ProtectorHMI Human Machine Interface Software Manual

Visualization and Data Logging Software
For use with C1 and C2 Controllers

Software Manual, Release 2.1
April 2007

GDS CORP.
2513 HWY 646 SANTA FE, TEXAS 77510
(409) 927-2980 WWW.GDSCORP.COM SUPPORT@GDSCORP.COM

CAUTION: FOR SAFETY REASONS THIS EQUIPMENT MUST BE OPERATED AND SERVICED BY QUALIFIED PERSONNEL ONLY. READ AND UNDERSTAND INSTRUCTION MANUAL COMPLETELY BEFORE OPERATING OR SERVICING.

ATTENTION: POUR DES RAISONS DE SÉCURITÉ, CET ÉQUIPEMENT DOIT ÊTRE UTILISÉ, ENTRETENU ET RÉPARÉ UNIQUEMENT PAR UN PERSONNEL QUALIFIÉ. ÉTUDIER LE MANUE D'INSTRUCTIONS EN ENTIER AVANT D'UTILISER, D'ENTRETENIR OU DE RÉPARER L'ÉQUIPEMENT.

For further information about GDS Corp, please call (409) 927-2980 or email support@gdscorp.com

CONTENTS

1 *PROTECTOR*HMI SOFTWARE OVERVIEW

1.1 Description

Thank you for choosing GDS Corp. *PROTECTORHMI* (Human Machine Interface) Visualization and Data Logging software for use with C1 sixteen-channel controllers and C2 two-channel controllers. *PROTECTORHMI* software provides a complete data display and storage solution for standalone multipoint monitoring applications. *PROTECTORHMI* software can monitor a combination of up to ten C1 Controllers or C2 Controllers simultaneously, displaying up to 160 points on a single 19" or larger computer monitor. The status of each point is shown both in color code and engineering-units value. If a touch-screen or mouse is available, detailed real-time, geographic and historic information on each channel is instantly available.

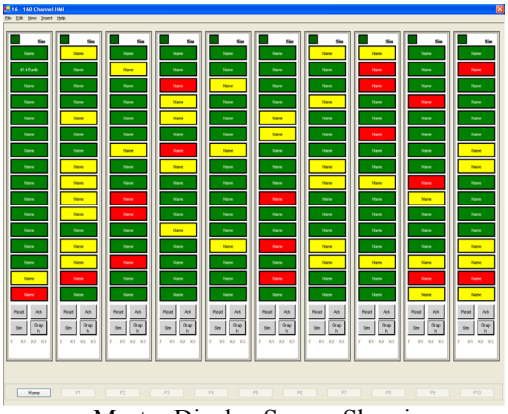
1.2 Features

The *PROTECTORHMI* software allows the operator to access channel data, including the most recent 24-hour trend, most recent real-time 15-minute trend, and historical alarm and maintenance data. Access to this information is obtained by "single-clicking" or "double-clicking" any channel indicator on any controller icon shown on the master display screen. All trend information displayed can be printed on a local or remote printer. A master log file is maintained by the *PROTECTORHMI* software that records HMI start and end times, communications timeouts and other system-wide events. Although designed for best operation with a screen resolution of 1280 x 1024, the *PROTECTORHMI* software will automatically scale images for resolutions between 1024 x 768 and 1600 x 1200 pixels. Operation outside this range is not recommended.

1.3 Master Display Screen

The master display screen is continuously displayed during normal operation. This screen contains a number of 'controller icons' that represent individual 16-channel or 2-channel controllers connected to the personal computer via an RS-485 MODBUS® connection. Each controller icon shows either two or sixteen channel status indicators.

Under no-alarm conditions, the channel status indicator will display the channel tag name and either indicate GREEN for OK or GRAY for channel-disabled. If a channel alarm occurs, the channel status indicator will either show YELLOW for Alarm 1 or either RED, BLUE or ORANGE for Alarm 2 depending on the stored configuration. If Alarm 3 is configured, the channel status indicator will show DARK RED.



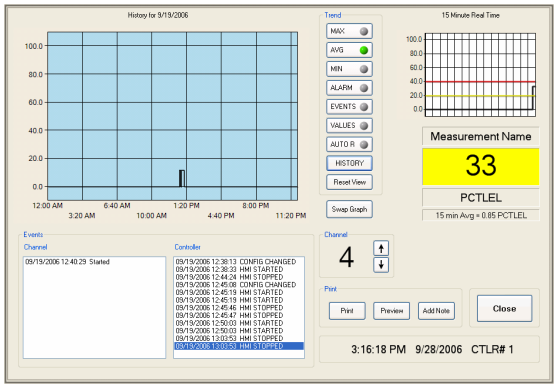
Master Display Screen Showing
Ten Controller Icons

If the mouse pointer is moved into one of the channel status indicators on a controller icon, the tag name will be replaced by the current channel numeric value for all channel status indicators on that controller icon. Removing the mouse pointer will cause the channel status indicators to revert to normal tag name display.

1.4 Channel Trend Screen

To access more detailed information on any given channel, move the mouse pointer over a channel status indicator and 'double click' the left mouse button. A channel trend screen will appear that provides 15 minute and interactive 24 hour trend graphs, channel-specific event and alarm log, sensor life information (if enabled) and other channel-specific data.

A snapshot of the channel status screen can be printed that displays the 24 hour graph and alarm / log data.



Channel Trend Screen Showing 24Hr and 15 Minute Graph and Alarm & Event Data

1.5 Graphics Plot Screen

Often, it is critical to be able to determine the location of specific flame or gas detector when an alarm occurs. To improve response time and provide a system operator with timely information on the location of any specific detector in alarm, the *PROTECTORHMI* software allows up to ten graphic plot screens to be configured. Each plot screen can be assigned an unlimited number of transmitter or sensor indicator icons, with each associated with a specific controller and channel number. 'Single-clicking' any channel indicator on the master display screen will show the associated plot screen and real-time alarm status and value for each sensor or transmitter icon. Moving the mouse cursor over any of these icons will show a real-time graphic display of the most recent 15-minute interval.

