radino 40 DW1000

The In-Circuit radino 40 DW1000 combines Nordic Semiconductor's **nRF52 840** microprocessor and Decawave's **DW1000** Transceiver in a small form-factor **EMC-compliant** module.

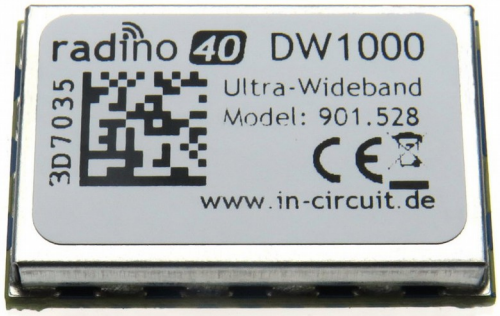
The radino 40 DW1000 integrates UWB and Bluetooth® functionality. It can be used in two-way-ranging or TDOA location systems to locate assets to a precision of 10 cm.

Features

- UWB Transeiver DW1000 by Decawave
  - IEEE802.15.4-2011 UWB compliant
  - Supports 6 RF bands from 3.5 GHz to 6.5 GHz
  - Data rates of 110 kbps, 850 kbps, 6.8 Mbps
- nRF52 840 by Nordic Semiconductors
  - 32-bit ARM® Cortex®-M4 CPU with FPU, 64 MHz
  - 1 Mbyte Flash, 256 kbyte RAM
  - Dynamic multiprotocol-transceiver:
    - Bluetooth 5 / Bluetooth Low Energy
    - IEEE 802.15.4/Thread
    - ANT/ANT+
    - Proprietary 2,4 GHz
  - 4x4 channel pwm unit with EasyDMA
  - 12 bit 200 ksps ADC
  - 5x 32 bit timer with counter mode
  - USB 2.0, I²C, QSPI, SPI, UART, NFC-A
  - Quadrature decoder (QDEC)
  - 3x RTC
- 37 GPIOs

Applications

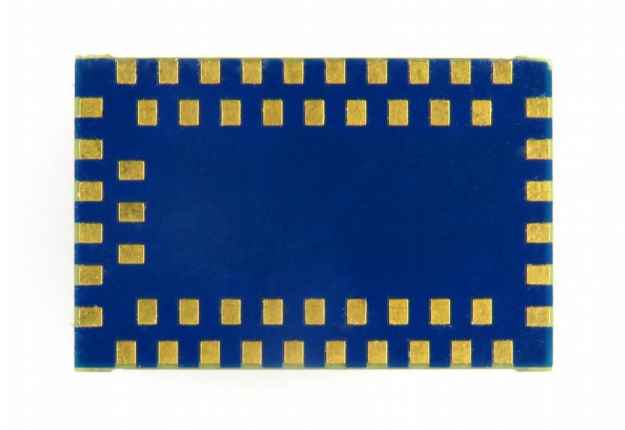
- Precision real time location systems (RTLS) using two-way ranging or TDOA schemes in a variety of markets:
  - Healthcare
  - Consumer
  - Industrial
  - Other
- Location aware wireless sensor networks

