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CompactRIO PROFIBUS DP

DP Master - Getting Started

V1.6/03.03.2010

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Revision History

Version	Date	Description	Resp.
V1.6	03.03.2010	Minor Fixes	SF
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V1.4	16.06.2009	Minor fixes	BS, MF
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1 Introduction

This document describes the set into operation procedure of the CompactRIO PROFIBUS DP module (cRIO PB) as DP-Master.

1.1 Prerequisites:

- A COMSOFT cRIO PB Master/Slave module and COMSOFT cRIO PB driver software on CD
- National Instruments CompactRIO system with real time controller and chassis
- The National Instruments LabVIEW Real time and FPGA Development System from Version 8.5 installed on a Windows PC
- NI-RIO Version 3.1.0 or higher needs to be installed.
- Please check your cRIO PB module if it supports Master/Slave operation mode. You can find the supported operation mode on the sticker on the back side beside the SPI plug:



Figure 1: Supported PROFIBUS operation mode

Note: The CompactRIO PROFIBUS DP modules require 2.5 W of power, so you must use it in Slot 1 while leaving Slot 2 empty.

Note: The CompactRIO PROFIBUS DP modules is supported only in CompactRIO reconfigurable chassis, such as an NI cRIO-911x, and NI Single-Board RIO devices.

Note: If your cRIO PB module only supports Slave mode it cannot be operated as DP Master.

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2 Installation

- Install the cRIO PB module in the CompactRIO chassis in slot 1
- Switch on the CompactRIO system
- Start the Setup from the COMSOFT driver CD delivered with the package.
- Check by the NI MAX (Measurement & Automation explorer) the proper installation of the cRIO system:

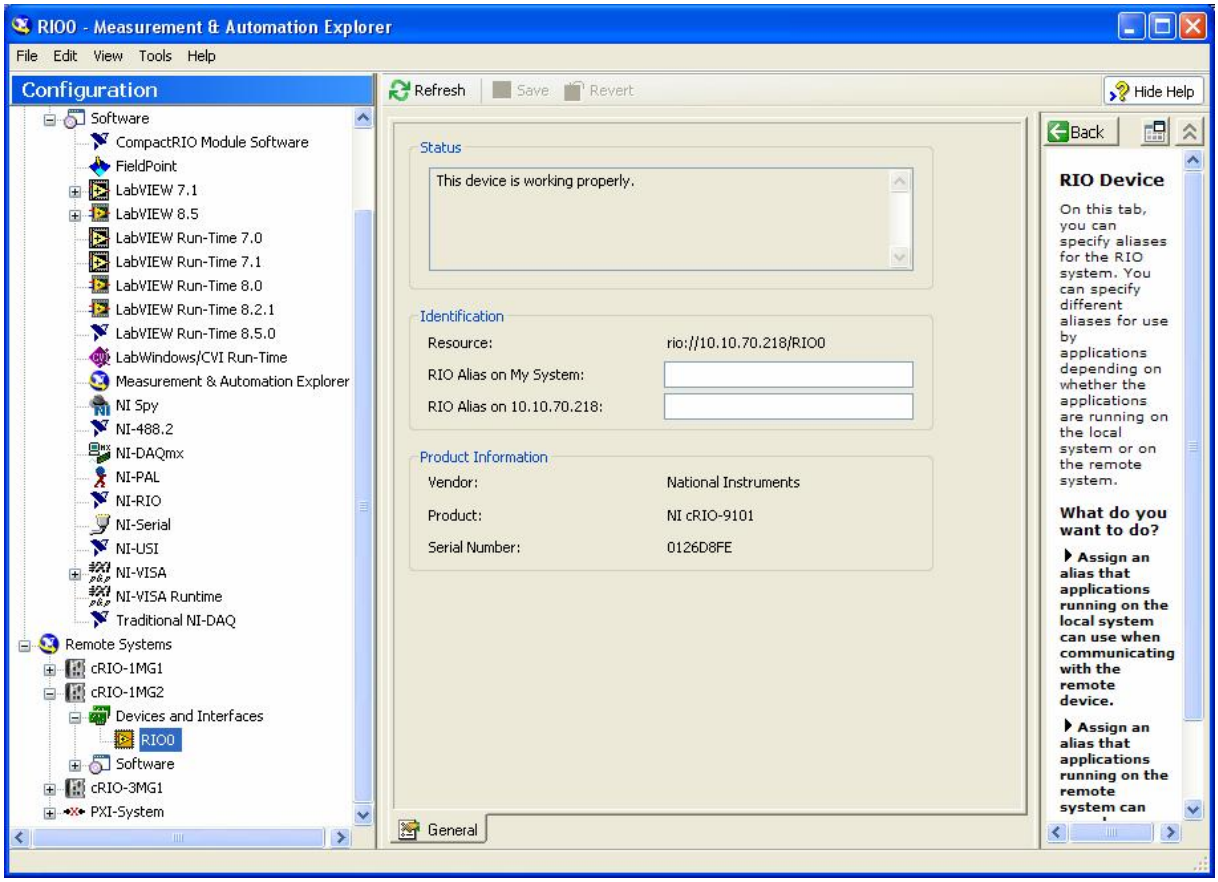


Figure 2: Measurement and Automation Explorer

Note: The CompactRIO PROFIBUS DP modules require 2.5 W of power, so you must use it in Slot 1 while leaving Slot 2 empty.
Note: The cRIO PB module will not be displayed here.

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- To allow the access to each cRIO System with an installed cRIO PB module check the VISA Server permissions. Create a new server permission as described in the picture below. Refer to the MAX help menu for more information.

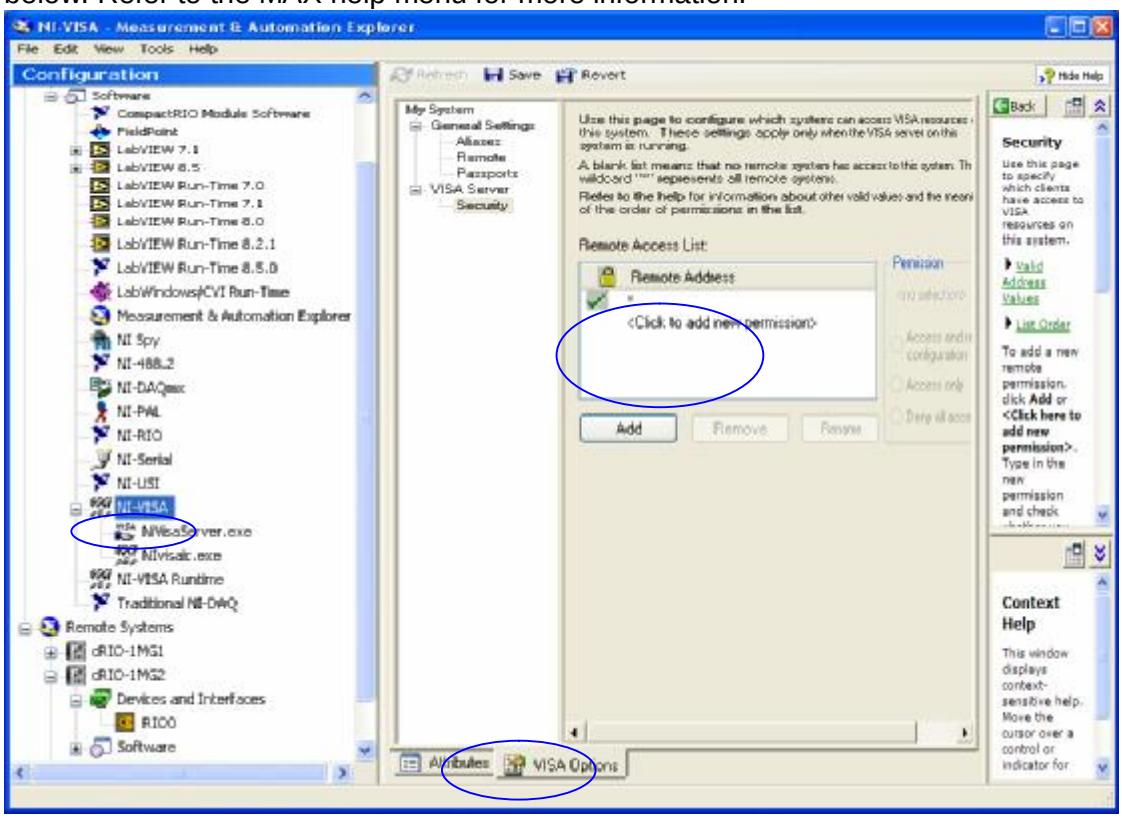


Figure 3: NI-VISA Server Security

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- To access the cRIO systems enable the corresponding remote address. Refer to the MAX help menu for more information.

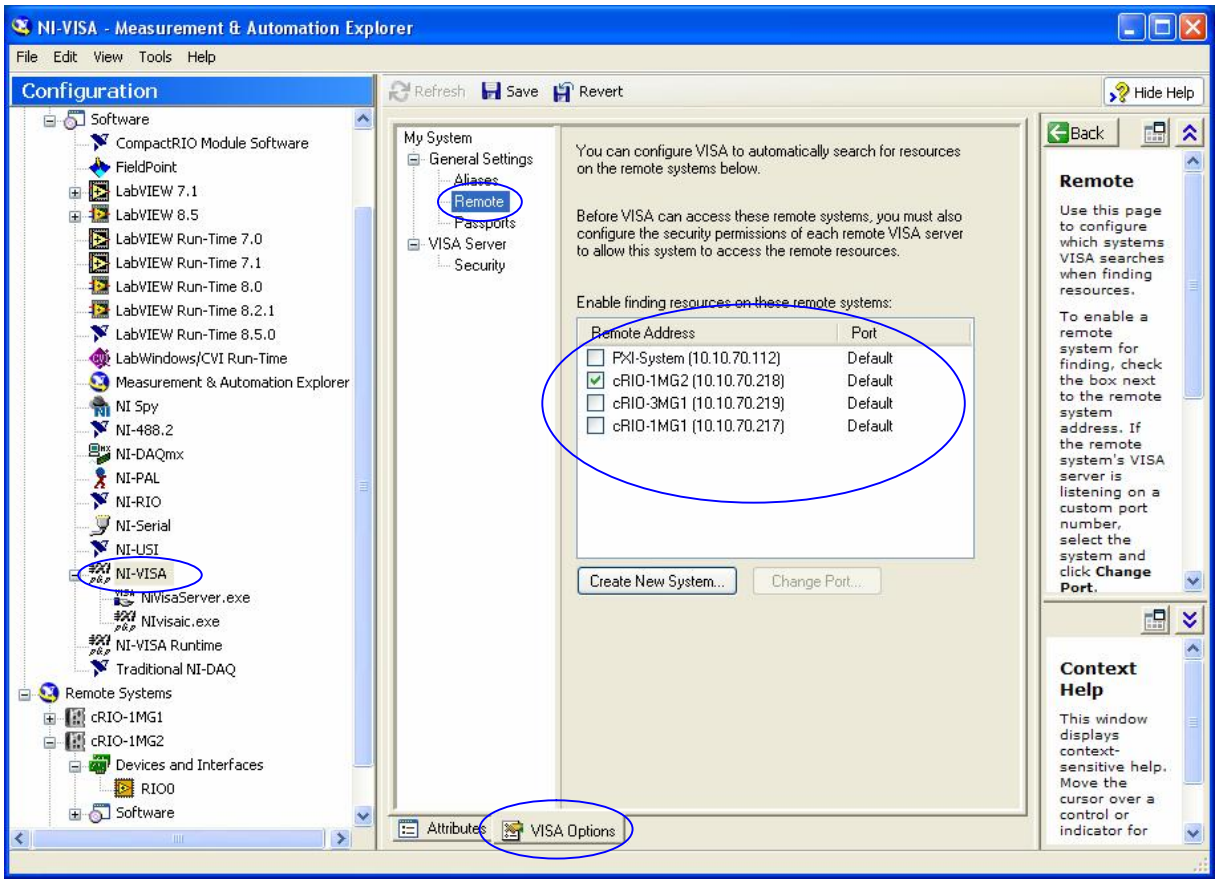


Figure 4: NI-VISA Remote Settings

Note: If the remote address is not listed, use the Create New System-button to create it manually.

