Datasheet

DCU040

Version 1.2

Revision History

Revision	Date	Change Description
1.0	Apr-2021	Preliminary version
1.1	Jul-2023	Updated pin-16 description & Module picture
1.2	Jun-2024	Updated with FCC Certification

Table of Contents

1. Introduction

The DCU040 is fully interoperable with IEEE® 802.15.4 HRP UWB standard. It is designed to operate worldwide with support of 500MHz UWB channels 5 (6489.6MHz) to 9 (7987.2MHz). It enables high-precision positioning applications with a non-Line-of-Sight precision of 5±10cm. It is a (SMD) Surface Mount Device designed to be easily mounted over custom Printed Circuit Boards (PCB) to deploy.

1.1. Key Features

Name	DCU040
Antenna Type	PCB patch
Size	Size 15.7 x 16.75 x 2mm
Communication Interface	SPI
Main Chip	SR040
Channel	5, 9
Frequency range	6.5GHz,8.00GHz
Supply Voltage	1.8 ~ 3.6V
Max Output Power (EIRP)	14.7 dBm

1.2. Applications

The perfect TAG for High Precision RTLS & Industrial application. Ideally suited as

TAG&TRACKER for IoT Consumer & Smart Home application.

1.3. Block Diagram

DCU040
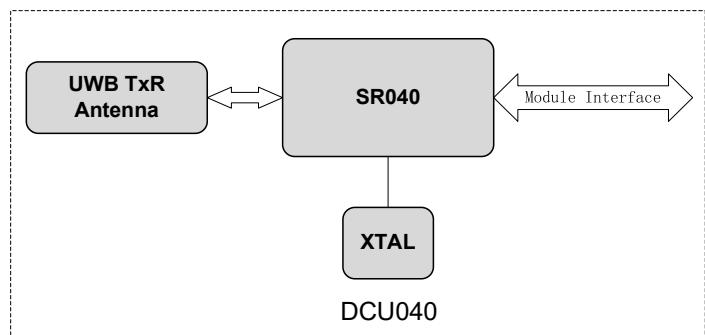
2. Electrical characteristics

2.1. Recommended operating conditions

When the input voltage of the module is lower than the rated operating voltage, the operation will be unstable. Input voltage higher than the maximum rating will cause permanent damage to the module. At the same time, working under the maximum rating for a long time also affects the stability of the module.

Parameter	Min	Type	Max	Unit	Conditions/Notes
Operating Temperature	–30		+85	˚C	
Supply Voltage (V$_{dd}$)	2.4	3.3	3.6	V	All specification parameters fulfilled
	1.8		2.4	V	• Device fully functional • TX PA peak power shall not be set higher than +9dBm
HIGH level input voltage (V$_{IH}$)	1.26		Vdd+0.5	V	
LOW level input voltage (V$_{IL}$)	–0.6	–	0.54	V	
HIGH level output voltage (V$_{OH}$)	Vdd–0.5	–	Vdd	V	
LOW level output voltage (V$_{OL}$)	–	–	0.2	V	

2.2. RF characteristics

Parameter		Min	Type	Max	Unit	Conditions/Notes
Frequency range		6240		8240	MHz	Channel 5 and 9
Channel bandwidth			500		MHz	
Power level range			32		dB	
Power level step			0.25		dB	
Rx Sensitivity (±10ppm carrier Offset)	Channel 5			-92	dBm	64 preamble, 6.8Mbps data rate
	Channel 9			-92	dBm	64 preamble, 6.8Mbps data rate

2.3. Antenna specifications

| Antenna Type	PCB Embedded
Antenna Polarization	Linear
Peak directivity	4.5dBi @CH5 3.8dBi @CH9
Radiation efficiency	60% @ CH5 77% @ CH9
Frequency range	6.50 , 8.0GHz
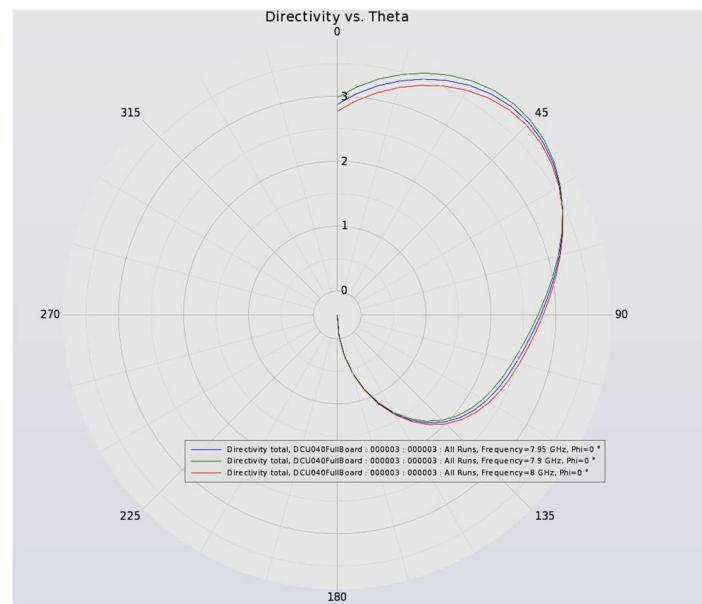
Fig. 1 Directivity at channel 9 center frequency and ch9 center frequency ±500MHz

