

# MURGAS

# DATASHEET

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**GLOSSARY**

BER	Bit Error Rate
CAN	Controller Area Network
CLI	Command Line Interface
CSP	CubeSat Space Protocol
GFSK	Gaussian Frequency-Shift Keying
GMSK	Gaussian Minimum-Shift Keying
HDLC	High-level Data Link Control
I <sup>2</sup> C	Inter-Integrated Circuit
IC	Integrated Circuit
KISS	Keep It Simple, Stupid
MMXC	Micro-Miniature Coaxial connector
NF	Noise Figure
NRZI	Non-Return-to-Zero Inverted
RS485	Recommended Standard 485
RX	Receiver
TRX	Transmitter and Receiver
TX	Transmitter
UART	Universal Asynchronous Receiver-Transmitter
UHF	Ultra High Frequency
VHF	Very High Frequency

# 1 PRODUCT OVERVIEW

The Murgas TRX is a half-duplex transceiver module for nanosatellite communication in UHF or VHF frequency bands. The module is optimized for long-range communication to and from Low Earth Orbit.

### Configurations options available:

- Amateur VHF 144-146MHz
- Amateur UHF 430-440MHz
- Commercial UHF 400-402MHz

Flight heritage on multiple missions (e.g. LASARsat, CroCube, GRBBeta and external customers).

# 2 TECHNICAL SPECIFICATION

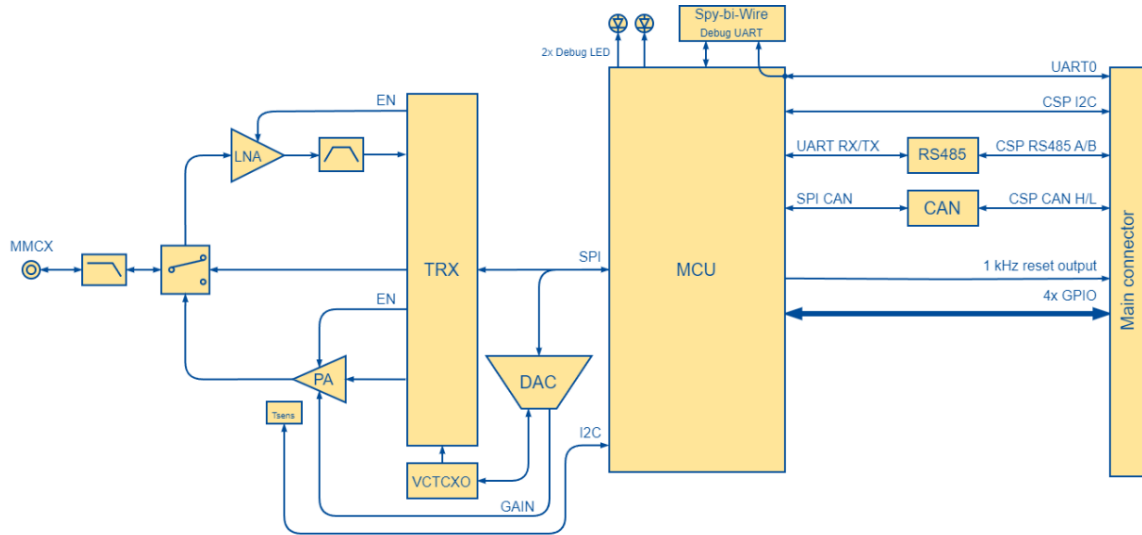


Figure 2-1: Murgas TRX block diagram

Table 2-1: Technical specification

Parameter	Value	Unit
Operating Temperature	-40 to +85	°C
Dimensions	67x42x7.5	mm
Mass	25	g
Power Supply	3.3 5 (for CAN)	V
Power Consumption - receiving	0.14	W
Power Consumption - transmitting	3.30	W
TX data rate	0.1 to 38.4	kbps
Modulation	GFSK/GMSK	
Data formats	HDLC, AX.25	
Framing	NRZI G3RUH scrambling	

### 3 INTERFACES

#### 3.1 ELECTRICAL

The Murgas TRX module implements a communication via I<sup>2</sup>C, RS485 and CAN buses. A debug UART with plain text CLI is also available, mostly for configuration purposes.

Table 3-1: Overview of interfaces

Interface	Description
CSP I <sup>2</sup> C	CSP over I <sup>2</sup> C bus. Speed up to 400 kHz
CSP RS485	CSP over RS485 KISS. Speed up to 38400 Bd.
CSP CAN	CSP over CAN. Speed up to 1 Mbit/s
Debug UART	Implements plain text CLI. Available on both Debug and Main connectors.
Antenna	MMCX, 50 Ω
External reset output	1kHz square wave signal
GPIO	4x, 3.3V level, available through CLI

##### 3.1.1 Main connector

The main interface of the module with its motherboard is realized using a board-to-board connector. This connector includes all interfaces apart from the antenna interface.

