FMB110 Datasheet

Ver. 1.1

Nov. 30, 2022

Release Record

Version	Release Date	Comments
0.9	Sept. 1, 2022	Draft release.
1.0	Nov. 11, 2022	Add Bluetooth QDID, FCCID, schematics of reference design, package information and update radio performance parameters.
1.1	Nov. 30, 2022	Update FCC statement.

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Description:

FMB110 is long range dual mode class 1 Bluetooth® V5.1 module. It integrates all necessary components including antenna, 2.4G power amplifier, band filter, baseband and profile processors into a small formfactor module in plated half-hole footprint. With its internal multiple processors, it runs a full Bluetooth stack including multiple profiles such as HSP/HFP, 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 advanced noise depression and echo cancellation for headset or speaker applications.

FMB110 also supports a Flairmesh proprietary 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, 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® v5.1
- Support BLE 2M PHY
- +18dBm BR TX power, -96.5dBm BR RX sensitivity, 1km line-of-sight range
- +8dBm BLE TX power, -99dBm BLE 1Mb/s RX sensitivity
- Chip antenna with 0~2.0dBi gain
- Qualified profiles: SPP, HID, OPP, HSP/HFP and BLE GATT DID, BAS.
- Profiles can support per request: A2DP, AVRCP, iAP over Bluetooth for Apple, HOGP, etc.
- USB/UART/I2C/SPI master multiplexed with PIOs
- 9 digital PIOs (multiplexed with USB/UART/I2C/SPI), 2 LED outputs multiplexed with AIOs
- Stereo differential audio output, can also be used as single-ended
- Differential mic input with bias generator
- Support SBC, AAC and aptX codec
- Support cVc noise depression and echo cancellation
- 30.8 x 14.00 x 2.20mm
- Weight: approximately 1.8g
- Plated half-holes SMT pads for easy and reliable PCB mounting
- Bluetooth QDID: 198003
- FCC ID: 2A22WFMB110
- CE
- RCM
- RoHS compliant

Ordering Number	Package	Items in One Package	Comments
FMB110-P	Plastic tray	70	

Table 1: Ordering Information

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

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1 Pinout and Description

1.1 Pin Assignments

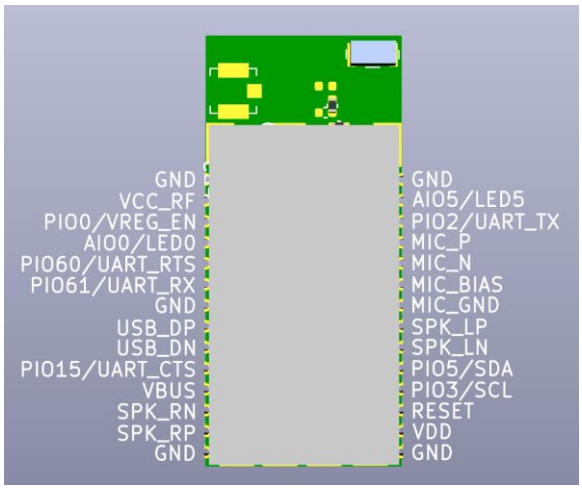

Figure 1: Pinout of FMB110

1.2 Pinout Descriptions

Pin	Symbol	I/O Type	Description
1	GND	Ground	Ground.
2	VCC_RF	Power input	3.3V power supply for RF power amplifier.
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	AIO0/LED0	Analog or digital input/open drain output	General purpose analog/digital input or open drain LED output 0.
5	PIO60/UART_RTS	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 60, weak pull down when reset.

			Alternative function: ■ UART RTS
6	PIO61/UART_RX	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 61, weak pull down when reset. Alternative function: ■ UART RX
7	GND	Ground	Ground
8	USB_DP	Digital	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection.
9	USB_DN	Digital	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection.
10	PIO15/UART_CTS	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 15, weak pull down when reset. Alternative function: ■ UART CTS
11	VBUS	Power input	5V Power supply for USB interface, must be powered at the same time as VDD or before it. If USB is not used, leave this pin unconnected.
12	SPK_RN	Analog	Headphone/speaker differential right output, negative.
13	SPK_RP	Analog	Headphone/speaker differential right output, positive.
14	GND	Ground	Ground.
15	GND	Ground	Ground.
16	VDD	Power input	3.3V power supply for Bluetooth, digital and analog IOs.
17	RESET	Digital input	Reset the device when pull high
18	PIO3/SCL	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 3, weak pull down when reset. Alternative function: ■ I2C SCL
19	PIO5/SDA	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 5, weak pull down when reset. Alternative function: ■ I2C SDA
20	SPK_LN	Analog	Headphone/speaker differential right output, negative.

