

# USER MANUAL

## HIGH INTERCEPT LOW NOISE AMPLIFIER (HILNA™)

### MODEL: HILNA CX



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## 1 HILNA™ PRODUCT LINE OVERVIEW

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NuWaves' HILNA family of amplifiers is designed to achieve high RF gain while maintaining extremely low noise, and high output third-order intercept point (OIP3) across a wide frequency band. HILNA's robust power supply also operates over a very broad range of input power, easily allowing the unit to be integrated into systems without regard to power supply precision.

### 1.1 HILNA™ PRODUCT LINE HIGHLIGHTS

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- High Performance – Noise Figure, Gain, Linearity, Broadband, Dynamic Range: Unique combination of extremely low noise figure, high gain, high OIP3, wide band frequency coverage, and wide dynamic range.
- Robust Power Supply: Operates over a very broad range of DC input supply voltages. Included with each HILNA is a mating power connector with cable attached.
- Enclosures:
  - HILNA V1, HILNA G2V1, HILNA GPS, HILNA HF, and HILNA CF are housed in a black or silver anodized extruded aluminum enclosure with mounting flanges.
  - $\mu$ HILNA is housed in a miniature sleek black anodized milled aluminum enclosure.
  - HILNA LS is housed in a black anodized milled aluminum enclosure with mounting holes incorporated into the chassis
  - HILNA CX is housed in a nickel plated rugged aluminum enclosure with mounting holes incorporated into the chassis.
- Completely Characterized: The HILNA family of low noise amplifiers has been completely characterized over temperature, voltage, and frequency. The amplifiers are robust, offering significant value for the OEM user or the Systems Integrator.
- User Friendly: Reverse-voltage protection and regulator thermal shutdown provide defenses against user interface issues.
- High Reliability: NuWaves' selection of conservatively rated components provides high reliability delivering high Mean Time Between Failure (MTBF). Each HILNA is inspected to IPC-A-610 Class III quality standards. NuWaves' Quality Management System is AS9100:2016 Rev D and ISO 9001:2015 certified.
- ESD Protection: The HILNA Amplifiers are suitable for many types of applications where ESD susceptibility is prominent. The amplifiers are designed to withstand up to 1000 V utilizing ESD waveforms described in IEC 61000 4-2.

- Applications: IF or RF Buffer Amplifier ▪ Overcome Systematic RF Losses ▪ Increase Antenna Signal Levels ▪ Military Radios ▪ RF Wideband Front-Ends ▪ RF Pre-Amp ▪ TV ▪ Final Stage Amplifier for Low-Level Repeaters ▪ Long Cable Runs to Antenna ▪ Ultra Low Noise Applications ▪ LNA for Cellular Base Station ▪ High Linearity Systems ▪ General Purpose Amplification ▪ High Performance Receivers ▪ High Power Drive Signals for Increased Dynamic Range ▪ High Reliability RF Amplifier Applications ▪ Base Station Applications ▪ VHF/UHF Amplification ▪ Final PA for Low-Power Applications ▪ Low-Noise Transmit Driver ▪ Cable Modem ▪ Fixed Wireless ▪ Mobile Infrastructure ▪ Industrial Scientific Medical Band Applications
- Users: Engineering and Scientific Laboratories ▪ Test and Measurement Facilities ▪ OEMs of RF High End Systems ▪ Research Laboratories ▪ Communications Engineering Firms ▪ Cable TV System Engineers ▪ RF System Integrators ▪ Test Ranges ▪ Universities ▪ Antenna Design Facilities ▪ Field Service Technicians ▪ Aerospace and Defense Systems ▪ Radio and TV Engineers ▪ Amateur Radio ▪ Scientific and Consulting Agencies ▪ Radio and Wireless Communication Services ▪ Precision Equipment Repair Organizations ▪ Professional and Technical Service Institutions ▪ Military Radio & Communication Facilities

## 1.2 HILNA™ PRODUCT LINE MODELS

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NuWaves offers several variants of the HILNA line-up. The HILNA family of amplifiers operates from 2 MHz to 12 GHz frequency range. Product availability is depicted in Table 1.

