WNC
Wistron NeWeb Corp.

Product Specification for model DNSA-141

Stamp Type IoE Module

Version 0.6

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Networking Business Unit
Wistron Neweb Corporation

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Revision History

Rev.	History	Date	Author
V0.4	- Initial version	2014/1/22	**TT**
V0.5	- Update RF Tx power and Rx Sensitivity, Antenna pattern　based on real module	2014/2/21	**TT**
V0.6	- Update the absolute rating and recommend use SPI for customer application, AT comments and package	2014/5/15	**TT**
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Contents

1. Key Features

- QCA4002 IoE solution

- Internal PA and LNA, no external RF switch

- 2.4GHz Single band IEEE 802.11b/g/n, single stream 1x1

- 11n support HT20 and HT40 Bandwidth

- On board printed antenna and U.FL antenna connector(optional)

- 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.

- 25mm x 20mm size, 2-layer, single side component

- Operation temperature: -40~+85 degrees C(Industry Class Version)

- TCP/IP offload, include Encryption

- SPI Slave interface to the MCU.

- Pre-certified FCC

2. System Block Diagram

■ DNSA141 is based on QCA4002 Internet of Everything chip and QCA's SP141 reference board design in stamp form factor.

■ Inside the module, there is a QCA4002 main chip which control the WLAN RF and BB function, also embedded a small processor which can do the encryption and TCP/IP off load. Only few external components are necessary such as XTAL and Flash. Block Diagram as Fig. 1:

■ Flash is only storing the binary code to control the QCA4002. RF calibration data is stored inside QCA4002 OTP not this flash. QCA also move the common data such as target power and CTL table to driver level called "Board Data File". This can reduce the OTP size usage.

■ For complex control or more GPIO demanding, customer has to use a Micro Processor to control this module through SPI interface. QCA4004 will be in SPI slave mode.

