Power Quality Interface for Low-, Medium- and High- Voltage Networks
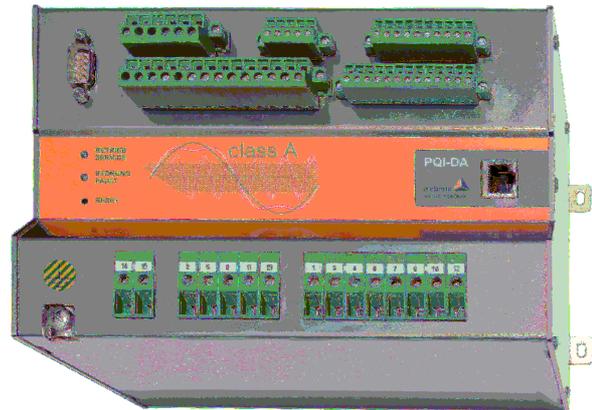
Type PQI-DA

▶ **As wall mounted housing**

▶ **As DIN rail mounted housing**

1. Application

The Power Quality-Interface for low-, medium- and high-voltage networks PQI-DA is the central component of a system, which executes all the measurement tasks in electrical networks.

The PQI-DA can be used both as Power Quality-Interface according DIN EN 50160 and as measuring device for all physically defined measured variables in three-phase systems.

The unit is mainly adapted for monitoring and recording certain supply qualities or quality objectives between utility and customer and, furthermore to provide the data for evaluation and storage.

Modern voltage-quality measurement devices operate according to IEC 61000-4-30. This standard defines measuring methods in order to establish a comparable basis for the user.

Devices from different manufacturers, operating according to this standard, have to provide approximately the same measurement results.

The standard distinguishes between two classes of measurement devices.

● Class A measurement devices are mainly used for contractual measurements in customer-supplier relations,

● Class B measurement devices can be used to determine statistical quality values.
  For measurements according to EN50160 a class B device is sufficient.

For the following parameters PQI-DA fulfills the requirements of IEC 61000-4-30 for class A devices.

Parameter	Class
Accuracy of voltage measurement	A
Determination of time intervals	A
Marking of measured values at events	A
Harmonics, interharmonics	A
Frequency	A
Voltage asymmetry	A
Event recording	A
Time synchronization	A (with DCF77 or GPS)

In addition, three different fault recorders can be used.

The oscilloscope recorder collects fault records consisting of 100 µs-sampling values whose length (pre-event and post-event history) is freely selectable.

The r.m.s. recorder collects fault records consisting of r.m.s. values of half-period values (10ms). The length

of the fault record (pre-event and post-event history) is also freely selectable.

When exceeding a limiting value (harmonic or THD of a voltage), the harmonic recorder registers the corresponding spectrum of all harmonics from 2nd to 50th harmonic.

All fault records are triggered by a freely definable event. Phase-phase and phase-earth events can be recorded simultaneously.

The signal-voltage-recorder registers a freely adjustable frequency (e.g. ripple control frequency) over a period that can be selected.

Limit violations can be signalled via relays, if required.

On the input-side (U, I) the interface is available in different hardware-versions.

Current inputs are available for the measuring circuit (C20, C30) and for the protection circuit (C21, C31).

The following input characteristics can be selected:

- 8 voltage transformers for power-quality applications in double-busbar systems (code C10)
- 4 voltage transformers and 4 current transformers for power quality and general measuring tasks (code C20, C21, C30, C31)

Theoretically, up to 255 devices can be interlinked via the system bus (E-LAN). Even connections to devices of the voltage regulator system REGSys™, the Peterson-coil controller REG-DP, the earthfault detection system EORSys and the collapse prediction system CPSys are possible.

Each device offers two RS 232 interfaces (COM1 and COM2) and two E-LAN (Energy Local Area Network) interfaces.

Optional the PQI-DA can be equipped with an integrated TCP/IP-interface. In this case COM 2 is not available.

Possible firmware-updates can be easily made via a pushbutton, prevented against unintentional touch.

1.1 Features of the Power-Quality-Interface PQI-DA

- Recording of the voltage quality according to DIN EN 50160
- Class A device according to IEC 61000-4-30
- Sampling frequency 10,24 kHz
- Fault recording function up to 20 x In
- Phase-phase and phase-earth measurements are possible simultaneously
- Voltage measurement channels for U12, U23, U31, UNE
- Measurement of currents I1, I2, I3, I0
- Acquisition of more than 3000 measured values
- Freely programmable limiting values and output via insulated contacts.
- Freely programmable binary inputs to start or stop measurements
- Data analysis via WinPQ software, using a mySQL-supported database
- Version with integrated TCP/IP-interface available
- Connection to SCADA according IEC 870-5-101
- Connection to SCADA according IEC 61850 in preparation

