

# DASCOR DATA LOGGER

SERIES MOD-1A  
and  
Software Final Release  
M1A-v30

## OPERATORS MANUAL

**PREPARED  
BY**

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## 1 Notes for Release M1A-V30

The M1A-V30 release of the DASCOR Data Logger Software is designed to work specifically with DASCOR Data Loggers that have been upgraded to the M1A Hardware Version. Operation with older loggers that have not been upgraded is not guaranteed, and may cause loss of data. With this hardware and software release, all known issues have been resolved, and the M1A-V30 release of the software is considered to be the final release.

The Appendices contain images and detailed descriptions of all of the user interface screens, and should be treated as the final authority on the V30 release. The manual text, although detailed, does include material from earlier software releases.

One of the most significant changes with the V30 release is the ability to access this manual on-line by using the Help menu items on the software screens.

NOTE: the Data Logger label and *Data Logger* tab will clearly identify the logger as being a MOD-1A type, and the serial interface connector will be black plastic and located on the side of the Logger.

## 2 Getting Started Checklist for MOD-1A

The following section is a quick review of the basic operation of the MOD-1A Data Logger. It is recommended that you review this manual in detail, and become familiar with the various screen functions described in the Appendices.

Load the software onto the PC, and initialize the default data path and Comm port, and enter any required passwords (optional for access to the *Calibration* tab) using the *Defaults* tab.

### 2.1 Connecting the System and Signing On

The Serial Interface Adapter (SIA) should be connected to the host PC using the 9-pin Serial cable supplied. Standard DB-9 “Mouse Extender Cables” may be placed in series if a longer length is needed. 25 feet is the upper limit. The power adapter supplied (15 volt DC, center positive) should be plugged into an outlet, and the power cable plugged into the SIA. Check the power LED on the SIA to be sure that power is on.

The MOD-1A Logger is connected to the SIA using the attached cable with the small circular connector. Lift the rubber seal on the logger to expose the connector and insert the plug end of the cable into it. The cables are polarized so that they can only be plugged in correctly. Please note that two types of connectors may be used depending on the model variant. Loggers for use with the Micron DBST Sensors will have a Hirose Push-Pull type of connector, while other models will have an Alden push-on/twist-off type. For both types, the connector is oriented so the keyways are aligned with the receptacles, and then pushed in until a click is felt or heard. The Alden’s may require slightly more force to seat the sealing ring. When properly connected the alignment arrow will match the tab on the receptacle.

The Hirose types are removed by holding the shell of the plug and pulling straight out. The Alden type is removed by gently rotating the holding ring about 1/8 turn in the direction indicated by the arrow on the housing and gently pulled off at the same time. Neither connector requires any force to connect or disconnect, and neither connector twists off or unscrews. If you feel excessive force is required, check the alignment of the keyways, look for bent pins, or for dirt or other obstructions in the receptacle or plug. DO NOT FORCE the connectors!

On successful connection, the Software will read the logger information and display it on the PC. If the SIA is not connected, the power is not applied, or the SIA has not been upgraded to operate with this release, a message box may pop up indicating a problem. Please see the Appendices for details.

A more detailed top drawing identifying the various components is provided on the distribution CD. Please note that the connections between the PC, wall power module, and MOD-1A loggers are virtually identical with older versions except for the shapes of the SIA modules and connectors.



This is a standard configuration for the MOD-1A loggers. The wall-mount power supply would be plugged into a wall socket and the small cord would be plugged into the SIA module. The 9-pin connector cable would connect the SIA module to a COMM Port on the PC, and the remaining cable would plug into the I/O socket on the logger module.

### 2.2 Initial Calibration

If the calibration data for logger and sensors being used has not been loaded into the logger, please go to the calibration section of this manual and follow the detailed procedures given there. There is an optional password for the *Calibration* screen, which may be assigned by the system administrator using the *Defaults*

tab. If a password is required, you will be required to enter only once per session on the first time attempt to access a calibration screen.

### 2.3 Setting Up a Test

First, be sure that a NEW battery is installed in the logger. Connect the logger to the PC via the SIA. *Download* any test data in the logger from a prior test. Next, go to the *Setup* tab after the logger information is displayed, and then:

1. Select the number of channels to be logged.
2. Enter the time interval, and click on the *Seconds*, *Minutes*, or *Hours* button. Verify the maximum number of scans and logging duration in the *User Message Area*.
3. Enter up to 64 characters in the *Project Identification* field.
4. Print the screen and optional notes, if desired.
5. Initialize the logger. If data is on the logger from a previous test and has not been downloaded during the current session, then you will be offered the opportunity to download the data, or bypass the download and initialize the logger anyway.
6. Follow the directions to disconnect the Logger and wait for the first flash of the LED to verify independent operation. Then reconnect the Logger to reload the display and verify that all the setup parameters are indeed correct.
7. Finally, disconnect the logger and deploy it.
8. There is an option to delay the actual start of logging by shorting the “remote start” pin in the SIA connector to ground by means of inserting the “Remote Start” plug. The logger will not log data while this plug is installed. Use of the remote start plug will not change the scan rate, but will invalidate the date and time associated with the first scan.

### 2.4 Downloading Test Data

1. Connect the logger to the PC via the SIA.
2. Review the data on the logger that is displayed in the *Data Logger* tab.
3. Press the *Download* button to start the download process. The data will be stored to the default download path set in the *Defaults* tab, and a unique file name will be generated, based on the host PC's location code, and the date and the time. This information is displayed on a screen common to most windows' applications, and may be modified as desired. Press OK when the path and file name are acceptable.
4. Download progress will be shown on the Data Logger tab as a progress bar. Downloading occurs at about 500 characters a second. With a 64K memory, downloading can take several minutes.
5. When download is complete, you may proceed to another task by selecting the appropriate tab, or unplugging the logger from the SIA. The logger will also be in the low power/stop mode at this time.
6. The data, time, and download file name will be displayed on the *Data Logger* tab.
7. Two files will be created with the same name. The .CSV file is in the standard “Comma Separated Variable” format, which is readable by almost every spreadsheet or data analysis program. The .RAW file is an image of logger memory and is available for analysis in the event of lost or corrupted .CSV files.

### 2.5 Observing Real Time Data

By selecting the Real Time tab, and selecting the appropriate commands, data may be rapidly taken by the logger and displayed in numeric or graphic format on the PC. This function is useful for checking the operation of sensors, generating or verifying calibration, and visually tracking data. Details on the screens, the commands, and options are given in the appendix A.

To utilize the high-speed features of the RT screen, the data logger must be stopped. However, it is possible to bypass stopping the logger and simply monitoring data as it is acquired and stored by the logger. In this case, the RT screens will be updated at the scan interval set into the logger—which could range from seconds to hours.

## **2.6    *Signing Off***

When you are done with all logger operations, select the *Log Off* tab, then click on the *Exit* button to shut down the program.

## 3 Theory of Operation

### 3.1 Overview

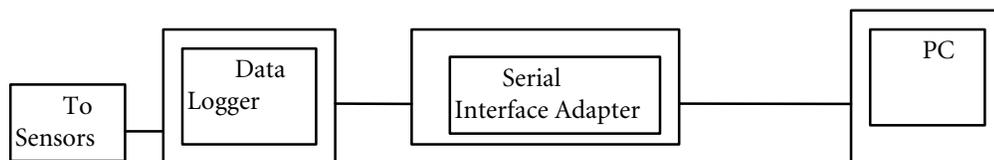
The Data Logger records from one to eight channels of information from connected sensors. Sampling rates are user definable from once per second to once every 18.2 hours. The Data Logger operates from a self-contained 9-volt battery and is totally autonomous once the Data Logger setup information has been uploaded to memory. Standard memory options vary from 16K to 160K. Data is retained even if power is lost. The Data Logger is designed to operate within a temperature range of -40 to +85 degrees Centigrade (-40 to +185 F.) if suitable batteries are installed. Loggers have been accidentally exposed to temperatures as high as 150-200 degrees Centigrade and continue to operate with little or no detectable shifts in the calibration. The battery, however, usually dies almost immediately at the elevated temperatures, which will generate a *low battery* fault condition before the logger stops completely due to lack of adequate power.

The Data Logger is contained in an aluminum NEMA-4 housing (Bud AN1301), normally powder coated to the User's specifications for corrosion resistance. A Serial Interface Adapter (SIA) provides the interface between the Data Logger and the host computer. A 9-pin "D" connector plug on the SIA connects via cable to a serial port on the host computer. A second 6-wire cable connects the SIA to the Data logger via a receptacle on the logger.

The eight channel Data Loggers set up for DBST style sensors have four 7-wire connectors mounted on the surface of the case to connect with four dual channel external sensors. Other variants will have different connector sets.

Power is supplied to the Serial Adapter unit from a 115 volt AC to 15 volt DC wall mount converter. Once connected to the SIA, the Data Logger is removed from internal power for downloading and uploading information. Refer to the diagram below for a connection block diagram or the Calibration setup Appendix for detailed photographs.

The Data Logger program operates on IBM compatible computers using the Windows operating system. Once started, the user may use the [tab] key, [enter] key, or mouse to move between tabs/options. The Data Logger is programmed by connecting the Data Logger serial port to a PC running the Data Logger software. Data is transmitted between the data logger and the host computer at 9600 baud. Data files are downloaded in both a "raw" memory image archive format file, and ".CSV" comma separated variable file format which can be input by most spreadsheet programs for data manipulation.



#### 3.1.1 Channels

The number of installed channels in the Data Logger is dependent upon the Data Logger model purchased. Current models provide from one to eight channels. The number of active channels installed in a given Data Logger is presented on the "Logger ID" tab. Users have the option of determining how many of the installed channels will be active. This feature is provided by a row of push buttons on the "Set Up" tab. The number of active channel buttons displayed is limited to the number of channels installed in the Data Logger. Active channels always start with the first channel and count upwards. It is not possible to select random channels or provide a scan list with the M1A logger.

### 3.1.2 Memory

The Data Logger uses EEPROM memory. This results in retention of data even after battery power is lost. The amount of memory installed in a given Data Logger is presented on the *Data Logger* tab. Current Data Logger models range from 16K to 160K bytes, with 64K being the default.

### 3.1.3 Rate

The Data Logger can record data from once every 18.2 hours to once per second. Models with faster scan rates are in development. The Data Logger utilizes a “burst” mode to sample the active channels to minimize skew between channels. It is not recommended to sample faster than once every 5-10 seconds if possible, as communications with the PC can be erratic, and the time base in the logger is subject to increased jitter.

In order to verify that the logger is in fact taking data when it is disconnected from the SIA, the first scan can be delayed by a *delay in seconds* set on the default screen. This allows the logger to be set up, disconnected from the SIA, and to have the LED blink on the first scan after a reasonable interval where the operator can observe it.

In cases where a fast scan rate is required, but there will be an unknown interval between setup and the desired start of data taking, the SIA socket has a pair of pins designated for *Remote Start*. When this pin is shorted to ground using with the insertion of the *Remote Start* plug, the logger will not take data. The logger will not log data while this plug is installed. Use of the remote start plug will not change the scan rate, but will invalidate the date and time associated with the first scan.

From an intrinsic safety standpoint, the absolute maximum voltage that will appear on this pin is the battery or external power supply voltage less one diode drop—typically this is 9 volts or less. Current is resistor limited to a few micro-Amps, and there is no capacitance in the circuit.

### 3.1.4 Environment

#### 3.1.4.1 Temperature Limits

The Data Logger electronics are designed to operate within the temperature range of -40 degrees. to +85 degrees Centigrade (-40 to 185 degrees F.). Limits on the battery installed in the logger will, however, restrict the total operating temperature range to that of the battery. Temperature also affects the available power from the battery—and thus its life—and should be considered when selecting batteries and setting up the test parameters. Loggers have been inadvertently exposed to temperatures in excess of 150 degC and have continued to operate successfully no damage other than the loss of the battery.

#### 3.1.4.2 Humidity

The MOD-1A series Data Logger is designed to operate from 0 to 100% humidity, non condensing, when operating as a stand-alone unit, with the Nema-4 enclosure intact. If operation in regions of high humidity are anticipated, freshly activated de-humidifier packets should be included in the case with the battery.

## 3.2 Physical Characteristics

### 3.2.1 Dimensions

The MOD-1A series Data Logger units are approximately 2.5 by 2.25 by 2.5 inches excluding connector protrusion. The Center of Gravity is within 1/8” of the center of the box, looking at each face. The enclosure is manufactured by BUD, P/N AN1301.

Other sizes are available by special order.

### 3.2.2 Weight

The MOD-1A series 8-channel Data Logger weighs approximately 230 grams in the aluminum enclosure configuration, including the battery.

### 3.2.3 Power Requirements

9-volt batteries are used as the source of power for the M1A loggers. A lithium battery is recommended for both long life and safety considerations. High quality alkaline batteries will give good service at lower cost when shorter intervals between changes and their failure modes can be tolerated. It is **STRONGLY** recommended that new batteries be installed at the beginning of tests, which cannot be repeated easily due to their expense in set-up or duration. Batteries are very inexpensive compared to potentially lost data. Remember to reset the battery-installed date as well.

When connected to the Serial Adapter Unit, powered by a 115v AC to 15V DC wall unit, the Data Logger will operate off the external power as long as external power is higher than internal power by about 1.6 volts. This conserves internal battery power during upload and download operations. It also enables continuous on-line logging, if desired.

The logger may be run with external power. Please contact the manufacturer for more information.

Sudden loss and rapid return of power will cause a "Power On Reset" condition, which will be reported on the logger data screen. Logging will continue with accurate data being recorded, but the time base will be corrupt for all data logged after the error occurred. This is different than a low battery error, in that the battery has been disconnected and reconnected, rather than being used up. With a battery low condition, data taken after the battery passes its lower limit may be seriously corrupted.

**NOTE that changing the battery may cause the loss of the logger setup information. Data should ALWAYS be downloaded prior to changing batteries.**

## 3.3 Software Description

The software is provided as a self-installing program for Windows™ based IBM compatible personal computers. Once the program is installed, all communications with the Data Logger are performed by input to text boxes or selection of command buttons contained on the tabs. All required functions to setup, operate, maintain, and download the Data Logger, are provided by the Data Logger software. The user may move from one function to another through the use of the [enter] key, [tab] key, short cut keys or mouse. The shortcut keys consist of the [Alt] key and the underlined letter on the desired tab. The program is designed to run on an IBM compatible computer running the Microsoft Windows 2000 Pro™ operating system. The Data Logger program was developed using Microsoft Visual Basic Version 6™.

### 3.3.1 Windows 95 and 98 and XP

Versions prior to M1A-V30, and operating systems other than Windows 2000Pro are NOT supported, although the software is believed to be stable on most installations of XP, Windows NT 4.0 or later, and on Windows 98 Release 2. Operation on Dell computers has been frequently reported to be unreliable, and use on Dell computers is not recommended or supported. Problems with installations on computers running XP will be handled on a case-by-case basis.

## 3.4 Installation

The software is provided on a CD, along with copies of this manual, and other useful Utilities. Please consult the README.TXT file in the root directory of the CD for current installation and setup information, as well as known bugs. Further detailed information is given in *the Installation and Documentation CD* section.

### **3.5 Version Information**

This manual is intended for use with the program *Data Logger M1A-V30* ONLY. All screens were drawn from this version. Prior versions are different, but the overall concept has remained the same and it should be possible to move from older versions to the current version with a minimal learning curve.

## 4 Operator Tasks

### 4.1 Overview

The user programs the Data Logger by selecting the tab associated with the desired function. The tabs that appear when the program first starts are the *Log-On* and the *Defaults* tabs. The *Log-On* tab enables the user to log on to the system and perform all normal logger functions. The *Defaults* tab enables a user to select the default Comm port to be used by the computer to communicate with the Data Logger, the default file storage path, and other optional features. Successful log-on results in the system verifying that it is communicating with the Data Logger and displaying Data Logger identification information on the *Data Logger*. Download data capability is provided by a command button at the bottom of this tab. The user may then proceed to the *B* tab to input new Data Logger setup information or to any of the other tabs to select auxiliary functions. Prior versions allowed for three passwords with protected levels of access, which have been removed on this release. Prior to delivery, logger I. D. and sensor calibration data is up-loaded to the Data Logger memory. This information is subsequently displayed to the user on the *Data Logger* and *Cal Data* tabs. The various Tabs and the controls contained therein are shown in the Appendices, along with summary information on their use.

### 4.2 Tabs

#### 4.2.1 Log-On Tab

The *Log-On* Tab enables the user to gain access to the system. Upon successful log-on, the appropriate tabs become visible and program variables are set. The individual data elements that appear on the *Log-On* tab are described below. The *Log-On* tab will automatically load the *Waiting* tab, after which the logger setup is loaded into the user's PC memory. Upon successful log-on, the title of the *Log-On* tab changes to *Log-off*. To exit the program the user returns to the *Log-Off* tab and selects the *Exit* command button.

Also shown on the *Log-On* screen are the current date and time from the local computer, and the GMT (Greenwich Mean Time or UCT) based on the time zone information entered into the *Default* tab. Selecting this item terminates the program and returns the user to the main window.

#### 4.2.2 Waiting Tab

This tab is displayed while the program is waiting for a Data Logger to be plugged in. Once connected, a progress bar is displayed while the Data Logger downloads header information. If communication could not be successfully established with the Data Logger, an error message is displayed advising the user to check the connections. Upon completion of header download the *Data Logger* tab is displayed.

If the information in the *Data Logger* tab needs to be updated, the logger should be disconnected and then re-connected. Following initialization, this step is required to allow observation of the first LED blink which verifies autonomous operation, and forces a reload of the setup information for further verification of the setup.

#### 4.2.3 DATA LOGGER Tab

The *Data Logger* tab identifies the specific Data Logger that is connected to the PC. The individual data elements that appear in the *Data Logger* tab are described below. All fields are "read-only"--except where noted. Otherwise, data displayed is set at the factory and the user cannot change the displayed data. The data shown is retrieved from the Data Logger memory upon connection with the PC. Initial logger ID data is loaded by the factory prior to shipment. Advisory Messages and Current Set-Up information is derived from data currently stored in the Data Logger memory.

This screen is also updated after every initialization, and can be updated on command by clicking the lower left box in the status bar at the bottom of the open window. Several boxes will change color depending on the data contained and its importance to test status.

#### **4.2.3.1 Model Number**

Identifies the Model Number.

#### **4.2.3.2 Serial Number**

Identifies the Serial Number.

#### **4.2.3.3 Header Version**

Identifies the Header Version.

#### **4.2.3.4 Firmware Version**

Identifies the Firmware Version.

#### **4.2.3.5 Memory Installed**

Identifies the quantity of memory installed in bytes. Divide this number by two to get the number of possible data points. The number of data points may be divided by the number of active channels to get the maximum number of scans. Dividing the maximum number of scans into the total logging time will give the scan interval.

#### **4.2.3.6 Installed Channels**

Identifies the number of installed channels. (i.e. the number of channels physically present in the logger.)

#### **4.2.3.7 Active Channels**

Identifies the number of currently active channels. This information can be changed by the user on the *Set-Up* tab, and is limited by the number of installed channels.

#### **4.2.3.8 Resolution**

Identifies the data resolution in bytes. This will always be 12 bytes for the Mod-1 loggers.

#### **4.2.3.9 Battery Change Date**

Identifies the date the battery was last changed. The user can enter the date of battery replacement on the *Cal Data* tab.

#### **4.2.3.10 Project Information**

Identifies the Project Identification information. The user can enter this information on the *Set Up* Tab.

#### **4.2.3.11 Termination**

Displays message describing conditions that affect the data and/or time base stored in the logger. If a temporary low battery condition occurred, the low battery flag would be set. The low battery flag is set at 7.2 volts, which is the effective end of life for most 9-volt batteries. On low battery, the signal conditioner voltages are approaching a level where accuracy will be compromised, and the data will be unreliable. A power-on reset is most often caused by changing the battery. This condition will corrupt the time base following the event, but the data will still be valid.

**4.2.3.12 Event Occurred**

Displays an alarm indicating that a low battery or power-on reset condition was detected.

**4.2.3.13 Test Status**

Displays a brief message on test and memory status. Messages are “Logging Enabled,” “Test Done,” and “Memory Full”.

**4.2.3.14 Download Status**

Displays whether or not the data in the Data Logger has been downloaded. If data has been downloaded since the logger was initialized, the date, time, and filename of the most recent download will be shown.

**4.2.3.15 Sampling Period**

Displays the sample period in hours, minutes, and seconds that is currently in Data Logger memory. User can change this information on the *Set-Up* tab.

