



# WHM500A

P/N : WSWHM500A00

***DATA SHEET / REV0.2***

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## Document Information

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## Revision History

<b>Rev.</b>	<b>Date</b>	<b>Note</b>	<b>Remark</b>
0.0	24.04.15	<b>Preliminary</b>	
0.1	23.12.23	<b>1) Change Company name</b> SJI → SJIT	1 page
0.2	24.12.05	<b>1) CE certification completed</b>	17 Page

## Aim of this Document

The aim of this document is to give a detailed product description including interfaces, features and performance of the module WHM500A.

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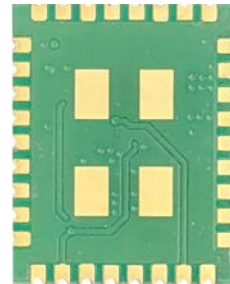
# 1. Introduction

The WHM500A uses the new Wi-Fi standard IEEE 802.11ah, which uses the Sub 1 GHz license-exempt band. It has long range, low power and high permeability and is optimized for IoT modules.

The WHM500A includes a RF switch and an internal PA in the SoC to increase transmit power up to 17dBm.



&lt; TOP &gt;



&lt; BOTTOM &gt;

Figure 1-1: Picture of WHM500A

## 1.1 Key Features

- Compact module 14 x 17.5 x 2.5mm. (Typ.)
- Full IEEE 802.11ah compatibility with enhanced performance
- AP and STA, mesh network support
- UART and SPI support for host interface
- Low-Power Long Range Transceiver operating in the sub-1GHz ISM band
- RF interface optimized to 50  $\Omega$ .
- Output Power Level up to +17dBm
- -104 dBm minimum receive sensitivity (MCS10)

## 1.2 Applications

- Smart home and home security
- Smart factory and factory automation
- Smart city and public transportation management
- Smart grid/metering
- Surveillance camera and remote monitoring of wildlife
- Wireless sensor network
- Health care
- Electric vehicle and charging
- Commercial drone
- Wireless Alarm and Security Systems.

## 2. Description

The WHM500A is a long range, high-performance module for wireless communication. The module is solder-able like a SMD component and can easily be mounted on a simple carrier board with a minimum of required external connections.

It includes all necessary passive components for wireless communication as depicted in the following figure.

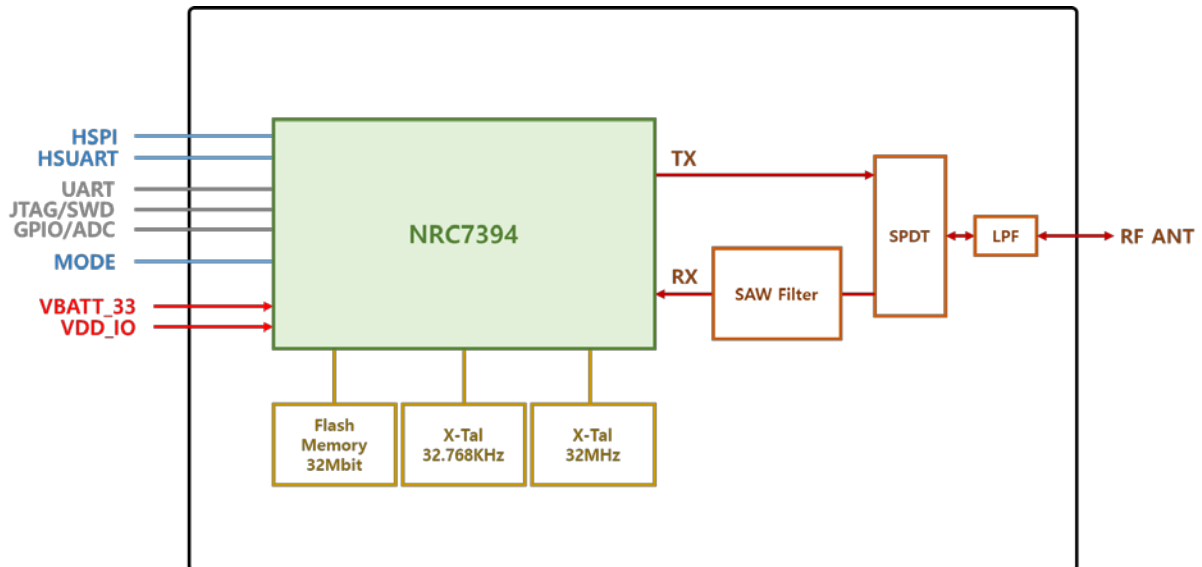


Figure 2-1: Block Diagram

### 2.1 CPU

- ARM® Cortex-M3 for IEEE 802.11ah WLAN and application
- Clock frequencies for processor(Max 32MHz)

### 2.2 Memory

- CPU Internal Memory
  - ▲ 32KB Boot ROM
  - ▲ 1,088KB system SRAM
  - ▲ 192KB Key Memory for security
  - ▲ 16KB cache for XIP
- CPU External Memory
  - ▲ 32Mbit Flash Memory

### 3. Electrical Characteristics

In the following different electrical characteristics of the WHM500A are listed.

