



AM TELECOM

Communication Module

AML550

Hardware User Guide



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Introduction

This module is designed with a Qualcomm MDM9207 chipset solution. It supports GSM, UMTS, LTE, GNSS with small size and thin 2.2mm thickness.

It will be given a best choice to all customers who want LTE wireless data communication. Any portable devices such as Laptop, Tablet PC and PDA, and various M2M devices can be designed with minimum efforts.

1. System Specification

1.1. Physical feature

Item	Specification
Dimension ^(*1)	30.0±0.20 (W) x 30.0±0.20 (D) x 2.2±0.15 (H) mm
Weight	T.B.D
Mounting type	SMD

*NOTE^(*1): The dimension includes a label thickness*

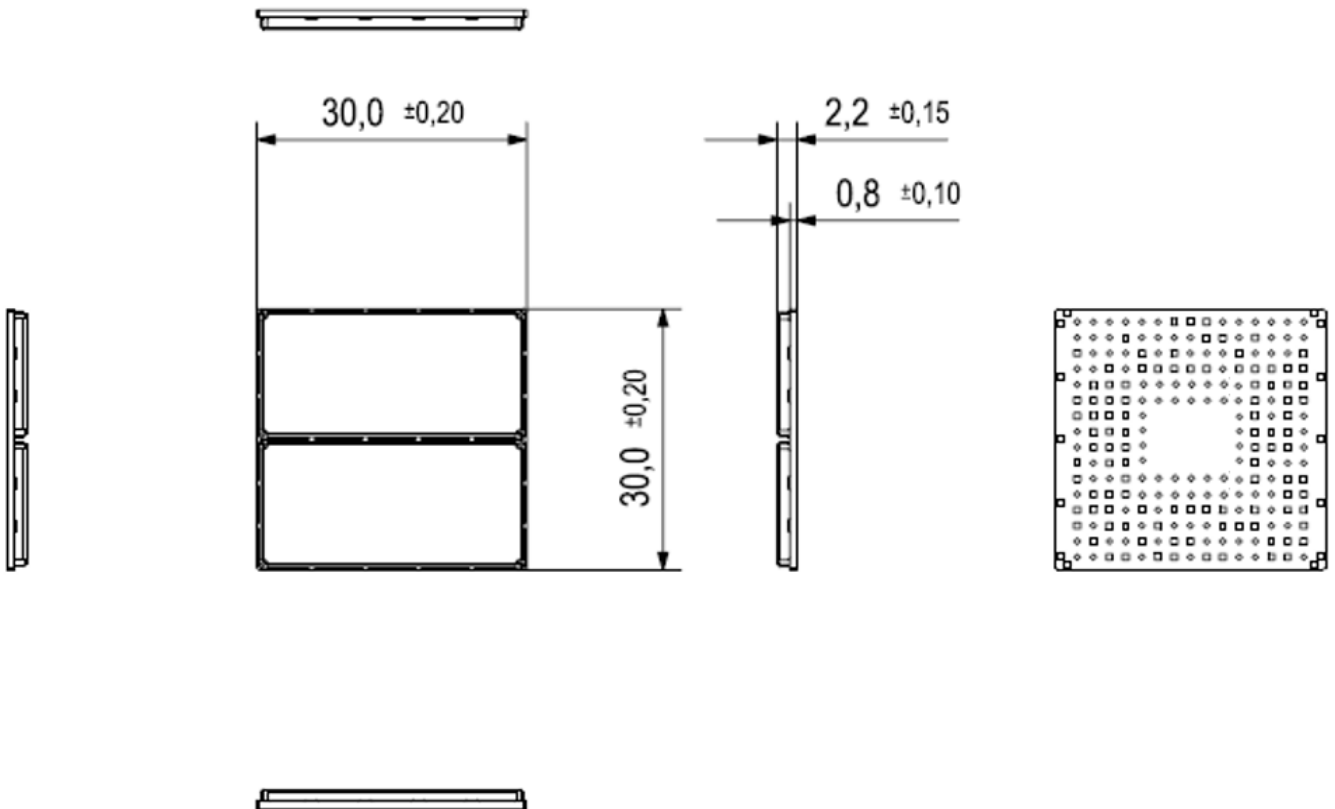


Figure 1. Physical dimension

1.2. Modem specification

1.2.1. Modem Frequency specification

Technology		Uplink	Downlink	Comment
LTE	Band 1	1920 ~ 1980 MHz	2110 ~ 2170 MHz	FDD
	Band 2	1850 ~ 1910 MHz	1930 ~ 1990 MHz	
	Band 3	1710 ~ 1785 MHz	1805 ~ 1880 MHz	
	Band 4	1710 ~ 1755 MHz	2110 ~ 2155 MHz	
	Band 5	824 ~ 849 MHz	869 ~ 894 MHz	
	Band 7	2500 ~ 2570 MHz	2620 ~ 2690 MHz	
	Band 8	880 ~ 915 MHz	925 ~ 960 MHz	
	Band 9	1749.9 ~ 1784.9 MHz	1844.9 ~ 1879.9 MHz	
	Band 12	699 ~ 716 MHz	729 ~ 746 MHz	
	Band 17	704 ~ 716 MHz	734 ~ 746 MHz	
	Band 18	815 ~ 830 MHz	860 ~ 875 MHz	
	Band 19	830 ~ 845 MHz	875 ~ 890 MHz	
	Band 20	832 ~ 862 MHz	791 ~ 821 MHz	
	Band 26	814 ~ 849 MHz	859 ~ 894 MHz	
UMTS	Band 1	1920 ~ 1980 MHz	2110 ~ 2170 MHz	FDD
	Band 2	1850 ~ 1910 MHz	1930 ~ 1990 MHz	
	Band 4	1710 ~ 1755 MHz	2110 ~ 2155 MHz	
	Band 5	824 ~ 849 MHz	869 ~ 894 MHz	
	Band 6	830 ~ 840 MHz	875 ~ 885 MHz	
	Band 8	880 ~ 915 MHz	925 ~ 960 MHz	
	Band 19	830 ~ 845 MHz	875 ~ 890 MHz	
GSM	850	824.2 ~ 848.8 MHz	869.2 ~ 893.8 MHz	TDD
	900	880.2 ~ 914.8 MHz	925.2 ~ 959.8 MHz	
	1800	1710.2 ~ 1784.8 MHz	1805.2 ~ 1879.8 MHz	
	1900	1850.2 ~ 1909.8 MHz	1930.2 ~ 1989.8 MHz	

1.2.2. Electrical Specification

Parameter	Description	Min.	Typ.	Max.	Units
+VPWR	Absolute maximum voltage	-	-	5.5	V
	Operating voltage	3.4	3.8	4.2	V
VIH	High-level Input Voltage, CMOS	1.2	1.8	-	V
VIL	Low-level Input Voltage, CMOS	0	-	0.63	V
VOH	High-level Output Voltage, CMOS	1.2	1.8	-	V
VOL	Low-level Output Voltage, CMOS	0	0	0.45	V

Note: Refer to 4.Current Consumption

1.2.3. Environment Specification

Item	Spec.
Storage Temperature	-40°C to + 90°C
Operating Temperature	-40°C to + 85°C
Humidity (Operational)	85% relative humidity, Non-condensing
Vibration (Operational)	5 Hz to 500 Hz sinusoidal, 1.0G
Drop	No damages after 75cm drop over concrete floor
ESD [Electrostatic discharge]	+/- 1 kV Human Body Model

