FMB100 Datasheet

Ver.1.6

Jan. 27, 2025

Release Record

Version	Release Date	Comments
0.9	Jul. 1, 2021	Draft release.
1.0	Jul. 16, 2021	Modify the pinout according to latest hardware change.
1.1	Oct. 1, 2021	Update FCC ID, thickness of the module and some minor descriptions.
1.2	Jan. 20, 2022	Update the description of power class to class 1. Update the transmit power and receiver sensitivity as the values at the antenna point. Update the description of qualified and supported profiles. Update plastic tray package. Add reference design. Add the PCB antenna gain. Add Bluetooth QDID, RCM.
1.3	Apr. 7, 2022	Update the firmware stack description.
1.4	Aug. 15, 2022	Update 3D antenna pattern.
1.5	Nov. 30, 2022	Update FCC statement.
1.6	Jan. 27, 2025	Update the tray packaging.

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Description:

FMB100 is a dual mode class 1 Bluetooth® V5.2 module. It integrates all necessary components including antenna, RF filter, baseband and profile processors into a small formfactor module in half though hole footprint. With its internal multiple processors, it runs a full Bluetooth stack including multiple profiles such as HSP/HFP, A2DP, AVRCP, OPP, SPP, HID, and GATT based BLE profiles. It also supports high quality A2DP codec such as AptX®. Wideband SBC is supported for HFP/AG applications. It supports two MIC cVc which enables super noise depression performance for headset applications.

FMB100 also supports a Flairmesh property GATT based BLE profile called iGate. It can be used to build a SPP like bi-directional raw data channel over BLE to iOS, Android devices.

With its ASCII command-based control interface, fully qualified Bluetooth stack and modular approvals for major markets such as FCC/CE, it helps customer to integrate Bluetooth functionality to their host system with least efforts.

Typical Bluetooth audio applications:

- Headset
- Industry and office equipment
- Home entertainment and fitness equipment
- Mobile accessories

Features:

- Dual mode Bluetooth® v5.2
- Support BLE 2M PHY
- +13dBm BR TX power, -97dBm BR RX sensitivity
- +6dBm BLE TX power, -100dBm BLE 1Mb/s RX sensitivity
- PCB antenna with 2.7dBi gain
- Qualified profiles: SPP, HID, OPP and BLE GATT DID, BAS.
- Profiles can support per request: HSP/HFP, A2DP, AVRCP, iAP over Bluetooth for Apple, HOGP etc.
- UART/I2C/SPI master multiplexed with PIOs
- 10 digital PIOs (multiplexed with UART/I2C/SPI), 3 LED outputs multiplexed with AIOs
- Support SBC, AAC and AptX codec
- 22mm x 12mm x 2.2mm
- Weight: approximately 1g
- Castellated pins for easy and reliable PCB mounting
- Bluetooth QDID: 180451
- FCC ID: 2A22WFMB100
- CE
- RCM
- RoHS compliant

Ordering Number	Package	Items in One Package	Comments
FMB100-P	Plastic tray	100	
FMB100-T	Tape	TBD	

Table 1: Ordering Information

Please also supply the customer firmware code issued by Flairmesh Technologies when you place the order.

1 Pinout and Description

1.1   Pin Assignments
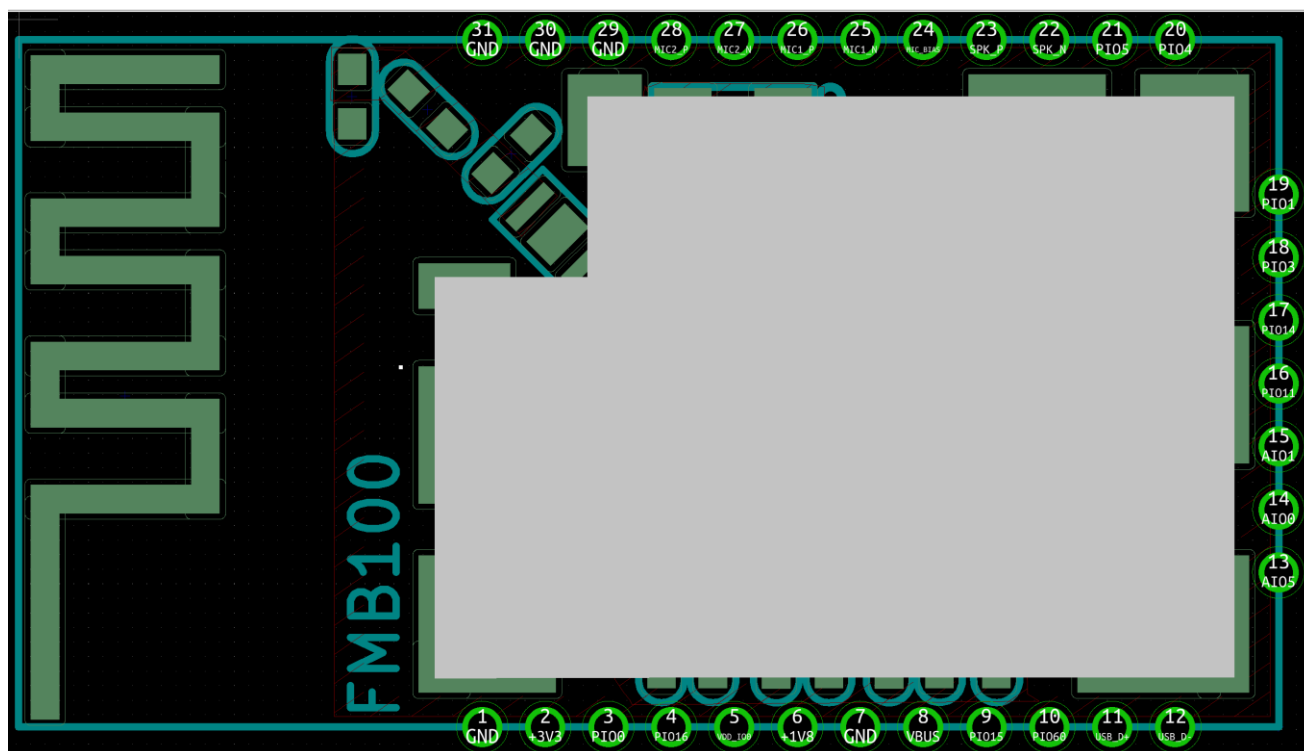
Figure 1: Pinout of FMB100

1.2   Pinout Descriptions

Pin	Symbol	I/O Type	Description
1	GND	Ground	Ground
2	3V3/VBAT	Power input	Battery voltage input
3	PIO0/VREG_EN	Digital input	Typically connected to an ON/OFF push button. If power is present from the battery and/or charger, and software has placed the device in the OFF or DORMANT state, a button press boots the device. Also usable as a digital input in normal operation. No pull. Additional function: ■ PIO[0] input only
4	PIO16	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 16, weak pull down when reset

