

# USER MANUAL

## NUPOWER XTENDER SCISR-20-C01-S01

### TRI-BAND BIDIRECTIONAL AMPLIFIER

PART NUMBER:  
NW-BA-SCISR-20-C01-S01



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# 1 NUPOWER XTENDER™ PRODUCT LINE OVERVIEW

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The NuPower Xtender family of solid-state bidirectional RF amplifier modules, or “T/R 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 Xtender’s power efficiency and miniature form factor make it ideal for size, weight, and power-constrained broadband RF telemetry and tactical communications systems.

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## 1.1 NUPOWER XTENDER™ PRODUCT LINE HIGHLIGHTS

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- High Performance: Unique combination of broadband coverage, miniature form factors, and high efficiency.
- Enclosures: The NuPower Xtender family of bidirectional amplifiers is housed in an aluminum enclosure with mounting holes incorporated into the chassis.
- Completely Characterized: The NuPower Xtender family of solid-state bidirectional 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: 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

## 2 NUPOWER XTENDER SCISR-20-C01-S01 OVERVIEW

The NuPower Xtender™ SCISR-20-C01-S01 Bidirectional Tri-Band Amplifier module is a small, lightweight, and power-efficient bidirectional amplifier (BDA) ideal for extending the communication range of half-duplex transceivers using continuous wave (CW) and near-constant envelope waveforms.

Based on the latest Gallium Nitride (GaN) technology, the NuPower Xtender SCISR-20-C01-S01's high-efficiency and 32.6 in.<sup>3</sup> form factor make it ideal for SWaP-constrained applications. In addition, the NuPower Xtender SCISR-20-C01-S01's broadband frequency coverage supports operational flexibility.

NuPower Xtender bidirectional amplifiers are designed with a ruggedized chassis for high reliability in harsh environments.

