

SATTRAC™

Modem/Baseband Unit



Satellite Telemetry, Ranging, and Commanding
High-Performance, High-Availability Modem/BBU for
TT&C, Payload, and Satellite Test

- **High Performance Software Modem**
- **Customer Configurable User Interface**
- **Published Open Interfaces**
- **Proven Compatibility**
- **Built-in Testing**
- **Enthusiastic Customer Support**

Ensured Performance for Satellite Contacts

satTRAC's second generation hardware provides increased data rates and additional features to simplify ground station integration. The satTRAC Modem, first introduced in 2011, was the first true software modem for satellite operations and factory testing. More than 50 customers worldwide now use satTRAC Modems for telemetry, ranging, and commanding.

satTRAC's second generation modems offer:

- 100 MHz usable bandwidth (sample rate = 120 Msamples/sec)
- Payload data rates up to 180 Mbps
- Two TT&C transmit outputs
- Increased diagnostics and built-in aids

All without compromising the configurability, performance, and support that satTRAC customers rely on.

“With NextRate, a single satTRAC Modem supports TT&C, in-band telemetry and commanding, and payload processing.”

satTRAC: A True Software Modem

satTRAC's second generation modems are delivered with a new set of high-performance signal converters. Depending on the antenna site configuration, satTRAC Modems connect at IF or RF frequencies. The satTRAC signal converter performs signal conditioning, filtering, ADC/DAC conversion, digital up and down sampling, and time processing.

Digital IF over 10 Gbps Ethernet connects the satTRAC Signal Converter to the satTRAC Server Platforms. These high-availability commercial servers provide the multi-core processors that host the satTRAC Modem Applications, where all downlink demodulation, uplink modulation, and ranging computations are performed.

The satTRAC software contains the intelligence of the modem. With a comprehensive suite of Applications, satTRAC Modems can be delivered for nearly any satellite mission.

satTRAC Frequencies

satTRAC Signal Converters:

- 70MHz
- L-Band
- S-Band

satTRAC Block Converters:

- X-Band
- K-Band*
- Ka-Band*

satTRAC Modem Software

Telemetry Waveforms:

- BPSK/PM
- BPSK/FM
- BPSK/QPSK
- SQPSK/OQPSK
- GMSK

Command Waveforms:

- BPSK/PM
- BPSK/FM
- FSK
- FSK/AM

NASA Waveforms:

- TDRS
- C2V2

Ranging:

- ESA, ESA-like Tone Ranging
- SGLS PRN
- CCSDS PRN

NextRate (Payload) Waveforms:

- BPSK/QPSK
- 8PSK

Proven Compatibility

satTRAC has been compatibility tested with nearly all commercial satellite buses through in-factory compatibility testing and on-orbit operations.

Plus, a number of SmallSat flight radios use satTRAC for development and compatibility testing.

“The satTRAC modem was practically plug and play.”

Government Satellites

- GPS
- GOES-R
- AEHF
- SBIRS
- Others - Contact Us

Small Sat Flight Radios

- Vulcan Wireless
- Sierra Nevada SN-100, 200
- L3Com CR-312
- Innoflight
- Space Micro μ SGLS-100, μ STDN-100
- Tethers

Satellite Buses

- Space Systems Loral LS, FS-1300, Omega 2, 3
- OrbitalATK STAR-2, 3
- Lockheed Martin A2100
- Airbus (Astrium) E3000
- Boeing 601, 702
- Thales Spacebus 3000, 4000
- ISRO 1-2K, 1-3K
- Ball BCP 5000
- SSTL

* Contact us to add your bus or transponder to satTRAC's compatibility list.



Satellite Operators and Manufacturers Rely on satTRAC Modems

High Availability

satTRAC provides the vital link to an on-orbit or in-test spacecraft. Many of the design elements of satTRAC were chosen to ensure high-availability.

- **Dual Redundant Power Supplies:** The high-availability servers have hot-swappable power supplies and satTRAC extends this feature to the signal converter. A DC power cable connects the signal converter to the server's dual, redundant power supplies.
- **Server Management:** Commercial servers provide a full complement of remote management and diagnostic tools, such as iDRAC (Dell), OpenView (HP), and SNMP.
- **MTBCF:** satTRAC has a Mean Time Between Critical Failure (MTBCF) that exceeds 40,000 hours.
- **Server Maintenance:** We deploy satTRAC Modems on Dell and HP servers to allow our customers to take full advantage of world-wide, next-business day support for failed components.
- **Red Hat Enterprise Linux:** The RHEL operating system provides a robust, secure environment for the satTRAC Applications.
- **Direct Support:** AMERGINT engineers provide direct support to you for any hardware, software, or operating system issues and to assist with setup, operations, and troubleshooting.

