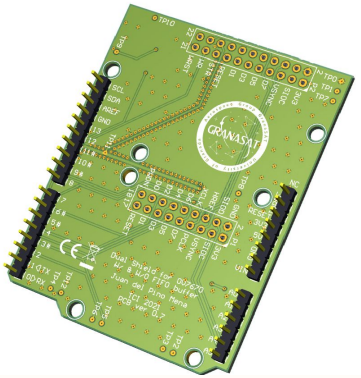
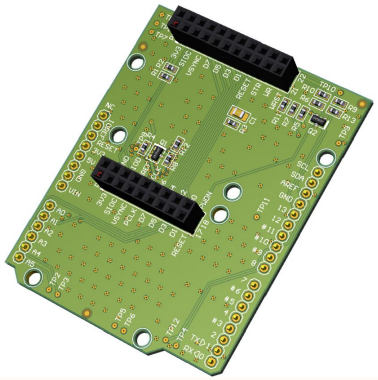
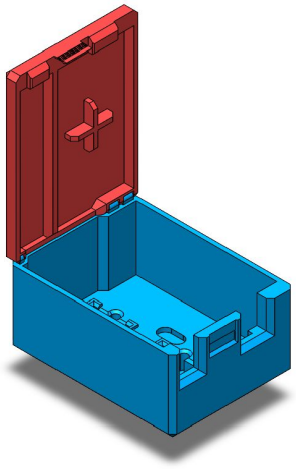
Dual 0V7670 Shield for Arduino UNO Rev 3

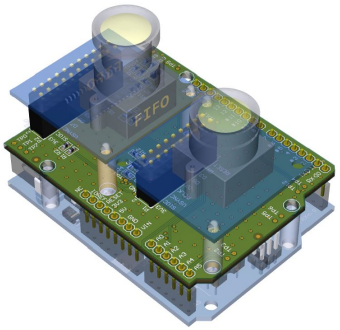




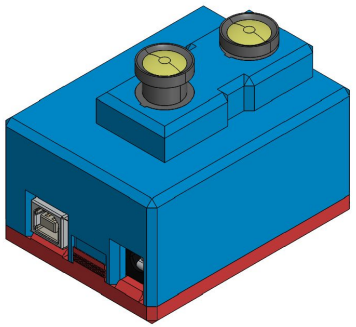


The PCB contains a lot of features, some of which are not stricty needed but they were introduced for the sake of learning:

- The PCB is quad-layer (top+bottom and 2 extra power planes: 3V3 and ground). This eases power distribution and reduces EMI between traces and layers. Circuit is simple and has plenty of room to lessen PCB to only 2 layers.
- Via stitching on GND, shorting the 2 ground polygon pours of top and bottom layers, and ground plane. This connects isolated copper islands, provide a low-resistance path to ground for returning currents and provides thermal relief.
- Via shielding on XCLK traces from top/bottom to the ground plane to maintain good signal integrity.
- Includes some logos on the back: Granasat Aerospace Group, Conformité Européenne (CE), RoHS compliant and Waste Electrical and Electronic Equipment (WEEE) Directive.
- 3 Arduino mounting holes and 2 mounting holes for every camera module.
- Multiple Test-Points.
- 3 Fiducials.

