DALLAS
SEMICONDUCTOR

TMEX Runtime Environment
Version 3.20 Reference Manual

iButton

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Introduction

The Dallas Semiconductor TMEX Runtime Environment is a set of software drivers and utility programs to interface with the Dallas Semiconductor iButton products (Touch Memories) and other 1-Wire devices including sensors. iButtons are high-capacity, general-purpose electronic data carriers, each with a unique registration number acting as a general identification number and a unique network node address. Communication with iButtons and 1-Wire devices is done over a single data line plus ground reference using the 1-Wire protocol. This network is called a 1-Wire Net or "MicroLAN".

The drivers enable TMEX-ready 1-Wire applications to run. The TMEX Runtime Environment, referred to simply as TMEX, supports Microsoft Windows 95/98/Me, Windows NT 4.0, and Windows 2000 on standard desktop and laptop computers.

The TMEX Runtime Environment can be used
   a) stand alone with the provided utilities
   b) in conjunction with other Dallas Semiconductor TMEX-based kits
   c) with third party applications that require TMEX.

Dallas Semiconductor offers the 1-Wire Software Developer's Kit (SDK) for Windows (part number DS0621-SDK), to develop applications for this runtime environment. This SDK was formerly known as the iButton-TMEX Software Developer's Kit. The SDK supports all of the platforms provided in the TMEX Runtime Environment. It includes multiple source code examples in several languages including C, Pascal and VB. It also includes the full documentation of the TMEX API.

Overview

The following section of this document describes the installation of the 1-Wire drivers under Windows 95, Windows 98, Windows Me, Windows NT 4.0, and Windows 2000. The TMEX Runtime Environment installs the TMEX API drivers and all the associated interface DLLs accompanying them. In addition, subsequent sections of this document describe the default 1-Wire Port, and the use of the iButton Viewer software application. Different 1-Wire adapters are available to be used to communicate with 1-Wire devices, including ones for serial ports, parallel ports, and USB ports. The iButton Viewer uses these ports and combines the features of multiple 1-Wire software utilities in a single software program. The iButton Viewer supports a multi-drop environment where multiple iButtons may reside on the 1-Wire bus and are accessed independently of each other.

Installation

Before upgrading to this version of TMEX Runtime Environment (formerly referred to as Single User License 'SUL') always remove any previous version with its uninstaller. The uninstall program can be accessed with the 'Add/Remove Software' utility in Windows (discussed below).

1. Click on the 'Start' button
2. Click on 'Settings' and then 'Control Panel'
3. Double-click on the 'Add/Remove Programs' icon in the 'Control Panel'
4. Select the 'iButton-TMEX (32-Bit) VX.XX' line in the 'Add/Remove Programs' window (where X.XX is the old version number)
5. Click OK at the bottom of the 'Add/Remove Programs' window
6. When asked if you want to remove all of iButton-TMEX, click OK.

The installation of TMEX Runtime Environment for 32-Bit Windows is a standard wizard format install program. This install program can come in various formats:

1. Menu option from a CD install program
2. Floppy with a SETUP.EXE program
3. Downloaded from Dallas Semiconductor's Web site. ([http://www.ibutton.com)](http://www.ibutton.com).

In each case, once the install begins it will look the same. If the install does not automatically start then double click on the 'SETUP.EXE' or 'TM320_32.EXE' self-extracting install program using 'Windows Explorer'.

Details on the files that are copied to the system during the install can be found in **Appendix B**.

Please note that there are multiple installation distributions available. Two distributions are available that contain the iButton Viewer, along with the TMEX API drivers. Three distributions contain the TMEX API drivers only. All of them are available for download from http://www.ibutton.com/software/tmex.

Of the two installation distributions that include the iButton Viewer, one of them is a self-extracting executable. This can be simply downloaded and run (by double-clicking). The second installation distribution is available as an archive of two tar/zipped diskettes. The archive will need to be unzipped, and then the contents can either be copied onto diskettes, and run from there (by double-clicking the SETUP.EXE file on the first diskette), or just unzipped to a specified folder and run.

The second group of installation distributions is the drivers-only group. Three distributions are available for a drivers-only installation. Similar to the installation distributions mentioned above, the first one is a self-extracting executable, and the second is an archive of two tar/zipped diskettes. They function identically to the installations above except that the iButton Viewer is not installed. Thirdly, an

installation distribution exists as one tar/zipped archive. It contains all the driver files for a manual two-diskette installation in one folder.

Initial Screens

Before installing the Windows 32-Bit version of the TMEX Runtime Environment, connect a 1-Wire adapter to the PC. See **Appendix A** for a description of available adapters from Dallas Semiconductor and third party suppliers. Close any open application before starting the installation.

Start the installation as described above (i.e. SETUP.EXE …). The first screen that is returned from the installation program asks the user whether or not to proceed with the installation of TMEX. See picture below.
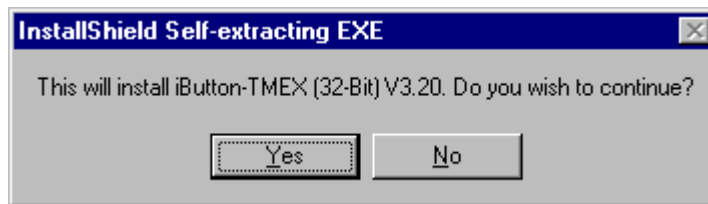
If the user selects to continue with the TMEX installation by clicking "Yes", then after the installation program completely loads, a USB warning screen appears, prompting the user to unplug any 1-Wire USB device plugged into the computer if the user wants the USB driver to be updated.
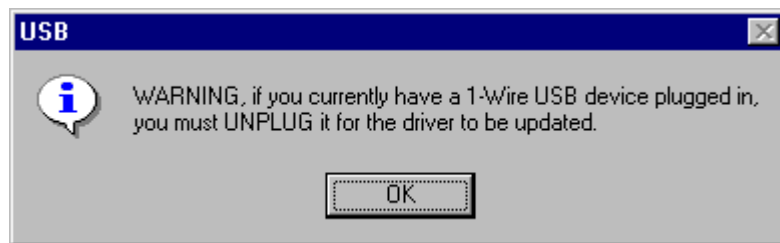
After the above screen is presented, several other screens will follow. During the installation you can move from screen to screen by clicking on the button "Next >" or "< Back" or cancel the installation ("Cancel").

License Agreement

Right after the initial screens, the Software License Agreement is displayed. The license agreement can be scrolled through on screen or, after the installation is completed, be printed (LICENSE.TXT). The next screen provides general informa-

tion on the TMEX Runtime Environment and a reminder to uninstall any earlier revision of the program before proceeding with this installation.

Readme Information

In one of the subsequent screens, the user is displayed the contents of the primary readme.txt file. It covers the installation process and some of the major points contained in this document. It is also available as a text file after the installation completes.

Destination Location

In the next step the installer asks for the Destination Location where the program files are to be copied. The default location is on the Windows drive in the \Program Files \Dallas Semiconductor\iButton-TMEX (32-Bit) V3.20\ directory. You may enter any other destination directory using standard conventions. If the directory does not yet exist it will be created. You may instead click on "Browse..." and select an existing directory.

Program Folder

Windows allows programs to be grouped into "Program Folders". If you accept the default shown on the Select Program Folder screen, the installer will create a new program folder "iButton-TMEX" with the icons for the iButton Viewer {32 Bit}, iButton-TMEX ReadMe {32-Bit}, the iButton Viewer Help {32-Bit} , and the Default 1-Wire Net Port {32-Bit} utility. Alternatively you may create a new folder by typing its name or select an existing folder by scrolling through the list of folders.

1-Wire Net Port Selection

After the Program Folder has been selected, one has to specify which of the ports with a 1-Wire adapter connected is to be defined as the TMEX default 1-Wire Net port. This is done through the Port Selection Screen. It is possible to have more than one port adapter plugged in at a time. However, only one of them can be selected as the default.
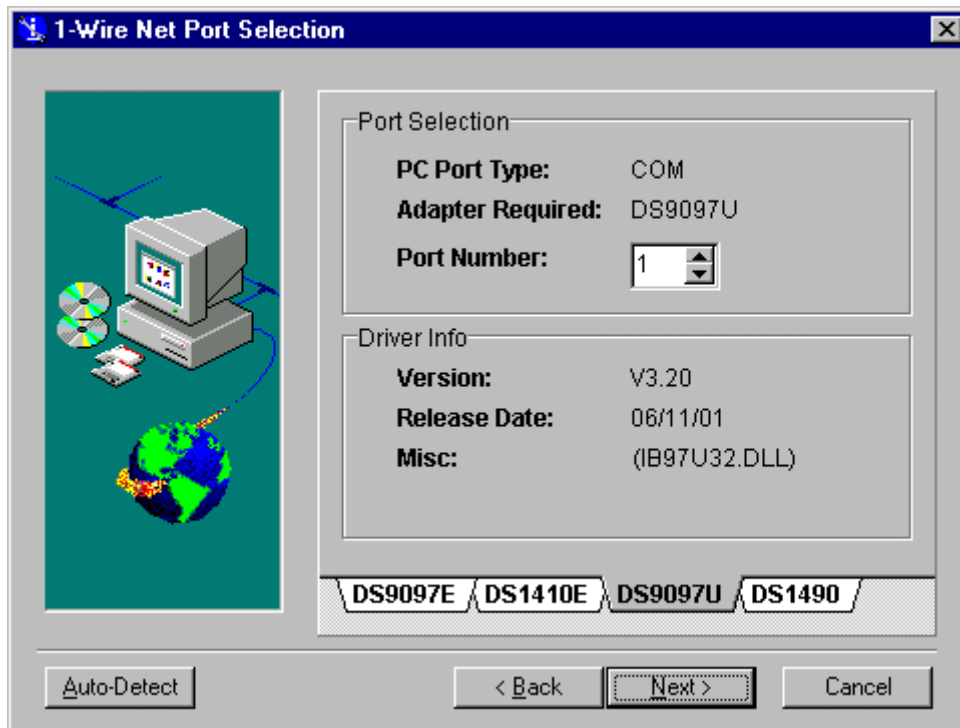
On the Port Selection Screen, select the tab of the hardware adapter that is to be used. Next enter the port number where the 1-Wire adapter was attached during the preparation of the installation (see Initial Screens). After a port with adapter has been selected, the port number, adapter type and driver information will be displayed, and the user can proceed to the next screen. If a port with no adapter connected is selected, you will get an error message. Alternately the 'Auto-Detect' button can be clicked to search through all port types.

Setup Complete

When you reach this screen, the TMEX installation is completed. Re-booting is not required.

Setup Complete

Setup has finished copying files to your computer.
Setup will now launch the program. Select your option below.

☐ Yes, I want to view the README File

Click Finish to complete Setup.

InstallShield

< Back   Finish
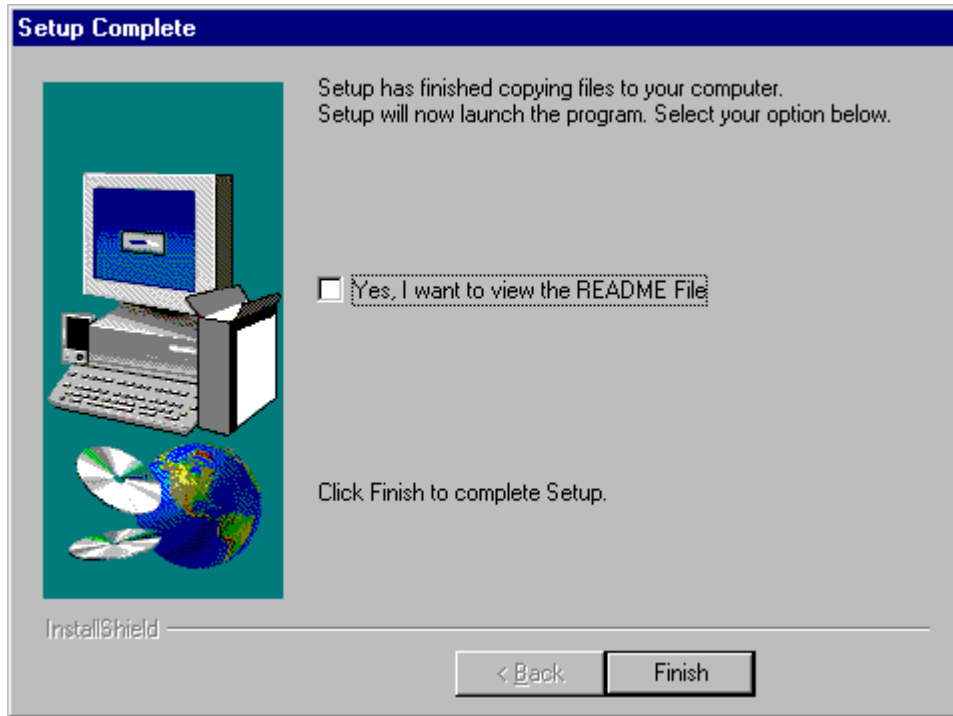
Notes
After TMEX is installed, the iButton Viewer and other TMEX-dependent programs
(not included in the TMEX install) can be used without having to run the installer
again. If you change the 1-Wire port on your computer, however, the application
software such as the viewer needs to be reconfigured. The iButton Viewer has a
function to do this (see next section for details), but it does not change the TMEX
default 1-Wire port in the registry. To change your default port use the 'Default 1-
Wire Net Port' as described in the next section.

Default 1-Wire Net Port

TMEX applications will use the 'Default 1-Wire Net' port on their first invocation. Some of these applications such as the iButton Viewer will then allow you to change the 1-Wire Net port it uses. This will not change the default port. Applications without a means to select a port will use the 'Default 1-Wire Net' port exclusively. To change the 'Default 1-Wire Net' port after installation, run the 'Default 1-Wire Net Port {32-Bit}' icon in the iButton-TMEX folder. This will run the application SETPRT32.EXE.
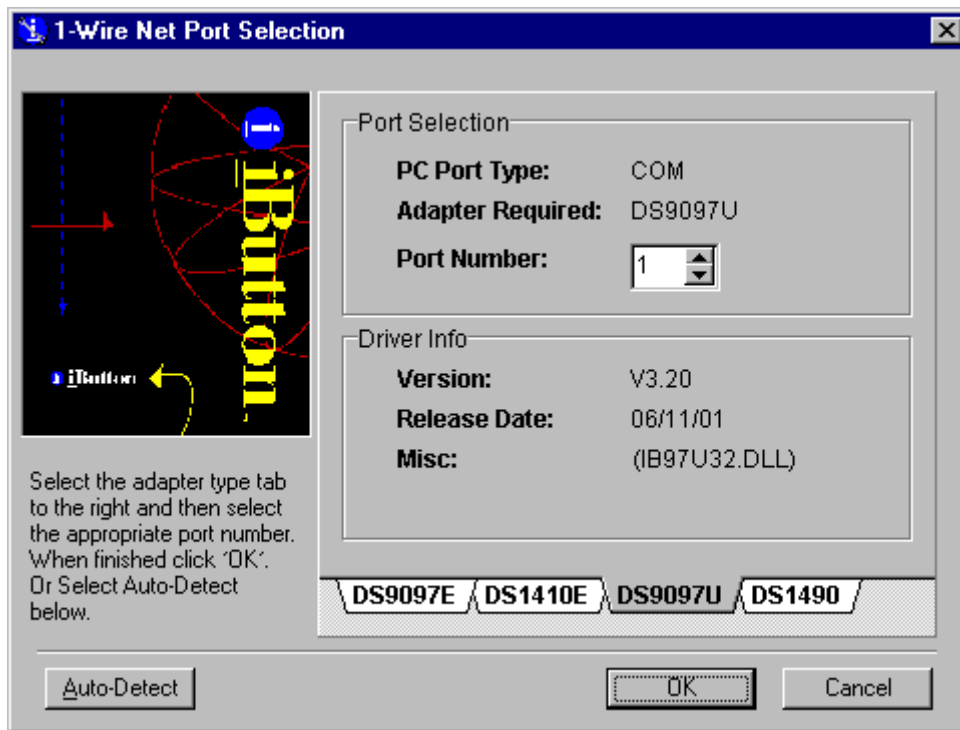
iButton Viewer

Introduction

The iButton Viewer is a Windows program for communicating with iButtons and other 1-Wire Net compatible 1-Wire devices. The iButton Viewer supports a true network environment. Device-specific viewers allow evaluation of special function devices.

The main features of the iButton Viewer are:

- Supports 1-Wire Net environment with no logical limit for the number of devices on the bus

- Reads and writes Memory iButtons based on SRAM, EPROM and EEPROM technology

- Supports all currently available iButtons and their solder-mount equivalents

- Thermochron (temperature recorder) viewer for the DS1921

- A/D viewer for the DS2450 quad A/D device

- DS2438 Viewer supports A/D voltage readings, temperature, and relative humidity measurements (for the DS1910 Hygro iButton) (new for V3.20)

- Counter viewer for DS2423 and DS2422

- DS2890 1-Wire Potentiometer viewer (new for V3.20)

- Sophisticated 1-Wire File Structure viewer for DS1973 (DS2433), DS1963L, DS1963S, DS1982 (DS2502), DS1985 (DS2505), DS1986 (DS2506), DS1992, DS1993, DS1994 (DS2404), DS1995, DS1996, DS2406, and DS1921 with upload/download from PC to iButton and iButton to clip board

- Time register viewer for DS1994 (DS2404)

- Secure viewer for DS1991

- EEPROM viewer for DS1971 (DS2430)

- Temperature viewer for DS1920 (DS18S20)

- Switch viewer for DS2406, DS2409

- Serial Number Viewer for DS1990 (DS2401A) and device types currently without a dedicated viewer

- Debug 'raw' viewer for (DS2430A), DS1973 (DS2433), DS1963L, DS1963S, DS1982 (DS2502), DS1985 (DS2505), DS1986 (DS2506), DS1992, DS1993, DS1994 (DS2404), DS1995, DS1996, DS2406, and DS1921.

- Multiple window, multiple port operation to view several devices simultaneously

- Supports Overdrive communication

- Context sensitive help

The iButton Viewer accepts generic as well as custom ROM devices. For devices currently under development the iButton Viewer will, in most cases, display the part number together with a short description. As soon as these devices become generally available, the iButton Viewer will be revised to include the necessary viewers. Until then a message "This device type is not currently supported by this version of the iButton Viewer." will be displayed. The iButton Viewer is able to read the ROM Registration Numbers of future 1-Wire Net-compatible 1-Wire device types but it will be unable to provide a description or Dallas Semiconductor part number.

Main Screen

The iButton Viewer is launched like other Windows program by double-clicking on its icon in the 'iButton-TMEX' folder. The main screen of this program (see marked sample below) consists of several sections, each with its special purpose. These sections are: Network Listbox (left), Part Number drop-down Combobox (top), Viewer Launching Button (lower right), Menu Bar (top) and the Status Bar (bottom).
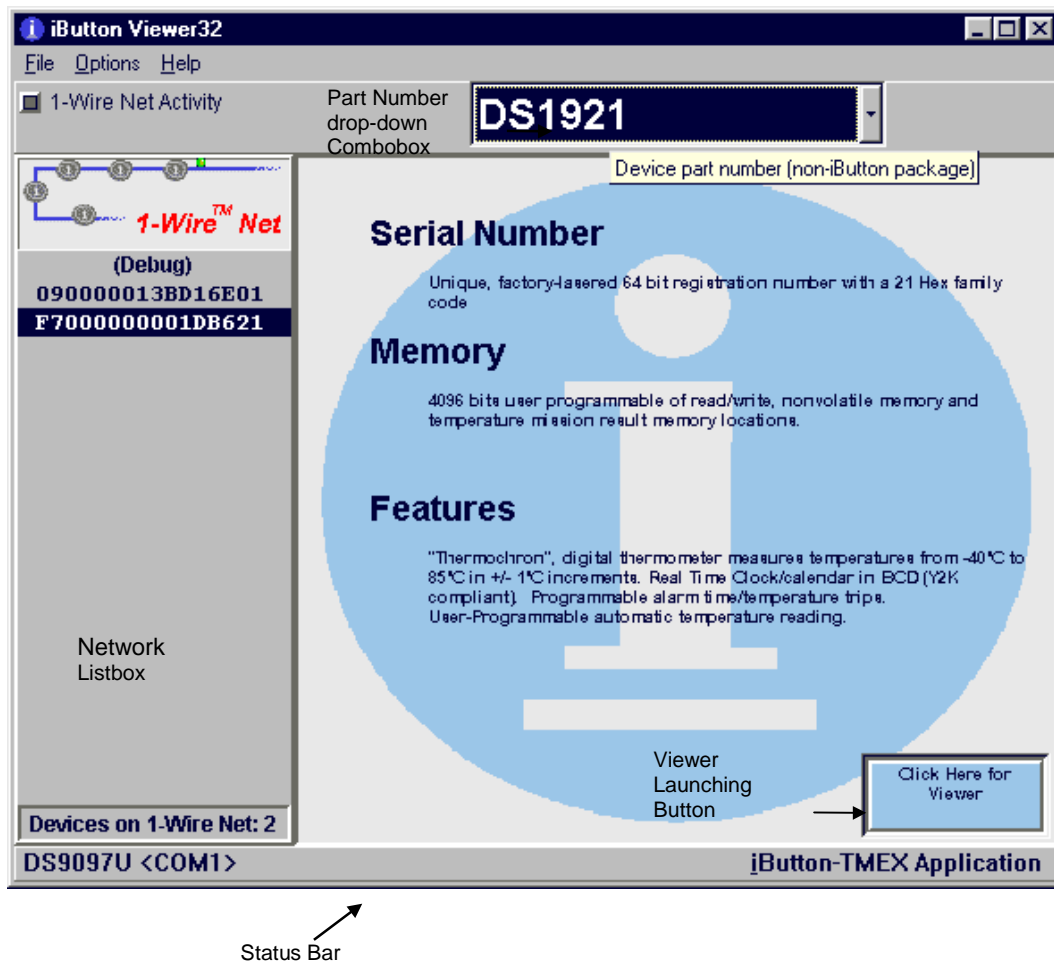
The **Network Listbox** is the primary switchboard of the iButton Viewer. It lists the ROM codes (= network node addresses) of all devices currently connected to the 1-Wire network. The user can scroll through this list with the cursor keys or click on a network node address to select a device. Depending on the number of devices connected, the Network Listbox may have a scroll bar to allow reading all addresses and selecting a device. If no device is connected the Network Listbox will be empty.

