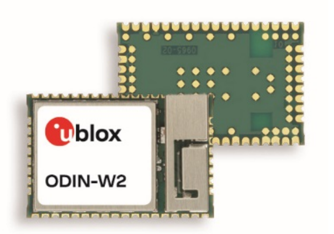
S

ODIN-W2 series

Stand-alone multiradio modules with Wi-Fi and Bluetooth

System Integration Manual



Abstract

This document describes the system integration of ODIN-W2 series multiradio modules. The ODIN-W2 module is a compact, stand-alone, dual-band Wi-Fi, Bluetooth® dual-mode (Bluetooth BR/EDR v2.1 and Bluetooth Low Energy v4.0), multiradio module designed for Internet-of-Things gateway applications.

www.u-blox.com

UBX-14040040 - R18

Document Information

Title	ODIN-W2 series	
Subtitle	Stand-alone multiradio modules with Wi-Fi and Bluetooth	
Document type	System Integration Manual	
Document number	UBX-14040040	
Revision and date	R18	9-Jan-2020
Disclosure Restriction		

Product status	Corresponding content status	
Functional Sample	Draft	For functional testing. Revised and supplementary data will be published later.
In Development / Prototype	Objective Specification	Target values. Revised and supplementary data will be published later.
Engineering Sample	Advance Information	Data based on early testing. Revised and supplementary data will be published later.
Initial Production	Early Production Information	Data from product verification. Revised and supplementary data may be published later.
Mass Production / End of Life	Production Information	Document contains the final product specification.

This document applies to the following products:

Product name	Type number	Software version	Hardware version	PCN reference	Product status
ODIN-W260	ODIN-W260-04B-00	5.0.0, 5.0.1	06	N/A	Mass production
	ODIN-W260-05B-00 ODIN-W260-05X-00	6.0.0, 6.0.1	06	N/A	Initial production
	ODIN-W260-06B-00	7.1.0	06	N/A	Initial production
ODIN-W262	ODIN-W262-04B-00	5.0.0, 5.0.1	06	N/A	Mass production
	ODIN-W262-05B-00 ODIN-W262-05X-00	6.0.0, 6.0.1	06	N/A	Initial production
	ODIN-W262-06B-00	7.1.0	06	N/A	Initial production
ODIN-W263	ODIN-W263-06B-00	7.1.0	06	N/A	Initial production

Contents

1 System description

1.1 Overview and applications

The ODIN-W2 is a compact and powerful stand-alone multiradio module, designed for Internet-of-Things gateway applications. The module includes an embedded Bluetooth stack, Wi-Fi driver, IP stack, and an application for wireless data transfer, all configurable using AT commands. The wireless support includes dual-mode Bluetooth v4.0 (BR/EDR and low energy) and dual-band Wi-Fi (2.4 and 5 GHz bands).

The module supports point-to-point and point-to-multipoint configurations and can have concurrent Bluetooth and Wi-Fi connections. It can operate in Wireless Multidrop™ or Extended Data Mode for advanced multipoint capabilities. Operation in Point-to-Point Protocol (PPP) mode gives the host a UART-based IP interface for advanced use cases. The software provides support for RMII with a micro Access Point.

Additionally, interfaces like SPI, I2C, CAN, and ADC are made available through the software libraries provided by the Arm Mbed development tool.

	ODIN-W260		ODIN-W262/ ODIN-W263	
Grade				
Automotive				
Professional	•		•	
Standard				
Radio				
Bluetooth qualification	v4.0			
Bluetooth profiles	SPP, DUN, PAN, GATT			
Bluetooth BR/EDR	•		•	
Bluetooth low energy	•		•	
Bluetooth output power EIRP [dBm]	14		11	
Wi-Fi 2.4 / 5 [GHz]	2.4 and 5		2.4 and 5	
Wi-Fi IEEE 802.11 standards	a/b/g/n		a/b/g/n	
Wi-Fi output power EIRP [dBm]	18		15	
Max Wi-Fi range [meters]	300		250	
Antenna type	c		i	
Application software				
u-connectXpress software	•		•	
Open CPU for embedded customer applications		•		•
Interfaces				
UART	1	♦	1	♦
SPI		♦		♦
I^2C		♦		♦
I^2S				
RMII	1	♦	1	♦
GPIO pins	23	29	23	29
AD converters (ADC)		♦		♦
Features				
AT command interface	•		•	
Point-to-Point Protocol	•		•	
Extended Data Mode	•		•	
Low Energy Serial Port Service	•		•	
Wi-Fi throughput [Mbit/s]	20		20	
Maximum Bluetooth connections	7		7	
Micro Access Point [max stations]	10		10	
Wi-Fi enterprise security	•		•	
End-to-end security (TLS)	•		•	
WPA/WPA2	•		•	
ATEX / IECEx certified	•		•	

c = U.FL connector(s) for externa antenna

♦ = Feature enabled by HW. The actual support depends on the open CPU application SW.

Table 1: Key features of ODIN-W2 series

1.1.1 Module architecture

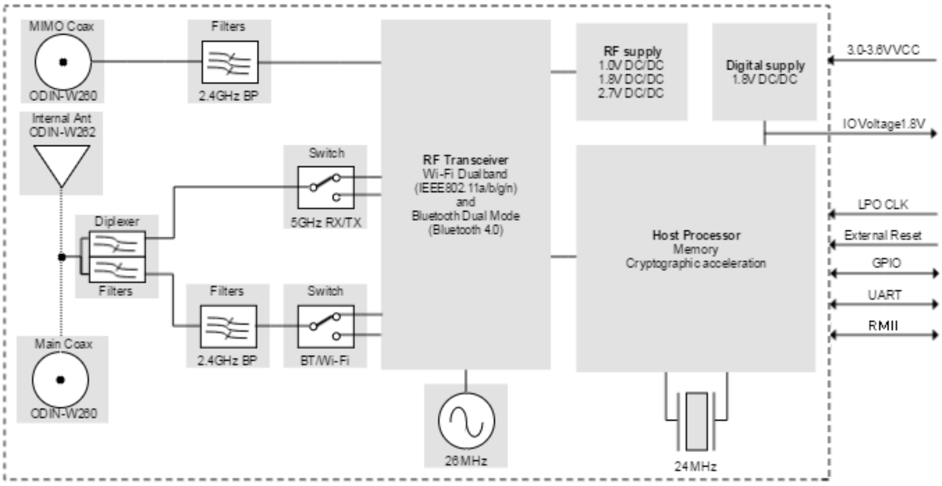


Figure 1: Block diagram of ODIN-W2 series

1.1.2 Radio interfaces

The radio frequency (RF) section contains an RF transceiver, RF switches, RF filters, RF diplexer and a high tolerance crystal oscillator. The transceiver has the following five RF ports:

- Bluetooth 2.4 GHz in/out, Classic Bluetooth and Bluetooth low energy
- Wi-Fi 2.4 GHz band main port in/out
- Wi-Fi 5 GHz band In
- Wi-Fi 5 GHz band out
- Wi-Fi 2.4 GHz band MIMO port in/out

The Wi-Fi MIMO port is separate from the other ports and connected directly to a coaxial U.FL. connector through a band pass filter. The U.FL. connector should be connected to an external antenna through a coaxial cable. See Approved antennas section in *ODIN-W2 Series Datasheet [2]* section for more information about how to select the antennas.

☞ The MIMO port/functionality is available only in the ODIN-W260 module.

Different antenna options are available depending on the chosen ODIN-W2 series model:

- ODIN-W260: A standard coaxial U.FL. connector that must be connected to an external antenna through a coaxial cable. See Antenna connectors section for more information about the antenna connectors.
- ODIN-W262 and ODIN-W263: An internal dual-band PIFA antenna. See Internal antenna subsection for more information about the internal antenna. ODIN-W263 is a special version of ODIN-W262 configured to always support the ETSI domain and is only allowed to be used in countries allowing ETSI domain channels.

Three internal DC/DC regulators generate 1.1 V, 1.8 V and 2.7 V to the RF parts.

1.1.3 Host processor

The host processor is composed of a high-performance Arm® Cortex®-M4 with FPU. The MCU operates at a system frequency of up to 168 MHz and has 2 MB of Flash and 256 KB of RAM memory. A 24 MHz crystal supplies the host for accurate interface timing. The host enables communication with the ODIN-W2 module over both UART and RMII.

The power management is handled by a 1.8 V DC regulator that supplies the host core and iOS. The 1.8 V IO voltage is also available on the solder pads for use on external interface logic. The 1.8 V is always available if the VCC supply to the module is stable.

1.1.4 Radio modes

The ODIN-W2 series is a stand-alone multiradio module that supports Wi-Fi, Classic Bluetooth, and Bluetooth low energy. It can run as a single radio module with only one radio-mode enabled or as a true multiradio module with both Bluetooth and Wi-Fi enabled concurrently.

When the ODIN-W2 series runs as a multiradio module, coexistence is handled internally. In other words, the ODIN-W2 series module will swap between Bluetooth and Wi-Fi when needed and ensures that no transmissions occur simultaneously.

1.1.5 u-blox connectivity software

The ODIN-W2 module is pre-flashed with u-blox connectivity software. See the *ODIN-W2 Getting Started Guide [3]* and the *u-blox Short Range AT Commands Manual [1]* for more information.

1.1.6 Mbed™

The ODIN-W2 series modules are designed to be able to run in an Mbed environment.
The Arm® Mbed™ IoT device platform provides the operating system, cloud services, tools, and developer ecosystem that enable creation and deployment of commercial, standards-based IoT solutions possible at scale.

1.2 Pin configuration and function

1.2.1 Pin attributes

1. **FUNCTION:** Pin function
2. **PIN NAME:** The name of the package pin or terminal
3. **PIN NUMBER:** Package pin numbers associated with each signal
4. **GPIO_ID:** GPIO ID used for using pins in the GPIO mode
5. **Mbed pin:** Mbed pin number used by the EVK-ODIN-W2
6. **STM32 pin:** Pin number on the STM32
7. **SIGNAL NAME:** The signal name for that pin in the mode being used
8. **REMARKS:** Pin description and notes

1.2.2 Pin description

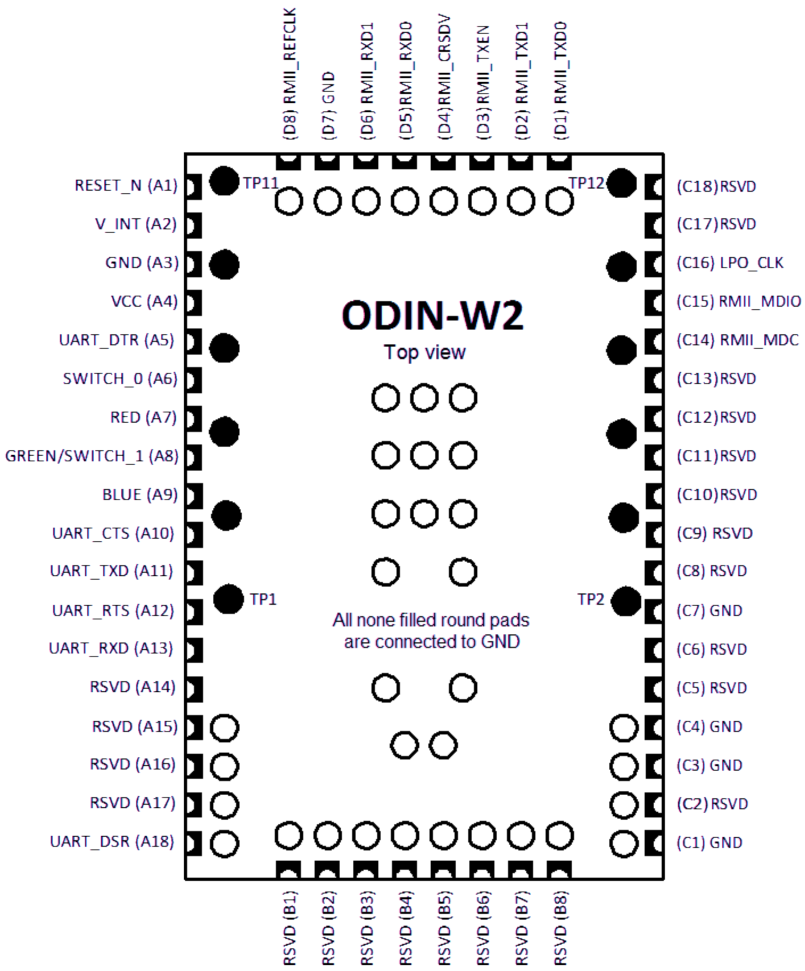


Figure 2: ODIN-W2 series pin assignment

The signals are available on castellation pads on the edge of the PCB. The unfilled circular pads are GND pads. Black circular pads are test and production points.

