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06/27/2016	1	Initial release
10/15/2016	2	Updates
12/07/2017	A	Released
03/28/2018	B	ECN 75574
05/13/2018	C	ECN 75597

SPECIFICATIONS

For APPROVAL

Part No. 1505982-0002
New JRC Model No. NJR2830M

Job		Approvals	Date	Title: LNA (Low Noise Amplifier), Ka-band
Originator:				
Approved:				
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Type: 201	Sheet 1 of 28			No. 1505982

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1. INTRODUCTION

1.1 PURPOSE/SCOPE/RESTRICTED USES

1.1.1 Purpose

This document defines the functional and performance requirements for the Low Noise amplifier (LNA) for the RF Equipment used in a Ka-band Satellite Gateway.

1.1.2 Scope

This document shall be used as the contractual performance requirement source for the design, development, fabrication, qualification, installation, and product acceptance activities pertaining to the procurement of the Low Noise amplifier.

Unless otherwise stated the technical requirements described in this document applies to both Ka-band LNA models:

- 1) LNA with a SMA connector shared by RF output and DC supply input, part # 1505982-0001, and
- 2) LNA with an SMA connector for RF output and a separate connector for DC supply input a, part # 1505982-0002.

1.2 REVISION HISTORY

Table 1-1: Revision History

Rev.	Description
1	Initial Release
2	Update to: A. Delete R4-06 requirement for noise source deleted. B. Table 5-1 the requirement for in-band Gain is <u>reduced</u> . C. Table 5-1 added requirement for out-of-band Gain D. Table 5-1 added requirement for Input IP3 out-of-band. E. Section 5.2 modified Voltage Range changed to +10 to +15 VDC. F. Section 5.2 modified power consumption. G. Section 5.2, added Reverse Polarity Protection for the DC power supply. H. Added 2 nd option: LNA with a separate power connector (1505982-0002)
A	Specs released. Same as revision 2.
B	Specs updated released to revision B 1. Added Outline drawing section 7.2 2. Relaxed VSWR specs R6-01 3. Updated IIP3 specs R5-010 4. Deleted optional requirement of section 6.4 5. Deleted section R7-08 6. Removed TBDs and TBRs
C	Typo correction in section 9.1 and 10.5.1. Deleted IEC61000-4-11 requirement in section 10.5.

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1.3 APPLICABLE DOCUMENTS

1.3.1 Applicable External Documents

Table 1-2: Applicable External Documents

Item #.	Document #	Rev.	Description
1.	Directive 2005/20/EC	Latest	DIRECTIVE 2005/20/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2005 amending Directive 94/62/EC on packaging and packaging waste
2.	DIRECTIVE 2011/65/EU	Latest	DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)
3.			Deleted.
4.			Deleted.
5.	DIRECTIVE 2012/19/EC	Latest	DIRECTIVE 2012/19/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE).
6.	Directive 2004/108/EC	12/15/2004	DIRECTIVE 2004/108/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC
7.	Directive 92/31/EEC	5/12/1992	Council Directive 92/31/EEC amending Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility
8.	JESD22-B102	Latest	Solderability
9.	IPC J-STD-006B	Latest	Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications Amendment 1
10.	IPC/JEDEC J-STD-020C	Latest	Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices
11.	JESD625	Latest	Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices
12.	JESD22-A114	Latest	For Electrostatic Discharge Sensitivity Testing Human Body Model (HBM) - Component Level
13.	JESD22-A115	Latest	Electrostatic Discharge (ESD) Sensitivity Testing, Machine Model (MM)
14.	47CFR15	Latest	Title 47, Code of Federal Regulations, FCC Part 15, Radio Frequency Devices, Sub part B (unintentional radiator), Class B

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Item #.	Document #	Rev.	Description
15.	UL 60950-1 2nd Edition	2007	Safety of Information Technology Equipment
16.	UL 6500 Ed. 2	09/30/1999	Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use
17.	CAN/CSA-C22.2 NO. 60950-1-07	2007	Safety of Information Technology Equipment
18.	IEC 61000-4-2 Edition 2.0	2008	Electromagnetic compatibility (EMC)- Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
19.	IEC 61000-4-5 Ed. 2.0	2005	Corrigendum 1 - Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
20.	IEC 61000-4-11 Ed 2.0	2004-02-24	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests
21.	IEC 60695-11-10 Ed. 1.1 b:2003	2003	Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods
22.	EN60950-1:	Latest	Information technology equipment. Safety. General requirements
23.	EN55022	Latest	Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement
24.	IEC 61000-4-2 Edition 1.2	Latest	Electromagnetic compatibility (EMC)- Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
25.	EN61000-4-3:2002	Latest	Electromagnetic compatibility (EMC). Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test
26.	EN61000-4-4:2004	Latest	Electromagnetic compatibility, Electromagnetic radiation, Electromagnetic fields, Electric power system disturbances, Electronic equipment and components, Electrical equipment, Noise (spurious signals), Electrical testing, Transient voltages, Verification
27.	EN61000-4-5:1995	Latest	Electromagnetic compatibility, Electromagnetic radiation, Electromagnetic fields, Electric power system disturbances, Noise (spurious signals), Electric fields, Magnetic fields, Field strength (electric), Electrical equipment, Electronic equipment and com
28.	EN61000-4-6:1996	Latest	Electromagnetic compatibility, Electromagnetic radiation, Electromagnetic fields, Electric power system disturbances, Electrical equipment, Electronic equipment and components, Noise (spurious signals), Radio disturbances, Circuits, Calibration, Test equipment