After a device has been selected in the Network Listbox, its node address is high-lighted and its part number appears in the **Part Number Combobox**. The area be-low the Part Number Combobox will then display some of the device's characteris-tics. The Part Number Combobox also may be used independently of the population of the 1-Wire network. Clicking on the down arrow at the right of the Combobox will display the list of devices that are recognized by the program. An optional scroll bar allows reading the entire list. Clicking on a part number will close the box and display the device description. If there is a device with the selected part number on the 1-Wire bus, it will automatically be selected.

The next step after selecting a device is launching a device viewer. There are cur-rently eleven device viewers implemented in the program. The family code of the device (i. e., the two least significant digits of the node address as displayed in the Network Listbox) determines which viewer applies. Usually the iButton Viewer selects the device viewer automatically. For some devices (such as the DS1994) there may be more than one viewer. In such a case the program will display the names of the applicable device viewers and ask the user to select one when trying to launch the device viewer.

There are several ways to launch a device viewer: a) clicking on the **Viewer Launching Button**, b) double-clicking on a network node address shown in the Network Listbox or c) pressing the right mouse button. Method a) is the direct one. Method b) combines device selection with launching the device viewer. Method c) displays a three-item Listbox next to the cursor where one then has to click on "Viewer". Regardless of the method, a viewer window will pop up that is associated only to the individual device that has selected. The individual device viewers are de-scribed in detail on the subsequent pages.

The iButton Viewer Main Screen has two more sections: Menu Bar and Status Bar. The **Menu Bar** has three entries: File, Options and Help. File opens a path to exit the iButton Viewer program, which is equivalent to closing the iButton Viewer's win-dow. Help launches the Windows Help Utility to access the program-specific help file. Selecting 'About' under help shows the user the version of the iButton Viewer as well as the versions of the underlying TMEX Runtime Environment drivers.

Options opens a list with six items: a function "1-Wire Net Port" to dynamically change the 1-Wire Port that is monitored by the iButton Viewer and four individual flags "Auto Viewer Start", "Auto Viewer Close", "Auto Save Size/Position", "File Auto Overdrive", "Set Flex Speed", and "Debug Enable". The function "1-Wire Net Port" is similar to the port selection scheme used during the TMEX installation. However, the port selected with "1-Wire Net Port" is valid for the iButton Viewer only. It does not alter the default selection made during the TMEX installation. The **Status Bar** shows the currently valid port name at its left side for verification.

The "Auto Save Size/Position" flag, if checked, will force the iButton Viewer to pop up always in the same window size and position it had when it was last used. The port selection function as well as the exit path is also accessible through the right mouse button. More details on port selection and a full discussion of the four option flags are found in the section "Viewer Customization/Advanced Features.

Just below the entry "File" in the menu bar there is a blinking spot labeled **1-Wire Net Activity**. Whenever this spot is green it indicates that 1-Wire Net communication such as ROM Search (see device data sheets) is in progress. An activity indicator is also found on each device viewer window. This indicator is green whenever the associated device viewer is accessing and in control of the 1-Wire Net.

Thermochron (temperature recorder) Viewer

The Thermochron (temperature recorder) Viewer is a tool to initialize and download the temperature data from a DS1921 Thermochron iButton.

Initializing the DS1921 is referred to as sending it on a 'mission'. There are several options when starting a mission. To go through each of these options, the Thermochron viewer incorporates a 'Mission Wizard'. If the device is not currently on a mission, then the Thermochron viewer defaults to display the wizard first.

The viewer has two other main tabs: 'Mission Results' and 'Status'. 'Status' will display the current settings in the DS1921 such as if a mission is in progress, the number temperature readings taken, etc. The 'Mission Results' will contain the log of temperature readings and histogram. The bottom of the viewer contains a status message describing the current operation being performed.

If 'Auto Save Size/Position' is checked in the main iButton Viewer options, then the state of the Thermochron Viewer is saved and restored on the next invocation. This includes the size, position of the window, choices in the mission wizard, and display options.

Menu Options

There are several menu options available. They can be accessed by clicking on the menu groups at the top of the viewer.
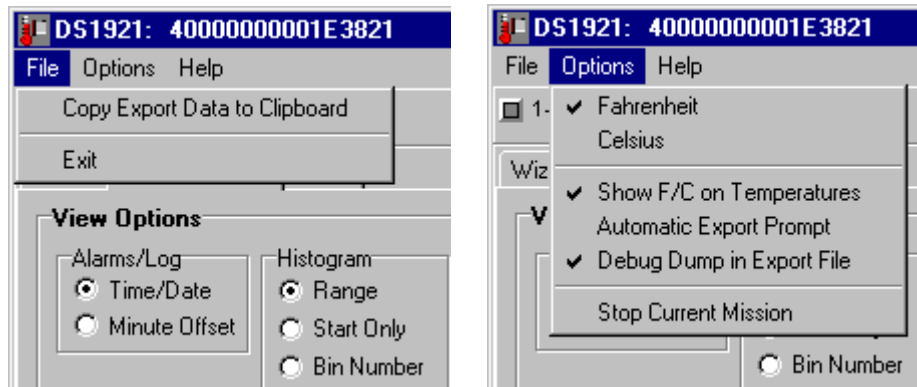
File / Copy Export Data to Clipboard
The Copy Export menu option will take mission status and results and copy it to the Windows clipboard in the form of text. This may be more convenient than saving the data to a text file before importing it into another program.

File / Exit
The Exit menu option will close this viewer and any open quick graphs.

Options / Fahrenheit and Celsius
The temperature mode options select whether all of the temperatures in this viewer are displayed as Fahrenheit or Celsius. Click on the desired format. This format will also be used in all graphs and export data.

Options / Show F/C on Temperatures
The Show F/C option toggles whether the temperatures displayed throughout the viewer have the F or C appended to indicate the temperature display mode. It is sometimes desirable to not have the letter displayed for easier import into other applications.

Options / Automatic Export Prompt
When checked, the 'automatic export prompt' will automatically prompt for an output text file immediately after the mission data has been downloaded. This could be used in combination with the iButton Viewer's 'Auto Viewer Start' and 'Auto Viewer Close' options to quickly download the results of Thermochron missions.

Options / Debug Dump in Export File
When checked, the 'Debug Dump' option will automatically copy the raw dump of the DS1921 memory pages into the export file or clipboard.

Options / Stop Current Mission
The 'Stop Current Mission' menu option will end a mission if one is currently in progress. It does not, however, stop the real-time clock.

'Mission' Wizard

The Mission Wizard can be started at any time by clicking on the 'Wizard' tab and proceeding through the options by clicking on 'NEXT >' button. At any time, previous options can be re-addressed by clicking on the '< BACK' button.
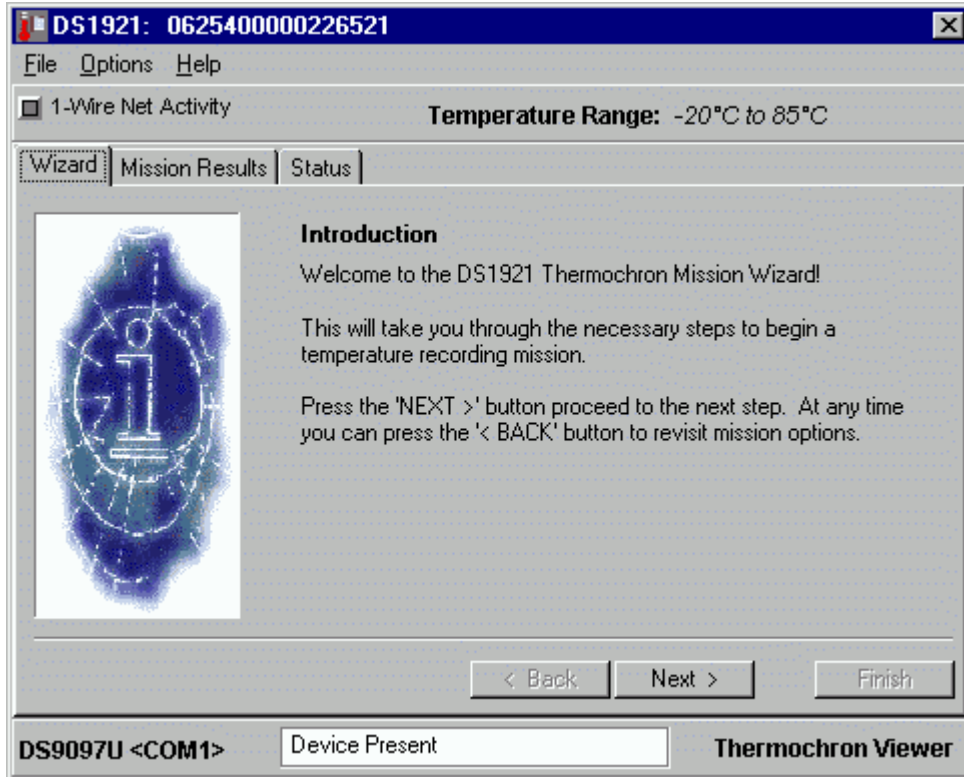
Real-Time Clock Set

The next Wizard screen will optionally set the DS1921's real-time clock from the PC clock. To help with this decision, the current device and PC clock time is displayed. The time display will be updated approximately every 3 seconds. The time is displayed in 24-Hour format. Clicking on the check box at the bottom will toggle whether the time will be set from the PC.
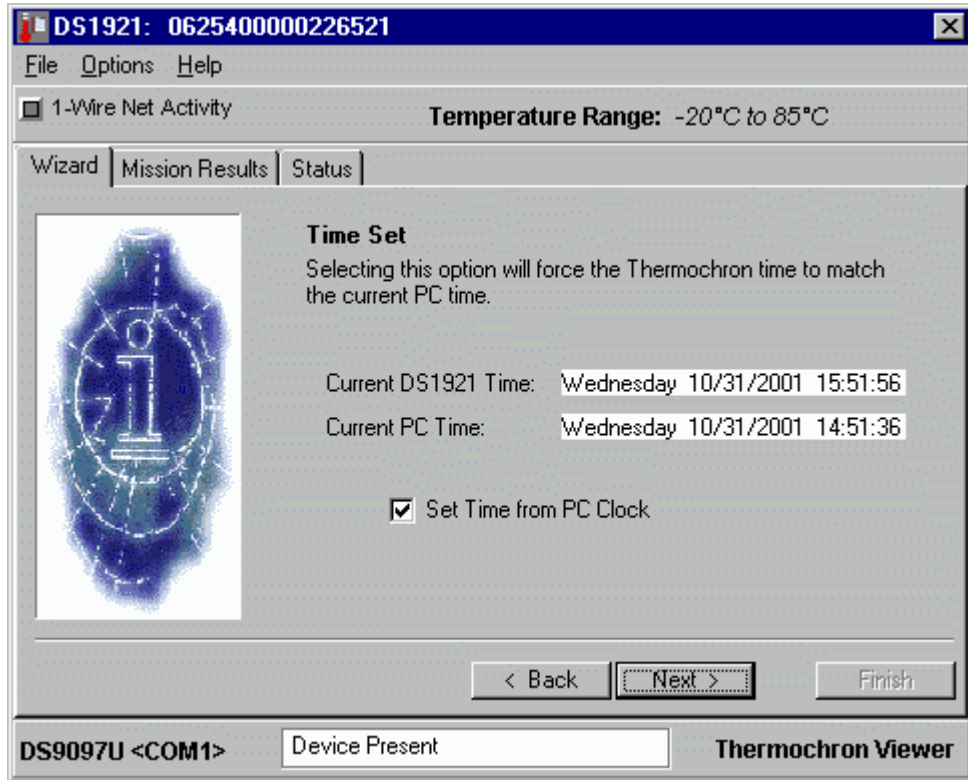
Time Alarm

The time alarm will select the time at which the DS1921 will start responding to a conditional search. The conditional search is a way to service only the device's that need attention in a multi-device network. The alarm can occur weekly, daily, hourly, minutely, or every second. The top drop-down box will select the mode. The lower drop-down boxes will select the relevant times. Some of the lower drop-down boxes will not be visible in some alarm modes. For example the 'Day' drop-down will not be visible when alarming hourly. The bottom check-box selects whether the device will respond to a conditional search when a Time alarm has occurred. Since the Time alarm cannot be disabled, selecting the alarm mode of 'none' will set a 'Weekly' alarm. The check-box at the bottom selects whether the device responds to a conditional search when a Time alarm occurs.
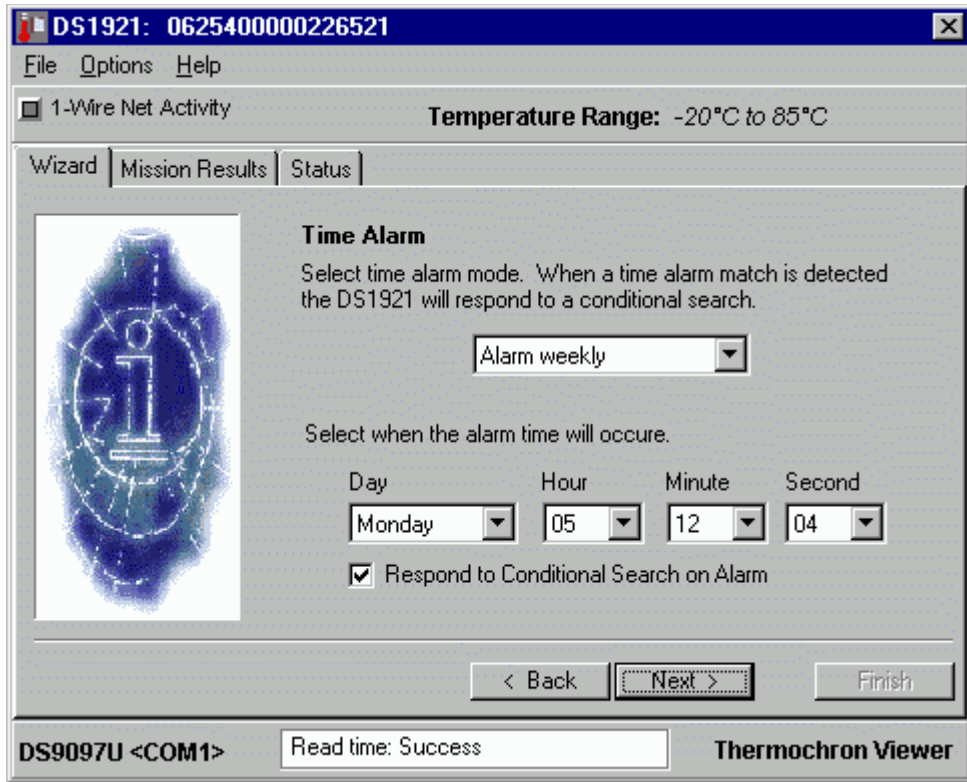
Mission Start Delay
The DS1921 can delay a specified number of minutes before it begins taking temperature readings. This feature can be used to prevent needless readings before the target time frame or to space several DS1921's at staggered intervals. As a convenience, drop-down boxes are used to select a number of days, hours, and minutes. The total minutes delay is displayed. The DS1921 has a maximum start delay of 65536 minutes or about 45.5 days. The drop-down boxes allow a maximum selection of 44 days, 23 hours, and 59 minutes giving a total of 64799 minutes.
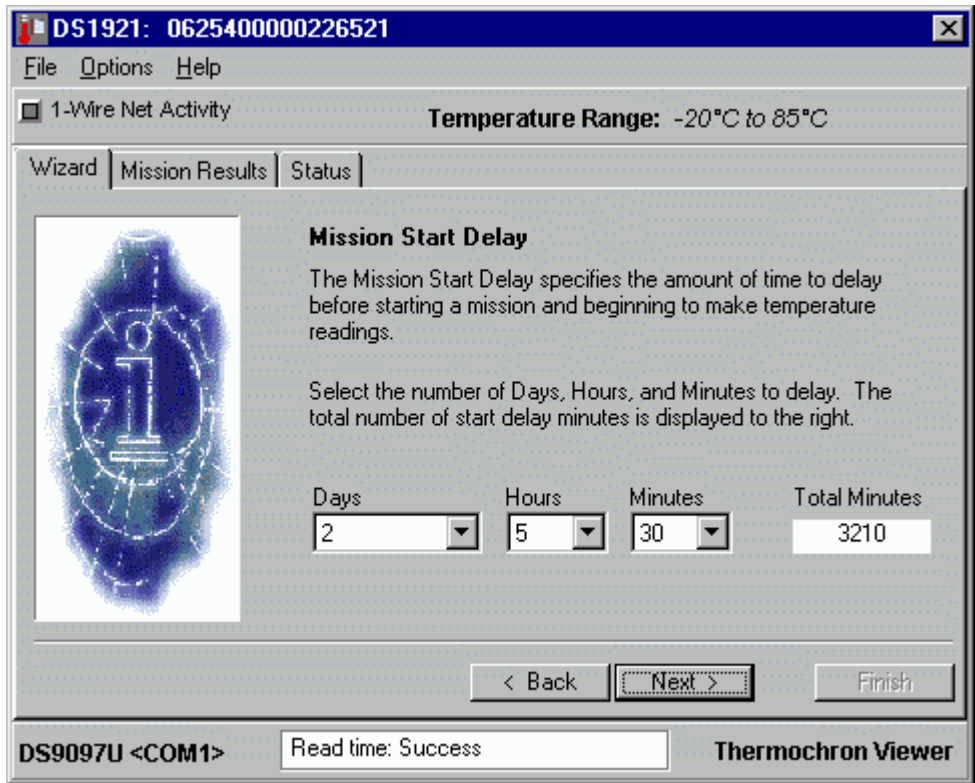
Sample Rate

The Sample Rate specifies the number of minutes between each temperature reading. The DS1921 can store 2048 time stamped temperature readings. Setting the sample rate will affect how long it takes for the memory to fill up or optionally roll over. The sampling rate can be from 1 to 255 minutes.
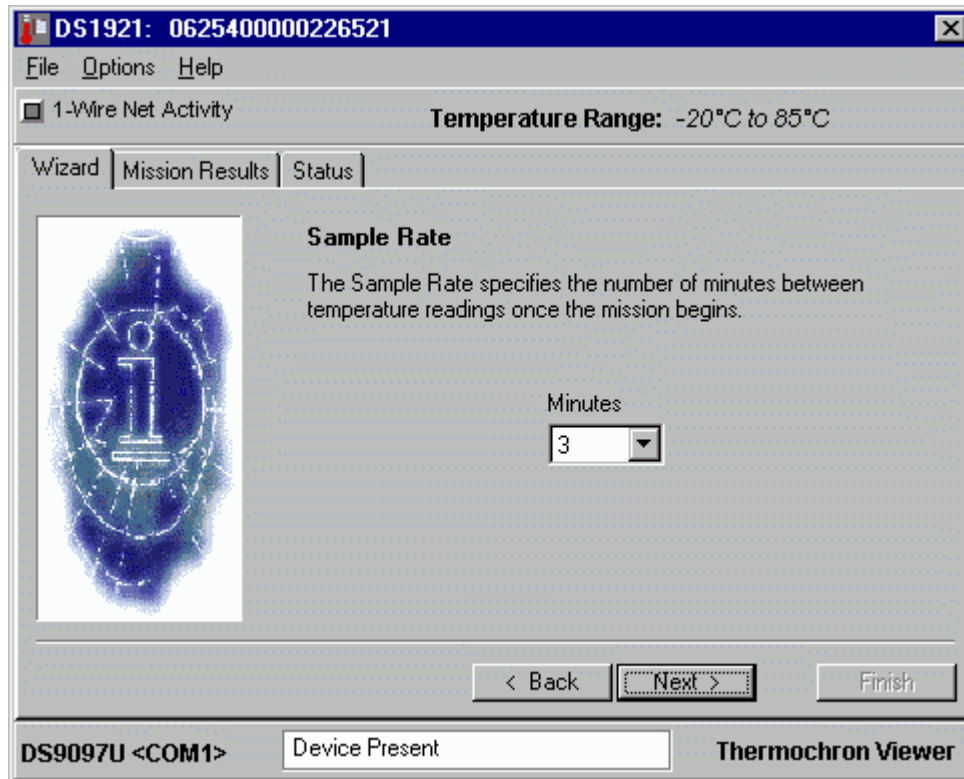
Temperature Alarms

Certain temperature extreme readings can be tracked by the DS1921 even after the 2048 time-stamped temperature readings have already been done. The start and duration of the violation of temperature bounds is recorded. The maximum duration for each event is 255 readings. The device can accommodate 12 separate high events and 12 low events. The check box at the bottom selects whether device responds to a conditional search when a High or Low temperature alarm occurs.
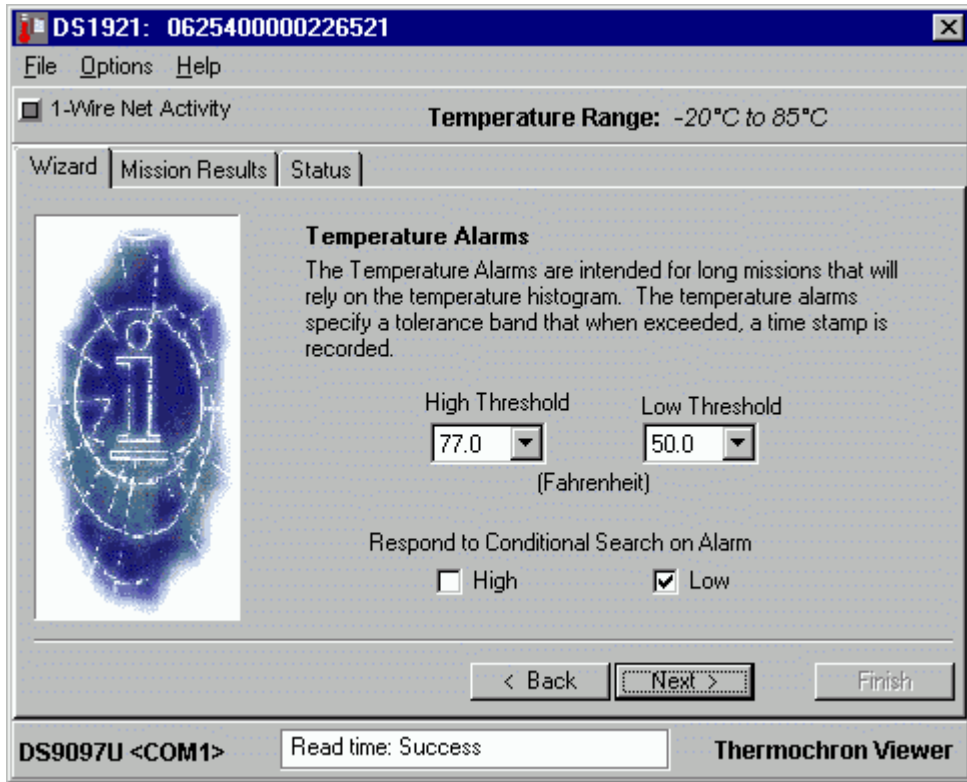
Roll-Over

