Profibus-DP Master

Overview

This technical note describes how to install and configure the example Profibus-DP® Master Software in order to use Opto 22's PAC Control™ to communicate with Profibus-DP slave devices through a SNAP-SCM-PROFI module. The SNAP-SCM-PROFI serial communication module is an electrical interface that provides serial hardware to enable an Opto 22 controller to communicate with a Profibus-DP system.

The example software is provided for you to use as a starting point to develop your own. It is expected that you will need to modify the example software in order to address the configuration requirements of your specific system.

This technical note includes the following topics:

The information in this technical note assumes that you are an advanced user who fully understands how to use PAC Control and is familiar with the Profibus-DP protocol.

System Description

The user interface for the example Profibus-DP Master software is comprised of an example *PAC Control strategy* and an example *configuration utility*.

The example **Profibus-DP Master Strategy** is comprised of PAC Control charts, subroutines, and tables, which complete the communication link with an Opto 22 SNAP-PDPRS64 Profibus-DP digital slave brain (see NOTE below). One chart reads the configuration information from the configuration utility and transfers the information to tables in the PAC Control strategy. Other charts use the information in the tables to configure the Profibus-DP devices. One large subroutine performs the Profibus-DP protocol communication with the Profibus-DP devices.

NOTE: The Opto22 example PAC Control strategy as-is only works when using an Opto 22 SNAP-PDPRS64 Profibus-DP digital slave brain. In order to communicate with any Profibus-DP slave device not manufactured by Opto 22, you must modify the example software.

The example **Profibus-DP Master Configuration Utility** loads information from the device's GSD file into the master strategy. It provides system and device parameters for you to set up communication. You select a Profibus-DP device configuration file (a GSD file) and the utility parses information from it. Based on the information provided in the GSD file, you set the system and device parameters and then send the configuration information to the controller, which is saved to the controller's flash memory.

What is a GSD File?

Each Profibus-DP device has a GSD file that provides enough information to enable serial communication with the device. This includes information such as baud rate, parity, number of stop bits, etc. as well as basic device configuration information (such as which points are inputs and which are outputs). The GSD file is created and made available by the manufacturer of the device.

NOTE: A GSD file does not contain all the information you will need to exchange user data (read/write) with a third-party Profibus-DP device.

Communicating with a Third Party Profibus-DP Device

If you want to use the SNAP-SCM-PROFI serial communication module to exchange (read/write) user data with the device to a third part Profibus-DP device, you must modify the Profibus-DP master example strategy to include information on the commands for the specific device.

This information includes:

- What commands or parameters must be sent to the device to operate it properly (including what order to send the commands or parameters)
- What parameters must be sent to the device to set or read control parameters
- The number of bytes per command
- What order the commands must be sent

If the manufacturer of a device provides their own software to communicate with it, then usually they have programmed into their software all the details of their device. For example, if you are using a SNAP-PDPRS64 digital slave brain, this information is included in the Profibus-DP master strategy. However, if you are communicating with any device other than the SNAP-PDPRS64, then the programmer or system integrator must take these additional details into account.

Sometimes this information can be found in the manufacturer's device documentation, which can be very helpful if it provides example communication exchanges showing how to configure, initialize, and control the device. However, the manufacturer of a third-party slave device may or may not have this information readily available. If you cannot find the information in the documentation, it may be necessary to contact the manufacturer's technical support group. If you still cannot find the information, you may need to use a Profibus-DP bus analyzer to monitor the data being sent to the device and received from the device when using the device manufacturer's software utility. Or at the very least, you

can use an RS485 monitor to record the conversation in Hex between the Opto22 SNAP-SCM-Profi Module and the device.

System Requirements

Here is what you need to install the example Profibus-DP Master software and connect to a Profibus-DP network:

- A computer with Ethernet capability and with Opto 22 PAC Control Basic or Professional installed. You can also use ioControl™ 7.0 or later.

- Opto 22 SNAP PAC or SNAP Ultimate controller with firmware version 7.0 or later. For more information, see the SNAP-SCM-PROFI module data sheet, form 1585.

