LN920

Hardware Design Guide

1VV0301730 Rev. 17 – 2024-07-11

Telit Technical Documentation

APPLICABILITY TABLE

PRODUCTS	PART NUMBER
LN920A12-WW	LN920A12xxx
LN920A6-WW	LN920A6xxx
LN920A13-WW	LN920A13xxx
LN920A6-NA	LN920A6xxx

CONTENTS

1. INTRODUCTION

1.1. Scope

This document introduces the Telit LN920 module and presents possible and recommended hardware solutions for the development of a product based on this module. Features and solutions described in this document apply to all LN920 variants listed in the applicability table.

Where the suggested hardware configurations are not to be considered mandatory, the information provided should be used as a guide and starting point for the development of a product based on a Telit LN920 module.

If a specific feature only applies to a specific product, it will be marked.

Note: LN920 refers to all modules listed in the Applicability Table.

1.2. Audience

This document is intended for Telit customers, especially system integrators, about to implement their applications using the Telit LN920 module.

1.3. Contact Information, Support

For technical support and general questions please e-mail:

- *TS-EMEA@telit.com*
- *TS-AMERICAS@telit.com*
- *TS-APAC@telit.com*
- *TS-SRD@telit.com*
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Alternatively, use:

https://www.telit.com/contact-us

Product information and technical documents are accessible 24/7 on our website:

https://www.telit.com

1.4. Symbol Conventions

	**Danger:** This information MUST be followed or catastrophic equipment failure or personal injury may occur.
	**Warning:** Alerts the user on important steps about the module integration.
	**Note/Tip:** Provides advice and suggestions that may be useful when integrating the module.
	**Electro-static Discharge:** Notifies the user to take proper grounding precautions before handling the product.

Table 1: Symbol Conventions

All dates are in ISO 8601 format, that is YYYY-MM-DD.

1.5. Related Documents

- LN920 SW User Guide, 1VV0301712
- LN920 AT Commands Reference Guide, 80675ST11077A
- LN920 Interface Board HW User Guide, 1VV0301735
- Generic EVB HW User Guide, 1VV0301249

2. GENERAL PRODUCT DESCRIPTION

2.1. Overview

This document aims to present possible and recommended hardware solutions useful for developing a product integrating Telit LN920 M.2 module.

- LN920 is Telit's M.2 form factor platform for applications, such as CPEs, routers, and gateways, based on the following technologies:
- LN920A12-WW: LTE FDD/TDD Cat 12, up to 3CA DL (600 Mbps, 60 MHz) with WCDMA fallback.
- LN920A6-WW: LTE FDD/TDD Cat 6, up to 2CA DL (300 Mbps, 40 MHz) with WCDMA fallback.
- LN920A13-WW:LTE FDD/TDD Cat 13, up to 2CA DL (400 Mbps, 40MHz) with WCDMA fallback.
- LN920A6-NA: LTE FDD/TDD Cat 6, up to 2CA DL (300 Mbps, 40 MHz).

2.2. Product Variants and Frequency Bands

The operating frequencies in LTE & WCDMA modes conform to the 3GPP specifications.

Product	3G Bands	4G Bands	Region
LN920A12-WW	1,2,4,5,6,8,9,19	1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 38, 39, 40, 41, 42, 43, 48, 66, 71	World Wide
LN920A6-WW			
LN920A13-WW			
LN920A6-NA	-	2,4,5,7,12,13,25,26,29,30,41,66	North America

Table 2: Product Variants and their Frequency Bands

Refer to the "RF Section" for details information about frequencies and bands.

Note: Enabled cellular technologies and frequency bands may vary based on the firmware version and configuration used.

2.3. Main Features

Function	Features
Physical	M.2 Type 3042-S2-B

Function	Features
Modem	Cellular modem for data communication • LN920A12-WW: LTE FDD Cat. 12 (600/150Mbps DL/UL) • LN920A6-xx: LTE FDD Cat. 6 (300/50Mbps DL/UL) • LN920A13-WW: LTE FDD Cat. 13 (400/150Mbps DL/UL) • WCDMA up to DC HSPA+, Rel.10 Support for SIM profile switching
GNSS	Support for GPS, GLONASS, BeiDou, Galileo, and QZSS
Application processor	Cortex-A7 up to 1.28 GHz with 256 KB L2 cache 4Gb : x8 NAND with 2Gb : x32 LPDDR2 533MHz, 4bit ECC 4K page
Interfaces	USB 2.0/3.0 – USB port is typically used for: • Flashing of firmware and module configuration • Production testing • AT command access • High-speed WWAN access to an external host Peripheral Ports: I2C, GPIOs Two USIM ports – dual voltage Antenna ports (Cellular Main, Cellular Aux, and GNSS)
Form factor	M.2 Form factor (30 * 42 * 2.3 mm), supporting multiple RF bands
Environment and quality requirements	The device is designed and qualified by Telit to satisfy environmental and quality requirements.
Single supply module	The module internally generates all its required internal supply voltages.
RTC	Real-time clock is supported
Operating temperature	Range -40 °C to +85 °C (conditions as defined in Section 2.9.1. Temperature Range)

Table 3: Functional Features

2.3.1. Configuration Pins

Based on PCI Express M.2 Specification, LN920 has 4 configuration pins: they allow the host to identify the presence of an LN920 data card in the M.2 socket and identify the main host interface and port configuration.

The state of the configuration pins is as follows:

Pin	Signal	State	Interface Type
21	CONFIG_0	GND	USB 3.1 Gen1 Port Configuration 2
69	CONFIG_1	GND	
75	CONFIG_2	NC	
1	CONFIG_3	NC	

Table 4: Configuration Pins

Note: On the host side, each of the CONFIG_0 to CONFIG_4 pins requires a pull-up resistor. Based on the configuration pins state on the LN920, being tied to GND or lifted to No Connect (NC), the sensed pins will create a 4-bit logic state.

For more details, please refer to PCI Express M.2 standard specifications.

2.4. Block Diagram

The diagram below shows an overview of the internal architecture of the LN920 data card.

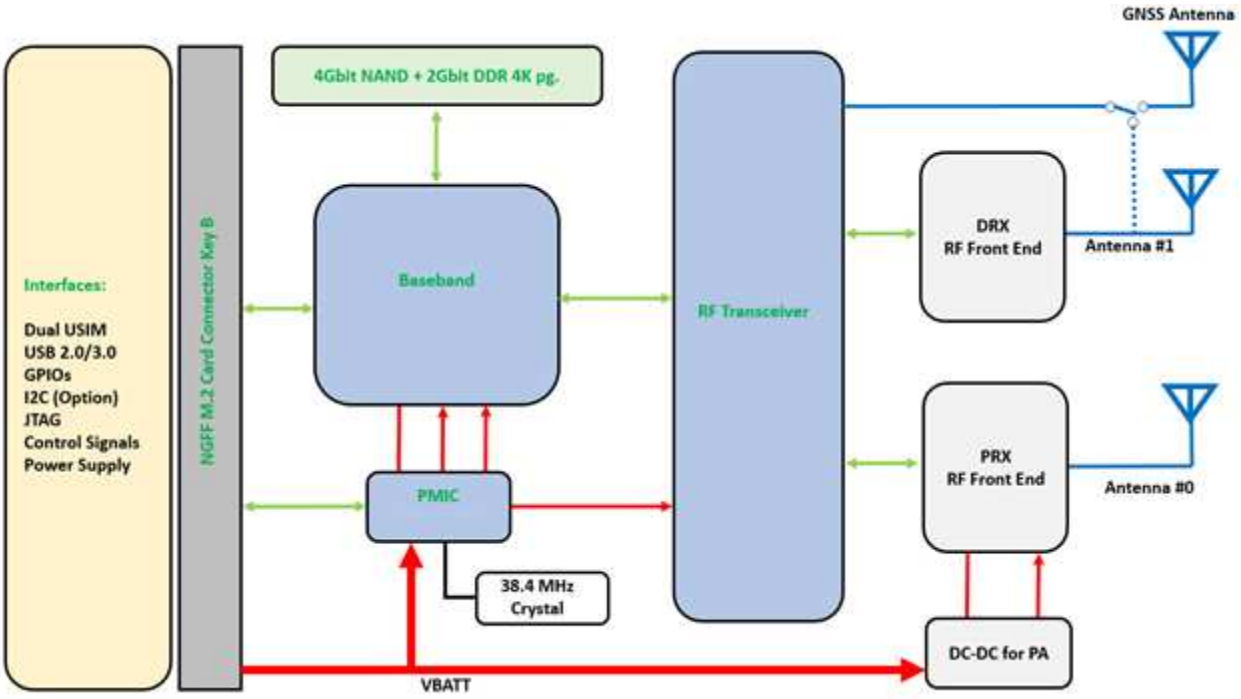

Figure 1: LN920 Block Diagram

2.5. Transmit Output Power

Band	Power class
3G WCDMA	Class 3 (0.2W)
LTE All Bands (except B41)	Class 3 (0.2W)
LTE Band41 (HPUE support)	Class 2 (0.4W)

Table 5: Transmit Output Power

Band	Mode	Class	RF power (dBm) Nominal*
B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71	LTE	3	23
B41	(LTE) HPUE	2	26
B1, B2, B4, B5, B6, B8, B9, B19	WCDMA	3	23

Table 6: Transmission Output Power

** Max output power tolerance range according to 3GPP TS 36.521-1 and 3GPP TS 34.121-1 or better*

2.6. RX Sensitivity

The 3GPP measurement conditions used to define the RX sensitivity are listed below:

Technology	3GPP Compliance
4G LTE	Throughput >95% 10MHz Dual Receiver
3G WCDMA	BER <0.1% 12.2 Kbps Dual Receiver

Table 7: Reception Sensitivity

Product	Band	Sensitivity (dBm)
LN920A12-WW	LTE FDD B1 LTE FDD B2 LTE FDD B3 LTE FDD B4 LTE FDD B5 LTE FDD B7 LTE FDD B8 LTE FDD B12 LTE FDD B13 LTE FDD B14 LTE FDD B17 LTE FDD B18 LTE FDD B19 LTE FDD B20 LTE FDD B25 LTE FDD B26 LTE FDD B28 LTE FDD B29 LTE FDD B30 LTE FDD B66 LTE FDD B71 LTE TDD B38 LTE TDD B39 LTE TDD B40 LTE TDD B41 LTE TDD B42 LTE TDD B43 LTE TDD B48 WCDMA B1 WCDMA B2 WCDMA B4 WCDMA B5 WCDMA B6 WCDMA B8 WCDMA B9 WCDMA B19	LTE -98.0 WCDMA -110
LN920A6-WW	LTE FDD B1 LTE FDD B2 LTE FDD B3 LTE FDD B4 LTE FDD B5 LTE FDD B7 LTE FDD B8 LTE FDD B12 LTE FDD B13	LTE -98.0 WCDMA -110

Product	Band	Sensitivity (dBm)
	LTE FDD B14 LTE FDD B17 LTE FDD B18 LTE FDD B19 LTE FDD B20 LTE FDD B25 LTE FDD B26 LTE FDD B28 LTE FDD B29 LTE FDD B30 LTE FDD B66 LTE FDD B71 LTE TDD B38 LTE TDD B39 LTE TDD B40 LTE TDD B41 LTE TDD B42 LTE TDD B43 LTE TDD B48 WCDMA B1 WCDMA B2 WCDMA B4 WCDMA B5 WCDMA B6 WCDMA B8 WCDMA B9 WCDMA B19	
LN920A13-WW	LTE FDD B1 LTE FDD B2 LTE FDD B3 LTE FDD B4 LTE FDD B5 LTE FDD B7 LTE FDD B8 LTE FDD B12 LTE FDD B13 LTE FDD B14 LTE FDD B17 LTE FDD B18 LTE FDD B19 LTE FDD B20 LTE FDD B25 LTE FDD B26 LTE FDD B28 LTE FDD B29 LTE FDD B30 LTE FDD B66 LTE FDD B71 LTE TDD B38 LTE TDD B39 LTE TDD B40 LTE TDD B41 LTE TDD B42 LTE TDD B43 LTE TDD B48 WCDMA B1	LTE -98.0 WCDMA -110

Product	Band	Sensitivity (dBm)
	WCDMA B2 WCDMA B4 WCDMA B5 WCDMA B6 WCDMA B8 WCDMA B9 WCDMA B19	
LN920A6-NA	LTE FDD B2 LTE FDD B4 LTE FDD B5 LTE FDD B7 LTE FDD B12 LTE FDD B13 LTE FDD B25 LTE FDD B26 LTE FDD B29 LTE FDD B30 LTE FDD B66 LTE TDD B41	-98.0

Table 8: Product Sensitivity

Band	REFsens (dBm) Typical			3GPP REFsens (dBm)*/**
	Main	Aux	Combine	
LTE Band1	-98.0	-96.0	-100	-96.3
LTE Band2	-97.5	-96.0	-99.5	-94.3
LTE Band3	-98.0	-96.0	-100	-93.3
LTE Band4	-98.0	-96.0	-100	-96.3
LTE Band5	-97.5	-97.0	-100	-94.3
LTE Band7	-94.0	-96.5	-98.0	-94.3
LTE Band8	-96.0	-96.5	-99	-93.3
LTE Band12	-96.5	-99.0	-101	-93.3
LTE Band13	-97.0	-99.0	-101	-93.3
LTE Band14	-97.5	-98.0	-100	-93.3
LTE Band17	-96.5	-99.0	-101	-93.3
LTE Band18	-97.0	-97.5	-100	-96.7
LTE Band19	-97.0	-97.5	-100	-96.3
LTE Band20	-97.0	-99.0	-101	-93.3
LTE Band25	-97.5	-96.0	-99.5	-92.8
LTE Band26	-97.0	-97.5	-100	-93.8

Band	REFsens (dBm) Typical			3GPP REFsens (dBm)*/**
	Main	Aux	Combine	
LTE Band28	-98.0	-98.5	-101	-94.8
LTE Band29	-98.0	-98.5	-101	-94.0
LTE Band30	-94.5	-95.0	-98.0	-95.3
LTE Band38	-96.0	-95.5	-99.0	-96.3
LTE Band39	-98.0	-96.0	-100	-96.3
LTE Band40	-96.0	-95.5	-99.0	-96.3
LTE Band41	-95.5	-95.5	-98.0	-94.3
LTE Band42	-97.5	-97.0	-100	-95.0
LTE Band43	-96.5	-98.0	-100	-95.0
LTE Band48	-96.5	-98.0	-100	-95.0
LTE Band66	-97.5	-96.0	-99.5	-95.8
LTE Band71	-98	-97.0	-100	-93.5

Table 9: Reception Sensitivity LN920A6-xx, LN920A12-WW, and LN920A13-WW

**3GPP TS 36.521-1 Release 16 Table 7.3.3-1 Reference sensitivity QPSK PREFSENS, Channel bandwidth 10MHz*

*** LTE Rx Sensitivity shall be verified by using both(all) antenna ports simultaneously.*

Band	REFsens (dBm) Typical		3GPP REFsens (dBm)*/**
	Main	Aux	
WCDMA Band1	-109	-109	-106.0
WCDMA Band2	-109	-109	-104.0
WCDMA Band4	-109	-109	-106.0
WCDMA Band5	-110	-110	-104.0
WCDMA Band6	-109	-110	-106.0
WCDMA Band8	-109	-109	-103.0
WCDMA Band9	-110	-109	-105.0
WCDMA Band19	-109	-110	-106.0