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Item #.	Document #	Rev.	Description
29.	EN61000-4-11:2004	Latest	Electromagnetic compatibility, Electromagnetic radiation, Electromagnetic fields, Electrical equipment, Electronic equipment and components, Electrical testing, Voltage fluctuations, Low voltage, Testing conditions, Circuits
30.	6500	1.1.6 – 08/15/2001	Audio/Video and Musical Instrument Apparatus for Household, Commercial, and Similar General Use
31.	UL 1409		Low-Voltage Video Products Without Cathode Ray Tube Displays (discharge path section only)
32.	MIL-HDBK-217F	2 December 1991	Reliability Prediction of Electronic Equipment
33.	IEEE C62.41	Jan, 1, 1991	IEEE Recommended Practice on Surge Voltage in Low-Voltage AC Power Circuits.
34.	CE Mark	N/A	EU safety
35.	SR-322	N/A	Reliability Prediction Procedure for Electronic Equipment
36.	UL 94 Ed 5	10/21/2010	TESTS FOR FLAMMABILITY OF PLASTIC MATERIALS FOR PARTS IN DEVICES AND APPLIANCES
37.	Procedure 1 A	N/A	Packaged-Products weighing 150 lb. (68 kg) or Less Basic Requirements: fixed displacement vibration and shock testing.
38.	MIL-STD-1189B	Jun 18, 1997	ARMY MIL-STD-1189B CANC NOTICE 1 STANDARD DEPARTMENT OF DEFENSE BAR CODE SYMBOLOGY
39.	ESTI EN 300-673 V1.2.1	2000-03	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for Very Small Aperture Terminal (VSAT), Satellite News Gathering (SNG), Satellite Interactive Terminals (SIT) and Satellite User Terminals (SUT) Earth Stations operated in the frequency ranges between 4 GHz and 30 GHz in the Fixed Satellite Service (FSS)
40.	ETSI EN 302 307	Latest	Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering, and other broadband satellite applications (DVB-S2)
41.	GR-63	Latest	Physical Protection
42.	Safety Code 6	Latest	Limits of Human Exposure to Radiofrequency Electromagnetic Fields.
43.	47 CFR Part 25	Latest	Title 47—Telecommunication Chapter I--Federal Communications Commission Subchapter B--Common Carrier Services Part 25—Satellite Communications
44.	OET Bulletin 65	Latest	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

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Item #.	Document #	Rev.	Description
45.	UL 60950-22	Latest	Information Technology Equipment - Safety - Part 1: General Requirements
46.	IEC 61000-4-5 ed.2.0	Latest	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
47.	IEC 60068-2-27	Latest	Environmental testing: Shock
48.	IEC 60068-2-64	Latest	Environmental testing: Vibration, broadband random

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1.4 TERMS, ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

Table 1-4: Terms, Abbreviations, Acronyms, and Definitions

Terms / Acronym	Definition/Descriptions
ACU	Antenna Control Unit
AFR	Annualized Failure Rate
CFE	Customer Furnished Equipment
COTS	Commercial Off-the-Shelf
Cpk	Process Capability index. Cpk of at least 1.33 is desired.
CPL	Critical Part List
CW	Continuous Wave
dB	Decibel: a logarithmic unit that expresses the ratio of two values of a physical quantity, often power or intensity.
dB/K	Decibel/kelvin
dBc/dBC	Decibels relative to Carrier Power
dBm	Decibel-milliwatt: an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW)
dBW	Decibel-Watt: an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one watt (W)
DOA	Dead on Arrival
DPMO	Defects per Million Opportunities
DVB-S2	Digital Video Broadcasting - Satellite - Second Generation (DVB-S2)
EIA	Electronic Industries Association – A standards body
EIRP	Equivalent Isotropically Radiated Power.
EMS	Element Management Subsystem
FRU	Field Replaceable Unit
GaAs	Gallium Arsenide
GaN	Gallium Nitride
G/T	Gain and Temperature Ratio
GN	Ground Network
GUI	Graphical User Interface
GW	Gateway
Hz	Hertz.
I/O	Input/Output
IF	Intermediate Frequency
IP	Internet Protocol
ITU	International Telecommunication Union - http://www.itu.int/en/pages/default.aspx

