


Caveatron Bill of Materials

Hardware Revision: B

Date: 2020-10-26


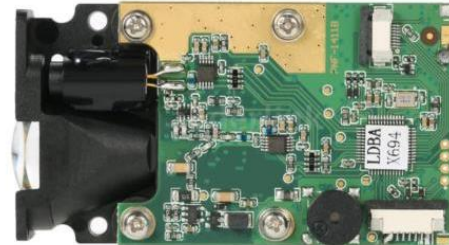
All the parts in this list have been tested with the Caveatron and integrated into the code. For some parts, alternate options are available.


Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Main Processor	1	PJRC Electronics	Teensy 3.6	Teensy 3.6	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).


Touchscreen LCD	1	BuyDisplay	N/A	<p>LCD 3.5" 320x480 TFT Display Module,OPTL Touch Screen w/Breakout Board</p> <p>Options:</p> <ul style="list-style-type: none"> - Resistive touch panel - 16-bit 8080 40-pin header - 3.3V supply - No font chip 	BuyDisplay	
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Notes: *The display and user interface.* This is the new and currently preferred choice for the display. At present the Caveatron PCB and enclosure designs have not been updated for this display.

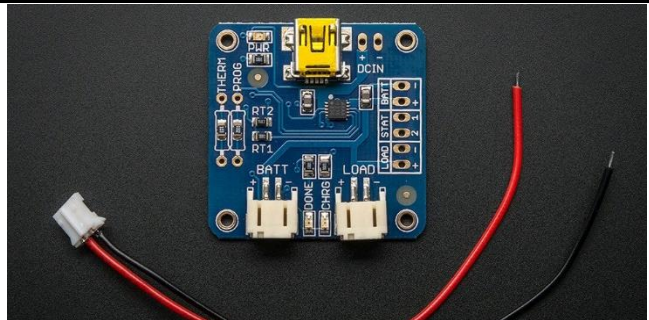
Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Laser Rangefinder OPTION 1	1	Uni-T	UT390B	Laser Distance Meter	Ebay. Availability very limited and changes frequently.	
Notes: Used for station distance measurements. This item is long since discontinued but can still be found online from a few sources. Do not confuse this with the UT390B+, which is widely available but does not have an accessible serial port, so is not useable. The UT390B+ has a bubble level in the upper left which the UT390B does not. The UT390B must be disassembled and the LCD removed to access the electronics board. The JRT rangefinder (OPTION 2) has wider availability, but has operational disadvantages. The UT390B remains the preferred rangefinder if you can find one.						
Laser Rangefinder OPTION 2	1	JRT Meter Tech., Co, Ltd.	Unknown	100m Laser Distance Sensor Module	Ebay Availability changes frequently.	
Notes: Used for station distance measurements. This rangefinder module is similar in size to Option 1 above and is easier to find. However, it's method of operation is less well suited to the Caveatron since it has a variable measurement time (rather than the UT390B's fixed 1 sec measurement time) and can take up to 3 sec to acquire a reading or timeout. This means that when scanning in Passage mode, you can end up with fewer reference points and a less accurate scan.						

Gyroscope Module	1	Pololu	L3GD20H (#2129) Or L3GD20 (#2125)	L3GD20H 3-Axis Gyro Carrier with Voltage Regulator	Pololu	
<p>Notes: <i>Used to supplement compass module to improve orientation measurement.</i> As an alternative to the single AltIMU, separate compass and gyroscope modules are supported, but must be co-aligned with each other. This module uses the same gyroscope as the AltIMU-10 v3 and v4. The older L3GD20 module can also be used.</p>						

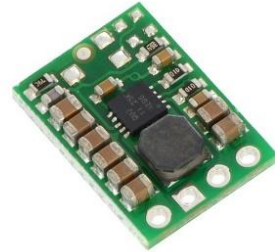

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Battery Pack OPTION 1	1	Adafruit	354	Lithium Ion Battery Pack - 3.7V 4400mAh	Adafruit	
Notes: <i>Primary system battery.</i>						

Battery Pack OPTION 2	1	Tenergy	354	Tenergy Li-Ion 18650 3.7V 5200mAh Rechargeable Battery PCB module with Bare Leads	Walmart Tenergy	
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Notes: *Primary system battery.* Higher capacity battery with identical dimensions and voltage to Option 1. Does not include connector unlike Option 1.





Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Battery Charging Module	1	Adafruit	259	USB Lilon/LiPoly charger - v1.2	Adafruit	

Notes: *Controls the charging of the LI-Ion battery pack and provides charge indication to power switch LED.* Default charge current is 500 mA, but can be increased to 1200 mA by adding a 1.5 kΩ resistor (see assembly instruction.)




Voltage Regulator – 5V	1	Pololu	2123	Pololu 5V Step-Up/Step-Down Voltage Regulator S7V8F5	Pololu	
Notes: <i>Power supply for LIDAR.</i> A Pololu 2118 (see below) could also be used if set to 5.0 V.						
Voltage Regulator – Adjustable	1	Pololu	2118	Pololu Adjustable Step-Up/Step-Down Voltage Regulator S7V8A	Pololu	
Notes: <i>Power supply for Laser Rangefinder.</i> Output needs to be set to 3.0V.						




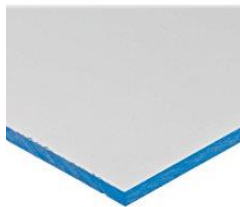
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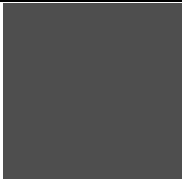


Power Switch Module	1	Pololu	2808	Mini Pushbutton Power Switch with Reverse Voltage Protection, LV	Pololu	
Notes: Turns on and off system power when pushbutton power switch is pressed and also controls timed auto power-off.						
Piezoelectric Buzzer	1	Uxcell	a14062400ux0173	Uxcell 5 Pcs DC 1-30V 90Db Sound Passive Electronic Buzzer Alarm Black, 30 x 6 mm	Amazon	
Notes: Indicator buzzer.						
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. Other 16mm momentary pushbutton switches from Adafruit are available with a single color LED, though they are longer in length, so may not fit well in the enclosure. If you buy from another source be sure to get the common anode version.						
Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo



USB Jack	1	GT Contact	GT114200-50	Waterproof USB Connector - Mini-B Female to Mini-B Female	USBFireWire.com	
Notes: Mini-USB jack for data download, battery charging, and loading of software and calibration parameters. The connector on the back plugs into the Teensy micro-USB port using the adapter cable below. The RR-114200-10 version with solder pins on the back can also be used if you use a micro-USB that terminates in bare leads.						
USB Cap	1	GT Contact	GT1C5221 22	Seal Cap	USBFireWire.com	
Notes: Waterproof cap for USB jack.						
Teensy USB interface cable	1	StarTech or Seismic Audio	UMUSBO TG8IN or SA-USBM8i	Micro USB Male to Mini USB Male Adapter Cable	Amazon or Amazon	
Notes: Connects the micro-USB connector on the Teensy to the external waterproof mini-USB jack shown above.						
RTC Battery Holder	1	Unknown	PRT-00783	Coin Cell Battery Holder - 20mm (PTH)	Sparkfun	
Notes: Holds a CR2032 battery to provide power to maintain the Real-time clock on the Teensy 3.6. Similar holders are available from many sources. So long as they can hold a CR2032 and the pins have a 20 mm spacing, it should work.						