There is a maximum of 2048 time-stamped temperature readings. This Wizard panel indicates the amount of time it will take to fill up this memory, depending on the sample rate. The behavior of the DS1921 can optionally be set to begin overwriting the early readings when the memory is filled. If this sample period is too small, use the '< BACK' button to go back to the sample rate selection and pick slower sample rate. Note that any readings beyond 2048 are still recorded in the histogram data.
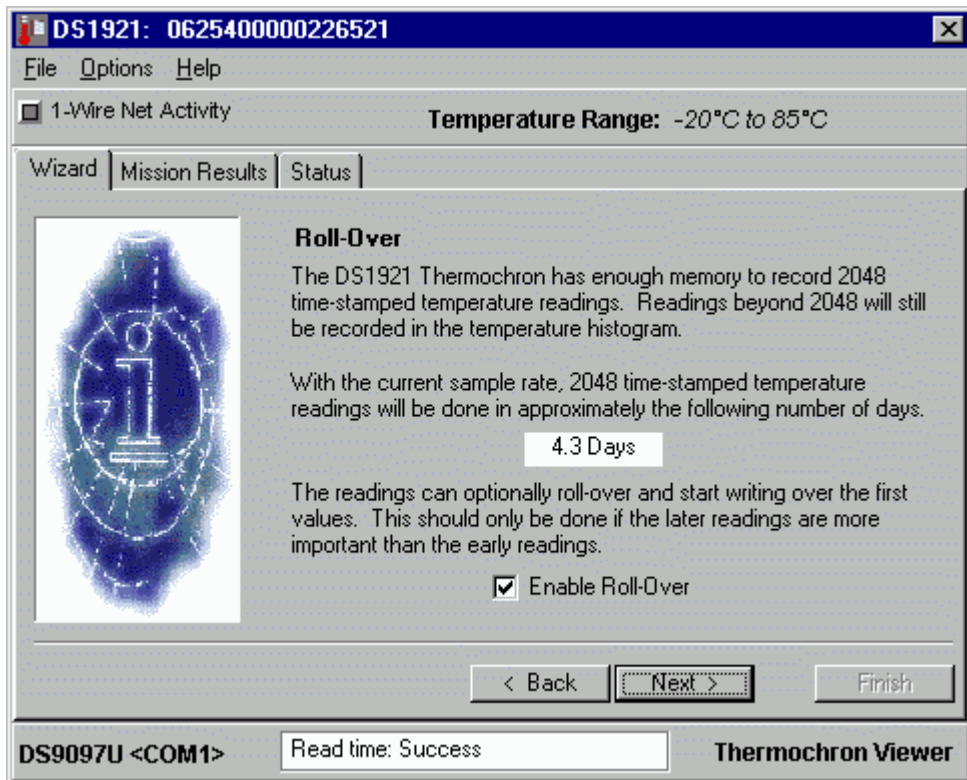
Finish

The final panel of the Wizard displays all of the options selected. If any of these settings is not desired, use the '< BACK' button to revisit the different options. The box at the bottom of the panel may not be able to display all of the options. Use the scroll bar to view all of the options. When satisfied, click on the 'FINISH' button. The mission settings will then be written to the DS1921 and the mission will begin. To show the state of the new mission, the viewer will automatically switch to the 'STATUS' tab.
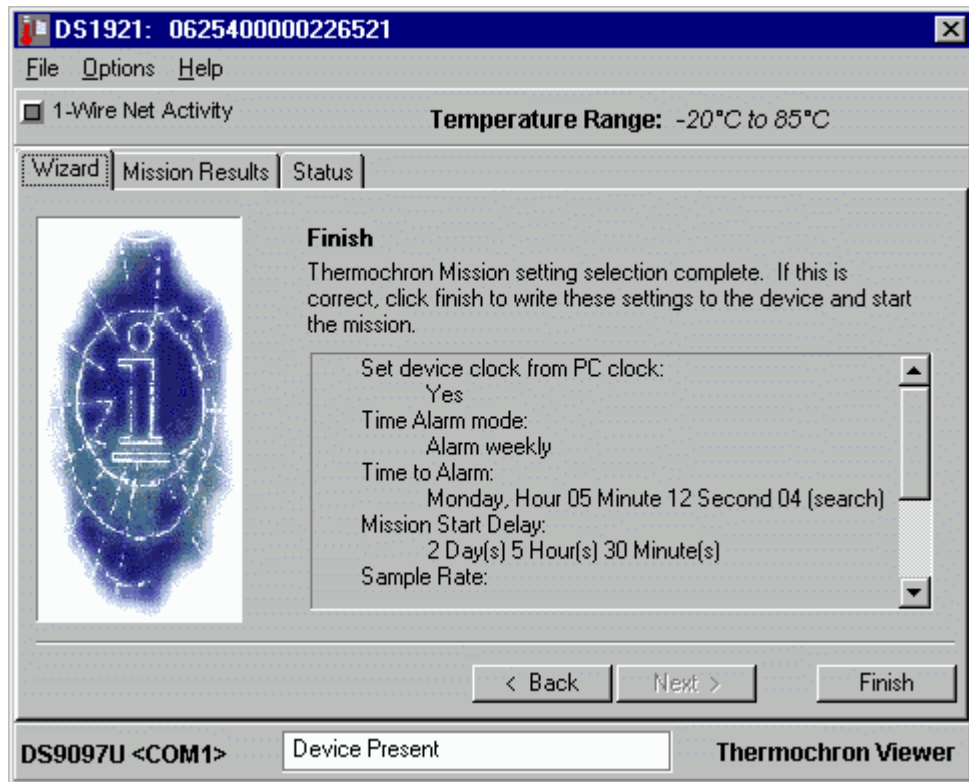
Status Display

The Status Tab displays the current DS1921 status.
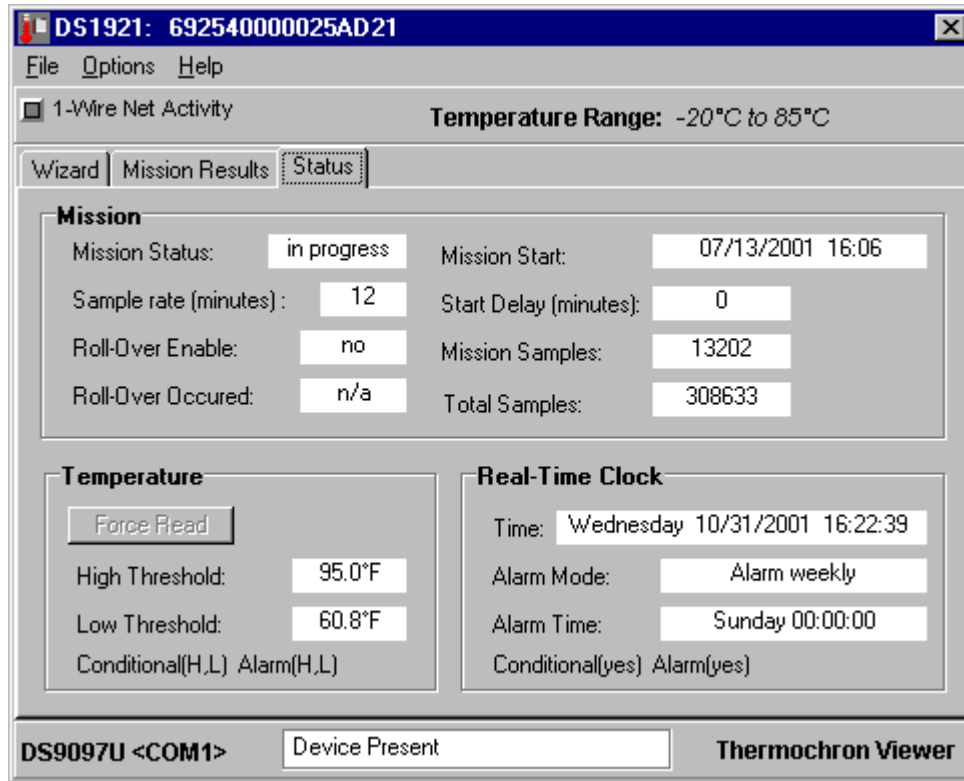
Mission Status
The Mission Status will indicate 'in progress' if a mission is currently running. It will display 'ended' if there is no mission.

Mission Start
The Mission Start is the date/time stamp of the beginning of temperature readings. Note that this is the start time after the start delay has expired and the first reading has been taken. While the start delay is counting down the Mission Start will be displayed as 'not started yet'. The mission start is displayed in 24-hour format.

Sample rate (minutes)
The Sample Rate is the number of minutes between samples.

Start Delay (minutes)
The Start Delay is the current delay count down value in minutes. For example, if in the mission Wizard a start delay of 10 was selected, then the initial value viewed in

this box would be 10. After a minute it would decrement to 9 and then to 8 and so on. When the start delay goes to 0, then the mission sampling will begin.

Roll-Over Enabled
Roll-Over Enabled will say 'yes' if the device has been missioned to overwrite early readings after the 2048 time-stamped readings have been done. It will say 'no' if roll over is not enabled.

Mission Samples
The Mission Samples indicates the number of temperature samples that have been taken during the current mission.

Roll-Over Occurred
Roll-Over Occurred will say 'n/a' for not-applicable if roll-over is not enabled. If roll-over is enabled, then this box will display 'yes' if more then 2048 readings have been made, or 'no' if the number of readings is less then 2048.

Total Samples
Total Samples indicates the total number of temperature samples that have been taken on the device.

Force Read
If there is no current mission, the Force Read button is enabled. Clicking this button instructs the DS1921 to read the current temperature. The temperature will be displayed to the right of the button after a few seconds. The Force Read button is disabled if a mission is currently running.

High Threshold
High Threshold indicates the upper bound temperature maximum. If during a mission the temperature reading goes above this value, an alarm event will occur and the time and duration of this event will be recorded.

Low Threshold
Low Threshold indicates the lower bound temperature minimum. If during a mission the temperature reading goes below this value, an alarm event will occur and the time and duration of this event will be recorded.

Temperature Threshold Status
The Temperature Status below the 'Low Threshold' will indicate the settings and the state of the temperature threshold violations. There are two parts to the statement: 'Conditional' and 'Alarm'. The 'Conditional' part indicates the settings for the device to respond to a conditional search on an alarm condition. A value of (H,L) indicates both High and Low thresholds will enable a conditional search response. 'H' indicates High threshold is used and 'L' the Low threshold. 'none' indicates that neither of the thresholds will cause a response to a conditional search. In the same manner, the 'Alarm (H,L)' indicates if there is currently an alarm condition with either threshold.

Time
Time displays the current real-time-clock value from the DS1921. This value is updated every 3 seconds, except during the download of the mission results. It is displayed in 24-hour format.

Alarm Mode
The Alarm Mode indicates the period at which the time alarm can occur. The possible alarm modes are: 'Alarm weekly', 'Alarm daily', 'Alarm hourly', 'Alarm minutely', and 'Alarm every second'. If no alarm mode was selected in the Wizard then the default mode is 'Alarm weekly'.

Alarm Time
The Alarm Time will indicate the relevant time in the alarm mode when the time alarm will occur. The format of this will depend on the alarm mode.

Alarm Time Status
The Alarm Time Status below the 'Alarm Time' will indicate the settings and the state of the conditional search on a time alarm. There are two parts to the statement: 'Conditional' and 'Alarm'. The 'Conditional' part indicates the settings for the device to respond to a conditional search on an alarm condition. A value of (yes) indicates the device will respond to a conditional search on an alarm event. (no) indicates that it will not respond to a conditional search. In the same manner, the 'Alarm (yes)' part indicates in the same format if there is currently a time alarm condition.

Mission Results

The Mission Results tab displays the temperature reading results from the current or last mission. The mission results are automatically downloaded when the Thermochron Viewer is started if there is a mission running. If the mission has been ended, then results can still be downloaded using the 'Read Data' button. The 'Read Data' button can also be used to refresh the result contents if the device has been connected long enough for a mission reading to take place.
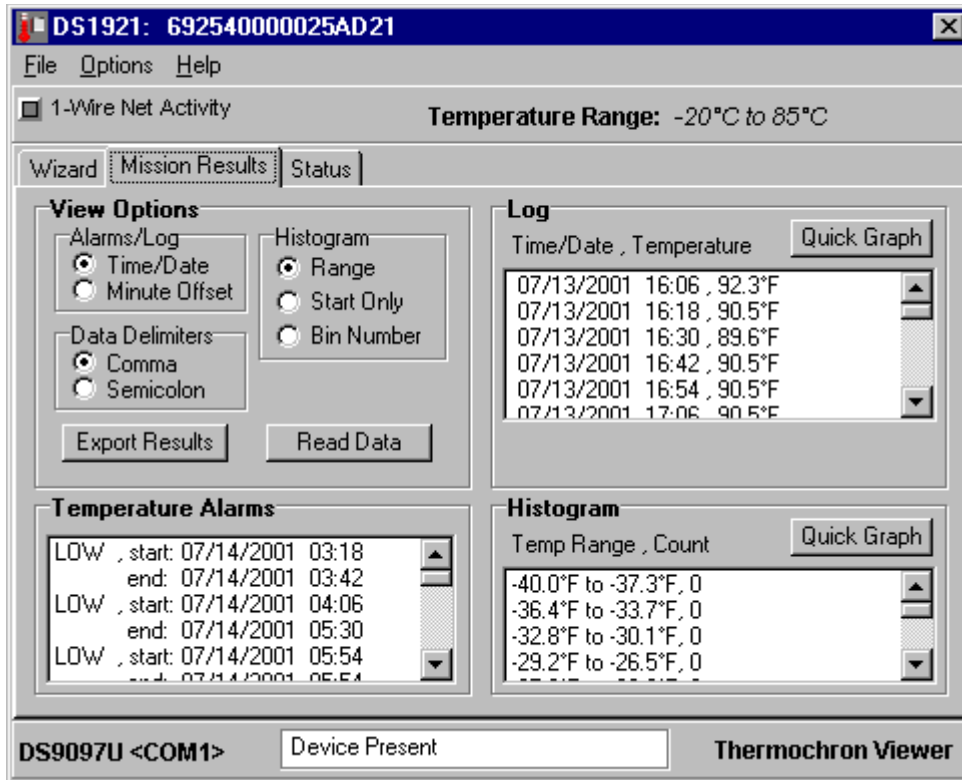
View Options

The View Options modify how the temperature reading results are displayed. The 'Alarms/Log' radio control selects displaying a true time/data or a minute offset from the beginning of the mission. This option affects the Log and Temperature alarms results. The 'Histogram' radio control selects the histogram display options. The 'Range' option shows a temperature range for each bin in the histogram. 'Start Only' displays only the starting value for each bin. 'Bin Number' displays a number 0 to 55 to indicate the bin number. Finally, the 'Data Delimiters' radio control selects what character (comma or semicolon) is used to delimit the information in the Lot, Temperature Alarms, and Histogram display areas. It is also used to delimit the data when exporting the results. The View options will be used in the export file and quick graphs.

The 'Export Results' button prompts for a text file to export all of the mission results and status. Note that there is a menu option to copy the same contents to the clipboard.

The 'Read Data' button will force the viewer to re-read the mission results. This can be used to refresh the result data if a mission is currently running and it has made new measurements.

Log

The Log displays the time-stamped temperature readings in a Listbox. The format for the entries is displayed above the Listbox (see View Options). The 'Quick Graph' button in the Log box will display a quick line graph of the data collected. The line graph is color coded to indicate values above (red) or below (blue) the temperature thresholds. For more sophisticated graphs it is recommended to use the data export features to import the data into another application with advanced graphing capabilities.
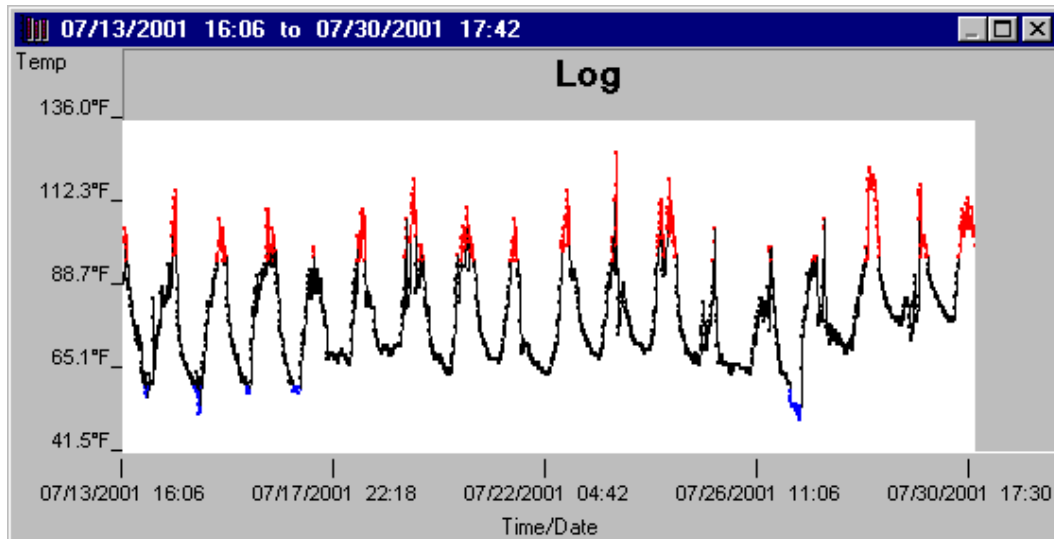
Temperature Alarms

The Temperature Alarms box displays the temperature alarm events. An alarm event is created when the temperature read during a mission goes outside the specified thresholds. There can be up to 12 high and 12 low alarm events. Each event lists the event type (High, Low) and the start and end time. A time/date stamp or minute offset will represent the time range depending on the view options.

Histogram

The Histogram box displays the temperature history as defined by 56 bins. Each bin represents a temperature range. When a temperature reading is made, the associated bin in incremented. Each bin can hold up to 65536 readings. The 56 bins are listed in a Listbox in the format specified by the view options. The 'Quick Graph' button displays the bar graph of the histogram data. The labels on the bar graph are in the format specified by the view options.
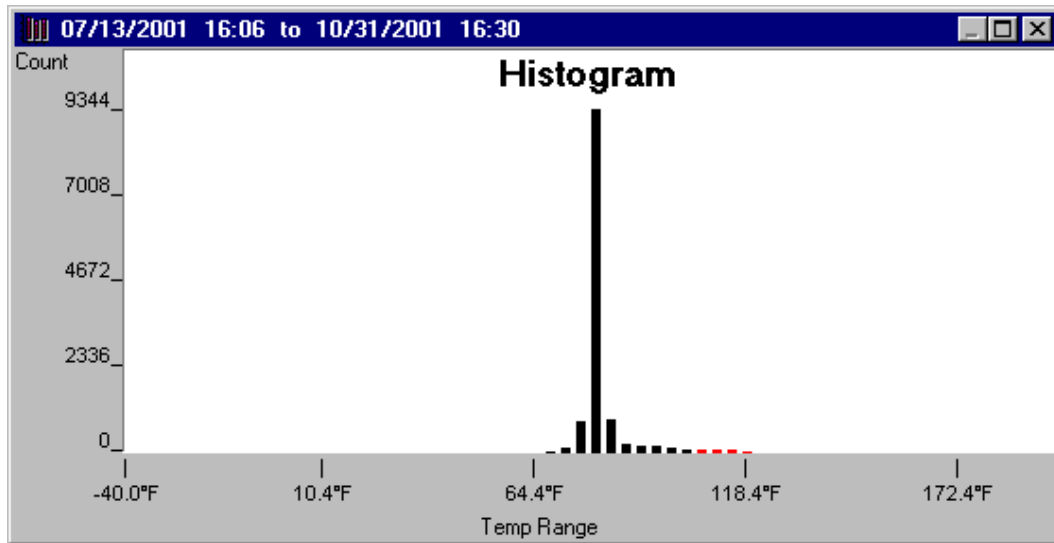
A to D Viewer

The Analog to Digital viewer displays the results and allows manipulation of the settings for the DS2450 low power 1-Wire quad A/D. All four of the channel results can be viewed at the same time as seen in the screen capture below.
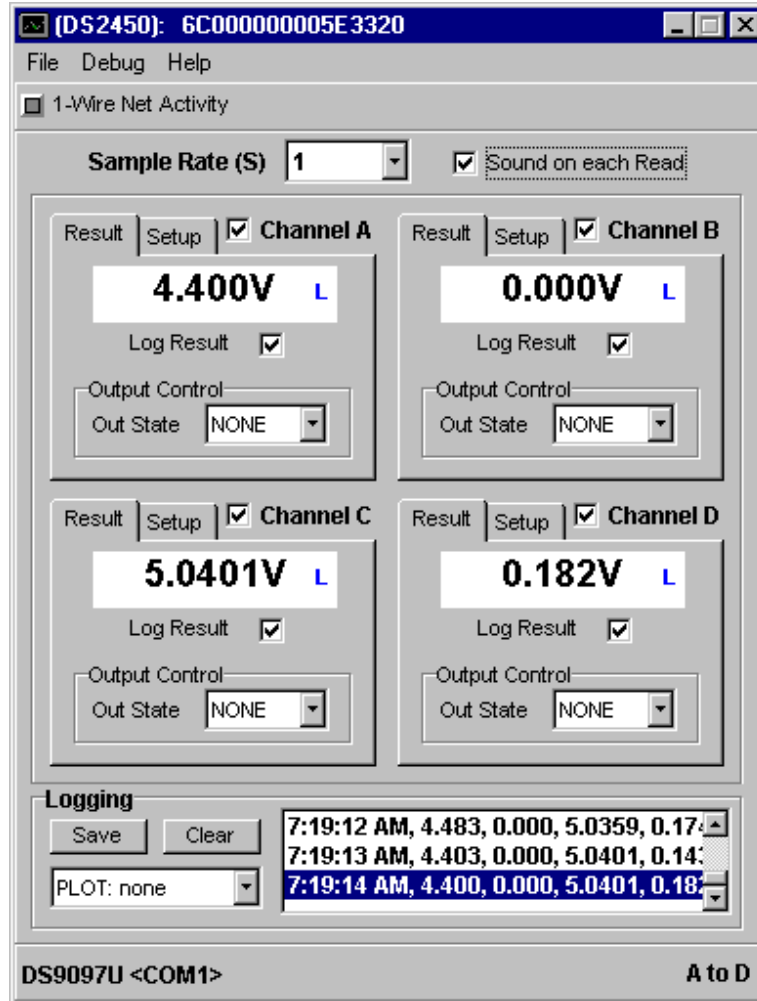
The center box has four smaller boxes representing each of the four A/D channels.

