FMB121 Datasheet

Ver.1.0

Jul. 16, 2024

Release Record

Version	Release Date	Comments
1.0	Jul. 16, 2024	The first release.

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Description:

FMB121 is a dual-mode Class 1 Bluetooth® V5.4 module, offering robust support for both classic Bluetooth profiles (A2DP/HSP/HFP) and the latest low energy audio standards TMAP and PBP in a single unit. Powered by internal multi-core processors, it efficiently handles all required audio codecs and profiles. The module features an integrated PCB antenna, stereo audio output, and a single analog MIC input, all packed into a compact castellated hole footprint. This makes it an ideal System-on-Chip (SoC) solution for Bluetooth headsets and speakers. In addition to standard SBC and LC3 decoders for A2DP and LE audio respectively, FMB121 supports advanced audio codecs such as aptX®, aptX HD, and aptX adaptive, ensuring high-fidelity music streaming. It includes a super low latency gaming mode for enhanced gaming experiences.

With an ASCII command-based control interface accessible via UART, FMB121 simplifies integration of Bluetooth audio functionality into host systems, requiring minimal effort from developers.

Typical Bluetooth & LE audio applications:

- Bluetooth audio speaker
- Auracast® receiver
- Home entertainment equipment

Features:

- Dual mode Bluetooth® v5.4
- Support BLE 2M PHY
- +15dBm BR TX power, -97dBm BR RX sensitivity
- +15dBm BLE TX power, -100.5dBm BLE 1Mb/s RX sensitivity
- PCB antenna with 2.7dBi gain
- Supported profiles: TMAP (CT, UMR, BMR), PBP (PBK, Auracast®), A2DP (SNK), AVRCP (TG/CT).
- Profiles supported with customized firmware: HFP, HID, SPP, OPP etc.
- UART/I2C/SPI master multiplexed with PIOs
- 11 digital PIOs, 2 LED outputs multiplexed with AIOs
- SBC, aptX, aptX HD, aptX adaptive and lossless decoder and LC3 encoder/decoder
- 22mm x 12mm x 2.2mm
- Weight: approximately 1g
- Plated half-holes SMT pads for easy and reliable PCB mounting
- Bluetooth QDID:
- FCC ID:
- CE
- RCM
- RoHS compliant

Ordering Number	Package	Items in One Package	Comments
FMB121-P	Plastic tray	80	
FMB121-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

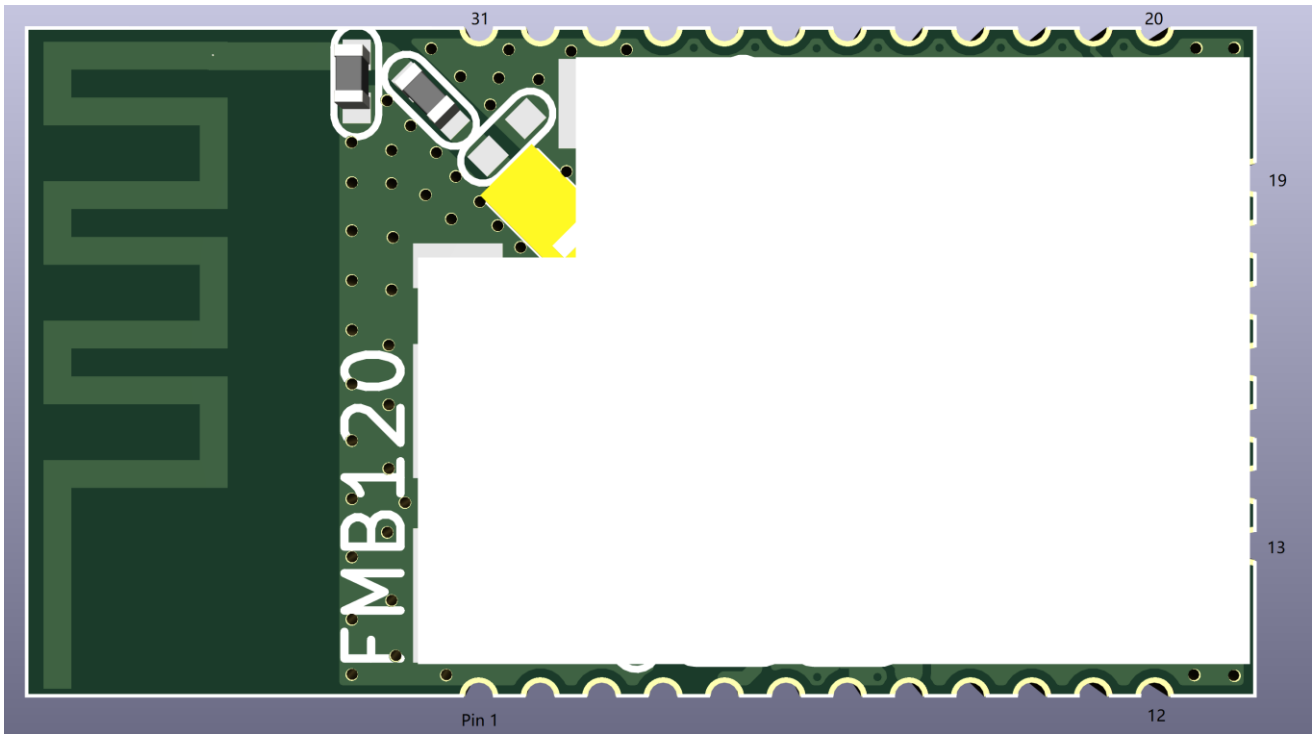

Figure 1: Pinout of FMB121

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	PIO8	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 8, weak pull down when reset

