
The LS-28-SRSM is an advanced technology Single-Channel Receiver employing sophisticated “fifth generation” Digital Signal Processing (DSP) technologies. The LS-28-SRSM supports RF telemetry reception of up to six RF bands including E, S, Lower-L, Upper-L, P, C, (as well as customer defined bands from 250 MHz to 6 GHz). The RF input signal is converted to a fixed 70 MHz intermediate frequency (IF). The IF signal is then digitized by a high performance software defined digital IF receiver. The receiving unit has provisions for direct PCM bit-synchronization from external baseband sources as well from the RF channel data. Digital multi-mode demodulation options include Multi-Symbol PCM/FM, SOQPSK, BPSK, QPSK, OQPSK, SQPSK, AQPSK, AUQPSK, PCM/PM, and Multi-H CPM. Sub-carrier(s) demodulation can also be provided. In addition to the digital FM demodulation, traditional analog single-symbol FM demodulation is included simultaneously. PCM code converted output data is provided simultaneously to TTL and high speed differential (RS422/485 signal standards). Optional IRIG Chapter10 UDP time stamped data outputs are available. Standard user features such as O-scope Eye Pattern and Constellation diagram displays, IF spectral displays at 70 MHz, Bit Error Rate Reader and a very powerful “onboard 70 MHz signal modulator” are included at no additional cost. The LS-28-SRSM is compatible with any Operating System and is controlled and statused either serially (USB or 232) or via Ethernet. All Ethernet receiver command and status controls are TCP, and the resulting user displays and data streaming is via UDP ethernet. The unit has the ability to optionally record up to 128GB of demodualted data (minor frame time stamped). The unit is powered from a single DC power supply from +9V to +42V, consuming under 25 watts of power.

Unlike analog legacy receivers, the LS-28-SRSM is a true software-defined radio whose digital implementation is highly flexible and expandable. The IF receiver functionality is realized using an architecture employing five state-of-the-art digital processing engines, which can operate as a single or dual channel receiver/combiner. The IF receiver processes data rates from 1 kbps to 30 Mbps for MS-PCM/FM, 1 Kbps to 30 Mbps for BPSK & PCM/PM, and 50 Mbps for QPSK/OQPSK/SQPSK/AQPSK/Multi-H CPM. The LS-28-SRSM sensitivity and adjacent channel interference performance is superior due to the use of hardware IF “SAW” and DSP “FIR” filtering method. By using this method, IF bandwidths are optimally set by software “as a function of data rate/PCM code/modulation format”, but can be overridden by the user if required. For multi-path avoidance scenarios, the digital combiner operates at fade margin “break frequencies” up to 50 KHz. Best source selection/combining can also be performed via software. The performance of the LS-28-SRSM is repeatable, day-after-day, year-after-year, from unit-to-unit. It requires no periodic calibration. Life cycle costs are greatly reduced because future upgrades (such as new modulation formats) or an improved DSP algorithm are all implemented via software and/or firmware via an on-site upgrade.
SPECIFICATIONS:

Down-Converter/Tracking Receiver (2 each, up to six bands up to 6000 MHz):

RF Input Frequency:
- S-band (S): 2200-2400 MHz
- NATO E-Band (E): 2185-2485 MHz
- Upper L-Band (U): 1710-1850 MHz
- Lower L-Band (L): 1435-1540 MHz
- C1 band (C1): 4400-4940 MHz
- C2 band (C2): 5091-5150 MHz
- C2e band (C2e): 5091-5250 MHz
- CIF band (CIF): 400-1150 MHz
- CIFe band (CIFe): 300-1150 MHz
- P-band (P): 215-320 MHz
- 70 MHz (I): 70 MHz

(Input Level: +10 dBm to threshold
Maximum Input Level: +29 dBm (self-protection at startup)
Frequency Accuracy: 50 KHz (consult factory for tighter resolution option)
Noise Figure: 5 dB (max); 3-4 dB (typical, near threshold)

IF Filters: SAW and FIR filters, default bandwidth auto-selected by “data rate, PCM code and modulation format”, or user over-ride programmable filters.
Eight SAW pre-selection filters (0.25, 0.50, 1, 2, 5, 10, 20, 40 MHz)

