Data Manager User Manual

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1.0 FEATURES

The Dynotek Data Manager is a flexible, self-contained, 4-20mA data logger designed for rugged, indoor or outdoor use.

- Measure and record parameters from up to four 4-20mA current loop transducers, or two or three 4-20 mA transducers and one or two pulse devices (for a total of four)
- Record up to approximately 693,500 time stamped data points
- Perform up to 16 programmable data log “steps”
- Ability to “press the button” to advance to the next step in a step data log
- Low power sleep mode maximizes battery life by waking when a scheduled reading is taken, or when a key is pressed
- Built-in USB interface to connect to any Windows based computer
- Optional Modbus RS-485 interface for connection to PLC, SCADA system or remote telemetry device (radio, satellite, or cell phone)
- Display and report all measured parameters in the selected measurement units on the LCD display or laptop computer

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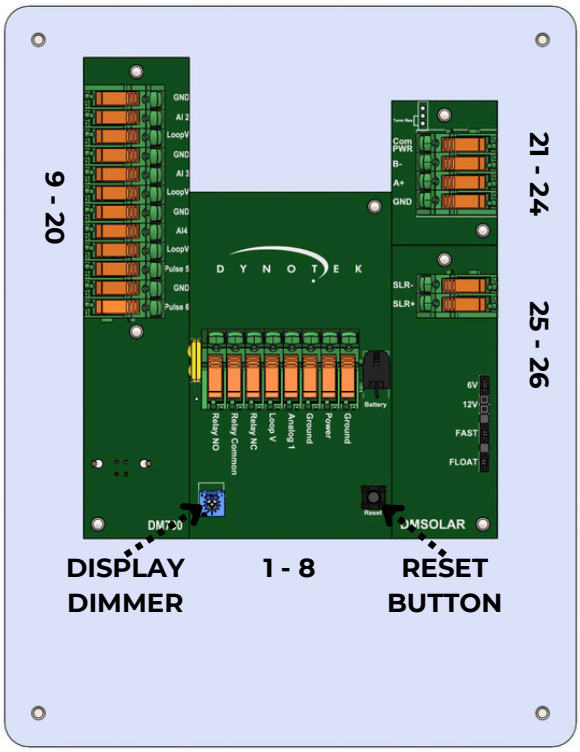
TERMINAL BLOCK SCHEMATIC

Standard Module

1. Relay – Normally open terminal
2. Relay – Common terminal
3. Relay – Normally closed terminal
4. Channel 1 – Loop power supply
5. Channel 1 – 4-20 mA analog input
6. Ground
7. 12-24 volt external power positive terminal
8. Ground



Logger Module

9. Ground
10. Channel 2 – 4-20 mA analog input
11. Channel 2 – Loop power supply
12. Ground
13. Channel 3 – 4-20 mA analog input
14. Channel 3 – Loop power supply
15. Ground
16. Channel 4 – 4-20 mA analog input
17. Channel 4 – Loop power supply
18. Channel 5 – Digital/Pulse input
19. Ground
20. Channel 6 – Digital/Pulse input

485 Modbus

21. Communication power supply
22. Modbus 485 B- Output
23. Modbus 485 A+ Output
24. Ground

Solar Controller

25. Solar panel negative
26. Solar panel positive

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3.0 OPERATING MODES

3.1 Wake and Sleep Modes

The Data Manager automatically goes into a “sleep mode” after approximately three minutes of keyboard inactivity. During this sleep mode, only the clock, keyboard and data logging circuits remain active to maximize battery life. Press any key to wake the instrument.

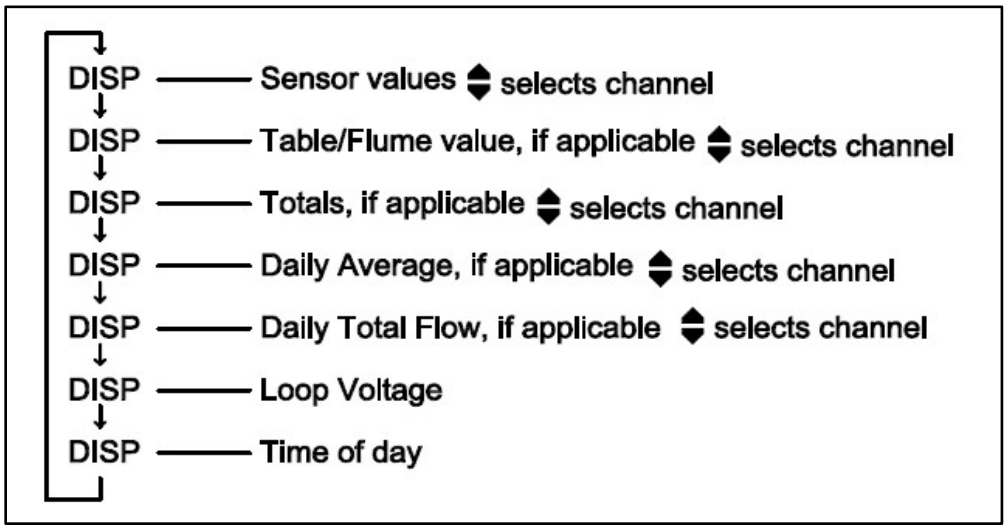
In logging mode, the display will show the measured value, alternating with LOGGING for 3 minutes. After 3 minutes, the logger goes into sleep mode and only displays LOGGING to show that it is active, but on a reduced power level.

Pressing and holding EXIT for more than 3 seconds will force the Data Manager 700 into sleep mode, however the unit will not enter sleep mode if Modbus is enabled or if the alarm contact function is enabled.

3.2 Display Mode

Pressing DISP brings the Data Manager out of sleep mode, and enters Display Mode. Pressing DISP also exits the Menu mode and returns to Display Mode. If the logging feature is not running, the display shows the current time of day.

Multiple presses of DISP toggles through the following functions: Sensor values; Table/Flume values*; Totalizer Total value*; Daily Average value*; Daily Total Flow*, Loop voltage value and Time of Day. The starred values (*) only appear if that function is enabled.



Should an input value exceed 23 mA, the display will show TRIPPED. The display will automatically resume displaying values after the value returns under 23mA. If a tripped condition occurs during logging, the recorded value will be as if the sensor has been disconnected. See Appendix A: FAQ for tips on dealing with a tripped value.

In each applicable display mode, pressing the UP or DOWN arrows will select the channel to display if there is more than one channel being used. The channel number is displayed in the upper right of the display, next to some abbreviations to indicate which value is being displayed.

