Doc V1.1

ESP32 Hardware & Wiring_V4 28/10/2024

This document should be read alongside

Schematic diagram. Note: - Schematics show a bare board, rather than it sitting in the breakout

'Build a Box' document. Details how to mark out, cut and mount everything into a project box. It also has photos detailing the finished wiring.

All of the boards are pre-made, you will not have to solder the components yourself. Most boards will also have the header pins pre-soldered. The GY-302 (light-meter) and the LED matrix require the header pins soldered. Soldering is also required for the buttons, flash socket and external connectors, if you choose to use them.

Using JST HX connectors, the different modules can be connected to the breakout board. They make a neat solution and fit tightly to the header pins on the modules, so do not work loose, like Dupont, but have the disadvantage of requiring some of the pins removed and their places swapped. The wire is also very thin, so good quality wire strippers designed for fine wiring are required. Alternately a sharp Stanley knife or scalpel is required to carefully remove the insulation. Tinning the bared wire (adding a little solder to it with a soldering iron) helps it gain thickness, to better be gripped in the screw terminals.

Alternately Dupont wires can be used. These are a little easier as they are single wires, not requiring any alteration and the male end fits nicely into the breakout board screw terminals. The disadvantage is that the female ends tend to come loose, so need sticking to the header pins (a dab of hot-glue works well for this).

There are many 3.3V, 5V & GND power connections. These will not all fit into the breakout board screw-terminals. It will be necessary to connect them in groups with a choc-block or similar, then take one wire to the screw terminal.

Whilst it is not good practice to mix voltages, there is no way to avoid this, as some modules require 3.3V and others 5V. Please take care to ensure the correct voltage is supplied to each module and on the correct pin.

As JST HX connectors are used, a red wire will be used for either 3.3 or 5V. Be very careful that you connect the module to the correct voltage. If using Dupont wires, I would suggest using Brown for 3.3V and Red for 5V.

Light-meter, LED matrix and LCD all require 5V. If not using these modules, then 5V wiring is not required.

Ensure you pay particular attention to the polarity of the connections. The boards are clearly marked.

The LCD is marked Vcc and is connected to 5V. (Red wire) and GND, (Black wire)

The GY-302 Light Sensor is marked Vcc and is connected to 5V and GND, (Black wire)

The Laser tx board is marked as S (3.3V) and - (GND) Do not connect anything to the centre pin.
On many Laser boards, the Laser barrel is only held to the board by its wires. This means it can easily be knocked out of alignment. Consider using hot-glue or similar to affix the Laser barrel to the board.

The Sensor (rx) board is marked VCC (3.3V) and GND. The centre pin is marked OUT, which is wired to one of the input pins on the ESP32 breakout board.

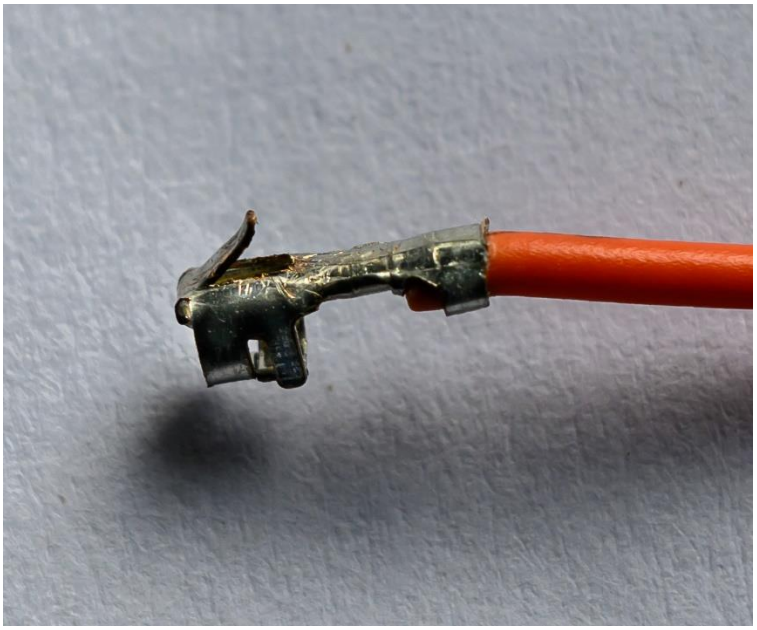
Be very careful when fitting the receiver sensor into the board. Refer to the photograph. The little lens must be pointing towards the header pins on the board.

The TFT is marked VDD (3.3V) and GND (0V). The tft board LED pin is also connected to 3.3V

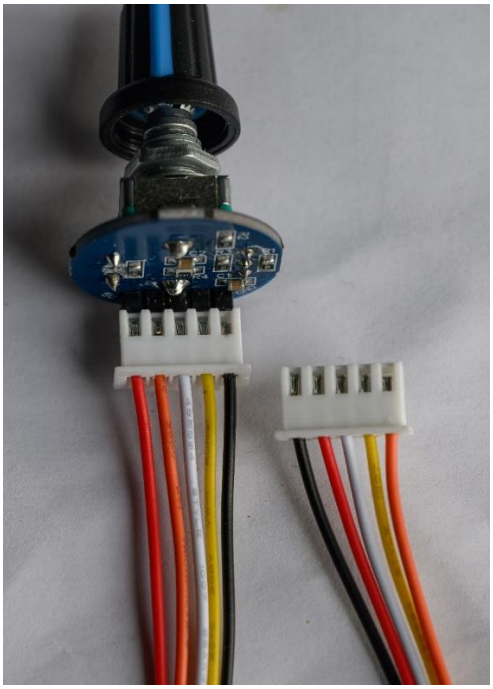
It is recommended that The Shutter Tester is built with the TFT screen. However, it can be omitted, as all results are also sent to the computer screen.

Modifying the JST HX connectors.

