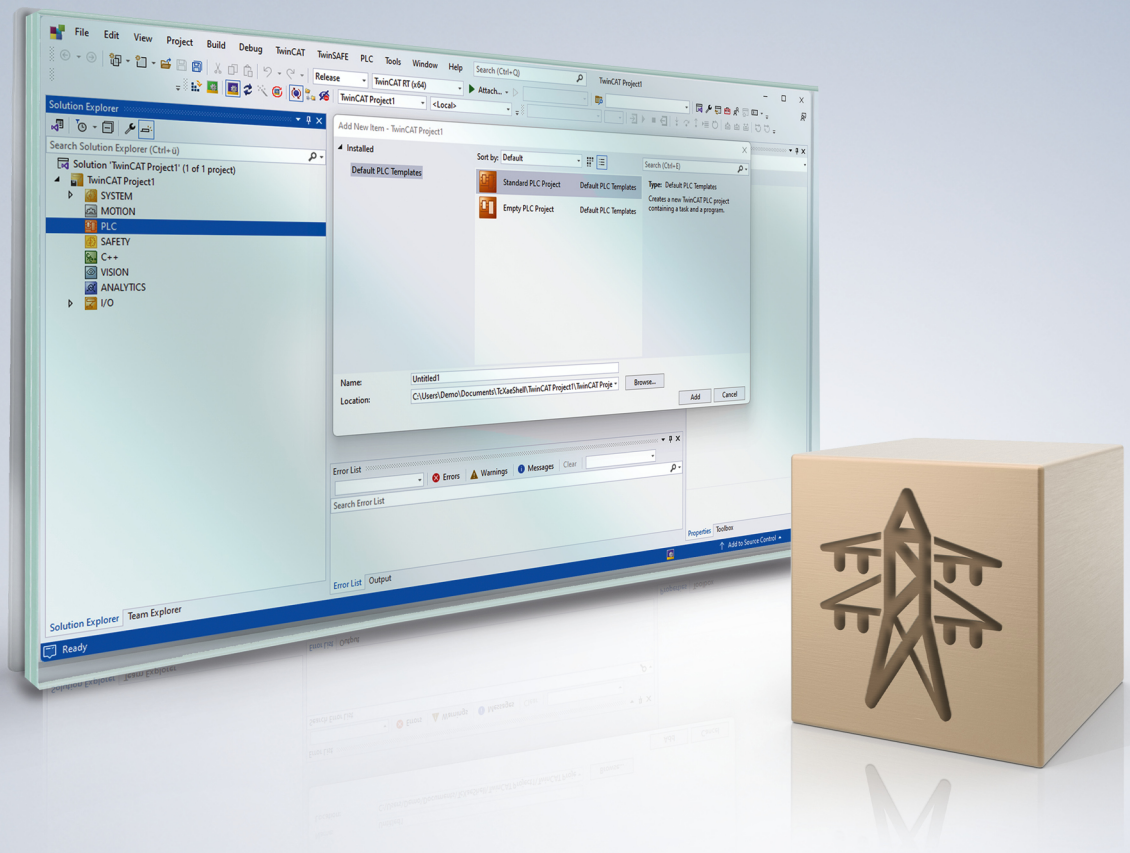
BECKHOFF New Automation Technology

Manual | EN

TF8330

TwinCAT 3 | Power Collector



2025-09-29 | Version: 0.1.0

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1 Foreword

1.1 Notes on the documentation

This description is intended exclusively for trained specialists in control and automation technology who are familiar with the applicable national standards.
The documentation and the following notes and explanations must be complied with when installing and commissioning the components.
The trained specialists must always use the current valid documentation.

The trained specialists must ensure that the application and use of the products described is in line with all safety requirements, including all relevant laws, regulations, guidelines, and standards.

Disclaimer

The documentation has been compiled with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without notice.
Claims to modify products that have already been supplied may not be made on the basis of the data, diagrams, and descriptions in this documentation.

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1.2 For your safety

Safety regulations

Read the following explanations for your safety.
Always observe and follow product-specific safety instructions, which you may find at the appropriate places in this document.

Exclusion of liability

All the components are supplied in particular hardware and software configurations which are appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation, and drive technology who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

⚠ DANGER
Hazard with high risk of death or serious injury.

⚠ WARNING
Hazard with medium risk of death or serious injury.

⚠ CAUTION
There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE
The environment, equipment, or data may be damaged.

Information on handling the product

This information includes, for example:
recommendations for action, assistance or further information on the product.

1.3 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

1.4 Documentation issue status

Version	Changes
0.1.0	First release with TF8330 in version 0.1.0

2 Overview

The *TwinCAT 3 Power Functions* provide software in the form of TwinCAT modules for use in electrical power systems. These are divided into three *TwinCAT Functions* with corresponding licenses:

- **TF8330 | TwinCAT 3 Power Collector**
  Functions for power measurement using EtherCAT Terminals of the EL34xx series.
- **TF8350 | TwinCAT 3 Power Technologies**
  Functions for power measurement using EtherCAT Terminals of the EL37x3 and ELM3xxx series.
- **TF8360 | TwinCAT 3 Power Control**
  Functions for the control of power generating plants.

3 Functions

The *TF8330 | TwinCAT 3 Power Collector* offers modular software blocks for power measurement. These modules provide a standardized interface for all *EL34xx* series power measurement terminals. Key parameters such as conversion ratio and frequency range can be configured automatically.

3.1 Measure

The TwinCAT modules in the *TwinCAT Power Collector* of the `Measure` group interact with EtherCAT power measurement terminals of the *EL34xx* series and handle both their configuration and the acquisition of measurement data.

The focus is on measuring the three phase voltages against neutral conductor and the three phase currents in a star connection.

CoE parameters are automatically set according to the module parameters via SDO communication. Measured values are read out via PDOs, variant handling and, if necessary, additional SDO communication. The recorded data is structured and made available for further processing in the system via defined Data Areas.

- **PDO (Process Data Objects)**
  PDOs are used for fast, cyclic data exchange between the EtherCAT Terminal and the TwinCAT module. These transmit current measured values (e.g. current, voltage, power).
- **SDO (Service Data Objects)**
  SDOs enable acyclic access to parameters and internal process data of the EtherCAT Terminal. They are used to configure the EtherCAT Terminal (e.g. setting converter ratios) and to read out non-cyclic and extensive process data (e.g. harmonics), which should not be transmitted via PDOs due to their data volume or low update rate.
- **CoE (CANopen over EtherCAT)**
  CoE maps the communication between TwinCAT and the EtherCAT Terminal. It defines a standardized object dictionary that enables access to all parameters, states and data objects of the device via PDO and SDO.
- **Variant handling**
  The EL34x3 terminals support so-called variant handling. Different measured variables can be output via dedicated variant PDOs. The respective measured variable is selected via a multiplexing technique that uses selectors. This method allows the sequential reading of values (e.g. power components of the fundamental) that do not have to be transmitted cyclically.

PDOs ensure cyclic data exchange, while SDOs and variant handling are suitable for slower updated measured values and large amounts of data. Depending on the configuration and selection of process data, the modules use a combination of PDOs, SDOs and variant handling to record all process data. This ensures low utilization of cyclic communication via EtherCAT, while at the same time ensuring complete and timely acquisition of all measurement data.

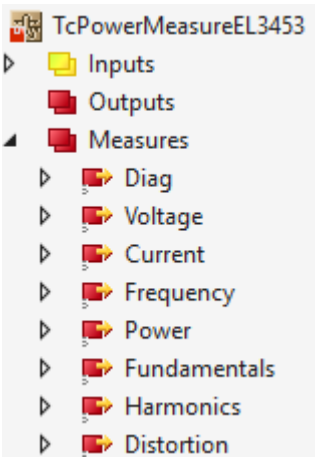
The following is an overview of supported terminals and the corresponding modules:

Terminal	Module
EL3443	TcPowerMeasureEL3443 [▶ 17]
EL3453	TcPowerMeasureEL3453 [▶ 30]
EL3444	TcPowerMeasureEL3444 (follows with version 0.1.1)
EL3446	TcPowerMeasureEL3446 (follows with version 0.1.1)
…	

Further modules of the `Measure` group for EtherCAT Terminals of the EL37x3 and ELM3xxx series can be found in the documentation for *TF8350 | TwinCAT 3 Power Technologies*.

3.1.1 Measurement data

Each module of the `Measure` group provides the recorded measurement data as output process data via a defined Data Area.

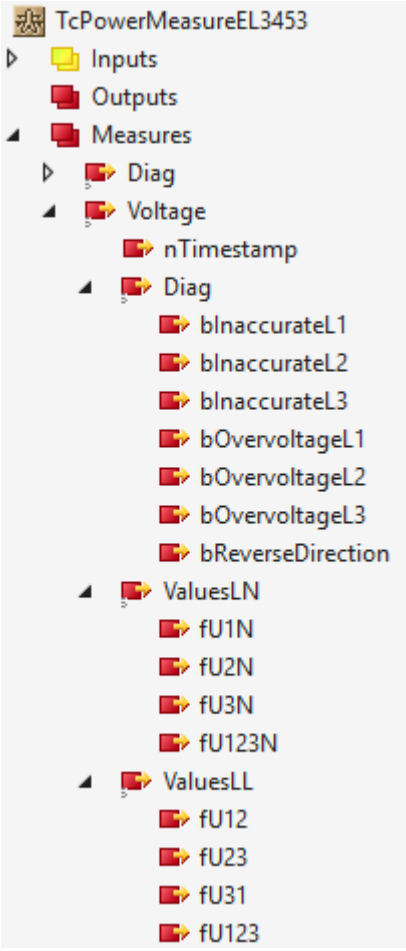


The measurement data is divided into logically separate structures, which can be individually enabled or disabled as required under *Data Area* in the *Enable* column. When starting up, the module automatically recognizes the activated structures and only reads the relevant measured values from the EtherCAT Terminal.

Object | Context | Parameter (Init) | Parameter (Online) | **Data Area** | Interfaces | Interface Pointer

	Area No	Enable	Name	Type
+	0 (1)	☑	Inputs	InputDst
+	1 (1)	☑	Outputs	OutputSrc
-	10 (1)	☑	Measures	OutputSrc
		☑	Diag	STcPowerMeasureDiag
		☑	Voltage	STcPowerMeasureVoltageArea
		☑	Current	STcPowerMeasureCurrentArea
		☑	Frequency	STcPowerMeasureFrequencyArea
		☑	Power	STcPowerMeasurePowerArea
		☐	Fundamentals	STcPowerMeasureFundamentalsArea
		☐	Harmonics	STcPowerMeasureHarmonicsArea
		☑	Distortion	STcPowerMeasureDistortionArea

Each of these structures begins with a timestamp (`Timestamp`), which indicates the time of the last update in distributed clocks time (DC time). This is followed by the diagnostic structure (*Diag*), which contains status information such as when measuring ranges are exceeded or not reached. This is followed by the actual measurement data, which can be divided into further substructures, for example to distinguish between phase-neutral (`LN`) and phase-phase voltages (`LL`).



By default, the measured values are output as RMS values per phase and as a total value across all three phases. They are expressed in SI units (e.g. Volt, Ampere, Watt) as floating-point numbers with single precision according to IEEE 754.

The following is an overview of the data types for corresponding structures:

Name	Data type	Description
Diag	STcPowerMeasureDiag [▶ 45]	General state of the measurement.
Voltage	STcPowerMeasureVoltageArea [▶ 45]	Measured voltages for all three phases as phase-neutral and phase-phase values.
Current	STcPowerMeasureCurrentArea [▶ 46]	Measured currents for all three phases, as well as error and neutral currents.
Frequency	STcPowerMeasureFrequencyArea [▶ 47]	Determined frequency and frequency changes (RoCoF) and their filtered values.
Power	STcPowerMeasurePowerArea [▶ 47]	Determined active, reactive and apparent power.
Fundamentals	STcPowerMeasureFundamentalsArea [▶ 48]	Determined voltage, current and power components of the fundamental.
Harmonics	STcPowerMeasureHarmonicsArea [▶ 49]	Determined harmonics of the three voltage and current phases.
Distortion	STcPowerMeasureDistortionArea [▶ 50]	Determined harmonic distortion (THD and TDD) of the three voltage and current phases.

3.1.2 Naming

In the measurement data, electrical variables are labeled with a uniform naming convention. These are based on the usual parameters in three-phase systems.

Phases

- **L1, L2, L3**: Individually considered conductors (phases).

Voltages

- **U1N, U2N, U3N**: Phase-to-phase voltages against neutral conductor.
- **U123N**: Voltage of the three-phase system (mean value).
- **U12, U23, U31**: Conductor voltages between two outer conductors.
- **U123**: Voltage of the three-phase system (mean value).

Currents

- **I1, I2, I3**: Currents of the individual conductors.
- **I123**: Total current of the system (mean value).

Power

- **P1, P2, P3**: Active power per phase.
- **P123**: Total active power of the system.

Similarly, Q1/Q123 for reactive power and S1/S123 for apparent power.

3.1.3 Diagnostic data

There is a structure and diagnostic information for each structure of measurement data. It specifies the following typical states.

Inaccurate

The `Inaccurate` state indicates an inaccurate measurement, for example if the measured values are below the specified measuring accuracy. This accuracy is defined as a parameter and is referred to as `Threshold`.

Overvoltage/Overcurrent

The states `Overvoltage` and `Overcurrent` indicate that the measured voltage or current exceeds the permissible measuring range of the EtherCAT Terminal.

4 Installation

4.1 System Requirements

Engineering (XAE)

Technical data	Requirements
Operating system	Windows 10, Windows 11
Target platform	x64
TwinCAT version	Build 4026
Required TwinCAT license	

Runtime (XAR)

Technical data	Requirements
Operating system	Windows, Beckhoff RT Linux®, TwinCAT/BSD
Target platform	x64
TwinCAT version	Build 4026
Required TwinCAT license	TF8330

4.2 Installation

TwinCAT Package Manager: Installation (TwinCAT 3.1 Build 4026)

Detailed instructions on installing products can be found in the chapter Installing workloads in the TwinCAT 3.1 Build 4026 installation instructions.

Install the following workload to be able to use the product:

TwinCAT Package Manager UI:

- TF8330 | TwinCAT 3 Power Collector

TwinCAT Package Manager CLI:

- `TcPkg install TF8330.PowerCollector.XAE`

4.3 Licensing

The TwinCAT 3 function can be activated as a full version or as a 7-day test version. Both license types can be activated via the TwinCAT 3 development environment (XAE).

Licensing the full version of a TwinCAT 3 Function

A description of the procedure to license a full version can be found in the Beckhoff Information System in the documentation "TwinCAT 3 Licensing".

Licensing the 7-day test version of a TwinCAT 3 Function

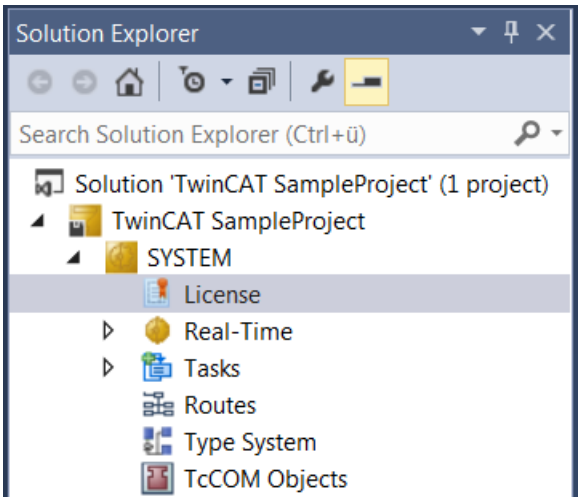
A 7-day test version cannot be enabled for a TwinCAT 3 license dongle.

1. Start the TwinCAT 3 development environment (XAE).
2. Open an existing TwinCAT 3 project or create a new project.

3. If you want to activate the license for a remote device, set the desired target system. To do this, select the target system from the **Choose Target System** drop-down list in the toolbar.

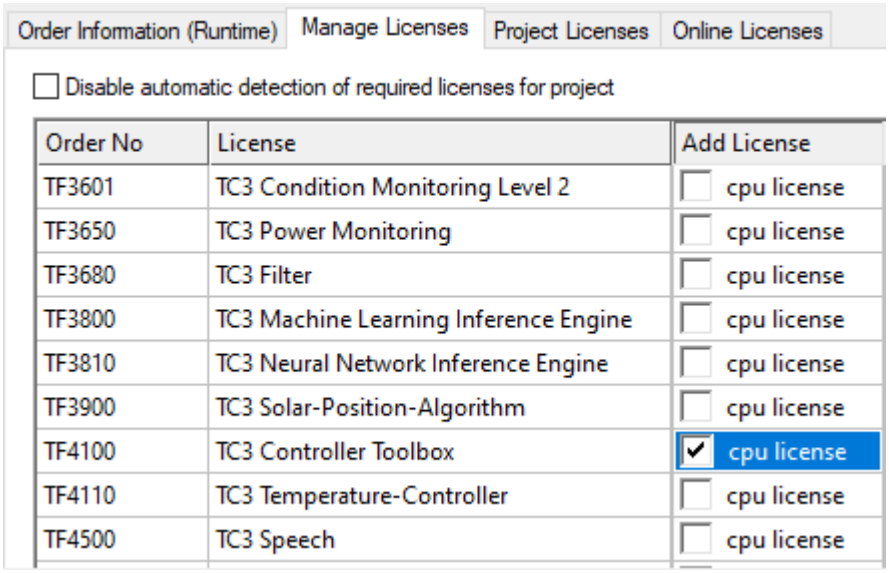
   ⇨ The licensing settings always refer to the selected target system. When the project is activated on the target system, the corresponding TwinCAT 3 licenses are automatically copied to this system.

4. In the **Solution Explorer**, double-click **License** in the **SYSTEM** subtree.



   ⇨ The TwinCAT 3 license manager opens.

5. Open the **Manage Licenses** tab. In the **Add License** column, check the check box for the license you want to add to your project (e.g. "TF4100 TC3 Controller Toolbox").

