

Mark* V1e Control PROFIBUS® Interface Application Guide



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Document Updates

Location	Description
Chapter, Overview	Updated with additional functional description for customer communications, including a diagram displaying hotbackup and redundancy

Acronyms and Abbreviations

DM	Device Manager
DME	Device Manager Essential
DP	Data Processing
DTM	Device Type Manager
EDDL	Electronic Device Description Language
FDT	Field Device Tool
GSD	Generic Station Description
GUI	Graphical User Interface
OS	Operating System
PA	Process Automation
PDH	Plant Data Highway
SDI	System Data Interface

Related Documents

- *GEH-6700, ToolboxST* User Guide for Mark VIe Control*
- *GEH-6721 Vol II, Mark VIe Control System Guide Volume II*
- *GEH-6761, FOUNDATION Fieldbus™ Application Guide*
- *GEH-6762, FOUNDATION Fieldbus User Guide*
- *GEH-6821, Device Manager User Guide*
- *GEI-100614, Mark VIe Control PROFIBUS Master Gateway (PPRF) Module Description*
- *GEI-100757, WorkstationST* Device Manager Gateway Instruction Guide*

Safety Symbol Legend



Warning

Indicates a procedure, condition, or statement that, if not strictly observed, could result in personal injury or death.



Caution

Indicates a procedure, condition, or statement that, if not strictly observed, could result in damage to or destruction of equipment.



Attention

Indicates a procedure, condition, or statement that should be strictly followed to improve these applications.



Warning

To prevent personal injury or equipment damage caused by equipment malfunction, only adequately trained personnel should modify any programmable machine.



Warning

Always ensure that applicable standards and regulations are followed and only properly certified equipment is used as a critical component of a safety system. Never assume that the Human-machine Interface (HMI) or the operator will close a safety critical control loop.

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1 Overview

The Mark* V1e control offers a PROFIBUS DP-V0 and DP-V1, Class 1 Master that maps I/O from Slave devices to the controllers.

1.1 Bus Performance

The gateway is an I/O module that communicates on the 100 MB Ethernet I/O network to the controllers and an RS-485 interface to Slave devices. It supports 9.6 to 12 MB communications for up to 125 nodes, with 244 bytes of I/O per Slave. Data can be communicated between the controller and the PROFIBUS I/O module as fast as 10 ms. Data is asynchronously communicated to the slaves at the fastest possible rate, determined by the PROFIBUS network baud rate, Slave quantity, I/O quantity, and Slave response time. At a 10 ms performance rate (frame rate), 500 inputs and 500 outputs (half Boolean and half analog) can be processed. For input event detection, Boolean inputs can be configured for SOE logging with 10 ms time tags. Analog data can be configured for point-to-variable data type conversion and scaling. Online downloads of control software are supported.

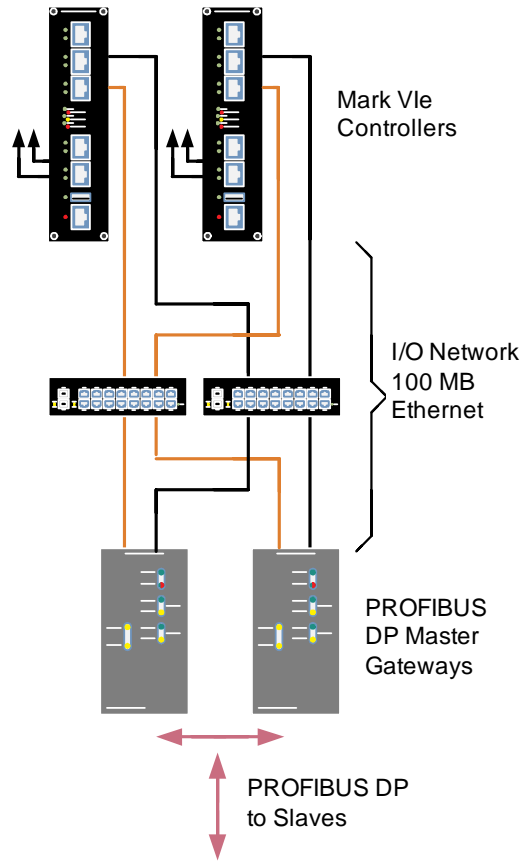
1.2 Redundancy

The gateway can be configured for three types of redundancy:

- One I/O module with one I/O network
- One I/O module with dual I/O networks
- Hotbackup I/O modules with dual I/O networks

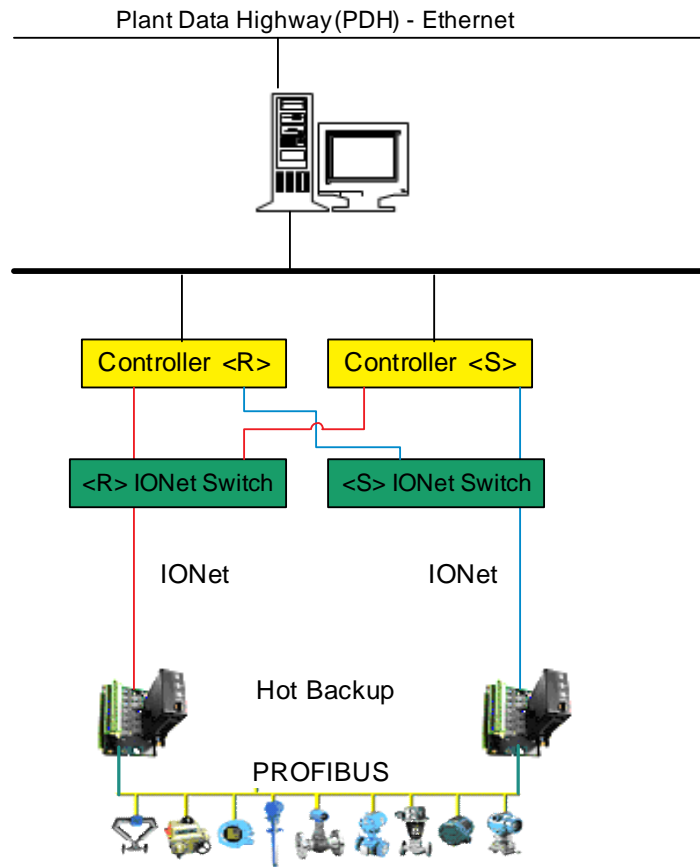
The active Master communicates with the Slaves while the backup Master is in standby mode. The gateway supports automatic switch-over in less than 200 ms if any of the following conditions occur:

