User Manual
NuPower™ LS5MI01
Micro L- & S-Band Power Amplifier

Part Number:
NW-PA-LS-5-MI01

NuWaves RF Solutions



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1 NUPOWER™ PRODUCT LINE OVERVIEW

The NuPower family of solid state RF power amplifier (PA) modules is designed to meet the demanding needs of the Aerospace & Defense, Industrial, and Commercial markets. Based on the latest gallium nitride (GaN) technology, NuPower's miniature form factor and power efficiency make it ideal for size, weight, and power-constrained broadband RF telemetry and tactical communications systems.

1.1 NUPOWER™ PRODUCT LINE HIGHLIGHTS

- High Performance: Unique combination of broadband coverage, miniature form factors, and high efficiency.

- Enclosures: The NuPower family of power amplifiers is housed in a silver nickel plated aluminum enclosure with mounting holes incorporated into the chassis.

- Completely Characterized: The NuPower family of solid state power amplifiers has been completely characterized over temperature, voltage, and frequency. These high-performance modules offer significant value for the OEM user or the Systems Integrator.

- User Friendly: Reverse-Voltage & Over-Voltage protection and regulator thermal shutdown provide defenses against user interface issues.

- High Reliability: NuWaves' selection of conservatively rated components provides high reliability. Each NuPower is inspected to IPC-A-610 Class II quality standards. NuWaves' Quality Management System is AS9100:2016 Rev D and ISO 9001:2015 certified.

- Applications: Unmanned Aircraft Systems (UAS) • Unmanned Ground Vehicles (UGV) • Unmanned Surface Vehicles (USV) • Broadband RF Telemetry • RF Communication Systems • Software Defined Radios • Test Labs

- Available Options:

    - Fan-cooled heat sink with North American AC/DC wall plug adapter
    - Labeled interface cable with banana jack plugs
    - 1 Watt input drive level (Part Number: NW-PA- LS-5-MI01-D30)

2 NUPOWER™ MICRO L- & S-BAND POWER AMPLIFIER

The NuPower™ LS5MI01 Micro L- & S-Band Power Amplifier boasts the smallest form factor of the NuPower family of PAs at 1.62 cubic inches. This highly efficient solid state power amplifier provides over 5 watts of RF power across both L and S frequency bands.

Based on the latest GaN technology, NuPower's power efficiency and miniature form factor make it ideal for size, weight, and power-constrained broadband RF telemetry and tactical communication systems. The NuPower Micro L- & S-band power amplifier takes low SWaP to a new level, allowing it to be integrated into the smallest aerial platforms flying today.

The NuPower LS5MI01 Micro L- & S-Band Power Amplifier is also available with a 1 watt input drive level version (P/N: NW-PA-LS-5-MI01-D30), making it ideal for use with L-3 Communications' Bandit miniature L- and S-band transceiver.

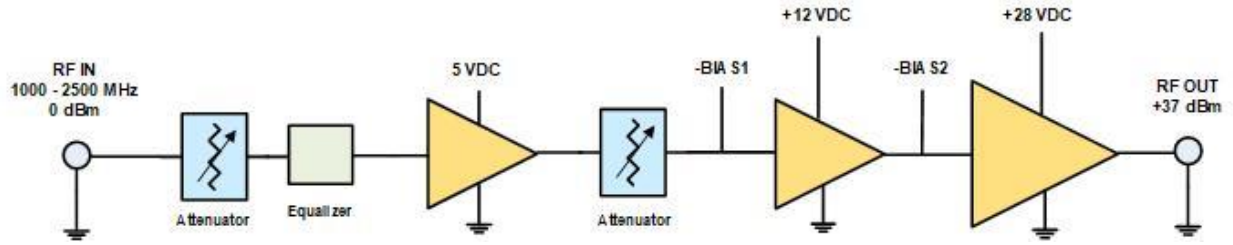


Figure 1: NuPower LS5MI01 Functional Diagram

2.1 NUPOWER LS5MI01 SPECIFICATIONS

The subsequent tables in this section outline the NuPower LS5MI01's performance specifications.

