# AMO UWB Module(SR150)

## Rev 0.1

### (ASMOP1BO0N21)



| Revision | Contents | Date |
|---|---|---|
| 0.0 | New | 6th, Dec, 2021. |
| 0.1 | Modified the some parts | 19th, Jan, 2022 |
| | | |
| | | |
| | | |

## 19th, Jan, 2022

# AMOSENSE Co., LTD.

**Notes**

The contents of this data sheet are subject to change without notice.  Please confirm the specifications and delivery conditions when placing your order.

# Table Of Contents

# 1. Introduction

The UWB module is based on NXP's SR150 Ultra Wideband (UWB) transceiver IC. It integrates all RF circuitry and clock circuitry in one module compliant to IEEE 802.15.4/4z HRP UWB PHY.

It can be used for 2-way ranging measurement and TDoA based one way ranging.

Embedded PHY and MAC compatible with FiRa consortium specification

▶ **This device is prohibited application to aircraft, ships, satellites, and model airplanes.**

## 1.1 Key Features

| AMO UWB SR150 Module | |
|---|---|
|  | |
| **ANT Type** | • External Antenna |
| **Size** | • 10mm x 10 mm x 1.8mm |
| **Interface** | • Host interface is SPI, Secure element interface is I2C |
| **Main ICs** | • SR150, ARM® Cortex-M33 32 Bit processor (SR150 is not customer programmable so these flash and RAM/ROM are not available to end customer.) |
| **Reference Clocks** | • 38.4MHz clock<br>• 32.768KHz clock |
| **Frequency Band** | • 6.24 GHz ~ 8.24 GHz (ch.5, ch.9) |
| **Supply Voltage** | • 1.71 ~ 1.98 (Typ. 1.8) V |
| **Output Power** | • MAX +9 dBm |
| **Package** | • Metal Shield CAN |

Table 1. Key Features

* Shield CAN size : 9.3mm x 9.3mm x 1.15mm

## 1.2 Applications

① IOT applications

② Consumer devices

③ Smart home devices

④ RTLS anchor etc.

## 2. Part Numbering

[ Example ]

Device Family

<div align="center">AS    MO    P    1B    O    0    N    21</div>

**Company name**

**AS** = AMOSENSE

**Device type**

**MO** = Module, **DT** = Tag, **DA** = Anchor

**Type**

**P** = PCB, **F** = FPCB, **K** = Package

**Chipset**

**1B** = SR150, **1C** = SR040

**Configuration**

**O** = UWB Only, **B** = UWB + BLE(MCU), **M** = UWB + MCU

**MCU Part number**

**0** = UWB Only, **1** = QN9090

**Antenna**

**N** = Non, **A** = Antenna, **R** = Receptacle, **S** = SMA

**Version**

2-1

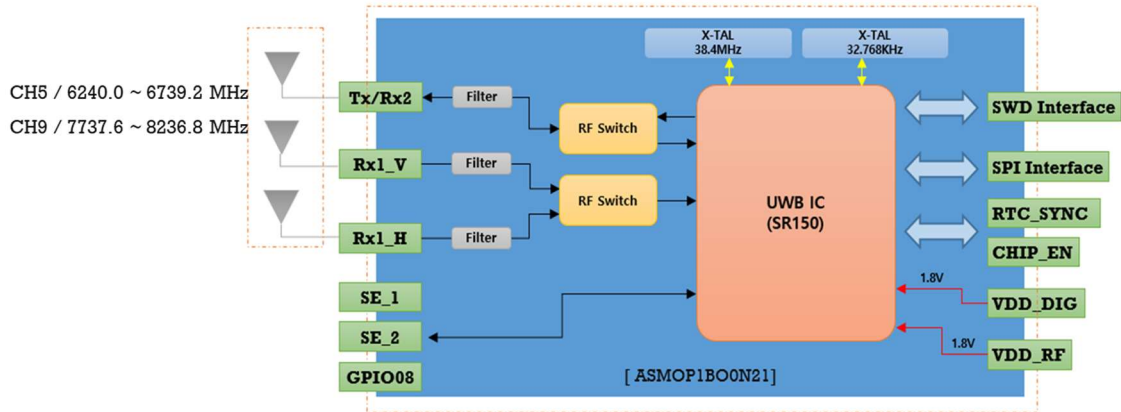Note : Provisional designation

# 3. Module Block Diagram



Figure 1. Block Diagram of AMO UWB Module

# 4. Module Characteristics

## 4.1 Electrical Characteristics

| Parameter | Min | Typ. | Max | Unit |
|---|---|---|---|---|
| Supply Voltage(VDD) | 1.71 | 1.8 | 1.98 | V |
| SR150 Current Consumption<br>- Hard Power Down State<br>- Peak Current RX(Dual RX)<br>- Peak Current TX(Max) | - | - | 5<br>306<br>273 | uA<br>mA<br>mA |
| Operating Temperature | -30 | 25 | +85 | ˚c |
| Max. Input level | - | - | 7 | dBm |
| ESD   (Human Body Model) | | | 2000 | V |

