

USER MANUAL

NUPOWER™ S100A01

S-BAND POWER AMPLIFIER

PART NUMBER:
NW-PA-S-100-A01



NuWaves RF Solutions
132 Edison Drive
Middletown, Ohio 45044
PH: 513-360-0800
FAX: 513-539-8782
www.nuwaves.com
sales@nuwaves.com

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 power efficiency and miniature form factor 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 are 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 have 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: 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: Broadband RF Telemetry • RF Communication Systems • Electronic Warfare • Unmanned Aircraft Systems (UAS) • Unmanned Ground Vehicles (UGV) • Unmanned Surface Vehicles (USV) • Software Defined Radios • Test Labs
- Available Options:
 - Fan-cooled heat sink with 28V operated fan
 - Labeled interface cable with banana jack plugs

2 NUPOWER™ S100A01 PA OVERVIEW

The NuPower™ S100A01 PA is a highly efficient, solid state power amplifier that typically provides 125 Watts of RF power across 2000 MHz – 2500 MHz.

Based on the latest gallium nitride (GaN) technology, NuPower S-Band power efficiency and < 10 in³ cubic inch form factor make it ideal for size, weight, and power-constrained broadband RF telemetry and tactical communication systems.

The NuPower™ S100A01 ruggedized chassis allows the system integrator to easily incorporate the unit into a platform operating in harsh environments with limited space, such as small Unmanned Aircraft Systems (UAS).

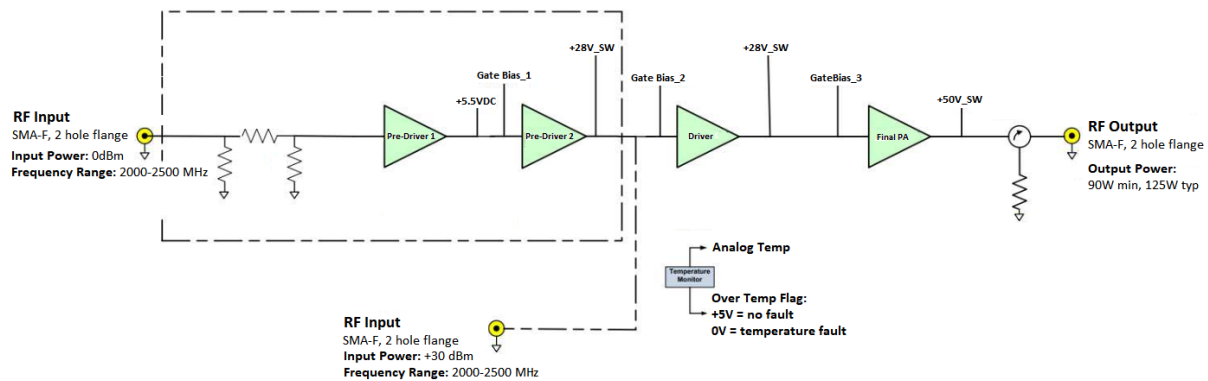


Figure 1: NuPower S100A01 Functional Diagram

2.1 NUPOWER S100A01 PA SPECIFICATIONS

The subsequent tables in this section outline the NuPower S100A01's performance specifications.

Table 1: NuPower S100A01 Electrical Specifications

| Parameter | Specification |
|--|---------------------------------|
| Frequency Range | 2000 MHz to 2500 MHz |
| RF Output Power | 90 Watts (min); 125 Watts (typ) |
| Output Power @ 1 dB Compression | 36 dBm @ 2000 MHz |
| | 37 dBm @ 2250 MHz |
| | 41 dBm @ 2500 MHz |
| RF Large Signal Gain | 21 dB (typ) |
| Input VSWR | 1.5:1 (typ) |
| Output Mismatch Max (No Damage all Phase Angles) | 10:1 |
| Nominal Input Drive Level | +30 dBm |
| Maximum Input Drive Level (No damage) | +33 dBm |
| Harmonics | 2 nd : ≤-52 dBc |
| | 3 rd : ≤-55 dBc |
| Third Order Intercept Point (Two tone test at 1 MHz spacing, Pout = 30 dBm / tone) | 46 dBm @ 2000 MHz |
| | 47 dBm @ 2250 MHz |
| | 49 dBm @ 2500 MHz |
| Switching Speed | 2 μs (max), 500 ns (typ) |
| Operating Voltage | +27 to +32 VDC |
| Operating Current | 11.5 A @ +28 VDC (typ) |
| Module Efficiency | 40% (typ) |
| Power Amplifier Enable | RF Enable = Low (0V – +0.8VDC) |
| Impedance | 50 Ω |