The pin id in the table below refers to the ids used in the *u-blox Short Range AT Commands Manual [1]*.

Function	Pin name	Pin No.	GPIO id	Mbed pin	STM32 pin	Signal description	Remarks
Power	**VCC**	A4				Module power supply.	3.0 – 3.6 V power supply.
	V_INT	A2				Regulated output voltage for external interface supply.	1.8 V, max output current 100mA. The maximum output current can be limited by the internal current consumption of the V_INT rail.
	GND	A3, C1, C3, C4, C7, D7				All GND pads must be connected to ground.	
System IO	**RESET_N**	A1				External reset input.	Internal active pull-up to V_INT.
	SWITCH_0	A6		SW0	PF2	System Input Signal	Active low. The module will revert to factory settings if both SWITCH_1='0' and SWITCH_0='0' for 10 sec startup (RESET_N pin is released or power is applied).
	RED	A7		A5 / LED1 / LED_RED	PE_0	Logic Red LED Signal.	Active low.
	GREEN/ SWITCH_1	A8		LED2 / LED_GRE / SW1	PB_6	Logic Green LED Signal. System Input Signal	Active low. The GREEN signal is not valid until 500 ms after the startup (RESET_N pin is released or power is applied). If the level on this pin is pulled-down during start-up the unit goes back to default serial settings. The SWITCH_1 input is only active during the first 500ms after startup. The module will revert to factory settings if both SWITCH_1='0' and SWITCH_0='0' for 10 sec startup.
	BLUE	A9		D5 / LED_BLU	PB_8	Logic Blue LED Signal.	Active low.
Clock	**LPO_CLK**	C16	14	A3	PF_7	Low Power Oscillator clock input	The modules require an external 32.768 kHz clock for low power modes. Should be left unconnected if not used.
UART	**UART_RXD**	A13		D2	PA_10	UART Receive.	
	UART_TXD	A11		D8	PA_9	UART Transmit.	
	UART_RTS	A12	28	D4	PA_12	UART Request To Send, Hardware flow control.	Active low.
	UART_CTS	A10	27	D3	PA_11	UART Clear To Send, Hardware flow control.	Active low.
	UART_DTR	A5		A2	PC2	UART Data Terminal Ready System Output Signal	Active low. Is used as a System IO
	UART_DSR	A18		A1	PA_3	UART Data Set Ready.	Active low. Can also be used as a System IO.

Function	Pin name	Pin No.	GPIO id	Mbed pin	STM32 pin	Signal description	Remarks
RMII	**RMII_MDC**	C14	12			Management data clock line	
	RMII_MDIO	C15	13			Management data I/O line	An external pull-up resistor is required on the bidirectional data signal.
	RMII_TXD0	D1	20			RMII Transmit 0	
	RMII_TXD1	D2	21			RMII Transmit 1	
	RMII_TX-EN	D3	22			RMII Transmit enable	Active high.
	RMII_CRS-DV	D4	23			Carrier Sense/Receive Data Valid input	Carrier Sense and Receive Data Valid signals are multiplexed together; the multiplexing scheme varies with implementation.
	RMII_RXD0	D5	24			RMII Receive 0	
	RMII_RXD1	D6	25			RMII Receive 1	
	RMII_REF-CLK	D8	26			RMII Reference clock input	Continuous 50 MHz reference clock input.
IO	**UART3 RX**	A14	7	D0	PD_9	IO	UART3 not used for u-blox connectivity software
	UART3 TX	A15	8	D1	PD_8	IO	UART3 not used for u-blox connectivity software
	UART3 CTS	A16	9	D6	PD_11	IO	UART3 not used for u-blox connectivity software
	UART3 RTS	A17	10	D7	PD_12	IO	UART3 not used for u-blox connectivity software
	RSVD	C13	11	A0	PF_6	IO	IO
	RSVD	C5	15	A4	PG_4	IO	IO
	SPI MISO / SDIO D0	C6	16	D12	PE_13	IO	SPI not used for
	SPI SCK/ SDIO CLK	C8	17	D13	PE_12	IO	SPI not used for u-blox connectivity software
	SPI MOSI / SDIO CMD	C10	18	D11	PE_14	IO	SPI not used for u-blox connectivity software
	SPI SEL	C11	19	D10	PE_11	IO	SPI not used for u-blox connectivity software
IO	**SDIO CD**	C12	29	D9	PE_9	IO	
RSVD	**RSVD/ I2C_SCL**	C17		D15	PF_1		I^{2}C not used for u-blox connectivity software
	RSVD/ I2C_SDA	C18		D14	PF_0		I^{2}C not used for u-blox connectivity software
RSVD	**RSVD**	B1, B2, B3, B4, B5, B6, B7, B8, C2, C9				Reserved pin.	All RSVD should be left unconnected.
Test point	**JTAG_NTRST**	TP5		JTAG_NTRST	PB_4		JTAG not used for u-blox connectivity software
	JTAG_TMS	TP7		JTAG_TMS	PA_13		JTAG not used for u-blox connectivity software
	JTAG_TDI	TP8		JTAG_TDI	PA_15		JTAG not used for u-blox connectivity software

Function	Pin name	Pin No.	GPIO id	Mbed pin	STM32 pin	Signal description	Remarks
	JTAG_TCK	TP9		JTAG_TCK	PA_14		JTAG not used for u-blox connectivity software
	JTAG_TDO	TP10		JTAG_TDO	PB_3		JTAG not used for u-blox connectivity software
	SYS_BOOT	TP11		SYS_BOOT	BOOT0	Pull to V_INT to enter the ROM based Bootloader	10k internal pull down
	RSVD	TP1, TP2, TP3, TP4, TP6, TP12				Reserved pin.	All RSVD should be left unconnected.

Table 2: ODIN-W2 pin description

⚠ Do not apply any Voltage to Digital, Control and Radio signal groups while in Not Powered mode to avoid damaging the module.

1.3 Supply interfaces

1.3.1 Main supply inputs

The ODIN-W2 series modules must be supplied with a DC power through VCC pins. Voltage must be stable, as during operation, the current drawn from the VCC can vary significantly depending on the power consumption profile of the Bluetooth (BT) and Wi-Fi technologies. See Supply interfaces section for power supply design information and the *ODIN-W2 series Data Sheet [2]* for information about voltage supply requirement.

Rail	Voltage requirement	Current requirement (peak)
VCC	Refer to ODIN-W2 series Data Sheet [2]	900 mA

Table 3: Summary of voltage supply requirements

The ODIN-W2 series modules must be supplied with a proper DC power supply through the VCC pins, which can be one of the following:

- Switching Mode Power Supply (SMPS)
- Low Drop Out (LDO) regulator

The SMPS is the ideal choice when the available primary supply source has higher value than the operating supply voltage of the ODIN-W2 series modules. The use of SMPS provides the best power efficiency for the overall application and minimizes current drawn from the main supply source.

⚠ While selecting SMPS, ensure that AC voltage ripple at switching frequency is kept as low as possible. Layout shall be implemented to minimize impact of high frequency ringing.

The use of an LDO linear regulator is convenient for a primary supply with a relatively low voltage where the typical 85-90% efficiency of the switching regulator leads to minimal current saving. Linear regulators are not recommended for high voltage step-down as they will dissipate a considerable amount of energy.

Independent of the selected DC power supply, it is crucial that it can handle the high peak current generated by the ODIN-W2 series module. It is recommended to use a supply that can handle 1000 mA.

It is considered as best practice to have decoupling capacitors on the supply rails close to the ODIN-W2 series module, although depending on the design of the power routing on the host system, capacitance might not be needed.

1.3.2 Generic digital interfaces supply output (V_INT)

The ODIN-W2 series modules provide a 1.8 V supply rail output through the V_INT pin, which is internally generated when the module has VCC supply. The same voltage domain is used internally to supply the generic digital interfaces of the modules. The V_INT supply output can be used instead of an external discrete regulator.

The V_INT supply is available 2.5 ms after applying the VCC.

1.4 System function interfaces

1.4.1 Module reset

You can reset (reboot) the ODIN-W2 series modules using one of the following methods:

- Hardware reset: Low level on the RESET_N pin, which is normally set high by an internal pull-up, for a valid time period (see ODIN-W2 series Data Sheet [2]). This causes an "external" or "hardware" reset of the module. The RESET_N line should be driven by open drain, open collector or contact switch.
- Software reset with an AT command: This causes an "internal" or "software" reset of the module. See *u-blox Short Range AT Commands Manual [1]* for more information.

1.4.2 External low power clock for power saving modes

An external 32.768 kHz Low Power Clock (LPO) is required for using power saving modes. See the *u-blox Short Range AT Commands Manual [1]* for more information about the different power saving modes. The clock must be available during start-up (after power on or while leaving the reset-state).

See the low power clock (LPO_CLK) design section for more information about external LPO clock design. The LPO clock should be left unconnected if not needed in the design. See *ODIN-W2 series Data Sheet [2]* for electrical requirements.

1.4.3 System input and output signals

The module can be in the Command mode, Data mode, and Extended Data mode. The RED, GREEN, BLUE and UART DTR signals are used to indicate the status.

The UART_DTR pin can be set to indicate whether the module is in one of the below-mentioned modes:

- Data mode
- Command mode
- If there are any remote peers connected to the module

The UART_DSR pin can used to put the module in Command or it can be used to disconnect all remote pears. For more details see the *u-blox Short Range AT Commands Manual [1].*

Table 4 describes the default setup of the RED, GREEN and BLUE System iOS. For more information, see the *u-blox Short Range AT Commands Manual [1]* and Pin attributes section.