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Terms / Acronym	Definition/Descriptions
LEO	Low Earth Orbit: altitude between 160 kilometers (99 mi) and 2,000 kilometers (1,200 mi)
LHCP	Left Hand Circular Polarization
LNA	Low Noise Amplifier
LNB	Low Noise Block Down-Converter
M&C	Monitor & Control
ME	Managed Element
MES	Manufacturing Execution System
MPN	Manufacturer Part Number
MVT	Manufacturing Verification Test
NOC	Network Operations Center
NOCC	Network Operations and Control Center
NRTL	Nationally Recognized Testing Laboratory
PA	Power Amplifier
PBB	Polybrominated Biphenyls
PBDE	Polybrominated Diphenyl Ethers
PCCP	Product Characteristic and Compliance Plan
Pol	Polarization
PPM/ppm	Part Per Million – The Electrical and Mechanical failure rate, outgoing.
PSD	Power Spectral Density
RFE	Radio Frequency Equipment
RHCP	Right Hand Circular Polarization
RIP	Receive Isotropic Power
RMA	Return Material Authorization
RSP	Radio Signal Processor
SCD	Specification Control Document
SOCC	Satellite Operations and Control Center
SOW	Statement of Work
SQC	Statistical Quality Control
TBC	To Be Confirmed
TBD	To Be Determined
TBR	To Be Reviewed
TRIA	Transmit Receive Integrated Assembly
TS	Technical Specification
TT&C	Telemetry Tracking and Control
UTC	Universal Time Coordinated
VSAT	Very Small Aperture Terminal
WEEE	Waste Electrical and Electronic Equipment

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3. OVERVIEW

3.1 GATEWAY AND LNA

The Low Noise amplifier (LNA) is an essential part of the satellite gateway receiver system. The LNA provides low noise amplification of the signal received from the satellite.

Figure 3-1 depicts a simplified context diagram for the LNA in the Satellite gateway.

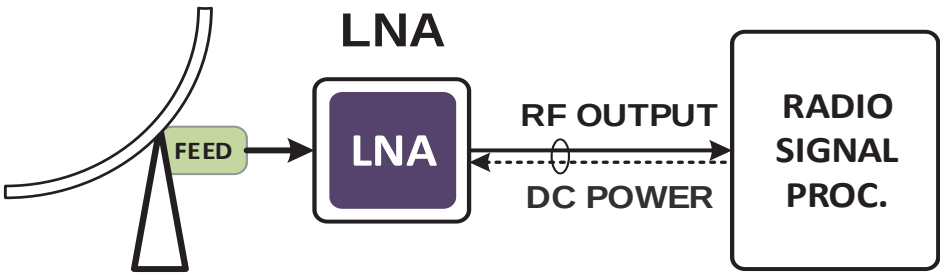


Figure 3-1. LNA Context Diagram

The LNA interfaces with the antenna feed and the Radio Signal Processor (RSP or Modems). There are two LNAs connected to the antenna feed system to realize simultaneous reception of RHCP and LHCP signals.

To minimize loss in the signal power, the LNA will be mounted directly to the antenna feed (or very close) of the tracking antenna. It will move along with the tracking antenna and subject to vibration and displacement due to tracking motion.

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4. FUNCTIONAL DESCRIPTION AND REQUIREMENTS

4.1 FUNCTIONAL DESCRIPTION

The Low Noise amplifier (LNA) allows the satellite gateway to receive RF signal from the satellite and amplifies to an acceptable level to the radio signal processor modem.

4.2 FUNCTIONAL REQUIREMENTS

The Low Noise amplifier (LNA) block diagrams are shown in Figure 4-1.

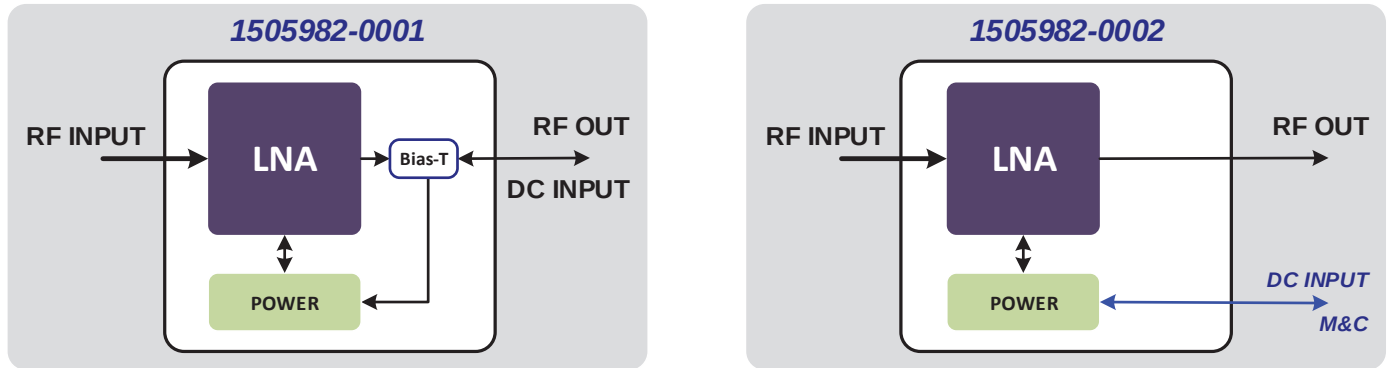


Figure 4-1. LNA Block Diagram

The LNA functional requirements are summarized below:

- R4-01. The LNA Input port shall interface to the antenna feed assembly.
- R4-02. The LNA shall be able to receive multiple incoming carriers at Ka-band.
- R4-03. The LNA shall provide low noise amplification to Ka-band receive signals as specified in section 5.1.
- R4-04. The LNA (1505982-0002 only) shall provide fault detection (Input Voltage and Current Consumption).
- R4-05. The LNA shall implement mechanism to protect itself in event of any adverse operating conditions.
- R4-06. Requirement deleted.

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5. PERFORMANCE REQUIREMENTS

Unless otherwise stated herein, the performance requirements in this chapter apply to all LNAs under all environmental conditions.

5.1 LNA PERFORMANCE REQUIREMENTS

The LNA performance requirements are listed in Table 5-1.

Table 5-1. LNA Performance Requirements

Req. Number	Performance Parameter	Requirement	Notes
R5-01.	RF Input Frequency Range	17.8 – 19.3 GHz	In-band definition
R5-02.	Gain Range	45 ± 2 dB	In-band
R5-03.		At least 30 dB less than gain measured at 18.55 GHz	≤ 15.2 GHz and ≥ 21.4 GHz
R5-04.	Noise Figure	≤ 1.5 dB ≤ 1.75 dB	@ 25° ambient Over operational temp and voltage range
R5-05.	Noise Figure Desensitization (due to TX power)	≤ 0.1 dB	-10 dBm input power in the TX Band (27.5-30.0GHz)
R5-06.	Gain Flatness	< 0.25 dB peak-to-peak	Across any 20 MHz carrier band
		< 1.0 dB peak-to-peak	Across any 500 MHz band
R5-07.	Group Delay	≤ 1 ns peak-to-peak	Across any 125 MHz band
R5-08.	Gain Stability (Time)	≤ 0.5 dB in 24 Hrs.	At any fixed temperature
R5-09.	Gain Stability	< ± 1.0 dB	Over operational temperature and voltage range
R5-010.	Input IP3	≥ -30 dBm	Over 17.8 – 19.3 GHz
R5-011.		≥ -20 dBm	≤ 15.2 GHz and ≥ 21.4 GHz
R5-012.	Maximum In-band Input Level without damage	> -20 dBm	
R5-013.	Spurious (signal related)	≤ -60 dBc	@ -10 dBm output
R5-014.	Spurious (signal independent)	≤ -80 dBm	In-band
R5-015.	Input & Output Stability	Unconditionally stable	for all possible input and output loads

5.2 POWER REQUIREMENTS

The LNA Power requirements are listed below.

- R5-016. DC power shall be provided
via SMA connector for LNA 1505982-0001 and
via a separate 8-pin connector for LNA 1505982-0002 as specified in section 6.2.
- R5-017. Voltage Range: +10 to +15 VDC
- R5-018. Power Consumption: < 5 Watts
- R5-019. Reverse Polarity Protection for the DC power supply.

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6. INTERFACE REQUIREMENTS

6.1 EXTERNAL INTERFACES

LNA key external interfaces are identified in Figure 6-1 and the interface spectrum is depicted in Figure 6-1.

