CompactRIO PROFIBUS DP

DP Master - Getting Started

V2.4/25.09.2017

Revision History

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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 Worldwide Support and Services

The National Instruments website is your complete resource for technical support. At *ni.com/support*, you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

1.2 Prerequisites:

- A cRIO PB Master/Slave module.
- Download the cRIO PB Master/Slave Driver Software from the LabVIEW Tools Network
- National Instruments CompactRIO system with real time controller and chassis.
- The National Instruments LabVIEW Real time and FPGA Development System from Version 2012 installed on a Windows PC.
- NI-RIO Version 14.5 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:

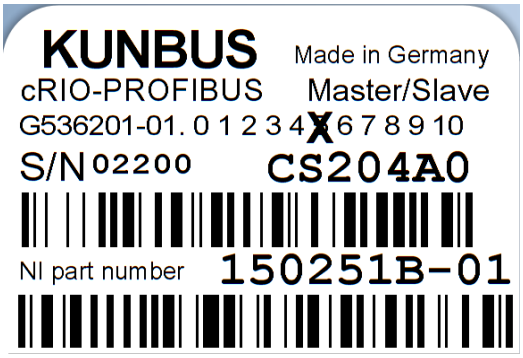


Figure 1: Supported PROFIBUS operation mode

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.

2 Installation

- Install the cRIO PB module in the CompactRIO chassis in slot 1.
- Switch on the CompactRIO system.
- Install the KUNBUS cRIO PB package downloaded from LabVIEW Tools Network.
- Check by the NI MAX (Measurement & Automation explorer) the proper installation of the cRIO system:

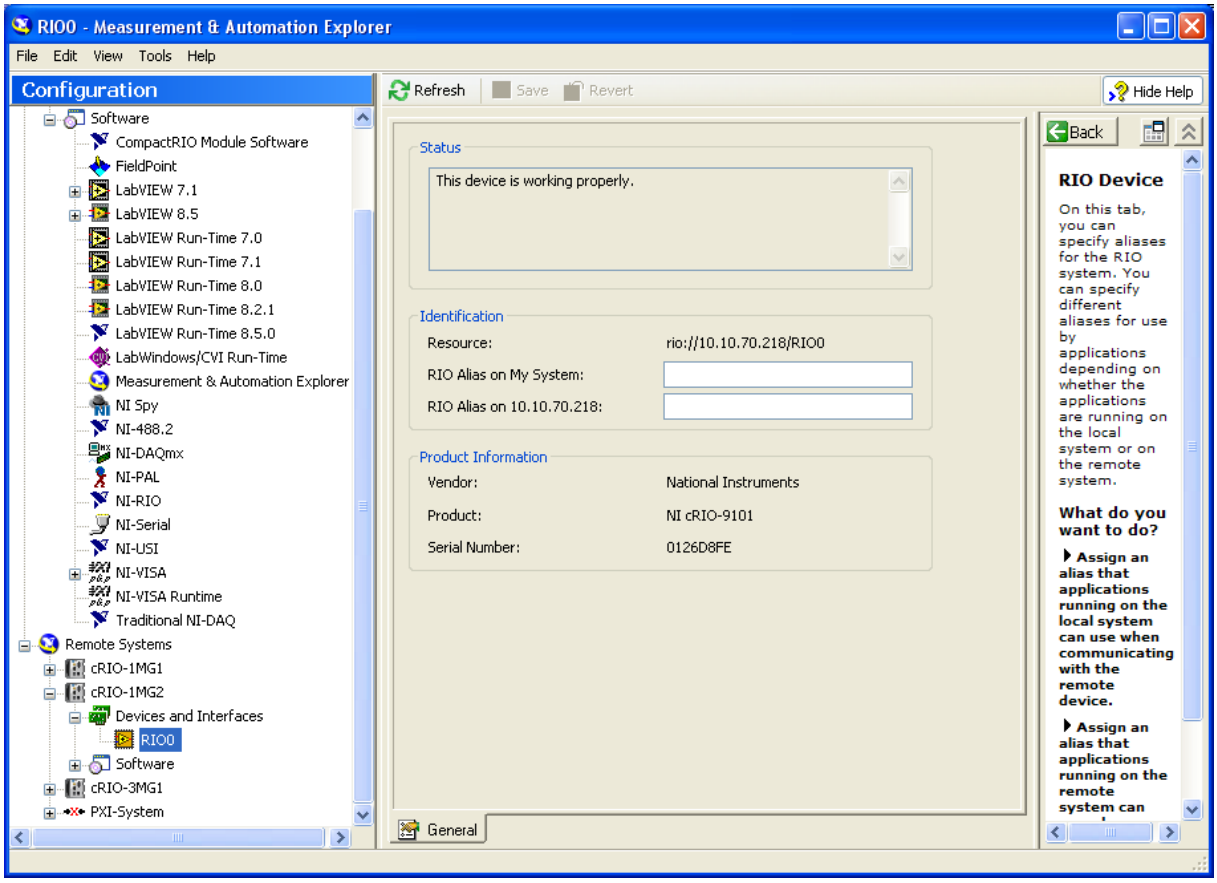


Figure 2: Measurement and Automation Explorer

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.

3 PROFIBUS configuration

The PROFIBUS configuration is carried out by the **KUNBUS** PROFIBUS configuration tool Configurator III.exe. Users new to the Configurator should read the “Starting a new profibus project” chapter of the Configurator PROFIBUS getting started guide. Within the Configurator the getting started guide can be accessed by clicking Help » Getting started » Profibus.

- Click Start » KUNBUS GmbH » PROFIBUS Configurator » Configurator III to open the PROFIBUS Configurator III. The Configurator III allows creating the complete PROFIBUS configuration based on DP Slave GSD-Files.
- Create and save the configuration.

