

# Wireless Communication Module

## AMP520 Hardware User Guide

Rev. 1.2

◆ Product Name: LTE & WCDMA / HSPA+ Wireless Module
◆ Model Name: AMP520
◆ Document No: NO.2015-0206
◆ Approval No:

CHECK	CHECK	Approval
/ /	/ /	/ /

CHECK	CHECK	Approval
/ /	/ /	/ /

## **Limitations of Liability**

This user guide is provided "as is" and the recipient of the user guide shall endorse all risks arising from its use.

In no event shall AM Telecom has any responsibility for any damages if the product(s) has been improperly stored, installed, used or maintained, or if it has been made under any unauthorized modifications, adjustments and/or repairs to such product(s).

In no event will am telecom or its affiliates be liable for any lost profits, lost savings or incidental, indirect, special or consequential damages, arising out of use or inability to use the product, even if advised of the possibility of such damages. some states do not allow the limitation or exclusion of liability for incidental or consequential damages so the above limitation or exclusion may not apply.

## **Copyright © AM Telecom co.,Ltd, 2014**

Transmittal, reproduction, dissemination and(or) editing of this document as well as utilization of its contents and communication thereof to others without express authorization are prohibited. Offenders will be held liable for payment of damages. All rights are reserved.

## ■ Revision History

Version	Date	Description	Author
1.0	2014.07.25	Initial release	S.W HAN
1.1	2014.10.30	Hardware User Guide_Rev.1.1 release	S.W HAN
1.2	2015.02.06	Update 3. Modem interface description	S.W HAN

## [ Contents ]

<b><i>Introduction.....</i></b>	<b><i>6</i></b>
<b><i>1. System Layout &amp; Specification.....</i></b>	<b><i>7</i></b>
1.1. Physical feature .....	7
1.2. Interface parts specification.....	8
1.3. Modem specification .....	9
1.4. RF specifications.....	11
1.5. System block.....	17
<b><i>2. Interface Connector.....</i></b>	<b><i>18</i></b>
2.1. Pin assignment .....	18
2.2. Pin description.....	20
<b><i>3. Modem Interface Description.....</i></b>	<b><i>23</i></b>
3.1. Power supply .....	23
3.2. USB.....	23
3.3. Power_key .....	23
3.4. RESET_N .....	24
3.5. USIM.....	25
3.6. UART.....	26
3.7. GPIO .....	26
3.8. WAKE_ON_WWAN_N.....	26
3.9. Reserved .....	27
<b><i>4. Current Consumption.....</i></b>	<b><i>28</i></b>
4.1. Standby current.....	28
4.2. Operating current.....	28
4.3. In-rush current.....	29
4.4. Leakage current.....	29

<b>5. Signal Timing</b> .....	<b>30</b>
5.1. Power on sequence.....	30
5.2. Reset sequence.....	30
<b>6. Mechanical Design Guide</b> .....	<b>31</b>
6.1. PCB layout guide.....	31
6.2. Insert nut & screw guide.....	31
<b>7. Module Assembly</b> .....	<b>33</b>
<b>8. Packaging</b> .....	<b>34</b>
8.1. Product label dimension.....	34
8.2. Packaging method.....	34
<b>9. Cautions</b> .....	<b>35</b>
9.1. Safety precautions.....	35
9.2. Product handling precautions.....	35
<b>10. Acronyms</b> .....	<b>37</b>
<b>11. Contact Information</b> .....	<b>39</b>

## Introduction

This module (LTE & WCDMA/HSPA) is designed with a Qualcomm MDM9215 chipset solution. It supports LTE\_FDD with small size and thin 2mm thickness.

This module is designed on Linux OS that software design is simple. It will be given a best choice to all customers who want 4G & 3G wireless data communication. Any portable devices such as Laptop, Tablet PC and PDA, and various M2M devices can be designed with minimum efforts.

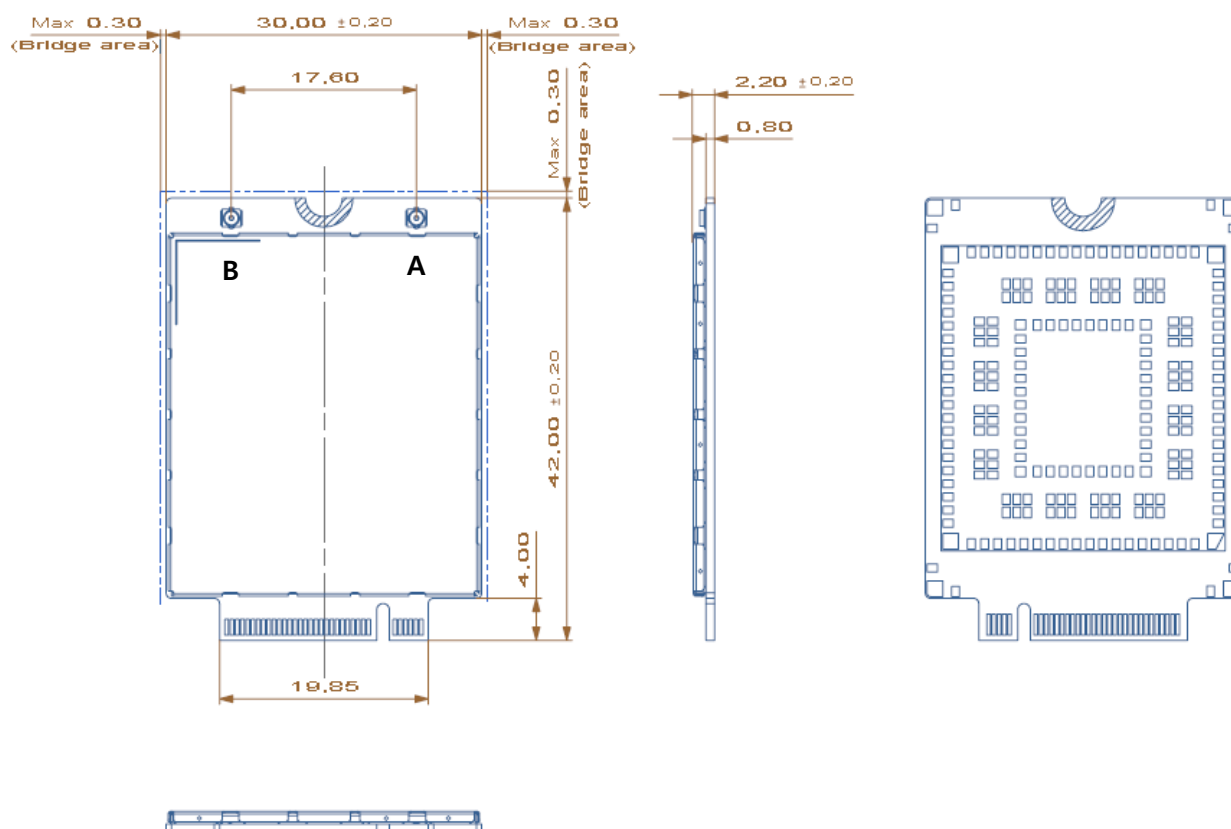
TELEC certification number is 003-140259

JATE certification number is D140192003

# 1. System Layout & Specification

## 1.1. Physical feature

ITEM	Specification
Dimension	30.0 x 42.0 x 2.2 mm
Weight	Typ. 6.0 gram
Mounting hole	1 hole