21	SPK_LP	Analog	Headphone/speaker differential right output, positive.
22	MIC_GND	Microphone ground	Ground of microphone
23	MIC_BIAS	Mic bias output	Mic bias output
24	MIC_N	Analog	Microphone differential input, negative
25	MIC_P	Analog	Microphone differential input, positive
26	PIO2/UART_TX	Digital bidirectional with programable strength internal pull-up/pull-down	Programmable IO 2, weak pull down when reset. Alternative function: ■ UART TX
27	AIO5/LED5	Analog or digital input/open drain output	General purpose analog/digital input or open drain LED output 5.
28	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	7.0	V
USB_DP/USB_DN Voltage	-0.4	3.8	V
VDD Voltage	-0.4	3.8	V
VCC_RF Voltage	-0.3	3.6	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

VBUS	4.75	5.0	6.5	V
USB_DP/USB_DN Voltage	0	--	3.6	V
VDD Voltage	3.0	3.3	3.6	V
VCC_RF Voltage		3.3		V
PIO Voltage	3.0	3.3	3.6	V
LED voltage	0	--	6.5	V
AIO Voltage	0	--	1.95	V

Table 4: Recommended Operating Conditions

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	kΩ
Weak pull-up/down	500	2200	5000	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		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: 10-bit Auxiliary ADC

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	-	98.3	-	dBA
THD+N	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz -1dBFS signal 32Ω load	-	-87.5	-	dB

Digital Gain	Digital Gain Resolution = 1/32	-24	-	21.5	dB
Stereo separation	-	80	-	-	dB
Max capacitive load	Per terminal to ground	-	-	100	pF

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	-	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	-	101	-	dBA
THD+N	f_{in}=1kHz 48kHz F_{sample} B/W=20Hz->20kHz -1dBFS signal 32Ω load	-	-90.5	-	dB
Digital Gain	Digital Gain Resolution = 1/32	-24	-	21.5	dB
Stereo separation	-	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)	-	101	-	dBA

THD+N	f_{in}=1kHz 48kHz 2.4V pk-pk input (0dB gain)	-	-85	-	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)	-	100	-	dBA
THD+N	f_{in}=1kHz 48kHz 2.4V pk-pk input (0dB gain)	-	-91	-	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
Load capacitance	From parasitic PCB routing and package	-	-	0.1	nF

Table 12: Microphone Bias

2.4 Power consumptions

Operating Condition	Typical	Unit
Dormant	2	uA
Deep sleep, idle	80	uA
Connectable, average	250	uA
Connected, 975ms BT Sniff, AFH on, average	550	uA
Radio TX on, peak	120	mA

Table 13: 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.

3 Physical Interfaces

3.1 Power Supply

The module needs two power supplies to work properly. One is for the Bluetooth, digital and analog IOs and the other is for the radio frequency power amplifier. Please refer to the reference designs in 5.

3.2 Reset

The module may be reset from several sources: RESET pin, power-on reset, USB attach reset and software configured watchdog timer.
The RESET pin is an active high reset. It is recommended that RESET 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
Other PIOs	PDW

Table 14: Pin Status on Reset

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

3.3 PIO

The module has 9 digital I/O pads multiplexed with USB/UART/SPI/I2C.

3.4 Audio Interfaces

3.4.1 Analog Audio Interface

FMB110 analog interfaces include:

■ Line/Mic inputs

■ Line/Headphone outputs

Inputs should be AC coupled, typically with a 2.2uF. It receives a differential/single-ended input. The module has internal pre-amplifier for connecting a low-level MIC signal. The microphone bias source is capable of biasing external analog microphone at a load current of up to 3mA.
Two high-quality audio output channels can drive stereo low impedance differential loads or Line out. They 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. Additional external filtering may be required for line out applications that drive an active component such as a power amplifier.

3.4.2 Digital Audio Interface

Audio digital interfaces include:

■ Digital microphone inputs

The digital mic function can be assigned to PIOs, the clock frequency can be configured at 500 kHz, 1MHz, 2 MHz and 4MHz.