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JST Connector 5-pin	3	Various	JST-XH	JST 2.54mm pitch, 5 pin, male connector	Amazon, Ebay and others	
Notes: Connector for LRF, LIDAR, and power switch. If you order them prewired as in the photo, be sure they are at least 150 mm in length.						
JST Connector 2-pin	2	Various	JST-XH	JST 2.54mm pitch, 2 pin, male connector	Amazon, Ebay and others	
Notes: Connector used for battery and piezo buzzer. If you order them prewired as in the photo, be sure they are at least 150 mm in length.						
MicroSD Card	1	Various	Various	SanDisk 16GB Ultra microSDHC UHS-I Memory Card	Amazon	
Notes: Storage for Caveatron data. Numerous brands and sources available. MicroSD card must be SDHC type not larger than 32 GB. SanDisk brand is preferred as they are generally the most reliable.						

Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
2-28 Thread Rolling Screws	14	Small Parts		410 Stainless Steel Thread Rolling Screw for Plastic, Passivated Finish, Pan Head, Phillips Drive, #2-28 Thread Size, 1/4" Length	Amazon	
Notes: Screws for threading directly into 3D printed holes						
4-20 Thread Rolling Screws	10	Small Parts		410 Stainless Steel Thread Rolling Screw for Plastic, Passivated Finish, Pan Head, Phillips Drive, #4-20 Thread Size, 1/4" Length	Amazon	
Notes: Screws for threading directly into 3D printed holes						
LIDAR Window Material	1	Small Parts	5302441212	Acrylic Sheet, Transparent Clear, Standard Tolerance, ASTM D788, 0.118" Thickness, 12" Width, 12" Length	Amazon	
Notes: Transparent acrylic sheet for LIDAR window. This 0.118" transparent acrylic sheet is used for the LIDAR windows. Requires cutting to size. Acrylic seems to be the most transparent with the least distortion and defects of the various clear plastics tested, which is important for getting good LIDAR and rangefinder readings.						
LRF Window Material	1	Sibe Polymers	5064981212	Clear Acrylic Plexiglass 12" x 12" - 3/32" (.090)	Amazon	
Notes: Transparent acrylic sheet for Rangefinder window on Main Body. The 0.118" transparent acrylic sheets used for the LIDAR windows could be used as well if you don't want to order this 0.090" thick sheet. Requires cutting to size.						

Laser Rangefinder Optical Filter	1	Rosco	299	Roscolux 1.2 Neutral Density Filter, 20x24"	Adorama	
Notes: Filters rangefinder receiver to only accept readings from the retroreflective card.						
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	
Notes: Protection film for touchscreen. Needs to be cut to length. Most any PET screen protector film for iPhone 4, 4S, 5, 5s, or SE should work as they have the same screen width as the 3.5" LCD. Multiple vendors produce a similar product.						
Strap Attachment Hardware	1	122317	Hillman Group	D-Ring Hangers	Lowes	
Notes: Small D-rings for attaching neck strap. Available from multiple sources and similar parts likely available from other vendors.						

Neck Strap	1	DOROM	N/A	DOROM Universal Adjustable Slim Shoulder Sling Neck Strap for All Camera DSLR SLR	Amazon	
Notes: <i>Neck Strap.</i> This neck strap works well, but other options are available. Recommend a nylon camera strap of 52-60" in length and about 3/8" wide in the ends.						
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	
Notes: <i>O-Ring material for seals in main enclosure and LIDAR module.</i> 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:

PETG Filament for 3D Printing
 Caveatron Printed Circuit Board
 CR2032 Battery
 Single row male headers
 Single row female headers
 Double row female headers 2x20 (for 40 pin LCD Connector)
 1.5 kΩ resistor
 6-32 x 1/2" Flat Head Screws (8x)
 6-32 x 3/8" Pan Head Screws (4x)
 6-32 x 9/16" Pan Head Screw (1x)
 6-32 Nut (3x)
 Adhesive-backed foam
 Epoxy, sealant, and grease
 Tape (Kapton or electrical)
 Soldering supplies

Notes: *For assembly and electrical interconnections between boards.* Several sizes of standard hardware required. More information in assembly instructions.

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