3. Module Package

3.1. Pinout Description
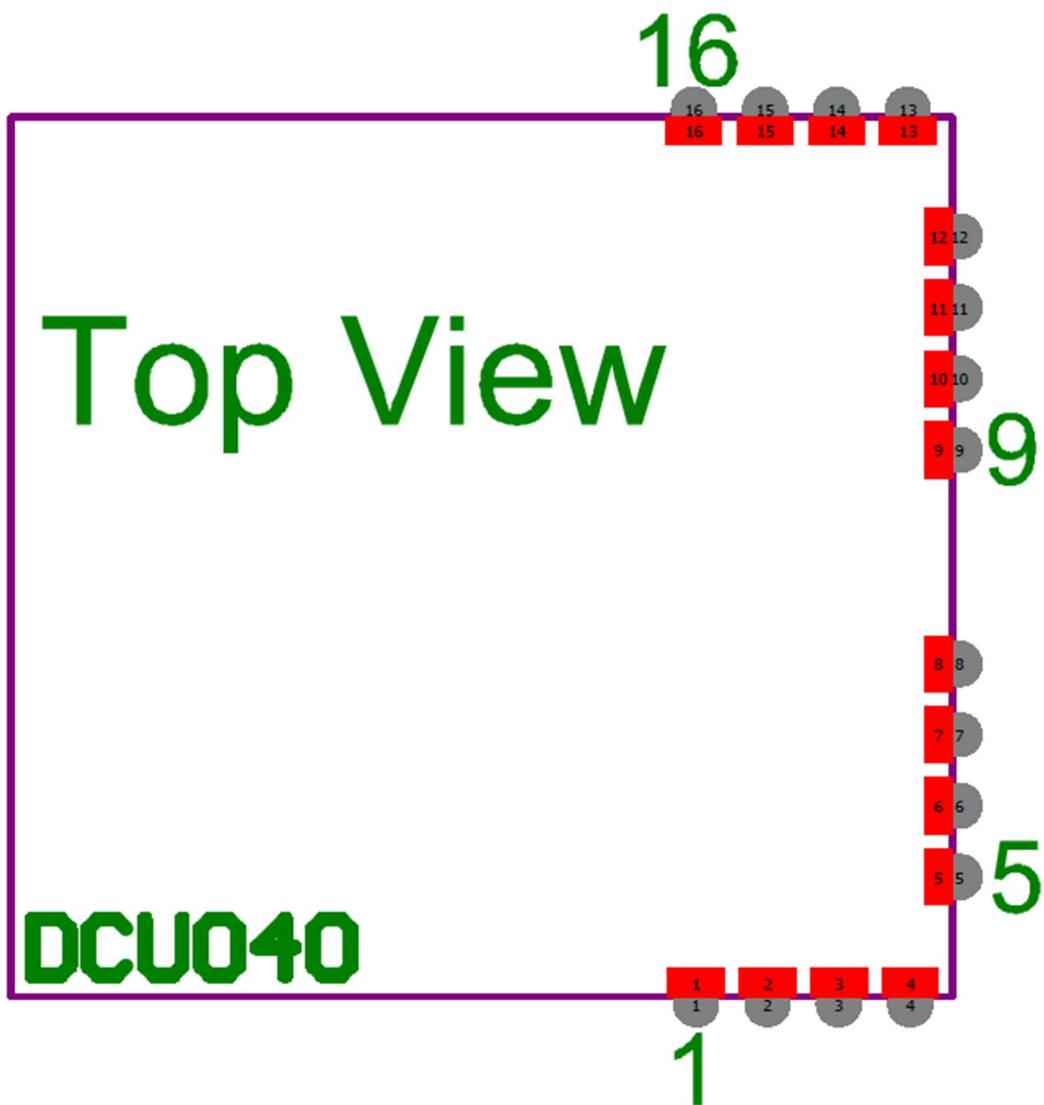
3.2. Pin Description Box

| Pin	Pin Name	Pin Type	Description
1	P12/TX	O	GPIO TX - Data output in UART operation
2	SWCLK	I/O	Serial Wire Debug (SWD) clock, internal pull-up resistor
3	SWDIO	I/O	Serial Wire Debug (SWD) data, internal pull-up resistor
4	P13	I/O	GPIO CS2_N - Second Chip Select (active low) output in SPI Master operation RTS - "Request To Send" in UART operation
5	P14/CS_N	I/O	GPIO CS_N - Chip Select (active low); output in SPI Master operation; input in SPI Slave operation
6	P21/SDI	I	GPIO SDI - Data input for SPI full duplex operation
7	P17/SCLK	I/O	GPIO SCLK - Data clock for SPI operation; output in SPI Master operation; input in SPI Slave operation
8	P20/SDIO	I/O	GPIO SDIO - Data I/O for SPI operation; output in full duplex operation; input/ output in half-duplex operation
9	GND	G	Ground
10	P15/INT_N	O	GPIO INT_N - Interrupt output (active low) in 6-wire SPI operation
11	P16/RDY_N	O	GPIO RDY_N - Ready output (active low) in 6-wire SPI operation
12	RST_N	I	Reset input (active low), internal pull-up resistor
13	P11/RX	I	GPIO RX - Data input in UART operation
14	P10	I/O	GPIO CTS - "Clear To Send" in UART operation PA_ENBL - Gating signal for an optional external PA
15	VBAT	P	Power supply for digital I/Os and power supply for the chip via current limiter
16	VLIM	P	Power supply for digital domain and XTAL

