



Willkommen

Power Control Unit (PCU) Change Notes

**Release:
PCU_3_1_0_2022_0_2**

VMM Solar Power / 20.08.2021

Change Notes: PCU_3_1_0_2022_0_2

Agenda

- System requirements
- PLCnext component
- Basic application



System requirements

Controller / PLCnext Engineer / Firmware

- Controller
 - SOL-SA-PCU-41XX ([1114234](#))
 - AXC F 2152 ([2404267](#))
 - AXC F 3152 ([1069208](#))
- PLCnext Engineer
 - >= 2022.0.2 ([Download PLCnext Engineer](#))
- Firmware
 - >= 2022.0.4 ([Download Firmware](#))



Extension P(f) characteristic (1/3)

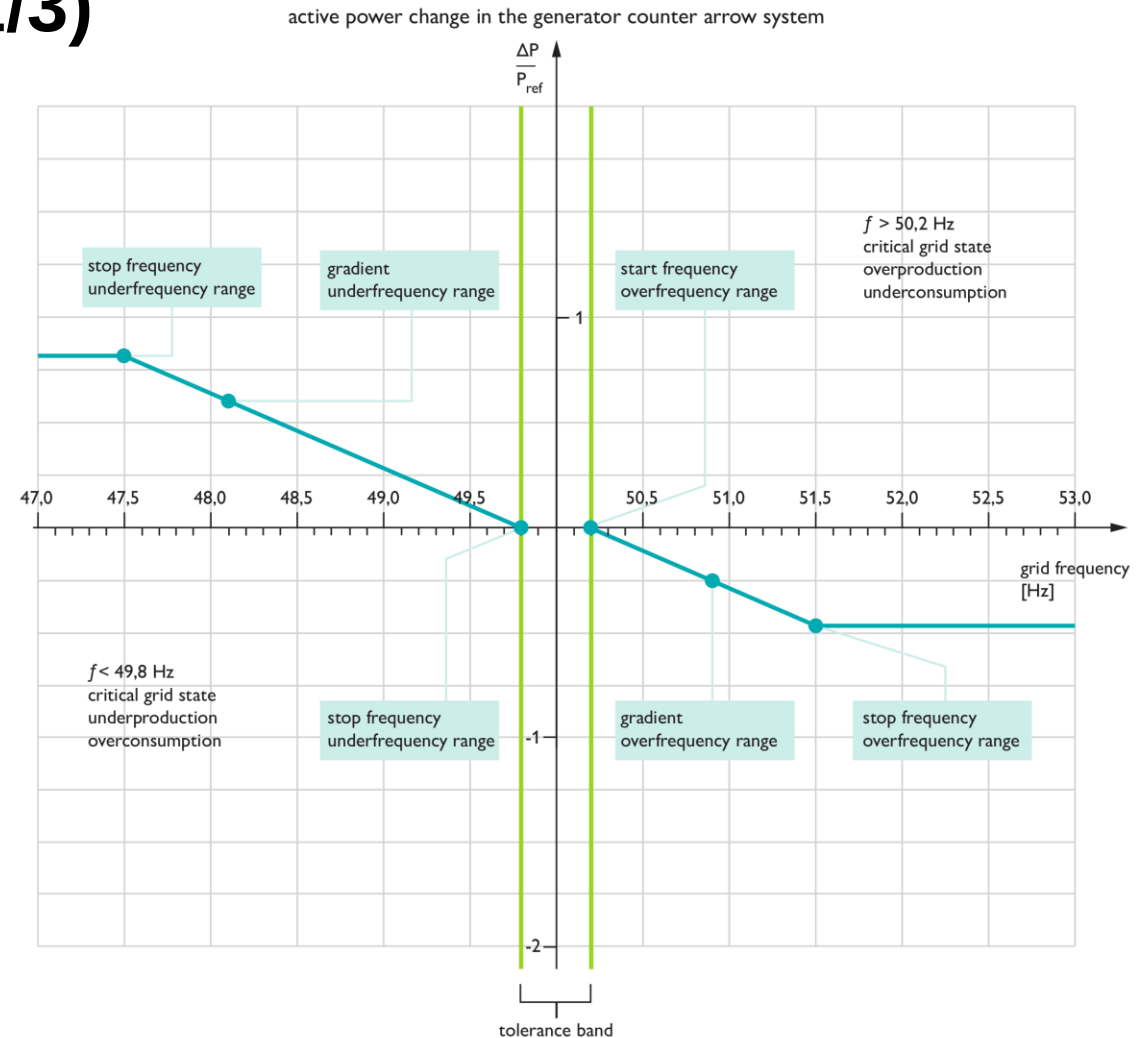
- **PREVIOUS VERSION (SPMpcu41xx.pcwlx)**
- Definition of the characteristic curve via the start or stop frequencies, gradients, and the tolerance band*.
- P_{ref} corresponds to the currently feed-in active power at the transition to the critical network state
- ΔP change of the active power

$$\Delta P = \frac{1}{2} * gradient * P_{ref} * \left(\frac{start\ frequency - f_{act}}{nominal\ frequency} \right)$$

- In the case where no gradient is given, but the statics is, the gradient can be calculated as follows.

$$static = 2 * \frac{1}{gradient} * 100 \%$$

- Parameterization is specified by the grid operator
- Normally the P(f)-characteristic is activated in die power generation unit (e.g.: pv inverter)



Extension P(f) characteristic (2/3)

