

Telink

Product Specification for Telink Multi-Standard Wireless Module ML7218A-GAIA-M0-PE11

PS-ML7218A-GAIA-E1

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Keyword

Bluetooth® LE; Zigbee/Rf4CE; Thread; 2.4 GHz, rich set of peripherals

Brief

This specification is dedicated for Telink multi-standard wireless Module ML7218A-GAIA-M0-PE11.

In this specification, function block diagram, key features, and electrical specifications of the module are introduced.

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1 Overview

The ML7218A-GAIA-MO-PE11 is a general-purpose module for Bluetooth low energy, 802.15.4 and 2.4GHz proprietary. The ML7218A-GAIA-MO-PE11 supports standards and industrial alliance specifications including Bluetooth LE, Zigbee/RF4CE, Thread, and 2.4GHz proprietary standard. Thread and Zigbee share the same radio physical layer (modulation, occupied bandwidth, power level, channel frequency). The ML7218A-GAIA-MO-PE11 combines the features and functions needed for high quality wireless IoT equipments into a single module.

1.1 Block Diagram

The module is built around the chip TL7218A. The function block diagram of the module and the chip block diagram are as shown in the figure below.

Figure 1-1 Function Block Diagram of the Module

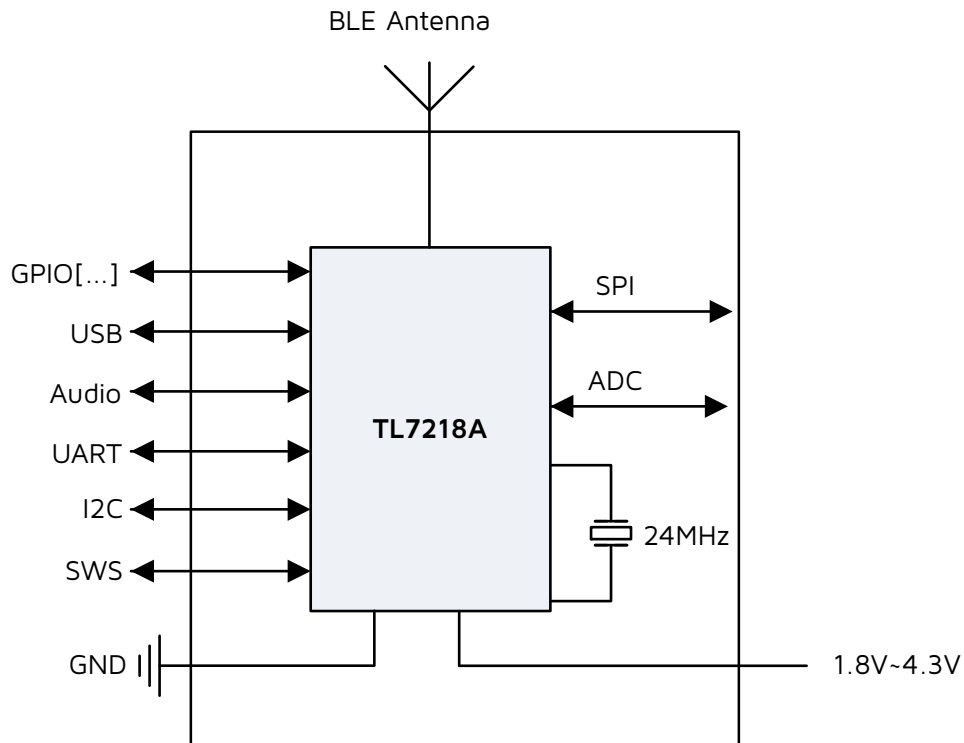
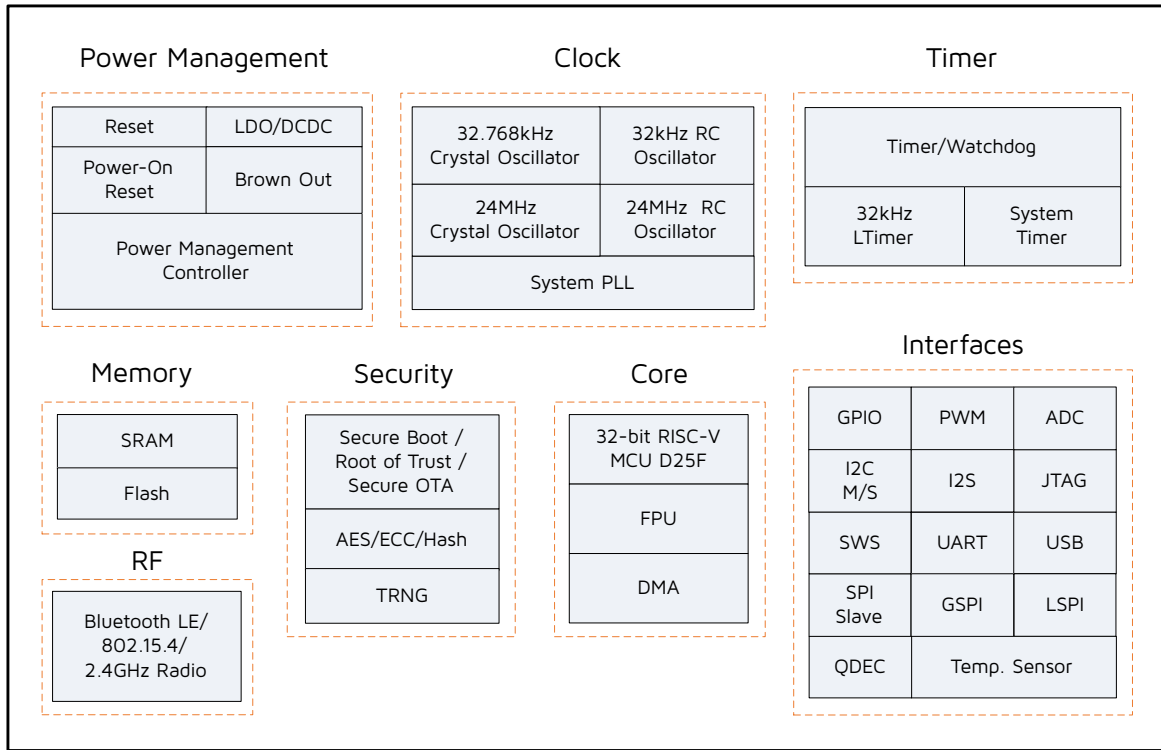


Figure 1-2 Block Diagram of the Module


The module integrates a powerful 32-bit RISC-V MCU, 512 KB SRAM including 256 KB retention SRAM, with 2 MB embedded flash, 12-bit ADC, PWM, flexible IO interfaces, and other peripheral blocks required for IoT applications.