**4.2.3.16 Memory Available**

This box contains three numbers in the following format: [2045 / 2045 = 100%]. The first number is the number of scans commanded to be taken. This number should match closely the number of maximum scans calculated during logger setup. The cause of any deviations of more than 2% should be determined before deploying a logger to the field. The incidence of deviations will increase significantly at very low scan intervals (of a few seconds). The second number is the number of scans remaining to be taken at the moment the logger is read. The last number is the percentage of unused or remaining memory based on the known amount of installed memory and the actual memory pointer in the logger. It may deviate from the results derived by dividing the first two numbers due to math errors caused by the low resolution of timing data stored in the logger.

**4.2.3.17 Download Command Button**

Selecting this command button enables the user to download the header and all the data stored in the connected data logger. Selection results in the display of a standard Windows Dialog box for opening and saving data to a file. User can select the default file name and directory or can input the directory and file name of their choice. Two files are downloaded. The first file carries the extension “.RAW”. This is an archival log of the raw data coming through the serial port and is in a packed ASCII hexadecimal format, and is generally used only for debugging and recovering from setup and download problems.

The second file carries the extension “.CSV”. This file displays all the information from the header and the sensor readings after conversion to engineering units. The readings are indexed to the time that the reading was taken. This data can be displayed and manipulated in most spreadsheets as either columnar data or as a graph.

**4.2.3.18 Print Command Button**

Selecting this command button will send an image of the window to the local printer.

**4.2.3.19 Set Low Power Mode**

This command button forces a *Stop Logging* condition to maximize battery life. It is used whenever it is desired to store the loggers for a short period of time without removing the batteries. Once selected, the logger must be re-initialized to set it up for any subsequent tests.

**4.2.4 Setup Tab**

The *Set Up* tab is used to initialize the Data Logger at the beginning of a test. The *Set Up* tab is shown in Appendix A. The individual data elements contained on the *Set Up* tab are described below.

#### 4.2.4.1 Active Channels

A bar consisting of multiple push buttons allowing selection of 1 to 8 channels is displayed at the top of the tab. The number of buttons displayed is limited to the number of channels physically installed in the Data Logger. Selecting a button will enable recording of data on the number of channels indicated. Active channels always begin at channel one and progress upward. Individual channel selection is not supported.

One button must always be selected. The default will be based on information from the logger currently connected.

#### 4.2.4.2 Scan Period

##### 4.2.4.2.1 Interval

The user inputs how frequently the Data Logger is to scan the sensors and record the data. Acceptable values range from 1 second to 18.2 hours. Input of less than 1 second or more than 18.2 hours result in an error message being displayed. The MOD-1A loggers were intended for long term environmental logging, and although it is possible to set the scan interval to once per second, it is not recommended to scan much faster than once per 5-10 seconds.

##### 4.2.4.2.2 Time Unit

User inputs the unit of time to be used with the sampling interval. Unit selections are seconds, minutes or hours. One button must be selected. Changing any of the other settings will un-select all of the three options. The units must be selected again to force the correct calculations for start and stop times.

##### 4.2.4.2.3 Calculations

Based on user scan period selections, installed memory, and number of active channels, the system computes the maximum logging duration and displays maximum scans and maximum logging duration. The stop date is also calculated and displayed in the Stop Date box. These messages are displayed in the User Message Area.

#### 4.2.4.3 Project Identification

User may input up to 64 characters to describe the project. Any standard keyboard characters may be used.

#### 4.2.4.4 Initialize Command Button

Selecting this item initiates the uploading of setup information to the Data Logger.

In the event the data in the logger has not been downloaded, or newer data has been acquired since the last download, a warning will be shown, and the screen will change to show two new commands: *Download Data* and *No Download, Initialize*. Selecting the first button returns the user to the *Logger Data* tab to allow a normal data download. After download, the user must return to the *Set-Up* tab to continue initialization of the logger.

The second button, *No Download, Initialize*, bypasses the data download and initializes the logger immediately. If the second button is selected, and data has not been downloaded in a recent prior session, new data, and possibly all of the old data may be lost!

Once the logger is initialized, it is almost impossible to recover old data.

The PC Clock time at time when the initialize command is selected becomes the immediate start time. It is important the time setting of the Host PC's clock be accurate and set to a national time standard. The Atomic Clock software package from Parsons Software is an inexpensive way to maintain accuracy, and other shareware packages are available through NIST. Clock accuracy is particularly important if loggers are set and downloaded by multiple PC's, and the time of logged events must be compared between multiple loggers.

#### 4.2.4.5 **Print**

This command button will send an image of the current window to the local printer.

### 4.2.5 **Cal Data Tab**

This tab option enables the user to view the sensor calibration data initially entered by the factory, or subsequently updated by the Depot.

This data is used to convert the raw data into engineering units.

#### 4.2.5.1 **Show Cal Data**

Selecting this command button fills the displayed grid with the cal data previously entered for each of the sensors. The individual columns are defined below.

##### 4.2.5.1.4 **CH # (Channel Number)**

Numeric identification of channel position from one to eight.

##### 4.2.5.1.5 **Model Number**

Model number of the specified sensor. May be up to 8 ASCII characters.

##### 4.2.5.1.6 **Sensor # (Serial Number)**

Serial number of the specified sensor. May be up to 8 ASCII characters.

##### 4.2.5.1.7 **Slope**

The value of the slope used in the calibration of the specified sensor. Used to convert the raw data to engineering units. This is the “m” of the formula “ $y = mx + b$ ”

##### 4.2.5.1.8 **Offset**

The value of the offset used in the calibration of the specified sensor. Used to convert the raw data to engineering units. This is the “b” of the formula “ $y = mx + b$ ”

##### 4.2.5.1.9 **(Engineering) Units**

The engineering units for the specified sensor, such as degrees Centigrade or pounds per square inch. This may be up to four ASCII characters.

##### 4.2.5.1.10 **LOC (Location Code)**

A brief indication of the location where the specified sensor is installed. This may be up to four ASCII characters.

##### 4.2.5.1.11 **CAL DATE**

Due date for the next calibration.

#### 4.2.5.2 **Perform Calibration**

Channels are selected for calibration by double-clicking on one of the channels shown in the table. If the system administrator has entered a password on the default tab, then that password must be entered when attempting to access a calibration screen for the first time during a session.

This action presents a new form that enables the user to input selected data. Upon entering the data and selecting the *Compute Calibration* command button the calibration data is automatically calculated and shown on the screen. It is saved to the logger when exiting the form using the *Exit/Save to Logger* button. A complete description of various aspects of the Calibration Subroutine is provided in the Appendices.

#### 4.2.5.3 **Battery Replaced**

Checking this box results in the current system date being up-loaded to the Data Logger memory. This date is subsequently displayed on the *Data Logger* tab. It is the user's responsibility to check this box when a new battery has been installed! It has no effect on battery life or logger performance, but is included to help track the age of batteries. See the Appendices for more information on battery life.

Any data should be downloaded prior to changing the battery, and the logger must be re-initialized afterwards.

#### 4.2.5.4 **Print**

This command will send an image of the current window to the local printer. NOTE that only what is displayed will be printed! Columns not shown (off to the right) will not be displayed.

#### 4.2.6 **Defaults Tab**

The *Defaults* tab can only be accessed from the sign-on flash screen that appears when the program first loads. Once *log-on* has clicked, the tab is no longer accessible.

##### 4.2.6.1 **Serial Port Selection**

This menu selection enables the user to select which serial port will be used to communicate with the Data Logger. User may choose between communication ports 1 to 4. This data is saved to the PC's Registry and is recalled during subsequent startups of the program.

The program will not automatically search for the correct port. The user must determine the port and enter it correctly for the program to work.

##### 4.2.6.2 **Default Path**

This group of boxes allows the user to select the default directory to be used for storage of data files. This data is stored in the PC's Registry and is recalled during subsequent startups of the program. It can be over-ridden when the data is downloaded from the logger.

##### 4.2.6.3 **Location Code**

This box allows the user to input a one letter location identifier or computer ID code. This information is subsequently used in the file name to distinguish files downloaded on different computers. This is provided as an additional identifier in the default file names provided for each download data set, and differentiates between download computers.

##### 4.2.6.4 **Calibration Password**

This function allows the system administrator to require a password for access to the calibration screens for each channel. If no password is entered, then no password will be required.

##### 4.2.6.5 **Date Time Settings**

Local system, and calculated GMT times are shown in the shaded boxes. Current date, time, and time zone (Difference in hours from time at the Greenwich meridian) offset may be entered in the light colored boxes and will update the PC's real time clock. If a separate program such as "Atomic Clock" is used to keep the PC's time current, then only the GMT delta in hours needs to be entered to have correct GMT time shown.

It cannot be over-emphasized that the accuracy of the dates and times used by the loggers are based on the correctness of the dates and times entered here!

## 4.2.7 Real Time Tab

This tab option allows the user to view the real time sensor readings on the active channels. This data is displayed in engineering units or in milli-Volts. Columns displayed are Sensor Number, Current Reading, and Engineering Units. A check box is also provided to display the data as Volts without any conversion being applied. Another check box is provided to display cumulative statistics on each channel. Checking the box will reset the values and sample count, and start the process. Un-checking the box will freeze the readings at the last count.

Prior to actually entering this tab, the operator will have the option of stopping the logger if it is set up and logging. If the logger is stopped, then the Start/Stop buttons will function, and data will be read and displayed at the interval selected at the top of the window. If the logger is allowed to continue logging, then the screen will be updated whenever the logger takes data based on its own internal scan rate. If logging is stopped, then the logger must be re-initialized to continue logging data. Be sure to download any data prior to stopping logging!

The Stop and Start RT Display command buttons at the bottom of the window will start and stop the real time readings. Disconnecting the logger will also stop the display. RT Display should be stopped whenever leaving this tab.

### 4.2.7.1 Update Interval

This box allows the user to input the desired sampling interval of the data displayed in the Real Time display grid. Entered numbers will update the sample interval at the next event. 1/2 [0.5] second is the fastest interval allowed.

### 4.2.7.2 Start Real Time Display Command Button

Selecting this item initiates data flowing into a data grid showing current sensor readings.

### 4.2.7.3 Stop Real Time Display Command Button

Selecting this item terminates additional readings from being displayed in the grid. It is always a good idea to stop the real time display before moving to a different tab, although this is done automatically under certain situations.

### 4.2.7.4 Show Graph Command Button

Selecting this command will bring up a strip chart presentation of the data in mV. Values for various Axis scaling can be set as well. Additional information is given in Appendix A-7b.

## 4.2.8 About Tab

This tab item provides a brief overview of the Data Logger functions and operator interface. It also provides contact information for the Data Logger manufacturer.

## 4.2.9 Program Help Tab

Although almost every command and option has a “tool tip” that pops up when the cursor is placed over the item, this manual is also accessible—complete with table of contents, index, and search functions. For quick access to answers for most questions, go directly to the screen descriptions in the Appendix.

## 4.2.10 Log-Off Tab

The only option here is to exit the program.

## 4.3 Unit Maintenance

### 4.3.1 Battery Replacement

### 4.3.2 Frequency

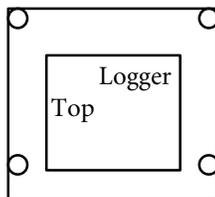
Frequency of battery replacement is dependent upon the environment that the Data Logger is exposed to, amount of memory installed and scan frequency selections. Battery life is projected to be just over 1 year for normal use in environmental logging—but can be as short as a few days!

**Batteries are Cheap compared to the cost of setting up and running a test—always install fresh batteries when starting a high cost or long duration test.**

**IMPORTANT:** Always set up your tests so that you can download the data BEFORE memory is completely filled. Downloading sets the logger to the lowest power mode and preserves battery life. If memory is filled prior to downloading, the logger goes into a higher power mode, which is guaranteed to drain most batteries in a day or less!

### 4.3.3 Methodology

Battery replacement is accomplished by unscrewing the screws in the top of the Data Logger, removing the top, snapping the battery out of the battery connection, installing the new battery, and reinstalling the top and screws. Upon completion of battery replacement, the new date is uploaded to Data Logger memory by checking the Battery Replaced box on the *Cal Data* tab. Please note that the case may contain optional packs of silica gel to maintain a dry environment. The top should be off for as short a period as possible to avoid premature saturation of the packs. The packs may be dried by placing them for a few minutes in a microwave oven. The packs should always be used when the loggers are to be operated in a humid environment.



### 4.3.4 Battery Type

The Data Logger uses a standard 9-volt radio battery. Lithium batteries are recommended for both life and safety considerations. Alkaline or NiMh batteries may also be used. Carbon and Ni-Cd batteries should not be used. There are significant differences in performance between batteries from different manufacturers—and often between batches of batteries. Please call DASCOR if you have any concerns over battery selection!

## 4.4 Software & Documentation CD

### 4.4.1 Program Installation

The software is supplied as a self-installing executable. The current version of the program is written in Microsoft Visual Basic Version 6 and should install correctly and operate under Windows 95™, Windows 98™, and Windows NT 4.0™. HOWEVER, it is guaranteed to work properly ONLY under Windows 2000. Please read the README.TXT file on the distribution CD for current instructions, changes to the software, and known bugs. Versions prior to M1A-V30 are no longer supported, as are loggers that have not been upgraded to the M1A standard.

To install the software, load the CD into the drive on your computer. Click the *My Computer* icon on your desktop, and change to the CD drive, then to the folder called *DataLogger Programs*. Double-click on *Setup.exe* and follow the directions. You may select the folder in which to place the program, or use the default.

To access the program, you may click on *start / programs / DataLogger /M1A-V30.EXE*. Alternatively you can go to the directory holding the programs, and using the right-click button, drag M1A-V30.EXE to the main desktop to create a shortcut.

On first time installations, you will also need to go to the default screen and set the various required system parameters. The Administrator can set the calibration password if required. See the appropriate sections of the manual for details on these procedures.

If you receive a message that the Comm port is already open, then a device may already be active on that port. Use the default tab to select another free port. You will then need to exit and re-enter the program for the change to take effect.

If older installations exist, they should be removed using the Windows Setup folder “Remove Software” option.

### 4.4.2 Documentation

Complete documentation, including this manual, is located on the CD in the folder called *DataLogger Documentation \ Adobe PDF Files*. The files are in Adobe Acrobat format (.PDF file type) and require the Acrobat Reader in order to access the files. Most systems set up for Internet access already have this utility installed, and double-clicking on any of the file Icons will bring up Acrobat and open the file. If not, you will need to install Acrobat on your system.

To install Acrobat, open the Adobe Acrobat Reader folder, and read the *readme.wrt* file for detailed instructions. From within Acrobat, you can print the files to your system printer.

### 4.4.3 Calibration Spreadsheets

The folder called *DataLogger Documentation \ MSEXcel Spreadsheets* may contain archive copies of actual calibration data on recently delivered loggers, and a blank set for your use in doing in-house calibrations. Detailed information is contained in the Appendix on DataLogger Signal Conditioner Calibration. Depending on the date of the release CD, data for recently released loggers may not be included.

## **5 Warranty**

### **5.1 Time Period**

DASCOR, or its resellers, provide a one-year warranty on the Data Logger, Serial Interface Adapter, and Data Logger Setup software except for damage due to improper use or battery failure as determined by DASCOR. DASCOR, or the reseller will repair or replace standard production units at their option as soon as possible after receipt—typically within ten working days. Custom units, including those with DBST signal conditioners may require a longer period.

Please contact the company from which you purchased the logger before contacting DASCOR.

There are no warranties against loss of data or other consequential damages.

### **5.2 Product Certifications and Registrations (UL, FM, EC, ETC.) & Fitness for Use**

#### **5.2.1 Regulatory and other Agencies**

Due to their experimental nature and currently limited production, as well as being incorporated into products manufactured by others, the MOD-1A loggers have not been tested to the requirements of any governmental or other regulatory agencies. Several users have performed in-house testing for use in explosive environments, and for shock and vibration resistance. Referrals are available on request.

#### **5.2.2 Fitness for Use**

DASCOR and its resellers make no warranty of fitness of use for any particular applications. It is the sole responsibility of the purchaser to determine if the loggers and support software will meet the requirements of their particular application.

## 6 Trouble Shooting Suggestions

### 6.1 *Port Already Open Error Message*

This error message may occur on new installations if the Data Logger Programs' default port, COM port 1, is already in use by another program. Possible solutions are to change the Data Logger communication port to another port or to change the port assignment of the conflicting device. The Data Logger default port may be changed on the "Default" tab. Selecting this tab allows the user to select COM port 1, 2, 3, or 4. This data is then saved to the Registry and is used by the program as the new default port the next time the program is loaded. This error can also occur if a second copy of the program is opened. Use the CTRL-ALT-DEL key combination to check to see if a copy of the Data Logger Program is already open. If it is, choose *close task* to close the copy/ies already running, then re-open one new copy.

In extreme cases, MS-Windows gets confused, and nothing works but shutting down and re-booting the system. Unfortunately, this is a recurring problem with many applications and is not unique to ours, and we have not been able to positively identify the cause.

### 6.2 *Bad File Name or Number*

This error may occur on new installations during the first attempt to download data to a file if the default path is not already on the computer. On first bringing up the software, select the "Default" tab and enter the desired default path for saving data files. Exit the program and Log-On again. The program will retrieve from the Registry the new default path that was entered and use it for saving data files. The V30 release will force the creation of a folder *C:\Logger Data* in the event it cannot find the default folder.

### 6.3 *Cannot Communicate with Data Logger*

Ensure that power is applied to the Serial Interface Unit. Verify that all connections between the Data Logger, Serial Interface Unit and Computer are secure. Check for bent or missing pins on connector. Cycle power to Serial Interface Unit.

It is always a good idea to apply power to the SIA prior to connecting it to the PC.

There are also times when the software will continue to attempt to download or upload data after losing contact with the logger. This condition self-corrects if the logger is left unplugged for one or two minutes, and then is re-connected.

It is always a good idea to be sure the battery in the logger is good. Dead batteries will often prevent the logger from starting from external power provided through the SIA.

### 6.4 *Will Not Accept Password*

Passwords are case sensitive, so ensure that proper combination of upper and lower letters are being used. Check with your Administrator to ensure that you have the latest password.

### 6.5 *When in Doubt*

When in doubt, always shut down the program and restart it. Cycle power to the SIA as well. Serial ports will occasionally lock up, and restarting Windows will often cure the problem.

**PLEASE!**

**Chronic problems that can be repeated under controlled circumstances should be reported to Dascor as soon as they are identified.**

## **6.6 Data Becomes Unusually Noisy Or Goes To An Extreme Value**

This is almost always caused by one of the sensors failing, and resulting in a conditioned signal output that is higher than can be accepted by the analog to digital converter. If one or more channels are in this condition, then other channels may exhibit unusual behavior in the form of noise and major offsets in values.

This condition can be observed by periodically downloading data, or running *real-time*. If a channel is showing maximum or minimum full-scale readings without changing, then the sensor, leads, or connectors are faulty.

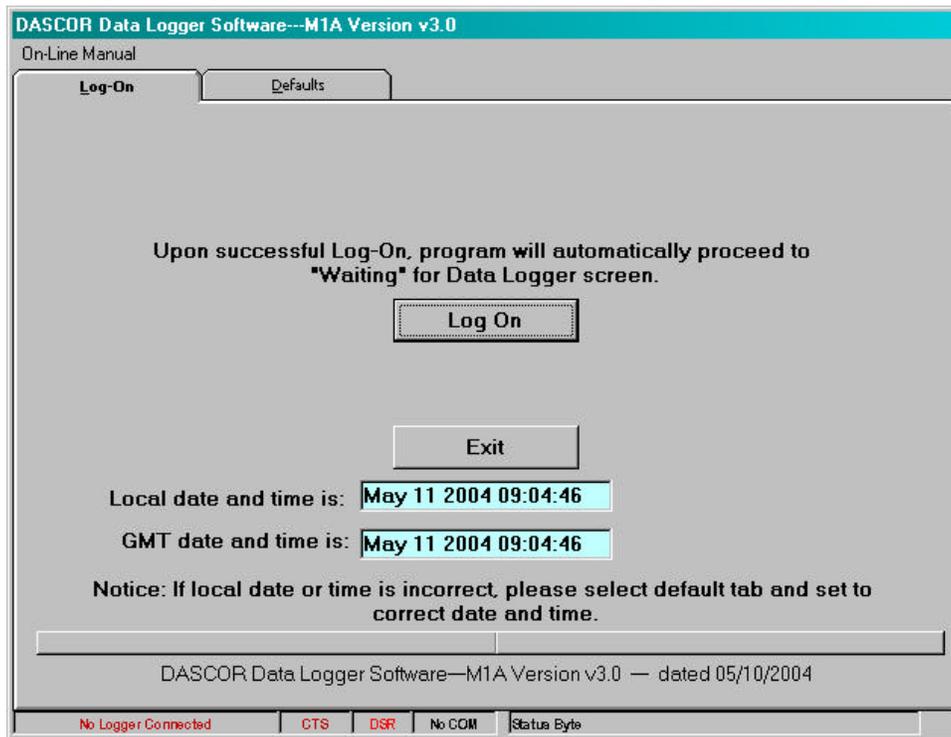
Also, be sure the logger is grounded to a local chassis or earth ground point using the thumbscrew attachment point on the logger case.

