

RTX4144 Wi-Fi module

RTX A/S

RTX4144

User Manual

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Revision History

Rev.	History	Date	Author
V0.3	- Initial version	2015/2/26	TT
V0.4	- Update the mechanical dimension	2015/11/27	TT
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Federal Communication Commission Interference Statement

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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

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.

IMPORTANT NOTE:

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 20cm between the radiator & your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Country Code selection feature to be disabled for products marketed to the US/CANADA

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna,
- 3) For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

As long as 3 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

IMPORTANT NOTE

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC 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 FCC authorization.

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 FCC ID: S9J4144".

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.

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;
- 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Caution:

(i) the device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

(ii) for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the e.i.r.p. limit;

(iii) for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the band 5725-5850 MHz shall be such that the equipment still complies with the e.i.r.p. limits specified for point-to-point and non-point-to-point operation as appropriate; and

Operations in the 5.25-5.35GHz band are restricted to indoor usage only.

Avertissement:

- (i) les dispositifs fonctionnant dans la bande de 5150 à 5250MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux;
- (ii) pour les dispositifs munis d'antennes amovibles, le gain maximal d'antenne permis pour les dispositifs utilisant les bandes de 5250 à 5350MHz et de 5470 à 5725 MHz doit être conforme à la limite de la p.i.r.e.;
- (iii) pour les dispositifs munis d'antennes amovibles, le gain maximal d'antenne permis (pour les dispositifs utilisant la bande de 5725 à 5850 MHz) doit être conforme à la limite de la p.i.r.e. spécifiée pour l'exploitation point à point et l'exploitation non point à point, selon le cas;

Les opérations dans la bande de 5.25-5.35GHz sont limitées à un usage intérieur seulement.

Radiation Exposure Statement:

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

Déclaration d'exposition aux radiations:

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20cm entre le radiateur et votre corps.

This device is intended only for OEM integrators under the following conditions:

- 1) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 1 condition 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:

1) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 1 condition 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 co-location 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

The final end product must be labeled in a visible area with the following: "Contains IC: 4979A-4144".

Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 4979A-4144".

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.

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1. Key Features

- QCA4004 IoE solution
- Internal PA and LNA, with external RF Switch for Antenna Diversity
- 2.4GHz and 5GHz Dual band IEEE 802.11a/b/g/n, single stream 1x1
- 11n support HT20 and HT40 Bandwidth
- 1 On board dual-band printed Antenna and optional U.FL antenna connectors.
- GPIO voltage is flexible, can between 1.8~3.3V
- Single power supply: 3.3V, Low Power Consumption, also support Green Tx and very low power sleep mode for mobile battery operation application. Can be wake up and go to sleep quickly.
- 42mm x 20mm size, 2-layer, single side component
- Operation temperature: -40~+85 degrees C(Industry Class Version); 0~+85 degrees C(Commercial Class Version)
- TCP/IP offload, include Encryption
- QCA4004 has Hardware Wake Up Manager allow chip go to sleep and wake up later automatically. This feature can reduce normal operation power consumption.
- SPI Slave interface to the MCU.
- DNSA-144 also can be host-less mode(stand-alone). Allow user to run tiny size application.

2. Electrical Specification

■ General DC electrical characteristics

These conditions apply to all DC characteristics unless otherwise specified:

Temp = 25 °C, VDD33= 3.3 V

Table 4: DC electrical characteristics for digital I/Os

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{IH}	High level I voltage	–	1.8	–	3.6	V
V _{IL}	Low level I voltage	–	-0.3	–	0.3	V
V _{OH}	High level O voltage	–	2.2	–	3.3	V
V _{OL}	Low level O voltage	–	0	–	0.4	V
I _{IL}	Low level I current	–	–	–	0.1	μA
I _{IH}	High level I current	–	–	–	0.1	μA
I _{OH}	High level O current for GPIO0 to GPIO13	–	–	–	8	mA
	High level O current for GPIO18 to GPIO25	–	–	–	20	
I _{OL}	High level O current for GPIO0 to GPIO13	–	–	–	20	mA
	High level O current for GPIO18 to GPIO25	–	–	–	20	
C _{IN}	I capacitance for GPIO0 to GPIO13	–	–	5	–	pF
	I capacitance for GPIO18 to GPIO25	–	–	3	–	

■ Power Consumption

Vcc=3.3V, Room temperature

Condition	Average	Unit
2.4G 11g continue Tx@6M_17dBm	900	mWatt
2.4G 11n continue Tx@HT40MCS7_11dBm	630	
2.4G 11b/g and 11n HT20 continue Rx	314	
2.4G 11n HT40 continue Rx	340	
5.18G 1a continue Tx@6M_14dBm	947	
5.18G 11n continue Tx@HT40MCS7_6dBm	660	
5.18G 11a and 11n HT20 continue Rx	320	
5.18G 11n HT40 continue Rx	342	

Note A: External IO voltage (DVDD_GPIO) can be 1.8~3.3V.

