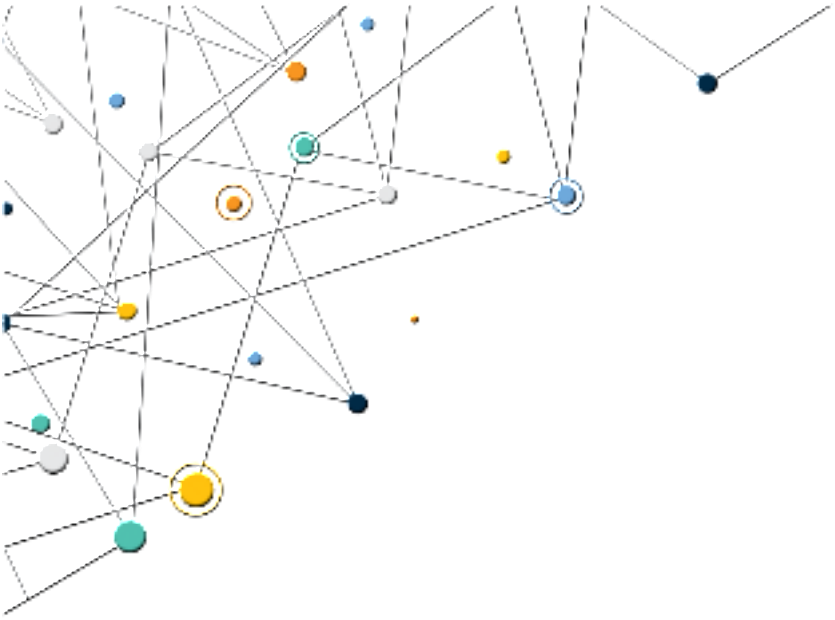

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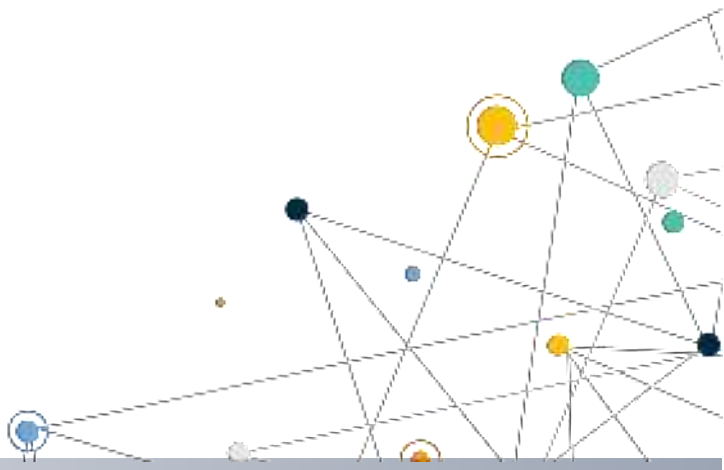

Telit Technical Documentation

APPLICABILITY TABLE

PRODUCTS	PART NUMBER
LN920A12-WW	LN920A12xxx
LN920A6-WW	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 are applicable 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 development of a product based on a Telit LN920 module.

If a specific feature is applicable to a specific product only, it will be clearly 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 general contact, technical support services, technical questions and report of documentation errors contact Telit Technical Support at:

- *TS-EMEA@telit.com*
- *TS-AMERICAS@telit.com*
- *TS-APAC@telit.com*
- *TS-SRD@telit.com*
- *TS-ONEEDGE@telit.com*

Alternatively, use:

https://www.telit.com/support

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

https://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates the user feedback on our information.

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

The aim of this document is 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 (150 Mbps, 40 MHz) with WCDMA fallback

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			

Table 2: Product Variants and their Frequency Bands

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

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

2.3. Main Features

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

Modem	• Cellular modem for data communication
	  ○ LN920A12-WW: LTE FDD Cat. 12 (600/150Mbps DL/UL)
	  ○ LN920A6-WW: LTE FDD Cat. 6 (150/50Mbps DL/UL)
	  ○ WCDMA up to DC HSPA+, Rel.10
	• Support for SIM profile switching

GNSS	• Support for GPS, GLONASS, BeiDou and Galileo
Application processor	• Cortex-A7 up to 1.28 GHz with 256 KB L2 cache

Function	Features
	• 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 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 main host interface and port configuration.

The state of 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 require 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.

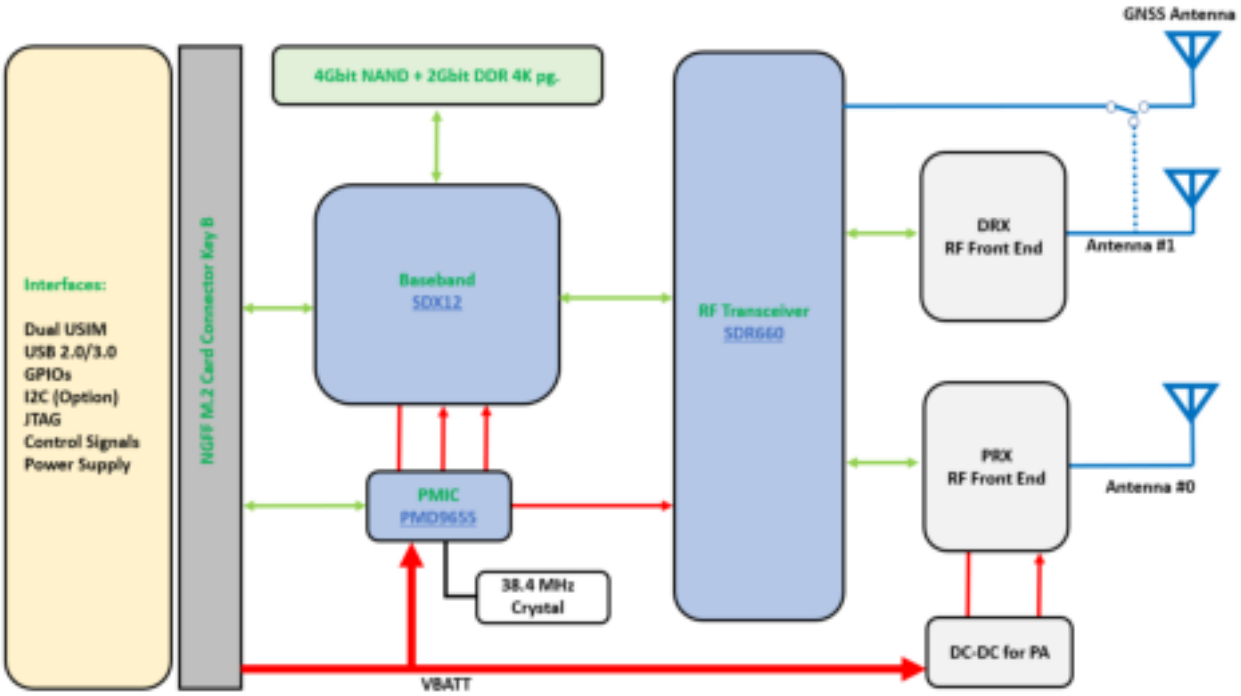

Figure 1: LN920 Block Diagram

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)
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 +/- 2.7dB tolerance
B41	(LTE) HPUE	2	26 +/- 2.7dB tolerance
B1, B2, B4, B5, B6, B8, B9, B19	WCDMA	3	23 +/- 2.7dB tolerance

Table 6: Transmission Output Power

2.6. RX Sensitivity

The 3GPP measurement conditions used to define the RX sensitity 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 -98.5 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 FDD B14 LTE FDD B17 LTE FDD B18 LTE FDD B19	LTE -98.5 WCDMA -110

Product	Band	Sensitivity (dBm)
	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	

Table 8: Product Sensitivity

Band	REFsens (dBm) Typical	3GPP REFsens (dBm)*/**
LTE Band1	-100	-96.3
LTE Band2	-99.5	-94.3
LTE Band3	-100	-93.3
LTE Band4	-100	-96.3
LTE Band5	-99.5	-94.3
LTE Band7	-98.5	-94.3
LTE Band8	-100	-93.3
LTE Band12	-100	-93.3
LTE Band13	-100	-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

