### Revision History

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Change Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>Jan-2021</td>
<td>Draft</td>
</tr>
<tr>
<td>1.0</td>
<td>Mar-2021</td>
<td>First Release</td>
</tr>
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</table>
Sunway Communication

SW-M1000-SR150: Complete UWB module with integrated frontend
IEEE 802.15.4z Low Power UWB module with external antennas

Sunway Communication is a world leading provider of RF connectivity and performance critical components and modules. With a broad range of connectivity products for Bluetooth, Wi-Fi, UWB, GNSS, NFC, various cellular standard including 4G, LTE, 5G with MIMO and wireless charging, Sunway has grown to become a dominant player in automotive, IoT, wearables, small cell base stations and many more areas.

The SW-M1000-SR150 is a complete UWB module with fully integrated RF frontend, optional DCDC converter and EEPROM, onboard system clock and 32 kHz crystal. The SW-M1000-SR150 is designed to deliver high precision two-way ranging which enables many new location-based services and device to device IoT applications both in consumer and industrial settings. The module offers wide supply voltage range including direct Lithium-Ion battery connection giving customers maximum flexibility while reducing the external component count.

The SW-M1000-SR150 comes with full FiRa Consortium ready MACPHY, multicast and multisession capability to facilitate many use cases. It supports up to 3 external antennas for high accuracy secure ranging with 3D Angle-of-Arrival (AoA). Based on the NXP SR150 UWB IC, SW-M1000-SR150 offers high level of security through Arm® TrustZone®. It comes with an interface and integration to support secure ranging via an external secure element for key management. The SW-M1000-SR150 is designed with many end applications in mind, to reduce system level BOM cost and minimize time to first revenue.

**Features**
- Complete UWB module RF frontend PHY.
- Excellent receive sensitivity and transmit power.
- Integrated MAC exposed via SPI interface.
- Time of Flight (ToF)
- Time Difference of Arrival (TDoA)
- Angle of Arrival (AoA).
- Support 3D positioning using three antennas.
- Typical +/-10 cm ranging accuracy.
- Typical +/-5 degrees direction accuracy.
- Optional EEPROM for calibration & custom parameters

**Benefits**
- Optional integrated DCDC
- Low power consumption
- Onboard 32 kHz crystal for low power operation
- High level of integration for minimal BOM cost

**Applications**
- Indoor location and tracking
- Smart home control
- Secure access control
- RTLS anchors
General Features

- Complies to IEEE 802.15.4z
- FiRa ready embedded MAC and PHY
- Integrated hardware crypto accelerator
- Direct logical interface to secure element with pre integrated support for protection of secure ranging key
- Integrated 32 kHz crystal and system clock to minimise system level BOM cost
- Multi session support to prevent tailgating
- Outstanding indoor and outdoor location and tracking accuracy.

RF Features

- Complete RF frontend with integrated Tx/Rx switches and bandpass filters
- Three port antenna interface for accurate 3D ranging
- Dual Rx input for AoA support

Power Management

- Optional onboard DC/DC converter
- Wide supply voltage range
- Onboard LDOs

Interfaces

- Three RF antenna interface ports
- SPI port provides host interface
- I2C port provides access to internal EEPROM
- Dedicated I2C for an external secure element

Package Dimension

- 13.0 mm x 18.0 mm x 2.2 mm (L x W x H)

UWB Standards Support

- IEEE 802.15.4z
- FiRa Consortium Ready

<table>
<thead>
<tr>
<th>Part Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW-M1000-SR150-3DFE-1</td>
<td>UWB Module, 3 External Antennas, DC/DC supply, EEPROM, RF Filters *</td>
</tr>
</tbody>
</table>

*The module is also available with different antenna configuration options and with or without DC/DC converter, EEPROM and RF Filters. Refer to section 7 for part code for your preferred configuration.
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1. Overview

1.1. Introduction

The SW-M1000-SR150 is a complete FiRa compliant UWB module designed with high level of integration to minimise system level BOM cost. Based on the NXP SR150 UWB chip, the SW-M1000-SR150 module conforms to the IEEE 802.15.4z standard and it comes with SPI host interface and I2C interface to an optional onboard EEPROM for storage of antenna calibration and other custom data.

The SW-M1000-SR150 include the following key components:

- Fully integrated RF frontend
- Onboard LDOs and optional DC/DC converter
- Onboard system clock and 32.768 kHz crystal
- SPI Host interface
- Slave I2C port for access to the optional internal EEPROM
- External antenna ports

The SW-M1000-SR150 comes in 13 mm x 18 mm x 2.2 mm package.

Refer to Section 5 for mechanical dimension and recommended land pattern.

