AzureWave Technologies, Inc.

AW-CU478

IEEE802.15.4 Wireless Microcontroller Zigbee 3.0 Stamp LGA Module (M03)

Datasheet

Rev. F

DF

(For STD)

Features

Benefits

- Single chip device to run stack and application
- Very low current solution for long battery life; over 10 years
- Very low RX current for low standby power of mains powered nodes
- Integrated power amplifier for long range and robust communication
- High tolerance to interference from other 2.4 GHz radio sources
- Supports multiple network stacks
- Highly featured 32-bit RISC CPU for high performance and low power
- Large embedded Flash memory to enable over-the-air firmware updates without
- external Flash memory
- System BOM is low in component count and cost
- Flexible sensor interfacing options

Radio

- Radio link budget 106 dB
- Compensation for temperature drift of crystal oscillator frequency
- 128-bit AES security processor
- MAC accelerator with packet formatting, CRCs, address check, auto-acks, timers
- Integrated ultra low-power RC sleep oscillator (0.7uA)
- 2.0 V to 3.6 V battery operation
- Deep sleep current 50 nA (wake-up from IO)
- Antenna diversity (Auto RX)

Microcontroller

- 32-bit RISC CPU; 1 MHz to 32 MHz clock speed
- Variable instruction width for high coding efficiency
- Multi-stage instruction pipeline
- 512 kB Flash
- 32 kB RAM
- 4 kB EEPROM
- Data EEPROM with guaranteed 100 k write operations
- Zigbee PRO stack with Home Automation, Light Link and Smart Energy profiles
- 2-wire I2C-bus compatible serial interface; can operate as either master or slave
- 5 x PWM (4 timers, 1 timer/counter)
- 2 low-power sleep counters
- 2 x UARTs
- SPI-bus master and slave port, 3 selects
- Supply voltage monitor with 8 programmable thresholds
- 6-input 10-bit ADC, comparator
- Battery and temperature sensors
- Watchdog and Supply Voltage Monitor (SVM)
- Up to 20 Digital IO (DIO) pins

Applications

- Robust and secure low-power wireless applications
- Zigbee 3.0
- Internet of Things (IoT)
- Zigbee Smart Energy networks
- Zigbee Light Link networks
- Zigbee Home Automation networks

- Toys and gaming peripherals
- Energy harvesting

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Revision History

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Version	Revision Date	DCN NO.	Description	Initials	Approved
A	2020/4/13	DCN017088	● Initial Version	Shihhua Huang	NC Chen
B	2020/5/6	DCN017356	● Added more info about chapter 3.2	Shihhua Huang	NC Chen
C	2020/6/23	DCN017620	● Modify Storage Temperature	Shihhua Huang	NC Chen
D	2020/8/11	DCN018073	● Added certification info at chapter 1.3.1 ● Added power consumption	Shihhua Huang	NC Chen
E	2020/12/24	DCN019673	● Update pin table description	Shihhua Huang	NC Chen
F	2021/4/14	DCN021284	*Changed to new format ● Modify Block Diagram	Shihhua Huang	NC Chen

