

24 Bit Data Monitoring and Data Logging System

DLM24Mag GradMag®

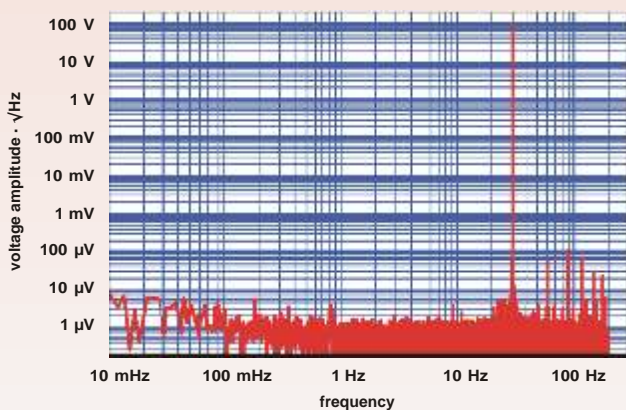
The Data Logging and Monitoring System **DLM24Mag** is a very flexible multi-channel measurement system for a variety of applications. It combines a precise **7 decades** data acquisition with the **GB memory capacity** of today's SDRAM boards. **Battery operation**, its fast **fibre-optic interface** (BiFOC) additional to the RS232 standard interface, and the full **support of GPS** data for global time and position synchronization are features to match complex measurement tasks especially outside the lab environment. The DLM24Mag system can be controlled by a **notebook** due to a **PCMCIA** card supporting up to 4 of the 20 MBit/s fibre-optical interfaces. A unique phase synchronized fibre-optic network enables **simultaneous triggering** of several units with sub-microsecond accuracy. Delta-Sigma converters are used to provide the **huge dynamic range** and **high linearity**.

Acquisition Unit DLM24Mag-Cx



| Type | DLM24Mag-C4 | DLM24Mag-C8 | DLM24Mag-C12 | DLM24Mag-C16 |
|---------------------|-------------|-------------|--------------|--------------|
| Differential Inputs | 4 | 8 | 12 | 16 |

The **DLM24Mag-Cx** offers 4, 8, 12, or 16 simultaneously triggered true differential inputs (+/- 10 V) for data acquisition with its 24 bit ADCs. The sampling rate may be selected from 0.1 Hz to 10 kHz. Built-in digital filters can be chosen and complemented with user defined transfer functions. As an example a low pass filter with 120 dB attenuation within 12% of the sample rate is possible. While fully digital, the filtered signals can still be monitored as analog signals in real-time with an oscilloscope using the 4 built-in 16 bit ADC outputs to be connected to any of the inputs allowing free scaling and offset compensation. While optimised for the frequency range up to 300 Hz the DLM24Mag-Cx can be operated up to 4 kHz with a 10 kHz sample rate.



Noise spectrum of the DLM24Mag-Cx. The input signal is generated by a low distortion signal generator operating at 30 Hz.
sample rate : 400 Hz, bandwidth : 100 Hz, 2¹⁹ data points

Memory Unit DLM24Mag-Mx

The memory unit DLM24Mag-Mx offers 1 or 4 fibre-optical data inputs and 4 memory slots for SDRAM modules of 128, 256 or 512 MB size covering up to 2 GB or 500 million data points. Each fibre-optic interface is capable of a 2 MB/s data rate resulting in a maximum speed of 8 MB/s. The DLM24Mag-Mx is able to serve up to four DLM24Mag-Cx units and permits autonomous measurement control and data acquisition without a computer. The SDRAM modules are buffered by an internal rechargeable battery. In a fibre-optic network the DLM24Mag-Mx synchronizes the clock and serves as a router. Complex simultaneously triggered networks with over 1000 units can be operated in a cascaded structure with up to 5 levels. Global time and co-ordinates are offered when combined with a GPS or DGPS system. Global time synchronization with microsecond accuracy is supported using the 1 PPS signal of a GPS receiver.



| Type | DLM24Mag-M1 | DLM24Mag-M4 |
|----------------|-------------|-------------|
| Optical Inputs | 1 | 4 |

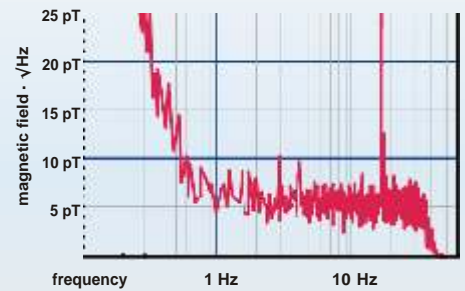
Versatility and Dedication

The high flexibility of the DLM24Mag system is the result of combining **24 bit ADC** operation, real-time 16 Bit DAC **analogue monitoring** and event generation, **battery** operation, **fibre-optical** data transmission, **notebook** access using the **PCMCIA** fibre-optic interface, today's **mass storage** capabilities, **GPS** or **DGPS** support, digital filtering and intuitive software to form a simultaneously triggered **multi-channel** and even multi-device measurement **system network**. The input connectors of the system are built to match the requirements of the fluxgates **Mag03** of **Bartington Instruments Ltd.** . Up to 4 **Mag03** units may be run from a single DLM24Mag-C16 unit simply by plugging in the cable from the magnetometers. Additionally to any of the **Mag03** inputs, an auxiliary SMB input is available which could be used e.g. for acceleration, vibration, tilt, pressure or temperature measurement. A constant current power supply mode commonly used together with built-in piezo-electric pre-amplifiers can also be activated.