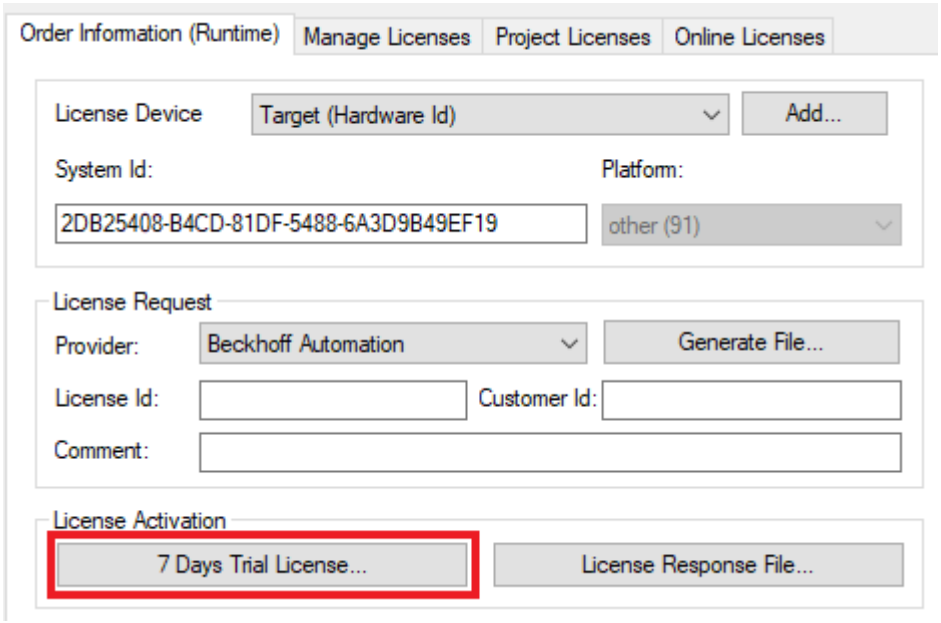


Order No	License	Add License
TF3601	TC3 Condition Monitoring Level 2	cpu license
TF3650	TC3 Power Monitoring	cpu license
TF3680	TC3 Filter	cpu license
TF3800	TC3 Machine Learning Inference Engine	cpu license
TF3810	TC3 Neural Network Inference Engine	cpu license
TF3900	TC3 Solar-Position-Algorithm	cpu license
TF4100	TC3 Controller Toolbox	cpu license
TF4110	TC3 Temperature-Controller	cpu license
TF4500	TC3 Speech	cpu license

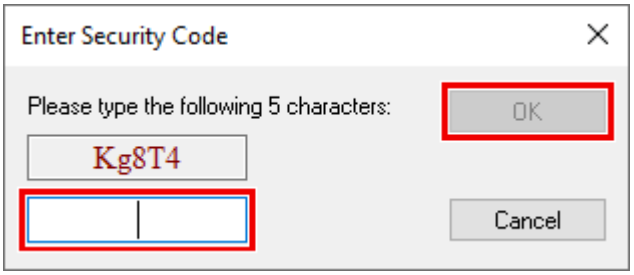
6. Open the **Order Information (Runtime)** tab.

   ⇨ In the tabular overview of licenses, the previously selected license is displayed with the status “missing”**.**

7. Click **7-Day Trial License...** to activate the 7-day trial license.



⇨ A dialog box opens, prompting you to enter the security code displayed in the dialog.



8. Enter the code exactly as it is displayed and confirm the entry.
9. Confirm the subsequent dialog, which indicates the successful activation.
   ⇨ In the tabular overview of licenses, the license status now indicates the expiry date of the license.
10. Restart the TwinCAT system.

⇨ The 7-day trial version is enabled.

5 Modules

5.1 TcPowerMeasureEL3443

The `TcPowerMeasureEL3443` module supports all EtherCAT Terminals of type *EL3443* as well as their variants such as *EL3443-0010*, *EL3443-0013* or *EL3443-0020* from firmware version 12.

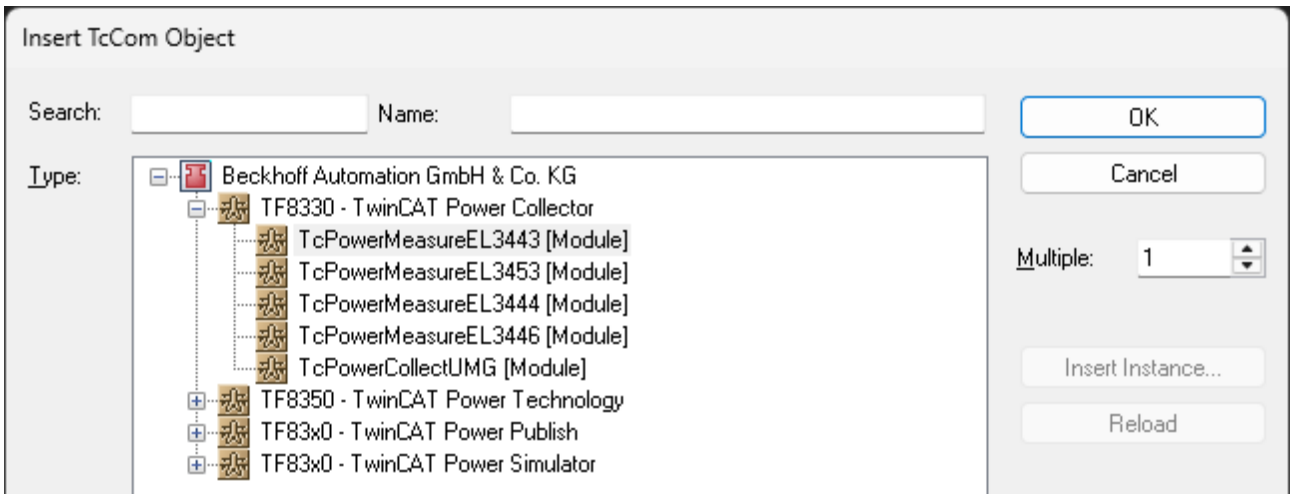
The specific properties of the terminals are abstracted and provided via a standardized interface.

Detailed information on the functionality and technical details of the EL3443 can be found in the corresponding documentation. See EL34xx.

5.1.1 Function

The `TcPowerMeasureEL3443` is integrated into the system as a TcCOM object and executed cyclically via a *task* (see Context [▶ 17]). It takes the measurement data from an *EL3443* and makes it available as a *Data Area* (see DataAreas [▶ 18]) for downstream processes. A data exchange using PDOs, SDOs and variant handling is used for this (see Function/Measure [▶ 10]).

5.1.2 Module



License

A valid *TF8330 | TwinCAT Power Collector* license is required for permanent operation of the module. Alternatively, a 7-day trial license can be used for testing or evaluation (see Licensing [▶ 14]).

5.1.3 Context

Under Context, select the task under which the module is to be executed.

For `TcPowerMeasureEL3443`, the use of a task with a cycle time between 1 ms and 10 ms is recommended.

Even if the *EL3443* only provides new measured values every 10 ms (corresponding to each half-wave), a longer cycle time can still speed up the asynchronous querying of process data via variant handling and SDO communication.

5.1.4 DataAreas

The inputs and outputs of the process data are configured in the Data Areas of the module. The areas `Inputs` and `Outputs` contain the structures for exchanging the process data (PDOs) with the EtherCAT Terminal, while the determined measured values are provided in the `Measures` area (see Measurement data [▶ 11]).

For different use cases, the *EL3443* offers the option of exchanging various process data objects (PDOs) cyclically. The configuration can be used to define which measured values are transmitted cyclically as PDOs and which are transmitted acyclically as SDOs. In order to map this behavior in the TwinCAT modules, the process data used can also be specifically selected there. Typical use cases are already available in the module as predefined PDO sets. This also enables automated mapping of the process data between the EtherCAT Terminal and the TwinCAT module.

The following table provides an overview of the predefined PDO sets of the EtherCAT Terminal with the corresponding Data Areas in the TwinCAT module:

Data Areas	PDOs	Use case
Default	Default	Cyclic recording of voltage, current and power measurement.
Variant	Default + Variant	Use variant handling instead of SDOs for extended measurement data.
Distributed	Default + Variant Values + DPM	For combination with EL3444 and EL3446 using Distributed Power Measurement (DPM)

5.1.5 Parameter

The parameters in `TcPowerMeasureEL3443` are used to configure the EtherCAT Terminal and to set internal evaluations.

Settings

Name	Data type	Default	Unit	Description
`VoltageRatio`	REAL	1.0		Factor for scaling the voltage.
`VoltageInaccurate Threshold`	REAL	0.3	%	Threshold value of the voltage for detecting inaccuracies.
`VoltageInaccurate Mode`	ETcPowerInaccurate Mode	`FlagOnly`		`FlagOnly`: Display only `SetZero`: Measured values to 0
`CurrentRatio`	REAL	1.0		Factor for scaling the current.
`CurrentRange`	CurrentRange	1 A	A	Measuring range for current.
`CurrentInaccurate Threshold`	REAL	0.3	%	Threshold value of the current for detecting inaccuracies.
`CurrentInaccurate Mode`	ETcPowerInaccurate Mode	`FlagOnly`		`FlagOnly`: Display only `SetZero`: Measured values to 0
`FrequencyRange`	FrequencyRange	45_65Hz	Hz	Range for determining the frequency.
`FrequencySource`	FrequencySource	L123_PT2		Source and function for determining the frequency.
`FrequencyFilterTime1`	REAL	0.1	s	Time constant of the first frequency filter.
`FrequencyFilterTime2`	REAL	0.5	s	Time constant of the second frequency filter.
`DisableGuarding`	BOOL	FALSE		Switches off the Guarding function of the terminal.

5.1.6 Interfaces

In addition to the typical *TcCOM* interfaces, the `TcPowerMeasureEL34x3` modules offer two specific interfaces for supplementary modules.

ITcPowerMeasure

Using the ITcPowerMeasure interface, downstream modules can reference the measure process data directly and in a structured manner without the need for additional mapping (see Measurement data [▶ 11]).

ITcPowerInputDPM

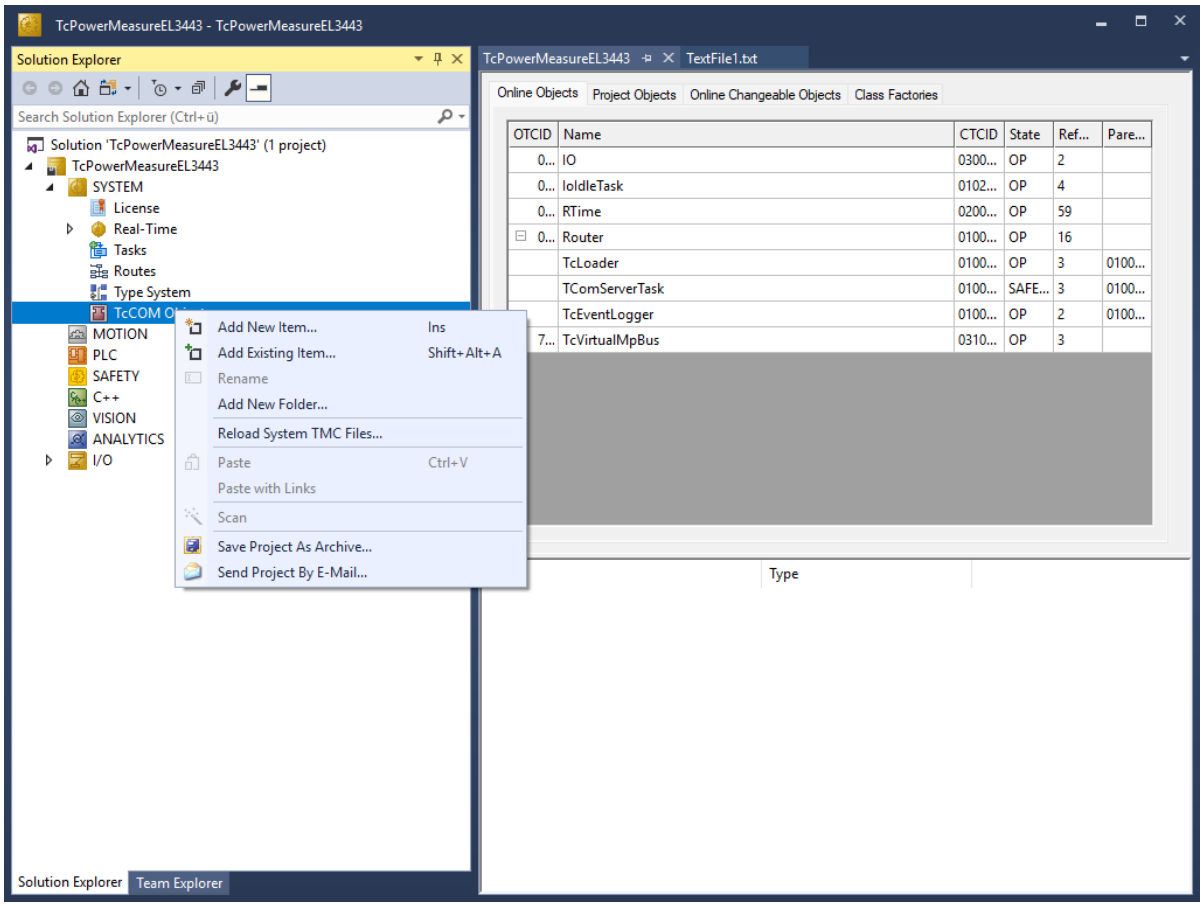
The interface `ITcPowerInputDPM` enables the use of *Distributed Power Measurement (DPM)* by providing the measured voltages for downstream modules without the need for additional mapping.

Modules such as TcPowerMeasureEL3444 and TcPowerMeasureEL3446 can access the DPM process data via this interface and transmit it to the associated EtherCAT Terminals. These terminals only record currents and receive the required voltage information via the DPM data to determine power and other measured variables.

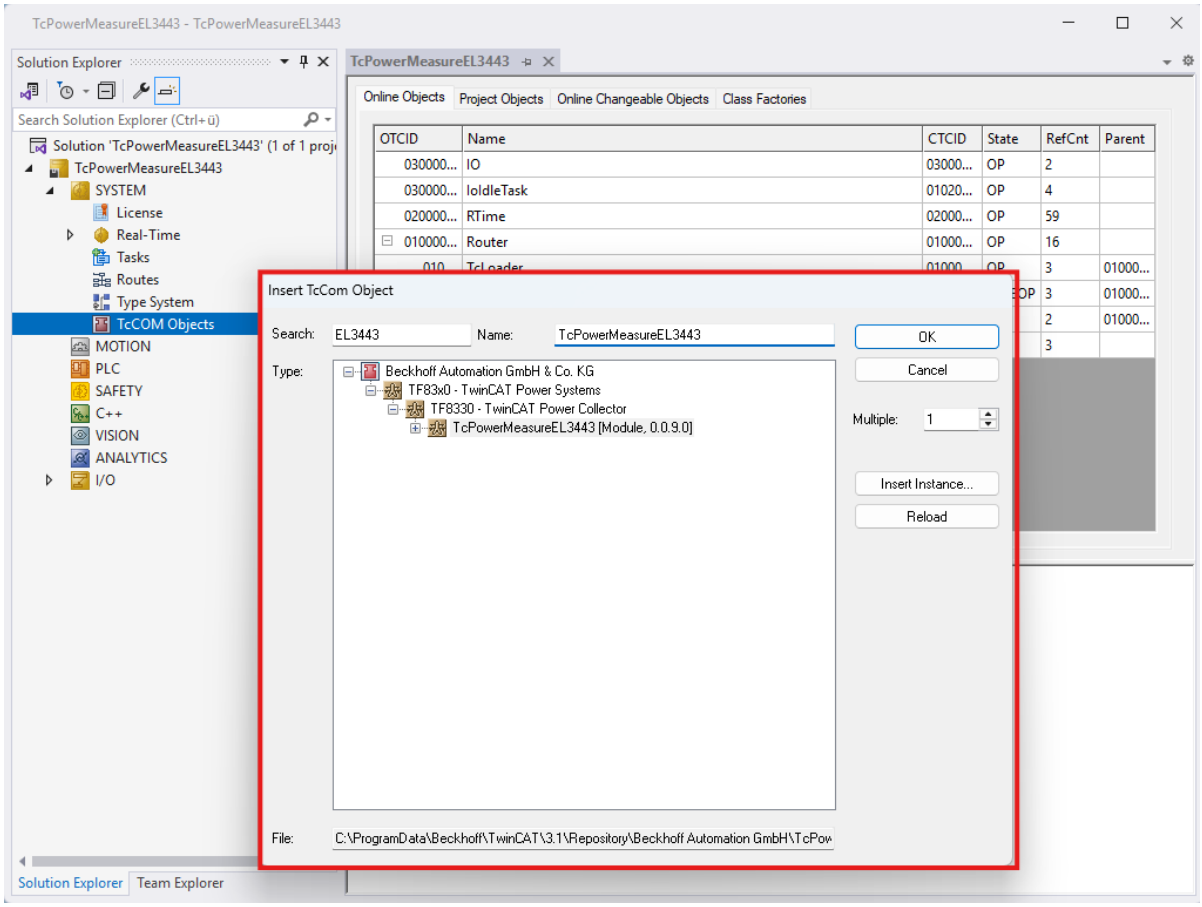
5.1.7 Application

The following section provides instructions on how to integrate the `TcPowerMeasureEL3443` into a TwinCAT project and connect it to a *EL3443* in order to use the module in the application.

