G-886 MARINE MAGNETOMETER

Operation Manual

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Rev. B

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1.0 INTRODUCTION TO THE G-886 MARINE MAGNETOMETER

This document describes the basic operation of the G-886 Marine Magnetometer. See also the manual included with the **MagSea**™ software (if purchased) which provides information on the control and display software.

There is also plotting software called **MagPlot** which may be purchased and used for post acquisition plotting of acquired data on a PC printer.

The G-886 is a recording proton precession magnetometer. The following provides a basic introduction to magnetometers and to recording proton precession magnetometers. Then it provides an introduction to the G-886 Magnetometer.

1.1 WHAT IS A MAGNETOMETER

A magnetometer is an instrument that is used to measure the value of the earth's magnetic field. Measurements are used to identify the physical characteristics of the objects or structures that have produced the readings. For example, a marine search team could use a magnetometer to locate a sunken ship, since shipwrecks produce magnetic "signatures" that appear on magnetometers as "anomalies" or noticeable deviations from the usual intensity of the earth's magnetic field in that sector of the ocean floor.

The unit of measurement used to express the intensity of the earth's magnetic field is the **gamma** (1 gamma equals 10^{-5} gauss or 10^{-9} tesla or 1 nanotesla). Depending on where you are actually measuring it, the earth's magnetic field can range in intensity from 20,000 to 70,000 gammas.

Magnetometers can be hand-carried, fixed as base stations, or operated aboard aircraft, marine vessels, or even spacecraft. Data collected from magnetometers can be used to describe some characteristics of the geologic structure of specific areas of the earth and thereby locate and retrieve minerals and petroleum. Magnetometers can also provide valuable assistance in locating buried pipelines, electrical cables, cultural artifacts, unexploded ordnance or buried waste.

The G-886 is one of several kinds of magnetometers, all of which are named by the way that they measure the strength of the earth's magnetic field. The G-886 uses 'proton precession' to make this measurement. Other magnetometers are 'flux gate' or optically pumped devices that use operating principles that differ from that used by a proton precession magnetometer. The following discussion will be limited to the proton precession principle.

In order to understand the proton precession principle in a magnetometer, one needs to understand what happens inside the sensor of the proton magnetometer. Sensors come in many shapes and sizes, but for the proton precession magnetometer, sensors share the same operational design: A non-magnetic container is filled with a liquid (water, decane, kerosene) in which a coil is immersed. So long as no current is applied to the coil, protons of the liquid will align themselves with the earth's magnetic field. However, as soon as "polarizing" current is applied to the coil the protons will align themselves with the magnetic field of the energized coil. When the current is removed from the coil, the protons will "turn away" from their alignment with the field of the coil to become realigned with the earth's magnetic field. As they "turn away", the protons do not directly turn to align themselves with the earth's field, but rather "precess", like a spinning top. As they precess, the protons behave like tiny magnets inside the sensor coil , inducing a small AC signal in the coil. This signal can be amplified and its frequency counted to produce a highly accurate measurement of the intensity of the magnetic field at the sensor. The frequency of the measured signal is proportional to the absolute value of the earth's magnetic field in which the magnetometer's sensor is operating. Thus, a proton precession magnetometer is an instrument that measures the absolute value of the earth's magnetic field by measuring the proton precession frequency and converts that frequency into the units that are used to quantitatively represent the earth's magnetic field, gammas.

You may want to obtain more information on the operation and application of magnetometers. This information can be found in the Geometrics publication, Applications Manual for Portable Magnetometers, by Sheldon Breiner.

The G-886 is a digitally connected magnetometer. This means that it communicates via an RS-232 serial port. The G-886 may be purchased with either an AC Power Unit or a DC Power Unit. The AC Power Unit may be purchased and provides a nominal 30 volt AC-DC supply which is connected to the ship's mains. The DC Power Unit may be purchased and provides for operation from a 24-32 volt DC source such as batteries.

The G-886 Magnetometer is contained in a watertight box which should be mounted at the vessel stern for best performance. There are three water tight connectors on the magnetometer. One, a three pin connector, is for the sensor cable. The second, a five pin connector, is used for DC power input and the RS-232 connection to the Magnetometer. This is where the stern end of the onboard cable connects. The third, a four pin connector, is for the depth sensor option. The other end of the onboard cable is connected to either the AC Power Unit or the DC Power Unit. Either Power Unit provides a standard 9-pin "D" for connection to the RS-232 cable of the control computer.

NOTE: The magnetometer serial output is set at 1200 baud, 8-bit no parity, 1 stop bit. The baud rate can be changed, as instructed in Appendix A of this manual.

The G-886 magnetometer contains a power supply that provides +/- 12VDC, +5VDC, and 24-32 VDC (from the Power Unit). This unit also includes the Mag/CPU module in a shielded tubular assembly.

The sensor fish may be a G-886 type or a modified G-801 type. The tow cable may be up to 1200 feet long.

It is imperative that you read the introductory and operation parts of this manual in their entirety prior to system assembly and initialization. Also, it is important to read the **MagSea**™ Software Manual. Additional technical information is included in Appendix A of this manual and in the accompanying **G-886 Service Manual**.

