ZMDI
The Analog Mixed Signal Company

Data Sheet *Preliminary*

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ZWIR4512

Secure Low-Power Wireless IPv6 Module

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Brief Description

The ZWIR4512 enables secure low-power wireless IPv6 communication for sensors and small devices. ZMDI provides a user-programmable, royalty-free 6LoWPAN stack with mesh routing capability with the ZWIR4512. 6LoWPAN is an Internet Engineering Task Force (IETF) standard to build wireless, low-power IP-based sensor and device networks. These networks can easily be integrated into existing IT infrastructure or operate autonomously.

Secure communication is provided by standard-compliant implementations of the Internet Protocol Security (IPSec) protocol suite and the Internet Key Exchange Protocol version 2 (IKEv2), which enable highly secure end-to-end communication, including over unsecure network nodes.

The module is powered by an ARM® Cortex™-M3 microcontroller* and provides a rich set of GPIO and peripheral interfaces. Up to 192 kB of flash and 32 kB of RAM are available for the user application. Different low power modes are provided to save energy in battery-operated devices. The modules provide superior radio properties without the need for complicated external RF-design.

Hardware Features

- ARM® Cortex™-M3 32-bit microcontroller
- Up to 192 kB flash for user applications
- Up to 32 kB RAM for user applications
- Unique EUI64 address
- 2D barcode address label
- 4 (10) channels in EU (US) mode
- 19 GPIOs with multiplexed peripheral functions:
  - 2 x UART, SPI, 3 x ADC, 2 x DAC, 11 x PWM, USB, CAN, I2C, 8 x Timer
  - Several 5 V tolerant I/Os available
- Low current consumption:
  - 3.5 µA Standby Mode
  - 13.5 mA Receive Mode
  - 18.5 mA Transmit Mode @ 0 dBm
- Modulation schemes
  - BPSK (20 kBps EU, 40 kBps US)
  - O-QPSK (100 kBps EU, 250 kBps US)
- Receiver sensitivity: up to -110 dBm
- TX output power: up to 10 dBm (US Mode)
- ETSI / FCC compliant

Firmware Features

- Serial command interface with built in security and over-the-air (OTA) update functionality
- Royalty-free library bundle for custom firmware
  - 6LoWPAN communication library with mesh routing capability
  - IPSec and IKEv2 security libraries
  - Over-the-air update library
  - Several peripheral libraries

Benefits

- Uniquely simple programmability
- Standard-compliant security solution
- No need for external microcontroller
- Plug-and-Play integration into local land wide-area networks
- No RF design required
- Superior radio propagation

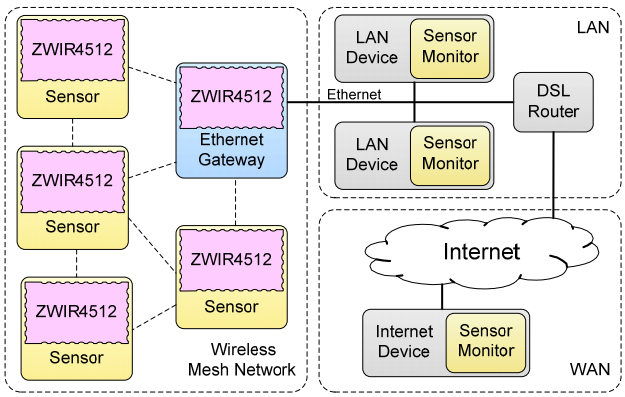
Available Support

- Development Kit
- Programming guide and application notes
- Ethernet-gateway firmware
- Example programs demonstrating C-API usage

Physical Characteristics

- Supply voltage: 2.0 V to 3.6 V
- Operating temperature: -20 °C to +70 °C
- 30-pin surface-mount package: 28 mm x 16.5 mm x 3.5 mm

Typical ZWIR4512 Application Setup



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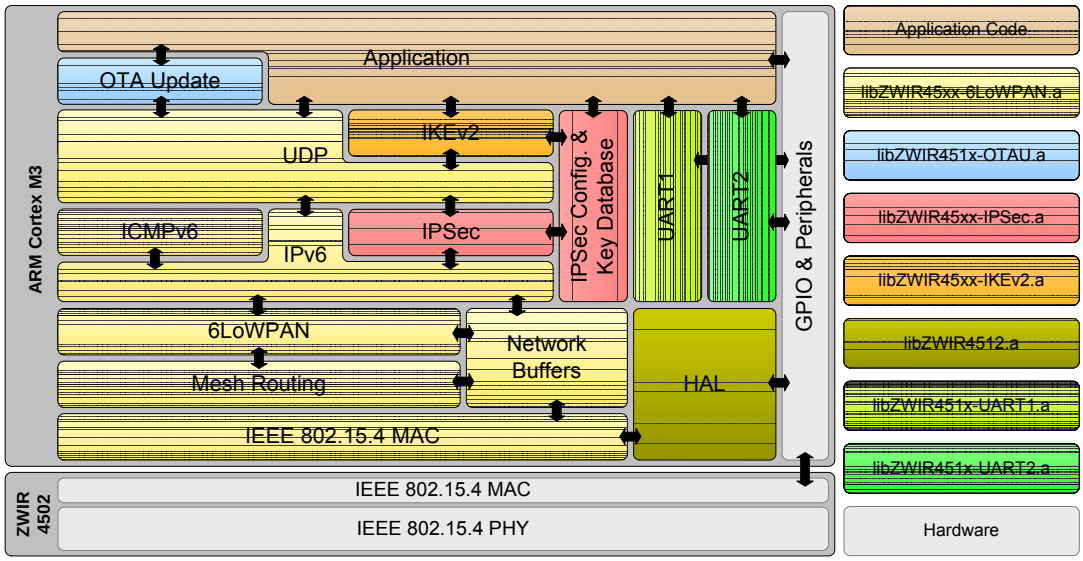
Stack Architecture

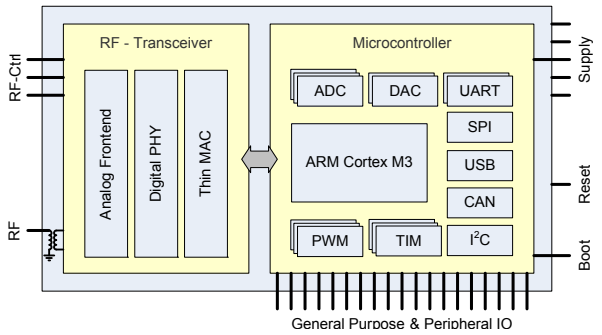


Applications

The ZWIR4512 serves as a universal secure radio communication module. Typical application examples include home and industry automation, health monitoring, smart metering / smart grid applications, and keyless entry systems.

