Model 4100G

100 mm video-graphics recorders

Ethernet Option Manual

EUROTHERM

Invensys
An Invensys company

100mm GRAPHICS RECORDERS

ETHERNET OPTION

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4100G ETHERNET OPTION

1 INTRODUCTION

This option allows the user to connect a graphics recorder to an Ethernet network. The Ethernet connection to the unit can be used in two ways, i) for Modbus/TCP data transfer, ii) to view the process via an intranet or the Internet (web viewer), using a standard web browser and the embedded server on the unit. Multiple types of each connection can be made simultaneously to the unit. A maximum of two Modbus/TCP connections can be made concurrently, with the total number of connections (Modbus and web viewer) not exceeding 5.

Notes:
1. For details of the video recorder itself, refer to the Installation and Operation Manual.
2. For details of how to set up your computer for communication over the Internet/intranet, refer to the documentation supplied with your computer and TCP/IP connection.
3. For the Modbus/TCP specification, refer to http://www.modicon.com/openmbus/standards/openmbus.htm
4. For Ethernet standards documentation, refer to http://standards.ieee.org/

2 ETHERNET CONNECTION

Connect the recorder to the network using a Category 5 UTP cable. The graphic unit supports 10BaseT only and all requirements for 10BaseT Ethernet physical network topology must be met when installing the unit.

The cable, with an RJ-45 plug at each end, must be “straight” for connection through a hub, or “crossover” for a direct connection to a computer.

Make the network connection by plugging one end of the cable into the RJ-45 socket on the unit and the other end into a port of the supporting Ethernet hub. Figure 2 shows the Ethernet cable plug-in on the underside of the graphic unit.

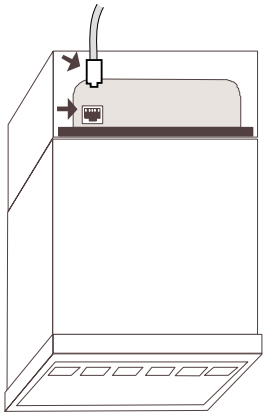

Figure 2
Ethernet RJ-45 Cable Connector

Ethernet communications quality depends on many factors such as latency, the number of clients logged on to the server, and other network traffic. For any LAN connection to industrial instrumentation, it is recommended that industrial data be separated from business traffic via switches, and other routing means. For Internet use, a connection speed of 128kbps or faster is recommended. Dial-up connections may work, but are not guaranteed (Windows users, see section 2.3).

2.1 RUN DISTANCES

For Ethernet, the maximum individual cable run between any station and its supporting hub or switch is 100 metres for unshielded, twisted pair cable. The maximum cable run joining two hubs is 10 metres in general, but is 100 metres when both hubs qualify as Ethernet Class 2 Repeaters. These cable runs may need to be shorter than the individual maximum lengths, because their lengths are also restricted by the rule that the maximum aggregated cable run between any two stations is 205 metres. See Note 4 above for further information.

2.2 NETWORK CONFIGURATION

Graphic units are shipped from the factory without an IP address, gateway address, or subnet mask, and with all boot protocols (DHCP, BOOTP, RARP) disabled. The unit must be configured using its Ethernet address (also called MAC address) which is to be found inside the cover of the graphic unit. The address has the form: 00-80-A3-xx-xx-xx, where the factory- entered number sequence xx-xx-xx is unique to each recorder fitted with the option.

There are three possible ways to configure the unit to operate on the network as follows:

1 Use Telnet to assign a static IP address to the unit. The unit can then be accessed using this IP address. (This is the recommended procedure described in section 2.2.1.)
2 Enable the unit's DHCP (or BOOTP, or RARP) protocol. Upon initialization, the unit will automatically request an IP address from the DHCP server on the network. The assigned IP address can be determined by examining the DHCP server, or by using a utility such as EZWebCon (see section 2.2.2).
3 Use the Lantronix EZWebCon utility (found at http://www.lantronix.com/products/software/ezwebcon/) to assign a static IP address to the unit. The unit can then be accessed using this IP address.

2.2.1 Using Telnet to assign the IP address

The easiest method is to assign a static IP address to the graphic unit using Telnet. Since Telnet requires an IP address to access the unit, a temporary IP address must first be assigned to the unit using ARP (Address Resolution Protocol). (A working knowledge of TCP/IP and Ethernet network configuration is recommended.) The procedure is as follows:

1. Connect the graphic unit to the network and locate a workstation on the same network that will be used to configure the unit.
2. Establish an unused IP address, ddd.ddd.ddd.xxx on the same domain as the workstation. Workstation domain information can be obtained by entering the following at the command prompt:
   ipconfig (Unix, Windows NT)
   winipcfg (Windows 95/98)
   To determine that the address being established is unused, 'ping' the address by entering the following at the command prompt:
   ping ddd.ddd.ddd.xxx
   Verify that there is no response (the request should time out).
3. Create a new ARP cache entry on the workstation including the unused, temporary IP address and the unit's Ethernet address by entering the following command at the command prompt:
   arp -s ddd.ddd.ddd.xxx 00:80:A3:xx:xx:xx (Unix)
   arp -s ddd.ddd.ddd.xxx 00-80-A3-xx-xx-xx (Windows DOS shell)
4. Verify that the ARP cache now contains the desired cache entry by entering:
   arp –a
   The ARP cache contents will display, for example:
   Interface: ddd.ddd.ddd.242 on Interface 0x2000003

Internet Address	Physical Address	Type
ddd.ddd.ddd.17	00-a0-c9-69-c0-35	dynamic
ddd.ddd.ddd.21	00-90-27-cc-af-25	dynamic
ddd.ddd.ddd.xxx	00-80-a3-xx-xx-xx	static

Note: For Windows users only: under Windows, the unit will not be accessible unless there is at least one ***dynamic*** ARP cache entry present in the workstation's ARP cache. The simplest way to add a dynamic ARP cache entry is to ping another node on the network, or ping ddd.ddd.ddd.255.