Table 2. Electrical Characteristics

## 4.2 RF Characteristics

● T = 25°C, VDD = 3.3 V (typ.)

| Parameter | Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|
| Frequency Range | | 6.24 | - | 8.24 | GHz |
| TX Output Power | CH5 during preamble peak | | 9.5 | | dBm |
| | CH9 during preamble peak | | 10.5 | | |
| Data Rate | | 0.85 | 6.8 | 31.2 | Mbps |
| AOA accuracy | SNR ≥ 34dB at input | -3 | | +3 | Deg |
| | 26dB ≤ SNR < 36dB at input | -10 | | +10 | |
| ToF accuracy | LOS when STS is used | -10 | | +10 | Cm |
| | NLOS when STS is used | -20 | | +20 | |
| RF Sensitivity | Single / 6.8 Mbps | | -92 | | dBm |
| | Dual / 6.8 Mbps | | -94 | | |

Table 3. RF Characteristics

## 5. Power Up

SR150 Module has a main power up sequence that require VDD.
High level boot sequence is indicated below, when voltages are settled down CE can be asserted along with VDD within 50us, else design will transition to HPD state.
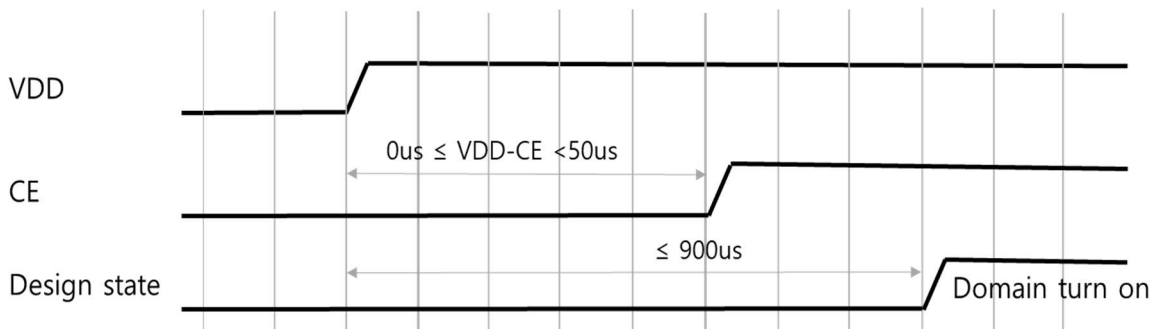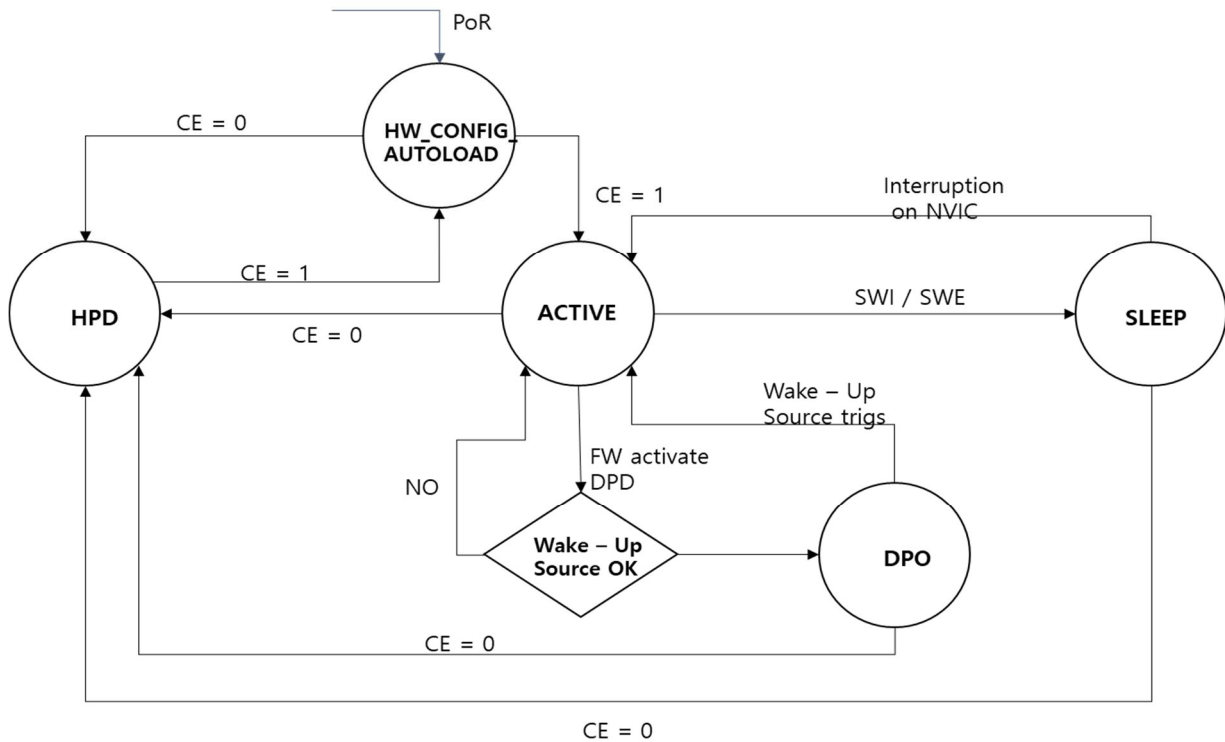