Table 10: Reception Sensitivity LN920A6-WW, LN920A12-WW and LN920A13-WW

**3GPP TS 34.121-1 Release 16*

2.7. Supported Carrier Aggregation Combinations

2.7.1. Downlink Two Carrier Aggregation Combinations (LN920A6-xx, LN920A12-WW and LN920A13-WW)

2xCA Combinations (LN920A6-WW, LN920A12-WW and LN920A13-WW)
CA_1A-19A, CA_1A-1A, CA_1A-20A, CA_1A-26A, CA_1A-28A, CA_1A-38A, CA_1A-3A, CA_1A-41A, CA_1A-42A, CA_1A-5A, CA_1A-7A, CA_1A-8A, CA_1C, CA_12A-12A, CA_12A-25A, CA_12A-30A, CA_12A-66A, CA_12B, CA_13A-66A, CA_14A-30A, CA_14A-66A, CA_19A-42A, CA_2A-12A, CA_2A-13A, CA_2A-14A, CA_2A-28A, CA_2A-29A, CA_2A-2A, CA_2A-30A, CA_2A-48A, CA_2A-4A, CA_2A-5A, CA_2A-66A, CA_2A-71A, CA_2C, CA_20A-38A, CA_20A-40A, CA_20A-42A, CA_25A-25A, CA_25A-26A, CA_26A-41A, CA_28A-38A, CA_28A-40A, CA_28A-41A, CA_28A-42A, CA_29A-30A, CA_29A-66A, CA_3A-19A, CA_3A-20A, CA_3A-26A, CA_3A-28A, CA_3A-38A, CA_3A-3A, CA_3A-40A, CA_3A-41A, CA_3A-42A, CA_3A-5A, CA_3A-7A, CA_3A-8A, CA_3C, CA_30A-66A, CA_38C, CA_39A-41A, CA_39C, CA_4A-12A, CA_4A-13A, CA_4A-28A, CA_4A-29A, CA_4A-30A, CA_4A-4A, CA_4A-5A, CA_4A-71A, CA_4A-7A, CA_40A-40A, CA_40A-42A, CA_40C, CA_41A-41A, CA_41A-42A, CA_41C, CA_42C, CA_48C, CA_5A-25A, CA_5A-30A, CA_5A-38A, CA_5A-40A, CA_5A-41A, CA_5A-5A, CA_5A-66A, CA_5A-7A, CA_5B, CA_66A-66A, CA_66A-71A, CA_66B, CA_66C, CA_7A-12A, CA_7A-20A, CA_7A-28A, CA_7A-42A, CA_7A-66A, CA_7A-7A, CA_7A-8A, CA_7B, CA_7C, CA_8A-38A, CA_8A-39A, CA_8A-40A, CA_8A-41A, CA_8A-42A, CA_8B, CA_66A-48A, CA_4A-48A*, CA_13A-48A*

**FW version M0L.0x0003.*

2xCA Combinations (LN920A6-NA)
CA_12A-12A, CA_12A-25A, CA_12A-30A, CA_12A-66A, CA_12B, CA_13A-66A, CA_2A-12A, CA_2A-13A, CA_2A-29A, CA_2A-2A, CA_2A-30A, CA_2A-4A, CA_2A-5A, CA_2A-66A, CA_2C, CA_25A-25A, CA_25A-26A, CA_26A-41A, CA_29A-30A, CA_29A-66A, CA_30A-66A, CA_4A-12A, CA_4A-13A, CA_4A-29A, CA_4A-30A, CA_4A-4A, CA_4A-5A, CA_4A-7A, CA_41A-41A, CA_41C, CA_5A-25A, CA_5A-30A, CA_5A-41A, CA_5A-5A, CA_5A-66A, CA_5A-7A, CA_5B, CA_66A-66A, CA_66B, CA_66C, CA_7A-12A, CA_7A-66A, CA_7A-7A, CA_7B, CA_7C

2.7.2. Downlink Three Carrier Aggregation Combinations (LN920A12-WW)

3xCA Combinations (LN920A12-WW)
CA_1A-19A-42A, CA_1A-1A-28A, CA_1A-1A-5A, CA_1A-20A-42A, CA_1A-26A-41A, CA_1A-28A-42A, CA_1A-3A-19A, CA_1A-3A-20A, CA_1A-3A-26A, CA_1A-3A-28A, CA_1A-3A-32A, CA_1A-3A-38A, CA_1A-3A-41A, CA_1A-3A-42A, CA_1A-3A-5A, CA_1A-3A-7A, CA_1A-3A-8A, CA_1A-41A-42A, CA_1A-41C, CA_1A-42C, CA_1A-5A-38A, CA_1A-5A-40A, CA_1A-5A-7A, CA_1A-7A-20A, CA_1A-7A-28A, CA_1A-7A-42A, CA_1A-7A-8A, CA_1A-7C, CA_1C-3A, CA_1C-41A, CA_12A-30A-66A, CA_12A-66A-66A, CA_12A-66B, CA_12A-66C, CA_13A-66A-66A, CA_13A-66B, CA_13A-66C, CA_14A-30A-66A, CA_14A-66A-66A, CA_19A-42C, CA_2A-12A-12A, CA_2A-12A-30A, CA_2A-12A-66A, CA_2A-12B, CA_2A-13A-66A, CA_2A-14A-30A, CA_2A-14A-66A, CA_2A-29A-30A, CA_2A-29A-66A, CA_2A-2A-12A, CA_2A-2A-13A, CA_2A-2A-14A, CA_2A-2A-29A, CA_2A-2A-30A, CA_2A-2A-4A, CA_2A-2A-5A, CA_2A-2A-66A, CA_2A-2A-71A,

3xCA Combinations (LN920A12-WW)
CA_2A-30A-66A, CA_2A-48C, CA_2A-4A-12A, CA_2A-4A-13A, CA_2A-4A-29A, CA_2A-4A-30A, CA_2A-4A-4A, CA_2A-4A-5A, CA_2A-4A-71A, CA_2A-5A-30A, CA_2A-5A-66A, CA_2A-5B, CA_2A-66A-66A, CA_2A-66A-71A, CA_2A-66B, CA_2A-66C, CA_2A-7C, CA_2C-12A, CA_2C-29A, CA_2C-30A, CA_2C-5A, CA_2C-66A, CA_20A-38C, CA_25A-25A-26A, CA_26A-41A-41A, CA_26A-41C, CA_28A-40C, CA_28A-41A-42A, CA_28A-41C, CA_28A-42C, CA_29A-30A-66A, CA_39A-41C, CA_39C-41A, CA_3A-19A-42A, CA_3A-20A-38A, CA_3A-20A-42A, CA_3A-28A-38A, CA_3A-28A-40A, CA_3A-28A-41A, CA_3A-28A-42A, CA_3A-38C, CA_3A-3A-20A, CA_3A-3A-5A, CA_3A-3A-7A, CA_3A-3A-8A, CA_3A-40A-40A, CA_3A-40C, CA_3A-41A-42A, CA_3A-41C, CA_3A-42C, CA_3A-5A-38A, CA_3A-5A-40A, CA_3A-5A-7A, CA_3A-7A-20A, CA_3A-7A-28A, CA_3A-7A-42A, CA_3A-7A-7A, CA_3A-7A-8A, CA_3A-7B, CA_3A-7C, CA_3A-8A-38A, CA_3A-8A-40A, CA_3C-20A, CA_3C-28A, CA_3C-40A, CA_3C-41A, CA_3C-5A, CA_3C-7A, CA_3C-8A, CA_4A-12A-12A, CA_4A-12A-30A, CA_4A-12B, CA_4A-29A-30A, CA_4A-4A-12A, CA_4A-4A-13A, CA_4A-4A-29A, CA_4A-4A-5A, CA_4A-4A-71A, CA_4A-5A-30A, CA_4A-5B, CA_4A-7A-12A, CA_4A-7C, CA_40A-40C, CA_40A-42C, CA_40C-42A, CA_40D, CA_41A-41C, CA_41A-42C, CA_41C-42A, CA_41D, CA_42D, CA_48D, CA_5A-30A-66A, CA_5A-40A-40A, CA_5A-40C, CA_5A-5A-66A, CA_5A-66A-66A, CA_5A-66B, CA_5A-66C, CA_5A-7A-7A, CA_5A-7C, CA_5B-30A, CA_5B-66A, CA_66A-66A-71A, CA_66A-66B, CA_66A-66C, CA_66C-71A, CA_66D, CA_7B-28A, CA_7C-20A, CA_7C-28A, CA_7C-8A, CA_7A-20A-42A, CA_7A-7A-8A, CA_8A-39C, CA_8A-40C, CA_8A-41C, CA_8A-42C, CA_66A-48A

2.7.3. Uplink Carrier Aggregation Combinations (LN920A12-WW, LN920A13-WW)

UL CA Combinations (LN920A12-WW, LN920A13-WW)
CA_3C, CA_5B, CA_7C, CA_38C, CA_39C, CA_40C, CA_41C, CA_42C

2.8. Mechanical Specifications

2.8.1. Dimensions

The overall dimensions of LN920A12-WW, LN920A6-xx and LN920A13-WW modems are:

- Length: 30.0 mm
- Width: 42.0 mm
- Thickness: Max. 2.3 mm

2.8.2. Weight

The nominal weight of the LN920A12-WW is 6.5 grams.

The nominal weight of the LN920A6-xx is 6.5 grams.

The nominal weight of the LN920A13-WW is 6.5 grams.

2.9. Environmental Requirements

2.9.1. Temperature Range

Mode	Temperature	Note
Operating Temperature Range	-20°C ~ +55°C	This range is defined by 3GPP (the global standard for wireless mobile communication). Telit guarantees its modules to comply with all 3GPP requirements and to have full functionality of the module within this range.
	-40°C ~ +85°C	Telit guarantees full functionality within this range as well. However, there may be some performance deviations in this extended range relative to 3GPP requirements, which means that some RF parameters may deviate from the 3GPP specification in the order of a few dB. For example, receive sensitivity or maximum output power may be slightly degraded. Even so, all the functionalities, such as call connection, SMS, USB communication, UART activation, and so on, will be maintained, and the effect of such degradations will not lead to malfunction.
Storage and non-operating Temperature Range	-40°C ~ +85°C	

Table 11: Temperature Range

2.9.2. RoHS Compliance

As a part of the Telit corporate policy of environmental protection, the LN920 complies with the RoHS (Restriction of Hazardous Substances) directive of the European Union (EU directive 2011/65/EU).

3. PINS ALLOCATION

3.1. Pin-out

Pin	Signal	I/O	Function	Type	Comment
USB HS 2.0 COMMUNICATION PORT (FW upgrade and Data)					
7	USB_D+	I/O	USB differential Data (+)	Analog	
9	USB_D-	I/O	USB differential Data (-)	Analog	
29	USB3.0_TX-	O	USB 3.0 super-speed transmit - Minus	Analog	
31	USB3.0_TX+	O	USB 3.0 super-speed transmit - Plus	Analog	
35	USB3.0_RX-	I	USB 3.0 super-speed receive - Minus	Analog	
37	USB3.0_RX+	I	USB 3.0 super-speed receive - Plus	Analog	
SIM Card Interface 1					
36	UIM1_PWR	O	Supply output for an external UIM1 card	1.8V / 2.85V	Power
34	UIM1_DATA	I/O	Data connection with an external UIM1 card	1.8V / 2.85V	
32	UIM1_CLK	O	Clock output to an external UIM1 card	1.8V / 2.85V	
30	UIM1_RESET	O	Reset output to an external UIM1 card	1.8V / 2.85V	
66	UIM1_PRESENT	I	UIM1 card present detect	1.8V	Active Low
SIM Card Interface 2					
48	UIM2_PWR	O	Supply output for an external UIM2 card	1.8V / 2.85V	Power
42	UIM2_DATA	I/O	Data connection with an external UIM2 card	1.8V / 2.85V	
44	UIM2_CLK	O	Clock output to an external UIM2 card	1.8V / 2.85V	
46	UIM2_RESET	O	Reset output to an external UIM2 card	1.8V / 2.85V	
40	UIM2_PRESENT	I	UIM1 card present detect	1.8V	Active Low
Miscellaneous Functions					
6	FULL_CARD_POWER_OFF#	I	Module On/Off	1.8V / 3.3V	
8	W_DISABLE1#	I	RF disable	3.3V	Active Low Internal PU
10	WWAN_LED#	O	LED control		Open Drain

Pin	Signal	I/O	Function	Type	Comment
23	WOW#	O	Wake Host	1.8V	
25	DPR	I	Dynamic Power Reduction	1.8V	
26	GPS_DISABLE#	I	GPS disable	3.3V	Active Low Internal PU
67	RESET#	I	Reset Input	1.8V	Active Low Internal PU
DIGITAL IO					
38	GPIO11	I/O	General Purpose I/O	1.8V	
20	GPIO5	I/O	General Purpose I/O	1.8V	
22	GPIO6	I/O	General Purpose I/O	1.8V	
24	GPIO7	I/O	General Purpose I/O	1.8V	
28	GPIO8	I/O	General Purpose I/O	1.8V	
I2C Interface					
56	SDA_GPIO9	I/O	I2C Data Can be configured as GPIO9	1.8V	
58	SCL_GPIO10	O	I2C Clock Can be GPIO10	1.8V	
Antenna Control					
59	ANTCTL0_GPIO1	I/O	Antenna control0 Can be configured as GPIO1	1.8V	
61	ANTCTL1_GPIO2	I/O	Antenna control1 Can be configured as GPIO2	1.8V	
63	ANTCTL2_GPIO3	I/O	Antenna control2 Can be configured as GPIO3	1.8V	
65	ANTCTL3_GPIO4	I/O	Antenna control3 Can be configured as GPIO4	1.8V	
Power Supply					
2	VBATT	I	Power supply	Power	
4	VBATT	I	Power supply	Power	
70	VBATT	I	Power supply	Power	
72	VBATT	I	Power supply	Power	
74	VBATT	I	Power supply	Power	
GND					
3	GND	-	Ground	Ground	

Pin	Signal	I/O	Function	Type	Comment
5	GND	-	Ground	Ground	
11	GND	-	Ground	Ground	
27	GND	-	Ground	Ground	
33	GND	-	Ground	Ground	
39	GND	-	Ground	Ground	
45	GND	-	Ground	Ground	
51	GND	-	Ground	Ground	
57	GND	-	Ground	Ground	
71	GND	-	Ground	Ground	
73	GND	-	Ground	Ground	
Config					
21	CONFIG_0	-	Ground	Ground	
69	CONFIG_1	-	Ground	Ground	
75	CONFIG_2	-	Floating	-	
1	CONFIG_3	-	Floating	-	
Reserved for future use					
41	Reserved	-	-	-	
43	Reserved	-	-	-	
47	Reserved	-	-	-	
49	Reserved	-	-	-	
50	Reserved	-	-	-	
52	Reserved	-	-	-	
53	Reserved	-	-	-	
54	Reserved	-	-	-	
55	Reserved	-	-	-	
62	Reserved	-	-	-	
64	Reserved	-	-	-	
RFU					
60	RFU	-	-		
No Connection					
68	NC	-	-	-	

Table 12: Pin-out Information

Warning: Unless otherwise specified, RESERVED pins must be left unconnected (Floating).

3.2. LN920 Signals for Debugging Purposes

The table below specifies the LN920 signals that must be connected for debugging purposes, even if not used by the end application.