2.2.1 USING TELNET TO ASSIGN THE UNIT'S IP ADDRESS (Cont.)

5. Ping the recorder by entering:
   ping ddd.ddd.ddd.xxx
   (This causes the unit to search the network for duplicate IP addresses, and if none is found, the unit will successfully respond to the ping command.) The unit will then ***temporarily*** be available at the ddd.ddd.ddd.xxx IP address so it can be configured via Telnet. The unit will ***not*** store this IP address permanently.
6. Telnet to the unit using the temporary IP address ddd.ddd.ddd.xxx on the Telnet port (port 23) by entering the following:
   telnet ddd.ddd.ddd.xxx
   This must be done without delay as ARP cache entries not used for a given amount of time (in the order of 15 minutes) will automatically be removed from the ARP cache.
7. If successful, a header followed by a Username> prompt will be displayed. At the prompt, enter a user name (any name will do).
8. Go to privileged mode by entering:
   set priv
9. At the Password> prompt, enter the password (the factory default password is **system**). Once in privileged mode, the Telnet prompt should have two '>' characters, such as Local_3>>. The unit is now ready to be configured as described below, either by enabling the unit's DHCP protocol, or by configuring the unit's IP address.

DHCP PROTOCOL ENABLING

The unit can be configured by enabling the server's DHCP (or BOOTP, or RARP) protocol, as follows:-

1. At the Local_*n*>> prompt, enter:
   change dhcp enabled
2. To reboot the server in the unit for the changes to take effect, enter:
   init delay 0
   The unit displays the following message:
   %Info: Server reset scheduled - delay = 0 minute
   Exiting the Lantronix MSSLITE
   The Telnet session is then closed and the recorder re-boots
3. While rebooting, the unit will request a dynamically assigned IP address from the DHCP server present on the network. The assigned IP address can be determined by examining the DHCP server, or by using the utility EZWebCon.

Notes
1 The unit is also capable of issuing BOOTP and RARP requests. These protocols can be enabled with the **change bootp enabled** and **change rarp enabled** commands respectively.
2 After re-booting, a minimum of two minutes should be allowed to elapse before the web viewer applet or the web server administration applet is started. Otherwise, the following error message will appear:
Unable to establish a connection to the server. Check that the server code is executing.

2.2.1 USING TELNET TO ASSIGN THE UNIT'S IP ADDRESS (Cont.)

IP ADDRESS CONFIGURATION

The unit can be configured with a fixed IP address, for use, for example, in small networks where no DHCP server is available.

At the Local_*n*>> prompt, enter the following:

1. To change the IP address, enter:
   change ipaddress xxx.xxx.xxx.xxx

   Note: The IP address change does not take effect until the recorder is re-booted. The unit signals this byy displaying the message: %Info: TCP users exist - reboot to take effect.

2. To change the gateway address, enter:
   change gateway ggg.ggg.ggg.ggg
3. To change the subnet mask, enter:
   change subnet mask sss.sss.sss.sss
4. To reboot the server in the unit for the changes to take effect, enter:
   init delay 0
   The unit displays the following message:
   %Info: Server reset scheduled - delay = 0 minute
   Exiting the Lantronix MSSLITE
   The Telnet session is then closed and the recorder re-boots

5. After rebooting, the unit can be accessed using its new IP address xxx.xxx.xxx.xxx from anywhere on the network. The new IP address (xxx.xxx.xxx.xxx) can (but does not necessarily have to be) the same as the temporary IP address (ddd.ddd.ddd.xxx) in the workstation's ARP cache used to start the first Telnet session.

   Note: After re-booting, a minimum of two minutes should be allowed to elapse before the web viewer applet or the web server administration applet is started. Otherwise, the following error message will appear:
   Unable to establish a connection to the server. Check that the server code is executing.

2.3 WORKSTATION CONFIGURATION

The workstation used to access the graphic unit does not normally require configuration. Windows 95/98 users with a dial-up connection, who experience problems getting the web viewer applet to start, may have to modify the IP packet size of their dial-up adapter as shown in the following steps.

1. Open the Windows 95/98 Control Panel
2. Open **Network**
3. Select **Dial-Up Adapter**
4. Click **Properties**
5. Click the **Advanced** tab
6. Select **IP Packet Size** in the **Property** pull-down list
7. Select **Large** in the **Value** pull-down list (default is Automatic)
8. Click **OK**
9. Reboot the machine in order that the changes take effect.

2.4 RECORDER CONFIGURATION

The graphic unit comes configured from the factory for operation as a web-enabled unit. Users should not modify the Serial Comms settings in web-enabled graphic units. The factory settings for web-enabled operation are as follows.

Protocol	Modbus
Baud Rate	9600
Parity	None
Stop Bits	One
Address	1

3 MODBUS/TCP

The graphic unit contains a Modbus/TCP server which converts the messages it receives to Modbus/RTU messages and forwards them to the Modbus slave within the graphic unit. When the Modbus slave within the graphic unit replies, the Modbus/TCP server converts the response from Modbus/RTU back to Modbus/TCP and returns it to its Modbus/TCP client.

Note: Modbus/TCP is an Ethernet protocol, and can therefore be implemented over the Internet as well as over private Ethernet networks (intranets).

3.1 MODBUS/TCP ADDRESS

The Modbus/TCP server forwards only messages with Modbus address 1. Modbus address 2 is reserved for internal use by the web viewer and server administration client applets, and the other addresses are invalid. Therefore all Modbus/TCP traffic to the graphic unit must be sent to Modbus address 1. The domain name or IP address of the graphic unit must also be specified as this allows individual graphic units on the network to be identified.

3.2 MODBUS/TCP REGISTERS

Refer to the list of Modbus registers and function codes for the graphic unit used. The Modbus/TCP server makes available the entire set of registers and function codes to the Modbus/TCP client over an Ethernet connection.

Note: Exception: the Modbus/TCP server will not allow the graphic unit to enter the XModem mode. Modbus/TCP messages with function code 65 (enter XModem mode) will be discarded by the Modbus/TCP server.