5	VCC_IO	Power input	1.8V/3.3V PIO supply
6	1V8_OUT	Power output	Not recommend for powering external circuits
7	GND	Ground	Ground
8	VCHG	Power input	5V charger input
9	PIO15	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 15, weak pull down when reset
10	PIO60	Input with strong pull-up	Programmable IO 60, weak pull down when reset
11	USB_DP	Digital	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection
12	USB_DN	Digital	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection
13	AIO5/LED5	Analog or digital input/open drain output	General purpose analog/digital input or open drain LED output 5
14	AIO0/LED0	Analog or digital input/open drain output	General purpose analog/digital input or open drain LED output 0
15	AIO1/LED1	Analog or digital input/open drain output	General purpose analog/digital input or open drain LED output 1
16	PIO11	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 11, strong pull up when reset
17	PIO14	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 14, strong pull up when reset
18	PIO3	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 8, weak pull down when reset
19	PIO1/RESETB	Digital bidirectional with programable strength internal pull-up/pull-down	Automatically defaults to RESETB mode when the device is unpowered, or in off modes. Reconfigurable as a PIO after boot, strong pull up when reset, Alternative function: ■ Programmable I/O line 1
20	PIO4/UART_RX	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 4, weak pull down when resetting, Additional function: ■ UART RX
21	PIO5/UART_TX	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 3, strong pull up when reset,

			Additional function: ■ UART TX
22	SPK_N	Analog	Headphone/speaker differential output, negative
23	SPK_P	Analog	Headphone/speaker differential output, positive
24	MIC_BIAS	Mic bias output	Mic bias output
25	MIC1_N	Analog	Microphone differential 1 input, negative
26	MIC1_P	Analog	Microphone differential 1 input, positive
27	MIC2_N	Analog	Microphone differential 2 input, negative
28	MIC2_P	Analog	Microphone differential 2 input, positive
29	GND/MIC_GND	Microphone ground	Ground of microphone
30	GND	Ground	Ground
31	GND	Ground	Ground

Table 2: Pinout Definitions

2 Electrical Characteristics

2.1 Absolute Maximum Rating

Rating	Min	Max	Unit
Storage Temperature	-40	+85	°C
VCHG Voltage	-0.4	7.0	V
USB_DP/USB_DN Voltage	-0.4	3.8	V
VBAT Voltage	-0.4	4.8	V
PIO Voltage	-0.4	3.8	V
LED Voltage	-0.4	7.0	V
AIO Voltage	-0.4	2.1	V

Table 3: Absolute Maximum Rating

2.2   Recommended Operating Conditions

Operating Condition	Min	Typ	Max	Unit
Operating Temperature Range*	-40	--	+85	°C
VCHG	4.75	5.0	6.5	V
USB_DP/USB_DN Voltage	0	--	3.6	V
VBAT Voltage	2.8	3.7	4.6	V
PIO Voltage	1.7	3.3	3.6	V
LED voltage	0	--	6.5	V
AIO Voltage	0	--	1.95	V

Table 4: Recommended Operating Conditions

Note *: Charger operates in a range from -10 to +85 (not including battery).

2.3   Input/output Terminal Characteristics

2.3.1 Digital Terminals

Supply Voltage Levels	Min	Typ	Max	Unit
Input Voltage Levels				
V_{IL} input logic level low	0	-	0.22 x VCC_PIO	V
V_{IH} input logic level high	0.7 x VCC_PIO	-	-	V
Drive current (configurable 2,4,8,12mA)	2	4	12	mA
Output Voltage Levels				
V_{OL} output logic level low, at max rated drive	-	-	0.22 x VCC_PIO	V
V_{OH} output logic level high, at max rated drive	0.75 x VCC_PIO	-	-	V
Pull Strength				
Strong pull-up/down	15	65	150	k Ω
Weak pull-up/down	500	2200	5000	k Ω

Table 5: Digital Terminal

2.3.2 LED Driver Pads

LED driver pads		Min	Typ	Max	Unit
Open drain current	High impedance state	-	-	5	uA
	Current sink state	-	-	50	mA
LED pad resistance	V < 0.5V	-	-	12	Ω
V$_{IL}$ input logic level low		-	-	0.4	V
V$_{IH}$ input logic level high		1.0	-	-	V

Table 6: LED Driver Pads

2.3.3 10-bit Auxiliary ADC

10-bit auxiliary ADC		Min	Typ	Max	Unit
Resolution		-	-	10	Bits
Internal voltage reference		1.746	1.800	1.854	V
Functional input voltage range		0	-	Internal voltage reference	V
Accuracy (Guaranteed monotonic)	INL	-3	-	3	LSB
	DNL	-1	-	2	LSB
Offset		-1	-	1	LSB
Gain error		-1	-	1	%
Hardware conversion time		-	10	-	us
LED pad leakage		-1	-	1	uA
External pad capacitance for < 0.5 LSB error		0	100	-	nF

Table 7: LED Driver Pads

2.3.4 Class-D DAC Audio Output

Parameter	Conditions	Min	Typ	Max	Unit
Input Sample Width	-	-	-	24	Bits
Input Sample Rate, F$_{sample}$	-	8	-	192	kHz
Output Power	0 dBFS, 32Ω load -3dBFS, 16 Ω load	-	-	30	mW
Load	-	16	32	30k	Ω

Signal to Noise Ratio, SNR	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz A-Weighted 0dBFS signal 32Ω load	-	99.3	-	dBA
THD+N	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz -1dBFS signal 32Ω load	-	93.5	-	dB
Digital Gain	Digital Gain Resolution = 1/32	-24	-	21.5	dB
Max capacitive load	Per terminal to ground	-	-	100	pF