***Have Technical Questions?
Ask Us.***

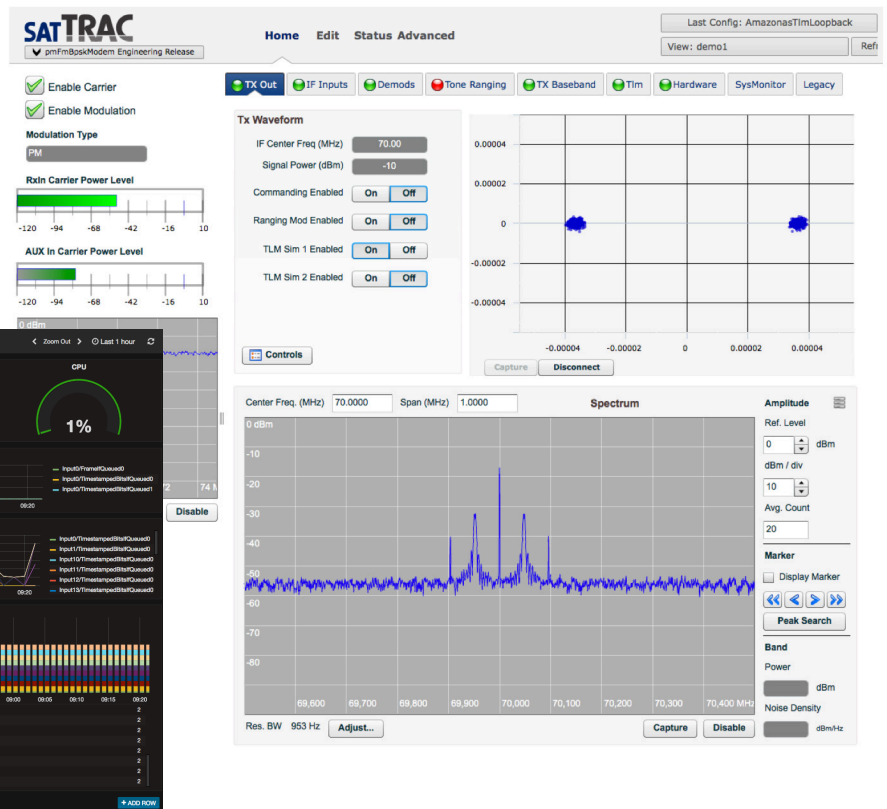
Built-in-Tools

satTRAC provides the critical link to an on-orbit spacecraft. With the coming constellations of lower cost satellites, ground operators and engineers expect an increased number of anomalies and likely more vexing ones at that.

satTRAC offers a suite of diagnostic tools to get to the root cause of contact failures and to resolve them quickly.

- **Spectral Display:** Continuously display the downlink or uplink spectrum to assess and measure power levels, purity, frequency offsets, C/N₀, distortion, and interference.
- **Data Viewing:** Display raw command and telemetry data.

- **App Diagnostics:** App diagrams provide a comprehensive view of how data flows through the modem's software.
- **inSIGHT:** inSIGHT solves the crux of troubleshooting and analysis—collecting real time data over long periods, having it be fully searchable, and providing the visualization to extract useful information.
- **Triggered Buffers:** Raw I/Q sample data can be continuously collected and captured on operator-defined trigger events. Data before and after the trigger is available for analysis.
- **Engineering Support:** An expert staff of modem and satellite communications engineers come with every satTRAC Modem (just ask).



“The many software tools that come with satTRAC provide exceptional value beyond what is expected of a typical modem.”

Configurability

Multiple Bands/Channels: The functions of the satTRAC Signal Converter remain constant across waveforms and applications, and are configurable per the operational frequencies and number of channels required. A single signal converter supports two transmit channels and two receive channels. Each receive channel can support multiple independent carriers. In some configurations, satTRAC can even have multiple signal converters to provide flexibility in the antenna site configuration.

High-Availability Servers: satTRAC Applications run across a set of servers, where the server is sized (number of cores, memory, disk) per the processing requirements.

Independent Software Applications: satTRAC implements a related set of waveforms in each application, with different waveforms in different applications. This simplifies each App, making them more reliable and more thoroughly tested, while also enabling the addition of new waveforms without invalidating existing ones.

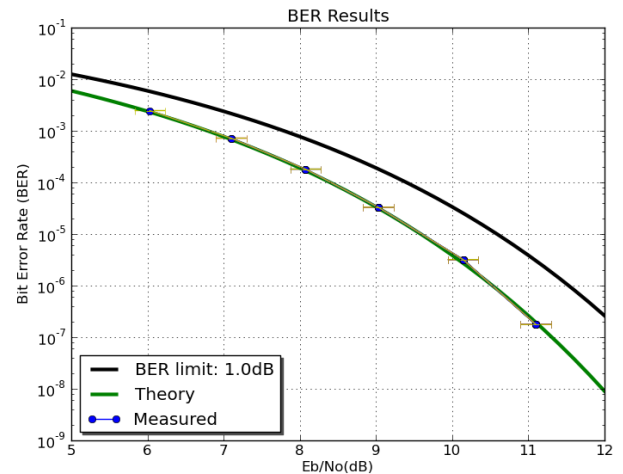
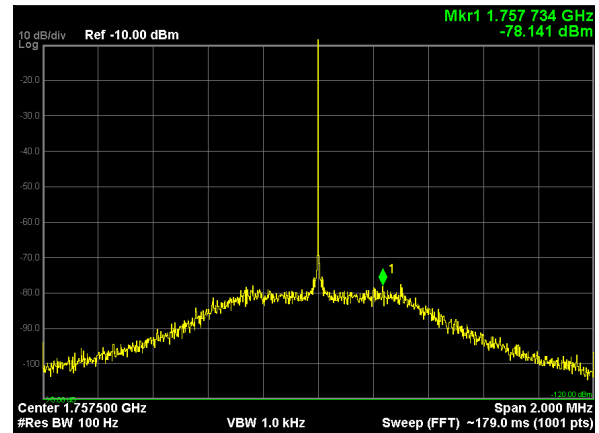
Backward Compatibility

AMERGINT is committed to product longevity and backward compatibility. satTRAC signal converters have a long life cycle (12+ years), so technology refresh requires upgrading only the commercial server. Compared to a full product replacement, these upgrades are very economical. We help our customers select the new host and provide an updated satTRAC App that is fully regression tested.