- Note: Stress exceeding of one or more of the limiting values listed under “Absolute Maximum Ratings” may cause permanent damage to the radio module

#### 3.1 Absolute Maximum Ratings

Parameter		Min	Max	Unit
Storage Temperature		-40	+125	°C
Supply Voltage	VBATT	-0.5	3.8	V
	VDD_IO	-0.5	3.8	V

Table 3-1-1: Absolute Maximum Ratings

#### 3.2 Recommended Operating Condition

Parameter		Min	Typ	Max	Unit
Operating temperature range		-40	-	+85	°C
Operating Voltage	VBATT	2.7	3.3	3.6	V
	VDD_IO	1.68	3.3	3.6	V
Operating current (peak) Tx @17dBm	VBATT	250			mA
	VDD_IO	2			mA
Operation Clock Frequency	Transceiver		32		MHz
	MCU RTC		32.768		kHz

Table 3-2-1: Operating Condition

#### 3.3 Electrical Specification

MODE	DUT Status	VDD_IO(mA)	VBATT(mA)
802.11ah	Tx @ 0 dBm	1.0	126
	Tx @ 10 dBm	1.0	150
	Tx @ 15 dBm	1.0	190
	Continuous Rx @ -85 dBm	2	25

Notes :

Unless otherwise specified, TA.=25°C, VBATT= 3.3V, Continuous Mode, MCS0, 865.5MHz

Table 3-3-1: Current Consumption

### 3.4 RF Characteristics

#### 3.4.1 Transmitter(Max Power by Country Code)

Country Code	BandWidth	CF	Max Power (Technical Regulations)
EU	1MHz	863.5 MHz	25mW(14dBm)
	1MHz	864.5 MHz	25mW(14dBm)
	1MHz	865.5 MHz	25mW(14dBm)
	1MHz	866.5 MHz	25mW(14dBm)
	1MHz	867.5 MHz	25mW(14dBm)

Table 3-4-1-1: Technical Regulations.

#### 3.4.2 Transmitter

Band	BW	MCS	Modulation/ Coding Rate	EVM spec [dB]	Max. Power [dBm]
863.5 ~ 867.5  MHz	1 MHz	10	BPSK 1/2 rep. 2x	-4	17
		0	BPSK 1/2	-5	17
		1	QPSK 1/2	-10	17
		2	QPSK 3/4	-13	17
		3	16QAM 1/2	-16	17
		4	16QAM 3/4	-19	17
		5	64QAM 2/3	-22	16
		6	64QAM 3/4	-25	15
		7	64QAM 5/6	-27	14
※ T = 25°C, VDD = 3.3 V (typ.), if nothing else stated					

Table 3-4-2-1: Transmitter(Module's Max Power)

### 3.4.3 Receive Sensitivity

BW	MCS	Modulation / Coding Rate	11ah spec	Min. Sensitivity [dBm]		
				Min	Typ	Max
1 MHz	10	BPSK $\frac{1}{2}$ rep. 2x	-98		-104	
	0	BPSK $\frac{1}{2}$	-95		-101	
	1	QPSK $\frac{1}{2}$	-92		-101	
	2	QPSK $\frac{3}{4}$	-90		-98	
	3	16QAM $\frac{1}{2}$	-87		-95	
	4	16QAM $\frac{3}{4}$	-83		-92	
	5	64QAM $\frac{2}{3}$	-79		-87	
	6	64QAM $\frac{3}{4}$	-78		-85	
	7	64QAM $\frac{5}{6}$	-77		-84	

Figure 3-4-3-1: Receive Sensitivity



## 3.4.4 Output Power vs. Input Voltage(VDD) table

Input Voltage(VDD)	2.7V	2.8V	3.0V	3.2V	3.3V	3.6V
Output Power (Typ.) / dBm	12.83	13.22	13.53	13.84	14.03	14.36
※ T = 25°C, MCS7, VDD_IO=3.3V, Target Power : 14dB						