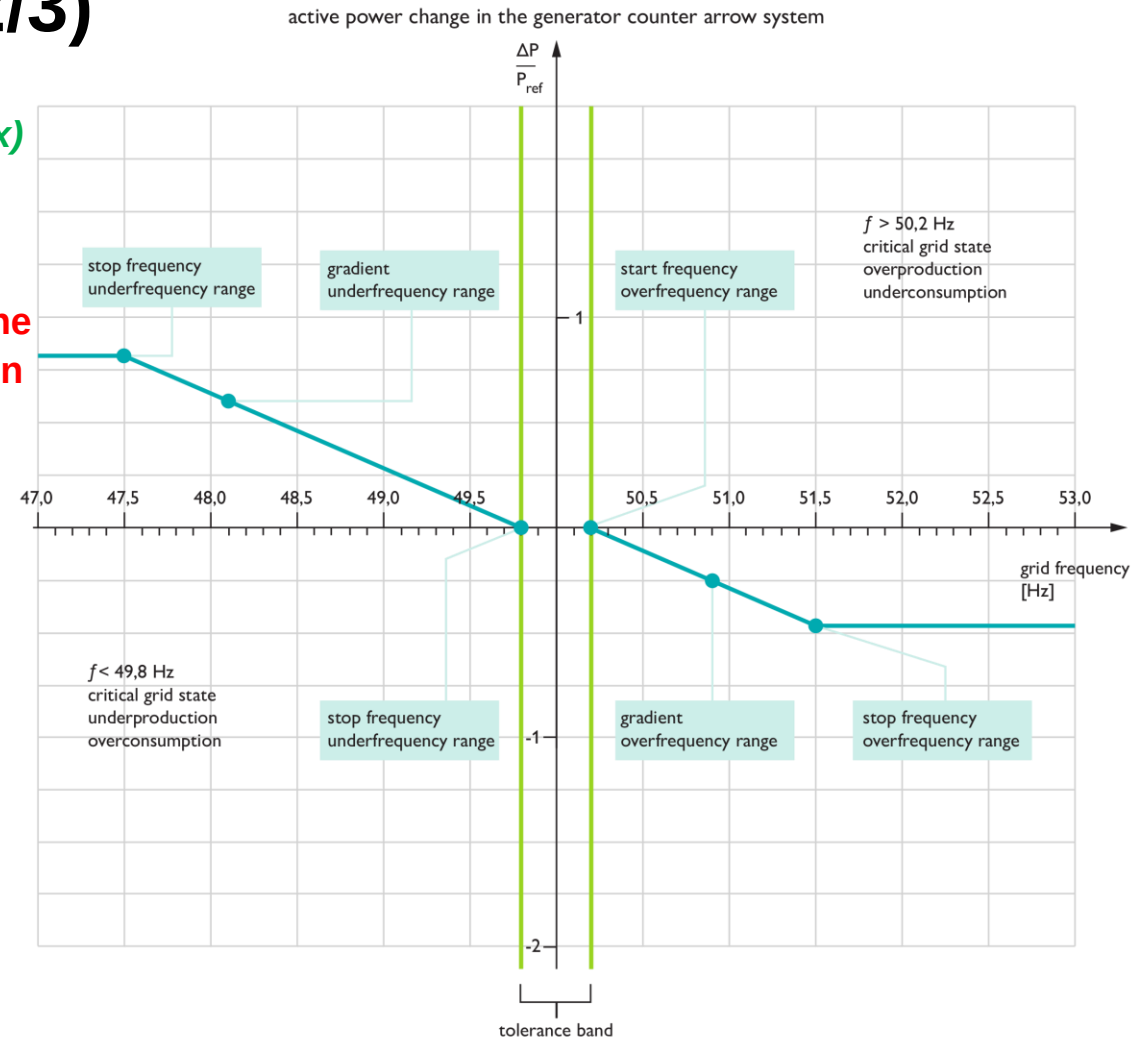
- **NEW VERSION** → *IPMpcu_2152.pcwlx* (*IPMpcu_3152.pcwlx*)
- Definition of the characteristic curve via the start or stop frequencies, gradients, and the tolerance band*.
- **P_{ref} corresponds to the currently feed-in active power at the transition to the critical network state or P_{max} depending on the characteristic mode siMod (see chapter eHMI)**
- ΔP change of the active power

$$\Delta P = \frac{1}{2} * gradient * P_{ref} * \left(\frac{start\ frequency - f_{act}}{nominal\ frequency} \right)$$

- In the case where no gradient is given, but the statics is, the gradient can be calculated as follows.

$$static = 2 * \frac{1}{gradient} * 100 \%$$

- Parameterization is specified by the grid operator
- Normally the P(f)-characteristic is activated in die power generation unit (e.g.: pv inverter)



Extension P(f) characteristic (3/3)

- New parameter siMod
- Mode for P_{ref}
 - 1: $P_{ref} = P_{actual}$
 - 2: $P_{ref} = P_{max}$
- Example PCU 1 (also valid for PCU 2)

The screenshot displays the Phoenix Contact PLCnext Control software interface. The top navigation bar includes the Phoenix Contact logo and a status bar with local time (2022-05-29T21:03:18), project name (Phoenix Contact Electronics GmbH), firmware version (2022.0.4 LTS (22.0.4.144)), and application name (PCU_Beta_3_1_0_2022_0_1_220).

The main interface is divided into several sections:

- General:** Includes tabs for Info, Control (selected), Meter, Test, Logger, and Trend.
- Init:** Includes tabs for Common, PID PCtrl, PID QCtrl, Rmp, P(f) (selected), PriCtl, Q(Vlim), Q(V), Q(P), and EnaPoi.
- Settings:** Includes tabs for Home, Settings, and PGS.
- PGS:** Includes tabs for PCU 1 (selected) and PCU 2.
- Telecontrol:** Includes tabs for IEC 60870-5-101 and IEC 60870-5-104.

The **P(f) characteristic** configuration window is open, showing a table of parameters. The parameter **Ctrl.PCtrl.ActPwrHz.siMod** is highlighted with a red box, indicating its value is 2. The table also shows other parameters related to frequency ranges and gradient limits.