4 WEB VIEWER APPLET

The web viewer applet is a Java applet that gives the ability to view the process on a computer, monitoring real-time information via the Internet or intranet. No special acquisition software needs to be installed on the computer — only a standard web browser and a TCP/IP connection. The unit's embedded web server displays graphical and alarm-summary data in a single display.

4.1 BROWSER PROGRAMS

Internet Explorer (4.0 or later) or Netscape Navigator (4.0 or later) can be used on the client computer to access the process data from the graphic unit.

Note: Java must be enabled in the browser being used.

4.2 LINKING THE BROWSER TO THE RECORDER

To start the web viewer applet, launch the web browser, then enter the IP address of the recorder in the address field (see section 2.2 for IP address assignment). The web viewer applet will start and ask the user whether to download and display historical data. The historical data is the last 3,600 data samples logged by the graphic unit. If the user chooses to download historical data, the web viewer will start with the oldest samples and catch up with the live data. Under optimal network conditions, it will take the web viewer approximately 20 minutes to catch up with the live data. If the user chooses to display live data, the web viewer will start with the most recent set of measurements. The initial screen is shown on Figure 4.2 below.

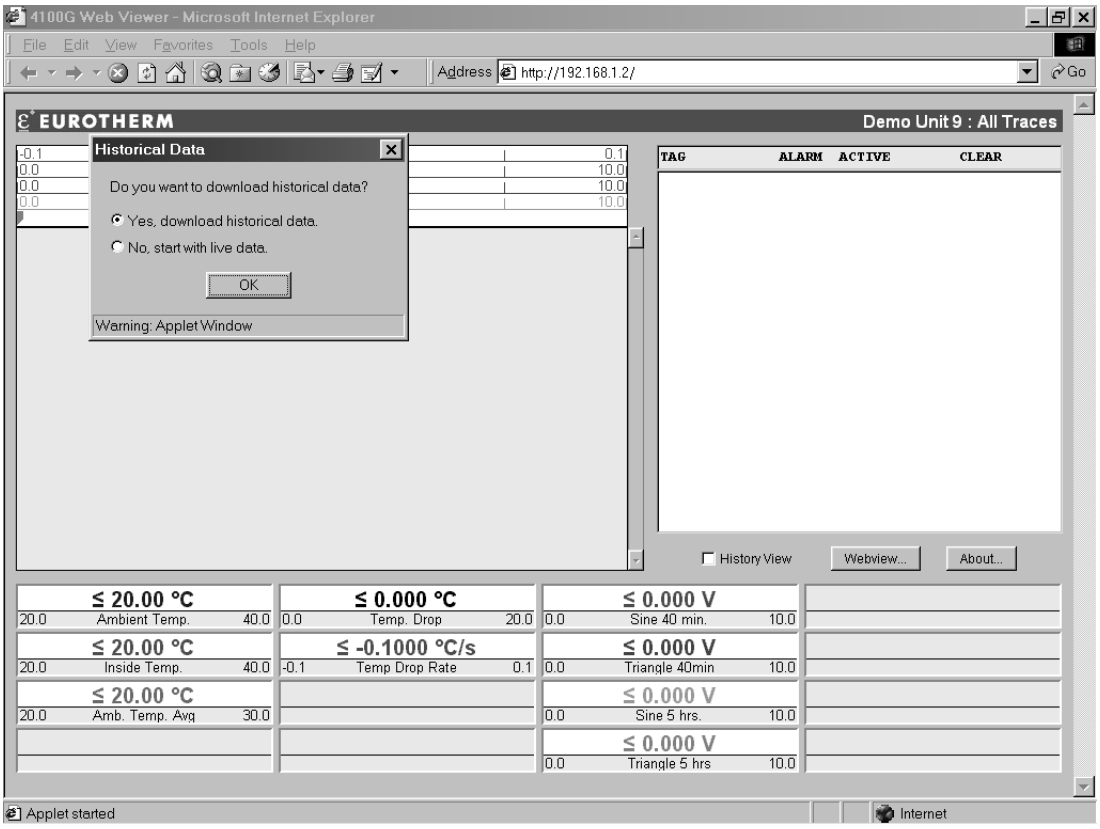

Figure 4.2 Initial web viewer screen

Note:
The recorder has a chassis that can be pulled out of the unit from the front panel. Pulling out the chassis will not cut power to the Ethernet interface board mounted in the rear bucket, and some sampling errors will result.

In the event the chassis is inadvertently pulled out, the web viewer applet may stop retrieving data and display an error message reading **`Sample data contain repeated errors.`** If this is the case, verify the chassis is plugged back in, restart the web viewer applet and start with live data (***not*** historical data as historical data will still contain the sampling errors).

4.3 SCREEN COMPONENTS

A single screen shows complete process information including trends, bargraphs, and alarm summary.