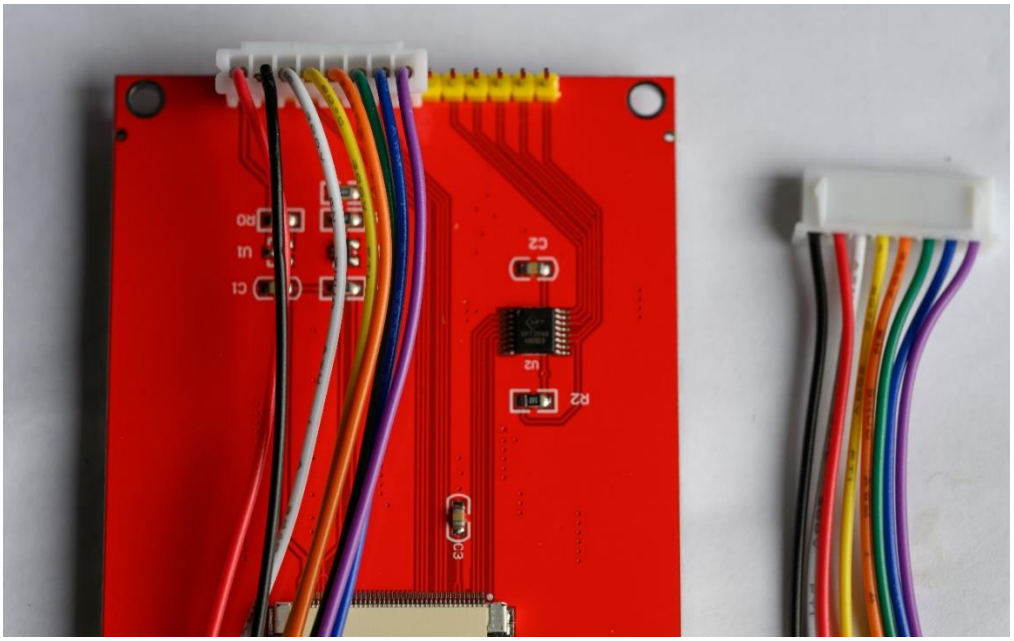
To keep the colour coding correct, Red for power and black for 0V, some pins on the JST HX connectors will require removing and swapping.
To do this, carefully press down on the exposed side of the metal pin, to push the barb down and then slide the pin & wire out of the connector. It does take a little practice and if too much force is used, the barb can be pushed down too far making it impossible to bend back up, for re-inserting. It is worth sacrificing one connector to practice on, to get the hang of doing it. If all else fails, the pins can be re-inserted without the barb and a dab of-hot-glue used to hold the wire in the plastic connector.



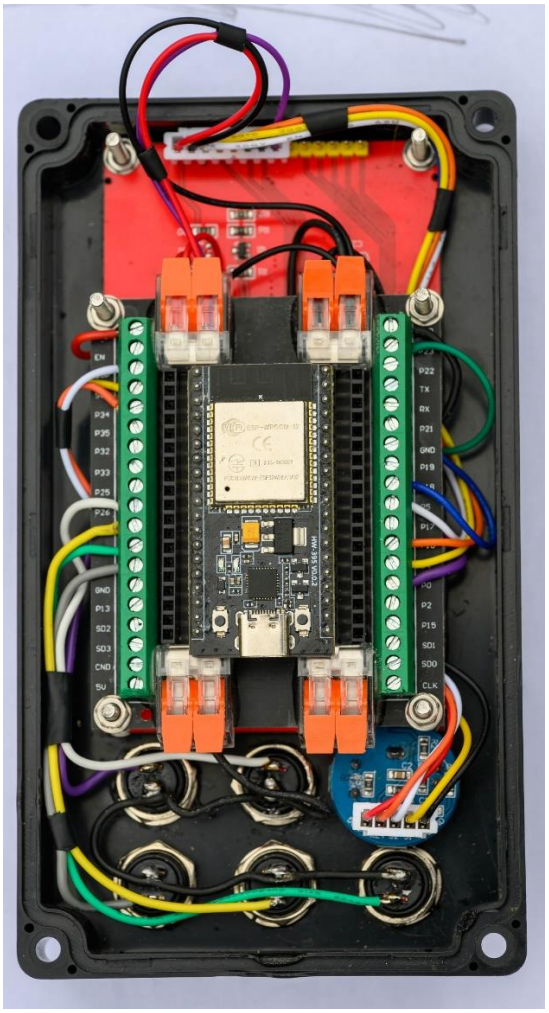
This is the connector removed from the plastic housing. The barb can be seen protruding at the top.
During removal, the barb was pushed too far down, taking a lot of effort with a sharp thin blade, whilst wearing protective gloves and keeping the knife pointing away, to get the barb bent back up, as is evident by all the scratch marks



This is the encoder, showing the required changes to the JST HX pins.
On the right, the original connector and on the left, Red has been moved to the left and Black to the right, with orange being placed in the second position (vacated by the Red)



The JST HX connector, 8-pin. Red & Black require swapping.
Origiinal connector shown on the right.
The unused pins on the tft board are for touch, which is not implementsed in the Shutter tester and are left disconnected.



Wiring for the tft screen, encoder and buttons.
Orange terminal connectors have been glued to the board using epoxy resin.
Top terminal connectors are +3.3V and 0V

Bottom terminal connectors are not yet connected, but will be 0V (left) and +5V (right)

LCD & Flash connections.

The LCD is a legacy from the Arduino unit and cannot display as much information as the tft or PC screen. The text size is larger than the tft, so can be used as a quick reference display.

The LCD is depreciated and may not be supported In future firmware updates.
In place of the LCD, a larger font and simplified display will be added to the existing tft screen, allowing the user the option of detailed or larger simplified display.

The JST connector, 4-pin version does not require any modification.

Note: - The specified project box is too small to also house the LCD. A larger project box or separate housing for the LCD will be required. (see V3 documents for larger project box & pictures of the LCD).

The flash connection can be used to detail when the flash will fire during the shutter cycle, to ensure it is triggered at the correct time. A suitable cable and 3.5mm socket is given in the parts document. Two wires require soldering to the socket.

Note: - only cameras with mechanical flash contacts should be connected.

