Smart Monitoring of Air Quality

Hardware Documentation | First Release: 24/03/2020 | Revision: 1.1

FULL BOARD DESIGN DOCUMENTATION

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An Open Source Project from Team 7 in University of Glasgow

"In 2015, 53 people died in the UK from accidental carbon monoxide poisoning"

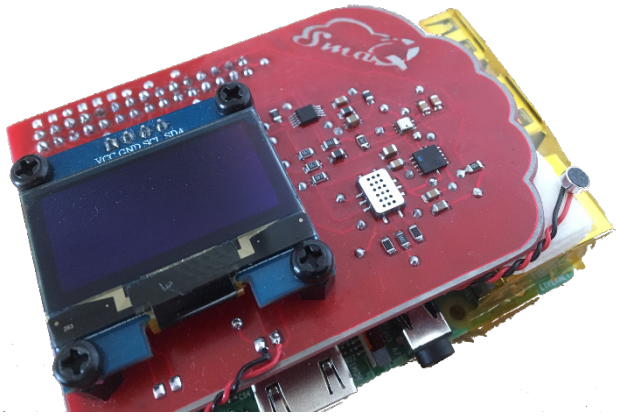
Carbon monoxide (CO) is an odourless, colourless gas that is found naturally occurring in the atmosphere. It exists at around 0.2 parts per million (ppm) and this is deemed to be a safe level for humans. To give context, oxygen naturally exists at 209,000 ppm. At a concentration of 12,800 ppm, CO will cause someone to collapse and lose consciousness, and death is likely to occur in just one to three minutes. Our innovatively designed board will warn you in case an unusual concentration of harmful gases including CO is found in your room.

Features

- Measure Basic Environmental Data, i.e. Ambient Temperature, Relative Humidity, Barometric Pressure
- Identify and Quantify Harmful Gases
- Measure Sound Levels and Light Intensity
- User Interaction Via OLED Screen
- Hand Gesture Identification
- Efficiency Levels Up to 90%
- Wide Operating Temperatures ranging from -40 to 85 ^{o}C
- I2C Protocol Implementable on Various Microcontrollers and Processors
- Protection Circuitry on Signal Lines
- Industry Standard Components on Surface Mount Packages
- Wide Operating Voltages (2.8 V to 4.9V) with a Logic Voltage set on 3.3V
- User Safety and Long-Life Cycle

Applications

- Indoor and Outdoor Air Quality Measurement Unit
- Installation as Safety Device on Hospitals
- Integration on Smart Home Systems with Automations
- Weather Forecast



Description

The SMAQ is a low-cost, robust and accurate device that can deliver a plethora of information with regards to the air quality of a room. It can be placed anywhere inside the house as the device's name hints (Smack it anywhere). The board is designed to fit tightly a Raspberry Pi. Since this is an Open Source project, any collaboration and improvements are encouraged under the licenses specified in the GitHub folder. You can type or if viewing this document electronically follow this link: https://github.com/MustafaBiyikli/SMAQ . Changes can be easily made on the header style to accommodate any I2C Compatible device available.

The board is designed from ground up to facilitate all aspects of the desired specifications and to produce a high-grade board with all safety and design rules taken into consideration. Components are sourced from one distributor, as mentioned on the Bill of Material (BOM) on page 20. Since some sensors are hard to find, it is recommended to search for the availability before ordering to make your own board.

Device Specifications

Since the idea of constructing an Air Quality Monitoring was established a thorough search on available technologies was conducted to find the most compatible sensors available. The main focus was on finding robust accurate and up to date Environmental sensors with regards to Temperature sensing and Hazardous gas detection. Sensors from reputable companies like Bosch and Sensortech were chosen. To add extra capabilities to our product, a proximity and light intensity sensor from VISHAY was chosen. All Sensors except the Gas Sensor are digital and accommodate the I2C protocol. The latter is connected to an Analog to Digital Converter (ADC) that is I2C compatible. Lastly, an OLED screen, a class D audio amplifier and an analogue microphone circuitry were realised to accommodate user interaction facilities.

Below you can find a table with the specifications of the SMAQ Board. The last greyed out parameters are ones that can be measured but are not incorporated in the software.

Parameter	Condition	Min	Max	Resolution	Unit
Humidity	Temperature range between -40 to 85	0	100	0.008	% RH
Temperature	_	-40	85	0.01	°C
L	Full accuracy	0	65	0.01	°C
Pressure	_	300	1100	0.18	hPA
Ambient Light	_	0.25	16383	0.25	lx
Proximity	_	1	200	1	mm
Carbon Monoxide	Device warm-up for at least 10 minutes to one hour is advised.	1	1000	0.015	Ppm
Nitrogen Dioxide	Device warm-up for at least 10 minutes to one hour is advised.	0.05	10	0.015	Ppm
Ammonia	Temperature range between -30 to 85	1	500	0.015	Ppm
Sound Levels	Device warm-up for at least 10 minutes to one hour is advised.	0	100	1	%
Hydrogen	Temperature range between -30 to 85	1	1000	0.015	Ppm
Methane	_	1000	N/A	-	Ppm
Propane	_	1000	N/A	-	Ppm
Iso-Butane	_	1000	N/A	-	Ppm
Ethanol	Temperature range between -30 to 85	10	500	0.015	Ppm

For more information, you can use our Dynamic PDFs on the following pages or visit our GitHub page.

Absolute Maximum Ratings

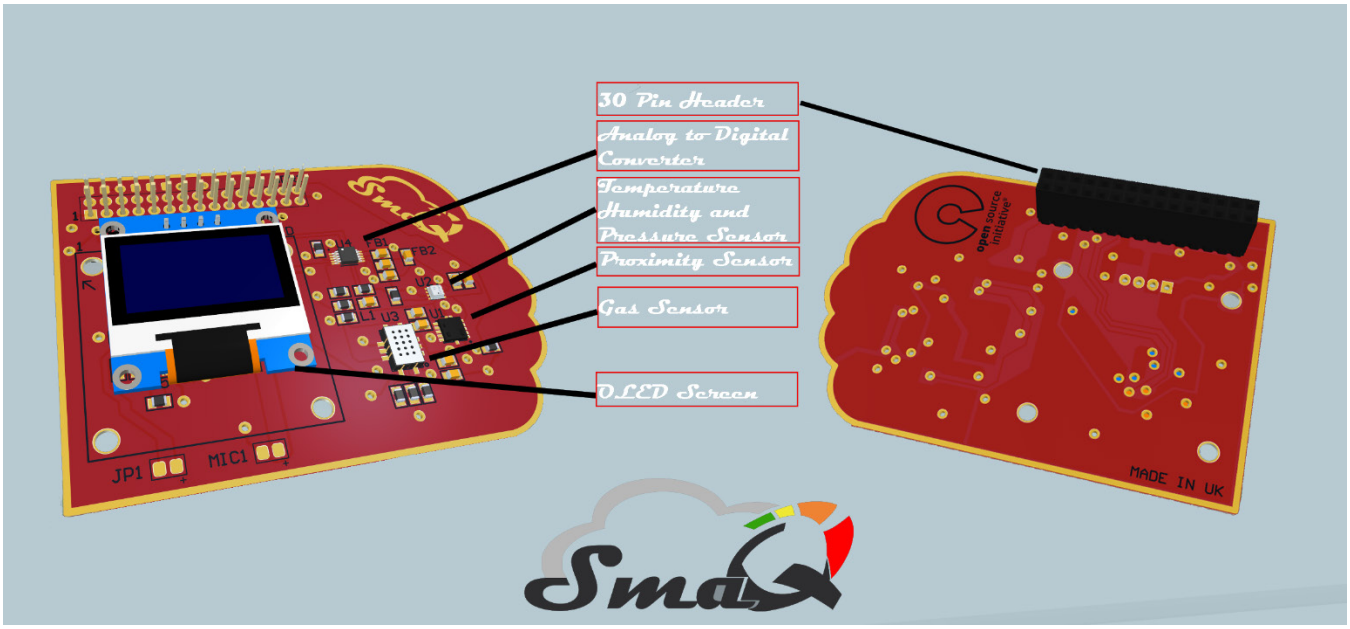
Rating Type	Min	Nominal	Max	Units
Operating Temperature	-30	….	85	ºC
Operating Pressure	0	….	20000	hPa
Operating Humidity (advised)	0	….	95	% RH
Operating Voltage	2.8	3.3	4.9	V
Condensation build-up (Look-Up Storage Instructions)		Not Advised		
Storage Temperature	-40	25	100	ºC
Storage Humidity	5	….	95	% RH

Soldering Ratings

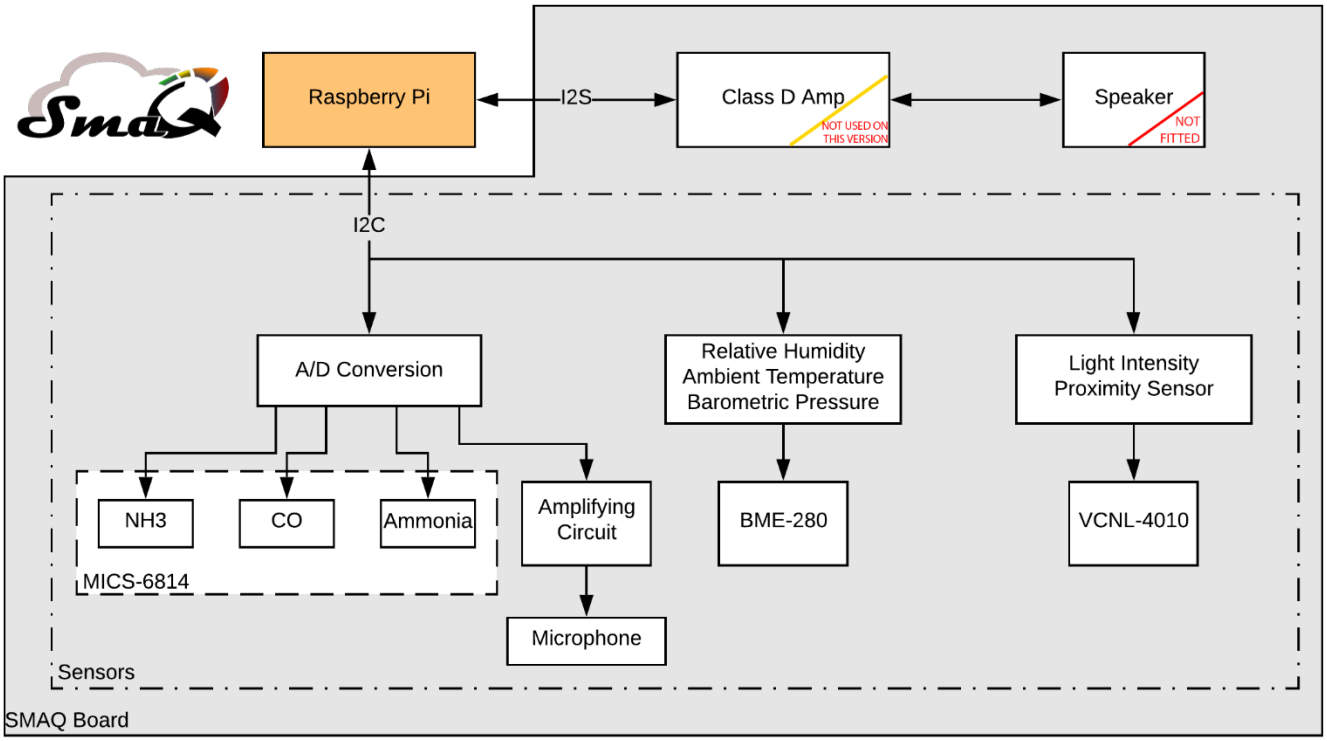
	Max	Units
Solder Reflow Temperature (1)	260	ºC
Lead Temperature (IC's)	5	seconds
Solder Type	…	Leaded 60/40
Solder Mask Temperature	300	ºC
Flux (2)	…	No-clean

(1) The delicate nature of the sensors should provoke extra precaution while soldering. A layer of Kapton tape should be applied on top of each sensor covering any vent holes since all of them are sensitive to vapours. In addition, the board should not be exposed to high concentrations of solvents and silicone vapours.

(2) A clean-up cycle on an ultrasonic cleaner with cleaner solution is advised but a pure 99 % Isopropyl alcohol can substitute the latter.



Above is a photorealistic model of our board made early in the development process. The board produced fully represents the models since all components were custom made. The positioning of the basic elements are also shown. Detailed drawings are in the Draftsman section of this PDF.



A Simplified block diagram showing basic functionalities of the SMAQ

Troubleshooting

You can use our source code uploaded on our GitHub page or utilize our conveniently made dynamic PDFs to troubleshoot your SMAQ. The pages on the upcoming sections contain vital information if this document is viewed electronically. An explanation video can be found under the hardware section in our GitHub page showing ways to navigate through our documentation. Nevertheless, you can find all the essential information regarding component placement, Mechanical Drawing, Manufacturing, Schematics and BOM tables in here. The 3DPDF document that accompanies this document can help you navigate through the components and identify them. This small guide is not definitive; therefore, you are responsible for all actions done on the board. Once more any encountered issues can be reported on our GitHub page, including also any recommendations that you might have.

Some of the frequent faults that might occur on the SMAQ are below:

- ***BME-280 not working (Basic):*** Please check the component seating on the board. Due to the small size of the package a misconception while soldering can occur, leading to poor joints. A reflow with a hot air gun can resolve this issue. If the error is persistent and net Voltage is present a check on the decoupling capacitors can help with further investigation of the problem. Lastly, if you are working on a copy of your own, please check that you are using the correct I2C addresses taken from our Schematics.