5	VDD_IO	Power input	PIO supply, 1.8V or 3.3V, needs to be powered at the same time as VBAT or VBUS
6	1V8_OUT	Power output	Can provide 100mA for external circuits
7	GND	Ground	Ground
8	VBUS	Power input	5V input
9	PIO1/RESETB	Digital bidirectional with programable strength internal pull-up/pull-down	Automatically defaults to RESET# mode when the device is unpowered, or in off modes. Reconfigurable as a PIO after boot. Programmable IO 1, strong pull-up when reset
10	PIO2	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 2, 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	PIO4	Analog or digital input/open drain output	Programmable IO 4, weak pull down when reset
14	AIO1/LED1	Analog or digital input/open drain output	General purpose analog/digital input or open drain LED output 1
15	AIO0/LED0	Analog or digital input/open drain output	General purpose analog/digital input or open drain LED output 0
16	PIO34	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 34, weak pull-down when reset
17	PIO21	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 21, weak pull-down when reset
18	PIO36	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 36, strong pull-up when reset
19	PIO7	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 7, strong pull-up when reset
20	PIO5/UART_RX	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 5, weak pull down when resetting, Additional function: ■ UART RX
21	PIO15/UART_TX	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 15, strong pull-up when reset,

			Additional function: ■ UART TX
22	SPK_LN	Analog	Headphone/speaker left channel differential output, negative
23	SPK_LP	Not connected	Headphone/speaker left channel differential output, positive
24	MIC_BIAS	Mic bias output	Mic bias output
25	MIC2_N	Analog	Microphone differential 2 input, negative
26	MIC2_P	Analog	Microphone differential 2 input, positive
27	SPK_RP	Analog	Headphone/speaker right channel differential output, positive
28	SPK_RN	Analog	Headphone/speaker right channel differential output, negative
29	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
VBUS Voltage	-0.4	6.5	V
USB_DP/USB_DN Voltage	-0.4	3.8	V
VBAT Voltage	-0.4	4.8	V
PIO Voltage	-0.4	3.6	V
LED Voltage	-0.4	6.5	V
AIO Voltage	-0.4	1.95	V
MIC 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
VBUS	4.75	5.0	6.5	V
USB_DP/USB_DN Voltage	0	--	3.6	V
VBAT Voltage	3.0	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	-	0.25 x VDD_PIO	V
V_{IH} input logic level high	0.625 x VDD_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 VDD_PIO	V
V_{OH} output logic level high, at max rated drive	0.75 x VDD_PIO	-	-	V
Pull Strength				
Strong pull-up/down	50	70	125	kΩ
Weak pull-up/down	729	1050	1350	kΩ

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		0.8	-	-	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	-	μs
LED pad leakage		-1	-	1	uA
External pad capacitance for < 0.5 LSB error		0	40	-	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	-	96	kHz
Output Power	0 dBFS, 32 Ω load -3 dBFS, 16 Ω load	-	-	30	mW
Load	-	16	32	30k	Ω

SNR	F_{in}=1kHz 48kHz F_{sample} Input amplitude = 0 dBFS Analog gain = 0 dB B/W=20Hz->20kHz A-Weighted 32 Ω load	-	105.1	-	dB
THD+N	F_{in}=1kHz 48kHz F_{sample} Input amplitude = 0 dBFS Analog gain = 0 dB B/W=20Hz->20kHz 32 Ω load	-	-88.1	-	dB
RMS noise	48kHz F_{sample} Input amplitude = -200 dBFS Analog gain = 0 dB B/W=20Hz->20kHz A-Weighted 32 Ω load	-	5.50	-	uVrms

Table 8: Class-D DAC Audio Output

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	-	96	kHz
Output Power	0 dBFS, 32 Ω load -3 dBFS, 16 Ω load		-	-	30	mW
Load	-		16	32	30k	Ω
SNR	F_{in}=1kHz 48kHz F_{sample} Input amplitude = 0 dBFS B/W=20Hz->20kHz A-Weighted 32 Ω load	Analog gain = 0 dB	-	104.7	-	dB
		Analog gain = -6 dB		103.8		
		Analog gain = -12 dB		100.2		
	Quiet mode	Analog gain = 0 dB		120.0		

THD+N	F_{in}=1kHz 48kHz F_{sample} Input amplitude = 0 dBFS B/W=20Hz->20kHz 32 Ω load	Analog gain = 0 dB	-	-93.3	-	dB
		Analog gain = -3 dB		-92.5		
		Analog gain = -6 dB		-91.9		
RMS noise	48kHz F_{sample} Input amplitude = -200 dBFS B/W=20Hz->20kHz A-Weighted 32 Ω load	Analog gain = 0 dB	-	5.77	-	uVrms
		Analog gain = -6 dB		3.23		
		Analog gain = -12 dB		2.44		
	Quiet mode	Analog gain = 0 dB		<1		
Stereo separation (crosstalk)	-		80	-	-	dB

Table 9: Class-AB DAC Audio Output

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)	-	99.4	-	dBA
THD+N	F_{in}=1kHz 48kHz 2.4V pk-pk input (0dB gain)	-	-91.9	-	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	-	dBA
THD+N	F_{in}=1kHz 48kHz 2.4V pk-pk input (0dB gain)	-	-94.9	-	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	-	6.00	mA
DC accuracy	-	-60	-	60	mV
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	+/-1.5	%

