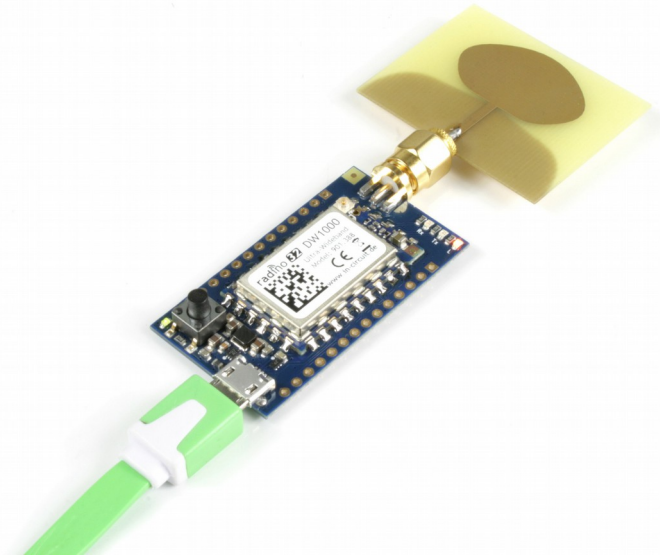


## radino 32 DW1000

The In-Circuit radino 32 DW1000 combines an **STM32L1** with the **DW1000** RF Transceiver in a small form-factor **EMC-compliant** module.

It's part of the radino-series, which provides full-Arduino-compatible wireless communication devices in a small form factor, all **pin-compatible** to each other.



## Features

- Arduino-compatible
- UWB Transceiver DW1000 connected internally
- IEEE802.15.4-2011 UWB compliant
- Supports high tag densities in RTLS
- STM32L151CC by STMicroelectronics with 32-bit ARM® Cortex®-M3 CPU
- 256 kbyte Flash, 32 kbyte RAM, 8 kbyte EEPROM
- Low Power RTC
- 12 bit ADC and DAC
- Capacitive touch sensing supported
- 23 multifunctional GPIOs (14 PWM, 10 ADC IN, 1 DAC OUT)
- USB, I<sup>2</sup>C, SPI, 2xUSART

## Applications

- Precision real time location systems (RTLS) using two-way ranging or TDOA schemes in a variety of markets:
  - Healthcare
  - Consumer
  - Industrial
  - Other
- Location aware wireless sensor networks

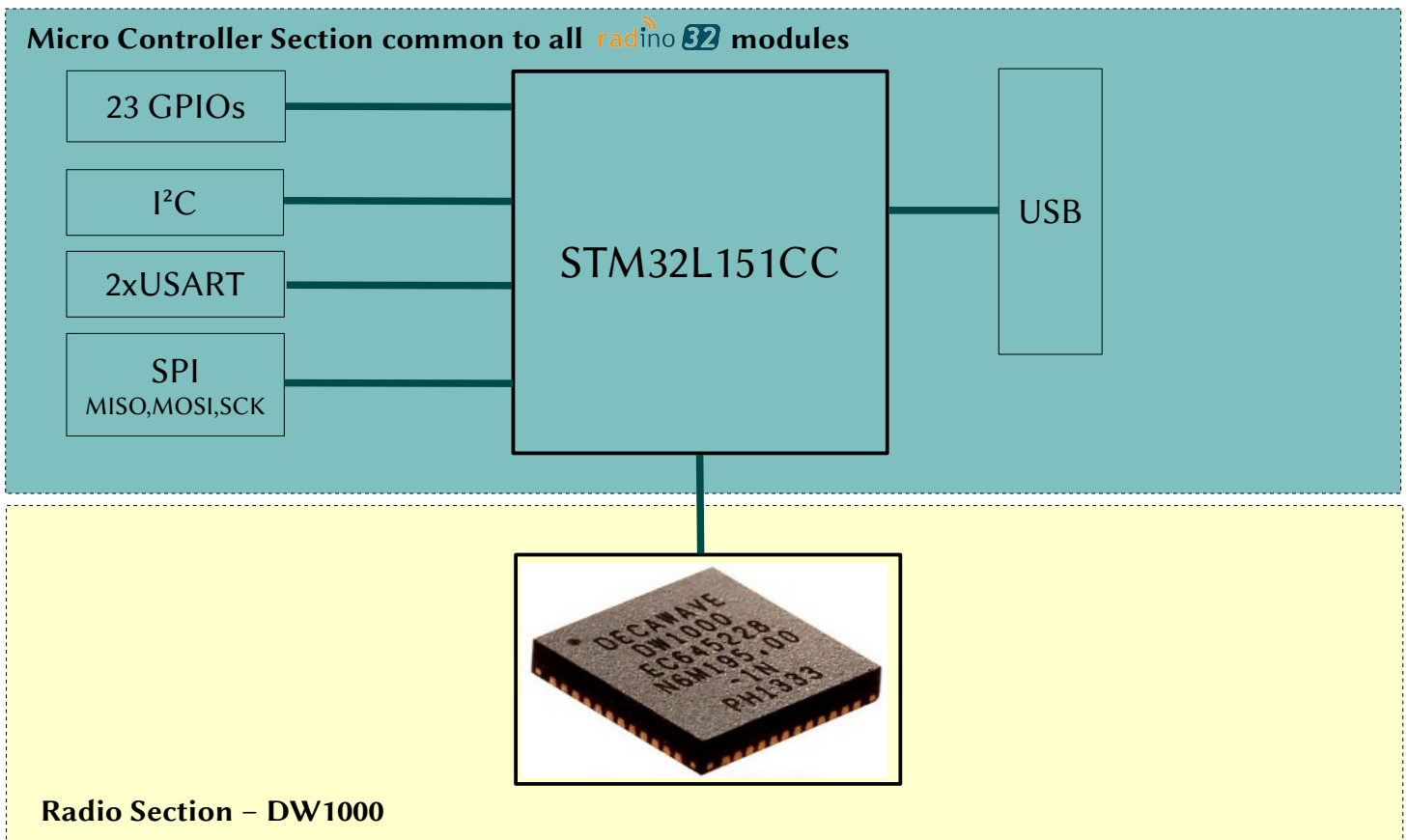
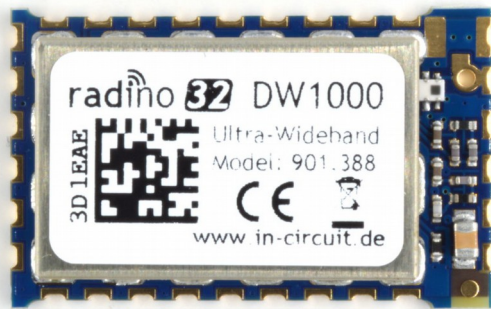


