

BARTINGTON

MAG-03DAM

DATA ACQUISITION MODULE

OPERATION AND MAINTENANCE MANUAL

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Issue 10

**OPERATION AND MAINTENANCE
MANUAL FOR MAG-03DAM
Data acquisition module**

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FIGURES

Figure 1 MAG-03DAM Wiring Diagram

Figure 2 MAG-03DAM PC45

1. INTRODUCTION

The software supplied with the MAG-03DAM is for operation under MSDOS only. It will operate in a DOS window from Windows 3.x, Windows95/98 but will not operate in a DOS window under WindowsNT, Windows2000 or later. For computers which normally run WindowsNT or Windows2000, the computer must be booted to MSDOS.

This manual should be read in conjunction with the Lawson Labs Inc. Model 201 manual.

The MAG-03DAM allows data to be collected from two Bartington MAG-03 three-axis magnetometers and stored on a personal computer. The module has applications in geomagnetic observatories as an inexpensive monitor of the operation of the main instrumentation, as a general purpose monitor for earth's field measurements and in some surveillance applications.

The module contains a data acquisition card with up to 24-bit resolution and a battery-backed power supply. Power is provided from a mains adaptor and the data is transmitted to the user's computer via an optically isolated RS232 serial link. The low magnetic signature of the module permits operation within a few metres of the magnetometer whilst the magnetometer output characteristics allow the module to be situated up to 600 metres from the magnetometer. Hence the unit can be situated in the most convenient position.

The parameters of the data acquisition card are under software control. Programs are provided for recording geomagnetic field data from each of the three axes of one or two MAG-03 magnetometers.

The ALLMAG program scans the six data channels at five-second intervals, displays the results on the screen and stores the accumulated results to disc at one-minute intervals.

The MAGSCAN1 program stores only the average value for each minute to disc.

The AUTOSCAN program is a version of the MAGSCAN1 program which provides for automatic start-up after power failures if the user enters suitable code in the AUTOEXEC.BAT file.

Demonstration software for the data acquisition system is also provided. The source code for all programs in Microsoft QuickBASIC (V4.5) is included, allowing users to adapt the programs as required. The module allows the user to program the data acquisition system for the optimum speed or resolution for a particular application.

The unit is supplied complete with:-

- a. Mains power adaptor (220 V or 110 V AC as specified on the order)
- b. RS232 serial cable to computer serial port (25 way plug to 25 way socket)
- c. 25 way to 9 way D type serial adaptor
- d. 9 way null modem cable
- e. Mating connectors as appropriate
- f. Software on 3.5 inch floppy disc
- g. Lawson Labs Model 201 manual
- h. This operation and maintenance manual

If the user requires only one magnetometer to be connected to the module for monitoring the geomagnetic field then the three unused channels are available for recording other parameters such as temperature. It is then necessary for the user to scale the input voltage to suit the ± 10 V full scale input of the data acquisition module and modify the program as required.

An output connector allows direct access to the analog signals from the magnetometers.

2. GENERAL DESCRIPTION

The MAG-03DAM data acquisition module is a freestanding unit which is positioned between the magnetometers and the computer. The unit has a low magnetic signature but should not be placed closer than about 2 metres from either magnetometer to avoid affecting the measured field. The unit can be positioned up to 30 metres from the computer. The two magnetometer inputs (labelled MAG-03/1 and MAG-03/2) allow other 10 V bipolar signal sources to be recorded if only one magnetometer is used. (The power supply from the MAG-03DAM to the magnetometer is also available for external use.) The optically isolated serial link between the MAG-03DAM and the computer prevents the internal computer noise from affecting the data acquisition circuits and allows more precise measurements than can be obtained with computer plug-in cards.