■ USB interface is only for engineering RD mode such as production testing purpose or reprogram the external flash memory.
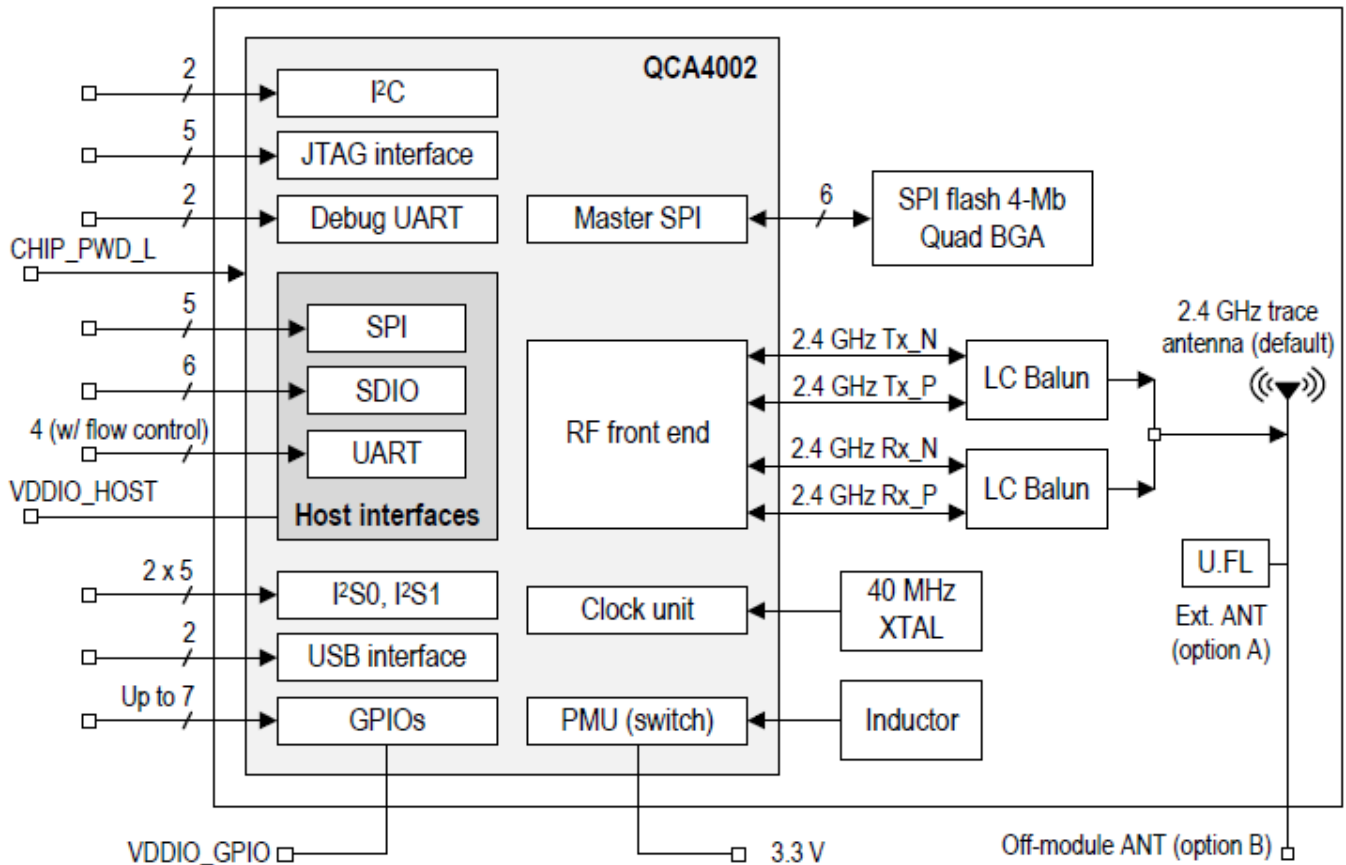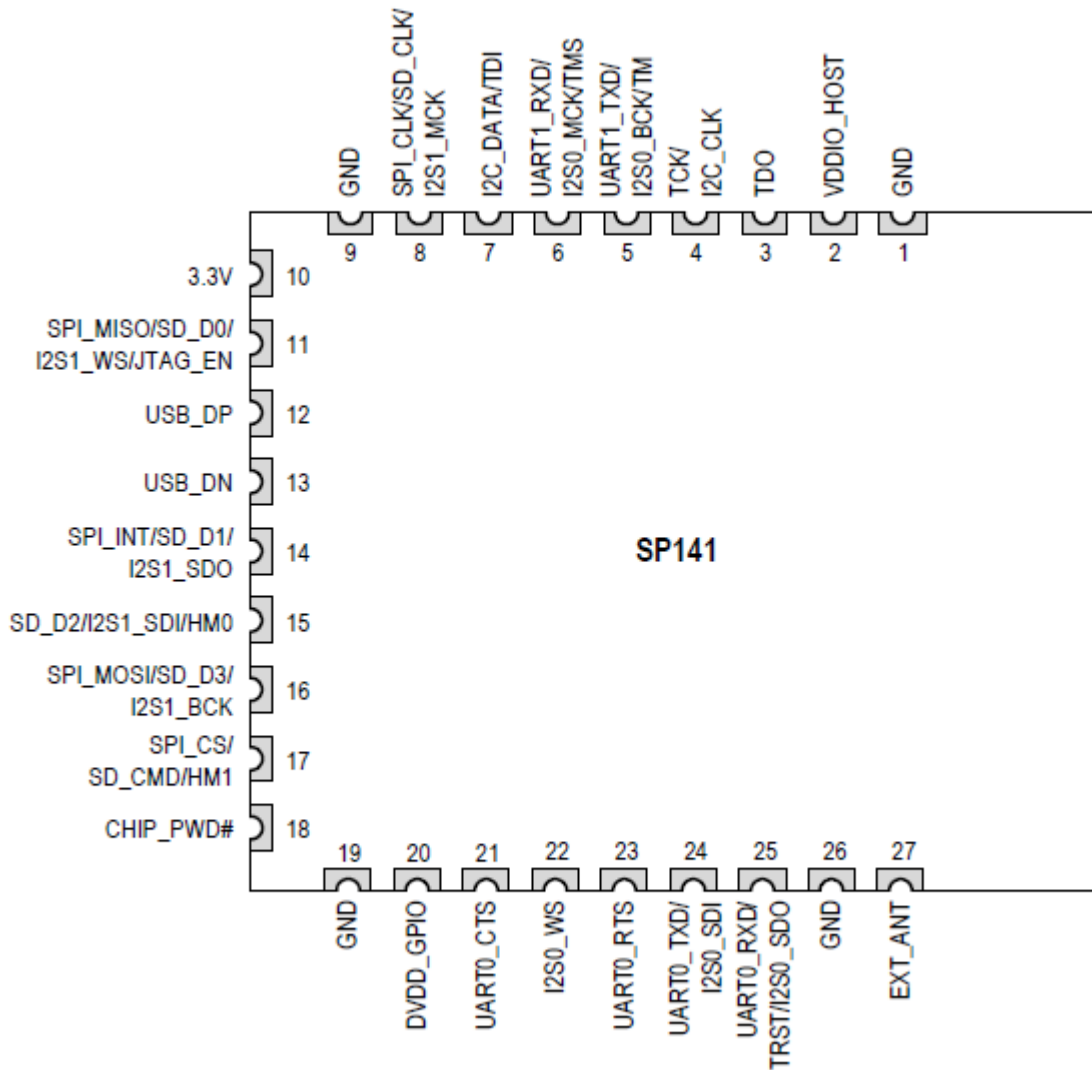