- All Master or Slave communication is lost
- Master or controller communication is lost on both I/O
- Master is powered down



Hotbackup PROFIBUS DP Gateways with Dual I/O Networks

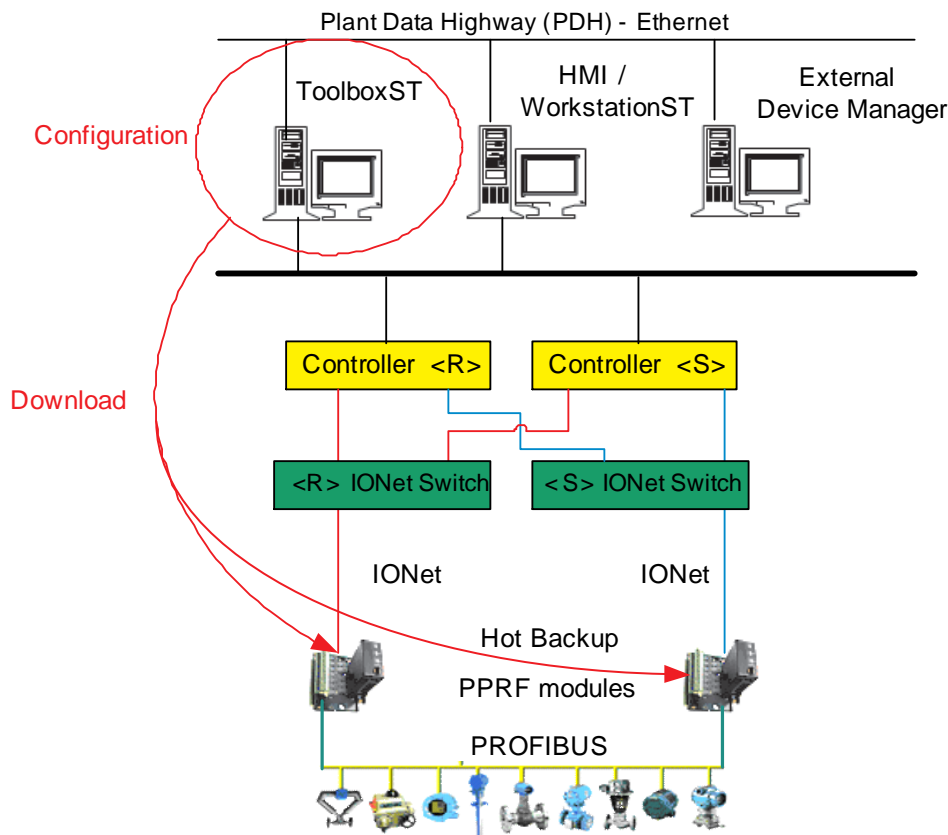
2 PROFIBUS Architecture



The Mark VIe control system includes the following:

- ToolboxST application for controller and I/O configuration
- HMI/workstations for operator interface and communications
- An external device manager for PROFIBUS
- Mark VIe controllers in various configurations of redundancy
- IONet switches to support various configurations of redundancy
- PPRF I/O module in simplex or hot backup configurations
- PROFIBUS devices with simplex and/or hot backup connections

2.1 PROFIBUS DP Configuration



Refer to GEH-6700, *ToolboxST User Guide for Mark VIe Control, Chapter 12, Special I/O Functions, the section, PROFIBUS Communications.*

The ToolboxST application is used to configure the PPRF, PROFIBUS devices and their associated I/O, and data. The Generic Station Description (GSD) Manager is used to add a PPRF module to the IONet and devices to the PROFIBUS network.

The Variables tab is used to specify which I/O variables of each device will be used. The definitions of the selected I/O variables are used during the batch build and download process to create the .dbm file. This file is downloaded to the Hilscher PROFIBUS Master Com-C board in the PPRF module. It specifies exactly which variable(s) of the slave device will be requested and sent during the DPV0 cyclic message request. This I/O configuration also defines what DPV0 data to include on IONet EGD exchanges, as follows:

- PPRF configuration and status information – details of redundant modules and active status on a Class 1 exchange (at frame rate ~ 40 ms)
- PROFIBUS device input data – by selecting the PROFIBUS inputs to be read from each device, the ToolboxST application puts all the input data into one or more pages of Class 2 exchanges at frame rate. (This is a hybrid exchange since Class 2 is normally not at frame rate; it is at a slower rate, ~160 ms.)

Note PROFIBUS device output data is mapped to the Mark VIe EGD exchange, and can be one or more pages, depending on the number of PROFIBUS outputs selected in the ToolboxST application.

- PROFIBUS device diagnostic data – depending on the diagnostic data selected for each device, the ToolboxST application puts all diagnostic data into one or more pages of Class 2 exchanges (~160 ms).

Note There are limits to the amount of processing the PPRF can perform without degradation of operation. Whether Boolean or analog, the I/O types and quantities produce non-linear effects on processor loading due to other related processing that occurs for sequence of events (SOE), alarming, and diagnostics.

Refer to GEI-100614, Mark VIe Control PROFIBUS Master Gateway (PPRF) Module Description.