1.2 Key Features

1.2.1 General Features

General features are as follows:

1. Supports 128-bit Unique ID (UID)
2. Security solution
 - Root of Trust
 - Secure Boot
 - Secure OTA
 - Firmware encryption
 - Secure Debug Port Control
 - Signature and verification based on RSA2048 or ECC256
 - Embedded hardware AES block cipher with 128-bit & 256-bit keys and software AES-CCM
 - Embedded hardware acceleration for elliptical curve cryptography (ECC) including ECC-P192, ECC-P256, ECC-P384, ECC-P512, ECDSA+ECDH, ED25519, and Curve25519
 - Embedded hardware acceleration for Hash function including SHA-1, SHA-2, SHA-256, SHA-384, and SHA-512



- Secure Key Accessing
- Supports PKE, Hash, SKE, TRNG
- 3. RTC and other timers
 - Clock source of 24 MHz & 32.768 kHz Crystal and 24 MHz & 32 kHz embedded RC oscillator
 - Two general 32-bit timers with four selectable modes in active mode
 - Watchdog timer
 - A low-frequency 32 kHz timer available in low power mode
 - A low-frequency 32 kHz Platform-Level Machine Timer (PLMT)
- 4. A rich set of digital and analog interfaces
 - Up to 48 GPIOs
 - 3 different SPI channels
 - GSPI: Global SPI
 - Up to 48 MHz SPI clock
 - Supports quad/dual/signal data line
 - Supports PSRAM interface
 - Supports Nor-Flash interface
 - Supports 4-channel CS_N for Multi-SPI Slave
 - LSPI: LCD SPI
 - Up to 48 MHz SPI clock
 - Supports quad/dual/signal data line
 - Supports TFT panel interface
 - Supports TFT panel interface without internal RAM
 - SPI Slave (SSPI): SPI Slave for external accessing
 - 2x I2C
 - 3x I2S
 - 3x UART with hardware flow control and 7816 protocol support
 - Supports JTAG/SDP/SWS debug interface
 - One JTAG/SDP interface for RISC-V core
 - SWS interface for whole system
 - USB 2.0 device, Full Speed
 - Up to 7 channels of differential PWM
 - Deep diming synchronization function
 - Preventing dead zones function
 - Enhanced resolution with dithering function
 - One quadrature decoder (QDEC), two-phase input selectable
 - Single-channel AMIC (Analog MIC) and Dual-channel DMIC with common audio chain
 - 12-bit auxiliary ADC
 - Low power comparator
 - Supports RZ (Return to Zero)
 - Supports PDM interface

- Supports PEM (Peripheral Event Matrix)
- 5. Supports OTA upgrade and Secure Boot switch, allowing convenient product feature roll outs and upgrades
- 6. Operating temperature range: -40°C ~ +85°C

1.2.2 CPU and Memory

1. 32-bit RISC-V micro-controller, D25F
 - Instruction and data cache controller (16 KB I-Cache and 8 KB D-Cache)
 - Maximum running speed up to 240 MHz
 - Integrated DSP extension instructions
 - SIMD Data Processing Instructions
 - Partial-SIMD Data Processing Instructions
 - 64-bit Profile Instructions
 - Non-SIMD Instructions
 - Overflow Status Manipulation Instructions
 - RISC-V RV32I base integer instruction set
 - RISC-V RVC standard extension for compressed instructions
 - RISC-V RVM standard extension for integer multiplication and division
 - RISC-V RVA standard extension for atomic instructions
 - RISC-V "F" standard extensions for single-precision floating-point
2. Memory architecture
 - Program memory: 2 MB embedded flash
 - 512KB SRAM including 256KB retention SRAM
 - Supply PSRAM from 2MB to 16MB
 - 8K bits OTP (One Time Program)
 - ROM for Secure Boot solution

1.2.3 RF Features

RF features include:

1. Bluetooth/802.15.4/2.4 GHz RF transceiver in worldwide 2.4 GHz ISM band
2. Bluetooth LE 1 Mbps and 2 Mbps, Long Range 125 kbps and 500 kbps, Hyper-length
3. Bluetooth High Accuracy Distance Measurement (AKA Channel Sounding) pre-standard version
4. Bluetooth LE AoA/AoD location features
5. IEEE 802.15.4 compliant, 250 kbps, and proprietary 2 Mbps High-Rate mode
6. 2.4 GHz proprietary 1 Mbps/2 Mbps/250 kbps/500 kbps mode
7. Supports flexible 2.4G link layer with configurable packet format
8. Rx Sensitivity: -96 dBm @ Bluetooth LE 1 Mbps, -93 dBm @ Bluetooth LE 2 Mbps mode, -104.5 dBm @ Long Range 125 kbps, -99 dBm @ Long Range 500 kbps; -103 dBm @ 802.15.4
9. TX output power: up to +9 dBm @ GFSK modulation
10. 50 Ω matched single-pin antenna input
11. RSSI monitoring with +/-1 dB resolution

12. Auto acknowledgment, retransmission and flow control
13. Supports PTA (Packet Traffic Arbitrator) for Wi-Fi co-existence

1.2.4 Features of Power Management Module

Features of power management module include:

1. Power supply
 - VDD (battery): 1.8 V ~ 4.3 V
 - VBUS (USB): 4.5 V ~ 5.5 V
2. Embedded LDO and DCDC
 - DCDC for 1.8 V flash with bypass LDO
 - DCDC for chip with bypass LDO
3. Battery monitor for low battery voltage detection
4. Brownout detection/shutdown and Power-On-Reset
5. Supports power reduction in different Clock Scenarios
6. IO power supply configurable 1.8 V or 3.3 V
7. Low power consumption:
 - Whole chip, BLE Receive: 2.6 mA @ BLE Rx 3.3 V DCDC mode, 5.5 mA @ BLE Rx LDO mode
 - Whole chip, BLE Transmit: 2.8 mA @ BLE Tx OdBm, 3.3 V DCDC mode, 8.8 mA @ BLE Tx OdBm LDO mode
 - Deep sleep with external wakeup (without SRAM retention): 1.0 μ A
 - Deep sleep with 32K RC oscillator and SRAM retention: 1.2 μ A (with 32 KB SRAM retention)

1.2.5 Bluetooth LE Features

Bluetooth LE features include:

1. Qualified Bluetooth[®] LE 6.0, main features include:
 - 1Mbps, 2Mbps, Long Range S2 (500 Kbps), S8 (125 Kbps)
 - High duty cycle non-connectable ADV
 - Extended ADV
 - LE channel selection algorithm #2
2. Bluetooth SIG Mesh support
3. Bluetooth based location and indoor positioning support with AoA and AoD (aka Bluetooth 6.0)
4. Bluetooth ISO channel support (aka Bluetooth 6.0) with broadcast and connected mode

1.2.6 Zigbee Features

Zigbee features include:

1. Supports Zigbee Pro R23, compatible with Zigbee Pro R22 and Zigbee Pro R21, supports Touchlink
2. Supports devices including Coordinator, Router and End Device
3. Supports Zigbee Direct protocol
4. Supports Sink mode and Proxy mode of Green Power

1.2.7 RF4CE Features

RF4CE features include:

1. Compliant to IEEE 802.15.4
2. Utilizes the industry standard AES-128 security scheme
3. Low-power and low-latency control for remote control products
4. Simple and intuitive discovery and pairing mechanism

1.2.8 OpenThread Features

OpenThread features include:

1. Implement all Thread networking layers (IPv6, 6LoWPAN, IEEE 802.15.4 with MAC security, Mesh Link Establishment, Mesh Routing)
2. Supports Full Thread Device (FTD) and Minimal Thread Device (MTD)
3. Supports rich applications
 - IPv6 configuration and raw data interface
 - UDP sockets
 - CoAP client and server
4. Thread and Zigbee share the same radio physical layer (modulation, occupied bandwidth, power level, channel frequency)

1.2.9 Matter Features

Matter features include:

1. Supports Matter over Thread
2. Supports Multi-Admin works across & with multiple ecosystems

1.2.10 Timer Features

1. The SoC has two timers: timer0 and timer1
2. Both timers support four modes:
 - Mode 0 (System Clock Mode)
 - Mode 1 (GPIO Trigger Mode)
 - Mode 2 (GPIO Pulse Width Mode)
 - Mode 3 (Tick Mode)
3. The input capture function and output compare function of timer0 and timer1 are new
4. The Input Capture function can be used with mode 0 and mode 3
5. The Output Compare function can be used with the mode
6. The Input Capture function and the Output Compare function can work at the same time
7. New Input Capture function for System Timer

1.2.11 RZ Features

1. The RZ (Return to Zero) module adopts single wire return to zero code protocol for communication transmission, and can drive serial or parallel pixel ICs