Its very low current consumption makes the module suitable for battery-operated devices.

ZWIR4512 Block Diagram



Ordering Information

Product Sales Code	Description	Package
ZWIR4512AC1xA	Unprogrammed module for user application programs	30 pin SMT, 28 mm x 17 mm
ZWIR4512AC1xI	Preprogrammed module with serial command interface	30 pin SMT, 28 mm x 17 mm
ZWIR4512-Devkit	Development Kit	

Sales and Further Information

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1 Module Characteristics

1.1. Absolute Maximum Ratings

1.1.1. Voltage Characteristics

Parameter	Symbol	Min	Max	Unit
Main supply voltage	V_{CC}	-0.3	4	V
Backup supply voltage	V_{BAT}	-0.3	4	
Input voltage at 5V-tolerant GPIO pin	V_{IN}	-0.3	5.5	
Input voltage at any other GPIO pin		-0.3	V_{CC}+0.3	

1.1.2. Current Characteristics

Parameter	Symbol	Max	Unit
Total current consumption	I_{VCC}	175	mA
Driving strength of each GPIOx pin	I_{GPIO}	±25	
Driving strength of RF-control pins (PACTLN, PACTLP, DIG1)	I_{RFCTRL}	8	

1.1.3. Thermal Characteristics

Parameter	Symbol	Value	Unit
Storage temperature range	T_{STOR}	-50 to +150	°C
Ambient temperature range	T_{AMB}	-20 to +75	

1.2. Operating Conditions

1.2.1. General Operating Conditions

Note: *See important notes at the end of the table.*

Parameter	Symbol	Min	Typ	Max	Unit
Electrical Characteristics					
Main supply voltage – ADC not used	V_{CC}	2.0		3.6	V
Main supply voltage – ADC used	V_{CC}	2.4		3.6	
Backup supply voltage	V_{BAT}	1.8		3.6	
Digital I/O high level input voltage	V_{IH}	V_{CC} – 0.4			
Digital I/O low level input voltage	V_{IL}			0.4	
Digital I/O high level output voltage	V_{OH}	V_{CC} – 0.4			
Digital I/O low level output voltage	V_{OL}			0.4	
MCU Clock Characteristics					
MCU core clock frequency [1]	f_{AHB}	8		64	MHz
MCU core clock frequency accuracy range	Δf_{AHB}	-2		2.5	%
MCU peripheral bus 1 clock frequency [2]	f_{APB1}		4		MHz
MCU peripheral bus 2 clock frequency [2]	f_{APB2}		8		

Parameter		Symbol	Min	Typ	Max	Unit
RF Parameters						
Frequency range		f_{RF}	865		928	MHz
Output power [3]				5	10	dBm
Output power tolerance			-3		+3	dB
Receiver sensitivity	BPSK, EU Mode			-110		dBm
	BPSK, US Mode			-108		
	QPSK, EU Mode			-101		
	QPSK, US Mode			-101		
Gross data rate	BPSK, EU Mode			20		kBit/s
	BPSK, US Mode			40		
	QPSK, EU Mode			100		
	QPSK, US Mode			250		
Channel spacing	EU Mode			1		MHz
	US Mode			2		
Number of channels	EU Mode [4]			1 (+3)		
	US Mode			10		
Input/output impedance				50		Ω
Frequency offset			-10		+10	kHz
Spurious emission					tbd	

1. *The f_{CORE} clock can be configured to be 8, 16, 32 or 64 MHz. After Reset the clock is set to 8 MHz.*
2. *f_{APB1} and f_{APB2} are derived from f_{AHB}. Therefore, the same tolerances apply to these clocks.*
3. *10 dBm output power is only available in US Mode; EU Mode provides 5 dBm maximum output power.*
4. *The IEEE802.15.4 standard defines only 1 channel for EU Mode, but extension channels are available in almost all EU countries.*

1.2.2. Current Consumption per Operating Mode

Operating Mode	Condition	Typ	Unit
Run Mode	RX Mode	13.5	mA
	TX Mode, BPSK, 4dBm	23.5	
	TX Mode, QPSK, 4dBm	22.9	
	TX Mode, BPSK, 0dBm	19.1	
	TX Mode, QPSK, 0dBm	18.5	
	TRX Off	4.4	
Sleep Mode	TRX Off, RTC running	4.2	
Stop Mode	TRX Off, RTC running	23.5	µA
Standby Mode	TRX Off, RTC running	3.7	

2 Module Description

The ZWIR4512 is a programmable wireless IPv6 communication module. Communication is based on 6LoWPAN, a free and open communication standard developed by the Internet Engineering Task Force (IETF). This standard specifies how to transmit IPv6 (Internet Protocol Version 6) packets over low power wireless personal area networks.

ZWIR4512 modules come with a preprogrammed command interface, allowing modem-like communication based on simple commands sent over a serial interface. Alternatively, the module is freely programmable on the basis of an API which exposes abstract communication functionality to the programmer.

Both software options offer secure communication on the basis of the IP Security (IPSec) protocol suite. Additionally, an implementation of the Internet Key Exchange version 2 (IKEv2) is provided, in order to make key management as easy as possible. IPSec and IKEv2 are the mandated standards for securing IPv6 networks. Refer to *ZWIR45xx Application Note—Using IPSec and IKEv2 in 6LoWPANs* for more detailed information about IPSec and IKEv2.