3.5 General Purpose Analog IO

The module has two general-purpose analogue interface pins multiplexed with LED pads.

3.6 LED Pads

The module includes 2 LED pads 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.

3.7 Serial Interfaces

3.7.1 UART

The module has a standard UART serial interface that provides a simple mechanism for communicating using RS232 protocol. The UART interface multiplexes with PIOs and other functions. Hardware flow control is optional.

Table 15 : 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

3.7.2 USB

The module has a full-speed (12 Mbps) USB interface for communicating with other compatible digital devices. The USB interface on FMB110 acts as a USB peripheral, responding to requests from a master host controller.
FMB110 contains internal USB termination resistors and requires no external resistors.
FMB110 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 FMB110 also supports USB HID/CDC and audio function.

3.7.3 I^2C

Any two PIOs can be used to form a master I^2C interface. It is compliant with the Fast-mode UM10204 I^2C-bus specification.

3.7.4 SPI Interface

Any four PIOs can be used to form a master SPI interface. The maximum frequency is 16MHz. Firmware can be customized to connect with variable peripherals.

4 Firmware Stack

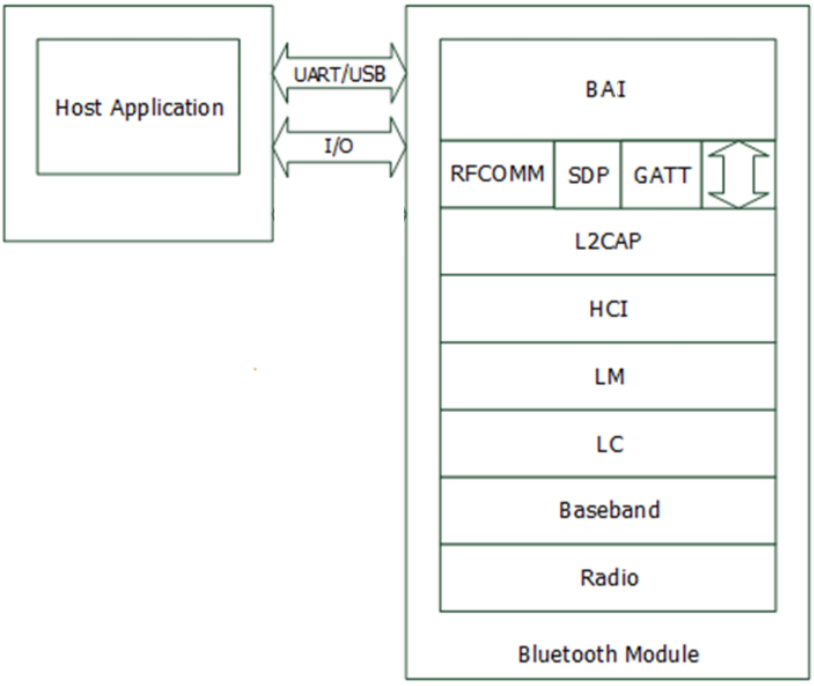

Figure 2: FMB110 Stacks

FMB110 is supplied with Bluetooth 5.1 compliant stack firmware. With Flairmesh's BAI interface, the host MCU can easily controls HSP/HFP, SPP, OPP, HID profiles running on the module, it also supports GATT based profiles over BLE such as HOGP.