In all of the examples below, x = channel number

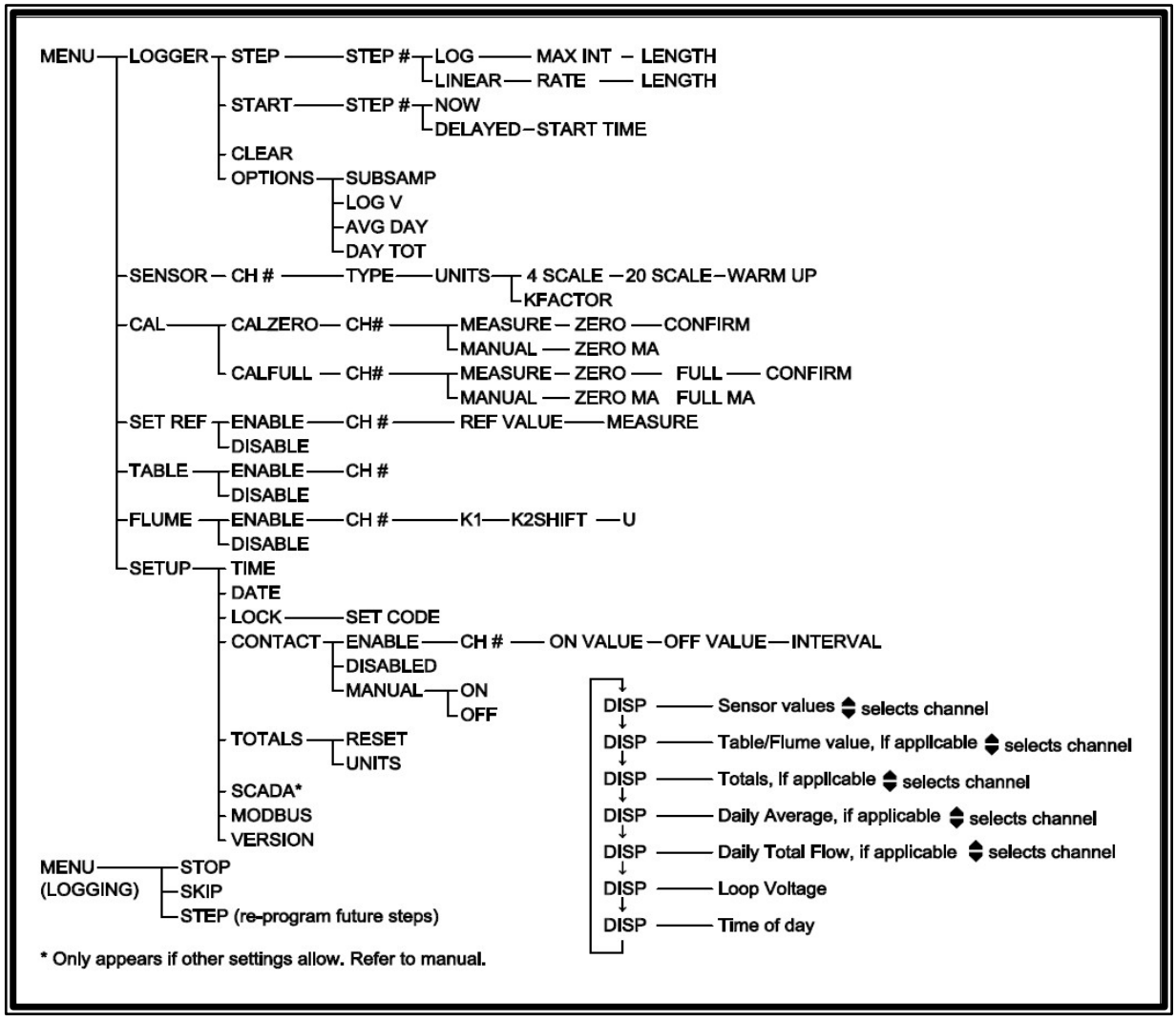
CH-x: Current value for the selected channel TbLx: Current look-up table value FLUx: Current flow value based on flume equation totx: Cumulative total since it was last zeroed (See SETUP menu) AdFx: Average daily flow computed at previous midnight dt-x: Daily total computed at previous midnight LOOP: Loop voltage

During logging mode, the current step number is displayed in the upper right, such as S-01, to indicate step 1.

3.3 Menu Mode

The menu mode is activated by pressing MENU. Each menu item is accessed by pressing ▲/▼ Press ENTER to select.

The menu tree for the logger is shown below.



3.3.1 LOGGER Menu

The LOGGER menu provides access to data logging features such as Step Number, Clear, and Stop. To access the LOGGER menu, press MENU then ▲/▼ until the display shows LOGGER, then press ENTER.

STEP: From the LOGGERmenu, press ▲/▼ until the display shows STEP, then press ENTER. A data logging session is created using the STEPMenu feature. A step consists of a Linear time base (Logarithmic time base only available on Data Manager 2000 model), a logging Rate, and a Length. After each step completes, the next step in sequence automatically begins. Up to 16 steps can be defined. The data logger automatically stops after the 16th step, or when memory is full.

For a single step, the approximate maximum number of data points is:

1 channel: 693,500 points
2 channels: 520,100 points
4 channels: 346,700 points

A Data Manager Model 700 configured with a sensor that measures head, gauge or pressure, in conjunction with a flume equation, total, daily average (optional) and loop voltage (optional) is equivalent to logging 5 channels.

Note: Additional logger steps will use more memory for the storage of parameters thus slightly less memory will be available for data points.

Linear Time Base: This time mode consists of an even interval of time, which can range from 1 second to 99 hours. In a linear time base, data points are spaced evenly over time.

Rate: For a linear test, Rate is the periodic rate at which the input channel is sampled.

Length: For a linear test, Length defines the amount of total time for the step.

Note: A step with length of 99 hours (with any minutes and seconds) denotes a step that runs indefinitely until logging is manually stopped or until memory is full.

Linear Example: To define a three step data log file, with linear one minute steps sampling at a rate of 1 second, 5 seconds, 10 seconds and the following would be entered:

Step	Type	Rate	Length
1	Linear	00:00:01	00:01:00
2	Linear	00:00:05	00:01:00
3	Linear	00:00:10	00:01:00

The total no. recorded data pts would be 60 (step1) +12 (step2) +6 (step3) = 78.

START The START menu selection starts a data log session. The step number is first prompted to start the test. This can range from 1 to the maximum number of steps defined in the step menu. The next two options are displayed to start the data logging; Selecting NOW starts the data logger as soon as START is selected.
Selecting DELAYED will start the logger at a later time. The time is entered in 24 hour format. If the time has already passed for today, data logging will start at the time entered tomorrow. For example, to start the data log session at 1:00 PM, the following time would be entered (24 hour format) 13:00:00

CLEAR The CLEAR menu selection clears the current data log file from memory. The data cannot be retrieved after it is cleared, so be sure to download data to a computer before clearing the data log: ERASING

OPTIONS The OPTIONS menu selection contains additional features related to the logger.

SUBSAMP The SUBSAMP menu selection determines the number of subsamples to take during a single logging event. The default value of 0 (or 1) takes one sample per logging event. Setting the subsample to a non-zero number will sample multiple times during the logging interval, then average the result and store it at the end of the logging interval. For example, if the logging interval is set to 15 minutes, and the subsample is set to 3, then a subsample will be taken every 5 minutes. When the 15 minute logging interval is complete, the three readings are averaged and a single value is written to data logging memory.

LOGV The LOGV menu selection enables or disables logging of the 4-20mA loop voltage. When enabled, loop voltage is logged and displayed as a separate channel in the Data Manager data log.

AVG DAY The AVG DAY menu selection enables or disables the calculation of an average daily value. The 24 hour calculation period runs midnight to midnight. During the 24 hour period, values are averaged at each logging event. For example, if the AVG DAY feature is enabled and the logging interval is 15 minutes, then 96 values are averaged, and a single value is written to the data log at midnight.

DAY TOT The DAY TOT function presents the total flow from the previous day (midnight to midnight) in a column on the data download, and on the display screen. Press ▲/▼ to enable or disable. When viewing the display, cycle through the display value by repeatedly pressing the DISP. button until dt-x appears in the upper right of the display, where 'x' is the channel number. This value gives amount of water flowing in the previous 24 hour day.

3.3.2 SENSOR Menu

The SENSOR menu is used to configure each sensor's 4-20mA reading (or pulse rate), display units, range, etc. To access: MENU, then ▲/▼ until the display shows SENSOR, then ENTER. As you go through the sequence of the SENSOR menu, the

title of each option is displayed for 1 second, then the current value is displayed. If you wish to keep the current setting, simply press ENTER.

CHANNEL NUMBER The channel number (1-6) is selected by using ▲/▼ and ENTER. Each channel corresponds to a physical connection on the Data Manager 700. Channels 1-4 are for 4-20 mA inputs. Channels 5 and 6 are for pulse inputs. (If using a pulse input, skip down to K-Factor

TYPE This menu selection is used to select the sensor type. Available options include:

NONE (no sensor attached) Note: Selecting "NONE" clears the sensor channel.
PRESS Pressure - in PSI, Inches Mercury (IN Hg), Meters H2O, Inches H2O, Feet H2O, or BARS (use ▲/▼ to change the units)
FLOAT. Channel or Flume Depth, FT H2O, IN H2O, or M H2O
CONDUCT Connductivity - microsiemens
FLOW Gallons per minute GPM, Liters per minute LPM, Cubic feet per second (CFS)
Note: If flow is a 4-20 mA input, use channel1-4. If pulse input, use channel 5 or 6.
DO Dissolved Oxygen - % Saturation, PPB, or PPM
TEMP Temperature - degrees C or F
MA milliamp
COUNTS raw a/d counts 0-65535

Note: One additional sensor type BARO will be displayed for channel 4, if the optional Barometric Pressure Sensor is present. This sensor automatically shows up as BARO in the sensor type. Selecting BARO preloads the scaling values with the defaults associated with that sensor.

4 SCALE (analog input only) This setting is the value that corresponds to the 4 mA input reading. Typically, the 4 SCALE value is set to zero.

20 SCALE (analog input only) This setting is the value that corresponds to the 20 mA input reading, usually sensor full scale. For example, to set the 20 SCALE limit to 50 PSI, enter 50.