<p align="center">Table 8: Class-D DAC Audio Output</p>

2.3.5 Class-AB DAC Audio Output

Parameter	Conditions	Min	Typ	Max	Unit
Input Sample Width	-	-	-	24	Bits
Input Sample Rate, F_{sample}	-	8	-	192	kHz
Output Power	0 dBFS, 32Ω load -3dBFS, 16 Ω load	-	-	30	mW
Load	-	16	32	30k	Ω
Signal to Noise Ratio, SNR	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz A-Weighted 0dBFS signal 32Ω load	-	100.9	-	dBA
THD+N	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz -1dBFS signal 32Ω load	-	93.5	-	dB
Digital Gain	Digital Gain Resolution = 1/32	-24	-	21.5	dB

<p align="center">Table 9: Class-AB DAC Audio Output</p>

2.3.6 High-quality (HQADC) Single-ended Audio Input

Parameter	Conditions	Min	Typ	Max	Unit
Output Sample Width	-	-	-	24	Bits
Output Sample Rate, F_{sample}	-	8	-	96	kHz
Input level	-	-	-	2.4	V pk-pk
Input impedance	0dB to 24dB analog gain	-	20	-	k Ω

	27dB to 39dB analog gain	-	10	-	k Ω
Signal to Noise Ratio, SNR	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz A-Weighted THD+N < 0.1% 2.4V pk-pk input (0dB gain)	-	101.1	-	dBA
THD+N	f_{in}=1kHz 48kHz 2.4V pk-pk input (0dB gain)	-	85.9	-	dB
Digital Gain	Digital Gain Resolution = 1/32	-24	-	21.5	dB
Analog Gain	3dB Steps	0	-	39	dB

Table 10: High-quality Single Ended Audio Input

2.3.7 High-quality (HQADC) Differential Audio Input

Parameter	Conditions	Min	Typ	Max	Unit
Output Sample Width	-	-	-	24	Bits
Output Sample Rate, F_{sample}	-	8	-	96	kHz
Input level	-	-	-	2.4	V pk-pk
Input impedance	0dB to 24dB analog gain	-	20	-	k Ω
	27dB to 39dB analog gain	-	10	-	k Ω
Signal to Noise Ratio, SNR	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz A-Weighted THD+N < 0.1% 2.4V pk-pk input (0dB gain)	-	99.4	-	dBA
THD+N	f_{in}=1kHz 48kHz 2.4V pk-pk input (0dB gain)	-	95.5	-	dB
Digital Gain	Digital Gain Resolution = 1/32	-24	-	21.5	dB
Analog Gain	3dB Steps	0	-	39	dB

Table 11: Class-D DAC Audio Output

2.3.8 Microphone Bias

Parameter	Conditions	Min	Typ	Max	Unit
Output voltage (Tunable, step = 0.1V)	-	1.5	-	2.1	V
Output current capability	-	0.07	-	3.00	mA

Output noise	B/W=20Hz->20kHz Unweighted	4.5	5.1	7.3	uVrms
Crosstalk between microphones	Using recommended application circuit	-	80	-	dB
Load capacitance	From parasitic PCB routing and package	-	-	0.1	nF

Table 12: Microphone Bias

2.3.9 VBAT voltage measurement accuracy

Measurement	Min	Typ	Max	Unit
VBAT voltage measurement accuracy	-	+/-1	+/-3	%

Table 13: VBAT Measurement Accuracy

2.4 Power consumptions

Operating Condition	Typical	Unit
Dormant	<20	uA
Deep sleep, idle	50	uA
Connected, 495ms BT Sniff sub-rating	100	uA
Connected, 187ms BT Sniff, 2 links, four slots no retry, AFH on	0.27	mA
Connected, 11.25ms BT Sniff	1.5	mA
Connected with audio streaming (A2DP), SBC in 192 kbit, SBC Out 192kbit, Output Mono LP_DAC 48 KHz	5	mA

Table 14: Power consumptions

Note:

Power consumption depends on the firmware used. Typical values are shown in the table.

Sniff mode ----- In Sniff mode, the duty cycle of the slave's activity in the piconet may be reduced. If a slave is in active mode on an ACL logical transport, it shall listen in every ACL slot to the master traffic, unless that link is being treated as a scatternet link or is absent due to hold mode. With sniff mode, the time slots when a slave is listening are reduced, so it benefits the power consumption of the slave and the master shall only transmit to a slave in specified time slots. The sniff anchor points are spaced regularly with an interval of Tsniff, which depends on the firmware used.

2.5 Antenna Performance and Radiation Patters

Antenna performance measured from the evaluation board.

Frequency (MHz)	Efficiency %	Efficiency dB	Gain dB
2400	40%	-4.0	1.1
2410	45%	-3.4	2.2
2420	52%	-2.9	2.2
2430	55%	-2.6	2.0
2440	56%	-2.5	2.1
2450	53%	-2.8	1.4
2460	61%	-2.2	2.7
2470	61%	-2.2	2.1
2480	60%	-2.2	2.7
2490	58%	-2.4	2.1
2500	57%	-2.4	2.3

