

USER MANUAL

NUPOWER™ S-10-C02-S01

S-BAND POWER AMPLIFIER

PART NUMBER:
NW-PA-S-10-C02-S01



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1 NUPOWER™ PRODUCT LINE OVERVIEW

The NuPower™ family of solid-state RF power amplifier (PA) modules are 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. NuPower™ amplifiers are designed with ruggedized chassis for high reliability in harsh environments.

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 an 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: Reverse-voltage and 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 120V AC/DC wall plug adapter
 - Labeled interface cable with banana jack plugs
 - Custom filtering for mission specific needs

2 NUPOWER™ S-10-C02-S01 OVERVIEW

The NuPower™ S-10-C02-S01 S-Band Power Amplifier module is a small, lightweight, and power-efficient amplifier, ideal for extending the communication range of half duplex and full duplex S-band transceivers running constant-envelope or near-constant-envelope waveforms. The amplifier generates at least 10 watts of RF transmit power (14 watts typical) from 2200 to 2500 MHz.

The NuPower™ S-10-C02-S01 provides user control of the RF output power setting through RS-232 serial commands. The output power controls from Pmax to Pmin allow the user to have flexibility in RF output power (see Section 5.1.1 for power control). When operating in close proximity, the user can operate at a reduced RF output power, such as Pmin, to avoid co-located interference. The user can easily command the PA to switch to higher RF output power levels once the aircraft is in flight or once the risk of co-located interference is removed.

Based on the latest Gallium Nitride (GaN) technology, NuPower’s high-efficiency and 7.75 in.³ form factor make it ideal for SWaP-constrained applications.

