

Reference manual



MPFC-EM

MULTIUSE ENERGY MONITOR AND MULTIMETER

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Revision	Date	Name	Comment
01.0	22.10.2025	AJ	Creation of MPFC-EM reference manual

Subject to technical changes

The contents of our documentation have been compiled with the utmost care and in accordance with our current state of knowledge. However, we would like to point out that this document cannot always be updated at the same time as technical developments to our products. Information and specifications are subject to change at any time.

Please refer to www.beluk.de for the latest version.

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1. Safety

IMPORTANT SAFETY INFORMATION AND INSTRUCTIONS– READ THESE INSTRUCTIONS CAREFULLY BEFORE INSTALLING AND OPERATING THE DEVICE!

The following symbols are used in the manual and on the back of the device to highlight hazards or provide special instructions.

! DANGER	
 	indicates an imminent dangerous situation. If this is not avoided, death or serious injury will result.

! WARNING	
	Electrical voltage! Indicates a potentially imminent hazardous situation. If this is not avoided, death or serious injury will also result.

! CAUTION	
	Warning signs indicate a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

! NOTE	
NOTICE indicates a situation that may result in damage to the product or other property if not avoided.	

Note: Our devices must not be subjected to high-voltage testing
(1000V according to VDE 0113)!

When testing your entire system, please exclude the MPFC-EM from the measurement.

The MPFC-EM has been tested in accordance with IEC/EN/UL/CSA 61010-1.

2. Product description

The **MPFC-EM** from **BELUK** is an energy, monitoring, and measuring multimeter.
With true RMS measurement
Sampling rate of 6.4 kHz (128 samples/period)
40 alarm messages can be selected from 105 measured values,
including compliance with voltage harmonics according to EN50160 and
2 tariff meters that show your network utilization in all 4 quadrants.

2.1 Product configuration

		EM6R4A			Options	
EM	6	R	4	A	L	I
Family Energy multimeter	Number Outputs 6 / 12	Output type Relay	Number Current measurement inputs 4	Power supply AC / DC	Data memory + event recorder + 8 GB microSD card	IEC61850

Standard configuration:

- AC power supply
- 2 digital inputs AC
- 6 relay outputs
- 4 current measurement inputs
- 3 voltage measurement inputs
- RS485 interface
- Input for external temperature sensor NTC22K

2.2 List of options

Description	Hardware option	Software option
EM -6	Digital outputs	
-R	Type: Relay	
-	Number of current measurement inputs	
-A / D	Power supply	
	Data logger / event recorder	-L
-	IEC61850 protocol via Ethernet interface	

Not yet
available

2.3 Performance characteristics

Hardware:

Front panel mounting device 144 x 144 mm

Connection Screw terminals max. 2.5 mm²

Optional software tool for configuration via Modbus RTU

3 voltage measurement inputs (L1-L2-L3-N)

4 current measurement inputs (via external x/1A and x/5A current transformers for energy monitoring)

2 digital inputs

1 potential-free changeover contact

1 potential-free normally open contact

6/12 digital outputs (AC)

Data memory with an 8 GB microSD card

RS485 interface (Modbus RTU, slave, up to 115200 baud)

NTC22K temperature sensor

Measurement:

True RMS measurement

Determination of cos phi relative to the fundamental wave

Harmonics up to the 63rd harmonic

Overvoltage category: AC: IEC/EN/UL/CSA 61010-1 (VDE 0411-1)

CAT III: < 300 V LN / < 519 V LL

CAT II: 300-317 V LN / 519-550 V LL

Overvoltage category: DC: IEC/EN/UL/CSA 61010-1 (VDE 0411-1)

CAT III: 40-240 V

Sampling rate: 6.4 kHz (128 samples / period)

Measurement category: IEC/EN/UL/CSA 61010-2-030 (VDE 0411-2-030)

CAT IV: <= 300 V

CAT III: > 300 V to 600 V

2.3 Intended use

The device is suitable for use in industrial environments () for installation in stationary electrical switchgear indoors. The environment must be free of harmful oils, acids, gases, vapors, dust, radiation, etc. Ambient temperature -20°C – 45° C. The EM may only be operated by qualified personnel who are familiar with the use of the device.

For current measurement, external listed current transformers for energy monitoring with reinforced insulation according to IEC 61010 with secondary current X/1 A or X/5 A must be used.

For use in low-voltage applications (phase-phase 400 V / phase-neutral conductor 230 V) and under certain conditions

(use of current measuring and voltage measuring transducers!)

for use in medium-voltage switchgear.

The installation of the device requires an external all-pole disconnecting device (pre-fuse 10 A).

2.4 Certificates

CE, cTÜVus

The product meets the requirements of:

EN 61010-1:2010/A1:2019

UL 61010-1:2012/R:2023-06

CSA C22.2 No. 61010-1:2012/U3:2023-06

EN IEC 61010-2-030:2021/A11:2021

UL 61010-2-030:2018

CSA C22.2 No. 61010-2-030:2018

2.5 Scope

1	MPFC-EM device
Screw terminals max. 2.5 mm ²	Connection terminals
2	Mounting terminals
1	Installation instructions
1	Test report

Connection terminals

Standard:

Quantity	Order number	Designation	Application	Connection designation
1	1231078	SK ST2Z	Supply voltage	L (+); N (-) Power supply
1	1231148	SK MST4Z	Digital inputs	DI 1.1, DI1.2; DI2.1, DI2.2
1	1231150	SK ST4Z	Voltage measurement inputs	UN, UL1, UL2, UL3
1x	1260730	SK ST8Z	Current measurement inputs	K1, L1...K4, L4
1x	1232297	SK MCST3Z	Modbus	A (+) / GND / (-) B
1x	1231410	SK MCST2Z	External temperature sensor	External Temp

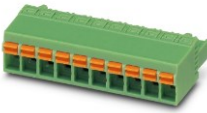
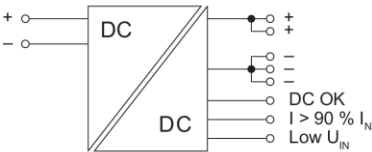
Optional digital output card 1

Quantity	Order number	Description	Application	Connection designation
1	1230881	SK MST3Z	Changeover contact	12,14,11
1	1231280	SK MST2Z	Normally open contact	23,24
1	1231080	SK MST7Z	Relay outputs	C1, S1-S6
1x	1230533	SK MST6Z	Relay outputs	S7-S12

Optional communication card

Quantity	Order number	Designation	Application	Connection designation
1	1230881	SK MST3Z	Changeover contact	32,34,31
1x	1231280	SK MST2Z	Normally open contact	43.44

2.6 Accessories

Designation	Order number:	Product
8 GB microSD card	1264602	Compatibility tested by BELUK Requirement Data storage / event recorder function available
Modbus USB converter 	125882	Modbus USB converter consisting of hardware, a 1.5-meter-long RS485/USB cable and the software. To enable communication with a computer,
Spring-loaded terminal block set 	Availability On request	Push-in spring connection
Fully transparent door VT + seal 	1230538 1260390	Full-view door complete with lock, lockable, dimensions 144 x 144 mm. This is glued to the front of our devices. The seal goes between the control cabinet and the full-view door. This achieves protection class IP54 on the front , while IP20 continues to apply to the rear, which is located inside the control cabinet.
Top-hat rail mount 	Availability On request	
DC-DC converter 	Availability On request	Dimensions: 120x130x43 mm (LxWxH) Output power: 240W Output voltage: 48 V DC / 5 A 24V DC / 5 A

AC-DC converter 	1262015	Dimensions: 125x130x35 mm (LxWxH) Input voltage AC: 85 ...277 V AC Output power: 120 W Output voltage: 24 V DC / 5 A
Buffer module UPS	Availability On request	

3. Assembly, installation, and commissioning

! DANGER	
	RISQUE D'ÉLECTROCUTION, D'EXPLOSION, OU ARC ÉLECTRIQUE (FR) HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH (EN) GEFAHR VON ELEKTRISCHEM SCHLAG, EXPLOSION, ODER LICHTBOGEN (DE)
Installation, commissioning, and maintenance must only be carried out by a qualified electrician with the necessary qualifications. A qualified electrician is a person who has the ability, experience, and necessary knowledge to construct, install, and operate electrical equipment and systems, and who has been instructed in the recognition and prevention of potential hazards. During installation, the relevant regulations for the installation of switchgear and accident prevention must be observed. Devices with damaged or open housings or open connection terminals must not be operated on the mains and must be disconnected and isolated immediately. Before disconnecting the current measuring path on the device or current transformer, the current transformer must be short-circuited. To avoid electric shock, current transformers must always be disconnected from the power distribution system or the building's power supply before installation or maintenance work. Failure to do so may result in life-threatening voltage at the connections of the current measuring path or the transformer. The transformer will be destroyed by a sustained high voltage.	

3.1. Installation

Installation location:	in switch cabinet door
Installation position:	Vertical
IP protection	Front: IP50 / Rear: IP20
Mounting type:	2x mounting clamps

The following distances must be maintained to ensure adequate ventilation:

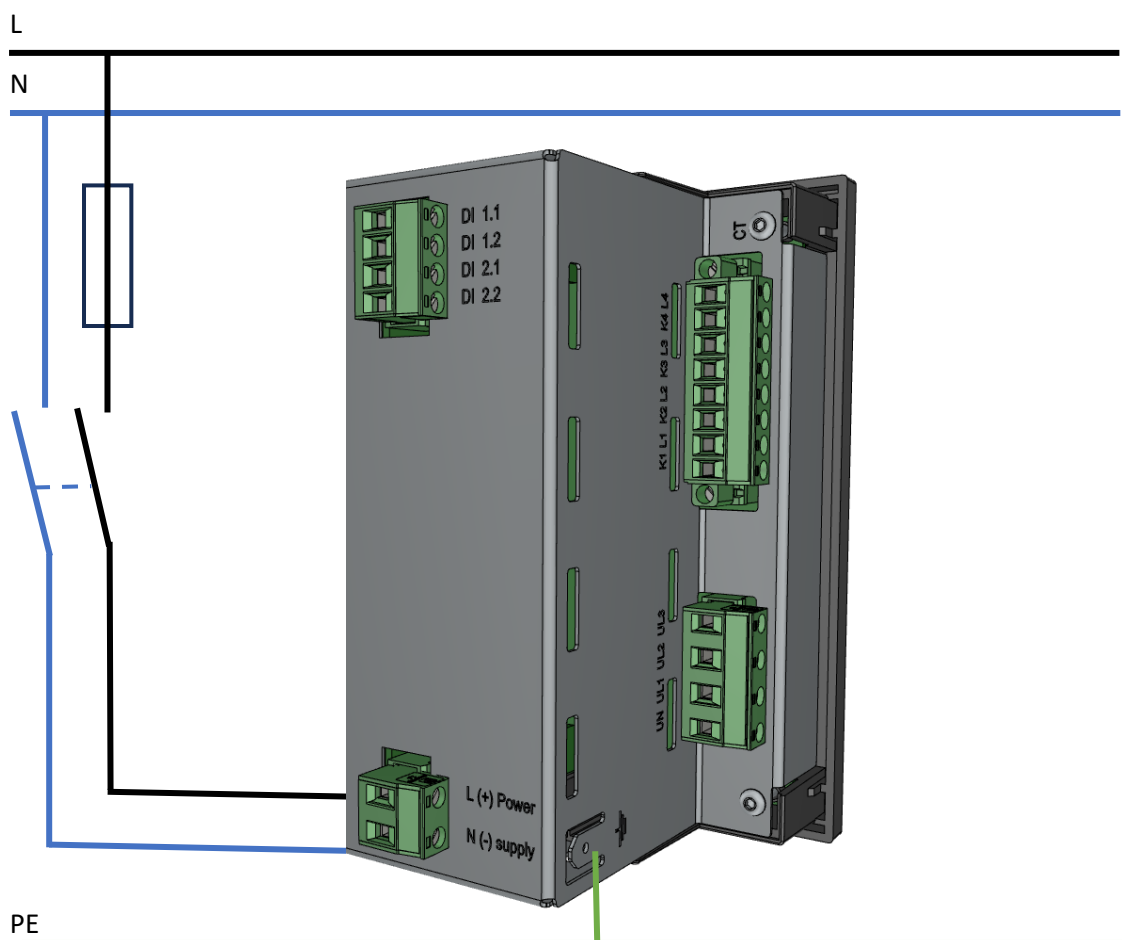
Top/bottom: min. 50 mm
Left/right: min. 20 mm

3.2. Installation

Mains voltage:	Range:	Connection:
High voltage:	110,000 V – 35,000 V AC	Via voltage transformer
Medium voltage:	35,000 V – 10,000 V AC	Via voltage transformers
Low voltage:	1000 V AC / 690 V	Via voltage transformers
	400 V / 230 V AC	Direct
Extra-low voltage:	50 V AC	/
	120 V DC	Directly on the DC version

3.2.1. Supply L N

The installation of the device requires an external all-pole disconnect device (10 A backup fuse).