- ***MICS-6814 not working (Gases*)**: As mentioned above, please check the seating of the component and afterwards an optical check of the surroundings is advised. The most common issue if some readings are showing up on the software but are incorrect, the heating resistors R5, R10, R12 supplying the needed current in the element inside the sensor can be malfunctioning. Replacing them can eliminate the error. **CAUTION:** *Since these act as current limiting resistors — in case of a short circuit, a full replacement of the sensor is advised.*

- ***The OLED Screen is not working:*** Since these screens are mostly from OEM Manufacturers before fitting the screen or when the problem occurs, please check the I2C address in the back of the screen that they match the address described on our schematic. Other than that, please check that both sides of the pads that the screen rests are soldered. **CAUTION:** *Do not forget to fit the screen properly on the standoffs to provide the maximum support on the weight of the screen.*

- ***VCNL-4010 not working (Light):*** This problem can occur if the decoupling capacitors in the IR Anode Pin of this chip fail. These serve the purpose of stabilising the voltage of the IR Led incorporated inside the IC. They are labelled under C1 and C2. Also, as advised on the schematic, the IR Cathode should not be connected anywhere.

- ***I2C Line not Detected (Common):*** When encountered with that problem, check that all sensors are soldered properly. The most common issue causing this fault is the wrong placement of the D1 Diode. This Zener diode protects the I2C 3.3V logic SDA line from voltage surges or wrong operating voltages. The wrong orientation of this diode can cause it to clamp the voltage to ground, therefore, immobilising the I2C Line. Therefore, please check the orientation and correctness of the value of the diode. **CAUTION:** *The value is calculated upon 3.3 V logic and not on a level-shifted line, i.e. 5V Level Shifting.*

- ***Microphone is not working:*** The analogue circuitry involved in this configuration is a simple operational amplifier. Please check that there is net Voltage, specifically on the +3.3V Net. Further

troubleshooting involves cleaning of the microphone and checking for any objects obstructing the microphone.

Basic: *There is no Temperature, Humidity or Pressure data stream.* ***Gases:*** *No values on Carbon Monoxide, Nitrogen Dioxide and Ammonia levels.* ***Light:*** *No hand gesture wake-up or no light intensity values.* ***Common:*** *I2C detection errors.*

Safety

The board employs all necessary safety measures on the component level but also user level. The UV homemade solder mask applied protects the circuitry and the person that handles the board, eliminating any unwanted accidental short circuits. Also using lower voltages as of 3.3V logic, users can be assured that even in the case of a short circuit, the damage is minimal to the board and none existent to the owner. Lastly, with the incorporation of a casing, the board becomes fully encapsulated and out of reach enhancing safety measures.

Storage

If the building procedures are followed, the board will have a long shelf life and can be stored safely for long periods. The solder mask protects the etched copper from oxidation and eases the soldering process. Meanwhile, the last electroless tin plating on the board creates a five m protective layer for the exposed copper. You can identify the plating from its silver shine.

Since sensitive components populate the board, it is advised that the board should be stored in a dark place with nominal humidity levels. If you can find a silica gel pack, it is recommended to put one right next to the board. After a shutdown and storage period when restarting our board, a warm-up time is necessary to heat the sensing element and stabilise the sensors. Since there are no batteries currently on our design, the transportation of the device by air means is not restricted. If the board is not in a casing, then it is advised to be stored inside an electrostatic safe plastic bag.

Casing

A model ready to be 3D printed was realised, but due to unforeseen circumstances emerged from COVID-19 the production of it was not possible. The material selected was ABS due to its exceptional mechanical properties. The casing would include a netting in its face which with the combination of the side ventilation holes would provide the appropriate airflow inside the enclosure. That way, we create a protective barrier for the inside and meanwhile allow the sensors to monitor the surrounding air freely. Mechanical Drawings with Assemblies can be found on later sections.

Packaging Information

The board enclosed in an elegant casing would be boxed inside a rectangular board coming with instructions and silica gel pouch. A mock-up of the final box is shown below.

Author : Alexandros Charitonidis

You can fully interact with all elements present in the following pages.

DESIGN NOTE:
Debug notes.

DESIGN CONSIDERATIONS

DESIGN NOTE:
Informational design notes.

DESIGN NOTE:
Critical design notes.

DESIGN NOTE:
Cautionary design notes.

LAYOUT NOTE:
Critical layout guidelines.

Connectors / Various Circuitry

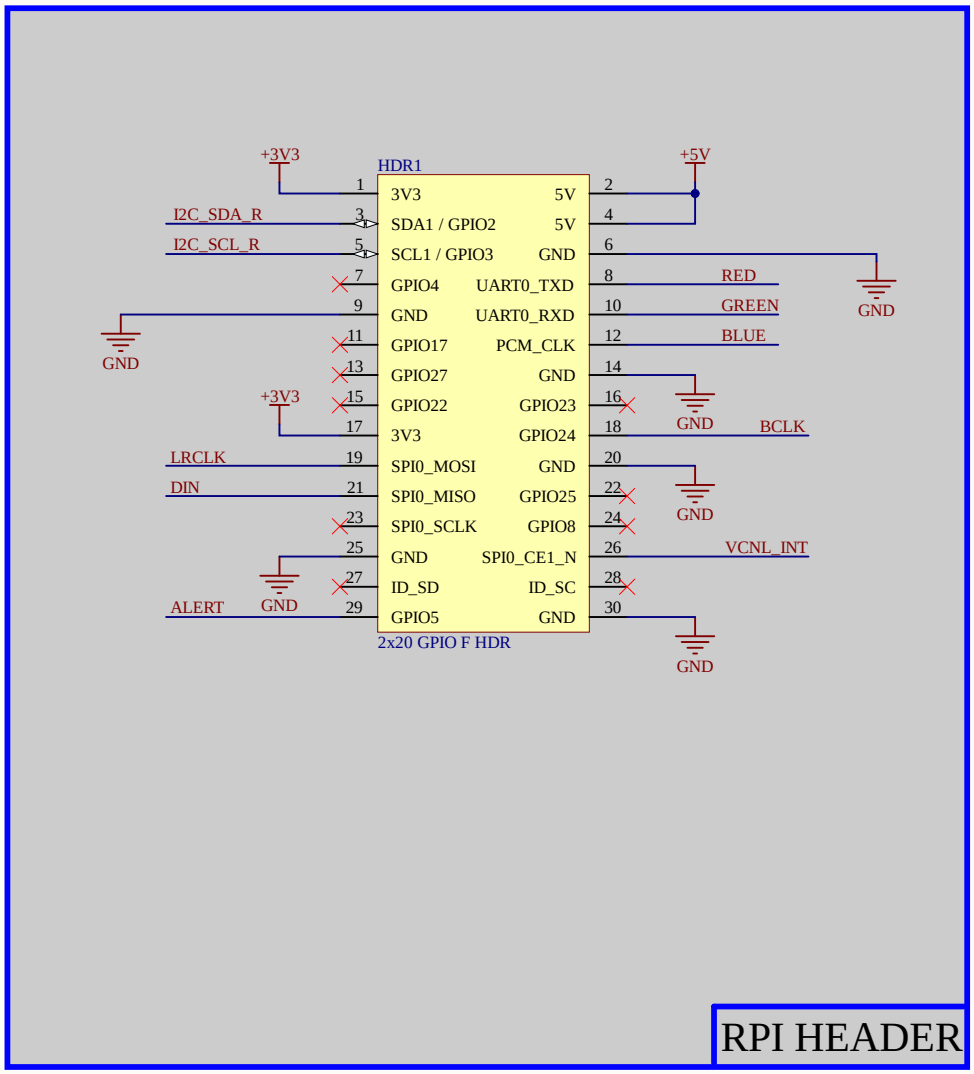
Sensors

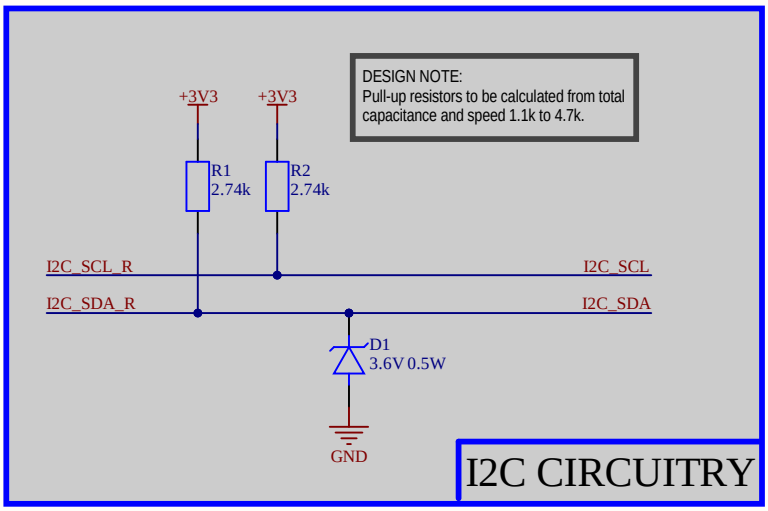
Supporting Electronics

RELEASED: 27-MAR-20

University of Glasgow | School of Engineering

Title	***Layout Information***		Drawn By: Charitonidis A. Checked By: Charitonidis A. Approved By: Team 7 Team Number: 7
Size: A4	Number: SCH-000	Revision: 1.1	
Date: 14/04/2020	Time: 20:13:55	Sheet 1 of 6	





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Size: A4	Number: SCH-001	Revision: 1.1	
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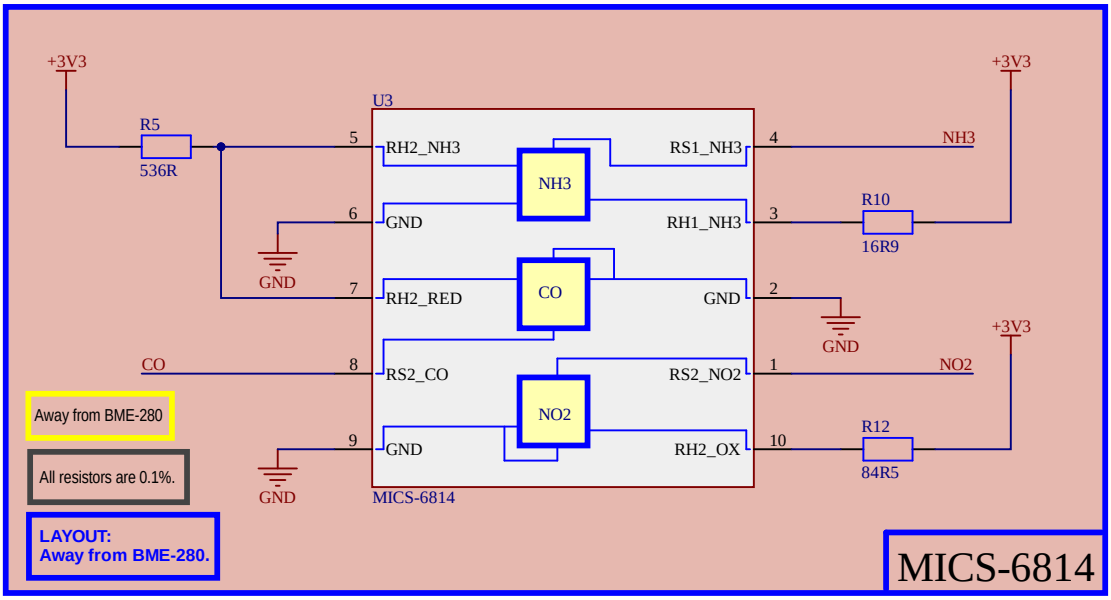