2.0 G-886 SYSTEM INSTALLATION AND COMMISSIONING

2.1 SYSTEM DESCRIPTION

The G-886 Marine Proton Magnetometer system includes the following assemblies/modules: Control and Display Computer (386/486 PC/AT), Printer, AC Power Unit, Onboard Power/Data cable (runs from the instrument room to the stern mounted G-886 Magnetometer), G-886 Magnetometer, Sensor Tow cable and Sensor Fish (the Control and Display Computer may be customer supplied). The Control and Display Computer incorporates a color monitor, 130 MB hard disk, 9-pin graphics printer, printer and serial cables. The system requires 115 or 220 VAC, 50/60 Hz at 250 watts or 24-32 VDC.

The system is shipped with a communications software package called "PROCOMM". This is used as a terminal emulator for any direct communication to the G-886 outside of any logging software that may be used. A computer with Windows may also contain a similar terminal communication function that could be used.

2.2 SYSTEM INSTALLATION

Begin by installing the Control and Display Computer (includes printer) and AC Power Unit in the instrument room and connecting them to 115 VAC (220VAC optional) 50/60 Hz power. If a DC Power Unit is used, connect it to a source of 24-32 VDC (such as two 12 Volt batteries in series). Connect the printer to the computer with the Printer cable and load the paper. Connect the computer to the Power Unit with the Serial cable. Attach the Onboard Power/Data cable to the Power Unit at the ONBOARD CABLE connector.

Run the Onboard Power/Data cable from the AC or DC Power Unit out to the mounting location of the G-886 Magnetometer unit and connect the 5 pin female plug on the cable to the 5 pin male connector marked "24 VDC on the Magnetometer unit.

The tow cable is made with one 3 pin connector for the sensor or with a second 4 pin connector added if the Depth Option is present. The 3 pin connector plugs into the "SENSOR" connector on the Magnetometer unit. The 4 pin connector, if present, plugs in to the DEPTH" connector. Pull the rubber retaining loops over all of the chassis connectors to lock them in place.

ATTENTION !

BEFORE CONNECTING ANY OF THE CONNECTORS TO THE G-886 MAGNETOMETER, MAKE SURE THE CONNECTORS ARE DRY AND SALT FREE. USE A SMALL AMOUNT THE SUPPLIED SILICONE GREASE LUBRICANT OR SPRAY ON ALL MALE CONNECTOR PINS BEFORE ATTEMPTING TO MATE THEM. DO NOT PACK THE FEMALE RECEPTACLES WITH GREASE, THEY ARE NOT VENTED.

If the connectors get salt water in them, rinse with fresh water and then use compressed air to blow the water out. When dry, use the supplied silicone grease or silicone spray to lubricate the connectors. *This procedure is necessary for all connectors on the G-886 Magnetometer unit*.

Sensor cables up to 200 feet in length may be deployed from the tow vessel. Deployment of cables exceeding 200 feet in length should be accomplished with a winch. If a hand deployed cable is used, it should be tied off to the vessel or secured with a Kellems grip to prevent damage to the SENSOR connector of the G-886 Magnetometer unit.

After installing the system as described above, turn on the power to the AC or DC Power Unit and the Display and Control Computer. After about 40 seconds the G-886 will automatically start to send data to the Display and Control Computer over the RS-232 serial interface. Also during this time the computer will boot up. In order to observe and record the data coming from the G-886 either a terminal communication software (such a PROCOMM, supplied) or a logging software (such as **MagSea**™ which may be purchased from Geometrics) must be initiated on the computer.

2.2.1 Quick Start for the G-886 Magnetometer

The G-886 Magnetometer communicates via RS-232. Measured Data, as well as all control and setup commands are handled over this link.
To communicate with the G-886 Magnetometer, as a minimum, a "dumb" terminal is required. The usual method to operate is with a computer running at least a program such as "PROCOMM". This will allow all commands to be transmitted
and a way to capture data to a file. The usual system may also have

a logging software package, such as **MagSea™** mentioned elsewhere in this manual.

----------**NOTE**----------
All communication to the G-886
Magnetometer must be CAPS

The following table lists the commands that are possible to transmit to the G-886 while it is running:

Command Letter	Command Meaning	Description
T	Tuning	Allows Setting To Local Field
C	Cycle Rate	Sets Cycle Rate In Seconds
P	Polarize On/Off	Means Of Stopping Signal To Observe System Noise
TA	Autotune On	Engages Automatic Tuning
Q	Quit	Stops Cycling To Get Into Setup Menu(Hold Q Down Till Cycling Stops)

The Following table lists the commands that may be transmitted to the G-886 while it is in the Setup Menu (may be used for changing operating default settings):

M	Mode of operation
T	Tuning
B	Baud and modem setting (1200 Baud is normal factory setting)
L	cable and sensor
A	All of above
Q	Quit, abandon changes (Activates menu to reload default settings)
S	Save parameters
C	Cycle time
F	Format of output
R	Run magnetometer
D	Display all parameters

All of the setups are stored in EAROM so they are saved when power is shut off. Many of the settings are only set at the factory and never need to be changed in the field. The setting can be saved by typing "S" at the ">" prompt and following the directions.