For more information visit:  
<http://www.in-circuit.de/>  
<http://www.radino.cc/>

## Overview

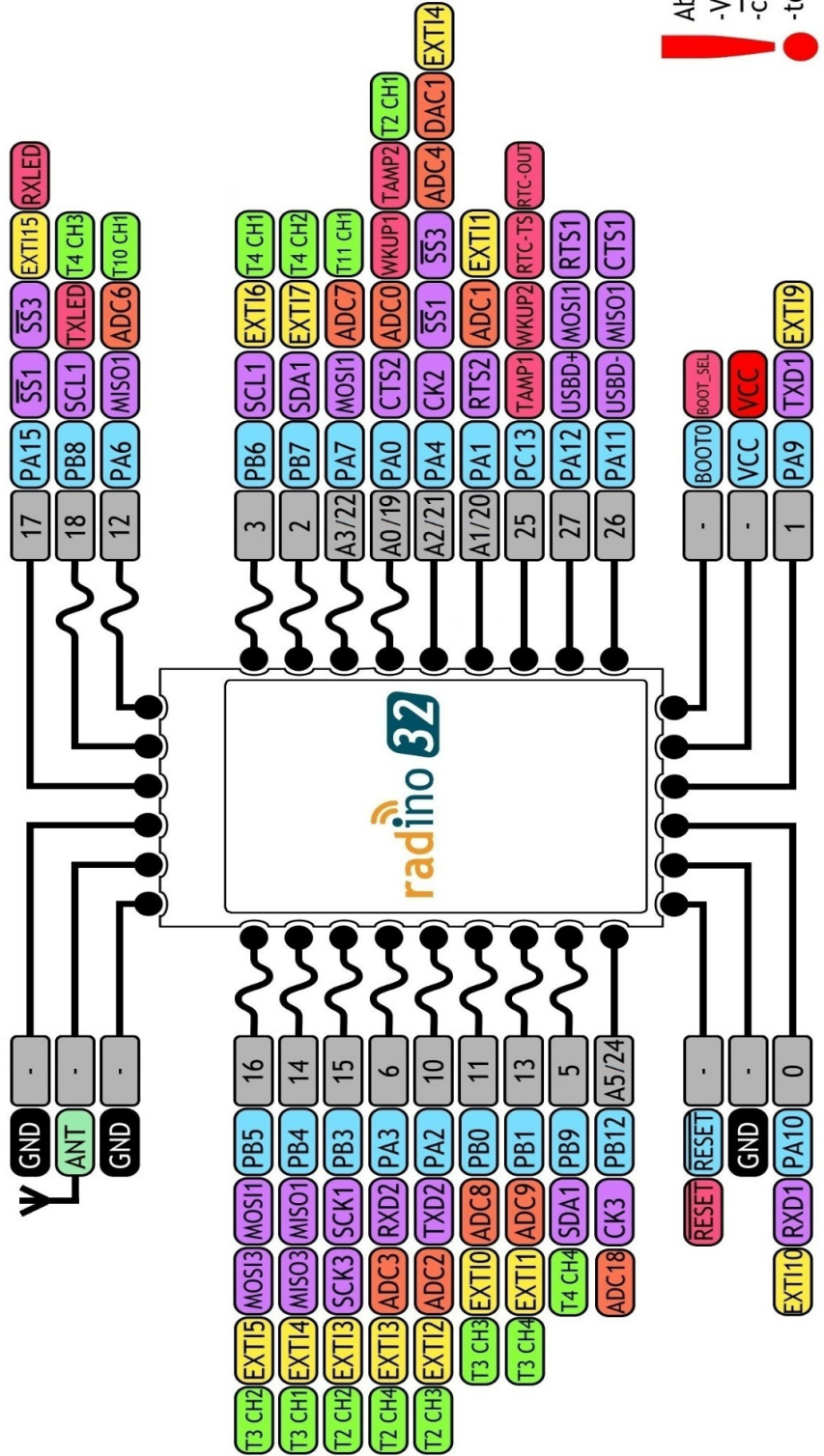
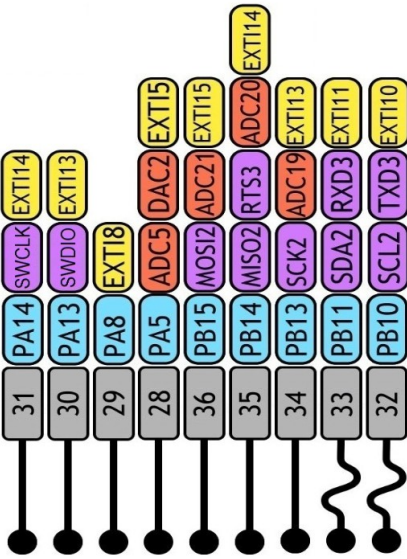
The In-Circuit radino 32 DW1000 combines an STM32L151 with the DW1000 RF Transceiver. Despite its small form factor, the radino 32 DW1000 offers great connectivity. Many GPIOs and interfaces (USB, I<sup>2</sup>C, SPI, 2xUSART) of the STM32L151 can be connected to external circuitry.