3. POWER

The module contains an internal lead acid battery which can power two magnetometers and the data acquisition circuit for up to 6 hours. This is increased to 11 hours when only one magnetometer is used. The battery is recharged from a DC voltage of 9 to 36 V. The mains power adaptor (110 V or 220 V AC available) provides 12 V DC unstabilised at 0.5 A and trickle charges the battery continuously. The battery will be fully charged from a discharged state in about 4 days. The mains adaptor will normally be connected continuously during data collection if power is available. The battery may be charged with or without the magnetometer and data acquisition operating. The battery will be charging whenever the mains adaptor is connected and powered. The on/off switch controls only the power out to the magnetometer and data acquisition circuits. The "CHARGING" indicator on the front panel shows when the battery is being charged. When the unit is switched on, the "LOW BATTERY" warning indicator on the front panel illuminates and an internal sounder bleeps to indicate that the unit is active. If the battery voltage is above the minimum level, the battery warning indicator and associated sounder will turn off in about 0.5

seconds. The indicator and sounder will be switched on continuously when the internal battery is below 10.5 V and requires re-charging.

The unit should be switched off at the front panel when not in use to prevent the battery being discharged. If the battery becomes completely discharged and left for some time it will be irreversibly damaged. If the unit is to be stored for longer than a few months it is advisable to recharge the battery at three-monthly intervals for 24 hours or remove the battery for indefinite storage.

4. CONNECTION

Before turning on the power to the magnetometers or computer, connect all the cables to the connectors on the rear panel as follows:-

- a. If mains power is available connect the mains adaptor to the charger inlet connector.
- b. Connect the magnetometers to the connectors MAG-03/1 and MAG-03/2 with the appropriate cables. If only one magnetometer is used it should be connected to the MAG-03/1 connector.
- c. The RS232 cable should be connected from the RS232 COMMS PORT connector to the appropriate computer serial port. A 25-way to 9-way adaptor and 9-way cable is provided for connection to portable computers which use a 9-way connector. The pin connections are shown in the following table.

PIN	SIGNAL	COMPUTER CONNECTION	
		25 PIN	9 PIN
2	TX	3	2
3	RX	2	3
20	DTR	20	4
7	GND	7	5
4	RTS	4	7

- d. The data acquisition module is isolated from mains ground and should be connected to a local ground, where possible, using the earth tag on the rear panel. This will reduce noise due to interference from power lines etc.
- e. If only one magnetometer is connected the MAG-03/2 connector may be used for recording other parameters. The input range is ± 10 V full scale with respect to the common input. (See section 7)
- f. The 9 way D-type socket on the rear panel provides access to the analog outputs from the magnetometers. The full-scale levels are ± 10 V and the pin allocation is given in the following table.

PIN	SIGNAL
1	Magnetometer 1 - X axis output
2	Magnetometer 1 - Y axis output
3	Magnetometer 1 - Z axis output
4	Magnetometer 1 - common
5	Magnetometer 2 - X axis output
6	Magnetometer 2 - Y axis output
7	Magnetometer 2 - Z axis output
8	Magnetometer 2 - common
9	no connection

For the best results measurements should be made between the output signal and the common line from the appropriate magnetometer. Care should be taken to avoid injecting noise if the signals are to be recorded through the MAG-03DAM to a computer.

5. OPERATION

5.1 Initial operation

Create a new directory on the hard disc (e.g. MAGSCAN) and copy the contents the Mag-03DAM disc into this directory. If the computer does not have a hard disc the user should make a back-up copy of the disc. The disc contains executable programs with the filename extension of .EXE, their source code in QuickBASIC with the filename extension of .BAS, two files containing configuration data with the filename extension of .CFG and one README file on control codes. The configuration files are updated from the menu selections made when running the programs but for the AUTOSCAN program they must be updated using a text editor. The programs DRIVR201, DEMO201, SCAN201 and SCRIPT are provided by Lawson Labs Inc. and details appear in the manual supplied by them.

If power is available, switch on the power to the mains adaptor and check that the "CHARGING" light on the front panel is illuminated. Turn on the MAG-03DAM unit and the computer. If the "LOW BATTERY" indicator and sounder remain on the unit should be switched off and left on charge until the indicator and sounder turn off automatically about 0.5 seconds after the unit is switched on. The "LOW BATTERY" indicator is illuminated and the sounder switched on when the battery voltage reaches a level where there are only a few minutes of operational life left in the battery. The unit should not be left running when the warning devices indicate that the battery charge level is low or the battery will be deeply discharged and may not recover.