2.2.2 G-886 Installation Hints.

The G-886 sensor and cable, as in other magnetometer systems, is sensitive to interference from A.C. or pulsed sources. These sources would include motors in winches, tuggers and capstans. Hydraulic pump power packs are also a noise source as are engines with spark plugs. The placement of the G-886 Magnetometer unit and the sensor cable should consider avoiding all such noise sources for best system performance.

The placement of the magnetometer deck unit is mainly determined by the vessel size and tow cable entry to the rear deck area. The deck unit should be fixed in place by bolting, if possible. There are mounting plates provided to allow secure mounting. The deck unit should be located away from electrically-operated devices, such as pumps motors and deck lighting.

The cable from the tow system to the deck unit should be routed way from any of the above mentioned devices. The fields from electrical devices can cause data scatter.

The onboard cable from the deck unit to the data logging portion of the system (Power Unit/CPU) is less sensitive to interference and the routing of this cable should be less critical.

All cables connected to the deck unit should be protected from wave damage.

The power to operate the magnetometer system must be isolated from all ground connections except one ground connection to the hull or to sea water. This one connection should be to the rear panel of the AC Power Unit. There is a grounding post provided for this purpose.

WARNING!
DAMAGE MAY RESULT TO THE AC POWER UNIT IF CONNECTED TO THE WRONG AC MAINS VOLTAGE

READ THE FOLLOWING BEFORE CONNECTING THE AC POWER UNIT TO THE AC MAINS.

If an incorrect AC voltage is applied to the AC Power Unit, damage may be done to the circuitry inside. There is a AC voltage selection switch on the rear panel of the AC Power Unit. Switch it to the correct voltage before connecting the AC Power Unit to the AC mains.

Magnetometer systems which are run from DC voltage, such as batteries, should be grounded by a connection from the lowest negative battery terminal to the hull or sea

water. A fuse should be wired in series with the battery bank. Place the battery in a well-ventilated space away from any source of ignition. Any lead-acid battery is a possible source of hydrogen gas emission.

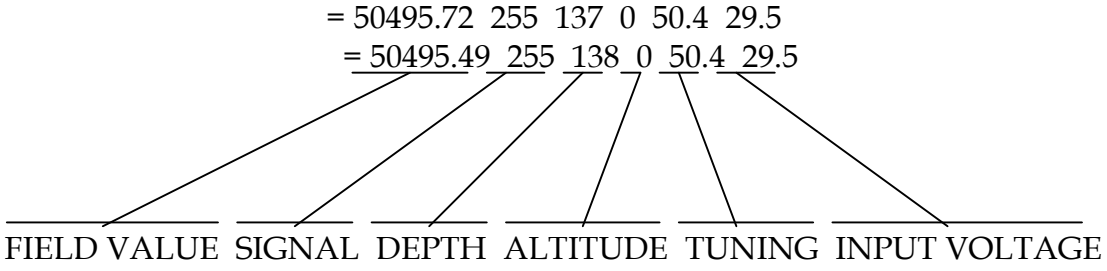
The operating voltage for the computer is set by a switch located on the rear panel next to the AC cord entry receptacle. The switch may be covered by a label with the voltage setting marked upon it. Unplug the AC cord and then move the switch to the new operating voltage. If the correct voltage is not applied to the computer, it may be damaged.

If a video monitor is supplied it may have a wide-range power supply. If so it will not have a voltage selector switch. If it does have a voltage selector switch, select the proper voltage value.

The G-886 Magnetometer may be used as a diagnostic tool to verify a "clean" installation. With the G-886 powered on, observe the incoming data stream, in particular the "signal" amplitude. Locate the sensor and sensor cable away from any noise sources. Observe the "signal" amplitude with the polarize disabled (see paragraph 3.4, Pol OFF). This is accomplished by typing "P255" <Enter> on the Control and Display Computer. The "signal" amplitude should be approximately in the range 10 to 50. By moving either the sensor cable and/or the G-886 Magnetometer unit, search for a location where the smallest number for "signal" may be found. If the G-886 Magnetometer begins to polarize again while still searching, type "P255" <Enter> again until the search is complete. Typing "P1" <Enter> will restart sensor polarization.

2.3 COMPUTER DATA LOGGING OPERATION

Observe the MAG SETUP display screen. After a few seconds the magnetometer will begin sending serial data in the following format which is compatible with Mag Sea logging software:



The values shown are for example only and will vary with system configuration. The first reading is the magnetometer field and its value will vary greatly if the sensor is

positioned close to a large ferromagnetic mass such as a steel deck or dock. The normal format is magnetometer data, signal strength, input voltage and tuning.

Note that the altitude will always display "0". This is required as a place holder by the Mag Sea logging software. If an Altimeter option were installed, the actual distance to the bottom would appear.

You will use the signal level to tune the magnetometer for maximum signal under actual survey conditions. The value at maximum tune should be between 400 and 500. However, this can vary with ambient field strength (signal amplitude is proportional to field strength, i.e., we would expect half the signal strength value in a 25,000γ field compared to a 50,000γ field), sensor orientation (you will get more signal going north-south than east-west) and gradients (you will not get a useable signal with the sensor on a steel deck due to high magnetic field gradient). Data quality will vary from installation to installation depending upon the distance of the sensor from the ship and general diurnal conditions, but in general, you should expect data in the 0.1 to 0.2 gamma range. If the data is significantly noisier than that, re-tune for maximum signal.