Figure 2. power up sequence

Figure 3. SR150 power modes state diagram

# 6. SYSTEM MODES

The SR150 Module has 6 power modes that are specified: Host power down mode, Deep power down mode, Deep power down retention mode, Sleep, Active mode and Hardware configuration Autoload. A description of the states can be found in Table 4

| System power state | Description |
|---|---|
| Active mode | The device is running and supplied by the Platform PMU, in this mode several active states are available: Idle, TX, RX and Dual RX |
| Deep power down mode (DPD) | The device is in low power mode and supplied by the Platform PMU, the memory are not supplied, a configured wake up can bring the device back to the Active mode, for this a firmware reload is necessary, no RF communication is possible |
| DPD retention mode | The device is in deep power down mode but the memory is supplied |
| Sleep | Specific parts can be active or inactive, this sleep mode can be configured by firmware which enables several power states, no RF communication is possible |
| Hard power down mode | The device is powered down and supplied by the PMU, it can by activated by the chip enable signal |
| Hardware configuration Autoload | The devices is supplied by the platform PMU and is loading the Hardware configuration and firmware into the memory |

Table 4. System Power states description

The time required for SR150 to go into DPD from is <100us controlled by the firmware.
Similarly, the required time for SR150 to enter HPD state is less than 100us starting for the instance that CE is de-asserted. The Wakeup timing from DPD state is around 370 us, the wakeup form HPD state is triggered once CE is asserted and takes around 380us.

## 7. SPI Host Interface

SPI-bus Master/Slave interface, up to 20 Mbits/s

Features
• Synchronous, Serial, Full-Duplex communication, up to 16.66 Mbits/s
• Data frames of 8-bits and 16bits supported
• Programmable clock polarity and phase
• LSB/MSB first order
• Programmable SSEL polarity

SPI-bus configuration options In order to select SPI-bus interface for host communication, the host interface choice and settings are programmed during production. The SPI-bus IP supports four operating modes selectable using SPInCfg register. The operation mode of the SPI-bus is shown in Table 5, CPHA refers to the Clock Phase option and CPOL refers to the Clock Polarity.

| Connection |
| --- |
| CPHA switch: Clock Phase: defines the sampling edge of MOSI data<br>• CPHA = 1: data are sampled on MOSI on the even clock edges of SCK after NSS goes low<br>• CPHA = 0: data are sampled on MOSI on the odd clock edges of SCK after NSS goes low |
| CPOL switch: Clock Polarity<br>• CPOL = 0: the clock is idle low and the first valid edge of SCK will be a rising one<br>• CPOL = 1: the clock is idle high and the first valid edge of SCK will be a falling one |

Table 5. SPI-bus configuration
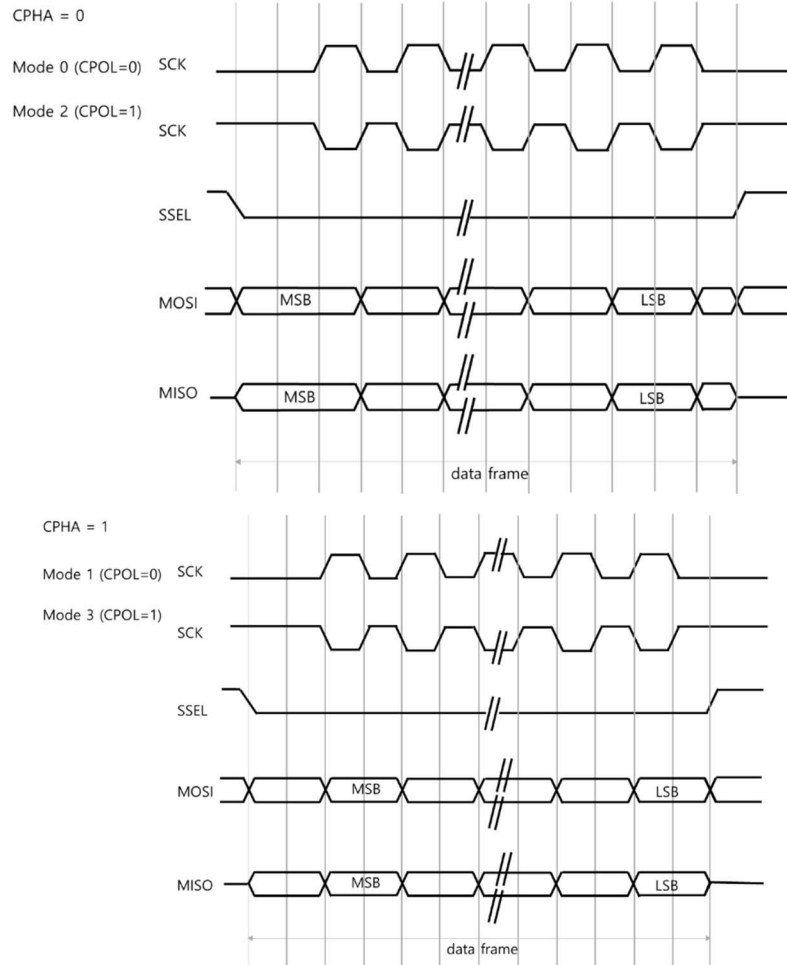
Figure 4. SPI date frame