5.2 Setting communication parameters

In order to set up the serial communications parameters select the directory containing the copied files as the current directory, type DRIVR201 and press ENTER. This will start the

program to allow the parameters to be changed and the serial communications channel to be tested. The program starts with a menu which shows the current baud rate, the computer serial port to which the data acquisition module is connected and the input buffer size. By pressing the 1 key the baud rate will decrement through the available rates. A rate of 9600 baud should be selected initially although this may need to be reduced for longer cable lengths. By pressing the 2 key the comms port selected will toggle between com1: and com2:. The user should ascertain which comms port the data acquisition module is connected to, com1: is often allocated to the mouse pointer. The size of the input buffer is selectable by pressing key 3. This has been set at 512 bytes by the manufacturer and should be sufficient for most applications.

The serial interface can be tested after setting up the baud rate and allocating the serial port. Ensure that the data acquisition module is switched on and preferably connected to the mains adaptor, then press key 4 for a check on the serial communication. The software runs the sign-on procedure to wake the data acquisition unit and then continuously transfers data from the module, showing the number of bytes transferred and the number of errors. If the computer cannot communicate with the data acquisition module an error message is generated. The most likely causes of a failure to communicate are no power to the data acquisition unit, a connection error or the incorrect comms port being specified. If a 9-pin serial port is being used, ensure that the cable configuration is correct by using only the cables and 25 to 9 way converter supplied.

When communication has been established with negligible errors, the program can be terminated. Pressing Enter will then show the analog data conversions for one channel and offer calibration and offset correction procedures. When leaving this program the user will be able to select whether or not to store the current configuration data. If changes have been made the response should be "yes". The data will then be stored in the DRIVR201.CFG file with other relevant data.

5.3 Starting a data logging program

The data logging programs ALLMAG and MAGSCAN1, store the values of selected channels at five-second intervals or averaged over one minute, respectively, together with the date and time of each record. As the date and time are obtained from the computer it is advisable to check that the current date and time are correct before starting the program by typing DATE and TIME at the DOS prompt and resetting them if necessary.

When the communication parameters and the clock have been set the relevant data logging program can be started by typing either ALLMAG or MAGSCAN1 and pressing ENTER. The programs begin by presenting a menu allowing the user to set the range of the magnetometer, the number of channels logged and the drive and filename for the recorded values. These values are stored in the LOGGER.CFG file.

The range of the magnetometer in microtesla (e.g. 70, 100 etc.) can be changed by typing 1. The new value can then be typed and after pressing ENTER this value will appear in the menu.

By selecting 2 the user can change the number of channels to be logged. When running, the program will scan and display all six channels but will only log to disc the number of channels selected. This allows the user to observe variations in some channels without logging them to disc, thereby economising on disc space. The channels are always logged sequentially from channel 0 so that if three channels are selected for logging, only channels 0, 1 and 2 will be recorded to disc. The channels are allocated as in the following table.

CHANNEL No.	INPUT
0	Magnetometer 1 - X axis output
1	Magnetometer 1 - Y axis output
2	Magnetometer 1 - Z axis output
3	Magnetometer 2 - X axis output
4	Magnetometer 2 - Y axis output
5	Magnetometer 2 - Z axis output

If only one magnetometer is being used then it should be connected to the MAG-03 1 connector and the inputs to the MAG-03 2 connector (channels 3, 4 and 5) can be used to log other variables such as temperature etc. The first of these inputs should be applied to channel 3. Four, five or six channels can then be logged.

The logger drive and filename may be modified by selecting 3 from the menu. The drive and filename must be typed in full as for example:

a:\mag1.dat

The program will create a file with the name specified if it does not exist. If the drive specification is omitted a file will be created in the current directory. A file in any directory may be specified provided that the directory exists and the path is valid. If the directory **magdata** exists on the disk in drive **a:** then the logger file may be specified as:

a:\magdata\mag1.dat

If a filename is specified which already exists the new data will be added to the end of any data already in that file.