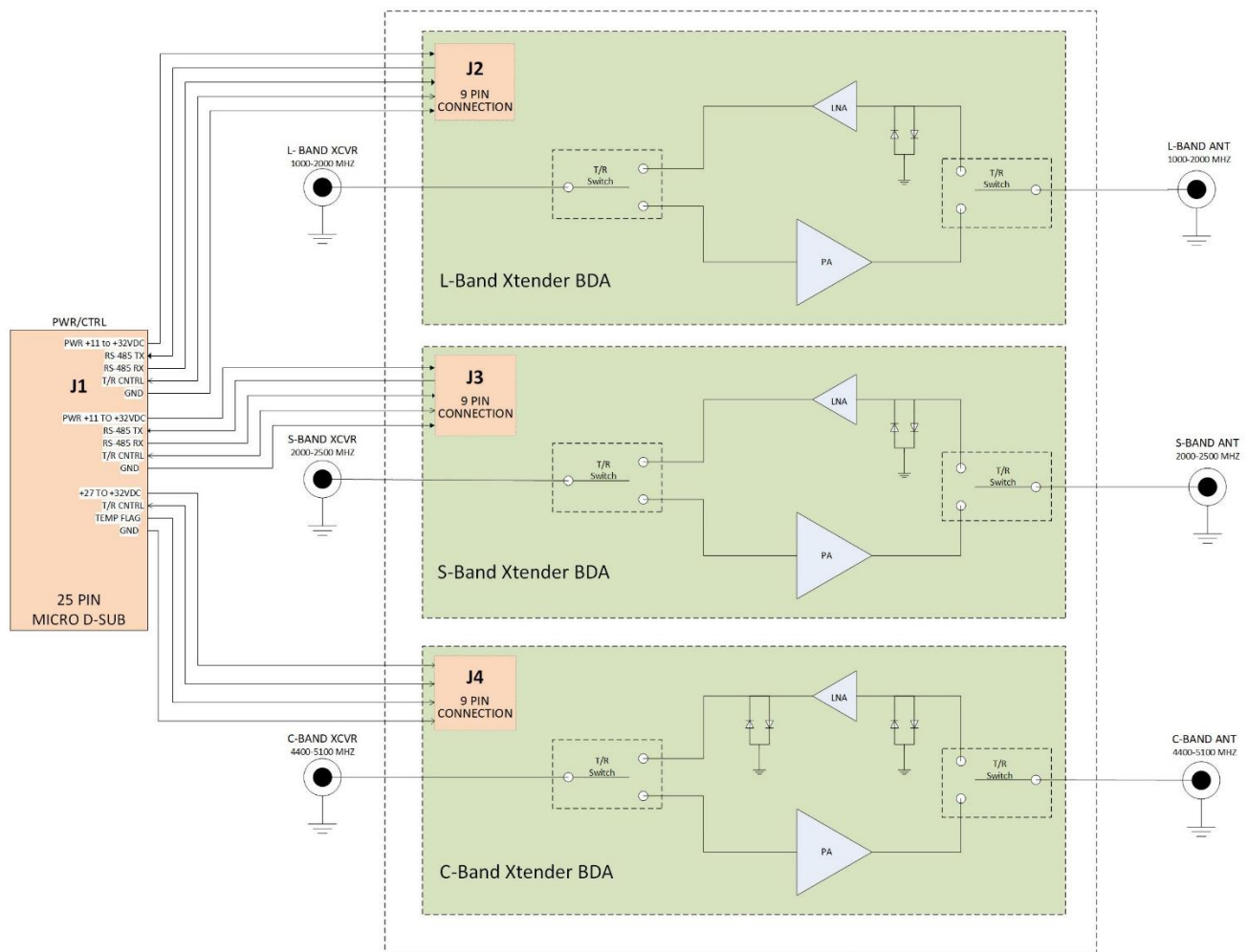


Figure 1: NuPower Xtender SCISR-20-C01-S01 Functional Diagram

## 2.1 PRELIMINARY SPECIFICATIONS

The subsequent tables in this section outline the NuPower Xtender SCISR-20-C01-S01's performance specifications.

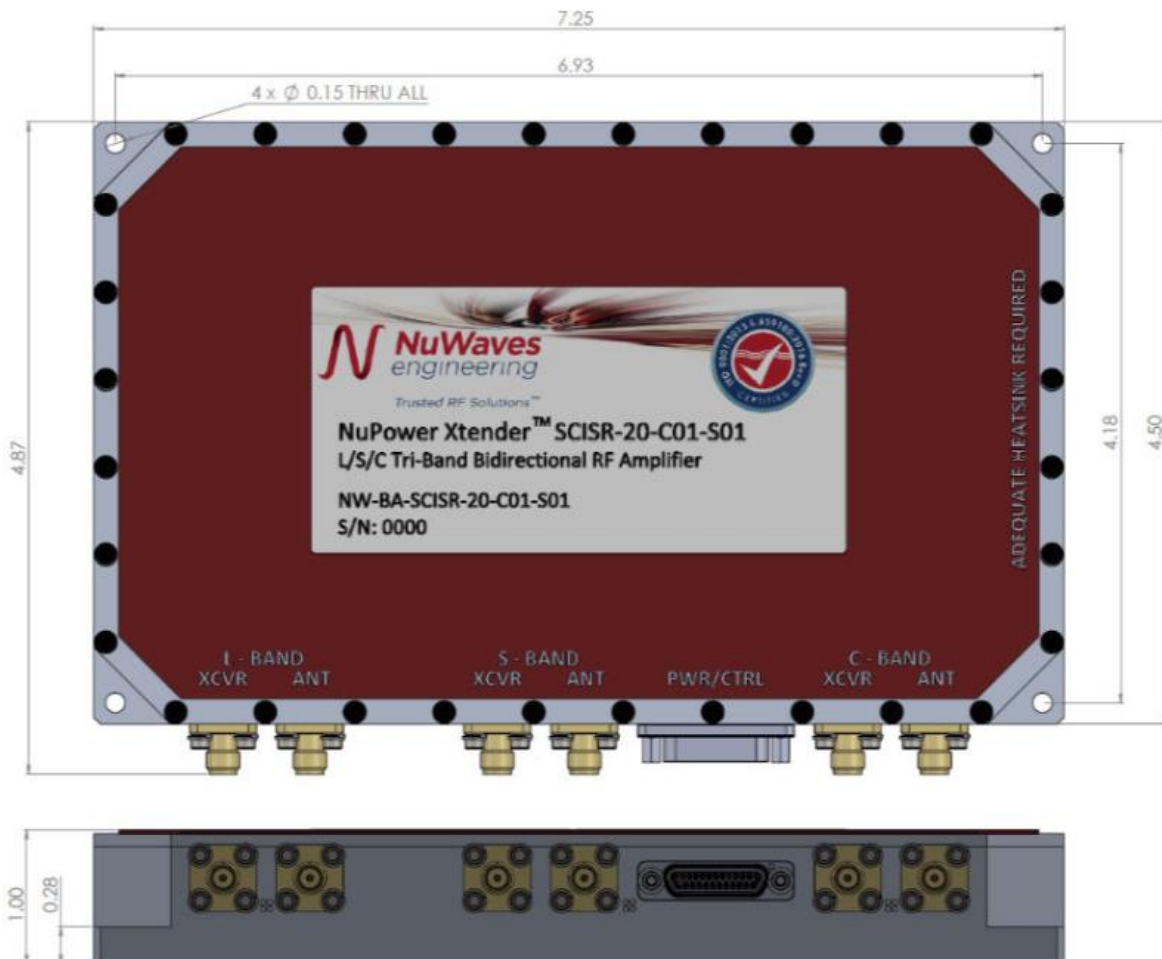
**Table 1: NuPower Xtender SCISR-20-C01-S01 Electrical Specifications**

