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LS-28-DRSM Advanced 4th Gen Technology
Modular Dual-Channel Receiver/Combiner Telemetry
Recording & Processing System with TMoIP UDP Data Broadcast
Data Sheet

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

The LS-28-DRSM is an advanced technology Dual-Channel Receiver/Combiner employing the most current sophisticated Digital Signal Processing (DSP) technologies. The LS-28-DRSM supports independent two-channel reception and/or combining of up to five RF bands including E, S, Lower-L, Upper-L, P, C, (as well as 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 receiver. The IF receiver provides diversity combining as well as 2-channel independent mode operation. The system has a provision for direct dual channel PCM bit-synchonization from external sources as well for Combined or Independent channel data demodulation from RF or IF signals. Digital multi-mode demodulation options include Multi-Symbol PCM/FM, SOQPSK, BPSK, QPSK, OQPSK, SQPSK, AQPSK, AUQPSK, PCM/PM, and Multi-H CPM. Analog FM demod is an option. Sub-carrier(s) demodulation can also be provided, other formats available upon request.

In addition to the digital FM demodulation, traditional analog single-symbol FM demodulation is included. PCM code converted output data is provided simultaneously to both TTL and high speed differential (RS422/485 signal standards). Optional IRIG Chapter10 UDP time stamped data packet outputs in throughput mode are available. Other TMoIP formats 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 Data 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 a GigaBit Ethernet connection. 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 32 GB 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 45 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 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 up to 60 Mbps for QPSK / OQPSK / AQPSK / SOQPSK / Mutli-H CPM. The LS-28-DRSM sensitivity and adjacent channel interference performance is superior due to the use of combining hardware IF "SAW" and DSP "FIR" filtering methods. 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 high rate 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. The unit also provides logging of setup and measured receiver parameters.

SPECIFICATIONS:

Down-Converter/Tracking Receiver (2 each, up to six bands up to 7000 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 readily available, please consult the factory)*	

Input Level:	+17 dBm to threshold
Maximum Input Level:	+29 dBm (self-protection at startup)
Tuner Resolution:	50 KHz typical (consult factory for tighter resolution options)
Frequency Accuracy:	0.001% typical, 0.002% max
Noise Figure:	6 dB (at high signal level inputs); 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 with a "10 KHz resolution bandwidth" capability, over 40,000 values
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 (+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, with AM Output Filtering using thirty-two software selectable Lowpass filters
Adj Channel Interference:	exceeds IRIG requirements, contact Lumistar for more information

Pre-D Combiner:

Combiner Types:	Digital Pre-D, multiple modes
Combining Modes:	Optimal Ratio (combining algorithm based upon measured S/N for each channel), Equal Gain (for high multipath scenarios), 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 Analog PCM FM, Subcarrier, Analog FM supports NTSC and PAL Video
Data Rates:	10 kbps – 30 Mbps (Multi-symbol PCM/FM) 1 kbps – 20 Mbps (Single-symbol PCM/FM) 1 kbps – 30 Mbps (BPSK, PCM/PM) 1 kbps - 60 Mbps (QPSK, OQPSK, SQPSK, AQPSK, AUQPSK) 50kbps – 60Mbps (SOQPSK-TG) 100kbps – 60Mbps (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, with software selectable Independent Dual Channel Bit Sync Mode
UDP Data Streaming:	Data is converted to UDP format, time stamped and broadcast via Ethernet port (optional). Other UDP formats available, such as RCC-218 and CH 10. See "ICD" for additional information.
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:

Multi-symbol PCM/FM:	Improves BER performance by approx. > 2.5 dB vs. analog 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), 70 MHz Data Modulator
IF Spectrum Displays:	Displays 70 MHz IF Spectrum of CH1 and CH 2. 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)

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 interfaces operate 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

Specifications are subject to change. Please verify the latest specifications at time of order.   *10-1-24*

Data Archive Storage:

Optional; 64 GByte per channel x 3, Solid state NAND flash memory, time stamped data. 18 hours record time per channel (x3) at 8 Mbps. The unit also provides logging of setup and measured receiver parameters.

Optional Features:

Lumistar offers various frequency bands, demodulation formats, various Ethernet Data Streaming options, Data and/or Frame Recording, IRIG and/or PTP Time and Data Decoding as options. Ordering information is in parenthesis.

Pricing is dependent upon the customer selection of these options. Some examples are listed below:
- o Demodulation Formats:
  - o PCM/FM only (-M1), SOQPSK (-M2), PCM/FM and SOQPSK only (-M6)
  - o PCM/FM, BPSK, QPSK, OQPSK, AQPSK, SQPSK, SOQPSK, and PM (-M3)
  - o M3 formats plus AUQPSK (-M4),
  - o BPSK, QPSK, OQPSK, SOQPSK, PM with sub-carrier (-M5)
  - o PCM/FM, SOQPSK and Multi-h CPM (-M7)
- o CH10 UDP Packet Data Broadcast w/ Time Stamp (-E)
- o CH10 UDP Packet Data Broadcast w/ Time Stamp (-10E)
  - o Requires 28M "Pro" application
  - o Other formats available, please consult factory
- o IF Modulation (-MOD)
- o Viterbi decoding (-V2)
- o Reed-Solomon (-RS2)
- o Soft Bit Decision Outputs (-SB3)
- o Space Time Coding (-SC3)
- o LDPC Coding (-LD3)
- o Sub-carrier (-S2)
- o Viterbi and Reed-Solomon Decoding (-VRS2)
- o IRIG Pre-D Record/Playback (-PD)
  - o IF Signals down converted to approx. <10 KHz to >10 MHz.