Note B: QCA4004 need 3.3V and 1.2V supply. For 1.2V supply there are 2 methods: Switching and LDO. Inside the QCA4004, there is embedded a switching regulator to convert 3.3V to 1.2V for its chip core voltage supply. Also it has a LDO driver to act as 3.3V->1.2V LDO driver (might need external transistor). In this table we consider to use switching regulator method to have better power efficiency. The tradeoff is we have to add a power inductor near QCA4004 chip. Also shielding height has to be caution to prevent the inductor magnetic field interaction with the iron

material in the shielding.

■ Absolute Rating

Symbol	Description	Range	Unit
VDDIO	All IO supply voltage	-0.3~+4.0	Volt
3.3V	All 3.3V net	-0.3~+4.0	Volt
Min Digital IO	All Digital IO pins	-0.3	Volt
Max Digital IO	All Digital IO pins	(VDDIO+0.3)	Volt
RFin	Max Input RF signal	10	dBm
Tstorage	Storage Temperature	-40~+135	°C
ESD-HBM	Human Body Model, all pins		Volt
ESD-CDM-nonRF	Charged Device Model, non-RF pins	500	Volt
ESD-CDM-RF	Charged Device Model, RF pins	400	Volt

Note: This table is the level that could permanent cause damage to the module. For normal operating, please use below table for design consideration.

■ Recommend Operating Condition

Symbol	Description	Range	Unit
VDDIO_GPIO	All IO supply voltage	1.8~3.4	Volt
3.3V	All 3.3V net	3.15~3.45	Volt
Min Digital IO	All Digital IO pins	-0.2	Volt
Max Digital IO	All Digital IO pins	(VDDIO+0.2)	Volt

■ SPI slave interface electrical timing diagram

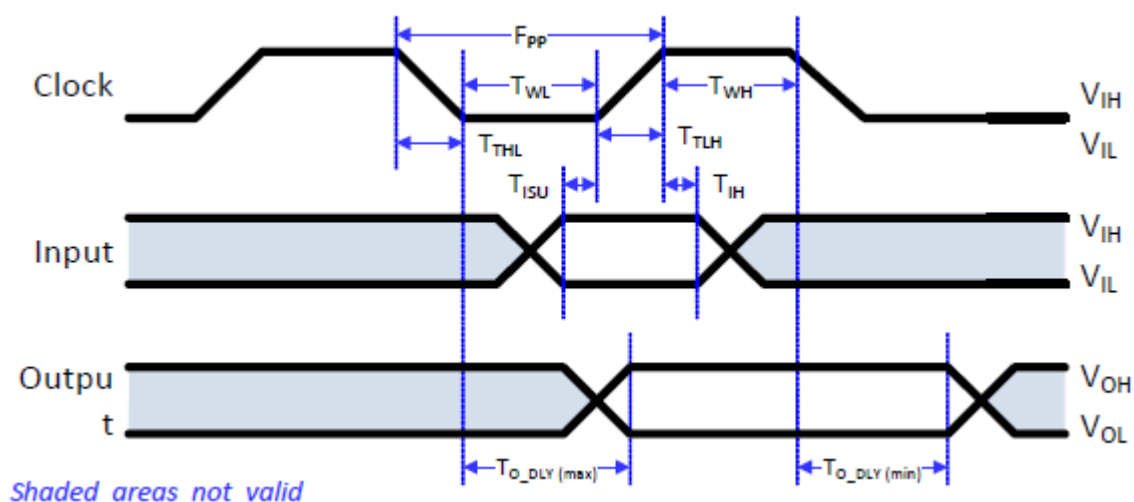


Fig.4: SPI slave timing

Table 4: SPI slave port timing (48 MHz reference clock)

Parameter	Description	Min	Max	Unit
f_{PP}	Clock frequency	0	48	MHz
t_{WL}	Clock low time	8.3	–	ns
t_{WH}	Clock high time	8.3	–	ns
t_{TLH}	Clock rise time	–	2	ns
t_{THL}	Clock fall time	–	2	ns
t_{ISU}	Input setup time	5	–	ns
t_{IH}	Input hold time	5	–	ns
t_{O_DLY}	Output delay	0	5	ns

- RF Tx target power [unit:dBm], IEEE mask and EVM compliance power.