Band	REFsens (dBm) Typical	3GPP REFsens (dBm)*/**
LTE Band25	-99.5	-92.8
LTE Band26	-100	-93.8
LTE Band28	-101	-94.8
LTE Band29	-100	-94.0
LTE Band30	-98.5	-95.3
LTE Band38	-99.5	-96.3
LTE Band39	-100	-96.3
LTE Band40	-99.5	-96.3
LTE Band41	-99	-94.3
LTE Band42	-99	-95.0
LTE Band43	-99	-95.0
LTE Band48	-99	-95.0
LTE Band66	-99.5	-95.8
LTE Band71	-100	-93.5

Table 9: Reception Sensitivity LN920A6-WW, LN920A12-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)*/**
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
WCDMA Band8	-112	-103.0
WCDMA Band9	-111	-105.0
WCDMA Band19	-112	-106.0

Table 10: Reception Sensitivity LN920A6-WW, LN920A12-WW *3GPP TS 34.121-1 Release 16*

2.7. Supported Carrier Aggregation combinations

2.7.1. Two Carrier Aggregation combinations (LN920A6-WW + LN920A12-WW)

2xCA Combinations (LN920A6-WW and LN920A12-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

2.7.2. 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, 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-

3xCA Combinations (LN920A12-WW)
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

2.7.3. Uplink Carrier Aggregation combinations (LN920A12-WW)

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

2.8. Mechanical Specifications

2.8.1. Dimensions

The overall dimensions of LN920A12-WW and LN920A6-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-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 with in this range.
	-40°C ~ +85°C	Telit guarantees full functionality within this range as well. However, there may possibly 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: receiver sensitivity or maximum output power may be slightly degraded. Even so, all the functionalities, such as call connection, SMS, USB communication, UART activation etc., 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	
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	
Miscellaneous Functions					
6	FULL_CARD_POWER_OFF#	I	Module On/Off	1.8V / 3.3V	Open Drain
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 / 3.3V	Open Drain
25	DPR	I	Dynamic Power Reduction	1.8V	
26	GPS_DISABLE#	I	GPS disable	3.3V	Active Low Internal PU
60	COEX3	I/O	TBD	1.8V	
62	COEX_UART_RX	I	TBD	1.8V	
64	COEX_UART_TX	O	TBD	1.8V	
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	VPH_PWR	I	Power supply	Power	
4	VPH_PWR	I	Power supply	Power	
70	VPH_PWR	I	Power supply	Power	

Pin	Signal	I/O	Function	Type	Comment
72	VPH_PWR	I	Power supply	Power	
74	VPH_PWR	I	Power supply	Power	
GND					
3	GND	-	Ground	Ground	
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	-	-	-	
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.

Mandatory Signals

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

Table 13: Mandatory Signals

3.3. Pin Layout

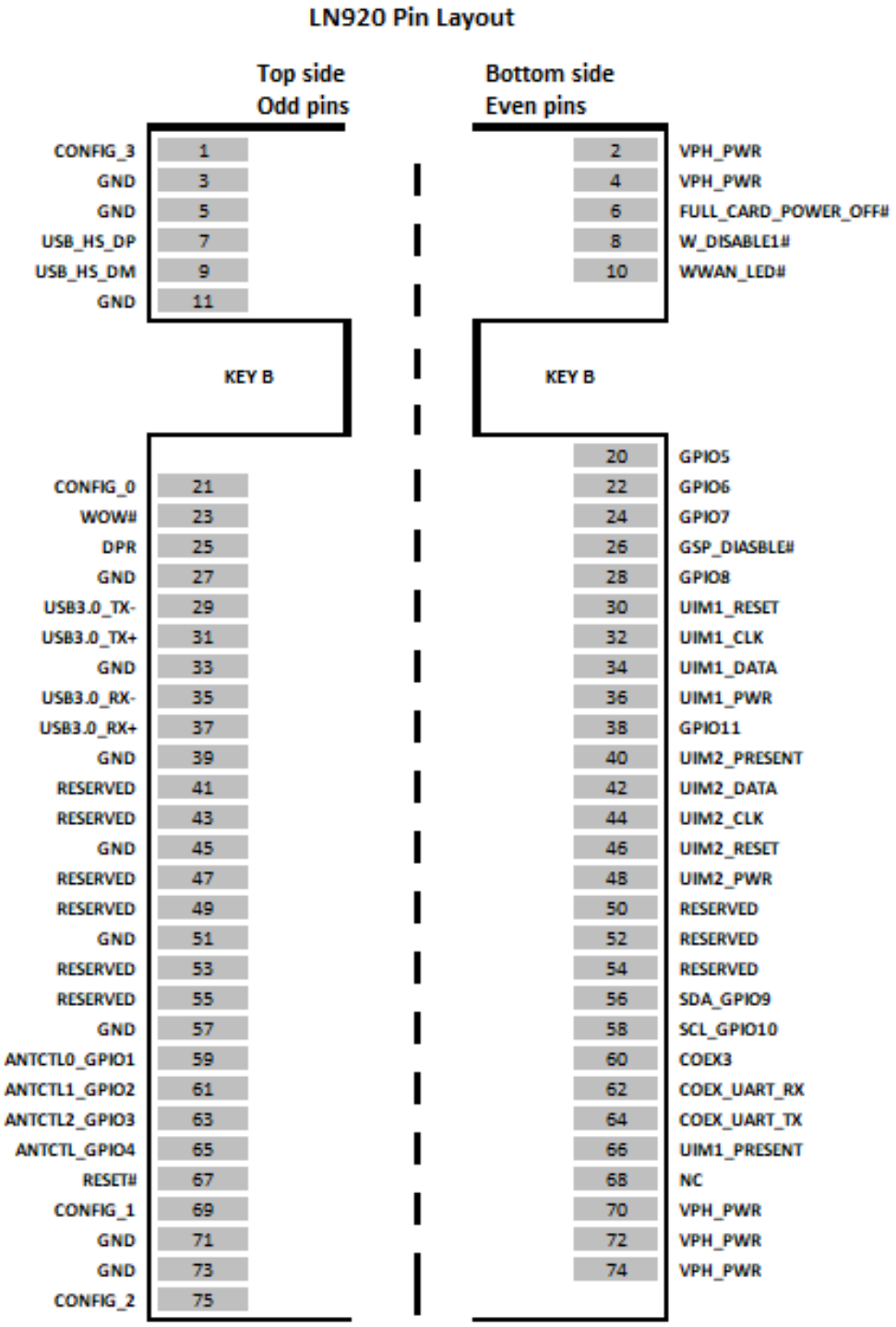

Figure 2: LN920 Pin-out

4. POWER SUPPLY

Both power supply circuitry and board layout are a 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 module input supply	TBD

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 on the module.

4.2. Power Consumption

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

4.2.1. Idle Mode

Mode		Average	Mode Desciption
IDLE mode			
AT+CFUN=1		18mA	No Call Connection. USB is connected to host.
Airplane Mode (PSMWDISACFG=1, W_DISABLE_N: Low)			
AT+CFUN=4		4.1mA[1]	TX and Rx are disabled: module is not registered on the network (Airplane mode) USB is disconnected.
Sleep Moode (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 *[1]PSM in between eDRX*

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)

[1] Value under optimization

Mode	Measure (Typical)		Mode Description
	750mA	790mA	2DL (2x2 MIMO) CA_7C Full RB, 256QAM DL/64QAM UL(400Mbps DL/150Mbps UL)
	800mA	830mA	3DL (2x2 MIMO) CA_7A-28A Full RB, 256QAM DL/64QAM UL(400Mbps 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 in order to dissipate the power generated.
- A Bypass low ESR capacitor of adequate capacity must be provided in order 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 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

The aim of this chapter is to provide thermal design guidelines useful for developing a product with the LN920.

Proper thermal protection design protects against human or component damage for 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 device is requested to transmit via the network.

Therefore, the average current consumption varies significantly.

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

Modem temperature can be read by means of 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 by means of 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. 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 performances.

- The Bypass low ESR capacitor must be placed closed to the LN920 power input pins or. 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 an TBD(A) 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 an TBD A 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 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 in order 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 to any noise sensitive circuitry, such as audio amplifiers etc.
- 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	-	-	TBD	[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 lines that are inverted, that is are active low, are labelled 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	-
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
Input voltage on any analog pins when on		3.42V
Input high level	1.995V	3.15V
Input low level	-0.3V	0.57V
Output high level	2.28V	2.85V
Output low level	0V	0.4V

Low-level input leakage current		1000 uA
High-level input leakage current	-20 uA	20 uA

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/Tip: 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 USB port, the device might not be yet fully operational. In general, as shown in below figure, the LN920 becomes fully operational (in the Activation State) at least 50 seconds after the FULL_CARD_POWER_OFF# line is asserted.