Pin	Signal	Notes
2, 4, 70, 72, 74	VBATT	
3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73	GND	
7	USB_D+	If not used, connect to a test point or a USB connector
9	USB_D-	If not used, connect to a test point or a USB connector

Table 13: Mandatory Signals

3.3. Pin Layout

LN920 Pin Layout

Odd pins			Even pins	
CONFIG_3	1		2	VPH_PWR
GND	3		4	VPH_PWR
GND	5		6	FULL_CARD_POWER_OFF#
USB_HS_DP	7		8	W_DISABLE1#
USB_HS_DM	9		10	WWAN_LED#
GND	11			
	KEY B		KEY B	
			20	SCK_GPIO5
CONFIG_0	21		22	DIN_GPIO6
WOW#	23		24	DOUT_GPIO7
DPR	25		26	GSP_DIASBLE#
GND	27		28	WS_GPIO8
USB3.0_TX-	29		30	UIM1_RESET
USB3.0_TX+	31		32	UIM1_CLK
GND	33		34	UIM1_DATA
USB3.0_RX-	35		36	UIM1_PWR
USB3.0_RX+	37		38	GPIO11
GND	39		40	UIM2_PRESENT
RESERVED	41		42	UIM2_DATA
RESERVED	43		44	UIM2_CLK
GND	45		46	UIM2_RESET
RESERVED	47		48	UIM2_PWR
RESERVED	49		50	RESERVED
GND	51		52	RESERVED
RESERVED	53		54	RESERVED
RESERVED	55		56	SDA_GPIO9
GND	57		58	SCL_GPIO10
ANTCTL0_GPIO1	59		60	RFU
ANTCTL1_GPIO2	61		62	RESERVED
ANTCTL2_GPIO3	63		64	RESERVED
ANTCTL_GPIO4	65		66	UIM1_PRESENT
RESET#	67		68	NC
CONFIG_1	69		70	VPH_PWR
GND	71		72	VPH_PWR
GND	73		74	VPH_PWR
CONFIG_2	75			

Figure 2: LN920 Pin-out

4. POWER SUPPLY

Both power supply circuitry and board layout are very important parts of the full product design and they strongly reflect on the product overall performances, so the requirements and the guidelines that will follow should be read carefully for a proper design.

4.1. Power Supply Requirements

The LN920 power requirements are as follows:

Power Supply	Value
Nominal Supply Voltage	3.3V
Supply Voltage Range	3.1 V - 3.6 V
Maximum ripple on the module input supply	30mV

Table 14: Power Supply Requirements

Note: The Operating Voltage Range MUST never be exceeded; the application's power supply section must be designed with care to avoid an excessive voltage drop.

If the voltage drop exceeds the limits, it may cause unintentional module power off of LN920.

The minimum voltage must be at least $VBATT_{min}$ to power the module.

4.2. Power Consumption

The below table provides typical current consumption values of LN920 for various operation modes.

4.2.1. Idle Mode

Mode	Average	Mode Description
IDLE mode		
AT+CFUN=1	18mA	No Call Connection. USB is connected to the host.
Airplane Mode (PSMWDISACFG=1, W_DISABLE_N: Low)		
AT+CFUN=4	4.1mA*	TX and Rx are disabled: module is not registered on the network (Airplane mode)

Mode		Average	Mode Description
			USB is disconnected.
Sleep Mode (PSMWDISACFG=1, W_DISABLE_N: Low)			
AT+CFUN=1	LTE	4.6mA	Module cycles between wake and sleep USB is disconnected DRX 2.56s
		4.9mA	Module cycles between wake and sleep USB is disconnected DRX 1.28s
	WCDMA	4.5mA	Module cycles between wake and sleep USB is disconnected DRX 2.56s
		4.8mA	Module cycles between wake and sleep USB is disconnected DRX 1.28s

*Table 15: Idle and PSM Mode *PSM in between eDRX*

*Note: * = Value under optimization*

4.2.2. LN920 Connected Mode Current Consumption

Mode	Measure (Typical)		Mode Description
Connected mode	Average (mA)	Peak (mA)	
WCDMA	690mA	720mA	WCDMA B1 Voice call (Tx=23dBm)
	640mA	660mA	WCDMA data call (DC-HSDPA up to 42Mbps, Max through-put)
LTE	750mA	780mA	B66 BW 10MHz, 1RB, 23dBm, QPSK DL/QPSK UL
	700mA	750mA	2DL (2x2 MIMO) CA_7A-20A Full RB, 256QAM DL/64QAM UL(400Mbps DL/75Mbps UL)
	750mA	790mA	2DL (2x2 MIMO) CA_7C Full RB, 256QAM DL/64QAM UL(400Mbps DL/150Mbps UL)
	800mA	830mA	3DL (2x2 MIMO) CA_7C-28A Full RB, 256QAM DL/64QAM UL(600Mbps DL/75Mbps UL)

Table 16: LN920 Connected Mode Current Consumption

4.3. General Design Rules

The main guidelines for the Power Supply Design include three different design steps:

- Electrical design of the power supply
- Thermal design
- PCB layout

4.3.1. Electrical Design Guidelines

The electrical design of the power supply strongly depends on the power source where this power is drained. We will distinguish them into three categories:

- +5V input (typically PC internal regulator output)
- +12V input (typically automotive)
- Battery

4.3.1.1. +5V Source Power Supply Design Guidelines

- The desired output for the power supply is 3.3V, so the difference between the input and the desired output voltage is limited and a linear regulator can be used. A switching power supply will not be suitable for this application, due to the low drop-out requirements.
- When using a linear regulator, a proper heat sink shall be provided to dissipate the power generated.
- A Bypass low ESR capacitor of adequate capacity must be provided to cut the current absorption peaks close to the Module, a 100µF capacitor is usually suitable.
- Make sure the low ESR capacitor on the power supply output is rated at least 10V.
- A protection diode must be inserted close to the power input to protect the LN920 module from power polarity inversion.

4.3.2. Thermal Design Guidelines

This section aims to provide thermal design guidelines useful for developing a product with the LN920.

Proper thermal protection design protects against human or component damage in worst-case conditions.

Furthermore, it reduces the failure probability and does not adversely affect normal module operation, and greatly extends the operation time with maximum performance.

For more details, please refer to the dedicated thermal design guideline document.

Note: The average consumption during transmission depends on the power level at which the device is requested to transmit via the network.

Therefore, the average current consumption varies significantly.

Note: There is a large solder resist opening area on the bottom side of the module. Adding a TIM to that area with a heatsink is one of the recommended ways to dissipate heat.

Modem temperature can be read using AT commands.

Note: For best RF performance, thermal dissipation, and mechanical stability, the LN920 must be connected to the ground and metal chassis of the host board.

The module shield and host device main board or metal chassis should be connected using conductive materials.

4.3.3. Power Supply PCB Layout Guidelines

As mentioned in the electrical design guidelines, the power supply shall have a low ESR capacitor on the output to absorb current peaks on the input and protect the supply from voltage spikes. The placement of this component is crucial for the correct working of the circuitry. A misplaced component can be useless or can even decrease the power supply performance.

- The Bypass low ESR capacitor must be placed close to the LN920 power input pins. In the case the power supply is a switching type, it can be placed close to the inductor to reduce ripple, provided the PCB trace from the capacitor to the LN920 is wide enough to ensure a voltage dropless connection even during a 2.5A current peaks.
- The protection diode must be placed close to the input connector where the power source is drained.
- PCB traces from the input connector to the power regulator IC must be wide enough to ensure no voltage drops occurs when a 2.5A current peak is absorbed.
- The PCB traces to the LN920 and the Bypass capacitor must be wide enough to ensure no significant voltage drops occurs. This is for the same reason as the previous point. Try to keep this trace as short as possible.
- To reduce EMI due to switching, it is important to keep the mesh involved very small; therefore the input capacitor, the output diode (if not embodied in the IC),

and the regulator, shall form a very small loop. This is done to reduce the radiated field (noise) at the switching frequency (100-500 kHz usually).

- Power supply placement on the board should be designed to guarantee that the high current return paths on the ground plane are not overlapping any noise-sensitive circuitry, such as audio amplifiers and so on.
- The power supply input cables should be kept separate from noise-sensitive lines such as microphone/earphone cables.

4.4. RTC (Real Time Clock)

The RTC function is provided to keep time information with low power consumption even when the LN920 is turned off. It is also provided to enable alarm wake-up when the LN920 is turned off.

5. ELECTRICAL SPECIFICATIONS

5.1. Absolute Maximum Ratings – Not Optional

Warning: A deviation from the value ranges listed below may harm the LN920 module.

Parameter	Parameter	Min	Max	Unit
VBATT	Battery supply voltage on pin VBATT	-0.5	+4.2	[V]

Table 17: LN920 Absolute Maximum Ratings – Not Operational

5.2. Recommended Operating Conditions

Parameter	Parameter	Min	Typ	Max	Unit
T_{amb}	Ambient temperature	-40	+25	+85	[°C]
VBATT	Battery supply voltage on pin VBATT	3.1	3.3	3.6	[V]
I_{BATT}	Peak current on pin VBATT	-	-	2.5	[A]

Table 18: Recommended Operating Conditions

6. DIGITAL SECTION

Unless otherwise specified, all interface circuits of the LN920 operate at 1.8V CMOS level.

Only USIM interfaces support dual voltage I/O levels.

The following tables show logic level specifications used in the LN920 interface circuits. The data specified in the tables below are valid throughout the operating voltage and temperature range.

Warning: Do not connect LN920's digital logic signal directly to host digital signals with a voltage higher than 2.3V for 1.8V CMOS signals.

LN920 has four main operation states:

- **OFF state**: Vbatt is applied and only RTC is running. Baseband is switched OFF and the only transition possible is the ON state.
- **ON state**: Baseband is fully switched on and LN920 is ready to respond to AT commands. The modem can be idle or connected.
- **Sleep mode state**: Main baseband processor is intermittently switched ON and AT commands can be processed with some latency. LN920 is idle with low current consumption.
- **Deep sleep mode state**: PSM (Power Saving Mode) as defined in 3GPP Release 12. Baseband circuitry is switched OFF most of the time.

Note: Throughout this document, all inverted lines, that is are active low, are labeled with a name ending with"#","*", or with a bar above the name.

6.1. Logic Levels

Parameter	Min	Max
ABSOLUTE MAXIMUM RATINGS – NOT FUNCTIONAL		
Input level on any digital pin (CMOS 1.8) with respect to ground	-0.3V	2.1V
Operating Range - Interface levels (1.8V CMOS)		
Input high level	1.25V	2.0V
Input low level	-0.3V	0.6V
Output high level	1.4V	-

Parameter	Min	Max
Output low level	-	0.45
Input High leakage Current	-	1uA
Input low leakage current	-1	-

Table 19: Logic Levels Minimum and Maximum

Parameter	Min	Max
1.8V SIM Card Pins		
Input high level	1.26V	2.1V
Input low level	-0.3V	0.36V
Output high level	1.44V	1.8V
Output low level	0V	0.4V
Low-level input leakage current		1000 uA
High-level input leakage current	-20 uA	20 uA
2.85V SIM Card Pins		
Input level on any digital pin when on		3.42V

Table 20: Operating Range – SIM Pins Working

6.2. Power On

To turn on the LN920, the FULL_CARD_POWER_OFF# pin must be asserted to high.

Note: To turn on the LN920 module, the RESET# pin must not be asserted to low.

6.2.1. Initialization and Activation State

After turning on the LN920, the module is not instantly activated because the SW initialization process takes some time to complete. For this reason, it is recommended not to communicate with the LN920 during this initialization phase.

When the AT command interface is accessible via a USB port, the device might not be yet fully operational. In general, as shown in the below figure, the LN920 becomes fully operational (in the Activation State) at least 50 seconds after the FULL_CARD_POWER_OFF# line is asserted.

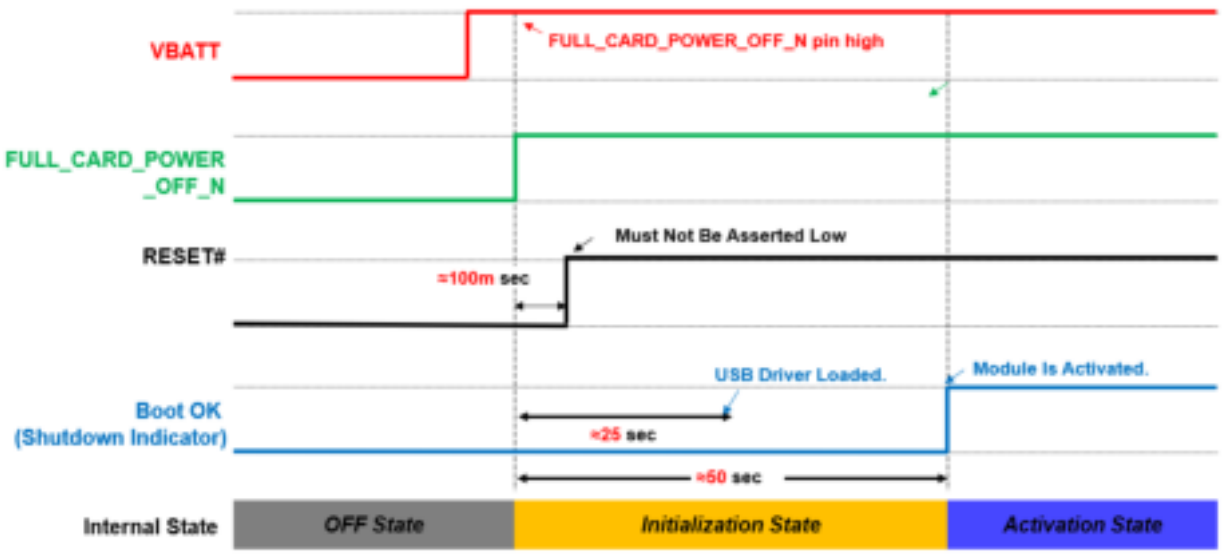

Figure 3: LN920 Initialization and Activation

As shown in the diagram above, Boot OK* pin will indicate when the module is activated.

When the line status transitions to high, the module has completed boot-up.

* Boot OK (Shutdown indicator) is an optional function and is disabled by default.

The host can use the AT#SHDNIND command to assign one of the GPIOs as the Boot OK pin. After enabling the function, the corresponding pin operates as a Book OK and also a Shutdown Indicator function. Please refer to the Power Off chapter for more information regarding the shutdown indicator.

Please refer to the AT Reference guide document for more details about AT#SHDNIND command.

Note: To avoid the back-powering effect, it is recommended to avoid applying HIGH logic level signals applied to the module digital pins when it is powered OFF or during an ON/OFF transition.

6.3. Power Off

Turning off the device can be performed in two ways:

- Graceful shutdown using FULL_CARD_POWER_OFF# line
- Fast Shutdown by GPIO triggered

Warning: Not following the recommended shut-down procedures might damage the device and consequently void the warranty.

6.3.1. Graceful Shutdown

To safely power off the LN920 module, the host can use the graceful shutdown function.

To gracefully shutdown the LN920 module, FULL_CARD_POEWR_OFF# should be asserted as Low.

Once FULL_CARD_POWER_OFF# is asserted LOW, the LN920 module enters the finalization state, terminates active processes, and prepares to turn off safely.

As shown in the diagram below, the Shutdown Indicator* pin will indicate when the module has completely turned off.

When the status transitions to Low, the module has completed the shutdown procedure.