Table 13: VBAT Measurement Accuracy

2.4 Power consumptions

Operating Condition	Typical	Unit
Dormant	23	uA
Deep sleep, idle	-	uA
Connected, 495ms BT Sniff sub-rating	-	uA
Connected, 187ms BT Sniff, 2 links, four slots no retry, AFH on	-	mA
Connected, 11.25ms BT Sniff	-	mA
Connected with audio streaming (A2DP), SBC in 192 kbit, SBC Out 192kbit, Output Mono LP_DAC 48 KHz	-	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

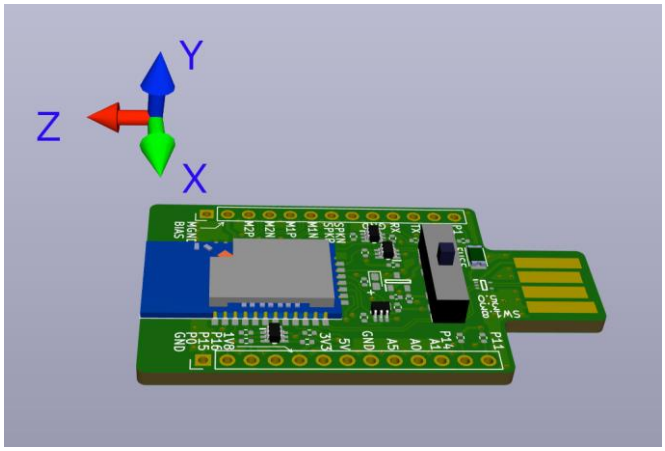

Figure 2: Coordinate System Used in 3D Patterns

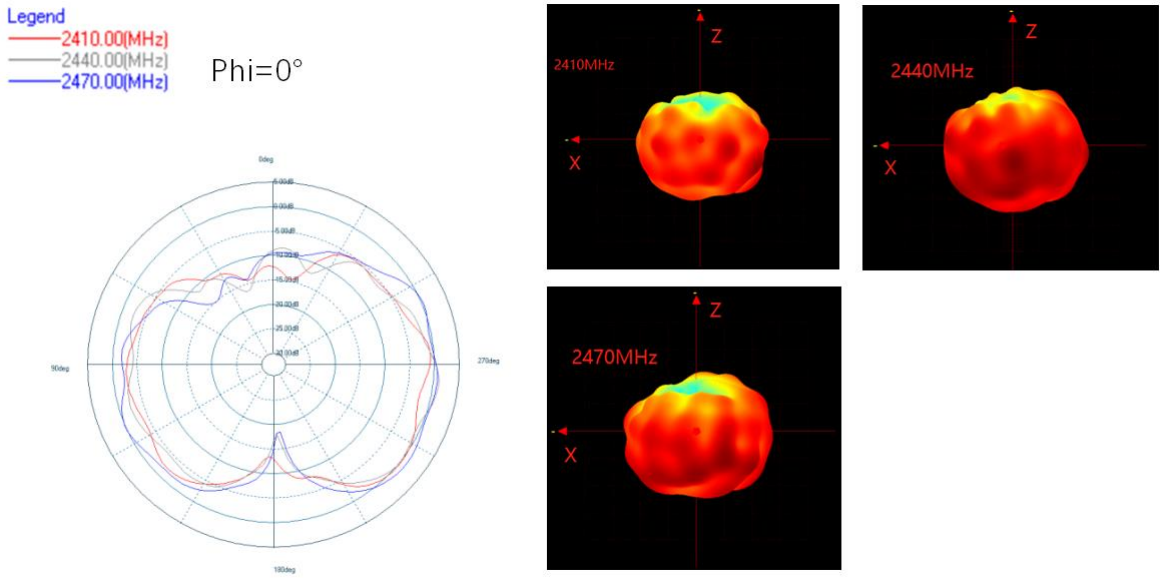

Figure 3: 3D Patterns – XZ Plane

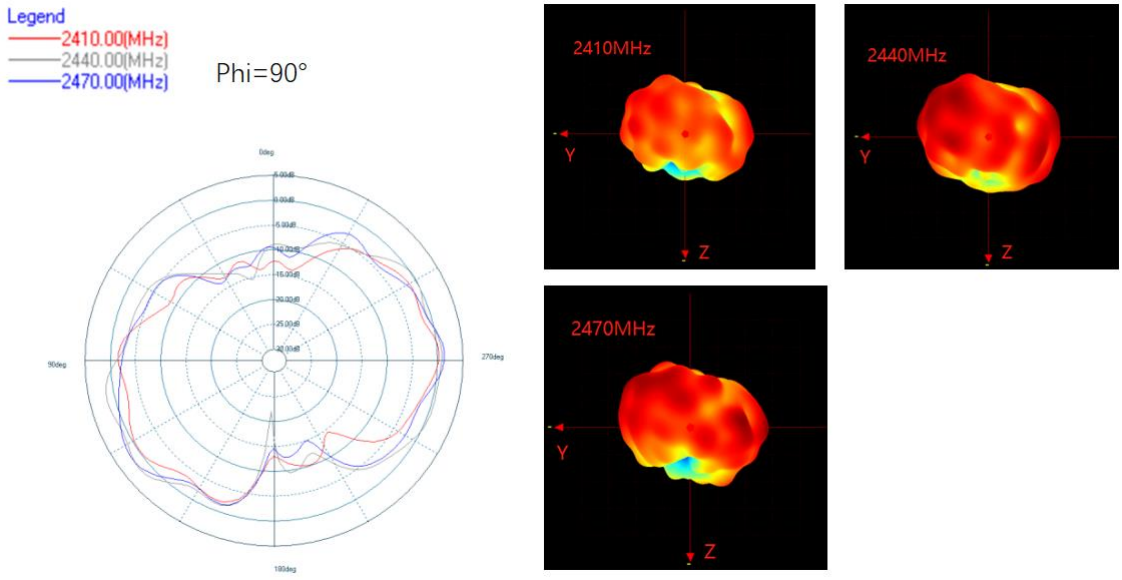

Figure 4: 3D Patterns – YZ Plane

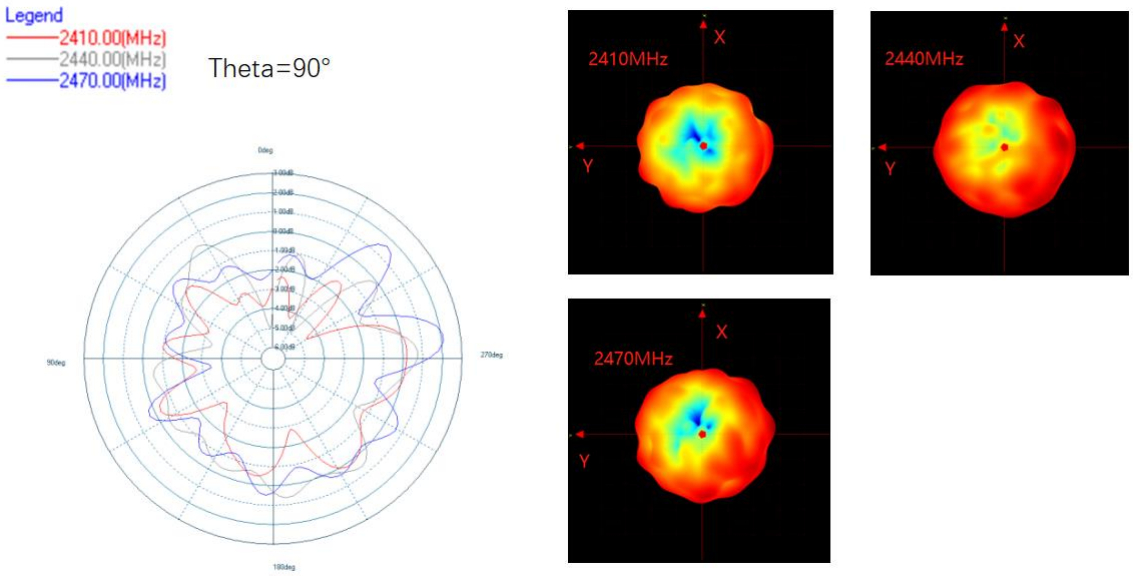

Figure 5: 3D Patterns – XY Plane

3 Physical Interfaces

3.1 Power Supply

There are three power supply schemes available for the module. It can be powered by a Li-poly battery (3.7V), a 3.3V DC on its VBAT or a 5V DC on its VBUS. 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 120μs.

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[1,7,15,36]	PUS
PIO[2,4,5,8,21,34]	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 VBUS is not applied, the module turns off. A rising edge on PIO0 or VBUS is then required to power on.

3.3 Audio Interfaces

3.3.1 Line/Mic inputs

The module has one high-quality audio input ADC (HQADC). They are also suitable for supporting mixed differential and single-ended applications. The ADC is 24-bit, and capable of sample rates from 8 kHz to 96 kHz.

Inputs should be AC coupled, typically using a 2.2 μF capacitor. Reducing this capacitor value, reduces low-frequency response attenuation.

The ADC channel receives a differential/single-ended input and generates a 3-bit Delta-Sigma modulated output that goes into a decimator. The ADC serves both line and mic modes.

The input is fed into a programmable gain amplifier. The audio output from the pre-amplifier stage is always differential and has a maximum amplitude of 2.4 Vpp (peak-to-peak). The pre-amplifier can support single ended and differential inputs at the same input amplitude. At 0 dB gain the maximum input is 2.4 Vpp.