Table 15: Antenna Efficiencies and Gains
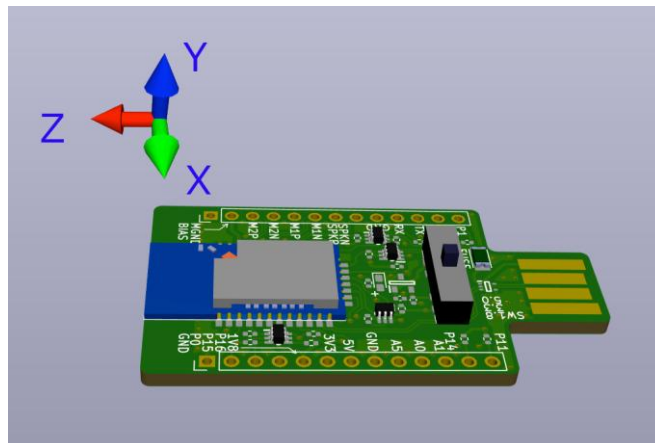
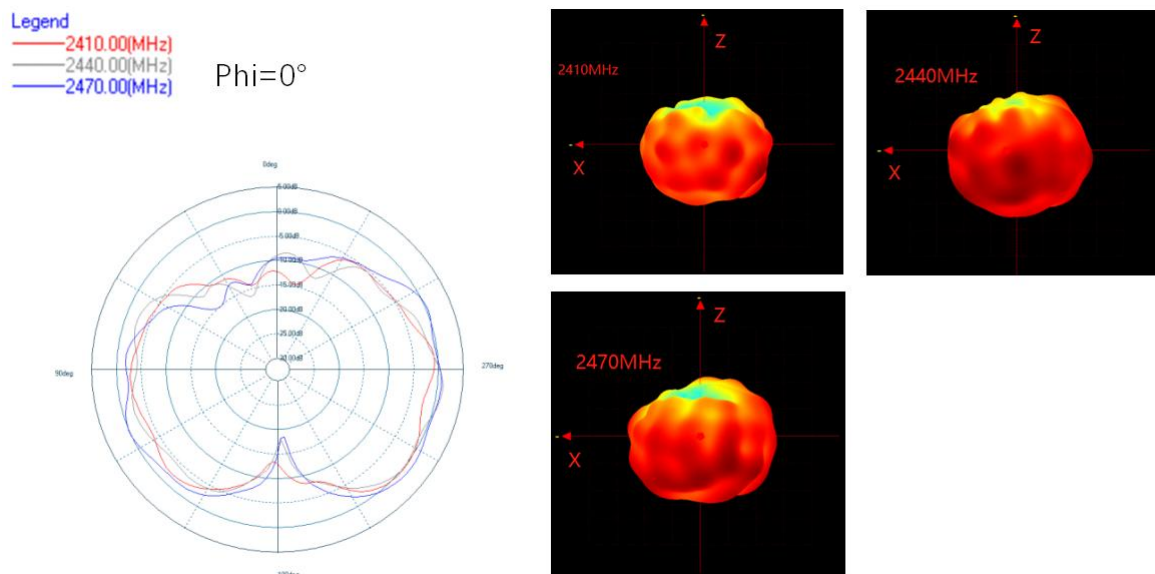Figure 2: Coordinate System Used in 3D Patterns
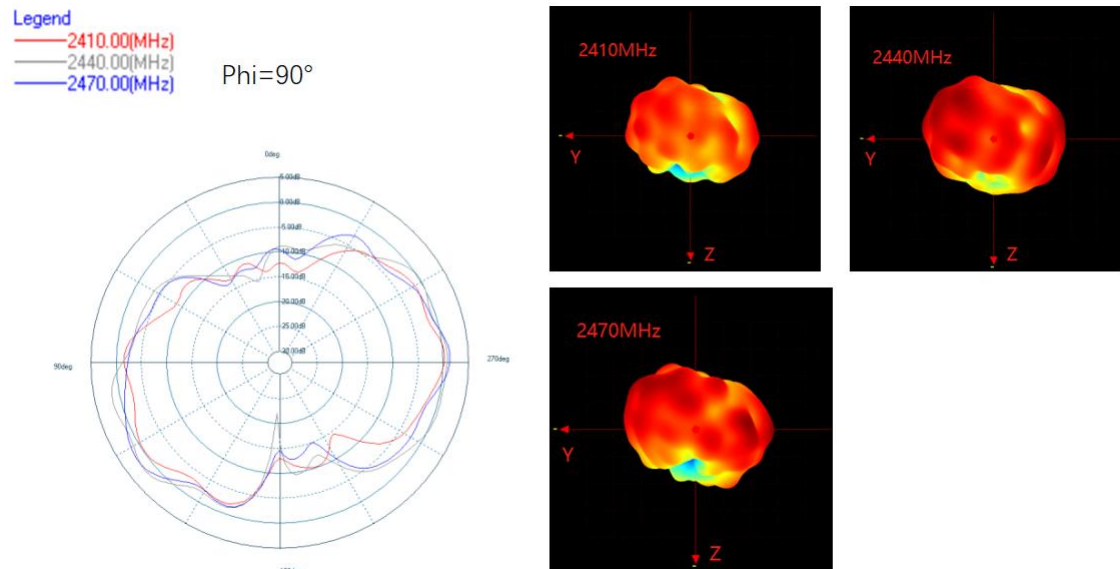

Figure 3: 3D Patterns – XZ Plane
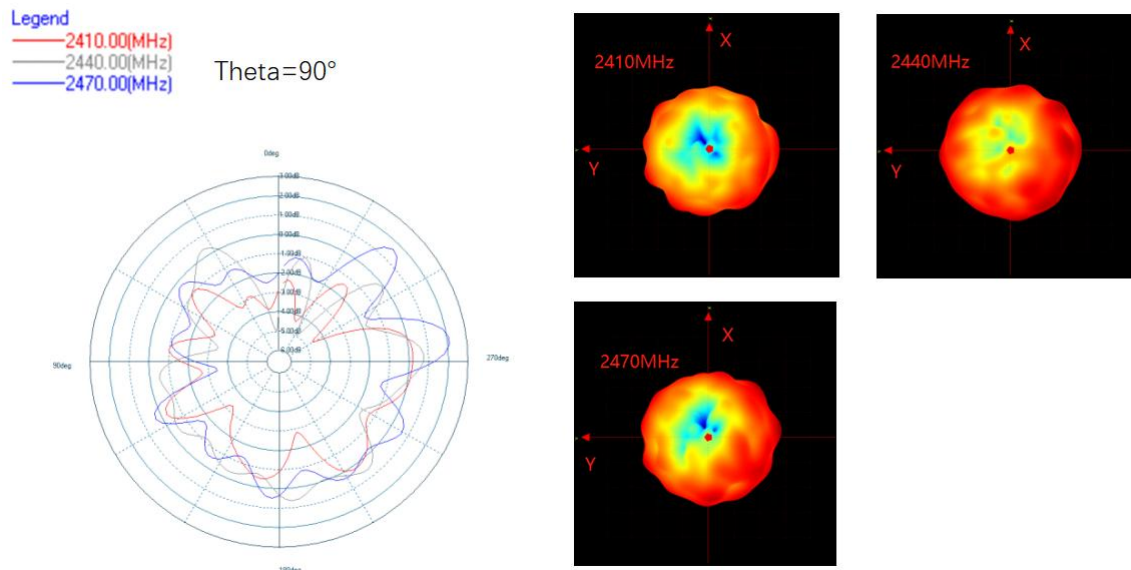
Figure 4: 3D Patterns – YZ Plane

Figure 5: 3D Patterns – XY Plane

3 Physical Interfaces

3.1 Power Supply

There are two power supply schemes available for the module. It can be powered by a Li-poly battery (3.7V) or a 3.3V DC. Please refer to the reference designs in 5.

3.2 Reset

The module may be reset from several sources: RESETB pin, power-on reset, USB charger attach reset

and software configured watchdog timer.