Table 1: NuPower LS5MI01 Electrical Specifications

Parameter	Specification
Frequency Range	1.0 GHz to 2.5 GHz
RF Output Power	5 Watts (min)
RF Gain	37 dB (typ) (7 dB w/ 1 Watt input drive level option)
2nd Harmonic	≤ -13 dBc
Supply Voltage	+28 VDC (nominal) +/- 2 VDC
Current Consumption[1]	1.25 A @ +28 VDC (max)
Nominal Input Drive Level[2]	0 dBm

Parameter	Specification
Maximum Input Drive Level (No damage)	+10 dBm (standard model only; not applicable to 1 Watt input drive level option)
Power Amplifier Enable	GND On
Impedance	50 Ω

[1]Part number NW-PA- LS-5-MI01-D30 has a current consumption of 0.85 A @ +28 VDC (max).

[2]The nominal input drive level for part number NW-PA- LS-5-MI01-D30 is +30 dBm.

Table 2: NuPower LS5MI01 Environmental Specifications

Operating Conditions	Specification
Operating Temperature for Continuous Operation (>5 minutes)	-30 to +55 °C (ambient) -30 to +60 °C (baseplate)
Operating Temperature for 20% Duty Cycle	-30 to +60 °C (ambient) -30 to +65 °C (baseplate)
Storage Temperature	-40 to +85 °C

2.2 NUPOWER LS5MI01 MECHANICAL SPECIFICATIONS

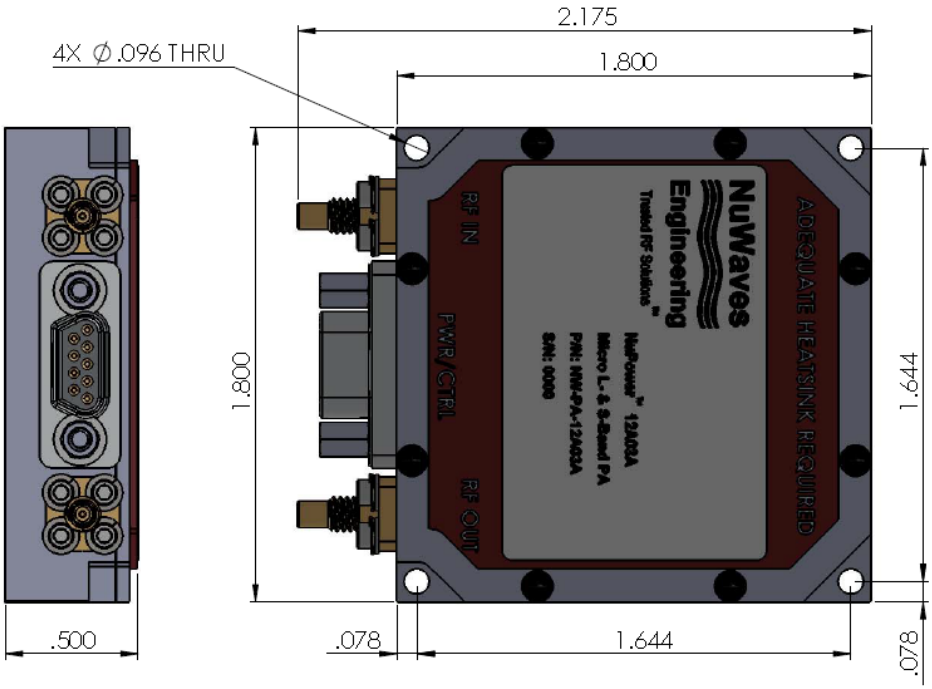


Figure 2: NuPower LS5MI01 Mechanical Outline

Table 3: NuPower LS5MI01 Mechanical Specifications

Parameter	Specification
RF Connectors	SSMC (female)
Power / Interface Connector	9 Pin Micro-D (socket)
Dimensions (L x W x H)	1.80” x 1.80” x 0.50”
Weight	1.3 oz.

2.3 HEAT SINKING

The NuPower LS5MI01 is offered as a stand-alone module or with a kit, which also includes a fan-cooled heat sink with an AC/DC adapter, and an interface cable.