With our Arduino Library the radino 32 DW1000 becomes fully Arduino-compatible, which enables easy programming, using the Arduino IDE (<http://www.arduino.cc/>).



# radino 32 Pinout

Connected to internal radio section:



- Power
- GND
- Arduino Pin
- STM Port
- Timer Channel
- Serial Pin
- Analog Pin
- Interrupt Pin
- Control Pin
- Antenna
- PWM Pin

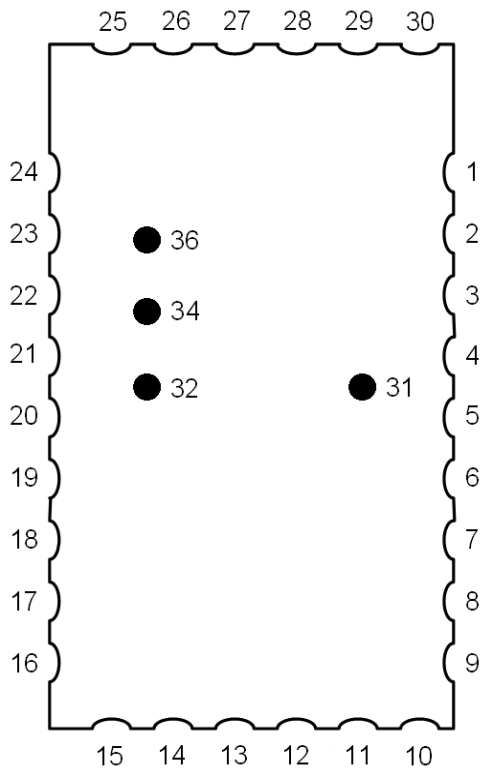
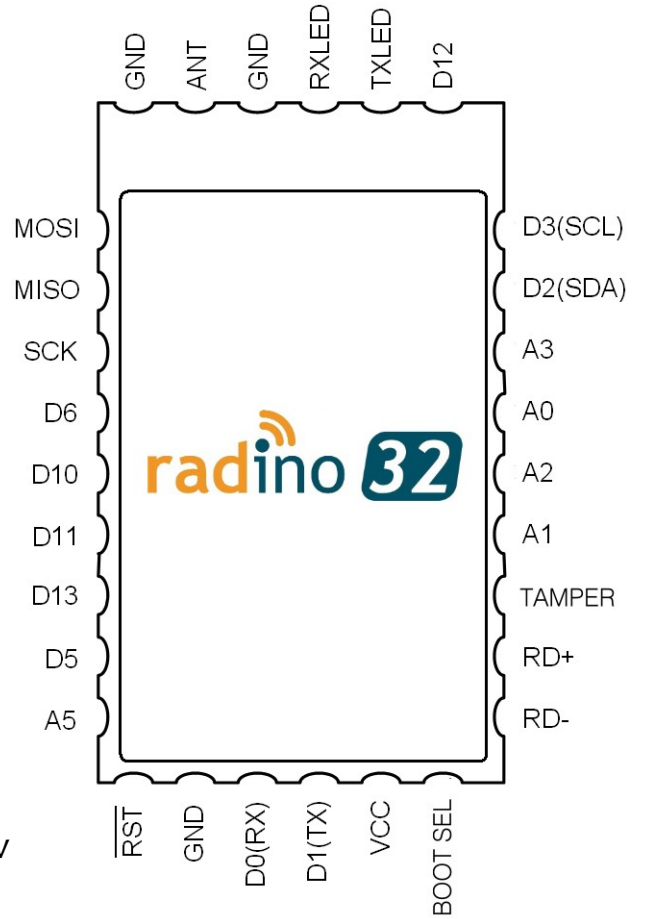
**!** Absolute max. ratings:  
 -VCC: max. 3.6V  
 -current per Pin max. 20mA  
 -total I/O current max. 60mA