Mode/Rate	MHz
	2412~2472
11b 1Mbps	16
11b 11Mbps	16
11g 6Mbps	17
11g 54Mbps	17
11n HT20 MCS0	17
11n HT20 MCS7	12
11n HT40 MCS0	14
11n HT40 MCS7	11

Mode/Rate	MHz	MHz	MHz
	5180	5500	5825
11a 6Mbps	14	12	12
11a 54Mbps	8	7	7
11n HT20 MCS0	14	11	11
11n HT20 MCS7	7	6	6
11n HT40 MCS0	13	11	11
11n HT40 MCS7	6	5	5

- RF Rx sensitivity [unit:dBm]:

Mode/Rate	MHz
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	2412~2472
11b 1Mbps	-92
11b 11Mbps	-85
11g 6Mbps	-88
11g 54Mbps	-71
11n HT20 MCS0	-87
11n HT20 MCS7	-67
11n HT40 MCS7	-64

Mode/Rate	MHz	MHz	MHz
	5180	5500	5825
11a 6Mbps	-88	-88	-88
11a 54Mbps	-71	-71	-71
11n HT20 MCS0	-87	-87	-87
11n HT20 MCS7	-67	-67	-66
11n HT40 MCS7	-64	-64	-63

■ Antenna performance: on board printed ANT

The on board printed antenna VSWR is better than 3 and efficiency is around 40~57%.

Frequency (MHz)	Efficiency		Peak Gain
	(%)	dB	
2400	53%	-2.76	4.63
2450	57%	-2.44	4.98
2500	47%	-3.28	3.57
5150	44%	-3.56	3.09
5250	46%	-3.35	3.12
5350	50%	-3.03	3.45
5470	53%	-2.76	3.95
5600	52%	-2.85	3.65
5725	44%	-3.54	2.92
5850	40%	-3.95	1.58

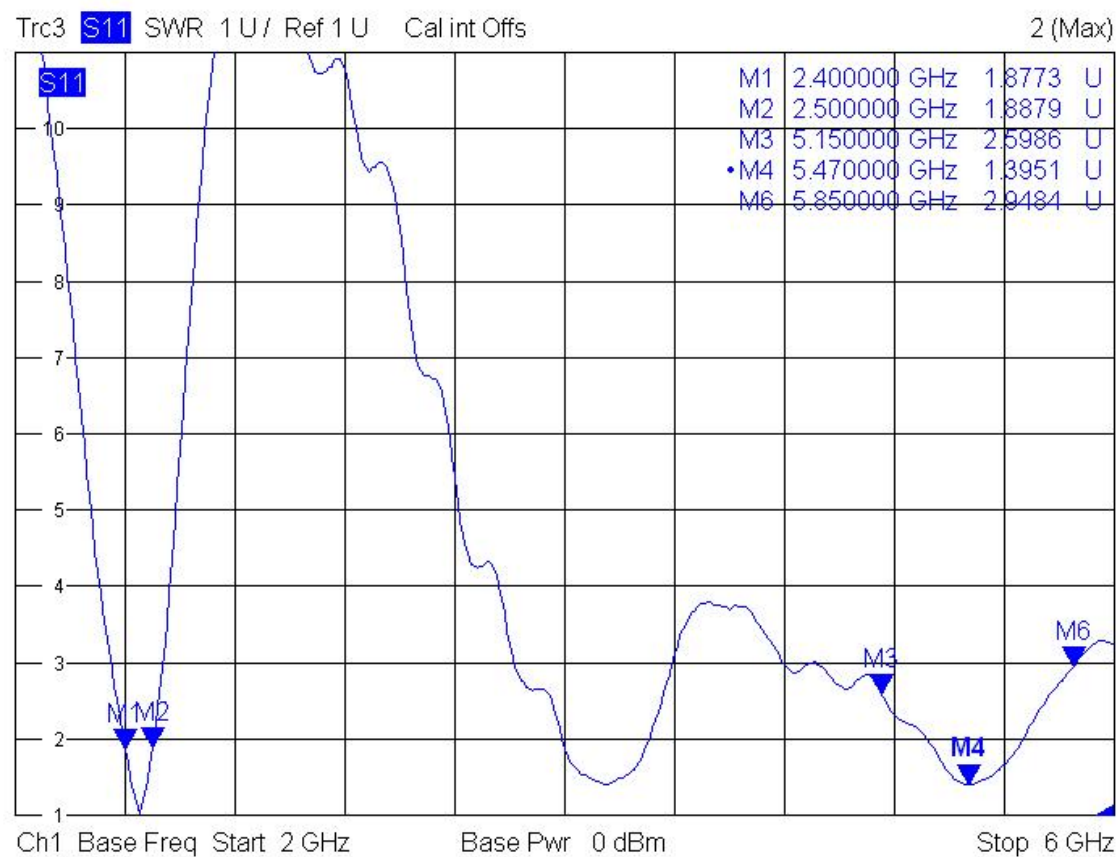


Fig.5 Antenna VSWR (Testing point is same as Fig.6)