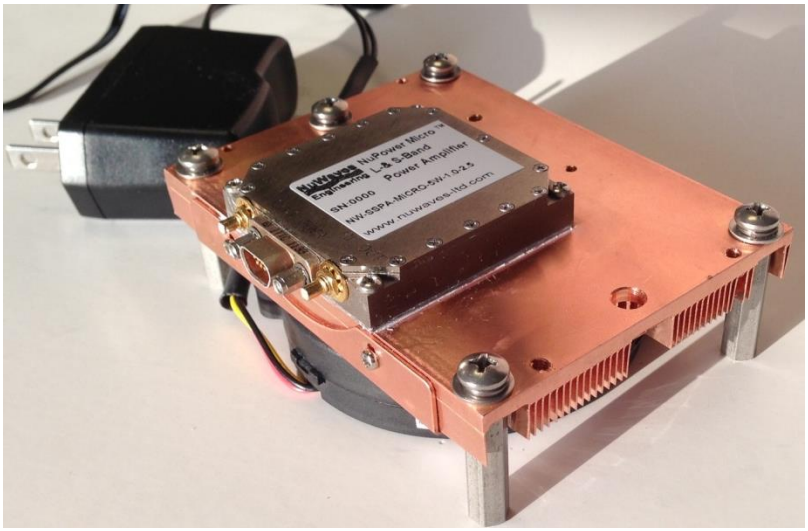


Figure 3: The NuPower PA Kit offers "out-of-the-box" operation for the user. The fan-cooled heat sink with an AC/DC adapter is shown with an example PA (NuPower LS5MI01 not shown).



Caution: The use of external heat-sinking is required especially for those applications requiring high duty cycle operation (e.g. continuous wave) or for extended on-time testing. Operation without a proper heat sink under these conditions will cause permanent damage to the product and will void the product warranty.

3 SETUP AND OPERATION

This section provides specific details for proper operation of the NuPower Micro L- & S-Band PA module. Following these guidelines will prevent damage to the power amplifier or external equipment.

3.1 POWER SUPPLY REQUIREMENTS

To operate the NuPower LS5MI01, ensure that the power supply has adequate overhead to source the current demand of the RF power amplifier. The power supply source must provide a typical voltage of +28 VDC with greater than 3 amps capability.

3.2 CONNECTING A PROPER LOAD TO THE ANTENNA TERMINAL

To prevent damage to the PA, the antenna terminal must be terminated into a 50 Ω load. Examples of a proper load include:

- Directly connecting to an antenna specified for the frequency range (1.0 GHz to 2.5 GHz). Connecting to an inappropriate antenna may result in damage to the PA module.
- Connecting to a proper antenna through a 50 Ω transmission line or coaxial cable. Avoid using damaged cables or corroded connectors while attaching the unit to an antenna.
- Terminating the antenna terminal into a 50 Ω power attenuator with minimum 20 dB attenuation.
- Connecting to a load capable of dissipating the RF power from the PA module. Loads capable of handling 20 Watts (min) are recommended.

3.3 POWERING-UP THE LS5MI01

The NuPower LS5MI01 must be terminated to a proper load before power is applied. Refer to Section 3.2 for the specifications of the proper load. After the PA is properly terminated, the interface cable can be connected to the unit and power can be applied. The PA is now ready for operation.

3.4 TRANSMIT TURN-ON TIME



Caution: Do not apply transmit data until the PA module is at full power. This will prevent loss of data at the beginning of a message.

The NuPower LS5MI01 is at full power approximately 500 µS after the RF Enable line goes low (ground). Therefore, transmit data can be applied to the input after 500 µS without loss of data.

4 HARDWARE INTERFACE

- The RF Input connector is SSMC (female).
- The RF Output connector is SSMC (female).
- The pin-out definitions for the 9 pin Micro-D socket connector are provided in Table 4. In a typical installation, the PA module is mated to a host controller board via a cable harness.



The RF Out SSMC connector is the antenna connection. This connection should always be loaded into 50 Ω, otherwise the PA could be damaged.

4.1 INTERFACE CABLE HARNESS

The cable harness that connects the host controller to the 9 pin Micro-D connector of the NuPower LS5MI01 is made up of 9 wires.