The bottom box has logging and plotting options and data.

If 'Auto Save Size/Position' is checked in the main iButton Viewer options, then all of the state of the A to D Viewer is saved and restored on the next invocation for each DS2450 device. This includes the size, position of the window, settings for each channel and sample rate.

Sample Rate
The drop down box at the top selects the sample rate. The sample rate can be from 1 to 32 seconds. Due to Window's multitasking, the sample rate is approximate. The sample rate drop down box can also select 'STOP' which disables reading the channels.

Sound on each Read
The check box at the top right of the main window selects whether a sound is played when a new reading is made.

Menu Options

There are several menu options available. They can be accessed by clicking on the menu groups at the top of the viewer.
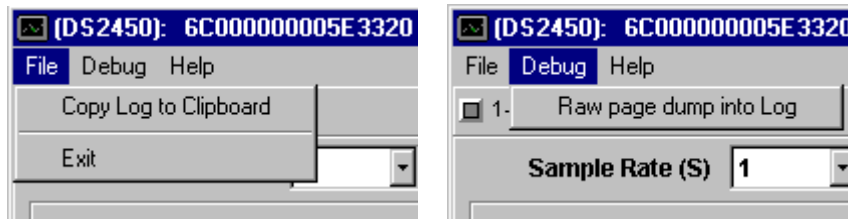
File / Copy Log to Clipboard
The Copy Log menu option will take the current log data as seen in the log Listbox and copy it to the Windows clipboard in the form of text. Note that the log also contains the setup information for each of the channels. This may be more convenient than saving the log to a text file before importing it into another program.

File / Exit
The Exit menu option will close this viewer and any plot this viewer opened.

Debug / Raw page dump into log
The Raw Page Dump menu option will place a copy of the current memory pages of the DS2450 into the log.

Channel Results

Each of the four channels has its own display with two tabs as seen in the following cutout from the A to D viewer. The tabs are 'Result' and 'Setup'. The 'Result' tab displays the current readings from the channel.

Channel Enable Check
The check-box outside the tab structure enables or disables the channel. Notice in the above cutout, Channel C is enabled but Channel D is not.

Voltage Out and Alarm Flags
The top label in the 'Result' tab shows the current voltage measured on the Channel. The number of significant digits in the voltage displayed changes to reflect the accuracy provided by the selected number of bits used to make the conversion. To the left of the voltage a small red 'H' can be seen. This indicates that the current value has exceeded the high trip threshold. A small blue 'L' would appear to the right of the voltage if the voltage went below the low trip threshold.

Log Select
The check mark bellow the voltage selects whether the voltage is logged to the list box at the bottom of the window.

Output Control
Each channel can optionally be used as an open drain output. The 'Output Control' selects the output state of the channel. 'NONE' indicates that the channel is uses as an input. '1' indicates that the channel is an output letting the channel float to high. A '0' value indicates that the channel is being pulled to ground.

Channel Setup

The 'Setup' tab displays the current settings for the channel and allows changes by utilizing the drop-down Listbox.
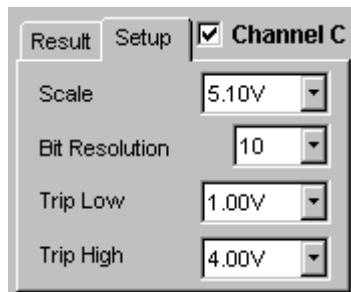
Scale
The scale indicates the highest possible voltage value that is read by the channel. The two choices are 5.10 Volts and 2.55 Volts. Selecting the lowest range required gives a higher measurement granularity for a given bit resolution.

Bit Resolution
The bit resolution indicates the number of bits in the conversion result. The range is 1 to 16 bits. Changing the bit resolution changes the available Low and High trip values.

Trip Low
The trip low is the low voltage threshold. A low threshold alarm is set when the voltage read goes below this value.

Trip High
The trip high is the high voltage threshold. A high threshold alarm is set when the voltage read goes below this value.

Logging
The logging box is at the bottom of the A to D Viewer window. The right side of the logging box contains a Listbox with the updated log.

Log Data
The log consists of a time stamp followed by each channel's value read delimited by commas. If a channel is not enabled or logging is not selected then there is no value between the commas. For example the log data line of '2:23:59 PM, 1.01, 2.23, , 4.55' shows the time-stamp, channel A data, channel B data, (no data for channel C), and channel D data.
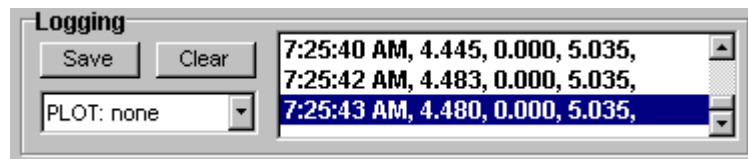
Save
Clicking the Save button prompts the user to enter a text file to save the log data delete to.

Clear
Clicking the clear button will clear the current log data.

Plot

The plot combo box provides a choice on which if any channel will be plotted. The plot is an auto-ranging line graph of the last 100 readings. The plot is color coded to indicate readings outside the high (red) and low (blue) trip values for the selected channel.
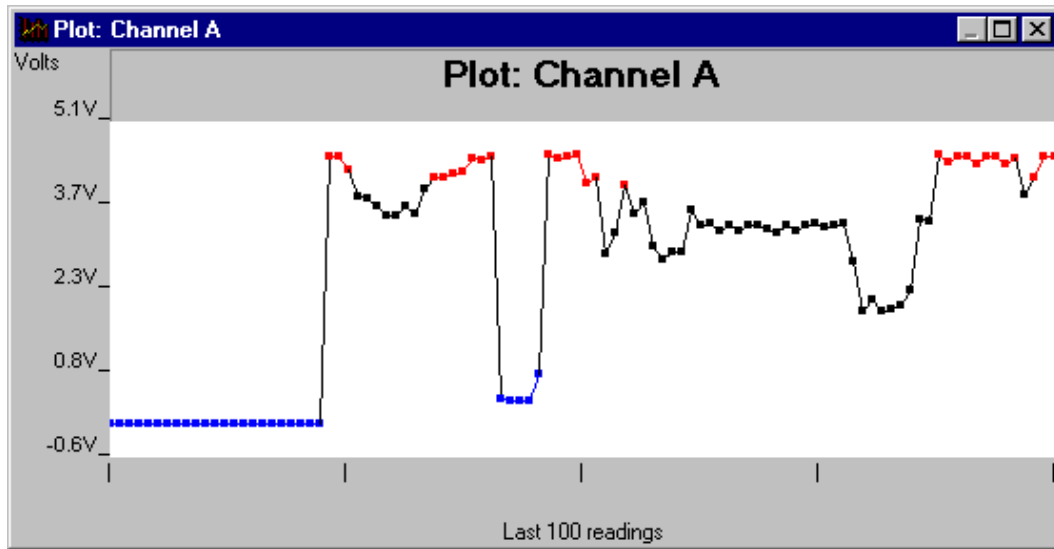
Sensor Viewer

The Sensor Viewer displays the results and allows manipulation of the settings for the DS2438 as it pertains to sensors. Temperature, VDD (voltage supply), and VAD (output voltage) can be viewed at the same time as seen in the screen capture below. These three measurements that the DS2438 takes, allow it to be used as a sensor. The actual sensor data can be calculated from the three different measurements. Currently, a DS2438-based relative humidity sensor is supported. Also displayed in the viewer is a fourth measurement, Vsens, which is a measure of the instantaneous voltage across the DS2438's Vsens pins. With a photodiode, this can be used as a light detector/sensor.

The center region of the main sensor viewer window has five distinct areas representing each of the above measurements plus the actual sensor calculation. The bottom box has logging and plotting options and data.

If 'Auto Save Size/Position' is checked in the main iButton Viewer options, then all of the state of the Sensor Viewer is saved and restored on the next invocation for each DS2438 device. This includes the size, position of the window, settings for each measurement and sample rate.

Sample Rate
The drop down box at the top selects the sample rate. The sample rate can be from 2 to 32 seconds with an additional rate of 'continuous'. 'Continuous' means with no delay between sample reads. Due to Window's multitasking, the sample rate is approximate. 'STOP' is another selection of the drop down box. With 'STOP' selected, reading of the different measurements taken by the DS2438 is disabled.

Sound on each Read
The check box at the top right of the main window selects whether a sound is played when a new reading is taken.
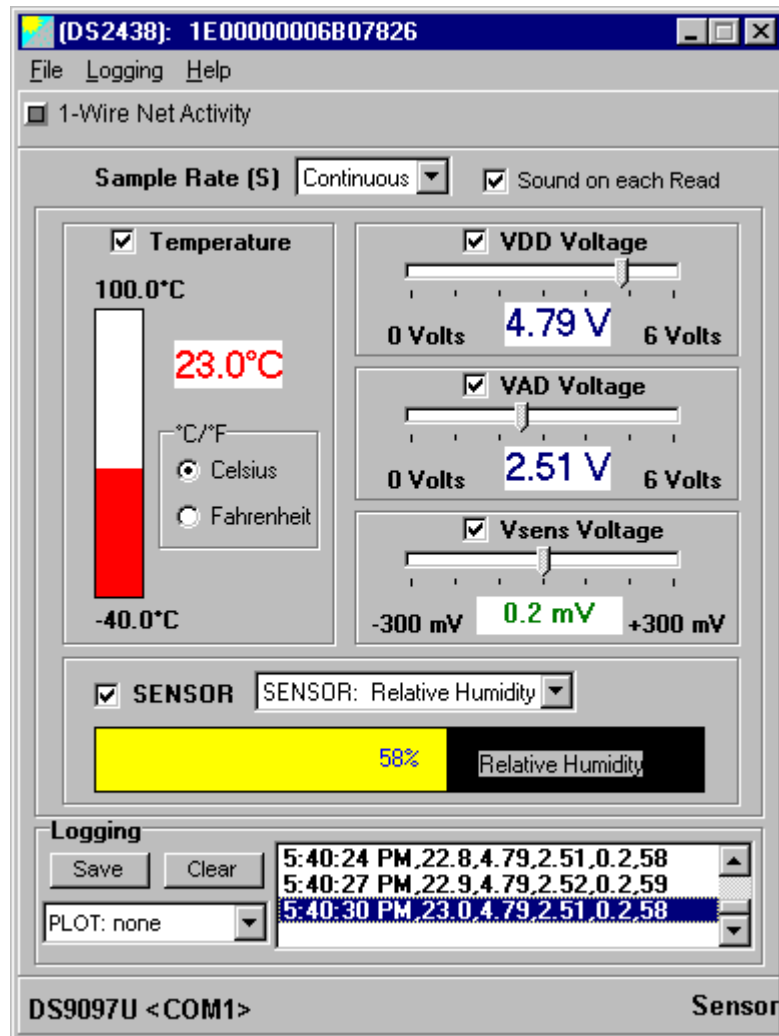
Menu Options

There are several menu options available. They can be accessed by clicking on the menu groups at the top of the viewer.
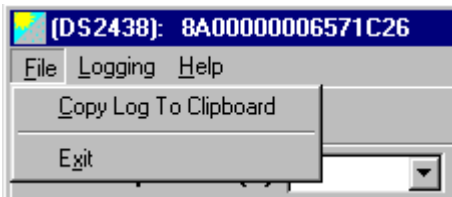
File / Copy Log to Clipboard
The Copy Log menu option will take the current log data as seen in the log Listbox and copy it to the Windows clipboard in the form of text. Note that the log also contains the setup information for each of the DS2438 measurments. This may be more convenient than saving the log to a text file before importing it into another program.

File / Exit
The Exit menu option will close this viewer and any plot this viewer opened.
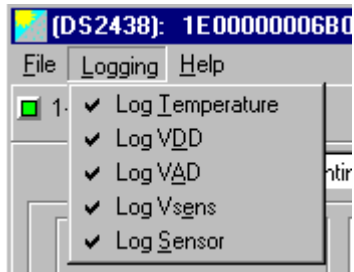
Logging / Log Temperature
The check mark on the left side of the 'Log Temperature' menu item selects whether the temperature is logged to the list box at the bottom of the window.

Logging / Log VDD
The check mark on the left side of the 'Log VDD' menu item selects whether the VDD voltage is logged to the list box at the bottom of the window.

Logging / Log VAD
The check mark on the left side of the 'Log VAD' menu item selects whether the VAD voltage is logged to the list box at the bottom of the window.

Logging / Log Vsens
The check mark on the left side of the 'Log Vsens' menu item selects whether the Vsens voltage is logged to the list box at the bottom of the window.

Logging / Log Sensor
The check mark on the left side of the 'Log Sensor' menu item selects whether the Sensor data is logged to the list box at the bottom of the window.

Display Areas

Each of the four DS2438 measurements has its own display area of the viewer window. The fifth area represents the calculated sensor data. Each display area has a checkbox associated with it that enables the display area when checked and disables it when unchecked. See the pictures below for examples.
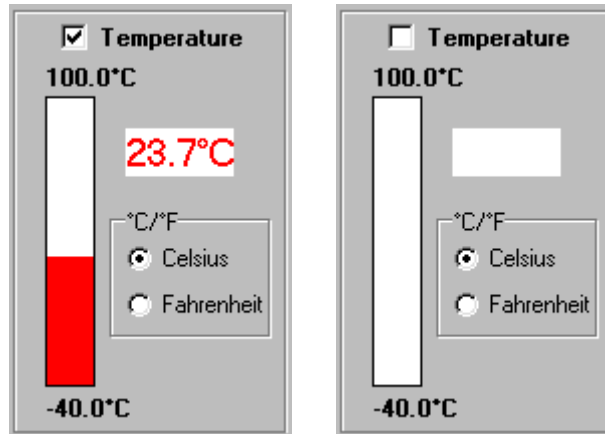
The above images show the temperature display area enabled and disabled. Please note the radio buttons that will allow changing between Celsius and Fahrenheit temperature scales.
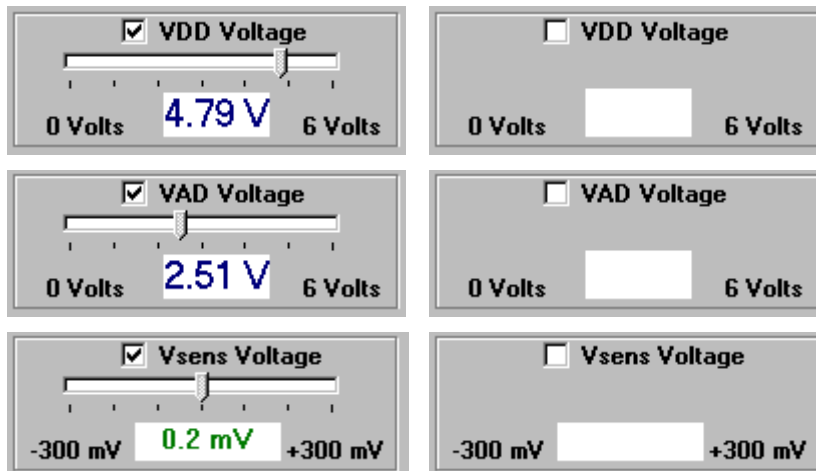
The above six images show the VDD, VAD, and Vsens voltage display areas (respectively) enabled and disabled.
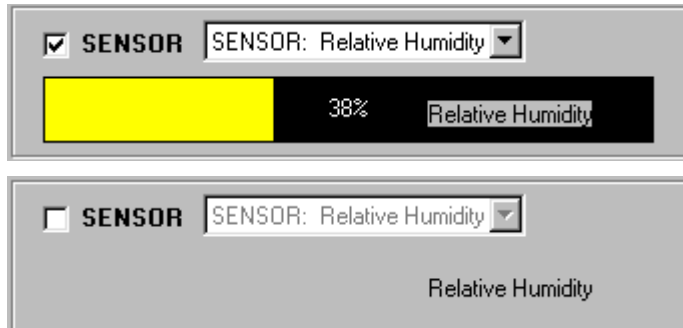
The two images above show the sensor display areas enabled and disabled. If enabled and three other display areas (Temperature, VDD, and VAD) are not, they will automatically be enabled (because calculating sensor data requires Temperature, VDD, and VAD to be enabled). Likewise, if one of the three areas is disabled, the sensor display area will also become disabled.

Logging

The logging box is at the bottom of the Sensor Viewer window. The right side of the logging box contains a Listbox with the updated log.

Log Data
The log consists of a time stamp followed by each DS2438's measurement delimited by commas. If a display area is not enabled or logging is not selected then there is no measurement between the commas. For example, the sample log data line highlighted in the picture below shows the data to be "5:40:30 PM,23.0,4.79,2.51,0.2,58." This shows the data for every channel. However, if VDD and Vsens were disabled, the line would have been: "5:40:30 PM,23.0,,2.51,, " showing the time-stamp, temperature, no data for VDD, VAD voltage, no Vsens data, and no sensor data.
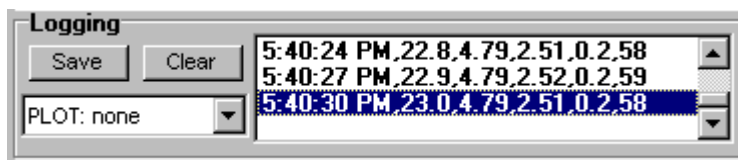
Save
Clicking the Save button prompts the user to enter a text file in which to save the log data. It also prompts the user to clear the log listbox.

Clear
Clicking the clear button will clear the current log data.

Plot
The plot combo box provides a choice on which, if any, DS2438 measurement will be plotted. The plot is an auto-ranging line graph of the last 100 readings.

Plot: Relative Humidity
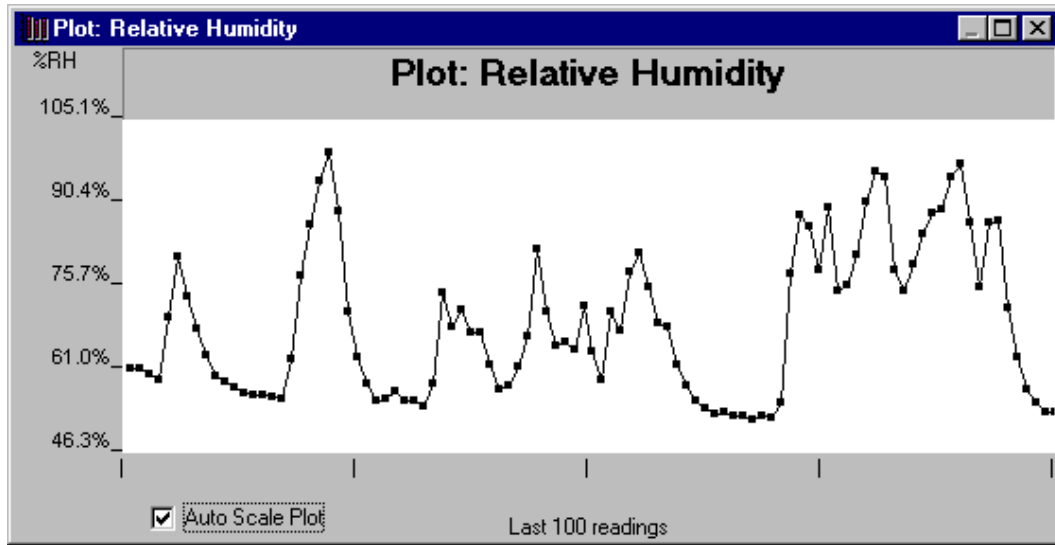
Digital Potentiometer Viewer

The Digital Potentiometer Viewer displays the results and allows manipulation of the DS2890. The DS2890 is a single element, 256-position linear taper potentiometer with terminal working voltages up to 11V and a 100 KiloOhm resistor element value. It can be powered either parasitically or through an external power supply. Potentiometer wiper positions can be set and read through this viewer, along with setting a Charge Pump for greater sensitivity (only for externally powered potentiometers).

As with the other viewers, if 'Auto Save Size/Position' is checked in the main iButton Viewer options, then all of the state of the Digital Potentiometer Viewer is saved and restored on the next invocation for each DS2890 device. This includes the size and position of the window settings.