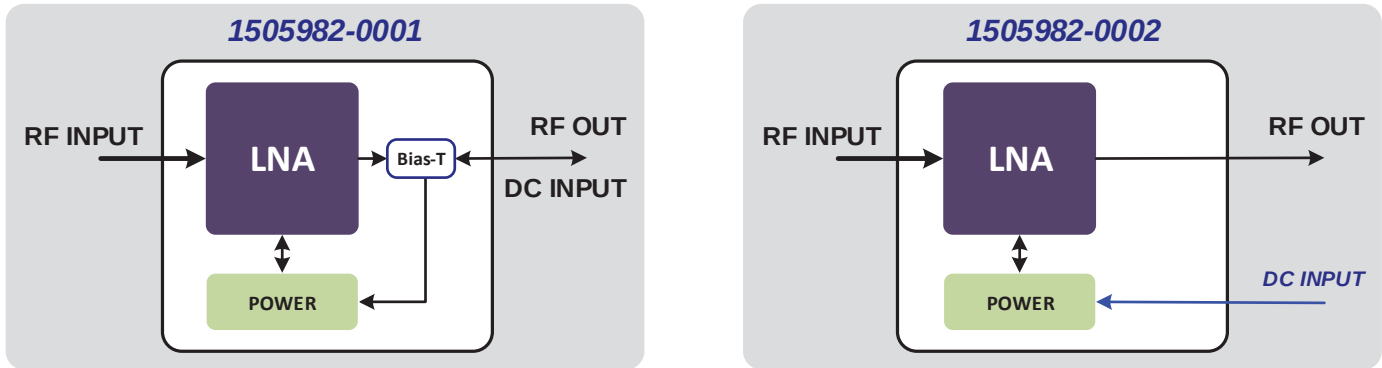


Figure 6-1. LNA External Interfaces

- R6-01. RF Interfaces’ VSWR requirements are given below:
- a. Input VSWR shall be better than 1.8:1
 - b. Output VSWR shall be better than 1.45:1, with Goal of better than 1.3:1.

6.2 LNA INTERFACE TO RSP (MODEM)

R6-02. The individual interfaces between the RSP and LNAs are detailed in Table 6-1 and Table 6-2.

Table 6-1. RSP (Modem) and LNA Interfaces (for 1505982-0001 only)

Req. Number	Name	Function	LNA I/O	QTY	Interface Description	LNA Connector
R6-03.	J1	RF Output & DC Power Input	Output / Input	1	RF output, and DC Power Input	IP67 rated SMA-female (unterminated or open)

Table 6-2. RSP (Modem) and LNA Interfaces (for 1505982-0002 only)

Req. Number	Name	Function	LNA I/O	QTY	Interface Description	LNA Connector
R6-04.	J1	RF Output	Output	1	RF output	IP67 rated SMA-female (unterminated or open)

Req. Number	Name	Function	LNA I/O	QTY	Interface Description	LNA Connector
R6-05.	J2	DC Power Input & Fault Monitor Output	Input / Output	1	DC Power Input & Fault Monitor Output (Input Voltage and Current Consumption.) Pin Assignment as shown in Table 6-3.	IP67 rated 8-pin Connector (unterminated or open) BSD-08PMMS-SS7001

Table 6-3. LNA DC Power and Monitor Interfaces (for 1505982-0002 only)

Pin #	Signal	Description
1	DC Power (+)	+10 to +15 VDC
2	DC Power (-)	Return
3	N/A	Do Not Connect
4	N/A	Do Not Connect
5	Alarm (+)	Open Collector Normal: Short Fault: Open
6	Alarm (-)	Analog GND
7	N/A	Do Not Connect
8	N/A	Do Not Connect

6.3 INTERFACE TO ANTENNA FEED

The interface to the antenna feed is shown in Table 6-4.

Table 6-4. LNA to Antenna Feed Interface

Req. Number	Name	Function	LNA I/O	QTY	Interface Description	LNA Connector
R6-06.	RX RF	RX RF Signal input	Input	1	RX signal from Antenna Feed	WR-42
R6-07.	The LNA waveguide flange shall be sealed to prevent moisture ingress to the waveguide system.					
R6-08.	The waveguide shall have O-ring groove and threaded screw holes as shown in the outline drawing in Figure 7-1. The vendor shall supply O-ring and a set of screws with each unit.					

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7. MECHANICAL REQUIREMENTS

7.1 OVERVIEW

The LNA shall be designed to support the operational, configuration, and performance requirements as defined in **Table 7-1**.

Table 7-1 Physical Requirements

R7-01.	The physical construction of the LNA shall support the requirements in their entirety as outlined in this document.
R7-02.	The physical partitioning of functional blocks shall be determined by considering: 1. Performance requirements 2. Ease of Installation and Maintainability 3. Environmental requirements

7.2 MECHANICAL REQUIREMENTS

The LNA shall have the following mechanical requirements as defined in Table 7-2 and the outline drawing as shown in

Figure 7-1.

Table 7-2 Mechanical Requirements

R7-03.	Size: Less than 4.6" x 3.2" x 1.6" .
R7-04.	Weight: Less than 2.0 lb. Less weight is preferred.
R7-05.	Paint color: White spray paint coat except on connectors and waveguides.
R7-06.	Mounting: The LNA shall be capable of mounting behind the tracking antenna at the feed port and/or close to the feed.
R7-07.	Deleted.
R7-08.	Deleted.
R7-09.	The Field Replaceable Unit (FRU) concept shall be employed in the functional partitioning and physical construction of the LNA.
R7-010.	All ports requiring controlled impedance terminations to maintain performance shall be provided with such terminations.
R7-011.	All external interface connectors shall provide adequate clearance for tightening / removal tools.