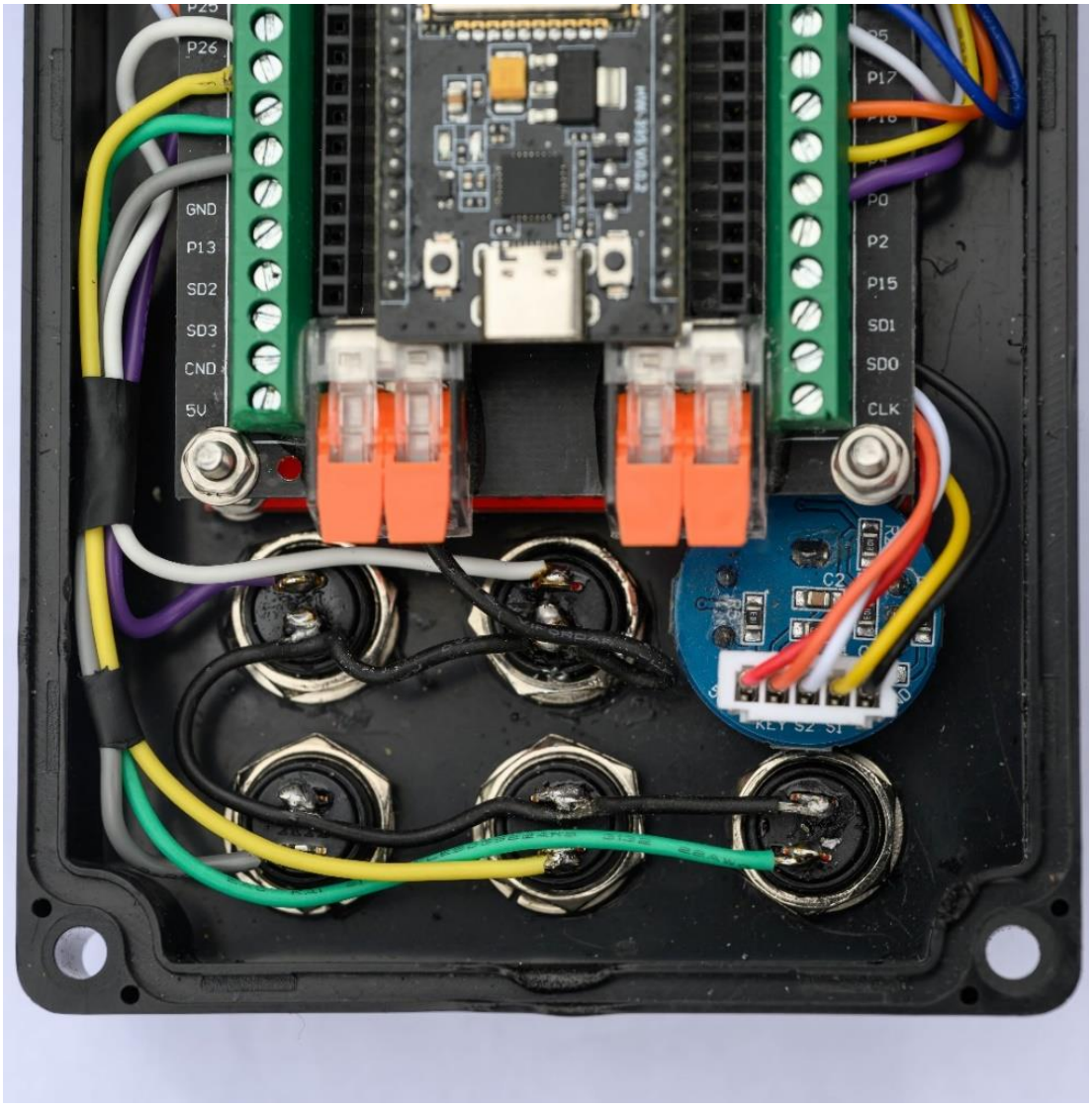
Connections to 3.5MM jack socket.

Button Wiring.

A black wire is connected to one leg on each button in a daisy-chain and then run to the 0V connector block.
The other leg on each button is connected to the corresponding screw terminal on the breakout board.

The wires used were the same colour as the buttons, except for the Black button, where a grey wire was used and the red button, where a purple wire was used.

A single colour wire can be used for all the buttons, but avoid using Red or Black.



Close up of button wiring. Black wire is common to all buttons and then goes to 0V
Grey wire has been used for the Black button and a purple wire for the Red button to avoid confusion with +V and 0V wires.

Other Module wiring

LED matrix and light-meter can be connected using JST HX connectors. The wires then require soldering to the multicore cable. It can be easier to solder the multicore cable directly to the module.

The alternate is to purchase the JST HX bare pin connectors (female type) and a crimp tool, to attach them to the end of the multicore cable. Suitable connectors & crimp tool are shown on the parts document.

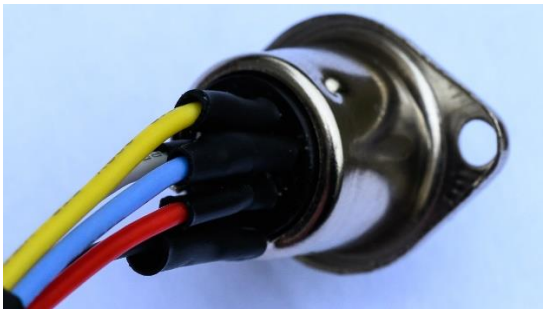
The multicore cable can then be run directly into the project box and to the corresponding terminals on the breakout board. An alternate is to use a plug & socket mounted on the project box.

Extreme care must be used if using plugs & sockets, that dedicated pins are used for 3.3V and 5V.
Connecting voltage to a data pin of a module is likely to destroy it.

It is also possible to use a connector with different pin configuration for each module. For example, 6 pin for the sensors/Lasers, 4 pin for the Light-meter and a 5 pin for the LED matrix.

Wiring for the Light-meter.
+5V is on the bottom right pin and 0V the bottom large flat pin
Going anti-clockwise, the next pin is not used, the next pin is Yellow.
The centre pin is White.

Additionally, the bottom left pin (unused here) has been insulated as it is used for 3V for other sensors.



The LED matrix uses +5V (Bottom right) 0V bottom flat pin
and anti-clockwise, the next two pins for Blue and Yellow.
Centre pin is White

All pins have been insulated with shrink tube, to ensure no short can occur.