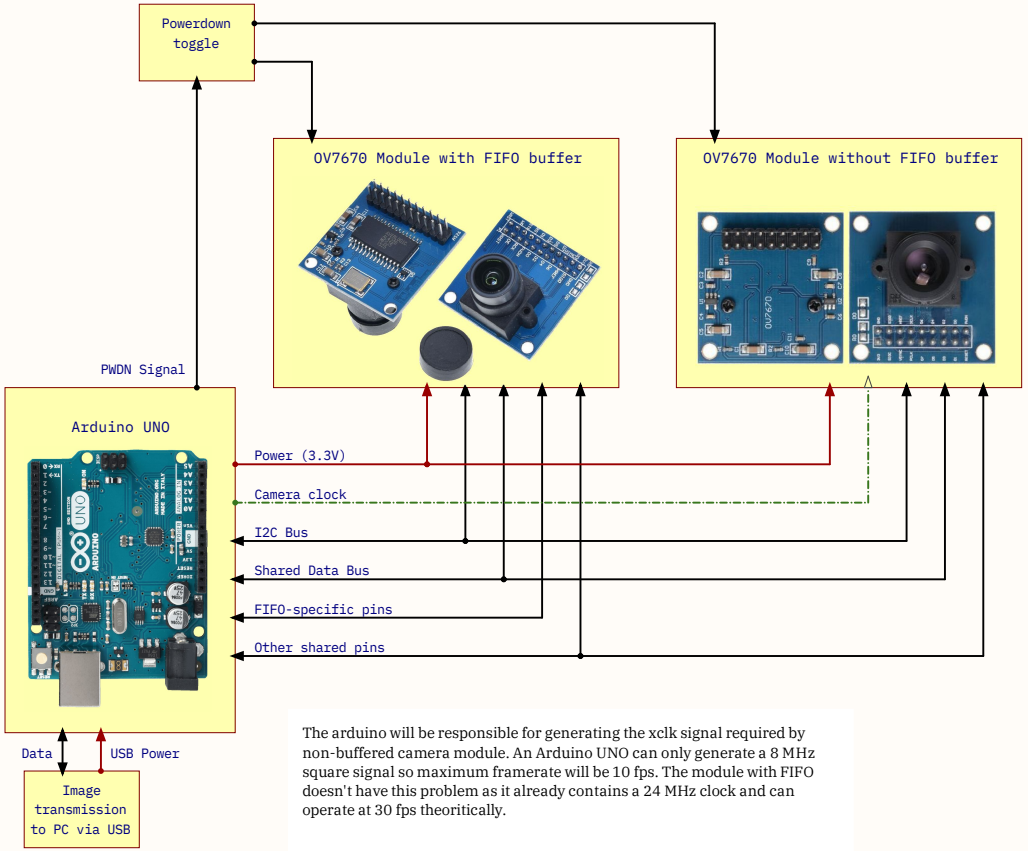


This project also includes the design of a case for the electronics aiming for a screw-free desing.



This project has been developed as part of Printed Circuit Technology (TCI), a subject taught in Telecommunications Engineering Degree in the University of Granada.

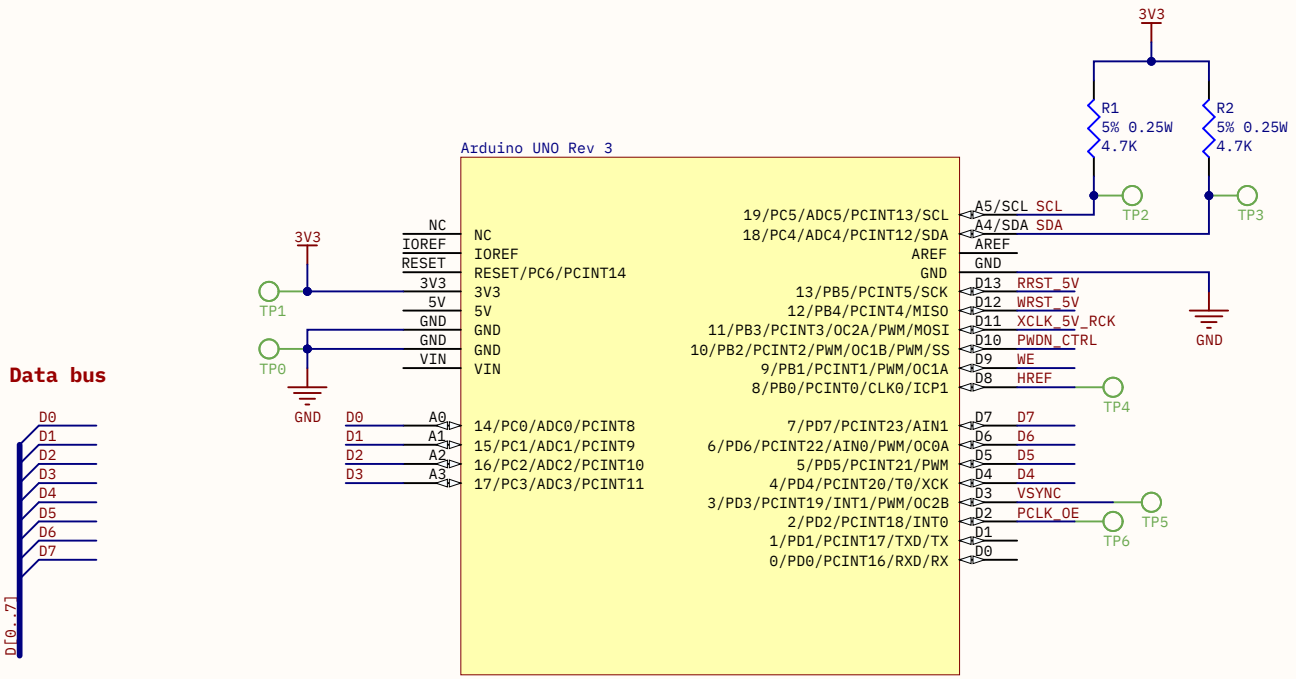
This PCB is a shield for Arduino UNO (Rev 3) that allows connecting simultaneously two OV7670 camera modules, one with a FIFO buffer built in and other without it.
Both cameras can't work at the same time as UNO's I/O is very limited. Both modules share the data bus and other pins, and we toggle their shutdown state by using a NMOS inverter controlled by a digital pin.