Key Performance Items

satTRAC's performance derives from digital processing and an ultra-clean RF design in the satTRAC Signal Converters. This combines with floating point precision in the modem algorithms and processing, by virtue of the software implementation of the DSP functions.

- **Spectral Purity:** High compression points and multi-rate digital filtering insure NTIA compliance. That means < -65 dBc.
- **Noise Figure (Receiver):** The noise figure targets high performance test and measurement applications, exceeding most ground station needs.
- **Implementation Loss (BER):** The measured implementation loss for satTRAC is well below 0.7 dB across a typical E_b/N_0 range, often within 0.25 dB of theory.
- **Output Power Range:** satTRAC's outputs have an accuracy of better than 0.5 dB over the output power range and over the specified temperature range.
- **Dynamic Range:** An instantaneous dynamic range of 80 dB enables multi-carrier reception on a single RF/IF input.



Information Assurance

Security hardening can optionally be applied per the appropriate Security Technical Implementation Guides (STIGs), making Information Assurance an integral part of the modem. Customers can subscribe to periodic RHEL updates containing the latest security patches.

NextRate

The second generation satTRAC Modems take advantage of multi-core servers and our sophisticated parallel processing algorithms to support payload data rates up to 180 Mbps. And the scalable parallelism of the algorithms means that satTRAC's maximum data rates grow with Moore's Law.

Power of SOFTLINK

All AMERGIN products build on the SOFTLINK product architecture. This enables satTRAC to add in network gateway protocols, support for SLE, data recording/playback, channel emulation, and a host of other processing capabilities specific to customer applications.

***Proven Valuable Features with
NextRate Capability***

Multi-Carrier

satTRAC enables customers to operate with fewer modems by channelizing the received bandwidth into multiple independent software demodulators. Multi-mission ground stations can support more vehicles with less equipment, complexity, and cost.

Legacy M&C Interfaces

satTRAC has been deployed to replace obsolete equipment, where this equipment is operating with existing control and monitoring software at satellite ground stations. To minimize disruption, customers can order satTRAC Modems with internal M&C interface translation, providing a forward solution with backward compatibility for Cortex-NT, Cortex-CRT, Cortex-Q, Enertec, and other legacy TT&C products.

satTRAC 70MHz Signal Converter Hardware Specifications

IF Output	Specification
Number of Output Channels	2
Output Frequency Tuning Range	65 to 75 MHz
Tuning Step Size	< 1 μ Hz
Instantaneous Bandwidth	40 MHz max
Output Power Range	-40 to +3 dBm
Output Dynamic Range	80 dB
Output Power Accuracy	+/- 0.5 dB
Output Impedance (nominal)	50 Ohms
Output VSWR	1.3:1
Output Spurious	< -65 dBc with output power from -30 to +3 dBm
Output Spurious with Analog Video I/O enabled	< -55 dBc with output power from -30 to +3 dBm
Sweep Modes	Triangle, Return to 0
Sweep Rates	10 kHz/s max
Sweep Limits	center-500 to center+500 kHz
Phase Noise	
10 Hz	-70 dBc/Hz
100 Hz	-87 dBc/Hz
1 kHz	-100 dBc/Hz
10 kHz	-105 dBc/Hz
100 kHz	-115 dBc/Hz
1 MHz	-130 dBc/Hz
10 MHz	-133 dBc/Hz

Analog Video I/O	Specification
Video Input & Output Channels	2 In, 2 Out
Video Bandwidth	7.5 MHz

IF Input	Specification
Number of Input Channels	2
Input Power Range	-100 to +7 dBm
Instantaneous Dynamic Range	74 dB max
Noise Figure	< 9.5 dB (typical) 12 dB max
VSWR	1.5:1
Input Impedance (nominal)	50 Ohms
AGC (31 dB range) time constant	0.001 to 1 seconds
Input Frequency Tuning Range	65 to 75 MHz
Instantaneous Bandwidth	40 MHz max
Tuning Step Size	< 1 μ Hz

Timing and Reference Signals	Specification
Frequency Reference	10 MHz
Internal Reference Accuracy	< 0.1 ppm
Time References Supported	IRIG-B, 1PPS, NTP
Time Reference Voltage Levels (for IRIG and 1PPS)	0.1 to 5 V peak-to-peak
Timing Reference Impedance	50 Ohms
Timing Reference Switching Threshold	-10 dBm
Timing Reference Max Input Level	+10 dBm