Real time readings that are at either rail will display as HI-CLIP or LO-CLIP to alert the operator that the readings have exceeded the range of the logger.

## 7 Appendices

### 7.1 Appendix A - Data Logger Tabs

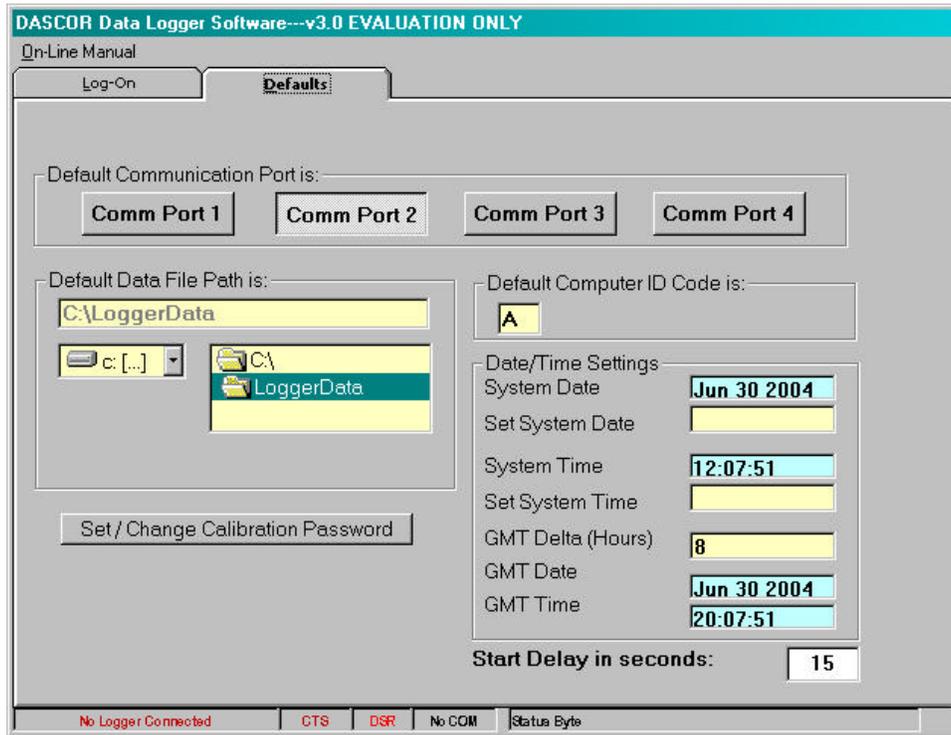
#### 7.1.1 Active Tab: Log-On



- Called By: When program starts
- Description: Main Startup screen
- Action: **Log On:** Move to Waiting Screen while Logger downloads setup information or waits for a logger to be connected.  
**Exit:** Exit the program and return to Windows.  
**Default Tab:** To Set system defaults.

- Note the version number and date at the bottom of the window.
- The “Defaults” tab is available for setting systems options from this entry screen only.
- Please check the date and time locally and for GMT. Use the *Defaults* tab to correct for your time zone.
- The Status Bar at the bottom is visible from all tabs, and provides an indication of logger connection status, RTS and CTS handshake line activity, the selected Comm-port, and the status byte information returned by the connected logger. If you contact DASCOR regarding the software’s operation, you may be asked to relate the information on the Status Bar.
- Note the *On-Line Manual Menu* option above the tabs. This option is always available.

### 7.1.2 Active Tab: Defaults



Called By: Main Startup screen when Defaults Tab is selected.

Description: Set Default Values for the Communications Port, and the Default Directory where data is stored. Also, set date and time.

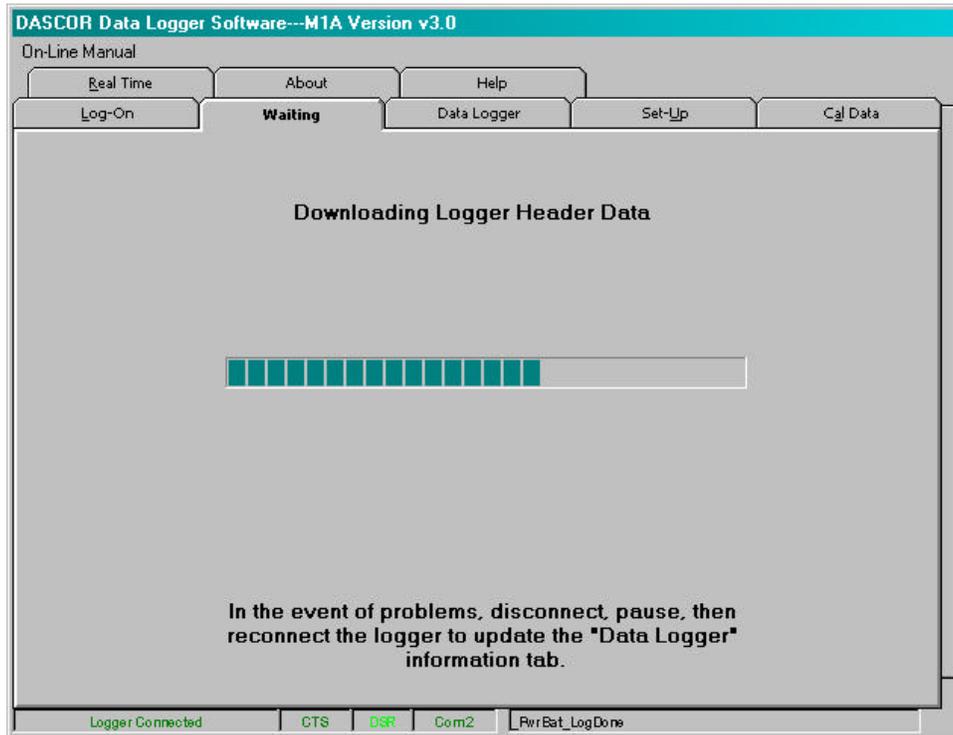
Action:

- Comm Port 1:* Set Comm 1 as active Comm. Port.
- Comm Port 2:* Set Comm 2 as active Comm. Port.
- Comm Port 3:* Set Comm 3 as active Comm. Port.
- Comm Port 4:* Set Comm 4 as active Comm. Port.
- Default Data File Path:* Set the default path where data is to be stored.
- Default Computer ID Code:* Set the Default Computer ID Code.
- System Date and Time:* View and set the System Date and Time.
- Set / Change Calibration Password:* Set password for access to the calibration screen
- Log-On Tab:* Move to Log on tab.
- Start Delay in Seconds:* Sets the time in seconds between the finish of the initialization process and the first scan.

- A Comm port MUST be selected.
- The default data-file path should always be selected using the two lower boxes. Double clicking on the selection will move it to the top box, and will move you up and down through the directory tree. The information in the top box is what is stored to the registry for future use when you leave this tab. The selected path is the default path for storing downloaded data from the logger. The file path must already exist in order to be located and selected. It is suggested that you create a default folder such as *LOGGER DATA* in the root directory of your computer.

- The Set System Date and Time boxes (yellow) may be used to enter the current date and time, or this may be done using the System Time option in the Windows Control Panel.
- The *GMT Delta* must be entered here. It is the number of hours difference between the local time zone and the Greenwich Time Zone. For example, for California (PST), the GMT Delta is +8 hours.
- PLEASE NOTE: GMT and Time Zone information is included in the Header Data. This information can be critical if the loggers are initialized and downloaded in different time zones.
- The *Default Computer ID Code* becomes the first letter of the filename automatically created for storing downloaded data. It is intended to identify the computer performing the download in the event there are multiple download locations.
- Use the *Set/Change Calibration Password* to set or change the password required to access the calibration screens for each channel. To set the password for the first time, type the password twice as requested. To change the password, enter the old password, then enter the new password twice. The default password is [NULL] i.e. no characters are entered, and allows immediate access to the calibration screens. A password is required ONLY if one is set using this command function. Further, a password need only be entered the first time a user tries to access a calibration screen during any given session.
- The *Start Delay in Seconds* box sets the number of seconds between the conclusion of initialization and the first scan. The intention is to allow enough time to complete initialization, unplug the logger so that it is running autonomously off of its internal battery, and have the first LED flash that accompanies the first scan happen fast enough that it can be observed by the user. If a flash is not observed, then logger initialization was not successful, or there is either no battery or a dead battery installed.

### 7.1.3 Active Tab: Waiting



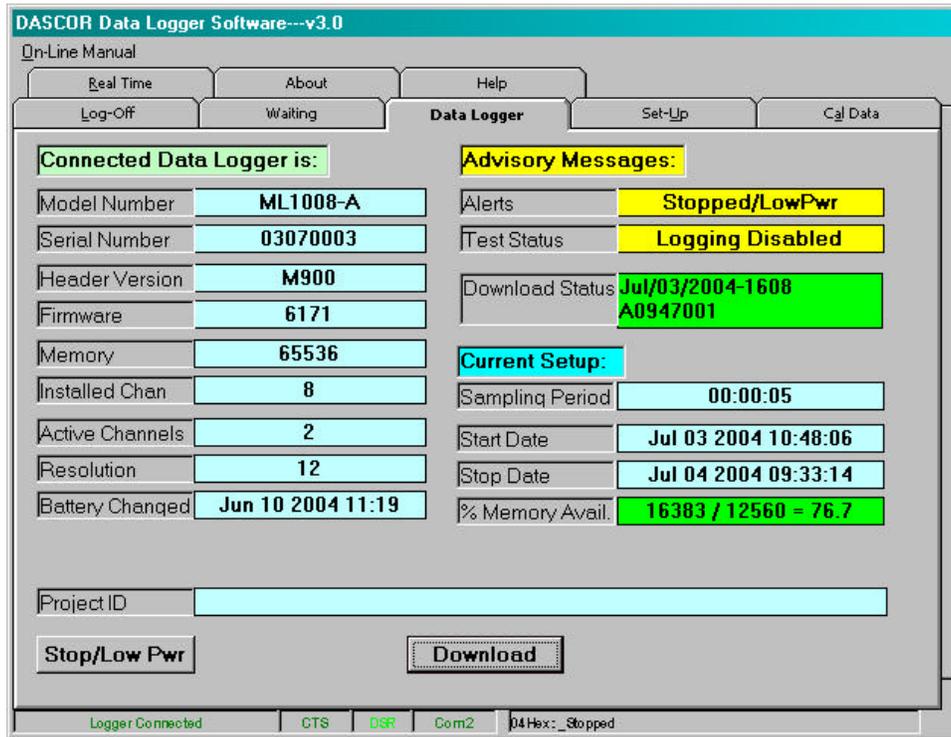
Called By: Main Startup screen once the Log-On button is selected

Description: A progress bar is displayed as information is downloaded from the Data Logger during initialization.

Action: **None** - Data Logger Tab will be displayed automatically on the completion of download. Other messages may appear here requesting the user to disconnect the logger and check the LED for the first Scan blink, and then reconnect the logger to update and verify setup information.

- In the event that the information from the logger needs to be updated, follow the instructions to disconnect then reconnect the logger to update the logger information tab—this is just a reminder of how to do it.

### 7.1.4 Active Tab: Data Logger



Called By: Startup process after the Log-On button has been selected or the download process has been completed.

Description: Displays information about the Data Logger.

Action: **Stop/Low Pwr:** Stop the Data Logger and set it to Low Power Mode.  
**Download:** Begin the process of downloading the Data Logger's data.  
**Any Tab:** Select any one of the eight systems tabs.

- Use the Download button to download data. You will be required to stop logging.
- The light blue boxes hold the basic logger information from the logger currently connected.

**PLEASE! Always check the sampling period, and start and stop dates and times before deploying a logger.**

- Note the Alerts box. This indicates conditions that occurred while data was being logged—and does not represent a condition present when the window is viewed. *Stopped/Low Power* indicates that the logger is stopped and in low power mode.
- The Test Status box indicates that logging has been stopped. This is normal after a download, calibration, or other procedure, which requires that logging be stopped.
- The *Test Advisory* boxes may be highlighted to draw the operator's attention to various conditions that may be of concern. Critical conditions are highlighted in RED and warnings are in yellow.
- The Download Status bar will turn green once the data has been downloaded. In the example above, the date, time, and filename are given for the downloaded data.
- The % Memory Available box shows Three numbers:

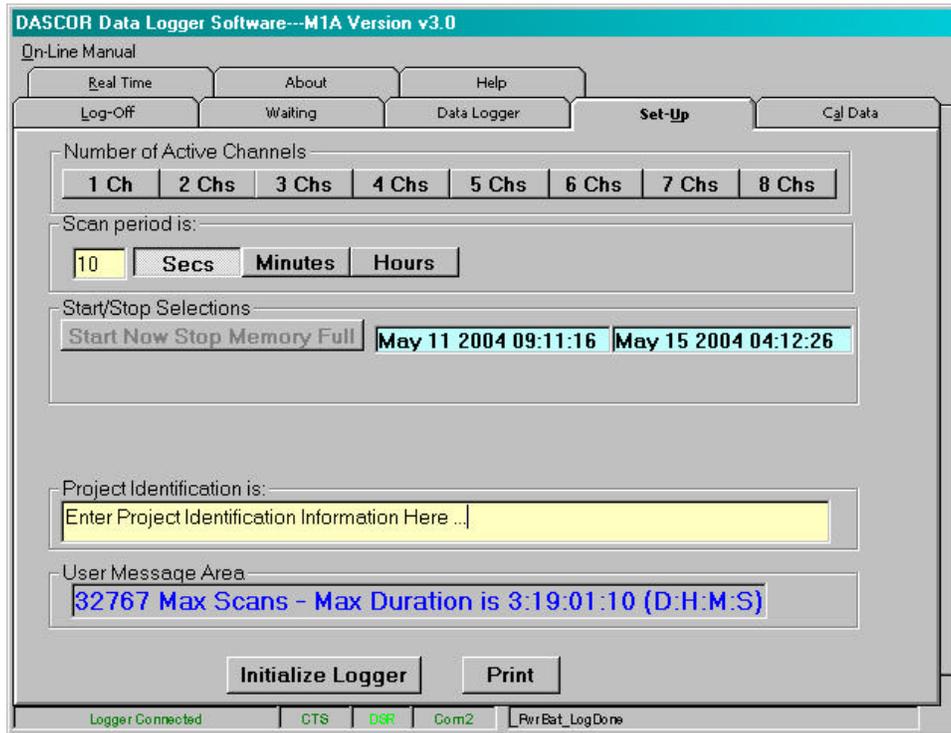
## ACTIVE TAB: DATA LOGGER

The first is the number of scans that the logger has been commanded to take. This number times 2 times the number of active channels should always be close to the total memory installed. For 32K bytes and 8 channels, the normal maximum number of scans is 2047 (or 4095 for 64K), and the number in the box should be within a few scans. Occasionally, depending on scan rate and the number of channels, the figure given could be up to 4% low, which is caused by normal truncation and rounding of the various variables during calculations. This error should disappear as the scan duration increases. If an error has been detected during initialization, the Memory box will be RED to provide a positive warning.

**THERE HAVE BEEN VERY SPORADIC OBSERVATIONS OF THE COMMANDED SCANS BEING ½ OF THAT EXPECTED! THIS CONDITION WILL COMPROMISE A TEST, AND STATED STOP TIMES WILL NOT BE VALID. ALWAYS CHECK THIS NUMBER FOR REASONABLENESS AND RE-INITIALIZE THE LOGGER IF IT DOES NOT APPEAR CORRECT!**

The second number is the number of scans remaining to be taken—in this case none, since the test is complete. The box will turn YELLOW when less than 5% of memory is remaining. The third number is the percent of memory unused or remaining.

### 7.1.5 Active Tab: Set-Up



Called By: By selecting the Set-up tab.

Description: Set the number of active channels and scan period. Enter Project Identification information.

Action: **Number of Active Channels:** Select a button, [1 Ch] through [8 Ch], to set the number of active channels.

**Scan Period is:** First enter a number and then select the unit of measure. The start and stop times will be calculated.

**Project Identification is:** Enter notes identifying the project here.

**Initialize Logger:** Begin process of uploading logger settings information to the logger.

**Print:** To print the information on this tab.

**Any Tab:** Select any one of the eight systems tabs.

- Active Channels MUST be selected. (No channels have been selected in this screen.) The scans will start with channel 1, and scan through the channel selected. Channels above the number selected will not be scanned. For example, if 5 is selected, the logger will scan channels 1, 2, 3, 4, & 5, but NOT 6, 7, & 8.
- Scan Period must be entered and the units (seconds, minutes, hours) selected as well. A scan interval of 10 seconds has been selected in this screen. **The scan period and units will be un-selected if changes are made to the number of active channels. Leaving the Tab and coming back will also clear all selections!**
- **Project Identification** is 64 characters of alphanumeric data that may be entered by the operator to describe the current test. It acts as a “note pad.”
- After selecting **Initialize Logger**, the user will be provided with a series of opportunities to check the setup for correctness, or download data if that step had been forgotten. See the Message Box section for more details. In the event that data has not been downloaded, the following screen will appear:

**DASCOR Data Logger Software---v3.3 EVALUATION ONLY**

Help On-Line Manual

Real Time About Help

Log-Off Waiting Data Logger **Set-Up** Cal Data

Number of Active Channels

1 Ch 2 Chs 3 Chs 4 Chs 5 Chs 6 Chs 7 Chs 8 Chs

Scan period is:

10 Secs Minutes Hours

Start/Stop Selections

Start Now Stop Memory Full Jul 02 2004 22:18:53 Jul 03 2004 09:41:23

Project Identification is:

Enter Project Identification Information Here.

User Message Area

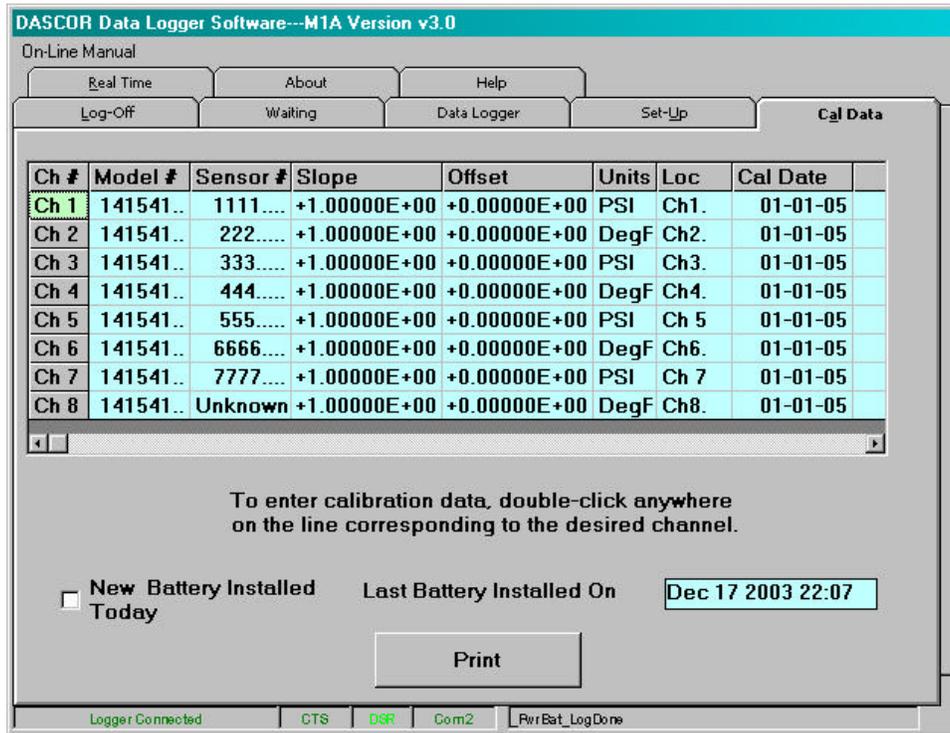
4095 Max Scans - Max Duration is 0:11:22:30 (D:H:M:S)

Download Print No Download, Initialize

Logger Connected CTS DSR Com2 PwrBat

- BE CAREFUL in selecting *Initialize--No Download* as any data in the logger that has not been downloaded will be lost!
- ALWAYS OBSERVE THE MAXIMUM NUMBER OF SCANS shown in the *User Message* area prior to initializing the logger! This number times 2 times the number of channels selected, should always be equal to the memory installed. In the example shown  $4096 * 2 * 8 - 1 = 65535$ . Odd numbers of channels might result in a slightly smaller number, but never a larger one. This number should be compared to the first number shown in the % Memory Available box on the setup window following initialization. Small errors are acceptable, but when large ones occur, the logger should be re-initialized. Errors will also increase below scan rates of a minute or so due to rounding and other errors inherent in the calculations.