Table 3-4-4-1: Output Power vs. Input Voltage

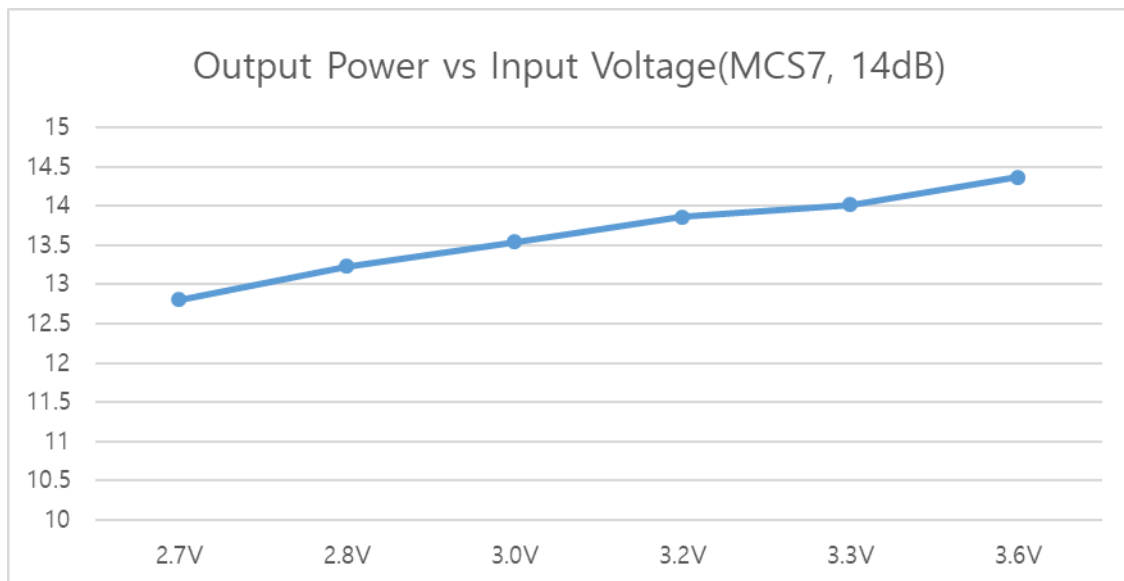


Figure 3-4-4-1: Output Power vs. Input Voltage Graph

## 4. Module Package

In the following the WHM500A module package is described. This description includes the WHM500A pinout as well as the modules dimensions. Furthermore a recommendation for a suitable footprint is given, which should be used for further mounting on appropriate carrier boards.

### 4.1 Pinout Description

Figure 4-1-1 depicts a description of the WHM500A's pads on the bottom side. The figure shows the module with its pinout in top view (right figure). A detailed description of the individual pins can be found in Table 4-1-1: Pinout Table.

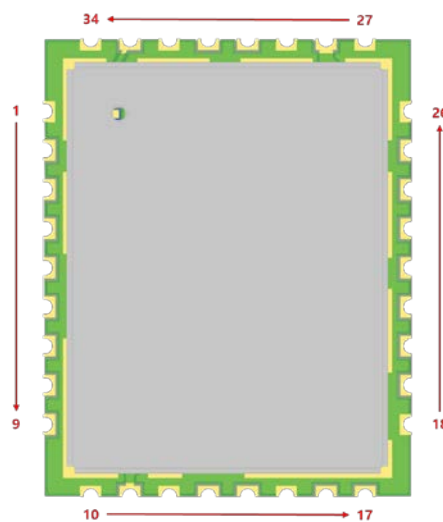


Figure 4-1-1: Description of module pins and top view

Pin No	Name	Direction	Description	GPIO Function
1	GND	GND		
2	UART1_TXD/GP12	O	UART channel1 Tx data	GP12
3	UART1_RXD/GP13	I	UART channel1 Rx data	GP13
4	UART1_CTS/GP14	I	UART channel1 clear to send	GP14
5	UART1_RTS/GP20	O	UART channel1 request to send	GP20
6	Mode/GP19	I	Boot mode (0: ROM boot, 1: XIP boot)	GP19
7	ADC0/GP17	I	Auxiliary ADC channel 0	GP17
8	ADC1/GP18	I	Auxiliary ADC channel 1	GP18
9	GP25	I/O	GPIO	GP25
10	GND	GND		
11	VDD_IO	P	NRC7394 I/O power input	

12	GND	GND		
13	UART0_RXD/GP09	I	UART channel0 Rx data	GP09
14	UART0_TXD/GP08	O	UART channel0 Tx data	GP08
15	GND	GND		
16	VBATT	P	NRC7394 PMS, RF/PA power input	
17	PMS_nPOR/nRST	I/O	NRC7394 reset (active low) input, POR reset output (internal pull-up)	
18	GND	GND		
19	HSPI_nCS/GP28	I	Host SPI – chip select (active low)	GP28
20	HSPI_MISO/GP29	O	Host SPI – master in slave out	GP29
21	HSPI_MOSI/GP06	I	Host SPI – master out slave in	GP06
22	HSPI_CLK/GP07	I	Host SPI – clock	GP07
23	HSPI_nEIRQ/GP30	O	Host SPI – interrupt (active low)	GP30
24	SWD_IO/GP10	I/O	SWD data	GP10
25	SWD_CLK/GP11	I	SWD clock	GP11
26	GND	GND		
27	GND	GND		
28	NC			
29	GND	GND		
30	NC			
31	NC			
32	GND	GND		
33	RF_ANT	I/O	RF input/output	
34	GND	GND		

Table 4-1-1: Pinout Table

## 4.2 Module Dimensions

The outer dimensions of the WHM500A are given by Figure 4-2-1.