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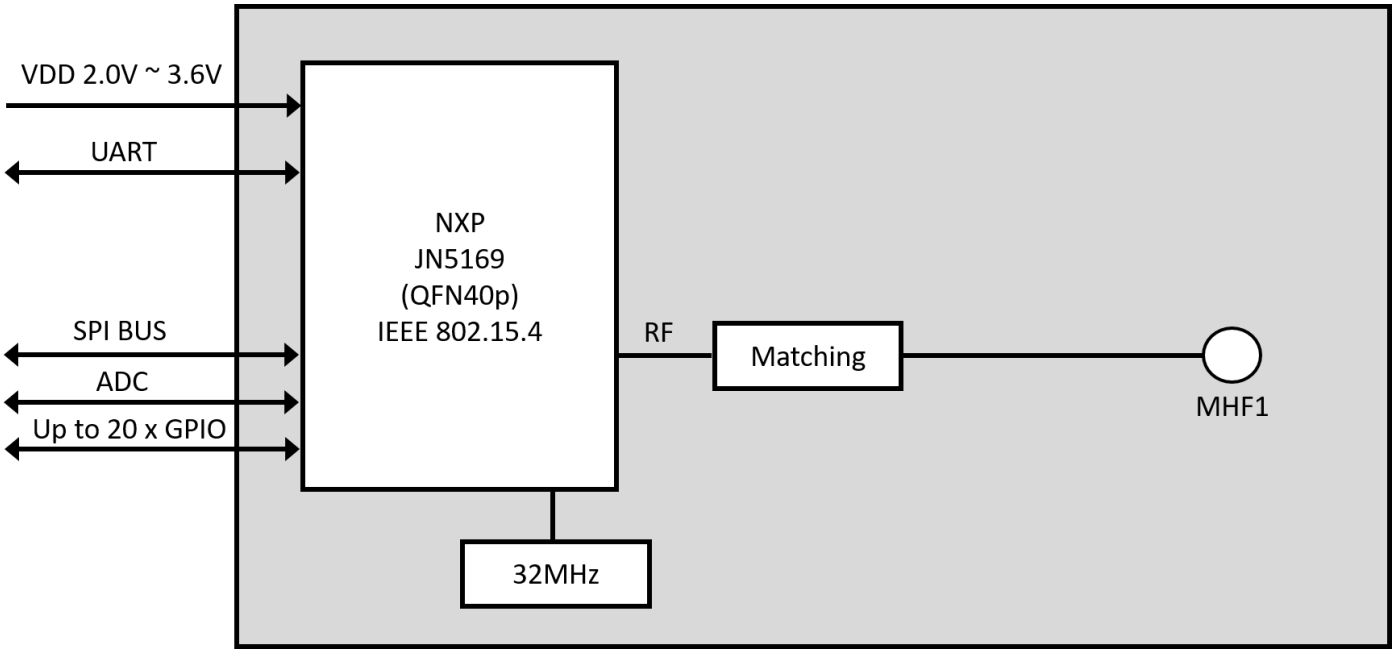
1. Introduction

1.1 Product Overview

AzureWave Technologies, Inc. introduces the pioneer of the IEEE 802.15.4 Zigbee module --- AW-CU478. The AW-CU478 wireless microcontroller that provides a fully integrated solution for applications that use the IEEE802.15.4 standard in the 2.4 GHz to 2.5 GHz ISM frequency band, including Zigbee PRO applications based on the Smart Energy, Light Link and Home Automation profiles. The AW-CU478 features 512 kB embedded Flash, 32 kB RAM and 4 kB EEPROM memory. Applications that transfer data wirelessly tend to be more complex than applications for wired solutions. Wireless protocols make stringent demands on frequencies, data formats, and timing of data transfers, security and other issues. Application development must consider the requirements of the wireless network in addition to the product functionality and user interfaces. To minimize this complexity, AzureWave provides a series of software libraries and interfaces that control the transceiver and peripherals of the AW-CU478. These libraries and interfaces remove the need for the developer to understand wireless protocols and greatly simplifies the programming complexities of power modes, interrupts and hardware functionality. In view of the above, we do not provide the AW-CU478 register details in this data sheet. The device includes a wireless transceiver, RISC CPU, on-chip memory and an extensive range of peripherals.

1.2 Block Diagram



AW-CU478 BLOCK DIAGRAM

1.3 Specifications Table

1.3.1 General

Features	Description
Product Description	IEEE 802.15.4 Zigbee 3.0 Module (Stamp LGA)
Major Chipset	JN5169 (QFN 40p)
Host Interface	Zigbee ● UART
Dimension	16mm x 21mm x 2.95mm (Tolerance remarked in mechanical drawing)
Form factor	Stamp LGA module
Antenna	I-PEX MHF1 Connector Receptacle (20279) Main：Zigbee → TX/RX
Certification information	AW-CU478 are FCC, IC, CE and ANATEL certified. FCC ID: XXMJN5169M3V2 / IC ID: 8764A-JN5169M3 / ANATEL ID: 04451-16-09529
Weight	1.406g

