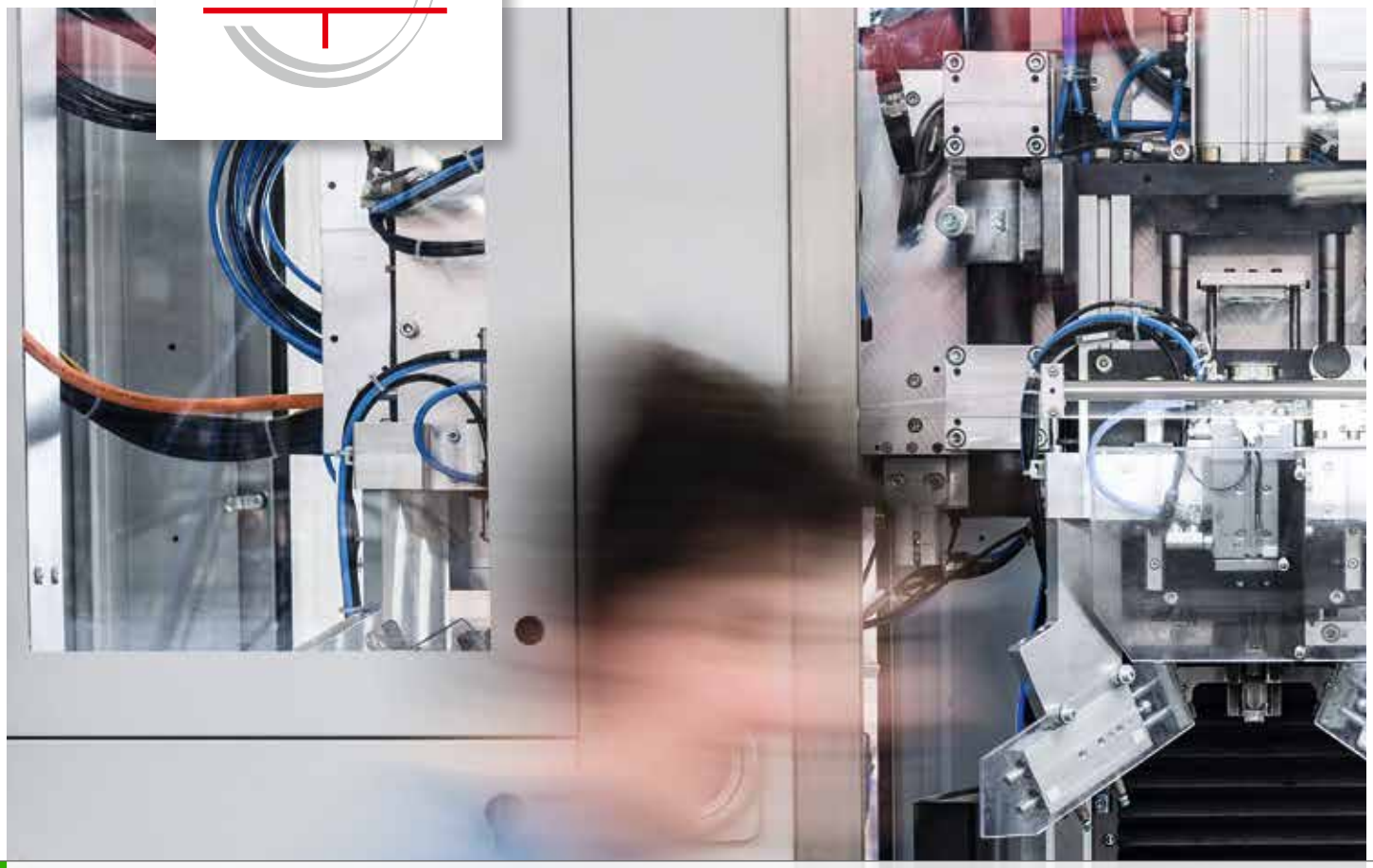
FRAKO

MAIN CATALOGUE **2016**



POWER FACTOR CORRECTION

POWER QUALITY

ENERGY MANAGEMENT

www.frako.com

FRAKO – Leading-edge technology for safe and reliable network solutions

FRAKO's mission is to provide solutions that are designed and optimized to meet the needs of our customers. Our accumulated experience and our expertise in development and manufacture are applied to achieve this. The operational reliability of our products is as well known internationally as our track record in developing new solutions.

Every sphere, every activity and every operation of our company is hallmarked by quality. This bears fruit in FRAKO's renowned product quality as well as the quality of our advisory and field services. We value reliability, punctuality and transparency with the same commitment we have for durability and performance. This is why FRAKO today leads the entire world in its areas of business:

- High quality capacitors
- Individually specified power factor correction systems
- Efficient power quality solutions
- Intelligent Energy Management Systems
- Dependable customer service before and after sales

Our customers and business partners know that: FRAKO means quality, and that quality means safety and reliability. Because of this we can shoulder the responsibility for the correct functioning, profitability and environmental compatibility of our products and can guarantee their safety to life, limb and property. We are in a position to fulfil the most demanding requirements and develop innovative solutions to suit individual needs.

Our excellently trained and motivated employees have the technical competence and in-depth expertise to design and implement new installations successfully. We ourselves also take particular care to ensure that energy is used sparingly and efficiently in the manufacture and operation of our products. Our own energy consumption and the emissions generated are continually monitored with our in-house Energy Management System to ensure that we achieve the highest levels of energy efficiency and environmental compatibility.

For the future we are committed to an ongoing and intensive effort to maintain our leading position and to justify the trust placed in us by our customers in the fields of power quality, energy cost minimization and energy efficiency.

At FRAKO we look forward to developing, manufacturing and supplying innovative and productive systems for our customers and business partners in the future.

Dr. Matthias Sehmsdorf Achim Lösch

QUALITY means safety and reliability

Exacting and ever more demanding quality specifications in all areas are the criteria for our products and services.

A particularly important role in meeting this challenge is our individual advisory and project planning. The basis for our successful cooperation with our customers is given by our certified quality and environmental management systems and our own research and development departments. On top of this we always adhere to our guiding principles that make us a straightforward and agreeable partner to work with. You can always take us at our word; for us that is as much a matter of course as being able to deliver, delivering on time and reacting promptly to handle any complaints.

As a supplier of complete systems, we pay attention to the quality and good working order of every individual component. In this way we achieve the high profitability and increased service life of our installations and systems. We fulfil the most exacting requirements in all areas: when advising customers, honouring commitments and turning individual needs into concrete products and special services.

FRAKO POWER CAPACITORS

FRAKO power capacitors offer 'Made in Germany' quality and form the optimum basis for both fixed installed capacitance for specific duties and controlled power factor correction systems. Our power capacitors incorporate a fourfold safety system for maximum operational reliability. They are the first choice when consumers worldwide need to reduce reactive power, improve power quality and avoid charges for reactive demand.

Distinct advantages of our power capacitors:

- High overload capability
- Long service life
- Maximum operational reliability

FRAKO's patented power capacitors are lead-free because of the patented contact ring and comply with the RoHS Directive. They are available in Basic, Standard, Premium and Heavy Duty versions, so that you can specify the ideal power capacitor for your individual requirements in terms of ampacity, ambient temperature and expected service life.

POWER QUALITY & POWER FACTOR CORRECTION

Poor power quality in the supply network can result in upsets or even failure in technical equipment and installations. FRAKO power quality products offer the right solution to maintain the quality of the power supply at a high level.

FRAKO's power factor correction and filter systems are individually designed for the user, as are our active harmonic filters.

They are installed at those locations where electrical energy is to be saved, voltage fluctuations avoided and harmonics eliminated, or simply where reactive power must be compensated.

ENERGY MANAGEMENT SYSTEMS

FRAKO Energy Management Systems help your company to cut costs and achieve energy efficiency.

The FRAKO Energy Management System supplies the optimum basis for all decisions to be made in optimizing energy consumption. With a FRAKO Energy Management System in place, the flow of utilities in the company is made transparent, their costs can be clearly allocated and accurately charged for, and approaches to saving energy become much easier to identify.

CUSTOMER SERVICES

FRAKO's range of services offers a comprehensive program for achieving high energy efficiency and availability.

Particular importance is attached to the individual advisory and training services offered to our customers, special inspection and maintenance contracts and customized project execution. Every solution that we propose to our customers is based on detailed network measurement readings and an in-depth analysis of the status quo and individual requirements.

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und Anlagenbau GmbH
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K18-0657
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FRAKO

POWER FACTOR CORRECTION

1 Components

LKT
Power Capacitors

FRAKO Power Capacitors are installed in power factor correction systems and in passive filters.

FRAKO Power Capacitors have been developed and manufactured for decades solely at the company‘s Teningen production site in Germany. This has resulted in a consistently high product quality being maintained, the basis for assured operational reliability and a long service life.

Application Recommendations

FRAKO offers Power Capacitors for a variety of applications. They are divided into four separate categories with different specifications:

- Basic Capacitors
- Standard Capacitors
- Premium Capacitors
- Heavy Duty Capacitors

FRAKO Power Capacitors with **UL/CSA certification**:

Please contact us if you require information on our UL/CSA series of Power Capacitors.

FRAKO Power Capacitors are available as single-phase and 3-phase versions.

Voltage and power ranges:

- Nominal voltage: 240–800 V, 50 / 60 Hz
- Nominal power: 1.0–40.0 kvar

Design & quality

FRAKO Power Capacitors are manufactured in a unique dry design. Each comprises up to three interconnected capacitor coils wound in a low-loss, metallized polypropylene film and enclosed in a cylindrical aluminium casing provided with an M12 mounting stud. In addition to a PCB-free, flame-resistant mineral filler material, the casings also contain an adhesive stabilizer. Discharge resistors, permanently connected in the factory, guarantee that the residual voltage falls to <50 V within one minute after the capacitor has been disconnected. The electrical connections are by means of female slide connectors (IP00) or a patented spring-clamp connector (IP20) available separately.

The use of rigorously inspected materials and their careful processing guarantee excellent quality and a long product service life. FRAKO manufactures its Power Capacitors to its own in-house specifications, which are far more exacting than the requirements of the applicable standards.

Quality control inspections after each individual manufacturing step ensure that the final product is of a high quality. These demanding quality standards, together with specially developed manufacturing technology, enable FRAKO Power Capacitors to achieve a longer-than-average service life. At the end of the manufacturing process, each capacitor is inspected individually. The in-house requirements for this special inspection are considerably more stringent than those of the routine tests specified by the relevant standards.

Standards

All FRAKO Power Capacitors comply with the international standards IEC 60831-1 and -2, and of course with EN 60831 1 and -2. In addition, a special series developed for the North American market complies with the requirements of UL 810 and CSA 22.2 No. 190.

Four safety features ensure uninterrupted operation

The reliability of Power Capacitors is crucially important for the problem-free operation of power factor correction systems and passive filters. FRAKO's measures to ensure this are now fourfold:
Power Capacitors nowadays usually use polypropylene as the dielectric material, its surfaces being metallized. This design has the important property that if local overloading occurs and punctures the substrate film, the fault automatically isolates itself, a phenomenon known as **self-healing**.

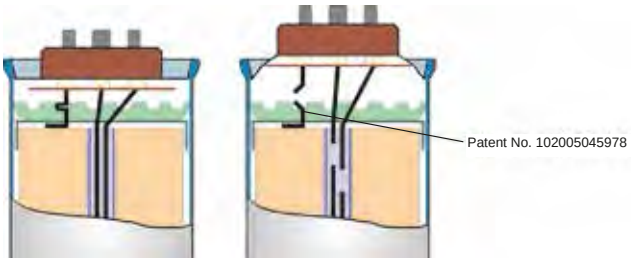
Self-healing is due to the heavy short-circuit current that flows between the films immediately vaporizing the very thin metal coating at the damaged location, thus ending the flow of current.

If several punctures occur in a small area of metallized film, the amount of energy involved might be too much for the **self-healing** action alone to cope with. This could lead to complete failure of the capacitor. However, in this case the second fail-safe function of the fourfold safety design comes into play: the **segmented metallization.**

In the manufacturing process, the polypropylene film for FRAKO Power Capacitors is metallized by vapour deposition to form a pattern of separate individual segments. Each segment is connected to the power supply by slender contact bridges, these being so dimensioned that when severely overloaded (several substrate punctures within one segment), they act as fuses by simply vaporizing, thereby securely isolating the damaged segment from the power supply.

The **segmented metallization** technique increases the reliability of the capacitors and prolongs their service life.

The third design feature for increases product safety is the three-phase **overpressure disconnector**, a mechanical fuse included in every FRAKO capacitor.
If an excessive internal pressure develops due to overloading, or at the end of the capacitor's service life, the mechanical fuse isolates the capacitor safely from the power supply by disconnecting all poles. Should puncturing of the dielectric occur on a major scale, this results in the substrate film melting and generating gases inside the casing, thus building up pressure in the capacitor. This causes the diaphragm lid to bulge outwards, thereby tensioning the internal leads to the coils until they act as mechanical fuses, breaking cleanly at defined locations. The bulging of the lid also increases the internal volume, therefore reducing the pressure inside the capacitor.



Principle of the overpressure disconnection system

In 2015, FRAKO added the patented **contact ring** to the other safety and reliability features, thus making them fourfold.

These patented rings are stamped from a special alloy and are formed with a number of pointed teeth that press into the zinc end-face contact layers on the windings to make electrical contact. The internal connecting leads are spot-welded to the **contact rings** before final assembly of the capacitor.

The great advantage of this solder-free design: it has completely excluded the risk of damaging the capacitor windings at the manufacturing stage due to overheating during soldering of the connecting leads. The quality of the winding connection is significantly increased, and the reliability of the mechanical fuse that protects against excessive internal pressure is improved by its being securely spot-welded in place.

The **contact ring** also enables FRAKO to produce completely lead-free capacitors and make yet another improvement to their operating reliability.

Special technical features

In our ongoing development work on FRAKO Power Capacitors, we always focus on those attributes that are called for in present-day applications. The three following factors are especially important:

- Overvoltage tolerance
- Current-carrying capacity
- Thermal endurance

Overvoltage tolerance

As required by the standards IEC 60831-1 & -2, as with EN 60831-1 & -2, all FRAKO Power Capacitors are designed to withstand the following overvoltages:

8 hours daily:	1.10 × capacitor nominal voltage
30 minutes daily:	1.15 × capacitor nominal voltage
5 minutes:	1.20 × capacitor nominal voltage
1 minute:	1.30 × capacitor nominal voltage

The following table shows a selection of nominal voltage ratings and maximum overvoltages:

Capacitor nominal voltage	240	400	440	480	525	600	690	760	800
8 hours daily	264	440	484	528	578	660	759	836	880
30 min daily	276	460	506	552	604	690	794	874	920
5 minutes	288	480	528	576	630	720	828	912	960
1 minute	312	520	572	624	683	780	897	988	1040

All voltages in volts [V]

Current-carrying capacity

All over the modern world, harmonics are polluting the electricity supply networks. The increasing use of devices such as frequency converters has a growing impact on capacitors. If these are operated in a power supply network contaminated by harmonics, dangerous resonances can result, which can again significantly increase the currents that the capacitors must withstand.