The viewer has three distinct sections: the top, middle, and bottom sections. They allow for both reading and setting a DS2890.
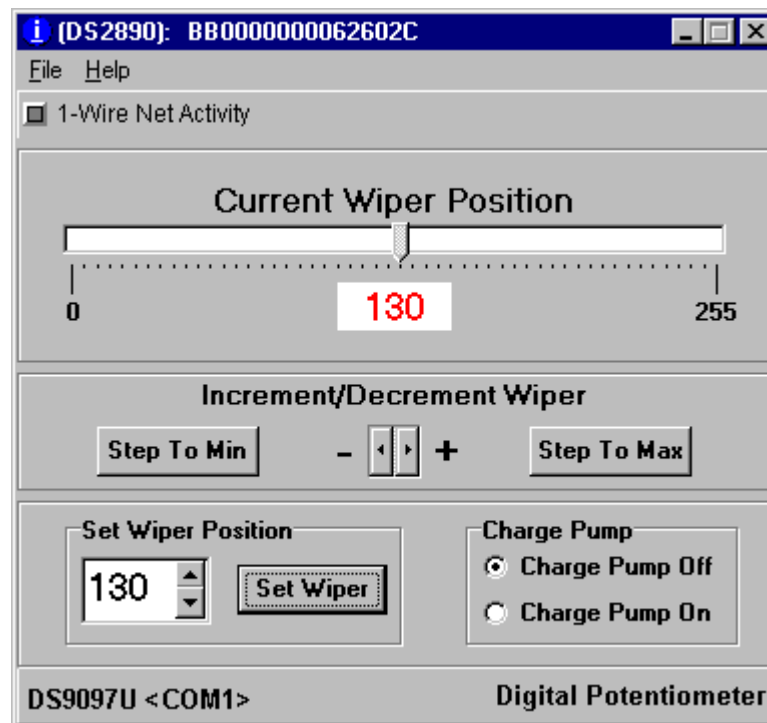
Top Section

The top section of the viewer displays the current wiper setting of the potentiometer. A valid setting is from 0 to 255. See the image below:
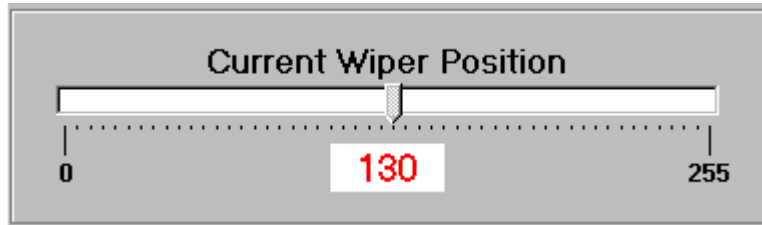
Middle Section

The middle section of the viewer allows the user to increment or decrement the wiper value through clicking the right or left arrows respectively. It also allows the user to either step the wiper positions (in increments of 1) to the maximum setting (255) or to the minimum setting (0) through clicking on the appropriate buttons. See the image below:

Bottom Section

The bottom section of the viewer allows the user to set the wiper value directly through inputting a number in the edit box and then clicking the "Set Wiper" button. It also contains an option to turn the "Charge Pump" on or off by clicking on the appropriate radio box. If it is not possible to turn the Charge Pump setting on, the viewer will respond with an appropriate message telling the user that it could not. See the image below:

Counter Viewer

The Counter Viewer displays and calculates rate (counts per second) for iButtons that incorporate counters such as the DS2423.
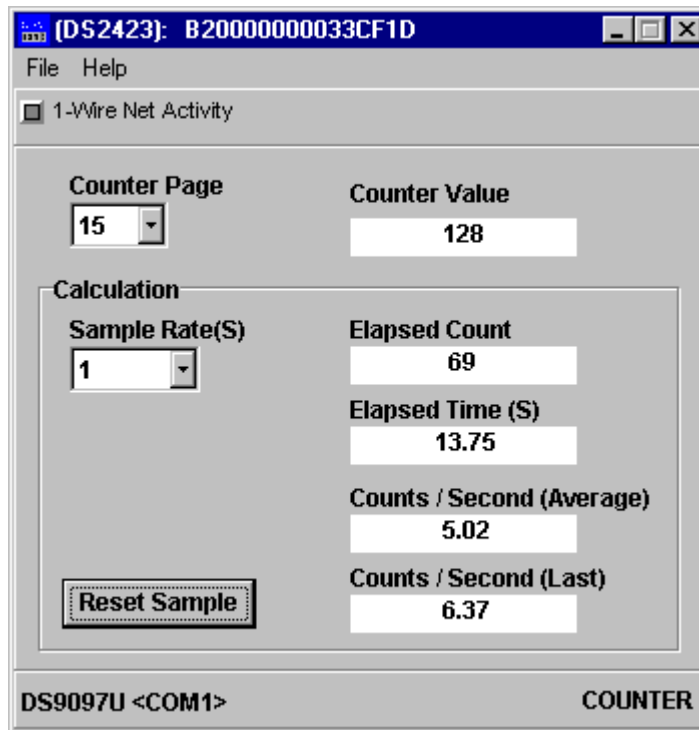
Counter Page
The Counter Page combo Listbox selects the page that is associated with the counter to read.

Counter Value
The Counter Value is the current value of the counter from the last sample. The counter value is represented as a decimal number.

Calculation

The Calculation box contains the sample rate and various calculations on the counter as it changes with time.

Sample Rate
The Sample Rate when the counter is read and the calculation performed. The range is 0.5 to 32 seconds. Due to Window's multitasking, the sample rate is approximate.

Elapsed Count

The Elapsed Count depicts the increase in the value of the counter from start of the sample session. A sample session will begin when the viewer is started, when the counter page is changed, or when the 'Reset Sample' button is clicked. At the beginning of a sample session, the elapsed count will start out as 0.

Elapsed Time (S)

The Elapsed Time depicts the total time in the current sample session. The elapsed time, represented in seconds, will be updated when the counter is read at the sample rate.

Counts / Second (Average)

The 'counts per second average' is simply the elapsed counter divided by the elapsed time.

Counts / Second (Last)

The 'counts per second last' is defined as the change in count from the last sample to the change in time from the last sample. For example, if the sample rate is 2, and during the last sample period the counter changed 10 then the counts per second would be 10 / 2 = 5.

Reset Sample

The 'reset sample' button clears the current sample session and starts a new one. The elapsed count and elapsed time are reset to zero.

File Viewer

The file viewer is the common tool to access the memory of any 1-Wire device with at least 1K bit of memory. It is capable of reading and writing devices manufactured in SRAM, EEPROM and EPROM technology. The file viewer supports the 1-Wire File Structure file format. Valid file names are maximum four characters long and have a numeric extension in the range of 0 to 99 (decimal). With EPROM devices it is possible to create so-called "append files". Append files can be modified by appending data at the end of existing data. This provides an economic way of updating information without re-writing the whole file, as it is normally done in file oriented systems. A file is created as an "append file" if one specifies an extension of 100.   Extension 101 is reserved for "monetary files". See the section 'Editing Monetary Files' for details.

As any advanced file system, TMEX allows organizing files into several levels of sub-directories (see App Note 114). As a consequence, accessing a file requires two steps: first, selecting the file in the directory tree; second, displaying the file's data. If the file is new, one first has to select the directory where the file is to be created and then create it. For this reason the file viewer operates through two windows: the **Directory Window** to select/create a file and the **File Editor Window** to read/edit its contents.

Understanding the Directory Window

The Directory Window consists of three major sections:

file Listbox	(left) to display file and directory names,
information area	(center) to display information on the selected file, directory and device
button area	(right) with buttons for the four most often used file functions.

File Viewer, Directory Window
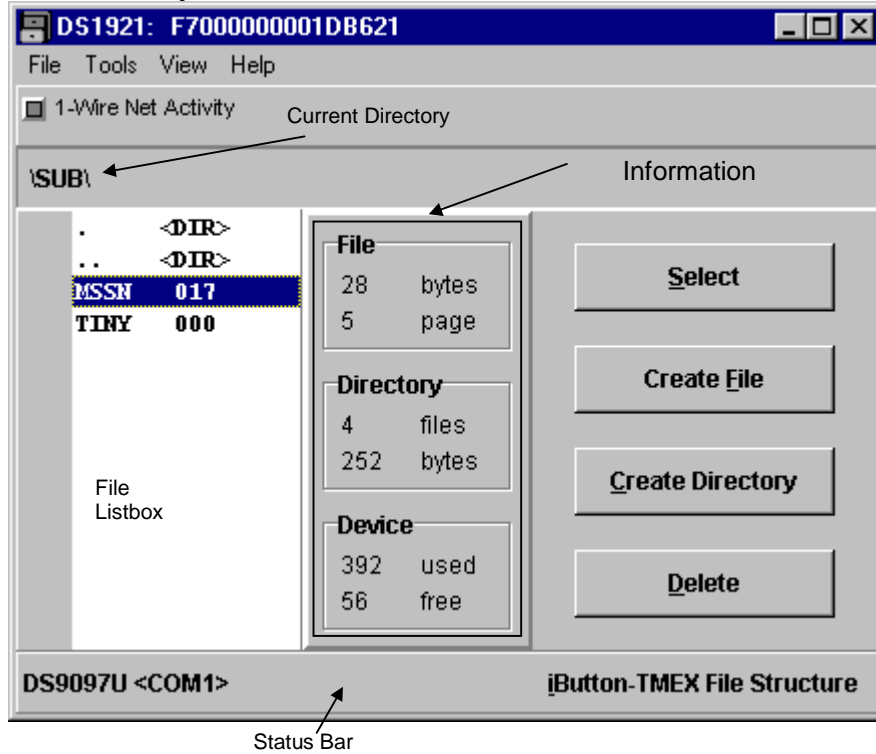
In addition, the Directory Window has a **Status Bar** and a **Menu Bar**. The Status Bar indicates the type and number of the port through which the selected device is accessed. After one has begun a write session to an EPROM device the message "Program Buffer Enabled" appears in the center of the Status Bar. This is to remind that all changes are collected in a buffer to be written all at once to minimize the consumption of memory space. Before actually writing, the program checks the population of the 1-Wire bus. The message "*Non program devices detected on the 1-Wire Net! Programming voltage may damage these non-program devices. Remove these devices and then click OK.*" will be displayed if non-EPROM devices have been found and writing will not take place unless these devices have been removed.

File and device functions that are needed less often are accessible through the Menu Bar. The menus and their functions are:

File   **Rename** to change the name (not the path) of a file
            Attribute to toggle the attribute of a file between normal and "read-only"
            or to toggle the attribute of a directory between normal and "hidden",
            Program Now to copy the buffer contents to the EPROM device
            Exit to exit the file viewer
Tools   **Format** to prepare a memory device for the storage of data files
View   **Refresh** to re-read the directory information and update the File Listbox
            Show Hidden to include hidden directories in the File Listbox in order to
            select one and reverse its hidden attribute

Managing Files and Directories

The File Listbox presents a list of the files and sub-directory entries in the current directory on the device. Revision 3.20 of the iButton Viewer does not allow sorting files. Therefore, files are listed in the same sequence as their entries are stored in the device directory. As more files or directories are created or deleted, this sequence may change.

A file or directory is selected in the File Listbox by clicking on it once. Under the headline "File" in the information area, the file size in granularity of the data page size of the device type is displayed. Also displayed is the file's physical starting page address. A directory is not considered to have a size; therefore only its starting page is displayed. Double-clicking on a file name or clicking on the Select Button opens the File Editor Window. Double-clicking on a directory name changes from the current directory to the sub-directory. The path to the sub-directory will be displayed just above the File Listbox.

In the information area under the headline "Directory" the total number of files and directories in the current directory level is displayed together with their combined size in a granularity of the data page size. The total balance of used and unused bytes within a device is shown under the headline "Device". Note: a 32 byte memory page can only store 28 bytes since four bytes per page are reserved for formatting and CRC protection.

If one has entered a sub-directory the File Listbox begins with two dummy files marked as ". <DIR>" and ".. <DIR>". The first one is identical to the current directory. The only effect from clicking on it is getting the physical page address of the sub-directory displayed under "File". The second one is the reference to the next higher directory level. Clicking on it once displays the physical page address of the higher directory. Double-clicking it changes from the current level to the next higher one. These dummy files are counted when determining the total number of files in a sub-directory.

Formatting A Device
Like a floppy disk, a fresh memory iButton needs to be formatted before data files can be written to it. If the user has selected a device and starts the file viewer, the

program first tries to read the device directory. Since an unformatted device does not have a directory this reading will fail. The user will get the error message: "*Could not read the directory! Format the device now ?*" Simply click on "OK" and the device will be formatted. Clicking on "CANCEL" will not format the device. However, upon attempting to create a file, the message "*Error reading the directory, operation aborted!*" will be displayed. After the formatting is completed the confirmation message "*Device successfully Formatted!*" will be displayed.

Formatting is required in any case, regardless of SRAM or EPROM technology. When formatting an EPROM device, the program will give several notifications to alert the user of the special conditions that apply. The first message is: "*WARNING, a buffer has been created to log changes to this EPROM device. Do NOT change the memory of this device in any other window!*" This is to remind the user, that although it is possible the device should not be written to through more than one File Viewer window. With SRAM based devices this is not a problem since data is written immediately without buffering it. A further warning "*The Program Buffer will be written when this window is exited or from the file menu. Aborting the EPROM write will negate any changes made.*" is then displayed. This confirms that any physical writing will be delayed until the file viewer to the device is exited. All data changes until then will be collected in a buffer.

A device may be re-formatted at any time. With an SRAM-based device this will erase the device directory and release the memory space to store new data. As with the "Quick Format" function the memory is not physically cleared. Although most of the data remains in the device, the links to it are lost. Re-formatting an EPROM-based device is also possible. However, one will not be able to re-gain memory space for new data. The only effect of re-formatting is clearing the device directory so that the existing files will no longer be found by the File Viewer. As explained in the data sheets of EPROM-based iButtons, the current directory is just re-directed to an unused page. This leaves the links to old files intact and makes them still read-accessible with customized software.

To re-format a device, click on "Tools" in the Menu Bar and click on option "Format". This will display a message "*Format this device now?*". Click on "OK" and the device will be formatted. The end of formatting will be confirmed in the same way as with a fresh device.

Creating and Writing A File

To create a file, click on the "Create File" button. This will open a child-window where the name of the file is to be entered. The file name consists of up to four characters and a file extension in the range of 0 to 99 (decimal). The extension is separated from the file name by a decimal point. If no extension is entered, the value 000 will be assigned by default. After the file name and extension are entered, click on "OK". The program returns back to the Directory Window where the newly created file name will show up in the File Listbox. Now double-click on the file name or click once on the name and once on the select button. This will open the File Editor Window where the empty file is to be filled with data.

With EPROM devices the extension 100 is also permissible if one intends to create an "append file". Another specialty extension is 101 for DS1963/DS1962 Monetary iButtons. The Monetary file is a single page file in a special part of memory that has a read-only counter associated with it. The counter increments with each write to the page and can be used to detect tampering to the file.

Creating A Directory

To create a directory, click on the "Create Directory" button. This will open a child-window where the name of the directory is to be entered. The maximum length of a directory name is four characters. After the directory name is entered, click on "OK". This transfers back to the Directory Window where the newly created directory will show up in the File Listbox. To enter the directory, double-click on the directory name. Now the File Listbox will contain only the two dummy files ". <DIR>" and ".. <DIR>". Files can be created in the directory as described in the previous paragraph.

Deleting A File or Directory

To delete a file, select the file in the File Listbox by clicking on it once and then click on the "Delete" button. The program will ask for a confirmation. Click on "OK" to delete the file. To delete a directory, select the directory in the File Listbox by clicking on it once and then click on the "Delete" button. As with a file, the program will ask for a confirmation. Click on "OK" to delete the directory. The directory will only be deleted if it is empty. Otherwise an error message "Directory is not empty, operation aborted!" will be displayed. This message needs to be acknowledged by clicking on "OK". After all the files in the directory are deleted individually, the deletion of the directory will be successful.

Renaming A File

To rename a file, select the item to be renamed in the File Listbox by clicking on it. Then click on "File" in the Menu Bar and click on option "Rename". This will open a child-window with a field for entering the new file or directory name. After the name and extension are entered, click on "OK". This will update the name and close the child-window. **Note:** It is not possible to convert a file to an "append file" or vice versa by renaming it. Renaming is only possible as long as the new extension does not indicate different file characteristics.

Moving A File

There is no direct way to move a file from one directory or device to another. If moving a file within a device, open the file first in the File Editor Window and copy its contents to the clipboard (see File Editor description, Copy All). Exit the file editor and delete the file. Now go to the directory the file is supposed to be moved to and create the file name. Next open the file and paste in the contents of the clipboard (see File Editor description, Paste All) and exit the file editor.

Moving or copying a file from one device to another is done in a similar way. First the contents of the source file needs to be copied to the clipboard. Then the file name is created in another device and the contents is then pasted into the opened file and written to the target device. This procedure works independent of the device

technology. It is possible to copy the contents of an "append file" to an SRAM device. However, the extension of the copy must be different from 100.

Attributes

The 1-Wire File Structure is able to set attributes for files and directories. Possible attributes are "read-only" (R) for files and "hidden" (H) for directories. To make a file read-only, select the file in the File Listbox, open the "File" menu in the menu bar and click on option "Attribute". This will open a box with the text " Read Only". Now click on the box and the attribute of the file will change. The character "R" will now appear to the right of the file name in the File Listbox. To reverse the "read-only" attribute, follow the same steps again. Instead of " Read Only" the contents of the box will be "√ Read Only". Now click on the box and the attribute of the file will be reversed. Clicking anywhere else will not change the attribute.

To hide a directory, select the directory in the File Listbox, open the "File" menu in the menu bar and click on option "Attribute". This will open a box with the text " Hidden". Now click on the box and the directory will no longer be found in the File Listbox. To make a hidden directory visible again, open the "View" menu in the menu bar and click on Show Hidden. This will list the hidden directory (if any) in the File Listbox with the character "H" to the right of the name as attribute. To make the hidden directory permanently visible, select it in the File Listbox, open the "File" menu in the menu bar and click on option "Attribute". This will open a box with the text "√ Hidden". Now click on the box and from now on the directory will be listed again. Clicking anywhere else will not change the attribute.

Show Hidden

This option of the "View" menu is implemented to find hidden directories, select them and make them visible again. For details on the use of this option, see the description under "Attributes".

Refresh

Since it is possible to access a single device through more than one directory window it may be possible that one window shows files that have already been deleted through another window or does not show items that just have been created, for example. To avoid uncertainty caused by contradicting information, the refresh option has been implemented. To refresh the contents of the Directory Window, open the "View" menu in the menu bar and click on "Refresh". This will automatically re-read the device directory and display the updated information.

Program Now (EPROM only)

If one intends to write to an EPROM device before closing the Directory Window, one can do this through the option "Program Now" listed under "File" in the menu bar. After having selected this option, one will get the message: "*Program the EPROM device now? CANCEL will leave the device unchanged.*" To actually write the new information to the device, click "OK". Clicking on "Cancel" will not write but keep all changes in the buffer. If one does not use the "Program Now" option, one will get the message "*Program the EPROM ...*" on exiting the Directory Window. If one now clicks on "Cancel", however, the buffer will be cleared all changes are lost.

File Editor Window

The purpose of the File Editor Window is to examine and edit an iButton file that has previously been selected in the Directory Window of the File Viewer. Files can be viewed in three different ways: as ASCII **Text**, **Binary** Data in hexadecimal format and **BMP** Picture. These different views are reflected in the three tabs that fill the center of the File Editor Window (see below).

The name of the selected file and its path are listed above the display area. The mode of viewing is determined by the file contents. The file extension, except for values of 100 and higher, does not indicate the file type. If a file is recognized as BMP formatted picture it will be displayed as such. If a file is not a picture and does not contain Null bytes (code 00 hex), it is assumed to be ASCII text. Otherwise its contents will be displayed as binary data. An empty file will be treated as text. Text can be edited in text mode as well as in binary mode. Binary files can be edited in the binary mode only. Although pictures can be displayed with the file viewer, they have to be edited using special graphics programs.

Regardless of the file type, one can change the viewing mode by clicking on the label of the tab. However, if the representation is not adequate to the file contents, one may get error messages (when trying to view a text or binary file as BMP picture or viewing a picture as text, for example) and editing may not be possible.

File Viewer, File Editor Window, Text Mode
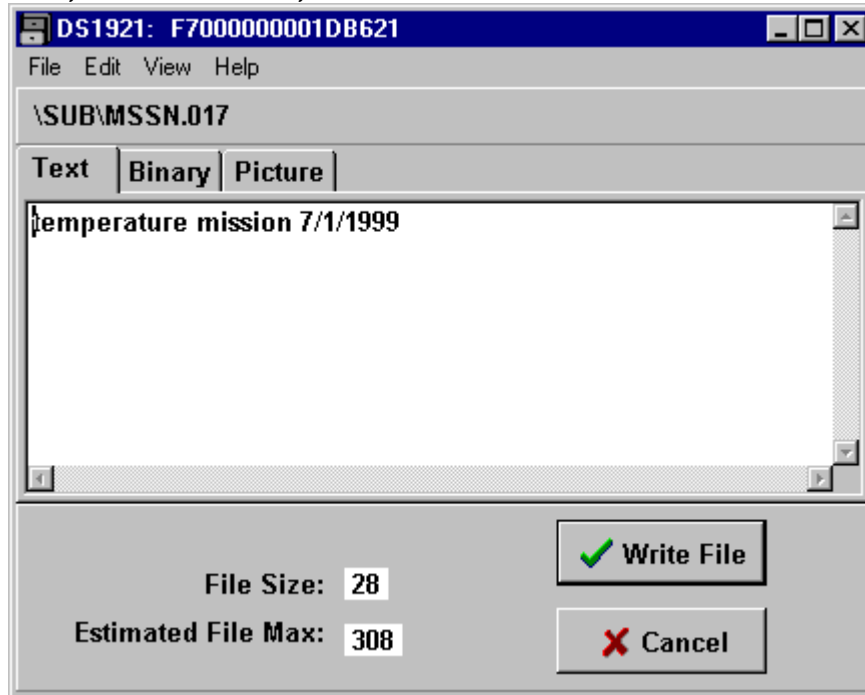
The **File Size** of the file being viewed or edited and its maximum possible size are indicated beneath the viewing tabs. In contrast to the file size in the Directory Window, which is rounded upwards to the next multiple of 28 bytes, the file size shown in the Editor Window is always exact. When editing text, the number will increase or decrease as characters are added or deleted. In Binary mode the file size is updated whenever a group of bytes has been revised (see "Editing Binary Files", below).

The **Estimated File Max**{imum} Size is calculated from the number of unused pages within the device plus the number of pages already used. This estimate usually is very accurate. Under certain conditions, however, the file may finally be up to 28 bytes longer than the estimate displayed. Extensive use of sub-directories reduces the memory space available for data storage.

To the right of File Size and Estimated File Max there are two buttons, "*Write File*" and "*Cancel*". The Write File button has to be clicked on if the changes made during an editing session are to be written to the device. With an SRAM device, data will be written immediately. With an EPROM device one will get the message that a buffer is created and no writing will take place before leaving the file viewer or the Program Now function (Directory Window, File Menu) has been invoked. Clicking on Cancel will close the File Editor Window and transfer back to the Directory Window ignoring all edits made during the session. If one has modified a file and tries to close the edi-

tor window, one will be reminded of this by the message "File had changed. Update Now ?" Click on "OK" to save the changes or on "Cancel" to exit without updating.

The Menu Bar of the File Editor Window contains elementary functions to exchange data between the iButton and the PC and the Windows Clipboard, respectively. These menus and their functions are:

File	**Open File (PC)** to select an file on the PC to replace the entire contents of the iButton file,	
	Save File (PC) to copy the entire iButton File to the PC	
	Exit to exit the file editor window	
Edit	**Copy All** to copy the entire contents of the iButton file to the clipboard,	
	Paste All to replace the entire contents of the iButton file with data from the clipboard	
	Clear	
View	**Proportional** to temporarily change to a non-proportional font (text tab only)	

Transfers to the iButton will only be successful if the data does not exceed the storage capacity available in the device. Otherwise one will get an error message and the remainder of the file data or clipboard contents will be cut off.