Table 2: NuPower S100A01 Environmental Specifications

| Operating Conditions | Specification |
|-----------------------|--|
| Operating Temperature | -40 to +45 °C (ambient) ¹ -40 to +70 °C (baseplate) ² |
| Storage Temperature | -55 to +85 °C |

Table 2 Notes:

¹45°C max ambient operating temperature with HTSK-07; P_{out} = 100W²70°C max baseplate operating temperature (S100A01 module only); P_{out} = 100W**Table 3: NuPower S100A01 Mean Time Between Failure (MTBF)**

| Conditions | Hours |
|------------------------------------|---------|
| Ground Benign (GB) | 526,231 |
| Airborne Inhabited Cargo (AIC) | 158,020 |
| Airborne Inhabited Fighter (AIF) | 131,963 |
| Airborne Uninhabited Cargo (AUC) | 51,259 |
| Airborne Uninhabited Fighter (AUF) | 43,418 |

2.2 NUPOWER S100A01 PA MECHANICAL SPECIFICATIONS

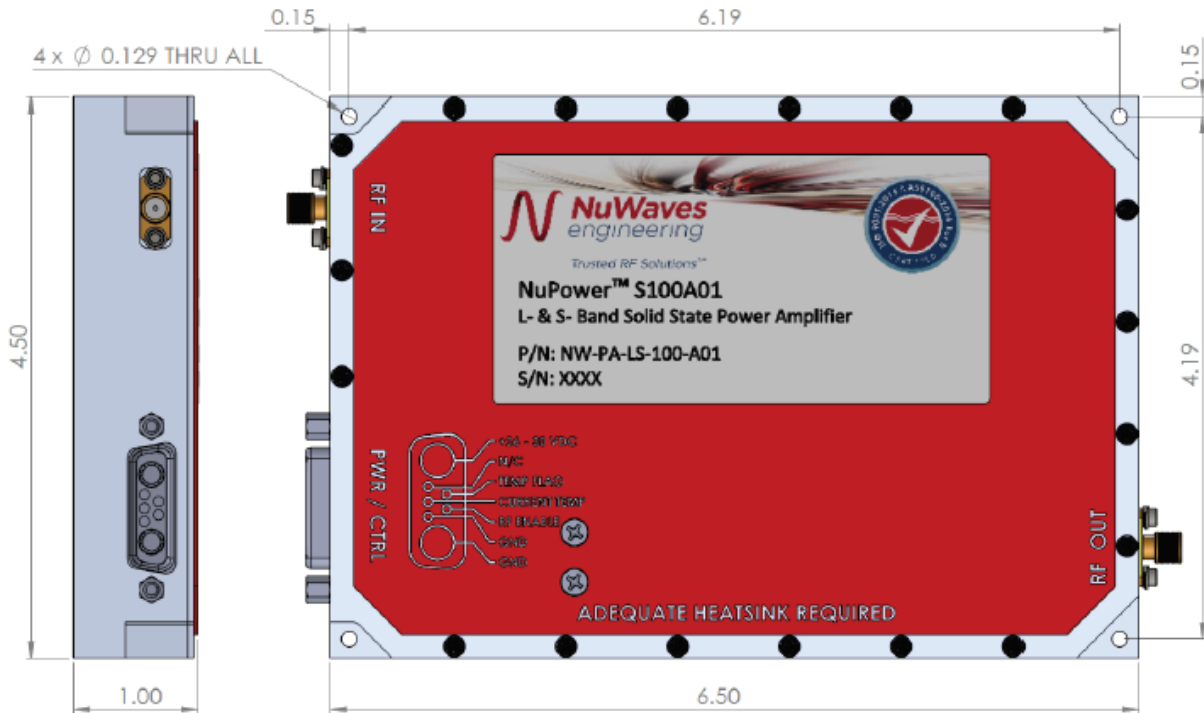


Figure 2: NuPower S100A01 Mechanical Outline

Table 4: NuPower S100A01 Mechanical Specifications

| Parameter | Specification |
|-------------------------------------|--------------------------------|
| RF Connectors | SMA (female) |
| Control / Power Interface Connector | Micro-D Hybrid, 7+2-pin Socket |
| Dimensions (L x W x H) | 6.5" x 4.5" x 1.0" |
| Weight | 22.6 oz. |

2.3 HEAT SINKING

The NuPower S100A01 is offered as a stand-alone module or with an optional heat sink (p/n: HTSK-07), which includes a 28 VDC fan-cooled heatsink and requisite power cable.