- SNAP-SCM-PROFI communication module

- Standard Profibus-DP cables

- Profibus-DP network with a SNAP-PDPRS64 Profibus-DP brain or other compatible Profibus-DP slave devices (requires modifications to the Profibus-DP master example strategy)

System Parameters

When setting up your Profibus-DP network, keep the following things in mind:
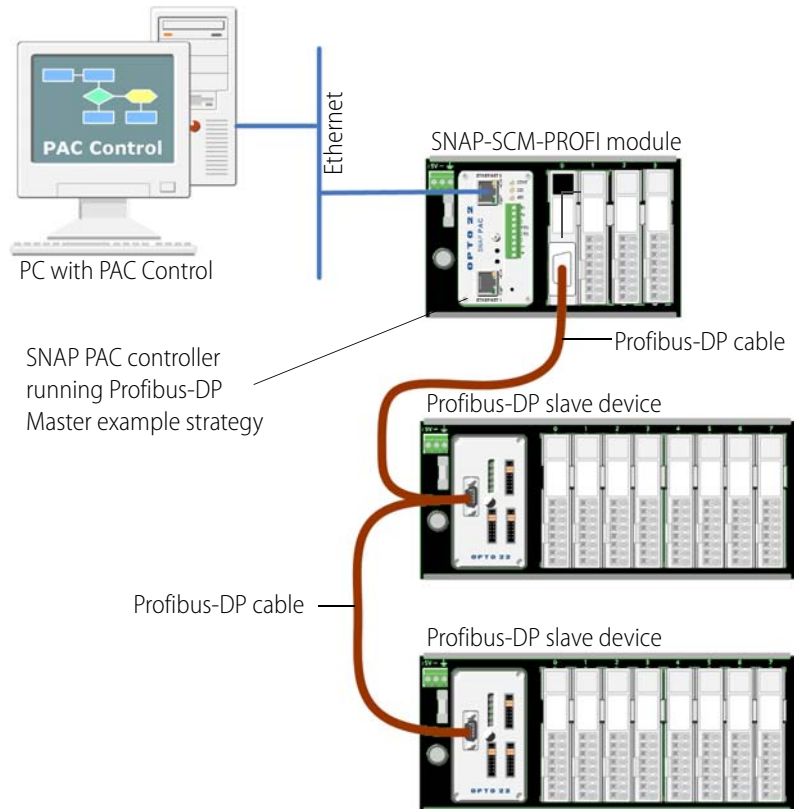
- There can be only one master on the Profibus-DP network. Therefore, the Opto 22 SNAP PAC or SNAP Ultimate controller must be the only master.

- There can be up to 32 stations on the link. To increase the number of stations beyond 32, you must use repeaters as per the Profibus-DP specification. The maximum number of slave stations on a network with repeaters is 125. In practice it may be less due to the network configuration.

- The Opto 22 master is assigned address number 1 on the Profibus-DP network. This is not changeable.

- Addresses for slave devices are limited to the range of 2–126. (Address 1 is used by the Profibus master and address. 127 is a reserved broadcast address per the Profibus-DP standard.)

- The current maximum baud rate is 1.5 Mbaud.