(Fig. 1) Physical dimension

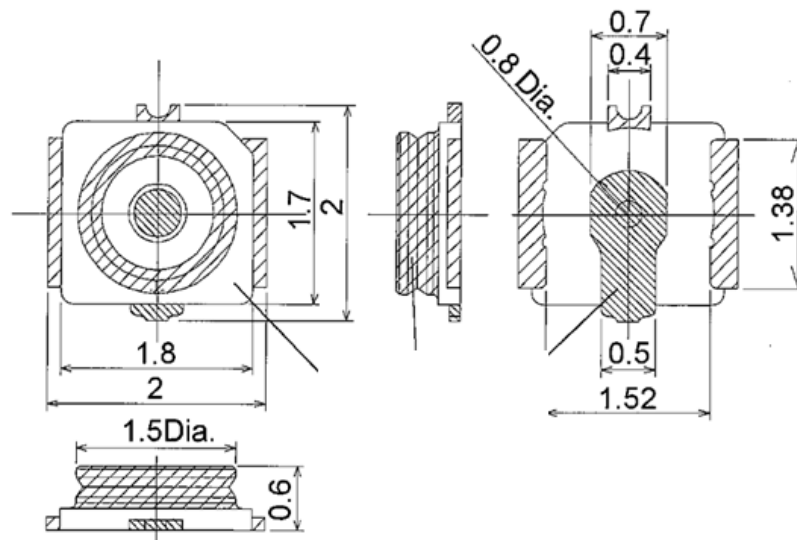
Note A: Main antenna for LTE, WCDMA and HSPA+ modes

Note B: Aux antenna for LTE\_RX, and GPS modes

## 1.2. Interface parts specification

### 1.2.1. Coaxial RF connector

- a. Manufacturer : Murata
- b. Part number : MM4829-2702RB0
- c. Dimension



(Fig.2) Coaxial RF connector dimension

### 1.2.2. Interface connector

- ① Host part
  - a. Manufacture: Kyocera.
  - b. Parts number: 24-6411-067-101-894B
  - c. Dimension: 21.9mm x 8.7mm x 2.0mm



### 1.3. Modem specification

#### 1.3.1 Module frequency specification

Technology	RF Band	Frequency Range(MHz)	Diversity	Comment
LTE	Band 1	1920 ~ 1980 (UL) , 2110 ~ 2170 (DL)	○	
	Band 19	830 ~ 845 (UL), 875 ~ 890 (DL)	○	
	Band 21	1447.9 ~ 1462.9 (UL) ,1495.9 ~ 1510.9(DL)	○	
WCDMA (HSPA)	Band 1	1920 ~ 1980 (UL), 2110 ~ 2170 (DL)	○	
	Band 19	830 ~ 845 (UL), 875 ~ 890 (DL)	○	
GPS	Tracking sensitivity: -157dBm<, Fc=1575.42Mhz			

#### 1.3.2 Module frequency specification (Qualcomm MDM9215)

Standard	Feature
R7 HSPA	Downlink 64 QAM; up to 21 Mbps Uplink 16 QAM; up to 5.76 Mbps DTX and DRX Enhanced F-DPCH Layer 2 optimizations Enhanced cell forward access channel (FACH)
R99,R5,R6	Downlink : up to 14.4Mbps Uplink ; up to 5.76 Mbps

### 1.3.3 LTE network feature summary (Qualcomm MDM9215)

Standard	Feature
R8 Cat3 FDD	FDD: up to 100 Mbps downlink, 50 Mbps uplink 1.4 to 20 MHz RF bandwidth 2 × 2 downlink SU-MIMO; IPv6, QoS Inter-RAT capabilities with WCDMA, HSPA and applicable backward-compatible modes

### 1.3.4 Electrical specification

Parameter	Description	Min.	Typ.	Max.	Units
+VPWR	Absolute maximum voltage	-	-	5	V
	Supply Voltage	3.0	3.3	3.6	V
VIH	High-level Input Voltage, CMOS	1.2	1.8	2.1	V
VIL	Low-level Input Voltage, CMOS	0	0	0.6	V
VOH	High-level Output Voltage, CMOS	1.2	1.8	2.1	V
VOL	Low-level Output Voltage, CMOS	0	0	0.45	V

Note : Refer to 4. Current consumption

### 1.3.5 Environment specification

ITEM	Spec.
Storage Temperature	-40°C to + 90°C
Operating Temperature	-40°C to + 85°C
Humidity (Operational)	85%(50°C) relative humidity
Vibration (Operational)	5Hz to 500Hz sinusoidal, 1.0G
Drop	No damages after 75cm drop over concrete floor
ESD [Electrostatic discharge]	+/- 1 kV Human Body Model (JESD22-A114-B)

## 1.4. RF specifications

### 1.4.1. RX/TX Frequency specification -WCDMA mode

Item	Specification
Maximum Output Power	+23 dBm / 3.84 MHz, +1 / -3 dB
Frequency Error	within $\pm 0.1$ PPM
Open Loop Power Control	Normal conditions : within $\pm 9$ dB, Extreme conditions : within $\pm 12$ dB
Minimum Transmit Power	< -50 dBm /3.84 MHz
Occupied Bandwidth	< 5 MHz at 3.84 Mcps (99% of power)
Adjacent Channel Leakage Power Ratio	> 33 dB @ $\pm 5$ MHz, > 43 dB @ $\pm 10$ MHz
Spurious Emissions $ f-f_c  > 12.5$ MHz	< -36 dBm / 1 kHz RW @ $9 \text{ kHz} \leq f < 150 \text{ kHz}$ < -36 dBm / 10 kHz RW @ $150 \text{ kHz} \leq f < 30 \text{ MHz}$ < -36 dBm / 100 kHz RW @ $30 \text{ MHz} \leq f < 1 \text{ GHz}$ < -30 dBm / 1 MHz RW @ $1 \text{ GHz} \leq f < 12.75 \text{ GHz}$ < -41 dBm / 300 kHz RW @ $1893.5 \text{ MHz} < f < 1919.6 \text{ MHz}$ < -67 dBm / 100 kHz RW @ $925 \text{ MHz} \leq f \leq 935 \text{ MHz}$ < -79 dBm / 100 kHz RW @ $935 \text{ MHz} < f \leq 960 \text{ GHz}$ < -71 dBm / 100 kHz RW @ $1805 \text{ MHz} \leq f \leq 1880 \text{ MHz}$
Transmit Intermodulation	< -31 dBc @ 5 MHz & < -41 dBc @ 10 MHz when Interference CW Signal Level = -40 dBc
Error Vector Magnitude	< 17.5 %, when Pout $\geq$ -20 dBm
Peak Code Domain Error	< -15 dB at Pout $\geq$ -20 dBm
Reference Sens. Level	BER < 0.001 when $\hat{I}_{or} = -106.7$ dBm / 3.84 MHz
Maximum Input Level	BER < 0.001 when $\hat{I}_{or} = -25$ dBm / 3.84 MHz
Adjacent Channel Selectivity (ACS)	ACS > 33 dB where BER < 0.001 when $\hat{I}_{or} = -92.7$ dBm / 3.84 MHz & Ioac = -52 dBm / 3.84 MHz @ $\pm 5$ MHz
Blocking Characteristic	BER < 0.001 when $\hat{I}_{or} = -103.7$ dBm / 3.84 MHz & Iblocking = -56 dBm / 3.84 MHz @ F <sub>w</sub> (offset) = $\pm 10$ MHz

	or Iblocking = -44 dBm / 3.84 MHz @ F <sub>uw</sub> (offset) = ±15 MHz
Spurious Response	BER < 0.001 when I <sub>or</sub> = -103.7 dBm / 3.84 MHz & Iblocking = -44 dBm
Intermodulation	BER < 0.001 when I <sub>or</sub> = -103.7 dBm / 3.84 MHz & I <sub>ouw1</sub> = -46 dBm @ F <sub>w1</sub> (offset) = ±10 MHz & I <sub>ouw2</sub> = -46 dBm / 3.84 MHz @ F <sub>w2</sub> (offset) = ±20 MHz
Spurious Emission	< -57 dBm / 100 kHz BW @ 9 kHz ≤ f < 1 GHz < -47 dBm / 1 MHz BW @ 1 GHz ≤ f ≤ 12.75 GHz