Note: For level measurements, the Data Manager can be set to read "static level" or measurement from Top of Casing down to water level. This procedure is described in Appendix A "Top of Casing Procedure"

Note: To enter fractional values for the scale values, DISP. can be used. For example, to enter 11.47, first enter 1147 by using the ▲/▼/◀/▶ keys, then press DISP. until the decimal point is in the proper location. Accept the value by pressing ENTER. If you accidentally go past the desired location, keep pressing DISP. until the decimal point wraps around to the left.

WARM UP (analog input only) This setting is the warm-up time in milliseconds. This is the delay time from when power is applied to the sensor, until the reading is taken. For example, to set a warm-up delay of 1 second, set the warm-up time to 1000. The maximum warm-up time is 60,000 milliseconds (60 seconds). The default value (a

setting of 0) is 120 milliseconds. For most sensors this will be sufficient. If initial zero readings are unstable, try a longer warm up time. This must be less than the logging interval.

BARO (analog only) If the optional barometric pressure sensor is installed and channel 4 has been activated, the -BARO(subtract barometric pressure) menu will be displayed for channels 1 through 3. If there is no barometric pressure sensor installed on channel 4, then this option will not be displayed. This option automatically subtracts the internal barometric pressure sensor reading from channel 1-3, to compensate for changes due to weather related pressure changes, and is used only with absolute or sealed gauge transducers.

K Factor (pulse input only) If the sensor input is pulse, select channel 5 or 6. When one of these channels is selected, the choices for sensor type will be flow, strokes, or counts. After a choice has been made, press ENTER to bring up K FACTOR The K factor will be provided by the manufacturer of the instrument connected, and will represent units of measure per pulse. It is important to note that this may be in terms of gallons per pulse (for flow) or pulses per gallon. The Data Manager is looking for gallons per pulse, so if the parameter provided is pulses per gallon (ppg), use the inverse (1/ppg).

3.3.3 CAL Menu (applies to analog sensors only)

The CALIBRATE menu is used to set the zero and full scale point for each analog sensor. To access the CAL menu, press MENU, then ▲/▼ until the display shows CAL, then press ENTER. Next select CALZEROor CALFULLto perform a calibration of the zero or full scale value, respectively.

Note: CALFULLshould be used only if the input sensor can be forced to both its zero and full scale values either by pressurizing a sensor, or by using a loop tester in source mode. CALZEROshould be used if the sensor can be forced to its zero value, for example by removing the pressure sensor from the water.

> Never use CALFULL unless a 4-20 mA sourcing device is available to provide a calibrated 20 mA current.

Next select the channel (1-4) using ▲/▼, then ENTER.
Please note that the selected channel must already be defined in the SENSOR menu, or the display will flash "ERROR, NO SENSORS ENABLED". Next select the mode of calibration, either MEASURE or MANUAL. In MEASURE mode, the 4-20mA

loop is read, and actual values are used (useful if the sensor can be placed into the zero and full scale conditions). In MANUALmode, the 4-20mA value is input by the user (useful if the sensor cannot be placed into the zero and full scale conditions).

MEASURE Mode: Press ENTER at the MEASUREprompt.
Ensure the probe is ready for the zero or full scale reading (previously selected before the channel number), then press ENTER to measure the zero value.
The current milliamp value is displayed. Press ENTER to accept.

CH-1
+0004

Press ENTER to complete the zero cal procedure.

CH-1
CONFIRM

MANUAL Mode: Press ENTER at the MANUALprompt. Zero will be displayed. Use ▲/▼ to edit, then press ENTER.

CH-1
+4.000

Press ENTER to complete the manual cal procedure.

3.3.4 SET REF Function (analog sensors only)

The SET REFmenu is used to set a sensor to read a known value without changing the scaling factors. This is useful for Top Of Casing measurements as described in Appendix A, or setting the current gauge height on a flume or weir using a pressure or float sensor. To access the SET REFmenu, press MENU, then ▲/▼ until the display shows SET REF then press ENTER.
Next select the channel by using ▲/▼.
Next select whether to enable or disable this function for the previously selected channel. The present state is displayed first.
REF VALis display for 1 second, followed by the currently selected units for the channel. Enter the known reference value for the sensor (i.e. the value you want the sensor to read) and press ENTER.
Next the present sensor value that the Data Manager is reading is displayed. This is without the reference value applied. Press ENTER, SAVEDwill appear on the display. The Data Manager is returned to the beginning of the SET REF menu.
Press DISP to verify that the SET REF function is working as expected.

3.3.5 TABLE Menu

The TABLEmenu is used to access a preloaded lookup table. For example, a flume equation may be implemented using a lookup table to display flow for a primary device.
To enable the Table function, press MENU, then select TABLEthen ENABLE

Note: The lookup table must be uploaded via Dynoware or ERROR- NO TABLE LOADEDis displayed. See section 4.7 for information on uploading a lookup table.

Select the channel number you would like to be the input to the look-up table. Either an analog or pulse channel may be selected. The lookup table may only be used with a single channel.

3.3.6 FLUME Menu

Automatically computes flow based on the standard Parshall flume equation: $flow = k_1 * (h + k_2)^u$. To enable the Flume computation, press MENU, then select FLUME then ENABLE

Next select the channel (1-4) using ▲/▼, then press ENTER.

Please note that a pressure channel must already be defined, or the display will show ERROR- NO SENSORS ENABLED.

Next enter values for k_1, k_2 and u. Press DISP. to enter a decimal point into the number.

Note: SHIFT/K2 is normally zero. It can also be used to enter a shift when actual conditions such as silting or erosion change the flume performance. To enter a shift, go through the flume setup procedure, and enter the shift value when K2/Shift is offered. To enter a negative value, press the left arrow first, and change the plus sign to a minus.

3.3.7 SETUP Menu

The SETUP menu is used to set the time, date, display version etc. To access; press MENU, then ▲/▼ until the display shows SETUP, then press ENTER.

TIME is used to set the system time in 24 hour format.

DATE is used to set the system date.

LOCK sets the keyboard lock. A 4 digit code must be entered. This code is required to access the menu system. The lock will take effect after 3 minutes of inactivity on the keypad. Note: A code of 0000 will disable the locking function.

CONTACT
This menu selection is used to set up the relay contact closure (dry contact).

ENABLE is used to enable the automatic relay contact closure feature. The Channel number (CH1-4), ON VALUE, OFF VALUE, and sampling interval must be entered.

DISABLED is used to disable the automatic relay contact closure feature

MANUAL is used to manually open or close the relay contact closure. Either ON or OFF must be entered. The automatic relay contact closure feature is disabled in this mode of operation, and is typically only used for testing the relay contact connections.

Note: The Contact function will only operate when the Data Manager is powered externally. The Contact function will be active in both Display and Logging modes. The sampling interval is entered in seconds. This is how often the selected channel is checked for turning the relay on or off, regardless of the logging interval.

TOTALS
is used to setup the flow totalizer. The total function can be used with any channel with FLOW units including a TABLE or FLUME.

RESET resets the flow totalizer to zero.

UNITS selects units for the flow totalizer. Available units are gallons (GAL), 1000 gallons (1000GAL), acre feet (AC FT), and acre inches (AC IN) and cubic meters (CUBIC M).

SCADA The choice here is to ENABLE, or DISABLE the SCADA function. The SCADA function is found only in Channel 1, and only when all other channels are turned off. SCADA locks the 4-20 mA loop in Channel 1 ON at all times.

It should only be used with remote power, since in battery mode it will drain the battery in 1-3 days.

When SCADA is enabled, the sensing loop can be fed into a PLC or other external 4-20 mA reading device. If the PLC is providing loop power, an external loop power pigtail must be used.

MODBUS (only units with MODBUS option installed)
This menu selection is used to configure the Modbus communication settings. Modbus commands are accessible only over the RS-485 communication port (not the USB port). See section 2.1.4 for Modbus RS-485 wiring details.

ENABLE Enables or disables the Modbus communication protocol on the RS-485 port.

ADDRESS The Modbus slave address for the Data Manager. The range is 1-247. The default value is 1.

MODE selects the Modbus mode, RTU is binary, ASCII is text. The default value is Modbus RTU.

BAUD Sets the Modbus baud rate. Acceptable values are 9600 and 19,200 bits per second. The default value is 19,200.

PARITY selects the Modbus parity. Acceptable values are Odd, Even, and None. The default value is Even.

NOTE: When using Modbus, such as in a remote monitoring configuration with a radio, satellite, or cell modem, The logger must be logging for the Modbus feature to work. Modbus reads the logging registers for the numbers to transmit. If the logger is stopped for calibration, entering a shift or other reasons, it must be started again after servicing. If it is not started, it will continue to read the last values logged before the unit was stopped.

