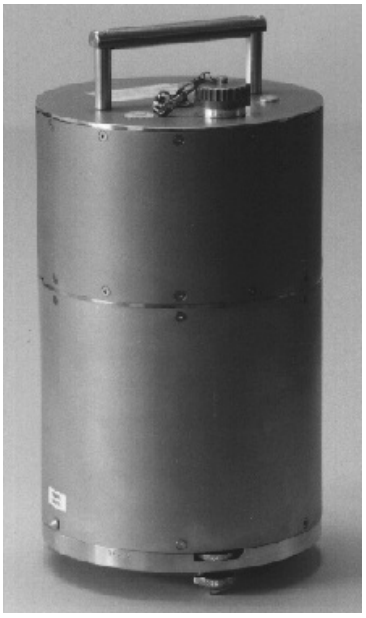
GÜRALP CMG-DM24

DIGITIZER MODULE

The three component digital output broadband sensor system consists of two modules. Module one being the broadband sensor such as CMG-1T, CMG-3T, CMG-3ESP or CMG-40T and Module 2 the high resolution broadband seismometer digitizer. The 24-bit low noise digitizer module has been designed to stack on top of the analogue sensor as shown in the photograph.



There are many advantages in using an integrated digitizer with a broadband seismometer, these being;

a) clean, isolated, pressure and temperature stable sensor environment for wide dynamic range digitizer,
b) sensor analogue outputs cannot be contaminated with external analogue noise as the output is in digital form,
c) wiring between the sensor and the digitizer is minimised,
d) sensor outputs transfer function and system responsivity cannot be confused by misconnection of analogue cables,
e) A truly portable, self-contained seismic sensor system which can be transported with ease due to the reduced number of components and cabling,
f) ease of installation in temporary or permanent sites.

CMG-DM24 is organised to be a 3 channel acquisition system. It is housed inside a stainless steel circular housing with 'O' ring seals, ensuring a 100% waterproof environment.

CMG-DM24 has a further 8 auxilliary channels (or optional 16 channel) with 16-bit digitizer inputs to provide low sample rate data (4 s/s) which are primarily used for 'state of health' monitoring of the broadband sensor, e.g. sensor mass position outputs, temperature, pressure, input supply voltage and the injected calibration signal. The slow data channels can be switched on or off remotely and this data is packaged and processed in exactly the same method as the primary digitizer channels.

The total power consumption of the DM24 unit is 1.45 Watts and the supply voltage can be from 12 to 36 Volts.

GÜRALP SYSTEMS LIMITED
3 Midas House, Calleva Park, Aldermaston,
Reading, Berks, RG7 8EA, United Kingdom.
Tel: +44 (0) 118 9819 056
Fax: +44 (0) 118 9819 943
e-mail: sales@guralp.com
Website: http://www.guralp.com

DM24 features:

* Built-in digital signal processors provide simultaneous multiple sample rate data streams at user selectable rates. Up to four streams of data for each component are available at sample rates from 200 samples/second down to 4 samples/second.
* All data is produced in a unified compressed data format, each block of data containing the unique source id and accurate UTC (GPS) time stamp.
* Precision microprocessor controlled time base synchronises analogue to digital converters and DSP and time stamps data blocks.
* Time synchronisation to external GPS or serial time code.
* Control microprocessor formats and buffers data in on-board 512K RAM ring buffer.
* Optional extra RAM up to 16 Megabytes for data storage for triggered event operation.
* Continuous or triggered data output is available concurrently.
* Serial data outputs are optically isolated with user selectable baud rates.
* Digital data output options are RS232, RS422 or fibre-optic.
* Built-in microprocessor system configuration and broadband sensor control via interactive command mode.
* Extensive and sophisticated multi-tasking software (SCREAM!) allows full digitizer and sensor control.
* Block format supports system status reports in plain text.
* Very small power, less than 1.45 Watts.