Mode	Status	RGB LED Color	GREEN GPIO	BLUE GPIO	RED GPIO
Data mode, EDM	IDLE	Green	LOW	HIGH	HIGH
Command mode	IDLE	Orange	LOW	HIGH	LOW
Data mode, Command mode, EDM	CONNECTING[1]	Purple	HIGH	LOW	LOW
Data mode, Command mode, EDM	CONNECTED1	Blue	HIGH	LOW	HIGH

Table 4: LED Signal states in different module modes

[1] On data activity, the active LED flashes.

1.4.4 Restoring default configuration

In some situations, it is necessary to restore the settings to their default values. The following two levels of restore to default configuration can be activated through hardware:

- **Serial Settings:** The serial settings are restored to default if SWITCH_1='0' during start-up. See the table in Universal asynchronous serial interface (UART) section for more information about the default serial settings.
- **Factory Settings:** The module will restore all factory settings if both SWITCH_1='0' and SWITCH_0='0' for more than 10s during start-up. See the *u-blox Short Range AT Commands Manual [1]* for more information about the default factory settings.

1.5 Data communication interfaces

1.5.1 Universal asynchronous serial interface (UART)

The ODIN-W2 series module provides a Universal Asynchronous Serial Interface (UART) for data communication. The ODIN-W2 series module can be in configuration mode (Command mode) and data mode. See the *u-blox Short Range AT Commands Manual [1]* for more information about the different modes of the module.

The following UART signals are available:

- Data lines (RXD as input, TXD as output)
- Hardware flow control lines (CTS as input, RTS as output)

The UART can be used as both 4 wire UART with hardware flow control and as 2-wire UART with only TXD and RXD. If using the UART in 2-wire mode CTS should be connected to GND on the ODIN-W2 module. The use of flow control is configured with an AT command. See the *u-blox Short Range AT Commands Manual [1]* for more information.

The Link status pins (DTR as output, DSR as input) are available as System IO signals, this is described in System input and output signals section. It is recommended to use CMOS compatible signal levels.

The UART interface is also used for software upgrade. See the *u-blox Short Range AT Commands Manual [1]* for more information about the software upgrade.

See the *ODIN-W2 series Data Sheet [2]* for characteristic information about the UART interface.

Interface	Default configuration
COM port	115200 baud, 8 data bits, no parity, 1 stop bit, hardware flow control

Table 5: Default settings for the COM port

1.5.2 Ethernet (RMII+SMI)

☞ The IO voltage of the ODIN-W2 is 1.8 V, which means that the RMII interface operates outside the RMII specification v1.2. If the RMII has to be connected to a PHY circuit, then that circuit must support 1.8 V operation. If a direct MAC to MAC connection is to be used, then a level shifter might be needed depending on the selected host. The selected hardware setup must be verified on the application board to guarantee operation.

RMII:
The ODIN-W2 series module includes a full RMII either for Ethernet MAC to MAC communication or for MAC to PHY communication using the included Station Management Interface (SMI). The RMII and SMI use 9 signals in total. The interface requires an external 50 MHz clock source either from a compatible PHY chip or from an external oscillator. The ODIN-W2 series module cannot provide this clock signal by itself.

SMI (MDC/MDIO management interface):
The two-wire SMI is used to configure PHY chip. It uses a clock line and a data line to setup the internal registers on PHY chip.

A pull up resistor of 1.5 kΩ must be added to MDIO pin.

MAC to MAC connection:
If you connect the ODIN-W2 series module using a direct MAC to MAC connection, the SMI interface can be left unconnected. Depending on the routing of the RMII interface on the host PCB, termination resistors might also be needed.

An external 50 MHz oscillator is needed while running a MAC to MAC connection.

MAC to PHY connection:
If you connect the ODIN-W2 series module to an external PHY circuit, both the RMII and SMI interfaces must be connected. The default PHY address (0x1) must be configured on the PHY side. Follow the recommendations from the selected PHY chip for implementation details.

An example of a PHY implementation is shown in Figure 3. The PHY KSZ8081 is the recommended PHY that is used on the EVK-ODIN-W2.

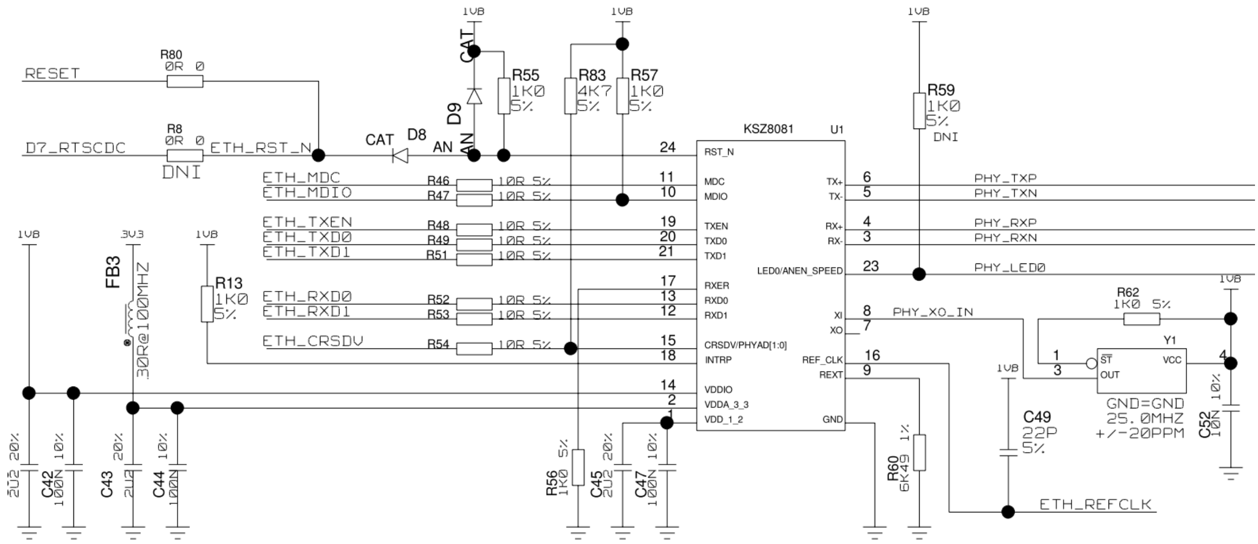


Figure 3: Example schematic RMII to PHY

1.5.3 Mbed Data communication interfaces

Through the Mbed software, the ODIN-W2 series module can be used with a wide range of interfaces and is not limited to the pinout used by the serial port service.

⚠ Only the interfaces used by the EVK-ODIN-W2 are described here.

1.5.3.1 CAN

The CAN bus is compliant with the 2.0A and B (active) specifications with a bitrate of up to 1 Mbit/s. They can receive and transmit standard frames with 11-bit identifiers and extended frames with 29-bit identifiers. Each CAN has three transmit mailboxes; two receive FIFOS with 3 stages and 28 shared scalable filter banks (you can use all of them even though you use only one CAN). 256 bytes of SRAM are allocated for each CAN.

An external transceiver is needed to connect the ODIN-W2 series module to a CAN bus.

1.5.3.2 SPI / SD card

The SPI bus supports both slave and master modes in full-duplex and simplex communication modes. It can communicate up to 45 Mbits/s. The 3-bit prescaler gives 8 master mode frequencies and the frame is configurable either up to 8 bits or 16 bits. The hardware CRC generation/verification supports basic SD Card/MMC modes.

1.5.3.3 I²C

The I²C bus interfaces can operate in multimaster and slave modes. They can support the standard (up to 100 KHz), and fast (up to 400 KHz) modes. It supports the 7/10-bit addressing mode and the 7-bit dual addressing mode (as slave). A hardware CRC generation and verification is embedded.

1.6 Antenna interfaces

☞ The antenna interface is different for each module version in the ODIN-W2 series.

1.6.1 Antenna connectors

The ODIN-W260 module has two RF antenna U.FL. connectors with a characteristic impedance of 50 Ω. The main supports both Bluetooth and dual-band Wi-Fi. See Figure 4.

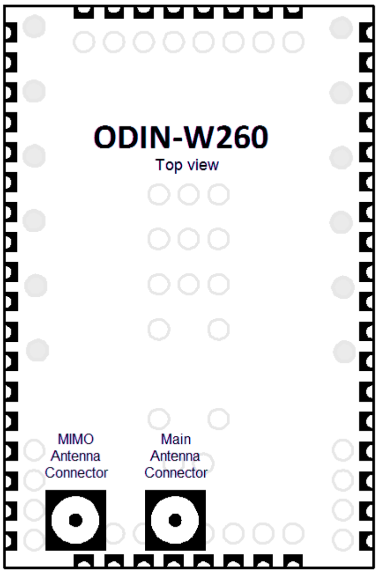


Figure 4: ODIN-W260 with external antenna connectors

The MIMO antenna connector supports 2x2 MIMO 2.4 GHz single band Wi-Fi. The use of multiple antennas at both the transmitter and receiver improves communication performance. A MIMO m x n system consists of m transmit and n receive antennas, where the data to be transmitted is divided into m independent data streams.

For Bluetooth and Wi-Fi operation, the module has been tested and approved for use with the antennas listed in the *ODIN-W2 series Data Sheet [2]*.

☞ 2x2 MIMO is supported from software version 5.0.1 onwards.

1.6.2 Internal antenna

The ODIN-W262 and ODIN-W263 modules have an internal dual-band PIFA antenna. See “Internal antenna design” section for antenna design information.

1.7 GPIO pins

On the ODIN-W2 series module, 23 pins can also be used as GPIO to control external logic. They can be configured as output or input. When used as input, pull up or pull down resistor can be enabled.

The mapping of the GPIO pins can be found in the pin description in chapter 1.2. For more information on setting up the GPIO pins, see the *u-blox Short Range AT Commands Manual [1]*.

1.8 Reserved pins (RSVD)

Do not connect reserved (RSVD) pin. The reserved pins can be allocated for future interfaces and functionality.

1.9 GND pins

Good connection of the module's GND pins with solid ground layer of the host application board is required for correct RF performance. It significantly reduces EMC issues and provides a thermal heat sink for the module.

The following two types of ground (GND) pads are available:

- GND pads and the PCB edge (castellations): Mainly for power supply return path and RF ground.
- Heat dissipation GND pads under the module: Mainly used for dissipation of heat, especially during intensive Wi-Fi activity.

See the Module footprint and paste mask and Thermal guidelines sections for information about ground design.

2 Software

The u-blox connectivity software flashed on the ODIN-W2 module consists of a binary software file. The ODIN-W2 also has a built in ROM-based bootloader that can be used to reflash the u-blox software and for flashing Mbed applications. Flashing the u-blox connectivity software is done using the UART interface of the ODIN-W2 module.

You can use the SWD/JTAG if you use Arm Mbed applications together with the ODIN-W2 module.