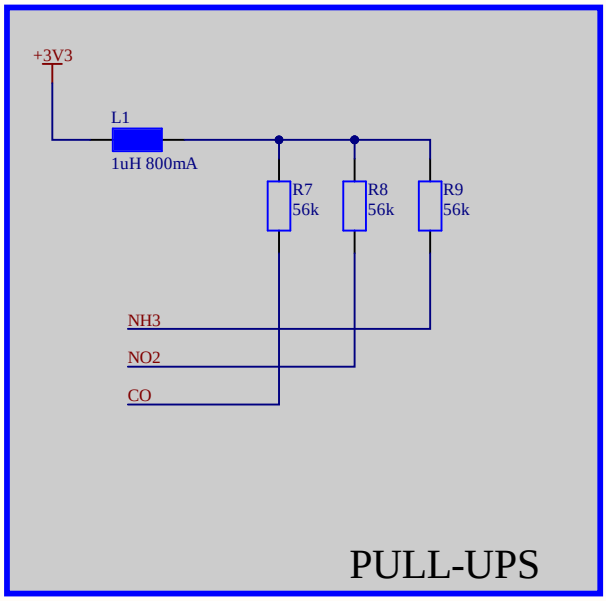

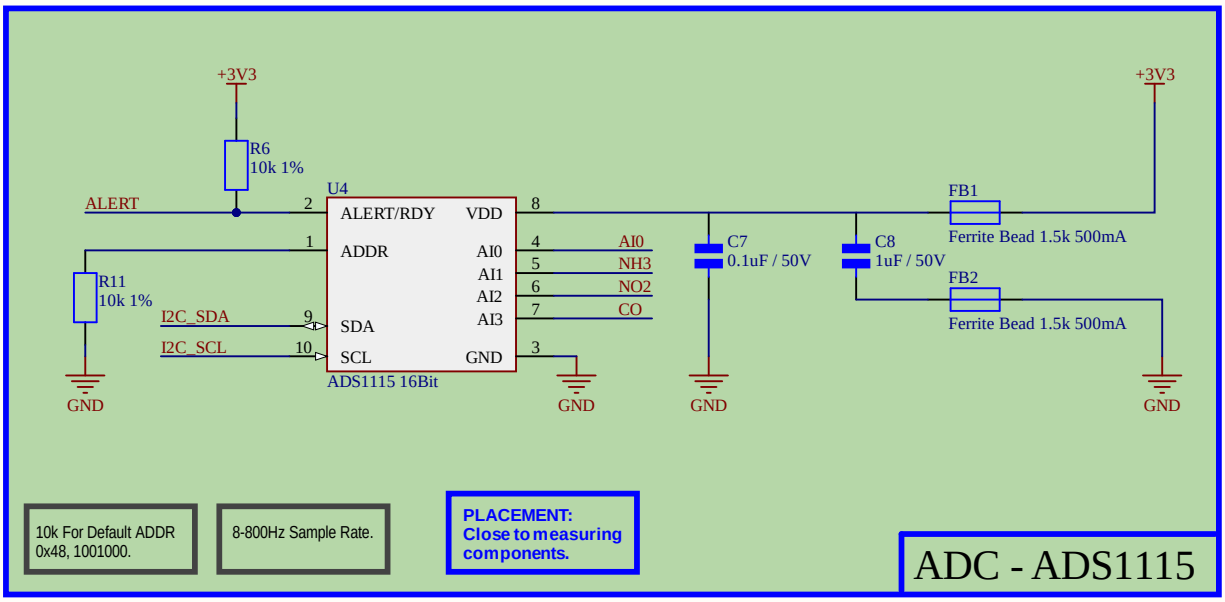

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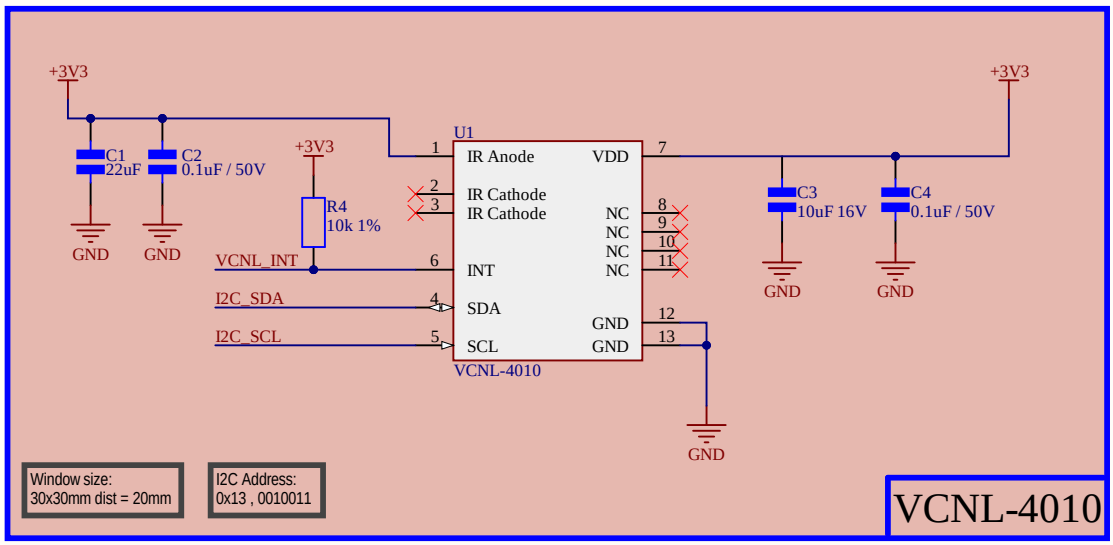
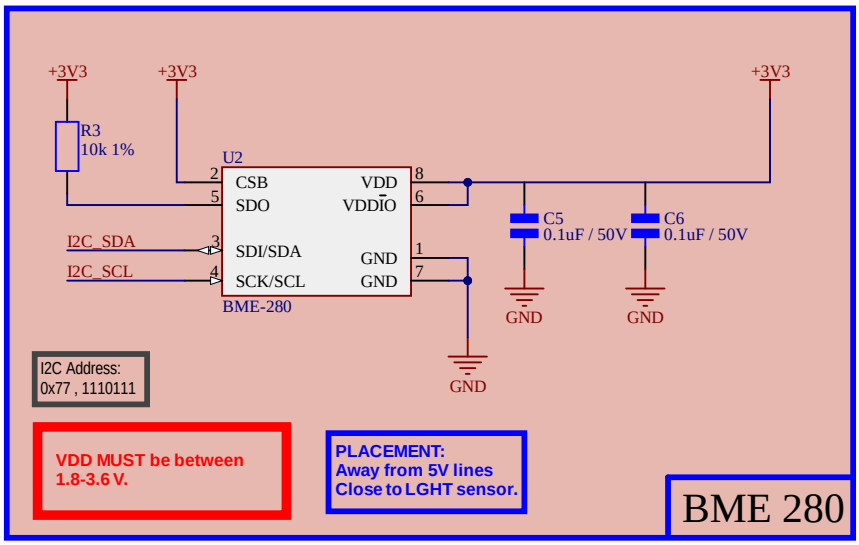
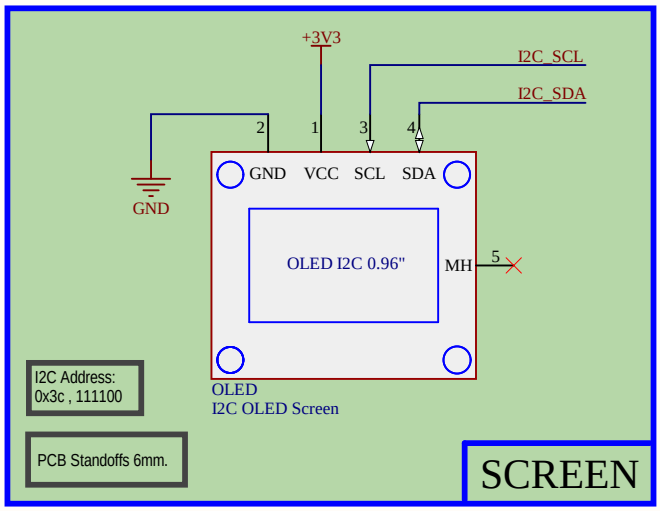
Size: A4	Number: SCH-002	Revision: 1.1	Checked By: Charitonidis A.
Date: 14/04/2020	Time: 20:13:56	Sheet 3 of 6	Approved By: Team 7
			Team Number: 7







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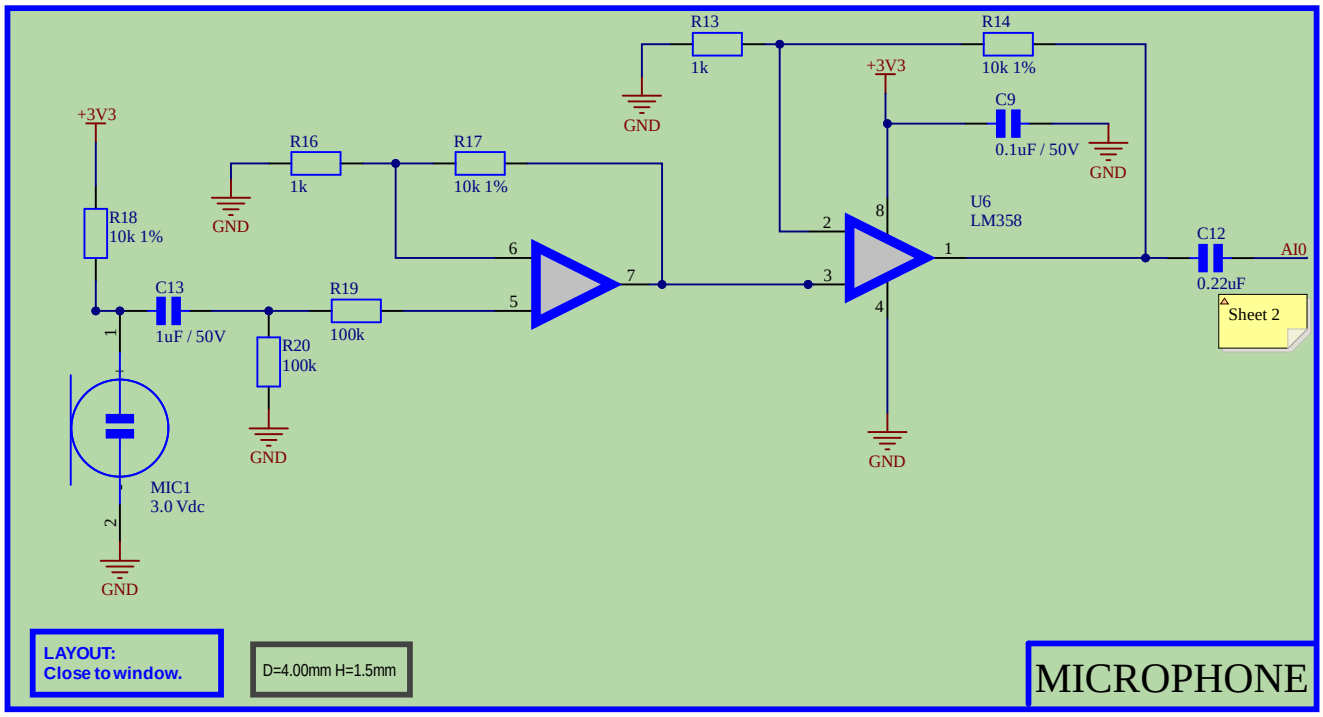
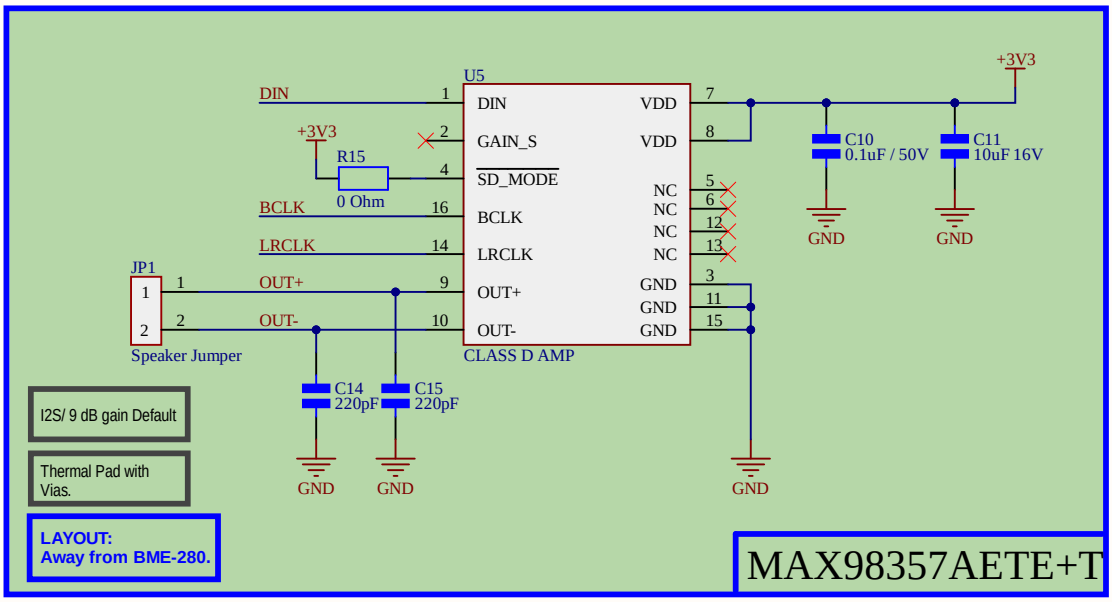
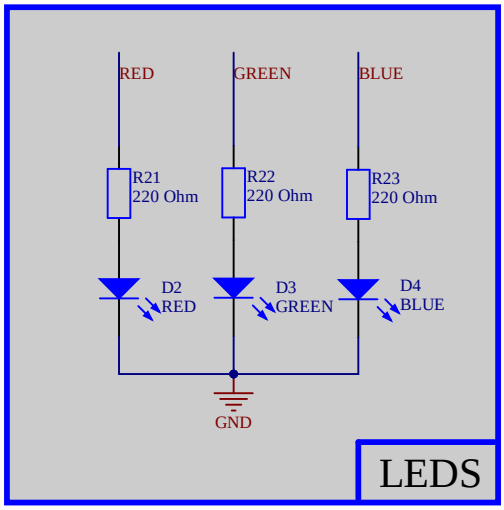
Size: A4	Number: SCH-003	Revision: 1.1	Checked By: Charitonidis A.
Date: 14/04/2020	Time: 20:13:56	Sheet 4 of 6	Approved By: Team 7
			Team Number: 7







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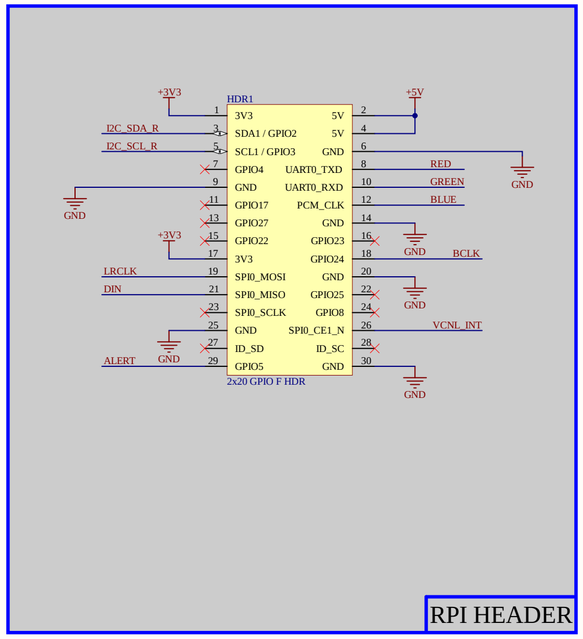
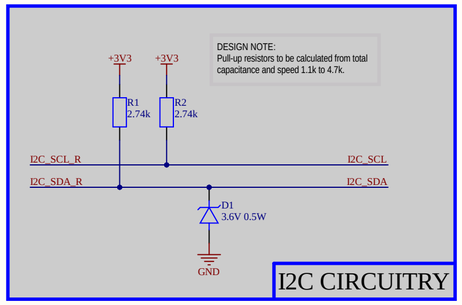
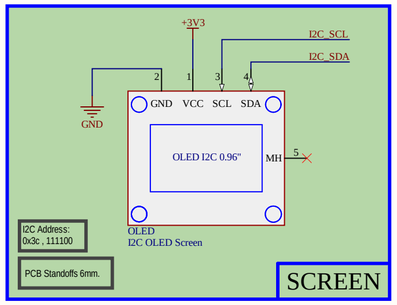
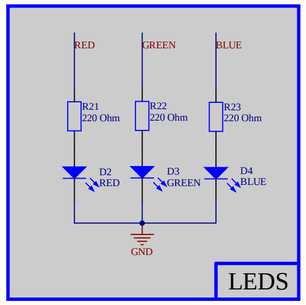
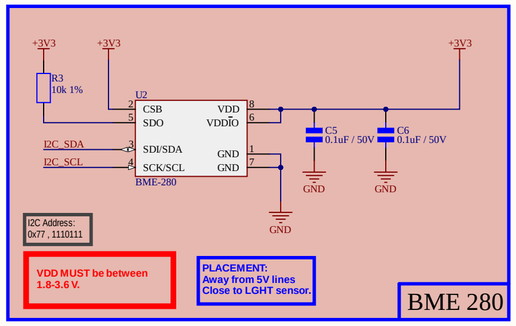
Size: A4	Number: SCH-004	Revision: 1.1	Checked By: Charitonidis A.
Date: 14/04/2020	Time: 20:13:56	Sheet 5 of 5	Approved By: Team 7
			Team Number: 7

