USERS MANUAL
FOR
SMART CHART II ™
DATA LOGGER

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DEVAR Inc.

USING THE LOGGER

General Operation:

The logger has three modes of operation: RECORD, STANDBY, and SLEEP. A LED on the front indicates the current operation mode.

RECORD is indicated by double LED blinks. The logger is actively measuring and saving the input. Once the logger is put into RECORD mode, all previous data is lost.

STANDBY is indicated by single LED blinks. The previously collected data is available and the logger is keeping track of the elapsed time since the last sample was saved.

SLEEP is indicated by a dark LED. The logger will only respond to the control button. If the logger is put to sleep by mistake, the data can be recovered. Please refer to Recovering Lost Data.

The control button, labeled on the front panel, is used to change the logger from one mode to another. Pressing the button briefly while the logger is in SLEEP puts it into RECORD mode. Pressing the button when the logger is in RECORD will put the logger into STANDBY mode. Pressing and holding the button for five seconds or longer will put the logger into SLEEP mode.

Available Inputs:

If an external sensor is not connected, the SmartChart II measures the ambient temperature using an internal precision thermistor. While this works well for measuring naturally occurring slowly changing temperatures, it will not work well in all situations. For instance, when a SmartChart II was placed into a plastic bag (for moisture protection) at a room temperature of 85ºF, then moved into a freezer at 0ºF, it took thirty minutes to reach final temperature.

A variety of input cables are available:

The temperature input cables all use a thermistor sensor. They are available for low (-56ºC to 30ºC), normal (-20ºC to 85ºC), and high (15ºC to 145ºC) temperature ranges. These cables have low thermal mass and are suitable for measuring rapidly changing temperatures. The internal sensor corresponds to the "normal" temperature range.

The voltage input cable has a red (positive) and black (negative) lead terminated with alligator clips. Maximum input is rated at 20VDC. For signal levels that remain below 400mV during the entire logging session, the SmartChart II has a minimum resolution of 1.6mV. The impedance of this cable is 100Kohms. If the leads are left unconnected, the SmartChart II will float to an indication of 1.25V. This property can be used to detect contact closure.

The current input cable was designed to monitor 4/20mA loops. The cable should be connected such that current flows into the RED wire (towards the +24V) and out the BLACK

wire (towards GND or -24V). The cable puts a constant 38 ohm load on the loop and can remain in the loop without the SmartChart II being connected.

Other Applications:

Several products incorporate the SmartChart II as part of an overall signal monitoring solution. Details on how to set up the software will be found in the manuals for those products.

CAUTION: Do not connect the SmartChart II to circuits that may produce hazardous voltages.

CAUTION: Do not connect the logger to a computer while it is also connected to an external input cable unless you are absolutely sure that the computer is electrically isolated from the input circuit. For instance, desktop computers are connected to earth ground and 4/20mA loops are frequently connected to earth ground. It is therefore possible to short out the 24V loop supply through the input cable, SmartChart II, and desktop computer!

Recording Data:

Follow these steps to execute a logging session:

1. If using an external input cable, plug it into the receptacle marked Sensor.
2. If the LED on the logger is blinking, put it in SLEEP mode by pressing and holding the control button for five seconds. The LED is now dark.
3. Briefly press the control button. The LED now double blinks to indicate that the logger is recording. For optimal performance, the input cable should already be reading the input signal when the recorder is turned on, (e.g. connect the current input cable to a working 4 to 20 mA loop before starting the recorder. If single blinks are observed, go to 2.

4. Allow the logger to record data for a while...

5. After the data is recorded, put the logger into STANDBY mode by pressing and holding the control button for a second. The LED single blinks. The data will be retained, and may be transferred to your computer at any time. The logger should be placed into the standby mode before being disconnected from the input signal. Once in the standby mode the logger can be disconnected from the input cable; the input cable can be left connected to the process input if desired.

6. Plug the serial cable into the receptacle marked P.C. and initiate a download.

7. When you no longer need the data in the loggers memory, press and hold the control button for four or more seconds. A dark LED indicates the logger is in SLEEP mode. The microprocessor is shut down and battery drain is minimal.

Note:
Data from the SmartChart II can be downloaded while the unit is recording, and while it is still connected to an external input cable.

