PRODUCT SPECIFICATION

Product Name	**S76S**
	LoRa Wireless Communication Module
Version	**H**
Doc No	**901-10201**
Date	**Mar 22nd, 2017**

Document History

Date	Revised Contents	Revised By	Version
July 20th ,2016	Draft Version	Chunyi	A
Aug 25th ,2016	Revised 7.1 marking without logo	Nick	B
Sep 10th ,2016	Revised marking with Acsip logo	Nick	C
Sep 26th ,2016	Revised 4.1 footprint drawing	Nick	D
Oct. 7 th ,2016	Update footprint	Nick	E
Oct. 11 th ,2016	Add pin assignment, revise footprint and mechanical dimension	Kenny	F
Mar 22nd ,2017	Modify Marking information	Kenny	G
Nov 13nd ,2017	Add FCC statement	Kenny	H

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1. General Description

The S76S integrates ARM Coretex®-M0+ (32-bit RISC core operating at a 32MHz frequency) MCU with LoRa^{TM} modulation that provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption.
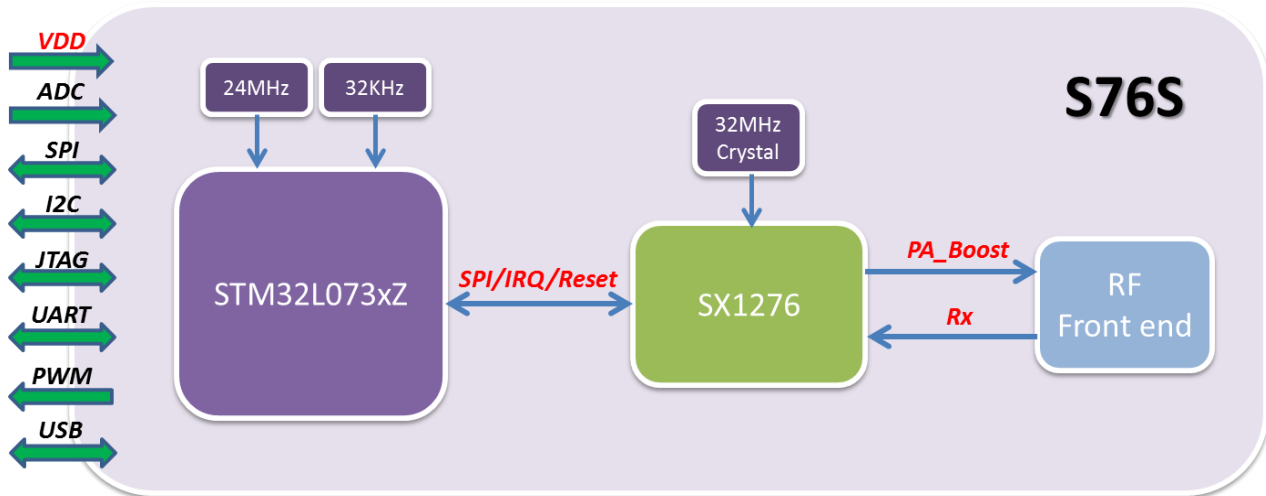
S76S can achieve a sensitivity of over -137 dBm. The high sensitivity combined with the integrated +20 dBm power amplifier yields industry leading link budget making it optimal for any low data rate application requiring range or robustness. LoRa^{TM} also provides significant advantages in both blocking and selectivity over conventional modulation techniques, solving the traditional design compromise between range, interference immunity and energy consumption.

Feature

- Small footprint：13 mm x 11 mm x 1.1 mm

- LoRa^{TM} Modem

- +20 dBm constant RF output vs. V supply

- Programmable bit rate up to 37500 bps

- High sensitivity: down to -137 dBm

- Excellent blocking immunity

- Preamble detection

- Automatic RF Sense and CAD with ultra-fast AFC

- Payload up to 128 bytes with CRC

- Embedded memories (up to 192 Kbytes of Flash memory and 20 Kbytes of RAM)

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1-1 Block Diagram

A simplified block diagram of the S76S module is depicted in the figure below.

1-2 Product Version

The features of S76S is detailed in the following table

Part Number	Frequency Range	Spreading Factor	Bandwidth (K Hz)	Effective Bitrate (bps)	Est. Sensitivity (dBm)
S76S	902.3-914.9 MHz	6 - 12	62.5 - 500	146 - 37500	-109 to -137*

Note: * LORA setting SF=12, BW=62.5k, Long-Range Mode, highest LNA gain, *LnaBoost* for Band 1.