5 Reference Design

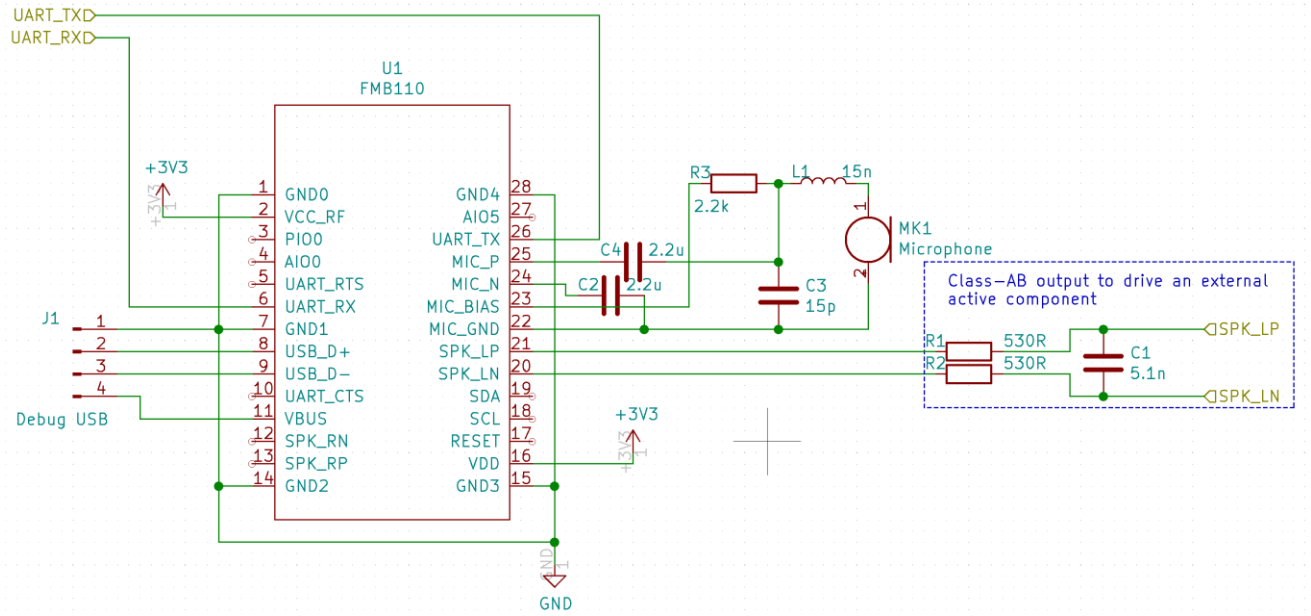

Figure 3: Reference Design

6 Mechanical Size and Recommended PCB Footprint

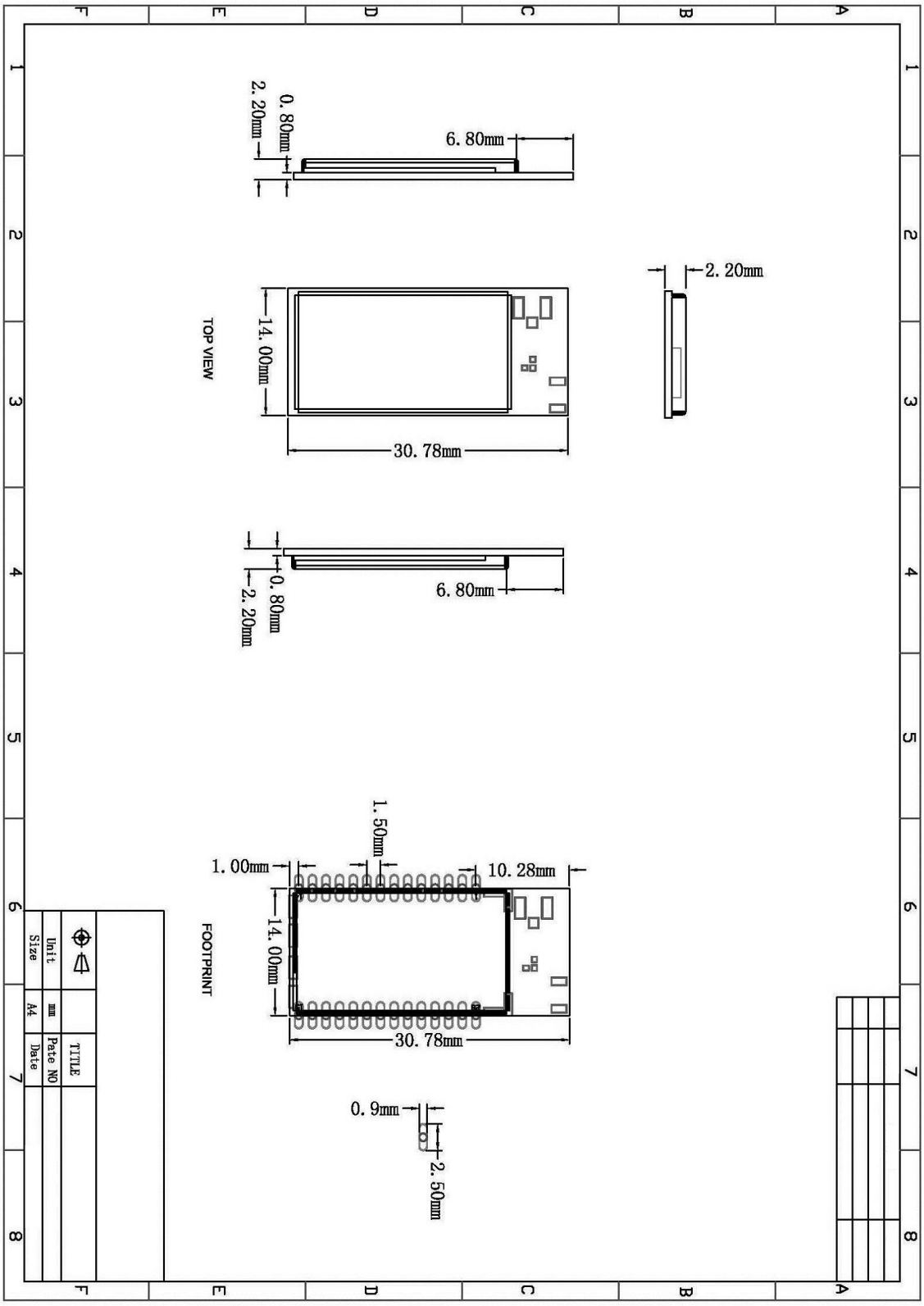

Figure 4: Mechanical Size and Recommended PCB Footprint

7 RF Layout Guidelines

The module integrates a multilayer chip 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.
2. There should also have a good ground panel and clearance on the main PCB board on which the module is mounted.

