



LN920

HW Design Guide

Preliminary

1VV0301730 Rev. 1 – 2021-08-11

APPLICABILITY TABLE

PRODUCTS	PART NUMBER
LN920A12-WW	LN920A12xxx
LN920A6-WW	LN920A6xxx

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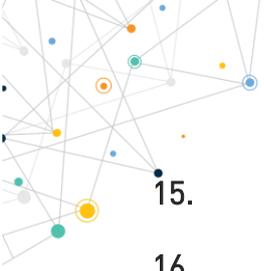
CONTENTS

APPLICABILITY TABLE	2
CONTENTS	3
1. INTRODUCTION	8
1.1. Scope	8
1.2. Audience	8
1.3. Contact Information, Support	8
1.4. Symbol Conventions	10
1.5. Related Documents	10
2. GENERAL PRODUCT DESCRIPTION	11
2.1. Overview	11
2.2. Product Variants and Frequency Bands	11
2.3. Main Features	11
2.3.1. Configuration Pins	12
2.4. Block Diagram	14
2.5. Transmit Output Power	14
2.6. RX Sensitivity	14
2.7. Supported Carrier Aggregation combinations	18
2.7.1. Two Carrier Aggregation combinations (LN920A6-WW + LN920A12-WW)	18
2.7.2. Three Carrier Aggregation combinations (LN920A12-WW)	18
2.8. Mechanical Specifications	20
2.8.1. Dimensions	20
2.8.2. Weight	20
2.9. Environmental Requirements	20
2.9.1. Temperature Range	20
2.9.2. RoHS Compliance	21
3. PINS ALLOCATION	22
3.1. Pin-out	22
3.2. LN920 Signals for debugging purposes	26
3.3. Pin Layout	27

4.	POWER SUPPLY	28
4.1.	Power Supply Requirements	28
4.2.	Power Consumption	28
4.2.1.	Idle Mode	29
4.2.2.	LN920 Connected Mode Current Consumption	29
4.3.	General Design Rules	30
4.3.1.	Electrical Design Guidelines	30
4.3.1.1.	+5V Source Power Supply Design Guidelines	30
4.3.2.	Thermal Design Guidelines	31
4.3.3.	Power Supply PCB Layout Guidelines	32
4.4.	RTC (Real Time Clock)	33
5.	ELECTRICAL SPECIFICATIONS	34
5.1.	Absolute Maximum Ratings – Not Optional	34
5.2.	Recommended Operating Conditions	34
6.	DIGITAL SECTION	35
6.1.	Logic Levels	36
6.2.	Power On	37
6.2.1.	Initialization and Activation State	37
6.3.	Power Off	38
6.3.1.	Graceful Shutdown	39
6.3.2.	Fast Shutdown	39
6.4.	RESET	41
6.4.1.	Unconditional Hardware Reset	41
6.5.	Communication Ports	42
6.5.1.	USB Interface	42
6.5.2.	SIM Interface	44
6.5.2.1.	SIM Schematic Example	45
6.5.3.	Control Signals	45
6.5.4.	General Purpose I/O	46
6.5.4.1.	Using a GPIO as INPUT	47
6.5.4.2.	Using a GPIO as OUTPUT	47
6.6.	I2C – Inter-integrated circuit	48

7.	RF SECTION	49
7.1.	Bands Variants	49
7.2.	TX Output Power	49
7.3.	RX Sensitivity	49
7.4.	Antenna Requirements	50
7.4.1.	Antenna Configuration	51
7.4.2.	Antenna Connector	53
7.4.2.1.	Antenna Cable	54
7.4.2.2.	Antenna Installation Guidelines	54
8.	GNSS SECTION	56
8.1.	GNSS Signals Pin-out	56
8.2.	RF Front End Design	56
8.2.1.	Guidelines of PCB Line for GNSS Antenna	56
8.2.2.	Hardware-Based Solution for GNSS and LTE Coexistence	57
8.3.	GNSS Antenna Requirements	58
8.3.1.	GNSS Antenna Specifications	58
8.3.2.	GNSS Antenna – Installation Guidelines	58
8.4.	GNSS Characteristics	58
9.	MECHANICAL DESIGN	60
9.1.	General	60
9.2.	Drawing	60
10.	APPLICATION GUIDE	61
10.1.	Debug of the LN920 Module in Production	61
10.2.	Bypass Capacitor on Power Supplies	61
10.3.	EMC Recommendations	62
11.	PACKAGING	63
11.1.	Tray	63
12.	CONFORMITY ASSESTMENT	65
12.1.	Approvals Summary	65
12.2.	RED Approval	65
12.2.1.	RED Declaration of Conformity	65

12.2.2.	Antennas	65
12.3.	FCC and ISED Approval/ <i>FCC et ISDE Approbation</i>	66
12.3.1.	FCC Certificate	66
12.3.2.	ISED Approval/ <i>ISDE Approbation</i>	66
12.3.3.	Applicable FCC and ISED Rules / <i>Liste des Règles FCC et ISDE Applicables</i>	66
12.3.4.	FCC and ISED Regulatory Notices/ <i>Avis Réglementaires de FCC et ISDE</i>	66
12.3.5.	Antennas /Antennes	68
12.3.6.	FCC Label and Compliance Information	70
12.3.7.	ISED Label and Compliance Information/ <i>ISED Étiquette et Informations de Conformité</i>	70
12.3.8.	Information on Test Modes and Additional Testing Requirements / <i>Informations sur les Modes de Test et les Exigences de Test Supplémentaires</i>	71
12.3.9.	Fcc Additional Testing, Part 15 Subpart B Disclaimer	72
12.4.	ANATEL Regulatory Notices	72
12.5.	RoHS and REACH Info	72
12.5.1.	RoHS Info	72
12.5.2.	REACH Info	72
13.	REFERENCE TABLE OF RF BANDS CHARACTERISTICS	73
14.	PRODUCT AND SAFETY INFORMATION	75
14.1.	Copyrights and Other Notices	75
14.1.1.	Copyrights	75
14.1.2.	Computer Software Copyrights	75
14.2.	Usage and Disclosure Restrictions	76
14.2.1.	License Agreements	76
14.2.2.	Copyrighted Materials	76
14.2.3.	High Risk Materials	76
14.2.4.	Trademarks	77
14.2.5.	3rd Party Rights	77
14.2.6.	Waiver of Liability	77
14.3.	Safety Recommendations	78



15.	GLOSSARY	79
16.	DOCUMENT HISTORY	80

Preliminary

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.

Preliminary

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, TBD
- LN920 AT Commands Reference Guide, TBD
- LN920 Interface Board HW User Guide, TBD
- Generic EVB HW User Guide, 1VW0301249

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	1,2,4,5,8,9,19	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	<ul style="list-style-type: none"> • M.2 Type 3042-S2-B
Modem	<ul style="list-style-type: none"> • Cellular modem for data communication <ul style="list-style-type: none"> ○ 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	<ul style="list-style-type: none"> • Support for GPS, GLONASS, BeiDou and Galileo
Application processor	<ul style="list-style-type: none"> • Cortex-A7 up to 1.28 GHz with 256 KB L2 cache

Function	Features
	<ul style="list-style-type: none"> 4Gb : x8 NAND with 2Gb : x32 LPDDR2 533MHz, 4bit ECC 4K page
Interfaces	<ul style="list-style-type: none"> USB 2.0/3.0 – USB port is typically used for: <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> M.2 Form factor (30 * 42 * 2.3 mm), supporting multiple RF bands
Environment and quality requirements	<ul style="list-style-type: none"> The device is designed and qualified by Telit to satisfy environmental and quality requirements.
Single supply module	<ul style="list-style-type: none"> The module internally generates all its required internal supply voltages.
RTC	<ul style="list-style-type: none"> Real-time clock is supported
Operating temperature	<ul style="list-style-type: none"> 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.

