


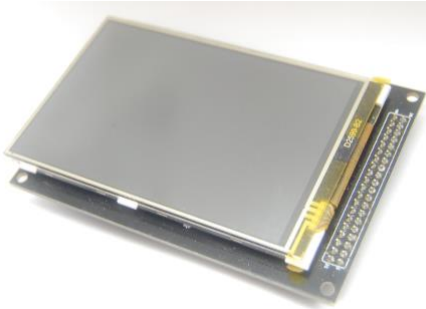

## Caveatron Bill of Materials

**Hardware Revision: B**




**Date: 2021-03-24**

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


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Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Touchscreen LCD  <b>OPTION 2</b>	1	Coldtears Electronics	N/A	3.5 inch TFT LCD module w/Font IC 480x320 full angle Arduino DUE MEGA 3.2 4.3	No longer available	
<b>Notes:</b> <i>Alternate display.</i> This display was previously the preferred choice but is likely no longer going to be available. At present the Caveatron enclosure is only designed to use this display.						
Touchscreen LCD  <b>OPTION 3</b>	1	Coldtears Electronics	N/A	4.0" inch TFT LCD module w/Font IC 480x320 ILI arduino DUE MEGA 3.2 2.5 STM32	No longer available	
<b>Notes:</b> <i>Alternate display.</i> Same resolution as the 3.5" in a larger size but with slightly less viewing angle contrast. This display is likely no longer going to be available.						
Graphics Module (SPI Flash Memory)	1	Multiple (Winbond IC)	W25Q64 or similar	W25Q64 64Mbit 8MByte Flash Memory Module Data Flash SPI Interface	<a href="#">Amazon</a>	
<b>Notes:</b> <i>Storage for fonts and graphics used in the GUI.</i> SPI Flash memory must be Winbond W25Q32, W25Q64, or W25Q128 (memory size should be 32Mbit or higher.) Winbond W25Q16 (16 Mbit) could be used, but will only hold the fonts and not support the graphics.						




Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Laser Rangefinder  <b>OPTION 3</b>	1	JRT Meter Tech., Co, Ltd.	Unknown	40m – 60m Laser Distance Sensor Module	<a href="#">Ebay</a> Availability changes frequently. Site linked above has availability as of the date of this BOM	
<b>Notes:</b> <i>Used for station distance measurements.</i> This rangefinder module has not been tested but it appears to operate with an identical protocol to the Option 2 rangefinder, so would be compatible. However, it also likely has the same performance considerations. It is significantly smaller than the others.						
IMU/ Compass Module  <b>OPTION 1</b>	1	Pololu	MiniIMU-9 v5 (#2738)  Or  AltIMU-10 v5 (#2739)	AltIMU-10 v5 Gyro, Accelerometer, Compass, and Altimeter (L3GD20H, LSM303D, and LPS331AP Carrier)	<a href="#">Pololu</a>	
<b>Notes:</b> <i>Used to determine orientation of the Caveatron and measure azimuth and inclination.</i> This is the best currently available IMU module option although the discontinued models below have half the noise floor if you can find them. The AltIMU-10 and MiniIMU are equivalent parts since the altitude sensor in the AltIMU is not used.						
IMU/ Compass Module  <b>OPTION 2</b>	1	Pololu	AltIMU-10 v3 (#2469)  Or  AltIMU-10 v4 (#2470)	AltIMU-10 v3 Gyro, Accelerometer, Compass, and Altimeter (L3GD20H, LSM303D, and LPS331AP Carrier)	<a href="#">Pololu</a> (Discontinued)	

**Notes:** *Used to determine orientation of the Caveatron and measure azimuth and inclination.* The AltIMU-10 v4 is an equivalent part and can also be used. The older v3 and v4 versions of the modules are preferred over the newest AltIMU-10 v5 or the MiniMU-9 v5 since the magnetometer in this module (LSM303D) has a lower noise output than the LIS3MDL used in the newest versions. At this time, it appears that this part is no longer available.

Compass Module  <b>OPTION 3</b>	1	Pololu	LSM303D (#2127)	LSM303D 3D Compass and Accelerometer Carrier with Voltage Regulator	<a href="#">Pololu</a> (Discontinued)	
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**Notes:** *Used to measure azimuth and inclination.* 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 accelerometer and magnetometer IC as the AltIMU-10 v3 and v4. If you use this option, you must also option the gyroscope module below. At this time, it appears this part is no longer available.