2. RZ Code Timing can be configured flexibly to match different Pixel ICs
3. There are two addressing modes for pixel ICs:
 - Serial sequential addressing
 - Parallel random addressing
4. The RZ module has no CPU intervention during transmission
5. DMA handling data is bounded by 8 bits

1.2.12 Certification

1. RF certification: FCC/IC/CE/TELEC/NCC/SRRC
2. Environmental certification: RoHS/REACH

1.3 Typical Applications

The ML7218A-GAIA-MO-PE11 is an ideal module for IoT applications. Its typical applications include, but are not limited to the following:

- Smart RF remote control
- Keyboard, mouse, dongle
- Smart home device
- Smart lighting device
- Wireless HID
- Wearable device
- Asset tracking device

1.4 Ordering Information

Table 1-1 Ordering Information of ML7218A-GAIA-MO-PE11

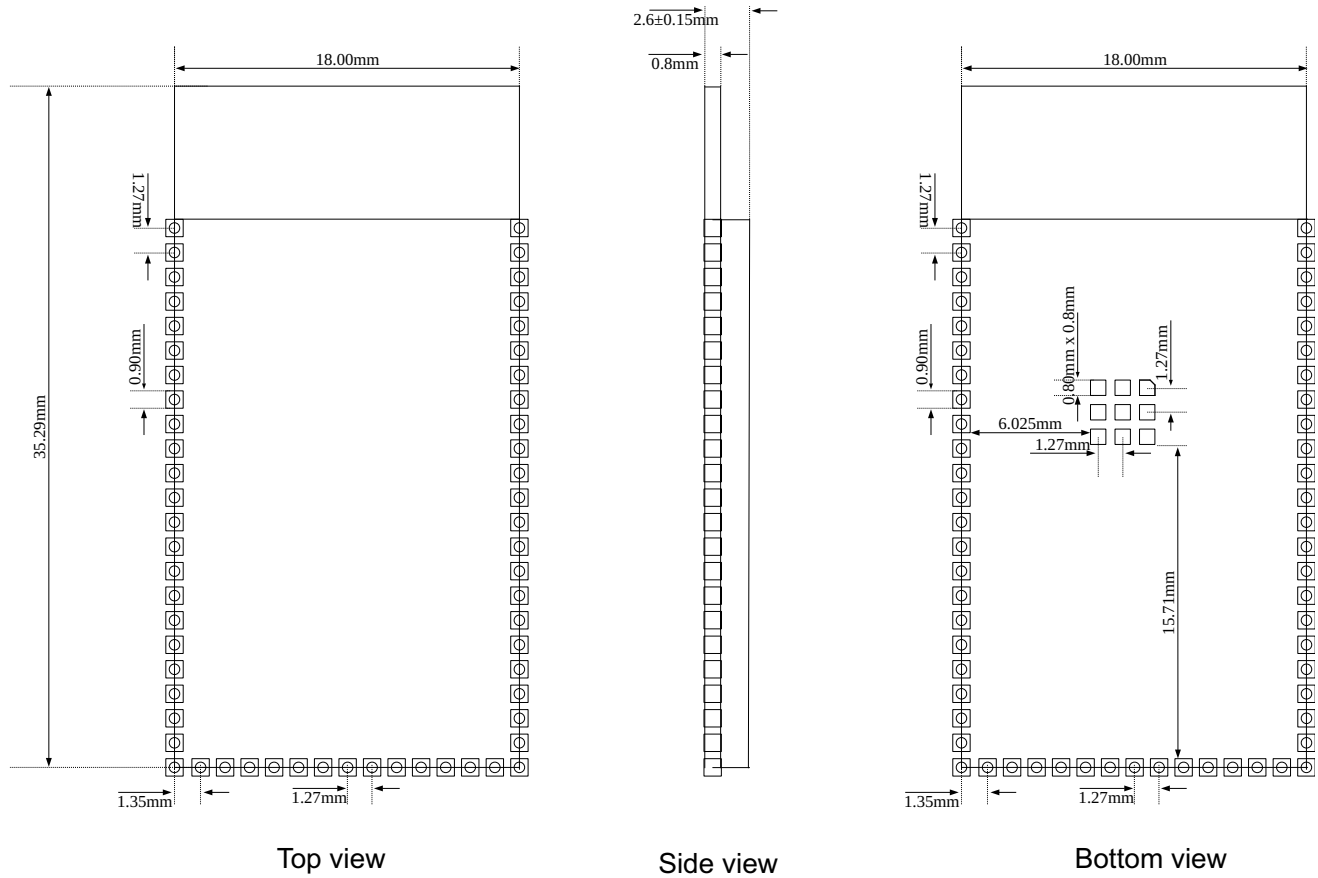
Product Series	Ordering No.	Package	SRAM	Flash	Temperature Range
ML7218A-GAIA	ML7218A-GAIA-MO-PE11	18x35.29 mm	512 KB	2 MB	-40°C~+85°C

1.5 Package Information

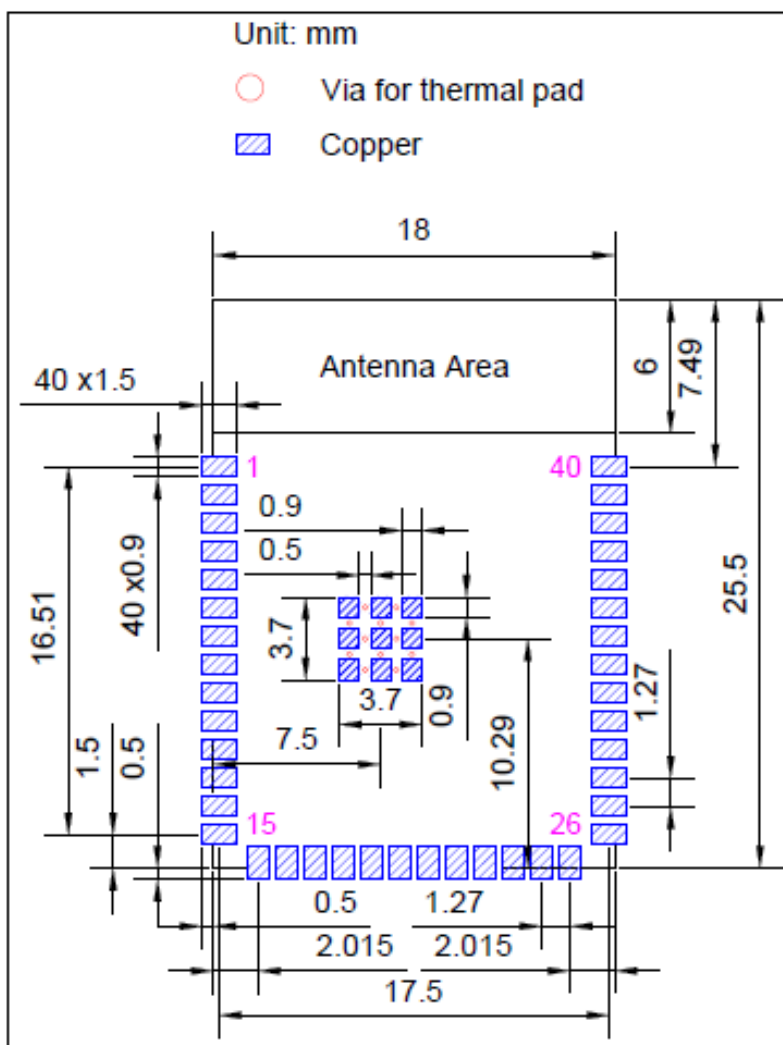
1.5.1 Module Dimensions

The Package dimensions of ML7218A-GAIA-MO-PE11 are shown below.