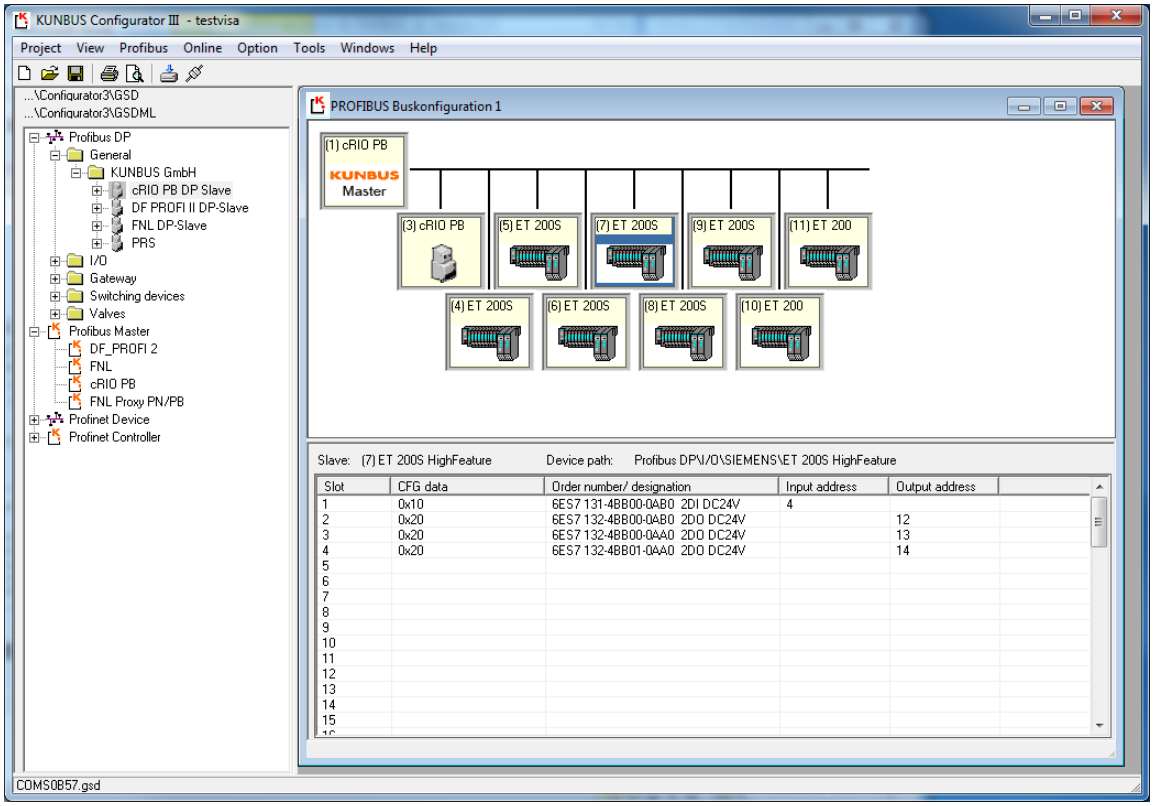


Figure 3: KUNBUS Configurator III

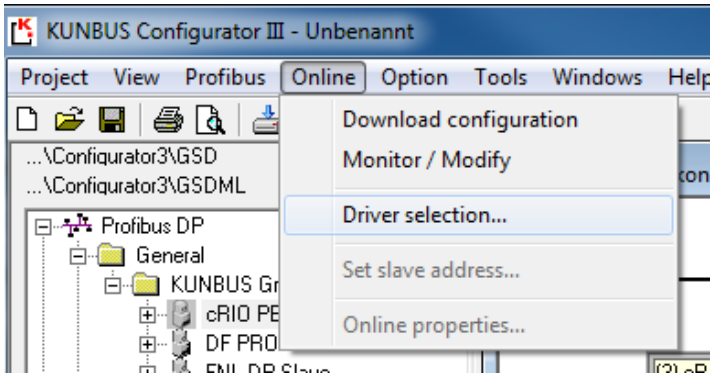
<u>Note</u>: Former PROFIBUS projects created by Configurator II can be loaded without any problems into Configurator III. To create new PROFIBUS projects by Configurator III on base of the installed GSD files in Configurator II the GSD path definition in Configurator III must be changed to the former path definition in Configurator II by the function “Open new GSD-device catalog path” of the “Project” menu.

3.1 PROFIBUS-DP configuration download

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

Proceed with the following steps:

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



The installed cRIO systems with their slots are displayed:

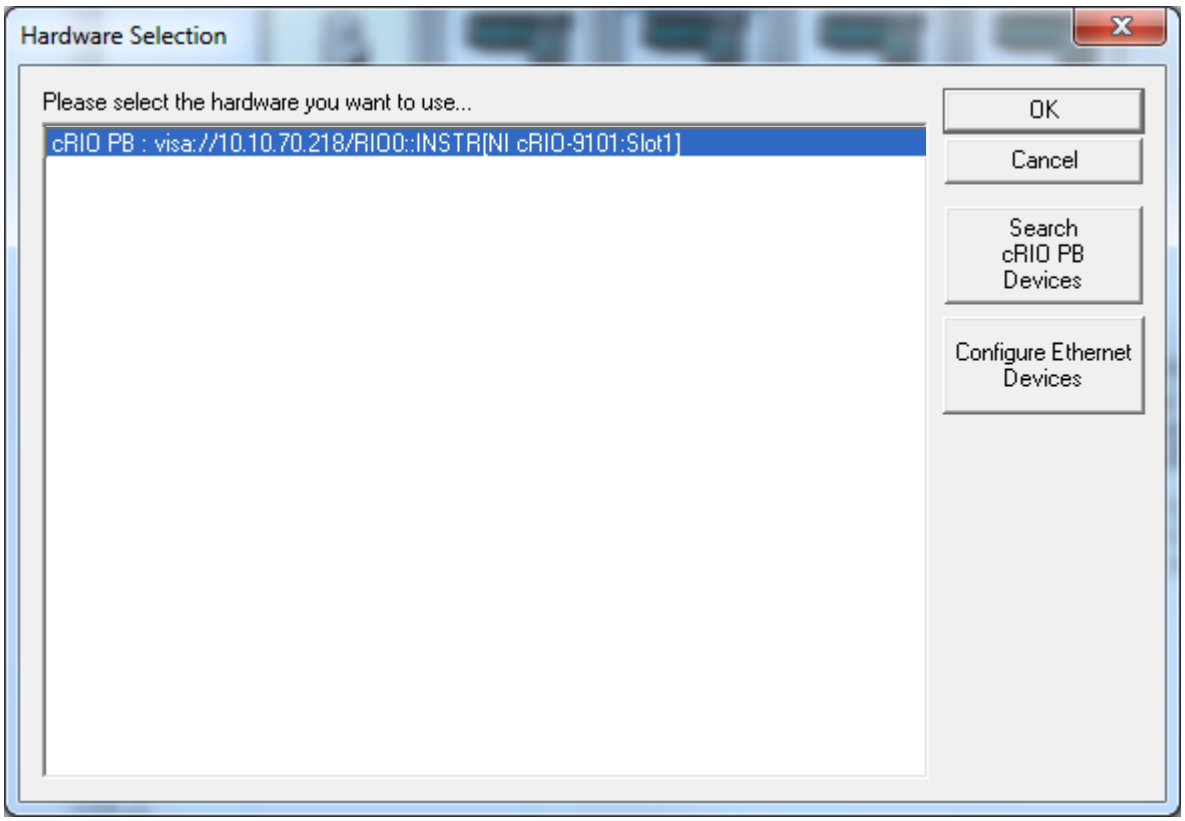


Figure 4: Selection of the cRIO PB module

If nothing is displayed click the Search ‘cRIO PB Devices’ Button to rescan the available cRIO systems.

Select the correct cRIO system.

Note: Configurator III 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 III for details of the driver selection.