1.2 Description
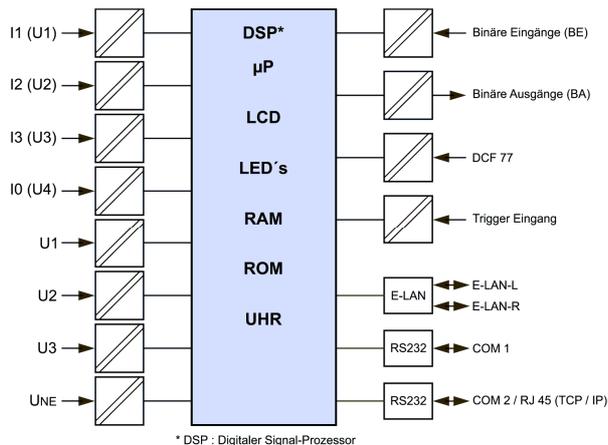
Function of Power Quality-Interfaces

2. Technical Data

Standards

IEC 61010-1	/ DIN EN 61010-1
IEC 60255-4	/ DIN EN 60255-4
IEC 61326-1	/ DIN EN 61326-1
IEC 60529	/ DIN EN 60529
IEC 60068-1	/ DIN EN 60068-1
IEC 60688	/ DIN EN 60688
IEC 61000-6-2	/ DIN EN 61000-6-2
IEC 61000-6-4	/ DIN EN 61000-6-4

$C\mkern-2mu E$

AC voltage inputs	
Measurement voltage U_E	$0\ V < 100\ V \leq 2 \cdot U_N$ (E1)[*] $0\ V < 230\ V \leq 2 \cdot U_N$ (E2)[*]
Waveform	Any
Frequency range of the fundamental wave	45....<u>50</u>....<u>60</u>....65 Hz
Integrated 4th order anti-aliasing filter (Limit frequency: 2,5kHz). Measurements up to the 50th harmonic are possible..	
Internal consumption	$\leq U^2 / 360\ k\Omega$ (E1) $\leq U^2 / 230\ k\Omega$ (E2)
Overload capacity	200 V continuous L-E (E1) 460 V continuous L-E (E2)

AC current inputs	
Measurement current In	1 A / 5 A
Measuring range − C20, C30 − C21, C31	 $0 \leq I \leq 2 \times In$ $0 \leq I \leq 20 \times In$
Waveform	any
Frequency range of the fundamental wave	45....<u>50</u>....<u>60</u>....65 Hz
Internal consumption	5 A : < 0,5 VA 1 A : < 0,1 VA
Overload capacity	10 A continuous 100 In for 1 s (max. 300 A) 30 In for 10 s 500 A for 5 ms

[*]) Note: Codes e.g. "E1, E2, C20, C31…"; see characteristics on page 13 and 14

Binary inputs (BI)	
Control signals U_{st}	In the range AC/DC 48 V...230 V
Waveform − H – Level − L – Level	Rectangular, sinusoidal ≥ 35 V < 20 V
Signal frequency	DC ... 60 Hz
Switching delay	Selectable from 1..999 s
Input resistance	108 kΩ
Electrical isolation	Optocoupler; always two earthed

Binary outputs (BO)	
Max. switching frequency	≤ 1 Hz
Electrical isolation	Isolated from all internally potentials

Binary outputs (BO)	
Type of relay	Changeover contact
— Status, R2, R3	Galvanically isolated from each other
— R4, R5	Earthed
Contact load	AC: 250 V, 5 A ($\cos\varphi = 1{,}0$) AC: 250 V, 3 A ($\cos\varphi = 0{,}4$) DC: 220 V, 150 W switching capacity
No. of switching operations	$\geq 1{\cdot}10^4$ electrical
LED-display	
— Operation	Green
— Error	Red

Limited value monitoring	
Limited values	Programmable
Response times	Programmable

Measurement quantities (selection from over 3000 measurement quantities)	
TRMS voltages	U_{1N}, U_{2N}, U_{3N}, U_{NE}, U_{12}, U_{23}, U_{31}
TRMS current	I_1, I_2, I_3, I_0
Active power	P_n
Reactive power	Q_n
Apparent power	S_n
Power factors	$\cos\varphi_n$
Harmonics U / I	up to the 50th.
Interharmonics	U / I
Frequency	f

Reference conditions	
Reference temperature	23°C ± 1 K
Input parameters	U_E = 90 ... 110V I_E = 0 ... 1A / 0 ... 5A
Auxiliary voltage	H = Hn ± 1 %

