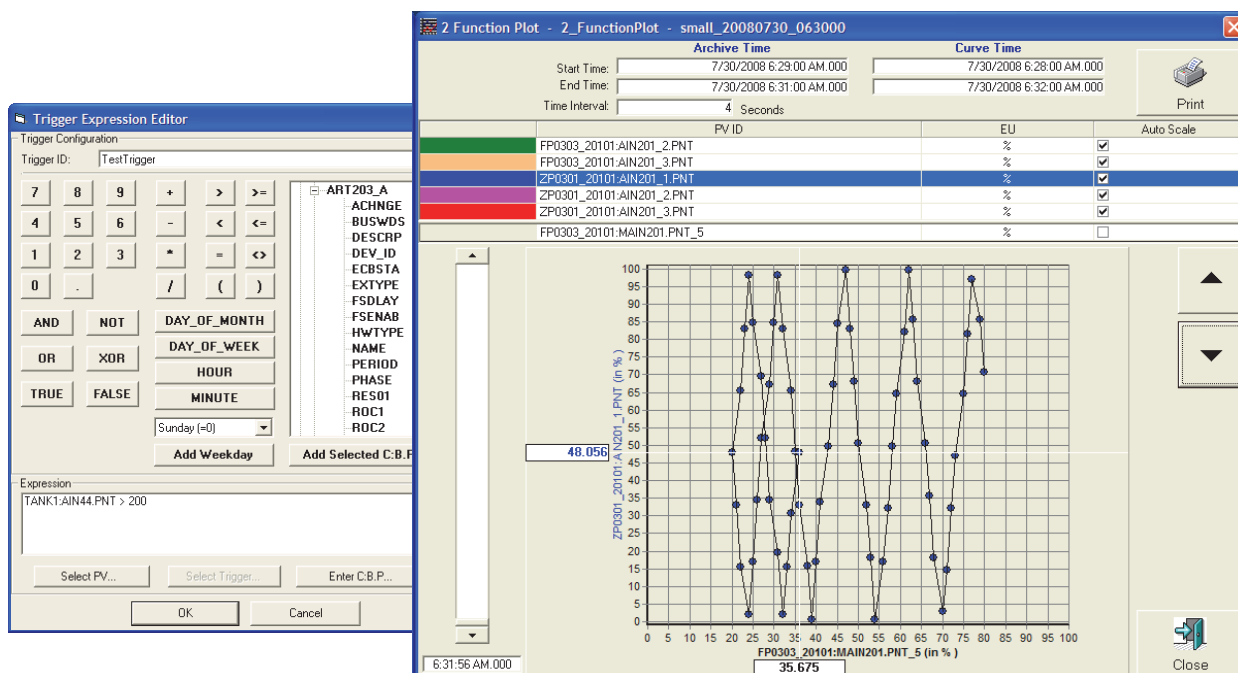


Transient Data Recorder and Analyzer



Transient Data Recorder and Analyzer (TDR/TDA) software collects high resolution digital and analog data from your control system, allows analysis of the data, and stores it in historical archives.

OVERVIEW

The Transient Data Recorder/Transient Data Analyzer (TDR/TDA) software package collects high resolution digital and analog data from the control system, allows analysis of the data, and stores it in historical archives. Data collection and analysis are based on specific events or “trips” that occur. A trip occurs when a user-defined trigger expression becomes true.

The Transient Data Recorder (TDR) continuously stores the data it receives in the “Transient Data Circular Buffer”, which is a cyclically overwritten intermediate buffer that can store up to 20 minutes of

transient data before and after an event. On detection of a user-defined trigger signal, the software extracts the data from a defined timeslice in the buffer and stores the data in a separate “Transient Data Archive” file for analysis.

Transient Data Analyzer (TDA) is a collection of functions that analyze data from the Transient Data Circular Buffer or from the Transient Data Archive. Transient data from these FBMs’ I/O channels can be collected, recorded, and analyzed with TDR/TDA software:

- ▶ FBM201/b/c/d/e Analog Input (0 to 20 mA, 0 to 100 mV, 0 to 5 V, 0 to 10 V dc) Modules
- ▶ FBM207/b/c Voltage Monitor/Contact Sense Input Modules
- ▶ FBM208/b, Channel Isolated, Redundant with Readback, 0 to 20 mA, I/O Module
- ▶ FBM217, Group Isolated Discrete Input Module
- ▶ FBM219, Group Isolated Discrete Input Module
- ▶ FBM247, Current/Voltage Analog/Digital/Pulse I/O Configurable Module, and FBM248, Current/Voltage Analog/Digital/Pulse I/O Configurable Redundant Module (4-20, 0-5 V dc, 0-10 V dc, and SOE inputs for TDR).

TDR supports V8.3 or later controllers. The listed FBMs provide time-stamped unfiltered analog input samples every 10 milliseconds to the TDR software running in the Control Core Services Workstation. The faster scan rate is activated in the FBM by the TDR software when data collection starts. For additional specifications for the FBMs, refer to “RELATED PRODUCT SPECIFICATION SHEETS (PSS)” on page 15.

