

AW-CU659

IEEE 802.15.4z UWB IoT Module

Datasheet

Rev. A

DF

(For Standard)

Features

UWB

- IEEE 802.15.4z HRP PHY compliant
- Supports SHF UWB bands from 6.24 GHz to 8.24 GHz for worldwide use (channel 5 and 9)
- Supports 64MHz and 128MHz PRF mode to optimize FCC TX spectrum efficiency
- Data rates of 850kbps, 6.8Mbps, 7.8Mbps, 27Mbps and 31.2Mbps
- Supports 2-way ranging and one-way ranging (TDOA)

- Supports Angle of Arrival Measurement
- FiRa ready MAC and PHY; with priority based scheduling and hopping

MCU

- Arm Cortex-M4 processor, running at a frequency of up to 48 MHz
- 640 KB flash, 152 KB SRAM
- Up to 16 programmable I/Os

Revision History

Document NO: R2-2544-DST-01

Version	Revision Date	DCN NO.	Description	Initials	Approved
A	2024/		● Initial Version	Steven Jian	Chihhao Liao

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1. Introduction

1.1 Product Overview

AzureWave presents AW-CU659 IEEE 802.15.4z UWB IoT Module solution which provides a highly cost-effective, flexible and easy to-use hardware/software platform to build a new generation of connected, smart devices. Developers can leverage the rich connectivity features of these new smart devices to create wide range of applications and services such as Real-Time Location Systems (RTLS), Secure Access Control, Virtual Reality/ Augmented Reality and Location-Based Services

1.1.1 Ordering Information

Planned versions:

Model Name	MCU	Antenna
AW-CU659	640KB flash, 152KB SRAM	Internal Antenna

1.2 Block Diagram

TBD

1.3 Specifications Table

1.3.1 General

Features	Description
Product Description	IEEE 802.15.4z UWB IoT Module
Major Chipset	NXP SR150 (WLCSP 68p), NXP QN9090HN (HVQFN40)
Host Interface	SPI/UART/I2C/SWD
Dimension	50.0mm(L) x 30mm(W) x 2.75mm(H)
Package	LGA Module, 98p
Antenna	Internal PCB antenna ANT1: UWB → TX1/RX1 ANT2: UWB → RX2 ANT3: UWB → RX3
Weight	TBD

1.3.2 UWB

Features	Description				
UWB Standard	IEEE 802.15.4z HRP PHY compliant				
Frequency Rage	6.24 GHz to 8.24 GHz				
Modulation	BPM-BPSK (BPRF) BPSK(HPRF)				
Number of Channels	CH5,CH9				
Output Power (Board Level Limit)*	CH5				
		Min	Typ	Max	Unit
	6.8Mbps @NMSE<2%		TBD		dBm/MHz
	CH9				
		Min	Typ	Max	Unit
	6.8Mbps @NMSE<2%		TBD		dBm/MHz