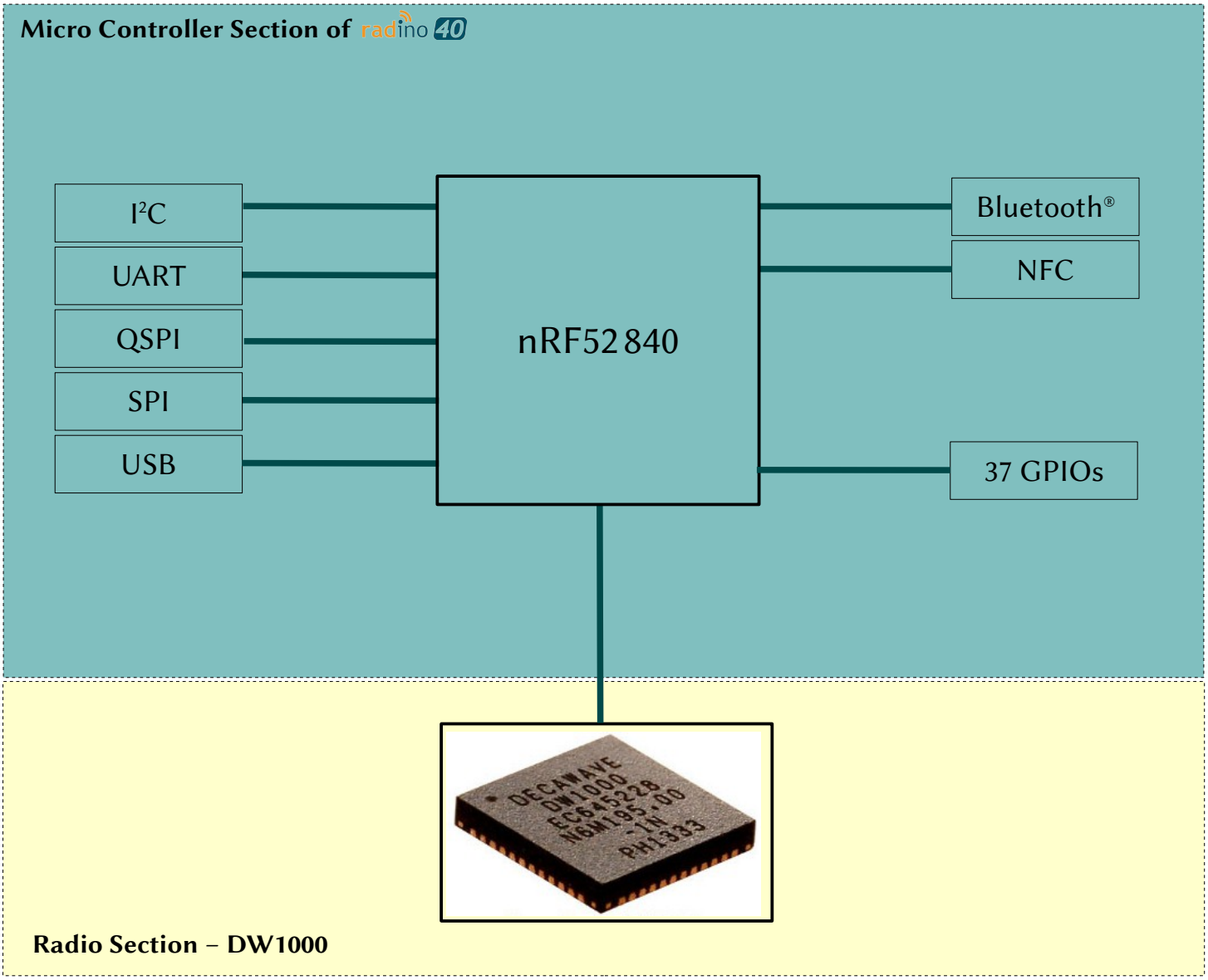


For more information visit:
http://www.in-circuit.de/
http://www.radino.cc/

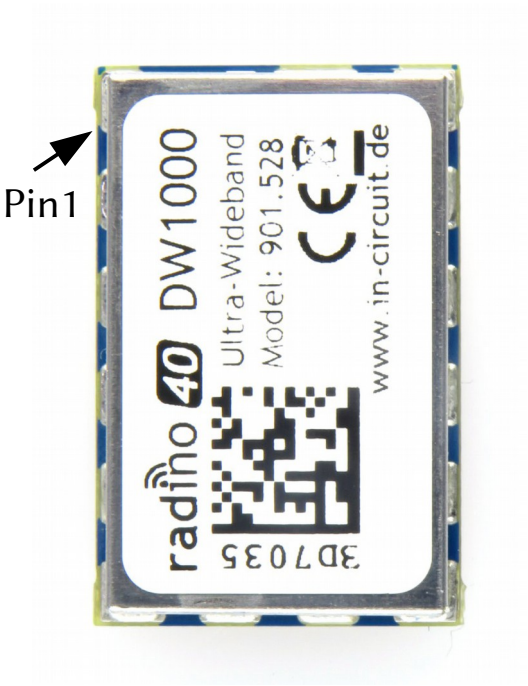
Overview

The In-Circuit radino 40 DW1000 combines a **nRF52 840** microprocessor and the **DW1000** RF Transceiver. Despite its small form factor, the radino 40 DW1000 offers great connectivity. Many GPIOs and interfaces (USB 2.0, I²C, QSPI, SPI, UART, NFC-A) of the **nRF52 840** can be connected to external circuitry.

