Application Note

Type 2DT Hardware Application Note

Semtech LR1110 Chipset for LoRa, Wi-Fi Scan, GNSS Scan

- Design Name: Type 2DT
- P/N: LBAA0XV2DT-158

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About This Document

Murata's Type 2DT is a small and high-performance module based on Semtech LR1110 chipset, supporting LoRa + IEEE 802.11 b/g/n Wi-Fi Passive Scanner + GNSS. This application note provides RF and hardware design guidance. Refer to Type 2DT datasheet for module specification.

Audience & Purpose

Intended audience includes any customer looking to integrate this module into their product. In particular, RF, hardware, systems, and software engineers.

Document Conventions

Table 1 Describes the document conventions.

Table 1: Document Conventions

Conventions	Description
	Warning Note Indicates very important note. Users are strongly recommended to review.
	Info Note Intended for informational purposes. Users should review.
	Menu Reference Indicates menu navigation instructions. **Example**: Insert➔Tables➔Quick Tables➔Save Selection to Gallery
	External Hyperlink This symbol indicates a hyperlink to an external document or website. **Example**: Embedded Artists AB Click on the text to open the external link.
	Internal Hyperlink This symbol indicates a hyperlink within the document. **Example**: Scope Click on the text to open the link.
`Console input/output or code snippet`	**Console I/O or Code Snippet** This text ***Style*** denotes console input/output or a code snippet.
`# Console I/O comment` `// Code snippet comment`	**Console I/O or Code Snippet Comment** This text ***Style*** denotes a console input/output or code snippet comment. • Console I/O comment (preceded by "#") is for informational purposes only and does not denote actual console input/output. • Code Snippet comment (preceded by "//") may exist in the original code.

1 Scope

This document describes the design recommendation for schematic diagrams, printed circuit board (PCB), and also provide the hardware design guide for Type 2DT.

2 Intended Audience

This document is intended for:

- Technical support personnel
- Board hardware engineer
- Software engineer

3 Related Documents

- Type 2DT Datasheet
- UM.LR1110.W.APP
- DS.LR1110.W.APP

4 Clock circuit

4.1 TCXO

There is a 32MHZ TCXO for LR1110 IC inside the module. And the 32MHz TCXO is powered by VTCXO of LR1110 IC internally.

4.2 LSE

There is an LSE 32.768KHz crystal for LR1110 IC inside the module.

5 Power supply of the module

There is one input power supply on the module.

VDD: Power supply for the LR1110 IC inside the module

The power supplied decoupling capacitors should follow to Figure 1. The capacitors should be placed as close as to the module pins. Figure 2 is an example.

Figure 1 Decoupling capacitors of Power

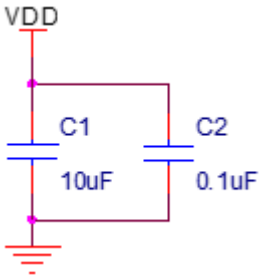
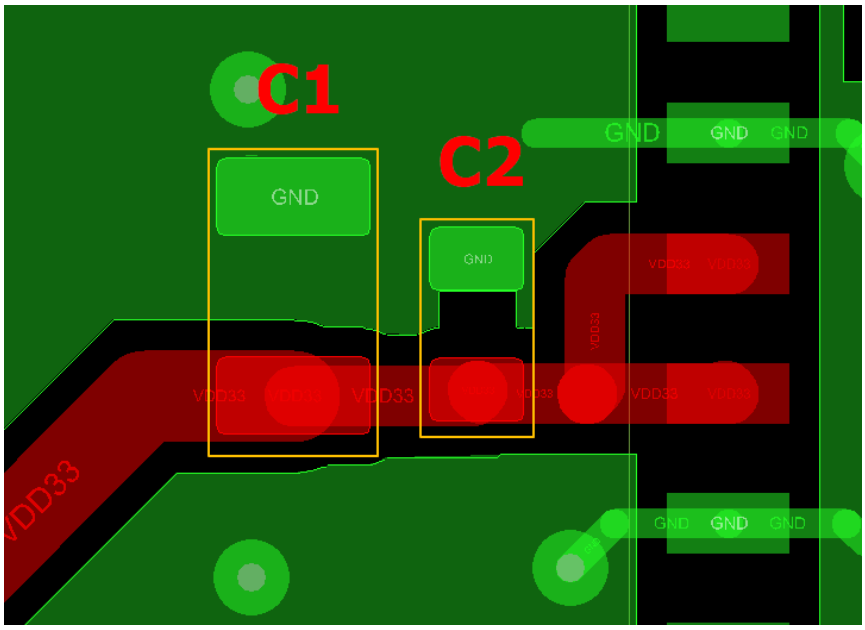


Figure 2 Placement of Decoupling capacitors



6 ANT ports

The ANT ports are the RF path of LoRa, GNSS and Wi-Fi signals. The port impedance is designed as about 50ohm. So, when customer connects the port to SMA port or antenna using RF trace, make sure the RF trace impedance is about 50ohm. The RF trace can be stripe line or co-plane mode. It is better to add some PI type matching components on the trace. In case of mismatch, the impedance can be compensated by the matching circuit.

