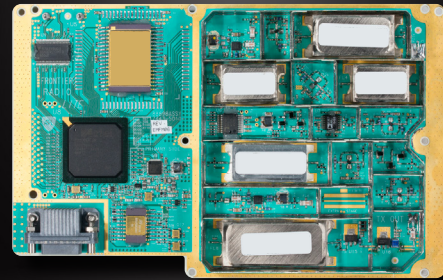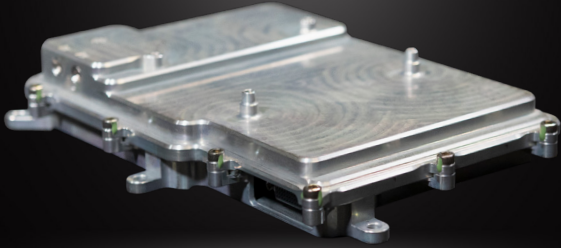# FRONTIER-S

BY ROCKET LAB

A Software Defined TT&C Radio

The Frontier-S by Rocket Lab is a single board, software-defined telemetry, tracking, and command (TT&C) S-band radio designed for both near Earth and deep space missions.
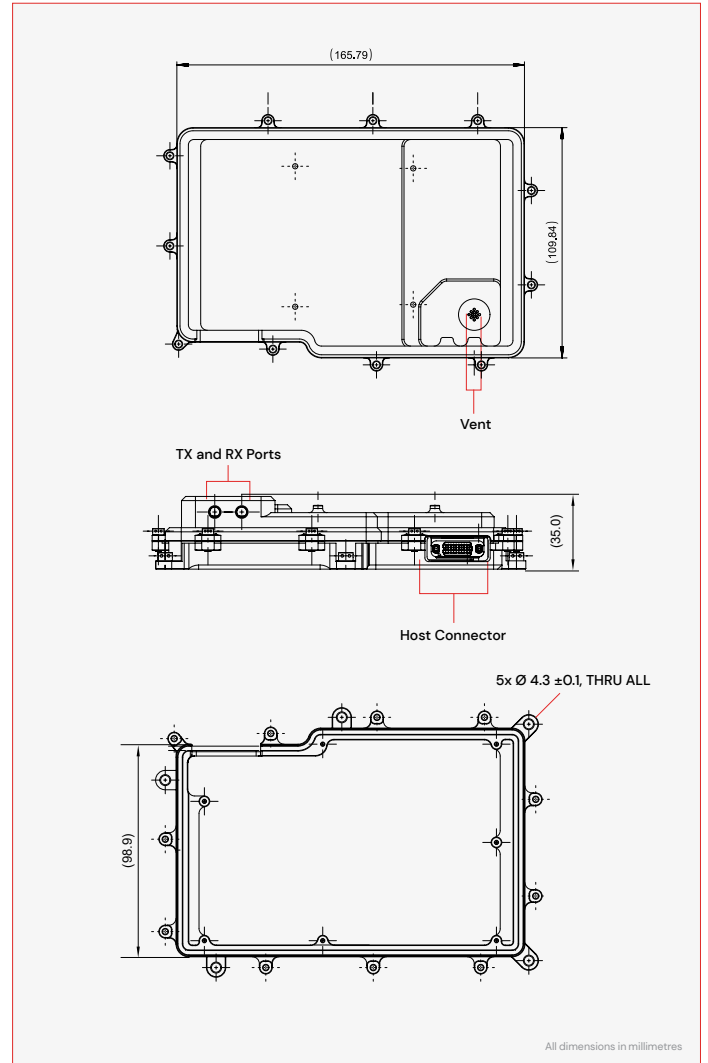
The Frontier-S by Rocket Lab, based on the Johns Hopkins University (JHU) Applied Physics Lab (APL) Frontier Radio, packs Deep Space Network (DSN) and other typical waveforms (TDRSS, NEN, AFSCN, commercial) into a single board package with up-screened commercial components for high reliability applications. Frontier-S by Rocket Lab includes extended functionality not typically available in a low-cost radio including a coherent transponder to enable radiometric navigation methods, timekeeping functions and hardware based critical command decoder (CCD).
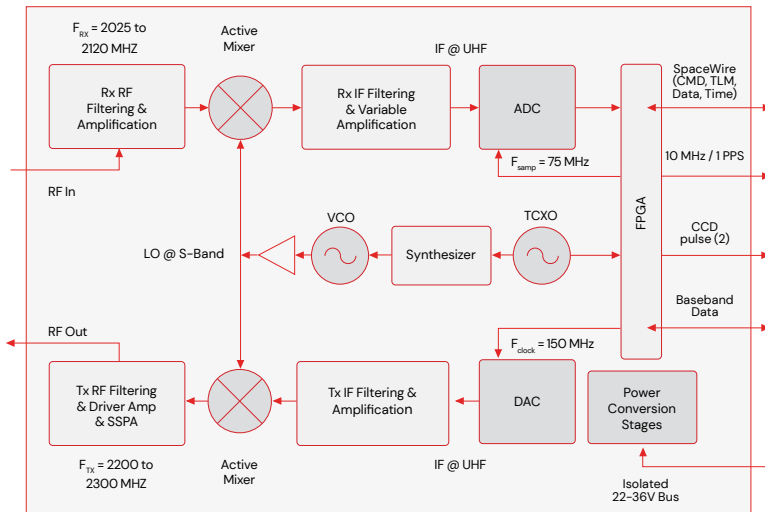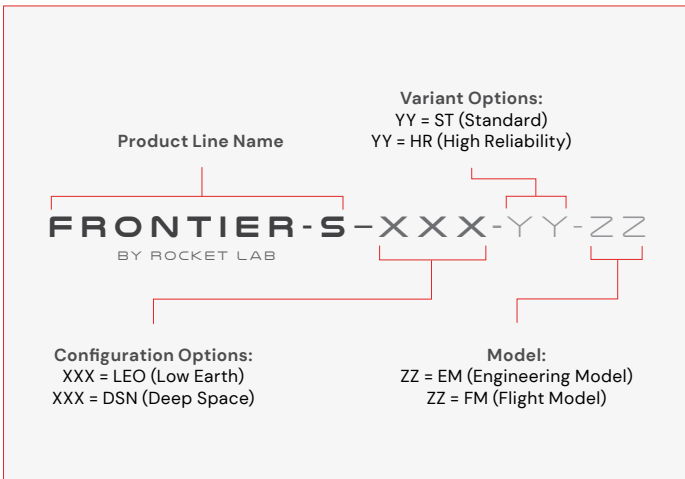
KEY FEATURES

