

radino40 DW1000

Datasheet — Ultra-Wideband + Bluetooth® LE module, CE and FCC certified



The In-Circuit **radino40 DW1000** combines Nordic Semiconductor's **nRF52840** microprocessor and Decawave's (Qorvo) **DW1000** transceiver in a small form-factor, **EMC-compliant** module.

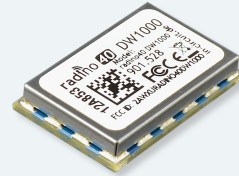
The radino40 DW1000 integrates UWB and Bluetooth® functionality and can be used in location tracking systems with a high precision of 10 cm. The module is fully **CE and FCC certified** — and field-proven as the UWB core of In-Circuit's industrial ICPROX collision-avoidance systems.

10 cm
ranging
precision

6
bands
3.5 – 6.5 GHz
UWB

6.8 Mbps
UWB data
rate

14.9×22.9 mm
module size



radino40 DW1000 · Model 901.528 · fully shielded, EMC-compliant

Features

- ▶ UWB transceiver **DW1000** by Decawave (Qorvo)
 - IEEE 802.15.4-2011 UWB compliant
 - Supports 6 RF bands from 3.5 GHz to 6.5 GHz
 - Data rates of 110 kbps, 850 kbps, 6.8 Mbps
- ▶ **nRF52840** by Nordic Semiconductor
 - 32-bit ARM® Cortex®-M4 CPU with FPU, 64 MHz
 - 1 Mbyte flash, 256 kbyte RAM
 - Dynamic multiprotocol transceiver: Bluetooth 5 / BLE, IEEE 802.15.4/Thread, ANT/ANT+, proprietary 2.4 GHz
 - 4×4 channel PWM unit with EasyDMA
 - 12-bit 200 ksp/s ADC
 - 5× 32-bit timer with counter mode
 - USB 2.0, I²C, QSPI, SPI, UART, NFC-A
 - Quadrature decoder (QDEC), 3× RTC
- ▶ **37 GPIOs**

Applications

- ▶ Precision real-time location systems (RTLS) using two-way ranging or TDoA schemes in a variety of markets:
 - Industrial — collision avoidance, proximity warning
 - Healthcare
 - Consumer
 - Social distancing
 - Other
- ▶ Location-aware wireless sensor networks

radino40 Family

All radino40 modules are **pin-compatible** and share the same outline, footprint and tape & reel packaging. For FiRa™ and direct smartphone ranging, the pin-compatible **radino40 DW3000** (datasheet 305000 184A003) is a drop-in upgrade.

More Information

www.in-circuit.de

UWB 802.15.4-2011

TWR / TDoA

BLE 5

NFC-A

CE / RED

FCC

RoHS

Hardware.**Software**.Wireless.

The radino40 DW1000 is more than a module: it is the proven UWB core of In-Circuit's industrial safety systems, backed by an SDK, ranging firmware and long-term OEM/ODM support — developed and maintained in Germany.

■ Software & Support

Ranging Firmware

- ▶ Two-way ranging (TWR) between modules, distance + zone evaluation
- ▶ Multi-anchor operation (distance and angle with 3 anchors)
- ▶ Field-proven in ICPROX forklift/AGV collision avoidance

SDK & Examples

- ▶ radino40 SDK: GCC toolchain, Makefile projects
- ▶ DW1000 example projects (ranging, RSSI, data transfer)
- ▶ BLE stack (Nordic SoftDevice) usable in parallel

Lifecycle & OEM/ODM

- ▶ USB bootloader — field updates without a debugger
- ▶ Firmware maintenance and feature development by In-Circuit
- ▶ Custom hardware: form factor, battery, housing, certification

Upgrade Path

- ▶ Pin-compatible **radino40 DW3000**: FiRa™, smartphone ranging (iPhone/Android)
- ▶ Same footprint, same tape & reel — no PCB change required
- ▶ See datasheet 305000 184A003

■ Evaluation Hardware

The quickest way to evaluate: the **radino40 Spider RP-SMA** carrier board — the module on a development carrier with USB, buttons, LEDs, accessible pin headers and RP-SMA antenna connector. Available from In-Circuit on request.