FEATURES

TDR/TDA software provides these features:

- ▶ Highly accurate data collection and continuous storage of up to 500 data points, including digital signals at a resolution of 1 ms, analog signals at a resolution of 10 ms, and snapshots of selected data at the time of a trigger. Up to 128 of the analog points can originate from a single FCP/FCM.
- ▶ High-resolution data acquisition across multiple control processors with the optional GPS time synchronization feature
- ▶ Storage capacity in the circular buffer for up to 20 minutes of data before and after a trip
- ▶ Ability to continuously monitor the data stream for specified trigger signals
- ▶ Processing and storage of active data until all actions related to the trigger are finished
- ▶ Report generation and data analysis at any time using transient data stored in the circular buffer or an archive file
- ▶ Ability of an operator to manually trigger an event
- ▶ Support for user-defined automatically generated actions, such as informing an operator that an archive is being generated
- ▶ Capability to display or print reports of transient data both within the Foxboro Evo™ system (on a Control Core Services workstation and associated printers on the control network) or on system units attached to the Ethernet network above the Foxboro Evo system (for example, personal computers and printers in the application network).

CONFIGURATION AND OPERATOR CLIENTS

TDR/TDA software uses server/client architecture, and provides two different types of interaction: configuration and operation.

Before recording transient data, the process engineer uses the configuration client to define the behavior of the TDR/TDA software by setting general operating parameters, specifying the data sources and signal types that are monitored and stored, and developing the trigger expressions that initiate events. In addition, the process engineer can organize process variables into groups using the configuration client, and the groups can be configured to contain specific PVs, triggers, actions, and displays that the process needs.

A process operator monitoring the plant uses the operator client to generate configured displays for data analysis, create and view transient data archive files, and manually invoke trigger events. The operator client can be used with a mouse or a touchscreen.

SOFTWARE OPERATION

When your process is running, the TDR/TDA server software acquires the specified raw data from FBMs on the control domain using a high-speed data acquisition interface. TDR monitors the stream of data to detect trigger signals, and sends the data stream for temporary storage in the transient data circular buffer.

When the software detects a trigger signal, TDR continues to monitor data from the stream and stores data in the circular buffer until a configured amount of time passes, called the post-trip time. After the post-trip time elapses, the Event Handler appends post-trip data to pre-trip data and initiates the execution of any tasks scheduled for TDR/TDA operator clients, such as creating a transient data archive of data from the event, generating a report, or exporting data.

Using data from the transient data circular buffer, the periodic log buffer, the event files, or the transient data archives, client machines can generate reports or export data.

Data Collection

Data collection is performed by the same high speed data acquisition interface to the control domain used by Sequence of Events (SOE) software. The SOE product is licensed separately from the TDR/TDA product; but for digital points designated for both transient data and sequence of events reporting, the two packages run in the same workstation and share the same high speed data acquisition interface.

Process Variables

A process variable (PV) represents a digital or analog data point that is equivalent to the scaled raw count signal from the FBM. Signal conditioning and/or scaling of the raw count is based upon the configuration data within the controller. You can add up to 500 digital and analog PVs total per server from your system (with up to 128 analog points from a

single FCP/FCM) to the set of transient data points to be monitored by the TDR/TDA software.

THE TDR/TDA CONFIGURATION CLIENT

The TDR/TDA configuration client has a standard Microsoft® Windows look-and-feel, and contains an easy-to-use navigation tree control for selection of the different client windows. The selected window is displayed to the right of the tree.

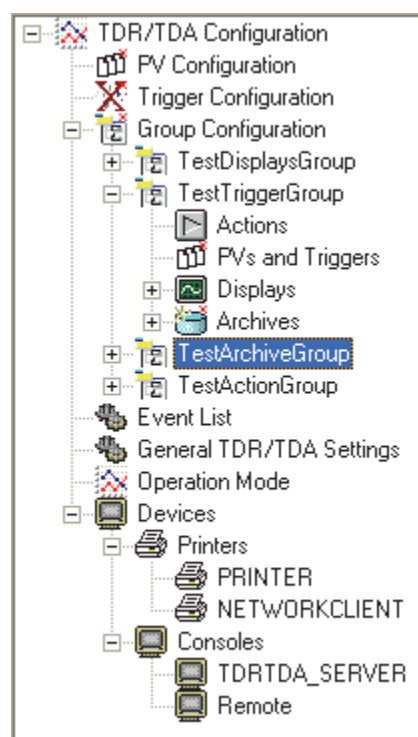


Figure 1. Configuration Client Navigation Tree

The configuration client provides a user interface with which you can specify the behavior of TDR/TDA software. Generally, the steps for setting up your TDR/TDA software include:

- ▶ Defining the data that you want to monitor by choosing process variables from configured compounds and blocks

- ▶ Defining the signals or groups of signals you want to use as triggers
- ▶ Creating groups of process variables corresponding to plant units
- ▶ Configuring the displays and reports that you would like to generate for each group
- ▶ Configuring printers and consoles for display output
- ▶ Adding automatic transient data tasks to each group
- ▶ Testing triggers and automatically generated actions
- ▶ Saving the configuration for use on another workstation (optional).

The configuration client also allows you to view, change, or delete configuration data and archives, and allows you to customize general operating parameters, such as:

- ▶ The default location for circular buffer and archive files
- ▶ The default frequency of data collection and storage to the circular buffer and archive files
- ▶ Time periods after which the intermediate buffers start overwriting themselves
- ▶ Time delay, in seconds, between the time a process variable is collected and the calculation of a trigger. Since process data needs to be sorted by time stamp before a trigger can be calculated, this time delay helps ensure that accurate data from different sources is used in trigger calculations.
- ▶ The names of the default printers for each of the periodic log types
- ▶ The name of the default printer for the other displays.