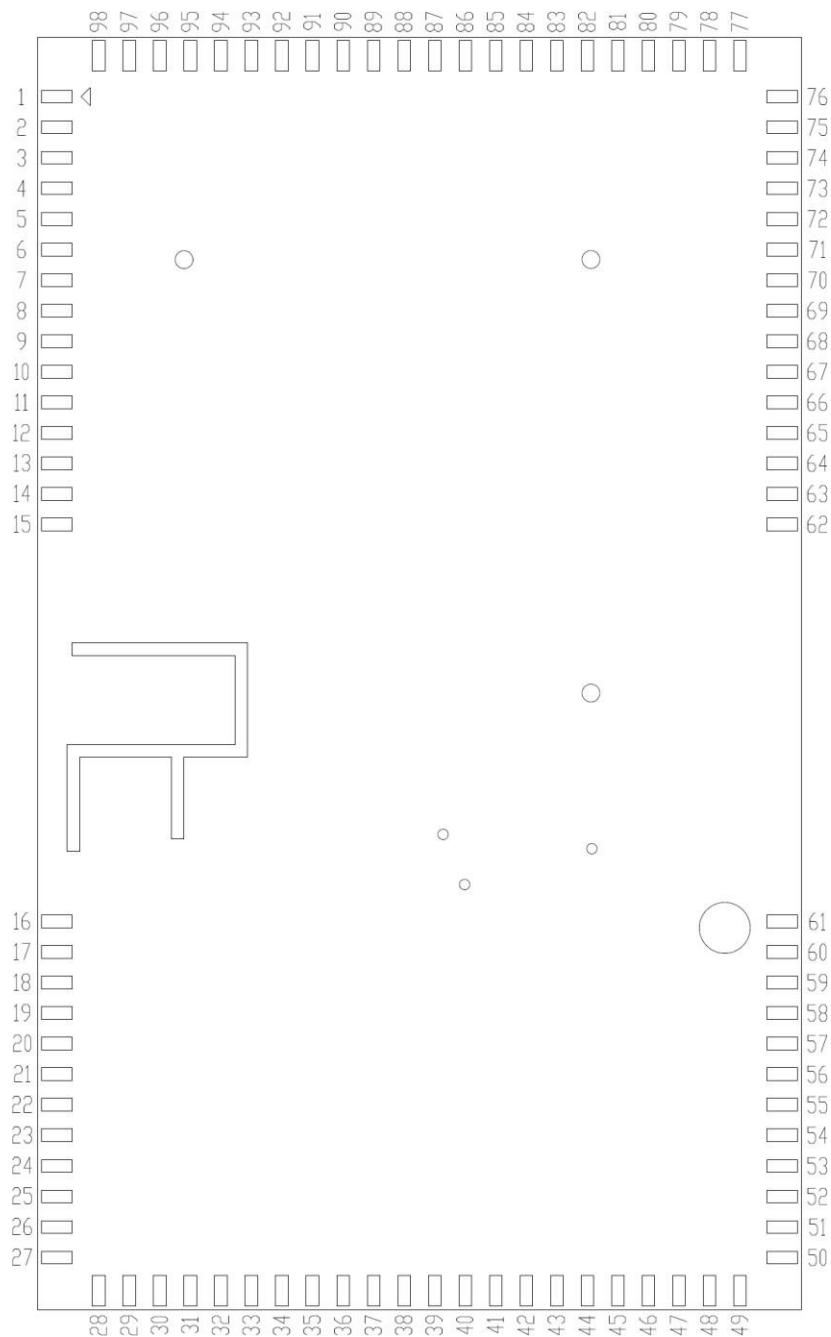
Receiver Sensitivity		Min	Typ	Max	Unit
	6.8Mbps SP0 20 byte payload @PER<1%		TBD		dBm
Data Rate	850kbps, 6.8Mbps, 7.8Mbps, 27Mbps and 31.2Mbps				
Security	◆ Security PHY Layer Secure Ranging features to reject Cicada and Preamble Injection attacks ◆ Scrambled Timestamp Sequence (STS) generation compliant to NIST SP 800-90A ◆ Based on ARM® Cortex-M33 with ARM® TrustZone ◆ Built-in Secure FW Update capability				

1.3.3 Operating Conditions

Features	Description
Operating Conditions	
Voltage	VDD_UWB_IO, VDD_UWB_RF:1.71~1.98 (1.8V Typical) VDD_MCU_IO:3.0V~3.6V(3.3V Typical)
Operating Temperature	-30°C to 85°C
Operating Humidity	less than 85% R.H.
Storage Temperature	-40°C to 90°C
Storage Humidity	less than 60% R.H.
ESD Protection	
Human Body Model	TBD
Charged Device Model	TBD