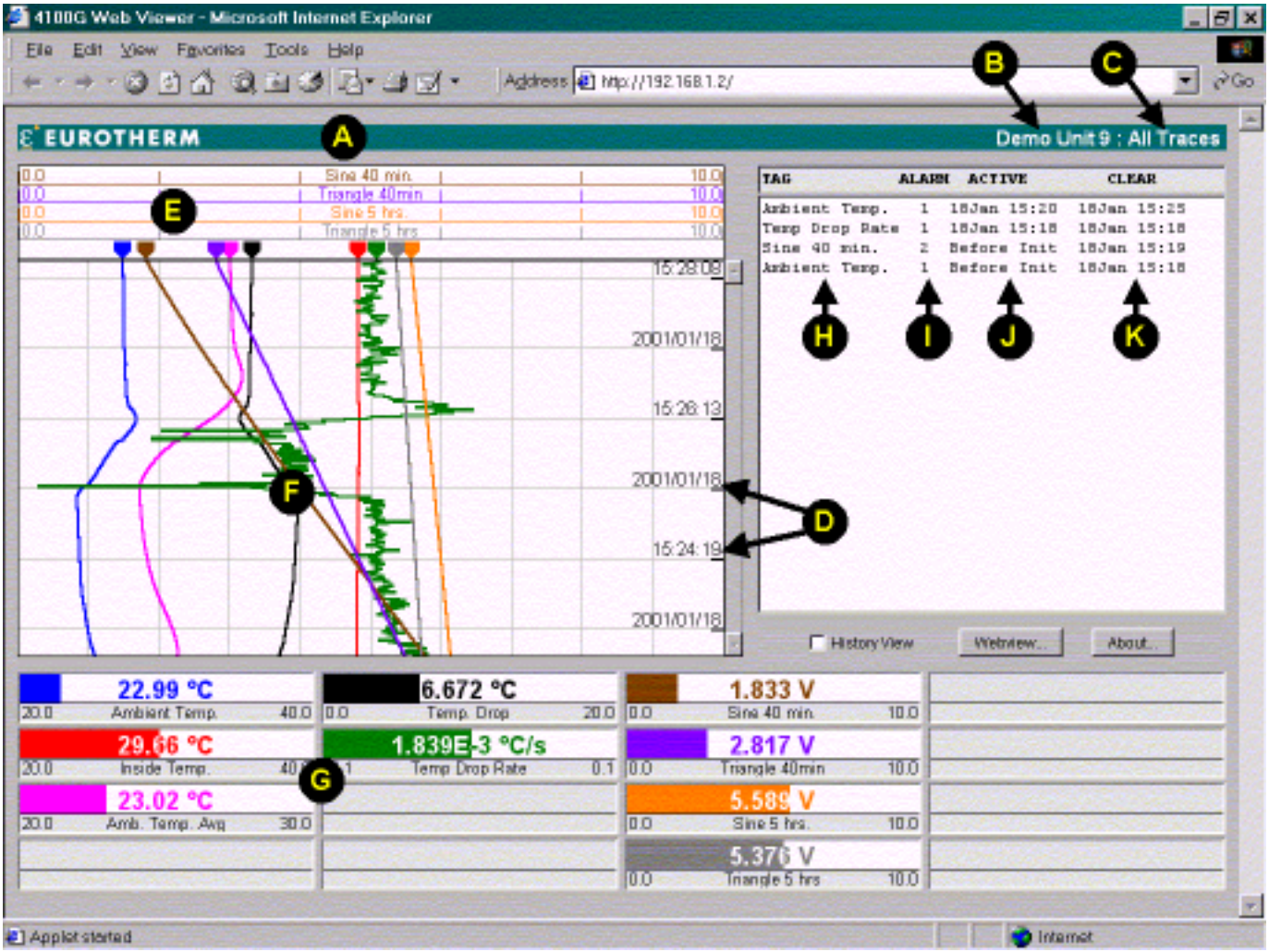

Figure 4.3 Web viewer components

	Web viewer information		Process data		Alarm Summary
A	Title bar	**D**	Time & date on chart	**H**	Channel descriptor
B	Graphic unit tag	**E**	Chart scales (rotating)	**I**	Alarm number
C	Webview name	**F**	Trends	**J**	Time & date alarm activated
		G	Bargraphs	**K**	Time and date alarm cleared

4.4 HISTORY VIEW

Historical trend data can be viewed by first clicking to enter a checkmark in the **History View** box. The vertical scroll bar to the right of the trend data can then be moved to view historical process data, as shown in Figure 4.4. The period of historical data available to view is a function of the sampling interval (see section 6.2). The graphic unit makes the most recent 3,600 samples available to the web viewer, so a sample interval of 1 second gives a 1 hour historical data period; a 2 second interval gives a 2 hour period, etc.

