G-880 CESIUM MARINE MAGNETOMETER

25505-OM REV. E1

Operation Manual

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1.0 Introduction

This manual is produced with the intent that it will offer the marine magnetic survey operator a good understanding of the science involved in alkali vapor magnetometry. It is not meant to be exhaustive for every case as there are many different situations and applications in which the magnetometers are used. We have attempted to discuss the important topics of system theory, equipment configuration, installation and field operation. Please contact the factory should you have specific questions relating to your special application. We assure you rapid and informed support.

The Geometrics G-880 Marine Magnetometer employs a Cesium atomic magnetic resonance system operating as the frequency controlling element of an oscillator. The frequency of the oscillation varies directly with the external magnetic field at the sensor. This frequency can be measured with great accuracy, yielding precise measurements of the magnetic field. This technique has been used in research and production geophysics since the late 1950's, and is now the preferred method for magnetic anomaly detection in military applications as well.

The G-880 Marine Magnetometer consists of two modules (pressure vessels): the sensor and sensor electronics packages mounted in a fish which may be deployed and towed for marine applications. The G-880 has its own internal counter to count and digitize the larmor frequency which it then transmits digitally up the tow cable. Usually, due to cable length, the Magnetometer must be deployed with the use of a winch.

A basic understanding of the physics employed in the G-880 Marine Magnetometer, and optically pumped resonance magnetometers in general, will be helpful in achieving optimum results during field use.

2.0 Operation

The G-880 Marine Magnetometer may be purchased with optional software such as **MagSea**™ logging software and **MagPlot** post acquisition plotting software. Please refer to the Manuals associated with these, if purchased. If **MagSea**™ is not purchased, terminal software may be used to communicate with the G-880. Refer to Appendix A for a set of **Quick-start G-880 Operating Instructions** to help with the initial setup and running of the magnetometer.

2.1 Performance

Geometrics G-880 magnetometer produces a Cesium **Larmor** frequency output at 3.49872 Hz per nT (in this text, nT refers to nanotesla or gamma or 10^{-5} gauss). Thus, in a nominal 50,000 nT field this frequency is about 175 kHz. The output of the system is a continuous sine wave at the Larmor frequency. The typical signal amplitude is approximately 2 volts peak-to-peak at optimal orientation.

This frequency is counted with the counter at 10 readings per second. The G-880 is intended for use in marine applications, and operates over the earth's magnetic field range of 20,000 to 100,000 nT.

Absolute accuracy depends on sensor orientation, internal light shift and the accuracy of the external counter's time base. Orientation error of the G-880 does not exceed 1 nT p-p (peak-to-peak) throughout the active zone(s) (see auto-hemispheric switching section). This is due in part to the use of a split-beam circular polarizer.

Sensors are compensated to provide a flat response over the center most angular orientation of less than 0.5 nT.

Like all magnetometers, performance of the G-880 in a mobile installation is primarily dependent upon the compensation and noise reduction techniques used on the platform (i.e., ship). Navigation/position errors, radiated magnetic noise and heading error from the ship's induced and remnant magnetic fields are typically the major contributors to "noise" in the marine environment.

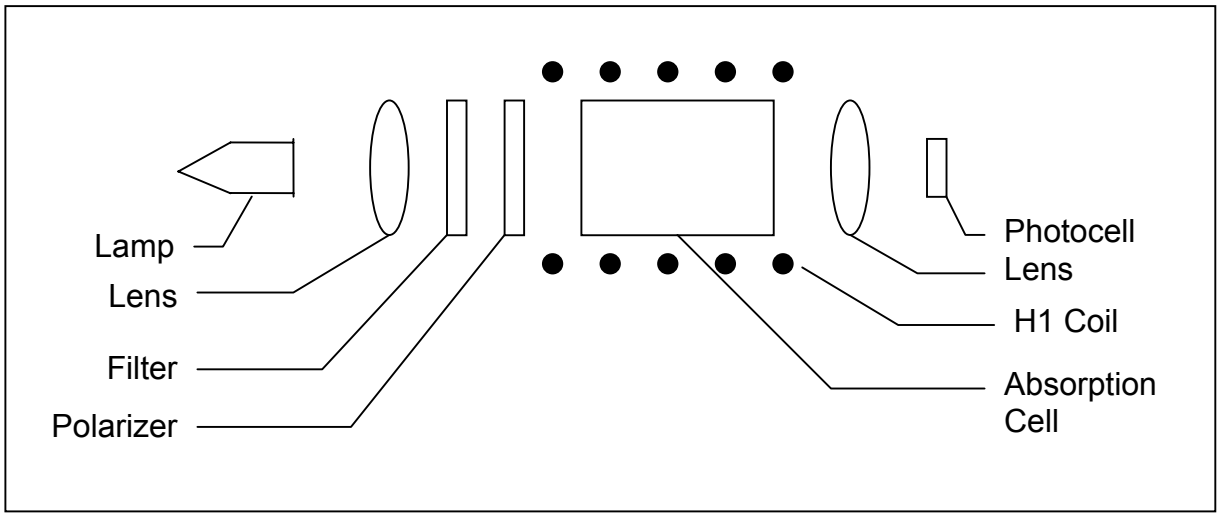
The G-880 Sensor Package consists of a sensor head and sensor electronics package joined by a cable. The electronics package contains an integral Geometrics mini-counter which converts the Larmor signal into a magnetometer reading in nano-Teslas and also provides for up to 3 channels of other measurements such as depth. Digital data is transmitted via RS-232 to a data logging system. A five pin underwater connector on the sensor electronics package receives power on two pins. The other three pins are used to provide an RS-232 connection upon which the G-880 transmits magnetometer and auxiliary (e.g., depth) data readings in digital format. The maximum cable length may vary, decreasing in length as data reading rate increases.

Environmental conditions for proper operation are -35 to +50°C (-31 to +122° F). The standard G-880 will operate to a depth of 4000 feet. The deep version of the G-880 will operate to a depth of 10,000 feet.

2.2 Optical Pumping Theory

Note: The following section is provided for information purposes only. Understanding this theoretical discussion is not required for proper operation of the magnetometer.

For purposes of this discussion, the ambient magnetic field or earth's magnetic field is called H_0. A separate magnetic field generated by an AC signal applied to a coil inside the sensor is called H_1. Refer to the drawing on the next page for the following discussion.



G-880 CESIUM SENSOR

To initiate operation of the sensor, the lamp oscillator's RF power increases until the lamp strikes (plasma ignites and fluoresces). The lamp oscillator then reduces its power to produce the regulated amount of light. The heater warms the absorption cell until a Cesium vapor is formed. A lens bends the light from the lamp to parallel rays. The lamp produces many spectral lines but only one line in the infrared region is employed. All of the other light is blocked by a high grade optical filter.

The infrared line of interest is then passed through a split-circular polarizer. On one side of the polarizer the transmitted light has an electrostatic vector that advances with a right-handed rotation. For conceptual purposes, it can be said that all of the photons in this light have the same right-hand spin direction. The light transmitted through the other side of the split-circular polarizer produces light in which the vector advances with a left-handed rotation, therefore having the opposite spin. Both circular polarized light beams pass through the absorption cell. Because there is a buffer gas in the cell, the single cell can be considered as two separate cells, each having the opposite sense polarized light passed through it. Both light beams exit the cell and pass to a second lens. This lens focuses the light onto an infrared photo-detector.

Because Cesium is an alkali metal, the outer most electron shell (orbit) has only one electron. It is the presence of this single electron that makes the Cesium atom well-suited for optical pumping and therefore magnetometry.

The Cesium atom has a **net magnetic dipole moment**. This net dipole moment, termed **F**, is the sum of the **nuclear dipole moment**, called **I**, and the **electron's angular momentum**, called **J**. In a Cesium atom:

I = 7/2
J = 1/2

and thus **F** can have two values depending on whether the electron's angular momentum adds to or subtracts from the nuclear dipole moment. Therefore, **F** can have the value of **3** or **4**. These values are called the hyperfine energy levels of the ground state of Cesium.

Normally the net dipole moments are randomly distributed about the direction (vector sum of the 3 axial components) of the ambient magnetic field (H_0). Any **misalignment** between the net atomic dipole moment and the ambient field vector causes the Cesium atom be at a higher energy level than if the vectors were aligned. These small differences are called **Zeeman splitting** of the base energy level.

The laws of quantum electrodynamics limit the inhabitable atomic magnetic dipole orientations and therefore the atomic excitation energy to several discreet levels: 9 levels for the **F=4** state and 7 levels for the **F=3** state. *It is this variation in electron energy level state that is measured to compute the ambient magnetic field strength.*

When a photon of the infrared light strikes a Cesium atom in the absorption cell, it may be captured and drive the atom from its present energy level to a higher energy level. To be absorbed the photon must not only have the exact energy of the Cesium band gap (therefore the narrow IR line) but must also have the correct spin orientation for that atom.

There is a high probability that the atom will immediately decay back to the initial energy level but its original orientation to the ambient field is lost and it assumes a random orientation. An atom that returns to the base level aligned such that it can absorb another photon, will be driven back to the higher state. Alternately, if the atom returns to the base level with an orientation that does not allow it to absorb an incoming photon, then it will remain at that level and in that orientation. Atoms will be repeatedly driven to the higher state until they happen to fall into the orientation that cannot absorb a photon. Consequently, the circularly polarized light will depopulate either the aligned or inverse aligned energy states depending on the orientation (spin) of light polarization. Remember that one side of the cell is right-hand polarized and the other left-hand polarized to minimize sensor rotational light shifts and subsequent heading errors.

Once most of the Cesium atoms have absorbed photons and are in a state that does not allow them to absorb another photon, the light absorption of the cell is greatly reduced, i.e., more light hits the photo-detector. If an oscillating electromagnetic field of the correct radio frequency is introduced into the cell, the atoms will be driven back (depopulating the energy level) into an orientation that will allow them to absorb photons again. This frequency is called the Larmor frequency and is exactly proportional to the energy difference caused by the Zeeman splitting mentioned previously. This energy splitting is in turn directly proportional to the ambient magnetic field strength. The relationship between frequency and energy is given by:

$$E = f\hbar$$

Where:

E is the Zeeman energy difference
f is the frequency of the Larmor
$\hbar$ is Planck's constant

In Cesium this Larmor frequency is exactly 3.49872 times the ambient field measured in nano-Teslas (gammas). In the G-880 this radio frequency field is generated by a coil, called the H1 coil, wound around the tube holding the optical components. When the RF field is present the total light passing through the cell is reduced because atoms are in an energy state in which they can again absorb the infrared light.

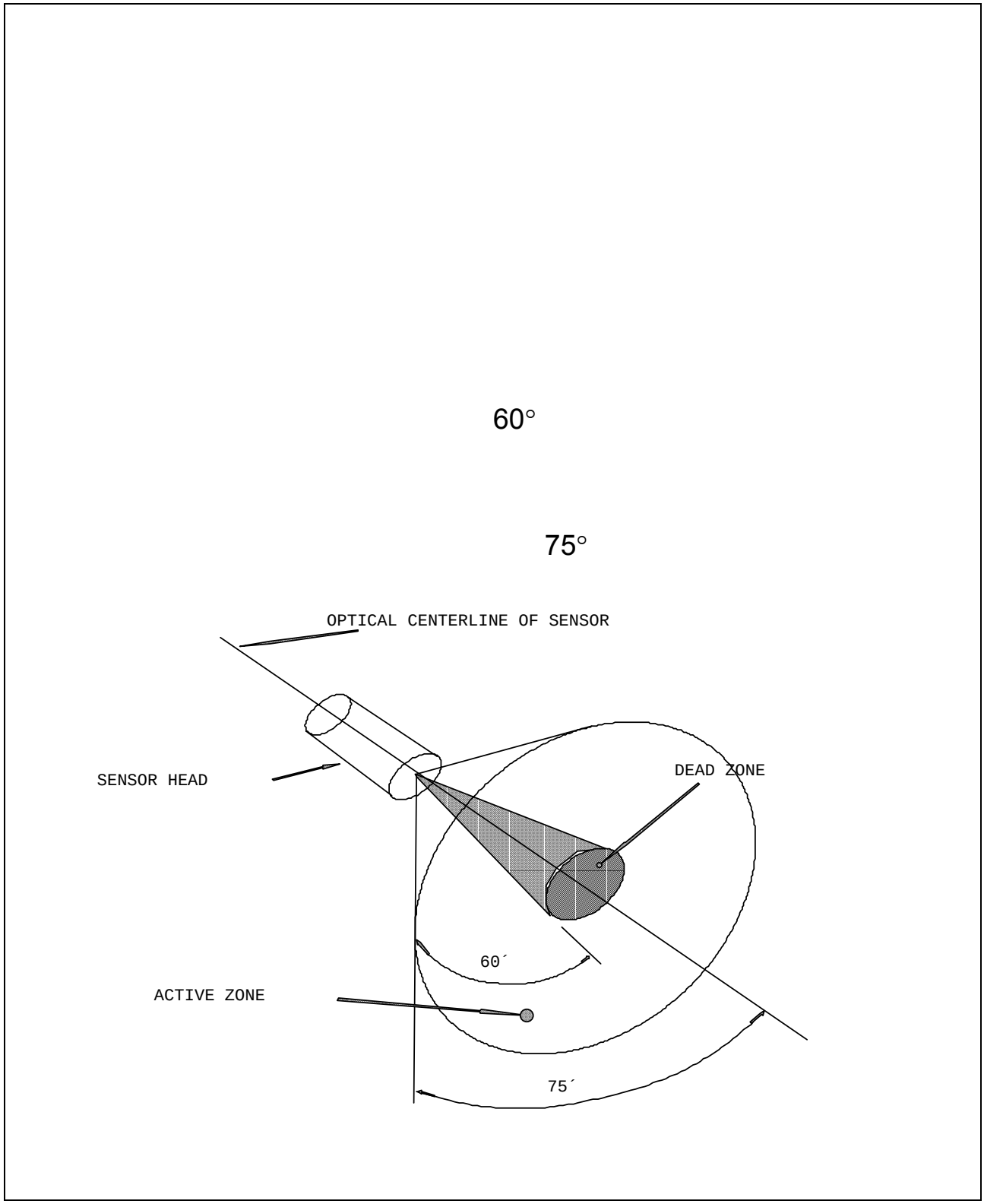
There is a small variation in the atomic light absorption at the frequency of the applied H1 depopulation signal. This variation in light intensity appears on the photo-detector as a small AC signal (microvolts). If this AC signal is amplified and shifted to the correct phase, it can be fed back to the H1 coil to produce a self sustaining oscillation. In practice simply connecting the 90° phase shifted and amplified signal to the H1 coil will cause the oscillation to spontaneously start. Reversing the direction of the earth field vector (H_0) through the sensor requires the drive to the H1 coil to be inverted to obtain oscillation. (See Automatic Hemisphere Switching, section 2.4.3).

2.3 Sensor Orientation Guide

The G-880 is designed such that the sensor ‘s optical axis may be adjusted to any angle in relation to the direction of tow. This angle should be adjusted to optimize the magnetometer’s performance depending upon where in the world it will be operated.

The sensor head should be oriented so that the earth's field vector arrives at an angle of from 15° to 75° to the optical axis of the sensor, for all towing attitudes. For optimal performance the sensor orientation should preferably be such that the earth’s field vector arrives at a angle of from 30° to 60° to the optical axis of

the sensor. The sensor will not produce usable data when the angle between the earth's field vector and a plane perpendicular the optical axis of the sensor is less than 15°. In this "equatorial dead zone" the pumping and Zeeman splitting phenomena fails to function, as the signal to noise ratio falls off proportional to the function $2\sin\theta\cos\theta$ where θ the optical axis and H_0 (external field). Similarly when the optical axis of the sensor is within 15° of parallel with the earth's field it will be in the "polar dead zone." In latitudes where the inclination of the earth's field vector is $45° \pm 15°$, vertical orientation will allow operation in all practical towing directions. In equatorial regions it may be necessary to orient the sensor horizontally and at an angle to the towing direction. In more Northern latitudes where the dip angles become much steeper, tilt the sensor to 45° of vertical to enable towing in all directions.



The G-880 Sensor must be oriented for best performance in any particular survey or search application. The program named "CsAz" will give the user the ideal sensor angles for the area of interest.

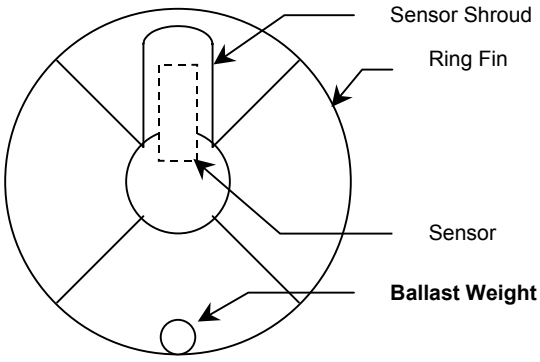
There are very simple adjustments which can be made to get to the best sensor position. These adjustments will allow the sensor axial, or fore/aft angle and the radial or roll angle to be set.

The axial adjustment is made by first removing the six screws holding the sensor fairing in place. If possible, always use a new flat-blade screwdriver, so no magnetic particles get carried to any structures near the sensor. If a non-magnetic, non-sparking screwdriver is available, so much the better. There are two 1/4-20 roundhead screws located at either side of the sensor mount which can be slightly loosened so the sensor fore/aft angle can be set. The usual settings will be one of three angles. These are 90° or perpendicular to the tow fish long axis, 45° from this angle and 0° which is parallel to the tow fish long axis. After this adjustment has been made, tighten the 1/4-20 screws to clamp the sensor mounting angle. Now the fairing can be put back in place.

The roll angle is set by the position of the ballast weight on the speed ring tail in relation to the sensor fairing. To change this angle, remove the eight speed ring tail mounting screws and then the tail can be rotated to a new position. The adjustments are in 45 degree increments. After this adjustment, put the eight screws back to hold the tail in place.

This completes the angle adjustments.

This illustration depicts the relationship of The sensor to the ballast weight “as shipped”. If deployed as shipped the sensor will tow vertical to the earth’s surface.