### 1.4.2. RX/TX frequency specification -HSPA mode

Item	Specification																						
Maximum Output Power	Sub-Test 1=1/15, 2=12/15      21~25dBm / 3.84 MHz 3=13/15 4=15/8      20~25dBm / 3.84 MHz 5=15/7 6=15/0      19~25dBm / 3.84 MHz																						
HS-DPCCH	<table border="1"> <thead> <tr> <th>Sub-test in table C.10.1.4</th> <th>Power step</th> <th>Power step slot boundary</th> <th>Power step size, P [dB]</th> <th>Transmitter power step tolerance [dB]</th> </tr> </thead> <tbody> <tr> <td rowspan="4">5</td> <td>1</td> <td>Start of Ack/Nack</td> <td>6</td> <td>+/- 2.3</td> </tr> <tr> <td>2</td> <td>Start of CQI</td> <td>1</td> <td>+/- 0.6</td> </tr> <tr> <td>3</td> <td>Middle of CQI</td> <td>0</td> <td>+/- 0.6</td> </tr> <tr> <td>4</td> <td>End of CQI</td> <td>5</td> <td>+/- 2.3</td> </tr> </tbody> </table>	Sub-test in table C.10.1.4	Power step	Power step slot boundary	Power step size, P [dB]	Transmitter power step tolerance [dB]	5	1	Start of Ack/Nack	6	+/- 2.3	2	Start of CQI	1	+/- 0.6	3	Middle of CQI	0	+/- 0.6	4	End of CQI	5	+/- 2.3
Sub-test in table C.10.1.4	Power step	Power step slot boundary	Power step size, P [dB]	Transmitter power step tolerance [dB]																			
5	1	Start of Ack/Nack	6	+/- 2.3																			
	2	Start of CQI	1	+/- 0.6																			
	3	Middle of CQI	0	+/- 0.6																			
	4	End of CQI	5	+/- 2.3																			
Spectrum Emission Mask	Sub-Test : 1=1/15, 2=12/15, 3=13/15, 4=15/8, 5=15/7, 6=15/0 <table border="1"> <thead> <tr> <th>Frequency offset from carrier <math>\Delta f</math></th> <th>Minimum requirement</th> <th>Measurement Bandwidth</th> </tr> </thead> <tbody> <tr> <td>2.5 ~ 3.5 MHz</td> <td>-35-15<math>\times</math>(<math>\Delta f</math>-2.5)dBc</td> <td>30 kHz</td> </tr> <tr> <td>3.5 ~ 7.5 MHz</td> <td>-35-1<math>\times</math>(<math>\Delta f</math>-3.5)dBc</td> <td>1 MHz</td> </tr> <tr> <td>7.5 ~ 8.5 MHz</td> <td>-35-10<math>\times</math>(<math>\Delta f</math>-7.5)dBc</td> <td>1 MHz</td> </tr> <tr> <td>8.5 ~ 12.5 MHz</td> <td>-49dBc</td> <td>1 MHz</td> </tr> </tbody> </table>	Frequency offset from carrier $\Delta f$	Minimum requirement	Measurement Bandwidth	2.5 ~ 3.5 MHz	-35-15 $\times$ ( $\Delta f$ -2.5)dBc	30 kHz	3.5 ~ 7.5 MHz	-35-1 $\times$ ( $\Delta f$ -3.5)dBc	1 MHz	7.5 ~ 8.5 MHz	-35-10 $\times$ ( $\Delta f$ -7.5)dBc	1 MHz	8.5 ~ 12.5 MHz	-49dBc	1 MHz							
Frequency offset from carrier $\Delta f$	Minimum requirement	Measurement Bandwidth																					
2.5 ~ 3.5 MHz	-35-15 $\times$ ( $\Delta f$ -2.5)dBc	30 kHz																					
3.5 ~ 7.5 MHz	-35-1 $\times$ ( $\Delta f$ -3.5)dBc	1 MHz																					
7.5 ~ 8.5 MHz	-35-10 $\times$ ( $\Delta f$ -7.5)dBc	1 MHz																					
8.5 ~ 12.5 MHz	-49dBc	1 MHz																					
Adjacent Channel Leakage Power Ratio (ACLR)	Sub-Test : 1=1/15, 2=12/15, 3=13/15, 4=15/8, 5=15/7, 6=15/0 > 33 dB @ $\pm 5$ MHz > 43 dB @ $\pm 10$ MHz																						
Maximum Input Level (BLER or R), 16QAM Only	Sub-Test : 1=1/15, 2=12/15, 3=13/15, 4=15/8, 5=15/7, 6=15/0 BLER < 10% or R $\geq$ 700kbps																						

### 1.4.3. RX/TX frequency specification -LTE mode

Item	Specification					requirement	Units
	BW	DL conf	UL conf				
			Mod	RB	Offset		
Maximum Output Power (Class III)	5/10/20M	N.A	QPSK	1	0/0/0	23dBm +/- 2.7dBm	
	5/10/20M	N.A	QPSK	1	24/49/99		
	20M	N.A	QPSK	18	0		
	20M	N.A	QPSK	18	82		
	10M	N.A	QPSK	12	0		
	10M	N.A	QPSK	12	38		
	5M	N.A	QPSK	8	0		
	5M	N.A	QPSK	8	17		
Minimum Output Pwr	20M	N.A	QPSK	100	0	<- 39 dBm	
	10M	N.A	QPSK	50	0		
	5M	N.A	QPSK	25	0		
Frequency Error	20M	N.A	QPSK	50	50	within $\pm 0.1$ ppm + 15Hz	
	10M	N.A	QPSK	50	0		
	5M	N.A	QPSK	25	0		
EVM	20M	N.A	QPSK/16QAM	18	0	< 17.5% (QPSK) <12.5% (16QAM)	
	20M	N.A	QPSK/16QAM	18	82		
	20M	N.A	QPSK/16QAM	100	0		
	10M	N.A	QPSK/16QAM	12	0		
	10M	N.A	QPSK/16QAM	12	38		
	10M	N.A	QPSK/16QAM	50	0		