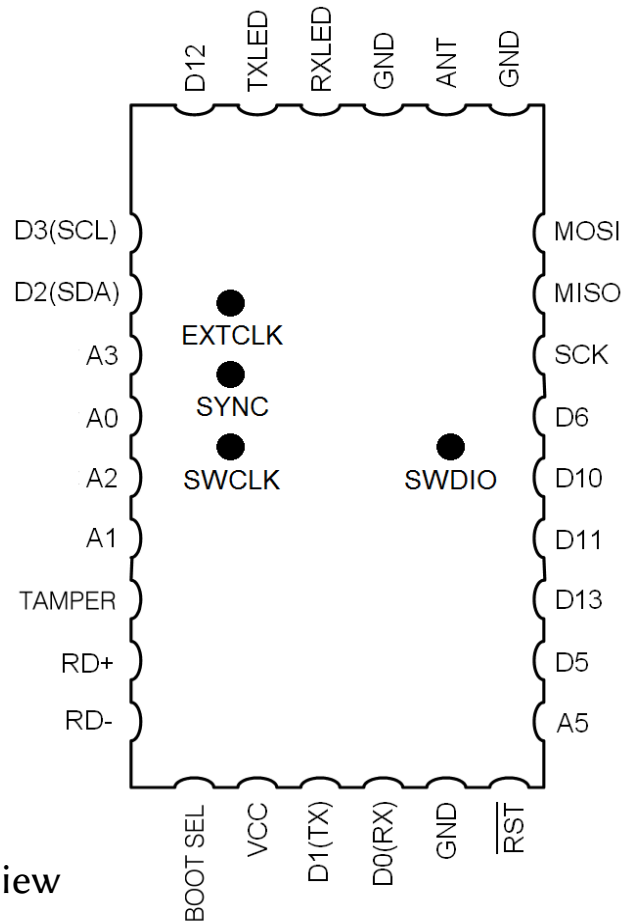
## Pinout and Terminal Description



Top View



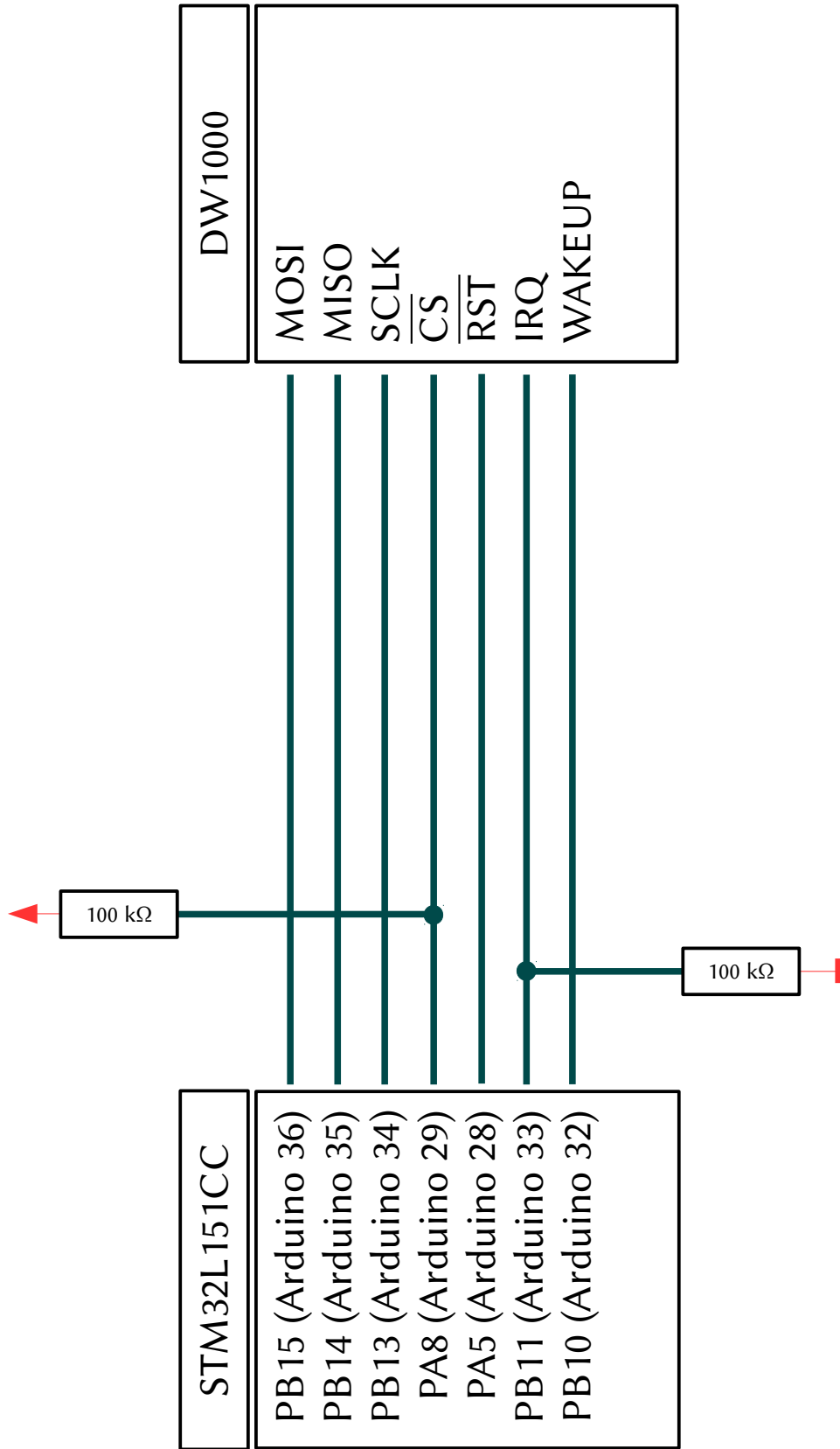
Bottom View



radino Pin No.	Name	Arduino Pin No.	STM32L151 CC Port	Description / Function (bold = main function)
1	MOSI	16	PB5	<b>SPI1-MOSI</b> SPI3-MOSI; I2C1-SMBA; PWM; TIM3-CH2; EXTI5; GPIO
2	MISO	14	PB4	<b>SPI1-MISO</b> SPI3-MISO; PWM; TIM3-CH1; EXTI4(shared with P20); GPIO
3	SCK	15	PB3	<b>SPI1-SCK</b> SPI3-SCK; PWM; TIM2-CH2; EXTI3 (shared with P4); GPIO
4	D6	6	PA3	GPIO; USART2-RX PWM; TIM2-CH4; ADC3; OPAMP1-VOUT; EXTI3 (shared with P3)
5	D10	10	PA2	GPIO; USART2-TX; PWM; TIM2-CH3; ADC2; OPAMP1-VINM; EXTI2
6	D11	11	PB0	GPIO; PWM; TIM3-CH3; ADC8; OAMP2-VOUT; EXTI0
7	D13	13	PB1	GPIO; PWM; TIM3-CH4; ADC9; EXTI1 (shared with P19)
8	D5	5	PB9	GPIO; I2C-SDA; PWM; TIM4-CH4;
9	A5	A5 24	PB12	ADC18; USART3-CK; SPI2-NSS; GPIO;
10	Reset	-	NRST	Reset of STM32L151CC
11	GND	-	VSS	Ground
12	D0(RX)	0	PA10	<b>USART1-RX</b> ; EXTI10; GPIO
13	D1(TX)	1	PA9	<b>USART1-TX</b> ; EXTI9; GPIO
14	V <sub>CC</sub>	-	VCC	Power supply
15	BOOT_SELECT	-	BOOT0	Boot Select
16	RD-	26	PA11	<b>USB-D-</b> ; USART1-CTS; SPI1-MISO; GPIO
17	RD+	27	PA12	<b>USB-D+</b> ; USART1-RTS; SPI1-MOSI; GPIO
18	TAMPER	25	PC13-WKUP2	RTC-TAMP1; WKUP2; RTC-TS; RTC-OUT; GPIO
19	A1	A1 20	PA1	ADC1; USART2-RTS; OAMP1-VINP; EXTI1(shared with P7); GPIO
20	A2	A2 21	PA4	ADC4; DAC1; USART2-CK; SPI1-NSS; SPI3-NSS; EXTI4(shared with P4); GPIO
21	A0	A0 19	PA0-WKUP1	ADC0; USART2-CTS; WKUP1; RTC-TAMP2; PWM; TIM2-CH1; GPIO
22	A3	A3 22	PA7	ADC7; SPI1-MOSI; PWM; TIM11-CH1; OPAMP2-VINM; GPIO