3.3.Package outline
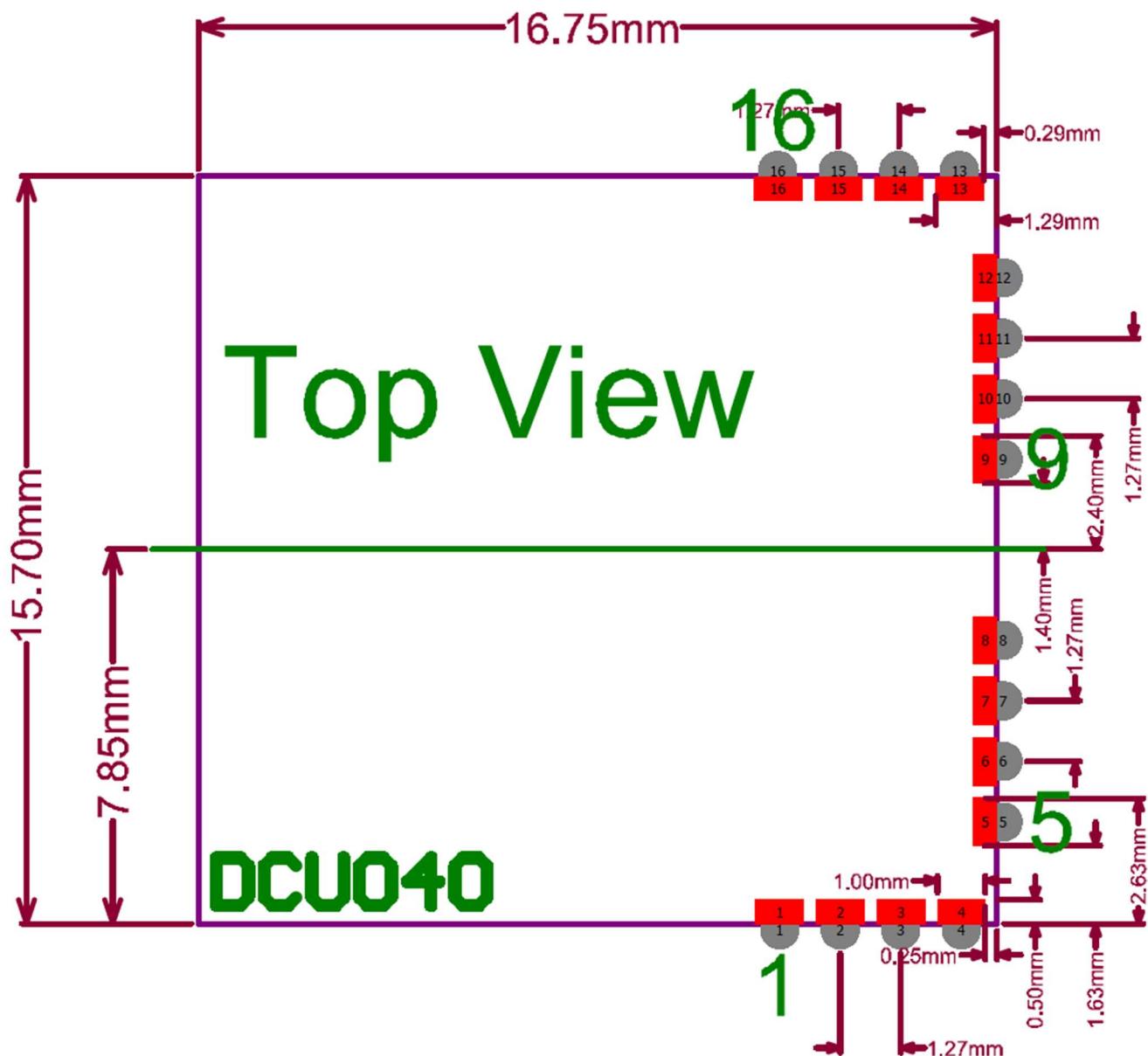
3.4. Recommended PCB Footprint
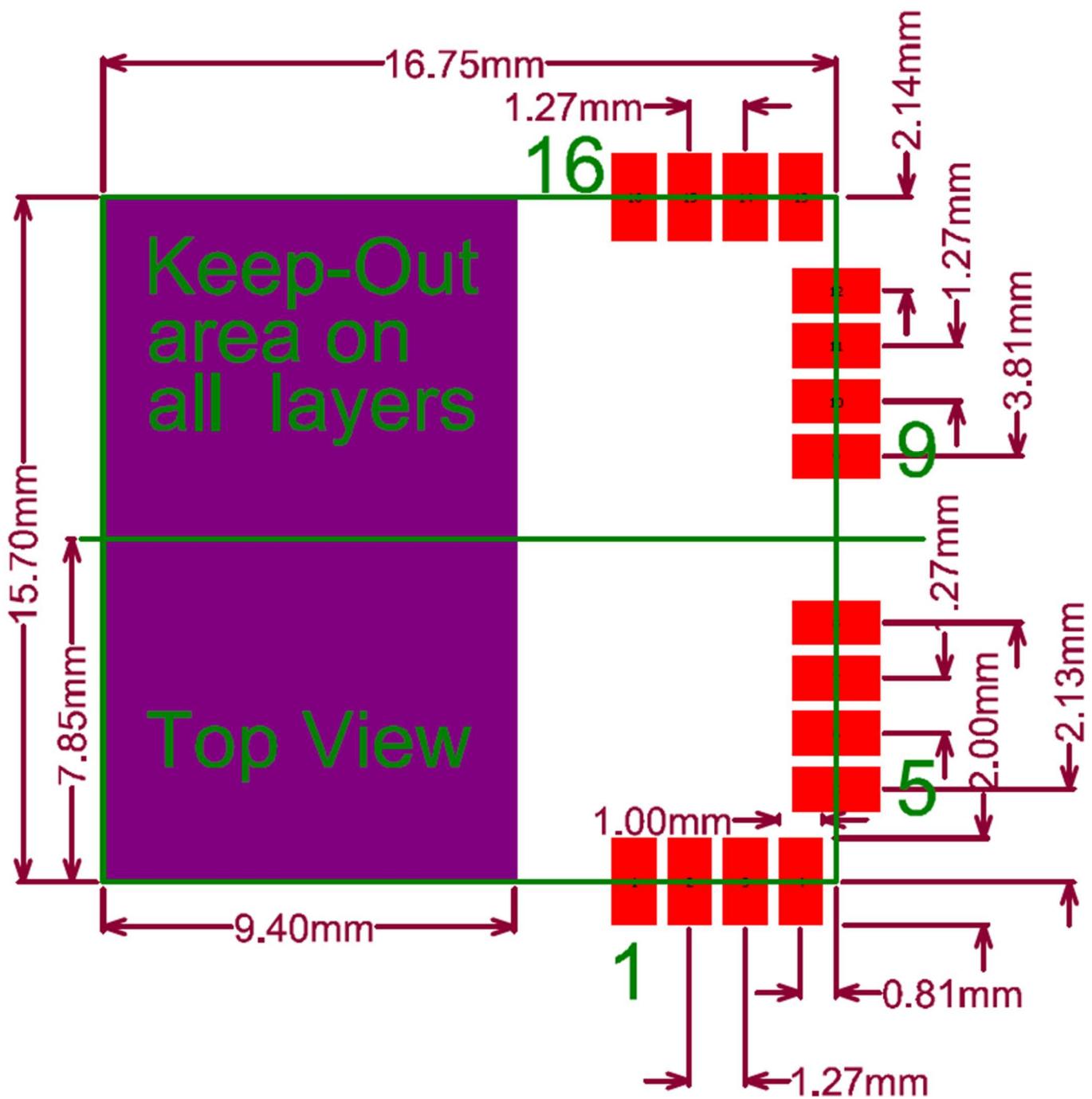
3.5 Host board mounting