Precision digital FIR filtering employed at demodulation input

Phase Noise: Exceeds requirements for ARTM Tier II phase noise
AGC Slope and Range: Programmable over any portion, -4V to +4V, Linear, Pos/Neg
AGC Time Constants: Selectable: 0.1, 1, 10, 100, 1000 mSec
Programmable between 0.1 and 6500 mSec
RF Input AGC Range: 120 dB (+10 to -110 dBm)
Input Compression: > +10 dBm
AM Demodulation: DC to 50 KHz bandwidth, programmable output vs. AM depth
(Typical 2V p-p for 50% modulation depth in to 75 ohms)
CH1/CH2 & Combined
AM Filtering: 32 each lowpass filters
Adj Channel Interference: exceeds IRIG requirements, contact Lumistar for more information
Demodulator Output

Analog Video FM supports NTSC and PAL Video

Data Rates:
- 1 kbps – 30 Mbps (Multi-symbol PCM/FM)
- 50 kbps – 20 Mbps (Single-symbol PCM/FM)
- 1 kbps – 30 Mbps (BPSK, PCM/PM)
- 1 kbps - 50 Mbps (QPSK, OQPSK, SQPSK, AQPSK, AUQPSK)
- 5 kbps – 50 Mbps (SOQPSK-TG)
- 100 kbps – 50 Mbps (Multi-H CPM)

Bit Sync: Data/Clock Outputs for TTL and High-speed RS-422 available simultaneously
>3V peak in to 50 ohms

CH10 UDP Data Streaming: Data is converted to CH10 format, time stamped and broadcast via Ethernet port (optional)

Code Conversion: NRZ-L/M/S, Bi-Φ L/M/S, RZ, DM-M/S, MDM-M/S, Diff Bi-Φ M/S, RNRZ-LMS in (11, 15, 17, and 23), Inverted state of all PCM codes listed

Standard Features:

Internal IF Modulator: Internal 70 MHz Digital IF Modulator for loop-back self-test of the receiver. Power output from 0 to -80 dBm. Formats include PCM/FM, PCM/PM, BPSK, QPSK, SQPSK, SOQPSK, OQPSK, AQPSK, and Multi-h CPM, with data rates from 10 bps to 10 Mbps (for FM/PM/BPSK) and 20 Mbps for all QPSK formats and Multi-H CPM. Includes precision calibrated noise feature, output code selection (NRZ-L/M/S, Bi-Phase L/M/S, DMM/S, and RNRZ15), external modulation input, internal PRN pattern generation, adjustable deviation, and Convolutional encoding. Separate “70 MHz to RF upconverter” available to support RF bands.

Multi-symbol PCM/FM: Improves BER performance by approx. > 2.5 dB vs. standard PCM/FM

Constellation Display: for all PSK formats

Eye Pattern Display: for all formats

Bit Error Rate TX/RX: Two Receivers
Two PRN Generators (I and Q)

IF Spectrum Displays: Displays 70 MHz IF Spectrum, has typical spectrum analyzer controls and capabilities (such as Span, Averaging, Ref Level, Max Hold, Clear/Write, Averaging, etc…). All displays can be captured via “Screen-Shot” hardcopy feature, available in JPG file format.

IRIG Pre-D: Supports IRIG Pre-D Recording and Playback
**Control / Time Interfaces:**
Serial interface for control and general status only with USB 2.0 or RS232 format. Ethernet interface supports 10/100/1000 Mbps rates. IPv4, UDP (including multi-cast), TCP, ARP, ICMP, IGMP, PTP, and HTTP. Ethernet provides multiple sockets for data, control and status. Serial interface operates simultaneously with Ethernet interface. IRIG A, B, or G input/output, selectable AC or DC coupled, Ethernet IEEE 1588 with trigger input and clock interfaces.

**Data Archive Storage:**
Optional; 32, 64 or 128 GB per channel x 3, Solid state NAND flash memory, removable (14.2 hours per channel x 3 at 20 Mbps/channel).