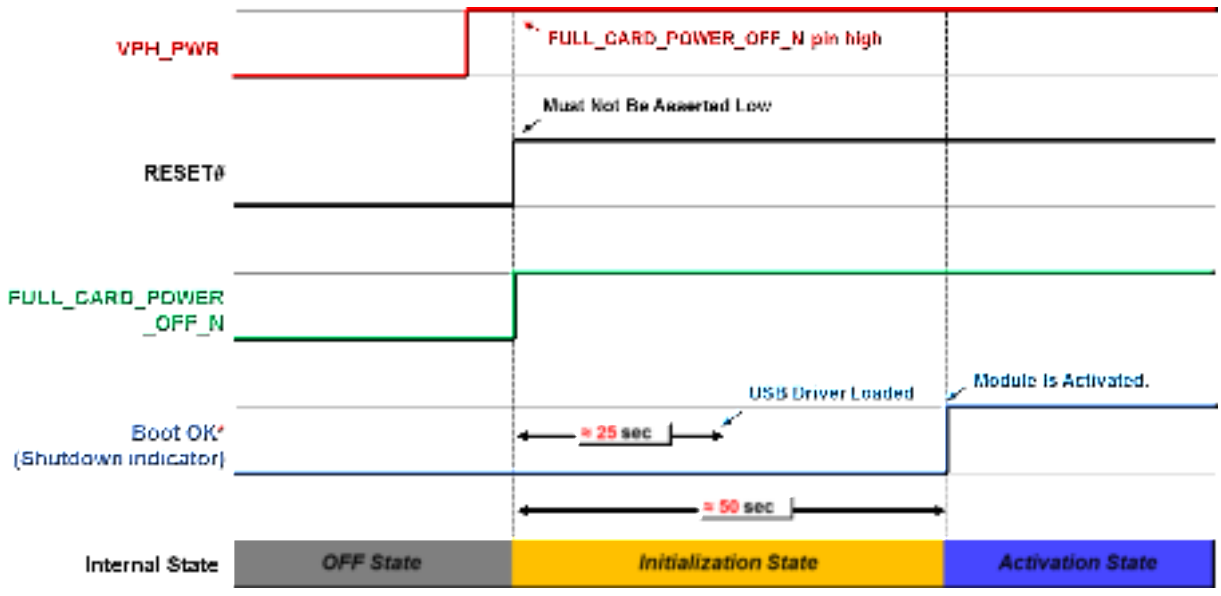

Figure 3: LN920 Initialization and Activation

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.

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 Shutdown Indicator function. Please refer to the Power Off chatper for more information regarding Shutdown indicator.
Please refer to the AT Reference guide document for more details about AT#SHDNIND command.

Note: To avoid 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 of the device can be performed in two ways:

- Graceful shutdown by means of 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 Low.

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

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

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

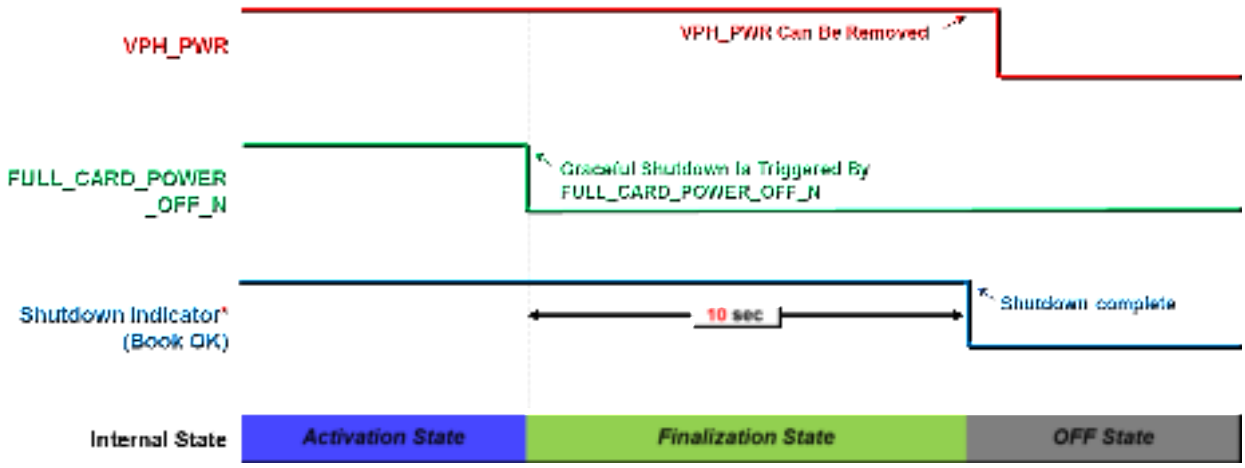

Figure 4: Graceful Shutdown by FULL_CARD_POWER_OFF_N

* Shutdown Indicator (Boot OK) is 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 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 GPIO lines can be used as Fast Shutdown** Trigger.

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

Then the LN920 module enters 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 Shutdown Indicator*.

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

* Shutdown Indicator (Boot OK) is optional function and is disabled by default.
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 Boot OK function. About Boot OK, please refer to the Power On chatper.
Refer to the AT Reference guide document for more details about AT#SHDNIND.

** Fast Shutdown is optional function and is disabled by default.
Host can use the AT#FASTSHDN command to assign one of the GPIOs as the Fast Shutdown Trigger pin. After enabling the function, Fast shutdown will be triggered by HIGH to LOW transition through corresponding pin.

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

Fast shutdown by GPIO

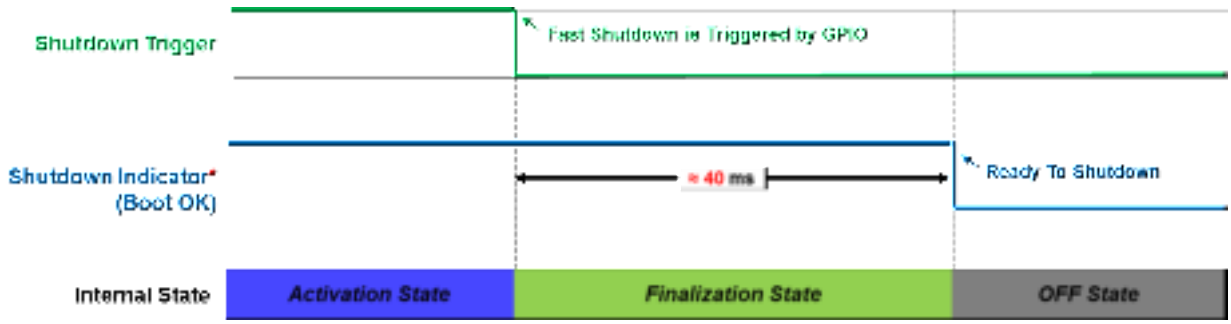

Figure 5: Fast Shutdown by GPIO

Warning: If VPH_PWR is still supplied after Fast Shutdown is completed, the module will re-start 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 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 High to Low, the module has completed power off procedure.
When the status transitions Low to High, the module has completed power on procedure.

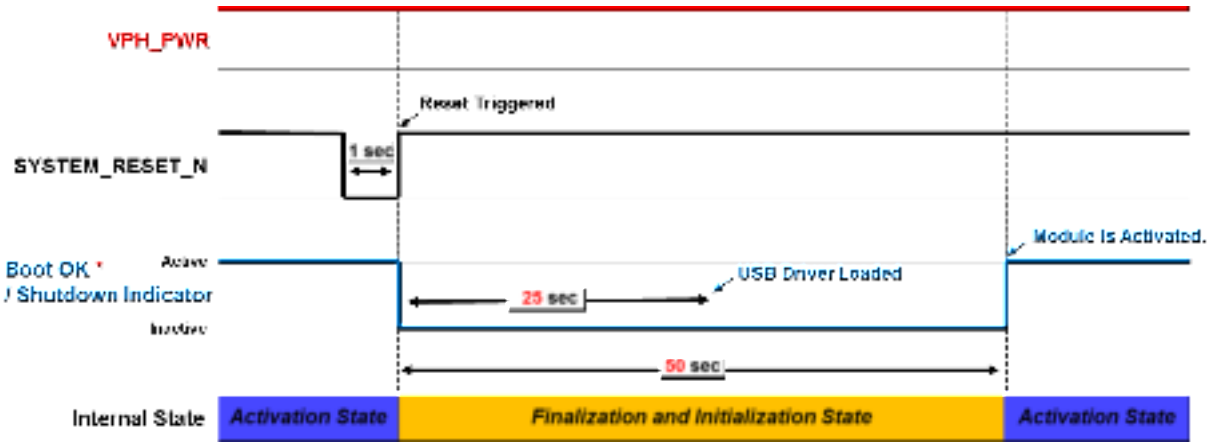

Figure 6: Unconditional Hardware Reset by SYS_RESIN_N Pad

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

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.