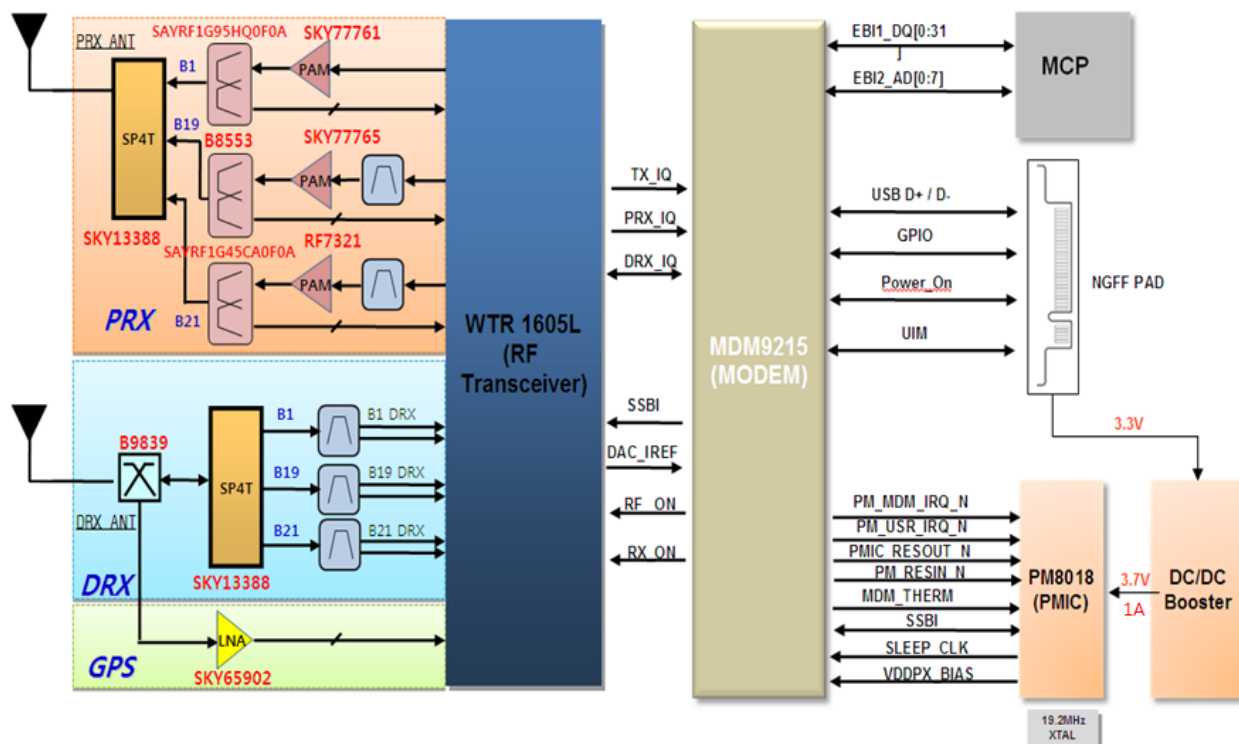
	5M	N.A	QPSK/16QAM	8	0	
	5M	N.A	QPSK/16QAM	8	17	
	5M	N.A	QPSK/16QAM	25	0	
In-band emissions for non allocated RB	20M	N.A	QPSK	18	0	<- 24.2 dB
	20M	N.A	QPSK	18	82	
	10M	N.A	QPSK	12	0	
	10M	N.A	QPSK	12	38	
	5M	N.A	QPSK	8	0	
	5M	N.A	QPSK	8	17	
Spectrum Flatness	20M	N.A	QPSK	100	0	Range1: F UL_Meas - F UL_Low $\geq$ 3 MHz and F UL_High - F UL_Meas $\geq$ 3 MHz, Max Ripple : 4 p-p dB Range2: F UL_Meas - F UL_Low < 3 MHz and F UL_High - F UL_Meas < 3 MHz, Max Ripple : 8 p-p dB
	10M	N.A	QPSK	50	0	
	5M	N.A	QPSK	25	0	
Occupied bandwidth	20M	N.A	QPSK	100	0	20MHz 10MHz 5MHz
	10M	N.A	QPSK	50	0	
	5M	N.A	QPSK	25	0	
ACLR Adjacent Channel Leakage Power Ratio)	20M	N.A	QPSK/16QAM	18	0	UTRAACLR1 : <-32.2dB UTRAACLR2 : <-35.2dB E-TRAACLR1 : <-29.2dB
	20M	N.A	QPSK/16QAM	18	82	
	20M	N.A	QPSK/16QAM	100	0	
	10M	N.A	QPSK/16QAM	12	0	
	10M	N.A	QPSK/16QAM	12	38	
	10M	N.A	QPSK/16QAM	50	0	
	5M	N.A	QPSK/16QAM	8	0	

	5M	N.A	QPSK/16QAM	8	17		
	5M	N.A	QPSK/16QAM	25	0		
Transmitter Spurious emissions	20M	N.A	QPSK/16QAM	18	0	BW 5Mhz :10 ΔFOOB(Mhz) , BW10Mhz :15 ΔFOOB(Mhz) , BW20Mhz :25 ΔFOOB(Mhz) *ΔF OOB ( Δ Frequency of Out Of Band emission) 9 kHz≤f<150kHz; Limit -36 dBm, measurement BW 1khz 150 kHz≤f<30MHz; Limit -36 dBm, measurement BW 10khz 30 MHz≤f<1000MHz; Limit -36 dBm, measurement BW 100khz 1 GHz≤f<12.75GHz; Limit -30 dBm, measurement BW 1Mhz	
	20M	N.A	QPSK/16QAM	18	82		
	20M	N.A	QPSK/16QAM	100	0		
	10M	N.A	QPSK/16QAM	12	0		
	10M	N.A	QPSK/16QAM	12	38		
	10M	N.A	QPSK/16QAM	50	0		
	5M	N.A	QPSK/16QAM	8	0		
	5M	N.A	QPSK/16QAM	8	17		
	5M	N.A	QPSK/16QAM	25	0		
Minimum Sensitivity Level	20M SIMO	QPSK 100RB	QPSK	100	0	< -93.3 dBm/20MHz	
	20M SISO	QPSK 100RB	QPSK	100	0	< -90.3 dBm/20MHz	
	10M SIMO	QPSK 50RB	QPSK	50	0	< -96.3 dBm/10MHz	
	10M SISO	QPSK 50RB	QPSK	50	0	< -93.3 dBm/10MHz	
	5M SIMO	QPSK 25RB	QPSK	25	0	< -99.3 dBm/5MHz	
	5M SISO	QPSK 25RB	QPSK	25	0	< - 96.3 dBm/5MHz	
Maximum input Level	20M SIMO	64QAM MCS26	QPSK	18	0	> - 25.7	dBm/20MHz
	10M SIMO	64QAM MCS26	QPSK	12	0		dBm/10MHz
	5M SIMO	64QAM MCS26	QPSK	8	8		dBm/5MHz



## 1.5. System block

This module is composed of MDM9215, Memory, RF frontend, WTR1605L, PM8018 and interface connector. MDM9215 chipset supports high performance data applications over a wide range air interface standards including HSPA, WCDMA, and Category 3 LTE. And the supported RF operating bands are defined by the chipset's WTR1605L. The built-in memory capacity is NAND 2Gbit and SDRAM 1Gbit. The PM8018 device integrates all wireless data card power-management, general-housekeeping, and user-interface support functions into a single IC. The interface connector supports functions of UART, USIM, GPIO'S and USB.



(Fig. 3) System block diagram

## 2. Interface Connector

### 2.1. Pin assignment

1	Config_3	2	+VPWR
3	GND	4	+VPWR
5	GND	6	Power_Key
7	USB_D+	8	Reserved <sup>(+1)</sup>
9	USB_D-	10	Reserved <sup>(+1)</sup>
11	GND	12	Module key <sup>(+3)</sup>
13	Module key <sup>(+3)</sup>	14	Module key <sup>(+3)</sup>
15	Module key <sup>(+3)</sup>	16	Module key <sup>(+3)</sup>
17	Module key <sup>(+3)</sup>	18	Module key <sup>(+3)</sup>
19	Module key <sup>(+3)</sup>	20	RTS
21	Config_0	22	TXD
23	WAKE ON WWAN_N	24	RXD
25	Reserved <sup>(+1)</sup>	26	Reserved <sup>(+1)</sup>
27	GND	28	NC <sup>(+2)</sup>
29	NC <sup>(+2)</sup>	30	UIM_RESET
31	NC <sup>(+2)</sup>	32	UIM_CLK
33	GND	34	UIM_DATA
35	NC <sup>(+2)</sup>	36	UIM_PWR
37	NC <sup>(+2)</sup>	38	NC <sup>(+2)</sup>
39	GND	40	Reserved <sup>(+1)</sup>
41	Reserved <sup>(+1)</sup>	42	GPIO_1
43	Reserved <sup>(+1)</sup>	44	GPIO_2
45	GND	46	GPIO_3
47	Reserved <sup>(+1)</sup>	48	CTS
49	Reserved <sup>(+1)</sup>	50	NC <sup>(+2)</sup>
51	GND	52	Reserved <sup>(+1)</sup>
53	Reserved <sup>(+1)</sup>	54	Reserved <sup>(+1)</sup>
55	Reserved <sup>(+1)</sup>	56	Reserved <sup>(+1)</sup>
57	GND	58	Reserved <sup>(+1)</sup>
59	Reserved <sup>(+1)</sup>	60	NC <sup>(+2)</sup>