VERSION Shows the firmware version number.

4.0 DYNOWARE SOFTWARE UTILITY

The Dynoware Software Utility is a Microsoft Windows program which allows data transfers and real time readings to be displayed from the Data Manager via the USB port.

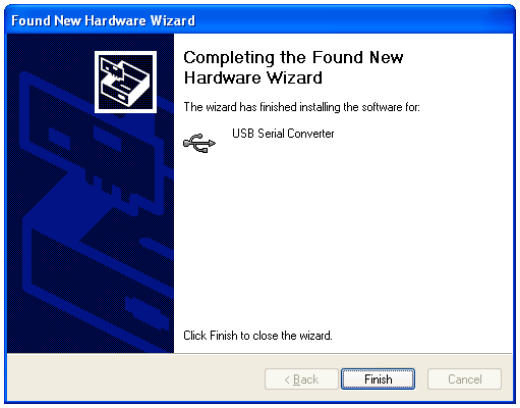
4.1 Dynoware Installation

The Dynoware software can be installed from either CD, or from the Dynotek website at http://www.dynotekflm.com

Note: Ensure the Dynoware software and USB drivers are completely installed before the Data Manager is plugged into the computer for the first time to ensure USB drivers load properly.

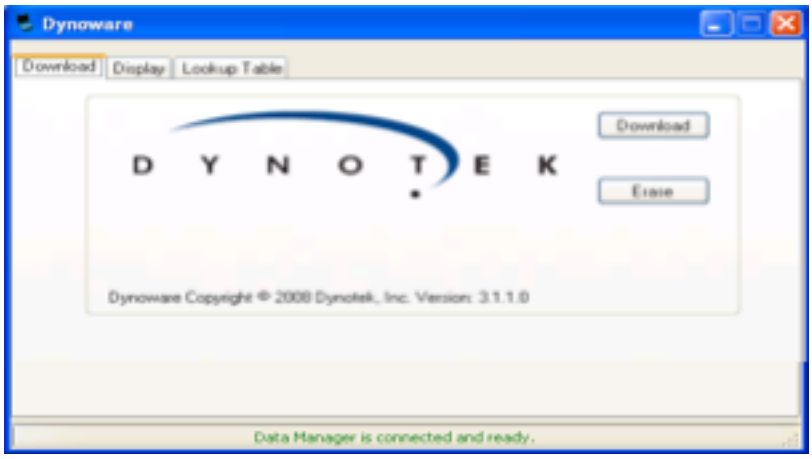
4.2 Running Dynoware

Open the Dynoware application. Attach the provided USB cable to the Data Manager 700. A screen may appear to install the USB driver. Click “Yes, This Time Only” then OK to continue.

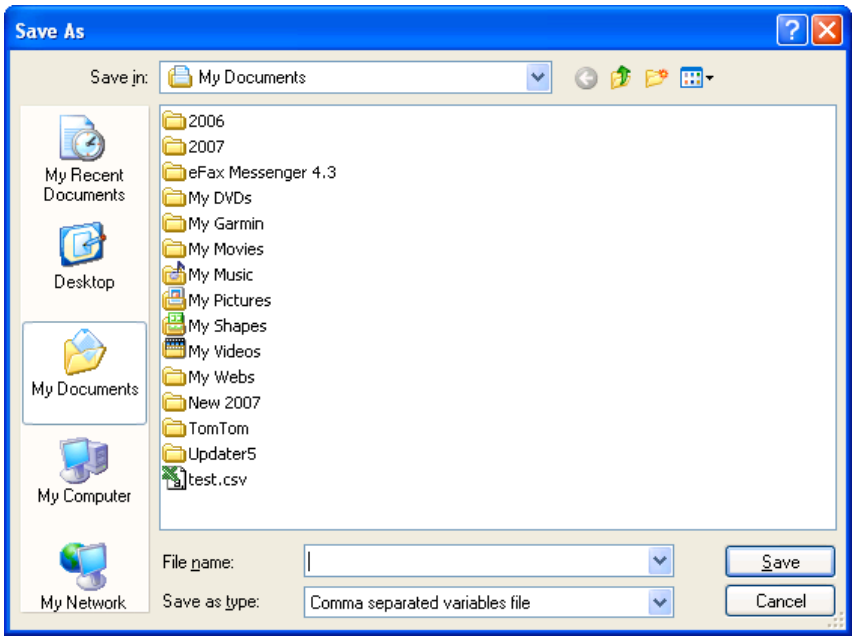


4.3 Download

To prepare for Downloading, connect the USB cable, then launch Dynoware. Click the Download button on the Download tab to start the download process.



Save As: Select a directory and filename, then click “Save”. The default file extension is “CSV” (comma separated values file). A status bar appears while data is being transferred, then the following screen appears:



- If the data log is empty, the message “There are no records available to download” appears.
- If there are more than 65,400 data records to download, a message box will appear stating that the file will be too large for Microsoft Excel and asks if the file should be split. By clicking "Yes", Dynoware will split the file, appending "_1", "_2", etc. to the end of the filename you selected.
- An error message will be displayed if you try over-writing a file that is currently open in Excel. Close the file in Excel to allow Dynoware to over-write the file, or choose a different file name.

Note: The logger continues to log data normally during data downloading. After connecting the the USB cable, it may take Windows 10-30 seconds to locate the Data Manager, especially when connecting for the first time. Once the connection has been established "Data Manager is connected and ready" is displayed at the bottom of the Dynoware window.
When disconnecting the Data Manager from the computer, it is best to close Dynoware first.

4.4 Erase

To erase all logged values, click the Erase button on the Download Tab.

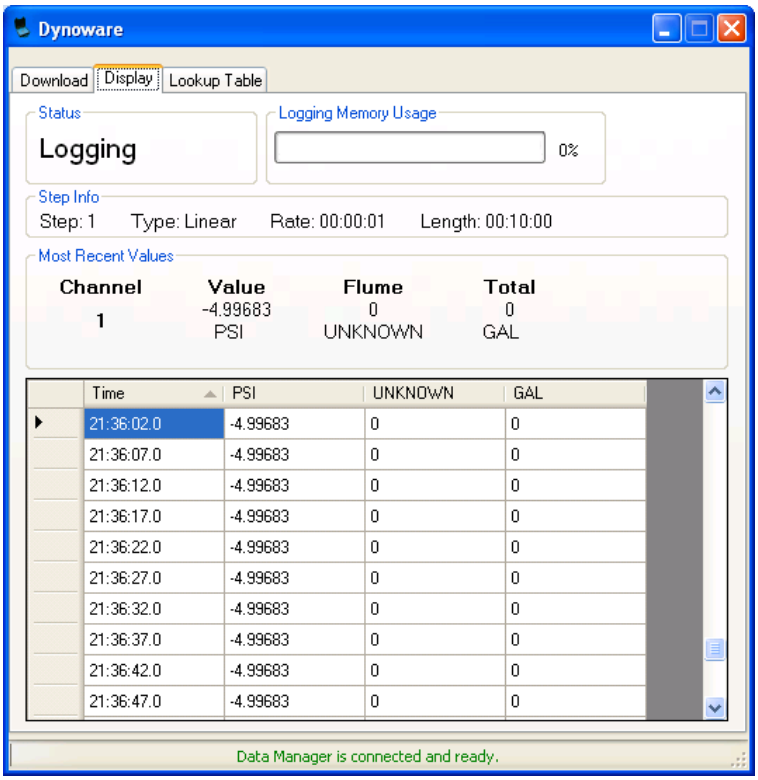
Note: The data log records are permanently deleted from the Data Manager memory after the erase procedure is complete so please ensure the data has been saved using the Download button before proceeding.

Note: The Erase procedure can occur only if the Data Manager is not actively logging. An error message will be displayed if logging is enabled.

4.5 Display

To display the current sensor readings, click the Display tab. The current status, most recent values, units, logging memory, and step information are displayed along with recent time stamped data logged values.

Note: Displayed values only update while the Data Manager is logging.



In the tabular area at the bottom of the window, click the column headers to sort. The default method is by Time ascending. This will show the oldest values at the top of the list and the newest values at the bottom.

For example, clicking on the Time column will change the up-arrow symbol to a down-arrow symbol and the newest values will be displayed and added at the top. Clicking on one of the value columns will sort the values from lowest to highest. This may be useful to find what time the highest value was reached.