Fig. 1: Block Diagram

3. DNSA-141 Outlook and Pinout

Fig.3: DNSA-141 Pinout (Top side)

Table 1: Module Pin assignment and description

Signal name	Pin	Type	Description
USB_DP	12	Analog IO	USB device / manufacturing test and configuration interface
USB_DN	13	Analog IO	
CHIP_PWD#	18	Digital I	Power down control signal. Setting this pin low forces the module in to its lowest power state.
TDO	3	Digital IO	GPIO with multiplexed functions.
TCK / I2C_CLK	4	Digital IO	
UART1_TXD / I2S0_BCK / TM	5	Digital IO	
UART1_RXD / I2S0_MCK / TMS	6	Digital IO	
I2C_DATA / TDI	7	Digital IO	
SPI_CLK / SD_CLK / I2S1_MCK	8	Digital IO	
SPI_MISO / SD_D0 / I2S1_WS / JTAG_EN	11	Digital IO	
SPI_INT / SD_D1 / I2S1_SDO	14	Digital IO	
SD_D2 / I2S1_SDI / HM0	15	Digital IO	
SPI_MOSI / SD_D3 / I2S1_BCK	16	Digital IO	
SPI_CS / SD_CMD / HM1	17	Digital IO	
UART0_CTS	21	Digital IO	
I2S0_WS	22	Digital IO	
UART0_RTS	23	Digital IO	
UART0_TXD / I2S0_SDI	24	Digital IO	
UART0_RXD / TRST / I2S0_SDO	25	Digital IO	
EXT_ANT	27	RF	Single-ended antenna connection
GND	1, 9, 19, 26	Power	Ground
VDDIO_HOST	2	Power	3.3 V supply for the host IOs
3.3V	10	Power	Analog 3.3 V supply
DVDD_GPIO	20	Power	VDDIO 3.3 V supply for GPIOS

Table 2: SPI Slave Signals

Signal name	Direction	Description
SPI_CLK	I	Clock line from master, maximum rate 48 MHz
SPI_CS	I	Chip select, active low
SPI_INT	O	Active low interrupt to SPI master controller
SPI_MISO	O	Serial data to master
SPI_MOSI	I	Serial data from master

4. Electrical Specification

■ General DC electrical characteristics

These conditions apply to all DC characteristics unless otherwise specified:
Temp = 25 °C, VDD33= 3.3 V

Table 3: 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
11g continue Tx@6M_18dBm	810	
11n continue Tx@HT40MCS7_12dBm	600	
11b/g and 11n HT20 continue Rx	210	mWatt
11n HT40 continue Rx	240	
Chip Power Down	0.04	
Sleep	0.4	

Note A: External IO voltage (DVDD_GPIO) can be 1.8~3.4V.
Note B:QCA4002 need 3.3V and 1.2V supply. For 1.2V supply there are 2 methods: Switching and LDO. Inside the QCA4002, 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). This table we use switching regulator method to have better power efficiency. The tradeoff is we have to add a power inductor near QCA4002 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	℃
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	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