Housing grounding: flat plug 6.3 x 0.8 mm

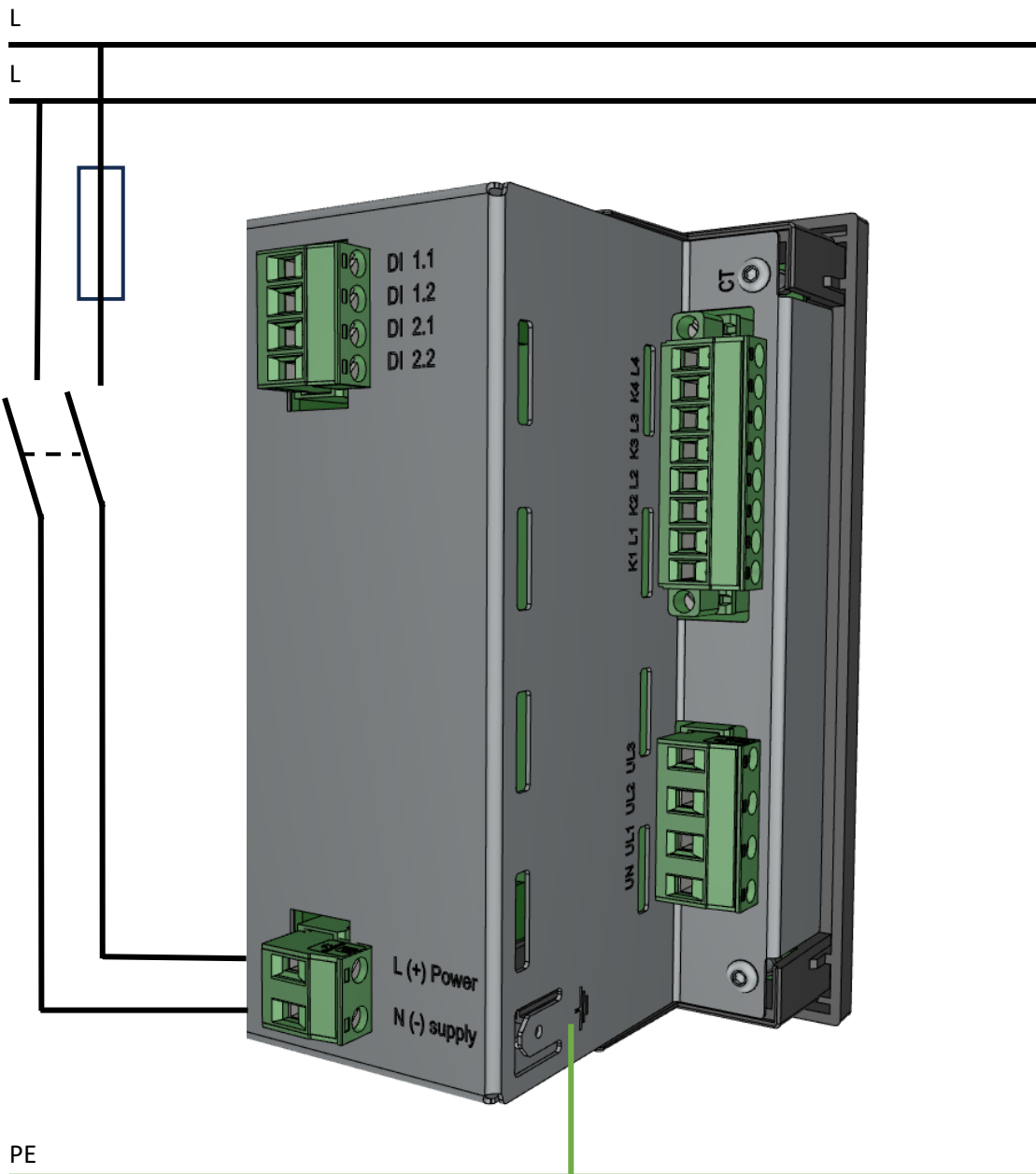
! WARNING



If the voltage exceeds the voltage specified on the type plate, a voltage converter must be used! Otherwise, the device may be damaged.

3.2.2. Supply L L

The installation of the device requires an external all-pole disconnect device (10 A backup fuse).



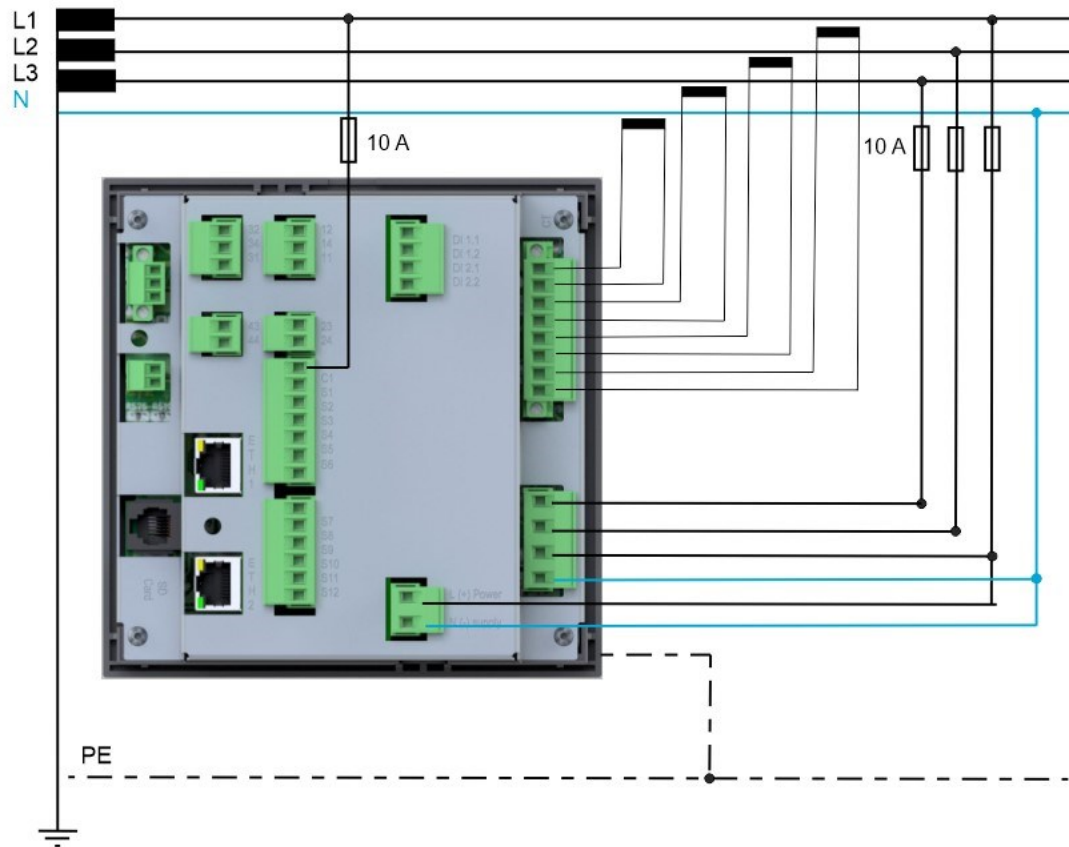
Housing grounding: flat plug socket 6.3 x 0.8 mm

! WARNING

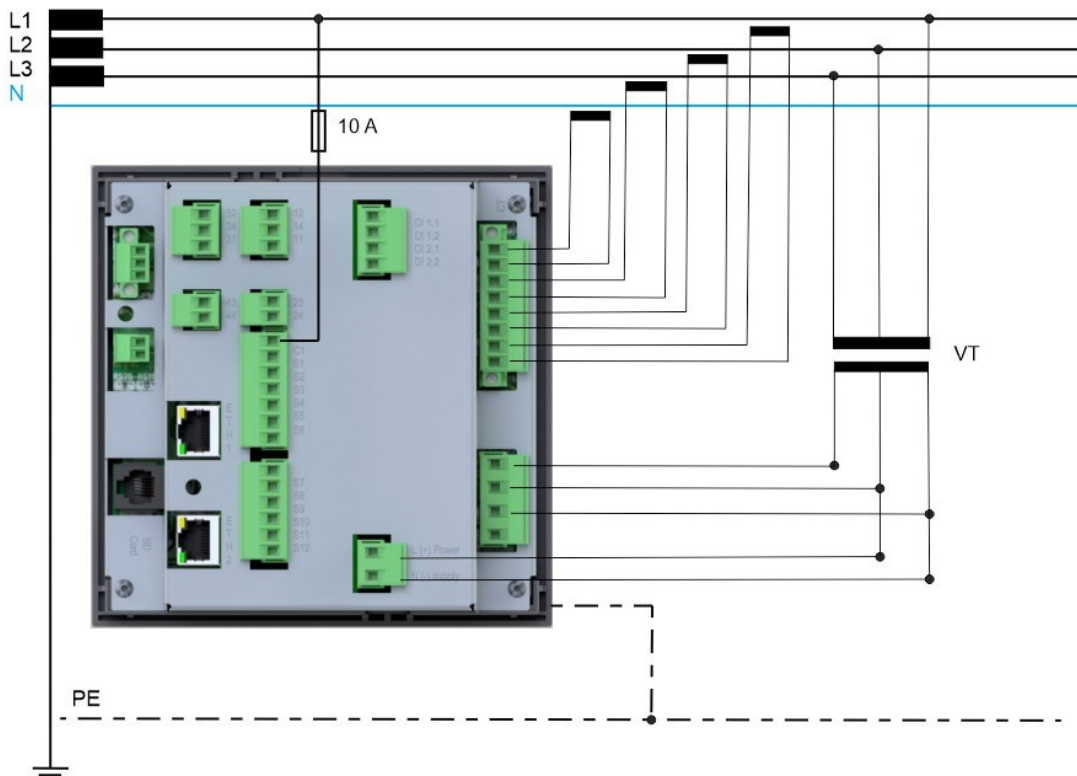


If the voltage exceeds the voltage specified on the type plate, a voltage converter must be used! Otherwise, the device may be damaged.

3.2.3. connection diagram



3.2.4. Connection diagram Voltage measurement input via transformer



! WARNING

Caution – Danger of electric shock!



Touching bare or stripped live wires can result in serious injury or even death.

1. Disconnect the system from the power supply!
2. Secure against being switched back on!
3. Check that all poles are de-energized!
4. Ground the system properly!
5. Only use grounding points with the grounding symbol!

! CAUTION

Malfunction and damage to the device or risk of injury due to improper connection.



Improperly connected devices may

- deliver incorrect measurements,
- damage the device,
- and cause injury to persons.

