MagLog-Lite™
MagLogNT™
Data Acquisition Software
25479-01 Rev.G

User's Guide

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MagLogNT™/MagLog-Lite™

Software Installation and Registration Procedure

This program is the newest version of our standard MagLogNT™ logging package. It now includes a Configuration Wizard that will step the user through set up of the G-877, G-881 and G-880 Marine Magnetometer systems. Another new feature, Survey Playback, enables high-speed anomaly detection and location.

Important! A software key (Dongle) or serial number copy protects these versions of MagLogNT™ and MagLog-Lite. You must follow the procedure below in order to enable the version that you purchased, either MagLogNT™ or MagLog-Lite™.

1. Install MagLogNT™ or MagLog-Lite™ by inserting disk 1 in the A:\ drive and running SETUP. Insert the other disks as required.

2. After installation, connect the software key (dongle) to any PC parallel port. Start the MagLogNT™ program (via desktop shortcut or via menu). The program will ask you to enter your company name and user name. You must answer these questions in order to register your software. After you answer these questions, the program will exit.

3. To use MagLogNT™ or MagLog-Lite™, you must always have the software key (dongle) connected to a parallel port of the PC on which the software is installed (or you must have a digital key code from Geometrics, see below). Start the program again and you will be operating as either MagLogNT™ or MagLog-Lite™, depending on which program you purchased.

4. You may install MagLog on as many computers as you wish, but only the computer with the software key connected will be able to acquire data. If you have installed with a software key, you may ignore steps 5, 6 and 7.

5. If you do not have a software key or have lost it, when you start MagLog it will be running as a demo version of MagLogNT™. This means that you cannot read data from the serial ports, only playback surveys from files. To enable the software for logging use, you must contact **Geometrics, Inc.** to obtain a **Registration Number.** ***BEFORE YOU CONTACT US, YOU MUST FOLLOW THIS PROCEDURE:*** First, click on **Help/About** and write down **your User Code** on the supplied blank **Registration Disk**. Then, contact **Geometrics, Inc.** via either e-mail, telephone or fax and inform us of your **User Code**. In response, Geometrics will provide to you your **Registration Number**. Write this number on the blank **Registration Disk**.

Geometrics, Inc.
Tel: 408-954-0522
Fax: 408-954-0902
E-mail: sales@mail.geometrics.com

6. With your **Registration Number** at hand, start MagLogNT™ again and go to **Help/Register . . .** Insert the blank **Registration Disk** into drive A: and then enter your **Registration Number**. Press **Ok** to create your **Registration Disk**. After the message **Operation completed** is observed, you have registered MagLogNT™ or MagLog-Lite™.

7. Geometrics licenses this software for installation on one PC only. You will have to repeat these steps every time that you install MagLogNT™ on a new PC. The registration number is unique for each installation, even if you reinstall on the same PC. However, if you created the **Registration Disk** you may use it to re-install on the same PC without contacting Geometrics. To do so, press **Have Registration Floppy** instead entering the company name and user name.

Completion of the above procedure enables full operation of the version of software you purchased, either **MagLogNT™ or MagLog-Lite™.**

Quick Start Survey Configuration

Connect the GPS and Magnetometer or Gradiometer (2 concatenated magnetometers) to the communication port on the computer. Start MagLog. To begin configuration, click on File in the menu bar and then on Survey Wizard. The program will ask some basic questions about the marine system you are using (type of magnetometer), GPS antenna to tow point offsets, tow cable lengths and give an explanation of the setup procedure. When you have completed the wizard, the software will begin displaying the data in analog chart format on the computer screen. Begin logging by clicking on File and then Start Logging.

This manual is for both MagLog-Lite™ and MagLogNT. Almost all sections pertain to MagLog-Lite™ except those that refer to logging such devices as Gyro, ORE Trackpoint II, cable payout indicators, etc. However, MagLog-Lite™ does include the ability to log other devices using the generic serial device logging option under Configure and Input Devices.

Recorded data may be processed using MagMap-2000. Check Geometrics website (www.geometrics.com) for the latest version of MagMap 2000.

Data Logger User's Guide

TABLE OF CONTENTS:

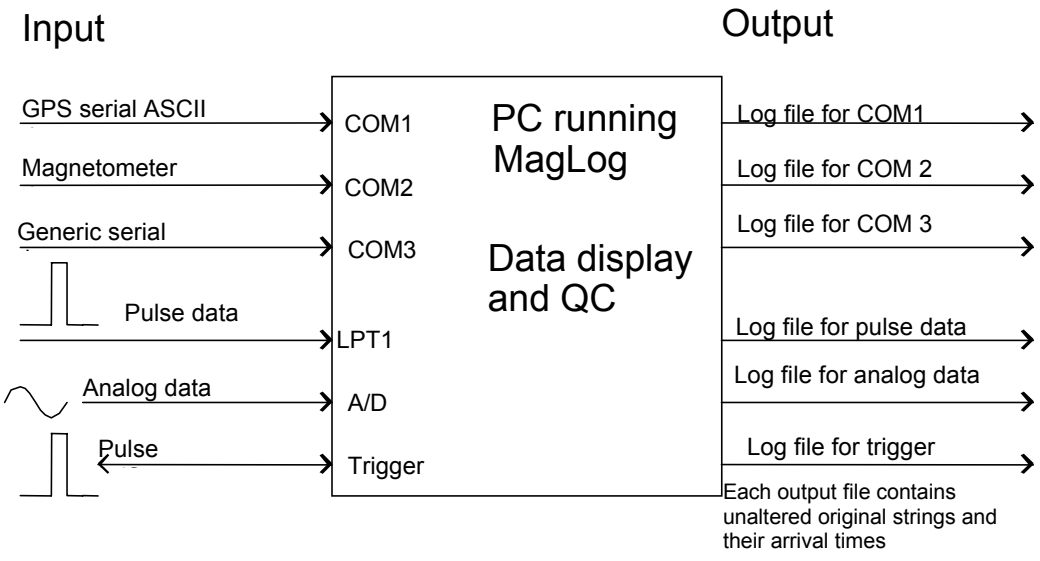
1 Introduction.

This section describes general MagLog operating principles and will be useful for understanding the overall software and hardware architecture.

MagLog is a general-purpose data logger that provides logging to disk and display of the following types of information:

- Serial data streams which comply with RS-232 specifications. MagLog assumes that there are 8 bits of information, no parity, 1 stop bit and no hardware flow control. ASCII data is preferable, but binary data also is accepted.
- Hardware generated pulses. Typically this is a TTL (5 volt) pulse arriving at the computer parallel port from an external device. MagLog fixes the time of the pulse arrival and writes this time into the log file. Examples of such hardware pulse devices are various event markers, GPS PPS (pulse per second) output and trigger pulses used to start other devices (e.g., air guns). The recommended width of such a pulse should be greater than 1 ms.
- Analog inputs. This requires a special A/D converter card installed into the computer. Geometrics can recommend the model and performance specifications.
- Trigger output. The pulse generated is similar to an event mark, however this feature requires the installation of a special multi-function card. The card works as a pulse generator and MagLog can provide a logged pulse time stamp for each output pulse generated.

Figure below explains how MagLog handles data streams:



Most common are serial data that may not require any additional hardware (if number of data streams does not exceed two).

MagLog handles incoming data in the following manner:

- Records PC clock time when the string becomes available to the program.
- Logs the string into a log file, if logging is switched ON. The string is logged with its arrival date and time.
- Parses string (converts ASCII text into digits) to display its content. However the parsing result is not saved and is used only temporarily.
- Display the string content as digits or graphs as defined in setup.

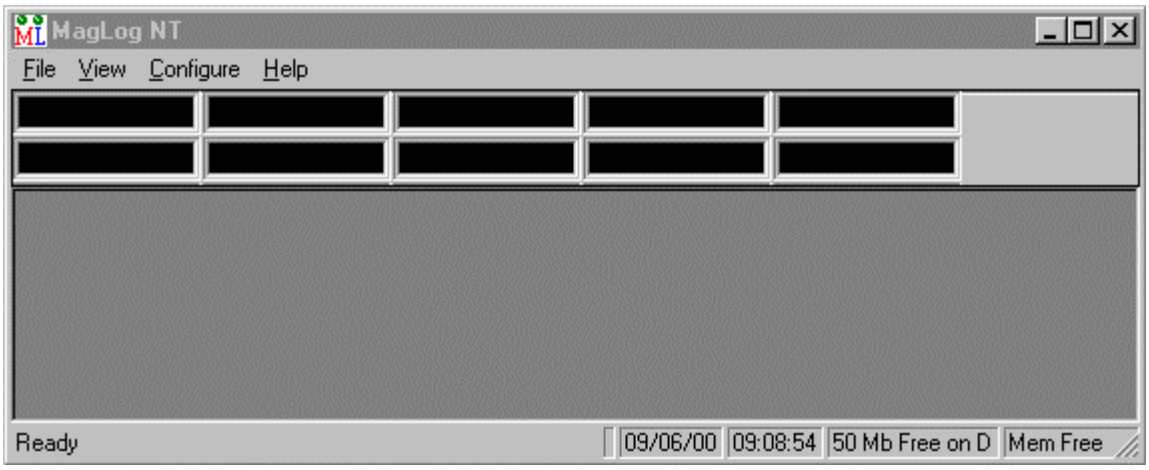
In simple terms, MagLog logs data with date and time if its arrival and then displays the data while performing real time Quality Control.

2 Getting Started:

Click on the Windows Start Button to start the program. Select "*Programs*", and then "*Geometrics*". You should see and be able to select "*MagLog for Geometrics Acquisition System*".

Or, click on the MagLog icon located on the Desktop:

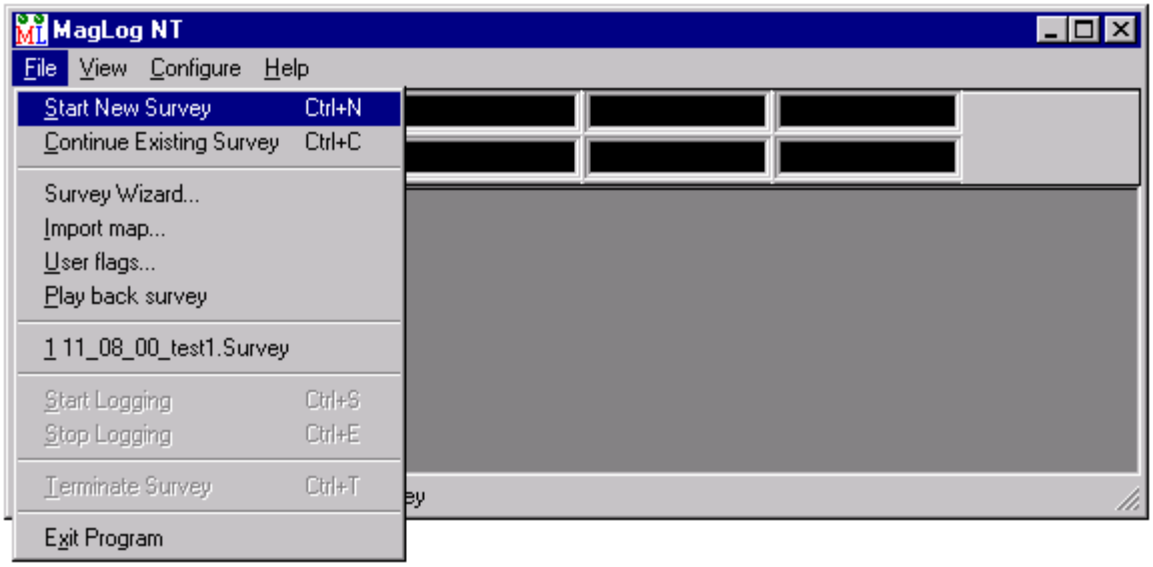
You should immediately see the main MagLog screen:



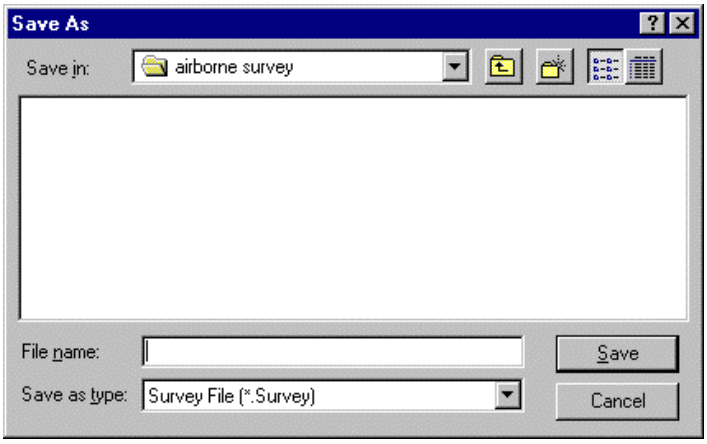
You are ready to begin initializing your survey.

2.1 Starting a new survey

You can select a new survey by selecting "*Start New Survey*" from the file menu.

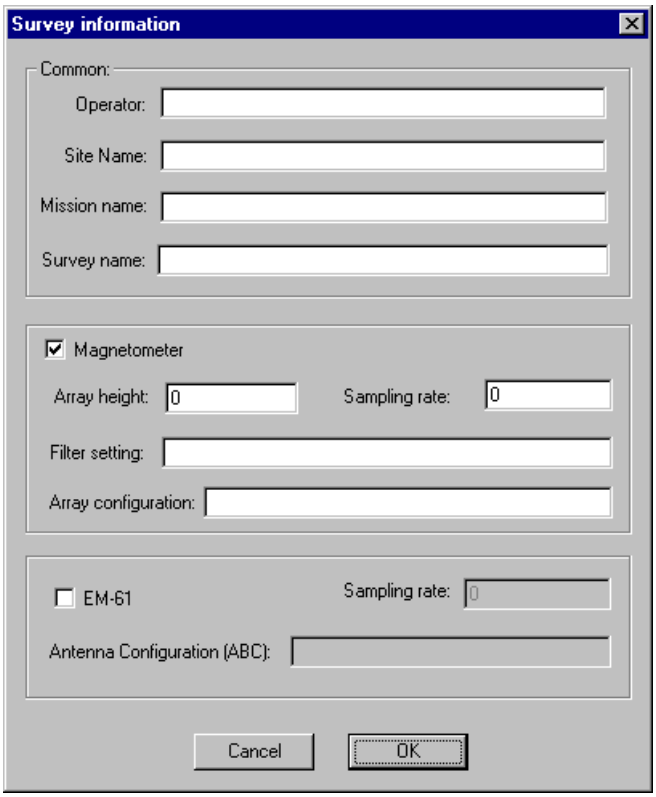


Then enter the name of your survey in the field "**File name:**" of the "Save As" dialog box. Click on the "*Save*" button.



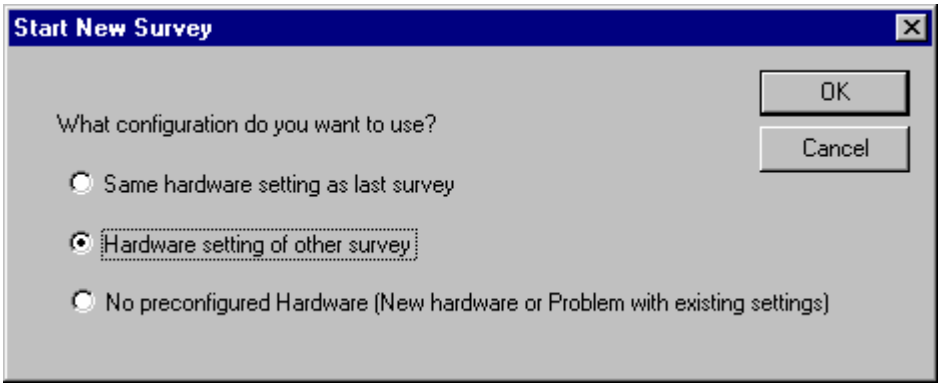
Next, you will see the following survey information dialog box:*

* This dialog box can be switched off if field *Info Dialog* is set to 0 in Maglog.ini file (see below)



The information in this dialog box must be filled out before you may proceed.
It is primarily used for book keeping. These fields are not actual configuration settings – they are notes about the survey for future reference. It is not necessary to fill in every field and the contents will not affect future performance. Click "OK" to proceed.

Next, you will be presented with the following choices:



You may base the new survey on any of the following settings:

- **Same hardware setting as last survey**: This will copy the hardware settings from the most recent survey that you have run. This would be the option to choose if you wish to start a new survey with the same hardware settings as previously used.
- **Hardware setting of other survey**.
  This will copy the settings of a different survey than the last one used. If you choose

this, you will get a dialog box allowing you to specify the name of the survey from which to copy the hardware settings.

- **No pre-configured hardware**.
  Use this option if you want to start the hardware configuration from scratch, or if there is no previous survey. Also, use this choice if you have updated the version of MagLog, and the new version is not compatible with previous Survey Files.

Since this is a new survey, and there should be no previous surveys, choose: "*No Preconfigured Hardware*".

2.2 Continuing an Existing Survey:

If you don't wish to start a new survey, you can continue an existing survey by selecting: "*Continue Existing Survey*" from the menu above. This will then allow you to load your survey file.

Note: Once you have specified a password on a survey file, this will remain for the life of the file. Remember your passwords for your surveys because you will be prompted for them each time you make configuration changes.

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3 Configuring Input Devices and Displays with MagLog wizard.

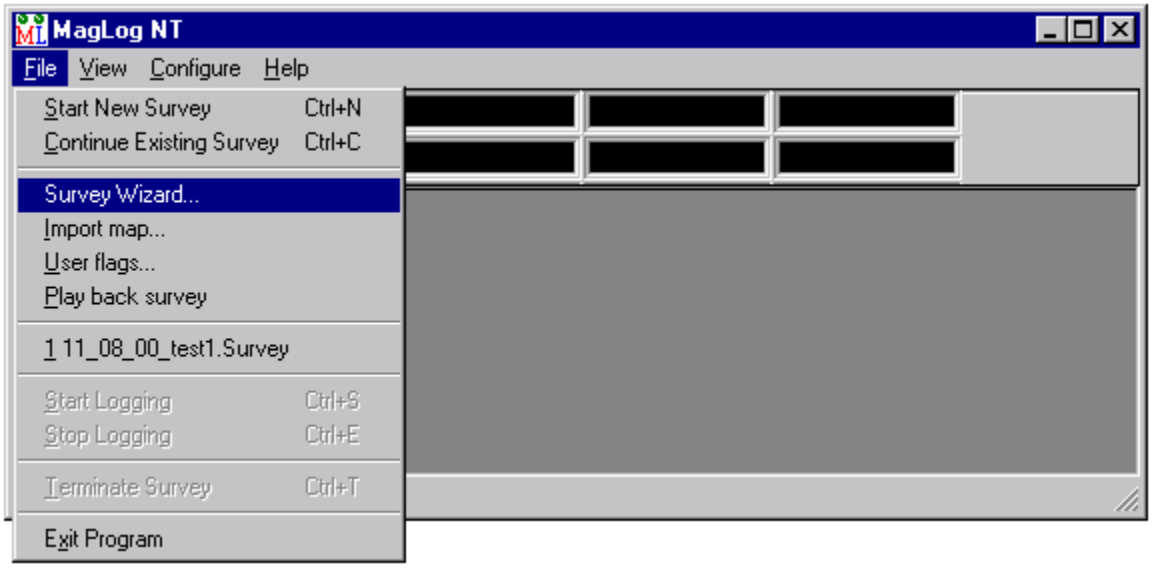
To work with a particular hardware configuration MagLogLite™ or MagLogNT™ should be configured accordingly. It is a highly customizable program that allows a variety of different data presentations. However, flexibility always comes at the cost of complexity and therefore we have endeavored to minimize configuration confusion. For this reason, we have created the *MagLog Configuration Wizard* that is provided to make it easy to configure a survey. It should be pointed out here that the wizard covers only a limited number of hardware configurations that include:

- GPS device sending NMEA $XXGGA strings to one of PC's serial ports. Here "XX" are any characters. For example, for GPS receiver sends $GPGGA messages (GP stands from GPS). Later in this manual GPS string is also referred to as $GPGGA.
- *Geometrics* magnetometers connected to another serial ports. The models supported are:
  - G-880/881 cesium vapor magnetometers with up to two magnetic sensors and optional pressure transducer and altimeter.
  - G-886 / G-877 proton precession family
  - Pulse 12 EM
  - G-823A or B airborne systems (same setup as G-880/881)

Other devices for logging and display may be configured manually (see below). It is possible to configure basic devices (such as the GPS and magnetometer) with the wizard and then append more devices by hand later

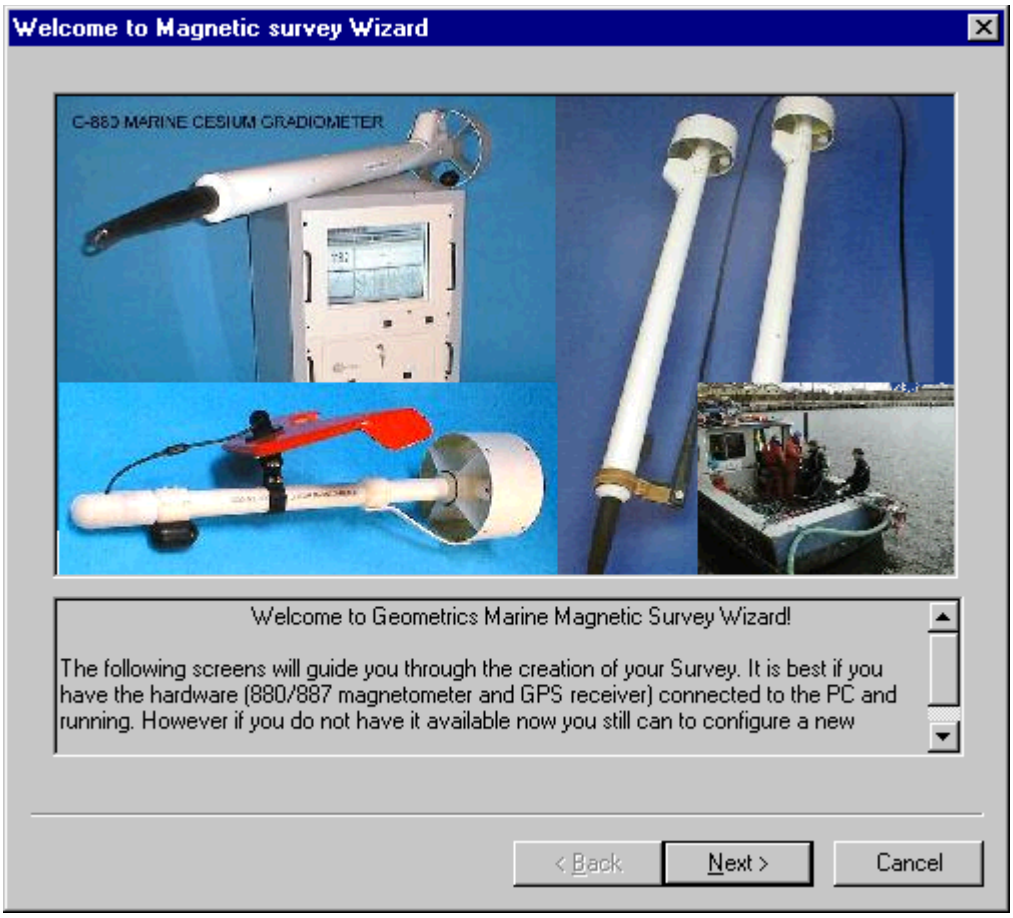
3.1 Starting MagLog Wizard.

To start wizard, select *Survey Wizard* from file menu:



It is recommended that you have your hardware (magnetometer and GPS) connected to the computer and running at this time. GPS should be outputting real positions, and the magnetometer also should be running although it need not be producing real measurements (for instance, it can be lying on the ship's deck). If these requirements are not met you still can proceed with the *Wizard*, but there is some chance that you may encounter configuration problems in future and have to reconfigure the system.

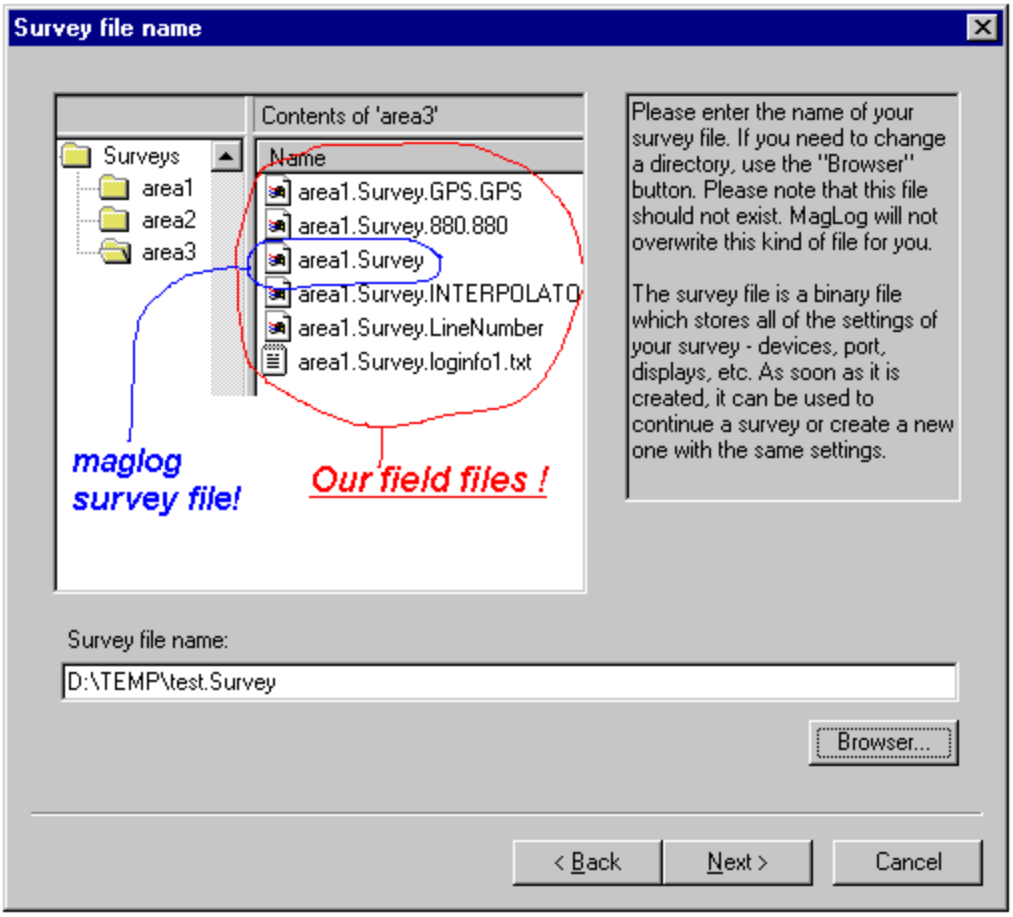
The next screen it the *Welcome* screen:



All *Wizard* screens have a short help file associated with them (duplicated in this document).

Next you must specify a *survey* file name. It is recommended that you press the *Browse* button and select an appropriate folder and name (don't place your survey files in the same folder where maglog.exe executable files reside but in another folder such as C:\DATA\SURVEY1). Please note that the new file name should not previously exist in the folder. MagLog will not overwrite previous survey files.

The survey file is a binary file that stores all of the settings of your survey - devices, ports, display configurations, etc. As soon as it is created, it can be used to continue a survey or create a new one with the same settings.



3.2 Configuring GPS and its display.

The next screen will allow you to configure the GPS. It will work best if the GPS is connected to one of your serial ports during setup. If this is the case, press "Auto set communication parameters" and MagLog will scan your serial ports to find the GPS port and its baud rate. It may take a few minutes; therefore if you know (or you think you know) these com port parameters, set them in the dialog box and press "Auto set Communication Parameter" to check if they are correct.

MagLog can generate a warning if the GPS signal deteriorates during survey. To enable this feature, you should check "Differential GPS fix required" and set the minimum number of satellites. If one of these conditions is not met, an Alarm Window with a warning appears on the screen and a verbal alarm is voiced (requires a sound card and speakers).

A note on real-time layback calculations: MagLog provides a feature that calculates where the Fish is at all times. It does this by noting the position of the GPS antenna and then taking input from you regarding the antenna position relative to the tow point on the back of the ship and the amount of cable deployed. If you plan to use real time layback calculations you will need the *central UTM meridian of your location.* If you are located

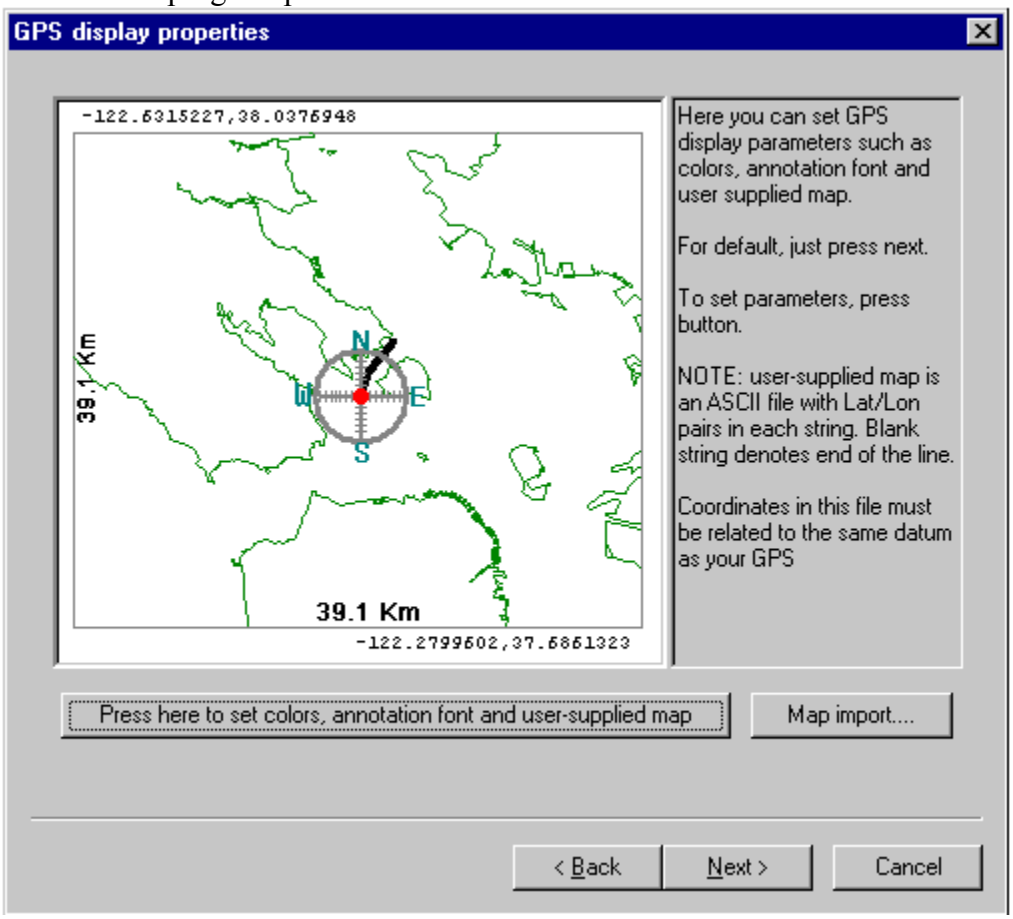
at the same area where you plan to make a survey (or at least in vicinity of few hundreds of kilometers) and your GPS is getting real positions, the *Wizard* will analyze the GPS messages, find the corresponding central meridian and enter them automatically into the proper part of the program. This makes it very easy to configure MagLog Interpolator as shown in the next screens and why we recommend that you have a good GPS data transmission as you set up the survey.

The GPS display can be configured with user selectable background colors and annotation fonts. Also, MagLog has the capability to import ArcInfo shape file maps (more on this in the MagLog Manual). If there is a map available (presented in *ArcInfo* Shape file format) it is possible to combine the GPS display with that map. The screen below shows a typical view of the *MagLog* GPS screen and allows the user to set parameters such as:

- *Press here to set annotation font and user-supplied map*. An additional dialog appears which allows user to set all these parameters. It is assumed that user map (if any) is presented in MagLog format already and user can simply import it. If the map has not yet been transformed into MagLog format, use the next button:
- *Map Import*. This allows the user to select a set of ArcInfo shape files (both .shp and .shx set of files must be available) to be converted into MagLog format. During conversion geometry information can be clipped into a rectangular region and *user marks* and *user lines* can be added to the view. Note that ArcInfo shape

files are available for most regions of the world on several Internet sights at no charge.

Only linear features (such as coastlines, roads, etc) are taken from shape files. Point features as well as names in any associated .dbf file are ignored. The user should take care in employing this MagLog feature as large numbers of shape file elements can slow down the program performance.

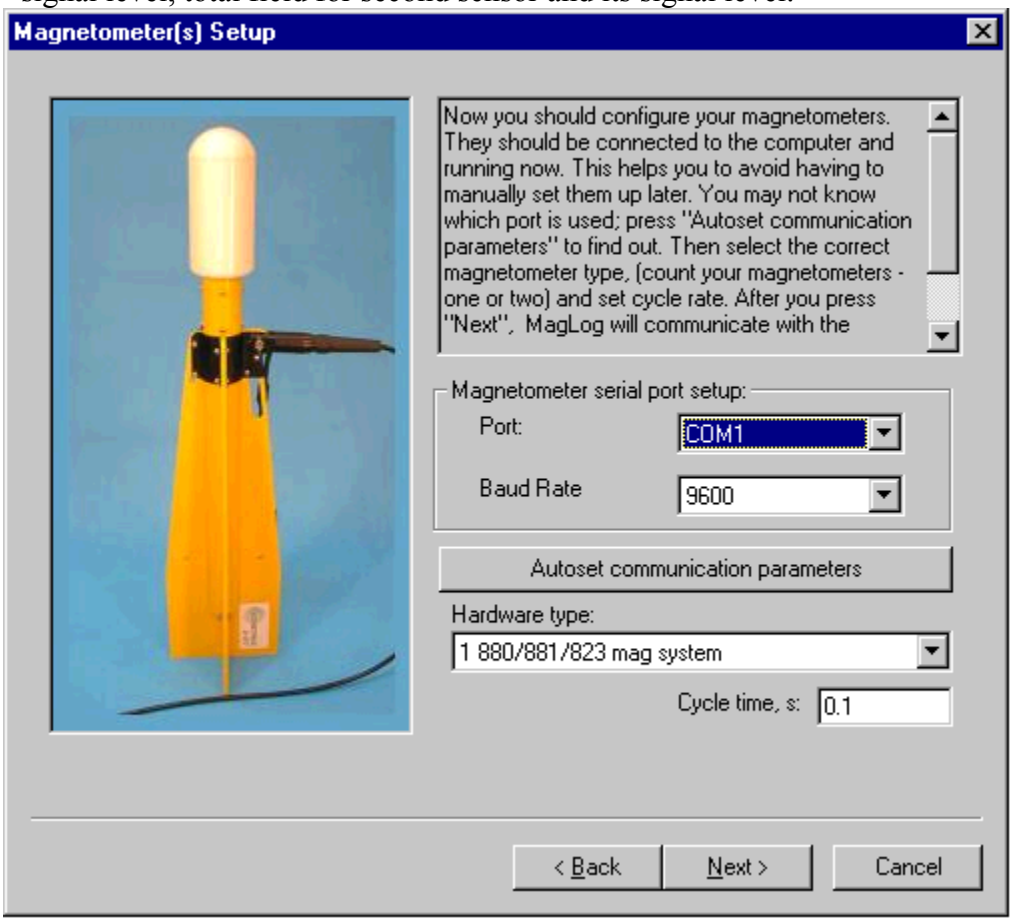


3.3 Configuring magnetometer or EM (pulse 12) hardware.

The Wizard next takes us to the magnetometer configuration section. It is recommended that the magnetometer be connected to one of the computer serial ports and sending data during this procedure. If you know the port and baud rate, set it and *press Autoset communication parameters*. MagLog scans all available ports and baud rates trying to find the magnetometer data. It starts the search with the parameters you have set; therefore if the port and baud rate are set correctly, the magnetometer will be found very quickly.

Next set *Hardware Type*. The following configurations are available:

1. **1 G-880/881/823 mag system**. This system consists of one magnetic sensor with its signal strength channel. It outputs two numbers per reading – total field and signal strength.
2. **1 G-880/881/823 mag with depth sensor**. The same as above, but with pressure transducer. It outputs 3 numbers per reading: total field, signal and a depth reading that needs to be calibrated.
3. **1 G-880/881/823 mag with depth & altimeter.** The same as (2) but altimeter data has been added. The system outputs 4 numbers: total field, signal, depth and altitude. Depth and altitude data both need to be calibrated (see calibration section).
4. **2 G-880/881/823 mag system.** Same as (1) but two magnetic sensors connected into a gradiometer chain (Note: See manual setup for configuration of multiple sensor arrays). Now the system outputs 4 numbers: Total field for first sensor, its signal level, total field for second sensor and its signal level.



5. **2 G-880/881/823 mag with depth sensors** Identical to (2) but has two magnetic sensors connected into the concatenation chain. Outputs 6 numbers: total field for 1st sensor, its signal, depth, and then repeated for the second sensor.
6. **2 G-880/881/823 mag with depth & altimeter.** Identical to (3) but has two magnetic sensors connected into the chain, each with its own depth transducer and its own altimeter. The system outputs 8 numbers that are total field, signal, depth,

altitude and then repeated for the second sensor. Depth and attitude sensors have to be calibrated.

7. **G-877 / 886 Proton Magnetometer.** This device may have additional channels (depth) but they are normally factory pre-configured. Magnetometers need to be tuned for the region you are surveying.
8. **Pulse 12 1 coil system.** For Pulse 12 EM device with one coil (Fish) use this selection. Please connect coil to the first slot.
9. **Pulse 12 2 coil system.** For Pulse 12 EM device with two coils use this selection. Connect coils to slots #1 and #2.
10. **Pulse 12 3 coil system.** For pulse 12 EM device with three coils. Note that even if there is only one coil available but is connected to slot #3, you should select system as "3 coils" after wizard finishes, remove slots for coils #1 and #2.

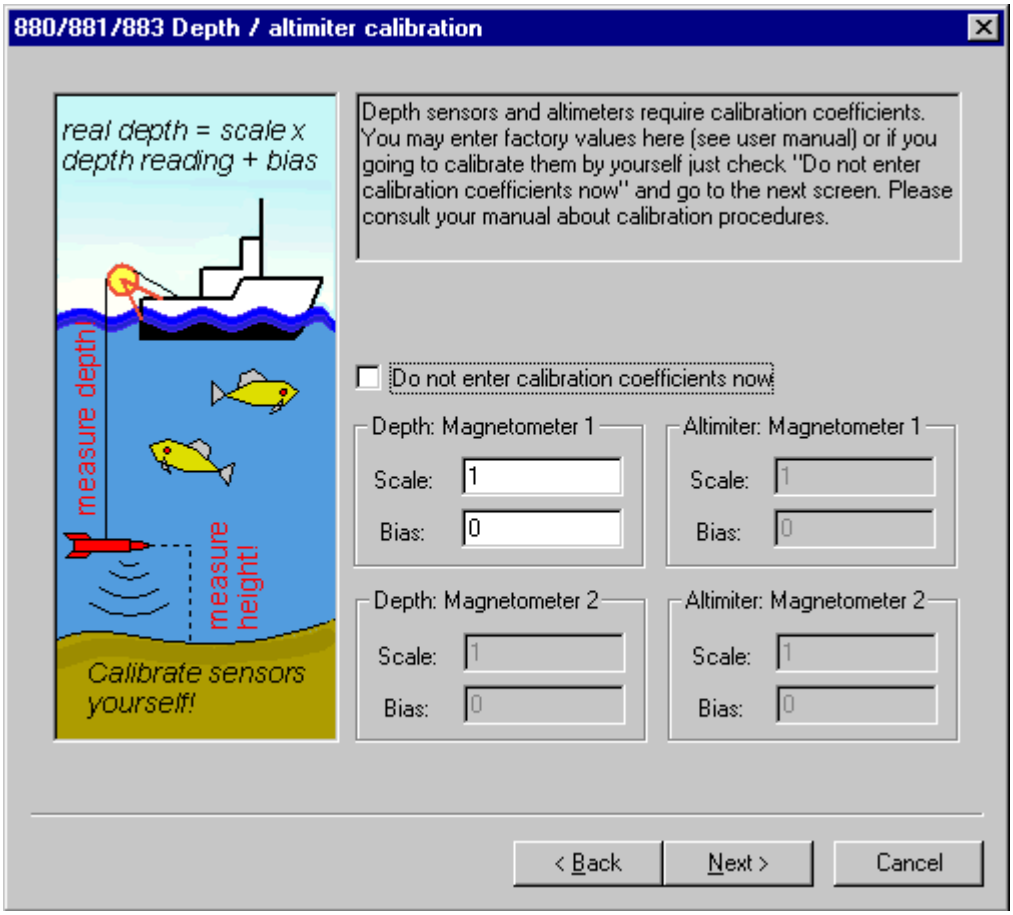
If your hardware configuration does not match exactly one of these 7 pre-defined sets, some adjustments are usually easy to make. For example if you have 2 each G-880 magnetometers with depth sensor and altimeter on one of them; then you can use configuration (6). In this case the depth transducer and altimeter for the second magnetic sensor will output zero values and that is ok for most data processing programs. However if your hardware consists of 3 magnetic sensors in a gradiometer array, you will not be able to use the Wizard to set up the (multi-sensor) array and will have to configure the logging and display manually.

On the Wizard screen you should now set the desired cycle rate for magnetometer. Typical values for the 880 family would be 0.1 seconds (10 HZ) and typical value for proton magnetometer is 1.0 seconds (1.0 Hz) or 2.0 seconds (0.5 Hz).

After all parameters are set and the auto detection sequence has been completed, you can press the *Next* button. Before goings to the next Wizard screen, the program will try to communicate with the magnetometer configure it accordingly. If the magnetometer is not connected, the program will fail to converse with the mag and you will have to press the Cancel button. However, after this cancellation you can still proceed to the next dialog box but we recommend that you use the Wizard only when all devices to be logged are connected and sending data to minimize possible mislabeling of input devices.

The communication program may fail for other reasons as well, such as a wrong number of magnetic sensors entered into the dialog box. For example, if your system has only one sensor and you are trying to configure it as 2-sensor system this situation will occur. Simply go back to the start and set up a new survey with the proper configuration information.

3.4 Magnetometer calibration.

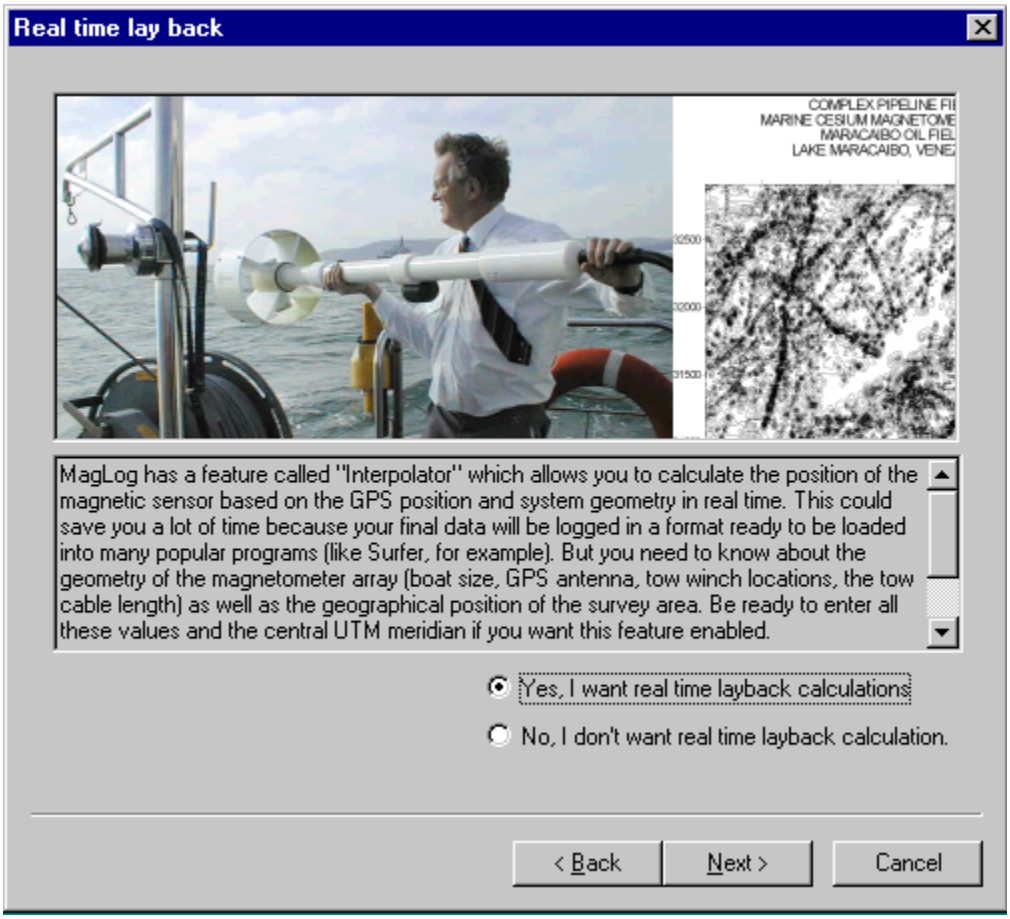


This section is not available for the proton G-877/866 magnetometers or for the EM Pulse 12. If you have one of these devices you can skip to the next section.

If your hardware includes depth or altimeter sensors, they need to be calibrated. The Wizard does not provide full calibration capabilities (see below how to do depth / altimeter calibration) however it allows entering of the calibration coefficients if you know them. These values might be obtained from the factory or as the result of previous calibration procedures. These procedures are outlined in the Magnetometer support disk. Please check your magnetometer manual for more information on how to calibrate depth and altimeter.

You can check the *Do not enter calibration coefficients now* button and the scale will be set as 1 and bias as 0. Do this if you don't know the calibration coefficients at this time. Note that this screen will not appear if you do not have depth or altimeter sensors in your system.

3.5 Real time lay back calculations.



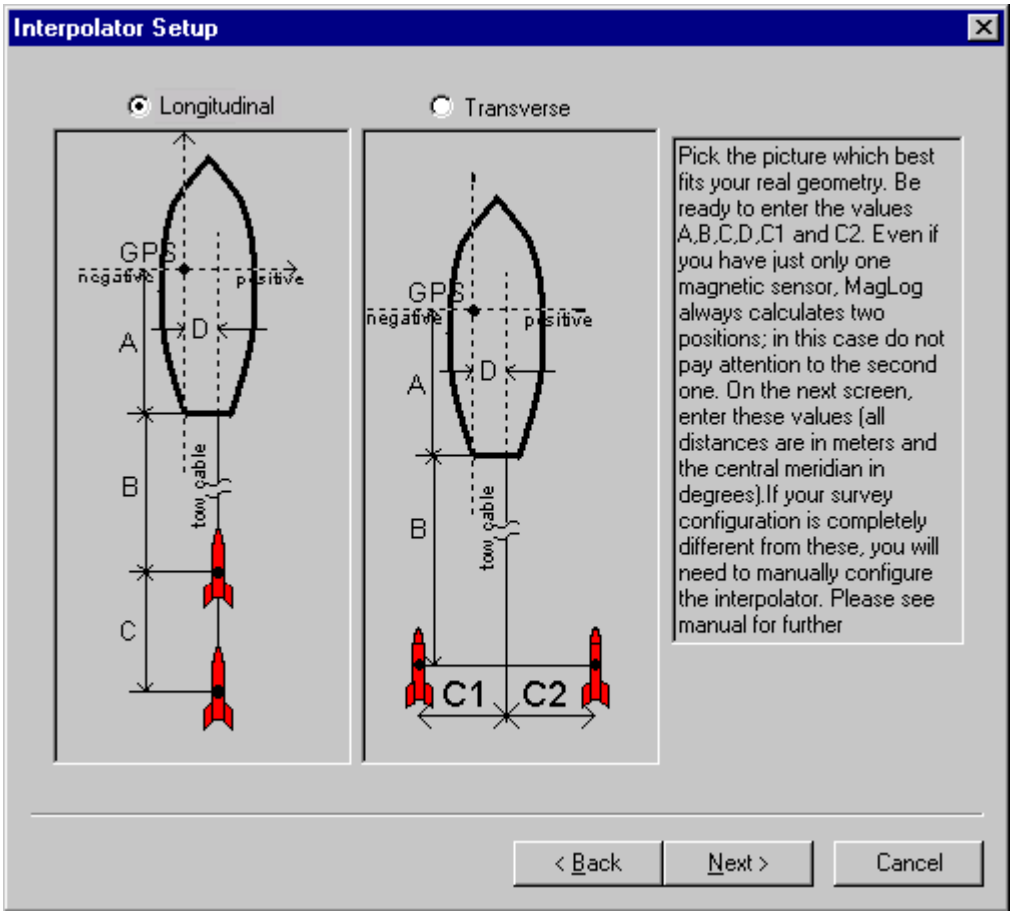
MagLog has a feature called "Interpolator" which allows you to calculate the real time position of the magnetic sensor based on the GPS position and the system geometry. This function saves time and effort because the final data will be logged in a format ready to be loaded into many popular programs (like Surfer or Geosoft for example) with the position of the Fish (not the GPS antenna on the boat) in the file. In order to use this feature, you will need to know the geometry of the magnetometer array (boat size, GPS antenna, tow winch location, tow cable length) as well as the geographical position of the survey area. Be ready to enter all these values and the central UTM meridian if you want to enable this feature.

Hint: If your GPS is reporting correct positions and you "auto detected" it during the GPS configuration step, and then the central meridian will be computed and entered automatically!

To enable the “Interpolator” function, just click “Yes, I want real time layback calculation” and fill in the subsequent information. If you answer “No”, then the set of subsequent screens are skipped and this feature is disabled. If you answer “Yes”, be prepared to answer questions about your boat and cable geometry.

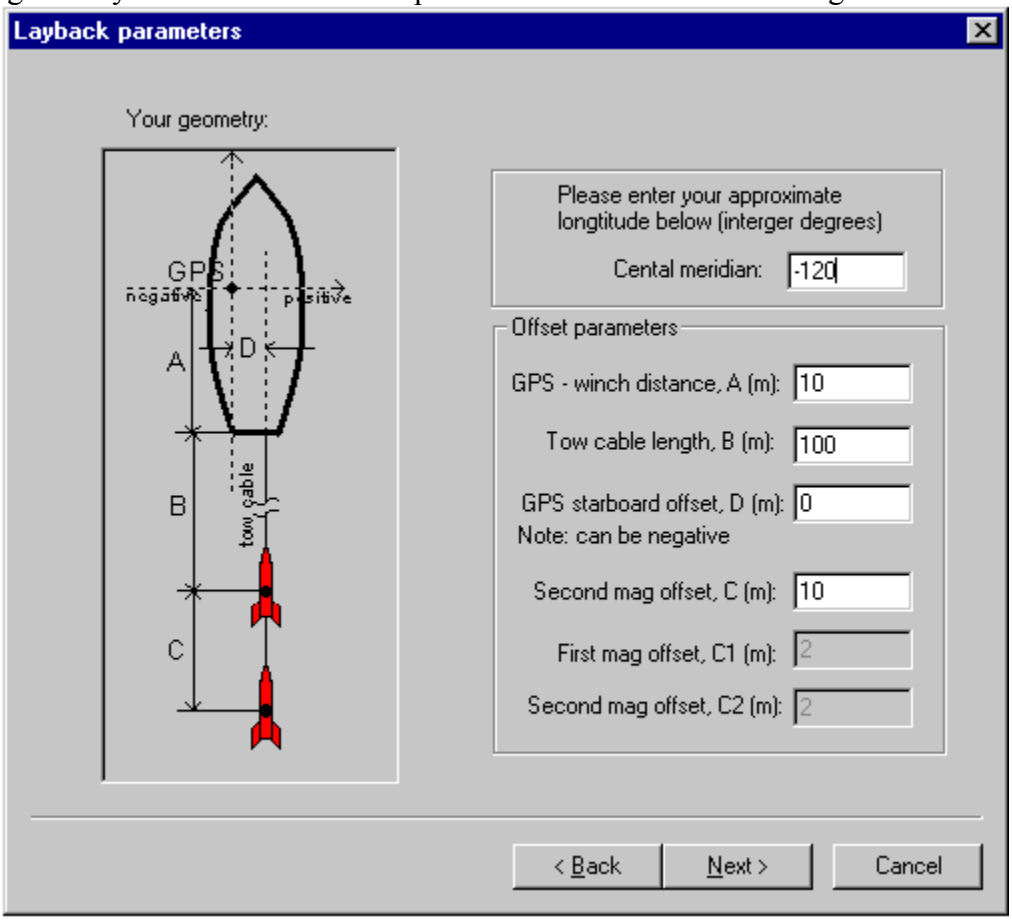
The Wizard does not cover all possible aspects or subcomponents of the *Interpolator* configuration such as the use of a GYRO compass or ORE TrackPoint II underwater positioning system. In the case where you are using such systems you should configure the interpolator manually (see below).