The SPI-bus interface shares the pins with the other host interfaces that are supported by SR150. When SPI-bus is configured the functionality of the interface pins is as described in Table 6.

When a master device transmits data to the SR150 via the MOSI line, the SR150 responds by sending data to the master device via the MISO line. This implies full-duplex transmission with both, data out and data in synchronized with the same clock signal.

SR150 starts sampling when receiving a logic low at pins NSS Host_2 pin and the clock at input pin HOST_1. Thus, SR150 is synchronized with the master. Data from the master is received serially at the slave MOSI line and loaded in the 8-bit shift register.

After the 8bit shrift register is loaded, its data is transferred to the read buffer. During a write cycle, data is written into the shift register, then the SR150 waits for a clock train form the master to shift the data out on the MISO line.

Both master and slave devices must operate with the same timing. The master device always places data on the MOSI line a half cycle before the clock edge SCK, for the slave device to latch the data.

| Pin | functionality | HW connection when used | HW connection when NOT used |
|---|---|---|---|
| Host conntection | | | |
| Host_1 | SCK (Serial input Clock) | host | Must be connected |
| Host_2 | NSS (Not Slave Select) | host | Must be connected |
| Host_3 | MOSI (Master Out Slave In) Data input | host | Must be connected |
| Host_4 | MISO (Master In Slave Out) Data output | host | Must be connected |
| GPIO05_SENSORINT | IRQ sent to the Host to let it know data are available for read | host | Must be connected |
| CHIP_EN | connection for the HOST to disable/enable the chip | host | Must be connected |
| RTC_SYNC | TBD | TBD | TBD |
| GPIO03_WAKEUP | SPI Rx Handshake from Host to SR150 | host | Must be connected |

Table 6. the functionality of the interface pins

# 8. Secure Element (SE) interface

I2C Connections with SE for secure ranging are described below.

| Pin | functionality |
|---|---|
| SE_1 | SCL<br>10k pull up to VDD 1V8 to be tune according to I2C line shape analysis |
| SE_2 | SDA (secure keys generated by SE exchange)<br>10k pull up to VDD 1V8 to be tune according to I2C line shape analysis |
| GPIO08 | Host Secure Element interrupt (IRQ flag to indicate that data are ready to be shared via I2C) |

Table 7. Secure Element (SE) interface

# 9. RF connections

SR150 has 2 RF inputs (RX1, RX2) and one RF output (TX). Our module has changed RF Pass to Tx/Rx2, Rx1_V and Rx1_H by embedded RF Switch. These 3 RF ports can be connected to 3 antennas. RX1_V and RX1_H path was guarantee the same path characteristics (insertion loss, electrical delay).

Connecting each Antenna to the Tx/Rx2 pad and Rx1_H pad are fulfilled ranging and 2D AoA.
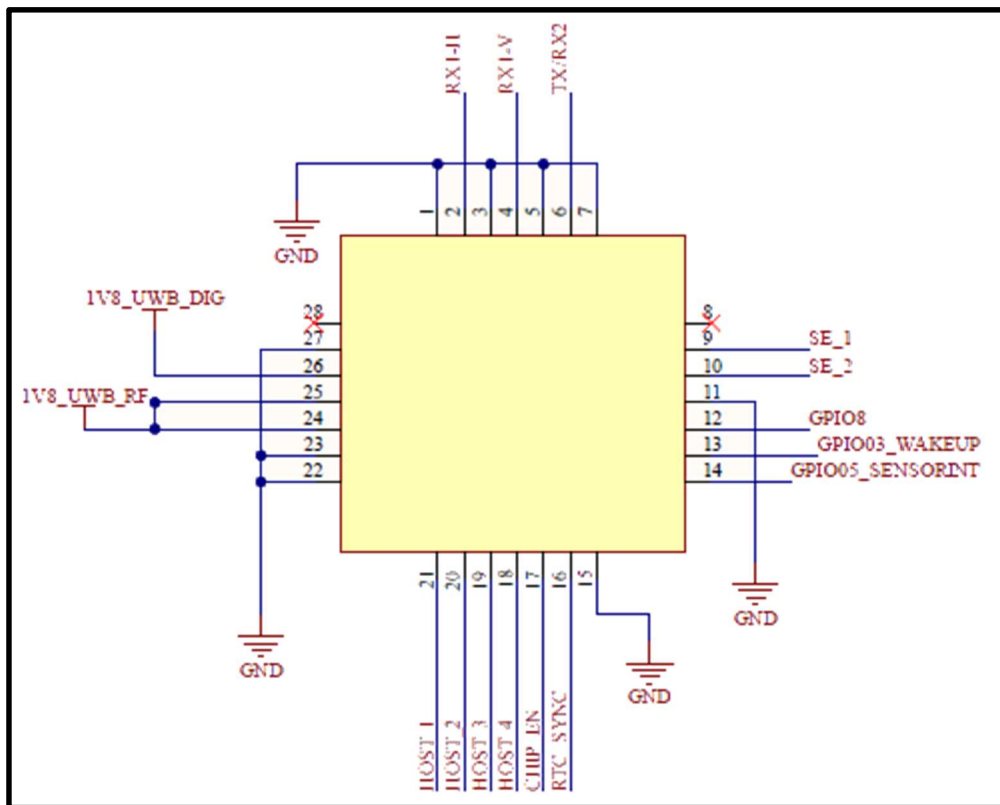
# 10. Application design-in information