### 7.1.6 Active Tab: Cal Data



Called By: By selecting the *Cal Data* tab.

Description: Call the Calibration screen to set the calibration data for each active channel by double clicking a line on the Channels grid.

Action: **Channel grid rows:** Select any channel by double clicking on it. This will take you to the screen to set the calibration data for the selected channel.

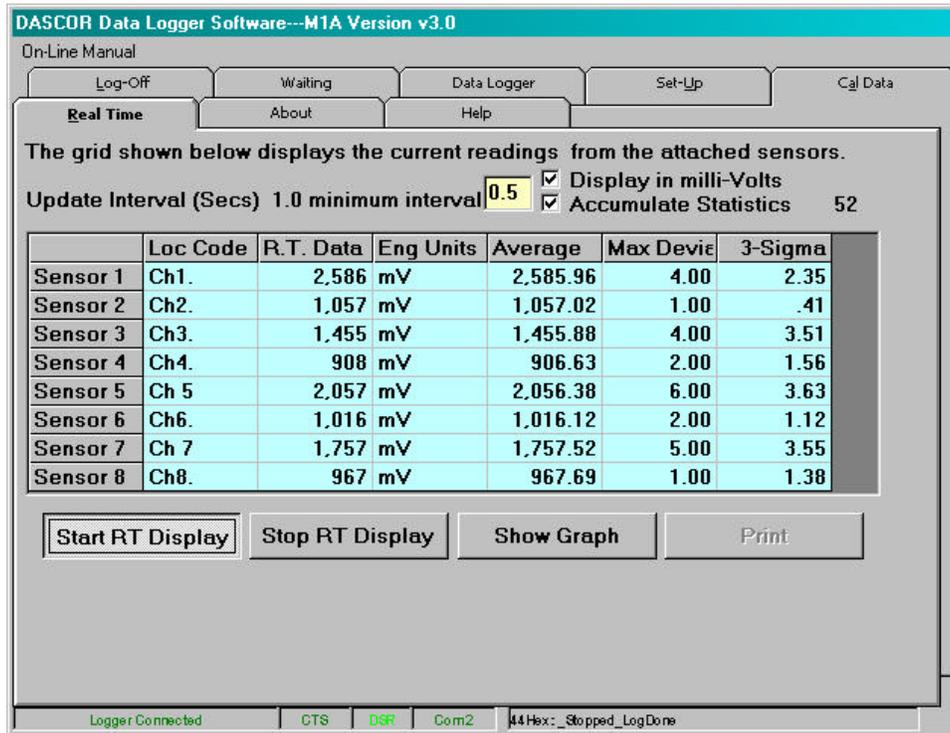
**Print:** to print the information on this tab.

**New battery installed check box:** This writes today's date to the new battery memory location in the logger. ALWAYS download data before changing the battery and re-initialize the logger afterwards.

**Any Tab:** Select any one of the eight systems tabs.

- Data will be shown only for active channels. If you want to see all channels, go to the Set-Up tab and select 8 channels, then reinitialize the logger. If your logger has fewer than 8 channels installed, you will be able to view only those channels.
- Data may NOT be changed in this screen. However, the widths of the columns may be adjusted by placing the cursor over the vertical bar between column labels (it will turn to  $\leftarrow\rightarrow$ ) and may be used to drag the right hand side of the column to a new width. This works the same way as column management in Excel and Word.

## 7.1.7 Active Tab: Real Time



Called By: By selecting the Real Time tab.

Description: Displays Logger data in real time.

Action: **Display in milli-Volts:** Check the box to see data in milli-Volts.

**Accumulate Statistics:** Check the box to have program calculate Average, Max Deviation, and 3-Sigma.

**Start RT Display:** Starts active display

**Stop RT Display:** Stops active display

**Show Graph:** Display a window that will give a graphic display of the data.

**Print:** To print the current data being displayed.

**Any Tab:** Select any one of the eight systems tabs.

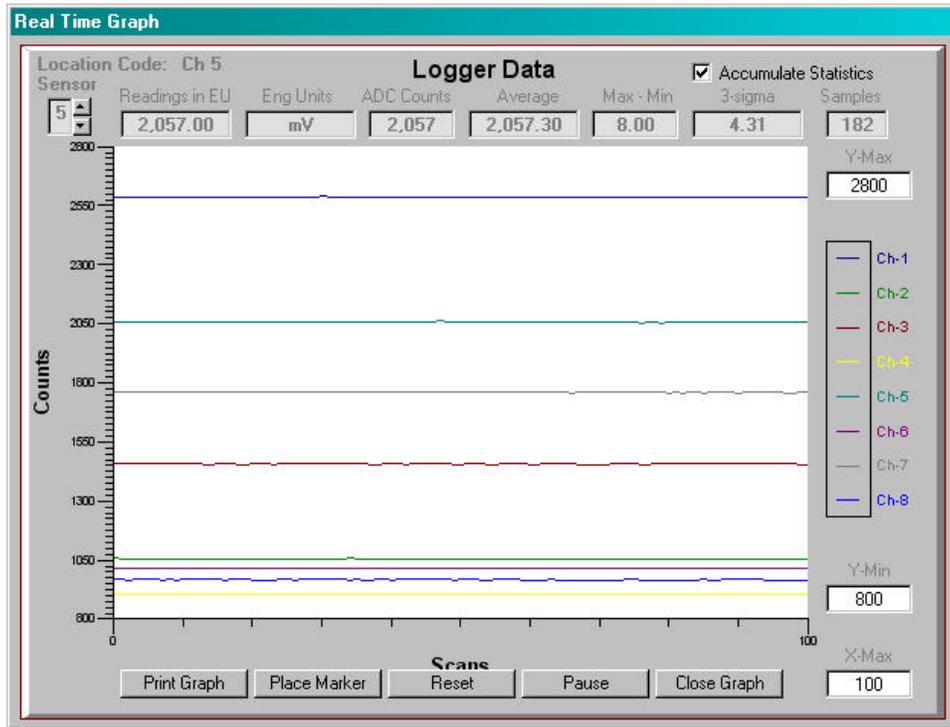
- Prior to getting to this tab, if the logger is in logging mode, you may be asked if you want to stop logging (which will allow the fastest possible scan rate), or to continue logging and display the data as it is acquired by the logger at the programmed scan rate. If you choose to stop logging (or the logger is already stopped), all the functions will be available. However if you choose not to stop logging, the **Start RT Display** and **Stop RT Display** functions will be disabled!
- Only active channels (i.e. the number of channels selected during setup) will be shown. Use the setup screen to select all 8 channels, and then initialize the logger, to show all channels.
- In the example above, the Accumulate Statistics and Display in milli-Volts functions have been enabled. The number to the right of the Accumulate Statistics is the number of consecutive readings taken and used to calculate the statistics. Un-checking the Accumulate Statistics box will freeze the readings. Clicking it again will reset the count to zero and start accumulating again.
- The Display in milli-Volts Function gives the data in milli-Volts ( equal to ADC Counts), and is “raw” data that has not been converted to EU or Engineering Units. Un-clicking this box will display the data

## ACTIVE TAB: REAL TIME

converted to EU using the calibration factors stored in the logger. The EU units will be updated on the next reading.

- Remember that the Calibration values for the Cal Constants are stored using the Calibration tab, and the Data in the left hand set of columns in .CSV file is Raw ADC counts (mV) and has NOT been converted to engineering units—Although the data shown in this screen may be in EU if the milli-volts box has not been checked.
- The Graphics button will bring up a real-time strip chart of the data, but data is presented only in mV.

### 7.1.8 Active Tab: Real Time Strip Chart



**Called By:** By selecting the Real Time tab.

**Description:** Displays Logger data in real time.

**Action:** *Accumulate Statistics:* Check the box to have program calculate Average, Max Deviation, and 3-Sigma for the channel selected. Repeats action in main table.

*Select Channel:* Scrolls the statistics display up and down through the active channels.

*Print Graph:* Will dump the chart to the system printer.

*Close Graph:* Will close the chart and return to the RT tab.

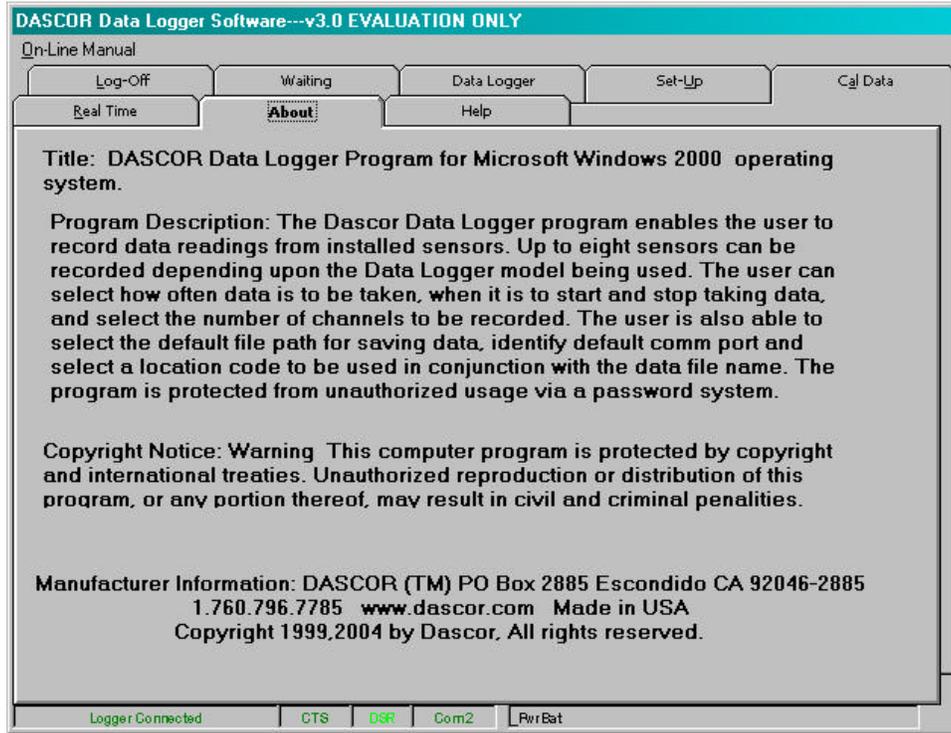
*X-Max* sets the number of scans to be displayed in the horizontal axis. The minimum is 10. *Y-Max and Y-Min* sets the upper and lower values displayed (in mV). These numbers can range from 10 to 4095.

*PAUSE* or *RUN* is disabled when monitoring data being logged, and is operational when the logger is stopped. It mimics the *Start Display* and *Stop Display* buttons on the Real Time screen.

*Place marker:* Creates a vertical spike in the displayed data when pressed. This function is not operable in monitor mode.

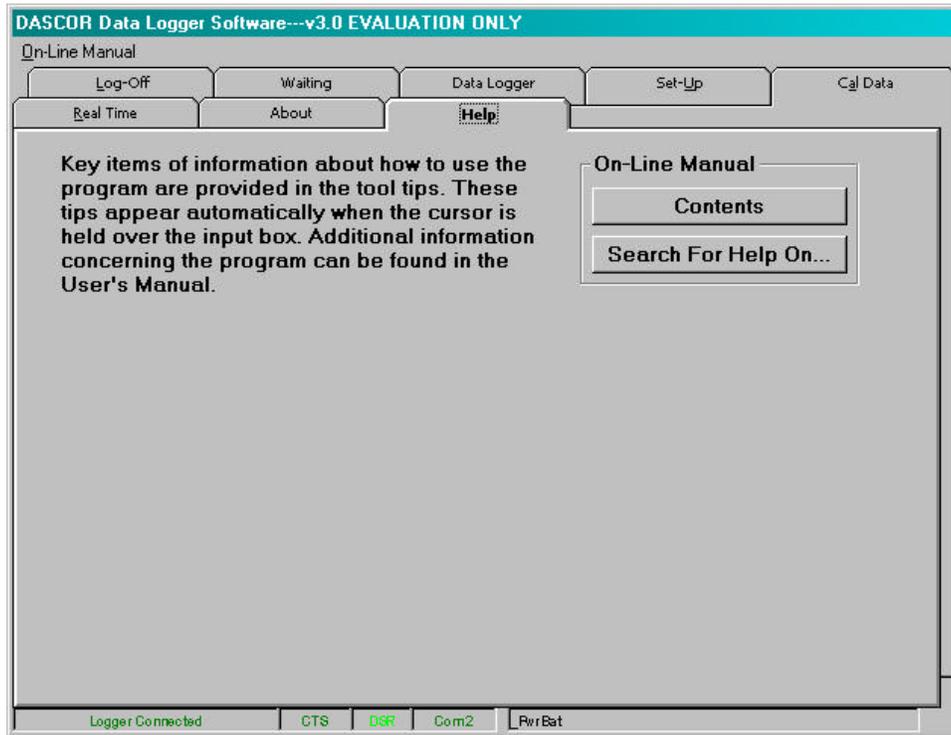
If the display does not come up immediately, try clicking in the white central area. If the graph is in monitor mode, it will wait for the first data from the logger before updating the screen. This might take quite some time if the scan rate is in minutes or hours.

### 7.1.9 Active Tab: About



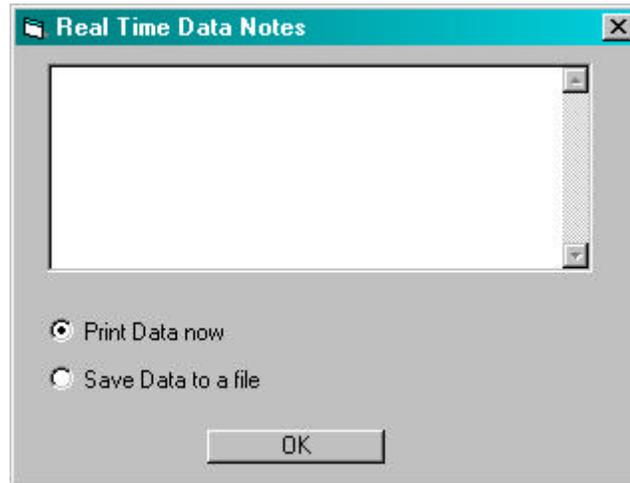
- Called By: By selecting the About tab.
- Description: Displays information about the Data Logger program which includes the Software title, Program Description, Copyright Notice, and Manufacturers Information.
- Action: *Any Tab:* Select any one of the eight systems tabs.

### 7.1.10 Active Tab: Help



- Called By: By selecting the Help tab.
- Description: Displays information regarding the programs help system.
- Action: **On-Line Manual:** Displays this document.  
**Any Tab:** Select any one of the eight systems tabs.

PLEASE NOTE: The *Search for Help* and *Contents* buttons will display [Appendix A \(Para 7.1\)](#) of this manual.

**7.1.11 Window Title: Real Time Data Notes**

Called By: By selecting the *Print* button from the Real Time screen.

Description: Enter a description for the Real Time information to be printed. The description will show at the top of the Real Time print out.

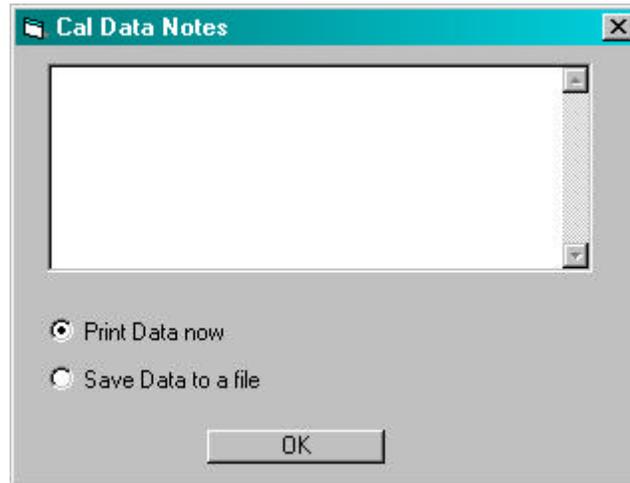
Action: *Enter Text:* Enter and edit text in the box.

*Select print option:* Send to printer now or save to a file.

*OK:* To continue.

NOTE: There will be an opportunity to cancel this procedure in the printer setup window that appears next.

### 7.1.12 Window Title: Cal Data Notes



- Called By:** By selecting the *Print* button from the Cal Data screen.
- Description:** Enter a description for the Calibration information to be printed. The description will show at the top of the Cal Data print out.
- Action:** *Enter or edit Text* in the scroll box.  
**Select print option:** send to printer now or save to a file.  
**OK:** to continue.
- NOTE:** There will be an opportunity to cancel this procedure in the printer setup window that appears next

### 7.1.13 Window Title: Data Calibration Sub-Routine

**Called By:** The *Calibration* screen by double clicking a line on the Channels grid.

**Description:** Allows an authorized user to set up the calibration for the logger and the attached sensor.

**Action:** Calibration sequence details and the meanings and functions of the command boxes are described in further detail in the logger specific Calibration Procedures Appendices, and in 7.1.13.

**Data Logger Cal Information:** Data specific to the calibration of the logger itself is entered here. It should not be changed without first saving the screen to a file, and then only if performing a two-point field calibration.

**Compute Cal Factor:** Uses the sensor and logger calibration data to calculate the slope and offset factors to convert raw milli-Volt (ADC Count) data to engineering units (EU).

**Save to Clipboard:** Save the current settings so that they may be recalled when setting up the next sensor.

**Save to File:** Save the current settings to a file to recalled at any time.

**Recall from Clipboard:** Recall last saved Sensor setting.

**Recall from File:** Recall Sensor setting saved to a file.

**Print Channel Settings:** To print the current settings.

**Exit / Save to Logger:** To Exit this window and save sensor information to the logger. You will then be prompted to acknowledge that you wish to save the information. Choose yes to save changed settings or no to exit without saving.

- Only sensor calibration information should be changed in the *Sensor Calibration Information* fields.

## WINDOW TITLE: DATA CALIBRATION SUB-ROUTINE

- Signal conditioner Calibration Information in the *Logger Settings* frame is normally set at the factory and should not be changed unless a re-calibration is performed.

**Changing data in the Signal Conditioner fields DOES NOT change the actual gains and offsets hardwired in the logger.**

- These values are fixed in hardware and are NOT programmable. It may be necessary to change these values when doing two point field calibrations (See the appropriate appendix), or forcing the outputs to volts or milli-volts—but the original calibration numbers should be recorded for later re-entry.
- The small box in the upper Right Corner shows the units of the Excitation supplies being used—these units must be common to all excitation entries! The software does not really care what the units are—Volts, MV, Kilo-Amps, or micro-amps—as long as all measurements are present using the same units.

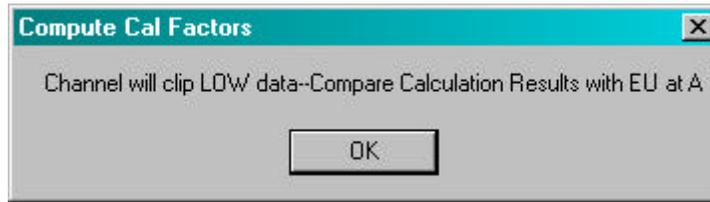
<i>Channel Number</i>	Channel number being calibrated
<i>Cal Due</i>	Optional 8-character text entry for a reminder of the next calibration due date.
<i>Excitation EU</i>	Engineering Units (EU) used for the excitation supply. Typically uA or Volt
<i>Sensor Calibration Information</i>	<b>SENSOR specific information</b>
<i>Model Number</i>	8-character text field for the model or type of sensors
<i>Serial Number</i>	8-character text field for the serial number of the sensor
<i>Engineering Units</i>	4-character field for the EU associated with the sensor (PSI, %RH, DegC, etc.)
<i>Location Code</i>	Optional 4-character code to note where the sensor is mounted (e.g. frame number x)
<i>Excitation (uA/mV)</i>	Numeric value for the excitation current or voltage used during the actual calibration of the sensor
<i>MilliVolts at A</i>	numeric value in Milli-Volts of input at calibration point A
<i>EU at A</i>	numeric value in EU for the stimulus applied at point A
<i>MilliVolts at B</i>	numeric value in Milli-Volts of input at calibration point B
<i>EU at B</i>	numeric value in EU for the stimulus applied at point B
<i>MIN Full Scale EU</i>	Numeric value in EU for the lowest reading possible by the sensor
<i>MAX Full Scale EU</i>	Numeric value in EU for the highest reading possible by the sensor
<i>Data Logger Cal Information</i>	<b>DATA LOGGER SIGNAL CONDITIONER specific information</b>
<i>Serial Number</i>	Serial number of the signal conditioner module, not user changeable
<i>Excitation (uA/mV)</i>	numeric value for the channel excitation in uA or Volts
<i>Offset (milli-Volts)</i>	Numeric value for the channel offset in Milli-Volts or ADC Counts
<i>Gain</i>	Numeric value for the channel gain
<i>Logger Settings</i>	<b>Calculated <math>y=mx+B</math> factors for converting raw readings to EU</b>
<i>Slope</i>	“m” variable of the $y=mx+b$ equation
<i>Offset</i>	“b” variable of the $y=mx+b$ equation

**Calculation results**

<b>Maximum EU Output</b>	Calculated maximum reading in EU...must be >MAX full scale entered for the sensor to avoid clipping data. If the measurement will be outside of this limit, then a red background will be displayed as a warning along with a message box (see next paragraph).
<b>Minimum EU Output</b>	If the measurement will be outside of this limit, then a red background will be displayed as a warning along with a message box (see next paragraph).
<b>Sensitivity (EU/mV)</b>	Calculated resolution of sensitivity in terms of EU per mV where one mV = 1 ADC Count.