The next screen allows you to choose between two basic single sensor or gradiometer sensor array configurations (for multiple sensors). Note the gradiometer applications are many and varied, primarily associated with wider swath of coverage (transverse horizontal) or removal of the diurnal field variations (longitudinal). Contact Geometrics for more details:



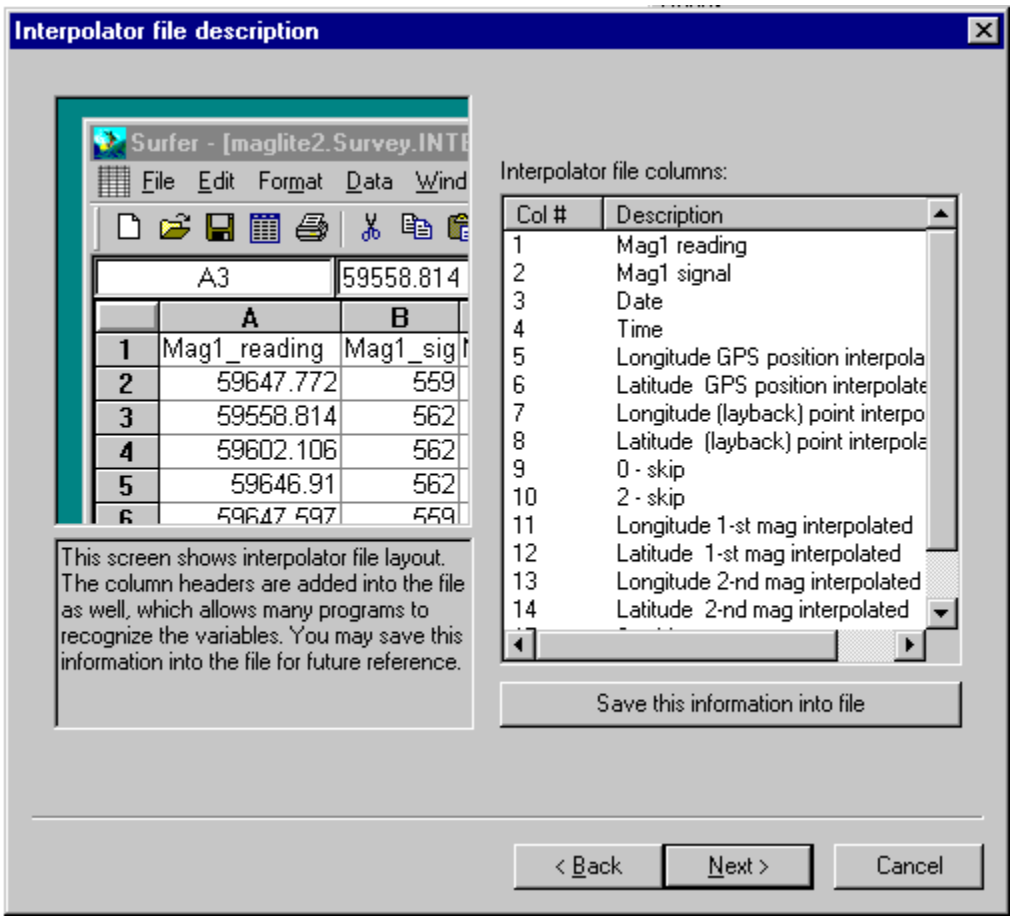
Pick the picture which best fits your actual geometry. Enter the values of A, B, C, D, C1 and C2. Even if you have only one magnetic sensor, MagLog always calculates two positions; in this case simply ignore the second sensor position data. On the next screen, enter these values (all distances are in meters and the central meridian in degrees). If your survey configuration is completely different from these, you will need to manually configure the interpolator. Please see the section on manual Interpolator configuration later in this manual.

On the previous screen you choose which mode (longitudinal or transverse) fits your actual geometry best. The next screen presents the selected mode dialog box:



Note that *Central meridian* field will be filled in automatically if you auto-detected GPS. Other values have to be physically measured on the vessel and entered.

The final Interpolator Configuration screen presents the layout of the interpolator log file. This file consists of many columns and includes magnetic field, signal, depth and altimeter readings as well as the GPS antenna and magnetometer Fish positions. The file can be loaded directly into popular programs like Golden Software's SURFER or *Geometrics* MagMap 2000. It is recommended that you note which data are in which columns for future reference during the analysis and interpretation phase of the data reduction and map making.



3.6 Data Display configuration.

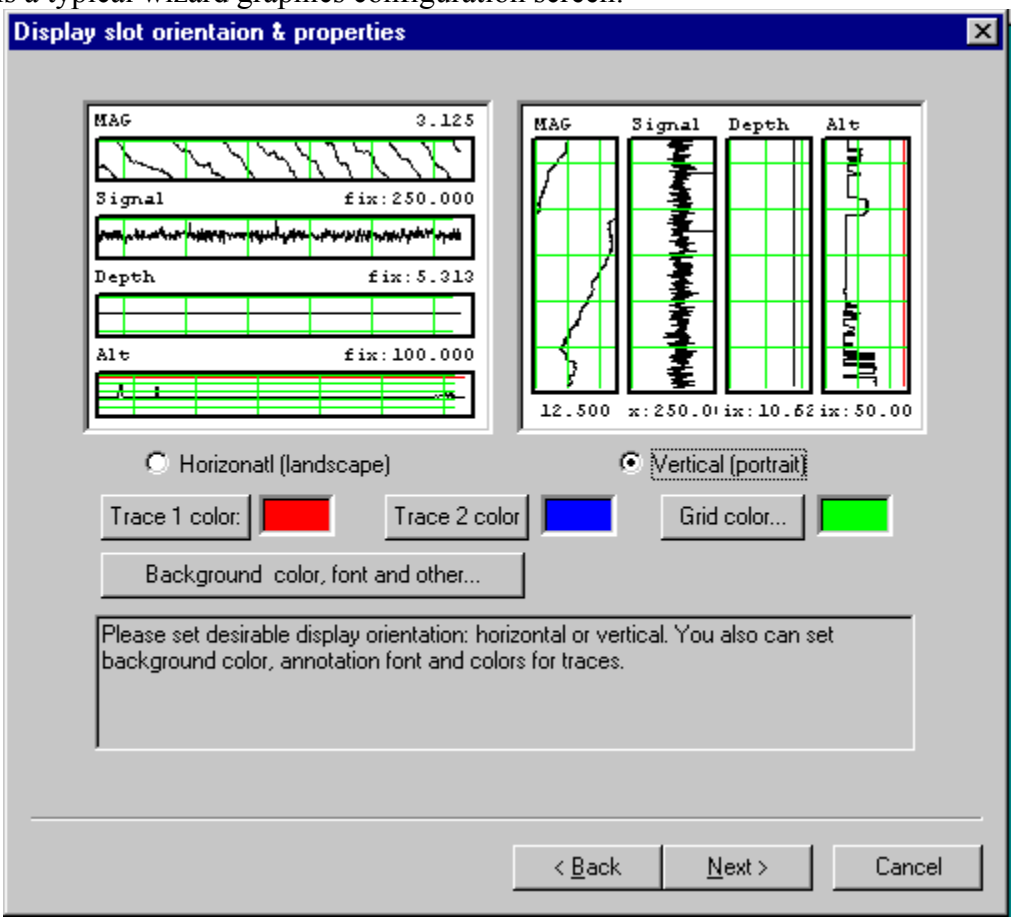
MagLog has several different options for displaying incoming data. Primarily, the data is presented in the form of analog strip chart traces. There can be multiple analog charts on the screen (slots) with multiple pens (profiles) per slot and they can be oriented in either horizontal or vertical mode. Also, each chart (slot) can be set with individual rates of speed and full-scale values. The Wizard covers only a subset of the possible display configurations. The user can choose from the following display configurations:

- Horizontal (landscape) or vertical (portrait) graph orientation
- Traces color.
- Coordinate grid color.
- Annotation text font and color.
- Window background color.

Depending on the configuration, MagLog will display one or more traces in each display slot. For example, if there is only one magnetic sensor, its field is displayed with color 1;

If there are two magnetometers, then color 1 used for first sensor and color 2 used for the second sensor, and both fields are displayed in the same slot. All these parameters can be changed later manually after the survey is configured.

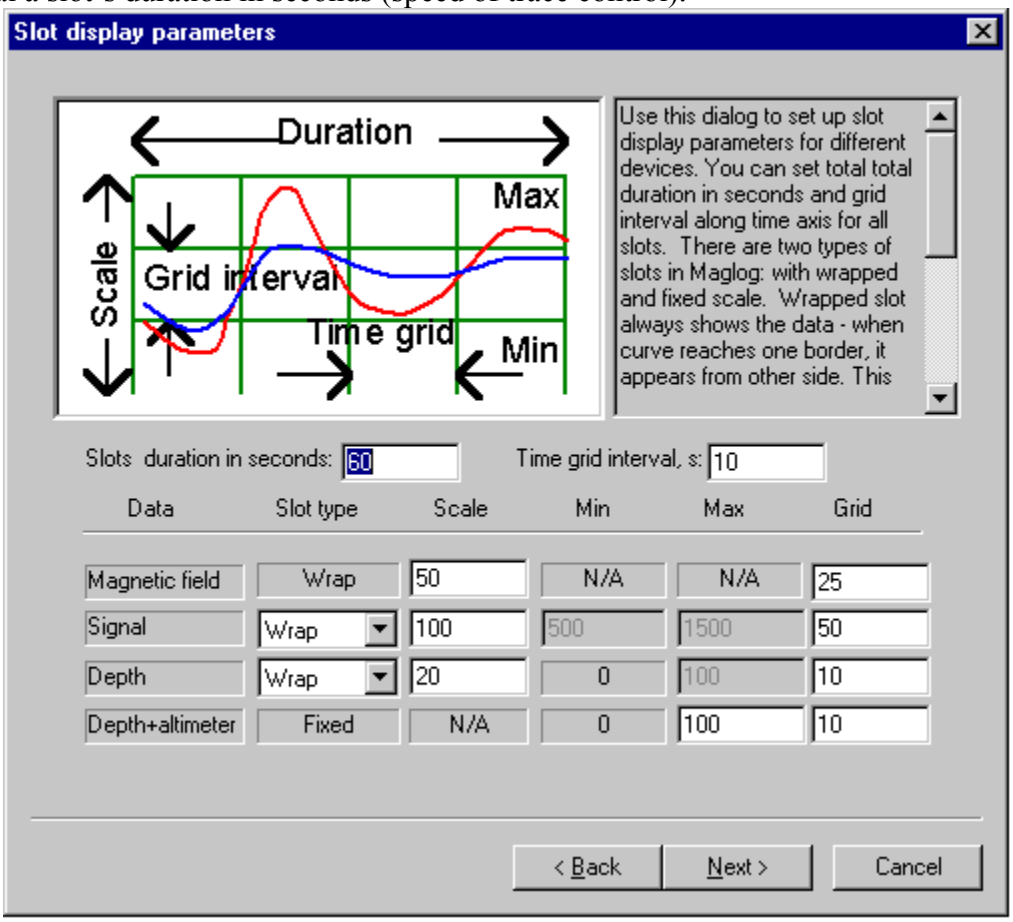
Here is a typical wizard graphics configuration screen:



The next screen allows you to set the scale and grid parameters for the slots, as well as the slot type. MagLog produces an automatic display layout based on your configuration and the following rules:

- Magnetic field is always displayed in the wrapped mode. This means that when the graph reaches the slot's border, it reappears from other side of the slot.
- Signal strength can be displayed as in wrapped mode or in fixed mode. In fixed mode, slot's borders have fixed values; if value to be plotted is out of this range, the profile simply disappears from the screen.
- Depth also can be plotted in either mode.
- If there are depth and altimeter sensors, MagLog makes a "flying Fish" plot. This includes plotting of sum of depth+altitude to show bottom profile and depth plotting in the same slot to show the Fish's actual vertical position in the water column. This kind of plot has a fixed range with the positive axis pointing down (in landscape mode) or left (in portrait mode).

In the dialog box below, the user can set ranges and scales for all the above slots, as well as total a slot's duration in seconds (speed of trace control).



3.7 Configuring printer.

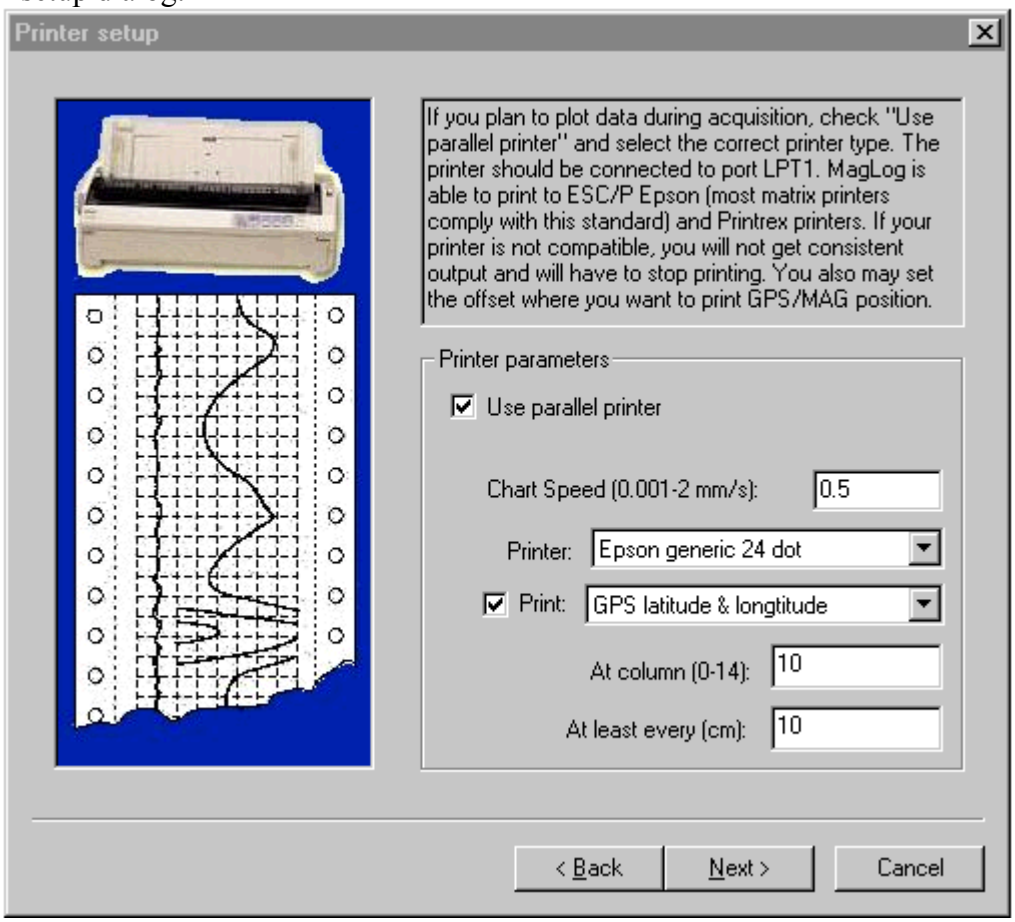
MagLog allows you to produce hardcopy output during data acquisition. This option works with Printrex 8" or 11.5" thermal printers or with standard Epson type dot matrix 8 or 24 pin printers that are ESC/P compatible. Most dot matrix and some ink-jet printers are compatible with these specifications; however consult your printer manual regarding your specific printer.

Connect the printer to LPT1 (or back of the software key or dongle) and check the *Use parallel printer* box to enable printing. Then select the correct printer type. Note that if the printer type is incorrectly selected, unrecognizable characters will be printed.
You also can configure the following printer options:

- Select chart speed.
- If layback calculation is enabled, print GPS position in decimal formal or layback calculated position (actual sensor position in Lat Long).
- Select the position on the chart where text is printed.

MagLog creates an automatic printer layout based on your hardware configuration. This layout can be altered later by hand if you wish. At the beginning of the chart MagLog prints a short legend where it explains the printer layout.

Printer setup dialog:



3.8 Finishing setup.

After the Finish button on the final screen is clicked (not shown here), MagLog will attempt to set up the survey as it was configured. You should have your GPS and magnetometer up and running at this time. If you don't have real inputs coming into the serial ports, MagLog will still create a survey, but you won't be able to run it. If you are running an unregistered version of the program or do not have a registration Dongle Key (goes into printer port to enable full access to program), MagLog will switch data inputs from serial ports input to data file input (demo mode).

MagLog creates two windows, a magnetometer display window and a GPS view window, and tiles them on the screen. The GPS window initially has the minimum possible magnification so you are able to see whole earth globe. Make this window active with the mouse (by clicking once on it) and then use "+" and "-" keys to set desirable magnification (zoom to your area). Use the arrow keys to shift or translate the location map horizontally or vertically

The Magnetometer window begins with a default layout. It can be altered manually if desired (see manual configuration section below). Make this window active with a mouse click and then use the arrow keys to navigate between the slots and change the data FULL SCALE values inside each slot.

4 Manual Configuration of Input Devices:

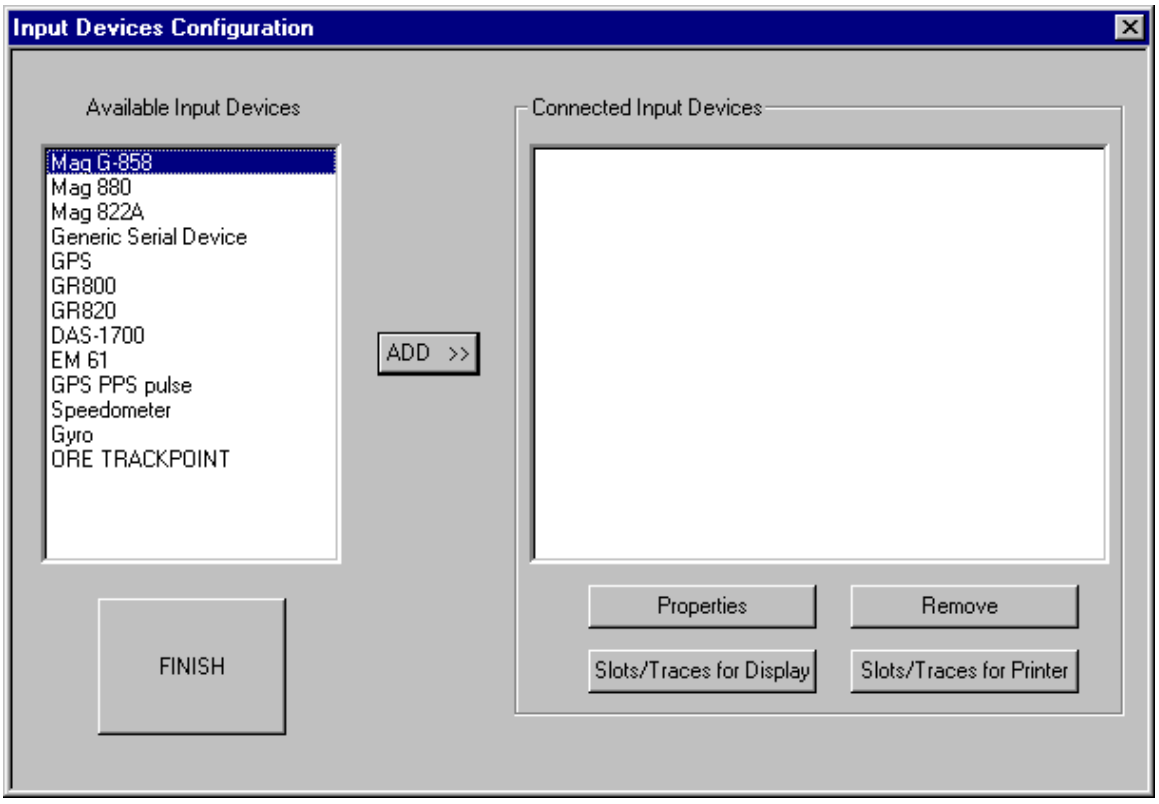
The following procedures will show you how to manually configure input devices. This includes magnetometers, global positioning systems, gyro's, tracking systems and others.

For each device that you want to configure, you need to have a unique communications port assigned to that device.

If your current survey is based on hardware settings from a previous survey, or you opened an existing survey, you will not need to start the hardware configuration procedure from the beginning. You will simply have to edit or revise the existing settings. The following section assumes you are initializing a new hardware configuration.

You may select "*Configure / Input Devices*" from the menu:

You will then see the following dialog box:



This is the Input Devices Configuration dialog box. It is the central dialog box for changing which devices will be logged, how the displays will appear on the screen and how the data will be printed on the printer.

From this dialog, you add devices of your choice. After adding the devices, you will then specify how you wish the data to be plotted on the screen or printer.

4.1 Configuring serial port parameters.

All serial devices supported by MagLog have a common menu in their configuration – serial port parameters. MagLog assumes that every serial connection has the following fixed parameters:

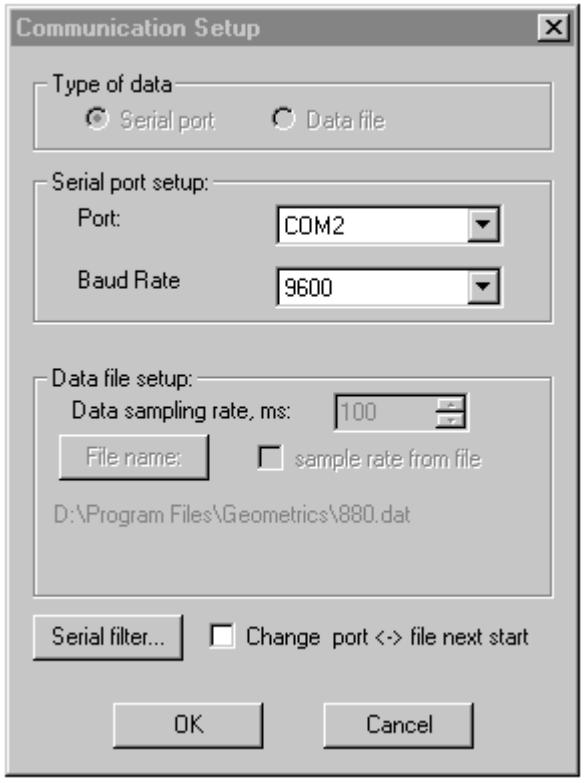
- 8 information bits.
- No parity.
- 1 stop bit.
- No hardware flow control.

These parameters cannot be changed within MagLog and therefore devices must be configured in such a way as to meet these requirements.

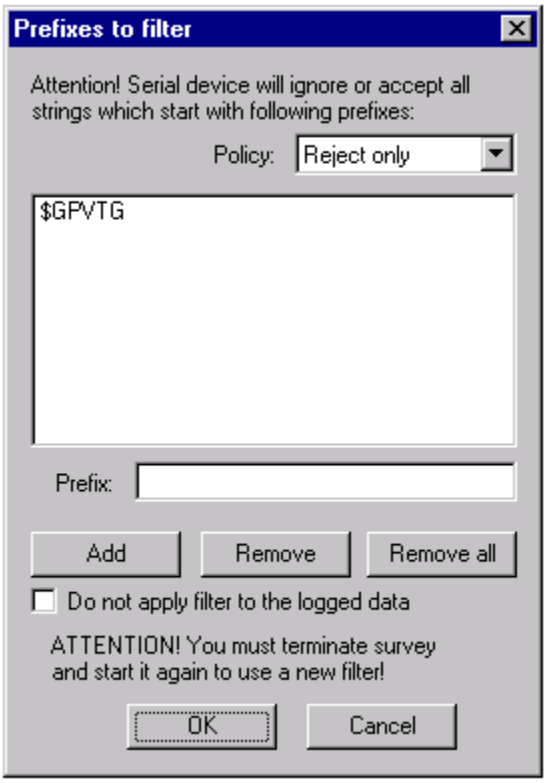
Other parameters can be configured (for each device individually):

- Data Source: from serial port or data file. Once a device is created, you cannot alter this choice.
- Serial port number (COM1, COM2 etc.)
- Baud rate.
- Data sampling rate if data is being read from a file, in milliseconds. Note that MagLog may not keep up with this rate precisely: it depends on system load and other factors. If you are using this feature to play back your data, there might be slight discrepancies between GPS positions and magnetometer readings.
- File name to retrieve and read data
- There is an option that allows the program to compute the sample rate from the data in the file. In this case the file must have date/time stamps (the typical case when data is logged with MagLog).
- Serial filter. This is list of prefixes to filter out unwanted serial strings. When MagLog sees a string that starts with one of these prefixes, it filters it out (no logging, no parsing). One of the possible applications for this is to connect one physical device with multi-string output to two serial ports (thus creating two MagLog logical devices) and set proper filters for both of them such that one string is received in each port.
- Change "port <-> file" next start. If user wants to change input data source from serial port to data file or vise versa, this box should be marked. It signals MagLog to switch data source from serial port to data file (or the reverse) the next time the survey is started. *For example, the user has acquired some data and now he or she wishes to use these files for training purposes. To "reconnect" MagLog from the serial port to the file, check this box and terminate the survey. Then restart the survey. MagLog will try to read data from the files, and there will be an opportunity to enter the file name. Another case is when the user is preparing for a field trip. He or she can create a survey to be used later for the actual acquisition. The created survey includes all the devices with their display configurations, etc., and it works with all files. To use this survey as a real survey, check this box for all serial devices and terminate survey. Then restart it. If the serial port information is not correct (port and baud rate) adjust it*.

This is what the serial parameters dialog box will look like:



And the Serial filter dialog box appears as:



To add prefixes, type the new string into the **Prefix:** field and press **Add.** The string will be added to the prefix list for the particular device. You can remove a filter string from the list by selecting it and pressing the **Remove** button, or by pressing **Remove All** to clear the list.

Depending on the *Policy* settings, MagLog will accept or reject strings with prefixes in the list. If the policy is set to *Reject only*, then all strings with the listed prefixes are rejected. If the policy is *Accept only* then *only* strings identified in the list are accepted, the rest are rejected. This latter condition may be useful when some string formats are unknown.

A Serial filter can be applied to MagLog displays without being applied to the recorded data. If "*Do not apply filter to the logged data*" is checked, then MagLog uses filters inside the program to filter serial data for display purposes but all data transmissions from the serial device are logged. If this box is not checked, the filter is applied to the logged data also, which then reduces the amount of logged information and the data file size.

For example, a Gyrocompass outputs two messages:

$HEHDT,183.1,T*24 06/22/01 10:22:55.737
$HEROT,13.5,A*1C 06/22/01 10:22:55.754

The first message, $HEHDT reports true ship heading and is used by MagLog. To accept this message add $HEHDT in the list and select the "*Accept only*" policy. If "*Do not apply filter to the logged data*" box is not checked then only $HEHDT messages are logged. However if box is checked both $HEHDT and $HEROT messages are logged.

Now if there is a $HEHDT prefix in the list and the "*Reject only*" policy is selected, MagLog filters out all data strings (and therefore gyro compass light stays red). If at the same time "*Do not apply filter to the logged data*" box is checked, the data is still saved to disk. (Light stays red, but numbers show increasing size of log file).

Note: For a new list to take affect, you must restart your survey.

Note: If you don't want any filter, select "*Reject only*" policy and leave the prefix list blank (this is the default condition).

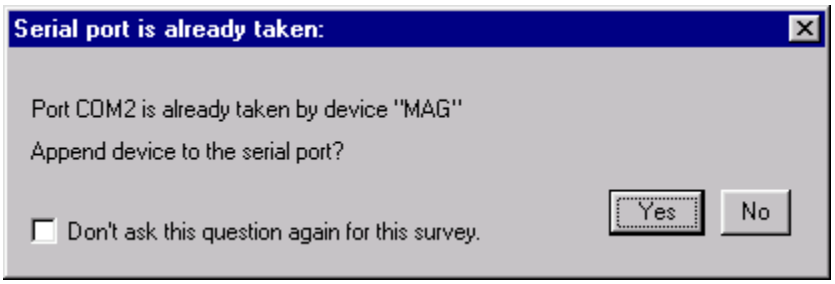
4.2 Using one serial port to record multiple serial devices.

It is possible to attach more than one logical serial device to one physical serial port. For instance, if the GPS and magnetometer data are mixed in the same data stream, the MagLog GPS device and the MagLog 880 device can share the same port. The software can open the data stream twice to log each part of the serial stream as a separate input,

thus allowing each “device” to have its own display window. Proper prefix filtering in this case could be used to separate 880 and GPS data inside MagLog.
To share serial port among multiple devices the following conditions must be met:

- Each device has exactly the same baud rate.
- Each device should work in ASCII mode and use same string terminator.
- Only one device is allowed to talk back. For example for 880 / 881 magnetometers, MagLog sends commands down the line to configure the magnetometer. This means that two 880 devices cannot share the same port. However a G-880 magnetometer and a Generic Serial Device can share the same port.

When the user sets up another serial device using the same port the following message appears:



Here is “MAG” name of the device that is using this port already.

Note: If there are no serial filters used (see Configuring serial port parameters.) log files for each serial device sharing the same port hold the same information.

4.3 Configuring the G-880 magnetometer:

In order to configure your magnetometer correctly, you need to know

1) How many magnetometers you have.
2) How many analog channels each magnetometer has.

In this manual, we will refer to channels as analog to digital converted data transmissions such as the signal, depth sensor, and altimeter that your magnetometer outputs. We also assume that every magnetometer outputs a magnetic field by default.

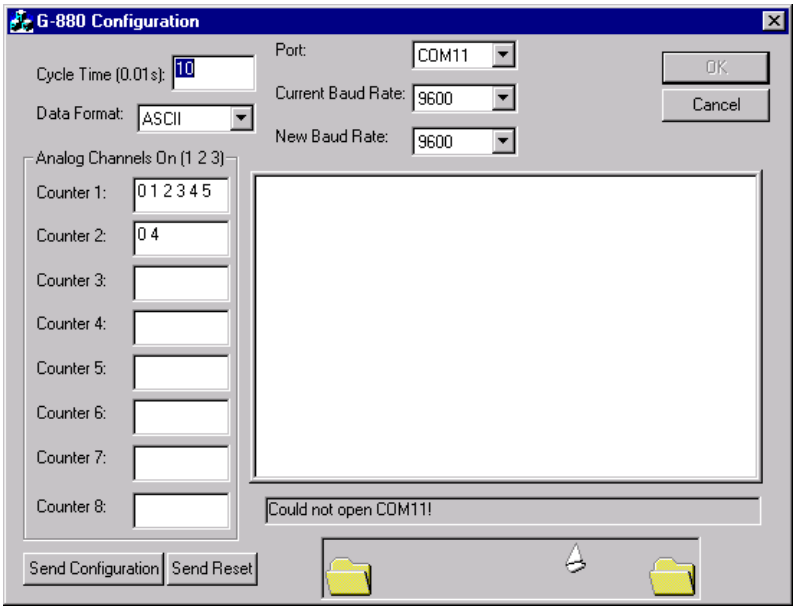
The magnetometer configuration is accomplished in two steps discussed in this section:

1) Configure the hardware (tell the magnetometer what to output)
2) Configure MagLog NT (tell the software what is coming).

4.3.1 Configuring the magnetometer:

The hardware configuration is achieved through a screen labeled "G-880 *Configuration"*.

You access this screen by selecting "Mag880" on the left pane of the Input Devices dialog box and then clicking on the "ADD" button. This is the screen that allows you to setup and communicate with the magnetometer hardware. If you have used a terminal emulation program such as Hyperterminal, you will find it quite similar in that you can use this screen to see the data coming in on a given port, adjust the baud rate, and enable channels through device-specific commands.



The program will attempt to communicate with the magnetometer using the default communications port. If you get a message such as the one seen above: "Could not open COM11!" this means that MagLog NT is unable to read any data coming in on the specified communications port. The following steps should allow you to systematically correct the error and get your device working:

1) **Set the communications port and baud rate**. Complete the entries in the boxes labeled "*Port*" and "*New Baud Rate*". After you have specified these, you should then press "*Send Configuration"*. (Default baud rate for the CM-201 counter in G-880/881/823 is 9600. Port refers to the computer serial port to which you have connected the device). You should then see a series of numbers (magnetometer data strings) scrolling up on the large empty box. This confirms that the communications port is receiving data.

2) **Enable analog channels:** This is accomplished by making entries in the section labeled "*Analog Channels On*". "Counter" refers to the CM-201 counter board that is installed in each magnetometer, so we are effectively setting up the analog output channels in each magnetometer sensor electronics assembly. To enable a channel from

a counter, enter a channel number as shown above. Multiple channels should be separated by a space. For instance, if you have two magnetometers, one with field, signal, depth, and altimeter and the second with field and signal, you will enter the following:

Counter 1: 1 2 3	Note:	Channel 1 default is Signal Strength
Counter 2: 1		Channel 2 default is Depth Transducer
		Channel 3 default is Echo Sounder Altimeter

In this case, "0" always refers to the digital magnetic field value that is always on, and 1, 2, and 3 refer to the auxiliary analog channels that the program will attempt to enable. It is not necessary to enter "0" in the dialog box because the magnetic field is always enabled. If the analog channel is not valid, you will probably get some nonsensical "dummy" strings, i.e., the counter will try to output a number even if there is no reading. If you accidentally enable a channel that is not valid, you can correct the setup and then re-send it to the CM-201 counter in the magnetometer using the "*Send Configuration*" button.

3) Check **for correct data:** After entering all channel information, you can check to see if you are getting correct data by counting the number of transmitted data fields separated by commas. For instance, in the above example, one would expect to see strings such as:

40001.24, 0243, 2001, 1209, 40291.35, 0543

From this, you could easily tell if there was a missing a channel by counting the fields. In this case, you specified six channels and received six strings, the correct result.

4) Specify **Cycle Time:** You may also specify the **cycle time** – the time between sequential magnetometer readings. Cycle time is specified in units of 0.01 seconds (total time between readings = cycle time times .01 seconds), so if you want ten magnetometer readings per second, you will specify 10, or if you wanted five magnetometer readings per second, you will specify 20. Note that for the CM-201 the practical limit on cycle time is approximately 20Hz. The system can be run at 40Hz or higher but there will be significant degradation of the signal quality.

Remember that you have to press "***Send Configuration***" to make any changes to the above configuration. If you want to reset the magnetometer to its original powered on state, press ***"Reset Configuration***".

Note: After you have specified these settings once, setup will default to these same settings until you change them.

Possible Problems and Solutions to Communications Setup:

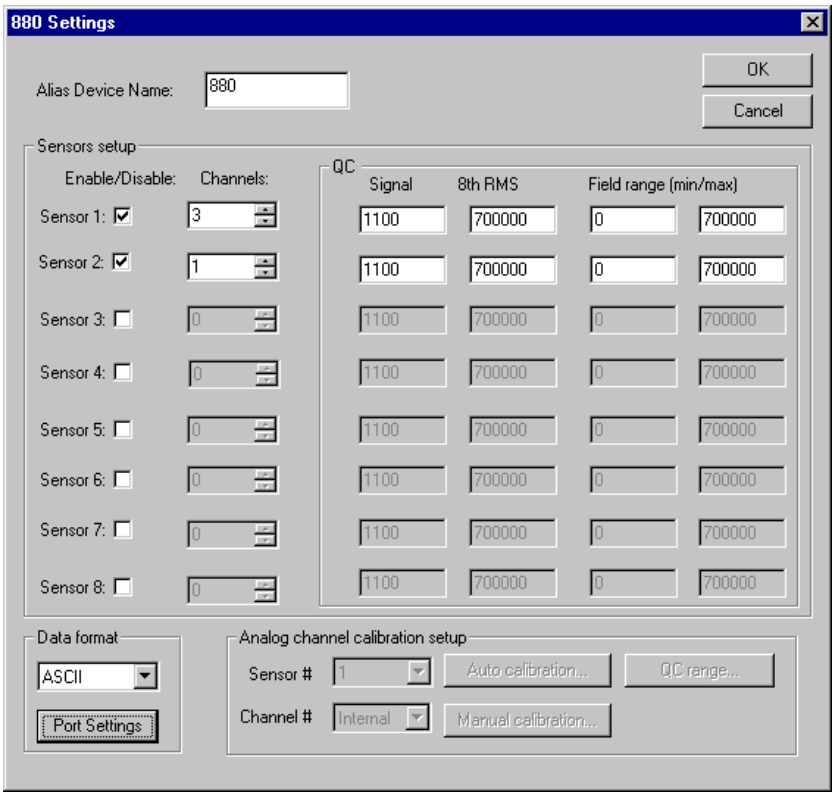
a) **No magnetometer data on the screen**: This could mean that you have an invalid communications port, your magnetometer is not powered on, or your magnetometer is not properly connected. If you are not getting a message like the one described above: "Could not open COM11", you should check to see if your magnetometer is on. If it is, try to test the communications port by using another source of external data (e.g. you could try a simulator that outputs RS232 serial data streams, or you could hook up a GPS or Personal Digital Assistant to that port to check communications).

   If you are unable to open the communications port, make sure that you don't have any other devices using the same port. Right click on My Computer, then left click on Properties, left click on Device Manager and then scroll down to Ports (Com & LPT). Expand this section by clicking on the + box next to Ports and identify that the Com port you are setting up exists and that it is not conflicting with any other device (IRQ conflict). Also, some "listening" programs such as Hyperterminal, PDA Palm HotSync, Modems or Fax software will keep the communications port busy until you exit it. If you still have trouble, it sometimes helps to completely shut off the system, and reboot. This will reset all the computer hardware.

   It is necessary to resolve any problems in the setup of communications ports at this time. If you are not getting good transmission from the magnetometer or GPS please detail all information about the setup and hardware configuration in an email to support@geometrics.com. We will do our best to troubleshoot your hardware difficulties.

b) **Data is scrolling up the screen, but it is not recognizable:** Check the baud rate. Often, if you are on the correct communications port, but the baud rate is incorrect, you will get gibberish on the screen.

After you are done, press "OK" and you should see the following screen:



4.3.2 Configuring MagLog NT or MagLogLite to recognize incoming data:

While we previously informed the Magnetometer what data we wanted sent to the surface, we now enter data to inform MagLog how to interpret the incoming data flow. Specify the number of channels you expect to see as per the previous magnetometer setup, and label the device name for in-survey reference. You can also set pre-set limits on the values of the analog and digital channels that will generate warning messages (visual and auditory) if values go out of range. This is very useful in a noisy environment where you cannot watch the screen at all times. Types of warning might be lack of data, bad GPS fix, sensor too deep or too close to the bottom.

To specify an alias for your device (the name that will appear on all windows associated with your magnetometer), you can type a name under **"Alias Device Name**". Here, we have selected "G-880".

The sensor setup is also very important. You need to carefully count how many strings are coming in your communications port. Above, a sample string for two magnetometers was given as:

40001.24, 0243, 2001, 1209, 40291.35, 0543

The incoming string is shown above. The MagLog program needs to know

1) The number of concatenated magnetometers you have coming into a single serial port – you can select up to eight by checking the sensor boxes as shown (note that cable length and bandwidth considerations may limit the number of concatenated magnetometers one can employ).
2) The number of additional analog channels for each magnetometer. The magnetic field value is not assumed to be a channel.

If we apply the above two rules to the string above, we notice that we have two magnetometers, one with three channels, and the second with one channel.

Enabling the proper number of channels and sensors is very important.

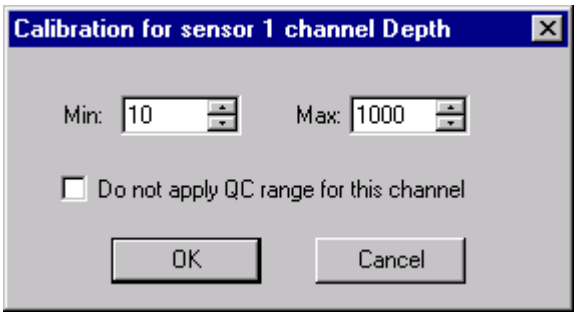
You also have another opportunity to change port settings by selecting the "*Port Settings*" button and entering information into the following dialog box. If the "*G-880 Configurations*" screen exited successfully, you will see the dialog box below that reflects the port settings you previously selected. Otherwise, port settings will default to COM1.

You also have the option to set various quality control values that will generate useful warning messages during survey operations:

The quality control options are:

a) **Signal**: Set the minimum signal value you would like to allow during the survey. Good data is characterized by a strong signal, and data with signals lower than 300 are suspect. A good range for this value is probably somewhere between 600 and 1200. If the signal drops below this value during the survey, you will get a warning message.
b) **8^{th} RMS**: This is the magnetic field quality control value that gives a measure of how much the field is varying. The 8^{th} RMS is computed by computing successive differences of 10 readings. A higher RMS is indicative of a noisy field, and you should specify the highest value you will tolerate, e.g. 2nT.
c) **Min and Max Field**: This will allow you to specify minimum and maximum fields you expect to occur during normal survey. This could be set so that you will be alerted to the existence of a large anomaly.

You also have the ability to set quality control values for your analog (e.g. depth and altimeter) channels by selecting the sensor number, channel number, and pressing "QC Range…". This will bring up a dialog box that you can fill out to set quality control values. A sample is shown below:



Here, we have selected Sensor 1, and selected the analog channel, "depth". The option labeled "*Do not apply QC range for this channel*" is usually checked, which would result in no quality control factors being used for this channel. However, we have unchecked it and set a minimum value of 10, and a maximum of 1000. If a depth value is not within the range we have specified, we will get a warning message.

Note: The signal quality control should only be enabled from the main screen. If you enable quality control through the button, "*QC Range*", but do not specify any values under "*QC*" on the main screen, the program will not generate any warning messages.

You also have the option of setting quality control values for the three unnamed analog channels, 4, 5 and 6. (Channels 1 to 3 are for signal, depth and altimeter. Additional analog channels are available in the 880 internal counter modules [CM-201 or CM-221] for special purposes like yaw, pitch and roll sensors).

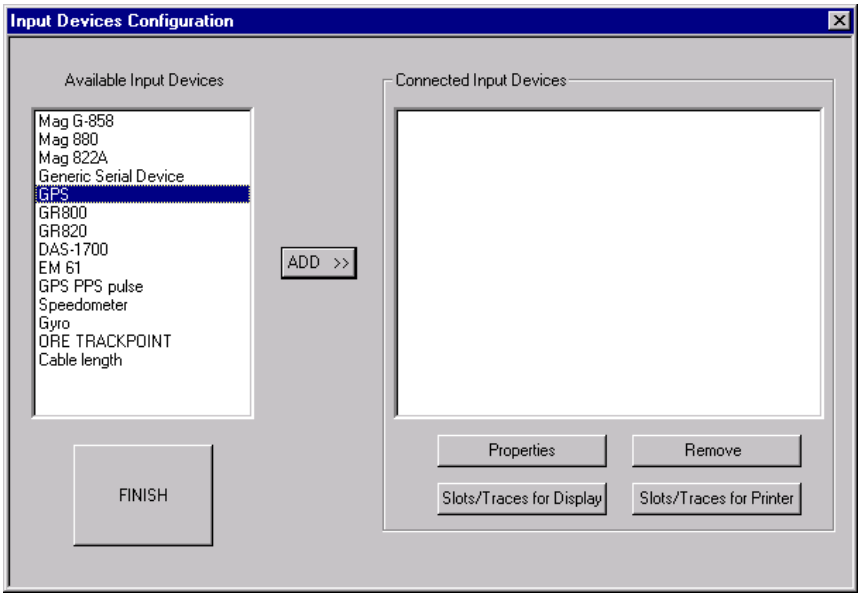
The calibration of analog channels will be discussed later in this manual.

When you are done, press "*OK*" to continue on with your setup, or "*Cancel*" to cancel any changes you made.

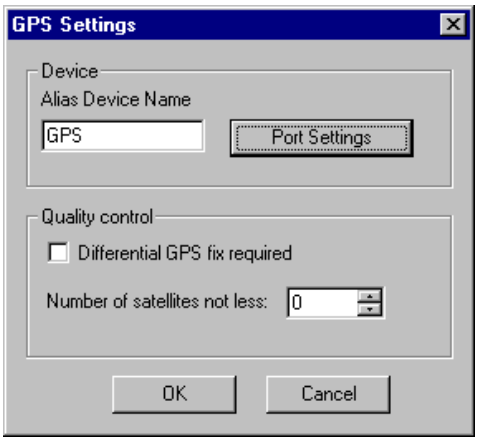
Note: Once this screen has been exited, the only way to change the port settings is to delete the magnetometer setup and start over.

4.4 Configuring the GPS:

The GPS can be configured by highlighting the selection "*GPS*" located in the left window of the Input Devices Configuration dialog box.



The following dialog box will appear:



This dialog box allows you to select a device name, configure the port settings (much like that done with the magnetometer) and set quality control factors.

Click on "Port Settings" to specify the communications port selection.

The quality control factors available are:

a) **Differential GPS fix required**: This will give a warning message if there is no differential fix available.
b) **Number of Satellites**: If the number of satellites is not at least as many as you specify, you will get a warning message each time a new GPS reading comes in (e.g. in the above example, you will never get a warning message because there are always at least 0 satellites). This can get rather annoying if you don't have enough satellites, but it is a good indicator of the accuracy of the GPS

coordinates. It is commonly understood that 6 or more satellites are necessary to get the best position data.

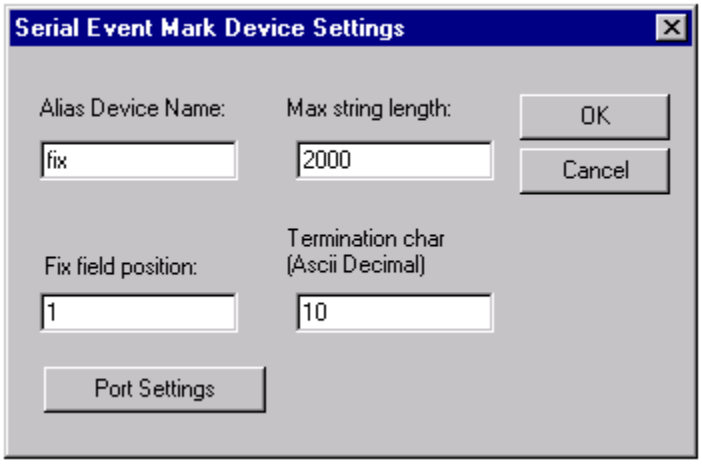
4.5 Configuring Serial Event device.

Serial Event Mark device is useful if some event is used as an index for all data streams, and user wonted to include “event number” into every log file and print it. Let’s assume that some device generates strings like:

1241, 21-Feb-01 17:24:30,351783.12,146676.69,01°19'36.000"N,103°40'04.002"E

Here is first number, “1241” is fix (or shot, event) number. To include “fix” value into every log file and print it, user has to configure *Serial Event Mark* device. Note that “fix” number is always an integer.

Go to Configure / Input devices and select *Serial Event Mark* from the list of available devices on the left side of the dialog box. Press Add and the following configuration dialog box will appear:



Alias device name: User enters device name.
Max string length: Set buffer size to accommodate any possible string coming out of your device. In many cases 2000 will work just fine, but you should change this value if your device generates particularly long strings.
Fix field position: Numerical field number where “fix” is located. For above example It would be 1, because “fix” is first in the string. Here is how MagLog parses an ASCII string:

11111s22222s33333s44444s55555s66666<LF>

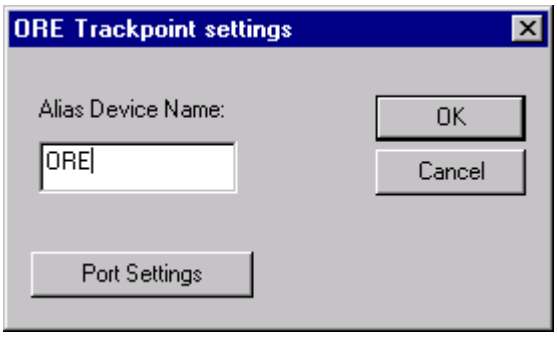
We have used a symbolic format for clarity, here “11111 …. 66666” represents numerical fields and “s” represents a separator that can be any character that is not in the string: “-0123456789.EeDe+” To display a value “11111” as a fix you should refer to it as “1” and to display value “66666”,refer to it as “6”.

Termination char This is the last character of the string. In the case of ASCII strings it is normally ASCII 10 (LF or Line Feed).

If a *Serial Event Mark* device is present, it will change the log files of other devices: before recording the date and time stamps, MagLog records the current fix value.

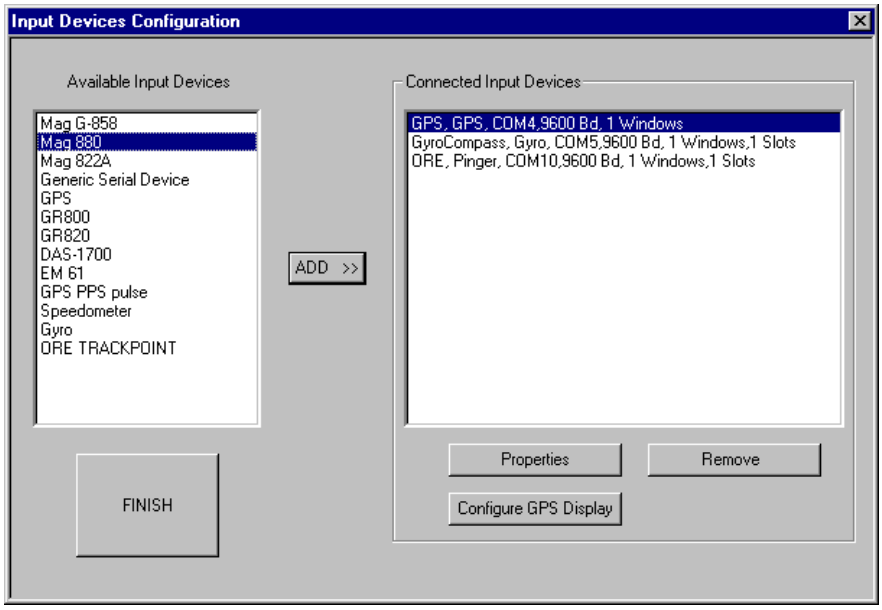
4.6 Configuring the ORE Trackpoint II Sonar Tracking Device

Select ORE Trackpoint and click on the "ADD" button. You should see the screen below:



Here, you can set the device name (specified as *ORE* in this example) and the communications port and baud rate (through the "*Port Settings*" button).

After you have pressed "OK", you will then see the following display in the Input Devices dialog box:

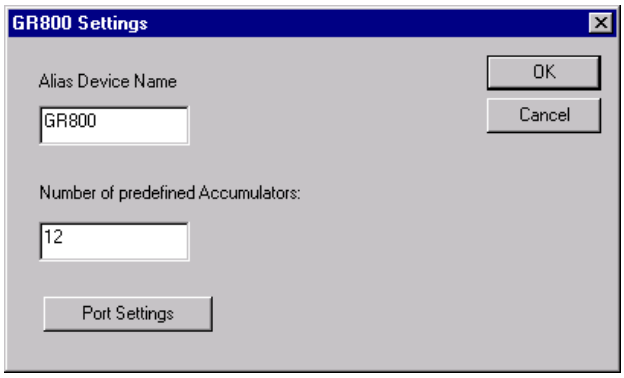


This confirms and summarizes the hardware that has been configured.

4.7 Configuring the GR800 Gamma Ray Spectrometer (airborne):

Select GR800 and click on the "ADD" button.

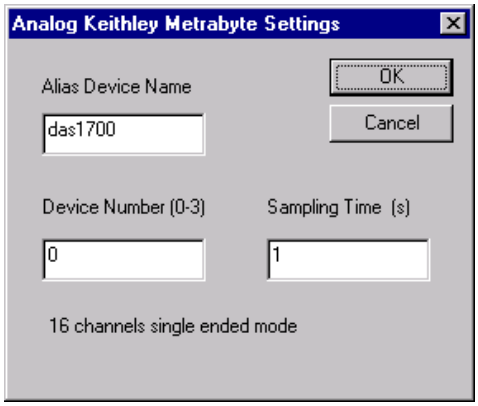
The GR800 Settings dialog box will appear on the screen:



The "*Number of predefined Accumulators*" is varies in some GR-800's. Some people may have custom firmware with more or less than 12 accumulators. This number represents the number of custom channels (like K- potassium40).

4.8 Configuring the DAS1700 analog to digital converter card:

Select DAS-1700 and click on the "ADD" button.



The DAS-1700 Settings dialog box will appear on the screen:

The DAS-1700 card is shipped with Driverlinx software where you can configure the card (Interrupt, DMA, single ended or differential mode, and device number).

You can have up to 4 analog cards in your computer. However only one card can be used at a time and it will be enabled by selecting the corresponding device number.

Select the card you want to use by entering a number between 0 and 3 for the device number.

The sampling time is entered in seconds. All the analog channels will be sampled at that rate at approximately the same time (10 microsecond delay between each channel).

Refer to the Driverlinx manual for more information. Note that if you change any parameters using the Driverlinx driver (including switching from 8 channels differential to 16 channel single ended), you must reboot your computer.

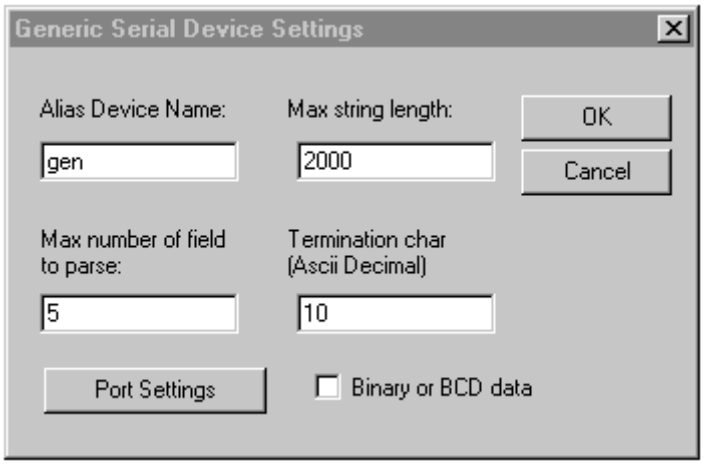
If no card is plugged in your computer or an invalid IRQ and DMA have been set you will get the following error:

4.9 Configuring a Generic serial device

To log and display customer supplied serial devices, MagLog provides a *Generic Serial Device* interface. Devices that can be logged with this interface must comply with the following specifications:

- Output one string of characters per reading. The string should have a unique termination character. The user is asked to provide the decimal value of the string termination character.
- ASCII strings are preferred but binary data also can be recorded with some limitations.
- To be displayed by the MagLog program, the string should have a fixed number of numerical *fields* separated with non-numerical characters. The number of fields should not vary between different readings.

To use the *Generic Serial Device* go to Configure / Input devices and select *Generic Serial Device* from the list of available devices on the left side of the dialog box. Press Add and the following configuration dialog box will appear:



The user must enter:
Alias Device Name: Enter a device name as you wish it to appear in MagLog.
Max string length: Set buffer size to accommodate any possible string coming out of your device. In many cases 2000 will work just fine, but you should change this value if your device generates particularly long strings.
Max number of field to parse In this example, MagLog will try to parse first 5 numerical fields of your string. If the actual number of numerical fields in your string is more then 5 then you won't be able to display the rest of the values unless you change this number to a larger value. If total number of fields is less then 5, then zero values are displayed for those fields where there is no data. However, the string will always be logged in its entirety regardless how many fields are set to parse for display purposes.

