

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY  
BANGALORE

ELECTRONIC SYSTEMS PACKAGING  
VL 603

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## Project - SMART RING

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[Drive Link containing Project Zip](#)

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# 1 Description of the Project

We have constructed a Smart Ring integrating a Heart Rate monitor, a Pulse Oximeter, and a temperature Sensor in a Rigid-Flex PCB.

## 2 Description of Blocks

### 2.1 Temperature Sensor – TMP119AIYBGR

1. 0.149 cm x 0.095 cm x 0.0525 cm
2. Works on 3.3 V
3. Would be used to detect the temperature of the surrounding environment and would send the readings to the microcontroller.
4. Pin Description -
  - SCL – connected to Microcontroller to serve as the I2C protocol serial clock.
  - SDA - connected to Microcontroller to serve as the I2C protocol serial Data line.
  - ALERT – connected to Microcontroller to serve as the output signal to alert for a high temperature.
  - GND – Ground Pin
  - V+ - VDD pin driven to 3.3V

### 2.2 Heart Rate and Pulse Oximeter monitor - MAXREFDES117

1. 1.27 cm x 1.25 cm
2. Works on 3.3V
3. Would be used to detect the Heart rate and SpO2 levels using the integrated red and IR LEDs and would send the readings to the microcontroller.
4. Pin Description -
  - SCL – connected to Microcontroller to serve as the I2C protocol serial clock.
  - SDA - connected to Microcontroller to serve as the I2C protocol serial Data line.
  - GND – Ground Pin
  - V+ - VDD pin driven to 3.3V

### 2.3 Power Management Circuit

1. This is the power management unit of the entire design containing the C-type charger and the Li-ion Battery charger circuit.
2. Consists of MCP73831-2DCI-MC as the Li-ion Charger circuit. This will be connected to the LIPO battery.
3. Consists of GSB1C41110SSHR as the C-type connector to the Charger circuit.
4. Pin description -
  - GND – Ground Pin
  - 3V3 - Will provide the 3.3 voltage to the entire circuit.
  - LIPO - Will be connected to the [Curved Lipo Battery](#).

## 2.4 JTAG Protocol Unit

1. This consists of the USB connector unit to program the firmware onto the microcontroller.
2. Pin description -
  - TMS (Test Mode Select) – this signal is sampled at the rising edge of TCK to determine the next state.
  - TCK (Test Clock) – this signal synchronizes the internal state machine operations.
  - TDI (Test Data In) – this signal represents the data shifted into the device's test or programming logic. It is sampled at the rising edge of TCK when the internal state machine is in the correct state.
  - TDO (Test Data Out) – this signal represents the data shifted out of the device's test or programming logic and is valid on the falling edge of TCK when the internal state machine is in the correct state.

## 2.5 Switch - B3F1000

1. 0.45 cm x 0.6 cm x 0.65 cm
2. Works on 3.3 V
3. This will be used to send the SOS Signal when pressed a specific number of times.
4. Pin description -
  - S1 – connected to the Microcontroller for control.
  - S2 – Ground Pin

## 2.6 Crystal Oscillator – ABM8-27.120MHZ-B4-T

1. External clock provider to the Microcontroller.

## 2.7 Microcontroller – ESP32-C3-MINI-1U-H4

1. 1.32 cm × 1.25 cm × 0.24 cm
2. Works on 3.3V
3. The microcontroller for our design. Has an inbuilt Bluetooth and Wifi module which can be used to easily transfer information collected from the sensors to an Android device.
4. Pin description -
  - I/Os are connected to the other blocks as discussed in their descriptions.
  - USB/ JTAG Protocol Unit Pins – connected to the JTAG connector which will be used for programming the firmware onto the microcontroller.
  - GND – Ground Pin
  - VDD - VDD pin driven to 3.3V