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3 PROFIBUS configuration

The PROFIBUS configuration is carried out by the COMSOFT PROFIBUS configuration tool Configurator II.exe.

- Start Configurator II from the Comsoft GmbH / Profibus Configurator / Configurator II menu. The Configurator II allows to create the complete PROFIBUS configuration based on DP-Slave GSD-Files. Refer to the programs online help menu for all details.
- Create and save the configuration.

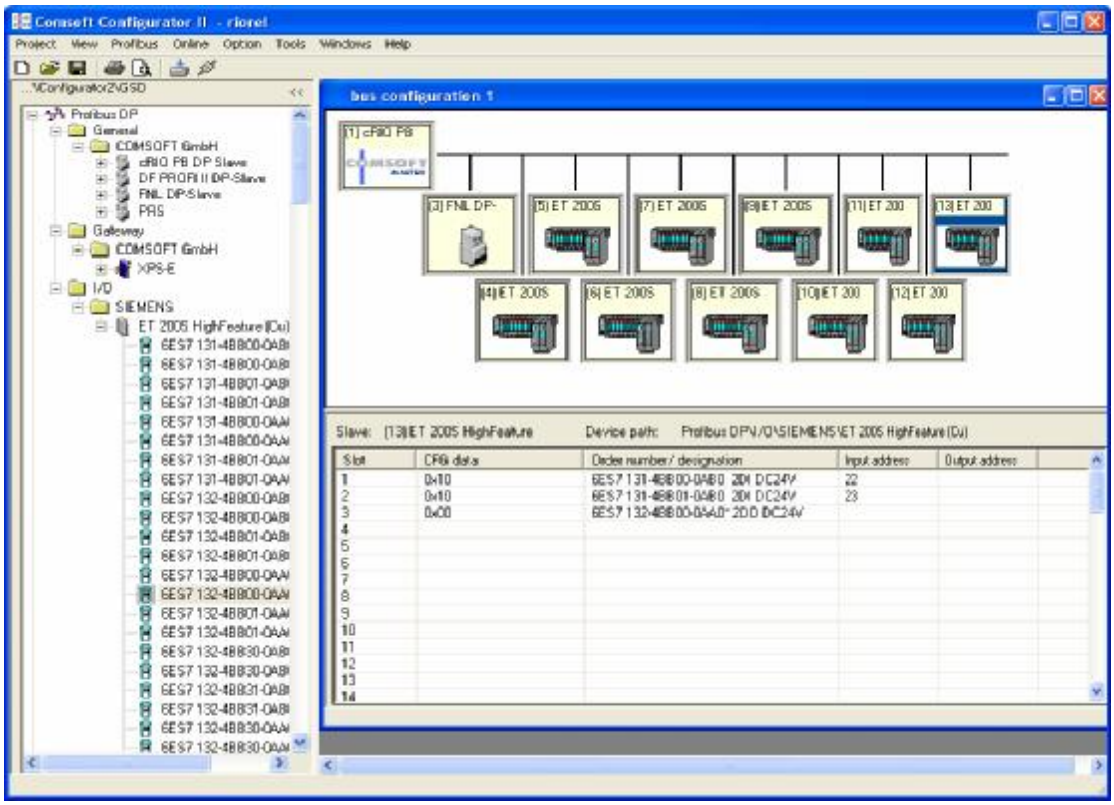


Figure 5: Comsoft Configurator II

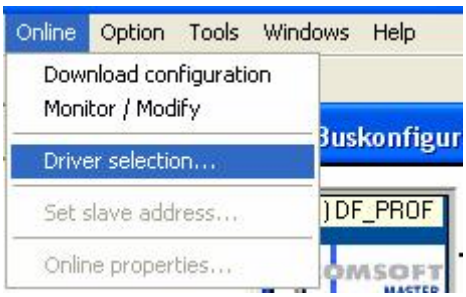
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3.1 PROFIBUS-DP configuration download

Configurator II provides an integrated download function to flash the PROFIBUS-DP configuration on the cRIO PB module.

Proceed the following steps:

- **Select a cRIO PB module from Configurator II driver selection dialog:**



The installed cRIO systems with their slots are displayed:

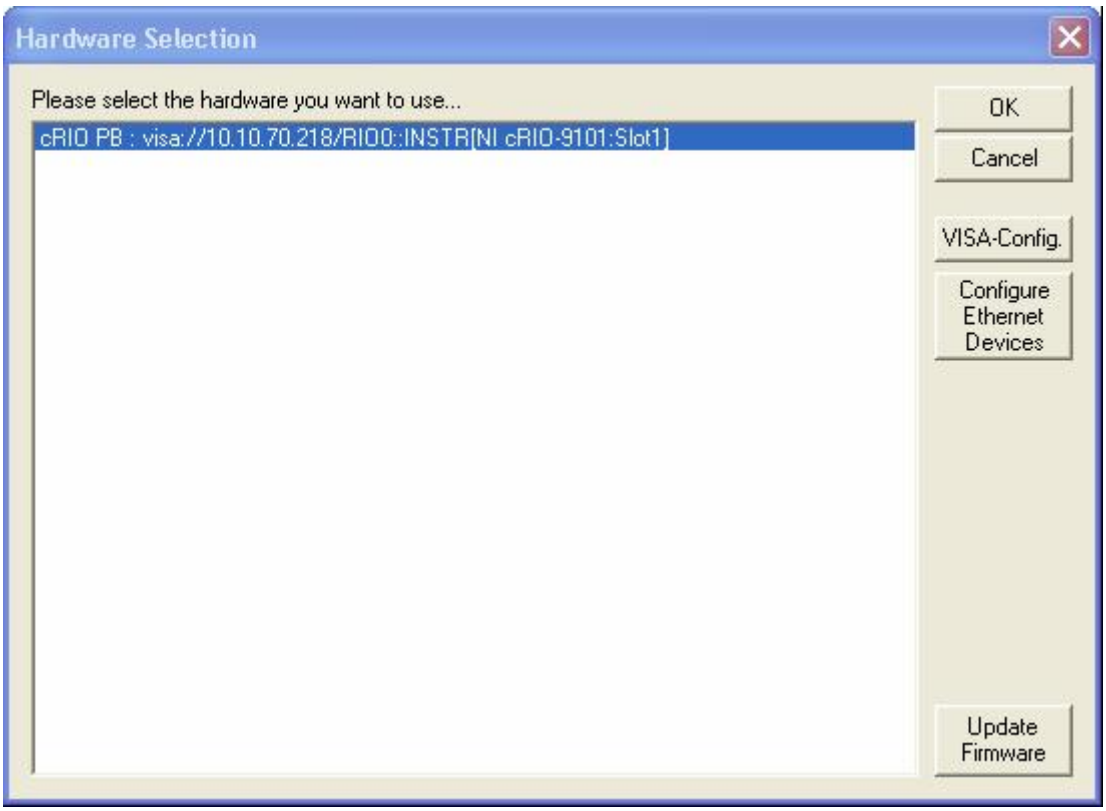


Figure 6: Selection of the cRIO PB module

If nothing is displayed click the VISA-Config-Button to rescan the available cRIO systems.

Select the correct cRIO system.

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Note: Configurator II does not detect automatically the cRIO PB module, the selection must be correct otherwise no download is possible. Refer to the Online – Help System of Configurator II for details of the driver selection.

To activate the cRIO PB module for download Configurator II will change the FPGA configuration which has to be confirmed clicking the OK button:



Figure 7: Confirmation FPGA reconfiguration

- **Download the PROFIBUS configuration**

Click the Download Symbol in the tool bar of Configurator II:



The PROFIBUS-DP configuration is downloaded to the cRIO PB module:

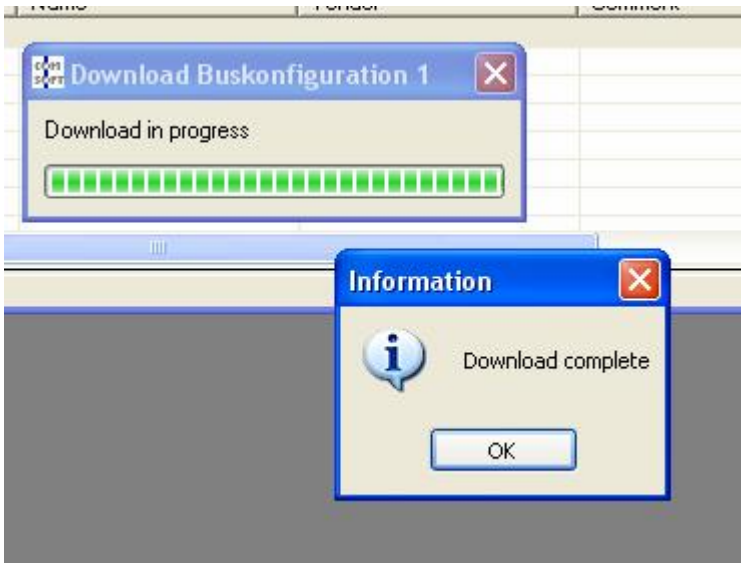


Figure 8: Download of PROFIBUS configuration

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3.2 Configurator II Monitor/Modify mode

With the Monitor/Modify mode of the Configurator II the flashed PROFIBUS-DP configuration can be tested immediately. Please note that the configured DP-Slaves must be connected to the cRIO PB module.

