ESP32-M1

PN: BSESP32-M1-BHP

The ESP32-M1 Reach Out is a long-range Wi-Fi communication development board that features ESP32 microcontroller and RFFE (Radio RF Front End) module. ESP32-M1 able to transmit 30dBm (1W) conducted RF power, further, the transmitter power is adjustable from 21dBm to 30dBm. The board on top has Bluetooth and BLE. The board has 18 GPIOS, 3 different voltage outputs, a USB bridge, digital external interfaces, external antenna connectors for W-Fi and Bluetooth. The ESP32-M1 powered from the USB port, (power bank, laptop, or any USB 3.0 port).

The ESP32-M1 is 62mm by 40mm in dimension, the entire RF section is shielded and space available for the heat sink at the bottom section of the board. The ESP32-M1 is compatible with ESP32-A1 antenna board for Wi-Fi and Bluetooth.

ESP32-M1 Reach Out benefits in the area of remote monitoring and sensing, drone radios, long-range video streaming, security measures, mesh networking, long-range IoT and as common development board.

1. Summary of ESP32-M1

Section	Details
MCU	ESP32-D0WDQ6, RF System on a Chip from Espressif.
	MCU Frequency 240 MHz.
	CP2102 USB Serial Bridge (USB to UART Converter).
	32 Mbit Flash.
Radio	Wi-Fi 802.11 b/g/n.
	Bluetooth 4.2 Classic and Bluetooth Low Energy BLE.
	QPF4219 Wi-Fi front end module from Qorvo. 33 dB PA gain and 15 dB LNA gain.
	ESP32-M1 Wi-Fi Transmit Output Power: Adjustable from 21dBm to Max 30 dBm (1 Watt) conducted.
	Wi-Fi front end bypass mode. (Wi-Fi RFFE off and use only ESP32 to transmit and receive similar to ESP32 Dev Kit).
	RF Switch to switch between Wi-Fi and Bluetooth.
	2 x RP-SMA Female connector for Wi-Fi and Bluetooth.
Interface and Peripherals	UART, I2C, I2S, SPI.
	12 Bit-ADC.
	PWM.
	16 accessible GPIOs.
	2 accessible Input only IO.
Input Power	USB +5 V, approximately ~770 mA when using high power Wi-Fi front end operation transmitting 27dBm (half watt).
	USB +5 V, approximately less than <330 mA using normal Wi-Fi (RFFE Off), BT, BLE and general operation.
Output Power	+3.3 V
	+4.9 V
	USB Voltage
Dimensions	72 mm (L) including RP-SMA x 40 mm (L) x 1.6 mm (T) board thickness
	22 mm (W) x 22 mm (L) Heat Sink Placement Area x2

2. Technical Detail

2.1. Radio

Table 2.1: Radio Characteristics.

Wi-Fi Radio: 802.11b 11Mbps				
Parameter	Min	Typical	Max	Unit
Operating frequency range	2.401		2.484	GHz
Output Impedance. Wi-Fi Port		50		Ohm
Tx Power using RFFE, *Note1*	21		30	dBm
Tx Power RFFE Bypass, *Note2*	1.7		16	dBm
Rx Sensitivity using RFFE		-96		dBm
Rx Sensitivity RFFE bypass		-86		dBm
Bluetooth Radio				
Operating frequency range	2.402		2.48	GHz
Output Impedance. BT Port		50		Ohm
Tx Power	-2.5	-2	-1.5	dBm
Rx Sensitivity	-87	-86	-85	dBm
BLE Radio				
Operating frequency range	2.402		2.48	GHz
Output Impedance		50		Ohm
Tx Power	-2.5	-2	-1.5	dBm
Rx Sensitivity	-91	-90	-89	dBm

Note1: The transmit power measured on ESP32-M1 running AP (Access Point) Firmware version 4.1, https://github.com/espressif/esp-idf/tree/release/v4.1/examples/wifi/getting_started/softAP. Power level setting in ESP32: 8 for minimum power and 56 for maximum power.
Note2: Power level setting in ESP32: 8 for minimum power and 78 for maximum power.

2.2. Power

Table 2.1: Measured on AP 802.11b 11Mbps.