3.0 APPENDIX A

3.1 INSTALL SOFTWARE

There are several alternatives for configuring and operating the Magnetometer. Configuration may be accomplished with either PROCOMM or LOADER software provided with the Magnetometer. Operation may be accomplished with any of three software as follows: **MagSea™** logging software, PROCOMM, LOADER.

If **MagSea™** logging software was purchased, follow the instructions in the **MagSea™** logging software manual to install the **MagSea™** software.

PROCOMM terminal emulation software may be used to configure and run the Magnetometer. Install PROCOMM per instructions in the PROCOMM manual. Start PROCOMM and turn on power to the magnetometer. After some time the Magnetometer will begin transmitting data or information for the configuration mode.

The LOADER program is a backup method by which the Magnetometer may be configured and/or reloaded with operational software called "G876.HEX". This may be useful for software upgrades or if EAROM software has been corrupted. There is a section of the LOADER program that which is a terminal emulator that communicates with the Magnetometer to download configuration information to the EAROM. This program may also be used to communicate with the Magnetometer. The LOADER program may be initiated by typing "loader" at the prompt line followed by the enter key.

3.2 G886.BAT SYSTEM INITIALIZATION BATCH FILE

The G-886 Display and Control Computer communicates with the magnetometer electronics through an RS-232 serial port. Type "SEA" <Enter> at the **C:\>** prompt to begin logging and displaying magnetometer data.

3.3 G-886 MAGNETOMETER ELECTRONICS SOFTWARE

DOWNLOAD OF PARAMETERS

To change the magnetometer operational parameters other than the Tuning (for example, change cycle rate or set auto tuning) you must enter the Software Configuration Mode by using a communication package (terminal emulator) such as PROCOMM. System Tuning and cycle rate, however, may also be changed directly from within the MagSea logging software.

We assume here that the modem has initialized properly, that the magnetometer is cycling and sending data and PROCOMM is receiving and displaying the transmissions from the Magnetometer. The software will enter set-up mode if it sees a string of upper case "Q" keys on its serial input. Enter these "Q's" by pressing and holding down the Q key. Only the upper case "Q" character will be accepted. For convenience, we suggest that you use the "CAPS-LOCK" key on the keyboard. You also can enter the Mag Setup/ Configuration Mode by running the EAROM downloading program **LOADER.EXE**. The LOADER program is explained later.

When the system is in the configure mode it will display a prompt that looks like "->", at which the user may type a single character to select the item to be set (character set listed below). When the character is typed, the system will respond with the current value of the parameter and allow the user to edit the value or press return to retain the old value. Section 4.5 lists the messages that can be displayed during the configuration process and their meanings. If an entry is in error, you will have to proceed down through the menu of changes and restart. If entries are out of bounds, a comment will appear.

Note: ***If instead you see "CHECK SUM ERROR****", this means that both primary and backup parameter blocks in the EAROM have been corrupted. You will need to go into the configure mode and set all the parameters correctly and save them before you can run.*

> ***Warning:***
>
> *A space and return, i.e., " <return>" is not the same as "<return>".*

In many cases, pressing a character will cause a list of items to be sent and/or set before returning the prompt. A few moments may be required before you get a response.

Once finished with the configuration changes, save the new configuration into EAROM **by pressing the character "S"** at the prompt. If you don't save the changes now, they could be lost should power inadvertently be removed from the system. During the save process, the software checks for proper ranges in the new configuration and will not download erroneous or out-of-range values.

After the checking, the software requires that you **press a "Y" to write data to the EAROM**. If you inadvertently disconnect power during the download, the results can be difficult to predict, but significant effort may be needed to reinitialize the system. When the prompt comes back it is safe to turn off the power.

3.4 G-876/G-886 MAGNETOMETER ELECTRONICS COMMAND CODES

M Run mode (0=config, 1=magnetometer) : 1
Determines at "power on" if the magnetometer will begin operation in the configuration mode or the run mode. This feature may be useful in certain battery-powered applications.

Q If pressed while in the magnetometer run mode, will switch from the run mode to configure mode (press and hold down until the magnetometer recognizes the command).
If pressed while in the configure mode two choices appear:
1) to reload from EAROM (pressing a "1" will cause the user saved defaults to be reloaded)
2) to reload factory settings (pressing a "2" will allow a reload of the factory settings)

D Pressing will cause all of the current system default parameters to be displayed on the CPU screen. This is useful when using a terminal emulator to allow capture of this information to a file.

S Pressing will cause any changes made to system parameters to be saved to the EAROM. If not pressed before "power off" any changes will be lost.

R Pressing will exit the configuration mode returning to the run mode.