SCREAM! SOFTWARE

The SCREAM! data acquisition software package allows the user, within Windows 95 environment, advanced data access from the acquisition system, data storage and digitizer/sensor setup and configuration. The details of SCREAM! are given on a separate data sheet.

DATA OUTPUT

The digitized data is transmitted from the digitizer via the optically isolated serial port. The same port is also used to configure and set up the digitizer system.

All the data, including the state of health channels and triggered data, is transmitted with an efficient transmission protocol through the same port. This port can be connected directly to the storage and acquisition module, PC serial port, modems and any kind of serial data transmission medium.

DATA COMPRESSION

All the data produced by the Digitizer Modules and handled by the Storage Acquisition Modules and Combiner Repeater Modules are in the same block format, which greatly simplifies the processing software.

The block format has also been designed to require minimal programming effort to handle and decompress, while still achieving efficient compression

Each block contains only data from one component (stream) which is uniquely identified by 2 fields in the header. Another field contains the accurate UTC (GPS) time of the first sample of the block which is always by definition on an integer second and blocks always contain an integer number of seconds of data. The final header field specifies the compression format, sample rate and number of samples in the block. The header totals 4 * 32 bit (long word) fields.

The maximum block size is 1k (1024) bytes, which consists of the 16 byte header plus 2 fields (8 bytes) for the Forward Integration Constant (1st sample absolute value) and Reverse Integration Constant (allows checking after decompression) and a maximum 1000 bytes of data. The data fields contain either 1 * 32 bit difference, 2 *16 bit or 4 *8 bit differences. All data on a block will be in the same format. If the data dynamic range requires a different compression format blocks can be shorter than 250 fields (1000 bytes), but block boundaries always occur on integer seconds. For example, at 100s/s 32 bit format the block size is 2 seconds or 800 + 24 bytes. The use of byte, word or long word differences allows for efficient and fast decompression of the block data.

TRANSMISSION EFFICIENCY

The transmission protocol similarly has been designed with a minimum overhead and consists of a 4 byte header and 2 byte tail (block checksum).

To further improve the transmission efficiency 32 bit blocks are transmitted without the (redundant) most significant byte of the difference fields reducing the block size and link bandwidth requirement by nearly 25%.

The following tables give examples of the block sizes and data rates for different compression formats and the typical baud rate for a 3 component system.

Sample Rate 100s/s

Format	Bytes/ sec	Secs/ blk	Samples/ block	Block size	Tx Block	Bits/ sec	3 comp system	Baud rate
32	400	2	800	824	630	3150	9450	
16	200	5	1000	1024	1030	2060	6180	9600
8	100	10	1000	1024	1030	1030	3090	

Sample Rate 20s/s

Format	Bytes/ sec	Secs/ blk	Samples/ block	Block size	Tx Block	Bits/ sec	3 comp system	Baud rate
32	80	10	800	824	630	630	1890	
16	40	25	1000	1024	1030	412	1236	1800
8	20	50	1000	1024	1030	206	318	

Sample Rate 4s/s

Format	Bytes sec	Secs/ blk	Samples/ block	Block size	Tx Block	Bits/ sec	3 comp system	Baud rate
32	16	50	800	824	630	126	378	
16	8	125	1000	1024	1030	82	246	300
8	4	250	1000	1024	1030	41	123	

As a general rule it is possible to use a transmission baud rate that is adequate for data in 16 bit format as the internal buffering in the DM and CRM allows for the occasions (during events) that data will be in 32 bit format, which would only temporarily require a higher bandwidth link. Data will accumulate in the buffer faster than it can be transmitted but as seismic activity decreases the buffer will automatically empty.

The internal buffering also accommodates the bursts of data from the slow rate (environmental) channels that occur every few minutes (see table for 4s/s). The link speed required can be estimated by adding the bit rates for all the selected channels and sample rates (streams).