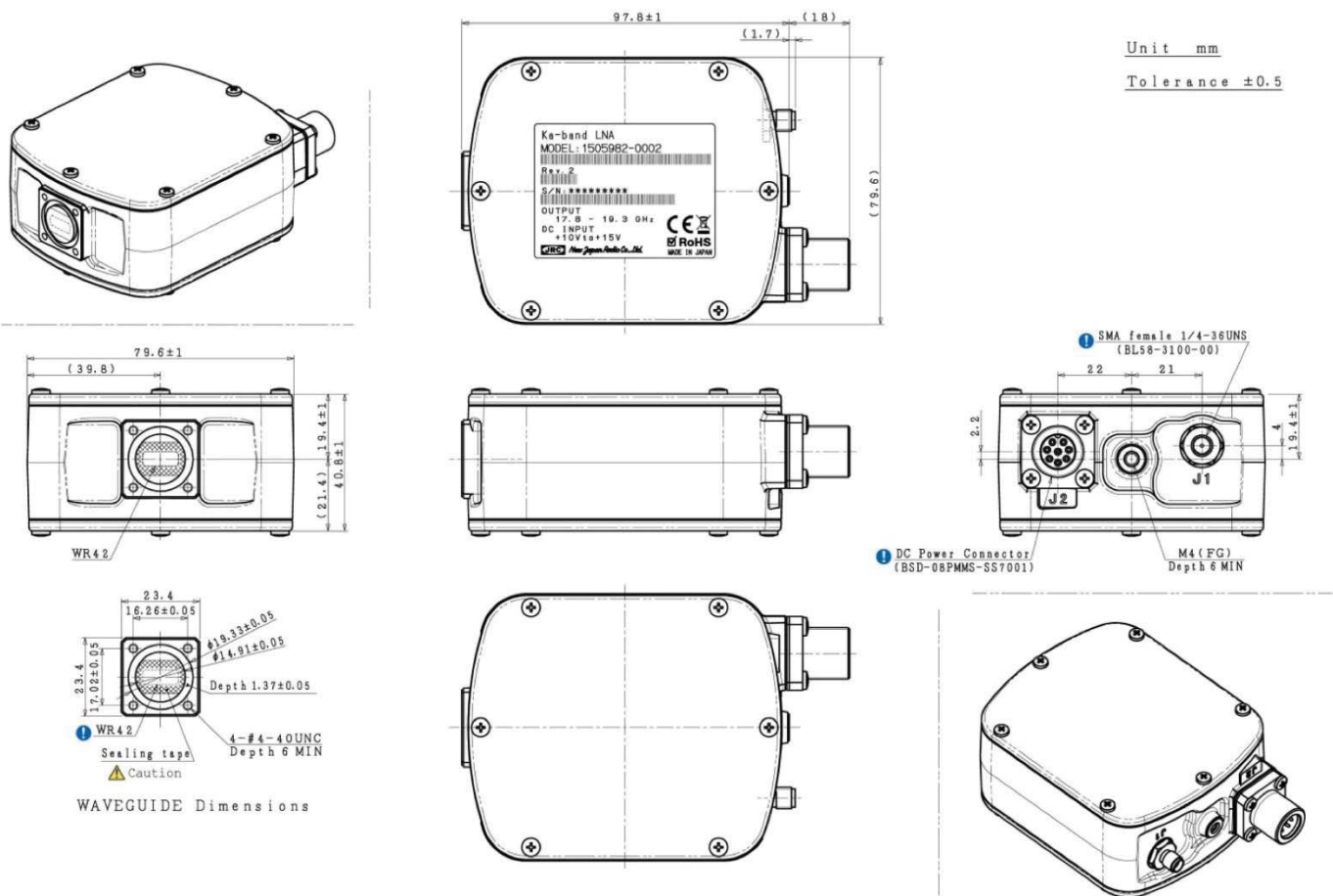
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Interface: Waveguide WR-42 RX RF Signal Input		
#	Signal	Description
WG	RF INPUT	17.8 to 19.3 GHz

Interface: J1 Connector RF Output SMA Female 1/4-36UNS		
#	Signal	Description
Coax.	RF OUTPUT	17.8 to 19.3 GHz

Interface: J2 Connector DC Power Input & Fault Monitor Output DC Power Connector (BSD-08PMMS-SS7001)		
#	Signal	Description
1	DC Power (+)	+10 to +15 VDC
2	DC Power (-)	Return
3	N/A	DO NOT CONTACT
4	N/A	DO NOT CONTACT
5	Alarm (+)	Open Collector Normal: Short Fault: Open
6	Alarm (-)	Analog GND
7	N/A	DO NOT CONTACT
8	N/A	DO NOT CONTACT

Caution: **DO NOT** remove the sealing tape on the waveguide.
If the sealing tape is removed, it may lose the performance of waterproof.

Figure 7-1. LNA (1505982-0002) Outline Drawing

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7.3 MARKING AND LABELING

7.3.1 General

The Marking and Labeling Requirements stated herein are included as guidelines to achieve successful implementation, deployment, and servicing of the Gateway RF equipment.