C	Cycle time in seconds	: 1.5	in seconds
T	Initial tuning in kilogammas	: 50.0	In Kγ
	Auto tuning (0=off, 1=on)	: 0.0	Logical
	Max auto tuning in kilogammas	: 100.0	In Kγ
	Min auto tuning in kilogammas	: 20.0	In Kγ

F Pressing will cause the initiation of the process of defining the format of the data string that is transmitted by the Magnetometer. Each paragraph below represents a data item that may be included in the data string. For each data item its individual format (e.g. ######.##) and position in the data string may be defined. Each data item will be presented by the Magnetometer one at a time showing the current definition for acceptance or new definition. After any changes desired are made press the <Enter> to accept the changes and proceed to the next data item. The current definition may be accepted by pressing the <Enter> key. Each data item must be acknowledged by pressing the <Enter> key until the Magnetometer has presented all the data items. Note that some data items in the data string with a "0" (zero) position setting are not transmitted.

Preamble := [NOTE: This "=" is used by the MagSea software and may be different for other logging software.] The preamble is factory set to "=" but may be changed to be compatible with other data logging software.

DATA ITEM	STRING POSITION	COMMENTS
field display position (1=1st, 2=2nd, etc.) : field display format :######.##	1	
signal display position (0=none, 1=1st, etc.) : signal display format :###	2	
time display position (0=none, 1=1st, etc.) : time display format :#####.#	0	Accumulated cycles in seconds from power-up.
fid display position (0=none, 1=1st, etc.) : fid display format :#####	0	Accumulated measurement cycles
ADC[1] display position (0=none, 1=1st, etc.) : ADC[1] display format :####.#	3	Depth Channel
ADC[2] display position (0=none, 1=1st, etc.) : ADC[2] display format :####.#	0	
ADC[3] display position (0=none, 1=1st, etc.) : ADC[3] display format :######.#	0	
ADC[4] display position (0=none, 1=1st, etc.) : ADC[4] display format :######.#	0	
ADC[5] display position (0=none, 1=1st, etc.) : ADC[5] display format :####.#	6	Battery Voltage Channel
ADC[6] display position (0=none, 1=1st, etc.) : ADC[6] display format :####.#	0	
ADC[7] display position (0=none, 1=1st, etc.) : ADC[7] display format :####.#	0	
ADC[8] display position (0=none, 1=1st, etc.) : ADC[8] display format :####.#	4	Altimeter Channel
Tuning display position (0=none, 1=1st, etc.) : Tuning display format :###.#	5	
Status display position (0=none, 1=1st, etc.) : Status display format :##	0	

Postamble :		\N	This may consist of any string of characters terminated by \N which causes a carriage return/line feed character pair to be transmitted. The factory setting is as shown, "a blank".
B Baud rate :		1200	Modem not present in G-886 model
Modem mode (0=none, 1=answer, 2=originate) :		0	
L Cable length in feet :		200.0	may be longer - maximum, 1200 ft
Capacitance per foot in pF :		25.0	
Sensor inductance in mH :		30.0	
P Password :			

The following parameters are password protected. Care must be exercised in changing any of these values. If you are unsure of the purpose of the command, we suggest that you contact the factory Customer Support before changing any values. If you do make any changes that are inconsistent with viable operation of the magnetometer, the software will not accept any changes and will revert to the previous settings:

"GORT" Group:

Gate time as percent of cycle time:	60.0
Maximum gate time in seconds:	0.6
Maximum polarize time:	3.0
Auto tuning search increment in Kγ:	2.0
Bad readings before auto Tuning searches:	3
Max change in auto tuning per reading in kilogammas :	5.0
Minimum accepted signal for autotune:	75
When in configure mode turn polarize (0=OFF,1=ON) :	0

"KLATU" Group

Note:Do not change these parameters without factory consultation.

Lump capacitance in nF :	27.0	
C[01] in nF:	3.7	
C[02] in nF:	7.5	
C[04] in nF:	15.0	
C[08] in nF:	30.0	These values are for example only.
C[10] in nF:	60.0	
C[20] in nF:	120.0	
C[40] in nF:	240.0	
C[80] in nF:	480.0	
Pol to connect delay in mS:	5.0	
Connect to damp delay in mS:	4.0	
Damp to deQ delay in mS:	2.0	
DeQ to narrow delay in mS:	5.0	
Narrow to gate delay in mS:	200.0	
IPP timer value in 11.0592MHz/512:	6500	

(In Phase Polarization)
Serial Number_____

"VERADDA" Group:

Note: For example only, format varies with system mission and hardware configuration.

ADC[1] scale factor:	1
ADC[1] bias sign (0 = add, 1=subtract):	0
ADC[1] bias :	0
ADC[1] decimals :	0
ADC[2] scale factor:	1
ADC[2] bias sign (0 = add, 1=subtract):	0
ADC[2] bias :	0
ADC[2] decimals:	0
ADC[3] scale factor:	1
ADC[3] bias sign (0 = add, 1=subtract):	0
ADC[3] bias :	0
ADC[3] decimals:	0
ADC[4] scale factor:	1
ADC[4] bias sign (0 = add, 1=subtract):	0
ADC[4] bias :	0
ADC[4] decimals:	0
ADC[5] scale factor:	1458
ADC[5] bias sign (0 = add, 1=subtract):	0
ADC[5] bias :	0
ADC[5] decimals:	5
ADC[6] scale factor:	1
ADC[6] bias sign (0 = add, 1=subtract):	0
ADC[6] bias :	0
ADC[6] decimals:	0
ADC[7] scale factor:	1
ADC[7] bias sign (0 = add, 1=subtract):	0
ADC[7] bias :	0
ADC[7] decimals:	0
ADC[8] scale factor:	1
ADC[8] bias sign (0 = add, 1=subtract):	0
ADC[8] bias :	0
ADC[8] decimals:	0

A Pressing will allow all parameters that may be changed in **B, C, F, L, P,** and **T** to be accessed for change, all at the same time, in one large list.