Figure 5 : UWB SR150 Module Reference Circuit
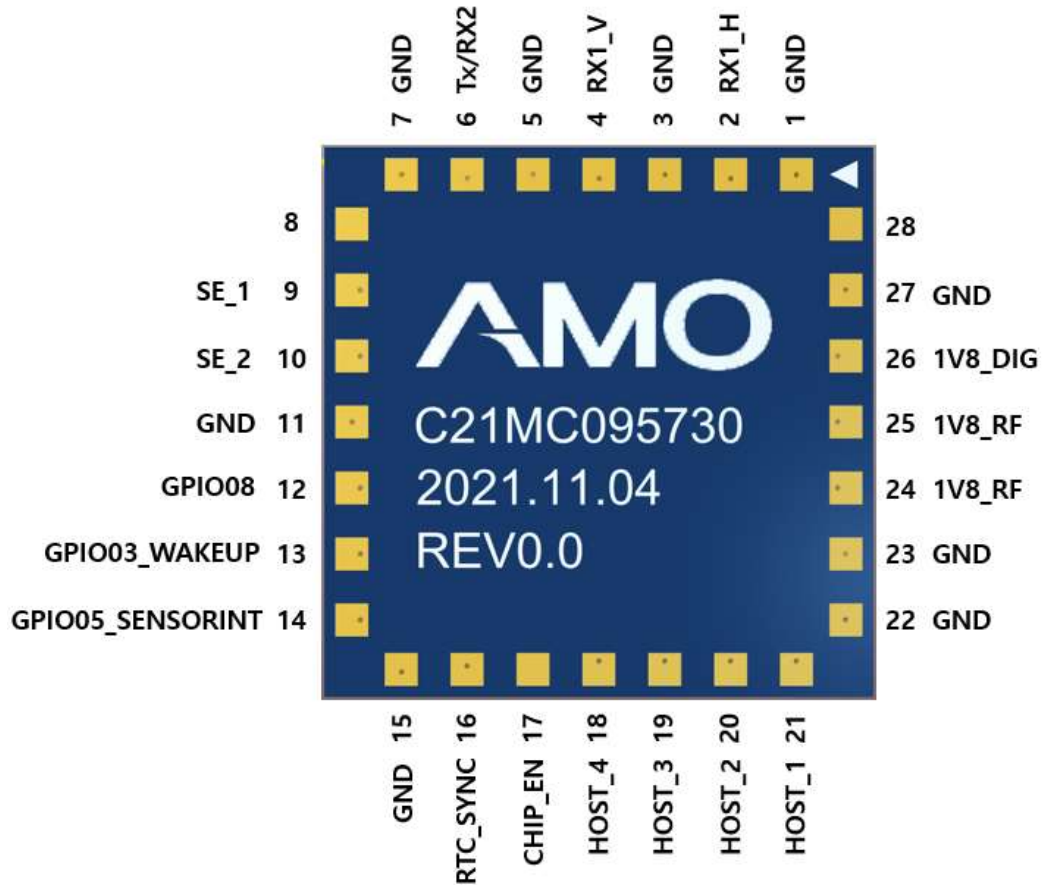
## 11. Module Package

## 11.1 Pinout Description



Figure 6 : Pin out Description(Bottom View)