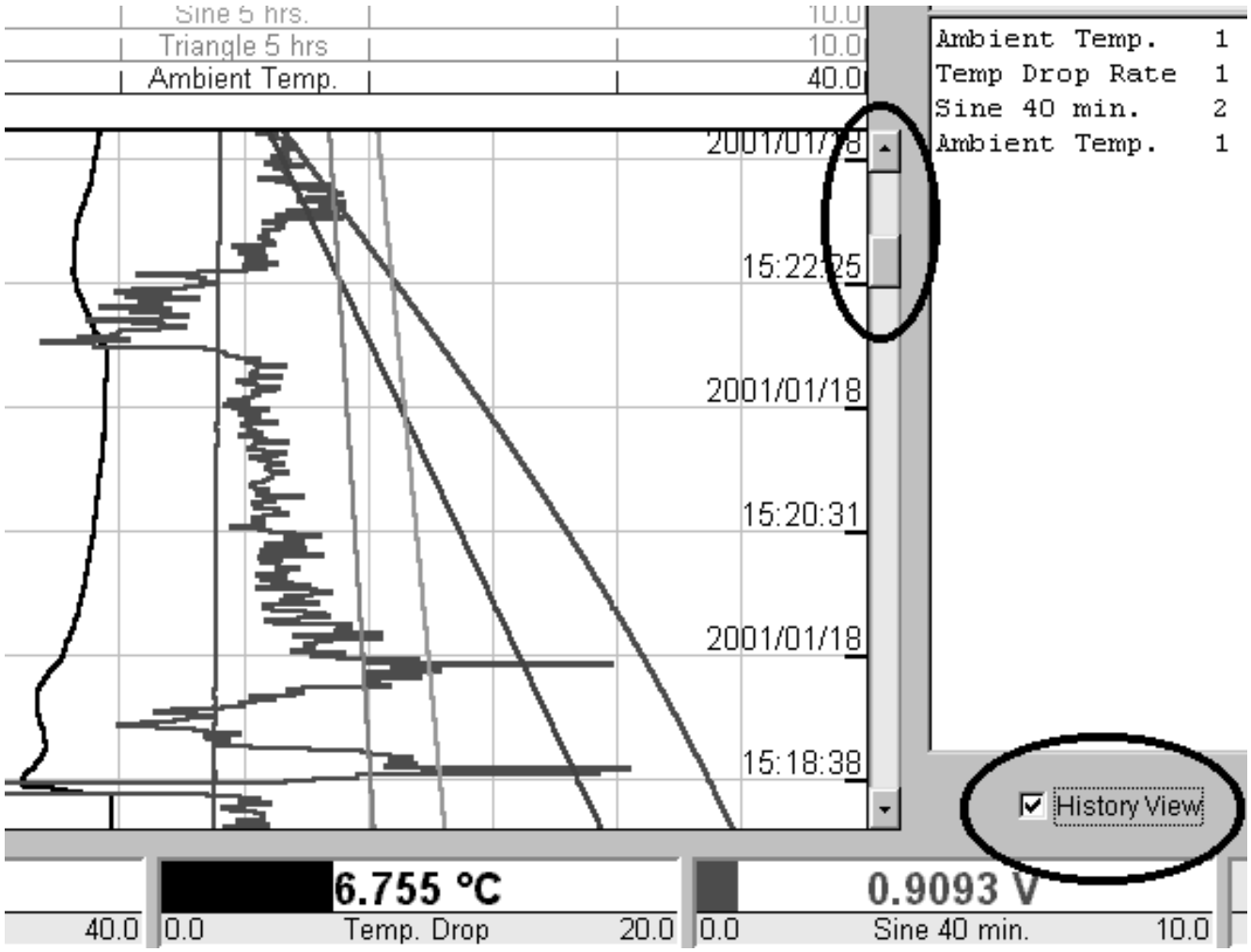

Figure 4.4 History view

4.5 WEBVIEW SELECTION

A webview is defined as an element which associates channels (PV's and DV's) to web viewer bargraphs and trace colours. By defining a webview, the user decides which channel is shown on which bargraph on the web viewer applet and which colour should be used to draw that channel's bargraph and trace on the screen. The user may define up to twenty (20) different webviews. See section 6.3 for details.

To select a different webview, click the web viewer's **Webview** button and select the desired webview as shown in Figure 4.5 below. After clicking **OK** or **Apply**, the new webview selection takes effect immediately. The name of the newly selected webview appears in the upper right corner of the web viewer screen (see Figure 4.3 item C). Graphic units are shipped from the factory with only one webview defined, called ***Default***, and shows the first six process values (PVs).

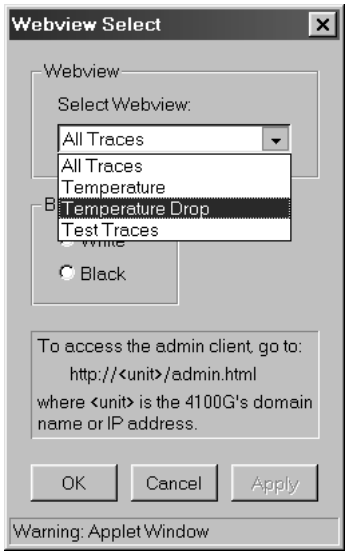

Figure 4.5 Selecting a webview

4.6 BACKGROUND COLOUR SELECTION

The Webview Select window shown in Figure 4.5 above also allows the user to select white or black as background colour. After clicking **OK** or **Apply**, the new background colour selection takes effect immediately and is independent of the webview selection.

Note: The background colour selection is not saved between sessions; the web viewer always starts with a white background.

5 E-MAIL ALARM NOTIFICATION

Messages can be sent to designated e-mail addresses to notify the recipients when process alarms occur. The alarms for which e-mail notification is required are flagged on a per-alarm basis in the user-defined Alarm Flags Matrix (see section 6.4). Up to eight e-mail addresses can be stored, and these will receive e-mail notification should any of the flagged alarms become active. Data included in e-mail alarm notification is:

- Recorder unit tag
- Channel descriptor
- Alarm number
- Time and date alarm activated

See sections 6.2, 6.4, and 6.5 for instructions on how to set up the e-mail alarm notification feature. Figure 5 below shows a sample alarm notification e-mail message.

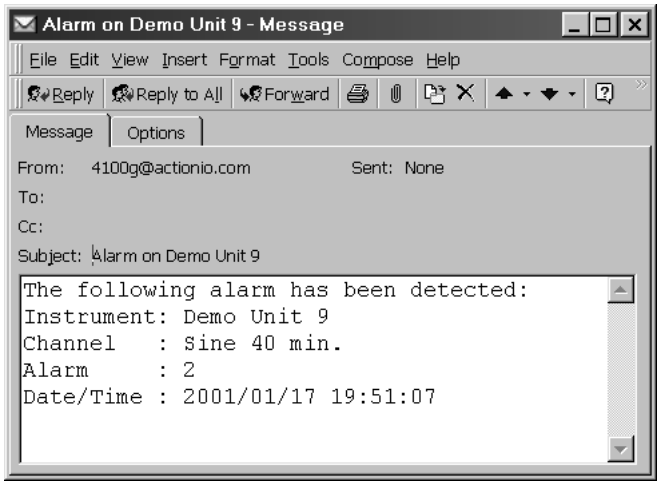

Figure 5 Sample alarm notification e-mail message

6 WEB SERVER ADMINISTRATION

The Web Server Administration applet is a Java applet that lets the administrator modify web viewer configuration parameters. To start the Web Server Administration applet, launch the web browser, then enter the IP address of the graphic unit in the address field followed by **/admin.html**. A password will be requested before any server administration functions can be performed (the unit is shipped with a default user password of 10 — see section 6.1 for password details).
The Web Server Administration applet is shown in Figure 6 below.
The following changes can be initiated from the Server Administration page by clicking on the associated button.