To start logging data type L as indicated in the menu, **but do not follow this with ENTER as this will terminate the program.**

It should be noted that both the ALLMAG and MAGSCAN1 programs refer to the LOGGER.CFG file in the current directory. If the user operates both programs, it may be advisable to copy the disc supplied into two directories so that the configuration may be varied independently for each application. As each record is tagged with the time, it will be immediately obvious from the data which program has been used.

5.4 The AUTOSCAN program

This program is the same as the MAGSCAN1 program except that it can be arranged to automatically start on power-up. This allows a system to be left unattended. The data for the period during which power is down but collection will be resumed when power is restored.

In order to restart automatically, the menu for the configuration data is bypassed. The configuration information must therefore be edited using the menu at the start of the MAGSCAN1 program or by editing the LOGGER.CFG file with a text editor. This file contains three items separated by commas e.g.:

```
70,3,"c:\mag03.dat"
```

where 70 represents the full scale range of the sensor in uT, 3 represents the number of channels to be saved to disc and "C:\mag03.dat" is the file name to which the magnetic field data is to be logged.

The serial port, baud rate, sampling etc must be pre-set as before by running DRIVR201. The set-up is most easily done using DRIVR201 and then MAGSCAN1.

To auto start the program the user should edit the file C:\AUTOEXEC.BAT as follows:

- a. In the PATH= statement insert the directory in which the AUTOSCAN.exe exists.
- b. Insert the clear screen command cls.
- c. Insert the command cd c:\MAGSCAN to change to the directory where AUTOSCAN exists.
- d. Insert the command to start the program AUTOSCAN

The file will therefore contain something like:

```
PATH=C:\MAGSCAN;C:\OTHER\MYPROG; .....  
cls  
cd C:\MAGSCAN  
autoscan  
....
```

When the computer starts it should then run AUTOSCAN.EXE immediately.

5.5 Data logging program timing

The data logging programs are intended to run with the maximum resolution and the speed is therefore limited. When L is typed to start the program it logs on to the data acquisition module. The MAGSCAN1 program then synchronises with the clock which may cause a delay of up to 10 seconds, the ALLMAG program begins without synchronisation. Every five seconds the program runs a calibration and offset routine and scans each of the six differential inputs.

The MAGSCAN1 program calculates the average value of the field for the last minute at about 30 seconds past each minute and the selected channels are stored to disc with the

date and time. The averages are calculated at 30 seconds after each minute so that the data is centred evenly around each minute.

The ALLMAG program simply stores the calculated values of the field for each channel accumulated over the previous minute with the time and data for each value.

5.6 Data logging program display

The MAGSCAN1 program displays the current date and the time at which each scan is completed, the scan number and the voltage measured at each of the six input channels. It should be noted that the voltage shown is that measured after a 2/1 voltage divider to reduce the full scale input from ± 10 V to ± 5 V. The last one-minute average values recorded (in microtesla) are shown, together with the time of recording. Channels 0,1 and 2 correspond to the X, Y and Z axes of the magnetometer connected to the MAG-03/1 input, whilst channels 3, 4 and 5 correspond to the MAG-03/2 input. At the bottom of the screen are shown the latest offset and calibration values, and the scan interval. The operation of any key will cause the program to be halted and the user will be returned to DOS.

The display for the ALLMAG program shows the magnetic field values for each channel as they are measured together with the date and time of the last value. The screen is cleared at about 30 seconds past each minute when the values are stored to disc.

5.7 Recorded data format

The data is recorded to a file in ASCII format so that it can be read using a DOS command TYPE, or can be modified using any editor. The information can also be transferred into a spreadsheet for editing or displaying in graphical form. If transferring into a spreadsheet note that commas are used as delimiters between data columns.