Parameter	Description	Min	Max	Actual	Edit	Unit
Ctrl.PCtrl.ActPwrHz.xEna	Enable/Disable P(f) characteristic	Off	On	false	On/Off	-
Ctrl.PCtrl.ActPwrHz.siMod	Mode for Pref (1: Pref = Pact 2: Pref = Pmax)	1	2	2	2	-
Ctrl.PCtrl.ActPwrHz.IrFqTolRng	Tolerance range grid frequency	0	2	0.01	0.01	[p.u.]
Ctrl.PCtrl.ActPwrHz.IrFqStrHi	Start frequency overfrequency range	0	2	1.01	1.01	[p.u.]
Ctrl.PCtrl.ActPwrHz.IrFqStrLo	Start frequency underfrequency range	0	2	0.9900	0.9900	[p.u.]
Ctrl.PCtrl.ActPwrHz.IrFqStpHi	Stop frequency overfrequency range	0	2	1.03	1.03	[p.u.]
Ctrl.PCtrl.ActPwrHz.IrFqStpLo	Stop frequency underfrequency range	0	2	0.9500	0.9500	[p.u.]
Ctrl.PCtrl.ActPwrHz.IrGraHi	Gradient overfrequency range	0	100	16.667	16.667	[%/Hz]
Ctrl.PCtrl.ActPwrHz.IrGraLo	Gradient underfrequency range	0	100	16.667	16.667	[%/Hz]
Ctrl.PCtrl.ActPwrHz.IrGdFrqSttTr	Waiting time after critical grid frequency state	0	3600	0	0	[s]

On the right side, there is a **Write parameter** section with an **Apply** button. The table shows the status of the write operation:

Write parameter	Apply
File write state	Write
File write done	false
Error	false

Extension primary control

- The described modification of the P(f) characteristic has also been carried out for the primary control.



Local time

2022-05-29T21:19:30

Firmware

2022.0.4 LTS (22.0.4.144)

Project

Phoenix Contact Electronics GmbH

Application

PCU_Beta_3_1_0_2022_0_1_220

General

Home

Settings

PGS

PCU 1

PCU 2

Telecontrol

IEC 60870-5-101

IEC 60870-5-104

Info

Control

Meter

Test

Logger

Trend

Init

Common

PID PCtrl

PID QCtrl

Rmp

P(f)

PriCtl

Q(Vlim)

Q(V)

Q(P)

EnaPol

Primary control

Parameter	Description	Min	Max	Actual	Edit	Unit
Ctrl.PCtrl.PriCtl.xEna	Enable/Disable P(f)-characteristic	Off	On	false	On/Off	-
Ctrl.PCtrl.PriCtl.siMod	Mode for Pref (1: Pref = Pact 2: Pref = Pmax)	1	2	2	2	-
Ctrl.PCtrl.PriCtl.IrActPwrDltMax	Maximum active power for primary control	0	2	0.1	0.1	[p.u.]
Ctrl.PCtrl.PriCtl.IrFrqStrHi	Start frequency to decrease the active power	0	2	1.0005	1.0005	[p.u.]
Ctrl.PCtrl.PriCtl.IrFrqStrLo	Start frequency to increase the active power	0	2	0.9994	0.9994	[p.u.]
Ctrl.PCtrl.PriCtl.IrGraHi	Gradient to decrease the active power	0	100	50	50	[%/Hz]
Ctrl.PCtrl.PriCtl.IrGraLo	Gradient to increase the active power	0	100	50	50	[%/Hz]

Write parameter

Apply

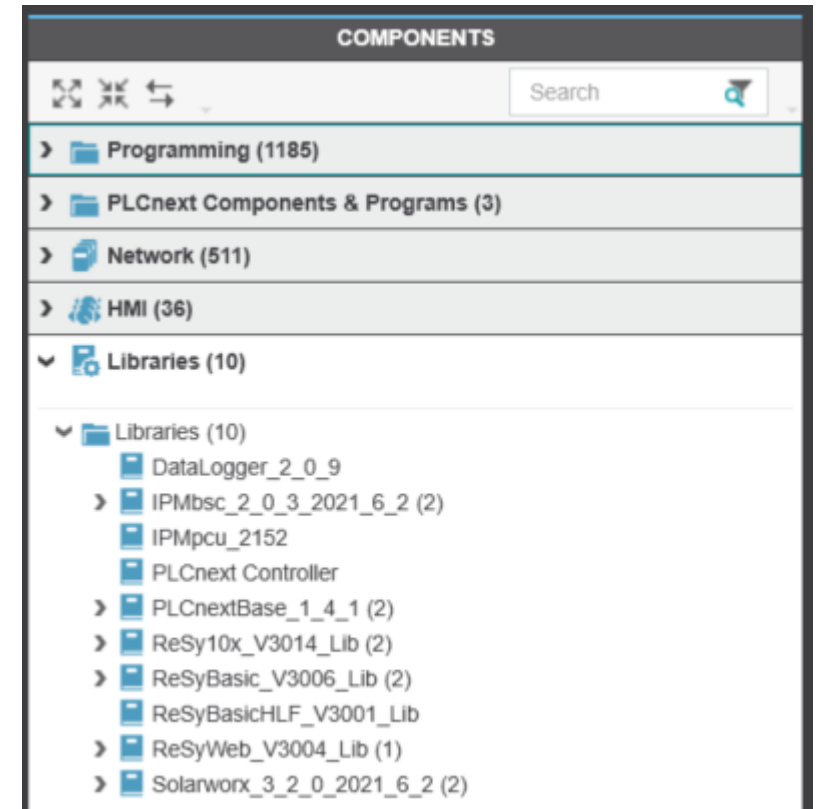
File write state	Write
File write done	true
Error	false

- Example PCU 1 (also valid for PCU 2)

Basic application

Libraries

- New library version added
 - IPMpcu_2152
 - IPMbsc_2_0_3_2021_6_2
 - Solarworx_3_2_0_2021_6_2
 - ReSy10x_V3014_Lib
 - ReSyBasic_V3006_Lib
 - ReSyBasicHLF_V3001_Lib
 - ReSyWeb_V3004_Lib