Attention!

Measured currents must come from the same power supply.

Do not use the measuring device to measure direct current!

The device cover must be grounded!

! NOTE

At least 35 VAC TRMS must be applied to **the voltage measurement input**.

Use a line protection (10A) as overcurrent protection.

The neutral conductor is not absolutely necessary.

Without an external neutral conductor, a virtual neutral conductor is formed in the device.

Use a voltage transformer VT for voltage measurement in **MV switchgear**.

A VT ratio of 1.0 - 5000.0 can be set in the software.

! NOTE

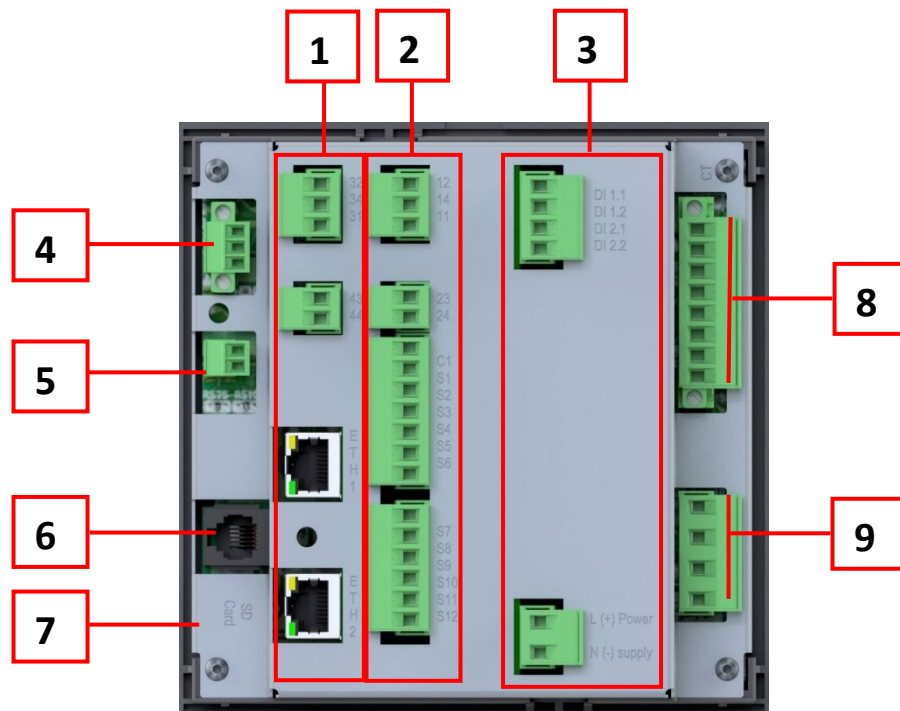
For **current measurement**, external listed current transformers for energy monitoring with reinforced insulation according to IEC 61010 with secondary current X/1A or X/5A must be used.

At least 10 mA TRMS must be present at the current measurement input.

Current transformers must always be used with isolating terminals!

An open current transformer generates a very high voltage that is dangerous to humans and equipment. This can lead to destruction of the current transformer.

3.2.5. Rear panel connection ratings



1	Option Communication card <u>3-pin terminal</u> 32,34,31(NO) / (NC) <u>2-pin terminal</u> 43, 44(NC) RJ45 RJ45	1 x changeover contact (M1) 1 x signal contact (A1) Ethernet 1-8 IEC61850 protocol Ethernet 1-8 IEC61850 protocol	Fine-stranded conductors with ferrule: 0.2 – 2.5 mm ² , AWG 24-12 Stripping length: 7 mm Tightening torque: 0.5 Nm
1	Option Digital output card <u>3-pole terminal</u> 32,34,31, (NO) / (NC) <u>2-pin terminal</u> 43,44(NC) <u>7-pin terminal</u> C2 S13-S18 <u>6-pin terminal</u> S19-S24	1 x changeover contact 1 x signal contact 13 x programmable signal contacts (NO)	Fine-stranded conductors with ferrules: 0.2 – 2.5 mm ² , AWG 24-12 Stripping length: 7 mm Tightening torque: 0.5 Nm
2	Digital output card <u>3-pin terminal</u> 12,14,11, (NO) / (NC) <u>2-pin terminal</u> 23,24(NC) <u>7-pin terminal</u> C1 S1-S6	1 x changeover contact 1 x signal contact 13 x programmable signal contacts (NO)	Fine-stranded conductors with ferrules: 0.2 – 2.5 mm ² , AWG 24-12 Stripping length: 7 mm Tightening torque: 0.5 Nm

	Option <u>6-pin terminal</u> S7-S12		
3	Supply card <u>4-pole terminal</u> DI 1.1 DI 1.2 DI 2.1 DI 2.2 <u>2-pole terminal</u> L (+) N (-)	2 x programmable digital inputs <u>Variant 1 AC:</u> Phase – neutral: 90 – 317 V AC Phase – Phase: 155 – 550 V AC 2 x programmable digital inputs <u>Variant 2 DC:</u> 40 – 240 V DC	Fine-stranded conductors with ferrule: 0.2 – 2.5 mm ² , AWG 24-12 Stripping length: 7 mm Tightening torque: 0.5 Nm
4	Interface Modbus RS485 <u>3-pin terminal</u> A (+) ⊥ B (-)	Use shielded cable The cable shield must be connected to ground to reduce external interference.	Fine-stranded conductors with ferrule: 0.2 – 1.0 mm ² , AWG 30-16 Stripping length: 5 mm Tightening torque: 0.3 Nm
5	External temperature sensor 2-pole terminal Ext1 / Ext2	NTC22K	Fine-stranded conductors with ferrule: 0.2 – 2.5 mm ² , AWG 24-12 Stripping length: 7 mm Tightening torque: 0.5 Nm
6	System interface	for firmware update via special programming cable and tool	
7	microSD card slot	8	
8	Current measurement inputs <u>2-pin terminal</u> K1 L1 Optional <u>8-pin terminal</u> K1 L1 K2 L2 K3 L3 K4 L4	10 mA – 6 A (overload 10 A continuous)	Fine-stranded conductors with ferrule: 0.2 – 2.5 mm ² , AWG 24-12 Stripping length: 7 mm Tightening torque: 0.5 Nm
9	Voltage measurement inputs <u>4-pole terminal</u> UN UL1 UL2 UL3	40 – 600 V AC	Fine-stranded conductors with ferrule: 0.2 – 2.5 mm ² , AWG 24-12 Stripping length: 7 mm Tightening torque: 0.5 Nm

3.2.6. Type plate

AC supply		Series:	MPFC-EM
 MPFC-EM made by BELUK GmbH in Germany Us: 90-317VAC LN Um: 40-600VAC $\wedge$ 155-550VAC LL 50/60Hz Is: 100mA Im: 10mA-6A Ser.-Nr 3024123345678 DANGER:UL1, UL2, UL3 and C must be protected by fuses max. 10A CT's must be shorted before disconnection		Manufacturer	BELUK GmbH
		Supply voltage:	Us
		Max. current consumption	Is
		Measuring voltage:	Um
		Measuring current:	In
		Serial number:	Barcode
		Declaration of conformity:	CE
		Disposal:	Electronic waste
		Hazard symbols:	Chapter 1 Safety

DC power supply		Series:	MPFC-EM
 MPFC-EM made by BELUK GmbH in Germany Us: 40-240VDC Um: 40-600VAC --- 50/60Hz Is: 225mA Im: 10mA - 6A Ser.-Nr 3024123345678 DANGER:UL1, UL2, UL3 and C must be protected by fuses max. 10A CT's must be shorted before disconnection		Manufacturer	BELUK GmbH
		Supply voltage:	Us
		Max. current consumption	Is
		Measuring voltage:	Um
		Measuring current:	In
		Serial number:	Barcode
		Declaration of conformity:	CE
		Disposal:	Electronic waste
		Hazard symbols:	Chapter 1 Safety

3.2.7. Eplan macro

3.3. Commissioning

 **GEFAHR**



The work area must be disconnected from the power supply and secured against unauthorized and accidental reconnection. Use a standardized measuring device to verify that the power supply has been disconnected. The power-free system must be grounded and short-circuited. Cover and/or fence off any adjacent live parts.

To avoid electric shock, current transformers must always be disconnected from the power distribution system or the building's power supply before installation or maintenance work.

1. Before installation, compare the connection data with the mains data.
2. Short-circuit the current transformers!

NOTE: Current transformers must always be used with disconnecting terminals. An open current transformer generates a very high voltage that is dangerous to people and equipment. This can lead to destruction of the current transformer.

3. Insert the device into the switch panel cutout and secure it with **2 mounting clips**.
4. The protective conductor must be connected to the designated PE connection on the metal rear panel.

A 6.3 x 0.8 mm flat plug sleeve is required for this.



5. All connecting cables must be connected in accordance with the connection diagram.
When using the pluggable screw terminals,
Note the tightening torque of 0.4 Nm...0.5 Nm.
6. Fuse the device with a 10 A circuit breaker.
7. Remove the current transformer bridge.
8. The voltage can now be switched on.
9. The device starts up.

4. Operating the MPFC-EM

The MPFC-EM is operated using 4 buttons.

NOTE: If no button is pressed for 5 minutes, the device returns to the main display.

If no button is pressed within 5 minutes, the backlight dims. Pressing any button turns the backlight back on. The background contrast can be changed as follows:

via the **menu -> Settings -> System -> Contrast and brightness**



1

- Exit menu item
- Move cursor to the left
- The alarm can be reset by pressing any key.