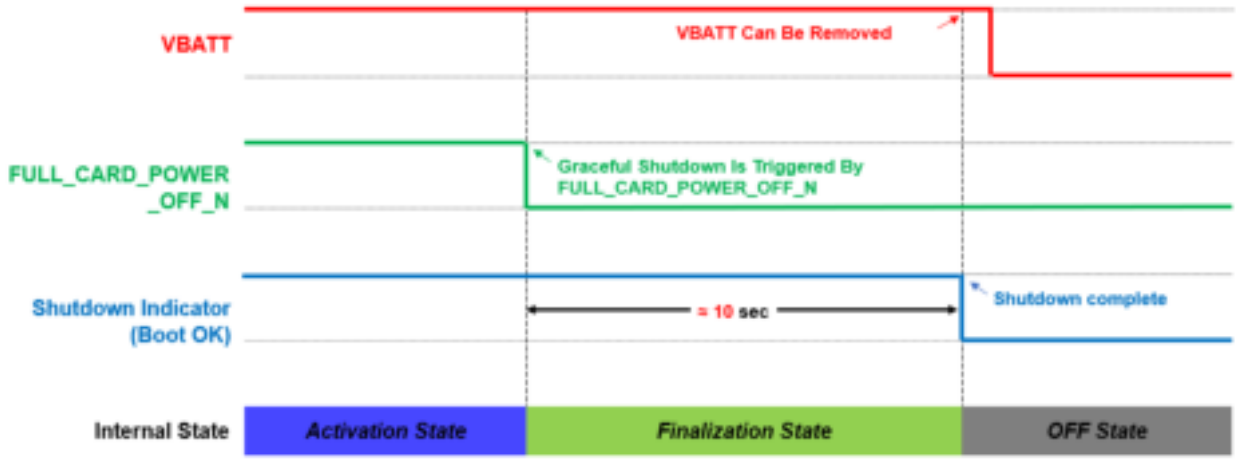

Figure 4: Graceful Shutdown by FULL_CARD_POWER_OFF_N

* Shutdown Indicator (Boot OK) is an optional function and is disabled by default.

The host can use the AT#SHDNIND command to assign one of the GPIOs as the Shutdown Indicator pin. After enabling the function, the corresponding pin operates as a Shutdown Indicator and also a Boot OK function. About Boot OK, please refer to the Power On chapter.

Refer to the AT Reference guide document for more details about AT#SHDNIND.

6.3.2. Fast Shutdown

For a quicker shutdown of the LN920 module, the host can use the fast shutdown function.

If properly configured, one of the GPIO lines can be used as Fast Shutdown** Trigger.

Once the Fast Shutdown Trigger senses a HIGH to LOW transition, the fast shutdown is triggered.

Then the LN920 module enters the finalization state, it terminates active processes and prepares to turn off safely. As shown in the diagram below, when the module is ready to be turned off, it will be indicated via the Shutdown Indicator*.

When the status transitions to Low, the module is ready to shutdown.

* Shutdown Indicator (Boot OK) is an optional function and is disabled by default.

The host can use the AT#SHDNIND command to assign one of the GPIOs as the Shutdown Indicator pin. After enabling the function, the corresponding pin operates as a Shutdown Indicator and also a Boot OK function. About Boot OK, please refer to the Power On chapter.

Refer to the AT Reference guide document for more details about AT#SHDNIND.

** Fast Shutdown is an optional function and is disabled by default.

The host can use the AT#FASTSHDN command to assign one of the GPIOs as the Fast Shutdown Trigger pin. After enabling the function, the Fast shutdown will be triggered by a HIGH to LOW transition through the corresponding pin.

Refer to the AT Reference guide document for more details about AT#FASTSHDN.

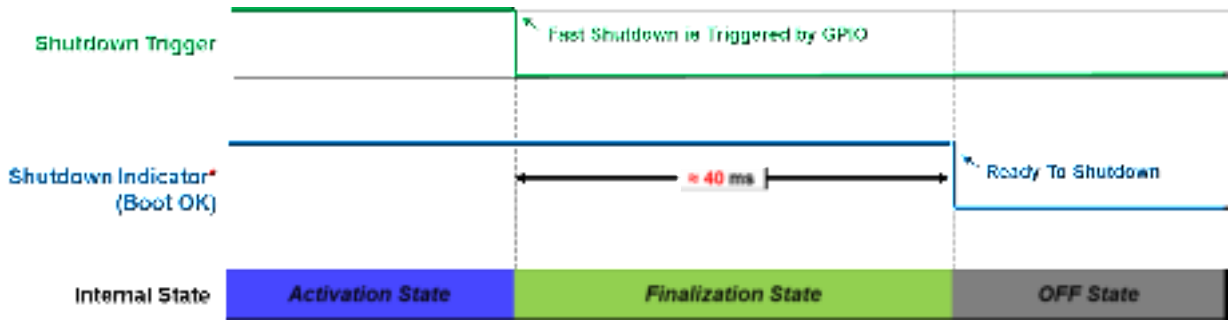

Figure 5: Fast Shutdown by GPIO

Warning: If VBATT is still supplied after Fast Shutdown is completed, the module will restart the Power On procedure. Because the Power On is triggered again by FULL_CARD_POWER_OFF_N.

To avoid this, enable the Shutdown indicator function.

6.4. Reset

Device reset can be triggered by an Unconditional reset using the RESET#.

6.4.1. Unconditional Hardware Reset

To unconditionally restart the LN920 module, the RESET# pin must be asserted LOW for more than 1 second, then released.

As shown in the diagram below, Boot OK/ Shutdown Indicator* pin will indicate module status.

- When the status transitions from High to Low, the module has completed the power-off procedure.
- When the status transitions from Low to High, the module has completed the power-on procedure.

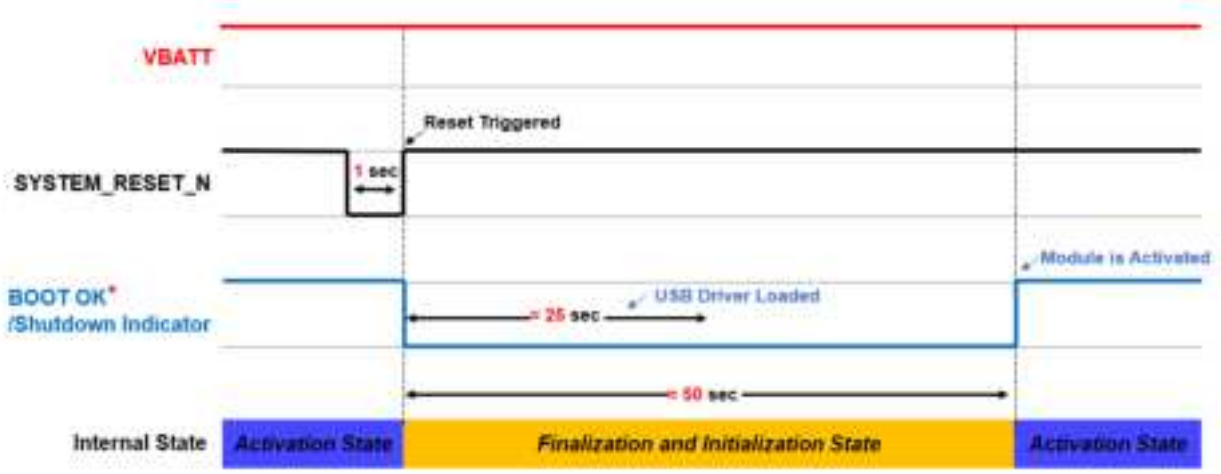

Figure 6: Unconditional Hardware Reset by SYS_RESIN_N Pad

* Boot OK/ Shutdown Indicator (Boot OK) is an optional function and is disabled by default. The host can use the AT#SHDNIND command to assign one of the GPIOs as the Boot OK/ Shutdown Indicator pin. After enabling the function, the corresponding pin operates as a Boot OK and Shutdown Indicator function. Refer to the AT Reference guide document for more details about AT#SHDNIND.

Note: Unconditional Hardware Reset must be used only as an emergency procedure, not as a normal power-off operation.

Note: Do not use any pull-up resistor on the RESET# line or any other totem pole digital output. Using a pull-up resistor may cause latch-up problems on the LN920 power regulator and incorrect module operation.

The RESET# line must be connected only in an open-collector configuration.

The below figure shows a simple circuit for this action.

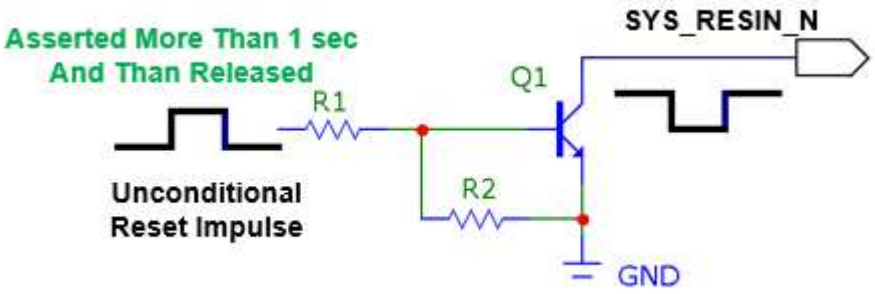

Figure 7: Circuit for RESTE by SYSTEM_RESET_N

6.5. Communication Ports

The below table summarizes all the hardware interfaces available for the LN920 module.

Interface	LN920
USB	Super-speed USB 3.0 with high-speed USB 2.0
USIM	X2, dual voltage each (1.8V/2.85V)
Control Signals	W_DISABLE1#, GPS_DISABLE#, WOW#, WWAN_LED#
Antenna ports	2 for Cellular, 1 for GNSS
I2C	I2C

Table 21: LN920 Family Hardware Interfaces

6.5.1. USB Interface

The LN920 module includes a super-speed USB 3.0 interface with high-speed USB 2.0 backward compatibility. It is compliant with Universal Serial Bus Specifications, and Revision 3.0 and can be used for control and data transfers as well as for diagnostic monitoring and firmware update.

The USB port is the main interface between the LN920 module and the host controlling the modem hardware.

USB 3.0 needs AC coupling series capacitors on the TX lines in both directions. To interface USB 3.0 with the application board controlling the modem, 0.1uF capacitors should be installed on the USB_SS_RX_P/M lines of the LN920. Series capacitors are already placed on USB_SS_TX_P/M lines inside the LN920 module.

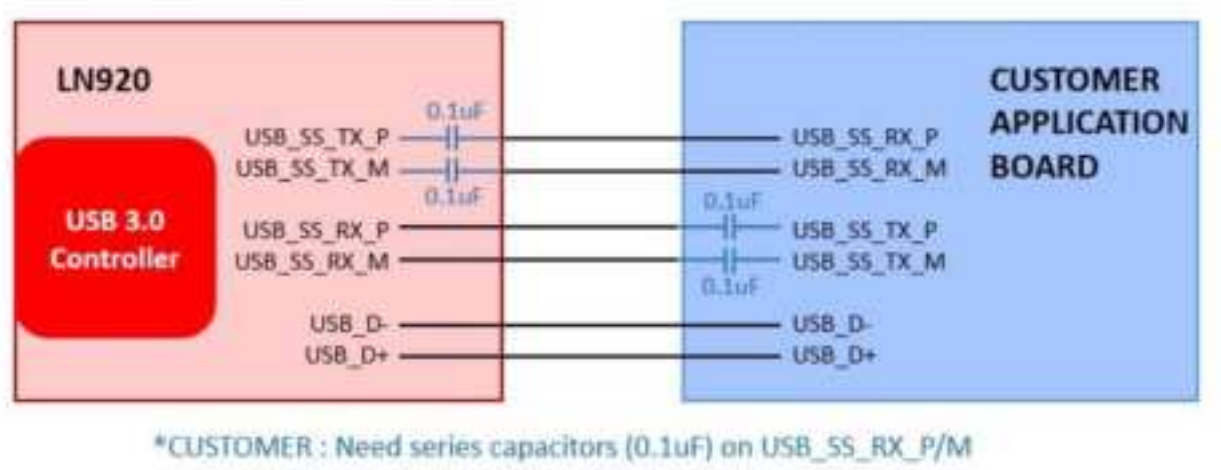

Figure 8: Connection for USB Interface

Note: The USB signal traces must be carefully routed: minimize trace lengths, number of vias, and capacitive loading. The impedance value should be as close as possible to 90 Ohms differential.

The below table lists the USB interface signals.

PIN	Signal	I/O	Function	NOTE
7	USB_D+	I/O	USB2.0 DATA Plus	
9	USB_D-	I/O	USB2.0 DATA Minus	
29	USB3.0_TX-	O	USB3.0 super-speed transmit – Minus	
31	USB3.0_TX+	O	USB3.0 super-speed transmit – Plus	
35	USB3.0_RX-	I	USB3.0 super-speed receive – Minus	
37	USB3.0_RX+	I	USB3.0 super-speed receive – Plus	

Table 22: USB Interface Signals

Note: Consider placing a low-capacitance ESD protection component to protect the LN920 against ESD spikes.

6.5.2. SIM Interface

The LN920 supports two external SIM interfaces (1.8V or 2.85V).

SIM Interface Signals					
SIM Card Interface 1					
36	UIM1_PWR	O	Supply output for an external UIM1 card	1.8V / 2.85V	Power
34	UIM1_DATA	I/O	Data connection with an external UIM1 card	1.8V / 2.85V	
32	UIM1_CLK	O	Clock output to an external UIM1 card	1.8V / 2.85V	
30	UIM1_RESET	O	Reset output to an external UIM1 card	1.8V / 2.85V	
66	UIM1_PRESENT	I	UIM1 card present detect	1.8V	Active Low*
SIM Card Interface 2					
48	UIM2_PWR	O	Supply output for an external UIM2 card	1.8V / 2.85V	Power
42	UIM2_DATA	I/O	Data connection with an external UIM2 card	1.8V / 2.85V	
44	UIM2_CLK	O	Clock output to an external UIM2 card	1.8V / 2.85V	
46	UIM2_RESET	O	Reset output to an external UIM2 card	1.8V / 2.85V	
40	UIM2_PRESENT	I	UIM1 card present detect	1.8V	Active Low*

Table 23: SIM Interface Signals

Note: Unlike the M.2 specification, the UIM_PRESENT pin is set to active low (Inserted) by default for the Telit unified function.
So LN920 will detect the SIM card insertion when UIM_PRESENT input is changed from logic 1 to logic 0.

If the user wants to change the UIM_PRESENT pin to active high (inserted), please refer to AT#SIMINCFG of LN920 AT Commands Reference Guide.

But if the user wants to change the default value of the firmware itself to reduce unnecessary input of AT commands, please contact Telit technical support or sales.

6.5.2.1. SIM Schematic Example

The following diagrams illustrate how the application interface should be designed.

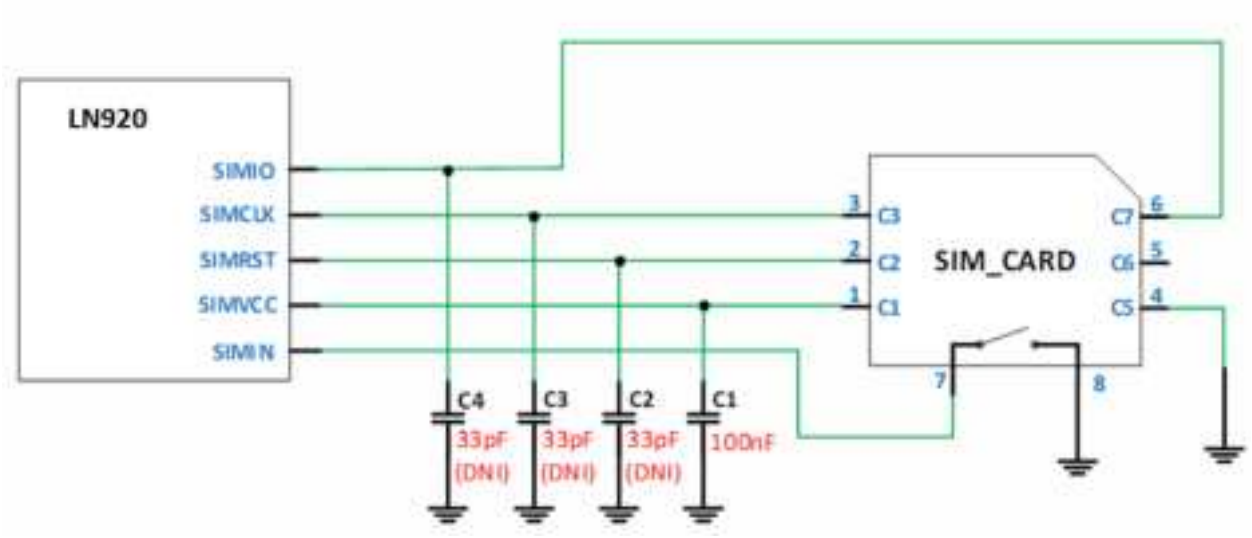

Figure 9: SIM Schematics

Note: LN920 contains an internal pull-up resistor on SIMIO lines, thus it is not necessary to install external pull-up resistors.