1.3.2 Zigbee

Features	Description
WLAN Standard	IEEE 802.15.4 1T1R
WLAN VID/PID	N/A
WLAN SVID/SPID	N/A
Frequency Rage	2.4 GHz：2.405 ~ 2.480 GHz
Modulation	O-QPSK
Number of Channels	**2.4GHz** ■ USA, NORTH AMERICA, Canada and Taiwan – 11 ~ 24 ■ China, Australia, Most European Countries – 11 ~ 26
Output Power (Board Level Limit)*	**2.4G** 15.4 (0.25Mbps) @EVM<35%: Min 5.5 / Typ 8.5 / Max 11.5 / Unit dBm

<table>
<tr><td>Receiver Sensitivity</td><td>2.4G
<table>
<tr><td></td><td>Min</td><td>Typ</td><td>Max</td><td>Unit</td></tr>
<tr><td>15.4 (0.25Mbps)</td><td></td><td>-93</td><td>-90</td><td>dBm</td></tr>
</table></td></tr>
<tr><td>Data Rate</td><td>Zigbee:
802.15.4: 0.25Mbps</td></tr>
<tr><td>Security</td><td>■ 128-bit AES-CCM modes as specified by the IEEE802.15.4 2006 standard.</td></tr>
</table>

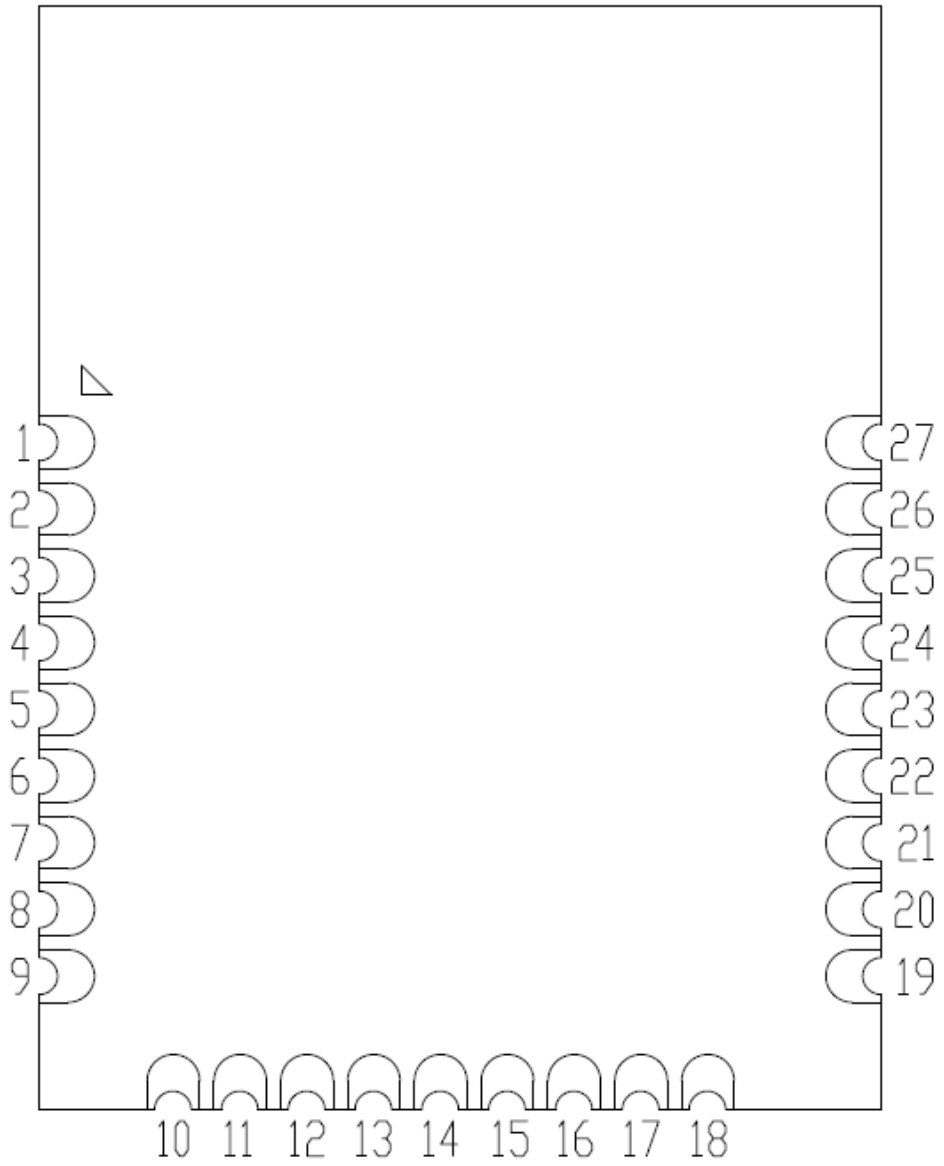
* If you have any certification questions about output power please contact FAE directly.