### 3 Level 1 Diagram

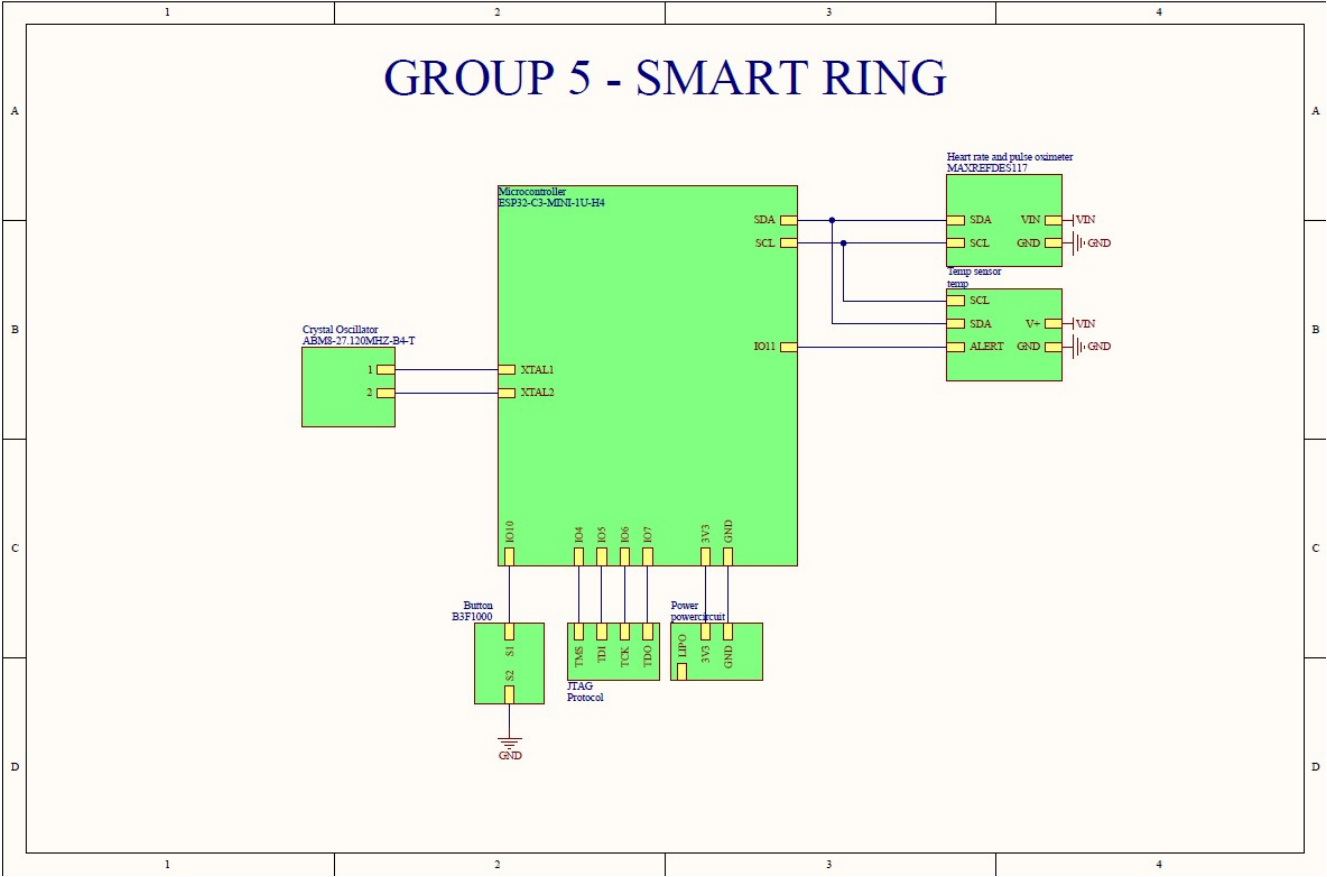


Figure 1

## 4 Level 2 Schematics

### 4.1 Temperature Sensor

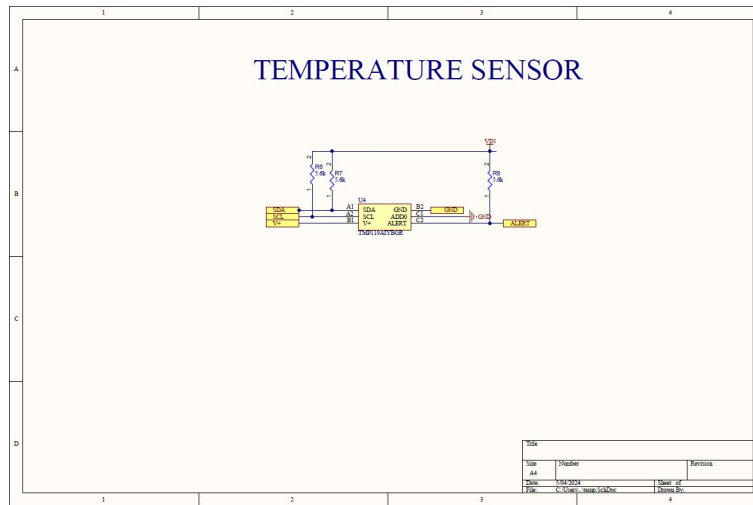


Figure 2: [Datasheet Link](#)

