

MODULAR LS-68-M SERIES TELEMETRY PROCESSING AND SIMULATION ENGINE

Advances in technology have enabled the developers of telemetry processing system to lower costs and reduce the footprint of equipment further

// BRYAN GRABER AND MARK MCWHORTER

Lumistar has completed engineering development and initial production deliveries of a revolutionary modular "4th generation" digital processing product primarily designed for applications in fixed ground, mobile and airborne flight-testing applications.

The Lumistar LS-68-M Modular Multi-Channel Telemetry Processing System offers an ultra-small, low-cost, high-performance, multi-channel COTS solution for PCM data synchronization, decommutation, recording and simulation applications. Building on the legacy of the Lumistar LS-45, LS-55 and LS-77 series of products, and utilizing technologies developed for the LS-28-DRSM series products, the LS-68-M enhances the feature sets of each of these product lines and supplies them in a format requiring no hardware drivers in an "OS-less" environment. The LS-68-M utilizes a high-speed Gigabit Ethernet interface for primary controls and data streaming.

The LS-68-M series includes all the traditional functions of a full rack mount baseband telemetry processing station in the approximate size of a 3.5" hard disk drive. Standard capabilities include bit synchronization, frame synchronization, decommutation, data recording, IRIG time and network time code reading and generation, graphical displays, baseband data acquisition, and Ethernet data distribution. This adaptable product has been found to be quite useful and



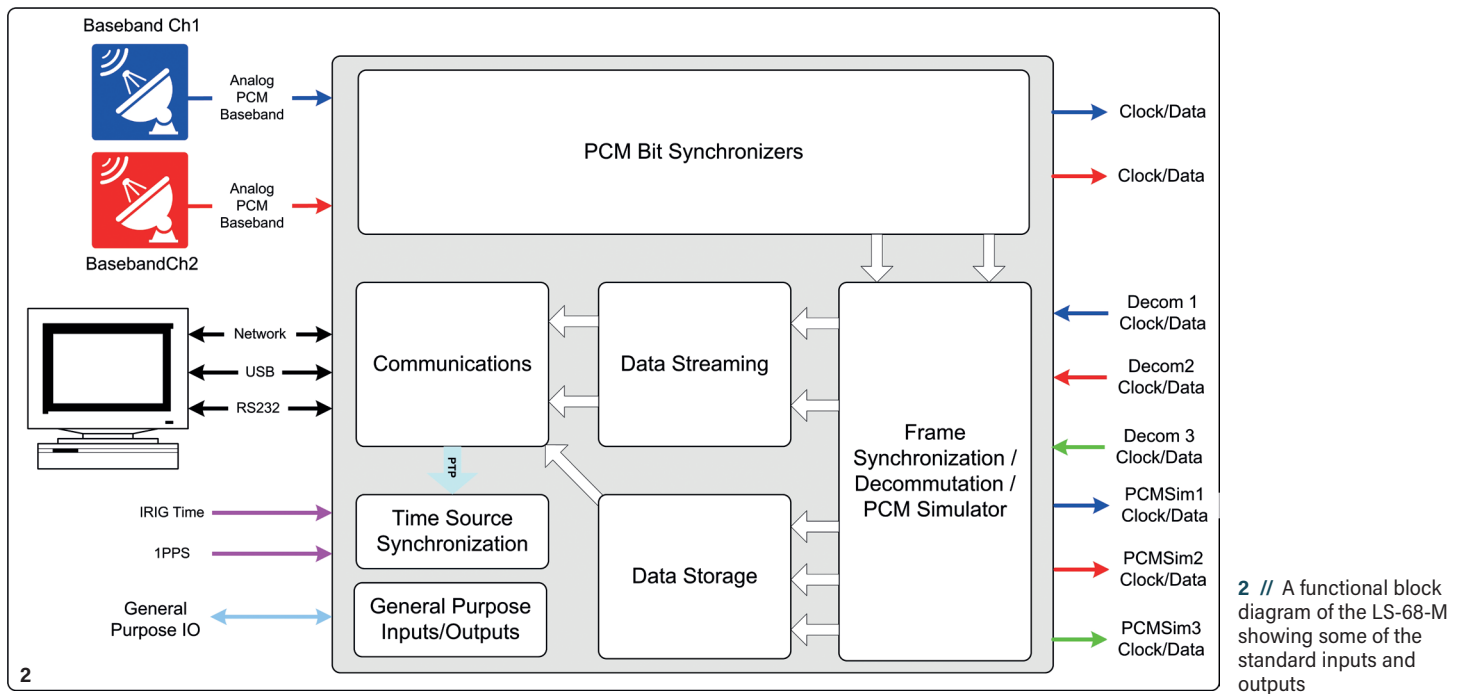
functional in many other applications such as traditional Data Acquisition applications with minor modifications to the firmware personality.

