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LS-28-DRSM-R1 Advanced Technology

Rack-Mount Dual-Channel Receiver/Combiner with Data Recording, TMoIP and TM Processing/Display Capabilities

The Lumistar LS-28-DRSM-R1 Dual-Channel TM Receiver/Combiner with Data Recording, TMoIP and TM Processing system offers a rack-mount high-performance competitively priced multi-band multi-mode COTS solution Ethernet Appliance for modern Telemetry Ground Receiving System applications. The unit also functions as an independent data & antenna tracking receiver in one enclosure, with data recording, Ethernet data streaming and TM processing options. A complete ground station.

The LS-28-DRSM Series is an advanced technology Dual-Channel TM Receiver/Combiner/Processor with TMoIP employing sophisticated “fourth-generation” Lumistar Digital Signal Processing (DSP) technologies. The LS-28-DRSM supports independent two-channel reception and diversity combining of up to five RF bands such as E, S, Lower-L, Upper-L, P, C, (as well as any customer defined bands from 200 MHz to 6 GHz). Each RF input is converted to a fixed 70 MHz intermediate frequency (IF). These IF signals are then



digitized by a two-channel digital IF DSP Engine. The DSP Engine provides all downstream processing functions, such as diversity combining, demodulation, bit sync, frame sync deconv and UDP packet data creation. The unit has a software selectable mode for stand-alone dual channel baseband PCM bit-synchronization from external sources. Digital “RF to bits” multi-mode demodulation options include Digital Multi-Symbol and True Analog Single-Symbol PCM/FM, SOQPSK, BPSK, QPSK, OQPSK, SQPSK, AQPSK, AUQPSK, PCM/PM, and Multi-H CPM. Sub-carrier(s) demodulation can also be provided. PCM output clock/data is provided simultaneously both TTL and high speed differential (RS422/485 signal standards) and has multiple code conversion options. *Optional* UDP multi-cast time stamped data is available. Standard user features such as O-scope Eye Pattern and Constellation Displays, 70 MHz IF Spectral Displays, Bit Error Rate Readers, Dual Channel PCM Data Simulator are included as standard features. A powerful “onboard 70 MHz signal modulator” is optionally available. The LS-28-DRSM is controlled/statused with any Operating System via Ethernet, USB or serial interfaces. All Ethernet receiver command and status controls are TCP, and the user displays and PCM data streaming is via UDP. The unit has optional features that add the ability to record 64GB of demodulated time stamped data or PCM frames for each channel (CH1, CH2 and Combined). The unit operates on standard AC power (110-230VAC, 50-60 Hz). Total power consumption is approx. 80 W.

Unlike analog legacy receivers, the LS-28-DRSM is a true “*software-defined radio*” whose digital implementation is highly flexible and expandable. The IF receiver/combiner 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 with multiple ancillary personalities. 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 or more for QPSK/OQPSK/SQPSK/SOQPSK/Multi-H CPM. The LS-28-DRSM sensitivity and adjacent channel interference performance is superior due to the use of “Dual hardware IF “SAW” and DSP “FIR” filtering methods”. By using this method, as many as 40,000 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 superior 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-DRSM 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.

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Specifications are subject to change. Please verify the latest specifications at time of order.

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SPECIFICATIONS:

Down-Converter/Tracking Receiver (*2 each, up to five RF 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 C band (USA): 4400-4940 / 5091-5150 MHz C2E band (Euro/ROW): 5091-5250 MHz CIF band (CIF): 400-1150MHz <i>(C band block downconversion)</i> CIFe band (CIFe): 300-1150 MHz <i>(C band block downconversion)</i> P-band (P): 215-320 MHz 70 MHz (I) 70 MHz <i>(Custom RF bands readily available, please consult the factory)</i>
Input Level:	+17 dBm to threshold
Maximum Input Level:	+29 dBm (self-protection at startup)
Tuner Resolution:	50 KHz or less (consult factory for tighter resolution option if needed)
Frequency Accuracy:	0.001% typical, 0.002% max
Noise Figure:	5-7 dB (max versus RF frequency); 3-4 dB (typical, near threshold)
IF Filters:	Eight SAW and 40,000 FIR filters, default bandwidth auto- selected by “data rate, PCM code and modulation format”, or by user over-ride programming. SAW pre-selection filters are 0.25, 0.50, 1, 2, 5, 10, 20, 40 MHz. Precision digital FIR filtering employed at demodulation input with <10 KHz resolution bandwidth
Phase Noise:	Exceeds requirements for ARTM Tier II phase noise (< -90 dBc/Hz typ at 10 KHz)
AGC Slope and Range:	Programmable over any portion, -5V to +5V, Linear, Pos/Neg CH1/CH2 & Combined
AGC Time Constants:	Selectable: 0.1, 1, 10, 100, 1000 mSec Programmable between 0.1 and 6500 mSec
RF Input AGC Range:	120 dB or more (+10 to -110 dBm minimum)
Input Compression:	> +17 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, software selectable, variable AM delay
Adj Channel Interference:	exceeds IRIG requirements, contact Lumistar for more information

Pre-D Combiner:

Combiner Types:	Digital Pre-D
Combining Modes:	Optimal Ratio (combining algorithm based upon measured S/N for each channel), Equal Gain (for fast fades), or Best Channel Select
Operational Modes:	Polarization, Frequency and Spatial Diversity modes
S/N Improvement:	> 2.6 dB typical for Optimal Ratio (equal RF input levels near threshold)
Break Frequency:	50 KHz minimum for up to 30 dB fades. The digital combiner employs a fast DSP-based algorithm to provide an “Optimal Ratio” combined signal based upon real-time CH1 v. CH2 “Signal to Noise” measurements. The IF combiner does not require low bandwidth AGC information for combining decision and it is not a simple “best-source selector” but a true diversity combiner. The combiner operates with a break frequency of > 50 KHz with worst case multipath fade scenarios (such as –sin/sin AM for CH1 vs. CH2).