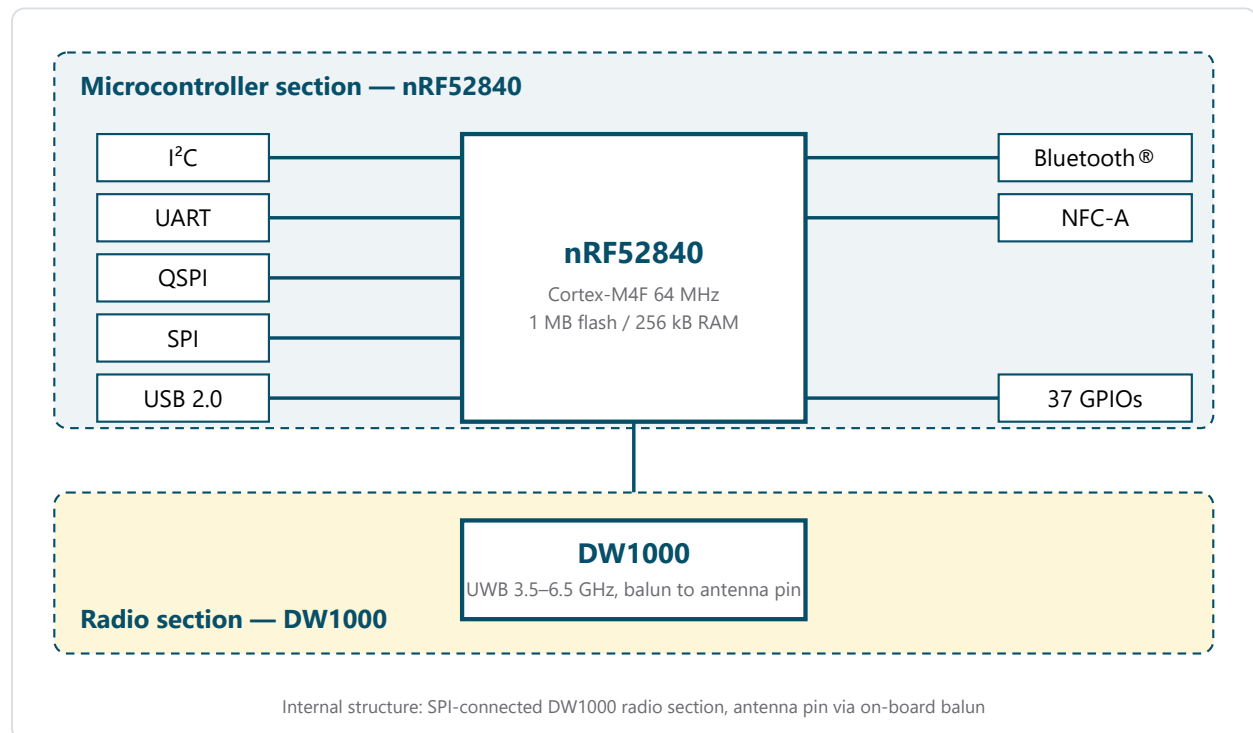
■ Why In-Circuit

- ▶ Hardware, RF and embedded software from one team — made in Dresden, Germany
- ▶ Proven in industrial UWB safety systems (ICPROX collision avoidance)
- ▶ From evaluation kit to certified series product, incl. long-term firmware maintenance

Overview

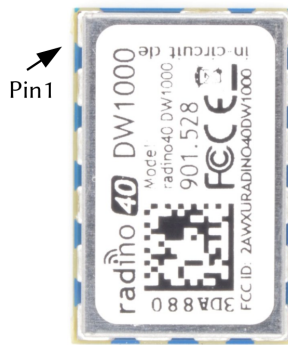
The In-Circuit radino40 DW1000 combines a **nRF52840** microprocessor and the **DW1000** RF transceiver. Despite its small form factor, the radino40 DW1000 offers great connectivity: many GPIOs and interfaces (USB 2.0, I²C, QSPI, SPI, UART, NFC-A) of the nRF52840 can be connected to external circuitry.

Block Diagram

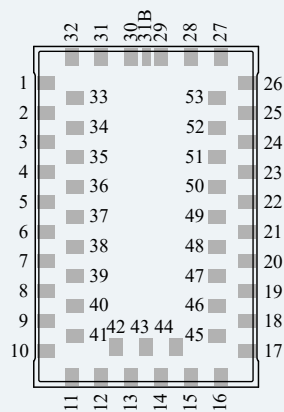


Pinout

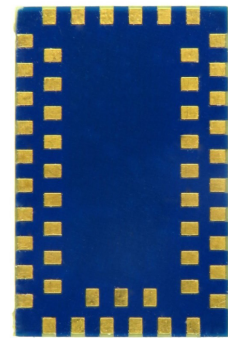
Pin 1 is located at the top-left corner (top view) and marked on the module shield.