**Table 1: List of Models**

MODEL	DESCRIPTION
HILNA V1	50 MHz to 1 GHz, 20 dB Gain
μHILNA	50 MHz to 1500 MHz, 20 dB Gain
HILNA G2V1	50 MHz to 1 GHz, 40 dB Gain
HILNA GPS	1.2 GHz to 1.6 GHz, 32 dB Gain
HILNA CF	50 MHz to 1 GHz, 38 dB Gain
HILNA HF	2 MHz to 50 MHz, 30 dB Gain
HILNA LS	1 GHz to 3 GHz, 50 dB Gain
HILNA CX	5 GHz to 10 GHz, 30 dB to 43 dB

## 2 HILNA CX OVERVIEW

NuWaves' HILNA CX™ is the latest addition to the family of HILNA broadband low noise amplifiers covering C- to X-band frequencies. This model features a miniature form factor of 1.2 cubic inches allowing ease of integration into space-constrained systems.

This high-performance module delivers over 35 dB of gain across the entire broad range of 5 GHz to 10 GHz with a typical noise figure of 2.5 dB and OIP3 of +21 dBm. The HILNA CX's ultra-broadband coverage allows the user comprehensive spectrum coverage within a single module.

HILNA CX's robust power supply also operates over a very broad range easily allowing the unit to be integrated into systems without regard to power supply precision.

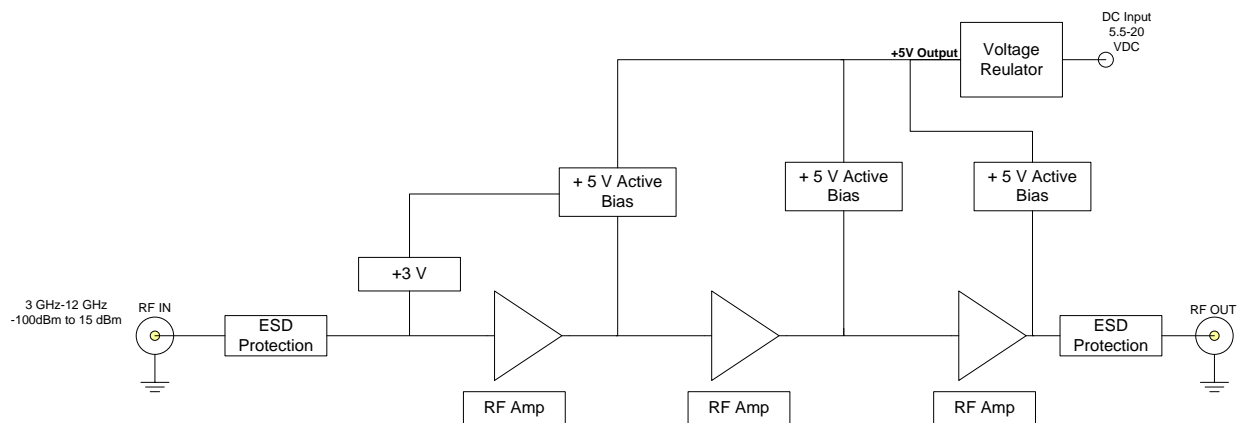


Figure 1: HILNA CX Functional Diagram

## 2.1 HILNA CX ELECTRICAL DATA

**Table 2: HILNA CX Absolute Maximum Ratings**

Operating Voltage	+20 VDC
RF P <sub>in</sub>	+15 dBm
Operating Temperature	-30 to + 70 °C
Storage Temperature	-40 to + 85 °C

**Table 3: HILNA CX DC Specifications**

		Min	Typ	Max
Operating Voltage	V	+5.5	12	+20
Current Consumption	mA		170	

**Table 4: HILNA CX RF Specifications**

PARAMETER	UNIT	HILNA CX		
		Min	Typ	Max
Frequency Range	GHz	5		10
Gain	dB	35		
Noise Figure	dB		2.5	
OIP3	dBm		+21	
P1dB	dBm		+11	
VSWR In			2.5:1	
VSWR Out			2.5:1	