1.6 Data Storage

On one-minute intervals, a snapshot of each channel's most recent minimum, maximum and one-minute average values are stored on the PC hard drive. This data, which also includes information on any alarms or events which occurred during the one-minute interval, is stored in a "comma-separated variable" format text file. See Appendix A for a detailed description of the data file format. A separate file is created for each controller for each day of operation. Under normal conditions, this application will create approximately 1.5 MB of data per day per controller; with a typical 40GB hard drive and 10 controllers, roughly 5 years of data could be stored on a single disk.

1.7 Platform Requirements

It is highly recommended that *PROTECTORHMI* software be installed on a dedicated computer that is not used for general computing needs, such as word processing, spreadsheets or databases. While Microsoft Windows does enable multiple programs to run simultaneously, unpredictable processing delays created by these programs can occasionally interfere with the periodic collection of data from C1 or C2 controllers installed in remote locations.

- Intel-compatible personal computer running Microsoft™ Windows® XP with Service Pack 2 or later
- 1.4 GHz Pentium III processor or better; Pentium IV processor is recommended

- CDROM Drive (CD/RW recommended)
- 512Mbytes Random Access Memory (RAM)
- Minimum one RS-232 or RS-485 Serial Communications Port or USB adapter
- 256MB free hard disk space for program plus 1GB per attached C1 controller
- Monitor resolution of 1280 x 1024 or better
- Screen color depth set to *16 bit color*
- 8/16 channel C1 controller with firmware version 4.19 or higher (10 max)
- *PROTECTORHMI* Installation CDROM
- *PROTECTORHMI* Manual

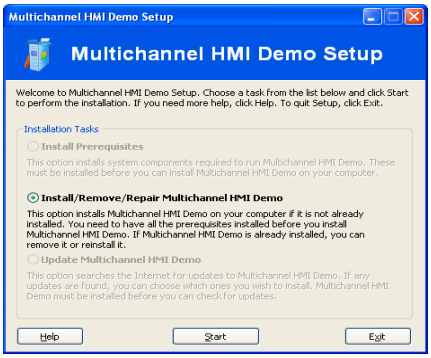
2 SOFTWARE INSTALLATION

2.1 Installing GDS Corp Software

GDS Corp develops software using a number of third party software products and tools that run on various operating systems and server platforms. Reports from the software industry suggest there are known security issues with some products and systems. GDS Corp recommends that, if you are using GDS Corp software, you review its use with your Information Technology (IT) department and their overall strategy to ensure that all recommended security updates and patches are installed as needed. If you have any questions, please call GDS Corp at 409-927-2980 (or email support@gdscorp.com).

2.2 Software Installation

Insert the CDROM into the PC's CDROM drive. In most systems the initial installation window will automatically appear. If not, browse to the CDROM directory and double-click the "setup.exe" file



Click "Start" to begin installation and follow the instructions shown on the screen.

Click "Accept" to agree to the terms of the license agreement. Each single user license is assigned a specific serial number.

When the HMI Setup screen reappears, installation is complete. Click "Exit" to finish the installation process.

2.3 If You Experience Difficulties

If you experience difficulties installing or accessing the application after standard installation on Microsoft Windows XP, please consult your IT department personnel to make sure you have proper access permissions setup for your use. If the problem cannot be resolved, please call GDS Corp at 409-927-2980 (or email support@gdscorp.com).

2.4 Hardware Installation (Third Party RS-232 to RS-485 Serial Converter)

If your computer has an existing RS-232 serial communications port (9 pin male), connect the RS-232 to RS-485 converter between the PC serial port and the C1 controller RS-485 interface. Either two-wire or four-wire connections are supported by the C1 controller. RS-485 signaling wires are polarity sensitive and it may be necessary to swap the A and B wires at the controller if communications are not established during HMI checkout.

2.5 Hardware Installation (GDS Corp USB to RS-485 Serial Converter)

If you have received a prototype USB to RS-485 Serial convert from GDS Corp as part of this package, please note the following additional installation instructions:

1. Place the *PROTECTORHMI* CDROM in the computers CDROM drive
2. Connect the USB-to-RS485 Converter to any open USB slot on the computer
3. When the "Found New Hardware" wizard opens, browse to the DRIVERS directory on the *PROTECTORHMI* CD where the USB-to-RS-485 serial device driver software is located.
4. Install the software by following the on-screen procedure.

If installed properly, the GDS Corp USB to RS-485 converter will appear to the system as a new Communications Port ("Comm Port"). To test the connection:

1. Connect an C1 sixteen-channel controller to the USB device using a two-wire RS-485 twisted pair (consult the C1 manual for more information).
2. Start the *PROTECTORHMI* application and insert a new controller icon. Open the controller icon configuration menu by clicking the SETUP button.
3. Change the MODBUS Address to match the controllers MODBUS address setting.
4. Click ENABLE.
5. Click on the Comm Port drop-down box and select the Comm Port assigned to the USB to RS-485 port.
6. Click the TEST button. If a "No Controller Found" message appears, try selecting a different comm port, or try swapping the polarity on one side of the RS-485 twisted pair connection.

3 SETUP

3.1 Overview

Once installation is complete, the *PROTECTORHMI* software must be configured for the specific application. Setup consists of creating and configuring the appropriate number of controller icons on the master display screen and creating and configuring the appropriate number of graphics plot screens and associated transmitter or monitor icons. Once setup is complete, the final system configuration can be saved using the *File – Save o*r *File – Save As* commands on the master display screen main menu. Previously created configurations can be accessed using the *File – Open* menu command on the master display main menu. The *File-New* menu command will create a blank configuration with all parameters reset to default.

IMPORTANT: Make sure to minimize the number of third-party programs that are running simultaneously. Background activities such as virus scanning or screen savers can adversely affect *PROTECTORHMI* operation.

IMPORTANT: If a configuration file with the name "default.xml" exists in the *PROTECTORHMI* software directory (CONFIG subdirectory) when the *PROTECTORHMI* software is started, the default.xml file will automatically load and the *PROTECTORHMI* software will begin data collection immediately. To stop data collection, click the STOP button or select STOP from the master display main menu and enter the appropriate access code (Default access code is "12345"). To keep the default file from causing the *PROTECTORHMI* software to automatically start running, rename the existing file to any name other than "default.xml".