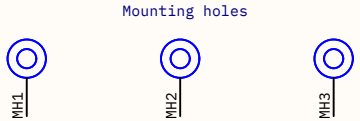


The arduino will be responsible for generating the xclk signal required by non-buffered camera module. An Arduino UNO can only generate a 8 MHz square signal so maximum framerate will be 10 fps. The module with FIFO doesn't have this problem as it already contains a 24 MHz clock and can operate at 30 fps theoritically.

Designer's signature	Sheet title: **Introduction**		*Dpto. Electrónica y Tecnología de Computadores* *University of Granada* *C/ Fuente Nueva, s/n, 18001 Granada, Granada, Spain* *Sr. Andrés Roldán Aranda*
Supervisor's signature	Project title: **OV7670 Shield 07.PrjPcb**		
	Desginer: **Juan del Pino Mena**		
	Date: **2022-01-17**	Revision: **0.8**	Sheet 1 of 3

Dual 0V7670 Shield for Arduino UNO Rev 3
Connections with the Arduino





PCB mounting holes

A maximum of 3 fiducials are recommended in a single board.
These fiducials are formed by pads of 1 mm diameter and solder resist of 2 mm diameter

Mounting Holes size M3 (3.1 mm PCB drill diameter) non-plated with keepout zone. For installing standoff spacers of brass, nylon o r plastic.

NOTE 1: MH0 replaced by one of the mounting holes for the camera modules.
NOTE 2: Inluded the rest of the MH inside the UNO symbol to avoid collisions with spacers.

Fiducials

Designer's signature	Sheet title: **Arduino Connections**		*Dpto. Electrónica y Tecnología de Computadores* *University of Granada* *C/ Fuente Nueva, s/n, 18001* *Granada, Granada, Spain* *Sr. Andrés Roldán Aranda*
Supervisor's signature	Project title: **OV7670 Shield 07.PrjPcb**		
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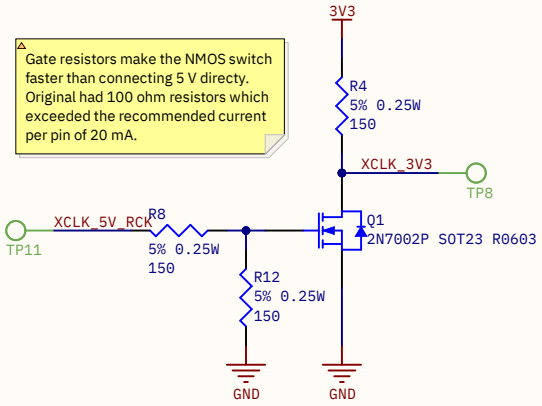
Dual 0V7670 Shield for Arduino UNO Rev 3
Header connections & voltage conversion

Voltage conversion for XCLK

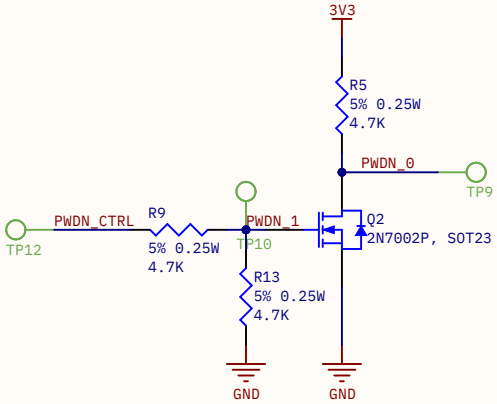


Gate resistors make the NMOS switch faster than connecting 5 V directy. Original had 100 ohm resistors which exceeded the recommended current per pin of 20 mA.