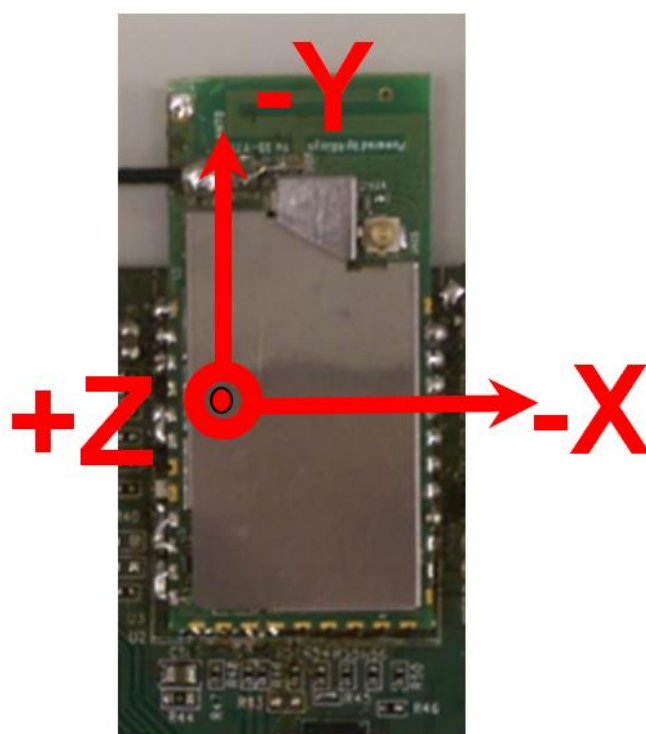




Fig.6: Antenna radiation pattern **XY-Plane**

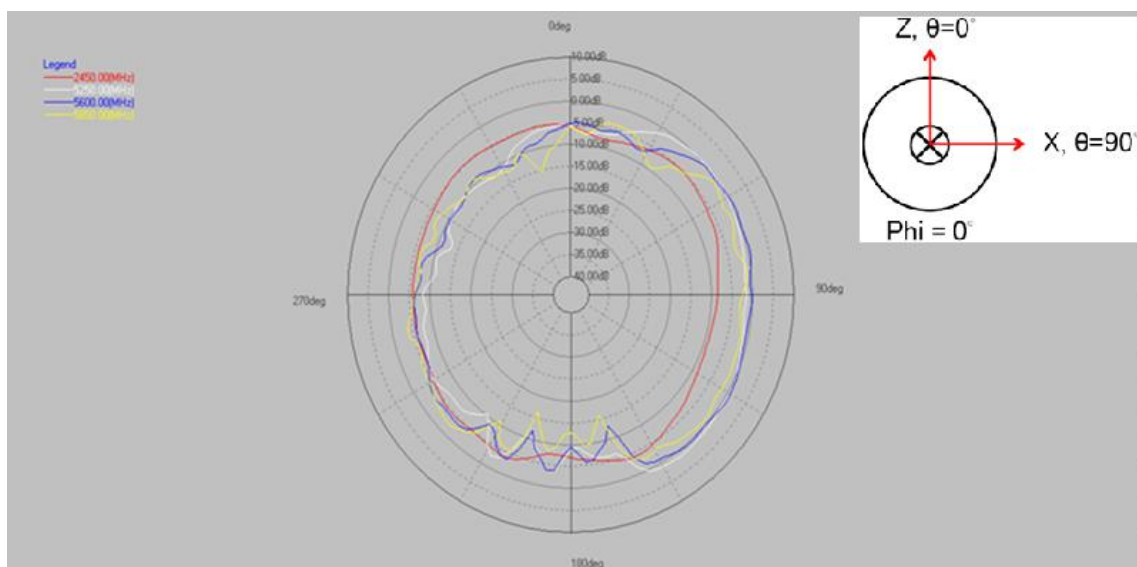


Fig.7: Antenna radiation pattern **XZ-Plane**

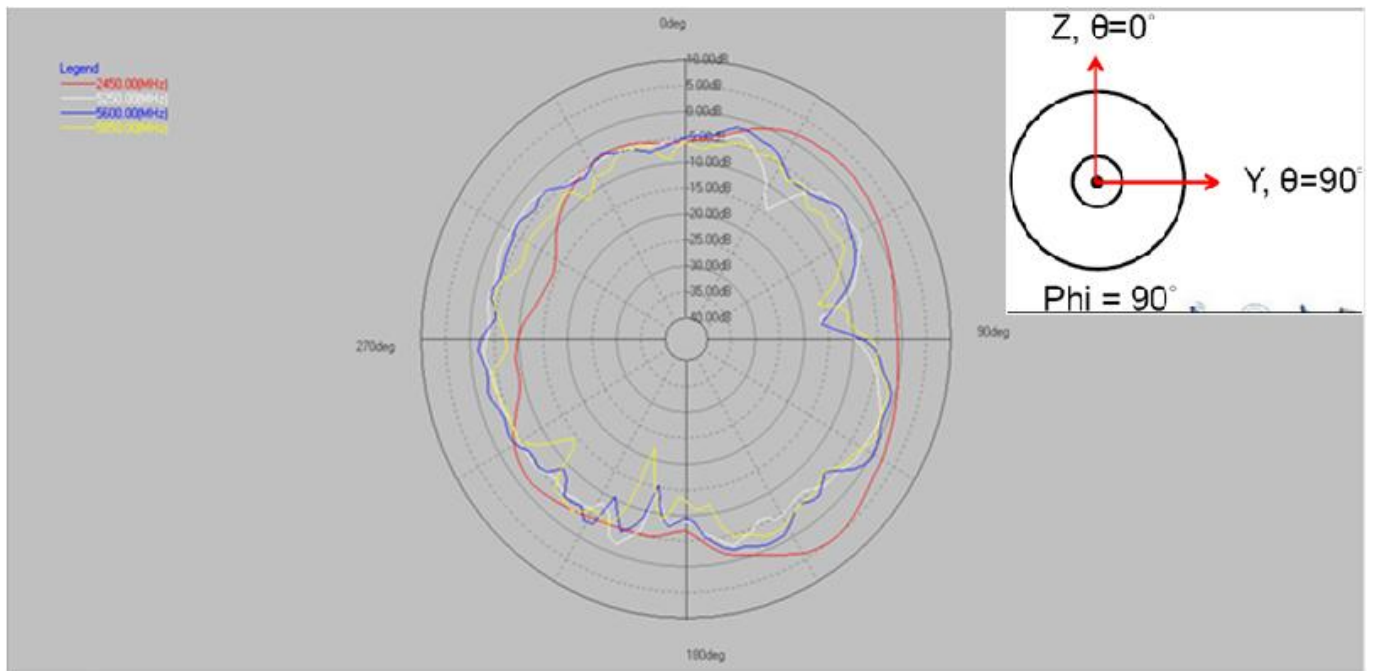


Fig.8: Antenna radiation pattern **YZ-Plane**

■ RF path:

- A. There is a SPDT RFSW to do the diversity between 2 RF ports during normal mode.
- B. For Port0, there are 2 options, U.FL0 or printed antenna by a jumper capacitor.
- C. If using on board printed antenna: Please do not cover or put anything close to the printed