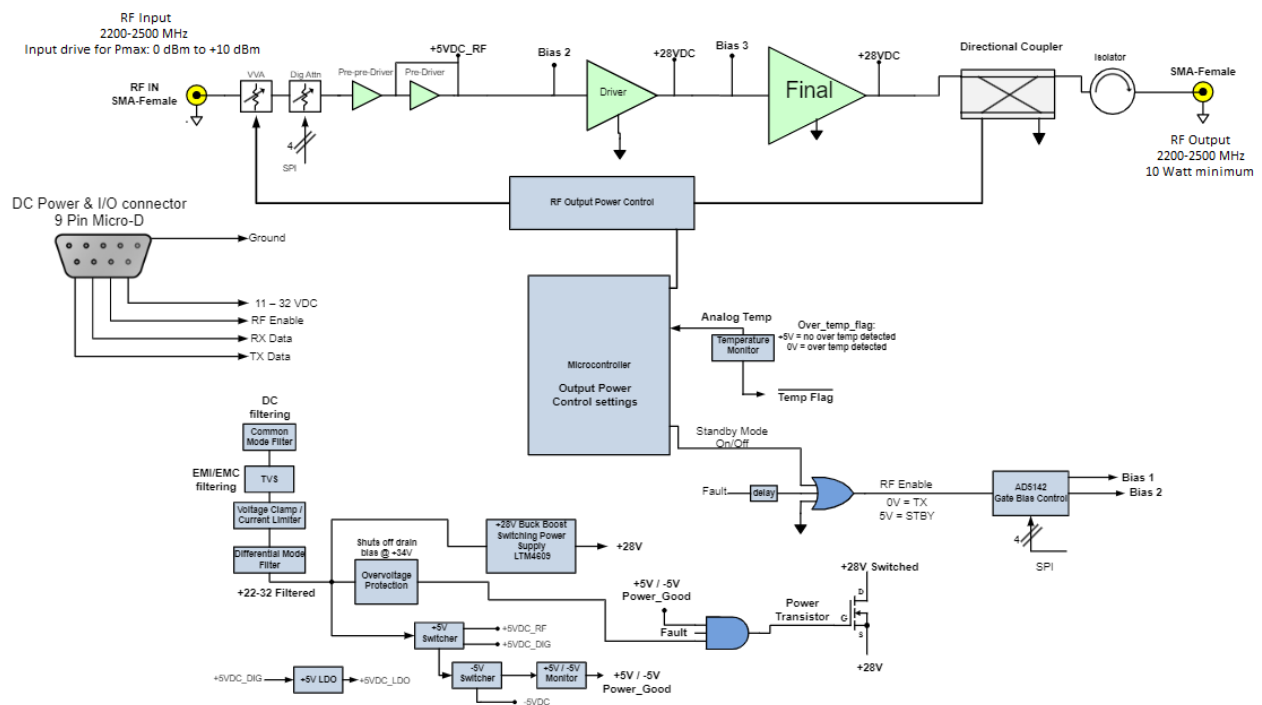


Figure 1: NuPower™ S-10-C02-S01 Functional Diagram

2.1 SPECIFICATIONS

The subsequent tables in this section outline the NuPower™ S-10-C02-S01's performance specifications.

Table 1: NuPower™ S-10-C02-S01 Electrical Specifications

Parameter	Specification
Frequency Range	2200 to 2500 MHz
RF Output Power	10 Watts (min), 14 Watts (typ)
Transmit RF Gain	41.5 dB (typ)
Nominal Input Drive Level	0 dBm
Small Signal Gain	49 dB
Maximum Input Drive Level	+12 dBm
Supply Voltage	22-32 VDC
Supply Voltage	+11 to +32 VDC
Quiescent (standby) Current	130 mA [RF OFF/RF Enable Floating]
Quiescent (bias) Current	430 mA [RF ON/RF Enable Low]
Operating Current	2.29 A @ +28 VDC (typ) 3 A @ +28 VDC (max)
Input VSWR	1.4:1
Output Mismatch (no damage)	10:1 (no damage at all phase angles)

Table 2: NuPower™ S-10-C02-S01 Environmental Specifications

Operating Conditions	Specification
Operating Temperature (100% transmit duty cycle)	-40 to +85 °C (baseplate)
Storage Temperature	-55 to +85 °C