- ⊕ GEO/deep space radiation tolerance – high tolerance to total dose, no destructive latchup, and robust to single event upsets

- ⊕ High Reliability variant available with enhanced radiation tolerance and upgraded parts program

- ⊕ Hardware critical command decoder (CCD) enables hardware-based functionality like fire-codes for spacecraft reset or precision time keeping

- ⊕ DSN, SN, NEN, AFSCN Unified S-band (USB), and commercial (SSC, KSAT) waveform compatible

- ⊕ CCSDS compliant turbo and convolutional encoding

- ⊕ Two-way Doppler and two-way ranging for navigation beyond low Earth orbit

- ⊕ Non-regenerative (coherent turn-around) or regenerative PN ranging

- ⊕ Very low data rates and beacon tones enable long range communications and signaling

ROCKETLAB

GENERAL SPECIFICATIONS

ENCLOSURE DIMENSIONS	179.9 mm x 125.4 mm x 35.0 mm
MASS	590 g, based on standard enclosure
BUS VOLTAGE	22 - 35 V, 30 V Nominal
POWER	<3.5 W, Rx only, <6.8 W full duplex with full RF output power
HOST INTERFACE	SpaceWire – ECSS-E-ST-50-12C single port, FPGA LVDS

RECEIVER

FREQUENCY	2020 to 2120 MHz (16 kHz sub-carrier)
NOISE FIGURE	<5.7 dB
IMPLEMENTATION LOSS	<2 dB
TURNAROUND BANDWIDTH	300 kHz to 1.7 MHz
CARRIER SENSITIVITY	–145 dBm

TRANSMITTER

TX POWER	700 mW (28.5 dBm)
FREQUENCY	2200 to 2300 MHz (25 kHz nominal sub-carrier frequency)
PHASE NOISE	<1.2° RMS
FREQUENCY STABILITY	<32 ppb/°C, <1 ppm/year

RF WAVEFORMS

COMPATIBILITY	DSN, SSC, SN, KSAT, TDRSS-SA
MODULATIONS	PM, BPSK, QPSK, O/SQPSK
RX RATE	100 Bd to 1 MBd
TX RATE	100 Bd to 10 MBd

ENVIRONMENTAL

RANDOM VIBRATION	GSFC-STD-7000
SHOCK	GSFC-STD-7000
TEMP	–30 to +60 °C op, –40 to +85 °C non-op
EMI/EMC	MIL-STD-461C/F
TID	>20 kRad, component level, enclosure not included (ST). Sensitive components are spot shielded. Custom kRad – with enhanced bulk and spot shield (HR)
SEL LET	No destructive latchup, >68 MeV-cm2/mg
SEU & SEFIET	<1 Event/Year @ GEO / Self-detecting and correcting through scrubbing ECC, TMR, and WDT

(165.79)
(109.84)

Vent

TX and RX Ports

(35.0)

Host Connector

5x Ø 4.3 ±0.1, THRU ALL

(98.9)

All dimensions in millimetres

CONNECTORS

HOST	VSRAF-04-10-50-03-N	AirBorn verSI right angle female (40 pin)
RF Receive/RF transmit (separate ports)	Huber & Suhner 29474BHC2R-32-41	SMP Male Full Detent

Product Line Name

Variant Options:
YY = ST (Standard)
YY = HR (High Reliability)

FRONTIER-S–XXX-YY-ZZ
BY ROCKET LAB

Configuration Options:
XXX = LEO (Low Earth)
XXX = DSN (Deep Space)

Model:
ZZ = EM (Engineering Model)
ZZ = FM (Flight Model)

DEEP SPACE FEATURES (DSN CONFIGURATION ONLY)

COHERENCY	Software selectable turnaround ratio (64 bit accuracy) <2.5E-13 Allen Deviation (@ 60 s)
RANGING	Turnaround channel (>2 MHz of BW) or regenerative PN ranging. Includes command feed-through suppression. Delay variation <40 ns, accuracy 1–10 m.
BEACON TONES	Tone based semaphores (up to 128) to quickly transmit spacecraft state of health
ADDITIONAL FEATURES	Multi-spacecraft per aperture (MSPA), delta-DOR

PART NUMBER	DESCRIPTION	FM PRICE (USD)
Frontier-S–LEO-ST	LEO Configuration, Standard	$115,000
Frontier-S–LEO-HR	LEO Configuration, High Reliability	Enquire
Frontier-S–DSN-ST	Deep Space Configuration, Standard	$165,000
Frontier-S–DSN-HR	Deep Space Configuration, High Reliability	Enquire
	AirBorn verSI mating connector with flying leads	$500

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