Termination char This is the last character of the string. In the case of ASCII strings it is normally ASCII 10 (LF or Line Feed).
Binary or BCD data If you device produces binary output, MagLog logs this data as mixture of binary bytes and program added ASCII strings (time and date). If you check this box MagLog will convert and log the data in hexadecimal format. This allows one to create and log a file that consists of pure ASCII characters (hexadecimal code is in ASCII format).

Note: Although binary data is logged to disk, there is no display for binary data in MagLog and presently MagMap2000 processing software also will not accept this kind of data file.

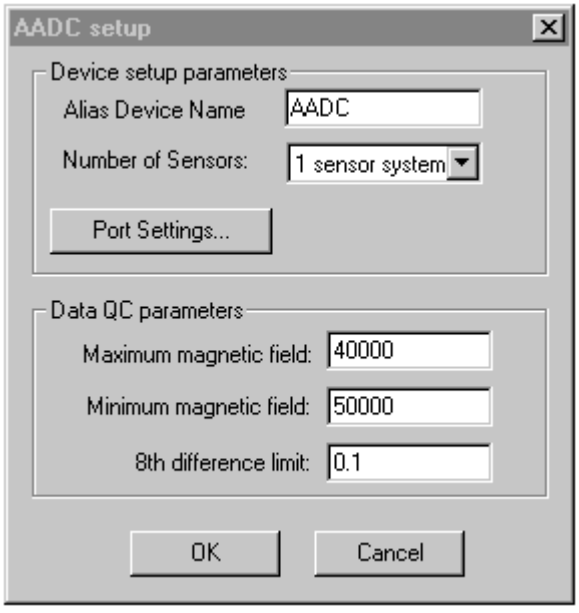
Here is an example how MagLog parses an ASCII string. We have used a symbolic format for clarity:

11111s22222s33333s44444s55555s66666<LF>

Here "11111 …. 66666" represents numerical fields and "s" represents a separator that can be any character which is not in the string: "-0123456789.EeDe+" To display a value "11111" in MagLog you should refer to it as "channel 1" and to display value "66666", refer to it as "channel 6".

4.10 Configuring the RMS AADC Aircraft Compensator.

Go to Configure / Input devices and select *AADC magnetometer* from list of available devices on the left side of the dialog. Press Add and this configuration dialog appears:



Alias device name: MagLog automatically knows the device name
Number of Sensors: Total number of magnetic sensors. MagLog supports AADC systems with one to four sensors.
Maximum / Minimum magnetic field: If recorded magnetic field does not fall into the preset range, a QC Alarm is generated and the QC device light is turned from green to yellow.
8th difference limit If the magnetic filed RMS 8th difference value is being calculated and it exceeds the preset limit, a QC Alarm is generated and the device light is turned from green to yellow.

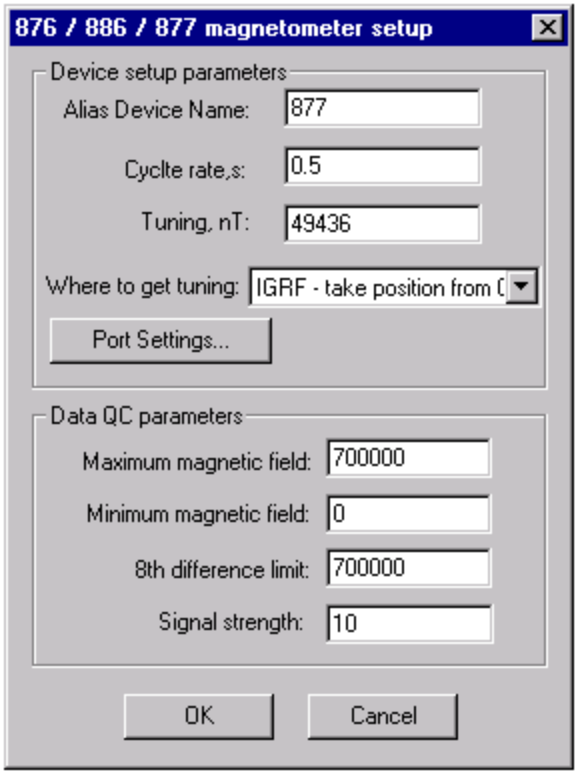
For the RMS AADC to be used with MagLog, it must be configured (on the front panel) so that it outputs the following information:

1.) Start char: symbol '#'
2.) Scan number: integer value (7 digits max)
3.) X-component (Fluxgate)[nT]: real number
4.) Y-component (Fluxgate)[nT]: real number
5.) Z-component (Fluxgate)[nT]: real number
6.) Uncompensated mag1 [nT]: real number
...
7.) Uncompensated magN [nT]: real number
8.) Compensated mag1 [nT]: real number
...
9.) Compensated magN [nT]: real number
10.) Error code: integer

Here N cannot be more then 4 and the user must configure the settings appropriately. MagLog does not parse (1) and (2), so the logical channels start with (3) (X fluxgate).

4.11 Configuring G-886 / G-877 proton magnetometers.

Like Geometrics' cesium vapor magnetometers, our proton precession magnetometers require MagLog to query the device to determine the hardware configuration and to set up the system. To set up the G-886 or G-877 magnetometer, go to Configure / Input devices and *select 886 Magnetometer* (used with both 886 and 877) from the list of available devices on the left side of the dialog box. Press Add and this configuration dialog box will appear:

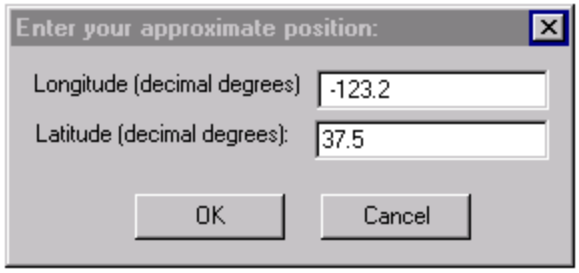


Alias device name: MagLog will use the device name you enter.
Cycle rate, s Sample rate in seconds (cycle time) for the magnetometer. The minimum allowable value is 0.5s (two readings per second). MagLog will configure the G-886/G-877 hardware to cycle at this rate.
Tuning, nT: Expected background magnetic field value for magnetometer hardware tuning. MagLog will configure the magnetometer hardware to this tuning value.
Where to get tuning: Depending on your selection the program can obtain G-877 tuning values from different sources. There are four options:

- Have user enter appropriate tuning value in the field above.
- Select *auto-tuning* mode for the 877 magnetometer. This is not recommended in most cases (see explanation below).
- Have user enter his approximate position on Earth (latitude and longitude) and use the internal IGRF model to calculate Earth's magnetic field at that point. (For more information about the IGRF model see, for instance IAGA Working Group V-8 (1995). *International Geomagnetic Reference Field, 1995 revision.* Submitted to EOS Trans. Am. Geophys. Un., Geophysics, geophys. J. Int., J. Geomag. Geoelectr., Phys. Earth Planet.Int., and others. You also can check out http://www.ngdc.noaa.gov:80/seg/potfld/magmodel.shtml).
- Have MagLog take the current position from the attached GPS device (if GPS is available) and calculate the tuning value using IGRF model.

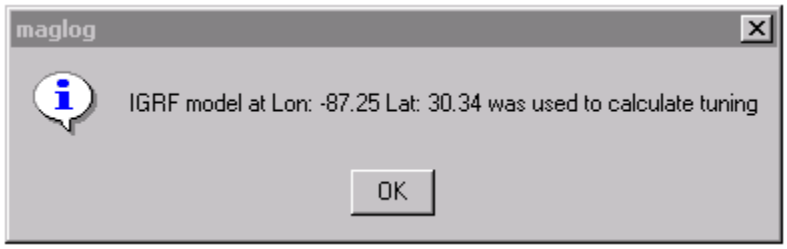
For best operation, the tuning value should be within the range of ± 500 nT of the average field in the survey area. The IGRF model suits this criterion perfectly and is a good solution for quickly tuning the magnetometer, even considering annual drift.

The program updates the tuning value when one of the IGRF options is selected. For example, if the user knows his approximate lat/long position, he may select *"IGRF – enter your position"* in the drop list. The following dialog appears:



Enter the approximate position of the survey area in decimal degrees and the program calculates Earth's magnetic field at this point and uses the value to tune the G-877 or G-886. To enter another position, just re-select the same string in the drop list.

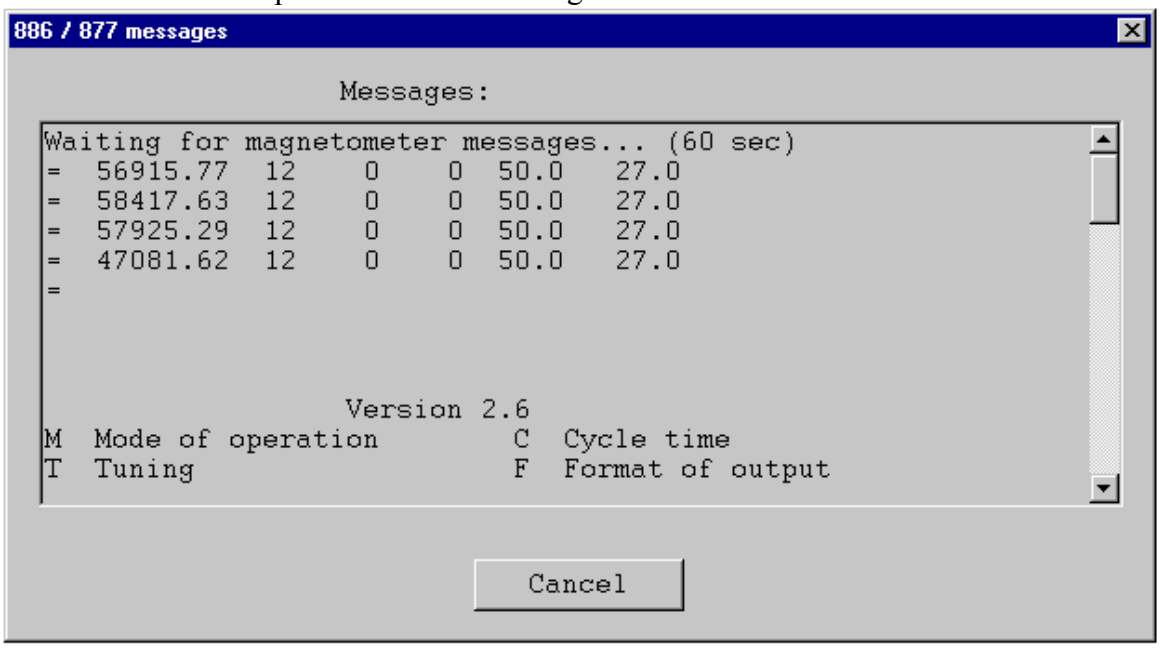
When user selects *"IGRF – take position from GPS"* , the program will try to obtain the position from the last GPS reading. If the GPS data is available, the following message appears:



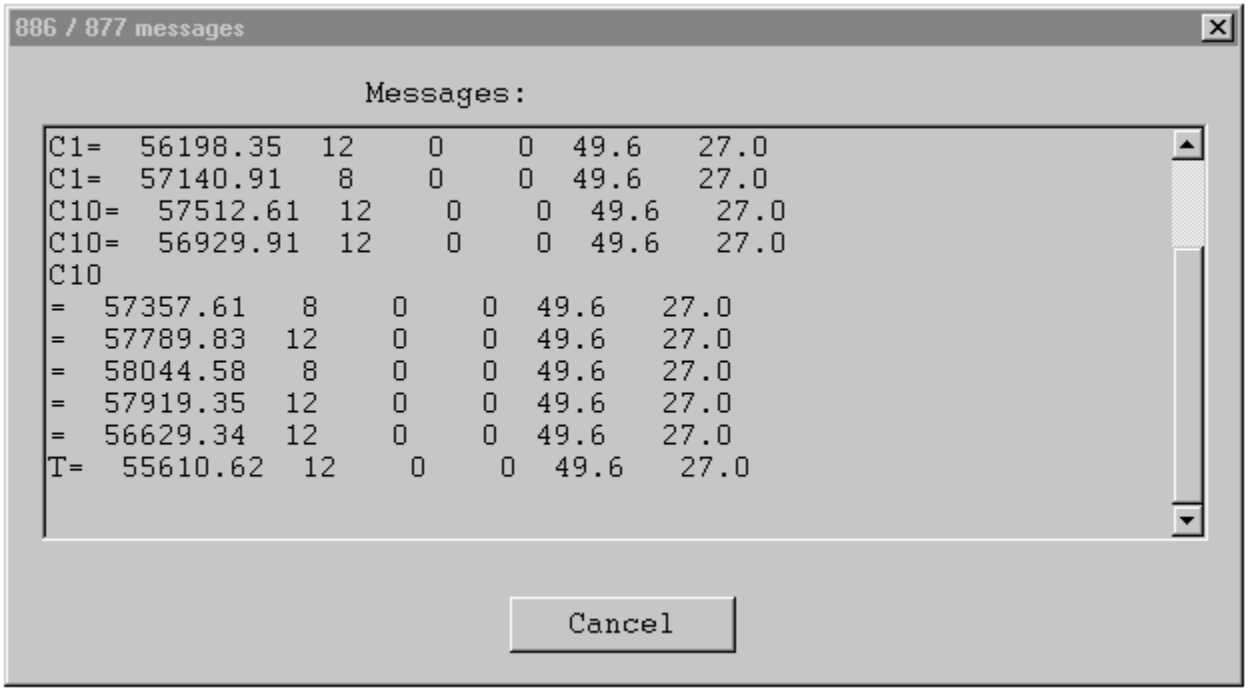
Check the reported position to ensure proper calculation of the reference field.
Port settings. Serial port communication settings.
Maximum / Minimum magnetic field: If recorded magnetic field does not fall into the preset range, a QC warning is generated and the device light is turned from green to yellow.
8th difference limit If the calculated RMS 8th difference is greater than this value, a QC warning is generated and device light is turned from green to yellow.
Signal strength. If proton magnetometer signal level is less then this value, a QC warning is generated and the device light is turned from green to yellow.

Upon completion of this dialog box and the following serial parameters dialog box, MagLog will communicate with the magnetometer hardware to ascertain its configuration. This may take as long as 5 minutes.
The program waits for incoming data strings and then sends a command to turn the magnetometer into a terminal (command) mode. Once in terminal mode the program issues a command to dump all hardware setting and proceeds to parse magnetometer's

output. Upon completion the program turns the magnetometer back into command mode. The user can see this process in the following window:



Note that at this stage MagLog simply reads the device configuration but does not set the cycle rate and tuning. This occurs after you close *Input Device Configuration* dialog box and again this may take a minute (it also happens every time when you change cycle rate and tuning for an already configured device). MagLog displays a dialog box with the magnetometer messages as below:



Note: Please do not use autotuning feature if you know the field range. Read below for additional explanation.

The G-877 magnetometer employs an AutoTuning function to automatically tune the magnetometer to the existing field value. This can maximize signal to noise ratios where the field values are expected to vary as much as 3,000 nT or more over a short amount of time. The situation where this might be encountered for instance might be in high gradient areas associated with volcanic geology or in harbor areas where there are large gradients due to steel objects. However, because the width of the G-877 tuning is broad (about plus-minus 2,000 nT before any noticeable degradation in signal strength is visible) and because under some low signal-to-noise conditions (in a low field area such as off the coast of Brazil or Peru, going east-west) the magnetometer may lose "lock" on one reading, it is not recommended that the AutoTuning function be used under all conditions.

Why?
When the AutoTuning function is informed that the magnetometer has lost "lock" on the field, it begins a search starting at the field value default which is set into the G-877 magnetometer (not the last known good reading for instance) and begins sequentially retuning to values at approximately 5,000nT above and then below the preset value in larger and larger jumps until it acquires signal or starts the process over. This can take several minutes if the default field value is not set to the background field value of the area you are surveying. Normally, one would not expect to encounter variations exceeding 2,000 to 3,000nT even over targets such as anchors. However, this might occur over large steel vessel at distances less than 500 ft., but under those conditions losing "lock" due to mistuning is a valid indication of a huge magnetic anomaly.

4.11.1 G-877 depth calibration

Geometrics G-877 magnetometer comes with a depth transducer calibrated at the factory and normally needs no calibration. However if the user has altered the factory settings or simply wants to provide more accurate depth estimation, the MagLog calibration procedure can be used.

The G-877 device stores all settings inside the magnetometer non-volatile memory and the user can permanently save calibration settings in this flash memory. The values are permanent and will not be lost after power is removed.

The G-877 has a sophisticated user interface accessible via a terminal program (such as MS Windows Hyper Terminal). This allows the user to make G-877 software changes employing standard Windows software. However, an inexperienced computer user may find using the terminal emulation mode difficult and therefore MagLog includes an easy to use interactive menu dialog to compute and store depth calibration parameters.

Here are general steps performed by MagLog to calibrate the G-877 depth sensor.

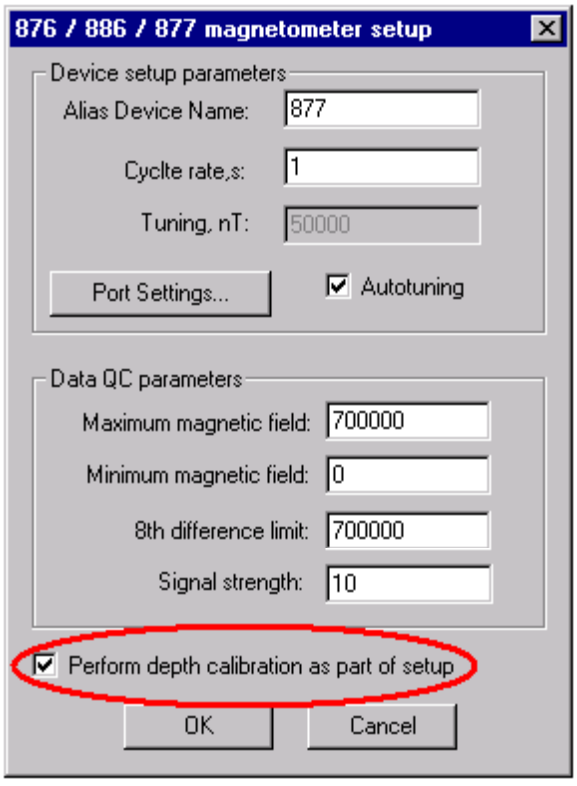
1. Find depth channel in G-877 data stream, or enable it if it is not enabled.

2. Set format appropriate for calibration.
3. Reset internal G-877 depth scaling and bias to their initial values (scale 1, bias 0).
4. Start magnetometer. Have user deploy and level the G-877 at different depths and take readings.
5. Calculate calibration coefficients based on several data points collected by the user.
6. Transform calculated scale and bias in the format appropriate for G-877 and write values into G-877 memory.
7. Set new format for the depth reading.
8. Save settings permanently in the G-877 device's flash memory.

If depth transducer calibration is accomplished using MagLog by itself, step (4) requires some user intervention. If the calibration is done via a terminal program, the user will be required to implement all 8 of the above steps using coded key commands.

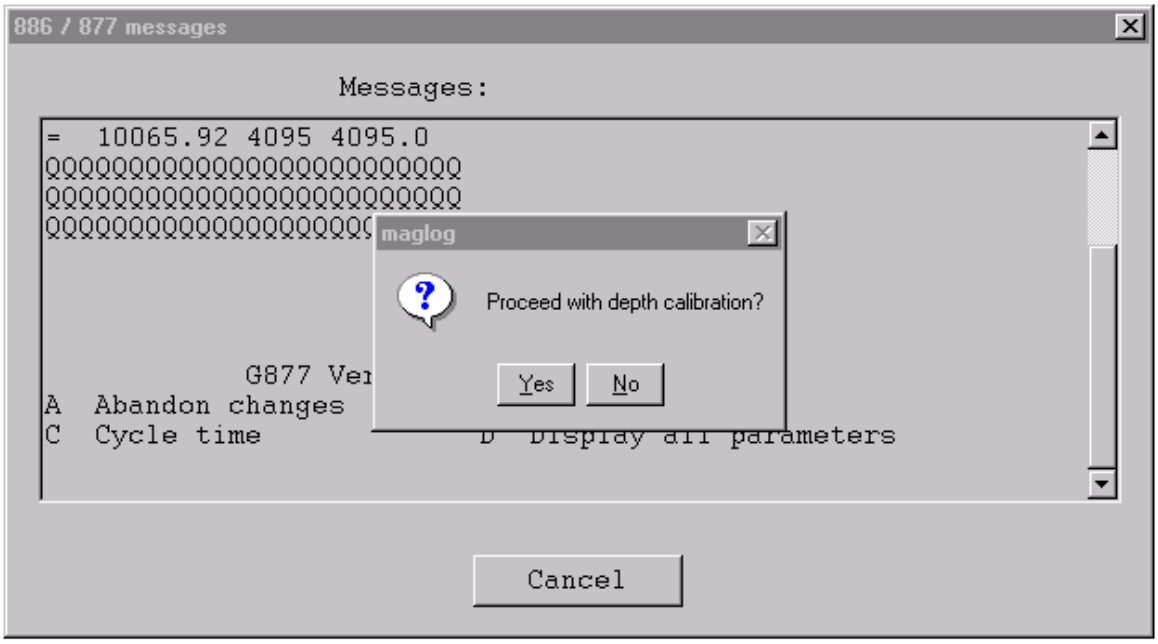
Note: Due to possible low baud rate communication rates, steps 1-3 and 5-8 can take several minutes. Please be patient during the calibration process.

The Calibration option is only available during the device setup which means that if you want to reset the calibration parameters that are stored in the G-877 electronics, you must setup a new survey and add the G-877 device. The G-877 can be the only device in the survey and you need not actually collect any data for that survey. After you press the "Add" button in "Configure / Input devices" dialog, the following screen appears:

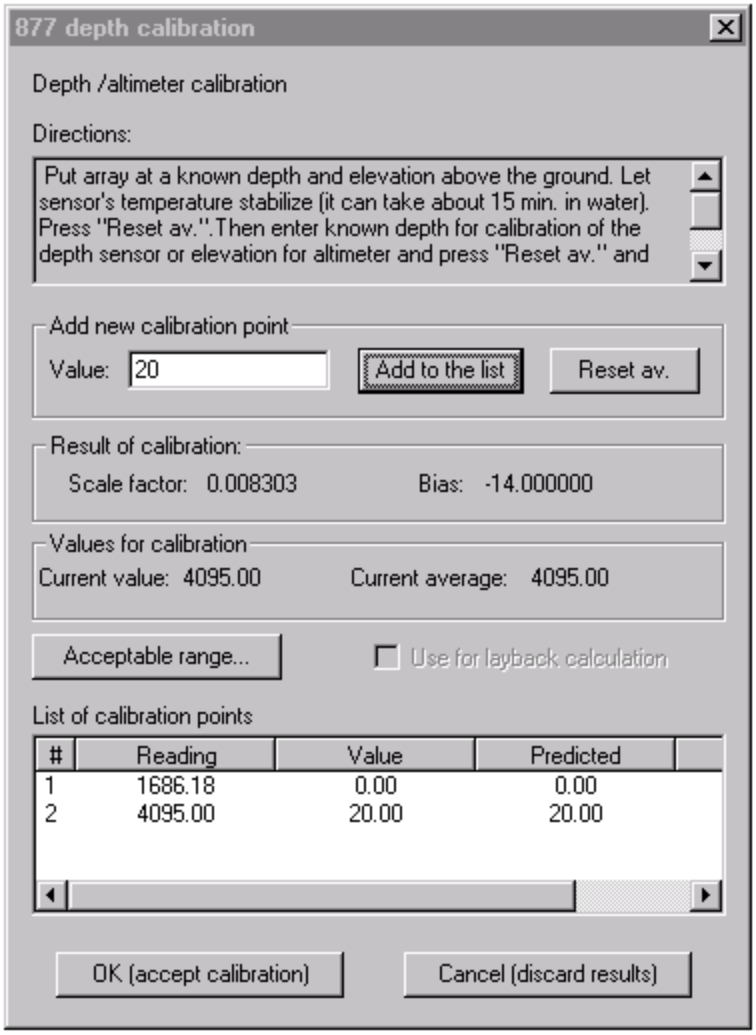


Here "Perform depth calibration as part of setup" is unchecked by default. Check it if you want to calibrate G-877 now.

After MagLog puts the G-877 into terminal mode, it confirms desire to calibrate:



If you answer “Yes”, MagLog starts with item (1) from the list above. The user can observe communication messages between the program and the G-877 on the screen. As soon as steps (1) to (4) are complete, MagLog launches the calibration dialog box:



Please read the "Directions" section of the dialog box and follow the instructions. Use the following procedure to calibrate the magnetometer:

- Place the G-877 fish at depth 0 (for instance, on deck or floating at surface). Enter *Value* equal to 0 and press *Reset av*. button. Wait about a minute to allow device to acquire some data. Then press *Add to the list*. Note that new string appears in the list at the bottom of the dialog box.
- Lower the magnetometer down the water column to a predetermined depth by marking the cable beforehand. Make sure that the *Current value* is changing (if current value is not changing, it may mean that your G-877 does not have the depth transducer installed or that the sensor or associated electronics is malfunctioning…contact Customer Service immediately). Measure the actual depth by pre-marking the cable or using a rope. Enter the actual depth in the *Value* field. Press button *Reset av*. and wait for about a minute to allow device to acquire new data. Then press *Add to the list*. Now the program has two depth points and can calculate depth and bias parameters for initial calibration.
- Lower magnetometer to another depth and repeat. Compare "predicted" and measured values in the list to make sure that they are consistent. If maximum depth

in the list is less than 20 meters, the results may not be optimal and a deeper calibration point should be used.

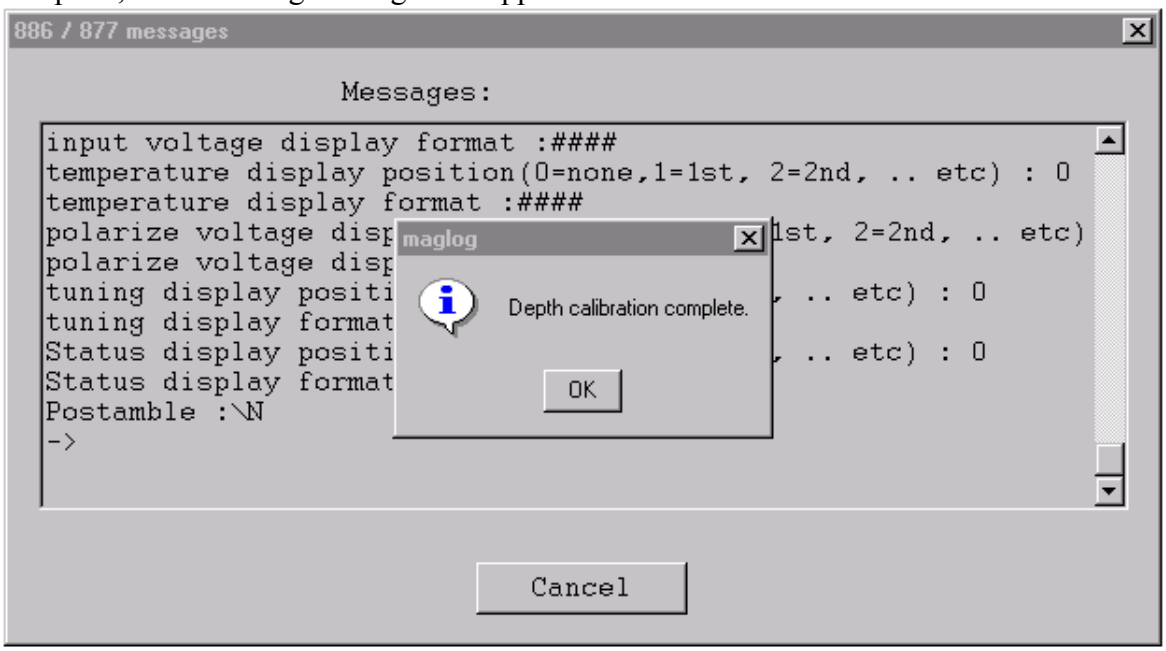
- You can delete a point in the list by right clicking on it and selecting “delete”.

Press OK (accept calibration) if you are satisfied with the results. MagLog will prompt you to save the calibration data into a file. This file is for your reference only and is not used by MagLog (remember the parameters are actually stored in the G-877 fish electronics). Here is an example:

```
877 depth calibration
# Reading Value     Pred.     Difference
1 2340.36 0.00      -0.00      0.00
2 4095.00 40.00     40.00     -0.00
 Results  scale: 0.022797     bias: -53.352331
G-877 setup values:
depth  scale factor : 5083
depth  bias sign (0 = add, 1=subtract) :1
depth  bias : 868
depth  decimals : 5
```

The last four strings represent values that are suitable for G-877 calibration in terminal mode. These are provided in case you need to reenter them into the G-877 using terminal emulation.

Now the program will set the new values into the G-877 magnetometer, by converting the depth output format and saving the results into the flash memory. When all these steps are complete, the following message will appear:



At this point, MagLog proceeds with the normal G-877 setup process. If you are not going to use this survey for actual data acquisition, you may terminate it at this time.

4.11.2 G-877 Terminal Calibration Log

I n this section we show an example of the G-877 depth calibration process using the Windows HyperTerminal program. This log corresponds to MagLog depth calibration described above. Characters that are sent by MagLog (or typed by the user if HyperTerminal is used) are printed with bold font. The fields that are being altered by MagLog or by the user are marked with an asterisk (*).

Q

G877 Version 1.13

```
A  Abandon changes          B  Baud rate
C  Cycle time               D  Display all parameters
E  Every thing              F  Format of output
L  cable and sensor         M  Mode of operation
N  Next (multi systems)     R  Run magnetometer
S  Save parameters          T  Tuning
```

-> **F**

Preamble :=
field display position(1=1st, 2=2nd, .. etc) : 1
field display format :######.##
time display position(0=none,1=1st, 2=2nd, .. etc) : 0
time display format :#####.#
fid display position(0=none,1=1st, 2=2nd, .. etc) : 0
fid display format :#####
signal display position(0=none,1=1st, 2=2nd, .. etc) : 2
signal display format :####
* depth display position(0=none,1=1st, 2=2nd, .. etc) : 3
* depth display format :####
input voltage display position(0=none,1=1st, 2=2nd, .. etc) : 0
input voltage display format :####
temperature display position(0=none,1=1st, 2=2nd, .. etc) : 0
temperature display format :####
polarize voltage display position(0=none,1=1st, 2=2nd, .. etc) : 0
polarize voltage display format :####
tuning display position(0=none,1=1st, 2=2nd, .. etc) : 0
tuning display format :###.#
Status display position(0=none,1=1st, 2=2nd, .. etc) : 0
Status display format :##

Postamble :\N

-> **P**

Password :**VERADDA**

signal scale factor : 1

signal bias sign (0 = add, 1=subtract) :0
signal bias : 0

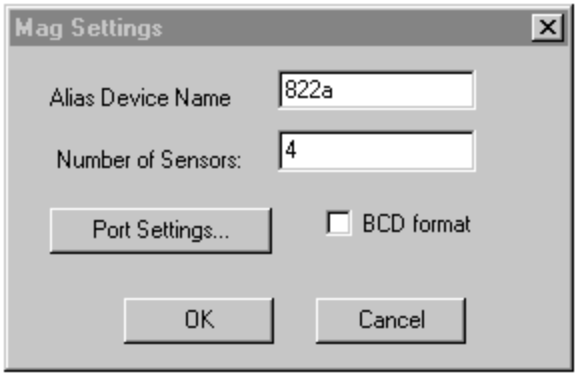
```
   signal decimals :0
*  depth  scale factor :1
*  depth  bias sign (0 = add, 1=subtract) :0
*  depth  bias :0
*  depth  decimals :0
   input voltage  scale factor :    1
   input voltage  bias sign (0 = add, 1=subtract) :0
   input voltage  bias :    0
   input voltage  decimals :0
   temperature scale factor :    1
   temperature bias sign (0 = add, 1=subtract) :0
   temperature bias :    0
   temperature decimals :0
   polarize voltage  scale factor :    1
   polarize voltage  bias sign (0 = add, 1=subtract) :0
   polarize voltage  bias :    0
   polarize voltage  decimals :0
   -> R
   Checking

   ---------- Running magnetometer software
   Setting Baud rate

   =  20131.84 4095 4095
   =  20131.84 4095 4095

   < Here is magnetometer put at different depths >

   Q

   QQQQQQQQQQQQQQQQQQQQQQQQ
   QQQQQQQQQQQQQQQQQQQQQQQQ
   QQQQQQQQQQQQQQQQQQQQQQQQ


         G877 Version 1.13
   A  Abandon changes       B  Baud rate
   C  Cycle time            D  Display all parameters
   E  Every thing           F  Format of output
   L  cable and sensor      M  Mode of operation
   N  Next (multi systems)  R  Run magnetometer
   S  Save parameters       T  Tuning

   -> P
   Password :VERADDA
   signal scale factor :    1
   signal bias sign (0 = add, 1=subtract) :0
   signal bias :    0
   signal decimals :0
*  depth  scale factor :83
*  depth  bias sign (0 = add, 1=subtract) :1
*  depth  bias :    1686
*  depth  decimals :4
   input voltage  scale factor :    1
   input voltage  bias sign (0 = add, 1=subtract) :0
```

```
   input voltage  bias :    0
   input voltage  decimals :0
   temperature scale factor :    1
   temperature bias sign (0 = add, 1=subtract) :0
   temperature bias :    0
   temperature decimals :0
   polarize voltage  scale factor :    1
   polarize voltage  bias sign (0 = add, 1=subtract) :0
   polarize voltage  bias :    0
   polarize voltage  decimals :0
   -> F
   Preamble :=
   field display position(1=1st, 2=2nd, .. etc) : 1
   field display format :######.##
   time display position(0=none,1=1st, 2=2nd, .. etc) : 0
   time display format :#####.#
   fid display position(0=none,1=1st, 2=2nd, .. etc) : 0
   fid display format :#####
   signal display position(0=none,1=1st, 2=2nd, .. etc) : 2
   signal display format :####
*  depth display position(0=none,1=1st, 2=2nd, .. etc) : 3
*  depth display format :###.##
   input voltage display position(0=none,1=1st, 2=2nd, .. etc) : 0
   input voltage display format :####
   temperature display position(0=none,1=1st, 2=2nd, .. etc) : 0
   temperature display format :####
   polarize voltage display position(0=none,1=1st, 2=2nd, .. etc) : 0
   polarize voltage display format :####
   tuning display position(0=none,1=1st, 2=2nd, .. etc) : 0
   tuning display format :###.#
   Status display position(0=none,1=1st, 2=2nd, .. etc) : 0
   Status display format :##
   Postamble :\N
   -> S
   Checking
   Press "Y" to save to FLASH any other key to abort:Y
   Saving-
```

At this point MagLog notifies the user that the calibration procedure is complete.

4.12 Configuring G-822A Super Counter device.

MagLog is specifically designed to log data from *Geometrics* airborne G-822A Super Counter. Go to Configure / Input devices and select *Mag 822A* from the list of available devices on the left side of the dialog box. Press Add and the next configuration dialog box will appear:



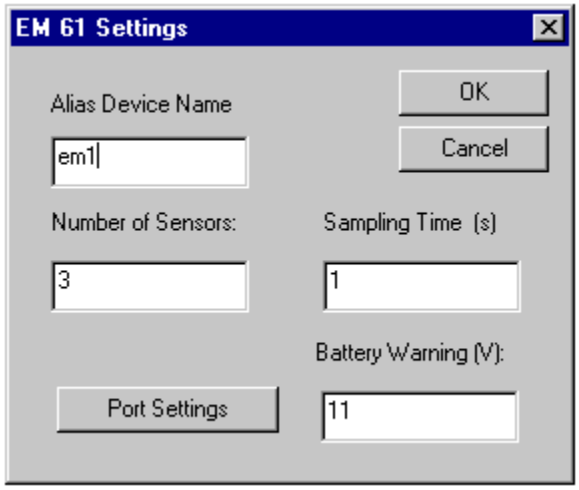
Alias device name: MagLog automatically knows the device name.
Number of Sensors: Total number of magnetic sensors. Maximum number is 4.
BCD format. Check this box if the magnetometer counter is set up to output in BCD mode (very high speed up to 100Hz sample rate). In this case the program logs a hexadecimal dump of magnetometer output.

4.13 Configuring EM61 device.

This feature provides a logging interface for the EM61. Note that this device needs to be triggered from the MagLog program by sending a command via the serial line. Therefore it should have both Tx and Rx lines wired in the interconnecting cable.

Note: If you have multiple EM61 devices and you want to trigger them all at the same time, you can use one Tx line from one serial port (on the PC). Connect this wire to all Rx pins on all the EM61's, and do not connect the remaining Tx wires from the other PC serial ports.

Go to Configure / Input devices and select *EM61* from list of available devices on the left side of the dialog box. Press Add and this configuration dialog box will appear:



Alias device name: MagLog automatically knows the device name.
Number of Sensors: Total number of electromagnetic sensors. .
Sampling Time (s): Trigger interval, in seconds.
Battery Warning (V): Voltage level to generate "low battery" warning.

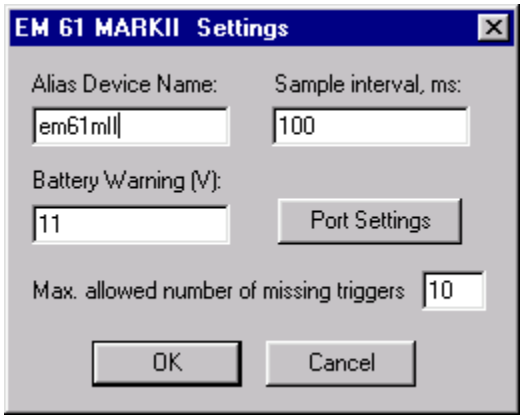
4.14 Configuring EM62 Mark II device.

This device provides interface to the newer EM61 Mark II system. It has a similar setup to the EM61 but there are some significant differences in data acquisition. Like the EM61, this device needs to be triggered with a serial character; therefore both the transmit and receive wires of the serial port must be wired. The original MagLog design tried to match the time when a trigger character was sent with the time of the data arrival. However at high cycle rates (around 100 ms per sample) the device cannot respond within the sample interval period. This means that if one trigger character was sent at 0 ms and the next at 100 ms, then at 200 ms, etc. data from the 0 ms trigger can arrive during 0-100 ms interval or 100-200ms interval or even in 200-300 ms. If for some reason the EM61 Mark II does not respond to the trigger character (for instance, if the trigger character was lost due to disconnection of the device) the trigger-data sequence is distorted which appears as additional latency (e.g., time stamp assigned to the data related to previous data, not the current data).

One of the techniques employed by MagLog is to count the number of triggers in the trigger buffer that did not produce data. For example if 10 trigger pulses were sent without getting data back the program knows that on the next data arrival the trigger and data buffers should be flushed because it is likely that there was data loss or a cable disconnection.

Another method used is to record the time of the data arrival. MagLog records this time as a time difference in ms between the arrival and trigger event times. Thus the arrival time can always be calculated (that is to say with Geometrics MagMap2000 program, which knows about this feature and computes the absolute arrival time on the data input load).

The following is the configuration dialog for the EM61 Mark II device:



This is almost identical to EM61 except for the field "*Max. allowed number of missing triggers*" discussed above.

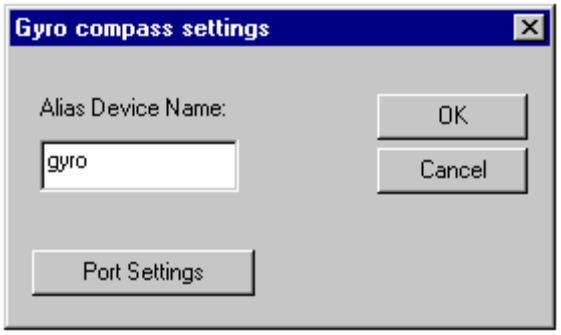
Note: To ensure proper operation and estimate overall latency of the system Geometrics recommends a latency test before surveying. The test need only be made only once for particular equipment set (including PC, EM61MII and GPS). If any of these parts are replaced or new software installed, a new latency test should be made.

4.15 Configuring Gyro Compass device.

MagLog can handle data from NMEA compliant Gyrocompass device connected to one of RS-232 ports (if your Gyro works with RS-422 use special wiring or RS422 to RS-232 converter). The Gyro hardware should output strings with the format:

$HEHDT,360.0,T*2
$HEHDT,360.0,T*2
…

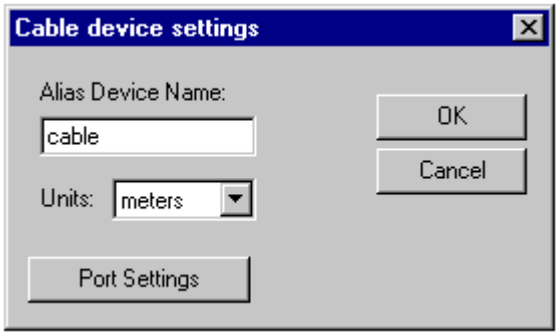
If the Gyro outputs other strings they are ignored my MagLog. Go to Configure / Input devices and select *GYRO* from list of available devices on the left side of the dialog. Press Add and this configuration dialog box will appear:



In this case there is only one field to be set – the alias name.

4.16 Configure Cable payout indicator.

Some marine systems can have devices that measure cable length automatically and transmit the results via a serial port as 5 digit floating number with CR & LF characters. Go to Configure / Input devices and select Cable from list of available devices on the left side of the dialog box. Press Add and the following configuration dialog box will appear:

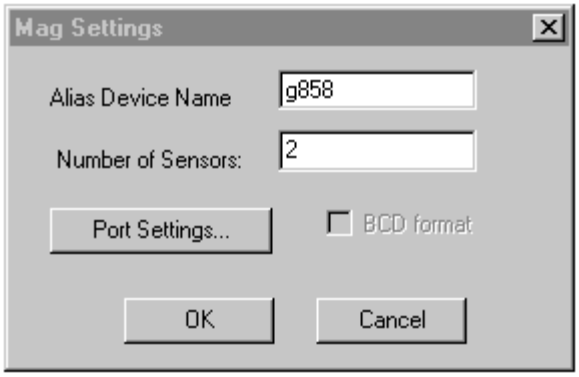


Alias device name: MagLog automatically knows the device name.
Units: Units are as per the setup of the indicator device. They can be *meters, feet* or *fathoms.* This selection does not affect log file but *should be set properly for use by MagLog real-time layback interpolator.*

4.17 Configuring the G-858 magnetometer.

The *Geometrics* G-858 MagMapper is a hand-held device used primarily for land magnetic surveys. It has an option to output magnetometer data via its serial port and can be used in conjunction with MagLog acquisition software.

- **Set up for the G-858 console.** Start a new survey as a *Base station.* Choose *Store mode* as *Transfer to PC only* or *Store & Transfer to PC.* In the first case, data will not be stored by the G-858 internally, but only by the PC. In the second case data will be stored both in the 858 and externally you can download the data set and process it in the *Magmap2000* program. Of course you can also bring in MagLogNT and MagLogLite Survey files into MagLog2000 as well.
- **Set up MagLog.** Go to Configure / Input devices and select *G-858* from the list of available devices on the left side of the dialog box. Press Add and the next configuration dialog box will appear:

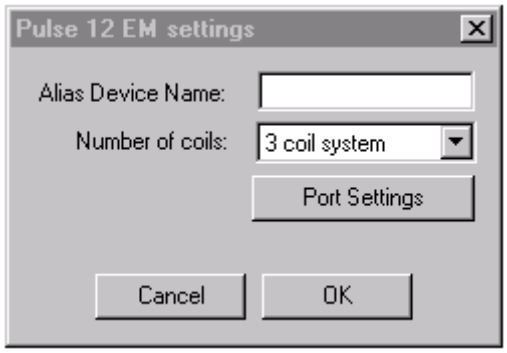


Alias device name: MagLog automatically knows the device name.
Number of Sensors: G-858 magnetometer can have one or two sensors connected.
BCD format: Always disabled for this device.

4.18 Configuring PULSE 12 EM device.

JW Fisher's Pulse 12 EM device may include up to 3 coils connected to three hardware ports. Regardless of the real number of coils available, the device always outputs voltage for these tree slots – if there is no coil present, it's just a constant value. Therefore if the user has just only one coil and accidentally connects it to slot #3, he should treat the device as a 3 coil system and neglect data for coils #1 and #2.

Next following dialog box appears to configure the Pulse 12 device:



As usual, user has to assign the alias name. Port settings are standard for any MagLog serial device.

Note: It is necessary to eliminate the coordinate strings in the Pulse 12 data string (starting with symbol "@"). MagLog automatically sets the filter reject prefix as "@" to remove those strings, which are therefore not recorded.

4.19 Pulse devices in MagLog.

"Pulse devices" refers to external time tags or event marks. Please do not confuse this type of device with the previous PULSE 12 EM device.

MagLog has ability to log the time of TTL pulse arrival that come to pin 10 of the printer parallel port. The recommended voltage is 5 volts with a duration of not less then 1 ms. This pulse generates a parallel port interrupt and MagLog will then obtain the time of the interrupt event.

Interrupt pulses can be treated with *Geometrics* parallel port custom drivers (under Windows NT only) or with general purposes driver DRVX28 (under Windows NT and WIN9x). The *Geometrics* parallel port driver has an advantage over DRVX28 because it provides high accuracy time stamps (1ms or less). However, as noted its usage is limited to the NT platform only. The Win9x DRVX28 driver gives less accuracy, in the 20 ms range. This is no doubt sufficient for slow moving surveys but perhaps not for airborne type surveys.

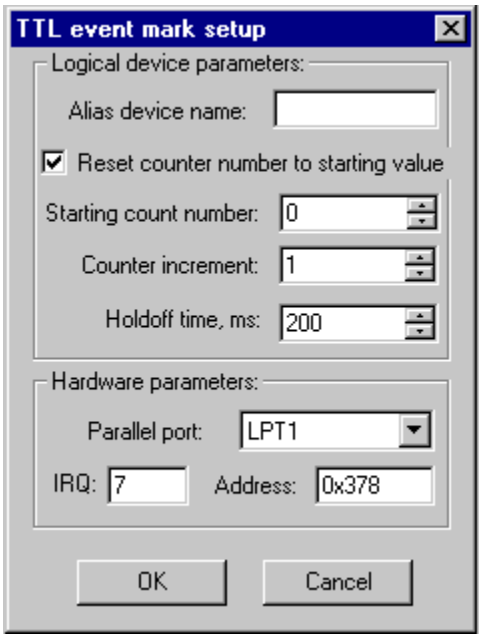
At present, the following devices are supported by one or the other of these drivers:

- *PPS* (pulse per second) GPS device. Some (usually expensive) GPS receivers can output 1 ms pulses synchronized with beginning of the UTC second. PC time tagging of these pulses can be logged with MagLog PPS device. At the same time GPS outputs UTC string which can be logged with MagLog *Generic Serial Device.* Having logged both these data streams it is possible to recalculate PC time into UTC and vise versa for increased accuracy of timing and positioning.
- *TTL Event Mark device* is similar to PPS, but has some additional features: user can set pulse counter starting value and increment. Often this is used as a shot counter in seismic type surveys where the shot point must be reference to the magnetometer reading.
- *Trigger.* This device is based on Keithley CTM-10 / CTM-05/A internal multifunction card that must be installed in the computer. This device works as an internal pulse generator driven my MagLog. It is used to trigger the G-822A Super Counter in high precision land and airborne MTADS type magnetic survey systems. The device also allows the user to log the time of the trigger pulses with accuracy to about 1 ms. It is available under the NT platform only.
- *Speedometer.* Also based on Keithley CTM-10 / CTM-05/A multifunction card and uses internal hardware counters to count pulses (without generating an IRQ to the CPU). It is used to count wheel ticks in specially equipped land vehicles (carts). It is available under NT only.

All these devices require a specialized driver and hardware installation. Please see details under **Hardware configuration** section. In the section below we assume that the drivers are properly configured and running.

4.19.1 Configuring **TTL event Mark** device.

Go to Configure / Input devices and select *TTL Event Mark* from the list of available devices on the left side of the dialog box. Press Add and the following configuration dialog box will appear:



Alias device name: User enters device name.
Reset counter to starting value. This is effective when you edit the configuration of an already running device. For example if the counter has counted: 1, 2, …50, and at 50 you opened the configuration dialog box and changed the increment to 2 to get numbers 52, 54, 56… If "Reset counter number" is checked and "Start count number" is set to "0", then the result would be 0,2, 4, etc.
If the box is not checked, then you would get 52, 54… regardless of the "Starting counter" setting.
Starting count number: Initial counter value (integer).
Counter increment: Step to increase / decrease counter value. Negative value will decrease counter, positive increase it. This is an integer value only.
Hold-off time: After program has received a pulse, it will not react to any additional pulses during this hold-off time interval. This provides protection from bouncing contacts or "ringing" in the wire that could produce false interrupts.

The Next group of parameters is effective only if device is powered by the DRVX28 driver (Win9x). If device is based on *Geometrics* custom parallel port driver (NT only) these parameters need to be set directly in the Windows Registry.

Parallel port. Port where TTL pulse is connected. Note that you still can use this port for printing; however you will need a special adaptor to disconnect pin 10 from printer side and connect it to TTL pulse source.
IRQ. Interrupt line for printer port interrupt. Usually it is 7 for LPT1 and 5 for LPT2. However this value can be changed in the BIOS setup (for on-board parallel port) or by

switches (for ISA parallel port extension card). Consult your computer or extension card manual.
Address: Parallel port base address. Similar to IRQ, this value can be altered by BIOS setup or by switches. Consult your manuals.

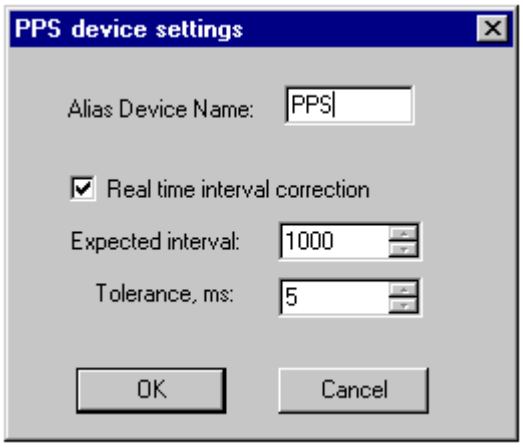
Note: MagLog is not known to work with PCI parallel port extension cards.

It is recommended that you use the Digital Display mode for the TTL event mark device display.

If a TTL Mark device is present, it will change the log files of other devices: before recording the date and time stamps, MagLog records the current value of the event counter(s).

4.19.2 Configuring PPS GPS device.

Go to Configure / Input devices and select *GPS PPS pulse* from list of available devices on the left side of the dialog. Press Add and next configuration dialog appears:



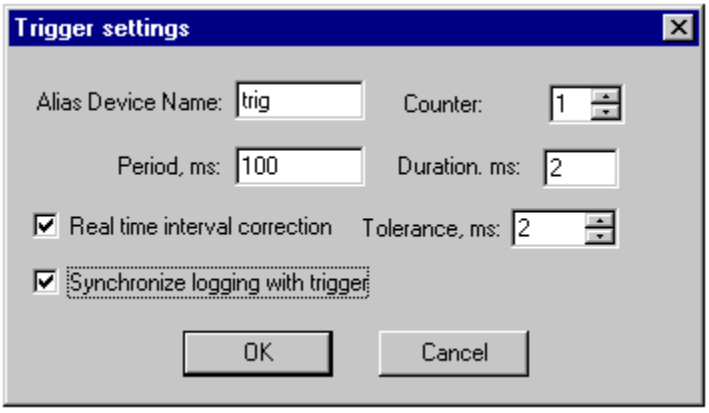
Alias Device Name: User inputs name of device.
Real time interval correction. One of the problems with original PPS pulse design was due to its short duration (1 ms). This kind of signal may or may not produce a PC interrupt. Thus without special treatment (hardware or software) half of the pulses will be lost. To solve this problem MagLog uses *real time interval correction*. Lets assume the program gets a pulse at 1000 ms relative time. If the *expected interval* is 1000 ms and *tolerance* is 5 ms, the program will be looking for the next pulse between 1995 and 2005 ms. If the pulse arrives during this interval, the program accepts it. If there is no pulse between 1995 and 2005, the program artificially creates a pulse at 2000 ms, as it would be as if it had arrived. If the pulse arrives at say 1500 ms, the program disregards it assuming that this is just noise.

The Log file for this device has a keyword “PPS” and the program records the arrival time in every string. There is no visual display for the PPS GPS device.

Note: After *real time interval correction* is selected you MUST restart the survey for the option to take effect.

4.19.3 Configuring Trigger device.

This device requires a CTM-10 (or CTM-05/A) multifunction card to be installed in the computer. Consult the “Hardware configuration” section and card manual how to install the board. The device is available under Windows NT only, and the `key.sys` driver must be properly loaded and running. If these conditions are met you can go to Configure / Input devices and select *Trigger* from list of available devices on the left side of the dialog box. Press Add and the following configuration dialog box will appear:



Alias Device Name: User enters the name of the device.
Counter: CTM-10 card has 5 counters that can be used to generate rectangular pulses. Select the number of required pulse generators between 1 and 5. Note that the counter selection will determine which pins of CTM-10 main I/O connector should be wired.
Period, ms: Period in milliseconds for generated pulses.
Duration, ms: Width of each pulse in milliseconds. If the signal is used to trigger the G-822A Super Counter the duration should be 2 ms. (1 ms may be too short).
Real time interval correction. CTM-10 card has evidenced a problem with internal interrupts, perhaps due to card design. This problem appears as false interrupt generation. For example, if the period is set to 100 ms., the expected interrupts times are 100, 200, 300, … 1000 ms. However in a few cases the card may produce interrupts at 100, 200, 202, 300, … 1000. Here is 202 is a false interrupt and must be discarded. In this case, *real time interval correction* should be used.

Let us assume that the first pulse arrived at 100 ms and that the period is 100 ms and tolerance is set to 2 ms. Then all pulses that appear between 100 and 198 ms will be discarded. OF the pulses arriving between 198 and 202 ms, only first one is counted. If there were no pulses between 198 and 202 ms an artificial pulse at 200 ms is inserted. The next period is counted from this artificial pulse (if there were no real pulses) or from real

pulse. Thus if a pulse came at 199 ms, the next check period would be between 297 and 301 ms.