Reference conditions	
Frequency	50 Hz...60 Hz
Other	IEC 688 - Part 1

Transmission behaviour	
Error limit	(all errors related to Y2)
— Voltage:	0,1 %
— Current:	0,1 % (C20, C30) 0,5 % (C21, C31)
— Frequency:	0,01 % (d.h. @ 50 Hz $\Rightarrow$ 5 mHz)
— Powers and all other measurement quantities:	0,25 % (C20, C30) 1,0 % (C21, C31)
Measurement cycle times	10 ms / 200 ms
Sampling rate	10,24 kHz

Storage of measured values	
Permanent	3,64 MB
Volatile	48 MB

Electromagnetic Compatibility	
CE-conformity • Electromagnetic Immunity — EN 61326 — EN 61000-6-2 • Emitted interference — EN 61326 — EN 61000-6-4	
ESD — IEC 61000-4-2 — IEC 60 255-22-2	8 kV / 16 kV
Electromagnetic fields — IEC 61000-4-3 — IEC 60 255-22-3	10 V/m
Burst — IEC 61000-4-4 — IEC 60 255-22-4	4 kV / 2 kV
Surge 1 MHz Burst — IEC 61000-4-5	4 kV / 2 kV

Electromagnetic Compatibility	
− IEC 61000-4-12 − IEC 60 255-22-1	2,5 kV, class III
Conducted high frequency magnetic fields − IEC 61000-4-6 − IEC 61000-4-8 − All positions	10 V, 150 kHz ... 80 MHz 100 A/m continuous 1000 A/m 1 s
Voltage dips − IEC 61000-4-11	30 % 0,02s, 60 % 1 s
Emitted interference − EN 61326 − EN 61000-6-4 ● Housing At a distance of 10m	30...230 MHz, 40 dB 230...1000 MHz, 47 dB
● AC supply connection At a distance of 10m	0,15...0,5 MHz, 79 dB 0,5...5 MHz, 73 dB 5...30 MHz, 73 dB

Electrical safety	
Degree of protection	I
Degree of pollution	2
Measuring category	III / 300 V optional III / 500 V

Operating voltages	
50 V	**230 V**
E-LAN, COM-Server COM1 ... COM2 Time / Trigger-BUS	Auxiliary voltage Binary inputs Relay outputs

Power supply		
Feature	**H0**	**H1**
AC (internal)	-	-
AC	85...264 V	-
DC	88...280 V	18...72 V
Power consumption.	≤ 15 VA	≤ 15 Watt
Frequency	45...400Hz	-
Miniature fuse	T2 250 V	T2 250 V

The following applies to all features: Voltage interruptions ≤ 80 ms do not cause a fault or loss of data.

Test voltages		Uaux	COMs	BO	BI	U_E	I_E
Auxiliary voltage	Uaux	-	2,7	2,7	2,7	4,0	4,0
COM´s, E-LAN, Time-/Trigger-BUS	COMs	2,7	-	2,3	2,3	4,0	4,0
Binary outputs	BO	2,7	2,3	-	2,3	4,0	4,0
Binary inputs (250 V)	BI	2,7	2,3	2,3	-	4,0	4,0
Input voltage (E1, E2)	U_E	4,0	4,0	4,0	4,0	-	4,0
Input currents	I_E	4,0	4,0	4,0	4,0	4,0	-

Note: All test voltages are AC voltages in kV, which may be applied for 1 minute. COM1, COM2 are tested against each other with 0.5 kV.

Environmental conditions	
Temperature range	
– Function	-15 ... +55°C
– Transport and storage	-25 ... +65°C
Humidity	
– No condensation on 30 days/year	95 % rel.
Dry, cold	
– IEC 60068-2-1	-15°C / 16 h
Dry, hot	
– IEC 60068-2-2	+55°C / 16 h
Constant humid heat	+ 40 °C/93 % /
– IEC 60068-2-3	2 days
Cyclical humid heat	
– IEC 60068-2-30	12+12h, 6 cycles, +55°C/93%
Toppling	
– IEC 60068-2-31	100 mm drop unwrapped
Vibration	
– IEC 60255-21-1	Class 1
Impact	
– IEC 60255-21-2	Class 1

Data storage	
Device settings	Serial EEPROM with ≥ 1000 k read/write cycles
RAM - data	Li – battery laser-welded

# 3. Mechanical Design

3.1 Housing

The Power Quality-Interface PQI-DA is kept in a rugged stainless steel case.

All connections are accessible via Phoenix terminals. The connections are made in plug-in/clamping technology, except the current and voltage inputs.

If the option COM-Server (code T1) is selected, a RJ 45-connection is available.