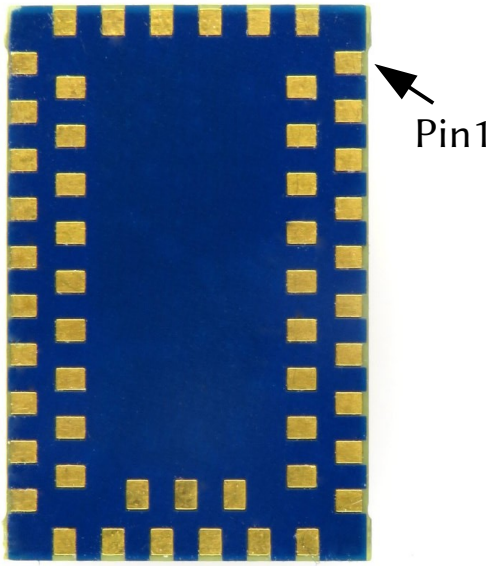




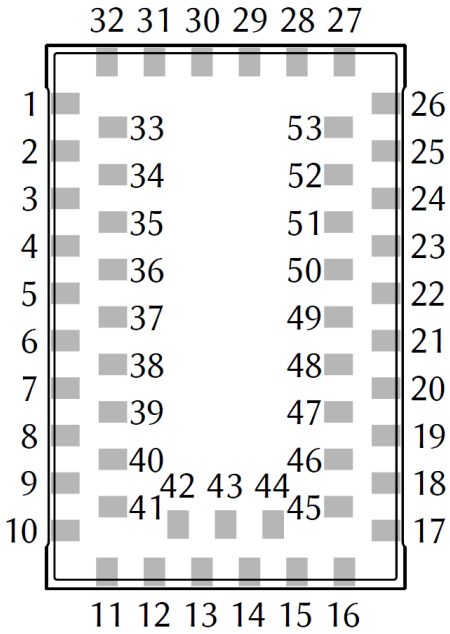
Pinout



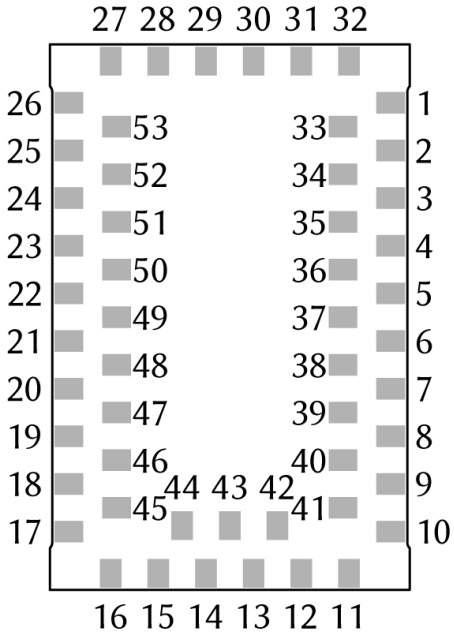
Top View



Bottom View



Pins seen from top side



Pins seen from bottom side

Pin List

radino Pin	Name	NRF52840 aQFN73Pin/Name	DW1000 Port/Name	Description / Function
1	P0.17	AD12/P0.17	-	GPIO
2	P0.15	AD10/P0.15	-	GPIO
3	P0.14	AC9/P0.14	-	GPIO
4	P0.12	U1/P0.12/ TRACEDATA1	-	GPIO; Trace buffer TRACEDATA[1]
5	P0.07	M2/P0.07/ TRACECLK	-	GPIO; Trace buffer clock
6	P0.03	B13/P0.03/AIN1	-	GPIO (low-freq.); Analog input
7	P0.05	K2/P0.05/AIN3	-	GPIO; Analog input
8	P0.29	A10/P0.29/AIN5	-	GPIO (low-freq.); Analog input
9	P0.31	A8/P0.31/AIN7	-	GPIO (low-freq.); Analog input
10	P0.01	F2/P0.01/XL2	-	GPIO; Analog input; Connection for 32.768 kHz crystal
11	$\overline{\text{Reset}}$	AC13/P0.18/ $\overline{\text{RESET}}$	-	GPIO; nRF52840 reset
12	GND	B7/VSS	-	Ground
13	P0.06	L1/P0.06	-	GPIO; (RXD)
14	P0.08	N1/P0.08	-	GPIO; (TXD)
15	VDD	VDD	VDD	Power supply
16	P0.13/BSL	AD8/P0.13	-	GPIO
17	USB-	AD4/D-	-	USB-D-
18	USB+	AD6/D+	-	USB-D+
19	P0.09	L24/P0.09/NFC1	-	GPIO (low-freq.); NFC antenna input
20	P0.10	J24/P0.10/NFC2	-	GPIO (low-freq.); NFC antenna input
21	BT_ANT	→H23/ANT	-	Bluetooth Antenna connection
22	P1.07	P23/P1.07	-	GPIO (low-freq.)
23	P1.05	T23/P1.05	-	GPIO (low-freq.)
24	P1.03	V23/P1.03	-	GPIO (low-freq.)
25	P1.01	Y23/P1.01	-	GPIO (low-freq.)
26	P1.00	AD22/P1.00/ TRACEDATA0	-	GPIO (low-freq.); Trace buffer TRACEDATA[0], SWO
27	DEC_PWR			needs at least 47µF ceramic to GND