Note: You should use this feature for proper operation unless tests show that there are no false interrupts being generated. This could be a case when another parallel port is used to log trigger pulse time.

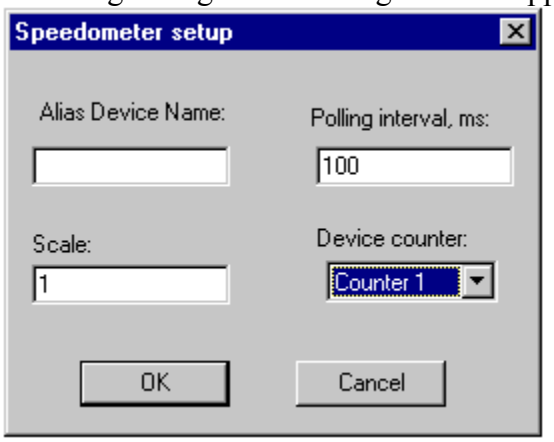
Synchronize logging with trigger. If a trigger is used with 822A Super Counters and the data is logged via serial ports, it is desirable that the trigger and serial log files match on a per string basis. This means that the first trigger string should match the first serial string. To ensure this, *Synchronize logging with trigger* box should be checked.

There is no display for *Trigger* device. The Log file has the keyword "TRIG" in each string and time stamp.

Note: IF *real time interval correction* and *synchronize logging with trigger* options are set you MUST restart the survey for these options to take effect.

4.19.4 Configuring Speedometer device.

This device requires the CTM-10 (or CTM-05/A) multifunction card to be installed into computer. Consult the "Hardware configuration" section and card manual on installation procedures. The device is available under Windows NT only, and `key.sys` driver must be properly loaded and running. If these conditions are met you can go to Configure / Input devices and select *Trigger* from list of available devices on the left side of the dialog box. Press Add and the following configuration dialog box will appear:



The CTM-10 has 5 internal counters that can be used to count external pulses. Normally these pulses come from vehicle's wheels or odometer/speedometer. Counting does not involve the main CPU unit and does not produce an additional IRQ overhead. Each *polling interval,* MagLog reads the current counter's value and writes the counter value and ratio [time interval]/[number of events] into the log file. This last value can be transformed into speed if the proper *scale factor* is used.

It is not recommended to use the polling interval with less then on pulse every 100 ms because this can produce an additional load on the CPU, slowing graphics and logging functions.

5 Configuring Input Devices for Display:

Once devices have been selected for input, you must now specify how you wish the information to be displayed on the screen. MagLog NT creates one window for each device. You can then add slots and traces to the windows to graph details that you want to see.

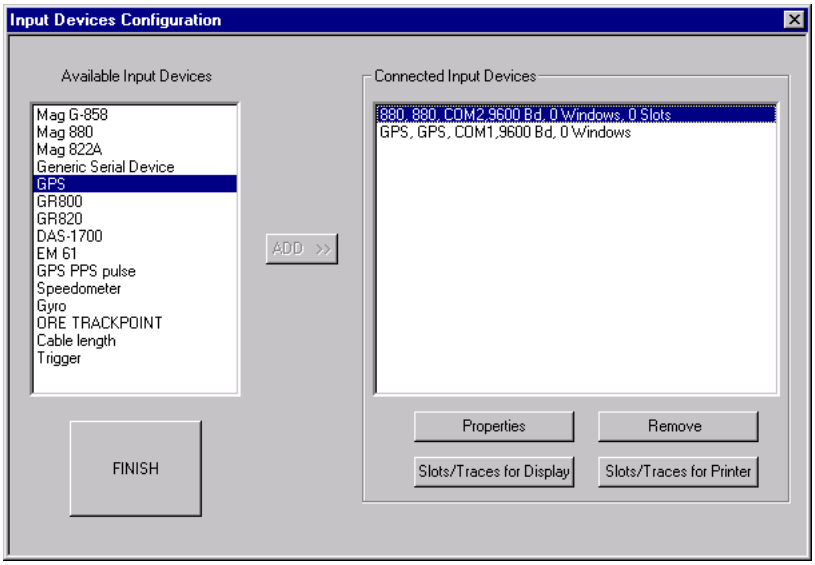
Terminology:

Window: An independent, sizeable object that you can use to display information about your device. Only one is allowed per device

Slot: A subdivision of a window. You can have as many slots as you want, and can use each slot to have as many traces as you want.

Trace: A graph of one variable.

This section will show how to configure the most commonly used displays, and will give some generic features common to all displays.

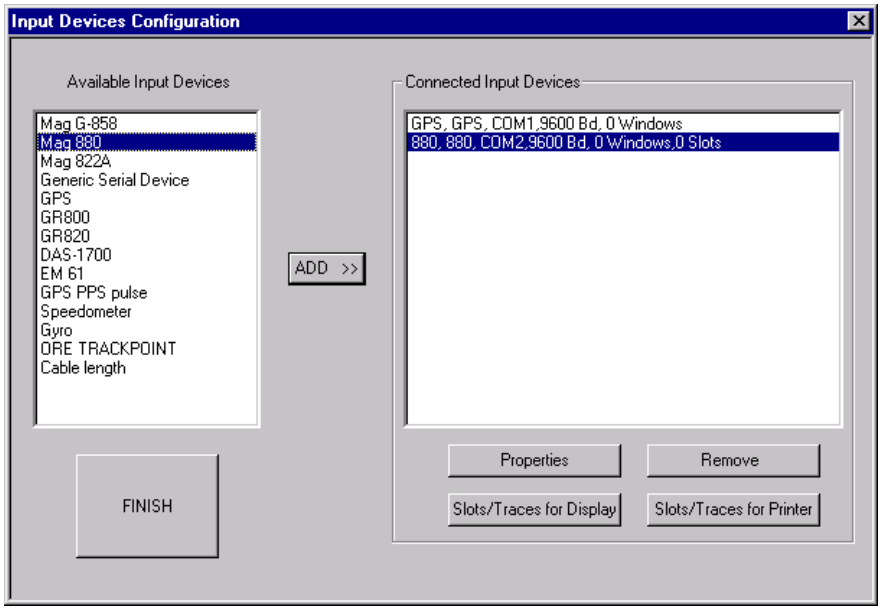


To configure the display for a device, you first need to select the device from the list of "*Connected Input Devices*". Then click on "*Slots/Traces for display*".

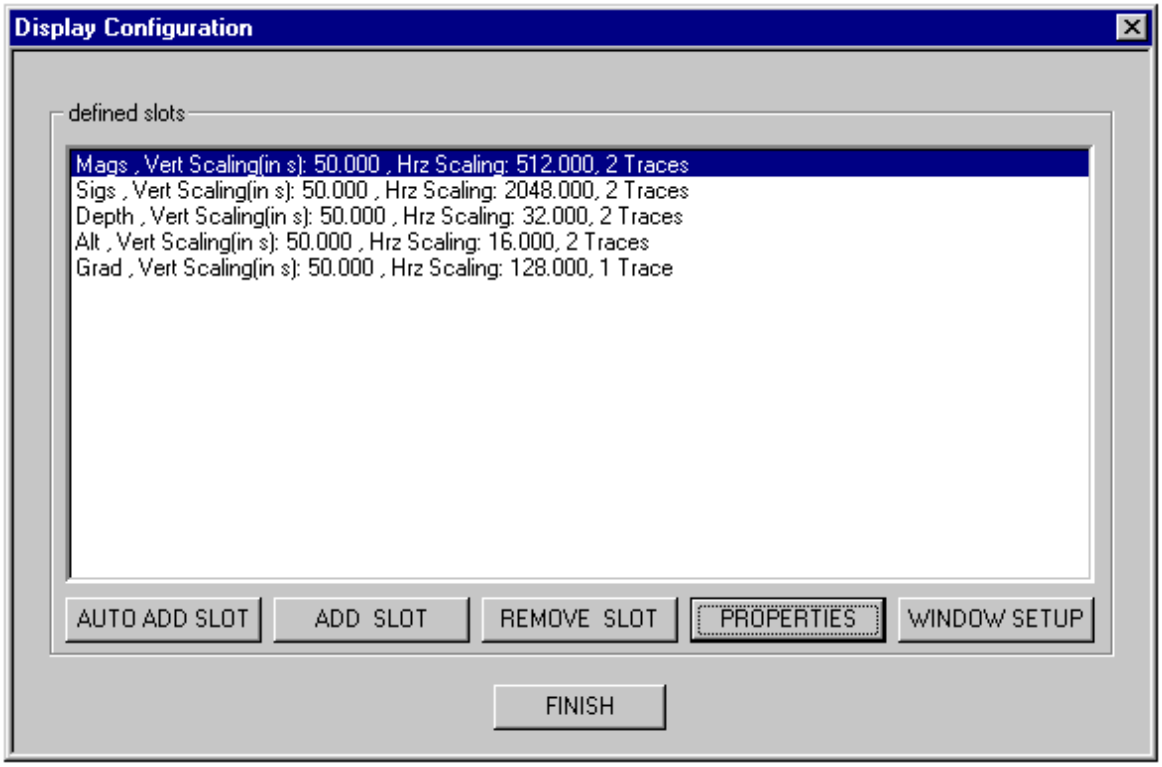
5.1 The Display.

Here is a description how to configure a device display. The G-880 magnetometer is used as an example but the methods can be applied to all other devices with the exception of the GPS and devices that have no visual display (e.g., trigger pulses).

To configure the G-880 display, you need to select the G-880 magnetometer and click on "*Slots/Traces for Display*".



You will get the following dialog box:



This window allows you to see the slots you have defined. In this screen, you have not specified any slots so it appears empty. The options available allow you to add, delete, and edit existing slots. Discussed in more detail:

Auto Add Slot: This button allows you to create one slot and one trace for each value MagLog receives. In the case of the sample input string:

40001.24, 0243, 2001, 1209, 40291.35, 0543

MagLog will create a window split into seven parts (slots). Each slot will have one graph (trace) that will correspond to a changing value in the above string. The slots will be given default names such as "Slot 1" (corresponding to the changing value of 40001.24), "Slot 2" (corresponding to the changing value of 0243), etc. This option is convenient for quickly getting a graph of all your data without having to customize each individual slot and trace.

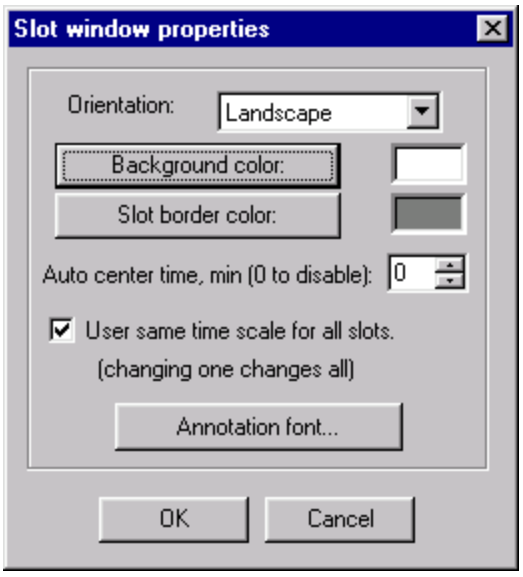
Add Slot: This button allows you to add a new slot.

Remove Slot: This will remove a selected slot and remove all traces inside the slot.

Properties: This will allow you to edit the properties of an individual slot once it has been created.

Finish: Exits the window.

Window setup: This controls window orientation, background color and font used for annotation. It brings the next dialog box:

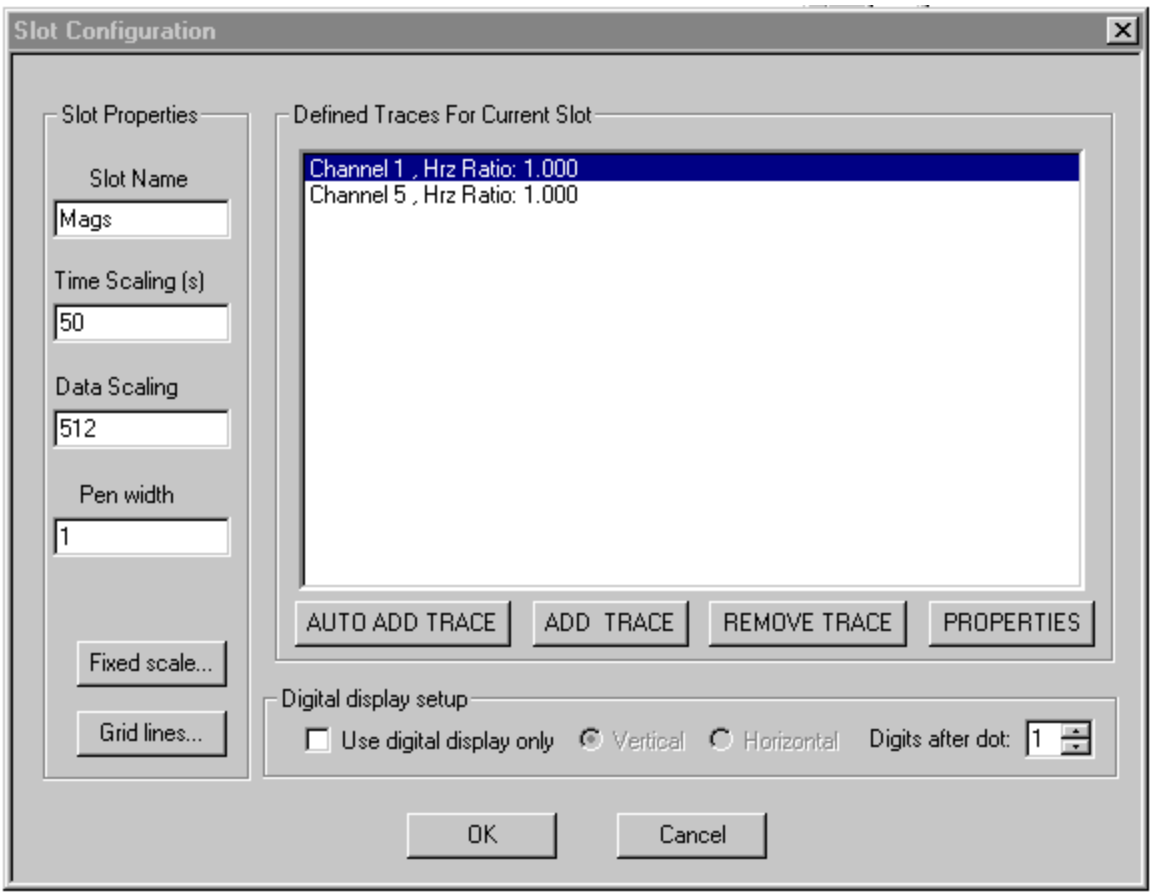


The following options are available:

- *Orientation*: Set *Portrait* for vertical slots or *Landscape* for horizontal.
- *Background color*: set background for slot.
- *Slot border color:* Set border color for the slot.
- *Auto center time, minutes.* Set this time to auto center wrapped slots after certain time. Use 0 to disable this feature.
- *Annotation font.* Set annotation font for the slot header.
- *Use the same time scale for all slots*. If this box is checked, then a change in the time scale for one slot will cause an automatic change in the time scale for all slots in the window. This makes it easy to keep all data slots synchronized.

5.1.1 Configuring a Slot:

This dialog box appears when you have selected “Add Trace” or “Properties” from the previous dialog box. It allows you to edit, add, and remove traces, as well as customize individual features of the selected slot.



A slot is a rectangular region where traces (corresponding to a sensor or channel) will be plotted. Slots are common to most MagLog NT windows, and will be used in the majority of your displays.

A slot can have unlimited traces. All traces will inherit the slot properties such as vertical scaling, and sizes of the traces.

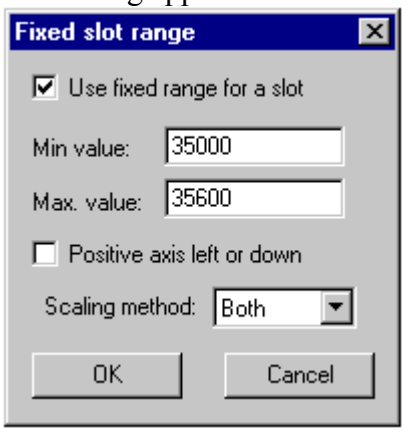
You can fill in details of the current slot as follows:

Slot Name: This is the name you wish to give to the slot. It will be printed on top of the slot.
Time Scaling: This is the total duration of the slot in seconds. If the duration of the slot exceeds the total size of a device internal buffer, MagLog will not be able to re-draw the complete slot. For instance, if the slot duration is large (say 600 seconds) MagLog will display the data normally, scrolling down the slot. However when the user changes the vertical scale, the beginning of the slot may not be plotted with data. The maximum slot duration can be calculated as MagLog device buffer length multiplied by actual device sample rate (see Setting options in "Maglog.ini" file)
Data Scaling: This is the width of the slot in data units. It corresponds to a variation of the data.
Pen width This how wide in pixels (1-5 pixels) the traces should be plotted. Higher values will make the graph appear to have a fatter pen.

Grid Lines: This will allow you to put grid lines on your slot. They are by default turned off, but you can turn them on and customize the color and frequency of the grid lines by pressing "*Grid Lines*".
The gridlines dialog box allows you to select time and data grid lines. You can also specify the number of grid lines you want by adjusting the interval (in seconds). For instance, using default settings in the "*Slot Configurations"* dialog box, you would get 10 horizontal grid lines if you enabled them by checking the "*time*" box.

You can select the color you want by selecting "*Grid Color*".

Fixed scale: This allows user to set a fixed data scale for the When you press this button next dialog appears:



To use *wrapped* scale (suitable for magnetic field display) uncheck *Use fixed range for a slot*. All other fields in the dialog become grayed. Press Ok.
To use fixed scale, check this box and fill in other fields.
Min and *Max* values represents limits of the slot in data units. If data is not in these limits nothing is plotted.
Positive axis left or down shows where maximum value is. For example if you plot depth inside horizontal slot it makes sense to check this box.
Scaling method has next choices: *Both, Min. Value, Max. Value.* It defines how to scale fixed range slot with arrow keys. It *Both* is set, then scaling changes both limits of the slot. When *Min. Value* is set, only minimum limit is changed, the same with maximum. For example to plot altimeter readings it makes sense to set fixed scale range, minimum value as 0, maximum value as 100, positive axis down and scaling method as maximum value. Then originally slot will represent depth in range 0 – 100 m. After you scale it with arrow key it may represent 0 – 200 m range or 0 – 50 m range depends on the scale direction.

Use Digital Display Only: This option allows you to use the slot to output a numerical rather than a graphed value. You can select either "*vertical*" or "*horizontal*" to show whether you would like to output the values in a vertical column or a horizontal row when you want to display numerical values for two or more traces.

Digits after Dot: This controls format of digital display.

You can also manipulate individual traces in the slot by using the following buttons:

Auto Add Trace: This works similarly to the previous option, "Auto Add Slot". In this case, a trace is generated for every data value, but all of them are confined to one slot. In the case of the sample string,

40001.24, 0243, 2001, 1209, 40291.35, 0543,

selecting this option would yield seven graphs, all within the same slot. (See the below discussion of traces for further description on how to identify them). The seventh trace corresponds to the gradient. This gradient value is automatically calculated anytime there is more than one magnetometer.

Add Trace: This option allows you to add and customize a trace.

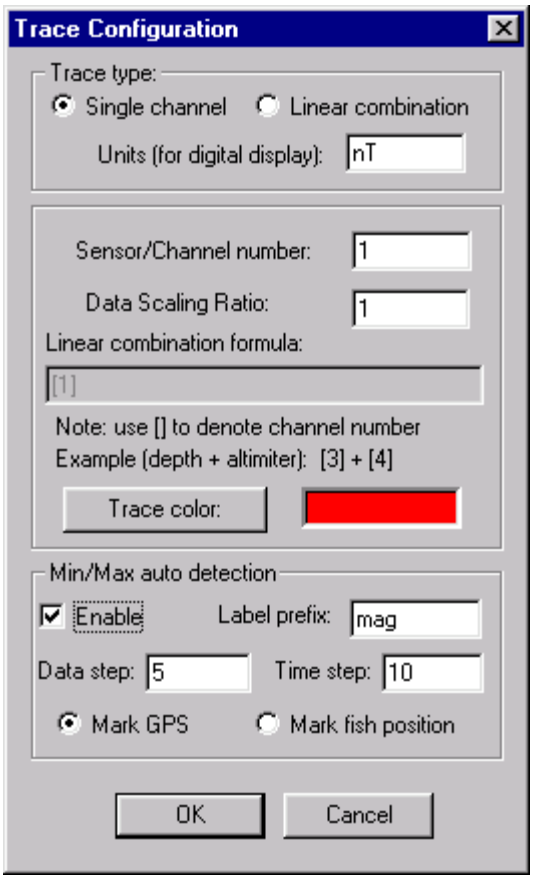
Remove Trace: This removes the currently selected trace from the slot. It will no longer be displayed.

Properties: This allows you to edit the properties of the currently selected trace.

In the screen above, no traces have been defined. To add a trace, click on *"Add Trace"*.

5.1.2 Configuring a Trace:

Traces, which represent profile plots of the data, are also common to most displays. The following dialog box allows you to choose what you would like to plot and how you would like to plot it.



The available options are:

Trace type: MagLog can display single channels or combinations of channels. If you want to plot just a single channel check *Single channel*. If you want to plot a combination (such as gradient or depth + altimeter) check *Linear combination.*

Units (for digital display). This is the suffix to be added to the digital display allowing easy recognition of the data source on the screen.

Sensor/Channel number: This represents which sensor (magnetometer) or which channel (analog device such as depth transducer) or which predefined accumulators (GR800 or GR820 gamma ray spectrometers – used in airborne survey) you want to plot. In the case of the earlier sample magnetometer string example:

40001.24, 0243, 2001, 1209, 40291.35, 0543

we plotted valid channels ranging from 1 – 7. In this case, the numbers would correspond to:

1 = Counter 1, Field
2 = Counter 1, Signal

3 = Counter 1, Depth
4 = Counter 1, Altimeter
5 = Counter 2, Field
6 = Counter 2, Signal
7 = Gradient (available only for 2 or more sensor systems)

Note: The gradient will always be included anytime there is more than one sensor. (i.e., compatible with concatenated 880/881/823 only) To get the channel number of the gradient, take the total number of channels specified for the magnetometer (in the above example, six), and add one.

Horizontal Scaling Ratio: This is a full-scale multiplicative coefficient that will be applied to the slot horizontal scale factor. This allows the user to plot the same channel at different horizontal scale factors in the same slot. The total width of the trace is found by multiplying the horizontal scale factor for the slot by the horizontal scale factor for the trace. In the case of this example, if we specified a horizontal scale factor of 2, and horizontal scaling (specified in the slot configuration screen) to be 128, the data would span a range of 256. If you had one trace with a scale factor of 1, and the second with a scale factor of 2, the second trace would appear to be one half the size of the first.

Linear combination formula: This can be used to display values like gradients and total depth of the water column in marine surveys. For gradient display the user has to determine the channel numbers for both magnetometers. For example, for a dual G-880 magnetometer system it might be 1 and 4. Then linear combination formula for pseudo gradient will then be:

[4] - [1]

If user wants to display the sea floor bottom topography for G-880 system with a depth sensor and an altimeter then the formula reads:

0.001*[3]+0.01*[4]

Here [3] is the depth sensor channel number and [4] is the altimeter channel number. 0.001 is the calibration coefficient for the depth sensor and 0.01 the coefficient for the altimeter. (These values will vary in each customer's system).

If depth and altimeter have non-zero bias (offset) in their calibration formulas then the complete formula will look like this:

a*[3]+b*[4]+bias

Where bias = bias3+bias4

For the G-880/881 magnetometers, depth/altitude calibration coefficients can be assigned to the corresponding MagLog device. Therefore there is no need to enter them in the trace configuration dialog. In the case of the G-877 magnetometer, the calibration coefficients are stored in the magnetometer internal memory. However the "*Linear combination*" feature will still useful if customer wants to display values in units other than those specified by the calibration units. The depth sensor is typically calibrated in meters; to display its reading in feet use the following formula:

3.28*[3]

and type "ft" as units for digital display.

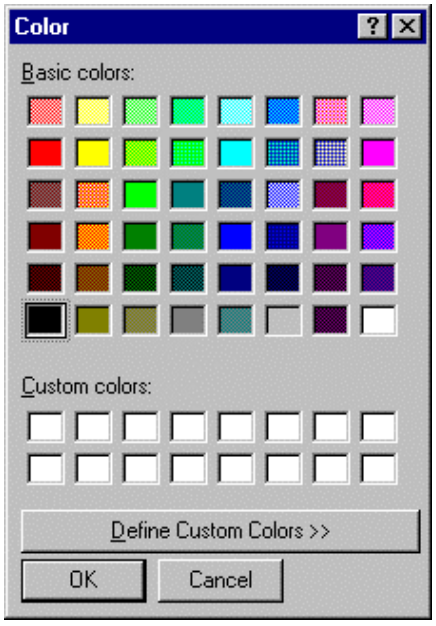
Note that *Linear combination trace*" can be represented with a constant like:

50

This means that the program will display and print a horizontal line.

Trace Color: This represents the color of the trace. Each trace can have its own color. To change the color of a trace click on "Change Color".

The following dialog box shown below allows you to select the color.



Once you have defined your trace color click "*OK"*.

Min/Max Auto Detection. MagLog has the ability to automatically detect the minimum and maximum values in the data as excursions occur during survey. As soon as min/max

point has been detected, the program sets a *user flag* on the GPS map and saves the position in the *user flag list*. (See *Using flags* below).

Any trace can be used for setting flags, however the user should not overuse this feature as a crowded map will result. The following parameters are used for automatic flagging:

- **Enable.** This enables flagging for the trace.
- **Label prefix.** This is the prefix used in the flag ID.
- **Data step, in trace units.** Only amplitudes equal to or greater than this threshold will be flagged. This provides a method for removing noise. It is recommended to set this value be set well above the device noise level.
- **Time step.** Points are marked only if time gradient exceeds a "data step/time step" value. It allows filtering out relatively flat minimum and maximum points that are of no interest. For example, if the survey vessel speed is 4 knots (which is approximately 2 meters/second) and the water depth is approximately 20 meters, then anomalies from the sources on the sea floor have half width of about 10 meters. Therefore, a suitable time step will be 10m / 2m/s which equals 5 seconds. If the time step is set to zero then the program marks all anomalies (even if they are very flat).
- **Mark GPS/ Mark fish position.** This controls where flags are placed on the map. To use this feature, the fish position interpolator feature must be configured properly.

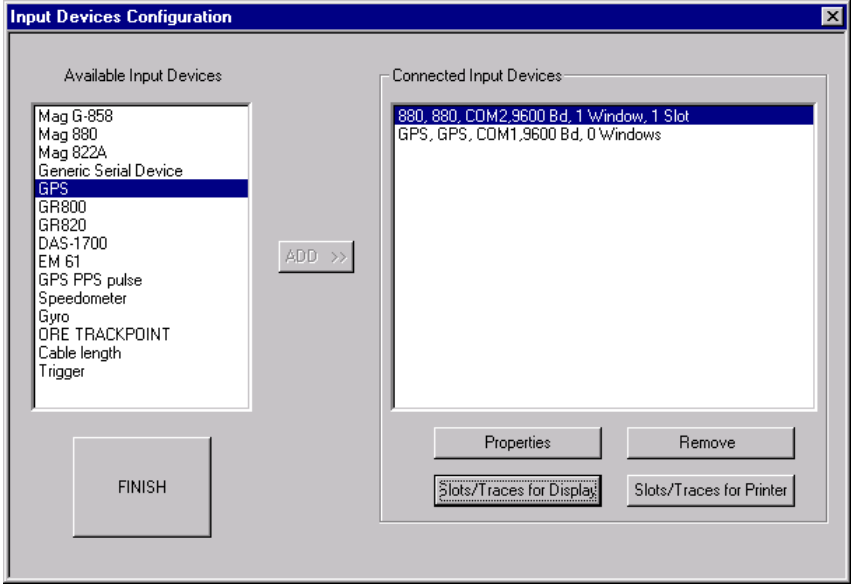
Flags are gathered in the *user flags* dialog list. The user can inspect, save or remove flags any time.

5.1.3 Editing the Display

The examples above illustrated how to add a single trace to a single slot. However, often you will want to add many more traces or slots to further customize your window.

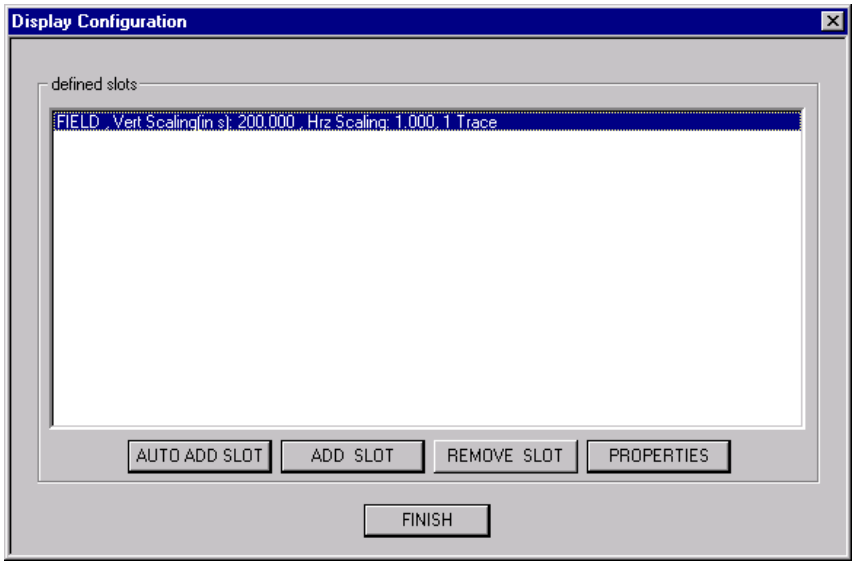
This section explains how you can edit existing traces and slots and add new ones.

Configuring the traces and slots can be done from the "*Input Devices Configuration*" screen or from the *"Configure / Display (slots)"* menu item or from the context menu (right click and *"Display: All slots"* item will appear).The latter two methods are recommended because MagLog does not re-initialize the device if the "*Input Devices Configuration"* dialog is not called. At this point in time, after adding a single trace, you should see your main configuration screen appear as:

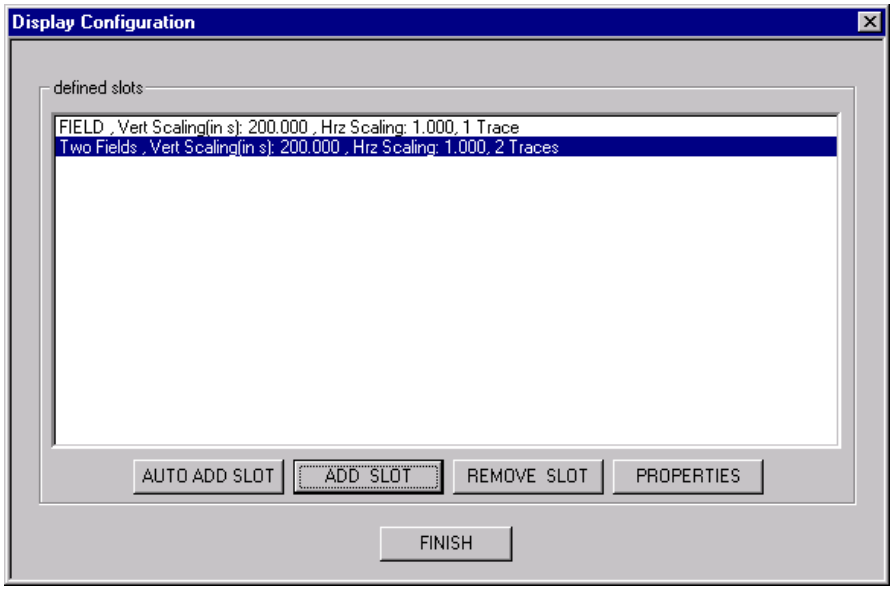


This window gives you a lot of useful information. By looking at the list of connected input devices, it allows you to see how many windows and slots you have for each device. You can also see there is currently no display set up for the GPS -- "0 Windows". This will be discussed later.

To edit the display for the G-880, press "*Slots/Traces for Display" (*the same dialog is accessible from *"Configure / Display (slots)"* main menu item or from context menu item "*Display: All slots*"). This will again bring you into the window that shows the slots you have defined.

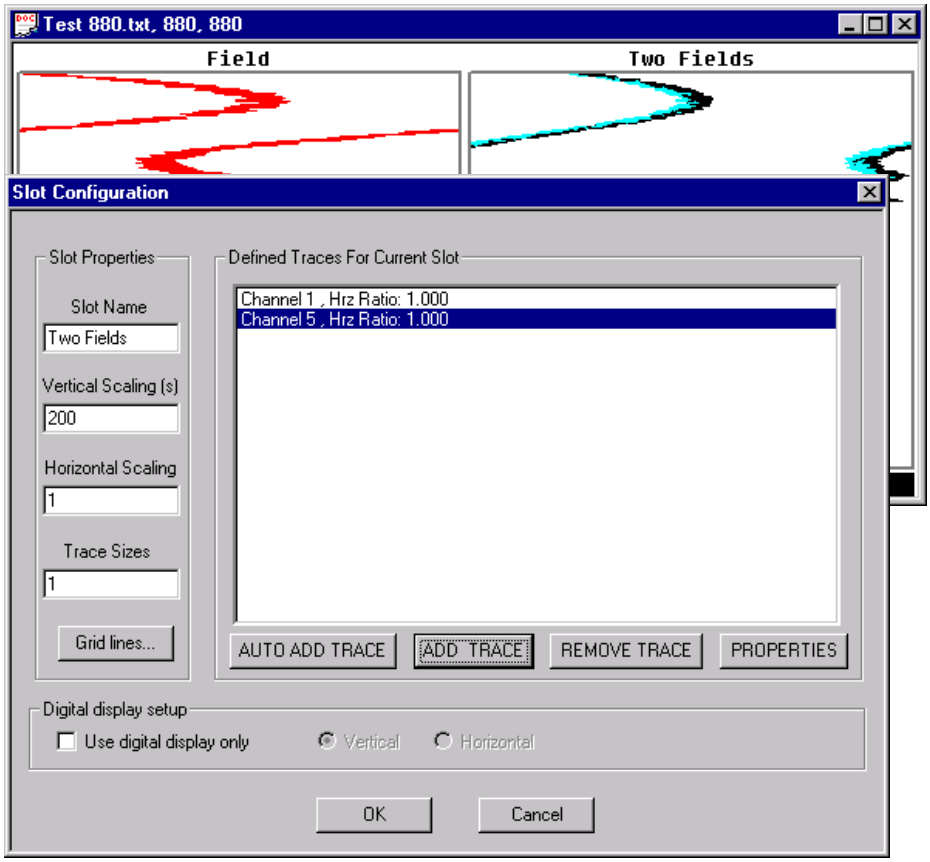


This window shows one slot with one trace. You can further edit this slot by pressing "*Properties*", or you can add a new slot by pressing "*Add Slot"*. This will discuss how to add an additional slot with two traces, and will show the resulting window. To add an additional slot, press "*Add Slot"*. In this example, we will name the new slot "Two Fields", and we will press "*Add Trace"* twice. We will use the first trace to plot channel 1, and the second trace to plot channel 5. The final window should appear similar to the screen below:



The resulting Display Configuration screen (seen when exiting the slot configuration window) should appear similar to the screen shown below:

When you press “Finish”, and exit out of the configuration screens, the final window generated for the G-880 display should appear similar to the screen below.



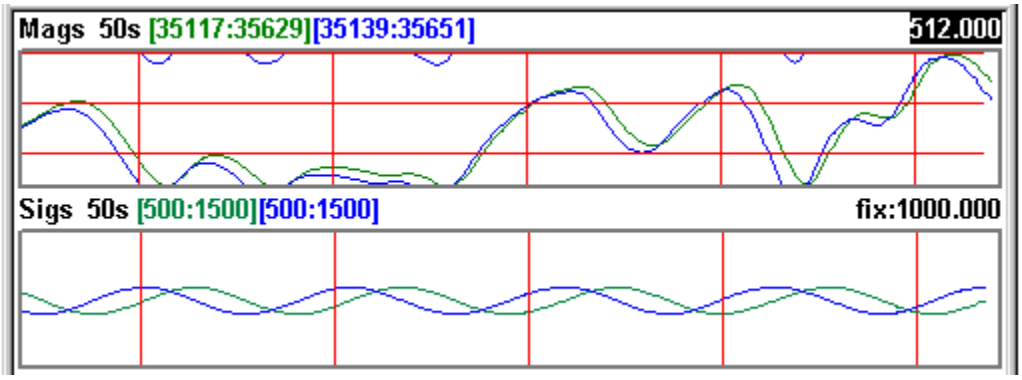
Note: Here, we have manipulated the scale factors to fit the data input. In this case, the first slot (Field) has a horizontal scale of 32, and the second slot (Two Fields) has a horizontal scale of 64. You can also see that channel one is graphed on both slots, but the second channel has an additional plot (channel 5) present.

Note: An easy way to change slot display parameters is by *right clicking* on the screen to call up the contextual menu. Then select *Display…* item. It will bring you immediately into the slot configuration dialog box.

You can configure the display in the same way for other devices.

5.1.4 Horizontal Slots and Slot Legend.

The graphic below is an example of horizontal slots mode often preferred to maximize the use of available screen area:



The labels “mags” and “sigs” are names of the slots. The total duration of the slot (50s) is computed in the following manner: Values in [] are current limits for green and blue traces. When the trace wraps, its limits are altered automatically to show the current slot scale. On the far right side is slot’s vertical scale. If slot has a fixed scale, the key word “fix” is present. This means that the traces for this slot cannot wrap.

Vertical slots have the same legend if space permits. If not, only the slot’s name is displayed.

5.1.5 Slot context menu

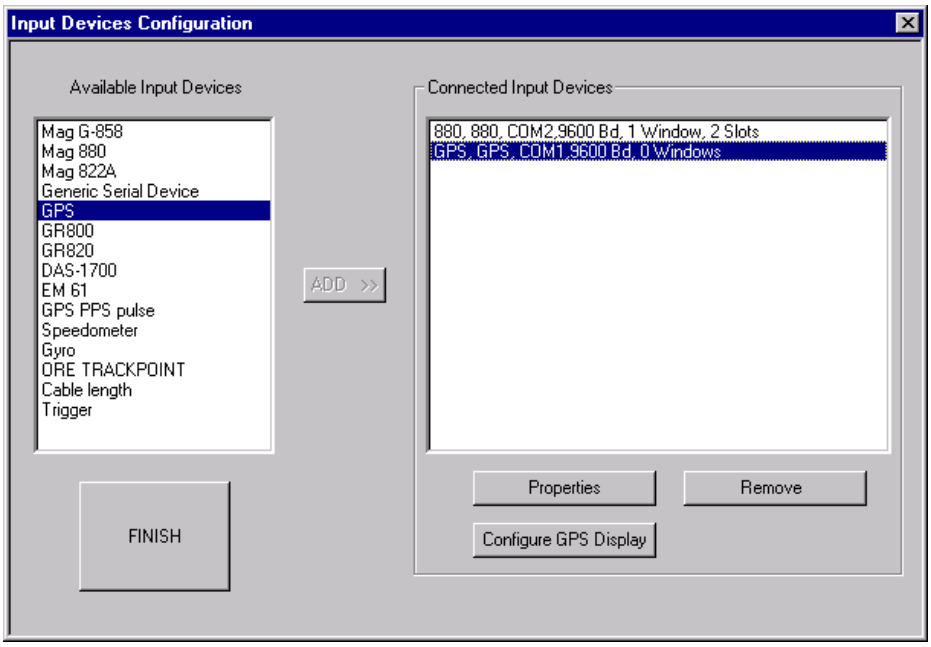
When the user right clicks on the slot window the context menu shown below will appear:

- *Set GPS Flag and Set FISH flag* allow the user to set flags on the anomalies at GPS or magnetic fish position accordingly (see "Adding flags from display slots." for more information.
- *List flags…* retrieves a dialog box with all existing flags listed allowing the user to save, load and modify flag information.
- *Display (All slots)* brings a dialog box that controls the appearance of the entire slots window.
- *Slot: MAG* ("MAG" is substituted with actual name of the slot selected by the user) retrieves a dialog box that controls the appearance of a particular slot.
- *Zoom In and Zoom Out* zooms the data axis in the slot (not the time axis). The same functions have can be accessed via cursor keys on the keyboard.

5.2 Configuring the GPS Display.

The GPS display configuration is different from the magnetometer display configuration because it displays spatial position information, not time series information. To show any point on the Earth on paper or computer screen some kind of *geographical projection* must be employed. To show GPS position, the map and flags MagLog uses orthographic *projection based on sphere* with the central latitude and longitude in the middle of the screen. This allows us to combine speed of calculation with reasonable accuracy. To read Latitude and Longitude at the mouse location, MagLog uses *inverse orthographic projection*. This cancels distortions introduced by the projection calculation process.

You can configure the GPS display by entering the device menu, and selecting GPS.

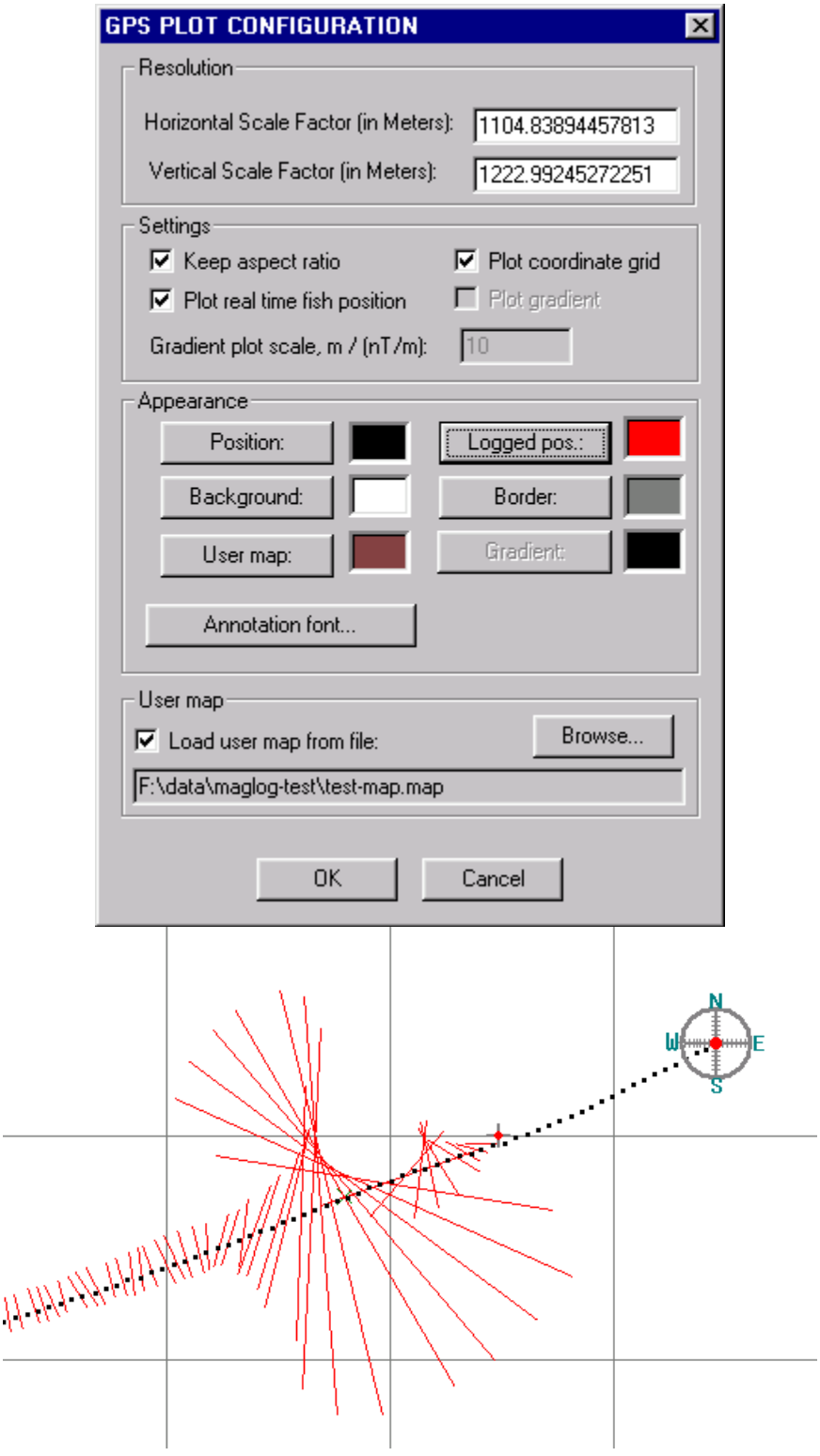


From here, you can press "*Configure GPS Display"* to add a new window and configure the display. At this point there is no window present for the GPS. To remove display if there is one delete the GPS input device, and then re-configure it without enabling the display. Use the "Properties" dialog box if you want to modify your GPS settings (e.g. communications port number, quality control values…).

If you press the option "*Configure GPS Display",* you will see the dialog box shown on the next page:

- This dialog box allows you to specify horizontal and vertical scale factors for the portion of the GPS graph you will be observing. Because of the projection distortion and aspect ratio of the window, the "input values" are used by MagLog as a "recommendation" only. The actual spatial extents are plotted in the window.
- **Plot real time Fish position**. This option is only available if the MagLog Interpolator is running (see below). MagLog will show the position of the vessel (GPS) and the calculated position of the magnetometer Fish, using an internal dragging algorithm. However, if the screen distance between the boat and Fish is less than the size of the GPS mark, the Fish position is not plotted.
- **Keep aspect ratio**. To have uniform scaling along both axes, check this box. This may misrepresent the trackplot x and y distances; however, it will have no effect on the logged data.
- **Plot coordinate grid**. If the extent of the area is less then 100 km, MagLog can plot a coordinate grid for easy distance estimates. The grid step value is chosen automatically, based on areal extent. The Grid color is the same as the border color.

- **Plot real time Fish position**. If the Interpolator device is configured, MagLog can also plot the Fish position (marine surveys). Note that the Fish mark will disappear if it is too close to the GPS mark.
- **Plot gradient**. With marine transverse gradiometer systems, MagLog can calculate and plot the full horizontal gradient. The interpolator device must be configured to utilize this feature.
- **Gradient plot scale**. If the above feature is enabled, enter the Gradient Plot Scale here.
- **Position…**. Sets the color for the dots that make up the GPS track plot.
- **Logged pos**.. Sets the color for the dots that make up the GPS track plot when the software was logging to disk.
- **Background…** Sets the background color for the GPS window.
- **Border ….** Sets the color of the border around the plot.
- **User Map…** Sets the color of the imported User Map, if applicable.
- **Gradient…** . Sets the color of the plotted gradient lines.
- **Load User Map from File**. Click this box if you want to load a *User Map.* NOTE: If you select this option, you must also specify the User Map file (including full path) in the provided entry field.



Typical real time gradient plot.

Note: Normally MagLog NT expects GPS input to be in geographical (latitude and longitude) coordinates. It will do an automatic conversion to meters (UTM) on the screen, and the scale factor that you choose will be roughly equal to the size of the area you would like to look at.

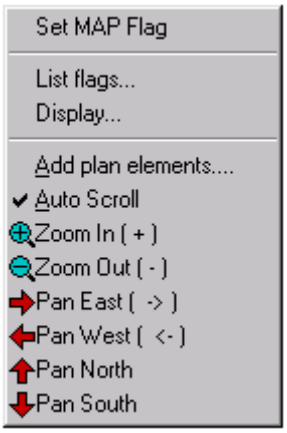
After making any adjustments to the GPS map parameters, you can enable the GPS display by pressing "*OK"*. You should then see a GPS window appear in your MagLog program.

After the GPS display is established the first time you can right click on it to call a contextual menu. Option *Display…*calls a dialog box to re-configure display (the same as above).

You also can read the Latitude and Longitude of the mouse position on the program status bar. The format can be set as decimal degrees, degrees and minutes or degrees, minutes and seconds.

5.2.1 GPS display context menu and mouse functions

Using a right mouse click on the GPS Track Plot window will bring the following menu:



- **Set MAP flag.** Sets a flag in the current mouse position. Flags set with this function have names such as "MAP_#" where "#" is the flag number. These flags are useful because they mark positions that can be converted into survey plan elements. (see below)
- **List Flags…** Brings a dialog box with a list of all flags set so far. It provides for saving or loading flags from the file, editing flag's position and associated text.
- **Display…** Bring the GPS display configuration dialog box (see Configuring the GPS Display.)
- **Add plan elements…** Allows converting flags into survey plan elements and saving the survey plan in a file. For instance two flags can be used to generate a set

of parallel lines to be displayed as a background navigation map in the GPS window. Note that user map (survey plan) has to be re-loaded after new elements are added.

- **Auto scroll… When** checked this keeps the GPS location in view and scrolls the window automatically. In this way the GPS location is always visible.
- **Zoom In…** Zooms in GPS window. The same function can be accessed via the "+" key on the computer's numeric keyboard (on many laptops press function key to access numeric "+" – typically marked in blue on the keyboard).
- **Zoom Out…** Zooms GPS window out. The same function can be accessed via the "-" key on the computer's numeric keyboard (on many laptops press function key to access numeric "-" – typically marked in blue on the keyboard).
- **Pan East, West, North and South** Pans GPS view in coordinal directions. Note that this might interfere with automatic scrolling if the latter is enabled (GPS position is never scrolled out of view if autoscrolling is on)

A simple click in the middle of the GPS window will center it at that point (autoscroll should be off to make this feature function properly) When mouse cursor is moved to borders of the GPS display, it will change its shape to  at the East border,  at the South border,  at the West border and  at the North border. When the cursor in moved in the corners of GPS display it changes its shape to  ,  ,  and  . If the cursor has changed its shape, using a mouse click causes panning in the direction shown. NB: This could interfere with the auto-scrolling feature.

5.3 Preparing a Survey plan file.

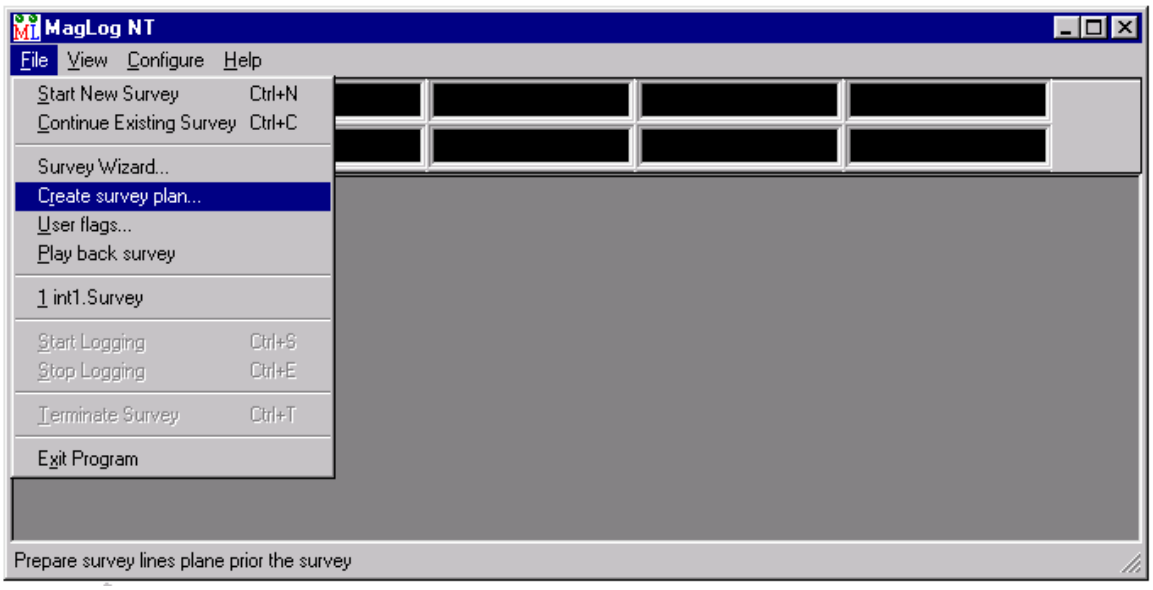
MagLog allows you to overlay GPS information on a map that consists of polylines. Each string has pair of numbers: latitude and longitude of the segment's node. An empty string indicates the end of the polyline segment; the next string shows the start of the next line. Here is an example:

```
37.778928000 -122.245980000 Label text
37.779128000 -122.247780000
37.785328000 -122.254680000

37.463138000 -121.968370000
37.461839000 -121.973271000
```

Here first polyline has 2 linear segments and second polyline has just one. Latitude and longitude are given in decimal degrees, and "-" indicates Western longitude or Southern latitude.

