

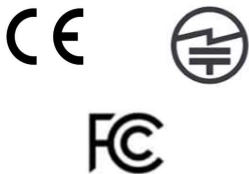


Low-power Wi-Fi 6 - Bluetooth® LE combo coprocessor module



Product status

ST67W611M1



Features

Module content

- All-in-one Wi-Fi®/Bluetooth® LE/802.15.4 wireless microcontroller
- Embedded 40 MHz high-precision crystal
- All RF components for transmission and reception matching network, including antenna filter
- Three variants: embedded antenna (-B version), RF connector (-U version), RF pin output (-P version)⁽¹⁾

Standard

- IEEE 802.11b/g/n/ax
- Bluetooth® LE 5.4
- IEEE 802.15.4 (Thread)⁽¹⁾
- Regulatory certifications: CE/RED, UKCA, FCC, IC, JRF/ARIB, ACMA/RCM, RSM, BIS/WPC, NBTC, RoHS, REACH
- Wi-Fi and Bluetooth LE can run concurrently dynamically

Wi-Fi

- Wi-Fi 6, 2.4 GHz RF transceiver
- Wi-Fi 20/40 MHz bandwidth, 1T1R
- Wi-Fi security WPS/WEP/WPA/WPA2/WPA3
- STA, SoftAP, concurrent STA + SoftAP
- Maximum Tx power (11b 1 Mbps): 21 dBm
- Tx power (HE40 and MCS9): 16 dBm
- Rx sensitivity (HE40 and MCS9): -67 dBm
- Application throughput up to 17 Mbps (TCP)
- LDPC, STBC, beamforming, DL/UL OFDMA, MU-MIMO, target wake time (TWT), spatial reuse (SR), dual carrier modulation (DCM), extended range (ER)
- A-MPDU, A-MSDU, immediate block ACK, fragmentation, and defragmentation

Bluetooth® LE

- Maximum Tx power: + 10 dBm
- Rx sensitivity
 - Bluetooth® LE (2 Mbps): -96.5 dBm
 - Bluetooth® LE (1 Mbps): -99 dBm

System peripherals

- SPI
- UART

Security

- PSA Level 1 certified
- Security system encryption engine
- Secure services: Secure boot and FOTA (firmware over-the-air)

**Voltage**

- Input voltage: 3.3 V
- I/O voltage: 1.8 V/3.3 V

Environmental specifications

- Temperature:
 - Operating: -40°C ~ +85°C
 - Storage: -40°C ~ +125°C
- Humidity:
 - Relative: < 90% noncondensing
 - Storage: < 90% noncondensing

1. This feature is not yet available.

All packages are ECOPACK2 compliant.

Application

- Smart homes:
 - Door lock and door-bells
 - Cameras
 - Smart hub
- Industrial IoT:
 - Industrial control IoT hub/gateways
 - Smart utility metering
 - EV chargers
- Smart appliances:
 - White goods
 - Kitchen appliances
- Healthcare:
 - Portable patient monitors
 - Handled devices



1 Introduction

This document provides information on ST67W611M1 modules, such as description, pin assignment and definition, electrical characteristics, packaging and ordering information.

DRAFT

2 Description

Powered by Qualcomm high-performance 1×1 2.4 GHz Wi-Fi 6 and Bluetooth 5.4 modem, the STMicroelectronics ST67W611M1 LGA module is purposely designed to pack processing capabilities, Wi-Fi and Bluetooth LE combo connectivity, and on-module memory into a single 32-pin LGA form factor.

This all-in-one design and capability contribute to reduced costs and enhanced performance, making it an attractive choice for IoT edge devices requiring a single-chip solution.

ST67W611M1 operates as an IoT connectivity transceiver, with an external STM32 host MCU running applications.

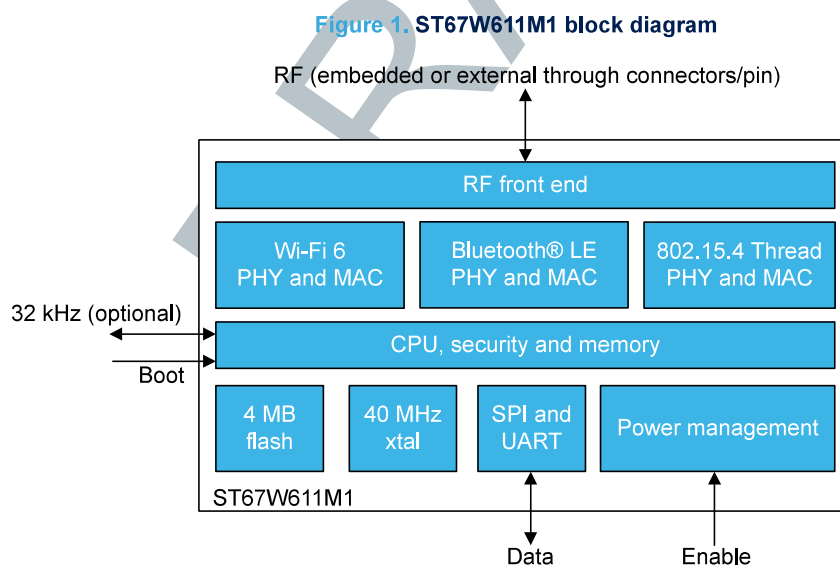
ST67W611M1 integrates:

- A PCB antenna (version -B), a RF connector (version-U) for external antenna, or version with a dedicated RF pin typically for support of multi-antenna implementations with external RF switch
- 4 MB NOR flash
- 40 MHz high-precision quartz for optimal RF performance
- SMPS functionality and associated bill of material (BOM)
- All needed discrete components to reduce the overall board BOM
- Data interface through SPI
- 32768 Hz internal oscillator. For low-power use cases, two pins are provided to use a 32768 Hz quartz. One pin can also be used to receive an accurate 32768 Hz from the host processor.