2.4 CM-201 Counter Data Format and Command Structure

The CM-201 counter module is a counting device that converts the cesium larmor signal (70 kHz to 350 kHz) into magnetic field strength in nano-Teslas (20,000 nT to 100,000 nT). In addition there are 5 external 12 bit A/D channels and 1 internal A/D channel that can be digitized and appended to the output data. A Julian clock string can be enabled and added to the output data stream as well. Finally there is an External Event pin that can be used for external trigger or event marking.

The output data format is programmable. For example each of the A/D channels can be added/removed from the output data stream by sending the appropriate commands. There are several other commands that are discussed in detail later in this document.

2.4.1 Output Format

Figure 1 shows the standard single counter configuration. Commands from the PC are sent out the RS232 transmit pin (TxD) to the counter. Mag and other data return on the receive pin (RxD).

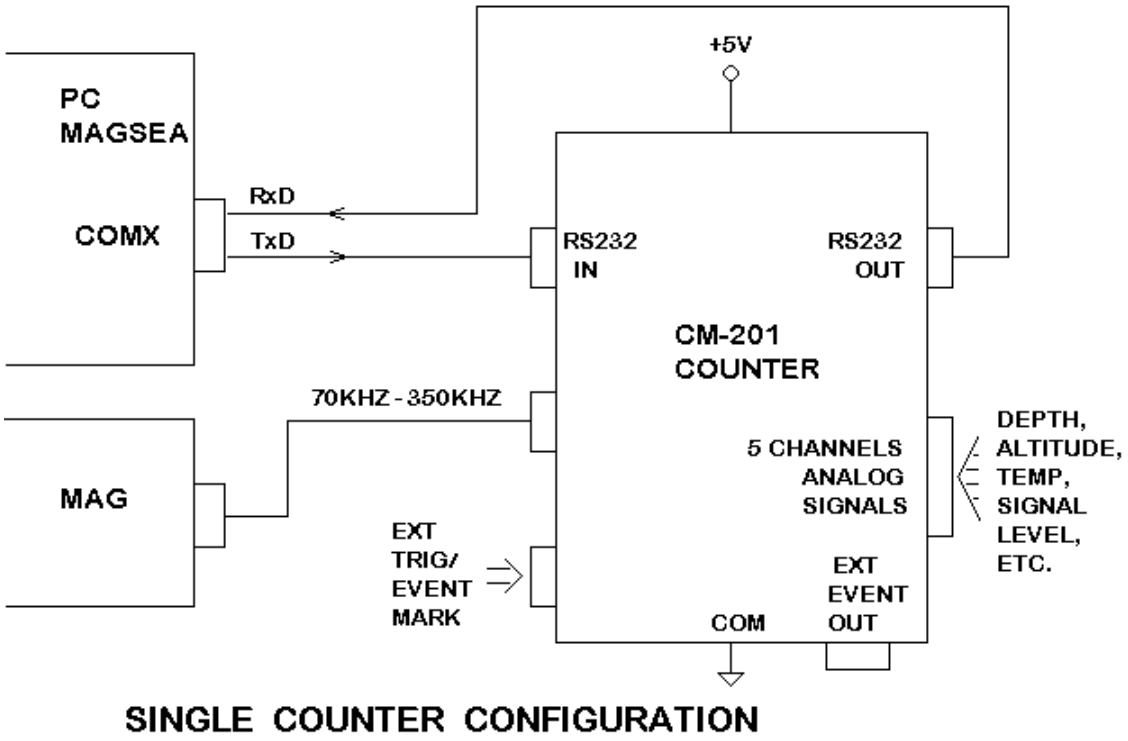


Fig. 1

Upon power on the counter module defaults to the following setup:

Baud rate: 9600 baud, 8 data bits, no parity, 1 stop bit

Cycle rate: 10 hertz

Analog channels: Channel 0 (Larmor signal level) enabled channels 1-5 disabled

Julian Clock: Disabled

Output Format: ASCII

The default output data stream contains all printable ASCII characters with each sample terminated with a carriage return/ line feed sequence. The following example illustrates this format:

char #	description
1	An ASCII '$' (marks first character of data stream)
2	an ASCII '1' or a blank (depending on whether Mag reading is above or below _99999.999 nT).
3-7	5 digits of Mag data
8	an ASCII decimal point ['.']
9-11	3 more digits of Mag data
12	an ASCII comma [',']
13-16	4 digits of A/D channel 0 (9999 full scale, 0 to +5 volts in). This channel is internal and contains the signal level of the magnetometer.
17	an ASCII carriage return
18	an ASCII line feed

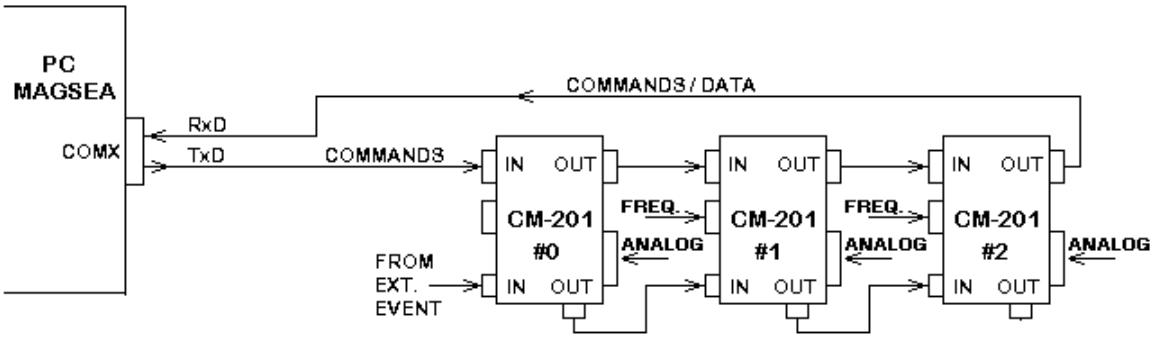
If the data were captured to a file and then copied to a line printer the printout would look something like this:

$ 99778.131,3749
$ 99890.376,3687
$ 99955.517,3545
$ 99998.293,3472
$100078.835,3329
$100032.071,3381
$ 99979.159,3498
$ 86778.508,3514
$ 78778.216,3645
$ 69978.347,3797

Counter modules can be daisy chained to form multiple sensor arrays as shown in Figure 2. Note that the output data from counter 0 goes into the input port of counter 1, and so on. This allows each counter module to append its output data onto the end of the data stream coming from the previous counter(s). As each counter receives data characters from previous counters they get echoed to the next. An exception to this is the carriage return/ line feed sequence. The carriage

return is replaced by a comma and the line feed is ignored. Thus one long concatenated string from all counters is output from/through the last counter, and is terminated by a carriage return/ line feed sequence by the last counter only.

Note that only the first counter outputs a preamble character (the default character is '$').



MULTI-COUNTER MODULE CONFIGURATION

Fig. 2

2.4.2 Commands

Commands are sent into the input port of the first counter. Note that commands are the only characters that enter the first counter. A command string is stored in an incoming buffer until terminated by a carriage return. The command will then be executed at the end of the current sample, immediately after the last 'data' byte has been sent out the output port. Then the command will be echoed to the next counter (or back to the logging computer if it is the last/only counter in the chain).

Subsequent counter modules in multiple counter arrays differentiate between output data and commands by assuming that all characters between the data preamble character ('$' is the default) and the next line feed are Data bytes from the previous counter(s). Commands only arrive at subsequent counters after the data transmission is complete. Each command is identified by the first character, followed by some number of operand characters and a carriage return.

Only one command can be sent at a time. After each command wait for the command echo before sending another.

All commands are terminated with a carriage return. A line feed may be sent as well, but it will be ignored by each counter module. However, at the end of every output data string there will be a carriage return and a line feed sent. This method insures that the final counter will have a carriage return/line feed sequence so that if the file is printed it will look correct on paper. By using the carriage return as the command terminator and stripping input line feeds insures that dumb terminals (and dumb terminal emulation software) can be used to control the counter output. (Dumb terminals do not normally transmit line feeds when <Enter> is pressed).

Here are the current list of commands and the format of each:

Command	**Format:**	**Description:**
Set Cycle time	Byte 1: 'C'	Set time in 0.01 sec increments
	2: x	MS digit of number ('0'-'9')
	3: x	3S digit of number
	4: x	2S digit of number
	5: x	LS digit of number
	x: x	5 MS optional char ('0' or '5')
	6/7: CR	carriage return

[Note: the 5 MS char is optional. It was added to allow setting the cycle time to more precision after the initial software release]

Command	Format:		Description:
Set A/D ch's	Byte	1: 'A'	Enable/disable A/D channels
		2: x	'0' = turn off channel; '1' = turn on
		3: x	select channel # ('0'-'5')
		4: x	MS digit of counter # ('0' or '1')
		5: x	LS digit of counter # ('0' - '9')
		6: CR	carriage return

[Note: characters 4 and 5 can be omitted. If this is done the command will default to counter 0.]

Change Baud Rate	Byte	1: 'B'	Baud rate change command
		2: x	MS char (1,0,0,0,0,0,0)
		3: x	S char (9,9,4,2,1,0,0)
		4: x	3S char (2,6,8,4,2,6,3)
		5: x	2S char (0,0,0,0,0,0,0)
		6: x	LS char (0,0,0,0,0,0,0)
		7: CR	carriage return

External Trigger Function	Byte	1: 'T	Enable/disable A/D channels
		2: x	'0' = turn off channel; '1' = turn on
		3 CR	carriage return

Output Format	Byte	1: 'O'	select output format
		2: x	format select: 'A'= ASCII (default) 'E'= excess 3 'P'= packed BCD 'S'= Sandia G822A fmt
		x: x	'0' = Sandia single Mag '1' = Sandia dual Mag
		3: CR	carriage return

[Note: the '0' and '1' 3rd characters are valid only when selecting the Sandia format]

Command	Format:		Description:
Julian Clock Format:	Byte	1: 'O'	select output format
		2: J	format select:
		3: x	Day field: '1'= on ; '0' = off
		4: x	Hour field: '1'= on ; '0' = off
		5: x	Min field: '1'= on ; '0' = off
		6: x	Sec field: '1'= on ; '0' = off
		7: x	10mS field: '1'= on ; '0' = off
		8: x	MSB of counter # ('0' or '1')
		9: x	LSB of counter # ('0' thru '9')
		10: CR	carriage return

[Note: characters 8 and 9 can be omitted. If this is done the command will default to counter 0.]

Julian Time Enable:	Byte	1: 'J'	Enable/Disable Julian time output
		2: x	'0' = turn off; '1' = turn on
		3: x	MS digit of which counter ('0','1')
		4: x	LS digit of counter # ('0' - '9')
		5: CR	carriage return

[Note: characters 3 and 4 can be omitted. If this is done the command will affect all counters in the chain.]

Set Julian Day:	Byte	1: 'D'	Set the Julian day number
		2: x	MS digit of number ('0'-'3')
		3: x	2S digit of number ('0'-'9')
		4: x	LS digit of number ('0'-'9')
		5: CR	carriage return
Set Hour:	Byte	1: 'H'	Set the hour
		2: x	MS digit of number ('0'-'2')
		3: x	LS digit of number ('0'-'9')
		4: CR	carriage return
Set Minute:	Byte	1: 'M'	Set the minute
		2: x	MS digit of number ('0'-'5')
		3: x	LS digit of number ('0'-'9')
		4: CR	carriage return
Set Second:	Byte	1: 'S'	Set the second
		2: x	MS digit of number ('0'-'5')
		3: x	LS digit of number ('0'-'9')
		4: CR	carriage return

Command	Format:		Description:
Find counters:	Byte	1: 'F'	Find and assign counter numbers
		2: '0'	assign first counter as # 0 (MSB)
		3: '0'	LSB
		4: CR	carriage return
Set Preamble	Byte	1: 'P'	Set the preamble char ('$')
		2: x	The desired character
		3: CR	carriage return
Jump to debug	Byte	1: 'X'	first char of 'XBUG' string
		2: 'B'	2'cnd char
		3: 'U'	3'rd char
		4: 'G'	4'rth char
		5: CR	carriage return
Error echo	Byte	1: 'E'	Syntax err - echo 'ERR' + counter #
		2: 'R'	2'cnd char
		3: 'R'	3'rd char
		4: x	MS digit of counter number ('0'-'1')
		5: x	LS digit of counter number ('0'-'9)
		6: ':'	colon delimits error message cmd

[Note: xxx: bad command string is echoed in the following characters, followed by a ...
x: CR carriage return]

Reset	Byte	1: 'R'	Reset the microprocessor
		2: 'E'	2'cnd char
		3: 'S'	3'rd char
		4: 'E'	4'th char
		5: 'T'	5'th char
		6: CR	carriage return

Command	**Format:**	**Description:**
Interrogate Setup:	Byte 1: 'I'	Interrogate command
	2: x	item select: 'A'= Analog output fields selected 'J'= Julian Clock fields selected 'V'= software version number.
	3: x	MS digit of counter number ('0'-'1')
	4: x	LS digit of counter number ('0'-'9)
	5: CR	carriage return

[Note: Characters 3 and 4 are optional. If they are omitted the command will return the output from counter 0.

The addressed counter will insert characters into the command string just before the carriage return before echoing to subsequent counters. See detailed command description for format and definition of these added characters.]

2.4.3 Detailed command descriptions:

Cycle Time Set:

Cycle time is set by transmitting the number of 0.01 second increments needed to make the desired output rate. The default rate is 10 hertz (C0010). To set the output rate to 1.2 seconds the command string would be "C0120".

After the initial software release another character was added to allow the cycle time to be set to 5 ms resolution. To maintain compatibility with older versions this character is optional. For an example on using this extra precision, the command "C00125" would set the cycle time to 8 hertz (125 ms).

A/D channel select/enable:

Three pieces of info are needed to select and turn on/off an A/D channel: The counter #, the channel number, and a flag indicating whether to enable or disable that channel. The enable/disable flag is sent first (after the 'A' command identifier). A '0' character will turn off the channel, a '1' turns it on. The next character specifies the channel number (0-5), followed by 2 characters indicating the counter number (00-19). If the counter number is not sent then it defaults to counter 0.

Baud Rate Change:

The baud rate can be commanded to change by giving a 'B' command character followed by 5 more number characters specifying the desired baud rate. Valid baud rate commands are: 'B19200', 'B09600', 'B04800', 'B02400', 'B01200', 'B00600', and 'B00300'. This command will not execute until the entire command has finished echoing out to the next counter/logging device. This allows the command to propagate through all counters and be implemented before output data arrives at a different rate.

External Trigger enable/disable: (NOT USED ON THE G-880)

Using the External Trigger Function

Starting with revision X8 (04/30/97) the CM-201 counter output can be externally triggered, allowing the counter output to be synchronized with other equipment.

External triggering mode is entered by sending the command string "T1" to the counter(s). Upon receiving this command the counter(s) will stop sending data at a fixed cycle rate and instead output one reading for each external trigger received. To leave external trigger mode and go back the internal cycle mode send the command string "T0". Note that the CM-201 will not execute a command until the end of transmission of the next data sample, therefore there must be at least one more external trigger received after the "T0" command string has been sent.

External triggers are input to the CM-201 counter via the External Event Pin of the counter board (JP1 pin 4) which is also wired to pin G of the 19 pin Bendix connector on the G-823A electronics module. In addition there is a BNC connector on the power supply interface box which can be used.

The external event input is compatible with both TTL and RS232 signal levels. A logic low is defined as any input level in the range of +0.8 volts to -25 volts. A logic high is defined as any input level in the range of +2.0 volts to +25 volts.11A trigger occurs on an input transition from low to high. The external trigger input has no internal pullup and floats near ground. The input impedance is 3000 ohms or higher.

The external trigger input is edge triggered. Therefore the external trigger signal must have sharp edges. If a mechanical switch is used as a trigger input it must be properly debounced to prevent multiple triggers. The trigger pulse must be greater than 2 microseconds in width.

When not in external trigger mode any external triggers received are ignored.

External Trigger Timing

When an external trigger is received a counting gate period is opened immediately. At the termination of counting gate the count values are read, the frequency calculated, converted to nanoteslas, and output through the RS-232 port. As long as the external trigger pulses occur less frequently then the length of the counting gate this process repeats with each external trigger. Thus if the counting gate time was set to 100 mS an external trigger would start counting, 100 mS later the counting would stop, and about 3 mS later the counter data would start transmitting out the serial port. The 3 mS time above represents the magnetometer value calculation time. Note that this is a calculation time but not a dead time. There are two counting banks. When one gate time ends the other begins simultaneously, thus the counting never stops.

The gate time is adjustable, and is set using the same method as for internal cycle mode. For example, to set the gate time to 20 mS the command would be "C0002" as described above. Note that a shorter gate time decreases the latency between external trigger and data output, but does so at the expense of frequency measurement resolution (as in all frequency counters).

If a new external trigger arrives before a currently open counting gate is finished the current gate is closed immediately, a new count gate is opened, and after the 3 mS calculation time the data from the just closed gate period is output. This process of closing a counting gate early as required for new triggers allows for external triggers to smoothly overrun the selected gate period without losing readings or corrupting the measured data. Note that drastically over-triggering the counter will drastically shorten the actual gate times which will reduce the frequency measurement resolution, but when the external triggers slow back down the gate times will resume their set gate periods.

Output Format Select:

The default (ASCII) output format is described in detail at the beginning of this document. This is the easiest format to view and import into various processing utilities. It is also very inefficient in terms of disk storage space and time required to transmit each cycle. There are three other output formats that can be used as well:

Packed BCD:

Packed BCD format throws away all commas, decimals, spaces, and the magnetometer most significant byte ('1' if more than 100,000 nT, or a blank is less than 100,000nT). The Preamble character is left alone. In addition all numeral characters (ASCII codes 30 hex through 39 hex) have the upper nibble (always a 3) discarded and two lower nibbles combined to form one byte. Finally, the carriage return, line feed sequence is replaced with a single terminating character '*' (2A hex).