To start the *PROTECTORHMI* application, double click on the *PROTECTORHMI* icon located on the computer desktop. If the license code has NOT been entered, an appropriate window will appear. Enter the activation code identified on the CD-ROM. The *PROTECTORHMI* application will initialize and the master display screen will be displayed. If no configuration file is loaded, the master display screen will be blank except for the main menu and real-time clock shown at the top of the display and the option buttons shown along the bottom of the display. If no code is entered, the *C1 HMI* will operate in DEMO mode for one hour intervals only.

3.2 Main Menu and Master Settings Window

When the application is first started, the Master Menu is shown across the top of the screen. See Section 3.7 for more information on the commands and setting choices available.

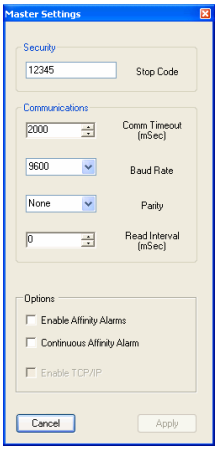
Selecting the *View-Settings* menu allows access to general settings that apply to all controllers configured by a specific configuration file. These include security, communications and affinity alarms.

Security - Once running, a security code is required to stop the HMI data collection process. The default code is “12345”. The code can be changed by the user, and can be unique for each configuration file.

Communications - The master settings menu also contains common settings for the serial communications protocol used to communicate with any controllers connected via an RS-485 MODBUS® serial link. The settings include baud rate and parity. Note that the baud rate and parity settings for each controller must be the same, but different controllers can be connected to different PC serial ports.

A “Read Interval” setting allows for the insertion of fixed time delays between controller MODBUS reads. This can be useful for debugging or if wireless MODBUS communications is in use.

Options - The “Affinity Alarm” feature allows a “sourcing” controller to generate an alarm signal that can be transmitted to an “accepting” controller, allowing an alarm indication in one controller to generate an alarm condition in another. Any controller can be configured to source either A1 or A2 alarms, or to accept either A1 or A2 alarms.

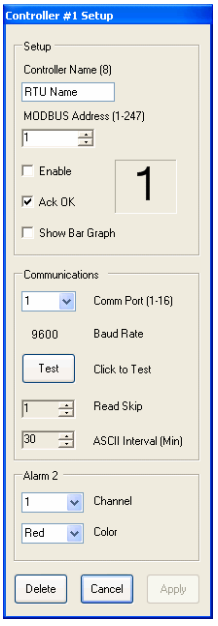


Master Settings Screen

IMPORTANT: DO NOT rely solely on the HMI to communicate critical alarm signals from one controller to another if there is a risk to equipment or personnel safety. The HMI software is primarily designed for visualization and historian functionality, and is not considered robust enough for alarm control. For these applications, dedicated controller cross-connection capability is available using direct wiring between two sixteen-channel controllers.

3.3 Controller Icon Setup

The first step in any controller configuration is to insert one or more controller icons on the main display screen. Up to ten controllers can be monitored by the software simultaneously. Any number of controllers can be daisy-chained on the same RS-485 two or four wire connection, or each controller can be connected via an independent RS-485 serial port. On the main menu, select the *Insert* option and select a controller icon to insert. The controller icon represents the physical controller device connected to the PC and will be the focus for all interaction regarding the gas detectors associated with that controller. Controller icons are automatically numbered 1 through 10. This number is not associated with the MODBUS address assigned to the controller, but is used by the software to identify connections between specific controller icons and the associated transmitter / sensor icons shown on graphic plot screens. Depending on the total number of controllers desired, the controller icons are available in 2X, 6X and 10X sizes, where the number represents the total number that can be displayed on the screen at any one time. For example, if only one controller is to be monitored, select the 2X icon. If eight controllers are to be monitored, select the 10X icon. After inserting the icon, it may be moved on the screen by using the mouse to point to the top border, holding the *left* mouse button and dragging the mouse until the controller icon is located in an appropriate position. An existing controller icon can



Controller Icon Setup Screen

be deleted by clicking the SETUP button on the icon and then clicking the DELETE button.

NOTE: The functionality of 2X, 6X and 10X controller icons is identical.

Once located on the screen, each controller icon will need to be configured. Click the CONFIG button to show the controller icon configuration menu. Configuration data required includes serial port and baud rate, controller name, MODBUS RTU address, data sample rate, alarm color selection and other specifics. For a complete description of controller icon configuration menu options, see section 3.3.

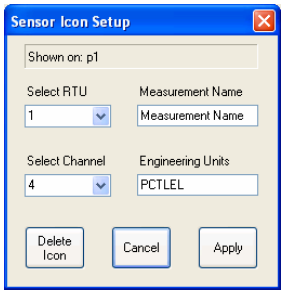
Controller Icon Quickstart Setup

1. Click the *File – Insert* menu to insert an appropriately sized controller icon
2. Using the mouse, move the controller icon to the desired screen location
3. Click on the controller icon SETUP button to show the controller icon setup menu
4. Configure the controller as desired and click the APPLY button
5. Save the new configuration using the *File – Save* or *File – Save As* menu options.

3.4 Graphic Plot Screen Setup

Graphic plot screens are used to create a visual connection between a specific controller channel and a physical location. To create a new plot screen, select *Insert – Plot Plan* from the main menu on the master display screen. A new plot screen dialog window will open. Enter the desired name of the plot screen (up to 16 characters maximum) and click OK. A blank plot screen window will open and the name of the plot screen will appear in the next available button at the bottom of the master display screen. To switch back and forth between plot screen windows and the master display screen, click on the appropriate button at the bottom of each screen ("Home" refers to the master display screen).

Once created, each plot screen should be configured with a background image and one or more transmitter or sensor icons by using the *Insert – Background Image* menu selection. Images can be in ".jpg", ".png", ".tiff" or ".bmp" format. When loaded, each image is automatically scaled to fit the *PROTECTORHMI* computer screen. For minimum distortion, the native resolution for images created for *PROTECTORHMI* graphic plot screens should roughly match the screen resolution of the HMI display.