1.3.3 Operating Conditions

Features	Description
Operating Conditions	
Voltage	Power supply for host: 2.0V ~ 3.6V
Operating Temperature	-40℃~ 85℃
Operating Humidity	less than 85%R.H.
Storage Temperature	-40℃~ 125℃
Storage Humidity	less than 60%R.H.
ESD Protection	
Human Body Model	2KV
Changed Device Model	1000V

2. Pin Definition

2.1 Pin Map



AW-CU478 Pin Map (Top View)

2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
1	ADC1	ADC input		I
2	SPICLK	SPI-bus master clock output		O
3	SPIMISO	SPI-bus Master In, Slave Out input		I/O
4	SPIMOSI	SPI-bus Master Out Slave In output		I/O
5	SSZ	SPI-bus master Select Output 0		I/O
6	DIO0	DIO0		I/O
7	DIO1	DIO1		I/O
8	DIO2	DIO2		I/O
9	DIO3	DIO3		I/O
10	DIO4	DIO4 UART 0 clear to send input		I/O
11	DIO5	DIO5 UART 0 request to send output		I/O
12	DIO6	DIO6 UART 0 transmit data output		I/O
13	DIO7	DIO7 UART 0 receive data input		I/O
14	DIO8	DIO8		I/O
15	DIO9	DIO9		I/O
16	DIO10	DIO10		I/O
17	VDD	Supply voltage		P
18	GND	Ground.		GND
19	DIO11	DIO11		I/O

20	DIO12	DIO12		I/O
21	DIO13	DIO13		I/O
22	RESETN	Reset input		I
23	DIO14	DIO14		I/O
24	DIO15	DIO15		I/O
25	DIO16	DIO16		I/O
26	DIO17	DIO17		I/O
27	ADC2	ADC2 input		I

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Conditions	Minimum	Maximum	Unit
V_{DD}	Power supply voltage		-0.3	3.6	V
V_{ADC1}	Voltage on pin ADC1		-0.3	V_{DD}+0.3	V
$V_{IO(dig)}$	Digital input/output voltage		-0.3	V_{DD}+0.3	V

3.2 Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VDD[1]	Power supply voltage	2	--	3.6	V

[1] To reach the maximum TX power, 2.8 V is the minimum.

3.3 Digital IO Pin DC Characteristics

Table 1. Digital IO DC Characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	0.7*VDD	--	VDD	V
V_{IL}	Input low voltage	-0.3	--	0.27*VDD	V
$V_{hys(i)}$	Input hysteresis voltage				

Table 2. Output on pins DIOx[1]

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{OH}	Output high voltage	VDD-0.4	--	VDD	V
V_{OL}	Output low voltage	0	--	0.4	V

[1] With x = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 or 19.