DCU040 is designed to be mounted onto a host board. Suggested host-board thickness is 0.8mm and it should be greater than 0.5mm. The DCU040 is preferably mounted close to the host board edge, as shown next. Maximum distance to the edge should be up to 1mm.


Copper free area (all layers)
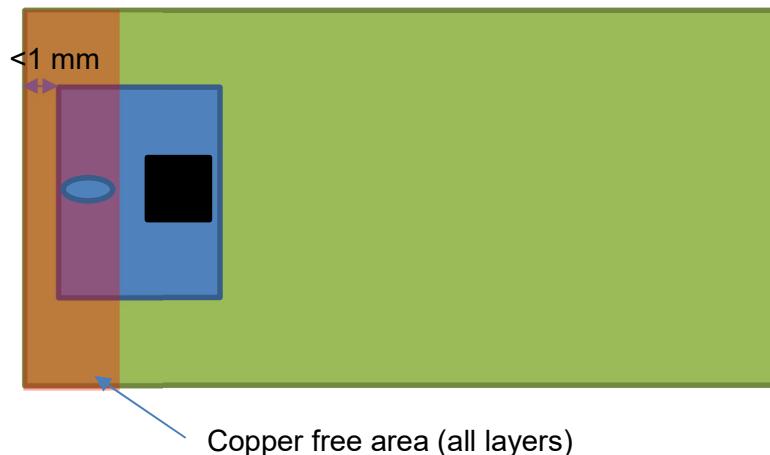
4. Soldering Condition

4.1. Manual Soldering – Pb Free

Soldering Temperature: 360ºC ± 5ºC, 5sec max.