antenna otherwise the radiation efficiency will be degraded. Also keep clean underneath the printed antenna area.
- D. For Port1, there are 2 options as well, U.FL1 or RF PAD by another jumper capacitor.
- E. RF PAD: Ideally, this can bridge the RF signal to the device outside the board. Application board designer must be caution on the impedance control of the RF pad and 50 Ohm trace at platform board.
- F. DNSA-144 MP version might remove the unused U.FL connector.

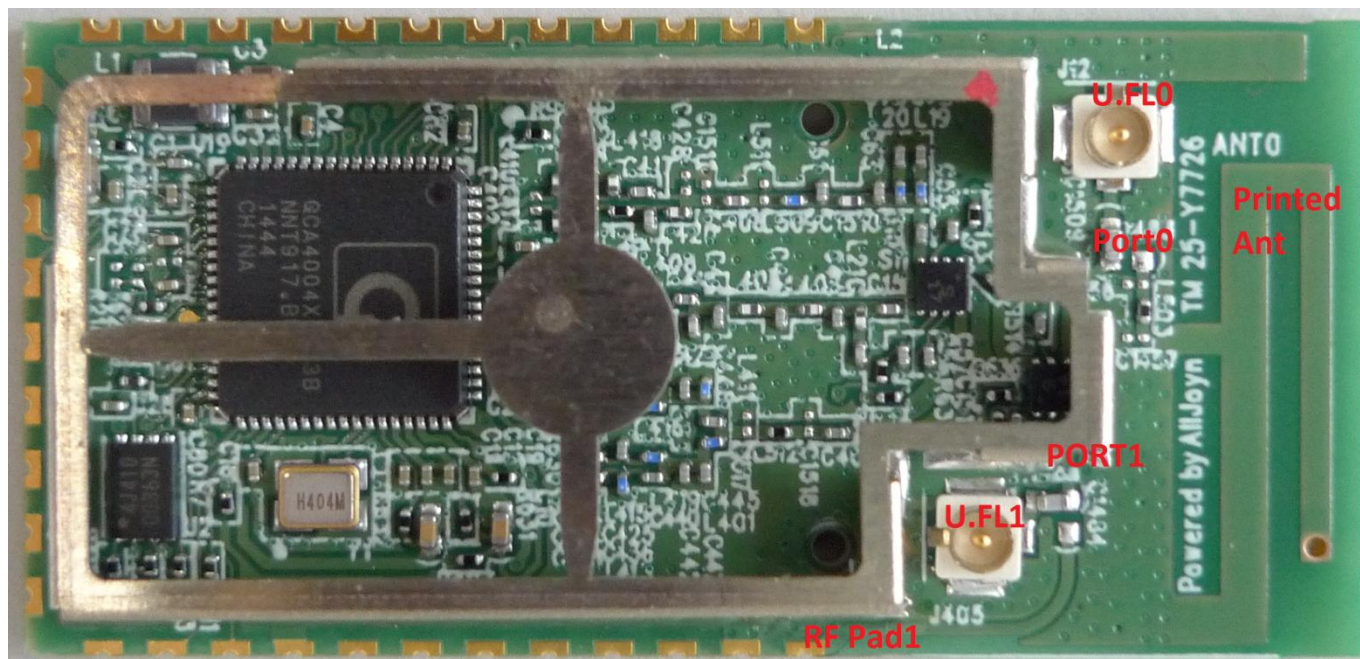
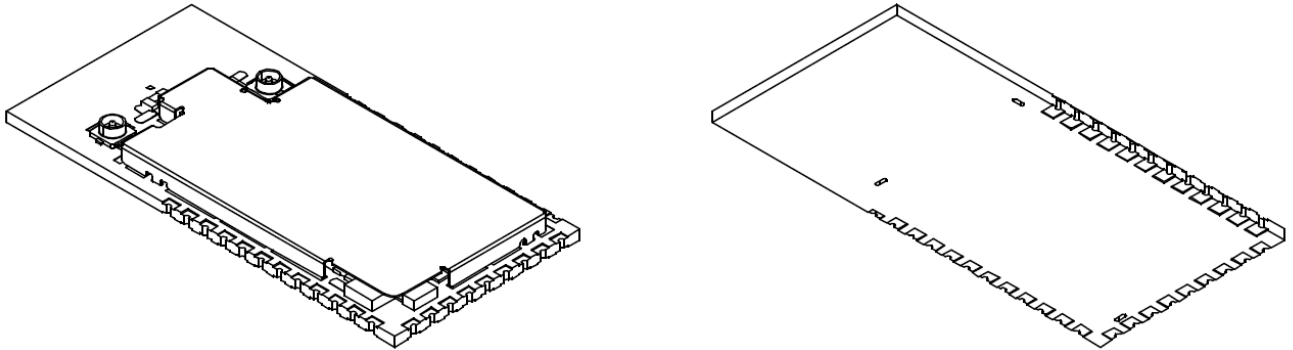