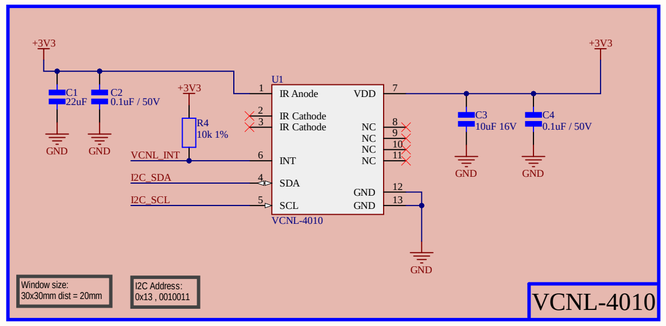


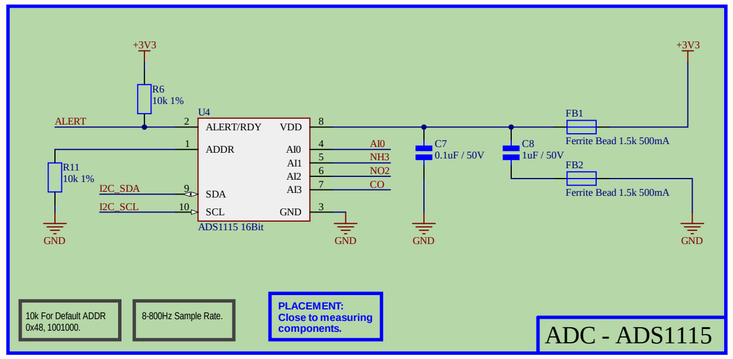


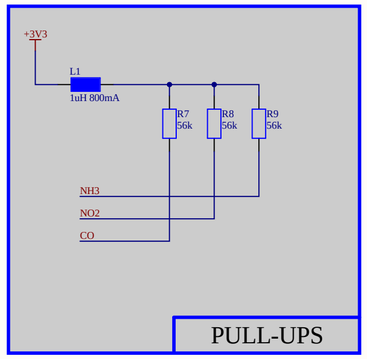


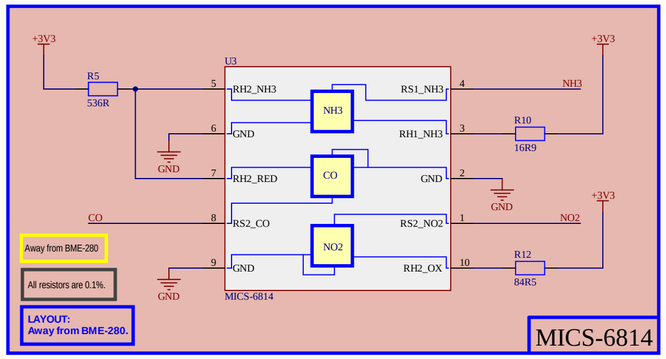


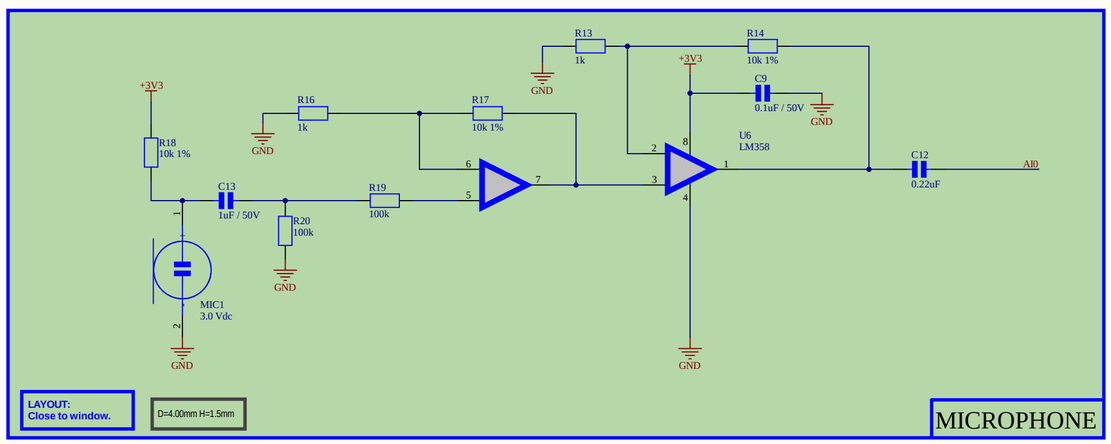


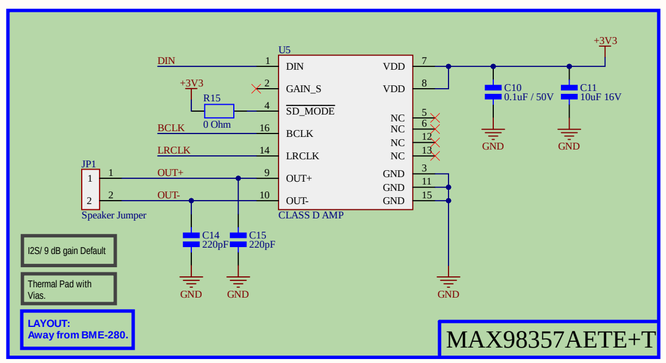












DESIGN CONSIDERATIONS

DESIGN NOTE:
Debug notes.

DESIGN NOTE:
Informational design notes.

DESIGN NOTE:
Critical design notes.

DESIGN NOTE:
Cautionary design notes.

LAYOUT NOTE:
Critical layout guidelines.

Connectors / Various Circuitry

Supporting Electronics

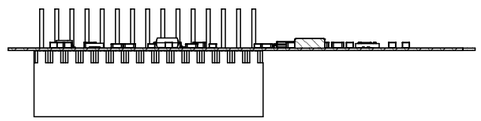
Sensors

RELEASED: 27-MAR-20

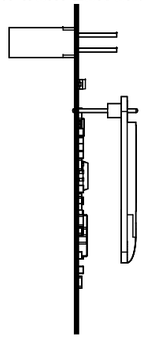
Title	***SMAQ Board Full Schematic***		
Size: A2	Number: SCH-A2	Revision: 1.1	
Date: 14/04/2020	Time: 21:27:37	Sheet 6 of 6	

Drawn By: Charitonidis A.
Checked By: Charitonidis A.
Approved By: Team 7
Team Number: 7

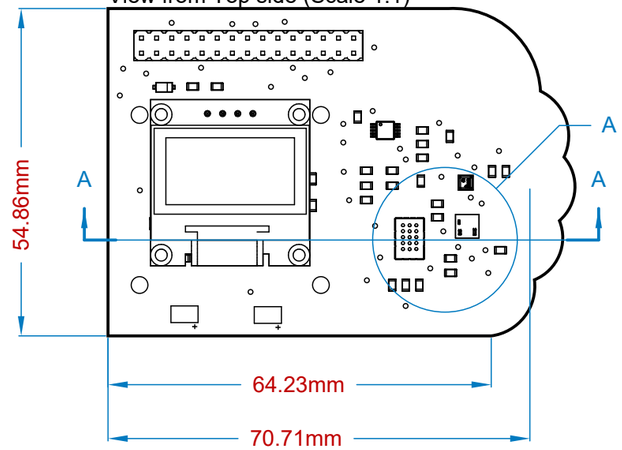
SECTION A-A (Scale 1:1)



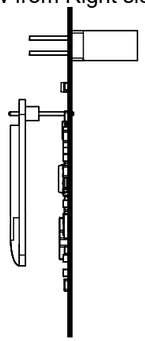
View from Left side (Scale 1:1)



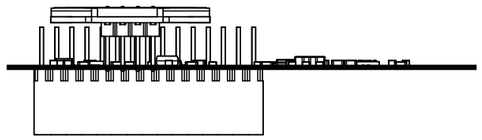
View from Top side (Scale 1:1)



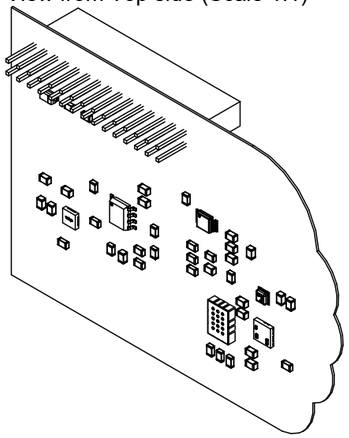
View from Right side (Scale 1:1)



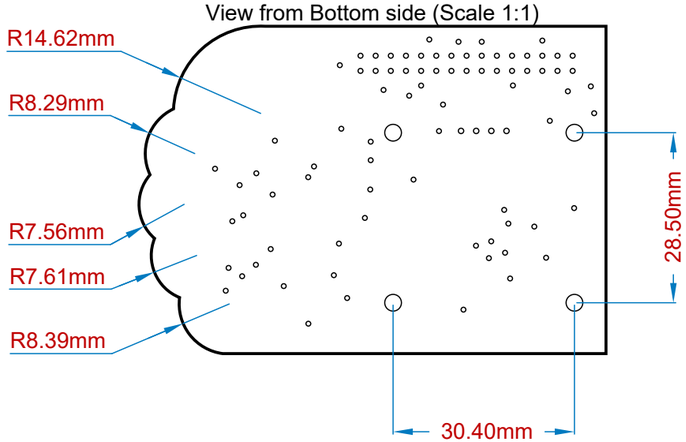
View from Front side (Scale 1:1)



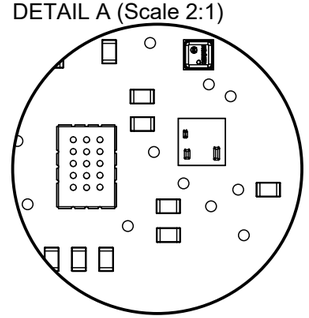
View from Top side (Scale 1:1)



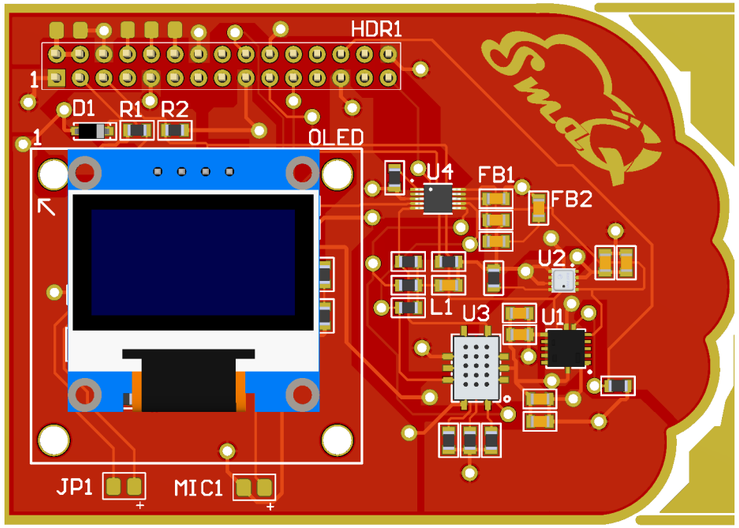
View from Bottom side (Scale 1:1)



DETAIL A (Scale 2:1)



Realistic View



NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MM
TOLERANCES: 0.01 MM
FRACTIONAL± 1/16
ANGULAR: MACH± 1 BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FR-4 BOARD
FINISH
Electroless Tinning
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	C. A.	25/03/2020
CHECKED	C. A.	25/03/2020
ENG APPR.	TEAM 7	26/03/2020
MFG APPR.	TEAM 7	26/03/2020
Q.A.	TEAM 7	26/03/2020

COMMENTS:

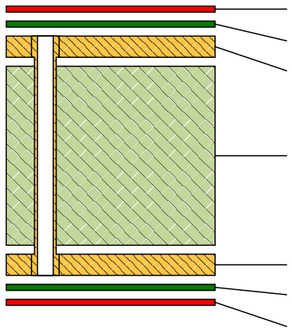
SMAQ -Smart Monitoring of Air Quality

TITLE

SMAQ - Assembly Views

SIZE	DWG. NO.	
B	ASSYVW-1	
SCALE: 1:1	WEIGHT: N.M.	SHEET 1 OF 5

Layer Stack Legend



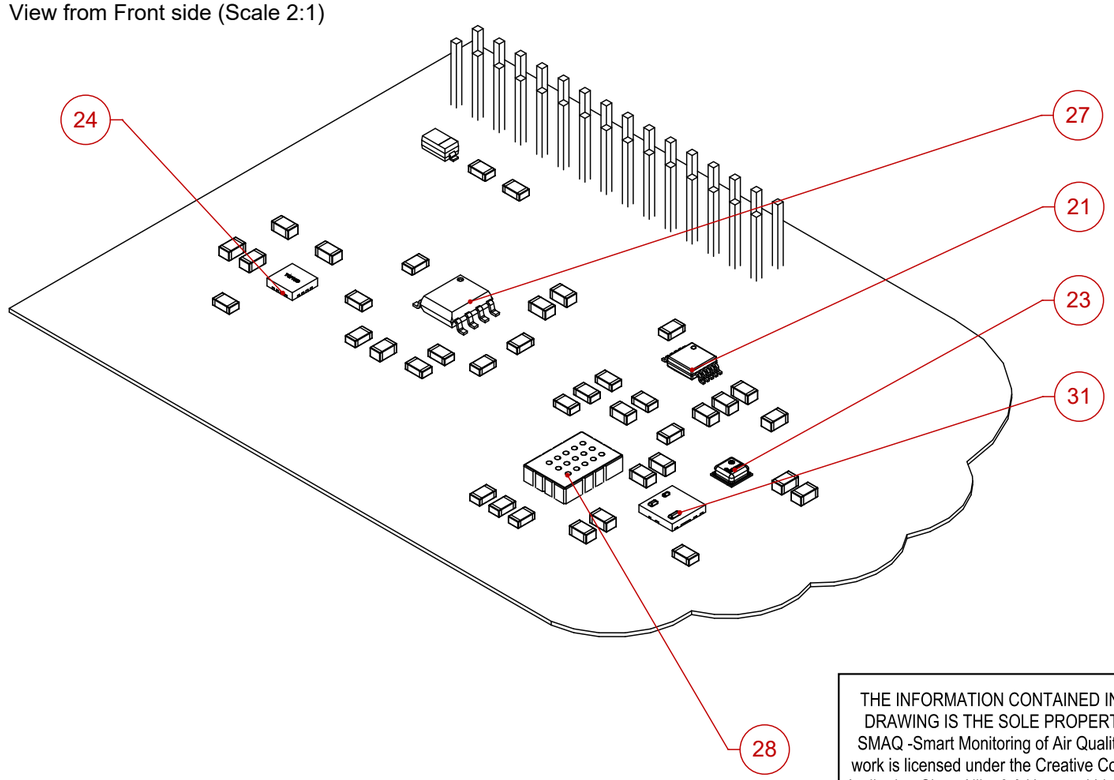
Material	Layer	Thickness	Dielectric Material	Type	Gerber
	Top Overlay			Legend	GTO
Surface Material	Top Solder	0.01mm	Solder Resist	Solder Mask	GTS
Copper	Top Layer	0.04mm		Signal	GTL
		0.32mm	*FR-4*	*Dielectric*	
Copper	Bottom Layer	0.04mm		Signal	GBL
Surface Material	Bottom Solder	0.01mm	Solder Resist	Solder Mask	GBS
	Bottom Overlay			Legend	GBO

Total thickness: 0.41mm

Bill Of Materials

Line #	Designator	Name	Quantity
1	R15	0 Ohm	1
2	C2, C4, C5, C6, C7, C9, C10	0.1uF / 50V	7
3	C12	0.22uF	1
4	R13, R16	1k	2
5	C8, C13	1uF / 50V	2
6	L1	1uH 800mA	1
7	HDR1	2x20 GPIO F HDR	1
8	R1, R2	2.74k	2
9	MIC1	3.0 Vdc	1
10	D1	3.6V 0.5W	1
11	R3, R4, R6, R11, R14, R17, R18	10k 1%	7
12	C3, C11	10uF 16V	2
13	R10	16R9	1
14	C1	22uF	1
15	R7, R8, R9	56k	3
16	R12	84R5	1
17	R19, R20	100k	2
18	R21, R22, R23	220 Ohm	3
19	C14, C15	220pF	2
20	R5	536R	1
21	U4	ADS1115 16Bit	1
22	D4	BLUE	1
23	U2	BME-280	1
24	U5	CLASS D AMP	1
25	FB1, FB2	Ferrite Bead 1.5k 500mA	2
26	D3	GREEN	1
27	U6	LM358	1
28	U3	MICS-6814	1
29	D2	RED	1
30	JP1	Speaker Jumper	1
31	U1	VCNL-4010	1

View from Front side (Scale 2:1)



NEXT ASSY	USED ON	
APPLICATION		

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MM
TOLERANCES: 0.01 MM
FRACTIONAL±1/16
ANGULAR: MACH± 1 BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FR-4 BOARD
FINISH
Electroless Tinning
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	C. A.	25/03/2020
CHECKED	C. A.	25/03/2020
ENG APPR.	TEAM 7	26/03/2020
MFG APPR.	TEAM 7	26/03/2020
Q.A.	TEAM 7	26/03/2020

COMMENTS:

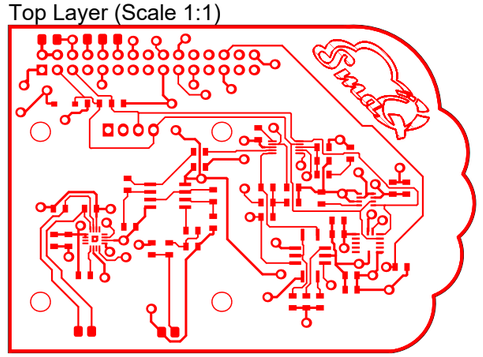
SMAQ -Smart Monitoring of Air Quality

TITLE

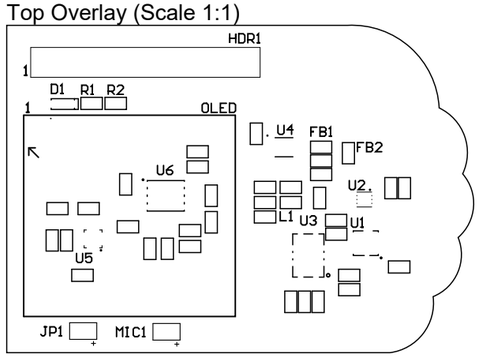
SMAQ - BOM and Layer Stack

SIZE	DWG. NO.	
B	BOMLYR-1	
SCALE: 1:1	WEIGHT: N.M.	SHEET 2 OF 5

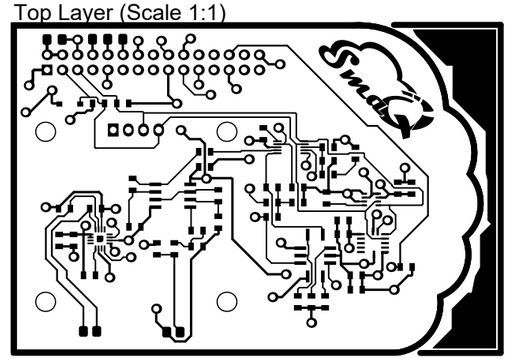
Top Layer (Scale 1:1)



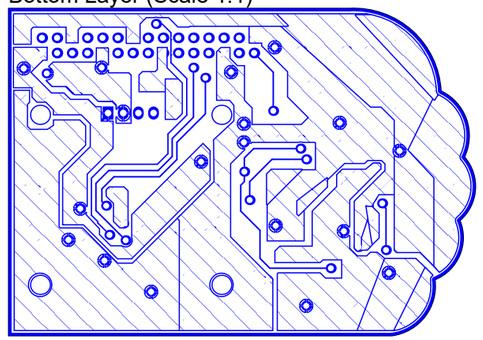
Top Overlay (Scale 1:1)



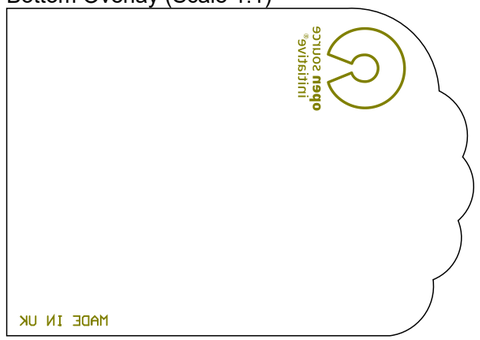
Top Layer (Scale 1:1)



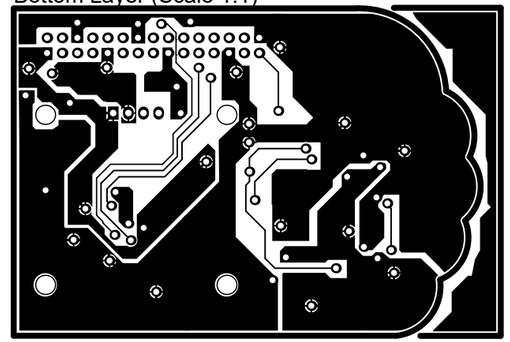
Bottom Layer (Scale 1:1)



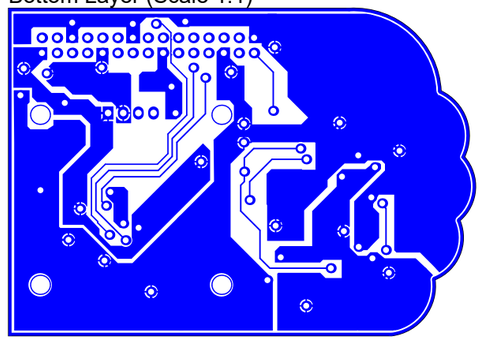
Bottom Overlay (Scale 1:1)



Bottom Layer (Scale 1:1)



Bottom Layer (Scale 1:1)



NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MM
TOLERANCES: 0.01 MM
FRACTIONAL± 1/16
ANGULAR: MACH± 1 BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FR-4 BOARD
FINISH
Electroless Tinning
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	C. A.	25/03/2020
CHECKED	C. A.	25/03/2020
ENG APPR.	TEAM 7	26/03/2020
MFG APPR.	TEAM 7	26/03/2020
Q.A.	TEAM 7	26/03/2020

COMMENTS:

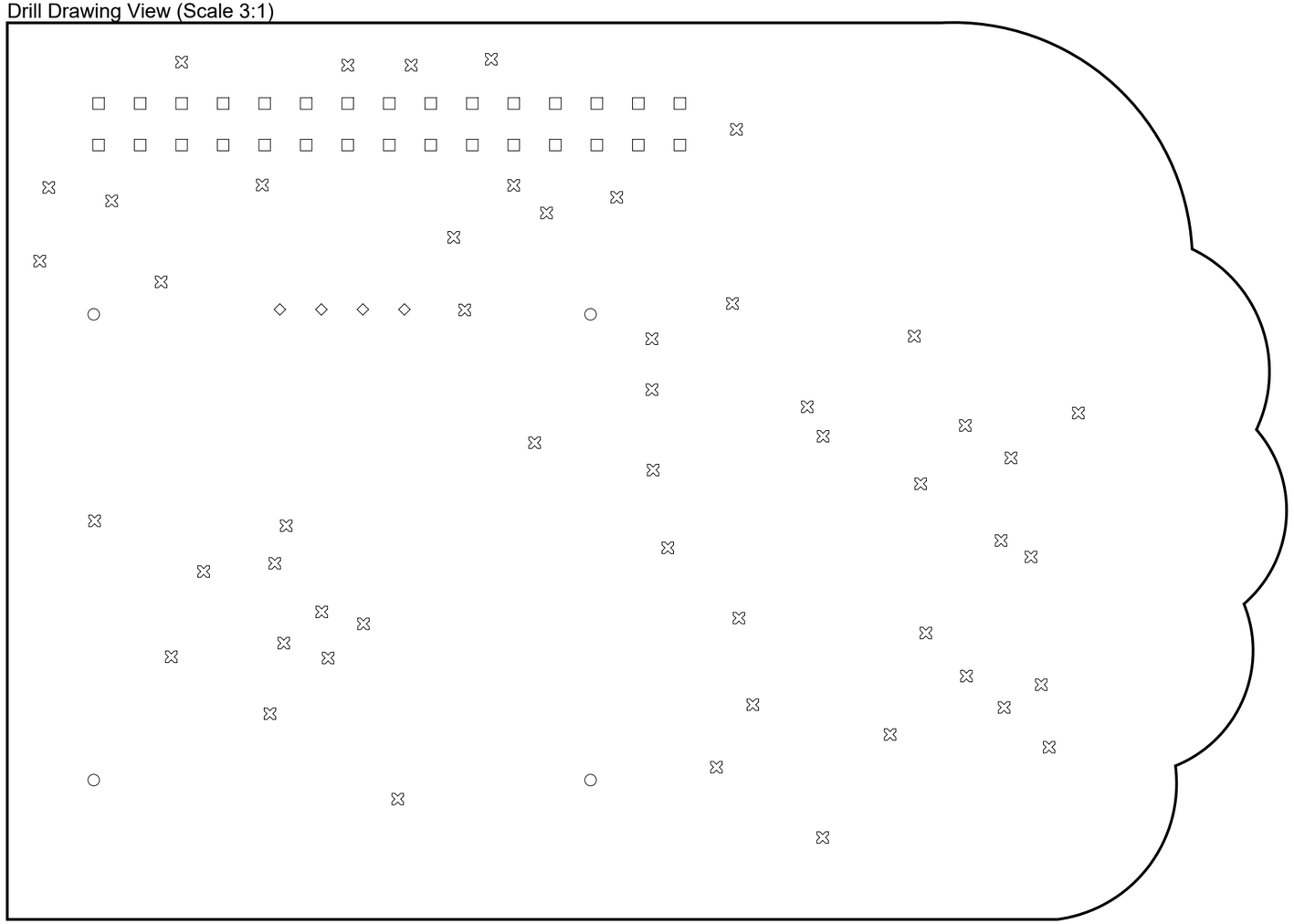
SMAQ -Smart Monitoring of Air Quality

TITLE

SMAQ - Fabrication Views

SIZE	DWG. NO.	
B	FBRVW-1	
SCALE: 1:1	WEIGHT: N.M.	SHEET 3 OF 5

Drill Drawing View (Scale 3:1)