XCLK is the clock signal for the module without FIFO. It's a 8 MHz (10 fps) square signal (the PWM clock limit of UNO). Its integrity is a priority, so it will be shielded. Needed PCB trace bandwidth is over 40 MHz.

In the original design the author used this transistor to regenerate the clock signal after a long cable. This is no longer necessary and can be replaced by a 0 Ohm resistor between G and D. The footprint has larger pads in those pins to ease soldering. It's faster and cheaper to use a voltage divider i.e R8 = 150 Ohm and R12 = 220 Ohm (from 5 V to 3 V)

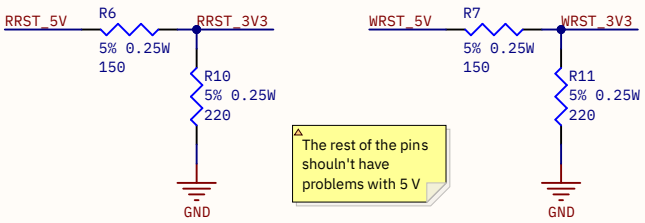
Powerdown control inverter



This NMOS inverter is necessary as we need two opposite PWDN signals for toggling between both camera modules. Resistors are big as it will switch 30 times per second at most (and realistically at 10 Hz).

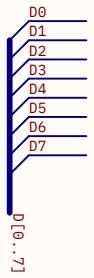
PWDN_1 is 2.5 V but should be enough for the digital threshold of the camera (0.7·3.3 = 2.3 V). In case of need, R13 can be changed by a 6.8 kOhm one.