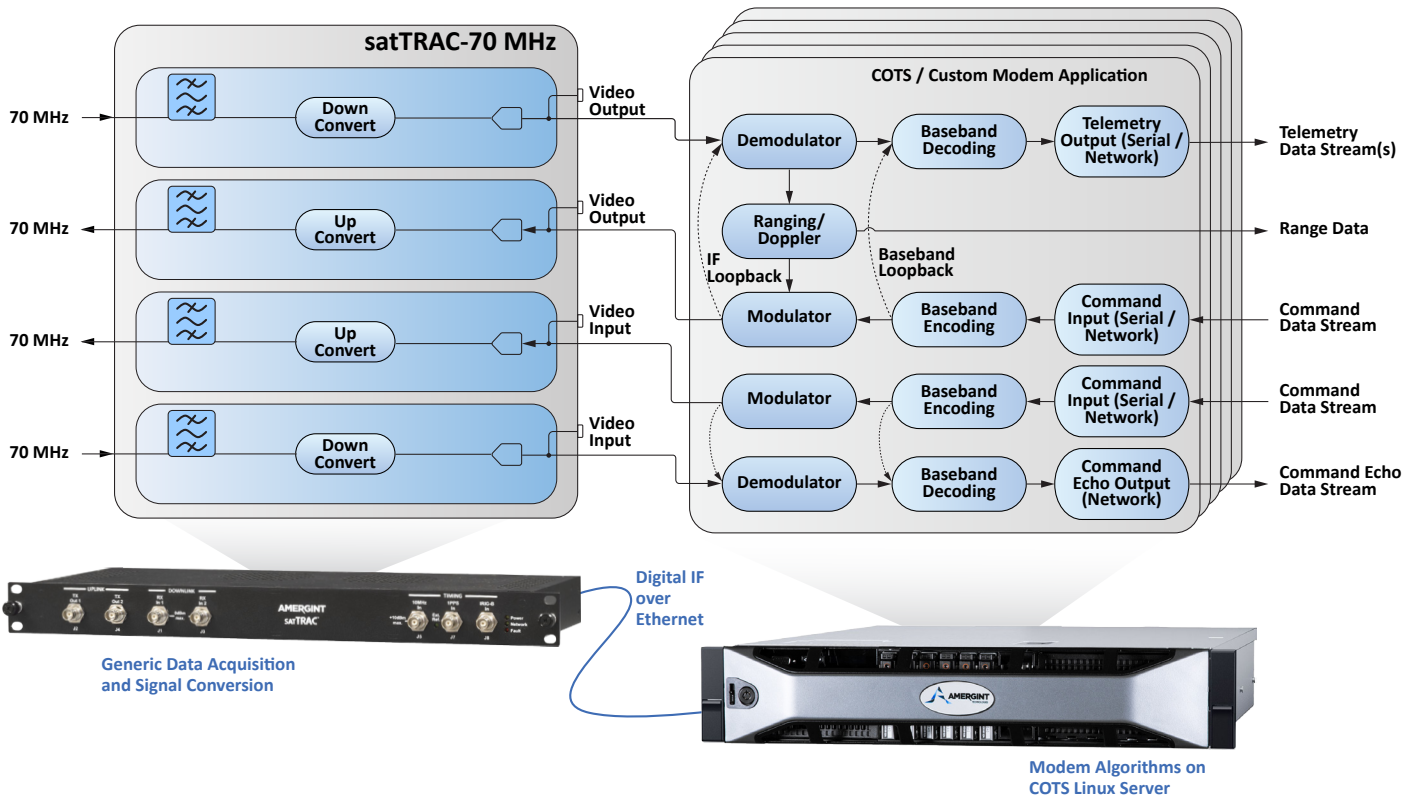


satTRAC 70MHz Signal Converter

Hardware Specifications continued

Physical Information	Specification
IF Connectors	50 Ohm BNC
Weight	< 65 lbs
Server Dimensions	3.42 H x 17.53 W x 26.17 D (in)
satTRAC-70MHz Dimensions	1.75 H x 17.3 W x 7.3 D (in) 1.75 H x 17.1 W x 15 D (in) with 10 MHz phase-locked oscillator option

Environmental Information	Specification
Server Temperature (Operating)	-5°C to 40°C
Server Temperature (Storage)	-40°C to 65°C
Server Relative Humidity	5% to 90% non-condensing
satTRAC-70MHz Temperature (Operating)	-5°C to 45°C
satTRAC-70MHz Temperature (Storage)	-40°C to 65°C
satTRAC-70MHz Relative Humidity	5% to 90% non-condensing



satTRAC SL and 1200 MHz Signal Converter

Hardware Specifications

SL and 1200 MHz frequencies may be mixed and matched within the same chassis

RF Output	Specification
Number of Output Channels	1
Frequency Ranges:	
SGLS Up	1750 to 1850 MHz
USB Up	2025 to 2120 MHz
1200 MHz	1150 to 1250 MHz
Test (unfiltered) ¹	1690 to 2400 MHz or 950 to 1450 MHz
Output Power Range	-30 to +13 dBm (S/L) -30 to +10 dBm (1200 MHz)
P1dB	+26 dBm (S/L) +16 dBm (1200 MHz)
Output Power Accuracy	+/-0.5 dB
Instantaneous Dynamic Range	80 dB
Noise Power Density	-135 dBm/Hz max (S/L) -123 dBm/Hz max (1200 MHz)
Output VSWR	1.3: 1
Output Impedance (nominal)	50 Ohms
Gain Adjustment	60 dB in 0.1 dB Steps
Instantaneous Bandwidth	> 40 MHz (at S/L) > 100 MHz (at 1200 MHz)
Tuning Step Size	< 1 μ Hz
Output Spurious	< -65 dBc with output power -15 to +13 dBm
Output Spurious with Analog Video I/O Enabled	< -55 dBc with output power -15 to +13 dBm
Frequency Stability and Aging (using internal reference)	+/- 5 ppb over operating temp range, < +/- 100 ppb/yr
Amplitude Response (Flatness)	+/- 0.2dB over 4 MHz
Phase Noise	
10 Hz	-60 dBc/Hz
100 Hz	-80 dBc/Hz
1 kHz	-92 dBc/Hz
10 kHz	-97 dBc/Hz
100 kHz	-101 dBc/Hz
1 MHz	-121 dBc/Hz
10 MHz	-124 dBc/Hz
100 MHz	-136 dBc/Hz

¹ Unfiltered outputs do not meet the output spurious performance specifications.