For data recorded using the MAGSCAN1 program the order of the data on the disc for each minute will be:

Date , Time , Ax, Ay, Az, Bx, By, Bz

where Ax is the field along the x axis of magnetometer 1 in μ Tesla. An example of a data file is shown below where the date is 6 June 1995 and the recording time of the first record is 14 hours, 45 minutes and 32 seconds. The data shown is for the fields in three axes of one magnetometer with no voltage applied to the last three inputs.

```
06-06-1995,14:45:32, -5.373, 45.054, 5.831, -0.000, 0.000, 0.000
06-06-1995,14:46:32, -5.378, 45.062, 5.824, -0.000, 0.000, 0.000
06-06-1995,14:47:32, -5.381, 45.061, 5.827, -0.000, 0.000, 0.000
06-06-1995,14:48:32, -5.384, 45.062, 5.828, -0.000, 0.000, 0.000
06-06-1995,14:49:32, -5.385, 45.062, 5.831, -0.000, 0.000, 0.000
06-06-1995,14:50:32, -5.386, 45.063, 5.831, -0.000, 0.000, 0.000
06-06-1995,14:51:32, -5.387, 45.063, 5.833, -0.000, 0.000, 0.000
06-06-1995,14:52:32, -5.388, 45.062, 5.835, -0.000, 0.000, 0.000
06-06-1995,14:53:32, -5.389, 45.063, 5.837, -0.000, 0.000, 0.000
06-06-1995,14:54:32, -5.392, 45.063, 5.839, -0.000, 0.000, 0.000
```

The data recorded by the ALLMAG program will have the same format except that the individual readings are shown with the date and the time, spaced at five second intervals.

5.8 Modifying data acquisition parameters

The current settings of the data acquisition system can be viewed and modified by running the DRIVR201 program. The program first indicates the communications settings and allows changes to be made. The program then shows the voltage input from a single channel using the polled mode. From this screen the command menu can be selected to allow the filter, sample rate, resolution, etc. to be set. By selecting the scanned mode the number of channels to be scanned and the scan rate can be set. See the Lawson Labs Model 201 operation manual for further details.

The MAGSCAN1 and ALLMAG programs operate in the scanned mode. If several modes of operation are required it is advisable to copy the complete set of programs to a separate directory for each application. This allows operation with separate versions of the configuration files.

5.9 Electromagnetic compatibility

The MAG-03DAM contains no high frequency electronics likely to cause emissions which could affect other apparatus. The metal case, constant voltage charger and lead-acid battery all combine to minimise any emissions. The unit is also unlikely to be affected by interference from other equipment in the normal operating environment. However, operation close to a source of high electromagnetic fields should be avoided to prevent pick-up which will be evident as noise in the recorded magnetic field values.

Due to the sampling operation of the MAG-03DAM this noise may cause aliasing, where the noise signal appears to have a frequency lower than the true value.

6. CONNECTING EXTERNAL SIGNALS

If only one magnetometer is connected to the data acquisition module then up to three single ended inputs can be recorded by the user in place of the three axes of the second magnetometer. The magnetometer should be connected to the MAG-03/1 connector and the user's inputs connected to the MAG-03/2 connector. The pin connections are shown in the following table.

PIN	FUNCTION
1	channel 3 input
2	channel 4 input
3	channel 5 input
4	common input
5	supply 0 V
6	supply +15 V
7	supply -15 V
8	no connection
9	no connection
10	no connection

The full-scale channel inputs are ± 10 V with respect to the common input. The supply 0V is connected to the earth terminal on the rear panel. The input circuit has a voltage divider

which reduces the voltage applied to the internal data acquisition board to ± 5 V full scale and presents an input impedance of $20\text{ k}\Omega$. The common input is connected to the supply 0V via a $1\text{ M}\Omega$ resistor. The supply 0V, +15V and -15V normally provide a power supply to the magnetometer but can be used for external sensors. The absolute maximum current available is ± 20 mA. Alternatively, an external, fully isolated supply can be used. The input signals should be referred to the supply 0V. The common line should be maintained within 6V of the supply 0V and no input should exceed ± 12 V. The user should avoid connecting any sensor which could introduce noise into the power supply lines as this will affect the operation of the magnetometer.