Parameter	Specification
Frequency Range:	
L-Band	1000 to 2000 MHz
S-Band	2000 to 2500 MHz
C-Band	4400 to 5100 MHz
RF Output Power, Psat	
L- & S-Band	25 Watts (typ)
C-Band	12 Watts (typ)
Nominal Input Drive Level	+30 dBm
Maximum Input Drive Level	+33 dBm
Receive RF Gain	
L- & S-Band	14 dB (typ)
C-Band	12 dB (typ)
Receive Noise Figure	
L- & S-Band	2.1 dB (typ)
C-Band	2.8 dB (typ)
T/R Mode	Automatic Sensing or Manual T/R Line
T/R Switch Time	2 $\mu$ S
Nominal Supply Voltage	28 VDC
Transmit Current Consumption	
L- & S-Band	2.4 A @ +28 VDC (typ) @ Pout = 25 W
C-Band	1.6 A @ +28 VDC (typ) @ Pout = 12 W
Receive Current Consumption	
L- & S-Band	75 mA @ +28 VDC (typ)
C-Band	50 mA @ +28 VDC (typ)

**Table 2: NuPower Xtender SCISR-20-C01-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 Xtender SCISR-20-C01-S01 Mechanical Outline**

Table 3: NuPower Xtender SCISR-20-C01-S01 Mechanical Specifications

Parameter	Specification
RF Connectors	SMA Female
Control / Power Interface Connector	25 Pin Micro-D (socket)
Dimensions (L x W x H)	7.25" x 4.50" x 1.00"
Weight	36 oz.

## 2.2 HEAT SINKING

The NuPower Xtender SCISR-20-C01-S01 is offered as a stand-alone module, or with optional accessories, which includes a fan-cooled heat sink with an AC/DC adapter, an interface cable with banana jack plug terminations, and harmonic filters that pair with each band. The fan-cooled heat sink provides sufficient cooling for operating the NuPower Xtender SCISR-20-C01-S01 at room temperature (25°C); however, higher ambient temperatures may require additional heat-sinking to maintain a baseplate temperature at 100% transmit duty cycle.



**Figure 3: The NuPower PA Kit offers “out-of-the-box” operation for the user. The fan-cooled heatsink is shown with an example PA (NuPower Xtender SCISR-20-C01-S01 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.

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## 3 SETUP AND OPERATION

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This section provides specific details for proper operation of the NuPower Xtender SCISR-20-C01-S01 module. Following these guidelines will prevent damage to the bidirectional amplifier or external equipment.

### 3.1 POWER SUPPLY REQUIREMENTS

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To operate the NuPower Xtender SCISR-20-C01-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 +28 VDC with greater than 5 amps capability if running only one channel or 15 amps capability if running all three channels simultaneously.

### 3.2 CONNECTING A PROPER LOAD TO THE ANTENNA TERMINAL

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To prevent damage to the amplifier module, the antenna terminal must be terminated into a 50  $\Omega$  load. Examples of a proper load include:

- Directly connecting to an antenna specified for the full frequency range (1000 to 5100 MHz), or operational range (1000-2000 MHz, 2000-2500 MHz or 4400-5100 MHz). Connecting to an inappropriate antenna may result in damage to the amplifier module.
- Connecting to a proper antenna through a 50  $\Omega$  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  $\Omega$  power attenuator with minimum 20 dB attenuation.
- Connecting to a 50  $\Omega$  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 XTENDER SCISR-20-C01-S01

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The NuPower Xtender SCISR-20-C01-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. The amplifier is now ready for operation.