23	D2(SDA)	2	PB7	<b>I2C1-SDA</b> ; USART1-RX; PWM; TIM4-CH2; EXTI7; GPIO
24	D3(SCL)	3	PB6	<b>I2C1-SCL</b> ; USART1-TX; PWM; TIM4-CH1; EXTI6; GPIO
25	D12	12	PA6	GPIO; SPI1-MISO; PWM; TIM10-CH1; OPAMP2-VINP; ADC6

radino Pin No	Name	Arduino Pin No.	STM32L151 CC Port	Description / Function (bold = main function)
26	TXLED	18	PB8	<b>TXLED</b> ; I2C1-SCL; PWM; TIM4-CH3; GPIO
27	RXLED	17	PA15	<b>RXLED</b> ; SPI1-NSS; SPI3-NSS; EXTI15; GPIO
28	GND	-	VSS	Ground
29	ANTENNA	-	-	Antenna pin
30	GND	-	VSS	Ground
31	SWDIO	30	PA13	SWDIO of STM32L151CC (pad on bottom)
32	SWCLK	31	PA14	SWCLK of STM32L151CC (pad on bottom)
34	SYNC	-	-	SYNC of DW1000 (pad on bottom)
36	EXTCLK	-	-	EXTCLK of DW1000 (pad on bottom)
-	RF_MISO	35	PB14	<b>connected to internal radio section</b> Signal: MISO
-	RF_MOSI	36	PB15	<b>connected to internal radio section</b> Signal: MOSI
-	RF_SCK	34	PB13	<b>connected to internal radio section</b> Signal: CLK
-	RF_SS	29	PA8	<b>connected to internal radio section</b> Signal: $\overline{CS}$ , 100k pullup attached on board
-	RF_RST	28	PA5	<b>connected to internal radio section</b> Signal: $\overline{RST}$
-	RF_WAKEUP	32	PB10	<b>connected to internal radio section</b> Signal: WAKEUP
-	RF_IRQ	33	PB11	<b>connected to internal radio section</b> Signal: IRQ, 100k pulldown attached on board

### Detailed Interconnection diagram



# Electrical Characteristics

## Absolut Maximum Ratings

Note: These are absolute maximum ratings beyond which the module can be permanently damaged. These are not maximum operating conditions.