6.5.3. Control Signals

The LN920 supports the following control signals:

- W_DISABLE1#
- GPS_DISABLE#
- WOW#
- WWAN_LED#

PIN	Signal	I/O	Function	Type	NOTE
8	W_DISABLE1#	I	RF disable (airplane mode)		Internal VBATT pull-up
26	GPS_DISABLE#	I	GPS disable		Internal VBATT pull-up
23	WOW#	O	Wake the platform with the WWAN device		
10	WWAN_LED#	O	LED control	Open-drain	

Table 24: Control Signals

WWAN_LED# signal drives the LED output to display the network registration state. The recommended LED connection is the following:

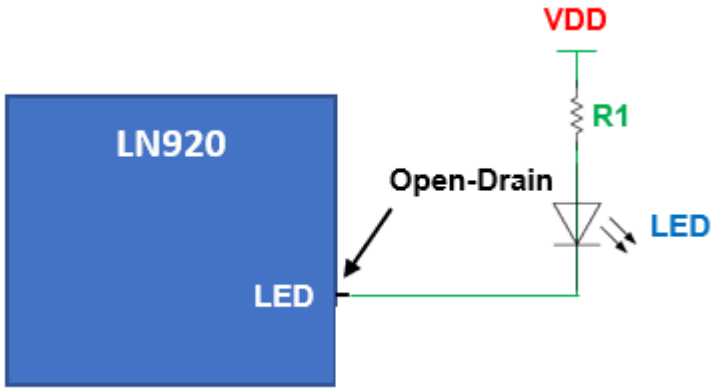

Figure 10: Recommended LED connection

R1 and VDD determine the brightness of the LED and forward current.

When VDD is 3.3V and LED's forward voltage is 2.0V, it is recommended to use the value of R1 from 66 ohms to 250 Ohms.

However, the resistor value must be calculated considering LED characteristics.

Note: If the WWAN LED function is enabled using the AT#WWANLED command and the LED is connected to the LED_N pin, current consumption is increased.

6.5.4. General Purpose I/O

The general-purpose I/O pins can be configured to operate in three different ways:

- Input
- Output
- Dedicate Function (Customer Requirement)

Input pins can only be read and report digital values (high or low) present on the pin at the read time.

Output pins can only be set or the pin level can be queried.

PIN	Signal	I/O	Function	Type	NOTE
59	GPIO1	I/O	Can be ANTCTL0	1.8V	
61	GPIO2	I/O	Can be ANTCTL1	1.8V	
63	GPIO3	I/O	Can be ANTCTL2	1.8V	
65	GPIO4	I/O	Can be ANTCTL3	1.8V	
20	GPIO5	I/O	General Purpose I/O	1.8V	
22	GPIO6	I/O	General Purpose I/O	1.8V	

PIN	Signal	I/O	Function	Type	NOTE
24	GPIO7	I/O	General Purpose I/O	1.8V	
28	GPIO8	I/O	General Purpose I/O	1.8V	
56	GPIO9	I/O	Can be I2C_SDA	1.8V	
58	GPIO10	I/O	Can be I2C_SCL	1.8V	

Table 25: LN920 Available GPIO

6.5.4.1. Using a GPIO as INPUT

The GPIO pins, when used as inputs, can be connected to the digital output of another device and report its status, provided that this device has interface levels compatible with the 1.8V CMOS levels of the GPIO.

If the digital output of the device to be connected with the GPIO input pin of LN920 has interface levels different from the 1.8V CMOS, then it can be buffered with an open collector transistor with a 47K pull-up to 1.8V.

Note: To avoid a back-powering effect, it is recommended to prevent any HIGH logic level signal from being applied to the digital pins of the LN920 when the module is powered off or during an ON/OFF transition. Refer to the LN920 AT command reference guide for GPIO pins configuration.

6.5.4.2. Using a GPIO as OUTPUT

The GPIO pins, when used as outputs, can drive 1.8V CMOS digital devices or compatible hardware. When set as outputs, the pins have a push-pull output, therefore the pull-up resistor may be omitted.

GPIO Output Pin Equivalent Circuit

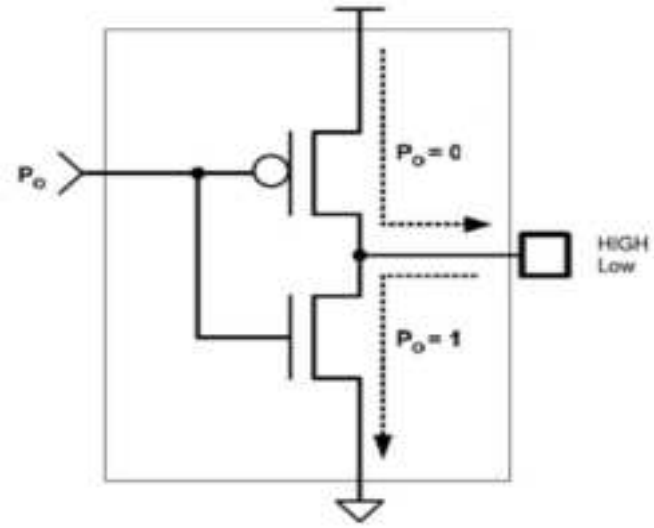

Figure 11: GPIO Output Pin Equivalent Circuit

6.6. I2C – Inter-integrated circuit

The LN920 supports an I2C interface on the following pins:

PIN	Signal	I/O	Function	Type	NOTE
56	I2C_SDA	I/O	I2C Data	CMOS 1.8V	
58	I2C_SCL	O	I2C Clock	CMOS 1.8V	

Table 26: Module I2C Signals

The I2C interface is used for controlling peripherals from within the module (such as sensors, codecs, and so on).

6.7. DPR(Dynamic Power Reduction)

The optional DPR control is applicable to assist in meeting regulatory SAR (Specific Absorption Rate) requirements for RF exposure.

PIN	Signal	I/O	Function	Type	NOTE
25	DPR	I	Dynamic power Reduction	CMOS 1.8V	Default: Disable

Table 27: DPR Signal

The control signals need to be provided by a proximity sensor located on the customer application for dynamic Transmit power reduction. It is recommended to reserve 1.8V pull-up resistors on the DPR pins as default to disable the DPR function. Note that the required power reduction value may depend on the customer application to determine from several experiments by the customer.

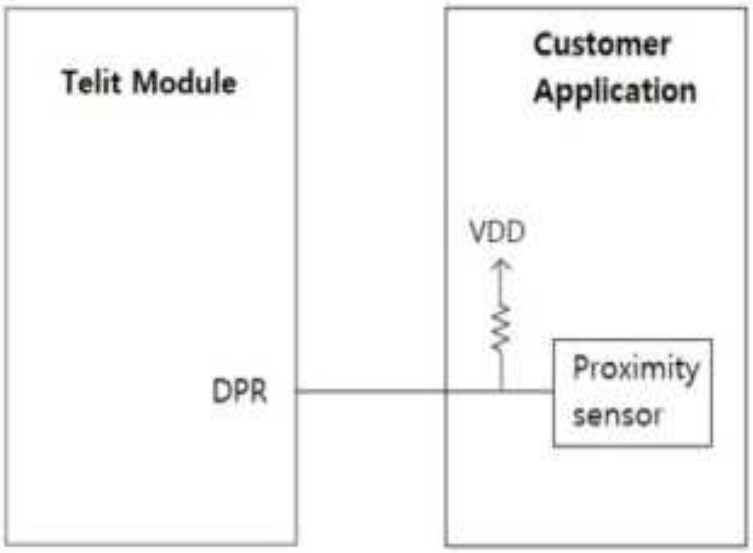

Figure 12: Antenna Configurations

Note: The DPR function is by default disabled. To use the DPR function, refer to LN920 AT Commands Reference Guide.

7. RF SECTION

7.1. Bands Variants

Product	Bands	
LN920A12-WW	LTE	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71
	WCDMA	B1, B2, B4, B5, B6, B8, B9, B19
LN920A6-WW	LTE	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71
	WCDMA	B1, B2, B4, B5, B6, B8, B9, B19
LN920A13-WW	LTE	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71
	WCDMA	B1, B2, B4, B5, B6, B8, B9, B19
LN920A6-NA	LTE	B2,B4,B5,B7,B12,B13,25,B26,B29,B30,B41,B66

Table 28: Bands Variant

7.2. TX Output Power

Band	Mode	Class	RF power (dBm)*
All bands	LTE	3	23
Band41	(LTE) HPUE	2	26
All bands	WCDMA	3	23

Table 29: TX Output Power

** Max output power tolerance range according to 3GPP TS 36.521-1 and 3GPP TS 34.121-1 or better*

7.3. RX Sensitivity

Measurement setup

Mode	Value
LTE	Throughput >95% According to 3GPP 36.521-1
WCDMA	BER < 0.1% According to 3GPP 34.121-1

Table 30: RX Sensitivity Measurement Setup

LN920A12-WW, LN920A6-xx, LN920A13-WW

MODE / Band	REFsens (dBm)	3GPP REFsens (dBm)
LTE / Band1	-100	-96.3

MODE / Band	REFsens (dBm)	3GPP REFsens (dBm)
LTE / Band2	-99.5	-94.3
LTE / Band3	-100	-93.3
LTE / Band4	-100	-96.3
LTE / Band5	-100	-94.3
LTE / Band7	-98.0	-94.3
LTE / Band8	-99	-93.3
LTE / Band12	-101	-93.3
LTE / Band13	-101	-93.3
LTE / Band14	-100	-93.3
LTE / Band17	-101	-93.3
LTE / Band18	-100	-96.7
LTE / Band19	-100	-96.3
LTE / Band20	-101	-93.3
LTE / Band25	-99.5	-92.8
LTE / Band26	-100	-93.8
LTE / Band28	-101	-94.8
LTE / Band29	-101	-94.0
LTE / Band30	-98.0	-95.3
LTE / Band38	-99.0	-96.3
LTE / Band39	-100	-96.3
LTE / Band40	-99.0	-96.3
LTE / Band41	-98.0	-94.3
LTE / Band42	-100	-95.0
LTE / Band43	-100	-95.0
LTE / Band48	-100	-95.0
LTE / Band66	-99.5	-95.8
LTE / Band71	-100	-93.5
WCDMA Band1	-111	-106.0
WCDMA Band2	-111	-104.0
WCDMA Band4	-111	-106.0
WCDMA Band5	-112	-104.0
WCDMA Band6	-112	-106.0

MODE / Band	REFsens (dBm)	3GPP REFsens (dBm)
WCDMA Band8	-112	-103.0
WCDMA Band9	-111	-105.0
WCDMA Band19	-112	-106.0

Table 31: RX sensitivity LN920A12-WW, LN920A6-xx and LN920A13-WW

7.4. Antenna Requirements

The antenna connection is one of the most important aspects of the full product design as it strongly affects the product overall performance. Hence, please read carefully and follow the requirements and guidelines for a proper design.

The antenna and RF transmission line on the host PCB for a Telit LN920-based device shall fulfill the following requirements:

Item	Value
Frequency range	Depending on the frequency band(s) provided by the network operator, the customer shall use the most suitable antenna for that/those band(s)
Bandwidth	250 MHz in LTE Band 1 140 MHz in LTE Band 2 170 MHz in LTE Band 3 445 MHz in LTE Band 4 70 MHz in LTE Band 5 190MHz in LTE Band 7 80 MHz in LTE Band 8 47 MHz in LTE Band 12 41 MHz in LTE Band 13 40 MHz in LTE Band 14 42 MHz in LTE Band 17 60 MHz in LTE Band 18 60 MHz in LTE Band 19 71 MHz in LTE Band 20 145 MHz in LTE Band 25 80 MHz in LTE Band 26 100 MHz in LTE Band 28 11 MHz in LTE Band 29, DL only 55 MHz in LTE Band 30 50 MHz in LTE Band 38 40 MHz in LTE Band 39 100 MHz in LTE Band 40 194 MHz in LTE Band 41 200 MHz in LTE Band 42 200 MHz in LTE Band 43 150 MHz in LTE Band 48 490 MHz in LTE Band 66 81 MHz in LTE Band 71
Impedance	50 ohm
Input power	LN920: > 24dBm Average power
VSWR absolute max	≤ 10:1 (limit to avoid permanent damage)

Item	Value
VSWR recommended	≤ 2:1 (limit to fulfill all regulatory requirements)

Table 32: LN920 Antenna and Antenna Transmission Line on PCB

7.4.1. Antenna Configuration

LN920 modems provide two MHF-4 type RF connectors for LTE/WCDMA and GNSS bands and one MHF-4 type RF connector dedicated to the GNSS receiver.

The diagram below shows the connector's position on the modem board.

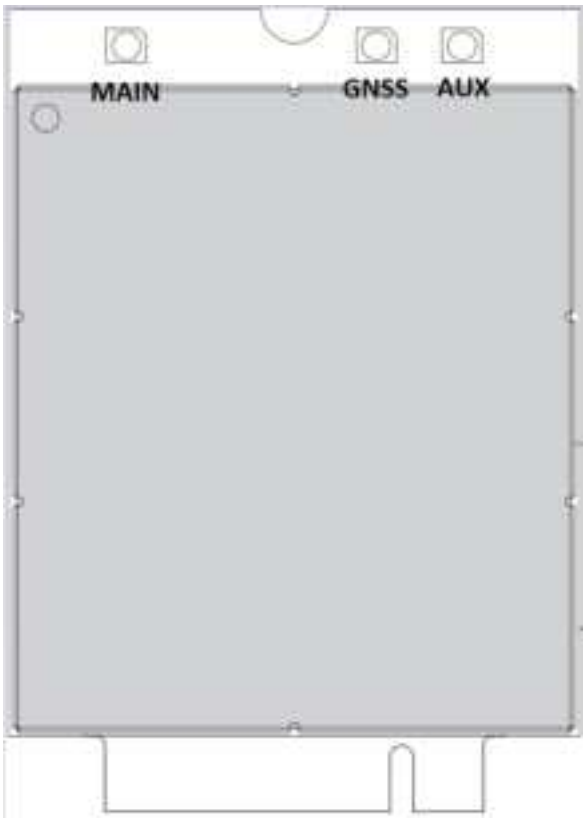

Figure 13: Antenna Configurations

Refer to the following antenna configuration assigned.

Antenna port	Technology	Tx	Rx	GNSS
MAIN	WCDMA	B1, B2, B4, B5, B6, B8, B9, B19	B1, B2, B4, B5, B6, B8, B9, B19	-
	LTE	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71	
AUX	WCDMA	-	B1, B2, B4, B5, B6, B8, B9, B19	

Antenna port	Technology	Tx	Rx	GNSS
	LTE	-	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B38, B39, B40, B41, B42, B43, B48, B66, B71	GPS, Galileo, Beidou, Glonass, QZSS
GNSS	GNSS	-	-	GPS, Galileo, Beidou, Glonass, QZSS

Table 33: Antenna Configurations

7.4.2. Antenna Connector

The LN920 Family is equipped with a set of 50 Ω RF MHF-4 Receptacles from I-PEX 20449-001E.