Basic application

Tasks and Events

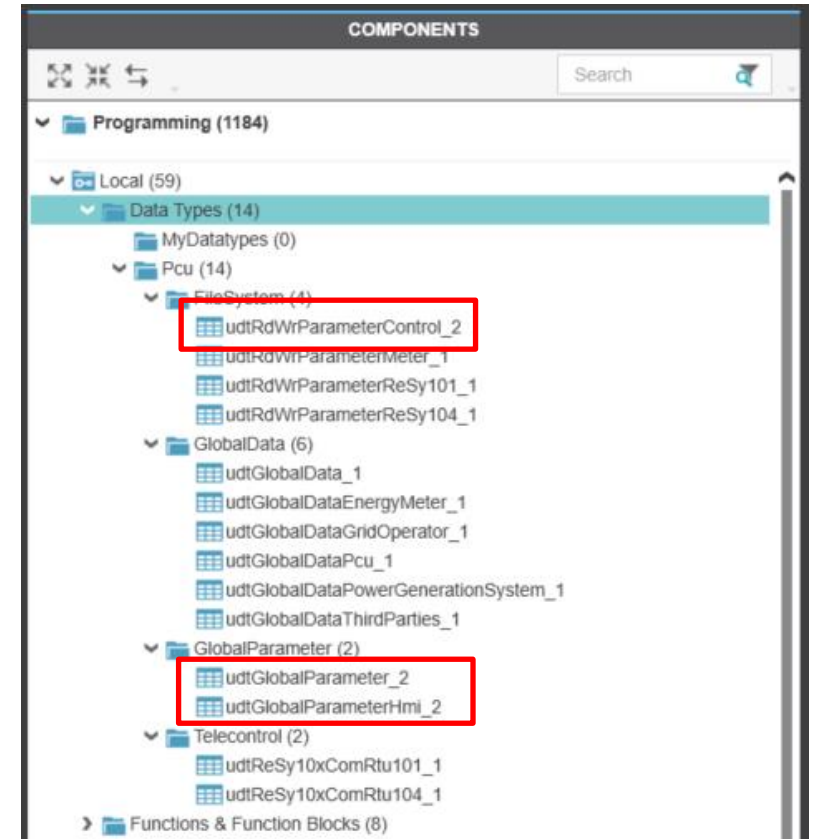
- New PLCnext component added

Name	Component name	Task type	Event name	Program type	Interval (ms)	Priority	Threshold (ms)	Watchdog (ms)
ESM1								
▶ Pcu_Parameter		Cyclic task			1000	10	0	1000
▶ Pcu_GridOperator		Cyclic task			50	1	0	50
▶ Pcu_ThirdParties		Cyclic task			50	4	0	50
▶ Pcu_EnergyMeter		Cyclic task			10	2	0	10
▼ Pcu_Control		Cyclic task			10	0	0	10
P_Pcu1_ExchangeIn	Arp.Plc.Eclr			P_Pcu1_ExchangeIn_2				
P_Pcu2_ExchangeIn	Arp.Plc.Eclr			P_Pcu2_ExchangeIn_2				
P_Pcu1_Control	IPMpcu_2152Compone...			IPMpcu_2152Program				
P_Pcu2_Control	IPMpcu_2152Compone...			IPMpcu_2152Program				
P_Pcu1_ExchangeOut	Arp.Plc.Eclr			P_Pcu1_ExchangeOut_2				
P_Pcu2_ExchangeOut	Arp.Plc.Eclr			P_Pcu2_ExchangeOut_2				
Enter program instance name here				Select program type here				
▶ Pcu_PwrGenSys		Cyclic task			50	3	0	50
▶ Pcu_Debug		Cyclic task			50	5	0	50
Enter task name here								
ESM2								
▶ IPMbsc		Cyclic task			500	11	0	500
Enter task name here								

Basic application

Data Types

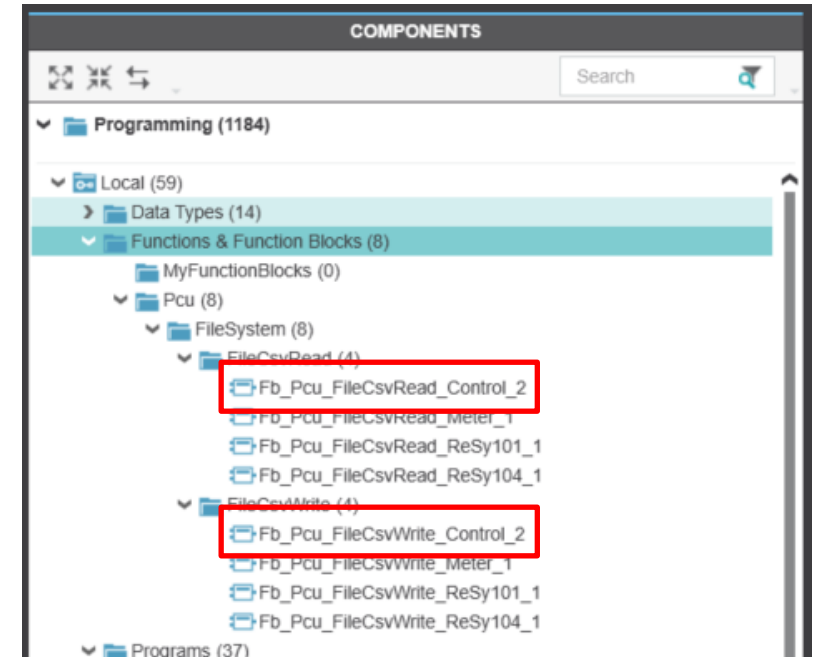
- Extension of the following data type code worksheets due to the parameter extension of the P(f) characteristic and the primary control
 - Folder FileSystem
 - udtRdWrParameterControl_2
 - Folder GlobalParameter
 - udtGlobalParameter_2
 - udtGlobalParameterHmi_2