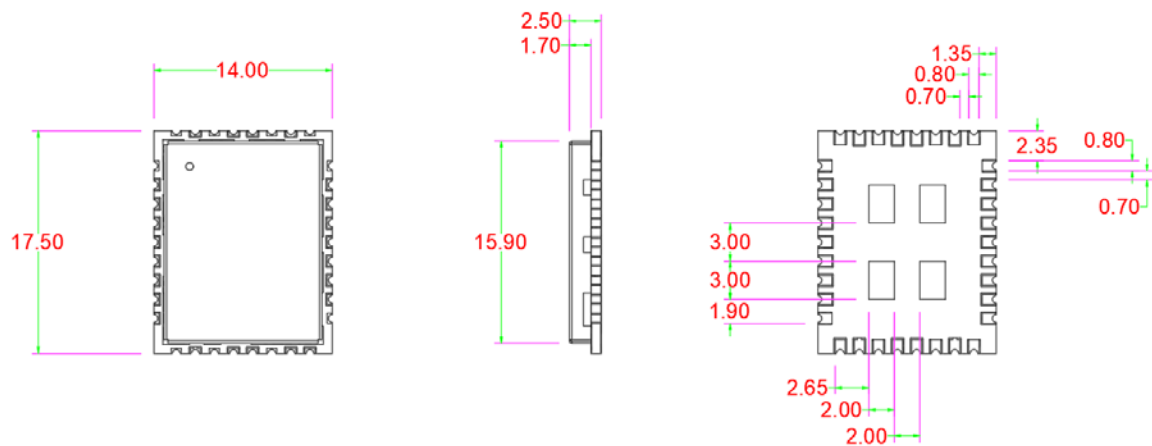


Figure 4-2-1: Outer Dimensions

## 4.3 Recommended Footprint

According to Chapter 4.2, a recommendation for the footprint of the WHM500A is given by Figure 4-3-1.

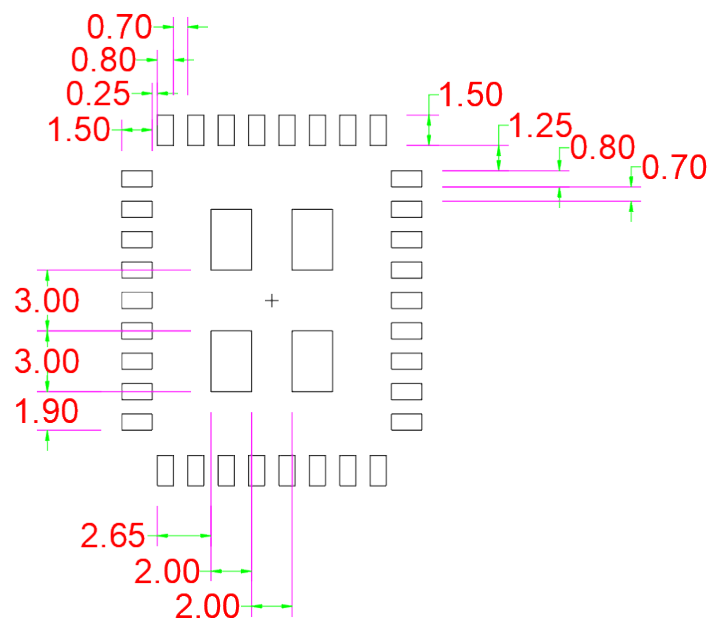


Figure 4-3-1: Recommended footprint (top view)

## 4.4 Recommended PCB design guide

To protect a contact short or electrical shock when WHM500A module is mounted on customer's board, we recommend PSR ink-coating(Green Area) of top side at module mount area on customer's board as Figure 4-4-1.