4.6 Data Log Format

A sample data file is shown below. The data is stored in Comma Separated Values (CSV) format, which is directly compatible with Excel. Double clicking a data file on most computers will automatically launch Excel and display the data.

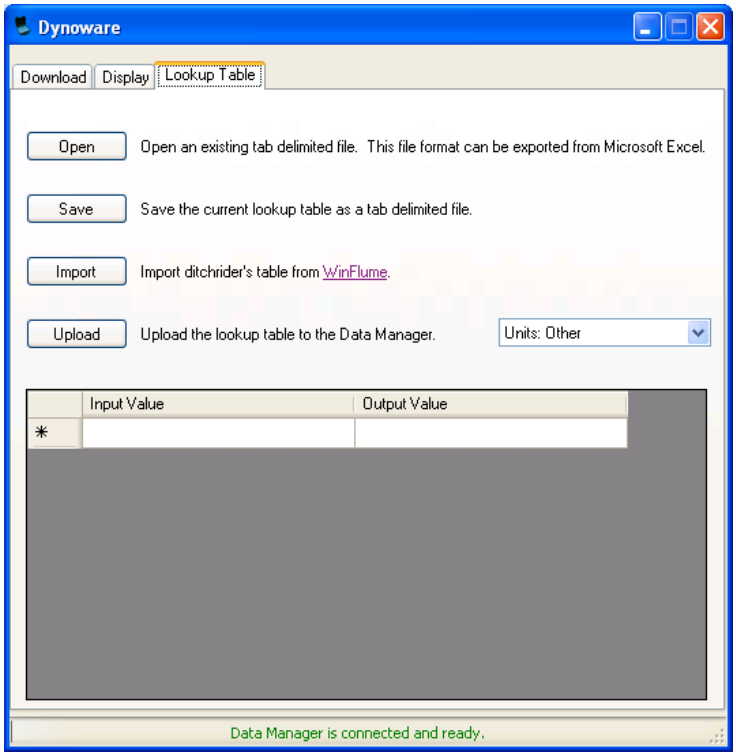
```
Step #,Type,Rate or Max. Rate,Length1,Linear,00:15:00,99:00:00
YYYY/MM/DD,HH:MM:SS.f,Elapsed Time,Elapsed Minutes,Ch 5,Ch 5,Ch 5,Ch 5
,,,,GPM,Total,Daily Avg.,Daily Tot.,,,,K=1.12000,AC FT  , ,AC FT

2011/08/09,09:59:00,00:00:00,0.000,0.00000,0.00000,0.00000,0.00000
2011/08/09,10:14:00,00:15:00,15.000,0.00000,0.00000,0.00000,0.00000
2011/08/09,10:29:00,00:30:00,30.000,0.00000,0.00000,0.00000,0.00000
2011/08/09,10:44:00,00:45:00,45.000,0.00000,0.00000,0.00000,0.00000
```

The first 5 lines of each step contain information on the step parameters, sensor scaling and whether a "REF" and/or "BARO" correction is being applied for the channel.

4.7 Lookup Table

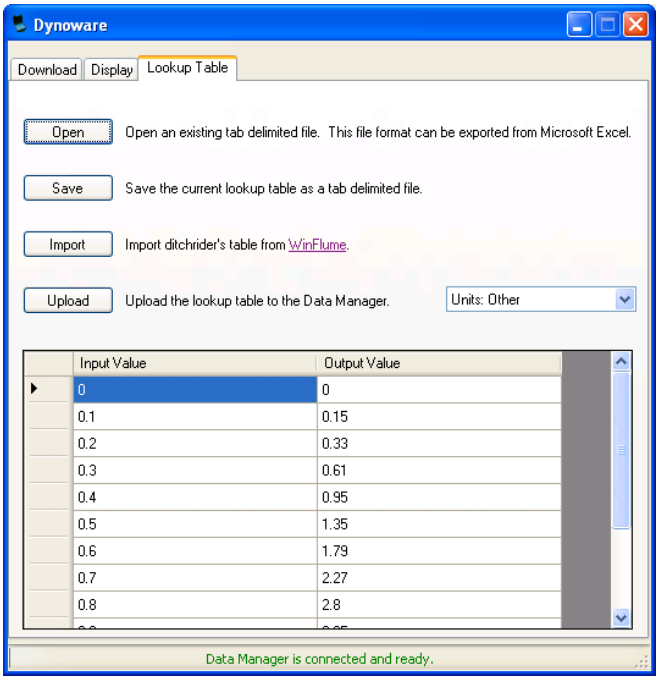
A lookup table is uploaded into the Data Manager by clicking on the “Lookup Table” tab. This is useful, for example, for displaying flow on the Data Manger using level as in input from a weir or flume. The lookup table function computes a linear segment between each value in the table, and displays the calculated value. Only one data table can be resident in the Data Manager memory at a time.

There are 4 buttons on the Dynoware lookup table tab, along with a drop down box to select units.



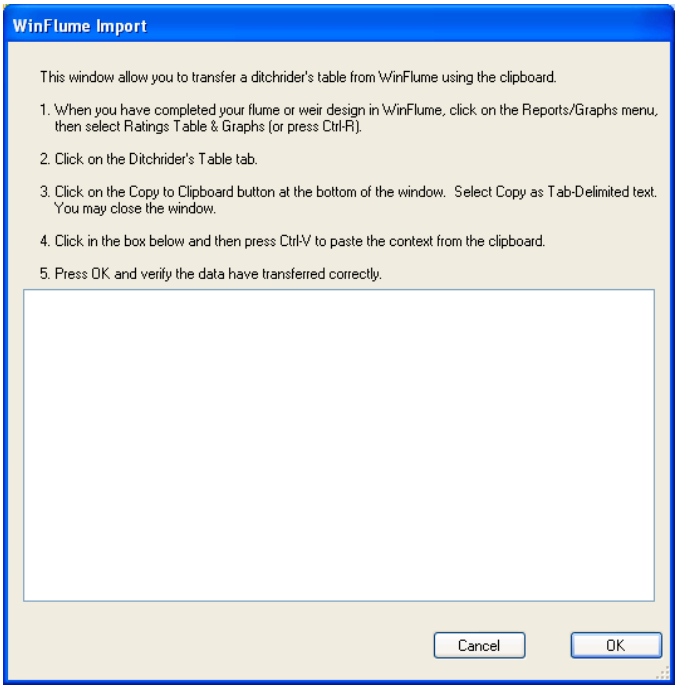
Open opens a file dialog box from which a Tab Delimited File can be loaded. Each line of the lookup table is displayed in the “Input Value / Output Value” display, however the file is not stored in the Data Manager memory until the “Upload” button is clicked.

Note: Tab Delimited Files typically have the extension “.txt”



Save saves the current lookup table to a tab delimited file, which can be opened again at a later time using the “Open” button.

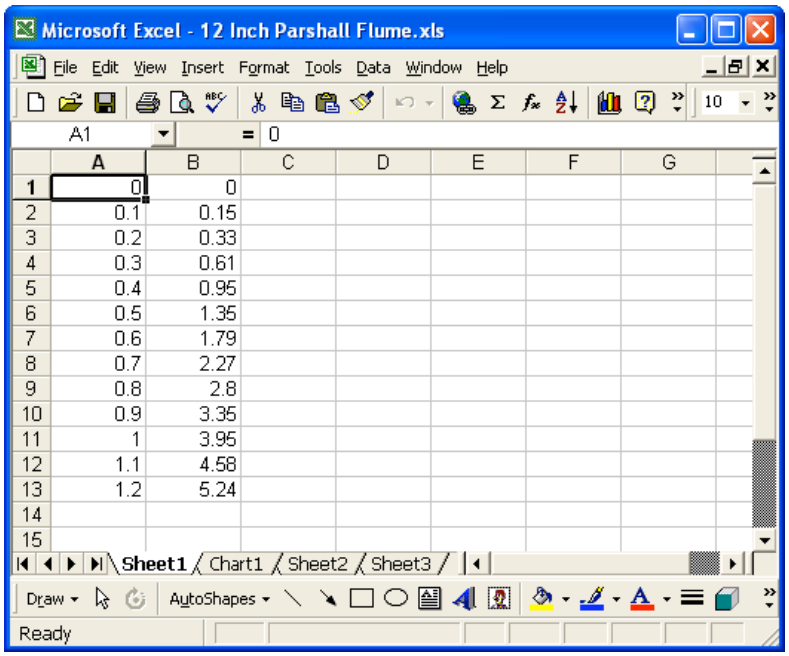
Import opens a dialog box from which a WinFlume “Ditchriders Equation” can be imported. Follow the instructions on the screen to copy and paste the table into the dialog box, then click “OK”.