Preliminary

2.4. Block Diagram

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

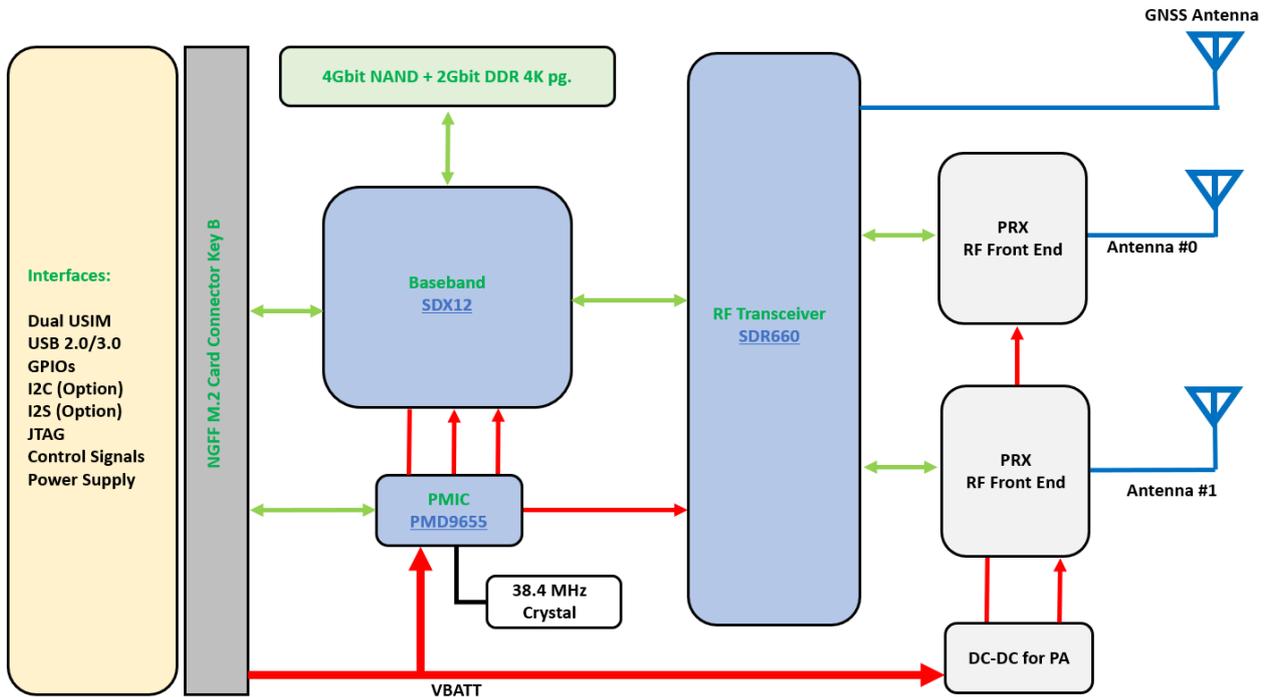


Figure 1: LN920 Block Diagram

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

Table 6: Transmission Output Power

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	TBD
	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 B8		
WCDMA B9		
WCDMA B19		
LN920A6-WW	LTE FDD B1	TBD
	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	

Product	Band	Sensitivity (dBm)
	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 B8	
	WCDMA B9	
	WCDMA B19	

Table 8: Product Sensitivity

Band	REFsens (dBm) Typical	3GPP REFsens (dBm)*/**
LTE Band1	TBD	-100.0
LTE Band2	TBD	-98.0
LTE Band3	TBD	-97.0
LTE Band4	TBD	-100.0
LTE Band5	TBD	-95.0
LTE Band7	TBD	-95.0
LTE Band8	TBD	-94.0
LTE Band12	TBD	-94.0
LTE Band13	TBD	-94.0
LTE Band14	TBD	-94.0
LTE Band17	TBD	-94.0
LTE Band18	TBD	-97.0
LTE Band19	TBD	-97.0
LTE Band20	TBD	-94.0
LTE Band25	TBD	-93.5

Band	REFsens (dBm) Typical	3GPP REFsens (dBm)*/**
LTE Band26	TBD	-94.5
LTE Band28	TBD	-95.5
LTE Band29	TBD	-
LTE Band30	TBD	-96.0
LTE Band38	TBD	-97.0
LTE Band39	TBD	-97.0
LTE Band40	TBD	-97.0
LTE Band41	TBD	-95.0
LTE Band42	TBD	-96.0
LTE Band43	TBD	-96.0
LTE Band48	TBD	-96.0
LTE Band66	TBD	-96.5
LTE Band71	TBD	-94.2

Table 9: Reception Sensitivity LN920A6-WW, LN920A12-WW

*3GPP TS 36.521-1 Release 16 Table 7.3.3-1 Reference sensitivity QPSK $P_{REFSENS}$, 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	TBD	-106.7
WCDMA Band2	TBD	-104.7
WCDMA Band4	TBD	-106.7
WCDMA Band5	TBD	-104.7
WCDMA Band8	TBD	-103.7
WCDMA Band9	TBD	-105.7
WCDMA Band19	TBD	-106.7

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-40A, 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_18A-28A, 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_2A-7A, CA_2C, CA_20A-38A, CA_20A-40A, CA_20A-42A, CA_25A-25A, CA_25A-26A, CA_25A-41A, 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-29A, 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-18A-28A, 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-40A, 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-7A, CA_1A-7A-8A, CA_1A-7C, CA_1A-8A-40A, 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-4A-7A, CA_2A-5A-12A, CA_2A-5A-29A, 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-7A-12A, CA_2A-7A-66A, CA_2A-7A-7A, 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_25A-25A-41A, CA_25A-26A-41A, CA_25A-41A-41A, CA_25A-41C, 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_30A-66A-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-38A, 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-30A, CA_4A-4A-5A, CA_4A-4A-71A, CA_4A-4A-7A, CA_4A-5A-29A

3xCA Combinations (LN920A12-WW)

CA_4A-5A-30A, CA_4A-5B, CA_4A-7A-12A, CA_4A-7A-7A, 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-12B, CA_5A-29A-30A, 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-38A, CA_7A-20A-42A, CA_7A-66A-66A, CA_7A-7A-8A, CA_8A-39C, CA_8A-40C, CA_8A-41C, CA_8A-42C

Preliminary

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 **TBD** grams.

The nominal weight of the LN920A6-WW is **TBD** 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).