Additionally, the bottom left pin (unused here) has been insulated as it is used for 3V for other sensors.

Sensors & Laser wiring.

All of the 3.3V connections, marked as ‘S’ on the Laser board and ‘Vcc’ on the sensor board can be linked together in a daisy chain. Then the same sone with the 0V connections.

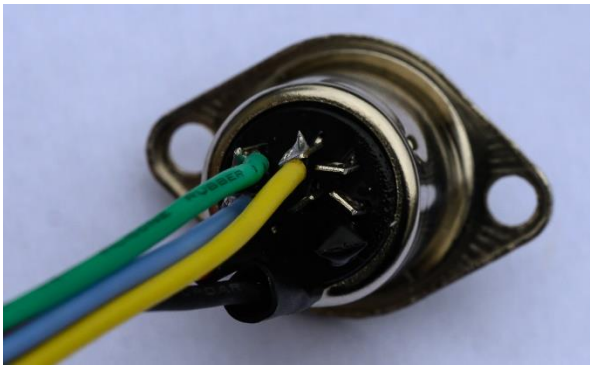
Alternately JST HX connectors can be used on each of the boards (pins will require swapping to ensure power colour codes are followed) and the ends of these joined together.

The centre pin on each of the sensor boards has its own wire going back to the ESP32 breakout board.

The multicore cable can be run directly to the breakout board, or a plug & socket used on the exterior of the project box. Using a plug & socket will allow the sensor frame to be changed, for example from a horizontal to a vertical layout.

If using a plug & socket, an 8 pin version would allow two modules (sensors/Lasers & light meter for example) to both use an 8 pin connector to save money, as they come in packs of 5.

Be very careful with the 3V and 5V wires, ensuring they do not come into contact with any of the data pins.

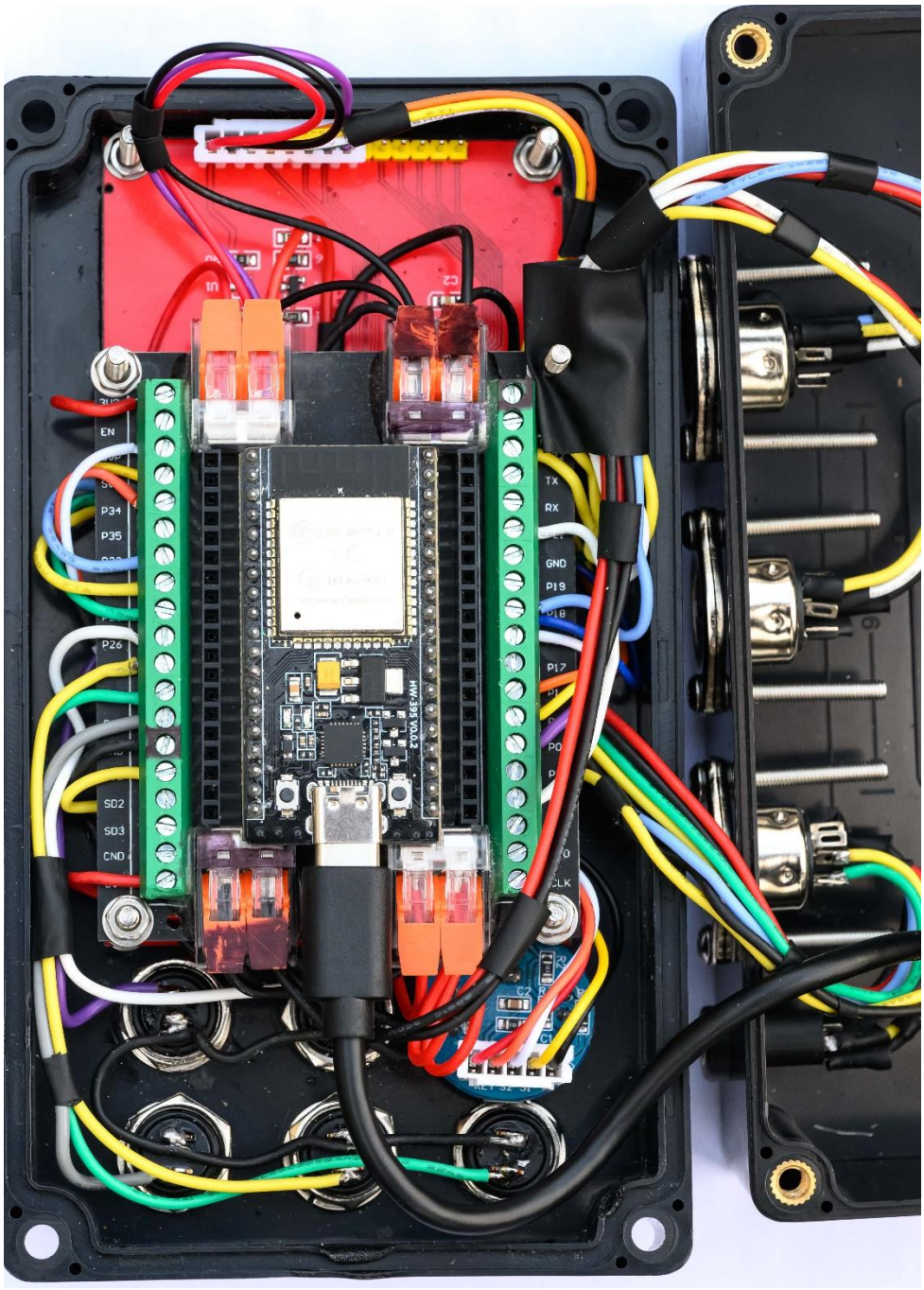


9 pin Din socket wiring. 0V is the large flat terminal at the bottom.
Red is 3V and used the bottom left pin.

The pins are very tightly spaced, so the +3V and 0V have been insulated with shrink tube to avoid any short circuits. Blue, Green, Yellow then use the next three pins, going clockwise.

Additionally, the bottom right pin (unused here) has been insulated as it is used for 5V for other modules.

Completed Unit.