The module comprises an STM32F103RC ARM® Cortex™-M3 microcontroller from ST Microelectronics and a ZWIR4502 transceiver from ZMDI. These components ensure leading edge performance values at very low power consumption. The module provides a hardware-programmed 64-bit MAC address which is guaranteed to be globally unique.

2.1. Radio Transceiver

The module includes ZMDI's ZWIR4502 radio transceiver. This circuit performs modulation and demodulation of outgoing and incoming data, respectively. The modulation scheme is configurable according to the IEEE802.15.4 standard. The radio transceiver is never accessed directly by application code. This task is performed by the communication stack, which encapsulates such low level functionality in abstract functions.

2.2. Microcontroller

The protocol stack and the user application are executed on an STM32F103RC microcontroller (MCU) from ST Microelectronics. It provides 256 kB flash and 48 kB SRAM memory. The MCU provides a rich set of peripherals and a number of general purpose input/output (GPIO) ports. The GPIO ports of the module are directly connected to the GPIOs of the MCU. Please refer to Table 4.2 for an exact mapping.

2.2.1. MCU Core

The MCU core is an ARM® Cortex™-M3. This is a 32-bit RISC core with a performance of 1.25 DMIPS/MHz. Using ZMDI's software stack, the maximum operating frequency is 64 MHz. This allows for computational intensive applications. In order to save power, the core can be shut off completely, waking up only on external activity.

2.2.2. Peripherals and Interfaces

The module was designed to make maximum use of the controller's internal peripherals. Up to 15 digital general purpose I/Os can be used by the application. Most of these I/Os have alternative functions. Some of them are 5V-tolerant. Table 2.1 lists all available communication interfaces with their performance values. The last column shows which interfaces are possibly interfering and therefore cannot be used in parallel.

Besides communication interfaces, the module also provides signal conversion peripherals. Three analog-to-digital converters (ADCs), two digital-to-analog converters (DACs) and two pulse-width modulation (PWM) peripherals are available.

Table 2.1 List of Peripheral Interfaces

Interface	MCU Peripheral	Comments	Module Pins	Not usable together with
UART1	USART1	MaxBaudrate: 230400	9,10,16,17 23,24	USB CAN
UART2	USART2	MaxBaudrate: 115200	5,6,7,8	TIM2-PWM, TIM5-PWM
SPI	SPI1	SCK Max Speed: 4 MHz	1,2,3,4	DAC1 DAC2
I2C	I2C1	400 kHz	23,24	TIM4-PWM
USB	OTG_FS		16,17	CAN
CAN	bxCAN		16,17	USB
PWM	TIM1	4 PWM channels 1 complementary output	1, 12,13,16	
	TIM2	4 PWM channels	5, 6, 7, 8 19	USART2, TIM5-PWM
	TIM3	1 PWM channel	1	SPI1
	TIM4	2 PWM channels	23, 24	I2C
	TIM5	4 PWM channels	5, 6, 7, 8	USART2, TIM2-PWM

2.2.3. Programming and Debugging

Programming and debugging the module is typically done via JTAG. All required MCU ports are connected to module pins for that purpose. Alternatively, Serial Wire Debug (SWD) can be used for programming and debugging. This requires just two bits that have to be reserved, providing two additional GPIO pins.

Alternatively, if debug functionality is not required, it is possible to program the module over a two-wire UART interface. This option allows using all GPIO pins provided by the module. For that purpose, the MCU's internal boot-loader must be started. This is done by holding the BSEL pin of the module high, while a reset is performed or the module is powered on. Please refer to the MCU documentation for more information about serial programming.

2.3. Firmware

2.3.1. Command Interface (CI) Firmware

A module programmed with the Command Interface firmware is able to act like a modem. In this configuration, the module is controlled over a serial interface that is SPI, USB, or one of the two UARTs. The CI Mode provides all standard communication functions like unicast and multicast data transmission and reception, as well as all security functions. Access to internal peripherals is limited in this mode. Typically, an external microcontroller or a PC is required to control module operation. However, for simple sensing or acting applications, it is also possible to configure the module to run autonomously without the need for an external controller. Please refer to the *ZWIR45xx Command Interface Manual* for further information.

2.3.2. C Application Programming Interface (C-API)

A C-API is provided for applications that should run directly on the embedded microcontroller. Communication and security functionalities are encapsulated in a set of libraries that export functions for accessing and controlling them. The library architecture is modular, allowing tailoring applications to user needs. Applications running on the microcontroller can make use of the rich set of peripherals that are provided by the controller.

Depending on the library configuration, there are up to 192 kB of flash and 32 kB of RAM available for the user application. This is sufficient even for complex applications with high memory needs. If over-the-air (OTA) update functionality is required, the amount of flash available for user applications is reduced to one half. For further information on C-API programming and over-the-air update, please refer to the *ZWIR451x Programming Guide* and the *ZWIR45xx Over-the-Air Update Manual*.

2.4. Power Modes

The ZWIR4512 module provides a set of operating modes with different capabilities and power requirements. This document only highlights the main features of these operating modes. Table 2.2 gives an overview of the characteristics of the available power modes. A table of typical power consumption in the different modes can be found in specification section 1.2.2.

Refer to the *ZWIR451x Programming Guide* for detailed usage instructions for the operating modes.

Table 2.2 Power Modes Overview

Mode	Wakeup		Clock		Context [1]	I/O	Transceiver
	Source	Time	MCU Core	Peripherals			
Run			On	On [2]	Retained	As configured	On [3]
Sleep	Any IRQ	1.8 µs	Off	Off [4]	Retained	As configured	Off [4]
Stop	RTC IRQ External IRQ	5.4 µs	Off	Off	Retained	As configured	Off [4]
Standby	RTC IRQ Wakeup pin	50 µs	Off	Off	Lost	Analog input	Off

1. *Refers to the status of the RAM and peripheral register contents after wakeup – the backup registers of the MCU are always available.*
2. *Clock is enabled for all peripherals that have been enabled by application code and all peripherals that are used by the library.*
3. *Can be powered off by application code.*
4. *Remains if peripheral/transceiver is selected as wakeup source.*

2.4.1. Run Mode

In Run Mode, all functions of the module are available. The microcontroller and all its peripherals are powered. Typically the transceiver is also powered, but it can be disabled by software. The module enters Run Mode automatically after startup. The application software must switch to one of the other operating modes if required.

