

# **BARTINGTON**

## **MAG-03-OCTO-PSU**

### **POWER SUPPLY UNIT**

#### **OPERATION/MAINTENANCE MANUAL**

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**OPERATION/MAINTENANCE MANUAL  
FOR *Mag-03-OCTO-PSU* POWER SUPPLY UNIT**

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## **1 INTRODUCTION – SEE FIG 1**

This manual describes the operation of the *Mag-03-OCTO-PSU* power supply unit. The unit provides a battery backed power supply of  $\pm 12\text{V}$  for up to eight *Mag-03* series three-axis fluxgate magnetic field sensors. Signal inputs from the *Mag-03* sensors are fully differential and the buffered outputs can be selected to be all a.c. or all d.c. coupled. The connector pin allocation details are given in the SPECIFICATIONS section.

## **2 POWER**

The *Mag-03-OCTO-PSU* contains a 12V, 4Ah rechargeable Nickel Metal Hydride battery pack. The battery is charged from the 240Vac or 120Vac mains adaptor supplied, which provides a regulated supply of 12Vdc at 1.25A. When in good condition the battery will power eight *Mag-03* sensors for up to 10 hours.

A switch controls the power to the sensors. A 2.1mm input socket is provided for connecting the 12V mains adaptor for charging the battery. The centre pin is positive and the battery pack input is protected against reversed polarity. The sensors may be operated during battery charging provided the ambient temperature is below 30°C. This is a precaution to avoid excessive internal temperatures.

A red indicator is constantly illuminated when the battery is being charged. The battery should always be charged after use.

The +12V supply for the *Mag-03* series of magnetic field sensors is provided by the battery pack and the -12V supply by a dc to dc converter. Each *Mag-03* sensor is connected by a 6-conductor cable, the screen of which is used for the 0V power supply return (common) line. (See Figure 2)

## **3 FILTERS**

A low pass and a high pass filter are included in the signal path of the outputs from the X, Y and Z axes of each of the sensors. The low pass filters provide a frequency response from dc to 4.5kHz. These filters remove the high frequency noise components of the signal from the sensor.

The high pass filters have a fixed low frequency cut off at 0.1Hz and are intended to isolate the dc or static field component so that the alternating components above this frequency can be measured or analysed. A switch allows the high pass filters to be de-selected or selected to provide a sensor response from dc to 3kHz or an ac response from 0.1Hz to 3kHz.

## **4 BUFFERS**

The three XYZ signal outputs from each individual magnetometer share a common signal return line which is separate from the power return line. In this way dc errors which could arise due to power supply return currents are completely eliminated. The common mode rejection ratio is 50dB minimum.

The three signal lines from each magnetometer are buffered by an amplifier with a fully differential input stage, filtered and fed via a buffer to the appropriate pin of one of the two output connectors. The signal

common is also buffered. The buffers allow long cables and low input impedance data acquisition systems to be used. The load should not be less than 10kohm resistance or greater than 2000pF.

The output common is referenced to the internal chassis ground.

## **5 CONNECTORS**

Each *Mag-03* sensor is connected to one of the eight Hirose 10-pin connectors on the front panel. The filtered and buffered sensor outputs are available through two 37-way Cannon D type connectors with four sensors being allocated to each connector. A nine-pin Cannon D type connector is available for connecting external temperature sensors and the output signals from these are linked internally to the 37-way connectors.

## **6 CABLES**

Cables can be supplied to connect any of the *Mag-03* series of sensors to the *Mag-03-OCTO-PSU*. Details are given in the operation manual for the sensor. The cables carry the supply voltage to the magnetic field sensor with the 0V connected through the screen. Analog signals are returned via three conductors and the analog return is via a separate conductor.

The maximum cable length of 600 metres is derived from the following considerations:

- (a) Above this length the positive supply current of up to 30mA will produce a 1.5 V voltage drop which may restrict the analog output swing especially where a low voltage supply is used.
- (b) Above this length the maximum capability for capacitance loading of the magnetic field sensor output will be exceeded.

Cables other than those provided by Bartington Instruments should generally conform to the specifications given and a screened type is essential if low noise performance is to be achieved. An example of an alternative cable is Belden Type 9536 for use in protected conditions, e.g. ducts etc.

## **7 ANALOG VOLTAGE MEASUREMENTS**

To obtain the full precision of the magnetic field sensor the analog outputs should be connected only to analog inputs which have an impedance greater than 10 k $\Omega$ .