2

- Reduce values
- Select next measured value, menu item or step number

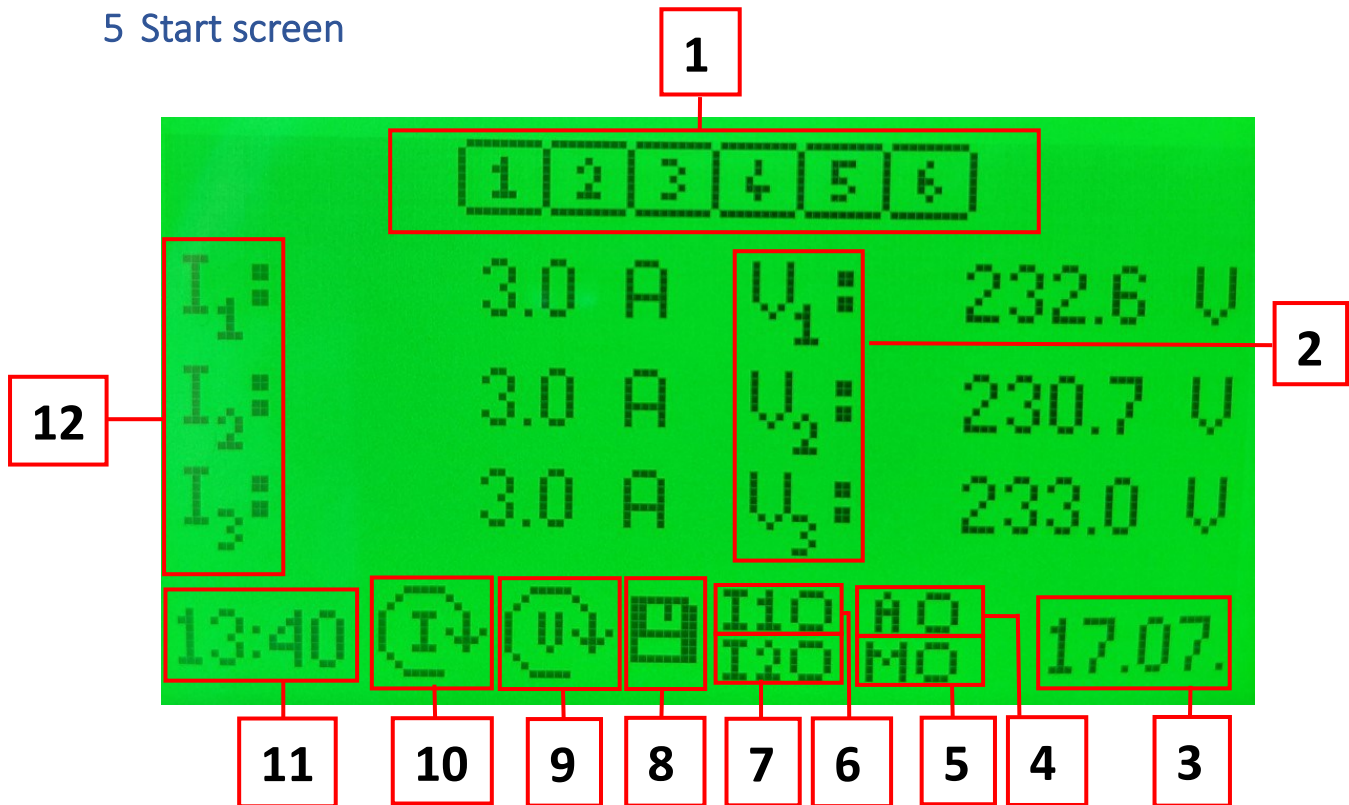
3

- Increase values
- Select previous measured value, menu item or step number

4

- Open menu item
- Move cursor to the right
- Accept value

5 Start screen



1	Digital output relays
2	Voltage display
3	Date
4	A = Alarm relay
5	M = Multi-use
6	I1 = Digital input 1
7	I2 = Digital input 2
8	Memory card present Flashes when data is being logged/saved
9	Rotation direction voltage, Only displayed when measurement voltage is connected
10	Rotation direction current, Only displayed if measuring current is connected
11	Time
12	Current display

6 Menu display

6.1 Measured values

3-phase measurement			
V1	Voltage TRMS [V]		Tan ϕ 1
V2	Phase – neutral		Tan ϕ 2
V			Tan ϕ 3
V12	Voltage TRMS [V]		Cos ϕ Total
V2	Phase – Phase		Cos ϕ total
V31			PF sum
			Total power factor
V1f	Voltage TRMS [V]		Tan ϕ total
V2f	Fundamental wave		ϕ 1
V3f			Phase shift [°]
I1	Current TRMS [A]		ϕ 2
I2			ϕ 3
I3			THDU1
If1	Current TRMS [A]		THD-U [%]
If2	Fundamental wave		THDU2
If3			THDU3
I1th	Thermally damped current		THDI1
I2th	Average value over a		THD-I [%]
I3th	defined time constant		THDI2
P Sum	Total active power [W]		THDI3
Q Total	Total reactive power [var]		F
S Sum	Total apparent power [VA]		Frequency [Hz]
P1	Active power [W]		THDU1 max
P2			THD-U maximum values [%]
P			THDU2 max
P1th	Thermally damped active power		THDU3 max
P2th	Average value over a		THDU1 max
P3th	defined time constant		THD-U maximum values [%]
Q1	Blind power [var]		THDU2 max
Q2			THDU3 max
Q3			THDI1 max
S1	Apparent power [VA]		THD-I maximum values [%]
S2			THDI2 max
S3			THDI3 max
cos ϕ 1	Cos ϕ		T int
cos ϕ 2			Internal temperature [°C]
cos ϕ 3			T extr
			External temperature [°C]
			Tmax
			Maximum temperature [°C]
			PFavg
			Ø Power factor
			OPH
			Operating hours of device [h]
			I4
			Current TRMS [A]
			I4f
			Current TRMS [A] fundamental wave
			THDI4
			THD-I [%]
			I4th
			Thermally damped current
			Average value over a
			defined time constant

PF1	Power factor		
PF2			
PF3			

6.2 Counter

WPI	Active power meter import [Wh] Total tariff 1	WQi T2	Inductive reactive power meter [varh] Total tariff 2
WPE	Active power meter export [Wh] Total tariff 1	WQc T2	Capacitive reactive power meter [varh] Total tariff 2
WPI1	Active power meter import [Wh]	WQi1 T2	Inductive reactive power meter [varh]
WPI2	Single phase	WQi2 T2	Single phase
WPI3	Tariff 1	WQi3 T2	Tariff 2
WPE1	Active power meter export [Wh]	WQc1 T2	Capacitive reactive power meter [varh]
WPE2	Single phase	WQc2 T2	Single phase
WPE3	Tariff 1	WQc3 T2	Tariff 2
WQi	Inductive reactive power meter [varh] Total tariff 1		
WQc	Capacitive reactive power meter [varh] Total tariff 1		
WQi1	Inductive reactive power meter [varh]		
WQi2	Single-phase		
WQi3	Tariff 1		
WQc1	Capacitive reactive power meter [varh]		
WQc2	Single-phase		
WQc3	Tariff 1		
WPI T2	Active power meter import [Wh] Total tariff 2		
WPE T2	Active power meter export [Wh] Total tariff 2		
WPI1 T2	Active power meter import [Wh]		
WPI2 T2	Single phase		
WPI3 T2	Tariff 2		
WPE1 T2	Active power meter export [Wh]		
WPE2 T2	Single phase		
WPE3 T2	Tariff 2		

6.3 Harmonics

6.3.1 Table

The table provides an overview of the measured values, which show the ratio in % to the specified limit values of the EN 50160 standard. Switchover to current (A) possible.

U1 2-63
U2 2-63
U3 2-63
I1 2-63
I2 2-63
I3 2-63

2:	0.0
4:	0
6:	0
8:	0
10:	0.0

3	0.5
5:	1.7
7:	0.8
9:	0.7
11:	0.3

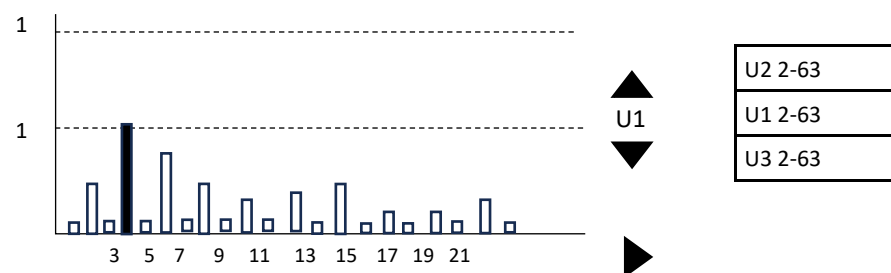




U1

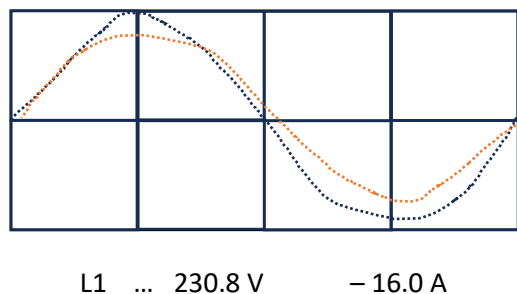
6.3.2 Bar chart

If the permitted limit value is exceeded, the bar is colored completely.



6.4 Oscilloscope

Visual representation of the effective values of voltage V and current A of the 3 phases L1, L2, L3, L4



6.5 Settings

6.5.1 Measurement

Setting range:

6.5.1.1 CT-F Actuator

1.0...50000

Current transformer factor	L1	100.0	/	5	L2	5.0	/	5	L3	5.0	/	5	N	5.0	/	5
Swap CT connection	☐			☐		☐		☐		☐		☐		☐		☐

The current transformer is entered separately for each phase.

Enter the ratio of the primary to secondary side of the transformer.

x/1 A transformer for long measuring cable lengths

x/5 A transformer higher accuracy class

! NOTE

The cable length and accuracy class must be taken into account when selecting the transformer!

The transformer must be selected so that a measured value resolution of **at least 10 mA** is achieved (the response threshold of the controller is 10 mA).

6.5.1.2 Replace CT connection

The K and L connections can be changed in the software for each converter

6.5.1.3 VT factor

1.0...5000.0

Enter the voltage transducer factor.

The ratio must be entered as a value (e.g., $1000/100 = 10$).

If the device is connected directly to the measurement voltage without a voltage transformer, the value 1 must be used.

! NOTE

At least 20 V eff must be applied to the voltage measurement input.

Use a circuit breaker (1-10A) as overcurrent protection.

Use a voltage transformer VT for voltage measurement in **MV switchgear**.

A VT ratio of 1.0-5000.0 can be set in the software.

6.5.1.4 Frequency

To achieve maximum accuracy in current and voltage measurement, the sampling rate must be synchronized to the mains frequency. Despite internal filtering, severe commutation dips in the mains voltage can interfere with automatic synchronization. Faulty synchronization in turn leads to measurement errors. For this reason, the following settings can be made.

AUTO: Automatic synchronization for maximum measurement accuracy with mains voltage without commutation drops 50: For safe operation in

50 Hz mains with extremely poor mains quality.

60 Hz: For safe operation in a 60 Hz network with extremely poor network quality.

6.5.1.5 Temperature offset internal -10...10 °C

A temperature offset for temperature measurement can be set here to correct any component-dependent deviations.

6.5.1.6 Temperature offset *external* -10...10 °C

A temperature offset for temperature measurement can be set here to correct any component-dependent deviations.

6.5.1.7 Time constant of thermal damping τ_{th} 0

This setting affects the time constant of the damped current values **I_{th}** and active power **P_{th}**. The time constant is entered in seconds. The value range extends from 1 second to 999.9 seconds (approx. 16 minutes). The average value is calculated over the set time.

6.5.1.8 Load peak calculation 1...1440 min

The highest measured average power value of an interval determines the amount of power costs.

6.5.2 Alarm

There are 64 signals available to generate **40 alarm messages**.

Alarm 1

Signal: Voltage LN1 [V] Type: Out range

MIN: 0.0 V Delay: 0.0 s

MAX: 0.0 V Delay: 0.0 s

A1 M1 1 2 3 4 5 6 7

8 9 10 11 12 D1 D2 RM A AT ET

Feedback: No function Latency: 0.1 s

64 signals

Frequency [Hz]	Q L2 [var]	WP L2 imp	THDU L2	tan (φ) L2
Voltage LN1 [V]	Q L3 [var]	WP L3 imp	THDU L3	tan (φ) L3
Voltage LN2 [V]	Q total [var]	WP total imp	THDI L1	tan (φ) sum
Voltage LN3 [V]	S L1 [VA]	WP L1 exp	THDI L2	phi L1
Voltage L1L2 [V]	S L2 [VA]	WP L2 exp	THDI L3	phi L2
Voltage L2L3 [V]	S L3 [VA]	WP L3 exp	THDI 4	phi L3
Voltage L3L1 [V]	S total [VA]	WP total exp	T int	Ith L1
Current I1 [A]	cos(φ) L1	WQ L1 ind	T ext	Ith L2
Current I2 [A]	cos(φ) L2	WQ L2 ind	Uf L1	Ith L3
Current I3 [A]	cos(φ) L3	WQ L3 ind	Uf L2	Ith 4
Current I4 [A]	cos(φ) sum	WQ total ind	Uf L3	Pth L1
P L1 [W]	Power factor L1	WQ L1 cap	If L1	Pth L2
P L2 [W]	Power factor L2	WQ L2 cap	If L2	Pth L3
P L3 [W]	Power factor L3	WQ L3 cap	If L3	Harmonics
P total [W]	Power factor sum	WQ total cap	If 4	DI1
Q L1 [var]	WP L1 imp	THDU L1	tan (φ) L1	

6.5.2.1 Type

There are 3 trigger types to choose from,
with limit values **Limit max.** / **Limit min.** and
Delay times **T-On** / **T-Off** can be set.