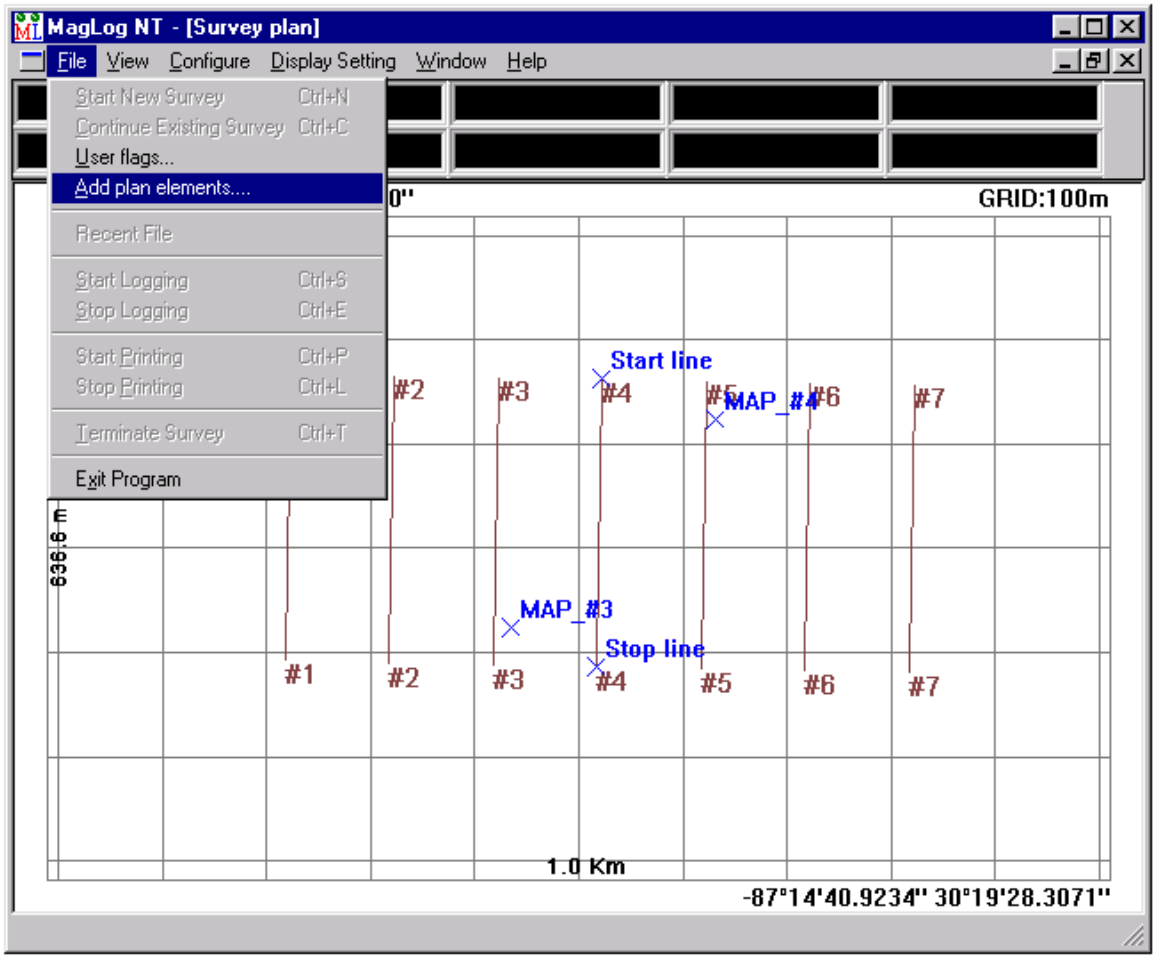
Optional *label text* can be added after the longitude to be plotted on the screen. Text size is not scaled with the map which makes it easy to recognize at any map magnification.

It is clear that the user could prepare this kind of file with an ASCII editor, however it would be time consuming. Because of this, a special tool is provided to convert GPS flags into plan elements: scaled marks, lines and line sets. GIS ArcInfo "shape" files can be converted into this format also. Option is available from main MagLog menu and should be used before starting any survey.



Select *Create survey plan* option under *File* menu. This will bring MagLog into the *survey plan preparation* mode. In this mode a maximized GPS window is displayed; however program cannot accept GPS information at this time. The user should insert flags on this map in the appropriate places using GPS display context menu. Prepare set of ArcInfo "shape" files if this information is available. After all information is ready select "*Add plan elements*" as it is shown below (you can call this dialog as many times as you need):

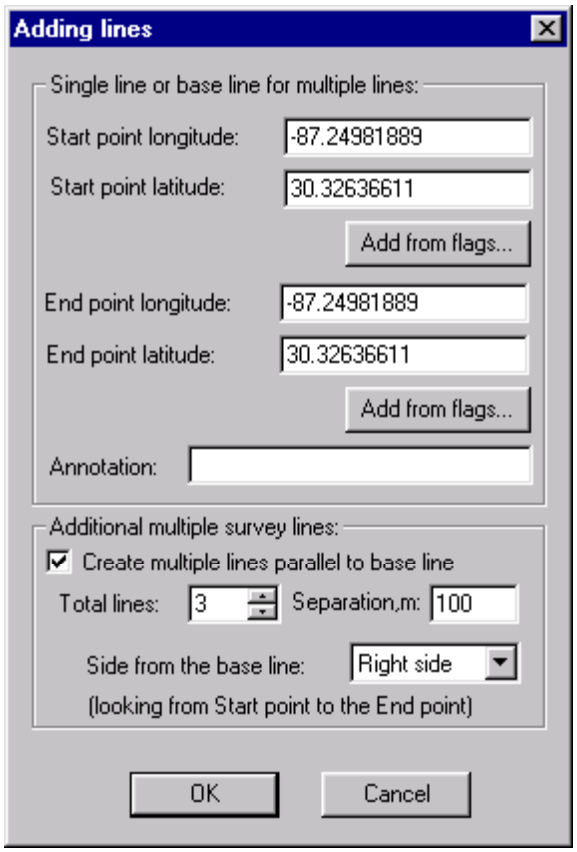
Note: All features described in this article are also available when the actual survey is running. However in this case, to update GPS display map the file must be re-loaded using "GPS PLOT CONFIGURATION" dialog.



The dialog box "*Create or import map data*" allows you to specify the following geometrical features:

- **User marks.** These are simple scalable crosses. Press *Add user mark* button to enter latitude and longitude of the center point and span (in meters) of the cross. To avoid typing latitude and longitude for the point, press "*Add from flags*" button and select the appropriate flag. The flag's position will be used as coordinates for the point. Note that you can still edit this position if you need to (in *Add mark* dialog or in *User flags* dialog.) Enter optional label text (recommended) for easy mark recognition on the screen (default is just the flag's name) Use this feature to mark known anomalies or other landmarks or hazards etc.

- **User lines.** These are simple line segments that can be used to set up a survey line grid for the survey process. Press *Add user line* and enter the end points (longitude and latitude). You can use "*Add from flags*" buttons to get positions. To setup multiple parallel lines check "*Create multiple lines parallel to the base line*" box. This will use the line you entered as a base line and will create additional lines parallel to the reference line at desired lane spacing. Enter the number of lines, line interval and which side of the base line you wish to create the lines. The choices are "*Right*" "*Left*" and "*Both*" MagLog creates lines on either side of the base line looking from start point to end point. If N additional lines are requested program creates N+1 lines for "Right" or "Left" options and N+1 line for "Both" option (including base line)



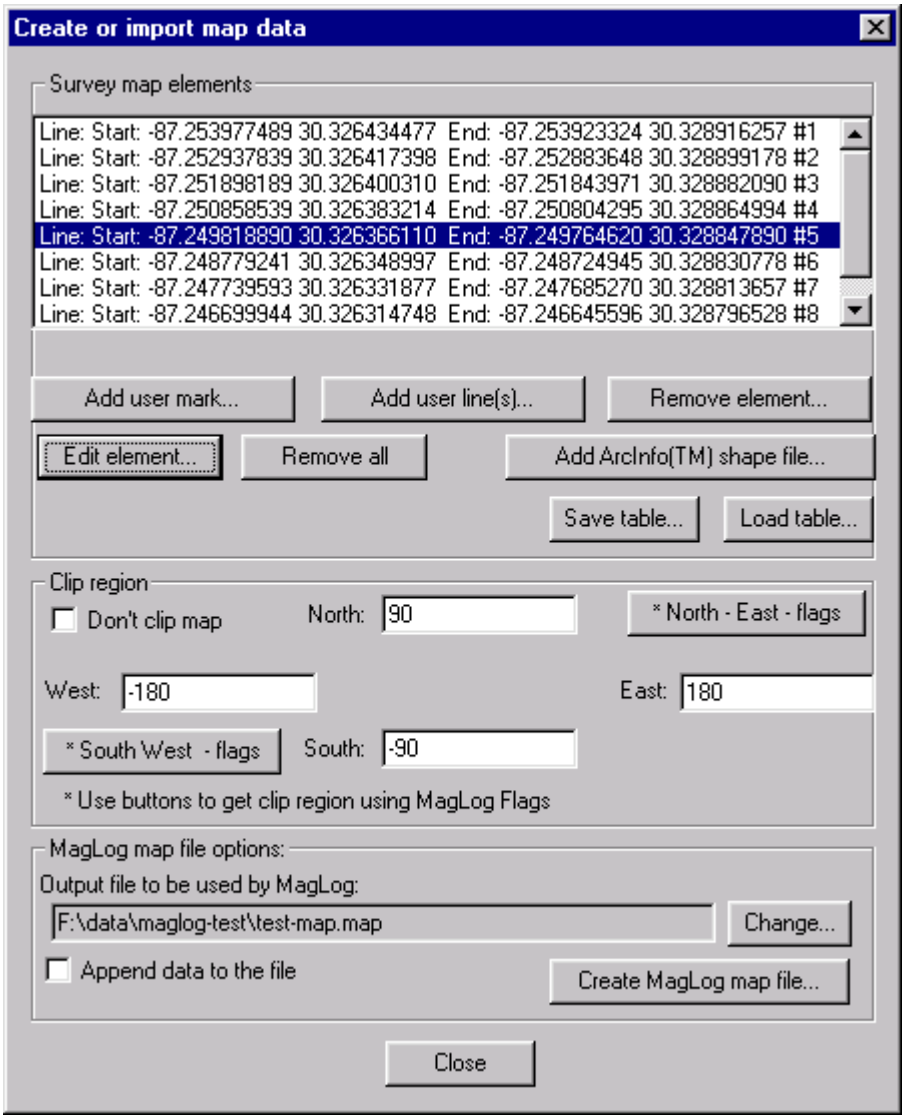
Enter optional text annotation (recommended) for easy line recognition on the screen. Annotation is used as a prefix to the line names which are #1, #2 etc starting from left to right (looking from start point of the line to the end point) In this manner a preconfigured grid pattern for the survey can be established prior to acquiring data. This can help the vessel stay on course, but it is recommended that such features present in the GPS itself be used to actually steer the vessel.

- **Button "Add ArcInfo™ shape file** allows the user to include shape files into the survey plan. Both .shp and .shx file type must be available for the program to import the boundary maps successfully. Shape files are available from the ESRI website shown below (ESRI requires that you register to download the data). We

suggest using the demographic Tiger database located at: http://www.esri.com/data/online/tiger/index.html. Please note that shape files should use the same geodetic datum as GPS you are using, for example WGS-84. Contact your GPS manufacturer or us if you are unclear on this point.

- **Buttons "Remove element" and "Remove all"** allows you to remove a selected element or all elements from the table "*Survey map elements*"
- **Button "Edit element"** modifies parameters of a mark or individual line. It does not allow you to change parameters in the shape file.
- **"Save table" and "Load table"** buttons allow you to save or modify the "Survey map elements" table for future reference. Note that it is a simple ASCII file which cannot be used as MagLog map.
- **Clip Area.** All survey plan information can be clipped into a rectangular region if needed. To clip, uncheck "*Don't clip*" box and specify West and East and North and South limits. Note that GPS flags can be used to enter limits of the clipping area using "*North – East flags*" and "*South - West flags*" buttons Clipping is highly recommended if shape files are used because they can cover a considerable area (like the entire coastline of the US) while just a small area may be needed during a survey or survey playback. Clipping also reduces the program overhead – the map file should be as small as possible and still cover the area of interest.
- **Output file.** Set output ASCII file used by MagLog. If *Append data to file* box *is not* checked then file is overwritten if it exists. If the append box *is* checked the program appends lines to the end of the existing file allowing sequential build of MagLog maps for the area
- "**Create MagLog map file…**" button produces an actual file loadable as a survey plan. The user must press this button to create a map before leaving the dialog box if he or she wants to generate a map. After the *Create MagLog map file* button is pressed, the program will process all elements (shape files, user marks and lines) in the list. This may take a while. The result is a file that can be used as a MagLog *Survey plan* file*.
- **Append data to the file.** If this box is checked, new map elements are added to the existing file without erasing the file. This allows you to keep previous a MagLog survey plan as part of the new plan.

* Some data for the US and other parts of the world are available at no charge at www.esri.com



Note: Be careful while using this feature. The map file *MUST BE IN THE SAME DATUM AS INCOMING GPS DATA*. For example if the GPS is transmitting WGS-84 coordinates and you are using a national map to create the map file, chances are that map positions differ from GPS by few hundreds of meters (unless you are operating in the US and map is based on NAD-83).

If the concepts "DATUM" or "WGS-84" are unfamiliar to you see your GPS manual or seek assistance from navigation professional.

This feature is not accurate enough to be used as a navigation aid for boat or vehicle steering. "***Geometrics" accepts no liability nor offers any warranty for the misuse of this feature***.

5.4 Using Atlas Boundary (BNA) as MagLog Map file.

The Atlas BNA format is a simple vector format supported by SURFER software. MagLog is capable of using this format in place of the internal map format described above. To take advantage of this feature, follow these steps:

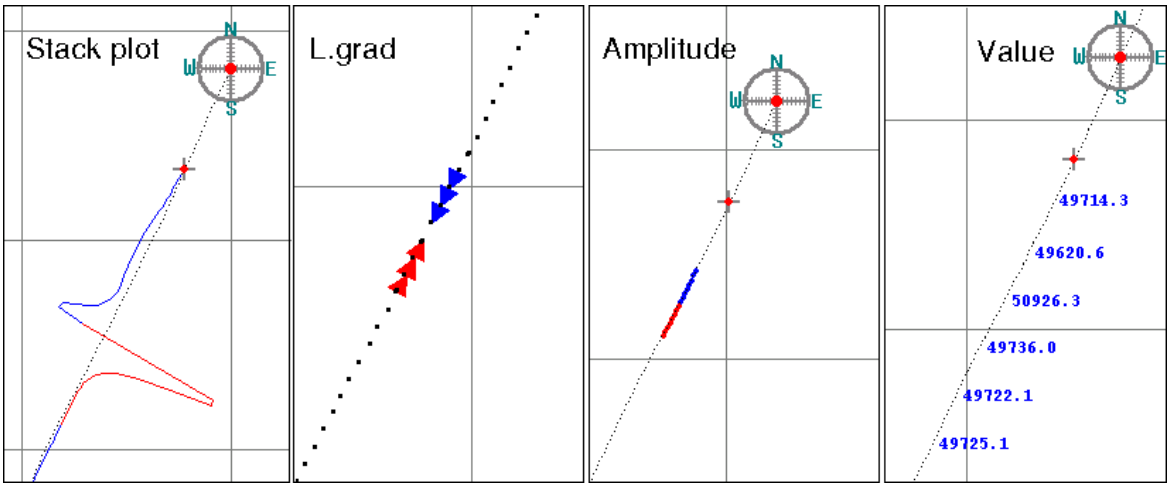
- **Prepare the map with SURFER**. The map must only include lines. Text will not be converted into the BNA format. It is possible to convert text into lines by exporting the map from SURFER in the AutoCAD DXF format and then importing it back into SURFER. This will convert text into graphical outlines. The map must be based on geodetic coordinates (latitude and longitude) or UTM coordinates, based on the datum that the GPS is using.
- **Export the map** in BNA format.
- In MagLog, follow the same steps described for importing a User Map above to load this base map.

Note: If the BNA file consists UTM coordinates, the UTM parameters in MagLog interpolator must match the map parameters.

5.5 Using Ontrack Plots.

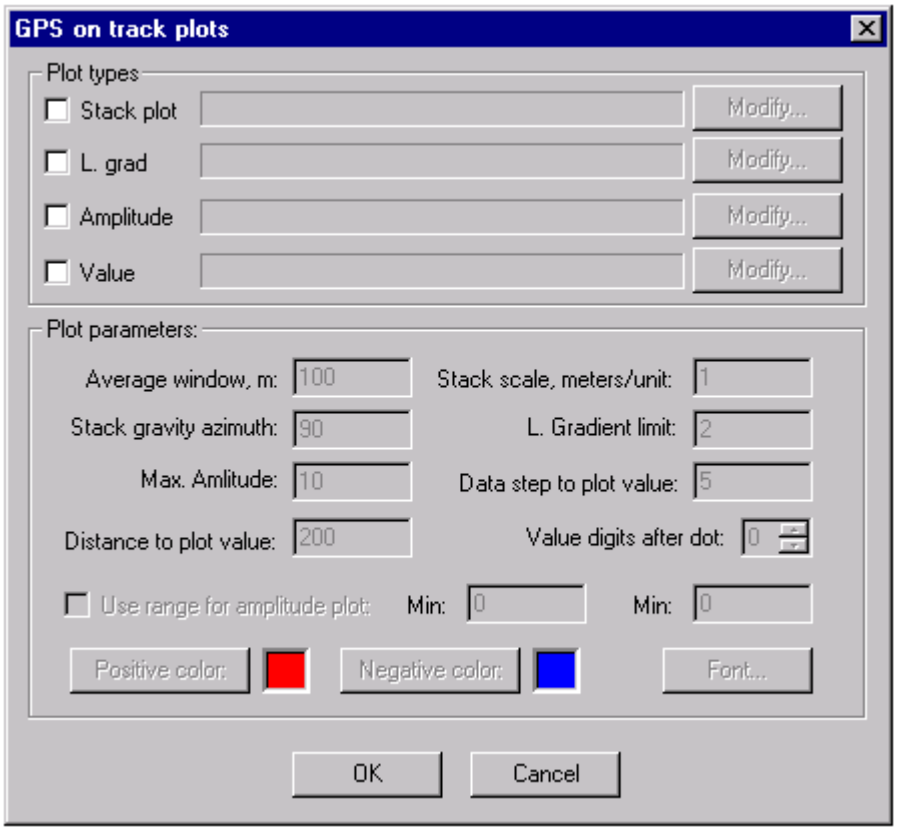
MagLog allows plotting information from other devices (typically magnetometers) as an overlay of the GPS plot for easy display. Data from different sources can be combined into single values to be displayed in the following ways:

- **Real time stack profile.**
- **Real time longitudinal gradient plot**. If the gradient along the line exceeds some user-defined value, colored triangles are plotted on the track. Triangles are scaled to the distance between adjacent GPS positions.
- **Real time amplitude plot**. If either the relative or absolute amplitude exceeds certain limits, colored circles are plotted on the track plot. These circles <u>are not scaled</u> if the scale of the map changes.
- **Real time value plot.** Readings (or combination of readings) from different devices can be plotted on GPS map equidistantly, or when the difference from a previously plotted value exceeds some limit. For example, "total depth" (for Systems with altimeter and depth-sensors) can be plotted each 100 m, or for a change of more then 2 meters. Another application of this feature is plotting of Event Marks on the GPS map.

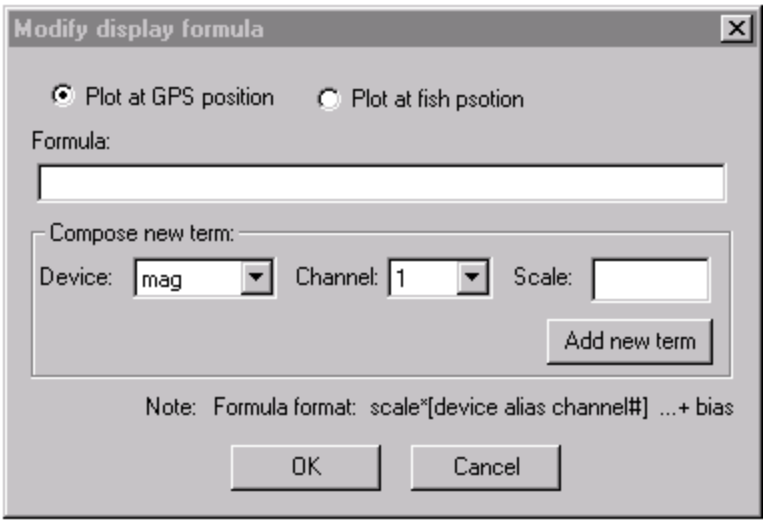


PRECAUTION! Use caution when activating these features, as they could obscure important data if survey line spacing is small.

To activate this feature, select the GPS display window and select *Configure / On track plots*. The following dialog box will appear:



All four possible On Track plots are listed under *Plot Types.* Initially, no data is selected for plotting. To enable a particular plot type, check its box, and then click *Modify* to assemble the *formula.* For example, to use a real time magnetometer stack plot, check *Stack Plot* and then click *Modify*. The following dialog box will be displayed:

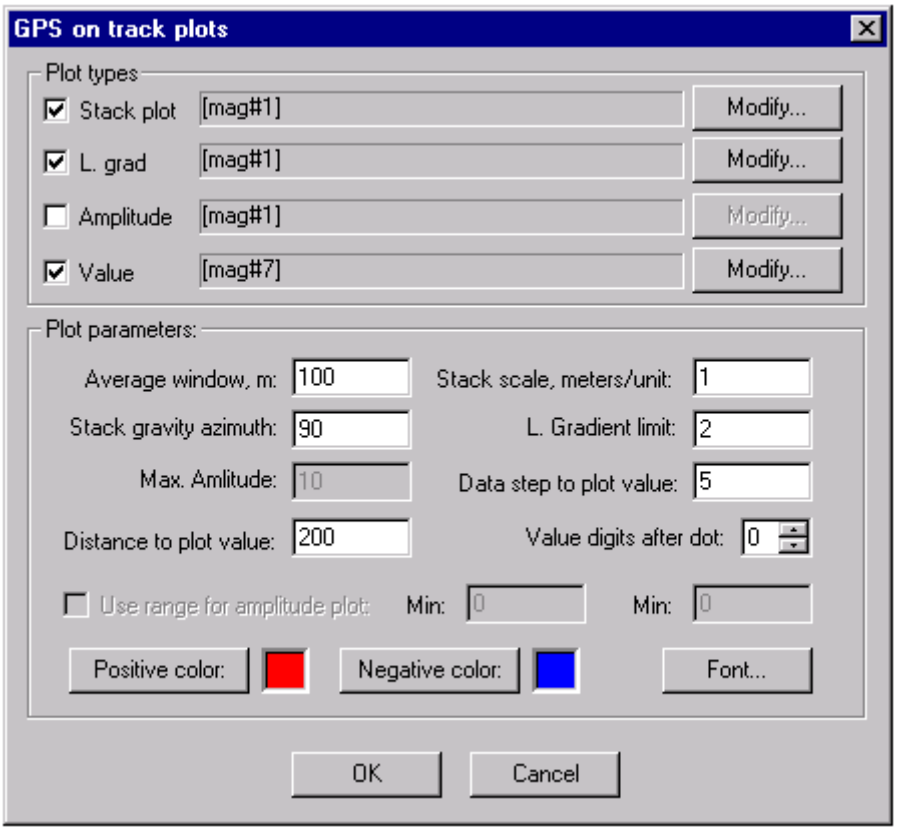


There are two ways to enter the formula:

- **Type it into the entry field.** The Formula must use the following syntax: multiplier1*[device-alias1#device-channel1]+multiplier2*[device-alias2#device-channel2] …+ bias. Multipliers must precede devices. "*Device-alias"* is the device alias assigned during creation of that device, and displayed on the light bar. *Device-channel* is the number of the channel to be used. Signs [] # * + (or -) are mandatory. No spaces are allowed inside []. You can mix different devices in one formula. *Bias* is a constant to be added to the final formula.
- **Use the lower area of the dialog box to create a new term for the formula**. For example, to plot magnetic field select "mag" in the *Device* field*,* "1" Channel field and then click *Add new term*. This Formula becomes [mag#1]. *"Add new term" can be used* as many times as needed. For example, to display total water depth (assuming that there is a depth sensor as magnetometer channel 3 and an altimeter as magnetometer channel 4), assemble the following formula: [mag#3]+[mag#4]. If you need to scale the data channel enter "*scale"* before pressing *add new term.* If there is any bias to be used in the final formula, append it.

Real time plots can be tied to the GPS position or the Fish position (the latter is only possible if the INTERPOLATOR device is used).

After enabling all the desired information, the *GPS on track plots* dialog may look like:



There are important parameters to be used for on-track plots. They are listed in the bottom part of the dialog box. Typically, each type of plot needs its parameters to be entered. Below is the list of plot types with their corresponding parameters.

1. **Stack plot.** The following values affect the Stack Plot:
    - *Average window*, in meters. To find the "middle line" for a Stack Plot, the program uses a low-pass Bartlett filter. You must enter the length of the filter. The typically filter should be longer than expected anomalies, but not too much longer. For example, for marine UXO survey at 40 feet total water depth, a value 100 meters for the filter would be logical.
    - *Stack scale*, meters per unit. This is the scale to convert field units (nT) into distance units (meters) to be plotted on the map.
    - *Stack gravity azimuth*. This is the direction where positive anomalies would "gravitate". For example, if the survey consists of lines going South – North and this value is 90 degrees, then positive anomalies would be plotted to the East regardless of the direction of the survey line.
    - *Positive and negative* colors. Positive areas of the Stack Plot are plotted with the "positive" color; negative areas are plotted with the "negative" color.

2. **Longitudinal gradient (L. grad).** The only value required is *L. gradient limit.* If the absolute value of the longitudinal gradient exceeds this limit, the program will plot arrows using the "negative" color if the gradient is below zero, or with the "positive" color if the gradient is above zero.

3. **Amplitude plot.** This plot cannot be used simultaneously with the Longitudinal Gradient plot. . If either of these plot-types is active when the other is selected, the former type will be de-selected. These parameters are required for the Amplitude plot:

    - *Average window - this* has the same meaning as in the Stack plot. The program calculates the average and plots colored circles if the absolute value of the difference between the current data and the average exceeds *max. amplitude*. Note that if both Stack and Amplitude plot are used simultaneously, they both share the same Average Window.
    - *Max. amplitude*. If the "*Use range for amplitude plot"* checkbox is not checked program starts plotting colored points if difference between average and current value exceeds this limit.
    - *Use range for amplitude plot*. There are two modes for an Amplitude plot:

      The first mode utilizes the Average Window, and therefore does not require absolute field values.

      The second mode allows control of the plot by setting absolute limits. If "*Use range for amplitude plot"* checked, *"min"* and "*max*" values must be entered. If the reading is below the *"min"* value, the program plots circles with the *"negative"* color. If the reading is above the *"max"* value the program plots circle with the *"positive"* color.
    - *"Min"* and *"Max"* values. These are the limits for an Amplitude plot in absolute mode.
    - *"Positive"* and *"Negative"* colors. Positive areas of the Amplitude Plot are plotted with the "positive" color; negative areas are plotted with the "negative" color.

4. **Value plot.** The following parameters are required for the Value plot:

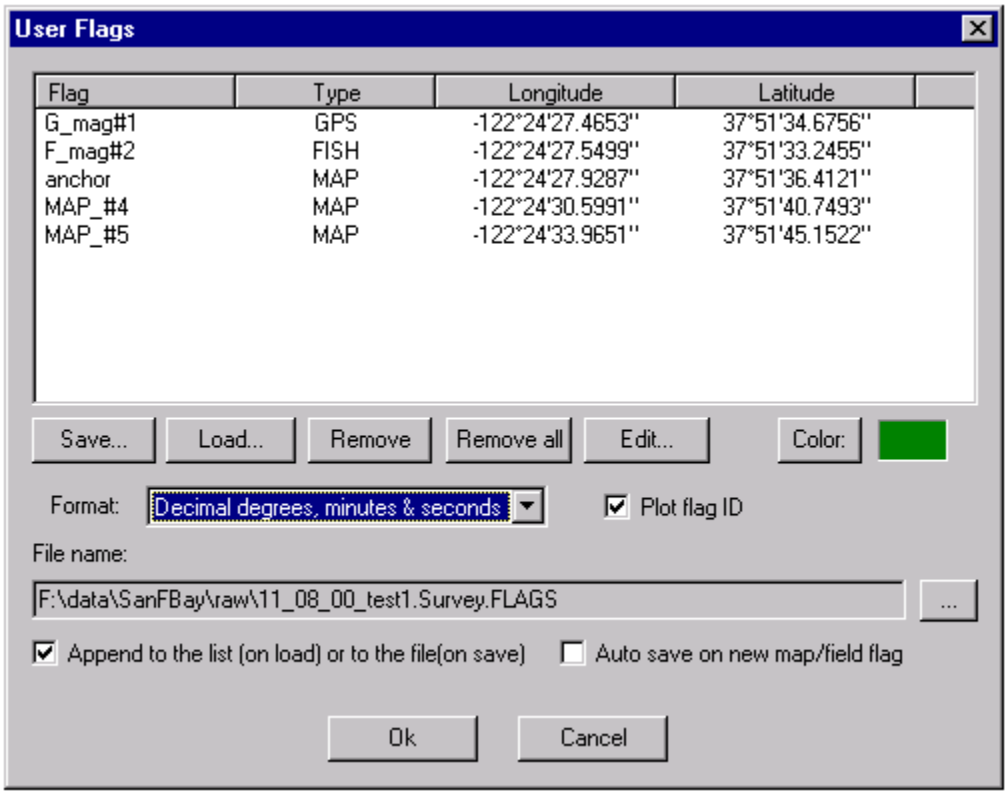
    - *Data step to plot value.* If the absolute difference between the last plotted value and the current data value exceeds this limit, the new value is plotted on the track.
    - *Distance to plot value.* If the distance between the last point where a value was plotted and the current point exceeds this limit, the current data value is plotted. For example, if you want to plot a value each 100 m, enter "100", and enter an unrealistic step in "*Data step to plot value*". This will effectively disable plotting by value. Conversely, if you enter very large value for "*Distance to plot value*" (for example - 100000m) and set the "*Data step to plot value*" to 1, a value will be plotted each time the data

changes by more than 1 (the latter might be useful to place event marks on the GPS track).

- *Value digits after dots.* This setting controls the Value Mark format.
- *Font.* This entry selects the font, and the color for the Value plot.

6 Using Flags.

It is a common need to identify an anomaly on the chart plot with a position. MagLog solves this problem by means of *User Flags*. Each flag is simply an identifier with its Flag type and Latitude and Longitude. Flags are saved in an ASCII file and can be edited with any ASCII editor or directly accessed via MagLog *File* menu under *User Flags*. If you call this item the following window appears:



Flag names created by MagLog are abbreviated in the following manner:

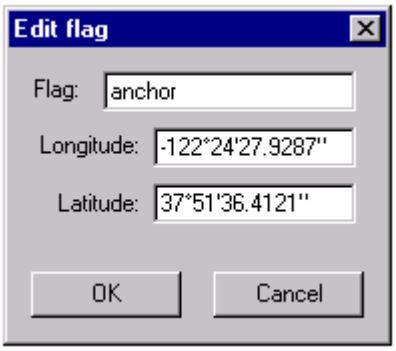
- Depending on type of position requested by the user when he or she created this flag, the first letter would be “G” for GPS position or “F” for the Fish position.
- If the flag was created on the GPS display at the mouse location, the first three letters will be MAP.
- If flag was created from display slot, the device alias name is included.
- Flags are numbered.
- Each flag is tagged with MagLog (PC) time.

Flag type can have these values:

- FISH – user created flag from display slot and requested Fish position. This is possible only if interpolator is running. In this case position is position of the magnetometer.
- GPS - user created flag from display slot and requested GPS (boat) position (always available).
- MAP – user created flag at mouse location on GPS display, not on the device slot.

User flags are plotted on the GPS display as crosses of constant size with associated labels. Label names can be turned off for clarity when many anomalies have been identified in a small area. If Plot flag ID is unchecked, no flag names are plotted on GPS screen.

User can change flag's name and position by selecting flag in the list and pressing Edit button. The following dialog appears:



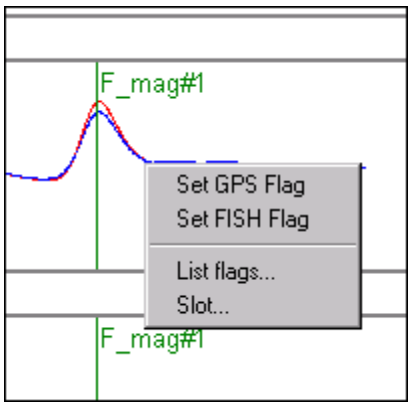
Name and position can be changed as desired.

If *Autosave on new map/field flag* is checked then program automatically saves flag list into the file each time a new flag is added.
This dialog box also allows merging flags from the different surveys. If *Append to the list* is marked then the program does not clean flags when a new flag file is loaded. Instead it increases the existing list. With this option the user can read a few files sequentially, remove unnecessary flags and save the remaining flags into new file as complete list.

All flags are drawn by the same selectable color.

6.1 Adding flags from display slots.

Figure below illustrates how flags can be added from display slots:



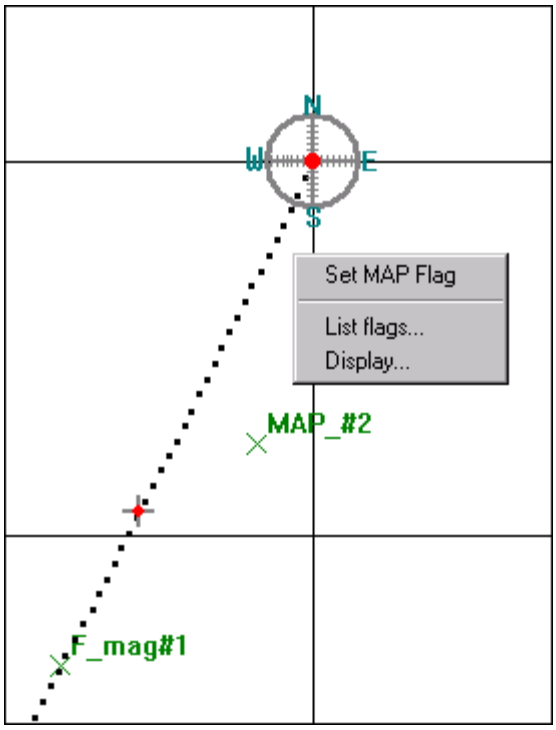
- Move mouse to the location where flag should be set.
- Click and hold *right* mouse button to display context menu. Select appropriate flag type (GPS or FISH) Note that FISH is not available if the Interpolator is not running.
- Release mouse button to set a flag.
- Flag is shown on all device slots and on the GPS display.
- If you want to remove previous flag(s) go to *List flags…*

6.2 Adding flags from GPS Display

Here is how flags can be set on the GPS display:

- Move the mouse to the location where a flag should be set. You can see latitude and longitude of the mouse position on the bottom status bar.
- Right Click mouse and hold it. Context menu appears.
- Select *Set GPS Flag* and release mouse button.
- Flag appears on the GPS display.
- You can call the general flag dialog box by selecting *List flags…* option

Figure below illustrates this procedure



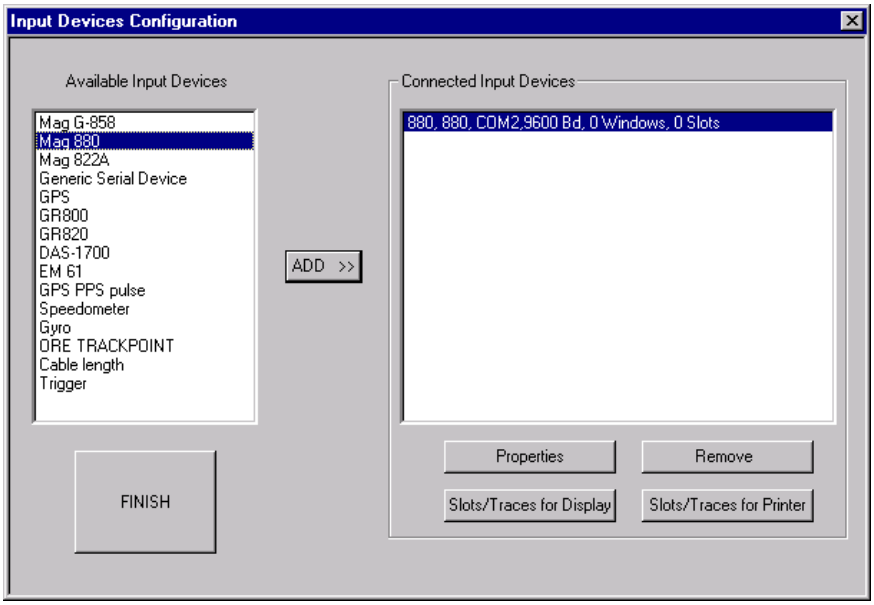
7 Configuring Other Devices.

7.1 Configuring Slots/Traces for Printer

You can control what the printer outputs by adding slots and traces to the printer. You have the ability to control the types of traces outputted, and the width, size, and position of each trace.

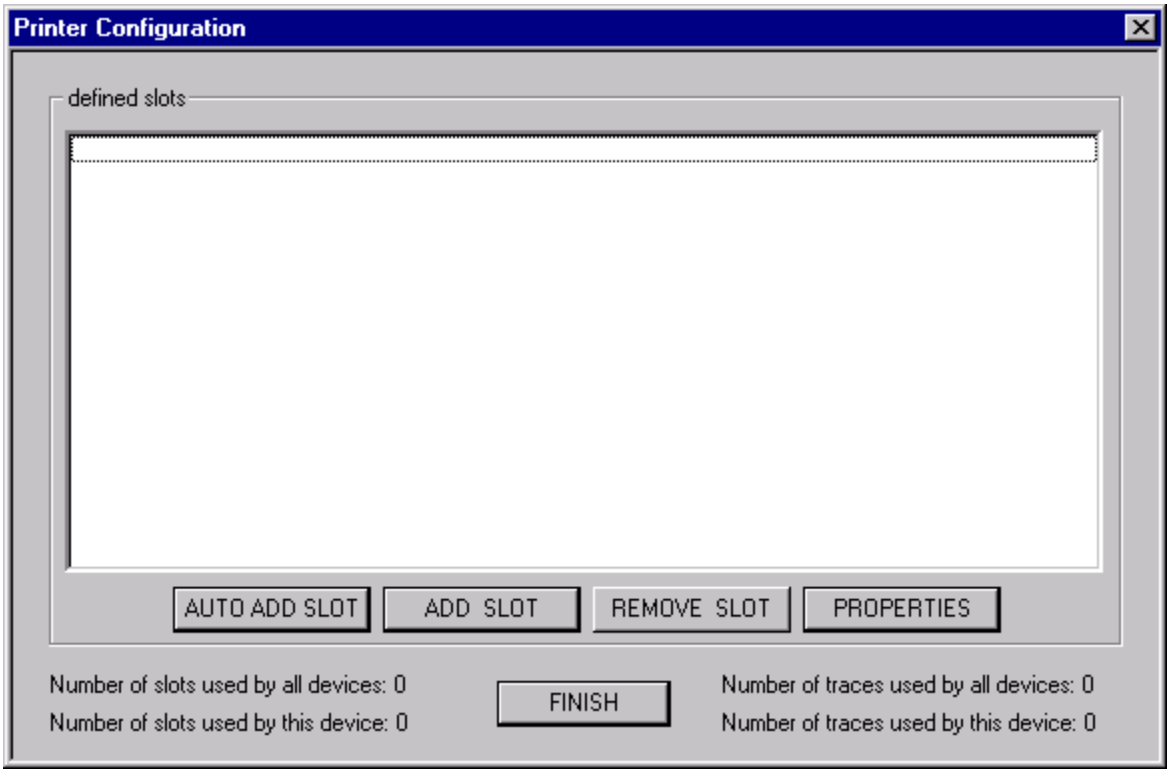
In order to configure the printer, you need to specify the traces you would like to output. This is done from within the "*Input Devices Configuration*" screen.

In the example below, we will configure the printer to output several G-880 traces.



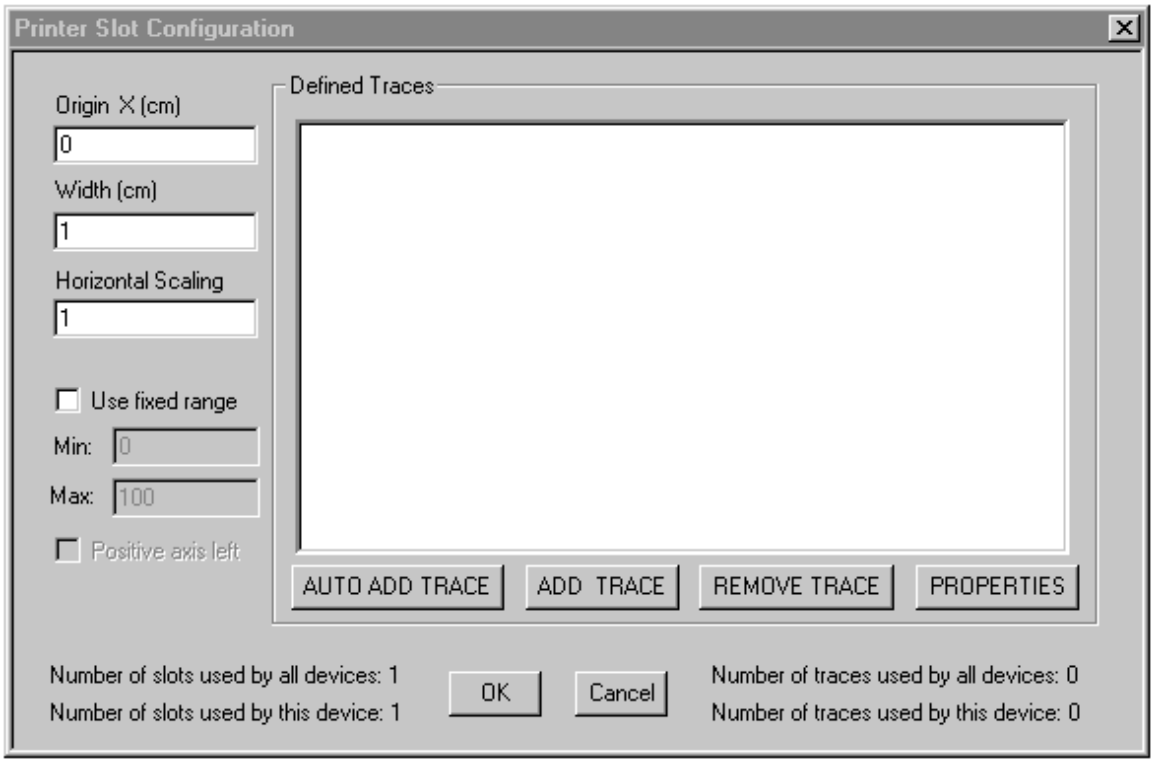
From the "Input Devices Configuration" screen, select "*Slots/Traces for Printer*".

You will see a summary of the traces your printer will output.



"Auto Add Slot" will generate one slot and one trace for each data field (similar to the "Auto Add Slot" feature seen in chapter three).

To add a slot, press "*Add Slot*". You should see the following dialog box:



From this screen you can specify the traces you would like to print, and where you would like the traces to appear on the printed page.

Origin X (cm): This affects the trace origin on the page. For instance, most pages have a width of 19 cm. If you want your slot to appear in the middle of the paper and be 2 cm wide, you would use an origin setting of 9 and a width of 2.

Width (cm): This is the slot width in centimeters.

Note: The program will check to make sure that you don't specify slots that could be printed outside of the printed page.

Horizontal Scaling: This specifies the full-scale range of the slot.

Use fixed range: Like display slots, printer slots can be *wrapped* or have a *fixed range.* If the trace is wrapped it always appears from the other side of the slot (wraps) if it is out of scale. If the slot has a *fixed range* data is not plotted if its value does not fall into slot's range, it is "clipped". This presentation can be useful for some types if data like depth and altimeter information.

Min Max Maximum and Minimum data ranges for a fixed slot.

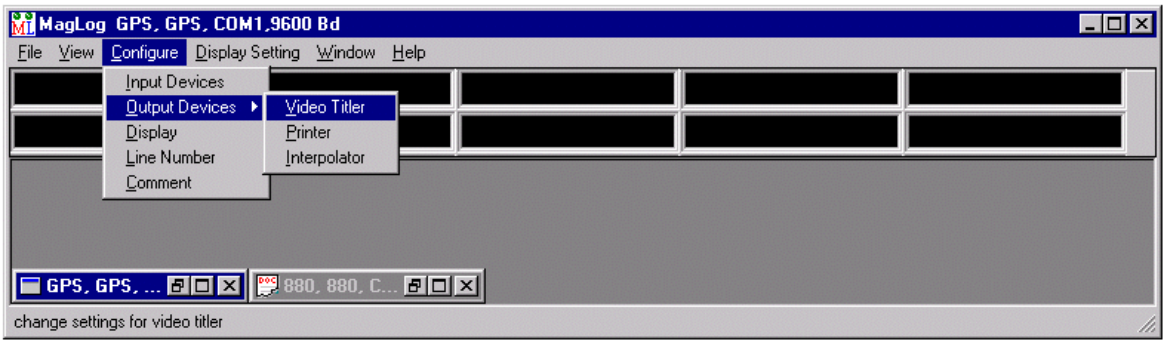
Positive axis left For some type of data (for example for bottom depth) it is natural to plot them with the positive axis down (left when you are looking at paper coming out of the printer). To enable this feature, check this box.

From this screen, traces can be added to the slots. Refer to chapter five for more discussion on adding traces.

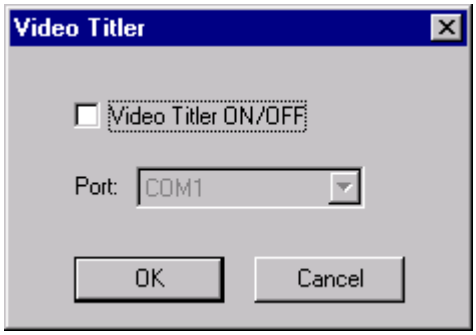
7.2 Configuring Output Devices:

7.2.1 Configuring the Video Titler (Airborne Applications):

Select "*Configure*" from the menu then "*Output Devices*" then "*Video Titler*".



The following video titler configuration dialog box will appear:



If Video Titler ON/OFF check box is checked then GPS, line number and time information will be sent to the video titler and will be recorded on the VCR. Otherwise no information will be sent.

The default port is COM1 for the video titler.

7.2.2 Configuring Printer

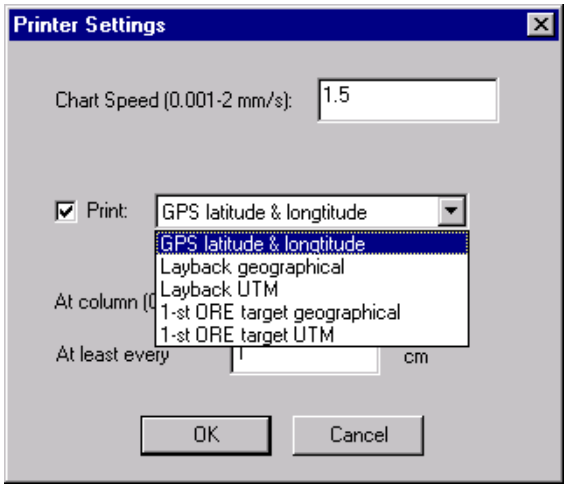
MagLog can support either the RMS GR33 printer/plotter OR the Printrex thermal printer and ECS/P compatible 9 and 24 pin dot matrix printers. Printer support is hardwired into the MagLog executable file. To find out if your version MagLog supports GR33 or thermal and dot matrix printers, go to MagLog Help /About. If the dialog box says "GR33" it means that the GR33 printing device is supported and this program will not support either the Printrex or ESC/P (Epson dot matrix) printers. Very few MagLog versions were released with GR33 compatibility.

Most copies of MagLog are designed with Printrex and ESC/P dot matrix support. If the Help /About dialog box. says nothing about printer type or says "PRINTREX" you have Printrex and dot matrix drivers.

7.2.2.1 Configuring the GR33A printer:

Select "*Configure"* from the menu then "*Output Devices*", and then "*Printer*".

You should see the following dialog box:



This dialog box allows you to adjust the speed of the printer, and how often the GPS data will be printed. The options given are:

Chart Speed: This is how fast the printer paper will go (in mm per second).
Print … - Here you are given a list of possible positions you can print.
GPS latitude and longitude: This will print the GPS coordinates in geographical coordinates.
Layback geographical: This will print a calculated layback position in geographical (latitude/longitude) coordinates.
Layback UTM: This will print the calculated layback position in UTM coordinates.
1st ORE target geographical: This will print the position of the ORE target in geographical coordinates.

1st ORE target UTM: This will print the position of the ORE target in UTM coordinates.

At column (0-11): This specifies the column where the position will be printed.
At least every: This specifies how often the position will be printed (given in centimeters of paper fed through the printer).

7.2.2.2 Configuring PRINTREX / DOT Matrix printer.

Printrex configuration dialog differs from the GR33:

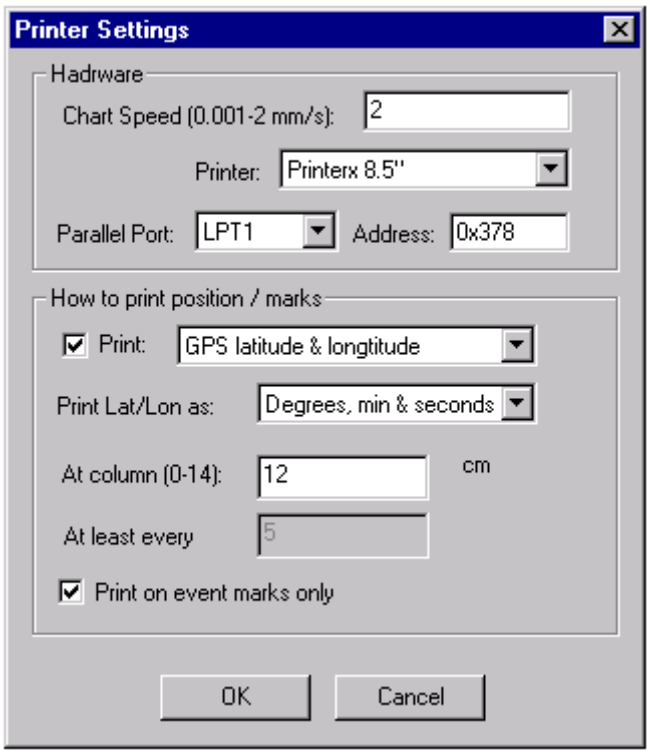


Chart Speed: This is how fast the printer paper will go (in mm per second).
Printer. There are 6 choices available under **Printer** selection box:

1. **Printrex 8.5 "** Actual paper width for data plots is 19 cm.
2. **Printrex 11.65"** Actual paper width for data plots is 19 cm.
3. **Epson generic 8 dot.** Low quality matrix printer with actual paper width 17 cm for data plots. Note that 24 pin printers normally can work in this mode.
4. **Epson generic 24dot.** High quality matrix printer with actual paper width 17 cm for data plots. You must physically have a 24 pin printer to use this mode
5. **Epson generic 8 dot wide.** Low quality wide matrix printer with actual paper width 29cm for data plots. Note that 24 pin printers normally also can work in this mode. You need a wide printer to use this mode.
6. **Epson generic 24 dot wide.** High quality wide matrix printer with actual paper width of 29cm for data plots . You need a wide printer to use this mode.

Parallel Port: specify the printer parallel port.
Address: Port address for the parallel port. 0x378 and 0x278 are defaults for LPT1 and LPT2 respectively.
Consult your computer or parallel extension card manual for correct values.

Print … - Here you are given a list of possible positions you can print.
GPS latitude and longitude: This will print the GPS coordinates in geographical coordinates.
Layback geographical: This will print a calculated layback position in geographical (latitude/longitude) coordinates.
Layback UTM: This will print the calculated layback position in UTM coordinates.
1st ORE target geographical: This will print the position of the ORE target in geographical coordinates.
1st ORE target UTM: This will print the position of the ORE target in UTM coordinates.
Print event (fix, shot) number only. This option is available if TTL or Serial event device is available.

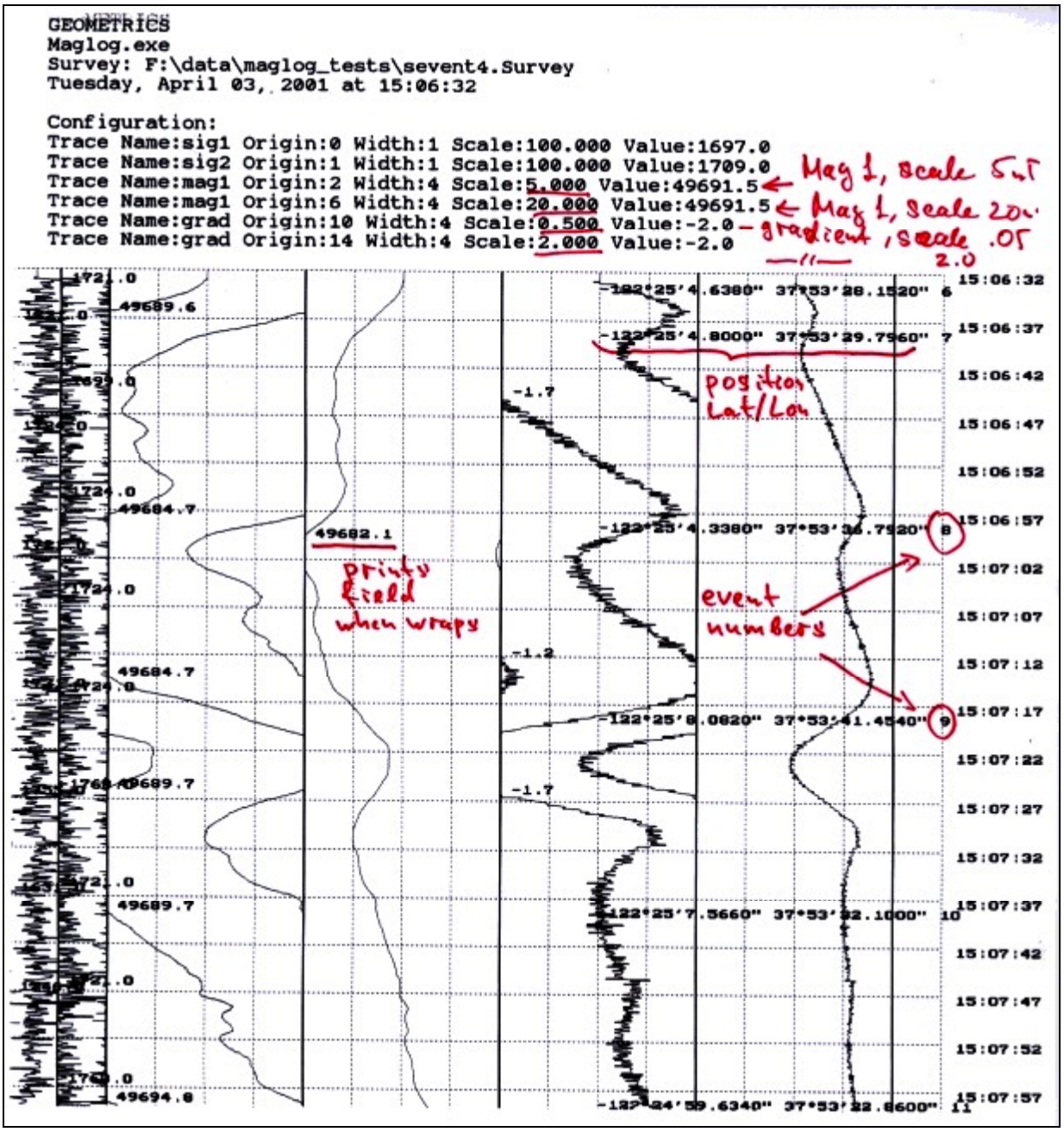
Print Lat/Lon as: Latitude and longitude can be printed as decimal degrees, degrees and minutes or degrees, minutes and seconds.