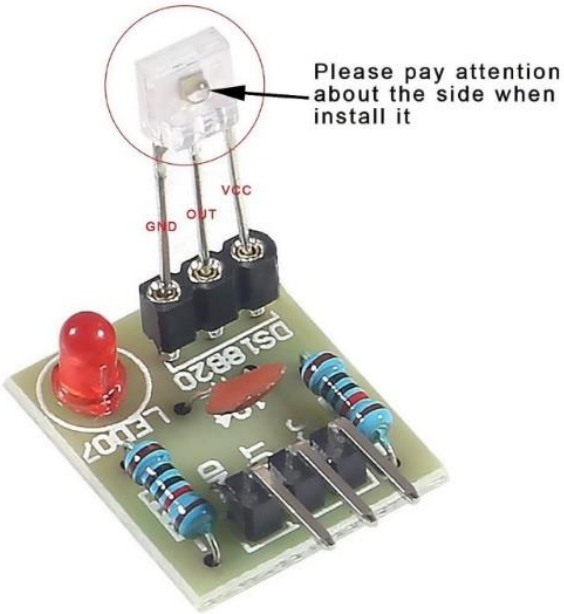
Sensors & Laser mounting

If just testing horizontal shutters, using the block-of-wood frame to hold Lasers & sensors works well. This is an easy way to get up & running. For measuring vertical shutters, the same idea can be used, but obviously the sensors and Lasers must be stacked vertically.

For a finished project, mounting the sensors & Lasers in boxes is the ideal.

O O O

[----------32mm horizontal spacing----------]



Sensor rx – showing correct sensor placement.

Note: - To protect the sensors from damage, they can be omitted before the initial power-up. The LED on the module should light, proving connection & polarity is correct. After de-powering, the sensor can then be fitted to the module.

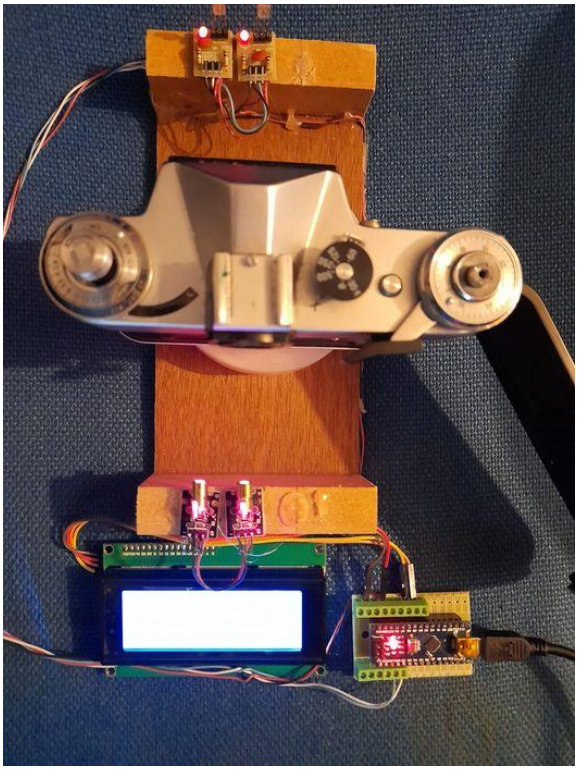
The project is powered via the USB connector on the ESP32 board. No other power is required. **Before connecting the USB power lead, check, double check and then treble check** all of your connections and the correct orientation of the receiver sensors.

When applying power, the Lasers will shine red and also the red LEDs on each of the rx boards should light.

For the prototype, to make the sensor unit, two pieces of wood were cut, one 40mm high, to mount the Lasers (tx). The other 28mm high, to mount the sensors (receivers, rx) Spacers under the camera (scrap wood, beer mats etc) used to raise different camera models to the correct height.

The Laser & sensor modules were hot-glued to the top of the wood. Hot-glue allows the lasers to be moved for alignment, whilst the glue cools.

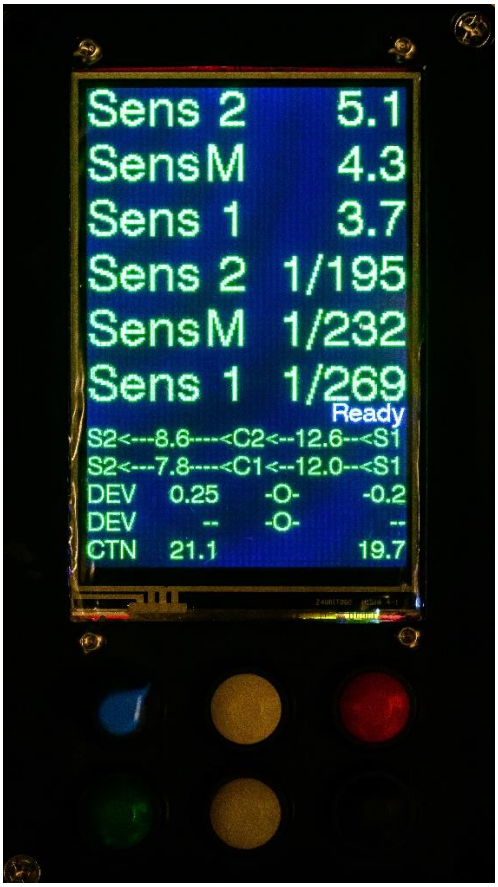
The below photo shows the Arduino prototype, which used two sensors and Lasers.



Prototype shutter tester with two Lasers.