Developing Triggers

Triggers are Boolean mathematical expressions that are developed using a Trigger Expression editor, shown in Figure 2. When the value of a trigger expression changes from false to true, a trigger event is generated.

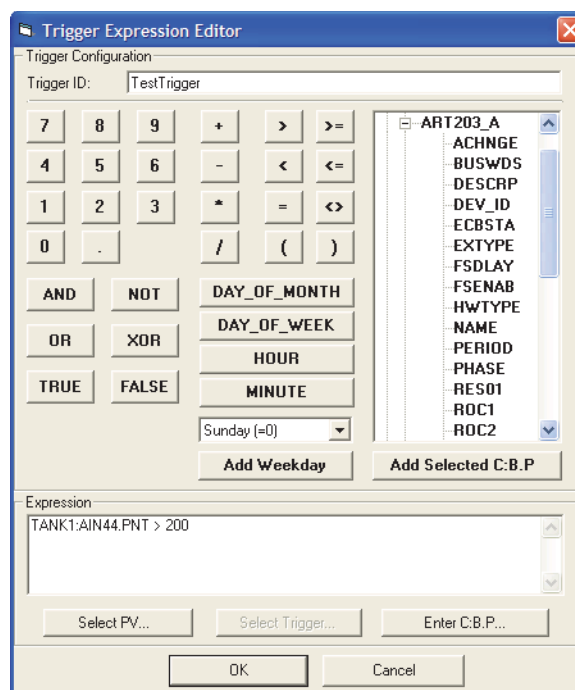


Figure 2. Trigger Expression Editor

The TDR/TDA software supports triggers derived directly from digital state changes, analog values reaching limits, as well as more complex trigger definitions that use logical and/or arithmetical calculations of both analog and digital points. To test your configuration, you can manually activate a trigger to initiate an event.

The configuration client provides an easy-to-use trigger development dialog box, shown in Figure 2 that allows you to select configured PVs, other triggers, or any configured block parameters from your control system for use as operands in your trigger expressions.

Creating Groups

The configuration client allows you to create groups that represent specific physical, logical, or organizational units of the plant. You can configure these groups according to your process control needs by including unique combinations of PVs, triggers, actions, and displays within each group.

Each group is identified by a unique name and number, and can be further defined by configuring:

- ▶ The amount of time during which data is recorded, both before and after a trip
- ▶ Specific digital and analog PVs to provide a snapshot of process data at the time of the event
- ▶ Specific digital and analog PVs for reporting historical values
- ▶ One or more triggers
- ▶ One or more displays with associated target output devices, for example, files, printers, or workstations
- ▶ Automatically generated actions that execute in response to a trip, including:
 - Invoking a program
 - Calling up a display
 - Creating an archive.

Configuring Displays

The configuration client provides the capability of adding new displays to a group and configuring them to perform different data analysis functions. TDR/TDA provides 10 display templates, each offering a unique view of transient data collected from your process.

When you add a new display, a configuration window corresponding to the display opens on the right side of the configuration client user interface where you can add PVs that will appear in the display and configure the display's general parameters.

Figure 3 shows an example of a tabular plot configuration screen.

No.	PV ID	EU per Grid	Offset
1	X4MAIN:201CH5.PNT	100	0
2	X4MAIN:201CH6.PNT	100	1
3	X4MAIN:201CH7.PNT	100	2
4	X4MAIN:201CH8.PNT	100	3
5	X4MAIN:217CH1.CIN	1	4
6	X4MAIN:217CH2.CIN	1	5
7	X4MAIN:217CH3.CIN	1	6

Figure 3. Display Configuration Window

The configurable parameters that appear in the display configuration window differ by display type. In addition to specifying the PVs to be included in the display, you can configure these parameters for nearly each of the display types:

- ▶ A title for the display
- ▶ The pre- and post-trip times to appear in the display
- ▶ The time interval at which data is displayed
- ▶ The default output device.

Additionally, you can configure the X and Y grids for plots and trends.

Configuring Display Output

Using the configuration client, you can assign different printers or workstations to display different transient data displays. You can set a specific output device, including printers and monitors, for each display, or you can specify a default output device in the General Settings window for the displays. The General Settings window also allows you to specify a default printer for each of the four periodic logs.

Usually for displays, depending on the type, you can display output on a screen, send the display to a configured printer, or save the display to a file. TDR/TDA also provides the capability to export displays to CSV (comma separated value) files, which can be loaded into a spreadsheet or a relational database application, or to XML (extended markup language) files, which can be used for presentation of data inside an HTML page or as a standardized data exchange mechanism.

You can view or print reports generated by TDR/TDA software from any workstation with the Transient Data client software installed, whether the workstation is part of the control network or on the enterprise network.

Configuring Automated Transient Data Tasks

For every group, TDR/TDA allows you to specify the actions that are automatically initiated in response to a trip. You can specify that the TDR/TDA client launch a new program, generate a display, export data, or create an archive of data from the event.

TDR/TDA provides the capability to schedule the execution of tasks. A convenient drop-down menu allows you to execute the action immediately upon detection of a trigger signal, after the configured post-trip time has elapsed, or after an archive for the event has been saved.

Testing the Configuration

Before implementing your TDR configuration, you can save configuration time by testing the settings directly from the configuration client. The configuration client's "operation mode" provides you with the capability to confirm that the expected data is collected, the displays appear correctly, and automatic actions execute correctly.

To test the generation of a display, click Generate Display. Verify that the correct display appears, the display contains the expected data, and that the display is sent to the correct output device or file.

