QUANTERRA Q4120

ADVANCED BROAD-BAND DATA ACQUISITION SYSTEM

General Description:

The Q4120 data acquisition system is an advanced low-cost integrated broad-band data acquisition system incorporating Quanterra's leading, proven broad-band technology. The system combines a 4 or 8-channel high-resolution digitizer having greater than 24-bit resolution and independent digital signal processors (DSP), and a powerful CMOS computer system with RAM, DAT tape and disk memory that supports both Quanterra's world-standard dial-up interface, a real-time packetized protocol, and TCP/IP communications.

Sampling rates available to the user are sub 1-Hz up to 1 kHz.

140+dB resolution A/D + DSP:

The Q4120 incorporates one or two independently optically-isolated 4-channel high-resolution analog front ends, an 8-channel DSP module, a power conversion module, a CPU/RAM module containing 8 or 16Mb. Optical isolation of the two channel groups, a unique Quanterra feature, allows attainment of full resolution using 2 sensors.

The analog front-end incorporates Quanterra's own patented delta-sigma modulator and operates at a fixed sample rate of 32kHz, with other rates derived by digital filtration and decimation in the DSP module. This is the same technique employed in Quanterra's Q52K-1 and Q680 family 24-bit digitizers, in use world wide in leading programs such as the IRIS GSN, TERRAScope, and US National Seismic Network. Our performance-leading design is unique: we do not use a design limited by under-performing "24-bit" chips.

The CPU/DSP module is an enhanced CMOS 68030, using the most modern VLSI in-circuit programmable gate arrays. The CPU/DSP supports Quanterra's *SHEAR* data acquisition and real-time dial-up data access software.

Sampling configuration (rates, filter characteristics, detectors, etc.) are programmable on a per-channel basis. The user may install their own FIR or IIR digital filters to provide any sample rates that are integer divisible into 2kHz independently on all channels.

Minimum or Linear Phase Filters:

The FIR digital filters are specified in simple ASCII text files, and may be either linear-phase (constant delay) or minimum-phase, which are causal. Causal filters may be essential where unambiguous onset times are a principal requirement. The system may simultaneously support both minimum and linear-phase filters. The user may also specify recursive filters to perform simple functions such as high-pass and band-pass where full broad-band coverage is not desired.

Real-time Packetized Transmission:

All Quanterra processors support a protocol jointly developed by Quanterra and Martin-Marietta for use in the IRIS Global Seismic Network (GSN) stations. The protocol allows selective user-definable

priority transmission of specific data types, such as broad-band event or long-period continuous, over a simple serial asynchronous link, or over a standard TCP/IP socket interface.

Extensive CRC error correction and sliding-window retransmission virtually eliminate the possibility of incorrectly-received data. The protocol also contains system advisory messages and event detections from the remote stations, and allows central-site triggering and reconfiguration without stopping data acquisition.

The transmitting system, or DA (Data Acquisition) processor will retain all data that are not acknowledged for later transmission. As buffer memory fills in the DA, previously acquired data will be overwritten in reverse-priority order to give the highest probability that the user's preferred data is transferred through the link. The link may be temporarily completely cut, and the receiver powered down without loss of data.

Software to receive the packetized data are available for both MS Windows ™ and Sun SPARC™ systems. Quanterra is developing jointly with UC Berkeley and IRIS the Sun package, providing central-site collection of data from multiple SHEAR-equipped systems.

Extensive Logging:

Quanterra's SHEAR package records on tape and disk not only the basic compressed data, but extensive timing information, detection logs, and complete logs of console text, all in FDSN-standard SEED format. Even a log of every keystroke is maintained for remote access users! These capabilities provide extensive performance analysis, and support remote maintenance, an essential feature in today's advanced systems, and a principal reason for selection of Quanterra's field-proven technology in demanding applications such as the Global Networks.

Data Compression:

Data are stored using Federation of Digital Seismic Network standard Level 1 or Level 2 compression algorithms used on IRIS stations, which was also developed by Quanterra. The compression method achieves up to 600% improvement over 32-bit data, and features quick and efficient decompression and exact reconstruction. Field systems directly generate mini-SEED format data, that allows maximum data integrity through subsequent processing: data are distributed and transferred exactly as recorded.

Dial-up Data Access:

Quanterra developed the world-wide defacto standard dial-up interface for broad-band seismic data. Quanterra's proven *SHEAR* software includes sophisticated file and resource management allow data storage to be configured optimally for user's requirements.

Our systems support transmission by Kermit of binary, compressed `mini-SEED' data files containing, for example, an entire day of event segments, or any user-specified data request. The `bufserv' data manager indexes recorded data by time to allow user requests to retrieve only relevant data. Data files transmitted are automatically uniquely named according to time and data type. With Quanterra compression, binary data file transfer can be up to 5 times as efficient as the best compression provided by high-speed modems on ASCII text files.