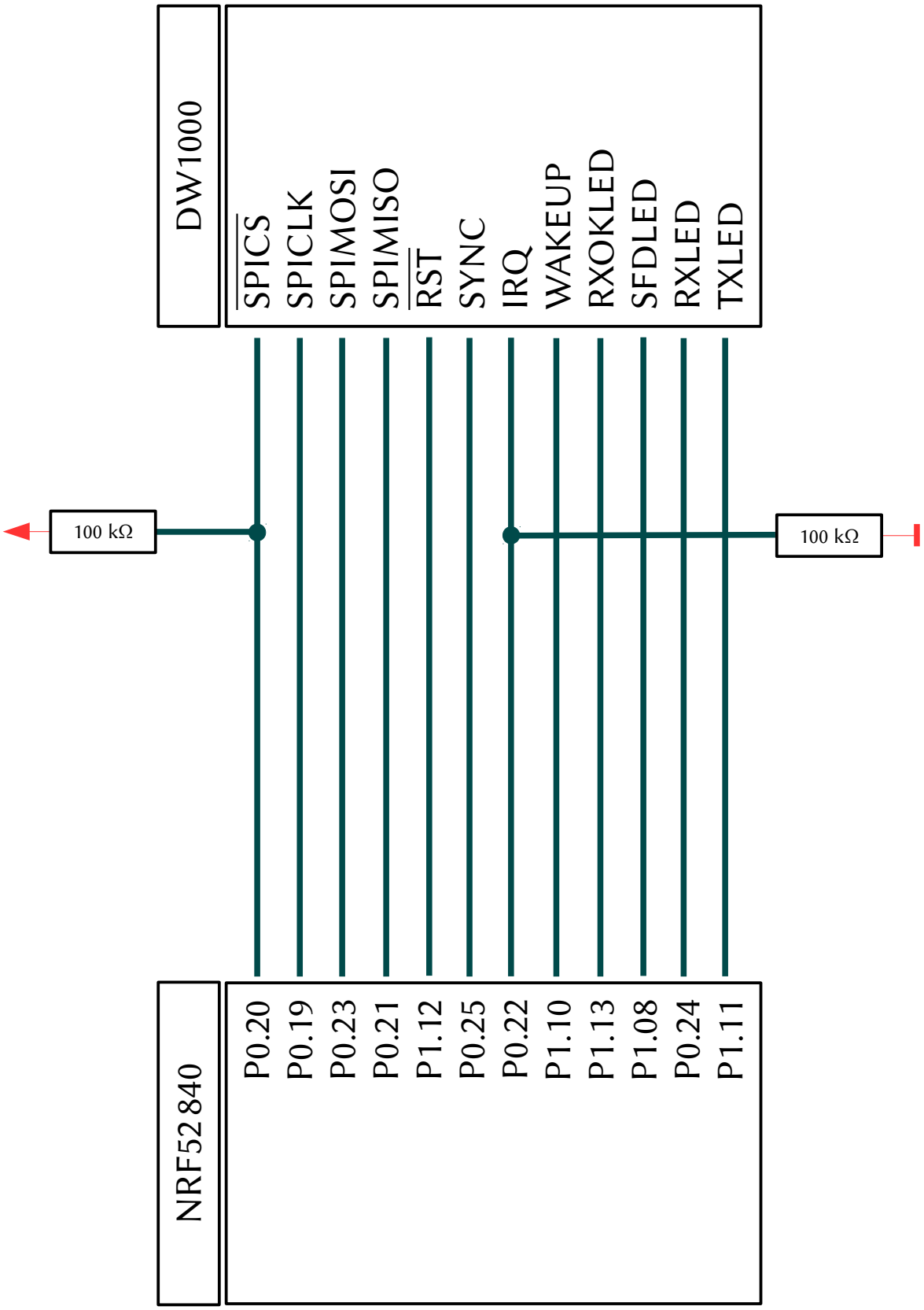
radino Pin	Name	NRF52840 aQFN73Pin/Name	DW1000 Port/Name	Description / Function
28	GND	VSS	VSS	Ground
29	DEC_RF			needs at least 47µF ceramic to GND
30	GND	VSS	VSS	Ground
31	DW_ANT	-	Balun→ 17/PF_N,16/RF_P	Antenna pin DW1000
32	GND	VSS	VSS	Ground
33	P0.16	AC11/P0.16	-	GPIO
34	SYNC	P2/P1.08	29/SYNC/GPIO7	GPIO; DW1000 external synchronization
35	VDDIO	-	31/VDDIO, 42/VDDIO	GPIO; Trace buffer clock
36	P0.11	T2/P0.11	-	GPIO
37	P0.02	A12/P0.02/AIN0	-	GPIO (low-freq.); Analog input
38	P0.04	J1/P0.04/AIN2	-	GPIO; Analog input
39	P0.28	B11/P0.28/AIN4	-	GPIO (low-freq.); Analog input
40	P0.30	B9/P0.30/AIN6	-	GPIO (low-freq.); Analog input
41	P0.00	D2/P0.0/XL1	-	GPIO; Analog input; Connection for 32.768 kHz crystal
42	P0.27	H2/P0.27	-	GPIO
43	P0.26	G1/P0.26	-	GPIO
44	P1.09	R1/P1.09/ TRACEDATA3	-	GPIO; Trace buffer TRACEDATA[3]
45	VUSB	AD2/VBUS	-	Power supply
46	SWCLK	AA24/SWDCLK	-	Serial wire debug clock input
47	SWDIO	AC24/SWDIO	-	Debug serial data
48	GND	VSS	VSS	Ground
49	GND	VSS	VSS	Ground
50	EXTCLK	-	3/EXTCLK/XTAL1	DW1000 reference crystal input
51	P1.02	W24/P1.02	-	GPIO (low-freq.)
52	P1.04	U24/P1.04	-	GPIO (low-freq.)
53	P1.06	R24/P1.06	-	GPIO (low-freq.)