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

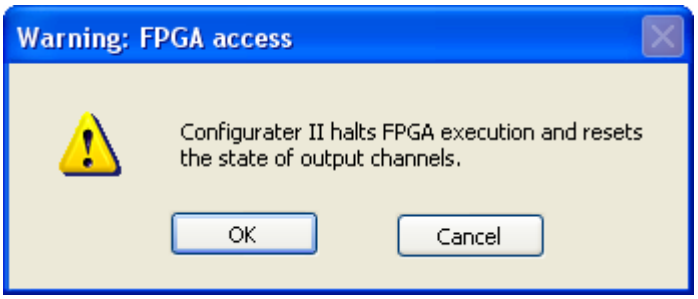
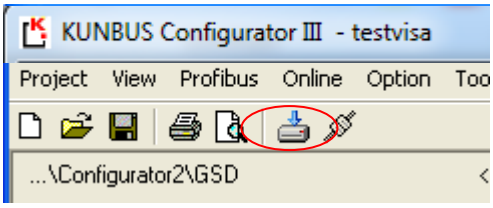


Figure 5: Confirmation FPGA reconfiguration

- **Download the PROFIBUS configuration**

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



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

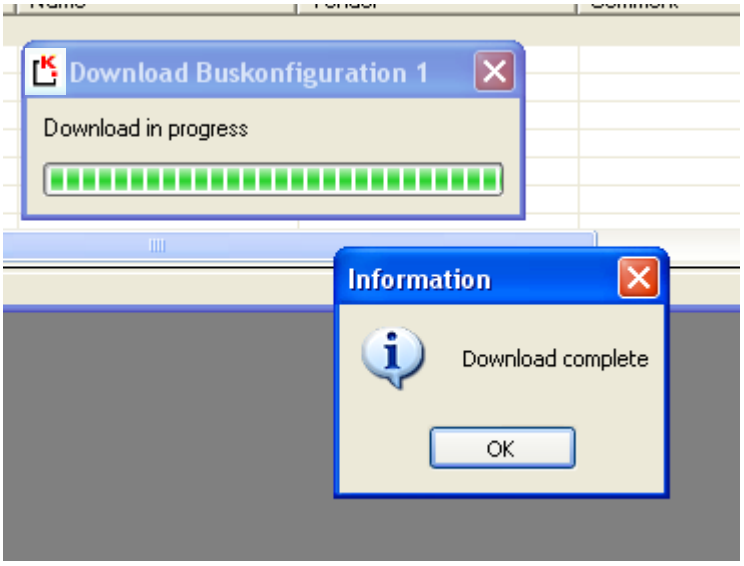
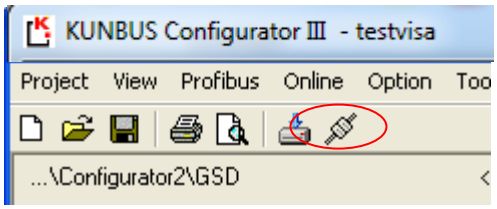


Figure 6: Download of PROFIBUS configuration

3.2 Configurator III Monitor/Modify mode

With the Monitor/Modify mode of the Configurator III 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 III:



Configurator III displays the PROFIBUS-Network in Online mode:

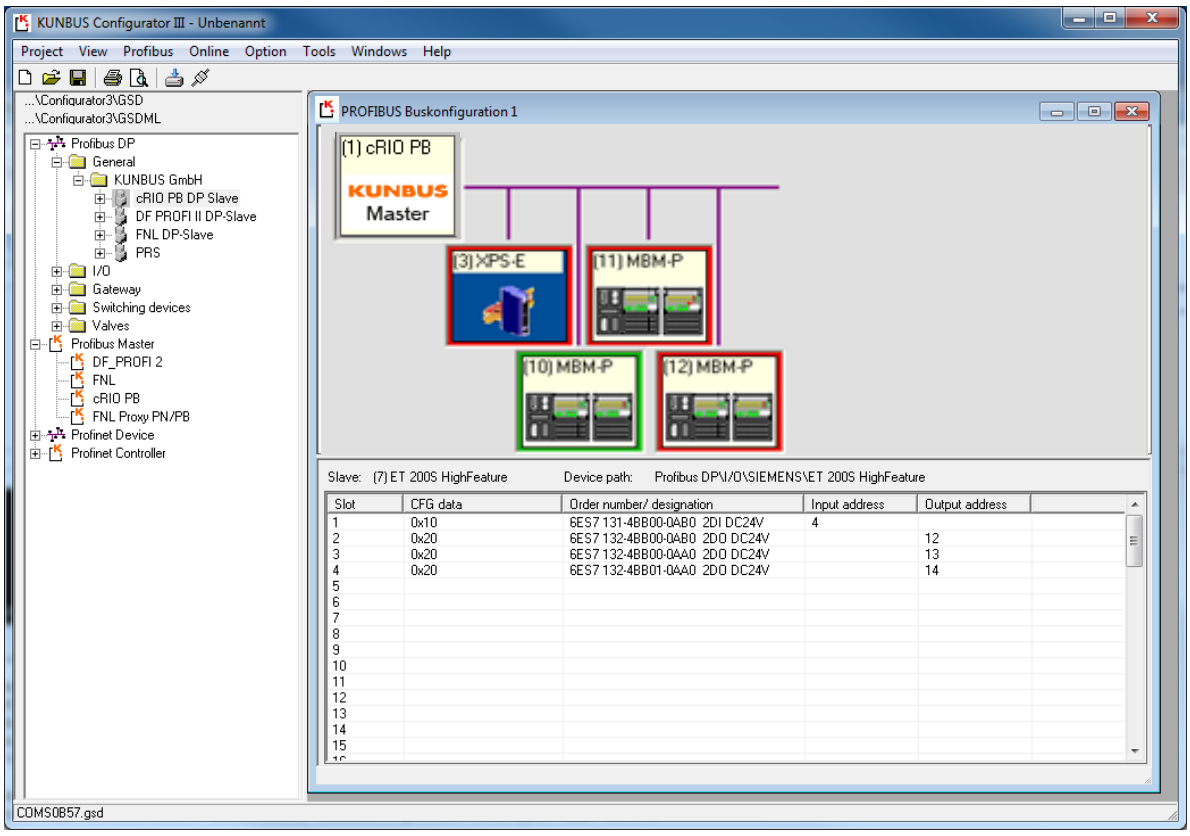


Figure 7: Configurator III – On line mode

Configurator III displays the status of every DP Slave (colored 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 III.

4 FPGA Method and Property Nodes

The lower level cRIO PB Module API consists of FPGA I/O Method and Property Nodes to be integrated into a FPGA based application. Additionally an easy to use high level RT API is available (see chapter 5). Three different APIs are available:

1. DP Master:
   Operation as DP Master to exchange cyclic I/O-Data with DP Slaves.

2. DPV1 Master:
   Operation as DPV1 Master Class 2 to perform acyclic read and write services with DP Slaves.

3. DP Slave:
   Operation as DP Slave to exchange I/O-Data with a DP Master.
   (see cRIO PB DP Slave Getting Started manual)

Add your FPGA target to a LabVIEW project. LabVIEW will discover your module automatically if it is connected.