The applicable standards call for a continuous current-carrying capacity of at least 1.3 times the nominal current to be designed for in Power Capacitors. In reality, however, even this value can be exceeded under conditions with extreme levels of harmonics.

For this reason, all FRAKO Power Capacitors are designed for a continuous current-carrying capacity of at least 1.5 times the nominal current. More information on ampacity is given in the specifications table on the following page.

Thermal endurance

Excessive temperatures also have a negative impact on the service life of a capacitor. Storage or operation of capacitors above their permitted temperature limits results in a drastic shortening of their service life. Power Capacitors are assigned to different temperature classes according to the permitted ambient temperature as follows:

Temperature class	Maximum ambient temperature		
	Absolute maximum temp.	Max. average temp. over 1 day	Max. average over 1 year
B	45 °C	35 °C	25 °C
C	50 °C	40 °C	30 °C
D	55 °C	45 °C	35 °C

The temperatures stated above refer to the direct environment of the capacitors. This means the internal temperature in the enclosure or control cabinet that houses them. Experience shows that the limits given in the table for the temperature classes can easily be exceeded in practice. Higher temperatures are to be expected in particular in the case of power factor correction systems fitted with filter reactors.

Power Capacitors in the Standard, Premium and Heavy Duty categories are therefore designed for continuous ambient temperatures of at least 60 °C.

This continuously rated thermal endurance is helped by the compact construction of the capacitors, which is conducive to optimum heat dissipation.

Patented capacitor connections

FRAKO Power Capacitors can be fitted either with standard slide connectors or, as optional extra, WAGO CAGE CLAMP® (AKD) connectors.

These patented, tried-and-tested connectors use special spring clamps that ensure a simple, vibration-resistant and maintenance-free electrical contact with the capacitor. They can be used to connect single-core, stranded or fine-filament copper cables. AKD connectors meet IP20 requirements and therefore provide protection against objects such as fingers inadvertently touching live conductors.

Article No.	Designation	Capacitor type and diameter
31-08000	AKD 25/3	3-phase, 60/70 mm
31-08002	AKD 25/2	1-phase, 60/70 mm
31-08003	AKD 30/3	3-phase, 85 mm
31-08004	AKD 30/2	1-phase, 85 mm
31-08005	AKD-UL	3-phase, 85 mm (specified as per UL)

Accessories

FRAKO Power Capacitors with 60 and 70 mm diameters that use standard slide connectors can be provided with an insulating cap to cover their terminals. Using the insulating cap then increases ingress protection to IP54.

Article No.	Designation	Description
69-00352	LKK 60	Insulating cap for Ø 60 mm Power Capacitors
69-00350	LKK 70	Insulating cap for Ø 70 mm Power Capacitors
69-00353	LKK	Cable sleeve for insulating caps LKK 60/70

Specifications of FRAKO Power Capacitors

Category	Basic	Standard	Premium		Heavy Duty
Type designation	LKT …-DB	LKT …-DP	LKT …-DL		LKT …-HD
Nominal voltage	400–525 V	280–800 V	400–525 V	440–615 V[1]	480–525 V
Nominal frequency	50/60 Hz				
Power rating	5.0–36 kvar	5.0–40 kvar	1.0–24 kvar	1.2–29 kvar	16.8–21.6 kvar
Capacitance tolerance[2]	-5 / +5 %				
Dielectric losses	0.2 W / kvar				
Power loss	0.5 W / kvar				
Residual voltage after 60 seconds discharge time	≤50 V				
Maximum overvoltage	1.10 x V_N – 8 hours daily 1.15 x V_N – 30 minutes daily 1.20 x V_N – 5 minutes 1.30 x V_N – 1 minute				
Maximum continuous overcurrent at nominal voltage (50 Hz)	1.5 x I_N	1.8 x I_N	2.2 x I_N	2.0 x I_N	2.7 x I_N
Maximum inrush current at nominal voltage (50 Hz)	200 x I_N	250 x I_N	300 x I_N	272 x I_N	450 x I_N
Test voltage (metal film–metal film)	2.15 x V_N, 2 seconds 1.85 x V_N, 18 seconds				
Test voltage (metal film–casing)	V_N < 600 V = 3.9 kV, 2 seconds V_N > 600 V = 4.3 kV, 2 seconds				
Insulation voltage rating dependent on V_N and diameter	3.9 / 8 kV 3.9 / 12 kV 4.3 / 8 kV 4.3 / 12 kV				
Temperature class	-25 / D	-40 / 60	-40 / 65	-40 / 60	-40 / 68
Min. / max. temperature[3]	-25 / +55 °C	-40 / +60 °C	-40 / +65 °C	-40 / +60 °C	-40 / +68 °C
Max. casing temperature	+70 °C	+75 °C	+78 °C	+75 °C	+78 °C
Min. / max. storage temperature	-25 / +85 °C	-40 / +85 °C			
Max. humidity	95 % non-condensing				
Max. site altitude	4 000 metres				
Service life	100 000 h	130 000 h	170 000 h	130 000 h	200 000 h
Max. number of switching cycles per year	20 000	40 000	60 000	40 000	100 000

[1] Capacitors of the Premium category can be operated above their nominal voltage if a reduced specification is acceptable. The tables on pages 18 and 19 give the maximum permissible continuous overvoltage for each capacitor type.

[2] Other tolerances on request

[3] The table of temperature classes on the previous page applies to capacitors of the Basic category. Capacitors of the categories Standard, Premium and Heavy Duty are specified for continuous operation at the stated maximum temperature.

Basic Capacitors (three-phase, V_N: 400 V...525 V)

Type LKT…-DB for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			230 V	300 V	400 V	415 V	440 V	480 V	525 V			
31-10414	LKT 5-400-DB	3 x 33.2	1.66 2.0	2.8 3.33	5.0 6.0					7.2 8.7	60 × 150 0.550	9
31-10400	LKT 6,25-400-DB	3 x 41.4	2.1 2.5	3.5 4.2	6.25 7.5					9.0 10.8	60 × 150 0.550	9
31-10415	LKT 7,5-400-DB	3 x 49.7	2.5 3.0	4.2 5.1	7.5 9.0					10.8 13.0	60 × 150 0.550	9
31-10416	LKT 10-400-DB	3 x 66.3	3.33 4.0	5.6 6.8	10.0 12.0					14.4 17.3	60 × 225 0.800	9
31-10401	LKT 12,5-400-DB	3 x 82.9	4.17 5.0	7.0 8.4	12.5 15.0					18.0 21.7	60 × 225 0.800	9
31-10417	LKT 15-400-DB	3 x 99.5	5.0 6.0	8.4 10.1	15.0 18.0					21.7 26.0	70 × 225 1.050	9
31-10418	LKT 20-400-DB	3 x 132.6	6.66 7.9	11.3 13.5	20.0 24.0					28.9 34.6	85 × 215 1.500	4
31-10402	LKT 25-400-DB	3 x 165.8	8.33 9.9	14.1 16.9	25.0 30.0					36.1 43.3	85 × 278 1.850	4
31-10403	LKT 30-400-DB	3 x 198.9	9.9 11.9	16.9 20.3	30.0 36.0					43.3 52.0	85 × 320 2.150	4
31-10404	LKT 6,25-440-DB	3 x 34.3	1.7 2.0	2.9 3.5	5.2 6.2	5.6 6.7	6.25 7.5			8.2 9.8	60 × 150 0.550	9
31-10412	LKT 10-440-DB	3 x 54.8	2.7 3.33	4.7 5.6	8.33 9.9	8.9 10.7	10.0 12.0			13.1 15.7	60 × 225 0.800	9
31-10379	LKT 12,5-440-DB	3 x 68.5	3.4 4.1	5.8 7.0	10.3 12.4	11.1 13.3	12.5 15.0			16.4 19.7	70 × 225 1.050	9
31-10406	LKT 15-440-DB	3 x 82.2	4.1 4.9	7.0 8.4	12.4 14.9	13.3 16.0	15.0 18.0			19.7 23.6	70 × 225 1.050	9
31-10436	LKT 20-440-DB	3 x 109.6	5.5 6.66	9.3 11.2	16.5 19.8	17.8 21.4	20.0 24.0			26.2 31.5	85 × 215 1.500	4
31-10407	LKT 25-440-DB	3 x 137.0	6.8 8.2	11.6 14.0	20.7 24.8	22.2 26.7	25.0 30.0			32.8 39.4	85 × 278 1.850	4
31-10437	LKT 28,2-440-DB	3 x 154.6	7.7 9.2	13.1 15.7	23.3 27.9	25.0 30.0	28.2 33.8			37.0 44.4	85 x 278 1.850	4
31-10408	LKT 30-440-DB	3 x 164.4	8.2 9.8	14.0 16.7	24.8 29.8	26.7 32.0	30.0 36.0			39.4 47.2	85 × 278 1.850	4
31-10438	LKT 33,3-480-DB	3 x 153.4	7.7 9.2	13.0 15.6	23.1 27.8	24.9 29.9	28.0 33.6	33.3 40.0		40.1 48.1	85 x 320 2.150	4
31-10409	LKT 6,25-525-DB	3 x 24.1	1.2 1.4	2.0 2.4	3.6 4.4	3.9 4.7	4.4 5.3	5.2 6.3	6.25 7.5	6.9 8.2	60 × 150 0.550	9
31-10435	LKT 10-525-DB	3 x 38.5	1.9 2.3	3.3 3.9	5.8 7.0	6.3 7.5	7.0 8.4	8.4 10.0	10.0 12.0	11.0 13.2	60 × 225 0.800	9
31-10410	LKT 12,5-525-DB	3 x 48.1	2.4 2.9	4.1 4.9	7.3 8.7	7.8 9.4	8.8 10.5	10.4 12.5	12.5 15.0	13.7 16.5	70 × 225 1.050	9
31-10419	LKT 15-525-DB	3 x 57.7	2.9 3.5	4.9 5.9	8.7 10.5	9.4 11.3	10.5 12.6	12.5 15.1	15.0 18.0	16.5 19.8	70 × 225 1.050	9
31-10434	LKT 17,2-525-DB	3 x 66.2	3.3 4.0	5.6 6.7	10.0 12.0	10.8 12.9	12.1 14.5	14.4 17.3	17.2 20.6	18.9 22.7	70 × 225 1.050	9
31-10420	LKT 20-525-DB	3 x 77.0	3.8 4.6	6.5 7.8	11.6 13.9	12.5 15.0	14.1 16.9	16.7 20.1	20.0 24.0	22.0 26.4	70 × 265 1.200	9
31-10411	LKT 25-525-DB	3 x 96.2	4.8 5.8	8.2 9.8	14.5 17.4	15.6 18.8	17.6 21.1	20.9 25.1	25.0 30.0	27.5 33.0	85 × 278 1.850	4
31-10439	LKT 30-525-DB	3 x 115.5	5.8 6.9	9.8 11.8	17.4 20.9	18.8 22.5	21.1 25.3	25.1 30.1	30.0 36.0	33.0 39.6	85 x 278 1.850	4

Standard Capacitors (three-phase, V_N: 300 V...480 V)
Type LKT…-DP for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			230 V	300 V	400 V	415 V	440 V	460 V	480 V			
31-10523	LKT 7,1-300-DP	3 x 83.7	4.17 5.0	7.1 8.5						13.7 16.4	60 x 225 0.800	9
31-10553	LKT 14,2-300-DP	3 x 167.1	8.33 10.0	14.2 17.0						27.3 32.7	85 x 215 1.500	4
31-10525	LKT 21,3-300-DP	3 x 251.1	12.5 15.0	21.3 25.5						41.0 49.2	85 x 278 1.850	4
31-10500	LKT 5-400-DP	3 x 33.2	1.66 2.0	2.8 3.33	5.0 6.0					7.2 8.7	60 x 150 0.550	9
31-10380	LKT 10-400-DP	3 x 66.3	3.33 4.0	5.6 6.8	10.0 12.0					14.4 17.3	70 × 225 1.050	9
31-10502	LKT 12,5-400-DP	3 x 82.9	4.17 5.0	7.0 8.4	12.5 15.0					18.0 21.7	70 × 225 1.050	9
31-10503	LKT 15-400-DP	3 x 99.5	5.0 6.0	8.4 10.1	15.0 18.0					21.7 26.0	70 × 265 1.200	9
31-10504	LKT 20-400-DP	3 x 132.6	6.66 8.0	11.3 13.5	20.0 24.0					28.9 34.6	85 × 278 1.850	4
31-10505	LKT 25-400-DP	3 x 165.8	8.33 9.9	14.1 16.9	25.0 30.0					36.1 43.3	85 × 278 1.850	4
31-10534	LKT 3,8-440-DP	3 x 20.8	1.0 1.25	1.8 2.1	3.1 3.8	3.4 4.1	3.8 4.6			5.0 6.0	60 × 150 0.550	9
31-10508	LKT 10-440-DP	3 x 54.8	2.7 3.33	4.7 5.6	8.33 9.9	8.9 10.7	10.0 12.0			13.1 15.7	60 × 225 0.800	9
31-10507	LKT 12,5-440-DP	3 x 68.5	3.4 4.1	5.8 7.0	10.3 12.4	11.1 13.3	12.5 15.0			16.4 19.1	70 × 225 1.050	9
31-10381	LKT 15-440-DP	3 x 82.2	4.1 4.9	7.0 8.33	12.4 14.9	13.3 16.0	15.0 18.0			19.7 23.6	70 × 265 1.200	9
31-10512	LKT 20-440-DP	3 x 109.6	5.5 6.66	9.3 11.2	16.5 19.8	17.8 21.4	20.0 24.0			26.2 31.5	85 × 278 1.850	4
31-10510	LKT 25-440-DP	3 x 137.0	6.8 8.2	11.6 14.0	20.7 24.8	22.2 26.7	25.0 30.0			32.8 39.4	85 × 278 1.850	4
31-10535	LKT 28,2-440-DP	3 x 154.6	7.7 9.2	13.1 15.7	23.3 27.9	25.0 30.0	28.2 33.8			37.0 44.4	85 × 320 2.150	4
31-10509	LKT 30-440-DP	3 x 164.4	8.2 9.8	14.0 16.7	24.8 29.8	26.7 32.0	30.0 36.0			39.4 47.2	85 × 320 2.150	4
31-10390	LKT 12,5-480-DP	3 x 57.6	2.9 3.4	4.9 5.9	8.7 10.4	9.3 11.2	10.5 12.6	11.5 13.8	12.5 15.0	15.0 18.0	70 × 225 1.050	9
31-10382	LKT 15,5-480-DP	3 x 71.4	3.6 4.3	6.1 7.3	10.8 13.0	11.6 13.9	13.1 15.7	14.2 17.1	15.5 18.6	18.6 22.4	70 × 265 1.200	9
31-10522	LKT 18-480-DP	3 x 82.9	4.17 5.0	7.0 8.4	12.5 15.0	13.5 16.2	15.1 18.2	16.5 19.8	18.0 21.6	21.7 26.0	70 × 265 1.200	9
31-10559	LKT 31-480-DP	3 x 142.8	7.1 8.5	12.1 14.5	21.5 25.8	23.2 27.8	26.1 31.3	28.5 34.2	31.0 37.2	37.3 44.7	85 × 320 2.150	4
31-10558	LKT 33,3-480-DP	3 x 153.4	7.7 9.2	13.0 15.6	23.1 27.8	24.9 29.9	28.0 33.6	30.6 36.7	33.3 40.0	40.1 48.1	85 × 320 2.150	4