The LS-68-M employs the most current sophisticated Digital Signal Processing (DSP) technologies. In essence, the LS-68-M acts as a configurable network device offering three real-time UDP data streaming ports that can support a multitude of PCM Frame Synchronizer/Decommulator and Real-Time PCM Simulator combinations. Licensing options allow the user to use the processing platform in a configuration containing three PCM Frame Synchronizer/Decommulators for one

1 // Lumistar's LS-68-M processes telemetry data at a low-cost within a small footprint

application and then redefine the same platform for a different application needing two PCM Frame Synchronizer/Decommulators along with a single Real-time PCM Simulator.

The LS-68-M supports up to three PCM frame synchronizers, up to two "real-time" PCM Simulators, and an IRIG/1PPS/PTP time synchronization engine. PCM Frame Synchronizer/Decommulators are IRIG 106 Class I and II compliant and time stamped. Data can be supplied to the processing platform as single-ended or high-speed differential clock and data inputs. The resulting data can be streamed via UDP in Multicast data packets. If the user requires analog PCM inputs, the



LS-68-M can offer up to two fully AGC / baseline controlled PCM bit synchronizer channels with software selectable input impedance.

To get a sense for the massive scope of the size/weight/power reduction achieved by the Lumistar design team, it is interesting to note the previous generation Lumistar products would operate with a 300 watt power requirement, weight of 62 pounds and were housed in a 4U Windows computer chassis occupying approx. 3100 cubic inches. Lumistar's latest 4th generation product consumes 40 watts typically, weighs 2 pounds, and occupies a volume of 25 cubic inches. This equates to using 13% of the power, 3.2% of the weight and occupies less than 1% of the volume of its predecessor.

One of the primary design goals was to get the traditional telemetry processing and simulation functionality product "off Windows" and provide it as a "network appliance", which was achieved. The unit is controlled and monitored using only Giga-bit Ethernet and/or USB and/or RS-232 protocols. Using our Interface description documentation, the customer can create their own interface GUI or use Lumistar's standard applications.

At the heart of the modular design is a flexible and extensible DSP Engine that can take on multiple personalities. The