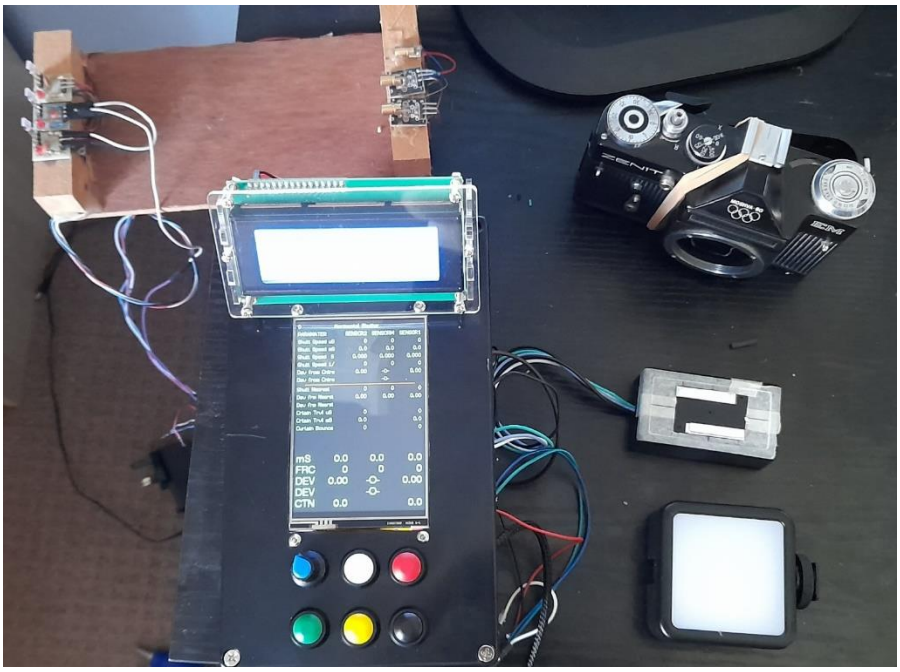
In this example, wires (taken from an Ethernet cable) are directly soldered to the Laser boards, rather than jumper wires being used.

This simple design works perfectly well & the third Laser & sensor for the ESP32 version easily added.



Here is the 158-90-60 project box with just the TFT display.
(It is displaying the Simple Screen).

Here is the ESP32 Shutter Tester in a larger 200-120-75 project box, with both TFT & LCD. The LCD is mounted in an acrylic frame and bolted to the top of the project box.



The original block of wood Laser and sensor frame can be seen at the top, now with three sensors and Lasers.

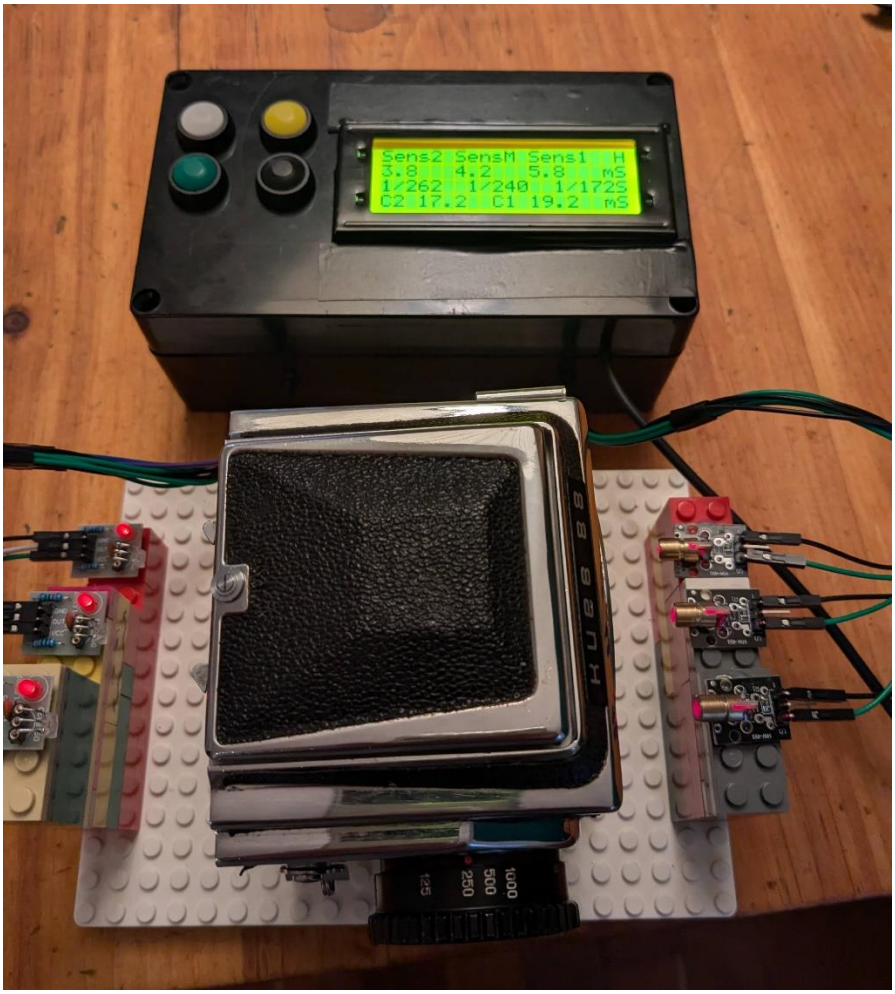
Below the camera is the film-gate sensor and LED light box used instead of the Lasers.

Note: - Lasers work far better than a LED light source and film-gate sensor. Some people like experimenting with the ‘traditional’ way of using a film-gate-sensor, thus details of how to make one are detailed in a separate document.

Here are some pictures from the Photrio thread, showing some of the designs people have made, many are the Arduino versions.

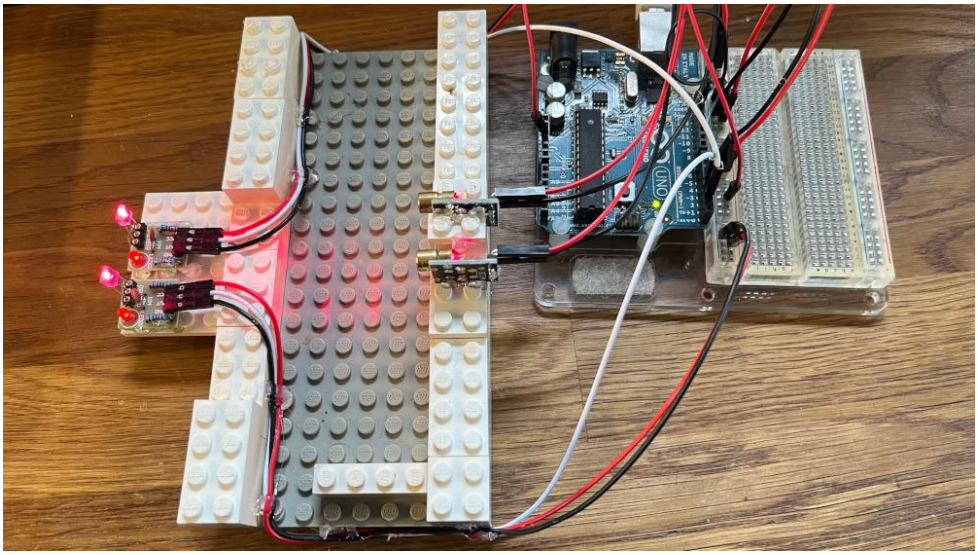
Compact version in 3d printed case

Inside the compact version.