Rating	Min	Max	Unit
Storage Temperature	-40	125	°C
$V_{CC}$	-0.3	3.6	V
Current per IO		20	mA
Total Current by sum of all IOs		60	mA

## Recommended Operating Conditions

Environmental conditions

Rating	Min	Typ.	Max	Unit
Operating Temperature	-40		85	°C
$V_{CC}$	2.8	3.3	3.6	V

### DC Characteristics

$T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{CC} = 2.7\text{V}$  to  $3.6\text{V}$  (unless otherwise noted)

Symbol	Rating	Min	Typ.	Max	Unit
$V_{BS}$	BOOT_SELECT Voltage	0		5.5	V
$V_{IL}$	Input Low Voltage,	-0.3		$0.2V_{CC}$	V
$V_{IH1}$	Input High Voltage, Pins: P4, P6, P7, P20	$0.9V_{CC}$		$V_{CC} + 0.3$	V
$V_{IH2}$	Input High Voltage, all other Pins	$0.9V_{CC}$		5.25	V
$V_{OL}$	Output Low Voltage			0.5	V
$V_{OH}$	Output High Voltage	$0.9V_{CC}$			V



## Current consumption parameters

### STMicroelectronics STM32L151CC

DC Current per I/O Pin: 25 mA  
 DC Current over all I/O Pins: 60 mA

Operation conditions:  $V_{CC}=3.3V$ ,  $T_A=25^{\circ}C$

The STMicroelectronics STM32L151CC at radino32 works with HSE = 24 MHz.

At running mode: up to 10 mA  
 At stop mode: down to 1.5  $\mu A$   
 For details view manufacturers datasheet.

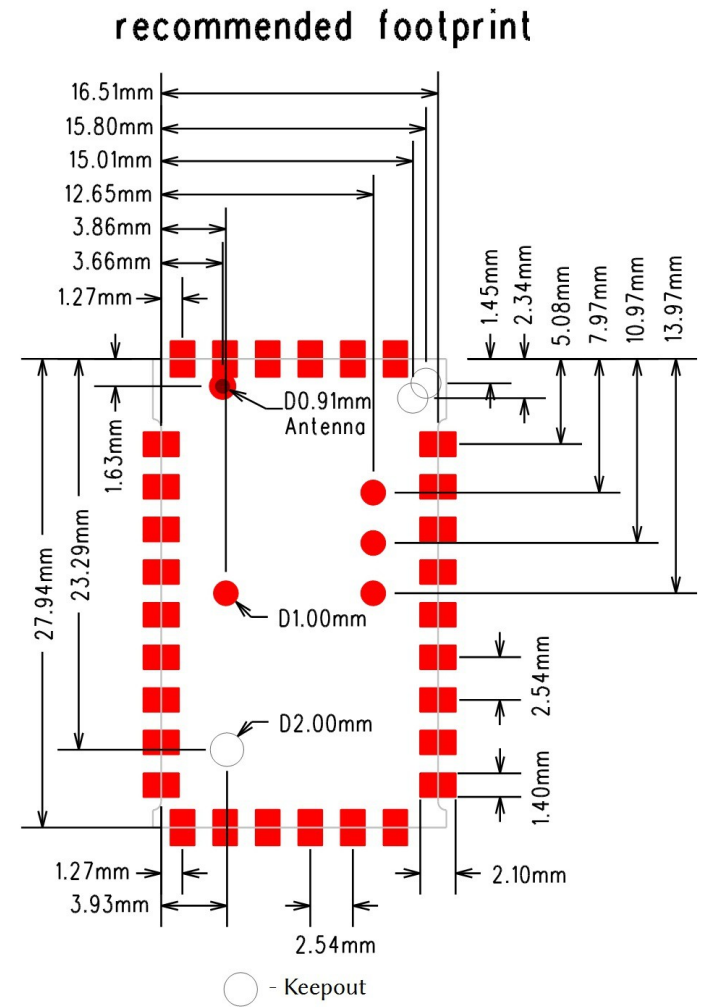
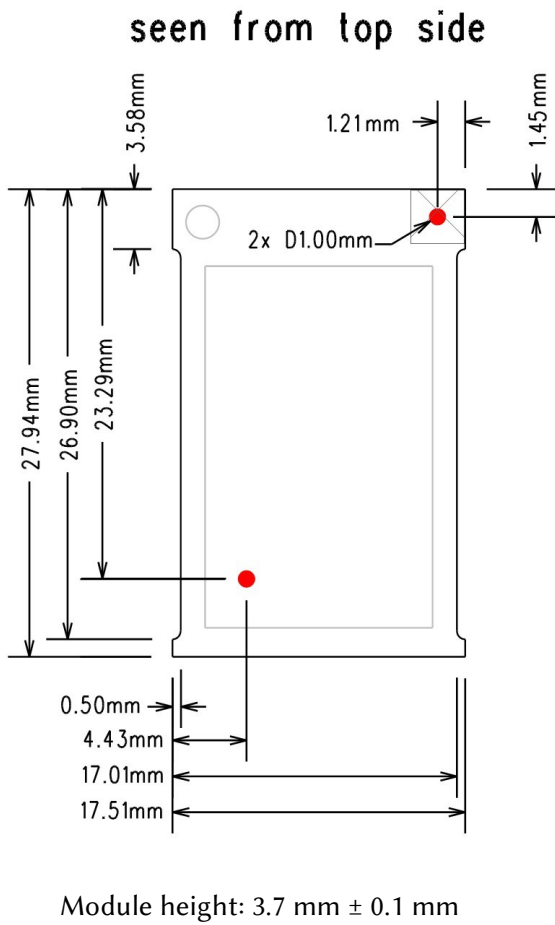
### Decawave DW1000

Operation conditions:  $T_{amb}=25^{\circ}C$ .