Figure 1: SW-M1000-SR150 block diagram
2. Functional Description

2.1. RF Interface

The SW-M1000-SR150 uses highly optimised RF frontend with industry leading transmit power and receive sensitivity. The SW-M1000-SR150 supports up to three antenna interface port for single-side two-way and double-side two-way ranging. Refer to your local Sunway sales office for suitable pre-approved antenna options.
3. Pin definitions

3.1. External Pads

Table 1 specifies the SW-M1000-SR150 pins description.

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Description</th>
<th>In/Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHIP_ENABLE</td>
<td>UWB Chip Enable (active low)</td>
<td>In</td>
</tr>
<tr>
<td>2</td>
<td>RTC_SYNC</td>
<td>UWB Chip RTC Synchronization</td>
<td>In</td>
</tr>
<tr>
<td>3</td>
<td>SENSOR_INT</td>
<td>SPI Data Ready Interrupt</td>
<td>Out</td>
</tr>
<tr>
<td>4</td>
<td>RESERVED</td>
<td>DO NOT CONNECT</td>
<td>Leave Open</td>
</tr>
<tr>
<td>5</td>
<td>SWDIO</td>
<td>UWB Chip Debug Interface</td>
<td>In/Out</td>
</tr>
<tr>
<td>6</td>
<td>SWDCLK</td>
<td>UWB Chip Debug Interface</td>
<td>In</td>
</tr>
<tr>
<td>7</td>
<td>RESERVED</td>
<td>DO NOT CONNECT</td>
<td>Leave Open</td>
</tr>
<tr>
<td>8</td>
<td>RESERVED</td>
<td>DO NOT CONNECT</td>
<td>Leave Open</td>
</tr>
<tr>
<td>9</td>
<td>RESERVED</td>
<td>DO NOT CONNECT</td>
<td>Leave Open</td>
</tr>
<tr>
<td>10</td>
<td>UART_TXD</td>
<td>Serial Debug Interface Port</td>
<td>Out</td>
</tr>
<tr>
<td>11</td>
<td>UART_RXD</td>
<td>Serial Debug Interface Port</td>
<td>In</td>
</tr>
<tr>
<td>12</td>
<td>POWER_EN</td>
<td>DC/DC Enable</td>
<td>In</td>
</tr>
<tr>
<td>13</td>
<td>VCC</td>
<td>Power Supply Input</td>
<td>In</td>
</tr>
<tr>
<td>14</td>
<td>GND</td>
<td>Ground</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>GND</td>
<td>Ground</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>GND</td>
<td>Ground</td>
<td>-</td>
</tr>
<tr>
<td>Pin Number</td>
<td>Pin Name</td>
<td>Description</td>
<td>In/Out</td>
</tr>
<tr>
<td>------------</td>
<td>---------------</td>
<td>--------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>17</td>
<td>GND</td>
<td>Ground</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>GND</td>
<td>Ground</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>GND</td>
<td>Ground</td>
<td>-</td>
</tr>
<tr>
<td>20</td>
<td>GND</td>
<td>Ground</td>
<td>-</td>
</tr>
<tr>
<td>21</td>
<td>EE_I2C_SCL</td>
<td>I2C Clock for Internal EEPROM</td>
<td>In</td>
</tr>
<tr>
<td>22</td>
<td>EE_I2C_SDA</td>
<td>I2C Data for Internal EEPROM</td>
<td>In/Out</td>
</tr>
<tr>
<td>23</td>
<td>SPI_MISO</td>
<td>SPI Data Output for Host Interface</td>
<td>Out</td>
</tr>
<tr>
<td>24</td>
<td>SPI_SCK</td>
<td>SPI Data Clock for Host Interface</td>
<td>In</td>
</tr>
<tr>
<td>25</td>
<td>SPI_CS</td>
<td>SPI Chip Select for Host Interface</td>
<td>In</td>
</tr>
<tr>
<td>26</td>
<td>SPI_MOSI</td>
<td>SPI Data Input for Host Interface</td>
<td>In</td>
</tr>
<tr>
<td>27</td>
<td>RESERVED</td>
<td>DO NOT CONNECT</td>
<td>Leave Open</td>
</tr>
</tbody>
</table>

**RF Interface**

<table>
<thead>
<tr>
<th>Interface</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF1</td>
<td>TX/RX RF Receive / Transmit Port</td>
</tr>
<tr>
<td>RF2</td>
<td>RX RF Input for 3D Direction</td>
</tr>
<tr>
<td>RF3</td>
<td>RX RF Input for 3D Direction</td>
</tr>
</tbody>
</table>

*Table 1: Pads, Pins and Signal Descriptions*

## 3.2. Interfaces

The SW-M1000-SR150 interfaces are listed in Table 2.