2. Pin Definition

2.1 Pin Map



AW-CU659 Top View Pin Map

2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
30	GND_15	Ground.		GND
37	GND_22	Ground.		GND
39	GND_24	Ground.		GND
41	GND_26	Ground.		GND
43	GND_28	Ground.		GND
44	GND_29	Ground.		GND
45	GND_30	Ground.		GND
46	GND_31	Ground.		GND
47	GND_32	Ground.		GND
49	GND_34	Ground.		GND
52	GND_37	Ground.		GND
19	GND_4	Ground.		GND
58	GND_43	Ground.		GND
61	GND_46	Ground.		GND
24	GND_9	Ground.		GND
31	I2C_SCL	I2C Clock	VDD_MCU_IO	I/O
32	I2C_SDA	I2C Data	VDD_MCU_IO	I/O
17	I2S_BCLK_IN	Floating Pin, No connect to anything.		Floating
21	I2S_BCLK_OUT	Floating Pin, No connect to anything.		Floating
20	I2S_DATA_IN	Floating Pin, No connect to anything.		Floating
23	I2S_DATA_OUT	Floating Pin, No connect to anything.		Floating
18	I2S_FSYNC_IN	Floating Pin, No connect to anything.		Floating
22	I2S_FSYNC_OUT	Floating Pin, No connect to anything.		Floating
16	I2S_MCLK	Floating Pin, No connect to anything.		Floating

26	IRQ_N	QN9090 GPIO6	VDD_MCU_IO	I/O
25	MCU_ISP_ENTRY	QN9090 GPIO5/ISP_ENTRY(In-System Programming Entry)	VDD_MCU_IO	I/O
33	MCU_SWCLK	QN9090 GPIO12/Serial Wire Debug Clock	VDD_MCU_IO	I/O
34	MCU_SWDIO	QN9090 GPIO13/Serial Wire Debug Input/Output	VDD_MCU_IO	I/O
35	MCU_SWO	QN9090 GPIO21/Serial Wire Debug Output	VDD_MCU_IO	I/O
29	MCU_UART_RXD	QN9090 GPIO9/Universal Synchronous/Asynchronous Receiver	VDD_MCU_IO	I/O
28	MCU_UART_TXD	QN9090 GPIO8/Universal Synchronous/Asynchronous Transmitter	VDD_MCU_IO	I/O
1	NC_1	Floating Pin, No connect to anything.		Floating
10	NC_10	Floating Pin, No connect to anything.		Floating
11	NC_11	Floating Pin, No connect to anything.		Floating
12	NC_12	Floating Pin, No connect to anything.		Floating
13	NC_13	Floating Pin, No connect to anything.		Floating
14	NC_14	Floating Pin, No connect to anything.		Floating
15	NC_15	Floating Pin, No connect to anything.		Floating
2	NC_2	Floating Pin, No connect to anything.		Floating
3	NC_3	Floating Pin, No connect to anything.		Floating
4	NC_4	Floating Pin, No connect to anything.		Floating
5	NC_5	Floating Pin, No connect to anything.		Floating
6	NC_6	Floating Pin, No connect to anything.		Floating
62	NC_62	Floating Pin, No connect to anything.		Floating
63	NC_63	Floating Pin, No connect to anything.		Floating
64	NC_64	Floating Pin, No connect to anything.		Floating
65	NC_65	Floating Pin, No connect to anything.		Floating
66	NC_66	Floating Pin, No connect to anything.		Floating



AzureWave

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67	NC_67	Floating Pin, No connect to anything.		Floating
68	NC_68	Floating Pin, No connect to anything.		Floating
69	NC_69	Floating Pin, No connect to anything.		Floating
7	NC_7	Floating Pin, No connect to anything.		Floating
70	NC_70	Floating Pin, No connect to anything.		Floating
71	NC_71	Floating Pin, No connect to anything.		Floating
72	NC_72	Floating Pin, No connect to anything.		Floating
73	NC_73	Floating Pin, No connect to anything.		Floating
74	NC_74	Floating Pin, No connect to anything.		Floating
75	NC_75	Floating Pin, No connect to anything.		Floating
76	NC_76	Floating Pin, No connect to anything.		Floating
77	NC_77	Floating Pin, No connect to anything.		Floating
78	NC_78	Floating Pin, No connect to anything.		Floating
79	NC_79	Floating Pin, No connect to anything.		Floating
8	NC_8	Floating Pin, No connect to anything.		Floating
80	NC_80	Floating Pin, No connect to anything.		Floating
81	NC_81	Floating Pin, No connect to anything.		Floating
82	NC_82	Floating Pin, No connect to anything.		Floating
83	NC_83	Floating Pin, No connect to anything.		Floating
84	NC_84	Floating Pin, No connect to anything.		Floating
85	NC_85	Floating Pin, No connect to anything.		Floating
86	NC_86	Floating Pin, No connect to anything.		Floating
87	NC_87	Floating Pin, No connect to anything.		Floating
88	NC_88	Floating Pin, No connect to anything.		Floating
89	NC_89	Floating Pin, No connect to anything.		Floating
9	NC_9	Floating Pin, No connect to anything.		Floating