2.1.1 MECHANICAL SPECIFICATIONS

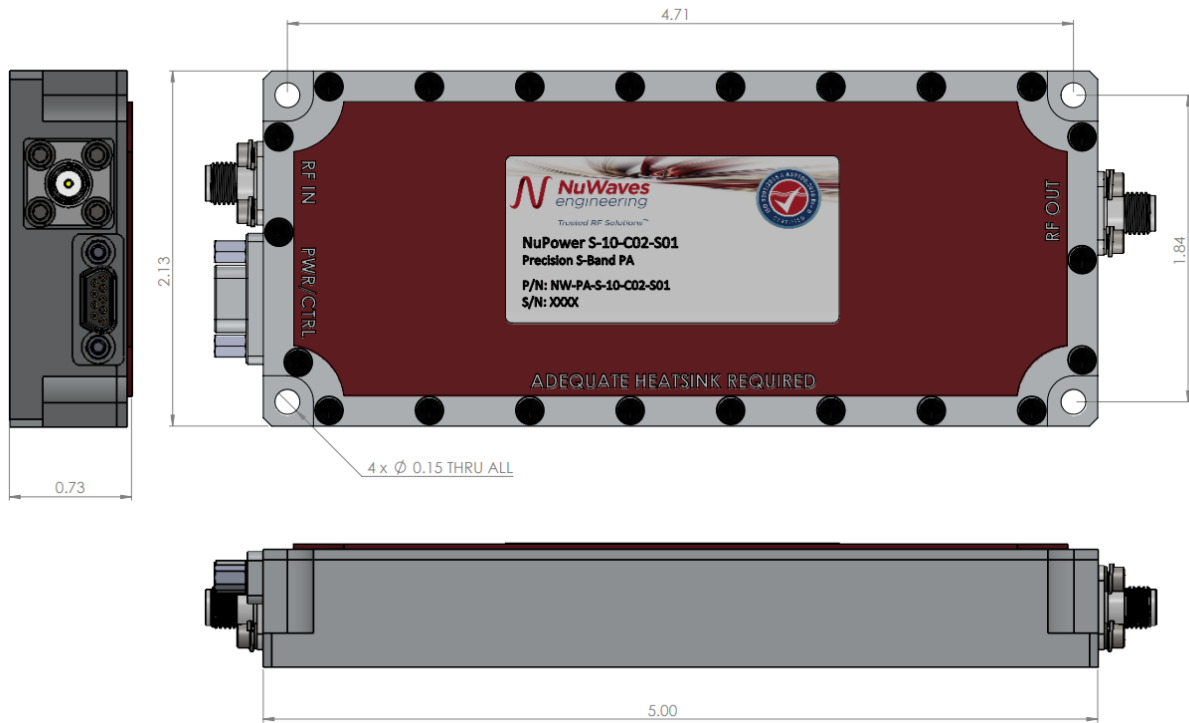


Figure 2: NuPower™ S-10-C02-S01 Mechanical Outline

Table 3: NuPower™ S-10-C02-S01 Mechanical Specifications

Parameter	Specification
RF Connectors	SMA (female)
Control / Power Interface Connector	9 Pin Micro-D (socket)
Dimensions (L x W x H)	2.125" x 5.000" x 0.730"
Weight	8 oz.

2.2 HEAT SINKING

The NuPower™ is offered as a stand-alone module, or as part of a kit, which also includes a fan-cooled heat sink with an AC/DC adapter and an interface cable with banana jack plug terminations. The fan-cooled heat sink provides sufficient cooling for operating the NuPower™ at room temperature (25°C); however, higher ambient temperatures may require additional heatsinking to maintain a baseplate temperature below 85 °C at 100% transmit duty cycle.

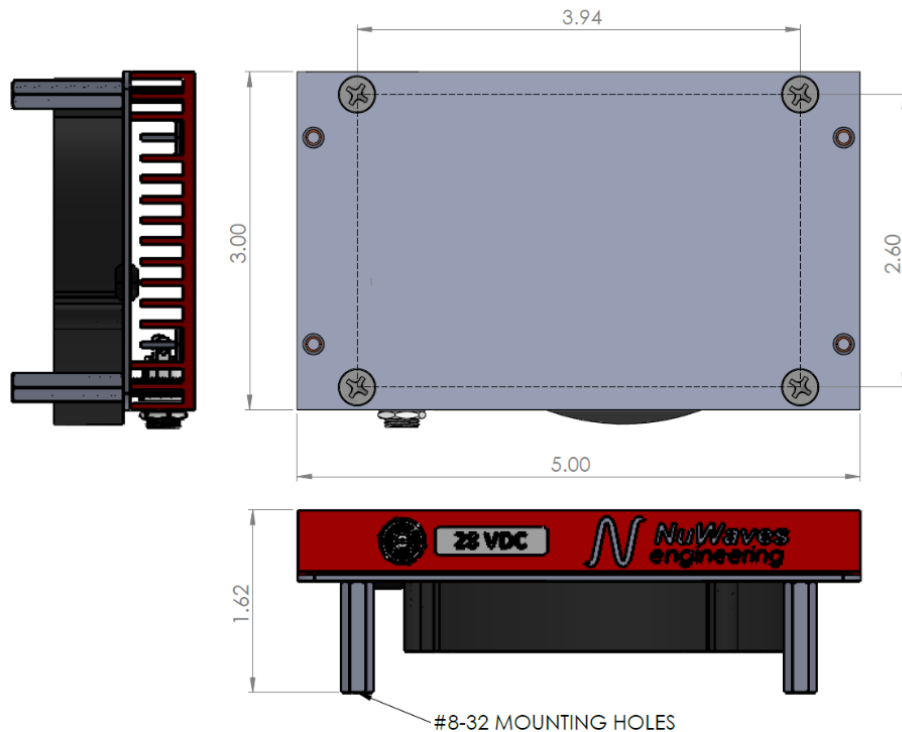


Figure 3: The NuPower™ S-10-C02-S01 pairs with heatsink P/N: HTSK-05 and is offered as an optional accessory. Heatsink is sold with 28 VDC power cable for “out of the box” operation.



Caution: The use of external heatsinking 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™ S-10-C02-S01 module. Following these guidelines will prevent damage to the power amplifier or external equipment.