Preliminary

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#	0	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	0	TBD	1.8V	
67	RESET#	I	Reset Input	1.8V	Active Low Internal PU
DIGITAL IO					
38	GPI011	I/O	General Purpose I/O	1.8V	
Audio					
20	SCK_GPI05	I/O	I2S_CLK Can be configured as GPI05	1.8V	
22	DIN_GPI06	I	I2S_DIN Can be configured as GPI06	1.8V	
24	DOUT_GPI07	0	I2S_DOUT Can be configured as GPI07	1.8V	
28	WS_GPI08	I/O	I2S_WS Can be configured as GPI08	1.8V	
I2C Interface					
56	SDA_GPI09	I/O	I2C Data Can be configured as GPI09	1.8V	
58	SCL_GPI010	0	I2C Clock Can be GPI010	1.8V	
Antenna Control					
59	ANTCTL0_GPI01	I/O	Antenna control0 Can be configured as GPI01	1.8V	
61	ANTCTL1_GPI02	I/O	Antenna control1 Can be configured as GPI02	1.8V	
63	ANTCTL2_GPI03	I/O	Antenna control2 Can be configured as GPI03	1.8V	
65	ANTCTL3_GPI04	I/O	Antenna control3 Can be configured as GPI04	1.8V	
Power Supply					

Pin	Signal	I/O	Function	Type	Comment
2	VPH_PWR	I	Power supply	Power	
4	VPH_PWR	I	Power supply	Power	
70	VPH_PWR	I	Power supply	Power	
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	-	-	-	

Pin	Signal	I/O	Function	Type	Comment
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

LN920 Pin Layout

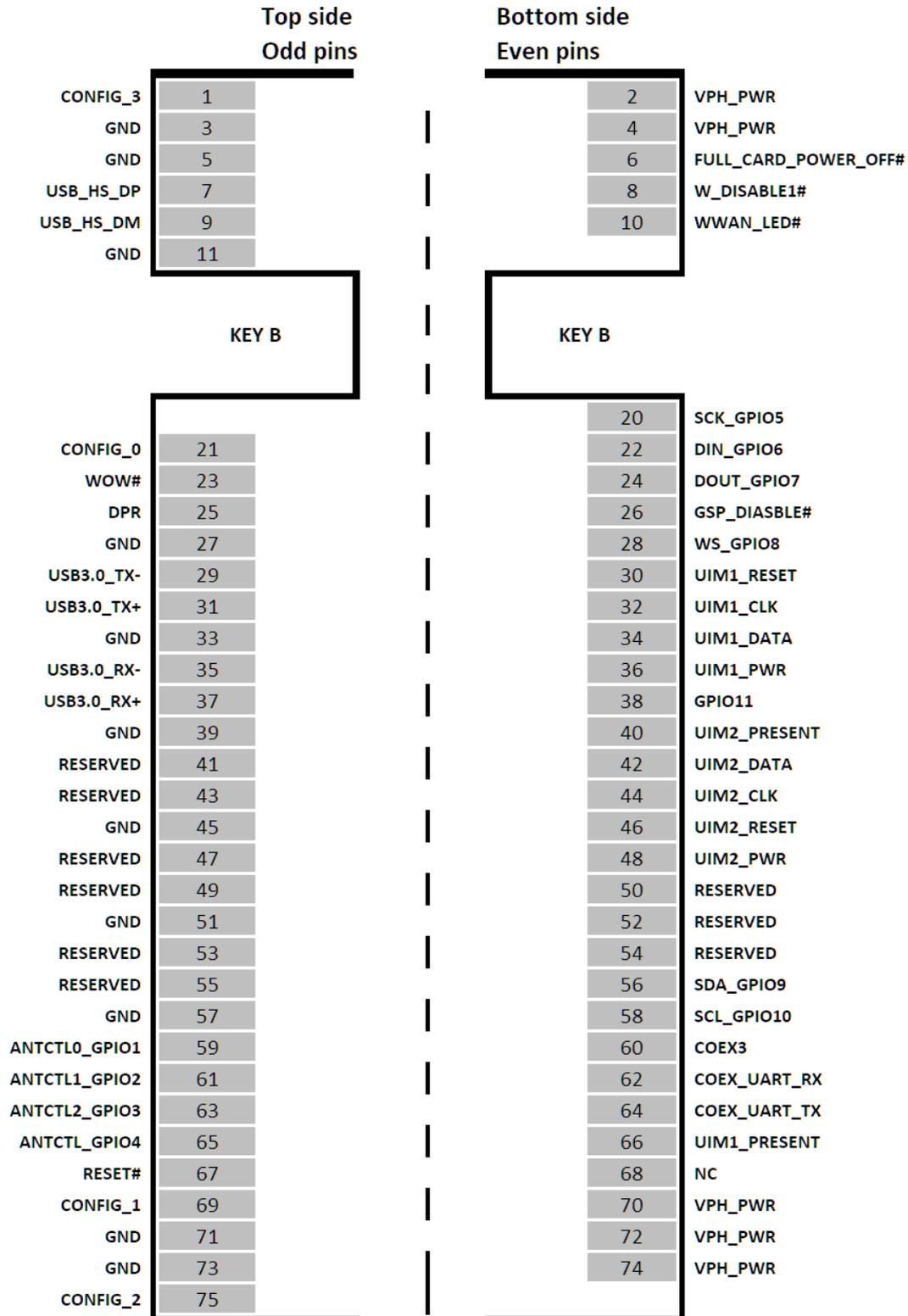


Figure 2: LN920 Pin-out

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 $V_{BATT_{min}}$ 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	Measure (Typical)			Mode Description
	WCDMA (mA)	LTE (mA)	2G (MA)	
IDLE mode				
AT+CFUN=1				Normal mode: full functionality of the module
AT+CFUN=4				Disabled TX and RX; module is not registered on the network
AT+CFUN=5				Paging cycle #256 frames (2.56s DRx cycle)
				81.92s eDRx cycle length (PTW=2.56s, DRX=1.28s)
				327.68s eDRx cycle length (PTW=2.56s, DRX=1.28s)
				655.36s eDRx cycle length (PTW=2.56s, DRX=1.28s)
				1310.72s eDRx cycle length (PTW=2.56s, DRX=1.28s)
				2621.44s eDRx cycle length (PTW=2.56s, DRX=1.28s)
				Paging Multiframe 9
PSM mode	Typical (mA)			
AT+CPSMS=1				No current source or sink by any connected pin

Table 15: Idle and PSM Mode

¹PSM in between eDRX

Mode		Measure* (Typical)	Mode Description
		(mA)	
GPS			
Active State (GNSS ON, CFUN=4)	Acquisition		GPS+GLO, DPO off
	Navigation		GPS+GLO, DPO on DWELL=280ms
			GPS+GLO, DPO off
Active State (GNSS ON, CFUN=5 eDRX)	Acquisition		GPS+GLO, DPO off
	Navigation		GPS+GLO, DPO on DWELL=280ms
		54	GPS+GLO, DPO off

Table 16: GPS Mode

*reference signal @-130 dbm with static scenario

4.2.2. LN920 Connected Mode Current Consumption

Mode	Measure (Typical)		Mode Description
	Average (mA)	Peak (mA)	
Connected mode			

Mode	Measure (Typical)		Mode Description
WCDMA			
LTE			

Table 17: 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 100 μ F 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.