90	NC_90	Floating Pin, No connect to anything.		Floating
91	NC_91	Floating Pin, No connect to anything.		Floating
92	NC_92	Floating Pin, No connect to anything.		Floating
93	NC_93	Floating Pin, No connect to anything.		Floating
94	NC_94	Floating Pin, No connect to anything.		Floating
95	NC_95	Floating Pin, No connect to anything.		Floating
96	NC_96	Floating Pin, No connect to anything.		Floating
97	NC_97	Floating Pin, No connect to anything.		Floating
98	NC_98	Floating Pin, No connect to anything.		Floating
36	PD_N	QN9090 GPIO16	VDD_MCU_IO	I/O
42	Reserved_27	Floating Pin, No connect to anything.		Floating
51	Reserved_36	Floating Pin, No connect to anything.		Floating
59	Reserved_44	Floating Pin, No connect to anything.		Floating
60	Reserved_45	Floating Pin, No connect to anything.		Floating
38	RESET_N	QN9090 Reset	VDD_MCU_IO	I
57	SPI_CLK	QN9090 GPIO16/ Serial Peripheral Interface-bus 1 clock input/output. Set QN9090 GPIO18 Low to Select The Interface	VDD_MCU_IO	I/O
55	SPI_CS0	QN9090 GPIO3/ Serial Peripheral Interface-bus 1 slave select not 0. S Set QN9090 GPIO18 Low to Select The Interface	VDD_MCU_IO	I/O
53	SPI_CS1	QN9090 GPIO4/ Serial Peripheral Interface-bus 1 slave select not 1. Set QN9090 GPIO18 Low to Select The Interface	VDD_MCU_IO	I/O
56	SPI_MISO	QN9090 GPIO1/ Serial Peripheral Interface-bus 1 master data input. Set QN9090 GPIO18 Low to Select The Interface	VDD_MCU_IO	I/O
54	SPI_MOSI	QN9090 GPIO2/ Serial Peripheral Interface-bus 1 master output slave Input. Set QN9090 GPIO18 Low to Select The Interface	VDD_MCU_IO	I/O
40	VDD_MCU_IO	IO Supply for MCU	3.3V	PWR

48	VDD_UWB_IO	IO Supply for UWB	1.8V	PWR
50	VDD_UWB_RF	RF Supply for UWB	1.8V	PWR
27	WAKE	QN9090 GPIO7	VDD_MCU_IO	I/O

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VDD_MCU_IO	Power supply for QN9090	-0.3		3.6	V
VDD_UWB_IO, VDD_UWB_RF	Power Supply for SR150	0		2.5	V

3.2 Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VDD_MCU_IO	Power supply for QN9090	3.0	3.3	3.6	V
VDD_UWB_IO, VDD_UWB_RF	Power Supply for SR150	1.71		1.98	V

3.3 GPIO DC Characteristics

Symbol	Parameter	Condition	Min	Typ	Max	Units
V _{IH}	Input high voltage	VDD_MCU_IO = 3.3V	0.7* VDD_MCU_IO		VDD_MCU_IO	V
V _{IL}	Input low voltage	VDD_MCU_IO = 3.3V			0.27* VDD_MCU_IO	V
V _{OH}	Output High Voltage	VDD_MCU_IO = 3V IOH = 5 mA	2.6		VDD_MCU_IO	V