## **8 *Mag-03-OCTO-PSU* WITH *Mag-03* SERIES SENSORS**

Use of the *Mag-03-OCTO-PSU* power supply eliminates any problems which may be encountered in providing a suitable isolated power source for an array of sensors. The unit also provides additional filtering of the analog signals to improve the signal to noise ratio. The high pass filter sections can be selected to provide either a dc or ac response.

## **9 BATTERY CHARGING**

A mains adaptor having a 12Vdc regulated output is supplied for battery charging. The unit supplied will operate from either 110V or 220V/240Vac, 60Hz or 50Hz, and provides full electrical isolation from the mains supply. As an alternative the battery may be charged from a vehicle dashboard 12V connector.

Note: the -ve terminal of the front panel charging socket is connected, via the battery pack, to system ground.

The power switch should normally be turned to off before charging. The internal battery will be completely charged in around 16 hours when connected to the mains adaptor and the red indicator will glow continuously while the battery is charging. The battery may be charged for 16 hours at any battery charge state but the battery should not be left on charge continuously.

If the ambient temperature is below 30°C the sensors may be operated while the battery is being charged. The battery charging period will not be increased.

## **10 BATTERY CARE**

In order to maintain the battery in good condition it should be completely discharged and recharged every three months. This applies whether the unit has been used regularly or not during this period. The unit can be fully discharged by connecting one or more sensors and leaving the unit switched on. The battery should then be recharged for 16 hours. The battery will fully self-discharge, when not in use, in 7-10 weeks.

## **11 ANALOG OUTPUT**

The output impedance of the signal buffers is 50 ohms. If measurement errors of more than 0.5% are to be avoided the analog outputs should not be loaded by an impedance of less than 10kΩ or 2000pF. Connection should be via a multiway screened cable of not more than 2 metres in length. If the analog outputs are to be connected to a differential input then ensure that the common mode range of the input is constrained to within a few volts of the system ground to which the magnetic field sensor is to be connected. This may usually be done by establishing a connection between the sensor signal common output and the system ground.

## **12 TAKING MEASUREMENTS**

### **12.1 CONNECTING UP**

Connection between the magnetic field sensor and the power supply should not be made or broken with the power supply switched on as this could damage the magnetic field sensor.

### **12.2 FILTER SELECTION**

The power supply contains a filter section for each channel. The low pass filters are always connected to remove unwanted high frequency components from the signals and the high pass filters can be

selected if required to block the static background field and provide only an ac response. The decision to use either a dc or ac response will depend upon several factors.

- (a) The need or otherwise to measure the static field.
- (b) The dynamic range of any associated measuring instrument.

If a 16-bit A/D converter is used, it will have a resolution of  $\pm 1$  in  $\pm 32768$ . This is just about sufficient to digitise a terrestrial field strength of  $47\mu\text{T}$  to 2 or 3 nT. Many 16-bit converters do not guarantee full monotonicity over 16 bits.

If only the alternating component of the magnetic field is of interest, the static component can be rejected by selecting AC on the AC/DC switch.

### 12.3 ADDITIONAL FILTERS

The output from the *Mag-03* sensor will contain break-through from the operating frequency of the sensors at 15.625kHz. The *Mag-03-OCTO-PSU* attenuates this component but care should be exercised when connecting to a sampling A/D converter. Avoid sampling rates which are close to this frequency and ideally choose an A/D converter with an anti-aliasing low pass filter with a cut-off frequency as low as possible for the application.

### 12.4 OVERLOAD

Exposure of the magnetic field sensor to a flux between +120% and +200% or -120% and -400% of the full-scale range will cause the analog output to saturate. Beyond this the output will become unpredictable, usually slewing to the opposite polarity. The magnetic field sensor will not be harmed permanently due to overload but this situation should be avoided.

### 12.5 AC MEASUREMENT PRECAUTIONS

The measurement and roll-off characteristics of the magnetic field sensor ensure great precision for measurements obtained within the specified bandwidth and freedom from errors at frequencies above the -3dB point. It must be noted, however, that all fluxgate magnetic field sensors employ some form of synchronous phase detector operating at a particular frequency. This gives rise to modulation products in the presence of an alternating flux close to the operating frequency. The magnitude of the products will be equal to the magnitude of the detected flux ( $\pm 3\text{dB}$ ) for a difference frequency of  $\pm 1.5\text{kHz}$ . The operating frequency of the *Mag-03* series of magnetic sensors is 31.25kHz.