### 3.4 IN-BAND AND CROSS-BAND OPERATION

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Each channel operates independent of one another. Here are a few examples of how the NuPower Xtender SCISR-20-C01-S01 could be operated:

- Receiving on S-band while transmitting on S-band (half-duplex)
- Receiving on S-band while transmitting on C-band (full-duplex)
- Receiving on S-band while transmitting on L- and C-band (full-duplex)
- Receiving on L-, S-, and C-band simultaneously
- Transmitting on L-, S-, and C-band simultaneously

## 4 HARDWARE INTERFACE

- The transceiver interface connector, “XCVR,” is SMA (female).
- The antenna connector, “ANT,” is SMA (female).
- The pin-out definitions for the 25 pin Micro-D socket connector, “CTRL/PWR,” are provided in Table 4. In a typical installation, the amplifier module is mated to a host controller board via a cable harness.



The ANT SMA connector is the antenna connection. This connection should always be loaded into 50  $\Omega$ , otherwise the amplifier could be damaged.

### 4.1 INTERFACE CONNECTOR

The NuPower Xtender SCISR-20-C01-S01 features a 25 pin Micro-D interface connector for control, power, and ground connections.

**Table 4: NuPower Xtender Interface Pin-Out Definitions**

Socket No.	Name	I/O	Description
12, 13, 22	V_Supply (L)	I	Primary Power, L-Band (+11 to 32 VDC)
5, 20, 21	V_Supply (S)	I	Primary Power, S-Band (+11 to 32 VDC)
1, 2	V_Supply (C)	I	Primary Power, C-Band (+27 to 32 VDC)
10, 11	DC_GND (L)	I	DC Ground, L-Band
18, 19	DC_GND (S)	I	DC Ground, S-Band
3, 4	DC_GND (C)	I	DC Ground, C-Band
23	T/R_CTL (L)	I/O	T/R Control, L-Band
6	T/R_CTL (S)	I/O	T/R Control, S-Band
14	T/R_CTL (C)	I/O	T/R Control, C-Band
24	RS-485+ (L)	I	RS-485 Data +, L-Band
25	RS-485- (L)	I	RS-485 Data -, L-Band
9	Dig_GND (L)	I	Digital Ground, L-Band
7	RS-485+ (S)	I	RS-485 Data +, S-Band
8	RS-485- (S)	I	RS-485 Data -, S-Band
17	Dig_GND (S)	I	Digital Ground, S-Band



15	Over_Temp (C)	0	Over Temp Flag, C-Band 0 V = Temperature Fault +5 V = No Fault
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The standard interface cable harness is comprised of 25 wires, includes a Micro-D connector with pins, and mates directly to the NuPower Xtender SCISR-20-C01-S01 interface connector.

## 4.2 DC POWER

The nominal supply voltage for the NuPower Xtender SCISR-20-C01-S01 is +28 VDC.

## 4.3 GROUND

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

## 4.4 TRANSMIT/RECEIVE (T/R) CONTROL

The T/R Enable line is configurable as either an output (source) or an input (sink) for all three bands. The T/R Enable line for all bands are configured as 5V logic and source mode (or “autosense”) by default<sup>1</sup>. This I/O line is described in more detail in Section 5.

When the T/R line is configured in source mode, the NuPower Xtender SCISR-20-C01-S01 transmit and receive switching occurs automatically. The transmit threshold is based on the T/R level setting and the detected input power on the XCVR port. Transmit thresholds for each respective band is graphed in section 5.1.2 and configuration details outlined in section 5.1.3.

When the T/R line is configured in sink mode, the transmit and receive switching is under manual control of the T/R Enable line. Applying a logic *high* to the T/R line places the NuPower Xtender SCISR-20-C01-S01 in transmit mode<sup>2</sup>. Likewise, applying a logic *low* to the T/R line places the NuPower Xtender SCISR-20-C01-S01 in receive mode.

<sup>1</sup>The T/R Enable line is user-configurable between 3.3V logic and 5V logic for L/S-Band only via RS-485. C-Band is factory configurable to 3.3V logic. Contact [sales@nuwaves.com](mailto:sales@nuwaves.com) for custom default options.