Reverse Isolation	dB	53
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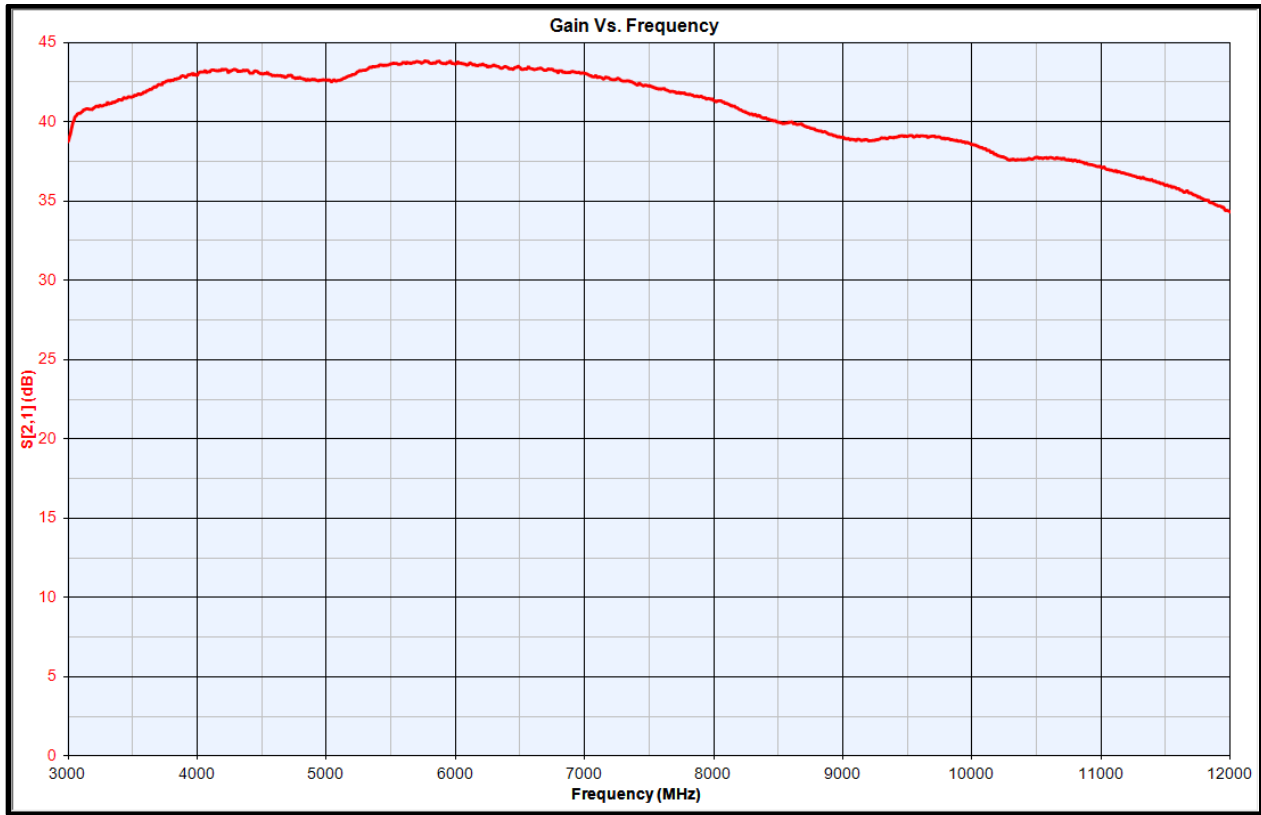