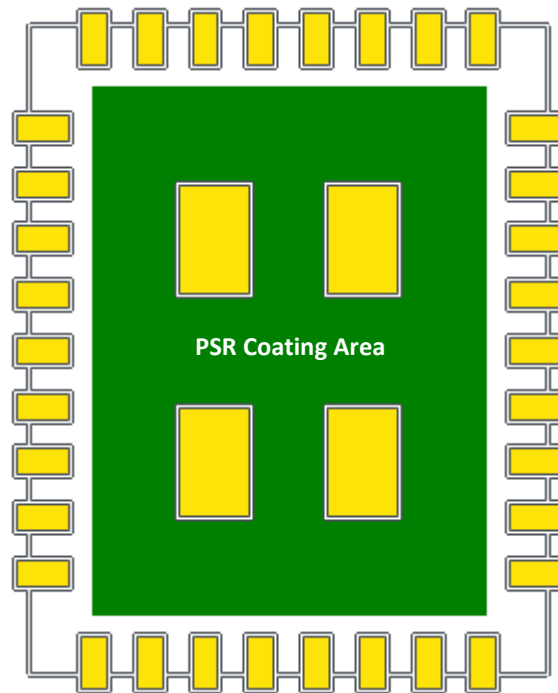


Figure 4-4-1: PSR ink Coating of mount board

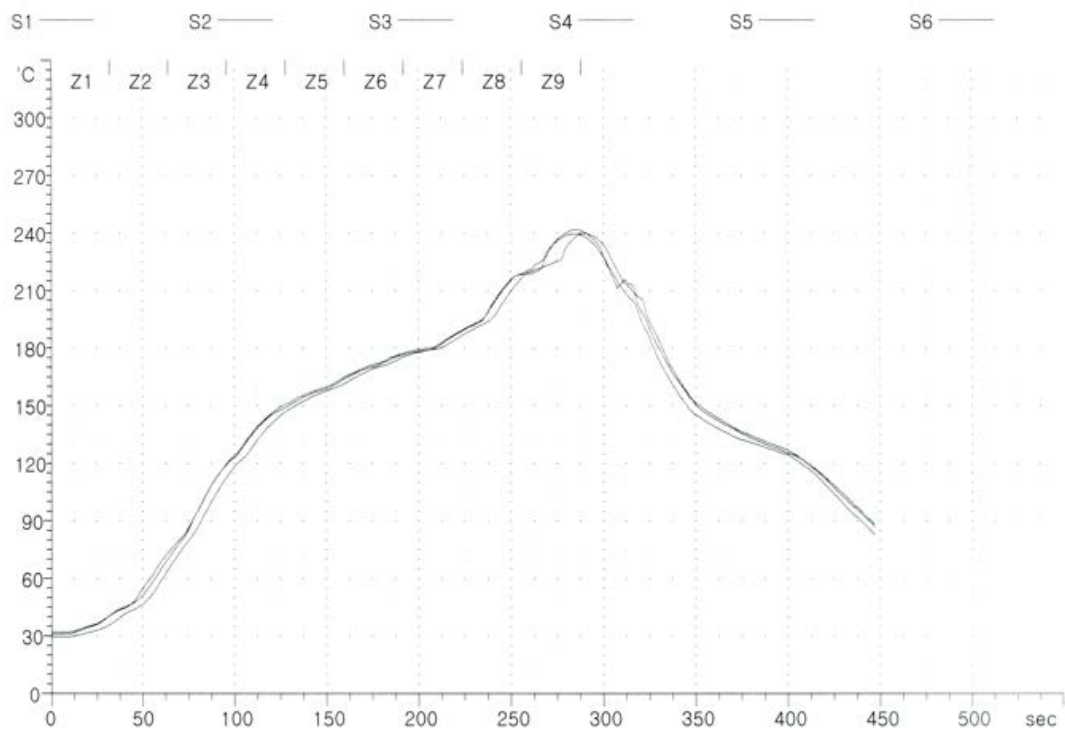
## 4.5 Reflow Profile of Module

Zone Setting Temperature									
	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9
Upper	150	160	170	180	190	200	220	250	285
Lower	150	160	170	180	190	200	220	250	285
Length	400	400	400	400	400	400	400	400	400

Machine No :  
Line Speed : 0.75 m/min  
Line Length : 3600 mm

Temperature Analysis & Temperature Zone														
	Max'C	at-sec	ov-220	T1-s	T2-s	T3-s	T4-s	T5-s	T1-'C/s	T2-'C/s	T3-'C/s	T4-'C/s	T5-'C/s	
S1	241.7	285.5	45.5	56.0	83.5	66.5	45.5	0.0	+1.1	+0.7	+0.5	+0.2	+0.0	
S2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	+0.0	+0.0	+0.0	+0.0	+0.0	
S3	239.6	283.0	40.5	56.5	84.5	65.0	40.5	0.0	+1.1	+0.7	+0.5	+0.2	+0.0	
S4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	+0.0	+0.0	+0.0	+0.0	+0.0	
S5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	+0.0	+0.0	+0.0	+0.0	+0.0	
S6	239.9	290.0	47.0	54.5	84.5	65.0	47.0	0.0	+1.2	+0.7	+0.5	+0.2	+0.0	

T1: 50 ~ 100 'C    T2: 100 ~ 170 'C    T3: 170 ~ 200 'C    T4: 220 ~ 'C    T5: 0 ~ 0 'C



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SPEC	Pre-heat	Soak	Ramp	PEAK
	50~100'C	100~170'C	220'C 이상	240'C
	1~2'C/sec	60~100 sec	30~50 sec	±5'C
Result	1.13	84	44.3	239.4
	OK	OK	OK	OK

## 5. Integration Guide

The WHM500A provides 34 connectors as described in Chapter 5. For integrating the WHM500A into an environment, a typically circuit as given in Chapter 5.1 can be used.

### 5.1 Mode Pin Setting

MODE pin is provided for boot mode selection to offer flexible and configurable boot options as shown in Table below

In the case of XIP boot, it is necessary to change to XIP boot mode after FW upload, so users need to install a switch that can control the mode pins on the board

MODE pin	Description
VDD	<b>XIP boot mode</b> Firmware must be downloaded to external flash memory before power on. The start address for boot is remapped to the start address of flash memory.
	<b>ROM boot mode</b> Boot from internal ROM code and wait for external command via HSPI or UART. The start address for boot is remapped to the start address of ROM memory.
GND	<b>FW upload mode</b> Firmware upgrade to external flash memory or upload to internal SRAM via UART0.