Sensor / Transmitter Icon Setup Menu

IMPORTANT: Due to their large size, image files are not stored as part of each configuration file. Instead, the filename and full file pathname are stored in the configuration file. Once configured, do not move or delete the graphics files associated with a specific configuration. If the *PROTECTORHMI* installation is moved to a different computer, the

associated graphics image files must be moved separately and a new configuration process should be performed.

Each transmitter or sensor icon represents information pertaining to a specific channel and controller. The functionality of sensor and transmitter icons is identical; both are provided to allow the user to indicate which sensor locations have local display capability and which do not. To configure a sensor or transmitter icon, move the mouse cursor over the icon and press the *right* mouse button. A sensor icon setup menu will appear. Select the desired controller number and channel number to assign. If data has already been read from the controller, the tag name and engineering units values read from the controller will be displayed as each controller / channel selection is made. When finished, click the ACCEPT button. If no changes are desired, click the CANCEL button.

IMPORTANT: More than one icon can be assigned to any given controller / channel combination. In the event a controller / channel selection is made that already is assigned, a warning message will be displayed. If the selection is confirmed, both icons will display the same channel data. However, if multiple icons are assigned to the same controller / channel selection, the 'last icon configured' will be the target for the 'single click' event on the master display screen.

Graphic Plot Screen Quickstart Setup

1. On the master display screen main menu, select the *File – Insert – Plot Screen* option to create a new plot screen
2. Assign a name to the plot screen
3. Assign a background image to the plot screen
4. Insert transmitter or sensor icons on the plot screen and locate as desired
5. Configure each transmitter or sensor icon for appropriate controller number and channel number. If more than one transmitter or sensor icon is assigned to the same channel, the "last one assigned" will be the target for the "single click" event.
6. Save the new configuration using the *File – Save* or *File – Save As* menu option.

3.5 Saving and Restoring Configuration Files

A complete *PROTECTORHMI* configuration profile contains information on the number of controller display panels, the configuration settings of each controller, the number of plot plans and the location of sensor icons, master settings and other information. Once a configuration is established, it should be saved to disk using the *File-Save* or *File-Save As* command on the master display screen main menu. *PROTECTORHMI* software provides a standard directory for this purpose ("Config") that should be used for saved configuration files. See Appendix A for more information.

3.6 Main Menu Reference

MASTER DISPLAY SCREEN MENU ITEM	ACTION
FILE *NEW*	Closes any previous configuration and prepares *PROTECTORHMI* to accept a new 'from scratch' configuration. If a current file is open, the operator is prompted to save the existing configuration before clearing the screen.
FILE *OPEN*	Opens a previously written configuration file.
FILE *CLOSE*	Saves and closes a current configuration
FILE *SAVE*	Saves the current configuration file using the most recent filename
FILE *SAVE AS*	Saves the current configuration under a new name
FILE *ANNOTATE LOG*	Allows the user to insert a text message into the HMI master log file. The message text is time and date stamped and written to the "HMI.LOG" text file located in the main application directory
FILE *VIEW LOG*	Shows the text of the HMI.LOG file stored in the current main application directory
FILE *RUN*	Selecting "Run" starts data collection using the current controller settings. During "Run", the menu selection changes to "Stop". Selecting Stop will bring up a numeric keypad; entering the pre-assigned Stop Code will cause the program to stop collecting data. A Run button also appears on the lower right screen corner.
FILE *EXIT*	Closes the program
VIEW *SETTINGS*	Displays Master Settings Menu
INSERT *16 CHANNEL CONTROLLER (2X)*	Adds a new large 16 channel controller icon to the master display screen. Up to two 2X controller display panels can be shown simultaneously
INSERT *16 CHANNEL CONTROLLER (6X)*	Adds a new medium 16 channel controller icon to the master display screen. Up to six 6X controller display panels can be shown
INSERT *16 CHANNEL CONTROLLER (10X)*	Adds a new tall 16 channel controller icon to the master display screen. Up to ten 10X controller display panels can be shown

INSERT *2 CHANNEL CONTROLLER (6X)*	Adds a new medium 2 channel controller icon to the master display screen.
INSERT *2 CHANNEL CONTROLLER (10X)*	Adds a new tall 2 controller icon to the master display screen
INSERT *PLOT PLAN*	Adds a new graphic plot plan to the current configuration. Each plot plan can be configured independently
HELP *ABOUT*	Shows current version information for *PROTECTORHMI* software.

3.7 Master Settings Reference

MASTER SETTINGS ITEM	ACTION
STOP CODE	Sequence used to enable STOP command. Default is "12345"
COMM TIMEOUT	Maximum time allowed between the transmission of a data request and the reception of valid data from a controller. If this value is exceeded three times in a row, the HMI will indicate a 'communications error'. Default setting is 2.
BAUD RATE	Common baud rate for RS-485 MODBUS communications protocol. Default is 9600 baud.
PARITY	Common parity setting (None, Even, Odd) for RS-485 MODBUS communications protocol. Default is "None".
READ INTERVAL	Value (in milliseconds) inserted between each controller read command. Default is 0.
ENABLE AFFINITY ALARMS	Enables controllers to source and/or accept alarm signals from each other. Default is OFF.
CONTINUOUS AFFINITY ALARM	If checked, an affinity alarm signal is generated and set to each accepting controller so long as any sourcing controller is in alarm. If not checked, a single alarm command is sent to each accepting controller any time a sourcing controller initiates an alarm condition. Another alarm command is not sent unless the sourcing controller goes out of alarm condition and then goes back into alarm.