The RSTB pin is an active low reset. It is recommended that RSTB be applied for a period greater than 120us.

At reset the digital I/O pins are set to inputs for bi-directional pins and outputs are tri-state. The pull-down state is shown below.

Pin Name / Group	Pin Status on Reset
USB_DP	Tristate
USB_DN	Tristate
PIO0	No Pull
PIO[1,3,11,14]	PUS
PIO[4,5,16,60]	PDW

Table 16: Pin Status on Reset

Note: PUS – Strong pull-up, PDS – Strong pull-down, PUW – Weak pull-up, PDW – Weak pull-down.

If RSTB is held low for > 1.8 s and VCHG is not applied, the module turns off. A rising edge on PIO0 or VCHG is then required to power on.

3.3   Audio Interfaces

3.3.1 Digital Audio Interface

Audio digital interfaces include:

■ Digital microphone inputs

■ Standard I^{2}S/PCM interface (Input only)

3.4   General Purpose Analog IO

The module has three general-purpose analogue interface pins multiplexed with LED pads. In a Li-poly battery application, the VBAT pin can measure the battery voltage directly.

3.5   LED Drivers

The FMB100 includes a 5 PWM LED driver for driving RGB LEDs for producing a wide range of colors. There are 3 open-drain LED outputs multiplexed with AIOs. Any PIOs can also be mapped into LED output by firmware.

3.6   Serial Interfaces

3.6.1 UART

The module has a standard UART serial interface that provides a simple mechanism for communicating using RS232 protocol.

Table 17 : Possible UART Settings

Parameter		Possible Values
Baud Rate	Minimum	1200 baud (≤2%Error)
		9600 baud (≤1%Error)
	Maximum	4M baud (≤1%Error)
Flow control		RTS/CTS or None
Parity		None, Odd or Even
Number of Stop Bits		1 or 2
Bits per Byte		8

3.6.2 USB

FMB100 has a full-speed (12 Mbps) USB interface for communicating with other compatible digital devices. The USB interface on FMB100 acts as a USB peripheral, responding to requests from a master host controller.

FMB100 contains internal USB termination resistors and requires no external resistors.

FMB100 supports the Universal Serial Bus Specification, Revision v2.0 (USB v2.0 Specification), supports USB standard charger detection, and fully supports the USB Battery Charging Specification v1.2.

With special firmware FMB100 also supports USB HID/CDC and audio function.

3.6.3 I2C

Any two PIOs can be used to form a master I2C interface.

3.6.4 SPI Interface

Any four PIOs can be used to form a SPI interface. Firmware can be customized to connect with variable peripherals.
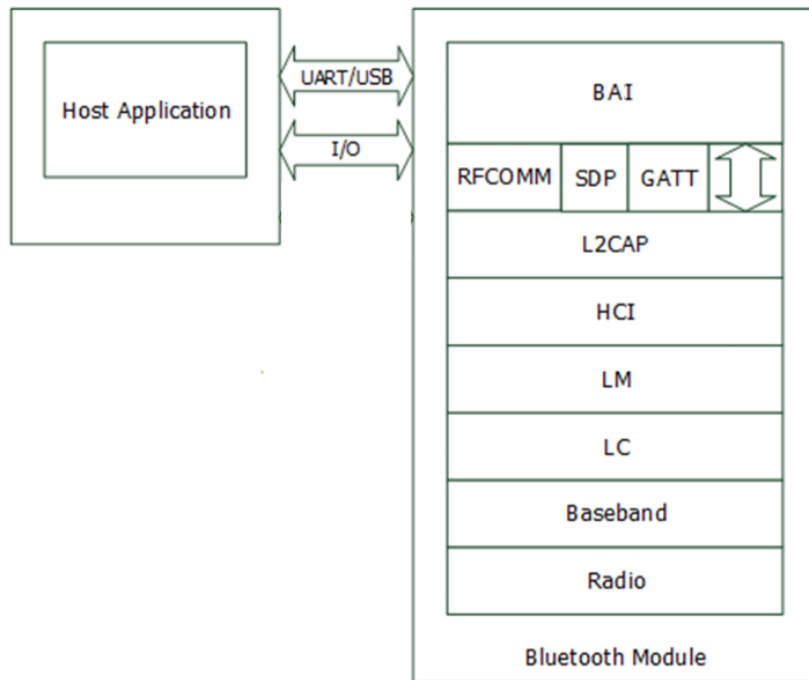
4 Firmware Stack

Figure 6: FMB100 Stacks

FMB100 is supplied with Bluetooth 5.2 compliant stack firmware. With Flairmesh's BAI interface, the host MCU can easily controls SPP, OPP, HID profiles running on the module, it also supports GATT based profiles over BLE such as HOGP.
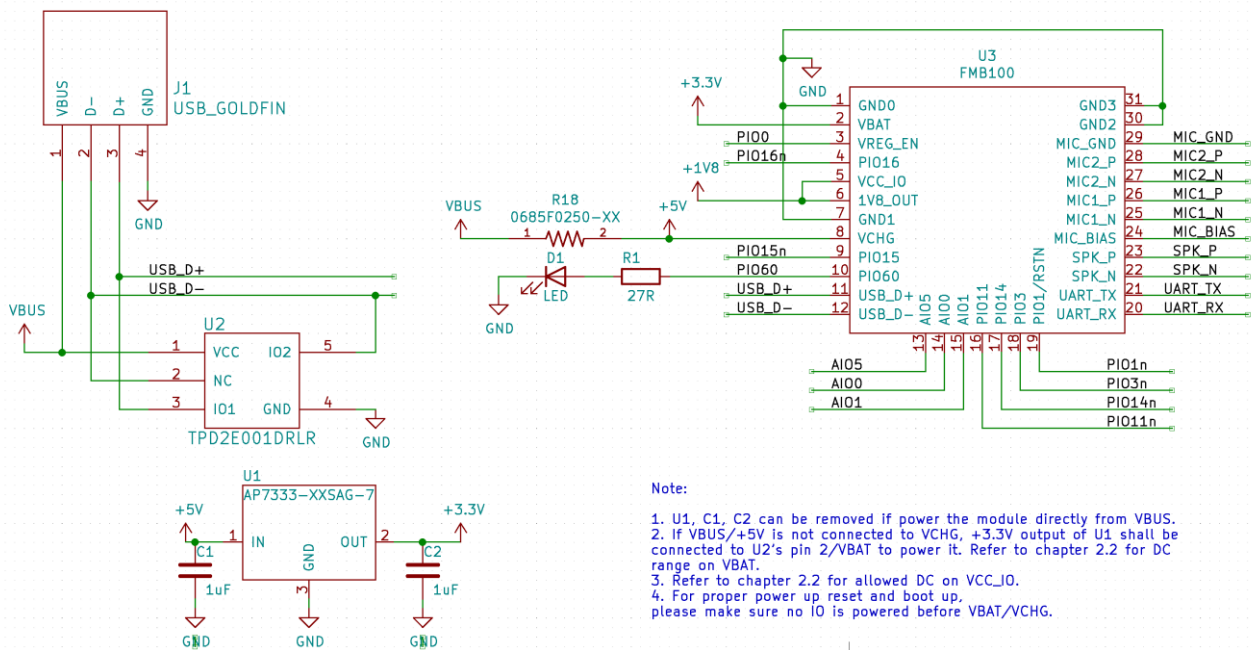
5 Reference Design