## 5.2 Typical Application Schematic

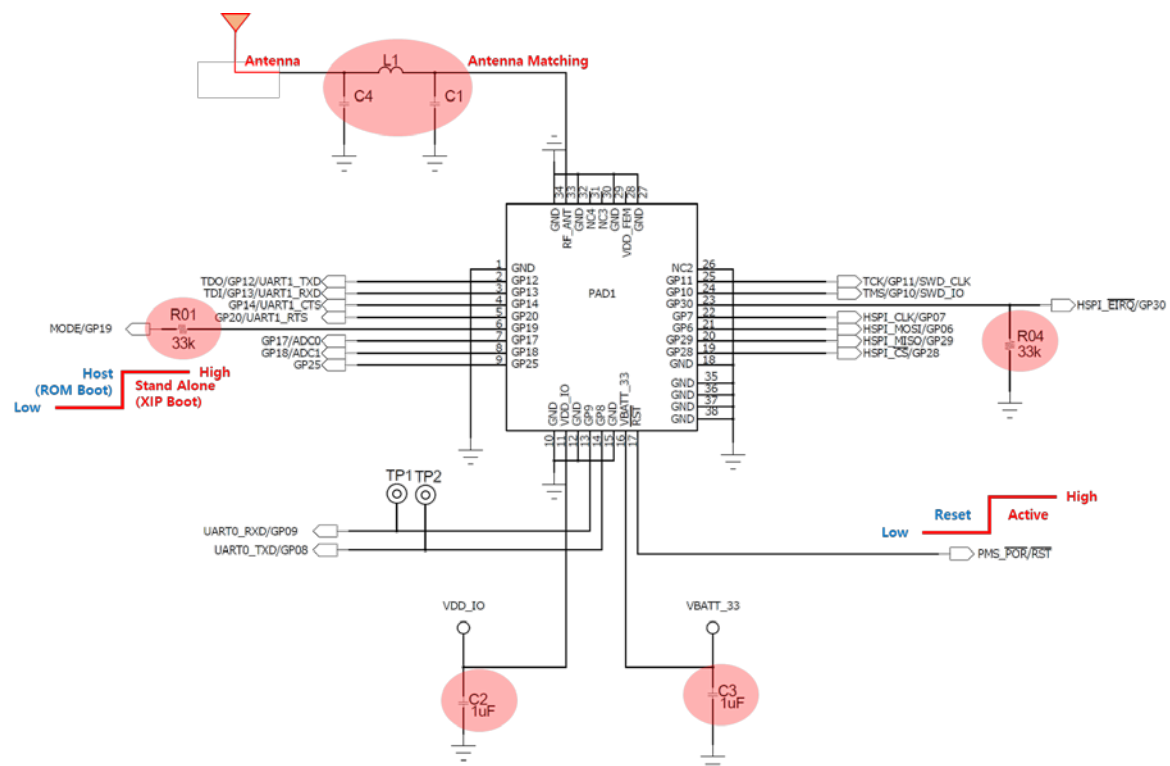


Figure 5-2-1: Typical Application Schematic



## 6. Laser Marking



CE

***“This Module may cause radio interference while in use and may cause harmful interference from other devices”***

**WHM500A Lot, No(9digits) Information**

<b>W</b>	<b>A</b>	<b>K</b>	<b>D</b>	<b>F</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>1</b>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

No.	EXPLANATION							
②	Blue Tooth(B), Wi-Fi(W), Zigbee(Z), Combo(C) , NFC(N)							
②	Manufacture Area							
	Packing Lot		A		B		C	
	Area		Korea		China		Vietnam	
③	Year							
	Year	2021	2022	2023	2024	2025	2026	2027
	Mark	H	I	J	K	L	M	N

④	Month												
	Month	1	2	3	4	5	6	7	8	9	10	11	12
	Mark	A	B	C	D	E	F	G	H	I	J	K	L
⑤	Day												
	Day	1	2	3	4	5	6	7	8	9	10		
	Mark	1	2	3	4	5	6	7	8	9	A		
	Day	11	12	13	14	15	16	17	18	19	20		
	Mark	B	C	D	E	F	G	H	I	J	K		
	Day	21	22	23	24	25	26	27	28	29	30	31	
Mark	L	M	N	O	P	Q	R	S	T	U	V		
⑥⑦	Model Serial Number (WHM500A : EU Low Power)												
⑧⑨	A Serial Number(1serial: 1Box)												

## WHM500A QR-code(44digits) Information



← ex) 500AXK4FR01000001G,88571DF1AD1D,88571DF1AD1F

Digits	QR code info	Description
1~18	Serial(Lot) No.	500AXK4FR01000001G
19	,	Comma
20~31	WIFI MAC0	Mac Address 12digits
32	,	Comma
33~44	WIFI MAC1	Mac Address 12digits

## Serial No.

Model	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	MODEL CODE				ASSY	YEAR	Month	Day	HW version			SW App.	SW Ver.	SERIAL NUMBER				Customer
WHM500A	5	0	0	A	X	K	4	F	R	0	1	0	0	0	0	0	1	G