The PQI-DA is applicable both as wall mountable as well as DIN rail mountable housing.
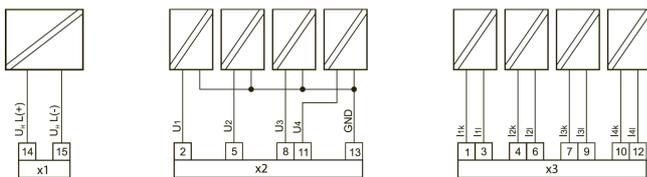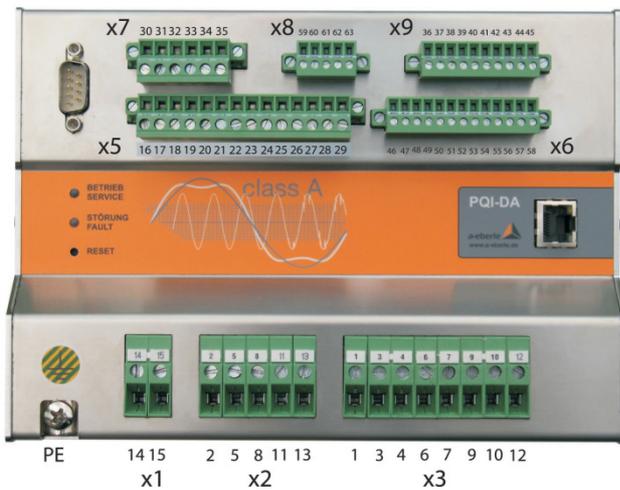
Material	Stainless steel
Degree of protection	
– Housing	IP 40
– Terminals	IP 20
Weight	≤ 2 kg
Dimensions	See fig. below
Connection elements	Screw terminals
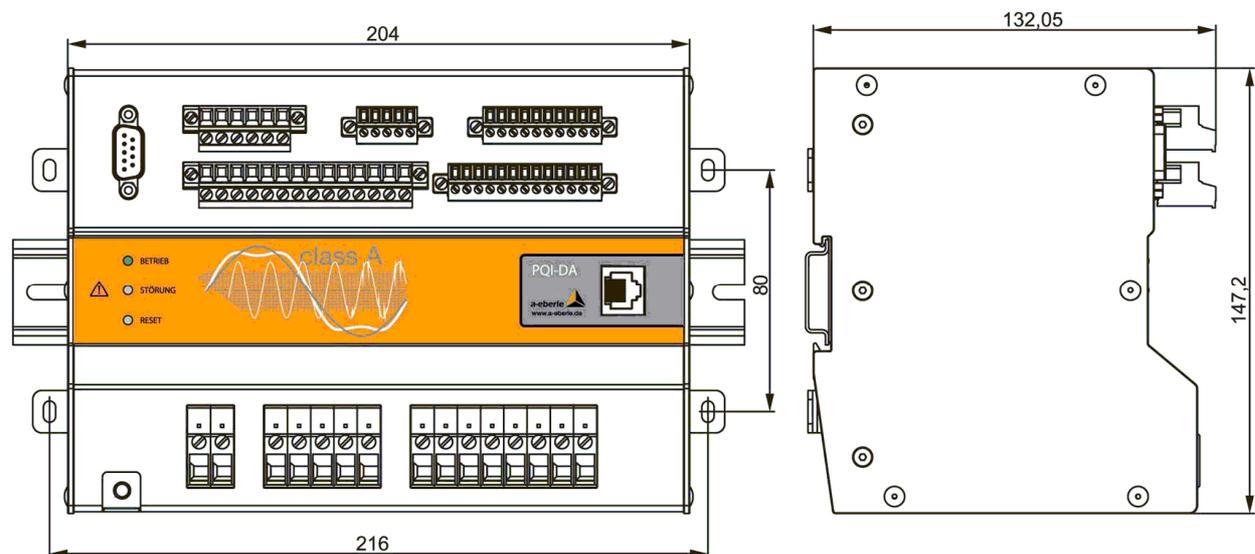
Dimensions

4. PQI-DA 4U / 4I

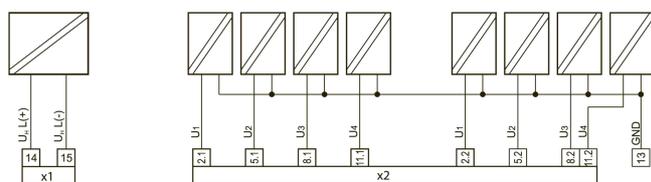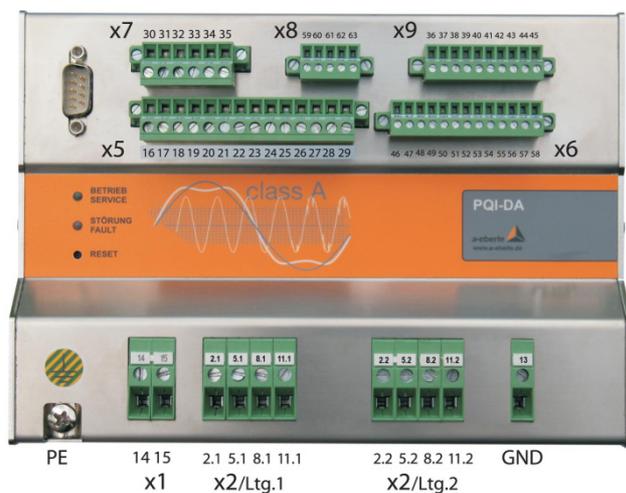## 4.1 Assignment of the terminal blocks x1 … x3