2.1 Flashing the u-blox connectivity software

2.1.1 Flashing using s-center

You can update the software through s-center [6] using one of the following methods:

- Click **Firmware Update** button on the bottom right as shown in Figure 5 or
- Select **Tools → Firmware Update** option

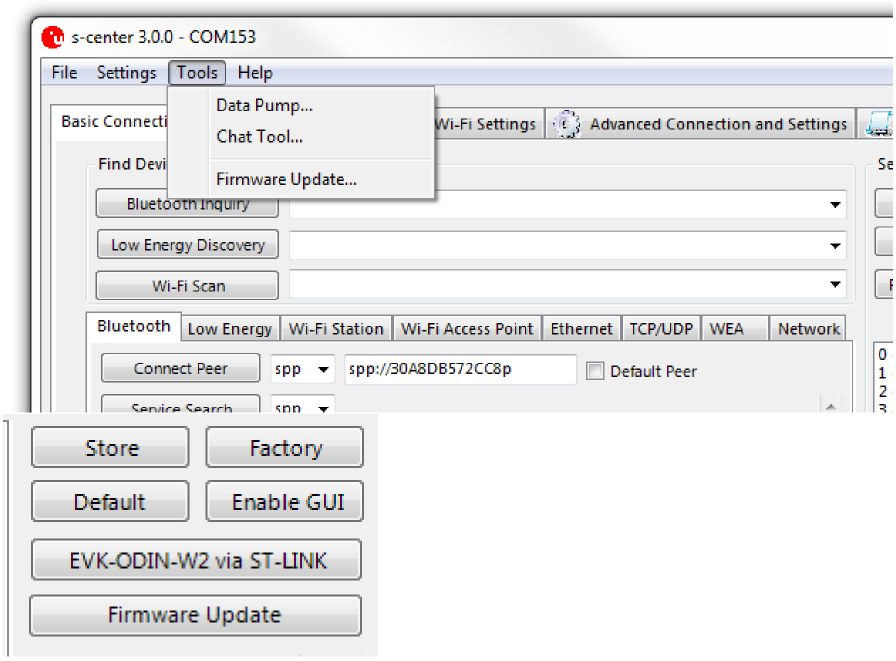


Figure 5: Screenshot that depicts Software Update options in the s-center

This will open Firmware Update window. In this window, select the binary file that should be flashed to the module and click **Update** as shown in Figure 6.

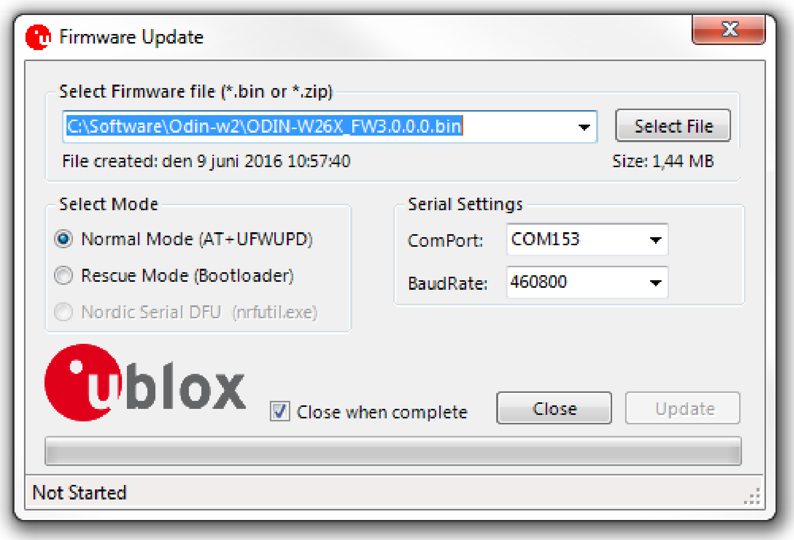


Figure 6: Software update window in s-center

The module is now re-flashed with the selected software.

2.1.2 Software update using AT command

Use the AT+UFWUPD AT command to update the software in the ODIN-W2 series module. This will trigger the bootloader to accept a file for download. The file download uses an XMODEM protocol.

☞ The UART HW Flow is not used during the software update. See the *u-blox Short Range AT Commands Manual [1]* for information about the firmware update command.

2.1.3 Software update using rescue mode

Flashing a new version of the ODIN-W2 connectivity software can also be done using the rescue mode; this mode also uses the XMODEM protocol. This mode is not started by an AT command, but by grounding pin A6 (SWITCH_0) and pin A8 (SWITCH_1) during a reset.

- When the module has started in bootloader mode, a '>' prompt will appear
- Note that the baud rate must be sent in hex, for example:
  - 115200 = 1C200
  - 230400 = 38400
  - 460800 = 70800
  - 921600 = E1000
- For example, to update the software using the baud rate of 460800, use the 'r' command
  - r 70800
- Start the software flashing with the 'x' command on address 0x8010000
  - x 0x8010000
- The module will now reply with 'C' characters showing it is ready to receive XMODEM-CRC16 data.

Once the download is complete, the command 'q' shall be sent to reset the module, or a power cycle. Keep in mind that the u-blox bootloader requires the following UART settings irrespective of the settings that were used before entering the bootloader:

- Baud rate: 115200
- Data: 8 bits
- Parity: none
- Stop: 1 bit
- Flow control: none

2.1.4 XMODEM protocol

The XMODEM protocol uses standard XMODEM-CRC16 protocol and 128 bytes packets.
For more information about XMODEM, see [7]. See XMODEM code example for a sample code in C#. Complete source code is available on request.

2.2 Flashing the u-blox bootloader

If the module has been using Mbed software or for some other reason the bootloader must be reflashed, how to flash a new u-blox bootloader on the ODIN-W2 module is described here.
There are two different ways to flash a new u-blox bootloader on the ODIN-W2 module, either using ROM based bootloader in the STM32 or using a JTAG/SWD debugger.

2.2.1 ROM based Bootloader

The module must be started in the ROM based bootloader. This is done by applying a high signal (1.8 V) on the SYS_BOOT pin during a reset.

The flash program stm32flash.exe [5] should then be used to flash the bootloader to the module.

- Start a command prompt in Windows and browse to the location of the stm32flash application.
- In the command line, write the following command.
    - stm32flash -b 115200 -w <sw_bin-file> -S 0x8000000 <COMport>
- Restart the module to boot into the u-blox bootloader and continue to flash the correct software as specified in section 2.1.1.

2.2.2 SWD/JTAG debugger

Flashing the u-blox bootloader with an external debugger is also possible.

- Connect a debugger to the SWD/JTAG interface as specified in the pinout section (section 1.2.2) and Figure 7.
- Use the flash program provided by the debugger vendor to flash the u-blox bootloader to the module.

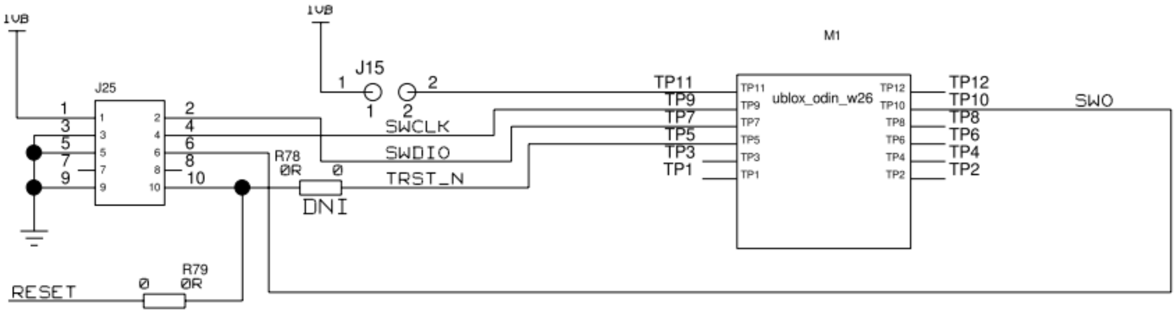


Figure 7: Example of SWD/JTAG debugger connecting to ODIN-W2 module

2.3 Flashing an Arm Mbed application

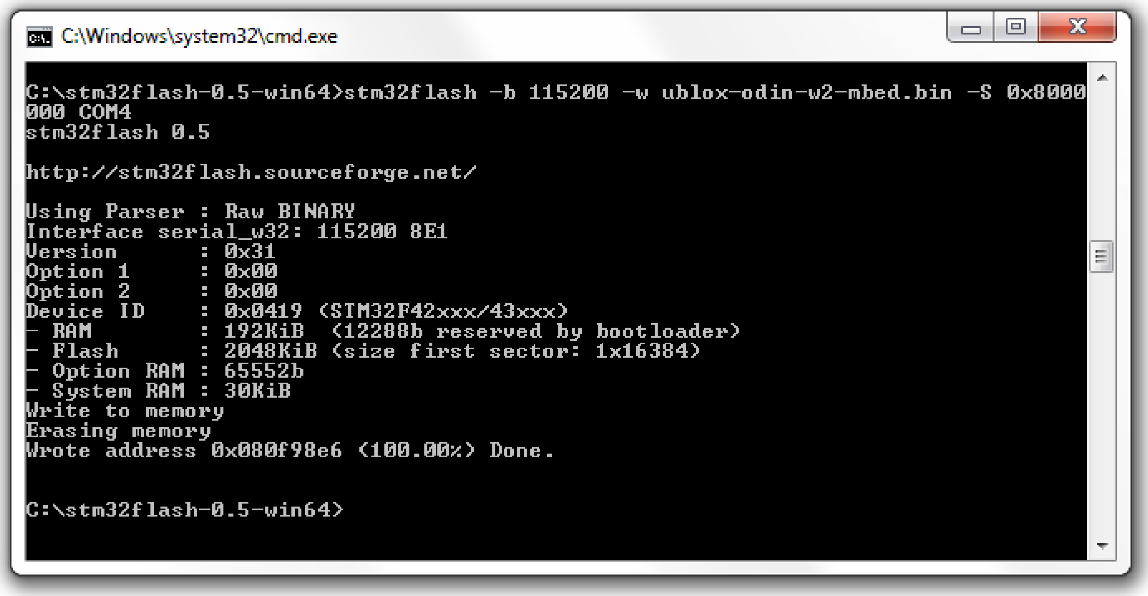
You can flash an Arm Mbed application on the ODIN-W2 module in two ways - either using a ROM based bootloader in the STM32 or using a JTAG/SWD debugger.

2.3.1 ROM based Bootloader

The module must be started in the ROM based bootloader. This is done by applying a high signal (1.8 V) on the SYS_BOOT pin during a reset.

The flash program stm32flash.exe [5] should then be used to flash the Arm Mbed application to the module.

- Start a command prompt in Windows and browse to the location of the stm32flash application.
- In the command line, write the following command.
  - stm32flash -b 115200 -w <sw_bin-file> -S 0x8000000 <COMport>



- After successful flash, restart the module to start the Arm Mbed application.

2.3.2 SWD/JTAG debugger

Flashing an Arm Mbed application with an external debugger is also possible.

- Connect a debugger to the SWD/JTAG interface as specified in the pinout section (section 1.2.2) and Figure 7.
- Use the flash program provided by the debugger vendor to flash the Arm Mbed application to the module.

3 Design-in

3.1 Overview

For an optimal integration of ODIN-W2 series modules in the final application board, it is recommended to follow the design guidelines stated in this chapter. Every application circuit must be properly designed to guarantee the correct functionality of the related interface, however a number of points require high attention during the design of the application device.

The following list provides important points sorted by rank of importance in the application design, starting from the highest relevance:

1. Module supply: **VCC**, **V_INT**, and **GND** pins.

   The supply circuit affects the performance of the device integrating ODIN-W2 series. Follow the recommendations provided in section 3.3 for schematic and layout design.