Table 4: NuPower LS5MI01 Interface Pin-Out Definitions

Pin No.	Pin Name	I/O	Description
1, 2	GND	I	Signal and Power Ground
3, 4	V Supply	I	Primary Power (+28 VDC)
5	RF Enable	I	Transmit Control
6, 7, 9	N.C.	-	N/A
8	Temp Flag	O	Over-temp Indicator

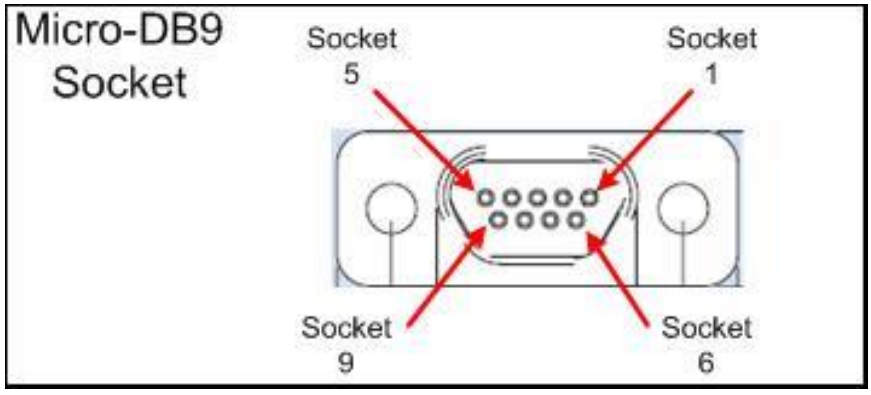


Figure 4: Micro-D Socket Locations

4.2 DC POWER

The typical supply voltage for the NuPower LS5MI01 is +28 VDC; however, the amplifier module is able to support operation over a supply voltage range of +26 to +30 VDC.

4.3 GND

The signal and power grounds are tied together in the PA module.

4.4 RF ENABLE

This signal is the logic control input that designates whether the unit is in transmit or standby mode. The RF Enable line is pulled high internally placing the PA module in *standby* mode. If the pin is left floating (i.e. not connected), the unit will default to *standby* mode.

Grounding the pin (i.e. a voltage below +0.2 VDC) places the unit in *transmit* mode. The user can either connect the RF Enable line to pins 1 & 2 on the CTRL/PWR interface connector, or an open drain logic line capable of sinking 500 μA to place the unit in *transmit* mode.

4.5 TEMP FLAG

This signal is a logic-level output to indicate an over-temperature condition in the NuPower LS5MI01. A logic high (+5 VDC) indicates normal operation, while a logic low (+0 VDC) indicates an over-temperature condition. The NuPower LS5MI01 incorporates internal logic circuitry that turns off the DC bias to the RF transistors.

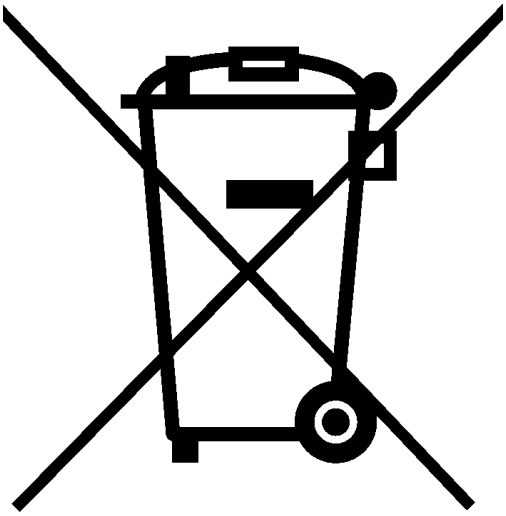


Caution: The amplifier should be shut down and allowed to cool off when the over-temperature flag is set low to avoid damage to the module.

5 PRODUCT DISPOSAL – END-OF-LIFE

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



6 GETTING HELP - APPLICATIONS ENGINEERING

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: sales@nuwaves.com

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

Product Warranty:

https://nuwaves.com/wp-content/uploads/NuWaves_Warranty_Repair-1.pdf

6.1 GENERAL INFORMATION

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