If Interpolator is not running, only choices (1) and (6) are available.

At column (0-11): This specifies the column where the position and event number will be printed.
At least every: This specifies how often the position will be printed (given in centimeters of paper fed through the printer).
Print on event marks only: This option is available only if TTL or Serial event mark device is present. If checked, MagLog prints GPS position and / or event number only when event actually arrives. If not checked the same information is printed equidistantly regardless of possible events.

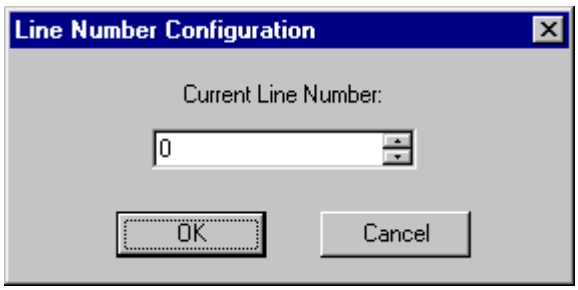
Picture below shows typical MagLog printout. It consist of next elements:

- Header. Each trace has its name, scale, paper origin and size and value printed. It is possible to print the same trace with different scale in different slots, or in the same slot.
- Separators. For clear view, slots can be separated with solid lines.
- Print trace value on wrapping. When trace is wrapping, current trace value is printed on the left side of the slot. To avoid overlapping next field value cannot be printed at distance shorter then 3 cm (along the paper).
- Position Latitude and Longitude.
- Event numbers (fixes) are printed after position, if event device is available. Alternatively, only event numbers can be printed (no position).


GEOMETRICS
Maglog.exe
Survey: F:\data\maglog_tests\sevent4.Survey
Tuesday, April 03, 2001 at 15:06:32
Configuration:
Trace Name:sig1 Origin:0 Width:1 Scale:100.000 Value:1697.0
Trace Name:sig2 Origin:1 Width:1 Scale:100.000 Value:1709.0
Trace Name:mag1 Origin:2 Width:4 Scale:5.000 Value:49691.5
Trace Name:mag1 Origin:6 Width:4 Scale:20.000 Value:49691.5
Trace Name:grad Origin:10 Width:4 Scale:0.500 Value:-2.0
Trace Name:grad Origin:14 Width:4 Scale:2.000 Value:-2.0
Mag 1, scale 5nT
Mag 1, scale 20nT
gradient, scale .05
—11—
2.0
49689.6
49684.7
49682.1
49684.7
49689.7
49689.7
49694.8
-1.7
-1.2
-1.7
position Lat/Lon
print field when wraps
event numbers
15:06:32
15:06:37
15:06:42
15:06:47
15:06:52
15:06:57
15:07:02
15:07:07
15:07:12
15:07:17
15:07:22
15:07:27
15:07:32
15:07:37
15:07:42
15:07:47
15:07:52
15:07:57

7.3 Changing line number during Survey:

Select "*Configure*" from the menu then "*Line Number*".
You should see the following dialog box that will allow you to change the line number.



The line number is used and recorded with the data while logging. It is automatically incremented by one when you stop logging.

You can change the line number only when you are not logging data.

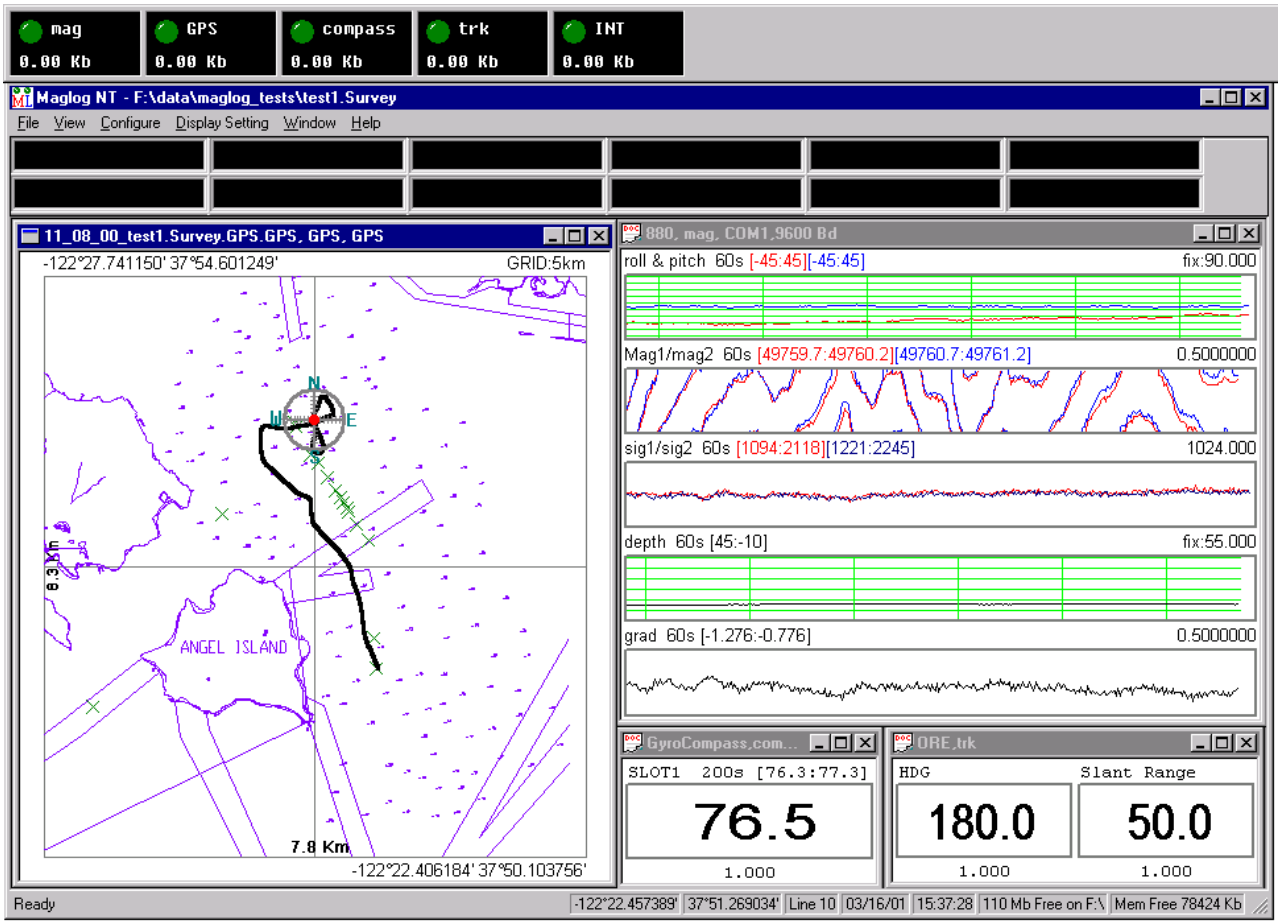
The line number is restricted to a range between 0 and 10000.

8 The Survey:

This section describes a typical survey screen, the menus available, and many of the operations you can do from within MagLog.

8.1 The Main Screen:

Once you have defined all your hardware, display and printer settings you will have a screen similar to the screen below:



Note: The screen below is used in a system with a G-880 magnetometer, GPS, compass and ORE TrackPoint II. User also has enabled real time position interpolation and has prepared vector map of the survey area. The screen that you see may be considerably different depending upon the exact display configuration you specified.

This screen has many features that can tell you a lot about your data.

Device Status Bar: This is located on the top of the screen when you start the program. The Status Bar is useful to quickly inform you of the data status. The LED's come in three colors:

Green: Data is being received.
Red: No data has been received within five seconds.
Yellow: Device dependent sign that something is wrong with the data. In the case of the G-880 magnetometer and GPS, this will turn yellow if one of the conditions for good quality data (e.g., signal strength or data out of range) is not met. Below the LED there is also a number that indicates the size in KB of data stored in the individual file for each device. When you are logging, this value will increment.

Data bar: This is located below the menu and contains 16 black mini-windows that indicate the last values of data received for the device *corresponding to the current active window i.e., what the mouse has selected*. This is also useful to make sure that your data is being parsed correctly. In the example of the sample magnetometer input string,

40001.24, 0243, 2001, 1209, 40291.35, 0543,

there should be seven windows with numbers. The first should correspond to 40001.24, the second to 0243, and so forth. The seventh number is a gradient value that is only available for two or more magnetometers.

The slot and trace window: This is where data will be plotted. In the example above, there are four independent windows. Currently, the window titled *822A* is the current selected active window (indicated by blue title bar). When a window is selected, you can use some short cut keys to make some changes to the window.

Left/Right Arrows: These will modify the scale factor for the selected slot.
Up/Down Arrows: These will allow you to navigate through the window and select the slot.

For other operations please look at the "*Display Setting*" menu items.

The status bar: This is located at the bottom of the screen and displays Latitude and Longitude of mouse pointer in mouse is inside GPS window. It also displays general information like current line number, time and date, disk and memory free space.

8.2 The Menus:

The menus that are available at a given time are dependent upon the active window you have selected. This section will describe many of the standard menus always present, and some of the device specific menus you will encounter.

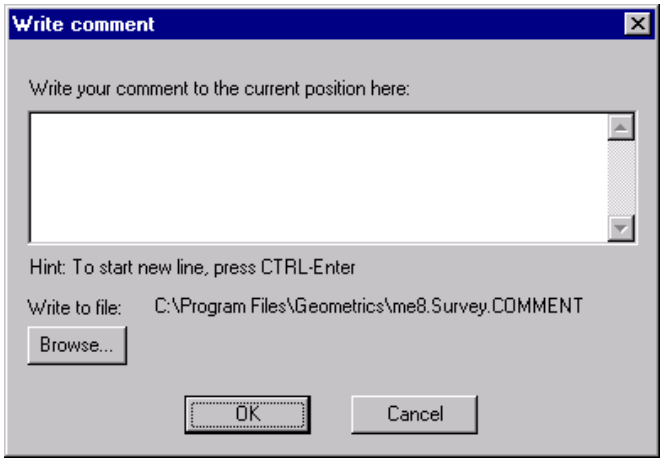
File Menu: This menu allows you to start a new survey, terminate your existing survey, and start or stop logging. The options available will depend on the state of the program, e.g., if you don't have any devices configured, it would not make sense to start logging so that option will be grayed out

View: This menu allows you to enable or disable the status bar at the bottom of the screen.

Configure: This is used any time you want to configure a device. After you have successfully configured your devices, it is not necessary to make adjustments in this area. Remember that you can reconfigure slot settings by right clicking on the pane and selecting either Display for GPS or SLOT for slot parameters.

Note: Many of the options of this menu can be password protected. If you supplied a password on entering the program, and later exited, you will need to supply a valid password to have access to enter configuration parameters in this menu.

An additional feature not discussed in the previous section is the "*Comment*" menu option. This can be accessed through the configuration screen. You will see the following dialog box:



By clicking on "*Browse…"*, you can modify the file name that will hold your comments information.

Typed comments are logged exactly as entered, with date and time stamp. Also, pressing "*Enter*" will exit the screen and save the comment. To start a new comments line, press "*CTRL-Enter*"

Display Settings: This menu is device dependent. A few options are discussed below:

G-880 Display Settings: This menu has many options for changing the scale factor and applying it to one or more slots. There are also shortcuts for centering the traces for a specified slot, or all slots in a window.
GPS Display Settings: This menu has options for independently changing the scales of X and Y, or changing them together. In addition, you can disable the "*auto scroll"* feature that automatically shifts the grid coordinates of the map when the GPS North icon moves off the current graph.

Window: You can use this menu to arrange your current windows neatly within your MagLog NT program. Some options that are available:

Cascade: This will overlap the windows. You can select a window by clicking on its title bar.
Tile vertically/horizontally: This will show all display windows in MagLog simultaneously. It will divide the desktop area by the number of windows and attempt to arrange them appropriately.

There is also a list of most recently used windows kept here. If you select one, it will become the active window.

Help: This displays the current version of MagLog.

9 Ready to start logging data:

When you are ready to log data, you should select "S*tart Printing* " first from the file menu because it takes a moment or two to print header information on the printer. Once you see data being plotted on the printer select "S*tart Logging*" from the file menu.

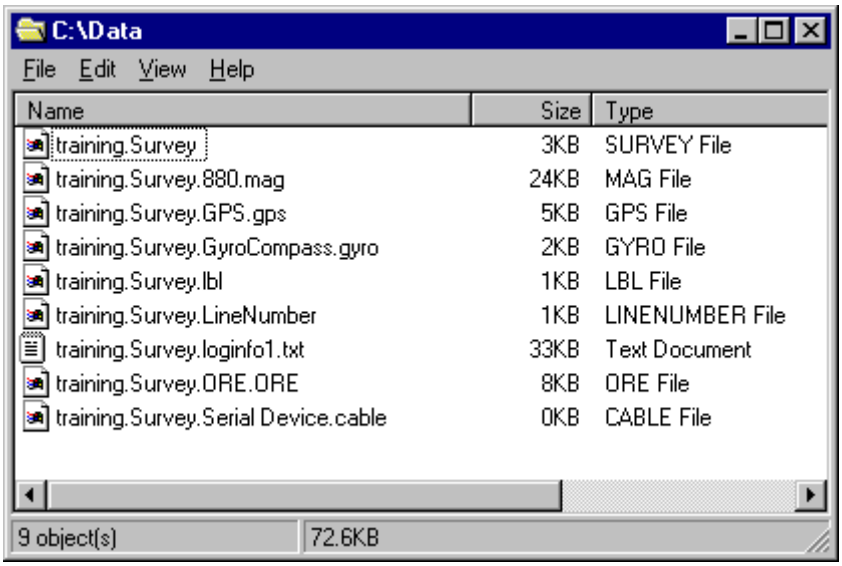
In between survey lines, the turns, select "*Stop Logging*", then "*Start Logging*" when you are ready. This will increment the line number automatically.

Unless you specify a different survey name, all new data will be appended to the old data files.

You may set the line number when logging is stopped to any other number in the *Configure / Line* number menu.

10 Output Files:

MagLog writes several files during the logging process. All files are placed in the same directory where the survey file was created:



Each file name starts with the Survey name, followed by ".Survey", then the type of device, then the name given to the device in the configuration.

Data is logged to each file as it comes into the serial port. A time stamp is added to provide positioning for all sensors with the GPS data. No processing is done to any files unless the interpolator is turned on. Thus, the GPS file will have GPGGA strings stored (exactly as they were received from the GPS with the addition of a time stamp added by MagLog NT), and the magnetometer file will have a series of magnetometer strings stored (also with a time stamp).

In the screen above, the survey was named “Training”. It had several device files:

- G-880 magnetometer – output file name: “training.Survey.880.mag”
- GPS - output file name: “training.Survey.GPS.gps”
- GYRO – output file name: “training.Survey.GyroCompass.gyro”
- ORE – output file name: “training.Survey.ORE.ORE”
- Cable length measuring device – output file: “training.Survey.Serial Device.cable”

These data files can be analyzed and plotted using MagMap2000, a free processing program from Geometrics. Files can be reformatted for plotting in Surfer or other graphics packages.

The above screen also has files used for annotation and document control:

- Survey file- "training.Survey". This survey file saves all device configuration settings and slots/traces settings.
- Log info file: "training.Survey.loginfo1.txt". This file logs important events that happen while the program is running. For instance, if you have an 880 magnetometer configured, it will record the settings used to initialize the G-880 magnetometer and it will state whether or not several of the operations involved in initializing the magnetometer succeeded. This also records when a device is removed.
- Line number file: "training.Survey.LineNumber". This file records the starting and stopping time of each line that you travel in your survey. This file will only be when you select "*Start Logging*" and "*Stop Logging*" from the main "*File"* menu.

The interpolator output file is discussed further in the "Interpolator" section.

11 Depth/Analog channel calibration

In order to get an accurate depth sensor reading, the pressure transducer sensor must be calibrated. This means that the depth sensor reading needs to be compared with a known depth to account for the variations occurring due to air pressure variations and to manufacturing variances. Bias and linearity adjustment can be made in the program to empirically calibrate for depth. (You can read more about this method at the end of the section).

The depth reading from the magnetometer is an integer between 0 and 4095. This represents the full-scale range of the depth transducer. There may also be a certain offset that must be adjusted.

MagLog NT offers a few ways of calibrating the depth.

Note: These methods also work for calibrating other analog channels.

11.1 Calibration Procedure:

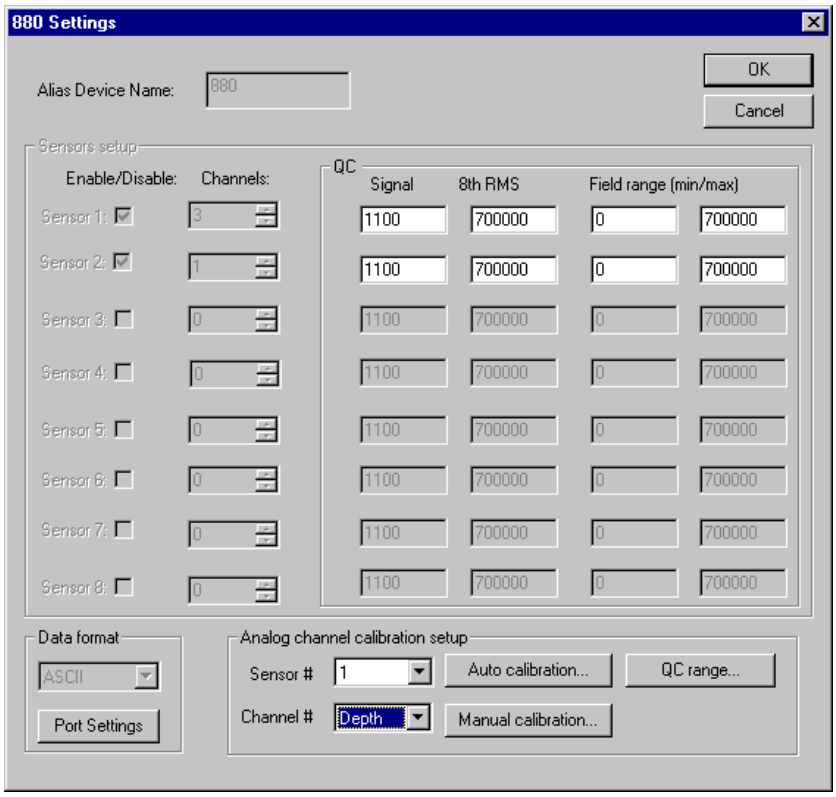
The basic procedure for calibrating the depth sensor is as follows:

1) Place magnetometer in the water for at least 15 minutes at a known depth, say 3 meters. This will give the temperature of the sensor time to stabilize.
2) Write down the depth and reading that MagLog NT gives you.
3) Place magnetometer in the water at a DIFFERENT depth.
4) Write down the depth and reading that MagLog NT gives you.
5) Use either automatic calibration feature or manual calibration to apply results.

Note: If you use automatic depth/analog channel calibration, you can do this while in the calibration screen.

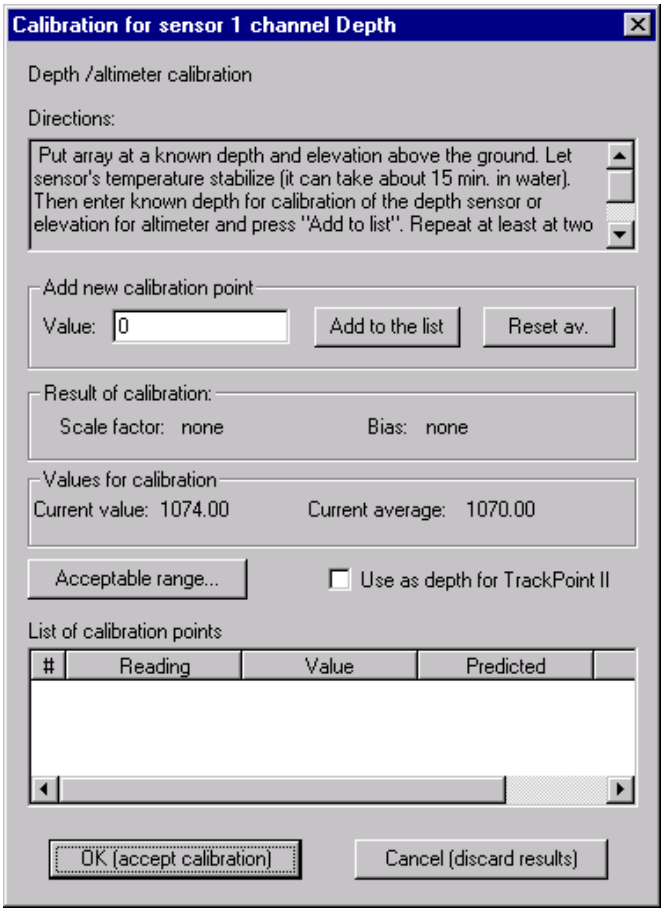
11.2 Automatic Depth/Analog Channel Calibration:

1) From your configuration screen, you should select the magnetometer. This should bring up the "*Settings*" screen that you originally used to input the number of sensors and analog channels. (You can get to this screen by going into your main list of devices, and then double clicking on the magnetometer description). You should see a screen similar to the one below:



2) In the section labeled "*Analog channel calibration setup*" select the sensor and channel number that you want to calibrate, e.g., to calibrate the depth of the first sensor in the earlier example, select
   Sensor #: 1
   Channel #: Depth

3) Select "A*uto calibration*". You should then see the following dialog box:



Note: At this time depth data is coming from the Fish that is being analyzed by the program to compute the bias and scale factor. You must place the Fish on at least two depths to get an accurate calculation. During Altimeter Calibration discussed later, you must be over a hard bottom and the Fish must be held horizontally level.

You can add measured points to this menu and have it automatically calculate your scale factor and bias. The depth sensor needs to be in the water for at least 15 minutes before you take your first measurement. This allows the temperature of the electronics to stabilize.

To add a new point, place Fish at known depth. Press *Reset Average* to discard current average and wait for a few minutes to acquire a new one. Number after text *Current average:* should stabilize. Then enter the depth that the device is at under "*Value*" and press "*Add to the list"*. This will take the average measurement MagLog NT currently sees for the depth, and it will add it to a list of calibration points.

It is important to remember to reset the average if you move the sensor. You can do this by pressing "*Reset Av.*".

You can also specify an acceptable range of points to be used by pressing "*Acceptable Range*". This will bring up a dialog box that will allow you to set a minimum and maximum allowed value. This is particularly important when you calibrate your altimeter

because occasionally you might get a spiked reading (missed echo) that you don't want included in the calculation of your average.

After you have at least two points, MagLog NT will then try to calculate a scale factor and bias. You need to make sure that you have at least two different depth points (e.g. it is advised to have one point near the surface, and the second point as close to the bottom as possible). Otherwise, the calibrations will not be accurate. It is advised to add more than two points to get improved accuracy.

You should also select "*Channel Represents Depth*". This option is important if you have an ORE device.

If you are satisfied with the calibration, select "*OK*".

4) You will then be given the opportunity to save your calibrations into a file. The file will keep track of the scale and bias calculated, and the readings used to make the calculation. It is advised to keep this for your records.

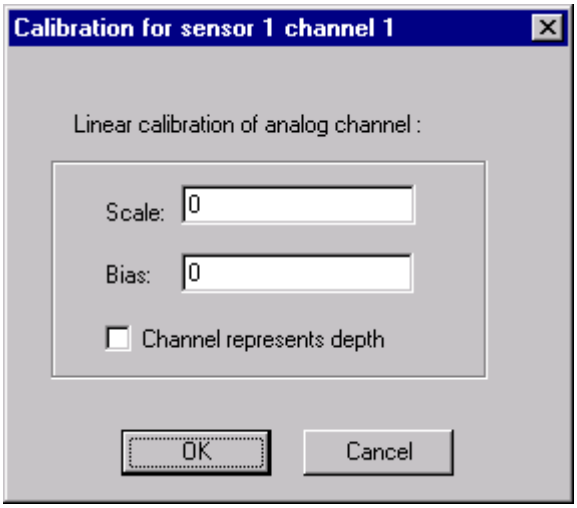
11.3 Manual Calibration:

Manual calibration gives you the opportunity to enter the scale and bias directly without having MagLog NT calculate it for you.

You can find the scale and bias by hand, or use third party software.

To use MagLog NT's manual calibration feature, select "*Manual Calibration*" from your device settings menu. (Make sure that you have the correct sensor and channel selected as discussed in the section on "Auto Calibration".)

You will see a dialog box:



Enter your scale and bias values, and check "*Channel represents depth*" if this is a depth calibration. Then press "OK".

You will be given the opportunity to save these into a file.

11.4 Effects of Depth calibration:

After you have calibrated your depth sensor, you should see immediate changes in your data. The graphs and displays will use the new calibrated values.

However, the device file will have the uncalibrated values in it (.G-880).

If you need to store calibrated values, you should use the Interpolator device that will write calculated depths and altitudes in the interpolator file.

11.5 Why should we calibrate?

This is a brief discussion on how MagLog NT calculates scale and bias values and why this is needed.

The depth sensor is a pressure transducer. This means that for a given pressure, it will output a number proportional to the pressure measured. However, the number is meaningless until we solve for a few factors.

Assume that the depth reading is related to the pressure reading by the following:

$$\text{Depth} = A \times \text{Pressure} + b$$

In this case, the two parameters A and b are the scale and bias values that we need to find.

We can solve for these two values if we have at least two sets of measurements. If we measure the following:

Depth	MagLog Reading (pressure)
Y1	X1
Y2	X2

I can then get two independent equations:

$$Y1 = A \times X1 + b \qquad Y2 = A \times X2 + b$$

Solving for A and b, I get:

$$A = (Y1 - Y2) / (X1 - X2) \qquad b = (Y2 \times X1 - Y1 \times X2) / (X1 - X2)$$

From here, we can now use these new values to calculate the correct depth, given only the pressure.

MagLog NT can then use these equations to automatically adjust all pressure readings to accurately reflect the depth measured.

12 The Interpolator

MagLog is able to do real-time calculation of magnetometer positions. The processed data is then made available via Ethernet (ship network with IP address), a serial connection, and stored into a file.

The following chapter explains the capabilities of the interpolator and the settings needed to make it work.

12.1 Overview

12.1.1 Uses of the interpolator:

The interpolator was made to solve the problem of getting real-time magnetometer positions. A typical survey has several different devices – some of which give positional information, and others which give measurements. The surveyor usually wants to make a spatial map of the magnitude of the measurement vs. the position where the measurement was taken. Since the device giving measurements usually doesn't output position information (e.g. G-880), we need a way of using the GPS information to calculate the position of the magnetometer. Additionally, there are devices such as the ORE Trackpoint II and the GYRO compass that can be used to obtain even more accurate positions of the magnetometer sensors. Usually the calculations of the magnetometer positions would have to be done after the survey is finished using additional software such as MagMap 2000. To solve this problem sooner, MagLog has an interpolator that is used for doing real-time calculations of the magnetometer positions – for each magnetometer reading, there will be a series of positions output.

MagLog also allows one to interactively specify a unique hardware configuration and select positions to be output.

Currently, it able to output several types of positions (depending on available hardware):

1) **Reference Point**: This is a point (e.g., geodetic coordinate) that is assumed to be on the ship. It is the starting point for most calculations and is present in all files generated. The user is able to specify the type of reference point output:
   a) GPS (raw antenna point) -- the actual reading from the GPS
   b) Tow point -- another point, still assumed to be on the ship a fixed offset away from the GPS. (More discussion is given at the end of this chapter).
2) **Shifted Point**: This is a point that is at a fixed, but not necessarily rigid offset relative to the ship. The two types of shifted points available are:
   a) Simple shifted point: This assumes a constant cable length (e.g., L) and it uses the past movements of the ship to extrapolate the likely point a distance L behind the ship.

b) Shifted point using variable cable length: This allows a variable cable length and works similarly to a).

3) **Acoustic Target Position**: This is only available when the ORE Trackpoint is used. The two types of position points that are output depend upon the type of GYRO device used.
   a) MagLog's calculation of acoustic target position: This is used when the ORE Trackpoint II does not have a GYRO connected. (Note that there must always be a GYRO connected in order for the ORE to work properly). It uses the ORE, GYRO and the GPS to calculate the position of the acoustic target.
   b) ORE's calculation of acoustic target: This is used when the ORE has a GYRO input available. This is a better position point because errors due to GPS latency are minimized.
4) **Sensor Positions**: (may be set up as many as needed)
   a) Calculated as towed distance behind acoustic target: This uses the ORE information and assumes that the magnetic sensor is a fixed distance behind the acoustic target. It uses the same method as that used for the shifted point to calculate the position behind the ship.
   b) Difference in direction from GPS: This is useful with horizontal gradiometers when there is a horizontal displacement between a line parallel to the course of the boat, and the sensor.
   c) Difference in direction from shifted point: This is almost the same as above, except that a shifted point is used as a reference point instead.

All positions may be output in UTM or geographical (Lat/Long) coordinates but geographical output is not recommended if the computer is underpowered or has a high workload.

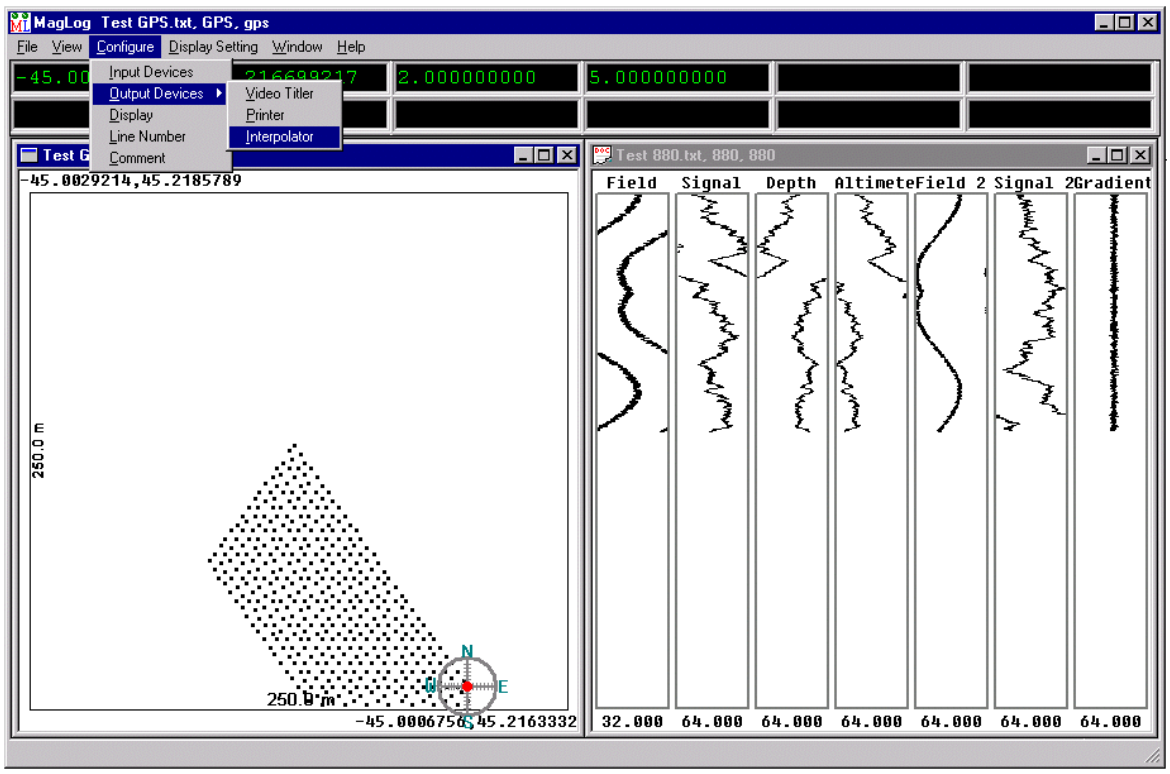
12.1.2 Output Capabilities

The interpolator is able to output data into a file, through the serial port, or via Ethernet.

12.2 Menu-oriented Interpolator setup:

This section explains how to set up the interpolator using the normal sequence of the menus. A few examples will be given later in this chapter to illustrate the concepts.

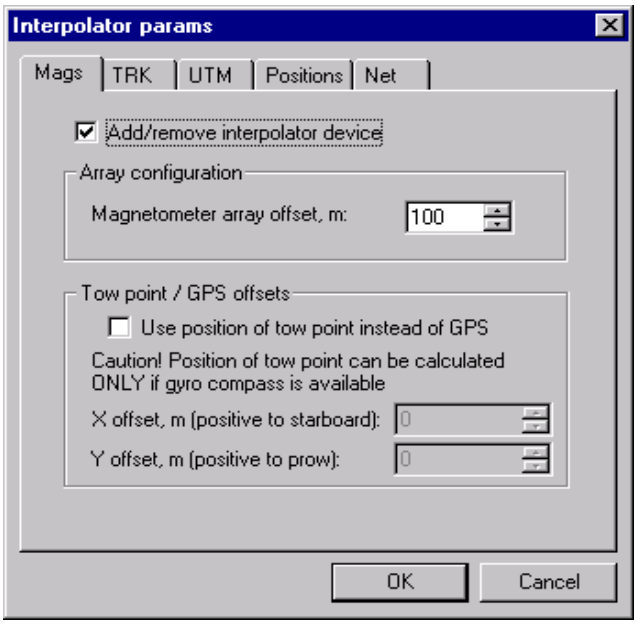
The interpolator can be accessed through the configuration screen. **No interpolator information will be available until a magnetometer and a GPS are installed.**



You can configure the interpolator by selecting the "*Configuration*" menu, followed by "*Output Devices*", and then "*Interpolator*".

This will allow you to access several tabbed dialog boxes (discussed below).

12.2.1 "Mags" Dialog:



This dialog box allows you to set several attributes about the magnetometer.

Add/Remove Interpolator Device: This check box enables the interpolator. There will be no output or calculations if this is not checked. When this is checked, you should see a circle with labeled "INT" at the top of the screen with the rest of your devices.

Magnetometer array offset: This is used in the calculation of a point behind the vessel. It will mean different things for different configurations. A brief summary is given below for a sample value of 100m that is input.

The ORE has no effect on any of the settings in the "MAG" dialog. However, to try to eliminate confusion, we have included the ORE in the list of "*Devices Present*".

All distances and points are calculated from the GPS:

DEVICES PRESENT	**RESULT OF 100m OFFSET**
ORE, GYRO, Cable Length	Will calculate a shifted point equal to the length of the cable measured + 100 meters behind the boat with respect to GPS. ORE is ignored.
ORE, GYRO	Will calculate a shifted point equal to 100 meters behind the GPS.
GYRO, Cable Length	Will calculate a shifted point equal to the length of the cable measured + 100 m behind the boat. *It is recommended to specify a tow point and put 0 for this value. If you don't specify a tow point, but still specify 0 for this value, you will a shifted*

	point that is calculated using a value equal to the distance to the GPS minus the distance to the point of attachment of the cable length indicator.
GYRO	Will calculate a shifted point equal to 100 meters behind the boat.
Cable Length	Will calculate shifted point equal to length of cable measured + 100 meters behind the boat.
NONE	Will calculate shifted point equal to 100 meters behind the boat.

See below for further discussion of what happens with this value if you specify a tow point position.

Use Position of Tow Point Instead of GPS Offset: This enables position 1b (as described earlier). To do this, you need to input two offsets from the GPS:

a) X offset – Distance from the GPS (in a direction parallel to a line going across the boat from port to starboard). Starboard is considered to be positive. (More discussion is given later in this chapter if needed).
b) Y offset – Distance from the GPS (in a direction parallel to a line going from the back of the boat to the front of the boat.) The front of the boat is considered the positive direction.

In order for this position to be calculated, you need to have a GYRO available.

Note: If this is checked, the tow point will be used in place of the GPS in all further calculations.

The results stated above will change when the Use Tow Point box is checked:

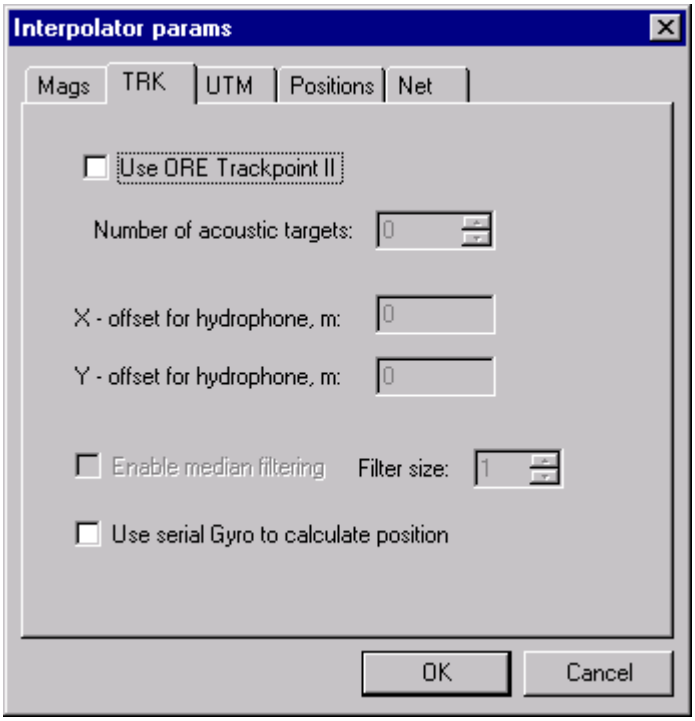
All distances and points are calculated from the Tow Point:

DEVICES PRESENT	**RESULT OF OFFSET**
ORE, GYRO, Cable Length	It is recommended to put 0 for this value. Otherwise, it will calculate a shifted point equal to the length of the cable measured + 100 meters behind the boat with respect to the tow point. ORE is ignored.
ORE, GYRO	Will calculate a shifted point equal to 100 meters behind the boat.
GYRO, Cable Length	It is recommended to put 0 for this value. Otherwise, it will calculate a shifted point equal to the cable length plus 100 meters

	with respect to the tow winch.
GYRO,	Will calculate a shifted point equal to 100 meters behind the boat.
Cable Length, no GYRO	NO CALCULATION POSSIBLE
NONE, no GYRO	NO CALCULATION POSSIBLE

12.2.2 "TRK" Dialog

The next dialog box sets up the ORE.



Use ORE Trackpoint II: This enables the ORE. If you don't have a GYRO, this should not be enabled.

Number of acoustic targets: Fill in the number of ORE targets you have. In most configurations, one is used.

X/Y offset for hydrophone: This is used when the GYRO is not connected directly to the ORE. If it is, these offsets will be input into the ORE, and the final position point that is output will be correct with respect to the GPS or tow point. If the GYRO is not connected, the computer needs to transform the position the ORE calculates, and take into account the position of the ORE. The values you will want to input will be summarized in the table below.

Use serial Gyro to calculate position: This should be enabled if the Gyro is connected to MagLog NT (e.g., not connected to ORE).

Settings for above values given different configurations:

Configuration:	**Enable Serial GYRO**:	**X/Y offsets:**
ORE, GYRO connected to ORE, tow point specified	NO	X = 0, Y = 0. Offsets should be specified internally in ORE relative to tow point.
ORE, GYRO not connected to ORE, tow point specified	YES	X and Y offsets are given with respect to tow point.
ORE, GYRO connected to ORE.	NO	X = 0, Y = 0. Offsets should be specified internally in ORE.
ORE, GYRO is not connected to ORE, but is connected to PC	YES	X and Y offsets are given with respect to GPS.
ORE	N/A	MUST HAVE GYRO TO WORK

Positive X is assumed to point in the direction of the starboard side of the ship, Positive Y points in direction of the bow or front of the ship.

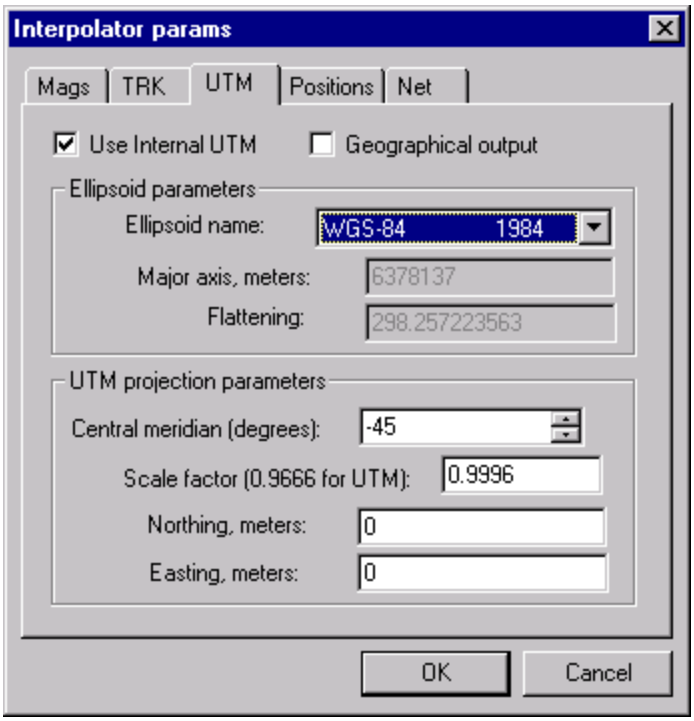
Enable median filtering: This option enables a filter that will output the median value of a history of ORE readings. The median value is found from taking a series of readings, arranging them in numerical order, and then selecting the middle one. This is useful for removing spikes.

Filter Size: This specifies the number of readings that are used when calculating the median.

12.2.3 "UTM" Dialog

This dialog allows you to set up parameters relating to the UTM coordinate transformation. The only case in which you will not need this dialog is when the GPS outputs UTM coordinates directly and you want your output in UTM coordinates. In all other cases, it needs to be set up with the correct parameters.

Shown below:



The configurable options available are:

Use Internal UTM: This should be enabled if the GPS outputs latitude/longitude (geographical) coordinates, and disabled if the GPS outputs UTM coordinates.

Geographical Output: This controls the format of the output position coordinates. It should be checked for geographical output (latitude/longitude) and unchecked for UTM output. If you want Lat/Long output, you must check both "Geographical Output", and "Use Internal UTM". Geographical output is currently unavailable for GPS input given in UTM coordinates.

Note: This will apply to all positions output.

Aside: This dialog is necessary because the program internally does all calculations in UTM coordinates. These coordinates are more convenient and faster for doing positional calculations. In order to do a conversion from geographical coordinates to UTM coordinates, the interpolator needs to approximate the earth as an ellipse with specified parameters. Additionally, there are several other positional dependent factors that you have to enter that are needed to get a correct UTM transformation. These factors are also needed in the reverse transformation from UTM to geographical coordinates.

The rest of these options are needed only when "Use Internal UTM" is checked, or when both "Use Internal UTM" and "Geographical Coordinates" are checked.

Ellipsoid Parameters: These parameters allow you to choose a shape other than a sphere to use when approximating the earth. This allows you to get better accuracy when doing a transformation from spherical (latitude, longitude) to rectangular (UTM) coordinates. These parameters must match those used by the GPS.

UTM Projection Parameters:

a) **Central meridian:** This value has a large impact on the UTM coordinates generated due to the non-uniformity of an ellipse. It can be quickly estimated as the value of the longitude, but you should look it up below for a better calculation of your positions.

The Universal Transverse Mercator (UTM) Coordinate System uses zone codes instead of specific projection parameters. The table that follows lists UTM zone codes as used by GCTPc Projection Transformation Package.

Zone	C.M.	Range	Zone	C.M.	Range
01	177W	180W-174W	31	003E	000E-006E
02	171W	174W-168W	32	009E	006E-012E
03	165W	168W-162W	33	015E	012E-018E
04	159W	162W-156W	34	021E	018E-024E
05	153W	156W-150W	35	027E	024E-030E
06	147W	150W-144W	36	033E	030E-036E
07	141W	144W-138W	37	039E	036E-042E
08	135W	138W-132W	38	045E	042E-048E
09	129W	132W-126W	39	051E	048E-054E
10	123W	126W-120W	40	057E	054E-060E
11	117W	120W-114W	41	063E	060E-066E
12	111W	114W-108W	42	069E	066E-072E
13	105W	108W-102W	43	075E	072E-078E
14	099W	102W-096W	44	081E	078E-084E
15	093W	096W-090W	45	087E	084E-090E
16	087W	090W-084W	46	093E	090E-096E
17	081W	084W-078W	47	099E	096E-102E
18	075W	078W-072W	48	105E	102E-108E
19	069W	072W-066W	49	111E	108E-114E
20	063W	066W-060W	50	117E	114E-120E
21	057W	060W-054W	51	123E	120E-126E
22	051W	054W-048W	52	129E	126E-132E
23	045W	048W-042W	53	135E	132E-138E
24	039W	042W-036W	54	141E	138E-144E
25	033W	036W-030W	55	147E	144E-150E

26	027W	030W-024W	56	153E	150E-156E
27	021W	024W-018W	57	159E	156E-162E
28	015W	018W-012W	58	165E	162E-168E
29	009W	012W-006W	59	171E	168E-174E
30	003W	006W-000E	60	177E	174E-180W

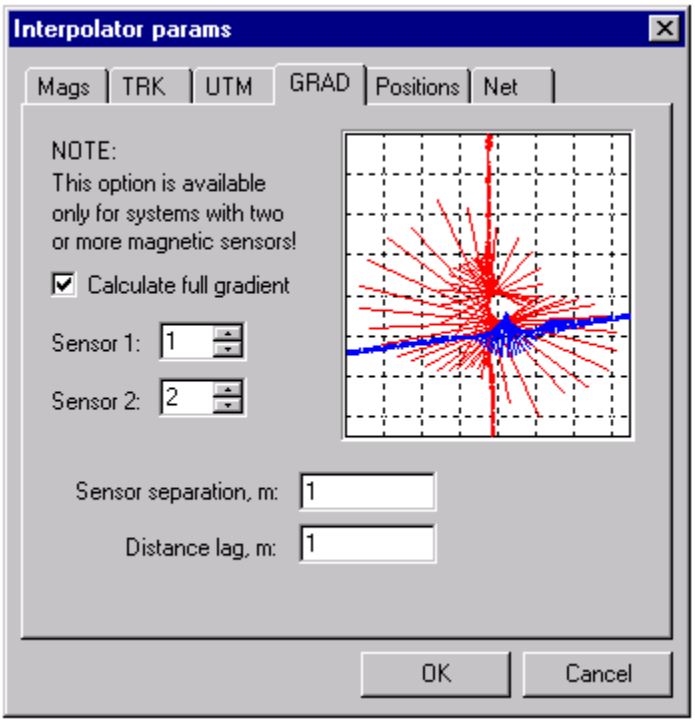
Obtained from Software Documentation for GCTP General Cartographic Transformation Package: National Mapping Program Technical Instructions, U.S. Geological Survey, National Mapping Division, Oct 1990,

b) Scale factor: Input 0.9996 for UTM coordinates.

c) Northing/Easting: These are constant values that you would like to add to your UTM coordinates. UTM coordinates are large numbers on the order of a million meters but your survey may only be looking at thousands of meters. This allows you to simplify your final numbers by adding or subtracting a large offset. These values will not be used if you specify "*Geographical Output*".

12.2.4 "GRAD" Dialog

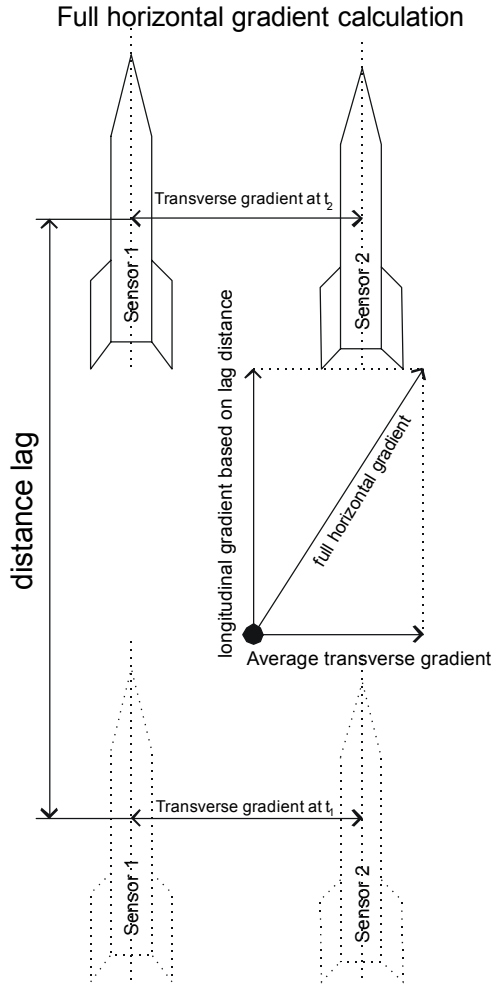
If a Marine Transverse Gradiometer system is used, MagLog can calculate the total horizontal gradient and plot it in real time. The difference between the two magnetic sensors is used for the transverse part of the full gradient; and data history is used for longitudinal part of the gradient, yielding the full horizontal gradient. This feature is controlled in the "GRAD" tab:



All controls in this tab are disabled if a transverse gradient system is not available. The following values must be entered:

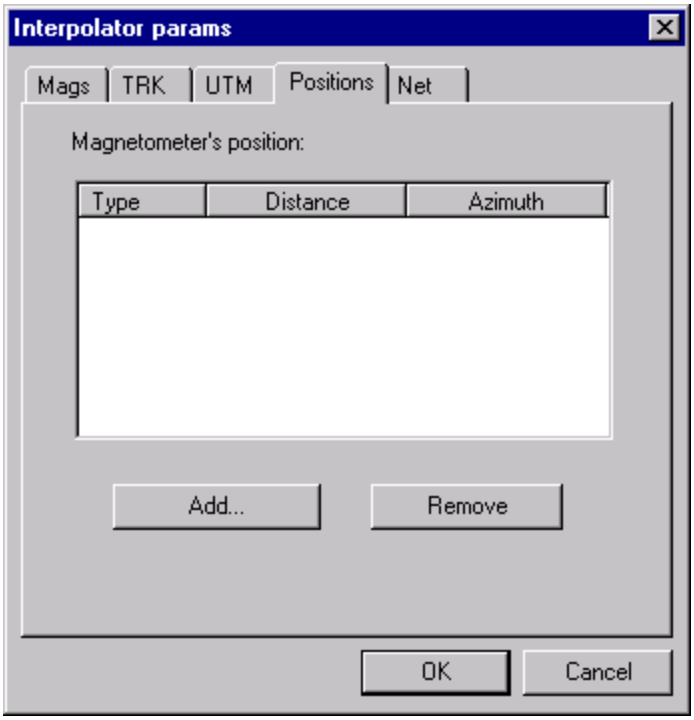
- *Calculate full gradient* - check to enable the feature.
- *Sensor 1 (and 2)* - Enter sensors numbers for first and second sensor. They are typically 1 and 2, but for multi-sensor system they may differ. For example, if there are 4 sensor arrays and sensors 2 and 4 are used as parts of transverse gradiometer, enter 2 and 4.
- *Sensor separation* - Enter the distance, in meters.
- *Distance lag, m* -Enter the distance to calculate the longitudinal part of the gradient. Typically, this should be the same order of magnitude as the separation between sensors. Lag also controls how often gradient lines are plotted on the map. For example, if Lag is 10 meters, each new line is plotted 10 meters from the previous one.

The figure below illustrates how the full gradient is calculated:

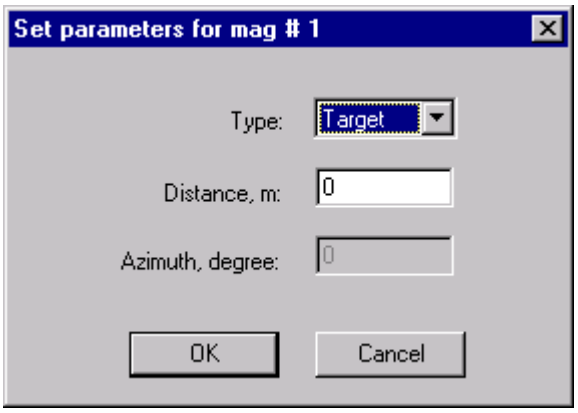


12.2.5 “Positions” Dialog

This dialog box allows you to specify additional position points you would like calculated. It will also allow you to specify what points of reference you want to use to calculate these positions.