It is very difficult to show what these files would look like if displayed on a computer screen since each type of computer would display these binary characters differently. Many of these binary characters would be interpreted as screen commands which might ring the bell or clear the screen. Therefore it is necessary to convert ASCII printouts to hexadecimal numbers to show the Packed BCD format.

An ASCII counter output of:

'$ 54369.127,1234,5678,0000'(plus carriage return line feed)

converted to hexadecimal numbers would be:

24 20 35 34 33 36 39 2E 31 32 37 2C 31 32 33 34
2C 35 36 37 38 2C 30 30 30 30 0D 0A

['$'= 24, ' '= 20, '.'= 2E, ','= 2C, CR/LF = 0D 0A,
'0'-'9'= 3x (where x = number 0-9)]

Using the above definition the same data in packed BCD output format would be:

24 54 36 91 27 12 34 56 78 00 00 2A
\ \ \ \ \ \ ___Terminating character ('*')
\ \ \ \ __analog channel #3 ('0000')
\ \ \ __analog channel #2 ('5678')
\ \ __analog channel #1 ('1234')
\ __Mag reading ('54369.127')
__Preamble Character ('$')

Note how easy it is to see the numbers if viewing a hex dump of the data. Remember though that it must be translated to printable characters before copying the raw data to printers or a CRT screen.

Commands that are echoed through the counter chain are received and sent as unmodified ASCII strings. Thus all commands will appear in the binary data set after the next '*' data terminating character and will be terminated itself by a carriage return line feed sequence. Binary transmission then resumes with the next sample.

Excess 3 format:

Excess three format is very similar to packed BCD. In fact the only difference is that each byte has 33 hex added to it after converting to Packed BCD. The reason for adding 33 hex to each packed BCD number is to avoid some difficult pitfalls with Packed BCD:

Packed BCD is a very common format but has many potential problems that can arise. ASCII digits are combined to form bytes with hexadecimal values in the control character range (less than 20 hex) which must be handled very carefully by the logging program. Examples of these characters include the Cntl-S and Cntl-Q software handshake controls (11 hex and 13 hex), the bell character (Cntl-G, 07 hex), and the ASCII null (Cntl-shift-@, 00H). Most terminal emulation programs can be configured to handle these characters as data instead of commands, but this is not the way the typical default configuration is set up.

Packed BCD eliminates this by shifting all numbers up by 33 hex. This moves all possible output values out of the control character range. It also makes them printable to a screen or printer without bells, beeps, screen clears, form feeds, etc. However they will still look like gibberish without translation.

Sandia/G822A format:

This is a printable ASCII format that mimics the output from a one or two channel G822A magnetometer. Its output is limited to one counter module, with the Mag and signal level values as the only data being sent out. The Mag reading is preceded with an 'A' followed by 10 characters of ASCII Mag data. The G822A format sometimes has a second Mag reading following the first which is preceded with an ASCII 'B'. If selected the CM-201 counter places the signal level in the first 4 significant characters of the second Mag data slot. The sample is terminated by a carriage return line feed sequence.

The purpose of this format is to allow customer with existing G822A Sandia logging software to be able to use the CM-201 without upgrading to new logging software.

The single channel Sandia format is selected with the command string "OS" or "OS0". The dual channel output is selected by the command string "OS1".

Example outputs:

This is the ASCII output example from earlier, but with 3 A/D channels:
- -

```
$ 99778.131,3749,0004,0005
$ 99890.376,3687,0003,0007
$ 99955.517,3545,0003,0006
$ 99998.293,3472,0005,0006
$100078.835,3329,0004,0005
$100032.071,3381,0006,0006
$ 99979.159,3498,0003,0007
$ 86778.508,3514,0004,0007
$ 78778.216,3645,0004,0004
$ 69978.347,3797,0003,0005
```

The same data displayed in hexadecimal:
- - - - - - - - - - - - - - - - - - - -

```
24 20 39 39 37 37 38 2E 31 33 31 2C 33 37 34 39
2C 30 30 30 34 2C 30 30 30 35 0D 0A 24 20 39 39
38 39 30 2E 33 37 36 2C 33 36 38 37 2C 30 30 30
33 2C 30 30 30 37 0D 0A 24 20 39 39 39 35 35 2E
35 31 37 2C 33 35 34 35 2C 30 30 30 33 2C 30 30
30 36 0D 0A 24 20 39 39 39 39 38 2E 32 39 33 2C
33 34 37 32 2C 30 30 30 35 2C 30 30 30 36 0D 0A
24 31 30 30 30 37 38 2E 38 33 35 2C 33 33 32 39
2C 30 30 30 34 2C 30 30 30 35 0D 0A 24 31 30 30
30 33 32 2E 30 37 31 2C 33 33 38 31 2C 30 30 30
36 2C 30 30 30 36 0D 0A 24 20 39 39 39 37 39 2E
31 35 39 2C 33 34 39 38 2C 30 30 30 33 2C 30 30
30 37 0D 0A 24 20 38 36 37 37 38 2E 35 30 38 2C
33 35 31 34 2C 30 30 30 34 2C 30 30 30 37 0D 0A
24 20 37 38 37 37 38 2E 32 31 36 2C 33 36 34 35
2C 30 30 30 34 2C 30 30 30 34 0D 0A 24 20 36 39
39 37 38 2E 33 34 37 2C 33 37 39 37 2C 30 30 30
33 2C 30 30 30 35 0D 0A
```

The same data in Packed BCD format:
- - - - - - - - - - - - - - - - - -

24 99 77 81 31 37 49 00 04 00 05 2A 24 99 89 03
76 36 87 00 03 00 07 2A 24 99 95 55 17 35 45 00
03 00 06 2A 24 99 99 82 93 34 72 00 05 00 06 2A
24 00 07 88 35 33 29 00 04 00 05 2A 24 00 03 20
71 33 81 00 06 00 06 2A 24 99 97 91 59 34 98 00
03 00 07 2A 24 86 77 85 08 35 14 00 04 00 07 2A
24 78 77 82 16 36 45 00 04 00 04 2A 24 69 97 83
47 37 97 00 03 00 05 2A

The same data in Excess 3 format:
- - - - - - - - - - - - - - - - -

57 CC AA B4 64 6A 7C 33 37 33 38 5D 57 CC BC 36
A9 69 BA 33 36 33 3A 5D 57 CC C8 88 4A 68 78 33
36 33 39 5D 57 CC CC B5 C6 67 A5 33 38 33 39 5A
57 33 3A BB 68 66 5C 33 37 33 38 5D 57 33 36 53
A4 66 B4 33 39 33 39 5D 57 CC CA C4 8C 67 CB 33
36 33 3A 5D 57 B9 AA B8 3B 68 47 33 37 33 3A 5A
57 AB AA B5 49 69 78 33 37 33 37 5D 57 9C CA B6
7A 6A CA 33 36 33 38 5D

The same data displayed in dual channel Sandia/G822A ascii format:
- -

A9977813100B3749000000
A9989037600B3687000000
A9995551700B3545000000
A9999829300B3472000000
A0007883500B3329000000 (Note how the most significant '1'
A0003207100B3381000000 is truncated for readings greater
A9997915900B3498000000 than 100,000 nT).11
A8677850800B3514000000
A7877821600B3645000000
A6997834700B3797000000

The same data in single channel Sandia format (ASCII):

A9977813100
A9989037600
A9995551700
A9999829300
A0007883500
A0003207100
A9997915900
A8677850800
A7877821600
A6997834700

Julian Time Set:

The Set Time commands (D,H,M,S) will initialize the time in all counter modules. If a particular counter has all Julian clock fields enabled the output string will have the following inserted after the last A/D channel and before the CR/LF:

,DxxxHxxMxxSxx_xx

The x's would be ASCII characters (0-9) as required. The time registers are not incremented until enabled with the 'J1xx' command, so they can be set up then synchronized by sending the enable command at the correct time.

In Packed BCD and excess format the letters D,H,M,S, and _ are stripped and the data encoded as per the Mag data above. The Day info is put into 2 bytes with the most significant nibble of the most significant byte set to zero.

Julian Time Enable:

This command starts/stops the Julian clock. To start the clock on counter 0 the command would be "J100". "1" turns on the clock, while the "00" selects counter 0. To turn off the clock update on counter 2 the command would be "J002".

If the counter number information is omitted the command will affect all counter in the chain. Thus the command "J0" will turn off the update for every counter.

Note that the "Jxxx" command only affect whether the clock increments with time. It has no effect on whether or which clock fields are output. The "OJxxxxxyy" commands selects which field are output.

Julian Output format:

There are five clock output fields that can be turned on or off. These are the Julian Day, Hour, Minutes, Seconds, and Fractional seconds (to .01 seconds). These are selected with the "OJxxxxxyy" command. Each of the five x's corresponds to an output field, and can either be a '0' or a '1'. '1' turns the field on, '0' turns the field off. The yy characters is the counter number. Following is a diagram showing which character corresponds which each display field:

command: "OJ0111103"

```
                \ \ \ \ \ \__Counter number LSB
                 \ \ \ \ \__Counter number MSB
                  \ \ \ \__10 ms field
                   \ \ \__Seconds field
                    \ \__Minutes field
                     \__Hours field
                      \__Days field
```

In this example counter three would have all clock fields output except the Julian Day.

The counter number characters are optional. If not present the command would affect only counter 0 in the chain.

Find Counters:

This command is used to figure out how many counters there are in the daisy chain. An 'F00' is sent to the first counter which assigns it as counter 0. Before the command is echoed to the next counter the command is modified to 'F01'. The next counter modifies it to 'F02', and so on until the logging PC gets the command echo of 'Fxx' where xx is the number of counters in the chain.

Continuous data output can be inhibited by sending the command 'F01' to the first counter. In this mode there is no first counter (#00) which normally starts data transmission. Data output can be resumed by sending a new 'F00' command.

Set Preamble character:

By default the first character of each data stream is a '$'. If another character is desired the 'Px' command is used to change it to the character sent following the 'P'. All characters are allowed except control characters, digits (0-9), spaces, commas, decimal points, and the termination char ('*').

Echo Error command:

This is not really a command but a message. If a command string is incorrectly sent or garbled the counter receiving it will change it to 'ERRxx' before echoing it to the next counter. 'xx' specifies the counter number where the syntax error first

occurred. This error message is interpreted as a command by subsequent counters which echoes the string unchanged.

Interrogate Setup command:

This command allows the operator or logging software to identify which analog channels and Julian clock fields are being output via the serial port. This information is used to verify output fields with their hardware channels, and to allow automated calculation of data field position within each sample being sent out. In addition the software revision number can be interrogated.

The first character 'I' designates the interrogate command, the second letter designates which item to interrogate. 'A' specifies interrogating the analog channels, 'J' specifies the Julian clock, and 'V' specifies the software revision number.

The next two characters specify the counter number '00' through '19'. If the counter number is omitted, counter 0 will respond.

The addressed counter will insert a response into the command string before sending echoing it out the serial port to the display terminal or subsequent counter modules. Subsequent counter modules will ignore these extra response characters and pass them unmodified down the chain. The response format for each of the three interrogate items are detailed in the examples below:

Analog channels:

The command "IA01" will command counter number one to output characters indicating which of the six analog channels have been selected for output. Counter 1 will modify the command string to "IA01:abcdef" where the letters a-f are either an ASCII '0' (channel off) or '1' (channel on) corresponding to channels 0-5 respectively. If analog channel 0,3, and 4 were selected on counter 1 the echoed command string would be "AI01:100110" followed with a carriage return line feed.

Julian Clock:

The command "IJ" will command counter 0 to output which Julian clock fields have been selected for output (note that the two digit counter number was not specified, so counter 0 responds by default). Counter 0 will modify the command string to "IJ:abcde" where the letters a-e would be replaced with an ASCII '0' (field off) or '1' (field on). The five output fields are:

a: Julian day
b: Hour
c: Minute
d: Second
e: Fractional Seconds (to 10 milliseconds)

If counter 0 had all clock fields selected for output except the Julian Day it would modify the command string to "IJ:01111" followed with a carriage return line feed.

Software Version Number:

The command "IV02" will command counter 2 to send its two character software version number. Counter 2 would change the command string to "IV02:xx" where xx is the version number of the software. If Counter 2 was software version "A4" then the echoed command string would be "IV02:A4" followed by a carriage return line feed.

Reset command:

If the command 'RESET' is sent to the counter a power up reset will occur initializing all parameters to default. The reset sequence will not start until the reset command has finished echoing out the RS232 port to the next counter/logging device. This allows each device down the chain to reset in sequence.

Jump to debug:

If the command string 'XBUG' is received the counter will do a one way jump to factory debug mode where a rudimentary operating system allows probing of registers, ports and memory for debugging purposes. It will only function properly with a single counter module (no daisy chained counters).

2.4.4 Powerup Initialization:

By default all counters will wake up thinking that they are counter #0 and begin to output data at the default 10 hertz rate. This data will appear as commands to any subsequent counters and will cause a brief period of chaos until each counter figures out where they stand in the daisy chain. Thus there will be some garbled transmissions to the logging PC upon power-up or reset.

2.5 Accessory Software

If you have MagSea version 3.03 or later you may ignore all of section 2.5.1 below. If you upgraded to 3.03 or later from an erlier version and your counter setup is different than as 3.03 sets it, run **magsea-i** to start MagSea and retain your original counter setup.

2.5.1 Cm201

Cm201 is a program that facilitates sending a command start-up file to the G-880 counter(s) and initiating system operation. The program is executed by typing “cm201” at the DOS prompt and pressing return. Cm201 expects a counter command file that must be called Cm201go.cnf. This file is a list of counter commands, each followed by a carriage return that may be required to configure the counter to your application.

This software and all its necessary files may be installed on your system by placing the Install disk in either your a: or b: floppy drive, switching to that drive, typing “install” at the DOS prompt and pressing return. Install will ask a number of questions to which you should respond to configure the CM-201 counter to your system and create the Cm201go.cnf file.

If, after installing Cm201, if further commands are required (such as CLOCK) to configure CM-201 operation to your application, they may be added to the Cm201go.cnf file by editing this file with any suitable text editor.

The following describes Cm201 and the files that will be installed on your C: drive:

Install.bat

This is a batch file used to copy the contents of the floppy onto your hard disk. A directory called "GeoUtil" is created on the "C" drive, then all of the files are copied into that directory. After the files are copied, this batch file then runs Cm201set.bat

Cm201Set.bat

This batch asks the user questions and based on the answers to these questions creates a batch file called "Cm201.bat". The questions include such things as, to which COM port the CM-201 counter is connected.

Cm201.bat

This batch file is created by Cm201set.bat. It invokes Cm201go.exe to send any command lines necessary to correctly configure the CM-201 counter(s) for the users application.

Cm201go.exe

This program is intended to send any commands to correctly configure the CM-201 counter module(s). Normally the commands are taken from the file Cm201go.cnf, but this can be overridden if needed.

The calling syntax for this program is:

Cm201go FileName.cnf /b:BBBBB /p:P /i:I /d:D

Where:

BBBBB	Is the baud rate that the CM-201 starts at. Normally this is 9600.
P	The port number /p:1 would mean use COM1. This parameter is optional. If it not specified COM1 will be used.
I	The interrupt number to use. This parameter is optional. If it is not specified the normal interrupt for the COM port is used.
D	Any value other than zero will turn on the debugging display. This parameter is optional. If it is omitted the debugging display is disabled.

The contents of the Cm201go.cnf file are sent line by line to the CM-201 counter module(s). After each line is sent the CM201go program waits for the confirmation that the command was received correctly. If the confirmation is not received the line is repeated. For lines that change the CM-201's baud rate the Cm201go program changes its baud rate as required. If the input line has the special code "[CLOCK]" on it, the CM-201's clock will be set to match that of the PC.

A typical Cm201go.cnf would be:

```
[CLOCK]
c0010
oj11111
```

Commflip.exe

Given the port numbers of two COM ports this program will exchange their addresses. On some note book computers this is needed to be able to use some software.

batmenu.exe, drawbox.exe, gotoxy.exe, yymmdd.exe, foreach.exe, getkey.com

These programs are utility programs that allow the batch files to interact with the user.

2.5.2 Cesium Sensor Azimuth Program - CsAz

CsAz is a program written by Geometrics for users of Cesium magnetometers. The purpose of the program is to determine the proper orientation of the Cesium sensor at various earth's field dip angles. Az stands for azimuth.