### 4.2 Heart Rate and Pulse Oximeter

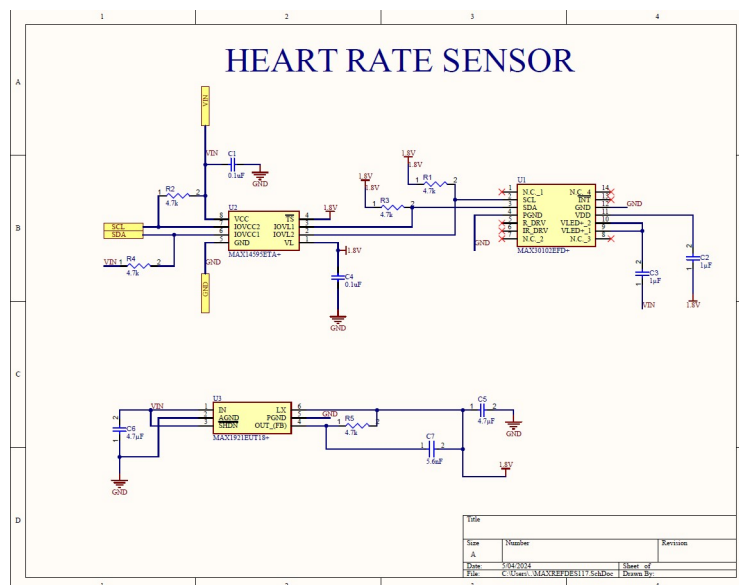


Figure 3: [Schematic Link](#), [Datasheet Link](#)

### 4.3 Power Management Circuit

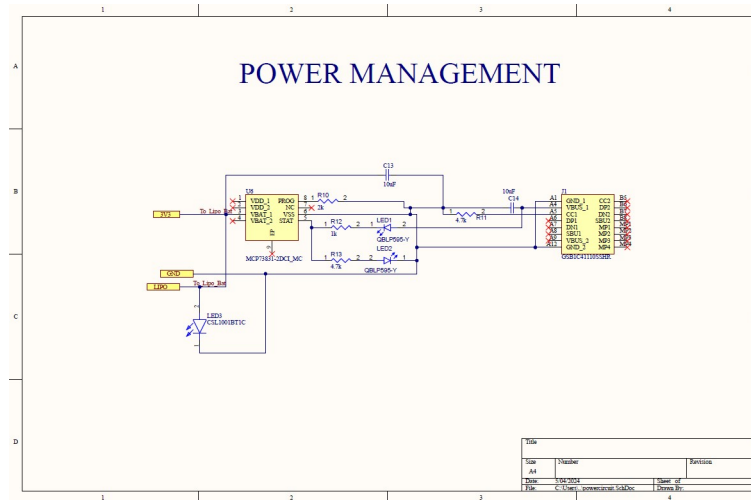


Figure 4: [Circuit Diagram Link](#)

## 4.4 JTAG Connector

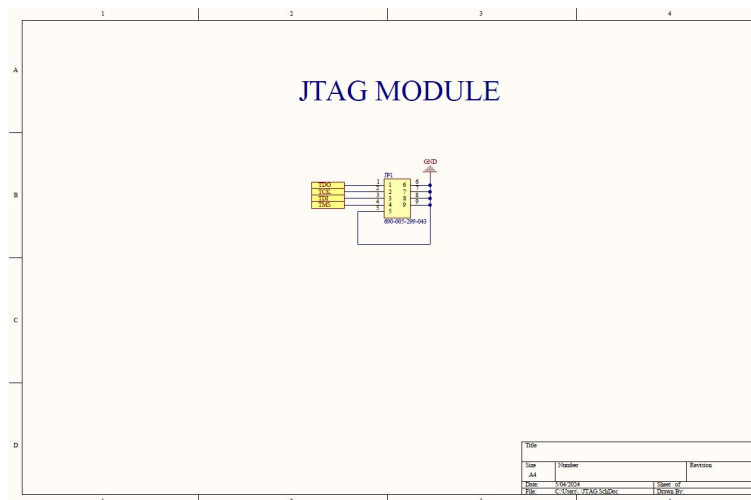


Figure 5: [Datasheet Link](#)