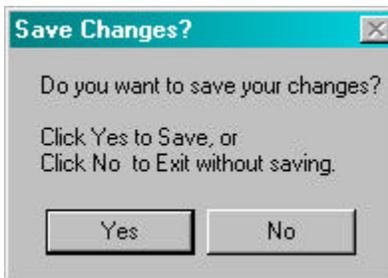
NOTE that if a red warning and message box occurs regarding data clipping, the logger will still continue to operate, but will only provide valid data only to the limits given in the Max and Min EU Output boxes. In other words, these boxes indicate the operating limits of the combination of sensor and fixed, pre-set logger gains and offsets.

#### 7.1.14 Message Box Title: Compute Cal Factors Warning Message



Called By: Calibration Sub-Routine after clicking the Compute Cal Factors button.  
Description: A warning message displayed if the Calibration results are not within acceptable values.  
Action: **OK:** Acknowledges the message and returns to the calling window.

#### 7.1.15 Message Box Title: Save Changes Warning Message



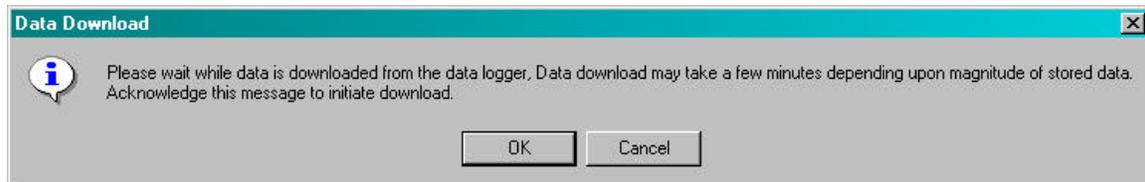
Called By: Calibration Sub-Routine after clicking the Exit / Save to Logger button.  
Description: A warning message displayed if the Calibration information has changed and needs to be saved before exiting.  
Action: **Yes:** To save current settings.  
**No:** To exit without saving.

### 7.1.16 Message Box Title: Stop / Low Power Mode Warning Message



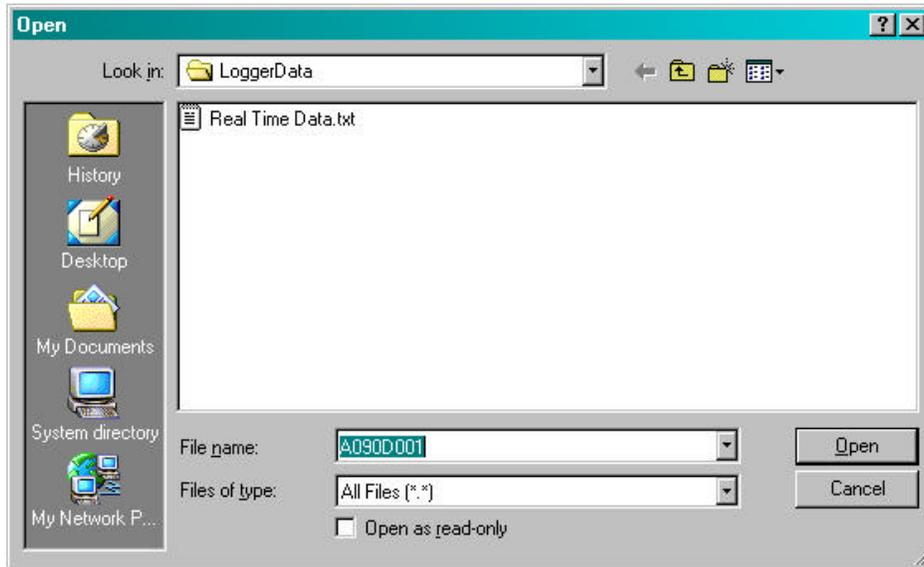
- Called By: Data Logger screen ONLY after clicking the *Stop/Low Pwr* button.
- Description: A warning message displayed to give a last chance cancel the process of stopping the Data Logger and setting it to Low Power Mode.
- Action: **OK:** Acknowledges the message and stop logging.  
**Cancel:** To return to the Data Logger Screen without stopping the logger.

### 7.1.17 Message Box Title: Data Download Warning Message



- Called By: Data Logger screen after clicking the Download button.
- Description: A warning message displayed to give conformation for the Data Logger to begin downloading data.
- Action: **OK:** Acknowledges the message and initiate download.  
**Cancel:** To return to the Data Logger Screen without downloading.

### 7.1.18 Window Title: Data Download Standard Dialog



**Called By:** Data Logger screen after clicking the Download button.

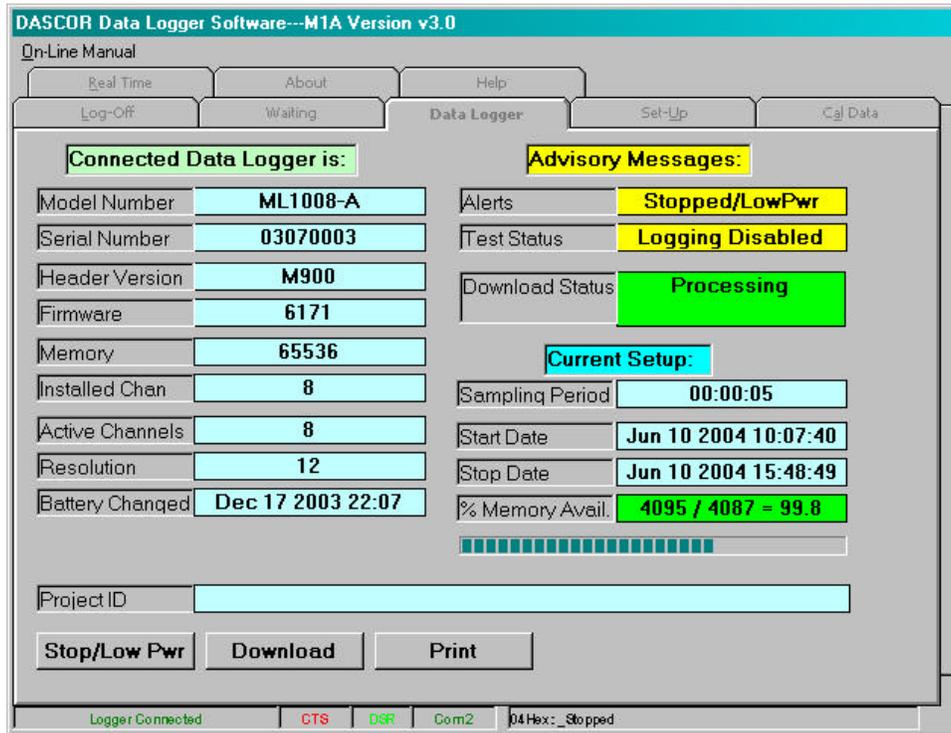
**Description:** A system specific standard dialog box to select the file to download the data to.

**Action:** **File and Directory Selection:** Select the directory and file name where the data will be written. The folder specified on the default screen will be shown, along with a default file name constructed from the one character Location Code entered on the Default screen, 4 characters of date code and a 3-character sequence number. These may be changed as required.

**Open:** To continue download of data to the specified file.

**Cancel:** To cancel download.

### 7.1.19 Active Tab: Data Logger - Data Download Status



Called By: Data Logger screen after clicking the Download button.

Description: The Download Status displays the green Processing message while the progress bar indicates how far through the download process the Logger is.

Action: **None:** The download status and progress bar are an indicator of how much longer the download process will take.

### 7.1.20 Active Tab: Data Logger - Data Downloaded Date/Time/File Name

**DASCOR Data Logger Software--M1A Version v3.0**

On-Line Manual

Real Time About Help

Log-Off Waiting **Data Logger** Set-Up Cal Data

**Connected Data Logger is:**

Model Number	ML1008-A
Serial Number	03070003
Header Version	M900
Firmware	6171
Memory	65536
Installed Chan	8
Active Channels	8
Resolution	12
Battery Changed	Dec 17 2003 22:07

**Advisory Messages:**

Alerts	Stopped/LowPwr
Test Status	Logging Disabled
Download Status	Jun/10/2004-1016 File Name A0930001

**Current Setup:**

Sampling Period	00:00:05
Start Date	Jun 10 2004 10:07:40
Stop Date	Jun 10 2004 15:48:49
% Memory Avail.	4095 / 4087 = 99.8

Project ID

Stop/Low Pwr Download Print

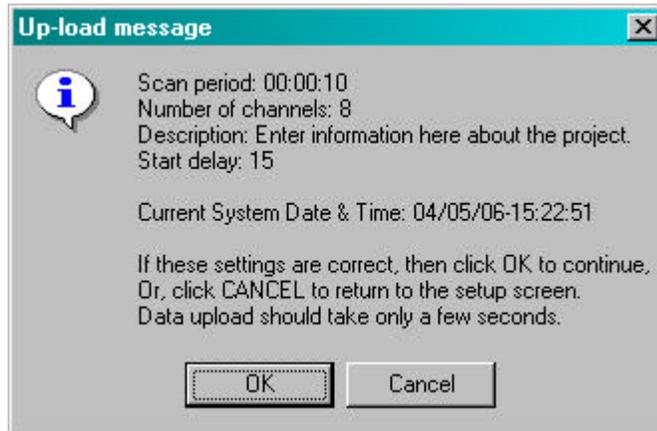
Logger Connected CTS DSR Com2 04Hex: Stopped

Called By: Data Logger screen after clicking the Download button.

Description: The Download Status displays the green Date and Time message to indicate when the data was downloaded.

Action: **None:** The download status is an indicator of when data was last downloaded and the file name.

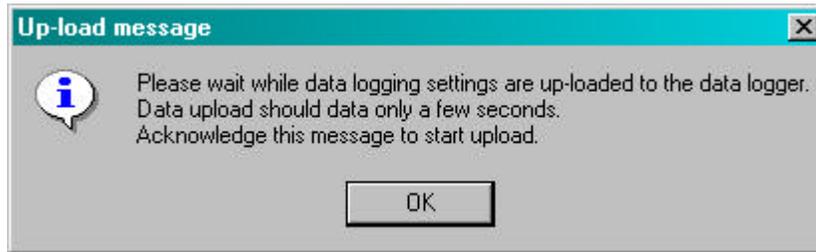
### 7.1.21 Message Box Title: Set-Up - Upload Message



- Called By: Set-Up screen after clicking the Initialize Logger button.
- Description: An informational message to display current settings for review before sending them to the Data Logger.
- Action: **OK:** Acknowledges the message and initiate upload.  
**Cancel:** To return to the Set-Up Screen without uploading data.

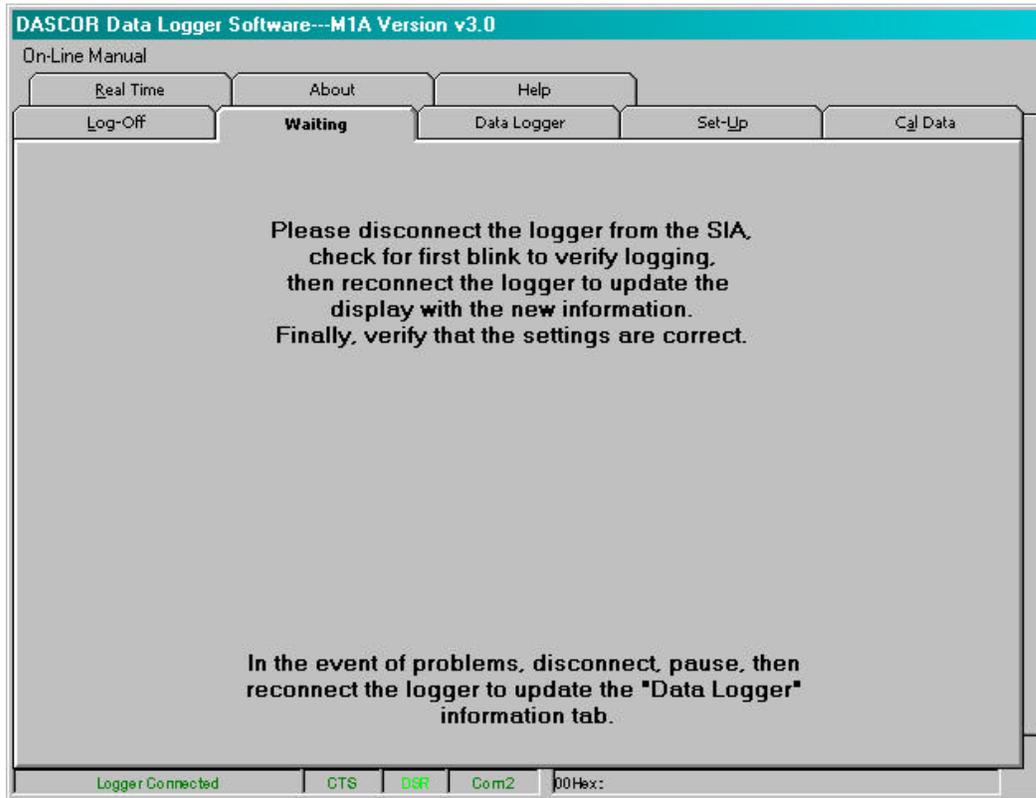
**ALWAYS Check this screen for accuracy before continuing.**

### 7.1.22 Message Box Title: Set-Up - Upload Acknowledgement



- Called By: Set-Up screen after clicking the Initialize Logger button.
- Description: An informational message to acknowledge the start of the upload process.
- Action: **OK:** Acknowledges the message and initiate upload.

### 7.1.23 Active Tab: Waiting - Upload Instruction



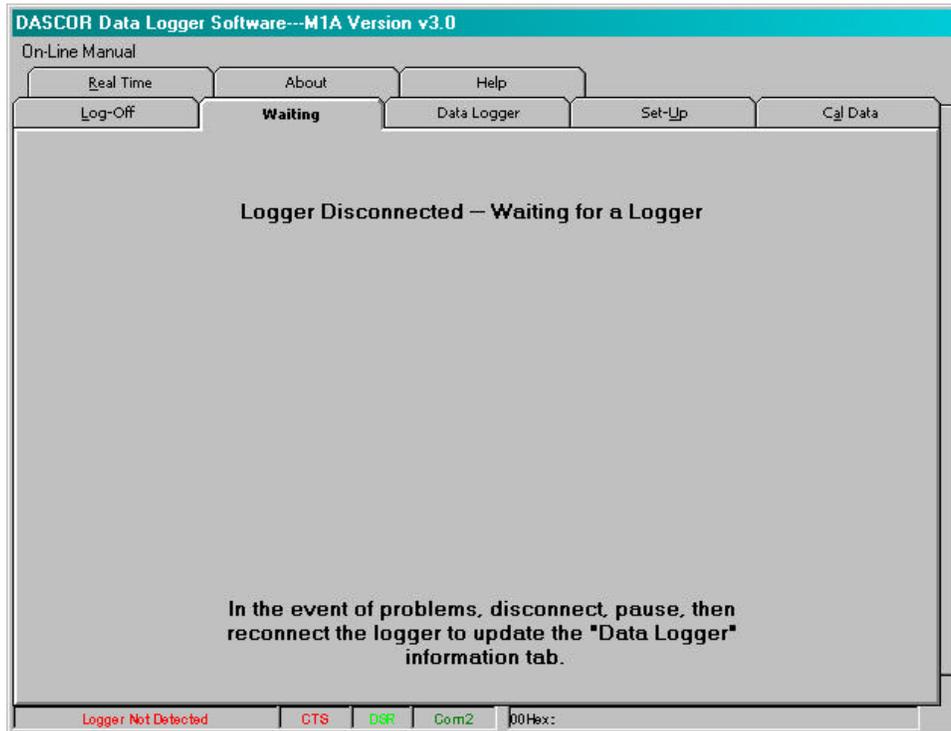
Called By: Set-Up screen after clicking the Initialize Logger button.

Description: An informational message to instruct the user to disconnect, and then reconnect the logger to complete the upload process.

Action: Disconnect the logger at this time.

Wait for the first flash of the LED to indicate that the Logger is working autonomously, then reconnect the logger and verify the settings are correct. Check the memory box to be sure that at least one scan of data has been taken! Finally, disconnect and deploy the logger.

### 7.1.24 Active Tab: Waiting - Upload Message

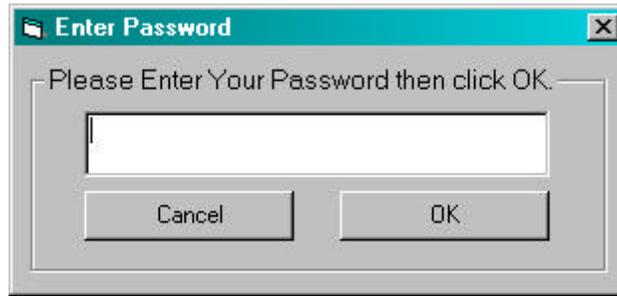


Called By: Set-Up screen after clicking the Initialize Logger button.

Description: An informational message to instruct the user to reconnect the logger to complete the upload process.

Action: Reconnect the logger at this time.

### 7.1.25 Message Box Title: Enter Password



- Called By: The Cal Data tab by double clicking a line on the Channels grid.
- Description: When a password is set it provides password security for the calibration screen.
- Action: **OK:** After entering password to continue to the calibration screen.  
**Cancel:** To return to the Cal Data screen.

### 7.1.26 Message Box Title: Set / Change Password



- Called By: The Defaults tab by clicking the Set / Change Calibration Password button.
- Description: It provides a way to set and to change a password that can provide security for the calibration screen.
- Action: **OK:** After entering password to continue to change your password.  
**Cancel:** To return to the Defaults tab without changing the password.

## 7.2 Appendix B - Program Message List

---

Message:	THIS WILL DESTROY ANY TEST DATA! Have you downloaded? OK to continue Test, Cancel to abort
Called By:	<i>Check Data Memory</i> on <i>Help</i> Tab.
Description:	To confirm start of test. Short test of data memory with random intervals. NOTE: Not available on all versions
Action:	<b>OK:</b> To continue Test. <b>Cancel:</b> To abort.

---

Message:	Please confirm that you want to stop the logger and set it to low power mode. Ok to stop logging. Cancel to continue
Called By:	<i>Stop/LowPwr</i> button on <i>Data Logger</i> Tab.
Description:	<i>Stop/LowPwr</i> message to stop the logger and set it in low power mode.
Action:	<b>OK:</b> To stop logging. <b>Cancel:</b> To Stop Logger.

---

Message:	Do you really want to stop the logger to reset?
Called By:	RESET LOGGER Low Power Mode button on Help Tab.
Description:	To confirm reset of the logger. NOTE: Not available on all versions
Action:	<b>Yes:</b> To reset the logger. The instructional message "Disconnect then reconnect logger to update display." will follow. <b>No:</b> To Cancel.

---

Message:	Logging is enabled. Logging must be turned off before continuing. You must re-initialize the logger to continue logging! Download data if necessary! Do you want to turn off logging now?
Called By:	Perform Calibration button on Cal Data Tab.
Description:	To confirm stopping the logger to enable user to perform sensor calibrations and transfer calibration data to <i>Cal Update</i> form.
Action:	<b>OK:</b> To stop the logger. The acknowledgement "Do you really want to stop the logger?" will follow. <b>Cancel:</b> To Cancel.

---

---

Message:	The default data file path is invalid. A data file folder has been created as 'C:\LoggerData'. See the manual for more information.
Called By:	Program startup.
Description:	This message is displayed if the default directory has not been set or if the default file path is invalid and the directory no longer exists.
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	The correct working Comm Port <b>MUST</b> is selected in the DEFAULTS tab before proceeding. Also, Be sure to set the correct path to the data file storage folder, or errors will occur during downloads. After setting all of the defaults, then select the LOG-ON tab and exit the program to complete the installation with the correct Registry settings. Read the README.TXT file for more details.
Called By:	Program startup.
Description:	This message is displayed if the Comm Port has not been set.
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	The Default Comm Port--Com # is not available. Please select a different Default Comm Port then exit the program and start it again.
Called By:	<b>Comm Port Selection</b> on <b>Defaults</b> Tab.
Description:	To inform that the selected Comm. Port is invalid.
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	Logging is enabled. Logging should be turned off (=YES) to use RT functions, or left ON (=NO) to monitor data as it is being logged. YES will require re-initialization of the logger to continue logging. Do you want to turn off logging now?
Called By:	Selecting the Real Time Tab.
Description:	To confirm stopping the logging of data to enable user to use the Real Time display.
Action:	<b>Yes:</b> To stop logging. The acknowledgement " Do you really want to stop the logger?" will follow. <b>No:</b> To continue logging and monitor data. <b>Cancel:</b> To Cancel.