Fig. 7: RF ports and on-board antenna (Engineering sample photo only, will be 1pcs shielding in MP stage)

3. Mechanical Dimension and Drawing



ISOMETRIC VIEW

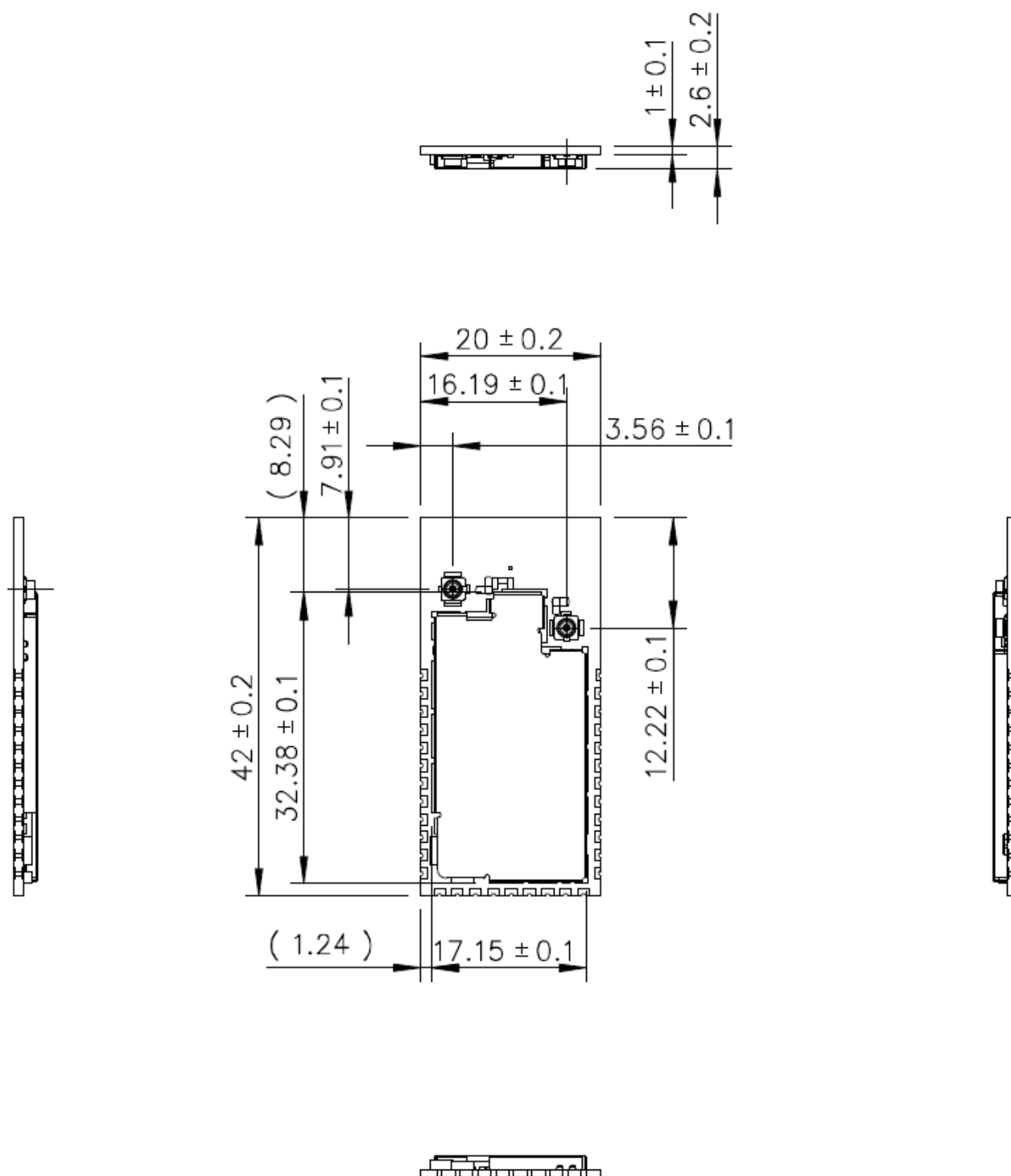


Fig. 8: Mechanical drawing with shielding [unit:mm]
 Note: MP version 1-element shielding,