Figure 1-3 Package of ML7218A-GAIA-MO-PE11



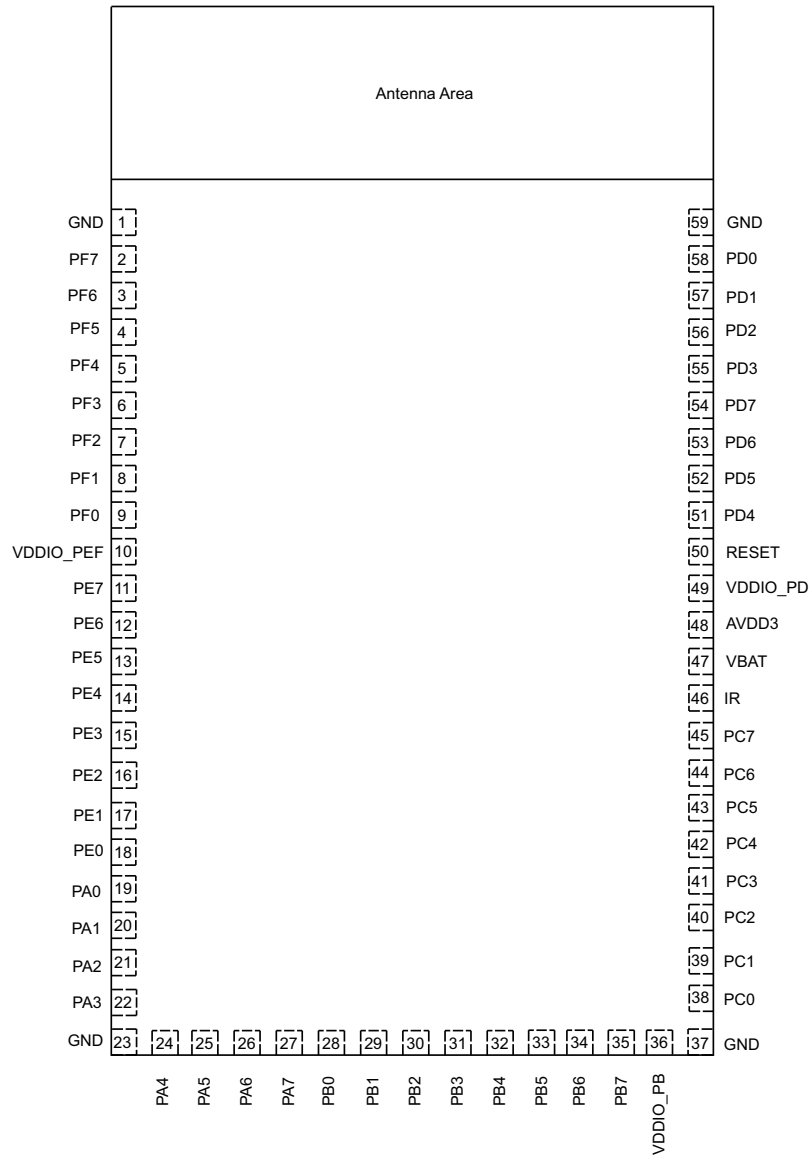
The PCB footprint and land pattern of the module is shown as below.



1.6 Pin Layout

Pin assignment of the module is shown below.

Figure 1-5 Pin Assignment



Functions of 59 pins are described in table below.

Table 1-2 Pin Function of ML7218A-GAIA-MO-PE11

No.	Pin Name	Type	Description
1	GND	GND	Ground
2	PF[7]	GPIO	GPIO PF[7]
3	PF[6]	GPIO	GPIO PF[6]
4	PF[5]	GPIO	GPIO PF[5]
5	PF[4]	GPIO	GPIO PF[4]

No.	Pin Name	Type	Description
6	PF[3]	GPIO	GPIO PF[3]
7	PF[2]	GPIO	GPIO PF[2]
8	PF[1]	GPIO	GPIO PF[1]
9	PF[0]	GPIO	GPIO PF[0]
10	VDDIO_PEF	PWR	IO voltage for PE0 ~ PE7, PFO ~ PF7, PA0 ~ PA4, configurable to 3.3V or 1.8V
11	PE[7]	GPIO	GPIO PE[7]
12	PE[6]	GPIO	GPIO PE[6]
13	PE[5]	GPIO	GPIO PE[5]
14	PE[4]	GPIO	GPIO PE[4]
15	PE[3]	GPIO	GPIO PE[3]
16	PE[2]	GPIO	GPIO PE[2]
17	PE[1]	GPIO	GPIO PE[1]
18	PE[0]	GPIO	GPIO PE[0]
19	PA[0]	GPIO	GPIO PA[0]
20	PA[1]	GPIO	GPIO PA[1]
21	PA[2]	GPIO	GPIO PA[2]
22	PA[3]	GPIO	GPIO PA[3]
23	GND	GND	Ground
24	PA[4]	GPIO	GPIO PA[4]
25	PA[5]	GPIO	GPIO PA[5]
26	PA[6]	GPIO	GPIO PA[6]
27	PA[7]	GPIO	GPIO PA[7]
28	PB[0]	GPIO	GPIO PB[0]
29	PB[1]	GPIO	GPIO PB[1]
30	PB[2]	GPIO	GPIO PB[2]
31	PB[3]	GPIO	GPIO PB[3]
32	PB[4]	GPIO	GPIO PB[4]
33	PB[5]	GPIO	GPIO PB[5]

No.	Pin Name	Type	Description
34	PB[6]	GPIO	GPIO PB[6]
35	PB[7]	GPIO	GPIO PB[7]
36	VDDIO_PB	PWR	IO voltage for PB0 ~ PB7, PC0 ~ PC7 and PA7, configurable to 3.3V or 1.8V
37	GND	GND	Ground
38	PC[0]	GPIO	GPIO PC[0]
39	PC[1]	GPIO	GPIO PC[1]
40	PC[2]	GPIO	GPIO PC[2]
41	PC[3]	GPIO	GPIO PC[3]
42	PC[4]	GPIO	GPIO PC[4]
43	PC[5]	GPIO	GPIO PC[5]
44	PC[6]	GPIO	GPIO PC[6]
45	PC[7]	GPIO	GPIO PC[7]
46	IR	Analog	Infrared radiation learning
47	VBAT	PWR	Battery power supply
48	AVDD3	PWR	3.3V analog power supply
49	VDDIO_PD	PWR	IO voltage for PD0 ~ PD7, configurable to 3.3V or 1.8V
50	RESET	RESET	Reset pin
51	PD[4]	GPIO	GPIO PD[4]
52	PD[5]	GPIO	GPIO PD[5]
53	PD[6]	GPIO	GPIO PD[6]
54	PD[7]	GPIO	GPIO PD[7]
55	PD[3]	GPIO	GPIO PD[3]
56	PD[2]	GPIO	GPIO PD[2]
57	PD[1]	GPIO	GPIO PD[1]
58	PD[0]	GPIO	GPIO PD[0]
59	GND	GND	Ground

GPIO pin mux functions of ML7218A-GAIA-MO-PE11 are shown in the table below.