CAUTION: Do not simultaneously connect the logger to your computer and to an external input cable unless you are absolutely sure that the computer is electrically isolated from the input circuit. For instance, desktop computers are connected to earth ground and 4/20mA loops are frequently connected to earth ground. It is therefore possible to short out the 24V loop supply through the input cable, SmartChart II, and desktop computer!
If you are not sure it is safe, UNPLUG THE INPUT CABLE!
Note that this type of damage isn't covered under warrantee.

CAUTION: Do not connect the SmartChart II to circuits that may produce hazardous voltages.

Recording Current-Loop Signals:

The SmartChart II can be used to record 4/20mA current loop signals, then to scale, plot, print, totalize and save the data in the process units being measured. Previously saved data can be examined or printed by utilizing the File / Open menu function. Execute the following steps to log a 4/20mA signal.

1. Connect the 4-20 mA input cable into the process loop, observing the proper polarity.
2. Connect the input cable to the input port of the SmartChart II. Press the control button to put the SmartChart II into record mode, observing the double blinking status LED.
3. Record data.
4. Press the control button to put the SmartChart II into standby mode, observing the single blinks from the status LED. Unplug the input cable.
5. Run the SmartChart II software. Select 4-20 mA from the Functions menu. A window opens, allowing the user to define the scaling and units of measure to apply to the data collected from the current signal. A previously saved profile can be loaded with File / Open. New profiles can be created by clicking "Clear All", entering the process values at 4 and 20 mA and entering a unit of measure in "UNITS". Profiles describing nonlinear input signals are created by entering process values in the 5mA, 6mA, ... 19mA spaces. Not all the spaces need entries, but enter enough values to describe the relationship accurately. A graph displays the relation between the current input signal and the values entered to scale the display.

6. A totalization feature is available for 4-20 mA inputs. To activate totalization click "totalize on" in the 4-20 mA scaling window. After entering a unit of measure in the "units" window, click on "per sec", "per min", "per hr" or "per day". While viewing the downloaded data, a total will be displayed along with Max, Min, Avg and Points, in a window just below the graph (e.g. if the graph is displaying Gal per Hr versus Time, the total will be in gallons). Note that all values being displayed are for the period of time presently being displayed by the graph (i.e. to total over a shorter period, increase the zoom).

7. Click OK. The software will then permit you to save the profile for later use. The downloaded data is now scaled to the entered values.

Note:
The input cable is not electrically isolated. Do not connect it and your computer to the logger at the same time unless you are working with an isolated process signal.

Automatic Scaling:

The logger begins each recording session by selecting the input scale range that is most appropriate for the applied input signal. Should the input signal exceed the present scale range, the range is increased until a valid reading is obtained. The logger notes when each change of scale took place, but can retain only four changes of scale. Should more than four rescalings occur, a message indicating that the scaling range of the logger has been exceeded will be displayed when the logger is connected to a computer. This error is uncommon because of the wide ratio of signals involved. The best resolution of the input signal is obtained when signals outside the range of interest are avoided. For example, when recording the temperature of a freezer, allow the sensor to cool before starting recording. It is also advisable to avoid connecting or disconnecting an input cable while the logger is recording, which could result in unwanted measurement spikes and possible rescaling.

Time-Extension Recording™:

The SmartChart II was designed to be as simple to use as possible. All that is required to successful log data is to plug in any desired input cable and turn it on. The input is automatically scaled to obtain the optimum resolution for the magnitude of the detected input signal. Time-Extension Recording™ scales the recording interval to obtain the maximum resolution given the length of time it has been recording. The net result is that the SmartChart II will contain data from the moment recording was initiated to the time it was stopped.

When the SmartChart II starts recording, the sampling interval is 1/4096 hour, or 0.88 seconds. When the memory becomes full, the sampling interval is doubled to 1/2048 hour, or 1.76 seconds. The samples taken at odd intervals of 0.88 seconds, such as 0.88 seconds, 2.64 seconds, 4.39 seconds, etcetera, did not occur on the present sampling interval and are now invalid. These values are discarded and the memory they occupied utilized to continue recording at the new sampling interval. This process repeats itself every time memory becomes full, and continues until the battery wears out or recording is stopped. For convenience in data analysis, the recording interval was selected so it takes on values of an hour, a half hour, a quarter hour, and so on.