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Demodulator Outputs (3 Each)

Demodulation Formats:	Multi-symbol PCM/FM, True Legacy Analog Single Symbol PCM/FM, PCM/PM, BPSK, QPSK, SQPSK, SOQPSK, OQPSK, AQPSK, AUQPSK, Multi-H CPM, Single-symbol PCM FM, Analog Video FM, Subcarrier Demodulation, (Analog Video FM supports NTSC and PAL Video Formats)
Data Rates:	1 kbps – 30 Mbps (Multi-symbol PCM/FM) 50kbps – 20 Mbps (Single-symbol PCM/FM) 1 kbps – 30 Mbps (BPSK, PCM/PM) 1 kbps – 50 Mbps (QPSK, OQPSK, SQPSK, AQPSK, AUQPSK) 5kbps – 50Mbps (SOQPSK-TG) 100kbps – 50Mbps (Multi-H CPM)
Bit Syncs and Video:	Three Independent Data/Clock Outputs for CH1/CH2 & Combined, TTL and High-speed RS-422 provided <u>simultaneously</u> on each channel (>3V in to 50 ohms), Baseband I/Q video outputs for CH 1, CH2 and Combined signals provided.
UDP Data Streaming:	Data is output via UDP multicasting format and can be converted to CH10 Thruput format, IRIG-218, CCSDS or other formats. Ethernet data is time stamped
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, Input or Output Code Conversion. Many more codes available.

Standard Features:

Internal IF Modulator:	Built-In 70 MHz Digital IF Modulator for loop-back self-test of the receiver or external use. Power output from 0 to -80 dBm. Modulation formats include PCM/FM, PCM/PM, BPSK, QPSK, OQPSK, SQPSK, SOQPSK, AUQPSK, AQPSK, and Multi-h CPM, similar to as listed above. The modulator includes a 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 FM deviation, and LDPC encoding. Lumistar can provide a separate LS-76-M2 “70 MHz to RF upconverter” to support RF bands.
Multi-symbol PCM/FM:	Improves BER performance by approx. > 2.5 dB vs. standard analog PCM/FM
Constellation Displays:	for all PSK formats
Eye Pattern Displays:	for all formats
Bit Error Rate TX/RX:	Six BER Receivers (CH1/CH2/Combined, I and Q for each stream), Two PRN Clock/Data Generators (I and Q) with PRN, User Defined patterns available
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 (Optional)

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Control / Time Interfaces:

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 telemetry data, control, status and displays. Serial interface for control and general status only with USB 2.0 or RS232 formats. The serial interface operates simultaneously with Ethernet interface. Time: IRIG A, B, or G input/output, selectable AC or DC coupled, selectable termination, PTP Ethernet IEEE 1588 with trigger input and clock interfaces

Data Archive Storage:

64 GByte per channel x 3, Solid State NAND Flash Memory, (19 hours per channel x 3 at 8 Mbps/channel). Logging tool for most Setup and Measured Receiver Parameters.

Other Features:

Lumistar offers various frequency bands, demodulation formats, Ethernet Data Streaming, Data Archive, and certain decoding schemes 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, SOQPSK, PM with sub-carrier (M5)
 - PCM/FM, SOQPSK and Multi-h CPM (-M7)
- Raw Data or Decom Frame Archive, Time Stamped (optional)
- UDP Data Broadcast of TM Data, Time Stamped (optional)
- Viterbi decoding (optional)
- Reed-Solomon (optional)
- Soft Bit Decision Outputs (optional)
- Space Time Coding (optional)
- LDPC Coding (optional)
- Sub-carrier (optional)
- AQPSK (optional)
- IRIG Pre-D Record/Playback (optional)

Environmental:

Operating Temperature:	-10° to +50° C (Extended Temp Ranges Available, consult Lumistar)
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:	19 inch rack mount, 1U, 12 inches deep
Weight:	20 pounds max.
Chassis Material:	Aluminum, T-6061
Power Supply:	110-240 VAC, 50-60 Hz at approx. 100-120 watts (configuration dependent)
Transient Protection:	Surge Protection up to 50 KV at 100 A
Status Monitoring:	Continuous Temperature, Voltage & Current, Operator Warnings

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Ordering Information:

Model Number Examples:

LS-28-DRSM-R1-M1LS	PCM/FM format, lower-L and S bands
LS-28-DRSM-R1-M2UE	SOQPSK format, upper-L and E-bands
LS-28-DRSM-R1-M6S	PCM/FM & SOQPSK formats, S-band
LS-28-DRSM-R1-M6LU	PCM/FM & SOQPSK, with Viterbi, Lower L and Upper L bands
LS-28-DRSM-R1-M3S	PCM/FM, BPSK, QPSK, OQPSK, SOQPSK, PCM/PM, S-band
LS-28-DRSM-R1-M6LUSC	PCM/FM & SOQPSK, lower/upper L bands, S and C bands
LS-28-DRSM-R1-M7LS	PCM/FM, SOQPSK, Multi-h CPM, lower-L and S bands

*This is a small 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 and ICD for LS-28-DRSM

User Manual for the LS-28-DRSM

http://lumi-star.com/uploads/MANUALS/LS-28-DRSM/LS-28-DRSM_UserManual.pdf

Interface Control Drawing for the LS-28-DRSM

http://lumi-star.com/uploads/MANUALS/LS-28-DRSM/LS-28-DRSM_ICD.pdf



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Front/Rear Elevation and I/O



LS-28-DRSM-R1
Front View



LS-28-DRSM-R1
Rear I/O View