Complete the following steps to add the cRIO PB module to a LabVIEW project if the module is not connected:

1. Right-click your FPGA Target in the Project Explorer window and select **New » C Series Modules** from the shortcut menu to display the Add Targets and Devices dialog box.

2. Click the **New target or device** radio button, select **C Series Module**, and click **OK** button to display the New C Series Module dialog box.

3. Select the **CS_cRIO-PBMS** module from the **Module Type** pull-down menu and click the **OK** button.

After the CS_cRIO-PBMS module is added, the cRIO PB Module API is displayed in the project as shown in Figure 8.

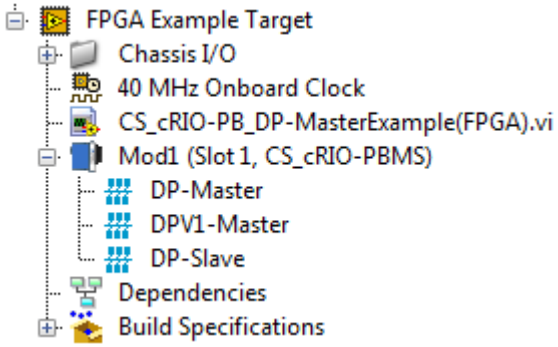


Figure 8: cRIO PB Module API

4.1 Module Property Nodes

4.1.1 Init cRIO PB Property

The Init cRIO PB Property Node configures the operation mode on the cRIO PB module. The cRIO PB module will always start up in the last set mode.

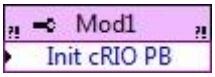


Figure 9: Init cRIO PB Property Node

Option	Mode of Operation
DP/DPV1 Master	Switches cRIO-PB into DP Master mode
DP-AutoSlave	Switches cRIO-PB into DP-AutoSlave mode

Table 1: Initialization Options

4.2 DP Master Methode Nodes

The DP Master API can handle single DP Slaves or the entire process image to handle all DP Slaves simultaneously.

4.2.1 Start/Stop DP Master Method

Starting the DP Master activates the PROFIBUS and the DP Slave scanning.

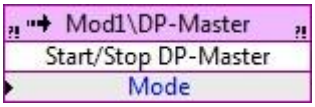


Figure 10: Start/Stop DP Master Method Node

Option	Mode of Operation
Start	Activates the cRIO-PB as DP Master Class 1 and Class 2
Stop	Resets the cRIO-PB

Table 2: Change Mode Options

4.2.2 Read/Write Data Method

The Read/Write Data Method transmits output data to the DP Slave(s) and receives input data from the DP Slave(s). The related I/O data are stored in the internal memory. The internal memory can be accessed by the Get Input Data Method, the Get Output Data Method and the Set Output Data Method.

Figure 11: Read/Write Data Method Node

4.2.2.1 Read/Write DP Slave I/O-Data

To exchange I/O Data with a single DP Slave a valid PROFIBUS address must be used.

Parameter	Value	Description
Slave	0 – 125	PROFIBUS DP Slave address
Slave Status	0x00	DP Slave is in DataExchange mode, I/O data are valid.
	0xC3	DP Slave is not in DataExchange mode, I/O data are invalid.
	0xFF	DP Slave is in DataExchange mode and reports external diagnostic data. Validness of I/O data depends on external diagnostic data.

Table 3: Read/Write I/O-Data Parameter

4.2.2.2 Read/Write process data image

To exchange the process data image (exchange of I/O-Data with all configured DP Slaves) use a value of -1 for the PROFIBUS address.

Parameter	Value	Description
Slave	-1	Process Data Mode
Slave Status	0	All DP Slaves are in DataExchange mode. All I/O data are valid.
	1 – 126	Number of DP Slaves which are not in DataExchange mode or report external diagnostic data. I/O data are partially invalid.

Table 4: Read/Write Process Data image

If the Read/Write Process Data Image Method returns a Slave Status <> 0, perform an additional Read Diagnostic Data Method ((see chapter 4.2.6) for every configured DP Slave to detect failing DP Slaves.

4.2.3 Get Input Data Method

The Get Input Data Method reads a single byte from a DP Slave's input data stream from the internal memory. Additionally the method returns the DP Slave's configured input data size. Use the Read/Write Data Method first to update the internal memory with the latest DP Slaves I/O-Data.

Figure 12: Get Input Data Method Node

Parameter	Value	Description
Slave	0 – 127	PROFIBUS DP Slave address
Index	0 – 254	Byte-Address of the DP Slave Input Data stream Index 0 = Input Byte 0; Index 1 = Input Byte 1; …
Data	0 – 255	Input data byte
Length	0 – 254	Configured DP Slave input data length

Table 5: Get Input Data Parameter

4.2.4 Get Output Data Method

The Get Output Data Method reads a single byte from a DP Slave's output data stream from the internal memory for information purposes. Additionally the method returns the DP Slave's configured output data size. The Start DP Master Method initializes the internal memory with the current DP Slave's output data.

Figure 13: Get Output Data Method Node

Parameter	Value	Description
Slave	0 – 127	PROFIBUS DP Slave address
Index	0 – 254	Byte-Address of the DP Slave Input Data stream Index 0 = Output Byte 0; Index 1 = Output Byte 1; …
Data	0 – 255	Output data byte
Length	0 – 254	Configured DP Slave output data length

Table 6: Get Output Data Parameter

4.2.5 Set Output Data Method

The Set Output Data Method writes a single byte of a DP Slave's output data stream to the internal memory. Use the Read/Write Data Method subsequently to transmit the output data stream from the internal memory to the DP Slave(s). Additionally the method returns the DP Slave's configured output data size.

Figure 14: Set Output Data Method Node

Parameter	Value	Description
Slave	0 – 127	PROFIBUS DP Slave address
Index	0 – 254	Byte-Address of the DP Slave Input Data stream Index 0 = Output Byte 0; Index 1 = Output Byte 1; …
Data	0 – 255	Output data byte
Length	0 – 254	Configured DP Slave output data length

Table 7: Get Output Data Parameter

4.2.6 Read Diagnostic Data Method

The Read Diagnostic Data Method reads the diagnostic data from a DP Slave. The diagnostic data are stored in the internal memory and can be read with the Get Diagnostic Data Method.