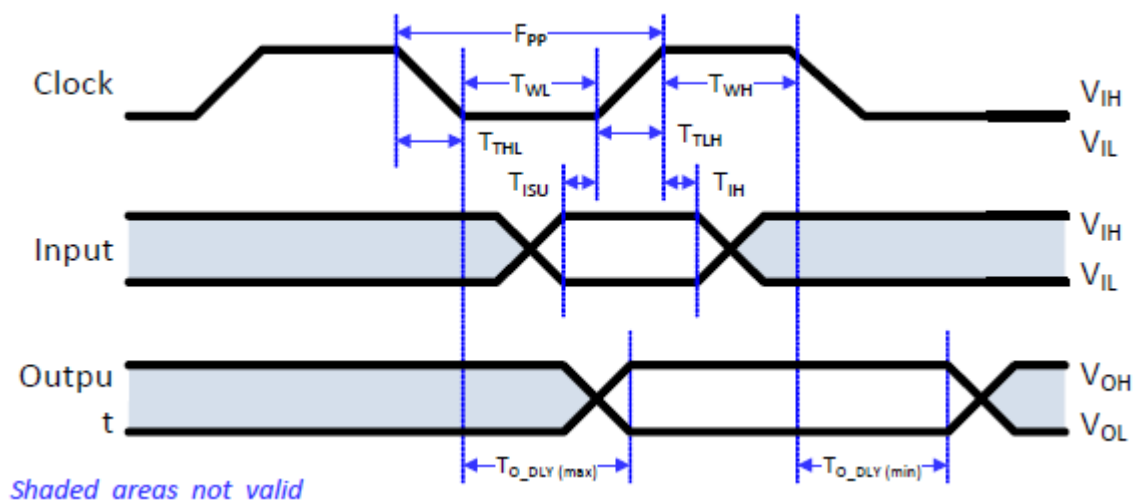■ SPI slave interface electrical timing diagram

Fig.4: SPI salve 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
tT_{HL}	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	17
11b 11Mbps	17
11g 6Mbps	18
11g 54Mbps	14
11n HT20 MCS0	18
11n HT20 MCS7	13
11n HT40 MCS0	16
11n HT40 MCS7	12

■ RF Rx sensitivity [unit:dBm]:

Mode/Rate	MHz
	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

■ Antenna performance: on board printed ANT

The on board printed antenna VSWR is better than 2.5 and efficiency is around 48%.

	2400	2450	2500	Avg.
Eff.	48%	51%	44%	**48%**
Avg. Gain	-3.19	-2.92	-3.53	
Peak Gain	0.03	0.44	-0.43	

Unit :Avg. Gain(dB), Peak Gain(dBi)

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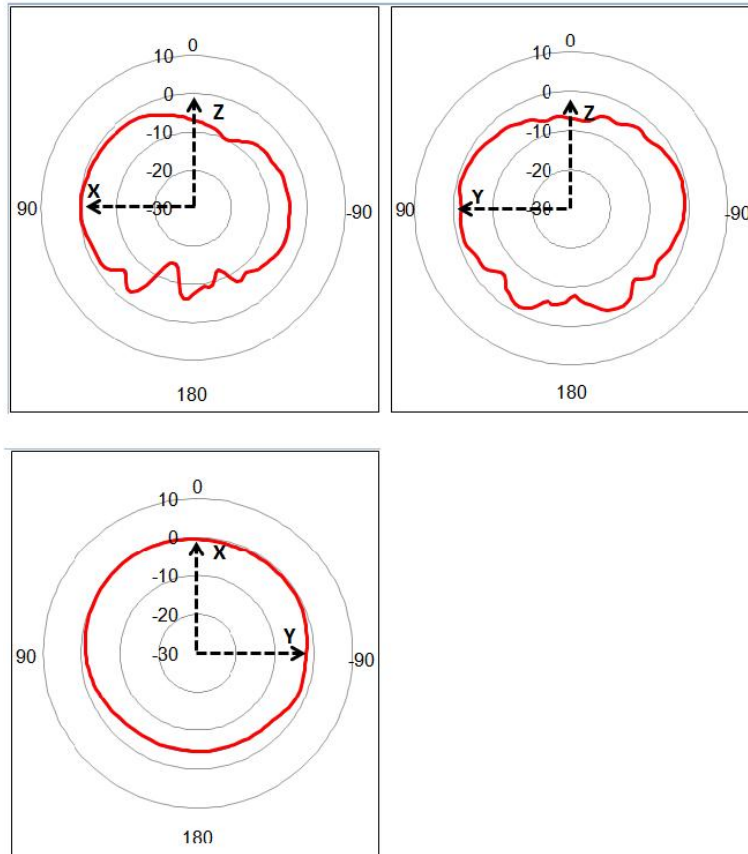
Fig.6: Antenna radiation pattern

- **RF path:**

A. On board printed antenna: Please do not cover or put anything close to the antenna otherwise the radiation efficiency will be degraded.