Below figure shows a simple circuit for this action.

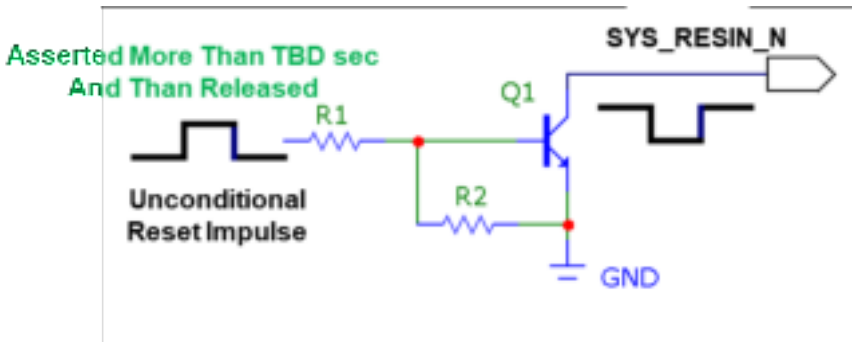

Figure 7: Circuit for RESTE by SYSTEM_RESET_N

6.5. Communication Ports

Below table summarizes all the hardware interfaces available of 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 super-speed USB 3.0 interface with high-speed USB 2.0 backwards compatibility. It is compliant with Universal Serial Bus Specifications, 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. In order to interface USB3.0 with the application board controlling the modem, 0.1uF capacitors should be installed on USB_SS_RX_P/M lines of the LN920. Series capacitors are already placed on USB_SS_TX_P/M lines inside LN920 module.

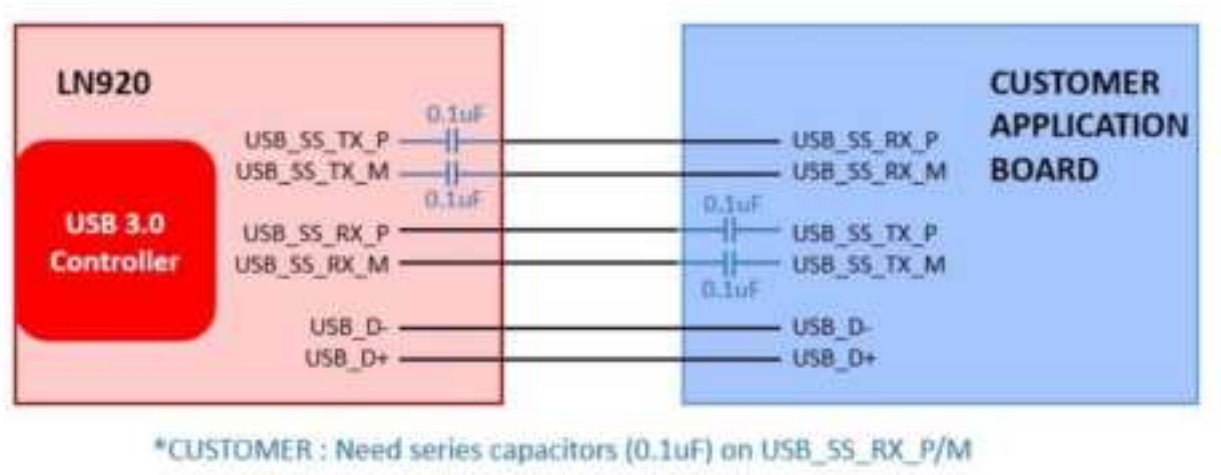

Figure 8: Connection for USB Interface

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.

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).

PIN	Signal	I/O	Function	Type
SIM Card Interface 1				
36	UIM1_PWR	O	Supply output for an external UIM1 card	1.8V / 2.85V
34	UIM1_DATA	I/O	Data connection with an external UIM1 card	1.85 / 2.85V
32	UIM1_CLK	O	Clock output to an external UIM1 card	1.85 / 2.85V
30	UIM1_RESET	O	Reset output to an external UIM1 card	1.85 / 2.85V
66	UIM1_PRESENT	I	SIM1 detect signal	1.8V
SIM Card Interface 2				
48	UIM2_PWR	O	Supply output for an external UIM2 card	1.8V / 2.85V
42	UIM2_DATA	I/O	Data connection with an external UIM2 card	1.85 / 2.85V
44	UIM2_CLK	O	Clock output to an external UIM2 card	1.85 / 2.85V
46	UIM2_RESET	O	Reset output to an external UIM2 card	1.85 / 2.85V

40	UIM2_PRESENT	I	SIM2 detect signal	1.8V

Table 23: SIM Interface Signals

6.5.2.1. SIM Schematic Example

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

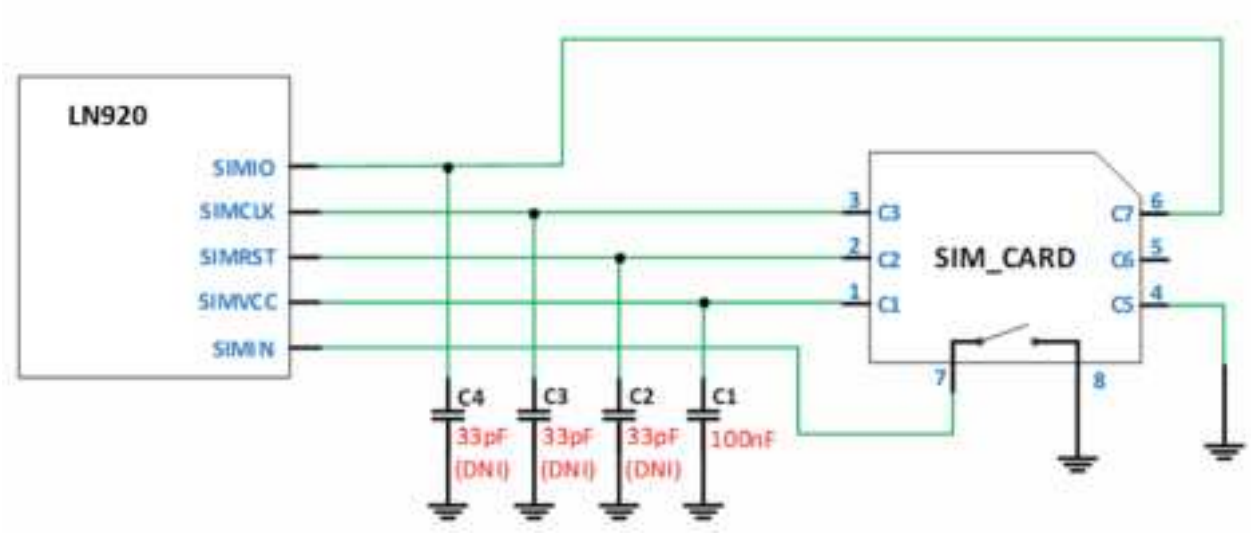

Figure 9: SIM Schematics

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 plaform by the WWAN device	Open-drain	
10	WWAN_LED#	O	LED control	Open-drain	

Table 24: Control Signals

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

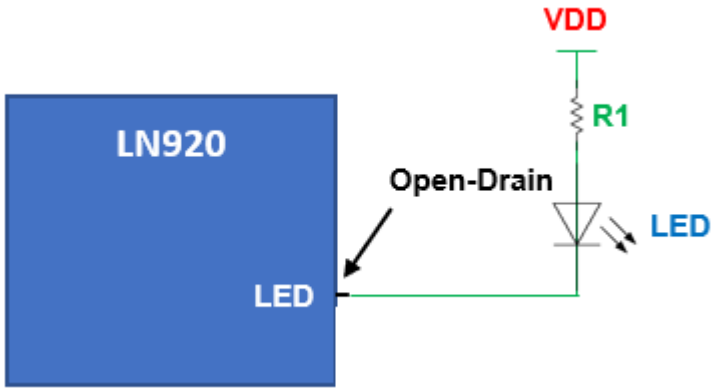

Figure 10: Recommended LED connection

R1 and VDD determine the brightness of 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 ohm to 250 Ohm.