Environmental:

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

Physical and Power:

Size:	6.00" x 4.00" x 1.67" inches
Weight:	2.1 pounds (0.95 Kg) max. (not including Desktop Mounting Fixture)
Chassis Material:	Aluminum, T-6061
Power Supply:	+9 to +42 V at approx. 45-50 Watts (mode dependent)
Transient Protection:	Surge Protection up to 50 KV at 100 A
Power On Self-Protect:	+29 dBm at Startup
Status Monitoring:	Continuous Temperature, Voltage & Current, Health & Status

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Ordering Information:

Model Number Examples:

LS-28-DRSM-M1LS	Digital 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
Custom Bands Available:	Consult Factory with your Requirements

Other Options:

Ethernet Data Streaming:	Add "-E" suffix to model number
CH10 Ethernet Data Streaming:	Add "-C10E" suffix to model number
LDPC Decoding:	Add "-LD" suffix to model number
IF Modulation	Add "-MOD" suffix to model number
Viterbi Decoding:	Add "-V2" suffix to model number
Reed-Solomon Decoding:	Add "-RS2" suffix to model number
Viterbi & Reed-Solomon:	Add "-VRS2" suffix to model number
Soft Bit Decision Outputs:	Add "-SB2" suffix to model number
Data Archive Storage:	Add "-D64" suffix to model number

This is a partial list of all possible options. Obviously there are dozens of model number scenarios.
Please consult Lumistar Sales Engineering to define the exact model required.

For additional technical information please see the following documentation at:

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

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

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

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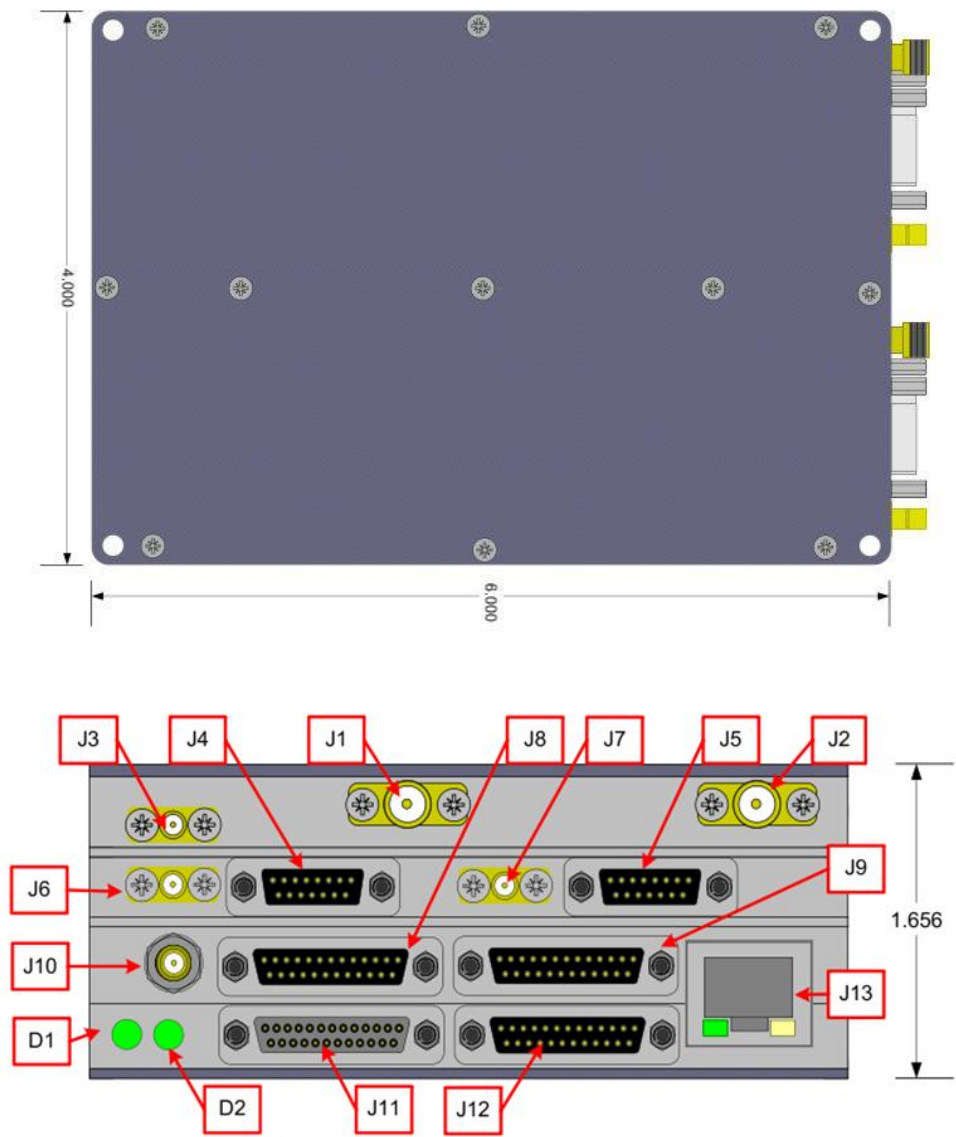**PHONE: 760-431-2181　　FAX: 760-431-2665　　EMAIL: sales@lumistar.net**　　　**http://www.lumi-star.com**

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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	Multi Color LED	Channel 1 Status LED
D2	Multi Color LED	Channel 2 Status LED