In addition, the P variant supports:

- External PA/LNA to increase power up to 30 dBm
- Rx antenna diversity to increase the reach of your final product using several antennas.

Figure 1 shows the general block diagram of the device family.



2.1 UART interface

The UART interface uses two pins (Rx and Tx) and is configured as follows:

- Full-duplex asynchronous communication
- Data bit length: 8 bits
- Stop bit length: 1 bit
- Parity: None
- Hardware flow control (RTS/CTS): None
- Baud rate: 2000000 bauds



2.2

SPI interface

The SPI bus is configured in full-duplex slave mode with three signals (SPI_CLK, SPI_MOSI, SPI_MISO).

The SPI_RDY pin is present and used by the ST67W611M1 as an interrupt towards the host processor.

The SPI_CS pin can also be used as a wake-up signal from the host processor.

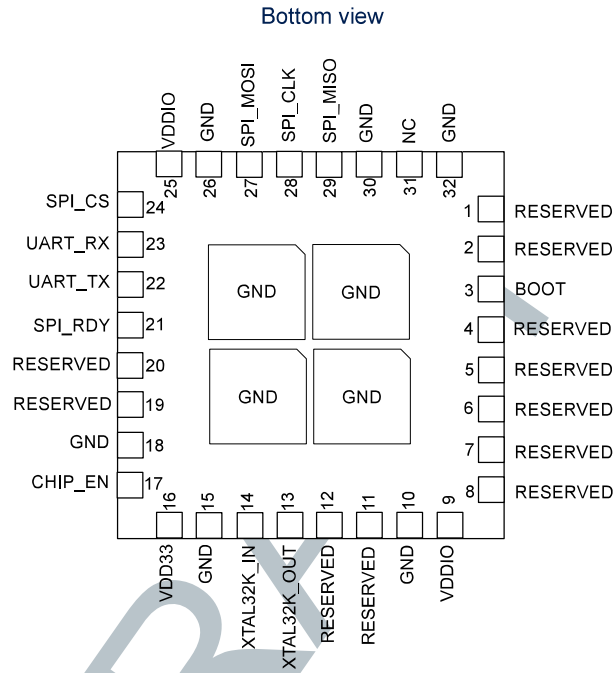
Maximum SPI frequency : 40 MHz.

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3 Pinouts and pin description