Application

The brand **GradMag**® indicates that the DLM24Mag series has been developed to get high resolution magnetometer data to form magnetic gradients by software algorithms. This requires high precision and linearity together with simultaneous triggering. Eight magnetometer channels are sufficient to calculate the full magnetic **gradient tensor** and to build a system for **localizing magnetic dipoles**. In cases where analogue signal subtraction is still used because of its precision the digital alternative is now available. It is especially suited for the dynamic signal calibration when using complex calibration coefficients together with the time derivative of the signals. Over 6 decades of signal cancellation can be achieved.

Data acquisition inside magnetically shielded rooms or **EMC** measurements are easily done without any 50 Hz or 60 Hz interference. Simultaneous triggering of any DLM24Mag-Cx unit connected to the fibre-optic data transmission network is guaranteed by a special master / slave concept locking the phase of all the network's 20 MHz fibre-optic signals serving as clock references for all individual units. The large semiconductor based memory of up to 500 million data points combined with small power consumption allow for 24 hours of autonomous data collection. Much longer unattended data acquisition is possible when using e.g. a conventional solar panel in connection with the battery. Together with a **GPS** or **DGPS** system any data point can be globally synchronized with microsecond accuracy and tracked down according to UTC co-ordinates. Due to the BiFOC's **2 MB/s data rate** the measured data are transferred into the computer in reasonable time. The built-in real-time clock permits time-controlled measurement protocols even involving the DACs as event generators. As an option additionally to the 4 on-board DACs, the 24 Bit ADCs can be replaced by 16 Bit DACs thus supporting up to 20 DAC channels or transforming the DLM24Mag-Cx into a multi-channel function generator. With the **PCMCIA** fibre-optic interface card the power of the DLM24Mag system is combined with the flexibility of a notebook computer. Glass fibres can be chosen instead of the PMMA fibres in cases where a long range interconnection is of the essence. (e.g. long **under water sensor chains**).



Noise of standard Mag-03 fluxgate (**Bartington**) being part of an underwater sensor system with 5 Mag-03 sensors measured in earth field (rural environment). Sample rate: 100 Hz, coupling: DC

Software

The DLM24Mag system comes with its **GradMag**® software currently running under Linux and WinNT / Win2000. Other operating systems may be supported on request.

Basic Version as Delivered with the DLM24Mag System

- remote measurement control of all functions of the DLM24Mag system up to one (optional up to 5) cascading level (1 DLM24Mag-Mx, max. 4 DLM24Mag-Cx) in the fibre-optic network
- visualization of data in time or frequency domain for max. 16 channels
- "data microscope" to magnify and scale a graphically selected part of the plot. This feature is mandatory to deal with the high dynamic range of the system
- system configuration and user specific information are saved together with data
- data are stored in ASCII or binary format (IEEE compatible, 32 bit signed integer)
- public file / data format allowing other software to interact via file interface
- support of digital real-time filters
- comprehensive documentation of all features (online-help, CDROM)

Optional Extensions

- FFT vs. time representation with colour encoded amplitude to display spectral variations in time (waterfall)
- calculation of auto-correlation, cross-correlation and transfer-function
- digital filters for off-line data analysis
- generation of arbitrary digital filters
- simultaneous display of more than one data window
- external triggering of the system
- support of the function-generator mode for the DACs
- script control for fully autonomous measurements
- support of multi-level cascaded systems in a network

Specifications

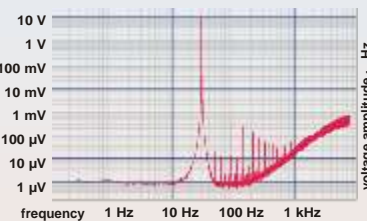
Acquisition Unit DLM24Mag-Cx

| | |
|---------------------|------------------------------|
| resolution ADC | see table and figure |
| noise level | < 1 μ V/ Hz |
| input voltage range | +/- 10 V |
| cross-talk | < -120 dB |
| bandwidth | filter dependent, max. 4 kHz |
| sample rate range | < 0.1 Hz - 15 kHz |
| DAC | 4 \times 16 Bit, 100 kS/s |
| no. of channels | 4, 8, 12, 16 *) |
| interfaces | BiFOC, RS-232 |
| power consumption | 2 - 4 W |
| dimensions [mm] | 205 \times 145 \times 90 |
| weight | 1.3 - 1.5 kg |