1.3. RF specifications

1.3.1. RX/TX frequency specification - LTE mode

항목	특성					비고	
	BW	DL conf	UL conf			조건	단위
			Mod	RB	RB idx		
Maximum Output Power (Class III)	1.4MHz 5MHz 10MHz 15MHz 20MHz	NA	QPSK	1.4MHz 1,5 RB 5MHz 1,8 RB 10MHz 1,12 RB 15MHz 1,16 RB 20MHz 1,18 RB	Low/ High	22.0dBm +/- 2.0dB	dBm
Minimum Output Power	1.4MHz 5MHz 10MHz 15MHz 20MHz	NA	QPSK	1.4MHz 6RB 5MHz 25 RB 10MHz 50 RB 15MHz 75 RB 20MHz 100 RB	0	<- 39	dBm
Frequency Error	1.4MHz 5MHz 10MHz 15MHz 20MHz	QPSK	QPSK	1.4MHz 6RB 5MHz 25,20 RB 10MHz 50,25,20 RB 15MHz 75,50,25,20 RB 20MHz 100,75,50,25,20 RB	0	$ \Delta f \leq (0.1 \text{ PPM} + 15 \text{ Hz})$	Hz
EVM	1.4MHz 5MHz 10MHz 15MHz 20MHz	NA	QPSK	1.4MHz 1,6RB 5MHz 25,8 RB 10MHz 50,12 RB 15MHz 75,16 RB 20MHz 100,18 RB	Low/ High	< 17.5	%
			16QAM	1.4MHz 1,6RB 5MHz 25,8 RB 10MHz 50,12 RB 15MHz 75,16 RB 20MHz 100,18 RB	Low/ High	<12.5	
Minimum Sensitivity Level	1.4MHz 5MHz	QPSK full RB	QPSK	10MHz 50 RB	0	B1 < -96.3 B2 < -94.3 B3 < -93.3	dBm

	10MHz 15MHz 20MHz					B5<-94.3 B7<-94.3 B8<-93.3 B12<-93.3 B20<-93.3	
Maximum input Level	10MHz	64QAM Cat4 50RB	QPSK	10MHz 50 RB	0	>- 25.7	dBm

1.3.2. RX/TX frequency specification - WCDMA mode

Item	Specification
Maximum Output Power (Class III)	+23.0 dBm / 3.84 MHz, +/- 2dB
Minimum Transmit Power	< -50 dBm / 3.84 MHz
Adjacent Channel Leakage Power Ratio	> 33 dB @ ±5 MHz, > 43 dB @ ±10 MHz
Reference Sensitivity. Level	BER < 0.001 when $\hat{I}_{or} = -106.7$ dBm / 3.84 MHz (B1) BER < 0.001 when $\hat{I}_{or} = -104.7$ dBm / 3.84 MHz (B5) BER < 0.001 when $\hat{I}_{or} = -103.7$ dBm / 3.84 MHz (B8)
Maximum Input Level	BER < 0.001 when $\hat{I}_{or} = -25$ dBm / 3.84 MHz

1.3.3. RX/TX frequency specification - GSM mode

Item	Band	Specification
Maximum Output Power	GSM850 (Class IV)	+32.5 dBm, +/- 1.0dB
	GSM900 (Class IV)	+32.5 dBm, +/- 1.0dB
	GSM1800 (Class I)	+28.5 dBm, +/- 1.0dB
	GSM1900 (Class I)	+28.5 dBm, +/- 1.0dB
Reference Sensitivity Level	GSM850 (Class IV)	-105dBm 이하 (BER<2.43%)
	GSM900 (Class IV)	
	GSM1800 (Class I)	
	GSM1900 (Class I)	

2. Interface Connector

2.1. Pin assignment

This figure is the pin arrangement of LGA Pad connected to the product.