Figure 15: Read Diagnostic Data Method Node

Parameter	Value	Description
Read Count	0 – 239	Data length of the read diagnostic data
Slave	0 – 125	PROFIBUS DP Slave address
Slave Status	0x00	DP Slave is in DataExchange mode without error
	0xC3	DP Slave is not in DataExchange mode
	0xFF	DP Slave is in DataExchange mode and reports external diagnostic data

Table 8: Read Diagnostic Data Parameter

4.2.7 Get Diagnostic Data Method

The Get Diagnostic Data Method reads a single byte from a DP Slave's diagnostic data stream from the internal memory. Use the Read Diagnostic Data Method first to update the diagnostic data section in the internal memory. Additionally the method returns the DP Slave's diagnostic data length.

Figure 16: Get Diagnostic Data Method Node

Parameter	Value	Description
Slave	0 – 127	PROFIBUS DP Slave address

Index	0 – 239	Byte-Address of the DP Slave Diagnostic Data Index 0 = Diag Byte 0; Index 1 = Diag Byte 1; …
Data	0 – 255	Diagnostic data byte
Length	0 – 238	Size of the diagnostic data

Table 9: Get Diagnostic Data Parameter

4.2.7.1 Diagnostic data description

A DP Slave's diagnostic data stream consists of 6 bytes standard diagnostic data and up to 230 bytes device specific diagnostic data. The standard diagnostic data start at Byte 3:

Octet 1: *DP Slave address*

Octet 2: *Diagnostic data length*

Octet 3: *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.

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 4: *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 5: *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

Octet 5: *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 7 to 8: *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.

4.3 DPV1 Master API

The DPV1 Master API can perform acyclic read- and write services with DP Slaves supporting DPV1 operation mode.

DPV1 is used for the configuration of complex DP Slaves like process devices, drives, etc. storing hundreds of additional configuration values that cannot be handled only via a cyclic PROFIBUS DP connection.

To get detailed information about the DPV1 variable directory of a specific DP Slave, please refer to the DP Slave specific user's guide.

To access a DPV1 variable of a DP Slave the following steps must be performed:

1. DPV1-Service Initiate:
   Establish a DPV1 connection to the DP Slave.

2. DPV1-Service Read and Write:
   Reads DPV1 variables from the DP Slave or Writes DPV1 variables to the DP Slave.

3. DPV1-Service Abort:
   Abort the DPV1 connection if access to the DPV1 variables is no longer required.

Note: The DPV1 service DataTransport is not supported.

4.3.1 Read/Write DPV1 Data Method

The Read/Write DPV1 Data Method performs a DPV1-Request with a DP Slave. The request data transmitted to the DP Slave and the response data received from the DP Slave are stored in the internal memory and can be accessed by the Set DPV1 Data Method and Get DPV1 Data Method. To optimize the required amount of internal memory the request data as well as the response data use the identical internal memory buffer. Therefore it is not possible to perform simultaneous DPV1-Services.

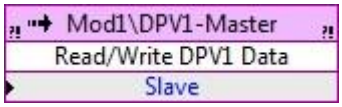


Figure 17: Read/Write DPV1 Data Method Node

Parameter	Value	Description
Slave	0 – 126	PROFIBUS DP Slave address

Table 10: Read/Write DPV1 Data Parameter

Note: The communication status for DPV1-Services is returned in the Error code section of the Read/Write DPV1 Data Method Node.

Right-click the Read/Write DPV1 Data Method Node and select **Show Error Terminals** from the shortcut menu to enable the error handling.

The following status and error codes apply:

Error code	Meaning	Detail	Help
Positive DPV1 confirmations			
0x57	DPV1-Initiate positive confirmation	The DPV1 Initiate service was successfully performed	-
0x5E	DPV1-Read positive confirmation	The DPV1 Read service was successfully performed	-
0x5F	DPV1-Write positive confirmation	The DPV1 Write service was successfully performed	-
0x82	DPV1-Abort positive confirmation	The DPV1 Abort service was successfully performed	-
Negative DPV1 confirmations			
0xD7	DPV1-Initiate negative confirmation	The DPV1 Initiate service failed. The DPV1 connection cannot be established	Refer to the Error section
0xDE	DPV1-Read negative confirmation	The DPV1 Read service failed	Refer to the Error section
0xDF	DPV1-Write negative confirmation	The DPV1 Write service failed	Refer to the Error section
Abort confirmation			
0x58	DPV1-Abort indication/confirmation	The DPV1 connection cannot be established or is aborted.	Refer to the Abort section

Table 11: DPV1 Communication Status

4.3.2 Set DPV1 Data Method

The Set DPV1 Data Method writes the DPV1 request data into the internal memory. Use subsequently the Read/Write DPV1 Data Method to perform the DPV1-Request with the DP Slave.

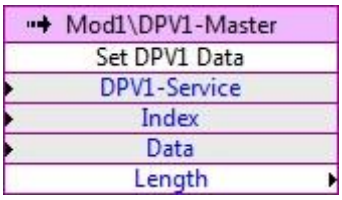


Figure 18: Set DPV1 Data Method Node

Parameter	Value	Description
DPV1-Service	Initiate	Establish a DPV1 connection to the DP Slave
	Read	Read DPV1 data from the DP Slave
	Write	Write DPV1 data to the DP Slave
	Abort	Abort the DPV1 connection to the DP Slave
Index	0 – 244	Byte-Address of the DPV1-Request Data
Data	0 – 255	DPV1-Request Data Byte
Length	242	DPV1-Initiate request data length
	4	DPV1-Read request data length
	1 – 244	DPV1-Write request data length
	5	DPV1-Abort request data length

Table 12: Set DPV1 Data Parameter

4.3.3 Get DPV1 Data Method

The Get DPV1 Data Method reads the response data from the internal memory. Use the Read/Write DPV1 Data Method first to perform a DPV1-Request to the DP Slave.

Figure 19: Get DPV1 Data Method Node

Parameter	Value	Description
Index	0 – 254	Byte-Address of the DPV1-Response Data
Data	0 – 255	DPV1-Response Data Byte
Length	241	DPV1-Initiate positive confirmation data length
	1 – 243	DPV1-Read positive confirmation data length
	2	DPV1-Write positive confirmation data length
	8	DPV1-Abort indication data length
	5	DPV1-Initiate/Read/Write negative confirmation length

Table 13: Get DPV1 Data Parameter

4.3.4 DPV1-Request/Response Data

4.3.4.1 DPV1-Initiate

Request Data		Response Data	
Index	Description	Index	Description
0	Communication ref.	0	Communication ref.
1	PROFIBUS Address	1	PROFIBUS Address
2	Send timeout LB	2	Feat. Supp. 1
3	Send timeout HB	3	Feat. Supp. 2
4	Feat. Supp. 1	4	Profile Feat. Supp. 1
5	Feat. Supp. 2	5	Profile Feat. Supp. 2
6	Profile Feat. Supp. 1	6	Profile ID number LB
7	Profile Feat. Supp. 2	7	Profile ID number HB
8	Profile ID number LB	8	S-Type
9	Profile ID number HB	9	S-Length
10	S-Type	10	D-Type
11	S-Length	11	D-Length
12	D-Type	12	Data[0]
13	D-Length	13	Data[1]
14	Data[0]	14	Data[2]
15	Data[1]	15	Data[3]
	…	…	
242	Data[228]	240	Max length data unit

Table 14: DPV1-Initiate Parameter

The communication status of a successful DPV1-Initiate is 0x57 and is returned in the Error code of the Read/Write DPV1 Data Method Node. For a DPV1-Abort indication (Error code 0x58) refer to 4.3.4.5 DPV1-Abort Indication and for a negative confirmation (Error code 0xD7) refer to 4.3.4.6 DPV1-Error (Negative Confirmation).