OUT RANGE	outside the range
IN RANGE	within range
Hysteresis	Hysteresis

If harmonics are selected as the signal, you can select the standard EN50160 or NRS048-2. **Offset min** % and **Offset max** % are then available to adjust the limit values.

6.5.2.2 Feedback

The feedback function provides feedback when a switching command is issued.
However, before activation, the function of the digital input must first be defined in the settings under **section 6.5.6** "System."
Only then can the feedback function be activated.

No function	No function
DI	Digital input
DI2	Digital input

6.5.2.3 Latency

The latency time can be configured between 0.1 s and 60 s, but only when feedback via DI1 or DI2 is activated.

6.5.2.4 Option

Alarm output 1	Set A1 to activate the signal (alarm output = normally open contact 23/24)
Multi-use output 1	Set M1 (multi-purpose output = changeover contact 12/14/11)
A digital output can be activated in response to an alarm event.	
Digital output 1	This output is designed as a potential-free normally open contact.
Digital output 2	
Digital output 3	
Digital output 4	
Digital output 5	
Digital output 6	
Manual reset	Manual reset
Event logger	Software function enabled
Alarm	Must be set in the system settings 6.5.6 beforehand.
Alarm text	Must be set beforehand in system settings 6.5.6

Option Communication card available

Alarm output 2	Set A2 to activate the signal (alarm output = normally open contact 43/44)
Multi-use output 2	Set M2 (multi-use output = changeover contact 32/34/31)

6.5.3 Tariff switching

The tariff can be switched either via a trigger signal given via a digital input or controlled on a time basis.

Trigger			
OFF		Digital input 2	Digital input 1

6.5.6 System settings -> Digital input function: **Tariff switching**

Time	
from e.g.	Until e.g.
10:00	06

6.5.4 Reset

The following parameters can be reset:

Reset	Settings	Counter	Operating hours	Power factor	Max. values	Data memory	Reset to factory settings Reset
--------------	----------	---------	-----------------	--------------	-------------	-------------	------------------------------------

6.5.5 Modbus

The device has a standard RS-485 communication interface.

Connection via a 3-wire screw terminal + / GND / -

A terminating resistor of 120 ohms must be connected at the end of the network.

On the EMM6, the terminating resistor can be set via a DIP switch. (Image)

Max. 32 participants per Modbus

The MPFC-EM operates as a slave participant

Modbus	Address	Baud rate	Parity	Access rights
	1	19200	801	Read
	247	9600	8E1	Write/read access
		4800	8N2	IP sensor
		2400		
		1200		
		115200		
		57600		
		3840		

The settings for baud rate and parity must be identical for all bus devices.

However, the slave address of a device may only exist once in the bus system.

6.5.5.1 Modbus register

Measured values

		Register	Value	Data type	min	max	Unit	Default
General	R	4000	$\cos(\phi)$ sum	float32				
	R	4002	PF_{sum}	float32				
	R	4004	PF_{avg}	float32				
	R	4006	$\tan(\phi)$ sum	float32				
	R	4008	P_{sum}	float32			W	
	R	4010	Q_{sum}	float32			var	
	R	4012	S_{sum}	float32			VA	
	R	4014	dQ_{sum}	float32			var	
	R	4016	Frequency	float32			Hz	
	R	4018	T_{int}	int8			°C	
	R	4019	T_{ext}	int8			°C	
	R	4020	T_{max}	int8			°C	
	R	4021	dyn Q. Ofst	float32			var	
	R	4023	red Field U	uint8	0	2		
	R	4024	red Field I	uint8	0	2		
	R	4025	active alarms	uint64				
	R	4029	DO status	uint16				
	R	4030	DI status	uint16				
	R	4031	Target $\cos(\phi)$	float32				
	R	4033	saved CO2	float32				
Phase L1	R	4040	$U_{L1NTRMS}$	float32			V	
	R	4042	U_{L1L2}	float32			V	
	R	4044	U_{L1} fundamental	float32			V	
	R	4046	I_{L1TRMS}	float32			A	
	R	4048	I_{L1} fundamental	float32			A	
	R	4050	$U_{L1NTRMSmax}$	float32			V	
	R	4052	$THDU_{L1}$	float32			%	
	R	4054	$THDI_{L1}$	float32			%	
	R	4056	$\cos(\phi)_{L1}$	float32				
	R	4058	PF_{L1}	float32				
	R	4060	$\tan(\phi)_{L1}$	float32				
	R	4062	P_{L1}	float32			W	

	R	4064	Q_{L1}	float32			var	
	R	4066	S_{L1}	float32			VA	
	R	4068	dQ_{L1}	float32			var	
	R	4070	$THDU_{L1max}$	float32			%	
	R	4072	$THDI_{L1max}$	float32			%	
	R	4074	ϕ_{L1}	uint16			°	
Phase L2	R	4080	$U_{L2NTRMS}$	float32			V	
	R	4082	U_{L2L3}	float32			V	
	R	4084	U_{L2} fundamental	float32			V	
	R	4086	I_{L2TRMS}	float32			A	
	R	4088	I_{L2} fundamental	float32			A	
	R	4090	$U_{L2NTRMSmax}$	float32			V	
	R	4092	$THDU_{L2}$	float32			%	
	R	4094	$THDI_{L2}$	float32			%	
	R	4096	$\cos(\phi)_{L2}$	float32				
	R	4098	PF_{L2}	float32				
	R	4100	$\tan(\phi)_{L2}$	float32				
	R	4102	P_{L2}	float32			W	
	R	4104	Q_{L2}	float32			var	
	R	4106	S_{L2}	float32			VA	
	R	4108	dQ_{L2}	float32			var	
	R	4110	$THDU_{L2max}$	float32			%	
	R	4112	$THDI_{L2max}$	float32			%	
	R	4114	ϕ_{L2}	uint16			°	
Phase L3	R	4120	$U_{L3NTRMS}$	float32			V	
	R	4122	U_{L3L1}	float32			V	
	R	4124	U_{L3} fundamental	float32			V	
	R	4126	I_{L3TRMS}	float32			A	
	R	4128	I_{L3} fundamental	float32			A	
	R	4130	$U_{L3NTRMSmax}$	float32			V	
	R	4132	$THDU_{L3}$	float32			%	
	R	4134	$THDI_{L3}$	float32			%	
	R	4136	$\cos(\phi)_{L3}$	float32				
	R	4138	PF_{L3}	float32				
	R	4140	$\tan(\phi)_{L3}$	float32				
	R	4142	P_{L3}	float32			W	
	R	4144	Q_{L3}	float32			var	

	R	4146	S_{L3}	float32			VA	
	R	4148	dQ_{L3}	float32			var	
	R	4150	$THDU_{L3max}$	float32			%	
	R	4152	$THDI_{L3max}$	float32			%	
	R	4154	ϕ_{L3}	uint16			°	
Neutral	R	4160	I_{4TRMS}	float32			A	
	R	4162	$I_{TRMSfundamental}$	float32			A	
	R	4164	$THDI_4$	float32			%	
Damped	R	4190	I_{th1}	float32			A	
	R	4192	I_{th2}	float32			A	
	R	4194	I_{th3}	float32			A	
	R	4196	I_{th4}	float32			A	
	R	4198	P_{th1}	float32			W	
	R	4200	P_{th2}	float32			W	
	R	4202	P_{th3}	float32			W	
I4	R	4210	P_4	float32			W	
	R	4212	Q_4	float32			var	
	R	4214	S_4	float32			VA	
	R	4216	$\cos(\phi)_4$	float32				
	R	4218	ϕ_4	uint16			°	
peak load	R	4220	Last load average				kW	
	R	4222	actual load peak				kW	
	R	4224	Time since last load average				sec	
	R	4226	Maximum load peak				kW	

Counter values

		Register	Value	Data type	min	max	Unit	Default
	R	5000	Operating hours	uint32			h	
	R	5002	$WP_{importsum}$	float32			Wh	
	R	5004	$WP_{exportsum}$	float32			Wh	
	R	5006	$WQ_{inductivesum}$	float32			varh	
	R	5008	$WQ_{capacitivesum}$	float32			varh	
	R	5010	$WP_{importL1}$	float32			Wh	
	R	5012	$WP_{importL2}$	float32			Wh	
	R	5014	$WP_{importL3}$	float32			Wh	
	R	5016	$WP_{exportL1}$	float32			Wh	

R	5018	WP _{exportL2}	float32		Wh
R	5020	WP _{exportL3}	float32		Wh
R	5022	WQ _{non-inductiveL1}	float32		varh
R	5024	WQ _{non-inductiveL2}	float32		varh
R	5026	WQ _{non-inductiveL3}	float32		varh
R	5028	WQ _{capacitiveL1}	float32		varh
R	5030	WQ _{capacitiveL2}	float32		varh
R	5032	WQ _{capacitiveL3}	float32		varh
R	5034	WP _{importsum} T2	float32		Wh
R	5036	WP _{exportsum} T2	float32		Wh
R	5038	WQ _{inductivesum} T2	float32		varh
R	5040	WQ _{capacitivesum} T2	float32		varh
R	5042	WP _{importL1} T2	float32		Wh
R	5044	WP _{importL2} T2	float32		Wh
R	5046	WP _{importL3} T2	float32		Wh
R	5048	WP _{exportL1} T2	float32		Wh
R	5050	WP _{exportL2} T2	float32		Wh
R	5052	WP _{exportL3} T2	float32		Wh
R	5054	WQ _{inductiveL1} T2	float32		varh
R	5056	WQ _{inductiveL2} T2	float32		varh
R	5058	WQ _{non-inductiveL3} T2	float32		varh
R	5060	WQ _{capacitiveL1} T2	float32		varh
R	5062	WQ _{capacitiveL2} T2	float32		varh
R	5064	WQ _{capacitiveL3} T2	float32		varh

Alarm Setup

		Register	Value	Data type	min	max	Unit	Default
Alarm 1	R/W	3000	signal ID	uint16				
	R/W	3001	Limit On	float32				
	R/W	3003	Delay On	float32				
	R/W	3005	Limit Off	float32				
	R/W	3007	Delay Off	float32				
	R/W	3009	Feedback DI	uint8				
	R/W	3010	Options	uint32				
Alarm 2	R/W	3012						
Alarm 3	R/W	3024						
Alarm 4	R/W	3036						
Alarm 5	R/W	3048						
Alarm 6	R/W	3060						

Alarm 7	R/W	3072					
Alarm 8	R/W	3084					
Alarm 9	R/W	3096					
Alarm 10	R/W	3108					
Alarm 11	R/W	3120					
Alarm 12	R/W	3132					
Alarm 13	R/W	3144					
Alarm 14	R/W	3156					
Alarm 15	R/W	3168					
Alarm 16	R/W	3180					
Alarm 17	R/W	3192					
Alarm 18	R/W	3204					
Alarm 19	R/W	3216					
Alarm 20	R/W	3228					
Alarm 21	R/W	3240					
Alarm 22	R/W	3252					
Alarm 23	R/W	3264					
Alarm 24	R/W	3276					
Alarm 25	R/W	3288					
Alarm 26	R/W	3300					
Alarm 27	R/W	3312					
Alarm 28	R/W	3324					
Alarm 29	R/W	3336					
Alarm 30	R/W	3348					
Alarm 31	R/W	3360					
Alarm 32	R/W	3372					
Alarm 33	R/W	3384					
Alarm 34	R/W	3396					
Alarm 35	R/W	3408					
Alarm 36	R/W	3420					
Alarm 37	R/W	3432					
Alarm 38	R/W	3444					
Alarm 39	R/W	3456					
Alarm 40	R/W	3468	Signal ID	uint16			
	R/W	3469	Limit On	float32			
	R/W	3471	Delay On	float32			
	R/W	3473	Limit Off	float32			
	R/W	3475	Delay Off	float32			
	R/W	3477	Feedback DI	uint8			
	R/W	3478	Options	uint32			
	R/W	3480	Tampering Options	uint32			
	R/W	3482	Latency DI1	float32			
	R/W	3484	Latency DI2	float32			
	R/W	3486	Latency DI3	float32			
	R/W	3488	Latency DI4	float32			
	R/W	3490	Latency DI5	float32			

	R/W	3492	Latency DI6	float32				
	R/W	3494	Latency DI7	float32				
	R/W	3496	Latency DI8	float32				
	R/W	3498	Latency DI9	float32				
	R/W	3500	Latency DI10	float32				

6.5.6 System

System	Date / Time	Contrast	Brightness	Password	Language	Alarm text
	Date				German	
	Time				English	
	Summer time Yes/No				Spanish	
	Set changeover time: Summer time Winter time				Portuguese	
					French	
					Italian	

Manipulation	Option		Communication card option
	Alarm output 1	Digital output 5	Alarm output 2
	Multi-use output 1	Digital output 6	Multi-purpose output 2
	Digital output 1	Manual reset	
	Digital output 2	Event logger	
	Digital output 3	Alarm	
	Digital output 4	Alarm text	
	Digital input 1	Digital input 2	
	Alarm	Alarm	
	Peak load calculation	Load peak calculation	
	Tariff switching	Tariff switching	
	Feedback (status monitoring)	Feedback (status monitoring)	
	Alarm blocking (for maintenance purposes and selector switch)	Alarm block (for maintenance purposes and selector switch)	

6.6 Manual

In "Manual mode," the switching outputs or digital outputs can be checked.