3.8 Controller Icon Setup Reference

CONTROLLER ICON SETUP SCREEN	ACTION
CONTROLLER NAME	ASCII string determined by the user; up to 8 characters in length. The controller name will be displayed on the screen and used as part of the data file name created by the *PROTECTORHMI* software, so only valid ACII letters or numbers are allowed.
MODBUS® ADDRESS	Must be set to match the MODBUS RTU setting programmed in the corresponding physical controller. Options are RTU#1 through RTU #247.
ENABLE	If checked (enabled), controller is periodically interrogated for data collection. If not checked (disabled), controller is not interrogated while in RUN mode. Allows controller to be temporarily placed out of service or disconnected. If not disabled, a not-present or inoperative controller will generate a continuous string of communication error messages.
ACK OK	If checked (enabled) allows a remote controller alarm indication to be acknowledged by a user through the HMI software. This remote acknowledge command will disable all alarms, sirens or flashing lights at the controller location. If not checked (disabled), the HMI user is not allowed to remotely acknowledge any controller alarms; these alarms then must be physically acknowledged at the controller itself.
SHOW BAR GRAPH	If checked (enabled), a left-to-right real-time bar graph display is shown as part of each channel indicator. If not checked (disabled), no bar graph indication is shown.
COMM PORT	Selects the RS-232 / 485 serial communications port to be used to connect to the designated controller. Note: All communications ports available on the PC will be shown, even those dedicated to internal hardware such as internal modems. The click-to-test function can be used to easily verify the presence of a valid serial connection.
BAUD RATE	Displays the RS-232 / 485 serial communications baud rate used to connect to the designated controller. Baud rate is selected on the master screen main menu settings screen.

CLICK TO TEST	Sends an immediate challenge / response signal across MODBUS using the current serial port and RTU number setting. The message "RTU Found" or "RTU Not Found" will be displayed to the right of the button. If the target RTU is not found, first try setting the serial port number to any one of the other selections shown in the Comm Port drop-down menu. Since RS-485 wiring is polarity sensitive, it also may be necessary to swap the two RS-485 wires at the controller connection.
READ SKIP	Determines data sample rate for this specific controller. During normal operation, the HMI will attempt to read each enabled controller in sequence, and the time interval between individual controller reads will be determined by how quickly the entire set of controllers can be polled. The default setting is "1", meaning the corresponding controller will be read once during each cycle. Setting the Read Skip value to a higher number will cause the controller to be "skipped" during subsequent read intervals. A setting of "2" will cause the specific controller to be read on every other cycle, etc. This feature can reduce MODBUS bandwidth requirements for controllers monitoring data points that cannot change quickly.
ASCII INTERVAL	Selects the background or "low speed" data interrogation interval (in minutes) for this specific controller. ASCII data read includes channel tag names, engineering units, channel zero and span settings and other controller data that does not change often. This data can be read on demand by clicking the READ button on the controller display panel while the HMI is running.
ALARM2 CHANNEL	Selecting a specific channel (1 – 16) will indicate the current "Alarm 2 Color" associated with that channel. Alarm 2 is by default set to RED, but can be changed to BLUE or ORANGE depending on the application.
ALARM2 COLOR	Selects the color associated with the channel shown in ALARM2 Channel described above.
AFFINITY ALARMS	If Affinity Alarms are enabled on the Master Settings menu, the Source and Accept check boxes will be enabled. To enable this controller to SOURCE A1 or A2 alarms, check the appropriate box. To enable this controller to ACCEPT A1 or A2 alarms, check the appropriate box.
DELETE	Causes this controller icon and all related data entries to be deleted.
CANCEL	Discards any changes made and closes the controller setup window
APPLY	Applies all changes made to the current RTU configuration. A *File – Save* or *File – Save As* command is then required to permanently record the changes in the appropriate configuration file. This button is not activated until configuration changes have been made.

3.9 Plot Screen Setup Reference

PLOT SCREEN MAIN MENU	Action
INSERT *BACKGROUND IMAGE*	Loads and scales a background image onto the plot screen surface. This image can be a jpeg, png, tiff or gif format file. The original image should be proportioned to roughly the same size as the computer screen; otherwise, the scaling process will distort the final image. An image size of 1024 pixels wide x 768 pixels high or 1280 x 1024 is preferred. **NOTE**: When saving an HMI configuration that contains plot plans, it should be noted that the location of the image in the PC's file system is stored, not the image itself. Be sure not to move image files once they are installed on the PC and incorporated into an HMI configuration.
REMOVE *BACKGROUND IMAGE*	Deletes the current background image from the screen. This command does NOT delete the background image file from the PC hard drive.
INSERT *(TRANSMITTER OR SENSOR)*	Creates a sensor icon that will display real time alarm and engineering units data on the plot plan. Once created, the icon can be moved into position over the plot plan image using the computer mouse (point, left click and hold down while moving). Each transmitter or sensor icon represents information pertaining to a specific channel and controller. The functionality of sensor and transmitter icons is identical; both are provided to allow the user to indicate which sensor locations have local display capability and which do not. To configure a sensor or transmitter icon, move the mouse cursor over the icon and press the *right* mouse button. A sensor configuration menu will appear. Select the desired controller number and channel number to assign. If data has already been read from the controller, the tag name and engineering units values read from the controller will be displayed as each controller / channel selection is made. When finished, click the ACCEPT button. If no changes are desired, click the CANCEL button. **NOTE**: More than one icon can be assigned to each channel. In the event a controller / channel selection is made that already is assigned, a warning message will be displayed. If the selection is confirmed, both icons will display the same channel data. However, if multiple icons are assigned to the same controller / channel selection, the 'last icon configured' will be the target for the 'single click' event on the master display screen.

4 OPERATION

4.1 Overview

The *PROTECTORHMI* software provides two simultaneous functions – data visualization and data logging. Once configuration is complete, data collection is initiated by selecting the RUN command from the master display screen main menu (*File – Run*) or by pressing the RUN button shown on the lower right side of the screen. Once Run has been selected, all configuration options are disabled.

While in the RUN mode, all controllers are sequentially queried by the *PROTECTORHMI* software. The total time delay between each succeeding query is dependent on the number of controllers attached, baud rate setting, wired or wireless communications links and other environmental factors. Controllers are read in sequence and read requests are normally generated at a maximum rate determined by the host PC. For typical wired installations, ten controllers can be read sequentially in about 8 seconds at 9600 baud.