For more information about mating connectors, please refer to: *https://www.i-pex.com*

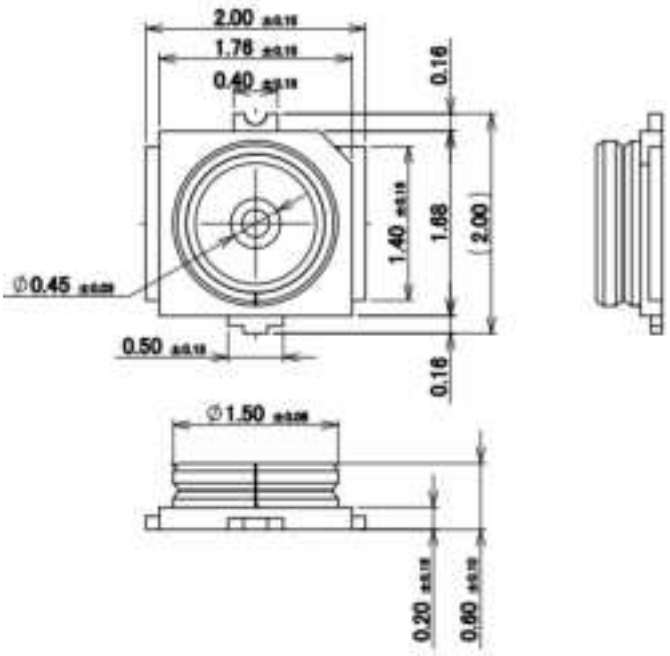

Figure 14: MHF-4 RF connector

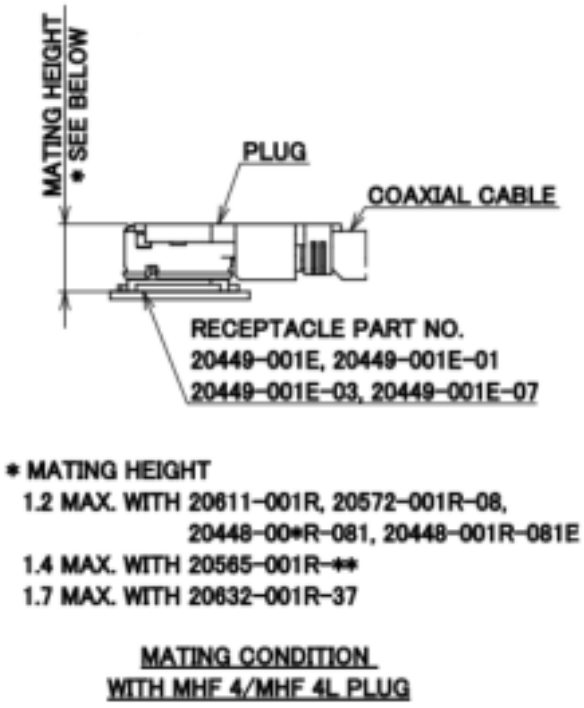

Figure 15: MHF-4 Receptacle

If FCC certification is required for an application using LN920, according to FCC KDB 996369 for modular approval requirements, the transmission line must be similar to the one implemented on the LN920 interface board and described in the following chapter.

7.4.2.1. Antenna Cable

Connecting cables between the module and the LTE/WCDMA antenna must have a 50 Ω impedance.

If the impedance of the module does not match, RF performance is significantly reduced.

Item	Value
Impedance	50 Ohm
Max cable loss	Less than 0.5 dB
Avoid coupling with other signals.	

Table 34: Minimize Antenna Cable Recommendations

Warning: Impedance of RF connector and RF cable must be matched to 50 Ohm. Impedance mismatching will cause poor RF performance especially that is RF cable with high insertion loss will affect Tx power and Rx sensitivity.

7.4.2.2. Antenna Installation Guidelines

- Each antenna must be installed with 20dB isolation.
- Install the antenna in a location with access to the network radio signal.
- The Antenna must not be installed inside metal cases.
- The Antenna must be installed according to the antenna manufacturer instructions.
- Antenna integration should optimize Radiation efficiency. Efficiency values > 50% are recommended on all frequency bands.
- Antenna integration should not perturb the radiation pattern described in the Antenna manufacturer documentation.
- It is preferable to get an omnidirectional radiation pattern.
- To meet the related EIRP limitations, antenna gain must not exceed the values indicated in regulatory requirements, where applicable. The Typical antenna Gain in most M2M applications does not exceed 2dBi.
- If the device antenna is located farther than 20 cm from the human body and there are no co-located transmitters, then the Telit FCC/IC approvals can be re-used by the end product.
- If the device antenna is located closer than 20 cm from the human body or there are co-located transmitters, then additional FCC/IC testing may be required for the end product (Telit FCC/IC approvals cannot be reused).

Note: GNSS receive path uses either the dedicated GNSS connector or the shared Secondary AUX antenna connector.

8. GNSS SECTION

The LN920 module includes a state-of-art receiver that can simultaneously search and track satellite signals from multiple satellite constellations. This multi-GNSS receiver uses the entire spectrum of GNSS systems available: GPS, GLONASS, Beidou, Galileo, and QZSS.

8.1. RF Front End Design

The LN920 GNSS receiver contains an integrated LNA and pre-select SAW filter.

This allows the module to work properly with a passive GNSS antenna. If the antenna cannot be located near the module, then an active antenna (that is, an antenna with a low noise amplifier built-in) can be used with an external dedicated power supply circuit.

8.1.1. Guidelines of PCB Line for GNSS Antenna

The following guidelines should be followed when choosing and integrating a GNSS antenna:

- Make sure that the antenna line impedance is 50 Ω
- Keep the antenna line on the PCB as short as possible to reduce losses.
- Antenna lines must have uniform characteristics, constant cross-section, and avoid meanders, and abrupt curves.
- If possible, keep one layer of the PCB used only for the Ground plane.
- Surround (on both sides, above and below) the antenna line on PCB with Ground, avoid having other signal tracks facing directly the antenna line.
- The ground around the antenna line on PCB must be strictly connected to the Ground Plane by placing away once per 2mm at least.
- Place EM noisy devices as far as possible from the antenna line.
- Keep the antenna line as far as possible from the power supply lines.
- Keep the antenna line far away from cellular RF lines.
- If there are noisy EM devices around the PCB hosting the module, such as fast switching ICs, shield the antenna line by burying it inside the layers of PCB and surrounding it with ground planes, or shielding it with a metal frame cover.
- If there are no noisy EM devices around the PCB hosting the module, use a strip-line on the superficial copper layer for the antenna line. The line attenuation will be lower than a buried one.

8.1.2. Hardware-Based Solution for GNSS and LTE Coexistence

When a stand-alone GNSS receiver is present in the user application, the transmitted LTE signal may desensitize the GNSS receiver, especially if the decoupling between the LTE and GNSS antennas is low. A SAW filter can be added on the LTE side to protect the GNSS receiver from LTE out-of-band emissions, as described in the schematic below.

When the GNSS receiver embedded in the LN920 module is used, the LTE transmitter and the GNSS receiver are never simultaneously active, thus filtering on the LTE side is not needed.

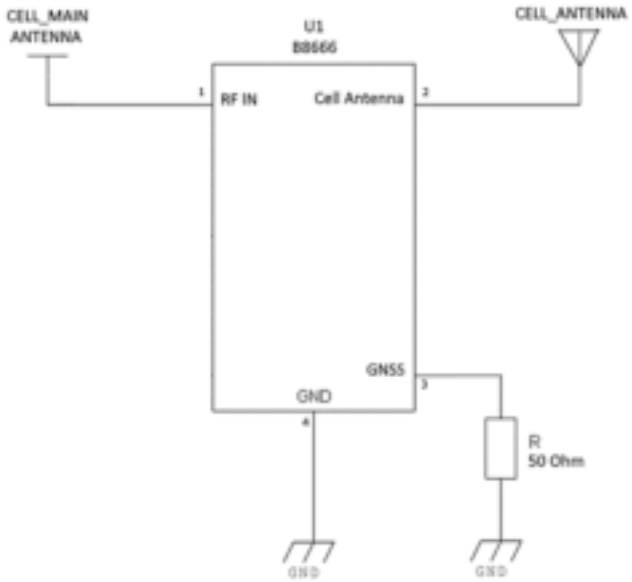

Figure 16: Reference Schematic

8.2. GNSS Antenna Requirements

For most applications, it is recommended to use an active GNSS antenna.

8.2.1. GNSS Antenna Specifications

Item	Value
Frequency range	1559.0 ~ 1610.0 MHz
Gain	15 ~ 30dB
Impedance	50 ohm
Noise Figure of LNA	< 1.5 (recommended)
DC supply voltage	DC 1.8 ~ 3.3V
VSWR	≤ 3:1 (recommended)

Table 35: GNSS Antenna Specification

Note: In the case of a GNSS antenna placed close to the module, a 15dB gain is sufficient. In the case of a long RF cable, the gain must be increased up to 30dB.

8.2.2. GNSS Antenna – Installation Guidelines

- The antenna must be installed according to the antenna manufacturer's instructions to obtain maximum performance from the GNSS receiver.
- The position of the antenna must be carefully evaluated if operating in conjunction with any other antenna or transmitter.
- The antenna must not be installed inside metal cases or near any obstacle that may degrade features such as antenna lobes and gain.

8.3. GNSS Characteristics

The table below specifies the GNSS characteristics and expected performance.

Parameters		Typical Measurement
Sensitivity	Tracking Sensitivity	-158dBm
	Navigation	-148dBm
	Cold Start	-145dBm
Min Navigation update rate		1Hz

Table 36: GNSS Characteristics

9. MECHANICAL DESIGN

9.1. General

The LN920 module was designed to be compliant with a standard lead-free SMT process.

9.2. Drawing

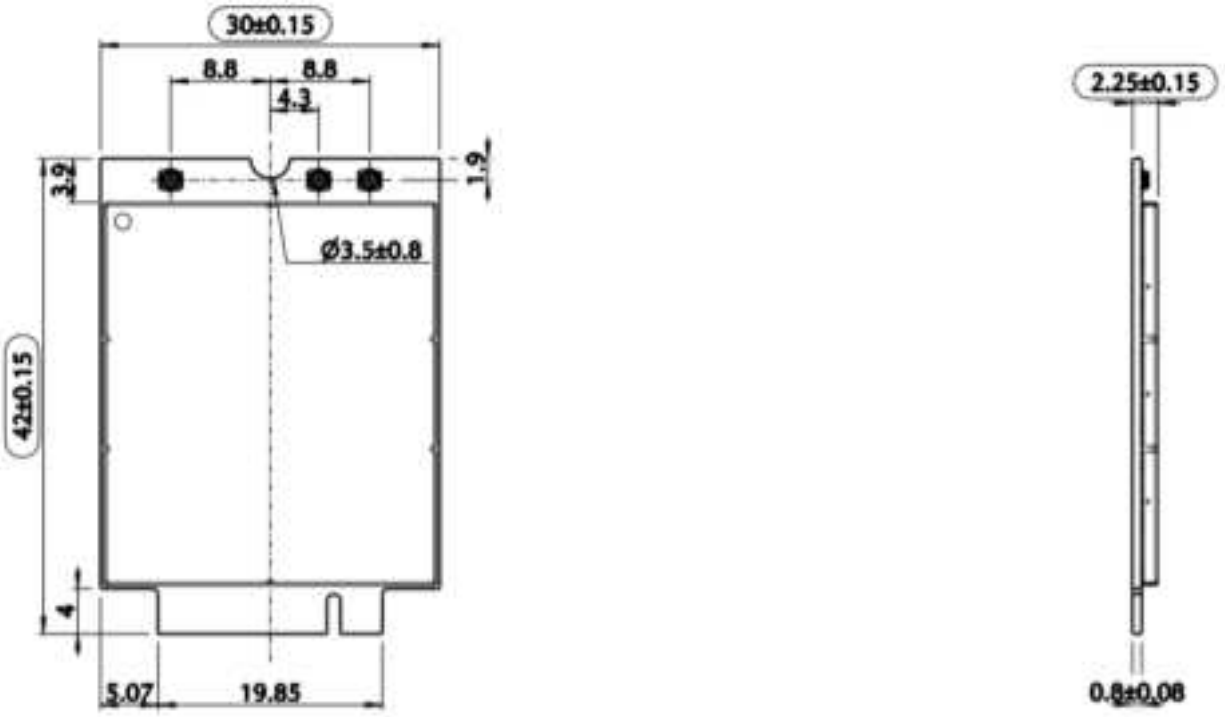

Figure 17: Mechanical Design Drawing

10. APPLICATION GUIDE

10.1. Debugging the LN920 Module in Production

To test and debug the LN920 module integration, it is strongly recommended to add test points on the host PCB for the following purposes:

- Checking the connection between the LN920 itself and the application
- Testing module performance by connecting it to an external computer

Depending on the customer application, these test pins include, but are not limited to, the following signals:

- RESET#, W_DISABLE1#
- VBATT, GND
- USB_D-, USB_D+
- USB3.0_TX-, USB3.0_TX+, USB3.0_RX-, USB3.0_RX+

In addition, the following signals are also recommended (but not mandatory):

- GPS_DISABLE#, WOW#, WWAN_LED#
- GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO6, GPIO7, GPIO8, GPIO9, GPIO10

10.2. Bypass Capacitor on Power Supplies

When a sudden power supply voltage variation or interruption, the steep transition causes effects such as overshoot and undershoot. This abrupt voltage transition can affect the device causing it to not operate or to malfunction.

Bypass capacitors are needed to prevent issues: special attention to this issue must be paid when designing the application board.

The length and width of the power lines must be carefully dimensioned, and the value of the capacitor must be selected accordingly.

The capacitor will also prevent power supply ripple and the switching noise caused in TDMA systems.

Most important, a suitable bypass capacitor must be mounted on the following lines on the application board:

- VBATT

Recommended values are:

- 100uF for VBATT

considerate must be kept in an account that the capacitance mainly depends on the application board.

Generally, additional capacitance is required when the power line is longer.

And if the fast power-down function is used, additional bypass capacitors should be mounted on the application board.

10.3. EMC Recommendations

EMC protection on all the pins of LN920 should be designed by the application side according to the customer's requirement.

ESD rating on all pins of the LN920 Family:

- Human Body Model (HBM): ± 1000 V
- Charged Device Model (CDM): ± 250 V
- All Antenna pins up to ± 4 kV

Warning: Do not touch the modem without proper electrostatic protective equipment. The product must be handled with care, avoiding any contact with the pins because electrostatic discharge may damage the product itself.

11. PACKAGING

11.1. Tray

The LN920 module is packaged in trays of 18 pieces each. These trays can be used in SMT processes for pick and place handling.