Click the Monitor/Modify symbol of the Toolbar of Configurator II:



Configurator II displays the PROFIBUS-Network in Online mode:

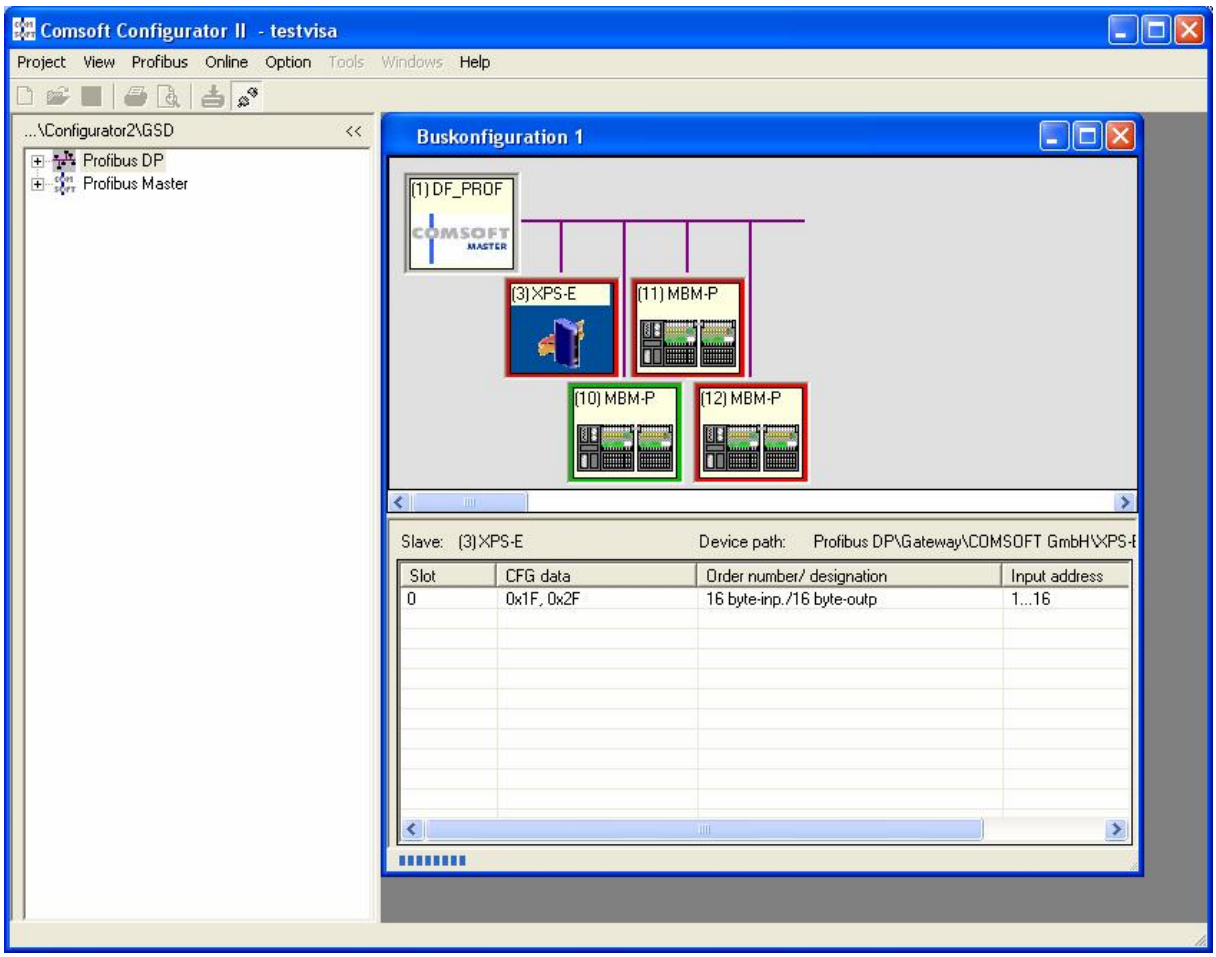


Figure 9: Configurator II – On line mode

Configurator II displays the status of every DP-Slave (coloured frame) and allows to monitor and modify the I/O data by clicking the DP-Slaves. For further details please refer to the online help system of Configurator II.

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4 cRIO PB Setting into Operation

The delivery package includes driver VIs to communicate with the cRIO PB module on FPGA level. Furthermore there is an example VI using the driver VIs demonstrating the following DP Master functions:

- Initialize and start the DP Master
- Read and Write IO data from/to the DP Slaves
- Read diagnostic data from the DP Slaves
- Stop the DP Master

Due to FPGA capacity reasons, the cRIO PB driver VIs use **FPGA memory** to exchange buffers in both directions with the cRIO PB module via the SPI bus.

The FPGA works as SPI Master, the cRIO PB module works as SPI Slave.

The cRIO PB driver software can handle single DP Slaves or the entire process image if all DP Slaves must be handled simultaneously. To handle the entire process image, the process data structure, that means in detail the location of the IO-data for the single DP-Slaves within the process image, must be known.

The driver software ships with 2 Master example VI's:

- To handle single DP Slaves the cRIO_PB_FPGA_DP-MasterExample.vi can be used
- To handle the entire process image the cRIO_PB_FPGA_DP-MasterProcessDataExample.vi can be used

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4.1 DP Master example

The cRIO PB setup installs a LabVIEW FPGA example project from which all necessary components can be retrieved and copied to the own FPGA project.

Note: This example demonstrates the IO- and diagnostic data exchange with a single DP Slave

Note: Before using the example code a valid PROFIBUS DP configuration must be downloaded to the cRIO PB module (see chapter 3).

*Note: To run the example, install the cRIO module in **Slot 1** of the cRIO chassis*.

- To start the example project click onto the cRIO PB DP Master icon in the COMSOFT start menu section:

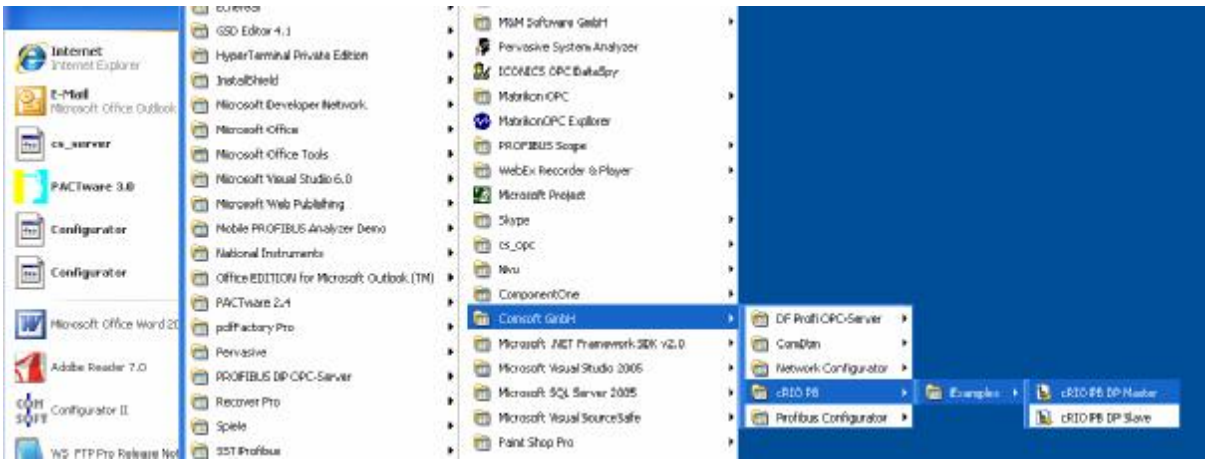


Figure 10: Open cRIO PB DP Master example

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- The FPGA example project opens:

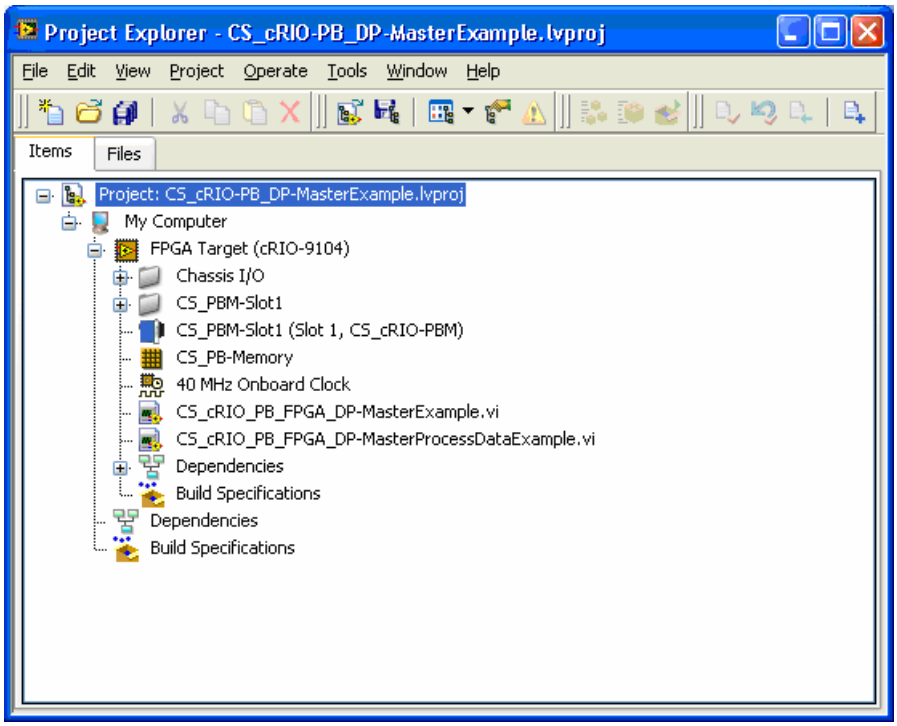


Figure 11: cRIO PBM Example project

- Create a new LabVIEW project on base of the used cRIO system:

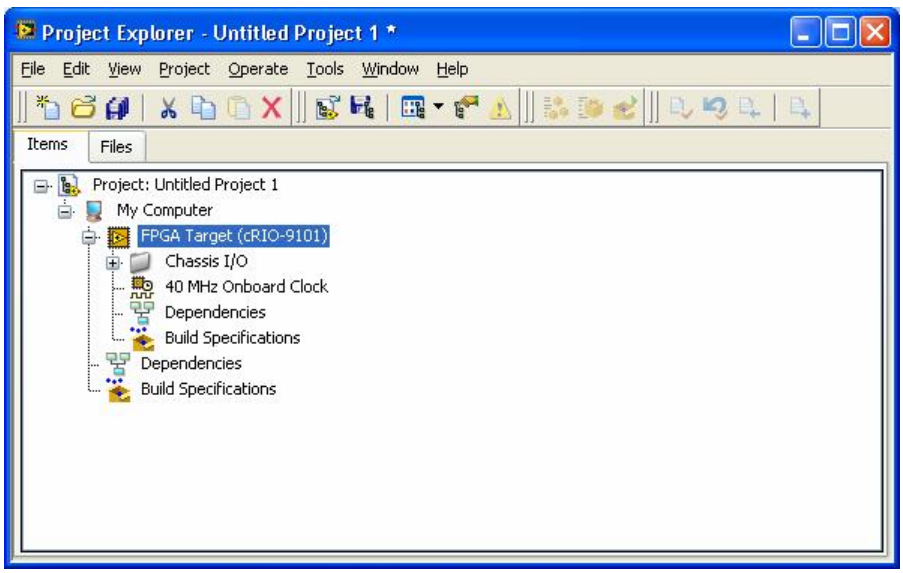


Figure 12: New LabVIEW cRIO FPGA project

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- Copy the following components from the example project to the own project:
  - CS_PBM-Slot1
  - CS_PBM-Slot1 (Slot 1, CS_cRIO-PBM)
  - CS_PB-Memory
  - CS_cRIO_PB_FPGA_DP-MasterExample.vi

The project now looks similar to:

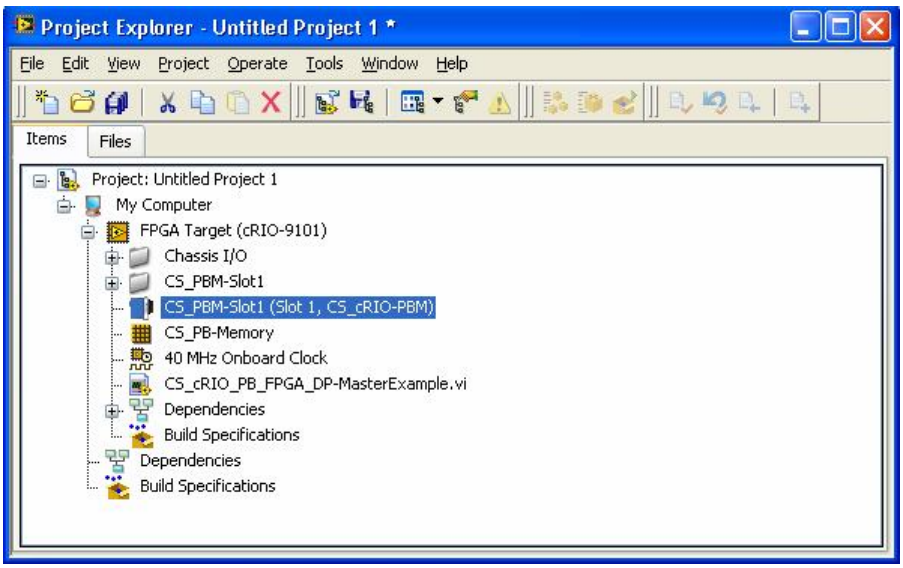


Figure 13: cRIO PB FPGA project

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- Open the CS_cRIO_PB_FPGA_DP-MasterExample.vi
- Enter the DP Slave address you want to communicate with
- Run the example