61	Reserved <sup>(*1)</sup>	62	NC <sup>(*2)</sup>
63	Reserved <sup>(*1)</sup>	64	NC <sup>(*2)</sup>
65	Reserved <sup>(*1)</sup>	66	Reserved <sup>(*1)</sup>
67	RESET_N	68	NC <sup>(*2)</sup>
69	Config_1	70	+VPWR
71	GND	72	+VPWR
73	GND	74	+VPWR
75	Config_2		

*NOTE<sup>(\*1)</sup> :Reserved pins are connected with signals in the module.*

*Purpose of the pin refer to 3.9 Reserved*

*NOTE<sup>(\*2)</sup> :NC Pins are opened in the module.*

*NOTE<sup>(\*3)</sup> :Module Keying (U-shaped indentation) is required by PCIe M.2 specifications to provide configurability as well as preventing incompatible module insertion.*

## 2.2. Pin description

Pin	Signal name	Pad Type	Pad Voltage	Functional Description
1	CONFIG_3	-	-	Ground
2	+VPWR	PI	3.3V	Main power supply input
3	GND	-	-	Ground
4	+VPWR	PI	3.3V	Main power supply input
5	GND	-	-	Ground
6	POWER_KEY	AI	1.8V	System Power On/Off, Active high
7	USB_D+	B		USB data (+)
8	Reserved	-	-	-
9	USB_D-	B		USB data (-)
10	Reserved	-	-	-
11	GND	-	-	Ground
12	Module key	-	-	-
13	Module key	-	-	-
14	Module key	-	-	-
15	Module key	-	-	-
16	Module key	-	-	-
17	Module key	-	-	-
18	Module key	-	-	-
19	Module key	-	-	-
20	RTS	IO	1.8V	UART ready for receive signal
21	CONFIG_0	-	-	Not Connected
22	TXD	DI	1.8V	UART transmit data output
23	WAKE_ON_WWAN_N	IO	1.8V	This pin is used to wake host, Active low
24	RXD	DO	1.8V	UART receive data input
25	Reserved	-	-	-
26	Reserved	-	-	-
27	GND	-	-	Ground
28	N/C	-	-	Not Connected
29	N/C	-	-	Not Connected
30	UIM_RESET	DO	2.85V/1.8V	UIM Reset

31	N/C			Not Connected
32	UIM_CLK	DO	2.85V/1.8V	UIM Clock
33	GND	-	-	Ground
34	UIM_DATA	B	2.85V/1.8V	UIM Data
35	N/C	-	-	Not Connected
36	UIM_PWR	DO	2.85V/1.8V	UIM Power
37	N/C	-	-	Not Connected
38	N/C	-	-	Not Connected
39	GND	-	-	Ground
40	Reserved	-	-	-
41	Reserved	-	-	-
42	GPIO_1	IO	1.8V	General Purpose Input Output Port
43	Reserved	-	-	-
44	GPIO_2	IO	1.8V	General Purpose Input Output Port
45	GND	-	-	Ground
46	GPIO_3	IO	1.8V	General Purpose Input Output Port
47	Reserved	-	-	-
48	CTS	DO	1.8V	UART clear to send signal
49	Reserved	-	-	-
50	N/C	-	-	Not Connected
51	GND	-	-	Ground
52	Reserved	-	-	-
53	Reserved	-	-	-
54	Reserved	-	-	-
55	Reserved	-	-	-
56	Reserved	-	-	-
57	GND			Ground
58	Reserved	-	-	-
59	Reserved	-	-	-
60	N/C	-	-	Not Connected
61	Reserved	-	-	-
62	N/C	-	-	Not Connected
63	Reserved	-	-	-
64	N/C	-	-	Not Connected

65	Reserved	-	-	-
66	Reserved	-	-	-
67	RESET_N	AI	1.8V	Hardware reset, Active low Open drain design is recommended.
68	N/C	-	-	Not Connected
69	CONFIG_1	-	-	Not Connected
70	+VPWR	PI	3.3V	Main power supply input
71	GND	-	-	Ground
72	+VPWR	PI	3.3V	Main power supply input
73	GND	-	-	Ground
74	+VPWR	PI	3.3V	Main power supply input
75	CONFIG_2	-	-	Not Connected

**[Remark]**

B : Bi-directional

AI : Analog Input into Module

AO : Analog Output from Module

DI : Digital Input into Module

DO : Digital Output from Module

PI : Power input into Module

PO: Power output from Module

IO: General Purpose Input Output Port

### 3. Modem Interface Description

#### 3.1. Power supply

Requirement of Input voltage is refer to the below table

Pin No.	Signal Name	Specification	Min	Typ	Max	Units
2, 4, 70, 72, 74	+VPWR	Voltage range	3.0	3.3	3.6	V
		Ripple voltage	-	-	100	mVpp
3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73	GND	-	-	0	-	V

#### 3.2. USB

This module supports the USB 2.0 Specification.

It is used for diagnostic monitoring and data transfer.

Entering into suspend mode is available from the host or module

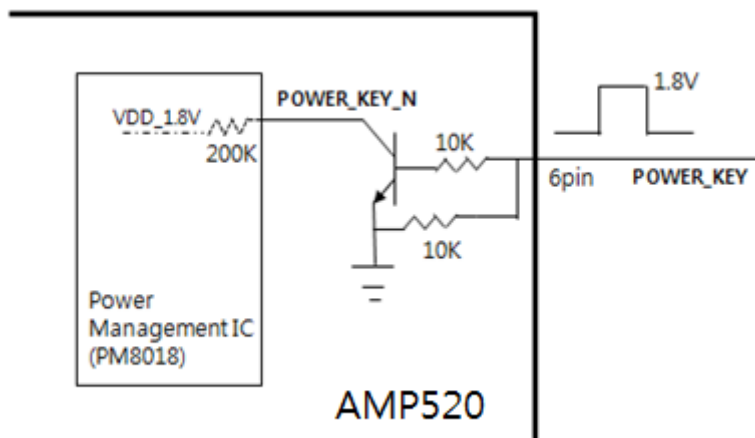
Pin No.	Signal Name	Signal Description	Direction
9	USB_D-	USB differential data (-)	Bidirectional
7	USB_D+	USB differential data (+)	Bidirectional

*NOTE: Differential line(D+,D-) impedance should be designed closely to 90-ohm..*

#### 3.3. Power\_key

To turn on, Power\_Key pin must be held high at least for one second, and then a module will start booting. In same procedure, to turn off, Power\_Key pin must be held high for at least 1 second, and then the power will switch off automatically.