---

Message:	Scans Commanded are over 2% below the maximum allowed of [Maximum Number of Scans]. Please verify and re-initialize the logger if this is not correct.
Called By:	Up-load message.
Description:	To confirm <b>Number of Scans</b> . Very rarely cumulative math errors in the date and time routines will cause the number of scans to be in error. If this message appears, re-initialize the logger. It occurs mostly when very short (<5 second) scan intervals are requested.
Action:	<b>OK:</b> To acknowledge the message.

---

---

Message:	Error in reading EEPROM, Logger may not be initialized. Contact factory for assistance if this error repeats after initializing logger.
Called By:	Initialization.
Description:	To acknowledge Invalid EEPROM. This is another very rare error and is usually encountered when the SIA plug is not rapidly connected to the logger and a number of intermittent connections occur (Contact bounce). Re-initializing the logger will almost always cure this problem. If not, please contact DASCOR.
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	Please wait while data is downloaded from the data logger, Data download may take a few minutes depending upon magnitude of stored data. Acknowledge this message to initiate download.
Called By:	Download button on <i>Data Logger</i> Tab.
Description:	To acknowledge Data Download.
Action:	<b>OK:</b> To acknowledge the message and begin download. <b>Cancel:</b> To Cancel.

---

Message:	Scan Period must be greater than 0.1 hours for hour selection.
Called By:	<b>Hours</b> button on Set-Up Tab.
Description:	To acknowledge <i>Logging Duration</i> .
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	Scan interval cannot exceed 18.2 hours, Please re-enter scan period.
Called By:	<b>Hours</b> button on <i>Set-Up</i> Tab.
Description:	To acknowledge Invalid time period.
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	Exceptionally long logging period, ensure battery is fresh.
Called By:	<b>Hours</b> button on <i>Set-Up</i> Tab.
Description:	<i>To acknowledge Long Logging Duration</i> .
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	Scan Period must be greater than 0.1 minutes for minute selections.
Called By:	<b>Minutes</b> button on Set-Up Tab.
Description:	To acknowledge Logging Duration.
Action:	<b>OK:</b> To acknowledge the message.

---

Message:	Scan Period must be greater than one second.
Called By:	<b>Seconds</b> button on Set-Up Tab.
Description:	To acknowledge Logging Duration.
Action:	<b>OK:</b> To acknowledge the message.

---

---

Message: Please select the number of active channels.  
 Called By: **Initialize Logger** button on *Set-Up* Tab.  
 Description: Called by *Select number of channels* if the requested number of active channels is less than 1 or greater than the number of installed channels.  
 Action: **OK:** To acknowledge the message.

---

Message: Please enter the scan period.  
 Called By: **Initialize Logger** button on *Set-Up* Tab.  
 Description: *Select scan period* displayed if the scan period has not been set.  
 Action: **OK:** To acknowledge the message.

---

Message: Scan period cannot be zero, please re-enter scan period and time interval.  
 Called By: **Initialize Logger** button on *Set-Up* Tab.  
 Description: Scan Period invalid displayed if the scan period has not been set.  
 Action: **OK:** To acknowledge the message.

---

Message: Please enter the scan period unit of measure.  
 Called By: **Initialize Logger** button on *Set-Up* Tab.  
 Description: *Select unit of measure* displayed if unit of measure (hrs, min, sec) has not been set.  
 Action: **OK:** To acknowledge the message.

---

Message: Init\_Error: Must select time unit for sample period.  
 Called By: **Initialize Logger** button on *Set-Up* Tab.  
 Description: Select unit of measure displayed if unit of measure (hrs, min, sec) has not been set.  
 Action: **OK:** To acknowledge the message.

---

Message: Scan period: [# hh:mm:ss]  
           Number of channels: [# Active Channels]  
           Description: [the Description]  
           Start delay: [Waits Time]  
           Current System Date & Time: [" Date / Time, "yy/mm/dd-hh:mm:ss]  
 If these settings are correct, then click OK to continue,  
 Or, click CANCEL to return to the setup screen.  
 Data upload should take only a few seconds.  
 Called By: **Initialize Logger** button on *Set-Up* Tab.  
 Description: An informative Up-load message. Last chance to verify the settings.  
 Action: **OK:** To acknowledge the message and continue with upload.  
       **Cancel:** To Cancel.

---

Message: Please wait while data logging settings are up-loaded to the data logger. Data upload should data only a few seconds.  
 Acknowledge this message to start upload.  
 Called By: **Initialize Logger** button on *Set-Up* Tab.  
 Description: Acknowledge this Up-load message to start upload.  
 Action: **OK:** To acknowledge the message and continue with upload.

---

---

Message: DATA HAS NEVER BEEN DOWNLOADED!  
 Select your choice from the below command buttons.

Called By: *Initialize Logger* button on *Set-Up* Tab.

Description: Data not Downloaded displayed if data on logger has never been downloaded.

Action: *Download*: To cancel upload and go to do download procedure.  
*No Download, Initialize*: To acknowledge the message and continue with upload. Current data will be lost.

---

Message: Value other than 0 must be entered.  
 Entry cannot be left blank.  
 Entry must be numeric.

Called By: *Scan period* entry on *Set-Up* Tab.

Description: Any one of these three messages could be display if scan period input is invalid.

Action: *OK*: To acknowledge the message.

---

Message: Entry must be numeric.  
 Entry must be greater than one.  
 Entry must be less than 255.

Called By: *Start Delay* in seconds on *Help* Tab.

Description: Any one of these three messages could be display if the start delay input is invalid.

Action: *OK*: To acknowledge the message.

---

Message: The Slope or Offset appears to be manually entered.  
 Click OK to keep the entered Slope & Offset, or  
 Click Cancel to Exit then click the Compute Cal Factors button to calculate new values.

Called By: *Exit / Save to Logger* button in the *Data Logger Calibration* Subroutine.

Description: To confirm use of the Slope or Offset that was manually entered.

Action: *OK*: To continue and save data.  
*Cancel*: To Cancel and then Re Calculate Values.

---

Message: Unanticipated error writing [CH#], please check input values.

Called By: *Exit / Save to Logger* button in the *Data Logger Calibration* Subroutine.

Description: To advise that an unanticipated error has occurred.

Action: *OK*: To continue.  
*Cancel*: To Cancel.

---

Message: Error in entering data. If Type error 13 reenter cal date.

Called By: *Exit / Save to Logger* button in the *Data Logger Calibration* Subroutine.

Description: To confirm an Unanticipated error.

Action: *OK*: To continue.  
*Cancel*: To Cancel.

---

---

Message: Channel will clip LOW data--Compare Calculation Results with EU at A.  
Channel will clip HIGH data--Compare Calculation Results with EU at B.

Called By: *Compute Cal Factors* button in the *Data Logger Calibration* Subroutine.

Description: One, or both of these messages may be displayed to warn of a possible problem due to values entered. Based on the logger calibration calculations, if the entered values for the full-scale range of the sensor are higher than the calculated full scale input range, then one or both of these messages may occur. For example, if the calculated MAX reading is 125 PSI, and the stated full-scale range of the sensor is 150 PSI, then the Clip HIGH Data message will appear since the full-scale range of the sensor cannot be reached.

Action: **OK:** To acknowledge.

---

Message: Channel number greater than number of installed channels, please re-enter channel number.  
Channel number less than one, please re-enter channel number.

Called By: *Channel number* input area in the *Data Logger Calibration* Subroutine.

Description: Invalid Channel Number. One, or both of these messages may be displayed to warn of a possible problem due to values entered. This message can only be reached by changing the channel number on the *Data Logger Calibration* Subroutine screen followed by a [tab] or clicking on another box.

Action: **OK:** To acknowledge.

---

Message: Range 0 – 1000000  
Range 0 – [Maximum Y Value]  
Min can not be greater than Max  
Max cannot be less than Min

Called By: When entering invalid values on Real Time Graph.

Description: One, or more of these messages may be displayed to warn of incorrect values entered.

Action: **OK:** To acknowledge.

---

Message: Please verify that the header information is still correct on the next screen. OK to continue.

Called By: *Check Header Memory* button on *Help* Tab.

Description: To inform user to check header information.  
NOTE: Not available on all versions

Action: **OK:** To continue.

## 7.3 Appendix C - SENSOR Calibration Notes

### 7.3.1 Introduction

Calibration of each of the logger's signal conditioner channels is performed at the factory, and generates values at 25 degrees Centigrade for the excitation current, offset voltage, and gain. On special order, values can also be generated for other temperatures. The following procedure outlines a method for combining these values with calibration information for each sensor to generate slope and offset for converting the final readings in volts to engineering unit values, such as psi, %RH, etc. The calibration subroutine screen can be initiated by double-clicking on any channel.

Each sensor is calibrated under controlled conditions, with a fixed excitation. In the case of Micron Instrument's DBST sensors, excitation is typically 4000 micro-Amps, or 4.000 mA. The sensor has two physical states applied to it: zero, and full scale. In the case of the DBST's, this often corresponds to 0 and 100 PSI, and -50 and 150 degrees Fahrenheit. The output of the sensor bridge is then measured in milli-Volts, and presented on the Calibration Certificate.

Measurements may be taken at other values as well—such as 20 and 80% of full scale. It is important that the EU and milli-Volts match a given reading—not that the readings are actually at 0 and 100% of Full scale.

By entering this information into the Calibration subroutine, the slope and offset values to be entered into the calibration data area of the Data Logger are generated. When data is subsequently downloaded, these slope and offset values are applied to the raw data in the classic  $Y=mX+b$  equation to convert the measured mV to the appropriate engineering units.

### 7.3.2 Calibration subroutine Inputs

#### For the Sensor

Identify which sensor is to be calibrated and enter the number into the Sensor Number box at the top of the screen. Repeat this process for each sensor to be calibrated. From the sensor calibration data sheet, determine the sensor model number, sensor serial number, and engineering units designator (e.g. psi, Deg. F, %RH, etc.), and enter them into the indicated text boxes. Although this information is not required for the calculations, it completes the record, and brings all of the information that is required to set up the logger together in one place.

From the sensor calibration data sheet, determine the excitation current used during the calibration, and enter it in the indicated box—"Excitation in micro-Amps." If the value is in milli-Amps, multiply it by 1000 to get micro-Amps.

From the sensor calibration data sheet, determine the engineering units value at the lowest point used for calibration. For pressure, this would typically be 0.00 psi, and for temperature might be 0, or -50 Deg. F—depending on the range being measured. Similarly, determine the engineering units value at the highest calibration point. For Pressure, this might be 100 psi or some other value. For temperature, typical values might be 100 or 150 Deg. F. Enter these values into their respective boxes ("EU at 0%", and "EU at 100%").

Next, from the sensor calibration data sheet, determine the sensor output in milli-Volts for each level, and enter into their respective boxes—labeled "milli-Volts at 0% EU" and "milli-Volts at 100% EU."

#### For the Logger Signal Conditioner

Determine the serial number of the logger, and enter it in the identified box.

From the Logger calibration sheet, determine the fixed excitation current in micro-Amps, and enter it in the box marked Excitation.

From the Logger calibration sheet, determine the offset voltage in milli-Volts, and enter this number in the box marked Offset.

Finally, from the logger calibration sheet, determine the gain and enter it in the box marked Gain. The gain is given as a ratio such as 16:1. The “:1” is assumed, and should not be entered.

Information of the methods used to calibrate the signal conditioners is contained in another appendix.

### 7.3.3 The Calculations

The signal conditioner portion of the logger multiplies the output of the sensor by the gain, and adds the offset voltage. It also uses (usually) an excitation current that is different from the one used to calibrate the sensors. The subroutine calculates this for 0% and 100% conditions.

The sensitivity of the logger is also calculated and presented in column “P.” The calculation determines the difference between the 0% and 100% EU values, and divides the result by the difference between the 0% and 100% mV signal conditioner output values. The logger resolution is one mV, so the sensitivity is also equivalent to the resolution of the logger, but in engineering units. Remember that resolution is the smallest unit that can be measured—and is NOT the same as accuracy! The data loggers typically have 1-4 mV of noise, and temperature drifts of 100 micro-Volts per degree are not unusual. So, to get a rough idea of the accuracy, multiply the sensitivity figure by 3 or 4.

The next set of calculations use the 0% and 100% EU values, and the 0% and 100% signal conditioner output values to calculate the slope (which happens to equal the sensitivity) and the offset needed to convert the raw data in milli-Volts to engineering units (EU’s).

#### 7.3.3.1 Entering the Calibration Data into the Logger Setup

The final step after entering the information is to select the *Compute Calibration* command button. This will complete the calculations and display the results in the boxes below the line of command buttons. The user may then determine if these values are to be saved or not. Selecting the *Exit/Save to Logger* command button will give *Save Changes Warning Message* ( See 7.1.15) and the opportunity to save data to logger or exit screen.

Since the data you enter now will be used to convert all subsequent readings to engineering units, it is strongly recommended that you validate the entry by disconnecting and re-connecting the logger, reading the header data, and checking the new calibration data against your calculation sheet. The calibration data sheet should also be printed and saved as part of your permanent test records.

#### 7.3.3.2 For Other Sources of Calibration Data

If system calibration data is available using a calibration stimulus applied directly to the sensor, with the data read directly from the Real Time screen, the following method may be used to enter this data into the calibration setup screen and derive the slope and offset:

Set the excitation current for both the sensor and the logger to the SAME value—typically 1000 uA. Set the GAIN of the signal conditioner to 1.0000. Set the OFFSET of the signal conditioner to 0.0000. Now enter the EU and milli-Volts for two levels of calibration data into the 0% and 100% boxes. Click on the calculate button to see the results. The Calculated Values reported at the bottom of the screen for zero, full scale, and sensitivity should match hand calculations and serve as a check of the data entered.

#### 7.3.3.3 For Constant Voltage or Constant Current Excitation Loggers

The calibration calculations are essentially identical. The math does not care whether the excitation is Kilo-Amperes or micro-Amperes. However—the units used MUST be consistent between the two boxes for the logger and the sensor! Cal Data is usually given in micro-Amps or milli-amps for constant current sensors, and milli-volts and Volts for constant voltage sensors.

## 7.4 Appendix D - Battery Life Calculations

Calibration sheets for the individual loggers will contain two numbers essential to estimating battery life: Quiescent (or continuous) and Active current draws. These numbers can also be easily determined by inserting a sensitive milli-Amp meter in series with a battery lead.

The actual numbers for your logger should be used in the following procedures. The numbers used below are a high, worst-case scenario using 4 of Micron's DBST sensors, and an 8-channel signal conditioner.

At 70 uA continuous, power consumption is 70  $\mu$ A/Hour, 1.68 mAH/Day, 11.76 mAH/Week, 50.96 mAH/month, or 611.5 mAH/Year. In other words,  $\mu$ AH/Hour is simply the same as quiescent current draw. Multiply this number by 24 hours to get the draw per day, by 168 for a week, 728 per month, and 8736 per year.

The signal conditioner is on for 200 mS (55.6  $\mu$ H) per scan, and off at all other times. At 26 mA/200mS per scan of 8 channels, one scan requires 1.44  $\mu$ AH ( $1.44 \times 10^{-3}$  mAH = 26 mA X 5.56  $\mu$ H). To fill maximum memory (5120 scans) requires 7.39 mAH or 1.44  $\mu$ AH X 5120.

At maximum scan rate of one scan per second, one hour of operation would use 5.20mAH, one day would use 124.8 mAH, one week would use 873.6 mAH, and two weeks would use 1747 mAH.

A Duracell Alkaline battery is nominally 580 mAH, and the UltraLife lithium batteries are nominally rated at 1,200 mAH. End-of-life voltage is considered to be 6.5 to 7.0 volts. Nominal "shelf life" of the UltraLife batteries is 10 years, with a temperature range of -40 to +70 degC. All calculations assume a constant 25 degC, and will change radically with temperature—particularly at the extremes. You should contact the manufacturer of the battery you plan to use to obtain current curves.

SO....for the lithium batteries:

No logging life: 1.96 years

Max continuous logging life at one scan per second: 1.37 weeks or 9.6 days.

One year of life would allow about 409,000 scans, for a scan interval of about 77 seconds.

Maximum life to fill memory once would be 1.95 years at a scan interval of 3.336 hours.

Are these numbers real? From data on a sample of 12 delivered loggers, the average quiescent current was 53 uA, peaking at 69 uA—thus the 70  $\mu$ A used above. For Scan power, the average was 23 mA, with a worst case of 26--which is also used above. The 580 and 1200 mAH values are straight out of the Mouser and Digikey catalogs.

Please install fresh batteries at the beginning of a test of any duration.

## 7.5 Appendix E - Technical Specifications

A/D converter--Maxim MAX186D

Note: all readings are ratiometric to Vref. 1 LSB = 0.024% or 244 PPM

Resolution 12 bits

"Relative Accuracy" +/- 1 LSB ("the deviation of the analog value at any code from its theoretical value after the full scale range has been calibrated.")

Differential Non-Linearity +/- 1 LSB

Offset Error +/- 3 LSB

Gain Error +/- 3 LSB

Vref output voltage 4.096 +/- 20 mV\*\*\*

Vref Tempco +/- 30 PPM/DegC

REF192 or 191-G's are used as the constant current and constant voltage sources

Reference voltage accuracy +/- 10 mV\*\*\*

Long term Stability--1000 hours at 125DegC, 1.2 mV

Tempco, 10 PPM/DegC

Offset and gain errors other than those related to temperature and time can be corrected during the system calibration of the sensor and the logger as a combined unit, and correction factors are incorporated into the  $y = mx + b$  coefficients entered into the logger and applied to the raw data during download.

Time related drifts are not quantified for the critical components such as the A/D, and can be gained only through experience.

Critical temperature data is given above. Worst offenders are the resistors used to set gains, calibration, and offset voltages at 100 PPM, and the Vref Tempco for the A/D converter at 30 PPM. Preliminary worst-case test runs suggest 9 mV over 0-50 DegC, or about 180 PPM/DegC from all sources.

In summary, overall accuracy should be better than six parts in 4096, or about 0.15% at constant temperature, and around 1% over 0-50 DegC.

Other sources of error: signal noise coming down the cable from your sensors. Typically using stable, fixed resistor bridges on a 24 inch unshielded cable, this is about +/- 1 mV --with a maximum of about +/- three mV.

\*\*\* Items corrected during system calibration and reflected in the slope and offset calibration figures.

## 7.6 Appendix F - Intrinsic Safety Issues

### GENERAL

The MOD-1A loggers were designed for long-term deployments running on a single battery, and they were to be removed from the environment being monitored to a non-hazardous depot for downloading and maintenance. Accordingly the components for the serial data interface to the PC and the external power supply were contained in a separate module called the SIA. The SIA also provided local power to the logger during the download stages, which was limited to approximately 11 volts DC, and derived from a small wall-mounted power supply. The logger itself had minimal protection of the interface—consisting primarily of Zener diodes from each I/O line to ground, which limit the maximum input power to 15 volts, and signal levels to 7.5 volts. There are no current limiting resistors or fuses on any of the lines.

BH-M1A Loggers, on the other hand, are designed to include the functions of the SIA within the logger case, and have RS-232 serial interface chips with up to 15KV of ESD protection. Up to 24 VDC external power can be applied to the logger, and is reduced to approximately 10 volts DC for distribution to the logger circuit. This supply can also provide current limiting if required—and it is fused and provided with both over-voltage protection Zener diodes, and reverse voltage protection diodes. This voltage is further reduced to 5 volts DC for digital logic functions within the logger.

Both loggers are designed to run from internal batteries—nominally 9-volt transistor radio batteries—of either Alkaline or Lithium chemistries. The batteries are diode isolated from the external power, and whichever voltage is higher will provide the operating current to the loggers. The batteries are not fused and do not have over-voltage protection diodes. The batteries are capable of providing several hundred milli-Amps for short periods. However, they feed drop-down regulators designed to current limit in the 40-100 mA range, and normally fail in the “no-output” mode—although this should be verified with the manufacturers of the regulators.

Since the Loggers draw minimal current while in operation, it would be practical to add external intrinsic safety barriers on the external power input.

Normally the logger itself would not be mounted in close contact with hazardous material. The sensors, however, may be in intimate contact with ignitable materials.