Figure 7: Reference Design Using USB or DC 3.3V

6 Mechanical Size and Recommended PCB Footprint
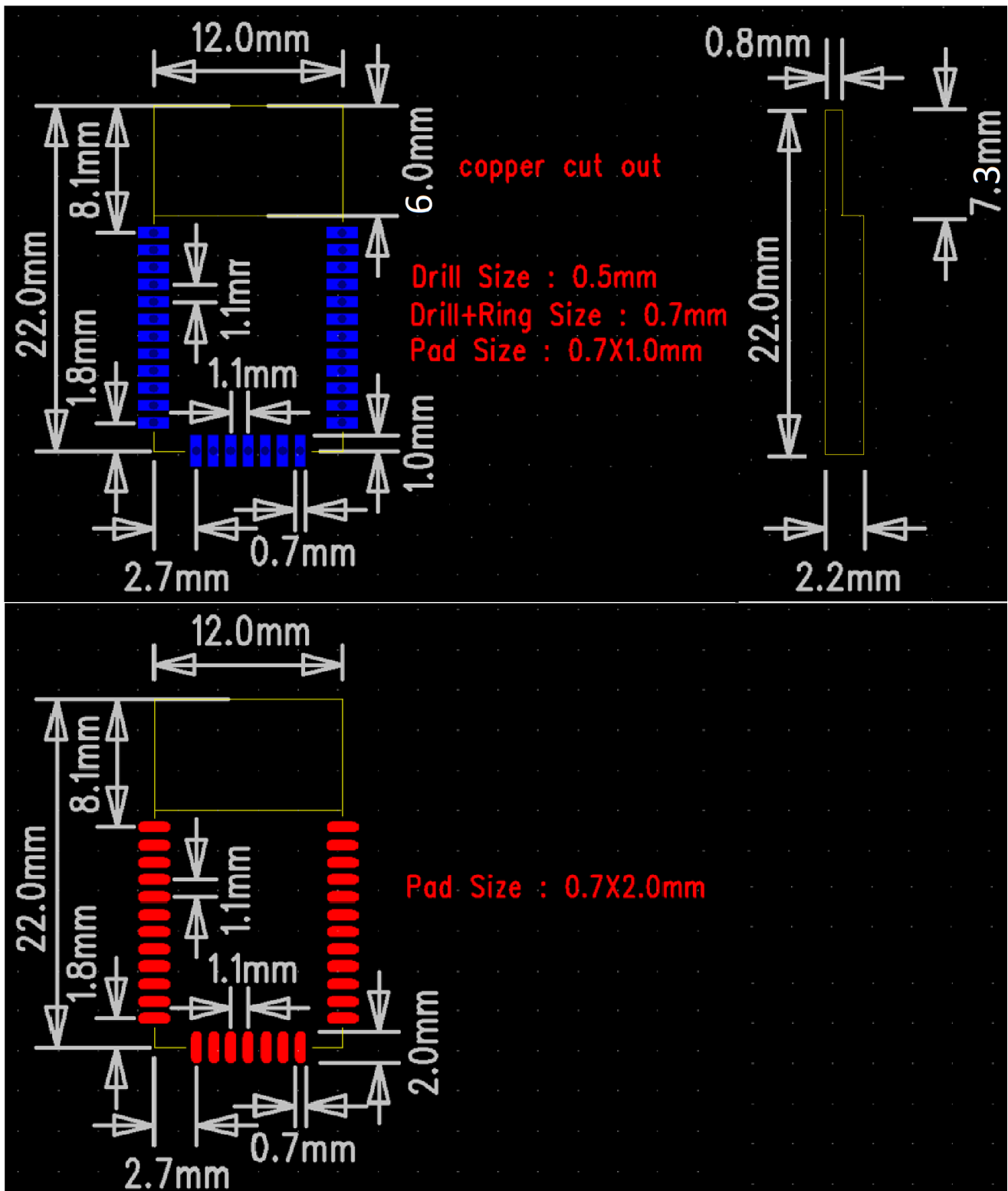

Figure 8: Mechanical Size and Recommended PCB Footprint

7 RF Layout Guidelines

FMB100 integrates an on-board Meander line antenna to radiate and receive the RF signals. The antenna has been well designed and tuned for common usage but it still needs to have good ground clearance around the antenna to get good RF performance.