Drill Table

Symbol	Count	Hole Size	Plated	Drill Layer Pair	Via / Pad	Hole Tolerance
⊠	51	1.00mm	Plated	Top Layer - Bottom Layer	Via	None
□	30	1.02mm	Plated	Top Layer - Bottom Layer	Pad	None
◇	4	1.10mm	Plated	Top Layer - Bottom Layer	Pad	None
○	4	3.00mm	Non-Plated	Top Layer - Bottom Layer	Pad	None
	89 Total					

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MM
TOLERANCES: 0.01 MM
FRACTIONAL±1/16
ANGULAR: MACH± 1 BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FR-4 BOARD
FINISH
Electroless Tinning
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	C. A.	25/03/2020
CHECKED	C. A.	25/03/2020
ENG APPR.	TEAM 7	26/03/2020
MFG APPR.	TEAM 7	26/03/2020
Q.A.	TEAM 7	26/03/2020

COMMENTS:

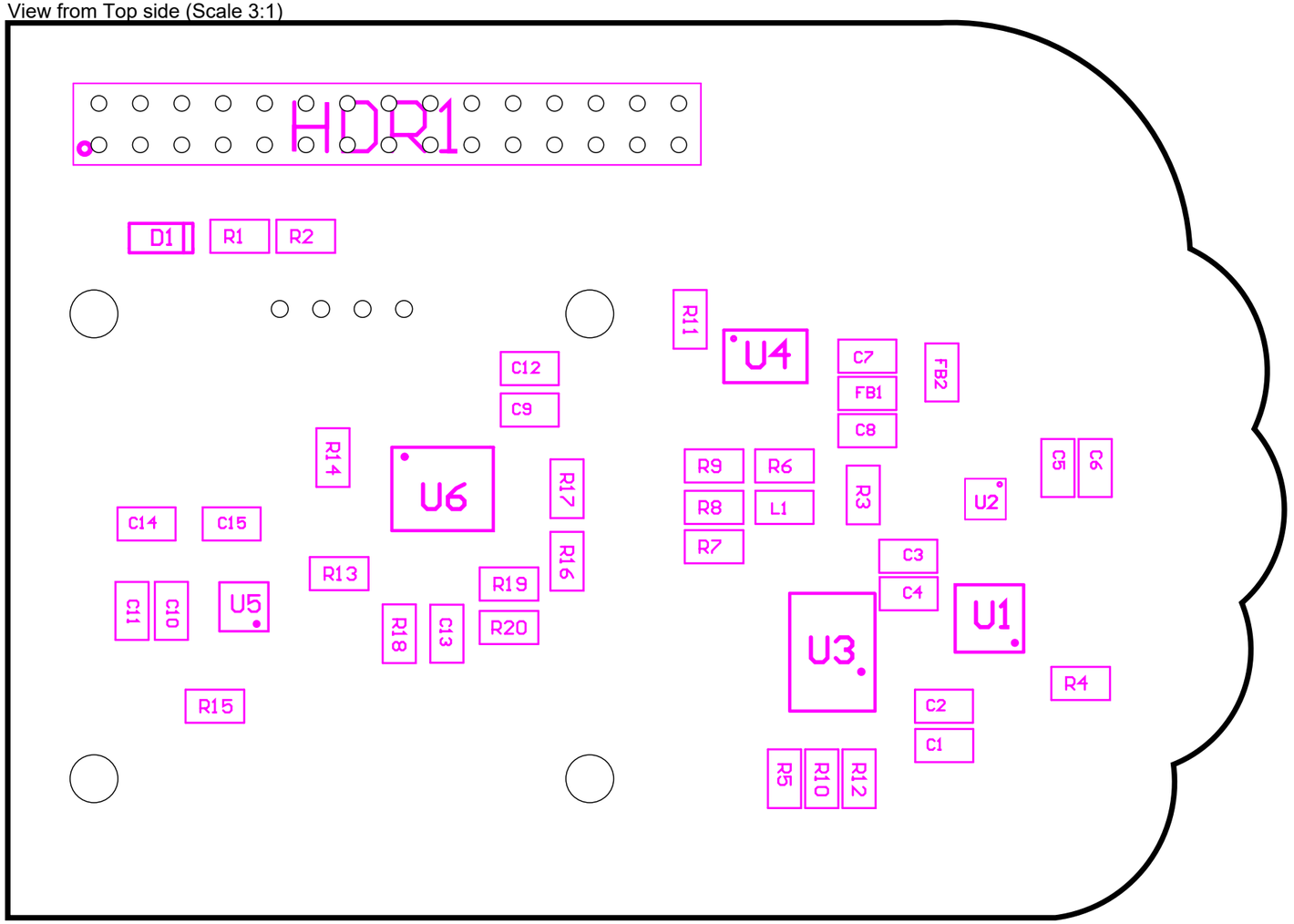
SMAQ -Smart Monitoring of Air Quality

TITLE

SMAQ - Drill Quide

SIZE	DWG. NO.	
B	DRLGUID-1	
SCALE: 1:1	WEIGHT: N.M.	SHEET 4 OF 5

View from Top side (Scale 3:1)



NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MM
TOLERANCES: 0.01 MM
FRACTIONAL±1/16
ANGULAR: MACH± 1 BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
INTERPRET GEOMETRIC TOLERANCING PER:
MATERIAL
FR-4 BOARD
FINISH
Electroless Tinning
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	C. A.	25/03/2020
CHECKED	C. A.	25/03/2020
ENG APPR.	TEAM 7	26/03/2020
MFG APPR.	TEAM 7	26/03/2020
Q.A.	TEAM 7	26/03/2020

COMMENTS:

SMAQ -Smart Monitoring of Air Quality

TITLE

SMAQ - Board Assembly View 2

SIZE	DWG. NO.	
B	ASSYVW-2	
SCALE: 1:1	WEIGHT: N.M.	SHEET 5 OF 5

Component list

Bill of Materials for Smart Monitoring of Air Quality

Source Data From: SMAQ-Board_Design.BomDoc
Project: SMAQ-Board_Design.PrjPcb
Variant: None

Contact: Alexandros Charitonidis

Gen

Report Date: 18/04/2020 01:18
Print Date: 18-Apr-20 1:18:49 AM

#	Category 1	Manufacturer 1	Manufacturer Part Number 1	#Column Name Error:' Package / Case	Description	Quantity	Supplier 1	Supplier Part Number 1	Supplier Order Qty 1	Supplier Stock 1	Supplier Unit Price 1	Supplier Subtotal 1	Supplier Currency 1
1	Chip SMD Resistors	Panasonic	ERJ-6GEY0R00V		RES SMD 0 OHM JUMPER 1/8W 0805	1	Mouser	667-ERJ-6GEY0R00V	1	788480	0.08	0.08	GBP
2	Ceramic Capacitors	Kyocera AVX	08055C104JAT4A		CAP CER 0.1UF 50V X7R 0805	7	Mouser	581-08055C104JAT4A	10	69837	0.12	1.16	GBP
3		Kyocera AVX	08053C224J4Z2A		Multilayer Ceramic Capacitors MLCC - SMD/SMT 25V 0.22uF X7R 0805 5% AEC-Q200	1	Mouser	581-08053C224J4Z2A	1	37020	0.15	0.15	GBP
4	Chip SMD Resistors	Panasonic	ERA-6AED102V		Res Thin Film 0805 1K Ohm 0.5% 1/8W ±25ppm/°C Molded SMD SMD Punched Carrier T/R	2	Mouser	667-ERA-6AED102V	2	18196	0.18	0.36	GBP
5	Capacitors	Kyocera AVX	08055C105JAT2A			2	Mouser	581-08055C105JAT2A	2	4264	0.39	0.77	GBP
6		TDK	KLZ2012MHR1R0HTD25		FIXED IND 1UH 800MA 130 MOHM SMD	1	Mouser	810-KLZ2012MHR1R0HTD	1	3633	0.24	0.24	GBP
7		Adafruit Industries	2222		GPIO FEMALE HEADER RASPBERRY PI	1	Mouser	485-2222					
8	Chip SMD Resistors	Panasonic	ERA6AEB2741V		Surface Mount Chip Resistor, Thin Film, AEC Q200 ERA Series, 2.74 kohm, 125 mW, 0.1%, 100 V	2	Mouser	667-ERA-6AEB2741V	2	8588	0.28	0.56	GBP
9		CUI Devices	CMC-4015-25L100		4.0 mm, Omnidirectional, Wire Leads, 3.0 Vdc, IP65 Rated, Electret Condenser Microphone	1	Mouser	490-CMC-4015-25L100	1	481	1.94	1.94	GBP
10	Zener Diodes	Vishay	BZT52B3V6-E3-08		Diode Zener Single 3.6V 2% 500mW 2-Pin SOD-123 T/R	1	Mouser	78-BZT52B3V6-E3-08	1	29413	0.25	0.25	GBP
11	Chip SMD Resistors	Yageo	AT0805FRE0710KL		RES SMD 10K OHM 1% 1/8W 0805	7	Mouser	603-AT0805FRE0710KL	10	12701	0.25	2.49	GBP
12		Kyocera AVX	0805YC106MAT2A			2	Mouser	581-0805YC106MAT2A	2	1716	0.45	0.90	GBP
13	Chip SMD Resistors	Panasonic	ERA-6AEB2741V		Res Thick Film 0805 16.9 Ohm 1% 1/4W 300ppm/C Molded SMD Punched Carrier T/R	1	Mouser	667-ERA-6AEB2741V	1	5043	0.28	0.28	GBP
14	Ceramic Capacitors	TDK	C2012JB1A226M085AC		CAP CER 22UF 10V JB 0805	1	Mouser	810-C2012JB1A226M08C	1	10381	0.53	0.53	GBP
15	Chip SMD Resistors	Panasonic	ERA-6AEB563V		RES SMD 56K OHM 0.1% 1/8W 0805	3	Mouser	667-ERA-6AEB563V	3	13309	0.28	0.84	GBP
16	Chip SMD Resistors	Panasonic	ERA-6AEB84R5V		RES SMD 84.5 OHM 0.1% 1/8W 0805	1	Mouser	667-ERA-6AEB84R5V	1	6045	0.28	0.28	GBP
17	Chip SMD Resistors	Panasonic	ERJ-6ENF1003V		RES SMD 100K OHM 1% 1/8W 0805	2	Mouser	667-ERJ-6ENF1003V	2	286752	0.08	0.15	GBP
18	Chip SMD Resistors	Panasonic	ERJ-6GEY0R00V		RES SMD 0 OHM JUMPER 1/8W 0805	3	Mouser	667-ERJ-6GEY0R00V					
19	Ceramic Capacitors	Kyocera AVX	08055A221F4T2A		T&R / COMMERCIAL CHIP	2	Mouser	581-08055A221F4T2A	2	6955	0.36	0.73	GBP
20	Chip SMD Resistors	Panasonic	ERA6AEB5360V		RES SMD 536 OHM 0.1% 1/8W 0805	1	Mouser	667-ERA-6AEB5360V	1	8172	0.28	0.28	GBP
21	Analog to Digital Converters (ADCs)	Texas Instruments	ADS1115IDGSR		IC ADC 16BIT 860SPS LP 10MSOP	1	Mouser	595-ADS1115IDGSR	1	13988	4.27	4.27	GBP
22					Typical RED GaAs LED	1							
23	Pressure Sensors	Bosch	BME280		Pressure, Temperature and Humidity Sensor Digital Output 1.8V 8-Pin LGA T/R	1	Mouser	262-BME280	1	17744	2.89	2.89	GBP
24	Amplifiers - Audio	Maxim	MAX98357AETE+T		IC AUDIO AMP CLASS D 16-TQFN	1	Mouser	700-MAX98357AETE+T	1	5567	1.82	1.82	GBP
25	Inductors	TDK	MMZ2012Y152BT000		Ferrite Beads Multi-Layer 1.5KOhm 25% 100MHz 500mA 400mOhm DCR 0805	2	Mouser	810-MMZ2012Y152BT000	2	110	0.09	0.17	GBP
26					Typical RED GaAs LED	1							
27	Amplifiers - Op Amps, Buffer, Instrumentation	Texas Instruments	LM358DR		IC OPAMP GP 700KHZ 8SOIC	1	Mouser	595-LM358DR	1	10391	0.29	0.29	GBP
28		AMPHENOL SGX SENSORTECH	MICS-6814		SHUT HEIGHT GAGE(119.5MM)	1	Mouser	523-MICS-6814	1	708	14.70	14.70	GBP
29					Typical RED GaAs LED	1							
30						1							
31	Sensors	Vishay Semiconductors	VCNL4010-GS08		SENS IR PROXIMITY AMB LT 12LLP	1	Mouser	78-VCNL4010-GS08	1	15551	2.40	2.40	GBP
						54			52			38.514	