 MP default is without U.FLO connector, Ref. to Fig.7 note.

■ Recommend layout footprint for the application board

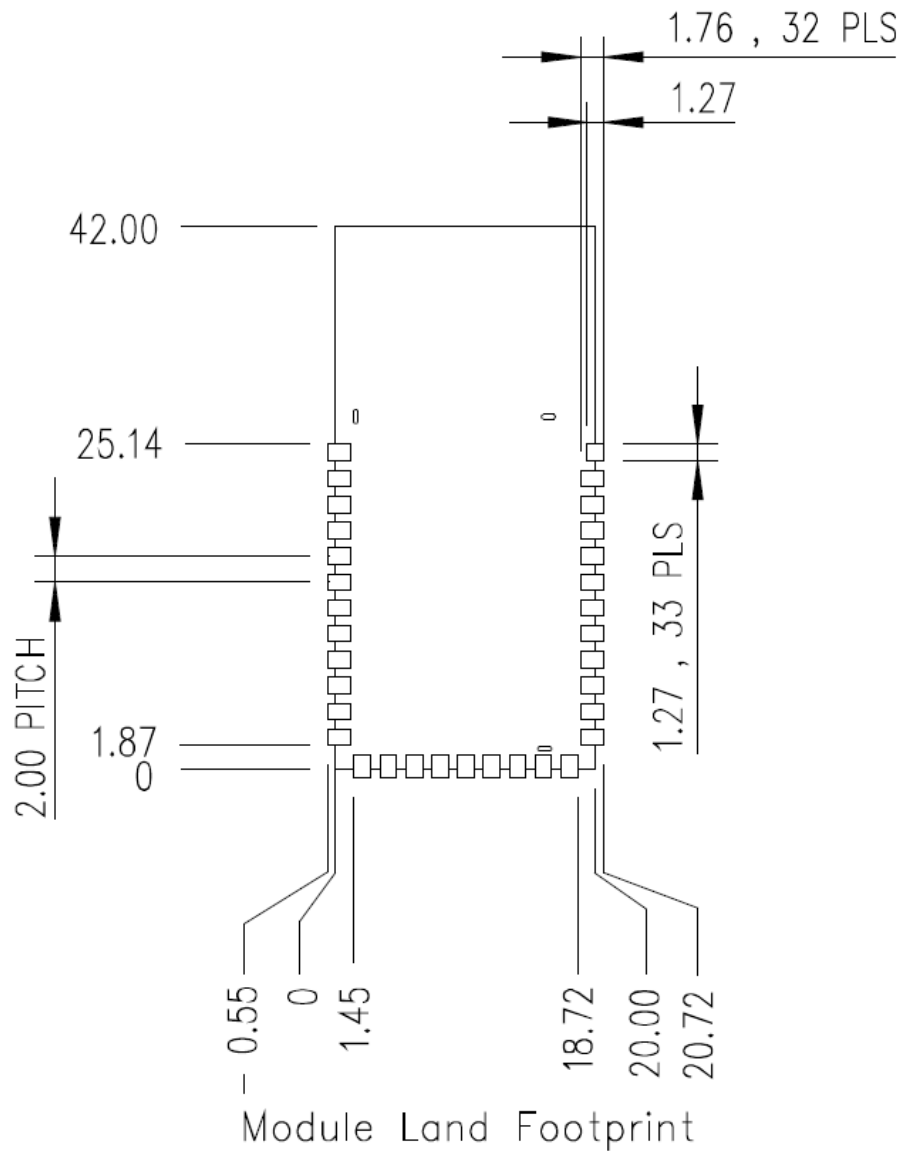


Fig. 9: Module Land Footprint [unit:mm]

■ Soldering Reflow Profile: Using WNC's internal SMT line profile. Solder paste: SAC305.