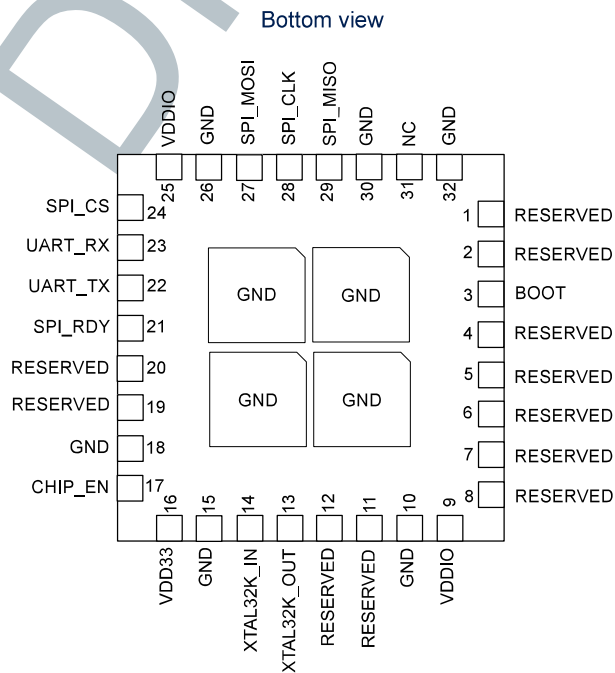
3.1 Pinout schematics

Figure 2. ST67W611M1A6B LGA module PCB antenna

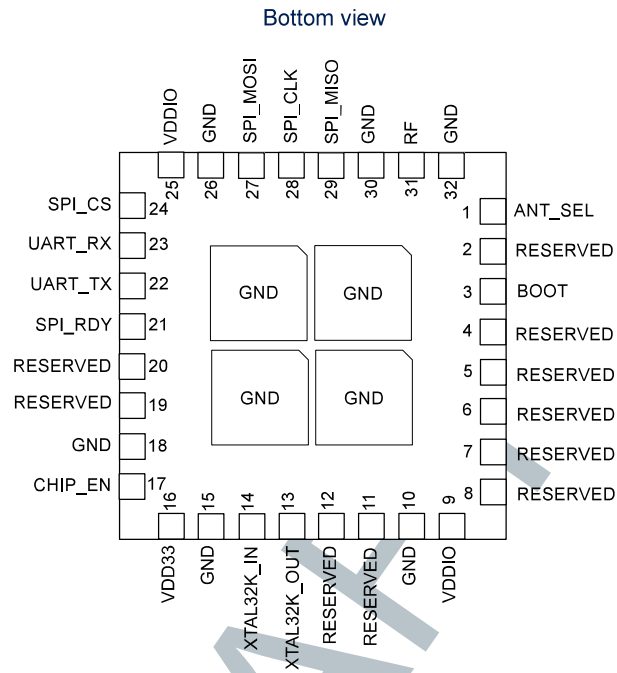


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Figure 3. ST67W611M1A6U LGA module antenna connector



DT75610V3

Figure 4. ST67W611M1A6P LGA module pin connector


DT75647V3



3.2 Pin description

Table 1. ST67W611M1 pin definition

Pin number	Pin name	Pin type	Power domain	Description
1	RESERVED ANT_SEL	I/O	VDDIO	RESERVED: ST67W611M1A6B and ST67W611M1A6U ANT_SEL: ST67W611M1A6P
2	RESERVED	I/O	VDDIO	-
3	BOOT	I/O	VDDIO	Select boot from SPI or from UART.
4	RESERVED	I/O	VDDIO	-
5	RESERVED	I/O	VDDIO	-
6	RESERVED	I/O	VDDIO	-
7	RESERVED	I/O	VDDIO	-
8	RESERVED	I/O	VDDIO	-
9	VDDIO	PWR	-	Host I/O voltage input (3.3 V or 1.8 V)
10	GND	GND	GND	Ground
11	RESERVED	I/O	VDDIO	-
12	RESERVED	I/O	VDDIO	-
13	XTAL32K_OUT	I/O	VDD33	32.768 kHz quartz is optional. 32.768 kHz coming from host processor can be provided on this pin.
14	XTAL32K_IN	I/O	VDD33	32.768 kHz quartz is optional.
15	GND	GND	GND	Ground
16	VDD33	PWR	-	Power input (3.3 V)
17	CHIP_EN	DI	-	Chip power on
18	GND	GND	GND	Ground
19	RESERVED	I/O	VDDIO	-
20	RESERVED	I/O	VDDIO	-
21	SPI_RDY	I/O	VDDIO	Data ready to be transmitted to host processor.
22	UART_TX	I/O	VDDIO	UART Tx line from ST67W611M1 point of view.
23	UART_RX	I/O	VDDIO	UART Rx line from ST67W611M1 point of view.
24	SPI_CS	I/O	VDDIO	Input of the SPI slave-select from the SPI master/host.
25	VDDIO	PWR	-	Host I/O voltage input (3.3 V or 1.8 V)
26	GND	GND	GND	Ground
27	SPI_MOSI	I/O	VDDIO	Input SPI data from the master/host to the module.
28	SPI_CLK	I/O	VDDIO	Input of SPI clock signal generated by the SPI master/host.
29	SPI_MISO	I/O	VDDIO	Output of SPI data from the module to the SPI master/host.
30	GND	GND	GND	Ground
31	NC RF	- RF	-	NC: ST67W611M1A6B and ST67W611M1A6U RF: ST67W611M1A6P
32	GND	GND	GND	Ground



4 Electrical characteristics

4.1 Absolute maximum ratings

The absolute maximum ratings provided in this section indicate the stress levels that, if exceeded, may result in permanent damage to the device. Functionality outside the specified operating conditions is not guaranteed. Both functionality and reliability are guaranteed only within the defined operating specifications.

Table 2. Absolute maximum ratings

Pin name	Min.	Max.	Unit
VDD33	-0.3	3.63	V
VDDIO	-0.3	3.63	
ESD protection (HBM)	-	2000	
T _S (storage temperature) ⁽¹⁾⁽²⁾	-40	+125	°C

1. The storage temperature range applies when the device is in the off state (the device is not assembled in any platform and is not electrically connected to any voltage or I/O signals). Damage may occur when the device is subjected to this temperature for any length of time.
2. For devices shipped in tape and reel, the storage temperature range is [+15 °C +35 °C] and < 90 % relative humidity (RH). ST recommends allowing the device to return to ambient room temperature before usage.

4.2 Electrical sensitivity characteristics

Table 3. Electrical sensitivity characteristics

Tests, standards, and conditions	Result
ESD contact discharge (IEC 61000-4-2)	2 KV Pass

4.3 Operating conditions

Operating conditions include controlled parameters such as power supply voltage, power distribution impedances, and thermal conditions. The ST67W611M1 meets all performance specifications when used within the operating conditions, unless otherwise noted in those sections (provided the absolute maximum ratings have never been exceeded).