1. No ground below antenna region (copper cut out in Figure 8) of the FMB100.
2. There should also have a good ground panel and clearance on the main PCB board on which the module is mounted. As shown in Figure 9.
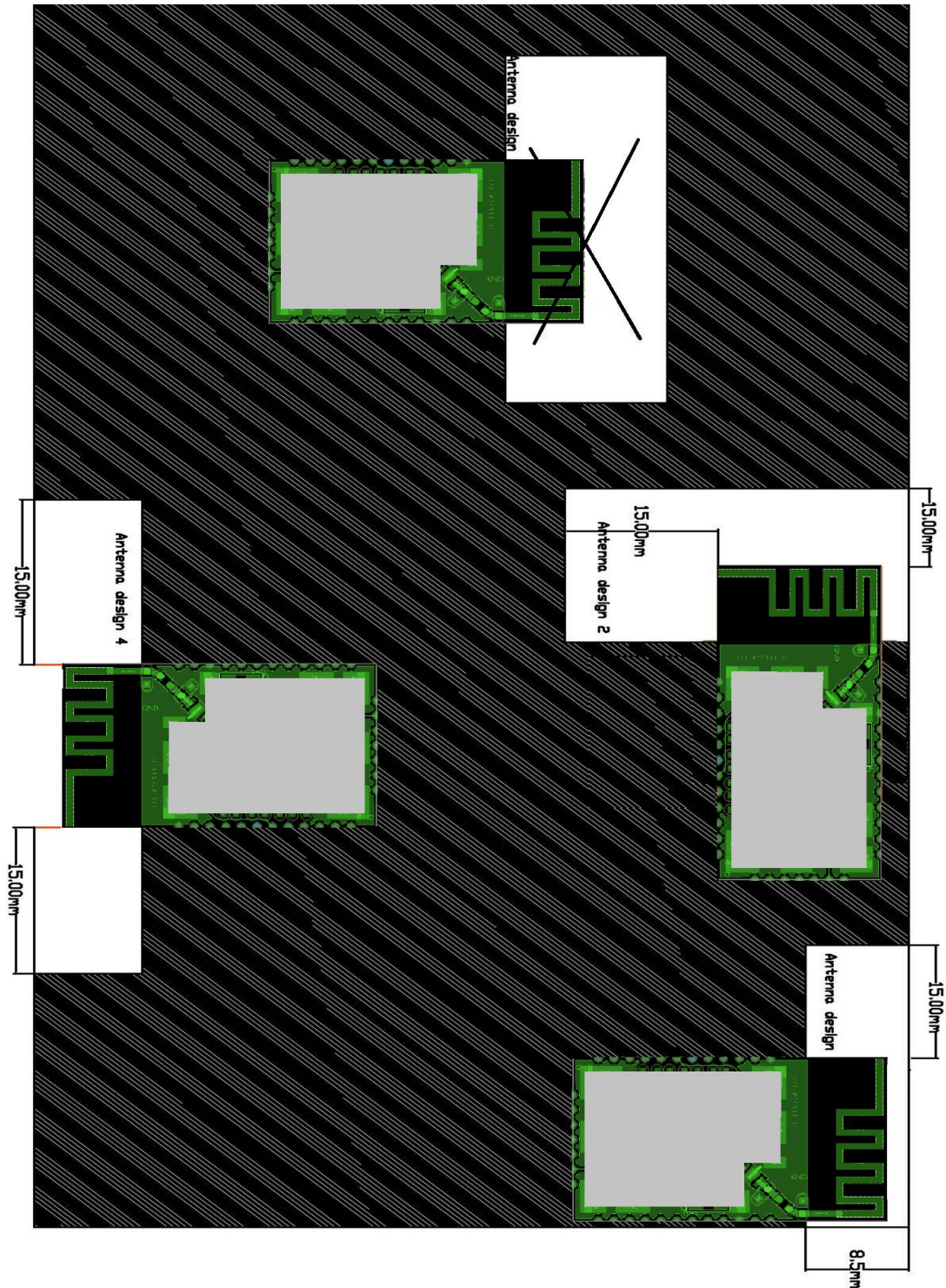
Figure 9 : Placement the module and the ground of main PCB Board

8 Reflow Profile

FMB100 is compatible with industrial standard reflow profile for Pb-free solders. The soldering profile depends on various parameters necessitating a set up for each application. The data here is given only for guidance on solder re-flow.

There are four zones:

Preheat Zone - This zone raises the temperature at a controlled rate, typically 1-2.5°C/s.

Equilibrium Zone - This zone brings the board to a uniform temperature and also activates the flux. The duration in this zone (typically 2-3 minutes) will need to be adjusted to optimise the out gassing of the flux.

Reflow Zone- The peak temperature should be high enough to achieve good wetting but not so high as to cause component discoloration or damage. Excessive soldering time can lead to intermetallic growth which can result in a brittle joint.

Cooling Zone - The cooling rate should be fast, to keep the solder grains small which will give a longer lasting joint. Typical rates will be 2-5°C/s.
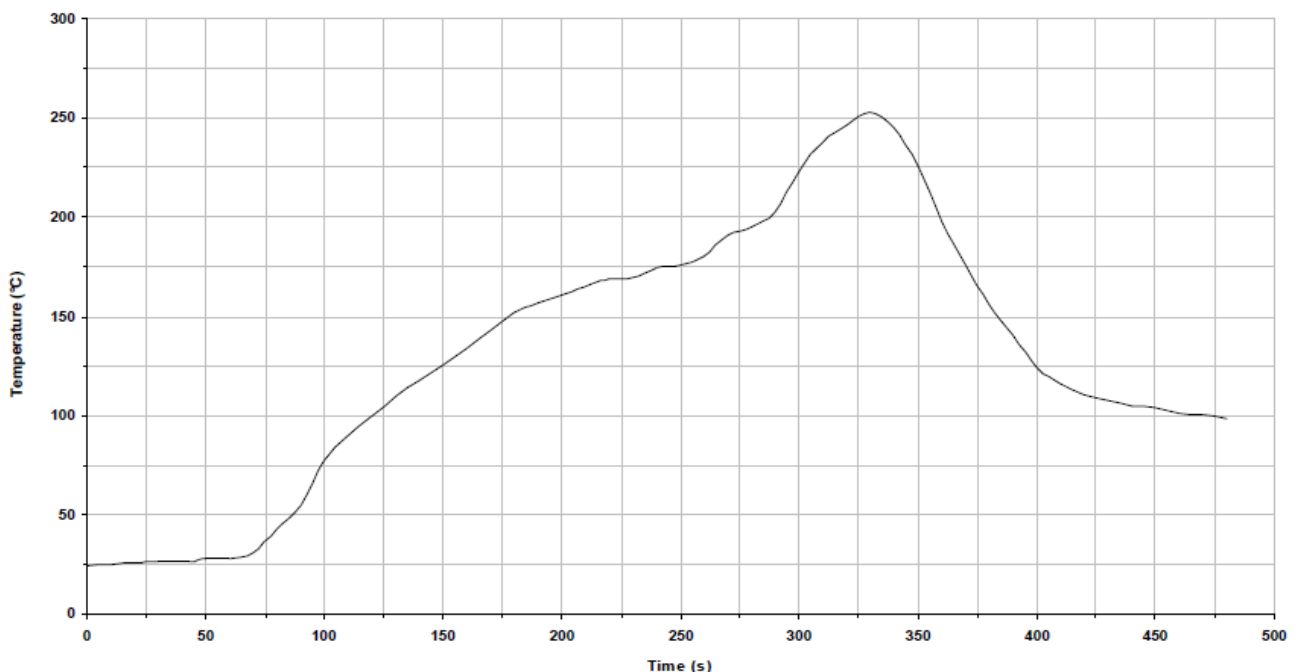

Figure 10: Typical Lead-Free Re-flow Solder Profile for FMB100

Key features of the profile:

■ Initial Ramp = 1-2.5°C/sec to 175°C ±25°C equilibrium

■ Equilibrium time = 60 to 180 seconds

■ Ramp to Maximum temperature (250°C) = 3°C/sec max.