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

Note: If WWAN LED function is enabled by means of 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	
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: In order 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 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

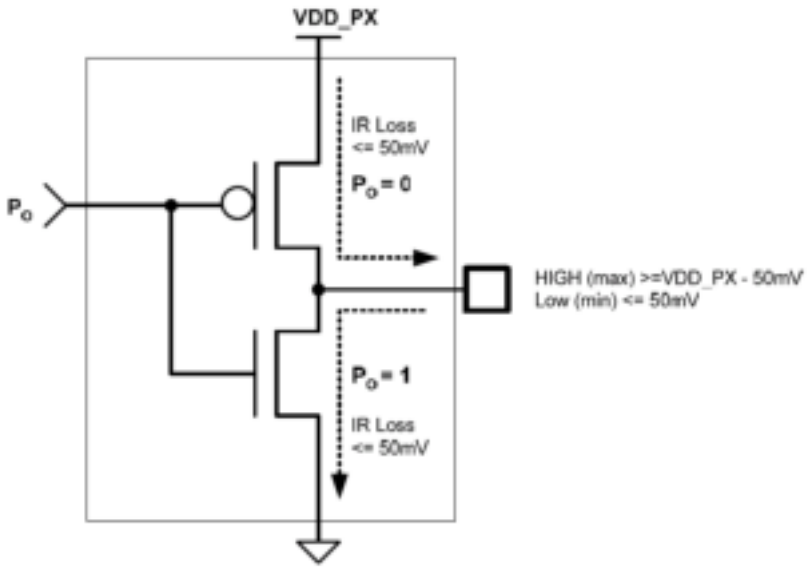

Figure 11: GPIO Output Pin Equivalent Circuit

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: Modult I2C Signals

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

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

Table 27: Bands Variant

7.2. TX Output Power

Band	Mode	Class	RF power (dBm)
All bands	LTE	3	23 (+/-2.7 dB)
Band41	(LTE) HPUE	2	26 (+/-2.7 dB)
All bands	WCDMA	3	23 (+/-2.7 dB)

Table 28: TX Output Power

7.3. RX Sensitivity

Measurement setup

MODE	Value
LTE	Throughput >95% According to 3GPP 36.521-1
WCDMA	Throughput >95% According to 3GPP 36.521-1

Table 29: RX Sensitivity Measurement Setup

LN920A12-WW, LN920A6-WW

MODE / Band	REFsens (dBm)	3GPP REFsens (dBm)
LTE / Band1	-100	-96.3
LTE / Band2	-99.5	-94.3
LTE / Band3	-100	-93.3
LTE / Band4	-100	-96.3
LTE / Band5	-99.5	-94.3

MODE / Band	REFsens (dBm)	3GPP REFsens (dBm)
LTE / Band7	-98.5	-94.3
LTE / Band8	-100	-93.3
LTE / Band12	-100	-93.3
LTE / Band13	-100	-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	-100	-94.0
LTE / Band30	-98.5	-95.3
LTE / Band38	-99.5	-96.3
LTE / Band39	-100	-96.3
LTE / Band40	-99.5	-96.3
LTE / Band41	-99	-94.3
LTE / Band42	-99	-95.0
LTE / Band43	-99	-95.0
LTE / Band48	-99	-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
WCDMA Band8	-112	-103.0
WCDMA Band9	-111	-105.0
WCDMA Band19	-112	-106.0

Table 30: RX sensitivity LN920A12-WW and LN920A6-WW

7.4. Antenna Requirements

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

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

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

Table 31: LN920 Antenna and Antenna Transmission Line on PCB

7.4.1. Antenna Configration

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 connectors position on the modem board.

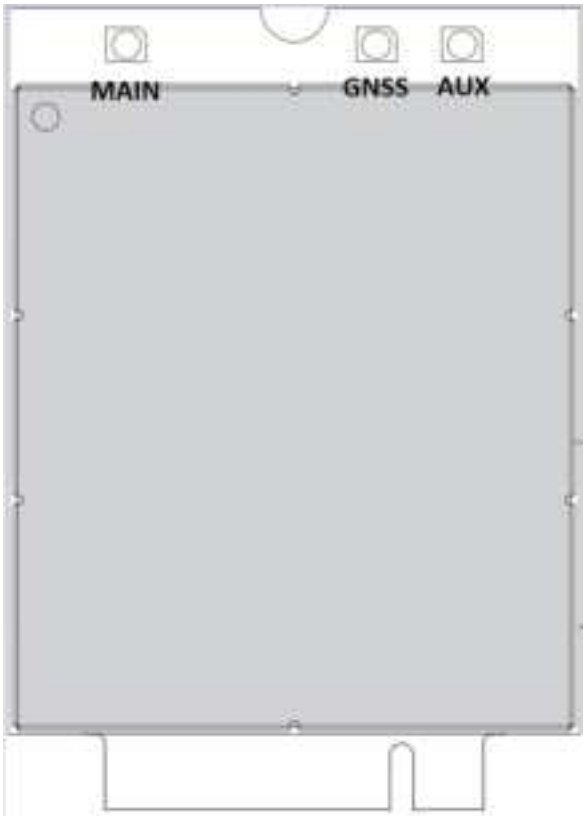

Figure 12: Antenna Configrations

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	GPS, Galileo, Beidou, Glonass
	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	
GNSS	GNSS	-	-	GPS, Galileo, Beidou, Glonass

Table 32: Antenna Configurations

7.4.2. Antenna Connector

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

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

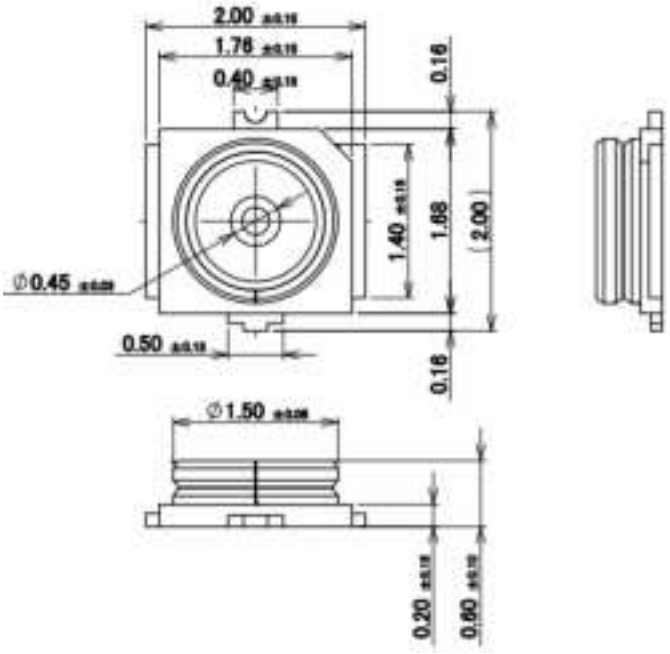

Figure 13: MHF-4 RF connector

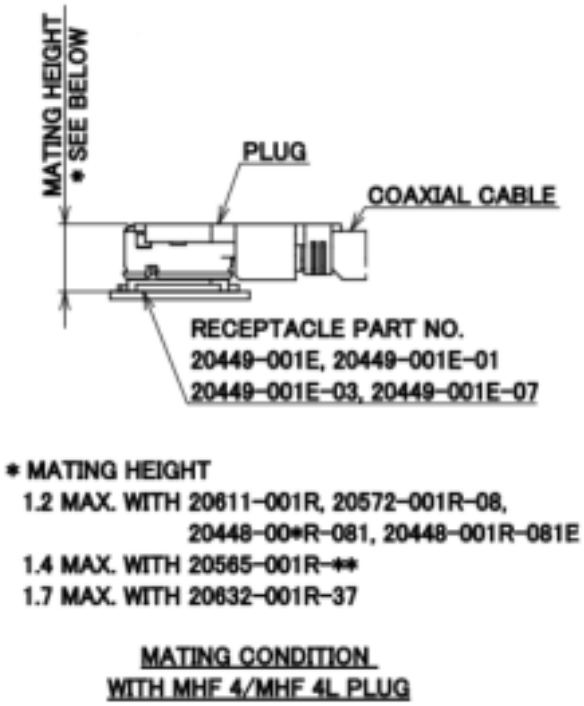

Figure 14: MHF-4 Receptacle

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 50 Ω impedance.