PQI-DA 4U / 4I – Assignment of t he terminal blocks x1 … x3

Terminal block no.	Description		Function		Terminal no.
x1	Auxiliary voltage	U_H	L (+)		14
			L (-)		15
x2	Phase voltage L1 (AC)	U_1	L1		2
	Phase voltage L2	U_2	L2		5
	Phase voltage L3	U_3	L3		8
	Neutral voltage	U_4	N		11
	Ground	GND	E		13
x3	Phase current L1	I1	k l		1 3
	Phase current L2	I2	k l		4 6
	Phase current L3	I3	k l		7 9
	Neutral-current	I4	k l		10 12

5. PQI-DA 8U

5.1 Assignment of terminal blocks x1 … x2

PQI-DA 8U – Assignment of terminal blocks x1 … x2

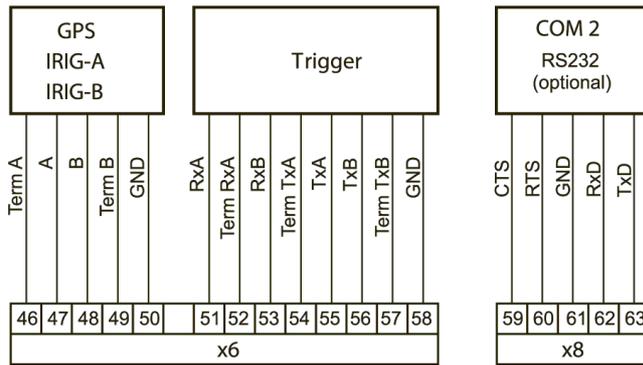| Terminal block no.	Description		Function	Terminal no.
x1	Auxiliary voltage	U_H	L (+)	14
			L (-)	15
x2 Line 1	Phase voltage	U_1	L1	2.1
	Phase voltage	U_2	L2	5.1
	Phase voltage	U_3	L3	8.1
	Neutral voltage	U_4	N	11.1
x2 Line 2	Phase voltage	U_1	L1	2.2
	Phase voltage	U_2	L2	5.2
	Phase voltage	U_3	L3	8.2
	Neutral voltage	U_4	N	11.2
	Ground	GND	E	13

6. PQI-DA 4U / 4I and 8U

6.1 Assignment of terminal blocks x5 … x9
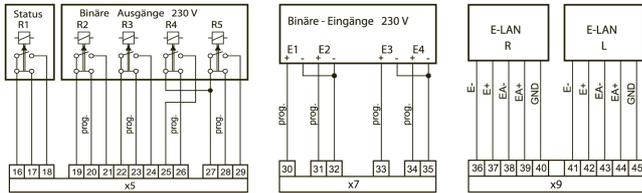
PQI-DA 4U / 4I and 8U – Assignment of terminal blocks x5 … x9

Terminal block no.	Description	Function		Terminal no.
x5	Status	R1	Pole	16
			NC contact	17
			NO contact	18
	Binary outputs 230 V	R2	Pole	19
			NC contact	20
			NO contact	21
		R3	Pole	22
			NC contact	23
			NO contact	24
		R4	Pole	27
			NC contact	26
			NO contact	25
		R5	Pole	27
			NC contact	28
			NO contact	29
x7	Binary inputs 230 V	E1	+	30
		E2	+	31
		E1 / E2	GND	32
		E3	+	33
		E4	+	34
		E3 / E4	GND	35
x9	E-LAN R (right)		E-	36
			E+	37
			EA-	38
			EA+	39
			GND	40
	E-LAN L (left)		E-	41
			E+	42
			EA-	43
			EA+	44
			GND	45

PQI-DA 4U / 4I and 8U – Assignment of terminal blocks x6 … x8

Terminal block no.	Description		Function	Terminal no.
x6	GPS, IRIG-A IRIG-B adapter card		Term A	46
			A	47
			B	48
			Term B	49
			GND	50
	Trigger		RxA	51
			Term RxA	52
			RxB	53
			Term TxA	54
			TxA	55
			TxB	56
			Term TxB	57
			GND	58
x8	COM 2 RS 232		CTS	59
			RTS	60
			GND	61
			RxD	62
			TxD	63

7. Serial interfaces

7.1 RS232 interfaces

Each PQI-DA has two RS 232 interfaces referred to as COM 1 and COM 2.