## 7. Packing

### 7.1 Reel Packing

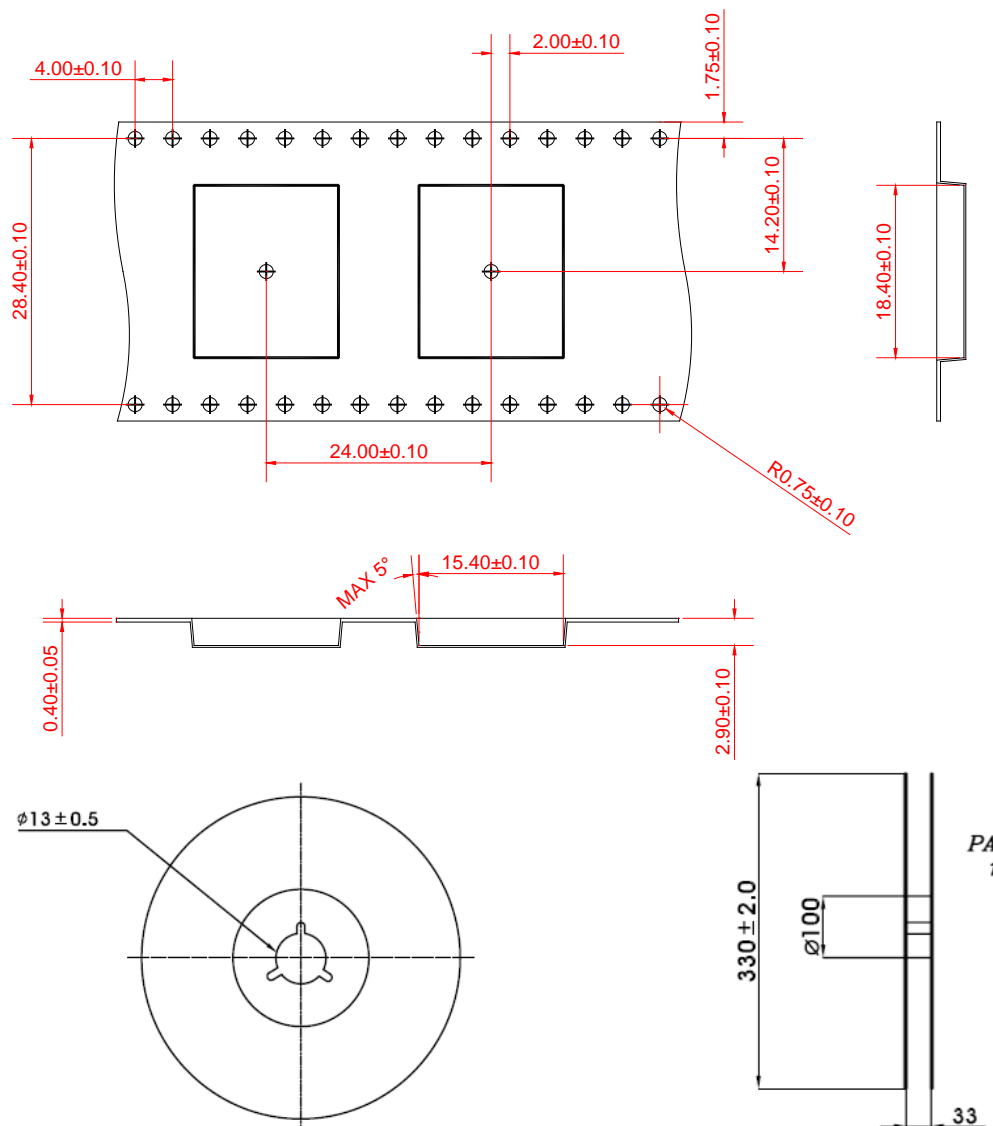


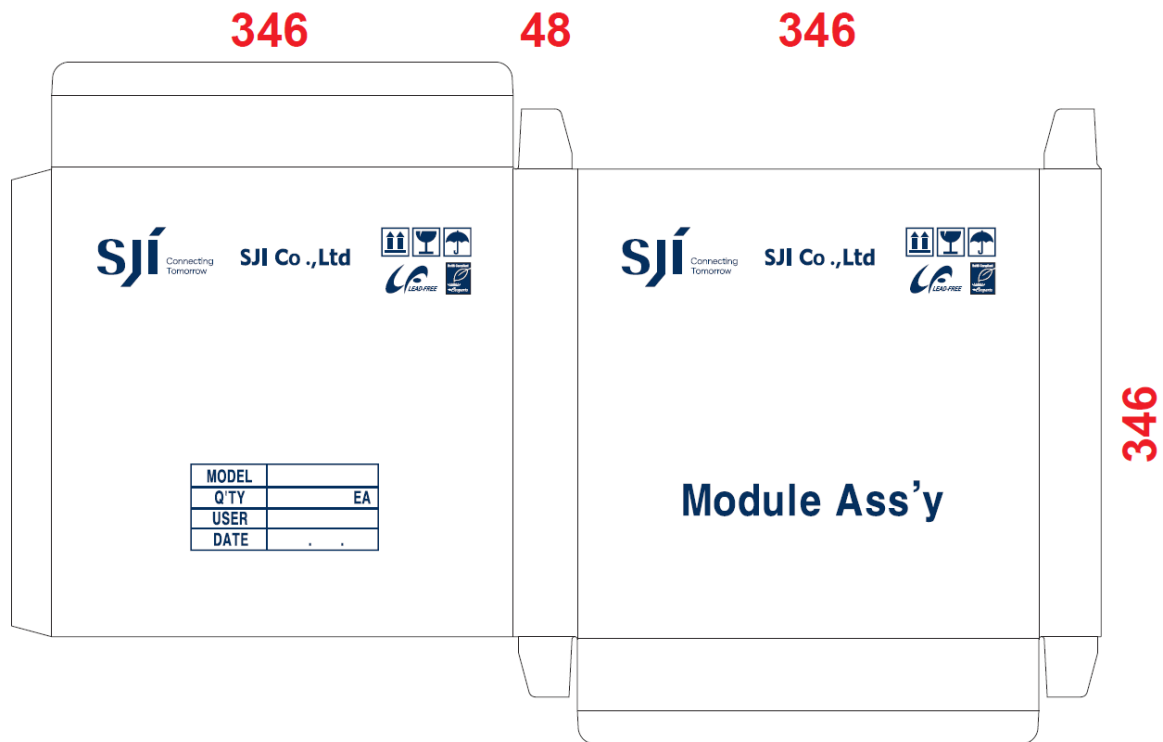
Figure 7-1: Reel packing

\* Reel Bobbin size: 15.4 x 18.4 X 2.9mm(480pcs/Reel)

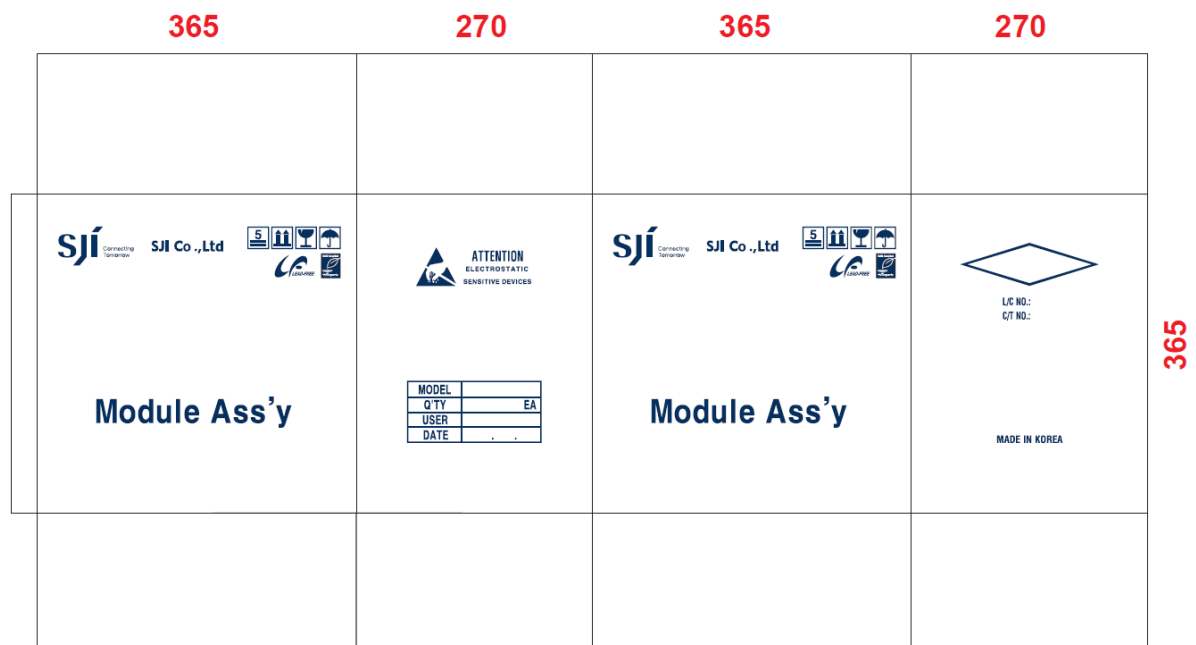
\* Packing Q'ty: 2,400pcs/Box

## 7.2 Packing Box

- Inner Box : 346 X 48 X 346 mm



- Out Box : 365 X 270 X 365 mm



## 7.3 Packing Bag & Silica Gel

	
Aluminum Bag	Silica Gel(20g)

## 8. Notice

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## ESD Warning



This modules are ESD sensitive devices, appropriate precautions should be taken during the module assembly in the final product.

Mechanical impact and harsh tools must be avoided during the module assembly in the final product.

Product ESD specification :

- ▲ HBM  $\pm 2\text{kV}$

The following precautions must be taken :

- ▲ Do not open the protective conductive packaging until you have use the following, and are at an approved anti-static work station.
- ▲ Use a conductive wrist strap attached to a good earth ground.
- ▲ If working on a prototyping board, use a soldering iron or station that is marked as ESD-safe.
- ▲ Use an approved anti-static mat to cover your work surface.