Like automatic scaling, Time-Extension Recording™ is largely invisible to the user. There will be 1024 data points recorded after the first fifteen minutes of operation. After an hour, there will be 4096 data points. From an hour onwards, there will be anywhere from 4096 to 8192 data points recorded. The exact number will depend on where in the Time-Extension Recording™ cycle the logger is currently operating. The best results are obtained by limiting the time that the logger is allowed to operate to the time of interest. For example, lets assume

that the logger is recording a 4 to 20mA signal that represents a temperature of 0ºF to 500ºF in an oven, and that the desire is to record a one time heating /cool down cycle that takes 2 hours. The logger is put into record mode, the oven is activated, and time passes. When complete, the logger is downloaded, and the data is found to cover 2 ½ hours, for approximately 5000 data points at an interval of 1.76 seconds. The 2 hour operation is documented by about 4000 data points. Now lets assume that the logger continues to run and is downloaded after a week. Time-extension recording adjusts this to approximately 5500 data points at an interval of 112.5 seconds. The 2 hour operation is now documented by about 200 data points.

Battery Replacement:

Under normal conditions, battery will last for a year of continuous recording, unless the logger is re-started very frequently. In the SLEEP mode, the logger puts almost no load on the battery, but the batterys life is limited by its rate of internal discharge. We suggest using the SLEEP mode when the logger is not in use, and replacing the battery once a year in normal use. If the logger will be used at temperatures below 32 degrees F (0 degrees C), replace the battery every six to nine months

Replace the battery with a CR2032 lithium cell, which is available at most hardware and electronics stores. To replace the battery, remove the cover from the logger and remove the circuit board from the case. Snap the old battery out of its holder and install the new battery with the positive (flat) side up. When replacing the cover, make sure to orient it so that the window in the cover is above the indicating light.

If the logger will not wake from sleep after the battery is replaced, remove the battery, press the button, and then replace the battery. If the light blinks rapidly after the battery is replaced, put the logger to sleep and wake it again.

Cleaning:

Clean the logger with a cloth dampened with soap and water. Be careful not to get the inside of the logger wet.

Precautions:

1. Do not connect the logger to your computer when the logger is connected to an external circuit unless you are absolutely sure that the logger or the external circuit is electrically isolated from the computer. If in any doubt, before downloading, stop recording, disconnect the logger from the external circuit, and then connect the logger to your computer.
2. Do not connect the logger to any circuit containing hazardous voltages. The logger and its input cables are for low-voltage service only.

3. If you have a battery-powered computer, do not leave the logger connected to the computer. The loggers input circuit draws a small amount of current; it could drain the batteries of the computer.

4. Keep the logger dry. If you will be using it outdoors, put it in a sealed plastic bag. Avoid condensation, which can occur when the logger is moved from a cold environment to a warm, humid environment.
5. Avoid plugging in or unplugging the input cable when the logger is recording. Doing so could interfere with the automatic scaling of the logger.

USING THE SOFTWARE

Connecting the Logger to Your Computer:

Plug the "D" shell end of the serial cable into an unused serial port on the computer. Plug the 1/8" diameter connector into the receptacle labeled P.C. on the SmartChart II. Start the SmartChart II software. When the program is communicating with a logger the upper pane will display various parameters about the connected logger. If this pane remains blank, the program is not communicating with the logger and a window may appear asking to which COM port the logger is connected. The COM port selection defaults to the port that was last used to communicate with a SmartChart II. Port selection "no logger" allows one to use the software without a connected logger.
Note:
Most common causes for a lack of communication are (1) serial cable disconnected or plugged into the wrong receptacle, (2) logger is in SLEEP mode, and (3) selected COM port is incorrect.

A note about COM ports:

Most computers have two COM ports. Usually on older machines, COM1 was a 9 pin connector and COM2 a 25 pin connector. Adapters are available in electronic stores. On modern machines, they are usually both 9 pin connectors. The most common COM problem is caused by the COM port not being properly configured. Valid COM ports will be configured as one of the following: COM1 = 3F8 IRQ4, COM2 = 2F8 IRQ3, COM3 = 3E8 IRQ4, or COM4 = 2E8 IRQ3. The second most common COM problem is a conflict in resources. Notice that COM1 and COM3 share IRQ4. Problems will arise if the machine is configured such that anything shares resources with the COM port being used for the SmartChart II. These problems can be unreliable communication to a total lack of communication between the software and the SmartChart II. The only solution is to resolve the resource conflict.