Interconnection

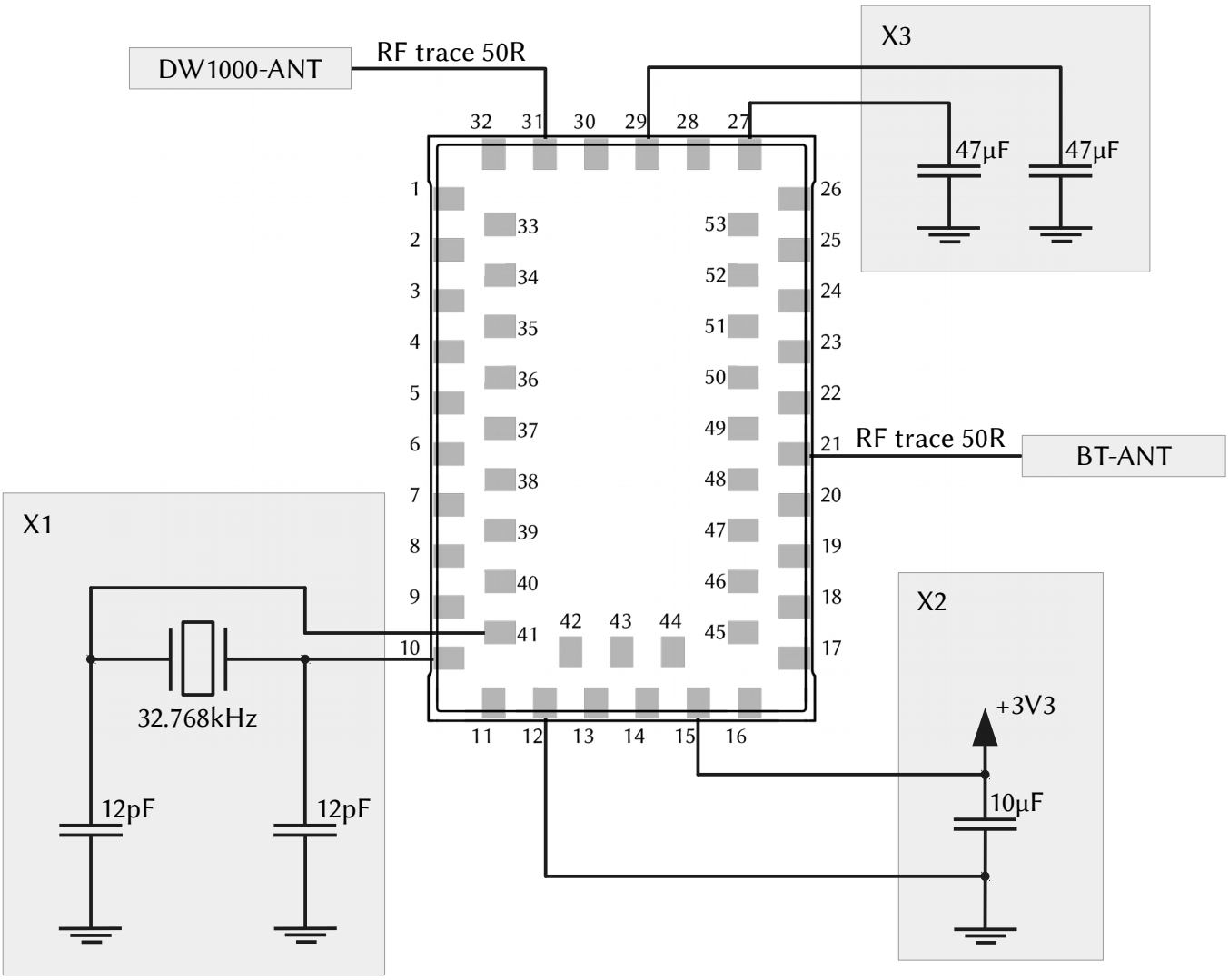
The nRF52 840 and the DW1000 are connected internally. The interconnections are listed below.