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.

The maximum operating temperature of the module only is 70° C (baseplate).

3 SETUP AND OPERATION

This section provides specific details for proper operation of the NuPower S100A01 module. Following these guidelines will prevent damage to the power amplifier or external equipment.

3.1 POWER SUPPLY REQUIREMENTS

To operate the NuPower S100A01, 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 13 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 (2000 MHz to 2500 MHz). 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 high 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 200 Watts (min) are recommended.

3.3 POWERING-UP THE NUPOWER S100A01

The NuPower S100A01 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

The NuPower S100A01 is at full power approximately 500ns after the RF Enable line goes low (ground). Therefore, transmit data can be applied to the input after 500ns without loss of data.

4 HARDWARE INTERFACE

- The RF Input connector is SMA (female).
- The RF Output connector is SMA (female).
- The pin-out definitions for the Micro-D Hybrid, 7 +2-pin socket connector are provided in Table 5. In a typical installation, the PA module is mated to a host controller board via a cable harness.



The RF Out SMA 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 Micro-D Hybrid, 7 +2-pin socket connector of the NuPower S100A01 is made up of 9 wires.

Table 5: NuPower S100A01 Interface Pin-Out Definitions

| Pin No. | Pin Name | I/O | Description |
|---------|-----------------------|-----|--|
| A2 | DC Power (+28V) | I | Primary Power (+28 VDC) |
| 3, A1 | GND | I | Signal and Power Ground |
| 2 | Over Temperature Flag | O | +5V TTL Logic Level 0V = Temperature Fault +5V = No Fault |
| 1 | RF Enable | I | Transmit Control: RF Enable Floating = RF Off RF Enable Logic Low (0V- +0.8V) = Bias Enabled |
| 4 | Current Temp | O | Analog voltage calibrated to internal temp |
| 5 | N/C | N/A | No Connect |

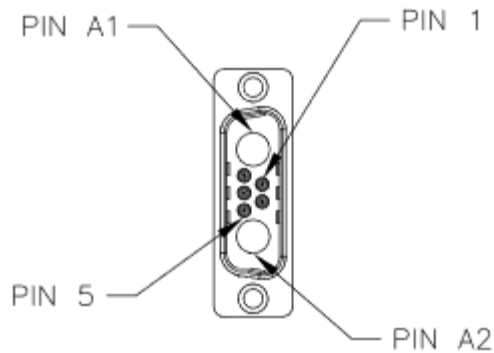


Figure 3: Micro-D Hybrid, 7 +2-pin Socket Locations

*Do not connect the Temperature Flag to DC Power (+28 Volts input). The Temperature Flag can be used to monitor thermal status.

4.2 DC POWER

The nominal supply voltage for the NuPower S100A01 is +28 VDC. The acceptable supply voltage range is +26 to +32 VDC. If a voltage above 32VDC is applied, the drain bias to internal amplifiers will be removed and the transmit path will be non-operational.

4.3 GROUND

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 +0.8 VDC) places the unit in *transmit* mode. The user can either connect the RF Enable line to pins A1 or 3 on the CTRL/PWR interface connector, or an open drain logic line capable of sinking 500 μ A to place the unit in *transmit* mode.

Do not connect the RF Enable line to DC Power (+28 Volts input). No input voltage is required on the RF Enable line.

4.5 TEMP FLAG

This signal is an output to indicate an over-temperature condition in the NuPower S100A01. A logic high (+5 VDC) indicates normal operation, while a logic low (0 VDC) indicates an over-temperature condition. The NuPower S100A01 incorporates internal logic circuitry that turns off the DC bias to the RF amplifiers. See section 4.6 for details on thermal shutdown points.



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.



Do not connect the Temperature Flag to DC Power (+28 Volts input). The Temperature Flag can be used to monitor thermal status.