4.5 Switch

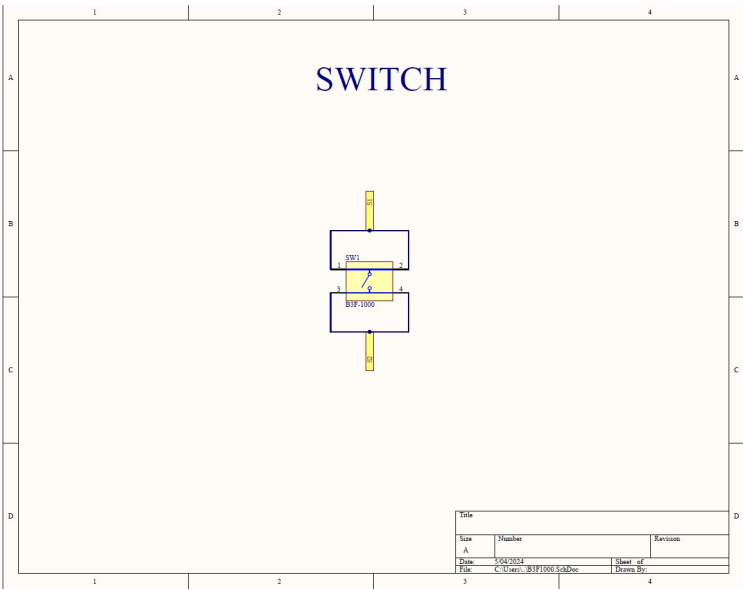


Figure 6: [Datasheet Link](#)

4.6 Crystal Oscillator

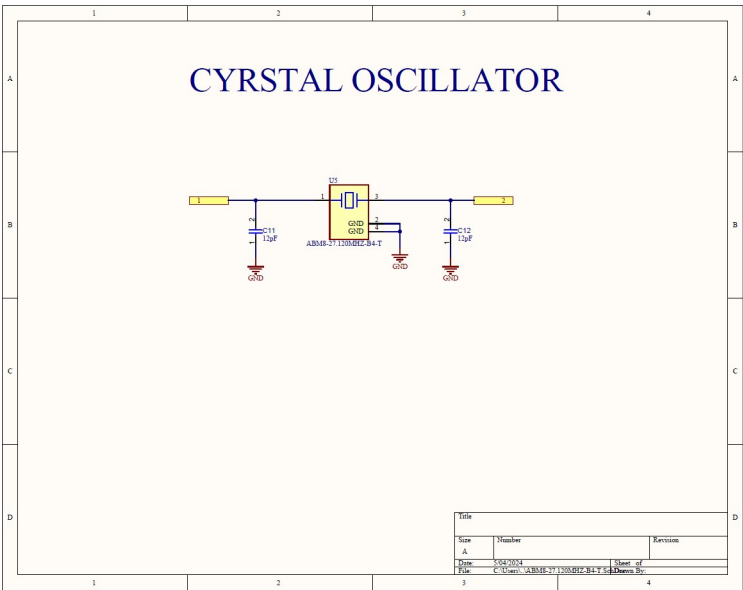


Figure 7: [Datasheet Link](#)