Data requests fall into two categories: 'low speed' data and 'high speed' data. 'High speed data' refers to information that must be read as rapidly as possible to ensure real-time indication of channel status. This includes the latest real-time value, alarm and alarm acknowledge status and channel enabled / disabled status. This real-time data is immediately used to update the channel indicators on each controller icon, changing the indicator color, flashing (or not) status, relay indicator and bargraph value.

"Low speed data", or "ASCII data" is information that does not change often, such as alarm setpoints, channel tag name, engineering units or zero and span values. The repetition rate for reading ASCII data can be set for each controller in the controller icon setup menu. The default interval setting is 30 minutes.

Immediately after RUN is selected, each controllers' "low speed data" is read within the first two minutes. Pressing the READ button on the controller icon at any time will cause a "low speed data" read request to be sent to the selected controller.

At the conclusion of each trend interval (1 minute), the most recent set of samples are processed and the minimum, maximum and averages are stored on the PC hard disk, along with alarm and event status information relevant to that interval. Due to the need to graph multiple data points, once in RUN mode it takes approximately three minutes for the first 24hr trend data screen to become available.

Alarm Files contain a human-readable text record of all alarm events for each 24 hour period. See Appendix A for more information on file format and content.

Data Files contain human-readable comma-separated-variable (CSV) numeric and status data for each 24 hour period. When first starting and at 12:01am each subsequent day, the *PROTECTORHMI* software creates a new formatted data file for each controller. This file is then used to store one-minute samples for that 24 hour period. As a result, each file contains the same amount of numeric data and any breaks in data collection are obvious. For consistency, alarm information is also stored at the end of each data file,

making each data file a complete historic record for a specific controller on a specific dat. See Appendix A for more information on file format and content.

4.2 Master Display Screen

During normal operation, the Master Display Screen is continuously displayed. Each controller display panel continuously indicates the status of its sixteen channels. GREEN corresponds to non-alarm condition, YELLOW for Alarm 1, either RED, ORANGE or BLUE for Alarm 2 (user configurable, see RTU Setup) and DARK RED for Alarm 3 (if enabled).

If a mouse is available, moving the mouse cursor over any of the channel indicators will cause that controller display panel to display real time channel values in place of the channel name shown by default. If Enable Bar Graphs has been selected, a left to right bar graph (scaled in 1% increments based on channel zero and span values) will be shown as a white bar across the top of each channel indicator.

To monitor controller read times, move the mouse cursor over the rectangular box in the upper left corner of the controller icon. A window will appear that shows the "low speed" ASCII Read time, "high speed" Data Read time and total interval between sequential reads for each controller.

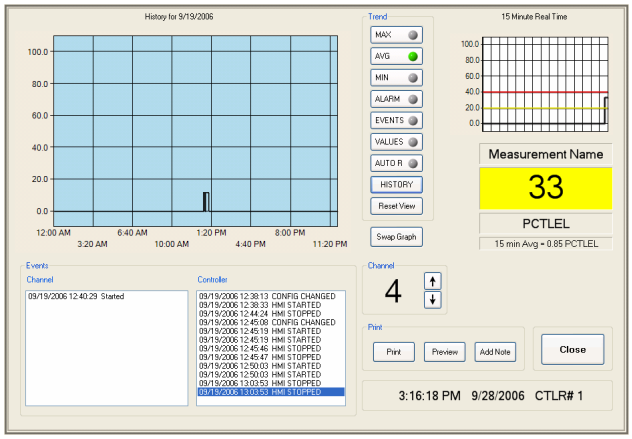
If a plot plan and sensor icon has been previously configured for that specific controller and channel, single-clicking on the channel indicator will immediately switch the computer display from the master display screen to the associated plot screen. See section 4.4 for more information.

For any enabled channel, double-clicking the channel indicator will open the channel trend screen. See section 4.3 for more information.

4.3 Channel Trend Screen ("Double Click" Channel Indicator)

If the mouse is used to "double click" a channel indicator on the master display screen, a channel trend screen will appear. The large graph on the left side of the trend screen by default shows the most recent 24 hour trend data for the specific channel. The smaller graph on the right shows the most recent 15 minute real time data. The location of the two graphs can be swapped by clicking the Swap Graph button.

If a mouse is available, specific areas of the 24 hour graph can be enlarged by pointing to the start of the desired area, pressing and holding the *left* mouse button, and dragging the mouse to the end of the desired section. The graph is scaled using the zero and span settings from the C1 controller. See section 4.6 for a detailed description of the data display options available.



Channel Trend Screen Showing 24Hr Graph, 15 Minute Graph, Channel Value, Channel Events, Sensor Life and Controller / HMI Events

4.4 Plot Plan Screen ("Single Click" Channel Indicator)

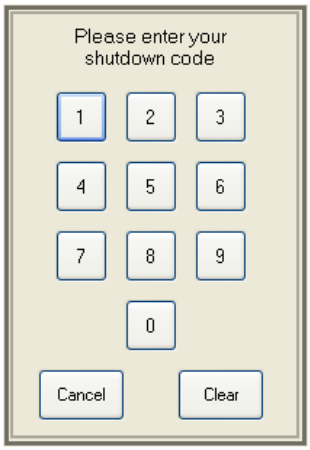
If the mouse is used to "single click" a channel indicator on the master display screen, the plot plan associated with that sensor will appear over the master display screen, and the sensor icon associated with the channel indicator will be shown surrounded by a double-lined box. While the plot plan screen is visible, moving the mouse over any sensor icon will open a 10 minute trend window showing the most recent 10 minutes of real time data. To return to the Master Display Screen, click the "Home" button on the lower left corner of the computer screen. To view any Plot Plan window at any time, click on the appropriate button on the lower computer screen. The names of all associated plot plans (up to 10 max) will be shown left to right.

4.5 Exiting the Run Mode

To exit data collection mode, select *File – Stop* from the main menu on the master display screen or press the STOP key at the lower right. A shutdown code keypad will open. Enter the numeric stop code. If the code is entered correctly, the HMI will stop collecting data and each controller display screen will indicate "Edit Mode'. Press Cancel to return to full operation or press Clear to reset the input code if an entry mistake is made. Select *File – Run* or press the RUN button to restart the *PROTECTORHMI* software.