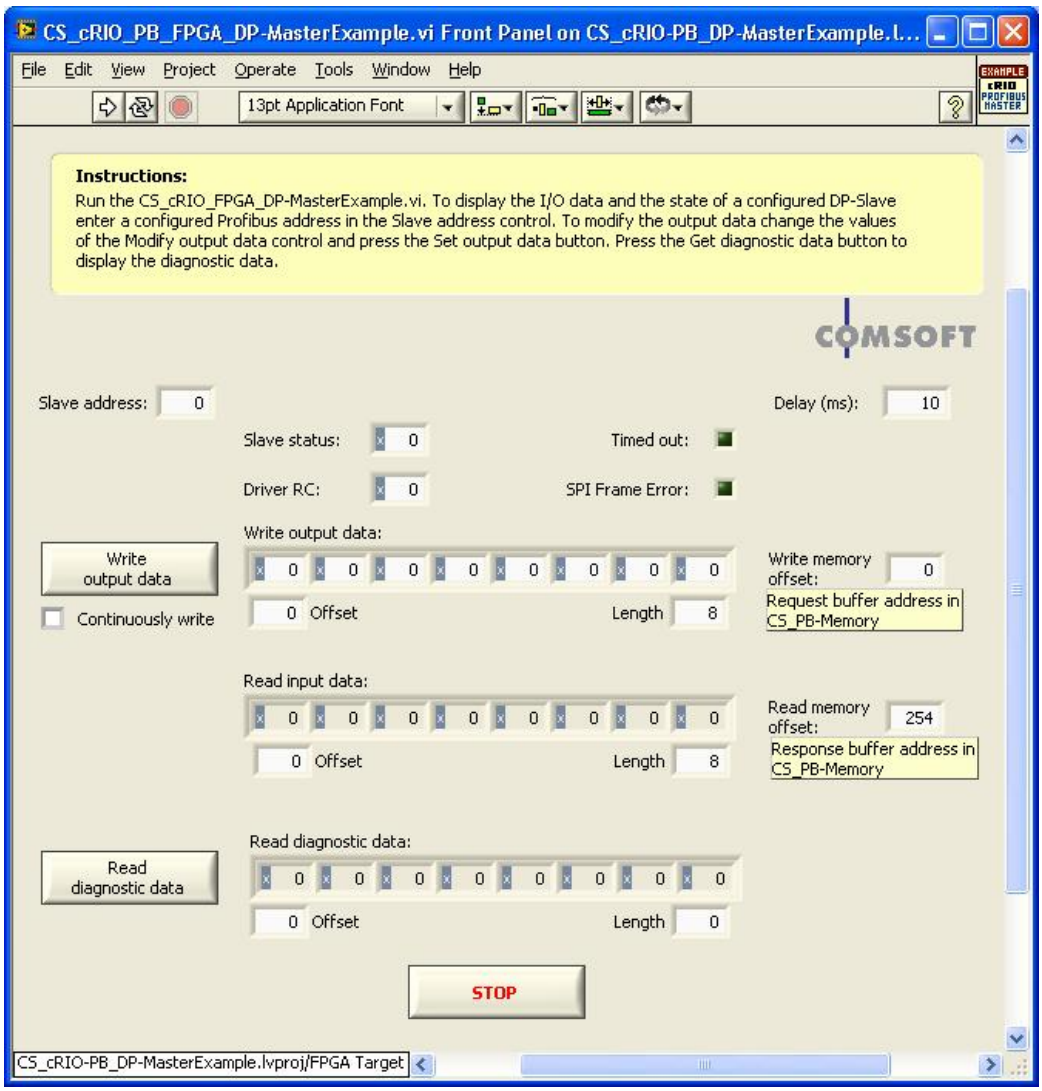


Figure 14: cRIO PB DP Master example

Note: First time after installation LabVIEW will compile the example before running it.

Slave address

PROFIBUS address of the slave to communicate with. The slave address can be changed without stopping the running example.

Range: 0 – 125.

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Slave status

Displays the communication status of the slave: (see chapter 5.2.2.3)

Driver RC

Displays the communication status of the cRIO PB module. (see chapter 5.2.2.2)

Note: If Driver RC is not 0, DP Slave related Input, Output and diagnostic data are not valid.

Timed out

SPI communication time out

Error

SPI Frame error

Write output data

The *Modify output data* field assigns the slave output data and is limited to 8 Bytes due to FPGA capacity. By the parameters **Offset** and **Length** any output data of the slave output data stream can be modified. The output data is modified by clicking on the button *Write output data*. The offset can be used for optimization. The data block can be partially addressed and not the whole length has to be transmitted with every update.

Note: Assigning a length / offset combination greater than the real data length of the DP Slave, results in inefficient use of the interface and a slow down of all components.

Read input data

The *Input data* field displays the input data of the slave and is limited to 8 Bytes due to FPGA capacity. By the parameters **Offset** and **Length** any input data in the slaves input data stream can be displayed. The offset can be used for optimization. The data block can be partially addressed and not the whole length has to be transmitted with every update.

Note: Assigning a length / offset combination greater than the real data length of the DP Slave, results in inefficient use of the interface and a slow down of all components.

Write memory offset

The *Write memory offset* is the address of the request header and output data in the CS_PB-Memory.

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Read memory offset

The *Read memory offset* is the address of the response header and input data in the CS_PB-Memory.

Read diagnostic data

The *Diagnostic data* field displays the diagnostic data of the slave and is limited to 8 Bytes due to FPGA capacity. By the parameters **Offset** and **Length** any diagnostic data in the slave diagnostic data stream can be displayed. The diagnostic data are read by clicking on to the *Get diagnostic data* button.

Note: Don't assign a length greater 241. The length is not checked due to FPGA capacity.

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4.2 DP Master ProcessData Example

The cRIO PB setup installs a LabVIEW FPGA example project from which all necessary components can be retrieved and copied to the own FPGA project.

Note: This example demonstrates the handling of the complete PROFIBUS process image, which means the handling of the IO- and diagnostic data of all DP Slaves connected to the PROFIBUS network.

Note: Before using the example code a valid PROFIBUS DP configuration must be downloaded to the cRIO PB module (see chapter 3).

*Note: To run the example, install the cRIO module in **Slot 1** of the cRIO chassis*.

- Start the example project click onto the cRIO PB DP Master icon in the COMSOFT start menu section:

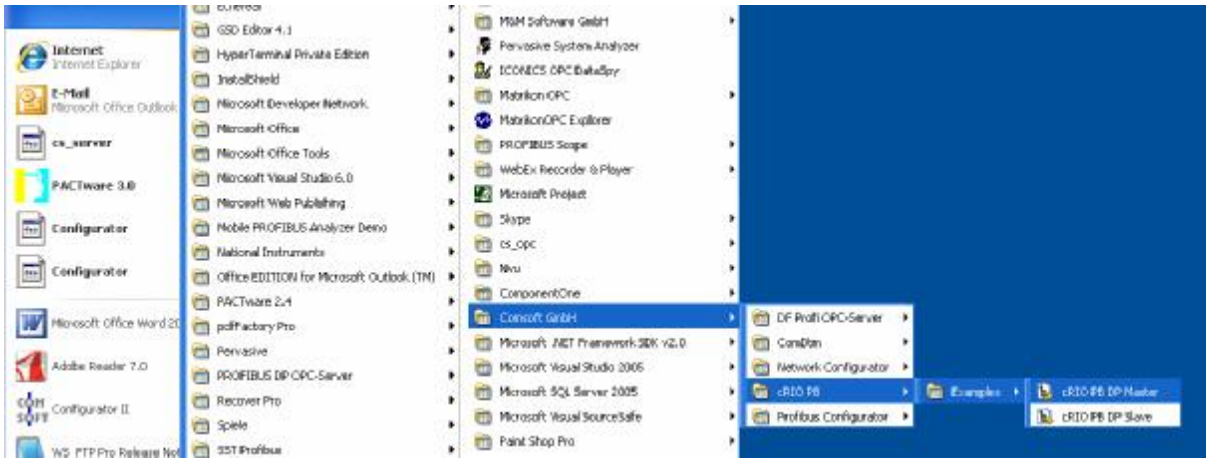


Figure 15: Open cRIO PB DP Master example

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- The FPGA example project opens:

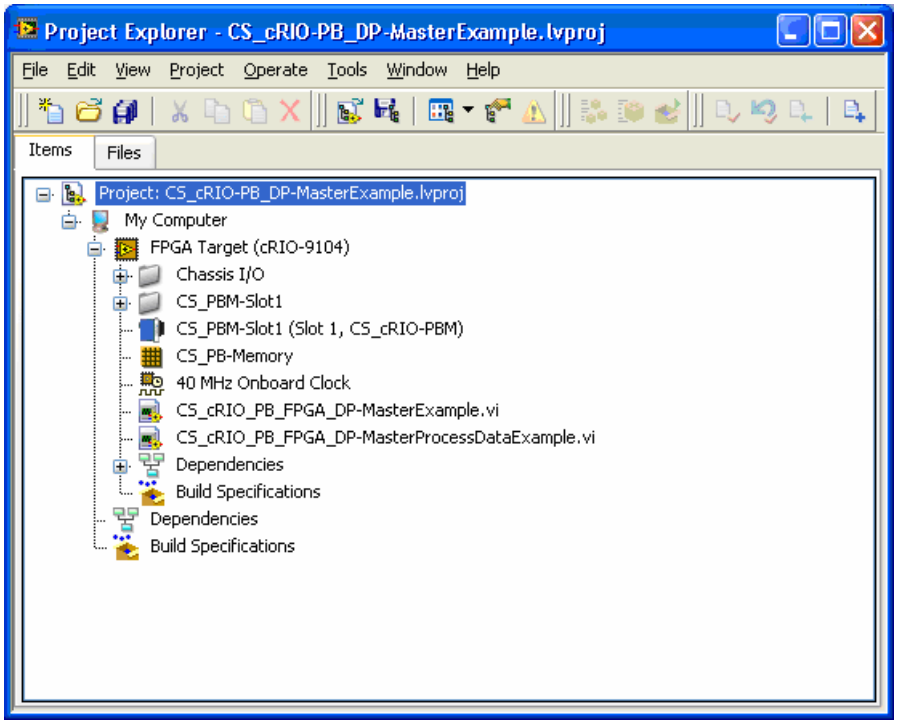


Figure 16: cRIO PBM Example project

- Create a new LabVIEW project on base of the used cRIO system:

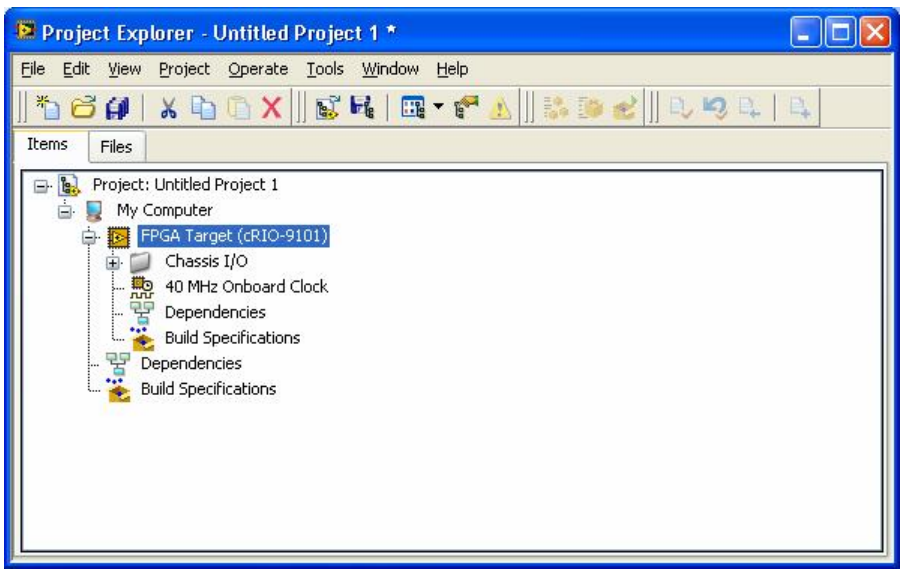


Figure 17: New LabVIEW cRIO FPGA project

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- Copy the following components from the example project to the own project:
  - CS_PBM-Slot1
  - CS_PBM-Slot1 (Slot 1, CS_cRIO-PBM)
  - CS_PB-Memory
  - CS_cRIO_PB_FPGA_DP-MasterProcessDataExample.vi

- The project now looks similar to:

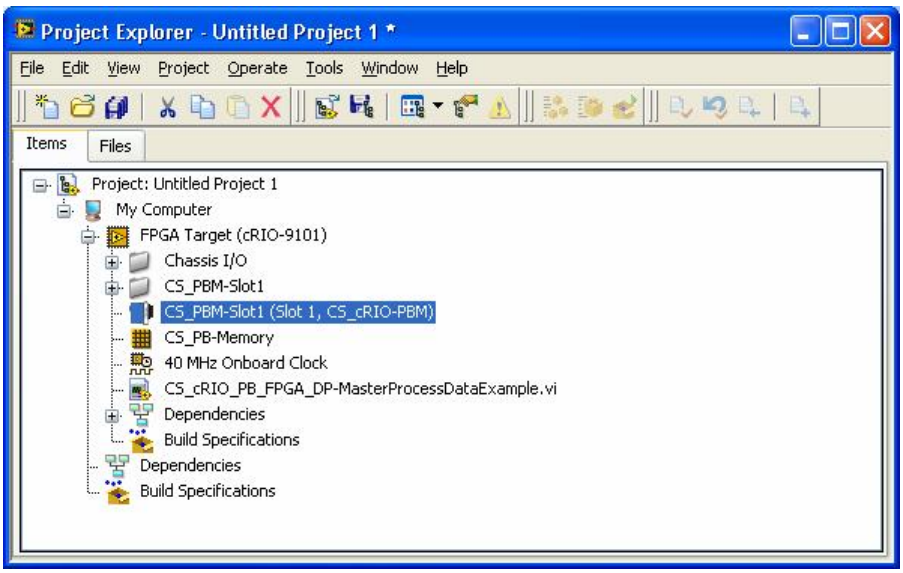


Figure 18: cRIO PB FPGA project

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- Open the CS_cRIO_PB_FPGA_DP-MasterProcessDataExample.vi
- Run the example

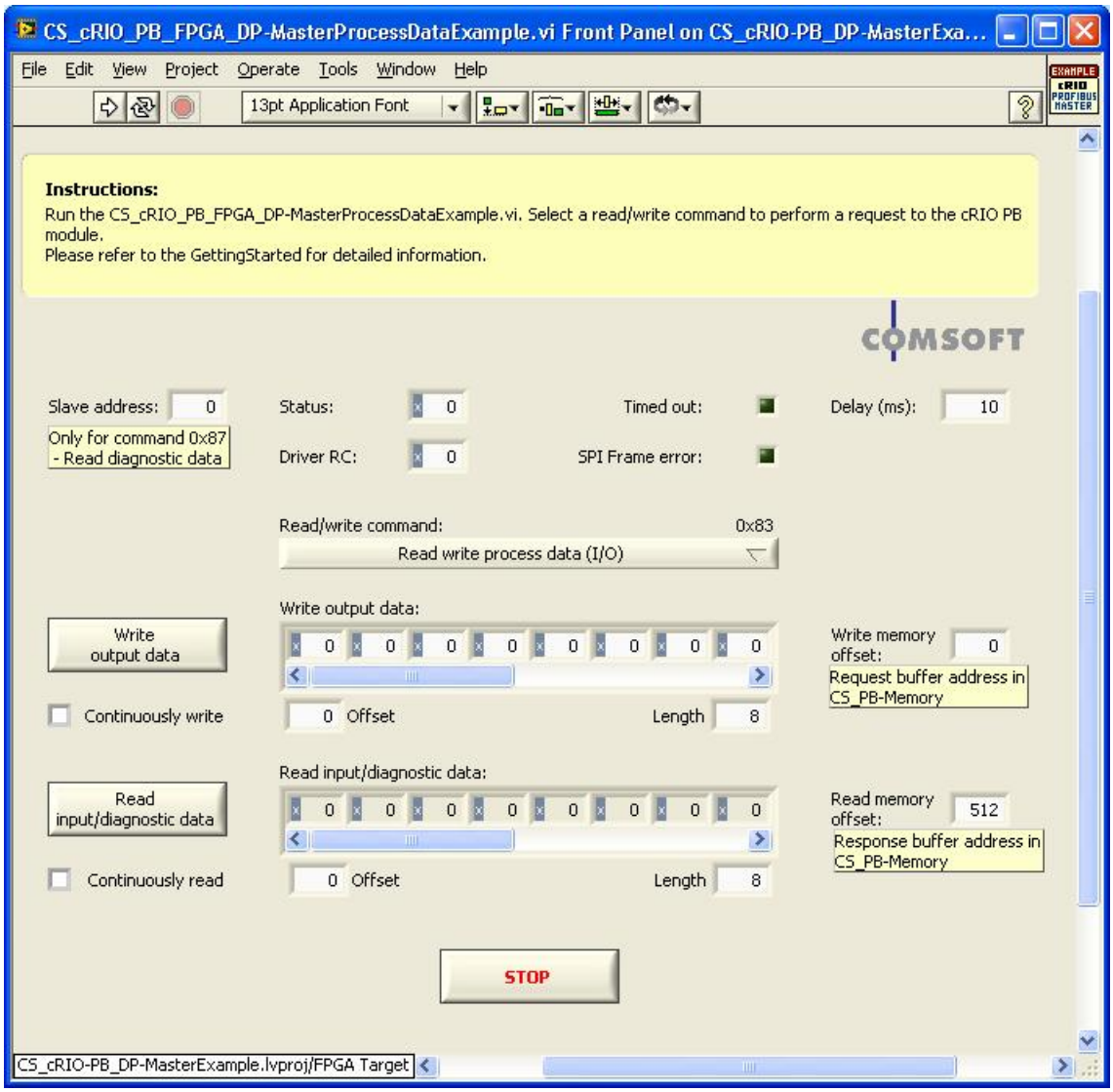


Figure 19: cRIO PB DP Master Process Data example

Note: First time after installation LabVIEW will compile the example before running it.

Slave address

PROFIBUS address of the slave to communicate with. The slave address can be changed without stopping the running example.

Range: 0 – 125.

Note: The DP Slave address is only required to read diagnostic data from a single DP Slave (command 0x87 - Read diagnostic data)

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Status

Displays the DP Slave summary communication status of the command "Read write process data (I/O)" and "Read process output data":

0x00:	DP Slaves are in DataExchange mode without error
0x01-0x7D	Number of DP Slaves which are not in DataExchange mode or are in DataExchange mode, but report external diagnostic alarm

Following status refers to the command "Read slave diagnostic data":

0x00:	DP Slave is in DataExchange mode without error
0xC3:	DP Slave is not in DataExchange mode (wrong configuration or not connected)
0xFF:	DP Slave is in DataExchange mode and reports external diagnostic data

Driver RC

Displays the general communication status of the cRIO PB module. (see chapter 5.2.2.2)

Note: If Driver RC is not 0, DP Slave related Input, Output and diagnostic data are not valid.

Timed out

SPI communication time out

Error

SPI Frame error

Read/write command

Command description see chapter 5.2.1.2.

Format of the process image

The process image is divided into 2 separate memory blocks, one for the input data and one for the output data of all configured DP Slaves.

The I/O data are stored in an ascending order starting with the lowest DP Slave address. All I/O data are in byte format and always start on even addresses. With odd I/O data lengths a padding byte is added.

To access the I/O data of a specific DP Slave, the offset values inside the memory blocks can be calculated manually or requested from the cRIO PB device. To request the offset

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values the commands READ_PROCESS_INPUT_OFFSETS and READ_PROCESS_OUTPUT_OFFSETS can be used (chapter 5.2.1.2).

Example:

A PROFIBUS network consists of the following DP Slaves:

DP Slave address	Number of output bytes	Number of input bytes
03	5	1
12	3	3
34	4	4

The structure of the appropriate process image **output buffer** is:

0	1	2	3	4	5	6	7	8	9	10	11	12	13
03.1	03.2	03.3	03.4	03.5		12.1	12.2	12.3		34.1	34.2	34.3	34.4

The structure of the appropriate process image **input buffer** is:

0	1	2	3	4	5	6	7	8	9	10
03.1		12.1	12.2	12.3		34.1	34.2	34.3		35.4

Explanation:

03.1	= DP Slave 03, Byte 1
	= Padding Byte

Write output data

The *Write output data* field displays the process image output buffer. The array control to enter output data is limited to 16 Bytes due to FPGA capacity. By the parameters **Offset** and **Length** any output data in the process image output buffer can be addressed. The output data is updated by clicking onto the button *Write output data*.

Note: Don't assign a length greater than the real output length of the process image. The length is not checked due to FPGA capacity.

Read input/diagnostic data

The *Read input/diagnostic data* field displays the process image input buffer or the DP Slave related diagnostic data depending on the selected command in **Read/write command** list box. The array indicator to display input/diagnostic data is limited to 16 Bytes due to FPGA capacity. By the parameters **Offset** and **Length** any input/diagnostic data can be displayed.

Note: Don't assign a length greater than the real input data length of the Process Data. The length is not checked due to FPGA capacity.

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Write memory offset

The *Write memory offset* is the starting address of the request structure (header and output data) in CS_PB-Memory.

Read memory offset

The *Read memory offset* is the starting address of the response structure (header and input data) in CS_PB-Memory.

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5 cRIO PB SPI Interface description

The data exchange between the FPGA module and cRIO PB module is based on Master/Slave SPI communication. The FPGA acts as SPI Master, the cRIO PB acts as SPI Slave..

The FPGA module exchanges buffers with the cRIO PB module in both directions whereas the FPGA module sends a **Request Buffer** and the cRIO PB module answers with a **Response Buffer**.

The driver VI is **not reentrant** since the SPI line cannot be shared. If multiple DP Slaves are handled in separate loops, the loops are automatically synchronized by waiting for the termination of the driver VI.

The central driver VI *CS_cRIO_PBM[1]FPGA_SPI_ReadWrite.vi*  transmits the request buffer to the cRIO PB module and returns the response buffer received from the cRIO BP module.