1-3 Specification

Model Name	S76S
Product Description	LoRa Wireless Communication Module
Host Interface	UART
Operation Conditions	
Temperature	■ Storage：-50℃ ~ +105℃ ■ Operating：-20℃ ~ +70℃
Humidity	■ Operating：10 ~ 95% (Non-Condensing) ■ Storage：5 ~ 95% (Non-Condensing)
Dimension	13 mm x 11 mm x 1.1 mm
Package	LGA type

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2. Electrical Characteristics

2-1. Absolute Maximum Ratings

Symbol	Parameter	Min.	Typ.	Max.	Unit
VDD33	Supply Voltage	-0.3		3.9	V
V_{IN}	Input voltage on digital pins	-0.3		3.9	V
Pmr	RF Input Level			+10	dBm

2-2. Recommended Operating Range

Symbol	Parameter	Min.	Typ.	Max.	Unit
VDD33	Supply Voltage	2.0	3.3	3.6	V
ML	RF Input Level			+10	dBm

2-3. Power Consumption Characteristics

Symbol	Parameter	Conditions	Typ.	Max.	Unit
IDDSL	Supply current in Sleep mode		TBD		uA
IDDST	Supply current in Standby mode	Crystal oscillator enabled	9	9.6	mA
IDDR	Supply current in Receive mode		17.5		mA
IDDT	Supply current in Transmit mode with impedance matching	RFOP = +20 dBm	127		mA
		RFOP = +17 dBm	82		
		RFOP = +13 dBm	65		
		RFOP = + 7 dBm	49		

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2-4. RF Characteristics

The table below gives the electrical specifications for the transceiver operating with LoRa^{TM} modulation.

Following conditions apply unless otherwise specified:

- Supply voltage = 3.3 V.
- Temperature = 25° C.
- Frequency bands: 915 MHz
- Bandwidth (BW) = 125 kHz.
- Spreading Factor (SF) = 12.
- Error Correction Code (EC) = 4/6.
- Packet Error Rate (PER)= 1%
- CRC on payload enabled.
- Output power = 13 dBm in transmission.
- Payload length = 64 bytes.
- Preamble Length = 12 symbols (programmed register PreambleLength=8)
- With matched impedances

LoRa Transmitter (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Band1		915		MHz
Tx Power Level	PA_BOOST pin	18.0	19.5	21.0	dBm
LoRa Receiver (Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range	Band1	863	915	928	MHz
RFS_L62_HF (Long-Range Mode, highest LNA gain, LNA boost, 62.5 kHz bandwidth)	SF = 6		-119		dBm
	SF = 7		-114		dBm
	SF = 8		-127		dBm
	SF = 12		-137		dBm
RFS_L500_HF (Long-Range Mode, highest LNA gain, LNA boost, 500 kHz bandwidth)	SF = 6		-109		dBm
	SF = 7		-114		dBm
	SF = 8		-117		dBm
	SF = 9		-120		dBm
	SF = 10		-123		dBm
	SF = 11		-126		dBm
	SF = 12		-128		dBm

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2-5. Digital Characteristics

2-5-1. DC characteristics

Input voltage levels

Symbol	Description	Conditions	Min	Typ.	Max	Unit
VIH	I/O input high level voltage	NRST	0.7xVDD33	-	-	V
		BOOT0	0.7xVDD33	-	-	V
		GPIO	0.7xVDD33	-	-	V
VIL	I/O input low level voltage	NRST	-	-	0.3xVDD33	V
		BOOT0	-	-	0.14xVDD33	V
		GPIO	-	-	0.3xVDD33	V
R_{PU}	Weak pull-up Equivalent resistor	V_{IN} = GND	30	45	60	K Ω
R_{PD}	Weak pull-down Equivalent resistor	V_{IN} =VDD33	30	45	60	K Ω

Output voltage levels

Symbol	Description	Conditions	Min	Max	Unit
V_{OL}	Output low level voltage for an I/O pin	CMOS port / IIO = +8 mA 2.7 V≦VDD33≦3.6 V	-	0.4	V
V_{OH}	Output high level voltage for an I/O pin		VDD33-0.4	-	
V_{OL}	Output low level voltage for an I/O pin	TTL port / IIO =+ 8 mA 2.7 V≦VDD33≦3.6 V	-	0.4	
V_{OH}	Output high level voltage for an I/O pin	TTL port / IIO =- 6 mA 2.7 V≦VDD33≦3.6 V	2.4	-	
V_{OL}	Output low level voltage for an I/O pin	IIO = +15 mA 2.7 V≦VDD33≦3.6 V	-	1.3	
V_{OH}	Output high level voltage for an I/O pin	IIO = -15 mA 2.7 V≦VDD33≦3.6 V	VDD33-1.3	-	
V_{OL}	Output low level voltage for an I/O pin	IIO = +4 mA 1.65 V≦VDD33≦3.6 V	-	0.45	
V_{OH}	Output high level voltage for an I/O pin	IIO = +4 mA 1.65 V≦VDD33≦3.6 V	VDD33-0.45	-	

2-5-2.   NRST pin characteristics

The NRST pin input driver uses CMOS technology.

It is connected to a permanent pull-up resistor (R_{PU}).