The PPRF documentation specifies the limits in terms of PROFIBUS device I/O on each PROFIBUS network. With the release of ControlST V04.04, the limits are checked by the ToolboxST application during the build process and a warning is produced when the limits for Booleans, analogs, or a combination of Booleans and analogs (per network) are exceeded.

2.2 Performance Factors

The performance of a PROFIBUS network is determined by many variables. Some of the significant factors are:

- **Baud rate** (limited by PROFIBUS network cable lengths)

Often, it is the required bus length that determines the data rate.

Maximum Bus Length	Maximum Kbits per Second
1,200 m (3937 ft)	9.6, 19.2, 31.25, 45.45, 93.75
600 m (1968.5 ft)	187.5
400 m (1312.3 ft)	500
200 m (656.2 ft)	1500
100 m (328.1 ft)	3000, 6000, 12,000

- **Number of devices on the network** (scan times increase for each device due to master/slave communication) – The PROFIBUS specification states 32 stations in every segment without repeaters; extendable up to 125 stations with repeaters. The number of devices on a PPRF segment is currently limited by the total segment I/O data types for the devices, as previously stated.

2.3 Connector and Cable Types

The connector and cable information in this section is an excerpt from the following documents:

- *GEI-100614, Mark VIe Control PROFIBUS Master Gateway (PPRF) Module Description*
- *GEH-6721 Vol II, Mark VIe Control System Guide Volume II*

2.3.1 Bus Installation Guidelines

The proper cable for a PROFIBUS network is a shielded, twisted-pair cable, and is sold as *PROFIBUS Network Cable*. This twisted pair cable consists of a green wire and a red wire. The following table lists some of the characteristics of the PROFIBUS network and cable.

Item	Specification
Network Topology	Linear bus, terminated at both ends, stubs possible
Medium	Shielded twisted pair cable. Shielding may be omitted depending upon the environment.
Number of Stations	32 Stations in every segment without repeaters. With repeaters, extendable up to 125.
Transmission Speed	9.6, 19.2, 31.25, 45.45, 93.75, 187.5, 500, 1500 Kbps 3, 6, 12 Mbps
Connector	9-pin D-sub connector
Cable Type	PROFIBUS DP
Surge Impedance	135 to 165 Ohms (3 to 20 MHz)
Working Capacitance	< 30 pF per meter
Loop Resistance	≤ 110 Ohms per Kilometer
Wire Diameter	> 0.64 mm
Conductor Cross-sectional Area	> 0.34 mm ²
L/R Ratio	≤ 15 μH/Ohm

The maximum bus length using shielded, twisted-pair cable for a single network segment is 1200 meters. Total network length can be increased with the use of repeaters, with up to a maximum of three repeaters per network. Other cable types are restricted to shorter bus lengths. The maximum bus length also depends on the data rate, as displayed in the following table.

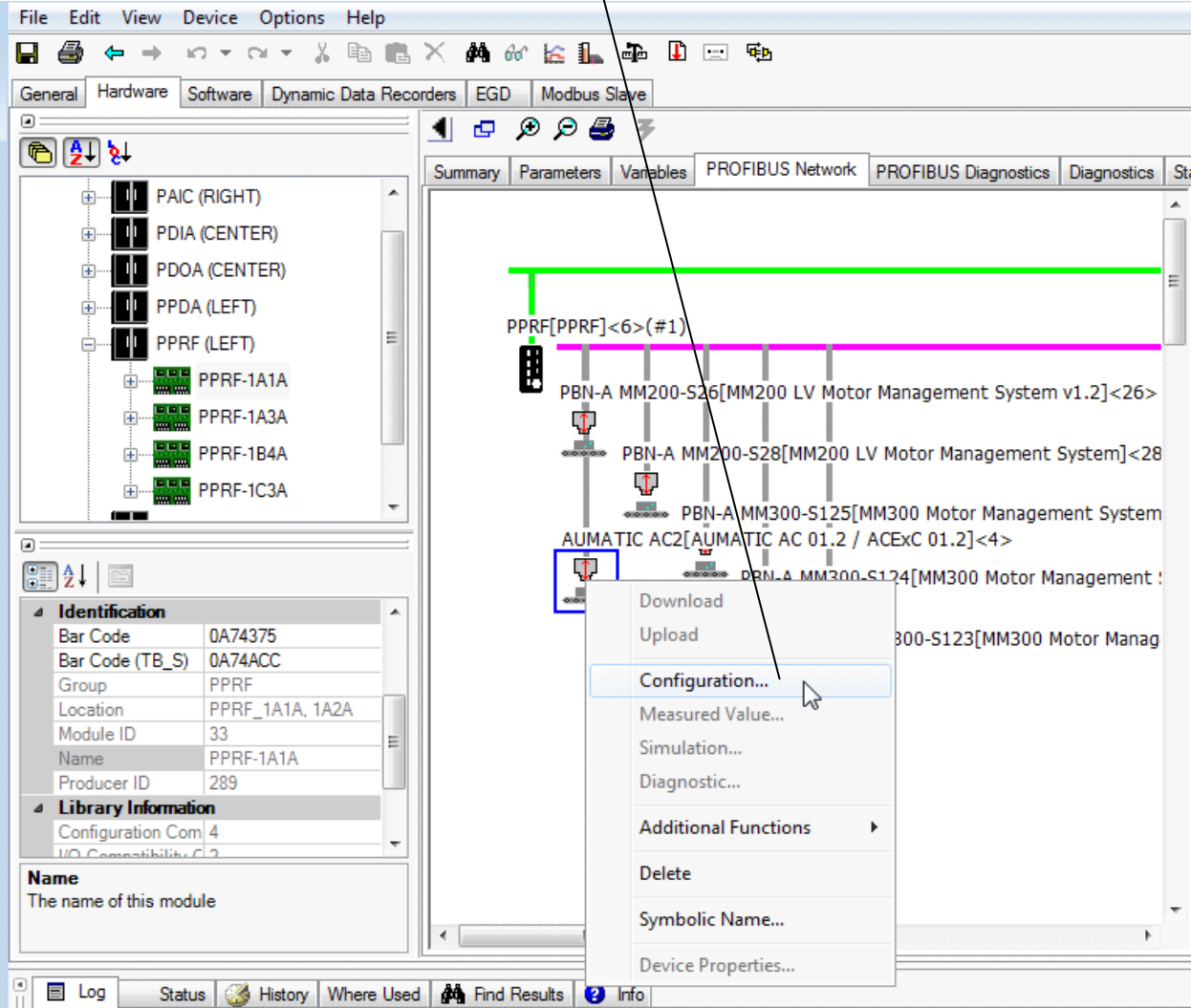
Maximum Bus Length	Maximum Kbits per Second
1,200 m (3937 ft)	9.6, 19.2, 31.25, 45.45, 93.75
600 m (1968.5 ft)	187.5
400 m (1312.3 ft)	500
200 m (656.2 ft)	1500
100 m (328.1 ft)	3000, 6000, 12,000