Basic application

Funtions & Function Blocks

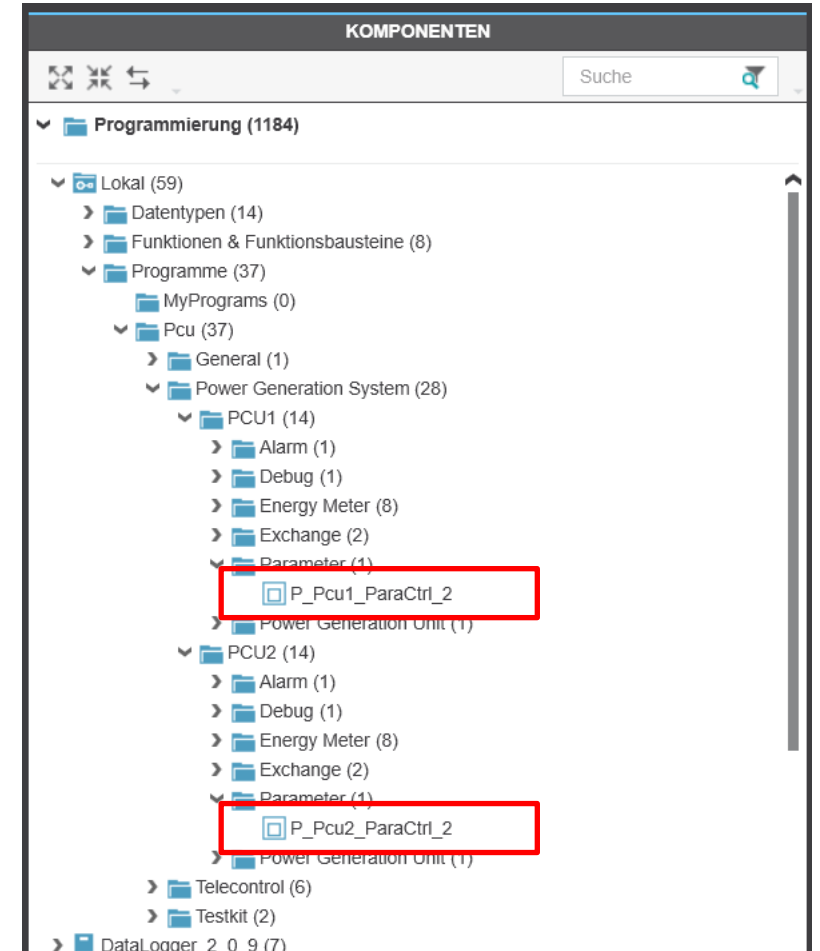
- Extension of the following function blocks due to the parameter extension of the P(f) characteristic and the primary control
 - Folder FileCsvRead
 - Fb_Pcu_FileCsvRead_Control_2
 - Folder FileCsvWrite
 - Fb_Pcu_FileCsvWrite_Control_2



Basic application

Programs: Parameter

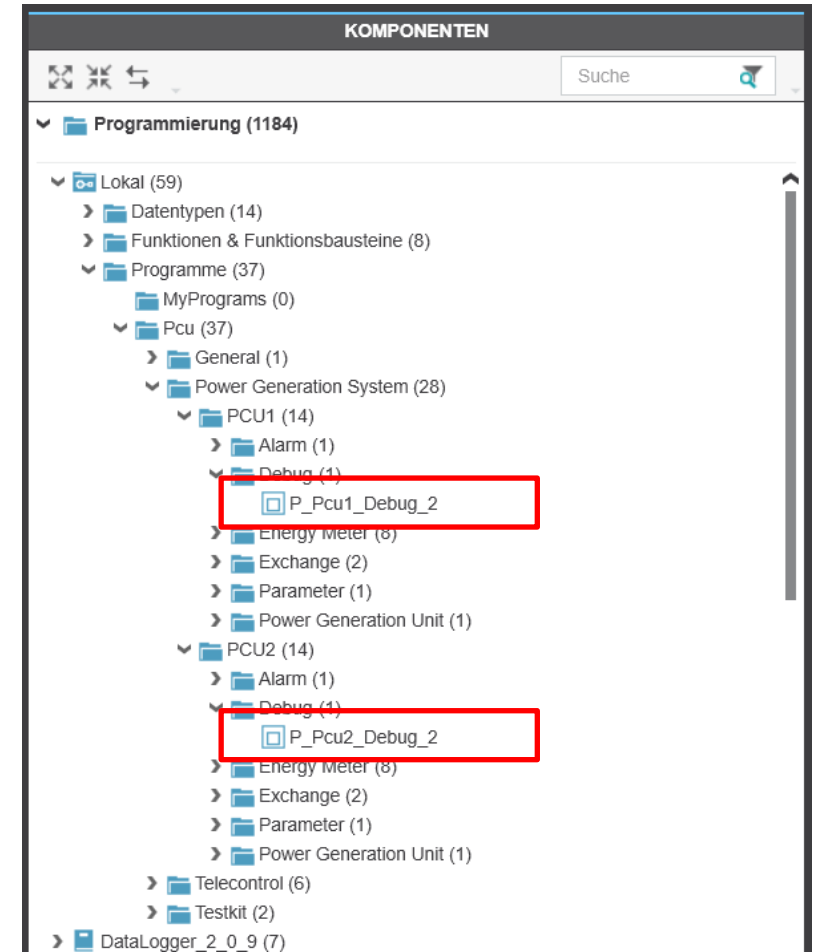
- Extension of the following programs due to the parameter extension of the P(f) characteristic and the primary control
 - Folder ../Parameter
 - P_Pcu[n]_ParaCtrl_2



Basic application

Programs: Debug (1/2)