Power					
Parameter	Symbol on PCB	Min	Typical	Max	Unit
Input Voltage, USB		5.0		5.5	V
Output Voltage	5V_USB		5.0		V
Output Voltage	VRF		4.9		V
Output Voltage	3V3		3.3		V
Average Current RFFE Bypass			125		mA
Max Current RFFE Bypass				330	
Average Current RFFE On, Tx = 21dBm, *Note3*			145		mA
Max Current RFFE On, Tx = 21dBm, *Note3*				530	mA
Average Current RFFE On, Tx = 27dBm, *Note3*			165		mA
Max Current RFFE On, Tx = 27dBm, *Note3*				770	mA
Average Current RFFE On, Tx = 30dBm, *Note3*			200		mA
Max Current RFFE On, Tx = 30dBm, *Note3*				1000	mA
Current BT, *Note4*		170	175	180	mA
Current BLE, *Note4*		120	145	170	mA

Note3: The current measured on a working ESP32-M1 running AP code communicating with Station.
Note4: The current measured on a working ESP32-M1 running BT Discovery code with default RF Power setting.

3. Block Diagram

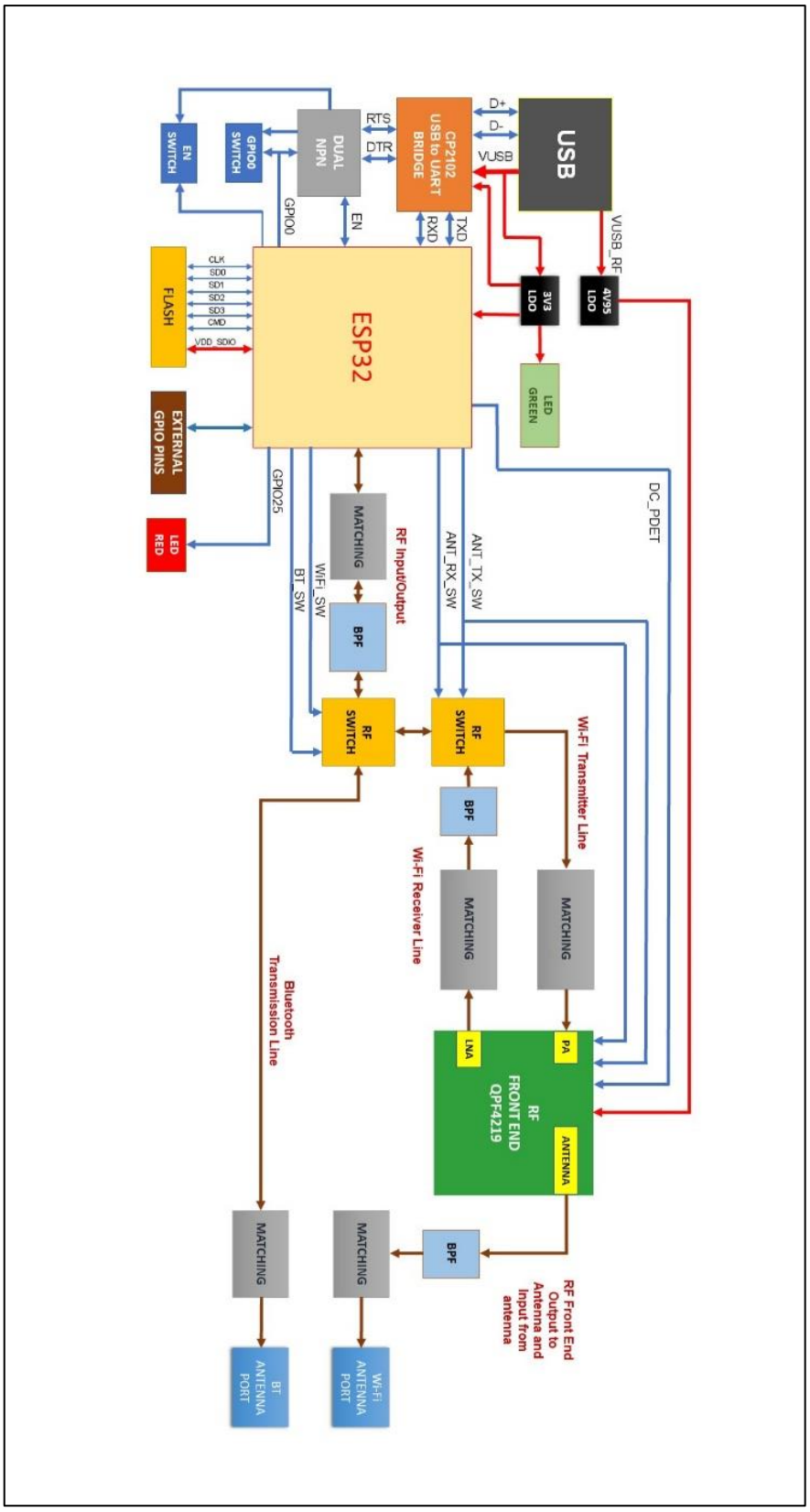

Fig 1: Block diagram of ESP32-M1.