Voltage dividers for WRST and RRST

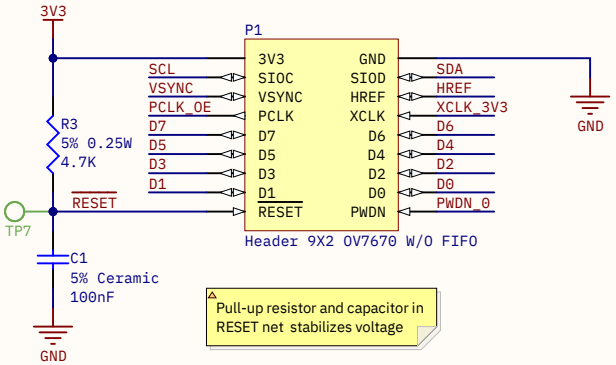


The rest of the pins shouln't have problems with 5 V

Data bus

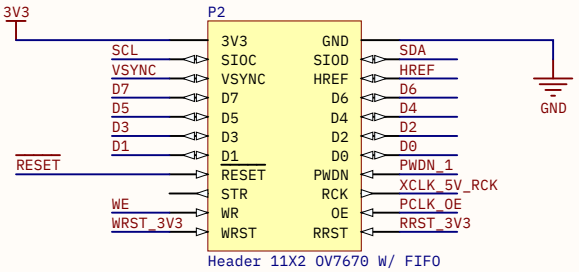


Camera module without FIFO



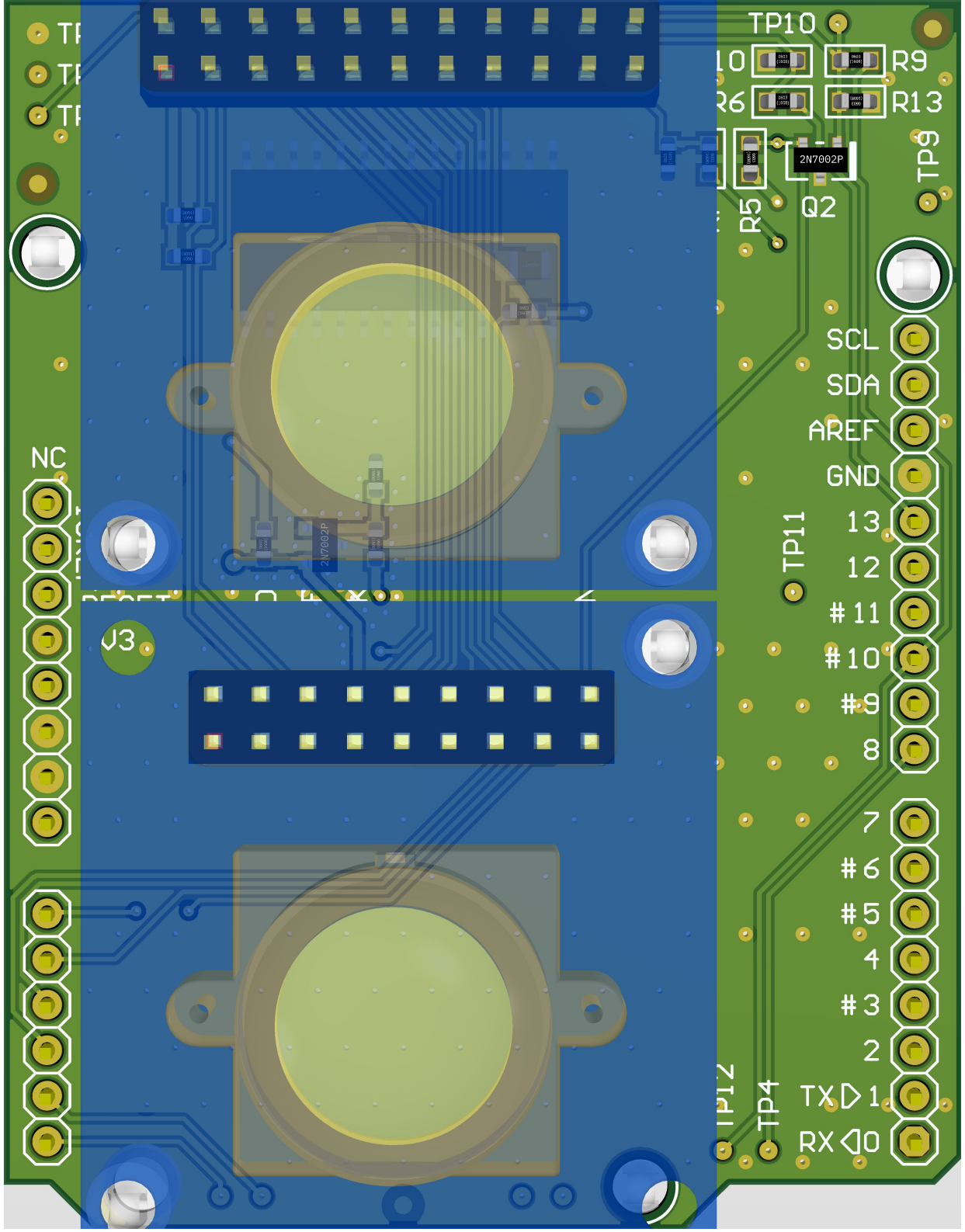
Pull-up resistor and capacitor in RESET net stabilizes voltage

Camera module with FIFO buffer



To avoid warning and errors in the nets, output-only digital pins (D0-D7, HREF and VSYNC) are marked as I/O. This happens because nets are shared between both the OV7670 modules and Altium detects that the same net has 2 output ports.

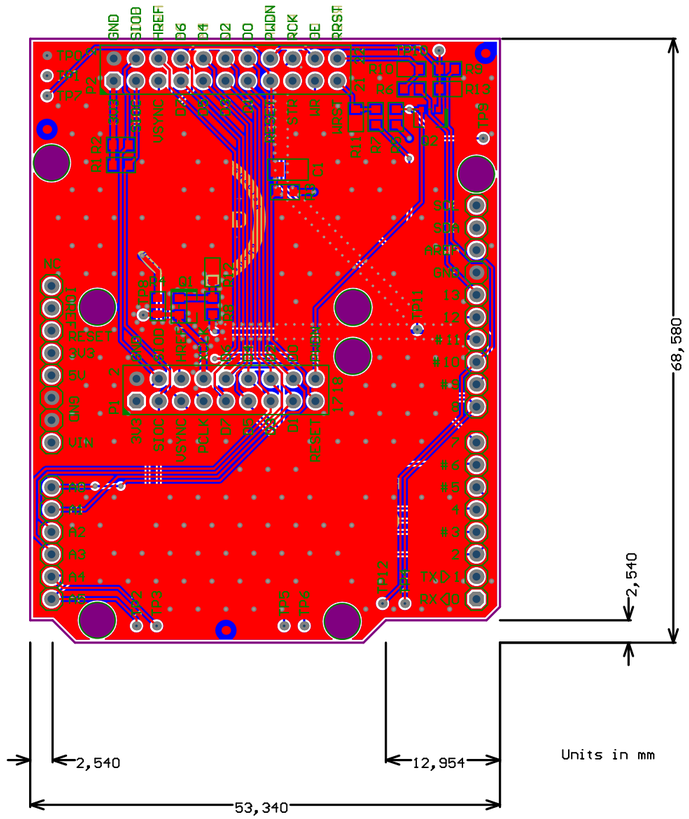
Designer's signature	Sheet title: **0V7670 header connections and voltage conversion**		*Dpto. Electrónica y Tecnología de Computadores* *University of Granada* *C/ Fuente Nueva, s/n, 18001 Granada, Granada, Spain* *Sr. Andrés Roldán Aranda*
Supervisor's signature	Project title: **OV7670 Shield 07.PrjPcb**		
	Desginer: **Juan del Pino Mena**		
	Date: **2022-01-17**	Revision: **0.8**	Sheet 3 of 3