Figure 2: HILNA CX Frequency Response

## 2.2 HILNA CX MECHANICAL SPECIFICATIONS

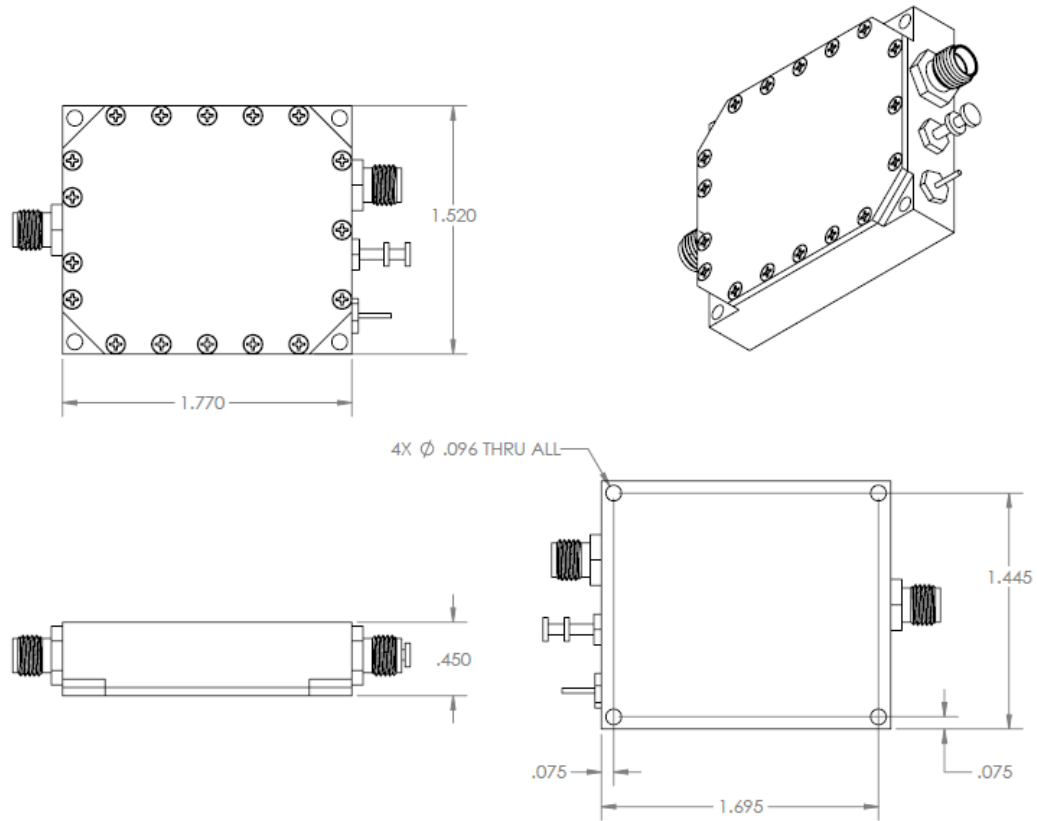


Figure 2: HILNA CX Mechanical Outline

Table 3: HILNA CX Mechanical Specifications

RF Bulkhead Connector	SMA female
RF Input and Output Mating Connector	SMA male
DC Power Connector	EMI Feed Through
Dimensions (L x W x H)	1.77" x 1.52" x 0.45"
Weight	1.3 oz.



## 3 INSTALLING, CONNECTING, AND USING THE HILNA AMPLIFIER

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HILNA amplifiers have been designed to be highly reliable under the specified operating conditions. The following installation and interfacing guidelines should be followed to prevent damage to the RF module.

**Caution: The HILNA amplifier contains components that are sensitive to Electro-Static Discharge (ESD). The use of wrist strap, mats, and ground straps should be adhered to during the installation process.**



### 3.1 CABLING

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The HILNA CX is equipped with high-performance RF connectors. Gold plated SMA-type receptacles are used because they perform very well across the usable frequency range of the unit. For optimal performance, a high-quality 50  $\Omega$  coaxial cable with SMA-type plugs should be used to interface with the amplifier.

**Caution: Due to the wideband nature of the unit, installation should not be attempted on a tower with transmit antennas.**

If cables with the SMA-type connectors are not available, high quality adaptors are available for most coaxial connector types.

### 3.2 POWER SUPPLY

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The HILNA CX contains internal linear voltage regulators. These regulators protect the circuitry from voltage variations at the input and allow for the wide operating voltage. The power connector for the units is an EMI Feed through connector. The only restrictions on the power source for the unit are:

- Capable of sourcing 170 mA of current
- Capable of sourcing +5.5 VDC to +20 VDC

Car batteries (through a cigarette lighter adaptor), laboratory DC power supplies, or wall transformers are suitable power sources as long as the superimposed ripple is low in amplitude.