4. Schematic

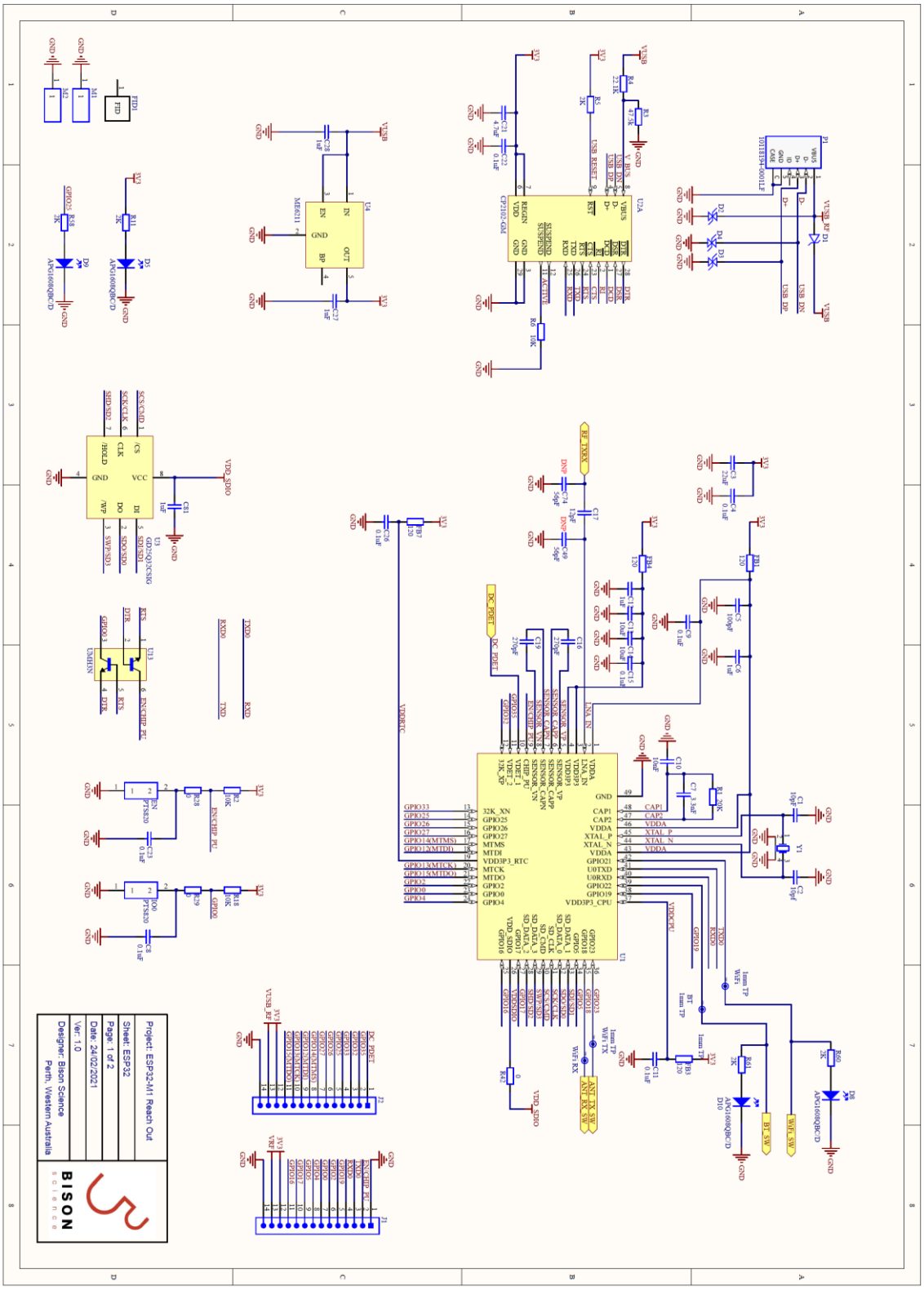

Fig 2: ESP32 section schematic.

