Digikey and others	The side and 2 paid on the outer.				
	Notes: Header sockets for Teensy and IMU. Optional but this shorter size is preferred over the more common 8.51mm height to avoid interference with the display. Other ariants with different numbers of pins are available. Two sets of 24 pins and 1 additional pin are needed for the Teensy 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	Screen Possessor				
		<i>Jor toucnscreen</i> . N Multiple vendors			en protector illm 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)	Ebay					
Notes: Heat set	t thread	ed inserts used in .	3D printed ei	nclosure.						
Threaded Inserts for external mounting (Optional)	1	Initeq		#1/4-20 1/4" Threaded Heat Set Inserts for 3D Printing (Short)	Ebay					
	Notes: Heat set threaded inserts used in 3D printed enclosure for external mounting. This is an optional part if you plan to attach something external to the Caveatron (like a nandle) or mount it to a tripod.									

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	arent 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	Notes: Wrist Strap. This wrist strap works well, but other options are available in various lengths depending on your preference.								
O-Ring Seals	4 ft	The O-Ring Store	N50.103/10	0.103" (2.62mm) Buna-N 50 O-Ring Cord Stock, 10' Piece, Black	O-Ring Store	The D			

Notes: *O-Ring material for seals in main enclosure and LIDAR module.* This 50 durometer material is preferred 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.

Other Required Items:

Caveatron SV Rev C Printed Circuit Board

CR1220 Battery

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)

 $4-20 \times \frac{1}{2}$ " 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.