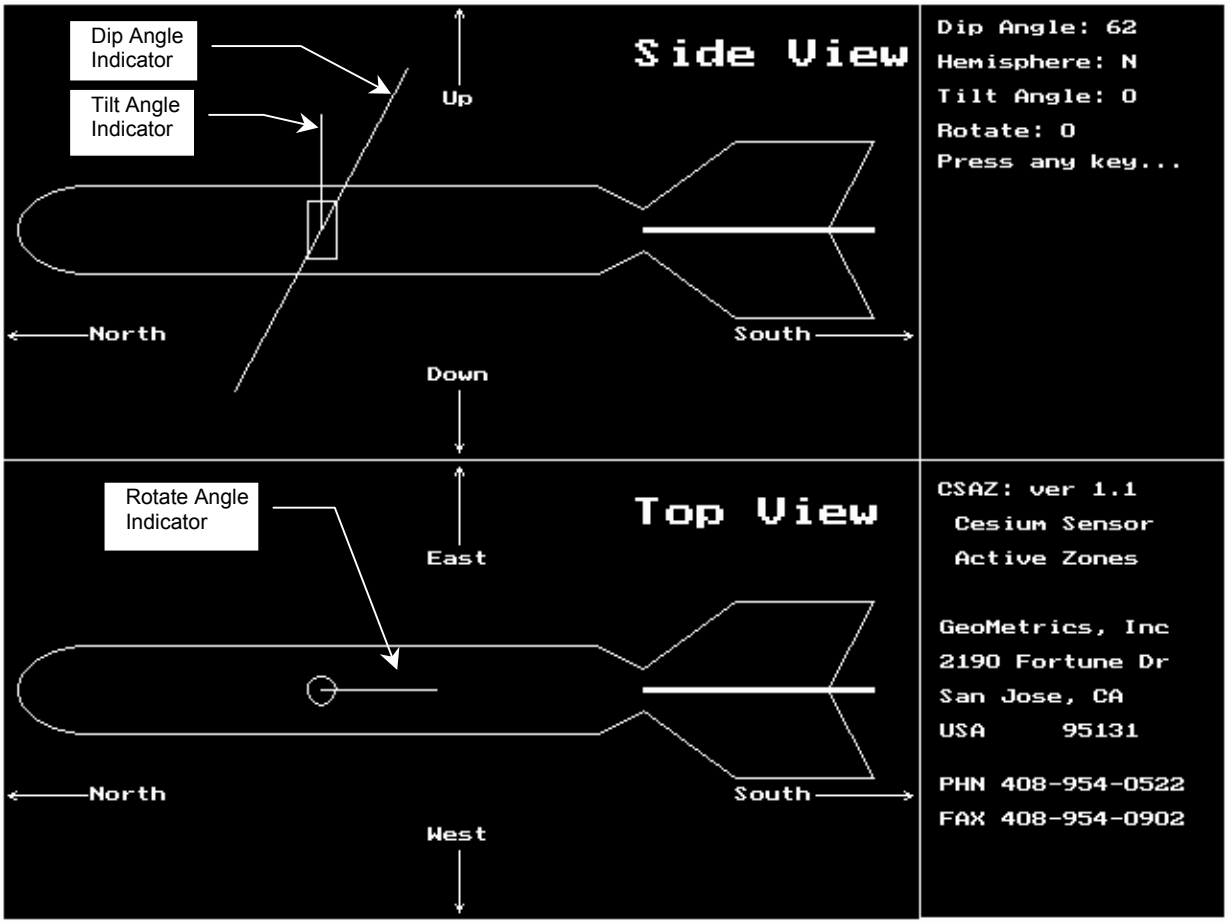
The program is easy to operate. Begin by typing CsAz at the DOS prompt. You will see a towed bird with the sensor mounted vertically. A lower graphic image displays the bird from a vertical perspective. If you are using the program for land or marine applications, the orientation of the bird can be taken to be the orientation of the fish.

> **Note:** It would be benificial to understanding to have CsAz running on a computer while studing the following material.

The first piece of information required is the earth's field angle of inclination (referred to as dip angle from hereon) in your survey area. Refer to the Inclination Map in the back of this manual. For instance, the dip angle in San Francisco is 62° North, Chicago is 72° North, Sao Paolo is 30° South and Singapore is 18° South.

Next enter a N or S for the hemisphere (no enter key required here). Choose 62° (San Francisco) and N for the northern hemisphere. See Fig. 3.

The first time, we recommend that you just press enter twice or enter a zero twice for no tilt and no rotation. In the G-880, as depicted, this is equivalent to a sensor position that is vertical with respect to the earth’s surface and perpendicular to the direction of tow. After a few moments you will hear a beep when the computations are completed. Press any key to see the graphical display of the signal to noise ratio of the sensor in that orientation at that dip angle.

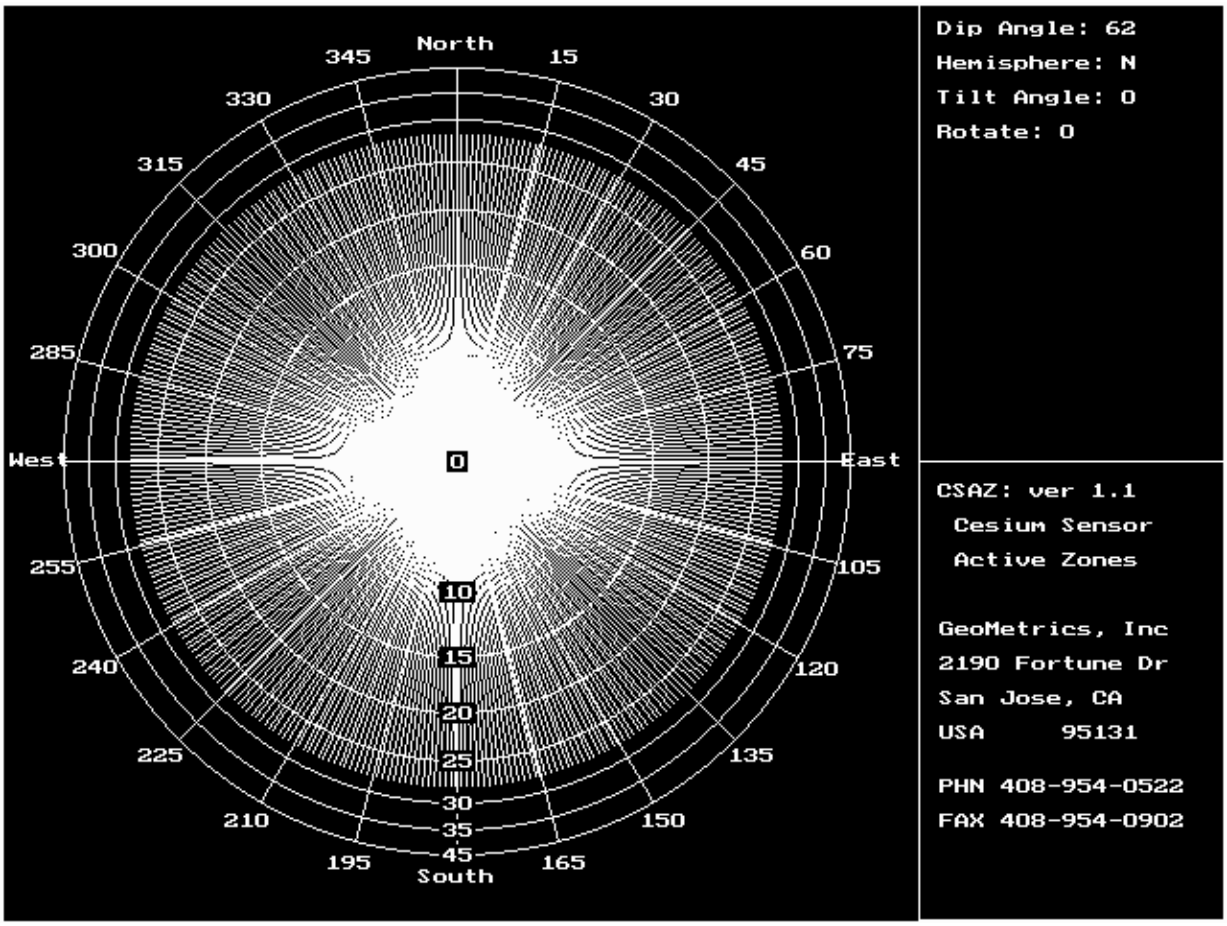


Position of the sensor at the specified Tilt and Rotate angels with respect to the fish and Dip Angle is depicted in a Top and Side View. Sensor position depicted is as shipped.

Fig. 3

The circumference of the graphic represents the compass directions in degrees i.e. the survey direction. The white portion of the graphic emanating from the center is the proportional signal-to-noise ratio that would be obtained if the survey were run in that direction. The black regions, when present, represent survey directions (approximately a 30° wide) in which the earth's magnetic field vector would be in the dead zone of the sensor. The region of the display that is white and outside of the 15° circle represents survey directions in which the earth's magnetic field vector would be in the sensor's active zone and provide good data. The longer the white line, the higher the signal amplitude of the Magnetometer in that direction. See Fig. 4.

The magnetometer will still provide high quality data even when the sensor is not in the optimum orientation. However, the further the sensor is operated from optimal orientation, the more likely small changes in yaw, pitch or roll may result in spikes or miscounts. Note also that if speed is less than 3 Knots, the tail of the fish may sag below the horizontal and produce the same type of erratic data.



Surveying in any direction (in an area with a dip angle of 62°) will produce good data.

Fig. 4

If the white line terminates inside the 10° circle, then you will get no signal traveling in that direction. If it terminates just outside the 10° circle, then the installation will tolerate very little in the way of yaw, pitch or roll (depending on orientation, but most likely yaw) of the sensor before the earth's field vector goes into the sensor dead zone. The sensor position should be adjusted so that at least ±5° of signal (sensor motion) is available and preferably even more.

As can be seen in Fig. 4 above, the position of the sensor is most optimal for the given dip angle. It provides equal performance of the sensor at any set of orthogonal angles that may be selected for survey, typically North-South survey lines and East-West tie lines. This facilitates a normal survey technique primary, parallel survey lines and orthogonal, parallel tie lines. That is, the sensor's position in the towfish does not require modification between orthogonal sets of survey lines.

Next, press escape and re-enter the dip angle and hemisphere information as above. Now you can tilt and rotate the sensor to see the effect on the signal versus survey direction. Select a Tilt of 45° and a rotation of 90°.11You will observe that the sensor response is not symmetrical about any two orthogonal

axis that might be selected for a survey. While it might work for this dip angle of 62°, it is less than optimal. As the dip angle becomes more shallow, say 50°, lack of symmetry becomes more severe and this particular sensor position becomes unusable.

Try a dip angle of 70° (Indiana) with a tilt of 45° and a rotation of 90°. In some areas, maximum signal cannot be achieved in all survey directions, but any signal-to-noise lines extending out to 20 and beyond will produce excellent data in those survey directions even in turbulent conditions. As the dip angle becomes more steep, this sensor position becomes more optimal until at 90° the sensor's response is perfectly symmetrical.

Now, try a dip angle of 0°, either N or S hemisphere, with a tilt of 90°.11Try rotating 45°.11Even in a horizontal field, one can survey in both north-south and east-west directions. Geometrics sensors are fully automatic hemispheric switching allowing this versatility. See the Figures below:

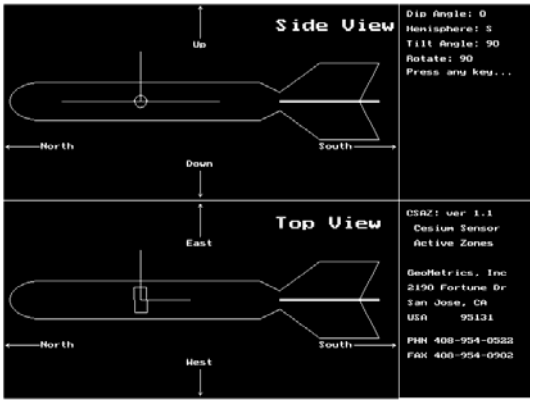


Fig. 5

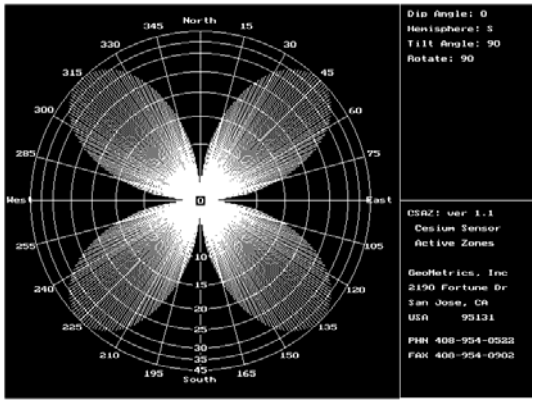


Fig. 6

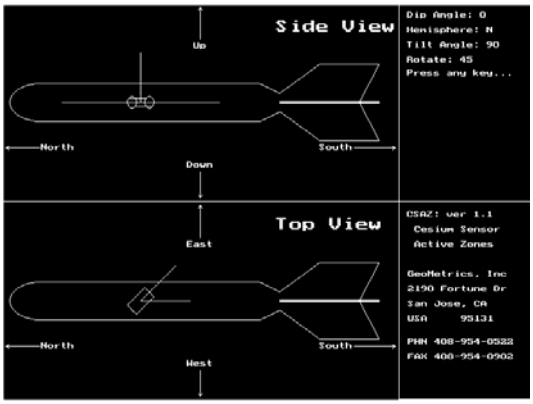


Fig. 7

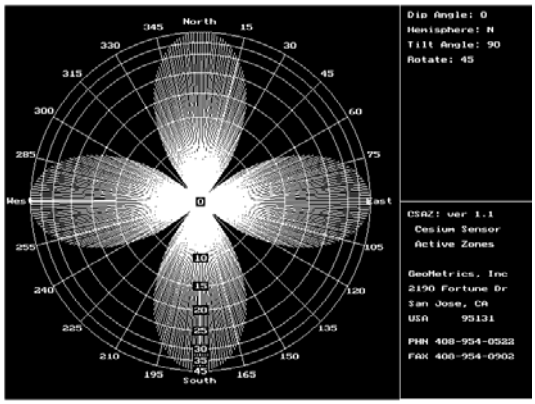


Fig. 8

In the G-880, to get the sensor in the position shown in Fig. 5, the magnetometer fish is rotated 90° by rotating the Ring Fin 90° from the as shipped configuration as described in Section 2.3.

In the G-880, to get the sensor in the position shown in Fig. 7, the sensor is tilted aft 45° and rotated by rotating the Ring Fin 90° (this shifts the ballast weight by 90°) from the as shipped configuration as described in Section 2.3.

With each entry of an angle of tilt and angle of rotation the sensor is depicted in the bird (fish) in the position that would be obtained if the sensor is first tilted aft from the depicted vertical axis by the specified angle and then rotated by the specified angle about the depicted vertical axis to its final position. Note the position of the sensor depicted in CsAz and make the appropriate mechanical adjustments to put the sensor in the position depicted by CsAz. I the case of the G-880 the two adjustments that are possible are as follows:

1. Adjusting the position of the sensor to any angle from perpendicular-to to collinear-with the longitudinal axis of the magnetometer fish. This adjustment corresponds exactly with the Tilt Angle of CsAz.

2. Rolling the magnetometer fish about its longitudinal axis by rotating the Ring Fin (hence the ballast weight with respect to the sensor) by 0°, 45° or 90°. Simulating this adjustment in CsAz will require a combination of Tilt Angle and Rotation. To roll the magnetometer fish 45°, in CsAz use Tilt Angle=45° and Rotation=90°. To roll the magnetometer fish 90°, in CsAz use Tilt Angle=90° and Rotation=90°.

Note: The G-880 is shipped with the sensor and ballast weight mounted such that the magnetometer fish would tow with the sensor in a position vertical to the earth's surface as initially depicted by CsAz. We have found that tilt and roll angles of 0°, 45° and 90° cover all realistic installations and dip angles.

Note: While different amounts of ballast weights may be used, it is important to remember that some amount of weight must always be installed, otherwise the system may not function. Geometrics recommends that the minimum amount required is "as shipped".

After familiarization with CsAz it will be evident that certain dip angles are more criticle and require greater attention for best system operation, e.g., 5° to 20°, 65° to 75°.

If you press F1 the program will identify your first available printer port and print out a laser printer compatible graphic of the screen. F2 is for Epson compatible printers. If you have both LPT1 and LPT2 operational and you want to go to LPT2, then add the following to the command line:

c:\csaz.exe /L=2 or /L=3 for LPT3

2.5.3 View201

View201 is a program that enables programming and viewing the magnetometer and analog data from one to three CM201 counter modules. It was written primarily as a factory debug/test utility and is provided as a tool to help installation and testing of the counter(s) in the field. The output can be viewed in both raw text and in graphics mode. In addition the output data can be logged to disk if desired. The program defaults to using Com port #1,although Com port #2 can be used be adding " /COM2" to the command line after "View201".

Upon startup the program listens to the output data stream from the counter(s) and synchronizes to the output baud rate. The raw output data is then displayed in a data text window. Along the top is a status bar showing the condition of the serial port and the serial input buffer.

View201 defaults to using COM port #1. COM port #2 can be selected by typing "View201 /COM2" and <ENTER> at the DOS prompt.

After the magnetometer has warmed up the first comma delimited field should be showing a stable magnetometer reading. The default counter output format includes the 4 character signal level in the next field (9999 full scale). Other data may be present as well depending on output configuration. If more than one magnetometer is daisy chained together there will be other magnetometer data field embedded in the output stream.

Commands can be sent to the counter module(s) at anytime. There are many commands that control the CM-201 which are detailed in the magnetometer manual. As an example, the command "A0000" followed by a carriage return turns off analog channel 0 (signal level) in counter 00: Each character is sent as it is typed and stored by the counter. When a carriage return is received by the counter the command is executed and then echoed down the daisy chain of counters until it is received back by the View201 program and displayed in the data window. A correctly echoed command string is a confirmation that the command was received and executed properly. Miss-typed or invalid commands will be turned into an error message and echoed through to the View201 display window. (Type A1000<return> to turn the signal level channel back on).

The magnetometer data can be viewed in graphics mode by pressing the <F5> function key. View201 defaults into displaying the magnetometer data from counter #0 at 10 nT full scale. Data from the second and third magnetometer can be displayed by pressing <F2> and <F3> respectively. If magnetometer 2 or 3 are not present the data fields are set to zero.

Data can be logged to disk at any time by pressing <F10>. A filename is created based on date and time and logged to disk. A logging message is displayed and a low frequency beeper plays to indicate that logging is taking place. Pressing <F10> again stops the logging process.

Currently, View201 only recognizes the ASCII output format. This is the default output format, but there is nothing preventing a change format command from being sent to the counter module. If the output format is changed the View201 program will cease to function correctly.

A list of function keys and their use can be viewed at anytime by typing a question mark (?).

Following is a description of each View201 function key. These are all functions that control the operation of the View201 program and should not be confused with commands that affect the counter module:

2.5.3.1 Function Keys

<F1> = Toggle graphics display of Mag1 on/off. Default setting is on. This key has effect in graphics mode only.

<F2> = Toggle graphics display of Mag2 on/off. Default setting is off. If turned on and no magnetometer#2 is present the magnetometer 2 data value is forced to zero. This key has effect in graphics mode only.

<F3> = Toggle graphics display of Mag3 on/off. Default setting is off. If turned on and no magnetometer#3 is present the Mag3 data value is forced to zero. This key has effect in graphics mode only.

<Alt F1> = Toggle graphics display of Grad1 on/off. Gradient channel 1 is the difference between Mag1 and Mag2. This key has effect in graphics mode only.