Table 4. Recommended power operating range

Pin name	Min.	Typ	Max.	Unit
VDD33	2.97	3.3	3.63	V
VDDIO	2.97/1.62	3.3/1.8	3.63/1.98	

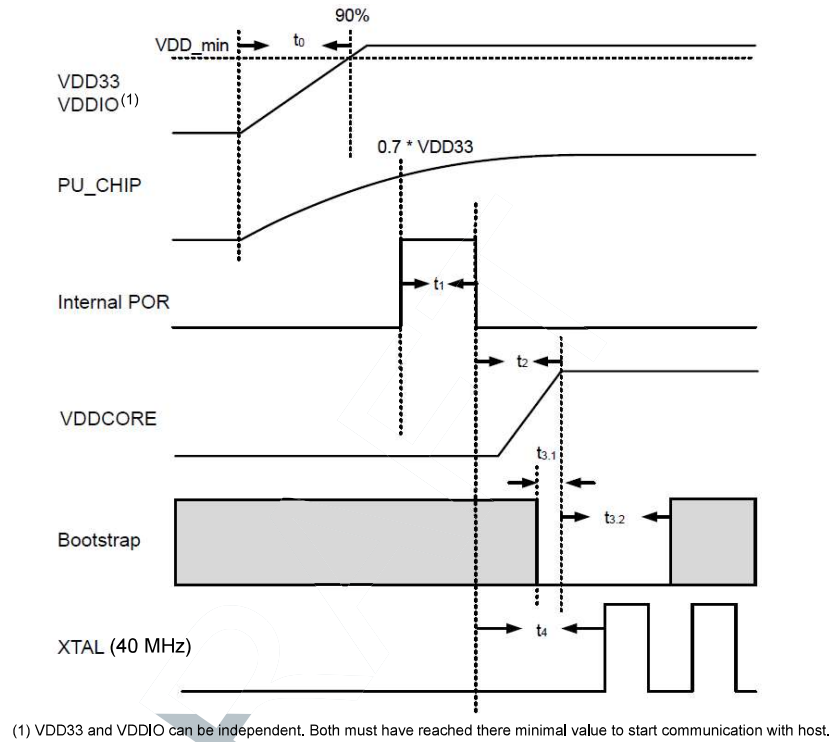
Table 5. Recommended temperature operating range

Item	Min.	Max.	Unit
Ambient temperature	-40	85	°C

4.4 Power-on sequence

To ensure normal power-on startup, the power, reset, and bootstrap pins must meet the corresponding timing requirements.

Figure 5. Power-on sequence



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Table 6. Power-on sequence parameters

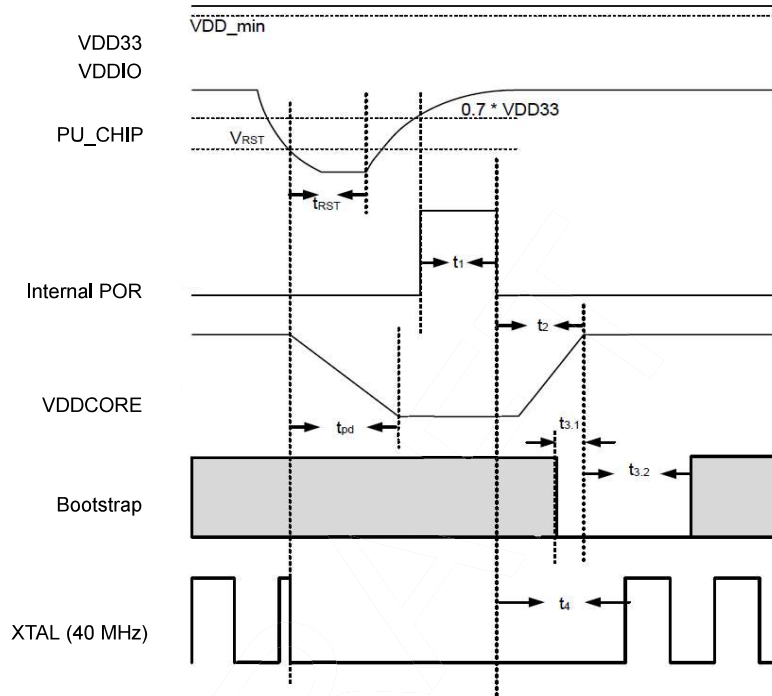
Parameters	Description	Min. (ms)	Typ (ms)	Max. (ms)
t_0	The power supply voltage reaches 90% rise time ⁽¹⁾	-	0.1	-
t_1	Internal POR duration	-	3	-
t_2	VDDCORE setting time after internal POR down	-	1	-
$t_{3,1}$	Bootstrap pin ⁽²⁾ preparation time before VDDCORE establishment	0	-	-
$t_{3,2}$	Duration of valid voltage level at the bootstrap pin.	2	-	-
t_4	XTAL startup time after internal POR down	-	1	-

1. VDD_min is the minimum value for proper chip operation.

2. The bootstrap pin is BOOT.

4.5 Shutdown sequence

Figure 6. Shutdown sequence



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Table 7. Shutdown sequence parameters

Parameters	Description	Min.	Typ	Max.	Unit
V_{RST}	Shutdown occurs after PU_CHIP lower than this voltage	0	$0.1 \times VDD33$	$0.3 \times VDD33$	V
t_{RST}	The required time that PU_CHIP lower than VRST	1	1	-	ms
t_{pd}	Time for VDDCORE to decrease to 0 after shutdown	1	1	-	ms