Parameter	Min	Typ.	Max	Unit
Supply current DEEP SLEEP mode	---	50	---	nA
Supply current SLEEP mode	---	1	---	$\mu A$
Supply current IDLE mode	---	19	---	mA
Supply current INIT mode	---	5	---	mA
TX	---	---	160	mA
RX	---	---	240	mA

Values from manufacturers datasheet.

# Package Dimensions and recommended PCB Footprint

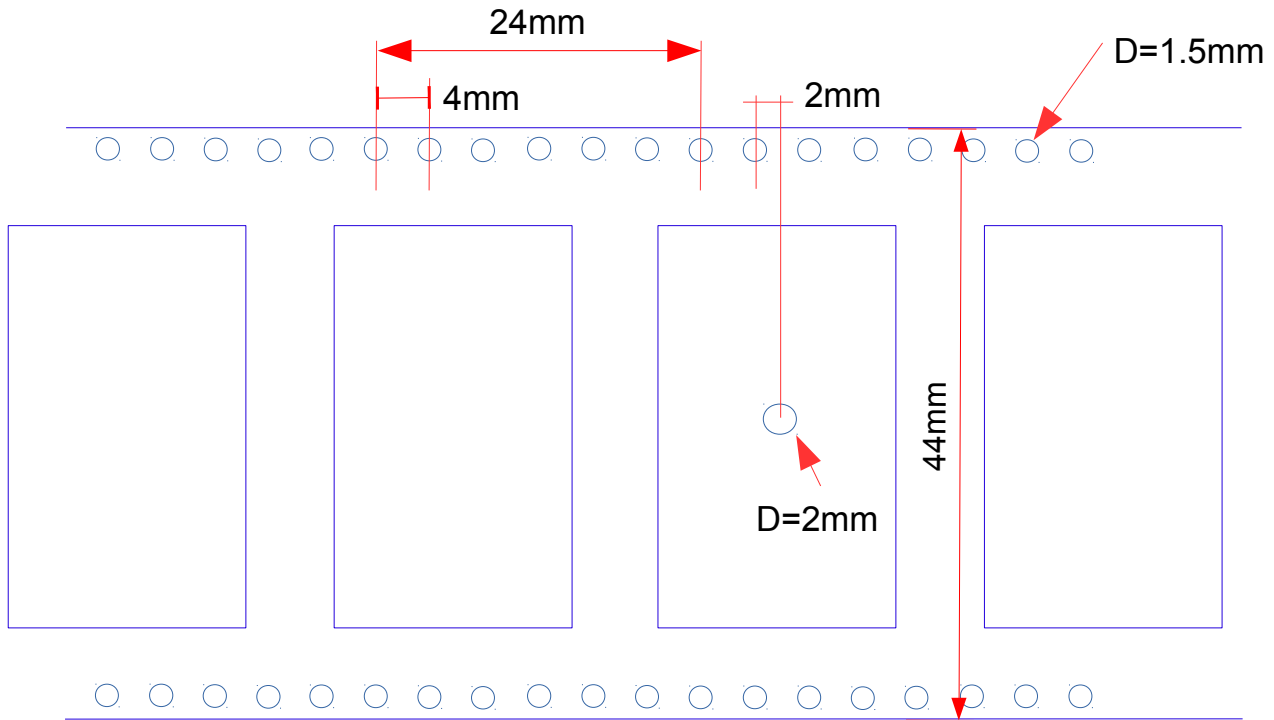


## Packaging: tape & reel specification

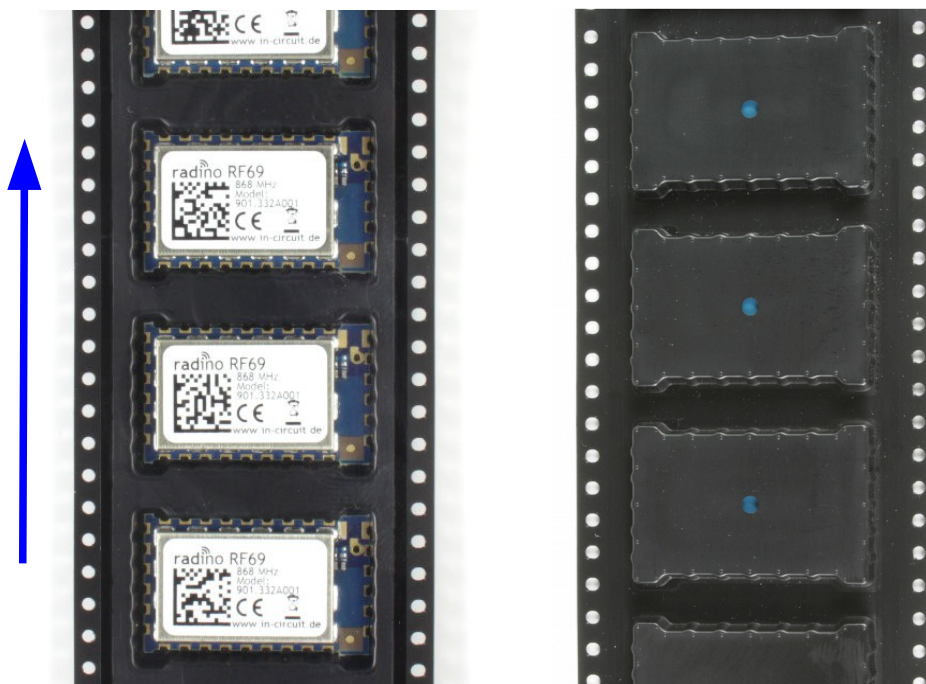
All radino modules come in a tape & reel package suitable for pick and place machines. Small quantities are delivered as cut-tape. There are 2 kinds of reels available with 100pcs and 500pcs per reel (see section ordering information)