<sup>2</sup>L/S-Band only; C-band's T/R Enable line is internally pulled high and may be left floating in sink mode to enable Transmit.

## 4.5 RS-485 SERIAL COMMUNICATIONS

These signals are for the RS-485 serial communications with the NuPower Xtender SCISR-20-C01-S01. This interface is described in Section 5.

## 4.6 OVER TEMPERATURE FLAG

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This signal is an output to indicate an over-temperature condition in the NuPower Xtender SCISR-20-C01-S01, but only when operating in C-Band. A logic high (+3.3 VDC or +5 VDC<sup>1</sup>) indicates normal operation, while a logic low (0 VDC) indicates an over-temperature condition. The NuPower Xtender SCISR-20-C01-S01 incorporates internal logic circuitry that turns off the DC bias to the RF transistors in all three bands when baseplate temperature reaches approximately 85°C. When the baseplate temperature reduces to approximately 70°C, the DC bias will be restored automatically, and the BDA will be fully operational<sup>2</sup>.

<sup>1</sup>The Over Temp Flag line is 5V logic by default and is factory configurable to 3.3V. Contact [sales@nuwaves.com](mailto:sales@nuwaves.com) for custom default options.

<sup>2</sup>C-Band offers an additional “power backoff” feature. This begins throttling drain bias back to reduce output power and power dissipation to allow unit to cool while maintaining communication link. Output power will reduce more as the unit approaches 85°C and will shut down as described above.



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 SERIAL INTERFACE

The NuPower Xtender SCISR-20-C01-S01 includes an RS-485 serial interface<sup>1</sup> for adjusting parameters via a serial terminal program, such as *Termite*.

The serial port must be configured with the following attributes:

- Baud rate: 9600 bps
- Data bits: 8
- Stop bits: 1
- Parity: None

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

- A command consists of a string of characters, followed by a terminating Carriage Return character,  $\r$  (hex 0D).
- Command processing is *not* case sensitive.
- Spaces are always allowed and always ignored.
- After receiving and processing a command, the NuPower Xtender SCISR-20-C01-S01 sends a Carriage Return terminated string as a notification that the command was completed.

<sup>1</sup>Applies only to L & S bands. All further descriptions regarding serial communications only apply to L & S bands.

### 5.1 SERIAL COMMANDS

Serial commands are outlined in the table below.

**Table 5: NuPower Xtender SCISR-20-C01-S01 Serial Commands**

Command	Function	ICD Section
CONSTO	Store settings to EEPROM	5.1.1
CONDEF	Return unit to factory default values	5.1.1
TRLVLxxxx	Set Transmit Threshold Control value	5.1.2
TRMODEx	Set T/R Mode	5.1.3
TRVOLTx	Set T/R Voltage	5.1.3
STAT?	Display Status	5.1.4

#### 5.1.1 Configuration Storage

The “CONSTO” command is used to store current NuPower Xtender SCISR-20-C01-S01 settings to the EEPROM. If a value is changed and the CONSTO command is not entered, the NuPower Xtender SCISR-20-C01-S01 will return to the last stored setting upon unit power cycling, and the changes will be lost.

The “CONDEF” command is used to return the NuPower Xtender SCISR-20-C01-S01 to the factory default settings.