2. High speed interfaces: **RMII** and **UART** pins.

   High speed interfaces can be a source of radiated noise and can affect the compliance with regulatory standards for radiated emissions. Follow the recommendations provided in section 3.4 and 3.6 for schematic and layout design.

3. System functions: RESET_N and other System input and output pins.

   Accurate design is required to guarantee that the voltage level is well defined during module boot. Follow the recommendations provided in section 3.6 for schematic and layout design.

4. Other pins:

   Accurate design is required to guarantee proper functionality. Follow the recommendations provided in section 3.6 for schematic and layout design.

3.2 Antenna interface design

As the unit cannot be mounted arbitrary, the placement should be chosen with consideration so that it does not interfere with radio communication. The ODIN-W262 with an internal surface mounted antenna cannot be mounted in a metal enclosure. No metal casing or plastics using metal flakes should be used. Avoid metallic based paint or lacquer as well. The ODIN-W260 offers more freedom as an external antenna can be mounted further away from the module.

3.2.1 Antenna connectors

The ODIN-W260 is equipped with dual U.FL connectors. The main antenna connector port is mandatory while the MIMO antenna connector is optional and used only in MIMO applications. See Figure 4.

The external antennas are connected to the board through U.FL connectors. Some of the antennas are connected directly to the U.FL connector of the board and some are connected using an SMA or reversed polarity SMA connector through a short U.FL to SMA or reversed polarity SMA adapter cable. In general, antennas with SMD connection, Reverse Polarity SMA connector or U.FL connector are included in FCC, IC, R&TTE and MIC radio tests. The antennas with SMA connector are included in R&TTE and MIC radio tests but not in FCC or IC due to FCC/IC regulations.

Antenna accessories and recommended antennas can be found in *ODIN-W2 series Data Sheet [2]*.

3.2.2 Internal antenna design

Keep a minimum clearance of 5 mm between the antenna and the casing. Keep a minimum 10 mm free space from metal around the antenna including under. If a metal enclosure is required, ODIN-W260 with antenna connectors has to be used.

It is recommended to place the ODIN-W262/ODIN-W263 module so that the internal antenna is in the corner of the host PCB (Pin B8 / C1 should be in the corner) as seen in Figure 8. The antenna side (short side closest to the antenna), positioned along one side of the host PCB ground plane is the second best option. It is beneficial to have a large ground plane on the host PCB and have a good grounding on the ODIN-W2 module.

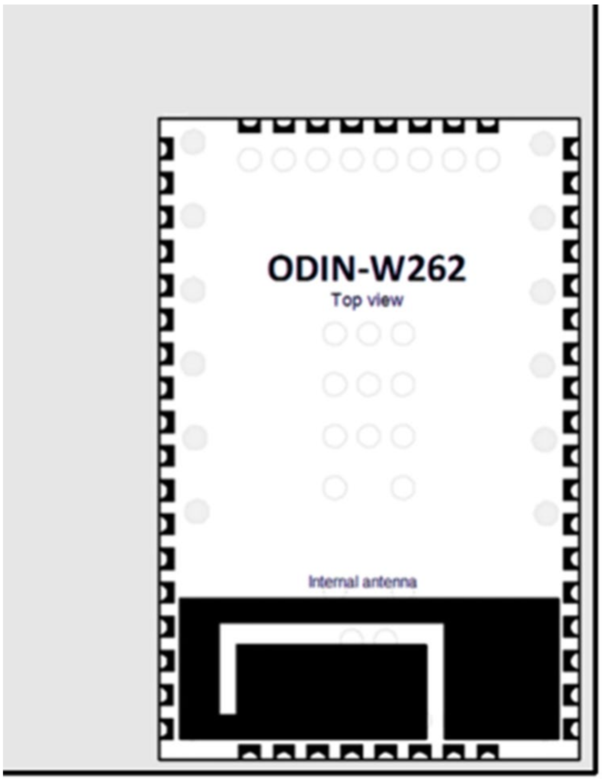


Figure 8: ODIN-W262/ODIN-W263 internal antenna.

3.3 Supply interfaces

3.3.1 Module supply design

Good connection of the module's VCC pin with DC supply source is required for correct RF performance. The guidelines are summarized below:

- VCC connection must be as wide and short as possible.
- Any series component with Equivalent Series Resistance (ESR) greater than few milliohms must be avoided.
- The VCC connection must be routed through a PCB area separated from sensitive analog signals and sensitive functional units. It is a good practice to interpose at least one layer of PCB ground between VCC track and other signal routing.

There is no strict requirement of adding bypass capacitance to the supply net close to the module. But depending on the layout of the supply net and other consumers on the same net, bypass capacitors might still be beneficial. Though the GND pins are internally connected, connect all the available pins to solid ground on the application board, as a good (low impedance) connection to an external ground can minimize power loss and improve RF and thermal performance.

3.3.2 Generic digital interfaces supply output (V_INT) design

The ODIN-W2 series modules provide a 1.8 V supply rail output through the V_INT pin. The same voltage domain is used internally to supply the generic digital interfaces of the modules. The V_INT supply output can be used for interface logic. The External digital interface logic should have decoupling on the supply pins according to the respective datasheet.

- Do not apply loads, which might exceed the limit for maximum available current from V_INT supply (see the *ODIN-W2 series Data Sheet [2]*) as this can cause malfunctions in internal circuitry.
- Since the V_INT supply is generated by an internal switching step-down regulator, it is not recommended to supply sensitive analog circuitry without adequate filtering for digital noise.
- V_INT can only be used as an output. Do not connect any external supply source on V_INT.
- If the line is externally accessible, a higher ESD protection level could be required and it can be achieved by mounting an ESD protection (for example, EPCOS CA05P4S14THSG varistor array) close to the accessible point.

See Schematic for ODIN-W2 section for V_INT design examples.

3.4 Data communication interfaces

3.4.1 Asynchronous serial interface (UART) design

The layout of the UART bus should be done so that noise injection and cross talk are avoided. See the Schematic for ODIN-W2 section for additional information.

It is recommended to use the hardware flow control with RTS/CTS to prevent temporary UART buffer overrun.

- If CTS is 1, then the Host/Host Controller is allowed to send.
- If CTS is 0, then the Host/Host Controller is not allowed to send.

3.4.2 Ethernet (RMII+SMI)

It is recommended to route all signals in the RMII bus with the same length and have appropriate grounding in the surrounding layers; total bus length should also be minimized. The layout of the RMII bus should be done so that crosstalk with other parts of the circuit is minimized providing adequate isolation between the signals, the clock and the surrounding busses/traces.

Termination resistors are recommended on the RX and TX lines of the RMII bus.
Pull-up resistor is required for MDIO.

The General High Speed layout guidelines in section 3.6 apply for the RMII and the SMI bus.

3.5 Other interface and notes

3.5.1 Low power clock (LPO_CLK) design

The LPO_CLK input pin requires accurate layout design. Avoid injecting noise on these pins as it may affect the stability of the LPO timing reference. See the Schematic for ODIN-W2 section for additional information.

3.6 General High Speed layout guidelines

These general design guidelines are considered as best practices and are valid for any bus present in the ODIN-W2 series modules; the designer should prioritize the layout of higher speed busses. Low frequency signals are generally not critical for layout.

⚠ One exception is represented by High Impedance traces (such as signals driven by weak pull resistors) that may be affected by crosstalk. For those traces, a supplementary isolation of 4w from other busses is recommended.

3.6.1 General considerations for schematic design and PCB floor-planning

- Verify which signal bus requires termination and add series resistor terminations to the schematics.
- Carefully consider the placement of the module with respect to antenna position and host processor.
- Verify with PCB manufacturer allowable stack-ups and controlled impedance dimensioning.
- Verify that the power supply design and power sequence are compliant with ODIN-W2 series module specification (refer to section 1.3).

3.6.2 Module placement

- Accessory parts like bypass capacitors should be placed as close as possible to the module to improve filtering capability, prioritizing the placement of the smallest size capacitor close to module pads.

⚠ Particular care should be taken not to place components close to the antenna area. The designer should carefully follow the recommendations from the antenna manufacturer about the distance of the antenna vs. other parts of the system. The designer should also maximize the distance of the antenna to Hi-frequency busses like DDRs and related components or consider an optional metal shield to reduce interferences that could be picked up by the antenna thus reducing the module's sensitivity.

- An optimized module placement allows better RF performance. See section 1.6 for more information on antenna consideration during module placement.

☞ The heat dissipation during continuous transmission at maximum power can significantly raise the temperature of the application baseboard below the ODIN-W2 series modules; Hence, avoid placing temperature sensitive devices close to the module.

3.6.3 Layout and manufacturing

- Avoid stubs on high speed signals. Even through-hole vias may have an impact on signal quality.
- Verify the recommended maximum signal skew for differential pairs and length matching of buses.
- Minimize the routing length; longer traces will degrade signal performance. Ensure that maximum allowable length for high speed busses is not exceeded.
- Ensure that you track your impedance matched traces. Consult with your PCB manufacturer early in the project for proper stack-up definition.
- RF and digital sections should be clearly separated on the board.
- Ground splitting is not allowed below the module.
- Minimize bus length to reduce potential EMI issues from digital busses.
- All traces (Including low speed or DC traces) must couple with a reference plane (GND or power), Hi-speed busses should be referenced to the ground plane. In this case, if the designer needs to change the ground reference, an adequate number of GND vias must be added in the area of transition to provide a low impedance path between the two GND layers for the return current.
- Hi-Speed busses are not allowed to change reference plane. If a reference plane change is unavoidable, some capacitors should be added in the area to provide a low impedance return path through the different reference planes.
- Trace routing should keep a distance greater than 3w from the ground plane routing edge.

- Power planes should keep a distance from the PCB edge sufficient to route a ground ring around the PCB, the ground ring must then be connected to other layers through vias.

⚠ The heat dissipation during continuous transmission at maximum power can significantly raise the temperature of the application base-board below the ODIN-W2 series modules. Avoid placing temperature sensitive devices close to the ODIN-W2 series module and provide adequate grounding of the module to transfer to the PCB the generated heat.

3.7 Module footprint and paste mask

Figure 9 describes the suggested footprint (that is, copper mask) layout for the ODIN-W2 series modules. The proposed land pattern layout reflects the pads layout of the modules and extends 0.2 mm outside the module outline.

The Non Solder Mask Defined (NSMD) pad type is recommended over the Solder Mask Defined (SMD) pad type, which implements the solder mask opening 50 µm larger per side than the corresponding copper pad.

The suggested paste mask layout for the ODIN-W2 series modules is to follow the copper mask layout as described in Figure 9.