Two copies of the configuration data block are stored with a checksum each. Should power be disconnected during the EAROM write, the software will reject the partially written block. If both blocks are bad, the software will be forced into Configuration Mode and all values will be set to factory default values. If the factory configuration block is bad, safe values are used.

If you exacerbate the situation by turning off the power before resetting and saving a valid configuration, or if you are having problems initializing the system, do the following:

1) Turn/leave the power off to the magnetometer.

2) Press the <CAPS LOCK> to select all upper case letters to be output to the Magnetometer.

3) Hold the "Q" key to return to configuration mode and turn the AC Power Unit on.

4) If this procedure fails to reinitialize the system, repeat from (1) above. Otherwise see the **G-876/G-886 EAROM DOWNLOADER PROGRAM** section below.

5) Correct the configuration and save.

3.4.1 Cycle time:

A two second cycle rate produces the best data, approximately 0.25 to 0.5 gamma during actual towing conditions. Some of this "noise" is a mixture of sea swell generated noise, ship motion noise, sensor motion noise with geologic signal and diurnal variations mixed in. The system will cycle at a 0.5 second rate if the transmitted data formats are short. Some loss of performance will occur at higher repetition rates.

3.4.2 Tuning:

The tuning value set during this procedure is used at power up. It can be changed during actual magnetometer operation by using the "T" command from the graphics or character display screen, but that value will not be permanently stored.

Auto tuning is not recommended if large changes in the field are anticipated, such as those associated with steel target location. The limits on the **span of autotuning** should be set close to the local field (i.e., ± 10Kγ) when the auto tuning is employed. The manual tuning uses strings in the form of:

T531<enter> meaning tune to 53,100 gammas

TA<enter> to enable auto tuning:

If you are in PROCOMM, you also can re-tune in this way. To send the tuning manually, press "T". <u>You must use upper case letters</u>. Wait for the magnetometer to echo the "T", then press the next character and wait for an echo and so on. The magnetometer assumes that the first digit it gets is the tens of kilogammas the next the kilogammas and third hundreds of gammas. All three digits must follow the "T" code. After the three digits are echoed, press enter. If you make an error, press "T" to restart the entry procedure.

3.4.3 Transmitted Data Format:

The data transmitted from the magnetometer has the following line format: [factory set - field changeable]

magnetometer value - signal level -depth - altitude- tuning - input voltage

MagSea defaults to assuming the preamble string is the "=" sign that is transmitted but not displayed. This string marks the start of the line of text that is the data so that the manual tuning information does not get confused with the data. After the preamble comes the data item selected by the user to be sent first, then the second, third, and so on until all selected values are displayed. This is followed by the postamble string. In the postamble string there will be a "\N" to cause a carriage return/line feed pair to be sent.

The formatting of the numbers is controlled by strings of pound signs (#) and optionally a decimal point (.). If the format is in the form "###.##" this would mean three digits before the decimal and two after. Only those digits specified in the format will be transmitted, e.g., if the field is 51234.56 and the field format is set to "###.#", then the value sent will be 234.5.

The total field reading is transmitted after conversion to nT (gammas). The A to D Converter values are scaled to a conventional unit of measure before transmission. For example, Volts (input DC voltage) and the signal strength presented in arbitrary units. Typical signal levels of 300-500 units can be expected depending on the direction of tow and local field strength. The signal strength scaling is fixed and can not be changed.

Status Codes:

0 I'm OK
1 Unexpected 'R' received
2..9 Reserved for other minor errors

11 Counter 1 failed
12 Counter 2 failed
13 Counter 3 failed
14 Counter 4 failed
15 Counter 5 failed
16 Counter 6 failed
17 Tuning reads back wrong
18..99 Reserved

3.4.4 Pol OFF:

This procedure provides a method to obtain a relative noise figure by turning off the polarizing current to the sensor. Type “Pn” (n=1 - 255) <Enter>. This will turn the polarizing cycles off for the number of cycles specified (n). Polarize will automatically restart after the n cycles. Polarize may also be restarted by typing P1 <Enter>.

This procedure should be useful to evaluate noise problems with a G-886 system installation.

3.5 Magnetometer Configuration Mode Message Displays

The following messages may be displayed during the configuration of the magnetometer electronics process. To help the user in properly programming the magnetometer operation, we offer these descriptions. Specific questions should be addressed to Geometrics Customer Service.

1." Invalid character in number "

This message is displayed anytime a character other than a digit or a decimal point is detected in a number entered.