Approved

FINAL

TEAM 7

Notes

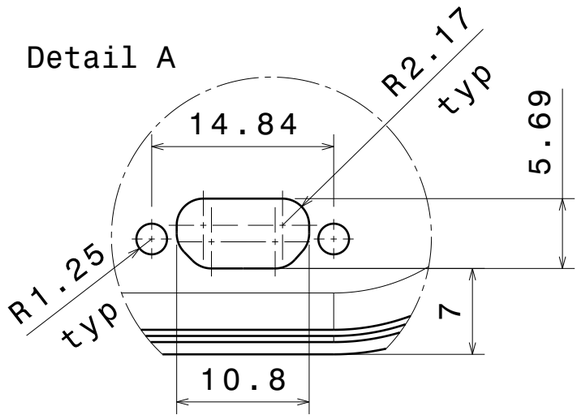
Altium

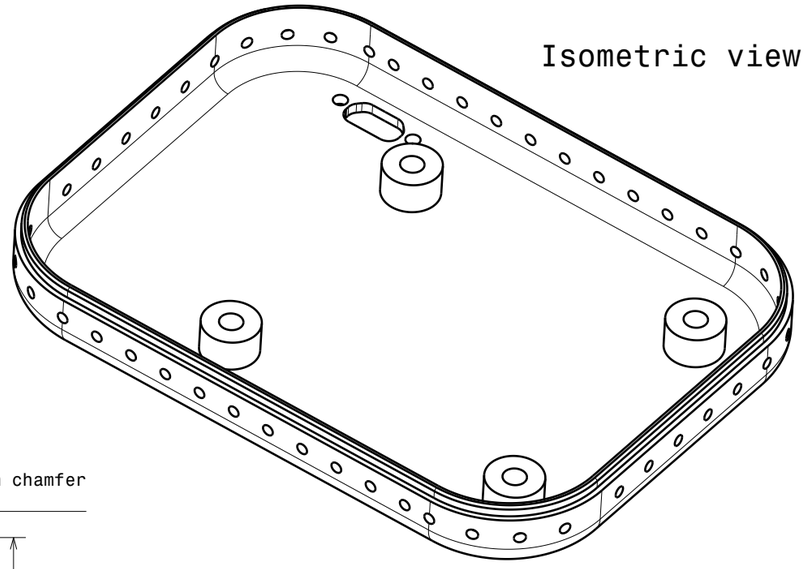
Revision Version: 1.1

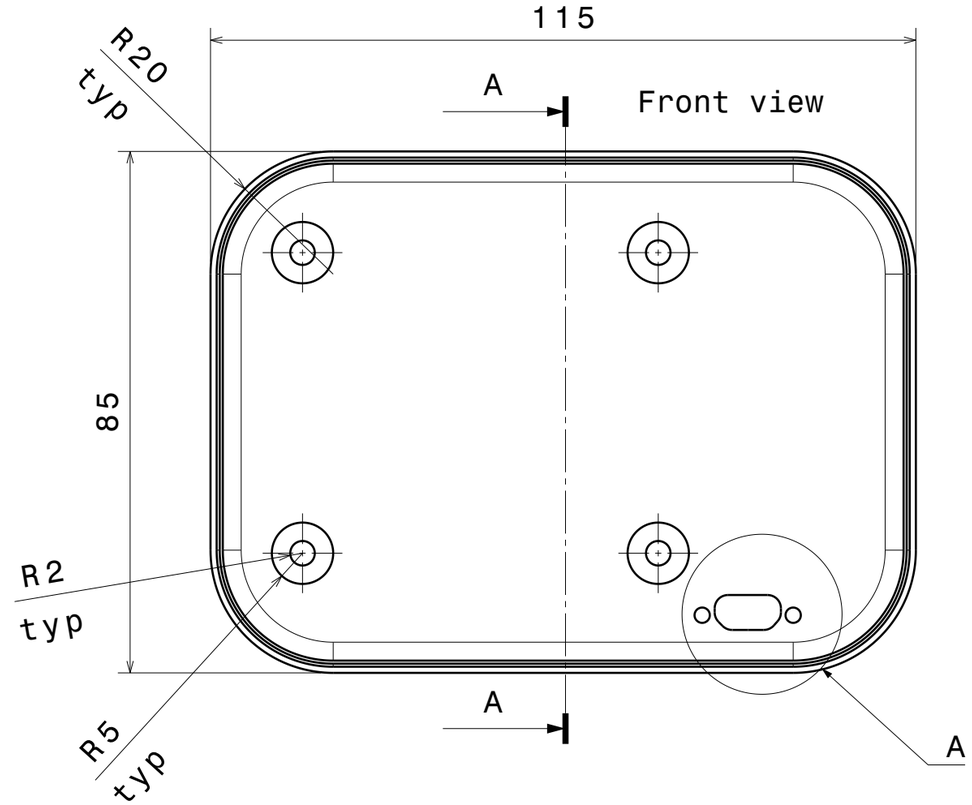
1 pcs: **Total** Price for 1pcs

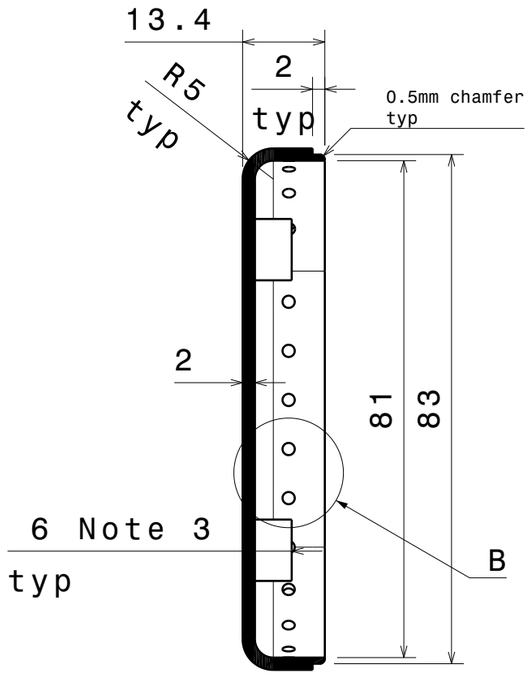
38.514 GBP

38.51 GBP

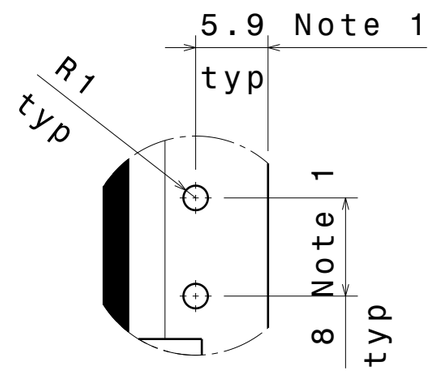








Section view A-A



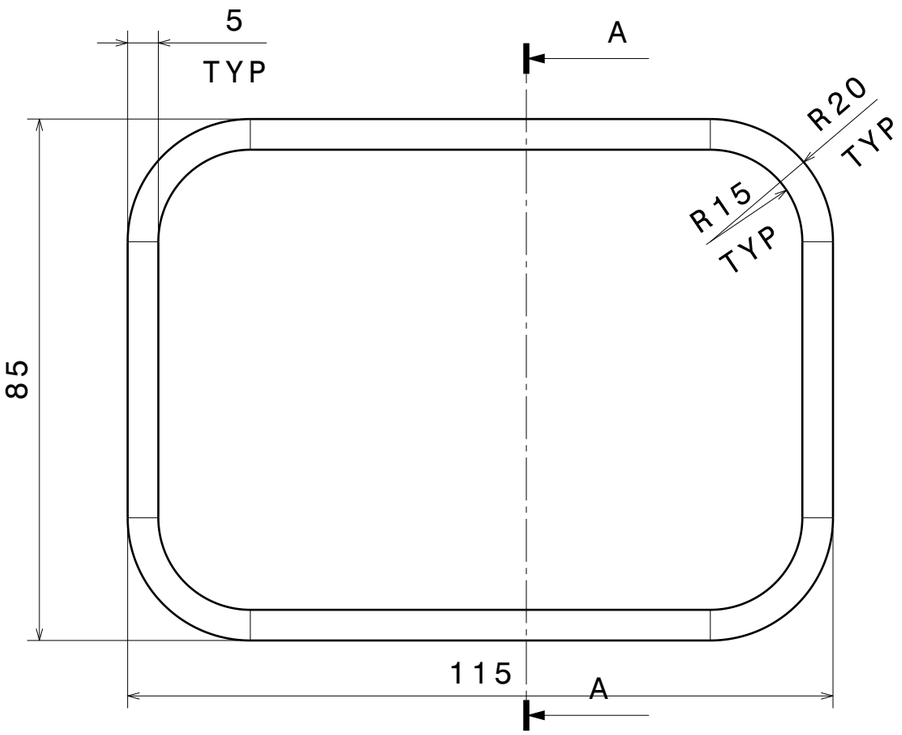
Detail B

Manufacturing Notes

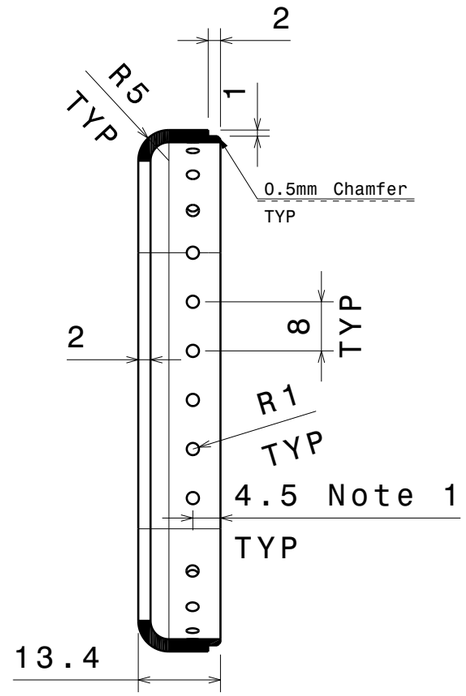
1. Additional ventilation holes. Dimensions apply throughout the body.
2. Detail A shows the panel mount usb-micro pocket.
3. Dimension applies for both boss and hole.
4. All unspecified tolerances are ± 0.5mm.
5. Material is ABS, colour is white.
6. Manufacture using selective laser sintering.

NOT FOR MANUFACTURING

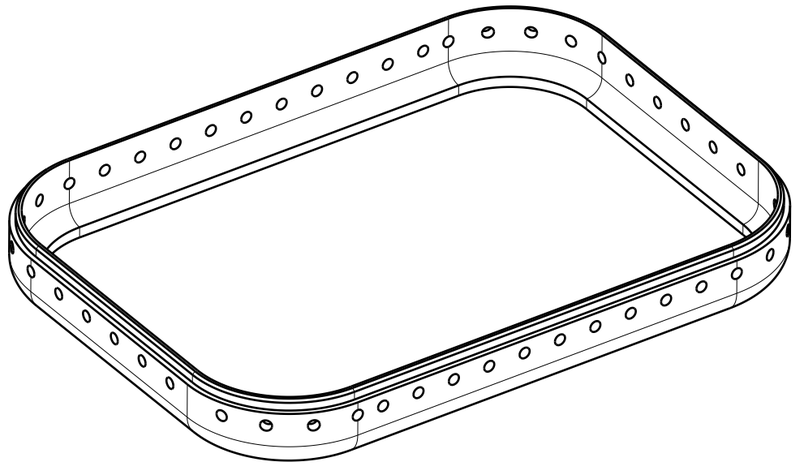
Initial Issue				14/04/2020	A
Change Descripion				DATE	ISSUE
	DIMENSIONS mm	DRAWN M.Biyikli	TITLE SMAQ casing bottom half		
SCALE NTS	TOLERANCE (See Drg)	SHEET 1/1	DRAWING NUBER ENG5220-SMAQ-01		ISS. A



Front View



Section view A-A



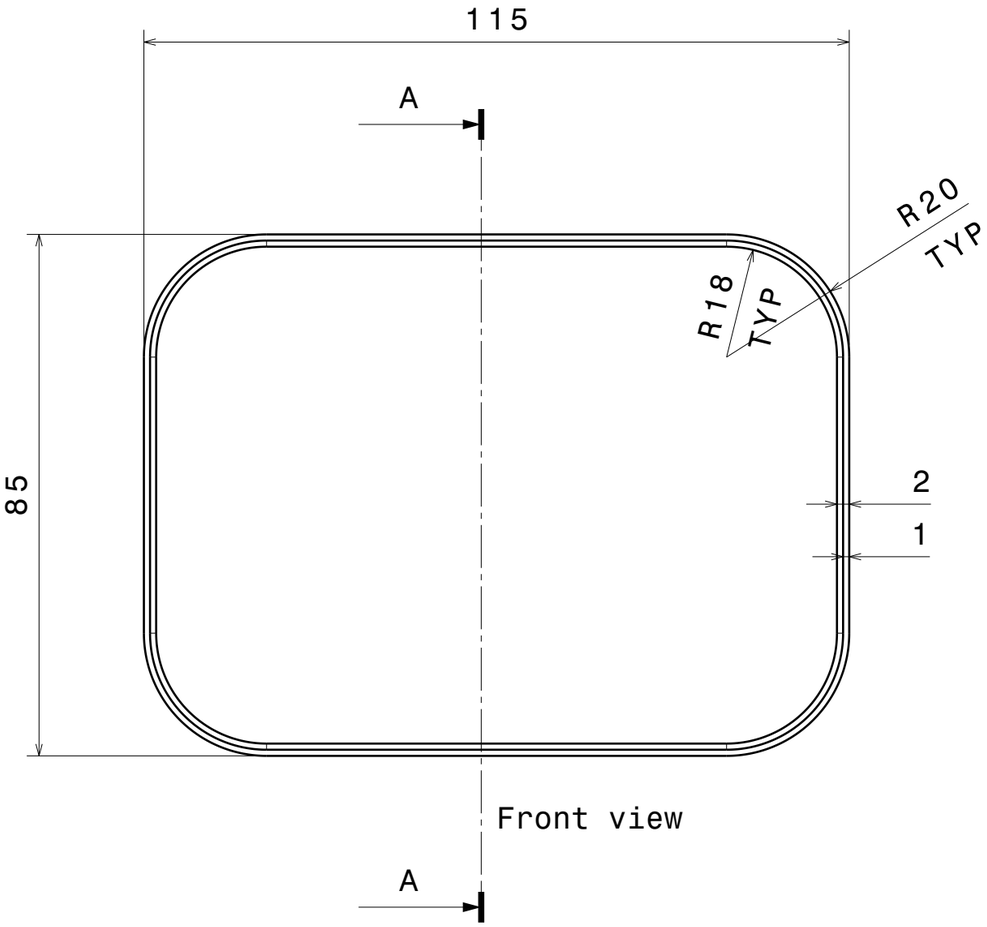
Isometric view

Manufacturing Notes:

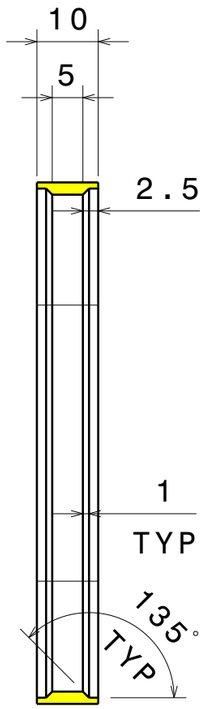
1. Additional ventilation holes.
Dimensions apply throughout the body.
2. All unspecified torerances are ± 0.5mm.
3. Material is ABS, colour is white.
4. Manufacture using selective laser sintering.

