SIEMENS

SICAM BC

AI-5313/TPSX05

System Element Manual

DC5-048-2.00

Note

Please observe Notes and Warnings for your own safety in the Preface.

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Preface

This document is applicable to the following product(s):

- SICAM BC
  - AI-5313/TPSX05

Purpose of this manual

This manual describes the functioning of the system element AI-5313/TPSX05 (**T**ransformer Input **P**reprocessing and **S**ynchronization) and essentially contains

- Functional descriptions
- Technical specifications
- Descriptions of interfaces to the process and other system elements
- Possible configurations

Target Group

The document you are reading right now is addressed to users, who are in charge of the following engineering tasks:

- Conceptual activities, as for example design and configuration
- Creation of the assembly technical documentation using the designated engineering tools
- System parameterization and system diagnostic, using the designated engineering tools
- Technical system maintenance

Placement in the Information Landscape

Document	Item no.
System Manual SICAM BC	DC5-014-2
SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104	DC0-011-2

Notes on Safety

This manual does not constitute a complete catalog of all safety measures required for operating the equipment (module, device) in question because special operating conditions might require additional measures. However, it does contain notes that must be adhered to for your own personal safety and to avoid damage to property. These notes are highlighted with a warning triangle and different keywords indicating different degrees of danger.

Danger

means that death, serious bodily injury or considerable property damage **will** occur, if the appropriate precautionary measures are not carried out.

Warning

means that death, serious bodily injury or considerable property damage **can** occur, if the appropriate precautionary measures are not carried out.

Caution

means that minor bodily injury or property damage could occur, if the appropriate precautionary measures are not carried out.

Note

is important information about the product, the handling of the product or the respective part of the documentation, to which special attention is to be given.

Qualified Personnel

Commissioning and operation of the equipment (module, device) described in this manual must be performed by qualified personnel only. As used in the safety notes contained in this manual, qualified personnel are those persons who are authorized to commission, release, ground, and tag devices, systems, and electrical circuits in accordance with safety standards.

Use as Prescribed

The equipment (device, module) must not be used for any other purposes than those described in the Catalog and the Technical Description. If it is used together with third-party devices and components, these must be recommended or approved by Siemens.

Correct and safe operation of the product requires adequate transportation, storage, installation, and mounting as well as appropriate use and maintenance.

During operation of electrical equipment, it is unavoidable that certain parts of this equipment will carry dangerous voltages. Severe injury or damage to property can occur if the appropriate measures are not taken:

- Before making any connections at all, ground the equipment at the PE terminal.
- Hazardous voltages can be present on all switching components connected to the power supply.
- Even after the supply voltage has been disconnected, hazardous voltages can still be present in the equipment (capacitor storage).
- Equipment with current transformer circuits must not be operated while open.
- The limit values indicated in the manual or the operating instructions must not be exceeded; that also applies to testing and commissioning.

Consider obligatory the safety rules for the accomplishment of works at electrical plants:

1. Switch off electricity all-pole and on all sides!
2. Ensure that electricity cannot be switched on again!
3. Double check that no electrical current is flowing!
4. Discharge, ground, short circuit!
5. Cover or otherwise isolate components that are still electrically active!

Table of Contents

1 Introduction

Contents

1.1 Application

The peripheral element AI-5313/TPSX05 is used in automation units of the system SICAM BC. It is deployed in the field of telecontrol and automation. The peripheral element is used for direct acquisition of transformer voltages and currents, as well as for the calculation of derivable values thereof.

System element type	Peripheral element
consists of	Module AI-5313 with firmware TPSX05
can be used in	SICAM BC
Engineering	SICAM TOOLBOX II with OPM II

1.2 Overview

Peripheral element for direct transformer input

- 3 current transformer inputs
  - Nominal current 6 A max. with 100% overrange
- 4 voltage transformer inputs
  - Nominal voltage 230 V max. with 50% overrange
- Nominal frequency 16⅔, 50 or 60 Hz
- Calculation of the r.m.s. values
  - Currents
  - Phase and phase-to-phase voltages
- Calculation of
  - Frequency
  - Active and reactive power, and power factor
- Synchrocheck
  - 2 1-pole relay outputs
  - Signal voltage 24 to 220 VDC, 400 VAC
- Acquisition and processing according to IEC 60870-5-101/104

1.3 Architecture

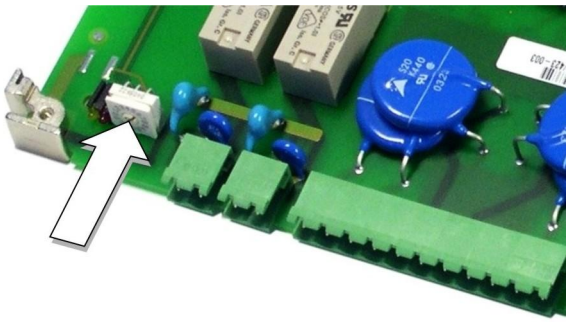
1.3.1 Mechanics

Module in double-euro format for equipping in a mounting rack.

1.3.2 Ax 1703 Peripheral Bus

The peripheral element is coupled to the basic system element via the Ax 1703 peripheral bus. The address of the peripheral element at the Ax 1703 peripheral bus is already specified during the assembly of the SICAM BC system.

This address can be changed afterwards also by a configuration change with the SICAM TOOLBOX II. This address is then to be set by means of the PBA switch (⇧) on the peripheral element.



2 Peripheral Element AI-5313/TPSX05

Contents

2.1 Features and Functions

Acquisition Functions

- **Transformer currents**
  - Acquisition of currents through direct transformers, up to the 8th harmonic using Fourier Analysis, signal scanning 256 times per period
  - Measuring range: 1 A, 2 A, 5 A or 6 A (0.5…6 A) with 100% overrange and a 16 bit resolution
  - Calculation of r.m.s. values by a digital signal processor,
  - Revision
- **Transformer voltages**
  - Acquisition of voltages through direct transformers, up to the 8th harmonic using Fourier Analysis *), signal scanning 256 times per period
  - Wiring of phase voltages or phase-to-phase voltages to voltage inputs *)
  - Measuring range: 230 V, 110 V or 110 V/√3 (10…230 V) with 50% overrange and a 16 bit resolution
  - Calculation of r.m.s. values by a digital signal processor
  - Messages of voltage transformer MCB's are considered
  - Revision
- **Frequency**
  - Acquisition of frequency using signal zero crossing of a selectable transformer input (voltage, current)
  - Failure strategy can use other transformer inputs
  - Measuring range: nominal frequency ±15% for selectable nominal frequencies of 16⅔ Hz, 50 Hz, and 60 Hz, with a resolution of 1 mHz
  - Revision

*) dependent on the assignment of the voltage transformer inputs
(see 2.2.1, Calculation Functions)

t **Telecontrol**
the function affects process information which is **spontaneously** transmitted

a **Automation**
the function affects process information which is **periodically** transmitted

c **Calculation**
the function affects process information which is used as input for the calculation of calculated (derived) values