2.4.2. Sleep Mode

In Sleep Mode, the microcontroller core is not clocked. The power state of the transceiver and the microcontroller peripherals depends on the wakeup configuration. All peripherals that are selected as wakeup source continue to operate. After wakeup, the application program continues execution at the position it was stopped. Sleep Mode allows reacting to external events such as the reception of data, external interrupts, or timer events. The power consumption in this mode strongly depends on which peripherals are enabled. The I/O configuration is not changed during Sleep Mode.

2.4.3. Stop Mode

Stop Mode is an ultra-low-power mode with RAM retention. The MCU core and the MCU peripherals are not clocked. Only the internal real-time clock or any external pin can be used for triggering wakeup from Stop Mode. After wakeup, the program continues execution at the position it was stopped. In Stop Mode, all I/Os remain in the configuration that was active when entering Stop Mode.

2.4.4. Standby Mode

Standby Mode is the lowest power mode. The transceiver and all microcontroller peripherals are consequently powered off. RAM contents are lost. Waking up from Standby Mode can be triggered by a real-time-timer event or by one dedicated pin. When going to Standby Mode, all I/Os are put into analog input mode, so the application circuit must ensure that external components receive defined signal levels if required. When the module exits Standby Mode, it is restarted from the reset handler in the same sequence as the restart after power-on or pressing the reset button.

3 Application Circuits

ZWIR4512 modules are designed to require minimal external circuitry. The following sections illustrate how modules must be connected in order to ensure proper power supply, reset behavior, programmability, and radio performance. Instructions for the connection of GPIO pins are not given.

3.1. Power Supply

All internal components of the ZWIR4512 that require a stable power supply are internally decoupled with a number of capacitors. Nevertheless, the module requires one external decoupling capacitor between VCC and GND. This is the minimal external circuitry required for proper operation.

The module provides two different power supply pins: VCC and VSTDBY. V_{CC} is the normal supply voltage that must be applied in Run, Sleep or Stop Mode. During Standby Mode, the module is powered by V_{STDBY} and V_{CC} can be switched off.

Figure 3.1 shows two possible power supply schemes. Scheme a) connects VSTDBY to the same voltage source as VCC. This is the commonly used configuration. However, scheme b) allows switching off V_{CC} in Standby Mode. This can help reduce power dissipation in applications with ultra-low power requirements. During the complete standby phase, VSTDBY is powered from a buffering capacitor.

Figure 3.1 Power Supply Schemes

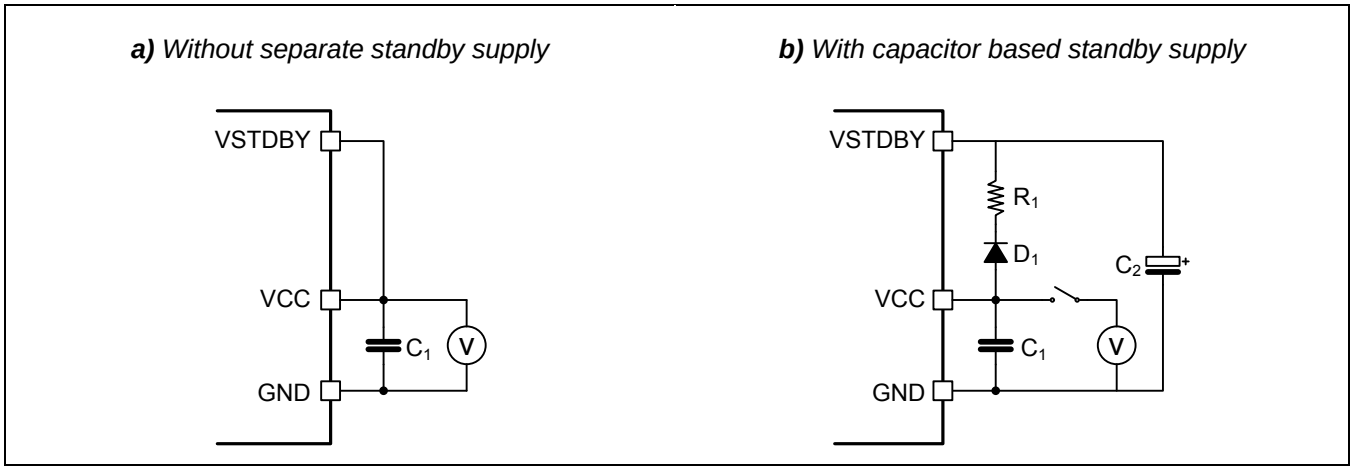


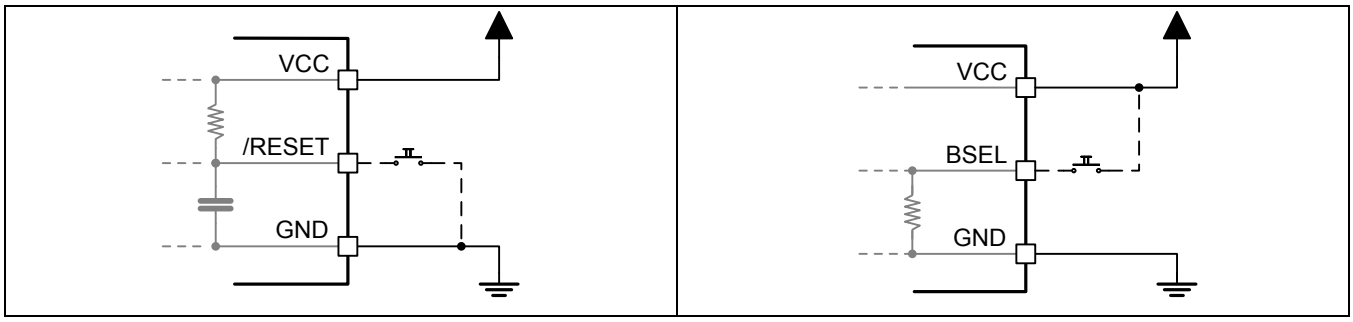
Table 3.1 External Power Supply Components