Preliminary

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]

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]

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:** V_{batt} 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	TBD	TBD
Operating Range - Interface levels (1.8V CMOS)		
Input high level	TBD	TBD
Input low level	TBD	TBD
Output high level	TBD	TBD
Output low level	TBD	TBD

Table 18: Logic Levels Minimum and Maximum

Parameter	AVG
Current characteristics:	
Output Current	TBD
Input Current	TBD

Table 19: Logic Levels Average

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 μ A
High-level input leakage current	-20 μ A	20 μ A
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 μ A
High-level input leakage current	-20 μ A	20 μ A

6.2. Power On

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

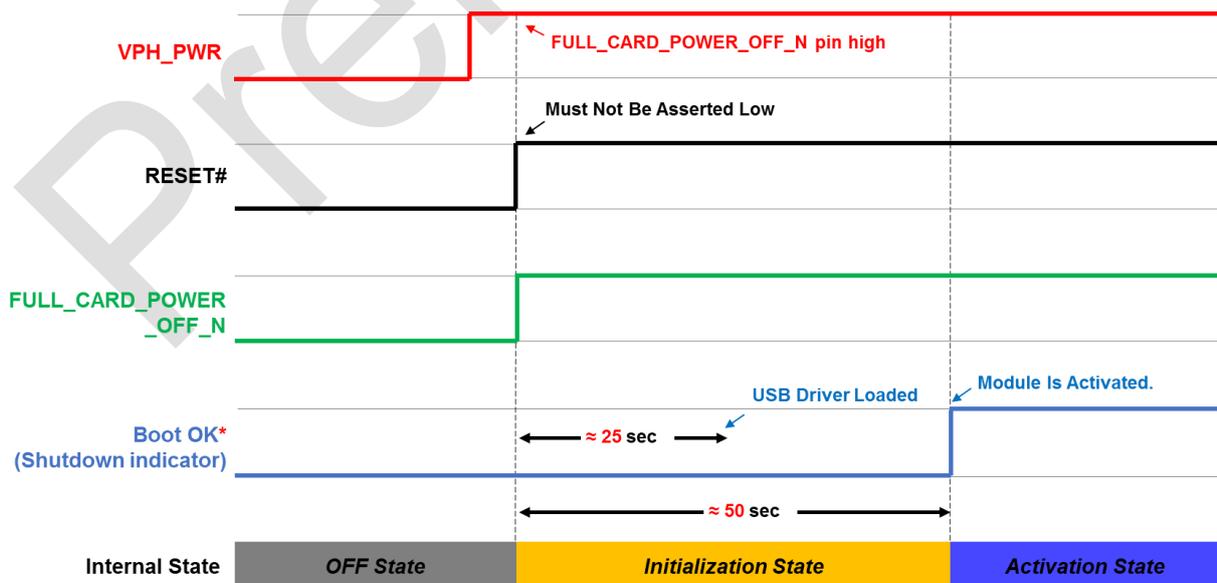


Note/Tip: To turn on the LN920 module, the RESET# pin must not be asserted to low.

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.



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 chapter 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

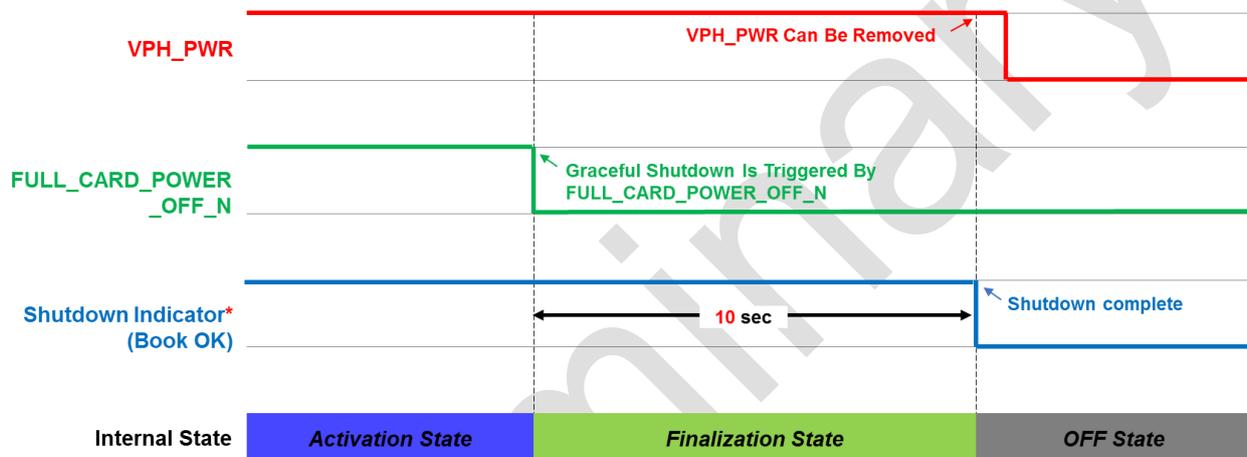
To safely power off the LN920 module, the host can use the graceful shutdown function.

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.



* 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 chapter.

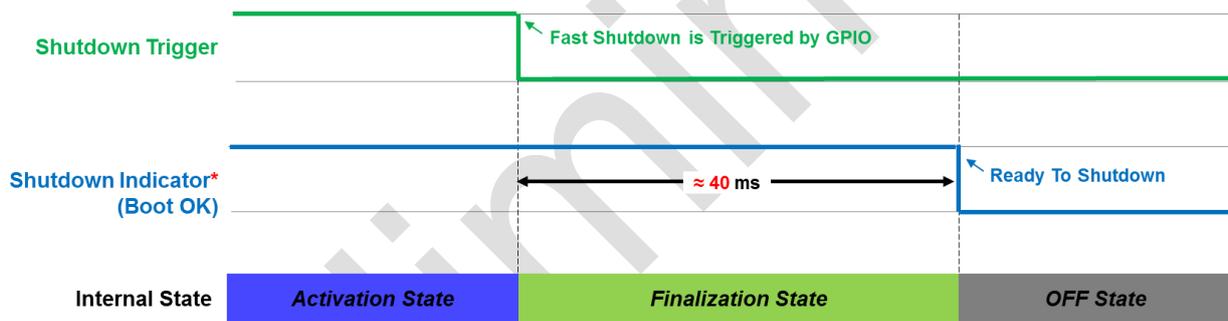
Refer to the AT Reference guide document for more details about AT#SHDNIND.

** 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



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

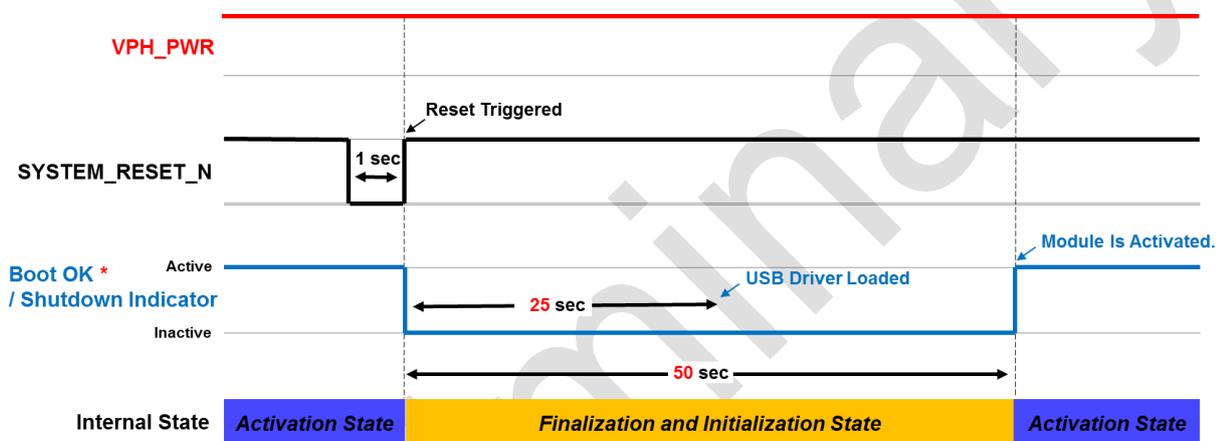
Device reset can be triggered by Unconditional reset using the RESET#.

