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LS-28-EC-QRS Advanced Technology
Portable Quad Channel Receiver/Combiner Unit
Data Sheet

The Lumistar LS-28-EC-QRS Economy Chassis Dual Receiver/Combiner System offers a low-cost high-performance COTS solution for a modern Telemetry Ground Station Receiving System.

The LS-28-EC-QRS is an advanced technology "Quad" Receiver/Combiner employing sophisticated fourth generation Digital Signal Processing (DSP) technologies. The LS-28-EC-QRS supports independent four channel reception and/or combining of up to four RF bands, such as E, S, lower/upper-L, P, K, or custom bands up to 7 GHz. The RF inputs are processed by two Lumistar LS-27 series dual channel quad band PCI-based tuner card that acquires and downconverts the signals to a 70 MHz intermediate frequency (IF). These IF signals are then digitized by two LS-35-R two-channel digital IF receiver. The IF receiver offers pre-D combining or routes the data directly to a multi-mode dual demodulator for two independent channel operation. The digital multi-mode demodulation options include Multi-Symbol PCM/FM, SOQPSK, BPSK, QPSK, OQPSK, AQPSK, PCM/PM, Sub-carrier(s)). Demodulated data is bit synchronized to TTL and RS-422 data/clock outputs, including PCM code conversions. Optional post-D combining is available. Standard features such as Constellation diagram displays, IF spectral displays, bit error reader and onboard 70 MHz modulator are included at no additional cost. Since telemetry data is not routed through the system's PCI bus, the LS-28-EC-QRS can process high data rate streams with no impact to the processing load of the CPU.

Unlike analog legacy Receivers, the LS-28-EC-QRS is a true software-defined radio whose digital implementation is highly flexible and expandable. The unit provides single/dual/tri/quad band operation utilizing Lumistar's "LS-27 series" dual channel/quad-band down converter in a single PCI slot. The IF receiver/combiner functionality is realized within a single PCI card state-of-the-art digital processing engine, which can operate as a single or dual channel receiver/combiner. The standard receiver processes data rates from 10 kbps to 30 Mbps for PCM/FM, 10 Kbps to 20 Mbps for BPSK & PCM/PM, and up to 30 Mbps for QPSK/OQPSK/SOQPSK. Higher data rates are available asd an option. The LS-28-QRS sensitivity and adjacent channel interference performance is superior due to the analog IF "SAW" and digital "FIR" filtering method employed at the IF. By using this method, IF bandwidths are optimaly set by software "*as a function of data rate/PCM code/modulation format*", but can be selected by the user as desired. The digital Combiner utilizes our "S/N Ratio Measurement" firmware technique to provide a signal to noise improvement of at least 2.5 dB with equal signals near threshiold level at the LS-28-EC-QRS inputs. For optimal multi-path avoidance, the Combiner operates at fade "break frequencies" up to 50 KHz. Best source selection can also be performed via software. The performance of the LS-28-EC-QRS 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:

Down-Converter (4 Each):

RF Input Frequency	S-band	2200-2400 MHz
	NATO E-Band:	2185-2485 MHz
	Upper L-Band:	1710-1850 MHz
	Lower L-Band:	1435-1540 MHz
	C-Band	4400-5250 MHz
	P-band:	215-320 MHz
	K-band:	680-760 MHz
	N-band:	830-1130 MHz
	70 MHz pass thru	70 MHz
	(*Other RF bands available, please consult Lumistar)*	
Input Level:	+10 dBm to threshold	
Maximum Input Level:	+28 dBm (self-protection at startup for > +28 dBm)	
Tuner Resolution:	50 KHz	
Frequency Accuracy	0.001% typical, 0.002% max	
Noise Figure	8 dB (Maximum); 5 dB (Typical at threshold)	
IF Filters:	Software set by data rate, PCM code and modulation format	
	User override available	
	Eight SAW anti-alias pre-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	
	(-110 dBm typ at 100 KHz)	
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:	110 dB (+10 to -100 dBm)	
Input Compression:	+10 dBm	
IP3:	+15 dBm typical (output)	
AM Demodulation:	DC to 50 KHz, programmable output vs. AM depth	
	typically 2V p-p for 50% modulation depth	
AM Filtering:	32 each lowpass filters, plus Bypass Mode	
Adj Channel Interference:	exceeds IRIG requirements, contact Lumistar for more information	
Bias “T” Power Supply:	up to +25V, 500 mA	