Standard Capacitors (three-phase, V_N = 525 V)

Type LKT…-DP for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			230 V	300 V	400 V	415 V	440 V	480 V	525 V			
31-10517	LKT 10-525-DP	3 x 38.5	1.9 2.3	3.3 3.9	5.8 7.0	6.3 7.5	7.0 8.33	8.33 10.0	10.0 12.0	11.0 13.2	70 × 225 1.050	9
31-10516	LKT 12,5-525-DP	3 x 48.1	2.4 2.9	4.1 4.9	7.3 8.7	7.8 9.4	8.8 10.5	10.4 12.5	12.5 15.0	13.7 16.5	70 × 225 1.050	9
31-10520	LKT 15-525-DP	3 x 57.7	2.9 3.5	4.9 5.9	8.7 10.4	9.4 11.3	10.5 12.6	12.5 15.0	15.0 18.0	16.5 19.8	70 × 265 1.200	9
31-10521	LKT 20-525-DP	3 x 77.0	3.8 4.6	6.5 7.8	11.6 13.9	12.5 15.0	14.1 16.9	16.7 20.1	20.0 24.0	22.0 26.4	85 × 278 1.850	4
31-10519	LKT 25-525-DP	3 x 96.2	4.8 5.8	8.2 9.8	14.5 17.4	15.6 18.8	17.6 21.1	20.9 25.1	25.0 30.0	27.5 33.0	85 × 278 1.850	4

Standard Capacitors (three-phase, V_N: 690 V...800 V)

Type LKT…-DP for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			525 V	570 V	600 V	615 V	690 V	760 V	800 V			
31-10560	LKT 5-690-DP	3 x 11.1	2.9 3.5	3.4 4.1	3.8 4.5	4.0 4.8	5.0 6.0			4.2 5.0	60 × 225 0.800	9
31-10561	LKT 10-690-DP	3 x 22.3	5.8 7.0	6.8 8.2	7.6 9.1	7.9 9.5	10.0 12.0			8.4 10.0	70 × 225 1.050	9
31-10562	LKT 12,5-690-DP	3 x 27.9	7.2 8.7	8.5 10.2	9.5 11.3	9.9 11.9	12.5 15.0			10.5 12.6	70 × 265 1.200	9
31-10563	LKT 15-690-DP	3 x 33.4	8.7 10.4	10.2 12.3	11.3 13.6	11.9 14.3	15.0 18.0			12.6 15.1	70 × 265 1.200	9
31-10564	LKT 20-690-DP	3 x 44.6	11.6 13.9	13.7 16.4	15.1 18.2	15.9 19.1	20.0 24.0			16.7 20.1	85 × 278 1.850	4
31-10565	LKT 25-690-DP	3 x 55.7	14.5 17.4	17.1 20.5	18.9 22.7	19.9 23.8	25.0 30.0			20.9 25.1	85 × 278 1.850	4
31-10569	LKT 28,2-760-DP	3 x 51.8	13.5 16.1	15.9 19.0	17.6 21.1	18.5 22.2	23.2 27.9	28.2 33.8		21.4 25.7	85 × 320 2.150	4
31-10570	LKT 6,7-800-DP	3 x 11.1	2.9 3.5	3.4 4.1	3.8 4.5	4.0 4.8	5.0 6.0	6.0 7.3	6.7 8.0	4.8 5.8	60 × 225 0.800	9
31-10571	LKT 10,5-800-DP	3 x 17.4	4.5 5.4	5.3 6.4	5.9 7.1	6.2 7.5	7.8 9.4	9.5 11.4	10.5 12.6	7.6 9.1	70 × 225 1.050	9
31-10572	LKT 13,3-800-DP	3 x 22.0	5.7 6.9	6.8 8.1	7.5 9.0	7.9 9.4	9.9 11.9	12.0 14.4	13.3 16.0	9.6 11.5	85 × 215 1.500	4
31-10573	LKT 21-800-DP	3 x 34.8	9.0 10.9	10.7 12.8	11.8 14.2	12.4 14.9	15.6 18.8	19.0 22.7	21.0 25.2	15.2 18.2	85 × 278 1.850	4
31-10574	LKT 26,7-800-DP	3 x 44.3	11.5 13.8	13.6 16.3	15.0 18.0	15.8 18.9	19.9 23.8	24.1 28.9	26.7 32.0	19.3 23.1	85 × 320 2.150	4

Standard Capacitors (single-phase, V_N: 280 V...525 V)
Type LKT…-EP for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			230 V	280 V	400 V	415 V	440 V	480 V	525 V			
31-10547	LKT 5-280-EP	1 x 203.7	3.4 4.1	5.0 6.0						17.9 21.5	60 × 138 0.500	9
31-10548	LKT 10-280-EP	1 x 407.4	6.8 8.1	10.0 12.0						35.8 43.0	85 × 131 1.150	4
31-10526	LKT 3,33-440-EP	1 x 54.8	0.9 1.1	1.4 1.6	2.8 3.3	3.0 3.6	3.33 4.0			7.6 9.1	60 × 90 0.325	9
31-10527	LKT 4,17-440-EP	1 x 68.6	1.1 1.4	1.7 2.0	3.4 4.1	3.7 4.5	4.17 5.0			9.5 11.4	60 × 138 0.500	9
31-10528	LKT 5-440-EP	1 x 82.2	1.4 1.6	2.0 2.4	4.1 5.0	4.4 5.33	5.0 6.0			11.4 13.6	60 × 138 0.500	9
31-10384	LKT 9,4-440-EP	1 x 154.6	2.6 3.1	3.6 4.3	7.8 9.3	8.4 10.0	9.4 11.3			21.4 25.6	70 × 153 0.650	9
31-10529	LKT 2,4-480-EP	1 x 33.2	0.6 0.7	0.8 1.0	1.7 2.0	1.8 2.15	2.0 2.4	2.4 2.9		5.0 6.0	60 × 90 0.325	9
31-10530	LKT 3,33-480-EP	1 x 46.0	0.8 0.9	1.1 1.4	2.3 2.8	2.5 3.0	2.8 3.4	3.33 4.0		6.9 8.3	60 × 90 0.325	9
31-10531	LKT 3,6-480-EP	1 x 49.7	0.8 1.0	1.2 1.5	2.5 3.0	2.7 3.2	3.0 3.6	3.6 4.3		7.5 9.0	60 × 138 0.500	9
31-10515	LKT 4,8-480-EP	1 x 66.3	1.1 1.3	1.6 2.0	3.33 4.0	3.6 4.3	4.0 4.8	4.8 5.8		10.0 12.0	60 × 138 0.500	9
31-10514	LKT 6-480-EP	1 x 82.9	1.4 1.7	2.0 2.5	4.17 5.0	4.5 5.4	5.0 6.0	6.0 7.2		12.5 15.0	60 × 138 0.500	9
31-10532	LKT 2,8-525-EP	1 x 32.3	0.5 0.6	0.8 1.0	1.6 1.9	1.7 2.1	2.0 2.4	2.3 2.8	2.8 3.4	5.3 6.4	60 × 90 0.325	9
31-10533	LKT 3,33-525-EP	1 x 38.5	0.6 0.8	1.0 1.1	1.9 2.3	2.1 2.5	2.3 2.8	2.8 3.3	3.33 4.0	6.3 7.6	60 × 138 0.500	9
31-10385	LKT 8,33-525-EP	1 x 96.2	1.6 1.9	2.4 2.9	4.8 5.8	5.2 6.3	5.9 7.0	7.0 8.33	8.33 10.0	15.9 19.0	70 × 153 0.650	9

Premium Capacitors (three-phase, V_N: 400 V...480 V)

Type LKT…-DL for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			230 V	400 V	415 V	440 V	460 V	480 V	525 V			
31-10598	LKT 1-400-DL	3 x 6.6	0.3 0.4	1.0 1.2	1.1 1.3	1.2 1.5				1.4 1.7	60 × 150 0.550	9
31-10599	LKT 1,5-400-DL	3 x 9.9	0.5 0.6	1.5 1.8	1.6 1.9	1.8 2.2				2.2 2.6	60 × 150 0.550	9
31-10600	LKT 5-400-DL	3 x 33.2	1.66 2.0	5.0 6.0	5.4 6.5	6.1 7.3				7.2 8.7	60 × 225 0.800	9
31-10601	LKT 6,25-400-DL	3 x 41.4	2.1 2.5	6.25 7.5	6.7 8.1	7.6 9.1				9.0 10.8	60 × 225 0.800	9
31-10602	LKT 9,3-400-DL	3 x 61.7	3.0 3.7	9.3 11.1	10.0 12.0	11.3 13.5				13.4 16.1	70 × 225 1.050	9
31-10603	LKT 10-400-DL	3 x 66.3	3.33 4.0	10.0 12.0	10.8 12.9	12.1 14.5				14.4 17.3	70 × 225 1.050	9
31-10604	LKT 11,7-400-DL	3 x 77.6	3.9 4.6	11.7 14.0	12.6 15.1	14.2 17.0				16.9 20.3	70 × 225 1.050	9
31-10386	LKT 12,5-400-DL	3 x 82.9	4.17 5.0	12.5 15.0	13.5 16.2	15.1 18.2				18.0 21.7	70 × 265 1.200	9
31-10606	LKT 20-400-DL	3 x 132.6	6.6 7.9	20.0 24.0	21.5 25.8	24.2 29.0				28.9 34.6	85 × 278 1.850	4
31-10607	LKT 5,0-440-DL	3 x 27.4	1.4 1.66	4.17 5.0	4.5 5.4	5.0 6.0	5.5 6.6	6.0 7.1		6.6 7.9	60 × 225 0.800	9
31-10608	LKT 7,6-440-DL	3 x 41.7	2.1 2.5	6.25 7.5	6.8 8.1	7.6 9.1	8.33 10.0	9.0 10.9		10.0 12.0	60 × 225 0.800	9
31-10387	LKT 9,1-440-DL	3 x 49.9	2.5 3.0	7.5 9.0	8.1 9.7	9.1 10.9	10.0 11.9	10.8 13.0		11.9 14.3	70 × 225 1.050	9
31-10610	LKT 12,1-440-DL	3 x 66.3	3.33 4.0	10.0 12.0	10.8 12.9	12.1 14.5	13.2 15.9	14.4 17.3		15.9 19.1	70 × 225 1.050	9
31-10612	LKT 17,6-440-DL	3 x 96.5	4.8 5.8	14.5 17.4	15.6 18.8	17.6 21.1	19.2 23.1	21.0 25.1		23.1 27.7	85 × 278 1.850	4
31-10613	LKT 3,6-480-DL	3 x 16.6	0.8 1.0	2.5 3.0	2.7 3.2	3.0 3.6	3.33 4.0	3.6 4.3	4.3 5.2	4.3 5.2	60 × 150 0.550	9
31-10388	LKT 4,5-480-DL	3 x 20.7	1.0 1.2	3.1 3.8	3.4 4.0	3.8 4.6	4.1 5.0	4.5 5.4	5.4 6.5	5.4 6.5	60 × 225 0.800	9
31-10615	LKT 7,2-480-DL	3 x 33.2	1.7 2.0	5.0 6.0	5.4 6.5	6.0 7.2	6.66 7.9	7.2 8.6	8.6 10.3	8.7 10.4	60 × 225 0.800	9
31-10616	LKT 7,8-480-DL	3 x 35.9	1.8 2.1	5.4 6.5	5.8 7.0	6.5 7.9	7.2 8.6	7.8 9.3	9.3 11.2	9.4 11.3	60 × 225 0.800	9
31-10617	LKT 10,4-480-DL	3 x 47.9	2.4 2.9	7.3 8.7	7.8 9.3	8.8 10.5	9.6 11.5	10.4 12.5	12.4 14.9	12.5 15.0	70 × 225 1.050	9
31-10618	LKT 12,5-480-DL	3 x 57.6	2.9 3.4	8.7 10.4	9.4 11.2	10.5 12.6	11.5 13.8	12.5 15.0	15.0 17.9	15.0 18.0	70 × 265 1.200	9
31-10389	LKT 15,5-480-DL	3 x 71.4	3.6 4.3	10.8 12.9	11.6 13.9	13.0 15.6	14.2 17.1	15.5 18.6	18.5 22.3	18.6 22.4	85 × 278 1.850	4

Generally, “Premium” (DL-type) capacitors can also be operated at higher voltages with the “Standard” (DP-type) specification.
Please note that the DP values in the chart are shaded dark grey.