The following figure is recommended NRST pin protection circuit against parasitic resets.
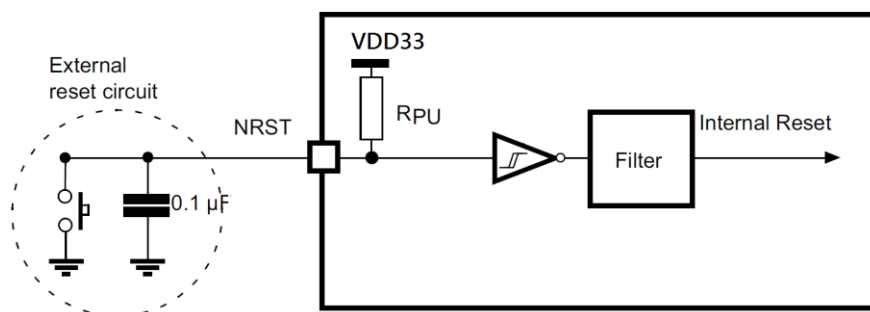
Symbol	Description	Conditions	Min	Typ.	Max	Unit
$V_{IL(NRST)}$	NRST input low level voltage		VSS		0.8	V
$V_{IH(NRST)}$	NRST input high level voltage		1.4		VDD33	V
$V_{OL(NRST)}$	NRST output low level voltage	I_{OL} = 2mA 2.7V＜VDD33＜3.6V			0.4	V
$V_{OL(NRST)}$	NRST output low level voltage	I_{OL} = 1.5mA 1.65V＜VDD33＜2.7V			0.4	V
$V_{hys(NRST)}$	NRST schmitt trigger voltage hysteresis			10% VDD33		mV
R_{PU}	Weak pull-up Equivalent resistor	V_{IN} = GND	30	45	60	KΩ
V_F	NRST Input filtered pulse				50	nS
V_{NF}	NRST Input not filtered pulse	VDD33 > 2.7 V		350		nS

2-5-3. UART Interface Parameters

Baud Rate = 38400 bps

Data Bits = 8 bits

Stop Bits = 1 bit

Parity Check = None

Flow Control = None

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3. Pin Definition

Pin	Definition	I/O	Description
1	NC		
2	GND		Ground pin
3	GND		Ground pin
4	PC0	I/O	MCU pin name: PC0
5	PC1	I/O	MCU pin name: PC1
6	PC2	I/O	MCU pin name: PC2
7	PC3	I/O	MCU pin name: PC3
8	NC		
9	NC		
10	NC		
11	NC		
12	NRST		Hardware reset pin
13	PA0	I/O	MCU pin name: PA0
14	GND		Ground pin
15	GND		Ground pin
16	PA2_TXD_A	I/O	MCU pin name: PA2
17	PA3_RXD_A	I/O	MCU pin name: PA3
18	PA4_SPI1_NSS	I/O	MCU pin name: PA4
19	PA5_SPI1_SCK	I/O	MCU pin name: PA5
20	PA6_SPI1_MISO	I/O	MCU pin name: PA6
21	PA7_SPI1_MOSI	I/O	MCU pin name: PA7
22	PC4	I/O	MCU pin name: PC4
23	PC5	I/O	MCU pin name: PC5
24	PB0_IO_INT1	I/O	MCU pin name: PB0
25	PB1_IO_INT2	I/O	MCU pin name: PB1
26	PC6	I/O	MCU pin name: PC6
27	PC7	I/O	MCU pin name: PC7
28	PC8	I/O	MCU pin name: PC8
29	PC9	I/O	MCU pin name: PC9
30	RXTX/RFMOD	O	Control signal from SX1276, which connects to internal RF switch at the same time.

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31	GND		Ground pin
32	GND		Ground pin
33	RF_ANT	I/O	RF I/O
34	GND		Ground pin
35	GND		Ground pin
36	PA1_RF_FEM_CPS	I/O	MCU pin name: PA1
37	GND		Ground pin
38	NC		
39	GND		Ground pin
40	NC		
41	GND		Ground pin
42	NC		
43	VDD33		Power Supply
44	VDD33		Power Supply
45	PA8_USART1_CK	I/O	MCU pin name: PA8
46	PA10_USART1_RX	I/O	MCU pin name: PA10
47	PA9_USART1_TX	I/O	MCU pin name: PA9
48	PA11_USART1_CTS	I/O	MCU pin name: PA11
49	PA12_USART1_RTS	I/O	MCU pin name: PA12
50	PA13_SWDIO		Serial wire (SWD) debug interface
51	PA14_SWCLK		Serial wire (SWD) debug interface
52	PC10	I/O	MCU pin name: PC10
53	PC11	I/O	MCU pin name: PC11
54	PC12	I/O	MCU pin name: PC12
55	PD2	I/O	MCU pin name: PD2
56	PB5	I/O	MCU pin name: PB5
57	PB6_SCL	I/O	MCU pin name: PB6
58	PB7_SDA	I/O	MCU pin name: PB7
59	BOOT0	I	Boot mode selection pin
60	PB8_IO_LED_FCT	I/O	MCU pin name: PB8
61	GND		Ground Pin
62	GND		Ground Pin