# 4.7 Microcontroller

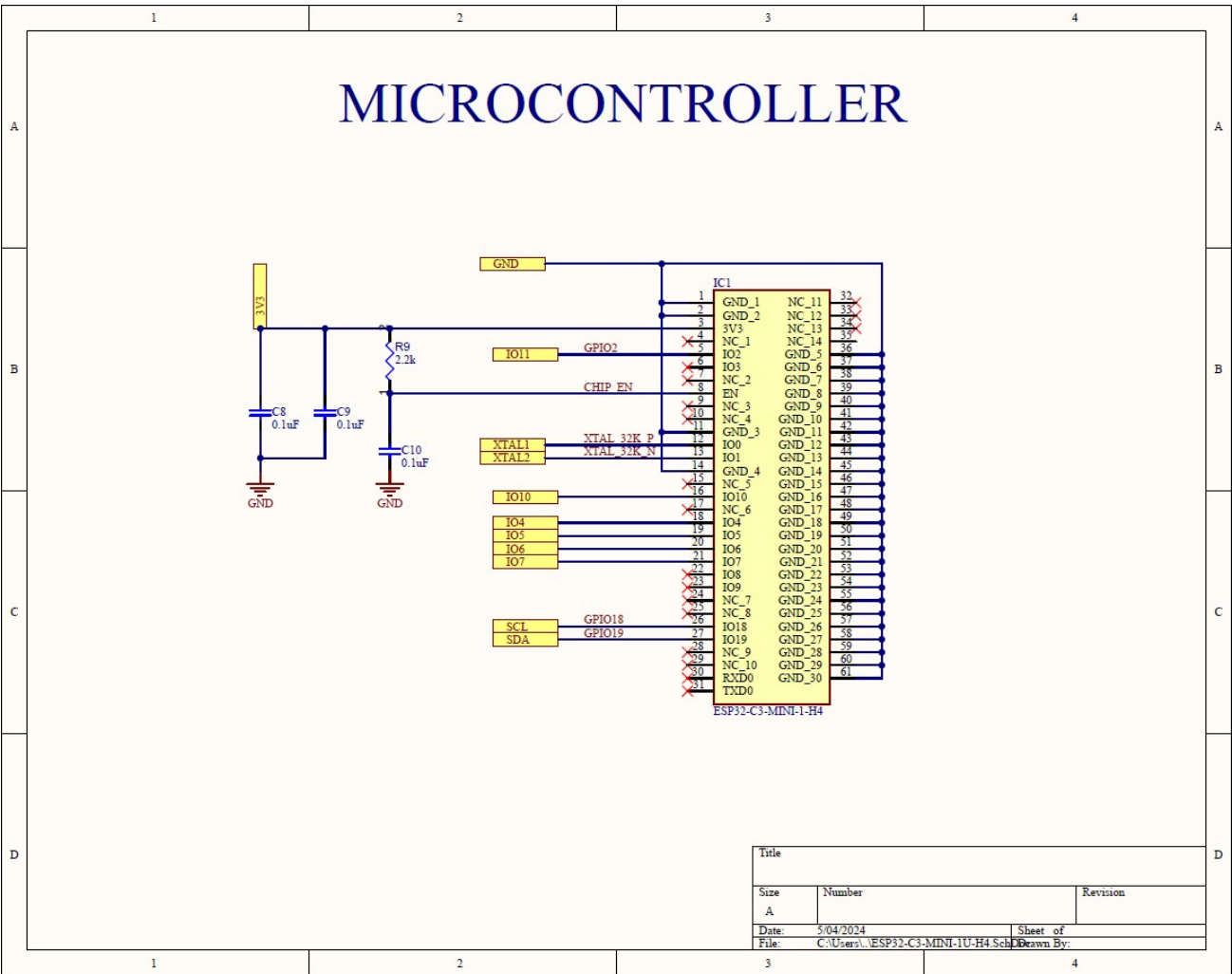


Figure 8: [Datasheet Link](#)