TELEPHONE DIAL-UP DATA ACCESS

The DM24 unit can be accessed through a modem without any special equipment. The internal buffered data or triggered event data can be accessed over a dial up modem. SCREAM! can be used to download the buffered data.

DIGITIZER SET UP

The digitizer parameters can be set up using set of converstaional English language or SCREAM! can be used to set up the digitizer, sample rates, digitizer data output rate or trigger parameters.

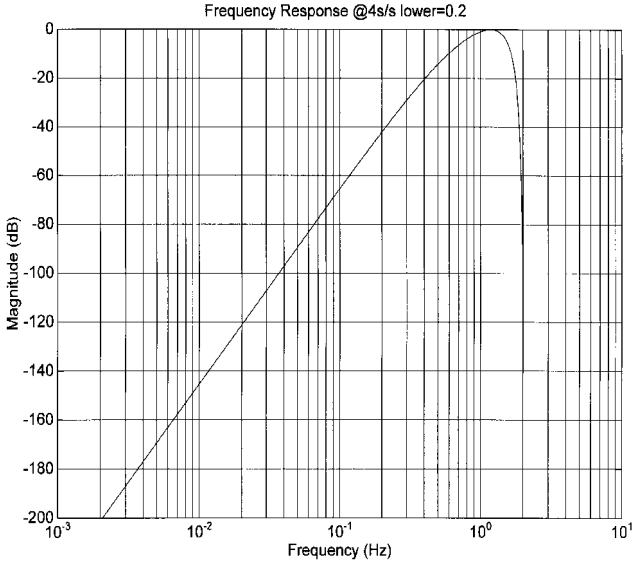
BROADBAND SENSOR REMOTE CONTROL

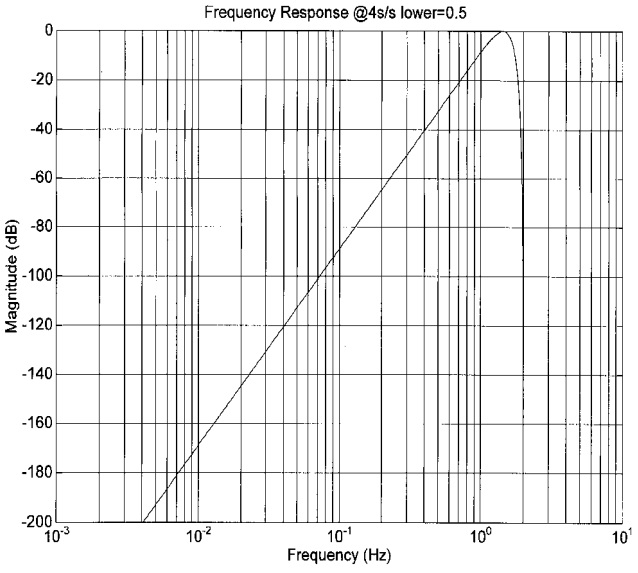
One of the main requirements from a broadband sensor digitizer system is the capability of remotely centring and calibrating the sensor system. In cases where the sensor system is sinstalled in postholes or boreholes the sensor system's inertial mass would require to be unlocked and locked.

DM24 provides all the requirements of a broadband system whether it is connected to the sensor as an add-on module or as a separate digitizing box.

EVENT DETECTION

The triggering algorithm is applied to the band pass filter. The bandpass corner frequencies can be set by the user. Typical band pass filtering amplitude responses are given below.





There are many filter configurations as shown in the following table.