Premium Capacitors (three-phase, V_N = 525 V))

Typ LKT…-DL for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			400 V	415 V	440 V	480 V	525 V	570 V	615 V			
31-10619	LKT 4,17-525-DL	3x 16.1	2.4 2.9	2.6 3.1	2.9 3.5	3.5 4.2	4.17 5.0	4.9 5.9	5.7 6.9	4.6 5.5	60 × 225 0.800	9
31-10620	LKT 5,9-525-DL	3x 22.7	3.4 4.1	3.7 4.4	4.17 4.97	5.0 5.9	5.9 7.1	7.0 8.4	8.1 9.7	6.5 7.8	60 × 225 0.800	9
31-10621	LKT 7,7-525-DL	3x 29.6	4.5 5.4	4.8 5.8	5.4 6.5	6.5 7.8	7.7 9.3	9.1 10.9	10.6 12.7	8.5 10.2	70 × 225 1.050	9
31-10622	LKT 8,33-525-DL	3x 32.1	4.8 5.8	5.2 6.2	5.8 7.0	7.0 8.33	8.33 10.0	9.8 11.8	11.4 13.7	9.2 11.0	70 × 225 1.050	9

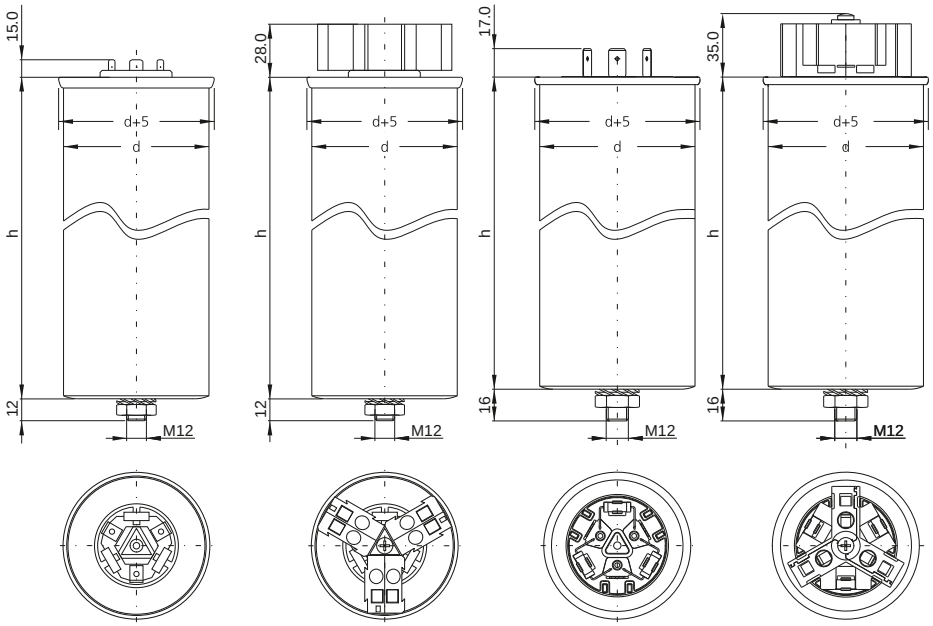
Generally, “Premium” (DL-type) capacitors can also be operated at higher voltages with the “Standard” (DP-type) specification. Please note that the DP values in the chart are shaded dark grey.

Heavy Duty Capacitors (three-phase, V_N: 480 V...525 V)

Typ LKT…-HD for 50 Hz / 60 Hz

Article-No.	Type	Capacitance [µF]	Rated Reactive Power in kvar at Rated Voltage (V_N) 50 Hz / 60 Hz							Rated current at V_N 50 Hz / 60 Hz [A]	Dimensions (d x h) Weight (net) [mm] [kg]	Packing Unit (pcs.)
			400 V	415 V	440 V	460 V	480 V	500 V	525 V			
31-10580	LKT 16,8-480-HD	3 x 77.4	11.7 14.0	12.6 15.1	14.1 16.9	15.4 18.5	16.8 20.2			20.2 24.2	85 × 215 1.500	4
31-10581	LKT 18,0-480-HD	3 x 82.9	12.5 15.0	13.5 16.2	15.1 18.2	16.5 19.8	18.0 21.6			21.7 26.0	85 × 215 1.500	4
31-10582	LKT 15,6-500-HD	3 x 66.2	10.0 12.0	10.8 12.9	12.1 14.5	13.2 15.8	14.4 17.3	15.6 18.7		18.0 21.6	85 × 215 1.500	4
31-10583	LKT 16,1-500-HD	3 x 68.3	10.3 12.4	11.1 13.3	12.5 15.0	13.6 16.4	14.8 17.8	16.1 19.3		18.6 22.3	85 × 215 1.500	4
31-10584	LKT 16,8-500-HD	3 x 71.3	10.8 12.9	11.6 13.9	13.0 15.6	14.2 17.1	15.5 18.6	16.8 20.2		19.4 23.3	85 × 215 1.500	4
31-10585	LKT 18,0-525-HD	3 x 69.3	10.5 12.5	11.3 13.5	12.6 15.2	13.8 16.6	15.1 18.1	16.3 19.6	18.0 21.6	19.8 23.8	85 × 215 1.500	4

Dimensions

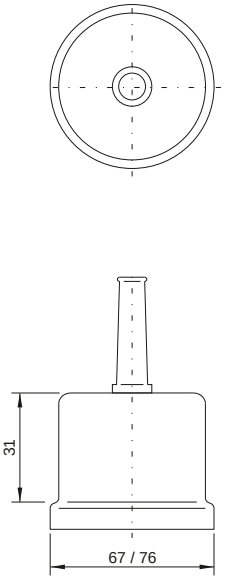


Three-phase capacitor with d = 60/70 mm
For connection with flat cable plug 6.3 × 0.8 mm

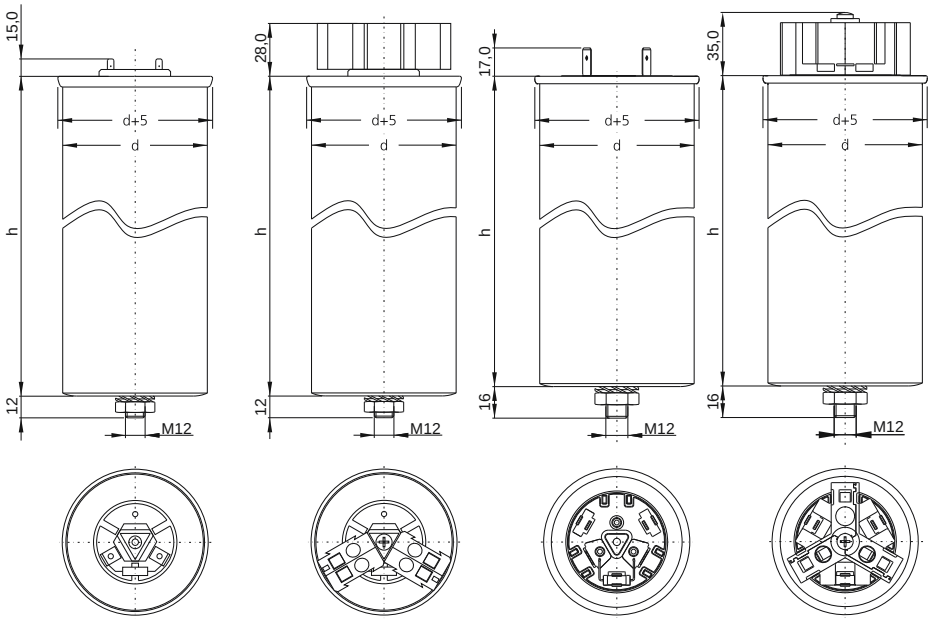
Three-phase capacitor with d = 60/70 mm
Spring tension terminal AKD 25/3 for 2 × 6 mm²
Art.-No. 31-08000

Three-phase capacitor with d = 85 mm
For connection with flat cable plug 9.5 × 1.2 mm

Three-phase capacitor with d = 85 mm
Spring tension terminal AKD 30/3 for 16 mm²
Art.-No. 31-08003



Plastic cap and rubber sleeve LKK 60/70 for capacitors with:
d = 60 mm (Art.-No. 69-00352) /
d = 70 mm (Art.-No. 69-00350)
(not available for capacitors with d = 85 mm)
Rubber sleeve for insulating cap
Art.-No. 69-00353



Single-phase capacitor with d = 60/70 mm
For connection with flat cable plug 6.3 × 0.8 mm

Single-phase capacitor with d = 60/70 mm
Spring tension terminal AKD 25/2 for 2 × 6 mm²
Art.-No. 31-08002

Single-phase capacitor with d = 85 mm
For connection with flat cable plug 9.5 × 1.2 mm

Single-phase capacitor with d = 85 mm
Spring tension terminal AKD 30/2 for 16 mm²
Art.-No. 31-08004

Harmonic Filter Reactors
Basic and Standard Harmonic Filter Reactors

Avoiding resonances – low-loss Harmonic Filter Reactors for your power factor correction – designed for operation with FRAKO Power Capacitors.

- Power range: 3.13 to 200 kvar
- Voltage range: 230 V to 690 V, 50 / 60 Hz
- Detuning factor p = 5.67 … 14 %
- Low-loss design

Application Recommendations

Used together with LKT type Power Factor Correction Capacitors, Harmonic Filter Reactors make it possible to install detuned versions of fixed capacitor banks and Power Factor Correction Systems. This enables switchgear manufacturers to plan and manufacture customer-specific systems.

Type Overview

Type series			Basic	Standard
Type			FDKT	FKD / FDR
Rated voltage			400…525 V	230…690 V
Rated stage power			6.25…200 kvar	3.13…50 kvar
Rated frequency		50 / 60 Hz	• / -	• / •
Series resonance frequency	p=5.67 %	210 / 252 Hz	- / -	• / -
	p=7 %	189 / 227 Hz	• / -	• / •
	p=8 %	177 / 212 Hz	- / -	• / -
	p=14 %	134 / 160 Hz	• / -	• / -
Temperature range			-10 … +60 °C	
Winding material			Al	Al /Cu
Insulation class			H (180 °C)	F (155 °C)
Temperature switch	pre-assembled		•	•
	Switching temperature		130…150 °C	140 °C
	Switching capacity		6.3A / 250 V AC	2.5A / 250 V AC
Ingress protection			IP00 according to IEC 60529	
Power loss max.			10 W/kvar	6 W/kvar
Connection			Terminal strip ≤ 25 kvar Ring terminal ≥ 50 kvar	Connecting cable
Catalogue page			Page 23 ff.	Page 27 ff.

Series Resonance Frequency

Version	Series resonance frequency (50 Hz Mains)	Detuning factor	For mains with utility audio frequency [1]
P1	134 Hz	P= 14 %	≥ 166 Hz
P8	177 Hz	P= 8 %	≥ 217 Hz
P7	189 Hz	P= 7 %	≥ 228 Hz
P5	210 Hz	P= 5.67 %	≥ 270 Hz

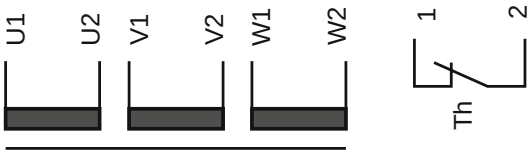
[1] Utility company specifications inconsistent with the above must be taken into account.

Please also refer to the design notes given in our manual of Power Factor Correction. Further series resonance frequencies are available on request.

Connection

Coil input: U1, V1, W1

Coil output: U2, V2, W2



Important Note

Please only use the correct number of the appropriate Power Capacitors as specified in our “Selection Aid: Harmonic Filter Reactors → Capacitors” in our Technical Annex. Apart from possibly overloading the installed components, the utility company‘s remote control systems could also be adversely affected.

FDKT
Basic Harmonic Filter Reactors

Avoiding resonances – low-loss Harmonic Filter Reactors for your power factor correction – designed for operation with FRAKO Power Capacitors.

- Power Range: 6.25 to 200 kvar
- Voltage range: 400 to 525 V, 50 Hz
- Detuning factor p = 7 … 14 %
- Low-loss design

Application Recommendations

Used together with LKT type Power Factor Correction Capacitors, Harmonic Filter Reactors make it possible to install detuned versions of fixed capacitor banks and Power Factor Correction Systems. This enables switchgear manufacturers to plan and manufacture customer-specific systems.

Technical Data

Version: P7 (Detuning factor p = 7 %) — **$I5_{max}$ = 33.8 %, $I7_{max}$ = 12.2 %, Linearity = 1.75 x I_N**

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection: Cable lug [mm²]	Connection: Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Basic Harmonic Filter Reactor - FDKT - V_N = 400 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-02103	FDKT 6,25-400-P7	6.3	9.9	6.139	3 x 38.5	a		10	5.5	Al	0.6
88-02045	FDKT 12,5-400-P7	12.5	19.8	3.067	3 x 77.6	b		10	8.0	Al	1.1
88-02046	FDKT 25-400-P7	25.0	39.7	1.533	3 x 155.2	d		10	17.0	Al	1.6
88-02047	FDKT 50-400-P7	50.0	79.4	0.767	3 x 310.4	i	M8		29.0	Al	2.2
88-02093	FDKT 75-400-P7	75.0	119.1	0.511	3 x 465.6	n	M8		40.0	Al	3.1
88-02094	FDKT 100-400-P7	100.0	158.9	0.384	3 x 620.8	q	M8		47.0	Al	5.1
Basic Harmonic Filter Reactor - FDKT - V_N = 415 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-02098	FDKT 12,5-415-P7	12.5	19.1	3.304	3 x 71.4	b		10	8.0	Al	0.9
88-02099	FDKT 25-415-P7	25.0	38.3	1.652	3 x 142.8	d		10	17.0	Al	1.3
88-02100	FDKT 50-415-P7	50.0	76.6	0.826	3 x 285.6	i	M8		29.0	Al	3.0
88-02101	FDKT 75-415-P7	75.0	114.8	0.521	3 x 428.4	n	M8		39.0	on request	on request
88-02190	FDKT 100-415-P7	100.0	153.2	0.413	3 x 572.3	r	M8		48.0	Al	5.4
Basic Harmonic Filter Reactor - FDKT - V_N = 525 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-02146	FDKT 12,5-525-P7	12.5	15.1	5.228	3 x 44.7	a		10	9.0	on request	on request
88-02147	FDKT 25-525-P7	25.0	30.3	2.644	3 x 89.4	f		10	16.0	on request	on request
88-02148	FDKT 50-525-P7	50.0	60.5	1.322	3 x 178.8	h	M10		30.0	on request	on request
88-02149	FDKT 75-525-P7	75.0	90.8	0.881	3 x 268.2	k	M10		43.0	on request	on request
88-02150	FDKT 100-525-P7	100.0	121.0	0.661	3 x 357.6	l	M10		51.0	on request	on request
88-02151	FDKT 150-525-P7	150.0	181.6	0.441	3 x 536.4	b	M10		87.0	on request	on request
88-02152	FDKT 200-525-P7	200.0	242.1	0.330	3 x 715.2	t	M10		102.0	on request	on request