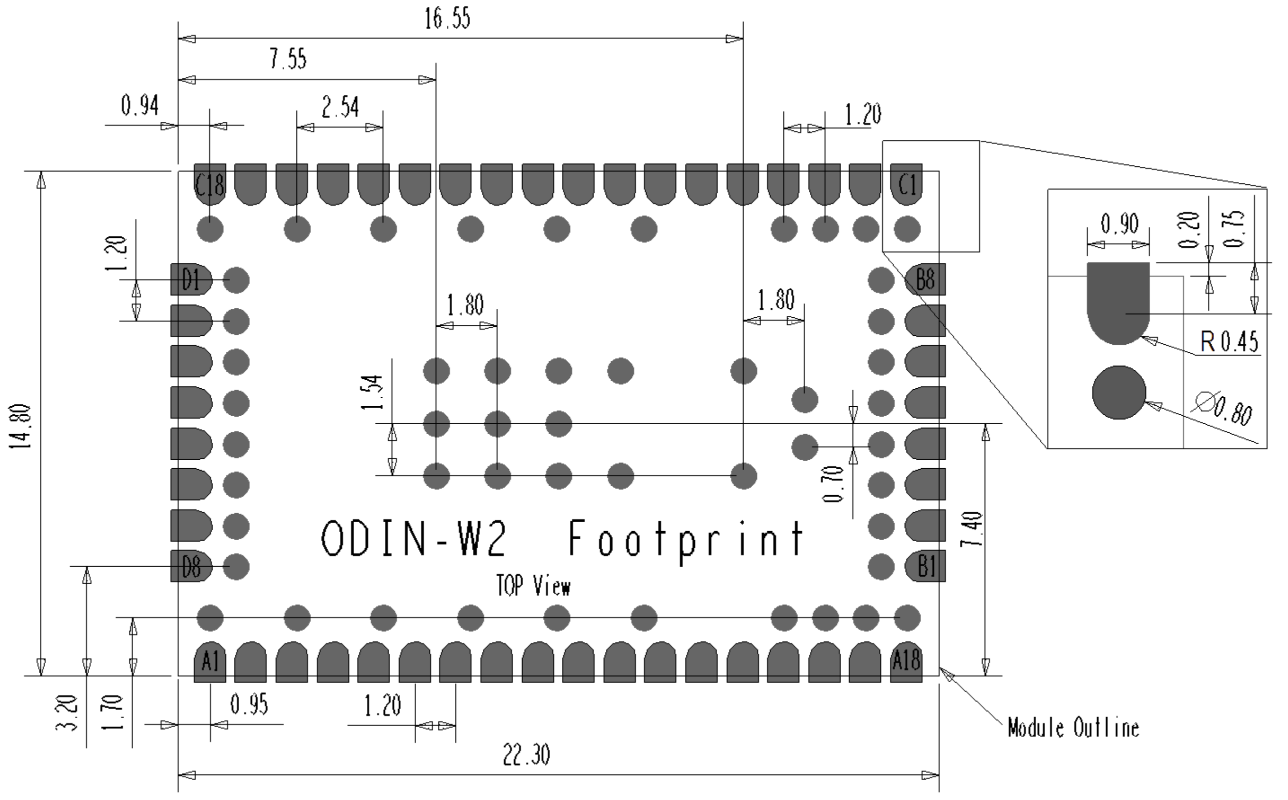


Figure 9: ODIN-W2 series footprint

☞ These are recommendations only and not specifications. The exact mask geometries, distances and stencil thicknesses must be adapted to the specific production processes (for example, soldering and so on) of the customer.

3.8 Thermal guidelines

The ODIN-W2 series modules have been successfully tested in -40 °C to +85 °C. The board will generate heat during high loads that must be dissipated to sustain the life time of the components.

During high ambient temperature, it is critical to dissipate the generated heat efficiently to keep the die temperature low.

3.8.1 Thermal protection

The ODIN-W2 module has built in thermal protection if the die temperature reaches too high levels. The following two preventive steps are implemented in the ODIN-W2 series module to control heating:

- Disable/Enable MIMO: When the die temperature exceeds high threshold, +103 °C device will switch to SISO rates only (as MIMO PA heating is the main contributor for heating).
- Halt TX: Suspend traffic to allow device cooling when maximum allowable die temperature of +120 °C is reached.

When the die temperature returns below the low threshold limit of +80 °C, the device will automatically Enable MIMO and TX transmission.

3.8.2 Heat dissipation

It is critical to design the host board in such a way that generated heat from the ODIN-W2 series module will be dissipated efficiently. Use the different approaches as mentioned below to achieve this:

- Connect each ground pin on the ODIN-W2 series module with a solid ground layer on the application board on both the top layer and with multiple vias to other GND planes on lower layers.
- Provide a ground plane as wide as possible on the application board.
- Optimize the thermal design of any high power component included in the application, such as linear regulators and amplifiers to minimize the temperature distribution in the application device.
- Select the material, thickness and surface of the mechanical enclosure of the end product in such a way that it provides good thermal dissipation.
- Force ventilation air-flow within the mechanical enclosure.
- Provide a heat sink component attached to the application board, on the opposite side of the ODIN-W2 module, as a large part of the heat is transported through the GND pads and dissipated over the backside of the application device.

3.9 ESD guidelines

The ODIN-W2 series module contains no ESD protection on any signals. Required ESD protection must be implemented by the interface board.

3.10 Schematic for ODIN-W2

Figure 10 is an example of an ODIN-W2 connected to a 3.3V application:

- A 3.3 V/1.8 level converter (Texas Instrument TXS0108E) is between the 3.3 V application processor and the 1.8 V ODIN-W2 UART Interface. The level converter is an 8-bit bidirectional voltage-level translator for Open-Drain and Push-Pull Application. Maximum speed for Push-Pull is 60 Mbps. If fewer signals are used (for example, only TxD/RxD and RTS/CTS) SN74AVC4T245 could be a good choice (2x2 bits). The level converter is supplied with 1.8 V from the ODIN-W2 V_INT output supply pin.
- The external LPO clock is at 1.8 V level. In the example below, a 3.3V LPO is available in the application and shared with the ODIN-W2 through the 3.3/1.8V level converter.
- An RGB LED is controlled by the LED signals through the open drain “glue” logic 74LVC3G07. The logic gates are supplied with 1.8 V from the ODIN-W2 V_INT output supply pin.
- Push buttons are connected to the SWITCH_0, SWITCH_1 and RESET_N signals. If the button pins have to be externally accessible on the application device, an ESD protection device should be provided close to accessible point. The SWITCH_1 button is connected through series resistors to prevent a short circuit when the multiplexed (GREEN/SWITCH_1) signal is high.

- The RESET_N should be driven from a GPIO on the host platform to enable reset/restore functionality.

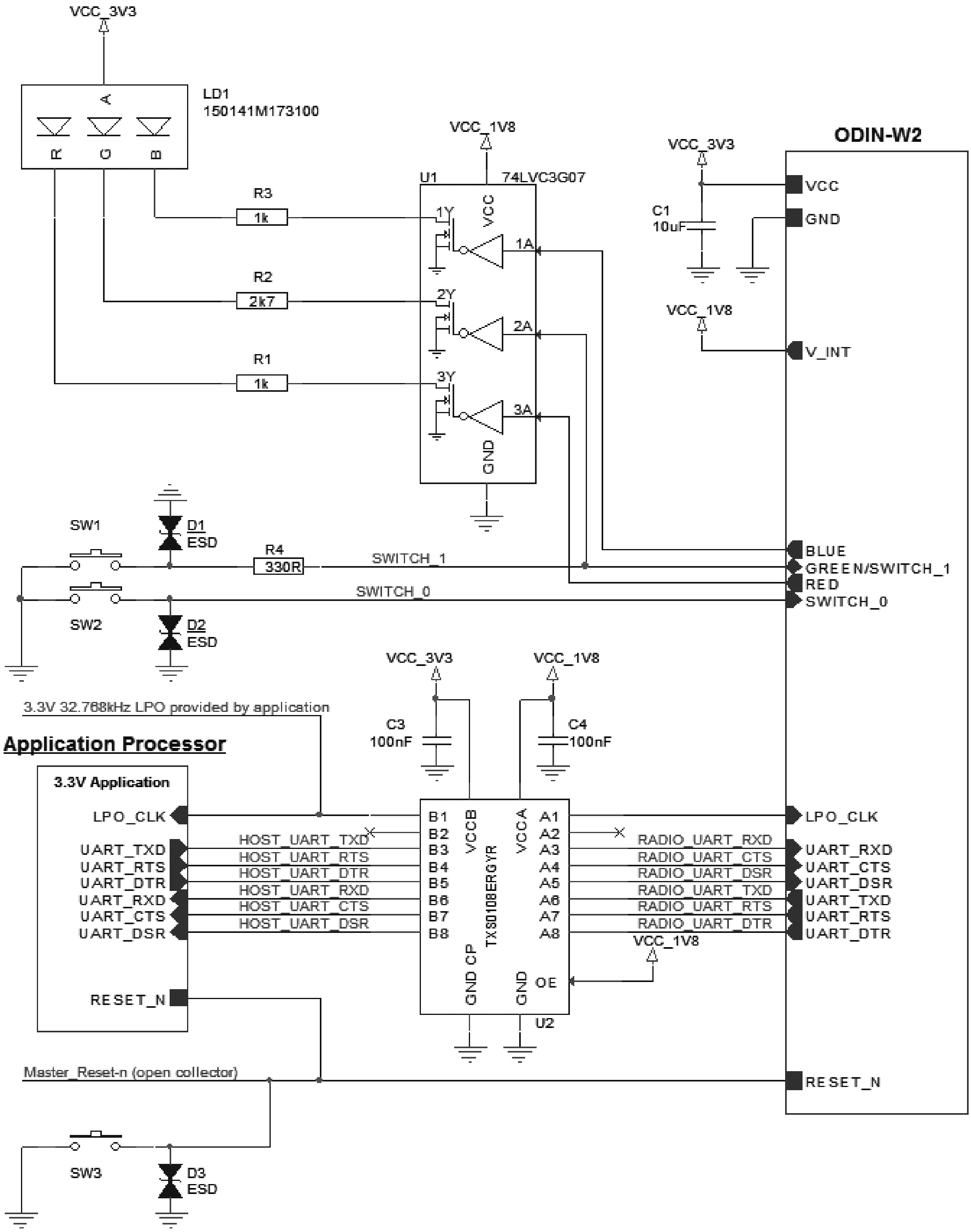


Figure 10: A complete ODIN-W2 design in a 3.3 V application

4 Handling and soldering

☞ No natural rubbers, hygroscopic materials or materials containing asbestos are employed.

4.1 Packaging, shipping, storage and moisture preconditioning

For information pertaining to the ODIN-W2 series reels/tapes, Moisture Sensitivity levels (MSL), shipment and storage information, and drying for preconditioning, refer to *ODIN-W2 series Data Sheet [2]* and *u-blox Package Information Guide [4]*.

4.2 Handling

The ODIN-W2 series modules are Electro-Static Discharge (ESD) sensitive devices.

⚠ Ensure ESD precautions are implemented while handling the module.

The ESD is the sudden and momentary electric current that flows between two objects at different electrical potentials caused either by direct contact or induced by an electrostatic field. The term is usually used in the electronics and other industries to describe momentary unwanted currents that may cause damage to the electronic equipment.

The ESD sensitivity for each pin of the ODIN-W2 series modules (as Human Body Model according to JESD22-A114F) is specified in the *ODIN-W2 series Data Sheet [2]*.