7. SOFTWARE DEVELOPMENT

The software is provided complete with the source code in Microsoft QuickBASIC to allow the user to develop programs by modifying copies of the originals. The ALLMAG and MAGSCAN1 programs were developed from the SCAN201 program in this way using Microsoft QuickBASIC version 4.5.

It should be remembered that the data acquisition module analog inputs have a 2/1 voltage divider and the voltage reported by the programs will reflect this. For further information on the operation of the data acquisition card see the Lawson Labs Model 201 manual.

8. CIRCUIT DESCRIPTION.

The MAG-03DAM data acquisition module contains a sealed lead-acid battery with associated charger and dual power supply together with a proprietary data acquisition board. A small printed circuit board (PC 45) contains the power supplies, diodes, input resistor networks and the battery fuse.

The MAG-03DAM data acquisition module is powered via a mains adaptor which provides 20 V DC at up to 0.5 A. This voltage is fed to the PC45 which contains a wide-range (9 - 36 V) input power supply with a 15 V stabilised output. This supply charges an internal 12 V lead-acid battery via a pair of diodes and a positive temperature coefficient thermistor, the front panel LED indicates when the battery charging supply is connected. The thermistor acts to limit the battery charging current to about 30 mA. The battery output is connected via a fuse and then diode 'ored' with the 15 V power supply to the front panel "POWER" switch. This switch supplies a wide range (9 - 36 V) input power supply with a regulated output of ± 15 volts. This supply is routed to the magnetometer connectors and the +15 volt rail is used for the data acquisition board supply. A voltage sensor circuit type ICL8211CPA compares a proportion of the battery voltage to the internal 1.15 V reference and when the battery is less than 10.5 V the current limited output operates the "LOW BATTERY" indicator and sounder. A capacitor across the comparator input resistor ensures that the low battery lamp and sounder operate for a short period when the unit is switched on.

The data acquisition board has full scale input levels of ± 5 V whilst the magnetometer outputs are ± 10 V full scale. Each of the magnetometer signals are therefore routed through a potential divider of two $10\text{ k}\Omega$ (0.1%) resistors to reduce the input level to ± 5 V. The three analog levels, X, Y and Z from the magnetometer 1 connector are routed to channels

0, 1, and 2 respectively while those from magnetometer 2 are routed to channels 3, 4 and 5. The data acquisition board has differential inputs and the negative sides of these inputs are connected at the board input to the common output line of the relevant magnetometer.

9. SERVICING

Servicing should only be undertaken by a qualified person with the appropriate knowledge and measuring equipment. If in doubt the equipment should be returned to the manufacturer for repairs.

9.1 Battery charging

The internal sealed lead acid battery is of the maintenance free type and will give many years of service if maintained in a charged condition. Using the mains adaptor provided the battery will be fully charged from a discharged condition in about 100 hours. The front panel switch should be left in the OFF position during battery charging, when recording is not required, to remove the supply to the internal circuits. Always check that the front panel amber LED is illuminated, indicating that the battery is being charged, when the mains adaptor is connected. Where possible the mains adaptor should be used to provide power during data logging so that the battery is being used as a back-up in case of mains failure. Where no mains supply is available the battery will power the module for up to 6 hours using two magnetometers or 11 hours using only one magnetometer. The battery must be recharged as soon as possible after use and in no circumstances should it be left in a discharged state for any length of time as this will cause irreversible damage to the battery. The battery may be left on charge for up to a week but it is not recommended to leave it permanently on charge when data is not being collected. The "LOW BATTERY" indicator and internal sounder operate when the unit is switched on with a battery voltage of less than 10.5 V. This indicates the end of the useful charge and the unit will continue to operate only for a further five minutes after this is lit.

The unit should be switched off at the front panel when not in use to prevent the battery being discharged. If the battery becomes completely discharged and left for some time it will be irreversibly damaged. If the unit is to be stored it is advisable to recharge the battery every three months for 24 hours. For indefinite storage the battery should be removed. (See 10.4 Battery replacement)

9.2 Access

Access to the internal circuits can be obtained by pulling off the plastic bezels around the front and rear panels. These bezels are held by lugs at the sides of the panels and can be removed by squeezing the corners to expand the sides away from the front panel. When the bezels have been removed the screws holding the front and rear panels to the case will be exposed. Each panel is held by four self-tapping screws. When the screws securing the front panel are removed the top of the case will slide forward to allow access to the internal circuitry.