3.1 POWER SUPPLY REQUIREMENTS

To operate the NuPower™ S-10-C02-S01, ensure that the power supply has adequate overhead to source the current demand of the RF amplifier. The power supply source must provide a voltage of +22 to +32 VDC with greater than 4 amps capability.

3.2 CONNECTING A PROPER LOAD TO THE ANTENNA TERMINAL

To prevent damage to the amplifier module, 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 (2.2 to 2.5 GHz). Connecting to an inappropriate antenna may result in damage to the amplifier 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 50 Ω load capable of dissipating the RF power from the amplifier module. Loads capable of handling 30 Watts (min) are recommended.

3.3 POWERING-UP THE NUPOWER™ S-10-C02-S01

The NuPower™ S-10-C02-S01 must be terminated into a proper load before power is applied. Refer to Section 3.2 for the specifications of the proper load. After the amplifier is properly terminated, the interface cable can be connected to the unit and power can be applied. Refer to Section 4.1 for information on power connections. The amplifier is now ready for operation.

4 HARDWARE INTERFACE

- The “RF In” interface connector is SMA (female).
- The “RF Out” interface connector is SMA (female).
- The pin-out definitions for the 9 pin Micro-D socket connector are provided in Table 4. In a typical installation, the amplifier 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 amplifier could be damaged.

4.1 INTERFACE CONNECTOR

The NuPower™ S-10-C02-S01 features a 9 pin Micro-D interface connector for control, power, and ground

connections.

Table 4: NuPower™ S-10-C02-S01 Interface Pin-Out Definitions

Socket No.	Name	I/O	Description
1, 2, 6	GND	I	Signal and Power Ground
3, 4, 5	DC Power	I	DC Power Input (22-32VDC)
7	RX Data	O	RS-232 Data Receive
8	TX Data	I	RS-232 Data Transmit
9	RF Enable	I	0VDC or GND=RF ON +5VDC or N/C (floating) = RF OFF

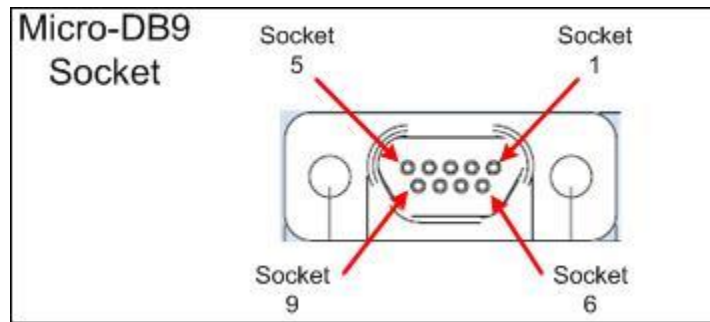


Figure 4: Micro-D Socket Locations

The standard interface cable harness is comprised of 9 wires, includes a Micro-D connector with pins, and mates directly to the NuPower™ S-10-C02-S01 interface connector.

4.2 DC POWER

The nominal supply voltage for the NuPower™ S-10-C02-S01 is +28 VDC. The amplifier module supports operation over a supply voltage range of +22 to +32 VDC with minimal performance degradation.

4.3 GROUND

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

4.4 RS-232 SERIAL COMMUNICATIONS

These signals are for the RS-232 serial communications with the NuPower™ S-10-C02-S01. This interface is described in Section 5.

4.5 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 (0VDC to +1.5VDC) places the unit in *transmit* mode. The user can either connect the

RF Enable line to pins, 1, 2, & 6 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.

5 SERIAL INTERFACE

The NuPower™ S-10-C02-S01 is designed to communicate with an RS-232 serial interface for adjusting linearization parameters via a serial terminal program, such as *Terminal*.

The serial port must be configured with the following attributes:

- Baud rate: 19200
- Data bits: 8
- Stop bits: 1
- Parity: None
- Handshaking: None

This section provides the user with the command syntax necessary to properly configure the amplifier module for use. All commands have the following attributes:

- Command processing is *not* case sensitive.
- Spaces are always allowed and always ignored.
- After receiving and processing a command, the NuPower™ sends a Carriage Return terminated string as a notification that the command was completed.