The ESD prevention is based on establishing an Electrostatic Protective Area (EPA). The EPA can be a small working station or a large manufacturing area. The main principle of an EPA is that there are no highly charging materials near ESD sensitive electronics, all conductive materials are grounded, workers are grounded, and charge build-up on ESD sensitive electronics is prevented. International standards are used to define typical EPA and can be obtained for example, from International Electrotechnical Commission (IEC) or American National Standards Institute (ANSI).

In addition to standard ESD safety practices, the following measures should be taken into account while handling the ODIN-W2 series modules:

- Unless there is a galvanic coupling between the local GND (that is, the work table) and the PCB GND, the first point of contact when handling the PCB, must always be between the local GND and PCB GND.
- Before mounting an antenna patch, connect ground of the device.
- When handling the module, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (for example, patch antenna, coax cable, soldering iron and so on).
- To prevent electrostatic discharge through the RF pin, do not touch any exposed antenna area. If there is any risk that such exposed antenna area is touched in non ESD protected work area, implement proper ESD protection measures in the design.
- When soldering the module, make sure to use an ESD safe soldering iron.

For more robust designs, employ additional ESD protection measures on the application device integrating the ODIN-W2 series modules, as described in the ESD guidelines section.

4.3 Soldering

4.3.1 Solder paste

No clean solder paste is strongly recommended for the ODIN-W2 series modules as it does not require cleaning after the soldering process. The paste listed in Table 6 meets these criteria:

Soldering Paste	OM338 SAC405 / Nr.143714 (Cookson Electronics)
Alloy specification	95.5% Sn / 3.9% Ag / 0.6% Cu (95.5% Tin / 3.9 % Silver / 0.6% Copper) 95.5% Sn / 4.0% Ag / 0.5% Cu (95.5% Tin / 4.0% Silver / 0.5% Copper)
Melting Temperature	217 – 220 °C
Stencil Thickness	150 µm for base boards

Table 6: Soldering paste information

The final choice of the solder paste depends on the approved manufacturing procedures. The paste-mask geometry for applying solder paste should meet the recommendations in Module footprint and paste mask section.

☞ The quality of the solder joints on the connectors ('half vias') should meet the appropriate IPC specification.

4.3.2 Reflow soldering

A convection type-soldering oven is strongly recommended over the infrared type radiation oven. The convection heated ovens allow precise control of the temperature and all parts will be heated up evenly regardless of material properties, thickness of components, and surface color.

Consider the "IPC-7530 Guidelines for temperature profiling for mass soldering (reflow and wave) processes", published during 2017. Select the reflow profiles as per the following recommendations:

⚠ Failure to observe these recommendations can result in severe damage to the device!

Controlled atmosphere
Soldering the ODIN-W2 module in a controlled atmosphere (for example N_2) is strongly recommended during the whole reflow, especially when the temperature is above 150 °C.

Preheat phase

Initial heating of component leads and balls. Residual humidity will be dried out. Note that this preheat phase will not replace prior baking procedures.

- Temperature rise rate: maximum 3 °C/s.
  If the temperature rise is too rapid in the preheat phase it may cause excessive slumping.
- Time: 60 to 120 seconds:
  If the preheat is insufficient, rather large solder balls could be generated. Conversely, if performed excessively, fine balls and large balls will be generated in clusters.
- End Temperature: 150 °C to 200 °C:
  If the temperature is too low, non-melting tends to be caused in areas containing large heat capacity.

Heating and reflow phase

The temperature rises above the liquidus temperature of 217 °C. Avoid a sudden rise in temperature as the slump of the paste could become worse.

- Limit time above 217 °C liquidus temperature: 40 to 60 s
- Peak reflow temperature: 245 °C

Cooling phase

A controlled cooling avoids negative metallurgical effects (solder becomes more brittle) of the solder and possible mechanical tension in the products. Controlled cooling helps to achieve bright solder fillets with a good shape and low contact angle.

- Temperature fall rate: max 2 °C/s between 200 °C and a higher peak temperature; max 4 °C/s when the temperature is below 200 °C.

☞ The modules should be placed on the topside of the motherboard during soldering to avoid falling off.

The soldering temperature profile chosen at the factory depends on additional external factors like choice of soldering paste, size, thickness and properties of the base board and so on.

⚠ Exceeding the maximum soldering temperature and the maximum liquidus time limit in the recommended soldering profile can permanently damage the module.

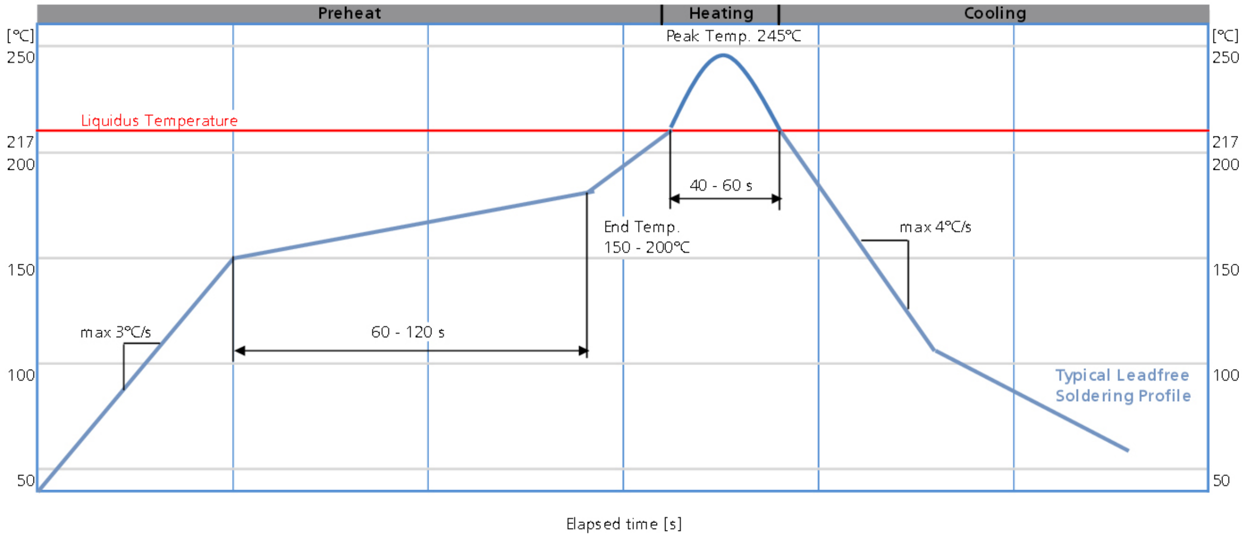


Figure 11: Recommended soldering profile

☞ The modules must not be soldered with a damp heat process.

4.3.3 Optical inspection

After soldering the ODIN-W2 series modules, inspect the modules optically to verify that the module is properly aligned and centered.

4.3.4 Cleaning

Cleaning the modules is not recommended. Residues underneath the modules cannot be easily removed with a washing process.

- Cleaning with water will lead to capillary effects where water is absorbed in the gap between the baseboard and the module. The combination of residues of soldering flux and encapsulated water leads to short circuits or resistor-like interconnections between neighboring pads. The water will also damage the sticker and the ink-jet printed text.
- Cleaning with alcohol or other organic solvents can result in soldering flux residues flooding into the two housing areas that are not accessible for post-wash inspections. The solvent will also damage the sticker and the ink-jet printed text.
- Ultrasonic cleaning will permanently damage the module especially, the quartz oscillators.

For best results use a “no clean” soldering paste and eliminate the cleaning step after the soldering.

4.3.5 Repeated reflow soldering

Only a single reflow soldering process is encouraged for boards with a module populated on it. The reason for this is the risk of the ODIN-W2 module falling off due to high weight in relation to the adhesive properties of the solder or the mated RF coaxial cable.

4.3.6 Wave soldering

Boards with combined through-hole technology (THT) components and surface-mount technology (SMT) devices require wave soldering to solder the THT components. Only a single wave soldering process is encouraged for boards populated with the modules.

4.3.7 Hand soldering

Hand soldering is not recommended.

4.3.8 Rework

Rework is not recommended.

☞ Never attempt a rework on the module itself; for example, replacing individual components. Such actions immediately terminate the warranty.

4.3.9 Conformal coating

Certain applications employ a conformal coating of the PCB using HumiSeal® or other related coating products.

These materials affect the HF properties of the modules and it is important to prevent them from flowing into the module. The RF shields do not provide protection for the module from coating liquids with low viscosity, therefore care is required while applying the coating.

☞ Conformal coating of the module will void the warranty

4.3.10 Casting

If casting is required, use viscose or another type of silicon pottant. The OEM is strongly advised to qualify such processes in combination with the modules before implementing this in the production.

☞ Casting will void the warranty.

4.3.11 Grounding metal covers

Attempts to improve grounding by soldering ground cables, wick or other forms of metal strips directly onto the EMI covers is done at the customer's own risk. The numerous ground pins should be sufficient to provide optimum immunity to interferences and noise.

☞ u-blox gives no warranty for damages to the modules caused by soldering metal cables or any other forms of metal strips directly onto the EMI covers.

4.3.12 Use of ultrasonic processes

The short range modules contain components that are sensitive to ultrasonic waves. Use of any ultrasonic processes (cleaning, welding and son) may cause damage to the module.

☞ u-blox gives no warranty against damages to the modules caused by any ultrasonic processes.

5 Qualifications and approvals

⚠ ODIN-W263 is configured to always support the ETSI domain and is only allowed to be used in countries allowing ETSI domain channels.

See *ODIN-W2 series Data Sheet [2]* for the qualifications and approvals for the ODIN-W2 series module.

6 Product testing

6.1 u-blox In-Series production test

u-blox focuses on high quality for its products. All units produced are fully tested automatically in production line. Stringent quality control process has been implemented in the production line. Defective units are analyzed in detail to improve the production quality.

This is achieved with automatic test equipment (ATE) in production line, which logs all production and measurement data. A detailed test report for each unit can be generated from the system. Figure 12 illustrates typical automatic test equipment (ATE) in a production line.

The following tests are performed as part of the production tests:

- Digital self-test (software download, MAC address programming)
- Measurement of current
- Functional tests
- Digital I/O tests
- Measurement and verification of RF characteristics in all supported bands (calibration not needed since performed automatically by radio chip every 5 minutes during normal operation)
    - Modulation and frequency accuracy
    - Power levels
    - Sensitivity

Figure 12: Automatic test equipment for module test

6.2 OEM manufacturer production test

As the testing is already done by u-blox, an OEM manufacturer does not need to repeat software tests or measurement of the module's RF performance or tests over analog and digital interfaces in their production test.

However, an OEM manufacturer should focus on:

- Module assembly on the device; it should be verified that:
    - Soldering and handling process did not damage the module components
    - All module pins are well soldered on device board
    - There are no short circuits between pins
- Component assembly on the device; it should be verified that:
    - Communication with host controller can be established

- o The interfaces between module and device are working
- o Overall RF performance test of the device including antenna

Dedicated tests can be implemented to check the device. For example, the measurement of module current consumption when set in a specified state can detect a short circuit if compared with a "Golden Device" result.

The standard operational module software and test software on the host can be used to perform functional tests (communication with the host controller, check interfaces) and to perform basic RF performance tests.

6.2.1 "Go/No go" tests for integrated devices

A "Go/No go" test compares the signal quality with a "Golden Device" in a location with known signal quality. This test can be performed after establishing a connection with an external AP or station.