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3-1. Pin Assignment

The SiP module will conform to the following pin map, shown in the following diagram (top view)
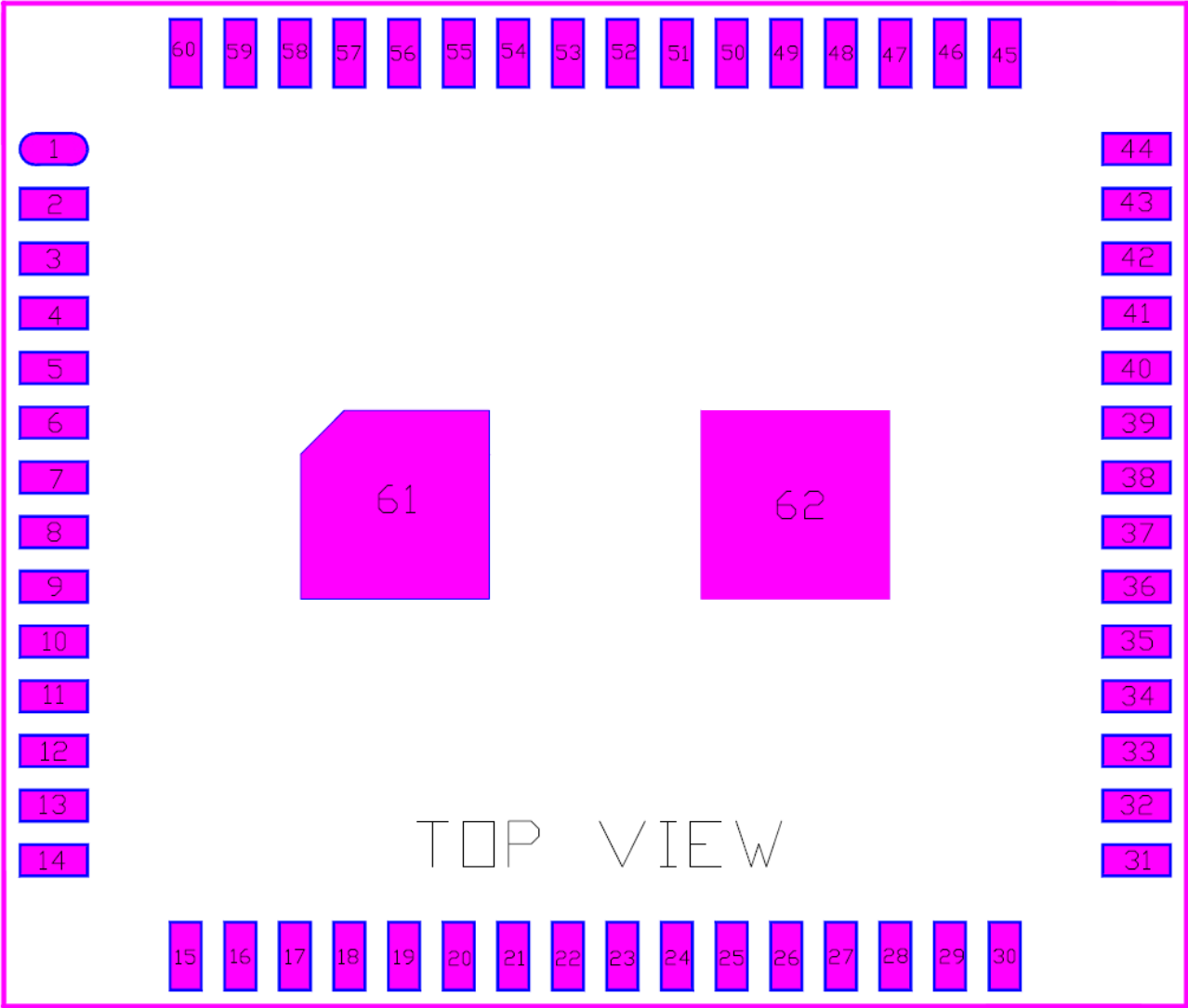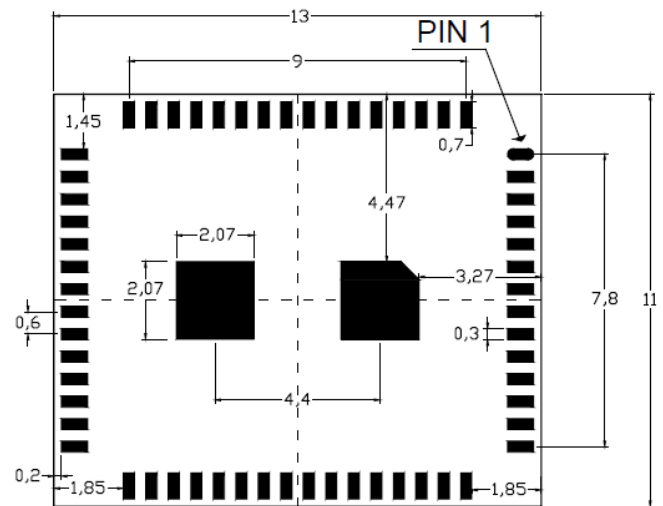
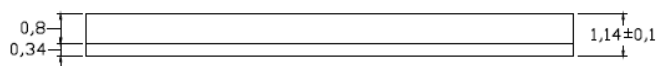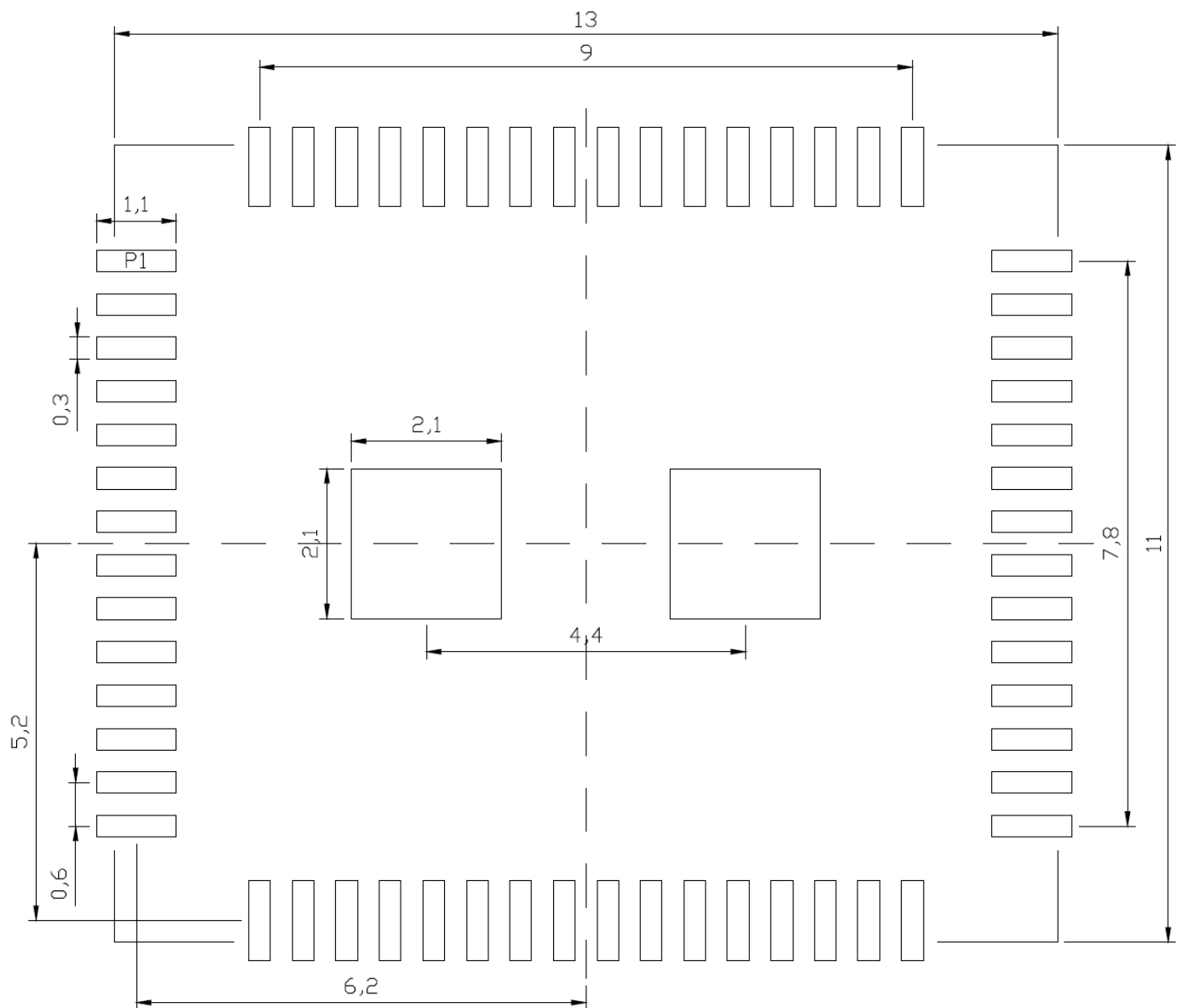# 4. Mechanical Dimension