3.4 AC characteristics

3.4.1 Reset and Supply Voltage Monitor

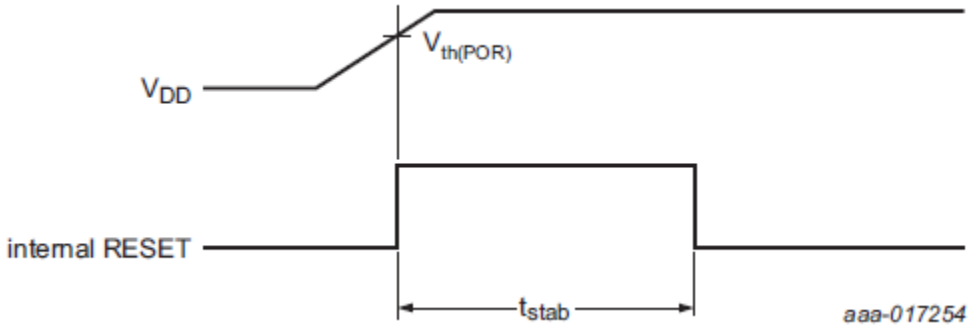


Fig 1. Internal Power-On Reset without showing Brown-Out

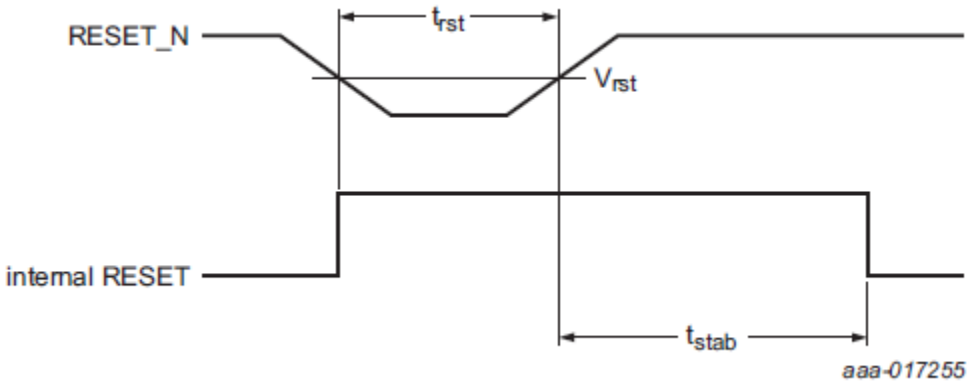
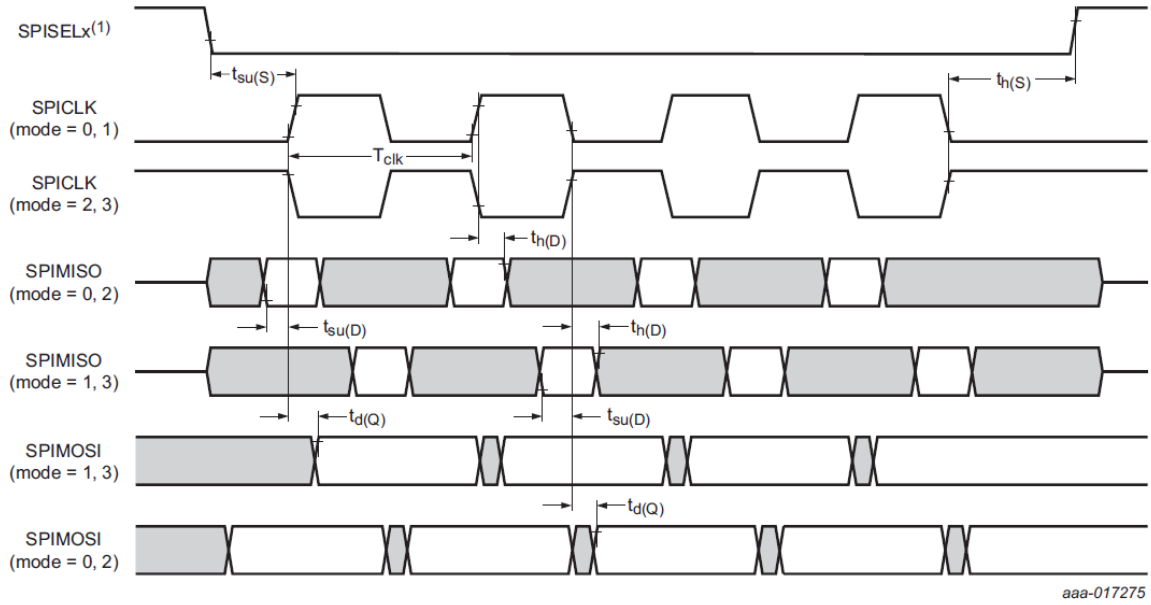


Fig 2. Externally applied reset

Table 3. Externally applied reset

Symbol	Parameter	Conditions	Min	Typical	Max	Unit
t_{rst}	Reset time	External reset pluse width to initiate reset sequence	1			us
V_{rst}	Reset voltage	External threshold voltage	0.7*VDD			V
$V_{th(POR)}$	Power-on threshold voltage	Rise time >10ms				
		Rising	-	1.44		V
		Falling	-	1.41		V
α spike	Spike rejection	Depth of pulse to trigger reset				
		1us square wave		1.2		V
		10us triangular wave		1.3		V
T_{stab}	Stabilization time	Reset		180		us

3.4.2 SPI-bus master timing



(1) With x = 0, 1 or 2.