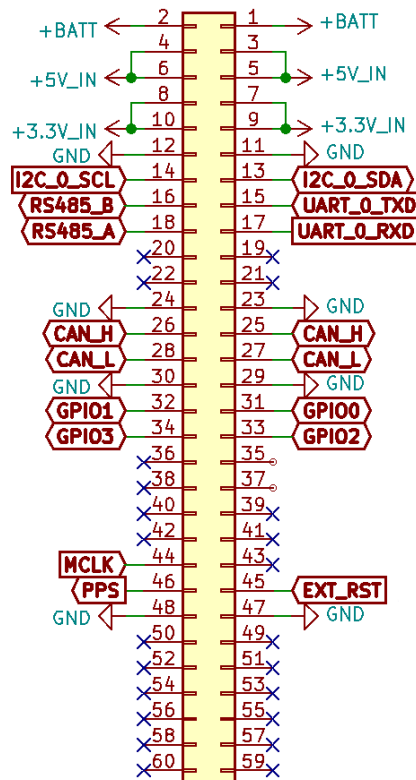


Figure 3-1: Main connector

Table 3-2: Main connector reference

Placement	Connector type
On module	Molex SlimStack 55650-0688
Mates with (on motherboard)	Molex SlimStack 54363-0689

When designing a motherboard for the Murgas TRX module, **ALWAYS** connect all power and ground pins to a suitable power supply.

### 3.1.2 Debug and programming connector

The debug connector is used for firmware programming and debugging purposes. A direct CLI interface is present on this interface. It implements 3.3 V voltage logic levels and **is not 5 V tolerant**. It can be used as a direct command line interface (no addressing needed). Debug messages (if enabled) are also printed to this interface.

Table 3-3: Debug connector reference

Connector	Type
On module	Molex PicoLock 503763-0691
Mates with (housing)	Molex PicoLock 503764-0601

Table 3-4: Pin description of the debug connector

Pin	Signal	Description	Direction	Notes
1	VCC	Power supply (+3.3 V)	Power input	
2	UART_0_TXD	3.3V level UART	Output	CLI communication
3	UART_0_RX	3.3V level UART	Input	CLI communication
4	SBWTCK	Spy-bi-wire test clock	Input/Output	Programming interface
5	RST#SBWTDIO	Spy-bi-wire data in/out	Input/Output	Programming interface
6	GND	Power supply ground	Power input	

### 3.1.3 Radio interface

The radio frontend consists of transmitting and receiving sections that share a single 50 Ω antenna connector. A low-pass filter, shared by both the transmitting and the receiving path, is connected to a common port of a switch that determines the signal path.

The receiving chain includes an LNA, followed by a band-pass filter that removes unwanted signals outside the target frequency band before feeding the transceiver chip.

The transmitting path features an impedance matching network and a filter connected to the output of the transceiver IC. The signal is then fed into a power amplifier before being routed to the switch.

Table 3-5: Radio connector reference

Connector	Type
On module	Molex MMCX 73415-1000
Mates with (example)	Molex MMCX 73415-0950

Table 3-6: Radio characteristics for amateur VHF band

Parameter	Test condition	Min.	Typ.	Max.	Unit
RX NF	-	1.9	1.95	2	dB
RX Gain	-	15.5	18	18.5	dB
RX frequency range	@ 3dB attenuation	130	-	175	MHz
RX sensitivity	(BER < 0.1%) (9600 bps, GFSK, BT = 0.5)		-100		dBm
RX channel bandwidth		1		58	kHz
TX output power	continuously regulated	+0	+30	+32	dBm

Table 3-7: Radio characteristics for commercial UHF band

Parameter	Test condition	Min.	Typ.	Max.	Unit
RX NF		1.75	1.9	2	dB
RX Gain		16	16.5	17	dB
RX frequency range	@ 3dB attenuation	390	-	450	MHz
RX sensitivity	(BER < 0.1%) (9600 bps, GFSK, BT = 0.5)		-100		dBm
RX channel bandwidth		1		58	kHz
TX output power	continuously regulated	+0	+30	+32	dBm

Table 3-8: Radio characteristics for amateur UHF band

Parameter	Test condition	Min.	Typ.	Max.	Unit
RX NF		1.7	1.85	2	dB
RX Gain		16.5	17	18	dB
RX frequency range	@ 3dB attenuation	418		488	MHz
RX sensitivity	(BER < 0.1%) (9600 bps, GFSK, BT = 0.5)		-100		dBm
RX channel bandwidth		1		58	kHz
TX output power	continuously regulated	+0	+30	+32	dBm

### 3.2 SOFTWARE

The Murgas TRX module implements CSP v1 as the main communication protocol on its RS485, CAN and I<sup>2</sup>C interfaces. The CSP address is always the same as the I<sup>2</sup>C slave address. Additionally, the module includes a command line interface (CLI) for operation and configuration available over debug UART and as a CSP service. For software and development support contact Spacemanic directly.