4.3.4.2 DPV1-Read

Request Data		Response Data	
Index	Description	Index	Description
0	Communication ref.	0	Communication ref
1	Slot number	1	Remote Address
2	Index	2	Length
3	Length	3 – 243	Data[0] – Data[240]

Table 15: DPV1-Read Parameter

The communication status of a successful DPV1-Read is 0x5E and is returned in the Error code of the Read/Write DPV1 Data Method Node. For a DPV1-Abort indication (Error code 0x58) refer to 4.3.4.5 DPV1-Abort Indication and for a negative confirmation (Error code 0xDE) refer to 4.3.4.6 DPV1-Error (Negative Confirmation).

4.3.4.3 DPV1-Write

Request Data		Response Data	
Index	Description	Index	Description
0	Communication ref.	0	Communication ref.
1	Slot number	1	Remote Address
2	Index		
3	Length		
4	Data[0] – Data[240]		

Table 16: DPV1-Write Parameter

The communication status of a successful DPV1-Write is 0x5F and is returned in the Error code of the Read/Write DPV1 Data Method Node. For a DPV1-Abort indication (Error code 0x58) refer to 4.3.4.5 DPV1-Abort Indication and for a negative confirmation (Error code 0xDF) refer to 4.3.4.6 DPV1-Error (Negative Confirmation).

4.3.4.4 DPV1-Abort

Request Data	
Index	Description
0	Communication ref. returned by the DPV1-Initiate service
1	Subnet
2	Instance & Reasoncode
3	Reason code
4	Additional Detail LB
5	Additional Detail HB

Table 17: DPV1-Abort Request Parameter

The communication status of a successful DPV1-Abort is 0x82 and is returned in the Error code of the Read/Write DPV1 Data Method Node. For a DPV1-Abort indication (Error code 0x58) refer to 4.3.4.5 DPV1-Abort Indication.

4.3.4.5 DPV1-Abort Indication

If the Error code of the Read/Write DPV1 Data Method Node returns a DPV1-Abort Indication read the response data by the Get DPV1 Data Method Node for detailed error information.

Response Data	
Index	Description
0	Remote Address
1	Response SAP
2	Instance
3	Reason code
4	Additional Detail LB
5	Additional Detail HB

Table 18: DPV1-Abort Response Parameter

The instance code **FDL (=0)** means that the physical connection to the DP Slave is not o.k and the physical connection and the parameter **Slave address** have to be checked.

The instance code **MSAC2_C2 (=1)** means that the connection setup on DPV1 level failed and the parameters of the DPV1-Initiate have to be checked.

Instance	Reason code	Name	Meaning
0 (FDL)	1	UE	see EN 50170 Part 2
	2	RR	see EN 50170 Part 2
	3	RS	see EN 50170 Part 2
	9	NR	see EN 50170 Part 2
	10	DH	see EN 50170 Part 2
	11	LR	see EN 50170 Part 2
	12	RDL	see EN 50170 Part 2
	13	RDH	see EN 50170 Part 2
	14	DS	master is not in the logical ring

	15	NA	No response from remote FDL
1 (MSAC_C2)	1	ABT_SE	sequence error; service not allowed in this state
	2	ABT_FE	invalid request PDU received
	3	ABT_TO	timeout of the connection
	4	ABT_RE	invalid response PDU received
	5	ABT_IV	invalid service from USER
	6	ABT_STO	Send_Timeout requested was to small
	7	ABT_IA	invalid additional address information
	8	ABT_OC	Waiting for FDL_DATA_REPLY.con

Table 19: DPV1-Abort Instance Parameter

Additional_Detail:

This parameter contains the minimum Send_Timeout required by the DP Slave if the instance is MSAC_C2 and the Reason_Code is ABT_STO. The parameter Send timeout in the DPV1 Initiate tab has to be set at minimum to this value.

4.3.4.6 DPV1-Error (Negative Confirmation)

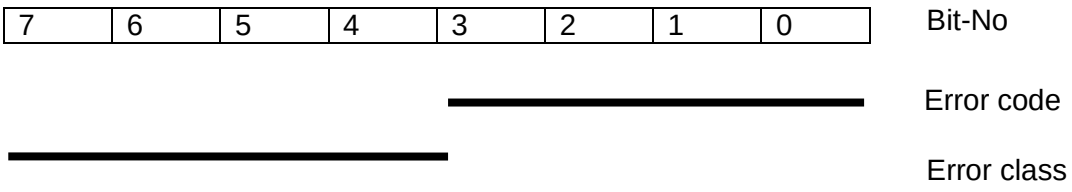
If the Error code of the Read/Write DPV1 Data Method Node returns a negative confirmation read the response data with the Get DPV1 Data Method Node for detailed information of the failure.

Response Data	
Index	Description
0	Communication ref.
1	Remote Address
2	Error decode
3	Error code 1
4	Error code 2

Table 20: DPV1-Error Parameter

The **Error decode** value is always 128 (=0x80) what classifies a DPV1 error.

The **Error code 1** value is divided into 2 sections:



Error class	Meaning	Error code
0 – 9	Reserved	-
10	Application	0 = read error 1 = write error 2 = module failure 3 - 7 = reserved 8 = version conflict 9 = feature not supported 10 – 15 = user specific
11	Access	0 = invalid index 1 = write length error 2 = invalid slot 3 = type conflict 4 = invalid area 5 = state conflict 6 = access denied 7 = invalid range 8 = invalid parameter 9 = invalid type 10 – 15 = user specific
12	Resource	0 = read constrain conflict 1 = write constrain conflict 2 = resource busy 3 = resource unavailable 4 – 7 = reserved 8 – 15 = user specific
13 – 15	user specific	

Table 21: DPV1-Error Code 1

Error code 2 is user specific!

5 LabVIEW RT PROFIBUS DP Master VIs

The RT DP Master VIs provide access to the PROFIBUS on RT-Level via the already described low level FPGA VIs. Refer to the RT Master Example for a fully working implementation example. The VI specific context help menu describes in detail all VI specific parameters.