System Architecture

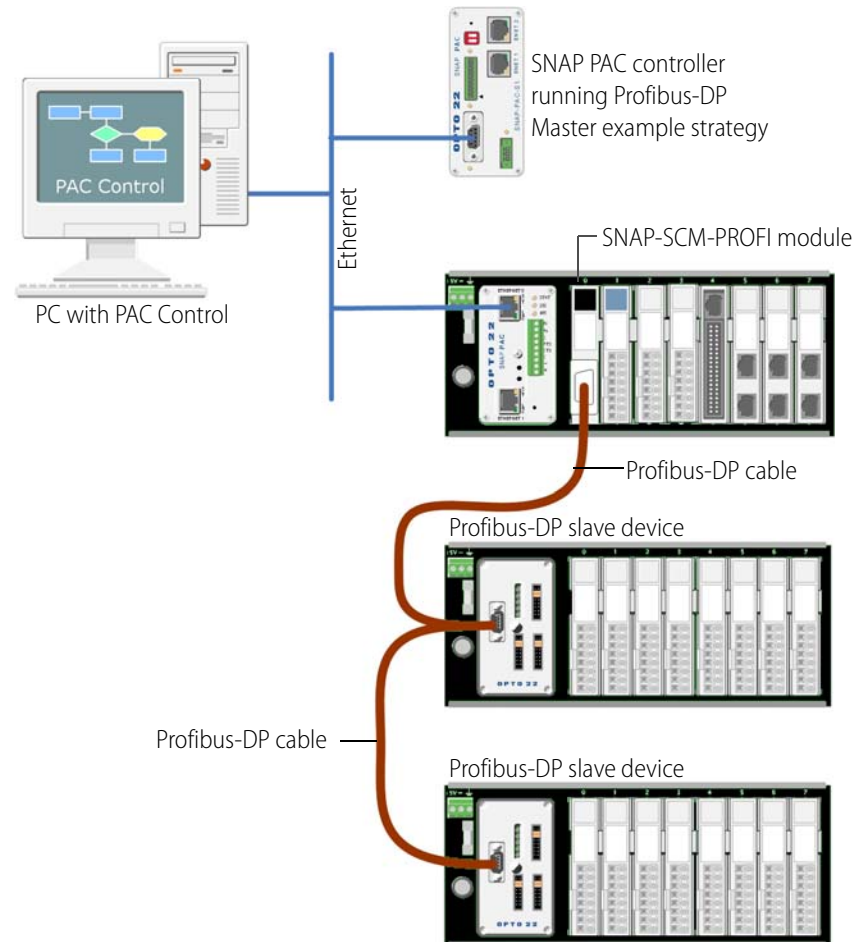The following diagrams show two basic ways to set up your Profibus-DP network.

Controller on Rack with SNAP-SCM-PROFI Module

As shown here, the SNAP-SCM-PROFI module can be on the same rack as the controller.

PC with PAC Control

Ethernet

SNAP-SCM-PROFI module

Profibus-DP cable

SNAP PAC controller running Profibus-DP Master example strategy

Profibus-DP slave device

Profibus-DP cable

Profibus-DP slave device

Standalone Controller

In this configuration, the SNAP-SCM-PROFI module is on an I/O unit. There is a separate, standalone controller.

SNAP PAC controller running Profibus-DP Master example strategy

SNAP-SCM-PROFI module

PC with PAC Control

Profibus-DP cable

Profibus-DP slave device

Profibus-DP cable

Profibus-DP slave device

Ethernet

Setting Up a Profibus-DP Connection

To install the example Profibus-DP Master software and connect to a Profibus-DP network, you must do the following things:

- Install the example Profibus-DP Master configuration utility.
- Install the SNAP-SCM-PROFI module.
- Download the example Profibus-DP Master strategy to the PAC Control controller.
- Set the system parameters.
- Set the slave device parameters.
- Run the strategy.

Each of these procedures is described below.

Installing the Example Configuration Utility

Install the Profibus-DP Master configuration utility on the same computer where PAC Control is installed as follows:

1. Create a Profibus folder under the Opto22 folder on your local hard drive.
2. Unzip the files in Opto22 Profibus VB Utility Install Files.zip to the new Profibus folder.
3. Double-click Setup.exe to begin installation, then follow the on-screen instructions.

If you have trouble installing the example Profibus-DP Master software, contact Opto 22 Product Support at 800-835-6786.

Installing the Profibus-DP Module

Make sure that power to the rack is turned *off*. Install a SNAP-SCM-PROFI module on the same mounting rack as your Opto 22 controller, and make note of the module position (0 through 15) of the SNAP-SCM-PROFI module. You will need the module position later when you set the system parameters.

Downloading the Example Profibus-DP Master Strategy

Using PAC Control, download the Profibus-DP master strategy to a PAC Control controller as follows:

1. Create a PAC Control folder under the new Profibus folder.
2. Unzip the files in Profibus-DP Master for PAC Control Basic.zip to the new PAC Control folder.
3. Open PAC Control.
4. Browse to directory for the Profibus-DP Master software, and open Profibus-DP Master.idb.
5. Edit the configured controller so that it matches your controller.