To test the triggers that you have developed, manually initiate a trip and observe the results. If you configured the trigger to automatically archive data for the group, verify that the data is archived to an archive file.

Saving the Configuration

After testing your TDR configuration, you can save the TDR configuration for use on another workstation.

THE TDR/TDA OPERATOR CLIENT

The TDR/TDA operator client allows you to view or print configured displays, manually create transient data archives, and manually trigger events. The operator client is designed for use with a touchscreen or a mouse.

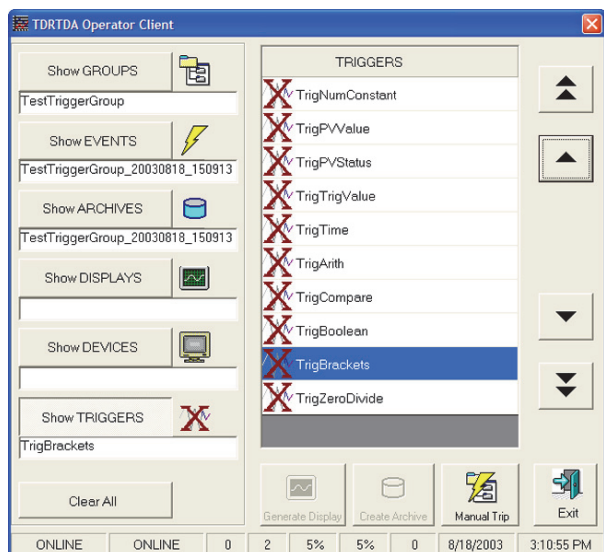


Figure 4. Operator Client Window

Before performing any operator tasks, click the appropriate “Show” buttons on the operator client window to navigate to the information you want to analyze. After selecting the appropriate display or event, you can:

- ▶ Open or print a display on a specific monitor or printer
- ▶ Create a transient data archive
- ▶ Manually initiate a trip.

If an automatically generated display is waiting to be opened, an Auto Action button appears on the user interface to notify you that an event has occurred and the associated display is ready. Clicking this button causes the configured action to be executed.

STATUS BAR

The status bar on the configuration and operator clients allows you to view TDR/TDA statistics at-a-glance. For example, you can look at the status bar to find out if the server is online, how many triggers are currently generating events, and the percent of the hard disk’s resources being used by the TDR/TDA buffer and archive tasks.

TRANSIENT DATA DISPLAYS

The TDR/TDA display function is the backbone of transient data analysis. Displays organize and present information so that process operators and engineers can easily determine the cause of a plant disturbance or monitor various plant subsystems during plant maneuvers and tests by examining historical or real-time transient data displays.

Logs, reports, trends, and plots that the TDR/TDA software generates can be displayed, and each display performs a different data analysis task. You can configure and generate these displays:

- ▶ Transient Data Report
- ▶ Statistical Summary Report
- ▶ Tabular Trending Report
- ▶ Tabular Plot (or Time Based Plot)
- ▶ Two Function Plot
- ▶ Real-Time Display and Trend
- ▶ Periodic Log
- ▶ Trip/Scram Log
- ▶ Turbine/Generator Log
- ▶ SOE Report.

Transient Data Report

A transient data report provides a comprehensive look at plant activity from the conditions leading up to the event to the results after an event occurs. This type of report displays this data for the specified group of PVs:

- ▶ A snapshot of transient data at the exact time the event occurred, including the name, description, engineering units (for analog PVs), and the value or state of each PV configured as a snapshot PV.
- ▶ A historical account of digital (SOE) data extracted from the circular buffer, from the beginning of the configured pre-trip time until the end of the configured post-trip time. It includes the time, name, and state of configured digital PVs.

- ▶ A matrix of historical analog data extracted from the circular buffer, from the beginning of the configured pre-trip time until the end of the configured post-trip time. It reports the values of the configured analog PVs at a specified frequency over the specified time period.

Statistical Summary Report

Each section of a statistical summary report pertains to a different historical process variable, and contains the PV ID, description, and engineering units, along with a statistical assessment of the variable's values over the configured time period. You can use statistical summary reports only for analog PVs. Mathematical calculations included in the report are minimum, maximum, mean, standard deviation, and variance.

Tabular Trending Report

The purpose of a tabular trending report is to provide a matrix of the values of selected process variables over time. Column headings represent PVs, and rows represent time intervals.

The upper portion of a tabular trending report summarizes and indexes each PV whose values are held in the table, including the ID, description, and engineering units for an analog PV or low and high state names for a digital PV. The lower portion contains the actual table of PV values at the specified frequency over the specified time period.

Tabular Plot (or Time Based Plot)

A tabular plot shows the values of up to 7 PVs over a specific period of time in a color-coded line-graph format. The X-axis represents time, and the Y-axis represents engineering units (EUs) for an analog PV or state for a digital PV. The X- and Y-axes are configurable.

You can modify the time range of the currently displayed chart using the scroll bar on the right side of the user interface. Using the scroll bar adjusts the time represented on the X-axis accordingly, and causes the values displayed in the grid to update. An example of a tabular plot is shown in Figure 5.