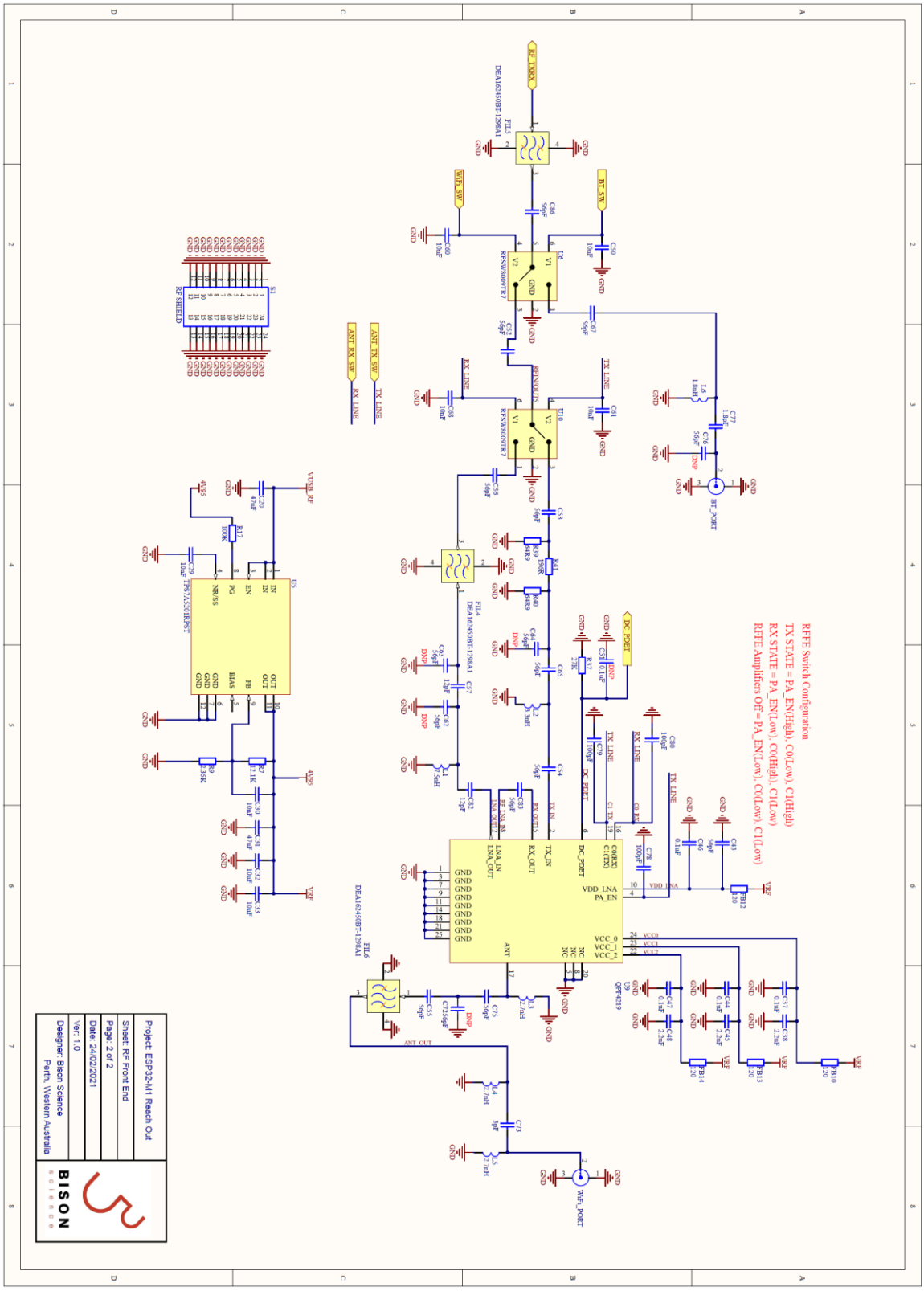

Fig 3: RFFE section schematic.

5. PCB

The ESP32-M1 PCB board is illustrated in Figure 4. All the components are placed on the top section of the board. The bottom section is used for heat sink placement shown in Figure 5. Figure 5 also shows the board dimension.