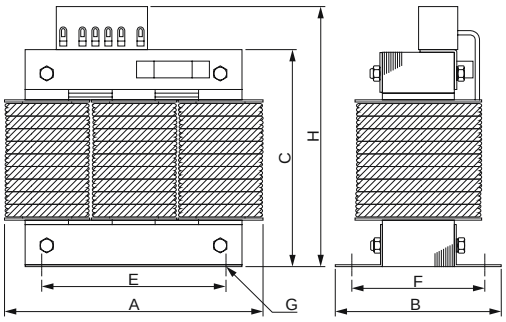
Version: P1 (Detuning factor p = 14 %) — **$I5_{max}$ = 9,6 %, $I7_{max}$ = 4,7 %, Linearity = 1,75 x I_N**

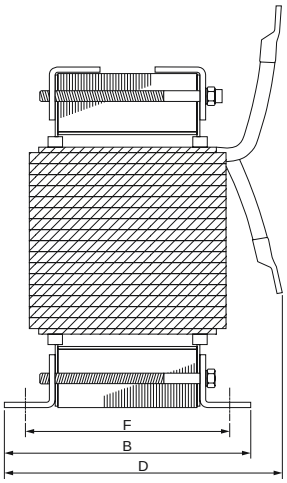
Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection: Cable lug [mm²]	Connection: Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Basic Harmonic Filter Reactor - FDKT - V_N = 400 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-02095	FDKT 12,5-400-P1	12.5	19.9	6.598	3 x 71.4	e		10	16.0	Al	1.1
88-02096	FDKT 25-400-P1	25.0	39.7	3.299	3 x 142.8	g		10	27.0	Al	2.4
88-02097	FDKT 50-400-P1	50.0	79.4	1.649	3 x 285.6	m	M10		42.0	Al	5.3
Basic Harmonic Filter Reactor - FDKT - V_N = 525 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-02153	FDKT 12,5-525-P1	12.5	15.1	11.445	3 x 41.1	c		10	15.0	on request	on request
88-02154	FDKT 25-525-P1	25.0	30.3	5.723	3 x 82.2	j		10	26.0	on request	on request
88-02155	FDKT 50-525-P1	50.0	60.5	2.861	3 x 164.4	o	M10		44.0	on request	on request
88-02156	FDKT 75-525-P1	75.0	90.8	1.908	3 x 246.6	p	M10		56.0	on request	on request
88-02157	FDKT 100-525-P1	100.0	121.0	1.431	3 x 328.8	u	M10		98.0	on request	on request
88-02158	FDKT 150-525-P1	150.0	181.6	0.954	3 x 439.2	v	M10		125.0	on request	on request
88-02159	FDKT 200-525-P1	200.0	242.1	0.715	3 x 657.6	w	M10		144.0	on request	on request

Important Note

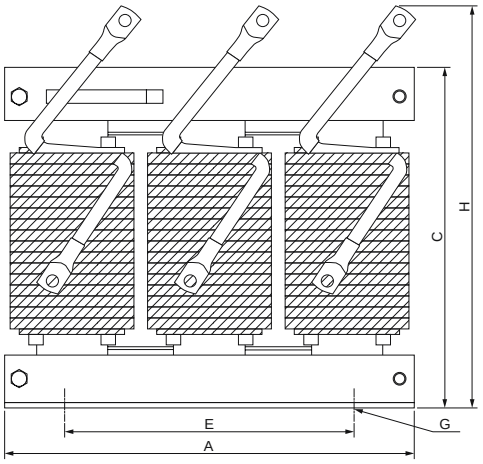
All Harmonic Filter Reactors, type FDKT are also available without temperature switch.
Harmonic Filter Reactors without temperature switch are marked type „FDK“.

Dimensions





6.25 - 25 kvar



50 - 200 kvar

Core 3UI	Dimensions [mm]							
	A	B	C	D	E	F	G	H
a	150	93	130		106	77	6 x 15	155
b	180	112	155		120	90	10 x 13	190
c	225	125	171		175	103	11 x 13	202
d	225	124	177	150	175	101	10 x 13	220
e	225	125	160		175	103	11 x 20	192
f	225	125	190		175	103	11 x 20	220
g	250	148	215		200	114	11 x 20	266
h	283	145	260	188	200	116	11 x 20	300
i	283	148	215	188	200	110	11 x 20	255
j	283	148	238	170	200	117	11 x 20	268
k	283	166	300	188	224	126	11 x 20	360
l	283	166	362	188	224	126	11 x 20	362
m	283	170	260	210	200	141	11 x 20	310
n	309	166	268	200	224	126	11 x 20	315
o	309	166	310	188	224	126	11 x 20	360
p	309	166	402	188	224	126	11 x 20	402
q	315	166	302	210	224	126	11 x 20	360
r	315	166	322	210	224	126	11 x 20	370
s	390	200	380	240	310	130	11 x 20	390
t	414	220	400	259	334	130	11 x 20	414
u	470	220	380	250	410	126	11 x 20	402
v	470	220	400	300	410	126	11 x 20	400
w	520	270	420	320	440	126	11 x 20	420

FDR / FKD
Standard Harmonic Filter Reactors

Avoiding resonances – low-loss Harmonic Filter Reactors for your power factor correction – designed for operation with FRAKO Power Capacitors.

- Power range: 3.13 to 50 kvar
- Voltage range: 230 to 690 V, 50 / 60 Hz
- Detuning factor p = 5.67 … 14 %
- Low-loss design

Application Recommendations

Used together with LKT type Power Factor Correction Capacitors, Harmonic Filter Reactors make it possible to install detuned versions of fixed capacitor banks and Power Factor Correction Systems. This enables switchgear manufacturers to plan and manufacture customer-specific systems.

1

Technical Data

Version: P7 (Detuning factor p = 7 %), 50 Hz

Permissible harmonics EN 61000-2-4 Class 2

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection Cable lug [mm²]	Connection Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 230 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-01980	FDR 5-230-P7	5.0	12.6	2.530	3 x 93.3	c	6		5.0	Cu	1.7
88-01575	FKD 10-230-P7	10.0	26.9	1.180	3 x 200.0	e	10		9.0	Cu	2.0
88-01974	FDR 12,5-230-P7	12.5	31.2	1.020	3 x 232.1	f	10		9.0	Cu	2.3
88-01583	FKD 16,7-230-P7	16.7	44.9	0.700	3 x 334.0	g	10/2x4		10.0	Cu	2.5
88-01576	FKD 20-230-P7	20.0	53.8	0.590	3 x 400.0	h	16/2x10		15.0	Cu	2.4
88-01943	FDR 25-230-P7	25.0	62.5	0.510	3 x 464.2	h	16		16.0	Cu	4.9
88-01568	FKD 33-230-P7	33.0	89.9	0.350	3 x 668.0	l	2x10/2x10		21.0	Al	3.9
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 400 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-01640	FKD 2,5-400-P7	2.5	3.9	14.200	3 x 16.6	a	4		5.0	Cu	0.4
88-01719	FKD 3,13-400-P7	3.1	4.7	11.900	3 x 19.9	a	4		5.0	Cu	1.0
88-01481	FKD 5-400-P7	5.0	7.8	7.120	3 x 33.2	c	4		7.0	Cu	1.1
88-01410	FKD 6,25-400-P7	6.3	9.7	5.700	3 x 41.5	c	4		7.0	Cu	1.7
88-01482	FKD 7,5-400-P7	7.5	11.6	4.760	3 x 49.7	c	4		7.0	Cu	1.6
88-01479	FKD 10-400-P7	10.0	15.5	3.550	3 x 66.3	g	4		10.0	Cu	1.5
88-01767	FDR 12,5-400-P7	12.5	18.0	3.070	3 x 77.1	g	4		10.0	Cu	2.1
88-01362	FKD 15-400-P7	15.0	23.3	2.370	3 x 99.5	h	6		15.0	Cu	2.2
88-01922	FDR 16,7-400-P7	16.7	24.1	2.300	3 x 102.9	h	6		13.0	Cu	1.7
88-01363	FKD 20-400-P7	20.0	31.0	1.780	3 x 132.6	h	10		19.0	Cu	2.6
88-01768	FDR 25-400-P7	25.0	36.1	1.530	3 x 154.2	h	10		21.0	Cu	3.9
88-01484	FKD 30-400-P7	30.0	46.6	1.180	3 x 198.9	m	10		21.0	Al	3.5
88-01923	FDR 33,3-400-P7	33.3	48.2	1.150	3 x 205.8	m	16		18.0	Al	3.5
88-02053	FDR 37,5-400-P7	37.5	54.3	1.020	3 x 213.9	m	16		31.0	Al	2.8
88-01782	FDR 40-400-P7	40.0	58.2	0.950	3 x 248.8	m	16		21.0	Al	2.8
88-01769	FDR 50-400-P7	50.0	72.2	0.770	3 x 308.4	n	16		27.0	Al	5.1
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 415 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-02034	FDR 6,25-415-P7	6.3	8.7	6.580	3 x 35.9	c	4		5.1	Cu	1.5
88-01937	FDR 12,5-415-P7	12.5	17.3	3.310	3 x 71.4	g	4		10.0	Cu	1.8
88-01938	FDR 25-415-P7	25.0	34.7	1.660	3 x 142.8	h	10		15.0	Cu	3.7
88-01930	FDR 50-415-P7	50.0	69.3	0.830	3 x 285.6	n	16		27.0	Cu	5.3
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 440 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-02160	FDR 6,25-440-P7	6.3	8.3	7.360	3 x 32.1	e	4		6.0	Cu	1,4
88-02161	FDR 12,5-440-P7	12.5	16.5	3.680	3 x 64.2	g	4		9.5	Cu	2.5
88-01008	FKD 25-440-P7	25.0	34.2	1.780	3 x 132.8	k	10		21.0	Cu	3.4
88-01124	FKD 50-440-P7	50.0	68.4	0.890	3 x 265.6	n	16 / 2x10		28.0	Al	4.7
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 525 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-01801	FDR 6,25-525-P7	6.3	7.0	10.320	3 x 22.9	c	4		7.0	Cu	1.4
88-01802	FDR 12,5-525-P7	12.5	14.1	5.160	3 x 45.8	g	4		10.0	Cu	1.8
88-01080	FKD 20-525-P7	20.0	24.7	2.940	3 x 80.5	i	6		19.0	Cu	3.3
88-01838	FDR 25-525-P7	25.0	27.5	2.640	3 x 89.5	k	10		21.0	Cu	3.9

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection Cable lug [mm²]	Connection Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
88-01837	FDR 50-525-P7	50.0	55.0	1.320	3 x 179.0	n	16 / 2x10		29.0	Al	3.1
88-01872	FDR 50-525-P7	50.0	55.0	1.320	3 x 179.0	n	16 / 16		29.0	Al	3.1
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 690 V / 50 Hz - p = 7 % - fres = 189 Hz											
88-01825	FKD 10-690-P7	10.0	8.9	10.700	3 x 22.1	g	4		10.0	on request	on request
88-01932	FDR 25-690-P7	25.0	20.8	4.590	3 x 51.5	h	4		19.0	Cu	3.7
88-01933	FDR 50-690-P7	50.0	41.6	2.290	3 x 103.1	n	10		27.0	Cu	4.5

Version: P7 (Detuning factor p = 7 %), 60 Hz

Permissible harmonics EN 61000-2-4 Class 2

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection Cable lug [mm²]	Connection Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 230 V / 60 Hz - p = 7 % - fres = 227 Hz											
88-01996	FDR 2,5-230-P7-60	2.5	6.2	4.260	3 x 38.5	a	4		4.0	on request	on request
88-01997	FDR 5-230-P7-60	5.0	12.5	2.120	3 x 77.3	d	6		6.0	on request	on request
88-01998	FDR 10-230-P7-60	10.0	25.0	1.060	3 x 154.6	c	6		7.0	on request	on request
88-02140	FDR 12,5-230-P7-60	12.5	31.4	0.840	3 x 194.3	g	10		10.0	Cu	1.8
88-02001	FDR 20-230-P7-60	20.0	49.9	0.530	3 x 309.2	g	16		12.0	on request	on request
88-01892	FDR 25-230-P7-60	25.0	62.2	0.430	3 x 385.5	h	16		21.0	Cu	2.3
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 380 V / 60 Hz - p = 7 % - fres = 227 Hz											
88-02179	FDR 12,5-380-P7-60	12.5	19.0	2.290	3 x 71.4	g	4		10.0	Cu	1.7
88-02180	FDR 25-380-P7-60	25.0	38.1	1.150	3 x 142.8	k	10		17.0	Cu	4.1
88-02181	FDR 50-380-P7-60	50.0	76.2	0.574	3 x 285.6	n	25		25.0	Al	3.9
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 400 V / 60 Hz - p = 7 % - fres = 227 Hz											
88-01963	FDR 12,5-400-P7-60	12.5	18.0	2.560	3 x 64.2	e	6		8.5	Cu	2.1
88-01964	FDR 25-400-P7-60	25.0	36.0	1.280	3 x 128.1	h	10		13.0	Cu	3.0
88-01965	FDR 50-400-P7-60	50.0	72.1	0.640	3 x 256.9	n	16		24.0	Cu	4.5
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 440 V / 60 Hz - p = 7 % - fres = 227 Hz											
88-01914	FKD 6,25-440-P7-60	6.3	9.2	5.480	3 x 29.9	b	4		6.0	Cu	1.8
88-01795	FDR 7,5-440-P7-60	7.5	9.9	5.120	3 x 32.0	b	4		6.0	Cu	1.9
88-01883	FDR 12,5-440-P7-60	12.5	16.9	2.990	3 x 54.8	e	4		21.0	Cu	2.7
88-01796	FDR 15-440-P7-60	15.0	19.8	2.560	3 x 64.0	g	6		10.0	Cu	2.5
88-01884	FDR 25-440-P7-60	25.0	33.1	1.530	3 x 107.2	h	10		11.0	Cu	3.8
88-01875	FDR 50-440-P7-60	50.0	66.2	0.760	3 x 214.2	m	16		29.0	on request	on request
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 460 V / 60 Hz - p = 7 % - fres = 227 Hz											
88-02123	FKD 2,5-460-P7-60	2.5	3.6	14.760	3 x 11.1	a	4		3.0	on request	on request
88-02124	FKD 5-460-P7-60	5.0	6.7	7.910	3 x 20.7	c	4		4.5	on request	on request
88-02125	FDR 10-460-P7-60	10.0	12.4	4.250	3 x 38.5	c	4		5.0	on request	on request
88-01854	FDR 12,5-460-P7-60	12.5	15.5	3.410	3 x 48.1	g	6		10.0	Cu	1.2
88-01855	FDR 25-460-P7-60	25.0	31.1	1.700	3 x 96.2	h	10		21.0	Cu	3.7
88-01856	FDR 50-460-P7-60	50.0	62.1	0.850	3 x 192.4	n	16		27.0	Cu	4.5