2.4 PROFIBUS DPV1 Configuration

Refer to GEH-6700, Chapter 12, Special I/O Functions, the section, PROFIBUS Communications.

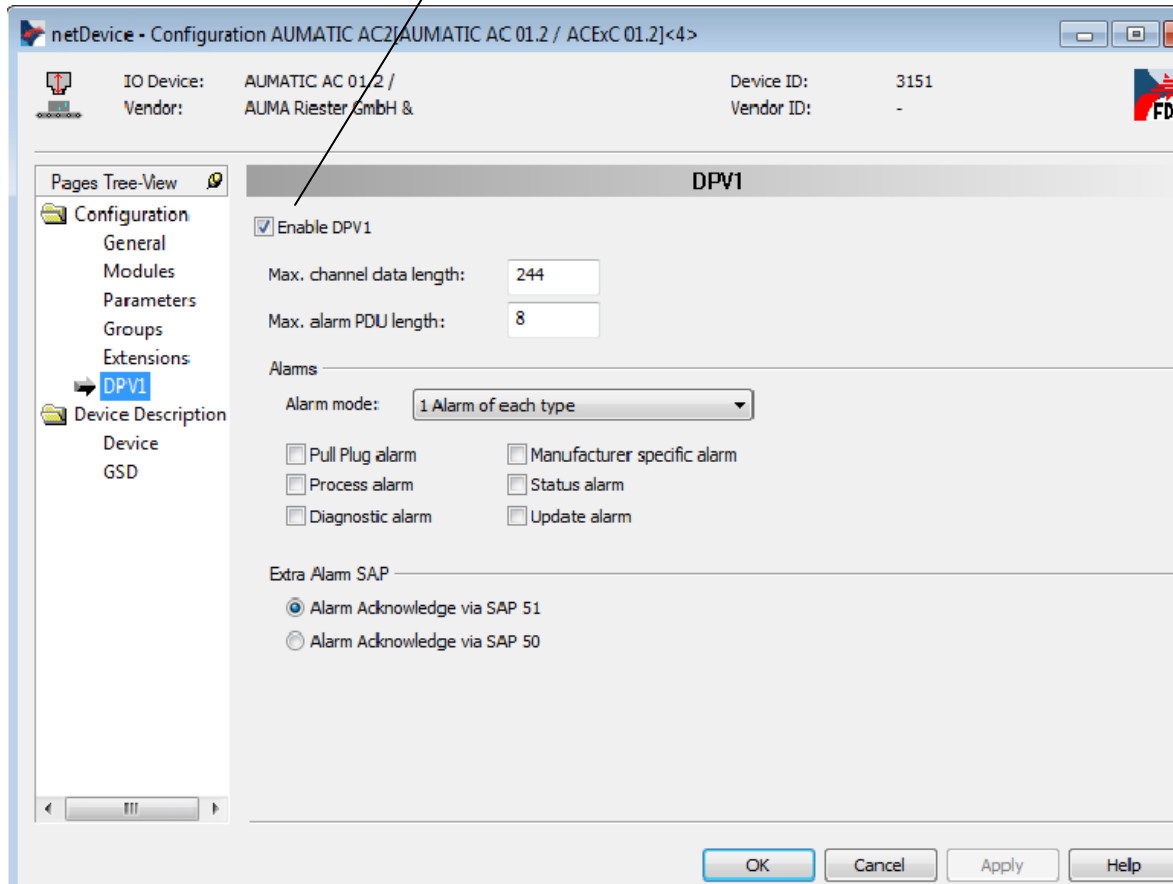
- To configure PROFIBUS DPV1: from the ToolboxST System Editor, double-click a controller to display the Component Editor.

From the **Hardware** tab, right-click the **PPRF** module, select **Configuration** to display the **netDevice** screen.