7 GPIOs

The Type 2DT module used 11 digital IOs of LR1110:

- LR1110:DIO0 is used as BUSY signaling, and it is mandatory to properly handle the host controller interface. The signal is connected to the module pin.
- LR1110:DIO1 to DIO4 are dedicated to the SPI interface signals NSS, SCK, MOSI and MISO respectively. These signals are connected to the module pins.
- LR1110:DIO5, DIO6, DIO7 are used to control RF switches in the module. These signals are connected to the module pins.
- LR1110:DIO8 is used to LNA on the GNSS of module, the signal connected to the module pin.
- LR1110:DIO9 is dedicated to the LR1110 interrupts. It is recommended to connect DIO9 to the host controller for the lowest-power applications. The signal is connected to the module pin.
- LR1110: NRESET allows to cancel on-going functions of the LR1110 and reset all HW and FW. Although a device restart is also possible through host controller commands, it is recommended to allow the host controller to control this signal. The signal is connected to the module pin.

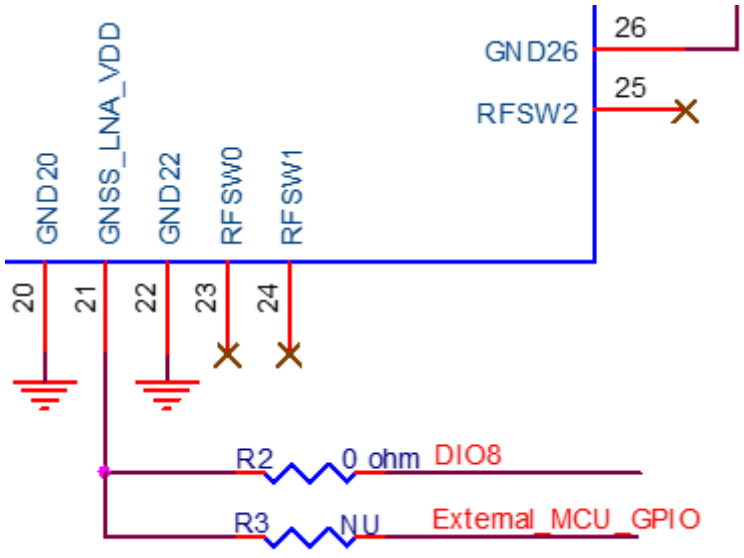
Table 2 Relation between module pins and LR1110 GPIOs

2DT module pin number	2DT module pin name	LR1110 pin
1	DIO9	DIO9
2	DIO8	DIO8
9	LR_BUSY	DIO0
10	LR_NSS	DIO1
11	LR_MISO	DIO4
12	LR_MOSI	DIO3
13	LR_SCK	DIO2
23	RFSW0	DIO5
24	RFSW1	DIO6
25	RFSW2	DIO7
35	LR_NRST	NRESET

8 Power supply of the GNSS LNA on module

There is LNA used for the GNSS in the module. Customer can choose the DIO8 of module or the external MCU GPIO for the LNA power supply. The recommended mode is to use the DIO8 of the module.

Figure 3 GNSS LNA power supply



9 DC-DC converter and LDO regulator mode

9.1 Selecting DC-DC Converter or LDO Regulation

Two forms of voltage regulation (DC-DC buck converter or linear LDO regulator) are available depending upon the design priorities of the application. These LDO or DC-DC is selected to be used in the chip core.

Beside it, the LDO and DC-DC are also related with the PA regulator in LR1110.

The PA regulator (Reg_PA) in LR1110 is used to supply of both the Low Power PA and the High Power PA.

The PA regulator is internally connected to the DC-DC/LDO output for the Low Power PA, allowing a +15dBm operation in both DCDC and LDO configurations.