- Change User Password (section 6.1)
- Edit System Parameters (section 6.2)
- Edit Webview Configurations (section 6.3)
- Edit Alarm Flags Matrix (section 6.4)
- Edit Address Book (section 6.5)

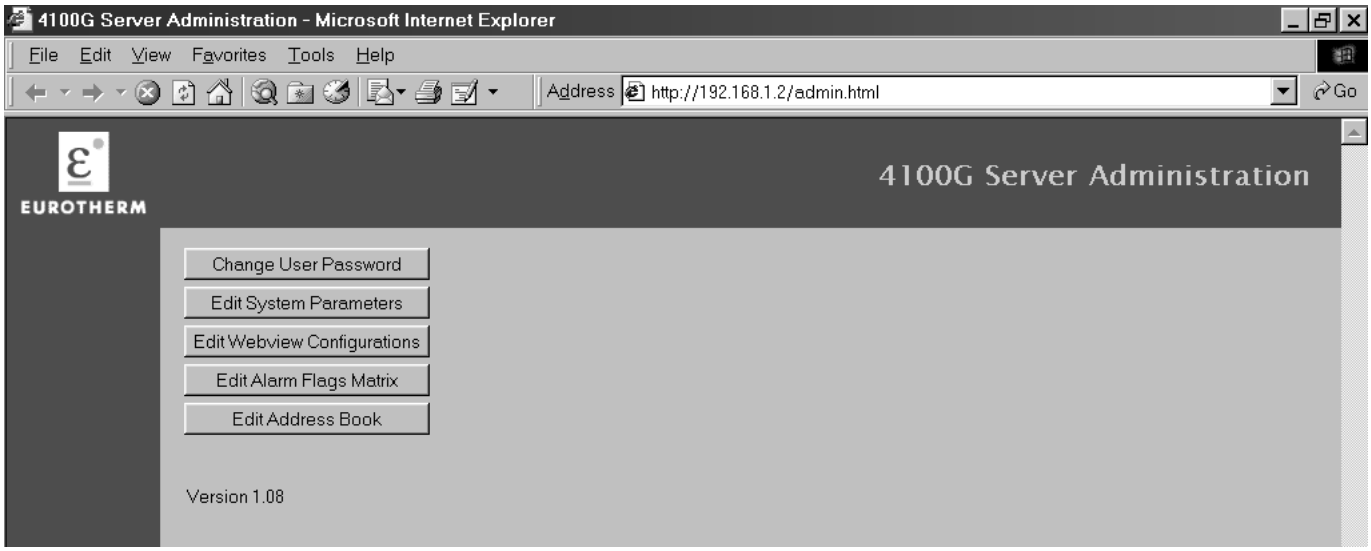

Figure 6 Web Server Administration

6.1 USER PASSWORD EDITING

The recorder is shipped with a default user password of 10. The password can be changed by clicking the **Change User Password** button on the Server Administration page, then entering a new password in the window as shown in Figure 6.1.

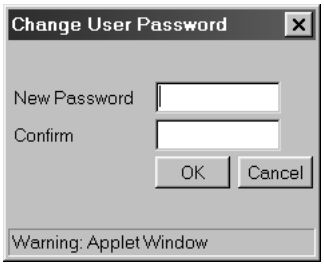

Figure 6.1 Change User Password

A zero length password means that the user is disabling the password validation feature, and no password checking should be performed by the Web Server Administration applet.

6.2 SYSTEM PARAMETER EDITING

Click the **Edit System Parameters** button on the Server Administration page to edit any of the system parameters as shown in Figure 6.2.
The system parameters are:

- The sampling interval
- The unit e-mail address
- The e-mail server location

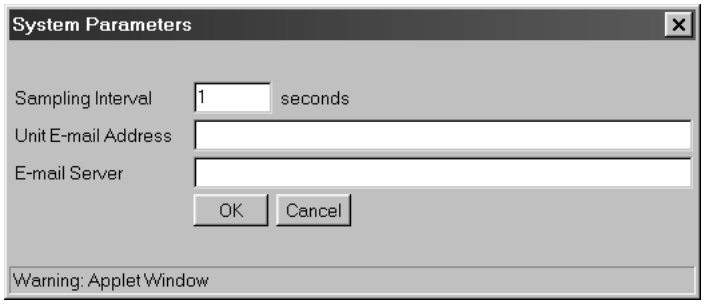

Figure 6.2 Edit System Parameters

6.2.1 Sampling interval

This is the display update rate on the PC and is entered in seconds. The shortest sample interval that can be requested is 1 second. However, the sampling interval of the unit should be selected to match the capabilities of the client-side (PC) connection as a slow PC connection to a recorder with a short sampling interval will lead to a “Message out of sync” error in the web viewer. If this occurs, the sampling interval of the unit should be increased to match the capabilities of the PC connection. The maximum supported sample interval is 1,200 seconds (20 minutes).

6.2.2 Unit e-mail address

This is the originator (or “from”) e-mail address entered if the e-mail server requires e-mail to be originated from a known account. This field can be left blank for e-mail servers that do not authenticate the originator.

6.2.3 E-Mail server

This is the domain name or IP address of the SMTP (e-mail) server accessible on the network. An SMTP server is required for the graphic unit to be able to issue e-mail notification messages.

6.3 WEBVIEW CONFIGURATION

See section 4.5 for the definition and purpose of a webview. To configure a webview, click the **Edit Webview Configurations** button on the Server Administration page. The webview configuration window appears as shown in Figure 6.3a. All currently defined webviews are listed in the webview configuration window.

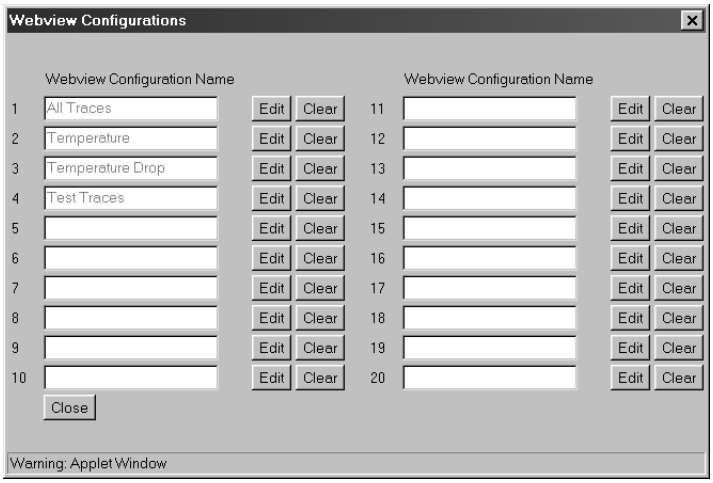

Figure 6.3a Webview Configuration window

To clear an existing webview, click the associated **Clear** button. To edit an existing webview, click the associated **Edit** button. To create a new webview, click the **Edit** button of a webview position with no name (indicating an undefined webview). Clicking the **Edit** button shows the Webview Detail window as shown in Figure 6.3b below.