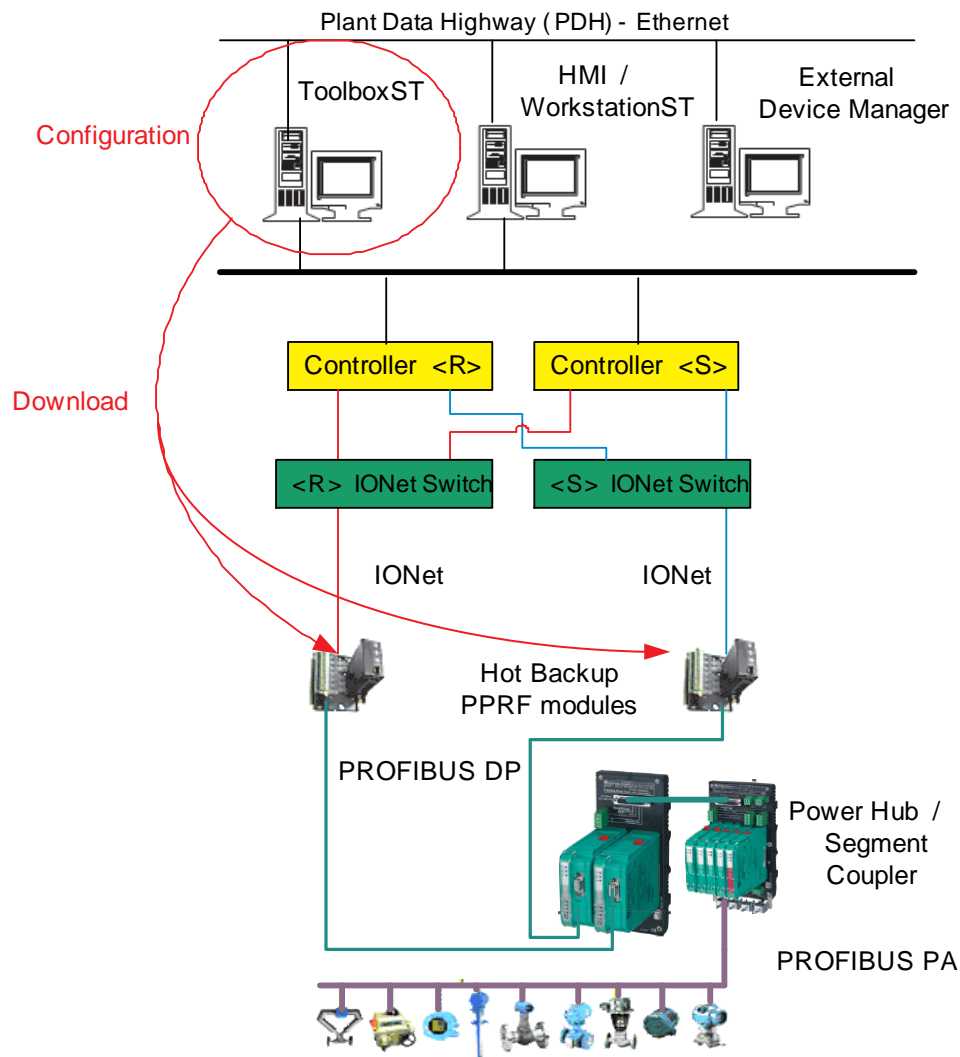
From the **netDevice** screen **Tree View**, select **DPV1** and click **Enable DPV1**.

Repeat this procedure for all PPRF devices



Note If it is a PROFIBUS PA device, Enable DPV1 must be unchecked.

2.5 PROFIBUS PA Configuration



For PROFIBUS PA devices there are at least two methods of connecting to a PROFIBUS DP network.

- Segment coupler
- Linking device

GE recommends the segment coupler option by Pepperl + Fuchs™ for the following reasons:

- The segment coupler is transparent to the DP network because:
 - In a simplex configuration, there is no configuration required for the segment coupler.
 - In a redundant segment coupler, the redundant couplers must be assigned PROFIBUS DP drop numbers (typically one for main master, and two for redundant master – but these addresses are not visible on the PROFIBUS DP side) to distinguish between primary and backup modules.
 - A segment coupler is essentially a media converter between the DP and PA network.
- PROFIBUS PA devices *appear* to controllers and Device Managers as *DP Devices*.

- In the ToolboxST application, a PROFIBUS PA device is added to the PROFIBUS network in the same manner as a DP device.

Note The PROFIBUS PA device must have a unique PROFIBUS drop number, just like the other DP devices on the same PROFIBUS network (PPRF I/O module).

- The segment coupler by Pepperl + Fuchs has buffering and does not require the DP network baud rate to be reduced to PA Network speed.

The linking device option can be used but requires:

- Configuration of the linking device as a *DP Device* with a DP drop number in all cases (simplex and redundant)
- All PROFIBUS PA devices and their I/O must be mapped to the linking device for the data to be accessible on the DP network, creating a *custom* DP device and preventing direct access of the PA device by a controller or Device Manager.

For more detailed information on PROFIBUS PA guidelines, refer to the Pepperl + Fuchs PROFIBUS PA Application Guideline:

http://files.pepperl-fuchs.com/selector_files/navi/productInfo/doct/tdoct1681_eng.pdf

For general component and configuration information, please consult the Pepperl + Fuchs Web site:

<http://www.pepperl-fuchs.com/global/en/3106.htm>

2.5.1 PROFIBUS PA Limitations

Referring to the Pepperl + Fuchs PROFIBUS PA Application Guideline, the following limitations apply:

- PROFIBUS PA supports up to 32 devices per segment (this includes the PA master integrated in the segment coupler).
- The field devices are bus-powered by the fieldbus cable.
- The DCS/PLC system could limit the number of PA devices due to available drop addresses. (PROFIBUS PA devices must fit in the 0 to 127 range for both DP and PA masters and devices when using a segment coupler.)
- Physical layer limitations include:
 - Field devices power supply is from the fieldbus cable
 - Average current of a PA field device is between 12 mA and 18 mA
 - Fieldbus power supply shall support a supply current for the total of all devices (minimum of 360 mA, typical of 500 mA).
- Cable length is a function of connected nodes in accordance with IEC 61158-2.

Number of addresses in use	Maximum spur cable length
1/12/2013	120 m (393.7 ft)
13-14	90 m (295.3 ft)
15-18	60 m (196.9 ft)
19-24	30 m (98.4 ft)
25-32	≤ 1 m (3.3 ft)

This is a sample of the details to consider when designing PROFIBUS PA. There are additional requirements and limitations when PROFIBUS PA is applied in hazardous areas.