### 12.6 ELECTROMAGNETIC COMPATIBILITY

The *Mag-03-OCTO-PSU* contains no high frequency electronics likely to cause emissions which could affect other apparatus and is heavily shielded. The constant voltage charger and battery combined with tantalum capacitors provide good filtering to minimise any emissions. The unit is also unlikely to be affected by interference from other equipment in the normal operating environment.

## 13 REPLACING THE INTERNAL BATTERY PACK

The battery pack is supplied as a module with connectors, a power switch and indicator. To replace the unit proceed as follows:

- (a) Disconnect the mains adaptor and ensure the power switch is in the OFF (O) position.
- (b) Undo the four screws on the underside of the unit and remove the top panel.
- (c) Remove the 2.1mm connector from the battery unit which is connected to the printed circuit board.
- (d) Remove the 2.1mm connector from the battery unit which is connected to the rear panel
- (e) Disconnect the black optical fibre from the indicator on the battery unit.
- (f) Lift the battery pack from the unit noting the orientation.
- (g) Insert a new battery pack in the same orientation.
- (h) Connect the output of the pack to the printed circuit board socket, the input lead from the rear panel to the input socket of the pack and the black optical fibre to the LED indicator on the pack.
- (i) Replace the top panel and secure with the four screws.

#### **14 OPERATION WITH AN EXTERNAL BATTERY PACK**

For applications where it is required to operate the power supply over long periods, it is possible to remove the internal battery pack and connect it externally. The battery should be removed as described above and the internal cable within the *Mag-03-OCTO-PSU*, which is normally connected to the battery pack input, should be connected directly to the PCB connector. The enclosure lid can then be replaced and the battery pack can be connected to the charging power input socket of the *Mag-03-OCTO-PSU*. In this way several battery packs can be used in rotation with charging being carried out remotely from the *Mag-03-OCTO-PSU*.

## 15 SPECIFICATIONS

<b>Electrical</b>	
Sensor power supply	±12V at 500mW per sensor. Power is on when power switch is on and battery is charged.
Sensor connector	8 off 10-pole Hirose plug type RM15TRD-10P
Output connectors	2 off 37 way D-type connector 1 off 9 way D-type connector
Battery	Bartington rechargeable power pack 12V 4Ah
Battery status lamp	On during charge
Battery charging supply	12V regulated dc from 240 or 120V mains adaptor, 1.25A minimum output
Battery charger socket	2.1mm dc socket
Charging time	16 hours
Fuse	4A internal
<b>Mechanical</b>	
Enclosure Materials	Polystyrene
Dimensions (mm)	237(L) X 222(W) X 70(H)
Weight	2.5kg with Battery Pack installed
<b>Environmental</b>	
Operating temperature	-32°C to +50°C (+30°C if simultaneously charging)
Storage temperature	-33°C to +70°C

*The specification of this product is liable to change without prior notice.*

## Connector detail

<b>CON1-CON8 Magnetic Sensor Connectors</b>	
Pin	Function
1	X out
2	Y out
3	Z out
4	signal/power ground
5	signal/power ground
6	+12V supply
7	-12V supply
8,9,10	no connection

<b>PL1 Signal Output Connector</b>					
Pin	Function	Pin	Function	Pin	Function
1		13		25	3Y
2		14		26	3Z
3		15		27	4X
4		16		28	4Y
5		17	0V	29	4Z
6		18	1X	30	Pin1 PL2
7		19	1Y	31	Pin2 PL2
8		20	1Z	32	Pin3 PL2
9		21	2X	33	Pin4 PL2
10		22	2Y	34	
11		23	2Z	35	
12		24	3X	36,37	

<b>PL3 Signal Output Connector</b>					
Pin	Function	Pin	Function	Pin	Function
1		13		25	7Y
2		14		26	7Z
3		15		27	8X
4		16		28	8Y
5		17	0V	29	8Z
6		18	5X	30	Pin5 PL3
7		19	5Y	31	Pin6 PL3
8		20	5Z	32	Pin7 PL3
9		21	6X	33	Pin8 PL3
10		22	6Y	34	
11		23	6Z	35	
12		24	7X	36,37	

<b>PL2 Temperature Sensor Connector</b>	
Pin	Link to
1	Pin30 PL1
2	Pin31 PL1
3	Pin32 PL1
4	Pin33 PL1
5	Pin30 PL3
6	Pin31 PL3
7	Pin32 PL3
8	Pin33 PL3
9	0V