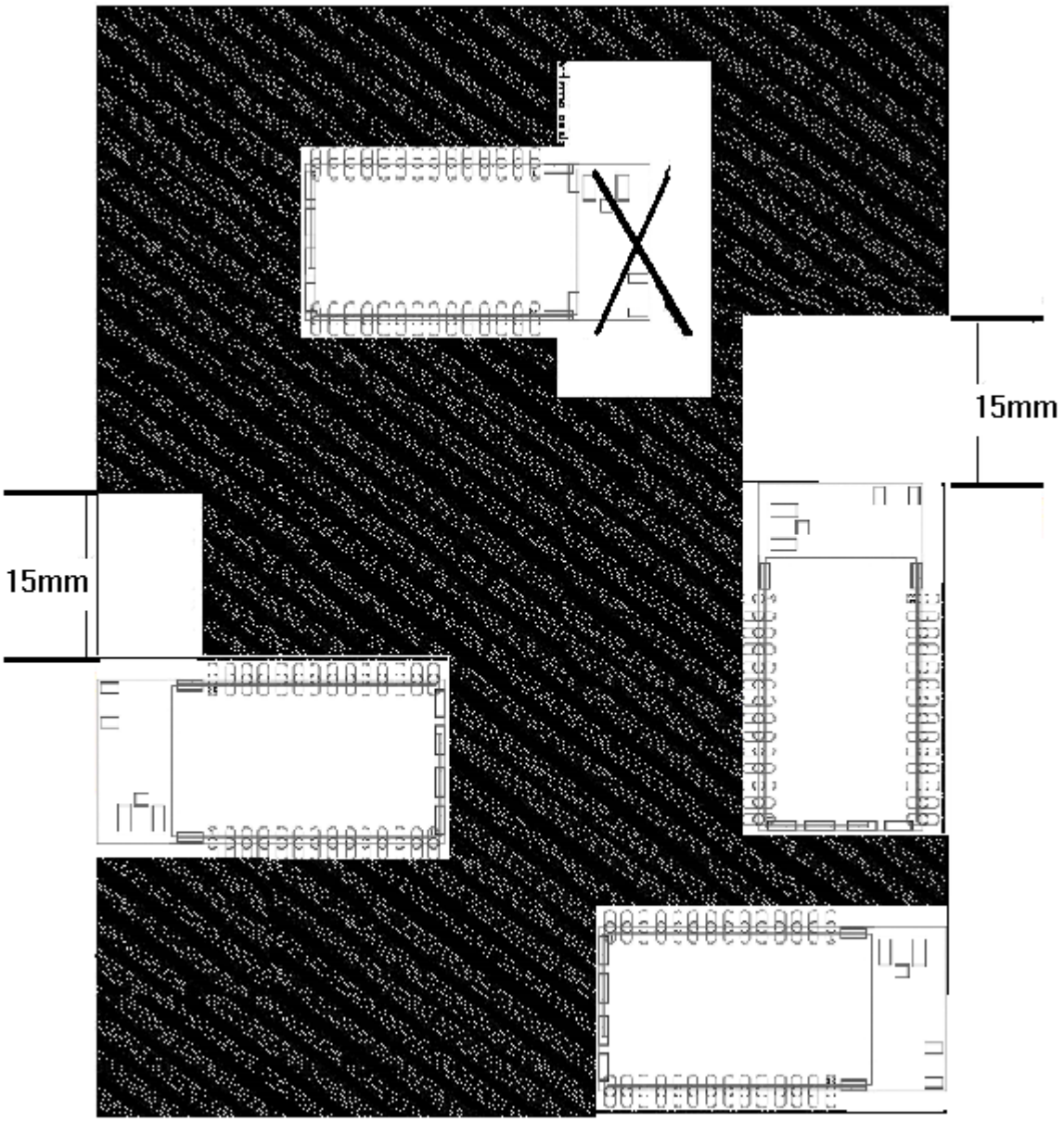

Figure 5 : Placement the module and the ground of main PCB Board

8 Reflow Profile

The module 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.