Unit: mm
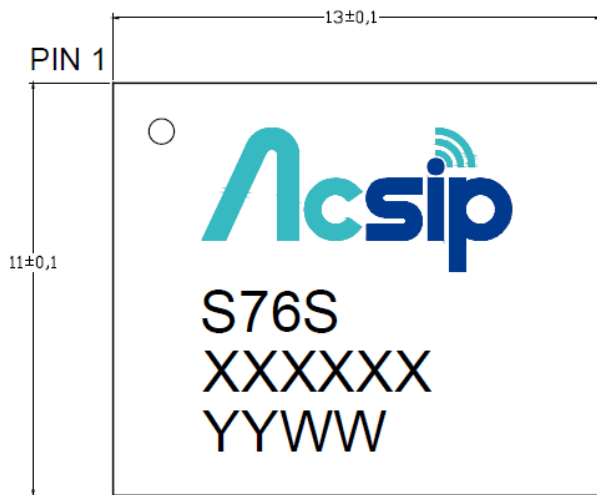
TOP VIEW

BOTTOM VIEW

SIDE VIEW

4-1   Recommended Footprint

Unit: mm

TOP View

5. Recommended Reflow Profile

Reflow Profile for SiP on board Assembly
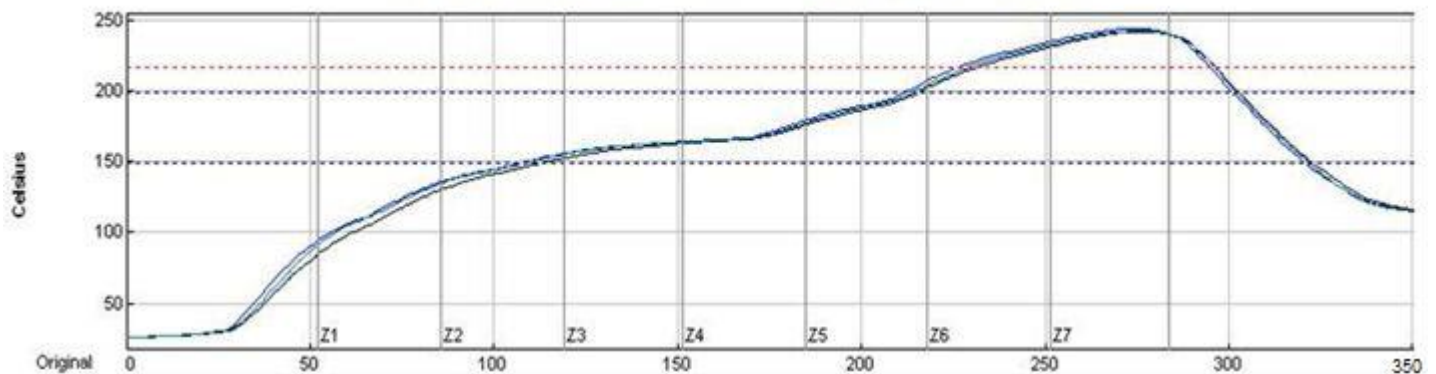
Preheat time	150℃—200℃ : 105+/-15sec
Dwell time	Over 220℃ : 70+5/-10 sec
Peak Temp	240 +10/-5℃
Ramp Up/Down Rate	Up: 3 +0/-2 ℃/ sec Down: 2 +0/-1℃/ sec

6. SiP Module Preparation

6-1.   Handling

Handling the module must wear the anti-static wrist strap to avoid ESD damage. After each module is aligned and tested, it should be transport and storage with anti -static tray and packing. This protective package must be remained in suitable environment until the module is assembled and soldered onto the main board.