VoL	Output Low Voltage	VDD_MCU_IO =3V IOH = 5 mA	0		0.4	V
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3.4 Host Interface

3.4.1 ISP Download Mode

In the default configuration, ISP mode is entered during a cold start if MCU_ISP_ENTRY is pulled low and QN9090 GPIO4 is pulled high. The normal approach to enter ISP mode is therefore:

1. Pull the RESET_N pin low
2. Pull MCU_ISP_ENTRY low
3. Pull QN9090 GPIO4 [ISP_SEL] high. Note that if there is no external driver into this pin then the internal pull-up will keep this pin high.
4. After a short delay (1 ms), release the reset pin
5. Do not release MCU_ISP_ENTRY for at least another 10 ms

In practice, MCU_ISP_ENTRY can continue to be held low in ISP mode, and only be released before the device is reset again. Note that, in a system design with high capacitance on the circuit around MCU_ISP_ENTRY, there must leave enough time after MCU_ISP_ENTRY is released for it to return to a high state before reset is asserted.

3.5 Power Consumption

3.5.1 UWB & MCU

TBD



FCC

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 or more 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.

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.

Information for OEMs and host integrators

The OEM or integrator is obligated to adhere to these requirements and restrictions as a condition for using the module's certification. The OEM or integrator is responsible to perform the required additional host regulatory testing and/or obtaining the required host approvals for compliance.

This module is intended for OEM integrators under the following conditions:

This module is only FCC authorized for the specific rule parts **15.517** listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host product as being Part 15 Subpart B compliant.

This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties.

UWB devices may not be employed to operate toys. Operation on board an aircraft, a ship, or a satellite is prohibited. Integration of this module into handheld applications is prohibited.

The host product manufacturer must provide following statement in end-product manuals.

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 module has been approved to operate with the antenna types **listed below**, with the maximum permissible gain indicated.

Antenna	Frequency Band	Antenna Type	Model Number	Gain(dBi)
1	6489.6MHz	printed	AN-2659-1	3.6dBi
	7987.2MHz	printed	AN-2659-1	4.4dBi
2	6489.6MHz	printed	AN-2659-2	4.4dBi
	7987.2MHz	printed	AN-2659-2	4.7dBi
3	6489.6MHz	printed	AN-2659-3	4.5dBi
	7987.2MHz	printed	AN-2659-3	5.3dBi

The user manual of the end product should include (information for OEMs)

The module must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

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.

The antenna(s) used for this transmitter must not transmit simultaneously with any other antenna or transmitter.

This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties.

UWB devices may not be employed to operate toys. Operation on board an aircraft, a ship, or a satellite is prohibited. The module must be installed handheld applications.

Integration of this module into handheld applications is prohibited.

Label of the end product:

The host product must be labeled in a visible area with the following " Contains FCC ID: **TLZ-CU659** ".

The end product shall bear the following 15.19 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.

ISED

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 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.

*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 **20cm** de distance entre la source de rayonnement et votre corps.*

OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Modular OEM Integrator Notice

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 transmitter module IC: 6100A-CU659".

Contient le module d'émission IC: 6100A-CU659

The Host Model Number (HMN) must be indicated at any location on the exterior of the end product or product packaging or product literature which shall be available with the end product or online.

IMPORTANT NOTE for OEM integrator:

This module is intended for OEM integrator.

The OEM integrator is still responsible for

1. ensuring that the end-user has no manual instructions to remove or install module
2. the ISED compliance requirement of the end product, which integrates this module.
3. Appropriate measurements and if applicable additional equipment authorizations of the host device to be addressed by the integrator/manufacturer.
4. The separate approval is required for all other operating configurations, including portable configurations and different antenna configurations
5. Integration of this module into handheld applications is prohibited.

CAN ICES-3 (B)/NMB-3(B)

NCC

取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前述合法通信，指依電信管理法規定作業之無線電通信。低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

本公司於說明書中提供所有必要資訊以指導使用者/安裝者正確的安裝及操作

本裝置限室內操作

Japan

Indoor use only