Configuring COM ports:

On very old machines, the COM ports were built into boards that plugged into the motherboard. These boards were configured by moving jumpers or switches. Refer to the original documentation. Sometimes, instructions were printed on the board itself. On newer machines, the COM ports are built into the motherboard. The resources the ports used are controlled by BIOS settings. On many machines, a prompt appears at startup to indicate the proper key to press to enter the BIOS configuration menu. The COM port settings can be changed in the peripheral setup section. The hardware ports are usually referred to as COMA and COMB, and the choice of settings as COM1 through COM4 and disabled, and sometimes a

choice for plug-n-play. There is occasionally a choice for IR (InfraRed, usually on COMB). Set the used hardware COM port as a valid port as described above.

Resolving COM port conflicts:

On old machines, and / or machines running Windows 3.1, find a good utility program that will correctly identify hardware resources and use that to help identify the problem. If the system has a serial mouse and/or a modem, check those out first. It may be necessary to temporarily remove the mouse or modem and its associated software drivers to use the SmartChart II on that machine.

On recent machines running Windows 9x/2000/NT, the system resources can be observed from the control panel. Click on the start button, scroll down to settings, then click on control panel. Once that opens, double click on system. Once that opens, click on the device manager tab. There are possibly two entries that we are interested in. Ports (COM and LPT) and Modem. If there is a modem entry, click on it to expand it, select the modem, then click on properties. Select the modem tab. The COM port used by the modem is displayed. Close the modem windows. The COM port being used by the modem can not be used for the SmartChart II. Now expand the Ports entry. Click on a COM port, then click on properties. Click on the resources tab and observe the conflicts pane. If this pane is blank, this is an acceptable port. Check all the COM ports listed. If there are no COM ports listed, they were probably disabled in the BIOS. If there is an IR port listed, the hardware port currently being used might have been disabled to allow resources for this port.

If All Else Fails try installing the software and running it on another machine, if one is available. Each SmartChart II is fully tested and operational before it leaves the factory. Observing a unit operate removes one layer of uncertainty in the troubleshooting process.

Specifying the Function of the Logger:

The logger operates by recording the magnitude of the input signal, which becomes a series of numbers. After the data is downloaded into the computer, there is no way for the program to determine what generated that data. The FUNCTION menu allows the user to identify the source of the data by picking it from a list. The function has to be specified prior to saving the data. The FUNCTION menu is only available when a logger is connected to the computer. The real time data displayed on the computer screen is based on the currently selected function. If the input connected to the SmartChart II is the same as the selection made in the FUNCTION menu, the indicated value is valid, otherwise this value is spurious and should be ignored.

Thermistor input (internal sensor or external probe):

Verify that the proper sensor is selected from File / Thermistor Select, then either Standard, High Temp, or Low Temp. Then pick Function as either deg F or deg C. Note that the internal sensor is the Standard thermistor.

Voltage input cable: Pick Function Volt.

Current input cable:

Pick Function 4 to 20 mA, then scale the data to the desired process values in the window that opens. One can create a calibration profile or use a pre-existing calibration profile to interpret the data. A profile is created by entering the process value that corresponds to the mA input signal. The process value can be defined at each milliamp boundary, which allows the user to linearize the input signal. The process input values only need to be defined at 4 and 20 mA for a linear input signal. Enter a process identifier in the box labeled units. The option to totalize the input may be activated by selecting "totalize on" and then picking per sec, per min, per hr or per day. After the OK button is clicked, the choice of saving the profile is offered. Pre-existing profiles are loaded from File / Open. Note that Function Ohms is used to calibrate and verify proper operation of the SmartChart II.

Other inputs:

SmartChart II as part of an overall measurement solution. Consult the documentation included with the system.

Setting Time:

The software uses the real time clock in the computer to determine when each sample was recorded. The accuracy of most of these clocks is poor. Corrections to the time and date are made using the Control Panel. Use TIME SET to correct the time used by the program without altering the computers real time clock. This is useful if downloading data recorded in another time zone, or if recovering data from a logger that has been accidentally put to sleep.

 As a reminder, the TIME SET menu appears automatically the first time you download during a session. If you do not need to change the time setting, clear the menu by clicking OK or pressing enter.

Downloading Data from the Logger to the Computer:

The transfer of the data takes approximately 90 seconds for a full 8K logger. The logger will not record data or keep track of time while downloading. If time data is critical, only download data after putting the logger into standby mode.

To transfer data from the logger:

1. If the units displayed in the status pane do not correspond to the parameter that was recorded, make the appropriate change using FUNCTION.
2. Select DOWNLOAD. The computer will re-read the configuration information, download the data, and then plot the results on the screen.
3. Click on ANNOTATE at the lower left of the screen to add a graph title or notes.

