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LS-28-DRSM Advanced Technology

Modular Dual-Channel Receiver/Combiner with CH10 Ethernet Data

Data Sheet

The Lumistar LS-28-DRSM Modular Dual-Channel Receiver/Combiner offers a small profile low-cost high-performance multi-band multi-mode COTS solution for a modern Telemetry Receiving System applications. The unit functions as an independent data & tracking receiver in one package.

The LS-28-DRSM is an advanced technology Dual-Channel Receiver/Combiner employing sophisticated "fifth generation" Digital Signal Processing (DSP) technologies. The LS-28-DRSM supports independent two-channel reception and/or combining 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). Each RF input is converted to a fixed 70 MHz intermediate frequency (IF). These IF signals are then digitized by a two-channel digital receiver. The IF receiver provides optional combining as well as 2-channel independent mode operation. The unit has provision for direct PCM bit-synchonization from external sources as well for Combined or Independent 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. 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-DRSM 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) for each channel (CH1/CH2/Combined). The unit is powered from a single DC power supply from +9V to +42V, consuming approximately 32 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. 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/OQPSKSQPSK/SOQPSK/Mutli-H CPM. The LS-28-DRSM 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 optimaly 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-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.

Lumistar, Inc. **2270 Camino Vida Roble Suite L** **Carlsbad, CA 92011**

PHONE: 760-431-2181 **FAX: 760-431-2665** **EMAIL: sales@lumistar.net.** **http://www.lumi-star.com**

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):	400-1150MHz
	CIFe band (CIFe):	300-1150 MHz
	P-band (P):	215-320 MHz
	70 MHz (I)	70 MHz
	(Custom *RF bands available, please consult the factory)*	
Input Level:	+10 dBm to threshold	
Maximum Input Level:	+29 dBm (self-protection at startup)	
Tuner Resolution:	50 KHz (consult factory for tighter resolution option)	
Frequency Accuracy:	0.001% typical, 0.002% max	
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 <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, -4V to +4V, 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 (+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	

Pre-D and Post-D Combiners:

Combiner Types:	Digital Pre-D, Post-D, Pre & Post
Combining Modes:	Optimal Ratio (combining algorithm based upon measured S/N for each channel), Equal Gain, or Best Channel Select modes
Modes:	Polarization, Frequency and Spatial Diversity
S/N Improvement:	> 2.6 dB typical for Optimal Select (equal RF input levels near threshold)
Break Frequency:	50 KHz minimum for 30 dB fades. The digital combiner employs a fast DSP-based algorithm to provide "Optimal Ratio" combined signal based upon real-time CH1 v. CH2 "Signal to Noise" measurements. The IF combiner does not require slow 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). The combiner supports polarization, frequency and spatial diversity applications.

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Demodulator Outputs (3 Each)

Demodulation Formats:	Multi-symbol PCM/FM, PCM/PM, BPSK, QPSK, SQPSK, SOQPSK, OQPSK, AQPSK, AUQPSK, Multi-H CPM, Single-symbol PCM FM, Analog Video FM, Subcarriers Analog Video FM supports NTSC and PAL Video
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:	Three Independent Data/Clock Outputs for CH1/CH2 & Combined TTL and High-speed RS-422 available simultaneously on each channel >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, OQPSK, SQPSK, SOQPSK, AUQPSK, 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 Displays:	for all PSK formats
Eye Pattern Displays:	for all formats
Bit Error Rate TX/RX:	Six Receivers (CH1/CH2/Combined, I and Q for each stream), 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

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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, SOQPSK, 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^{o} to $+70^{o}$ C
Storage Temperature:	-40^{o} to $+85^{o}$ 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:	4 pounds (8.8 Kg) typical
Chassis Material:	Aluminum, T-6061
Power Supply:	+9 to +42 V at approx. 30 Watts (mode dependent)
Transient Protection:	Surge Protection up to 50 KV at 100 A
Status Monitoring:	Continuous Temperature, Voltage & Current

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Ordering Information:

Model Number Examples:

LS-28-DRSM-M1LS	PCM/FM format, lower-L and S bands
LS-28-DRSM-M2UE	SOQPSK format, upper-L and E-bands
LS-28-DRSM-M6S	PCM/FM & SOQPSK formats, S-band
LS-28-DRSM-M6LU-V2	PCM/FM & SOQPSK, with Viterbi, Lower L and Upper L bands
LS-28-DRSM-M3S	PCM/FM, BPSK, QPSK, OQPSK, SOQPSK, PCM/PM, S-band
LS-28-DRSM-M6LUSC	PCM/FM & SOQPSK, lower/upper L bands, S and C bands
LS-28-DRSM-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 BG