### 3.3 MECHANICAL

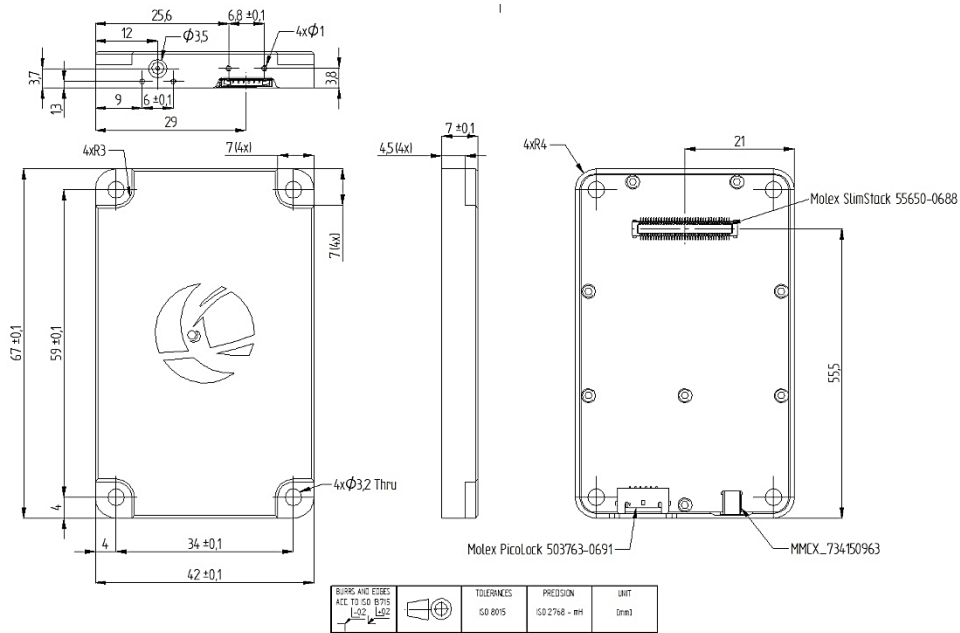


Figure 3-2: Mechanical interface of MURGAS TRX module

It is recommended to mount the module using four ISO 14579 M3x6 socket head hexalobular Torx titanium grade 5 screws against a 2.1 mm M3 brass spacers on the motherboard.

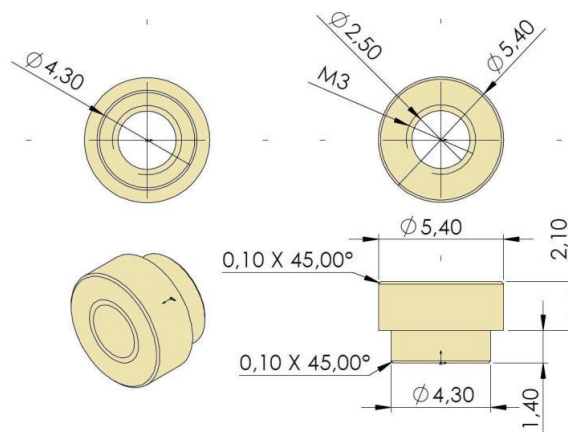


Figure 3-3: Recommended mounting spacer dimensions

## 4 DELIVERABLES

Table 4-1: Deliverables

Type	Item	Note
Mechanical Part	Aluminium cover	
Mechanical Part	USS module standoffs	
Interface	USS module V1b/V1c	
Wiring	Debug cable	Molex PicoLock 503764-0601 ~15cm terminated to female 2.54mm header
Documentation	Interface Control Document	
Support	Engineering support: 1 hour	

## 5 RELATED PRODUCTS

You may also be interested in:

- SAM 6U - Small Antenna Module – *Coming Soon*
- [1-16U CubeSat Platforms / Complete Mission](#)

## 6 DISCLAIMER

Spacemanic shall not be liable for any damages, losses, delays, or other consequences arising from improper use, unauthorized modifications, or incompatibility of the product with other systems, even in cases where these products are deployed in demanding environments such as satellite or space applications. The product is designed for specific use according to the technical specifications outlined in the official documentation, and the company is not responsible for any issues arising from usage beyond this scope.

The company is also not liable for damages caused by external factors that cannot be predicted or controlled, including but not limited to infrastructure failures, space conditions (e.g., radiation, microgravity), natural disasters, human error, unauthorized third-party interference, or unplanned changes in regulatory or legal requirements.

By using the product, the user acknowledges awareness of the risks associated with its use in satellite and space applications and accepts full responsibility for the correct deployment and use of the product.