COM 1 can be used as a parameterisation and programming interface via a 9-pole SUB-D plug.

COM 2 can be wired via a plug-in terminal block.

If option T1 (COM server / TCP/IP) is selected, an RJ 45 connection is available instead of COM 2.

Connection elements	
COM 1	Pin strip, Sub Min D on the front of the device, pin assignment as on PC
COM 2	Terminal strip x8
Connection options	PC, Terminal, modem, PLC
Number of data bits/ protocol	Parity 8, even, off, odd
Transfer rate bit/s	1200, 2400, 4800, 9600, 19200, 38400, 57600, 76800, 115200
Handshake	RTS / CTS oder X_{ON} / X_{OFF}

7.2 TCP/IP

The TCP/IP or COM server interface is galvanically isolated from all other electrical circuits.

Communication via this interface is possible with a baud rate of 100 MBaud.

Parameterisation of the connection (IP address etc.) is carried out using the WinPQ parameterisation software.

7.3 RS485 Interfaces

Each PQI-DA is equipped with a double E-LAN interface as standard. It provides the bus connection to PQI-DAs, REG-D voltage regulators, REG-DP Petersen coil regulators, or an EORSys earth fault locating system.

7.4 E-LAN (Energy-Local Area Network)

Features

- 255 bus stations can be addressed
- Multimaster structure
- Integrated repeater function
- Open ring, bus or combination of bus and ring possible
- Log based on SDLC/HDLC framework
- Transfer rates of 62.5 or 125 kbit/s
- Telegram length 10 to 30 Bytes
- Average throughput approx. 100 telegrams / s

8. Hardware-orientated device versions

The flexibility of the system, i.e. precisely matching specific requirements, can also be achieved using the hardware characteristics of the input and output configuration.
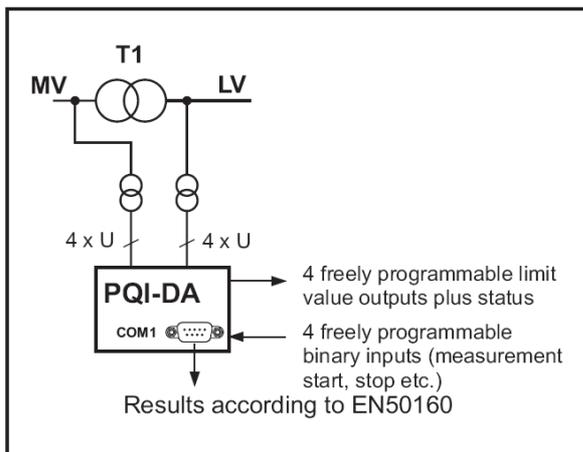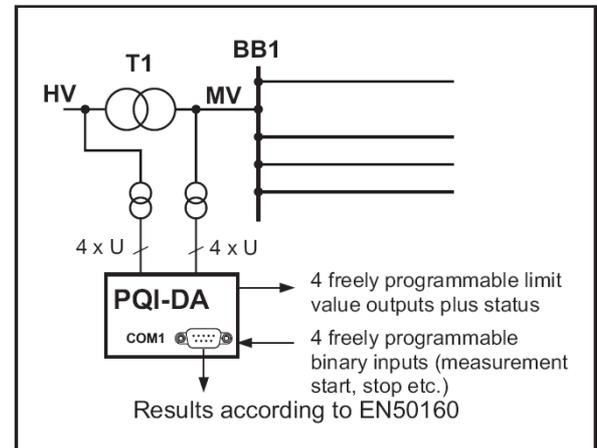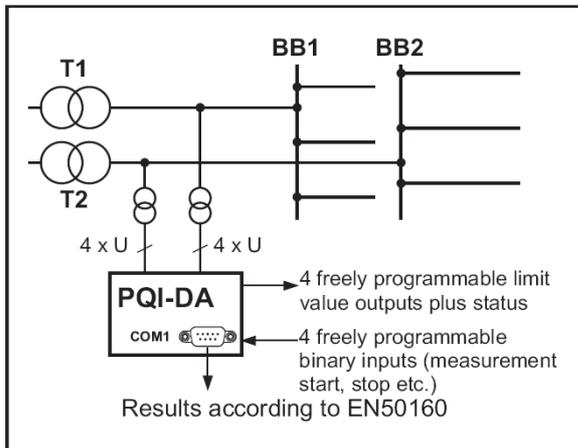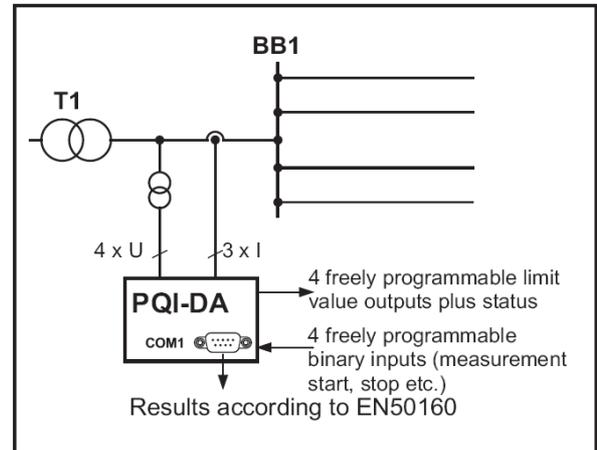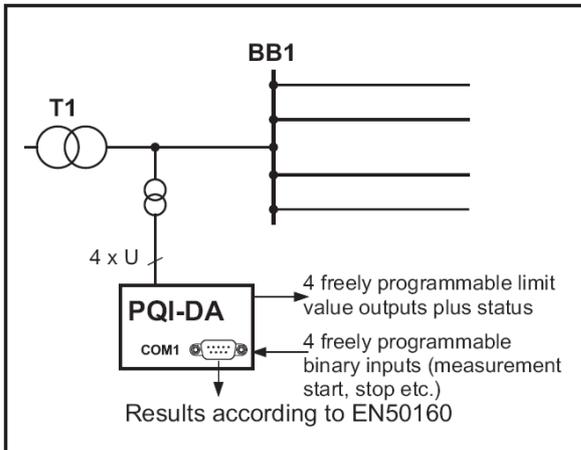
Table 1 shows the different possibilities.