But when the power is high than 15dBm, PA regulator must be configured to connect to VBAT_RF (VDD pin on 2DT module)

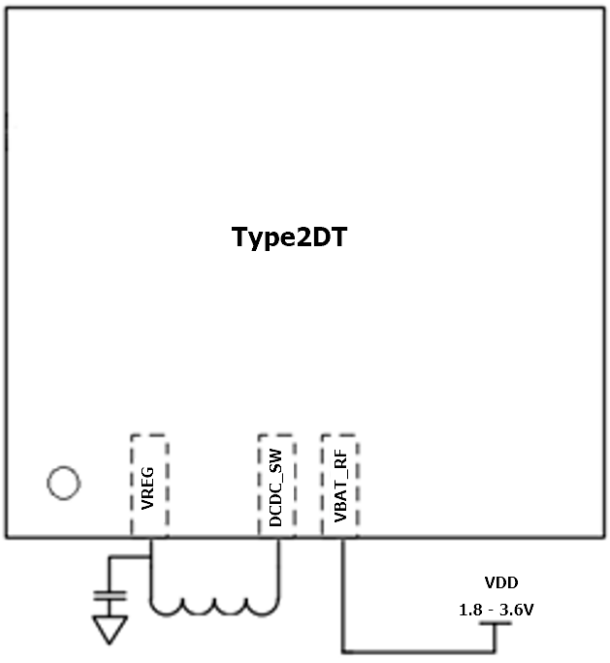
Table 3 Regulation Circuit Mode

Circuit Mode	Sleep	STDBY_RC	STDBY_XOSC	FS	Rx	Tx
Regulator Type = 0	-	LDO	LDO	LDO	LDO	LDO
Regulator Type = 1	-	LDO	DC-DC + LDO	DC-DC + LDO	DC-DC + LDO	DC-DC + LDO

9.2 2DT with DC-DC Regulator Option

Advantage of this option: The power consumption of the core is reduced. And power consumption of the Tx power (power value is under 15dBm) is smaller compared with LDO mode.
Note: Regulator Mode register value should be set as 0x01 under DC-DC Regulator mode.

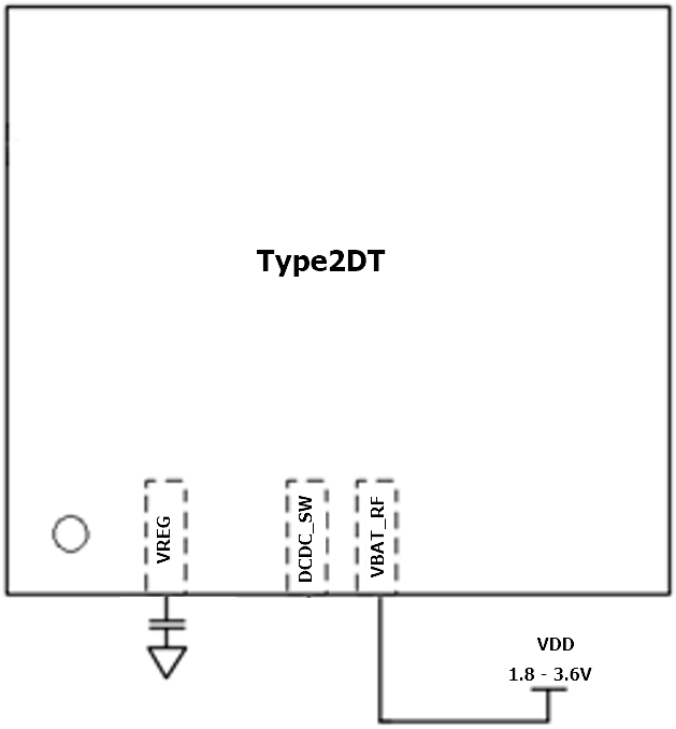
Figure 4 2DT with DC-DC Regulator Option



9.3 2DT with LDO Regulator Option

The LDO Regulator is used. Power consumption is higher than in DC-DC regulator.
Advantage of this option: The cost and space for an external 15 μH inductor are spared.

Figure 5 2DT with LDO Regulator Option



Note: **Regulator Mode register value should be set as 0x00 under LDO Regulator mode.**

10 Appendix

The connection information between LR1110 IC and RF switch inside the module is important for the software design.

10.1 Connection of LR1110 IC and RF switch

Table 4 Connection between LR1110 IC and RF switch

LR1110			RF switch	
Pin	Name		Pin	Name
25	DIO5	-----	3	V1
24	DIO6	-----	6	V2
23	DIO7	-----	7	V3

10.2 Relation between the module LoRa operation mode and LR1110 IC pin status

Table 5 Relation between the module operation mode and LR1110 IC pin status

LoRa work mode	LR1110 IC pin	LR1110 IC pin	LR1110 IC pin
	DIO5	DIO6	DIO7
Standby	0	0	0
LoRa Rx	0	0	1
LoRa Tx	0	1	0
LoRa Tx_High power	1	0	0

Revision History

Issued Date	Revision Code	Document Status	Changed Items
2023/06/29	A		Initial Release
2024/01/15	B		Changed the format of the document

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This document might include technical inaccuracies or other errors. Corrections and improvements might be incorporated in new version of the document.