B. On board U.FL connector*1: optional.

C. 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.

D. DNSA-141 adopts printed antenna and U.FL conn. is no load in generic MP version.

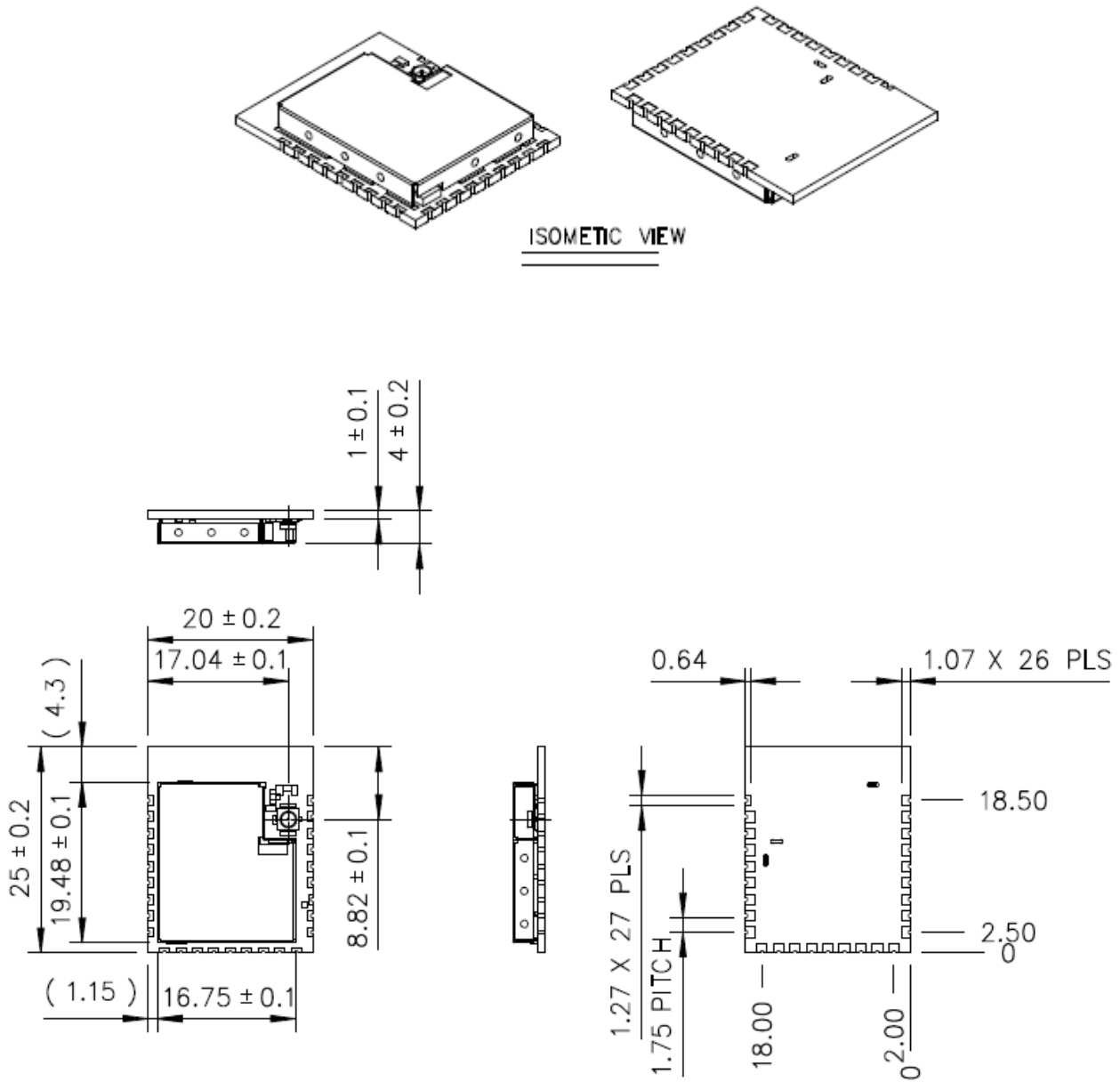## 5. Mechanical Dimension and Drawing

ISOMETIC VIEW

Fig. 8: Mechanical drawing with shielding
Note: MP version default is without U.FL connector