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.



* 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.



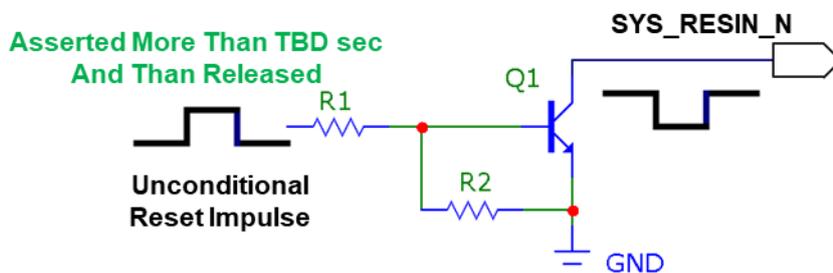
Note: Unconditional Hardware Reset must be used only as an emergency procedure, not as a normal power-off operation.



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.



6.5. Communication Ports

Below table summarizes all the hardware interfaces available of the LN920 module.

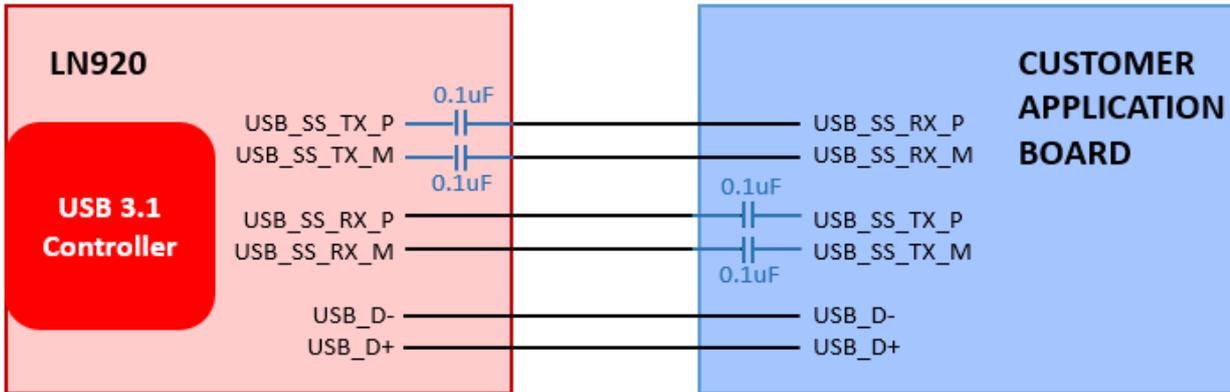
Interface	LN920
USB	Super-speed USB 3.0 with high-speed USB 2.0
USIM	X2, dual voltage each (1.8V/2.85V)
Control Signals	W_DISABLE1#, GPS_DISABLE#, WOW#, WWAN_LED#
I2S	I2S
Antenna ports	2 for Cellular, 1 for GNSS
TBD	

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.



***CUSTOMER : Need series capacitors (0.1uF) on USB_SS_RX_P/M**



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 20: Available Signals



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

6.5.2. SIM Interface

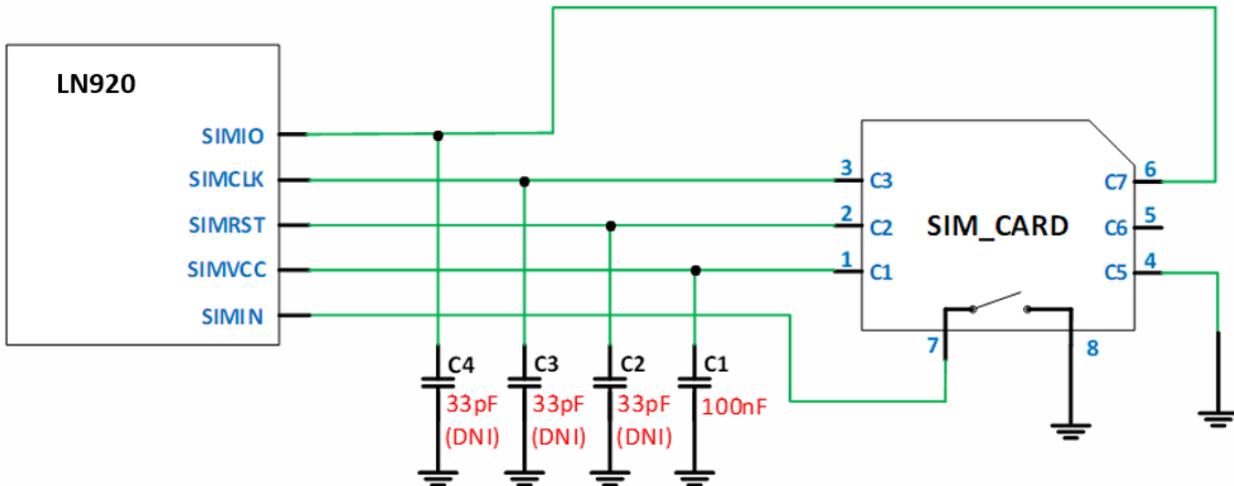
The LN920 supports two external SIM interfaces (1.8V or 2.85V).

PIN	Signal	I/O	Function	Type
SIM Card Interface 1				
36	UIM1_PWR	0	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	0	Clock output to an external UIM1 card	1.85 / 2.85V
30	UIM1_RESET	0	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	0	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	0	Clock output to an external UIM2 card	1.85 / 2.85V
46	UIM2_RESET	0	Reset output to an external UIM2 card	1.85 / 2.85V

40	UIM2_PRESENT	I	SIM2 detect signal	1.8V
----	--------------	---	--------------------	------

6.5.2.1. SIM Schematic Example

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



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

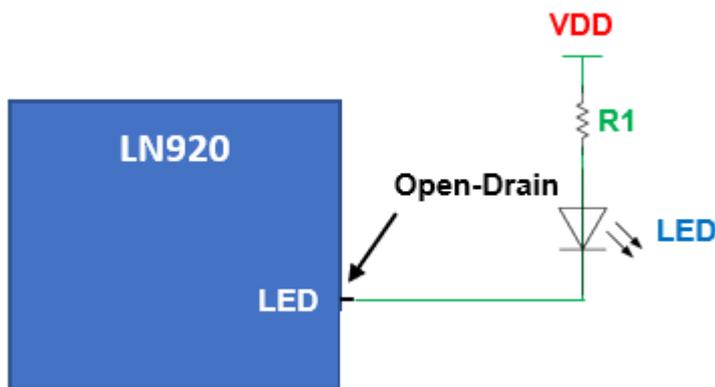
The LN920 supports the following control signals:

- 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#	0	Wake the platform by the WWAN device	Open-drain	
10	WWAN_LED#	0	LED control	Open-drain	

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



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	GPI01	I/O	Can be ANTCTL0	1.8V	
61	GPI02	I/O	Can be ANTCTL1	1.8V	
63	GPI03	I/O	Can be ANTCTL2	1.8V	
65	GPI04	I/O	Can be ANTCTL3	1.8V	
20	GPI05	I/O	Can be I2S_CLK	1.8V	
22	GPI06	I/O	Can be I2S_DIN	1.8V	
24	GPI07	I/O	Can be I2S_DOUT	1.8V	
28	GPI08	I/O	Can be I2S_WS	1.8V	
56	GPI09	I/O	Can be I2C_SDA	1.8V	
58	GPI010	I/O	Can be I2C_SCL	1.8V	

Table 21: 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.