### SIGNAL CONDITIONING CONSIDERATION

Both loggers draw from the 9-volt batteries to generate approximately +/- 8 volt power rails when the batteries are new—dropping to about 5 volts when the batteries are discharged. These rails are capacitively bypassed (with a cumulative total of <30 uF for MOD-1A), and connect to the Instrumentation Amplifier (IA), op-amps, excitation, and reference voltage supplies. The IA's do not supply voltage to the signal inputs, and generally clamp the signal inputs to close to the power supply rails. Failure modes of the IA's are unknown at this time.

The DBST sensors require about 1 mA of excitation current supplied by a constant current supply in the logger. Compliance voltages are the battery voltage less about 3 volts. With a new battery, this would be about 7 volts, and about 4 volts with a dead battery. The constant current supplies have a 1 uF capacitor to ground. The Mod-2 loggers have an optional capability to provide up to +/- 15 volts to the analog power rails for special sensors, but this circuitry is not installed for the DBST sensors.

## **7.7 Appendix G - Power and Timing Issues**

Over the past year, a number of requests have been made for alterations to the Dascor Loggers to minimize power draw and change the logger's overall functionality. This brief discussion is intended to review the operational architecture of the hardware, firmware and software so that the advantages and limitations of the loggers are understood.

### **Date and Time Generation**

There is no "real time clock" per se in the logger. This fundamental fact needs to be clearly understood! Time is kept very simply as a seconds count. There is a precise timer based on a watch crystal that activates the firmware once every second. A counter keeps track of the number of elapsed seconds, compares the reading with a "trigger" count, and performs an action when a match occurs. "Real" date and time of the initialization is stored as textual information within the logger, and indicates the "Zero count" moment when the seconds counter is set to zero and started.

The scan interval in seconds, minutes, or hours is entered by the operator. The software converts it to an interval in seconds, which is stored in the logger. A comparison value is calculated and stored, and once a match is realized with the elapsed seconds counter, a scan occurs, the next elapsed count is calculated and stored into the comparator, and the cycle repeats.

When the data is downloaded, the Header contains the date and time of the initialization and the scan interval. During the download process, the actual date and time of each scan is derived mathematically from this basic information and added to the data file in the first column.

The key point here is that date and time information that appears in the .CSV data file is not based on a real-time clock in the logger, and is not stored in the logger--it is re-created from the basic setup information.

### **Using The PC's Clock**

There is another critical point that needs to be made: The time and date stored in the logger is based on the time and date of the real-time clock in the PC or laptop that is setting up the logger. If that clock is in error--i.e. it does not reflect true Universal Coordinated Time with any time zone factors--then all times and dates reported by the logger will be relative to the initializing PC rather than "true" time and date.

If precise time relationships are required between multiple loggers to identify common events, then it is imperative that all of the loggers share a common, precise time reference. In turn this demands setting the internal clock on the PC's precisely to a common standard.

There are a number of public domain programs available from NIST, and an excellent application from Intuit Software called "Atomic Clock" (About \$19 + Shipping) that will automatically call a nearby standards lab (e.g. NIST in Boulder Colorado, or the Greenwich Observatory in England) and set the PC's internal clock to match time and date within a few milliseconds of UCT. This does require a modem and phone connection.

There are also dedicated low cost radio receivers that will perform the same function by monitoring one of the WWV or WWVH stations. These units may not function in your location if the signals are particularly weak. GPS receivers with serial interfaces can also be used as very accurate time bases, but in either case you would need to contact the manufacturer of the device for software support.

The clocks in PC's are fairly stable, but do drift with time, temperature and variations in power supplies. "Nominal" accuracy is a few seconds a day, but variations of several minutes over a few days have been observed.

### **Logger Clock Accuracy**

The clock in the data logger is derived from a standard watch crystal. Nominal accuracy is +/- 20 PPM or about 2 seconds per day. This is a ten-minute error over the course of a year. However, watch crystals have a fairly high temperature coefficient, and operation outside of a 20-25 DegC ambient will cause significant time drift—70 PPM is not unusual. Tempco's are fairly predictable, and drift can be estimated if the temperature history is known, but can be several hours per year.

For precision time bases that are stable over time and temperature, crystals must be maintained in a constant temperature oven, and/or have compensating circuitry--both of which are expensive in terms of cost and power consumption--and are usually not justified in a relatively low cost or very low power data logger.

Why does your \$10 watch keep better time than your \$2000 computer? It is next to your skin, and your body heat maintains it at a reasonably constant temperature.

Actual timer tests using a precision Fluke Counter indicate that at short scan intervals (say <30 seconds) there is a fair amount of jitter in the timing of the individual readings—on the order of 60-100 PPM, or about an hour a year. At scan periods longer than a minute, the jitter settles down to a reasonable 5-10 PPM, or about 5 minutes a year.

In general, the shorter periods see the short-term drift of the crystal, while the longer periods average this effect and minimize it. Keep in mind that although the actual time of an individual scan may be off slightly, the overall should average out to the rated 20 PPM of the watch crystal if it is maintained at constant temperature.

### Why not use a watch chip?

There were a number of reasons that went into the decision early in the design process. The main issues were programming complexity, cost, available memory, and the mandatory (at that time) requirement to monitor other activities such as the battery condition and the need to communicate with the external world. It was decided that the most effective solution from all standpoints was to dedicate a low cost, low power microprocessor to the task of keeping track of elapsed time and monitoring the battery and communications lines for activity, then waking up the main processor when required. Furthermore, storing trigger values as Years, Months, Days, Hours, Minutes, and Seconds would have required significantly more memory, and radically increased the complexity, reliability, and cost of the firmware and software.

### Power Issues

The processor that keeps track of the elapsed seconds count, and the event match counts must run continuously. If it is turned off for any reason, including disconnecting the batteries, or being "put to sleep," it will stop counting elapsed seconds. When it is turned back on, it has no way of knowing how long it was not counting, and will pick up where it left off. The result is that there is a missing number of seconds that cannot be determined, and the relation of subsequent second counts will have NO relation to the time the logger was initialized--and any reconstructed dates and times will be meaningless. It is for this reason that logging is not resumed following battery failure, and should not be resumed after a battery disconnect.

The point here is: Because the elapsed time count is compromised by any power loss, it is not possible to disconnect the power without initializing the logger again following restoration of power.

### Power Consumption

The lowest power consumption, by design, is when the clock processor is the only active device, and it is merely monitoring signal lines, counting elapsed seconds, and waiting for an event match. Typical power draw is typically between 30 and 50 micro-Amps--and is continuous.

When an event occurs, the main processor turns on, as does the signal conditioning power, and the current draw can go towards 30 milli-Amps--a three order of magnitude increase. However, when running strictly on battery power, the main processor is turned on for a fraction of a second at intervals ranging from

one second to over 18 hours. As a result, when in environmental logging mode with scan intervals of several hours, the power drawn by the main processor and analog circuits is insignificant compared to the continuous draw of the clock. As scan rates increase (intervals decrease), the duty cycle increases, and this power draw starts to become more and more significant.

### **Power Conservation and Storage**

Since the least amount of power is drawn when only the clock processor is running, the longest battery life is when the scan interval is at its maximum duration, and the delayed start is also at its maximum. These conditions effectively minimize the "on" time of the main processor and the analog circuitry.

If a logger is to be stored for extended periods of time without being used, the battery/s should be disconnected and removed--particularly if carbon or alkaline batteries are used. When the device is placed back into service, new batteries should be installed, and the device initialized using normal procedures.

For shorter periods of time, where it is not considered practical to remove the batteries, the logger should be initialized with the setup conditions that minimize battery drain. This would be to set both delayed start and scan intervals to the maximum values allowed. When required to be readied for service, a standard setup and initialization would be the only requirement. Bear in mind that power has been drawn from the batteries during the "idle" interval, and the remaining battery life should be kept in mind prior to long deployments!

### **Power Sources**

The data loggers are designed to derive their power from one or more internal batteries, or an external source. The internal "raw" power rail is connected to the various sources through isolating diodes. Whichever source has the highest voltage will supply the power to the "raw" power rail. This is why the SIA modules output about 11 volts--which is sufficient to over-ride the maximum fully charged battery voltage (9.5 volts nominal).

### **External Power**

In cases where it is desired to run the SIA in conjunction with a laptop, and utility power is not available for the wall-supply, a separate battery clip and plug are provided to allow the SIA to operate off of a standard 9-volt transistor radio battery. The SIA draws about 12.5 mA in idle mode, and increases depending on the state of the battery in the logger.

In the case of the MOD-1 logger, if it is desired to power the logger from the external battery as well, then a standard 2.5MM male monaural audio plug can be used to connect the SIA to a standard 12 volt cell, cigarette lighter or other 12 volt DC power source. The tip is positive, and the ring or barrel is negative/ground.

Both units are designed to work from internal 9 volt batteries, or external 12 volt supplies. Both units should operate from 24 volts DC as well, but will internally self-protect at voltages much over 24 by appearing to the power source as a short circuit.

### **Storage Options**

There are effectively two options: remove the batteries, or put the logger into the lowest power consumption mode.

The first option requires re-initialization on power-up. The second consumes small but finite amounts of power and potentially compromises battery life. It also requires re-initialization prior to deployment.

It should be noted that the **Remote Start** option was implemented primarily to allow conservation of memory during "dead" transit times to the deployment site--but also happens to be the lowest power consumption mode.

### **Battery Disconnect Switches**

It is possible to add a switch in series with the battery, so that the power to the logger may be completely disconnected for short-term storage without opening the case. However, it should be noted that the logger **MUST** be re-initialized on power-up to restore an accurate time base to the system, and any subsequent power-down and power-up will destroy any subsequent accuracy in the time base.

Further, a mechanical switch always has the potential of being "accidentally" turned off--or on--at the wrong time and potentially compromising all data in the logger. As a result, disconnect switches are not recommended and were not included in the original design.

It would be possible to add a mechanical switch to one of the logger engine battery stacks. During transport or storage, the second stack could be turned off, leaving the logger to draw power from the first stack. On field deployment, the second stack could be turned back on. Since it had not been used, its higher voltage would prevail until the second stack had been drawn down to the level of the first. At this point, power would be drawn from both stacks until they reached the "low battery" alarm level, at which point the logger would be put into permanent sleep mode until awakened by the download PC. The arguments above about accidental (or intentional) activation or de-activation of the second stack still apply.

## 7.8 Appendix H - Logger Calibration

NOTE that this procedure is different than that given previously for calibration of the sensors. This section applies only to the internal signal conditioner.

In order to calibrate the signal conditioner and ADC in the logger using a procedure similar to that used by DASCOR, you will need the following items:

- A set of four shorting plugs where all pins are tied together, except the Excitation plus pin. (Mandatory on all pre-M1A loggers. Optional on MOD-1A loggers.)
- A single sensor plug with the following connections:
  1. A resistor from Sp+ to Sp- to give a voltage at about 80% of full scale sensor output for the anticipated excitation current or voltage. A pair of leads should go from the resistor to a voltmeter capable of suitable resolution in the mV range.
  2. A resistor from St+ to St- to give a voltage at about 80% of full scale for the anticipated excitation current or voltage. A pair of leads should go from the resistor to a voltmeter capable of suitable resolution in the mV range.
  3. Sp- should be wired to St+, and St- should be wired to Ex-.
  4. A pair of leads should be brought out from SP+ and Ex+ and tied to a milli-Amp meter with suitable resolution.
- A worksheet copied from the Signal Conditioner Calibration spreadsheet on the Installation CD, or access to the spreadsheet itself, with the Master sheet copied to a new working sheet, with the serial number of the logger and other pertinent one-time data inserted appropriately.

### PROCEDURE:

Insert the shorting plugs into each of the four sensor connectors. With the battery installed, connect the logger to the Host Computer, and wait for the Logger Data screen to appear. Verify the serial numbers and other parameters are correct. Be sure the logger is set up and running with all 8 channels enabled. Re-initialize if necessary—but use a long scan interval such as one hour or more.

Move to the Real Time screen, and check the box to enable display in mV. Start the display, and then check the *Accumulate Statistics* box. Wait until at least 100 readings have accumulated (you may collect other amounts of readings if you wish), and click the *Accumulate Statistics* box again to freeze the readings. Transfer the average readings to the **Voffset** column on the worksheet. MaxDev and 3Sigma should also be recorded.

Replace one of the shorting plugs with the special plug. Check the *Accumulate Statistics* box to start the process again. After 100 readings, freeze the statistics, and transfer the averages for the channel pair with the special plug to the **Vout** column, along with MaxDev if desired. Read the excitation current in micro-amps and write it into the **Ix** column. Note that the spreadsheet will copy the number to the second channel of the pair automatically. Measure the voltage across the Pressure Resistor, and place the voltage in milli-Volts into the **Vin** column box for the first channel of the pair, and repeat for the Temperature resistor, with the data going into the second box in the **Vin** column.

When all of the data for a given channel has been entered, the gains and gain error will be automatically calculated according to the following formula:

$$\text{Gain} = (\text{Vout} - \text{Voffset}) / \text{Vin}$$

Dascor utilizes an HP 34970A Data Acquisition system which provides channels for measuring the excitation current and Vin voltages under computer control, and has 6-1/2 digits of resolution in each measurement range.

These tests are normally performed at ambient—20 to 25 degrees Centigrade, but may be performed at other temperatures to derive temperature coefficients for offset and gain.

## 7.9 *Appendix I - Printer Setup*

Many screens have a *Print* command button located on them. Clicking on this button will send an image of the present window to the system printer. In an office setting, this would be the “default” printer normally used when printing documents.

If you would like to send the image to a file for later printing (when running in the field on a lap-top, for example), then you will need to create a new printer and make it the system default.

Go Start / Settings / Printers / Add Printer. Create a new printer of the same make and model as your default system printer, but specify “FILE” for the destination, and “YES” to make the printer the system default.

Now when you hit the Print button, a file name dialog box will appear. You will need to enter the folder and file name for the file to be created, and click OK or save to store the image.

To print the image, move the file to the system with the actual printer and drag the icon from the folder to the printer icon on the desktop.

To reset your default printer to an actual printer, go to the printers window, select the desired printer, then select *File/Set Default*.

For unusual systems or problems, consult the Windows *HELP* system, or your MIS Manager.

### **7.10 Appendix J - Serial Interface Adapter (SIA)**

The SIA provides a means of powering the logger from the utility mains through a wall-mount power supply. It also provides an interface between the RS232 serial port on the PC and the TTL levels used by the logger in communication.

The SIA power supply should be plugged in to an outlet or power bar adjacent to the computer. The low voltage plug should then be inserted into the SIA and the standard DB-9 mouse extender cable connected between the SIA and an open serial port on the PC.

When the software is run for the first time, the Default Tab should be activated, and the correct serial port selected, and any other pertinent information should be entered as well.

With the software running, plug the SIA connector into the I/O port on the logger. The software will recognize the presence of the logger and begin downloading the Logger Header information. If a logger is not recognized, be sure the battery in the logger is installed, or still good. A missing or dead battery will not allow the SIA to communicate with the logger.

NOTE: occasionally if the SIA is connected to the PC and plugged into an operational logger, and the PC is started from a Power-Off condition or given a forced system reset, Windows will occasionally treat the SIA/Logger combination as a new "unknown" device. This can be prevented by unplugging the SIA from an attached logger prior to starting/re-starting windows.

For field use, the wall-mount power supply may be replaced by a 12-15 volt battery pack. It is essential for normal operation of the system that the power provided to the SIA be no lower than 12 volts, and no higher than 24 volts. Approximately 100 mA or less is required, but it is imperative that the power source be capable of providing much higher currents for short intervals. Batteries come into this category, but other sources should have a suitable LOW ESR Capacitor across the output. 2200uF or larger is suitable.

Inadequacy of the power supply will show up as excessive noise in the readings on the Real Time screen and in data logged while connected to the power supply.

## 7.11 Appendix K – Calibration Setup Procedures for Micron Instrument’s DBST Sensors with DASCOR ML 1000 Loggers Using M1A-V30 Software

### 7.11.1 GENERAL NOTES

This DBST/ logger setup procedure has been simplified for the entry of appropriate calibration information into the M1A data logger operator interface software and is specific to the DASCOR ML1000 series logger and the Micron Instruments DBST (Dual Bond Stress and Temperature Sensor). Future releases of the operator interface software may see minor changes to the descriptive fields identifying data entry boxes, but will be identical in performance.

On the calibration screen, there are several frames dedicated to specific types of data. In the procedure below, text in *italics* identifies the specific box into which data is to be entered, or chart from which the data is taken. Specific data to be entered is shown in the **bold** typeface on the logger calibration sheet and gray boxes on the sensor calibration sheet.

For the Logger frame, each channel needs three data entered into the signal conditioner frame that describe the hardware setup of the channel. The excitation describes the actual excitation current generated by the logger—which is not the same excitation used to calibrate the sensor. The offset and gain entries describe the hardware setup of the instrumentation amplifier for that channel. Changing the values entered does not change the setting of the signal conditioner!

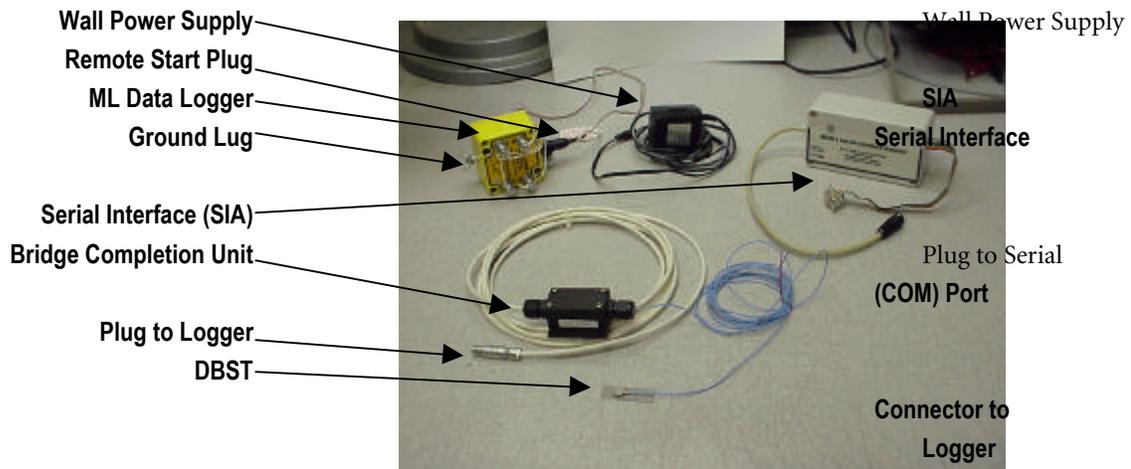
For the Sensor frame, it is important to correctly enter the excitation that was used to calibrate the sensor. In the case of the DBST sensors, this is typically 4000 uA (4.0 mA) constant current. The units used to enter the excitation in both sections must match. Entering one as uA and the other as mA will result in a 1000:1 error in the engineering units calculations! These numbers are used by the program to generate a composite calibration and generate the factors for converting raw ADC Counts to EU (Engineering Units) during download. Differences in excitation used to calibrate each unit are automatically taken into account by the program.

Many of the fields are “TEXT” fields. *EU*, *Serial numbers*, and *model numbers* are examples of this type of field. Any alphanumeric text may be entered, limited only by the available length of the field (usually four or eight characters). Any printable character is legal.

For numeric fields such as Gain and Excitation, numbers may be entered using either fixed (e.g. 1020.00) or floating point (e.g. 1.020E03) notation. They will be changed to floating point during storage to the logger, and will appear as floating point on any future connections. However, it is imperative that consistent engineering units are used! Do not enter mV in one field, and Volts in another that is expecting mV. Fields can be edited by usual windows editing techniques.

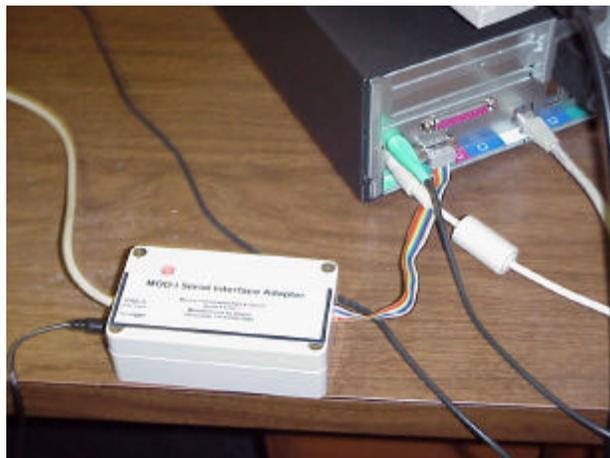
### 7.11.2 SYSTEM SETUP

The system consists of three parts, the sensors, the logger and the interface as shown in Figure 1. The interface can be powered from a mains adapter or from 15 DCV external batteries.