Starting and stopping data collection will not corrupt data files, but will leave gaps in the data. Any data stored in the previous 24hr temp file may be discarded.

NOTE: The demo version stop code is fixed at "1 2 3 4 5".



Shutdown Code Keypad

4.6 Channel Trend Screen Reference

TREND WINDOW BUTTON / GRAPH	ACTION / INDICATION
24 Hour TREND GRAPH	Interactive graph showing the most recent 24 hours of channel information. Default setting shows one-minute channel average values only. MAX, MIN, ALARM, EVENTS and VALUES buttons allow stored information to be added in real time. The mouse cursor can be used to zoom into any area on the display graph. Click RESET VIEW to restore display to default settings.
15 Minute TREND GRAPH	Non-interactive graph showing the most recent 15 minutes of channel data on one-second intervals. Alarm levels are shown by default.
MAX	Clicking the MAX button adds a graph series that represents the maximum value that occurred during each one-minute interval.
AVG	Clicking the AVG button adds a graph series that represents the average value measured during each one-minute interval. AVG is shown by default.
MIN	Clicking the MIN button adds a graph series that represents the minimum value that occurred during each one-minute interval.
ALARM	If clicked causes the Alarm 1 and Alarm 2 levels (also Alarm 3 levels if enabled at controller) to be displayed on the graph. Since the A1 / A2 / A3 levels are continuously recorded, the graph will show if and when the alarm levels were changed during the 24 hour interval. Clicking again causes the alarm levels to be removed.
EVENTS	If clicked causes the graph to indicate the beginning, duration and end points of Alarm 1 and Alarm 2 events.
VALUES	If clicked causes the graph to include data values for each interval shown. It is recommended that the graph view be zoomed in before selecting the Data Values button. Clicking again turns off data values.
AUTO R(ange)	If clicked causes the graph scale to be recalculated to show the graphed data at maximum resolution. Clicking again causes the graph scale to reset to previously read channel zero & span values.
HISTORY	If clicked opens a new calendar window. Simultaneously, the HMI software searches for previous Day Files associated with that RTU. If found, the appropriate date value on the calendar screen is darkened. Clicking on the darkened date will retrieve the Day File information.

RESET VIEW	Clicking this button will restore the default view – most recent 24hour trend with no data values, no alarm levels and standard scaling.
SWAP GRAPH	Clicking swap will switch the 24 hour and 15 minute graphs between the two graph windows. This can be useful if a closer view of the 15 minute real-time trend data is desired.
CHANNEL UP/DN	Clicking the UP or DN buttons allows rapid selection of individual channels within a single controller.
PRINT	Prints a data readout sheet that shows controller and channel events as well as any data shown on the 24hr interactive graph.
PREVIEW	Creates a Print Preview screen to show what a specific print
ADD NOTE	Allows the user to add a text note to the channel event log. This can be useful to record user input related to specific events.
CLOSE	Closes the trend window. In addition, the trend window automatically closes after 5 minutes of inactivity.
CHANNEL EVENTS	Left-most box lists events specific to this channel: alarm on or off, fault in or out, channel communications error (if MODBUS), channel calibration indication and other channel-specific events.
CONTROLLER EVENTS	Right-most box lists events specific to this controller: controller alarm ACK, controller communications error, ASCII read and other controller-specific events.
SENSOR LIFE	Displays bargraph indicating life remaining for attached sensor. Sensor must be attached to appropriate transmitter and sensor life setting in controller must be enabled for this value to appear.

A
APPENDIX – DATA STORAGE FORMAT

Overview

HMI data is stored in a series of text-based comma-separated-variable (CSV) files that are created by the *PROTECTORHMI* software. The names and location where these files are created is fixed and cannot be changed; however, copies of the files can be created while the program is running and moved to another directory or computer for further analysis.

Each file name contains information that includes the RTU name defined by the user, the date on which the file was created and whether the file is an ALARM file or a DATA file. Files normally contain information that spans a 24 hour period starting at 12:01am and ending at 12:00.

When the *PROTECTORHMI* software is installed, an application directory and several sub-directories are created.

NOTE: *PROTECTORHMI* software creates comma-separated variable **controller data files** that are wider (> 256 columns) than allowed by Microsoft™ Excel®, resulting in an error message. The files are designed such that all critical information for each of the 16 channels is stored in the first 250 columns. The additional width provides separated columns for each channel status bit, while a binary word that combines each channel's status is provided in the lower 250 columns. This error message may be ignored when opening the data file using Microsoft Excel or other spreadsheet program.

Program Directories

ALARMS – Contains the alarm files created for each controller. Alarm files are ASCII text files that end in an ".alg" extension. A separate alarm file for each controller is created each day.

CONFIG – Location for storage of configuration / setup files. Although configuration files can be located anywhere in the PC file structure, it is highly recommended they be kept here. Configuration files end in an ".xml" extension.

DATA – Contains data files created for each controller. Data files are CSV text files that end in a ".csv" extension. A separate data file for each controller is created each day.

PLOTPLAN – Location for storage of jpeg, png, tiff or bmp image files used as background images for plot screens. Although image files can be located anywhere in the PC file structure, it is highly recommended they be kept here.

TEMP – Contains temporary files used by the *PROTECTORHMI* application.