The *CS_cRIO_PBM[1]FPGA_SPI_ReadWrite.vi* uses a byte formated (U8) FPGA memory block named **CS_PB-Memory**. This block is mandatory and must be allocated within the LabVIEW FPGA project:

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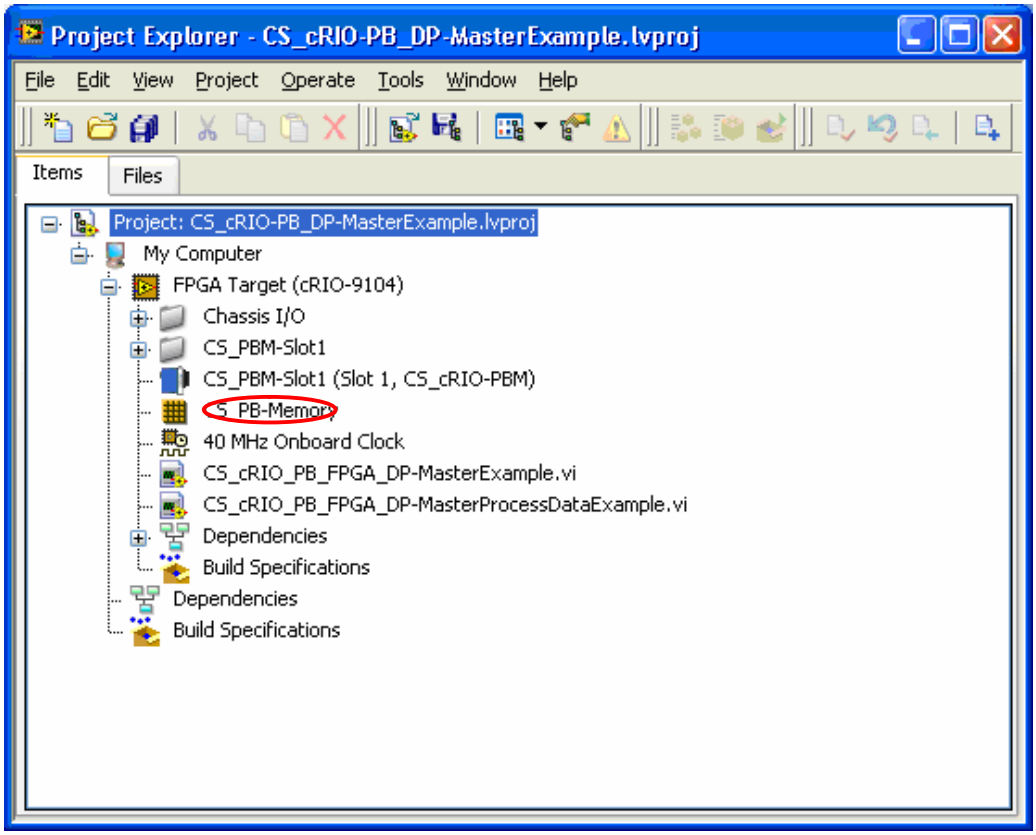


Figure 20: CS-PB-Memory in cRIO FPGA project

The minimum size of the **CS_PB-Memory** is **254 bytes (U8)** storing the header and the max. Input- and Output data for 1 DP Slave and overlapping request- and response buffers. If separate request- and response buffers are used, the minimum size is **508 bytes (U8)**.

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5.1 Driver VI description

The cRIO PB driver VI  handles the bidirectional SPI based communication between the FPGA module and cRIO PB module. The driver VI uses a FPGA memory buffer named **CS_PB-Memory**. This name is mandatory and cannot be changed.

To use the driver VI, 3 steps are necessary:

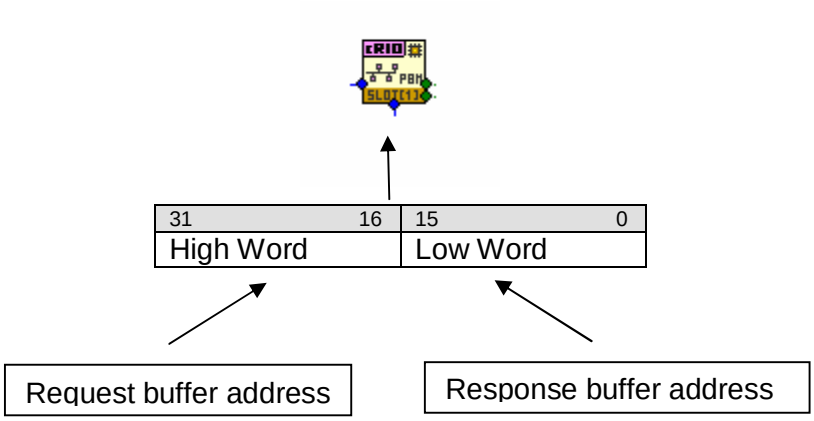
1. Prepare the Request buffer with header and data field in the **CS_PB-Memory**
2. Call the driver VI
3. Check the error and time out parameters
4. Decode the header and the data field in the Response buffer in **CS_PB-Memory**

5.1.1 Parameters

5.1.1.1 Memory address

The CS_PB-Memory buffer stores the **Request buffer** as well as the **Response buffer**. To optimize the necessary amount of memory the 2 buffers can be used as overlapping or separate buffers.

To control the buffer allocation the input parameter **Memory address** is used. **Memory address** is a 32 Bit value, where the high word assigns the offset for the **Request buffer** and the low word the offset for the **Response buffe**r in CS_PB-Memory**.**



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Examples:

Memory address	Description
0x00000000	Overlapping Request- and Response buffer, both buffers start at address 0 in CS_PB-Memory. The Request buffer is overwritten by the incoming Response buffer. Minimum size of CS_PB-Memory is 254 Bytes [U8].
0x000000FE	Separate Request- and Response buffer. Request buffer starts at address 0. Response buffer starts at offset 254 (00FE). The Request buffer is not overwritten by the incoming Response buffer. Minimum size of CS_PB-Memory is 508 Bytes [U8]

Note: If the process image (see chapter 4.2 and chapter 5.2.1.2, command 0x83) is used to handle the DP Slave I/O data, the buffers can exceed the minimum size of 254. The required buffer sizes depend on the number of configured DP Slaves and their I/O data lengths and has to be calculated in advance(total amount of all header and input- and output data). If the buffer sizes are too small, I/O data will be lost.

5.1.1.2 Timeout

Timeout value in milliseconds. Specifies how long to wait for the response from the cRIO PB module.

5.1.1.3 Timed Out

If the cRIO PB module does not respond within the defined timeout the driver VI returns *Timed Out* = TRUE otherwise *Timed Out* = FALSE. If *Timed Out* = TRUE the data in the Response buffer are not valid.

5.1.1.4 Error

If wrong or corrupt data are received from the cRIO PB module the driver VI returns *Error* = TRUE otherwise with = FALSE. If *Error* = TRUE the data in the Response buffer are not valid.

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5.2 Buffer structure

5.2.1 Request buffer

The request buffer transmitted to the cRIO PB module consists of a constant 14 byte header and a variable data field.

Note: All 2 Byte values (U16) are in little Endean format, that means they must be written in high byte/low byte order to the buffer.

Header	Data field

5.2.1.1 Header structure

Index	Format	Size	Description	Details
0	U8	1 Byte	Command	cRIO PB specific Command
1	U8	1 Byte	DP Slave address	0-125
2-3	U16	2 Byte	Input offset	0-8191
4-5	U16	2 Byte	Input length	0-8192
6-7	U16	2 Byte	Output offset	0-8191
8-9	U16	2 Byte	Output length	0-8192
10	U8	1 Byte	Reserved	0
11	U8	1 Byte	Reserved	0
12	U8	1 Byte	Reserved	0
13	U8	1 Byte	Reserved	0

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5.2.1.2 Command description

Value	Description	Parameters
0x80	**INIT_DP_MASTER** Starts the cRIO PB module as DP Master and activates DP Slave scanning.	None
0x82	**READ_WRITE_SLAVE** Transmits output data to DP Slave and receives input data from DP Slave.	**Input length**: Size of DP Slave input data to be received *The value may not exceed the real input data length of the DP Slave* **Input offset:** Offset in DP Slave input data stream *The value may not exceed the real input data length -1 of the DP Slave* **Output length:** Size of DP Slave output data to be transmitted *The value may not exceed the real output data length of the DP Slave* **Output offset:** Offset in DP Slaves output data stream *The value may not exceed the real output data length -1 of the DP Slave*
0x83	**READ_WRITE_PROCESS_DATA** Reads and writes the entire process image: Transmits process output data to the configured DP Slaves and receives process input data from the configured DP Slaves. The structure of the process image is described in detail in chapter 4.2.	**Input length**: Size of process input data to be received *The value may not exceed the real input data length of the process input data* **Input offset:** Offset in process image input buffer *The value may not exceed the real input data length -1 of the process input data* **Output length:** Size of process output data to be transmitted *The value may not exceed the real output data length of the process output data* **Output offset:** Offset in process image output buffer *The value may not exceed the real output data length -1 of the process output data*

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Value	Description	Parameters
0x85	**READ_PROCESS_OUTPUT_DATA** Reads the current process output data from the configured DP Slaves.	**Input length**: Size of process output data to be received *The value may not exceed the real output data length of the process output data* **Input offset:** Offset in process image output buffer *The value may not exceed the real output data length -1 of the process output data*
0x86	**ABORT_DEVICE** Stops the cRIO PB module.	None
0x87	**SLAVE_DIAG** Receives diagnostic data from DP Slave.	**Input length**: Size of DP Slave diagnostic data to be received *The value may not exceed 240.* **Input offset:** Offset in DP Slave diagnostic data stream *The value may not exceed 239.*
0x88 0x89	**READ_PROCESS_INPUT_OFFSETS** **READ_PROCESS_OUTPUT_OFFSETS** Reads the DP Slave dependent I/O data offsets (16 Bit values) within the process image. The returned array stores the offset values for the complete DP Slave address range (0 – 125) whereas values for non configured DP Slave addresses are not valid.	**Input length**: Number of I/O data offset values to read * 2 **Input offset:** Starting DP Slave address * 2
0x8A 0x8B	**READ_PROCESS_INPUT_LENGTH** **READ_PROCESS_OUTPUT_LENGTH** Reads the DP Slave dependent I/O data lengths (16 Bit values) within the process image. The returned array stores the length values for the complete DP Slave address range (0 – 125) whereas values for non configured DP Slave addresses are not valid.	**Input length**: Number of I/O data length values to read * 2 **Input offset:** Starting DP Slave address * 2
0x8D	**READ_PROCESS_STATUS_LIST** Receives status information of the configured DP Slaves dependent on the parameters.	**Input length**: Number of values to be received **Input offset:** Offset in offsets/length array Slave Address 0: Array-Index 0 Slave Address 1: Array-Index 1 … Slave Address 125: Array-Index 125

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5.2.1.3 Data field

The data field is byte oriented (U8) and stores the output data transmitted to the DP Slave

Byte 1
Byte 2
Byte 3
..
Byte n

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5.2.2 Response buffer

The response buffer received from the cRIO PB module consists of a constant header of 14 bytes and a variable data field.

Header	Data field

Note: All 2 Byte values (U16) are in little Endean format, that means in high byte/low byte.

5.2.2.1 Header structure

Index	Format	Size	Description	Details
0	U8	1 Byte	Command	Same value as in request buffer
1	U8	1 Byte	DP Slave address	Same value as in request buffer
2-3	U16	2 Byte	Input offset	Same value as in request buffer
4-5	U16	2 Byte	Input length	Same value as in request buffer
6-7	U16	2 Byte	Output offset	Same value as in request buffer
8-9	U16	2 Byte	Output length	Same value as in request buffer
10	U8	1 Byte	Reserved	0
11	U8	1 Byte	Reserved	0
12	U8	1 Byte	Slave status	See chapter 5.2.2.3 below
13	U8	1 Byte	Driver RC	See chapter 5.2.2.2 below

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5.2.2.2 Driver RC

The Driver RC assigns the communication status of the cRIO PB module.