Example commands that can be used to get the signal quality are:

- AT+UBTI Bluetooth Inquiry
- AT+UBTD BLE Discovery
- AT+UWSCAN WiFi Scan

More information about the AT commands and the required parameters can be found in the *u-blox Short Range AT Commands Manual [1]*.

A very simple test can be performed by just scanning for a known AP on a specific frequency and checking the signal level.

☞ These kinds of test may be useful as a "go/no go" test but not for RF performance measurements.

This test is suitable to check the functionality of the communication with the host controller and the power supply. It is also a means to verify if components are well soldered.

A basic RF functional test of the device including the antenna can be performed with standard Wi-Fi and/or Bluetooth devices as remote stations. The device containing the ODIN-W2 series module and the antennas should be arranged in a fixed position inside an RF shield box to prevent interferences from other possible radio devices to get stable test results.

Appendix

A Glossary

Abbreviation	Definition
ADC	Analog to Digital Converter
BT	Bluetooth
CAN	Controller Area Network
CTS	Clear To Send
DC	Direct Current
DSR	Data Set Ready
DTR	Data Terminal Ready
ESD	ElectroStatic Discharge
FW	Firmware
GND	Ground
GPIO	General Purpose Input Output
H	High
I	Input (means that this is an input port of the module)
IEEE	Institute of Electrical and Electronics Engineers
I2C	Inter-Integrated Circuit
L	Low
LDO	Low Drop Out
LPO	Low Power Oscillator
MCU	Microcontroller
MIMO	Multi-Input Multi-Output
N/A	Not Applicable
O	Output (means that this is an output port of the module)
PCN / IN	Product Change Notification / Information Note
PD	Pull-Down
PIFA	Planar inverted-F antenna
PU	Pull-Up
RF	Radio frequency
RMII	Reduced Media Independent Interface
RTS	Request To Send
RXD	Receive Data
SDIO	Secure Digital Input Output
SPI	Serial Peripheral Interface
TXD	Transmit Data
UART	Universal Asynchronous Receiver-Transmitter serial interface
USB	Universal Serial Bus

Table 7: Explanation of the abbreviations and terms used

B Checklist

B.1 Schematic checklist

No.	Description	Status
1.	Reserved pins not connected.	
2.	Correct voltage level for all interfaces.	
3.	Verify the startup sequence.	
4.	Errata reviewed for all chips and modules.	
5.	VCC supply must be provided and stay within operating conditions.	
6.	External LPO_CLK must stay within operating conditions, if applied.	
7.	Check UART signal direction.	
8.	Provide proper precautions for ESD immunity as required on the application board.	

Table 8: Schematic checklist

B.2 Layout checklist

No.	Description	Status
1.	Avoid noise and crosstalk on LPO Clock routing.	
2.	Route power with trace wide enough to handle the power consumption of the ODIN-W2 module. Also avoid injecting noise on the power trace.	
3.	Avoid routing on the top layer underneath the ODIN-W2 module.	
4.	Make sure to add good grounding underneath the ODIN-W2 series module. Multiple GND vias should be used both for thermal relief and grounding.	

Table 9: Layout checklist

C XMODEM code example

Example showing a basic XMODEM implementation and a CRC calculation in C#.

```
private const int XMODEM_ACK = 6;
private const int XMODEM_NAK = 21;
private const int XMODEM_EOT = 4;

public Boolean XModemSend(Stream inputStream)
{
        byte blockCnt = 0;
        Boolean result = false;
        BufferedStream bufferedInput = new BufferedStream(inputStream);
        byte[] block = new Byte[133];
        int bytesRead;

        do {
                for (int i = 0; i < 133; i++) {
                        block[i] = 0;
                }
                bytesRead = bufferedInput.Read(block, 3, 128);
                blockCnt++;

                block[0] = 1;
                block[1] = blockCnt;
                block[2] = (byte)(255 - blockCnt);

                ushort crc = xmodemCalcrc(block, 3, 128);
                block[131] = (Byte)((crc >> 8) & 0xFF);
                block[132] = (Byte)(crc & 0xFF);

                try {
                        this.Write(block, 0, block.Length);
                } catch (Exception) {
                        result = false;
                        break;
                }
                try {
                        Byte res = (Byte)this.ReadByte();

                        while (res == 'C') {
                                res = (Byte)this.ReadByte();
                        }

                        if (res == XMODEM_ACK) {

                                DebugPrint("Bytes sent {0}", bytesRead));

                                if (bytesRead < 128) {
                                        byte[] eot = new byte[1];
                                        eot[0] = XMODEM_EOT;
                                        this.Write(eot, 0, 1);
                                        res = (Byte)this.ReadByte();

                                        if (res == XMODEM_ACK) {
                                                /* File sent ok */
                                                result = true;
                                        } else {
                                                result = false;
                                        }
                                }
                        } else {
                                // No ACK received, stop transmission no retransmission implemented
                                result = false;
                                break;
                        }
                } catch (TimeoutException) {
                        result = false;
                        break;
                }
        }
        while (bytesRead == 128);
        DebugPrint("Bytes sent {0}", bytesRead));
        bufferedInput.Close();

        return result;
}
```

CRC calculation

```
/* Calculate the 16bit CRC for XMODEM */
/* byte = data buffer in the xmodem block */
/* count = number of data bytes */
/* offset = where to start the calculation */
private ushort xmodemCalcrc(byte[] buffer, int offset, int count)
{
         ushort crc, i;
         int j;

         crc = 0;

         for (j = offset; j < count + offset; j++) {
                  crc = (ushort)(crc ^ (buffer[j] << 8));

                  for (i = 0; i < 8; i++) {
                           if ((crc & 0x8000) > 0) {
                                    crc = (ushort)((crc << 1) ^ 0x1021);
                           } else {
                                    crc = (ushort)(crc << 1);
                           }
                  }
         }

         return (ushort)(crc & 0xFFFF);
}
```

Related documents

[1] u-blox Short Range Modules AT Commands Manual, document number UBX-14044127
[2] ODIN-W2 series Data Sheet, document number UBX-14039949
[3] ODIN-W2 series Getting Started Guide UBX-15017452
[4] u-blox Package Information Guide, document number UBX-14001652
[5] stm32flash.exe http://stm32flash.sourceforge.net/
[6] s-center evaluation software https://www.u-blox.com/en/product/s-center
[7] XMODEM https://en.wikipedia.org/wiki/XMODEM

☞ For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (www.u-blox.com).

Revision history

Revision	Date	Name	Comments
R01	21-Apr-2015	fbro	Initial release.
R02	15-Jul-2015	fbro	Major updates.
R03	23-Sep-2015	fbro	Major updates in all the sections. Updated the document status to Advance information.
R04	29-Jan-2016	fbro	Updated the document status to Early production information. Modified **Table 1**. Added section about Production testing. Rearranged sections to align with other short range manuals. Moved Antenna list to ODIN-W2 Datasheet. Other minor updates.
R05	20-Jul-2016	mwej, fbro	Updated to product version ODIN-W26x-01B-00. Updated key features of the ODIN-W2 series (**Table 1**). Added China and Taiwan approval info in Qualifications and approvals section. Added compliance information for Australia and New Zealand in Qualification and approvals section. Clarified formation about DSR/DTR and SW0/SW1 in section **1.4.3**.
R06	30-Sept-2016	fbro, hwin	Added information about GPIO pins (section **1.7**). Added pin ID for GPIO mapping in pin description (section **1.2.2**). Added support for Firmware 3.0.0. Removed information in Qualification and approvals chapter as this information is provided in the ODIN-W2 series Datasheet.
R07	02-Dec-2016	fbro	Added example on PHY implementation (section **1.5.2**). Included mbed information from ODIN-W2 SIM addendum mbed (section **1.5.3**). Included a new section for Software (Section **2**) and Appendix C.
R08	03-Jan-2017	kgom	Included support for ODIN-W2 firmware versions – 2.0.2 and 3.0.1. On page 2, replaced Document status with Disclosure restriction.
R09	30-Mar-2017	fbro, kgom	Included support for ODIN-W2 firmware version 4.0.0. Updated Table 1.
R10	1-Sep-2017	fbro, kgom	Included support for ODIN-W2 software version 4.0.1. Updated Table 1. Replaced firmware with software.
R11	13-Sep-2017	apet, kgom	Included Arm Mbed pin numbers in pin description for ODIN-W2 (Table 2).
R12	22-Dec-2017	ajah, kgom	Included support for ODIN-W2 software version 5.0.0. Updated section 1.1. Updated the note in section 1.6.1 to reflect support for 2x2 MIMO from software version 5.0.0 onwards. Updated Production test (sections 6.1 and 6.2) with test and calibration information.
R13	26-Jan-2018	kgom	Included support for ODIN-W2 software version 5.0.1.
R14	14-Mar-2018	apet, fbro	Added information about test points to the pin list (Table 2). Added flashing instructions for an Arm Mbed application (section 2.3).
R15	20-Jun-2018	kgom	Included support for ODIN-W2 software version 6.0.0. Updated Table 1.
R16	14-Nov-2018	kgom	Included support for ODIN-W2 software version 6.0.1.
R17	19-Dec-2019	fbro, mwej	Added recommendation on N2 during soldering in section 4.3.2. Updated applicable products table (page 2) with ODIN-W263 and removed obsolete product variants. Updated product feature table (Table 1).
R18	22-Jan-2020	fbro	Updated soldering instructions

Contact

For complete contact information, visit us at www.u-blox.com.

u-blox Offices

North, Central and South America

u-blox America, Inc.
Phone: +1 703 483 3180
E-mail: info_us@u-blox.com

Regional Office West Coast:
Phone: +1 408 573 3640
E-mail: info_us@u-blox.com

Technical Support:
Phone: +1 703 483 3185
E-mail: support@u-blox.com

Headquarters
Europe, Middle East, Africa

u-blox AG
Phone: +41 44 722 74 44
E-mail: info@u-blox.com
Support: support@u-blox.com

Asia, Australia, Pacific

u-blox Singapore Pte. Ltd.
Phone: +65 6734 3811
E-mail: info_ap@u-blox.com
Support: support_ap@u-blox.com

Regional Office Australia:
Phone: +61 2 8448 2016
E-mail: info_anz@u-blox.com
Support: support_ap@u-blox.com

Regional Office China (Beijing):
Phone: +86 10 68 133 545
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Chongqing):
Phone: +86 23 6815 1588
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Shanghai):
Phone: +86 21 6090 4832
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Shenzhen):
Phone: +86 755 8627 1083
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office India:
Phone: +91 80 405 092 00
E-mail: info_in@u-blox.com
Support: support_in@u-blox.com

Regional Office Japan (Osaka):
Phone: +81 6 6941 3660
E-mail: info_jp@u-blox.com
Support: support_jp@u-blox.com

Regional Office Japan (Tokyo):
Phone: +81 3 5775 3850
E-mail: info_jp@u-blox.com
Support: support_jp@u-blox.com

Regional Office Korea:
Phone: +82 2 542 0861
E-mail: info_kr@u-blox.com
Support: support_kr@u-blox.com

Regional Office Taiwan:
Phone: +886 2 2657 1090
E-mail: info_tw@u-blox.com
Support: support_tw@u-blox.com