5.1 DP Master menu

Use the cRIO PB palettes to access the RT DP Master VIs. Click Functions Palette » Addons » KUNBUS Librarys » cRIO PB Master/Slave » DP Master:

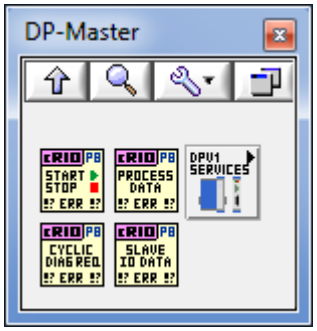


Figure 20: DP Master menu

5.1.1 DP Master Start/Stop

The CS_cRIO-PB_DP Master_StartStop.vi starts and stops the cRIO PB as PROFIBUS Master.

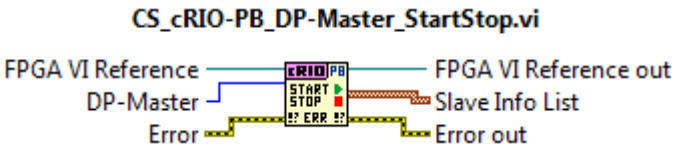


Figure 21: DP Master Start/Stop VI

Refer to Table 2 for a list of DP Master Change Mode Options.

The CS_cRIO-PB_DP Master_StartStop.vi returns a list of additional parameters describing input and output lengths of the configured DP Slaves:

Parameter	Value	Description
Address	0 – 127	Configured DP Slave Address
Input Lenth	0 – 255	Configured DP Slave input data length
Output Length	0 – 255	Configured DP Slave output data length

Table 22: Slave Info List Parameter

5.1.2 Slave I/O-Data

The CS_cRIO-PB_DP Master_SlaveIOData.vi exchanges I/O-Data and status with a single DP Slave.

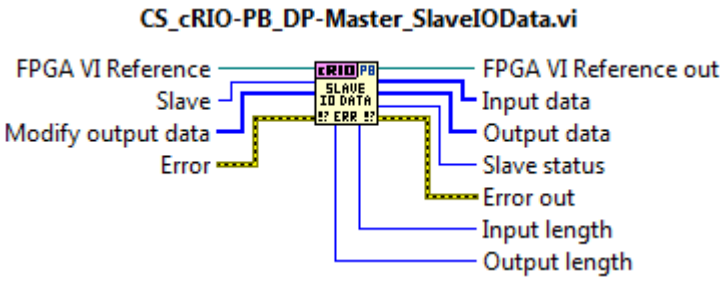


Figure 22: Slave I/O-Data VI

Parameter	Value	Description
Slave	0 – 127	Configured DP Slave Address
Modify output data	[0 – 255]	DP Slave output data to be changed
Input data	[0 – 255]	DP Slave input data
Output data	[0 – 255]	DP Slave output data
Slave Status	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
Input Lenth	0 – 255	Configured DP Slave input data length
Output Length	0 – 255	Configured DP Slave output data length

Table 23: Slave I/O-Data Parameter

5.1.3 Process Data

The CS_cRIO-PB_DP Master_ProcessData.vi exchanges I/O-Data and status with all configured DP Slaves.

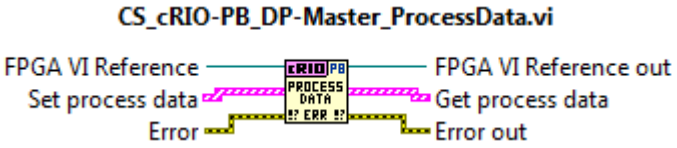


Figure 23: Process Data VI

Parameter	Value	Description
Slave	0 – 127	Configured DP Slave Address
Output data	[0 – 255]	DP Slave output data to be changed

Table 24: Set Process Data Parameter

Parameter	Value	Description
Input data	[0 – 255]	DP Slave input data
Output data	[0 – 255]	DP Slave output data
Slave Status	0x00	DP Slave is in DataExchange mode without error
	0xC3	DP Slave is not in DataExchange mode (wrong configuration or not connected)
Diag data	[0 – 238]	DP Slave diagnostic data

Table 25: Get Process Data Parameter

5.1.4 Cyclic Slave Diag Data

The CS_cRIO-PB_DP Master_CyclicSlaveDiagData.vi reads the diagnostic data of a DP Slave.

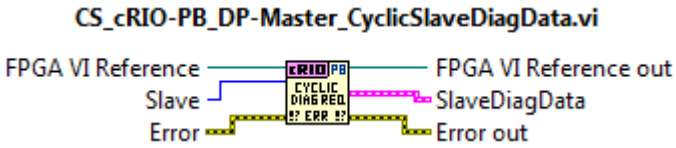


Figure 24: Slave Diagnostic Data VI

Refer to 4.2.7.1 Diagnostic data description for parameter description.

5.2 DPV1 Master menu

Use the cRIO PB palettes to access the RT DPV1 Master VI's. Click Functions Palette » Addons » KUNBUS Librarys » cRIO PB Master/Slave » DP Master » MSAC2 DPV1-Services:

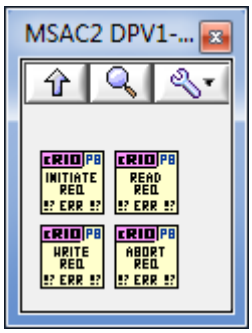


Figure 25: DPV1 Master menu

5.2.1 DPV1-Initiate

The CS_cRIO-PB_MSAC2_DPV1-InitiateReq.vi establishes a connection to a DPV1 Slave.

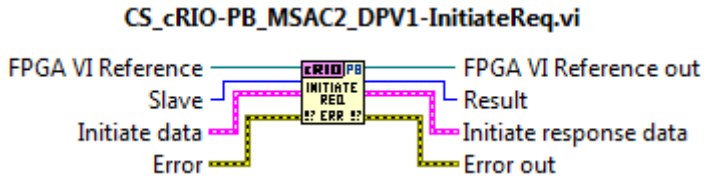


Figure 26: DPV1 Master Initiate VI

Refer to Table 14 for a list of DPV1-Initiate Parameter.

5.2.2 DPV1-Read

The CS_cRIO-PB_MSAC2_DPV1-ReadReq performs a DPV1-Read service with a DPV1 Slave.

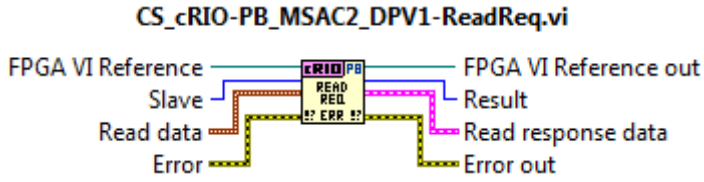


Figure 27: DPV1 Master Read VI

Refer to DPV1-Read ParameterTable 15 for a list of DPV1-Read Parameter.

5.2.3 DPV1-Write

The CS_cRIO-PB_MSAC2_DPV1-WriteReq performs a DPV1-Write service with a DPV1 Slave.