S	Normally open contact
A	Alarm output
M	Multi-use output

Activate -> YES

S1	S4	A1x
S2	S5	M1x
S3	S6	

Manual mode -> Digital outputs

Manual

DO1 ☐	DO5 ☐	DO9 ☐	Alarm 1 ☐
DO2 ☐	DO6 ☐	DO10 ☐	Multiuse 1 ☐
DO3 ☐	DO7 ☐	DO11 ☐	
DO4 ☐	DO8 ☐	DO12 ☐	

6.7 Data logger

The data memory records measurement and setting values that can be configured specifically for each customer.

6.7.1 Setup history

Up to 64 setting values that have been changed are stored with date, time, and setting value.

6.7.2 Alarm history

Up to 64 alarm messages are stored with date, time, and value.

6.7.3 Measured values

With the data storage option, the selected measured values can be displayed.

By selecting the values, they are recorded as an average value over the set sampling rate and written to the **microSD card** as a CSV file.

Measured values

Activate ☐

Sample rate s

☐

Voltage LN1

☐

Voltage L1L2

☐

Current L1

☐

Voltage LN2

☐

Voltage L2L3

☐

Current L2

☐

Voltage LN3

☐

Voltage L3L1

☐

Current L3

☐

Current 4

☐

P L1

☐

P L2

☐

P L3

☐

P total

☐

Q L1

☐

Q L2

☐

Q L3

☐

Q total

☐

S L1

☐

S L2

☐

S L3

☐

S total

☐

cos (φ) L1

☐

PF L1

☐

tan (φ) L1

☐

U fund. L1

☐

I fund. L1

☐

WP import L1

☐

WP export L1

☐

WQ ind. L1

☐

WQ cap. L1

☐

THDU L1

☐

THDI L1

☐

φ L1

☐

cos (φ) L2

☐

PF L2

☐

tan (φ) L2

☐

U fund. L2

☐

I fund. L2

☐

WP import L2

☐

WP export L2

☐

WQ ind. L2

☐

WQ cap. L2

☐

THDU L2

☐

THDI L2

☐

φ L2

☐

cos (φ) L3

☐

PF L3

☐

tan (φ) L3

☐

U fund. L3

☐

I fund. L3

☐

WP import L3

☐

WP export L3

☐

WQ ind. L3

☐

WQ cap. L3

☐

THDU L3

☐

THDI L3

☐

φ L3

☐

cos (φ) sum

☐

PF sum

☐

tan (φ) sum

☐

I fund. 4

☐

WP import sum

☐

WP export sum

☐

WQ ind. sum

☐

WQ cap. sum

☐

THDI 4

☐

Frequency

☐

Temp. internal

☐

Temp. external

☐

digital inputs

☐

digital outputs

☐

I th. damped L1

☐

I th. damped L2

☐

I th. damped L3

☐

I th. damped 4

☐

P th. damped L1

☐

P th. damped L2

☐

P th. damped L3

☐

I earth fault

Activate Sampling rate max. 3600 sec. Set signal

6.7.4 Event logger

The event memory records the current and voltage values with a sampling rate of up to 1600 Hz over a period of up to 10 seconds before the event. Please note that the sampling rate decreases dynamically as the recording time and number of values increase.

Recording can be started using the parameters listed. The selected measured values are stored on a memory card and made available as a CSV file for detailed evaluation on a computer.

Event logger

Activate ☐

Signal logging selection

Trigger selection

Recording duration s

Wave pre trigger %

☐

Voltage L1

☐

Current L1

☐

Voltage L2

☐

Current L2

☐

Voltage L3

☐

Current L3

☐

Current 4

The event triggers can be selected on the alarm page.

6.7.5 Export
Setup history

Alarm history

6.7.6 Eject card

NO YES

6.8 System info

APP:	MPFC	Application
SW:	V01.00.00	Software version Basis
HW:	V00.00.01	Hardware revision Base
SN	102200000001	Serial
OPT:	LOG	Options
M 1:	12R	Module slot 1
HW	V01.01.02	Hardware revision
M	IEC61850	Module slot 2
HW:	V01.01.02	
SW:	V02.01.01	

7 Applications

Monitoring under/over voltage
of the 3 phases L1, L2, L3 against N

Set 3 alarms with the signal:

Voltage LN1 (V),

Voltage LN2 (V),

Voltage LN3 (V),

Type: In range

Minimum: 207 V

Maximum: 253 V

Trip delay: 1.0 seconds

Feedback:

D1= blocked by D11

D2= blocked by DI2

A = Alarm message

ET = Event trigger

Alarm 1

Signal
Type

Voltage LN1 [V]
In range

MIN
MAX

207.0
253.0

Delay
Delay

1.0
1.0

A1 M1 1 2 3 4 5 6 7

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

8 9 10 11 12 D1 D2 RM A AT ET

☐ ☐ ☐ ☐ ☐ ☒ ☒ ☐ ☒ ☐ ☒

Feedback
Latency

No function
0.1

Alarm 2

Signal
Type

Voltage LN2 [V]
In range

MIN
MAX

207.0
253.0

Delay
Delay

1.0
1.0

Alarm 3

Signal
Type

Voltage LN3 [V]
Out range

MIN
MAX

207.0
253.0

Delay
Delay

1.0
1.0

A1 M1 1 2 3 4 5 6 7

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

8 9 10 11 12 D1 D2 RM A AT ET

☐ ☐ ☐ ☐ ☐ ☒ ☒ ☐ ☒ ☐ ☒

Feedback
Latency

No function
0.1

Alarm 4

Signal
Type

No function
Out range

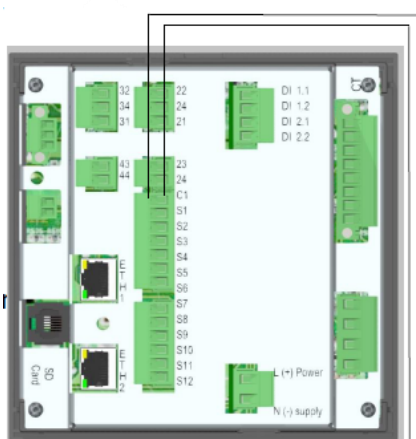
MIN
MAX

0.0
0.0

Delay
Delay

0.0
0.0

What can the digital outputs be used for?



Klemmenblock

Alarm 1

Signal Type

P total [W] Out range

MAX MIN

30.0 k 0.0

Delay Delay

0.0 s 0.0 s

AL MU 1 2 3 4 5 6 7 8

☐ ☐ ☒ ☐ ☐ ☐ ☐ ☐ ☐ ☐

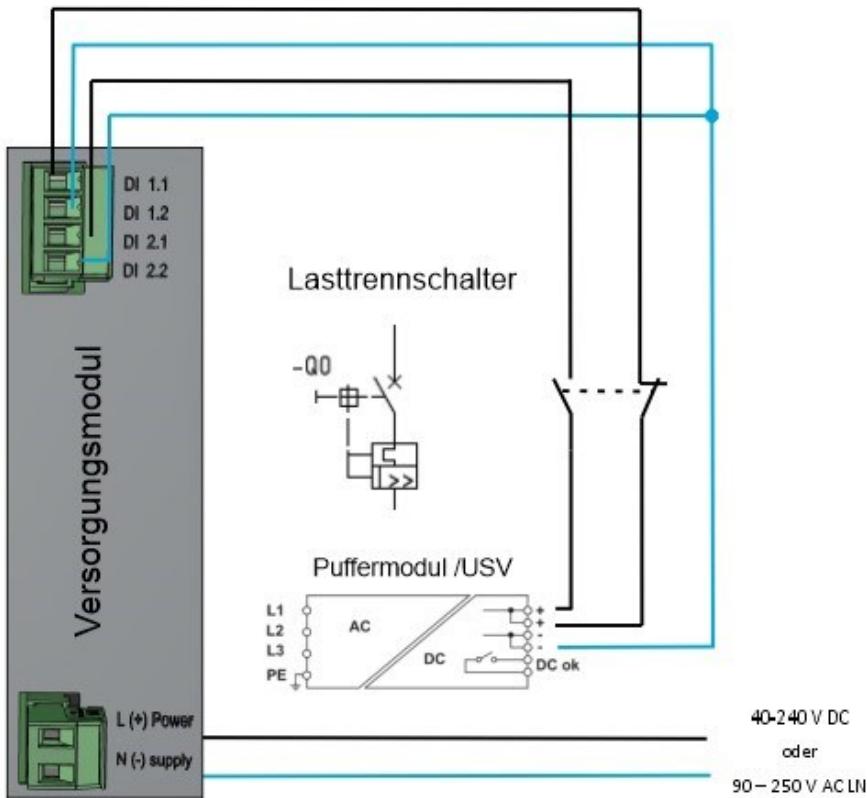
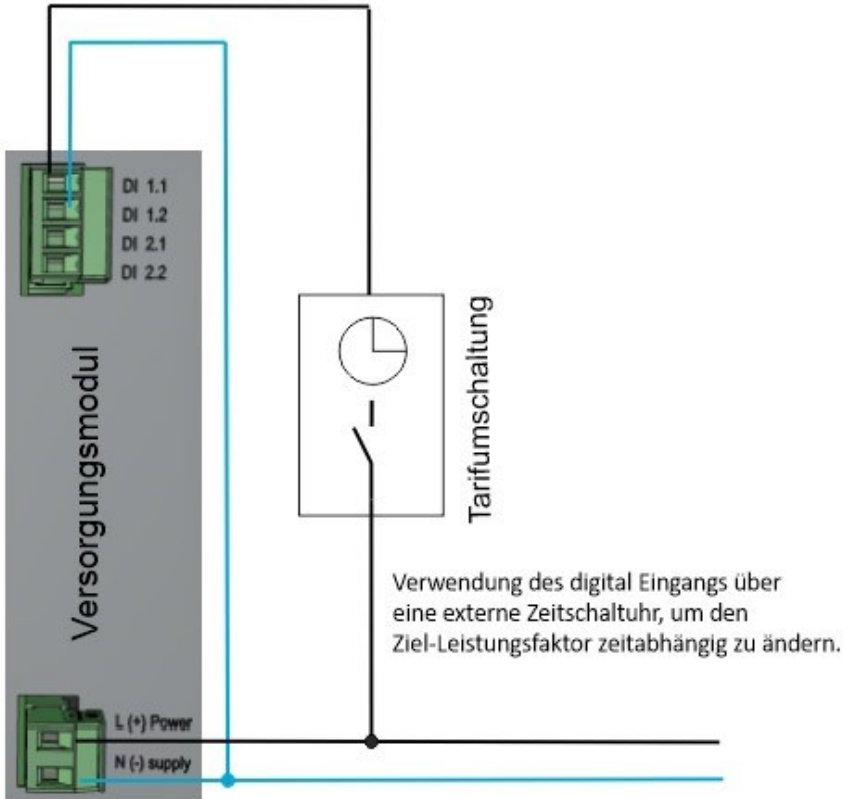
9 10 11 12 DI1 DI2 RM A AT ET