Calculation Functions

- **Calculation of Values from Acquired Values**

  Processing grid 60 ms (16⅔ Hz), 20 ms (50 Hz), 16,67 ms (60 Hz)

  - Current r.m.s. value I1 *tac*, I2 *tc*, I3 *tc*
  - Phase voltage r.m.s. value U1 *tac*, U2 *tc*, U3 *tc* *)
  - Phase-to-phase voltage r.m.s. value U12 *tac*, U23 *tc*, U31 *tc* *)
  - Voltage r.m.s. value U4 *tac* *)
  - Frequency instantaneous value *tac*
  - Frequency mean value *tc*
  - Frequency difference *tac* *)
    - Voltage U4 ⇔ one phase voltage or phase-to-phase voltage

Voltage and current r.m.s. values undergo a linear (technological) adaption *tac* and are the base for calculating further values

- Zero current r.m.s. value I0 *t*
- Zero voltage r.m.s. value U0 *t* *)
- Active power P1 *ta*, P2 *t*, P3 *t*
  - 1-, 2- or 3-wattmeter method *)
- Reactive power Q1 *ta*, Q2 *t*, Q3 *t*
  - 1-, 2- or 3-wattmeter method *)
- Power factor 1 *ta*, 2 *t*, 3 *t*
- Voltage difference r.m.s. value *)
- Phase difference *ta* *)

To calculated values the following functions are applied:

- Revision *tac*
- Smoothing *t*
- Format conversion *t*
  - Normalized, technologically scaled or short floating point
  - Suppression of zero range
- Change monitoring *t*
- Sspontaneous transmission of changes *t*
- Periodical transmission of selected values *a*

*) dependent on the assignment of the voltage transformer inputs (see 2.2.1, Calculation Functions)

Dedicated Functions

- **Synchro-check** *)
  - Determines the synchronity of two systems
  - Messages of voltage transformer MCB's are considered
  - Cold load pickup (4 sets of parameters)
  - Connecting de-energized lines to the system is supported
  - Creates the signal *Synchrocheck OK* [a]

*) dependent on the assignment of the voltage transformer inputs (see 2.2.1, Calculation Functions)

Output Functions

- **Output of Messages or Signals**
  - Output (optionally settable by means of parameter):
    - of the message
    - of the signal *Synchrocheck OK* *)
    - of both, logically ANDed
    - of both, logically ORed
  - Periodical transmission of the message [a]

*) dependent on the assignment of the voltage transformer inputs (see 2.2.1, Calculation Functions)

Note

The above mentioned functions are described in detail in the document *SICAM RTUs Common Functions Peripheral Elements according to IEC 60870-5-101/104*.

In the following section, features and functions and - if present - deviating and additional information to this document is listed.

2.1.1 Deviating and Additional Information

2.1.1.1 Transformer Currents

Functions and Features	Deviation / Remark
Number of current inputs	3
Measuring range	0.5…6 A +100% overrange
Sampling and resolution	256 times/period with 16 bits
Connection	External current transformers according to measuring range
Harmonic	25 by means of complex discrete Fourier transformation
Amplitude and phase correction	
Calculation of the effective values	In consideration of 25 harmonics
Linear adaptation	
Revision	
Smoothing	
Format conversion	
Zero range suppression	
Change monitoring	
Spontaneous information object	
Periodical information	Selected: see section 2.3, Datapoints
Calculation of the zero current	See Zero Current

2.1.1.1.1 Zero Current

Functions and Features	Deviation / Remark
Revision	
Smoothing	
Format conversion	
Zero range suppression	
Change monitoring	
Spontaneous information object	

2.1.1.2 Transformer Voltages

Functions and Features	Deviation / Remark
Number of current inputs	4
Measuring range	10…230 V +50% overrange
Sampling and resolution	256 times/period with 16 bits
Connection	External voltage transformers according to measuring range or directly
Harmonic	25 by means of complex discrete Fourier transformation
Circuitry of the voltage transformer inputs	
Amplitude and phase correction	
Calculation of the effective values	In consideration of 25 harmonics
Linear adaptation	
Revision	
Smoothing	
Format conversion	
Zero range suppression	
Change monitoring	
Spontaneous information object	
Periodical information	Selected: see section 2.3, Datapoints
Monitoring of the voltage transformer fuses	
Calculation of the phase-to-phase voltage	See Phase-to-Phase Voltages
Calculation of the phase voltages	See Phase Voltages
Calculation of the zero voltage	See Zero Voltage
Calculation of the voltage difference	See Voltage Difference
Calculation of the phase difference	See Phase Difference

2.1.1.2.1 Phase-to-Phase Voltages

Functions and Features	Deviation / Remark
Revision	
Smoothing	
Format conversion	
Zero range suppression	
Change monitoring	
Spontaneous information object	
Periodical information	Selected: see section 2.3, Datapoints

2.1.1.2.2 Phase Voltages

Functions and Features	Deviation / Remark
Revision	
Smoothing	
Format conversion	
Zero range suppression	
Change monitoring	
Spontaneous information object	
Periodical information	Selected: see section 2.3, Datapoints

2.1.1.2.3 Zero Voltage

Functions and Features	Deviation / Remark
Revision	
Smoothing	
Format conversion	
Zero range suppression	
Change monitoring	
Spontaneous information object	

2.1.1.2.4 Voltage Difference

Functions and Features	Deviation / Remark
Revision	
Smoothing	
Format conversion	
Change monitoring	
Spontaneous information object	

2.1.1.2.5 Phase Difference

Functions and Features	Deviation / Remark
Phase correction	
Plausibility check	
Revision	
Smoothing	
Format conversion	
Change monitoring	
Spontaneous information object	
Periodical information	

2.1.1.3 Frequency

Functions and Features	Deviation / Remark
Acquisition	Nominal frequency = 16⅔, 50, 60 Hz
Update of the signal sampling rate	
Failure strategy	
Measuring range	Nominal frequency ± 15%
Revision	
Plausibility check	
Smoothing	
Format conversion	
Change monitoring	
Spontaneous information object	
Periodical information	
Calculation of the frequency difference	See Frequency Difference

2.1.1.3.1 Frequency Difference

Functions and Features	Deviation / Remark
Revision	
Plausibility check	
Smoothing	
Format conversion	
Change monitoring	
Spontaneous information object	
Periodical information	

2.1.1.4 Active and Reactive Power

Functions and Features	Deviation / Remark
Power calculation according to 1 or 2 or 3 wattmeter method	In consideration of 25 harmonics
Revision	
Smoothing	
Format conversion	
Zero range suppression	
Change monitoring	
Spontaneous information object	
Periodical information	Selected: see section 2.3, Datapoints
Calculation of the power factor	See Power Factor

2.1.1.4.1 Power Factor

Functions and Features	Deviation / Remark
Revision	
Smoothing	
Format conversion	
Change monitoring	
Spontaneous information object	
Periodical information	Selected: see section 2.3, Datapoints