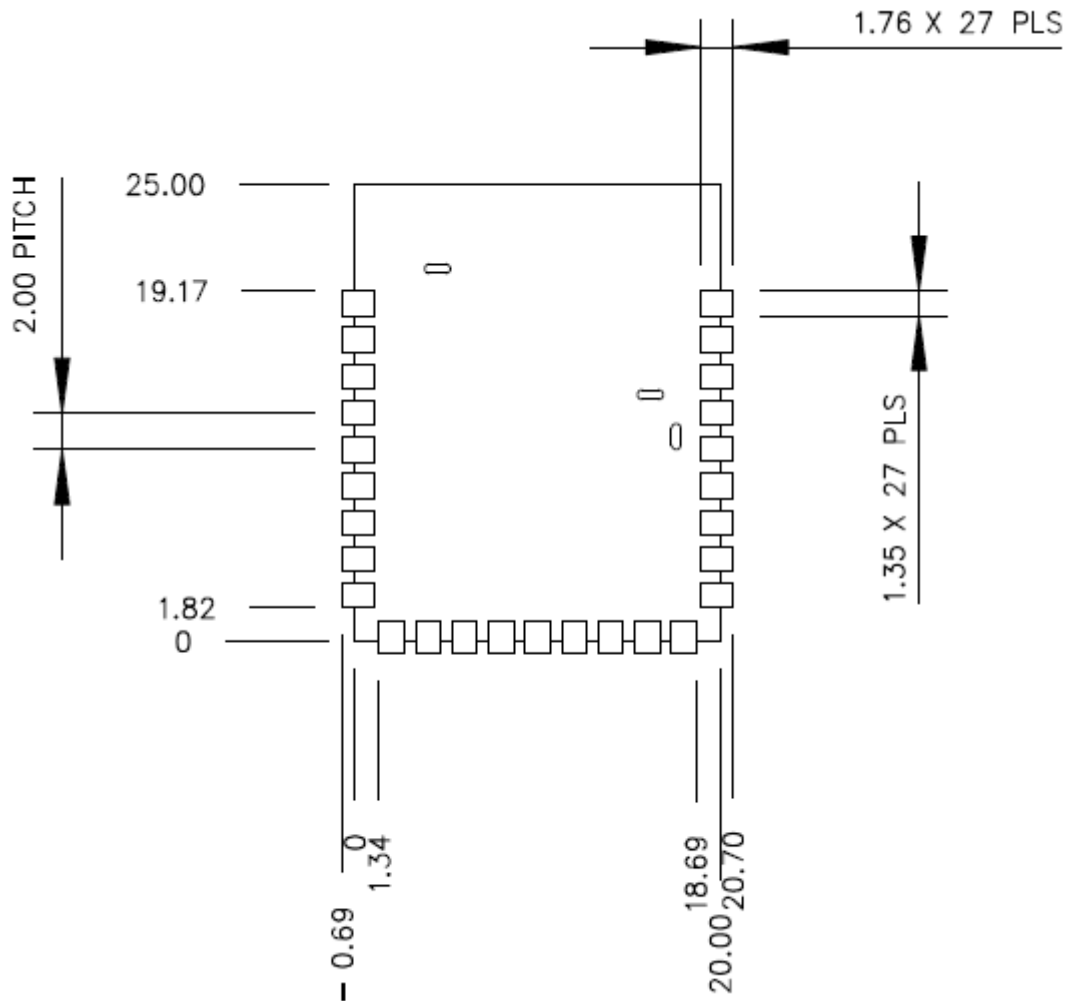
■ Recommend layout footprint for the application board

Fig. 9: Module Land Footprint

■ 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 ℃/sec	
	Soaking Time	140~190 ℃	70~105sec
	Wetting Time	217 ℃	70~90sec
	Peak Temperature	230~250 ℃	
	Over Wetting Time	230 ℃	40~60sec

Table 5: Reference soldering profile for customer to mount the module.