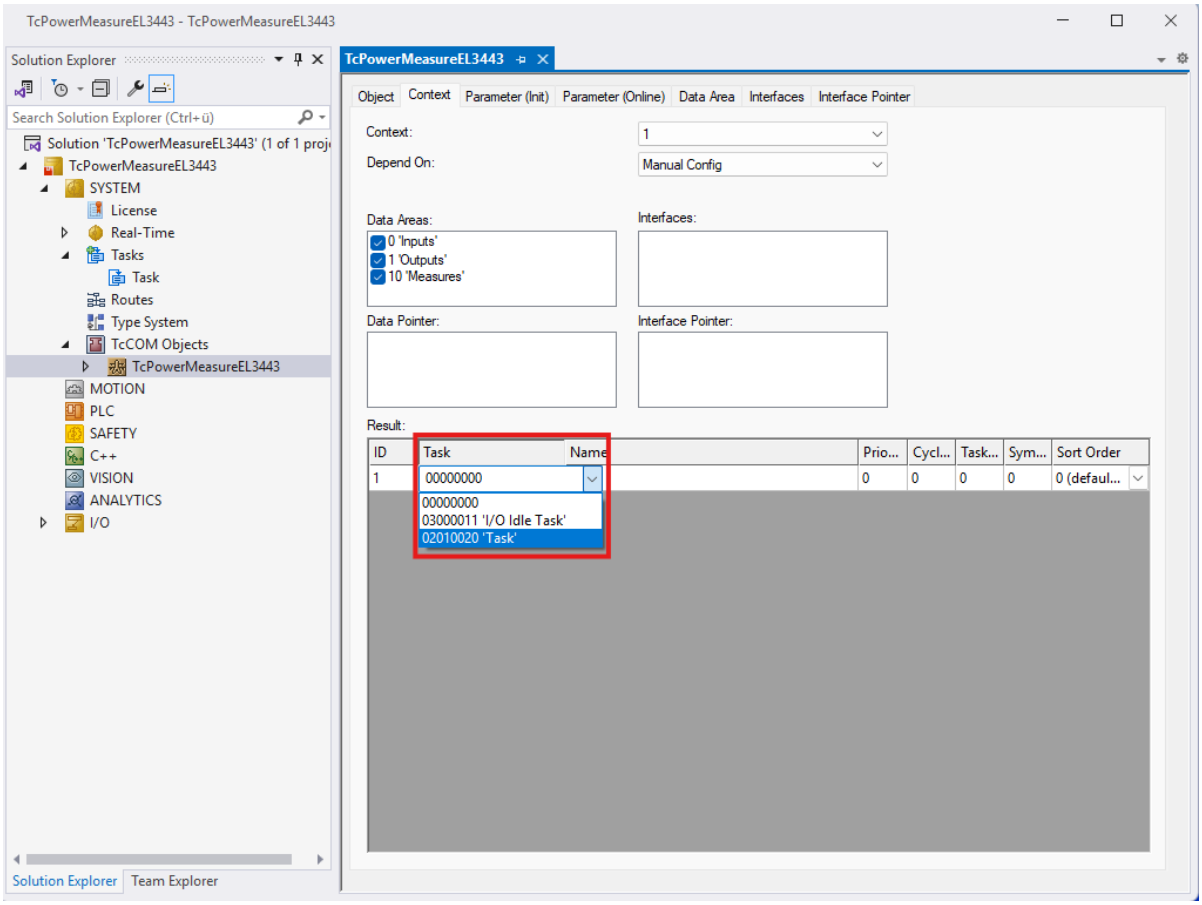
1. Add a new module at `TcCOM Objects` by right-clicking and `Add New Item...`.



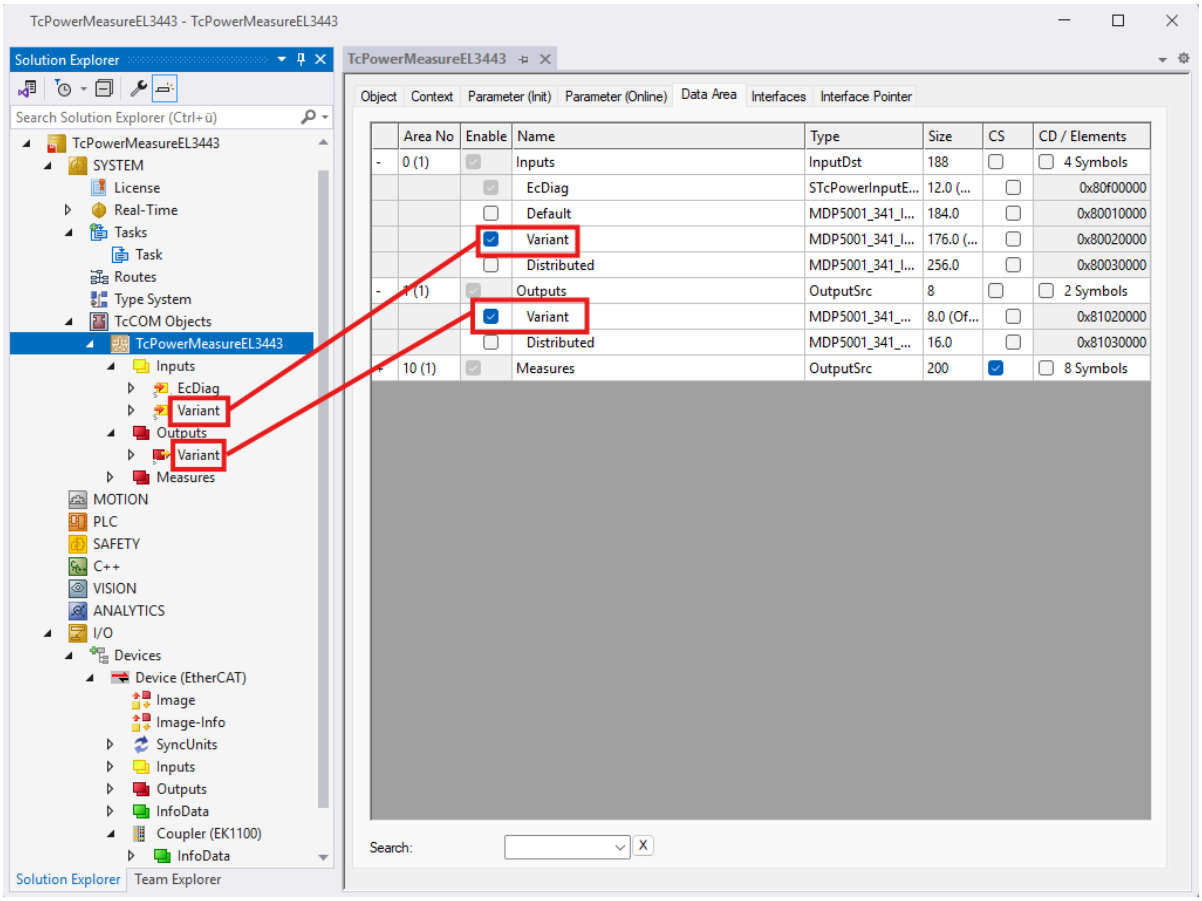
2. Use `Search` of *EL3443* to select the `TcPowerMeasureEL3443` module. Enter a name and click on `OK` .



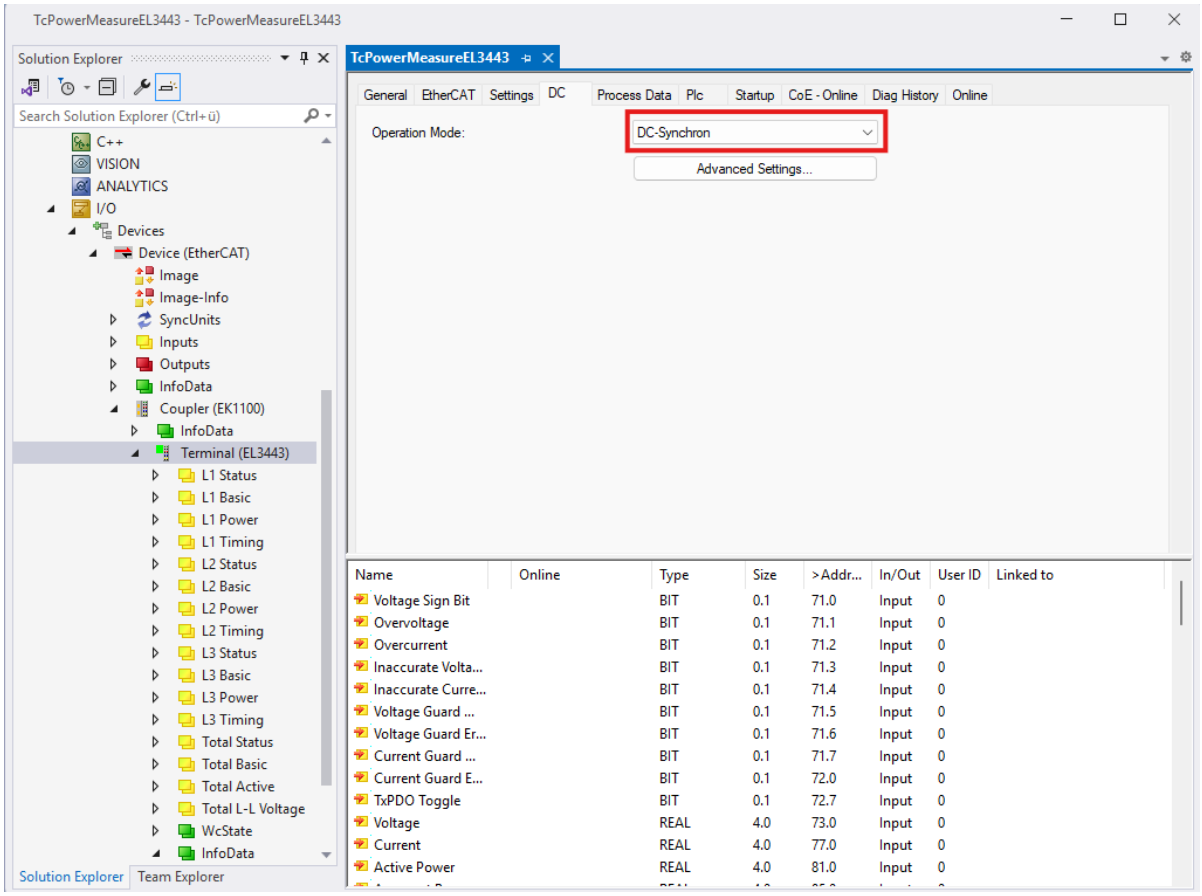
3. Assign a *task* to the module at `Context`.



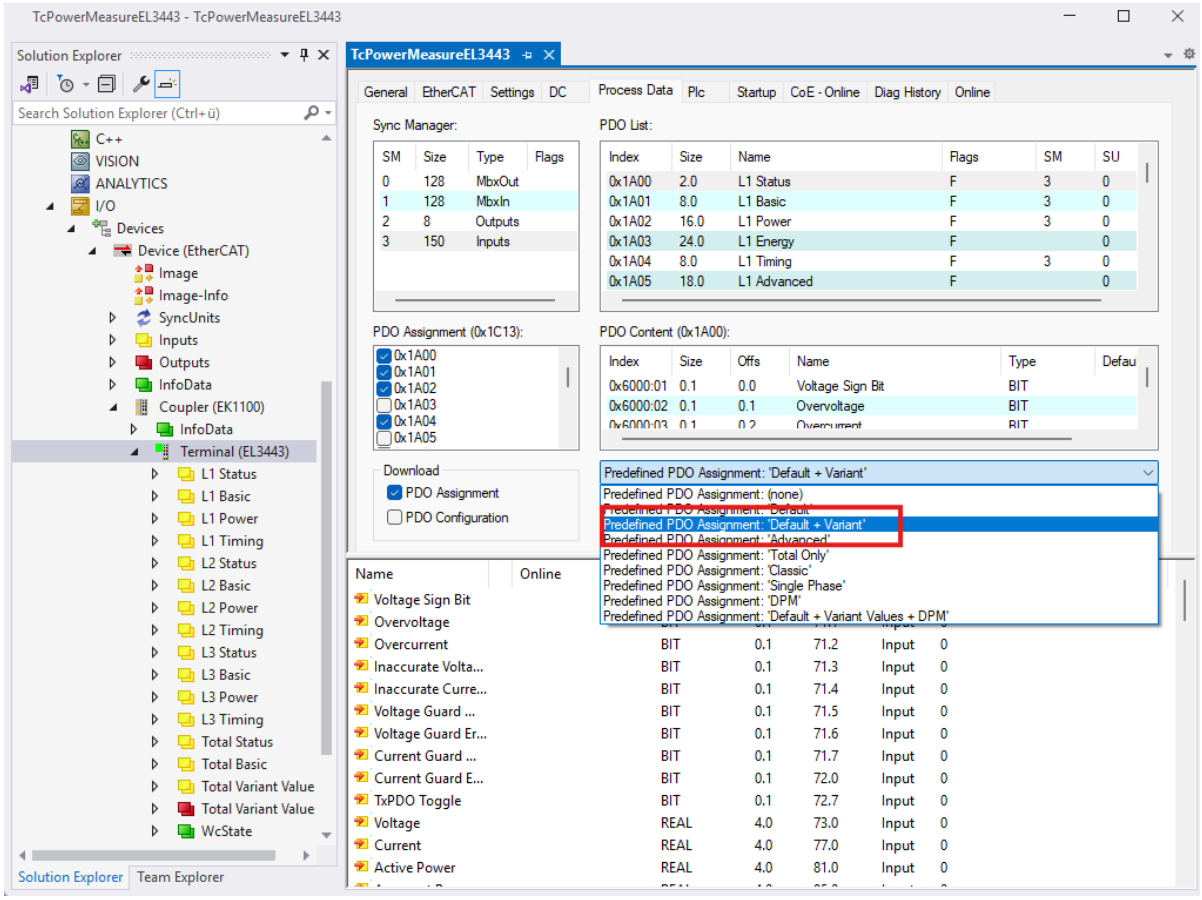
4. At `Data Area`, select the desired and related data areas using the checkbox in the `Enable` column.



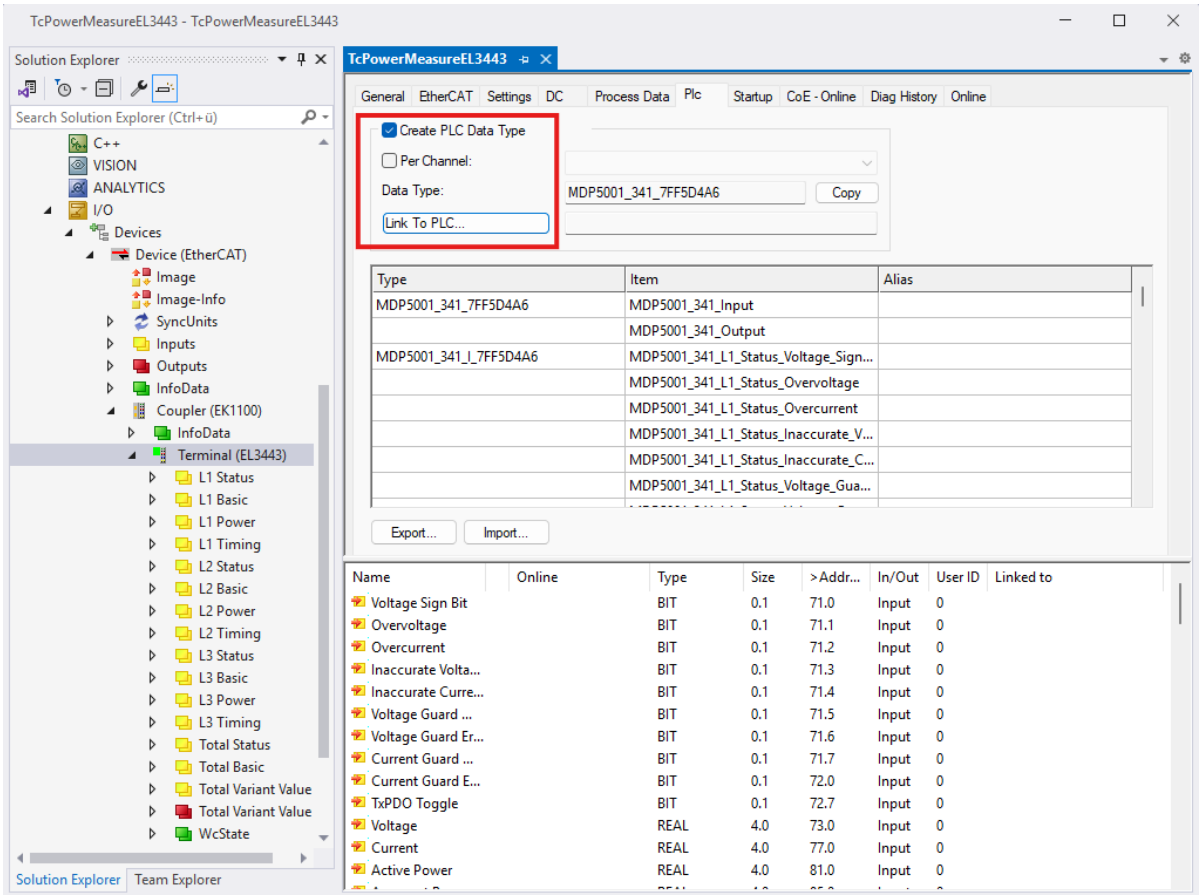
5. Under `I/O Devices`, select the *EL3443* and select `DC-Synchron` as the Operation Mode via the `DC` tab.



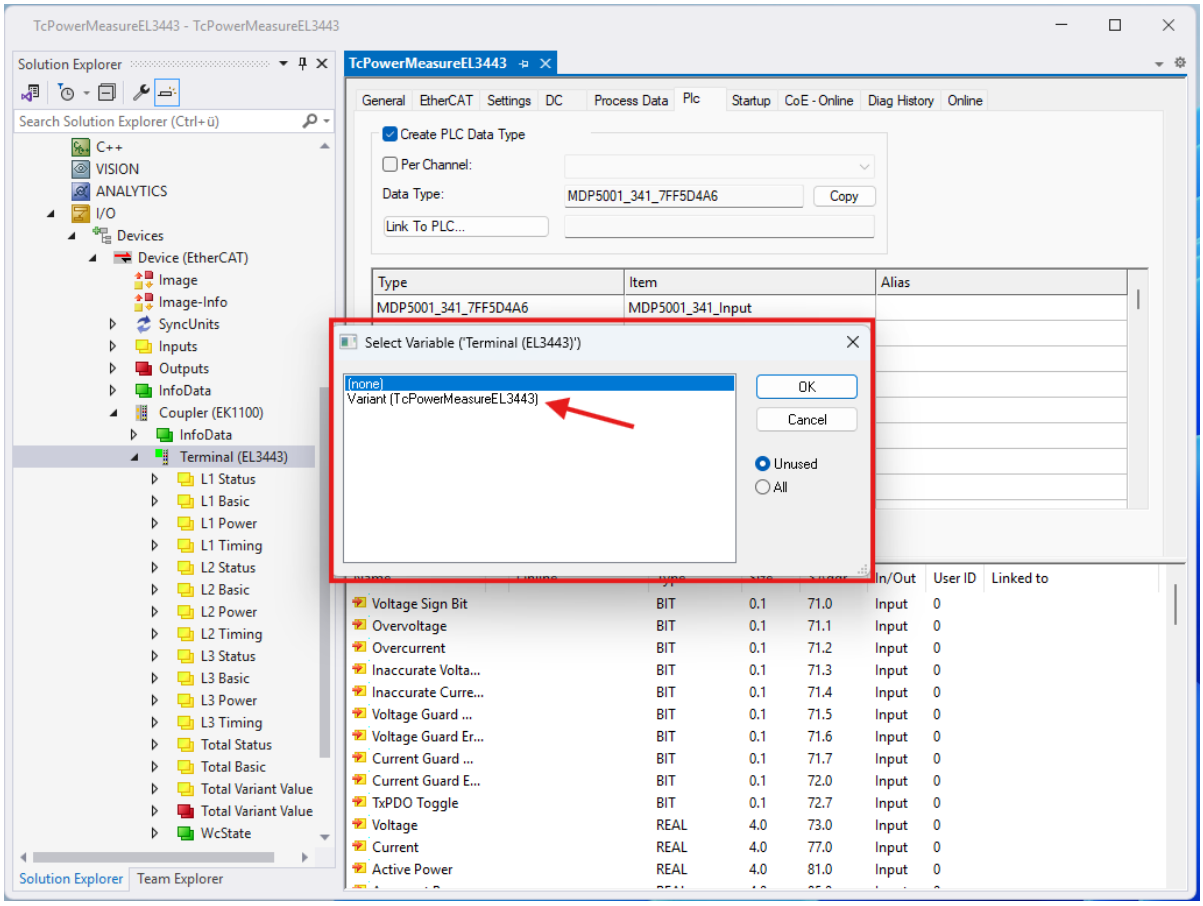
6. Under `Process Data`, select the process data using the `Predefined PDO Assignment` according to the previously selected inputs/outputs (see DataAreas [▶ 31]).