2.1.1.5 Synchro-Check

Functions and Features	Deviation / Remark
Revision	
Determination of the synchronicity	
Generation signal "Synchrocheck ok"	
Periodical information	
Relay output	2-pole activation
Synchronoscope	
Switchover of the parameters	
Connect a de-energized line	

2.2 Details Regarding Selected Functions

2.2.1 Calculation Functions

Dependency of Functions on the Assignment to Voltage Transformer Inputs:

Function	Y U1-3/ Y U4 [1]	Y U1-3/ △U4 [2]	△U1-3/ Y U4 [3]	△U1-3/ △U4 [4]
Calculation of phase-to-phase voltages U12, U23, U31	✓	✓	-	-
Calculation of the zero voltage U0	✓	✓	-	-
Calculation of the frequency difference	✓	✓	-	✓
Calculation of the voltage difference	✓	✓ [5]	-	✓
Calculation of the phase difference	✓	✓	-	✓
Synchro-check	✓	✓	-	✓
Calculation of power using 1-wattmeter method	✓	✓	-	-
Calculation of power using 2-wattmeter method	✓	✓ [5]	✓	✓
Calculation of power using 3-wattmeter method	✓	✓	-	-

[1] phase voltages assigned to U1, U2, U3 and U4

[2] phase voltages assigned to U1, U2, U3; phase-to-phase voltage assigned to U4

[3] phase-to-phase voltages assigned to U1, U2, U3; phase voltage assigned to U4

[4] phase-to-phase voltages assigned to U1, U2, U3 and U4

[5] the usage of the phase-to-phase voltages must be enabled

2.2.2 Synchro-Check

The function *Synchro-Check* decides, whether the systems are synchronous, and as the result, creates the signal *Synchro-Check OK*.

The signal *Synchro-Check OK* can

- be logically combined with two items of periodical information and be output through both relays of the system element
- be made available as periodical information to the application program of the *Open/Closed-Loop Control Function*

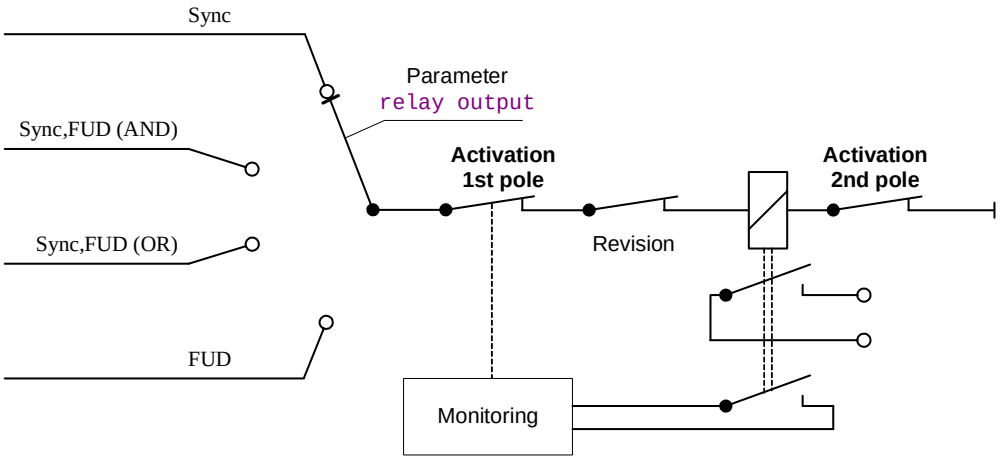
For project specific or market segment specific applications, the function *Synchro-Check* can help to accomplish:

- providing an enable signal to an external automation equipment or to the application program of the *Open-/Closed-Loop Control Function*
- support for switching-on a circuit breaker using DO-5212/PCCO55automatically starting up a generating unit and connecting it synchronously to the system

2.2.3 Output of Messages or Signals

The firmware can activate two relays. Via the parameter `relay output` can be selected wherewith the respective relay is activated. By means of

- the function *Synchro-Check*
- the function diagram
- the function *Synchro-Check*, the function diagram (logically AND)
- the function *Synchro-Check*, the function diagram (logically OR)



If the firmware is switched to revision, the relays are terminated.

Both relays are activated independently from each other. Each relay has two contacts, whereby the second is used for read back and thus a recognition of a welted contact is possible. If the read back signals an error on a relay, the relay output (for both relays) is closed by firmware, a relay selective diagnostic is set and possibly active outputs are terminated.

If a welted contact should separate independently (excluded in practice), this is not recognized.

The firmware examines already during startup both relays for a welted contact.

If both relays are defective, in the diagnosis only relay 1 is indicated as defective.

2.3 Datapoints

2.3.1 Input Data Periodical

Information	Format
User data invalid	
Board failure	
Factory calibration Bit 0	
Factory calibration Bit 1	
Factory calibration Bit 2	
Start factory calibration	
Output relay OUT D00	
Output relay OUT D10	

2.3.2 Output Data Periodical

Binary Data

Information	Format
User data invalid	
Board failed	
Factory adjustment running	
Voltage x too high	
Voltage x too low	
Frequency x too high	
Frequency x too low	
Phase x too far advanced	
Phase x too far lagging	
Current I1 faulty	
Phase voltage U1 faulty	
Phase-to-phase voltage U12 faulty	
Voltage U4 faulty	
Active power P1 faulty	
Reactive power Q1 faulty	
Power factor 1 faulty	
Frequency difference faulty	
Phase difference faulty	
Frequency instant. value faulty	
Synchro-check ok	

Analog Data

Information	Format	Unit	Resol.
Current I1	Measured value, short floating-point	A	
Phase voltage U1	Measured value, short floating-point	kV	
Voltage U4	Measured value, short floating-point	kV	
Phase-to-phase voltage U12	Measured value, short floating-point	kV	
Active power P1 (P)	Measured value, short floating-point	MVA	
Reactive power Q1 (Q)	Measured value, short floating-point	MVar	
Power factor 1 (power factor)	Measured value, short floating-point	1	
Frequency difference	Measured value, short floating-point	Hz	
Phase difference	Measured value, short floating-point	°	
Frequency instantaneous value	Measured value, short floating-point	Hz	

2.3.3 Input Data Spontaneous

Information	Format
Revision	Single-point information
Synchr. disable Ux zero	Single-point information
Synchr. disable U4 zero	Single-point information
VT U1 U2 U3 nok	Single-point information
VT U4 nok	Single-point information
Synchroch. param.bank 0 select.	Single command
Synchroch. param.bank 1 select.	Single command
Synchroch. param.bank 2 select.	Single command
Synchroch. param.bank 3 select.	Single command

2.3.4 Output Data Spontaneous

Measurement and Synchronization

Information	Format	Unit	Resol.
Synchr. Ux zero active	Single-point information	-	-
Synchr. U4 zero active	Single-point information	-	-
Synchr. param.bank 0 active	Single-point information	-	-
Synchr. param.bank 1 active	Single-point information	-	-
Synchr. param.bank 2 active	Single-point information	-	-
Synchr. param.bank 3 active	Single-point information	-	-