If the audio signal is single-ended, the input goes approximately 300 mV below ground and approximately 300 mV above the 1.8 V audio power supply rail.

The module has a microphone bias source for supplying electret or MEMS microphones, with an output voltage configurable from 1.5V to 2.1V, capable of biasing an external analog microphones at a load current of up to 6 mA.

3.3.2 Line/Headphone Outputs

Two high-quality audio output DACs (HQDAC) drive stereo low impedance differential loads (bridge-tied load (BTL)headphones) or Line out.

The HQ-DACs support two modes of operation. Class-D is a high efficiency, switching mode amplifier. The secondary Class-AB is a linear amplifier and consumes more power.

Mode	Description
Class-D	Enables a lower power consumption for the headset. 3-state BD modulation enables a filter-free configuration. Directly driven from the digital circuitry. Most of the analog portion is powered-down. Drives differential headphone loads of 16 Ω/32 Ω.
Class-AB	Enables either headphone or speaker applications. Can drive the same headphone outputs instead of switching to Class-D.

	Typically, useful for driving high impedance loads such as differential line out, or analog input power amp. Additional external filtering may be required for line out applications that drive an active component such as a power amplifier.

Table 17 : Headset Output Driver Modes

3.4 General Purpose Analog IO

The module has two 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 FMB121 includes PWM LED driver for driving LEDs. There are 2 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 18 : Possible UART Settings

Parameter		Possible Values
Baud Rate	Minimum	2400 baud (≤2%Error)
		19200 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

FMB121 has a full-speed (12 Mbps) USB port and enumerates as a compound device with a hub. The enabled audio source/sink/HID/CDC device appears behind that hub.
The DP 1.5k pull-up is integrated internally. No series resistors are required on the USB data lines.
The VBUS input is tolerant of a constant 6.5V and transients up to 7.0V. Use an external clamping protection device if extra overvoltage protection is required.