2.5.2 ToolboxST Settings

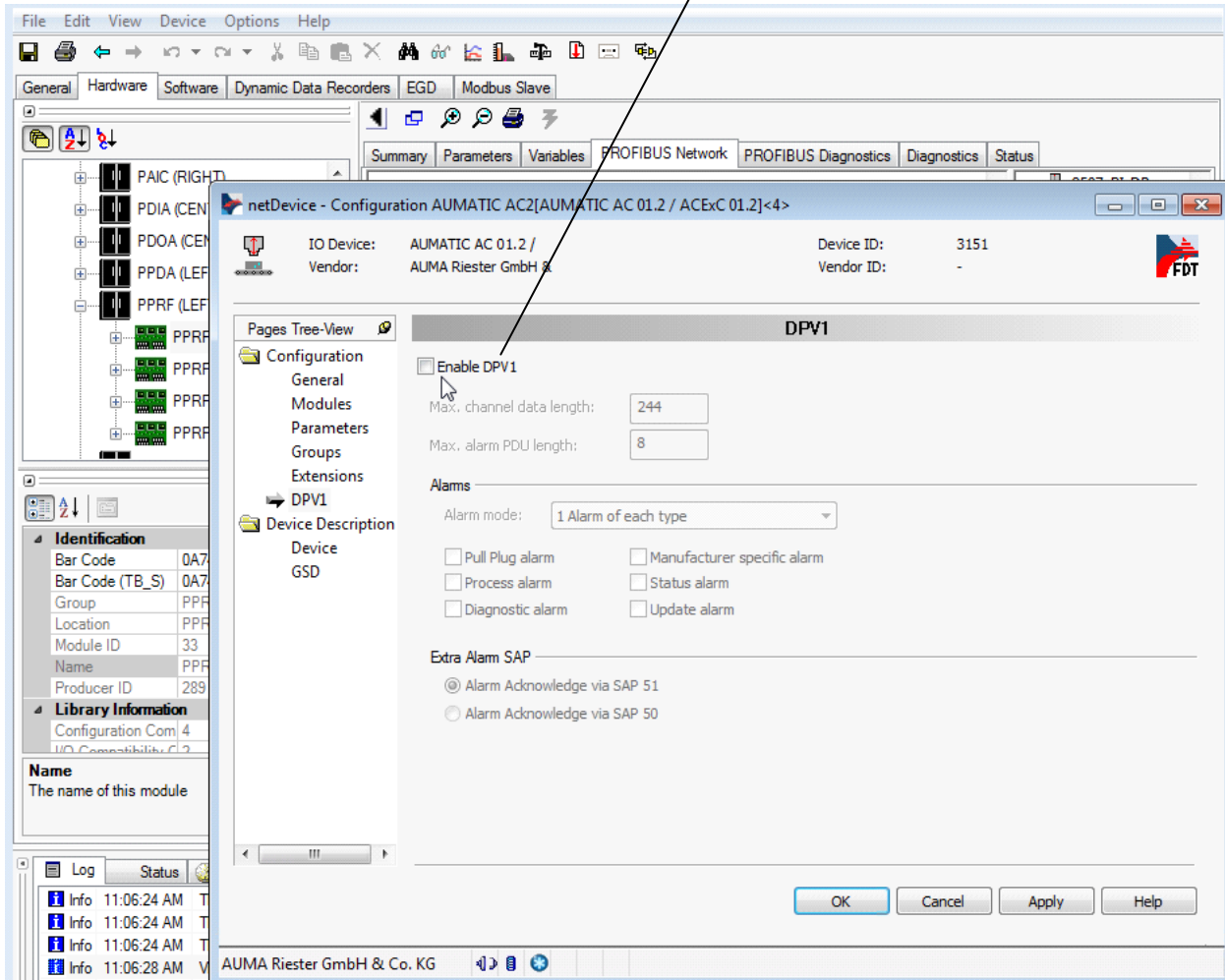
Refer to GEH-6700, Chapter 12, Special I/O Functions, the section PROFIBUS Communications.

- To configure the Enable DPV1 feature for PROFIBUS PA: from the ToolboxST System Editor, double-click a controller to display the Component Editor.

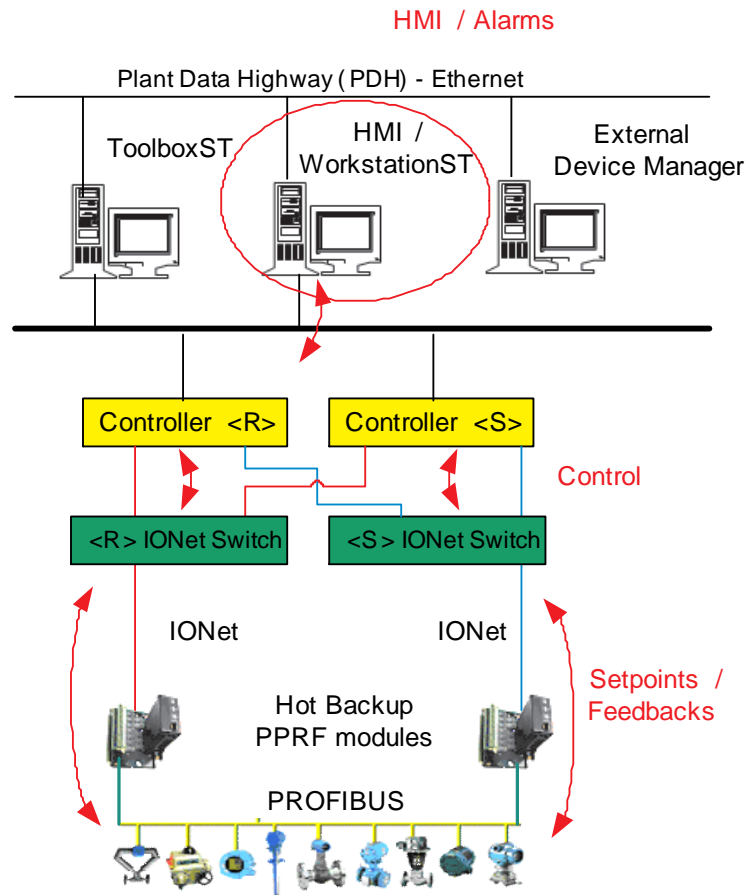
From the **Hardware** tab, right-click a **PPRF** module, select **Configuration** to display the **netDevice** screen.