Master Log File

The *PROTECTORHMI* software maintains a master log file ("HMI.LOG") in the root applications directory. This text file contains a running record of all major program-level events, including program startup, data collection start and stop, communications errors, software errors and others. An example is shown below:

LOG FILE NAME

HMI.LOG

LOG FILE DATA:

LOG 09/13/2006 09:01:40 HMI Application Started
LOG 09/22/2006 20:26:14 Loaded C:\My Documents\Config\test1.xml
LOG 09/22/2006 22:57:59 HMI Application Closed by User

Alarm Files

Alarm files contain a human-readable text description of all recorded alarm, comm error or calibration events. The name given to an alarm file is "rtu-name_RTU#_numeric-date_alarms.alg", where "rtu-name" is entered by the user on the controller icon configuration screen, "RTU#" is "RTU1" through "RTU10" as determined by the assigned screen number and "numeric-date" is a fully defined eight digit date value. An example is shown below:

ALARM FILE NAME:

Name_RTU1_09132006_alarms.alg

ALARM FILE DATA:

CTLR 09/13/2006 09:01:56 Controller 1 RTU_Name CONFIG CHANGED
CTLR 09/13/2006 09:01:59 Controller 1 RTU_Name HMI STARTED
CTLR 09/13/2006 09:03:32 Controller 1 RTU_Name HMI STOPPED
CTLR 09/13/2006 09:04:20 Controller 1 RTU_Name CONFIG CHANGED
CTLR 09/13/2006 09:04:23 Controller 1 RTU_Name HMI STARTED
CTLR 09/13/2006 09:04:44 Controller 1 RTU_Name HMI STOPPED

In this example, the first entry indicates that at 9:01 am on September 13th, 2006, the configuration of Controller #1 (Named "RTU_Name") was changed.

NOTE: Each occurrence of a communications error is recorded in the alarm log file, so it is recommended that any controller not in use be disabled; otherwise the alarm file can become very large.

Controller Data Files

Data files contain human- and spreadsheet-readable comma-separated ASCII values that can be easily imported into standard spreadsheet applications such as Microsoft ™ Excel ®. The name given to a data file is "rtu-name_rtu#_numeric-date_data.csv", where "rtu-name" is entered by the user on the controller icon configuration screen, "rtu#" is "RTU1" through "RTU10" as determined by the assigned screen number and "numeric-date" is a fully defined eight digit date value.

Both sixteen channel and two channel controllers generate similar files. For both, the definition of the first 10 columns is identical. For sixteen channel controllers, each row then contains sixteen groups of 15 columns each, followed by another 16 groups of 8 columns each. For two channel controllers, each row contains two groups of 15 columns followed by two groups of 8 columns.

NOTE: When opening 16 channel controller files with certain spreadsheets, an error will occur due to the fact these spreadsheets do not accept files with more than 256 columns. The controller data files are organized such that the most important data for all channels is stored within the first 250 columns (10 header + 15 columns / channel * 16 channels).

In each data file, a single row defines a complete entry for a specific one-minute interval. Each file, when created at 12:01am each morning, is pre-formatted with 1440 empty rows, each assigned a specific time interval. In this way, it is easy to determine if the *PROTECTORHMI* software was not operating during any specific interval.

A data file is broken up into three sections. The first row (Col#1 = FILEINFO) is an English-language header row to help make the file data more readable. The next 1440 rows (Col #1 = DATA) hold one minute values for each of the sixteen controller channel. At the end of the file, there are an indeterminate number of alarm event rows (Col#1 = CTLR).

The first ten columns on each DATA row are reserved for controller-specific data as shown below:

Column (L to R)	**Entry**
Column 1	Row Type – FILE INFO specifies header row; DATA specifies one minute data entry; CTLR specifies alarm event
Column 2	RTU number 1 thru 10 as defined when controller icon was created
Column 3	RTU Name as defined by user during controller icon configuration (**not** read from controller)
Column 4	Time value in ASCII HOUR:MINUTE AM/PM format
Column 5	Date value in MONTH / DAY / YEAR format

Column 6	ACK Sent – A one in this column indicates that an ACKNOWLEDGE command was sent from the *PROTECTORHMI* software to the controller during this time interval
Column 7	COMM ERR – A one in this column indicates that an HMI-to-controller communications error occurred during this interval
Column 8	ASCII RD – A one in this column indicates that an ASCII READ command was sent from the HMI to the controller during this interval.
Column 9	Spare (not used)
Column 10	Spare (not used)

Starting on column 11, each channel is assigned fifteen columns for specific data values. These are shown below. ***Absolute column = (((Channel # - 1) * 15) + 10) + Offset).***

Column	**Entry**
Offset = 0	On / Off – A one in this column indicates the channel is ENABLED. A zero indicates that the channel is DISABLED.
Offset = 1	Channel Name – ASCII text Tag Name read from controller
Offset = 2	Channel Eunits – ASCII text Engineering Units read from controller
Offset = 3	Minimum Value – holds most negative channel value read during interval
Offset = 4	Maximum Value – holds most positive channel value read during interval
Offset = 5	Average Value – holds average value for all reading taken during interval
Offset = 6	Alarm 1 Level – holds value assigned to Alarm 1 in controller
Offset = 7	Alarm 2 Level – holds value assigned to Alarm 2 in controller
Offset = 8	Alarm 3 Level – holds value assigned to Alarm 3 in controller (if A3 on)
Offset = 9	Channel Zero – holds channel zero value read from controller
Offset = 10	Channel Span – holds channel span value read from controller
Offset = 11, 12, 13	Spare

Offset = 14	Channel Status Bits – holds a binary word containing bits assigned to alarm and event indications. A one in any bit location indicates an associated alarm occurred during the interval Bit 0: Alarm 1 occurred in interval Bit 1: Alarm 2 occurred in interval Bit 2: Alarm 3 occurred in interval Bit 3: Fault Alarm occurred in interval Bit 4: Calibration occurred in interval Bit 5 – 15 Spare

Following the last 15 column entry for channel 16, each channel is assigned another 9 columns for digital and sensor life data. ***Absolute column = (((Channel # - 1) * 9) + 250) + Offset).***

Column	**Entry**
Offset = 0	A 1 in this column indicates that an Alarm 1 occurred during the interval
Offset = 1	A 1 in this column indicates that an Alarm 2 occurred during this interval
Offset = 2	A 1 in this column indicates that an Alarm 3 occurred during this interval
Offset = 3	A 1 in this column indicates that a Fault Alarm occurred during this interval
Offset = 4	A 1 in this column indicates that a Cal Event occurred during this interval
Offset = 5	A 1 in this column indicate that a Comm Error occurred during this interval
Offset = 6	Latest sensor life data (if enabled)
Offset = 7	Spare
Offset = 8	Spare