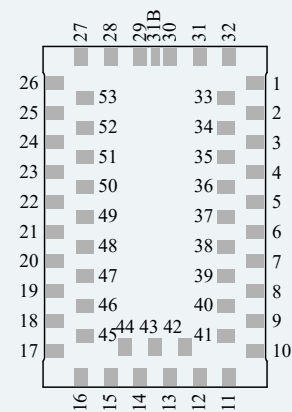
Top View



Top view — pins seen from top side



Bottom View



Bottom view — pins seen from bottom side

Pin List

Pin	Name	nRF52840 aQFN73 Pin/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	Reset	AC13/P0.18/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 (internal 1k pull-down)
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 47 µF ceramic to GND

Pin	Name	nRF52840 aQFN73 Pin/Name	DW1000 Port/Name	Description / Function
28	GND	VSS	VSS	Ground
29	DEC_RF			Needs at least 47 µF ceramic to GND
30	GND	VSS	VSS	Ground
31	DW_ANT	-	Balun→17/RF_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	DW1000 IO supply
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.)

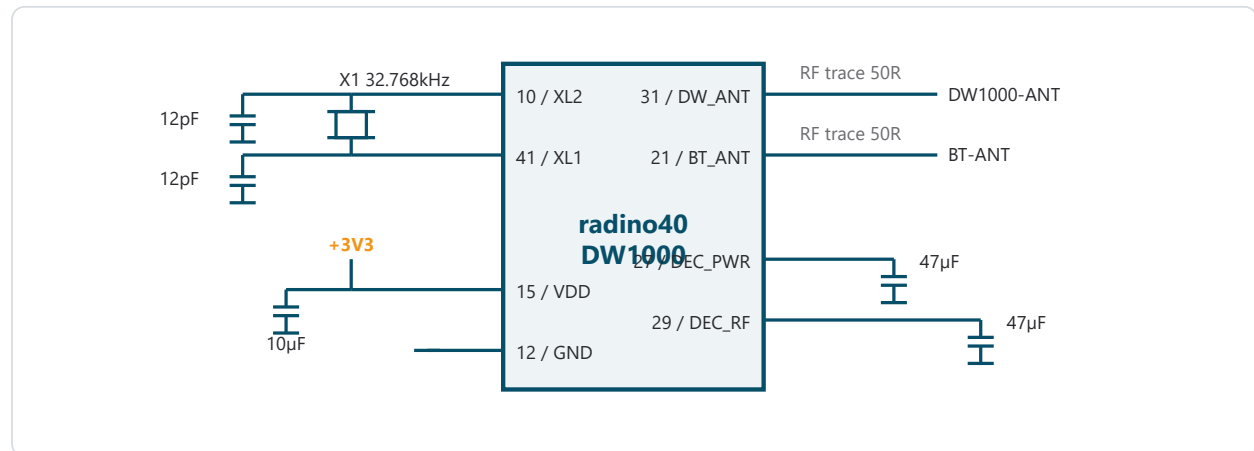
Interconnection

The nRF52840 and the DW1000 are connected internally. The interconnections are listed below.

Signal Name	nRF52840 aQFN73 Pin/Name	DW1000 Port/Name	Description / Function
RF_SS	AD16/P0.20	24/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/RST	DW1000 reset pin
SYNC	P2/P1.08	29/SYNC/GPIO7	DW1000 external synchronization
RF_IRQ	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 RX mode
TXLED	A16/P1.13	35/GPIO3/TXLED	DW1000 GPIO; can be configured to indicate TX mode

Internal biasing (see interconnection diagram, datasheet A001): 100 k Ω on the RF_RST net, 100 k Ω on the RF_WAKEUP net.