Table 4. SPI-bus master timing

Symbol	Parameter	Conditions	Min	Typical	Max	Unit
T_{clk}	Clock period		62.5			ns
$T_{su(D)}$	Data input set-up time	3.3V	12.5			ns
		2.7V	13			
		2.0V	14			
$T_{h(D)}$	Data input hold time		0			ns
$T_{d(Q)}$	Data output delay time	On SPIMOSI			15	ns
$T_{su(S)}$	Chip select set-up time		60			ns
$T_{h(S)}$	Chip select hold time	SPICLK = 16MHz	30			ns
		SPICLK < 16MHz; mode =0 or 2	0			
		SPICLK < 16MHz; mode =1 or 3	60			

3.4.3 SPI-bus slave timing

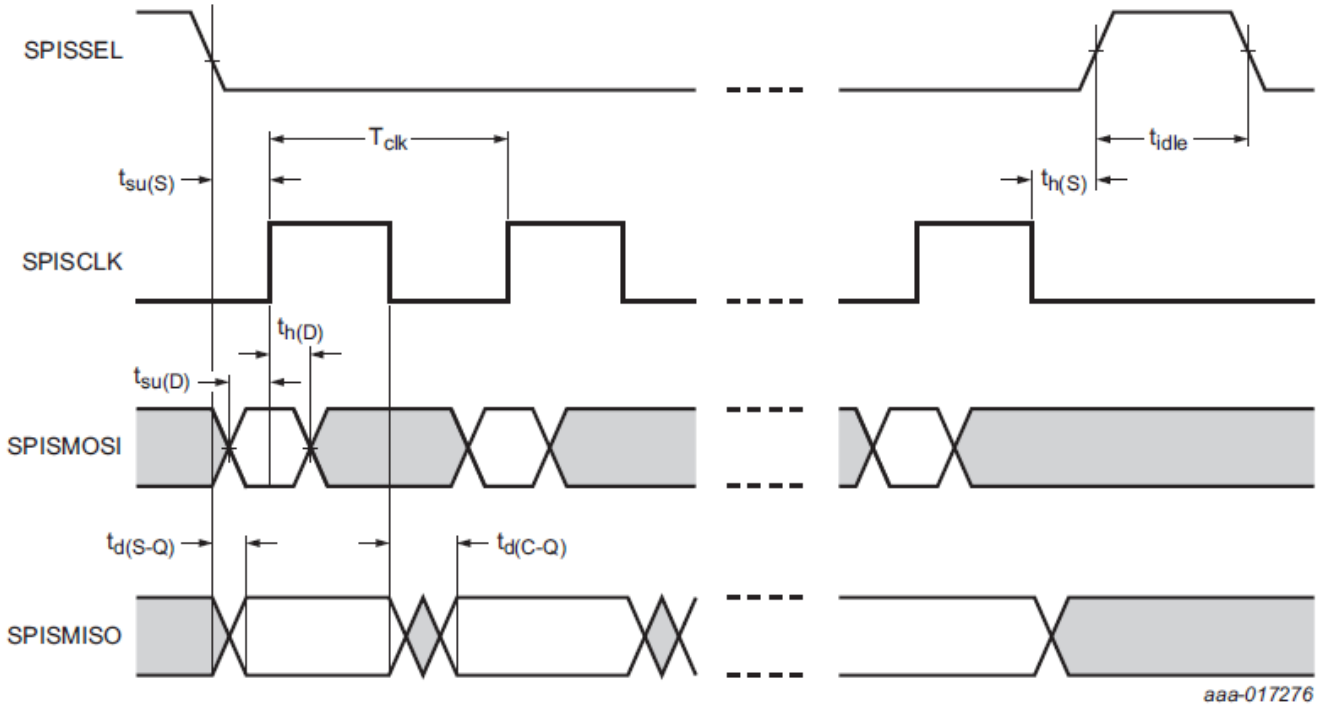


Table 5. PERST# Timing Parameters

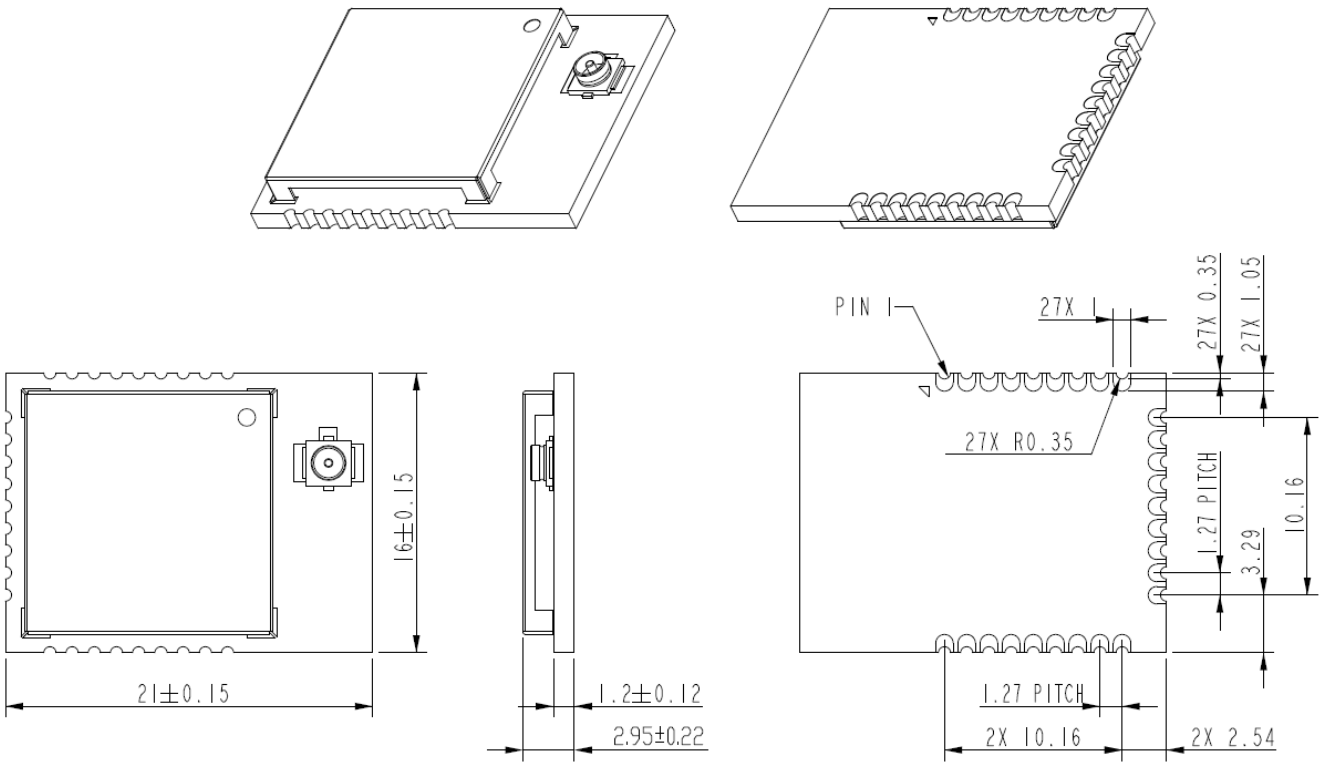
Symbol	Parameter	Conditions	Min	Typical	Max	Unit
T_{clk}	Clock period		125	-	-	ns
t_{idle}	Idle time		125	-	-	ns
$t_{su(D)}$	Data input set-up time		10	-	-	ns
$t_{h(D)}$	Data input hold time		10	-	-	ns
$t_{d(C-Q)}$	Clock to data output delay time	SPISCLK falling edge to SPISMISO output delay time	-	-	30	ns
$t_{d(S-Q)}$	Chip select to data output delay time	SPISSEL falling edge to SPISMISO output delay time	-	-	30	ns
$t_{su(S)}$	Chip select set-up time	SPISSEL falling edge to SPISCLK rising edge delay time	30	-	-	ns
$t_{h(S)}$	Chip select hold time	SPISCLK falling edge to SPISSEL rising edge delay time	30	-	-	ns