Version: P7 (Detuning factor p = 7 %), 60 Hz

Permissible harmonics EN 61000-2-4 Class 2

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection Cable lug [mm²]	Connection Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 480 V / 60 Hz - p = 7 % - fres = 227 Hz											
88-01962	FDR 12,5-480-P7-60	12.5	15.4	3.590	3 x 45.6	f	4		9.0	Cu	1.9
88-02056	FDR 25-480-P7-60	25.0	30.2	1.830	3 x 89.7	h	6		15.0	Cu	3.1
88-01732	FKD 50-480-P7-60	50.0	64.7	0.850	3 x 192.0	n	16 / 2x10		27.0	Al	3.7

Version: P8 (Detuning factor p = 8 %)

Permissible harmonics EN 61000-2-4 Class 2

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection Cable lug [mm²]	Connection Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 400 V / 50 Hz - p = 8 % - fres = 177 Hz											
88-01678	FKD 2,5-400-P8	2.5	3.9	16.200	3 x 16.6	a	4		5.0	Cu	0.8
88-01941	FKD 3,13-400-P8	3.1	4.7	13.540	3 x 19.9	a	4		5.0	Cu	0.8
88-01518	FKD 5-400-P8	5.0	7.9	8.150	3 x 33.2	c	4		7.0	Cu	0.5
88-01492	FKD 6,25-400-P8	6.3	9.8	6.520	3 x 41.5	c	4		7.0	Cu	1.4
88-01519	FKD 7,5-400-P8	7.5	11.8	4.750	3 x 49.7	c	4		7.0	Cu	1.5
88-01520	FKD 10-400-P8	10.0	15.7	4.080	3 x 66.3	g	4		10.0	Cu	1.4
88-01770	FDR 12,5-400-P8	12.5	18.2	3.500	3 x 77.1	g	4		10.0	Cu	2.0
88-01381	FKD 15-400-P8	15.0	23.5	2.720	3 x 99.5	h	6		15.0	Cu	1.8
88-01926	FDR 16,7-400-P8	16.7	24.3	2.620	3 x 102.9	h	6		13.0	on request	on request
88-01382	FKD 20-400-P8	20.0	31.4	2.040	3 x 132.6	h	10		19.0	Cu	4.0
88-01771	FDR 25-400-P8	25.0	36.5	1.750	3 x 154.2	h	10		19.0	Cu	3.7
88-01387	FKD 30-400-P8	30.0	47.1	1.360	3 x 198.9	m	10		21.0	Al	3.8
88-01927	FDR 33,3-400-P8	33.3	48.7	1.310	3 x 205.9	m	16		18.0	Al	3.8
88-02054	FDR 37,5-400-P8	37.5	54.9	1.160	3 x 231.9	n	16		25.0	Al	2.7
88-01781	FDR 40-400-P8	40.0	58.8	1.080	3 x 248.8	m	16		21.0	Al	3.0
88-01772	FDR 50-400-P8	50.0	72.9	0.870	3 x 308.4	n	16		31.0	Al	4.7
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 480 V / 50 Hz - p = 8 % - fres = 177 Hz											
88-01985	FDR 25-480-P8	25.0	30.5	2.510	3 x 107.4	h	10		16.0	on request	on request
88-01986	FDR 50-480-P8	50.0	61.0	1.250	3 x 214.8	n	16		27.0	Al	3.1
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 525 V / 50 Hz - p = 8 % - fres = 177 Hz											
88-01845	FKD 20-525-P8	20.0	25.0	3.350	3 x 80.5	h	6		15.0	Cu	3.5
88-01840	FDR 25-525-P8	25.0	27.8	3.010	3 x 89.5	k	10		21.0	Cu	3.7
88-01846	FDR 30-525-P8	30.0	35.0	2.390	3 x 112.7	k	10		21.0	on request	on request
88-01839	FDR 50-525-P8	50.0	55.6	1.510	3 x 179.0	n	16 / 2x10		29.0	Al	3.3
88-01871	FDR 50-525-P8	50.0	55.6	1.510	3 x 179.0	n	16 / 16		29.0	Al	3.3
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 690 V / 50 Hz - p = 8 % - fres = 177 Hz											
88-01807	FKD 25-690-P8	25.0	22.6	4.870	3 x 55.3	k	4		18.0	Cu	3.7
88-01912	FDR 50-690-P8	50.0	42.1	2.610	3 x 103.1	n	10		27.0	Al	4.8

Version: P1 (Detuning factor p = 14 %), 50 Hz

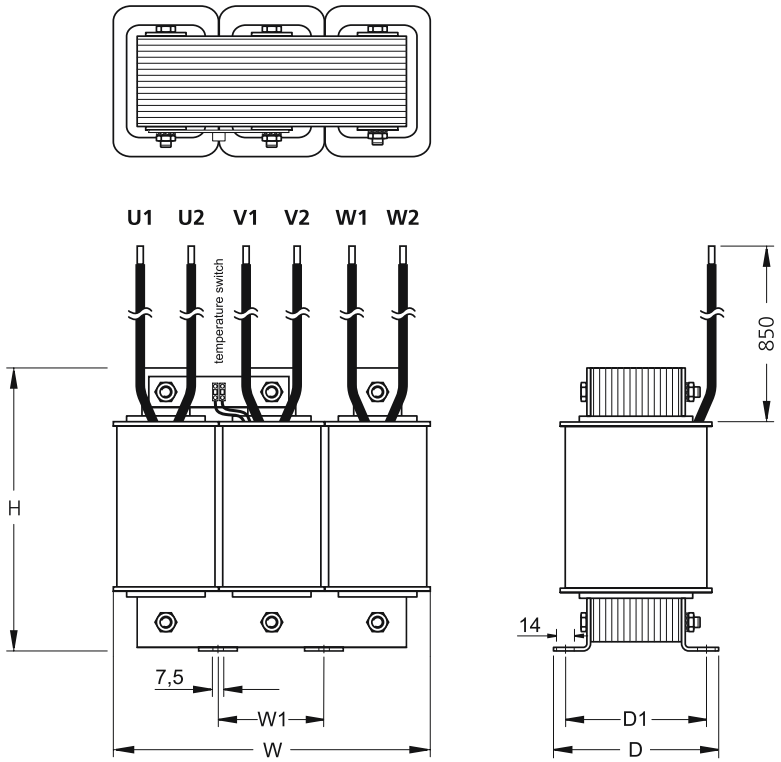
Permissible harmonics EN 61000-2-4 Class 2

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection Cable lug [mm²]	Connection Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 230 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-02020	FDR 15-230-P1	15.0	37.7	1.750	3 x 260.3	k	10		17.0	Cu	2.6
88-01868	FDR 30-230-P1	30.0	75.2	0.880	3 x 519.9	n	16		34.0	Al	4.3
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 400 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-01834	FDR 3,13-400-P1	3.1	4.2	28.300	3 x 16.6	c	4		5.0	Cu	0.9
88-02186	FDR 6,25-400-P1	6.3	9.1	13.100	3 x 35.9	f	4		7.0	Cu	1.4
88-01979	FDR 7,5-400-P1	7.5	11.0	10.800	3 x 43.4	g	4		10.0	Cu	2.1
88-01695	FDR 10-400-P1	10.0	15.1	7.860	3 x 59.8	g	4		11.0	Cu	3.2
88-01168	FDR 12,5-400-P1	12.5	18.1	6.590	3 x 71.4	h	4		13.0	Cu	2.5
88-02187	FDR 15-400-P1	15.0	22.7	5.250	3 x 89.6	h	4		15.0	Cu	4.0
88-02177	FDR 16,7-400-P1	16.7	24.2	4.910	3 x 95.8	h	4		15.0	Cu	4.0
88-01038	FDR 20-400-P1	20.0	28.6	4.160	3 x 113.1	k	6		21.0	Cu	5.7
88-01171	FDR 25-400-P1	25.0	36.1	3.290	3 x 142.8	n	10		25.0	Al	4.5
88-01039	FDR 30-400-P1	30.0	44.1	2.700	3 x 174.3	n	10		26.0	Al	4.3
88-01925	FDR 33,3-400-P1	33.3	48.2	2.470	3 x 190.7	n	16		25.0	Cu	4.5
88-02176	FDR 37,5-400-P1	37.5	54.2	2.200	3 x 214.2	o	10		32.0	Al	5.3
88-02175	FDR 40-400-P1	40.0	58.8	2.020	3 x 232.4	o	16		32.0	Al	5.3
88-02174	FDR 50-400-P1	50.0	71.9	1.600	3 x 285.6	o	16		33.0	Al	5.5
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 415 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-01956	FDR 25-415-P1	25.0	34.6	3.440	3 x 132.6	m	10		24.0	Cu	8.9
88-01957	FDR 50-415-P1	50.0	69.2	1.720	3 x 265.2	p	16		44.0	Al	4.8
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 440 V / 50 Hz - p = 14% - fres = 134 Hz											
88-02041	FDR 25-440-P1	25.0	33.0	3.960	3 x 118.0	n	6		25.0	Al	3.4
88-02007	FDR 50-440-P1	50.0	66.6	1.900	3 x 240.5	p	16		45.0	Al	5.2
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 480 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-02143	FDR 25-480-P1	25.0	30.4	4.690	3 x 100.2	n	6		25.0	Al	4,5
88-02144	FDR 50-480-P1	50.0	60.5	2.360	3 x 199.3	p	16		40.0	Al	7,4
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 525 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-02039	FDR 12,5-525-P1	12.5	15.1	10.360	3 x 45.4	h	4		14.0	Cu	3.7
88-01960	FDR 25-525-P1	25.0	27.9	5.410	3 x 84.4	n	10		25.0	Cu	5.9
88-01900	FDR 50-525-P1	50.0	55.8	2.700	3 x 168.8	p	16		52.0	Al	3.9
Standard Harmonic Filter Reactor - FDR/FKD - V_N = 690 V / 50 Hz - p = 14 % - fres = 134 Hz											
88-02122	FDR 12,5-690-P1	12.5	9.6	21.280	3 x 22.1	h	4		19.0	on request	on request
88-02120	FDR 20-690-P1	20.0	16.9	12.150	3 x 38.7	k	4		18.0	on request	on request
88-01842	FDR 25-690-P1	25.0	21.7	9.130	3 x 50.0	n	4		27.0	Cu	5.1
88-01843	FDR 50-690-P1	50.0	43.4	4.570	3 x 99.9	p	10 / 2x4		33.0	Cu	10.5

Version: P5 (Detuning factor p = 5,67 %) **$I5_{max}$ = 68 %, $I7_{max}$ = 19 %**

Article-No.	Type	Q [kvar]	I_N [A]	L [mH]	C [µF]	Size	Connection Cable lug [mm²]	Connection Terminal [mm²]	Weight approx. [kg]	Winding material	Al/Cu Weight [kg]
Standard Harmonic Filter Reactor - FDR/FKD - U_N = 400 V / 50 Hz - p = 5,67 % - fres = 210 Hz											
88-02141	FDR 25-400-P5	25,0	35,8	1,230	3 x 155,2	n	10		23,0	Al	2,8
88-02142	FDR 50-400-P5	50,0	71,6	0,617	3 x 310,4	o	25		33,0	Al	7,2

Dimensions



Core 3UI	Dimensions [mm] W_{max}	W1	D_{max}	D1	$H_{\pm 3,0}$
a	120	40	83	63	110
b	150	50	97	77	132
c	150	50	97	77	132
d	150	50	97	77	132
e	180	60	91	71	156
f	180	60	101	81	156
g	180	60	111	91	156
h	204	68	121	101	177
i	228	76	104	84	197
k	228	76	128	108	197
l	240	80	125	105	197
m	264	88	114	94	229
n	264	88	140	120	230
o	300	100	150	129	265
p	300	100	165	144	265

Components
Power Factor Control Relays

**The Reactive Power control Relay for maximum operational reliability.
Simple to install, easy to operate and automatic ‘plug and play’ start-up.**

Characteristics that count

FRAKO’s intelligent reactive power control relays automatically adjust themselves to suit the power factor correction system and the network that they serve. This automatically eliminates the risk of faulty programming.
Incorrect connections or inappropriate locations for the instrument transformers are identified and indicated, therefore making time-consuming and expensive troubleshooting unnecessary.
The patented characteristic curve controls the set target cos phi as a minimum value under normal load while simultaneously preventing overcorrection under low load conditions. This reliably prevents costs for reactive power arising and reduces the risk of network disruptions.
The control relay’s intelligent mode of operation ensures that the target parameters are controlled and maintained with the lowest possible number of switching cycles. This minimizes wear of the power factor correction system and reduces disturbances to the network.
Some control relay versions have a trip function to protect the power factor correction system from excessive levels of harmonics.
Last not least, our customers appreciate the user-friendly operation of our reactive power control relays.