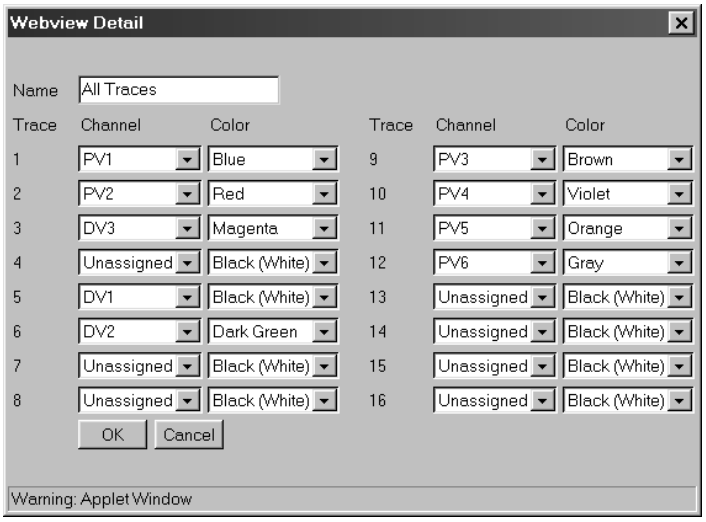

Figure 6.3b Webview Detail window

On the Webview Detail window, enter a name under which that webview will be stored, select the channels to be displayed in that view, and select a display colour for each channel to be seen in the view. If the colour **Black (White)** is selected, the colour for that channel will be black when a white background is selected and white when a black background is selected. See section 4.6 for background colour selection.

Click the **OK** button when the detail entries are complete. The name assigned to the configured webview now appears in the Webview Configuration window.

Clicking the **Close** button, then the browser's **Back** button returns the display to the process view (web viewer applet). When the web viewer applet is restarted, webview configuration number 1 will be selected. Once the connection is made, any of the configured webviews can be selected (see section 4.5).

6.4 ALARM FLAGS MATRIX EDITING

Alarms can be flagged on a per alarm basis for e-mail alarm notification. See section 5 for a description of the e-mail alarm notification feature. All recipients listed in the server's e-mail address book (see section 6.5) will receive e-mail notification each time a flagged alarm goes active. To flag or unflag an alarm, click the **Edit Alarm Flags Matrix** button on the Server Administration page. The alarm flags matrix window appears as shown in Figure 6.4. Check or uncheck the box corresponding to the channel and alarm number that needs to be flagged or unflagged.

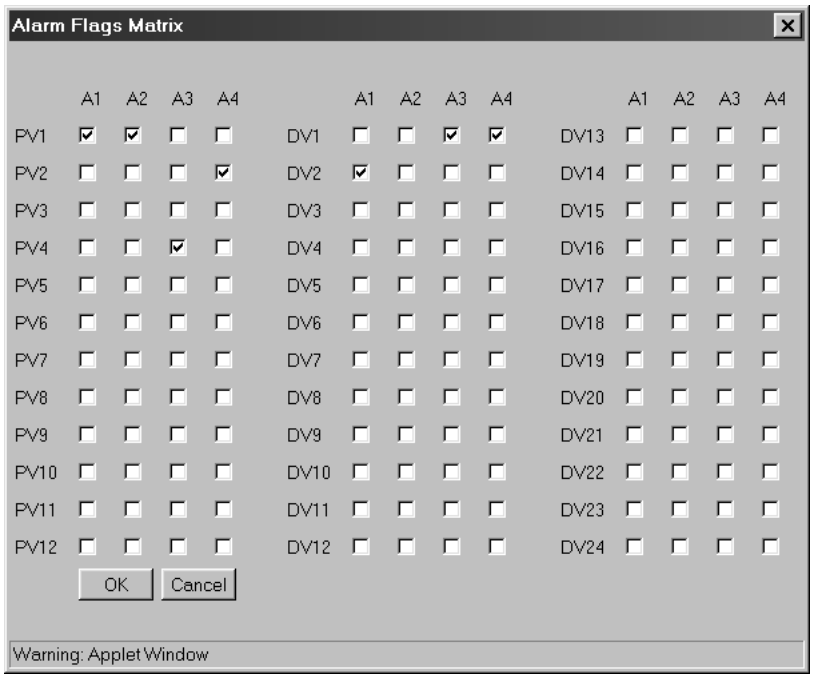

Figure 6.4 Alarm Flags Matrix

6.5 ADDRESS BOOK EDITING

Up to eight e-mail addresses can entered in the address book for alarm notification. To edit these e-mail addresses, click the **Edit Address Book** button on the Server Administration page. The address book window appears as shown in Figure 6.5. Enter the desired e-mail addresses.