You can add a new position by pressing “*Add*”. You should then see the following dialog box:



Type: Specify the type of reference point you are using. The available options are:

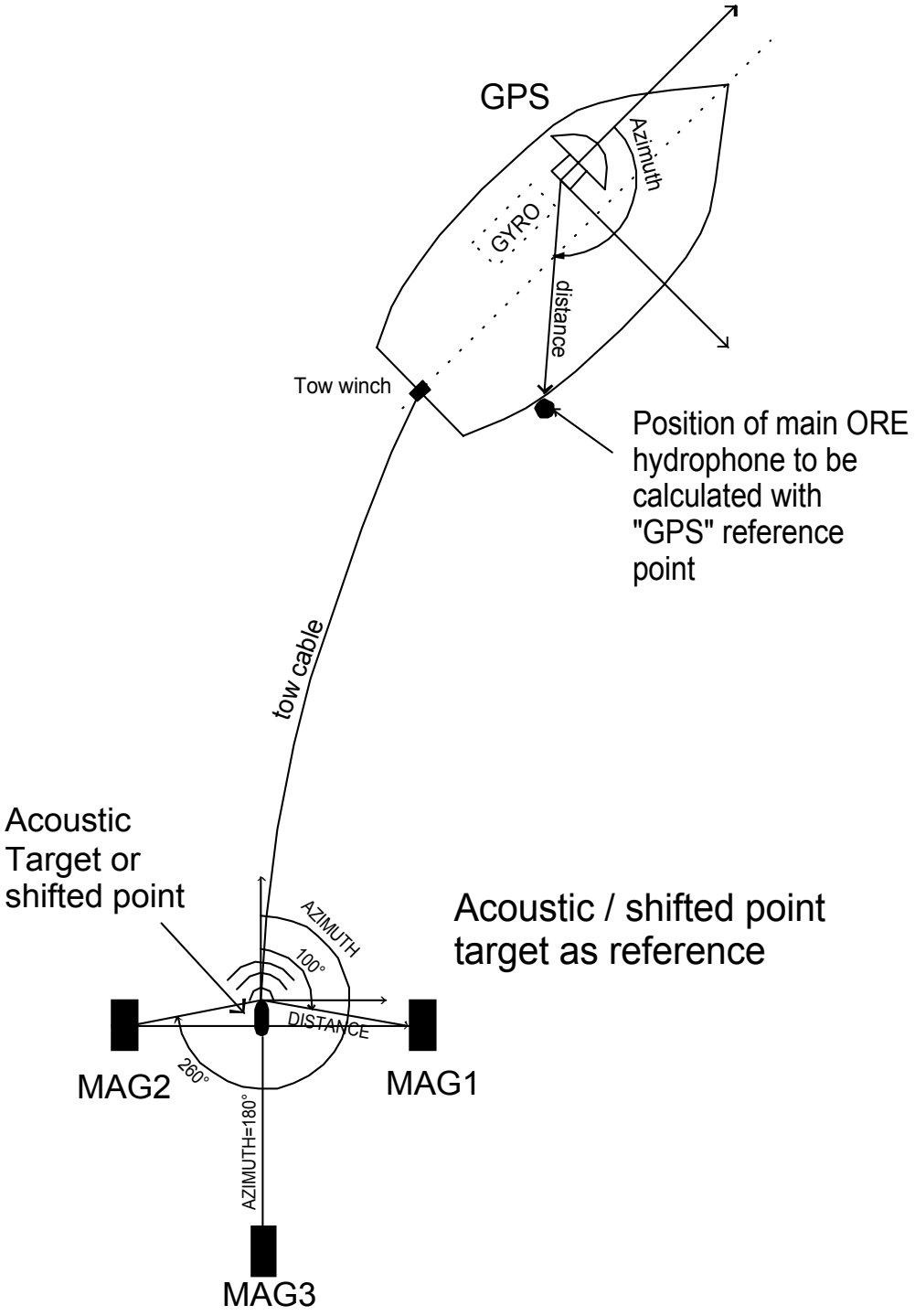
a) GPS – position of the GPS

b) Shifted – Position that takes the cable length and other options specified in the "Mag" screen. This is usually used for a horizontal gradiometer when you magnetometers located horizontally away from the center of the boat.
c) Target – acoustic target calculated from the ORE.

Distance: Horizontal distance from reference point to desired position point.

Azimuth angle: Angle between direction of boat travel (or cable) and line connecting GPS or Fish position (depending upon *Type* choice) to desired point. The positive direction is clockwise.

Picture below illustrates coordinates definition:



Four positions are to be calculated at time of every magnetometer sample: ORE main hydrophone position on the star side of the boat and positions for three magnetometers. To calculate first point GPS is taken as reference point; to calculate magnetometer positions acoustic target or shifted point serves as reference. For example, if distance between acoustic target and MAG3 is 10 meters specify distance as 10 and azimuth as 180.

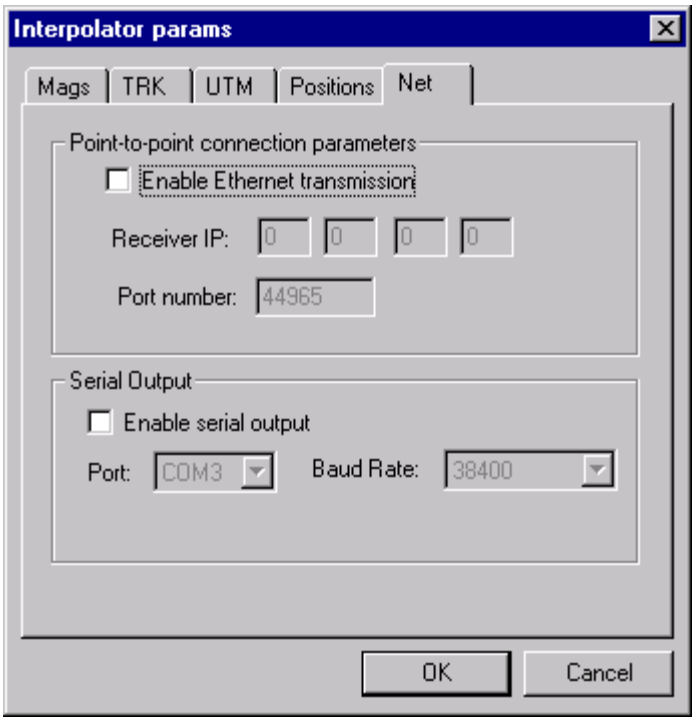
In general the positions will be specified differently depending on the type of reference point you are using.

Reference Point:	**Distance:**	**Azimuth Angle:**
GPS	Horizontal distance from GPS to desired position point.	Angle between direction of boat and the point to be calculated.
Shifted Point	Horizontal distance from shifted point to desired position point.	Angle between direction of cable and the point to be calculated.
Target	Distance from target.	If not equal 180 program uses sequence of target's position to find direction. If equal 180 dragging approach is used to find position.

Note: Always use 180 degrees azimuth if magnetometer is connected to the acoustic target with cable.

12.2.6 "Net" Dialog

This dialog box allows you to configure parameters for data output via Ethernet or serial connection.



Enable Ethernet transmission: This enables output via Ethernet. You will need to have a network card for this to work. You will also need to specify a receiver station IP address and a port number. The Interpolator uses a point-to-point connection. The receiver should be up when you start MagLog. If receiver is not running then MagLog tries periodically to establish connection trying to find receiver. In many cases if will find receiver as soon as it is started, however in some cases it will not.

Enable serial output: This will enable output out of a communications port. You can specify the output port and the baud rate. The baud rate must be high enough to transmit the data at the specified sample rate of the magnetometer and accessories package. For a magnetometer sampling rate of 100 ms (10 Hz), you should be able to transmit at least 2000 characters. We recommend a baud rate of at least 38400 BAUD.

12.3 Interpolator Output:

The interpolator will output a series of positions calculated for every magnetometer reading that you receive. For example, if your magnetometer outputs ten readings per second, you will get ten interpolator entries per second.

FILENAME

The format of the output depends on what options were selected. A sample output file where a magnetometer offset was used might have a string as follows:

```
49997.598 825.000 583.000 616.000 50008.885 1216.000 -11.287
14/01/99 14:27:49.336 499956.678 5007097.258 500014.710
5007015.819 0 0 2 8
```

This string can be broken up into several parts:

a) Magnetometer readings – This part has the recorded magnetometer readings, including *calculated* depth and altitude in feet or meters, and gradient like.
`49997.598 825.000 583.000 616.000 50008.885 1216.000 -11.287`

Note: Gradient is not recorded in single sensor magnetometer files.

---

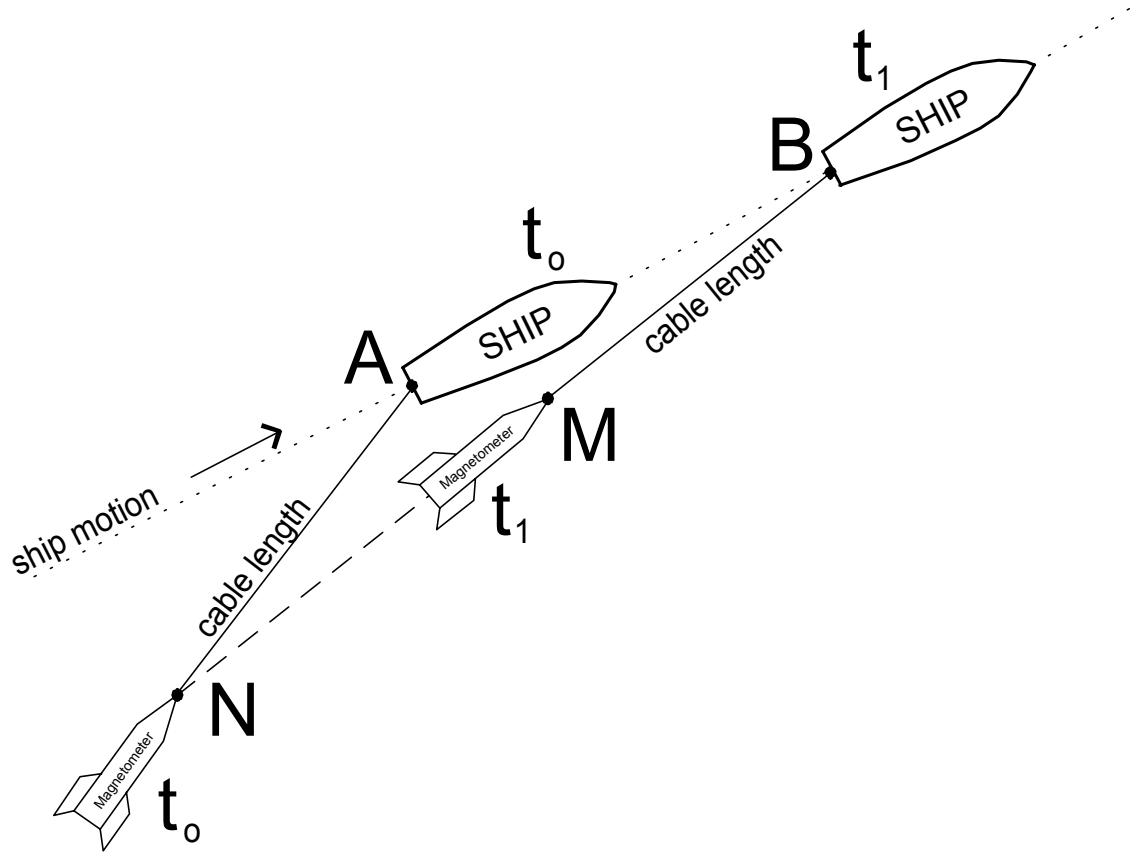
b) Time and Date – `14/01/99 14:27:49.336`
c) Position of GPS – This is the calculated GPS position in UTM or geographical coordinates with no offset at the time above.
`499956.678 5007097.258`
d) Position of shifted point – this is the point calculated behind the GPS at the time of the reading.
`500014.710 5007015.819`
e) Number of Acoustic targets and X, Y positions of each. – None were used in this example, so "0" is output.
0
f) Number of other position points and X, Y positions of each – None were used in this example so "0" is output.
`0`
g) GPS Quality Indicator:
2
h) Line Number:
8

12.4 How Interpolator calculates shifted position ("Dragging" algorithm)

Here you can find brief description of the method used to calculate position of the Fish being dragged behind the boat.

Let's consider object (magnetometer Fish) being dragged behind the boat with constant (and known) tow cable length. Boat is equipped with GPS receiver and therefore its position is available. The task is to provide reasonable approximation for magnetometer Fish position based on GPS readings and cable length.

Picture below illustrates suggested solution:



Solution is approximate and does not take into account 3-D configuration (depth) and physical effects like friction. Nevertheless it gives reasonable behavior even if ship makes a turn.

We assume that we know position of the ship (A) and the magnetometer (N) at time t_0 and cable length. At time t_1 we know position of the ship (B) but do not know position of the Fish (M.) To find it we draw straight line NB between old magnetometer position N and new ship position B. Then we count cable length from B towards N. New point M is estimated position of the magnetometer at time t_1

It can happen that distance BM is greater then BN (if ship does a sharp turn). In this case magnetometer position not changed (literally it should sink).

Method explained above assumes that magnetometer position at time t_0 is known but it is unknown at the start of the line. Therefore to start calculation process we need to find somehow initial magnetometer position. Different techniques might be employed for that but one of the easiest is using initial part of the recorded path to find direction of motion. We can approximate these positions with a straight line using least-squares method and count cable length back along this line. This gives reasonable estimation for initial magnetometer position; as soon as it is done dragging method can be used. After a while influence of initial position becomes negligible.

It should be noted here that method is not designed to work at sharp turns. It is also does not take into account depth of the Fish (if Fish is deep then horizontal distance is less then total cable length). Another problem is that GPS normally is not mounted at the same point where tow winch is; therefore effective cable length should include distance GPS - winch.

12.5 Interpolator Examples

This shows a few commonly used configurations and how you might want to set up the interpolator.

12.5.1 GYRO, GPS, and Cable length using transverse horizontal gradiometer.

The system components we have in this example are:

a) GYRO
b) GPS
c) Cable length measuring device (payout indicator)
d) 2 magnetic sensors separated by 20 meters (transverse horizontal gradiometer)

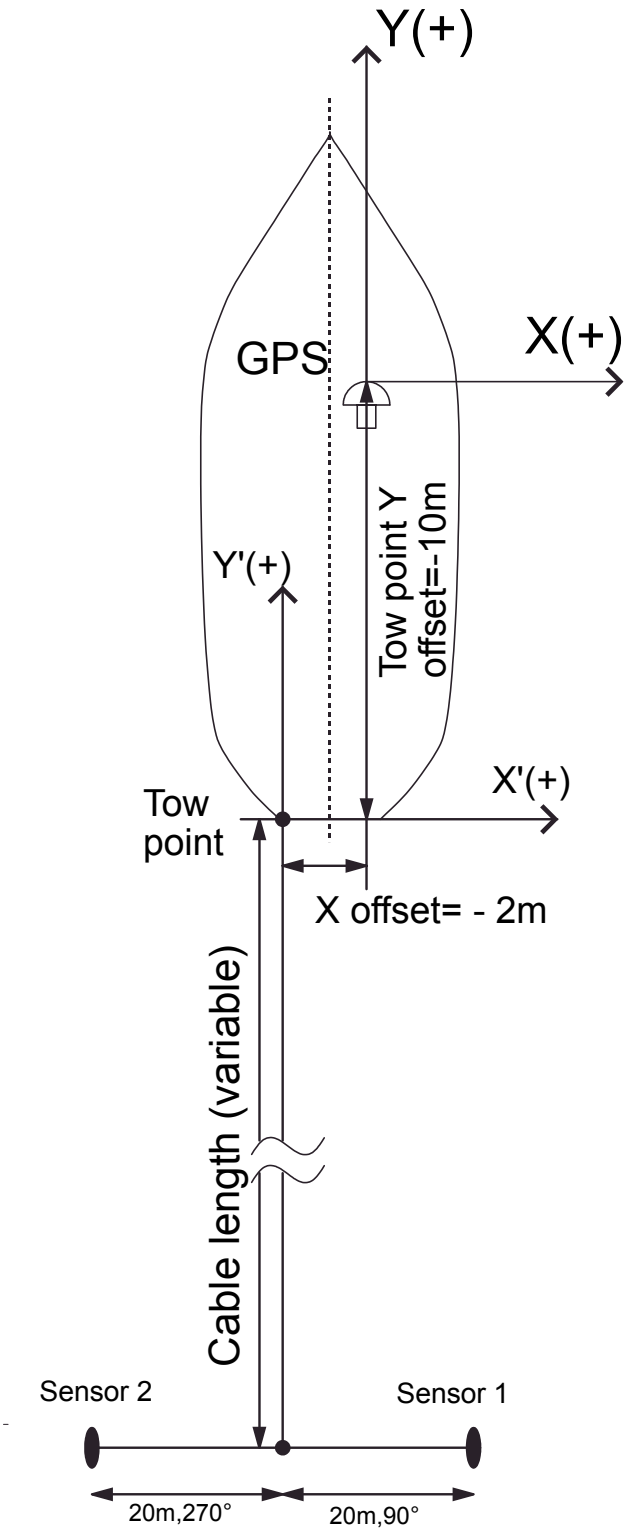
The *positions* we want to output are:

a) GPS
b) Tow point
c) Shifted point behind boat
d) Sensor 1
e) Sensor 2

Output is to go to file.

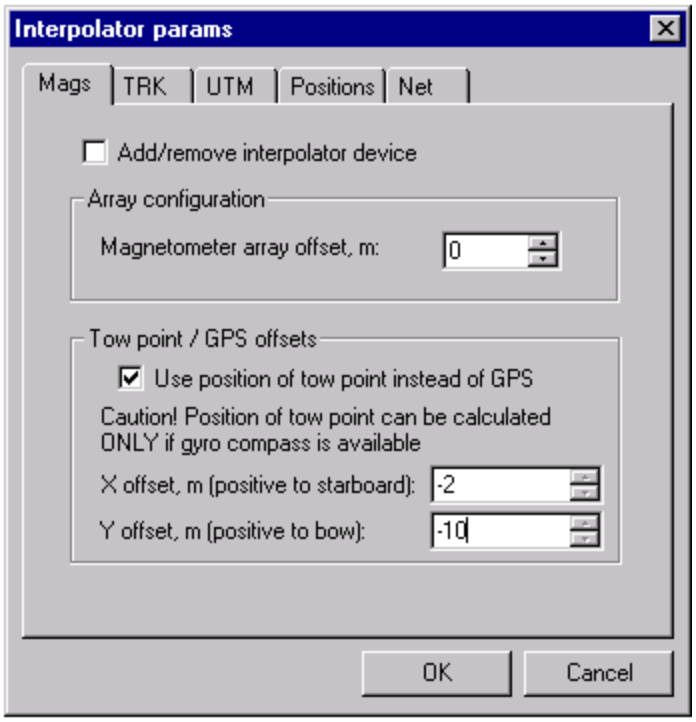
Output specifications are geographical coordinates, and the GPS outputs latitude and longitude coordinates ($GPGGA messages).

A graphic describing this is:



The interpolator setup is as follows:

1) Fill out “Mag” screen:
   Since I have a GYRO, I am able to specify a tow point that will be recalculated.

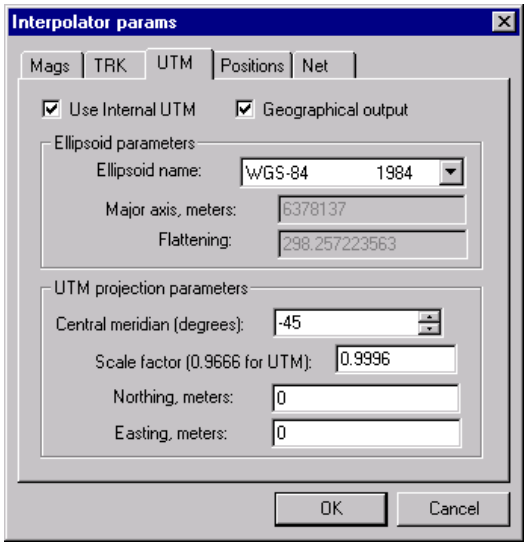


Here, the magnetometer array offset is zero because there is a cable length measuring device. Additionally, since there is a GYRO, the position of the tow point can be accurately calculated. The offsets for the tow point must then be put in (-2, -10) taking into account that this is relative to the GPS and starboard is positive.

2) Fill out "TRK" screen:
This is not needed because there is no ORE. Make sure that the option: "*Use ORE Trackpoint II*" is disabled.

3) Fill out “UTM” screen:

As shown below:



Here, “*Use Internal UTM*” is specified because the output of the GPS is in latitude and longitude coordinates. The UTM specific parameters must filled out correctly, and “northing” and “easting” are left to be 0 (they are ignored here).

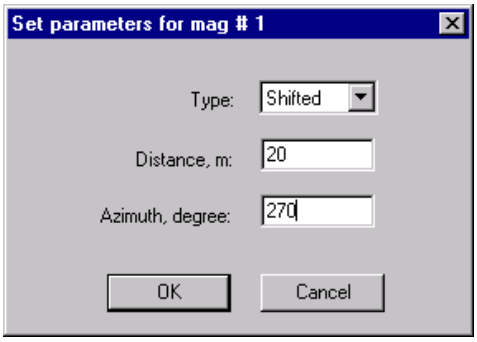
“*Geographical Output”* specifies that the all coordinates should be output in a latitude/longitude format.

Entering correct value for Central meridian is crucial. If this value is not correct interpolator will not work, and you’ll see a warning message at start up. Please use UTM zones table and your current position to find appropriate Central Meridian value

4) “Positions” Dialog:

There are two sensor positions that should be calculated here. The positions are filled out as follows:

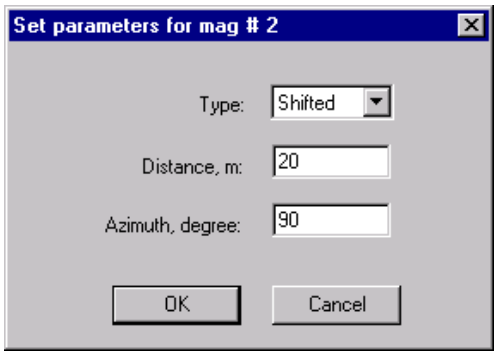
The first sensor position is specified as below:



Here, we are using the shifted point (a point behind the tow point) as a reference point. Since the sensor is 20 meters from the tow point, and it is the left sensor of a horizontal gradiometer, we specify the distance as 20 m, and the azimuth angle as 270 (360 + -90) degrees.

Note: If I were to use the GPS as a reference point, I would use a distance of 22 meters and an azimuth angle of 270 degrees.

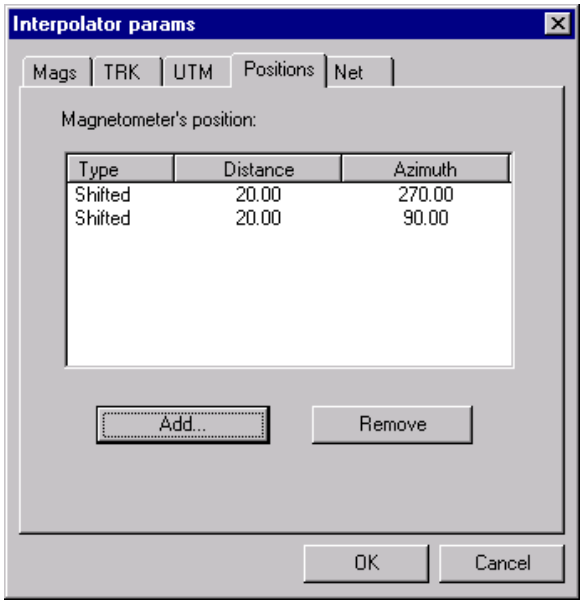
The second sensor position is also specified:



Again, the parameters are set with respect to the shifted point. The distance is 20 meters, and the azimuth angle is 90 degrees.

If the GPS were used as the reference point, you would specify a distance of 18 and an azimuth angle of 90 degrees.

The final screen should look like the screen below:



5) Net" Dialog:

This dialog is not needed because there is no serial output or output via Ethernet.

Important Point:

MagLog NT will use the GYRO information in position calculations when it is available. However, you need to check the calculations box for those that require GYRO because by default, they are disabled (e.g., for tow point calculation).

12.5.2 ORE Trackpoint II, GYRO, and three sensors:

This example has an ORE and a serial GYRO (Gyro is not connected to the ORE but IS connected to logging computer running MagLogNT).

The system components are:

a) Serial GYRO
b) GPS
c) ORE
d) 3 sensors -- sensor one is 5 meters behind acoustic target,
sensor two is 10 meters behind acoustic target,
and sensor three is 20 meters behind the acoustic target.

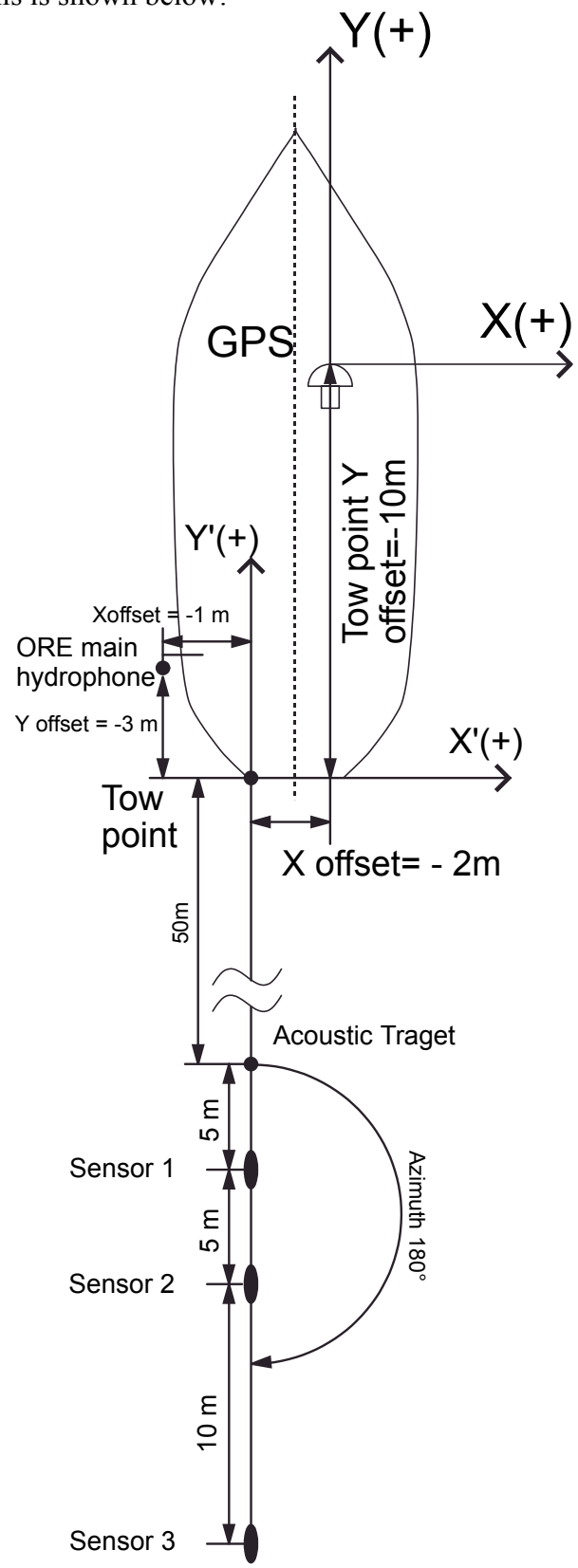
The *positions* that we would like to compute and output are:

a) Tow Point (when a tow point is specified, it is output instead of the GPS)
b) Shifted Point position
c) Position of acoustic target
d) Sensor 1
e) Sensor 2
f) Sensor 3

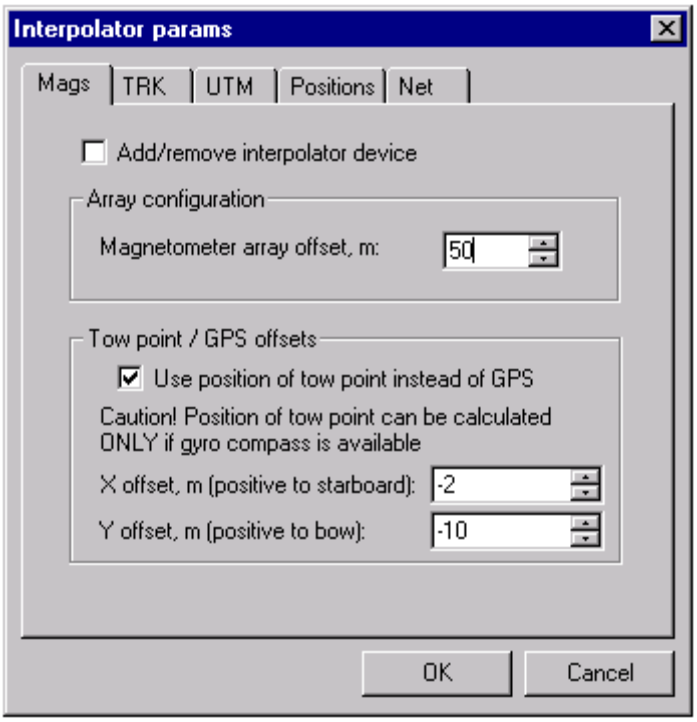
The output is to go to file and we would also like to do real time Ethernet transfer.

Output specifications are UTM coordinates, and the GPS outputs latitude and longitude coordinates.

A graphic describing this is shown below:



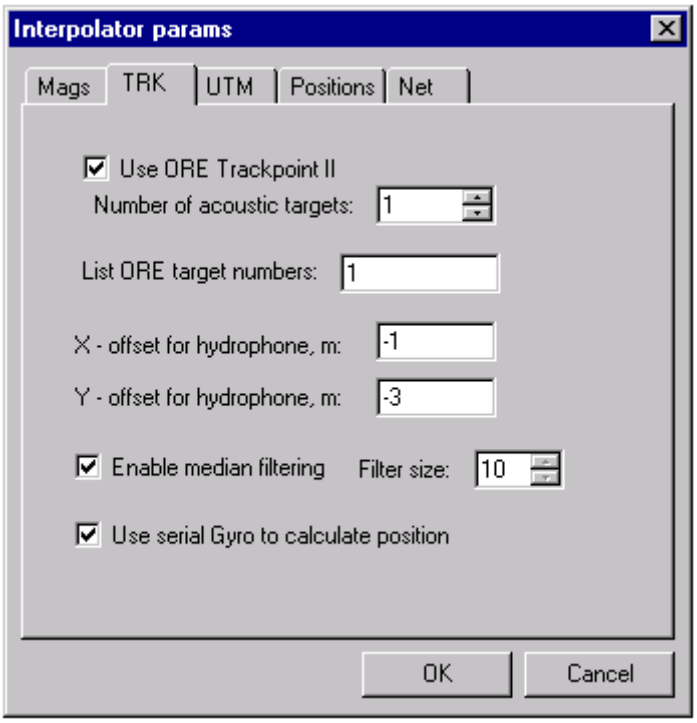
1) Fill out “Mag” screen:



It is beneficial to specify the magnetometer offset and the tow point as a backup. If the ORE were to malfunction, there would still be a valid calculation of the magnetometer positions using the tow point.

The magnetometer offset is specified to be 50 m (or if there was a cable length measuring device, this would be specified as 0). The X and Y offsets are measured from the GPS to the tow point (as seen in example A).

2) Fill out “TRK” Screen:

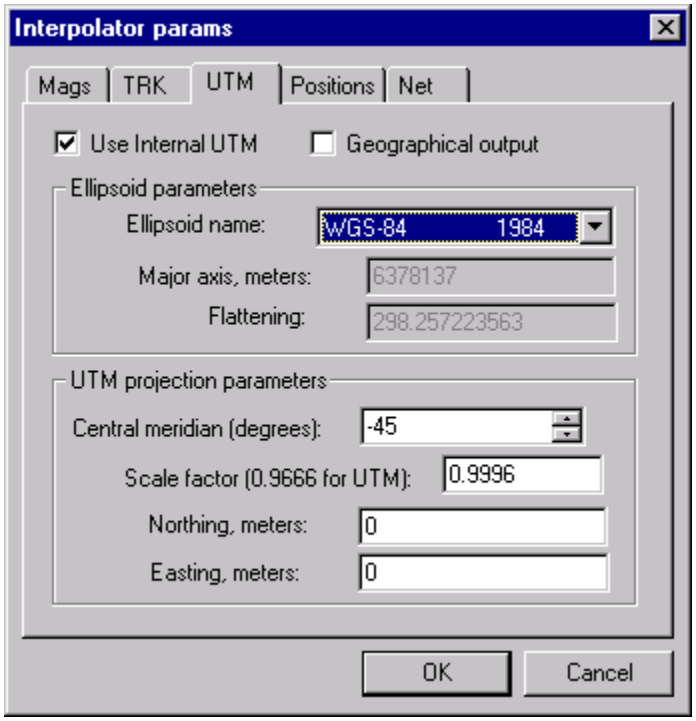


The “*Use ORE Trackpoint II*” option must be enabled in order for any ORE calculations to take place. There is only one acoustic target.

The X and Y offsets are specified with regard to the tow point. In this case, we are using a serial GYRO (the GYRO is not connected to the ORE) so we need to check the “*Enable Serial Gyro to calculate position*” option box . (The offsets cannot be entered until this is checked). We also specified a tow point (under “MAG” tab, see above), so the offsets must be given with respect to this tow point. If we hadn’t specified a tow point, these offsets would be given with respect to the GPS position.

We have also decided to enable median filtering with a filter size of 10 readings (not mandatory but will smooth results).

3) "UTM Screen:



Here, we enable "*Use Internal UTM*" because the GPS outputs geographical (latitude/longitude) coordinates ($GPGGA messages). Practically 99% of GPS receivers do it, therefore this box always should be checked. We then need to specify the ellipsoid parameters and UTM projection parameters. These parameters are position dependent and need to be looked up.

Entering correct value for *Central meridian* is crucial. If this value is not correct interpolator will not work, and you'll see a warning message at start up. Please use UTM zones table and your current position to find appropriate Central Meridian value.

We don't specify "*northing*" or "*easting*" here because we want the final output coordinates to be true coordinates, rather than adjusted coordinates.

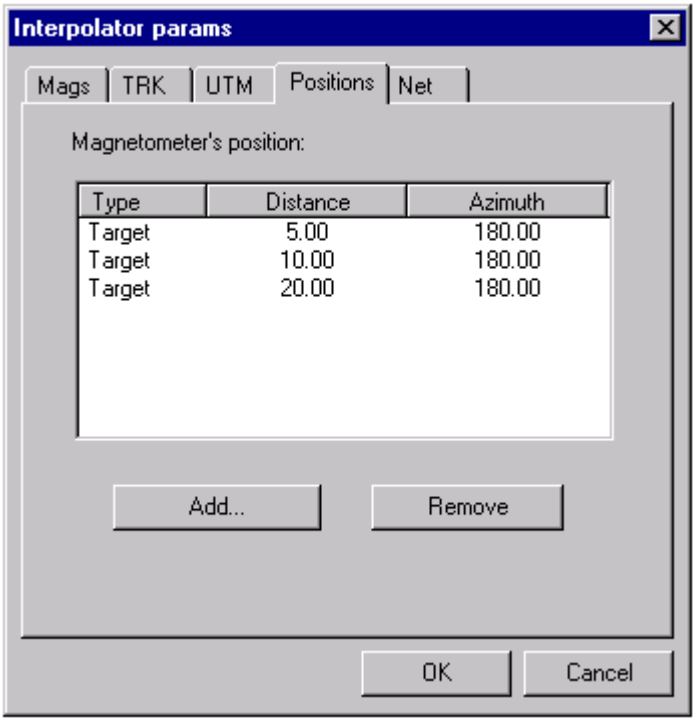
We also leave "*Geographical output*" unchecked because we want the output in UTM rather than recomputed into geographical (latitude/longitude) coordinates.

4) "Positions" Dialog:

Here we input the magnetometer positions that we want to track. We have three sensors so we need to enter three positions. Additionally, since there is an ORE Trackpoint II, we

can easily calculate the position of the acoustic target, so this is the best reference point to use.

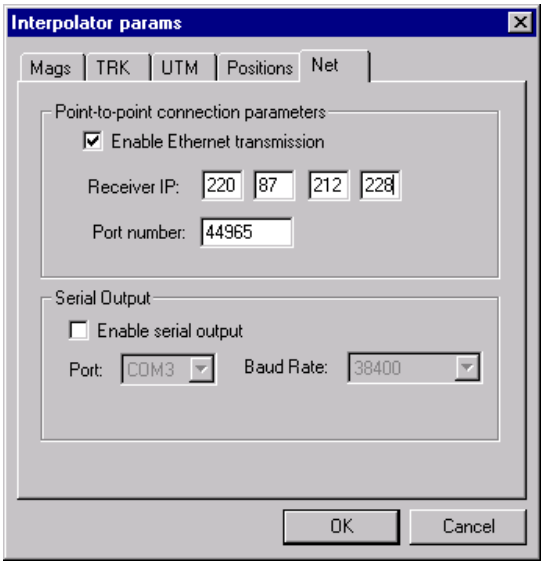
The final position screen should look like the following:



Here, we specify the sensor distances from the acoustic target. Because sensors are behind acoustic target azimuth must be equal 180^0 .

5) "Net" Dialog

Here, we enable Ethernet transmission by checking the box "*Enable Ethernet transmission*". We then need to specify the receiver IP address and the port number. Your system administrator should know these values.



Important Points: It is useful to input tow points when you can because these will allow MagLog NT to calculate the sensor positions in more than one way. Then, if you have a situation where a device malfunctions, you have more calculations that you can fall back on. MagLog NT will calculate all positions that you specify. For instance, you could also set up another set of points in the "Positions" dialog that are based on a shifted point. Since you have a tow point, MagLog NT will use the cable length to calculate a shifted point. You could then use this point to get a series of three sensor position calculations based on this "shifted point" and use these calculations as back-up calculations. For multiple calculations of this type on the fly (real time) we suggest a high performance computer with a fast drive and lots of memory

12.6 .Interpolator Diagnostic Messages

In certain cases the Interpolator cannot compute all or some of the requested positions. In this case the status light will remain red. However when logging is started, the log file size will increase.

In most cases there will be one-dime diagnostic message on the screen in the form of dialog box with an "Ok" button. If the "OK" button is pressed, the message disappears. To see it again the user should start / stop the interpolator or start / stop the survey. If the message appears on the screen but Interpolator light is green, this is a result of initialization of the system, please just disregard the message.

The following section defines Interpolator messages and their meaning:

- "**Wrong INTERPOLATOR central meridian! Please adjust in Output Devices / Interpolator / UTM!**" Indicates that the Interpolator cannot perform an internal UTM transformation because the current GPS position is more than 6

degrees away in longitude from the central meridian. Adjust the central meridian setting in UTM setup. Restart survey.

- **INTERPOLATOR: cannot accept GPS positions!** Interpolator cannot use positions from the GPS. This typically happens when the user mistakenly requests "*Use position of the tow point instead of GPS*" option on *Mags* tab of Interpolator setup dialog. To use this function, a GYRO compass *must* be available. Please check *Mags* tab and uncheck the box if needed. Restart survey.
- **INTERPOLATOR: cannot accept MAG data!** Interpolator cannot use magnetometer data. If the magnetometer is working correctly check if the depth sensor is calibrated properly and if the depth sensor reading is used in layback calculations.
- **1:INTERPOLATOR: cannot interpolate UTM.** Interpolator cannot interpolate GPS position at magnetometer sample times and shifted positions (this means that the log file does not have any useful position information). Check if GYRO was requested (on tab "TRK") but there is no gyro attached to the computer.
- **2:3 INTERPOLATOR: cannot interpolate Lat/Lon.** This is the same as the section above but the output has been requested as longitude and latitude.
- **4:5 INTERPOLATOR: cannot interpolate ORE.** If no underwater positioning system (ORE TrackPoint II) is available but an acoustic target interpolation was requested, the Interpolator outputs this message. Check the "TRK" tab in interpolator setup and make sure "*Use ORE Trackpoint II*" box is *not* checked. Box "Use serial gyro to calculate position" can be checked even if ORE II is pot present (however GYRO must be connected to the computer in this case).
- **6:INTERPOLATOR: cannot interpolate aux. points.** The usual reason for this message is that the user requested computation of the auxiliary position based on a position of the acoustic target when there is no ORE II system. In this case the Interpolator fails to compute these positions however still computes positions of the GPS and shifted point. Go to " Check "*Positions*" tab of the Interpolator setup and make sure there are no positions with type "*Target*". Remove them if they are present. Restart survey.

13 High precision Land / Airborne surveys.

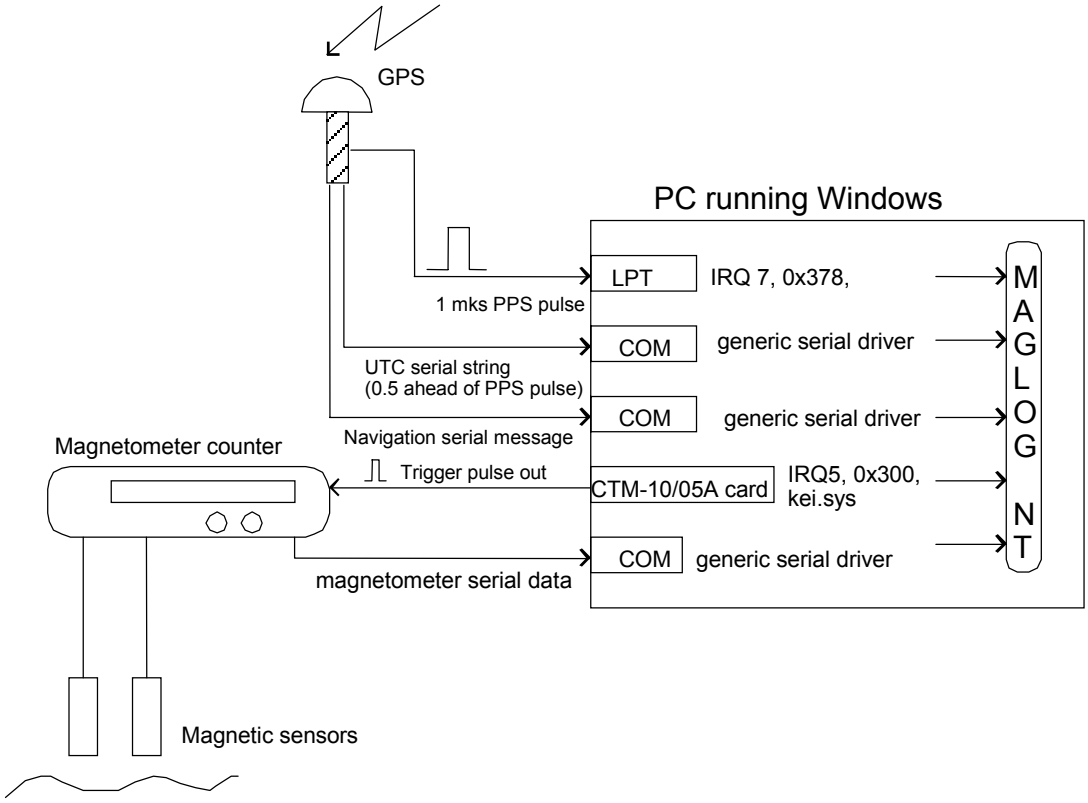
In the normal MagLog operational mode there are several sources of time inaccuracy that can lead to spatial errors in the location computation. There are certain surveys where even slight inaccuracies in the position of the sensors cannot be tolerated such as those that have to do with locating Unexploded Ordnance (MTADS systems). Geometrics has devised a proprietary method of dealing with the internal electronic delays that occur in all computational equipment including GPS's and PC's. Here we describe the problem and our solution.

- The GPS receiver has its own internal delay due to the time to calculate position. This value can vary between less than 10ms to 500ms! This is known as LATENCY and depends on the GPS model. A time stamp embedded in the GPS message corresponds to the location at the time it was calculated. However the transmitted string is slightly delayed due to internal GPS CPU cycle time. MagLog records the time when the GPS message becomes available to the computer (or more exactly to the software) thus there are a series of delays from the time of the actual position fix to the time that the information becomes available. MagMap processing software makes use of the *PC time stamp* to interpolate magnetometer position and thus ignores the delays. MagMap still has an ability to take the delays into account if the user explicitly enters the sum of delays. The delay is assumed to be constant.
- Windows NT/95/98 has its own delays when processing serial port notification. This means that when data physically arrives at the serial port it does not become available to the program immediately. The system itself has to spend some time to present data to the rest of the software. This depends on the speed of the computer this may vary from 10 ms average to 20 or even 50 ms. It should be noted that this delay is not constant and depends on the processor load. We have seen it vary between 2 ms to 500 ms!.

Because of the delays, normal MagLog operational mode does not provide the very best spatial accuracy possible. In simple terms, a solution to this problem is to use UTC GPS time instead of PC time and the time of the data arrival should be logged without delays.

Our solution is based on a process of external magnetometer triggering that has the ability to log the time of a specially generated trigger pulse event (with almost no delay) and to also log the UTC GPS strings *together* with a corresponding GPS PPS (pulse per second) UTC synchronized option available on some GPS systems. *Geometrics* has developed a special Windows NT driver that allows logging the time of the pulse arrival based using a parallel port interrupt. The accuracy of such a time stamp is about 1 ms and much less dependant on overall system load. A special multifunctional card from *Keithley* allows generation of the trigger pulse for the magnetometer. Each pulse induces a PC interrupt. The time of that interrupt can be logged in a manner that is similar to the process for the parallel port interrupt. These drivers are available for Windows NT only. Here we discuss the overall acquisition and processing steps necessary to employ this triggering scheme (see schematic below).

1. GPS system with PPS option. Approximately half a second ahead of each pulse the GPS generates a serial string with the pulse's UTC time. Then the pulse itself is generated. Serial strings are logged with MagLog *Generic Serial Device* and the time of the pulse arrival is recorded with a driver. By matching these two pulse streams it is possible to recalculate PC time into UTC time with a very high accuracy (about 1ms).
2. GPS also sends its normal navigation message. However the PC time stamp appended by MagLog is not used for calculation and interpolation of positions; instead the UTC time is taken from message's body.
3. The *Keithley* CTM-10 card is started in pulse generator mode. Each pulse induces an internal PC interrupt; and the time of this interrupt is logged with a special driver. The pulse also triggers the magnetometer. Then a serial string with the magnetic field value is sent from the magnetometer to the computer and logged with MagLog *G-822A* device setup.



The PC time stamps in the magnetometer log file are substituted with those from the trigger file thus providing a higher time accuracy (1ms vs. about 20 ms). Using the relation between PC and UTC time, the magnetometer times are recalculated into UTC time.

At this point all time stamps are expressed in the UTC time system and can be used for data locating directly.

Note:	Presently this system is available with G-822A Super Counters and under Windows NT only.

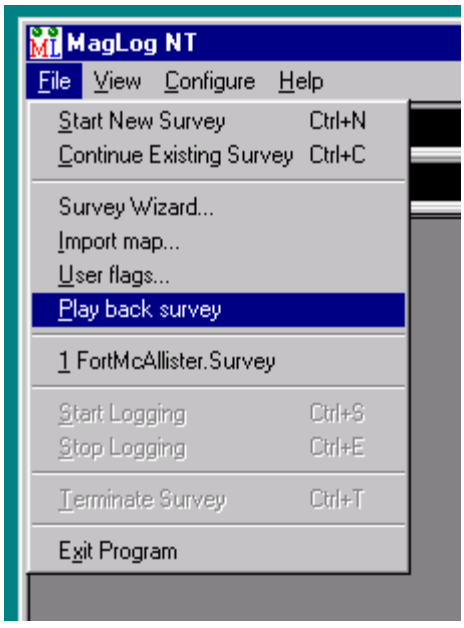
14 Playing existing surveys back – playback feature.

14.1 Viewing data with playback.

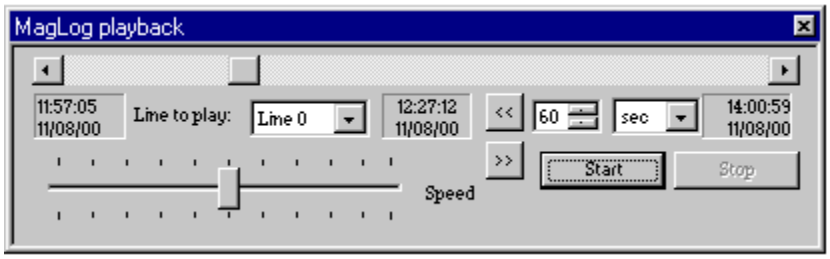
The latest MagLog versions have a new playback feature that allows replaying already acquired surveys to look for the anomalies and to check data quality. It is important for Playback Mode to keep the same sequence of data as was recorded during the original survey. Simply reading data from the files does not ensure this because the reading operations are not synchronized between various data streams coming from the files. There is a secondary ability to read and display data from files ("Reading from Files Mode" - this is the manner in which we distribute the fully operational program in demo mode) but this feature should be used only for training purposes, not for data evaluation. Use the new Playback Mode for proper review of your recorded data.

Due to nature of playback, some features are not available in this mode including logging (because these files are used as data sources). On the other hand, almost all MagLog features are available in the "Reading from Files Mode" which makes it more appropriate for training. See section 15.2 below on Sample Files under Other Topics for more information on this feature.

Playback is started by selecting "File / Play back survey" menu as it is shown in the following picture.



To prepare a survey for playback, MagLog reads all collected log files and sorts their records with respect to time. This might take a few minutes (depending on the amount of data). When this is complete, the playback control center dialog starts:



The following controls are available:

- Data playback is offered on a line-by-line basis. The top Scrollbar represents an entire line in time. When data is not being played, the user can drag the scrollbar handle to set a time for the playback starting point. The time listed in the upper middle box is the current playback time. The user cannot drag the scroll bar handle during data playback, he or she must stop the playback process first by pressing the "STOP" button.
- "Line to play" select the line to play. Times on the left and right are start and end times of the line.
- Speed. Depending on your computer hardware performance data can be played up to 50 times faster then they were recorded. The user can change the speed at any time. It is allowable for playback to skip same data samples to keep up if speed is set very high. Move Scrollbar slider to the most left position and the Speed control all the way to the left to play all the data at normal acquisition speed.
- "<<" and " >>" buttons will shift playback time in the past or in the future based on the time interval entered in the box just left of the "<<" button. In this example if user presses "<<" playback starting point shifts to 60 seconds back in past. Pressing "START" restarts the survey from that point. The time interval can be specified in seconds, minutes or hours.
- Start begins playback. To stop playback press "Stop". When the end of the line is reached playback will be stopped automatically.

Typically playback is used for data inspection after the survey. The user can start playback at a high speed to examine the data, stop it at interesting places, scroll back and start again slowly. A flag feature used to mark features in the magnetic field and on the GPS map can then be employed to specifically locate targets. This is a very powerful technique. Explore the possibilities by stopping the playback at an anomaly and then right clicking on the peak and valley of the anomaly and selecting FISH FLAG. You will see the corresponding positions of the sensor at the time the sensor encountered the anomaly enabling the user to bracket the anomaly for additional survey lines in the area.

When a MagLog survey is terminated and later restarted, it logs data into the existing survey files. Therefore, it is possible to use the Playback feature (which cannot run during normal survey operation) to review the data of several lines over an anomaly. This allows the operator to evaluate the size and shape of the anomaly by reviewing several different lines over the anomalous area and restructuring the survey plan to acquire additional data over the anomaly area. When exiting Playback mode and restarting the survey the new data will be appended to the existing survey data files.

For surveys where the INTERPOLATOR device enabled, the playback mode uses the INTERPOLATOR file to display GPS and fish position. If the INTERPOLATOR device was not working properly, no GPS display will be available. The program checks the size of the INTERPOLTOR log file and reports the following error if it does not exist or has size less then 80 bytes:

In this case user can re-create the INTERPOLTOR file in the playback mode (see the following section)

Some operations that cannot be performed in playback mode:

- Data cannot be logged.
- Program does not re-interpolate Fish position. If the Interpolator was used during the original survey its log file is taken as it was acquired.
- Program does post warning dialogs. However lights on light bar turn into green, red or yellow as they would during the normal survey.
- Duration of the display slot cannot be adjusted, i.e. you cannot make the slot length change in time, it is fixed to what was set during acquisition. Use playback speed to change display speed for all displays.
- If the user prints the analog traces of the data during playback, the label will be printed on the right side of the page each 10^{th} reading . Printed time labels correspond to the survey time, not playback time.

Presently MagLog does not play back the following types of surveys:

- Surveys with non-serial devices (including event marks)
- Surveys with serial binary devices
- Surveys with A/D converted devices.

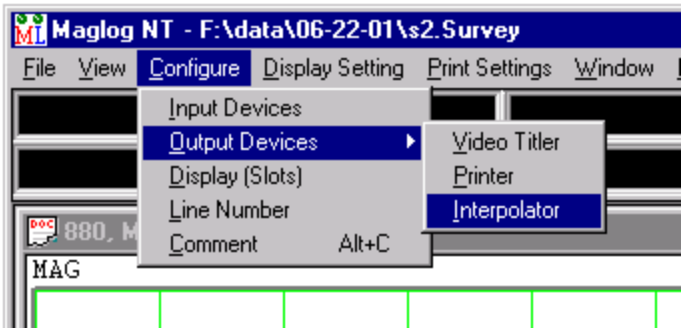
14.2 Position Interpolation with Playback and Interpolator

If you ran your survey without using the Interpolator feature or if you used wrong parameters in the Interpolator setup, it is possible to recreate the interpolated data file using a unique feature of playback mode. Note that the results will not be completely identical to real-time interpolation because the real-time interpolator uses *all* the data available during survey including those positions received before logging began. Re-interpolation uses only logged data and therefore positions may differ at the start of the line from those obtained in real-time. However this difference is not significant if there were no sharp turns before the line started.

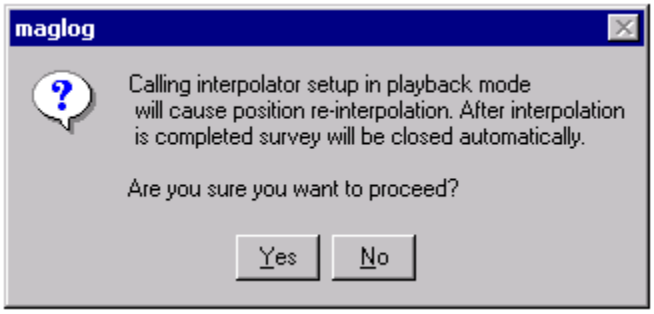
Because the interpolator log file is used during playback, the user has to reload the survey after re-interpolation is complete in order to observe the interpolated positions. Thus playback re-interpolation works as a one-way street, although the old interpolator file is automatically backed up as *.bak as described below.