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

Minimize Antenna Cable Recommendations

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

Table 33: Minimize Antenna Cable Recommendations

Warning: Impedence of RF connector and RF cable must be matched to 50 Ohm. Impedance mismatching will cause poor RF performance,especially i.e. RF cable with high insertion loss will affect on 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 Antenna manufacturer instructions.
- Antenna integration should optimize the 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.
- In order 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.

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 line must have uniform characteristics, constant cross section, 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 antenna line.
- Keep the antenna line as far as possible from 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 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 decoupling between the LTE and GNSS antennas is low. A SAW filter can be added on 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.

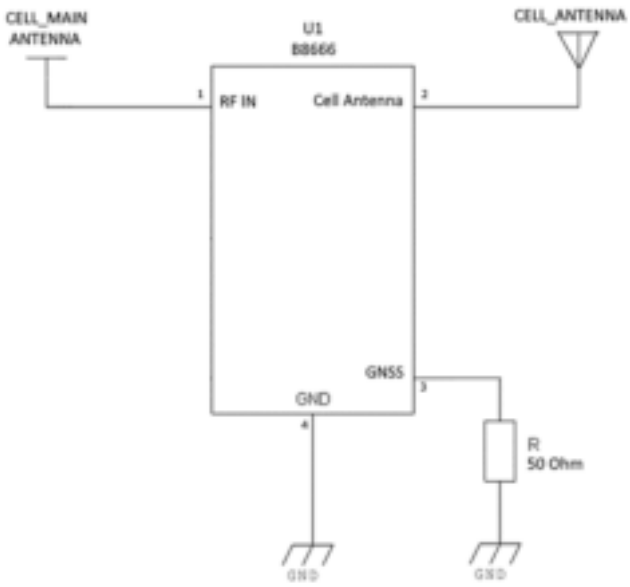

Figure 15: Reference schematic

8.2. GNSS Antenna Requirements

For most applications, it is recommented 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 34: GNSS Antenna specification

Note: In case of GNSS antenna placed close to the module, a 15dB gain is sufficient. In case of 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 the 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	-160dBm
	Navigation	-148dBm
	Cold Start	-145dBm
Min Navigation update rate		1Hz

Table 35: 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

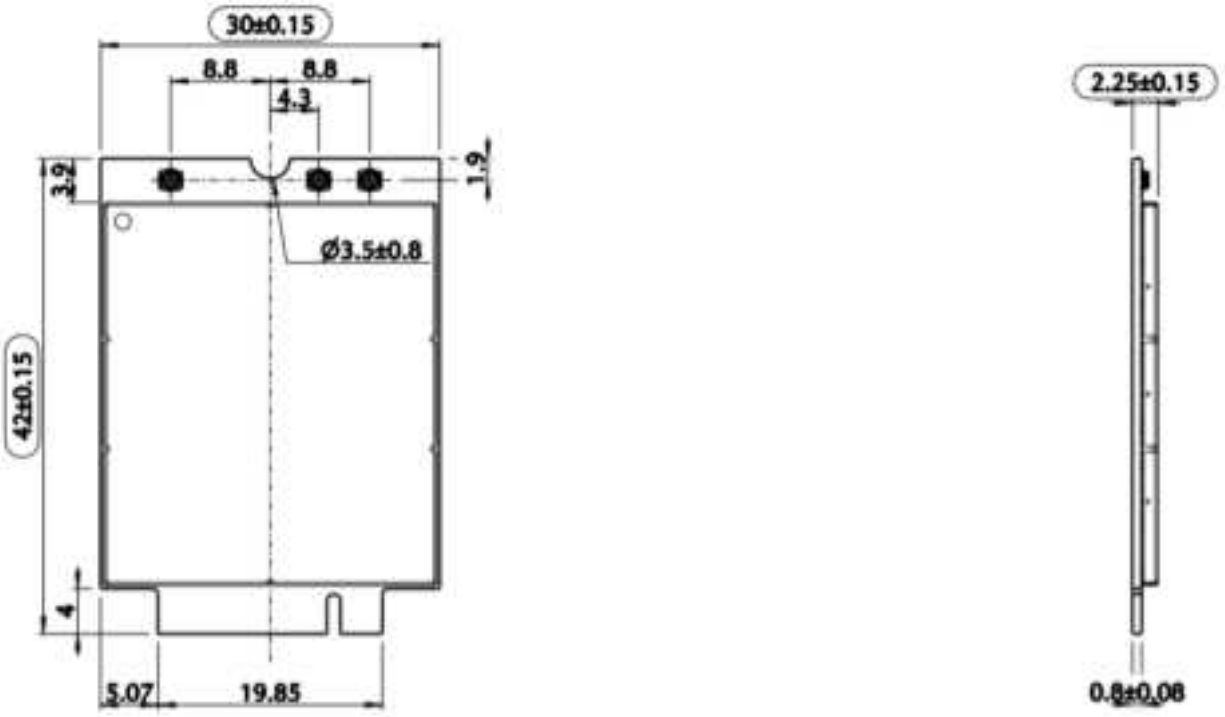

Figure 16: Mechanical Design Drawing

10. APPLICATION GUIDE

10.1. Debug of 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 capacitors value must be selected accordingly.

The capacitor will also prevent power supplies 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 into account that the capacitance mainly depends on the application board.

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

And if 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 application side according to the customer's requirement.

ESD rating on all pins of 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 on trays of 18 pieces each. These trays can be used in SMT processes for pick & place handling.