Application Recommendations

Consumer network with regulation on inductive target cos phi Quadrant: consumption – inductive	RM 2106 / RM 2112 / RM 9606 / EMR 1100 S EMR 1100
Consumer- and electricity producer networks with regulation in all 4 quadrants	RM 9606 / EMR 1100 S / EMR 1100
Measurement value logging of voltage and current (medium voltage)	EMR 1100 S / EMR 1100
Detuned Power Factor Correction Systems with detuning factors < 7 % or networks with sporadically higher harmonic voltages according to EN 61000-2-4 class 2	EMR 1100 S / EMR 1100
Dynamic Power Factor Correction Systems	RM 2012 12D
Part dynamic Power Factor Correction Systems	RM 2012 6+6D

Features / Technical Data

Category	Basic		Standard		Premium	Dynamic	
Type	RM 2106	RM 2112	RM 9606	EMR 1100 S	EMR 1100	RM 2012 6+6D	RM 2012 12D
Article-No. (German)	38-00320	38-00340	38-00100	38-00300	20-50006	39-29050	39-29051
Article-No. (English)	38-00320	38-00340	38-00103	38-00301	20-50008	39-29050	39-29051
Voltage measurement	L-N	L-N	L-N / L-L	L-N / L-L	L-N / L-L	L-L	L-L
EMR 1100 S Upgrade	-	-	-	20-50013	-	-	-
EMR-SW Configuration Software for EMR 1100	-	-	-	-	20-10312	-	-
Operating/ Measurement voltage [V]	220 - 240	220 - 240	220 - 400	-	-	400	400
Operating voltage [V]	-	-	-	220 - 240 380 - 420	220 - 240 380 - 420	-	-
Measurement voltage [V]	-	-	-	100 - 690	100 - 690	-	-
Frequency [Hz]	50 / 60	50 / 60	50 / 60	50 / 60	50 / 60	50 / 60	50 / 60
Current measurement	Single phase	Single phase	Single phase	Single phase	Single phase	Single phase	Single phase
Operating current min. [mA] man. programming	20	20	20	20	20	10	10
Operating current min. [mA] automatic detection	20	20	20	20	20	50	50
Current transformer X/…A	1 -5	1 -5	1 -5	1 -5	1 -5	1 -5	1 -5
Connection type	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto
Target cos phi	0.85 ind. - 1	0.85 ind. - 1	0.80 ind. - 0.90 cap.	0.80 ind. - 0.90 cap.	0.80 ind. - 0.90 cap.	0.80 ind. - 0.80 cap.	0.80 ind. - 0.80 cap.
Characteristics settings	Fixed	Fixed	Variable	Variable	Variable	Fixed	Fixed
Number of characteristics	1	1	1	1	2	2	2
Switching sequence	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto
Number of active switching outputs	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto	Man/Auto
Programmable fixed stages	0	0	3	3	3	3	3
Relay contacts	6	12	6	12	12	6	0
Loading capacity of the relay contacts	230 V / 950 VA	230 V / 950 VA	250 V / 1800 VA	250 V / 1800 VA	250 V / 1800 VA	250 V / 1000 VA	-

Category	Basic		Standard		Premium	Dynamic	
Type	RM 2106	RM 2112	RM 9606	EMR 1100 S	EMR 1100	RM 2012 6+6D	RM 2012 12D
Switching time delay of the relay contacts	Fixed 60 sec.	Fixed 60 sec.	Adjustable 5 - 500 sec.	Adjustable 5 - 500 sec.	Adjustable 5 - 500 sec.	Adjustable 0 - 1200 sec.	-
Real switching time delay of the relay contacts	Optimised, depending on the load changes	Optimised, depending on the load changes	Optimised, depending on the load changes	Optimised, depending on the load changes	Optimised, depending on the load changes	Fixed, corresponding to the settings	-
Switching time (discharge time) of the relay contacts	Fixed 60 sec.	Fixed 60 sec.	Adjustable 5 - 900 sec.	Adjustable 5 - 900 sec.	Adjustable 5 - 900 sec.	Adjustable 0 - 1200 sec.	-
Transistor-switching contacts	0	0	0	0	0	6	12
Loading capacity of the transistor-switching contacts	-	-	-	-	-	5 - 30 VDC / 50 mA	5 - 30 VDC / 50 mA
Switching frequency [Hz] of the transistor-switching contacts	-	-	-	-	-	0.1/0.2/0.5/ 1/10/50	0.1/0.2/0.5/ 1/10/50
Fault signal contacts	1 relay switch contact selectable	1 relay switch contact selectable	1 Normally closed contact potential-free	1 Normally closed contact potential-free	1 Normally closed contact potential-free	1 Normally closed contact potential-free	1 Normally closed contact potential-free
Loading capacity of the fault signal contacts	230 V / 950 VA	230 V / 950 VA	250 V / 3 A	250 V / 3 A	250 V / 3 A	250 V / 1000 VA	250 V / 1000 VA
Inputs	0	0	0	0	1 for switching the control characteristics	1 for switching the set cos phi	1 for switching the set cos phi
Interfaces	-	-	-	-	FRAKO Starkstrombus® RS-232	Optional Profibus Modbus	Optional Profibus Modbus
Dimensions W x H x D [mm]	144 x 144 x 40	144 x 144 x 40	144 x 144 x 40	144 x 144 x 105	144 x 144 x 105	144 x 144 x 53	144 x 144 x 53
Panel cut out [mm]	138 x 138	138 x 138	138 x 138	138 x 138	138 x 138	136 x 136	136 x 136
Ingress protection front	IP50 (IP54*)	IP50 (IP54*)	IP50 (IP54*)	IP50 (IP54*)	IP50 (IP54*)	IP65	IP65
Ingress protection backside	IP20	IP20	IP20	IP20	IP20	IP20	IP20
Weight (net) [kg]	0.8	0.8	0.9	1.2	1.2	1.0	1.0

* when using a sealing ring (optional)

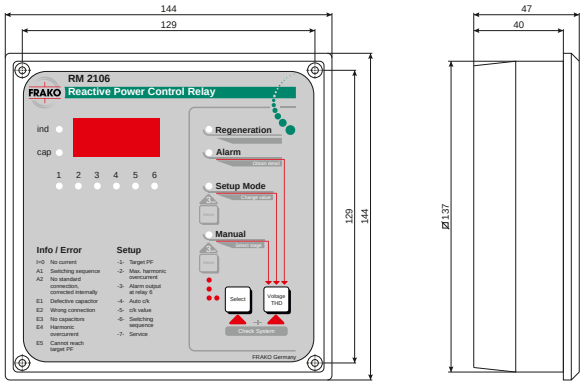
Operating mode displays

Category	Basic		Standard		Premium	Dynamic	
Type	RM 2106	RM 2112	RM 9606	EMR 1100 S	EMR 1100	RM 2012 6+6D	RM 2012 12D
Actual cos phi	Instantaneous value	Instantaneous value	Instantaneous value	Instantaneous value	Instantaneous value	Instantaneous and average value	Instantaneous and average value
Target cos phi	•	•	•	•	•	•	•
Active current [A]	•	•	•	•	•	•	•
Reactive current [A]	•	•	•	•	•	•	•
Apparent current [A]	Instantaneous value	Instantaneous value	Instantaneous value	Instantaneous value	Instantaneous value	Instantaneous and peak value	Instantaneous and peak value
Capacitor current	-	-	Overcurrent	Overcurrent	Overcurrent	•	•
Active power [kW]	-	-	-	-	-	Instantaneous and peak value	Instantaneous and peak value
Reactive power [kvar]	-	-	-	-	-	Instantaneous and peak value	Instantaneous and peak value
Apparent power [kVA]	-	-	-	-	-	•	•
Lack of capacitor rating (kvar)	-	-	•	•	•	•	•
Capacitor power per step	Value	Value	-	-	-	•	•
Connected capacitor steps	•	•	•	•	•	•	•
Mains frequency [Hz]	-	-	-	-	-	Instantaneous, peak and minimum value	Instantaneous, peak and minimum value
Mains voltage [V]	-	-	-	-	-	L2-L3 Instantaneous, peak value	L2-L3 Instantaneous, peak value
Harmonic voltage [%]	THDv	THDv	5., 7., 11., 13.	5., 7., 11., 13.	5., 7., 11., 13.	3., 5., 7., 9., 11., 13., 15., 17., 19.	3., 5., 7., 9., 11., 13., 15., 17., 19.
Harmonic current [%]	-	-	-	-	-	•	•
Temperature [°C]	-	-	-	-	-	•	•
Operating hours per step [h]	-	-	-	-	-	•	•
Switching operations per step [pcs.]	-	-	•	•	•	-	-
Lack of capacity	Alarm can be deactivated	Alarm can be deactivated	Alarm can be deactivated	Alarm can be deactivated	Alarm can be deactivated	Alarm can be deactivated	Alarm can be deactivated
Defective capacitor steps	Alarm	Alarm	-	-	-	-	-
Switching operations threshold value	Alarm	Alarm	Alarm	Alarm	Alarm	-	-

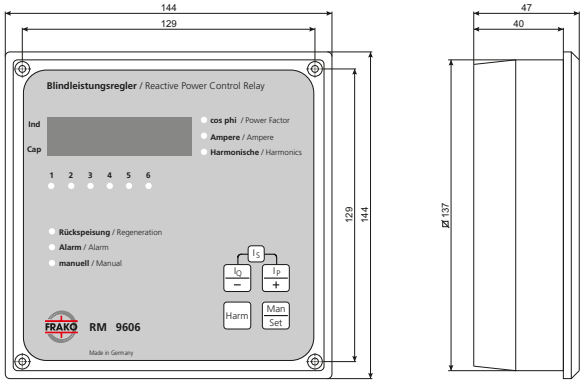
Category	Basic		Standard		Premium	Dynamic	
Type	RM 2106	RM 2112	RM 9606	EMR 1100 S	EMR 1100	RM 2012 6+6D	RM 2012 12D
Undervoltage	Alarm Switch-off	Alarm Switch-off	Alarm Switch-off	Alarm Switch-off	Alarm Switch-off	Alarm Switch-off - can be deactivated	Alarm Switch-off - can be deactivated
Overvoltage	-	-	-	-	-	Alarm switch-off - can be deactivated	Alarm switch-off - can be deactivated
Overcurrent	Alarm switch-off	Alarm switch-off	Alarm switch-off	Alarm switch-off - can be deactivated	Alarm switch-off - can be deactivated	Alarm - can be deactivated	Alarm - can be deactivated
Minimum current	Message switch-off	Message switch-off	Message switch-off	Message switch-off	Message switch-off	Alarm switch-off - can be deactivated	Alarm switch-off - can be deactivated
Harmonic voltage limit	Alarm	Alarm	Alarm	Alarm switch-off	Alarm switch-off	Alarm - can be deactivated	Alarm - can be deactivated
Over temperature	-	-	-	-	-	Alarm - can be deactivated	Alarm - can be deactivated

Dimensions

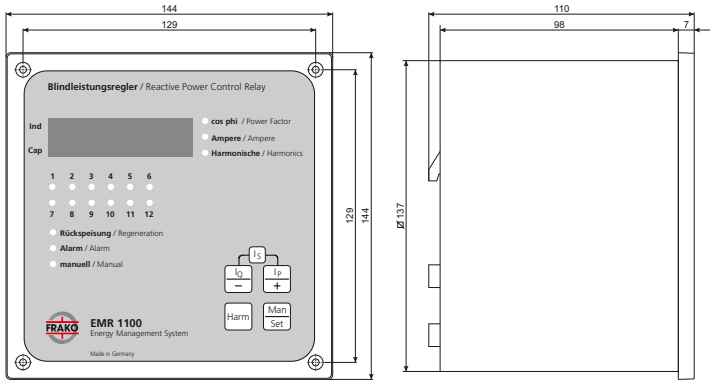
Dimensional drawing RM 2106 (RM 2112)



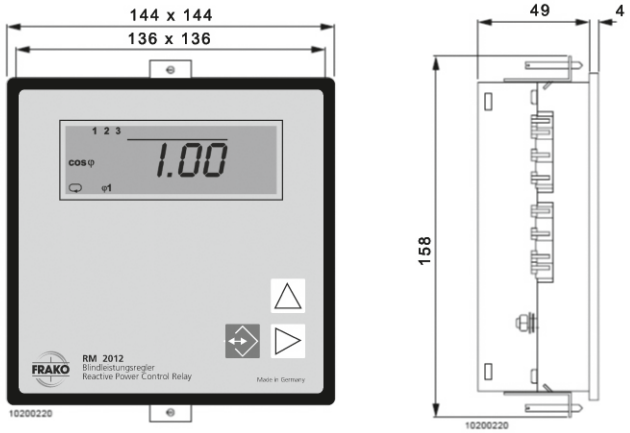
Dimensional drawing RM 9606



Dimensional drawing EMR 1100 / EMR 1100 S



Dimensional drawing RM 2012 6+6D/12D



All dimensions in mm

K3-...K... / K3-...A...

Capacitor Switching Contactors for Power Factor Correction Systems with or without reactors

Switching Power Capacitors safely –
Capacitor Switching Contactors for any application.

- Safe switching of capacitor stages with or without reactors
- Bounce-free switching contacts
- Wear-free contact material
- Long service life and a high number of switching operations

Application Recommendations
Depending on the application appropriate switching devices are needed for the switching of power factor correction capacitors.

During the switching of Power Capacitors a peak inrush current of 200 times of the rated current can occur. In order to limit the inrush current and to protect switching devices and capacitors, capacitor switching contactors type K3-…K with leading transition contacts are used. To limit the inrush current to <70 x I_N , damping resistors are used.

In case of detuned power factor correction systems the high inrush current is damped by the inductance of the harmonic filter reactor. In those applications capacitor switching contactors type K3-…A are used. Those contactors are made of a special contact material.

General Technical Data

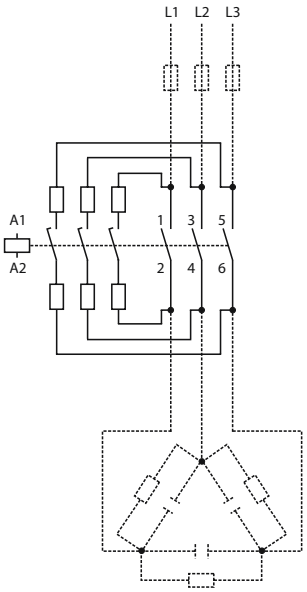
Main Contacts		Type	K3-18	K3-24	K3-32	K3-50	K3-62	K3-74	K3-90	K3-115
Max. ambient temperature										
Operation	open	[°C]	-40 to +60 (+90) [1]							
	enclosed	[°C]	-40 to +40							
Storage		[°C]	-50 to +90							
Short circuit protection										
for contactors without thermal overload relay Coordination-type „1“ according to IEC 947-4-1 Contact welding without hazard of persons										
Max. fuse size	gL (gG)	[A]	100	100	100	160	160	200	200	250
Mechanical life										
AC-operated	S x 10^6		10	10	10	10	10	10	5	5
DC-operated	S x 10^6		10	10	10	10	10	10	5	5
short-time withstand current	10s-current	[A]	144	184	240	360	504	592	680	880
Power loss per pole	at I_e/AC3 400 V	[W]	0.5	0.7	1.3	2.2	3.9	5.5	4.3	6.0

[1] With reduced control voltage range 0.9 up to 1.0 U_s and with reduced rated current I_e/AC1 according to I_e/AC3

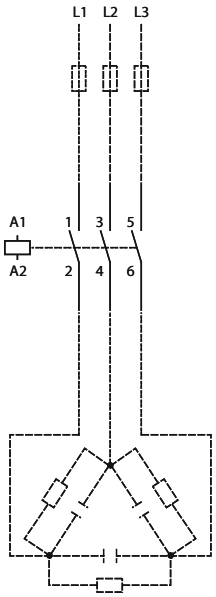
Mounting Instructions

In the area of capacitor switching contactors only self-extinguishing material and material of low inflammability may be used, as abnormal temperatures in the area of the resistor spirals, in case of a fault, cannot be excluded.

Typical Circuit Diagram



K3-...K...



K3-...A...