6. Click the Debug Mode button ![icon] on the toolbar (or select Debug from the Mode menu).

For more information on compiling the strategy, see form 1700, the *PAC Control User's Guide.*

Setting the System Parameters

1. Click the Start button and select Programs > Opto 22 > ProfibusDP Master for Opto22 PAC Control.
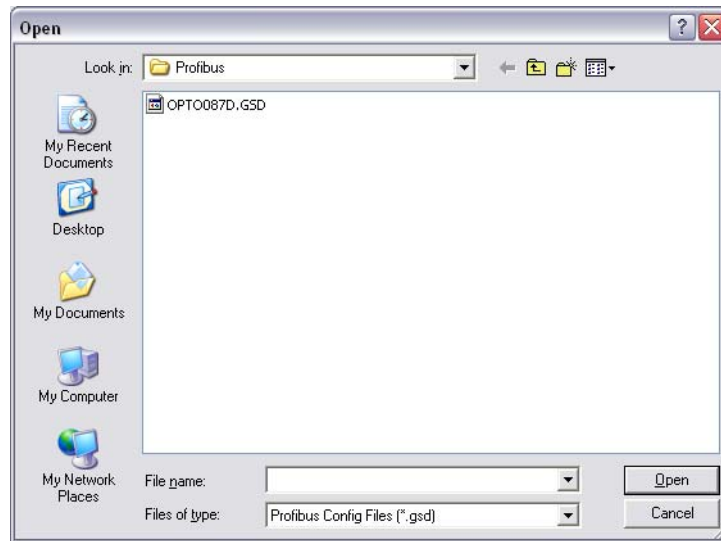
The initial configuration window opens.
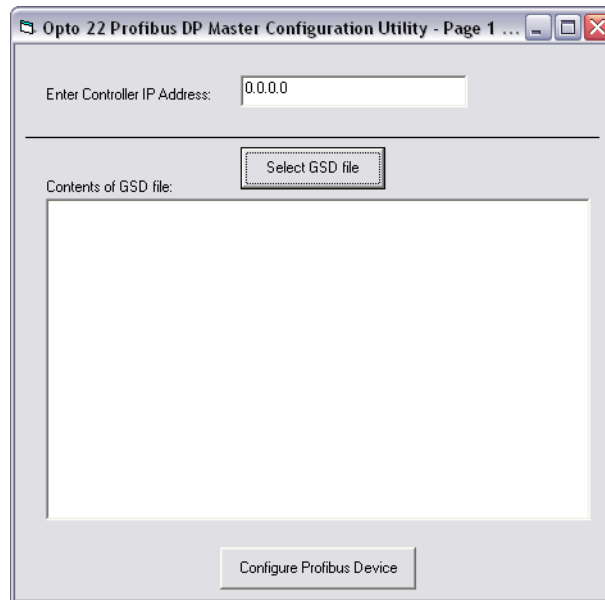
2. Enter the IP address of the PAC Control controller that will be running the Opto 22 Profibus-DP Master driver.

3. Click Select GSD file.

NOTE: To obtain a GSD file for your Profibus-DP slave device, contact the manufacturer of the device.