2." Number out of range. Value must be ?? to ?? "

After each number is entered, it is checked against the allowed range for this parameter. If it is outside the range this message is displayed with the range limits displayed where the "?" characters are above.

3." Checking "

Whenever you press "R" to run or "S" to save this message is displayed to indicate that the parameters are being checked for validity.

4." Press "Y" to store to EAROM, any other key to abort: "

When pressing "S" to save the software this gives you a chance to change your mind before writing to the EAROM.

5." Press "Y" to ignore warning and save to EAROM or any other key to abort: "

Some checking of values includes tests for unlikely values. When a value is not illegal but unexpected this message is displayed to inform the user.

6." Save function aborted "

When the user is asked to press "Y" to save, pressing any other key causes this message to be displayed.

7." Value has been corrupted "

This message should never be seen by the user except possibly after loading a new version of the software. This indicates that the parameter displayed has a value that is not allowed in this version of software. The remedial action is to change the listed parameter to a value that is legal.

8. " Two variables in same place "

This message indicates that the position numbers specified in the "F" group for two variables are the same.

9. " Has a gap before it "

If you have a variable specified to print in the fourth position you also must have ones in the first second and third positions.

10. " is a nonstandard BAUD rate "

If you enter a number such as 1300 for the baud rate you will see this message displayed after the baud rate. Although the hardware can transmit at such a rate it is very unlikely that this would be useful. **Do not save such a Baud rate, since communication would cease to work.**

11. " is not close to twice the previous "

The stored values for the tuning capacitors are checked whenever the "R" or "S" is typed. If a value is far from its expected relationship to the others, this message will be displayed.

12. " Running magnetometer software "

Obvious!

13. " Press "Y" to ignore warning- "

When a warning message is displayed after the "R" key is typed, this message gives the user the option of running the magnetometer software regardless by pressing the "Y" or returning to the configuration mode by pressing anything else.

14." Attempt to run aborted due to error "

This message is displayed if the checking done when the "R" is pressed discovers an error that precludes running the magnetometer software with the current parameters.

15. " Press: 1 to reload from EAROM
2 to reload factory settings "

When the "Q" is pressed this message gives the user the option of reloading the values he last saved or the ones we saved at the factory. Pressing any other key will cause neither to happen.

16. " Factory values corrupted default values loaded "

When an attempt to load the factory values from the EAROM discovers that the settings have been corrupted this message is displayed.

17. " M Mode of operation
T Tuning
B Baud and modem setting
L cable and sensor
A All of above
Q Quit, abandon changes
S Save parameters
C Cycle time
F Format of output
R Run magnetometer "
D Display all parameters

A message displayed as a reminder any time the user types an unrecognized key at the "->" prompt.

18. " Error on parameter block! Backup parameters used. Suggest you re-save "

There are two copies of the users' parameters saved in the EAROM. This suggests that one of them was damaged. The correct one is loaded but we suggest you save the parameters to write the correct values into the damaged block.

19. " Error on both parameter blocks! Factory values loaded. Suggest you reconfigure system and re- save. "

If both copies of the users' parameters are found to be damaged the software loads the factory settings and suggests that you manually restore the correct values and save them.

20. " Error EAROM damaged!! Default values loaded
Suggest you reconfigure system and re-save. "

This message indicates that none of the configuration blocks where "good." All parameters for the system need to be reset and saved.

3.6 G-876/G-886 EAROM DOWNLOADER PROGRAM

The G-886 contains an Electrically Alterable Read Only Memory IC. This device stores all the configuration parameters and the software program that operates the magnetometer. The supplied LOADER software programs this EAROM device over the serial data link and thus without disassembling the unit.

LOADER is used if the program in the G-886 magnetometer electronics has been corrupted or if you are to install a magnetometer operating software program upgrade.

The LOADER floppy disk comes with the files: LOADER.EXE, LOADER.HLP and G876.HEX. The first two files are the program and its help file. The third is a listing of the contents of the EAROM that is to be transferred by LOADER.EXE. There may be a fourth file LOADER.CNF that contains a configuration file.

Begin by copying the LOADER.EXE, LOADER.HLP and the G876.HEX files to a directory of your choice on your hard drive. Change to that directory and type LOADER. When you start loader it automatically checks for the file LOADER.CNF. If found, LOADER configures itself accordingly. If there is no configuration file found, the program configures itself in a default condition. (If you have previously saved a set up file other than the default name of LOADER.CNF press "ALT-F" and "L" to get into the configuration file load menu. Select the desired name.)

The program supports menu selection with mouse or key strokes. To bring up a menu hold the ALT key and press a highlighted letter to select a menu. You also can press the "F10" key and use the cursor keys to select the desired menu. Additionally, you may click on the menu using your mouse cursor. For example ALT-F will bring up the files menu.

Within menus the arrow keys move up and down and enter selects the item. Or, if an item in a menu has a highlighted letter you may press that letter (no ALT key) to select that item. Again, if you have a mouse you can just point and click. If you press the "F1" key at any time a context sensitive help screen will pop up. Help on using HELP can be obtained by pressing "F1" again.