**Optional Features:**
Lumistar offers various frequency bands, demodulation formats, Ch 10 Ethernet Data Streaming, Data Archive, and decoding as options. Ordering information is in parenthesis.

Pricing is dependent upon the customer selection of these options. Some examples are listed below:
- Demodulation Formats:
  - PCM/FM only (-M1), SOQPSK (-M2), PCM/FM and SOQPSK only (-M6)
  - PCM/FM, BPSK, QPSK, OQPSK, AQPSK, SQPSK, SOQPSK, and PM (-M3)
  - M3 formats plus AUQPSK (-M4), BPSK, QPSK, OQPSK, SQPSK, PM with sub-carrier (M5)
  - PCM/FM, SOQPSK and Multi-h CPM (-M7)
- CH10 Data Broadcast, Time Stamped (-C10E)
- Viterbi decoding (-V2)
- Reed-Solomon (-RS2)
- Soft Bit Decision Outputs (-SB3)
- Space Time Coding (-SC3)
- LDPC Coding (-LD3)
- Sub-carrier (-S2)
- AQPSK (-A2)
- Viterbi and Reed-Solomon Decoding (-VRS2)
- IRIG Pre-D Record/Playback (-IRP)

**Environmental:**
- Operating Temperature: -20° to +70° C
- Storage Temperature: -40° to +85° C
- Operating Humidity: 0 to 90% (Non-condensing)
- Storage Humidity: Protect from excessive moisture and contamination
- Operational Scenario: Ground or Airborne based

**Physical and Power:**
- Size: 6.00” x 4.00” x 1.70” inches
- Weight: 3 pounds (1.4 Kg) typical
- Chassis Material: Aluminum, T-6061
- Power Supply: +9 to +42 V at approx. 25 Watts (mode dependent)
- Transient Protection: Surge Protection up to 50 KV at 100 A
- Status Monitoring: Continuous Temperature, Voltage & Current
Ordering Information:

Model Number Examples:

- **LS-28-SRSM-M1LS**: PCM/FM format, lower-L and S bands
- **LS-28-SRSM-M2UE**: SOQPSK format, upper-L and E-bands
- **LS-28-SRSM-M6S**: PCM/FM & SOQPSK formats, S-band
- **LS-28-SRSM-M6LU-V2**: PCM/FM & SOQPSK, with Viterbi, Lower L and Upper L bands
- **LS-28-SRSM-M3S**: PCM/FM, BPSK, QPSK, OQPSK, SOQPSK, PCM/PM, S-band
- **LS-28-SRSM-M6LUSC**: PCM/FM & SOQPSK, lower/upper L bands, S and C bands
- **LS-28-SRSM-M7LS**: PCM/FM, SOQPSK, Multi-h CPM, lower-L and S bands

Frequency Band Examples:

- **S-band**: 2200-2400 MHz
- **NATO E-Band**: 2185-2485 MHz
- **Upper L-Band**: 1710-1850 MHz
- **Lower L-Band**: 1435-1540 MHz
- **C1 band**: 4400-4940 MHz
- **C2e band**: 5091-5250 MHz
- **C to IF band (CIF)**: 400-1150 MHz
- **P-band**: 215-320 MHz
- **N-band**: 830-1130 MHz
- **I-band**: 70 MHz

Other Options:

- **CH10 Ethernet Data Streaming**: Add “-C10E” suffix to end of model number
- **Viterbi Decoding**: Add “-V2” suffix to end of model number
- **Reed-Solomon Decoding**: Add “-RS2” suffix to end of model number
- **Viterbi & Reed-Solomon**: Add “-VRS2” suffix to end of the model number
- **Soft Bit Decision Outputs**: Add “-SB2” suffix to the end of the model number
- **Data Archive Storage**: Add “-D32 for 32 GB”, “-D64” for 64 GB, “-D128” for 128 GB

*This is a partial list of all possible options. Please consult Lumistar Sales Engineering to define the exact model required.*

*For additional technical information please see the User Manual for LS-28-SRSM*
Outline, I/O and Dimensions:

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