The configuration file appears.
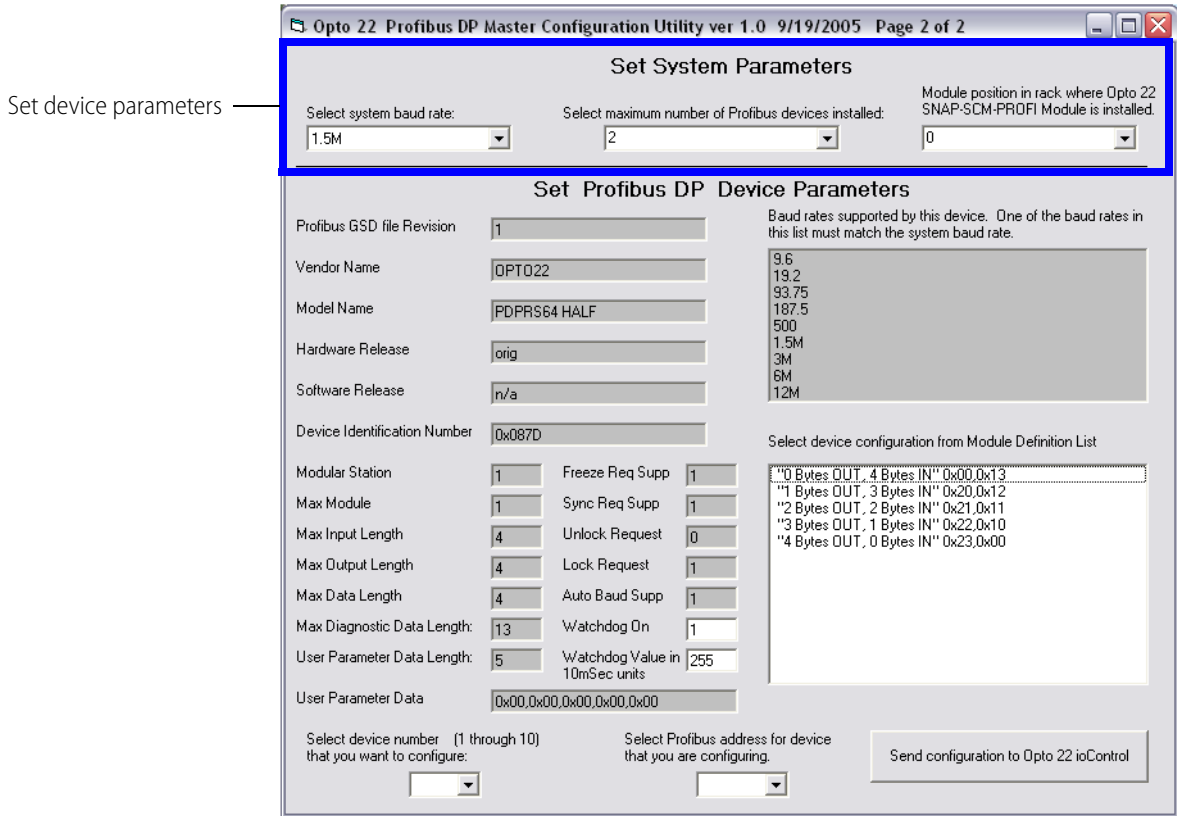

4. Double-click the GSD file to open it.

The contents of the GSD file appear.
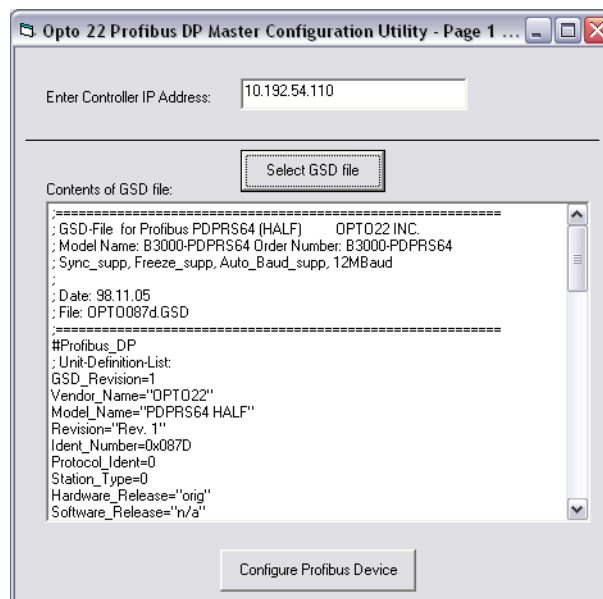
5. Verify that the contents of the GSD file are correct for the Profibus-DP slave device you want to configure, then click Configure Profibus Device.

The configuration window appears.

Set device parameters

6. At the top of the configuration window, select the system baud rate for communication on the Profibus-DP network.

   The baud rate must be the same for all devices on the Profibus-DP network.

7. Select the maximum number of Profibus-DP slave devices installed.

   NOTE: The slave devices are installed in sequence, starting with device #1.

   The controller will only poll the number of installed Profibus-DP devices, which improves the system response time.

8. Select the module position in the mounting rack (0 through 15) where the SNAP-SCM-PROFI module is installed.

   This is used to tell the controller which module to communicate through to the Profibus-DP devices.

Setting the Slave Device Parameters

The configurable device parameters are at the bottom of the parameters window. The grayed out areas show the contents of the configuration (GSD) file and are not configurable. For each slave device you will set three parameters (device number, Profibus-DP address, and configuration), and then click Send.