Editing Text Files
If a newly created file is selected, the cursor will be in the beginning of the empty text tab. Now one can type, erase and edit text similar to the Windows Notepad utility. All standard Windows keystroke editing commands apply. The most useful of these are:

Cut	= Shift + Del		
Copy	= Ctrl + Ins	or	Ctrl + C
Paste	= Shift + Ins	or	Ctrl + V
Clear	= Ctrl + Del		

In contrast to the menu functions, the keystroke commands affect the selected text section only, not the entire iButton file. When editing tables it may be useful to change the character font to a non-proportional one. To do this, click on the View menu. This will open a box with the text "√ Proportional". Click on the box to change to the non-proportional font. To change back to a proportional font, repeat these steps. The check mark " √ "will now be missing.

To copy a file **from the PC to the iButton** file, use the function Open File (PC) from the File Menu. The program will then display all "TXT" files found in the directory where the iButton Viewer Program is installed. The file selection can be changed to list "BMP" only or to include all files. However, the file size will not be visible. One can change the directory following the Windows convention to access any file stored in the computer. After the file in the PC is found, double-click it or click it once and then click OK to transfer its contents to the file editor, replacing previous data. Depending on the data transferred, the editor may change automatically to the binary or BMP display mode.

To copy a **segment of a file to the iButton**, access the file with a text editor or word processor and copy the segment to the Windows clipboard. Then return to the File Editor window and use the function Paste All from the Edit Menu. This will replace the previous contents of the iButton file with data from the clipboard.

Data can be copied **from the iButton to the PC** in two different ways: into a file of its own or to the clipboard to be incorporated into an existing file. To copy **to an independent file**, use the function Save File (PC) from the File Menu. By default, the program will create the file in the directory where the iButton Viewer Program is installed. The file name on the PC will be the same as in the iButton. For text files the extension will change to TXT and to BMP if one is copying a picture. Binary files will keep their original extension. However, name, extension and path of the file may be changed, if desired. To copy from the iButton **to the clipboard**, use the function Copy All from the Edit Menu. ASCII text or a picture can now be pasted into a word processor document and be re-used. Copy All does not work with binary files.
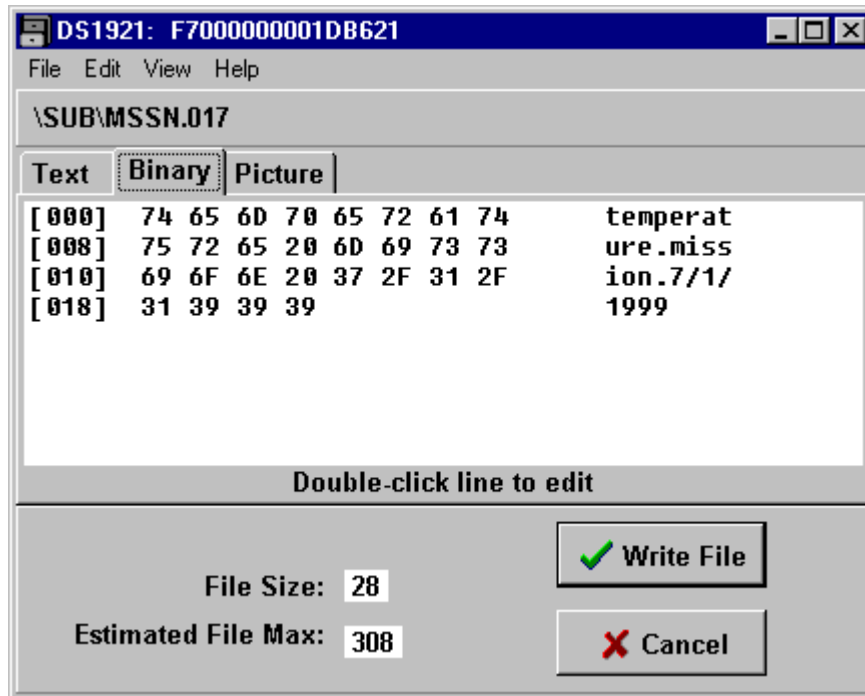
Editing Binary Files

Any file can be displayed and edited in the binary format. The picture below shows a sample text file in hexadecimal presentation. Each line starts with the byte address inside the file (not the device) followed by 8 bytes of data, each separated by a space. With an empty file one will only see the address information [000].

To enter or edit data, double-click on the line where the editing is to begin. This will select all eight bytes in that line and copy them into a child-window, as in the example below, where the editing takes place. Click anywhere in this line to set the cursor. Entering new data without setting the cursor will replace the whole line.
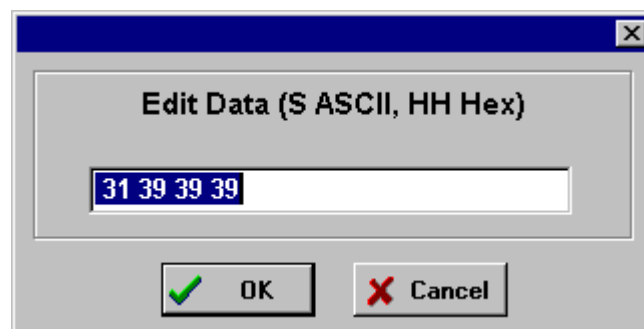
Data can be inserted or overwritten as in any typical Windows Application and is not limited to the 8 bytes of the line. Even the keystroke commands apply, but their use is rather limited. Input data may be hexadecimal or ASCII. Groups of *two* characters in the range of 0 to 9, A to F (not case sensitive) separated by a space are understood as hexadecimal (see picture). *Single* characters separated by a space are understood as ASCII and are translated into their Hex equivalent. Hexadecimal and ASCII data may be mixed in the same line during editing. Spaces themselves are delimiters and therefore cannot be entered as character, only as code 20 hex.

After the new data is entered, click on OK to transfer the edits to the main window where it will be inserted from the selected line onwards. Any changes in length will be reflected in the File Size below the display section.

File Viewer, File Editor Window, Binary Mode

```
DS1921:  F7000000001DB621                    _ □ ✕

File  Edit  View  Help

\SUB\MSSN.017

 Text  │ Binary │ Picture │

[000]   74 65 6D 70 65 72 61 74     temperat
[008]   75 72 65 20 6D 69 73 73     ure.miss
[010]   69 6F 6E 20 37 2F 31 2F     ion.7/1/
[018]   31 39 39 39                 1999



              Double-click line to edit

                                    ✔ Write File
           File Size:  28
      Estimated File Max:  308      ✗ Cancel
```

File Viewer, File Editor Window, Binary Mode, Hex-Editor Child-Window

```
                                             ✕

        Edit Data (S ASCII, HH Hex)

        31 39 39 39


            ✔  OK        ✗ Cancel
```

Handling Picture Files
The picture mode has been implemented to support viewing bitmap files stored in
iButtons and exchanging them between the iButton and PC. Bitmap files (file ex-
tension BMP) are created using programs such as Paint (PBRUSH.EXE) and other
graphic programs. They are pasted into a previously created and opened iButton file
using the "Open File (PC)" function of the File Menu or "Paste All" of the Edit Menu.

Data transfer of BMP or JPEG pictures to the PC is also possible. Use the File Menu function "Save File (PC)" to create a disk file or the Edit Menu function "Copy All" to copy to the clipboard from where the picture can be pasted into a word processor document, for example.

Although picture files can be displayed and edited in the binary mode, it is not recommended to do so unless the exact format of the BMP files is known in great detail. Changing or adding bytes arbitrarily is likely to corrupt the file and may lead to unpredictable results. The file may not even be recognized as a picture.

File Viewer, File Editor Window, BMP Mode
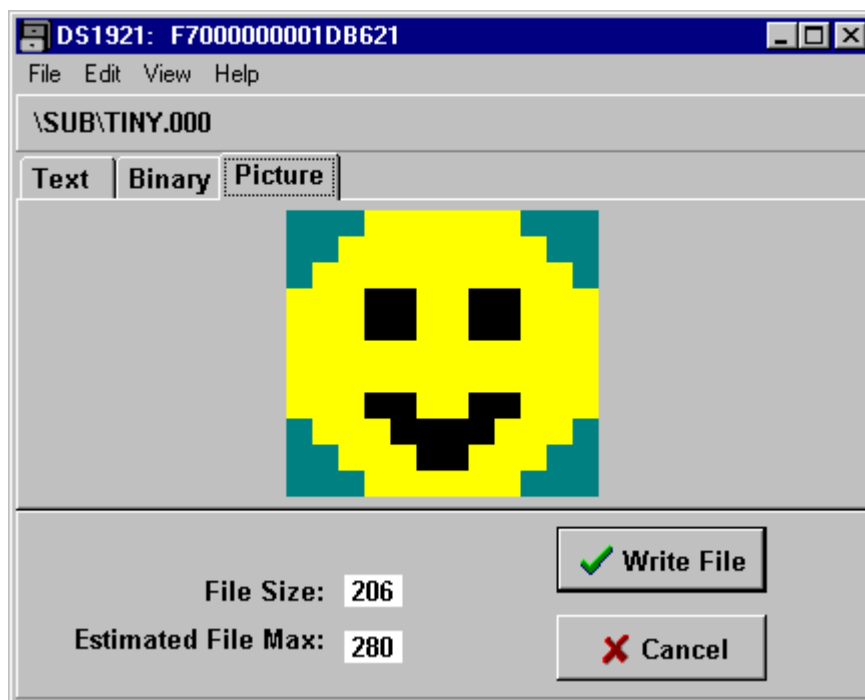
Editing EPROM Append Files
Append files may contain text or binary data. They are viewed in the same way as any other data file. However, there are some notable differences. After one has selected an append file in the Directory Window the following message will be displayed: "*The file selected is an AddFile. The data entered will be appended to the end of the file. Note that the current contents of the file is displayed.*" After clicking on OK the message will disappear and one can read the full file contents, either in the text or binary mode.

As soon as one clicks anywhere in the display area of the tab, the display area will be cleared and one can enter the data to be appended. In binary mode the first line will show the address of the next available byte of the file. After data entry is finished

one proceeds in the same way as with other text or binary files that are to be written to EPROM devices.

There are no restrictions on the data within an append file. The program determines the end of data by loading the append file into a buffer and then scanning it backwards (i. e., from the highest to the lowest address). The address of the first byte found that is different from FF hex is taken as "end of file marker". The starting address for new data will be "end of file marker" + 1. Since unprogrammed EPROM memory cannot be distinguished from a byte that deliberately has been written FF hex, the data of an append file **must not end** with FF hex. Otherwise it will be overwritten with new data in the next session. This special precaution does not apply to text files since FF hex is not a valid character code.

Editing Monetary Files

Monetary files must reside on DS1963L devices and have a 101 decimal extension. They have specific pages that are associated with read-only counters that increments when the page is written. This is used to detect tempering of the monetary file. When creating a Monetary file the following a message will be displayed *"Extension 101 is reserved for transaction type files. This type of file is located in a special memory page with a counter. Is this what you want?"* After clicking 'OK' the file will be created. When reading a Monetary file, the current counter and temper bits for the page the file is located on is displayed in a message box.

Time Viewer

The Time Viewer is an easy to use tool to read and set all of the counters and registers in the register page of the DS1994 (DS2404) iButton device. In addition, one has full access to the control and status register, which makes it possible to use all of the device's special features. The Time Viewer Window with sample settings is shown below.
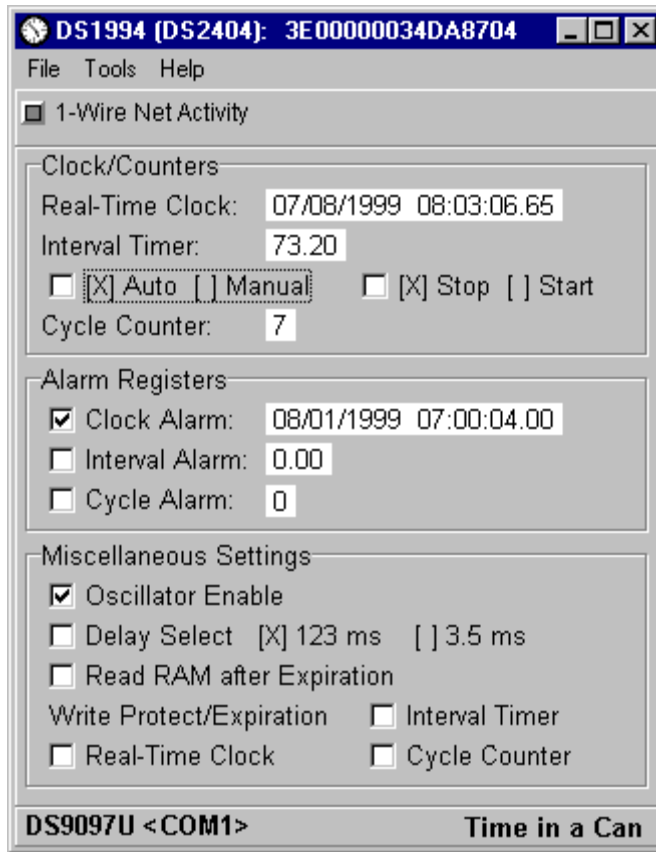
The window consists of three major sections labeled "Clock/Counters", "Alarm Registers", and "Miscellaneous Settings". In the "Clock/Counters" section the viewer displays and periodically updates the readings of the three counters of the device. These counters are called Real Time Clock (binary format, UNIX-compatible), Interval Timer and Cycle Counter. Associated with each counter is an Alarm Register of the same size. The contents of these registers is shown in the section "Alarm Register". Bits and flags that control the device operation are found either with the counters (interval timer control "Auto, Manual"; "Stop, Start"), the Alarm Registers (alarm enable, one for each counter) or in a separate section "Miscellaneous Settings"

(Oscillator Enable, Delay Select, Read RAM after Expiration and Write Protect/Expiration). As with the other windows, there is also a Status Bar that indicates the communication port in use and a short Menu Bar with the entries File (to exit the Time Viewer) and Tools (to set the clock).

Changing Settings

Any setting in the white fields of the display and control sections can be changed by simply clicking on it. For control functions, the contents of the field will toggle between "×" as a check mark and plain white. For registers a child window will pop up with the present contents of the register. To replace the contents completely, simply type the new value. Otherwise position the cursor, select the portion to be replaced and start typing, just as with Notepad, for example. After the new value is entered, click on "OK" to transfer the value to a buffer or click on "Cancel" to ignore the editing. The new value will be displayed in purple and two temporary buttons "Write" and "Abort" will appear below the Menu Bar. One may write each change individually or collect the changes of several controls and registers in the buffer and write them all at once. When write-protecting one or more counters, all the updates must be collected and written all at once. For the change(s) to become effective one has to click on the "Write" button. "Abort" will return to the previous settings without writing the buffer. Regardless if data is written the temporary buttons will now be gone. Closing or exiting the Timer Viewer while the temporary buttons are visible will ignore the updates collected in the buffer.

Operating the Clock

The real-time clock of the DS1994 (DS2404) is a 40-bit binary counter that increments 256 times per second. The 8 least significant bits count the fractional seconds. The upper 32 bits represent the number of seconds passed since January 1st, 1970, 0:00:00 hours (= 12:00:00 a. m.) as reference point. The 40 bits of the real-time clock can accumulate 136 years before rolling over.

With a DS1994 (DS2404) as shipped from the factory the real-time clock is not running. To **set the time**, click on the white field right of the text "Real-Time Clock" and enter the actual date AND time in the format MM/DD/YYYY hh:mm:ss (24-hour format). Alternatively one can use the function "Set Real-Time Clock From PC Clock" of the Tools Menu. In addition to setting the clock, the crystal oscillator needs to be enabled to get the clock running. To do this, click on the small square field "**Oscillator Enable**" in the Miscellaneous Settings section until the "×" appears and click on the temporary "Write" button below the Menu Bar. Now the real-time clock should be running and one should see how the date and time are constantly updated.

The crystal oscillator can be turned off by clicking on the "Oscillator Enable" control field until the "×" disappears. This will conserve energy if the device is not in use for a long time. **However, for the interval timer and cycle counter to function the** crystal **oscillator** that controls the real-time clock **must be enabled.**

Operating the Interval Timer

The interval timer is a 40-bit binary counter that, when enabled, counts at the same rate as the real-time clock. Its contents are displayed in seconds as a decimal number with fractions. The interval timer is either in the Automatic or in the Manual operation mode. The Automatic Mode is selected if the white square "[×] Auto [ ] Manual" in the Clock/Counter section of the Time Viewer Window contains the "×" check mark. Otherwise the timer is in the manual mode.

In the **Automatic mode**, the interval timer will begin counting after the data line has been high for a period of time determined by the **Delay Select** bit (see description below). The interval timer will stop counting after the data line has been low for the same time period. The automatic mode can be useful when monitoring the operating time of equipment. Simply provide a DC voltage in the range of 2.8 V to 6.0 V to the data contact of the DS1994 (DS2404) as long as the equipment is powered up. Removing the device and reading the interval timer will tell exactly how many seconds the equipment was running.

In the **Manual mode**, the interval timer is operated under software control. It is either running or stopped, regardless of the voltage on the data line. One may toggle between start and stop by clicking on white control field "[×] Stop [ ] Start". The interval timer is stopped, if the control field contains the "×" check mark. Otherwise the timer is running and one will see that its contents are periodically updated. Although one may change its setting, the Stop/Start control field has no function if the device is in the Automatic mode. The Manual mode can be useful when monitoring how long computer-controlled equipment is really productive (not just powered up). Whenever the equipment changes from idle to active, its controlling computer should start the interval timer and stop it as soon as the equipment returns to the idle state. In addition to this counting service the DS1994 (DS2404) also provides time and date information for event logging purposes and non-volatile memory for setup data.

To **preset or clear** the interval timer, click on the white field right of the text "Interval Timer" and enter the new value as a decimal number (integer or with decimal point, no comma). See section "Change Settings" above for details. The maximum value the interval timer can be preset to is approximately 4294 million (decimal) with a granularity of about 1/100 of a second.

Operating The Cycle Counter

The cycle counter is a 32-bit binary counter. It increments after the logical level at the data line changes from high to low and then stays low for a period of time determined by the Delay Select bit (Miscellaneous Settings section).

The cycle counter can be useful when monitoring the number of power up/down cycles of equipment or just counting pulses that represent revolutions of an object, for example. For cycle counting, connect a DC voltage in the range of 2.8 V to 6.0 V to a switch and connect the switch to the data contact of the DS1994 (DS2404). Every time the switch closes and opens the cycle counter will increment. In the example given for the Automatic mode with the interval timer the cycle counter will automatically count the power up/down cycles, thereby supplementing the run time information with stress information.

To **preset or clear** the cycle counter, click on the white field right of the text "Cycle Counter" and enter the new value as decimal integer number. See section "Change Settings" above for details. The maximum value the cycle counter can be preset to is approximately 4294 million (decimal).

Delay Select

The cycle counter and interval timer of the DS1994 (DS2404) are designed to work with digital signals as well as mechanical switches. A mechanical contact closure, however, is not a clean transition from an off to an on state. At a closer look one can see that a mechanical switch generates a series of uncontrolled short pulses ("bounces") until it finally reaches the steady on or off state. Therefore the DS1994 (DS2404) has an on-chip debouncing logic that filters the transitions and provide clean signals that finally control the counters.

One can set the time delay of the debouncing logic to either 123 ± 2 ms or 3.5 ± 0.5 ms. If possible, the longer delay should be chosen. This gives a good filtering and also allows communication on the data line without incrementing the cycle counter or starting the interval timer (if the communication occurs in short data packets with an idle low status). The shorter delay allows higher counting speeds, but under certain conditions may lead to incrementing the cycle counter by wave forms that the device generates itself (interrupts).

The **Delay Select** bit is found in the Miscellaneous Settings section of the Time Viewer Window. A check mark "[×]" in the control field left of "Delay Select" indicates the long delay, a missing mark represents the short delay. To toggle between the two delay values click on the control field and proceed as explained under "Changing Settings".

Using Alarms

To generate an alarm two things need to come together: the value of the counter must be equal to the value of the alarm register AND the alarm must be enabled. Setting the registers and enabling the alarms is done through the Alarm Registers section of the Time Viewer window. Alarm values are entered in the same way as counter values. To **enable an alarm**, click on the control field left of the name of the alarm type until the check mark "[×]" appears. This arms the device to generate interrupt signals as the alarm goes off. To disable the alarm, click again on the control field. The check mark will disappear. After the value is entered and the alarm is enabled, proceed as explained under "Changing Settings".

The iButton Viewer will perform a Conditional Search for all DS1994 (DS2404)s being viewed and read the Status Register as soon as an alarm has gone off. The type of alarm (time, interval or cycle) is then determined from the settings of the alarm flags inside the status register and a message like the sample below is displayed.

Reading the status register automatically clears the alarm flags. Once an alarm is enabled, it can be armed for the next event by writing a higher value into the alarm register or resetting the counter.

Compared to having the bus master permanently reading the counters and checking against a limit, using alarms in conjunction with interrupts is very efficient. It reduces traffic on the 1-Wire Net and makes sure that the master is informed the fastest possible way. Even if, due to poor electrical contacts during reading, the status of the alarm flags are lost, their status can be reconstructed by comparing counter registers and alarm registers and checking the interrupt enable bits.

Write Protect / Programmable Expiration
The DS1994 (DS2404) can be used as a programmable expiration controller, for example, to force a service call if a machine has been used for a predefined number of operating hours, a certain number of power on/off cycles, or if a certain date is reached. This mode is invoked by write protecting a counter/alarm register pair after it has been loaded with the desired values. The programmable expiration takes place when one or more registers have been write-protected and the first alarm condition occurs.

The behavior of the DS1994 (DS2404) after expiration is determined by the "**Read RAM after Expiration**" flag, located next to the Write Protect flags in the "Miscellaneous Settings" section of the Time Viewer Window. If this flag is set (check mark "[×]" is visible) one will still be able to read the memory, but any writing will be impossible after expiration. If this flag is not set (no check mark), only the ROM contents can be accessed after expiration. Before expiration the status of this flag has no impact on device operation.

Write-protecting counter/register pairs protects not only the register pair from modification but also all other write protect bits and the "Read RAM after Expiration" flag. The oscillator can still be started, but not stopped. If the cycle counter is write protected, the Delay Select setting can no longer be changed. Write protecting the interval timer also freezes the operation mode of the interval timer. If the timer is in manual mode, it will run continuously as soon as the write protection becomes effective.

The expiration controller function works even if the alarm for the particular register is not enabled. If the alarm is enabled, the expiration will be signaled by interrupt

pulses. In this case the "Read RAM after Expiration" flag should be set. Otherwise it will not be possible to stop the interrupt signals that go along with the expiration and slow down the communication on the 1-Wire Net.