Tap#	Samples/sec	Bandwidth 1	Bandwidth 2	Bandwidth 5
0	200	10 - 90 Hz	20 - 90 Hz	50 - 90 Hz
1	100	5 - 45	10 - 45	25 - 45
	40	2 - 18	5 - 18	10 - 18
2	50	2.5 - 22	5 - 22	12.5 - 22
	20	1 - 9	2 - 9	5 - 9
	8	0.4 - 3.6	0.8 - 3.6	2 - 3.6
3	10	0.5 - 4.5	1 - 4.5	2.5 - 4.5
	4	0.2 - 1.8	0.4 - 1.8	1 - 1.8

In it's standard configuration the DM24 outputs continuous data at a user-selectable sample rate. An additional powerful feature of the DM24 is the ability to simultaneously run a STA/LTA event triggering algorithm in parallel with the continuous acquisition. This permits the system to record continuously at a relatively low sample rate, and record at a much higher sample rate during short periods when triggered. Parameters controlling the triggering algorithm, and controlling the data output once the system is triggered, are all selectable by the user, permitting the maximum flexibility of operation and the most efficient use of available storage space.

CMG-DM24 SPECIFICATION

SEISMIC CHANNELS

Number of Channels	:	3 or 6 @ 24-bits
Inputs	:	Differential with transient protection
	:	±10 Volts input range
Input Impendance	:	1 MΩ, 10 nano Farad
Common Mode Rejection	:	120 dB at 10Hz

ENVIRONMENTAL CHANNELS

Number of Channels	:	8 (optional 16) @ 16-bits
Inputs	:	Single ended
	:	±10 Volts input range

GPS	:	External GPS (CMG-GPS2) GPS can be connected with 50 metres of cable
GPS Power	:	Supplied via the GPS connector on the digitizer
GPS Time Format	:	NMNI or TSIP (Trimble Standard Interface Protocol)

SENSOR CONTROL FUNCTIONS	:	Lock Sensor (active low CMOS$)
	:	Unlock Sensor (active low CMOS$)
	:	Centre Sensor (active low CMOS$)
	:	Calibration Enable - Vertical, North/South, East/West (can be enabled individually).

SENSOR CALIBRATION SIGNAL	:	Amplitude and frequency adjustable - sine or square wave

DIGITAL SIGNAL PROCESSOR

Type and Speed	:	M56001, 20 Mhz
Hardware Sampling Rate	:	2 Khz
Selectable Sample Output Rates available from the DSP	:	Up to four separate rates are available. User selects each in serial, beginning with 200 sps and dividing the prior rate by 2, 3, 4, 5, 8 or 10. Examples: 200, 100, 50, 10 sps or 100, 40, 20, 4 sps. The sample rates must be even integers.
Anti-alias Filters	:	3 pole
Low Pass Filters	:	FIR
Out of Band Rejection	:	140dB
In band ripple	:	- 140dB
Trigger Modes	:	STA/LTA

DIGITIZER PERFORMANCE

Standard Output Format	:	24-bits
Noise-free Resolution, NPR	:	22.5-bits @ 20 sps, 21.5-bits @ 100 sps
Absolute Accuracy	:	Standard - 0.5%, Optional - 0.1%
Type	:	5th order single bit low pass noise shaper
Analogue Transducer Outputs	:	3-C signals

CLOCK

Oscillator	:	Standard - 8×10^{-7}, Optional (oven-controlled) - 5×10^{-8}
Interface for External Receiver	:	GPS
Sync for External Receiver	:	<200 μsec

RAM STORAGE

Optional RAM, megabytes	:	1, 2, 4, 8, 16 Mb

Continued .....

CMG-DM24 SPECIFICATION Continued

POWER

Customer Power Supply	:	+10 to 36 Vdc
Current at 12 Vdc with 4 MS RAM	:	145 mA

PHYSICAL

Diameter	:	168mm (6.6 in)
Height	:	100mm (4 in)
Operating Temperature Range	:	- 20C to + 65C

OUTPUT OPTIONS

RS232	:	100 ft
RS422	:	500 ft
Optical	:	10 Km
DPSK/FSK	:	10 Km

TOP CAP CONNECTORS

Channels 1-3	:	26-way
Channels 4-6	:	26-way
Digital Outputs and Power	:	10-way
GPS Input	:	10-way