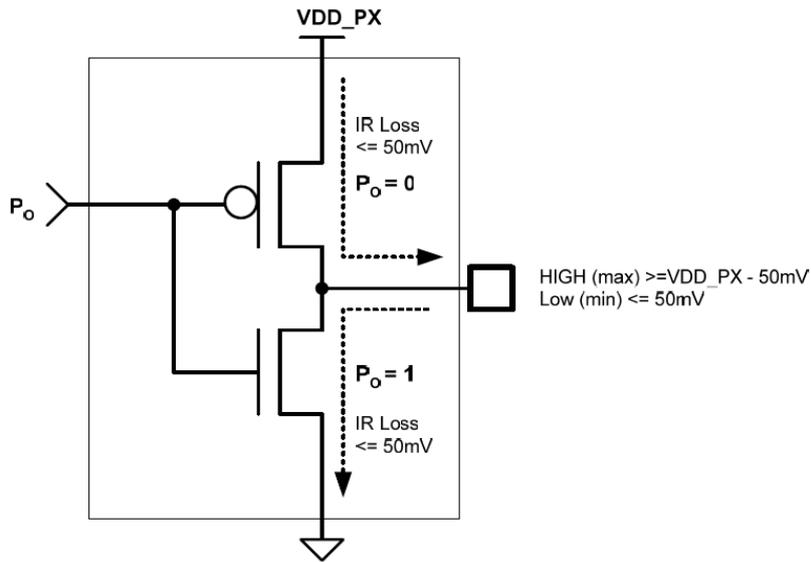


Note: In order to avoid a back powering effect, it is recommended to prevent any HIGH logic level signal from being applied to the digital pins of the LN920 when the module is powered off or during an ON/OFF transition. Refer to LN920 AT command reference guide for GPIO pins configuration.

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



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	0	I2C Clock	CMOS 1.8V	

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	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
LN920A6-WW	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

Table 22: Bands Variant

7.2. TX Output Power

Band	Mode	Class	RF power (dBm)
All bands	LTE	3	23 (+-2 dB)
Band41	(LTE) HPUE	4	26 (+-2 dB)
All bands	WCDMA	3	23 (+-2 dB)

Table 23: 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 24: RX Sensitivity Measurement Setup

LN920A12-WW

MODE / Band	REFsens (dBm)	3GPP REFsens (dBm)
LTE / Band1	TBD	-100.0
LTE / Band2	TBD	-98.0
LTE / Band3	TBD	-97.0
LTE / Band4	TBD	-100.0
LTE / Band5	TBD	-95.0

MODE / Band	REFsens (dBm)	3GPP REFsens (dBm)
LTE / Band7	TBD	-95.0
LTE / Band8	TBD	-94.0
LTE / Band12	TBD	-94.0
LTE / Band13	TBD	-94.0
LTE / Band14	TBD	-94.0
LTE / Band17	TBD	-94.0
LTE / Band18	TBD	-97.0
LTE / Band19	TBD	-97.0
LTE / Band20	TBD	-94.0
LTE / Band25	TBD	-93.5
LTE / Band26	TBD	-94.5
LTE / Band28	TBD	-95.5
LTE / Band29	TBD	-
LTE / Band30	TBD	-96.0
LTE / Band38	TBD	-97.0
LTE / Band39	TBD	-97.0
LTE / Band40	TBD	-97.0
LTE / Band41	TBD	-95.0
LTE / Band42	TBD	-96.0
LTE / Band43	TBD	-96.0
LTE / Band48	TBD	-96.0
LTE / Band66	TBD	-96.5
LTE / Band71	TBD	-94.2

Table 25: RX sensitivity LN920A12-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 26: 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 connectors position on the modem board.

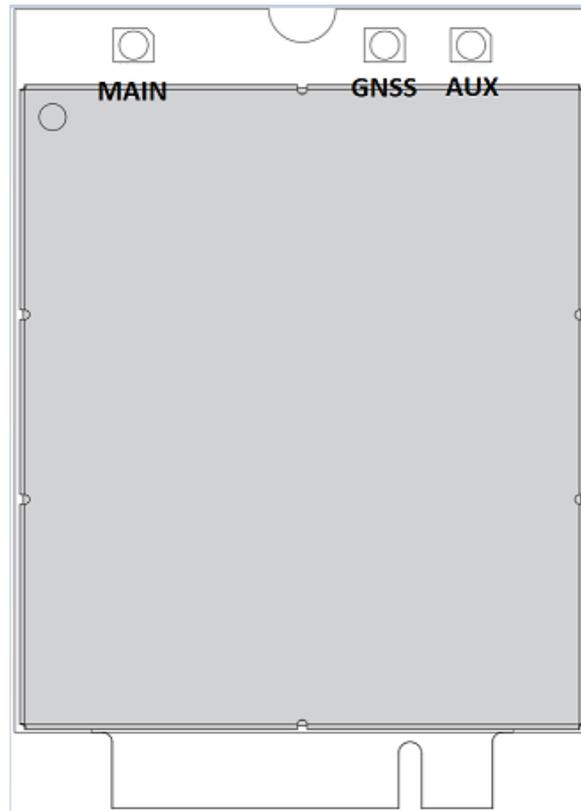


Figure 3: Antenna Configuration

Refer to the following antenna configuration assigned.

Antenna port	Technology	Tx	Rx	GNSS
MAIN	WCDMA	B1, B2, B4, B5, B8, B9, B19	B1, B2, B4, B5, 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, 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

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>

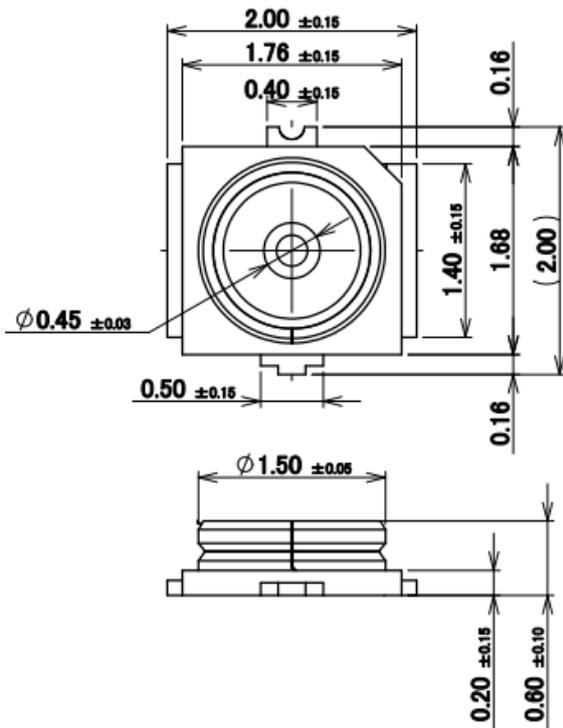
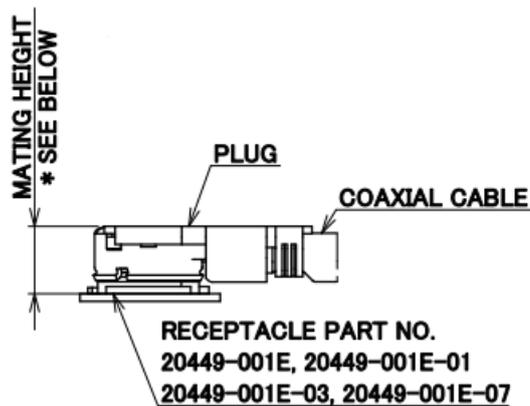