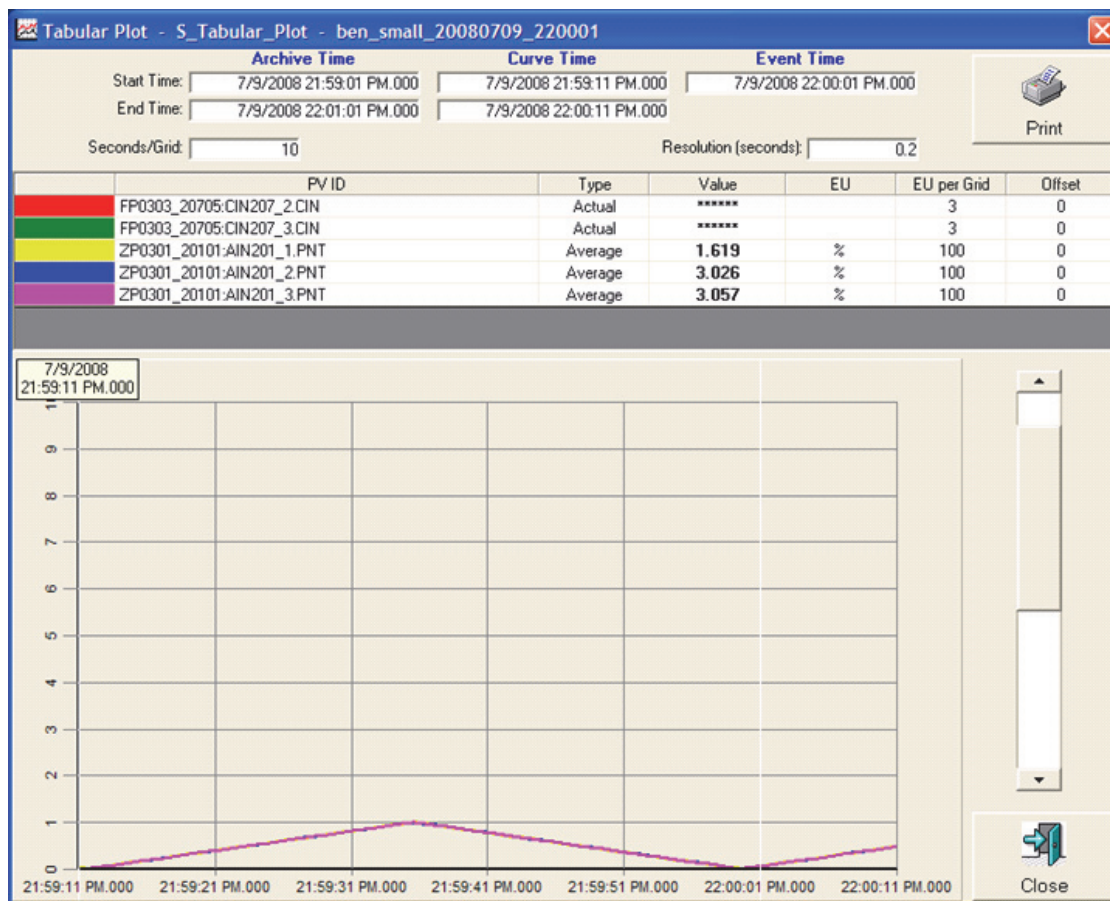


Figure 5. Tabular Plot

Two Function Plot

A two function plot compares the values of two process variables over the specified time period, and displays the values in a line-graph format. The X-axis represents the value of the independent variable, and the Y-axis represents the value of the dependent variable.

The dependent variable can be selected and changed using the arrow buttons or by selecting a new PV from the list at the top of the display. The two function plot also provides a time slider on the left side of the user interface, which causes the chart to

refresh with new values corresponding to the newly selected time.

Checking the Auto Scale box allows TDR/TDA to display a logical number of engineering units per grid on the X- or Y-axes so that the display fits nicely on the screen. An example of a two function plot is shown in Figure 6.