4.6 DC power characteristics

Test conditions: $V_{DDIO} = 3.3$ V, temperature = 25 °C

Table 8. I/O DC characteristics

Symbol	Description	Min.	Typ	Max.	Unit
V_{OH}	Output voltage high	-	$0.9 \times VDDIO$	-	V
V_{OL}	Output voltage low	-	$0.1 \times VDDIO$	-	
V_{IH}	Input voltage high	$0.7 \times VDDIO$	-	-	
V_{IL}	Input voltage low	-	-	$0.3 \times VDDIO$	



4.7 WLAN RF characteristics

Table 9. 802.11b/g/n/ax radio performance¹

1. The maximum power ratings reflect the transmitter's maximum power capability and is region-dependent. Refer to the specific certificate associated to the region for exact maximum output power.

Standard	PHY	Modulation	MCS Index	Max Tx Power (dBm)		Rx Sensitivity (dBm)	
				20 MHz	40 MHz	20 MHz	40 MHz
802.11b	CCK (DSSS)	DBPSK	—	21	—	-99	—
	CCK (DSSS)	DQPSK	—	21	—	-96	—
	CCK (DSSS)	B/DQPSK	—	21	—	-93.5	—
	CCK (DSSS)	Q/DQPSK	—	21	—	-90.5	—
802.11g	OFDM	BPSK	—	20	—	-93.5	—
	OFDM	BPSK	—	20	—	-93	—
	OFDM	QPSK	—	20	—	-92	—
	OFDM	QPSK	—	20	—	-89.5	—
	OFDM	16 QAM	—	20	—	-87	—
	OFDM	16 QAM	—	20	—	-83.5	—
	OFDM	64 QAM	—	18	—	-79	—
	OFDM	64 QAM	—	18	—	-78	—
802.11n	OFDM	BPSK	MCS0	19	18.5	-93	-90
	OFDM	QPSK	MCS1	19	18.5	-91	-88
	OFDM	QPSK	MCS2	19	18.5	-88.5	-85.5
	OFDM	16 QAM	MCS3	19	18.5	-86	-83.5
	OFDM	16 QAM	MCS4	19	18.5	-82.5	-79.5
	OFDM	64 QAM	MCS5	18.5	18	-78.5	-75.5
	OFDM	64 QAM	MCS6	18.5	18	-76.5	-74
	OFDM	64 QAM	MCS7	18	17	-75.5	-72.5
802.11ax	OFDMA	BPSK	MCS0	19	19	-93.5	-90.5
	OFDMA	QPSK	MCS1	19	19	-92.5	-89.5
	OFDMA	QPSK	MCS2	19	19	-90	-87.5
	OFDMA	16 QAM	MCS3	19	19	-87.5	-84.5
	OFDMA	16 QAM	MCS4	19	19	-84	-81.5
	OFDMA	64 QAM	MCS5	18.5	18	-80	-77
	OFDMA	64 QAM	MCS6	18	18	-79	-76
	OFDMA	64 QAM	MCS7	18	17	-78	-75
	OFDMA	256 QAM	MCS8	18	17	-73	-70.5
	OFDMA	256 QAM	MCS9	17	16	-72	-69.5

Table 10. Bluetooth LE performance

Standard	Topology	PHY	Modulation	Data Rate	Max Tx Power (dBm)	Rx Sensitivity (dBm)
BLE	P2P Broadcast Mesh	LE 2M	GFSK	2Mbps	+10	-97
		LE 1M	GFSK	1Mbps	+10	-99
		LE Coded (S=2)	GFSK	500 Kbps	+10	-102



Standard	Topology	PHY	Modulation	Data Rate	Max Tx Power (dBm)	Rx Sensitivity (dBm)
BLE	P2P Broadcast Mesh	LE Coded (S=8)	GFSK	125 Kbps	+10	-105

Table 11. Synthesizer composite characteristics and transmit output power accuracy

Symbol	Parameter	Conditions	Min.	Typ	Max.	Unit
Synthesizer composite characteristics for 2.4 GHz						
F _c	Center channel frequency	Center frequency at 5 MHz spacing	2412	-	2484	MHz
F _{ref}	Reference oscillator frequency	±20 ppm	-	40	-	MHz
F _{step}	Frequency step size (at RF)	-	-	5	-	MHz
T _{SPowerUP}	Time for power-up (from sleep)	-	-		50	us
Transmit output power accuracy						
APC ⁽¹⁾	Accuracy of transmit power control at 2.4 GHz at room temperature (3 sigma over top 10 dB of TPC range).	OLPC (Open Loop Power Control)	-	±1.5	-	dB

1. All APC numbers assume conducted test with 50 Ω load.

4.8

Power consumption

- **Active:** Continuous transmitting or receiving on connection to access point (AP).
- **DeepSleep:** Digital and analog parts are mostly powered off. RAM is in retention. This is the DTIM power-saving mode.
- **Shutdown:** The chip is supplied but in shut down.