## 11.2 Pin Description Box

| PIN | PIN Name | PIN Type | Description |
|-----|----------|----------|-------------|
| P1 | GND | G | Ground supply |
| P2 | RX1_H | I | RX1_Horizontal IN |
| P3 | GND | G | Ground supply |
| P4 | RX1_V | I | RX1_Vertical IN |
| P5 | GND | G | Ground supply |
| P6 | TX/RX2 | I/O | TX OUT / RX2 In |
| P7 | GND | G | Ground supply |
| P8 | - | - | - |
| P9 | SE_1 | I/O | clock for the secure element I2C interface |
| P10 | SE_2 | I/O | SDA connection for secure element I2C interface |
| P11 | GND | G | Ground supply |
| P12 | GPIO8 | I/O | SE_IRQ. GPIO8 |
| P13 | GPIO03_WAKEUP | I/O | Host wakeup |
| P14 | GPIO05_SENSORINT | I/O | GPIO05 |
| P15 | GND | G | Ground supply |
| P16 | RTC_SYNC | I | Real Time Clock Synchronization |
| P17 | CHIP EN | I/O | connection for disabling/ enabling the chip |
| P18 | HOST_4 | I/O | MISO connection for the SPI host interface |
| P19 | HOST_3 | I/O | MOSI connection for the SPI host interface |
| P20 | HOST_2 | I/O | Slave select connection for the SPI host interface |
| P21 | HOST_1 | I/O | clock for the SPI host interface |
| P22 | GND | G | Ground supply |
| P23 | GND | G | Ground supply |
| P24 | VDD_1.8V_RF | P | 1.8V Power supply for RF |
| P25 | VDD_1.8V_RF | P | 1.8V Power supply for RF |
| P26 | VDD_1.8V_DIG | P | 1.8V Power supply for Digital |
| P27 | GND | G | Ground supply |
| P28 | - | - | - |

Table 8. Pin Description

## 11.3 Module Dimension or Footprint
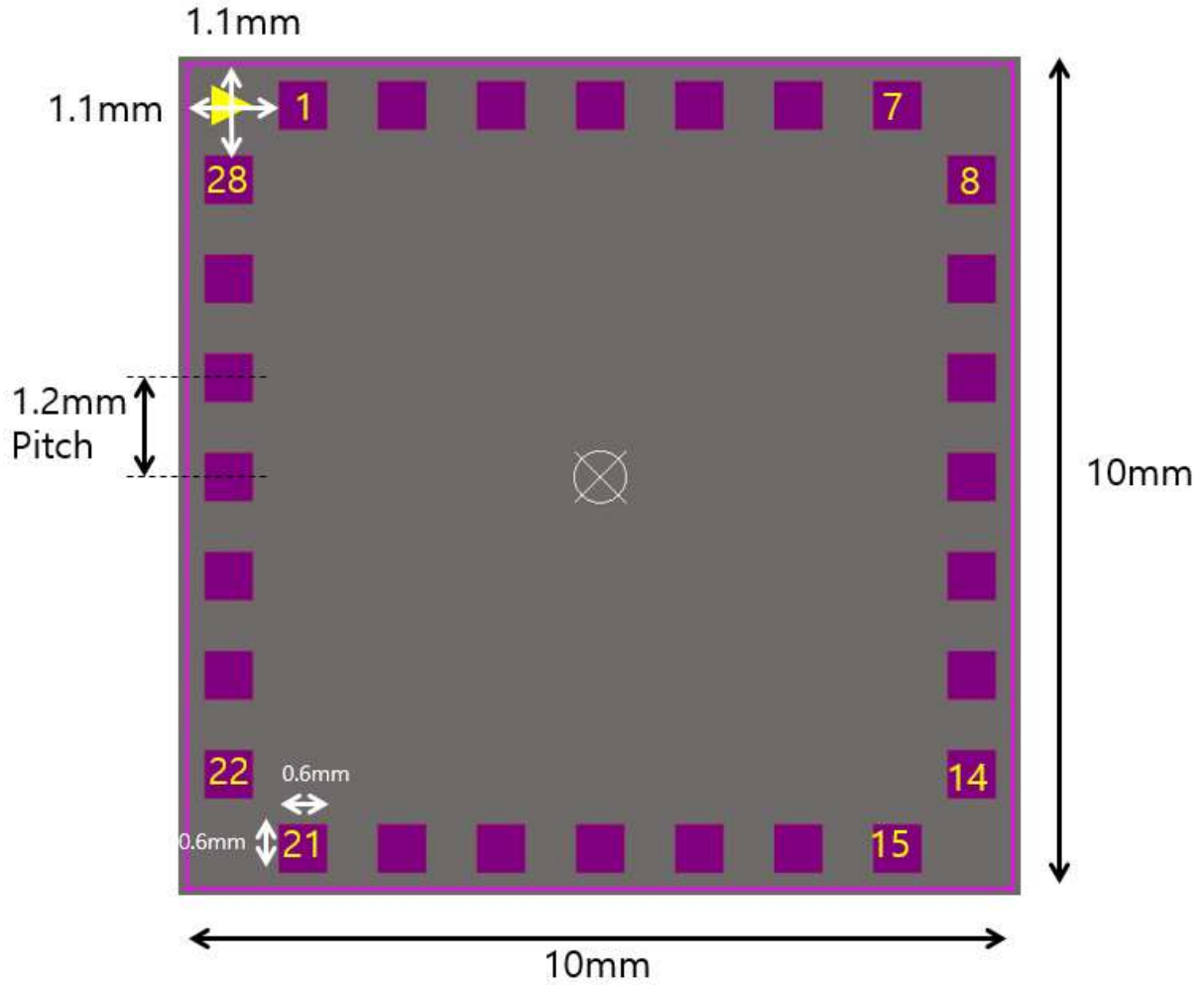


Figure 7. Pin Dimension or Footprint (TOP View)