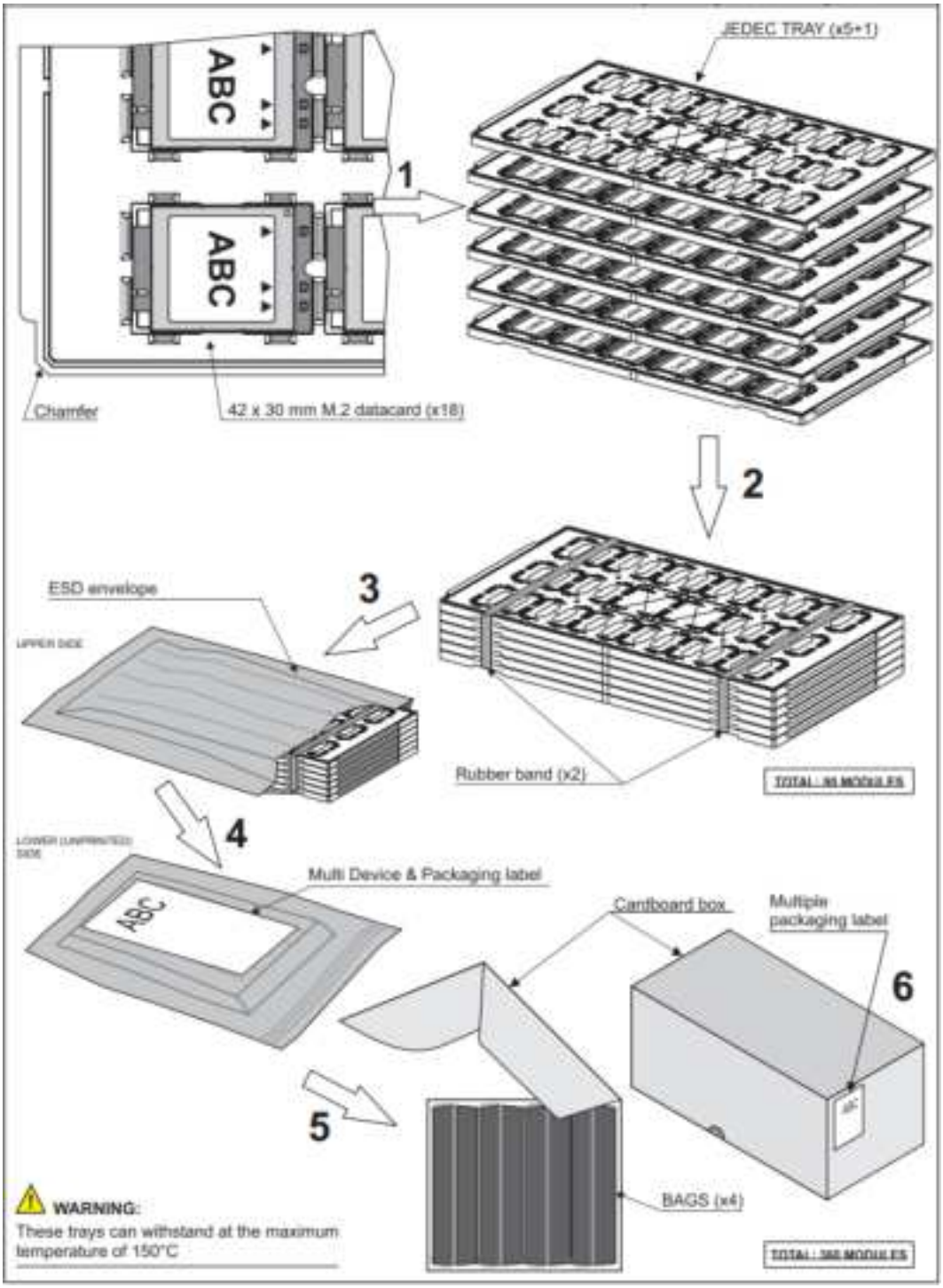

Figure 18: Tray Packaging

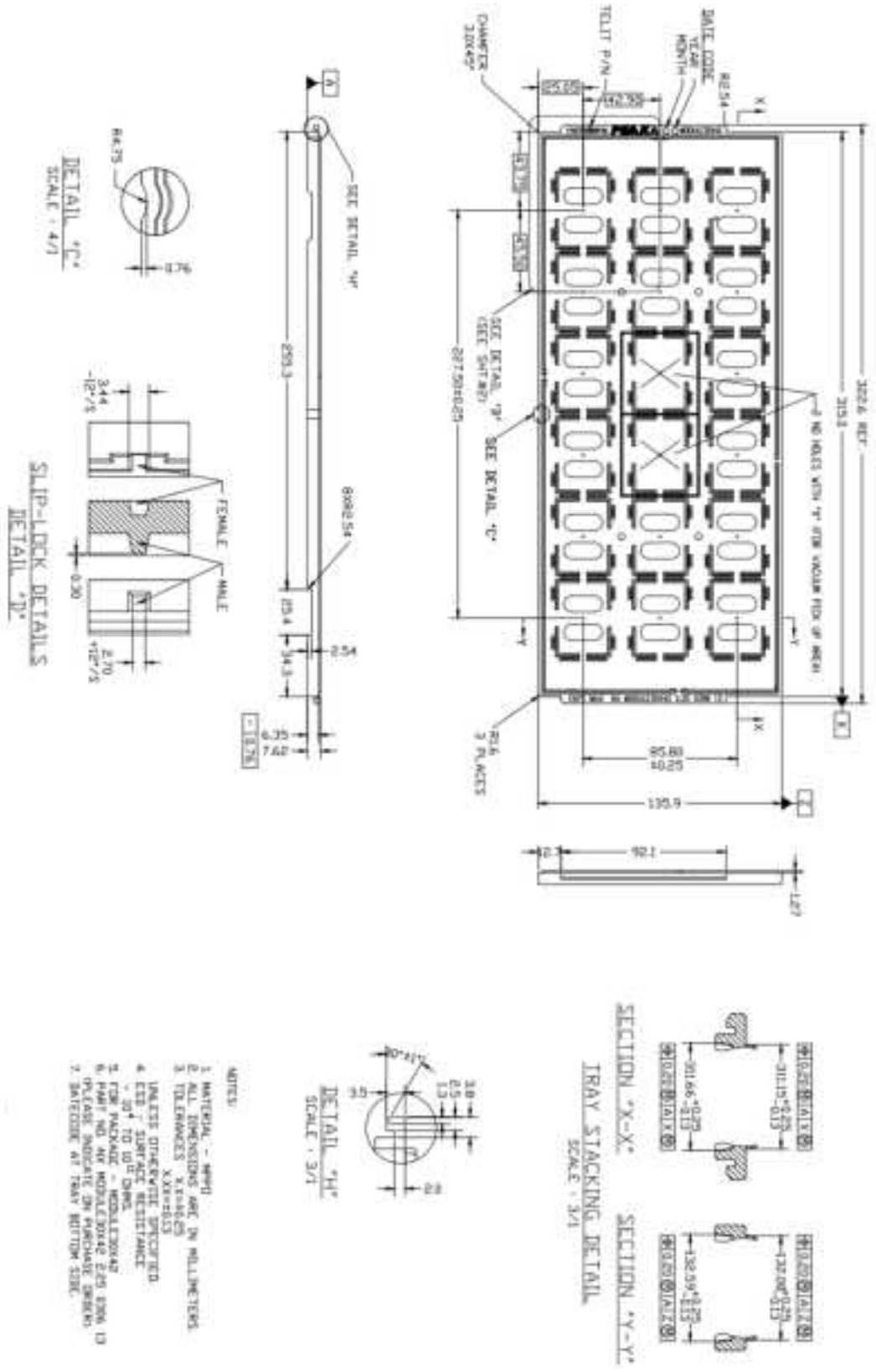

Figure 19: Tray Dimensions

12. CONFORMITY ASSESSMENT ISSUES

12.1. Approvals Compliance Summary

Region	Americas						
Country & Type Approval	AR ENACOM	BR ANATEL	CA ISED	CO CRC	MX IFETEL	PE MTC	US FCC
LN920A12-WW		●	●				●
LN920A6-WW		●	●				●
LN920A13-WW			●				●
LN920A6-NA			●				●

Table 37:Americas Approvals Compliance Summary

Region	APAC					
Country & Type Approval	AU RCM	CH CCC	JP JRL / JTBL	SG IMDA	TW NCC	KR KC
LN920A12-WW		●	●		●	●
LN920A6-WW		●	●		●	
LN920A13-WW			●		●	

Table 38: APAC Approvals Compliance Summary

Region	EMEA	
Country & Type Approval	EU RED	UK UKCA
LN920A12-WW	●	●
LN920A6-WW	●	●
LN920A13-WW	●	

Table 39: EMEA Approvals Compliance Summary

● The equipment is compliant

● Type approval is in progress

☐ The equipment is not compliant

12.2. Americas Approvals

12.2.1. USA FCC

12.2.1.1. FCC Certificates

The FCC Grants can be found here: *https://www.fcc.gov/oet/ea/fccid*

12.2.1.2. Applicable FCC Rules

Model	Applicable FCC Rules
LN920A12-WW	47 CFR Part 2, 22, 24, 27, 90
LN920A6-WW	
LN920A13-WW	
LN920A6-NA	

Table 40: Applicable FCC Rules

12.2.1.3. FCC Regulatory Notices

Modification Statement

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Wireless Notice

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines. This transmitter must not be co-located or operate in conjunction with any other antenna or transmitter. The antenna should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

FCC Class B digital device notice

This equipment has been tested and found to comply with the limits for a Class B digital device, according to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used per 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 taking one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to 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.

Information for the OEMs and Integrators

The following statement must be included with all versions of this document supplied to an OEM or integrator but should not be distributed to the end user.

1. This device is intended for OEM integrators only.
2. Please see the full Grant of Equipment document for other restrictions

Note EMI Considerations

Note that a host manufacture is recommended to use KDB996369 D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties. For standalone mode, reference the guidance in KDB996369 D04 Module Integration Guide and for simultaneous mode; see KDB996369 D02 Module Q&AQuestion 12, which permits the host manufacturer to confirm compliance.

How to make changes

Only Grantees are permitted to make permissive changes, if the module will be used differently than granted conditions, please contact us to ensure modifications will not affect compliance at the following contact points.

Grantee code:	RI7	**Grantee name:**	Telit Communications S.p.A.
Mailing address:	Viale Stazione di Prosecco 5/b, 34010 Sgonico – Trieste, Italy		
Website:	https://www.telit.com/	**Support contact:**	TS-EMEA@telit.com

Manual Information to the End User

The OEM integrator should be aware not to provide information to the end-user on how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warming as shown in this manual

Information on test modes and additional testing requirements

The module has been evaluated in mobile stand-alone conditions. For operational conditions other than a stand-alone modular transmitter in a host (multiple, simultaneously transmitting modules or other transmitters in a host), additional testing may be required (collocation, retesting...). If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093.

Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only authorized by the FCC for the specific rule parts (for example, FCC transmitter rules) listed on the grant, and that 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. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. The end product with an embedded module may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.

12.2.1.4. FCC Antenna info

This radio transmitter has been approved by FCC to operate with the antenna types listed below with the maximum allowable gain indicated. Antenna types not included in this list, with a gain greater than the maximum gain indicated for that type, are strictly prohibited from use with this device.

Max Gain for FCC (dBi)				
Band	LN920A12-WW	LN920A6-WW	LN920A13-WW	LN920A6-NA
UMTS B2	8.50	8.50	8.50	NA
UMTS B4	5.50	5.50	5.50	NA
UMTS B5	9.92	9.92	9.92	NA

Max Gain for FCC (dBi)				
LTE B2	9.50	9.50	9.50	9.50
LTE B4	6.50	6.50	6.50	6.50
LTE B5	10.91	10.91	10.91	10.91
LTE B7	9.50	9.50	9.50	9.50
LTE B12	10.19	10.19	10.19	10.19
LTE B13	10.67	10.67	10.67	10.67
LTE B14	10.71	10.71	10.71	NA
LTE B17	10.22	10.22	10.22	NA
LTE B25	9.50	9.50	9.50	9.50
LTE B26	10.91	10.91	10.91	10.91
LTE B26 Part 90	10.86	10.86	10.86	10.86
LTE B30	1.00	1.00	1.00	1.00
LTE B38	9.50	9.50	9.50	NA
LTE B41	9.50	9.50	9.50	9.50
LTE B41 HPUE	6.50	6.50	6.50	6.50
LTE B48	1.00	1.00	1.00	NA
LTE B66	6.50	6.50	6.50	6.50
LTE B71	9.98	9.98	9.98	NA
LTE 5C	10.41	NA	10.41	NA
LTE 7C	9.00	NA	9.00	NA
LTE 38C	9.50	NA	9.50	NA
LTE 41C	9.00	NA	9.00	NA

Table 41: Max Antenna Gain for FCC in dBi

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Labelling requirements for the host device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise, the host device must be labelled to display the FCC ID of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as in the below table.

Model	Host device FCC label

LN920A12-WW	Contains FCC ID: RI7LN920
LN920A6-WW	
LN920A13-WW	
LN920A6-NA	Contains FCC ID: RI7LN920NA

Table 42: Host device FCC Label

12.2.2. Canada ISED

12.2.2.1. ISED Database

The products ISED certified can be found here:

Les produits certifiés ISED peuvent être trouvés ici :

https://sms-sgs.ic.gc.ca/equipmentSearch/searchRadioEquipments?execution=e1s1&lang=en

12.2.2.2. Applicable ISED Rules / *Liste des Règles ISDE Applicables*

Model	Applicable ISED rules / *Règles ISDE applicables*
LN920A12-WW	RSS: 132 Issue 3, 133 Issue 6, 130 Issue 2, 139 Issue 3, 140 Issue 1, 195 Issue 2, 199 Issue 3; RSS-Gen Issue 5
LN920A6-WW	
LN920A13-WW	
LN920A6-NA	RSS: 132 Issue 4, 133 Issue 6, 130 Issue 2, 139 Issue 4, 195 Issue 2, 199 Issue 4; RSS-Gen Issue 5

Table 43: Applicable ISED rules / Règles ISDE applicable

12.2.2.3. ISED Regulatory Notices / *Avis réglementaires d'ISDE*

Modification Statement / *Déclaration de modification*

Telit has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Telit n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

Interference Statement / *Déclaration d'interférence*

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux applicables RSS standards d'Industrie Canada. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Radio Exposure Notice / *Avis d'exposition radio*

This device complies with ISED radiation exposure limits set forth for an uncontrolled environment and meets the RSS-102 of the ISED radio frequency (RF) Exposure rules. Antenna gain must be less than the values reported in the table below:

Le présent appareil est conforme à l'exposition aux radiations FCC / ISED définies pour un environnement non contrôlé et répond aux directives d'exposition de la fréquence de la FCC radiofréquence (RF) et RSS-102 de la fréquence radio (RF) ISED règles d'exposition. Gain de l'antenne doit être ci-dessous:

Gain maximum pour ISED (dBi) / *Gain maximum pour ISDE (dBi)*				
Band	LN920A12-WW *	LN920A6-WW *	LN920A13-WW *	LN920A6-NA **
UMTS B2	8.50	8.50	8.50	NA
UMTS B4	5.50	5.50	5.50	NA
UMTS B5	6.63	6.63	6.63	NA
LTE B2	9.50	9.50	9.50	9.50
LTE B4	6.50	6.50	6.50	6.50
LTE B5	7.62	7.62	7.62	7.60
LTE B7	9.50	9.50	9.50	9.50
LTE B12	7.13	7.13	7.13	7.11
LTE B13	7.46	7.46	7.46	7.43
LTE B14	7.49	7.49	7.49	NA
LTE B17	7.15	7.15	7.15	NA
LTE B25	9.50	9.50	9.50	9.50
LTE B26	7.62	7.62	7.62	7.60
LTE B30	1.00	1.00	1.00	1.00
LTE B38	9.50	9.50	9.50	NA

Gain maximum pour ISED (dBi) / *Gain maximum pour ISDE (dBi)*				
LTE B41	9.50	9.50	9.50	9.50
LTE B41 HPUE	6.50	6.50	6.50	6.50
LTE B48	1.00	1.00	1.00	NA
LTE B66	6.50	6.50	6.50	6.50
LTE B71	6.99	6.99	6.99	NA
LTE 5C	7.12	NA	7.12	NA
LTE 7C	9.00	NA	9.00	NA
LTE 38C	9.50	NA	9.50	NA
LTE 41C	9.00	NA	9.00	NA

** RSS 102 Issue 5 was evaluated using the PD exclusion method.*

*** RSS 102 Issue 6 was evaluated using the EIRP exclusion method.*

Table 44: Max antenna gain for ISED in dBi / Gain d'antenne max pour ISED en dBi

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. End-users and installers must be provided with antenna installation instructions and consider removing the no-collocation statement.