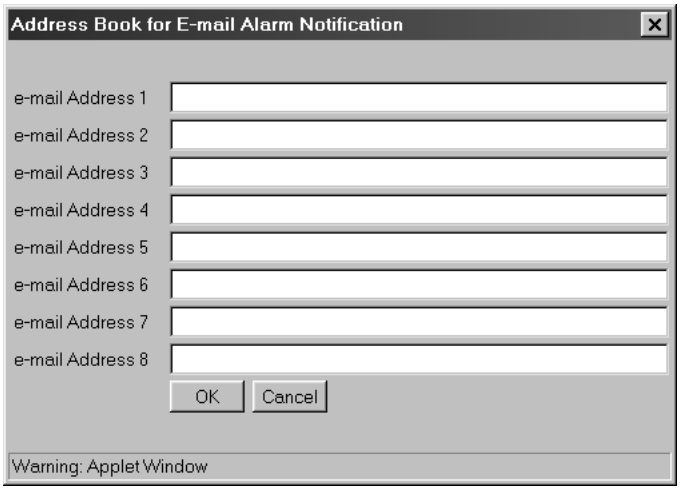

Figure 6.5 Address Book

7 SPECIFICATION

Physical network connection		10BaseT Ethernet
Network services available from the graphic unit: (Note 1)		
	HTTP:	IP Port 80
	Modbus/TCP:	IP Port 502
	Telnet:	IP Port 23
	FTP:	IP Port 21
Minimum Ethernet downlink connection speed		128 kbps (Note 2)
Recommended maximum number of simultaneous clients		
	Modbus/TCP:	2
	Total (Modbus/TCP and web viewer combined):	5
Absolute maximum number of simultaneous clients		8 (Note 3)
Number of samples available to the web viewer applet		3,600
Minimum sample interval		1 second
Maximum sample interval		1,200 seconds (20 min)
Duration of trend history	1 second sample interval:	1 hour
	20 minute sample interval:	50 days
Time to download the trend history		20 min typical (Note 4)
Maximum number of alarms in the alarm summary area		See note 5
Number of webviews		20
Number of channels per webview		16
Maximum number of e-mail recipients		8
Web Server Administration factory default password		10
Required recorder options:		Maths pack
Recorder power supply		Mains (AC) power only

Notes

1 SMTP services are not directly available from the graphic unit. In order for e-mail messages to be sent by the graphic unit, an external SMTP server must be present on the network and its address given to the graphic unit (see section 6.2).

2 Dial-up connections at 56 kbps or slower may work, but are not guaranteed. Windows users, see section 2.3.

3 Operation with more than 5 simultaneous clients is not recommended. Operation with 6 to 8 clients may be possible under optimal conditions and with slow sample intervals (20 seconds or slower), but is not guaranteed.

4 If not limited by network bandwidth.

5 There is no hard set limit to the number of alarm entries the alarm summary area can contain. The actual limit depends on the client computer configuration (available system memory, system resources, etc.)

8 USER MESSAGES

8.1 ERROR MESSAGES

1 Unable to establish a connection to the server. Check that the server code is executing.

In order to allow the Ethernet adapter to initialise a period of approximately 2 minutes should be allowed to elapse between applying power to the recorder, and starting the web viewer applet. If the applet is launched before this time has elapsed, the Ethernet adapter will not be ready to accept a connection, and the above message will be displayed.

2 Could not obtain initialization data. Check data connection to the 4100G

The applet has established communication with the recorder but has received non-valid replies when requesting initialisation data.

a Check the integrity of the wiring between the Ethernet unit (in the recorder rear terminal cover) and the recorder back plate (Figure 8.1).

b Verify that the recorder operating software is version 2.35 or higher. This is done by powering the recorder off, then on again, and observing the initialising display. The software is in two parts, the 'door software' and the 'operating software'. During the initialising display, the door software version appears first, centred within the display area and in the format 'S/W version N.NN', where N.NN is the door software version. This is followed by a display showing the operating software version near the top of the display, in the format :
INIT. VD.DD HHHH , where VD.DD is the operating software version, and must be V2.35 or higher.

c. Check that the comms settings for the Ethernet connection are:
Protocol = Modbus; Baud rate = 9600; Parity = None; Stop bits = One, Address = 1.

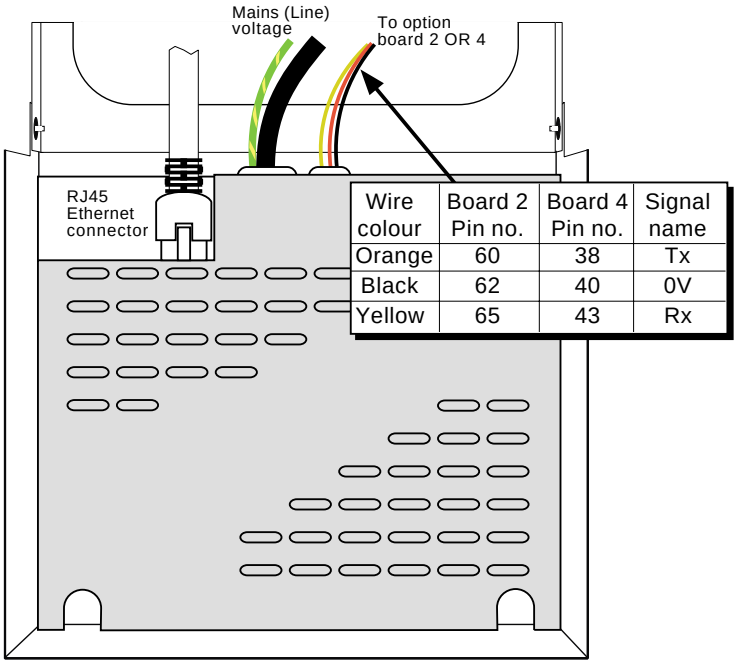

Figure 8.1 Ethernet unit wiring details

8.1 ERROR MESSAGES (Cont.)

3 Wrong number of PV's or DV's.

The web viewer applet is designed to work only with exactly 12 PVs and exactly 24DVs. The above message appears, and the applet halts if the number of configured PVs is not 12 and/or the number of configured PVs is not 24.

a. Check that the software version is 2.35 or higher, as described above, for the previous error message.
b. Check, from the recorder configuration menu, that the maths pack option is fitted. ('Conf:DV N' appears in the Configuration picklist.)

4 No webview configurations defined. Check webview configuration in admin client.

In order to display traces, at least one webview must be configured. The message above appears if the web viewer applet was able to establish a connection with the Ethernet adapter and retrieve the initialisation data, but no webview was found.

a. Launch the admin client, and configure at least one webview. Relaunch the web viewer applet.

5. Could not obtain webview configuration data. Check data connection to the 4100G

This message appears if the Ethernet adapter was able to retrieve initialisation data from the recorder, but the recorder then stooped responding. Possibly caused by an intermittent fault in the serial port wiring.

6. Sample data contain repeated errors. Check data connection to the 4100G

As error message 5, but can also be caused by the recorder's chassis having been removed from its case.

7. The server data pump could not be started. Check data connection with the 4100G

As error message 5

8.2 OTHER MESSAGES

1 Reset Notification message

Any modification to the recorder's channel configuration (range limits, scaling etc) causes the web viewer applet to reload the configuration data and to discard all historical data collected so far.

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