Application Circuit

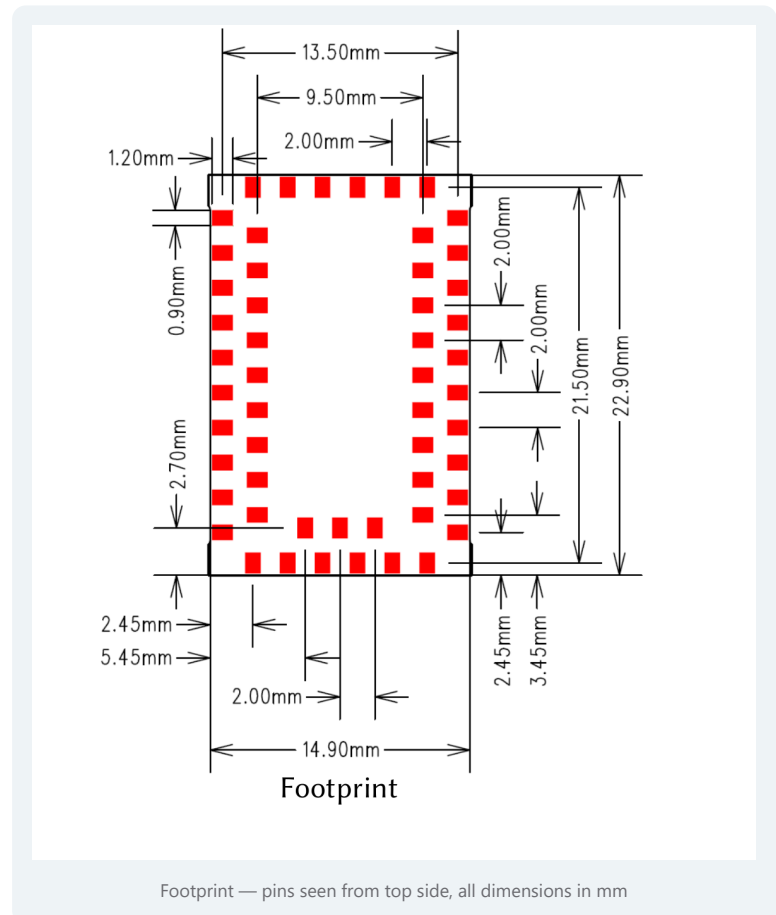


Ref	Function
X1	Crystal, for RTC functionality (32.768 kHz, 2×12 pF)
X2	Power supply, 10 µF (min.) ceramic capacitor in parallel
X3	2× 47 µF (min.) ceramic capacitor needed for operation (DEC_PWR, DEC_RF)
BT-ANT	Bluetooth antenna (50 Ω RF trace)
DW1000-ANT	DW1000 antenna (50 Ω RF trace)

The radino40 DW1000 is designed to be assembled like a standard SMT component: place it directly on your PCB with the footprint on the next page and solder it in a regular reflow process (profile see "Packaging & Processing").

■ Dimensions & Footprint

Module size **14.90 × 22.90 mm**, fully shielded. The module is assembled like a standard SMT component — solderable in a regular reflow process using the footprint below. Pin 1 is marked on the module shield.



Footprint drawings (EPS/SVG) for direct import into PCB layout tools are available from In-Circuit on request. All radino40 modules are pin-compatible and share this outline and footprint.

Absolute 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	°C
V_{DD}	-0.3	3.6	V
Current per IO		10	mA
Total current by sum of all IOs		60	mA

Recommended Operating Conditions

Rating	Min	Typ.	Max	Unit
Operating temperature	-40		85	°C
V_{DD}	2.8	3.3	3.6	V

DC Characteristics

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

Symbol	Rating	Min	Max	Unit
V_{IL}	Input low voltage	0	$0.3 V_{DD}$	V
V_{IH1}	Input high voltage	$0.7 V_{DD}$	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 Semiconductor nRF52840

$V_{CC} = 3.3\text{ V}$, $T_A = 25\text{ °C}$

Running mode	up to 10 mA
Stop mode	down to 0.4 μA

For details see manufacturers' datasheets.

Decawave DW1000

$T_{amb} = 25\text{ °C}$

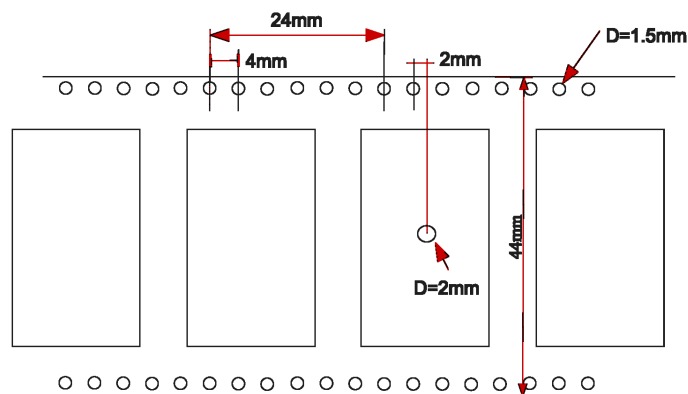
Parameter	Min	Typ.	Max	Unit
Supply current DEEP SLEEP mode	---	50	---	nA
Supply current SLEEP mode	---	1	---	μA
Supply current IDLE mode	---	19	---	mA
Supply current INIT mode	---	5	---	mA
TX	---	---	160	mA
RX	---	---	240	mA

Values from manufacturers' datasheets.