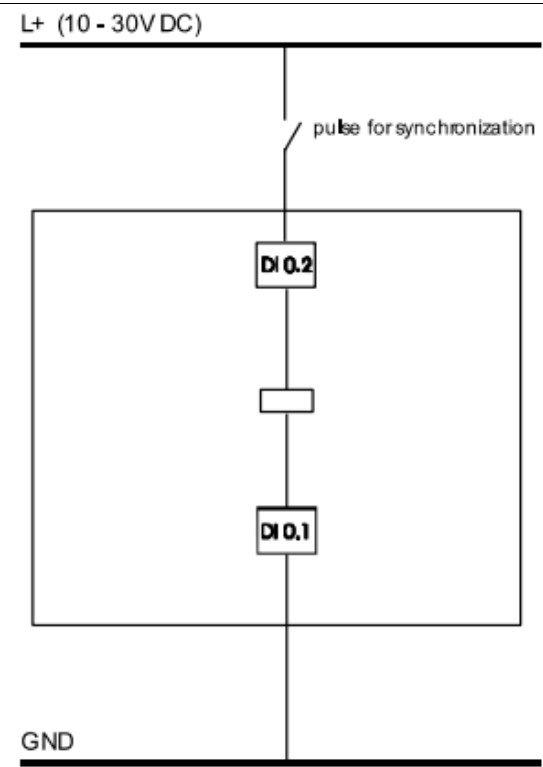
Feedback Latency

DI2 1.1 s

A switching command can be triggered. After a set limit value has been exceeded.

What can the digital inputs be used for?

 40-240 V DC oder 90-250 V AC LN	Switch monitoring
 Verwendung des digital Eingangs über eine externe Zeitschaltuhr, um den Ziel-Leistungsfaktor zeitabhängig zu ändern.	Tariff switching



Synchronization:
Triggered by an impulse from the digital input (setting "System") , the entire effective power average is reset to zero.

Function: Load peak calculation
Over 15 minutes (adjustable).
Can only be read via Modbus for the measured values.
The last value and the current value are displayed.

Event recorder Digital input as trigger alarm

Alarm 1

Signal

DI 1

OFF Low Delay 5.0 s

ON High Delay 5.0 s

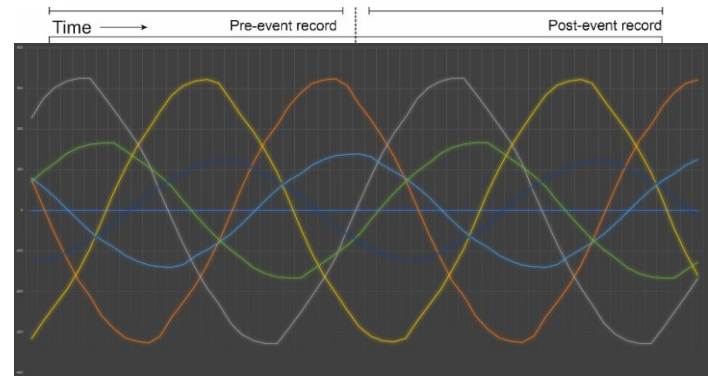
A1 M1 1 2 3 4 5 6 7

8 9 10 11 12 DI D2 RM A AT ET

Feedback No function Latency 0.1 s

Setting ET = event trigger

5 seconds **before** alarm event
5 seconds **after** alarm event



Event logger

Activate ☒

Signal logging selection

Recording duration 0.02 s

Wave pre trigger 0 %

Voltage L1 ☒
Current L1 ☐
Voltage L2 ☒
Current L2 ☐
Voltage L3 ☒
Current L3 ☐
Current 4 ☐

The event triggers can be selected on the alarm page.

Information on "shelf life," which refers to the storage life:

The device does not contain a battery

Alarm message via Modbus if a phase fails.

Alternatively, **rotating field monitoring**

In the event of a phase failure: no rotating field -> alarm message.

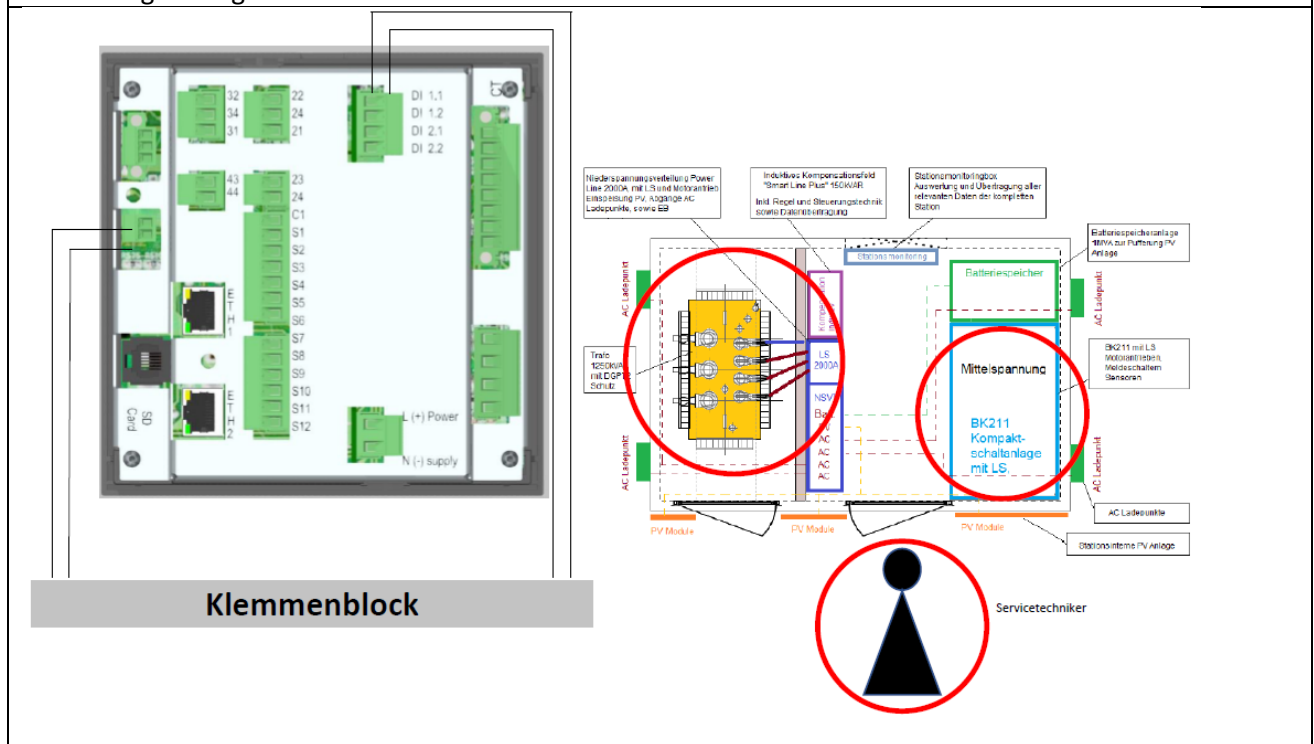
Function of the data logger/data memory?

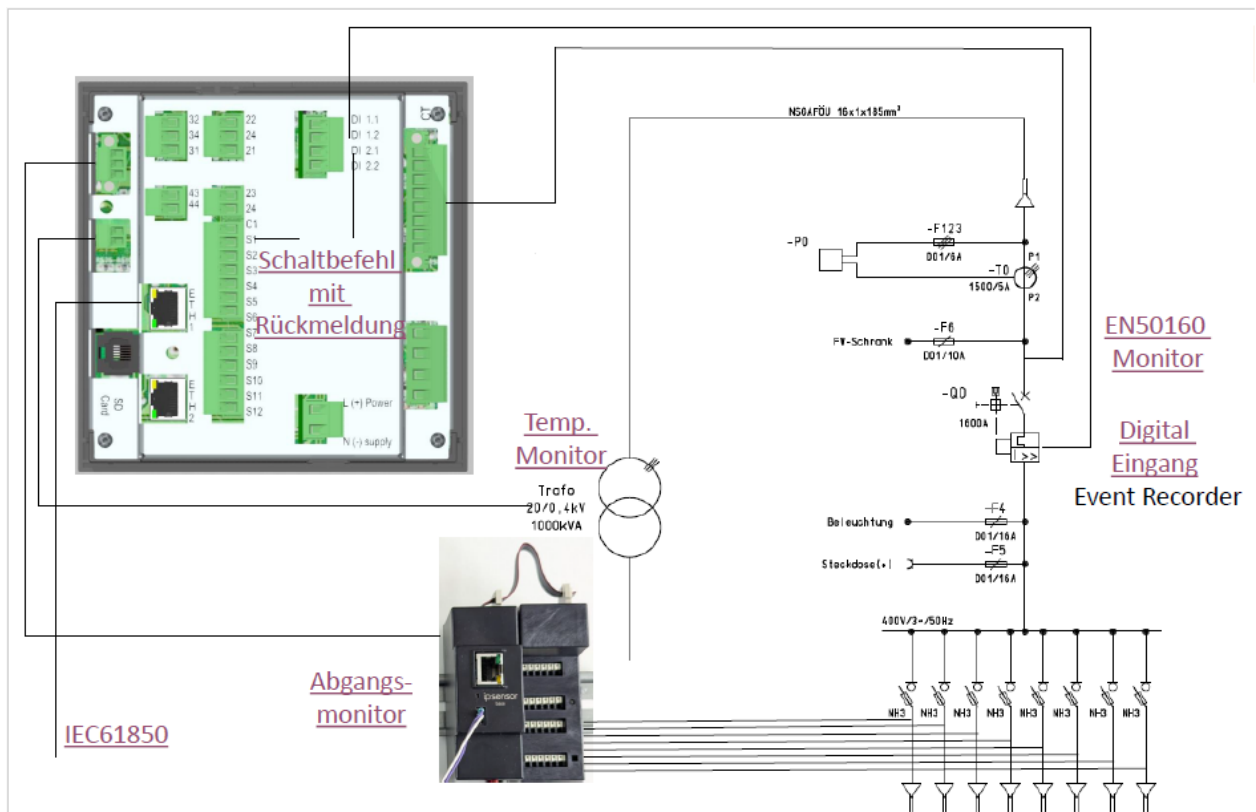
Select measured values manually from the available selection list.

Prerequisite: A **microSD card** is available to store the data.