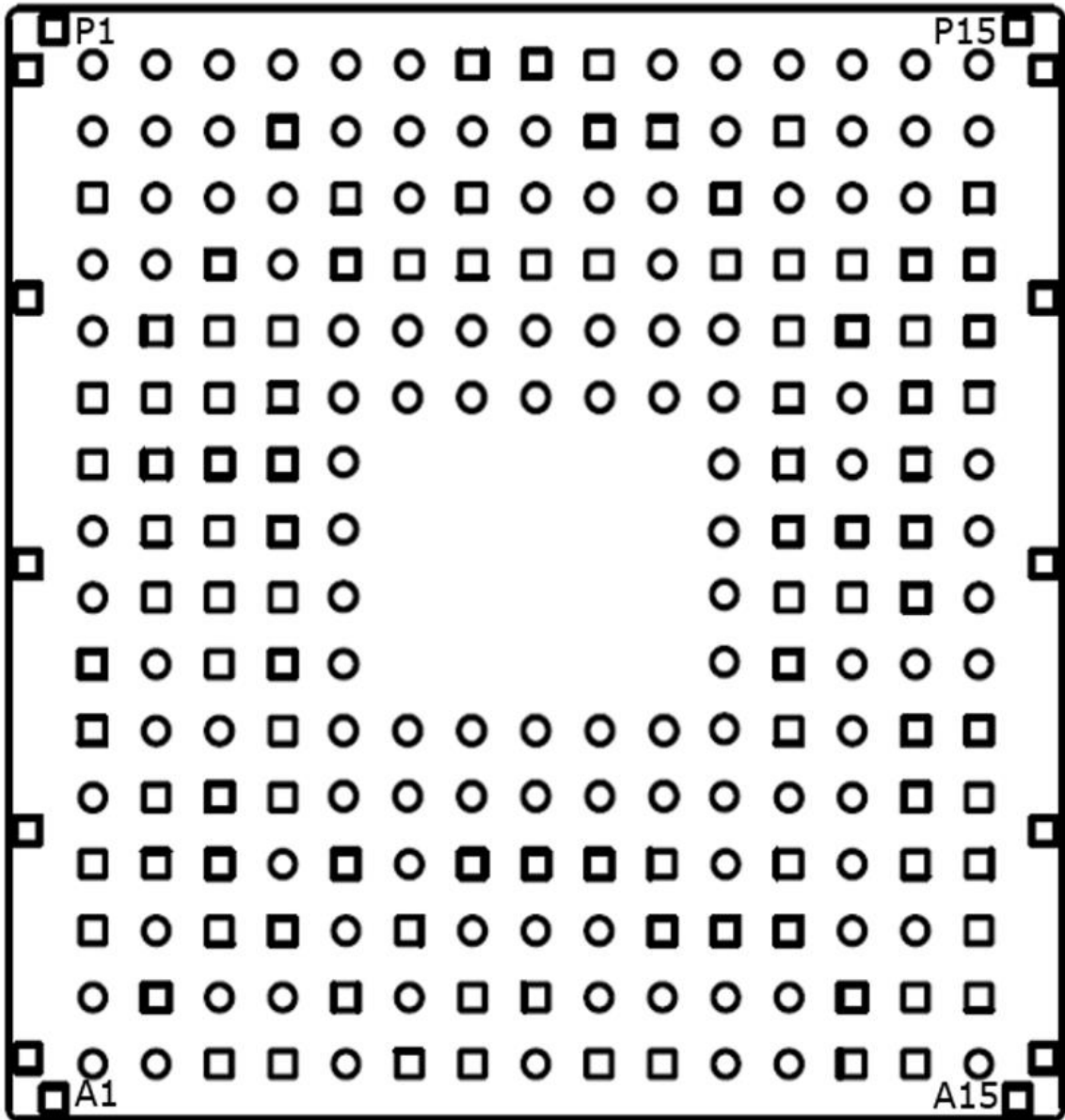


Figure 2. LGA Pin assignment

2.2. Pin Description

	Pin NO	Pin name	IN /OUT ^c	Pin Voltage	Description
Power	A1	GND	-	-	Ground
	A2	GND	-	-	Ground
	A5	GND	-	-	Ground
	A8	GND	-	-	Ground
	A11	GND	-	-	Ground
	A12	GND	-	-	Ground
	A15	GND	-	-	Ground
	B1	GND	-	-	Ground
	B3	GND	-	-	Ground
	B4	GND	-	-	Ground
	B6	GND	-	-	Ground
	B9	GND	-	-	Ground
	B10	GND	-	-	Ground
	B11	GND	-	-	Ground
	B12	GND	-	-	Ground
	C2	GND	-	-	Ground
	C5	GND	-	-	Ground
	C7	GND	-	-	Ground
	C8	GND	-	-	Ground
	C9	GND	-	-	Ground
	C13	GND	-	-	Ground
	C14	GND	-	-	Ground
	D4	GND	-	-	Ground
	D6	GND	-	-	Ground
	D11	GND	-	-	Ground
	D13	GND	-	-	Ground
	E1	GND	-	-	Ground
	E5	GND	-	-	Ground
	E6	GND	-	-	Ground
	E7	GND	-	-	Ground
	E8	GND	-	-	Ground
	E9	GND	-	-	Ground
E10	GND	-	-	Ground	
E11	GND	-	-	Ground	
E12	GND	-	-	Ground	
E13	GND	-	-	Ground	
F2	GND	-	-	Ground	

F3	GND	-	-	Ground
F5	GND	-	-	Ground
F6	GND	-	-	Ground
F7	GND	-	-	Ground
F8	GND	-	-	Ground
F9	GND	-	-	Ground
F10	GND	-	-	Ground
F11	GND	-	-	Ground
F13	GND	-	-	Ground
G2	GND	-	-	Ground
G5	GND	-	-	Ground
G11	GND	-	-	Ground
G13	GND	-	-	Ground
G14	GND	-	-	Ground
G15	GND	-	-	Ground
H1	GND	-	-	Ground
H5	GND	-	-	Ground
H11	GND	-	-	Ground
H15	GND	-	-	Ground
I1	GND	-	-	Ground
I5	GND	-	-	Ground
I11	GND	-	-	Ground
I15	GND	-	-	Ground
J5	GND	-	-	Ground
J11	GND	-	-	Ground
J13	GND	-	-	Ground
J15	GND	-	-	Ground
K5	GND	-	-	Ground
K6	GND	-	-	Ground
K7	GND	-	-	Ground
K8	GND	-	-	Ground
K9	GND	-	-	Ground
K10	GND	-	-	Ground
K11	GND	-	-	Ground
K13	GND	-	-	Ground
L1	GND	-	-	Ground
L5	GND	-	-	Ground
L6	GND	-	-	Ground
L7	GND	-	-	Ground
L8	GND	-	-	Ground
L9	GND	-	-	Ground

	L10	GND	-	-	Ground
	L11	GND	-	-	Ground
	M1	GND	-	-	Ground
	M2	GND	-	-	Ground
	M4	GND	-	-	Ground
	M10	GND	-	-	Ground
	N2	GND	-	-	Ground
	N3	GND	-	-	Ground
	N4	GND	-	-	Ground
	N6	GND	-	-	Ground
	N8	GND	-	-	Ground
	N9	GND	-	-	Ground
	N10	GND	-	-	Ground
	N12	GND	-	-	Ground
	N13	GND	-	-	Ground
	N14	GND	-	-	Ground
	O1	GND	-	-	Ground
	O2	GND	-	-	Ground
	O3	GND	-	-	Ground
	O5	GND	-	-	Ground
	O6	GND	-	-	Ground
	O7	GND	-	-	Ground
	O8	GND	-	-	Ground
	O11	GND	-	-	Ground
	O13	GND	-	-	Ground
	O14	GND	-	-	Ground
	O15	GND	-	-	Ground
	P1	GND	-	-	Ground
	P3	GND	-	-	Ground
	P5	GND	-	-	Ground
	P6	GND	-	-	Ground
	P10	GND	-	-	Ground
	P11	GND	-	-	Ground
	P13	GND	-	-	Ground
	P15	GND	-	-	Ground
	GND1~ GND14	GND	-	-	Ground
	A3	VCC	PI	3.8V	Main power(3.4V ~ 4.2V)
	A4	VCC	PI	3.8V	Main power(3.4V ~ 4.2V)
PAM	O9	PAM_VCC	PI	3.4~4.2V	PAM power supply input
	O10	PAM_VCC	PI	3.4~4.2V	PAM power supply input

Output Power	H13	+1.8V_OUT	PO	1.8V	1.8V Output port
	P8	+2.7V_OUT	PO	2.7V	2.7V Output port
ANT Interface	P2	DRX_ANT	AI		Antenna for LTE bands(Sub)
	P4	GNSS_ANT	AI		Antenna for GNSS
	P12	PRX2_ANT	AI,AO		Antenna for LTE bands(Main)
	P14	PRX1_ANT	AI,AO		Antenna for LTE bands(Main)
USB Interface	A9	USB_D-	B		USB data (-)
	A10	USB_D+	B		USB data (+)
USIM Interface	A6	USIM_PWR	PO	1.8V/2.85V	USIM Power
	D3	USIM_DATA	B	1.8V/2.85V	USIM Data
	E3	USIM_RESET	DO	1.8V/2.85V	USIM Reset
	E4	USIM_CLK	DO	1.8V/2.85V	USIM Clock
UART Interface	B5	UART1_RI	DO	1.8V	UART ring indicator (HOST ← MODULE)
	I12	UART1_TXD	DI	1.8V	UART1 Serial data input from DTE (HOST → MODULE)
	I13	UART1_RXD	DO	1.8V	UART1 Serial data output from DTE (HOST ← MODULE)
	J12	UART1_DSR	DO	1.8V	UART1 data set ready (HOST ← MODULE)
	I14	UART1_DTR	DI	1.8V	UART1 data terminal ready (HOST → MODULE)
	K12	UART1_DCD_N	DO	1.8V	UART1 data carrier detect (HOST ← MODULE)
	M11	UART1_RTS	DI	1.8V	UART1 Input for Request to send signal(RTS) from DTE (HOST → MODULE)
	M12	UART1_CTS	DO	1.8V	UART1 Output for Clear to Send signal(CTS) to DTE (HOST ← MODULE)
	G3	UART2_TXD	DI	1.8V	UART2- Serial data input from DTE (HOST → MODULE)
	G4	UART2_RXD	DO	1.8V	UART2- Serial data output from DTE (HOST ← MODULE)
DEBUG Interface	D5	PS_HOLD	DO	1.8V	Power supply hold pin to the PMD9607 for JTAG
	L2	JTAG_TDO	DO	1.8V	JTAG data output
	L3	JTAG_TDI	DI	1.8V	JTAG data input
	L4	JTAG_TRST_N	DI	1.8V	JTAG reset, Active low
	K2	JTAG_TMS	B	1.8V	JTAG mode select input
	K3	JTAG_TCK	DI	1.8V	JTAG clock input