NOT FOR MANUFACTURING

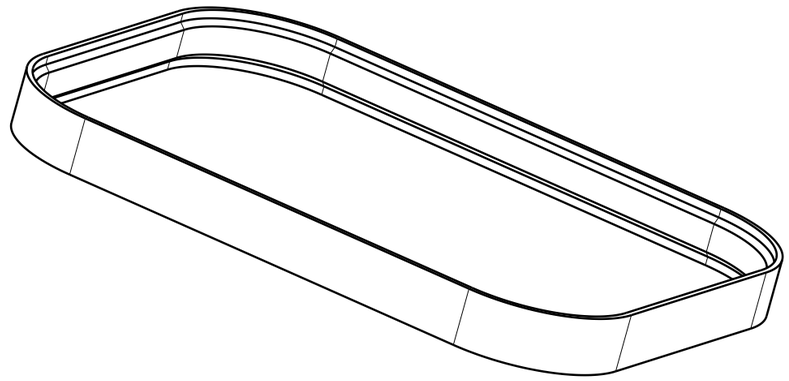
Initial Issue				14/04/2020	A
Change Descripion				DATE	ISSUE
	DIMENSIONS mm	DRAWN K.Lenard	TITLE SMAQ casing top half		
SCALE NTS	TOLERANCE (See Drg)	SHEET 1/1	DRAWING NUBER ENG5220-SMAQ-02		ISS. A



Front view



Section view A-A



Isometric view

Manufacturing Notes:

1. All unspecified tolerances are ± 0.5mm.
2. Material is ABS translucent.
3. Manufacture using fuse deposition modelling.
4. Surface finish RA 120.

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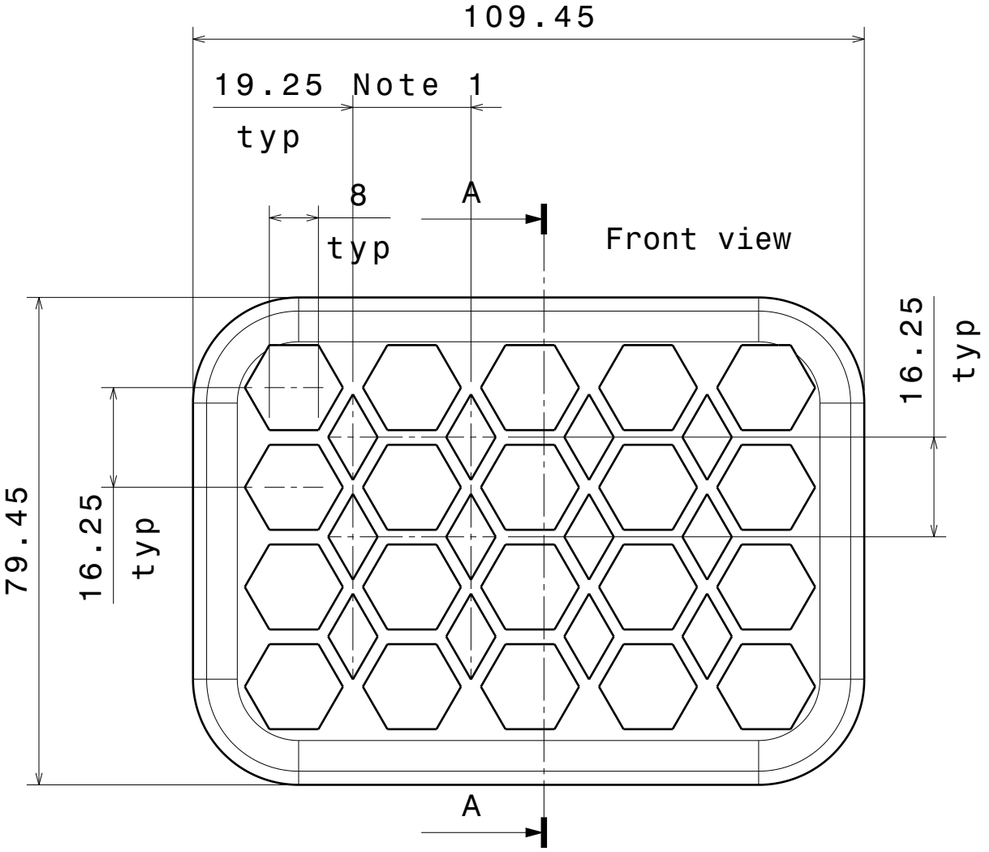
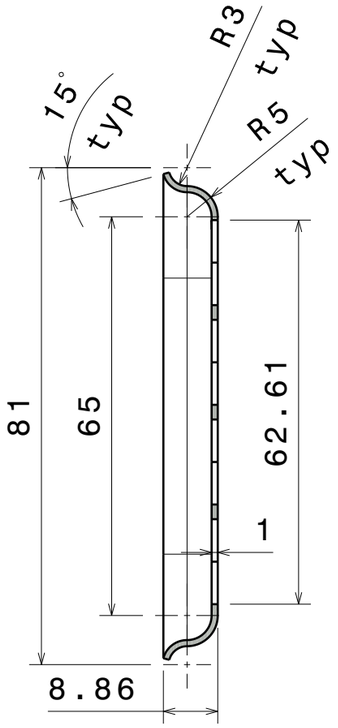
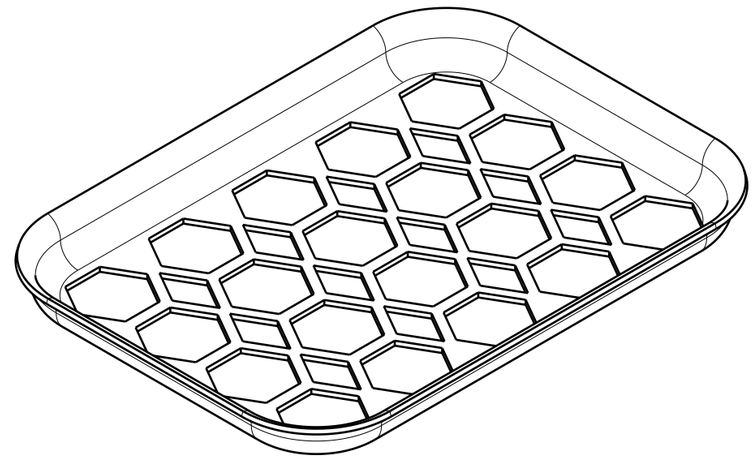
Initial Issue				14/04/2020	A
Change Descripion				DATE	ISSUE
	DIMENSIONS mm	DRAWN K.Lenard	TITLE SMAQ LED Pipe		
SCALE NTS	TOLERANCE (See Drg)	SHEET 1/1	DRAWING NUBER ENG5220-SMAQ-03		ISS. **A**





Section view A-A



Isometric view

Manufacturing Notes

1. Dimension applies for the hexagonal pattern as well.
2. All unspecified tolerances are ± 0.5mm.
3. Material is ABS, colour is transparent or white.
4. Manufacture using selective laser sintering or fuse deposition modelling.

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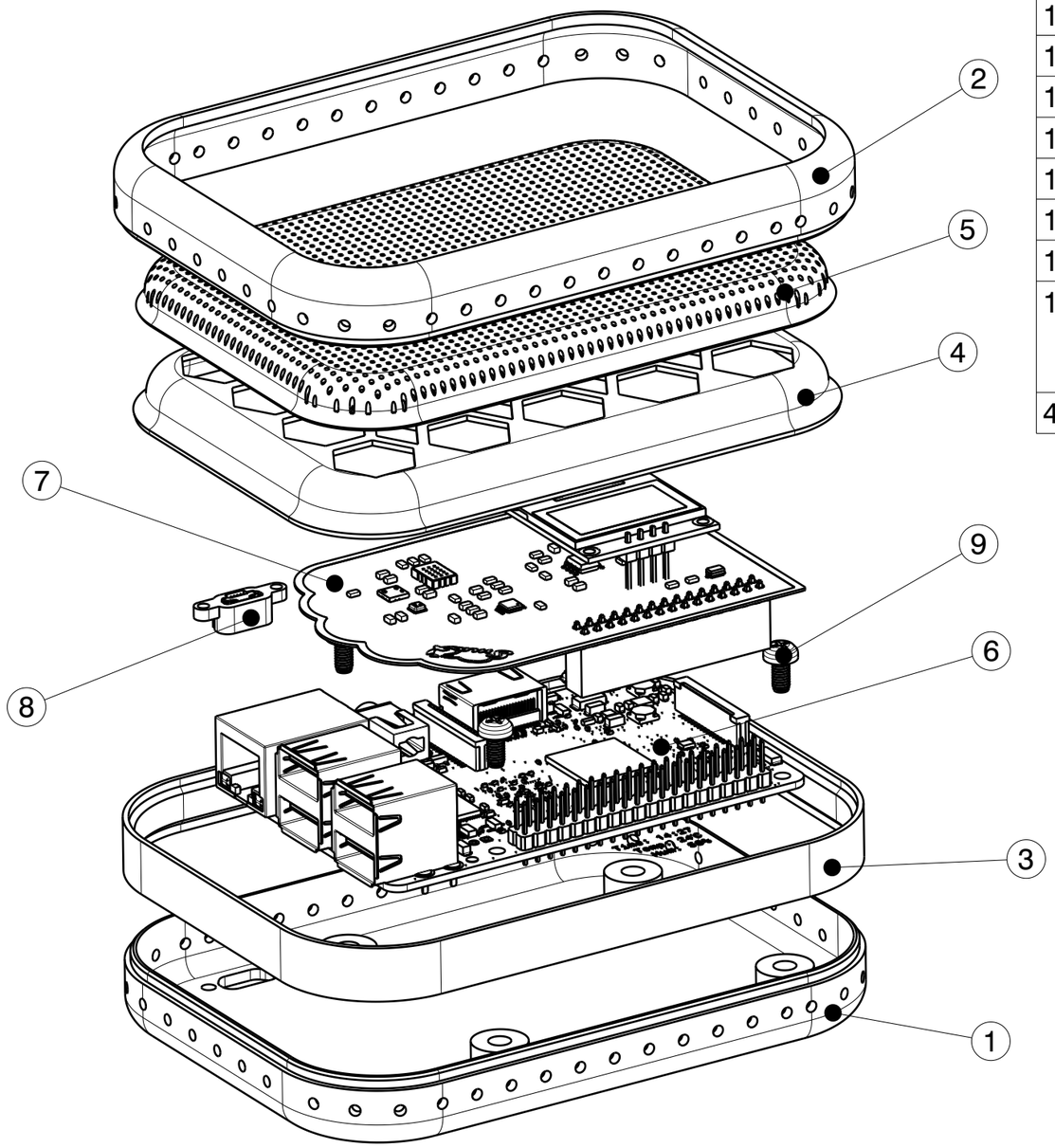
Change Descripion				DATE	ISSUE
This drawing and all information contained in it remains the copyright of SMAQ		DIMENSIONS mm	DRAWN M.Biyikli	TITLE SMAQ meshed top cover	
	SCALE NTS	TOLERANCE (See Drg)	SHEET 1/1	DRAWING NUBER ENG5220-SMAQ-04	ISS. **A**



Bill of Material: SMAQ

Quantity	Part Number	Description	Nomenclature
1	ENG5220-SMAQ-01	Bottom half of case	1
1	ENG5220-SMAQ-02	Top half of case	2
1	ENG5220-SMAQ-03	LED pipe	3
1	ENG5220-SMAQ-04	Support mesh	4
1	ENG5220-SMAQ-05	Tulle front cover	5
1	ENG5220-SMAQ-06	Raspberry Pi 3 Model B	6
1	ENG5220-SMAQ-07	SMAQ PCB	7
1	ENG5220-SMAQ-08	Micro USB panel mount, P3258 Micro USB M-F from Premier Cable	8
4	ENG5220-SMAQ-09	M3x8 nylon screw	9

Assembly Notes

1. Assemble item 7 (SMAQ pcb) onto item 6 (raspberry pi). Alignment is as shown in the drawing.
2. Assemble the sub-assembly of items 7 and 6 onto item 1 (bottom half of case) using item 9 (M3x8 screw).
3. Assemble item 8 (micro-usb panel mount) onto item 1 using the screws provided with item 8. Plug the male usb-micro into the power input of item 6.
4. Assemble item 3 (LED pipe) onto item 1.
5. Assemble item 5 (tulle) onto item 4 (Support mesh), then this sub-assembly into item 2 (top half of case).
6. Assemble the subassembly of items 5, 4 & 2 onto the previously assembled bottom half.
7. Parts assembly is tight-fit, no additional glue is required.

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Initial Issue				14/04/2020	A
Change Descripion				DATE	ISSUE
		DIMENSIONS mm	DRAWN M.Biyikli	TITLE SMAQ Assembly	
	SCALE NTS	TOLERANCE (See Drg)	SHEET 1/1	DRAWING NUBER ENG5220-SMAQ-A01	ISS. A