The power consumption for each state is listed in the table below:

Table 12. Power consumption at 3.3 V, 25 °C

Operation mode	State	Typ	Unit	Comments
Static				
Power saving	DeepSleep	90	μA	Digital and analog parts are mostly powered off. RAM is in retention. This is the DTIM power-saving mode.
	Shutdown	0.2		-
DTIM				
DTIM	DTIM1	720	μA	Ext32k
		720		Xtal32k
		830		RC32k
	DTIM3	300		Ext32k
		300		Xtal32k
		390		RC32k
	DTIM5	240		Ext32k
		240		Xtal32k
		290		RC32k
	DTIM10	130		Ext32k
		130		Xtal32k
		180		RC32k



TWT current consumption

The measurements are done in TWT mode between the ST67W611M1 and a commercialized Wi-Fi 6 access point.

The following TWT current consumption measurements are done on an X-NUCLEO board which has an average current consumption of 64 μ A when there is no activity (that is, in deepsleep during TWT doze state and while there is no hcp_coarse_tmr or probe request activity). Current consumption measurements are done after the initial phase of the probe requests. On STA side, TWT starts with several probe requests to gather AP timing data necessary for precise TWT wakeups.

Table 13. TWT current consumption

Mode	Average Current consumption SP = 32ms	Average Current consumption SP _{max} = 64ms	Unit
TWT 1 s	2762	4755	μ A
TWT 10 s	339.3	529	μ A
TWT 20 s	205.3	312	μ A
TWT 30 s	159.6	195	μ A
TWT 1 min	128.3	147.5	μ A
TWT 5 min	87.3	92	μ A
TWT 10 min	81	86	μ A
TWT 20 min	79.6	81.3	μ A
TWT 30 min	79.2	79.3	μ A
TWT 1 h	79.1	79.2	μ A

Table 14. Power consumption for continuous WLAN Tx 2.4 GHz at 3.3 V, 25 °C

Rate	Power (dBm)	Current consumption (mA)
11b 1 Mbps	22	372
11b 11 Mbps	22	377
11g 6 Mbps	21	352
11g 54 Mbps	19	304
MCS0 HT20	20	326
MCS7 HT20	19	311
MCS0 HT40	19	310
MCS7 HT40	18	292
MCS0 HE20	20	317
MCS9 HE20	18	285
MCS0 HE40	20	321
MCS9 HE40	16	262

Table 15. Power consumption for continuous WLAN Rx 2.4 GHz at 3.3 V, 25 °C

Rate	Current consumption (mA)
11b 1 Mbps	55
11b 11 Mbps	56
11g 6 Mbps	59



Rate	Current consumption (mA)
11g 54 Mbps	62
MCS0 HT20	59
MCS7 HT20	63
MCS0 HT40	71
MCS7 HT40	78
MCS0 HE20	60
MCS9 HE20	65
MCS0 HE40	74
MCS9 HE40	77

Table 16. Power consumption for Bluetooth® LE at 3.3 V, 25 °C

Description	Current consumption (mA)
Continuous Rx burst	53
Continuous Tx (+4 dBm)	107
Continuous Tx (+10 dBm)	167
1.28 sec page scan (non-interlaced)	0.75
1.28 sec LE ADV	0.32