Symbol	Function	Value/Comment
C_1	Decoupling capacitor	Mandatory, 10 µF
R_1	Charge current limitation	6.8 k
D_1	Buffering capacitor discharge protection	Shottky diode, e.g. BAT54-02V
C_2	Buffering capacitor	> 0.1F

3.2. Reset and Boot Select

The reset pin is debounced and has a pull-up resistor on the PCB. Thus, a push-button can be connected directly to GND or the pin can be left unconnected if it is not required. The BSEL pin is pulled down internally. If BSEL is not required, it can be left unconnected. Figure 3.2 shows how these pins are connected externally and illustrates the internal circuitry.

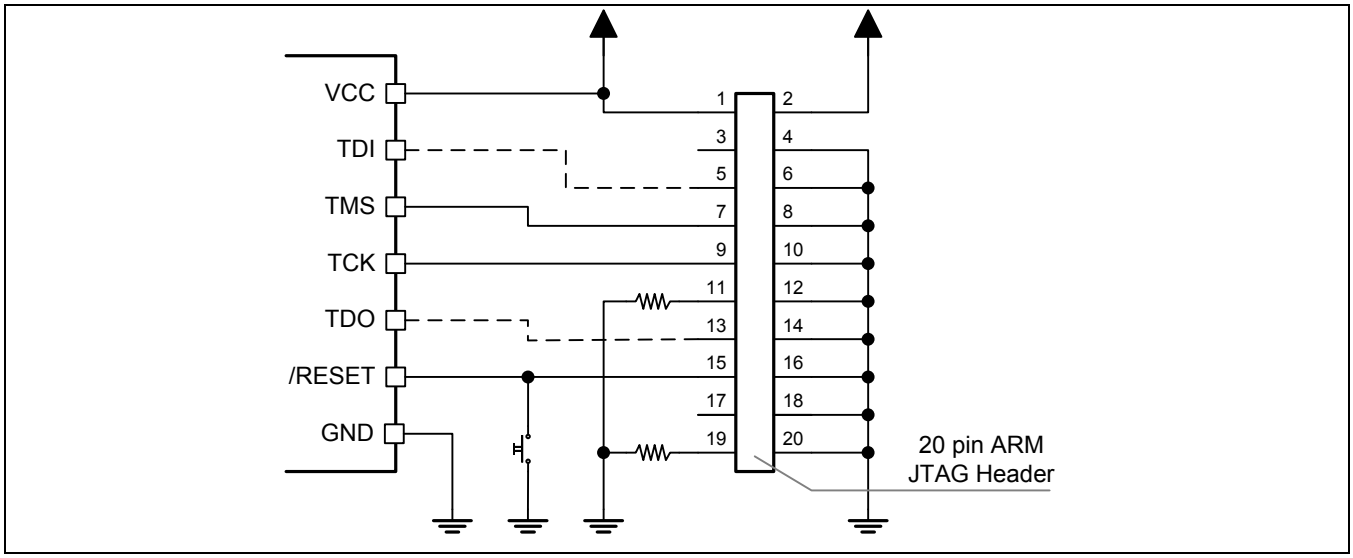
Figure 3.2 External Circuitry for /RESET and BSEL



3.3. Debug Access

The ZWIR4512 provides debug access by means of a JTAG or SWD interface. Figure 3.3 shows an example of connecting the module with a 20-pin standard ARM® JTAG header. If no JTAG connection is required, the dotted connections can be left out and two additional pins are available as GPIOs.

Figure 3.3 JTAG / SWD Connection for Programming and Debugging

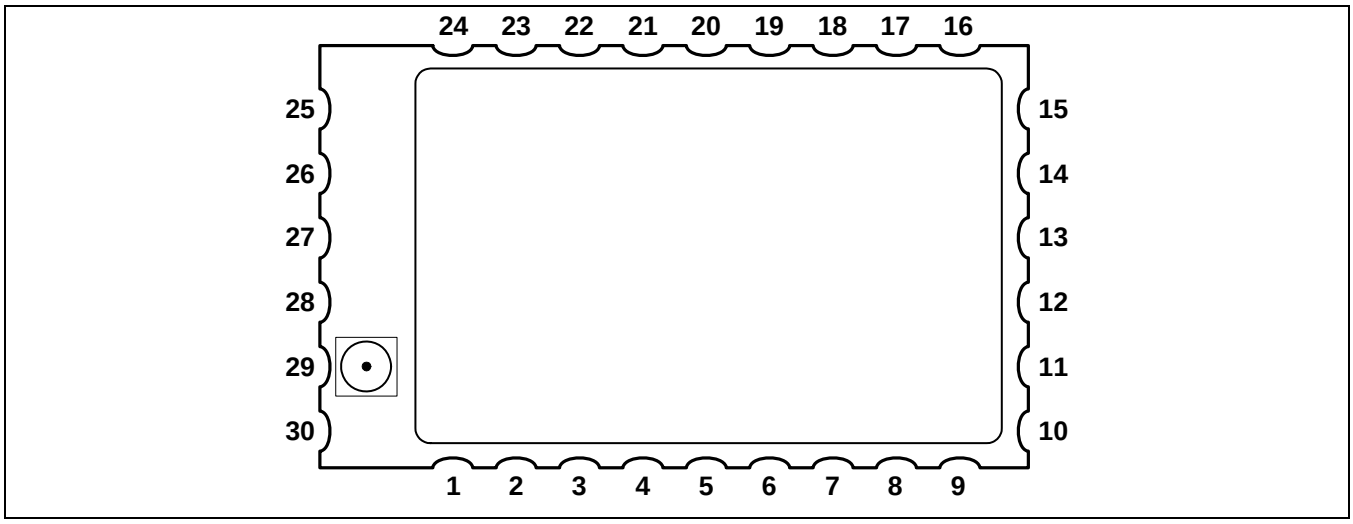


3.4. Antenna

There are two options to connect an external antenna. The antenna can be connected to the module using a coaxial cable that is mounted on the U.FL connector, or an external antenna terminal on the host PCB can be connected to the ANT pin. If the on-board U.FL connector is used, the ANT pin must be left unconnected. An external antenna must be connected with a 50 Ω microstrip wire.