RF Input	Specification
Number of Input Channels	2
Frequency Ranges:	
SGLS/USB Down	2200 to 2300 MHz
1200 MHz	1150 to 1250 MHz
Test/Echo (unfiltered) ¹	1690 to 2400 MHz or 950 to 1450 MHz
Input Power Range	-100 to -23 dBm
Maximum Input Signal (damage)	+18 dBm
Instantaneous Dynamic Range	> 74 dB
Noise Figure (at max gain)	< 4 dB typical 8 dB max
Input VSWR	1.3: 1
Input Impedance (nominal)	50 Ohms
AGC (50 dB range) Time Constant	0.001 to 1 seconds
Instantaneous Bandwidth	> 40 MHz (at S/L) > 100 MHz (at 1200 MHz)
Tuning Step Size	< 1 μ Hz
In-Band Spurious	< -59 dBc
Amplitude Response (flatness)	+/- 0.2dB over 4MHz

Timing and Reference Signals	Specification
Frequency Reference	10 MHz
Internal Reference Accuracy	< 0.1 ppm
Time References Supported	IRIG-B, 1PPS, NTP
Time Reference Voltage Levels (for IRIG and 1PPS)	TTL Levels
Timing Reference Impedance	50 Ohms
Timing Reference Switching Threshold	-10 dBm
Timing Reference Max Input Level	+10 dBm

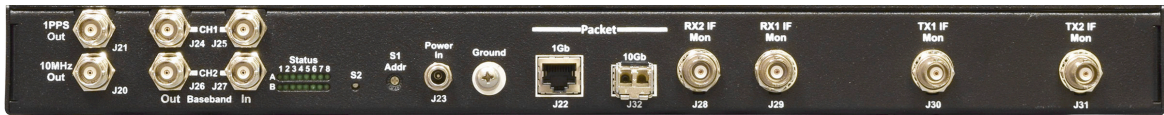
Analog Video I/O	Specification
Video Input & Output Channels	2 In, 2 Out
Video Bandwidth	7.5 MHz



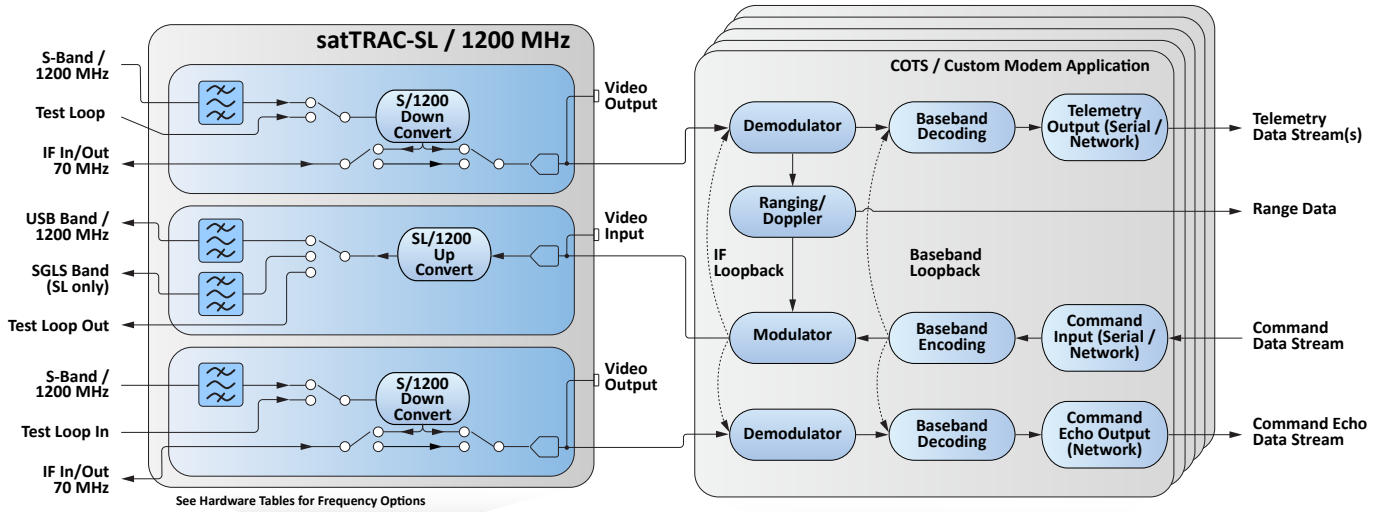
satTRAC SL and 1200 MHz Signal Converter Hardware Specifications continued

Environmental Information	Specification
Server Temperature (Operating)	-5°C to 40°C
Server Temperature (Storage)	-40°C to 65°C
Server Relative Humidity	5% to 95% non-condensing
satTRAC-SL Temperature (Operating)	-5°C to 45°C
satTRAC-SL Temperature (Storage)	-40°C to 65°C
satTRAC-SL Relative Humidity	5% to 90% non-condensing