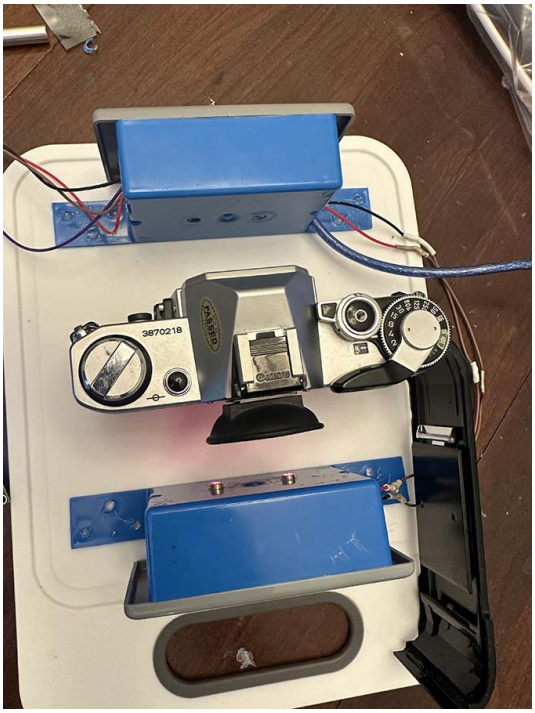
Lego version, testing a medium format camera.

3d printed version. Note lasers & sensors are arranged diagonally, 32mm spacing horizontally & 20mm vertically.
This way the same sensor frame can be used for horizontal or vertical shutters.
It does however make it a little more tricky to line up the film-gate with the Lasers.

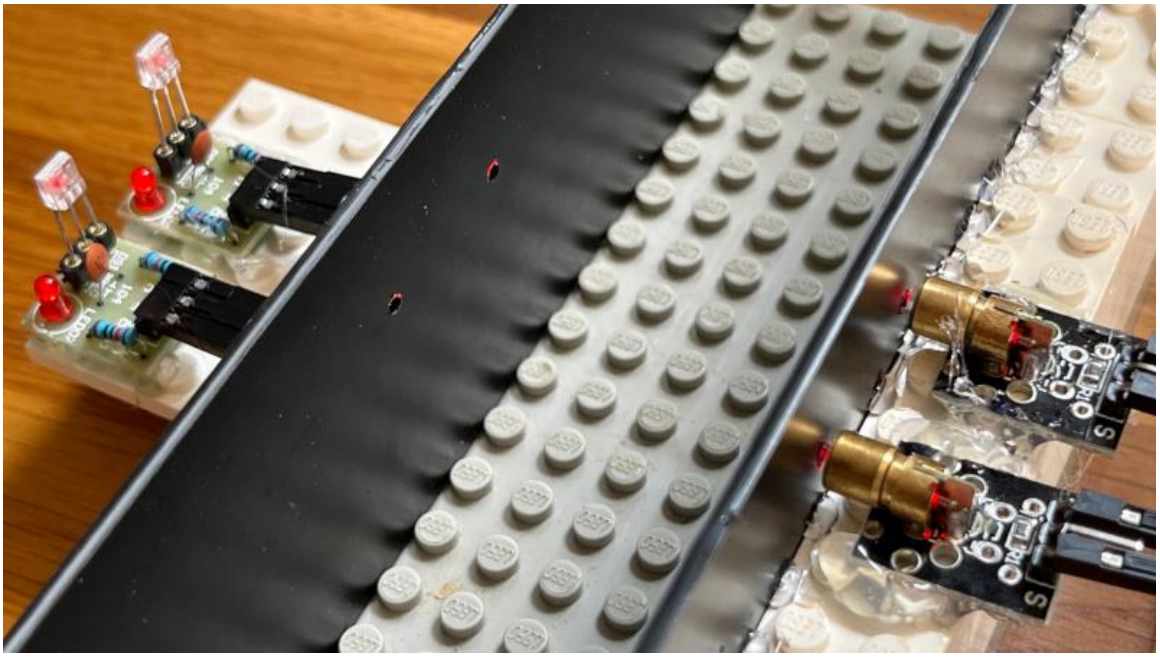


Lego :o)