FMB121 supports charger detection to the USB BC 1.2 specification.

It provides Data Contact Detection (DCD) using an internal current source, and provides:

- Detection of Standard Downstream Ports (SDP)
- Charging Downstream Ports (CDP)
- Dedicated Downstream Ports (DCP)

The 10-bit auxiliary ADC reads the voltage on the USB data lines. This enables detection of proprietary chargers that bias the voltage on the USB data lines.

For USB Type-C® connectors, use the LED pins to detect the voltage on the USB Configuration Channel (CC) line pins (CC1 and CC2) to detect the charge current capabilities of the upstream device.

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

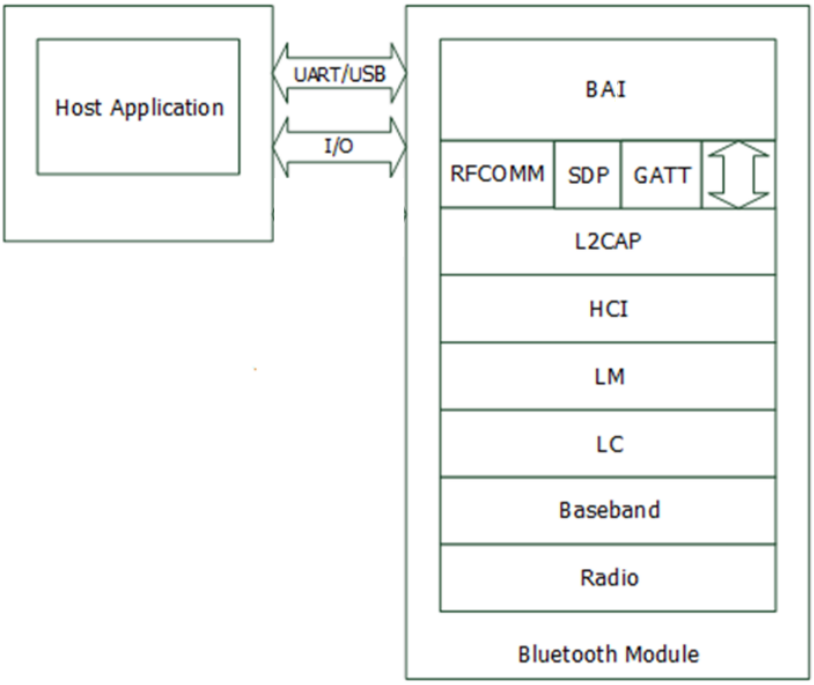

Figure 6: FMB121 Stacks

FMB121 is supplied with qualified Bluetooth 5.4 stack firmware. With Flairmesh's BAI interface, the host MCU can easily controls A2DP (SNK role), AVRCP (TG/CT role), HFP (handsfree role), TMAP (CT, UMR and BMR role), PBP (PBK role), SPP (A and B), OPP (client), HID (peripheral) profiles running on the module.