Table 1-3 GPIO Pin Mux of ML7218A-GAIA-M0-PE11

Pad	Default	Function1	Function2	Analog Function
PA[0]	GPIO	All functions ^a	SWM	-
PA[1]	GPIO	All functions	SWM	-
PA[2]	GPIO	All functions	SWM	-
PA[3]	GPIO	All functions	SWM	-
PA[4]	GPIO	All functions	SWM	-
PA[5]	GPIO	-	DM	-
PA[6]	GPIO	-	DP	-
PA[7]	SWS	-	SWS	-
PB[0]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PB[1]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PB[2]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PB[3]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PB[4]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PB[5]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PB[6]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PB[7]	GPIO	All functions	SWM	sar_in/lc_cmp_in
PC[0]	SSPI_CN	All functions	SSPI_CN	-
PC[1]	SSPI_CK	All functions	SSPI_CK	-
PC[2]	SSPI_SI	All functions	SSPI_SI	-
PC[3]	SSPI_SO	All functions	SSPI_SO	-
PC[4]	TDI	All functions special ^b	TDI	-
PC[5]	TDO	All functions special	TDO	-
PC[6]	TMS	All functions special	TMS	-
PC[7]	TCK	All functions special	TCK	-
PD[0]	GPIO	All functions	SWM	Audio in/sar in
PD[1]	GPIO	All functions	SWM	led_strip_in1/sar_in
PD[2]	GPIO	All functions	SWM	32K xc2/led_strip_in2

Pad	Default	Function1	Function2	Analog Function
PD[3]	GPIO	All functions	SWM	32K xc1/diag_hv_ana
PD[4]	GPIO	All functions	SWM	atb0
PD[5]	GPIO	All functions	SWM	atb1
PD[6]	GPIO	All functions	SWM	-
PD[7]	GPIO	All functions	SWM	-
PE[0]	GPIO	All functions special	SWM	-
PE[1]	GPIO	-	LSPI_CLK	-
PE[2]	GPIO	-	LSPI_MOSI	-
PE[3]	GPIO	-	LSPI_MISO	-
PE[4]	GPIO	-	LSPI_IO2	-
PE[5]	GPIO	-	LSPI_IO3	-
PE[6]	GPIO	All functions	SWM	-
PE[7]	GPIO	All functions	SWM	-
PF[0]	GPIO	All functions	SWM	-
PF[1]	GPIO	All functions	SWM	-
PF[2]	GPIO	All functions	SWM	-
PF[3]	GPIO	All functions	SWM	-
PF[4]	GPIO	All functions	SWM	-
PF[5]	GPIO	All functions special	SWM	-
PF[6]	GPIO	All functions special	SWM	-
PF[7]	GPIO	All functions special	SWM	-

a. "All functions" include 90 functions: SWM, RZ_TX, MSPI_CN1, LSPI_CN, TMR1_CMP, TMRO_CMP, PWM6_N, PWM6, PWM_SYNC, KEYS, SSPI_SO, SSPI_SI, SSPI_CLK, SSPI_CN, I2S2_CLK, I2S2_DAT1, I2S2_LR1, I2S2_DAT0, I2S2_LR0, I2S2_BCK, SDM1_N, SDM1_P, SDMO_N, SDMO_P, UART2_RTX, UART2_TX, UART2_RTS, UART2_CTS, IR_LEARN, ATSEL_5, ATSEL_4, GSPI_CN3, GSPI_CN2, GSPI_CN1, I2C1_SCL, I2C1_SDA, RX_CYC2LNA, ATSEL_3, ATSEL_2, ATSEL_1, ATSEL_0, BT_STATUS, BT_ACTIVITY, WIFI_DENY, TX_CYC2PA, MSPI_CN3, MSPI_CN2, DMICO_DAT, DMICO_CLK, I2S1_CLK, I2S1_DAT1, I2S1_LR1, I2S1_DAT0, I2S1_LR0, I2S1_BCK, I2S0_CLK, I2S0_DAT1, I2S0_LR1, I2S0_DAT0, I2S0_LR0, I2S0_BCK, CLK_7816, UART1_RTX, UART1_TX, UART1_RTS, UART1_CTS, UART0_RTX, UART0_TX, UART0_RTS, UART0_CTS, I2C_SDA, I2C_SCL, GSPI_MOSI, GSPI_MISO, GSPI_IO2, GSPI_IO3, GSPI_CLK, GSPI_CN0, PWM5_N, PWM4_N, PWM3_N, PWM2_N, PWM1_N, PWM0_N, PWM5, PWM4, PWM3, PWM2, PWM1, PWM0.

b. "All functions special" include 89 functions, which is above 90 functions exclude KEYS.



2 Electrical Specifications

NOTE: The electrical characteristics currently listed in this section are target specifications and only provided for reference. Some data may be updated according to actual test results.

2.1 Absolute Maximum Rating

Table 2-1 Absolute Maximum Rating

Characteristics	Sym.	Min.	Max.	Unit	Test Condition
Supply voltage	VBAT	-0.3	4.3	V	-
Voltage on input pin	V_{in}	-0.3	VDD+0.3	V	-
Output voltage	V_{out}	0	VDD	V	-
Storage temperature range	T_{Str}	-65	150	°C	-
Soldering temperature	T_{Sld}	-	260	°C	-

NOTE:

- Stresses above those listed in “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.
- VDD stands for IO voltage, the IO voltage for the GPIO pin refers to the specific group it belongs.

2.2 Recommended Operating Conditions

Table 2-2 Recommend Operating Conditions

Item	Sym.	Min.	Typ.	Max.	Unit	Condition
Power supply voltage	VBAT	1.8	3.7	4.3	V	-
Supply rise time (from 1.6 V to 1.8 V)	T_R	-	-	10	ms	-
Operating temperature range	T_{Opr}	-40	-	85	°C	-

2.3 DC Characteristics

Unless otherwise stated, the general test conditions are: T = 25°C.

Table 2-3 RX/TX Current and Sleep Current

Item	Sym.	Min	Typ.	Max	Unit	Conditions
RX current	I_{Rx}	-	2.6	-	mA	Whole chip, 3.3 V DCDC, BLE mode ^a
		-	5.5	-	mA	Whole chip, LDO mode
TX current	I_{Tx}	-	2.8	-	mA	Whole chip @ 0 dBm with 3.3 V DCDC, BLE mode
		-	8.8	-	mA	Whole chip @ 0 dBm LDO mode
Deep sleep with 32 KB SRAM retention	I_{Deep1}	-	2.4	-	μA	Without 32K RC ^b
Deep sleep with 64 KB SRAM retention		-	3.4	-	μA	
Deep sleep with 128 KB SRAM retention		-	5.4		μA	
Deep sleep with 256 KB SRAM retention		-	9.2		μA	
Deep sleep without SRAM retention	I_{Deep2}	-	1.0	-	μA	
Deep sleep with 32 KB SRAM retention	I_{Deep3}	-	3.4	-	μA	With 32K RC ^c
Deep sleep with 64 KB SRAM retention		-	5.5	-	μA	
Deep sleep with 128 KB SRAM retention			10.1		μA	
Deep sleep with 256 KB SRAM retention			18.7		μA	
Deep sleep without SRAM retention	I_{Deep4}	-	1.2	-	μA	

a. The complete test conditions for TX/RX current: (1) turn off the clock and power of the modules irrelevant to RF; (2) hold the modules irrelevant to RF; (3) disable PLL clock and RC_24M to make the Pad_24M is the only clock source for cclk; (4) stall the MCU.

b. Without 32K RC: The wakeup source is external signal from GPIO input, the internal 32K RC is disabled.

c. With 32K RC: The wakeup source is 32K RC, it is enabled.

Table 2-4 Digital Inputs/Outputs

Item	Sym.	Min.	Typ.	Max.	Unit	Conditions
Input high voltage	V_{IH}	$0.7 \cdot V_{DD}$	-	V_{DD}	V	-
Input low voltage	V_{IL}	VSS	-	$0.3 \cdot V_{DD}$	V	-
Output high voltage	V_{OH}	$0.9 \cdot V_{DD}$	-	V_{DD}	V	-
Output low voltage	V_{OL}	VSS	-	$0.1 \cdot V_{DD}$	V	-

2.4 AC Characteristics

NOTE: The data in this section is only provided for reference and will be updated according to actual test results.