TCP/IP Network Access:

Because Quanterra's SHEAR application software package operates with a true real-time operating system, many features such as remote login, data transmission to multiple independent clients, and standard functions such as telnet, ftp, and a Berkeley "sockets" programming interface are built-in. Quanterra's latest-release SHEAR package supports a powerful data collection over a TCP/IP network using the commonly available "finger" program, familiar to must users of e-mail. With a single command-line from your work-station, such as:

finger "retrieve:i bh? 94/7/22 94/7/23"@mystation.university.edu

you can collect all channels of broad-band (bhz,bhn,bhe) compressed data covering the user-specified time interval of 94/07/22 through 94/07/23. Time intervals may be specified to the nearest second.

SHEAR® software:

Our sophisticated system and application software gives our field systems capabilities that are impossible in simple 'field' boxes and 'recorders'. Multiple, simultaneous data access modes, simple reconfiguration, remote status acquisition, diagnostics, and software updates (by dial-up or network), TCP/IP login, and more. SHEAR is real, mature software, for your critical data acquisition needs.

Desk-Top or Rack-Mount Package:

The Q4120 is also available in a small totally-shielded metal package requiring minimum space, suitable for installation in a facility. Connection is made via standard "D" connectors:

Table 1. Q4120 Specification Summary

Channels	3, 4, 6 or 8. Multiple units may be slaved for more.
Resolution	approx 145 dB below 100 Hz. min 130 dB @ 500sps
Format	32-bit integer, compressed
Input Range	5-40V P-P. 0.1µV preamp available
Filtering	Digital, 8 × ADSP2105 + TMS320C31.
Sample Rate	1 kHz highest available to user, others derived from 2kHz. Initial rate 32kHz.
Time Base	Precision TCXO 1PPM/^{o}C. Time base is phase locked without sampling time-base distortion.
CPU	68030 CMOS CPU.
Memory	4Mb EPROM, up to 16Mb RAM
Serial Ports	6, of which 2 support dial-up.
Time	Integral Quanterra GPS1 with antenna + 16m cable.
Power	5-30W 12VDC, depending on configuration
Physical	Sealed, Polyethylene, 22 X 22 X 11 in.
I/O Interface	External SCSI, Ethernet TCP/IP optional

Price:

Very economical. Configurations vary. Contact Quanterra.

Quanterra *Q4128GS-10/E16* System Specifications

Specifications of the *Q4128GS-10/E16* illustrate a member of Quanterra's Q4120 family. Other members of the family include alternate configurations of disk, tape, processors, and channels:

Table 1: *Q4128GS-10/E16* System Specifications

Specification	Description
Channels	8 total. Two 4-channel groups separately galvanically and optically isolated.
Sample Rate	32000 Hz, simultaneous. user rates:1000,500,400, 250,125,200,100,50,20,10,1Hz.
Resolution and Dynamic Range	LSB (Least Significant Bit) = 2.34μV. 148 dB max. (±10.5 × 10^6 digital counts)
Bandwidth	0-0.8 Nyquist (-6dB point). Response controlled by digital FIR filter.
Noise and Distortion	Terminated input noise level typical -142 dBrmsrel to Full Scale, 0.25-50Hz. May exceed 146 dBrmsrel at sub-Hz frequencies and constant temperature, matched to high-dynamic range sensor, such as STS-2.
Full Scale	±20V differential input. Optional external preamp available for passive sensors.
Operating Temp Range	-10 to 45 °C ambient temperature external to sealed enclosure.
Signal Processing	Digital. One fixed-point ADSP2105 used per channel, one floating-point TMS320C31 master. User-loadable linear or minimum-phase FIR or IIR filters.
Sensor Calibration	None built-in. Optional calibration/state-of-health module available.
Timing	GPS C/A code. 1μsec accuracy to UTC. Position error 100 meter RMS. Sampling timebase phase-locked to GPS using software-controlled slew-limited low-distortion loop. Integral to Q4120 processor module.
Main Processor	One 25 MHz Motorola MC68EC030 microprocessor on Q4120 module.
Storage	One 1052Mb SCSI disk drive mounted to panel.
Memory	16Mb RAM on plug-in module.
Communications	4 asynchronous serial ports. 1 port used for dial-up modem, 1 for terminal, others available for data transmission.
Networking	Plug-in module supports standard TCP/IP protocols, with remote login via telnet, and data transmission via finger and ftp.
Software	*ULTRA-SHEAR*, resident on disk, fully installed, user-configurable.
Environmental	Sealed, polyethylene environmental enclosure. 22 X 22 X 11 in.
State of Health Monitoring	None built-in. Optional calibration/state-of-health module available.
Construction	Fabrication to ANSI/IPC-A-600D Class 3. Single-board digital, factory replacement and repair only. Each 3/4 analog channel group on a single board. Field-replace-able individual analog-channel pre-processors.
Power	12VDC, 2A average. Isolating DC/DC converters.