Information	Format	Unit	Resol.
Current I1 ($I1_{eff}$)	Measured value, floating-point	A	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	A	1 A
Current I2 ($I2_{eff}$)	Measured value, floating-point	A	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	A	1 A
Current I3 ($I3_{eff}$)	Measured value, floating-point	A	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	A	1 A
Zero current I0 ($I0_{eff}$)	Measured value, floating-point	A	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	A	1 A
Phase voltage U1 ($U1_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Phase voltage U2 ($U2_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Phase voltage U3 ($U3_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Phase voltage U4 ($U4_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Zero voltage U0 ($U0_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Phase-to-phase voltage U12 ($U12_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Phase-to-phase voltage U31 ($U31_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Phase-to-phase voltage U23 ($U23_{eff}$)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Frequency mean value	Measured value, floating-point	Hz	1 mHz
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-2} Hz	10 mHz
Frequency instantaneous value	Measured value, floating-point	Hz	1 mHz
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-2} Hz	10 mHz

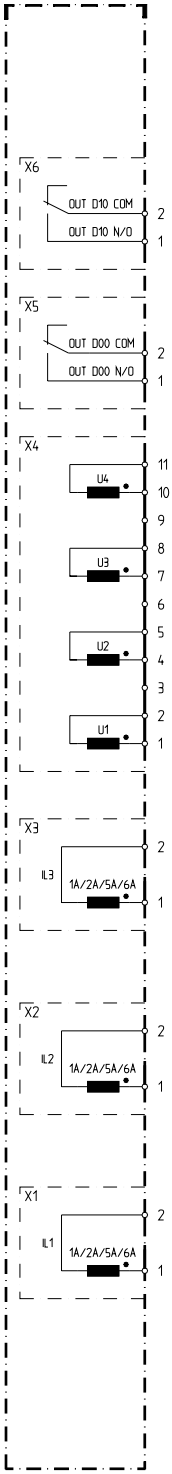
Information	Format	Unit	Resol.
Active power P1 (P)	Measured value, floating-point	MW	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	MW	1 MW
Active power P2	Measured value, floating-point	MW	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	MW	1 MW
Active power P3	Measured value, floating-point	MW	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	MW	1 MW
Reactive power Q1 (Q)	Measured value, floating-point	MVAr	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	MW	1 MW
Reactive power Q2	Measured value, floating-point	MVAr	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	MW	1 MW
Reactive power Q3	Measured value, floating-point	MVAr	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	MW	1 MW
Power factor 1 (power factor)	Measured value, floating-point	1	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-3}	10^{-3}
Power factor 2	Measured value, floating-point	1	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-3}	10^{-3}
Power factor 3	Measured value, floating-point	1	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-3}	10^{-3}
Voltage difference (Ux - U4)	Measured value, floating-point	kV	
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-1} kV	0,1 kV
Frequency difference (fUx – fU4)	Measured value, floating-point	Hz	1 mHz
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	mHz	1 mHz
Phase difference (φUx - φU4)	Measured value, floating-point	°	0,01125°
	Measured value 15 bits + sign normalized	1	
	Measured value 15 bits + sign scaled	10^{-2}°	0,01125°

x = 1, 2, 3 … parameter-settable

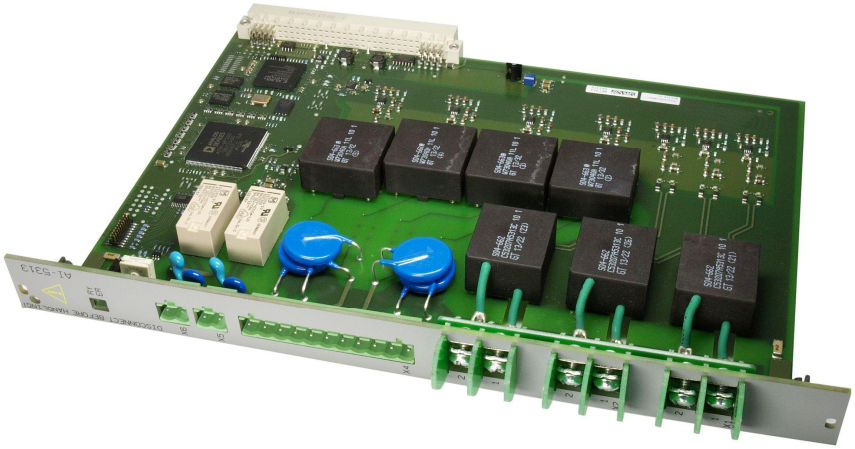
2.4 Engineering

For diagnosis, testing, parameter setting or documentation, the system element is supported by the engineering tools of SICAM TOOLBOX II. OPM II is required.

2.5 Block Diagram

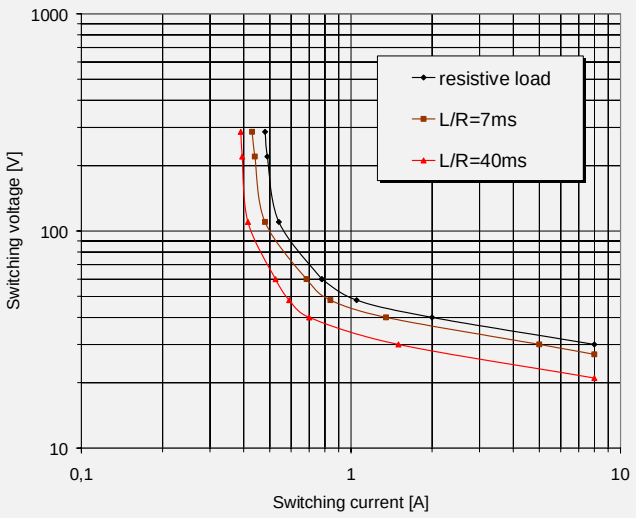


2.6 View



2.7 Technical Data

Processor and Memory		
Processor	BF531	
Clock pulse	Fclkin = 32 MHz, Fcore = 400 MHz, Fsys = 133.3 MHz	
Program memory	SPI Flash 128 Mbit	
Main memory	SDRAM 16 MByte	
Parameter memory	Within the program memory	
Inputs for Transformer Currents		
3 current inputs (X1, X2, X3)	The current inputs are galvanically insulated by transformers, from each other, from the voltage inputs, and from logic circuits	
Nominal current I_N	1 A / 2 A / 5 A / 6 A (settable)	
Max. measurement current	200% I_N	
Nominal frequency f_N	50 Hz, 60 Hz, 16⅔ Hz (settable)	
Resolution	16 Bit	
Scanning	256 values per system period	
Thermal withstand capability	25 A 500 A 1250 A	continuously 1 s 1 half-period
Intrinsic consumption	< 0.1 VA < 0.2 VA	at I_N = 1 A at I_N = 5 A
Inputs for Transformer Voltages		
4 voltage inputs (X4)	The voltage inputs are galvanically insulated by transformers, from each other, from the current inputs, and from logic circuits	
Nominal voltage U_N	230 V, 110 V, 110 V/√3 (settable)	
Max. measuring voltage	150% U_N	
Nominal frequency f_N	50 Hz, 60 Hz, 16⅔ Hz (settable)	
Resolution	16 Bit	
Scanning	256 values per system period	
Thermal withstand capability	440 V	continuously
Intrinsic consumption	< 0.11VA < 0.48VA < 0.04VA	at U_N = 110V at U_N = 230V at U_N = 110V/√3