2.4.1 RF Performance

Unless otherwise stated, the general test conditions are: $V_{DD} = 4.2 \text{ V}$, $T = 25^\circ\text{C}$.

Table 2-5 RF Performance Characteristics

Item		Sym.	Min.	Typ.	Max.	Unit	Conditions
RF frequency range		-	2400	-	2483.5	MHz	Programmable in 1 MHz step
Data rate		Bluetooth LE/2.4G proprietary 1 Mbps, ±250 kHz deviation Bluetooth LE/2.4G proprietary 2 Mbps, ±500 kHz deviation Bluetooth LE 125 kbps, ±250 kHz deviation Bluetooth LE 500 kbps, ±250 kHz deviation IEEE 802.15.4 250 kbps, ±500 kHz deviation 2.4GHz proprietary 250 kbps, ±62.5 kHz deviation 2.4GHz proprietary 500 kbps, ±125 kHz deviation					
Bluetooth LE 1 Mbps RF_RX Performance (±250 kHz Deviation)							
Sensitivity	1 Mbps	-	-	-96	-	dBm	-
Co-channel rejection		-	-	7.4	-	dB	Wanted signal at -67 dBm



Item		Sym.	Min.	Typ.	Max.	Unit	Conditions
In-band blocking rejection (equal modulation interference)	+1/-1 MHz offset	-	-	-4/-4	-	dB	Wanted signal at -67 dBm
	+2/-2 MHz offset	-	-	-42/-32	-	dB	
	≥ 3 MHz offset	-	-	-45	-	dB	
Image rejection		-	-	-32	-	dB	Wanted signal at -67 dBm; image frequency = RF_channel - 2MHz
Bluetooth LE 1 Mbps RF_TX Performance							
Output power, maximum setting		-	-	9	-	dBm	-
Output power, minimum setting		-	-	-20.2	-	dBm	-
Programmable output power range		-	30.2			dB	-
Modulation 20 dB bandwidth		-	-	1.4	-	MHz	-
Bluetooth LE 2 Mbps RF_RX Performance (±500 kHz Deviation)							
Sensitivity	2 Mbps	-	-	-93	-	dBm	-
Co-channel rejection		-	-	8	-	dB	Wanted signal at -67 dBm
In-band blocking rejection	+2/-2 MHz offset	-	-	-7/-8	-	dB	Wanted signal at -67 dBm
	+4/-4 MHz offset	-	-	-43/-31	-	dB	
	> 6 MHz offset	-	-	-50	-	dB	
Image rejection		-	-	-25	-	dB	Wanted signal at -67 dBm; image frequency = RF_channel - 3 MHz
Bluetooth LE 2 Mbps RF_TX Performance							



Item		Sym.	Min.	Typ.	Max.	Unit	Conditions
Output power, maximum setting		-	-	9	-	dBm	-
Output power, minimum setting		-	-	-20.2	-	dBm	-
Programmable output power range			30.2			dB	-
Modulation 20 dB bandwidth		-	-	2.5	-	MHz	-
Bluetooth LE 125 kbps RF_RX Performance (±250kHz Deviation)							
Sensitivity	125 kbps	-	-	-104.5	-	dBm	-
Co-channel rejection		-	-	3.3	-	dB	Wanted signal at -79 dBm
In-band blocking rejection (equal modulation interference)	+1/-1 MHz offset	-	-	-10/-10	-	dB	Wanted signal at -79 dBm
	+2/-2 MHz offset	-	-	-38/-38	-	dB	
	≥ 3 MHz offset	-	-	-48/-48	-	dB	
Image rejection		-	-	-38	-	dB	Wanted signal at -79 dBm; image frequency = RF_channel - 2 MHz
Bluetooth LE 125 kbps RF_TX Performance							
Output power, maximum setting		-	-	9	-	dBm	-
Output power, minimum setting (resolution)		-	-	-20.2	-	dBm	-
Programmable output power range		-	30.2			dB	-
Modulation 20 dB bandwidth		-	-	1.4	-	MHz	-
Bluetooth LE 500 kbps RF_RX Performance (±250 kHz Deviation)							
Sensitivity	500 kbps	-	-	-99	-	dBm	-



Item		Sym.	Min.	Typ.	Max.	Unit	Conditions
Co-channel rejection		-	-	4	-	dB	Wanted signal at -72 dBm
In-band blocking rejection (equal modulation interference)	+1/-1 MHz offset	-	-	-6/-6	-	dB	Wanted signal at -72 dBm
	+2/-2 MHz offset	-	-	-38/-34	-	dB	
	≥ 3 MHz offset	-	-	-48	-	dB	
Image rejection		-	-	-36	-	dB	Wanted signal at -72 dBm; image frequency = RF_channel - 2 MHz
Bluetooth LE 500 kbps RF_TX Performance							
Output power, maximum setting		-	-	9	-	dBm	-
Output power, minimum setting		-	-	-20.2	-	dBm	-
Programmable output power range		-	30.2			dB	-
Modulation 20 dB bandwidth		-	-	1.4	-	MHz	-
Zigbee/Rf4CE/6LoWPan/Thread RF_RX Performance (IEEE 802.15.4 250 kbps ±500 kHz Deviation)							
Sensitivity	250 kbps	-	-	-103	-	dBm	-
Adjacent channel rejection (-1/+1 channel)		-	-	-38/-38	-	dB	Wanted signal at -82 dBm
Adjacent channel rejection (-2/+2 channel)		-	-	-38/-38	-	dB	Wanted signal at -82 dBm
Zigbee/Rf4CE/6LoWPan/Thread RF_TX Performance (IEEE 802.15.4 250 kbps)							
Output power, maximum setting		-	-	8.5	-	dBm	-
Output power, minimum setting (resolution)		-	-	-20.2	-	dBm	-

Item	Sym.	Min.	Typ.	Max.	Unit	Conditions
Programmable output power range	-	28.7			dB	-
Modulation 20 dB bandwidth	-	-	2.7	-	MHz	-
Error vector magnitude	EVM	-	-	2%	-	Max (10 dBm) power output

2.5 ESD Characteristics

The module adopts the Contact test scheme specified in specification IEC61000-4-2 for the ESD characteristics, and it is capable of passing the test at the Level 1 test grade with the voltage of 2 KV.

Table 2-6 Contact Results

Model	ESD Sensitivity Pass: +/-2KV	V Class
Contact	±2KV	IEC 61000-4-2 (ESD)