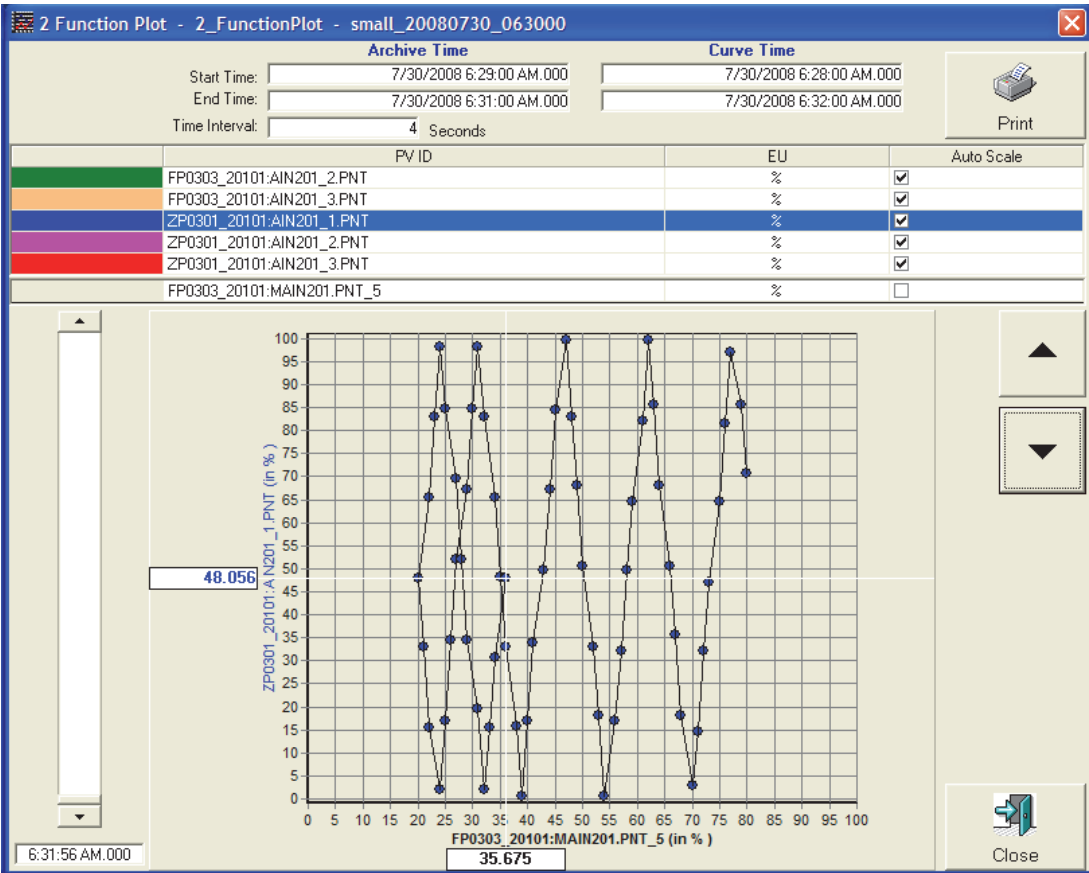


Figure 6. Two Function Plot, Screen Display

Real-Time Displays and Trends

TDR/TDA allows you to display real-time data in two formats; the real-time display and the real-time trend.

Real-Time Display Window

The real-time display shows up to 20 PVs in the selected group, along with additional relevant configuration information. See Figure 7.

For each analog PV on the display, the ID, description, current alarm status, current value, and engineering units are provided on the left side of the display. The right side of the interface contains a graphical representation of the PV value and configuration information, including its minimum and

maximum values and range limit values previously configured using the TDR/TDA configuration client.

For each digital PV on the display, the ID, description, current status, and current state are provided on the real-time display. The two possible digital states appear on the right side of the display, and the current state of the PV is highlighted.

Depending on your preferences and the nature of the digital process variable, you can reverse the positions of the two possible states by configuring the PV's digital polarity. If digital polarity is enabled, the non-zero state of the PV appears on the left, and the zero state of the PV is on the right. For normal polarity, the positions are reversed.

In addition, the real-time display is color coded so that you can easily identify abnormal conditions in your plant. For analog PVs, yellow signifies a value below the block's low alarm limit (LAL) or above the block's high alarm limit (HAL), and red signifies a value below the block's low-low alarm limit (LLALIM) or above the block's high-high alarm limit (HHALIM).

Green signifies that the value is within its limits.

The real-time trend display also provides arrow buttons to navigate through the process variables in the group, and sequentially numbered buttons that allow you to select a PV and generate a real-time trend, described in Figure 7.

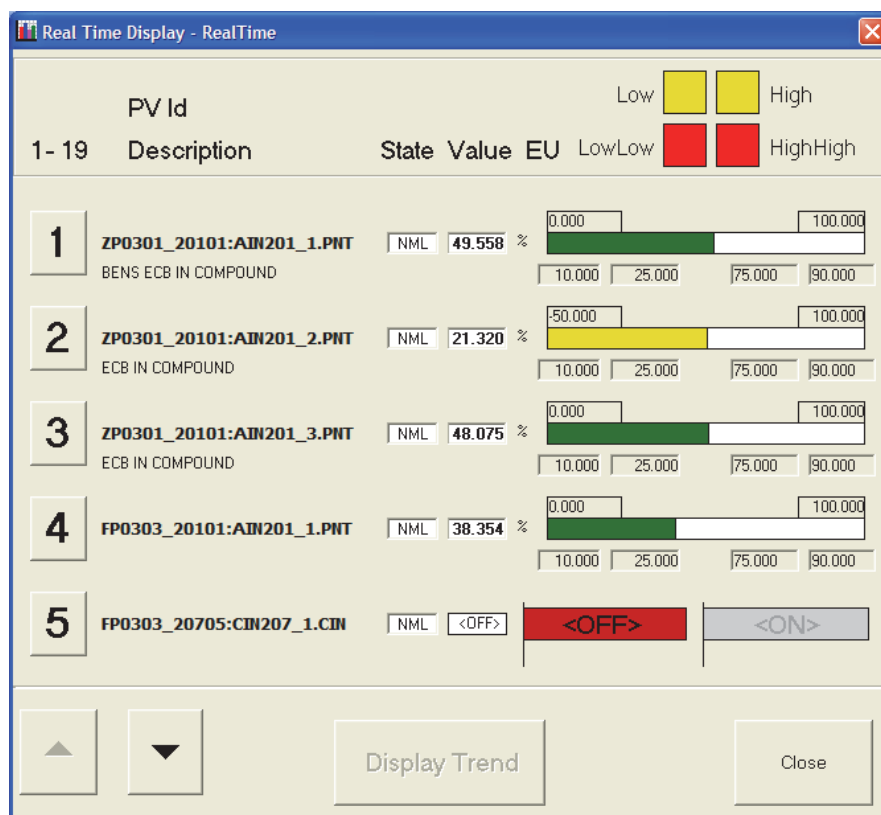


Figure 7. Real-Time Display Window

Real-Time Trend

From the real-time display (Figure 8), you can select a PV and generate a real-time trend. The real-time trend shows the changes in the PV value over a period of time in line-graph format, where the X-axis represents time, and the Y-axis represents the PV current value.