Figure 4: MHF-4 RF connector



- * MATING HEIGHT
- 1.2 MAX. WITH 20611-001R, 20572-001R-08,
20448-00*R-081, 20448-001R-081E
- 1.4 MAX. WITH 20565-001R-**
- 1.7 MAX. WITH 20632-001R-37

MATING CONDITION
WITH MHF 4/MHF 4L PLUG


 Figure 5: 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 27: 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 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. GNSS Signals Pin-out

Pin	Signal	I/O	Function	Type

Table 28: GNSS Signals Pin-out

8.2. 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.

8.2.1. 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.

8.2.2. 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.

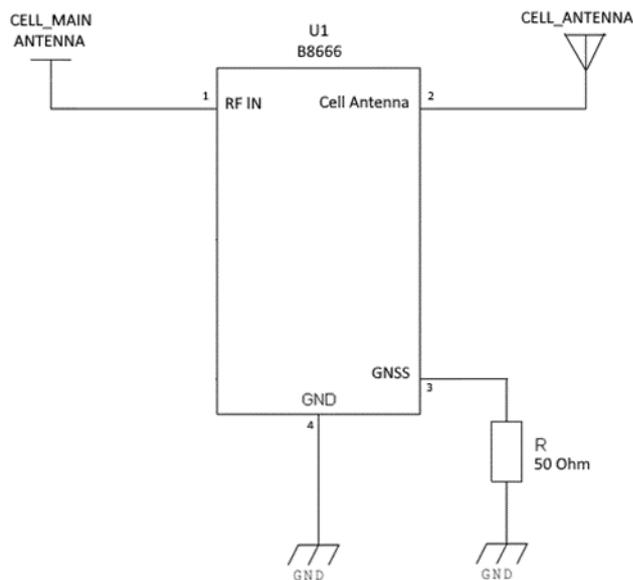


Figure 6: Reference schematic

8.3. GNSS Antenna Requirements

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

8.3.1. 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 29: 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.

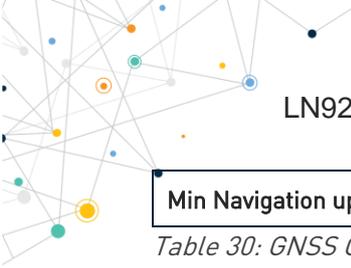
8.3.2. GNSS Antenna – Installation Guidelines

- 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.

8.4. GNSS Characteristics

The table below specifies the GNSS characteristics and expected performance.

Parameters		Typical Measurement
Sensitivity	Tracking Sensitivity	TBD
	Navigation	TBD
	Cold Start	TBD



Min Navigation update rate		1Hz
----------------------------	--	-----

Table 30: GNSS Characteristics

Preliminary

9. MECHANICAL DESIGN

9.1. General

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

9.2. Drawing

TBD

Figure 7: Mechanical Design Drawing

Preliminary

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 **TBD** pieces each. These trays can be used in SMT processes for pick & place handling.