To **invoke the expiration controller mode**, first set all counters to their starting values and the associated alarm registers to the value that marks the expiration. Enable the alarms (optional) and set the "Read RAM after Expiration" flag (unless the memory must not be accessible after expiration). All these settings are not critical and can be repeated. In the final step, set the write protect/Expiration bit for the counter(s) that shall determine the expiration. If the expiration shall be triggered by the counter that reaches its limit first, then write-protect all counters that apply and then write the buffered changes to the device. Once a counter has been write-protected one cannot protect another one.

The Write Protect / Expiration Controller function is not reversible. The chance to inadvertently invoke this mode is low. In contrast to the other settings, the program will pop up an extra window (see below) and ask for confirmation.
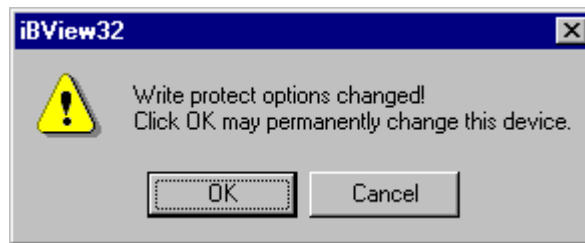
Only if one clicks on "OK" is the Write Protect / Expiration Controller function really activated.
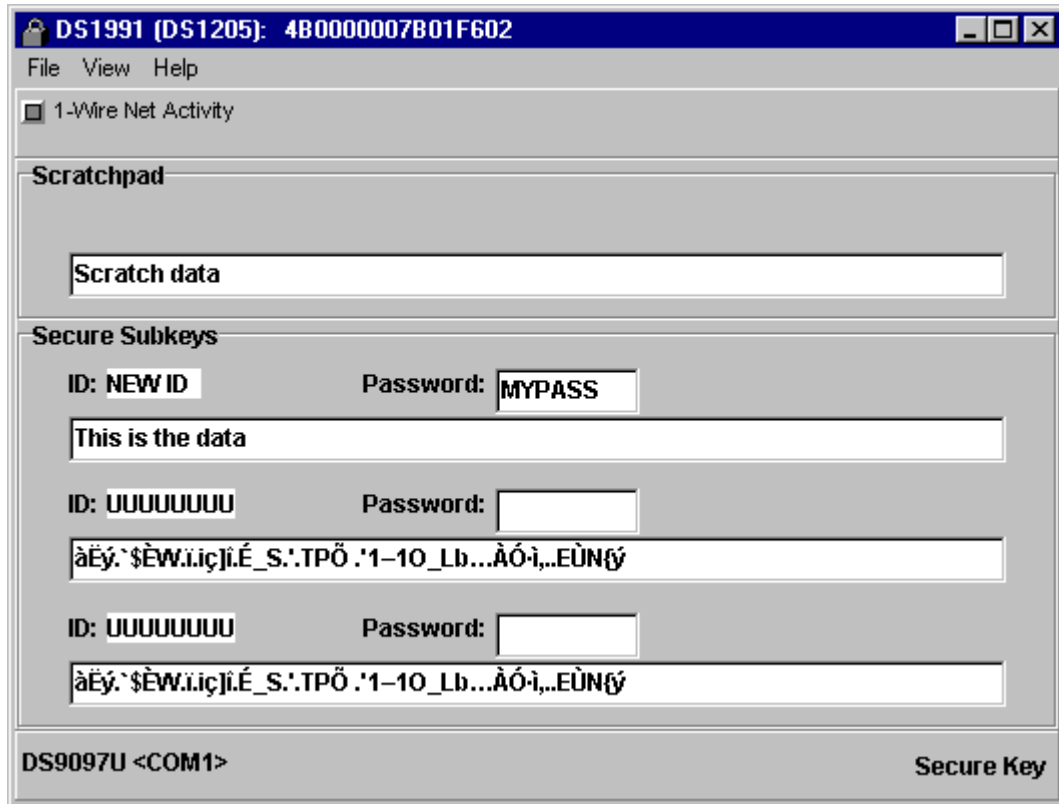
Secure Viewer

The Secure Viewer is used to read and write the DS1991 MultiKey iButton. In contrast to Memory iButtons, this device uses a file system that is implemented in hardware. The device is designed to store three files of 48 bytes each that are called Subkeys. Instead of 4 bytes with a numeric extension, the file name consists of 8 bytes and is called ID Field. In addition to the ID Field, each file has an 8-byte write-only password to protect its contents from unauthorized read access.

As with the other Memory iButtons, this device also includes a scratchpad. The scratchpad may be used to write data and read it back for verification before it is copied to its final destination in one of the Subkeys. With its 64 bytes, the scratchpad of the DS1991 can hold the ID Field, Password and all 48 data bytes of a Subkey. The usage of the scratchpad for intermediate storage is highly recommended for an environment where dwell time of the device at the 1-Wire network is short. Assuming that the dwell time is long enough, the iButton Viewer does not use the scratchpad and writes directly to the Subkey. As a consequence, the scratchpad becomes available as an additional publicly accessible memory space.

All of the memory areas of the DS1991 MultiKey iButton with the ID fields and password-entry boxes of the three Subkeys are laid-out in the window of the Secure Viewer in a straight-forward way, as shown below.

The three Subkeys combined into a block "Secure Subkeys" fill the lower three quarters of the window. To the left, above each Subkey's data field there is a box labeled "ID" to display the contents of the key's ID Field. Above the center of each Subkey's data field is another box labeled "Password". When reading a Subkey, one has to type the password into this box to give the program access to the secure data. Above the block of Subkeys there is a smaller block called "Scratchpad". The scratchpad is represented as one line that displays the contents of the scratchpad in character form. As usual, the window is completed by a Status Bar that indicates the communication port in use and a short Menu Bar with the entries File (to exit the Secure Viewer) and View (to refresh the screen, in case a single device is viewed through multiple windows). This sample picture was generated using a device in the state as it is shipped from the factory. The "U"s are the ASCII representation of the character code 55 hex (= 85 decimal), a pattern that typically is written to the device before it leaves the factory.

The Secure Viewer does not know or remember passwords. To meet the requirements of the communication protocol the viewer uses 8 spaces (code 20 hex or 32 decimal) as password when trying to read the Subkeys. Since this is usually different from the correct password, the device responds with "garbage" data, a pseudo-random pattern based on the provided password (not the stored one). The "garbage" is then checked for its printability. All non-printable codes, i. e., codes below 20 hex (32 decimal), are replaced by a "." before data is displayed in character form as Subkey contents. Depending on national settings, the characters actually seen may be different from those shown in the sample window.

Writing Secure Data
Before one can write secure data to a Subkey for the first time, one has to give the Subkey a name (optional) and specify a password (mandatory). To change the name of a Subkey, click on the box that displays the current contents of the key's ID Field. This will open a child-window with the current name already selected for re-placement, as shown below.

Enter New ID for Subkey 1

`UUUUUUUU`

✓ OK   ✗ Cancel
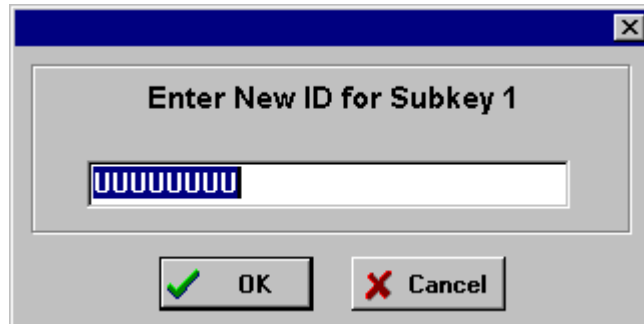
Enter the new name and click OK. This will bring up a similar window for setting the password.

Enter New Password for Subkey 1

`MYPASS`

✓ OK   ✗ Cancel
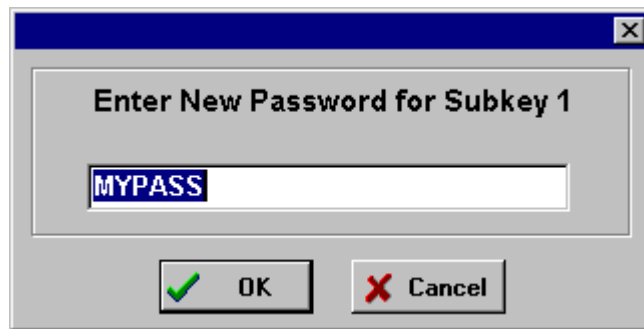
The default password of the Secure Viewer is 8 spaces. All but the first space are removed from the editing area of this child-window. The remaining single space is selected for replacement. Simply fill in the new password and click on OK. Clicking on "Cancel" will ignore the new name as well as the password. For both, the ID Field and the password, the program allows up to 8 characters, including embedded spaces, to be entered. Shorter names are padded with spaces to make the 8 characters necessary to meet the hardware requirements of the device.

After file name and password have been entered, the new names will be visible for the Subkey selected. Since writing a password erases the contents of the Subkey, the Subkey's data field will now be filled with 48 dots, representing the non-printable code 00 hex. Now double-click on the dots to select them for replacement and type the new contents of the Subkey. With the first character entered, a "Write" button will appear above the right end of the Subkey's data field. When finished typing, click on this temporary button to transfer the text to the secure Subkey. The text entered will be appended by spaces to fill the 48 bytes of the secure storage space of the key. To cancel the transfer without writing, exit the window of the Secure Viewer or click on "Refresh" in the view menu. After the data is written to the device, the "Write" button will disappear, but the file name, password and contents will remain visible. To

make the password and the true contents of the Subkey invisible, overtype the password.

Reading Secure Data
To read secure data, click on the password-entry box of the key to be read and type the password. When the typing ends, the program assumes that the password is complete and will access the device. If the password is correct, the secure data will be displayed in its true length, with trailing spaces removed. Otherwise the display will show random data, based on the password entered. Note that the password is case-sensitive and must be entered exactly as it is stored in the device. Although the program fills short passwords with trailing spaces to make up the 8 bytes required by the DS1991, these trailing spaces need not be entered.

Modifying Secure Data
After secure data is read from one of the Subkeys of the DS1991 it can easily be modified and written back to the device. First access the Subkey as described in section "Reading Secure Data". Now double-click on the word to be replaced and enter new text. To replace a selection, select the text to be replace with the mouse and type the new text. To replace the whole contents, select the full line. Alternatively, one can position the cursor anywhere in the data field and start erasing or typing, whatever is necessary. The program counts the characters and stops accepting more data as soon as the data field contains 48 characters. As described in section "Writing Secure Data", a "Write" button will appear that needs to be clicked to finally write to the device.

Changing the ID Field And/Or Password
The Secure Viewer allows the user to change the ID Field of a Subkey and its password while keeping the Subkey's contents. However, this is a multi-step procedure involving the Windows clipboard and keystroke commands. The procedure begins with displaying the contents of the subkey who's ID or password is to be changed. See section "Reading Secure Data" for details. Next select all the contents of the Subkey's data field with the mouse and copy it to the clipboard using the keystroke command Control + C.

Now click on the display area of the Subkey's ID Field. This will pop up the child-window for entering the file name with the current name filled-in and selected. Make changes as desired or click on OK. This will transfer to the password child-window with the current valid password filled-in and selected. Make the desired changes and click on OK. This will write the new ID and password and erase the Subkey's contents. Now double-click on the Subkey's data field that is now filled with dots and paste in the contents of the clipboard using the keystroke command Control + V. Now click on the "Write" button to write the data to the device.

Trying to change the password by simply typing new text in the password field is not possible. The programs would assume that one is going to try another password for reading the Subkey's contents. Changing the data field of the Subkey first and then the password before writing to the device will give the error message "Error writing the sub-key, password may be incorrect !". This comes from the fact that the program tries to write to the device using the password shown on the screen. In the

read-back cycle after writing the program will then see that the data does not match and therefore display the error message.

Reading/Writing The Scratchpad
With the Secure Viewer the scratchpad is treated as a Subkey without ID Field and password. The current contents therefore are displayed automatically. For editing and writing the scratchpad the same rules apply as for the data field of a secure Subkey. See section "Modifying Secure Data" for details. With the scratchpad, however, the program accepts up to 64 bytes.

EEPROM Viewer

The EEPROM Viewer provides a simple means to read and write the 256-bit Data Memory and the 64-bit one-time programmable Application Register area of the DS1971 (DS2430A) EEPROM iButton.

UDP stands for **U**niversal **D**ata **P**acket. It is a simple format that protects a serial data stream against transmission errors by cutting it into packets that each are preceded by a length information (e. g., one byte) and followed by an inverted CRC16 over the length byte and the data of the packet. With its 32 bytes of memory capacity and the formatting overhead of three bytes the DS1971 (DS2430A) can finally store 29 bytes of user data. The Data Memory can also be edited as 32 bytes of raw data. Radio buttons on the left side of the Data Memory panel controls the edit mode.

The Application Register can only be edited in 'Raw' format allowing you to alter all 64 bits (8 bytes) of data.
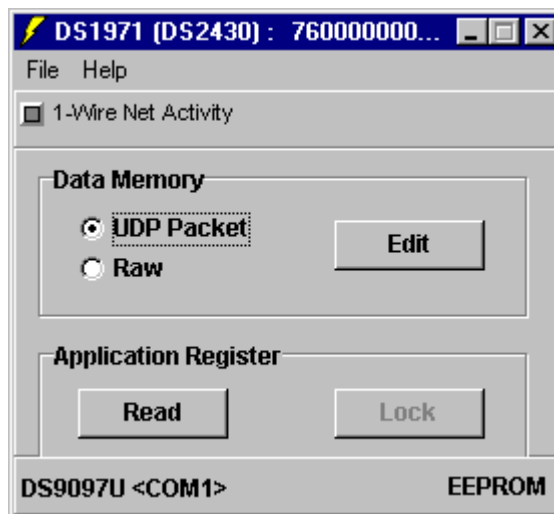
The edit window for the EEPROM Viewer is very similar to the File Editor Window of the File Viewer with only the Text and Binary edit modes functional.

Reading Data Memory
No memory is read upon activation of the EEPROM Viewer.   For the Data Memory, the edit mode must first be selected from the radio buttons and then the 'Edit' button clicked to read.   If the UDP Packet radio button is selected it checks the data format and displays the data content as ASCII text if it consists of text or as binary if 00 were detected. This works well if the device has been programmed in a previous session of the UDP Packet editing. Since a fresh device contains a constant pattern (typically 55 hex = 85 decimal) in every location, the format test will fail and the error message "*Could not read a valid UDP on this device !*" will be displayed in a separate window. In this case simply acknowledge the message by clicking "OK".

An empty packet to edit will then be displayed. If a valid UDP Packet is detected then the edit window is displayed with the packet contents. If 'Raw' format is selected then the entire 32 bytes of data is displayed for editing. Note that the 'Raw' edit is less reliable because it does not contain CRC validation. It is recommended you use the UDP Packet when possible. See the TMEX File Viewer description for details on how to use the data edit window.

Reading Application Register
The Application Register can be read by clicking on the 'Edit' or 'Read' button in the Application Register buttons. The button says 'Edit' if the Application Register contents are not yet locked. It says 'Read' if the Application Register has been locked and the contents can not be changed.

The Application Register can only be edited in a 'Raw' format fashion. All 8 bytes (64 bits) are available to edit.

Editing and Writing
When finished with editing the Data Memory or the Application Register the 'Write' button is used to transfer the changes to the DS1971.

The Application Register can be locked by clicking on the 'Lock' button in the Application Register options. The Register can only be clocked once so the contents must be edited with care before locking.

UDP Viewer

The UDP Viewer provides a simple means to read and write universal data packet.

UDP stands for **U**niversal **D**ata **P**acket. It is a simple format that protects a serial data stream against transmission errors by cutting it into packets that each are preceded by a length information (e. g., one byte) and followed by an inverted CRC16 over the length byte and the data of the packet. With its 128 bytes of memory capacity and the formatting overhead of three bytes the DS1992 can store 125 bytes of user data.

The window of the UDP viewer (see below) has some similarity with the File Editor Window of the File Viewer in text mode. The center of the window provides a large area for reading/editing text. The lower part of the window displays the character count of the data packet and its maximum size. The window is completed by a Status Bar that indicates the communication port that is in use and a short Menu Bar with the entries File (to exit the UDP Viewer) and View (to refresh the screen in order to cancel edits that are not yet saved).
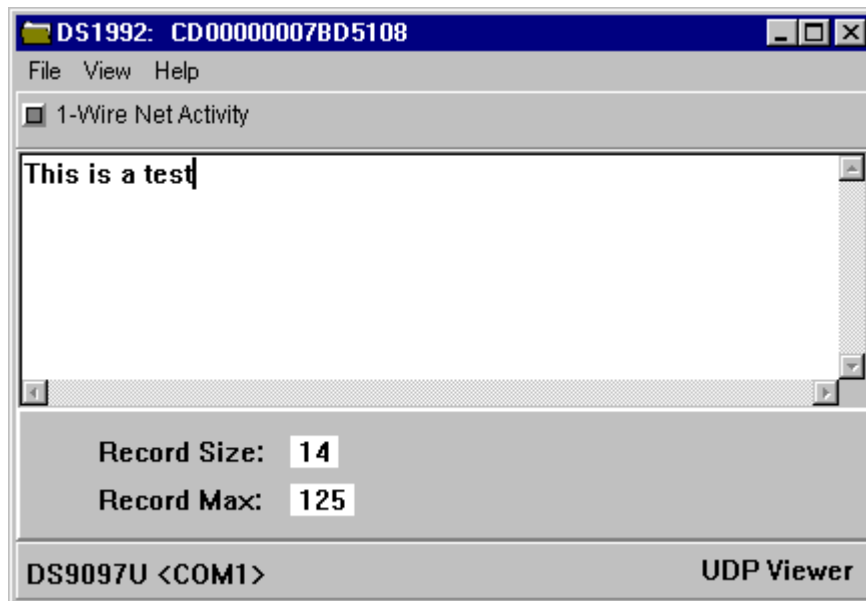
Reading Text
As the UPD Viewer is activated it automatically reads the main memory of the selected device, checks the data format and displays the data content as ASCII text. This works well if the device has been programmed in a previous session of the UDP viewer. Since a fresh device contains a constant pattern (typically 55 hex = 85 decimal) in every location, the format test will fail and the error message "*Could not*

read a valid UDP on this device !" will be displayed in a separate window. In this case simply acknowledge the message by clicking "OK". If a device has been formatted by the File Viewer it will contain a valid data packet, but no text data. Since the UDP viewer does not support editing binary data it will display the message "*WARNING, this record contains binary data. It may not display correctly in this editor.*" Simply acknowledge the warning. The data displayed and the length may be incorrect.

Editing And Writing Text
Once the text stored in the device is displayed, one can start typing new text if the device is empty or modify existing text. To replace a word, double-click it and enter new text. To replace a selection, select the text to be replace with the mouse and type the new text. Alternatively, one can position the cursor anywhere in the data field and start erasing or typing, whatever is necessary. The program counts the characters and stops accepting more data as soon as the data field contains 29 characters. The current number of characters is displayed as "Record Size" below the text reading/editing area.

As soon as the first modification is made, a button "Write UDP" will appear in the lower right of the UDP Viewer window. To write the new text to the device, click this button. To ignore the edits, exit the window of the UDP viewer or click on "Refresh" in the view menu.

Temperature Viewer

The Temperature Viewer was created to demonstrate the features of the DS1920 (DS18S20) Temperature iButton. The DS1920 (DS18S20) is a single-chip direct-to-digital thermometer with 1-Wire interface and parasitic power supply. It directly converts the temperature at the chip into a 9-bit digital reading in ° Celsius with a 0.5 °C resolution over a working temperature range from -55 to +100 °C (-67 to +212 °F). Access to counter registers of the temperature conversion logic allows the user to increase the resolution of the temperature reading to 1/100 °C approximately, depending on the actual temperature. To watch for extreme heat or cold the chip includes two non-volatile trip point registers that store an upper and lower temperature limit and are linked to the temperature converter by a comparison logic. If the actual temperature gets outside the predefined range, this logic will make the device respond to the conditional search command to signal an alarm.
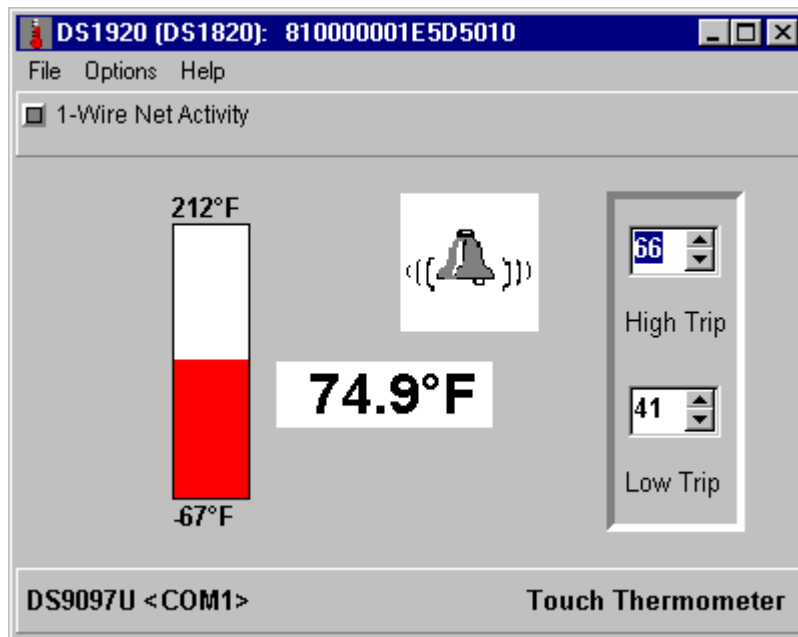
The resources of the DS1920 (DS18S20) are laid-out in the window of the Temperature Viewer as shown above. The temperature reading pictured as an analog thermometer and as a digital display occupy the majority of the window. The high and low trip points are displayed at the right side of the window. If the measured temperature is outside the interval set by the two trip points, an alarm bell will be visible above the digital temperature display. The window of the Temperature Viewer is completed by a Status Bar that indicates the communication port in use and a

short Menu Bar with the entries File (to exit the viewer) and Options (to change the temperature scale).

Reading the Temperature

The temperature display is updated continuously. With every new temperature conversion the color of the number in the digital display toggles between red and black to make the new value distinguishable from the previous one. The temperature viewer uses the contents of the counter registers of the conversion logic to interpolate the reading to a resolution of 0.1 °C/F.