The trend display allows you to change the time period represented in the trend. You can choose to display the trend for a period of 1, 10, 30, or 60 minutes, depending on how much data you want to see at a time. Refer to Figure 8.

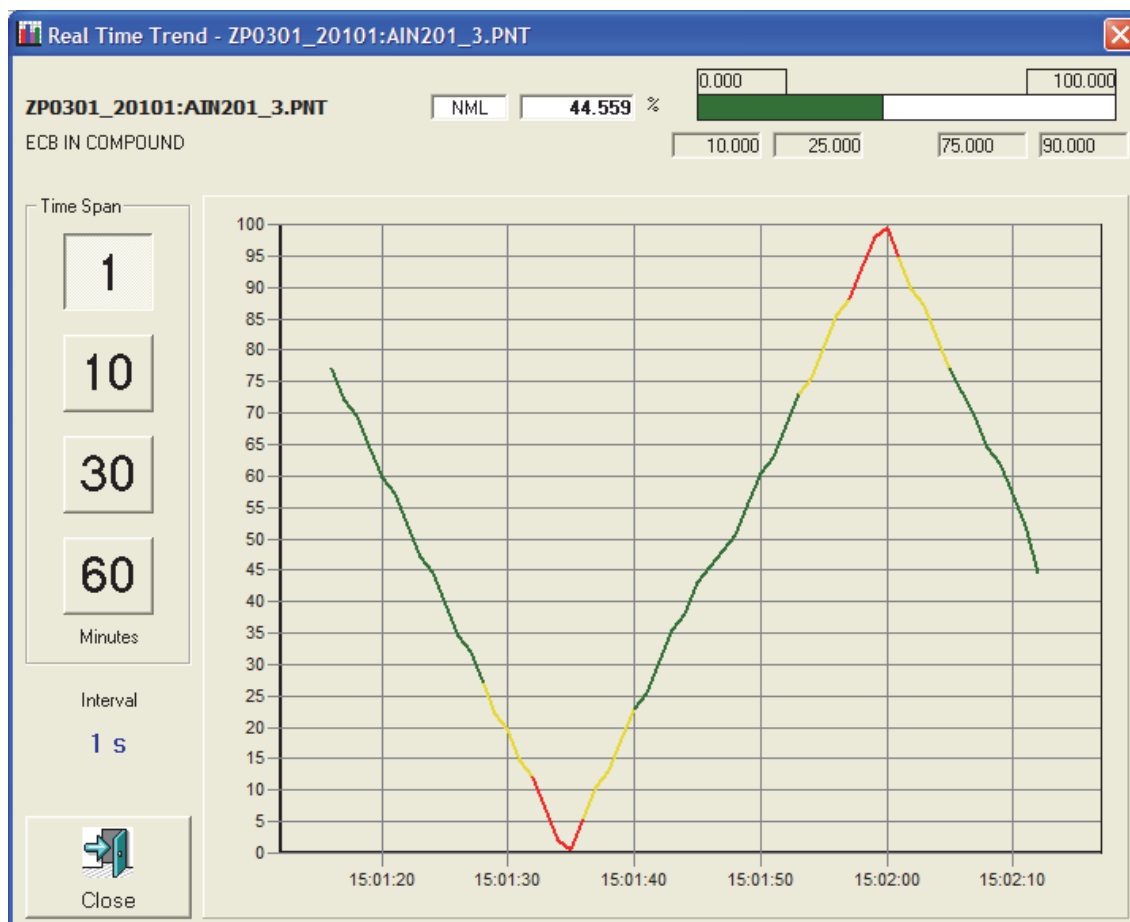


Figure 8. Real-Time Trend, Screen Display

Periodic Logs

Periodic logs display data collected for up to 12 specific process variables over a configurable amount of time, and provide statistical analysis of the data for that time period. For each PV selected to appear in a periodic log, you can choose to display actual values or a statistical rollup calculation for the PV value during the specified time interval. Supported calculations include a count, sum, average, minimum, maximum, peak to peak (maximum minus minimum), standard deviation, or variance.

You can configure four types of periodic logs: hourly, daily, shift, and monthly, and each of these can be scheduled to print automatically to a specific printer. Scheduling is accomplished in individual report configuration windows, and the default printer for each log is specified in the configuration client's General Settings window.

Hourly Log

This log is generated once per hour. It displays and analyzes data values for the specified PVs collected within that hour at intervals of one minute.

Daily Log

This log is generated once per day. The log displays and analyzes data values for the specified PVs collected within that day at intervals of one hour.

Shift Log

This log is generated once per shift. It displays and analyzes data values for the specified PVs collected within that shift at intervals of one hour. You can configure up to 4 shifts per day by specifying the time the shift begins (hour and minute).

Monthly Log

This log is generated once per month. It displays and analyzes data values for the specified PVs collected within that month at intervals of one day.

Trip/Scram Log

A trip log is a power industry specific log, and a scram log is specific to nuclear power plants. The trip/scram log provides a data table comprising the pre-trip, trip, and post-trip values of selected PVs sorted by time stamp. The first part of the log contains the pre-trip data values. The second part of the log begins on a new page and contains the values of the selected PVs at the time of the trip and continues until the end of the post-trip time span.

Turbine/Generator Log

The turbine/generator log is a power plant specific log that contains a list of varying turbine speed values sorted by time stamp, and a log of varying PV values over the specified time period. These logs can be configured to represent various states through which your process can transition; for example, you can configure an automatic turbine/generator log to record values when your process is starting or when your process is shutting down. TDR/TDA allows you to automatically generate the logs and send them to the default printer or demand available turbine/generator logs at any time.