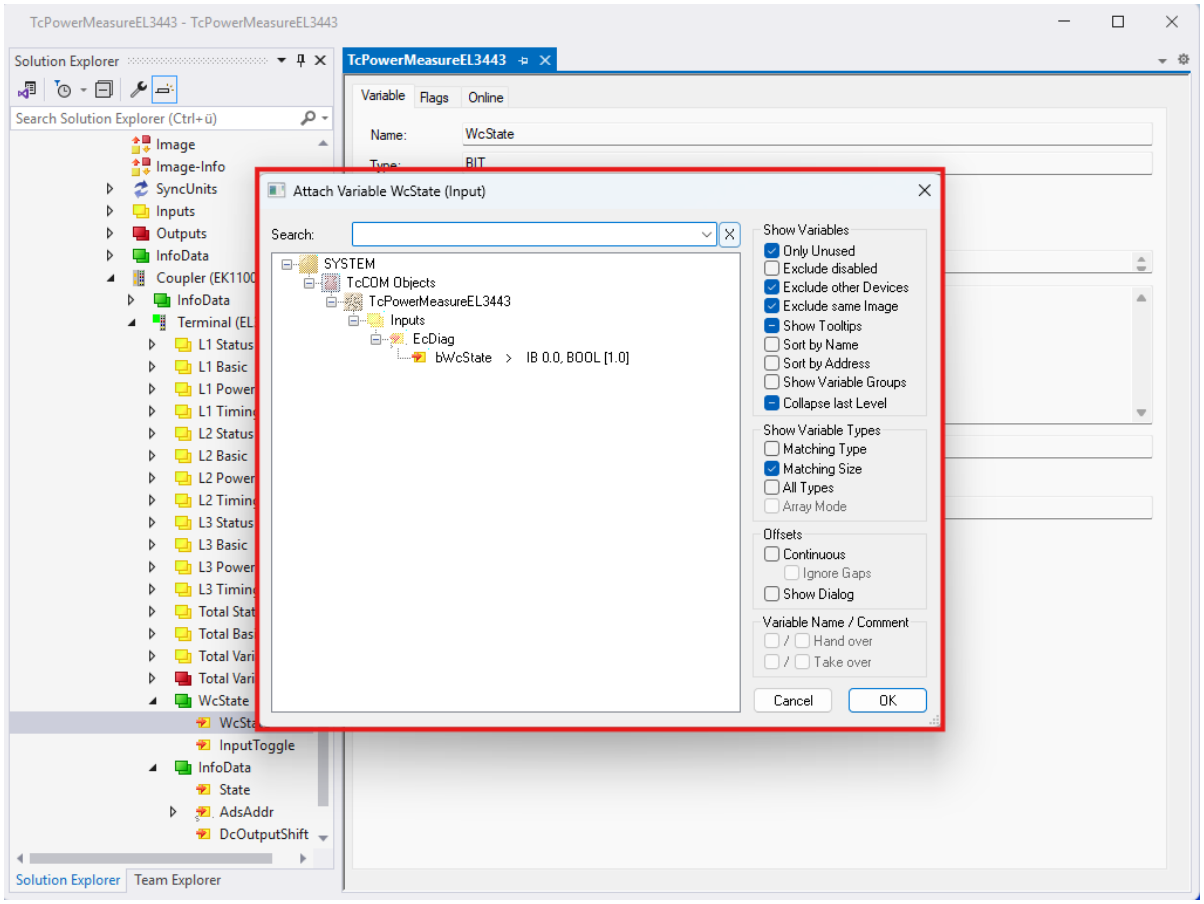
7. Under the `Plc` tab, activate `Create PLC Data Type` without using `Per Channel`, then click on `Link To PLC…`.

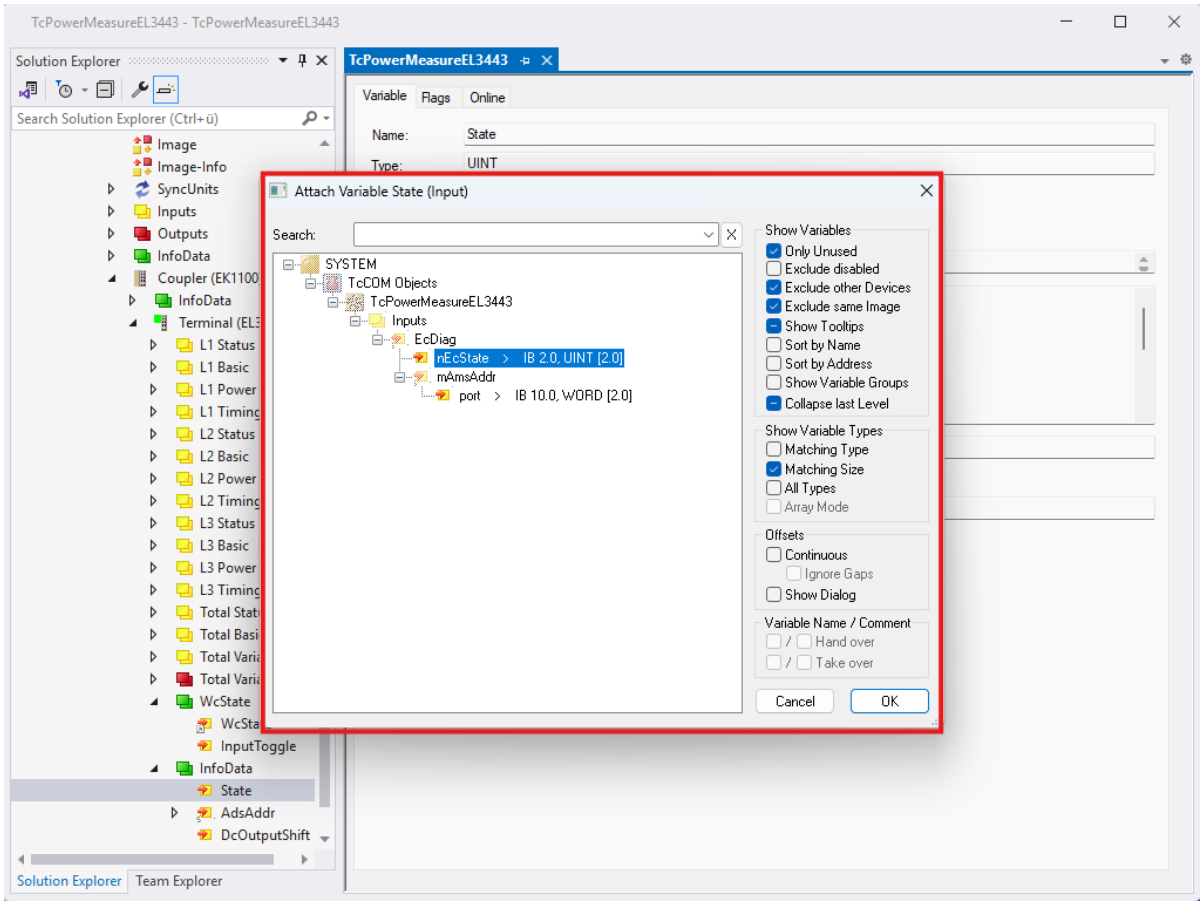


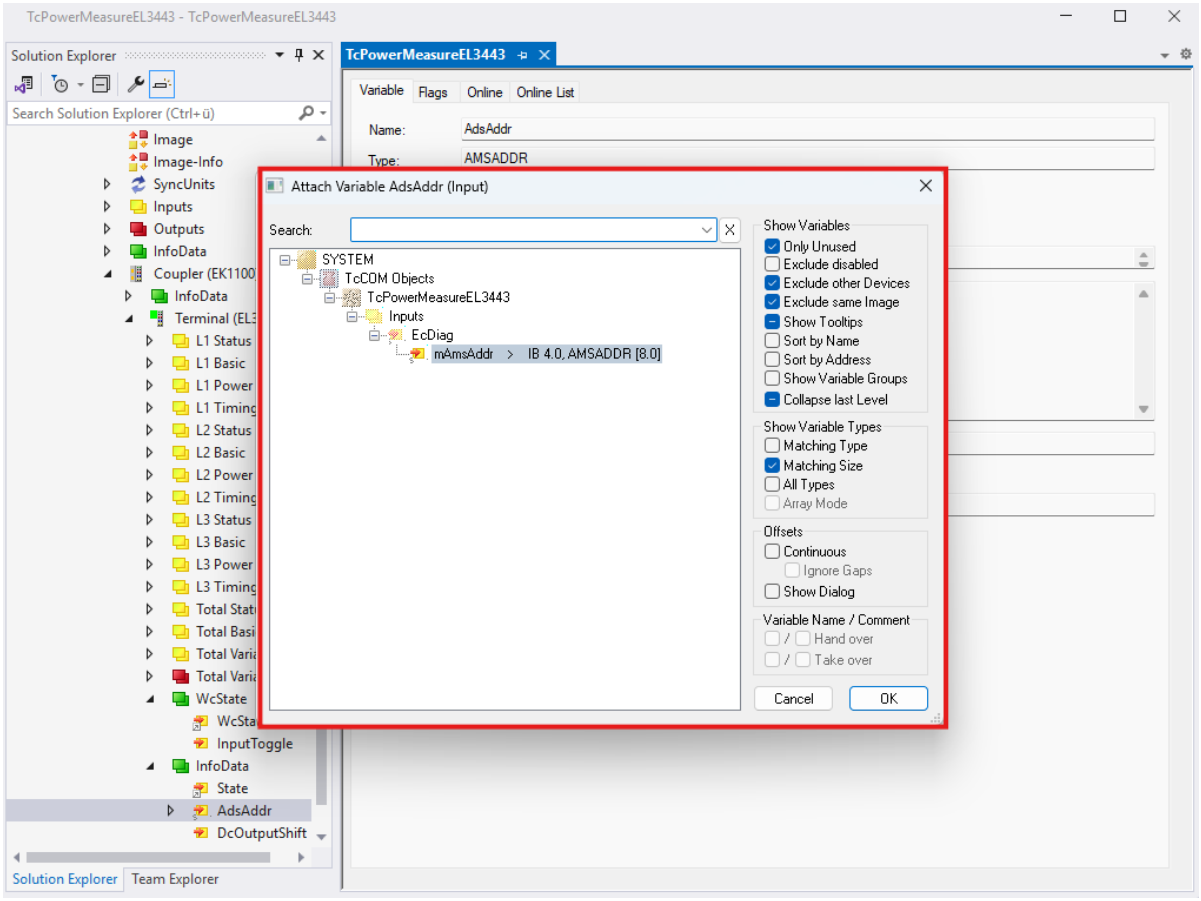
8. Under `Link To PLC...`, select the module you created earlier and click `OK` to establish the link between the terminal and the module. If the module is not listed, the PDO configuration of the terminal does not match the process data of the module (see DataAreas [▶ 31]).



9. In addition, link the EtherCAT diagnostic information from `WcState`, `EcState` and `AmsAddr` between the module and terminal as follows.






TcPowerMeasureEL3443 - TcPowerMeasureEL3443
Solution Explorer
Search Solution Explorer (Ctrl+ü)
Image
Image-Info
SyncUnits
Inputs
Outputs
InfoData
Coupler (EK1100
InfoData
Terminal (EL3
L1 Status
L1 Basic
L1 Power
L1 Timing
L2 Status
L2 Basic
L2 Power
L2 Timing
L3 Status
L3 Basic
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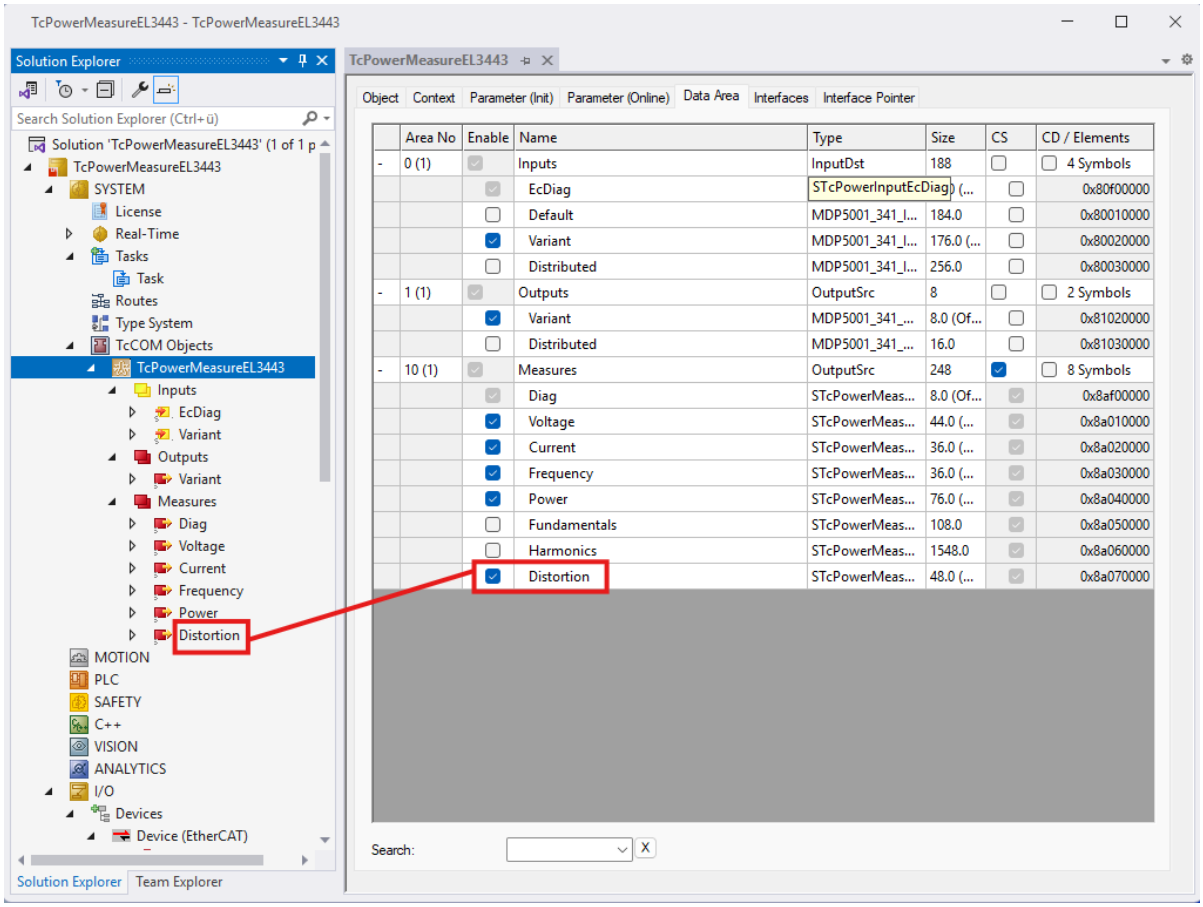
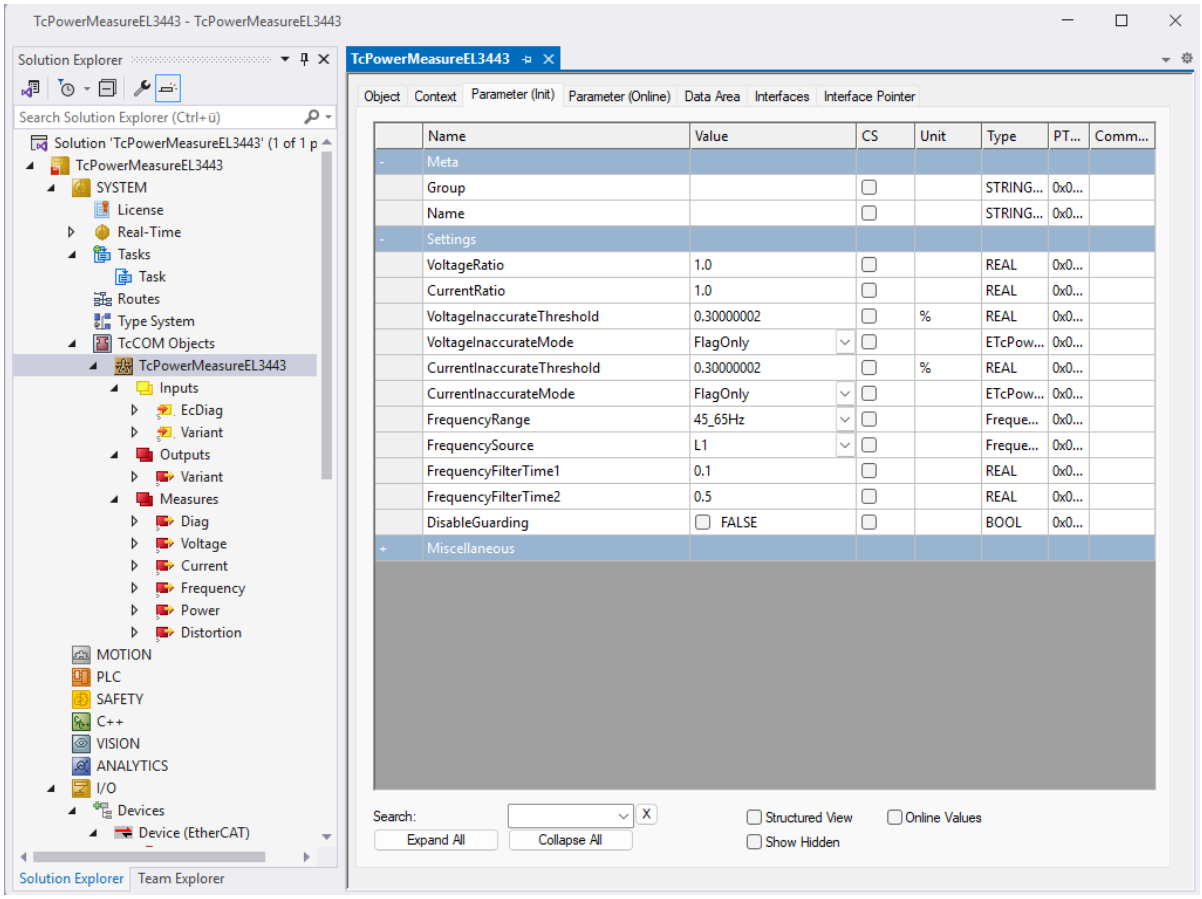
Total Basi
Total Varia
Total Varia
WcState
WcSta
InputToggle
InfoData
State
AdsAddr
DcOutputShift
Solution Explorer
Team Explorer
TcPowerMeasureEL3443
Variable
Flags
Online
Online List
Name:
AdsAddr
Type:
AMSADDR
Attach Variable AdsAddr (Input)
Search:
SYSTEM
TcCOM Objects
TcPowerMeasureEL3443
Inputs
EcDiag
mAmsAddr > IB 4.0, AMSADDR [8.0]
Show Variables
Only Unused
Exclude disabled
Exclude other Devices
Exclude same Image
Show Tooltips
Sort by Name
Sort by Address
Show Variable Groups
Collapse last Level
Show Variable Types
Matching Type
Matching Size
All Types
Array Mode
Offsets
Continuous
Ignore Gaps
Show Dialog
Variable Name / Comment
/ Hand over
/ Take over
Cancel
OK