■ Packaging: Tape & Reel Specification

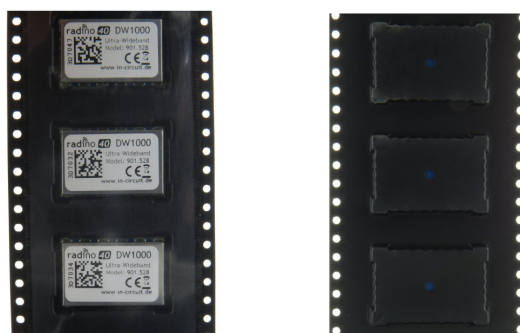
All radino modules come in a tape & reel package suitable for pick and place machines. Small quantities are delivered as cut-tape. There are two kinds of reels available with 100 pcs and 500 pcs per reel (see section Ordering Information). Except for the number of modules, all parameters are the same for both reel sizes:

- ▶ 13" reel size
- ▶ 44 mm tape width
- ▶ Tape pocket dimensions 29 mm × 19 mm × 4 mm
- ▶ Module spacing 24 mm
- ▶ 2 mm hole in the middle of the module body
- ▶ 1.5 mm tape holes for transport
- ▶ Transport direction: barcode to the left



Tape dimensions: 44 mm width, 24 mm module spacing, 2 mm body hole, 1.5 mm transport holes

Transport
direction
(Barcode to
the left)



radino40 DW1000 modules in tape — transport direction: barcode to the left

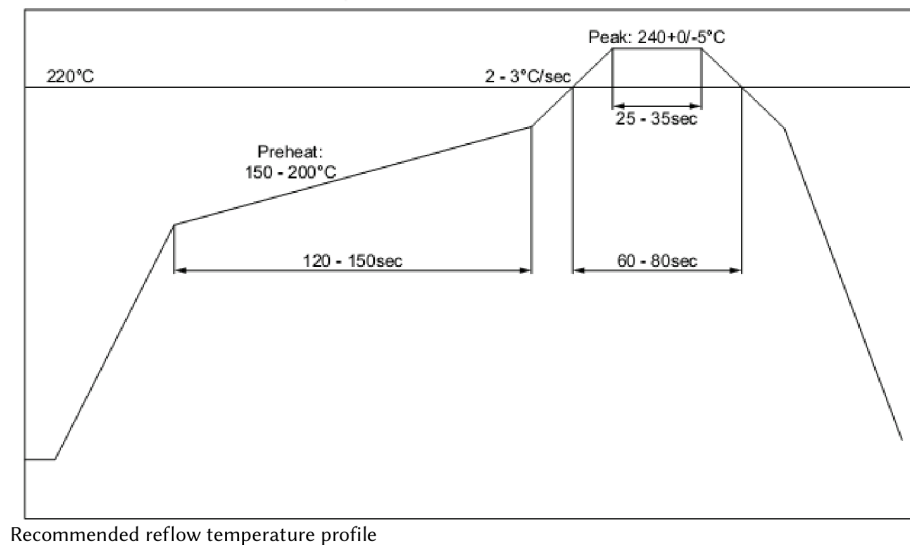
All modules of the radino40 family are pin-compatible and share the same outline dimensions, footprint and tape & reel packaging.

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 °C/sec
- ▶ Peak zone temperature of the module < 245 °C
- ▶ Time in peak zone < 40 sec
- ▶ Time above 220 °C < 80 sec

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



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
radino40 DW1000	901.528	1	Cut tape; reels 100 / 500

Recommended Accessories

Part	Ordering code	Note
UWB antenna ch. 5, male RP-SMA	902.067B	Omnidirectional PCB antenna, +2.5 dBi @ 6.5 GHz, minimal group-delay variation — designed for DW1000 anchors and tags
radino40 Spider RP-SMA	901.327E	Carrier/evaluation board with RP-SMA antenna connector (datasheet 305000 193A)

All radino modules are available online at www.in-circuit.de - SDK access and OEM/ODM engineering services on request.

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.



FCC certified

FCC ID: 2AWXURADINO40DW1000



RoHS / WEEE compliant

WEEE-Reg.-Nr. DE 17225017

Get in Touch

In-Circuit Solutions GmbH

Boltenhagener Str. 124, D-01109 Dresden, Germany

www.in-circuit.de · sales@in-circuit.de

Revision History

Version	Date	Changes	Editor
A	2020/07/20	Initial version	Träger
A001	2023/04/11	Inconsistent pin interconnections fixed	Klause
A002	2026/08/24	New layout; software & ecosystem section added	Träger