5 Reference Design

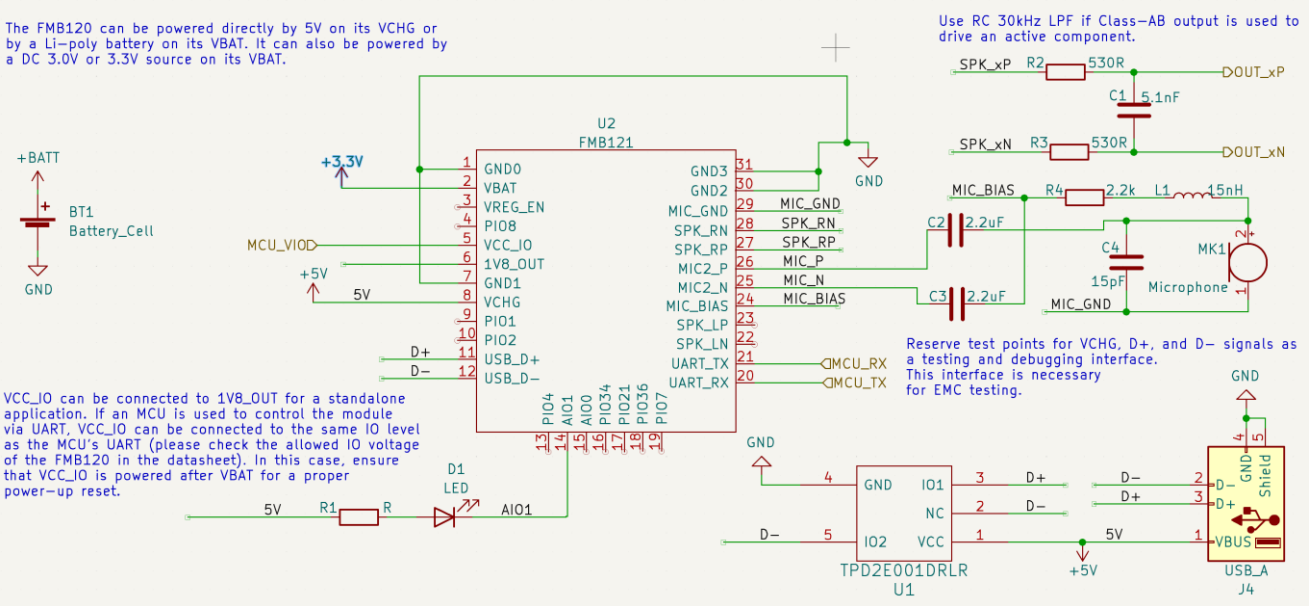

Figure 7: Reference Design

6 Mechanical Size and Recommended PCB Footprint

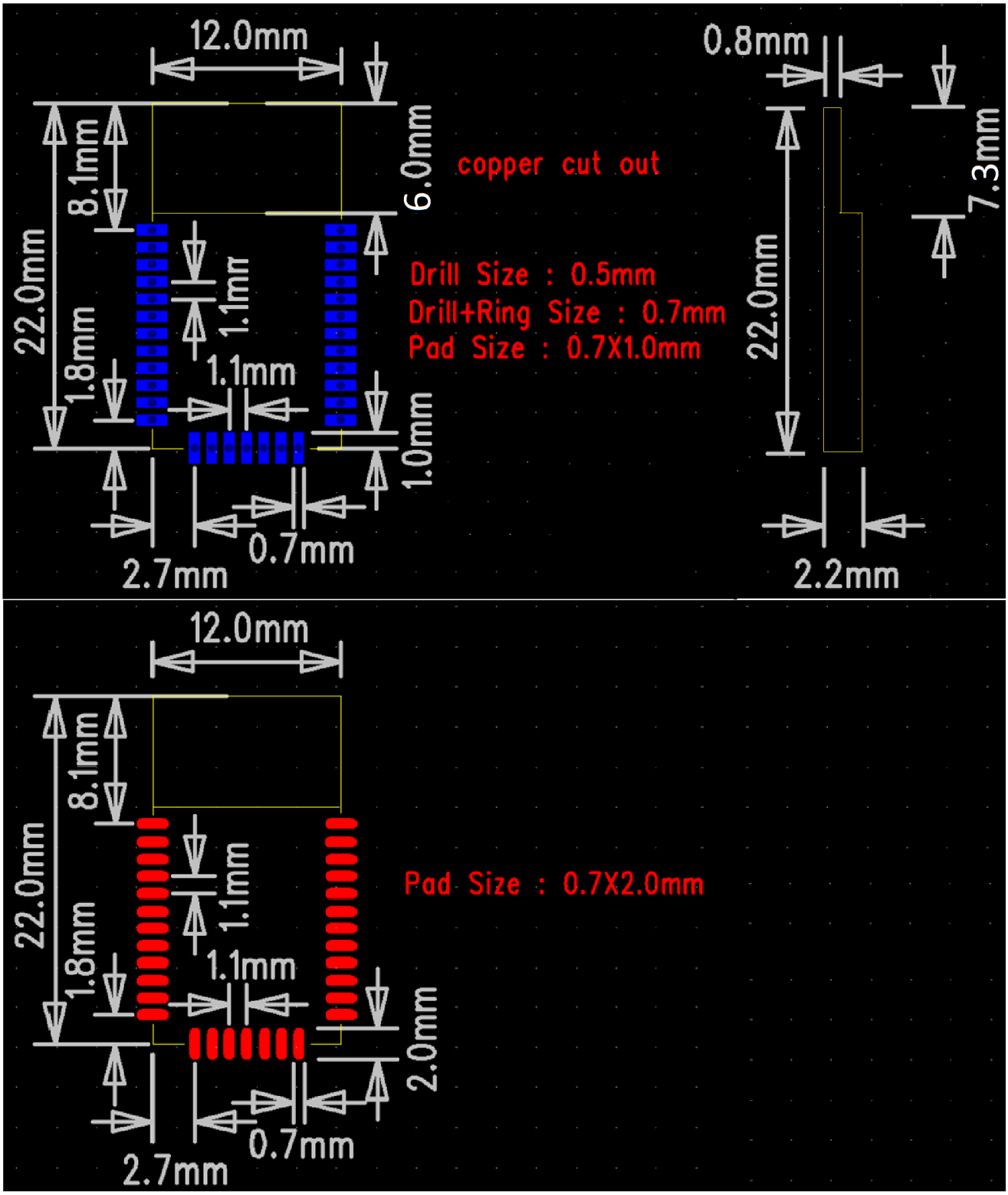

Figure 8: Mechanical Size and Recommended PCB Footprint

7 RF Layout Guidelines

FMB121 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 FMB121.
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.