	K4	JTAG_SRST_N	DI	1.8V	JTAG reset for debug, Active low
In/out Interface	G1	POWER_KEY	DI	1.8V	Power on / off control (Active high)
	B2	RESET_KEY	DI	1.8V	Hardware reset (Active Low)
	H2	USB_DISABLE	DI	1.8V	Active low signal to USB_DISABLE
	M5	READY	DO	1.8V	The boot sequence completed successfully.
	L13	/WAKE_UP	DO	1.8V	HOST Wake Up Signal
	N5	GNSS_LNA_EN	DO	1.8V	External GNSS LNA enable.
WLAN Interface	E15	SDIO_CMD	B	1.8V	WLAN Command
	F15	SDIO_CLK	B	1.8V	WLAN Clock
	F14	SDIO_DATA_0	B	1.8V	WLAN Data bit 0
	D15	SDIO_DATA_1	B	1.8V	WLAN Data bit 1
	E14	SDIO_DATA_2	B	1.8V	WLAN Data bit 2
	D14	SDIO_DATA_3	B	1.8V	WLAN Data bit 3
	L12	WIFI_EN	DO	1.8V	WLAN enable.
Ethernet Interface	A13	SGMII_RX_P	AI	-	SGMII receive - plus
	B13	SGMII_RX_M	AI	-	SGMII receive - minus
	A14	SGMII_TX_P	AO	-	SGMII transmit - plus
	B14	SGMII_TX_M	AO	-	SGMII transmit - minus
	F4	ETH_RESET_N	DO	1.8V	Ethernet PHY reset
	J14	ETH_INT_N	DI	1.8V	Ethernet PHY interrupt
	B8	SGMII_MDIO_CLK	DO	2.85V/1.8V	SGMII Clock
	D7	SGMII_MDIO_DATA	B	2.85V/1.8V	SGMII Data
Reserved	A7	Reserved ^(*)	-	-	-
	B7	Reserved ^(*)	-	-	-
	B15	Reserved ^(*)	-	-	-
	C1	Reserved ^(*)	-	-	-
	C3	Reserved ^(*)	-	-	-
	C6	Reserved ^(*)	-	-	-
	C10	Reserved ^(*)	-	-	-
	C11	Reserved ^(*)	-	-	-
	C12	Reserved ^(*)	-	-	-
	C15	Reserved ^(*)	-	-	-
	D1	Reserved ^(*)	-	-	-
	D2	Reserved ^(*)	-	-	-
	D8	Reserved ^(*)	-	-	-
	D9	Reserved ^(*)	-	-	-
	D10	Reserved ^(*)	-	-	-
D12	Reserved ^(*)	-	-	-	

	E2	Reserved ^(*1)	-	-	-
	F1	Reserved ^(*1)	-	-	-
	F12	Reserved ^(*1)	-	-	-
	G12	Reserved ^(*1)	-	-	-
	H3	Reserved ^(*1)	-	-	-
	H4	Reserved ^(*1)	-	-	-
	H12	Reserved ^(*1)	-	-	-
	H14	Reserved ^(*1)	-	-	-
	I2	Reserved ^(*1)	-	-	-
	I3	Reserved ^(*1)	-	-	-
	I4	Reserved ^(*1)	-	-	-
	J1	Reserved ^(*1)	-	-	-
	J2	Reserved ^(*1)	-	-	-
	J3	Reserved ^(*1)	-	-	-
	J4	Reserved ^(*1)	-	-	-
	K1	Reserved ^(*1)	-	-	-
	K14	Reserved ^(*1)	-	-	-
	K15	Reserved ^(*1)	-	-	-
	L14	Reserved ^(*1)	-	-	-
	L15	Reserved ^(*1)	-	-	-
	M3	Reserved ^(*1)	-	-	-
	M6	Reserved ^(*1)	-	-	-
	M7	Reserved ^(*1)	-	-	-
	M8	Reserved ^(*1)	-	-	-
	M9	Reserved ^(*1)	-	-	-
	M13	Reserved ^(*1)	-	-	-
	M14	Reserved ^(*1)	-	-	-
	M15	Reserved ^(*1)	-	-	-
	N1	Reserved ^(*1)	-	-	-
	N7	Reserved ^(*1)	-	-	-
	N11	Reserved ^(*1)	-	-	-
	N15	Reserved ^(*1)	-	-	-
	O4	Reserved ^(*1)	-	-	-
N/C	C4	N/C	-	-	Not connected in the module
	O12	N/C	-	-	Not connected in the module
	P7	N/C	-	-	Not connected in the module
	P9	N/C	-	-	Not connected in the module

[Remark]

B : Bi-directional

DI : Digital Input into Module

DO : Digital Output from Module

PI : Power input into Module

PO : Power output from Module

3. Modem Interface Description

3.1. Power supply

Requirement of Input Voltage is refer to the below table

N	Item	Pin NO	Min	Typ	Max	Unit	Comments	
1	Supply Voltage	VCC	A3, A4	3.4	3.8	4.2	V	
2	PAM_PWR	O9, 910	3.4	-	4.2	V		
3	VIH (High-level Input Voltage)		1.2	1.8	2.1	V		
4	VIL (Low-level Input Voltage)		0	0	0.6	V		
5	VOH (High-level Output Voltage)		1.2	1.8	2.1	V		
6	VOL (Low-level Output Voltage)		0	0	0.45	V		
7	GND	A1, A2, A5, A8, A11, A12, A15, B1, B3, B4, B6, B9, B10, B11, B12, C2, C5, C7, C8, C9, C13, C14, D4, D6, D11, D13, E1, E5, E6, E7, E8, E9, E11, E12, E13, F2, F3, F5, F6, F7, F8, F9, F10, F11, F13, G2, G5, G11, G13, G14, G15, H1, H5, H11, H15, I1, I5, I11, H15, J5, J11, J13, J15, K5, K6, K7, K8, K9, K10, K11, K13, L1, L5, L6, L7, L8, L9, L10, L11, M1, M2, M4, M10, N2, N3, N4, N6, N8, N9, N10, N12, N13, N14, O1, O2, O3, O5, O6, O7, O8, O11, O13, O14, O15, P1, P3, P5, P6, P10, P11	-	0	-	V		

Note : The Operating Voltage Range **MUST** never be exceeded; care must be taken when designing the application's power supply section to avoid having an excessive voltage drop.

If the voltage drop is exceeding the limits it could cause a Power Off of the module. Overshoot voltage (regarding Max Extended Operating Voltage) and drop in voltage (regarding Min Extended Operating Voltage) **MUST** never be exceeded;

The "Extended Operating Voltage Range" can be used only with completely assumption and application of the HW User guide suggestions.

3.2. USB Interface

This module supports the USB 2.0 Specification.

It is used for diagnostic monitoring and data transfer.

Differential line (D+,D-) impedance should be designed closely to 90Ω.

Pin no.	Pin name	Pin description	Direction
A9	USB_D-	USB data (-)	Bidirectional
A10	USB_D+	USB data (+)	Bidirectional

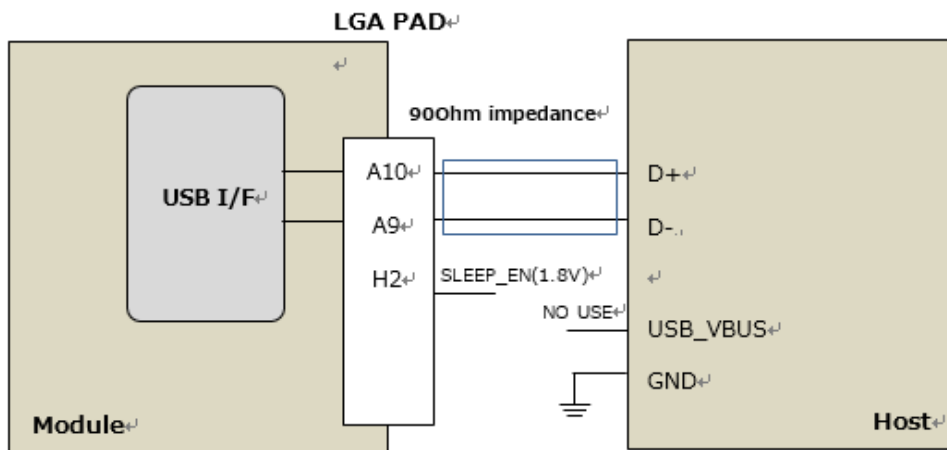


Figure 3. USB interface circuit

3.3. USIM Interface

This module supports UIM interface as the below table.