*) true differential inputs

Noise Spectrum

with low noise signal generator at 30 Hz
sample rate: 15625 Hz, bandwidth: 4 kHz



Memory Unit DLM24Mag-Mx

| | |
|-------------------|------------------------------|
| memory slots | maximum 4 |
| SDRAM | 64 - 512 MB modules |
| no. of channels | 1 4 |
| interfaces | 2 5 BiFOC, RS-232 |
| input data rate | 2 8 MB/s |
| output data rate | 2 MB/s |
| power consumption | < 2W |
| dimensions [mm] | 205 \times 145 \times 50 |
| buffer time | > 5h (512 MB) |
| weight | ca. 0.8 kg |

Fibre-Optic Interface

BiFOC

| | |
|-------------------|----------------------|
| baud rate | 20 MHz |
| data rate | 2 MB/s |
| protocol | hand-shake |
| type of fibre | duplex (PMMA, glass) |
| max. fibre length | 40 m (PMMA) |

Interface Card

HSCOM

| | |
|-----------------|----------------------|
| card type | PCI, PCMCIA |
| baud rate | 20 MHz |
| input data rate | 2 MB/s |
| interfaces | BiFOC |
| driver | Linux, WinNT/2000/XP |
| RAM | 8 MB |

Delivered Items

battery and charger with complete cable set
DLM24Mag-Cx and/or DLM24Mag-Mx
installation CD with basic software
hard- / software documentation

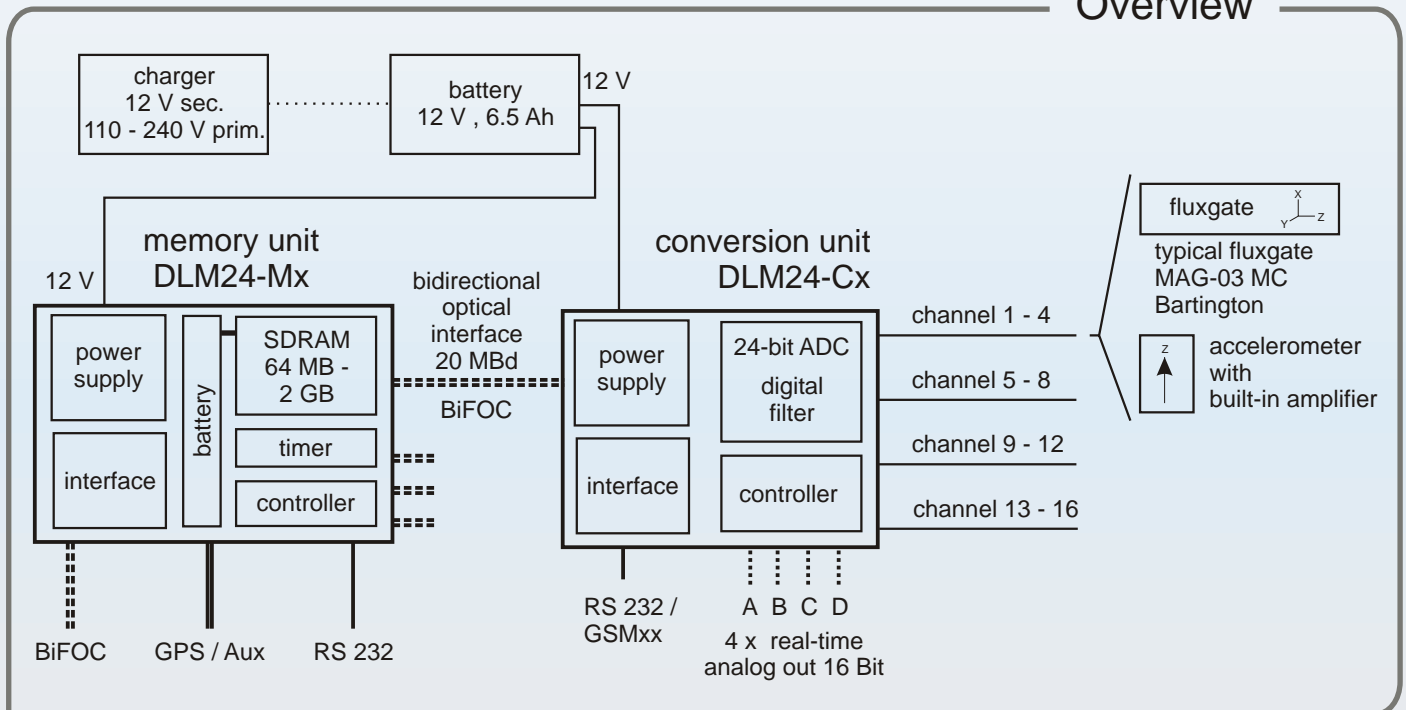
Optional: field case



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Data Logging and Monitoring - System DLM 24

Overview



fluxgate

typical fluxgate
MAG-03 MC
Bartington

accelerometer
with
built-in amplifier

Typical Applications

- site measurement
- gradiometry (full 1st, 2nd, 3rd and higher order tensor)
- pipeline localization
- magnetic target localization
- magnetic signature measurement
- magnetic sounding
- observatory measurement
- traffic monitoring and control
- mine detection / geological survey
- bore hole analysis
- archeology
- magnetic surveillance / safeguard
- magnetic susceptibility
- magnetic material characterization

Accessories

field case

PMMA to glass converter
over 1 km distance