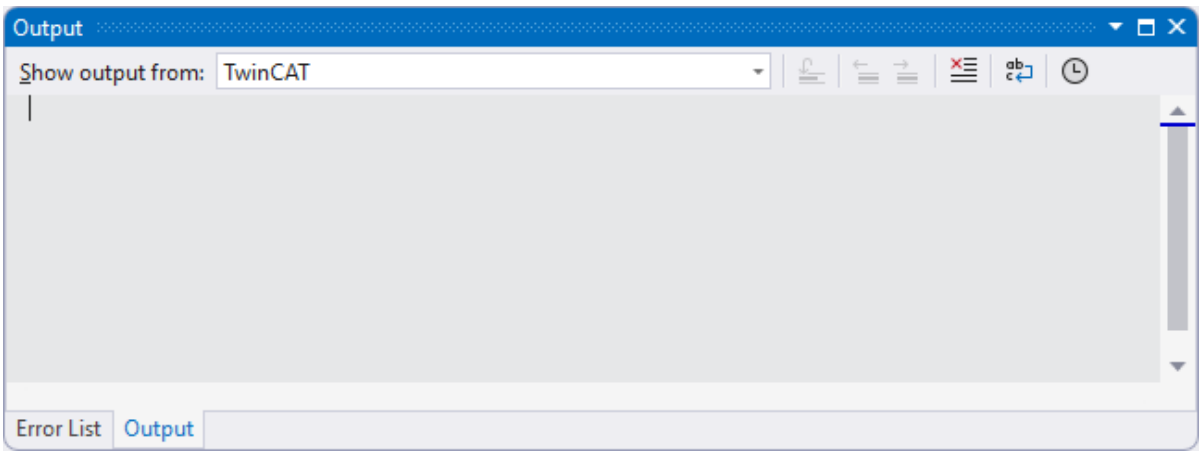
10. At `Data Area` of the module, the desired measurement data can be activated at `Measures` via the checkbox `Enable` (see Measurement data [▶ 11]).



11. The desired settings for the module, terminal and data processing can be made at `Parameter (Init)` of the module.



12. This configuration is executed by `Activate Configuration` and starting *TwinCAT* on a target system. The `bValid` under the `Measure` Data Area in the `Diag` structure can be used to quickly identify valid measurement data. Otherwise, the messages from `TwinCAT` should be checked in the `Output` window.



5.2 TcPowerMeasureEL3453

The `TcPowerMeasureEL3453` module supports all EtherCAT Terminals of type *EL3453* as well as their variants such as *EL3453-0020* or *EL3453-0100* from firmware version 12.

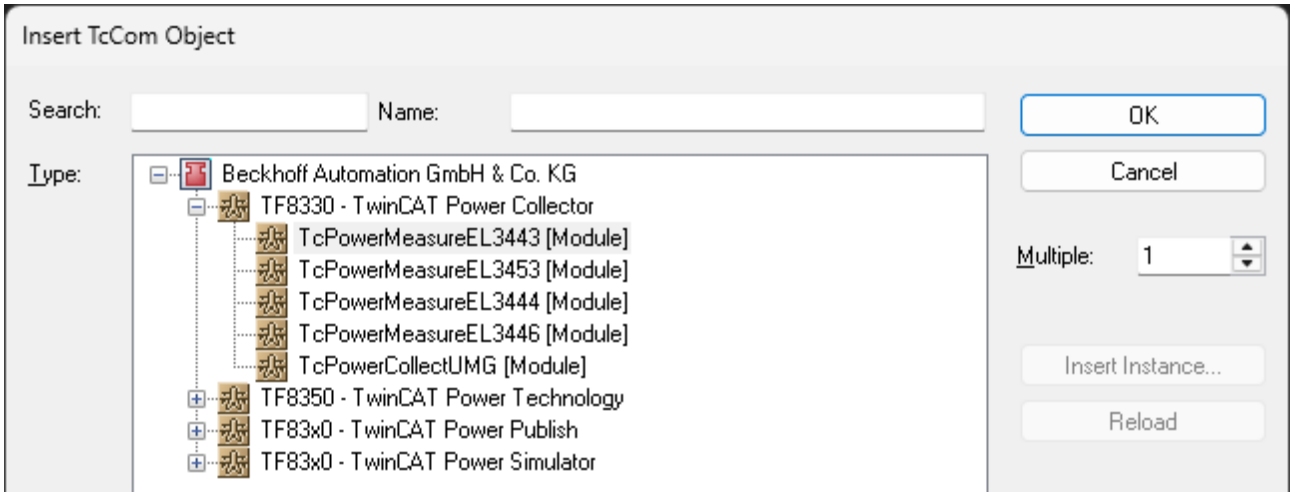
The specific properties of the terminals are abstracted and provided via a standardized interface.

Detailed information on the functionality and technical details of the EL3453 can be found in the corresponding documentation. See EL34xx.

5.2.1 Function

The `TcPowerMeasureEL3453` is integrated into the system as a TcCOM object and executed cyclically via a *task* (see Context [▶ 31]). It takes the measurement data from an *EL3453* and makes it available as a *Data Area* (see DataAreas [▶ 31]) for downstream processes. A data exchange using PDOs, SDOs and variant handling is used for this (see Function/Measure [▶ 10]).

5.2.2 Module



License

A valid *TF8330 | TwinCAT Power Collector* license is required for permanent operation of the module. Alternatively, a 7-day trial license can be used for testing or evaluation (see Licensing [▶ 14]).

5.2.3 Context

Under Context, select the task under which the module is to be executed.

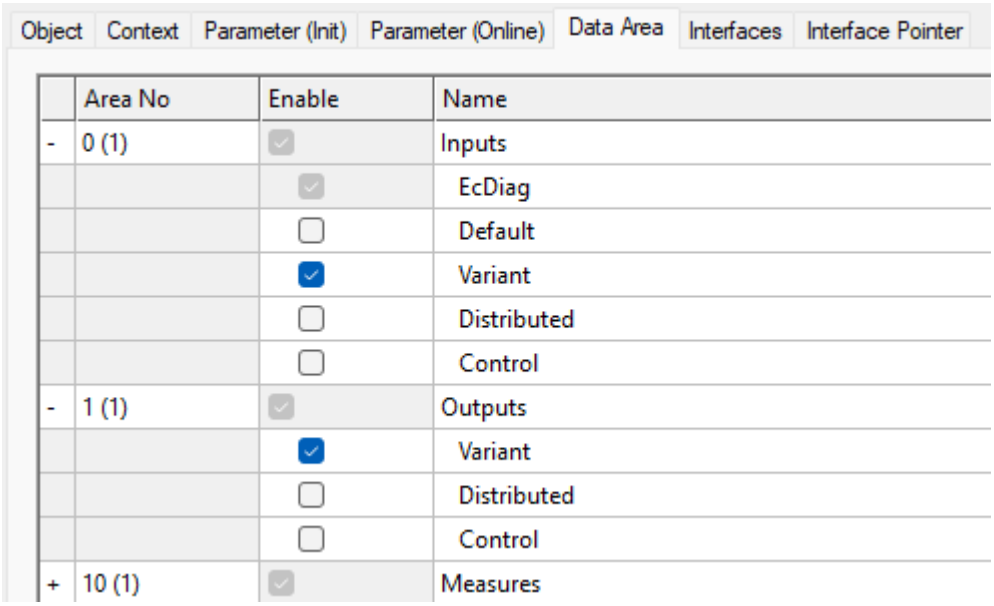
For `TcPowerMeasureEL3453`, the use of a task with a cycle time between 1 ms and 10 ms is recommended.

Even if the *EL3453* only provides new measured values every 10 ms (corresponding to each half-wave), a longer cycle time can still speed up the asynchronous querying of process data via variant handling and SDO communication.

5.2.4 DataAreas

The inputs and outputs of the process data are configured in the Data Areas of the module. The areas `Inputs` and `Outputs` contain the structures for exchanging the process data (PDOs) with the EtherCAT Terminal, while the determined measured values are provided in the `Measures` area (see Measurement data [▶ 11]).

For different use cases, the *EL3453* offers the option of exchanging various process data objects (PDOs) cyclically. The configuration can be used to define which measured values are transmitted cyclically as PDOs and which are transmitted acyclically as SDOs. In order to map this behavior in the TwinCAT modules, the process data used can also be specifically selected there. Typical use cases are already available in the module as predefined PDO sets. This also enables automated mapping of the process data between the EtherCAT Terminal and the TwinCAT module.



The following table provides an overview of the predefined PDO sets of the EtherCAT Terminal with the corresponding Data Areas in the TwinCAT module:

Data Areas	PDOs	Use case
Default	Default	Cyclic recording of voltage, current and power measurement.
Variant	Default + Variant	Use variant handling instead of SDOs for extended measurement data.
Distributed	DPM	For combination with *EL3444* and *EL3446* using Distributed Power Measurement (DPM)

5.2.4.1 Control PDOs

Fast acquisition of active power, reactive power and frequency is required for use of the `TcPowerMeasureEL3453` in combination with the `TcPowerPlantControl` from the *TF8360 | TwinCAT Power Control*.

Specific process data objects (PDOs) are used to enable the determination of the inductive or capacitive reactive power component of the fundamental in particular. A separate process data image is defined for this.

The following PDOs must be configured in the EL3453 for this purpose:

- Inputs
  - 0x1A00 L1 Status
  - 0x1A01 L1 Basic
  - 0x1A02 L1 Power
  - 0x1A03 L1 Power Fundamental
  - 0x1A0C L2 Status
  - 0x1A0D L2 Basic
  - 0x1A0E L2 Power
  - 0x1A0F L2 Power Fundamental
  - 0x1A18 L3 Status
  - 0x1A19 L3 Basic
  - 0x1A1A L3 Power
  - 0x1A1B L3 Power Fundamental

- 0x1A24 Total Status
- 0x1A25 Total Basic
- 0x1A2D Total L-L Voltage
- 0x1A2E Total Variant Value In

- Outputs
  - 0x1600 Total Variant Value Out

5.2.5 Parameter

The parameters in `TcPowerMeasureEL3453` are used to configure the EtherCAT Terminal and to set internal evaluations.

Settings

Name	Data type	Default	Unit	Description
`VoltageRatio`	REAL	1.0		Factor for scaling the voltage.
`VoltageInaccurate Threshold`	REAL	0.3	%	Threshold value of the voltage for detecting inaccuracies.
`VoltageInaccurate Mode`	ETcPowerInaccurate Mode	`FlagOnly`		`FlagOnly`: Display only `SetZero`: Measured values to 0
`CurrentRatio`	REAL	1.0		Factor for scaling the current.
`CurrentRange`	CurrentRange	1 A	A	Measuring range for current.
`CurrentInaccurate Threshold`	REAL	0.3	%	Threshold value of the current for detecting inaccuracies.
`CurrentInaccurate Mode`	ETcPowerInaccurate Mode	`FlagOnly`		`FlagOnly`: Display only `SetZero`: Measured values to 0
`NeutralCurrentRatio`	REAL	1.0		Factor for scaling the neutral current.
`NeutralCurrentRange`	NeutralCurrentRange	1 A	A	Measuring range for the neutral current.
`FrequencyRange`	FrequencyRange	45_65Hz	Hz	Range for determining the frequency.
`FrequencySource`	FrequencySource	L123_PT2		Source and function for determining the frequency.
`FrequencyFilterTime1`	REAL	0.1	s	Time constant of the first frequency filter.
`FrequencyFilterTime2`	REAL	0.5	s	Time constant of the second frequency filter.
`DisableGuarding`	BOOL	FALSE		Switches off the Guarding function of the terminal.

5.2.6 Interfaces

In addition to the typical *TcCOM* interfaces, the `TcPowerMeasureEL34x3` modules offer two specific interfaces for supplementary modules.

ITcPowerMeasure

Using the ITcPowerMeasure interface, downstream modules can reference the measure process data directly and in a structured manner without the need for additional mapping (see Measurement data [▶ 11]).

ITcPowerInputDPM

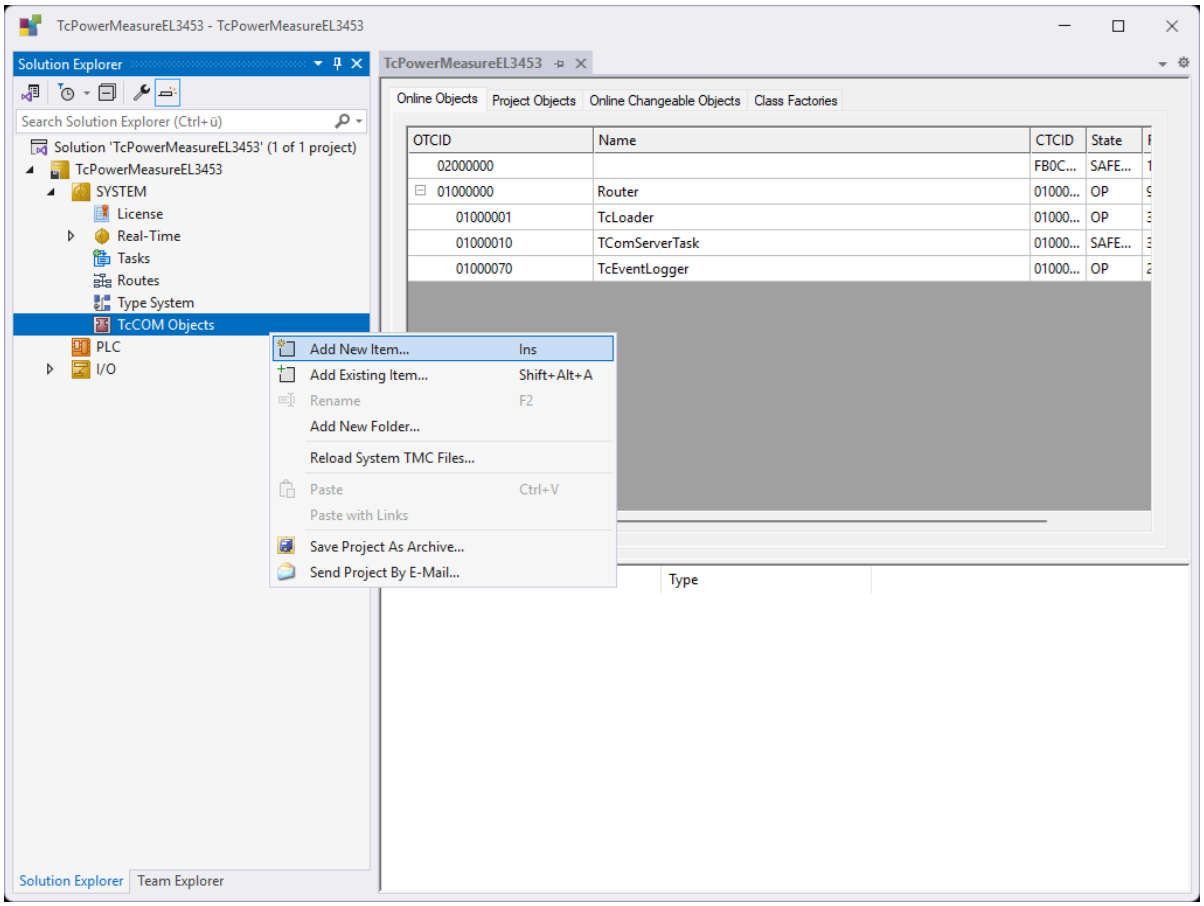
The interface `ITcPowerInputDPM` enables the use of *Distributed Power Measurement (DPM)* by providing the measured voltages for downstream modules without the need for additional mapping.

Modules such as TcPowerMeasureEL3444 and TcPowerMeasureEL3446 can access the DPM process data via this interface and transmit it to the associated EtherCAT Terminals. These terminals only record currents and receive the required voltage information via the DPM data to determine power and other measured variables.