4.2. Recommended Reflow Condition – Pb Free
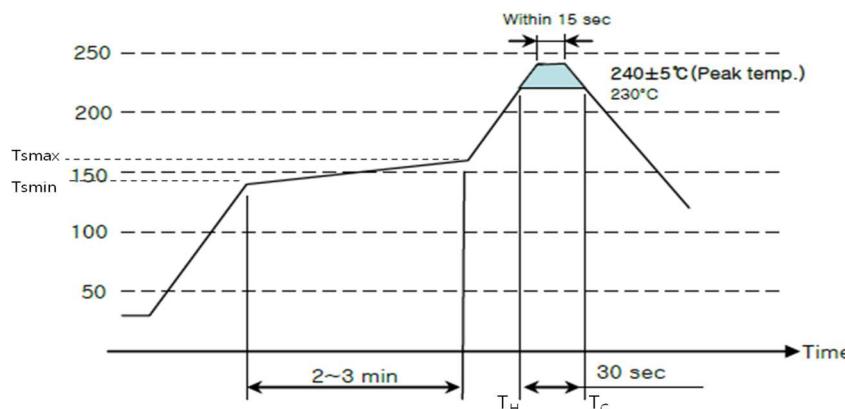
Profile Feature	Pb–Free Assembly
Preheat	
-Temperature Min (Tsmin)	140˚C
-Temperature Typical (Tstypical)	150˚C
-Temperature Max (Tsmax)	160˚C
-Time Tsmin to Tsmax	2 ~ 3 min
Peak Temperature	240±5˚C
Time of actual peak temperature	Max. 15 seconds
Heating to Cool	
-Temperature Heating (TH)	230˚C
-Temperature Cool (TC)	230˚C
-Time TH to TC	30 seconds

5. Application design-in information

5.1 Reference schematics for DCU040
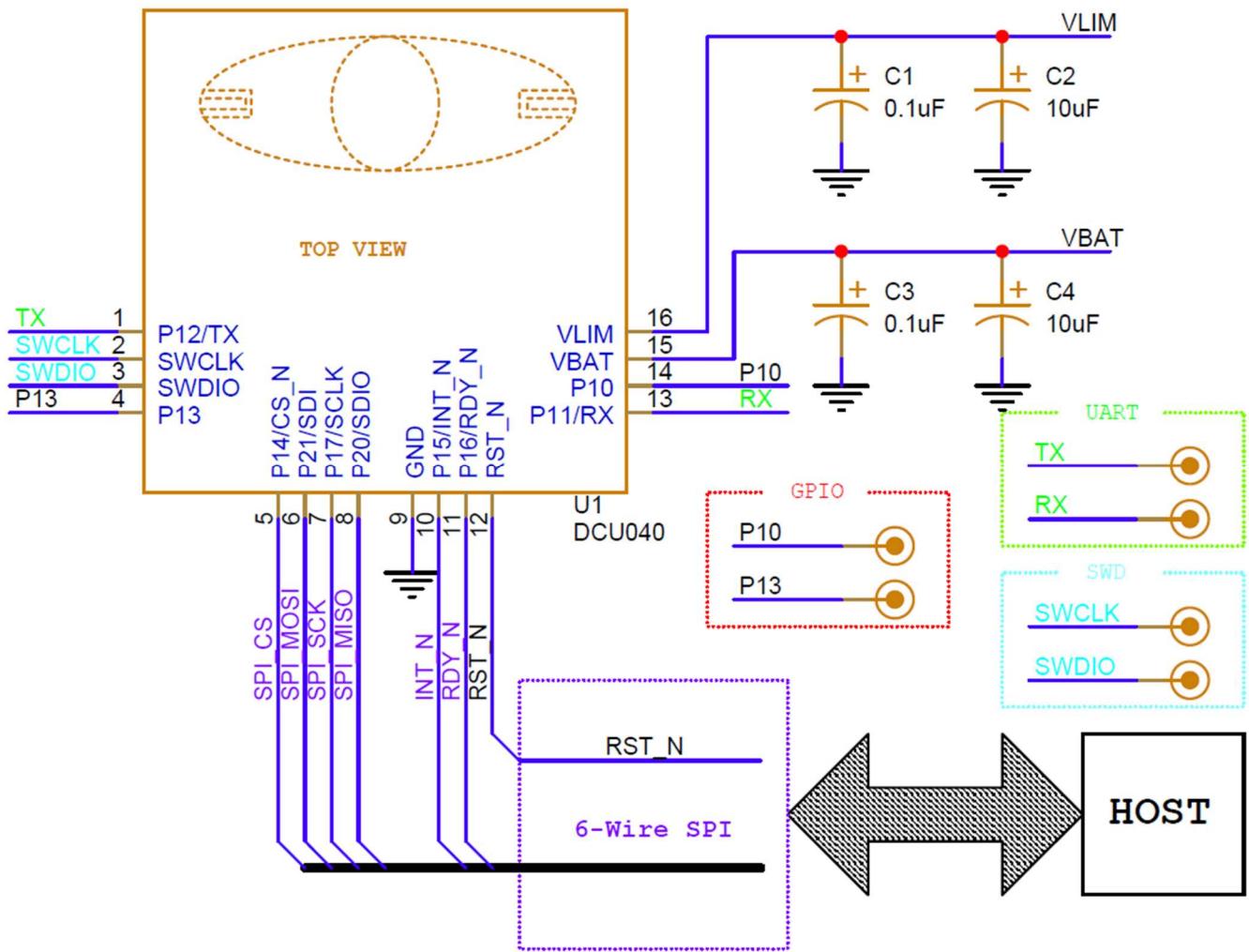
The key component values for the schematic are shown in

Part code	Description	Value	Notes
C1,C3	Multilayer Ceramic Capacitor, 0402, X7R	100nF ±10% / 16V	
C2,C4	Multilayer Ceramic Capacitor, 0402, X5R	10μF ±10% / 16V	

5.2 Power Supply Block Diagram with Host Device

DCU040 module typical power supply is 3.3V, below diagram includes but is not limited to 3 kinds of power supply mode with Host Device, for reference only.