# 12. Packing

| Description | Data |
|---|---|
| **Module  Dimension** | 10mm*10mm*1.8mm |
| **Reel  Carrier  Pocket** | 24W*20P |
| **Reel  Cover  Tape** | 21.3mm*480m |
| **Module  Quantity** | 1K |

Table 9. Reel Packing Description
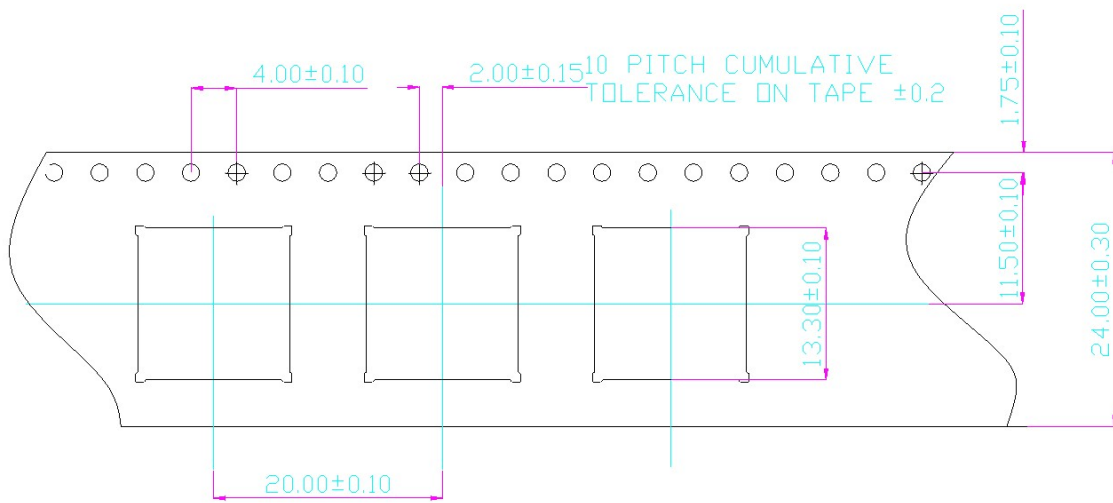




Figure 8. Reel Packing

## 13. Soldering Condition

### 13.1 Manual Soldering – Pb Free

① Soldering Temperature: 360℃ ± 5℃, 5sec max.

( Solder : Sn /Ag /Cu : 96.5 /3.0 /0.5)

② Moisture sensitivity precautions, as indicated on the packing, must be respected at all times

### 13.2 Recommended Reflow Condition – Pb Free
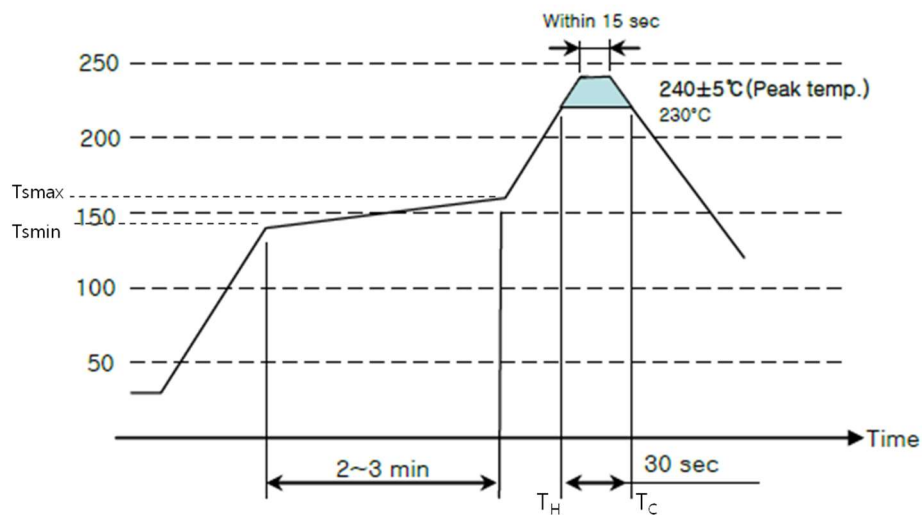


| Profile Feature | Pb-Free Assembly |
|---|---|
| Preheat<br>-Temperature Min ($T_{smin}$)<br>-Temperature Typical ($T_{stypical}$)<br>-Temperature Max ($T_{smax}$)<br>-Time $T_{smin}$ to $T_{smax}$ | -140˚C<br>-150˚C<br>-160˚C<br>-2 ~ 3 min |
| Peak Temperature | 240±5˚C |
| Time of actual peak temperature | Max. 15 seconds |
| Heating to Cool<br>-Temperature Heating ($T_H$)<br>-Temperature Cool ($T_C$)<br>-Time $T_H$ to $T_C$ | -230˚C<br>-230˚C<br>-30 seconds |