Physical Information	Specification
Weight	< 65 lbs
Server Dimensions	3.4 H x 19 W x 25.5 D (in)
satTRAC-SL Dimensions	1.75 H x 17.1 W x 15 D (in)



Back view of SL, 1200 MHz, and 70 MHz Signal Converter



Generic Data Acquisition and Signal Conversion

Digital IF over Ethernet



Modem Algorithms on COTS Linux Server

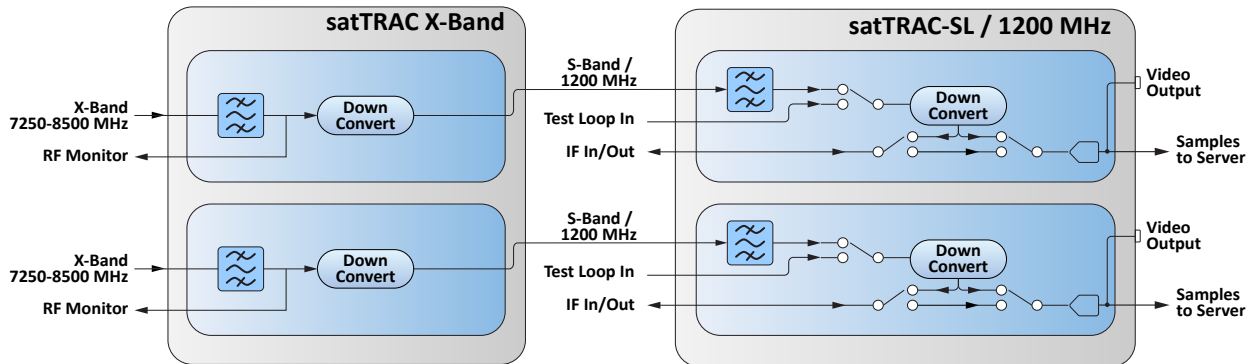
satTRAC X-Band Hardware Specifications

X-Band Converters pair with satTRAC 1200 MHz Signal Converter Hardware

RF Input	Specification
Number of Input Channels	2 max
Frequency Ranges:	
X-Band	7250 to 8500 MHz downlink
Test (unfiltered) ¹	Available on 1200 MHz Chassis
Input Power Range	-100 to -13 dBm
Maximum Input Signal (damage)	+18 dBm
Instantaneous Dynamic Range	> 74 dB
Noise Figure (at max gain)	< 11 dB
Input VSWR	1.3: 1
Input Impedance (nominal)	50 Ohms
AGC (50 dB range) Time Constant	0.001 to 1 seconds
Instantaneous Bandwidth	> 100 MHz
Tuning Step Size	< 1 μHz
Amplitude Response (Flatness)	+/- 0.5dB over 40MHz
Equalization	Fully Programmable, Contact Factory
RF Monitor Port	-20dB Gain

Timing and Reference Signals	Specification
Frequency Reference	10 MHz provided by satTRAC Chassis
Internal Reference Accuracy	None. Must be paired with satTRAC

¹ All specs assume X-Band Converter is paired to the satTRAC 1200 MHz input.



Application Specifications for Commercial Satellites

satTRAC Group1, Group2, Direct1, and NextRate software applications support most commercial vehicles

Command (Transmit)	Group1	Group2	Direct1		
Modulation	BPSK/PM or BPSK/FM	3 tone FSK	QPSK, OQPSK	BPSK	GMSK
Data Rate	250 bps; 1, 2, 4, and 8 kbps	50 bps to 10 kbps	1000 sps to 5 Msps	100 sps to 3 Msps	1000 sps to 1.5 Msps
Command Data Input	Network, Serial, GUI, or Internal BERT	Network, Serial, GUI, or Internal BERT	Network, Serial, GUI, or Internal BERT	Network, Serial, GUI, or Internal BERT	Network, Serial, GUI, or Internal BERT
Modulation Index (PM)	0.0 to 3.0 radians	0.0 to 3.0 radians	Not Applicable to the Direct1 Application		
Frequency Deviation (FM)	Fully Programmable	Fully Programmable			
Number of Subcarriers	1	NA			
Subcarrier Frequency	4 to 32 kHz	NA			
Tone Frequency	NA	1 kHz to 2 MHz			
Tones	NA	0, 1, Execute, Sync			
FSK Symbol Mode	NA	NRZ, RZ			

Telemetry Test (Transmit)	Group1	Group2	Direct1		
Modulation	BPSK/PM or BPSK/FM	BPSK/PM or BPSK/FM	QPSK, OQPSK	BPSK	GMSK
Data Rate	250 sps to 500 kbps	250 sps to 500 kbps	1000 sps to 5 Msps	100 sps to 3 Msps	1000 sps to 1.5 Msps
Convolutional Encoding	Rate 1/2; K=7	Rate 1/2; K=7	Rate 1/2; K=7 Single or Parallel	Rate 1/2; K = 7	Rate 1/2; K = 7
Reed-Solomon Encoding	(255, 223)	(255, 223)	(255, 223)	(255, 223)	(255, 223)
Reed-Solomon Interleave	0 to 8 frames	0 to 8 frames	0 to 8 Frames	0 to 8 Frames	0 to 8 Frames
PCM Coding	NRZ-L/M/S, BIΦ-L/M/S	NRZ-L/M/S, BIΦ-L/M/S	NRZ-L/M/S	NRZ-L/M/S, BIΦ-L/M/S	NRZ-L/M/S
Data Input	Network, Serial, File, GUI, or Internal BERT	Network, Serial, File, GUI, or Internal BERT	Single or Dual Input of TCP/IP, Serial, Internal BERT, or File I/O	TCP/IP, Serial, Internal BERT, or File I/O	TCP/IP, Serial, Internal BERT, or File I/O
Modulation Index	0.0 to 3.0 radians	0.0 to 3.0 radians			
Number of Subcarriers	2	2			
Subcarrier Frequency	8 kHz to 4 MHz	8 kHz to 4 MHz			