The re-interpolation procedure is described step by step in the following paragraphs:

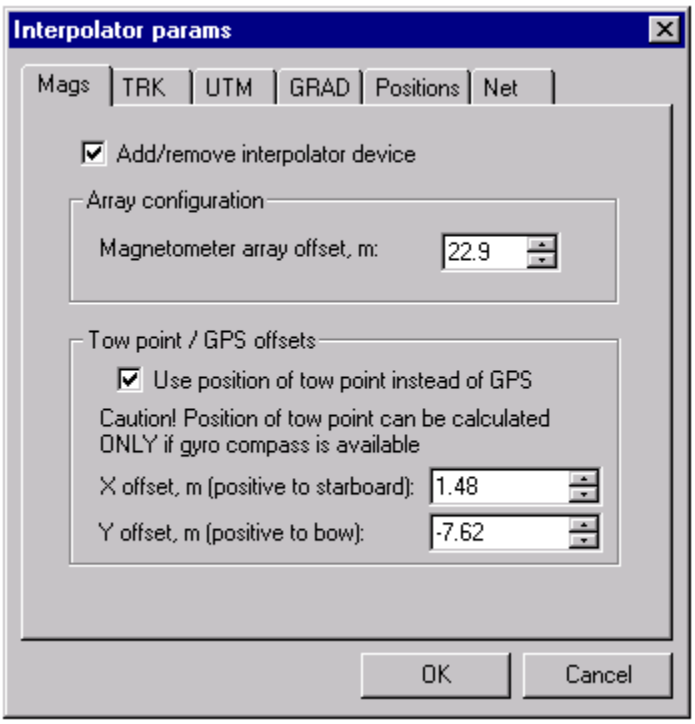
1. Start MagLog and load your survey in the playback mode, as described above. Then initiate the interpolator:



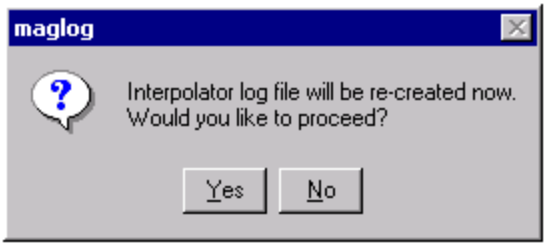
2. MagLog will warn that the survey will be closed after interpolation is completed or cancelled.



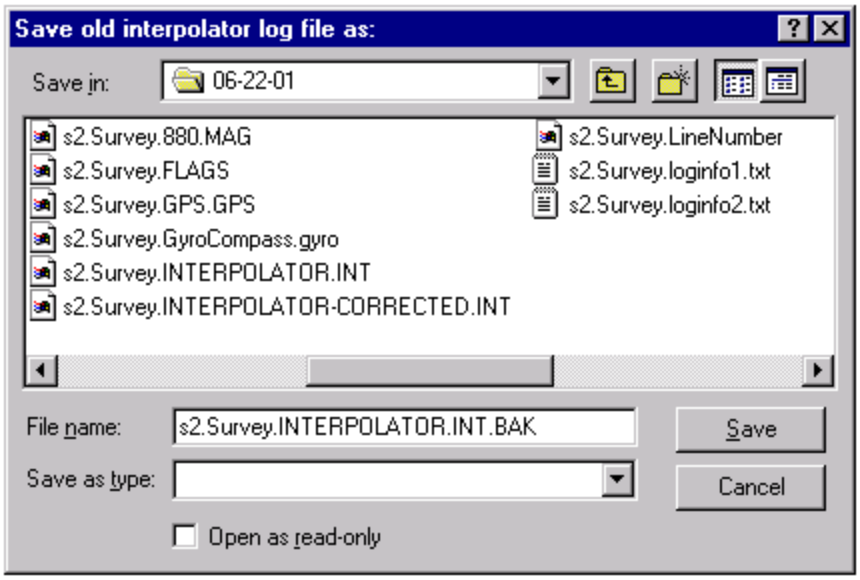
3. If you answer "Yes", MagLog proceeds to the standard interpolator setup screens as follows:



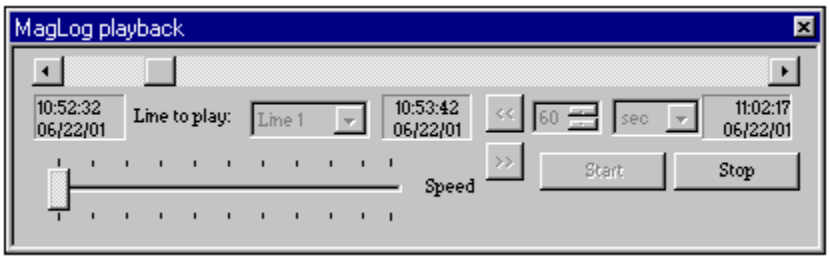
4. Setup the interpolator or change the settings in the dialog box. Refer to the interpolator section of the manual for more information. After "Ok" is pressed MagLog posts another warning giving you a chance to return to the normal playback mode:



5. The existing interpolator file (if any) is saved by MagLog with an extension "BAK". However if the "BAK" file already exists, the user must pick a different name (this is the case if the re-interpolation process is used a second time). In this case a file save prompt appears:

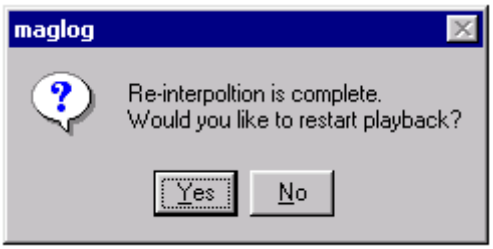


6. Finally MagLog begins the re-interpolation process. To increase interpolation speed all display windows are automatically closed. The user can observe the playback dialog as a progress indicator:



The Slider bar shows the progress for the current line and "Line to display" shows current line number. The only control enabled in this dialog is the "Stop" button.

7. When the user presses "Stop" or when MagLog reaches the end of the survey, the following message is posted:



Answering "Yes" causes MagLog to automatically re-load survey in playback mode. Answering "No" will simply close the survey. In this case to replay it with the new interpolator file, reload the survey in playback mode. Re-interpolation allows the user to see the fish position and some additional type of superimposed data plotting on the track plots (for instance, gradient plot).

If the user canceled re-interpolation, the following message appears:

MagLog restores the original INTERPOLTOR device file. Again, answering "Yes" re-loads survey in playback mode, answer "No" simply closes the survey.

15 Survey QC checks.

15.1 Layback and Latency Test using a Natural In-field Source

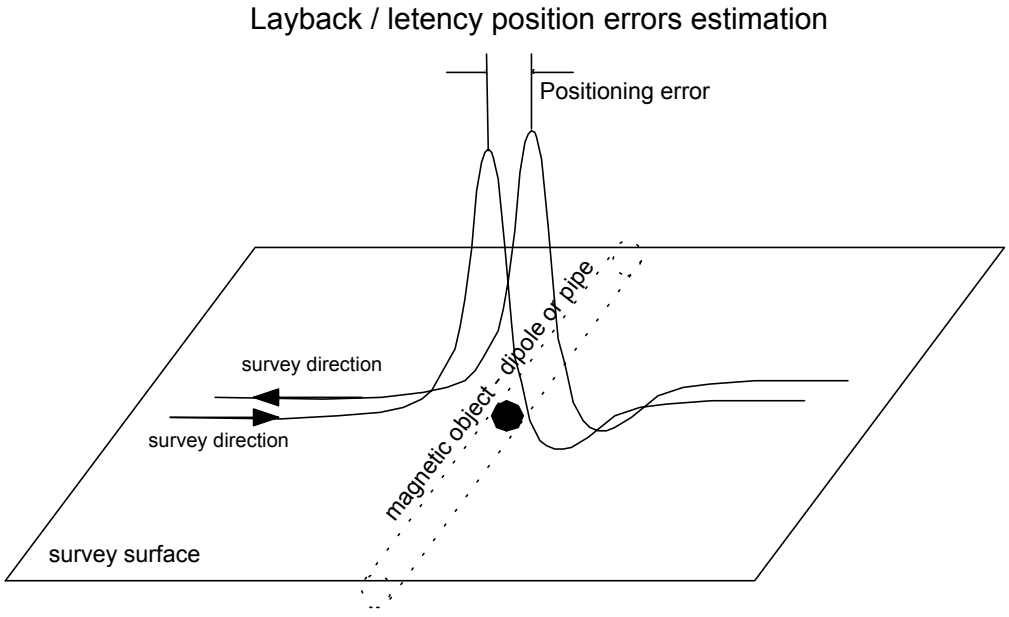
This test allows the user to estimate the overall timing and positional accuracies of the system, including the magnetometer or other sensor position (i.e., attached to the tow cable for marine surveys, mounted on the vehicle for land surveys or the stinger for airborne surveys), the GPS antenna position (connected to the computer via serial link) and taking into account inherent delays in the computer hardware and software system. One major reason for these inaccuracies stems from the timing delays present in current Windows ™ operating systems thus affecting the accuracy of the time stamp placed in the file when the data arrived, compared to the actual time the reading was acquired. This affects positioning in real time using the Interpolator feature or using MagMap2000 Interpolation software in post processing.

The following are error sources considered here:

- Errors in cable measurements, including boat dimension measurements.
- Latency in the magnetometer to PC channel. Due to nature of the Windows ™ operating system, data arriving into the computer serial port is not immediately available to the application (MagLog). Data is delayed in the system serial driver and therefore the time stamp assigned to the data by MagLog can be delayed as well. Measurements showed that this delay typically does not exceed 20-100 ms depending on computer performance.
- GPS channel has the same source of latency as the magnetometer channel. In addition, GPS itself reports positions with some time delay due to Differential Position calculations which are typically around 50 ms.

These delays are dependent upon the hardware used during the survey. Therefore it is always wise to check positional accuracies before the beginning the survey if there have been hardware changes.

To test overall system performance a distinctive magnetic anomaly is required. It can be a natural or artificial source (just piece of magnetic metal on the ground will suffice). The task is to complete two precise survey lines in opposite directions over the source as quickly as possible (to minimize diurnal shift offsets).



After the magnetometer positions are calculated (in real time or in post processing), the two recorded anomaly profiles should match. If not (as shown above) the distance between the anomalies is a positioning error. The following rules apply in understanding and correcting these errors.

Assuming that there is no notable latency in the GPS and magnetometer channels:

- If you have to shift anomalies forward along survey line to match them, the cable (or antenna to sensor distance) is actually shorter by half of the distance between anomalies.
- If you have to shift anomalies backwards along survey line to match them, the cable (or antenna to sensor distance) is really longer by half of the distance between anomalies.

Assuming the cable length is correct, magnetometer and GPS latency issues dominate :

- Assuming magnetometer has no latency: if you have to shift anomalies forward along survey line to match them then the GPS has latency.
- Assuming GPS has no latency: if you have to shift anomalies backward along survey line to match them then the magnetometer has latency.

For marine surveys, the maximum allowable mismatch between anomalies is about 1 meter, depending on GPS accuracy.

Note:	This discussion does not cover possible internal GPS errors due to loss of satellites or differential signal.

15.2 Conducting Laboratory Latency Tests for Magnetometer Data Acquisition Systems

This document describes how to test the overall latency of the logging computer and software when engaged in recording and storing magnetometer data. Latency in this case is defined as the time difference between when the actual reading is taken and when it is time tagged and written to disk. There is concern about excessive latency because it translates into position errors visible during data processing (herringbone or scalloped anomaly structure).

There is virtually no latency delay between time the magnetometer takes a reading and the time it outputs the reading to its serial port. However, on the data acquisition side of the system, computers and their serial connections are handled by MS Windows operating systems (win9x, NT, 2000, XP, etc.), and thus data is not immediately available to the logging software because the data transfer is delayed by Windows serial drivers. This delay can lead to position errors because computer generated time stamps are used to interpolate the locations of the magnetometer.

Here is a simple method to estimate system latency.

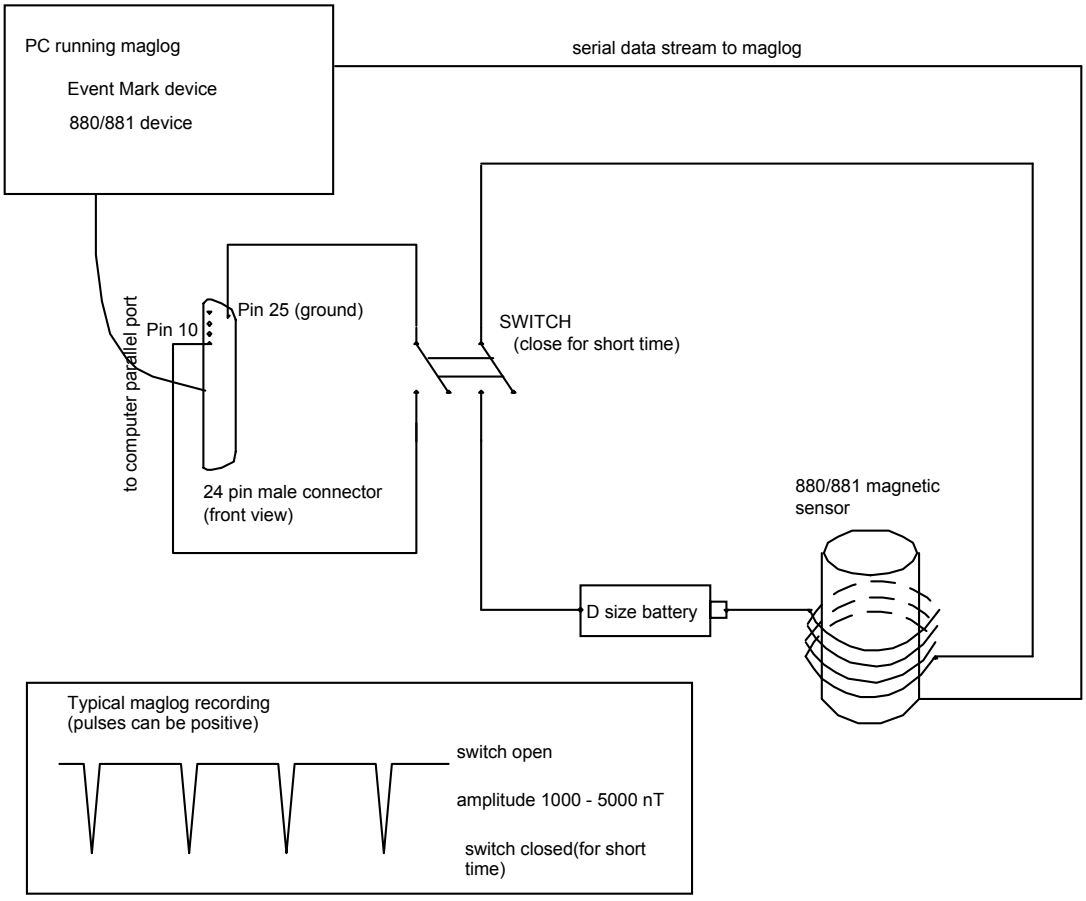
15.2.1 Hardware you will need:

- 880/881 magnetometer, cable, etc.
- Computer running MagLogLite or MagLogNT. The computer must have a parallel printer port.
- A few pieces of wire, total length about 10 ft.
- One D-size battery. It will be good to have a battery holder for it.
- 25 pin male connector to mate to computer parallel port.
- Double pole single throw switch to close two separate circuits at the same time.
- Soldering iron and solder

15.2.2 Assembly

We are going to make a switch controllable electromagnet to put timing pulses into the magnetometer sensor. Assemble the components as shown in figure below. Connect a fairly long wire to one terminal on the battery (polarity is not important) and then put few loops around the magnetometer sensor. Connect other end of the wire to one side of the single throw switch and then connect a wire between the other connection on the switch to the open terminal on the battery. Now when you close the switch, current in the loop produces a magnetic field that will be measured by magnetometer and recorded by MagLog software.

Magnetometer channel latency test

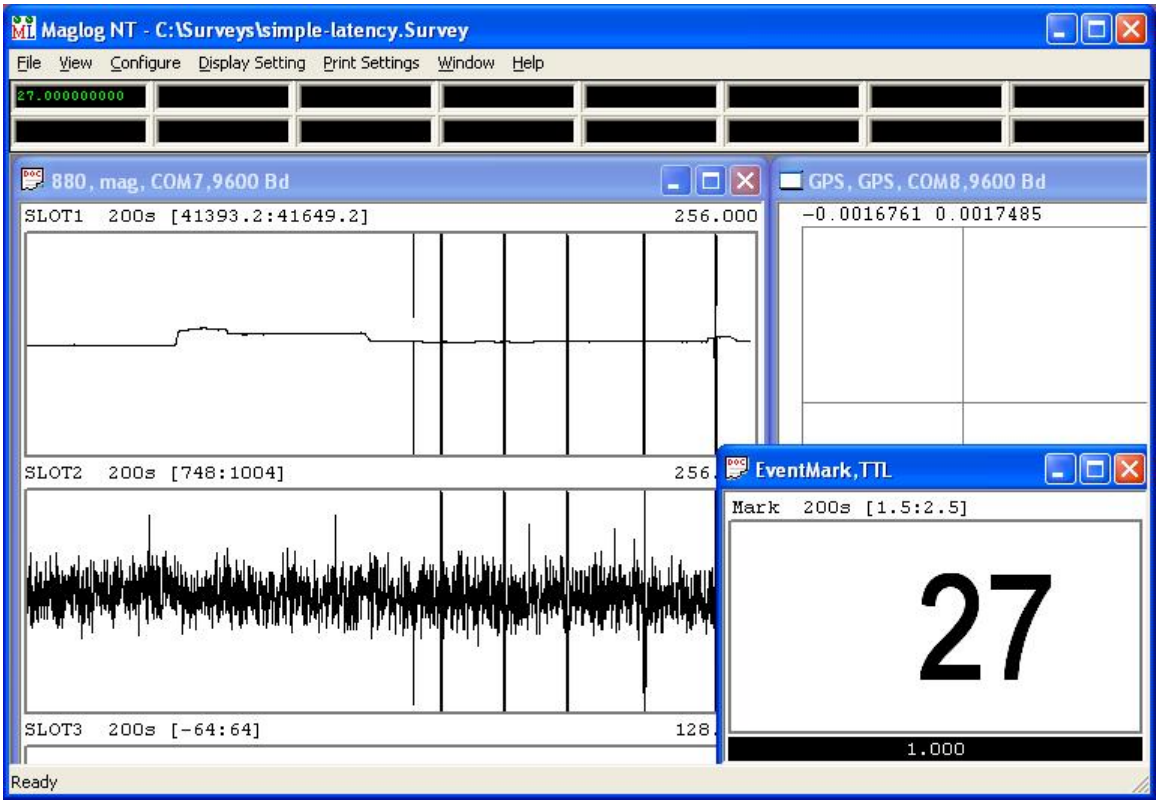


Solder pin 10 of the 25 pin male connector to one side the other pole of the switch and the other side of the switch to ground (pins 18 to 25 of the 25 pin D connector are industry standard specified to be ground on printer ports). Insert the connector into the printer port. By closing the circuit connection between pin 10 and ground on the parallel port you will generate a computer interrupt. The time of this interrupt will be recorded with the MagLog TTL marker device (you must add the MagLog TTL device to Input Devices in MagLog Configuration setup). This event mark and the anomaly produced by the current in the electromagnet about the sensor will demonstrate the latency in the computer/software interface.

15.2.3 Operation.

Start a MagLog survey as usual and add the "TTL Event mark" to the input device list. Make a display for the TTL event mark (screen shot is shown on figure below). Make sure that device is working by closing the switch and observing the result. Consult MagLog manual or contact Geometrics in case of problems. You may need to reboot the computer to set the correct parallel port mode in the computer BIOS. We suggest industry standard

ECP Printer Port. Note that Bi-Directional Printer Port mode will not work properly. Due to contact bounce, you may see two interrupts recorded, one when the switch is closed and other when it is opened.



Make these tests in a relatively quiet magnetic area and ensure that magnetometer is not in dead zone, i.e. that it is getting steady data when mounted in a fixed position and the impulse electromagnet windings are not energized.

When you close the switch for short period of time (as quick as possible, less then 1 second) you should observe spikes in the magnetic field profile. Spikes can be negative or positive. Typical amplitude would be around 5000 nT. When you see that magnetometer reacts to the switch closure, you are ready to perform the test.

Simply start MagLog data logging and click the switch a few times back and forth with an interval of about 20 seconds. Collect 10 events or so.

15.2.4 Analysis.

Two MagLog log files will be used in the analysis: magnetometer log file and TTL log file. Both files have recorded the time when the magnetic reading arrived or when the event mark occurred. Depending on what you named your survey, the files may be named *simple-latency.Survey.880.mag* and *simple-latency.Survey.EventMark.TTL.* Inspect the magnetometer log file with an ASCII editor. You will see records similar to the following:

```
$ 41538.806,0901 57  10/03/02 01:53:18.726
$ 41538.866,0835 57  10/03/02 01:53:18.826
$ 41538.825,0845 57  10/03/02 01:53:18.926
$ 41538.828,0840 57  10/03/02 01:53:19.026
$ 40417.202,0703 58  10/03/02 01:53:19.126
$ 34028.935,0569 58  10/03/02 01:53:19.226
$ 30035.559,0461 59  10/03/02 01:53:19.327
$ 33409.758,0610 59  10/03/02 01:53:19.427
$ 41338.322,0674 59  10/03/02 01:53:19.527
$ 41538.772,0759 59  10/03/02 01:53:19.627
$ 41538.806,0813 59  10/03/02 01:53:19.727
$ 41538.810,0854 59  10/03/02 01:53:19.827
$ 41538.806,0793 59  10/03/02 01:53:19.927
```

Look for a place where the column before date changes its value. This indicates a new event mark occurrence. In the example above, values “57”, ‘58” and “59” are event mark numbers (you will have different numbers). At “58” the switch was closed and magnetometer started recording a noisy field reading shift caused by the electromagnet field.

At “59” the switch was opened and the magnetometer returned to the normal field readings. Therefore in the above example there is virtually no latency. However, if the event counter has changed but magnetometer was still recording a steady field, there is latency in the system that will eventually appear as a position error in the survey results.

This latency can be removed spatially. Let us say that we detect an average latency of 40ms. Let us imagine we are traveling in a boat at 6 knots (about 10 ft per second). Then the amount of spatial offset is not much, maybe only a few inches.

However, let us say we are traveling in an ultralight aircraft at 60 mph (88ft/sec). Now 40ms latency will result in a 4 ft offset. Latencies in Windows operating systems can be as much as 100ms and thus this becomes an effective tool to improve mapping and target location.

16 Other Topics:

This section describes other topics not discussed above.

16.1 Password Protection

MagLog has a password feature that allows you to password protect your configuration settings. If an incorrect password is given, MagLog will block access to device configuration menus, and the user will only be allowed to log data.

The password is initially specified after the first series of device configuration screens. You will be asked for your password again if you exit and then re-enter the program.

The password dialog appears below:

If you enter your password and press "*OK*", the program will attempt to verify your password. If you press "*Cancel*", you will be allowed into the program, but you will be unable to change any configuration screens.

The password is part of the hardware configuration and will be copied to the next survey if you start a new survey and decide to use a previous hardware configuration.

16.2 Sample Files - Reading from Files Mode or DEMO Mode

This feature allows you to use a sample file instead of an incoming serial data string. The program will act as if a real-time data string were coming in – e.g., you can log your data, use the interpolator (if applicable) and set up device displays.

This feature is useful to learn the program and to replay data you have already taken although precise timing synchronization (and thus positioning) is not maintained. See Playback Mode in Chapter14 above.

This feature is set up through the "*Device Configuration*" screen. Our example will show how to set up a sample G-880 magnetometer file.

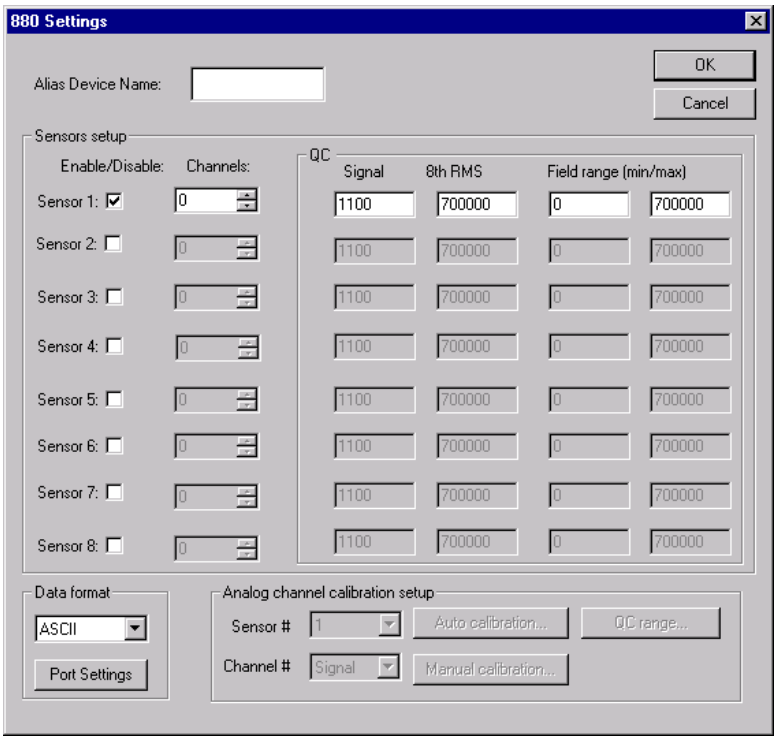
From your "*Input Device Configuration*" screen (accessed through the Configuration menu), add a G-880 magnetometer. (If you don't know how to do this, refer to chapter 2).

You should see the screen labeled "G-880 Configuration", and you will probably see an error message explaining that it cannot parse any incoming data streams. Since you do not want to use any hardware, press "*Cancel*".

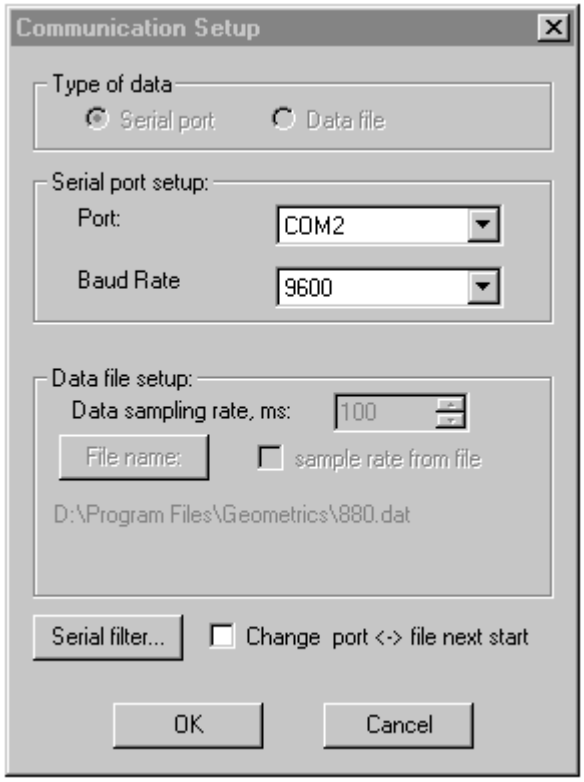
You will see a warning message similar to the message below:

Press "OK" to continue.

You should now see the "*880 Settings*" screen:



From here, press "*Port Settings*". You should see the following dialog box:



By default, this is set to use a serial port. To read data from a data file, select "*Data File*", and press "*File Name*" (under "*Data File Setup*") to select a file name.

The "**data sampling rate"** is how often you will read data from the file. That is to say, to simulate a magnetometer sending data ten times per second, you should use a data sampling rate of 100 ms. This option has a minimum time of 20 ms.

You could also use the **internal sampling rate**. This will look in the file, find out how often data was logged (using the internal time stamps), and read data from the file at the same rate.

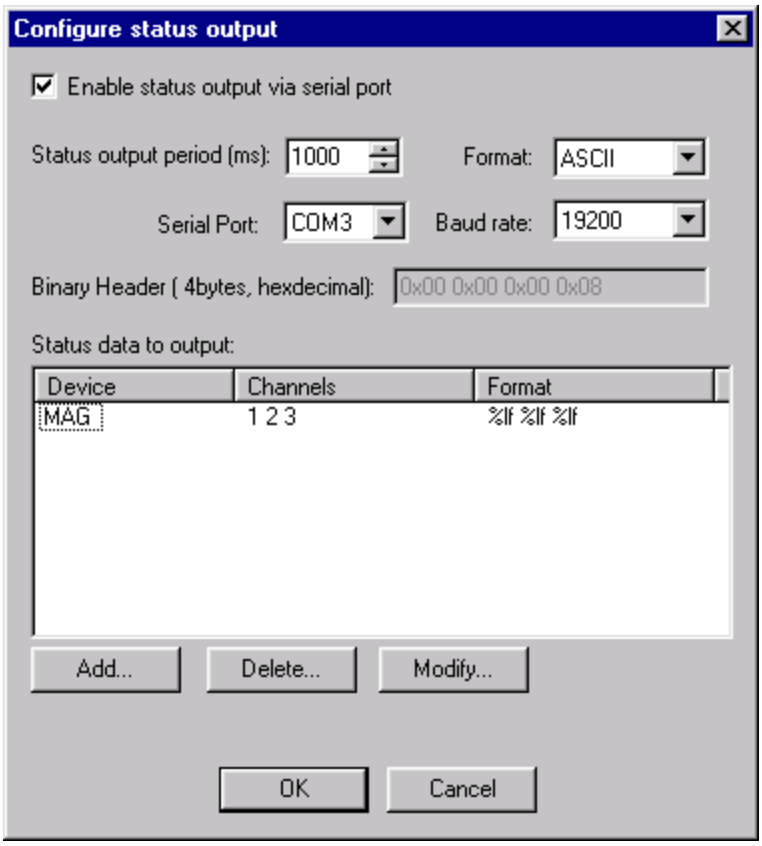
When you have selected your data file, press "OK", and fill out the rest of your G-880 parameters as desired.

16.3 Outputting status information for QC purposes.

This feature is typically used as a remote quality control device. For instance, let us say that we wish to remotely monitor the performance of the system via a RS-232 radio link. The MagLog system may be acquiring data at 100 or 50 or 10 times per second, but we cannot transmit all this data over a radio link as we are bandwidth limited. But let us say that we want to periodically SAMPLE the data being stored in order to verify proper operation and data integrity. In this case we set up an internal Multimedia Timer (a function inside Windows™) to periodically send a line of data out an available serial Com port for onward transmission to the control center. This may eliminate the need for a second person aboard the aircraft or land based survey craft (often referred to as the "operator".)

This feature is available in MagLog NT only (not MagLogLite).

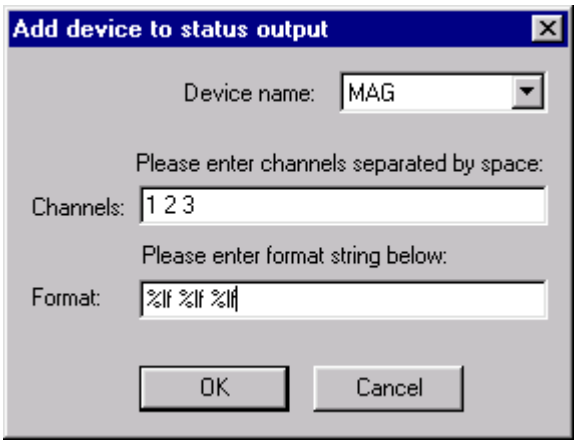
The option "Status" is available under Configure / Output Devices / Status. It retrieves the dialog box where the user will specify the following:



- **Status output period**, in ms. The program will run a multimedia timer with this interval and acquire data from MagLog devices for transmission out an available serial port.
- **Format:** ASCII or binary. In ASCII mode each device is represented by one string terminated with cartridge return. In binary mode all devices are sent as one binary parcel (see below). Format is the same for all devices.
- **Com port and baud rate**. Other parameters are" parity none, 8 bit data, 1 stop bit.
- **Binary header**, if binary output is to be used. The header consists of 4 user specified bytes. Bytes must be specified in hexadecimal notation (as 0xNN, where NN are between 0 to F) and all bytes must be set. It is recommended to use "-0" as a special header value. This value should not appear in any other data. For "-0" header is:

  0x00 0x00 0x00 0x80

  Note that the IBMPC uses LITTLE ENDIAN format, and therefore the sign bit is set in the last byte.
- **Status data to output list** This is core of the dialog. Use "Add..." , "Modify" and "Remove" buttons to populate the list. Pressing “Add...” or “Modify” calls “Add device to status output” dialog box below:



For each device the following information is needed:

- **Device name** (the same as on MagLog light bar)
- **Channels** to output in a space separated list. For example, GPS device has the following channels: 1 - Lon - 2 - Lat 3 - QC - 4 SV. Status list for this device may look like this:
  "1 2 4"
  The program will output Lon/Lat and SV. Order in the list is irrelevant.
- **Output format**. For ASCII mode, this is simply C language format for N double precision values. Only one format specifier is used - %lf. For example format string:

  GPS Lat:%.2lf Lon%.2lf

  will produce output like: GPS Lat: 30.02 Lon: -122.78 The program checks for proper format before accepting it. In general, N channels should match to N "%.[n]lf" codes. Here "n" is number of digits after the dot.
  In binary mode the program uses its own format codes, which are "D" for double precision, (8 bytes), "F" for float (4 bytes) "I" for int (4 bytes) "S" for short (2 bytes) and "C" for char (1 bytes). All formats are PC native formats. For example, GPS channel list "1 2 4" can be used with binary format string "DDC" which will output Lat/Lon as 8 byte floating point and the number of satellites as a character (it is unlikely that number of satellites exceeds 128). In this case total length for GPS data is 8+8+1 = 17 bytes.

In addition to the channels specified by user the following information isappended to the end of the string:

- number of error messages during status interval;
- number of samples during status interval.

These values are sent as integers in ASCII mode and as short values (2 bytes) in binary mode.

For the GPS device in addition to above 2 values, 5 values are appended: number of messages with GPS QC 0, 1, 2, 3, 4.

The entire data parcel in binary mode has the following structure:

1. Header (4 bytes)
2. Data parcel length (including header) - 2 bytes
3. Data for devices, in the same order as they are set in the configuration dialog.

16.4 Setting options through "Maglog.ini"

Some of the options specified in the file "*Maglog.ini*" are very useful. You can edit this file by navigating to your Windows NT directory and selecting the file "*maglog.ini*". The options you might find useful are:

1) Font: This describes the font used in the docking status bar. By default, it is set to 120.

2) Info Dialog: This is the dialog where you can fill in parameters such as your survey name. You can disable this by setting it equal to 0, e.g., the line in Maglog.ini should have:

   Info Dialog = 0

   It will be enabled if this is set equal to one.

3) Password Protection: This allows you to enable or disable password protection. If it is disabled, any surveys that were password protected before still will be protected. However, any future surveys will not be. You can enable it by setting "password protection" equal to one, and disable it by setting it equal to zero.

4) Demo: This will change the appearance of the "Port Parameters" dialog box when you set up a new device.

   Demo = 0: This does not allow you to use a sample file but you can specify a port from which to get data.

   Demo = 1: This allows you get data from a file only (pure demo mode).

   Demo = 2: This allows you to use a sample file or get data from a port.

5) Warning Increment: MagLog NT normally automatically increments the line number each time you stop logging. This allows you to change that behavior.

Warning Increment = 1 A dialog box will give you the option of incrementing each time you start logging.

Warning Increment = 0 MagLog NT will automatically increment the line number when you start logging.

6) Exit Windows: This will allow you to automatically exit Windows NT when you exit MagLog NT. By default it is set to 0, but it will automatically exit if you set it equal to one.

7) TimerCheckInterval: Controls timeout for every serial device to report "stop data flow" error. Time in ms.

8) Console window. If 1, DOS console window is started. All MagLog debug printout is going there. For developers only.

9) Windows98FontProblem . Some of the MagLog distributions had problems with True Type fonts under Windows 98. Setting this value to 1 causes MagLog always use system font for slot / map annotations.

10) KeithleyIntDevice. If one, CTM-10 card generates internal interrupts. If 0, output of CTM –10 is connected to one of the parallel ports.

11) ASCII symbol for degree. Decimal value for ASCII symbol to serve as a degree sign. In most systems this is 176.

12) [DEFAULT DEVICE BUFFER SIZES] These are variables that control the maximum history MagLog can acquire and display during survey. For instance if the GPS is sampling at10 times per second and GPSMaxSample=7200, then MagLog can display 720 seconds or 12 minutes of GPS position data. If GPS is sampling once per second MagLog can display 2 hours of GPS history. If the magnetometer is sampling at 10 Hz and 880MaxSample=2000 then maximum display slot duration is 200 seconds (if the user sets bigger value, the slot will not be completely filled with the data). The following variables control history length:

AADCMaxSample=2000
EM61MaxSample=2000
AnalogMaxSample=2000
DeviceMaxSample=2000
GPSMaxSample=7200
GR800MaxSample=2000

GR820MaxSample=2000
PPSMaxSample=2000
858MaxSample=2000
880MaxSample=2000
822AMaxSample=2000

17 Hardware Configuration

This section explains the basic installation procedure for the hardware on your machine. In case of a complete system failure, you would need to install each of these in sequence. For lesser problems, you can refer to the appropriate section:

17.1 Windows NT Installation:

NOTE: ***The following information is offered for example only. It contains references to specific computer hardware and accessories that may or may not be used by your system. In general, MagLogNT and MagLogLite will perform well on any Windows platform including Windows 98, 98SE, ME, NT 4.0, 2000 etc.***

You will need:

a) 3 each 1.44 MB Windows NT Workstation setup disks (bundled with your Windows software).
b) Your *Windows NT Workstation* CD ROM disk.
c) Your *Certificate of Authenticity* found with your Windows NT manual.

To begin:

1) Insert *Setup disk 1* into your 1.44 floppy drive. Then, reboot your computer. You should see a blue Windows NT screen appear when the computer begins to load from the disk.
2) When prompted, insert *Setup disk 2* in your floppy drive. You should see the computer load additional files for a while (A gray status bar at the bottom of the screen shows pertinent events).
1) You will be asked whether you want to repair a Windows NT installation, or install a new version of Windows NT. If your installation is severely damaged, you will probably want to completely re-install Windows NT.

Warning: depending upon the extent of your new installation, you may need to reinstall all of your programs and drivers. Make sure you have good backups of all data before continuing.

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4) To re-install Windows NT, press *ENTER*.
5) Insert *Setup disk 3* when prompted.

6) You should next see a screen that will give you the option of auto-detecting your devices. This will attempt to find CD ROM drivers, hard drive drivers, and other applicable devices. Press *ENTER* to let Windows NT attempt to automatically detect your devices.

Note: In rare cases, NT will not be able to detect your devices. In these cases, you will need to manually select your devices, which will involve going through the installation procedure again. The devices that it should automatically detect are:

a) IDE ATAPI PCI Controller

b) Adaptec AHA 294X /AHA 394X/AIC78XX SCSI controller.

---

7) After this is finished locating these, it will ask you to verify whether the devices found are correct. If they match those listed above, press *ENTER*. Windows NT will finish loading necessary drivers.
8) Insert *Windows NT Workstation* CD when prompted. Be sure to remove your installation disk from the disk drive. Wait a few seconds and then press *ENTER*.
9) Windows NT will next show a licensing agreement. You can proceed by using the *Page Down* key to get to the bottom of the license agreement, and press *F8* to continue.
10) In some cases, you might be told that setup has found Windows NT on your hard disk. This will happen primarily when you are overwriting an old installation. You can choose *ENTER* if you wish to try to preserve existing settings (note: this will probably NOT fix problems with device drivers, and corrupted program installations.)
To completely overwrite all of your old Windows NT settings, press *N*.

THE FOLLOWING ASSUMES A NEW INSTALLATION (OPTION N):

11) Setup will give you a list of optional keyboard layouts. You can press *ENTER* to edit these, or accept the default. NOTE: You can later change (or add) new keyboard and mouse settings from within the Windows NT Control Panel.
12) You then are given options for creating and deleting disk partitions. It is usually beneficial to keep existing partitions. To install Windows NT on a selected partition, press *ENTER*.
13) You will now be given the option of formatting your selected partition using FAT, NTFS, or leaving it alone. Any formatting will remove all data, so it is advised to select the option: "*Leave the current file system intact (no changes)"*.

Note: If you do select formatting, the type of file system will affect what kinds of things you can do with your computer.

** FAT is compatible with Windows 95, DOS, and Windows 98.

However, it is not as efficient in managing hard disk space as the NTFS system.

** NTFS is not compatible with Windows 95, DOS, and Windows 98. It is beneficial because it allows you to keep one hard drive, rather than having to make smaller partitions to make the best use of your space.

14) After you have made your selection, Windows will ask for the installation directory. A good default is *WINNT*.

15) You may be asked again if you want to completely overwrite your previous installation. If you do, press *ENTER*.
NOTE: If you are not sure, sometimes it is beneficial to create a new Windows NT installation by using a different directory name, and then deleting the old installation when you are sure that your new one will work.

16) You are given the option to perform an exhaustive examination of your hard disk. This usually takes a long time, and sometimes yields useful information. It is usually safe to skip it by pressing *ESC*.

16) You should now see setup copy files to your hard disk. It should do this for about five minutes. After this has completed, you will be prompted to remove all disks from your computer. It will automatically reboot.

17) When prompted, insert your *Windows NT Workstation* CD and press *OK*.

18) The next screen should give you an overview of the different parts of the setup process. To continue, press *Next.*

19) Select the type of installation you prefer. You can always add new features later when needed. If you prefer to customize your installation, you can go into custom, and manually select the features you need. The following assumes you select *typical.*

20) Enter a name and organization.

21) The next screen will ask for the Product ID number. This is found on the certificate of authenticity, which is located on the top page of your Windows NT Workstation manual.

22) You can then enter a computer name and on the following screen, a password.

23) You will then be given the option to create a repair disk. This can also be done later using an RDISK utility, when you want to save a lot of program settings as well.

24) The next screen gives you the option of installing components. New components can be installed later from the control panel. After selecting, you enter the *Windows NT Networking* by pressing *Next.*
25) The default configuration for this computer is: "*This computer will participate on a network"* → *"Wired to the network"*. This is true if you have a network adapter card, such as the 3Com Ethernet card sold with the computer.
26) Press *Start Search* to start searching for your network card. It should locate *3 Com Fast EtherLink XL Adapter (3C905).* Press *Next* to continue.
27) Select : *TCP/IP Protocol* and *NetBEUI Protocol.* Select *Next* to continue. You will be given the option to dynamically find a TCP/IP address from a D*HCP* server. Select *No.*
27) You should next be prompted to enter an IP address. If you know you have a TCP/IP address to connect to an outward network, enter it. Otherwise, any number should do for a local network. For everything else, take the defaults.
28) You may be prompted to pick a proper Internet host name. This is the name that your computer will be called over the network.
29) The next option allows you to choose whether your computer is a member of a workgroup or domain. Select *WORKGROUP.*
30) Press *Finish* to complete your setup.
31) The next option allows you to select your date and time, and time zone. You can make changes as needed (or later from your control panel).
32) The Dis*play Properties* dialog box allows you to select the type of display you have. If you want to try a display with a higher resolution, or more colors, it is good practice to test your settings first. This will allow you to fix it if you select incorrect settings.
33) You should then see setup copy more files and save its configuration. When prompted, remove the *Windows NT Workstation* CD ROM, and restart the computer. YOUR INSTALLATION SHOULD NOW BE COMPLETE.

17.2 Installation of Digi Adapter: (Optional)

1) Insert the *Microsoft Windows NT 3.51 and 4.x Digi disk* in your floppy drive.
2) Go to the Windows NT control panel.
   a) From your start menu, select *settings.*
   b) Select *Control Panel.*
   c) Select *Network.*
3) Select the *Adapters* tab. You should already see your 3Com adapter selected. If you haven't installed networking, refer to the Digi Software Manual for further instructions. Otherwise, select *Add.*
3) Click *Have Disk* and select A:\i386.
4) From the list of adapters shown, select: DigiAccelePort 8r 920 (ISA) Adapter. The setup should then install the appropriate drivers.
5) You will be asked for an I/O Base Port address and Memory Base Address. If your jumper settings on the back of the card (seen from the back of the computer) match with the settings shown on the picture, it is okay to use the defaults. Otherwise, refer to the deeigiPort Manual.
6) Click *OK* on the next window to continue.
7) You need to restart your computer for the new settings to take effect.

17.3 Installation of MagLog NT:

1) Insert your MagLog NT installation disk into your floppy drive.
2) Type a:\setup.
3) The MagLog NT installation will ask you the installation directory. To keep the default: C:\Program Files\Geometrics, press *Next,* or press *Browse* to continue.
4) You also have the option to create a program group in your start menu. Press *Next* to continue. MagLog will then copy needed files to your hard disk.
5) You will need to restart your computer for the new settings to take effect.

17.4 Installation of Printrex Printer (Optional):

In order to be able to print from Windows, you need to install a printer:
1) Go to your Start Menu. Select *Settings -> Control Panel ->Printers.*
2) Select the *Add Printer* option.
3) The next dialog box should ask you where your printer would be managed. Select *My Computer.*
4) Check *LPT1* as the port you would like to print to and press *Next.*
5) You will now be asked for the installation disk. Click on *Have disk*.
6) Then, type in the path where the installation files can be found: namely a:
7) Select *820DL: 1.6 ips.*
8) Type in a printer name.
9) For the sharing, select: *Not shared.*
10) You will then be asked to insert the *Windows NT CD ROM* and press *OK*.
11) It will try to copy files from f:\i386. When installation is completed, you will see an icon of your printer appear in the *Printers* dialog box.

17.5 Pulse drivers in MagLog distribution.

17.5.1 Windows NT

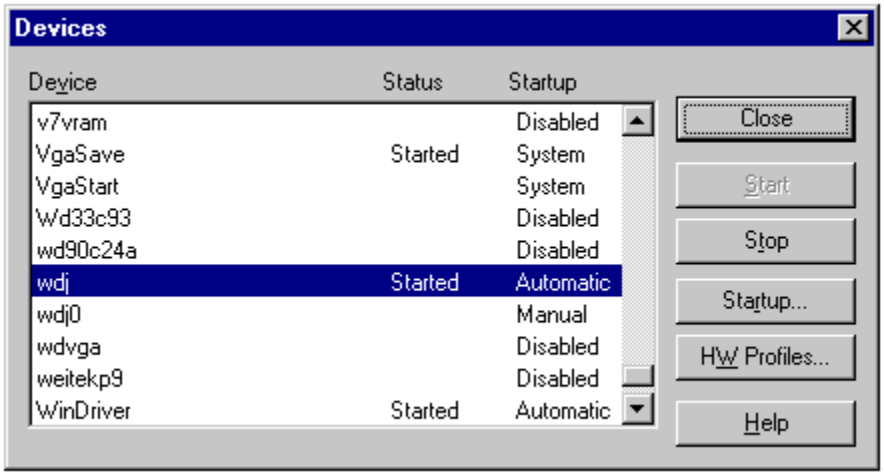
MagLog comes with next drivers available under Windows NT operating system:

- `wdj.sys:` This driver handles TTL pulse which can be connected to LPT1. It is also used to obtain time stamps for all data streams when program is running under Windows NT. If for some reason this driver did not start, you see next message after you start MagLog.

This means that you cannot use pulse devices with Geometrics parallel port driver. However it is still possible to work with the DRVX28 driver, which however gives less accuracy.

- `wdj0.sys:` Analog wdj.sys but to handle LPT2. Also can be used to log trigger pulses if internal CTM-10 interrupt is disabled (additional wiring between CTM-10 and LPT2 required).
- `kei.sys:` Driver to control CTM-10 card (if any). If this driver not started on improper configured you get next message when trying to start trigger device:

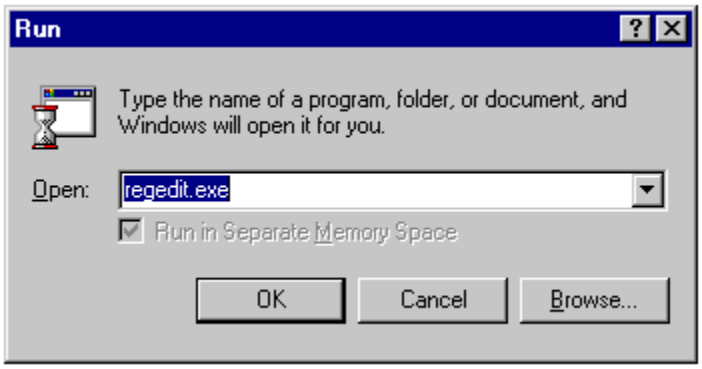
All driver files located under C:\WINNT\SYSTEM32\DRIVERS and have their parameters in the Windows Registry. To check if drivers are started you can use "Devices" applet from Windows Control Panel:



Here we can see that **wdj** driver started, and wdj0 not. By means of this applet you can start and stop drivers. Typically after you change driver's parameters in the Registry you have to restart it or by rebooting PC, or by stopping and starting driver by means of "Devices" applet. You also can check if DRVX28 started.

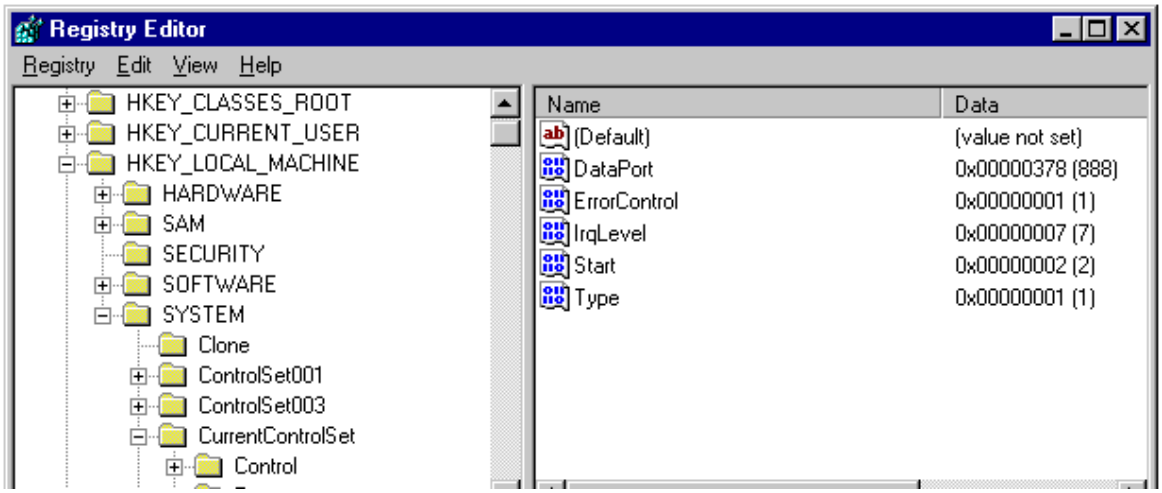
Note: Be careful stopping and starting drivers while system is running. NEVER do it when MagLog is running – it will crash the system.

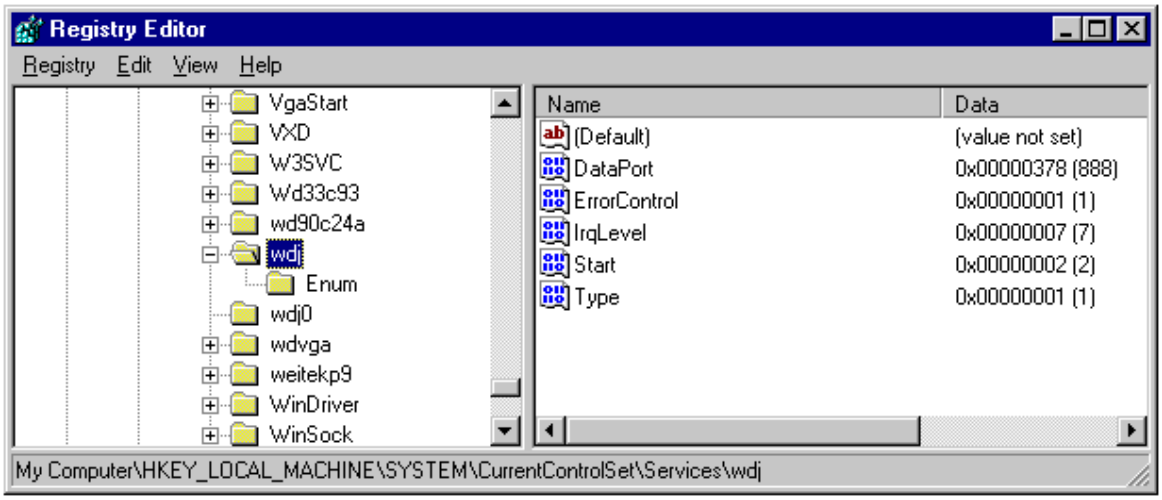
To change driver's parameters toy should use **regedit.exe** program that is part of standard Windows distribution. Be careful using this program and don't change values you don't know. To start **regedit.exe** go to Windows "Start" menu, then "Run" and type regedit.exe as it is shown below:



Then locate driver's entry. They are located at:
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\kei
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\wdj
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\wdj0

For example for wdj.sys driver:





Consult with your PC manual to find out which IRQ and port number your parallel port is using. If you are using ISA parallel port extension card (PCI extension won't work) then you can set these parameters by means of switches on the card. Then go with **regedit** and set correct parameters in the registry (DataPort and IrqLevel). Note that **regedit** is using hexadecimal format by default.

If you set IrqLevel > 15 (decimal) wdj and kei drivers won't react to interrupts. However wdj still can be used to obtain time stamps.

For CTM-10 card IRQ level and port are set with switches on the card. Write down these parameters and set them into the Registry. Avoid conflicting with other devices.

Here are the most important pins of the main CTM-10 connect. Consult CTM-10 manual for other connectors.

Pulse outputs:

counter 1:	ATOUT1: 35	GROUND: 38
counter 2:	ATOUT2: 33	GROUND: 32
counter 3:	ATOUT3: 31	GROUND: 32
counter 4:	ATOUT4: 30	GROUND: 32
counter 5:	ATOUT5: 28	GROUND: 26

Counter inputs:

counter 1:	ACIN1: 23	GROUND: 26
counter 2:	ACIN2: 22	GROUND: 20
counter 3:	ACIN3: 25	GROUND: 26
counter 4:	ACIN4: 29	GROUND: 32
counter 5:	ACIN5: 36	GROUND: 38

If you are using counter for pulse generation you cannot use the same counter for wheel tick input.

17.5.2 Windows 95/98.

Above drivers don't work under Windows 9x and to log Event Marks MagLog uses win95 version of DRVX28. Installation script sets it up for you; driver started after you reboot computer during installation. Port address and IRQ in this case are set within MagLog. Just in case of trouble you may check that registry entry:

HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\DRVX28\Parameters\MLm

exists and is set to the "default" value.

Note that event marker won't work if parallel port is in bi-directional mode. It can be changed via BIOS setup program or by means of switches on the ISA parallel port extension card.

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