9. Measurement inputs

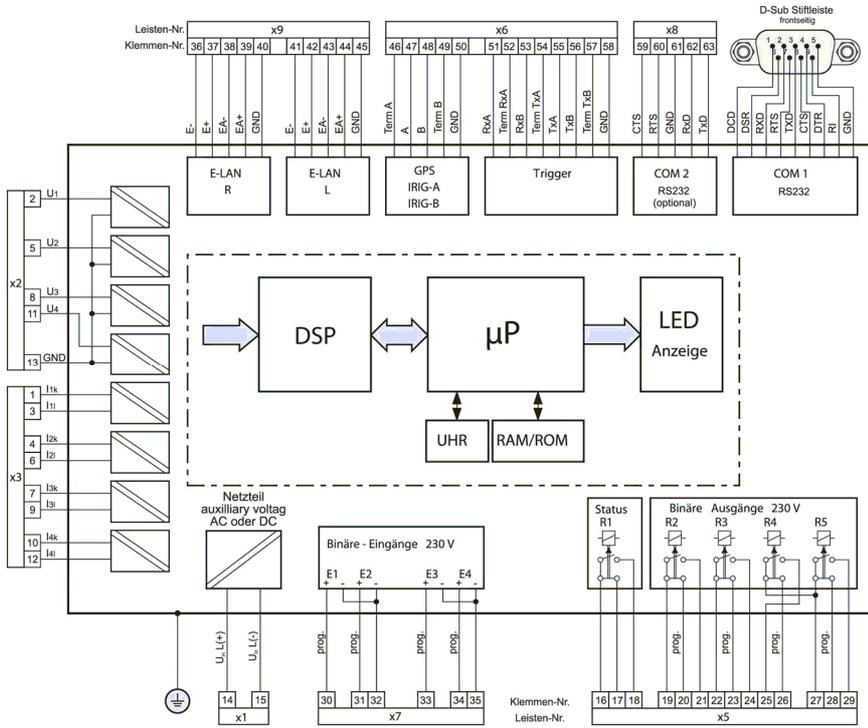| Feature	
C10	2 x 4 voltage inputs (100V / 230V) for double busbar system
C20...C31	4 voltage inputs (100V / 230V), 4 current inputs (1 A / 5 A)