Pin No.	Signal Name	Signal Description	Direction
6	POWER_KEY	Power On/Off , Active high	Input

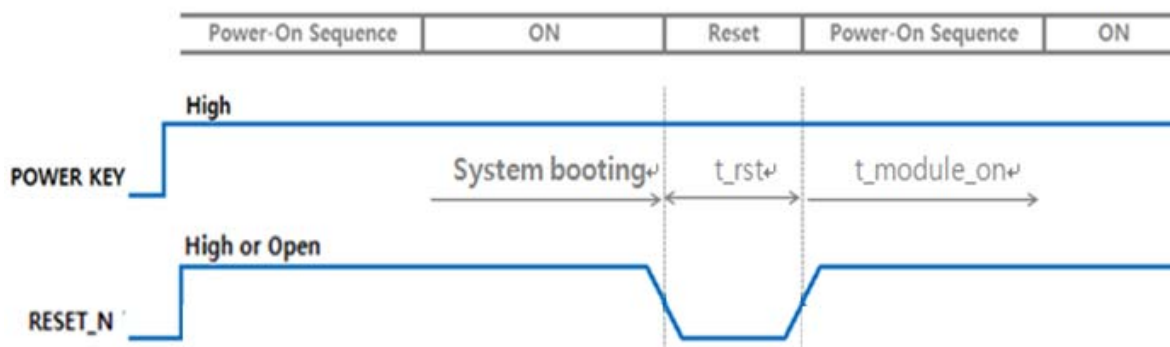


(Fig. 4) POWER\_KEY circuit

### 3.4. RESET\_N

This pin is for hardware reset of this module, which pin is recommended open-drain design in host. RESET\_N signal must be held low for at least 1s, and then released.

Pin No.	Signal Name	Signal Description	Direction
67	RESET_N	Reset input , Active low	Input



(Fig. 5) RESET\_N operation

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

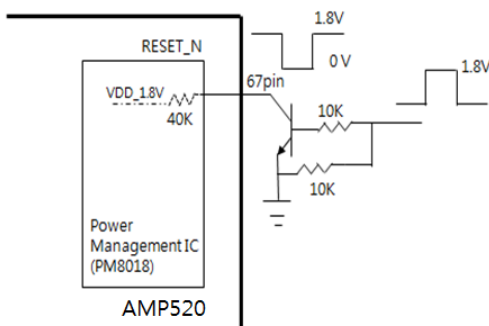
*In case of any communication problems, it is recommended that the host should perform reset in hardware and software manner.*

*Note 2 : Only in case software reset(AT command) can not solve the problem, executes a hardware reset.*

*Note 3 : During hardware reset, I/O signals connected to module including UART signals should be asserted to Low level or open state.*

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





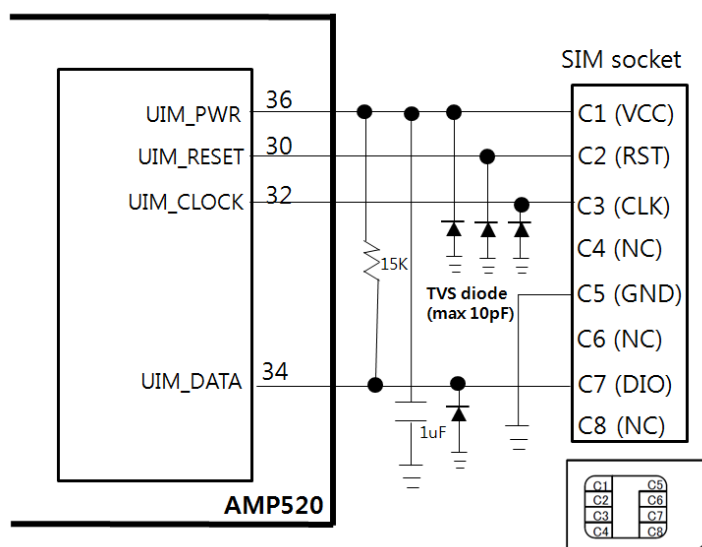
(Fig.6) RESET\_N circuit

### 3.5. USIM

This module supports USIM interface as the below table.

Pin No.	Signal Name	Signal Description	Direction
36	UIM_PWR	Power supply for SIM	Output
32	UIM_CLK	Serial clock for SIM data	Output
30	UIM_RESET	Active low SIM reset	Output
34	UIM_DATA	Bi-directional SIM data line	Output/Input

TVS Diodes in host design are recommended as below diagram for ESD protection.



(Fig.7) USIM interface design for ESD protection

*Note : ESD protection must be selected in consideration of the timing.*

### 3.6. UART

UART pins may support the AT command, may be used for data communication with the host.

Pin No.	Signal Name	Signal Description	Direction
20	RTS	Request to send	HOST → AMP520
22	TXD	Transmit Data	HOST → AMP520
24	RXD	Receive Data	HOST ← AMP520
48	CTS	Clear to send	HOST ← AMP520

*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. GPIO

GPIO supports two modes and can be input, output

Pin No.	Signal Name	Signal Description	Pad Type
42	GPIO_1	General Purpose Input Output Port	PD
44	GPIO_2	General Purpose Input Output Port	PD
46	GPIO_3	General Purpose Input Output Port	PD

*Note 1: Do not support default*

*Note 2: If the module is off, a leakage is generated when voltage is supplied at pin. It should be careful when you design.*

### 3.8. WAKE\_ON\_WWAN\_N

This pin must be used to wake host by module

Pin No.	Signal Name	Signal Description (Host Side)	Direction
23	WAKE_ON_WWAN_N	This pin is used to wake HOST, It will output a 1sec low pulse .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.*

### 3.9. Reserved

To use Reserved Pins, Customer must inform to AMTEL co.Ltd  
 Current purpose of Reserved pins is as the below table.

Pin No.	Signal Name	Signal Description	Direction
8	Reserved	WWAN disable function	-
10	Reserved	LED status indicator	-
25	Reserved	This signal is an input directly to the AMP520 from a suitable SAR sensor.	-
26	Reserved	GPS disable function	-
40	Reserved	General Purpose Input Output Port	-
41	Reserved	Power supply hold control for JTAG	Debug
43	Reserved	JTAG reset	Debug
47	Reserved	JTAG mode select input	Debug
49	Reserved	JTAG data input	Debug
52	Reserved	JTAG return clock	Debug
53	Reserved	JTAG clock input	Debug
54	Reserved	JTAG data output	Debug
55	Reserved	JTAG reset for debug	Debug
56	Reserved	Digital I/O supply voltage (1.8V)	
58	Reserved	Watchdog timer disable input	-
59	Reserved	These signals are used for Antenna Control	
61	Reserved	These signals are used for Antenna Control	
63	Reserved	These signals are used for Antenna Control	
65	Reserved	These signals are used for Antenna Control	
66	Reserved	SIM card detect	

*Note: Do not connect at host*

## 4. Current Consumption

The current consumption of the module is listed as below table.

The listed current consumption is tested at 3.3V power supply.

### 4.1. Standby current

Mode	RF mode	Current		Condition
		Typical	Unit	
Standby	LTE	13.0	mA	DRX=1.28s, GPS off (UART is not operation, USB is Suspend mode)
	WCDMA	11.5	mA	DRX=1.28s, GPS off (UART is not operation, USB is Suspend mode)
	LTE	11.4	mA	DRX=2.56s, GPS off (UART is not operation, USB is Suspend mode)
	WCDMA	10.9	mA	DRX=2.56s, GPS off (UART is not operation, USB is Suspend mode)

### 4.2. Operating current

Mode	RF mode	Current		Condition
		Typ.	Unit	
Call connected	LTE	670	mA	BW:10MHz,D/L:50RB,U/L:12RB @23dBm 3.3V , 25°C LTE B1
	LTE	330	mA	BW:10MHz,D/L:50RB,U/L:12RB @0dBm 3.3V, 25°C LTE B1
	WCDMA	580	mA	12.2K RMC @ 23dBm, 3.3V, 25°C, WCDMA B1
	WCDMA	250	mA	12.2K RMC @ 0dBm, 3.3V, 25°C, WCDMA B1

*Note : The maximum current is 810mA, but customer should check whether the voltage drop of +VPWR because the maximum current can be varied depending on the network environment and temperature.*

### 4.3. In-rush current

Signal	State	Current		Condition
		Max.	Unit	
+VPWR	Peak current	1.6	A	Power on state