### 5.1.2 Transmit Threshold Control

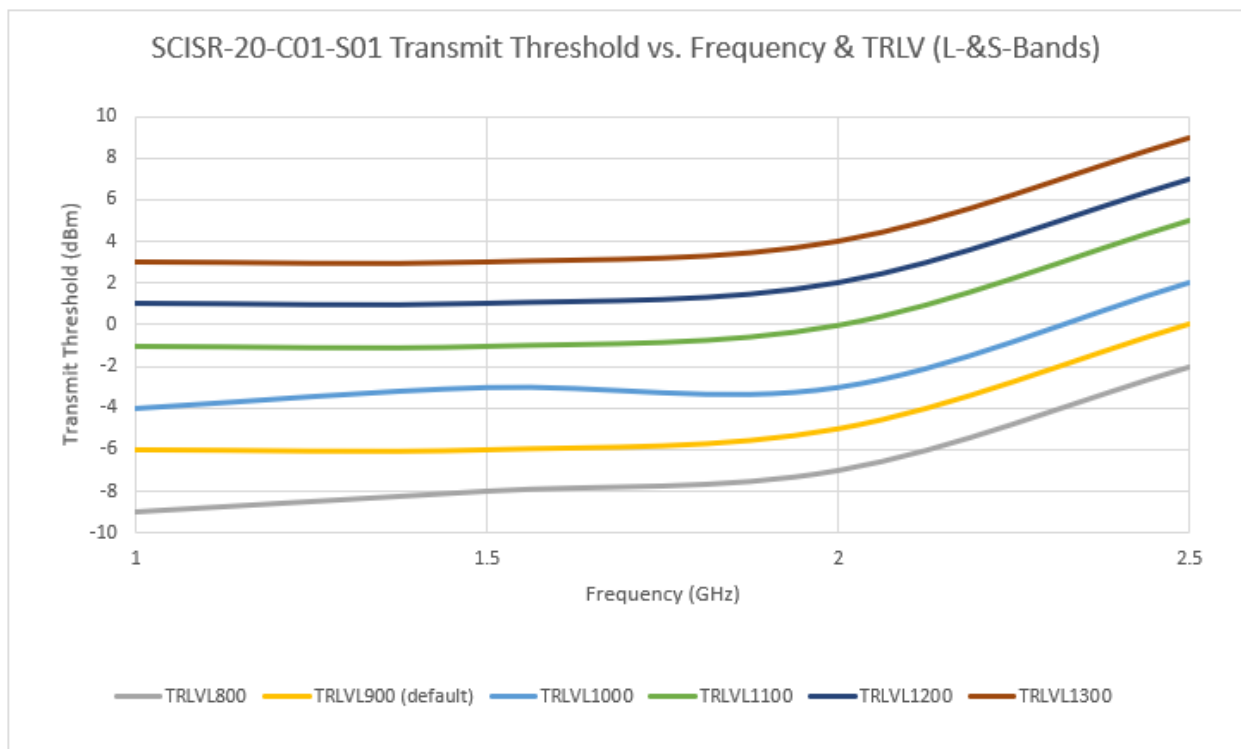
The Transmit Threshold Control feature enables the user to change the signal level threshold at which the Xtender SCISR-20-C01-S01 automatically switches from its default receive state to transmit mode.

The “STAT?” command can be used to display the current Transmit Threshold Control value.

The “TRLVLxxx” command is used to change the setting of the Transmit Threshold Control value.

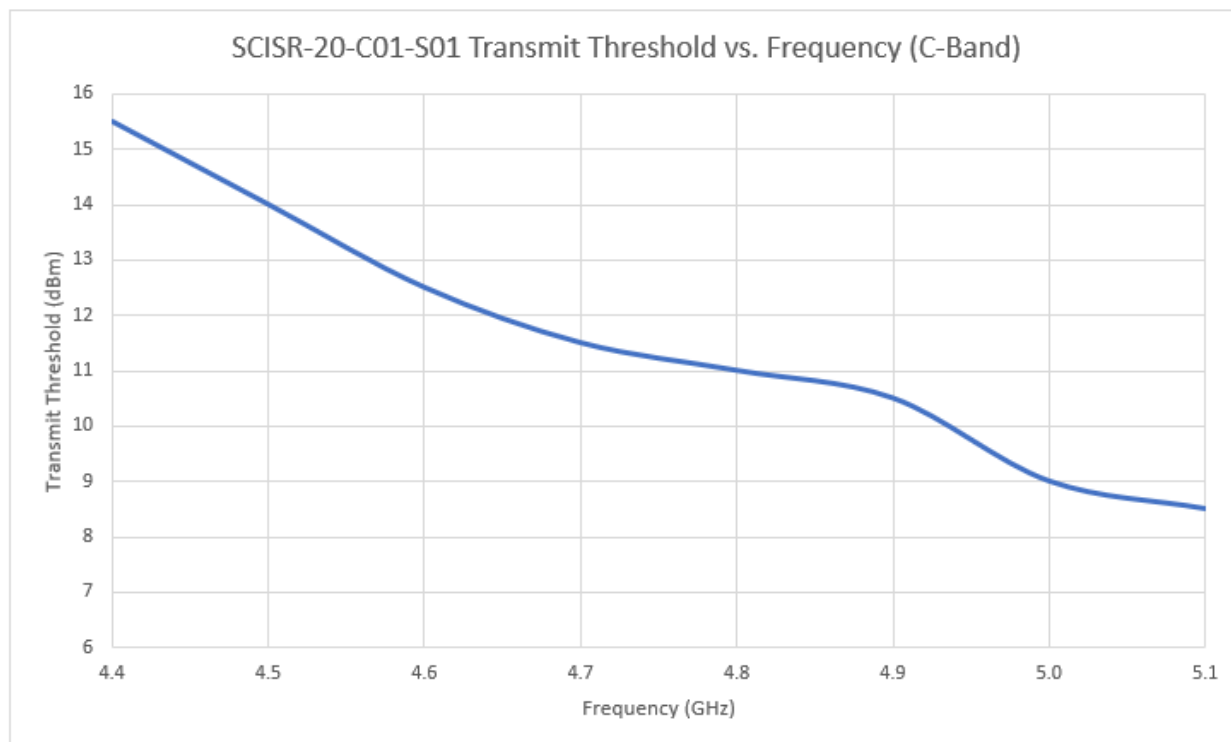
The Transmit Threshold Control settings are defined as:

- 0000 = lowest Transmit Threshold Control value, lowest transmit detection sensitivity.
- 4095 = highest Transmit Threshold Control value, greatest transmit detection sensitivity.
- *Note: Factory default setting is 0900 (~±0 dBm threshold).*



**Figure 4: L/S-Band Typical Transmit Threshold vs. TRLVL**

*Note: If the Xtender is exhibiting false transmit triggering, it is recommended to set a higher transmit threshold control value. This may occur when setting TRLVL at 0700 or below and is not recommended to set below 0800.*



**Figure 5: C-Band Input Power for Threshold Control**

### 5.1.3 T/R Source or Sink

The “TRMODEx” command only applies to L/S-Band operation of the NuPower Xtender SCISR-20-C01-S01 and is used to configure the mode of the T/R Source or Sink I/O line, where “x” is either 0 or 1.

The T/R Source or Sink settings are defined as:

- 0 = Source Mode. In Source Mode, the T/R Source or Sink line functions as an output. While in Source Mode, an auto-sense circuit controls the T/R switching. When the NuPower Xtender SCISR-20-C01-S01 is in transmit mode, a logic *high* signal will be output on this line. Conversely, when the NuPower Xtender SCISR-20-C01-S01 is in receive mode, a logic *low* signal will be output on this line.
- 1 = Sink Mode. In Sink Mode, the T/R Source or Sink line functions as an input, and the T/R switching is controlled by applying a logic *high* or logic *low* to this line. Applying a logic *high* signal to this line enables transmit mode, while applying a logic *low* enables receive mode.
- *Note: Factory default setting is 0 (Source Mode)*

The “TRVOLTx” command is used to configure the input and output logic levels, where “x” is either 0 or 1. The T/R Logic Level settings are defined as:

- 0 = 3.3 VDC Logic
- 1 = 5 VDC Logic
- *Note: Factory default setting is 0 (5 VDC Logic).*

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#### 5.1.4 Unit Status Command

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The “STAT?” command is used to display the system status. Information displayed in the system status is defined as:

- Model and Firmware Version
- Serial Number
- Transmit Threshold Control Value
- T/R Source or Sink Mode Value and Logic Level

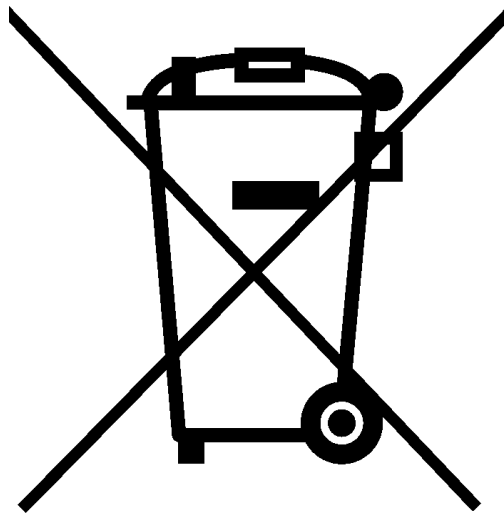
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## 6 PRODUCT DISPOSAL – END-OF-LIFE

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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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## 7 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:

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

Phone: (513) 360-0800

NuWaves Home Page:

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### 7.1 GENERAL INFORMATION

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