<Alt F2> = Same as <Alt F1> except it applies to Grad2 channel.

<Alt F3> = Same as <Alt F1> except it applies to Grad3 channel.

<Shft F1>= Change graphics display color for Mag1. Press this key several times to cycle through the 16 colors available for displaying mag1. Note that the display indicator for Mag 1 in the lower left hand corner of the graphics display changes as well, aiding in identifying which trace belongs to which variable. This key only has effect in graphics mode.

<Shft F2>= Same as <Shft F1> except it applies to Mag2 channel.

<ShftF3> = Same as <Shft F1> except it applies to Mag3 channel.

<Ctl F1> = Change graphics display color for Grad1 trace. Press this key several times to cycle through the16 colors available for displaying Grad1. Note that the display indicator for Grad1 in the lower right

hand corner of the graphics display changes as well, aiding in identifying which trace belongs to which variable. This key only has effect in graphics mode.

<Ctl F2> = Same as <Ctl F1> except it applies to Grad2 channel.

<Ctl F3> = Same as <Ctl F1> except it applies to Grad3 channel.

<F4> = Toggle between true and normalized gradient display. When measuring gradients it often desirable to center the display trace to the center of the screen so that small variations do not cause screen wrapping. Pressing F4 will calculate and add an offset value to force the gradient display traces to the center. Pressing F4 again will toggle back to absolute display mode. Note that the Grad display indicators in the lower right hand corner of the graphics display screen change from "Gradx" to " "GradZx" indicating the current mode. Note that this normalizing only takes place on gradient channels.

<Alt F4> = Toggle true and normalized w. offset grad display. When measuring gradients with all three gradient channels turned on it is often desirable to move the three gradient traces close to the center of the display - but not place them right on top of each other. This key works the same as F4 above but leaves the traces slightly offset from one another.

<F5> = Toggle between graphics and text display mode.

<F6> = Lower the magnetometer full scale coefficient in the graphics display window. This key only affects the Mag channels (not gradient).

<F7> = Raise the magnetometer full scale coefficient in the graphics display window. This key only affects the Mag channels (not gradient).

<Alt F6> = Lower the Grad full scale coefficient in the graphics display window. This key only affects the Grad channels (not magnetometer).

<Alt F7> = Raise the Grad full scale coefficient in the graphics display window.11 This key only affects the Grad channels (not magnetometer).

<F8> = Clear next graphics screen and jump to it.

<F9> = Clear Break, Frame, and Parity errors in the Com port status bar (text display screen only).

<ALT F9>= Auto adjust to incoming baud rate and clear errors.

<F10> = Toggle logging to disk.

<Esc> = Exit to text mode (if in graphics display mode). Exit to DOS (if text mode and not logging to disk).

2.5.3.2 Displaying Analog Channels

When in graphics display mode [F5] up to six analog channels may be enabled by typing <CTRL A>. This will activate a series of questions to format the analog data for display:

Display Channel Number [0-5]:

Selects one of six display channels. Any channel can be selected. The default number is the first unused display channel. If a channel currently in use is selected all subsequent menu items will have their default values set to the current values. This makes it easy to modify the format of a channel currently being plotted by simply pressing <enter> until the parameter to modify is reached.

Display channel ON/OFF [0/1]:

Type '0' to turn a channel off. No further menu parameters will follow and the channel will stop plotting. Type '1' to turn the display channel on or just <ENTER>, which defaults to on.

Counter Number [0-2]:

Selects which counter the analog data will come from. Up to three daisy chained counters may be logged by this program. The default is always counter 0 (the first [or only] counter).

Analog Channel Number [0-5]:

Selects which A/D channel of the above counter is to be displayed.

Note:

1) Do not confuse "analog channel number" with "display channel number" above. They are not related in any way. Think of the display channels as 6 separate input channels to a 6 channel analog strip chart recorder. The counter channel numbers (along with counter number information) specify a particular analog information channel. With three counters there could be 18 separate information channels - anyone of which could be configured to any display channel. In fact one analog channel could be assigned to two display channels with differing full scale coefficients - allowing a course and fine graphics display of the same channel.

2) This program does not know which analog channels are actually coming out of the counter. It is possible, for example, for the counter to be commanded to output channels 0, 4, and 5 only. This program sees only three analog channels in the counter's data stream and will refer to them as channels 0,1, and 2.

Unipolar/Bipolar [U/B]:

As described in the magnetometer/counter manual there are 4 unipolar (including the signal level) [0 to +4.096 volts], and 2 bipolar channels [ñ 2.048 volts]. This parameter is used to signify which type of analog channel this is.

Clip/Wrap [C/W]:

This parameter specifies what to do when the analog data exceeds the full scale setting (see next paragraph). Clip mode causes the data to be clipped at full scale so that the channel traces the top of the display screen (or possibly the bottom of screen in bipolar mode). Wrap allows the trace to overscale and wrap back around to the bottom or top of the screen.

Full Scale Set:

Set the full scale value of the display using the "+" and "-" keys. Note that a value of 10000 nT FS display as "0000" full scale. All other values display correctly in the allocated 4 digits.

Label:

This allows a 10 character label to be associated with the analog channel. These labels make it easy to identify what each trace is at a glance by looking at the label (which is printed at the top of the screen) and correlating the label's color to the matching display trace color. To erase the default label of "channel n" use the backspace key, then enter a new one.

Set trace color:

Use the "+" and '-' keys to cycle through all the possible trace colors using the label name entered above as a guide.

After the above data have been entered, the display channel will be plotting. At the top of the screen all of the activated display channels are documented in the same color as their associated trace color as in the following example:

Pitch
A13±1000C

The display channel in this case was labeled "Pitch". Underneath it is a shorthand display of all the setup parameters:

"A" : signifies this is an analog channel.
"1" : the counter number [0-2]
"3" : the counter channel number [0-5]
"±" : Bipolar mode, would have been set to "-" for unipolar
"1000" : Full scale value. If "0000" is displayed it mean "10000" full scale.
"C" : Clipped display, would be a "W" for wrap mode.

At the right edge of the screen are two normalized scales for the analog data. One scale is for unipolar analog channels [0-100%],and the other is for bipolar channels [± 50%].

2.5.4 DepthCal

This program is intended for use only if you purchased MAGSEA logging software and allows calibration of the depth sensor. If you are using some other logging software it might provide some useful information; however, Geometrics does not warrant this use for any logging software other than MAGSEA.

The Depthcal.exe program provides BIAS and SCALE values for entry in to the MAGSEA logging software to calibrate the depth sensor. This program was installed in C:\GEOUTIL on your hard drive when you installed the ACCESSORY software.

DepthCal is an independent program that will lead you through an experiment with your G-880 to derive the BIAS and SCALE values. To execute, at the DOS prompt in C:\GEOUTIL, type DEPTHCAL and press the Enter key. The questions that you answer will guide you through a simple experiment and then calculate the BIAS and SCALE values.

MagSea Bias and Scale Factors Explanation and Calculation:

Both the depth transducers and altimeters provide full scale readings of '9999' regardless of whatever there range may be. For a 30 meter Altimeter 9999=30m, a 100 meter, 9999=100m. Further, for Altimeters 9999 is displayed for "no echo".

The DepthCal program may be used to calculate the bias and scale factors for both the depth transducer and altimeter as explained below.

The DepthCal program assumes that MagSea has initial settings of zero bias with a scale factor of 1.000. What this means is that MagSea will output zero meters when the serial data stream has "0000" in the appropriate analog channel and 128 meters when it has '0128', 5000 meters when '5000' and 9999 meters when '9999' (full scale).

The depth and altitude channels do not put out exactly zero volts at zero depth or zero altitude. Nor does a change of one digit '0001' equal one meter. And it varies from unit to unit due to differing sensor full scale values that may have been installed per the customer's system requirements. To correct for this, MagSea allows the user to input a bias (offset) value and a scale factor to transform the incoming device data such that MagSea displays readings that correspond to the device's actual reading. DepthCal can be used to avoid having to do the math required to obtain the bias and scale factors as shown in the example below.

NOTE: The depth transducer uses a strain gauge mechanism to measure the depth. Strain gauges as a rule are also greatly affected by temperature changes. The depth sensor used in the G-880 has been specially designed to compensate for temperature variations using calibration curves stored in a lookup table which is custom set for each device. None the less it is not perfect. For the best possible depth accuracy the MagSea depth bias and scale factors should be set at sea water operating temperatures. A magnetometer on the deck can get very warm from the sun and internal dissipation in contrast to the much cooler ocean even though both are technically at zero depth. The depth sensor is also mounted to a thermally massive aluminum pressure vessel which takes a while to stabilize at the local ambient temperature. Keeping these points in mind please observe the following:

Submerge the magnetometer before performing any of these procedures and wait 15 minutes for the magnetometer to warm up and allow the sensors to normalize to the water temperature.

Lets do an example with a typical depth sensor.

1) First, in MagSea, set the bias and scale factors to their starting points. This can be found in Setup Menu, Device, Magnetometer, G880 menus. Adjust Depth Bias to 0.000 and Depth Scale Factor to 1.000. Accept these parameters back out to main screen and then start the program.

2) Adjust Units to meters in the Shift-F2 screen (if not in meters already).

3) While logging data tie off the magnetometer at the surface (zero depth) and write down the value that MagSea reports for Depth in Mag Screen Window (Cntl-F3 if not there already). Depth is in the lower left hand sub-window. You need not be logging to disk - you can pause and unpause disk logging with the F9 key. Lets say it reads 112 meters.

4) Lower the sensor down to a known depth (lets say 9 meters). Now, write down the values. You can watch the raw data coming in from the magnetometer with the Cntl-F4 window. At this point, a one digit LSB change results in a 1 meter change in the depth value reported my MagSea. Lets say the depth reads 917.0 meters.

5) Now run the Depth Cal program and enter the values written down above for the surface and at some known depth. DepthCal will return Bias and Scale Factors.

6) (I got Bias = -1.2522, Scale = 0.0112). Write these values down for use when setting up the MagSea logging software. See Setup in section 12 of the MagSea manual. Restart MagSea and inside the setup section enter the bias and scale factors output from the DepthCal program. Accept the parameters back out to main screen and start the program. Depth will now be working correctly. See example below:

```
Depth calibration calculator    Version 1.1

Note:
     All depth values are assumed to be in meters.

With the sensor on the deck:
    What did MagSea indicate for the depth? 112

With the sensor at the surface:
    What depth did you place the sensor at ? 9
    What did MagSea indicate for the depth ? 917

Enter a BIAS value of  : -1.2522
Enter a SCALE value of : 0.0112
```

NOTE: Some older versions of the DepthCal program instruct you to measure the “Zero Depth” value on the deck of the boat. Instead tie off the G-880 over the side at the surface but still submerged to do this measurement. See the discussion about temperature affects of the depth sensor in the paragraphs above.

Here is what the DepthCal numbers mean:

We entered a depth change of 9 meters and got a change of 805 meters in MagSea (917 at depth minus the 112 at surface). To get MagSea to correctly display a change in depth for a given depth change we have to multiply the incoming data by (9/906) which equals 0.0112. This is the scale factor calculated by DepthCal above.

We read 112 meters out of MagSea when the magnetometer was at the surface. Its not really 112 meters though. Using the scale factor correction above we get an actual error of 1.2522 meters (0.0112 * 112). Thus to make it read right we have to add a bias of –1.2522 meters which is the bias value calculated by DepthCal.

Miscellaneous:

Note that once these values are entered into MagSea you will not have to enter them again. MagSea remembers what was entered and scales automatically each time the program is started. Of course, if a different instrument is connected at some later time. MagSea will require new values corresponding to the new instrument.

Altimeter Calibration:

Setting up altitude works a little differently. Ideally we would like to get the sensor on the bottom for zero altitude but this is too close to receive an echo. The resolution of the altimeter is such that the zero need not be adjusted

however. Instead raise the magnetometer to a known height off the bottom and record what MagSea reads for altitude. The sensor will have to oriented such that the altimeter is pointing straight down in order to get a clean reflection. Run DepthCal and enter zero for the on deck reading, and then the known height reading of the altimeter. Then enter the reading indicated by MagSea for this known height. All else should be the same except enter the values returned by DepthCal into the altimeter section of MagSea.

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3.0 Service Information

3.1 G-880 Sensor Fish Disassembly Instructions

3.1.1 Sensor Fish Disassembly

The G-880 sensor fish can be completely disassembled using a flat-blade and a medium Phillips-head screwdriver. If possible, new, clean screwdrivers should be used and kept for only this purpose. The disassembly steps follow:

1. Remove the front end (nose cone) and tow cable to gain access to the connector on the sensor driver assembly. There are eight screws holding the nose cone in place.

2. Next, locate the four screws holding the sensor driver in place. Two of the screws are in a line with the bottom drain hole just aft of the front end. The other two are in a line along one side 90° from the first screws. With these screws removed, the sensor driver electronics can be slid out of the fish body. The cable pigtail from the nose cone can now be unplugged. First, unscrew the locking sleeve then pull the plug straight away from the bulkhead connector. Be careful with the cable between the driver assembly and the sensor. If the driver housing has to be opened, please refer to Section II for this procedure. Otherwise, take the mounting rings off of the driver housing. There is a clamping screw in each ring, which just has to be loosened so the mounting rings will come off.

3. To remove the entire sensor and sensor electronics package from the fish, proceed with this step. The speed ring-tail must be removed along with the tube coupler and the sensor fairing. First, remove the six screws holding the fairing to the fish tube. Then locate the eight screws forward of the split line between the tail and the main tube. With these removed, the tail and the tube coupler can be taken off as a unit.

4. The sensor and mount can now be removed. Locate the four Phillips head screws on either side of the tube at the sensor swivel point. Remove these, then the 1/4-20 slotted screws centered in the access holes on either side of the main tube. The sensor can now be rotated over so the entire assembly can be slid out the aft end of the main tube. Take care so the sensor cable is not pinched at any point during this removal step. The electronics package will come out with the sensor. Tilting up on the forward end of the main tube will make removal a bit easier. The sensor mount can be removed from the sensor by loosening one of the clamping screws. Now slide the mount off of the sensor.

> NOTICE--The sensor must be kept clean and away from any magnets or magnetic materials! Wrap it in a clean plastic bag, if possible.

To re-assemble the fish, follow the above steps in reverse.

3.1.2 Sensor Electronics Package

To open the sensor electronics, please follow these steps:

1. Before attempting to open the sensor electronics, particularly if it has been just recently removed from sea water, warm the electronics to at least the ambient air temperature. Slightly warmer would be better. This will, one ease the removal of the end caps and two prevent residual water around the end caps from being sucked into the electronics.

2. The end caps of the sensor electronics are not held in place with screws. The holding devices are thin plastic rods threaded around each end through access slots. These are just inside the ends of the pressure housing. To remove the rods, grasp either end with a needle-nose pliers (the pliers should have gripping teeth) and pull the rod out of the slot. The end cap with the connector must be removed first. It may be difficult to remove, because of the very tight o-ring seal.

> **NOTE**--Do not twist the end cap, as this will damage the cables and pressure sensor (if installed)!

Pull the cap straight away from the tube and then unplug the cable inside cap where it attaches to the wiring harness. Be careful, as there may be a depth sensor installed on this end cap. This unit has a small p.c. board wired to it. These are fairly fine wires and can be torn off easily.

3. The plastic rod on the other end can now be pulled out. Now pull off the pressure housing. Be very careful at this point, since all of the electronics are now exposed.

To reassemble the sensor electronics, follow the above steps in reverse.

> **NOTICE**--It is not recommended that the sensor be opened in the field, except by GEOMETRICS authorized personnel. The sensor assembly is a delicate optical assembly and there are no connectors to enable the physics package to be removed. It is not possible to repair the sensor in the field. If repairs are necessary, the entire assembly of sensor and electronics must be returned to the factory.

Do not twist the end caps of the sensor pressure housing assembly! To do so will severely damage the physics package.

3.1.3 G-880 Tow Cable Field Termination Instructions

The following tools will be required to terminate the G-880 tow cable:

1. A good heavy-duty bench vise with jaw padding.
2. A soldering iron of at least 50 watt capacity.

3. Rosin core solder. Either 60/40 or 63/37 alloy.
4. A hammer.
5. A sharp knife.
6. Wire cutters.
7. Hacksaw.
8. Medium straight slot screwdriver.
9. Medium Phillips screwdriver.
10. Two large straight slot screwdrivers
11. Plastic electrical tape.
12. A multimeter with both high and low resistance ranges. A megger would also be useful.
13. Alcohol. Denatured, methanol, or isopropyl alcohol for cleaning and preparing surfaces for potting. This must be obtained locally, as it can not be shipped as part of this termination kit.

Note: Do not smoke while using the epoxy or cleaning up with alcohol.

Note: If the tow cable jacket is torn and water has gotten into the strength member, the cable should be dried for as long as possible. This will reduce the likelihood of epoxy bonding problems during potting.

Assembly steps:

1. Start by removing the bulkhead from the magnetometer housing. Remove the eight brass screws from the bulkhead. Now, carefully unscrew the locking sleeve from the cable attached to the sensor driver pressure housing assembly. Next, unplug the connector from the driver end cap. The cable assembly can now be moved to the work area.

2. The cable termination assembly can now be taken apart. Start by removing the four stainless steel screws holding the termination stem in the bulkhead. Next, pry the rubber cable stiffener off the front of the termination. Use two large screwdrivers, if necessary, to do this. slide the stiffener up the cable past any portions to be scrapped. Cut the tow cable off at the top of the aluminum cable grip. The termination and stem should pass down through the hole in the front bulkhead. If there is any interference, use the hacksaw to cut through the grip where it is screwed into the stem. Neither the grip or the stem can be reused, as they have been potted to seal against water leaks into the electrical connections.

3. The eight conductor cable potted into the termination stem

could be saved for reuse, if it is not damaged, however, there is a replacement cable in the termination kit.11

4. Next, locate the cable termination assembly (item 5) and slide it up the cable with the threaded end towards the bare end of the cable. There is a split wedging collet inside the termination body. This will be used to grip the cable in the final termination. Put the body in the vise with the threaded end up and the vise clamped to the flats on the body.
The cable should be extending about eight inches from the body. Put the split wedging collet on the cable with the small end down and force it into the body until the cable end protrudes about one-half inch from the body end. The hammer will have to be used to force the collet in. The cable will now be gripped correctly.