10. Application Examples (a selection)

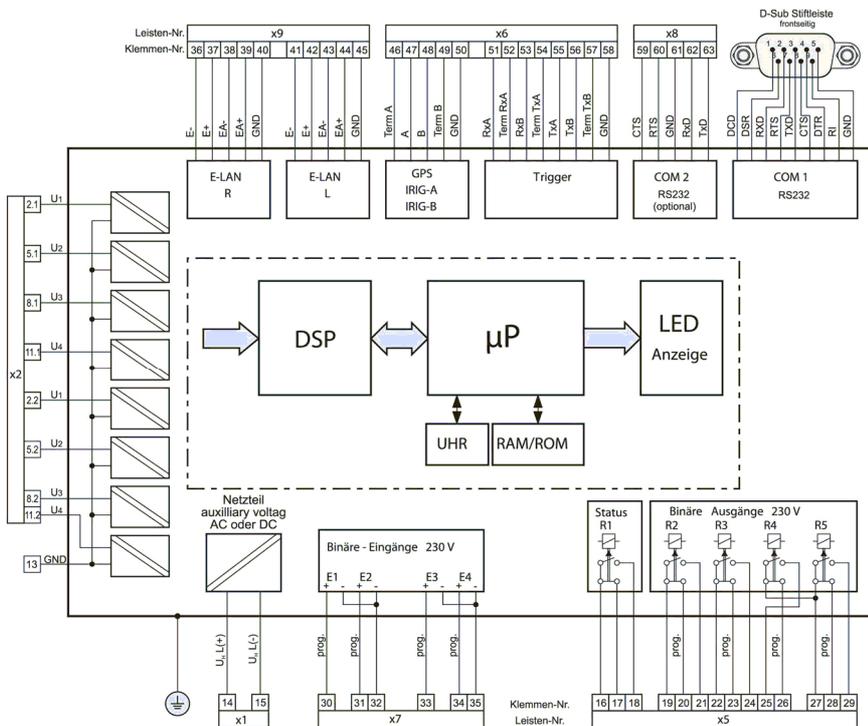**There are 5 typical applications using feature "C"**

Application Examples

11. Block diagram PQI-DA 4U / 4I

Features C20, C21, C30, C31

12. Block diagram PQI-DA 8xU

Features C10

13. Ordering information

When ordering please note:

- Only one code with the same capital letter is possible
- If the capital letter is followed by the number 9, additional details in plain text are required
- If the capital letter is followed by 0, the code can be omitted.

Characteristic	Code
Power Quality Interface - for medium and high voltage systems - according to DIN EN-50160 und IEC 61000-4-30 (class A) - with 4 binary in- and outputs plus life-contact - with two E-LAN interfaces for communication with - other REGSys- components like REG-D(A), PAN-D, REG-DP(A) - as wall- and/or DIN-rail mounting enclosure (204x142x132) mm	PQI-DA
Power Supply - AC 85V..110V..264V oder DC 88V..220V..280V - DC 18V...60V...72V	H0 H1
Input Configuration - 2 x 4 VTs - 4 VTs, 4 CTs In=1 A (Imax < 2x In) - 4 VTs, 4 CTs In=1 A (Imax < 20 x In) - 4 VTs, 4 CTs In= 5 A (Imax < 2 x In) - 4 VTs, 4 CTx In= 5 A (Imax < 20 x In)	C10 C20 C21 C30 , C31
Additional Interface - as RS 232 - as COM-Server (RJ 45)	T0 T1
Rated Input Values - 100 V / 110 V - 230 V / 400 V Other rated values (e.g. 4 x 100V and 4 x 400V) Please note: E9 can only be chosen together with C10!!	E1 E2 E9
Binary Inputs - 4 programmable binary inputs (AC/DC 48...250V) - 4 programmable binary inputs (DC 10...48V) - 4 programmable binary inputs with other input voltages	M1 M2 M9
Instruction Manual - German - English - French - Spanish - Italian	G1 G2 G3 G4 G5

Characteristic	Code
Software WinPQ in order to parameterize, to archive and evaluate PQI-DA measured values, with the following basic functions: • 32-bit-Windows programming interface • SQL-data base for the recording of the measured values per measuring point • Data access via TCP/IP • All measured values can be visualized both as a function of time and as statistical figure • One further licence is included in the price	**WinPQ**
Licences • as licence for 2 PQI-D • as licence for 2 to 10 PQI-D • as licence for more than 10 PQI-D	 L0 L1 L2
Language • German • English	 A1 A2
Additional licence for WinPQ for up to three PCs	
Software ParaPQ In order to parameterize PQI-DA and to read-out PQI-DA measured values as single licence	**ParaPQ**
Additional licence for ParaPQ	

Accessories	Code
• **TCP/IP Adapter 100MBit** • **DIN-rail 35mm with power supply unit AC 230V** • **TCP/IP Adapter; with extended bit rate 100 Mbit**	A90 A01 A90
Radio clock DCF 77	111.9024
USB- Adapter for zero-modem cable	111.9046
Tele-or Least-Line-Modem, Industrial version power supply AC 20V ... 264V / DC 14V ... 280V	111.9030.17
IRIG-DCF77 - Converter (10 TE) • **AC 85V ... 110V ... 264V / DC 88V ... 220V ... 280V** • **DC 18V ... 60V ... 72V** • **As wall mounting version 20TE**	IRIG-DCF H1 H2 B2
Instruction manual German English	 G1 G2

Notes

Notes

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http://www.a-eberle.de

Software - Version:

_____

Power Quality Interface – PQI-DA