## 5 Layout

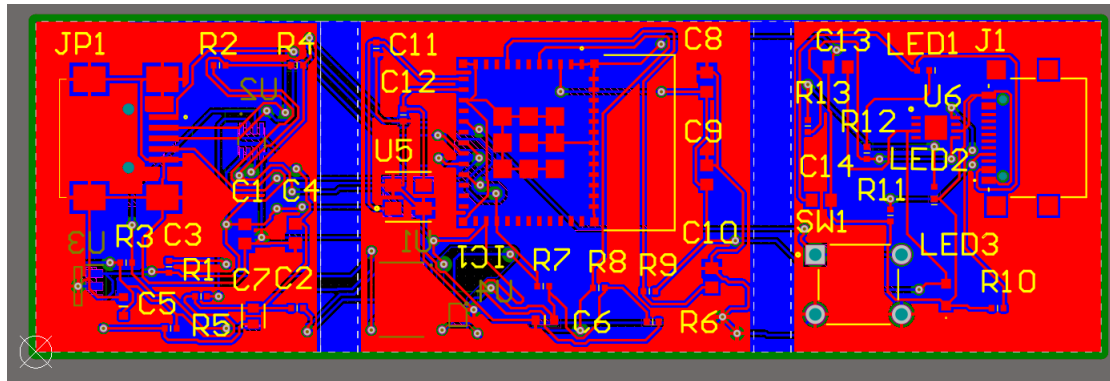


Figure 9: Top Layer

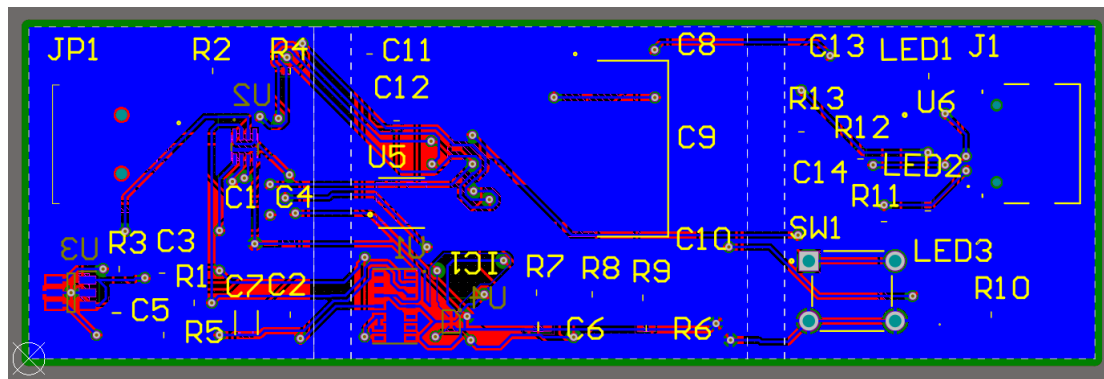


Figure 10: Bottom Layer

The smart PDF containing all the schematics and Layout can be found [here](#).