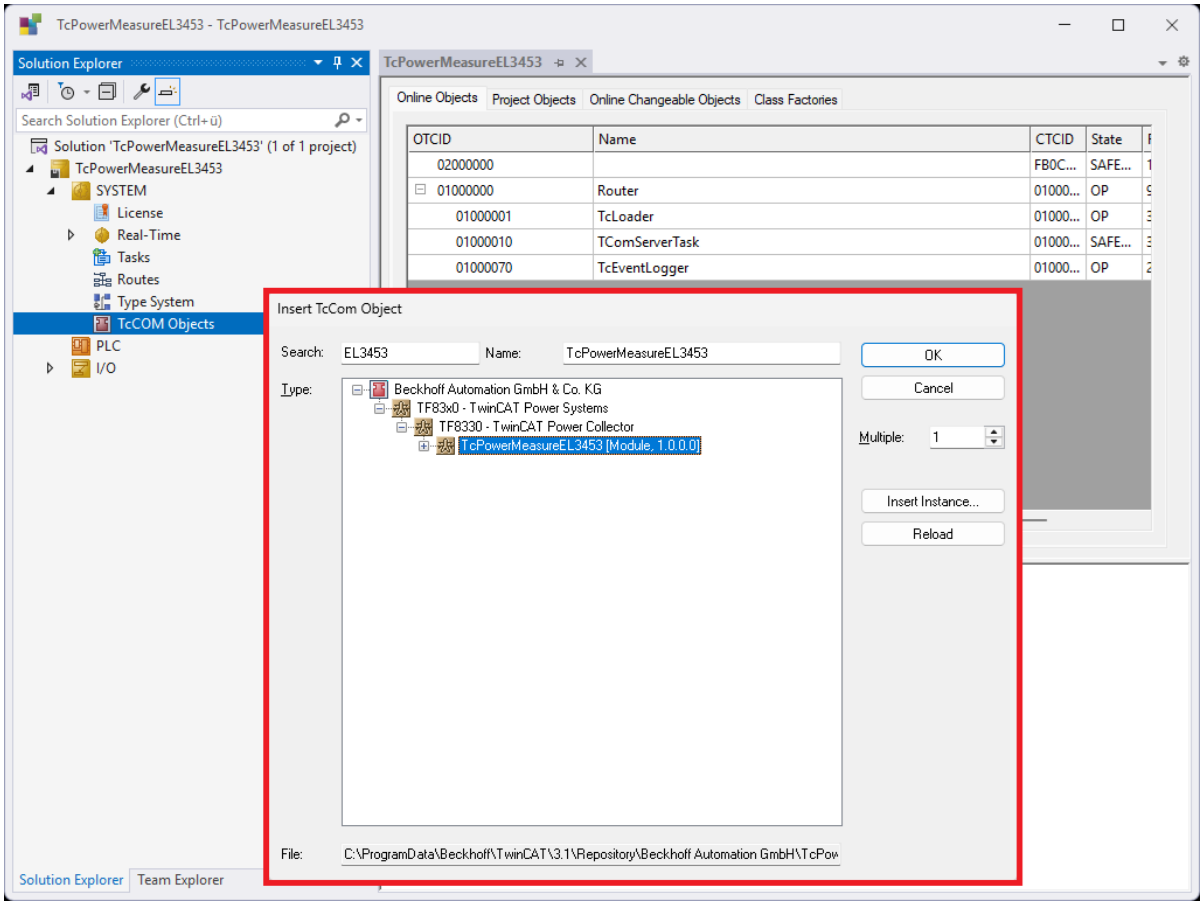
5.2.7 Application

The following section provides instructions on how to integrate the `TcPowerMeasureEL3453` into a TwinCAT project and connect it to a *EL3453* in order to use the module in the application.

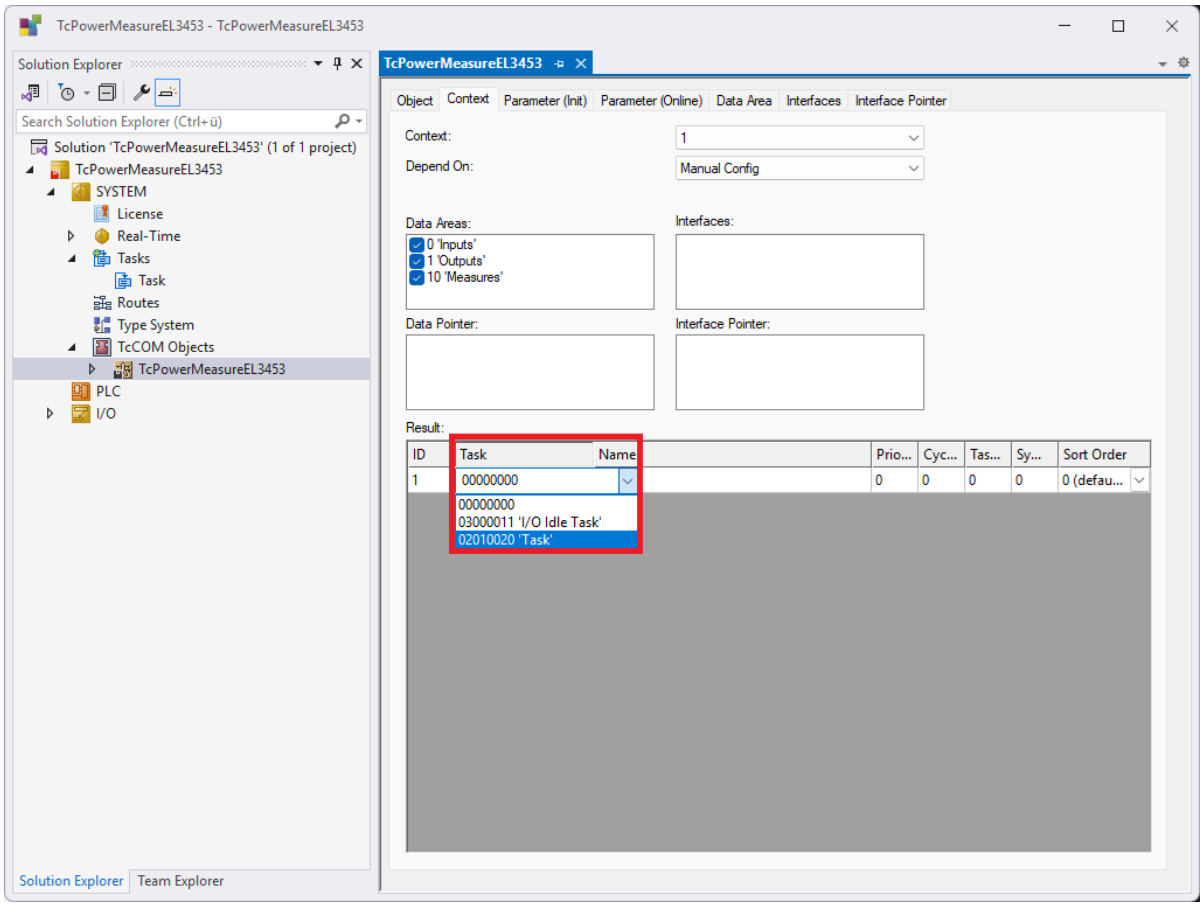
1. Add a new module at `TcCOM Objects` by right-clicking and `Add New Item...`.



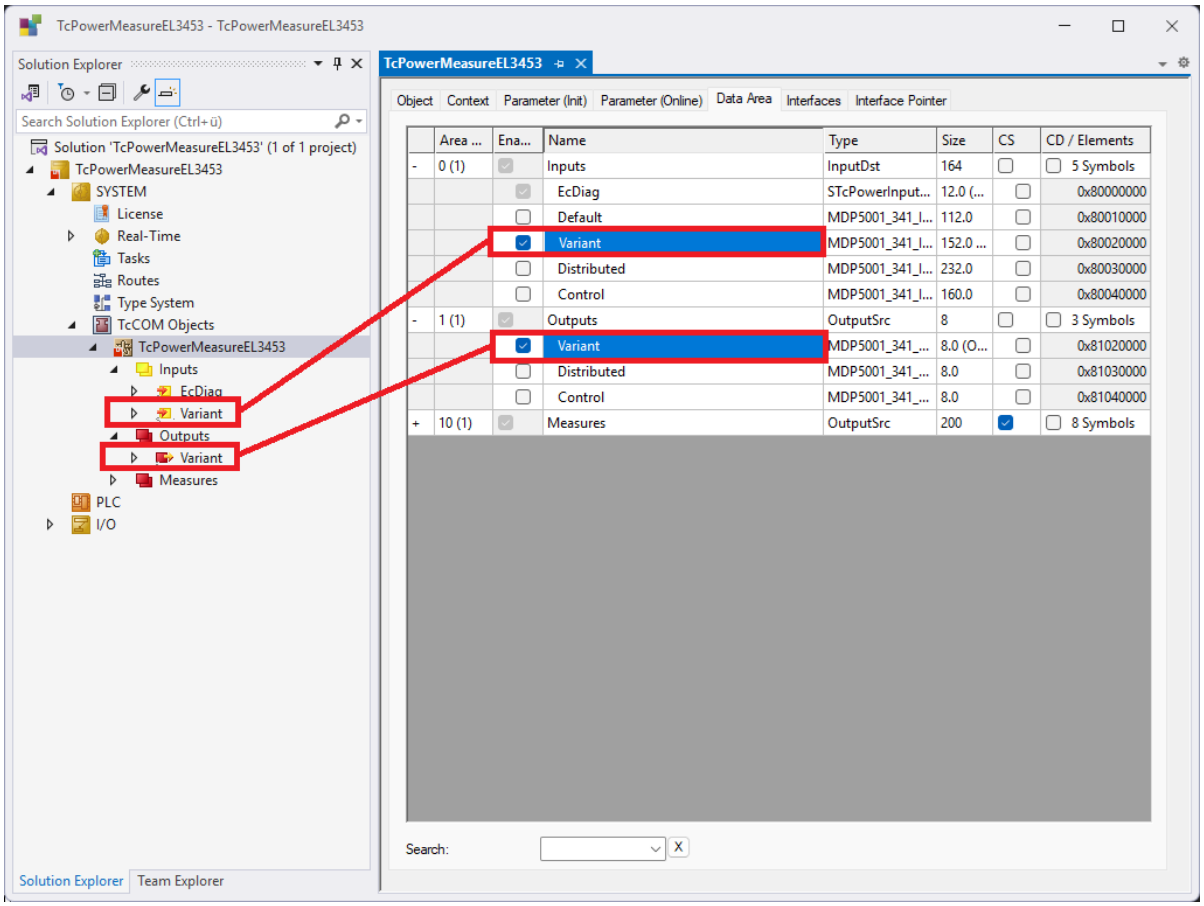
2. Use `Search` of *EL3453* to select the `TcPowerMeasureEL3453` module. Enter a name and click on `OK`.



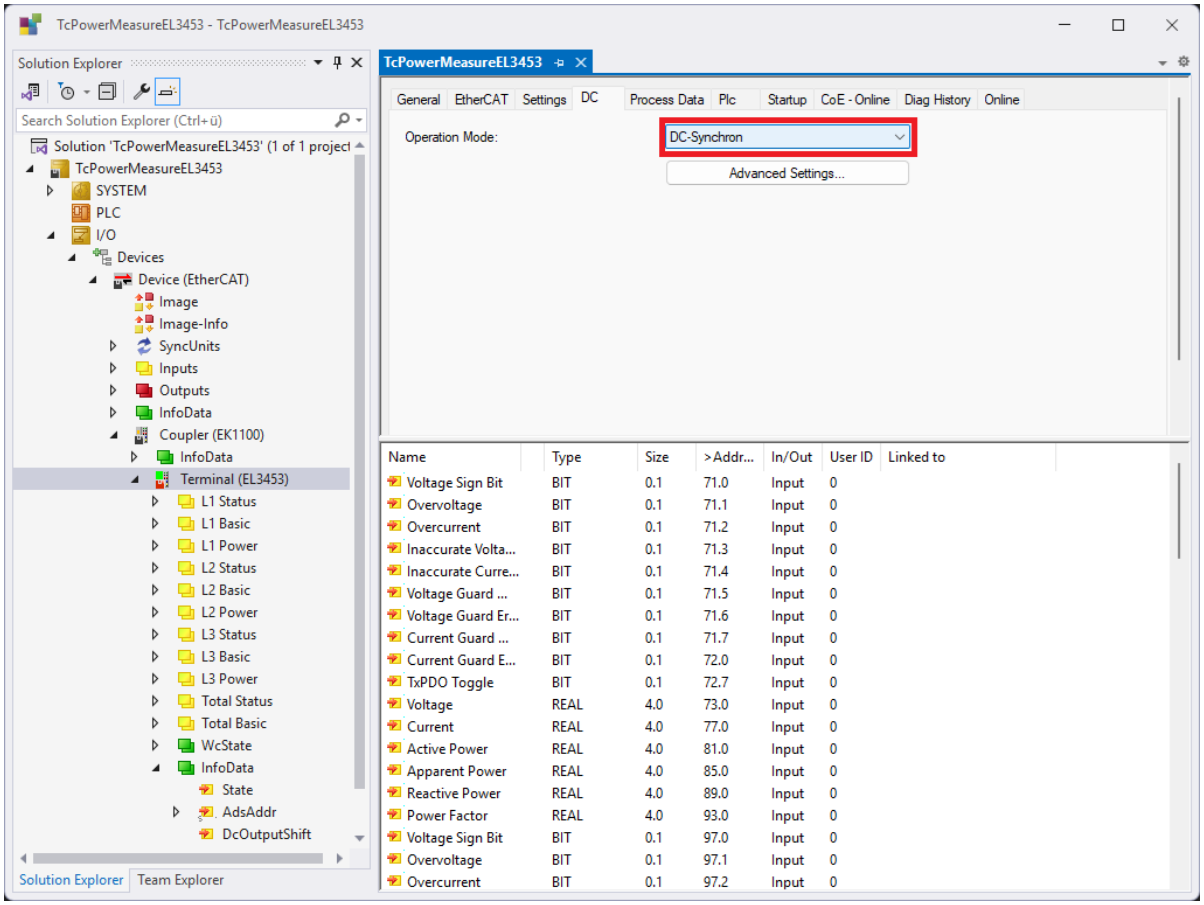
3. Assign a *task* to the module at `Context`.



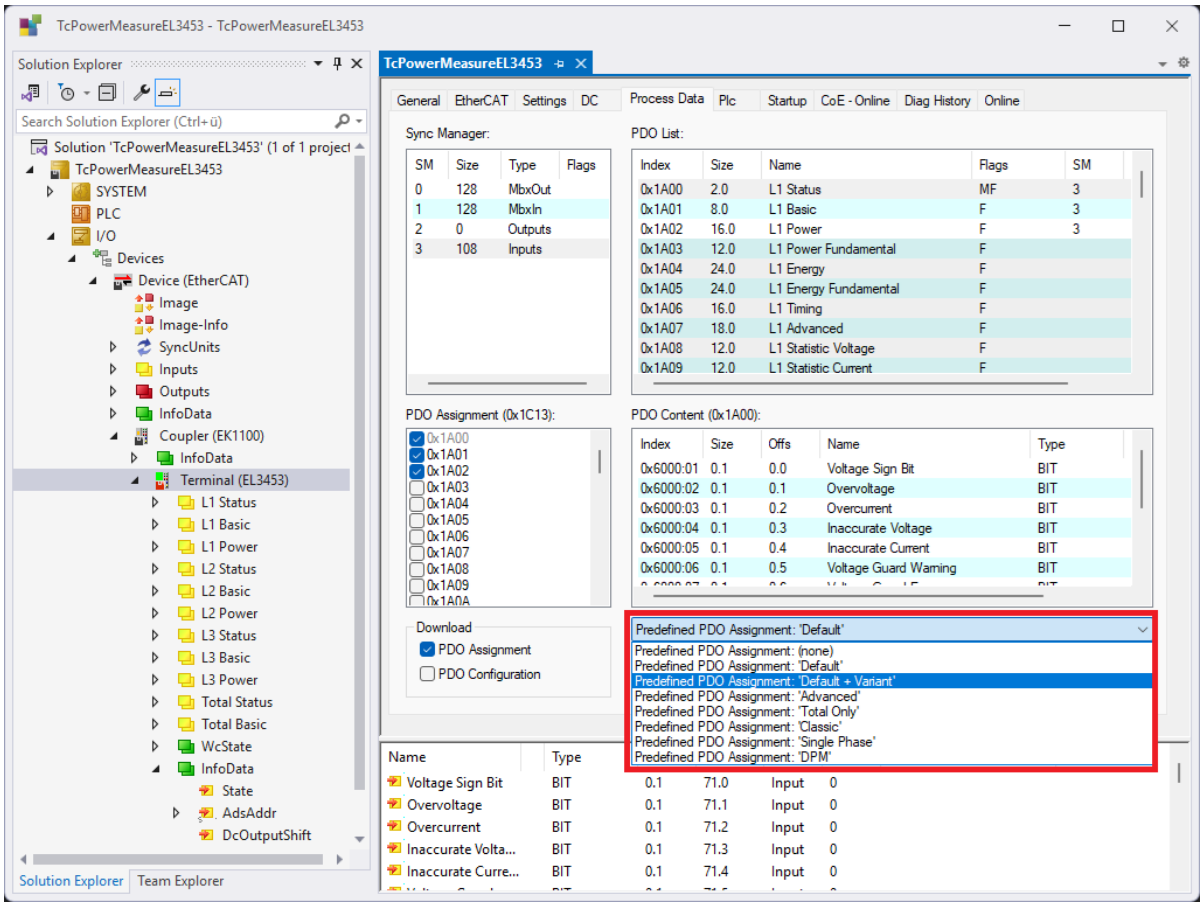
4. At `Data Area`, select the desired and related data areas using the checkbox in the `Enable` column.



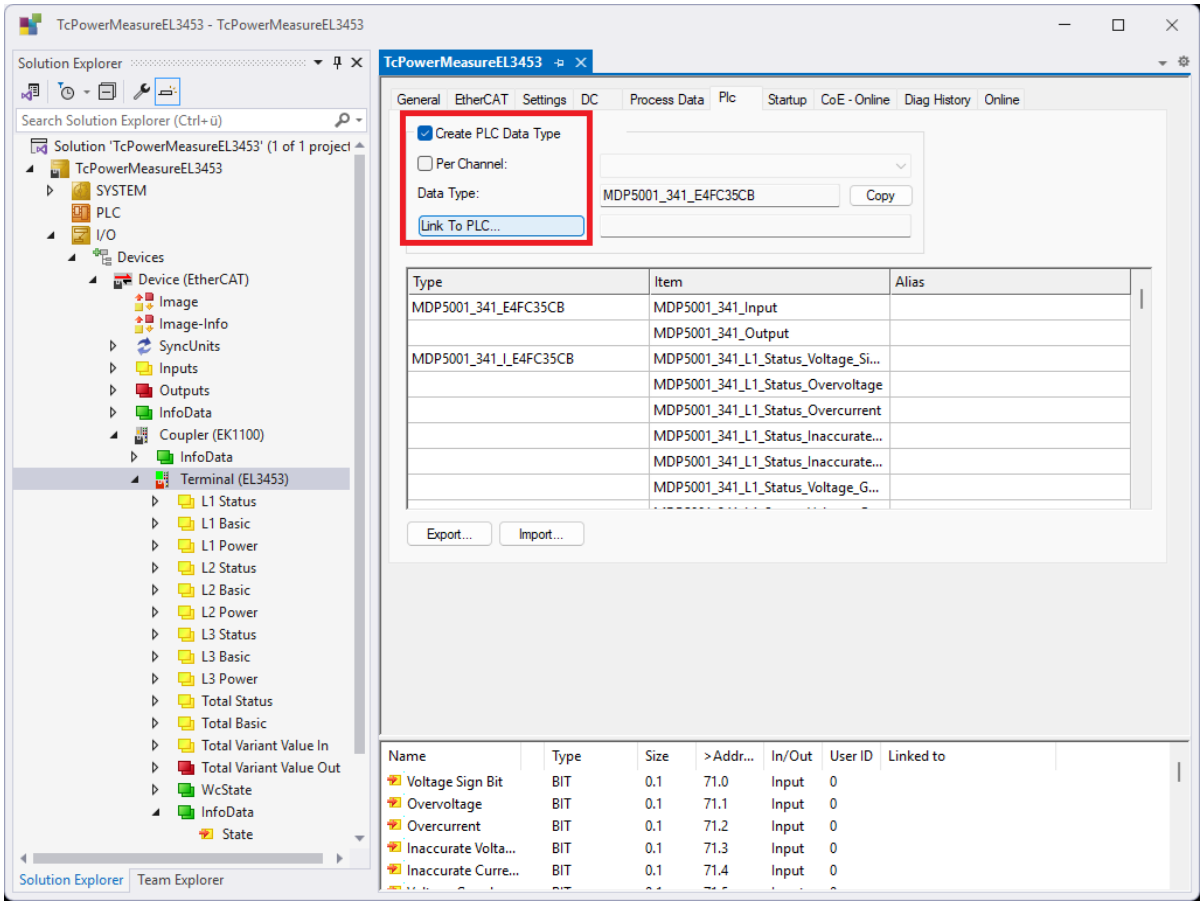
5. Under `I/O Devices`, select the *EL3453* and select `DC-Synchron` as the Operation Mode via the `DC` tab.