Pin no.	Pin name	Pin description	Direction
A6	UIM_PWR	UIM power	Output
E4	UIM_CLK	UIM clock	Output
E3	UIM_RESET	UIM reset	Output
D3	UIM_DATA	UIM data	Output/Input

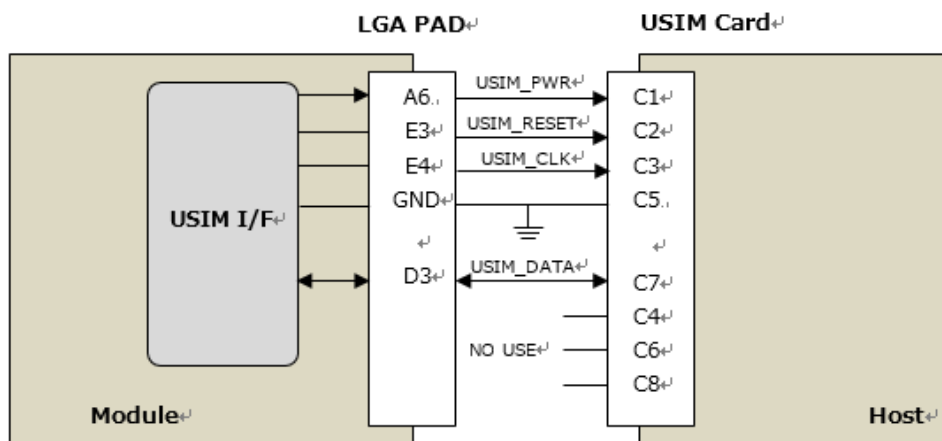


Figure 4. USIM Interface design

3.4. UART Interface

UART pins are used to communicate AT-COMMAND and DATA.

Software upgrade can be performed thru this UART

Pin no.	Pin name	Pin description	In/Out	Direction (Module ↔ Host)
I13	UART1_RXD	Receive Data	O	Module → Host
I12	UART1_TXD	Transmit Data	I	Module ← Host
M12	UART1_CTS	Clear to send	O	Module → Host
M11	UART1_RTS	Request to send	I	Module ← Host
J12	UART1_DSR	Data set ready	O	Module → Host
I14	UART1_DTR	Data terminal ready	I	Module ← Host
K12	UART1_DCD_N	Data carrier detect	O	Module → Host
B5	UART1_RI	Ring indicator	O	Module → Host
G4	UART2_RXD	Receive Data	O	Module → Host
G3	UART2_TXD	Transmit Data	I	Module ← Host

Note: If the module is off, a leakage is generated when voltage is supplied at pin. It should be careful when you design.

3.5. WLAN Interface

This module supports WLAN interface as the below table.

When using the WLAN interface, refer to the below table and connect all signal lines to the host.

Pin no.	Pin name	Pin description	In/Out	Direction
E15	SDIO_CMD	WLAN Command	I / O	Module ↔ Host
F15	SDIO_CLK	WLAN Clock	I / O	Module ↔ Host
F14	SDIO_DATA_0	WLAN Data bit 0	I / O	Module ↔ Host

D15	SDIO_DATA_1	WLAN Data bit 1	I / O	Module ↔ Host
E14	SDIO_DATA_2	WLAN Data bit 2	I / O	Module ↔ Host
D14	SDIO_DATA_3	WLAN Data bit 3	I / O	Module ↔ Host
E15	SDIO_CMD	WLAN Command	I / O	Module ↔ Host

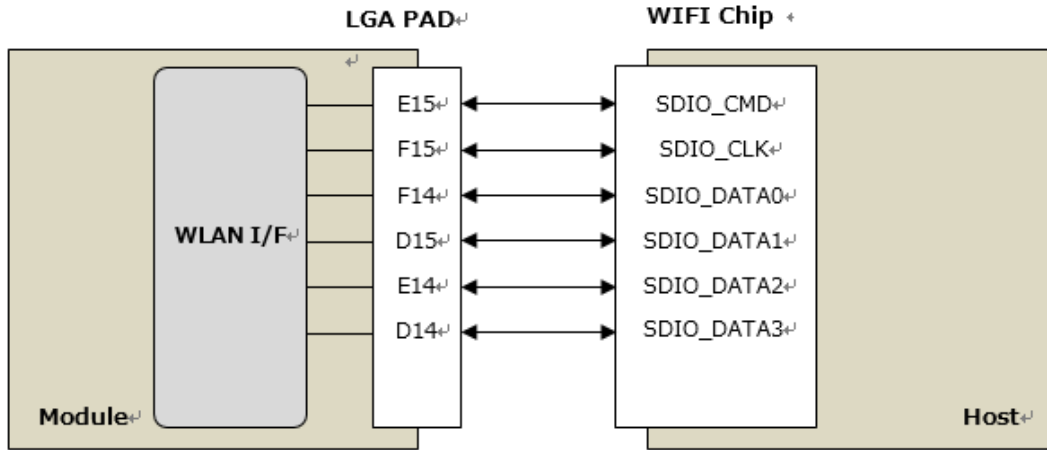


Figure 5. WLAN Interface connection

3.6. Ethernet Interface

This module supports Ethernet interface as the below table.

When using the Ethernet interface, refer to the below table and connect all signal lines to the host.

Pin no.	Pin name	Pin description	In/Out	Direction
A13	SGMII_RX_P	SGMII receive - plus	I	Module ← Host
B13	SGMII_RX_M	SGMII receive - minus	I	Module ← Host
A14	SGMII_TX_P	SGMII transmit - plus	O	Module → Host
B14	SGMII_TX_M	SGMII transmit - minus	O	Module → Host
B8	SGMII_MDIO_CLK	SGMII Clock	O	Module → Host
D7	SGMII_MDIO_DATA	SGMII Data	I / O	Module ↔ Host
F4	ETH_RESET_N	Ethernet PHY reset	O	Module → Host
J14	ETH_INT_N	Ethernet PHY interrupt	I	Module ← Host

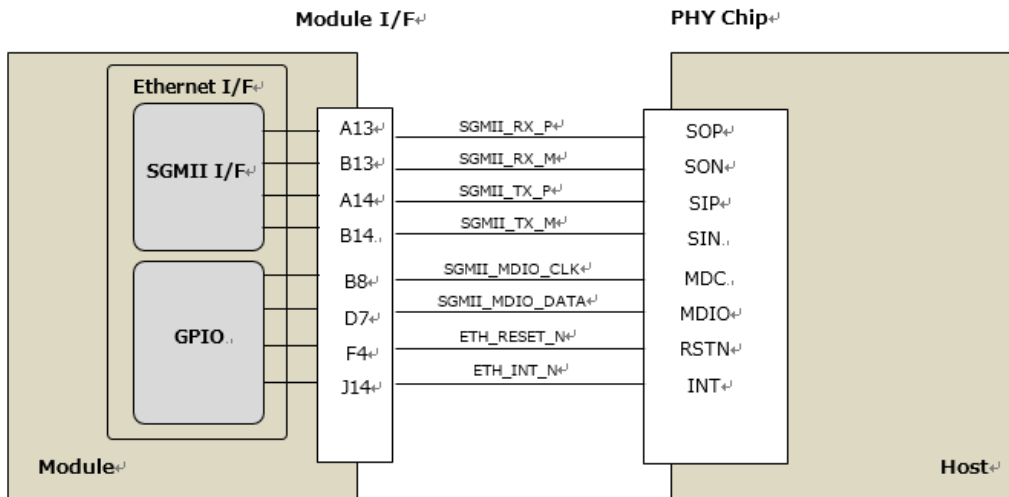


Figure 6. Ethernet Interface Connection

3.7. In/Out Interface

3.7.1. POWER_KEY

This pin must keep high for more than 1 second to turn on the module, then the module will turn on. Also, It must keep high for more than 3 second to turn off the module, then the module will turn off automatically.

