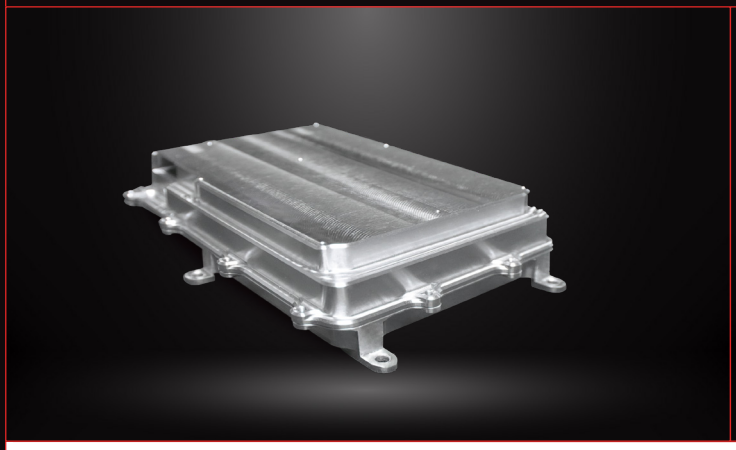
# FRONTIER-X

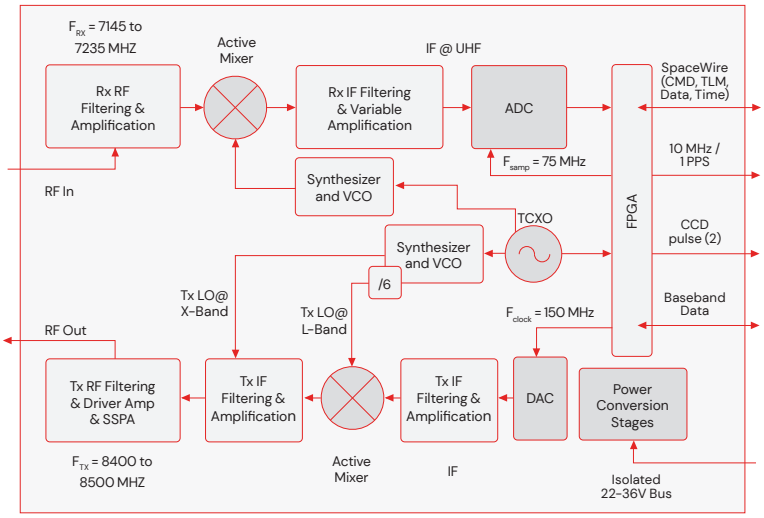
## BY ROCKET LAB

A Software Defined, High Data-Rate TT&C Radio



**The Frontier-X by Rocket Lab is a high-speed, X-band, software-defined telemetry, tracking, and control (TT&C) X-band radio designed for both near Earth and deep space missions.**

The Frontier-X 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 (SN, KSAT, SSC) into a compact package with up-screened commercial components for high reliability applications. Frontier-X by Rocket Lab includes extended functionality not typically available in a low-cost radio including a coherent transponder to enable radiometric navigation methods, precision timekeeping functions, FEC encoding and decoding, and a 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