The battery is held in position by means of a clamp across the top and by the rubber feet of the circuit board fixing screws. The data acquisition card is situated towards the front of the module whilst the board containing the power supplies, fuse, etc. is towards the back.

9.3 Fault finding

Examples of possible fault conditions are given in the fault finding table with a guide to their cause and remedy. Measurements on the module should be made with a high impedance digital voltmeter or oscilloscope.

FAULT	CHECK	RESULT	REMEDY
Failure of program to sign on (cannot wake data acquisition module)	Power is switched on at module	Correct	Next check
	Battery is charged (12 V)	Low voltage	Connect mains adaptor
		Correct	Next check
	Connections to serial port	Apparently correct	Next check
	Computer comms port allocation.	Incorrect/unknown	Change using DRVR201 program.
		Correct	Next check
15 V supply to data acquisition board	No supply	Replace MAD 4030 ± 15 V power supply	
	Correct	Change data acquisition board	
Failure to operate on battery power	Operation on mains adaptor	Correct	Next check
		No operation	Go to first fault symptom
	Internal 1A fuse on PC45	Blown	Identify short circuit and replace fuse
		Correct	Next check
	Battery voltage on charge	Correct	Replace battery
		Low voltage	Replace MLS 4040-8 +15 V supply or D2/D3
Failure to record the input variation on any one channel	Connections to magnetometer by connection to other input connector	Channel now correct	Test and repair input resistor network or connections
		No improvement	Test magnetometer and cables

9.4 Battery replacement

To replace the battery (type RS 595-047, 12 V, 2.1 Ah) remove the nuts holding the top battery clamp, disconnect the two spade connectors and lift the battery out. When fitting the new unit ensure that the battery has the rubber spacers fitted to the side and fit this side down. Connect the spade terminals after fixing the battery in position. Avoid shorting the terminals of the battery as it has a very high short circuit discharge current which could cause serious injury. Use insulating tape over the battery terminals until ready to connect to the rest of the circuit.

9.5 Fuse replacement

The battery is protected by a 1 A fuse fitted on the circuit board PC45. Access to the circuit board is as described above. Only replace the fuse if the fault causing the fuse to blow has been found and corrected. The fuse is 1 amp rating, anti-surge type 20mm.