For more information on WinFlume, please visit:
http://www.usbr.gov/pmts/hydraulics_lab/winflume/

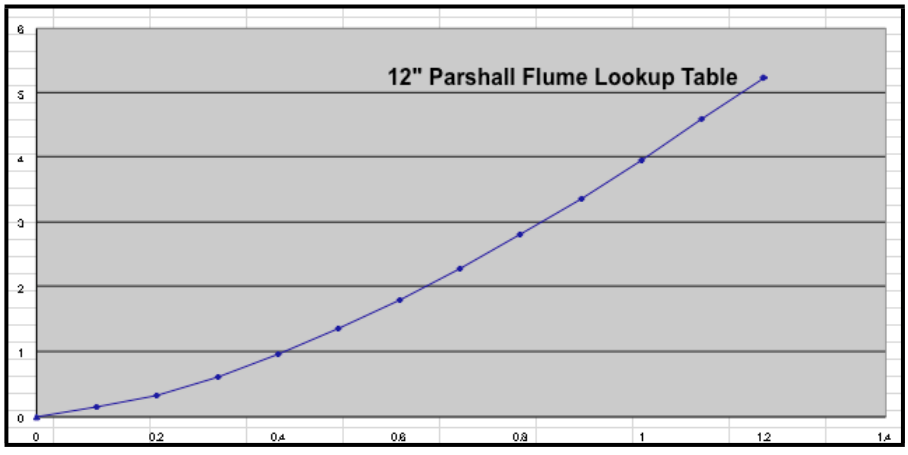
Upload sends the lookup table to the Data Manager. Once the table has been uploaded, the “TABLE” menu item becomes active in the main menu, and can be set to “ENABLE”.

Creating a Lookup Table in Excel: create a new worksheet, then enter the input/output values for each point in the lookup table. Column A = input values, and Column B = output values. An example is shown below for a Parshall Flume with 12” throat.



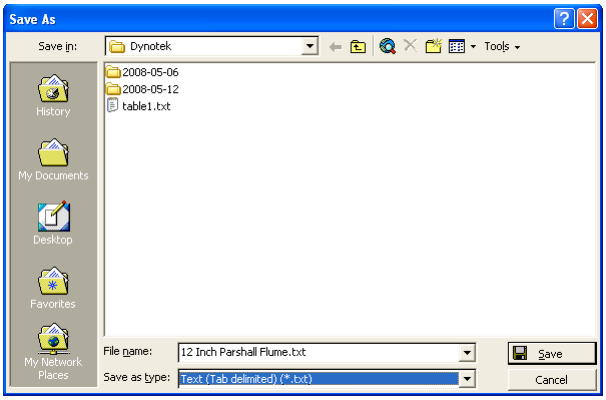
	A	B
1	0	0
2	0.1	0.15
3	0.2	0.33
4	0.3	0.61
5	0.4	0.95
6	0.5	1.35
7	0.6	1.79
8	0.7	2.27
9	0.8	2.8
10	0.9	3.35
11	1	3.95
12	1.1	4.58
13	1.2	5.24
14		
15		

This lookup table function is shown graphically below. Note that the Data Manager connects each dot with a linear segment to approximate the curve.

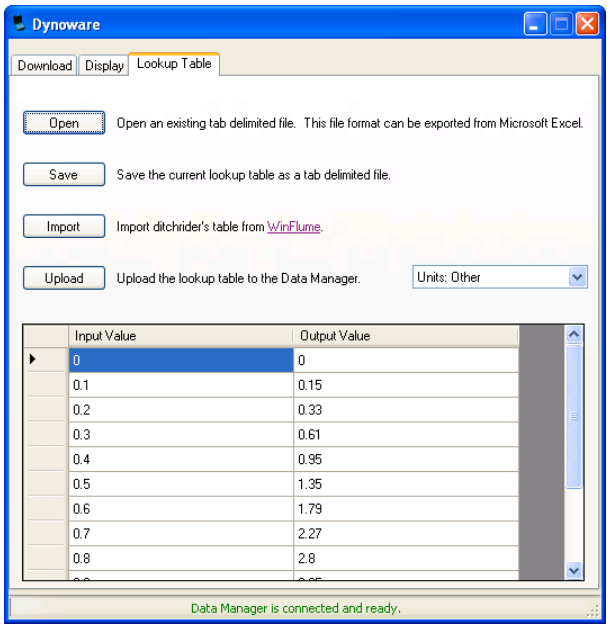


Next from Excel, select “File”, “Save As” and select the type “Text (Tab delimited) (*.txt)” under the file name.

Note: The file must be saved in tab delimited format so Data Manager can read the file. Native Excel files of type “.xls” cannot be opened with Dynoware.

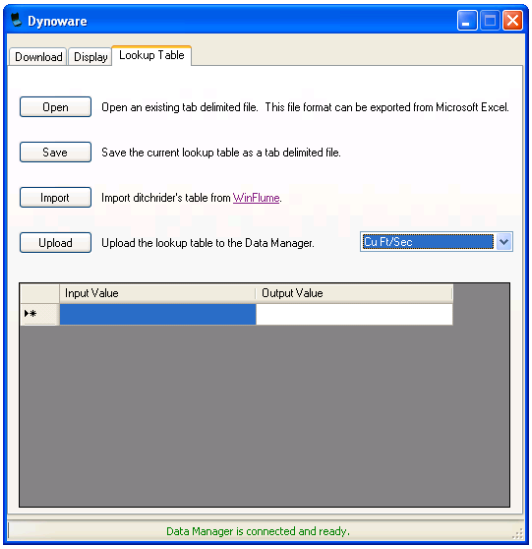


From Dynoware, click “Open”, then select the tab delimited file that was just created in Excel.



Click the upload button to store the lookup table into the Data Manager’s memory.

Units Flow measurement units can be selected by clicking the drop down arrow to the right of the “Upload” button. The default units are set to “Units: Other”.

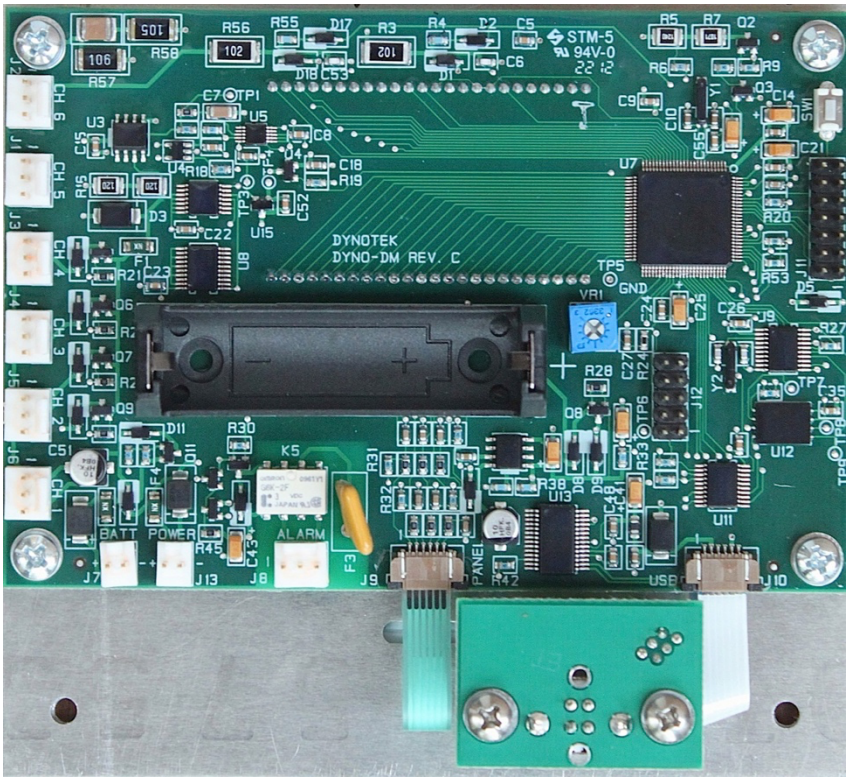


5.0 BATTERY REPLACEMENT AND INTERNAL CONNECTIONS

This section describes items which may be accessed by removing the four cover screws. Note: It is important to follow proper grounding procedures before touching the circuit board or components to avoid Electro-Static Discharge (ESD) damage.