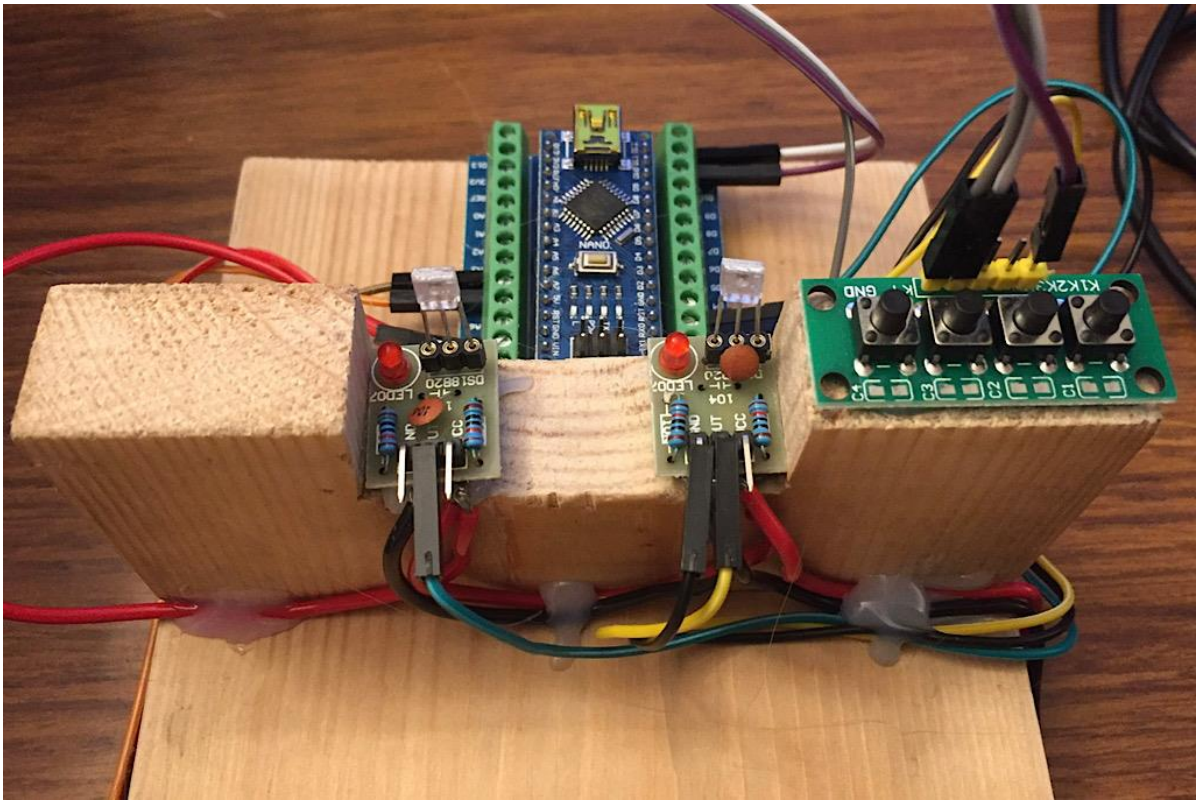
Horizontal or vertical shutters. Switch toggles horizontal or vertical Lasers.



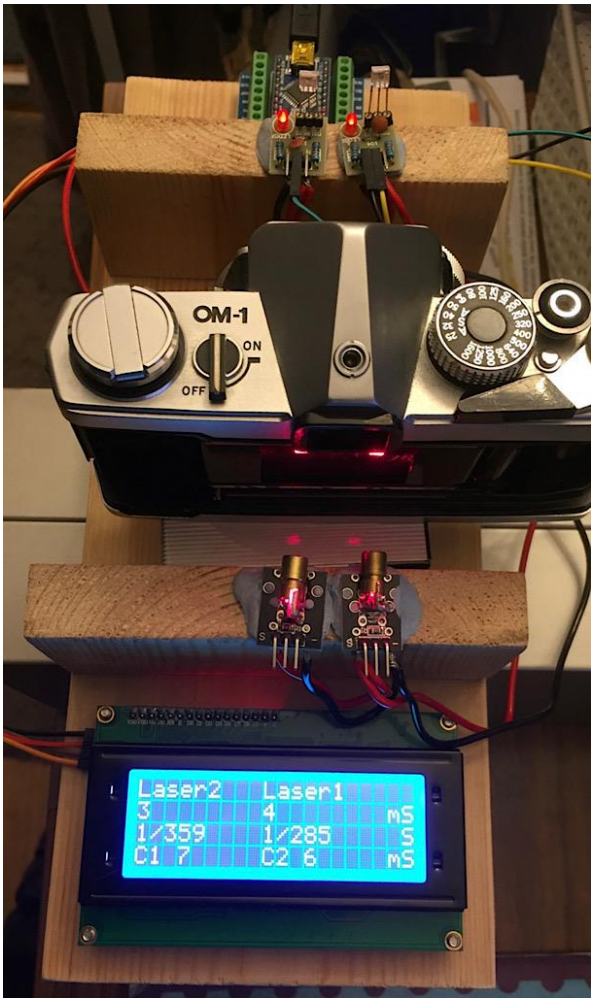
Chopping board used for base and electrical socket boxes used to house sensors & Lasers.

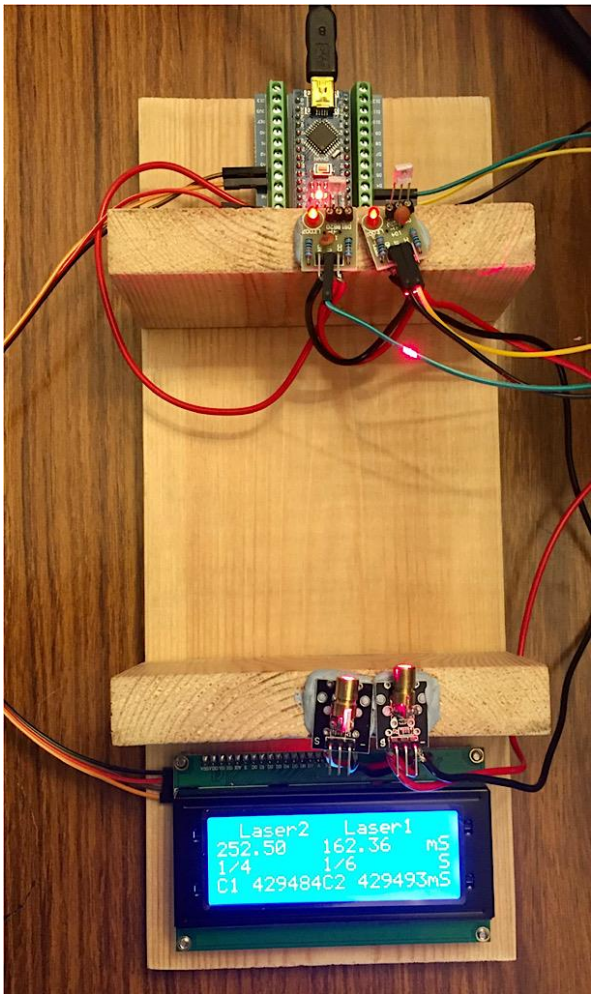


Mask added to the Lego version, for better accuracy at higher shutter speeds.



Simple ‘block of wood’ sensor frame.


OM-1
ON
OFF
Laser2 Laser1
3 4 mS
1/359 1/285 S
C1 7 C2 6 mS


Laser2 Laser1
252.50 162.36 mS
1/4 1/6 S
C1 429484C2 429493mS