2.6 Storage Conditions

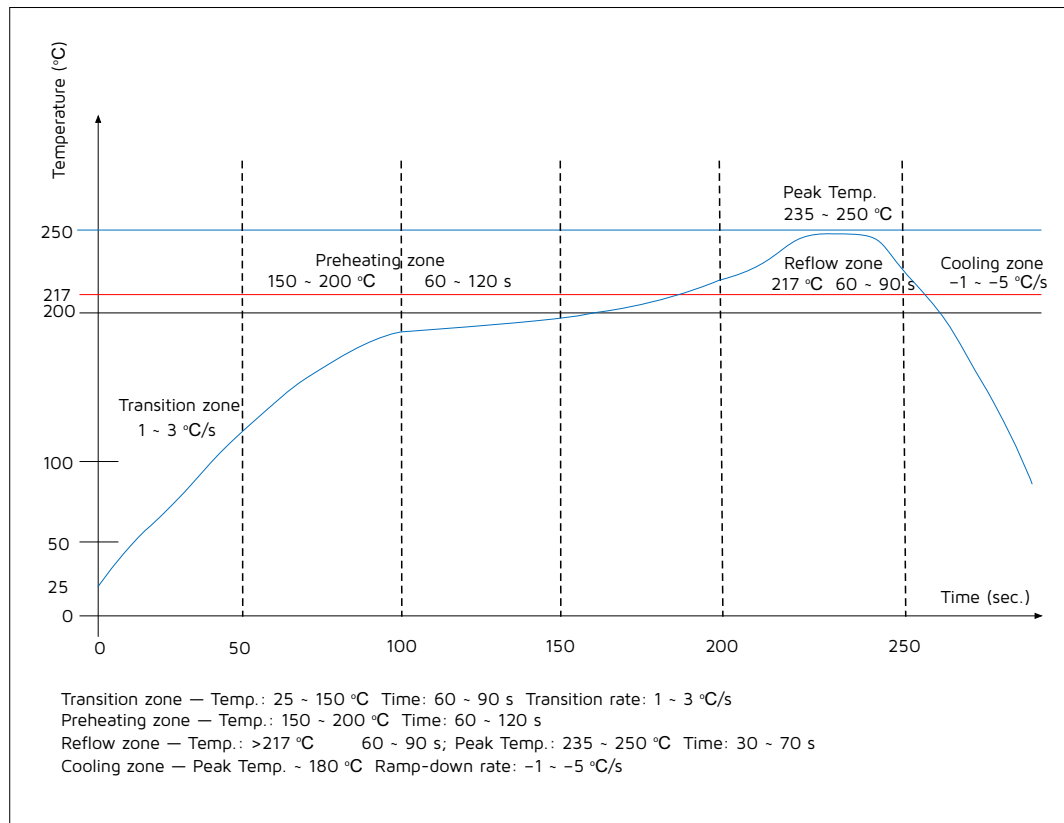
The module series is applicable to Moisture Sensitivity Level 3 (based on JEDEC Standard).

- Calculated shelf life in sealed moisture barrier bag (MBB): 12 months at <40°C and <90% relative humidity (RH)
- Peak package body temperature: 260°C
- After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be
 - Mounted within: 168 hours of factory conditions <=30°C/60% RH, or
 - Stored at <10% RH
- Devices require bake before mounting, if:
 - Humidity Indicator Card reads >10% when read at 23 ± 5°C
 - Both of the conditions in 3 are not met
- If baking is required, devices may be baked for 24 hours at 125 ±5°C

Note: If device containers cannot be subjected to high temperature or shorter bake times are desired, please refer to IPC/JEDEC J-STD-033 for bake condition.

2.7 Soldering Profile

The reflow profile is shown below. It is recommended that the module be soldered in a single reflow

Figure 2-1 Reflow Profile


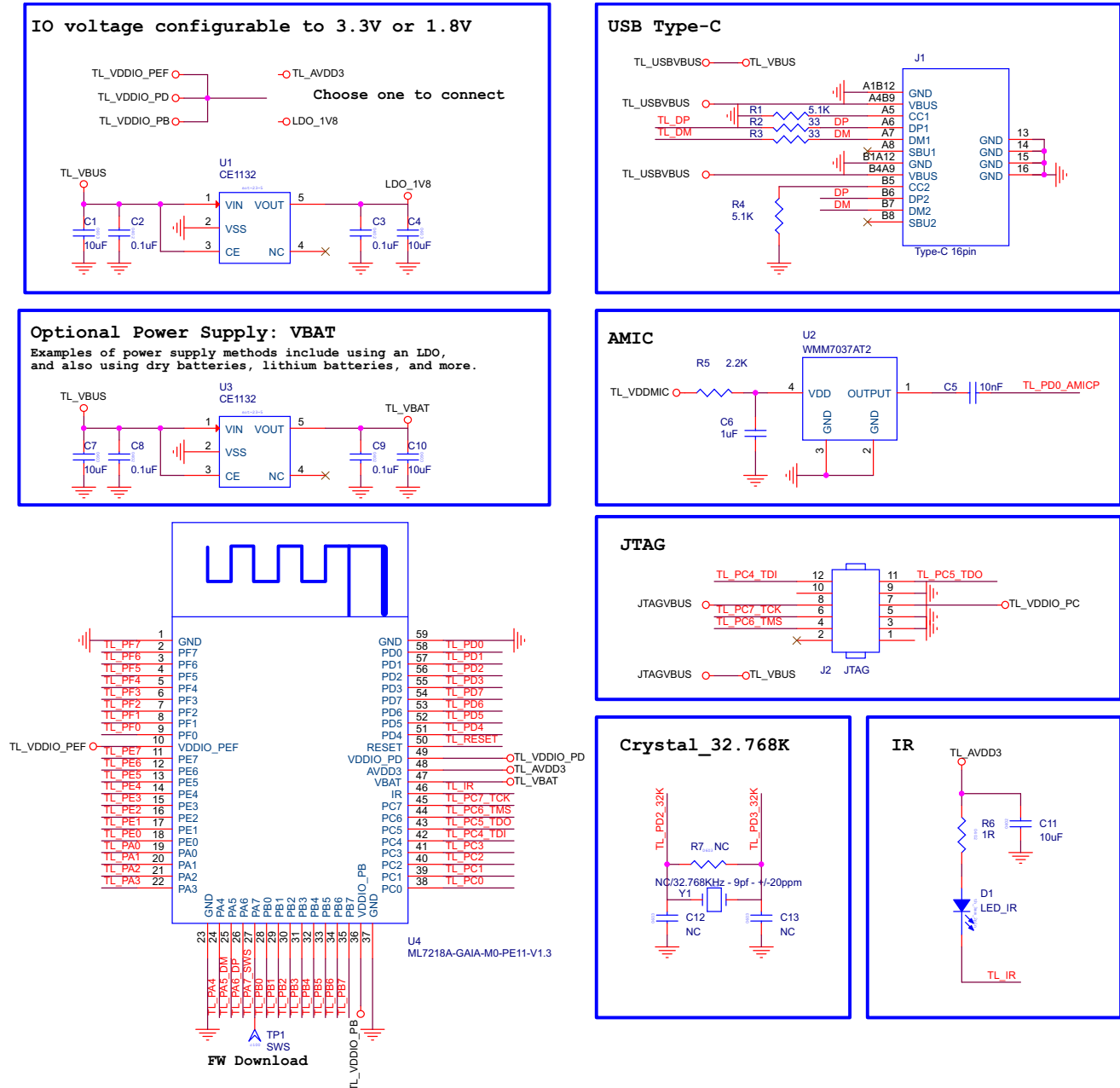


3 Schematics

3.1 Reference Schematic

The reference schematic of ML7218A-GAIA-MO-PE11 is shown below.