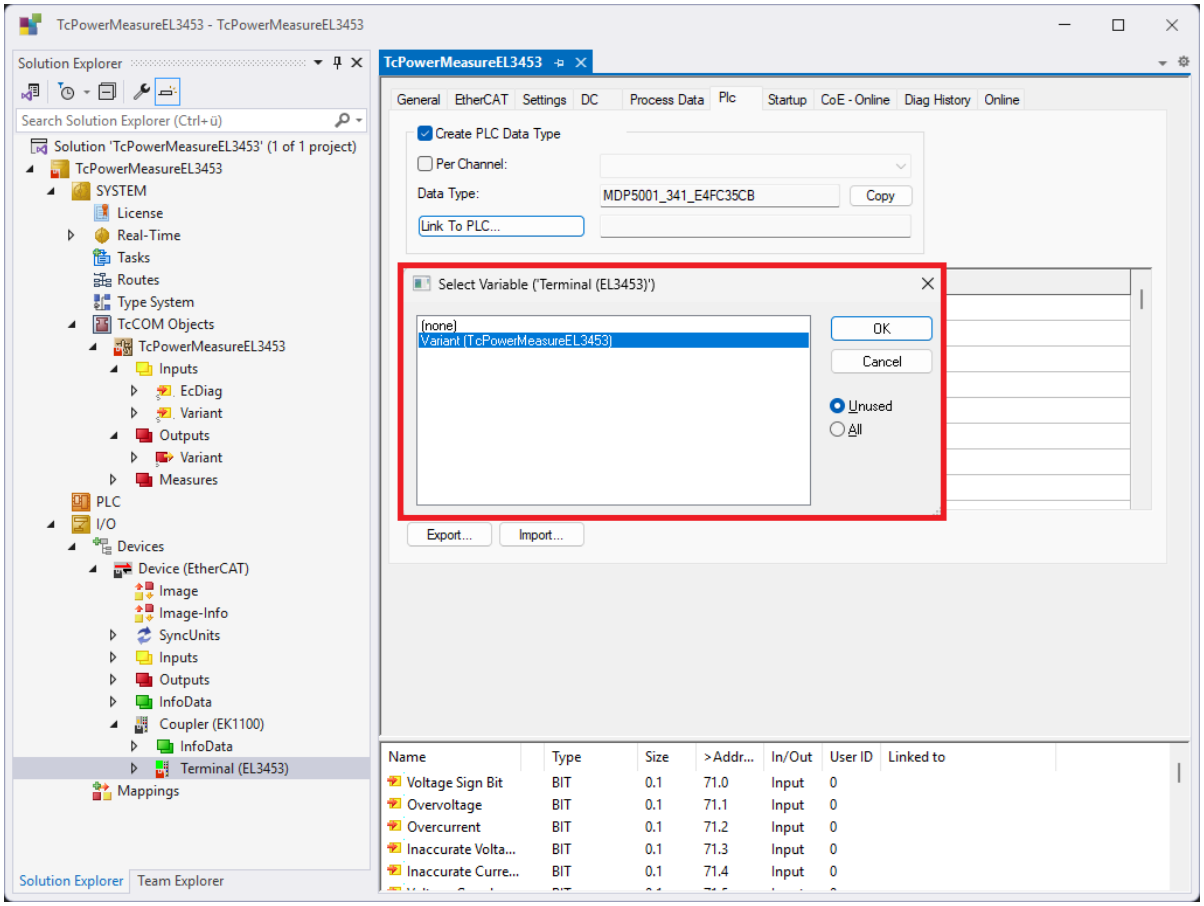
6. Under `Process Data`, select the process data using the `Predefined PDO Assignment` according to the previously selected inputs/outputs (see DataAreas [▶ 31]).



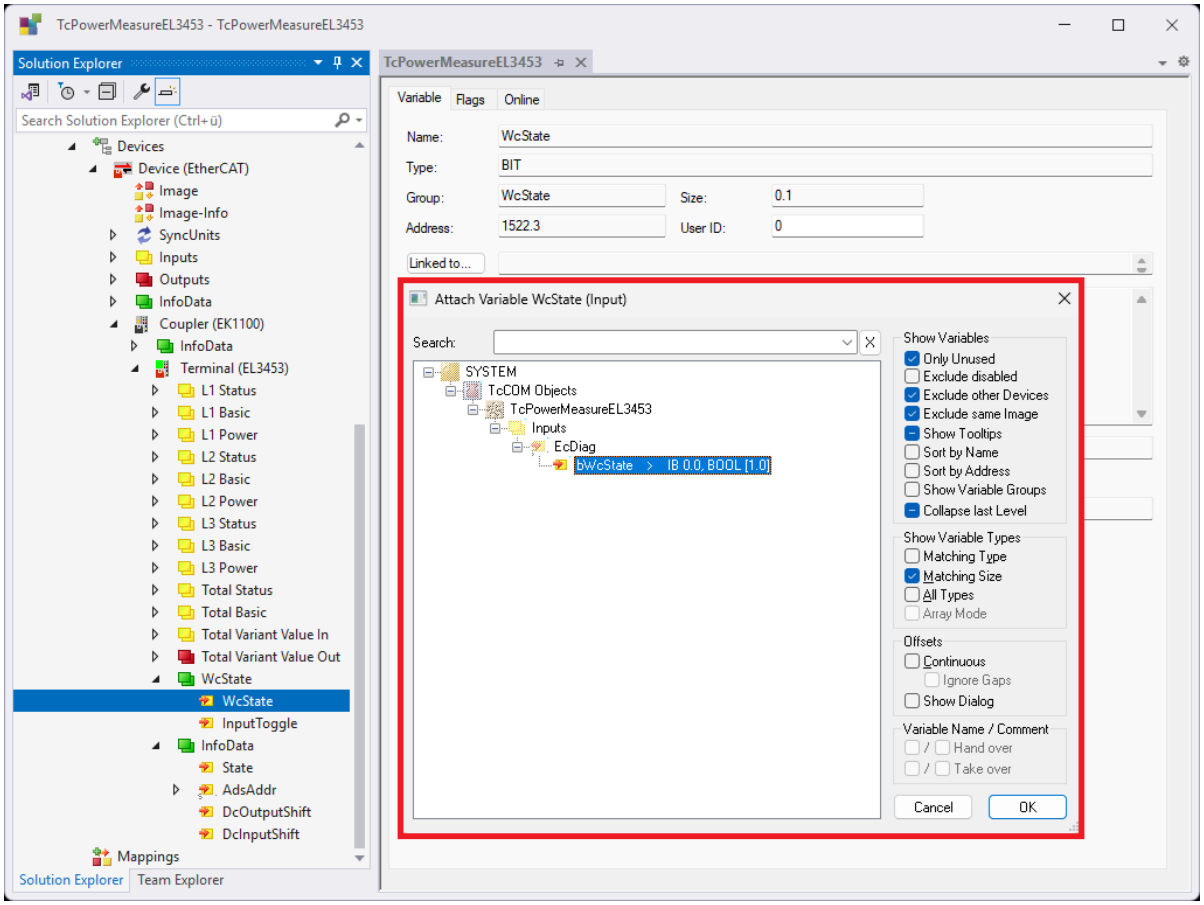
7. Under the `Plc` tab, activate `Create PLC Data Type` without using `Per Channel`, then click on `Link To PLC…`.

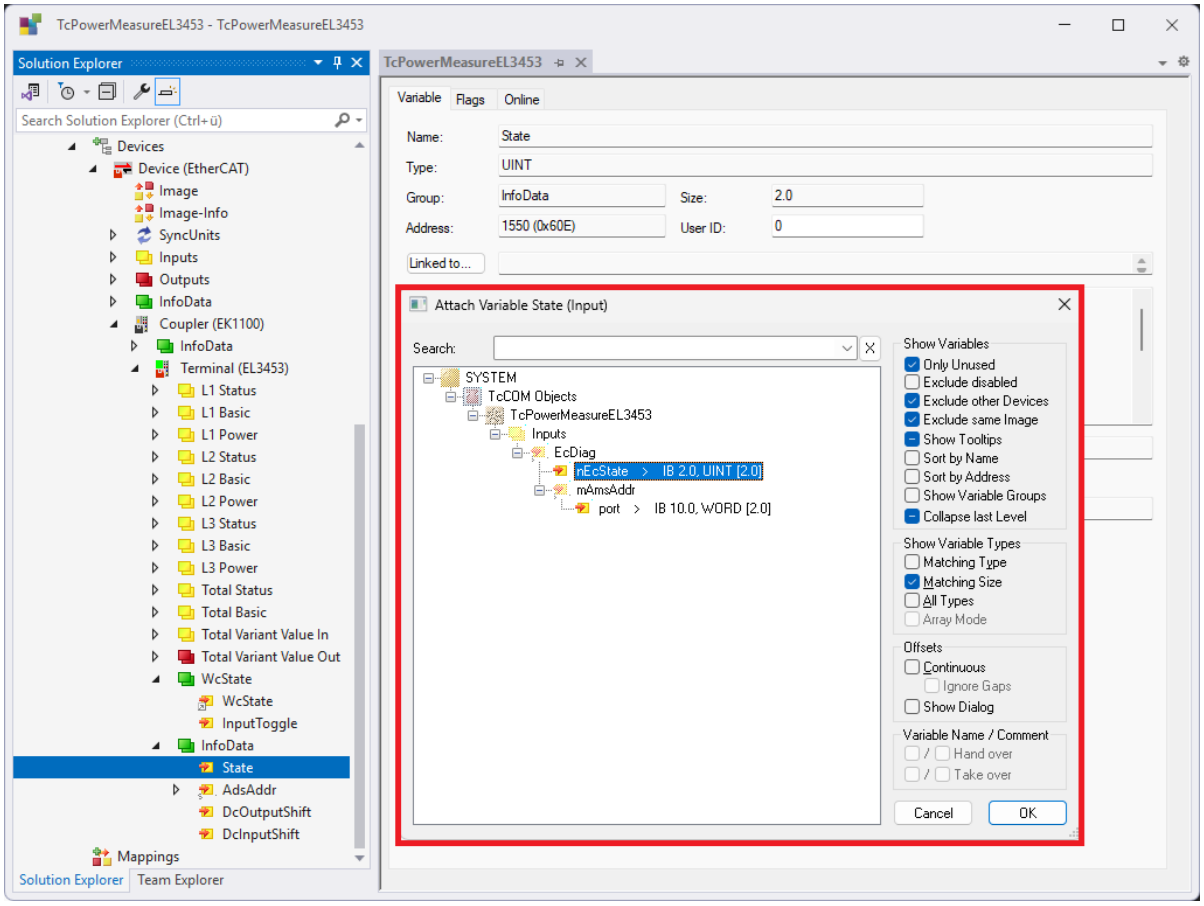


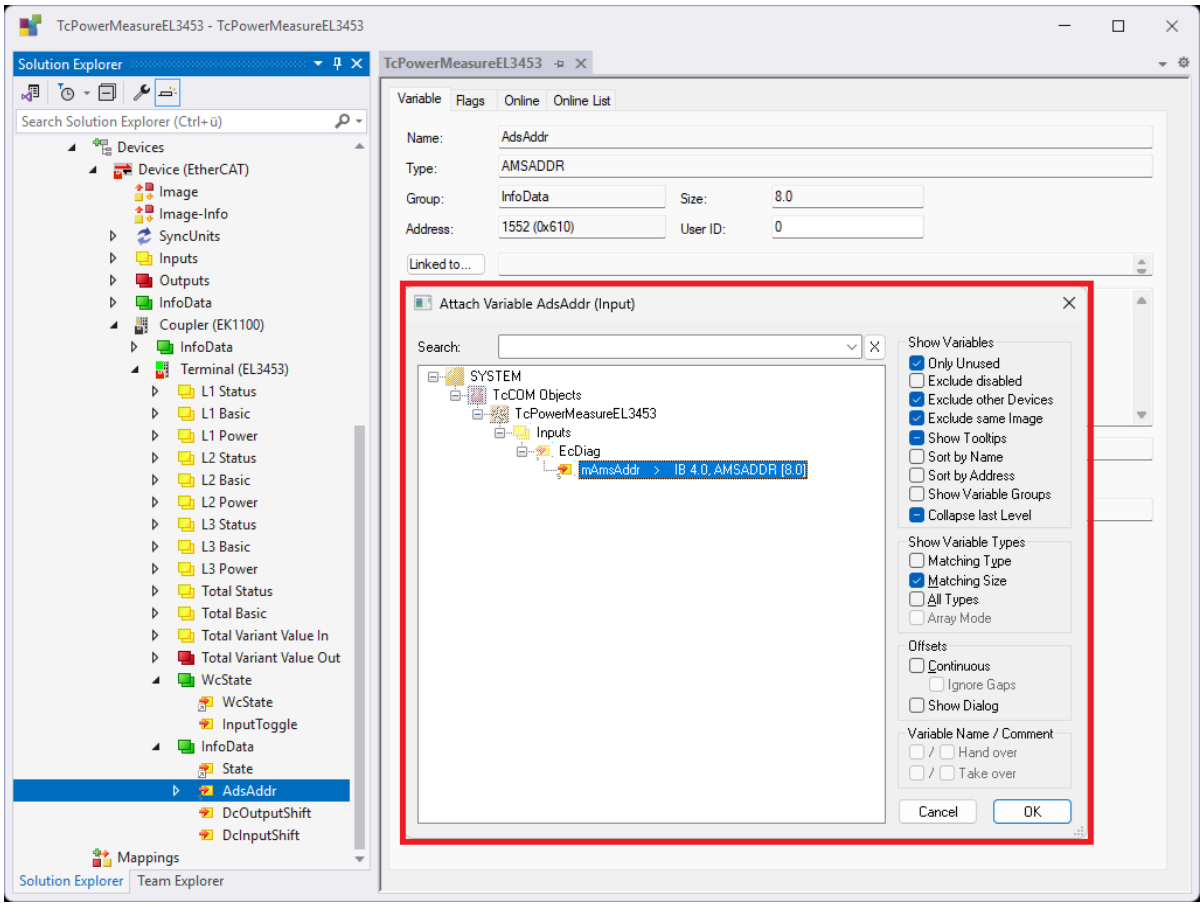
8. Under `Link To PLC...`, select the module you created earlier and click `OK` to establish the link between the terminal and the module. If the module is not listed, the PDO configuration of the terminal does not match the process data of the module (see DataAreas [▶ 31]).



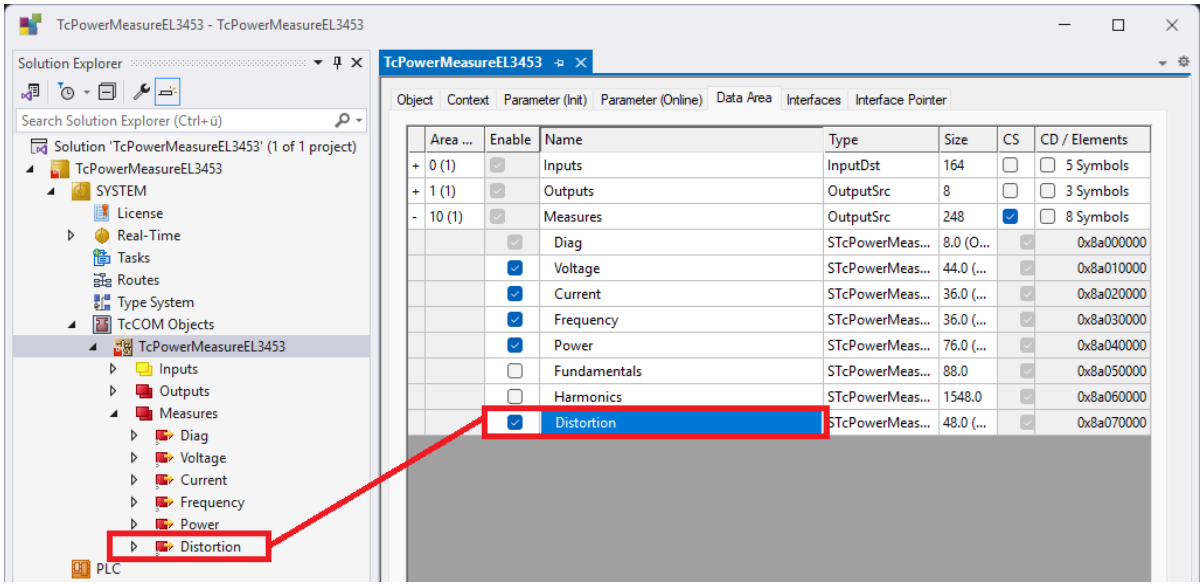
9. In addition, link the EtherCAT diagnostic information from `WcState`, `EcState` and `AmsAddr` between the module and terminal as follows.