From the **Tree View**, select **DPV1**, and click to clear the **Enable DPV1** box.

Repeat this procedure for each PROFIBUS PA device



3 PROFIBUS Operation



Refer to GEI-100614, Mark VIe Control PROFIBUS Master Gateway (PPRF) Module Description.

PROFIBUS device data is transmitted to the Mark VIe controller in DPV0 Cyclic messages during a master/slave data request-data response transaction. The PROFIBUS network master in the Mark VIe control system is the PPRF module. It is a PROFIBUS DPV0 or DPV1, Class 1 or Class 2 master that maps I/O from PROFIBUS slave devices to Mark VIe controllers on the IONet.

The PROFIBUS DPV0 cyclic data is requested by the master, one device at a time. The master makes the request and waits for the slave device response with the requested data. The slave can also inform the master of other diagnostic, alarm, or fault data being available. The master then requests this additional data from the slave.

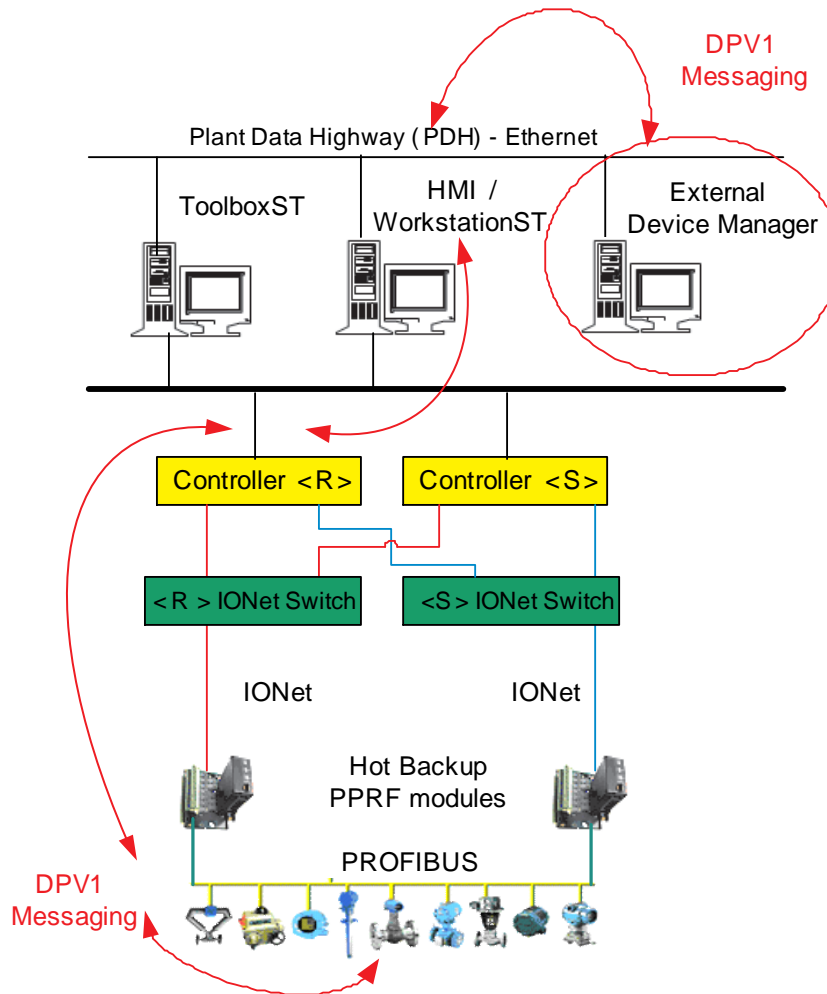
The PPRF module writes the DPV0 device data to variables on IONet pages. The Mark VIe controller reads the DPV0 data from the mapped variables on the IONet pages.

With the variables mapped to the IONet, the controller can reference the input variables in associated blocks for use in the control code. Block output references are written to the Mark VIe EGD Exchange.

Once the master completes the master/slave requests for all devices, the idle time (or gap time) available before the start of the next request cycle can be used by a Class 2 master for other activities, such as DPV1 messaging for extended data or diagnostics from slave devices. In the Mark VIe control system, the PPRF module serves as both the Class 1 and Class 2 master.