Application: transformer station

- Temperature monitoring of transformer
- Alarm trigger, e.g., switch
- Alarm suppression
- e.g. during maintenance work





Output monitoring


Alarm 1

Signal
Type

S total [VA]
Out range

MAX
MIN

60.0 k
0.0

Delay
Delay

2.0 s
0.0 s

AL MU 1 2 3 4 5 6 7 8

9 10 11 12 DI1 DI2 RM A AT ET

Feedback
Latency

No function
0.0 s


Alarm 2

Signal
Type

P total [W]
Out range

MAX
MIN

50.0 k
0.0

Delay
Delay

2.0 s
0.0 s


Alarm 3

Signal
Type

cos(φ) sum
Out range

MAX
MIN

0.9
1.1

Delay
Delay

4.0 s
4.0 s

AL MU 1 2 3 4 5 6 7 8

9 10 11 12 DI1 DI2 RM A AT ET

Feedback
Latency

No function
0.0 s


Alarm 4

Signal
Type

No function
In range

MAX
MIN

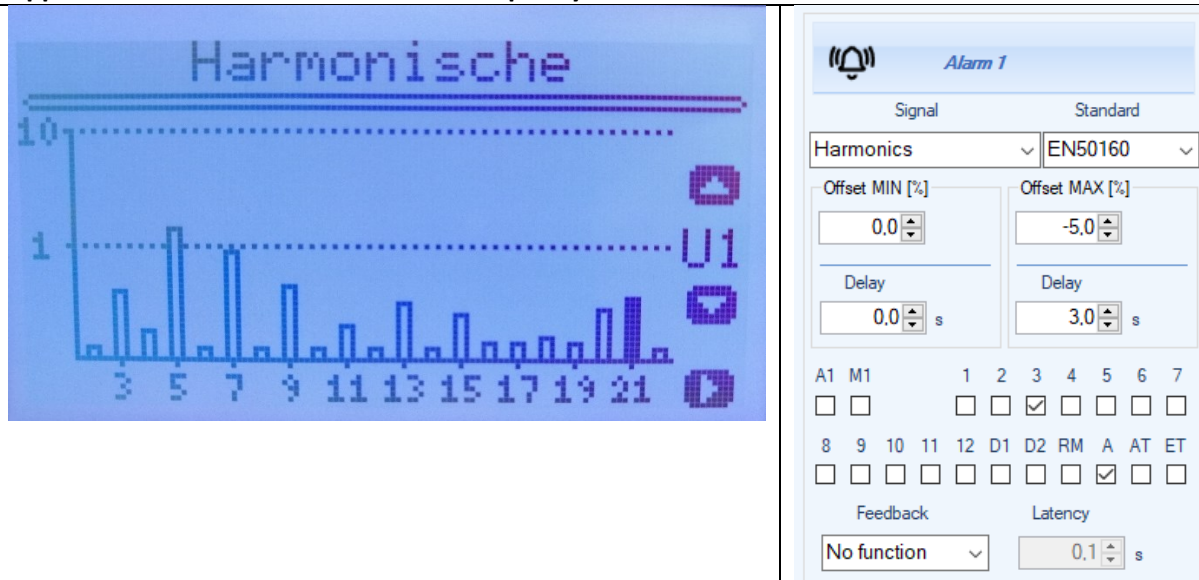
0.0
0.0

Delay
Delay

0.0 s
0.0 s

Messung	1	2	3	4	5	6	7	8
Effektivwert der Spannung	X	X		X				X
Frequenz	X	X	X	X	X	X	X	X
Effektivwert des Stroms	X	X	X	X	X	X	X	X
Wirkleistung	X	X	X	X	X	X	X	X
Scheinleistung	X	X	X	X	X	X	X	X
Blindleistung	X	X		X	X		X	
Cosinus Phi	X	X	X	X	X	X	X	X
Wirkenergie	X	X	X	X	X	X	X	X
Dreiecksspannung	X	X	X		X		X	X

Application Limit value exceeded Power quality EN50160



If the limit value defined in EN50160 for a single harmonic is exceeded, the corresponding harmonic is completely colored in the bar graph.

8 Technical data MPFC-EM

Device type: MPFC-EM

Supply voltage AC		OPTION: DC supply voltage	
L N	Phase - Neutral: 90 - 317 V AC (+/- 10%) Phase - Phase: 155 - 550 V AC (+/- 10%)	+ -	40 - 240 V DC (+/-10%)
Overvoltage category IEC/EN/UL/CSA 61010-1 (VDE 0411-1)	CAT III Phase - Neutral: < 300V AC Phase - Phase: < 519V AC CAT II Phase - Neutral: 300 – 317V AC Phase – Phase: 519 – 550V AC	Overvoltage category IEC/EN/UL/CSA 61010-1 (VDE 0411-1)	CAT III 40 - 240 V DC
Rated impulse voltage	CAT III 4 kV CAT II 2.5 kV	Rated impulse voltage	CAT III 4 kV
Power consumption max.	9 VA (90 V AC LN) to 55 VA (550 V AC LL)	Power consumption max.	9 VA
Max. current consumption	100 mA	Max. current consumption	225 mA
Fuse protection Line protection	10	Fuse protection	10
Frequency range	45 - 65 Hz	Internal fuse	Type T3.15 A / 400 DC according to IEC 60127-2
Digital input 2 x DI		Digital input 2 x DI	
DI 1.1 / 1.2 DI 2.1 / 2.2	90 – 250 V AC LN	DI 1.1 / 1.2 DI 2.1 / 2.2	40 – 240 V DC
Voltage measurement			
Measuring range	40 - 600 V AC TRMS		
UL3 UL2 UL1 UN	Direct measurement 40–600 V AC TRMS or via voltage transformer -> VT ratio adjustable up to 5000		
Response threshold	35 V AC TRMS		
Fuse	10		
Sampling frequency	6.4 kHz (128 samples/period)		
Power consumption	0.2 VA		
Impedance	3 MOhm / phase		
Current measurement CT	Only via external current transformers for energy monitoring With reinforced insulation according to IEC 61010		
Measuring range	10.0 mA - 6.0 A		
Continuous overload	10		
Overload for 1 second	120 A (sinusoidal)		
Sampling frequency	6.4 kHz (128 samples/period)		
Power consumption	1 VA		

4-phase current measurement L4 K4 L3 K3 L2 K2 L1 K1	Only via external current transformers! (x/1A); (x/5A)		
Measurement accuracy	Measuring voltage: +/- 1 Measuring current: +/- 1%		
Measurement category IEC/EN/UL/CSA 61010-2-030 (VDE 0411-2-030)	CAT IV: ≤ 300 V AC CAT III: > 300 V AC to 600 V AC		
Alarm outputs		Multi-use outputs	
12 32	1 or 2 potential-free changeover contacts (depending on configuration) Switching capacity (resistive load): 250 V AC/5A according to UL Duty cycle 100%	23 43	1 or 2 potential-free N/O normally open contacts (depending on configuration) Switching capacity (ohmic load): 250V AC/5A according to VDE 400V AC/1A according to VDE 48V DC/1A according to VDE 110V DC/0.2A according to VDE Duty cycle 100%
Relay outputs		OPTION I	IEC61850
Power C1	max. 10A Common supply	ETH1 ETH2	Transmission rate: 100 Mbit/sec
S1-6 S1-12	Switching capacity (ohmic load): 250V AC/5A according to VDE 400V AC/1A according to VDE 48V DC/1A according to VDE 110V DC/0.2A according to VDE Switching capacity (ohmic load): 250V AC/5A according to UL 30V DC/5A according to UL Duty cycle 100% up to		

	45°C ambient temperature Duty cycle 50% up to 50°C ambient temperature		
Modbus RTU interface		Analog input	
A (+) / GND / (-) B	Modbus RS485 (standard) Slave Transmission rates: 1200; 2400; 4800; 9600, 19200; 38400; 57600, 115200 baud	External temp	Only for 22k NTC External temperature sensor
Internal temperature measurement			
Under the housing cover	Type: NTC 22k Accuracy: +- 3 °C		
General			
Ambient temperature	Operation: -20 °C – 45 °C Storage: -40 °C – 85 °C	Cutout	138x138 (+0.5) mm
Humidity	Range: 0% – 95% Condensation: Not permitted	Dimensions	144 x 144 x 90 mm
Altitude	Up to 2000 m above sea level	Weight	Approx. 0.85 kg
Degree of contamination	2		
Protection	Front: IP50 Front with full-view door and seal: IP54 Rear: IP20	Housing	Front: Plastic device housing (UL94-VO), rear: metal
Protection class	1		
OPTIONS L	Data logger / Event recorder	HS code	90303200

Connection values Screw terminals, pluggable, max. 2.5 mm ²		Cross-section:
2-pole terminal	Fine-stranded conductors with ferrule: 2 conductors of the same cross-section, flexible with TWIN ferrule with plastic sleeve: Single-wire conductors with ferrule: Stripping length: Tightening torque:	0.2 – 2.5 mm ² , AWG 24-12
4-pole terminal		0.5 -1.0 mm ² , AWG 30-16
4-pole terminal		0.2 – 2.5 mm ² , AWG 24-12
8-pin terminal		7 mm
3-pin terminal		0.5 – 0.6 Nm
2-pole terminal		
7-pin terminal		
6-pin terminal		
3-pin terminal		

2-pin terminal		
7-pin terminal		
6-pin terminal		

Connection values for external temperature sensor interface		Cross-section:
2-pin terminal	Fine-stranded conductors with ferrules:	0.2 – 1.0 mm ² , AWG 30-16
Ext. 1	Single-wire conductors with ferrule:	0.2 – 1.0 mm ² , AWG 30-16
Ext. 2	Stripping length:	5 mm
	Tightening torque:	0.3

Connection values Modbus interface		Cross-section:
3-pin terminal	Fine-stranded conductors with ferrules:	0.2 – 1.0 mm ² , AWG 30-16
A (+) / GND / (-) B	Single-wire conductors with ferrule:	0.2 – 1.0 mm ² , AWG 30-16
	Stripping length:	5 mm
	Tightening torque:	0.3

Measured	
The following measured values are available for each phase individually and as a total value:	Individual harmonics as bar chart and table in %, frequency, operating hours of the device, operating hours of compensation stages, switching cycles Compensation stages, Internal temperature, External temperature, Average power factor, Maximum values: Voltage, Current, temperature, THDU, TDUI, Reactive power inductive / capacitive Active power import/export
Voltage phase – neutral, voltage phase – phase, Voltage fundamental wave, Current, Current fundamental wave, Thermally damped current active power, Reactive power, apparent power, Thermally damped active power Reactive power missing to control target, Cos phi, Power factor, tan phi, Phase shift, THD U, THD I,	

9 Service

The device undergoes various safety tests before delivery and is marked with a seal. If a device is opened, the safety tests must be repeated. A warranty is only provided for unopened devices.

If you have any questions that are not answered or described in this manual, please contact the manufacturer. Please have the following information ready when contacting us:

- Device name (see type plate)
- Serial number (see type plate)

- Contents of system info
- Measuring voltage and supply voltage
- Detailed description of the fault

9.1 Device defective

Before returning defective measuring devices to the manufacturer for inspection, contact the manufacturer's support team.

Send the device for inspection to the following address, quoting the RMA number assigned to you:

BELUK GmbH | Taubenstraße 1 | 86956 Schongau

9.2 Maintenance

! WARNING

Warning against unauthorized tampering or improper use of the device.



Opening, dismantling, or unauthorized manipulation of the device beyond the specified mechanical, electrical, or other operating limits may result in property damage or injury, including death. Only qualified electrical personnel may work on devices and their components, assemblies, systems, and electrical circuits! Always use your device or component as described in the accompanying documentation.

! NOTE

Care and cleaning of the display:

The use of water or other solvents, such as denatured alcohol, acids, or acidic agents on the front cover or display, may damage or destroy the device during cleaning.

Water can penetrate the device housing and destroy the device.

Clean the device, the front film, or the display with a soft cloth. For heavy soiling, use a cloth moistened with clear water. Clean the front film and the display, e.g., of fingerprints, with a special LCD cleaner and a lint-free cloth.

Do not use acids or acidic agents to clean the device.

9.3 Disposal

Please observe national regulations for the disposal of the measuring device!

If necessary, dispose of individual parts according to their nature and existing country-specific regulations, e.g. as

- electrical waste
- plastics
- metals

Commission a certified disposal company to scrap the device.