4 Pinout

Figure 4.1 Module Pin-out



4.1. Command Interface Mode

Table 4.1 Pin Assignment in Command Mode

Pin Nr.	Name	Functional Description / Comments
1	SPI_MOSI	The SPI is either used as the command interface or as the sensor interface. For more detailed information, see the *ZWIR45xx Command Interface Manual*.
2	SPI_MISO	
3	SPI_SCK	
4	/SPI_SSN	
5	UART2_RX	UART2 is either used as the command interface or as the sensor interface. For more detailed information, see the *ZWIR45xx Command Interface Manual*.
6	UART2_TX	
7	/RX_ACTIVE	Pins available for the connection of indicator LEDS. Low active, open drain.
8	/TX_ACTIVE	
9	/IDLE	
10	/RESET	Pulling this pin to low resets the controller and the module.
11	GND	
12	UART1_RX	UART1 is either used as the command interface or as the sensor interface. For more detailed information, see the *ZWIR45xx Command Interface Manual*.
13	UART1_TX	
14	VCC	
15	BSEL	If this pin is driven high during startup or when releasing the RESET line, the device starts its internal boot-loader, allowing reprogramming the device via UART1 or USB. Connect to GND if not required.
16	USB_DM	USB can be used for the command interface
17	USB_DP	
18	VBAT	Standby Mode power supply

Pin Nr.	Name	Functional Description / Comments
19	Unused	
20	Unused	
21	Unused	
22	Unused	
23	Unused	
24	Unused	
25	Unused	Leave unconnected.
26	Unused	Leave unconnected.
27	Unused	Leave unconnected.
28	GND	
29	ANT	Amplified RF output for antenna connection.
30	GND	

4.2. API-Mode

Note: See important notes at the end of Table 4.2. Pins that have a checkmark in the “5V” column are 5V-tolerant.

Table 4.2 Pin Assignment in API Mode

Pin	Name	MCU Port	Type [1]	5V	Startup Function	Alternative Function
1	GPIO7	PA7	IO		GPIO (input mode)	SPI1 – MOSI ADC1 / ADC2 – IN7 PWM (TIM8-1N, TIM3-1, TIM1-1N)
2	GPIO6	PA6	IO		GPIO (input mode)	SPI1 – MISO ADC1 / ADC2 – IN6 PWM (TIM3-1) Timer Break (TIM1, TIM8)
3	GPIO5	PA5	IO		GPIO (input mode)	SPI1 – SCK DAC – OUT2 ADC1 / ADC2 – IN5
4	GPIO4	PA4	IO		GPIO (input mode)	SPI1 – NSS USART2 – CK DAC – OUT1 ADC1 / ADC2 – IN4
5	GPIO3	PA3	IO		GPIO (input mode)	USART2 – RX ADC1 / ADC2 / ADC3 – IN3 PWM (TIM2-4, TIM5-4)
6	GPIO2	PA2	IO		GPIO (input mode)	USART2 – TX ADC1 / ADC2 / ADC3 – IN2 PWM (TIM2-3, TIM5-3)

Pin	Name	MCU Port	Type [1]	5V	Startup Function	Alternative Function
7	GPIO1	PA1	IO		GPIO (input mode)	USART2 – RTS ADC1 / ADC2 / ADC3 – IN1 PWM (TIM2-2, TIM5-2)
8	GPIO0	PA0-WKUP	IO		GPIO (input mode)	WKUP USART2 – CTS ADC1 / ADC2 / ADC3 – IN0 PWM (TIM2-1, TIM5-1) Timer Trigger (TIM2)
9	GPIO12	PC13	IO		GPIO (input mode)	TAMPER-RTC
10	/RESET	NRST, PB4	I	✓	Reset	Not available
11	GND	GND	S		Ground	Not available
12	GPIO9	PA10	IO	✓	GPIO (input mode)	USART1 – RX PWM (TIM1-3)
13	GPIO8	PA9	IO	✓	GPIO (input mode)	USART1 – TX PWM (TIM1-2)
14	VCC	VCC	S		Power Supply	Not available
15	BSEL	BOOT0	I		Boot mode selection	Not available
16	GPIO10	PA11	IO	✓	GPIO (input mode)	USART1 – CTS USB – D- CAN – RX PWM (TIM1-4)
17	GPIO11	PA12	IO	✓	GPIO (input mode)	USART1 – RTS USB – D+ CAN – TX Timer Trigger (TIM1)
18	VSTDBY	VBAT	S		Alternative power supply for Standby Mode	Not available
19	TDO	PB3	IO	✓	JTAG – TDO	TRACESW SPI1 – SCK PWM (TIM2-2)
20	TMS	PA13	IO	✓	JTAG – TMS	GPIO [2]
21	TDI	PA15	IO	✓	JTAG – TDI	GPIO [3] SPI1 – NSS Timer Trigger (TIM2)
22	TCK	PA14	IO	✓	JTAG – TCK	GPIO [2]
23	GPIO14	PB7	IO	✓	GPIO (input mode)	I^2C – SDA UART1 – RX [4] PWM (TIM4-2)