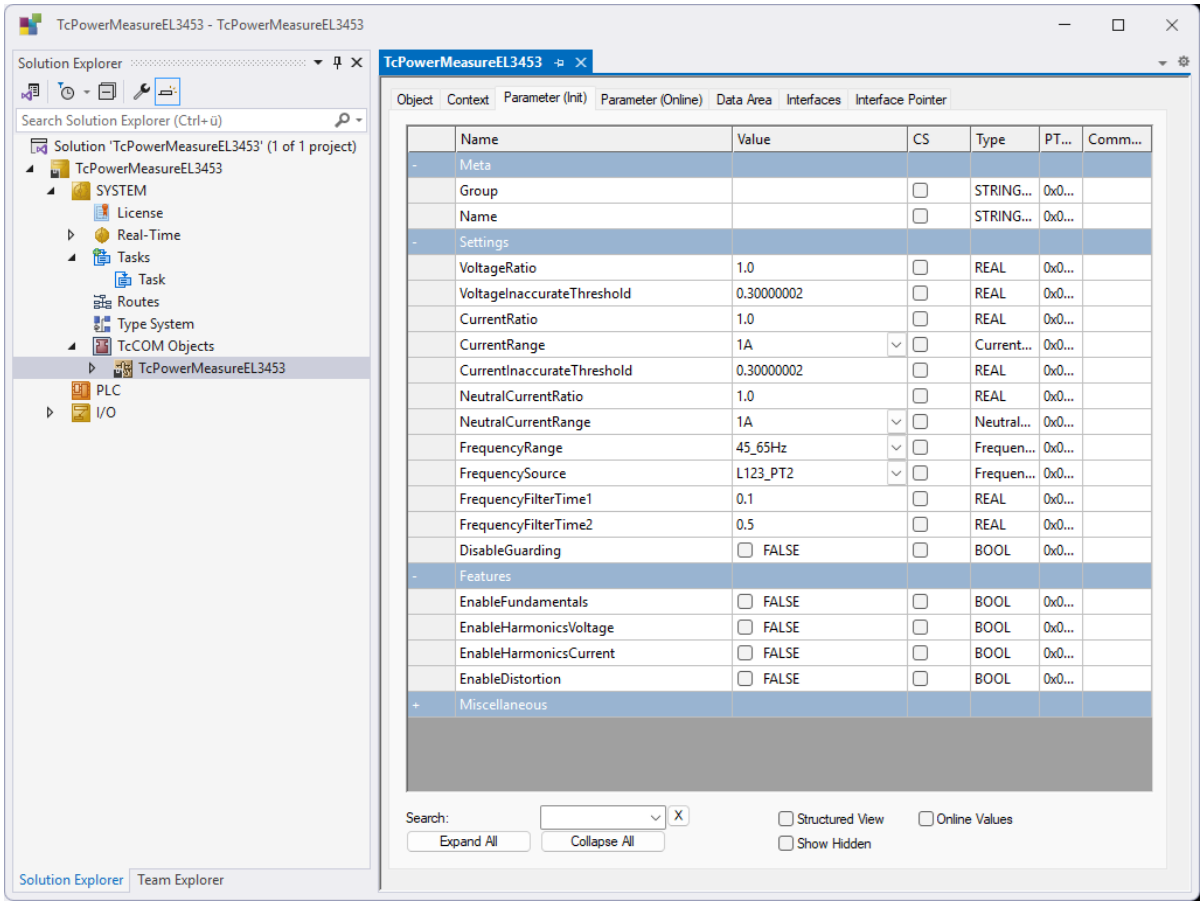




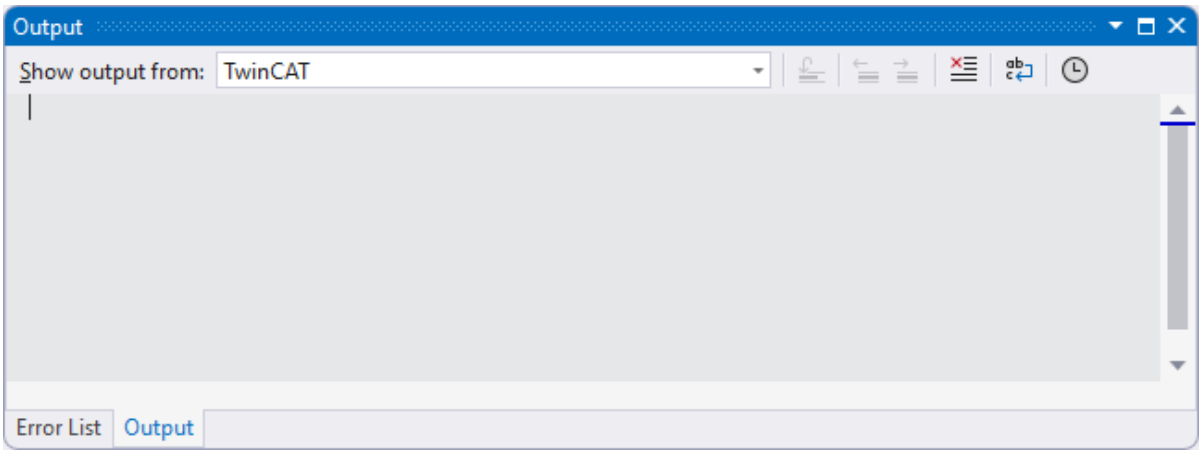
10. At `Data Area` of the module, the desired measurement data can be activated at `Measures` via the checkbox `Enable` (see Measurement data [▶ 11]).



11. The desired settings for the module, terminal and data processing can be made at `Parameter (Init)` of the module.



12. This configuration is executed by `Activate Configuration` and starting *TwinCAT* on a target system. The `bValid` under the `Measure` Data Area in the `Diag` structure can be used to quickly identify valid measurement data. Otherwise, the messages from `TwinCAT` should be checked in the `Output` window.



6 Appendix

6.1 Data types

6.1.1 STcPowerMeasureDiag

The `STcPowerMeasureDiag` structure displays general information on the state of the measurement data.

Name	Data type	Unit	Description
`bValid`	BOOL		Measurements are available and valid.

6.1.2 STcPowerMeasureVoltage

The structures `STcPowerMeasureVoltageDiag`, `STcPowerMeasureVoltageValuesLN` and `STcPowerMeasureVoltageValuesLL` represent measurement data of the voltage and are summarized in the `STcPowerMeasureVoltageArea` structure.

STcPowerMeasureVoltageDiag

State of voltage measurement. See also Diagnostic data [▶ 13].

Name	Data type	Description
`bInaccurateL1`	BIT	Inaccurate voltage phase L1.
`bInaccurateL2`	BIT	Inaccurate voltage phase L2.
`bInaccurateL3`	BIT	Inaccurate voltage phase L3.
`bOvervoltageL1`	BIT	Overvoltage phase L1.
`bOvervoltageL2`	BIT	Overvoltage phase L2.
`bOvervoltageL3`	BIT	Overvoltage phase L3.
`bReverseDirection`	BIT	Reverse direction (FALSE for L1-L2-L3).

STcPowerMeasureVoltageValuesLN

Voltages between phase and neutral conductor.

Name	Data type	Unit	Description
`fU1N`	REAL	V	RMS value of voltage L1-N.
`fU2N`	REAL	V	RMS value of voltage L2-N.
`fU3N`	REAL	V	RMS value of voltage L3-N.
`fU123N`	REAL	V	Mean value of the RMS values of the voltages L1-N, L2-N and L3-N.

STcPowerMeasureVoltageValuesLL

Voltages between the phases.

Name	Data type	Unit	Description
`fU12`	REAL	V	RMS value of voltage L1-L2
`fU23`	REAL	V	RMS value of voltage L2-L3.
`fU31`	REAL	V	RMS value of voltage L3-L1.
`fU123`	REAL	V	Mean value of the RMS values of the voltages L1-L2, L2-L3 and L3-L1.

STcPowerMeasureVoltageArea

Summary of the voltage measurement.

Name	Data type	Description
nTimestamp	DCTIME	Time of update.
Diag	STcPowerMeasureVoltageDiag	State of the measurement.
ValuesLN	STcPowerMeasureVoltageValuesLN	Phase to neutral voltages.
ValuesLL	STcPowerMeasureVoltageValuesLL	Phase to phase voltages.

6.1.3 STcPowerMeasureCurrent

The structures STcPowerMeasureCurrentDiag, STcPowerMeasureCurrentValues and STcPowerMeasureCurrentValuesEN represent measurement data of the currents and are summarized in the structure STcPowerMeasureCurrentArea.

STcPowerMeasureCurrentDiag

State of the current measurement. See also Diagnostic data [▶ 13].

Name	Data type	Description
bInaccurateL1	BIT	Inaccurate current phase L1.
bInaccurateL2	BIT	Inaccurate current phase L2.
bInaccurateL3	BIT	Inaccurate current phase L3.
bOvercurrentL1	BIT	Overcurrent phase L1.
bOvercurrentL2	BIT	Overcurrent phase L2.
bOvercurrentL3	BIT	Overcurrent phase L3.

STcPowerMeasureCurrentValues

Currents of the three phases.

Name	Data type	Unit	Description
fI1	REAL	A	RMS value of current L1.
fI2	REAL	A	RMS value of current L2.
fI3	REAL	A	RMS value of current L3.
fI123	REAL	A	Sum of the RMS values of the currents L1, L2 and L3.

STcPowerMeasureCurrentValuesEN

Currents of the three phases, as well as error current and neutral conductor.

Name	Data type	Unit	Description
fI1	REAL	A	RMS value of current L1.
fI2	REAL	A	RMS value of current L2.
fI3	REAL	A	RMS value of current L3.
fI123	REAL	A	Sum of the RMS values of the currents L1, L2 and L3.
fIE	REAL	A	Determined error current.
fIN	REAL	A	RMS value of the current in the neutral conductor

STcPowerMeasureCurrentArea

Summary of the current measurement.

Name	Data type	Description
nTimestamp	DCTIME	Time of update.
Diag	STcPowerMeasureCurrentDiag	State of the measurement.

Name	Data type	Description
Values	STcPowerMeasureCurrentValuesEN	Currents

6.1.4 STcPowerMeasureFrequency

The structures STcPowerMeasureFrequencyDiag, STcPowerMeasureFrequencyValues and STcPowerMeasureFrequencyRoCoF represent the determined frequency and frequency change (*RoCoF*) and are summarized in the structure STcPowerMeasureFrequencyArea.

STcPowerMeasureFrequencyDiag

State of the frequency determination. See also Diagnostic data [▶ 13].

Name	Data type	Description
bInaccurateL1	BIT	Inaccurate frequency phase L1.
bInaccurateL2	BIT	Inaccurate frequency phase L2.
bInaccurateL3	BIT	Inaccurate frequency phase L3.

STcPowerMeasureFrequencyValues

Determined frequency and filtered frequency values.

Name	Data type	Unit	Description
fF	REAL	Hz	Determined frequency.
fF1	REAL	Hz	First stage filtered frequency.
fF2	REAL	Hz	Second stage filtered frequency.

STcPowerMeasureFrequencyRoCoF

Determined frequency change and filtered frequency change.

Name	Data type	Unit	Description
fR	REAL	Hz/s	Determined frequency change.
fR1	REAL	Hz/s	First stage filtered frequency change.
fR2	REAL	Hz/s	Second stage filtered frequency change.

STcPowerMeasureFrequencyArea

Summary of the frequency determination.

Name	Data type	Description
nTimestamp	DCTIME	Time of update.
Diag	STcPowerMeasureFrequencyDiag	State of determination.
Values	STcPowerMeasureFrequencyValues	Determined frequency.
RoCoF	STcPowerMeasureFrequencyRoCoF	Determined frequency change.

6.1.5 STcPowerMeasurePower

The structures STcPowerMeasurePowerDiag and STcPowerMeasurePowerValues contain the calculated power values and are summarized in the STcPowerMeasurePowerArea structure.

STcPowerMeasurePowerDiag

State of power determination. See also Diagnostic data [▶ 13].

Name	Data type	Description
bInaccurateL1	BIT	Inaccurate power phase L1.
bInaccurateL2	BIT	Inaccurate power phase L2.

Name	Data type	Description
bInaccurateL3	BIT	Inaccurate power phase L3.

STcPowerMeasurePowerValues

Determined power values.

Name	Data type	Unit	Description
fP1	REAL	W	RMS value of the active power L1.
fP2	REAL	W	RMS value of the active power L2.
fP3	REAL	W	RMS value of the active power L3.
fP123	REAL	W	Sum of the RMS values of the active power L1, L2 and L3.
fQ1	REAL	var	RMS value of the reactive power L1.
fQ2	REAL	var	RMS value of the reactive power L2.
fQ3	REAL	var	RMS value of the reactive power L3.
fQ123	REAL	var	Sum of the RMS values of the reactive power L1, L2 and L3.
fS1	REAL	VA	RMS value of the apparent power L1.
fS2	REAL	VA	RMS value of the apparent power L2.
fS3	REAL	VA	RMS value of the apparent power L3.
fS123	REAL	VA	Sum of the RMS values of the apparent power L1, L2 and L3.
fPF1	REAL	-	Power factor phase L1.
fPF2	REAL	-	Power factor phase L2.
fPF3	REAL	-	Power factor phase L3.
fPF123	REAL	-	Average of the power factor of phases L1, L2 and L3.

STcPowerMeasurePowerArea

Summary of the power determination.

Name	Data type	Description
nTimestamp	DCTIME	Time of update.
Diag	STcPowerMeasurePowerDiag	State of determination.
Values	STcPowerMeasurePowerValues	Power

6.1.6 STcPowerMeasureFundamentals

The structures `STcPowerMeasureFundamentalsDiag` and `STcPowerMeasurePowerFundamentals` contain the determined voltage, current and power components of the fundamental and are summarized in the `STcPowerMeasureFundamentalsArea` structure.

STcPowerMeasureFundamentalsDiag

State of the fundamental determination. See also Diagnostic data [▶ 13].

Name	Data type	Description
bInaccurateL1	BIT	Inaccurate fundamental phase L1.
bInaccurateL2	BIT	Inaccurate fundamental phase L2.
bInaccurateL3	BIT	Inaccurate fundamental phase L3.

STcPowerMeasurePowerFundamentals

Determined power components of the fundamental.

Name	Data type	Unit	Description
fP1	REAL	W	Fundamental component of the active power L1.
fP2	REAL	W	Fundamental component of the active power L2.
fP3	REAL	W	Fundamental component of the active power L3.
fP123	REAL	W	Sum of the fundamental components of the active power L1, L2 and L3.
fQ1	REAL	var	Fundamental component of the reactive power L1.
fQ2	REAL	var	Fundamental component of the reactive power L2.
fQ3	REAL	var	Fundamental component of the reactive power L3.
fQ123	REAL	var	Sum of the fundamental components of the reactive power L1, L2 and L3.
fCosPhi1	REAL	-	Displacement factor phase L1.
fCosPhi2	REAL	-	Displacement factor phase L2.
fCosPhi3	REAL	-	Displacement factor phase L3.

STcPowerMeasureFundamentalsArea

Summary of the fundamental determination.

Name	Data type	Description
nTimestamp	DCTIME	Time of update.
Diag	STcPowerMeasureFundamentalsDiag	State of determination.
Voltage	STcPowerMeasureVoltageValuesLN [▶ 45]	Voltage components of the fundamental.
Current	STcPowerMeasureCurrentValues [▶ 46]	Current components of the fundamental.
Power	STcPowerMeasurePowerFundamentals	Power components of the fundamental

6.1.7 STcPowerMeasureHarmonics

The structures `STcPowerMeasureHarmonicsDiag` and `STcPowerMeasureHarmonicsValues` represent the determined harmonics and are summarized in the structure `STcPowerMeasureHarmonicsArea`.

STcPowerMeasureHarmonicsDiag

State of the harmonic determination. See also Diagnostic data [▶ 13].

Name	Data type	Description
bInaccurateL1	BIT	Inaccurate harmonics phase L1.
bInaccurateL2	BIT	Inaccurate harmonics phase L2.
bInaccurateL3	BIT	Inaccurate harmonics phase L3.

STcPowerMeasureHarmonicsValues

Determined harmonics up to and including the 64th harmonic.

Name	Data type	Unit	Description
aHarm1	ARRAY [0..63] OF REAL	%	Ratio of the nth harmonic to the fundamental L1.

Name	Data type	Unit	Description
aHarm2	ARRAY [0..63] OF REAL	%	Ratio of the nth harmonic to the fundamental L2.
aHarm3	ARRAY [0..63] OF REAL	%	Ratio of the nth harmonic to the fundamental L3.

STcPowerMeasureHarmonicsArea

Summary of the harmonics determination.

Name	Data type	Description
nTimestamp	DCTIME	Time of update.
Diag	STcPowerMeasureFrequencyDiag	State of determination.
Voltage	STcPowerMeasureHarmonicsValues	Harmonics of the voltage.
Current	STcPowerMeasureHarmonicsValues	Harmonics of the current.

6.1.8 STcPowerMeasureDistortion

The structures STcPowerMeasureDistortionDiag, STcPowerMeasureDistortionValues and STcPowerMeasureDistortionValuesTDD represent the determined harmonic distortion and are summarized in the structure STcPowerMeasureDistortionArea.

STcPowerMeasureDistortionDiag

State of the distortion determination. See also Diagnostic data [▶ 13].

Name	Data type	Description
bInaccurateL1	BIT	Inaccurate frequency phase L1.
bInaccurateL2	BIT	Inaccurate frequency phase L2.
bInaccurateL3	BIT	Inaccurate frequency phase L3.

STcPowerMeasureDistortionValues

Determined harmonic distortion in relation to the fundamental.

Name	Data type	Unit	Description
fTHD1	REAL	%	Distortion on phase L1.
fTHD2	REAL	%	Distortion on phase L2.
fTHD3	REAL	%	Distortion on phase L3.

STcPowerMeasureDistortionValuesTDD

Determined distortion in relation to the maximum fundamental.

Name	Data type	Unit	Description
fTDD1	REAL	%	Distortion on phase L1.
fTDD2	REAL	%	Distortion on phase L2.
fTDD3	REAL	%	Distortion on phase L3.

STcPowerMeasureDistortionArea

Summary of the distortion determination.

Name	Data type	Description
nTimestamp	DCTIME	Time of update.
Diag	STcPowerMeasureFrequencyDiag	State of determination.
VoltageTHD	STcPowerMeasureDistortionValues	Distortion of the voltage in relation to the fundamental.

Name	Data type	Description
CurrentTHD	STcPowerMeasureDistortionValues	Distortion of the current in relation to the fundamental.
CurrentTDD	STcPowerMeasureDistortionValuesTDD	Distortion of the current in relation to the maximum fundamental.

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