5 Mechanical information

5.1 Device physical dimensions

5.1.1 ST67W611M1 LGA module PCB antenna (-B version)

Figure 7. ST67W611M1 LGA module PCB antenna dimension

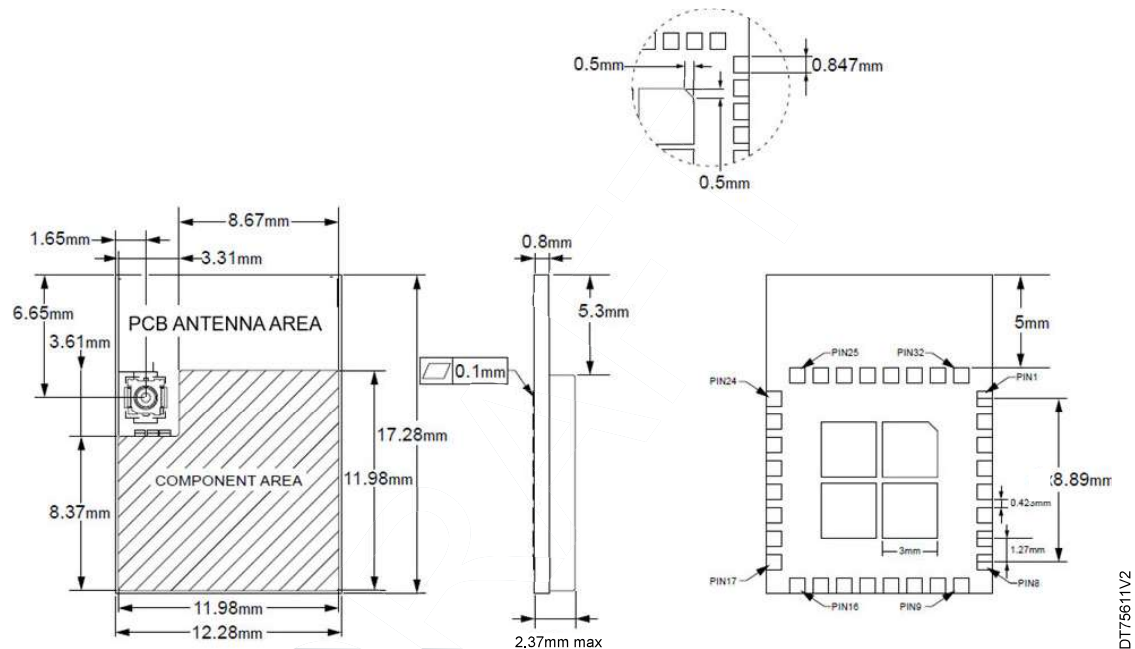
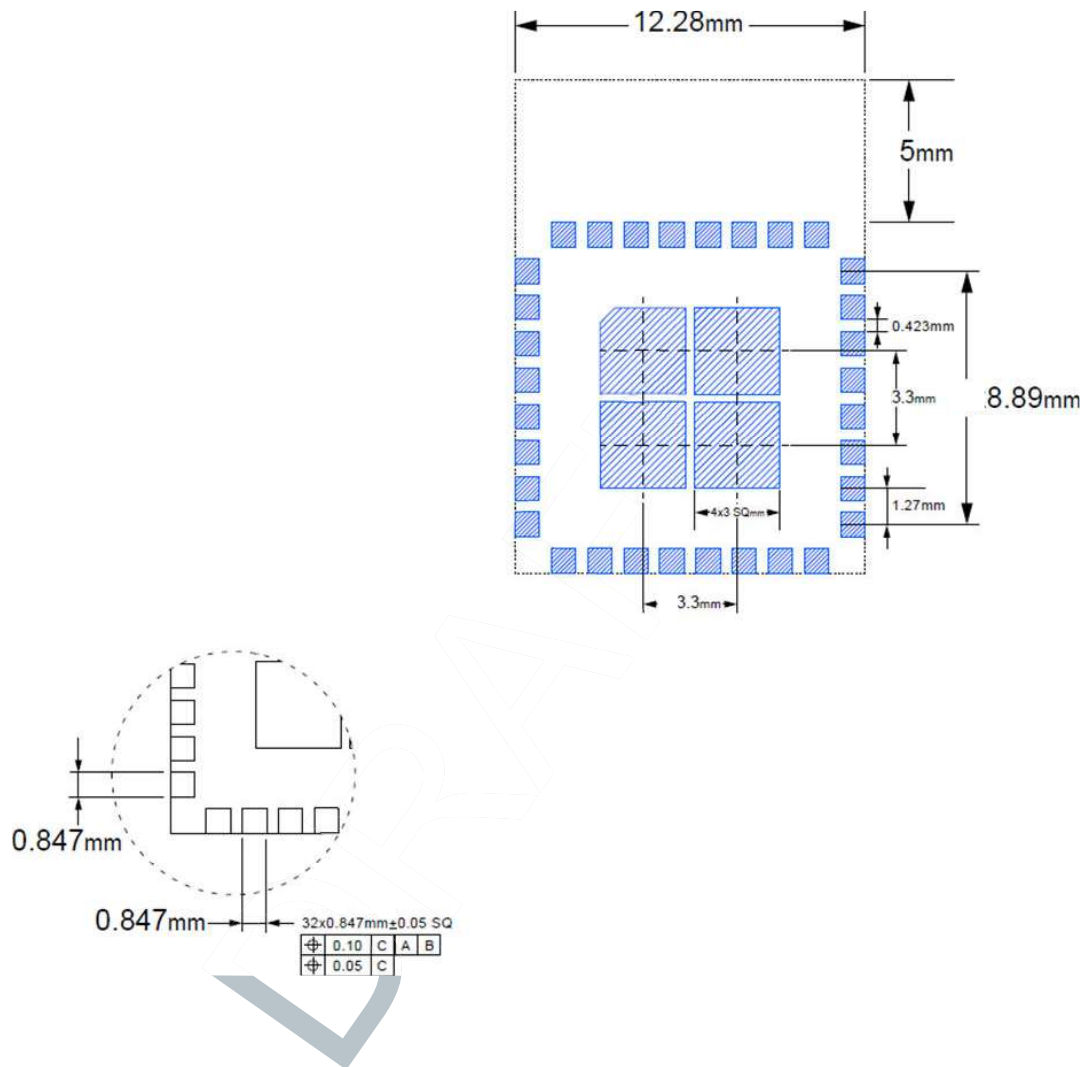
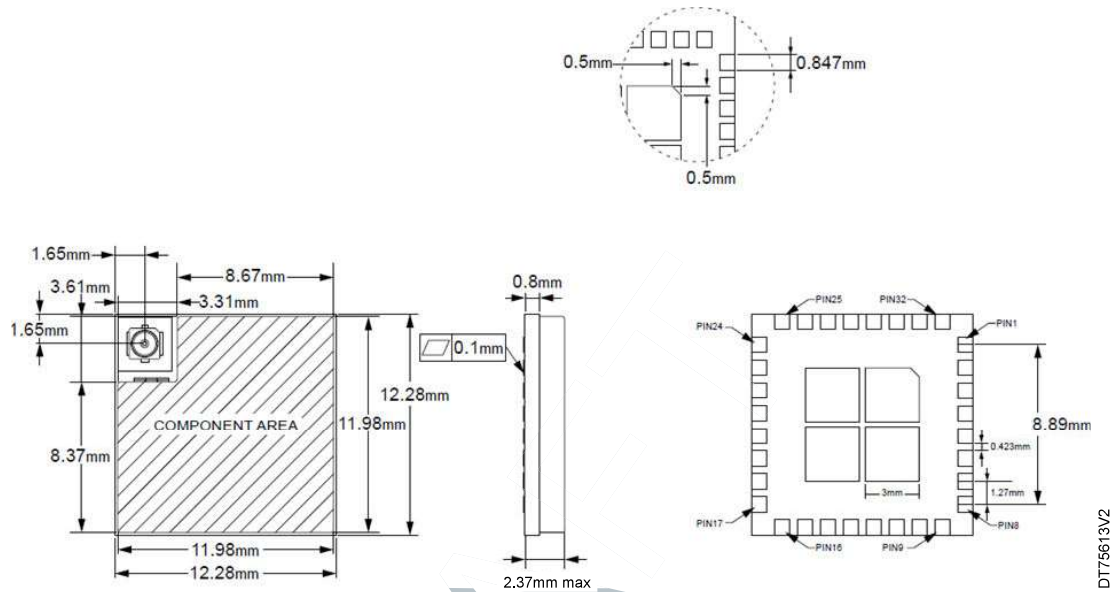