TP10
R9
R6
R13
2N7002P
TP9
R5
Q2
SCL
SDA
AREF
GND
13
12
#11
#10
#9
8
TP11
NC
V3
7
#6
#5
4
#3
2
TX 1
RX 0
TP4

AREF
GND
DIGITAL (PWM~)
TX-> 1
RX<- 0
ARDUINO
UNO
POWER
GND
Vin
ANALOG IN
A0
A1
A2
A3
A4
A5

All layers

top + top silk + bottom + bottom silk + multi-layer + keep-out

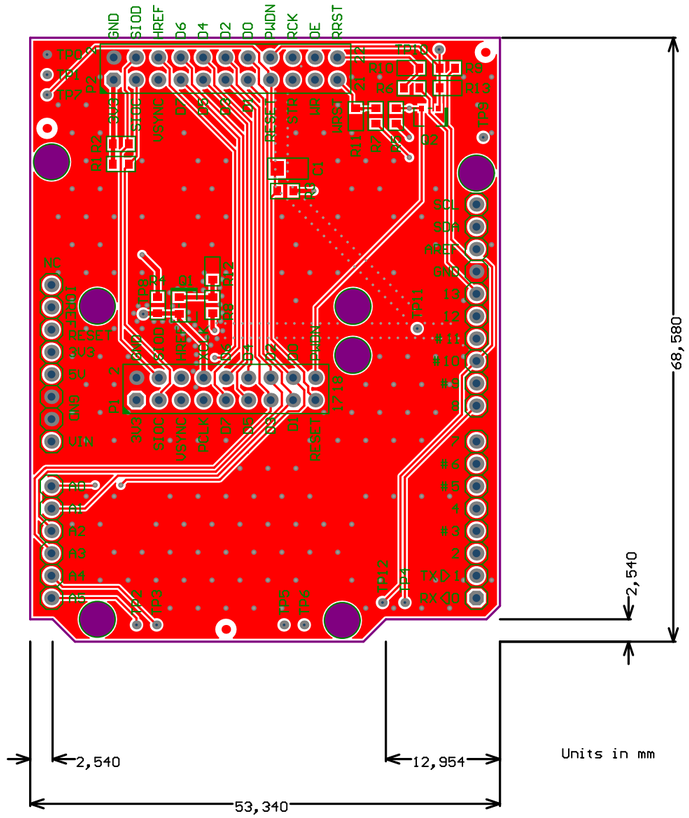


Using default trace width of 10 mil, with an approx resistance of 1.7 mOhm/mm. (1 oz/ft^2) (Calculated using Saturn PCB toolkit)
For power traces and XCLK, a low-resistance path is preffered to minimize power losses and maintain good signal integrity. These traces are 20 mil in width, with a resistance of 0.7 mOhm/mm.

Designer's signature:	Sheet title: Shield PCB for Arduino UNO	Dpto. Electronica y Tecnologia de Computadores University of Granada C/ Fuente Nueva, s/n, 18001 Granada, Granada, Spain Sr. Andres Roldan Aranda
	Project title: Dual OV7670 Shield	
Supervisor's signature:	Designer: Juan Del Pino Mena	
	Supervisor: Andres Roldan Aranda	**Date: 2022.01.17 Revision: 0.8** **Sheet 1 of 1**