Tone Ranging	Group1	Group2
Tone Frequency	1 kHz to 500 kHz	1 kHz to 500 kHz
Multiple Tone Sets	ESA, ESA-Like, USB or User Determined	ESA, ESA-Like, USB or User Determined
PM Mod Indices	0.0 to 3.0 radians	0.0 to 3.0 radians
Integration Time and Relative Tone Power	Fully Programmable	Fully Programmable
Min and Max Delay	Fully Programmable	Fully Programmable
Implementation Loss	< 0.5 dB	< 0.5 dB

Ask Us About Customization

Application Specifications for Commercial Satellites

Command Echo (Receive)	Group1	Group2	Direct1		
Demodulation	BPSK/PM or BPSK/FM	3 Tone FSK	QPSK, OQPSK	BPSK	GMSK
Data Rate	250 bps; 1, 2, 4, and 8 kbps	50 bps to 10 kbps	1000 sps to 5 Msps	100 sps to 3 Msps	1000 sps to 1.5 Msps
Command Echo Data Output	Network or Internal BERT	Network or Internal BERT	Network or Internal BERT	Network or Internal BERT	Network or Internal BERT
Number of Subcarriers	1	NA	Not Applicable to the Direct1 Application		
Subcarrier Frequency	4 to 32 kHz	NA			
Tones	NA	0, 1, Execute, Sync			
FSK Symbol Mode	NA	NRZ, RZ			

Telemetry (Receive)	Group1	Group2	Direct1		
Demodulation	BPSK/PM or BPSK/FM	BPSK/PM or BPSK/FM	QPSK, OQPSK	BPSK	GMSK
Data Rate	250 sps to 500 kbps	250 sps to 500 kbps	1000 sps to 5 Msps	100 sps to 3 Msps	1000 sps to 1.5 Msps
Acquisition Frequency Range	+/- 200 kHz with Aided PLL	+/- 200 kHz with Aided PLL	+/- 200 kHz with Aided PLL	+/- 200 kHz with Aided PLL	+/- 200 kHz with Aided PLL
Carrier Recovery Bandwidth	Programmable	Programmable	Programmable	Programmable	Programmable
Symbol Recovery Bandwidth	Programmable	Programmable	Programmable	Programmable	Programmable
Viterbi Decoding	Rate 1/2; K=7	Rate 1/2; K=7	Rate 1/2; K=7 Single or Parallel	Rate 1/2; K=7	Rate 1/2; K=7
Reed-Solomon Decoding	(255, 223)	(255, 223)	(255, 223)	(255, 223)	(255, 223)
Reed-Solomon Interleave	0 to 8 frames	0 to 8 frames	0 to 8 frames	0 to 8 frames	0 to 8 frames
PCM Decoding	NRZ-L/M/S, BIΦ-L/M/S	NRZ-L/M/S, BIΦ-L/M/S	NRZ-L/M/S	NRZ-L/M/S, BIΦ-L/M/S	NRZ-L/M/S
Implementation Loss	< 1 dB	< 1 dB	< 1 dB	< 1 dB	< 1 dB
Telemetry Data Output	Network, Serial, or Internal BERT	Network, Serial, or Internal BERT	TCP/IP, Serial, Internal BERT, or File I/O	TCP/IP, Serial, Internal BERT, or File I/O	TCP/IP, Serial, Internal BERT, or File I/O
Number of Subcarriers	4	4			
Subcarrier Frequency	8 kHz to 4 MHz	8 kHz to 4 MHz			

* Satellite simulator versions are available for Group1, Group2, and Direct1 Applications.

* NextRate Applications have loopback test transmitters.

Application Specifications for Commercial Satellites

Payload Data (Receive)	NEW NextRate
Demodulation	BPSK O/QPSK 8PSK
Data Rate	5 Msps to 61.5 Msps
Number of Subcarriers	NA
Subcarrier Frequency	NA
Acquisition Frequency Range	+/- 600 kHz
Carrier Recovery Bandwidth	Programmable
Symbol Recovery Bandwidth	Programmable
Viterbi Decoding	Rate 1/2; K=7
Reed-Solomon Decoding	(255, 223)
Reed-Solomon Interleave	0 to 8 frames
PCM Decoding	NRZ-L
Implementation Loss	< 1 dB
Telemetry Data Output	TCP/IP, Internal BERT, or File I/O

satTRAC NextRate supports payload rates up to 180 Mbps and traditional TT&C in one integrated solution.

Ask us how satTRAC can reduce your ground station footprint and costs.