Examining Data; Zoom Function

It is possible to zoom in on a portion of the graph. Place the cursor at one corner of the area of interest, and press and hold the left mouse button. A box will appear; use the mouse to stretch the box to enclose the area of interest, and release the left mouse button. The computer will then re-draw the graph, showing the area within the box. The graph can now be plotted in its zoomed condition. To return to the original graph, click on the "unzoom" button at the bottom of the graph.

Plotting and Saving Data:

The FILE menu provides four options for plotting and savings data.

1. To print the graph that appears on the screen, select "Print Graph".
2. To obtain a tabular listing of the data, select "Print Data". The listing gives the date, time, value and units for each reading. To save paper, the data are printed in small type, five columns to a page.
3. To place the graph in a document, select "Graph to Clipboard". This places the graph in the Windows clipboard; from there it can be pasted into another application with graphics capabilities.
4. To save the data for analysis by a spreadsheet program or for later display by the SmartChart II software, select "Save As .TXT". The resulting file can be imported into most spreadsheet programs. Please refer to "Importing text data files into Microsoft Excel" and "Formatting the Time and Date Information in Excel" for clarification.

The Zoom function does not affect how the data are saved; the complete record is saved even if only a portion is currently displayed on the graph.

To retrieve a file, select "open". It may not be possible to open files that have been altered and re-saved by other software. After retrieving a file, it is possible to change its title and its units, but it is not possible to change its time scale.

Importing text data files into Microsoft Excel:

1. Point and click on File Open, the Open window opens. Use the controls to navigate to the \SmartChart II\ folder and identify the file type as text files (*.txt), then pick the desired data file.
2. The Text Import Wizard Step 1 of 3 opens. The options should be set as:
   Original Data Type: Delimited
   Start Import at Row: 1
   File Origin: Windows (ANSI)

3. Click on Next, The Text Import Wizard Step 2 of 3 opens. The options should be set as:
   Delimiters: Comma
   Text Qualifier: "

4. Click on Finish and the file is opened as a one worksheet workbook.
5. Click on File / Save as and change Save as Type to Excel workbook (*.xls)

Formatting the Time and Date Information in Excel:

The numbers in column A, row 5 and greater, are a representation of the time and date. To format these numbers into time and date format:

1. Select column A, click the right mouse button, and select format cells from the pop up menu.
2. Select the Number tab.
3. Select Custom, then edit the pane to read "dd mmm yyyy hh:mm:ss AM/PM", which will format the date and time as "04 July 1998 11:45:34 AM"
4. Select cells A1 through A4, click the right mouse button, and select Format cells,
5. Select the Number tab.
6. Select general.

Merging Two Workbooks in Microsoft Excel:

1. Create a uniquely named workbook to analyze current data
2. Open the workbooks that are to be merged.
3. Click on Window <filename> to switch to one of the open workbooks.
4. Right button click on the worksheet tab (along bottom of screen), and a menu opens.
5. Click on Move or Copy and a window opens.
6. In the _To Book:, pane use the down button to view all open files and select the uniquely named workbook.

7. In the _Before Sheet: pane select (move to end) and click OK.

Repeat from 3 to 7 for the other file.

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GENERAL INFORMATION

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Recovering Lost Data:

Normally, the logger clears the portion of its memory that deals with timing and scaling when it wakes from the SLEEP mode. Once it has done this, it can no longer access the data in its main (EEPROM) memory. If you need to recover data from a logger that has been put to sleep, press the button three or four times in rapid succession. This will cause the logger to skip clearing its memory and go directly from SLEEP into the STANDBY mode. You can then download the data using the normal procedure. However, when the logger was in the SLEEP mode, its clock was not running. To have the time scale on the data correct, use the Time Set function to set the programs time back by the period the logger was asleep before downloading the data. (If you woke the logger immediately before downloading it, set the programs time to the time the logger was put to sleep.)

Troubleshooting:

Symptom: After being in a damp, cold environment, the logger does not function.
Cause, Correction: Condensation may have formed inside the logger, shorting out the circuitry and discharging the battery. Open the logger, remove the battery, and allow the circuit board to dry thoroughly in a warm location. Replace the battery.
Symptom: The indicating light is dim.
Cause, Correction: The battery is weak and should be replaced.
Symptom: The logger will not wake from sleep after the battery is replaced.
Correction: Remove the battery, press the button, and replace the battery.

Technical Assistance:

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