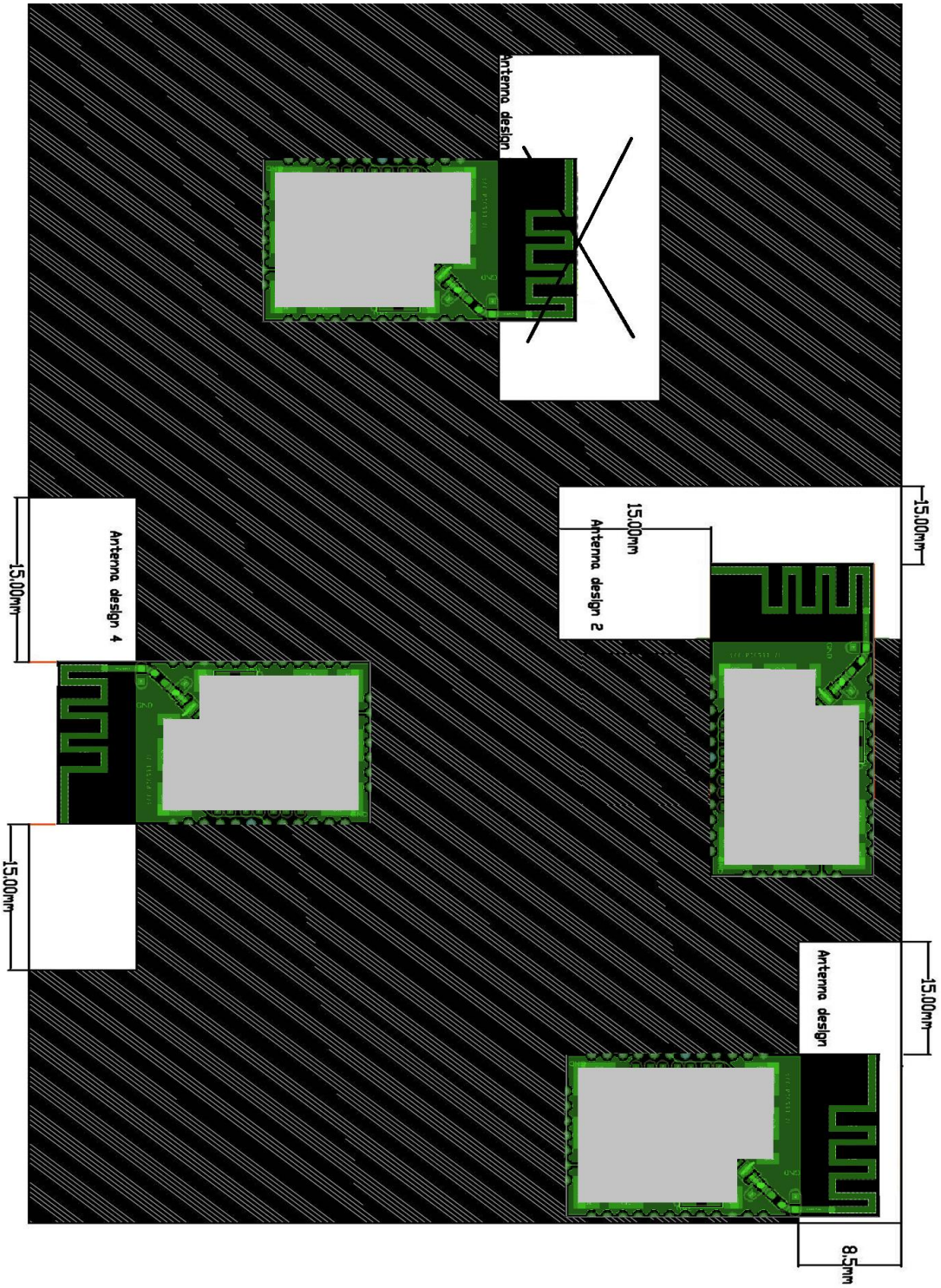

Figure 9 : Placement the module and the ground of main PCB Board

8 Reflow Profile

FMB121 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.