Binary outputs	
2 outputs (relay) (X5, X6)	• The outputs are galvanically insulated from logic circuits and ground by monostable relays • 2 contacts (make contact) each – 1 contact is used for reading back the relay activation – recognition of contact welding • By means of 2-pole activation of the relays a single error does not lead to activation
Fault behavior	Command termination resp. command disable
Check	Activation of the relay winding by means of reading back the respective second contact
Switching cycles	10^5 AC 220 V (≤ 8 A) @ cos φ = 1 • 5 x 10^4 DC acc. to DC Load Limit Curve
Electric strength with open contacts	• 1.0 kV AC or DC for 1 min
Maximum switching current	• 8 A AC or DC (input and output current)
Maximum switching voltage (output circuits)	• 220 V DC + 5% • 400 V AC + 10% The circuits are operated by means of external voltage
Minimum switching capacity	• 1 mW
Maximum switching capacity (switch-on and switch-off)	• AC: 4000 VA @ cos φ = 1 • DC: acc. to DC Load Limit Curve 
Power supply	
Operating voltage	4.75…5.25 VDC power consumption: typ. 2 W, max. 2.5 W The voltage is picked off from the bus of the mounting rack

Mechanics and connectors	
Ax 1703 peripheral bus	Transmission rate 16 Mbps
Bus connector X99 (backside)	VG strip, 96-pole (DIN 41612), design C (partially equipped)
3 peripheral connectors X1 to X3 (front side)	M4 screw terminals for fork type or ring type cable connections 3x transformer current input (2-pole each)
1 peripheral connector X4 (front side)	Plug terminal (11-pole) for screw connection, COMBICON RM 5.08 4x transformer voltage input (2-pole each)
2 peripheral connectors X5, X6 (front side)	Plug terminal for screw connection, COMBICON RM 5.08 2x digital relay output (2-pole each)
Dimensions	Double-euro format 233.4 x 160 mm, 4WU
Weight	Approx. 380 g

2.8 Acquired and Calculated Values

Current r.m.s. values		
Calculation	up to the 25th harmonic, by means of Fourier Analysis	
Accuracy under reference conditions 3x current (r.m.s. value) 1x zero current (r.m.s. value)	 class 0.2 class 0.5	
Reference conditions		
Reference factor	**Reference value**	
Ambient temperature	23°C ± 2°C	
Frequency	F_N ± 2%	
Input current	I_N ± 2%, sine alike with form factor 1.1107	
Warm-up time	≥ 15 minutes	
Other	IEC 60688	
Influencing factor		
Influencing value	**Nominal range of use**	**Additional error through influencing effects** *)
Ambient temperature	-25°C .. 23°C .. 70°C	-
Curve form of the input current	Rectangular 1:1	2.5%
	Sine phase control α=90°	2.5%
Other	IEC 60688	IEC 60688

*) Error to be added to accuracy under reference conditions

Voltage R.M.S. Values		
Calculation	up to the 8th harmonic, by means of Fourier Analysis	
Accuracy under reference conditions 7x voltage (r.m.s. value) 1x voltage difference 1x zero voltage (r.m.s. value)	 class 0.2 class 0.5 class 0.5	
Reference conditions		
Reference factor	**Reference value**	
Ambient temperature	23°C ± 2°C	
Frequency	F_N ± 2%	
Input voltage	U_N ± 2%, sine alike with form factor 1.1107	
Warm-up time	≥ 15 minutes	
Other	IEC 60688	
Influencing factor		
Influencing value	**Nominal range of use**	**Additional error through influencing effects** *)
Ambient temperature	-25°C .. 23°C .. 70°C	-
Curve form of the input voltage	Rectangular 1:1	1.5%
	Sine phase control α=90°	2.5%
Other	IEC 60688	IEC 60688

*) Error to be added to accuracy under reference conditions

Active and Reactive Power		
Calculation	up to the 25th harmonic, by means of Fourier Analysis	
Accuracy under reference conditions: 3 reactive power 3x power factor	 class 0.5 class 0.5	
Reference conditions		
Reference factor	**Reference value**	
Ambient temperature	23°C ± 2°C	
Frequency	F_N ± 2%	
Input voltage	U_N ± 2%, sine alike with form factor 1.1107	
Input current	I_N ± 2%, sine alike with form factor 1.1107	
Warm-up time	≥ 15 minutes	
Other	IEC 60688	
Influencing factor		
Influencing value	**Nominal range of use**	**Additional error through influencing effects** *)
Ambient temperature	-25°C .. 23°C .. 70°C	-
Curve form of the input voltage	Rectangular 1:1	2.5%
	Sine phase control α=90°	2.5%
Other	IEC 60688	IEC 60688

*) Error to be added to accuracy under reference conditions

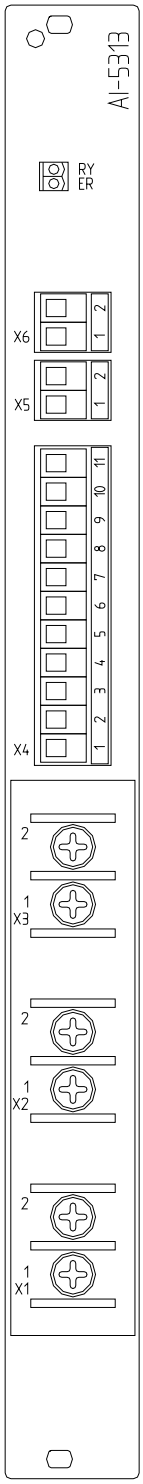
Phase Angle		
Calculation	only fundamental wave, by means of Fourier Analysis (DFT)	
Accuracy under reference conditions	class 0.5°	
Reference conditions		
Reference factor	**Reference value**	
Ambient temperature	23°C ± 2°C	
Frequency	F_N ± 2%	
Input voltage	U_N ± 2%, sine alike with form factor 1.1107	
Input current	I_N ± 2%, sine alike with form factor 1.1107	
Warm-up time	≥ 15 minutes	
Other	IEC 60688	
Influencing factor		
Influencing value	**Nominal range of use**	**Additional error through influencing effects** *)
Ambient temperature	-25°C .. 23°C .. 70°C	-
Other	IEC 60688	IEC 60688