Signal Name	NRF52 840 aQFN73Pin/Name	DW1000 Port/Name	Description / Function
RF_$\overline{SS}$	AD16/P0.20	24/$\overline{SPICS}$	DW1000 SPI chip select
RF_SCK	AC15/P0.19	41/SPICLK	DW1000 SPI clock
RF_MOSI	AC19/P0.23	39/SPIMOSI	DW1000 SPI data output
RF_MISO	AC17/P0.21	40/SPIMISO	DW1000 SPI data input
RF_RST	B17/P1.12	27/$\overline{RST}$	DW1000 reset pin
SYNC	P2/P1.08	29/SYNC/GPIO7	DW1000 external synchronization
RFIRQ	AD20/P0.24	45/IRQ/GPIOP8	DW1000 interrupt request output
RF_WAKEUP	B19/P1.11	23/WAKEUP	DW1000 wake up
RXOKLED	AC21/P0.25	38/GPIO0/ RXOKLED	DW1000 GPIO; can be configured to indicate reception of a good frame
SFDLED	AD18/P0.22	37/GPIO1/SFDLED	DW1000 GPIO; can be configured to indicate SFD discovery
RXLED	A20/P1.10	36/GPIO2/RXLED	DW1000 GPIO; can be configured to indicate RXmode
TXLED	A16/P1.13	35/GPIO3/TXLED	DW1000 GPIO; can be configured to indicate TXmode

Interconnection diagram

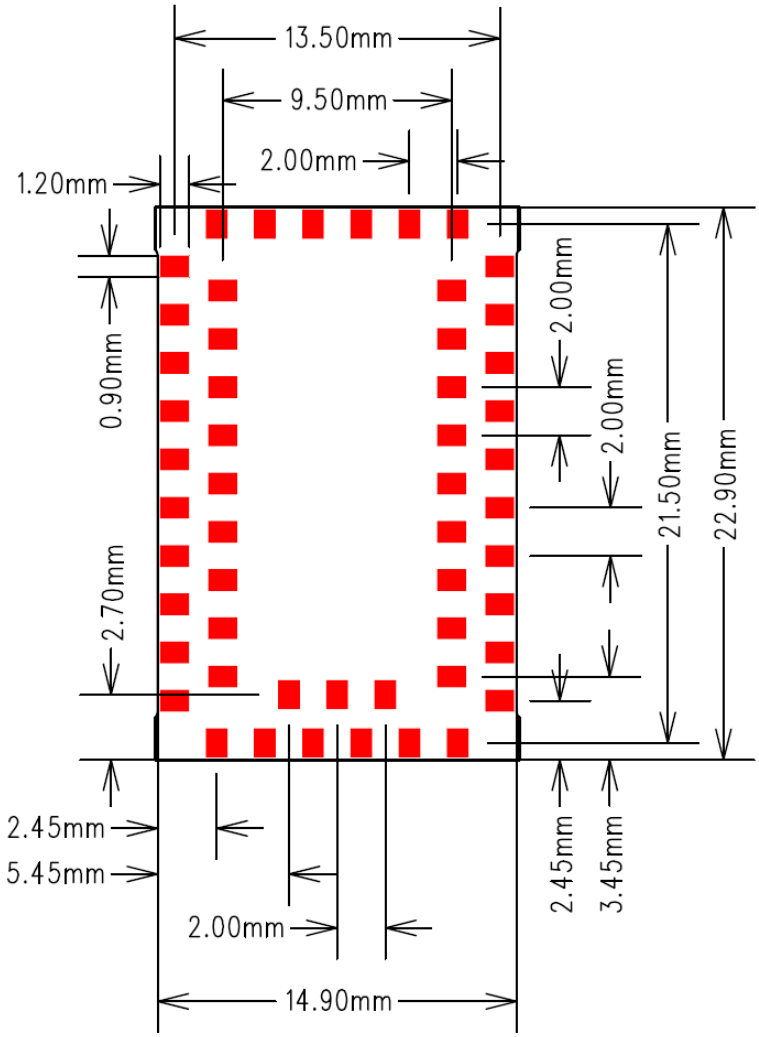


Application Circuit Diagram



Ref	Function
X1	Crystal, only needed for Bluetooth functionality
X2	Power supply, 10µF (min.) ceramic capacitor in parallel
X3	2x 47µF (min.) ceramic capacitor needed for operation
BT-ANT	Bluetooth Antenna
DW1000-ANT	DW1000 Antenna