When a brand new DS1920 (DS18S20) is viewed, both trip points are likely to be at 32 °F (= 0 °C) and the alarm bell will be visible. For information on how to set the trip pints, please see the next paragraph. Although the DS1920 (DS18S20) internally operates in the °C scale, the Temperature Viewer uses the °F scale to display the temperature reading and trip points whenever it sees a device for the first time. For convenience, the temperature scale can easily be changed to °C and back to °F. The program will remember the last setting when the same device is accessed later. To change between scales, open the Options menu and click on the preferred scale. Changing the scale automatically recalculates the actual temperature reading and the trip points.

Changing The Trip Points

The trip point temperatures are stored in the device with a resolution of 1 °C. By hardware design, changing the value of one trip point automatically re-writes the other. To change the value of a trip point, click on the up or down arrow to the right of the trip point display. A single click will increment or decrement the value by 1 °C. Keeping the mouse button pressed will change the number repeatedly in the direction of the arrow. Alternatively one can click on the value of the trip point and use the cursor up/down keys to change the setting. The upper and lower limits for the trip point setting are +100 °C (+212 °F) and -55°C (-67 °F) respectively. A few seconds after the last change new values will be written to the device. The numbers become black to indicate that they are identical to those stored in the device.

When using the °F scale the trip point value as selected on screen will be converted and rounded to the nearest °C value before it is written to the device. When read back, another conversion and rounding is performed. Since ± 1 °F is a smaller step than the ± 1 °C that the device can handle, the value read back may actually be ± 1 °F off from the desired value.

The Temperature Viewer does not check if the values of the trip points define a true interval. For proper functioning of the alarm signaling scheme the high trip point must have a higher value than the low trip point. To identify alarms, the program performs a Conditional Search on the DS1920 (DS18S20) being viewed. If the device responds, the alarm bell will be displayed.

Switch Viewer

The Switch Viewer was created to demonstrate the basic features of the DS2406/DS2407 Dual-Channel Addressable Switch Plus Memory or the DS2409 1-Wire Net Coupler. These devices have the following common features:

- electronic on/off switch
- activity sensor
- level sensor

The switching and sensing functions are reflected in the window of the Switch Viewer as shown below. The memory of the DS2406/DS2407 is accessed by means of the File Viewer. It has the same size as with the DS1982 and is typically used to store application specific data.
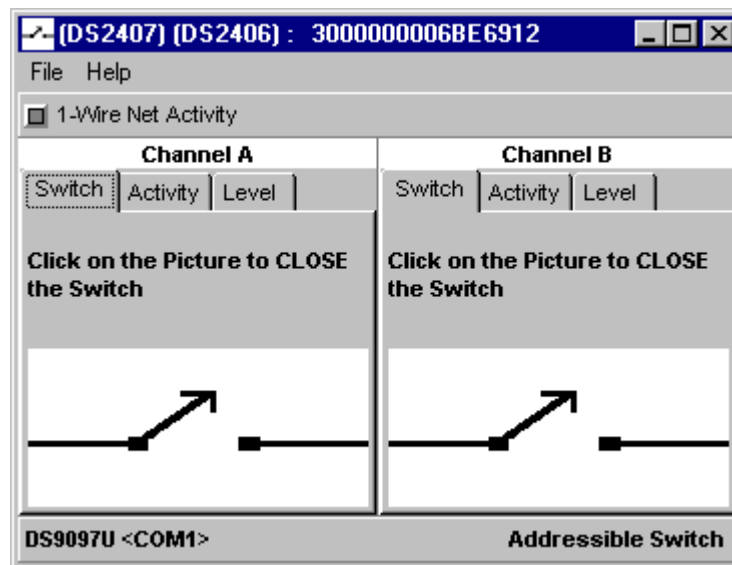

The Switch Viewer window has two identical working areas A and B for the DS2406/DS2407 and 'Main' and 'Auxiliary' for the DS2409. Each of these areas represents one channel and has three tabs: Switch, Activity and Level. The window is completed by a Status Bar that indicates the communication port in use and a short Menu Bar with File (to exit the viewer) as its only entry. As the Switch Viewer is started, the Switch tab is opened for both channels. The symbol of the switch in the lower half of the tab shows the actual status of the switches. On power-up both switches are in the open (off) state. Although the device can be programmed to power-up with one or both switches on, this function is not supported in this version of the Switch Viewer.

To **close the switch**, click anywhere on the switch symbol. The picture will immediately change to a closed (on) switch. If a load is actually connected to the switch, it will now be powered up. To **open the switch** again, click once more on the symbol of the switch. With each click the symbol will toggle from closed to open or vice versa and the load will be switched off or on. The switch remains in its current state if the Switch Viewer is closed. If the data line is disconnected, all devices will return to their power-on default setting as soon as communication on the 1-Wire bus resumes.

The input (sensing) capabilities of the device are accessed through the tabs Activity and Level. To change to these modes, click on the label of the tab. The picture below shows an example where channel A (or Main) monitors activity and channel B (or Aux) monitors the voltage level. **For any sensing to function, the switch of the sensing channel must be open**.

Activity is defined as the transition of voltage from low to high or high to low. The activity mode is most useful to monitor piezo sensors. The activity tab has two option settings, "Auto Clear" and "Sound on Activity". Auto Clear, if checked, clears the activity sensor so that it can capture the next transition. If checked, Sound on Activity allows a short beep to be generated with every transition as long as the activity is viewed. Whenever activity is detected, the lower half of the Activity tab shows an alarm bell to optically signal activity. With Auto Clear set, the bell disappears shortly after the activity was detected. If the bell remains visible, the activity sensor is most likely stimulated repeatedly or the Auto Clear is not checked (no "×" in the box left to Auto Clear). Since the activity sensor cannot distinguish between internally and externally induced transitions, activity will be signaled as one changes from switch mode to activity mode if there is a load connected and the load has been switched before.
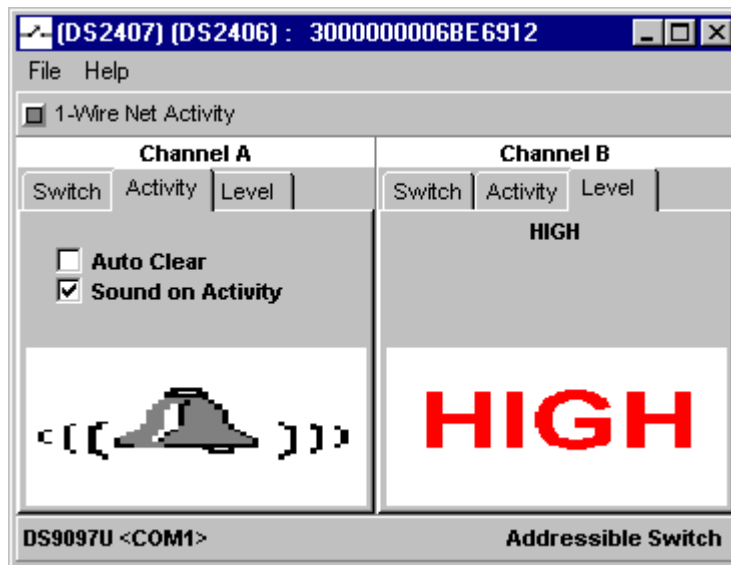
In the **Level** mode, a new sample of the logical level at the I/O channel is taken whenever the device is accessed and displayed as HIGH or LOW in the lower half of the Level tab. In contrast to Activity, which is sensitive to transitions, Level does not catch instances where the voltage level deviates from its quiescent level for a short moment only. In case one needs to see both, one may connect both channels outside of the device and view the activity with one and the level with the other.

The DS2406/DS2407 is available as Dual Channel and as Single Channel version. For the single channel version the window of the Switch Viewer includes channel A only and therefore is only half the size. Everything else works the same.

Using the Switch Viewer with the DS2409
The Switch Viewer does not support "Auto Clear" on the activity latches with the DS2409 1-Wire Net Coupler. The only way to clear an activity is to change the state of both switches to (off). If both switches are already (off), then turn one (on) and then (off). This will clear the activity latches.   Also, the DS2409 cannot have both Main and Auxiliary switches (on) simultaneously. If one switch is turned (on) and the other is already (on) then it will be switched to (off).

Serial Number Viewer

The Serial Number viewer displays the unique serial number for a iButton or 1-Wire device. This viewer is the primary viewer for the DS1990A. The Serial Number viewer is also used for devices that are not currently supported with a device specific viewer.
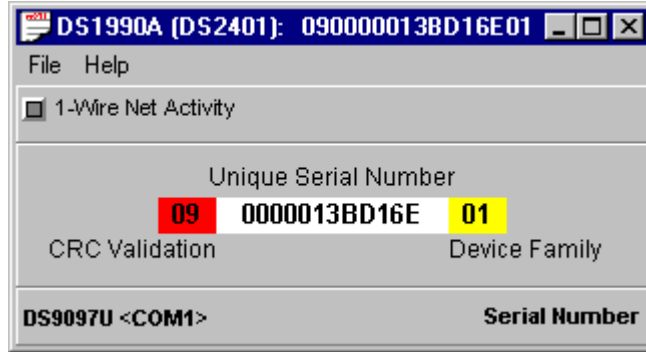
The serial number is displayed in three color coded segments. The left (red) part is the cyclic redundancy check 'CRC' that verifies the integrity of the number. The middle (white) part is the serial number the device was assigned. The right (yellow) part is the device family code. The family code indicates to an application the capabilities of the device. This family code is used by this application to spawn the appropriate viewer.

Debug Viewer

The Debug Viewer can only be used if the 'Debug Enable' option in the main menu is checked. The Debug Viewer allows byte level examination of some 1-Wire memory devices. A message '(DEBUG)' will be displayed above the list of ROM numbers to indicate 'Debug' mode is activated.
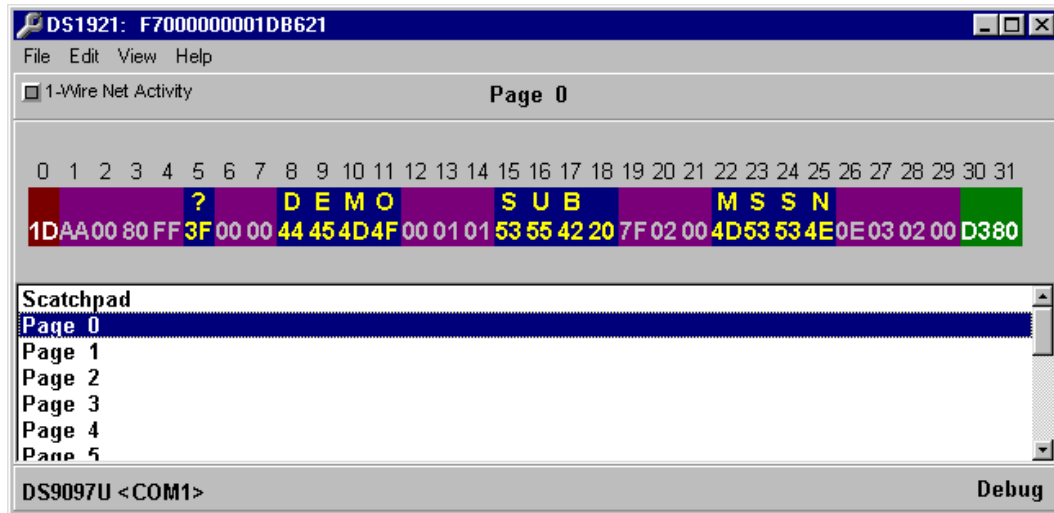
The contents of the memory pages will be color coded to indicate which bytes are length, data and CRC values that conform to the UDP format (see Dallas Semiconductor Application Note 114). The following is a list of the supported color codes in 'Debug' mode:

1D (white on red)		Length byte of Universal Data Packet (UDP)
N 4E (yellow on navy)		Printable CRC validated data
AA (gray on purple)		Non-printable CRC validated data
CB (white on green)		CRC byte of UDP
U 55 (black on light blue)		Data outside the UDP

iButton Viewer Customization/Advanced Features

Re-sizing Windows

As any common Windows program, the iButton Viewer allows several device viewer windows to be open at the same time. These windows are opened with a default size and position on screen. Both the size and position can be modified to provide more space for reading/editing files with the file viewer or UDP viewer, for example. To store modified window size/or position, the option "Auto Save Size/Position" must be checked.

1-Wire Net Port (Options Menu)

This function allows the user to dynamically change the 1-Wire Port that is monitored by the iButton Viewer to open additional sessions on a second or third port. It does not alter the default selection made during the TMEX installation. When activated, 1-Wire Net Port will display a window that provides a list of the possible ports similar to the port selection scheme used during the TMEX installation. A brief test is performed on the selected port to verify that communication is possible. If one changes the port the list of devices in the Network Listbox is cleared. If "Auto Viewer Start" is enabled another viewer for each device discovered will be launched.

Auto Viewer Start (Options Menu)

If this option is checked the iButton Viewer will automatically launch the primary viewer for each device discovered on the 1-Wire Net. For devices that have been viewed before, the latest window size and position will be used if "Auto Save Size/Position" is enabled. Otherwise the default window settings are applied. Auto Viewer Start is convenient when preparing demonstrations. If "Auto Viewer Close" is also checked, the primary viewer of arriving devices will automatically be opened in a predefined position and size and disappear as the device departs from the 1-Wire Net.

Auto Viewer Close (Options Menu)

If this option is checked the iButton Viewer will automatically close subsequently started device viewers when the device has departed from the 1-Wire Net. This option is normally used in conjunction with "Auto Viewer Start" to automatically start and close the primary device viewer when communicating with a transient device.

Auto Save Size/Position (Options Menu)

This option is by default checked. When checked, the size and position of the windows of the iButton Viewer and any subsequently started viewers together with the ROM code of every device viewed will be saved automatically in the IBVIEW.INI file (16-bit) or the registry (32-bit) and retrieved when the program is started again. This feature is convenient if the pool of devices viewed is limited and one cannot or does not want to use the default window sizes or positions. For each device the window configuration is also saved, so that if, many buttons are tested with this option enabled the IBVIEW.INI file (or registry) may grow substantially over time. To reduce the file size if this option was enabled accidentally or if one is concerned about decreasing system performance and/or disk space one may simply delete the

IBVIEW.INI file or the applicable registry keys. The next time the iButton Viewer is started, it will generate a new and short initialization file or new registry key without reporting an error message.

File Auto Overdrive (Options Menu)
If this option is checked the file viewer will attempt to communicate at a faster communication mode called Overdrive if the selected communication port and iButton device supports it. Overdrive-capable iButtons include the DS1996, DS1995, and DS1986. This option should be disabled if the length of the 1-Wire Net cable exceeds 10 meters. Refer to the introduction to review which adapters are capable of overdrive.

Set Flex Speed (Options Menu)
If this option is checked, then the adapter, if it supports Flex Speed, will be set to communicate to 1-Wire devices in Flex Speed. Flex Speed optimizes 1-Wire timings for 1-Wire communication across long lines.

Debug Enable (Options Menu)
The Debug Enable when checked will list an extra 'Debug Viewer' for some 1-Wire memory devices. The Debug Viewer permits raw examination and some write capabilities to the memory area.

Notes
If the iButton Viewer is minimized, all open device viewer windows will disappear. To keep device viewers visible as icons, reduce the window of the iButton Viewer as far as possible but do not use the Windows minimize function.

On the iButton Viewer and on all device viewers there is a green "1-Wire Net Activity" indicator. On the device viewers the activity indicator blinks while the particular device is accessed. If the indicator does not blink at all, then some other application has not released the 1-Wire Net. TMEX arbitrates the 1-Wire Net access by different applications and thus prevents collision. If a program is not acting correctly this error condition will persist.

Appendix A – 1-Wire Net PC Adapters

The following table lists the 1-Wire Net PC Adapters available from Dallas Semiconductor and third part suppliers that this version of the TMEX Runtime Environment supports.

Data sheets and purchase information on these adapters can be found on Dallas Semiconductor's Web site: http://www.maxim-ic.com.

iButton specific information can be found on the iButton web site: http://www.ibutton.com.

1-Wire Net PC Adapter Table

Part Number	PC Port	Extended Features
DS9097U-009 DS9097U-S09 DS1411	COM	Overdrive, Power Delivery
DS9097E	COM	EPROM Programming
DS9097 DS1413	COM	None
DS1410E	LPT	Overdrive, Power Delivery
DS1410D	LPT	None
DS9097U-25	COM	Overdrive, Power Delivery, EPROM Programming
DS1490F 2-in-1 Fob	USB	Overdrive, Power Delivery
DSXXXX (future product)	USB	Overdrive, Power Delivery, EPROM Programming

Special Feature

Overdrive

Normal 1-Wire Net communication operates at 16.3K bits per second. All iButtons and 1-Wire devices that operate on the 1-Wire Net support this communication speed. Some of the new model devices now also support a faster communication mode called 'Overdrive'. Overdrive mode boosts communication speed to 142K bits per second.

Power Delivery

Most iButton and 1-Wire devices are parasite powered. This means that they derive their operating energy from the 1-Wire Net during communication. Some devices however require more energy then can be accumulated in this fashion. These devices require an adapter that can provide extended power delivery on demand.

Normally this is a mode in the adapter that switches on a stronger 'pull-up' to power during the energy intensive operations. Here are some devices that benefit from this feature: DS1920 (temperature iButton), DS2450 (quad A/D), DS1954 (crypto iButton), and DS2430A (EEPROM memory).

EPROM Programming

iButton and 1-Wire devices that are One-Time-Programmable (OTP) incorporate technology called Electrically Programmable Read Only Memory (EPROM). EPROM programming requires a special 12 Volt pulse to write data. Although all of the available adapters can read an EPROM iButton, only adapters with EPROM programming capability can write to them. Examples of EPROM based iButtons: DS1982 (1K), DS1985 (16K), and DS1986 (64K).

Appendix B – Installation Details

Self-Extracting Install

The install file downloaded from Dallas Semiconductor web site will be in the form of a self-extracting single executable. When run, this executable will extract the standard install files into the Windows temporary directory and start the SETUP.EXE program. See the following section for details on the standard install files.

This installation comes with a means to uninstall TMEX as well. To do this, simply go to the Windows' Control Panel and double-click on the "Add/Remove programs" icon. This will bring up a window that lists all the software applications currently installed. From this list, highlight the "iButton-TMEX (32-bit) V3.20" selection, and then click on the "Add/Remove" button. This will start the un-installation process.

General Information

TMEX Runtime Environment is a set of drivers used to facilitate communications between TMEX applications and Dallas Semiconductor's one wire devices. Included in the Runtime Environment installation are the following:

iButton Viewer {32-Bit} - a Windows program for communicating with iButtons and other 1-Wire Net compatible 1-Wire devices. The iButton Viewer supports a true network environment. Device-specific viewers allow evaluation of special function devices.

iButton Viewer Help {32-Bit} – a hyperlinked Windows help file that describes in detail the full usage of the iButton viewer. This help file is also accessed through the help system of the iButton Viewer.

Default 1-Wire Net {32-Bit} – a Windows program for selecting the default 1-Wire Net port to be used by TMEX applications. Note that TMEX applications such as the iButton Viewer, only use this default port on the first invocation. Thereafter, they store their own current 1-Wire Net port. TMEX applications without a means to select a new 1-Wire Net port, may rely chiefly on the default port selected by this program.

Drivers Installed

The following drivers are installed with this utility. The location to which the drivers will be copied is described in the generic location specified by <>. This location is system depended and will automatically be changed for your system.

General (TMEX)

Provides general-purpose access to all 1-Wire devices. The API is outlined in the 1-Wire SDK. This installation is a drivers-only version of the TMEX RTE (32-bit).

Drivers:

All Platforms
>   <windows\system>\ibfs32.dll
>   <windows\system>\ib97u32.dll
>   <windows\system>\ib97e32.dll
>   <windows\system>\ib10e32.dll

Windows 98, Windows 2000, Windows ME
>   <windows\system>\ib90usb.dll
>   <windows\system32\drivers\>ds2490.sys

Windows 95, Windows 98, Windows ME
>   <windows\system>\vsauthd.vxd

Windows NT, Windows 2000
>   <windows\system32\drivers\>ds1410d.sys

Windows 98, Windows ME
>   <windows\INF>\DS2490.inf
>   <windows\INF\Other>\Dallas Semiconductor Corp.DS2490.inf

Windows 2000
>   <windows\INF>\DS24902k.inf

Java

Provides native access 1-Wire drivers to Java. This library layers on top of the 'General' library detailed above. See the 1-Wire API for Java on this web site: http://www.ibutton.com/software/1wire/1wire_api.html

Drivers:
<windows\system>\ibtmjava.dll

Java powered iButton

Provides the Java iButton Application Programmer Interface (JiB-API). See the Java-Powered Cryptographic iButton here:
http://www.ibutton.com/ibuttons/java.html

Drivers:

<windows\system>\jibcomm.dll
<windows\system>\jibapi.dll

Registry Keys Added

The following is a list of registry keys added during this installation.

All Platforms
[HKEY_LOCAL_MACHINE\Software\Dallas Semiconductor]
[HKEY_LOCAL_MACHINE\Software\Dallas Semiconductor\1-Wire Drivers (Win32) V3.20]
[HKEY_LOCAL_MACHINE\Software\Dallas Semiconductor\1-Wire Drivers (Win32) V3.20\3.20]
[HKEY_LOCAL_MACHINE\Software\Dallas Semiconductor\iButton TMEX]
[HKEY_LOCAL_MACHINE\Software\Dallas Semiconductor\iButton TMEX\3.00]
"MainDriver"="IBFS32.DLL"
"TYPE1"="IB97E32.DLL"
"TYPE2"="IB10E32.DLL"
"TYPE5"="IB97U32.DLL"
"TYPE6"="IB90USB.DLL"

Windows NT, Windows 2000
[HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\DS1410D]
"ErrorControl"=dword:00000001
"Group"="Extended Base"
"Start"=dword:00000002
"Tag"=dword:00000002
"Type"=dword:00000001

Windows 98
[HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Setup\SetupX\INF\OEM Name]
"C:\\WINDOWS\\INF\\OTHER\\Dallas Semiconductor Corp.DS2490.inf"="DS2490.inf"
[HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Class\{36FC9E60-C465-11CF-8056-444553540000}]
"Link"="USB"
"Class"="USB"
[HKEY_LOCAL_MACHINE\Enum\USB\VID_04FA&PID_2490]

Windows 2000
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Setup]
"SourcePath"="\\WINNT\\SYSTEM32\\drivers"