5. The cable jacket and Kevlar strength member can now be removed, about 2.5 cm (1 inch) above the end of the termination collet. Be very careful while stripping the jacket. The polyurethane is very tough and there is a possibility of cutting too deeply and damaging the underlying wires in the cable.
The Kevlar is also very resistant to cutting. Take enough time to do this step so nothing gets cut that should not be cut. With the Kevlar removed, the next layer is the mylar tape wrapping the cable wires and then the filler rods. There is a water blocking filler around the wires in this cable and this must also be removed. It is quite sticky, but will be easy to roll up into small lumps to remove it. Clean up after with alcohol.

6. The next step is to trim the cable wires to the correct length so that all solder joints will be buried in the potting epoxy. This assembly will be screwed into the new termination stem (item 1). The new termination stem must first be installed in the bulkhead. Proceed by sliding the stem down from the inner end of the bulkhead. Turn the flange of the stem until the screw holes line up. Now, install the new stainless steel screws with the lock washers and flat washers. The cable extending from the termination assembly can now be passed up through the stem and the termination and stem screwed together to do a "dry fit". Check to make sure that the cable wires are long enough to extend into the potting cup of the termination stem. There are two heavy wires and three thinner wires in the cable. In some cases, there may be two very small coaxial wires in the tow cable. These are not used and must be cut off, as was done with the Kevlar and filler rods.

7. If the wires are the correct length to splice, proceed with this step after screwing the termination and stem together as tightly as possible by hand only. The eight wire pigtail with the locking sleeve (items 3&7), is spliced to the cable wires following the drawing 25506-xx. Use the sleeving provided and keep all connections short, so they will be buried in the potting step. Check for correct wiring and continuity.

8. Locate the four epoxy packs (item 2) and warm them if possible. Warming makes the mixing easier. The packs can either be mixed by pulling the separators off and kneading the contents together, or cutting them and pouring them into a paper cup. Wear gloves to prevent the epoxy from contacting the skin. Stir the epoxy with a stick for about two minutes. Wrap a length of the plastic electrical tape around the end of the termination at the cable entry point. This must be done to prevent any epoxy from leaking out of the termination. Taping can be done while the assembly is held in the vise, in most cases. Now, pour the mixed epoxy into the potting cup of the stem until it reaches the top of the cup.

Wait a few minutes to make sure that all bubbles of trapped air have risen to the top. Add more epoxy, if necessary. The potting epoxy is very slow curing at room temperature. If there is access to a heat lamp, the cure time can be reduced. Don't heat the assembly hotter than 50 C. This should be just hot enough to be very uncomfortable to hold.
The assembly should be ready for use in 12-15 hours if cured at room temperatures. After curing, be sure to do another continuity and short check on the assembly.

9. The tow cable can now be finished. Slip the rubber cable stiffener over the termination body as far as it will go. It will snap into place on the ridge of the stem.

10. The repaired tow cable assembly can now be installed on the G-880 fish and connected up to do a final operation check.

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Appendix A - Quick-start G-880 Operating Instructions

The G-880 magnetometer includes the CM-201 Larmor counter. This means that there are some initializing steps which must be taken in order to establish the operating format including the analog channels for the Depth and also Altitude (if installed) data channels. Analog Channel 1 is the Depth and Channel 2 is the Altitude. The total field measurement is always available, as is the sensor signal amplitude. These two outputs do not require initializing.

The G-880 is shipped with a copy of "VIEW201" and other utilities. This software allows the operator to access the magnetometer field measurements. It also is used to set up the analog channels, such as Depth and Altitude, see **Depth and Altitude Initialization** on the next page.

The G-880 Magnetometer can be operated in the shop before installing it on board any vessel. It is usually shipped with an "Onboard Cable", which will allow connection between the magnetometer fish tow cable and the dry end "Power/Data Junction Box". This junction box is used to allow all communication and power connection to the tow cable and magnetometer. If the tow cable and onboard are available, the system can be connected together. A source of DC power is also required to operate the system. A mains power supply is usually sold with the G-880 system. The mains power required can be any voltage from 90 to 230 volts ac at a frequency of 50 to 60 Hz. This "AC Power Supply" plugs directly into the "Power/Data Junction Box". There is also an RS-232 cable in the "Ship Kit" to connect the junction box to a computer.

With all of the components of a system connected, apply power by first turning the AC supply on. There is a switch next to the mains power entry connection. A fan in the unit will start. Now, turn the DC power on. There is a locking toggle switch on the junction box. The power indicator will light up green if the DC input polarity is correct. If the DC input is derived from a battery set, there is the possibility of accidental reverse connection of the power. If this should happen, the power indicator will light up red. In this case, recheck the DC power connections.

Note: A minimum of 24VDC must be presented to the Magnetometer. Therefore 26 to 28VDC may be required at the junction box.

If all of the above connections are correct and the power is on, the data from the CM-201 counter in the G-880 Magnetometer will be RS-232 at a 9600 Baud rate. After about 2 to 5 minutes, the output from the magnetometer will be stabilized and can be observed by using the program "VIEW201".

Install this program and the other utilities on the disc labeled "Cesium Magnetometer Accessory Software". Do the installation by inserting the disc in drive "A". Type "Install" [Enter]. Follow the instructions and answer the questions. After the installation is complete, type "Cm201"[Enter],"VIEW201" [Enter]. The

“VIEW201” program will start and test for the baud rate and display a screen with the ASCII data coming from the magnetometer.

The following description will help explain the output format from the CM-201.

The defaulted output from the CM-201 counter will have the following format:

character#	description
1	An ASCII ‘$’
2	An ASCII ‘1’ or blank (depending on whether the reading is above or below _999999.999nT)
3-7	5 digits of mag data
8	An ASCII decimal point
9-11	3 more digits of mag data
12	An ASCII comma
13-16	4 digits of A/D channel 0. This channel contains the signal level
17	an ASCII carriage return
18	an ASCII line feed

For example:

$ 99778.131,3749 where the first 9 digits past the $ are the total field reading in nanotesla. The next 4 digits are the sensor signal strength. The example reading is only given here to indicate the type of data which can be expected.

This Quick-start 880 is meant only to get the user started. It is highly recommended that the G-880 Manual be referred to as soon as possible, since this short description does not cover the full extent of what is available in the software package. This suite of software is meant to be run under DOS. It will not run properly under “Windows NT”. If it is to be run in “Windows 95”, the DOS window must be set to full screen.

Depth and Altitude Initialization (Quick Start)

Once VIEW201 is running and magnetometer data is filling up the screen, the Depth and/or Altitude may be initialized.

Depth

Depth is connected to Analog Channel 1. Analog Channel 1 may be turned on by typing “A1100” and then depressing the Enter key. Four digits of Depth will appear in the data stream just after the signal level and be delimited by a comma. (Depth can be turned off by typing “A0100”[Enter].) Full Scale is 6927 for 1000psi (692.7 meters) or 3463 for 500psi (346.3 meters) sensors.

Altitude

Altitude is connected to Analog Channel 2. Analog Channel 2 may be turned on by typing “A1200” and then depressing the Enter key. Four digits of Altitude will appear in the data stream just after the Depth and be delimited by a comma. (Altitude can be turned off by typing “A0200[Enter].) Full scale is 9999 for either 100 meter or 30 meter altimeters.

Any other commands as described in section 2.4 of the manual may also be entered at this time.

Data may be logged to disk within VIEW201 by depressing the <F10> key. Logging may be stopped by again depressing the <F10> key.

If MagSea is to be used to log data, press the Esc key to Exit from VIEW201. Start up MagSea (see MagSea manual) without powering the magnetometer system down. If you test the Depth Sensor at a known depth that does not exactly agree with the reading displayed by MagSea it may be necessary to use the Depthcal utility to determine the bias and scale factors that can be entered into MagSea to cause the correct reading to be displayed.

Depth and Altitude Initialization (Normal Run)

Ignore the following if you are running MagSea version 3.03 or later.

As discussed in section 2.5 of the G-880 manual, the Accessory Software provides a method to create a batch file “Cm201” which may be executed after power on to simply and correctly initialize the magnetometer system. Running the “install” from the Cesium Magnetometer Accessory Software (as in the last paragraph of page 1 above) creates the Cm201.bat file. This batch file sends a series of initialization commands to the magnetometer’s CM201 counter. These commands are contained in a file called Cm201go.cnf. This file may be modified using a text editor to add the Depth and Altitude analog channel turn on commands plus any other commands desired for operation. See below:

```
[CLOCK]
c0010       Set cycle time to 10 times per second.
oj11111     Selects all five Julian Clock fields of Counter 0.
a1100       Turns on Depth analog channel of Counter 0.
a1200       Turns on Altitude analog channel of Counter 0.
```

Once the Cm201go.cnf file is modified as above, executing Cm201 will automatically turn on the Depth and Altitude.

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Appendix B – Tow Fish Assembly 25504-01

COMPONENT	DESCRIPTION	ITEM	QUANTITY	UM
0024867-02	RING-FIN ASSY, G-880	1	1	EA
0025507-01	BALLAST WEIGHT ASS'Y	2	1	EA
0025508-01	SENSOR/ELECTRONICS ASSY,G-880	3	1	EA
0025513-01	SENSOR TUBE G-880 STD LENGTH	4	1	EA
0025518-01	MAIN TUBE, G-880 SENSOR FISH	5	1	EA
0025519-01	TUBE COUPLER, G-880	6	1	EA
0025520-01	SENSOR CLAMP-COMPLETE	7	1	EA
0025521-01	SENSOR CLAMP SWIVEL MOUNT	8	2	EA
0025522-01	ELECTRONICS MOUNTING COLLAR	9	2	EA
0025523-01	SENSOR FAIRING	10	1	EA
28-103-008	SCREW FLHD 10-32X1/2 BR	11	33	EA
28-108-012	SCREW FILH 10-32X3/4 BR SLOT	12	3	EA
28-108-016	SCREW FILH 10-32X1 BR SL	13	7	EA
16-650-002	ANTI-SEIZE LUBE.PERMATEX 133A	14	0	EA
28-108-828	SCREW FILH 8-32X1.75 BR SL	15	2	EA
28-113-808	SCREW, 8-32 X .5, BRASS, PHIL	16	8	EA
28-117-108	SCREW RNHD .25-20X.5 BR SL	17	2	EA
28-205-010	NUT STOP BRASS 10-32	18	2	EA
28-302-008	WASHER, FLAT #8 BRASS	19	14	EA
28-302-010	WASHER, FLAT # 10 BRASS	20	10	EA
28-311-008	WASHER, SPLIT LOCK #8 BRONZE	21	8	EA
28-311-010	WASHER, SPLIT LOCK #10 BRONZE	22	10	EA
28-311-250	WASHER, SPLIT LOCK 1/4 BRONZE	23	2	EA
28-920-001	KWIK BLOCK KB20001 VEE BLOCK	24	2	EA
60-501-005	TIE CABLE PANDUIT #SST4I-M	25	4	EA

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Appendix C – Connection and Cable Wiring diagrams.)

Included:

G-880
G-880DEEP

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G-880

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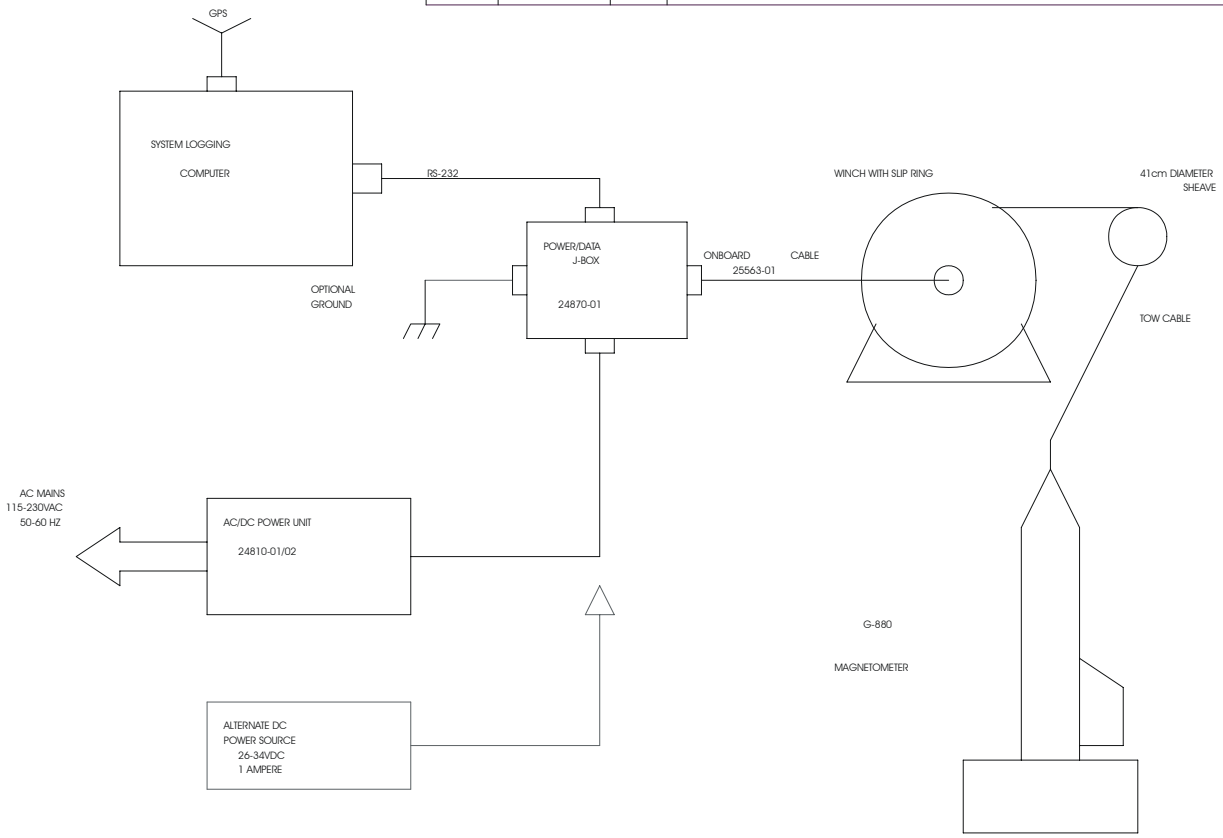
R E V I S I O N S

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	A	RELEASE FOR PRODUCTION.		05.27.02



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

SEE MATERIAL LIST

FINISH :

NONE.

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN : R.S.PALACIO	05.25.02
DESIGNED : A.Ackerknecht	12.18.01
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	
FILE NAME : 0025633-01	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

BASIC G-880 SYSTEM

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25633-01	A

SCALE : NONE SHEET : 1 of 1

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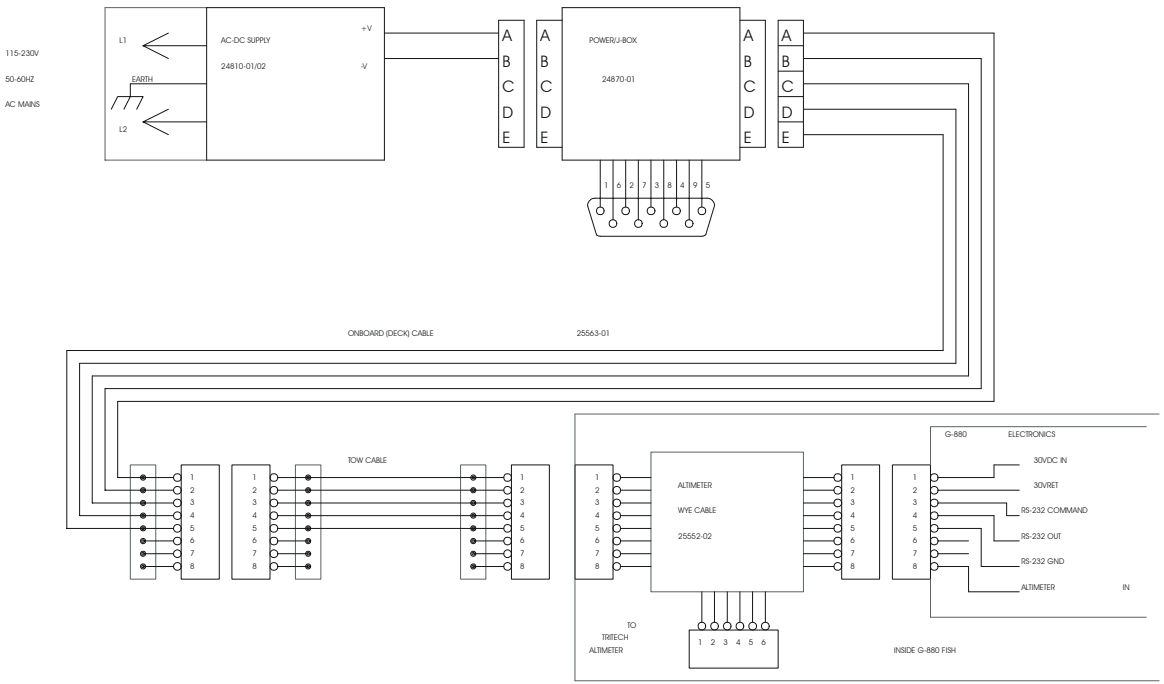
REVISIONS

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	A	RELEASE FOR PRODUCTION.		05.01.02



NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

FINISH :

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN : R.S.PALACIO	05.01.02
DESIGNED : A.Ackerknecht	12.18.01
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	
FILE NAME : 0025644-02	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

STANDARD G-880 SYSTEM WIRING

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25644-02 sch	A

SCALE : NONE SHEET : 1 of 1

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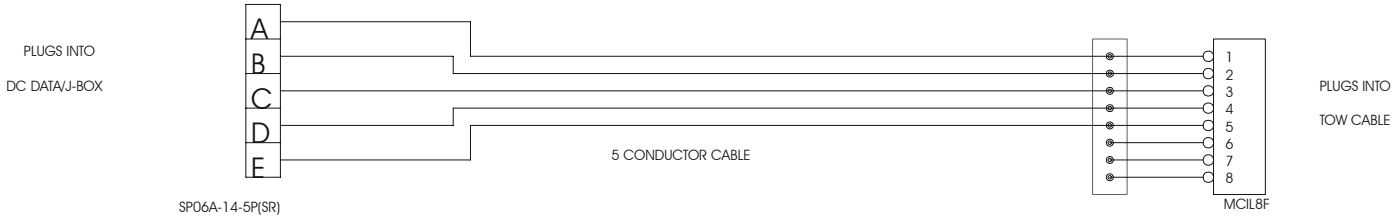
R E V I S I O N S

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	A	RELEASE FOR PRODUCTION.		05.27.02



WIRE TABLE

FROM PIN	TO PIN	COLOR	FUNCTION
A	1	BLACK	+30VDC
B	2	WHITE	30V RET
C	3	RED	RS-232 COMMANDS
D	4	GREEN	RS-232 DATA
E	5	ORANGE	RS-232 GROUND
	6	BLUE	NOT USED
	7	WHITE/BLACK	NOT USED
	8	RED/BLACK	NOT USED

NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 .XX ± .02 .XXX ± .005 ANGLES : 1/2

MATERIAL :

SEE MATERIAL LIST

FINISH :

NONE.