Pin no.	Pin name	Pin description	Direction
G1	POWER_KEY	Power On or Off control Active Low	Input

Note : an unexpected power shutdown can cause critical damage.

After performing power off sequence in the module, it should be designed to cut off the power supply in the host.

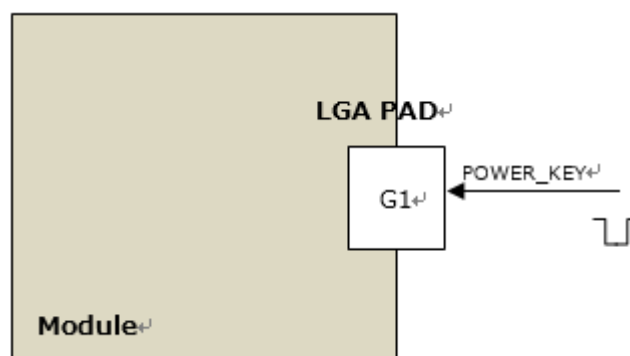


Figure 7. Power_Key Circuit

3.7.2. RESET_KEY

This pin is for hardware reset of this module. To reset, it must keep low for more than 2.5 seconds and the maximum time is less than 5 seconds.

Pin no.	Pin name	Pin description	Direction
B2	RESET_KEY	Hardware Reset, Active low Internal pulled-up to 1.8V	Input

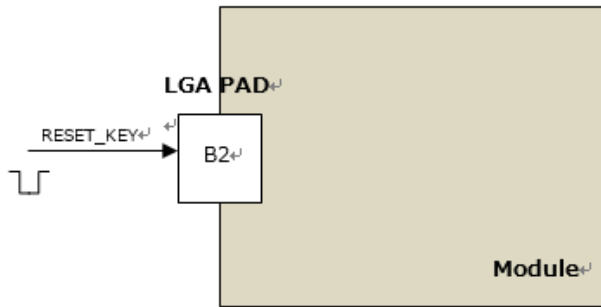


Figure 8. RESET_KEY Circuit

Note : (1) This hardware reset must be designed to be controlled by the host.

In case of any communication problems, it is recommended that the host should perform reset in hardware and software manner.

(2) Only in case SW reset can not solve the problem, apply the hardware reset.

(3) During hardware reset, I/O pins connected to module including UART pins should be asserted to be Low level or open state.

Otherwise, power leakage can cause an malfunction and the module can not be worked.

3.7.3. WAKE_UP

This pin is used to request that the system return from asleep/suspended state to service a function initiated wake event.

Pin no.	Pin name	Pin description	Direction
L13	WAKE_UP	This pin is used to wake host. It will output a 1s low pin. Active low	output

Note: If the module is off, a leakage is generated when voltage is supplied at pin. It should be careful when you design.

3.7.4. USB_DISABLE

This pin is used when you do not use the USB function.

Pin no.	Pin name	Pin description	Direction
H2	USB_DISABLE	Active low signal to disable USB operation	Input

Note: Please do Not Connect, if you do not use this pin.

3.7.5. READY

This pin is used to indicate the system is boot-up complete.

Pin no.	Pin name	Pin description	Direction
M5	READY	Active high ,boot-up complete	Output

3.8. Debug Interface

These pins are designed for software debugging of this product.

Debug pins are not used in the host and it is recommended to design open.

Pin no.	Pin name	Pin description	Direction	Voltage
D5	PS_HOLD	Power supply hold control for JTAG	DI	1.8V
L4	JTAG_TRST_N	JTAG reset	DI	1.8V
L3	JTAG_TDI	JTAG data input	DI	1.8V
K3	JTAG_TCK	JTAG clock input	DI	1.8V
L2	JTAG_TDO	JTAG data output	DO	1.8V
K2	JTAG_TMS	JTAG mode select input	DI	1.8V
K4	JTAG_SRST_N	JTAG reset for debug	DI	1.8V

3.9. Antenna

This is a description of the signal line of the antenna interface of this product.

Pin no.	Pin name	Pin description	In/Out	Direction
P12	PRX2_ANT	LTE/UMTS/GSM TX/RX	AI, AO	Module ↔ Host
P14	PRX1_ANT	NC	AI, AO	Module ↔ Host
P2	DRX_ANT	LTE/UMTS/GSM DRX/Diversity RX	AI	Module ← Host

3.10. Reserved

To use reserved pins, you must inform to the AM Telecom co.Ltd.

Current purpose of reserved pins is as the below table.

Pin no.	Pin name	Pin description	Remark
H13	Reserved	+1.8V Output Port	
P8	Reserved	+2.7V Output Port	
A7	Reserved	General Purpose Input Output Port	
B7	Reserved	General Purpose Input Output Port	
C1	Reserved	General Purpose Input Output Port	
C3	Reserved	General Purpose Input Output Port	
C6	Reserved	General Purpose Input Output Port	
C10	Reserved	General Purpose Input Output Port	
C11	Reserved	General Purpose Input Output Port	
C12	Reserved	General Purpose Input Output Port	
C15	Reserved	General Purpose Input Output Port	
D1	Reserved	General Purpose Input Output Port	
D2	Reserved	General Purpose Input Output Port	
D8	Reserved	General Purpose Input Output Port	
D9	Reserved	General Purpose Input Output Port	
D10	Reserved	General Purpose Input Output Port	
D12	Reserved	General Purpose Input Output Port	
E2	Reserved	General Purpose Input Output Port	
F1	Reserved	General Purpose Input Output Port	
F12	Reserved	General Purpose Input Output Port	
G12	Reserved	General Purpose Input Output Port	
H3	Reserved	General Purpose Input Output Port	
H4	Reserved	General Purpose Input Output Port	
H12	Reserved	General Purpose Input Output Port	
H14	Reserved	General Purpose Input Output Port	
I2	Reserved	General Purpose Input Output Port	
I3	Reserved	General Purpose Input Output Port	
I4	Reserved	General Purpose Input Output Port	
J1	Reserved	General Purpose Input Output Port	
J2	Reserved	General Purpose Input Output Port	
J3	Reserved	General Purpose Input Output Port	
J4	Reserved	General Purpose Input Output Port	
K1	Reserved	General Purpose Input Output Port	
K14	Reserved	General Purpose Input Output Port	
K15	Reserved	General Purpose Input Output Port	

L14	Reserved	General Purpose Input Output Port	
L15	Reserved	General Purpose Input Output Port	
M3	Reserved	General Purpose Input Output Port	
M6	Reserved	General Purpose Input Output Port	
M7	Reserved	General Purpose Input Output Port	
M8	Reserved	General Purpose Input Output Port	
M9	Reserved	General Purpose Input Output Port	
M13	Reserved	General Purpose Input Output Port	
M14	Reserved	General Purpose Input Output Port	
M15	Reserved	General Purpose Input Output Port	
N1	Reserved	General Purpose Input Output Port	
N11	Reserved	General Purpose Input Output Port	
N15	Reserved	General Purpose Input Output Port	
O4	Reserved	General Purpose Input Output Port	
P8	Reserved	General Purpose Input Output Port	

4. Current Consumption

The current consumption of the module is listed as below table. The listed current consumption is tested when the power supply of module is 3.8 V.