Pin	Name	MCU Port	Type [1]	5V	Startup Function	Alternative Function
24	GPIO13	PB6	IO	✓	GPIO (input mode)	I^2C-SCL UART1 – TX PWM (TIM4-1)
25	DIG1	-	O			Not available
26	PACTLN	-	O		PA control (differential) complementary output	Not available
27	PACTLP	-	O		PA control (differential)	Not available
28	GND	GND	S		Ground	Not available
29	ANT	-	IO		Antenna pin	Not available
30	GND	GND	S		Ground	Not available

1. *The "Type" column indicates the type of the pin: IO - input/output, I - input only, O - output only, S - power supply.*
2. *In order to enable alternative functions, field SWJ_CFG in MCU register AFIO_MAPR must be set to 0b100!*
3. *In order to enable alternative functions, field SWJ_CFG in MCU register AFIO_MAPR must be set to 0b010 or 0b100!*
4. *Remapped function.*

5 Physical Characteristics

5.1. Module Dimensions

Figure 5.1 Package Drawing (top, side and bottom view)

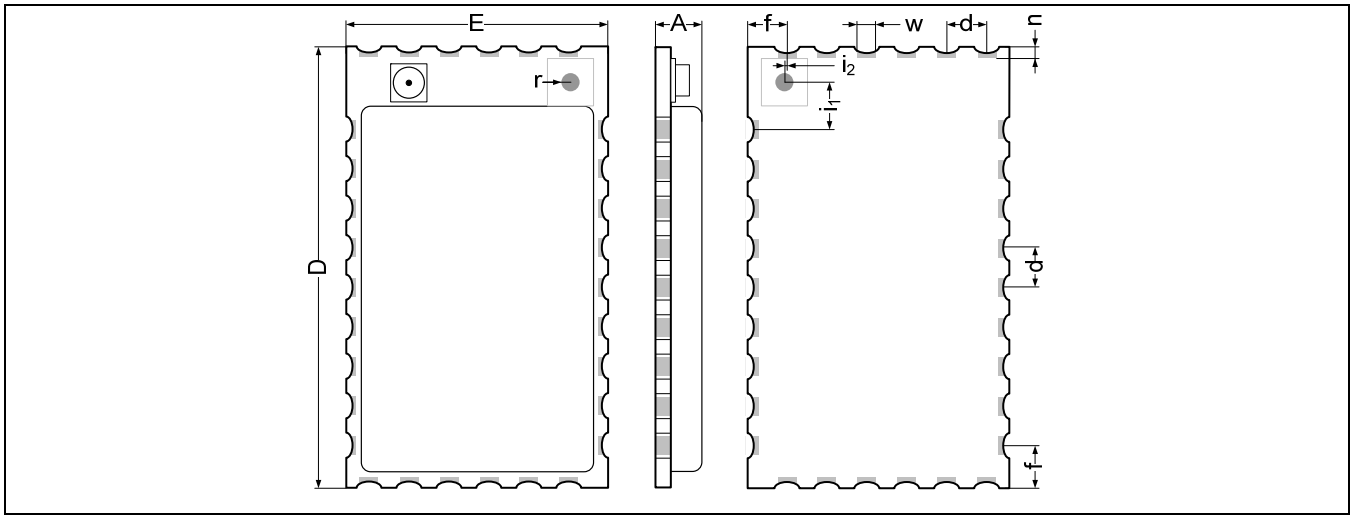
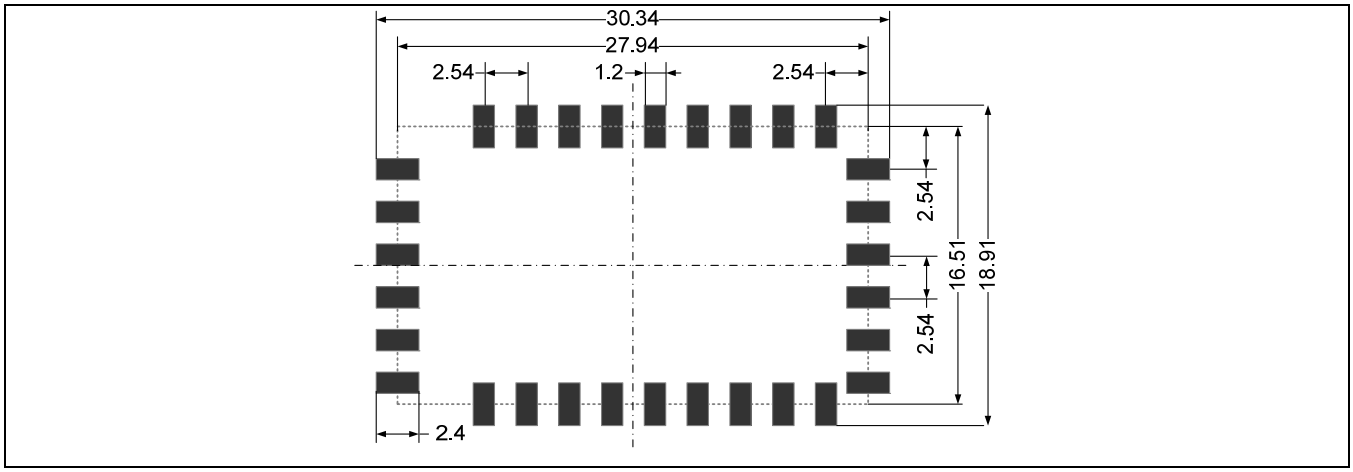


Table 5.1 Physical Dimensions and Tolerances

Symbol	Millimeters			Symbol	Millimeters		
	Min	Typ	Max		Min	Typ	Max
A	3.5	3.56	3.6	n		1	
D	tbd	27,94	tbd	w	1.08	1.1	1.12
E	tbd	16,51	tbd	i_1	tbd	2.67	tbd
d	tbd	2.54	tbd	i_2	tbd	0.27	tbd
f	tbd	2.54	tbd	r	tbd	0.5	tbd