Top layer

top + top silk + multi-layer + keep-out



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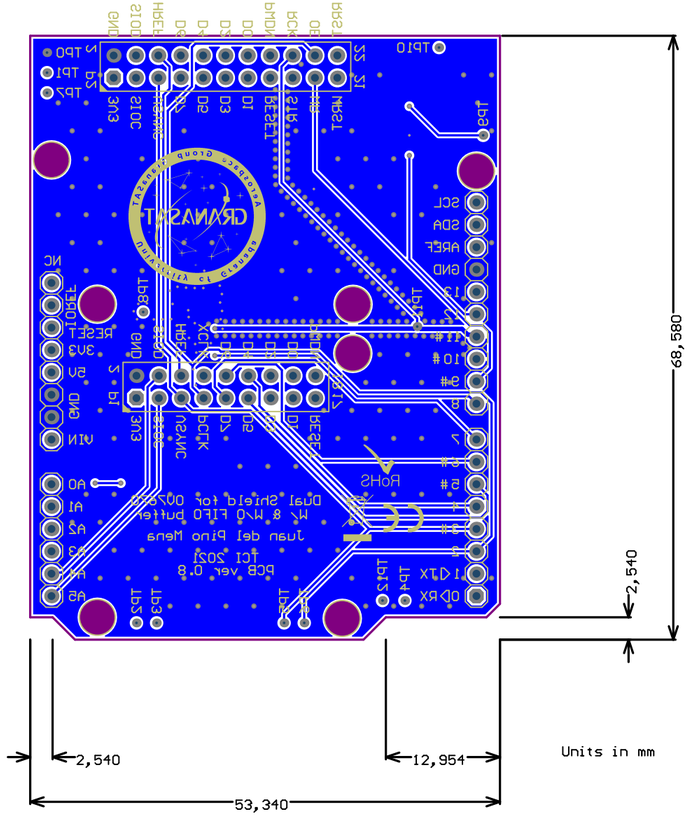
Supervisor's signature:	Designer: Juan Del Pino Mena		
	Supervisor: Andres Roldan Aranda	Date: 2022.01.17 Revision: 0.8 Sheet 1 of 1	

Bottom layer

bottom + bottom silk + multi-layer + keep-out



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Bill of Materials

Project Title: Export BOM to PDF for BOM Document [Bill of Materials.BomDoc]
Project File Name: OV7670 Shield 07.PrjPcb
Assembly Variant: None

Altium
2175 Salk Avenue
Suite 200
Carlsbad, CA 92008
USA

Part Number	Description	Designator	Manufacture	Manufacture Part Number	Supplier	Supplier Part Number	Supplier Unit Price	Quantity
Cap100nF	SMD Ceramic Capacitor 100nF 5% 0805	C1	Kyocera AVX	08055C104KAT2A	Mouser Electronics	581-08055C104K	$0,14	1
Fiducial_1mm_2r	Fiducial 1mm pad, 2mm solder resist	F1, F2, F3	N/A	N/A				3
Arduino UNO Rev	Arduino UNO Rev 3 pinout	MCU1	Arduino AG	A000066	Arduino AG	A000066	$20,00	1
Header 9X2 OV76	Header, 9-Pin, Dual row. Pinout of OV7670 module without FIFO buffer.	P1	N/A	OV7670 Camera Board W/O FIFO	N/A	N/A	$7,00	1
Header 11X2 OV7	Header, 11-Pin, Dual row. Pinout of OV7670 module with FIFO buffer.	P2	N/A	OV7670 Camera Board W/ FIFO	N/A	N/A	$12,00	1
2N7002P (0Ohm)	N-Channel MOSFET 2N7002P SOT23 version with footprint compatible with 0 Ohm 0603 resistor	Q1						1
2N7002P	N-Channel MOSFET 2N7002P SOT23	Q2	Kyocera AVX	2N7002P,235	Mouser Electronics	771-2N7002P235	$0,23	1
Res4K7	SMD Resistor 4.7 KOhm 5% 0.1W 0603	R1, R2, R3, R5, R9, R13	Vishay/Dale	CRCW06034K70JNEA	Mouser Electronics	71-CRCW0603J-4.7K-E3	$0,09	6
Res150R	SMD Resistor 150 Ohm 5% 0.25W 0603	R4, R6, R7, R8, R12	Vishay/Dale	CRCW0603150RJNEAHP	Mouser Electronics	71-CRCW0603150RJNEAH	$0,14	5
Res220R	SMD Resistor 220 Ohm 5% 0.25W 0603	R10, R11	Vishay/Dale	CRCW0603220RJNEAHP	Mouser Electronics	71-CRCW0603220RJNEAH	$0,14	2
Test Point Pad	Test point - PCB Pad type.	TP0, TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12	N/A	N/A				13
							$39,74	35

Approved	Notes