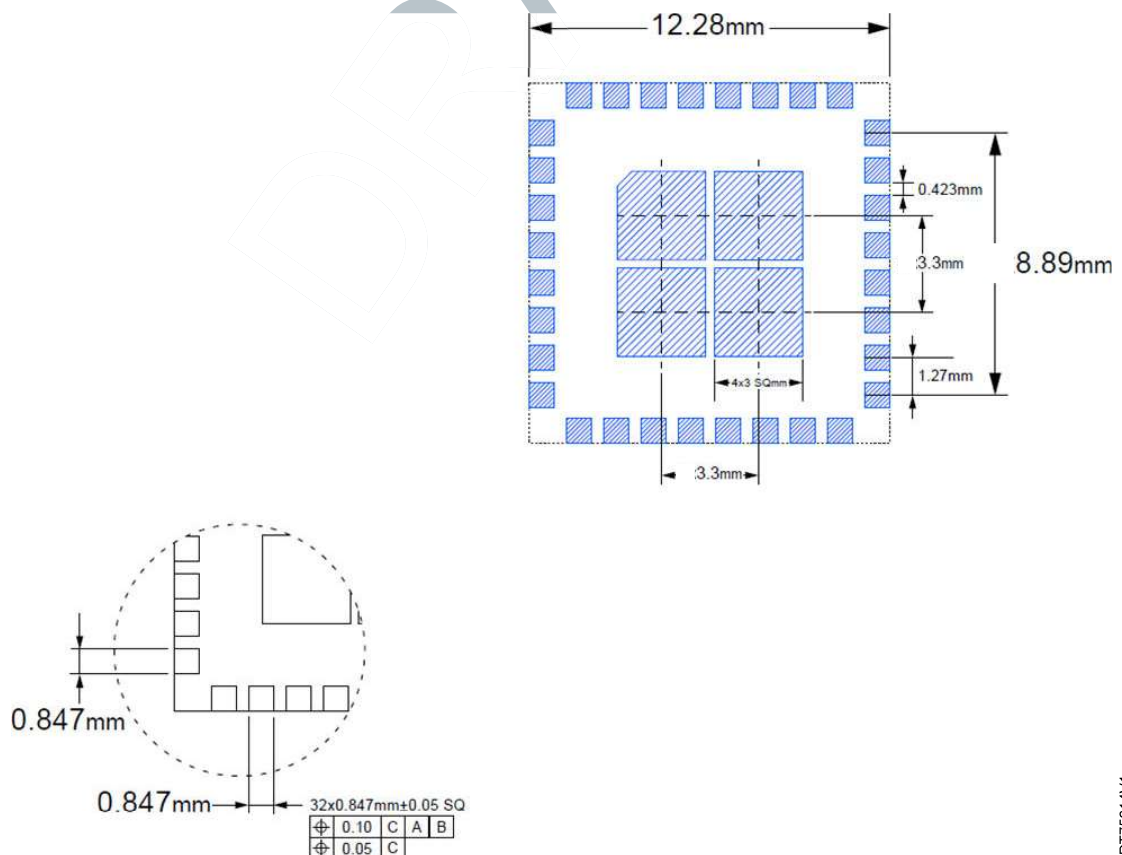


Figure 8. ST67W611M1 LGA module PCB antenna landing pad


DT75612V1

5.1.2 ST67W611M1 LGA module antenna connector
Figure 9. ST67W611M1 LGA module antenna connector dimension


DT75613V2

Figure 10. ST67W611M1 LGA module antenna connector landing pad


DT75614V1