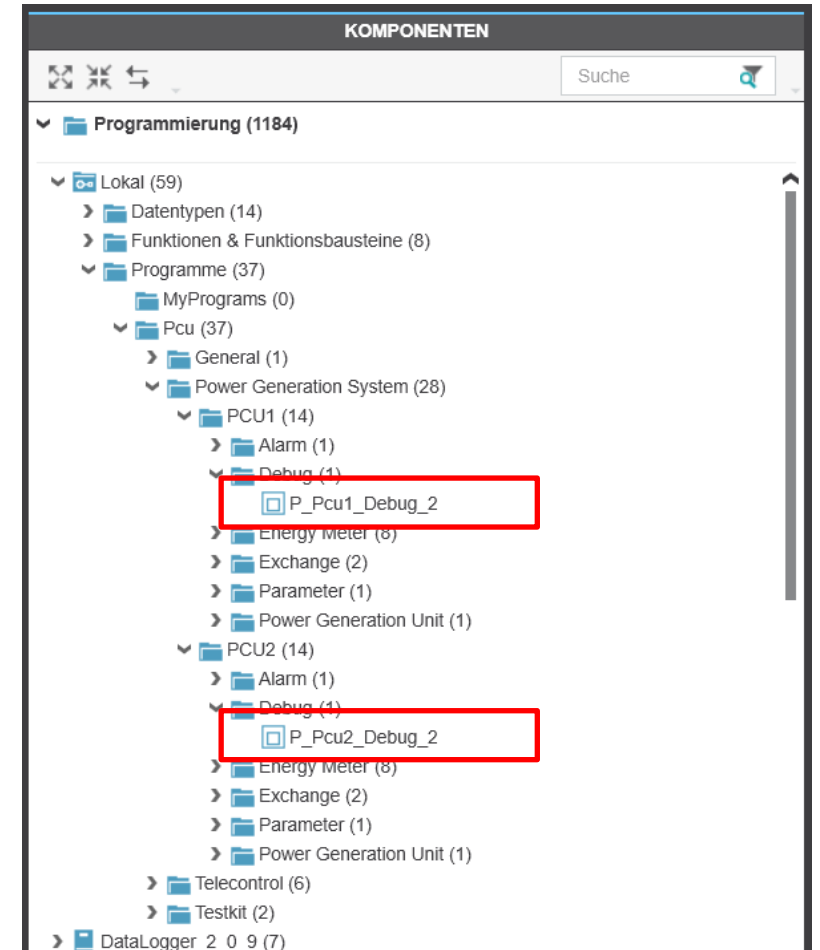
- Adjustment of the log data
 - New data
 - Setpoints
 - Active power grid operator [%]
 - Reactive power grid operator [%]
 - Cos(phi) grid operator [p.u.]
 - Active power third parties [%]
 - Measured values at the POI
 - Active power [%]
 - Reactive power [%]
 - Cos(phi) [p.u.]
 - Frequency [Hz]
 - Voltage (average value ph2ph) [p.u.]
 - Control values of the PID controller
 - Active power [%]
 - Reactive power [%]



Basic application

Programs: Debug (2/2)

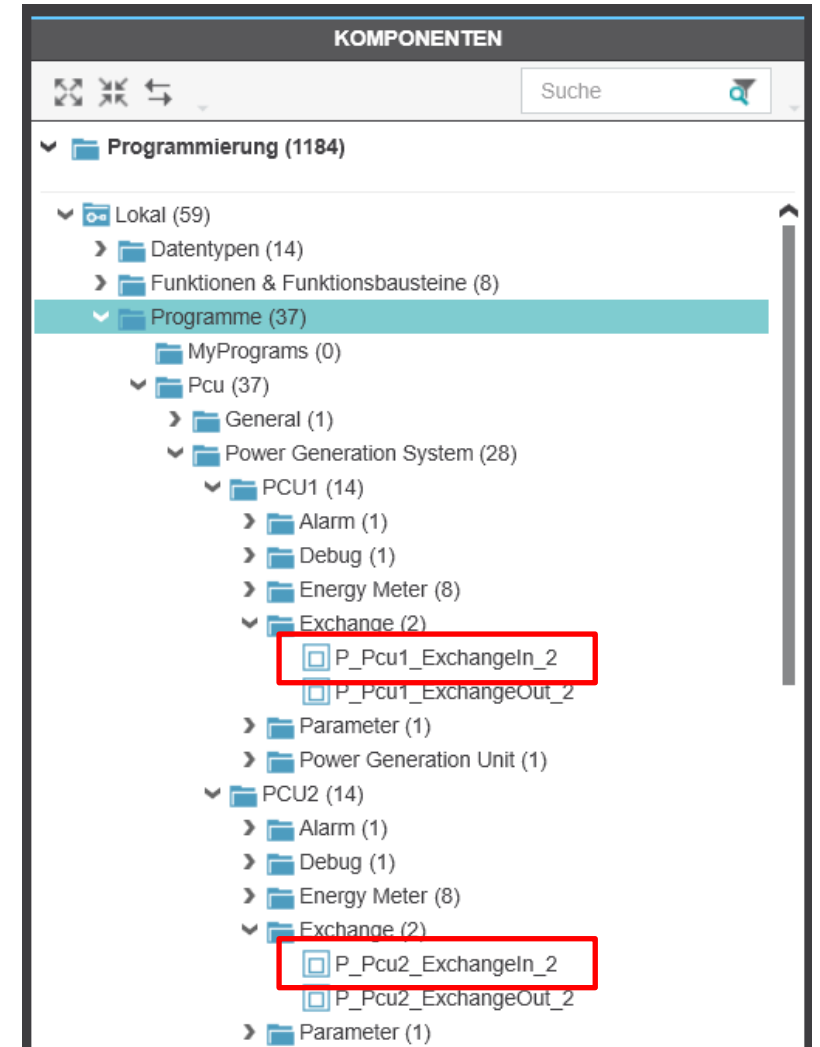
- Modified data logger settings (bConf := BYTE#2#0000_1011) regarding processor load
- Changed iDIId from INT#1to INT#2 for data logger of PCU2 to avoid that both data logger use the same instance
- Renamed code worksheet DataLoggerTrend to DataLogger
- Folder ../Debug
 - P_Pcu[n]_Debug_2