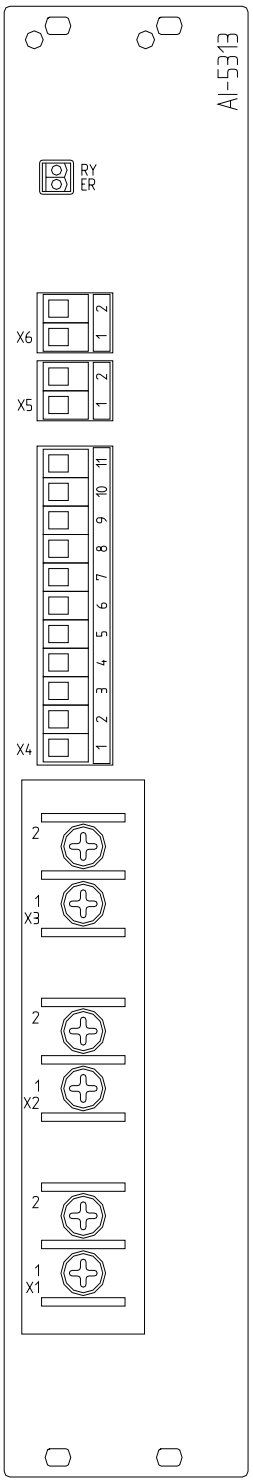
*) Error to be added to accuracy under reference conditions

Frequency		
Calculation	Via the zero crossing of the signal to a current or voltage input	
Resolution	1 mHz	
Accuracy under reference conditions	• 1 mHz for frequency mean value • 5 mHz for frequency instantaneous value	
Accuracy at 10% signal proportion of 25 Hz or higher harmonic	• 5 mHz for frequency mean value • 20 mHz for frequency instantaneous value	
Reference conditions		
Reference factor	**Reference value**	
Ambient temperature	23°C ± 2°C	
Frequency	F_N ± 2%	
Curve form on the used current or voltage input	I_N or U_N sinusoidal, distortion by means of harmonic with up to 100% permitted	
Warm-up time	≥ 15 minutes	
Other	DIN IEC 60688	
Influencing factor		
Influencing value	**Nominal range of use**	**Additional error through influencing effects** *)
Ambient temperature	-25°C .. 23°C .. 70°C	-
Other	DIN IEC 60688	DIN IEC 60688

*) Error to be added to accuracy under reference conditions

2.9 Front Panel





Variant used if module is installed on slot 1 of SICAM BC/C

Meaning of the Display elements:

RY Module operational
ER Error

2.10 Pin Assignment

The peripheral connectors are assigned according to the following tables.

X6:

pin	signal
2	OUT D10 COM
1	OUT D10 N/O

X3:

pin	signal
2	I3b
1	I3a

X5:

pin	signal
2	OUT D00 COM
1	OUT D00 N/O

X2:

pin	signal
2	I2b
1	I2a

X4:

pin	signal
11	U4b
10	U4a
9	N.C.
8	U3b
7	U3a
6	N.C.
5	U2b
4	U2a
3	N.C.
2	U1b
1	U1a

X1:

pin	signal
2	I1b
1	I1a

The abbreviations have the following meaning:

I1a ... I3a . . . . . current input, terminal a (k)
I1b ... I3b . . . . . current input, terminal b (l)
U1a ... U4a . . . . . voltage input, terminal a
U1b ... U4b . . . . . voltage input, terminal b

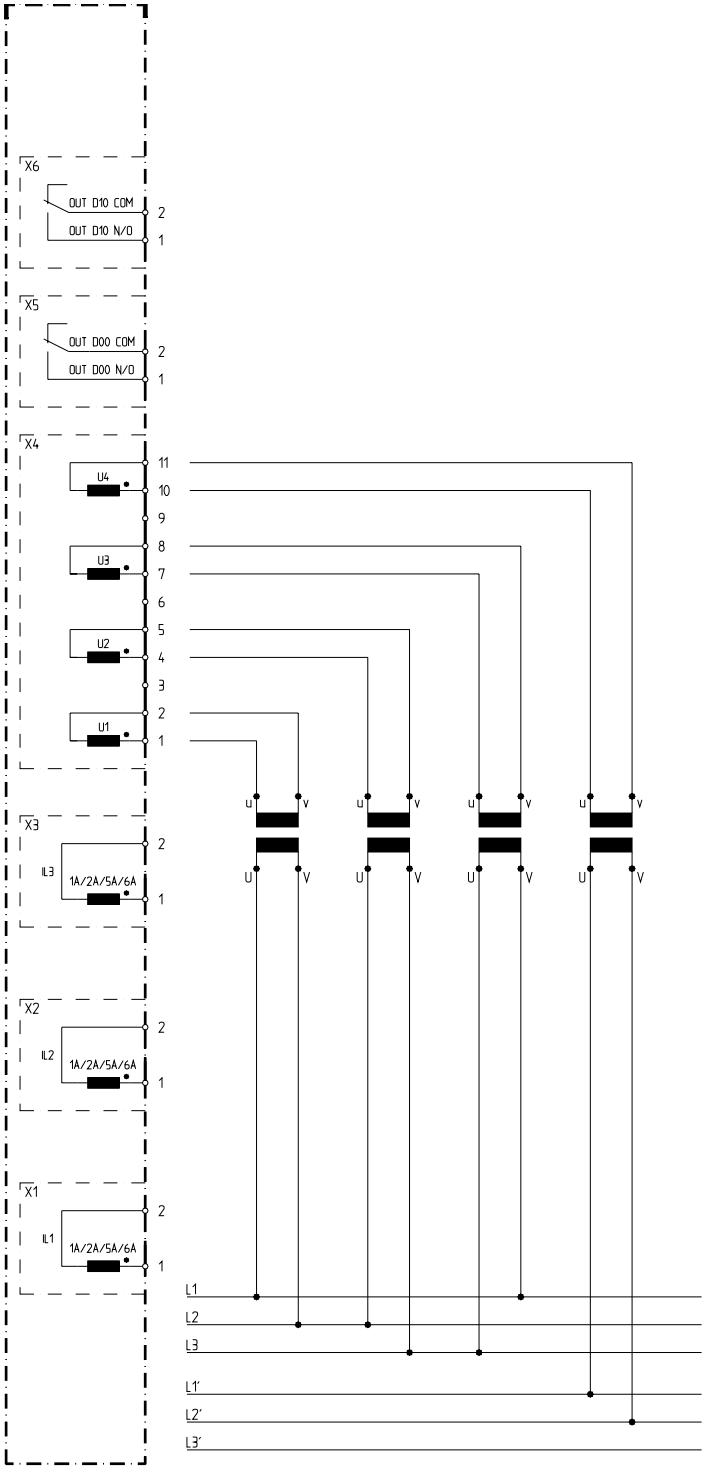
OUT D00_N/O . . . . . 1. relay synchro check, normally open con
OUT D00_COM . . . . . 1. relay synchro check, common contact
OUT D10_N/O . . . . . 2. relay synchro check, normally open cor
OUT D10_COM . . . . . 2. relay synchro check, common contact