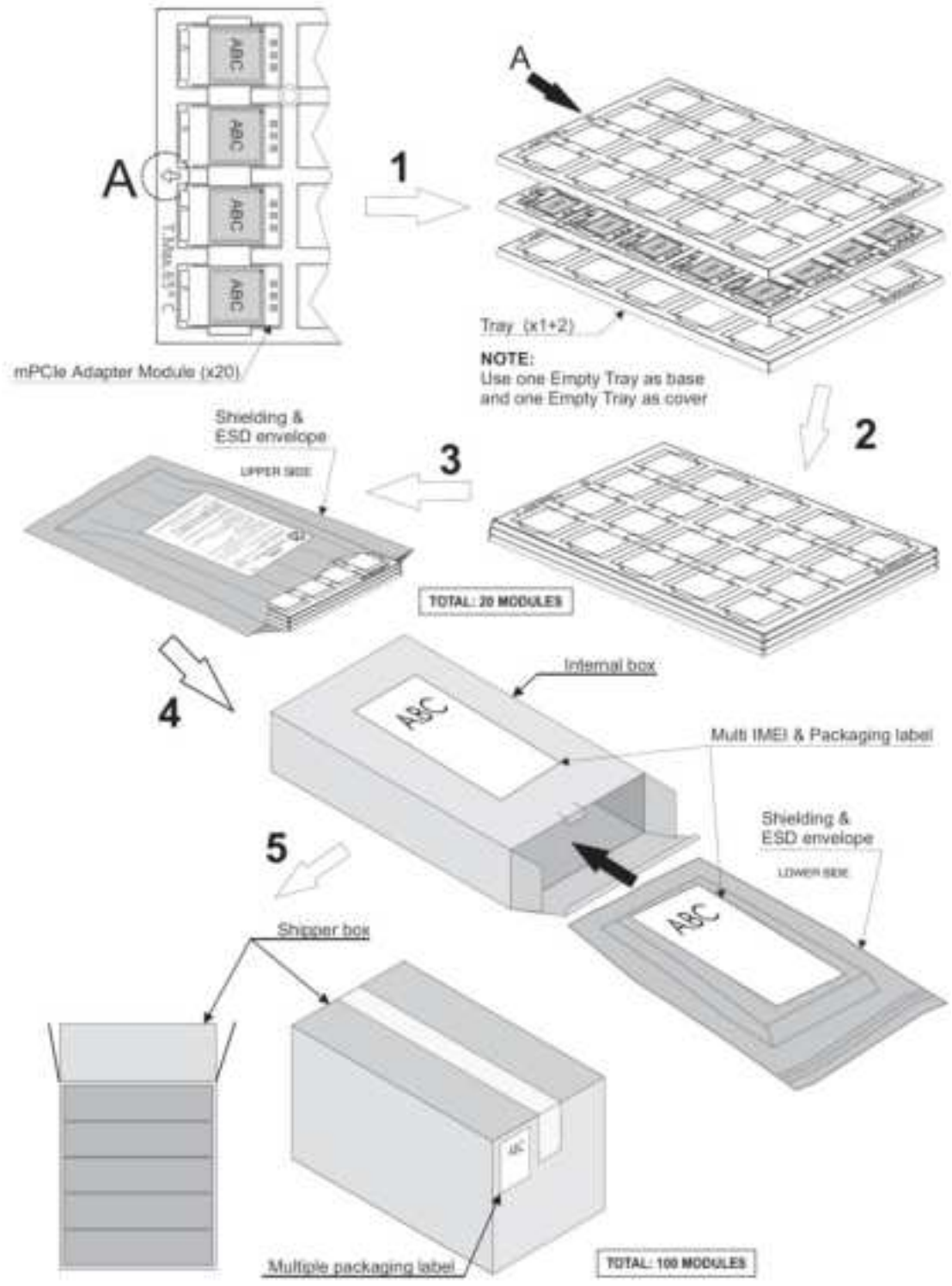

Figure 17: Tray Packaging

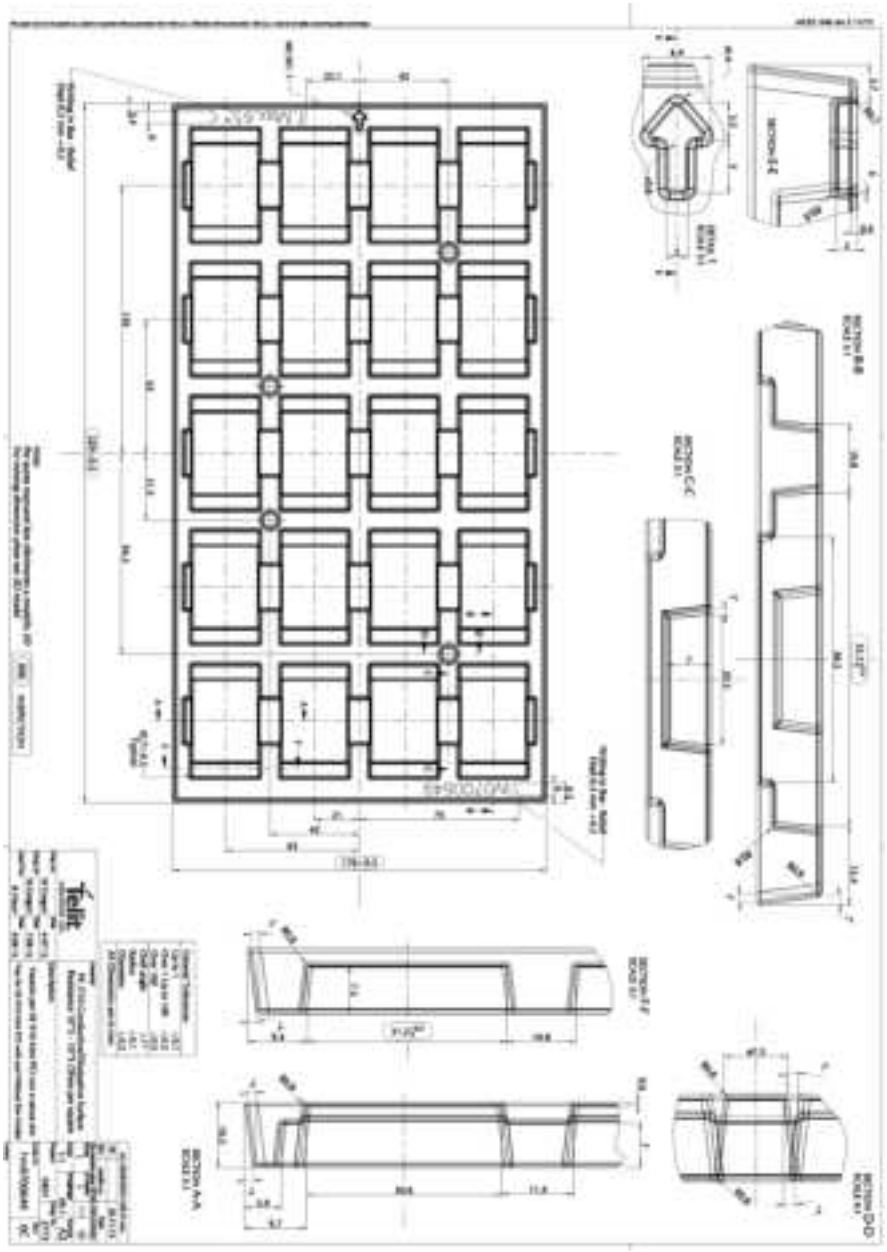

Figure 18: Tray Dimensions

12. CONFORMITY ASSESSMENT

12.1. Approvals Summary

Module	EU RED	US FCC	CA ISED	BR ANATEL	JP JRF&JTBL	CH CCC
LN920A12-WW	YES	YES	YES	TBD	YES	TBD
LN920A6-WW	YES	YES	YES	TBD	YES	TBD

Table 36: Approvals Summary

12.2. RED Approval

12.2.1. RED Declaration of Conformity

Hereby, Telit Communications S.p.A declares that the LN920A12-WW and LN920A6-WW Modules are in compliance with 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) can be found here:

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

12.2.2. 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.

Model	Antenna Type
LN920A12-WW	Monopole.
LN920A6-WW	

Table 37: RED Antenna Type

Max Gain for RED (dBi)		
Band	LN920A12-WW	LN920A6-WW
UMTS B1	11.85	11.85
UMTS B8	8.46	8.46
LTE B1	11.85	11.85

Max Gain for RED (dBi)		
LTE B3	11.35	11.35
LTE B7	11.96	11.96
LTE B8	8.46	8.46
LTE B20	8.22	8.22
LTE B28	7.48	7.48
LTE B38	11.96	11.96
LTE B40	11.96	11.96
LTE B42	11.96	11.96
LTE B43	11.96	11.96
ULCA_3C	11.35	11.35
ULCA_7C	11.96	11.96
ULCA_38C	11.96	11.96
ULCA_40C	11.96	11.96
ULCA_42C	11.96	11.96

Table 38: Max Gain for RED

12.3. FCC and ISED Approval/*FCC et ISDE Approbation*

12.3.1. FCC Certificate

The FCC Certifcate is available here:

https://www.fcc.gov/oet/ea/fccid

12.3.2. ISED Approval/*ISDE Approbation*

The ISED Certificate is available here /*Le certificat ISDE est disponible ici*:
https://smssgs.ic.gc.ca/equipmentSearch/searchRadioEquipments?execution=e1s1&lang=en

12.3.3. Applicable FCC and ISED Rules /*Liste des Règles FCC et ISDE Applicables*

Model *Modèle*	Applicable FCC Rules	Applicable ISED Rules *Règles ISDE applicables*
LN920A12-WW	47 CFR Part 2, 22, 24, 27, 90	RSS: 132 Issue3, 133 Issue 6, 130 Issue 2, 139 Issue 3; RSS-Gen Issue 5
LN920A6-WW		

Table 39: Applicable FCC and ISED Rules

12.3.4. FCC and ISED Regulatory Notices/*Avis Réglementaires de FCC et 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 Part 15 of the FCC Rules and 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 CNR d'Industrie Canada applicables aux appareils radio exempts de licence. 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.

Wireless notice / *Wireless avis*

This device complies with FCC/ISED radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the ISED radio frequency (RF) Exposure rules. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body.

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. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur. L'antenne doit être installée de façon à garder une distance minimale de 20 centimètres entre la source de rayonnements et votre corps.