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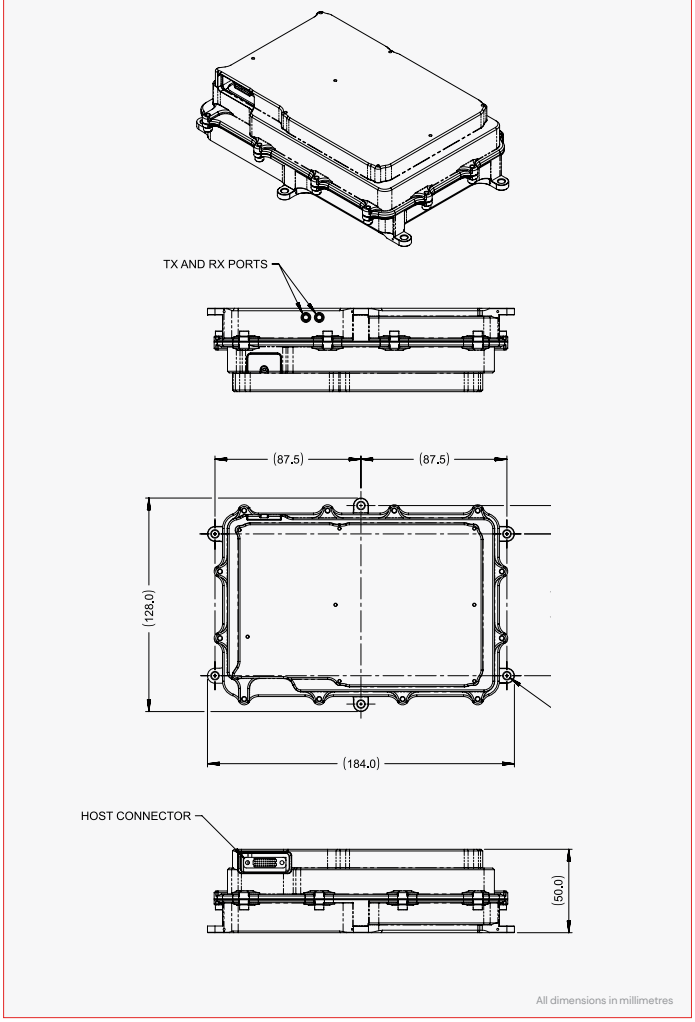
| GENERAL SPECIFICATIONS | |
|---|---|
| ENCLOSURE DIMENSIONS | 184 mm x 128 mm x 50 mm |
| MASS | 920 g, based on standard enclosure |
| BUS VOLTAGE | 22–35V, 30V Nominal |
| POWER | ≤ 1.5 W Standby, ≤ 7 W Rx only, ≤ 12 W Rx + Tx |
| HOST INTERFACE | SpaceWire – ECSS-E-ST-50-12C single port |
| **RECEIVER** | |
| FREQUENCY | 7145 to 7235 MHz (16 kHz nominal sub-carrier frequency) |
| NOISE FIGURE | ≤ 2.0 dB |
| IMPLEMENTATION LOSS | ≤ 2.0 dB at < 100 bps, 3.5 db at >100 bps |
| TURNAROUND BANDWIDTH | 300 kHz to 1.7 MHz |
| CARRIER SENSITIVITY | -154 dBm |
| **TRANSMITTER** | |
| TX POWER | +14 dBm ± 1dB |
| FREQUENCY | 8400 to 8500 MHz (25 kHz nominal sub-carrier frequency) |
| PHASE NOISE | <1.5° RMS |
| FREQUENCY STABILITY | <32 ppb/°C, <1 ppm/year |
| **RF WAVEFORMS** | |
| COMPATIBILITY | DSN, SSC, SN, KSAT |
| MODULATIONS | PM, BPSK, QPSK, O/SQPSK |
| CODING OPTIONS | CCSDS 131.0-B-3 compliant turbo (1/6 to 1/2) and convolutional (1/2 to 7/8) downlink encoding |
| DATA/SYMBOL RATES | Symbol Rate / Data Rate<br>Downlink: 10 Bd - 13.3 MBd / 1.7 bps - 13.3 Mbps*<br>Uplink: 10 Bd - 1 MBd / 8.8 bps - 1.8 Mbps** |
| **ENVIRONMENTAL** | |
| RANDOM VIBRATION | GSFC-STD-7000 |
| SHOCK | GSFC-STD-7000 |
| TEMP | -25 to +55 °C op, -35 to +70 °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 | >43 MeV-cm²/mg |
| SEU & SEFIET | <1 Event/Year @ GEO. Self-detecting and correcting through several methods including scrubbing, ECC, TMR and WDT |

*Specific data rate will depend on encoding (turbo, convolutional, or un-encoded). **Assumes BCH encoding




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-X-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)<br><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-X-LEO-ST** | LEO Configuration, Standard | $175,000 |
| **Frontier-X-LEO-HR** | LEO Configuration, High Reliability | Enquire |
| **Frontier-X-DSN-ST** | Deep Space Configuration, Standard | $225,000 |
| **Frontier-X-DSN-HR** | Deep Space Configuration, High Reliability | Enquire |
| | AirBorn verSI mating connector with flying leads | $500 |



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