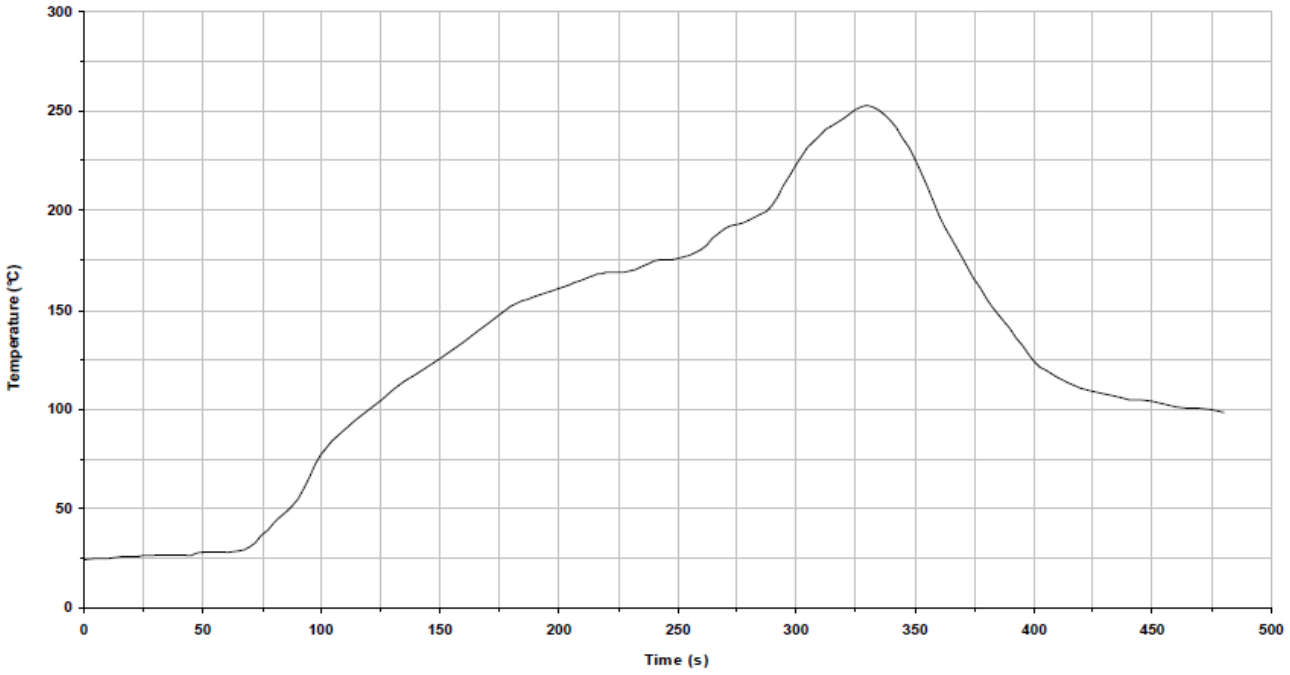

Figure 6: Typical Lead-Free Re-flow Solder Profile for FMB110

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

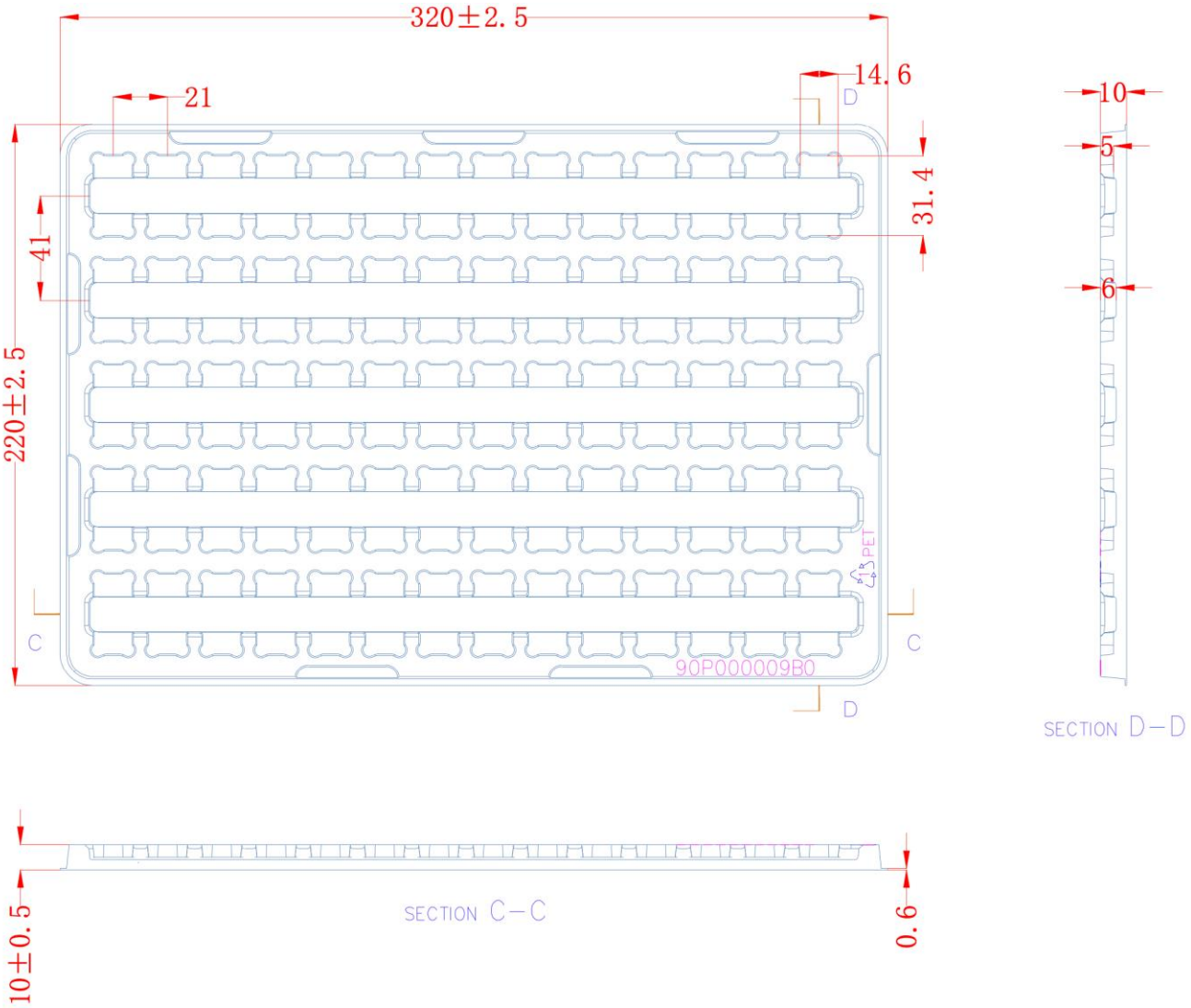

Figure 7: Plastic Tray Package

Modules are packaged in plastic trays and then put into vacuum aluminum bags before shipping. Each aluminum bag might have multiple trays inside depending on the number of the order. There are also humidity indicator card and desiccant pack inside each bag.

On each tray there are 60 PCS of modules.

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.

Statement

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: 2A22WFMB110". 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: 2A22WFMB110) has been approved by FCC to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Antenna used

Antenna Type	**Brand/ manufacturer**	**Model No.**	**Max. Antenna Gain**
Multilayer Chip	Microgate	MGMA3216H2450-A02	2dBi