6-2.   SMT Preparation

1. Calculated shelf life in sealed bag: 6 months at<40℃ and <90% relative humidity (RH).

2. Peak package body temperature: 250℃.

3. After bag was opened, devices that will be subjected to reflow solder or other high temperature process must.

    A.   Mounted within: 168 hours of factory conditions<30℃/60%RH.

    B.   Stored at≦10%RH with N2 flow box.

4. Devices require baking, before mounting, if:

    A.   Package bag does not keep in vacuumed while first time open.

    B.   Humidity Indicator Card is >10% when read at 23±5℃.

    C.   Expose at 3A condition over 8 hours or Expose at 3B condition over 24 hours.

5. If baking is required, devices may be baked for 12 hours at 125±5℃.

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7. Package Information

7-1.   Product Making

Figure 1 below details the standard product marking for all AcSiP Corp. products. Cross reference to the applicable line number and table for a full detail of all the variables.
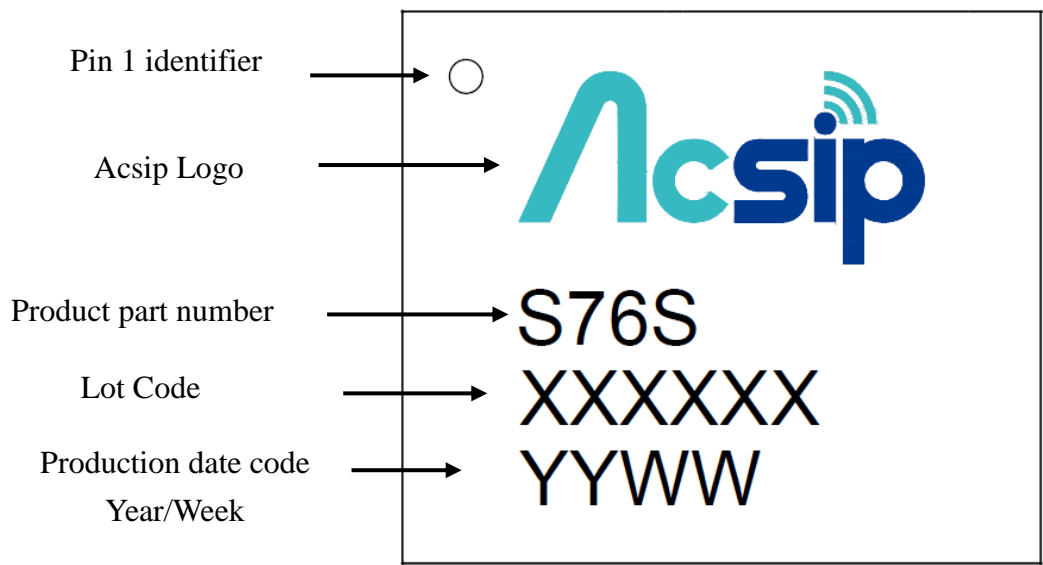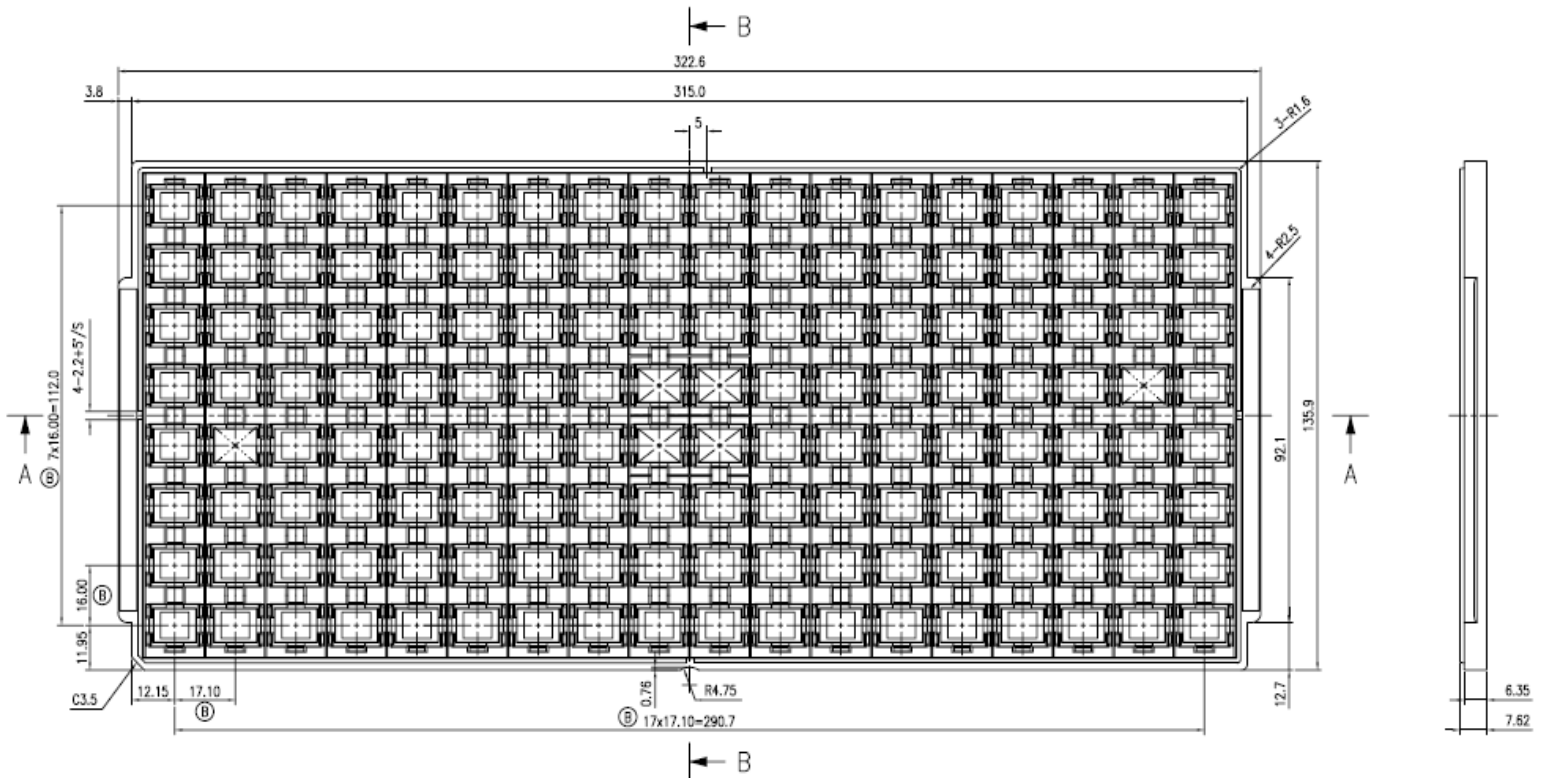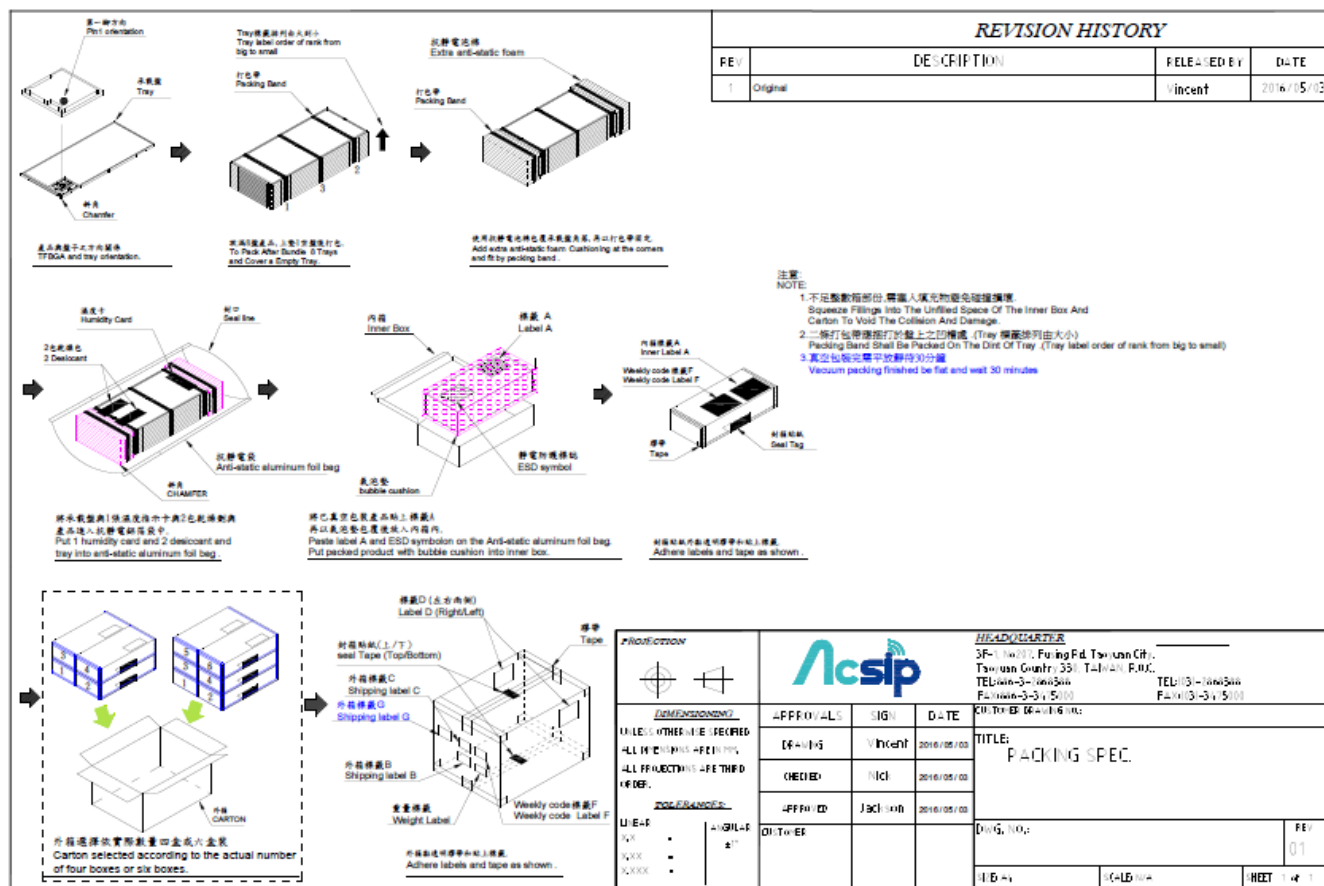
Pin 1 identifier

Acsip Logo

Product part number — S76S

Lot Code — XXXXXX

Production date code
Year/Week — YYWW

Figure 1 Standard Product Marking Diagram- TOP VIEW

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7-2. Tray Dimension

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7-3. Packing Information

7-4. Humidity Indicator Card

Dry

Wet

Indicates 指示點:
10%,20%,30,40%,50%,60% relative humidity
10%,20%,30,40%,50%,60% 相對濕度

Color Change 顏色變化:
Brown (Dry) ---> Blue (Wet)
棕色 (乾燥) ---> 藍色 (潮溼)

8. FCC statement

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:

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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 <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 <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: 2ADWC-S76S".

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.