Set device parameters

To set the system parameters:

1. Select the device number for the slave device.

    You must assign a different device number for each slave device, up to a maximum of 10. It is possible to expand the maximum number of slave devices, depending on the memory available in your Opto 22 controller. For more information, contact Opto 22 Product Support at 800-835-6786.

2. Select the Profibus-DP address for the device.

    Each slave device must use a different Profibus-DP address. If the device is a SNAP-PDPRS64 Profibus-DP brain, the address is set on the brain itself using jumpers. For more information on the SNAP-PDPRS64, see form 1109.

3. Select a device configuration from the module definition list.

    If the slave device is a SNAP-PDPRS64 Profibus-DP brain and you want 16 outputs and 16 inputs, you can choose "2 Bytes OUT, 2 Bytes IN". For other input/output

configurations, see the SNAP-PDPRS64 data sheet, form 1109. Or, you can edit the POLL_PROFIBUS_DEVICES chart as needed.

If you are using a Profibus-DP slave device from a manufacturer other than Opto 22, see the manufacturer's documentation.

4. Click Send Configuration to PAC Control.

The settings transfer to the controller and the following message appears, "File Successfully Transferred to Opto 22 PAC Control controller."

5. Repeat steps 1-4 for each slave device you want to connect.

Running the Strategy

1. Using a Profibus-DP cable, connect the SNAP-SCM-PROFI module to the Profibus-DP slave devices. If you have more than one device, you can daisy-chain the devices.

2. Run the PAC Control strategy. If it is already running, stop it and start it again. Or, remove power, wait five seconds and then re-apply power.

    a. Start PAC Control by clicking the Start button and selecting Programs > Opto 22 > PAC Project > PAC Control.

        The PAC Control main window opens.

    b. Click the Open Strategy button 📂 on the toolbar, or choose File > Open Strategy.

    c. In the Open Strategy dialog box, navigate to the directory where you installed the Profibus-DP Master for PAC Control.

        The strategy file Profibus-DP Master.idb appears.

    d. Double-click the Profibus-DP Master.idb file to open it.

        If you are using the SNAP-PDPRS64 Profibus-DP brain you should see outputs turn on and change state.

Viewing the Status of Digital Inputs

You can view the status of the digital inputs as follows:

1. In Debug mode, expand the Variables directory, and then expand String Tables.

2. Double-click one of the tables named stPB_Device_Params_Str_Tbl_xx table, where xx identifies a particular Profibus-DP device, 1 through 10.

The value of the inputs appears at index 4, Receive String. For more information on this table, see .

Strategy Tables

The Profibus-DP Master Strategy uses the following tables to configure and communicate with the Profibus-DP slave device:

• ntPB_Device_Params_Int_Tbl_xx

• stPB_Device_Params_Str_Tbl_xx

• ntPB_ProfibusDP_Parameters_Int_Table

• stPB_ProfibusDP_Parameters_Str_Table

• UIO_Port_Parameters_Int_Table

• PB_System_Parameters_Int_Table

Each of these tables is described in the sections below.

Profibus-DP Device Parameters Integer and String Tables

For each Profibus-DP device there are tables named:

• ntPB_Device_Params_Int_Tbl_xx, and

• stPB_Device_Params_Str_Tblx_xx

where xx identifies a particular device, 01 through 10. These tables contain integer and string values that the PAC Control strategy requires to be able to configure and communicate with the Profibus-DP slave device.

The indexes in these tables display the same information as for ntPB_ProfibusDP_Parameters_Int_Table and ntPB_ProfibusDP_Parameters_Str_Table, which are described in the next section.

Profibus-DP Parameters Integer and String Tables

In addition, the program uses the following tables to communicate with Profibus-DP devices:

• ntPB_ProfibusDP_Parameters_Int_Table

• ntPB_ProfibusDP_Parameters_Str_Table

These tables contain information which is passed to the main Profibus-DP Protocol subroutine, which uses the information in these tables to communicate with the Profibus-DP slave device. The Profibus-DP Protocol subroutine then passes any results, such as I/O status, from the Profibus-DP slave device back to the main program in the same tables.