1, Power Supply with Coin battery like CR2032, can directly connect Battery power 3.3V to DCU040 VLIM&VBAT pins.

2, Power Supply with Lithium Battery or multiple AA/AAA type Battery, use a Buck-Boost DC/DC Regulator to convert battery power to 3.3V.
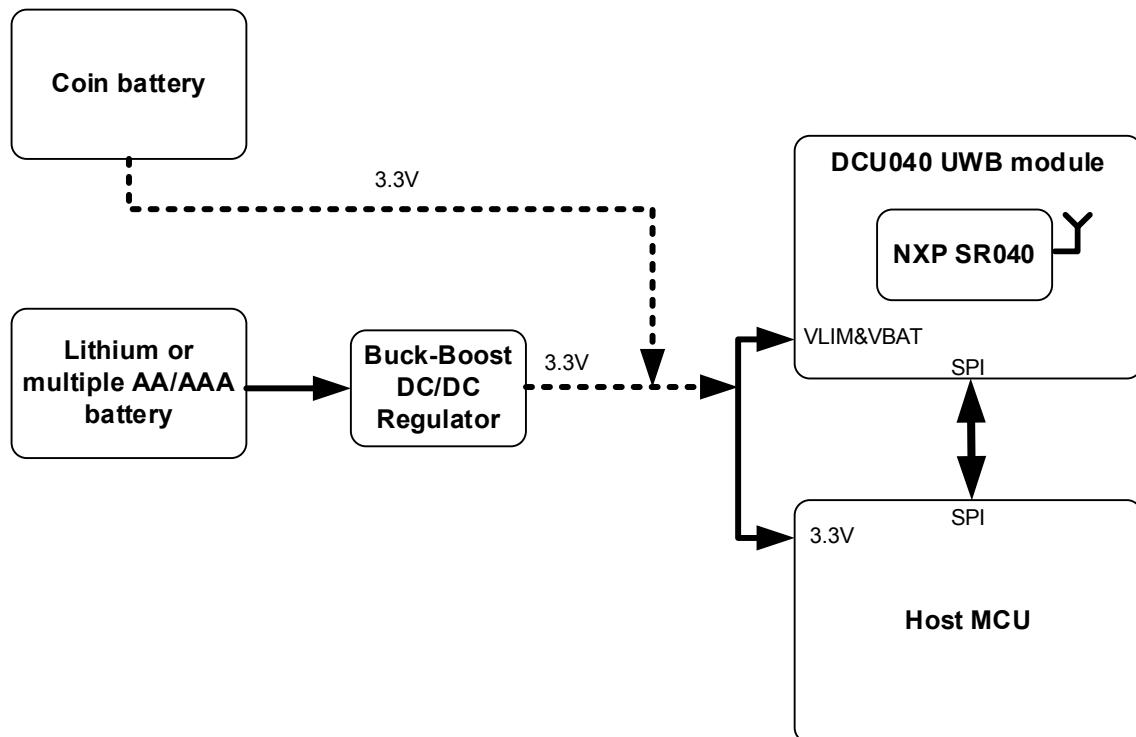
6. Regulatory approval

6.1 FCC Certification

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

6.1.1 List of applicable FCC rules

The DCU040 is an UWB Module with BPRF modulation. It operates on the 6.5GHz, 7GHz, 8GH and, therefore, is within U.S. FCC part 15.519,part 15.521,part 15.209 standard

6.1.2 Specific operational use conditions

The EUT is a UWB Module
Operation Frequency: 6.5GHz, 8GHz for UWB;
Modulation Type: BPRF
Number Of Channel: 2 channels
Antenna Designation: On Board PCB Patch Antenna
Antenna Gain: 6.5GHz:4.5dBi, 8GHz:3.8dBi

6.1.3 Limited module procedures

Applicable. The module is a Limited module and complies with the requirement of FCC Part 15.519. According to FCC Part 15 Subpart C Section15.212, The radio elements must have the radio frequency circuitry shielded. However, due to there is no shield and doesn't contain power supply regulation for this Module, this module is granted as a Limited Modular Approval. When this Module is installed into the other host, a Class II Permissive Change or a New FCC ID submission is required to ensure the full compliance of FCC relevant requirements.

6.1.4 Trace antenna designs

Not applicable; The module was designed with the fixed PCB print antenna, any

changes or modifications by the OEM integrator will require additional testing and evaluation.

6.1.5 RF exposure considerations

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction

6.1.6 Antennas

The DCU040 is an UWB Module beams signals and communicates with its antenna, which is On Board PCB Patch Antenna. The On Board PCB Patch Antenna gain is 6.5GHz:4.5dBi, 8GHz:3.8dBi. Antenna could not be in no-load state when module is working. During debugging, it is suggested to add 50 ohms load to the antenna port to avoid damage or performance degradation of the module under long-time no-load condition.