Note: If Driver RC is not 0, DP Slave related Input, Output and diagnostic data are not valid.

Value	Description	Reason	Help
0x00	No errors	cRIO PB module works without any problems	-
0x01	Error at undefined location	unknown	The error is not handled. Verify functionality with the standard examples and Contact Comsoft Support
0x02	Unknown command value	The 'command' value in the request header / contains an unknown value	Verify the request header and the correct transfer to the driver VI. The commands are listed in chapter 5.2.1.2
0x11	Duplicate DP Master PROFIBUS address	There is another DP Master connected to the network using the identical PROFIBUS address	Change cRIO PB DP Master address in Configurator II to a unique one.
0x12	No valid configuration on cRIO PB Module available	No valid configuration was downloaded with an configuration tool.	Use the Comsoft Configurator II to create and download a valid Profibus configuration to the cRIO PB Module.
0x13	cRIO PB module does not support DP Master mode	The cRIO PB module is configured for operation only as DP Slave and as DP Master/DP Slave	Contact Support
0x14	cRIO PB module hardware error	The B.I.S.T of the cRIO PB module reported a hardware error. The module is not operable.	Contact Support
0x15	cRIO PB module in AutoSlaveMode	cRIO PB module in AutoSlaveMode (no start as DP Master or former DP Slave mode possible)	Deactivate AutoSlaveMode (see chapter 4.1 of Slave Getting Started)
0x17	cRIO PB module not active	cRIO PB not initialized as DP Master or AutoSlaveMode not active	INIT-DP-MASTER (see chapter 5.2.1.2) or Activate AutoSlaveMode (see chapter 4.1 of Slave Getting Started)

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5.2.2.3 Slave status

The Slave status indicates the communication status of the related DP Slave.

Value	Description	Reason	Help
0x00	DP Slave is in state DataExchange, no errors, input- and output data are valid	-	-
0xC3	DP Slave is not in state DataExchange, the output data are not processed, the input data are not valid	DP Slave is wrongly configured or DP Slave does not respond	Activate Configurator II on line mode and check DP Slave related diagnostic information
			Receive and analyze DP Slave related diagnostic information
0xFF	DP Slave is in state DataExchange but reports external diagnostic data	DP Slave detected manufacturer specific error i.e. a broken wire on an input channel	Activate Configurator II on line mode and check DP Slave related diagnostic information
			Receive and analyze DP Slave related diagnostic information

5.2.2.4 Data field

The data field is byte oriented (U8) and stores the input data received from the DP Slave. The count of input data received is indicated by the header member *input_length*.

Byte 1
Byte 2
Byte 3
Byte 4
Byte 5
..
Byte n

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5.3 Buffer examples

5.3.1 INIT_DP_MASTER

Starts the cRIO PB module as DP Master and activates DP Slave scanning.

Request Buffer			Response Buffer		
Index	Value	Description	Index	Value	Description
0	0x80	Command	0	0x80	Command
1	0x00	Address	1	0x00	Address
2	0x00	Input Offset HB	2	0x00	Input Offset HB
3	0x00	Input Offset LB	3	0x00	Input Offset LB
4	0x00	Input Length HB	4	0x00	Input Length HB
5	0x00	Input Length LB	5	0x00	Input Length LB
6	0x00	Output Offset HB	6	0x00	Output Offset HB
7	0x00	Output Offset LB	7	0x00	Output Offset LB
8	0x00	Output Length HB	8	0x00	Output Length HB
9	0x00	Output Length LB	9	0x00	Output Length LB
10	0x00	Reserved	10	0x00	Reserved
11	0x00	Reserved	11	0x00	Reserved
12	0x00	Reserved	12	0x00	Slave Status
13	0x00	Reserved	13	0x00	Driver RC
Request Buffer Data Field			Response Buffer Data Field		

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5.3.2 READ_WRITE_SLAVE- Input and Output data

Transmits output data to DP Slave and receives input data from DP Slave.

DP Slave with address 16 and 4 Bytes output data and 8 Bytes Input data. All output data are written und all input data are read.

Request Buffer			Response Buffer		
Index	Value	Description	Index	Value	Description
0	0x82	Command	0	0x82	Command
1	0x10	Address	1	0x10	Address
2	0x00	Input Offset HB	2	0x00	Input Offset HB
3	0x00	Input Offset LB	3	0x00	Input Offset LB
4	0x00	Input Length HB	4	0x00	Input Length HB
5	0x08	Input Length LB	5	0x08	Input Length LB
6	0x00	Output Offset HB	6	0x00	Output Offset HB
7	0x00	Output Offset LB	7	0x00	Output Offset LB
8	0x00	Output Length HB	8	0x00	Output Length HB
9	0x04	Output Length LB	9	0x04	Output Length LB
10	0x00	Reserved	10	0x00	Reserved
11	0x00	Reserved	11	0x00	Reserved
12	0x00	Reserved	12	0x00	Slave Status
13	0x00	Reserved	13	0x00	Driver RC
Request Buffer Data Field			Response Buffer Data Field		
14	XX	Output Byte 1	14	YY	Input Byte 1
15	XX	Output Byte 2	15	YY	Input Byte 2
16	XX	Output Byte 3	16	YY	Input Byte 3
17	XX	Output Byte 4	17	YY	Input Byte 4
			18	YY	Input Byte 5
			19	YY	Input Byte 6
			20	YY	Input Byte 7
			21	YY	Input Byte 8

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5.3.3 READ_WRITE_SLAVE – Input data

Transmits output data to DP Slave and receives input data from DP Slave.

DP Slave with address 16 and 0 Byte output data and 8 Bytes Input data. No output data are written und all input data are read.

Request Buffer			Response Buffer		
Index	Value	Description	Index	Value	Description
0	0x82	Command	0	0x82	Command
1	0x10	Address	1	0x10	Address
2	0x00	Input Offset HB	2	0x00	Input Offset HB
3	0x00	Input Offset LB	3	0x00	Input Offset LB
4	0x00	Input Length HB	4	0x00	Input Length HB
5	0x08	Input Length LB	5	0x08	Input Length LB
6	0x00	Output Offset HB	6	0x00	Output Offset HB
7	0x00	Output Offset LB	7	0x00	Output Offset LB
8	0x00	Output Length HB	8	0x00	Output Length HB
9	0x00	Output Length LB	9	0x00	Output Length LB
10	0x00	Reserved	10	0x00	Reserved
11	0x00	Reserved	11	0x00	Reserved
12	0x00	Reserved	12	0x00	Slave Status
13	0x00	Reserved	13	0x00	Driver RC
Request Buffer Data Field			Response Buffer Data Field		
			14	YY	Input Byte 1
			15	YY	Input Byte 2
			16	YY	Input Byte 3
			17	YY	Input Byte 4
			18	YY	Input Byte 5
			19	YY	Input Byte 6
			20	YY	Input Byte 7
			21	YY	Input Byte 8

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5.3.4 READ_WRITE_PROCESS_DATA

Reads and writes the entire process image: Transmits process output data to the configured DP Slaves and receives process input data from the configured DP Slaves.

Example:

DP Slave address	Number of output bytes	Number of input bytes
03	5	1
12	3	3
34	4	4

Herefrom the following input- and output data sizes result:

Input data size: 8 + 2 padding bytes = 10 (0x0A)

Output data size: 12 + 2 padding bytes = 14 (0x0E)

Request Buffer			Response Buffer		
Index	Value	Description	Index	Value	Description
0	0x83	Command	0	0x83	Command
1	0x00	Address	1	0x00	Address
2	0x00	Input Offset HB	2	0x00	Input Offset HB
3	0x00	Input Offset LB	3	0x00	Input Offset LB
4	0x00	Input Length HB	4	0x00	Input Length HB
5	0x0A	Input Length LB	5	0x0A	Input Length LB
6	0x00	Output Offset HB	6	0x00	Output Offset HB
7	0x00	Output Offset LB	7	0x00	Output Offset LB
8	0x00	Output Length HB	8	0x00	Output Length HB
9	0x0E	Output Length LB	9	0x0E	Output Length LB
10	0x00	Reserved	10	0x00	Reserved
11	0x00	Reserved	11	0x00	Reserved
12	0x00	Reserved	12	0x00	Slave Status
13	0x00	Reserved	13	0x00	Driver RC
Request Buffer Data Field			Response Buffer Data Field		
14	XX	Output Byte 1 Slave 03	14	YY	Input Byte 1 Slave 03
15	XX	Output Byte 2 Slave 03	15	0x00	Padding Byte
16	XX	Output Byte 3 Slave 03	16	YY	Input Byte 1 Slave 12
17	XX	Output Byte 4 Slave 03	17	YY	Input Byte 2 Slave 12
18	XX	Output Byte 5 Slave 03	18	YY	Input Byte 3 Slave 12
19	0x00	Padding Byte	19	0x00	Padding Byte
20	XX	Output Byte 1 Slave 12	20	YY	Input Byte 1 Slave 34
21	XX	Output Byte 2 Slave 12	21	YY	Input Byte 2 Slave 34
22	XX	Output Byte 3 Slave 12	22	YY	Input Byte 3 Slave 34
23	0x00	Padding Byte	23	YY	Input Byte 4 Slave 34

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24	XX	Output Byte 1 Slave 34			
25	XX	Output Byte 2 Slave 34			
26	XX	Output Byte 3 Slave 34			
27	XX	Output Byte 4 Slave 34			

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5.3.5 READ_PROCESS_INPUT_OFFSETS

Reads the DP Slave dependent I/O data offsets (16 Bit values) within the process image. The returned array stores the offset values for the complete DP Slave address range (0 – 125) whereas values for non configured DP Slave addresses are not valid.

Example:

DP Slave address	Number of output bytes	Number of input bytes
03	5	1
12	3	3
34	4	4

Read offsets for Slave address 03 – 34 results in following input data size and offset:

Input offset: 6 (0x06) (lowest DP Slave address * 2)

Input data size: 64 (0x40) (address 3 – 34 => (34-3+1) * 2 = 64 (0x40))

Request Buffer			Response Buffer		
Index	Value	Description	Index	Value	Description
0	0x88	Command	0	0x88	Command
1	0x00	Address	1	0x00	Address
2	0x00	Input Offset HB	2	0x00	Input Offset HB
3	0x06	Input Offset LB	3	0x06	Input Offset LB
4	0x00	Input Length HB	4	0x00	Input Length HB
5	0x40	Input Length LB	5	0x40	Input Length LB
6	0x00	Output Offset HB	6	0x00	Output Offset HB
7	0x00	Output Offset LB	7	0x00	Output Offset LB
8	0x00	Output Length HB	8	0x00	Output Length HB
9	0x00	Output Length LB	9	0x00	Output Length LB
10	0x00	Reserved	10	0x00	Reserved
11	0x00	Reserved	11	0x00	Reserved
12	0x00	Reserved	12	0x00	Slave Status
13	0x00	Reserved	13	0x00	Driver RC
Request Buffer Data Field			Response Buffer Data Field		
			14	0x00	Input Offset Byte 1 Slave 03
			15	0x00	Input Offset Byte 2 Slave 03
			16	0x00	Input Offset Byte 1 Slave 04
			17	0x00	Input Offset Byte 2 Slave 04
			18	0x00	Input Offset Byte 1 Slave 05
			19	0x00	Input Offset Byte 2 Slave 05
			20	0x00	Input Offset Byte 1 Slave 06
			21	0x00	Input Offset Byte 2 Slave 06
			22	0x00	Input Offset Byte 1 Slave 07
			23	0x00	Input Offset Byte 2 Slave 07
			24	0x00	Input Offset Byte 1 Slave 08

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			25	0x00	Input Offset Byte 2 Slave 08
			26	0x00	Input Offset Byte 1 Slave 09
			27	0x00	Input Offset Byte 2 Slave 09
			28	0x00	Input Offset Byte 1 Slave 10
			29	0x00	Input Offset Byte 2 Slave 10
			30	0x00	Input Offset Byte 1 Slave 11
			31	0x00	Input Offset Byte 2 Slave 11
			32	0x00	Input Offset Byte 1 Slave 12
			33	0x01	Input Offset Byte 2 Slave 12
			…	…	…
			76	0x00	Input Offset Byte 1 Slave 34
			77	0x04	Input Offset Byte 2 Slave 34

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5.3.6 READ_PROCESS_OUTPUT_LENGTH

Reads the DP Slave dependent I/O data lengths (16 Bit values) within the process image. The returned array stores the length values for the complete DP Slave address range (0 – 125) whereas values for non configured DP Slave addresses are not valid..