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-DRSM

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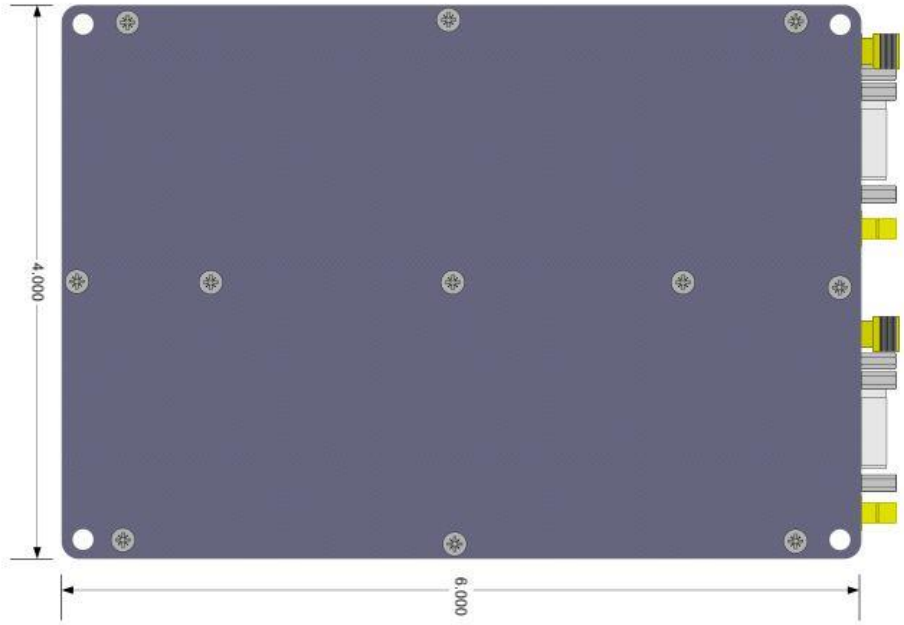
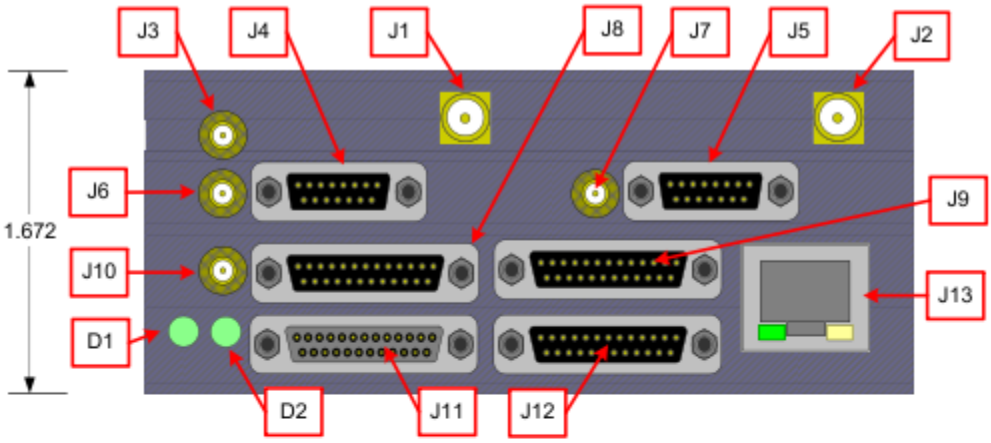
Outline, I/O and Dimensions:





Designator	Style	Signal Description
J1	SMA-F	Channel 1 RF/IF Input
J2	SMA-F	Channel 2 RF/IF Input
J3	SMB-M	10MHz Reference Input/Output
J4	uDSub15	Channel 1 Analog I/O (AM, AGC, Video, BSync In)
J5	uDSub15	Channel 2 Analog I/O (AM, AGC, Video, BSync In)
J6	SMB-M	Channel 1 70MHz IF Out Linear/DAGC
J7	SMB-M	Channel 2 70MHz IF Out Linear/DAGC
J8	uDSub25	Channel 1 Digital I/O
J9	uDSub25	Channel 2 Digital I/O
J10	SMB-M	IF Modulator Output
J11	uDSub25	Combiner Digital I/O (Power)
J12	uDSub25	User Digital I/O
J13	RJ45	Ethernet Control/Status/Data Interface
D1	GRN/YEL LED	Channel 1 Status LED
D2	GRN/YEL LED	Channel 2 Status LED