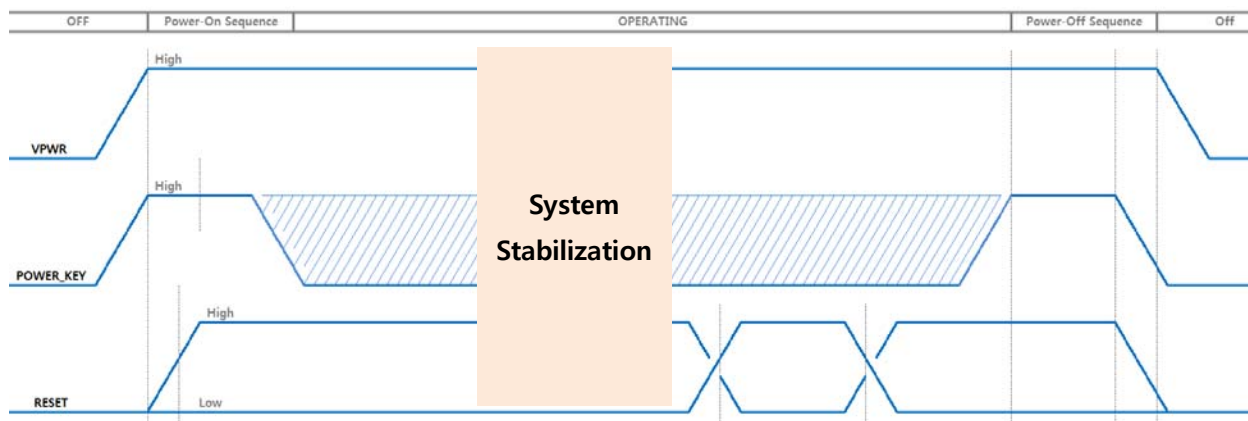
*Note : 10 times measured results after full discharging.*

### 4.4. Leakage current

Signal	State	Current			Condition
		Typical	Max	Unit	
+VPWR	Leakage current	-	100	uA	Power off state

## 5. Signal Timing

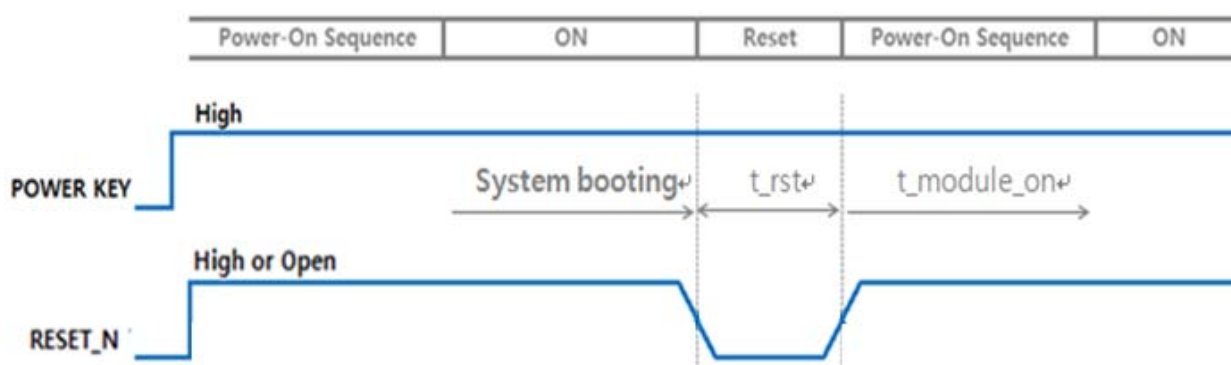
### 5.1. Power on sequence



(Fig. 8) Module power on sequence

Parameter	Description	Min	Typ	Max
T_power_on	POWER_KEY signal tied high	1s	-	-
T_module_on	After reset, the boot timing	5s	-	8s
T_power_off	POWER_KEY signal tied high	1s	-	-
T_module_off	After Power-off sequence start, power-off time	-	0.5s	-

### 5.2. Reset sequence

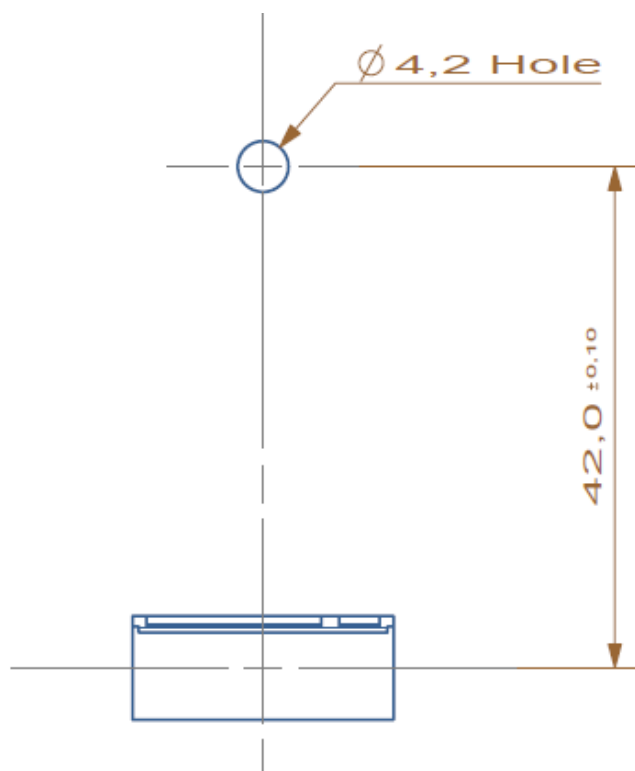


(Fig. 9) Module reset sequence

Parameter	Description	Min	Typ	Max
t_reset	Reset duration	100ms	400ms	-
t_module_on	After reset, the booting time	5s	-	8s

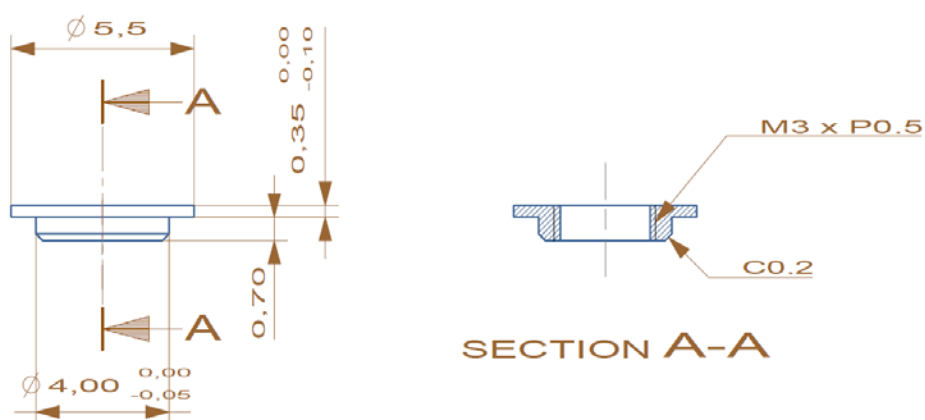
## 6. Mechanical Design Guide

### 6.1. PCB layout guide

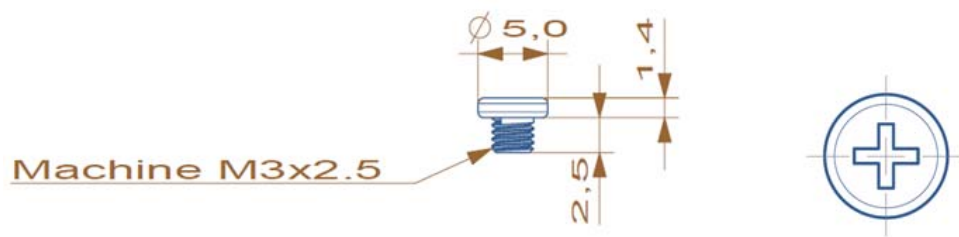


(Fig. 10) Modem layout guide

### 6.2. Insert nut & screw guide



(Fig. 11) Insert nut guide



(Fig. 12) screw guide

*Note : This guide is based on PCIe M.2 connector(Kyocera part no. 24 6411 067 101 894B).*