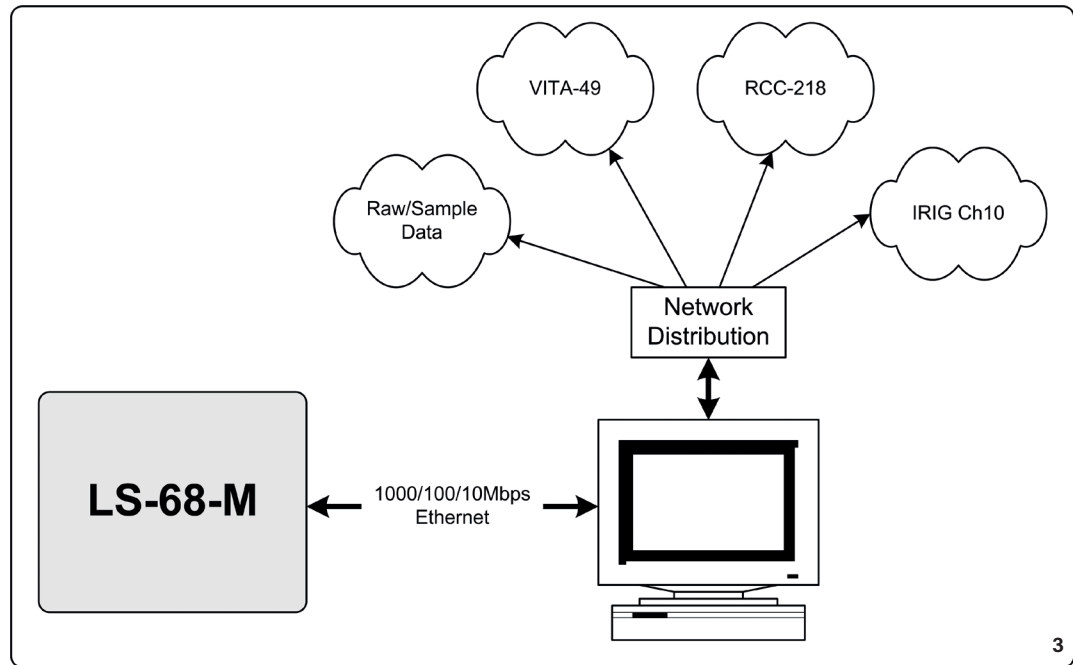
LS-68-M SPECIFICATIONS

Functions:	Bit Sync, Frame Sync, Decom, Simulation, Data Recording, TMoIP, Time Reader and Generator, Bit Error Rate Reader
Inputs:	Baseband PCM, TTL Data, TTL Clock and Data
Channels:	Single or Dual Channel, with Simulator
Bit Syncs:	Up to 2, One per decom, 50 Mbps, Input signal range from 0.1 Vpp to 10 Vpp, Code Conversion
Frame Synchronizer:	Up to 50 Mbps, 7 to 64 bit Frame Sync Pattern, Normal/ Inverted/Auto Polarity, Selectable FSP Window Tolerance
Decommutator:	IRIG Class I and II, 3 to 16 bit word lengths, Up to 65,536 Minor / Major Frames, LSB or MSB Bit Order, Frame Sync Location leads or trails, Sub-Frame Sync: FCC, FAC, SFID, URC
Control Interfaces:	232/422/485/USB/10 OR 100 Mbps Ethernet
Size:	4.00 x 6.00 x 1.13in (101.5 x 152.4 x 28.7mm)
Power:	+9 to +42 VDC, 20 Watts (typical)
Weight:	0.5kg
Temperature:	-20 to +70°C Operational, -40 to +85°C Storage
Status monitoring:	Continuous Temperature, Voltage and Current

device is configured using two hardware "slices": a DSP Engine and an Ethernet/Power/Processing Engine. The slices are interconnected together with internally stored firmware personalities which are recalled based on user needs. New firmware personalities and/or software revisions are easily updated in the field. There is no need to return the unit for most modifications.

When configured as a traditional Range Telemetry Baseband Telemetry Processor, the LS-68-M is capable of handling up to three streams of data. Functions can be allocated, such as two decommutation streams and one simulation stream. Various options include the addition of 32 GB (per channel) data recording at the bit level or of decommutated frame data with UDP data broadcasting of the received baseband telemetry.

The unit has a very flexible and useful internal Data/IF Modulator and Bit Error Reader/Frame Synchronizer Lock indicator for use in system LoopBack



3 // The processing engine of the LS-68-M can be included in a network-centric design

Tests. The unit is constantly measuring voltage and temperature, as well as other health parameters, and alerts to out of boundary conditions.

The LS-68-M provides the capability to decommutate the data from either analog or digital sources. The framed data is then broadcast via UDP multicast packets.

These packets can be brought in via "Auxiliary Input" to the Lumistar Data Processing Software (LDPS) suite of tools for real time display, archive, playback and simulation of flight test data. The LS-68-M is compatible with several other commercially available software packages, such as IADS® which is widely regarded as the industry standard for flight test display and analysis.

The LS-68-M is capable of handling many modern coding and digital link enhancement schemes, such as Viterbi, and Reed-Solomon. Each of these has its own special niche, applications and merits (as well as demerits) in modern telemetry flight test and space telemetry applications.

BASEBAND DATA ACQUISITION APPLICATIONS

The LS-68-M can be configured to act as a Baseband Data Acquisition Unit. Analog signals can be sampled, digitized, converted to various formats and then broadcast via Ethernet.

Owing to the open-ended architecture of the LS-28-DRSM series product, many more personality applications are conceivable. Please don't hesitate to contact Lumistar for additional information on these or any other potential applications for the use of the device. \

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LS-68-M ADVANCED BASEBAND TELEMETRY PROCESSING SYSTEM

The Lumistar LS-68-M Modular Multi-Channel Telemetry Processing, Recording, Playback and Simulation System offers a small, low-cost, high-performance, multi-channel COTS solution for PCM data synchronization, decommutation and simulation applications. The LS-68-M enhances the feature sets of Lumistar's legacy product lines and provides them in an "OS-less" environment.

The LS-68-M supports up to three IRIG 106 Class I and II compliant PCM frame synchronizer/decommutators and up to two "real-time" PCM Simulators with IRIG/1PPS/PTP time synchronization and data recording. Data can be supplied to the processing

platform as single-ended or high-speed differential clock and data inputs. The data can be streamed via IPv4 UDP data packets over a Gigabit Ethernet interface. If the user requires analog PCM inputs, the LS-68-M offers two PCM bit synchronizer channels with software selectable input impedance.

Included as a standard feature is an IRIG and 1PPS generator for occasions where one or more LS-68-Ms are being used in locations where a time source may not be available. An optional battery backed Real-time clock and calendar for those who want to have relative time adherence even in environments where no such time source exists.

The LS-68-M can be equipped with optional on-board data storage for each of the defined data channels. In the case that the channel has been defined as a Frame Synchronizer/Decommulator this on-board storage will record real-time data for post event downloads. In the case that the channel has been defined as a PCM simulator, this storage can be uploaded with a playback file and the onboard firmware will play the resulting file as a simulated PCM stream.

The LS-68-M is 4.00in x 6.00in x 1.13om, consumes under 20W of DC power at +9 to +42 VDC and weighs only 1.1 pounds.

For more information see Lumistar's website.