Pre-D Combiner (2 Each):

Combiner Type:	Digital
	Combining algorithm based upon measured S/N for each channel
S/N Improvement:	2.5 dB typical (equal RF input levels near threshold)
Break Frequency:	50 KHz minimum for 30 dB fades

The digital combiner employs a DSP-based algorithm to provide best combined signal based upon real time CH1 v. CH2 Eb/No measurements. The combiner does not require 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 (4 Each)

Demodulation Formats	Options include Multi-symbol PCM/FM, PCM/PM, BPSK, QPSK, SOQPSK, OQPSK, AUQPSK, Data Rates 10 kbps – 30 Mbps (Multi-Symbol PCM/FM) 10 kbps – 20 Mbps (BPSK, PCM/PM) 1 Mbps to 30 Mbps (QPSK, OQPSK, AQPSK, SOQPSK) (*Higher data rates are available, please consult Lumistar)*
Bit Syncs:	Two Independent Data/Clock Outputs for each channel CH1/CH2/Combined available (any two at a time) TTL and RS-422 available simultaneously on each channel >3V peak in to 50 ohms
Code Conversion:	NRZ-L, M, S and Bi-Φ L, M, S; DM-M, S; MDM-M, S

Standard Features:

Internal IF Modulator:	Internal 50-90 MHz 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, SOQPSK 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.
Multi-symbol PCM/FM	Improves BER performance by approx. 2.5 dB vs. standard PCM/FM
Constellation Displays	for all PSK formats
Bit Error Rate Readers:	One each per input channel, can be connected to Pre-D combiner
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, etc…). All displays can be captured via Screen-Shot" hardcopy feature, available in JPG file format.

Optional Features:

- Multimode demodulation formats
- PCM/FM only (-M1), SOQPSK only (-M2), PCM/FM and SOQPSK only (-M6)
- PCM/FM, BPSK, QPSK, OQPSK, SOQPSK, and PM (-M3)
  - Other demodulation options available, lease consult factory
- Viterbi decoding (-V2)
- Sub-carrier (-S2)
- AQPSK (-A2)
- Viterbi and reed / Solomon Decoding
- FPGA upgrade (for additional I/O)

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Environmental:

Operating Temperature	0º to +50º C
Non-Operating Temperature	-25º to +70º C
Operating Humidity	0 to 90% (Non-condensing)
Non-Operating Humidity	Protect from excessive moisture and contamination
Operational Scenario:	Portable, ground-based or remote (Option for airborne applications, please consult Lumistar)

Physical:

Size	Lumistar Economy Chassis (17” W x 8” D x 6” H)
Weight	17 lbs (7.7 Kg) typical
Power Supply	115 V/230 V Auto-sensing – 100W
Computer I/O:	Passive SBC backplane, 4 Gbyte RAM typ, 2.9 GHz Quad-Core Processor, TCP/IP, VGA, USB (2), PS2, Windows XP

Ordering Information:

Model Number Examples:	LS-24-QRS-EC-M1	(PCM/FM format only)
	LS-26-QRS-EC-M2	(SOQPSK format only)
	LS-24-QRS-EC-M6	(PCM/FM & SOQPSK)
	LS-24-QRS-EC-M6-V2	(PCM/FM & SOQPSK , with Viterbi)

For additional information please see data sheets for LS-35-R, LS-27-D3 and LS-84-EC

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