- | | |
|---------|---|
| R7-012. | All connectors shall be clearly marked. |
| R7-013. | All Connectors shall be appropriately weather sealed. |

7.3.2 Agency Certification

- | | |
|---------|---|
| R7-015. | Agency certification logos and information are required and shall be conveniently visible. <ol style="list-style-type: none">1. Input power rating2. Country of origin3. NRTL Logo and NRTL Listing file number as appropriate4. Any warning label for RF Safety |
|---------|---|

7.3.3 Operations and Servicing Tracking

- | | |
|---------|--|
| R7-016. | All Field Replaceable Units (FRU) shall be required to carry the vendor name, vendor part number, and any other vendor specific configuration identifiers. |
| R7-017. | The label shall be human readable. |
| R7-018. | Weather or aging effects shall not degrade the ability to read the label. |

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8. ENVIRONMENT REQUIREMENTS

8.1 OUTDOOR ENVIRONMENT

The outdoor LNA shall comply with the outdoor requirements detailed in Sections 8.1.1 and 8.1.2.

8.1.1 Operational

- R8-01. Temperature Range: -40⁰ C to +55⁰ C
- R8-02. Humidity: 0 to 100% (condensation)
- R8-03. Altitude: up to 3000m
- R8-04. Solar Radiation: 1120W/m²
- R8-05. Vibration: per IEC 60068-2-64
 - a) The equipment shall remain operational when subjected to a 3 shocks per axis as specified below (half sine) on x, y, z axes when tested in accordance with IEC 60068-2-27
 - b) The equipment, when tested in accordance with IEC 60068-2-64, shall remain operational when exposed to random vibration as specified. **Note:** 10 minutes per axis or sufficient time to ensure conformance to performance specifications, whichever is greater.
- R8-06. Atmospheric Conditions: The subsystem shall be resistant to Salt, Pollutants and Contaminants as Encountered in Coastal and Industrial Areas.
- R8-07. Ingress Protection: The LNA shall conform to IP66 standard or better. It shall remain operational when subjected to environment as defined in the IP66 standard.

8.1.2 Survival

- R8-08. Temperature Range: -40⁰ C to +70⁰ C
- R8-09. Humidity: 0 to 100% (condensation)
- R8-010. Altitude: up to 10000m
- R8-011. Vibration: per IEC 60068-2-64
 - a) The equipment shall survive when subjected to a 3 shocks per axis as specified below (half sine) on x, y, z axes when tested in accordance with IEC 60068-2-27
 - b) The equipment, when tested in accordance with IEC 60068-2-64, shall survive when exposed to random vibration as specified.
- R8-012. Ingress Protection: The LNA shall conform to IP66 standard or better.

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9. RELIABILITY REQUIREMENTS

9.1 DESIGN LIFE

R10-01. The design life of the device shall be 10 years minimum when the system environment does not exceed the operational conditions as specified in **Section 3** and **Section 5**. The design life is defined as all hardware remaining serviceable and operable at the specified performance level.

9.2 PRODUCTION LIFE

Production Life is defined as the number of years the supplier is expected to support the product.

R10-02. The production life of the 1505982-0002 shall be greater than 15 years.

9.3 ANNUALIZED FAILURE RATE (AFR)

R10-03. The LNA shall be designed and manufactured to allow an Annualized Failure Rate (AFR) no greater than 0.9% calculated as follows:

$AFR = (Failures/AFR \text{ Installed Base}) \times 1200.$

9.4 MEAN TIME BETWEEN FAILURES

R10-04. The LNA shall meet MTBF of greater than 1,000,000 hours based on MIL-HDBK-217, or Bellcore/Telecordia (SR-332) at ground fixed environment, or field demonstrated.

9.5 MEAN TIME TO REPLACE

R10-05. The mean time to replace the LNA shall not exceed 15 minutes after a failure is detected and isolated and the repair person is on site and has full access to the equipment.

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10. AGENCY CERTIFICATION

10.1 GENERAL

- R10-01. The Agency Certification and Regulatory Standards stated herein are requirements for LNA deployed in the U.S.A., Canada, Mexico, and Europe.
- R10-02. The LNA shall meet all applicable local, state, and federal regulations for the markets they serve.
- R10-03. The LNA shall be CE marked.

10.2 SAFETY AGENCY CERTIFICATIONS

- R10-04. The LNA shall be NRTL Listed by either Intertek, UL, or TUV by factory onsite inspection to the safety standards listed in the table below.

Table 10-1 Safety Requirements

Regulation	Standards for Information Technology Equipment		
	USA	Canada	Mexico
Product Safety	UL60950-1 (2 nd Ed., Indoor)	CSA C22.2 NO. 60950-01-07 (2 nd Ed., Indoor)	Same as USA through Mutual Rights Agreement (MRA) FOR REF ONLY {NOM-019-SCFI-1998 Data processing equipment – safety requirements}
	UL60950-22 (1 st Ed., Outdoor)	CSA C22.2 NO. 60950-22 (1 st Ed., Outdoor)	

10.3 EMISSIONS

- R10-05. The LNA shall comply with the following US emissions standards and the equivalent Canadian standard.