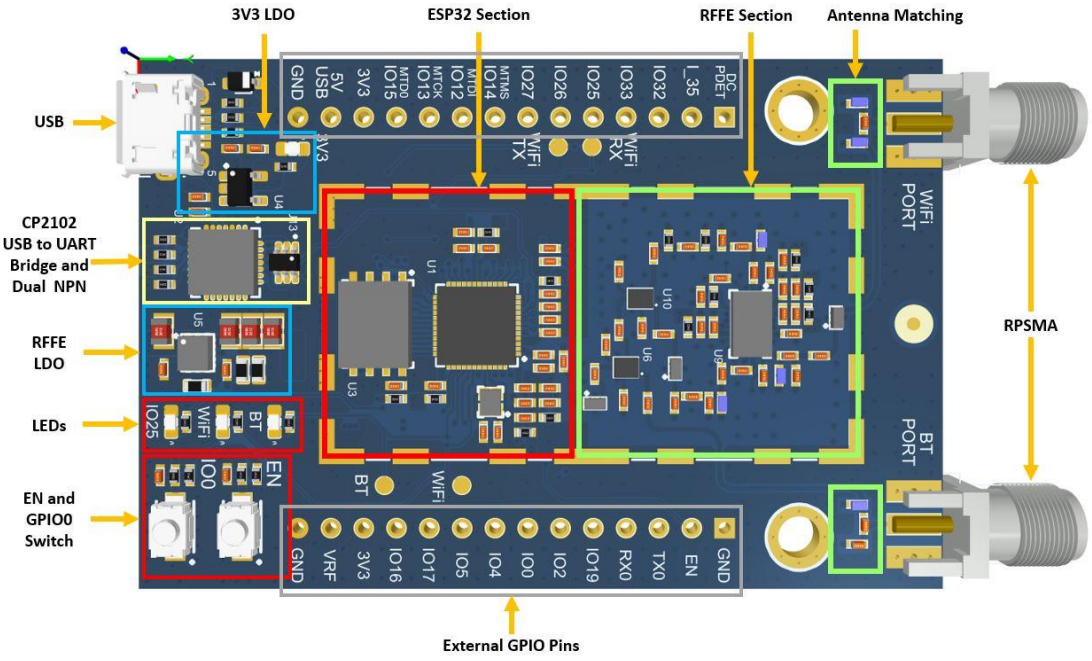

Fig 4: PCB view of top section.

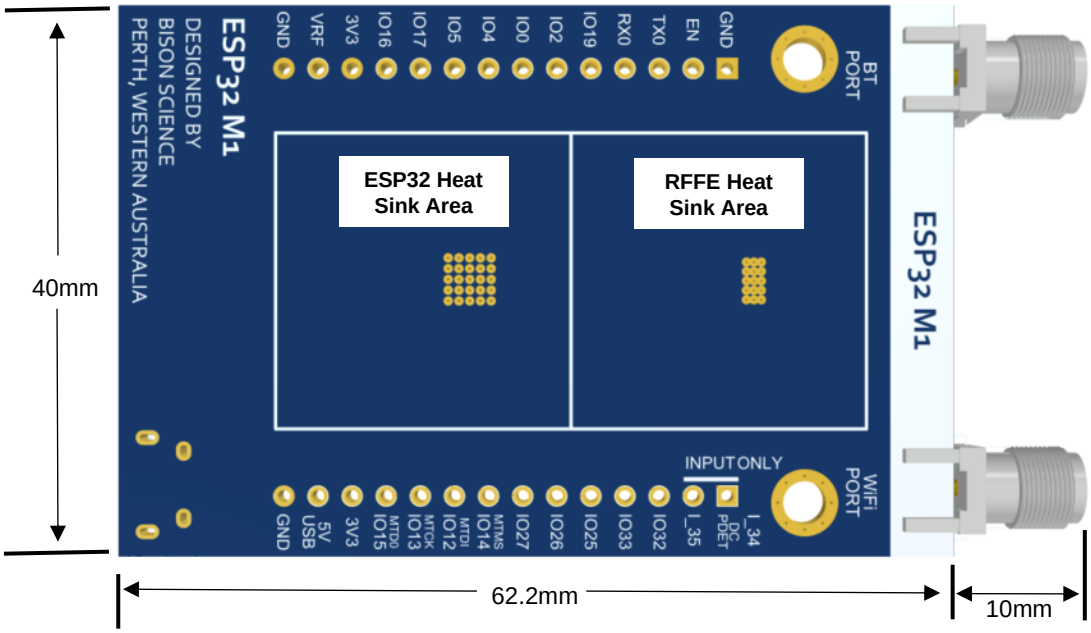

Fig 5: PCB view of bottom section and board dimension.