Cet équipement doit être installé et utilisé conformément aux instructions fournies et la ou les antennes utilisées pour cet émetteur doivent être installées pour fournir une distance de séparation d'au moins 20 cm de toutes les personnes et ne doivent pas être co-localisées ou fonctionner en conjonction avec toute autre antenne ou émetteur.

Les utilisateurs finaux et les installateurs doivent recevoir les instructions d'installation de l'antenne et envisager de supprimer la déclaration de non-collocation.

Information on test modes and additional testing requirement / *Informations sur les modes de test et exigences de test supplémentaires*

The module has been evaluated in mobile stand-alone conditions. For operational conditions other than a stand-alone modular transmitter in a host (multiple, simultaneously transmitting modules or other transmitters in a host), additional testing may be required (collocation, retesting...) If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements IC RSS-102.

Le module a été évalué dans des conditions mobiles autonomes. Pour des conditions de fonctionnement autres qu'un émetteur modulaire autonome dans un hôte (plusieurs modules transmettant simultanément ou d'autres émetteurs dans un hôte), des tests supplémentaires peuvent être nécessaires (colocalisation, retest...) Si ce module est destiné à être utilisé dans un appareil portable , vous êtes responsable de l'approbation séparée pour satisfaire aux exigences SAR IC RSS-102.

Labelling requirements for the host device / *Exigences d'étiquetage pour le périphérique hôte*

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as in the following table.

L'appareil hôte doit être étiqueté comme il faut pour permettre l'identification des modules qui s'y trouvent. L'étiquette de certification du module donné doit être posée sur l'appareil hôte à un endroit bien en vue en tout temps. En l'absence d'étiquette, l'appareil hôte doit porter une étiquette donnant le IC du module, précédé des mots « Contient un module d'émission », du mot « Contient » ou d'une formulation similaire exprimant le même sens, comme en tableau suivant.

Model / HVIN	Host device IC label / Ètiquette IC du dispositif hôte
LN920A12-WW	Contains IC: 5131A-LN920
LN920A6-WW	
LN920A13-WW	
LN920A6-NA	Contains IC: 5131A-LN920NA

Table 45: Host device IC label / Ètiquette IC du dispositif hôte

CAN ICES-3 (B) / NMB-3 (B)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de classe B est conforme à la norme canadienne ICES-003.

12.2.3. Brazil ANATEL

12.2.3.1. ANATEL Regulatory Notices

The LN920 module is certified in Brazil by Anatel.

"Este equipamento não tem direito à proteção contra interferência prejudicial e não pode causar interferência em sistemas devidamente autorizados"

"This equipment is not entitled to protection against harmful interference and must not cause interference in duly authorized systems"

LN920A12-WW Homologation # 08885-22-02618

LN920A6-WW Homologation # 08885-22-02618

12.3. APAC Approvals

12.3.1. Japan Approvals

Telit strongly recommends to customers, deploying the module to Japan, the usage of AT#FWSWITCH command to select the right Japanese carrier profile. The carrier profile has been designed to enable the right LTE and WCDMA bands and also the required carrier settings.

12.3.1.1. JRL/JTBL Regulatory Notices

Antenna info

According to Japan regulatory rule, module certification is valid only with the specific antennas registered to and approved by Japan Radio Law (JRL) certified body in relation to module certification. Customers who are going to use modules under JRL are responsible to contact Telit technical support or sales to get the list of these antennas.

12.3.2. Taiwan NCC

12.3.2.1. NCC Regulatory Notices

According to National Communication Commission (NCC) Taiwan requirements, the module, and the packaging shall be identified as described in the following lines. Shall be added also the specified safety warning statement.

- 「減少電磁波影響，請妥適使用」
  「此模組於取得認證後將依規定於模組本體標示審驗合格標籤，並要求平台廠商於平台上標示『本產品內含發射器模組： CCXXxxLPyyyZzW』字樣。」
  LN920A6-WW: CCAM22Y00011T8
  LN920A12-WW: CCAM22Y0010T6
  LN920A13-WW: CCAM22Y0012T0
- 「本產品 LN920A6-WW /LN920A12-WW / LN920A13-WW 支持 WCDMA B1/8, LTE B1/3/7/8/28/38/41. 」

12.4. EMEA Approvals

12.4.1. EU RED

12.4.1.1. EU Declaration of Conformity

In accordance with the above Approval Compliance Summary table, where applicable (green ball), hereby, Telit Communications S.p.A declares that the equipment is in compliance with the Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: *https://www.telit.com/red*

Text of 2014/53/EU Directive (RED) requirements can be found here:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0053

12.4.1.2. RED Antennas

This radio transmitter has been approved under RED to operate with the antenna types listed below with the maximum permissible gain indicated. The usage of a different antenna in the final hosting device may need a new assessment of host conformity to RED.

Max Gain for RED (dBi)			
Band	**LN920A12-WW**	**LN920A6-WW**	**LN920A13-WW**
UMTS B1	11.85	11.85	11.85

Max Gain for RED (dBi)			
UMTS B8	8.46	8.46	8.46
LTE B1	11.85	11.85	11.85
LTE B3	11.35	11.35	11.35
LTE B7	11.96	11.96	11.96
LTE B8	8.46	8.46	8.46
LTE B20	8.22	8.22	8.22
LTE B28	7.48	7.48	7.48
LTE B38	11.96	11.96	11.96
LTE B40	11.96	11.96	11.96
LTE B42	11.96	11.96	11.96
LTE B43	11.96	11.96	11.96

Table 46: Max Antenna Gain for RED in dBi

12.4.2. UK UKCA

12.4.2.1. UKCA Declaration of Conformity

In accordance with the above Approval Compliance Summary table, where applicable (green ball), hereby, Telit Communications S.p.A declares that the equipment is in compliance with the Radio Equipment Regulations 2017 for UKCA.

The full text of the UKCA declaration of conformity is available at the following internet address: *https://www.telit.com/ukca*

The UKCA requirements can be found here:

https://www.gov.uk/guidance/using-the-ukca-marking

12.5. RoHS and REACH Info

12.5.1. RoHS Info

Any requests on information related to RoHS certifications can be addressed to *Chemical.Certifications@telit.com.*

12.5.2. REACH Info

Any requests on information related to REACH certifications can be addressed to *Chemical.Certifications@telit.com.*

13. REFERENCE TABLE OF RF BANDS CHARACTERISTICS

Mode	Freq. Tx (MHz)	Freq. Rx (MHz)	Channels	Tx-Rx Offset
WCDMA 2100 – B1	1920 ~ 1980	2110 ~ 2170	Tx: 9612 ~ 9888 Rx: 10562 ~ 10838	190 MHz
WCDMA 1900 – B2	1850 ~ 1910	1930 ~ 1990	Tx: 9262 ~ 9538 Rx: 9662 ~ 9938	80 MHz
WCDMA AWS – B4	1710 ~ 1755	2110 ~ 2155	Tx: 1312 ~ 1513 Rx: 1537 ~ 1738	400 MHz
WCDMA 850 – B5	824 ~ 849	869 ~ 894	Tx: 4132 ~ 4233 Rx: 4357 ~ 4458	45 MHz
WCDMA 850 – B6	830 ~ 840	875 ~ 885	Tx: 4162 ~ 4188 Rx: 4387 ~ 4413	45 MHz
WCDMA 900 – B8	880 ~ 915	925 ~ 960	Tx: 2712 ~ 2863 Rx: 2937 ~ 3088	45 MHz
WCDMA 1800 – B9	1750 ~ 1784.8	1845 ~ 1879.8	Tx: 8762 ~ 8912 Rx: 9237 ~ 9387	95 MHz
WCDMA 800 – B19	830 ~ 845	875 ~ 890	Tx: 312 ~ 363 Rx: 712 ~ 763	45 MHz
LTE 2100 – B1	1920 ~ 1980	2110 ~ 2170	Tx: 18000 ~ 18599 Rx: 0 ~ 599	190 MHz
LTE 1900 – B2	1850 ~ 1910	1930 ~ 1990	Tx: 18600 ~ 19199 Rx: 600 ~ 1199	80 MHz
LTE 1800 – B3	1710 ~ 1785	1805 ~ 1880	Tx: 19200 ~ 19949 Rx: 1200 ~ 1949	95 MHz
LTE AWS – B4	1710 ~ 1755	2110 ~ 2155	Tx: 19950 ~ 20399 Rx: 1950 ~ 2399	400 MHz
LTE 850 – B5	824 ~ 849	869 ~ 894	Tx: 20400 ~ 20649 Rx: 2400 ~ 2649	45 MHz
LTE 2600 – B7	2500 ~ 2570	2620 ~ 2690	Tx: 20750 ~ 21449 Rx: 2750 ~ 3449	120 MHz
LTE 900 – B8	880 ~ 915	925 ~ 960	Tx: 21450 ~ 21799 Rx: 3450 ~ 3799	45 MHz
LTE 700a – B12	699 ~ 716	729 ~ 746	Tx : 23010 ~ 23179 Rx : 5010 ~ 5179	30 MHz
LTE 700c – B13	777 ~ 787	746 ~ 756	Tx : 27210 ~ 27659 Rx : 9210 ~ 9659	-31 MHz
LTE 700PS – B14	788 - 798	758 - 768	Tx : 23280 - 23379 Rx : 5280 - 5379	-30 MHz
LTE 700b – B17	704 ~ 716	734 ~ 746	Tx: 23730 ~ 23849 Rx: 5730 ~ 5849	30 MHz
LTE 800Lower – B18	815 - 830	860 - 875	Tx: 23850 - 23999 Rx: 5850 - 5999	45 MHz

Mode	Freq. Tx (MHz)	Freq. Rx (MHz)	Channels	Tx-Rx Offset
LTE 800 – B19	830 ~ 845	875 ~ 890	Tx: 24000 ~ 24149 Rx: 6000 ~ 6149	45 MHz
LTE 800 – B20	832 ~ 862	791 ~ 821	Tx: 24150 ~ 24449 Rx: 6150 ~ 6449	-41 MHz
LTE 850+ – B26	814 ~ 849	859 ~ 894	Tx: 26690 ~ 27039 Rx: 8690 ~ 9039	45 MHz
LTE 700 – B28	703 ~ 748	758 ~ 803	Tx : 27210 ~ 27659 Rx : 9210 ~ 9659	45 MHz
LTE 700d – B29	-	717 - 728	Rx: 9660 - 9769	-
LTE 2300WCS - B30	2305 - 2315	2350 - 2360	Tx: 27660 - 27759 Rx: 9770 - 9869	45 MHz
LTE TDD 2600 – B38	2570 ~ 2620	2570 ~ 2620	Tx: 37750 ~ 38250 Rx: 37750 ~ 38250	0 MHz
LTE TDD 1900 – B39	1880 ~ 1920	1880 ~ 1920	Tx: 38250 ~ 38650 Rx: 38250 ~ 38650	0 MHz
LTE TDD 2300 – B40	2300 ~ 2400	2300 ~ 2400	Tx: 38650 ~ 39650 Rx: 38650 ~ 39650	0 MHz
LTE TDD 2500 – B41	2496 ~ 2690	2496 ~ 2690	Tx: 39650 ~ 41590 Rx: 39650 ~ 41590	0 MHz
LTE TDD 3500 – B42	3400 - 3600	3400 - 3600	TX: 41590 - 43589 Rx: 41590 - 43589	0 MHz
LTE TDD 3700 – B43	3600 – 3800	3600 – 3800	Tx: 43590 – 45589 Rx: 43590 – 45589	0 MHz
LTE TDD 3600 – B48	3550 - 3700	3550 - 3700	Tx: 55240 - 56739 Rx: 55240 - 56739	0 MHz
LTE AWS-3 - B66	1710 - 1780	2110 - 2200	Tx: 131972 - 132671 Rx: 66436 - 67335	400 MHz
LTE 600 – B71	663 - 698	617 - 652	Tx: 133122 - 133471 Rx: 68586 - 68935	-46 MHz

Table 47: RF Bands Characteristics

14. PRODUCT AND SAFETY INFORMATION

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14.3. Safety Recommendations

Make sure the use of this product is allowed in your country and in the environment required. The use of this product may be dangerous and has to be avoided in areas where:

- it can interfere with other electronic devices, particularly in environments such as hospitals, airports, aircrafts, etc.
- there is a risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product. Therefore, the external components of the module, as well as any project or installation issue, have to be handled with care. Any interference may cause the risk of disturbing the GSM network or external devices or having an impact on the security system. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed carefully in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The equipment is intended to be installed in a restricted area location.

The equipment must be supplied by an external specific limited power source in compliance with the standard EN 62368-1:2014.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

https://ec.europa.eu/growth/sectors/electrical-engineering_en

15. GLOSSARY

ADC	Analog – Digital Converter
CLK	Clock
CMOS	Complementary Metal – Oxide Semiconductor
CS	Chip Select
ESR	Equivalent Series Resistance
GPIO	General Purpose Input Output
HS	High Speed
HSDPA	High Speed Downlink Packet Access
I/O	Input Output
PCB	Printed Circuit Board
RTC	Real Time Clock
SIM	Subscriber Identification Module
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
UMTS	Universal Mobile Telecommunication System
USB	Universal Serial Bus
VSWR	Voltage Standing Wave Radio
WCDMA	Wideband Code Division Multiple Access

16. DOCUMENT HISTORY

Revision	Date	Changes
17	2024-04-23	Added CA list CA-4A-48A, CA_13-48A Update APAC Approvals compliance summary Update PIN description Table 12 and figure 2 Update Table 16 3DL Mode Description Added New variant the LN920A6-NA Update the chapter 11.1 Tray
16	2023-03-08	Added Variant Cat13 Updated REFsens. Added Anatel homologation Updated Reference table of RF bands characteristics Added CA list CA_66A-48A Added QZSS
15	2022-11-24	Added chapter 12.3.1 Japan Approvals Added notes relate to the UIM_PRESENT setting
14	2022-09-29	Updated figure 3 Updated chapter 6.5.3 WOW# Updated chapter 6.7 DPR Unify the Pin name - VBATT
13	2022-07-06	Updated section 12.1Approvals Compliance Summary Minor editorial changes
12	2022-07-05	Updated Chapter 12. Conformity assessment issues
11	2022-06-17	Added NCC Waring statement
10	2022-04-28	Updated figure 3 : Power On Time Updated figure 6 : Reset Time Updated figure 7 : Reset_N Time Removed Anatle Regulatory notices
9	2022-03-08	Modified the Max Tput for LN920A6-WW. Updated Table 14. Maximum ripple on module input supply Updated Table 18. Peak current on pin VBATT Updated peak current value for 4.3.3 Power supply PCB layout guidelines Updated Table 12. Function for Pin 60, 62 and 64

8	2022-03-03	Updated table numbers. Updated figure numbers Updated Table 35: GNSS Characteristics Updated Table 27: Bands variant Updated Table 30: Rx sensitivity LN920A12-WW and LN920A6-WW
7	2022-02-22	Modified the Block diagram. Updated RF performance. Updated antenna maximum gain. Updated current consumption Table. Updated Pin-out Table and Pin Layout. Updated Logic Level Table. Updated Communication Port Table. Removed Table 27: GNSS Signal Pin-out
6	2022-02-09	Added to the type of antenna, FCC ID, and ISED Certification number.
5	2022-01-24	Mechanical drawing added
4	2022-01-18	WCDMA B6 added to supported bands list
3	2021-12-27	Uplink Carrier Aggregation combinations tables added
2	2021-10-20	Current consumption tables and supported CA lists updated
1	2021-08-11	Carrier Aggregation (CA) combinations tables added
0	2021-06-30	First Draft

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