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN : R.S.PALACIO	05.25.02
DESIGNED : A.Ackerknecht	12.18.01
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	
FILE NAME : 0025563-01	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

ONBOARD (DECK) CABLE

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25563-01	A

SCALE : NONE SHEET : 1 of 1

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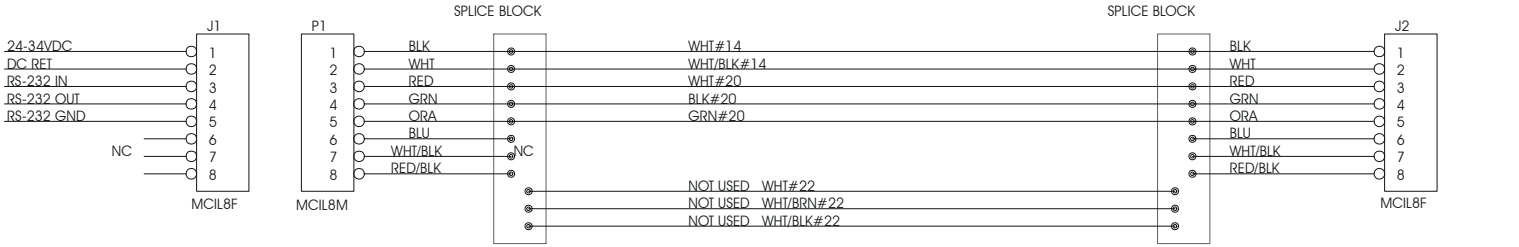
R E V I S I O N S

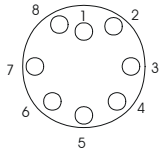
ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	A	RELEASE FOR PRODUCTION.		05.01.02

24-34VDC TOW CABLE



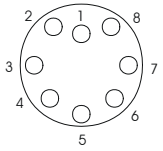
MALE FACE VIEW

P1



P.N. 21-236-411

FEMALE FACE VIEW



J1,J2

P.N. 21-236-410

REF. SCH. FOR:	
50010-01	
50010-01	
50010-01	
50010-01	
NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

SEE MATERIAL LIST

FINISH :

NONE.

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS		DATE
DRAWN :	R.S.PALACIO	06.06.02
DESIGNED :	A.Ackerknecht	05.01.02
ORIGINATOR :		
APP'D ENG'G. :		
APP'D MANUF. :		

FILE NAME : 0025750-01

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

STANDARD TOW CABLE WIRING

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25750-01 sch	A

SCALE : NONE SHEET : 1 of 1

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REVISIONS

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
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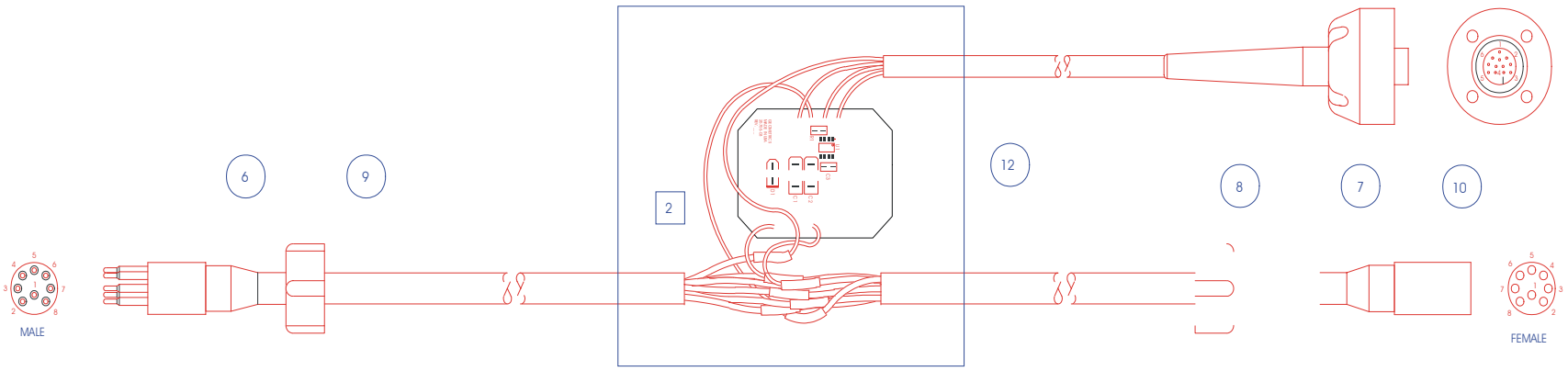

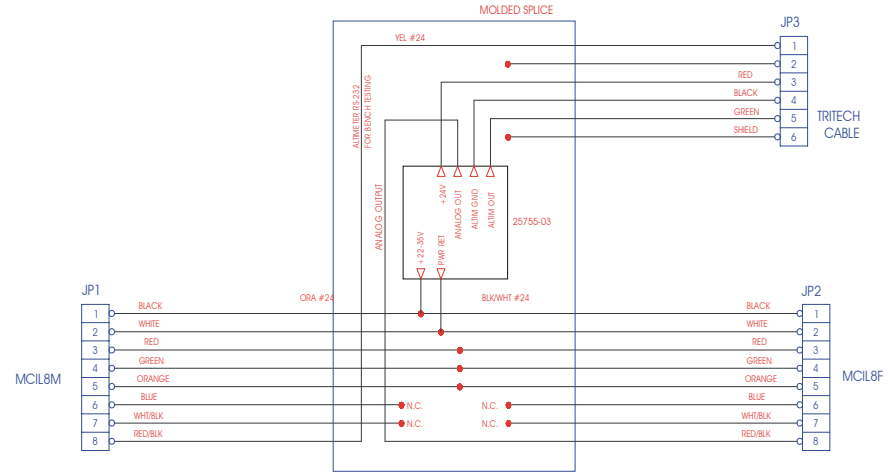

CABLE WIRING

JP3 WIRE TABLE

PIN #	FUNCTION	WIRE COLOR
1	RS-232 OUT	YELLOW
2	RS-232 IN	BLUE
3	+DC POWER	RED
4	POWER/DATA GND	BLACK
5	ANALOG OUT	GREEN
6	CASE SHIELD	✱ SHIELD

NOTE: ✱ NO CONNECTION

NOTES :

1. NO DC CONNECTION ALLOWED.
2. KEEP WIRES AS SHORT AS POSSIBLE. USE SLEEVING ON ALL SPLICES.
3. BAG AND TAG WITH PART NUMBER AND CURRENT REVISION.

XXXXX-XX	MODEL
XXXXX-XX	MODEL
XXXXX-XX	MODEL
XXXXX-XX	MODEL
XXXXX-XX	MODEL
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES:
DECIMALS .XX ±.50 .XXX ±.XXX
ANGLES ±.X

MATERIAL : SEE MATERIAL LIST. MATERIAL-LINE2

FINISH : NONE. FINISH-LINE2

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN BY : R.S.PALACIO	12.11.01
DESIGNED : A.Ackerknecht	12.04.01
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	
FILE NAME : 0025552-03	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

CBL ASSY, ALTIMETER BUFFER / REG WYE CABLE

SIZE	FSCM NO.	DRAWING NO.	REV.
B		25552-03	A

SCALE : NONE SHEET : 1 OF 1

R.S.P. RELEASED JAN. 1999

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G-880DEEP

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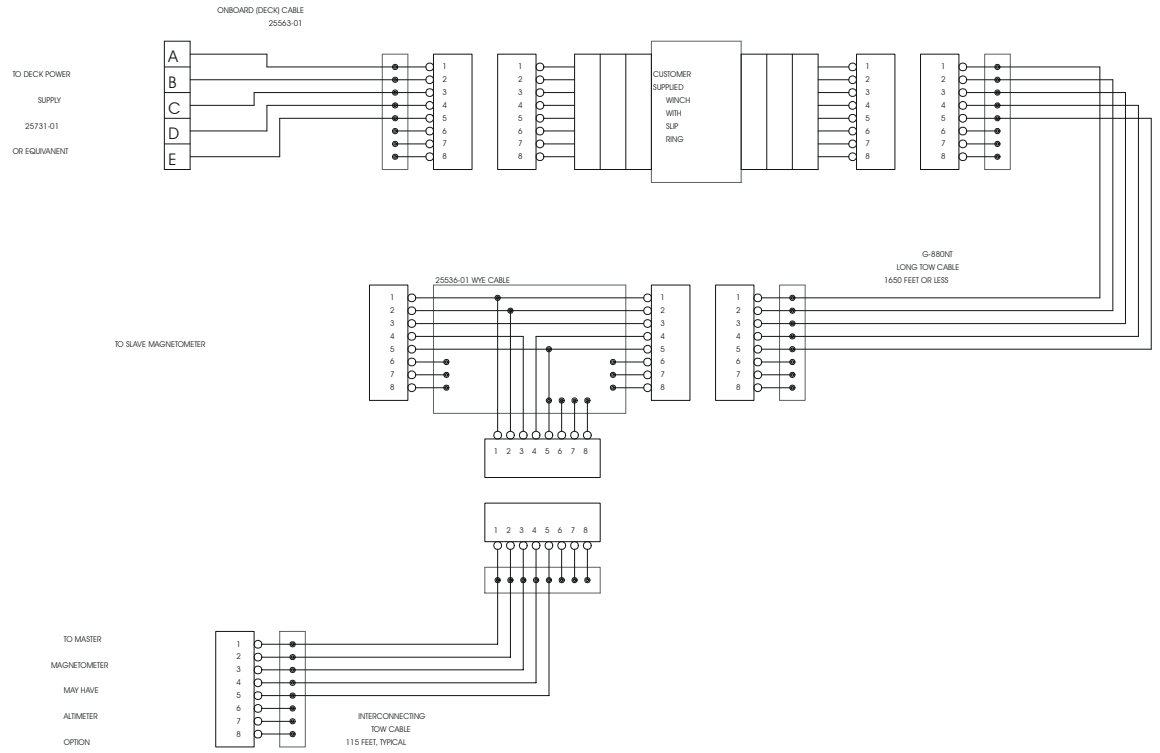
R E V I S I O N S

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	A	RELEASE FOR PRODUCTION.		05.01.02



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

FINISH :

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS		DATE
DRAWN :	R.S.PALACIO	05.01.02
DESIGNED :	A.Ackerknecht	12.18.01
ORIGINATOR :		
APP'D ENG'G. :		
APP'D MANUF. :		
FILE NAME :	0025644-03	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

LONG MULTI-WIRE TOW SYSTEM

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25644-03 sch	A

SCALE : NONE SHEET : 1 of 1

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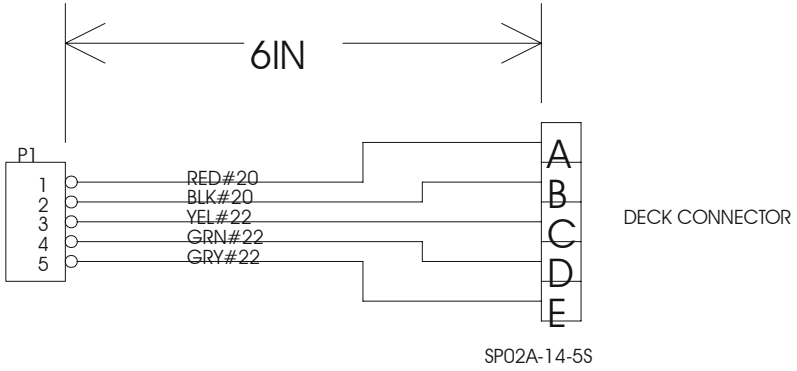
R E V I S I O N S

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	X1	RELEASE FOR PROTOTYPE.		05.01.02



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 .XX ± .02 .XXX ± .005 ANGLES : 1/2

MATERIAL :

FINISH :

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS		DATE
DRAWN :	R.S.PALACIO	05.01.02
DESIGNED :	A.Ackerknecht	07.12.01
ORIGINATOR :		
APP'D ENG'G. :		
APP'D MANUF. :		
FILE NAME :	0025760-01	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

DECK INPUT CABLE - XANTREX

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25760-01	X1

SCALE : NONE SHEET : 1 of 1

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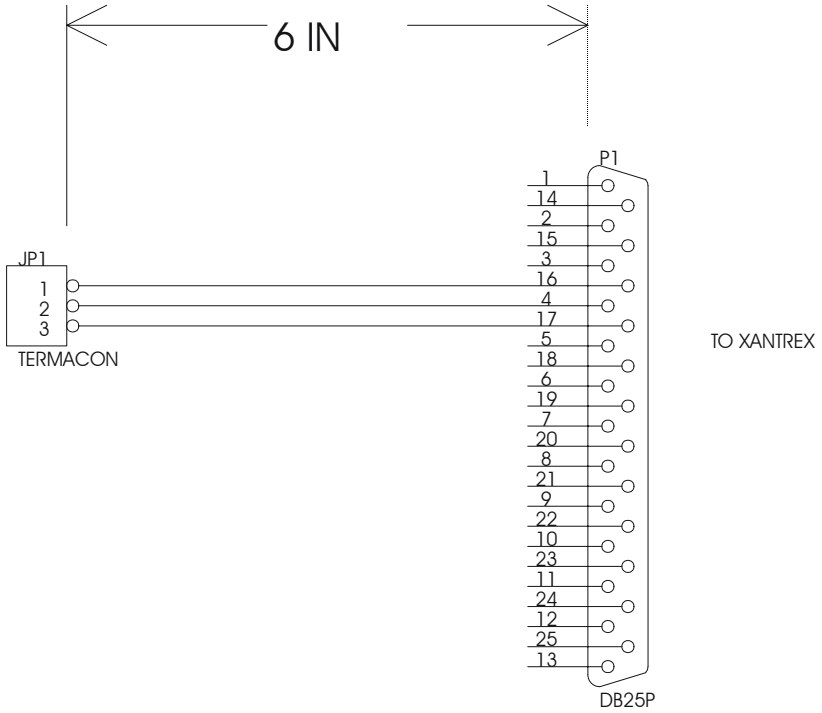
R E V I S I O N S

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	X1	RELEASE FOR PROTOTYPE.		05.01.02



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

FINISH :

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS		DATE
DRAWN :	R.S.PALACIO	05.01.02
DESIGNED :	A.Ackerknecht	08.06.01
ORIGINATOR :		
APP'D ENG'G. :		
APP'D MANUF. :		
FILE NAME :	0025759-01	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

CONTROL CABLE ASSEMBLY

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25759-01	X1

SCALE : NONE SHEET : 1 of 1

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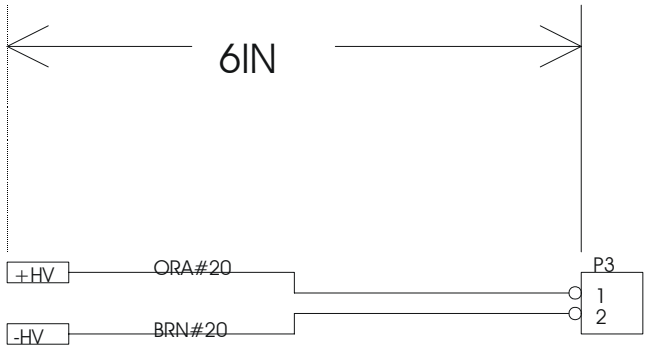
R E V I S I O N S

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	X1	RELEASE FOR PROTOTYPE.		05.01.02



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

FINISH :

CONTRACT NO.		
DO NOT SCALE DRAWINGS		
APPROVALS		DATE
DRAWN :	R.S.PALACIO	05.01.02
DESIGNED :	A.Ackerknecht	07.12.01
ORIGINATOR :		
APP'D ENG'G. :		
APP'D MANUF. :		
FILE NAME :	0025758-01	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