## 6 3D Model

### 6.1 Straight Model

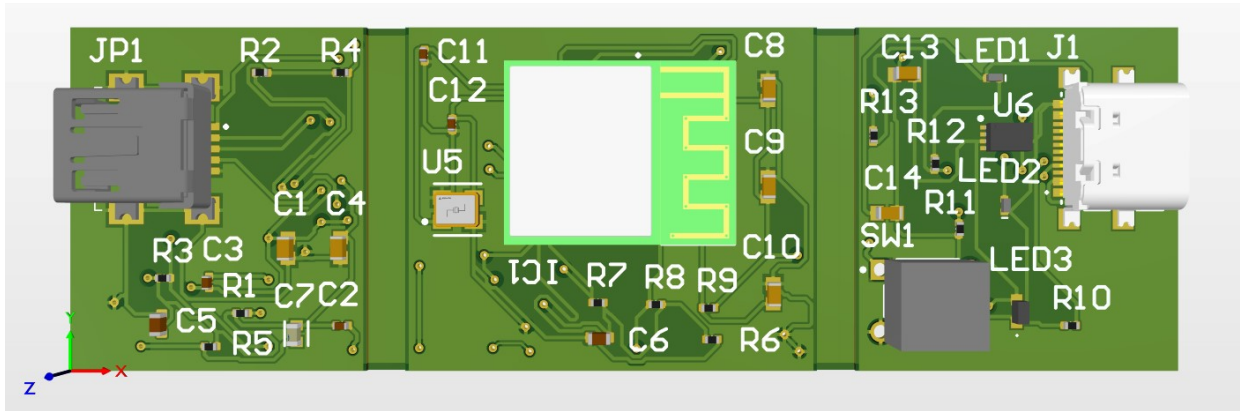


Figure 11

### 6.2 Curved Model

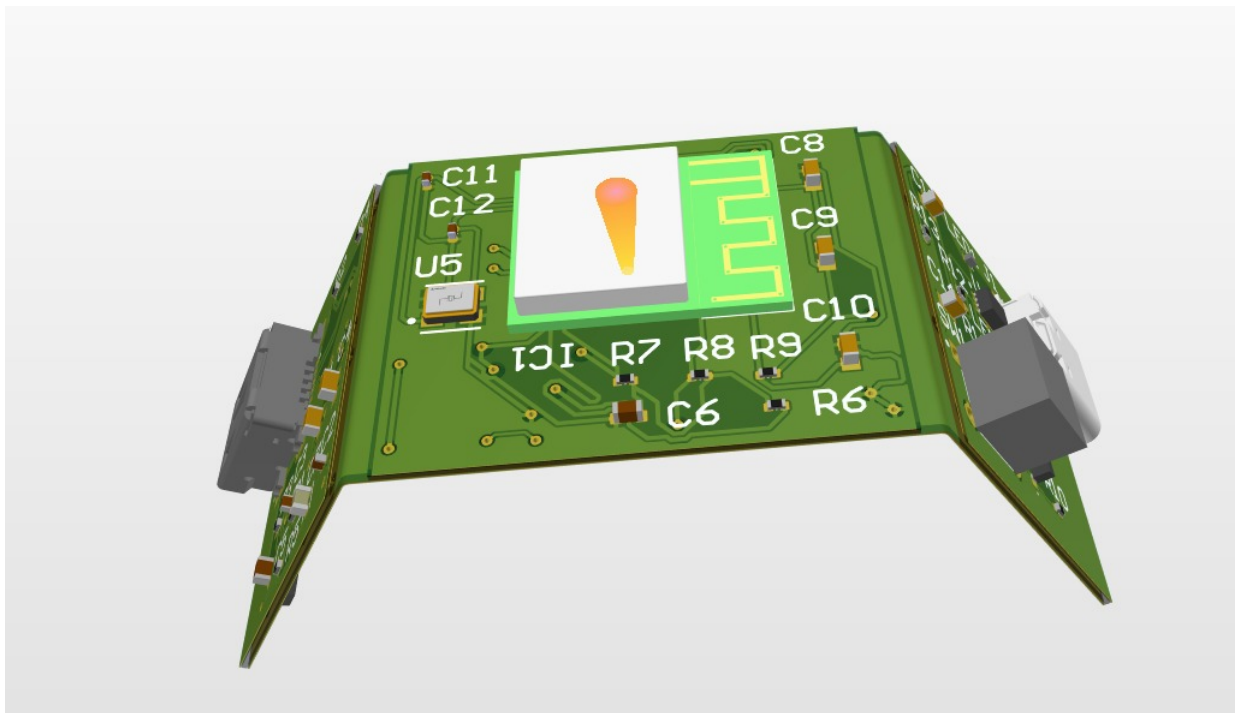


Figure 12

## 7 BOM

Name	Description	Designator	Revision ID	Revision State	Revision Status	Quantity	Manufacturer 1	Manufacturer Part Number 1	Manufacturer Lifecycle 1	Supplier 1	Supplier Part Number 1	Supplier Unit Price 1	Supplier Subtotal 1
GRM1887T1H104K483D	Chip Capacitor 0.1 uF C1, C4, C8, C9, C10		OMP-2100-036	Released	Up to date	7	KEMET	C0603X104K5R3316	Volume Production	Mouser	80-C0603X104K5R3316	6.5	65.04
Capacitor 1uF +/-20% 50V 0402	Chip Capacitor 1uF C2, C3		OMP-001-0006	Draft	Up to date	2	KEMET	C0402C104K8R3CTU	Volume Production	Newark	104K50R	3.09	6.17
Capacitor 4.7uF +/-20% 50V 0803	Chip Capacitor 4.7uF C5, C6		OMP-001-0007	Draft	Up to date	3	KEMET	C0803C475K8R3CTU	Volume Production	Newark	44K1377	4.25	12.75
C0603C560J5GACTU	CAP CER 5600PF 50V C7		OMP-2006-033	New From Design	Up to date	1	KEMET	C0603C560J5GACTU	Volume Production	Arrow Electron	C0603C560J5GACTU	19.71	19.71
Capacitor 10uF +/-30% 50V 0402	Chip Capacitor 10uF C11, C12		OMP-001-0007	Draft	Up to date	2	KEMET	C0402C100J5GACTU	Volume Production	Newark	10C3041	0.25014	0.50028
ESP8265-01S-MINI-1-H4	Integrated Circuit	U1		Not managed			Espressif Systems	ESP8265-01S-MINI-1-H4	Unknown	Digiparty	2805-ESP8265-01S-MINI-1-H4	158.42	158.42
GBS85C4110359HR	Connector	J1		Not managed			Amphenol	GBS85C4110359HR	Unknown	Mouser	525-GBS85C4110359HR	56.7	56.7
GBS105-299-04S	Connector	JP1		Not managed			ICOM	GBS105-299-04S	Volume Production	Digiparty	251-1005-1-N-D	54.2	54.2
GBL895-1	Chip LED 0402 Yellow LED1, LED2		OMP-007-0004	Draft	Up to date	1	2 of Digiparty	GBL895-1	Unknown	Digiparty	1516-1119-1-ND	28.95	57.9
CSL3001B73C	LED			Not managed			Rohm	CSL3001B73C	Unknown	Mouser	755-CSL3001B73C	45.86	45.86
407052P	407 0.063W 5% 0402 S1, R2, R3, R4, R5		OMP-009-0010	Draft	Up to date	5	TE Connectivity / A	6-1879051-6	Unknown	Digiparty	A118945CT-ND	27.52	137.56
Resistor 36k +/-5% 0402 63 mW	Chip Resistor 3.6 kOhm R7, R8		OMP-009-0010	Draft	Up to date	3	Peraselec	FR-2021500	Volume Production	Armet	30W412	0.25014	0.75042