N.C . . . . . not used

2.11 External Circuitry

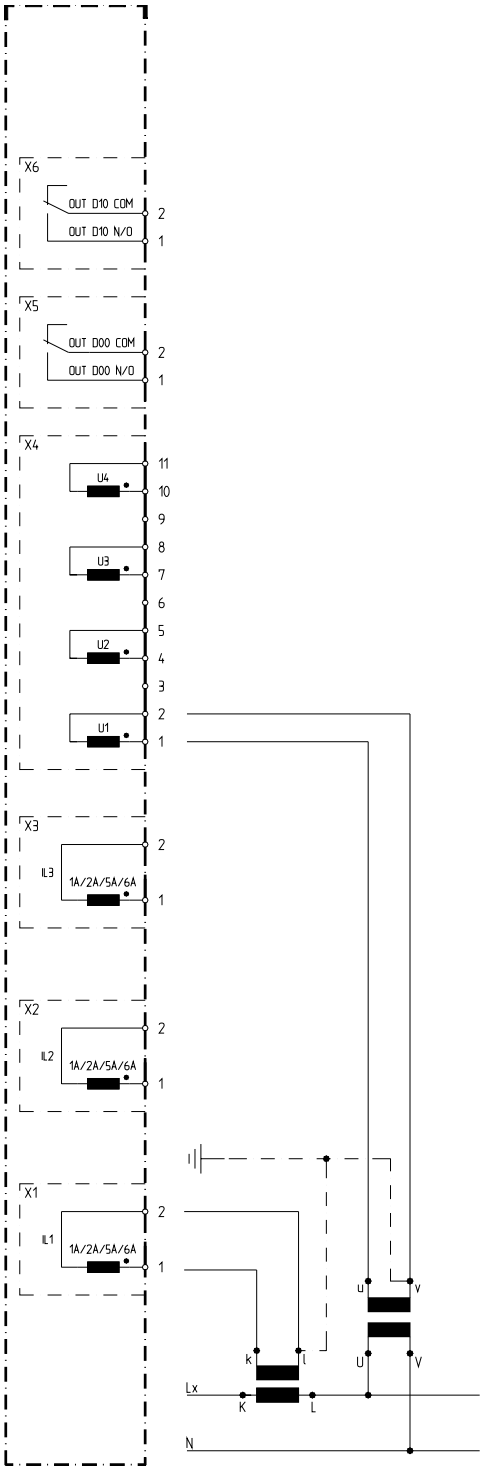
2.11.1 Circuitry with Phase-to-Phase Voltages

Connection via 3 respectively 4 voltage transformers.



2.11.2 Circuitry for 1-Wattmeter method

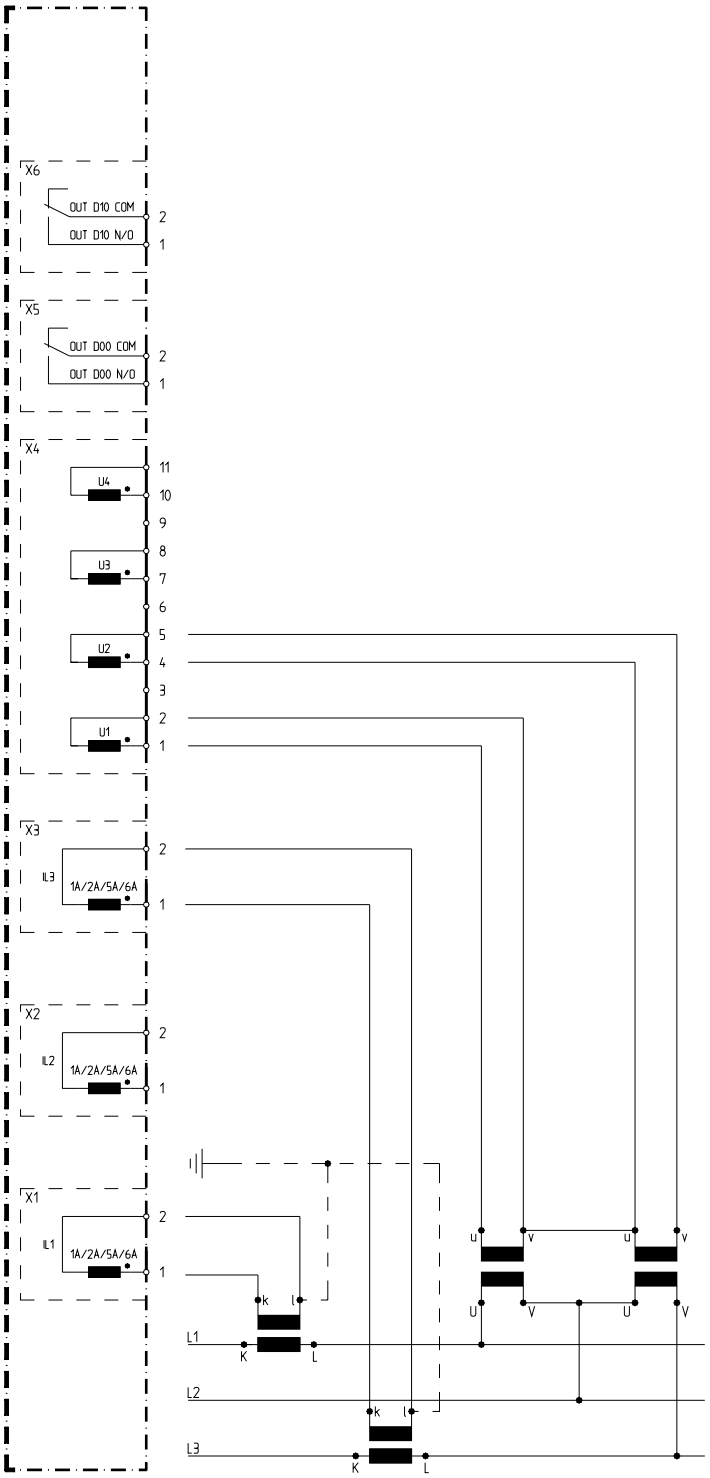
Measurement on single phase alternating current, connection via 1 current and 1 voltage transformer.



The system element can also be used for single-phase measurement in three different feeders (or components) of the same three-phase current system. In this case the same wiring principle is used in each feeder. Then the power calculation takes place 3 times according to the 1-wattmeter method.