Example:

DP Slave address	Number of output bytes	Number of input bytes
03	5	1
12	3	3
34	4	4

Read length for Slave address 03 – 34 results in following input data size and offset:

Input offset: 6 (0x06) (lowest DP Slave address * 2)

Input data size: 64 (0x40) (address 3 – 34 => (34-3+1) * 2 = 64 (0x40))

Request Buffer			Response Buffer		
Index	Value	Description	Index	Value	Description
0	0x8B	Command	0	0x8B	Command
1	0x00	Address	1	0x00	Address
2	0x00	Input Offset HB	2	0x00	Input Offset HB
3	0x06	Input Offset LB	3	0x06	Input Offset LB
4	0x00	Input Length HB	4	0x00	Input Length HB
5	0x40	Input Length LB	5	0x40	Input Length LB
6	0x00	Output Offset HB	6	0x00	Output Offset HB
7	0x00	Output Offset LB	7	0x00	Output Offset LB
8	0x00	Output Length HB	8	0x00	Output Length HB
9	0x00	Output Length LB	9	0x00	Output Length LB
10	0x00	Reserved	10	0x00	Reserved
11	0x00	Reserved	11	0x00	Reserved
12	0x00	Reserved	12	0x00	Slave Status
13	0x00	Reserved	13	0x00	Driver RC
Request Buffer Data Field			Response Buffer Data Field		
			14	0x00	Output Length Byte 1 Slave 03
			15	0x05	Output Length Byte 2 Slave 03
			16	0x00	Output Length Byte 1 Slave 04
			17	0x00	Output Length Byte 2 Slave 04
			18	0x00	Output Length Byte 1 Slave 05
			19	0x00	Output Length Byte 2 Slave 05
			20	0x00	Output Length Byte 1 Slave 06
			21	0x00	Output Length Byte 2 Slave 06
			22	0x00	Output Length Byte 1 Slave 07
			23	0x00	Output Length Byte 2 Slave 07
			24	0x00	Output Length Byte 1 Slave 08

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			25	0x00	Output Length Byte 2 Slave 08
			26	0x00	Output Length Byte 1 Slave 09
			27	0x00	Output Length Byte 2 Slave 09
			28	0x00	Output Length Byte 1 Slave 10
			29	0x00	Output Length Byte 2 Slave 10
			30	0x00	Output Length Byte 1 Slave 11
			31	0x00	Output Length Byte 2 Slave 11
			32	0x00	Output Length Byte 1 Slave 12
			33	0x03	Output Length Byte 2 Slave 12
			…	…	…
			76	0x00	Output Length Byte 1 Slave 34
			77	0x04	Output Length Byte 2 Slave 34

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5.3.7 SLAVE_DIAG

Receives diagnostic data from DP Slave

DP Slave with address 16 and 4 Bytes manufacturer specific diagnostic data.

Request Buffer			Response Buffer		
Index	Value	Description	Index	Value	Description
0	0x86	Command	0	0x86	Command
1	0x10	Address	1	0x10	Address
2	0x00	Input Offset HB	2	0x00	Input Offset HB
3	0x00	Input Offset LB	3	0x00	Input Offset LB
4	0x00	Input Length HB	4	0x00	Input Length HB
5	0xF0	Input Length LB	5	0xF0	Input Length LB
6	0x00	Output Offset HB	6	0x00	Output Offset HB
7	0x00	Output Offset LB	7	0x00	Output Offset LB
8	0x00	Output Length HB	8	0x00	Output Length HB
9	0x00	Output Length LB	9	0x00	Output Length LB
10	0x00	Reserved	10	0x00	Reserved
11	0x00	Reserved	11	0x00	Reserved
12	0x00	Reserved	12	0x00	Slave Status
13	0x00	Reserved	13	0x00	Driver RC
Request Buffer Data Field			Response Buffer Data Field		
			14	0x10	Slave address
			15	XX	Data length of the following diagnostic data
			16	Octet 1	Stationstatus_1
			17	Octet 2	Stationstatus_2
			18	Octet 3	Stationstatus_3
			19	Octet 4	Diag.Master_Add
			20	Octet 5	Ident Number (HB)
			21	Octet 6	Ident Number (LB)
			22	0x04	Length of manufacturer specific diagnostic data
			23	XX	Byte 1
			24	XX	Byte 2
			25	XX	Byte 3
			26	XX	Byte 4

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5.3.7.1 Description of the PROFIBUS standard diagnostic data

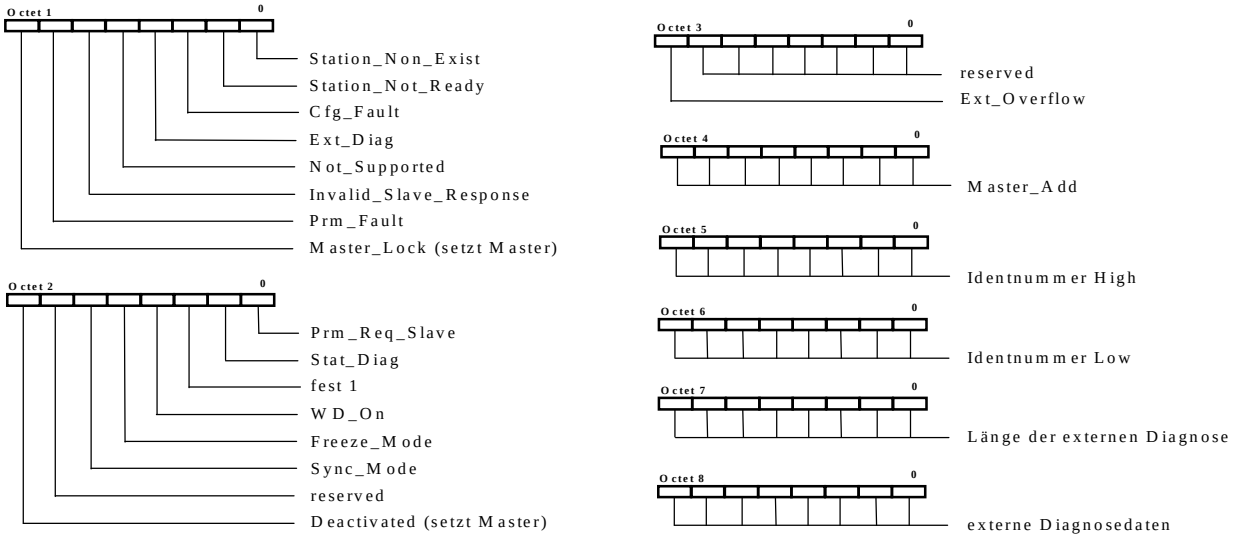


Figure 21: DP-Slave-Diagnostic Data

Octet 1: *Stationsstatus_1*

Bit 7: *Diag.Master_Lock*

The DP Slave has been parameterized by another master. This Bit is set by the DP Master (class 1) if the address in Octet 4 unequal 255 and unequal the own address. The DP Slave sets this Bit to zero.

Bit 6: *Diag.Prm_Fault*

This Bit is set by the DP Slave in case the last parameter telegram has been erroneous, e.g. wrong length, wrong *Ident_Number*, invalid parameter.

Bit 5: *Diag.Invalid_Slave_Response*

This Bit is set by the DP Master as soon as an implausible answer has been received by the contacted DP Slave. The DP Slave sets this Bit to zero.

Bit 4: *Diag.Not_Supported*

This Bit is set by the DP Slave as soon as a function has been requested that is not supported by this DP Slave.

Bit 3: *Diag.Ext_Diag*

This Bit is set by the DP Slave. If the Bit is set, a diagnostic input must exist in the slave-specific diagnostic area (*Ext_Diag_Data*). If the Bit is not set, a status message can exist in the slave-specific diagnostic area (*Ext_Diag_Data*). The meaning of this status messages is application-specific.

Bit 2: *Diag.Cfg_Fault*

This Bit is set by the DP Slave as soon as there is a discrepancy between the configuration data received last by the DP Master and the data determined by the DP Slave.

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Bit 1: D*iag.Station_Not_Ready*

This Bit is set by the DP Slave if the DP Slave is not yet ready for the data exchange.

Bit 0: Diag.*Station_Non_Existent*

This Bit is set by the DP Master if the DP Slave cannot be reached via the bus. In case the Bit is set, the diagnostic Bits contain the state of the last diagnostic message or the initial value. The DP Slave sets this Bit to zero.

Octet 2: *Stationsstatus_2*

Bit 7: *Diag.Deactivated*

This Bit is set by the DP Master as soon as the DP Slave has not been marked as active in the DP Slave parameter set and been excluded from the cyclic processing. The DP Slave sets this Bit always to zero.

Bit 5: *Diag.Sync_Mode*

This Bit is set by the DP Slave as soon as this DP Slave has received the sync control command.

Bit 4: *Diag.Freeze_Mode*

This Bit is set by the DP Slave as soon as this DP Slave has received the freeze control command.

Bit 3: *Diag.WD_On* (Watchdog on)

This Bit is set by the DP Slave. In case this Bit is set to 1, the supervision of the DP Slave will be activated.

Bit 2: This Bit is set to 1 by the DP Slave.

Bit 1: *Diag.Stat_Diag* (Statistic diagnosis)

This Bit is set by the DP Slave. If it is set, the DP Master has to collect diagnostic information until this Bit will be reset. The DP Slave will for example set this Bit if it cannot provide valid user data.

Bit 0: *Diag.Prm_Req*

This Bit is set by the DP Slave. If it is set, the DP Slave must be reparameterized and reconfigured. The Bit will remain until a parameterization has been effected.

In case the Bit 1 and the Bit 0 is set, Bit 0 has higher priority.

Octet 3: *Stationsstatus_3*

Bit 7: *Diag.Ext_Diag_Overflow*

In case this Bit is set, more diagnostic information exists than indicated in *Ext_Diag_Data*. The DP Slave will for example set this Bit if more channel diagnoses exist as the DP Slave can enter into its send buffer. The DP Master will set this Bit if the DP Slave sends more diagnostic information than the DP Master can consider in its diagnostic buffer.

Bit 0 to 6: reserved

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Octet 4: *Diag.Master_Add*

The address of the DP Master that has parameterized this DP Slave will be entered into this octet. In case the DP Slave has not been parameterized by a DP Master, the DP Slave will enter the address 255 into this octet.

Octet 5 to 6: *Ident_Number*

The supplier identification is allocated for a DP Slave type. This identification can be consulted for testing purposes as well as for the exact identification.

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