Resistor 2K2 +/-5% 0402 63 mW	Chip Resistor 2.2 kOhm R9		OMP-009-0016	Draft	Up to date	1	Vishay Dale	CRCW04022K20JNED	Volume Production	Newark	59M6710	0.25014	0.25014
2952L	2K 0.063W 5% 0402 S10		OMP-009-0009	Draft	Up to date	1	TE Connectivity	CR0402022K20	Volume Production	Mouser	279-CR0402022K20	8.94	8.94
Resistor 4K7 +/-1% 0402 63 mW	Chip Resistor 4.7 kOhm R11, R13		OMP-009-0015	Draft	Up to date	3	Peraselec	FR-2041470X	Volume Production	Newark	64P5108	0.33352	0.99956
IR92	JK 0.063W 5% 0402 S12		OMP-009-0007	Draft	Up to date	1	TE Connectivity	RP73P1E1K0B7DP	Volume Production	Newark	73AC0267	3	3
BSF-1000	Tactile Switch SPST SW1		OMP-1877-000	Released	Up to date	1	Omron	BSF-1000	Volume Production	Armet	BSF-1000	13.28	13.28
MAX3232CPE	Integrated Circuit	U3		Not managed			Maxim	MAX3232CPEH-T	Unknown	Newark	544K7470	697.89	697.89
MAX4595ETA	Integrated Circuit	U2		Not managed			Maxim	MAX4595ETA-T	Volume Production	Newark	03AC4899	164.26	164.26
MAX1512EUT18-T	Integrated Circuit	U5		Not managed			Maxim	MAX1512EUT18-T	Volume Production	Newark	38AC1322	289.33	289.33
TMP114V1G50	Integrated Circuit	U4		Not managed			Texas Instruments	TMP114V1G50	Unknown	Digiparty	296-TMP114V1G50CT-ND	516.13	516.13
ABMB-27.120MHz-84-T	Crystal 27.12MHz ±10ppm		OMP-27762-000	New From Design	Up to date	1	Abracon	ABMB-27.120MHz-84-T	Volume Production	Mouser	815-ABMB-27.12-84-T	30.85	30.85
MCP73851-2DC/1MC	Integrated Circuit	U6		Not managed			Microchip	MCP73851-2DC/1MC	Volume Production	Heseler	MCP73851-2DC/1MC	67.2	67.2

Figure 13: BOM link

## 8 Gerber Files

The Gerber files generated for our project can be found [here](#).

## 9 Division of Work

- Level 1 schematic: Asmita, Paras
- Level 2 schematic:
  - Microcontroller: Prabal, Paras
  - Switch: Paras
  - Heartrate sensor and Pulse Oximeter: Asmita
  - Temperature Sensor: Ishaan
  - Power Management Circuit: Prabal, Asmita
  - Jtag: Prabal
  - Crystal Oscillator: Ishaan
- PCB Layout, Routing: Prabal
- Flex PCB, Polygon pour: Ishaan
- DRC: Prabal, Ishaan
- Report: Asmita