5.1 Logger Battery Replacement

A 3.6V AA size lithium battery is located in the center of the circuit board as shown below. To replace the battery, remove the protective plastic cover, then remove the battery. Replace with Tadiran TL-2100, 3.6V lithium battery, noting the location of the “Plus” end.



5.2 Loop Battery Replacement

Two 9V alkaline batteries are located on the back panel of the Data Manger. These batteries are connected in series to provide a nominal 18VDC to each “loop”. To replace the batteries, lift the end of each battery, then replace in a similar fashion. Energizer Industrial or equivalent 9V batteries are recommended. The loop batteries should be connected to J7.

5.3 Reset

Should the Data Manager stop responding, the reset button can be pressed to reset the microprocessor. This is found in position SW1 at the upper right corner of the circuit board.

5.4 External Power

If your Data Manager is configured for external power, it is connected at J13. This will provide power for both the logger and the loop. Any power applied here will take precedence over batteries. If batteries are connected to J7 and power at J13 is lost, the batteries will take over. The voltage must not exceed 18 volts DC.

6.0 SPECIFICATIONS

- Dimensions: 11.5" wide, 9.5" deep x 4.75" high (portable)
  6" wide x 7" deep x 3.75" high (wall mount)
- Weight: 4.5 lbs (portable), 2 lbs (wall mount)
- Operating Temperature: -20 to 70 C (-40 to 158 F)
- Operating Humidity: 0 to 95% RH Non-condensing
- Number of Input Channels: 6 (4 analog, 2 pulse)
- Analog Input Type: 4-20 mA
- Analog Input Accuracy / Resolution: ± 0.002% full scale / 16 bit resolution
- Pulse Input Type: True contact closure, open collector, open drain, 3V-TTL, 12V or 24V active
- Max Pulse Input Frequency: 20 KHz
- Number of Math Channels: 2 user selectable
- Data Logging Memory: Non-volatile
- Memory Capacity: 8 Megabytes bytes, 693,500 points typical
- For a single step, the approximate number of data points are:1 channel: 639,500. 2 channels: 520,100.
- Channels: 346,700
- Max Sample Rate: Logarithmic mode: 1 channel 140 msec, 4 channels 560 msec Linear mode: 1 second
- Display: LCD 1.92"(W) x 0.8"(H), 7 Alphanumeric Digits, 4 Numeric Digits plus Battery Gauge
- Internal Batteries: 1 x AA 3.6V Lithium Tadiran/Saft (primary logger battery)
  2 x 9V Alkaline Energizer 522 or equivalent (loop batteries)
- Nominal Loop Voltage: 18 VDC (supplied by logger)
- External Power: 9 to 24 VDC (powers both primary logger and loop)
- Relay outputs: 2
- Alarming: High / low alarm set points
- Relay rating: 0.3 Amp at 125 VAC, 1 Amp at 30 VDC, resistive load, gold-plated
- External Communication: USB 2.0

APPENDIX A: MODBUS (Modified ENRON Protocol)

The Data Manager supports the Modbus protocol over a two wire (plus ground) RS-485 serial interface. The Modbus connector pinout is shown in section 2.1.4. Both RTU and ASCII modes are supported. Modbus is enabled and configured via the Data Manager Menu (see MODBUS in section 3.3.6).

Note: Modbus and the USB port cannot be operated at the same time. When Modbus is enabled and the USB port is connected, the USB port will have priority and Modbus will be ignored. When the USB cable is disconnected, Modbus will be re-enabled.

A.1 Modbus Function Codes

The following Modbus function codes are supported by the Data Manager.

Code (hex)	Description	Application
0x01	Read Boolean	Reads status of relay
0x05	Write Single Boolean	Controls aspects of Data Manager
0x03	Read Registers (reading multiple registers is supported)	Reads numeric values.
0x06	Write Single Register	Writes numeric values.

A.2 Boolean Registers

The boolean registers are used to control and monitor various aspects of the Data Manager. Modbus function codes 1 (read boolean) and 5 (write single boolean) are used to access these registers.

Register (decimal, Offset = 0)	Description	Access
1,001	The relay in the Data Manager can be programmed via the front panel to switch on/off at programmed sensor thresholds. If the relay is to be controlled by Modbus, it should be disabled via the front panel from the SETUP-CONTACT menu. The front panel setting of the relay will override the control via Modbus.	Read/Write
1,002	Forces the Data Manager to take a reading and update the registers that hold sensor and flow information. The time stamp contained in registers 7027-7028 is updated. Total flow and average daily	Write only

	flow values will not be updated.	
1,003	Erases the Data Manager logging memory. Logging will be stopped, the erase process will be started, then logging will resume. The erase process will take 2-50 seconds. No attempt should be made to read historical records during the erase process. To ensure this, the host should wait until one reading has been logged by checking register 5001 or 5002 (which are reset to 0 during the erase process) before reading from register 701. A value of 56101 (0xDB25) needs to be written to the unlock register at 3004 before the erase function will operate.	Write only

A.3 Registers 3001- 3003: 16-bit Integers

All of the 16-bit integers are unsigned. Modbus function codes 3 (read register) and 5 (write single register) are used to access these registers.

Register (decimal, offset = 0)	Description	Access
3,001	Data Manager Operational Status. 0: Display mode 1: Menu mode 2: Logging mode 3: Logging start delay 4: Logging is finished	Read only
3,002	Percentage of logging memory used	Read only
3,003	Number of values returned per data record when reading register 701 excluding the date and time (range 1 - 24). This is related to the number of sensors connected to the Data Manager as well as other logging options.	Read only
3,004	Erase logging memory unlock register. A value of 56101 (0xDB25 hexidecimal) must be written prior to erasing the logging memory (see register 1003). This register is automatically reset to zero during the erase process.	Read/Write

A.4 Registers 5001- 5003: 32-bit Integers

These 32-bit integers are unsigned. Modbus function codes 3 (read register) and 5 (write single register) are used to access these registers.

Register (decimal, Offset = 0)	Description	Access
5,001	Number of data records recorded since the start of logging	Read only
5,002	Number of data records recorded since the last read. This value is reset to 0 when a data record is read with register 701.	Read only
5,003	Data Record Index. This is used to select which data record should be read from the logging memory when reading register 701. An index of 0 will return the first data record. An index of the number obtained from register 5001 will return the most recent record. This index automatically increments every time a read from register 701 occurs. Trying to read an index beyond the most recently stored value will result in a ILLEGAL DATA VALUE exception response.	Read/Write

A.5 Registers 7001- 7036: 32-bit Floating point values

All of the float point values are read only. Registers 7001-7024 represent the most recent values that were logged and stored. Registers 7027-7028 indicate the date/time the most recent values were logged. Modbus function codes 3 (read registers) and 5 (write single register) are used to access these registers.

Register (decimal Offset = 0)	Description
7,001	Channel 1 sensor
7,002	Channel 1 first derived value, flume equation or lookup table value
7,003	Channel 1 second derived value, total volume
7,004	Channel 1 third derived value, average daily value of first derived value, usually flow
7,005	Channel 2 sensor
7,006	Channel 2 first derived value, flume equation or lookup table value
7,007	Channel 2 second derived value, total volume
7,008	Channel 2 third derived value, average daily value of first derived value, usually flow
7,009	Channel 3 sensor
7,010	Channel 3 first derived value, flume equation or lookup table value
7,011	Channel 3 second derived value, total volume
7,012	Channel 3 third derived value, average daily value of first derived value, usually flow
7,013	Channel 4 sensor
7,014	Channel 4 first derived value, flume equation or lookup table value
7,015	Channel 4 second derived value, total volume

7,016	Channel 4 third derived value, average daily value of first derived value, usually flow
7,017	Channel 5 sensor
7,018	Always returns 0.0
7,019	Channel 5 second derived value, total volume
7,020	Channel 5 third derived value, average daily value of first derived value, usually flow
7,021	Channel 6 sensor
7,022	Always returns 0.0
7,023	Channel 6 second derived value, total volume
7,024	Channel 6 third derived value, average daily value of first derived value, usually flow
7,025	Loop voltage
7,026	Logger voltage
7,027	Time of most recent update. This is a floating point representation of time. For example 11:23:00 is represented as a number 112300.0
7,028	Date of most recent update. This is a floating point representation of the date. For example 10/26/08 (MM/DD/YY) is represented as a number 102608.0
7,029	Current time. This is a floating point representation of time. For example 11:23:00 is represented as a number 112300.0
7,030	Current date. This is a floating point representation of the date. For example 10/26/08 (MM/DD/YY) is represented as a number 102608.0

Note: Registers 7031-7036 are third derived values (Total Flow Previous Day) for channels 1-6 respectively.