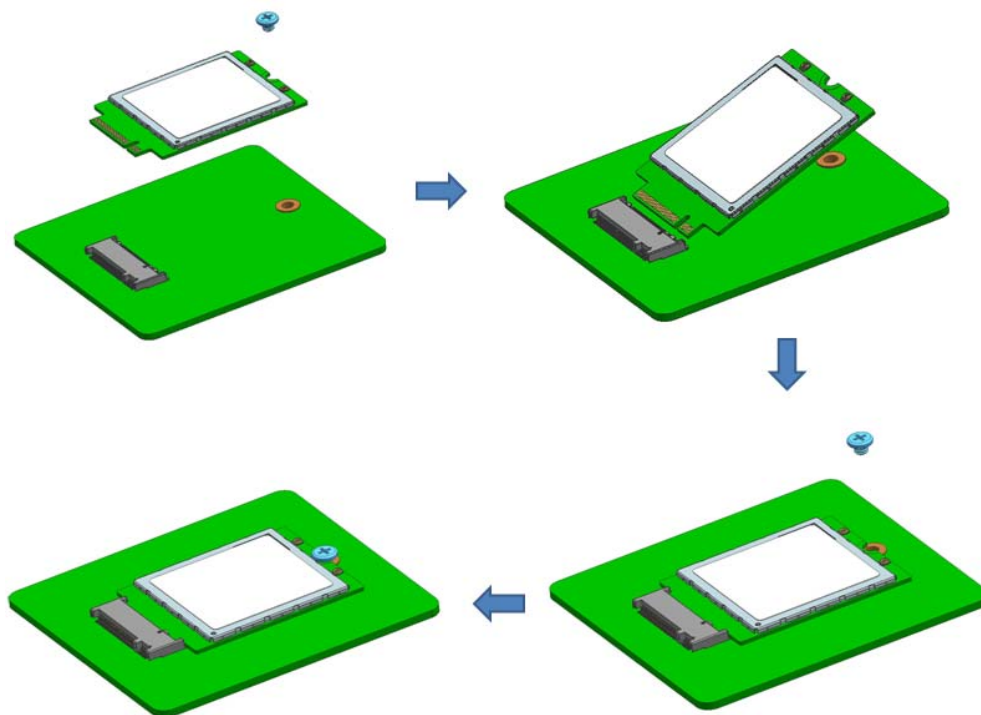
*In case of using different kind of connector, customer should consider if the insert nut and screw need to be changed.*



## 7. Module Assembly

When assembly or disassembly, please be careful any physical damage of module

- a. Do not use sharp tools.
- b. Be careful to mate the PCIe M.2 connector, and do not press very hard the module.



(Fig. 13) Assembly guide

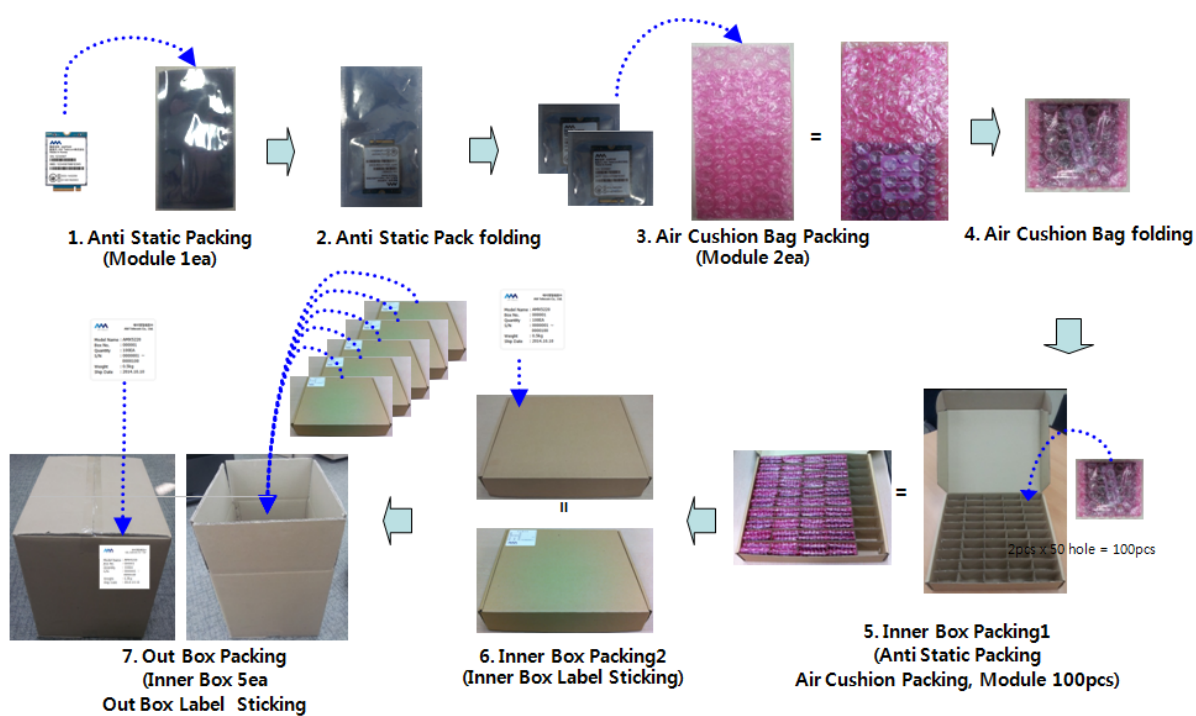
## 8. Packaging

### 8.1. Product label dimension



*Note : Label specification can be changed.*

### 8.2. Packaging method



*Note : Packaging specification can be changed.*

## 9. Cautions

### 9.1. 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.

### 9.2. 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.

## 10. Acronyms

Word	Description
AXGP	Advanced extended Global Platform
BER	Bit Error Rate
BLER	Block Error Rate
BW	Band Width
CW	Continuous Waveform
dB	Decibel
dBm	Decibels above 1 mill watt
DL	Down-link
DPCCH	Dedicated Physical Control CHannel
DRX	Discontinuous Reception
DTX	Discontinuous Transmission
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
F-DPCH	Fractional Dedicated Physical Channel
FDD	Frequency Division Duplex
GPIO	General Purpose Input Output
GPS	Global Positioning System
HSPA	High Speed Packet Access
LTE	Long Term Evolution
MCS	Modulation and Coding Scheme
MISO	Multiple Input Single Output
PPM	Parts Per Million
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RAT	Radio Access Technology
RF	Radio Frequency
Sensitivity	The minimum input signal to be specified value of the output power (or SNR/BER/BLER) in a wireless receiver.
SIMO	Single Input Multiple Output
TDD	Time Division Duplex

UL	Up-link
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
VPWR	The source of power to the Modem
WCDMA	Wideband Code Division Multiple Access

## 11. Contact Information

### - Korea

E-mail	Sales@amtel.co.kr
Telephone	+82-31-788-9809 (9945)
Address.	<b>AM Telecom Co., Ltd</b> #608, YatapLeaders bldg., 42, Jangmi-ro, Bundang-gu, Seongnam-si Gyeonggi-do, 463-828, Korea

### - Japan

E-mail	amjapan@amtel.co.jp
Telephone	+81-3-6257-3834
Address.	<b>AM Telecom Co., Ltd</b> 18F, Shinkasumigaseki Bldg., 3-3-2, Kasumigaseki, Chiyoda-ku, Tokyo, 100-0013