Except the number of modules, all parameters are same to both reel sizes:

- 13" reel size
- 44mm tape width
- tape pocket dimensions 29mm x 19mm x 4mm
- module spacing 24mm
- 2mm hole in the middle of the module body
- 1.5mm tape holes for transport



Transport direction  
(Antenna connector to the right)

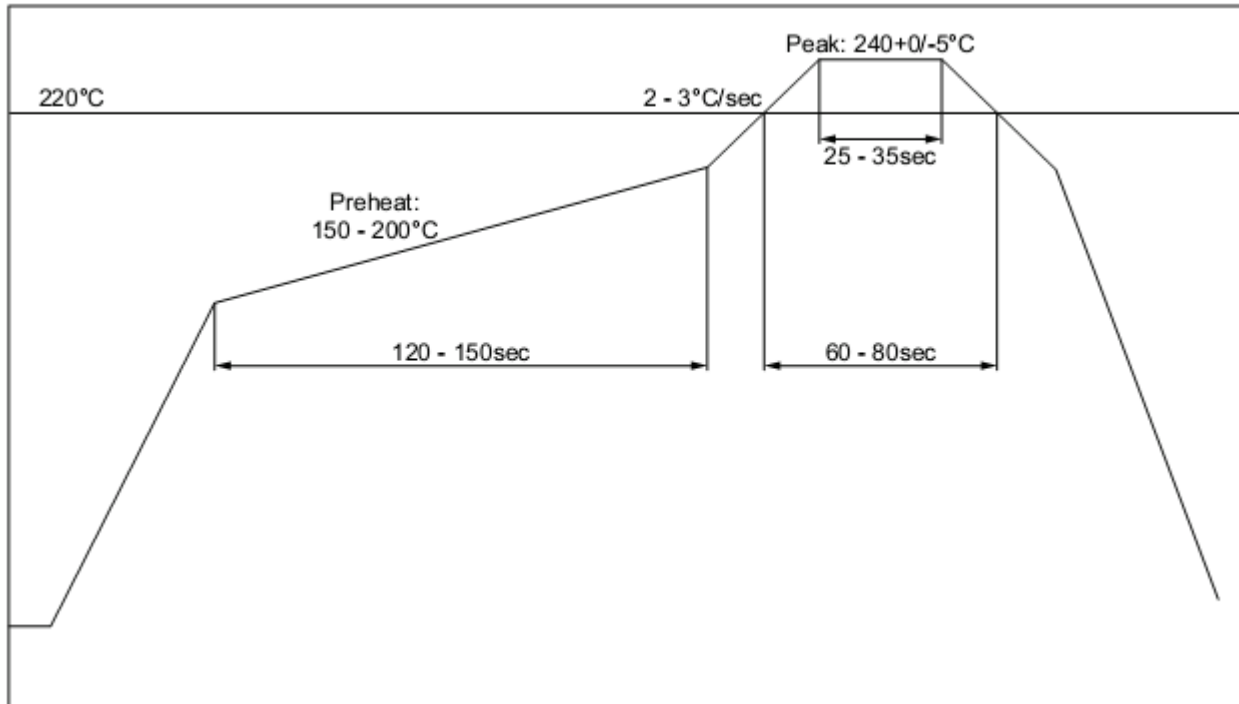


## Reflow temperature profile

The single most critical stage in the automated assembly process is the reflow stage. The reflow profile shall not exceed the following maximum ratings:

- heating gradients  $<3^{\circ}\text{C}/\text{sec}$
- peak zone temperature of the module  $<245^{\circ}\text{C}$
- time in peak zone  $<40$  sec.
- time above  $220^{\circ}\text{C}$   $<80$  sec.

Excessive temperatures, transport times and shocks during the reflow process **MUST** not be applied to the module.



Recommended reflow temperature profile

## Washability

The radino modules are wash-resistant, but are not sealed. In-Circuit recommends manufacturing without washing. If washing is needed make sure that a drying time is provided to the modules before applying electrical power. The drying time should be sufficient to allow any moisture that may have migrated into the module to evaporate, thus eliminating the potential for shorting damage during power-up or testing.

If the wash contains contaminants, the performance may be adversely affected, even after drying.

## Ordering Information

Part	Ordering Code	MOQ	Package
radino32 DW1000	901.388	1	Cut Tape, Reels 100/500

All radino modules are available online: <http://www.radino.cc/>



## Certifications



### European R&TTE Directive Statements

The radino32 DW1000 module has been tested and found to comply with Annex IV of the R&TTE Directive 1999/5/EC and is subject of a notified body opinion. The module has been approved for Antennas with gains of 2 dBi or less.



### RoHS / WEEE compliant

WEEE-Reg.-Nr. DE 17225017



FCC  
pending

### Revision history:

Version	Date	Changes	Editor
A	2016/02/01		Träger
	2016/09/13	Fix pulldown from RST to IRQ	Grünig
	2017/01/23	Major Update	Grünig
	2017/06/02	Update current consumption	Grünig
	2017/06/27	Minor Update	Grünig