5.1 SERIAL COMMANDS

Serial commands are outlined in the table below.

Table 5: NuPower™ S-10-C02-S01 Serial Commands

Command	Function
CONSTO	Store settings to EEPROM
FACTORY	Return unit to factory default values
ALL?	Reports all current operating parameters
STAT?	Displays basic system status
MANx	Sets automatic (0) or manual (1) adjustment mode
MTGTxx	Manually set target level (in man1); 0=min pwr; 15=max pwr; 16=standby

5.1.1 Power Control

The NuPower™ S-10-C02-S01 features precision power control, where the user can back off output power in 1dB steps without adjusting the input power to the amplifier. Prior to adjusting output power, the command 'man1' must be sent. See Table 6 below for the commands and performance of each power backoff mode:

Table 6: NuPower™ S-10-C02-S01 Power Control Commands & Performance

Command	Setting	Description	Typical Output Power (dBm)	Typical Current (A)
MTGT15	Pmax	Max Output Power	41.6	2.29
MTGT14	Pmax-1	1dB Backoff from Pmax	40.7	2.07
MTGT13	Pmax-2	2dB Backoff from Pmax	39.8	1.87
MTGT12	Pmax-3	3dB Backoff from Pmax	39.0	1.71
MTGT11	Pmax-4	4dB Backoff from Pmax	38.1	1.55
MTGT10	Pmax-5	5dB Backoff from Pmax	37.2	1.41
MTGT9	Pmax-6	6dB Backoff from Pmax	36.3	1.28
MTGT8	Pmax-7	7dB Backoff from Pmax	35.4	1.17
MTGT7	Pmax-8	8dB Backoff from Pmax	34.5	1.07
MTGT6	Pmax-9	9dB Backoff from Pmax	33.7	0.99
MTGT5	Pmax-10	10dB Backoff from Pmax	32.7	0.90
MTGT4	Pmax-11	11dB Backoff from Pmax	31.8	0.83
MTGT3	Pmax-12	12dB Backoff from Pmax	30.9	0.77
MTGT2	Pmax-13	13dB Backoff from Pmax	29.9	0.72
MTGT1	Pmax-14	14dB Backoff from Pmax	29.1	0.67
MTGT0	Pmin	Min Output Power	28.1	0.63
MTGT16	Stby	Standby; RF Off	N/A	0.13

5.1.2 Configuration Storage

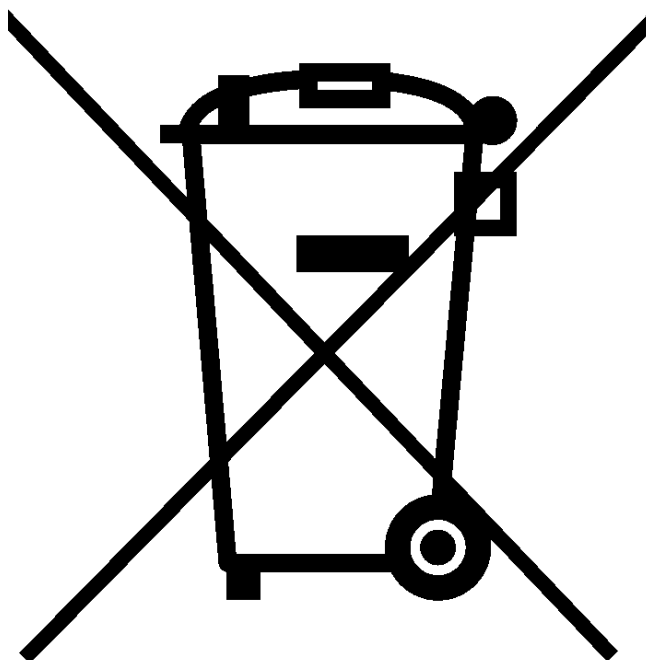
The “CONSTO” command is used to store current settings to the EEPROM. If a value is changed and the CONSTO command is not entered, it will return to the last stored setting upon unit power cycling, and the changes will be lost.

The “FACTORY” command is used to return to the factory default settings.

6 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



7 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:

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7.1 GENERAL INFORMATION

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