Mode	Typ.	Unit	Condition
Peak current	1	A	VCC
Data Call	300	mA	Band 7 CH BW=10MHz, TX=0dBm
	770	mA	Band 7 CH BW=10MHz, TX=22.5dBm

5. RF Design Guide

5.1. Antenna RF Design Guide

Please reserve a matching circuit between module and the antenna for antenna tuning.

The matching topology and the value of components can be achieved after antenna tuning and usually provided by antenna vendor.

it is recommended to use microstrip line for RF line of Module and antenna.

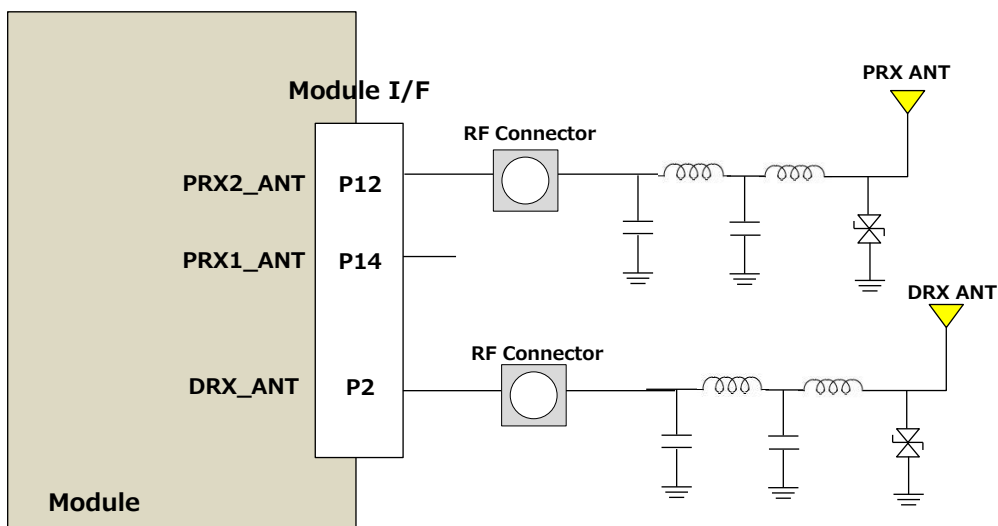


Figure 9. LTE Antenna Design Guide

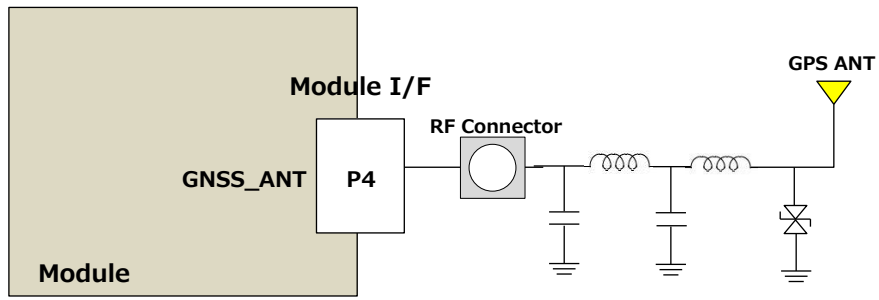


Figure 10. GNSS Antenna Design Guide

5.2. RF line Design Guide

RF line should be as short as possible with low loss controlled, and impedance of 50ohm. The 50ohm impedance(Z_0) of the RF trace is usually determined by the trace width (W), the materials' dielectric constant(E_r), the distance between signal layer and reference ground (H), and the clearance between RF trace and ground (D).



www.polarinstruments.com

Substrate 1 Height	H1	<input type="text" value="0.2000"/>
Substrate 1 Dielectric	Er1	<input type="text" value="4.2000"/>
Lower Trace Width	W1	<input type="text" value="0.3100"/>
Upper Trace Width	W2	<input type="text" value="0.2900"/>
Ground Strip Separation	D1	<input type="text" value="0.2500"/>
Trace Thickness	T1	<input type="text" value="0.0400"/>
Coating Above Substrate	C1	<input type="text" value="0.0250"/>
Coating Above Trace	C2	<input type="text" value="0.0250"/>
Coating Dielectric	CEr	<input type="text" value="4.2000"/>

Impedance	Zo	<input type="text" value="49.84"/>
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Notes: (First 5 lines will print)

Add your comments here

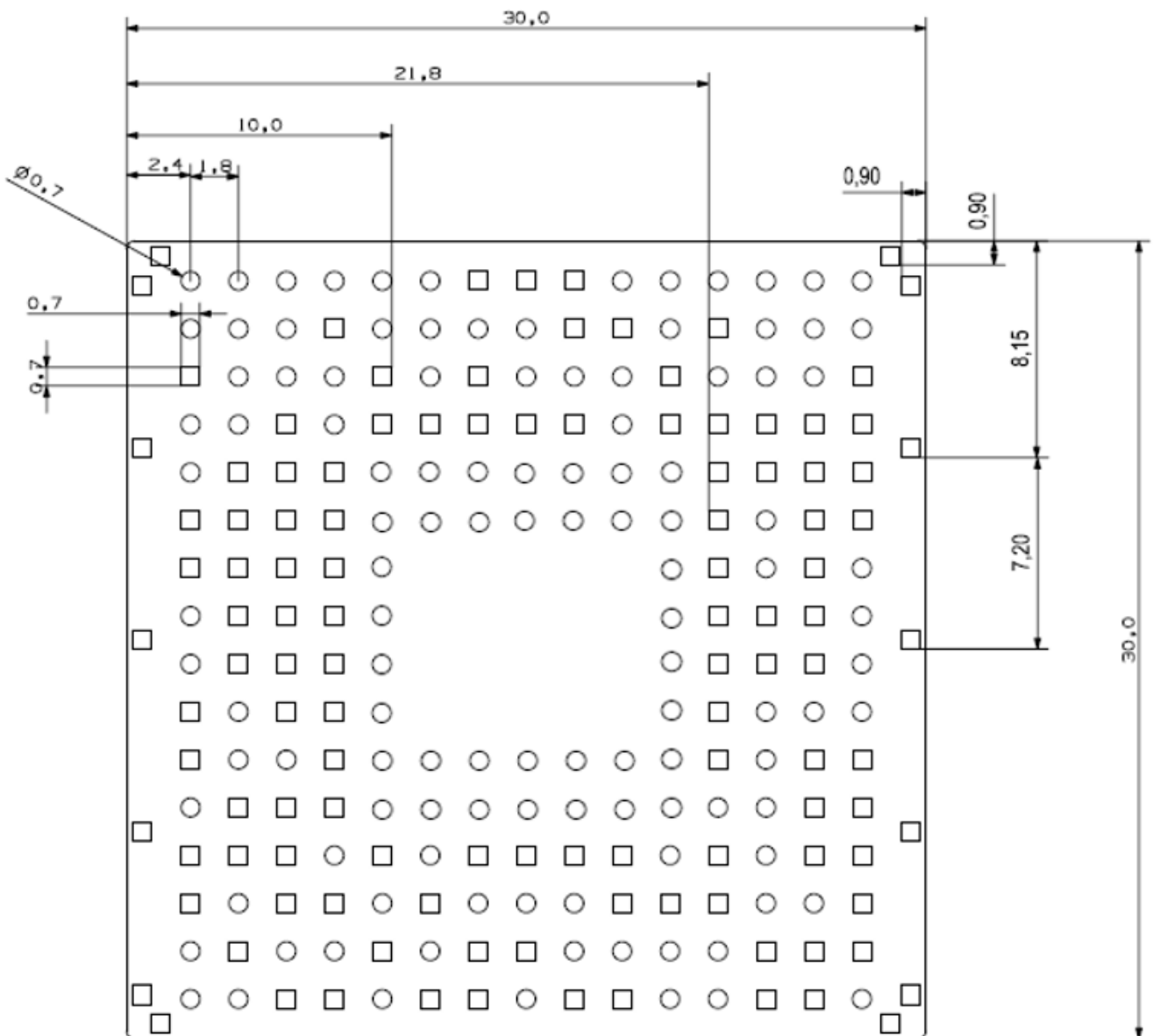
Interface Style

Standard

Extended

그림 2-3 Coated Coplanar Waveguide Line Design(Layer 2 as Reference Ground)