■ Time above liquidus temperature (217°C): 45-90 seconds

■ Device absolute maximum reflow temperature: 255°C

Note: Customer might choose a local 0.2mm thickness solder cream for the module, or use 0.15mm to match other components in the same PCB.
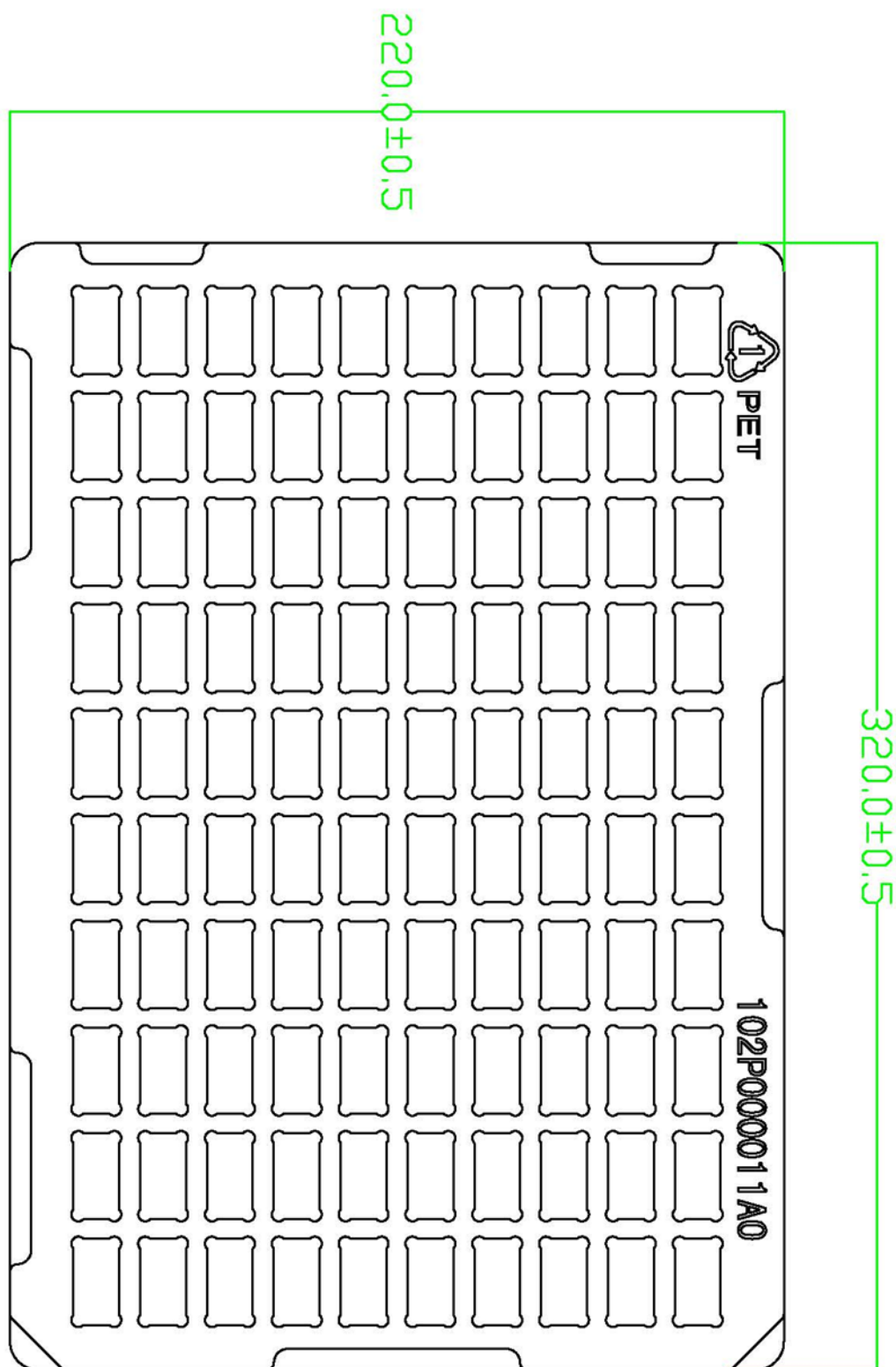
9 Package

Figure 11: FMB100 Plastic Tray Package

Plastic tray, plus aluminum bags do vacuum packing. Items in One Package number of 80 PCS, external aluminum foil vacuum packaging.

The module's Moisture Sensitivity Level is level 3 in accordance with JEDEC J-STD-020.

10 Statement and Contact Information

Radioworks Microelectronics PTY LTD is the business name holder of Flairmesh Technologies.

This device complies with part 15 of the FCC Rules and with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:
  (1) this device may not cause harmful interference, and
  (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This Module complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Please notice that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. For FCC, this exterior label should follow "Contains FCC ID: 2A22WFMB100". In accordance with FCC KDB guidance 784748 Labeling Guidelines.

If you desire to increase antenna gain and either change antenna type or use same antenna type certified, a Class II permissive change application is required to be filed by us, or you (host manufacturer) can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

This modular transmitter is only FCC authorized for the specific rule parts listed on our grant, host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

Host manufacturer in any case shall ensure host product which is installed and operating with the module is in compliant with Part 15B requirements.

Please note that For a Class B digital device or peripheral, the instructions furnished the user manual of the end-user product shall include statement below and place it in a prominent location in the text of host product manual.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception,

which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.

—Increase the separation between the equipment and receiver.

—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

—Consult the dealer or an experienced radio/TV technician for help.

In accordance with FCC Part 15C, this module is listed as a Single Modular Transmitter device.

This radio transmitter (FCC ID: 2A22WFMB100) has been approved by FCC to operate with the on board PCB antenna. External antennas having a gain greater than 2.7dBi are strictly prohibited for use with this device.