Gyroscope Module  <b>OPTION 3</b>	1	Pololu	L3GD20H (#2129)  Or  L3GD20 (#2125)	L3GD20H 3-Axis Gyro Carrier with Voltage Regulator	<a href="#">Pololu</a> (No longer needed since LSM303D is discontinued)	
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**Notes:** *Used to supplement compass module to improve orientation measurement.* This part is used ONLY if the separate OPTION 3 LSM303D compass module above is used rather than the integrated MiniMU or AltIMU. It must be aligned to the LSM303D. The older L3GD20 module can also be used.







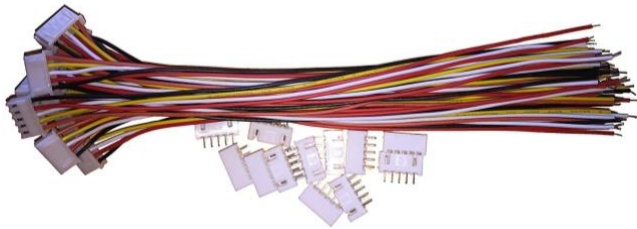


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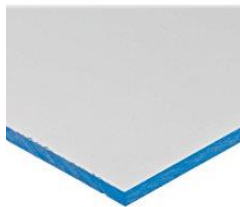


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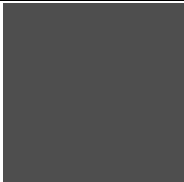






Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
JST Connector 5-pin	3	Various	JST-XH	JST 2.54mm pitch, 5 pin, male connector	Amazon, Ebay and others	
<b>Notes:</b> Connector for LRF, LIDAR, and power switch. If you order them prewired as in the photo, be sure they are at least 150 mm in length.						
JST Connector 2-pin	2	Various	JST-XH	JST 2.54mm pitch, 2 pin, male connector	Amazon, Ebay and others	
<b>Notes:</b> 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	<a href="#">Amazon</a>	
<b>Notes:</b> 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
Threaded Inserts for LIDAR Standoffs	4	Initeq	INM2504	M2.5-0.4 M2.5 Threaded Heat Set Inserts for 3D Printing (Long)	<a href="#">Ebay</a>	
<b>Notes:</b> Heat set threaded inserts used in 3D printed LIDAR enclosure for LIDAR standoffs. The standoffs that screw into these are included with the RPLIDAR.						
Threaded Inserts for Enclosure	10	Initeq		#6-32 Threaded Heat Set Inserts for 3D Printing (Long)	<a href="#">Ebay</a>	
<b>Notes:</b> Heat set threaded inserts used in 3D printed enclosure.						
Threaded Inserts for external mounting (Optional)	1	Initeq		#1/4-20 1/4" Threaded Heat Set Inserts for 3D Printing (Short)	<a href="#">Ebay</a>	
<b>Notes:</b> 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 handle) or mount it to a tripod.						

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	<a href="#">Amazon</a>	
<b>Notes:</b> 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	<a href="#">Amazon</a>	
<b>Notes:</b> 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	<a href="#">Amazon</a>	
<b>Notes:</b> 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)	<a href="#">Amazon</a>	
<b>Notes:</b> 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"	<a href="#">Adorama</a>	
<b>Notes:</b> <i>Filters rangefinder receiver to only accept readings from the retroreflective card.</i> This filter only has half the optical density required, so must be folded in half when installed						
Item	Qty	Manufacturer	Mfr. P/N	Description	Suggested Vendor Link	Photo
Screen Protector	1	Supershieldz	N/A	iPhone SE and iPhone 5 Screen Protector	<a href="#">Amazon</a>	
<b>Notes:</b> <i>Protection film for touchscreen.</i> 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	<a href="#">Lowes</a>	
<b>Notes:</b> <i>Small D-rings for attaching neck strap.</i> 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	<a href="#">Amazon</a>	
<b>Notes:</b> <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	<a href="#">O-Ring Store</a>	
<b>Notes:</b> <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.

**Date: 2019-11-07**

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