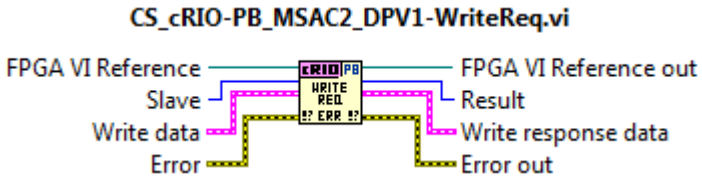


Figure 28: DPV1 Master Write VI

Refer to Table 16 for a list of DPV1-Write Parameter.

5.2.4 DPV1-Abort

The CS_cRIO-PB_MSAC2_DPV1-AbortReq disables the DPV1 connection to a DPV1 Slave.

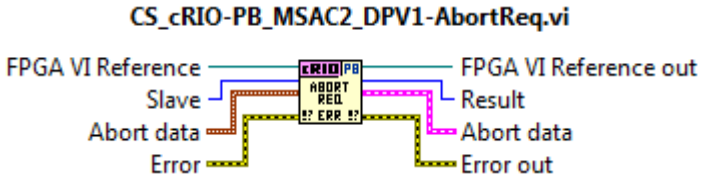


Figure 29: DPV1-Abort Write VI

Refer to Table 17 for a list of DPV1-Abort Request Parameter.

6 RT Master Example

The DP Master sample VI within scope of delivery demonstrates the following functions:

- Start/Stop DP/DPV1 Master
- Read and Write I/O data from/to DP Slaves
- Read diagnostic data from DP Slaves
- DPV1 communication

On LabVIEW click Menu Help → Find Examples. The “NI Example Finder” opens.

Choose the directory Toolkits and Modules -> Third-Party Add-Ons -> KUNBUS GmbH -> PROFIBUS and open the LabVIEW project “CS_cRIO-PB_DP-MasterExample.lvproj”.

Complete the following steps to use the CRIO PB module with your FPGA Target:

1. Add your FPGA target to the CS_cRIO-PB_DP MasterExample.lvproj.
2. Add the cRIO-PBMS module to your FPGA Target:
    - Right-click your FPGA Target in the Project Explorer window and select **New » C Series Modules** from the shortcut menu to display the Add Targets and Devices dialog box.
    - Click the **Discover an existing target(s) or device(s)** radio button, expand the **C Series Module** in the **Targets and Devices** list to discover existing C Series Modules.
    - Select **CS_cRIO-PBMS** module in the **Targets and Devices** list and click the **OK** button.
3. Copy the FPGA Master example to your FPGA Target:
    - Strg + drag and drop the **CS_cRIO-PB_DP MasterExample(FPGA).vi** from the FPGA Example Target to your FPGA Target.
4. Create a new Compilation for your FPGA Target:
    - Right-click the **CS_cRIO-PB_DP MasterExample(FPGA).vi** in the FPGA Target and select **Create Build Specification** from the shortcut menu.
    - Under **Build Specifications**, right-click the new build specification for the **CS_cRIO-PB_DP MasterExample(FPGA)**, select **Build**, and wait for the build to complete.
5. Copy the RT Master example to your cRIO Chassis:

- Strg + drag and drop the **CS_cRIO-PB_DP MasterExample(Host).vi** from the FPGA Example Target to your FPGA Target.

6. Configure **Open FPGA VI Reference** to communicate between the Host VI and FPGA VI.

   - Double-click the RT Master example **CS_cRIO-PB_DP MasterExample(Host).vi** and select **Window»Show Block Diagram**.

   - Right-click the Open FPGA VI Reference function and select **Configure Open FPGA VI Reference** from the shortcut menu to display the **Configure Open FPGA VI Reference** dialog box.

   - Click the **VI** radio button, select **CS_cRIO-PB_DP MasterExample(FPGA).vi** in the **Select VI** dialog box and click the **OK** button.

Run the **CS_cRIO-PB_DP MasterExample(Host).vi** and following the Instructions in the DP Master section.

7 Status and Error codes

Status and Error codes returned by the cRIO PB module are handled via the Error Terminal of the Property and Method Node. Right-click the Property or Method Node and select **Show Error Terminals** from the shortcut menu to enable the error handling.

Value	Description	Reason	Help
0x00	Success		-
0x01	Internal error		Contact support
0x02	Unknown command value	Wrong service request	Contact support
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 III to a unique one.
0x12	No valid DP Master configuration on cRIO PB Module available	No valid DP Master configuration was downloaded to cRIO PB Module.	Use the KUNBUS Configurator III PROFIBUS configuration tool to create and download a valid PROFIBUS configuration to the cRIO PB Module.
0x13	cRIO PB module does not support DP Master operation mode	Check sticker on the back side for supported operation modes (see chapter 1.2).	Contact support
0x14	cRIO PB module hardware error	The self-test of the cRIO PB module reported a hardware error. The module is not operable.	Contact support
0x15	cRIO PB module in AutoSlaveMode	If the cRIO PB module is configured for AutoslaveMode. None other operation than AutoslaveMode. mode can be activated	Deactivate AutoSlaveMode (see chapter 4.1.1)
0x17	cRIO PB module not actived	Operation mode is not set	Activate required operation mode (DP Master or AutoSlaveMode see chapter 4.1.1)
0x19	DPV1 Service pending	The pending DPV1 service must be completed first	cRIO PB module does not support simulteanous DPV1 services
0x1A	DPV1 Service pending	The pending DPV1 service must be completed first	cRIO PB module does not support simultaneous DPV1 services

0x57	DPV1-Initiate positive confirmation	DPV1 connection successfully established	-
0x58	DPV1-Abort indication	The DPV1 connection cannot be established or is aborted.	See also chapter 4.3.4.5 and following for additional details
0x5E	DPV1-Read positive confirmation	MSAC2_DPV1_READ_REQ service successfully performed	-
0x5F	DPV1-Write positive confirmation	MSAC2_DPV1_WRITE_REQ service successfully performed	-
0x82	DPV1-Abort positive confirmation	MSAC2_DPV1_ABORT_REQ service successfully performed	-
0xD7	DPV1-Initiate negative confirmation	The DPV1 connection cannot be established	See chapter 4.3.4.5 and following for additional details
0xDE	DPV1-Read negative confirmation	MSAC2_DPV1_READ_REQ service failed	See chapter 4.3.1 and following for additional details
0xDF	DPV1-Write negative confirmation	The MSAC2_DPV1_WRITE_REQ service failed	See chapter 4.3.1 and following for additional details
0x10000	No module or invalid	Unable to communicate with the module.	Reinsert the module and check connections.
0x10001	Incorrect module	The module that was detected is different than the module that was expected.	Make sure the slot the module is configured for in software matches the physical location of the module.
0x4353457B	Rdy/Bsy Timeout	The module is not ready for communication.	Reinsert the module and check connections
0x435345B0	Start Frame error	No or wrong or Start Frame received	Old Firmware version or Hardware defect.

Table 26: Status and Error codes

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