3.5 Power Consumption*

No.	Item	VDD_IN=3.3 V	
		Max.	Avg.
1	Deep sleep mode	2.91 uA	0.206 uA
2	Sleep mode without memory retention (60seconds)	1.74 uA	0.813 uA
3	Transmit mode (9.9dBm)	24.09 mA	24.06 mA
4	Receive mode, maximum input level at 0 dBm	16.68 mA	16.64 mA

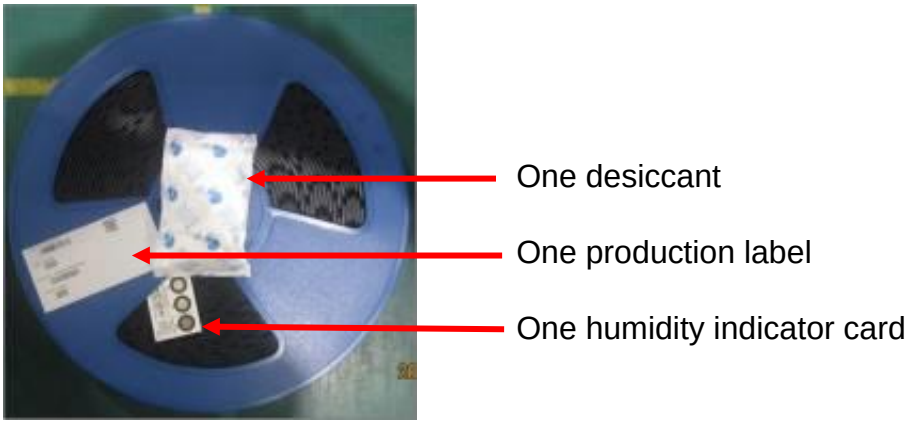
4. Mechanical Information

4.1 Mechanical Drawing

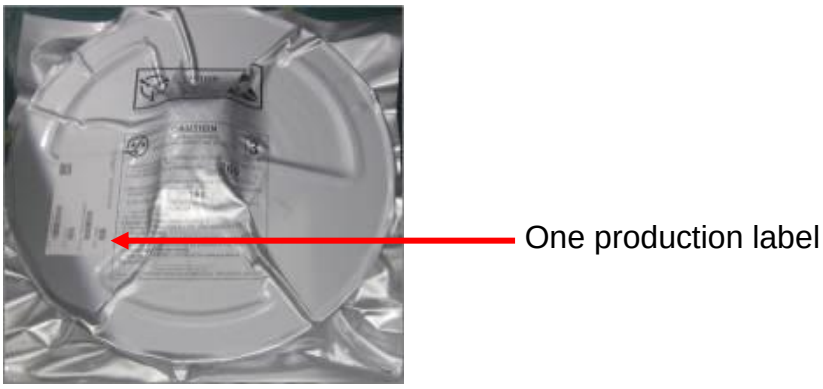


5. Packaging Information

1. One reel can pack 600pcs 16x21 stamp LGA modules
2. One production label is pasted on the reel, one desiccant and one humidity indicator card are put on the reel



3. One reel is put into the anti-static moisture barrier bag, and then one label is pasted on the bag



4. A bag is put into the anti-static pink bubble wrap

5. A bubble wrap is put into the inner box and then one label is pasted on the inner box

One production label

6. **3 inner boxes** could be put into one carton

7. Sealing the carton by AzureWave tape

8. One carton label and one box label are pasted on the carton. If one carton is not full, one balance label pasted on the carton

Example of carton label (出貨標籤的範例)	AzureWave AzureWave Technologies Inc. AzureWave P/N Customer 由業務提供 Customer P/N 由業務提供 Customer PO 由業務提供 Description AW-XXXXXX QTY 1200 pcs C/N N.W. G.W. RoHS COMPLIANT
Example of box label (箱號標籤)	BOX0012018
Example of production label (生產標籤)	P/N: D/C: 1309 PCK NO.: PCKNO0069097 QTY: 294 BAG SEAL DATE: _____

Example of balance label (尾數標籤)