Profile Type Selection		Lead Free Solder	
		(Sn3.0Ag0.5Cu)	
		Lead Free	
		Temperature	Time
Profile Parameter Setting	Max. Rising Slope	<3 °C/sec	
	Soaking Time	140~190 °C	70~105sec
	Wetting Time	217 °C	70~90sec
	Peak Temperature	230~250 °C	

	Over Wetting Time	230 °C	40~60sec
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Table 5: Reference soldering profile for customer to mount the module.

4. Regulatory & Environment

- Pre-certified FCC
- Regulatory Compliance:
- Environment policy: All material used inside this module is Lead Free, RoHS compliant.

5. Package Information

80 pcs DNSA-144 * 10 Trays = 800 pcs/SET
800 pcs * 3 SETS(33 Trays) = 2,400 pcs/CARTON
PS Tray Max. Temp is 75°C

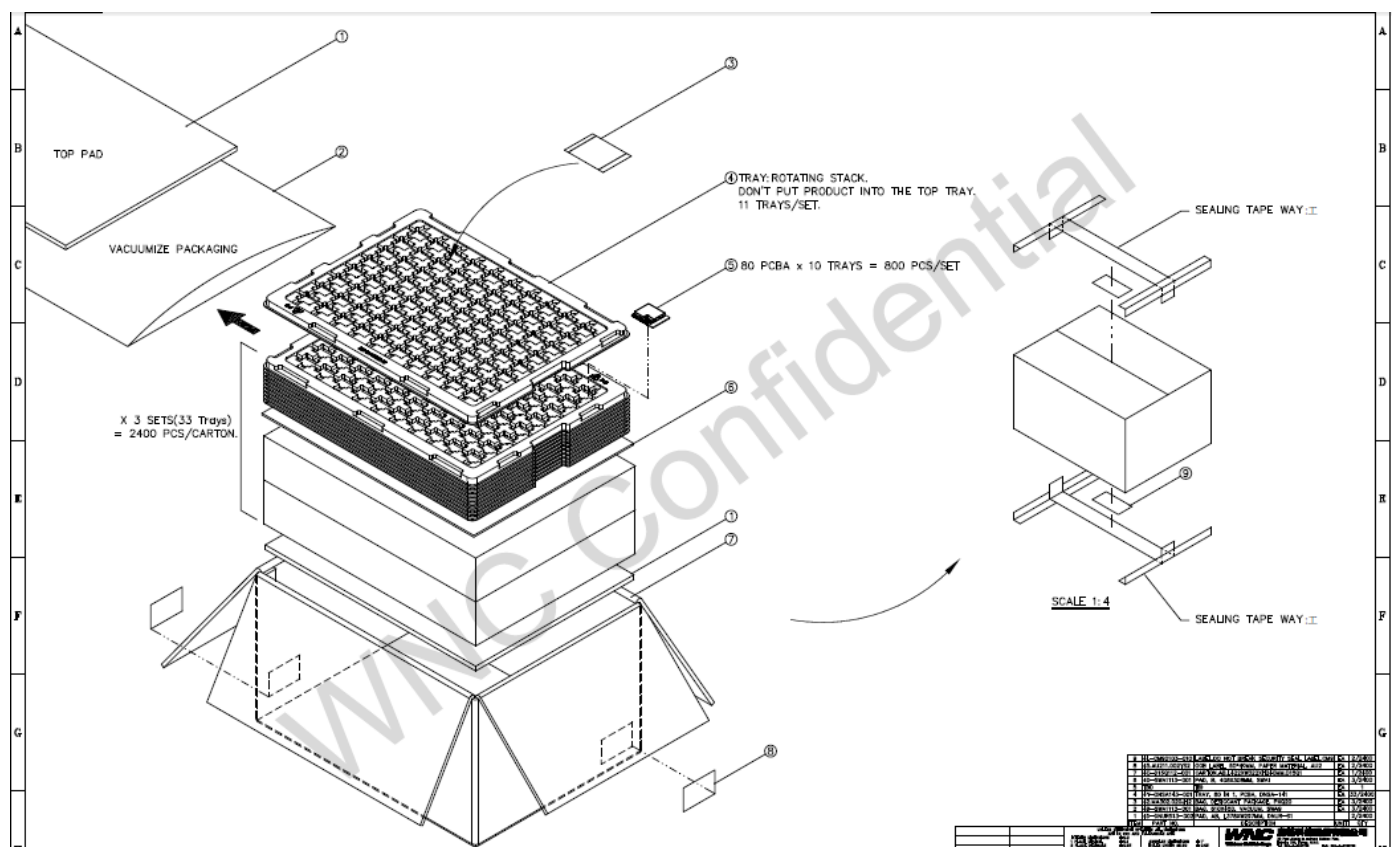


Fig. 10: DNSA-144 Package Drawing

6. Order Information

Model	Description
DNSA-144(I)	I-temp standard, SPI, Printing ANT ver.
DNSA-144(I_UFL)	I-temp standard, SPI, U.FL antenna conn. ver.