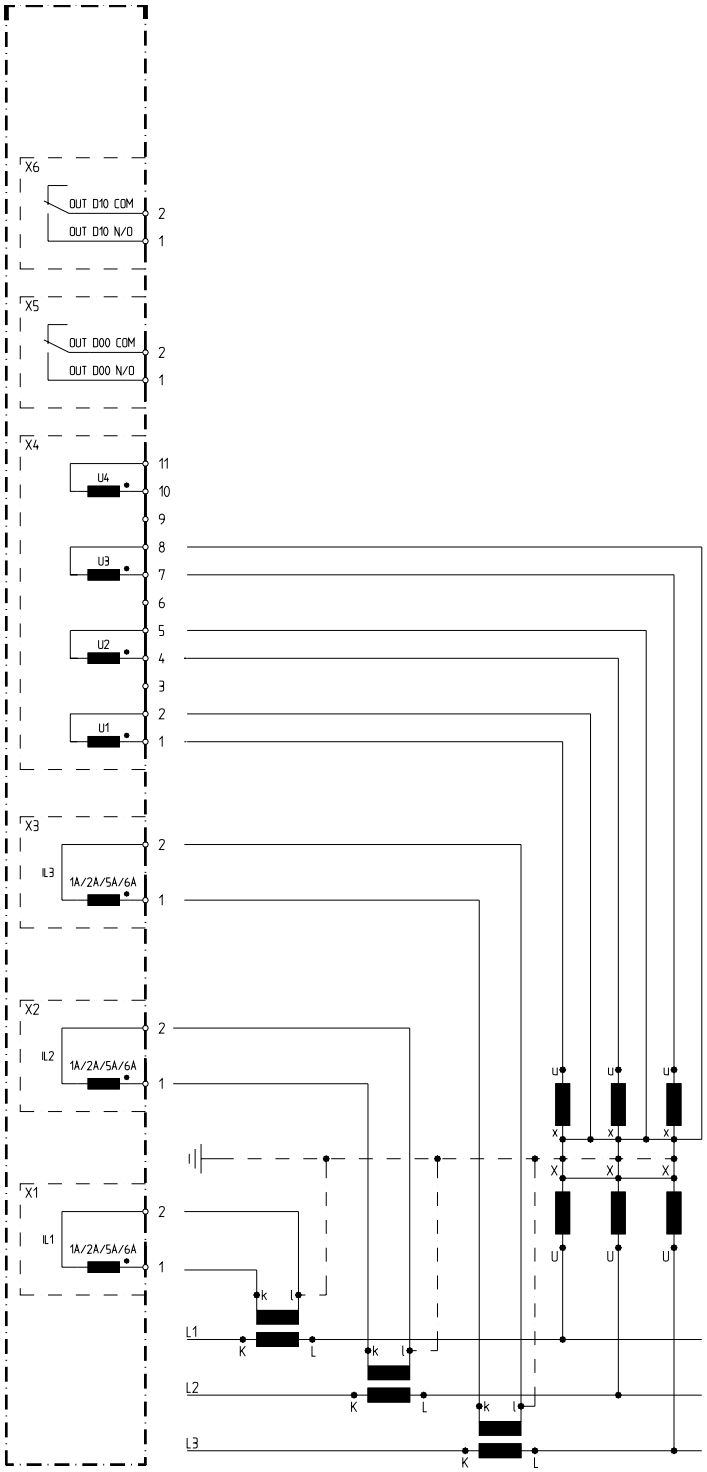
2.11.3 Circuitry for 2-Wattmeter method

Measurement in three-phase current system (unequally loaded), connection via 2 current and 2 voltage transformers.



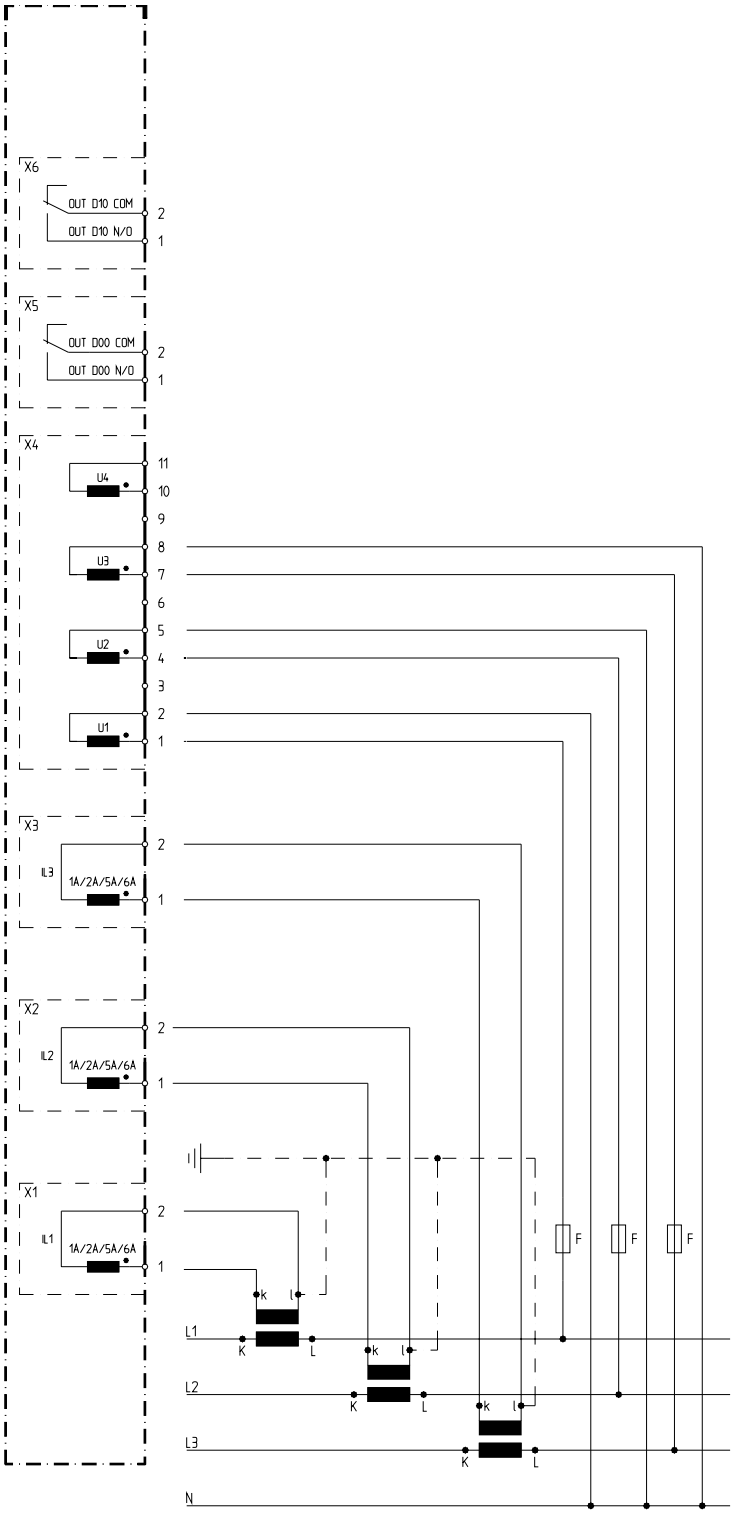
2.11.4 Circuitry for 3-Wattmeter method

Measurement in three-phase current system, connection via 3 current transformers and 3 unipolar isolated voltage transformers.



2.11.5 Circuitry in the Low Voltage

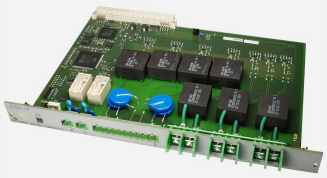
Measurement of the low voltage, connection via 3 current transformer and direct connection of the phase voltages and neutral conductor.



A Order Information

Contents

A.1 System Element

	Designation	Item Number/MLFB
	AI-5313/TPSX05 Direct Transformer Input (4x 220 V, 3x 6 A)	BC5-313 6MF10130FD031AA0