## 14. Glossary

| Abbreviation | Long term |
|---|---|
| AoA | Angle of arrival |
| DPD | Deep Power Down |
| HPD | Hard Power Down |
| HRP | High Rate Pulse Repetition Frequency |
| NC | Not Connected |
| OTP | One Time Programmable |
| PMU | Power Management Unit |
| RF | Radio Frequency |
| RSSI | Received Signal Strength Indicator |
| RTLS | Real-time locating systems |
| RX | Receiver |
| SFD | Start of Frame Delimiter |
| SNR | Signal to Noise Ratio |
| SPI | Serial Peripheral Interface |
| STS | Secure Training Sequence |
| SWD | Serial Wire Debug |
| TDoA | Time Difference Of Arrival |
| ToF | Time of Flight |
| TX | Transmitter |
| UART | Universal Asynchronous Receiver and Transmitter |

**DOCUMENT INFORMATION**

**Disclaimer**

**AMOSENSE reserves the right to change product specifications without notice. As far as possible changes to functionality and specifications will be issued in product specific errata sheets or in new versions of this document.   Customers are advised to check with AMOSENSE for the most recent updates on this product.**

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**Regulatory notice to host manufacturer according to KDB 996369 D03 OEM Manual**

**List of applicable FCC rules**

This module has been granted modular approval as below listed FCC rule parts.

FCC Rule parts 15C (15.209), 15F (15.519)

**Limited module procedures**

The module is approved as a "limited module" without shielding. The device can be used in mobile exposure conditions only. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

**RF exposure considerations**

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

**Antennas**

Antenna Specification are as follows:

Type: Dipole Antenna

Gain: 3.58 dBi

This device is intended only for host manufacturers under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna;

The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer 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.)

That the antenna cannot be mounted on outdoor structures. antennas mounted on the outside of a building or on a telephone pole.

**Label and compliance information**

The module is labeled with its own FCC ID Certification Number.

If the FCC ID Certification Number are not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module.

Contains FCC ID: 2A36P-ASMOP1BO0N21

**Information on test modes and additional testing requirements**

Operation Frequency: 6 ~ 8.5 GHz

Max Target Power : -41.5 dBm

Modulation: Orthogonal Frequency Division Multiplexing

**Additional testing, Part 15 Subpart B disclaimer**

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.209 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This is a limited module authentication case, and C2PC progress is required when the host is changed.

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc. according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

Only when all the test results of test modes comply with FCC requirements and C2PC grant is issued, then the end product can be sold legally

**FCC Instructions**

**FCC Compliance 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.

**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 transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

UWB devices operating under the provisions of this section must be hand held. (This module may only be used in handheld host.)

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must

continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

**CE RED_EU declaration**

This product can be used in which EU members, in accordance with Article 10(10) / or this product can be used in at least one EU country, in accordance with Article 10(2)

**RF Exposure**

The RF distance between body and product is 20cm

## Declaration of Conformity

| | |
|---|---|
| **Manufacturer Name:** | **AMOSENSE CO., LTD.** |
| **Manufacturer Address:** | **19-1BL, 90, 4Sandan 5-gil, Jiksan-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do, South Korea** |
| **Importer Name*:** (Or authorized representative): | **(Under Article 10(2) and 10(10), there are no restrictions of use)** **EBV Elektronik** |
| **Importer Address:** | **Im Technologiepark 2-8 85586 Poing Germany** |
| | |
| **Declare under our sole responsibility that the  product** | |
| **Product Type/Description:** | **UWB Module** |
| **Model:** | **ASMOP1BO0N21** |
| **Variant Model:** | **N/A** |
| **Trade Name:** | **N/A** |
| **Product Identification** | **N/A** |
| **Product Accessories (if** | **N/A** |
| **Hardware version** | **Rev 4.0** |
| **Software version** | **Rev 1.0(A27/v03.08.01)** |
| | |
| **Is in conformity with the following standards or other normative  documents** | |
| **Test standards** | |

Radio: ETSI EN 302 056-1 V2.1.1 (2016-11), EN 50663:2017

EMC :   ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-33 V2.1.1(2019-04)

Safety : EN IEC 62368-1:2020+A11:2020

We hereby declare that [all essential radio test suites have been carried out and that] the above named product is in conformity to all the essential requirement of Directive  2014/53/EU.

The conformity assessment procedure referred to in Article 17 and detailed in Annex [III] of Directive 2014/53/EU has been followed with the involvement of the following Notified  Body(ies):

PHOENIX TESTLAB GmbH (Notified Body Number: 0700) Königswinkel 10 D-32825 Blomberg Germany

| | |
|---|---|
| **Name :** | **Kyunghyun Ryu** |
| **Title :** | **Executive Director** |
| **Address:** | **19-1BL, 90, 4Sandan 5-gil, Jiksan-eup, Seobuk-gu, Cheonan-si, Chungcheongnam-do, South Korea** |
| **Date: February 04, 2022** | **Signature of Authorized person** |

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