Figure 3-2 Reference Schematic



4 Antenna Test

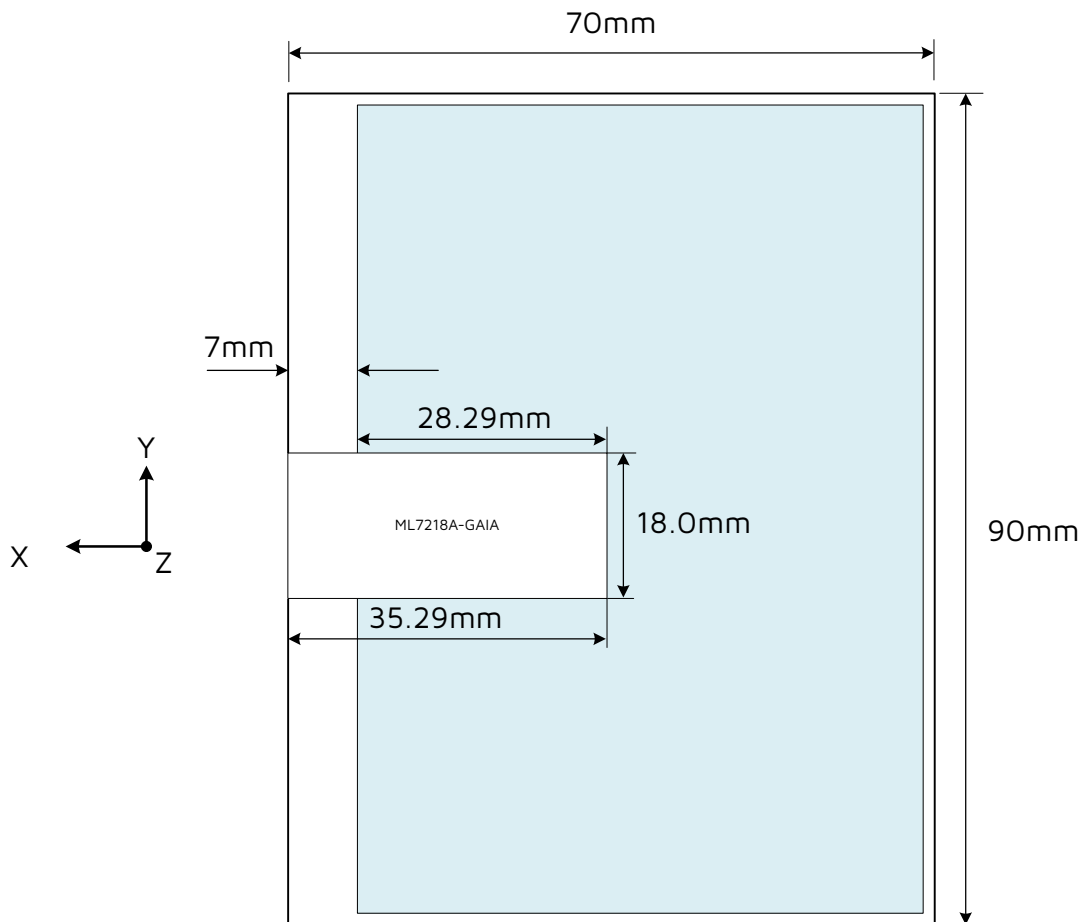
4.1 Test Condition

The integrated antenna of ML7218A-GAIA-MO-PE11 requires a suitable ground plane to radiate efficiently.

The area below and extending out of the module antenna part should be kept clean from copper and other metals. The module should be placed at the edge of the PCB with the edge face of the antenna facing outward.

The RF layout and ground plane dimension for the antenna test is shown as below.

Figure 4-1 RF Layout and Ground Plane



4.2 Test Result

4.2.1 Antenna Test Result

Table 4-1 Antenna Test Result

Test / Position	Gain / Free Space		
Frequency (MHz)	2402	2440	2480
Avg Gain	-1.8	-1.3	-1.0
Peak Gain	2.6	2.6	3.1
Directivity	4.4	3.9	4.1
Efficiency	-1.8	-1.3	-1.0
Efficiency (%)	66.1	73.7	79.5

4.2.2 Antenna Patterns

The antenna patterns are tested under [4.1 Test Condition](#) and the X-Y-Z orientation is shown in [Figure](#) .

Figure 4-2 Antenna Pattern of X-Y Plane

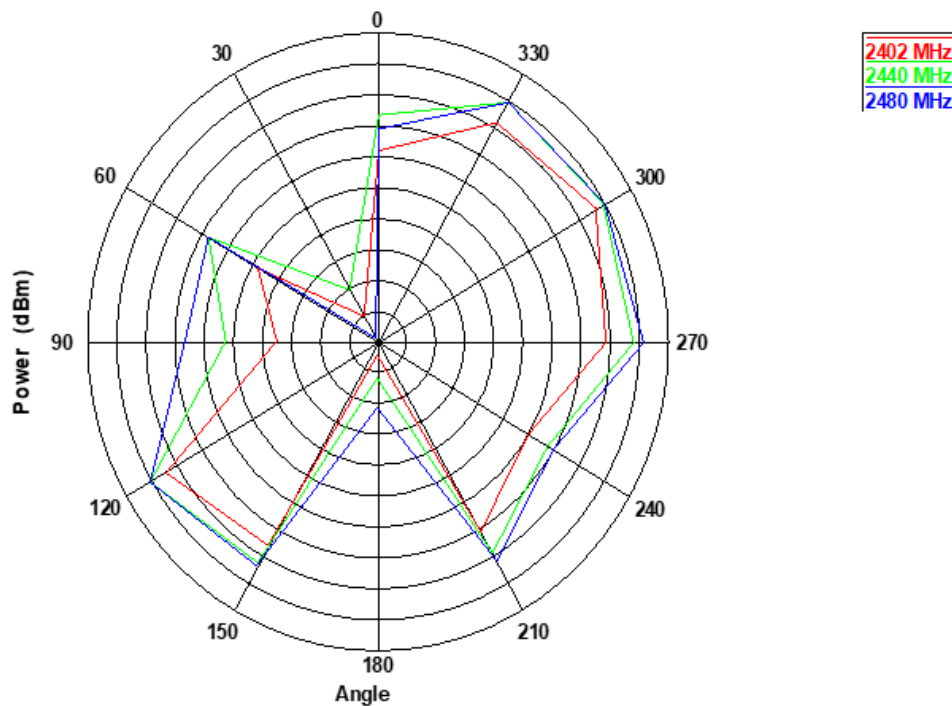


Figure 4-3 Antenna Pattern of X-Z Plane

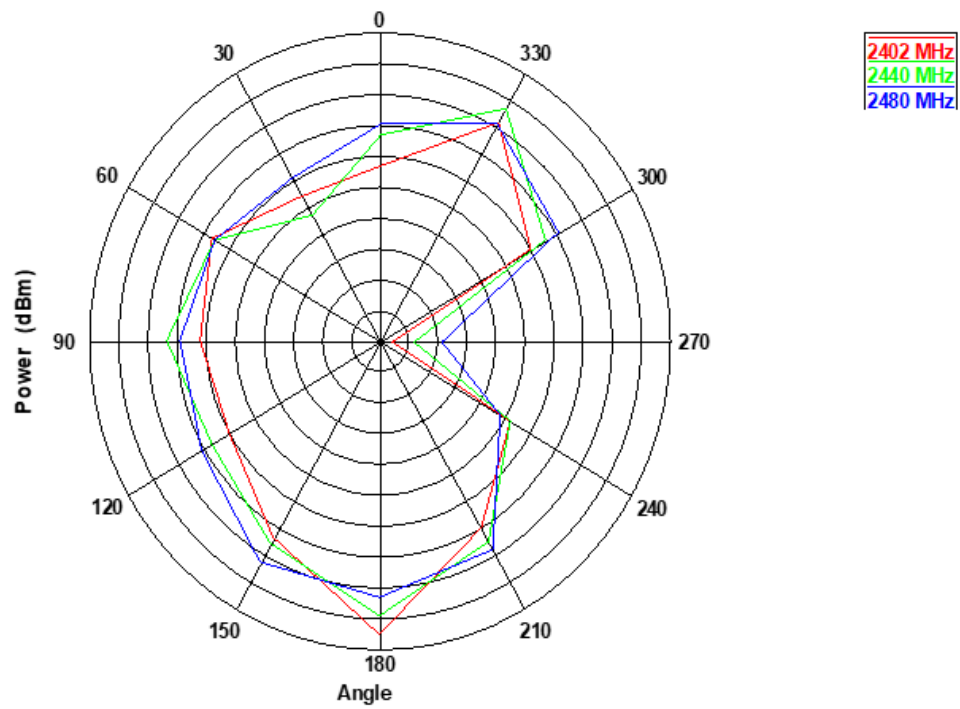


Figure 4-4 Antenna Pattern of Y-Z Plane