6. Regulatory & Environment

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

7. Package Information

80 pcs DNSA-141 * 10 Trays = 800 pcs/SET
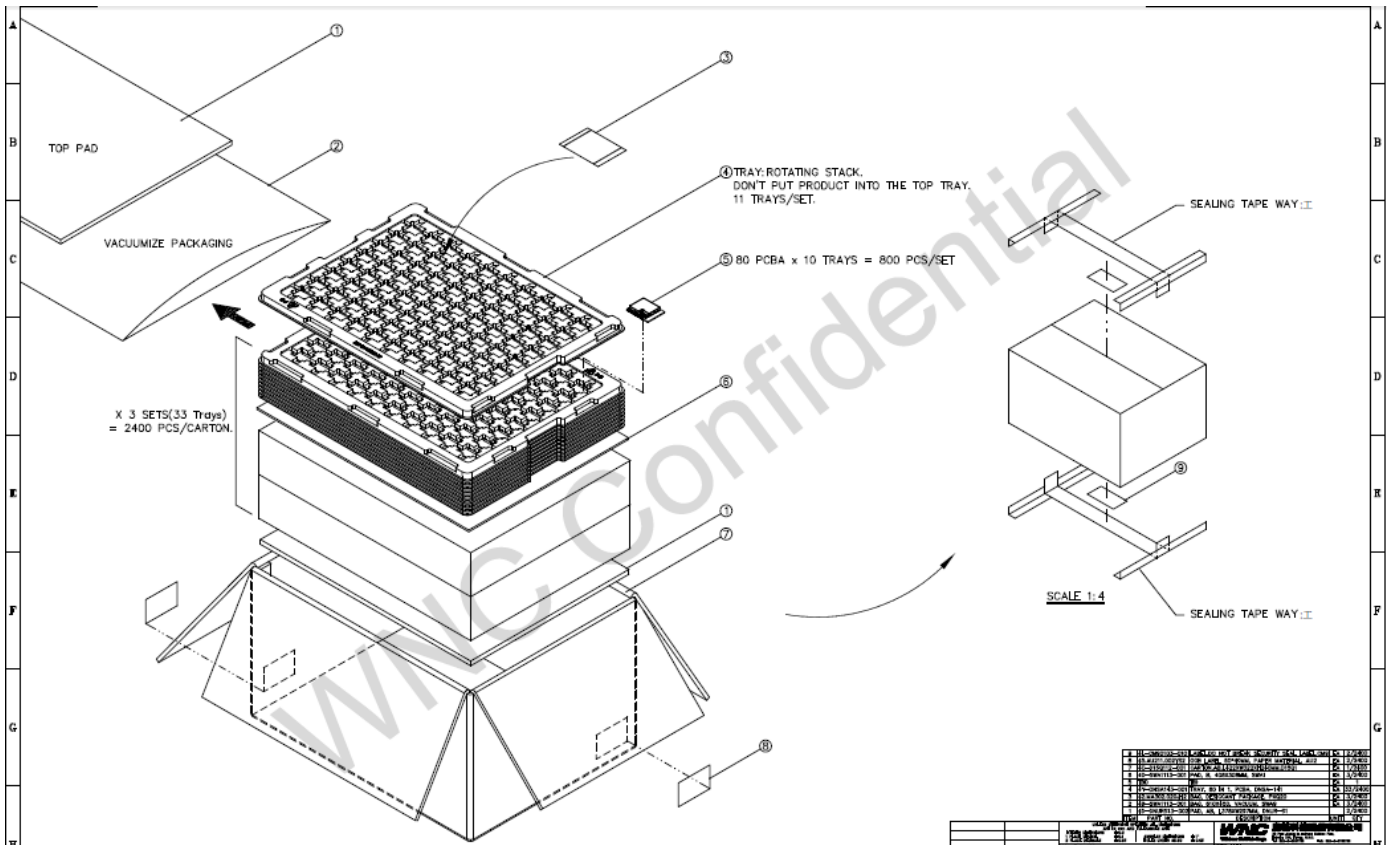800 pcs * 3 SETS(33 Trays) = 2,400 pcs/CARTON
PS Tray Max. Temp is 75℃

Fig. 10: DNSA-141 Package Drawing

8. Order Information

Model	Description
DNSA-141(I)	I-temp standard, SPI, Printing ANT ver.
DNSA-141(I_UFL)	I-temp standard, SPI, U.FL antenna conn. ver.

Industry Canada statement:

This device complies with RSS-210 of the Industry Canada 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.

Ce dispositif est conforme à la norme CNR-210 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

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 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:
Cet équipement est conforme aux limites d'exposition aux rayonnements IC 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.

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
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

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 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 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: 4441A-DNSA14".

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: 4441A-DNSA14".

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.

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.

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

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

As long as **2** conditions above are met, further <u>transmitter</u> 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 <u>can not be met</u> (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID: NKR-DNSA141 <u>can not</u> 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: NKR-DNSA141". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

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.