### 3.3 CONNECTIONS

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**Caution: Do not apply RF power to the unit until all cable connections are made and DC power has been applied.**

Making the connections from the HILNA CX is easily accomplished:

1. Connect the "RF OUT" connector on the unit to a 50  $\Omega$  coaxial cable
2. Apply power to the unit by first plugging in the power cable sent with the unit into the DC power input.
3. Connect the red lead to the positive side of the power supply and connect the black lead to the negative side of the power supply. Power is now ready to be applied to the unit.
4. Connect the RF Source to the RF Destination with a second 50  $\Omega$  coaxial cable.
5. Apply RF to the input cable assembly.

Powering down the unit is done by reversing this procedure.

Connection Summary:

- Connect the RF Output to a proper load capable of handling 20dBm of output power. The characteristic impedance is 50  $\Omega$ .
- Apply DC (+12 VDC Typical) at the power connector.
- Connect an RF source to the RF Input connector.



**Caution: Excess drive levels at the input to the amplifier can permanently damage the unit. Under no circumstance should the RF Input level exceed +15 dBm.**

### 3.4 ENVIRONMENTAL SPECIFICATIONS

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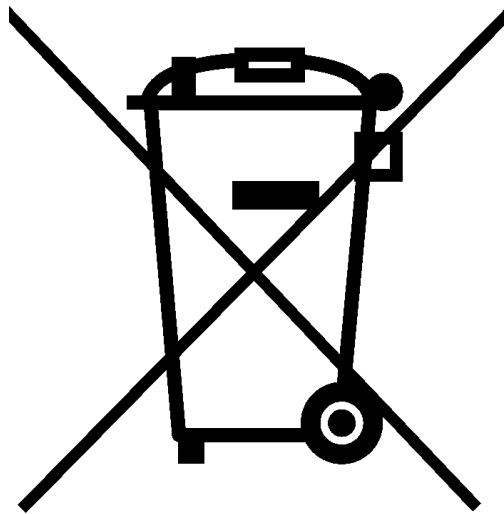
The HILNA CX units are rated for operation from -30 to +70 °C. The enclosure is **NOT** watertight; therefore, the unit must be kept dry. It is recommended that the unit be installed in a well-ventilated area or mounted to a heat sink if the input voltage exceeds +12 VDC. The unit will run warmer as the input voltage increases.

## 4 PRODUCT DISPOSAL – END-OF-LIFE

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Safety is a guiding principle of NuWaves RF Solutions. We ensure safe production and operation of our products, as well as end-of-life disposal. Improper disposal can adversely affect the environment, wildlife and human health. Please follow these guidelines when disposing of a NuWaves product:

- Do not remove the cover or any hardware
- Do not remove components from the circuit card assembly
- Do not incinerate
- Do not crush or shred
- Do not dispose of as unsorted municipal waste
- Do not export e-waste outside of the original destination country for recycling
- Utilize an e-Steward or ISO14001 certified e-waste recycler
- Consider export controls during recycler selection
- If a NuWaves product is incorporated into a larger system or sub-system, ensure that these guidelines are followed at system end-of-life



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## 5 GETTING HELP - APPLICATIONS ENGINEERING

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NuWaves RF Solutions offers technical support for basic configuration help and troubleshooting, Monday through Friday, 8 a.m. to 5 p.m. Eastern Time.

Technical Assistance, Application Engineering and Sales:

Phone: (513) 360-0800

Email: [product.sales@nuwaves.com](mailto:product.sales@nuwaves.com)

NuWaves Home Page: <https://www.nuwaves.com/>

Product Warranty:

[https://products.nuwaves.com/wp-content/uploads/NuWaves\\_Warranty\\_Repair.pdf](https://products.nuwaves.com/wp-content/uploads/NuWaves_Warranty_Repair.pdf)

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### 5.1 GENERAL INFORMATION

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