Dimensions & Footprint



Footprint

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	85	℃
V_{DD}	−0.3	3.6	V
Current per IO		10	mA
Total Current by sum of all IOs		60	mA

Recommended Operating Conditions

Environmental conditions

Rating	Min	Typ.	Max	Unit
Operating Temperature	−40		85	℃
V_{DD}	2.8	3.3	3.6	V

DC Characteristics
T_A = −40℃ to 85℃, V_{DD} = 2.7V to 3.6V (unless otherwise noted)

Symbol	Rating	Min	Typ.	Max	Unit
V_{IL}	Input Low Voltage,	0		$0.3V_{DD}$	V
V_{IH1}	Input High Voltage	$0.7V_{DD}$		V_{DD}	V
V_{OL}	Output Low Voltage	0		0.4	V
V_{OH}	Output High Voltage	V_{DD}−0.4		V_{DD}	V

Current consumption parameters

Nordic Semiconductors nRF52 840

Operation conditions: V_{CC}=3.3V, T_A= 25℃

At running mode: up to 10 mA
At stop mode: down to 0.4 µA
For details view manufacturers datasheet.

Decawave DW1000

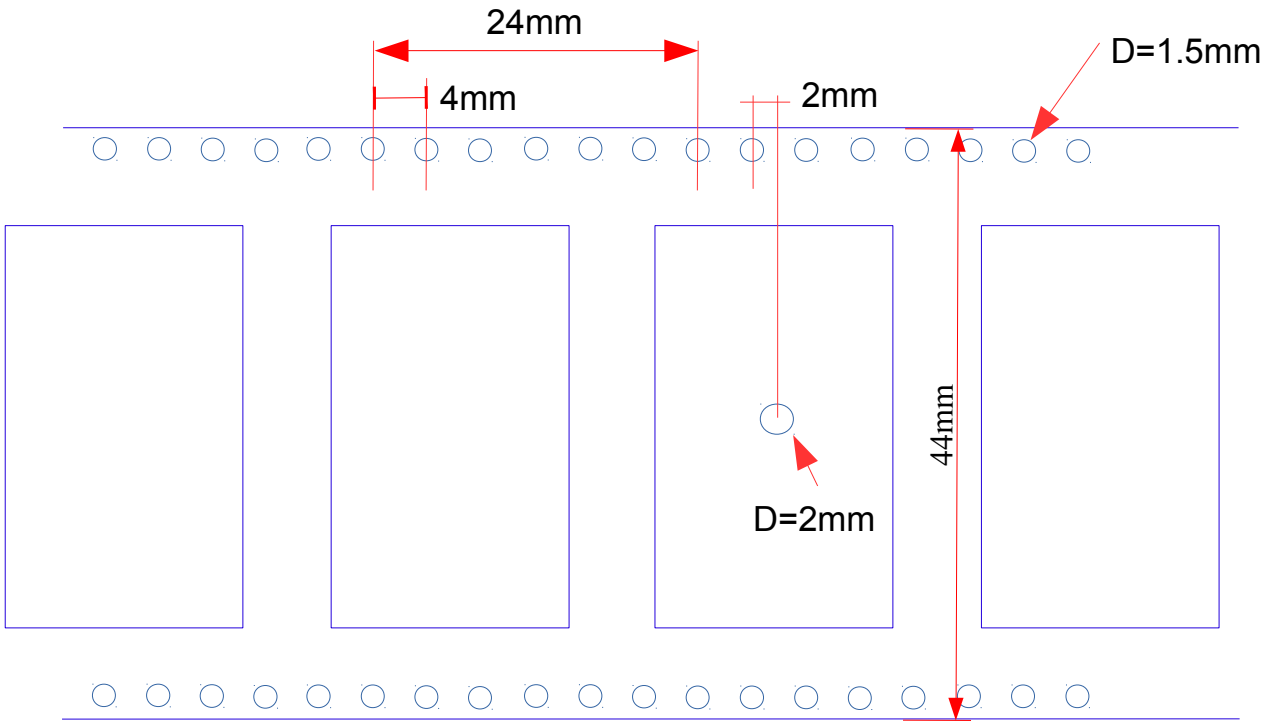
Operation conditions: T_{amb}=25℃.