Notes

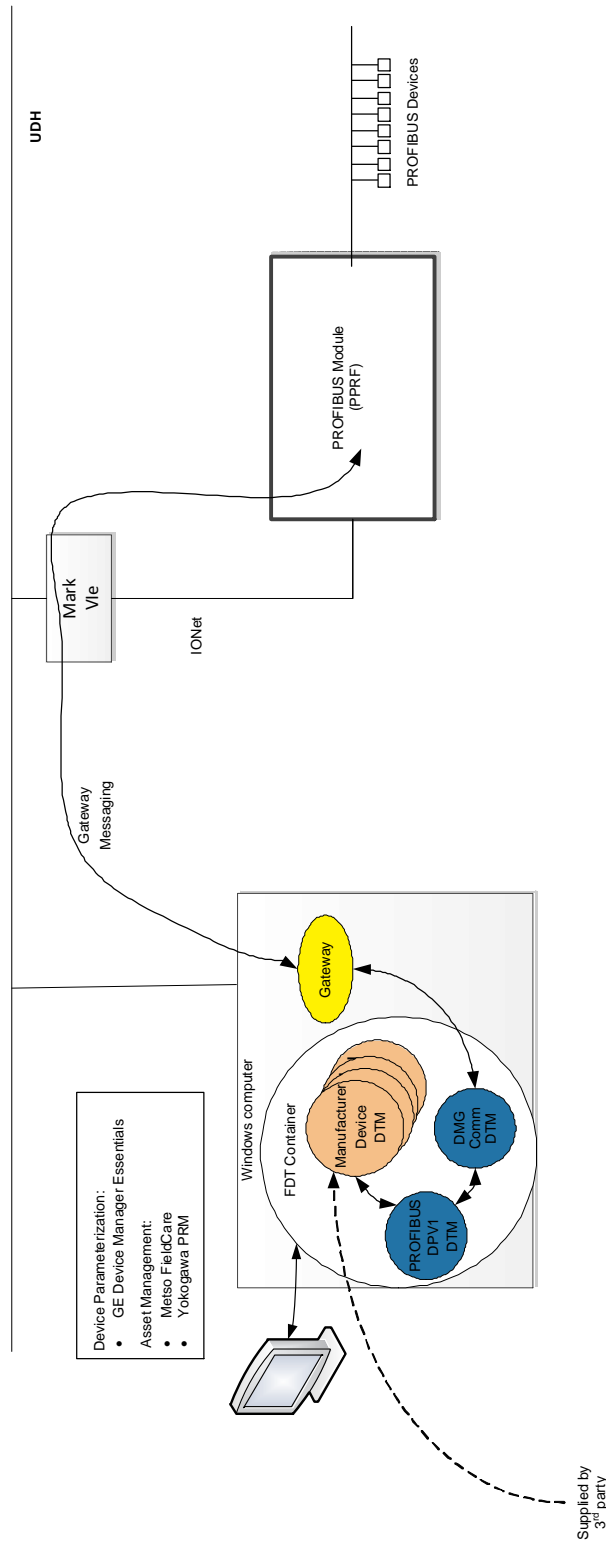
4 PROFIBUS Device Management



Device management utilizes the PROFIBUS DPV1 messaging feature to communicate with PROFIBUS DPV1 devices. External device management for PROFIBUS is performed using one of several device or asset management tools. GE has branded the M&M Software™ fdtCONTAINER as Device Manager Essentials. This is a device management tool only. It does not support historical tracking or programmatic condition monitoring of devices.

Other device or asset management tools are Metso™ Fieldcare™ and Yokogawa™ PRM with DTMs, both of which support FDT™/DTM technology. Emerson™ AMS™ does not support FDT/DTM technology, and therefore cannot be used for PROFIBUS within the GE control system. Emerson AMS is supported in the GE control system for HART® and FOUNDATION Fieldbus™.

The FDT/DTM technology provides a Windows® platform to host DTMs for communication, gateways, and devices. GE developed communication DTMs for PROFIBUS (and HART), which communicate to the gateway DTM (PROFIBUS DPV1 DTM) and to the Device Manager Gateway. The Device Manager Gateway forwards the device DTM DPV1 messages through the control system to the PPRF module through SDI messages, as shown in the following figure.



4.1 DPV1 Messaging

DPV1 messaging rules include:

- DPV1 acyclic message from a Class 2 bus master is only sent during the gap time of the DPV0 cyclic messaging.
- There is only one DPV1 message per sweep of the cyclic scan, and it occurs at a lower priority than the cyclic message.
- DPV1 message is limited to a maximum of 244 bytes.
- DPV1 devices are composed of *slots* regarding the acyclic accessible data. These slots may represent physical blocks of data.
- Slots contain information that is index addressable.
- Index addressable data represents variables or compact data blocks.
- Index data is accessed by read and write services and transmitted in a single frame.
- Concrete use of Slot Number and Index to address data blocks within the device is manufacturer-specific.

In the control system, DPV1 messaging to PROFIBUS devices are SDI re-directed messages, routed through the Mark VIe controller to the PPRF module. The response message is returned as a SDI response message. Thus, no data transmitted by DPV1 messaging is mapped on IONet exchanges (pages) as previously described for DPV0 data. Therefore, DPV1 messaging has no effect on DPV0 cyclic messaging, provided the PROFIBUS specifications of number of devices, segment lengths, and cycle times, combined with the PPRF limitations are not exceeded, which must occur with or without DPV1 messaging.

Notes

5 Online Monitoring and Parameterization with FDT/DTM

All online monitoring and parameterization for PROFIBUS in the GE control system is performed through the FDT Frame Application and the Device DTM supplied by the manufacturer. The extent and capability of the online monitoring and parameterization is strictly a function of the manufacturer's DTM.

GE has developed the internal communication methods to allow *transparent* communication between the Device DTM in the FDT frame and the PROFIBUS device. The Device Manager Gateway, SDI messaging, and PPRF communication to the PROFIBUS network is all done without any knowledge of the specific PROFIBUS DPV1 message content.

Refer to GEH-6821, Device Manager User Guide for additional troubleshooting information for the GE components.

Due to the many layers of application software, there will be a process of elimination required to find the source of a problem for a user experiencing issues with *device management*. This process of elimination should include the following considerations:

Frame Application – Is it GE DME, Metso Fieldcare, Yokogawa PRM, PACTware, or other?

Manufacturer Device DTM – Is the DTM certified by the FDT Group™? Is it compatible with the device firmware? Is it the latest version DTM available? (Check with the manufacturer or their Web site.)



Device parameter modifications made through online monitoring and parameterization through Device DTMs are independent of the ToolboxST configuration. To ensure future configuration downloads do not overwrite online changes you must also make the online changes in the ToolboxST configuration.

Notes



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