<table>
<thead>
<tr>
<th>Interface</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTAG</td>
<td>For debug and production test purposes</td>
</tr>
<tr>
<td>SPI</td>
<td>Slave SPI port for host interface with the SW-M1000-SR150</td>
</tr>
<tr>
<td>UART</td>
<td>Serial Debug Interface</td>
</tr>
<tr>
<td>EE_I2C</td>
<td>I2C Slave port for access to the optional on-module EEPROM</td>
</tr>
</tbody>
</table>

*Table 2: Interfaces*
3.3. Application Schematic

An example schematic including the power and RF interfaces is shown in Figure 2.

Notes
- The test / debug interfaces (JTAG / UART) are only utilised during production test and debug.

![Figure 2: Power and RF schematic for SW-M1000-SR150](image)

The key component values for the schematic in Figure 2 are shown in Table 3.

<table>
<thead>
<tr>
<th>Part code</th>
<th>Description</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Capacitor, Murata 0402 X7R</td>
<td>100nF ±10% / 16V</td>
<td></td>
</tr>
<tr>
<td>C3</td>
<td>Capacitor, Murata 0402 X5R</td>
<td>10µF ±10% / 16V</td>
<td></td>
</tr>
</tbody>
</table>

*Table 3: SW-M1000-SR150 Key component values*

3.3.1 Secure Element

The secure element is an NXP part SW051W and is used to store key material used to expedite secure ranging. It is the responsibility of the host MCU to provide a logical relay data path between the I2C interface of the secure element and the host SPI interface to the UWB module.
4. Electrical Specifications

4.1. Absolute Maximum Ratings

*Table 4* shows absolute maximum ratings for the SW-M1000-SR150. Exceeding these values will cause permanent damage to the module.

<table>
<thead>
<tr>
<th>Block</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage (with DC/DC)</td>
<td>2.2</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>Supply Voltage (without DC/DC)</td>
<td>1.71</td>
<td>1.98</td>
<td>V</td>
</tr>
<tr>
<td>Voltage at GND pins</td>
<td>0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Voltage at all other pins</td>
<td>-0.3</td>
<td>VDD+0.3</td>
<td>V</td>
</tr>
<tr>
<td>Radio RF Input Level</td>
<td>7</td>
<td></td>
<td>dBm</td>
</tr>
</tbody>
</table>

**Environmental**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Temperature</td>
<td>-40</td>
<td></td>
<td>+85</td>
<td>°C</td>
</tr>
</tbody>
</table>

*Table 4: Absolute Maximum Ratings*

4.2. Recommended Operating Conditions

*Table 5* summarises the recommended operating conditions for the SW-M1000-SR150. Functional operation beyond the conditions indicated in is not recommended.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Typical</th>
<th>Maximum</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VDD (with DCDC option)</td>
<td>2.2</td>
<td>3.3</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td>VDD (without DCDC option)</td>
<td>1.8</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Operating temperature (ambient)</td>
<td>-30</td>
<td></td>
<td>+85</td>
<td>°C</td>
</tr>
</tbody>
</table>

*Table 5: Recommended operating conditions*

4.3. Power Consumption

Please refer to the NXP SR150 Short Datasheet.

4.4. Radio Characteristics

Please refer to the NXP SR150 Short Datasheet.

4.5. Receiver Characteristics

Please refer to the NXP SR150 Short Datasheet.
5. Mechanical Information

5.1. Mechanical Information

The SW-M1000-SR150 mechanical dimension is shown in Figure 5 below. All dimensions are in mm.

![Figure 3: Module dimension (Top View)](image)
5.2. Host PCB land pattern

Recommended host PCB land pattern and antenna keep out area for the SW-M1000-SR150 is shown in *Figure 6* below. All dimensions are in mm.

*Figure 4: Module dimension (Top View)*
6. Soldering Profile

6.1. Manual soldering temperature

Manual soldering temperature: 360 °C ±5 °C Maximum

6.2. Reflow temperature profile

The temperature should not exceed the maximum specified temperature as shown on the figure 6 below.

*Figure 5: Module reflow temperature profile*
7. Part code

SW-M1000-SR150-3 D F E - 1

- Manufacturer
  SW = Sunway Communication

- Model number

- Core Chipset

- Revision number

- Memory option
  E = EEPROM, X = no EEPROM

- RF Filter option
  F= with Filter; X= no Filter

- Power supply configuration
  D=DC/DC; X= no DC/DC

- Number of antenna ports

Manufacturer
SW = Sunway Communication
Model number
Core Chipset
Revision number
Memory option
E = EEPROM, X = no EEPROM
RF Filter option
F= with Filter; X= no Filter
Power supply configuration
D=DC/DC; X= no DC/DC
Number of antenna ports
8. Regulatory Approval

Regulatory approvals are pending.