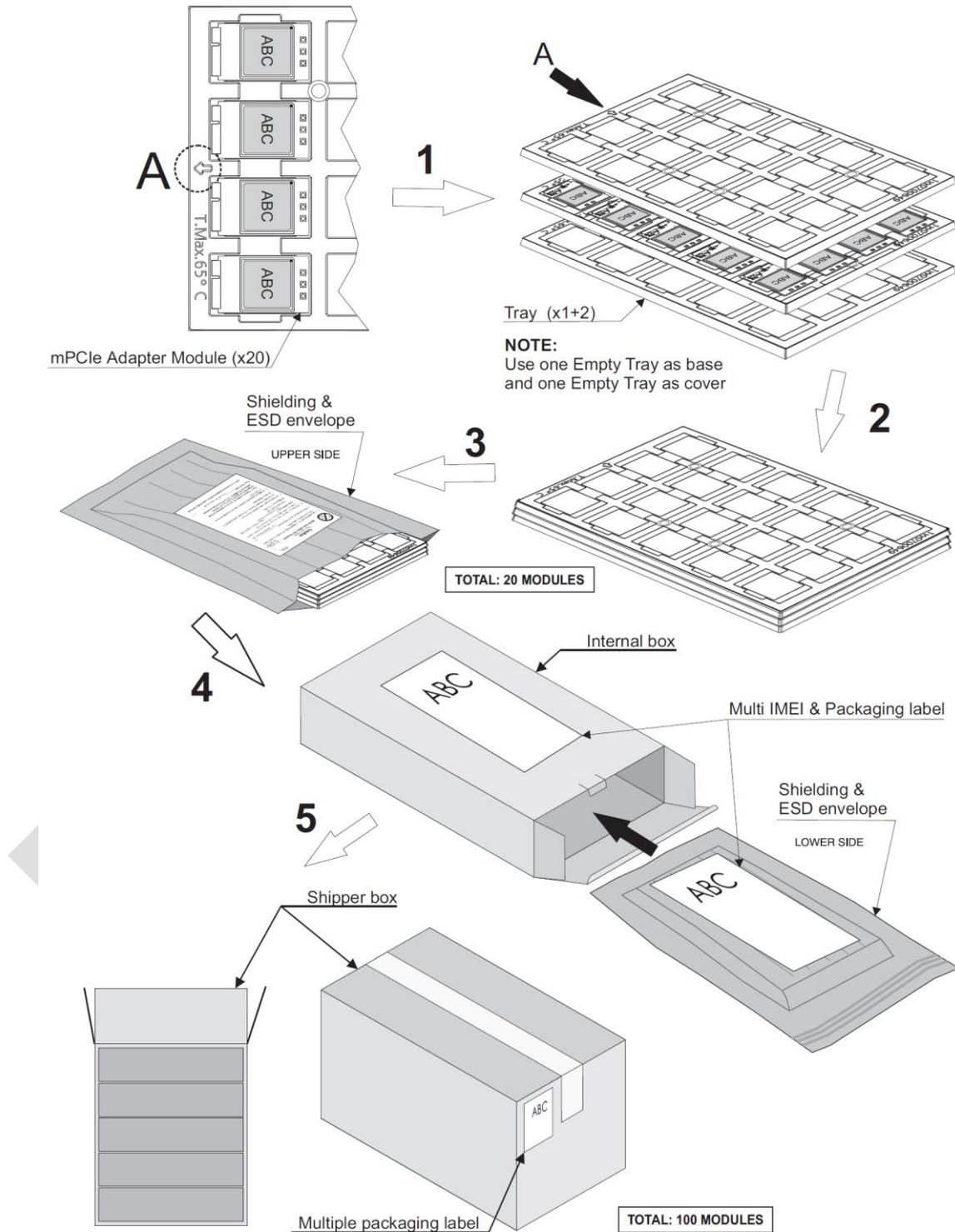


Figure 8: Tray Packaging

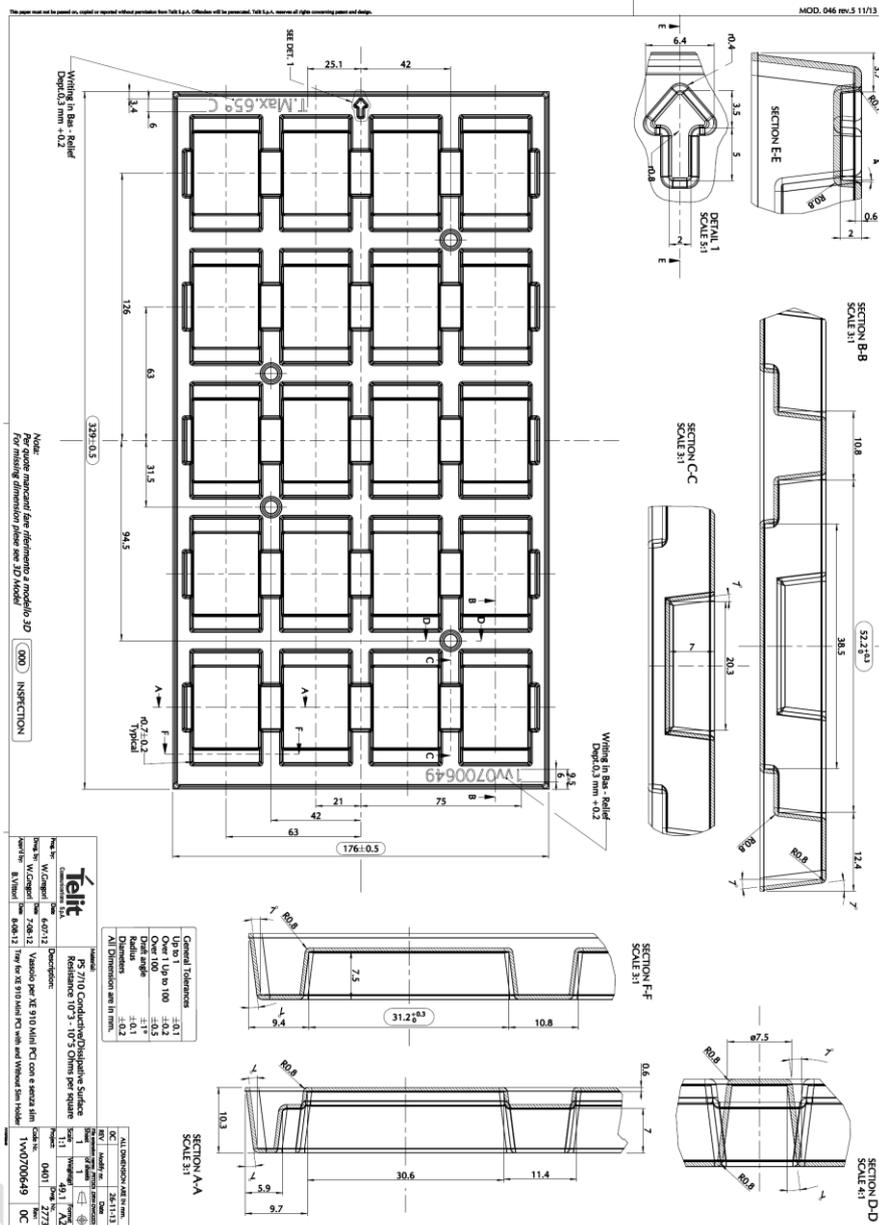


Figure 9: Tray Dimensions

12. CONFORMITY ASSESTMENT

12.1. Approvals Summary

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

ApprovalsTable 31: Approvals Summary

12.2. RED Approval

12.2.1. RED Declaration of Conformity

Hereby, Telit Communications S.p.A declares that the XX123Z4-W1, XX123Z4-WW and XX123Z4-WWV 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	Omnidirectional Antenna Gain 2.14 dBi
LN920A6-WW	

Table 32: RED Antenna Type

Max Gain for RED (dBi)			
Band	LN920A12-WW	LN920A6-WW	
FDD 1			
FDD 3			
FDD 8			

Max Gain for RED (dBi)			
FDD 20			
FDD 28			

Table 33: Max Gain for RED

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

12.3.1. FCC Certificate

The FCC Certificate 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://smssqs.ic.gc.ca/equipmentSearch/searchRadioEquipments?execution=e1s1&language=en>

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

Model <i>Modèle</i>	Applicable FCC Rules	Applicable ISED Rules <i>Règles ISDE applicables</i>
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 34: 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.

FCC Class B digital device notice (FCC only)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by taking one or more of the following measures:

Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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	TBD
LN920A6-WW	

Table 35: FCC Antenna Type

Max Gain for FCC (dBi)			
Band	LN920A12-WW	LN920A6-WW	
	TBD	TBD	TBD

Max Gain for FCC (dBi)			
	TBD	TBD	TBD

Table 36: 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	Omnidirectional Antenna Gain 2.14 dBi
LN920A6-WW	<i>Omnidirectionelle Gain de l'antenne 2.14 dBi</i>

Table 37: ISED Antenna Type

Gain maximum pour ISED (dBi) / Gain maximum pour ISDE (dBi)			
Band	LN920A12-WW	LN920A6-WW	

Gain maximum pour ISED (dBi) / <i>Gain maximum pour ISDE (dBi)</i>			

Table 38: 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: RI7XX123Z4W1" or "Contains FCC ID: RI7XX123Z4W1" for XX123Z4-W1 and : "Contains Transmitter Module FCC ID: RI7XX123Z4WW" or "Contains FCC ID: RI7XX123Z4WW" for XX123Z4-WW and XX123Z4-WWV

Below list of all the models and related FCC ID:

Model	FCC ID
LN920A12-WW	
LN920A6-WW	

Table 39: 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: XXXXXX-YYYYYYYYYY

In this case, XXXXXX-YYYYYYYYYYY 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 : XXXXXX-YYYYYYYYYYY

Dans ce cas, XXXXXX-YYYYYYYYYYY est le numéro d'homologation du module.

Model <i>Modèle</i>	ISED Certification Number <i>Num. de certification ISDE</i>
LN920A12-WW	
LN920A6-WW	

Table 40: 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 circuitry), 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"

LN920A12-WW, LN920A6-WW, Homologation #: XXXXX-XX-XXXXX

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 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
LTE 2600 – B7	2500 ~ 2570	2620 ~ 2690	Tx: 20750 ~ 21449 Rx: 2750 ~ 3449	120 MHz

Mode	Freq. Tx (MHz)	Freq. Rx (MHz)	Channels	Tx-Rx Offset
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 41: 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 Ratio
WCDMA	Wideband Code Division Multiple Access

16. DOCUMENT HISTORY

Revision	Date	Changes
0	2021-06-30	First Draft
1	2021-08-11	Carrier Aggregation (CA) combinations tables added

From Mod.0818 rev.2

Preliminary



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