	Group1	Group2	Direct1	NextRate
Compatibility Tested on These Satellite Busses / Radios	<ul style="list-style-type: none"> • Space Systems Loral LS/ FS-1300, Omega 2, 3 • OrbitalATK STAR-2, 3 • Airbus (Astrium) E3000 • Thales Spacebus 3000,4000 • ISRO 1-2K, 1-3K • SSTL • Space Micro μSTDN-100 	<ul style="list-style-type: none"> • Lockheed Martin A2100 • Boeing 601,702 	<ul style="list-style-type: none"> • Innoflight • Vulcan Wireless • Sierra Nevada SN-100, 200 • Small Sats 	<ul style="list-style-type: none"> • Your Payload Radio Here

We Can Add Your Bus, Radio or Smallsat to Our Compatibility List

SGLS* Application Specifications

Command (Transmit and Receive)	Specification
Modulation	FSK/AM
Symbol Rate	1, 2, and 10 kcps
Modulation Index	0.0 to 3.0 radians
Command Clock AM	20.0% to 80.0%
Command Clock Delay	53.0% to 67.0%
Tone Frequencies	65.0 to 2000.0 kHz
Command Data Input	Network, Serial Ternary, or Internal BERT

Telemetry Test (Transmit)	Specification
Modulation	BPSK/PM
Symbol Rate	250 to 500,000 sps
Modulation Index	0.0 to 3.0 radians
Number of Subcarriers	2
Subcarrier Frequency	8 to 4000 kHz
Convolutional Encoding	Rate 1/2; K=7
Reed-Solomon Encoding	(255,223)
Reed-Solomon Interleave	0 to 8 frames
PCM Coding	NRZ-L/M/S, BIF-L/M/S
Data Input	Network, Serial, File, GUI, or Internal BERT

Telemetry (Receive)	Specification
Modulation	BPSK/PM
Symbol Rate	250 to 500,000 sps
Number of Subcarriers	2
Subcarrier Frequency	8 to 4000 kHz
Acquisition Frequency Range	+/- 200 kHz with Aided PLL
Carrier Recovery Bandwidth	Fully Programmable per Symbol Rate
Symbol Recovery Bandwidth	Fully Programmable per Symbol Rate
Viterbi Decoding	Rate 1/2; K=7
Reed-Solomon Decoding	(255,223)
Reed-Solomon Interleave	0 to 8 frames
PCM Decoding	NRZ-L/M/S, BIF-L/M/S
Implementation Loss	< 1 dB
Telemetry Data Output	Network, Serial, or Internal BERT

Ranging	Specification
Modes	Long/Short Code, Clock Only
PN Chip Rates	100 to 1000 kcps
Range Measurement Resolution	< 0.1 ns
PLL Acquisition Bandwidth	0.0 to 100.0 Hz
PLL Tracking Bandwidth	0.0 to 100.0 Hz
Implementation Loss	< 1 dB

satTRAC's SGLS Application presently flies the GPS constellation

* This application is ITAR controlled

TDRSS Application Specifications

Compatible with NASA SNUG and CCSDS 415.1-B-1

TDRSS Spread Forward (Transmit and Receive)	TDRSS Specification
Modulation	Spread Unbalanced QPSK (Command and Range) Spread BPSK (Command Only)
Command Symbol Rate	0.1 to 300 ksps
QPSK Power Ratio (I/Q)	10:1
PN Code Spreading	Command Code on I Range Code on Q (QPSK)
Spreading Codes	As specified in 451-PN CODE-SNIP & CCSDS 415.1-B-1
Code Rate	2.9 to 3.2 Mcps Tx Rate Coherent with Carrier F*31/(221*96) S-Band or F*31/(1469*96) Ku-Band
Data - Code Combining	Data Modulo-2 Added Asynchronously to PN Code
PCM Encoding & Decoding	NRZ-L/M/S
Carrier Recovery Bandwidth	Programmable
Symbol & Code Recovery Bandwidth	Programmable
Implementation Loss	< 1dB
Transmit Carrier Sweeping	Triangle About Nominal
Command Data Input & Output	Network RS-422 Internal BERT

TDRSS Spread Return (Transmit and Receive)	TDRSS Specification
Modulation	Spread Unbalanced SQPN (Stagger on PN Codes) Spread BPSK
Telemetry Symbol Rate	Mode 1 & 2: 0.1 to 300 ksps (I & Q) Mode 3: 0.1 to 300 ksps (I) 1 ksps to 3 Msps (Q)
QPSK Power Ratio (I/Q)	4:1 to 1:4
PN Code Spreading	Mode 1 & 2: Code on I & Q Mode 3: Code on I No Code on Q
Spreading Codes	As Specified in 451-PN CODE-SNIP & CCSDS 415.1-B-1
Code Rate	2.9 to 3.2 Mcps
Data - Code Combining	Data Modulo-2 Added Asynchronously to PN Code
PCM Encoding & Decoding	NRZ-L/M/S
Convolutional Encoding & Viterbi Decoding	Rate 1/2; K=7 Rate 1/3; K=7 (Optional)
Carrier Recovery Bandwidth	Programmable
Symbol & Code Recovery Bandwidth	Programmable
Implementation Loss	< 1dB
Telemetry Data Input & Output	Network RS-422, Internal BERT

TDRSS Ranging & Doppler	TDRSS Specification
Modes	Forward Link with Ranging Return Link Mode 1 or 3 (Coherent Modes)
Range Measurement Resolution	< 1 ns
Carrier Doppler Measurement Resolution	< 1 mHz



2315 Briargate Pkwy., Suite 100
Colorado Springs, CO 80920

www.amergint.com • info@amergint.com

719•522•2800