Basic application

Programs: Exchangeln

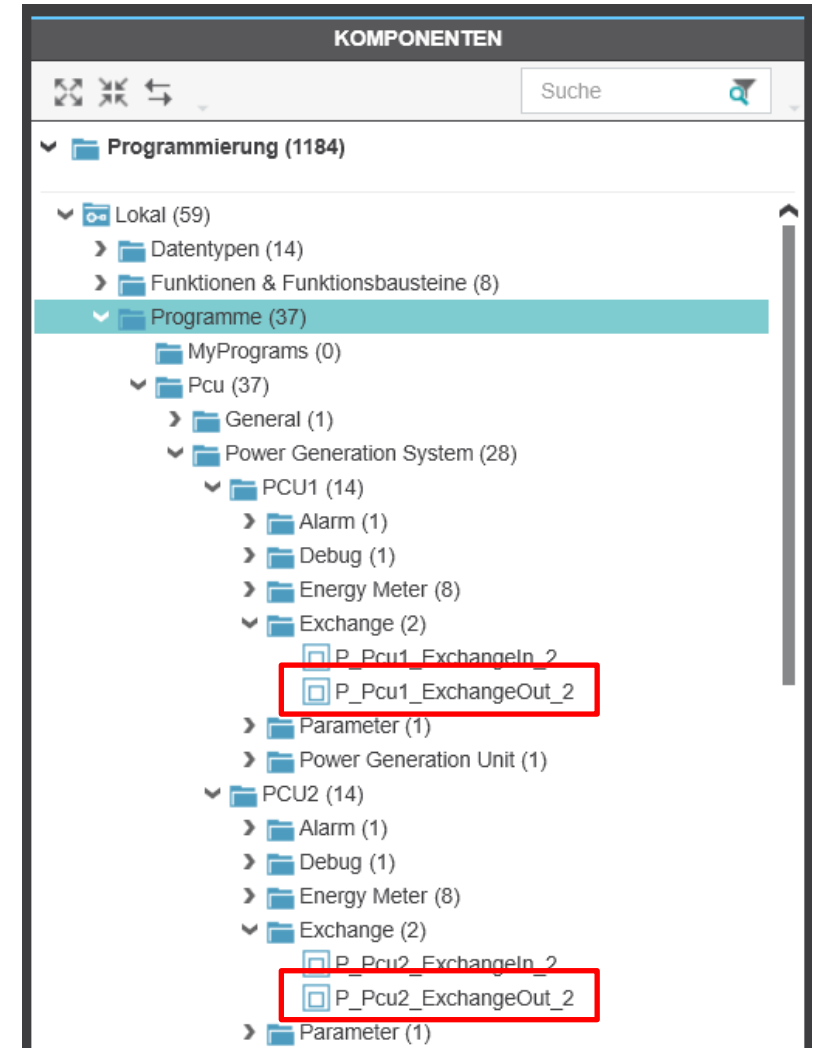
- Changed substruct *.P and *.Q to *.PCtrl and *.QCtrl due to the new PLCnext component
- Adjusted lower limit of the reactive power from LREAL#0.0 to LREAL#-1.0
- Added init I0 of the PID controller for active power control (code worksheet Parameter)
- Folder ../Exchange
 - P_Pcu[n]_Exchangeln_2



Basic application

Programs: ExchangeOut

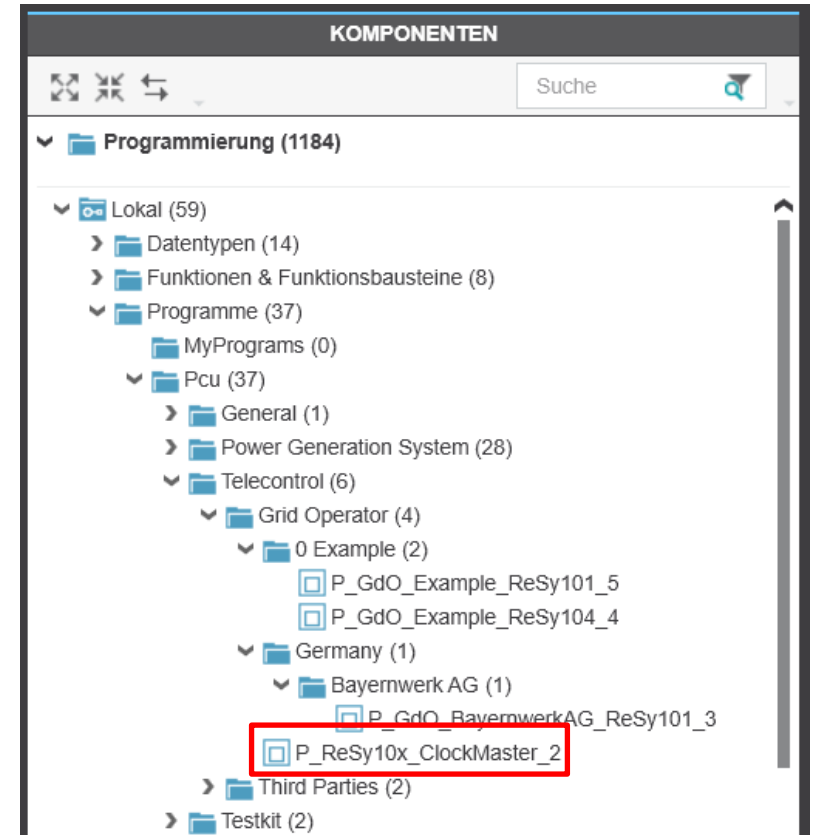
- Changed substruct *.P and *.Q to *.PCtrl and *.QCtrl due to the new PLCnext component
- Folder ../Exchange
 - P_Pcu[n]_ExchangeOut_2