6.1.7 Label and compliance information

The final end product must be label in a visible area with the following
Host must Contains FCC ID:2BFZA-DCU040. If the size of the end product is larger than 24x16mm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference and
(2) this device must accept any interference received, including interference that may cause undesired operation.

6.1.8 Information on test modes and additional testing requirements

Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

6.1.9 Additional testing, Part 15 Subpart B disclaimer

The host product manufacturer is responsible for compliance with any other FCC

rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

6.1.10 When this Module is installed into the Special host, defined in page 20 appendix 1 a Class II Permissive Change Test Plan will act as following:

The specified host Device install this limited modular which has no shield.

The host shall still apply C2PC change:

The host shall not change the module's hardware and software parameters. Modulation modes shall keep consistent with the certified modular.

The host shall still meet the rule section part 15.519,part 15.521,part 15.209 standard .

The host's fundamental maximum output power shall be confirmed under the worst case from module.

Host's AC Conducted emissions and radiated spurious emissions including radiate band edges shall be test to be confirm no parasitic emissions i.e., compliance emissions due to ingress. Band edge compliance test shall also to be verified under the worst case from module.

Host cannot change the RF Exposure use conditions. If use conditions is changed, the separate Approval shall be required.

Moudle integrated in other host need new FCC ID application.

6.2 ATTENTION

This device is intended only for OEM integrators under the following conditions: The antenna must be installed and operation without restriction is maintained between the antenna and users, and

1) This device and its antenna(s) must not be co‑located with any other transmitters except in accordance with FCC multi‑transmitter product procedures. Referring to the multi‑transmitter policy, multiple transmitter(s) and module(s) can be operated simultaneously without C2PC.

2) For all products market in US, OEM has to limit the Operating Frequency: 6500-8000MHz by supplied firmware programming tool. OEM shall not supply any tool or info to the end‑user regarding to Regulatory Domain change.

6.3 USERS MANUAL OF THE END PRODUCT:

The device has been evaluated to meet general RF exposure requirement. The devicecan be used in portable exposure condition without restriction.The end user has to be informed that the FCC radio‑frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference and

(2) this device must accept any interference received, including interference that may cause undesired operation.

6.4 FCC WARNING

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generate, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference

will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help.

UWB devices may not be employed for the operation of toys. Operation onboard an aircraft, a ship or a satellite is prohibited.
The use of antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.

this module integration is restricted to handheld host products only.

Appendix 1-Installation Guide

Host product name: UWB TAG

Host manufacturer: Truesense S.R.L

Details on Host product:

The UWB TAG based onNordicnRF52840 and Truesense DCU040 UWB module, supports the finder functionality, point to point triggering, and eventually tracking applications.

Host MCU: nRF52840-QIAA, Bluetooth 5, ARM Cortex-M4 32-bit processor with FPU, 64MHz, 1MB flash & 256KB RAM. nRF52840 as the host control Truesense UWB module DCU040 through 6-wire SPI interface.

Block Diagram:
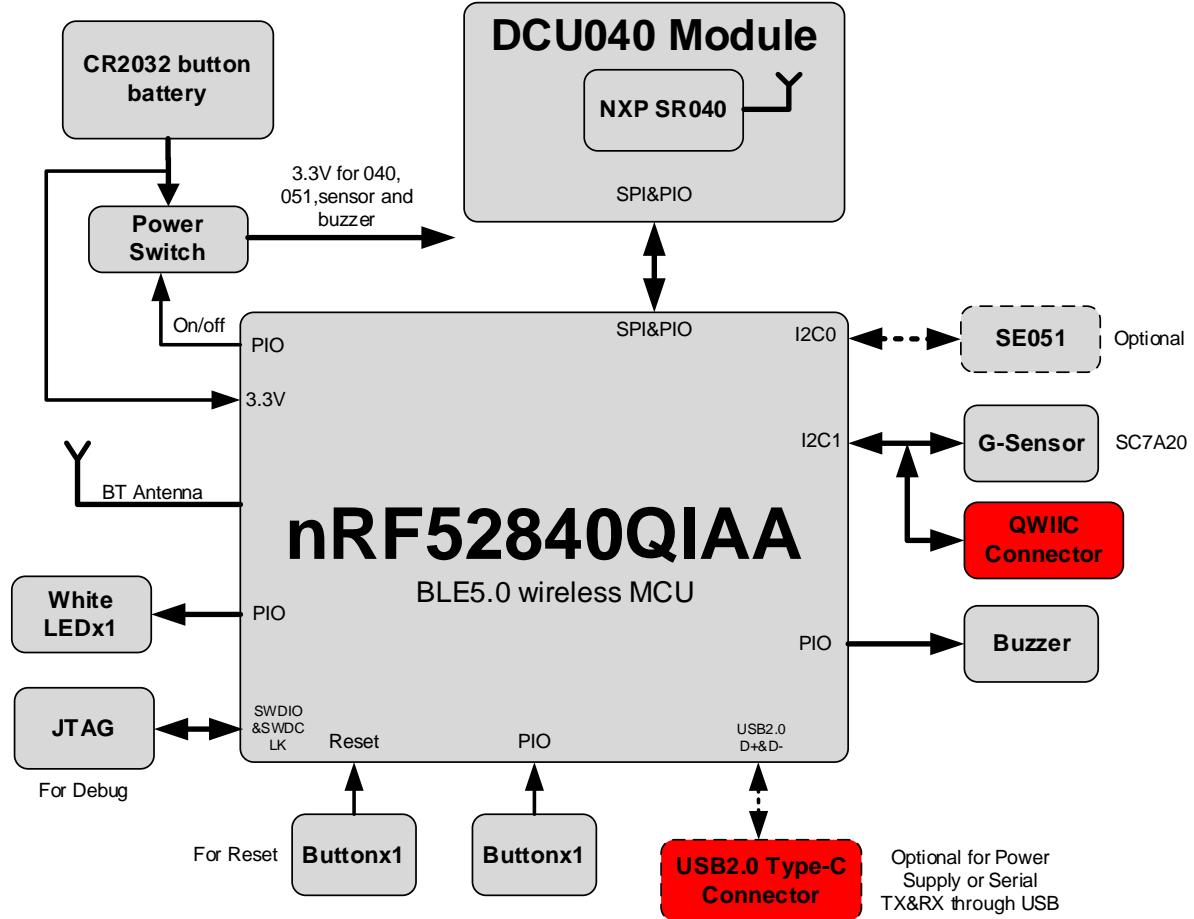
Host Installation instructions:

1, Solder the DCU040 module to host mainboard.
   please note that DCU040 module is a SMD module, not an easy plug & unplug module. DCU040 module can be manually or reflow soldered in a professional factory. Please refer to DCU040 spec.
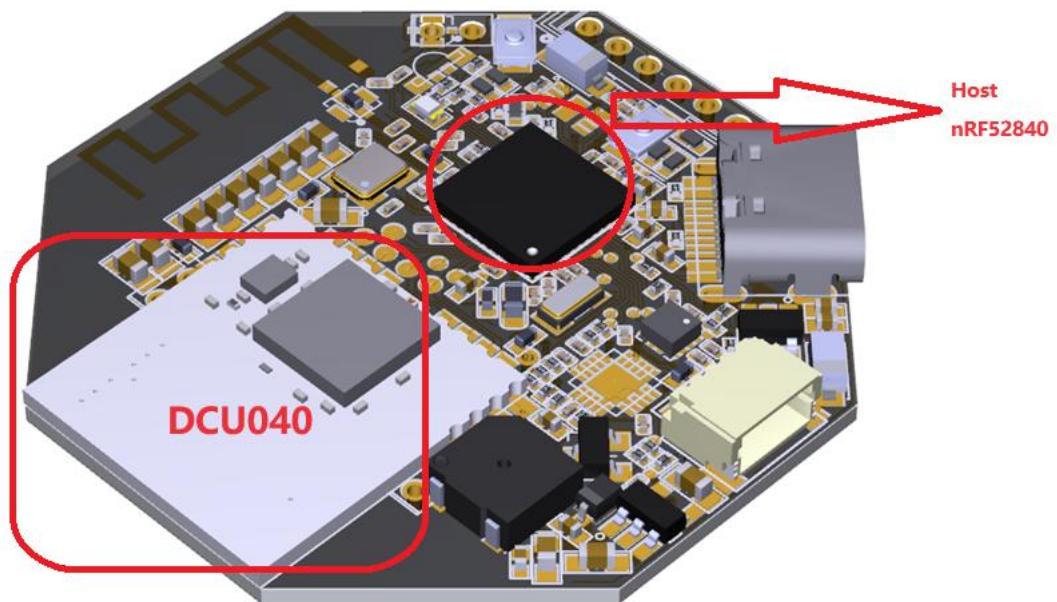
2，Firmware download.

Download firmware through J-link Connector, use the firmware which provided by Truesense.

3，Power up the UWB TAG.

Power up the UWB TAG through the CR2032 coin battery.

2032 Battery is mounted on the battery holder which is on the back side of the UWB TAG.
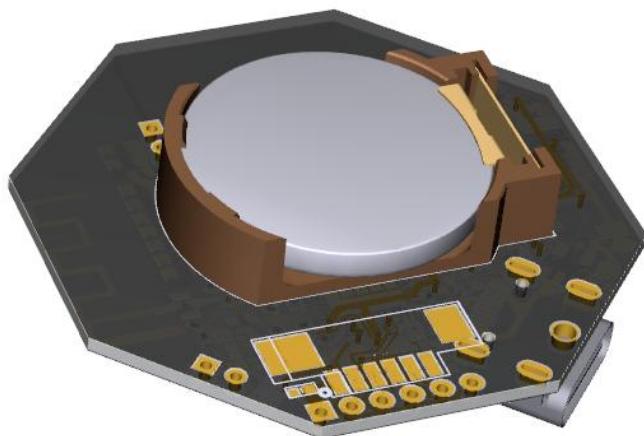
Appendix 2 -Maintenance instructions

1,During the UWB TAG installation and maintenance, 100% follow Truesense UWB module DCU040 spec, no any change on module HW. And use Truesense firmware, to guarantee the antenna performance is good and also within the limit of FCC.

2, This UWB TAG is a final product, and also it's proved that it can work properly without a shielding CAN.

3, If you encounter any problems during installaton and use, or the product is missing/damaged,please contact us at any time.
E-mail: info@truesense.it