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

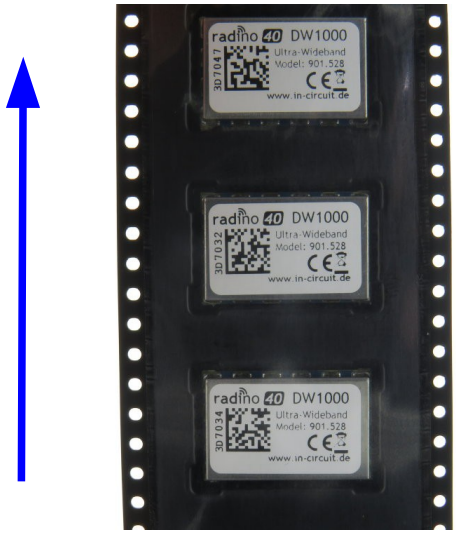
Values from manufacturers datasheet.

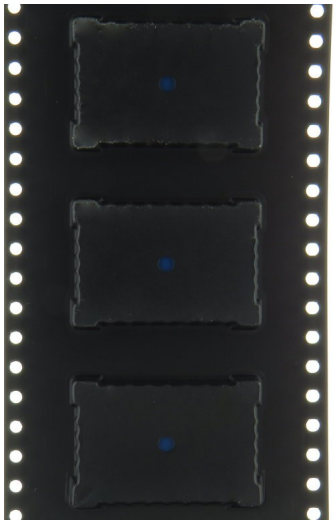
Packaging: tape & reel specification

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 booth 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 (Barcode to the left)

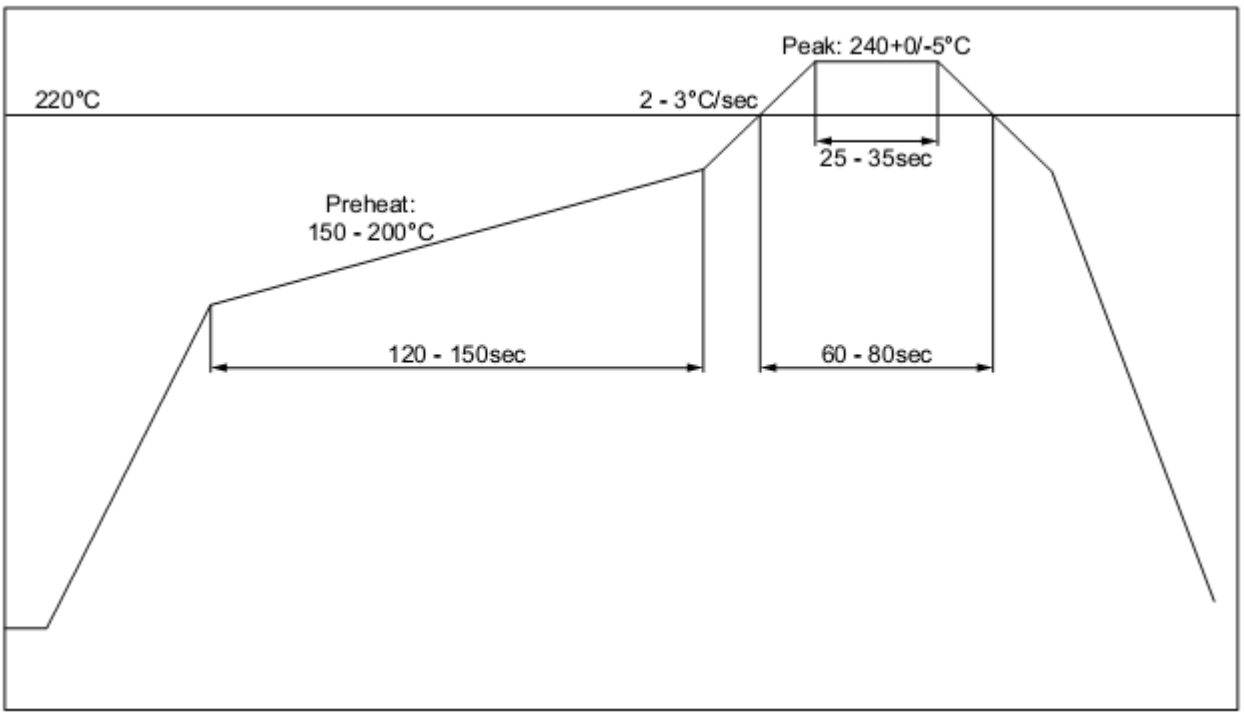




Reflow temperature profile

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℃/sec
- peak zone temperature of the module <245℃
- time in peak zone <40 sec.
- time above 220℃ <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 r 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
radino40 DW1000	901.528	1	Cut Tape, Reels 100/500

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

Certifications

European RED Directive Statements
The radino40 DW1000 module has been tested and found to comply with Annex II of the Radio Equipment Directive (RED) 2014/53/EU
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

Revision history:

Version	Date	Changes	Editor
A	2018/11/26	Initial version	Klause
A001	2019/02/06	Update RED statement & temp range	Klause