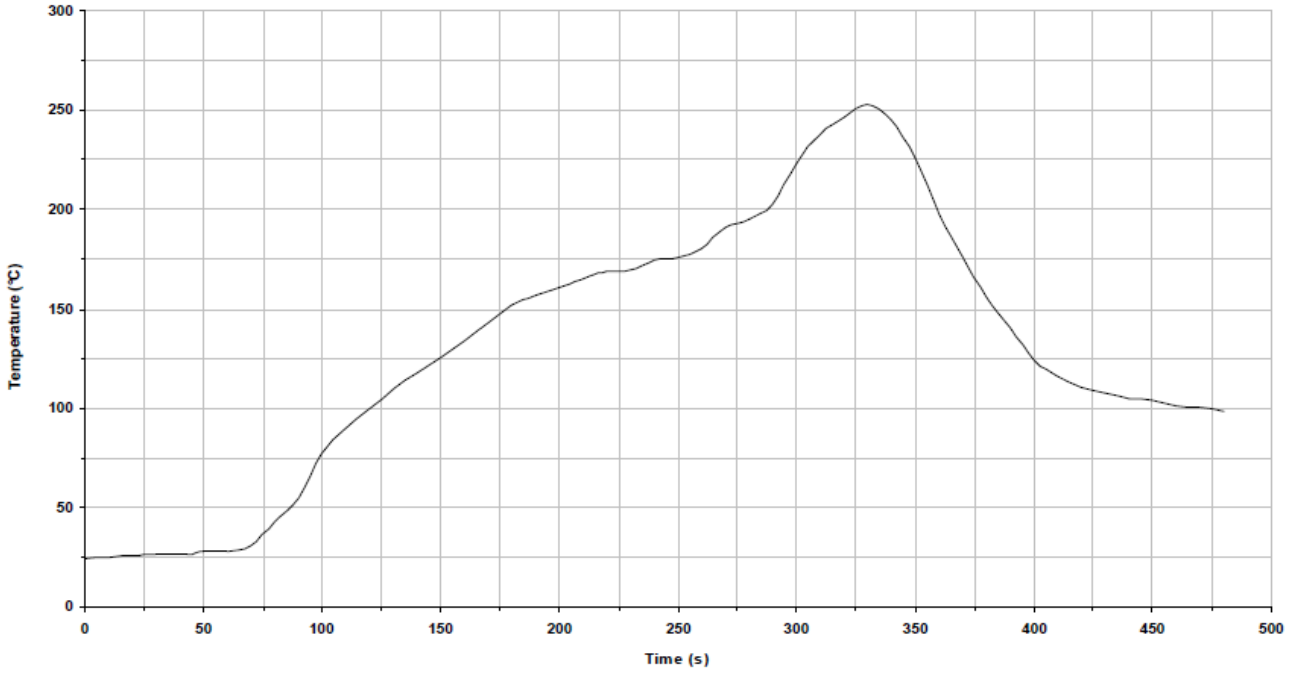

Figure 10: Typical Lead-Free Re-flow Solder Profile for FMB121

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

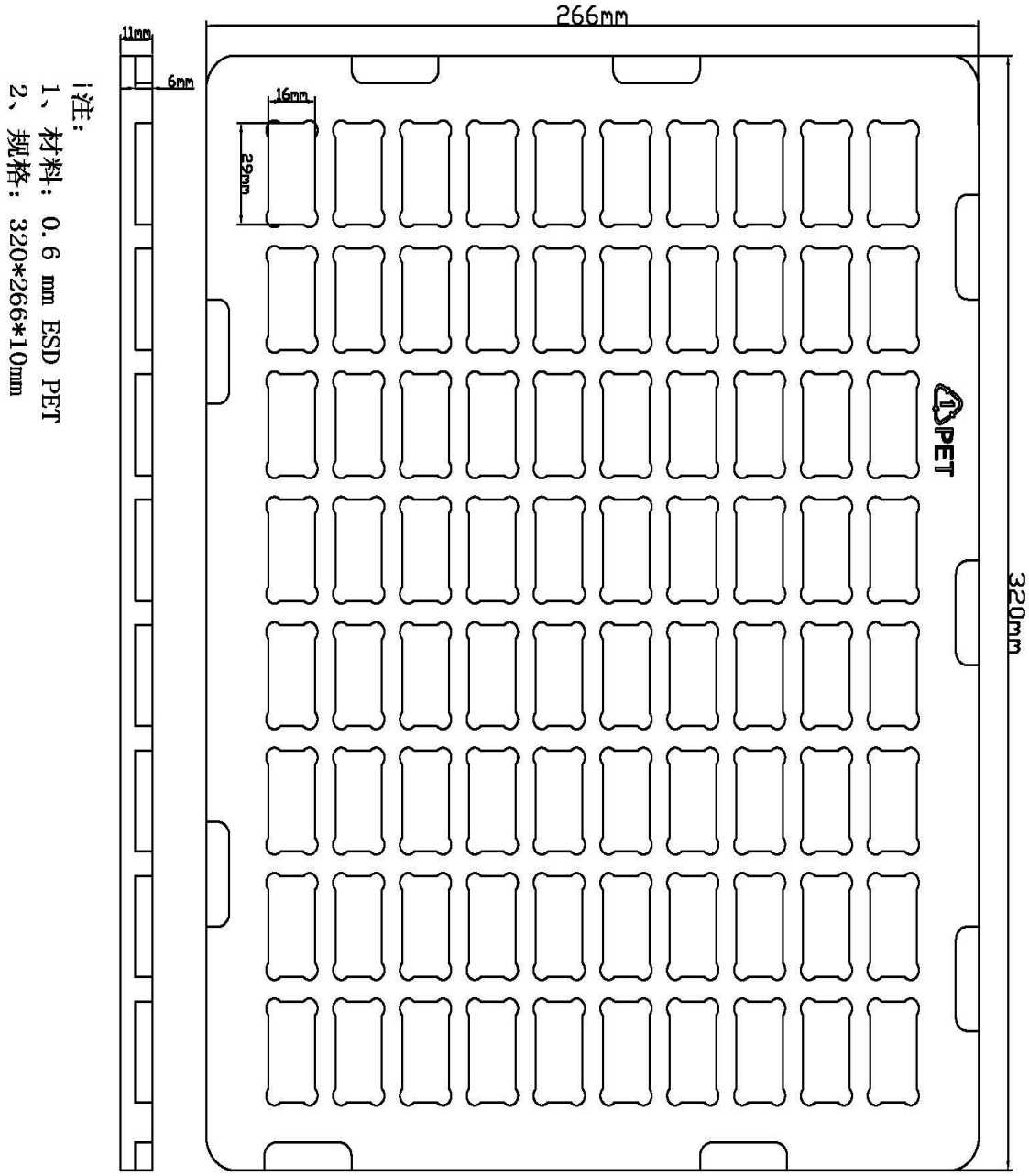

Figure 11: FMB121 Plastic Tray Package

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.

FCC statements:

This device complies with part 15 of the FCC rules. 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.
NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes could void the user's authority to operate the equipment.

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.

Federal Communication Commission (FCC) Radiation Exposure Statement
When using the product, maintain a distance of 20cm from the body to ensure compliance with RF exposure requirements.

This device is intended only for OEM integrators under the following conditions: 1. The antenna must be installed such that 20 cm is maintained between the antenna and users. 2. The transmitter module may not be co-located with any other transmitter or antenna. As long as the two conditions above are met, additional transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required for the installed module.

Important Note: In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the Federal Communications Commission of the U.S. Government (FCC) and the Canadian Government authorizations are no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator shall be responsible for re-evaluating the end-product (including the transmitter)
and obtaining a separate FCC authorization in the U.S.

OEM Integrators - End Product Labeling Considerations: This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users.

The final end product must be labeled in a visible area with the following: “Contains, FCC ID: 2A22WFMB121”. The grantee's FCC ID can be used only when all FCC compliance requirements are met.

OEM Integrators - End Product Manual Provided to the End User: The OEM integrator shall not provide information to the end user regarding how to install or remove this RF module in end product user manual. The end user manual must include all required regulatory information and warnings as outlined in this document.

Appropriate measurements (e.g. 15 B compliance) and if applicable additional equipment authorizations (e.g. SDoC) of the host product to be addressed by the integrator/manufacturer.
This module is only FCC authorized for the specific rule parts 15.247, 15.407 listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host product as being Part 15 Subpart B compliant.