ntPB_ProfibusDP_Parameters_Int_Table

Index	Description
0	State (0:init,...,7:Exchange)
1	Error (see error code list below)
2	Master Address
3	Device Address
4	Comm Port
5	Retries (if less than 1, then 1 try is always attempted)
6	Gap (ms) (if less than 150 ms, then 150 ms is used)
7	Frame Count FCV,FCB (initial value 0, afterwards the sub handles it)

stPB_ProfibusDP_Parameters_Str_Table

Index	Description
0	Profibus Device Name
1	Device Set Parameters String
2	Device Configuration String
3	Send String
4	Receive String
5	Baud Rate
6	(Not currently used)
7	(Not currently used)

UIO Port Parameters Integer Table

ntPB_UIO_Port_Parameters_Int_Table is primarily used to configure the serial port of the SNAP SCM-PROFI module.

Index	Description
0	(Not currently used)
1	(Not currently used)
2	(Not currently used)
3	Comm Handle Status (Open/Closed) (kept by subroutine - must be initialized to 0)
4	T0 - System Time when Open Session Issued (kept by subroutine)

Profibus System Parameters Integer Table

ntPB_System_Parameters_Int_Table is used primarily by the main program to configure the system parameters for all of the devices on the Profibus-DP network. It is not used by the Profibus-DP Protocol subroutine.

Index	Description
0	Baud Rate for all Profibus devices on system.
1	Max Number of Profibus Devices to poll.
2	Mounting Rack Slot Number (0 to 15) where Profibus module is installed.
3	(Not currently used)

Strategy Charts

The Profibus-DP Master strategy has the following charts:

- Powerup
- Configure_Ethernet_Serial_Port
- Poll_Profibus_Devices
- Load_Tables_from_FTP_file
- Calc_Receive_Timeout_and_Gap_Time

Each of these charts is described below.

Powerup Chart

The Powerup chart starts first when the controller receives power. It does the following:

1. Calls a chart that loads the contents of the Profibus-DP text files into the PAC Control tables.
2. Initializes the variables used to configure the serial port of the SNAP-SCM-485 module or SNAP-SCM-PROFI module.
3. Calls a chart that initializes the serial port of the SNAP-SCM-PROFI module.
4. Calls a chart that calculates the Receive_Timeout and Gap_Time_between_Transmits for the specific baud rate used by the Profibus-DP network.
5. Starts the Poll_Profibus_Devices chart.

Configure Ethernet Serial Port Chart

The Configure_Ethernet_Serial_Port chart is called by the Powerup chart. It does the following:

1. Calculates the correct values that are necessary to configure the SNAP-SCM-PROFI module.
2. Calculates the correct addresses for the controller memory map, which are necessary to configure the SNAP-SCM-PROFI module.
3. Writes the necessary values to the controller memory map.

Poll Profibus Devices Chart

The Poll_Profibus_Devices chart in this example does the following:

1. Calculates a value for the digital outputs. This value changes each time through the loop so that you can see the outputs change.
2. Copies the string containing the output value to the send string, Profibus-DP Device Parameters String Table index 3.
3. Copies the contents of the Profibus-DP Device Parameters Integer tables and the Profibus-DP Device Parameters String tables into the global tables that the Profibus-DP Protocol subroutine uses to communicate with the Profibus-DP network.
4. Calls the Profibus-DP Protocol Subroutine which performs the communication to the Profibus-DP slave device.
5. Copies the results from the Profibus-DP Protocol subroutine back into the Profibus-DP Device Parameters Integer tables and the Profibus Device Parameters String tables.

Error Codes

The following error codes may occur for the main subroutine. They appear in index 1 of ntPB_ProfibusDP_Parameters_Int_Table.

#	Description
0	No Error
-1	No Reply Or Session Closed
< -1	Errors as reported by Opto 22 controller while handling serial port. For more information, see form 1700, the *PAC Control User's Guide* . See also, form 1701, the *PAC Control Command Reference.*
1	Framing Error: End-Delimiter invalid or Length not matched
2	Checksum Error
3	Address fields in reply not matched
4	FC in reply not as expected
5	Invalid Start Delimiter
6	NAK Slave Diag
7	Device Identifier not matched
8	NAK Set Param
9	NAK Configuration Get
10	NAK Configuration Check
11	NAK Exchange
12	NAK FDL Status