Basic application

Programs: ReSy Clock

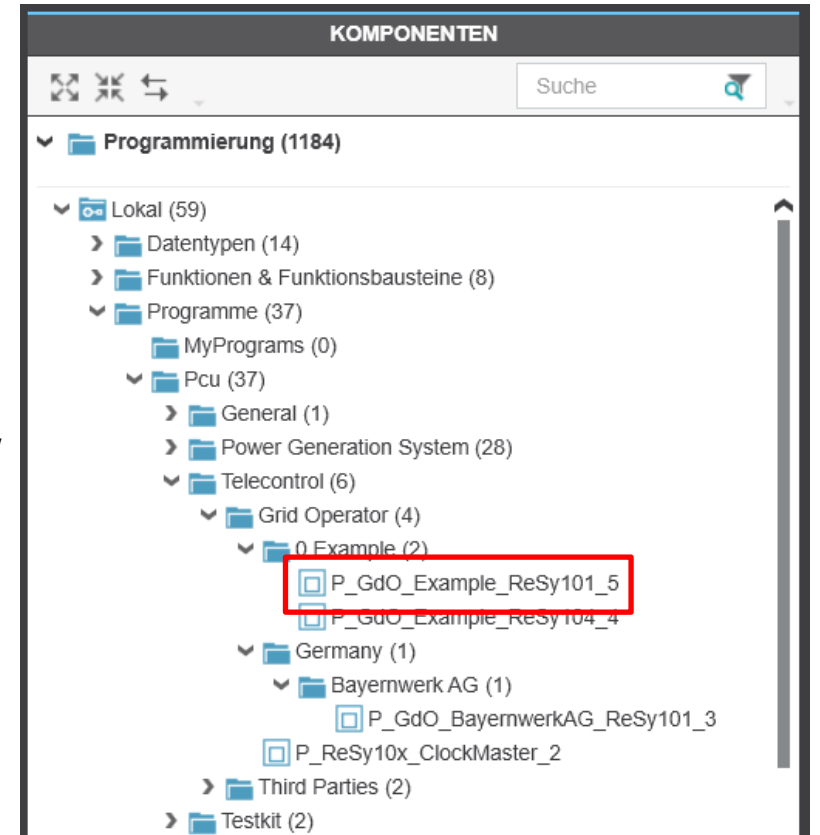
- Changed function block ReSyBasic_ClockMasterV03 to ReSyBasic_ClockSoft_V16
- Folder ../Telecontrol
 - P_ReSy10x_ClockMaster_2



Basic application

Programs: Example 101

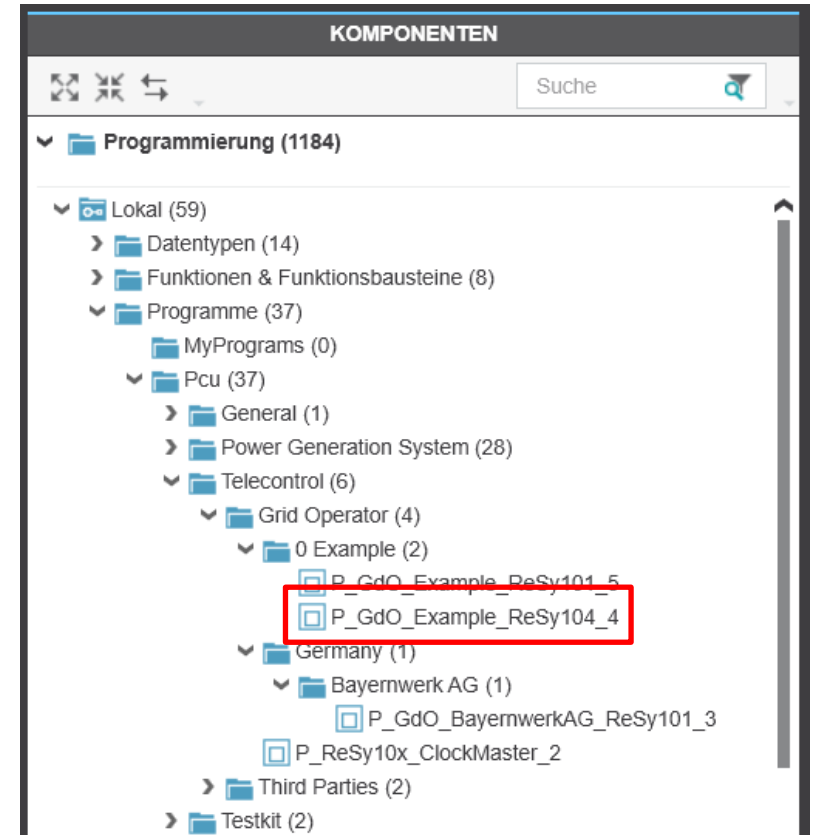
- Deleted variables udtConnectionPoint, udtGlobalConnectPoint and udtObjectConnectPoint from struct and added as local variables
- Changed function block instance from ReSy10x_MxMExFloatV10 to ReSy10x_MxMExFloatV11 due to the new Version of the function block library ReSy10x
- Changed input parameter of the object manager from IN_LI_DefaultDataclass to IN_LI_DefaultDataclassNo due to the new Version of the function block library ReSy10x
- Folder ../Telecontrol/0_Example
 - P_GdO_Example_ReSy101_5



Basic application

Programs: Example 104

- Deleted variables udtConnectionPoint, udtGlobalConnectPoint and udtObjectConnectPoint from struct and added as local variables
- Changed function block instance from ReSy10x_MxMExFloatV10 to ReSy10x_MxMExFloatV11 due to the new Version of the function block library ReSy10x
- Folder ../Telecontrol/0_Example
 - P_GdO_Example_ReSy104_4



Basic application

Programs: Example 101

- Deleted variables udtConnectionPoint, udtGlobalConnectPoint and udtObjectConnectPoint from struct and added as local variables
- Changed function block instance from ReSy10x_MxMExFloatV10 to ReSy10x_MxMExFloatV11 due to the new Version of the function block library ReSy10x
- Changed input parameter of the object manager from IN_LI_DefaultDataclass to IN_LI_DefaultDataclassNo due to the new Version of the function block library ReSy10x
- Adjusted default parameter setting
- Folder ../Telecontrol/Germany/Bayernwerk AG
 - P_GdO_BayernwerkAG_ReSy101_3