Configuration of the turbine/generator log is accomplished in three steps: assigning a PV to the turbine speed, configuring triggers, and adding process variables.

The main turbine/generator log configuration window allows you to define the specific triggers that cause the log to start and stop recording values.

Turbine/generator types of logs need you to configure each of these trigger conditions:

- ▶ Turning Gear Status
- ▶ Turbine Load (50%)
- ▶ Turbine Trip
- ▶ Turbine Control Valve
- ▶ Bearing Vibrations
- ▶ Main Steam Pressure
- ▶ Turbine Load Rate of Change
- ▶ First Stage Temperature Rate of Change
- ▶ Thrust Bearing Temperature
- ▶ Bearing Header Pressure.

When one of the trigger conditions becomes true, the log starts recording values and stops when the post trip time has elapsed.

The secondary window for turbine/generator log configuration allows you to add the PVs for which you want values to appear in the log.

SOE Report

A Sequence of Events (SOE) report retrieves the list of designated digital PVs and for each PV, reports the ID, the time (to the millisecond) at which the digital PV changed its state, its PV description, and its current state. The SOE report in the TDR/TDA software is limited. For enhanced reporting and archiving of Sequence of Events points, you need to install the Sequence of Events software, available separately, and described in *Sequence of Events* (PSS 31S-2SOE).

FUNCTIONAL SPECIFICATIONS

Hardware

A minimal system setup consists of:

- ▶ 2.2 GHz Intel® Pentium® 4 processor
- ▶ 512 MB Memory minimum (We recommend 1 GB Memory)
- ▶ Ultra SCSI 8 GB, 7200 rpm, 8 ms average seek time hard disks
- ▶ DVD/CD-ROM drive.

Software

These software applications need to be present on the target workstation prior to installing TDR/TDA software:

- ▶ Windows 7® or Windows Server 2008® with I/A Series® system software v8.8 or Foxboro Evo Control Core Services software v9.0 or later.
- ▶ Windows XP® or Windows Server 2003® operating system with I/A Series v8.3 to v8.7 system software.

Data Storage

The circular buffer allows the storage up to 20 minutes before and 20 minutes after a trip.

Data Acquisition

- ▶ Digital signals are acquired with a resolution of 1 ms⁽¹⁾.
- ▶ Time-stamped analog signals are acquired with a resolution of 10 ms. The faster scan rate is activated in the FBM by the TDR software when data collection starts.
- ▶ High-resolution data acquisition across multiple control processors with the optional GPS time synchronization feature.

Display and Process Variable Specifications

- ▶ TDR/TDA supports up to 500 transient data inputs (any combination of analog and/or digital points) originating from 200 Series FBMs. Of these points, there can be up to 128 analog points from one FCP/FCM.
- ▶ The number of process variables in a tabular trending report is up to 10.
- ▶ The number of process variables in a tabular plot is up to 7.
- ▶ The number of process variables in a periodic log is up to 12.
- ▶ The number of process variables in real-time displays and trends is up to 20.
- ▶ There is no limit to the number of process variables you can include in a TDR report, statistical summary report, two-function plot, trip/scram log, turbine/generator log, or SOE report.

(1) Digital data coming from FBMs with AC driven inputs could be delayed due to the dynamics of the AC waveform and filtering in the FBM and therefore may not be recorded until the following 10 millisecond sampling period.

RELATED PRODUCT SPECIFICATION SHEETS (PSS)

PSS Number	Description
PSS 31H-2SOV	Standard 200 Series Subsystem Overview
PSS 31H-2COV	Compact 200 Series I/O Subsystem Overview
PSS 31H-2W100	100 Series Fieldbus Module Upgrade Subsystem Overview
PSS 31H-2S201	FBM201/b/c/d/e Analog Input (0 to 20 mA, 0 to 100 mV, 0 to 5 V, 0 to 10 V dc, 0 to 20 mA High Accuracy)
PSS 31H-2C201	Compact FBM201 Analog Input 0 to 20 mA Interface Module
PSS 31H-2S207	FBM207/b/c Voltage Monitor/Contact Sense Input Modules
PSS 31H-2C207	Compact FBM207/b/c Voltage Monitor/Contact Sense Input Interface Modules
PSS 31H-2S208	FBM208/b, Redundant with Readback, 0 to 20 mA I/O Module
PSS 31H-2C208	Compact FBM208, Redundant with Readback, 0 to 20 mA I/O Module
PSS 31H-2S217	FBM217 Discrete Input Module
PSS 31H-2C217	Compact FBM217 Discrete Input Module
PSS 31H-2S219	FBM219 Discrete I/O Interface Module
PSS 31H-2C219	Compact FBM219 Discrete I/O Interface Module
PSS 31H-2S247	FBM247, Current/Voltage Analog/Digital/Pulse I/O Configurable Module
PSS 31H-2C247	Compact FBM247, Current/Voltage Analog/Digital/Pulse I/O Configurable Module
PSS 31H-2S248	FBM248, Current/Voltage Analog/Digital/Pulse I/O Configurable Module, Redundant
PSS 31H-2C248	Compact FBM248, Current/Voltage Analog/Digital/Pulse I/O Configurable Module, Redundant
PSS 21S-3CP270ICS	Control Processor 270 (CP270) Integrated Control Software
PSS 31S-3FCPICS	Field Control Processor 280 (CP280) Integrated Control Software

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