H.V. OUT CABLE - XANTREX

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25758-01	X1

SCALE : NONE SHEET : 1 of 1

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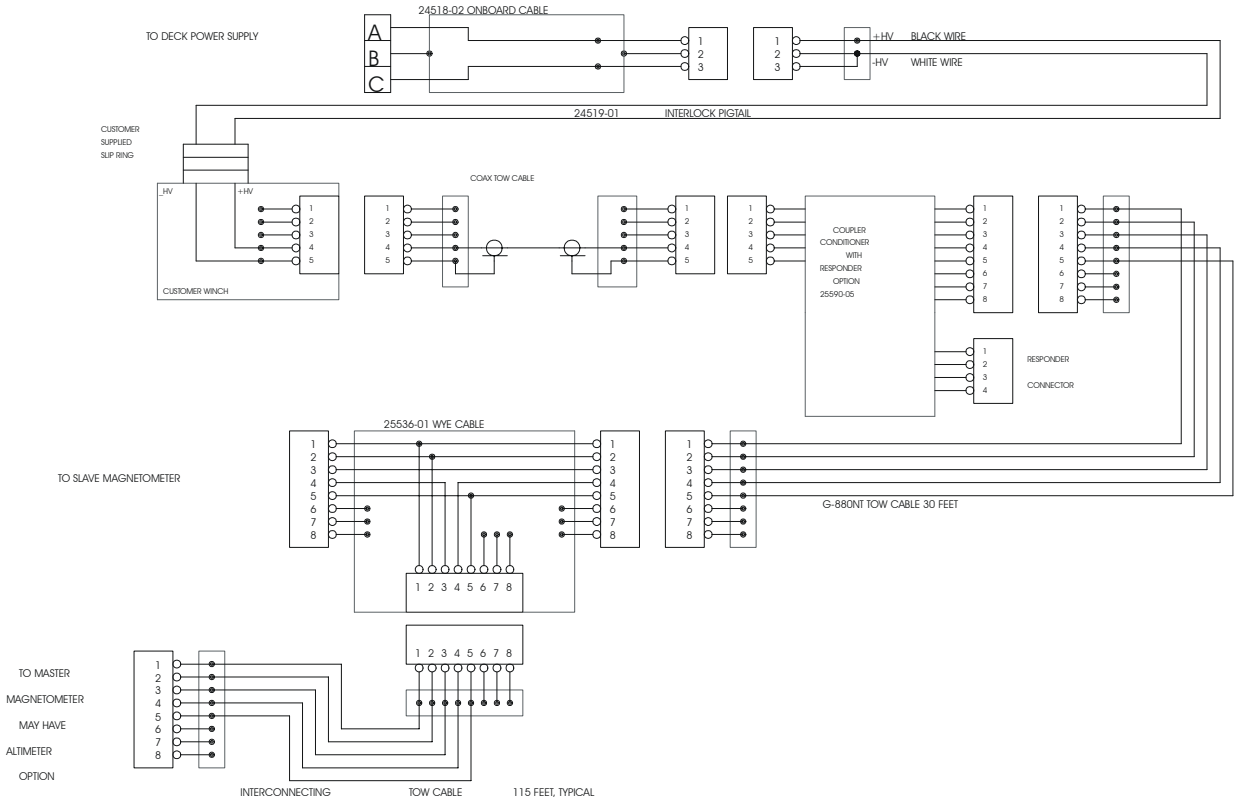
REVISIONS

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	A	RELEASE FOR PRODUCTION.		05.01.02



NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 .XX ± .02 .XXX ± .005

ANGLES : 1/2

MATERIAL :

FINISH :

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN : R.S.PALACIO	05.01.02
DESIGNED : A.Ackerknecht	12.18.01
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	

FILE NAME : 0025644-01

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

LONG CABLE GRADIOMETER SYSTEM

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25644-01 sch	A

SCALE : NONE

SHEET : 1 of 1

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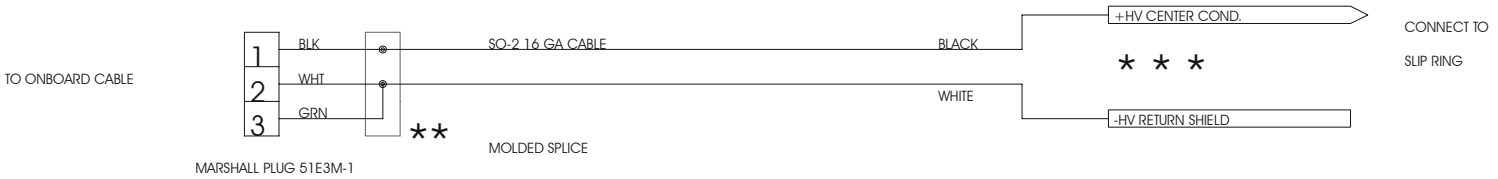
REVISIONS

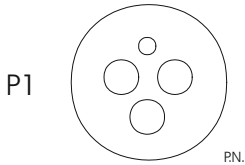
ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	B	ADDED FACE VIEW OF P1.		05.01.02



*** TIN 1/2" LONG AND TAG

** KEEP SPLICE ABOUT 4" FROM MARSHALL PLUG

MALE FACE VIEW



P.N. 21-109-010

24518-02KIT	ONBOARD CABLE
24518-200	ONBOARD CABLE
24518-100	ONBOARD CABLE
NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL : SEE MATERIAL LIST

FINISH : NONE.

CONTRACT NO.		
DO NOT SCALE DRAWINGS		
APPROVALS		DATE
DRAWN :	R.S.PALACIO	05.01.02
DESIGNED :	A.Ackerknecht	12.18.01
ORIGINATOR :		
APP'D ENG'G. :		
APP'D MANUF. :		
FILE NAME :	0024519-01	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

INTERLOCK PIGTAIL FOR G-876S / 880

SIZE	FSCM NO.	DRAWING NO.	REV.
A		24519-01	B

SCALE : NONE SHEET : 1 of 1

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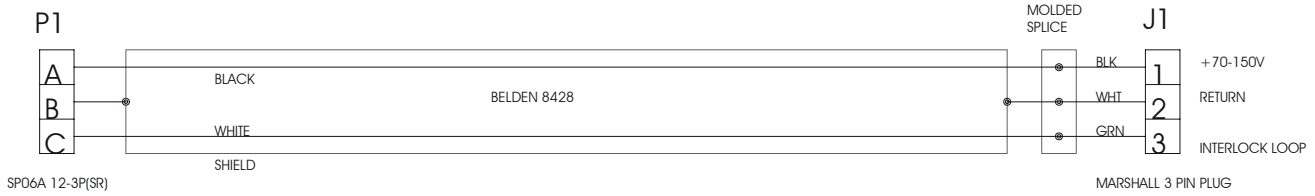
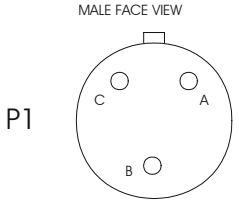
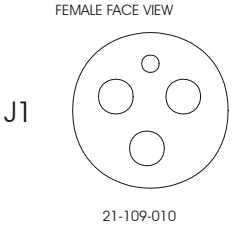
R E V I S I O N S

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	A	RELEASE FOR PRODUCTION.		05.01.02







G-880DEEP	MARINE MAG
NEXT ASSEMBLY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

SEE MATERIAL LIST

FINISH :

NONE.

CONTRACT NO.		
DO NOT SCALE DRAWINGS		
APPROVALS		DATE
DRAWN :	R.S.PALACIO	05.01.02
DESIGNED :	A.Ackerknecht	12.18.01
ORIGINATOR :		
APP'D ENG'G. :		
APP'D MANUF. :		
FILE NAME :	0024518-02	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

ONBOARD CABLE WITH INTERLOCK
N FEET LONG

SIZE	FSCM NO.	DRAWING NO.	REV.
A		24518-02	A

SCALE : NONE SHEET : 1 of 1

WIRING DIAGRAM TAKEN FROM AL's 12-19-01 .dXF FILE. 5.29.02

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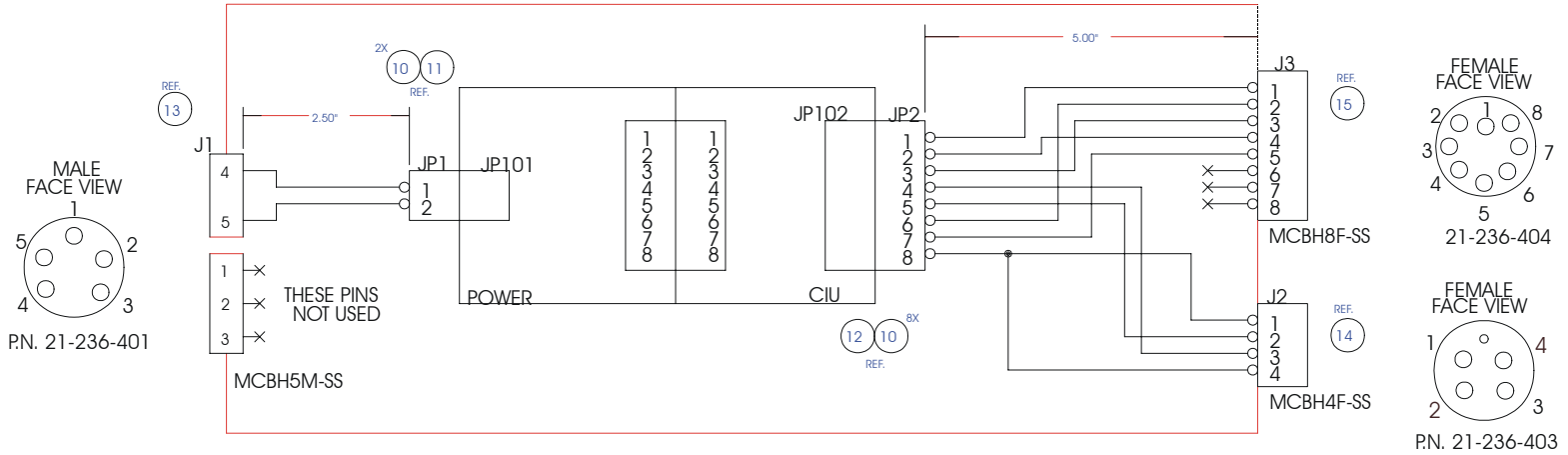
REVISIONS					
ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
			SEE PAGE 1 FOR CHANGE DESCRIPTION AND CURRENT REVISION.		



CONNECTOR PIN FUNCTION LIST

J1	JP1	JP2	J2	J3
1 NC		1 +28V OUT	1 GND	1 +28V OUT
2 NC		2 RS-232 DATA	2 +20V	2 28VRET
3 NC		3 RS-232 COMMAND	3 TRIGGER	3 RS-232 COMMAND
4 +CENTER	1+V	4 TRIGGER	4 GND	4 RS-232 DATA
5 -SHIELD	2-V	5 +20V		5 RS-232 GND
		6 GND		6 NC
		7 GND		7 NC
		8 GND		8 NC

SEE PAGE 1.	
NEXT ASSY	USED ON
DESCRIPTION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES.
TOLERANCES:
DECIMALS : .X ± ANGLES : ± .5
.XX ± .25
.XXX ±
MATERIAL : SEE PAGE 1.
FINISH : SEE PAGE 1.

CONTRACT NO.
DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN : R.S.PALACIO	05.30.02
DESIGNED : KEN SMITH	05.30.02
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	
FILE NAME : 0025590-01,-05	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

ASSY, COUPLER/COND. WITH RESP. OPTION

SIZE	FSCM NO.	DRAWING NO.	REV.
B		25590-01,-05	C

SCALE : NONE SHEET : 2 of 2

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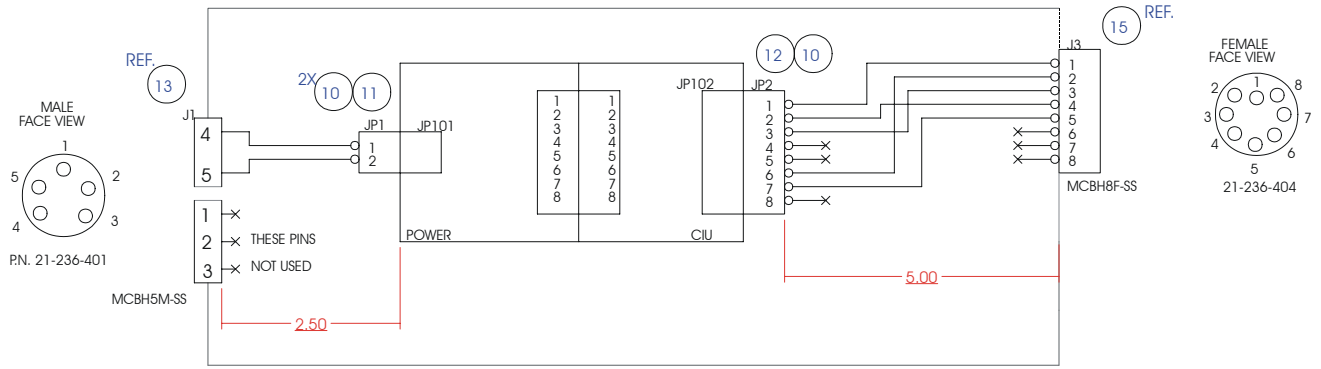
REVISIONS					
ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
			SEE PAGE 1 FOR DESCRIPTION AND CURRENT REVISION.		



CONNECTOR PIN FUNCTION LIST			
J1	JP1	JP2	J3
1 NC		1 +28V OUT	1 +28V OUT
2 NC		2 RS-232 DATA	2 28VRET
3 NC		3 RS-232 COMMAND	3 RS-232 COMMAND
4 +CENTER	1+V	4 TRIGGER	4 RS-232 DATA
5 -SHIELD	2-V	5 +20V	5 RS-232 GND
		6 GND	6 NC
		7 GND	7 NC
		8 GND	8 NC

SEE PAGE 1.	
NEXT ASSY	USED ON
DESCRIPTION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES.
TOLERANCES:
DECIMALS : .X ± .XX ± .XXX ±
ANGLES : ± .5
MATERIAL : SEE PAGE 1.
FINISH : SEE PAGE 1.

CONTRACT NO.
DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN : R.S.PALACIO	07.31.00
DESIGNED :	
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	
FILE NAME : 0025590-04	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

ASSY, COUPLER / COND. 200 KHZ

SIZE	FSCM NO.	DRAWING NO.	REV.
B		25590-04	SEE PAGE 1

SCALE : NONE SHEET : 2 of 2

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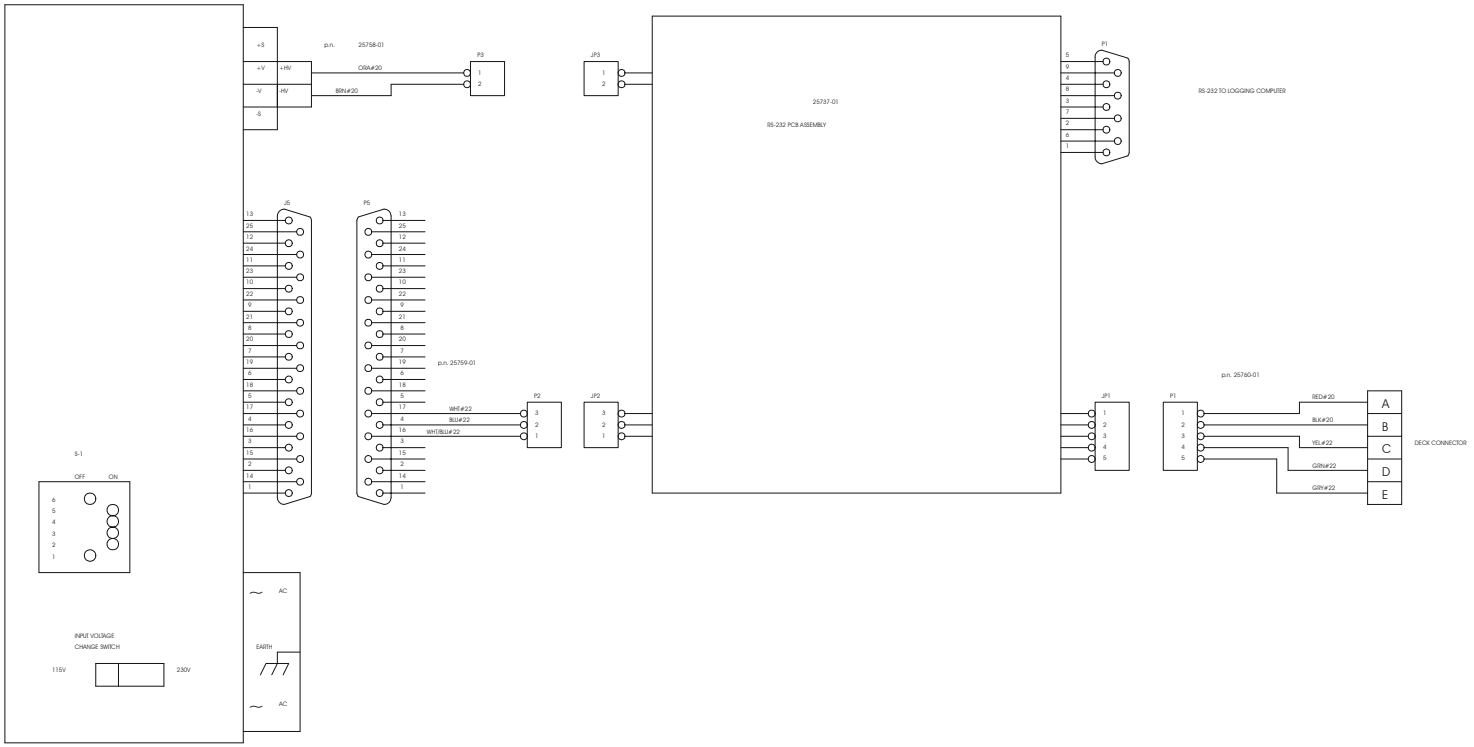
REVISIONS

ZONE	ECO #	REV.	DESCRIPTION	APPROVED	DATE
	ENG'G.	X2	RELEASE FOR PROTOTYPE.		05.01.02



NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.

TOLERANCES:

DECIMALS : .X ± .5 ANGLES : 1/2
.XX ± .02
.XXX ± .005

MATERIAL :

FINISH :

CONTRACT NO.

DO NOT SCALE DRAWINGS

APPROVALS	DATE
DRAWN : R.S.PALACIO	05.01.02
DESIGNED : A.Ackerknecht	12.17.01
ORIGINATOR :	
APP'D ENG'G. :	
APP'D MANUF. :	
FILE NAME : 0025731-01	

GEOMETRICS INC.
2190 FORTUNE DRIVE
SAN JOSE, CA 95131 USA
TEL: (408) 954-0522
FAX: (408) 954-0902

XANTREX DECK SUPPLY

SIZE	FSCM NO.	DRAWING NO.	REV.
A		25731-01	X2

SCALE : NONE SHEET : 1 of 1