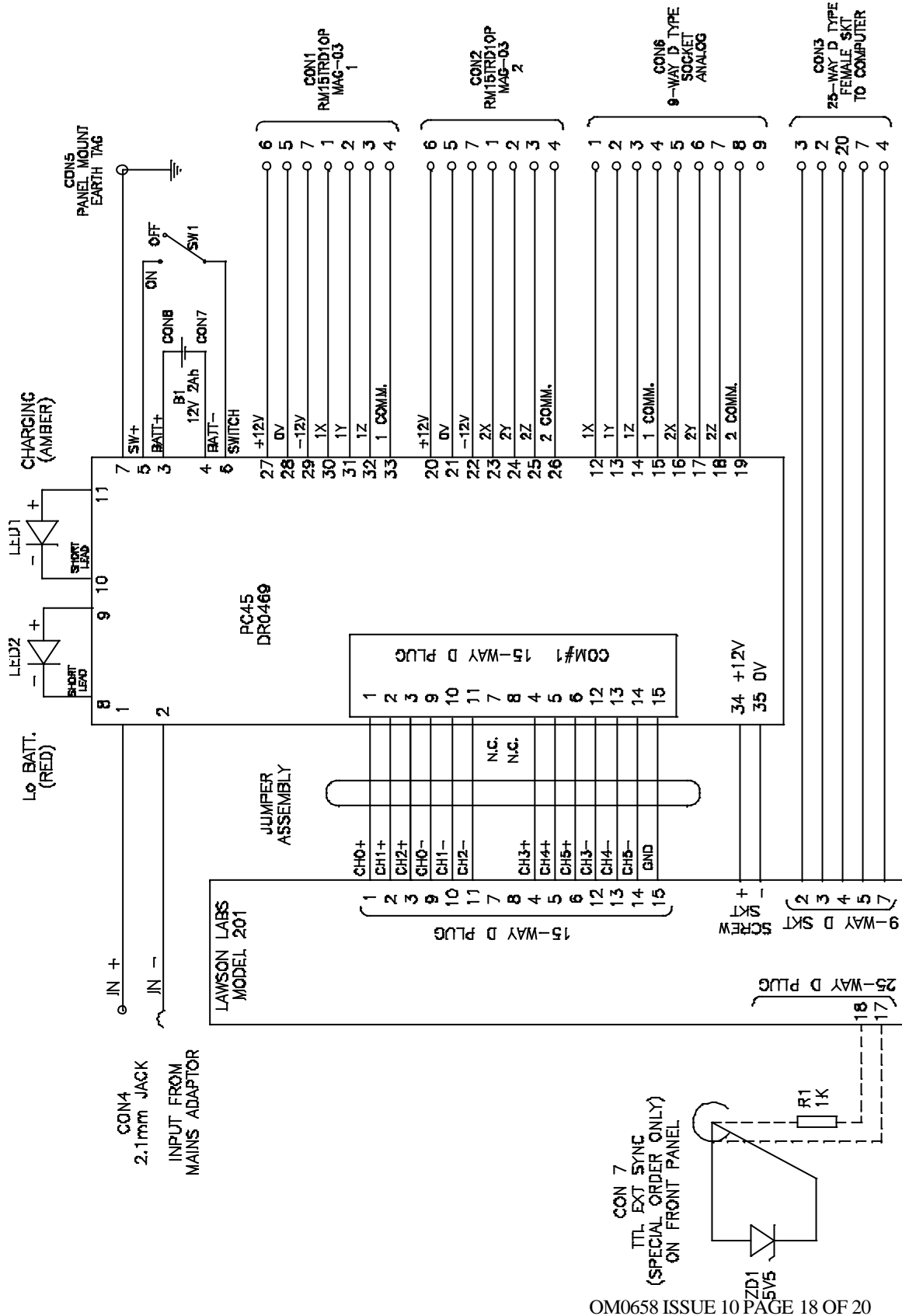
10. SPECIFICATION

Input Channels	: 6 differential (supports two 3-axis magnetometers)
Data acquisition card	: Lawson Labs type 201
Resolution	: 16 or 24 bits, software selectable
Monotonicity	: 24 bits up to 50 Hz data rate
Linearity	: 0.002% of full scale typical at up to 50 Hz data rate
Sample rate	: programmable (the programs supplied sample at 5-second intervals)
Input scale	: 10 volts full scale, bipolar
Scaling and offset	: automatic calibration under program control using two dedicated differential inputs
Computer interface	: RS232, optically isolated, full duplex, 300 to 9600 baud
RS232 cable length	: 30 m maximum (5 m supplied)
Magnetometer cables	: MAG-03M cable 600 m max. (see MAG-03M accessories)
Power input	: 9 to 35V dc (from mains adaptor supplied), 400 mA typical at 12 V, polarity protected
Internal battery type	: 12 V 2.1 Ah, lead-acid for up to 6 hours independent use*
Connectors	
Power	: 2.1 mm jack
Magnetometers	: 2 x10 way circular type RM15TRD10P plug
RS232	: 25 way D type socket
Analog	: 9 way D type socket
Ground	: Terminal
Controls	: Power on/off switch, battery can be charged with power off
Indicators:	: 2 x LED to indicate low battery voltage and battery charging
	: low battery sounder
Fuse	: 1 A 20 mm (internal)

Size : 255 mm (W) x 265 mm (D) x 55 mm (H)
 Weight : 2.8 kg.

- This will increase to 11 hours if only one magnetometer is used.

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Mag-03DAM PC45 SCHEMATIC

FIGURE 2