**Figure 1. System components.**

Initially, the logger must be connected to the SIA (serial interface adapter), which in turn must be connected to the host computer (PC or laptop) and to wall power using the adapter provided or external batteries. This arrangement is shown in Figure 2. The red active light will indicate that the system is running on external power and you can communicate with the logger. The M1A-V30 series of software must be running on the PC.



**Figure 2. Connecting the Logger to the PC.**

### 7.11.3 DATA INPUT PROCEDURE

Select M1A-V30 program and click on *Log On* tab. If the SIA is not powered or connected to the computer, a window message will warn operator. Once the logger is connected and the logger information screen is showing, click on the *Calibration* tab at the top of the main

window. Next, double-click on row for the channel desired to get to the window shown below in Figure 3. If the logger is enabled you will get a message box ask if you want to turn off logger. Click OK to continue.

You should note that some fields (such as Excitation EU, Model #, etc.) may be pre-loaded, and do not have to be re-entered unless there are changes to the information.

**Calibration Sub-Routine**

Data Logger Calibration Subroutine

Enter Channel number being calibrated:  Cal Due  Excitation EU (uAmp/mV)

Sensor Calibration Information

Model #:  S/N  Eng. Units

LocCode:  Excitation (uA/mV)

Millivolts at A  EU at A  MIN Full Scale EU

Millivolts at B  EU at B  MAX Full Scale EU

Data Logger Cal Information

S/N  Excitation (uA/mV)  Offset (Millivolts)  Gain

Logger Settings

Slope  Offset

Calculation results

Minimum EU Output  Maximum EU Output  Sensitivity (EU/mv)

Save / Recall Settings For This Channel

**Figure 3. Calibration Screen from DASCOR's software (pressure channel)**

The logger numbers the attached sensors from 1 through 4. Each connector on the logger (numbered P1 through P4) supports one DBST sensor with two channels: one pressure, and one temperature channel. Internally, P1 is assigned to channels 1 and 2, P2 is assigned to channels 3 and 4, and so on. Odd channels (1, 3, 5, 7) are always pressure (psi) channels as shown in Figure 3, and even channels (2, 4, 6, 8) are always temperature (deg F) channels with an example shown in Figure 4.

**Calibration Sub-Routine**

Data Logger Calibration Subroutine

Enter Channel number being calibrated:  Cal Due  Excitation EU (uAmp/mV)

**Sensor Calibration Information**

Model #:	<input type="text" value="141541.."/>	S/N	<input type="text" value="222...."/>	Eng. Units	<input type="text" value="DegF"/>
LocCode:	<input type="text" value="Ch2."/>	Excitation (uA/mV)	<input type="text" value="+4.00000E+03"/>		
Millivolts at A	<input type="text" value="-1.17400E+02"/>	EU at A	<input type="text" value="-5.00000E+01"/>	MIN Full Scale EU	<input type="text" value="-5.00000E+01"/>
Millivolts at B	<input type="text" value="+1.53700E+02"/>	EU at B	<input type="text" value="+1.50000E+02"/>	MAX Full Scale EU	<input type="text" value="+1.50000E+02"/>

**Data Logger Cal Information**

S/N  Excitation (uA/mV)  Offset (Millivolts)  Gain

**Logger Settings**

Slope  Offset

**Calculation results**

Minimum EU Output  Maximum EU Output  Sensitivity (EU/mv)

**Save / Recall Settings For This Channel**

**Figure 4. Temperature Channel Calibration Screen**

Select the sensor (channel) to be set up by entering its number (1 thru 8) into the top left box (*Enter Sensor Number Being Calibrated*). Then click on any other box, or hit the TAB key, which will load any pre-existing data held in the logger into the boxes on the form. *Recall from Clipboard* or *Recall from File* will also load data saved to the Logger clipboard (different from the windows clipboard) or from a file.

Update the *Cal Due* date if desired as a reminder of a scheduled re-calibration due date for either the logger or sensor, and enter the Engineering Units (EU) for the Excitation EU. This is "uAmp" or "uA" for the DBST sensors—and is usually pre-loaded. These are text fields and have no limits on their contents other than length.

In the *Sensor Calibration Information* frame, begin by entering from the *Transducer Calibration Data Sheet* (example given in Figure 5) the *Model Number*, *Serial Number*, and *Eng. Units* (EU) into their respective boxes. Again, these are text fields and have no limits on their contents other than length, but they should accurately describe the sensor and its intended operation. The *Model Number* and *Eng. Units* may already be loaded.

Enter a four-character string of your choosing that provides information about the location of the sensor into the *LocCode* box. Or, leave it as-is. This field is provided as a convenience for entering specific information about the sensor, such as its location number or other mnemonic. The field defaults to the channel number.

Enter the excitation current used to factory calibrate the sensor. For DBST's this is always **4000 uA**. Be sure the units are consistent with those shown in the Excitation EU box, and used for entering the signal Conditioner Cal Information. As shown above, 4,000 uA is equivalent with 4.000 mA and is consistent with the units shown (uA) and also used in the Signal Conditioner section (uA).

The values to be entered into the Milli-Volts at A and Milli-Volts at B boxes are sensors output at the given calibration levels and the details on determining the actual input values are given in Section D for both pressure and temperature calibration.

EU at A is one box to the right of Milli-Volts at A and is the lowest calibration stress (calibration pressure setting) and is **0.0** psi (gage) for stress channels and **-50** deg F for the temperature channels.

EU at B is just under EU at A and is the full scale or upper setting, which is **100** psi for stress and **+150** deg F for temperature.

These setting are used by the logger to identify the pressure and temperature value used for calibration at each of the two points. They may already be loaded.

For *Full Scale EU at A* which is the third light yellow box left to right and third yellow box top going down, set the most negative full scale rating of the sensor. For stress it is **-100** psi (where “-“ indicates tensile stress) and for temperature it is **-50** deg F. This setting is used to determine if the logger will clip the readings at the negative or lower full-scale, and may already be pre-loaded.

For *Full Scale EU at B* which is the third box left to right and the fourth top down, set the most positive full scale rating of the stress sensor, which is **+100** psi ( where “+” indicates compressive stress) or **+150** deg F for the temperature channels. This setting is used to determine if the logger will clip the readings at the positive or higher full-scale, and may already be pre-loaded.

From the DASCOR signal conditioner calibration sheet (example shown in Figure 6), enter the appropriate numbers for *Excitation*, *Offset*, and *Gain* into the fields in the *Signal Conditioner Cal Information* frame. Note: the correct numbers are highlighted by **BOLDFACE** on the DASCOR calibration sheet. They are the actual values set in hardware in the logger. Changing the entries will NOT change the settings in the logger, but will corrupt the conversion of the raw data to engineering units. Loggers will normally be delivered with these numbers pre-loaded, and they would be changed only when a 2-point field calibration is performed, or to return the original numbers after a field calibration.

### **CLICK ON COMPUTE CAL FACTORS, AND OBSERVE THE RESULTS**

It is important to note that the software will check the match between the sensor highlighted in RED until the condition is corrected. The logger will still function under these conditions but with a reduced range. These boxes (when green) show the over-range available for each channel as well.

The *sensitivity* Box shows about 0.05 PSI per ADC count as the resolution of the logger. The *Slope* and *Offset* boxes, in this example, show the factors used in the  $Y=MX+B$  form and the logger, and report conditions that would cause clipping of the input signal. The most common cause of clipping is a sensor sensitivity that is too high for the input gains built into the logger, or a logger offset voltage that does not match the range of the sensor. When this occurs, the logger

will show a message box, which requires the operator to acknowledge the condition before proceeding. Finally, the *output at 0 mV (Minimum EU Output)* and output at 4096 mV (Maximum EU Output) boxes will be used to convert raw ADC counts to engineering units in the spreadsheet generated during the downloading of raw data from the logger.

**ALWAYS REMEMBER TO SAVE THE RESULTS TO THE LOGGER!**

#### 7.11.4 DBST Specific Data Entry Discussion and Example.

DBST stands for **Dual Bond Stress and Temperature** sensor. During calibration of the sensor, pneumatic pressure is applied to the sensor to simulate bond stress. To apply this pressure to the cylindrical sensor, Micron uses a pressure calibration adapter. It has been proven that the pressure (stress) sensitivity of the sensor does not change from adapter to adapter but the balance offset does. This adapter-induced balance offset is usually small, usually less than 0.5 milli-volts. For maximum precision the balance offset taken with the sensor out of the pressure adapter should be used. The Temperature Sensor output at the calibration temperatures are as given with no offset.

All of the DBST data necessary to input into the logger is contained in Micron's standard calibration data sheets as shown in the Figure 5, *Transducer Calibration Data*. To make it easier to identify the four numbers required to range the logger, their backgrounds are shown in gray. The numbers used in this sample procedure are specific for sensor S/N 57862 only, and will be different for other sensors.

To set the loggers to read the correct pressure, i.e. the odd channels, two numbers are required. They are the balance of the sensor at zero pressure (stress) and the full scale (100psi) output of the sensor (given in milli-volts). Most sensors are purchased with the thermal hysteresis option. Therefore the zero pressure data point at 50 deg F should be used since it is mid-range and we also have a sensitivity reading at 50 deg F on the data sheet in the *Thermal Pressure Sensitivity Data* chart, which in this example is 22.95 mV.

The zero pressure stress sensor output is **-0.11** mV from the *Zero Stress Sensor Outputs/Versus Temperature* Chart at 50 deg F and this value is entered into the *Milli Volts at A* box.

The 100 psi full-scale milli-volts is calculated by algebraically adding the zero pressure offset to the (100 psi) sensitivity at 50 deg F. In this example algebraically adding the -0.11 to a value of 22.95 results in a **22.84** mV which is the full-scale output at 100 psi compression at 50 deg F for out of the fixture true settings. The value **22.84** mV should be entered into the *Milli-Volts at B* box. These example numbers may be seen in the screen shown in Figure 3. For sensors with full Thermal Hysteresis this number is printed in shaded gray box under the data table (not included in Figure 5).

The *Zero Stress Output/Temperature* chart shows data transferred from the Thermal Hysteresis (TH) test. In this application the sensor has been bonded to a shim, which may change the balance. Usually, this is a small change and sometimes it's negligible. The same chart will be provided for un-shimmed sensors.

For sensors purchased without TH, the *Zero Stress Output/Temperature Data* Chart will only have sensor outputs at -50, 50 and 150 deg F with the other boxes blank.

To set the loggers to read the correct temperature you follow essentially the same procedure outline above, you will need to move to the appropriate sensor channel for the sensor being set up. Since this is a temperature channel, it will be even numbered. As previously, enter the channel number into the top left box and click on any other box, or hit the TAB key to display any data already existing in the logger for that channel. Update the Logger settings from the DASCOR Cal Sheet shown in Figure 6 if necessary.

The Temperature Sensor output shown in the *Zero Stress Output/Temperature Data Chart* (Figure 5) at  $-50$  deg F (**-117.4** mV for this sensor) is the low setting value. This value of **-117.4** mV should be entered into the *Milli-Volts at A box*.

The Temperature Sensor output shown in the *Zero Stress Output/Temperature Data Chart* (Figure 5) at  $150$  deg F (**153.7** mV for the high setting) should be entered into the *Milli-Volts at B box*.

These figures came from the Micron Transducer Calibration Data sheet, zero stress/temperature outputs which are from the thermal hysteresis testing. See Figure 3 for the example showing the correct entry figures and the gray boxes in Figure 5 for the  $-50$  and  $+150$  deg F Temperature Sensor outputs.

### **CLICK ON COMPUTE CAL FACTORS, AND OBSERVE THE RESULTS**

#### **7.11.5 SYSTEM CALIBRATIONS**

For a two-point field calibration, see the appropriate addendum to the software manual for detailed procedures. In essence, the signal conditioner gain box is set to **1.000**, the offset to **0.000**, and the excitation to whatever value is set for the sensor. The actual value entered for excitation can be just about anything...the critical point is that the sensor and signal conditioner excitation entries be identical.

The two points are generated by applying known stimuli to the sensor, and the ADC counts (mV) are read from the Real Time screen on the logger software. This data is then entered for points A and B, and the software will calculate a correct slope and offset that automatically takes all other corrections into account.

**ALWAYS REMEMBER TO SAVE THE RESULTS TO THE LOGGER!**

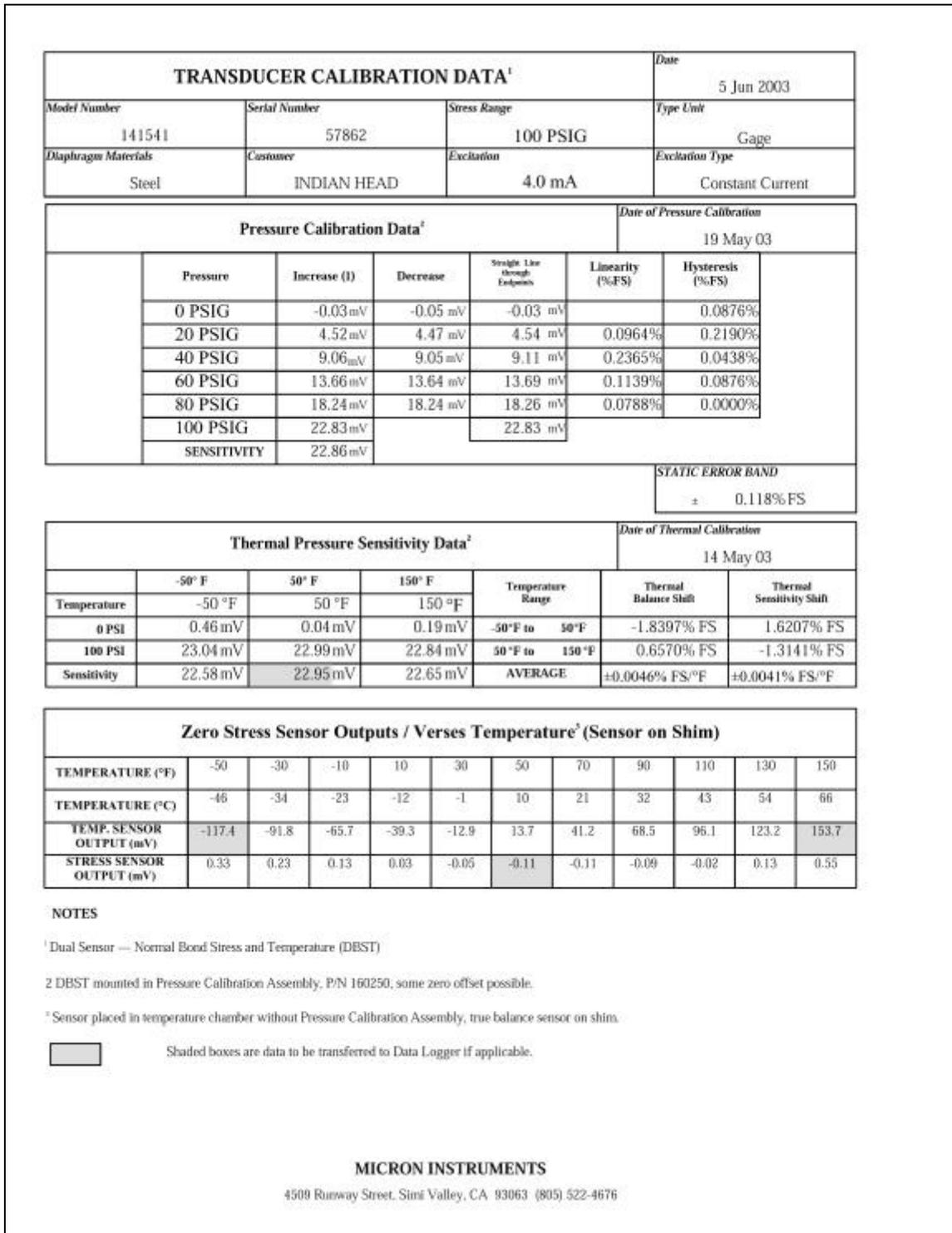


Figure 5. MICRON Calibration Sheet for the DBST Sensor used in the examples

**Serial #: 0305-0001--051303**

### Data Logger Calibration Report

Model No. **ML10081a**  
 Serial No. **0305-0001**  
 SGC S/N: **0305-0001**  
 Date: **5/13/2003**  
 Temp (C) **25**

Quiescent Power: **<=75 uA**  
 Header Memory: **OK**  
 Data Memory: **OK**  
 Download: **OK**  
 Low Battery: **OK**

Remote Start: **OK**

**Target Gains**  
 Odd Channels: **331.9**  
 Even Channels: **42.67**

ChNo.	Iexc-uA MicroAmps	Voffset Milli-Volts	Max Dev Counts	3-Sigma Counts	Vin MilliVolts	Vout Milli-Volts	MaxDev Counts	3-Sigma Counts	Gain Vout/Vin	Gain Error Percent
2	1016.26	<b>1,544.05</b>	1	0.65	50.483	3.693.52	20	19.6	<b>42.578</b>	-0.22%
3	<b>1016.62</b>	<b>2,055.00</b>	0	0.00	4.927	3.673.86	20	20.74	<b>328.569</b>	-1.00%
4	1016.62	<b>1,543.00</b>	0	0.00	50.502	3.694.81	20	20.1	<b>42.608</b>	-0.14%
5	<b>1016.85</b>	<b>2,055.00</b>	0	0.00	4.928	3.674.58	21	21.5	<b>328.649</b>	-0.98%
6	1016.85	<b>1,547.00</b>	0	0.00	50.513	3.697.95	20	21.04	<b>42.582</b>	-0.21%
7	<b>1017.54</b>	<b>2,038.00</b>	0	0.00	4.93	3.656.29	20	20.61	<b>328.659</b>	-0.98%
8	1017.54	<b>1,540.94</b>	1	0.70	50.546	3.693.48	21	20.93	<b>42.586</b>	-0.20%

**NOTES:** Data in **BOLD** face is to be entered in the DataLogger software Calibration window.  
 Measurements taken from the data logger are based on 100 or more sequential readings at 1/2 second inter  
**Iexc** and **Vin** measurements were taken with an HP 34970A Data Acquisition Unit. Readings were integrated over 100 lin

By: \_\_\_\_\_

MOD-1 Production Calibration Data M1a 0305-series Cal Only.xls 0305-0001--051303  
 Printed 6/9/2003, 12:24 PM

**Serial #: 0305-0001--051303**

Figure 6. DASCOR Calibration Sheet for a M1A Data Logger used in example

### 7.11.6 Saving and Recalling Calibration Settings to/from Files

```

"HFDL & Signal Conditioning Calibration
Data", "File"

"Friday, June 06, 2003      ", "2:18:43
PM"

" 1: Sensor Num", "5"
" 2: Cal Due Date", "6/05/04"
" 3: Exc EU", "mVm3"
" 4: Model Num", "141541.."
" 5: Serial Num", "57862..."
" 6: Eng Units", "psi."
" 7: Milli at 0", "-1.10000E-01"
" 8: EU at 0", "+0.00000E+00"
" 9: FSEU at 0", "+0.00000E+00"
"10: Excite", "+4.00000E+03"
"11: Milli at 100", "+2.28400E+01"
"12: EU at 100", "+1.00000E+02"
"13: FSEU at 100", "+1.00000E+02"
"14: Loc Code", "Ch5."
"15: DL Serial Num", "03050001"
"16: SC excite", "+1.01685E+03"
"17: SC Offset", "+2.05500E+03"
"18: SC Gain", "+3.28649E+02"
"19: Logger Slope", "+5.21540E-02"
"20: Logger Offset", "-1.06697E+02"
"21: SC Output at 0", "-68.82078"
"22: SC Output at 100", "210.32911568"

```

You have the option to save each channel setting to a file. These files may be reviewed at any time in the future and printed if desired. This feature is also a beneficial tool to use if you ever use the same sensor in another Data Logger.

On the “*Calibration Sub-Routine*” screen (see Fig. 3 & 4), select the “Save to File” button. You will be prompted to select a location (ie. “My Documents”) and a file name (i.e. “57862P or 57862T”), and select “Save”. The “.TXT” file extension will automatically be added to the file name. You will have a text document that looks like The image at right. This document may be opened with any word processor, but to maintain compatibility with the Logger software, it must always be re-saved as a text-only file with no formatting. It is suggested that NotePad or WordPad be used rather than Word.

If the sensor is to be used in a different Data Logger, you can retrieve the channel settings for that particular sensor from the saved files. When setting up the new Data Logger on the “*Calibration Sub-Routine*” screen, select the appropriate channel and select the “*Recall from File*” button. You will be prompted to select which file to use (ie. 57862P). After the selection, all the data will be transferred to the corresponding fields. This saves time from re-inputting the data and does not require the original sensor calibration sheets.

#### **Caution:**

**The “Signal Conditioner Cal Information” must be changed to reflect the information from the new Data Logger calibration sheet, as the recalled data will show the calibration information from the original Data Logger.**