Table 10-2 Emissions Requirement

Regulation	Standards for Information Technology Equipment		
	USA	Canada	Mexico
Emissions	FCC CFR Title 47, Part 15, CLASS A	ICES-003, CLASS A	Same as USA through Mutual Rights Agreement (MRA) FOR REF ONLY {NOM-088/1&2-SCT1-2002, “Telecommunications Radio communication Microwave equipment for multi-channel systems in the fixed service point to point and point to multipoint}

a) NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

b) Notice: Changes or modifications made to this equipment not expressly approved by New Japan Radio Co., Ltd. may void the FCC authorization to operate this equipment.

10.4 TYPE ACCEPTANCE

- R10-06. Requirement deleted.

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10.5 IMMUNITY

R10-07. The LNA shall meet the immunity requirements specified as detailed in Table 9-3. Immunity requirements in the European Union are covered by the EMC Directive 2004/108/EC

Table 10-3 Immunity Requirement

EN 55024 (Latest)	Limits and Methods of Measurement of Immunity Characteristics of Information Technology Equipment – Same as CISPR 22 – Ed. 5 – 2005-04, amd.1 – 2005-07
IEC 61000-4-2 (Latest)	Electromagnetic compatibility (EMC) – Part 4: Testing and Measurement Techniques – Section 2: Electrostatic Discharge Immunity Test. Basic EMC Publication
IEC 61000-4-3 (Latest)	Electromagnetic Compatibility (EMC) – Part 4: Testing and Measurement Techniques – Section 3: Radiated, Radio-Frequency, Electromagnetic Field Immunity Test
IEC 61000-4-4 (Latest)	Electromagnetic Compatibility (EMC) – Part 4: Testing and Measurement Techniques – Electrical Fast Transient/Burst Immunity Test – Basic EMC Publication
IEC 61000-4-5 (Latest)	Electromagnetic Compatibility (EMC) – Part 4 Testing and Measurement Techniques – section 5: Surge Immunity Test
IEC 61000-4-6 (Latest)	Electromagnetic Compatibility (EMC) – Part 4: Testing and Measurement Techniques – Section 6: Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields Test –

10.5.1 Surge Immunity

R10-08. The LNA shall survive when subjected to surge immunity testing per IEC 61000-4-5. The test levels are given in **Table 10-4**.

Table 10-4. Test Levels in Surge Immunity Testing

Port	Test Level	
	Common Mode	Differential Mode
Indoor Equipment Interfaces	±4.4 kV	±4.4 kV

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11. QUALITY SYSTEM

R11-01. Supplier shall be certified to the ISO 9001 Quality System and shall be subject to review .

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12. PACKAGING, SHIPPING AND LABELING

12.1 PACKAGING, SHIPPING, AND LABELING

R12-01. The devices shall be individually packaged in containers suitable for protection of the components from damage during shipment in a railroad boxcar, ship, an enclosed truck, or by airfreight for either domestic or international shipment.

R12-03. A certificate of origin shall be included in each shipment.

R12-05. Each shipment must be accompanied by a letter from the manufacturer or supplier certifying compliance with the RoHS directive.

12.2 PACKAGING AND PACKAGING WASTE

R12-06. Directive 94/62/EC - DIRECTIVE 2005/20/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - of 9 March 2005, amending Directive 94/62/EC on packaging and packaging waste.

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13. ENVIRONMENTAL REGULATORY REQUIREMENTS

13.1 WEEE REQUIREMENT

Directive 2012/19/EC of the European Parliament and of the Council of 4 July 2012 on Waste Electrical and Electronic Equipment (WEEE). This Directive will be transposed into national law by 14 February 2014. At that time, the old Directive (2002/96/EC) will be repealed. The period between 13 August 2012 and 14 August 2018 is a transitional period, the scope of the new WEEE Directive remains the same as the scope of the old WEEE Directive (10 categories). From 15 August 2018 onwards the scope of the Directive is widened to include all electrical and electronic equipment (EEE), the scope of the old WEEE Directive will no longer be valid.

13.2 DIRECTIVE REQUIREMENTS

13.2.1 Restriction of Hazardous Substances in Manufacture

All material supplied to this specification shall meet the Directive 2011/65/EU of the European Parliament and of the Council, on the restriction of the use of certain hazardous substances in electrical and electronic equipment, requires the reduction of the substances Lead, Mercury, Cadmium, Hexavalent Chromium, Polybrominated Biphenyls (PBB), and Polybrominated Diphenyl Ethers (PBDE) in electronic products as January 03, 2013. Unless otherwise noted, all materials used must be compliant with this directive and any subsequent revisions or amendments.

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