When LOADER requests that you input a file name, a dialogue box with a list of file options will appear. On the "enter" line you may type the name of the file, enter a string with a "*" or "?" or type the name of a directory. If you enter a file name, that name will be selected when you press < ENTER >. For the other cases the list of files displayed below will change to reflect the files matching the input string definition. You may press the tab key to go to the directory listed below. When in the directory

list, you may use the cursor keys to move the highlighted bar. Pressing < ENTER > selects the highlighted file name.

Depending on the type of display and display adapter installed in your system different methods of highlighting are used. In all cases, an effort was made to make the highlighted text visible.

If you need to change the RS-232 port settings press "ALT-R" to get the menu for RS-232 settings. Set the BAUD rate and the port number.

The first time you run loader you will need to specify the code to be loaded into the EAROM. Press the "ALT-C" to select the Configure Menu. If G876.HEX is not listed, press ALT-I to enter the file selection menu and select that file. If files are listed that will not be loaded, use the cursor keys to highlight that item and press the ALT-D to delete that item from the list.

Once the program is correctly configured you may then select the Down Load menu. Use the Download Type Function to get the system into the factory mode. When this function is selected the program operates much like a dumb terminal, i.e., what you type is sent over the RS-232 port to the magnetometer and what is received is displayed. Once the G-886 is in factory default mode, use the Down Load to EAROM selection to send the program(s) to the G-886 magnetometer EAROM.

Again use the Download Type Function to type an upper case "Q". Then "Quit", followed by an <ENTER>. Some illegal characters may be displayed during the G-886 Modem reprogramming process. After a short period, the magnetometer will begin transmitting magnetic data and this will be displayed on the screen. The software may detect that the configuration has been corrupted, and report. Then, reconfigure the system and save the new configuration.

If you wish to document what you have done you may select “ALT-F” and then select Report to produce a text file describing what was sent to the G-886. If you wish to save this configuration use the Files Menu's "Save" function. When finished, use the “ALT-X” key to exit.

3.7 FACTORY TEST MODE

The factory test mode allows the service technician to test the operation of the circuits on both the MAG and CPU PCB's. It also provides the interface for the on-site updating of software. The commands are based on single letters. The single letter may be followed by more characters but these are not checked for validity. The commands are mostly the same ones used by INTEL or NOHAU for programming the 8051 microprocessor. For example:

XBY 0 LENGTH 10

could also be written as:

X 0 L 10

or

X(anything) 0 L(something) 10

All entries must be in upper case. All numbers are in hex. Simple expressions are allowed in places where numbers are expected. Very little checking of user input is done and the most explanatory message produced is "WHAT".

Commands may be strung together on one line by separating them with semicolons. For example:

XBY 0 LENGTH 10 ; CBY 0 LENGTH 10

will display the contents of the external data space then the contents of code space.

Commands	Function
XBY address	Display external data or port.
XBY address=value	Set external ram or port
CBY address	Display code space.
DBY address	Display internal ram.
DBY address=value	Set internal ram.
REP	Repeat the rest of this line
UNTIL value	Stop repeat if value is not zero
LOAD	Call LOADER
QUIT	Restart the code from power on point.
EVAL value	Evaluate and display.
BAUD value	Set the BAUD rate
SUM address	Do a 16 bit checksum of the external data space

In all commands the address or value may be an expression instead of a number. The following operators are allowed in expressions:

! a	Returns 1 if a=0 or 0 if a<>0
~ a	Returns the ones compliment of a

a > b	Greater than returns 1 for true, 0 for false
a < b	Less than returns 1 for true, 0 for false
a : b	12:34 returns 1234H
a + b	Adds
a - b	Subtracts
a * b	Multiplies
a / b	Divides
CBY a	Returns code byte at address a
DBY a	Returns internal ram byte at address a
XBY a	Returns external data or port at address a
(a)	Evaluate 'a' first.

The external ports on the magnetometer and CPU boards are addressed as follows:

Port address	Description
XBY 0E000	Modem control reg 0
XBY 0E001	Modem control reg 1
XBY 0E002	Modem detect reg
XBY 0E003	Modem tone control reg
XBY 0E006	Modem I.D. reg
XBY 0E200	CPU U13 port 0
XBY 0E201	CPU U13 port 1
XBY 0E202	CPU U13 port 2
XBY 0E203	CPU U13 Control reg
XBY 0E400	CPU U14 Maxim ADC LSB
XBY 0E401	CPU U14 Maxim ADC MSB
XBY 0E800	MAG U10 counter 0
XBY 0E801	MAG U10 counter 1
XBY 0E802	MAG U10 Counter 2
XBY 0E803	MAG U10 Counter control reg
XBY 0EA00	MAG U9 Counter 0
XBY 0EA01	MAG U9 Counter 1
XBY 0EA02	MAG U9 Counter 2
XBY 0EA03	MAG U9 Control reg
XBY 0EC00	MAG U13 Signal level ADC

XBY 0EE00	MAG U11 port 0
XBY 0EE01	MAG U11 port 1
XBY 0EE02	MAG U11 port 2
XBY 0EE03	MAG U11 Control reg

Please refer any comments, questions or technical support issues to:

Customer Service
Ph: 408-734-4616
Fax: 408-745-6131

Phone Support Available
8 am to 5 pm Pacific Time Zone