5.2. Recommended PCB Footprint

Figure 5.2 Recommended PCB Footprint



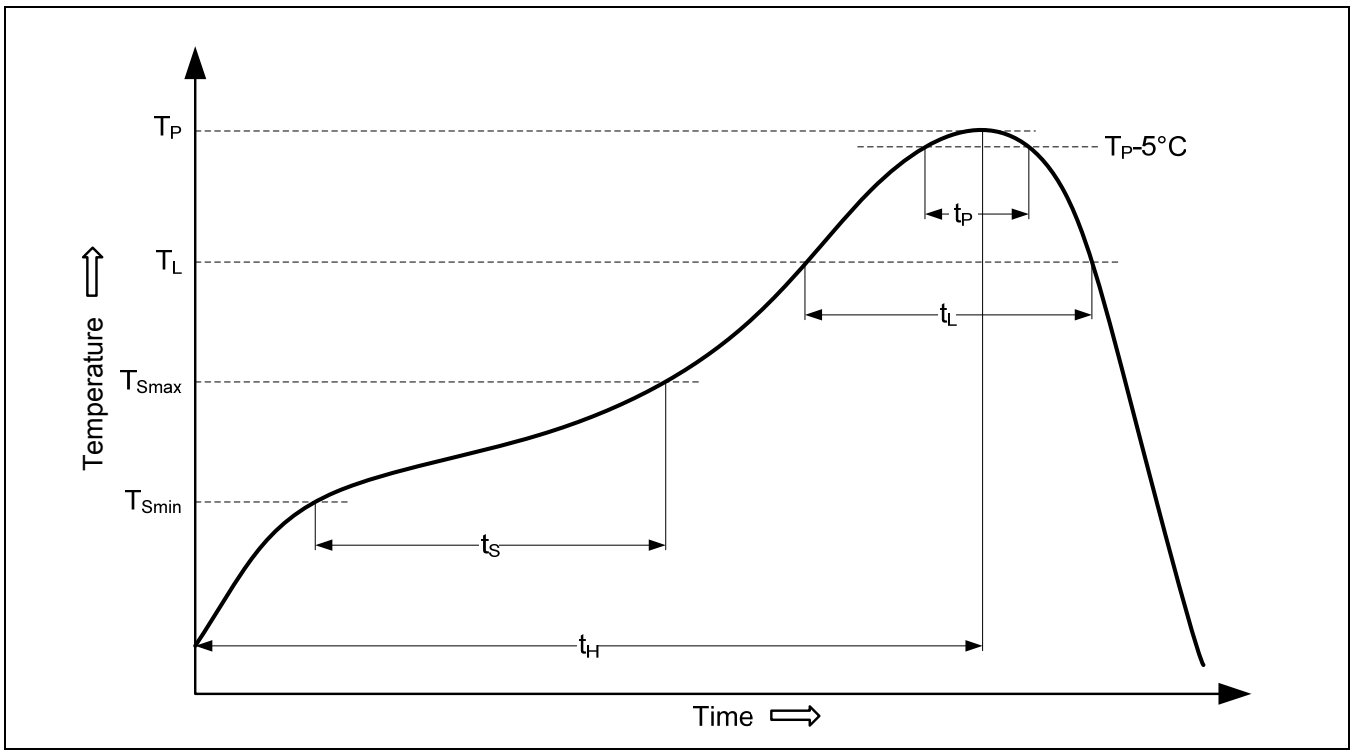
6 Soldering Information

To ensure that soldered connections do not break during the reflow soldering process of the application PCB, the soldering profile described in Figure 6.1 and Table 6.1 must be maintained. This profile is aligned with the profile defined in the IPC/JEDEC standard J-STD-020D.

Table 6.1 Soldering Profile Parameters (according to J-STD-020D)

Profile Feature	Symbol	Min	Max	Unit
Time 25°C to T_P	t_H		8	min
Peak package body temperature	T_P		260	°C
Preheat / Soak				
Soak temperature	T_S	100	150	°C
Soak time	t_S	60	120	s
Ramp-up				
Ramp-up rate	T_L to T_P		3	°C/s
Time maintained above T_L	t_L		150	s
Time within 5°C of T_P	t_P		30	s
Ramp-down				
Ramp-down rate	T_P to T_L		6	°C/s

Figure 6.1 Recommended Temperature Profile for Reflow Soldering (according to J-STD-020D)



7 Customization

For larger order quantities, it is possible to deliver modules with preprogrammed customer firmware. Depending on the quantity and user requirements, hardware customization to fit customer needs might be possible. Please contact our support team for requests regarding module customization.

8 Ordering Information

Product Sales Code	Description	Package
ZWIR4512AC1xA	Unprogrammed module for user application programs	30 pin SMT, 28 mm x 17 mm
ZWIR4512AC1xI	Preprogrammed module with serial command interface	30 pin SMT, 28 mm x 17 mm
ZWIR4512-Devkit	Development kit	

9 Related Documents

Document	File Name
ZWIR45xx Command Interface Manual	*ZWIR45xx_CI_Manual_revX.x.pdf*
ZWIR451x Programming Guide	*ZWIR451x_Programming_Guide_revX.x.pdf*
ZWIR45xx Over the Air Update Manual	*ZWIR45xx_OTA_Update_Manual_revX.x.pdf*
ZWIR45xx Application Note – Using IPSec and IKEv2 in 6LoWPANS	*ZWIR45xx_App-Note_Using_IPSec_IKEv2_revX.x.pdf*

Visit ZMDI's website www.zmdi.com or contact your nearest sales office for the latest version of these documents.

10 Glossary

Term	Description
6LoWPAN	IPv6 over Low Power Wireless Personal Area Networks
ADC	Analog-to-digital converter
API	Application Programming Interface
CI	Command Interface
DAC	Digital-to-analog converter
GPIO	General purpose input/output
IPv6	Internet Protocol Version 6
JTAG	Joint Test Access Group
MCU	Microcontroller (STM32F103RC)
OTA	Over-the-air update
PCB	Printed Circuit Board
PWM	Pulse-width modulation
SWD	Serial Wire Debug
TRX	Transceiver (ZWIR4502)

11 Document Revision History

Revision	Date	Description
0.90	April 4, 2011	First release of preliminary version.

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