All registers are IEEE 32-bit floating point values.

A.6 Register 701: Historical Data Record

Reading from register 701 will retrieve a logged data record from the logging memory of the Data Manager. The particular record is selected with register 5003. Modbus function 3 is used to read the data record.

The format of the request is as follows:
01: Slave Address (8-bits)
03: Modbus function (8-bits)
701: Register number (16-bits)
0: Index (16-bits) (This field is ignored. Use register 5003 to set/read the index.)
1234: CRC(16-bits) or LRC(8-bits)
The format of the response is as follows:
01: Slave Address (8-bits)
03: Modbus function (8-bits)
16: Number of bytes to follow (8-bits)
101608: Date stamp (32-bit floating point) 10/16/08
112300: Time stamp (32-bit floating point) 11:23:00
14.67: First logged value (32-bit floating point)
23.679: Second logged value (32-bit floating point)
... (more logged values)

1234: CRC(16-bits) or LRC(8-bits)

All of the logged values are in 32-bit floating point format. The number of logged values is site specific, determined by how many sensors are connected to the Data Manager and other logging options. The number of values that follows the Time Stamp can be determined by reading register 3003.

Every time a record is read from register 701, the current record index in register 5003 is automatically incremented. This allows repeated reads from 701 to return a sequential file of logged data.

The value in register 5002 is cleared to zero every time register 701 is read. This is used when Modbus is used only periodically or intermittently to indicate how many records have accumulated since the last reading with register 701.

Register 5001 indicates how many records have been stored since the start of the current logging session.

A.7 Exception Responses

Standard Modbus exception responses are used in the Data Manager as follows:

Exception Code	Meaning
1	Illegal Function: Modbus function code is not supported
2	Illegal Data Address: One or more of the specified registers is out of range.
3	Illegal Data Value: Reading a nonexistent historical data record with register 701.

A.8 Additional Modbus Information

More information on the modified Enron Modbus protocol, as well as communication test software, can be obtained at: http://www.simplymodbus.ca

APPENDIX B – Top of Casing Procedure

This appendix describes how to set the Data Manager to read Top of Casing to Water (Static Level). This will enable the user to calibrate the Data Manager to read static level directly.

TOC PROCEDURE

1. Set up sensor in normal manner (4.0 mA value = 0, 20 mA value = full scale).
2. Install the sensor into the well.
3. Read the display to obtain the height of water above the sensor.
4. Take a reading with a sounding device. The total of this reading (static level) plus the height of water above the sensor should equal the depth of the probe below the top of casing.
5. On the display, press MENU (LOGGERwill appear) and then scroll down with ▼ until you see SET REF.
6. Press ENTER. CH1will appear. If this is the channel the sensor is attached to, press ENTER. Otherwise scroll up to the correct channel and press ENTER.
7. Scroll up or down until you see ENABLED. Press ENTER. REF VAL, then FT H2O, then +0will appear. Push ◄ then ▼ . The plus (+) should change to a minus (-).
8. Push ►. The first digit will blink. Start entering the static value measured in step 4. Press ► to move to the next digits.
9. When you have finished entering the static value, it should be displayed as a negative number. If it is correct, press ENTER. The value of water above the sensor will be displayed as a check to see that the water level has not changed. If the value is the same as read in step 3, press ENTER ENTER to save the reference value. If it is not, re-check the static level, and enter the new value.
10. Press EXIT, DISP to display the measured value. The number you see will be the static level, or feet below the top of casing (as a negative number). From this point on, the display will read static level, or pumping level below TOC if the pump is on.

APPENDIX C – Quick Start: Flow Monitoring with the Data Manager

1. Connect the PULSE cable to the PULSE terminal on the Data Manager
2. Connect the power leads to a 24V DC Source (externally powered units only).
3. On the Data Manager, press the following KEYS. The resulting display is shown in DIGITAL TEXT.
   Press any key to turn logger on

MENU	TIME
MENU	LOGGER
▼	SENSOR
ENTER	CH1
▲ x4 times	CH5
ENTER	TYPE NONE
▲	FLOW
ENTER	UNITS GPM
ENTER	K FACTOR 193
ENTER	SENSOR
DISP	(DISPLAY WILL READ FLOW VALUE, TOTALS, TIME, AND LOOP VOLTAGE WITH SUCCESSIVE PRESSING OFDISP)

4. To Reset the Totalizer, use the following key strokes:

MENU	LOGGER
▲	SETUP
ENTER	TIME
▲ x2 times	TOTALS
ENTER	RESET
ENTER	CONFIRM
ENTER	SETUP
DISP	(DISPLAY WILL SHOW VALUES – SEE DISPLAY IN 3 ABOVE)

5. To set up logging, use the following key strokes

MENU	LOGGER
ENTER	STEP
ENTER	STEP 1
ENTER	RATEHOUR 00(Set in rate using arrows, in hr,min,sec)
ENTER	MIN 00
ENTER	SEC 00
ENTER	LENGTHHOUR 00(Enter test duration. 99 is default to keep logging for an indefinite time)
ENTER	MIN 00
ENTER	SEC
ENTER	STEP 2 Program steps 2-16 if needed, or press EXIT EXIT

6. To Start Logger:

ENTER	LOGGER	
ENTER	STEP	
▼	START	
ENTER	TESTING	STEP 1
ENTER	NOW	
ENTER	LOGGING	
DISP	(Readings will show)	

APPENDIX D – Quick Start; Flow Monitoring w/4-20mA Flowmeter input

1. To Set up Data Manager: On the Data Manager, press the following KEYS. The resulting display is shown in DIGITAL TEXT.

Press any key to turn logger on

MENU	TIME
MENU	LOGGER
▼	SENSOR
ENTER	CH1
ENTER	TYPE NONE
▲	FLOW UNITS
ENTER	GPM
ENTER	4 SCALE Enter 0
ENTER	20 SCALE Enter full scale value of flowmeter
ENTER	WARM UP Leave at 0 or observed warm up time of flowmeter.
ENTER	SENSOR
DISP	(Display will read FLOW VALUE, TOTALS, TIME, and LOOP VOLTAGE with successive pressing of DISP)

2. To Reset Totalizer:

MENU	LOGGER
▲	SETUP
ENTER	TIME
▲ twice	TOTALS
ENTER	RESET
ENTER	CONFIRM
ENTER	SETUP
DISP	(Display will show VALUES, See note above)

3. To set up logging:

MENU	LOGGER
ENTER	STEP
ENTER	STEP 1
ENTER	RATE HOUR 00 (Set rate using arrow keys in hr,min,sec)
ENTER	MIN 00
ENTER	SEC 00
ENTER	LENGTH HOUR 00 Enter test duration. (To leave on until manually turned off, enter the default value, 99.)
ENTER	MIN 00
ENTER	SEC 00
ENTER	STEP 2 (Program steps 2-16 if needed, OR press EXIT EXIT)

4. To Start Logger:

ENTER	LOGGER	
ENTER	STEP	
▼	START	
ENTER	TESTING	STEP 1
ENTER	NOW *	
ENTER	LOGGING	
DISP	(Readings will show, and display will turn off after 3 minutes.)	

* An alternative start method is to delay the start to the next even interval. For example, if readings are being taken at 15 minute intervals, starting on the next even hour, 15, 30, or 45 minute time will make all readings appear at a more understandable time schedule, with 00 seconds to make reading easier. To do this, perform the following keystrokes when NOW appears in the above menu.

	NOW	
▼	DELAYED	
ENTER	HOUR XX	(This will be the current hour. Leave as is unless desired start time is the next hour. In that case, change to next hour.
ENTER	MIN XX	Enter the desired minutes of the start time.
ENTER	SEC XX	Enter 00

NOTE: The data manager does not have to be stopped during download. After disconnecting from download, check to make sure the logger is still logging (Logging displayed on the display.) If it has stopped somehow, re-start using the above menu. The new file will simply be added to the memory below the previous file. Each file will remain on the Data Manager until manually cleared.

5. <u>To clear the Data Manager</u>:

MENU	LOGGER	
ENTER	STEP	
▼	START	
▼	CLEAR	
ENTER	CONFIRM	
ENTER	ERASING	LOGGER
DISP	DISPLAY	VALUE