6. PCB Layout Guide



Note : The unit is mm

7. Solder Reflow Profile

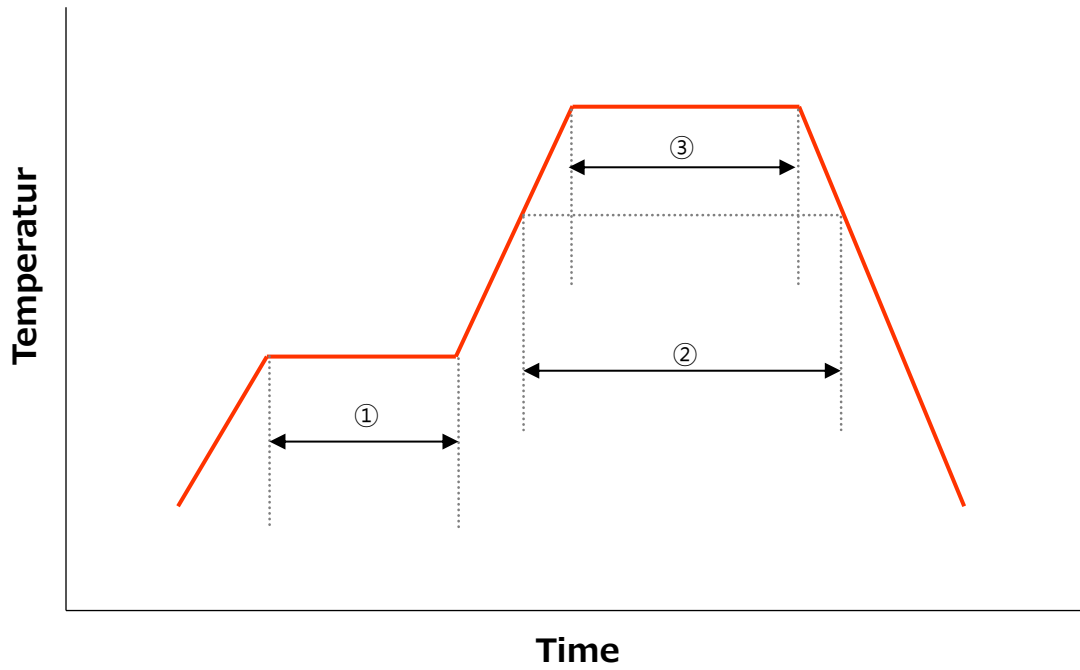


Figure 11. Reflow profile graph

No	Item	Temperture	Time
①	Preheat	+150 ~ +180°C	85 ~ 100sec
②	Primary heat	Over +220°C	40 ~ 50sec
③	Peak	+238 ~ +245°C	-
	Cooling down slope	2 ~ 4°C/sec	

Table 1. Recommended Reflow Table

8. Cautions

8.1. Safety precautions

This module should be used at authorized places or environments due to frequency jamming possibility while operating. If occur any issues when the module operates at not authorized places or environments, AM TELECOM does not have any responsibility.

- ① Do not use at life-saving places or areas such as hospitals or medical facilities. Also, should be 'power-off' nearby medical appliances in order to prevent errors caused by radio frequency interference while operating medical appliances or life-support system.
- ② Keep 'Power-off' at not authorized places in airport and airplane while taking off and landing in flight. It might be brought a risk of accident due to radio frequency jamming.
 - The limitation is different per each air flight company. So, follow instructions of each flight company.
- ③ Do not use at places of combustible storage and handling such as gas stations or chemical manufacturing plants in order to prevent from explosion or fire.

8.2. Product handling precautions

- ① Be careful not to excessive static applied.

The performance will be able decline if static with over $\pm 2\text{KV}$ is applied.

- ② Do not give a shock or impact or dropping.

If give strong shock or impact or dropping, those will be reasons about damage or breakdown or failure. Manufacture does not have responsibility if troubles are made by users.

- ③ Do not modify or take apart or fix.

If do above, risk will be happened such as product damage or breakdown or electric shock or fire. Manufacture does not have responsibilities on those cases.

- ④ Do not give damages or removals to product label.

It will be very hard to identify the product, so that AS is not available.

- ⑤ Be careful to tighten screws not to give excessive forces.

- ⑥ Always use and store at room temperature.

- ⑦ Avoid water or humidity directly.

- ⑧ Use antistatic gloves while handling.

- ⑨ Try connecting after checking any foreign materials on Connector or Pad.

If any foreign material is on connector, contact failure can be happened. Please clean the area, and then connect. Be careful not to give any damage.

- ⑩ Do not touch bottom side by hands while connecting.

- ① Do not presses the shield CAN. It can cause electrical short or declining RF performance by the CAN damage.

9. Acronyms

Word	Description
BW	Band Width
dB	A type of (relative) scale that represents the difference of some value as Log
dBm	An abbreviation for the power ratio in dB of the measured power referenced to one milliwatt (mW).
DL	Down-Link
ESD	Electro Static Discharge
FDD	Frequency Division Duplex
GPIO	General Purpose Input Output
GPS	Global Positioning System
LTE	Long Term Evolution
MCS	Modulation and Coding Scheme
PPM	Parts Per Million
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
Sensitivity	The minimum input pin to be specified value of the output power (or SNR/BER/BLER) in a wireless receiver.
UL	Up-Link
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
MODEM	MOdulator and DEModulator
MIMO	Multiple-input and multiple-output
PS_HOLD	Power supply hold signal to PMIC
JTAG	Joint Test Action Group
Cat	Category
PCB	Printed Circuit Board

10. Contact Information

➤ Korea

E-mail	Sales@amtel.co.kr
Address.	AM TELECOM Co., Ltd. #608, YatapLeaders bldg., 42, Jangmi-ro, Bundang-gu, Seongnam-si Gyeonggi-do, 463-828, Korea

➤ Japan

E-mail	amjapan@amtel.co.jp
Address.	AM Japan Co., Ltd. #201E Shinkasumigaseki Bldg. Lobby floor., 3-3-2, Kasumigaseki, Chiyoda-ku, Tokyo, 100-0013

11. OEM/Integrators Installation Guide

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions).
The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).
The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

End Product Labeling

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: 2AZDW-AML550”
The FCC ID can be used only when all FCC compliance requirements are met.

Antenna Installation

- (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.
- (3) Only antennas of the equal or less gains as shown below may be used with this module:

Frequency Band	700 MHz	800 MHz	1700 MHz	1900 MHz	2500 MHz
Max. Gain (dBi)	6.6	5.6	5.0	3.5	9.0

Note: The above gain is considered cable loss.

When using an antenna higher than the gain mentioned above, the conducted output power must be reduced, and the product may require C2PC filing with additional tests and RF exposure evaluation.

In the event that these conditions cannot be met (for example higher than max gain or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

Federal Communication Commission Interference Statement

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.

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 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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

List of applicable FCC rules

This module has been tested and found to comply with part 22, part 24, part 27, part 90 requirements for Modular Approval.

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the 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. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Industry Canada Statement

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

- (1) This device may not cause interference; and
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure. Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.

L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par la technologie.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- 2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

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 IC: 27086-AML550".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 27086-AML550".

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.