CAN ICES-3 (B) / NMB-3 (B) (ISED only) / *(ISDE seulement)*

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

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

12.3.5. Antennas /Antennes

FCC

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

Model	Antenna Type
LN920A12-WW	Monopole. Dipole.
LN920A6-WW	

Table 40: FCC Antenna Type

Max Gain for FCC (dBi)		
Band	LN920A12-WW	LN920A6-WW
UMTS B2	8.50	8.50
UMTS B4	5.50	5.50
UMTS B5	9.92	9.92
LTE B2	9.50	9.50
LTE B4	6.50	6.50
LTE B5	10.91	10.91
LTE B7	9.50	9.50
LTE B12	10.19	10.19
LTE B13	10.67	10.67
LTE B14	10.71	10.71
LTE B17	10.22	10.22
LTE B25	9.50	9.50
LTE B26	10.91	10.91
LTE B26 Part 90	10.86	10.86

Max Gain for FCC (dBi)		
LTE B30	1.00	1.00
LTE B38	9.50	9.50
LTE B41	9.50	9.50
LTE B41 HPUE	6.50	6.50
LTE B48	1.00	1.00
LTE B66	6.50	6.50
LTE B71	9.98	9.98
LTE 5C	10.41	10.41
LTE 7C	9.00	9.00
LTE 38C	9.50	9.50
LTE 41C	9.00	9.00

Table 41: Max Gain for FCC (dBi)

ISED / ISDE

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

Le présent émetteur radio a été approuvé par ISDE pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Model *Modèle*	Antenna Type *Type d'Antenne*
LN920A12-WW	Monopole. Dipole.
LN920A6-WW	

Table 42: ISED Antenna Type

Gain maximum pour ISED (dBi) / *Gain maximum pour ISDE (dBi)*		
Band	LN920A12-WW	LN920A6-WW
UMTS B2	8.50	8.50
UMTS B4	5.50	5.50

Gain maximum pour ISED (dBi) / *Gain maximum pour ISDE (dBi)*		
UMTS B5	6.63	6.63
LTE B2	9.50	9.50
LTE B4	6.50	6.50
LTE B5	7.62	7.62
LTE B7	9.50	9.50
LTE B12	7.13	7.13
LTE B13	7.46	7.46
LTE B14	7.49	7.49
LTE B17	7.15	7.15
LTE B25	9.50	9.50
LTE B26	7.62	7.62
LTE B26 Part 90	7.59	7.59
LTE B30	1.00	1.00
LTE B38	9.50	9.50
LTE B41	9.50	9.50
LTE B41 HPUE	6.50	6.50
LTE B48	1.00	1.00
LTE B66	6.50	6.50
LTE B71	6.99	6.99
LTE 5C	7.12	7.12
LTE 7C	9.00	9.00
LTE 38C	9.50	9.50
LTE 41C	9.00	9.00

Table 43: Gain Maximum for ISED (dBi)

12.3.6. FCC Label and Compliance Information

The product has a FCC ID label on the device itself. Also, the OEM host end product manufacturer will be informed to display a label referring to the enclosed module The exterior label will read as follows: “Contains Transmitter Module FCC ID: RI7LN920” or “Contains FCC ID: RI7LN920” for LN920A12-WW and LN920A6-WW.

Below list of all the models and related FCC ID:

Model	FCC ID
LN920A12-WW	RI7LN920
LN920A6-WW	

Table 44: FCC ID

12.3.7. ISED Label and Compliance Information/*ISED Étiquette et Informations de Conformité*

The host product shall be properly labelled to identify the modules within the host product.

The ISED certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labelled to display the ISED certification number for the module, preceded by the word "contains" or similar wording expressing the same meaning, as follows:

Contains IC: 5131A-LN920

In this case, 5131A-LN920 is the module's certification number.

Le produit hôte devra être correctement étiqueté, de façon à permettre l'identification des modules qui s'y trouvent.

L'étiquette d'homologation d'un module d'ISDE devra être apposée sur le produit hôte à un endroit bien en vue, en tout temps. En l'absence d'étiquette, le produit hôte doit porter une étiquette sur laquelle figure le numéro d'homologation du module d'ISDE, précédé du mot « contient », ou d'une formulation similaire allant dans le même sens et qui va comme suit :

Contient IC : 5131A-LN920

Dans ce cas, 5131A-LN920 est le numéro d'homologation du module.

Model *Modèle*	ISED Certification Number *Num. de certification ISDE*
LN920A12-WW	5131A-LN920
LN920A6-WW	

Table 45: ISED Certification Number

12.3.8. Information on Test Modes and Additional Testing Requirements / *Informations sur les Modes de Test et les Exigences de Test Supplémentaires*

The module has been evaluated in mobile stand-alone conditions. For different operational conditions from 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 and IC RSS-102.

Le module a été évalué dans des conditions autonomes mobiles. Pour différentes conditions de fonctionnement d'un émetteur modulaire autonome dans un hôte (plusieurs modules émettant simultanément ou d'autres émetteurs dans un hôte), des tests supplémentaires peuvent être nécessaires (colocalisation, retesting…)

Si ce module est destiné à être utilisé dans un appareil portable, vous êtes responsable de l'approbation séparée pour satisfaire aux exigences SAR de la FCC Partie 2.1093 et IC RSS-102.

12.3.9. Fcc Additional Testing, Part 15 Subpart B Disclaimer

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to 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.

12.4. ANATEL Regulatory Notices

"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"

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
PCS 1900	1850.2 ~ 1909.8	1930.2 ~ 1989.8	512 ~ 810	80 MHz
DCS 1800	1710 ~ 1785	1805 ~ 1880	512 ~ 885	95 MHz
GSM 850	824.2 ~ 848.8	869.2 ~ 893.8	128 ~ 251	45 MHz
EGSM 900	890 ~ 915	935 ~ 960	0 ~ 124	45 MHz
	880 ~ 890	925 ~ 935	975 ~ 1023	45 MHz
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 1800 – B3	1710 ~ 1785	1805 ~ 1880	Tx: 937 ~ 1288 Rx: 1162 ~ 1513	95 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
TDSCDMA 2000 – B34	2010 ~ 2025	2010 ~ 2025	Tx: 10054 ~ 10121 Rx: 10054 ~ 10121	0 MHz
TDSCDMA 1900 – B39	1880 ~ 1920	1880 ~ 1920	Tx: 9404 ~ 9596 Rx: 9404 ~ 9596	0 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

Mode	Freq. Tx (MHz)	Freq. Rx (MHz)	Channels	Tx-Rx Offset
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 1800 – B9	1749.9 ~ 1784.9	1844.9 ~ 1879.9	Tx: 21800 ~ 2149 Rx: 3800 ~ 4149	95 MHz
LTE AWS+ – B10	1710 ~ 1770	2110 ~ 2170	Tx: 22150 ~ 22749 Rx: 4150 ~ 4749	400 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 700b – B17	704 ~ 716	734 ~ 746	Tx: 23730 ~ 23849 Rx: 5730 ~ 5849	30 MHz
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 1500 – B21	1447.9 ~ 1462.9	1495.9 ~ 1510.9	Tx: 24450 ~ 24599 Rx: 6450 ~ 6599	48 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 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

Table 46: 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
DAC	Digital – Analog Converter
DTE	Data Terminal Equipment
ESR	Equivalent Series Resistance
GPIO	General Purpose Input Output
HS	High Speed
HSDPA	High Speed Downlink Packet Access
HSIC	High Speed Inter Chip
HSUPA	High Speed Uplink Packet Access
I/O	Input Output
MISO	Master Input – Slave Output
MOSI	Master Output – Slave Input
MRDY	Master Ready
PCB	Printed Circuit Board
RTC	Real Time Clock
SIM	Subscriber Identification Module
SPI	Serial Peripheral Interface
SRDY	Slave Ready
TTSC	Telit Technical Support Centre
UART	Universal Asynchronous Receiver Transmitter
UMTS	Universal Mobile Telecommunication System
USB	Universal Serial Bus
VNA	Vector Network Analyzer
VSWR	Voltage Standing Wave Radio
WCDMA	Wideband Code Division Multiple Access

16. DOCUMENT HISTORY

Revision	Date	Changes
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 Commumication Port Table. Removed Table 27: GNSS Signal Pin-out
6	2022-02-09	Added to 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

From Mod.0818 rev.2

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