4.6 CURRENT TEMP

This signal is an output to indicate internal temperature of the S100A01. Temperature Flag (Section 4.5) threshold is reached when internal temperature of approximately 85°C is exceeded and will re-enable bias to internal RF amplifiers at approximately 70°C. See Figure 5 below for 'current temp' voltage and corresponding internal temperature.

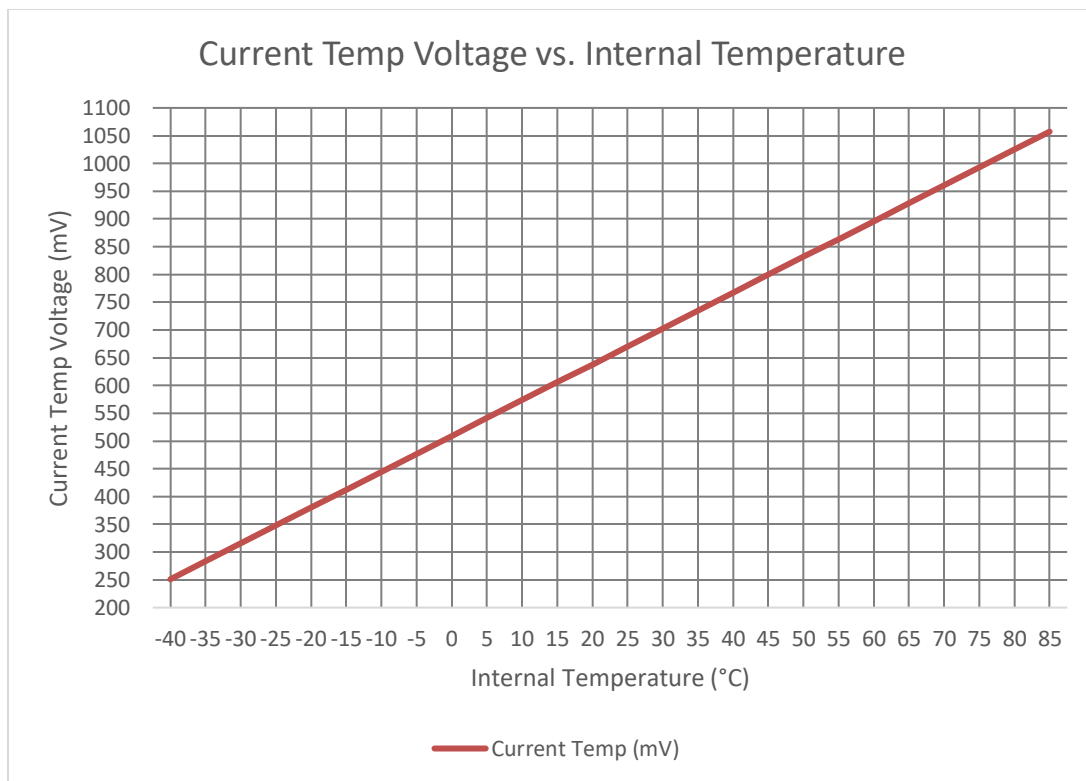
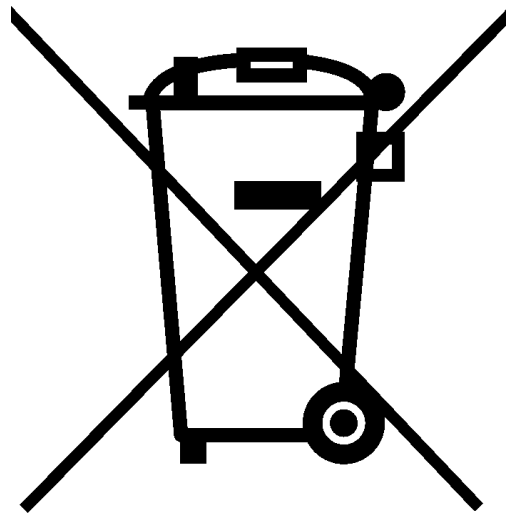


Figure 5. Current Temperature Output Voltage vs. Internal Temperature

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: support@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

Copyright © 2006 – 2022 NuWaves Ltd. All rights reserved. The information contained in this user manual is copyright protected. NuWaves reserves the right to make periodic modifications and product improvements to the NuPower product line and the associated documentation.