Technical Data

Article-No.	Type	Rated operational power at 50 / 60 Hz						Aux. contacts			Weight approx.
		Ambient temperature						built-in			
	Coil voltage	50 °C			60 °C						
	220-240 V, 50 Hz	**380 V**	415 V	660 V	380 V	415 V	660 V			add	
	230-264 V, 60 Hz	**400 V**	440 V	690 V	400 V	440 V	690 V				
		[kvar]	[kvar]	[kvar]	[kvar]	[kvar]	[kvar]	NO	NC	Pcs.	[kg/pc.]
Type K3-…A											
89-00288	K3-18ND10 230	12.5	13	20	12.5	13	20	1	-	4 [2]	0.3
89-00289	K3-24A00 230	20	22	33	20	22	33	-	-	6 [3]	0.5
89-00290	K3-32A00 230	25	27	41	25	27	41	-	-	6 [3]	0.5
89-00291	K3-50A00 230	33.3	36	55	33.3	36	55	-	-	6 [3]	0.9
89-00292	K3-62A00 230	50	53	82	50	53	82	-	-	6 [3]	0.9
89-00293	K3-74A00 230	75 [4]	75 [4]	100 [4]	60	64	100	-	-	6 [3]	0.9
89-00358	K3-90A00 230	80	82	120	75	77	120	-	-	9 [5]	2.2
89-00359	K3-115A00 230	100 [6]	103 [6]	148 [6]	90 [6]	93 [6]	148 [6]	-	-	9 [5]	2.2
Type K3-…K											
89-00280	K3-18NK10 230	0-12.5	0-13	0-20	0-12.5	0-13	0-20	1	-	1 [2]	0.4
89-00279	K3-24K00 230	10-20	10.5-22	17-33	10-20	10.5-22	17-33	-	-	3 [3]	0.7
89-00278	K3-32K00 230	10-25	10.5-27	17-41	10-25	10.5-27	17-41	-	-	3 [3]	0.7
89-00277	K3-50K00 230	20-33.3	23-36	36-55	20-33.3	23-36	36-55	-	-	3 [3]	1.0
89-00276	K3-62K00 230	20-50	23-53	36-82	20-50	23-53	36-82	-	-	3 [3]	1.0
89-00286	K3-74K00 230	20-75 [4]	23-75 [4]	36-120 [4]	20-60	23-64	36-100	-	-	3 [3]	1.0
89-00356	K3-90K00 230	33-80	36-82	57-120	33-75	36-77	57-120	-	-	6 [5]	2.3
89-00357	K3-115K00 230	33-100 [6]	36-103 [6]	57-148 [6]	33-90 [6]	36-93 [6]	57-148 [6]	-	-	6 [5]	2.3

[2] 1HN.. or HA.. snap-on [3] 1HN .. or HA.. snap-on + 2HB.. for side mounting

[4] Consider the max. thermal current of the contactor K3-74: I_{th} 130 A [5] 2HB.. on the left or right side and 4HN.. or HA.. snap-on

[6] Consider the min. cross-section of conductor at max. load

Specification: Contactors K3-..K are suitable for switching low-inductive and low-loss capacitors in capacitor banks (IEC70 and 831, VDE 0560) without and with reactors.

Capacitor switching contactors are fitted with leading auxiliary contacts and damping resistors, to reduce the value of current peaks < 70 x I_e.

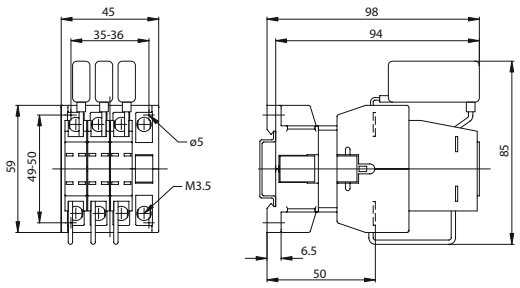
Operating conditions: Capacitor switching contactors are protected against welding for a prospective peak inrush current of 200 x I_e

Other coil voltages on request

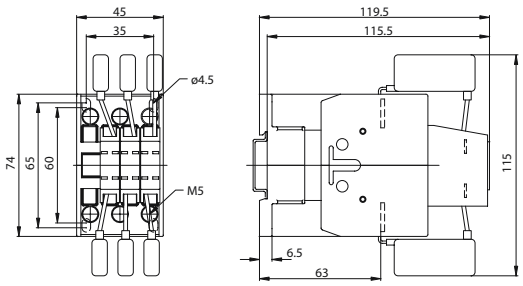
Auxiliary Contact Blocks

Article-No.	Type	Rated operational current			For contactors	Contacts		Weight approx.
		AC15 230 V [A]	400 V [A]	AC1 690 V [A]		NO	NC	[kg/pc.]
89-00294	HB11	3	2	10	K3-24… bis K3-115…	1	1	0.02
89-00281	HN10	3	2	10	K3-18… bis K3-115…	1	-	0.02

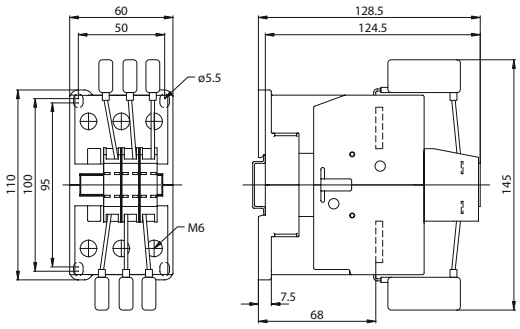
Dimensions



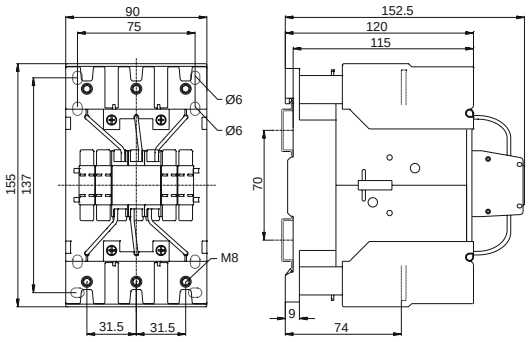
Dimensional drawing K3-18NK



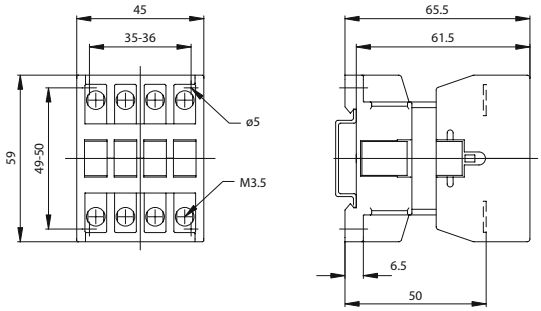
Dimensional drawing K3-24K00, K3-32K00



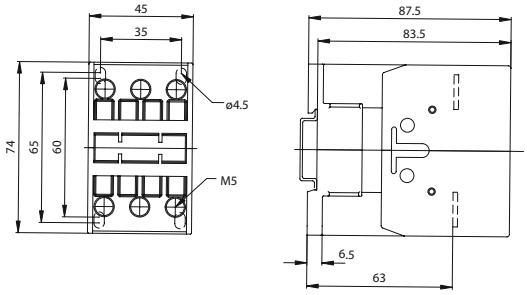
Dimensional drawing K3-50K00, K3-62K00, K3-74K00



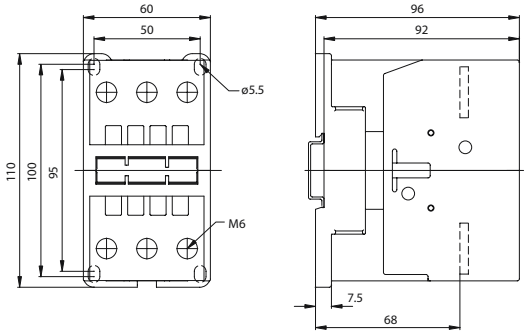
Dimensional drawing K3-90K00, K3-115K00



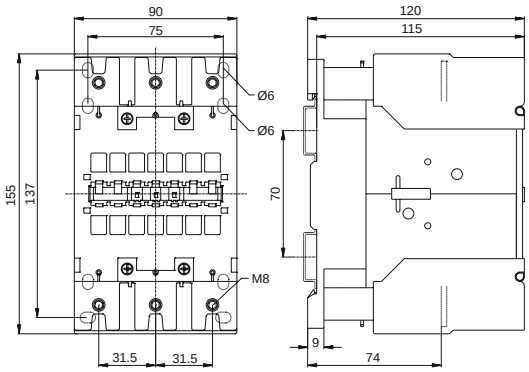
Dimensional drawing K3-18ND10



Dimensional drawing K3-24A00, K3-32A00



Dimensional drawing K3-50A00, K3-62A00, K3-74A00



Dimensional drawing K3-90A00, K3-115A00

All dimensions in mm

FR 3AC
Discharge Reactors

Fast and secure discharging of Power Capacitors with low-loss Discharge Reactors.

- Fast discharging of capacitors steps (< 5 seconds at 50 kvar / 400 V)
- 230 to 690 V rated operating voltage
- Three-phase design

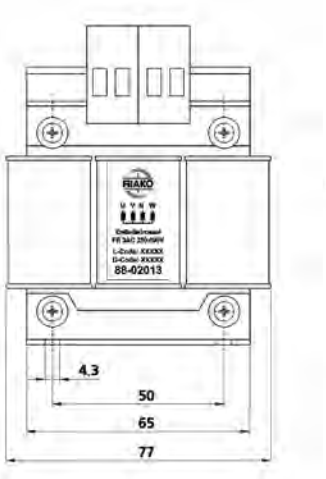
Application Recommendations

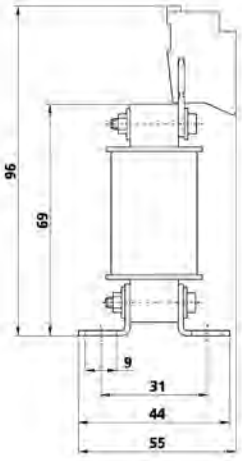
Due to the integrated discharge resistors FRAKO Power Factor Correction Capacitors discharge within approx. 1 minute. The reconnection of a capacitor stage will be delayed due to the time a capacitor needs for discharging.
Some applications require a fast reconnection. Therefore, the time a capacitor needs to discharge has to be reduced. Discharge reactors safely discharge the capacitor within a few seconds.

Technical Data

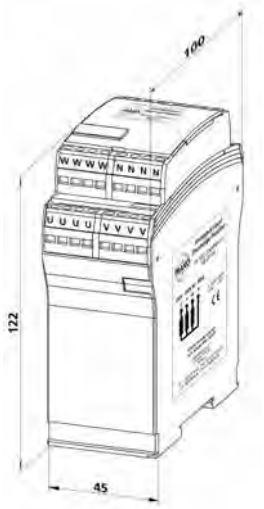
	Discharge Reactor	
Type	FR3AC230-690V	FR3AC230-690V-G
Rated operating voltage	3AC 230 V – 690 V	3AC 230 V – 690 V
Frequency	50 – 60 Hz	50 – 60 Hz
Operating losses	< 5 W	< 5 W
No-load current	< 4.5 mA	< 4.5 mA
Inductance	70H	70H
Time of discharge	230 V: 25 kvar < 5 s. 50 kvar < 10 s. 400 V: 50 kvar < 5 s. 100 kvar < 10 s. 690 V: 100 kvar < 5 s.	230 V: 25 kvar < 5 s. 50 kvar < 10 s. 400 V: 50 kvar < 5 s. 100 kvar < 10 s. 690 V: 100 kvar < 5 s.
Permissible discharges	3 / min	3 / min
Temperature class	T40 / E	T40 / E
Ambient temperature	-25…+60 °C	-25…+60 °C
Protection class	IP00	IP40
Abutting cross section	0.75-2.5 mm²	0.75-2.5 mm²
Fixing torque	0.5 Nm	0.5 Nm
Total weight	0.5 kg	0.6 kg
Testing voltage	4 kV AC	4 kV AC
Standards	EN 61558-2-20	EN 61558-2-20
Dimensions in mm (W x H x D)	77 x 96 x 55	45 x 122 x 100
Mounting	Mounted directly on the module	Snap assembly on top hat rail
Article-No.	88-02013	88-02132

Dimensions





Dimensional drawing FR3AC230-690V



Dimensional drawing FR3AC230-690V-G

All dimensions in mm

PFC Capacitors in sheet steel cases

2

Power Factor Correction Capacitors in sheet steel cases

Page 47

Power Factor Correction Capacitors in sheet steel cases – detuned

Page 53

Power Factor Correction Capacitors in sheet steel cases

Power Capacitors type LKN and LKSLT for fixed compensation of, for example, motors and transformers.

	LKN	LKSLT
		
Sheet steel case	•	•
With terminal block	•	
Ingress protection IP54	•	
With fuse switch		•
Ingress protection IP 20		•
Catalogue page	Page 49 ff.	Page 49 ff.

LKN / LKSLT
Power Factor Correction Capacitors in sheet steel cases

Power Capacitors type LKN and LKSLT for fixed compensation of, for example, motors and transformers.

- Power range: 7.5 to 100 kvar per case
- Ready for connection
- For floor installation or wall mounting
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Power Factor Correction Capacitors in sheet steel cases are mainly used for fixed compensation of motors and transformers. They are suitable for power factor correction in supply networks without harmonic distortion.

Attention: Even low harmonic levels can be amplified by network resonances. High harmonic levels can overload or damage all electrical devices and machines in the network.

Today, networks without harmonic distortion are quite rare. Therefore we generally recommend installing fixed capacitors with harmonic filter reactors (page 53 ff.).

PFC Capacitors in sheet steel cases

Power Factor Correction Capacitors in sheet steel cases

Power Range

Power Factor Correction Capacitors in sheet steel case:

- **LKN:** 7.5 to 100 kvar
- **LKSLT:** 7.5 to 60 kvar

Construction

Sheet steel case with plinth for floor mounting and lugs for wall mounting.

The case contains:

- Self-healing LKT type power capacitors with low loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Fuse switch disconnector size NH00 (only available for **LKSLT**)

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection

The supply cable enters the cabinet through a cable gland and is connected to the studs on the junction plate (**LKN**). In case of an **LKSLT** it is directly connected at the fuse switch disconnector.

Technical Data

Rated voltage	400 V / 50 Hz
Rated voltage of capacitors	440 V / 50 Hz
Ambient temperature	-10 °C to +45 °C
Humidity	Max. 90 %, no condensation
Case colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

The presence of inductive and capacitive reactances in the low voltage network means that the harmonics generated there, together with those fed in from the medium voltage network, can be amplified many times over due to resonance. Particularly in industrial networks with loads that generate harmonics, the use of conventional power factor correction systems without Harmonic Filter Reactors is not advisable. Instead, detuned systems should be installed. See the LKNS and LKND series of detuned power capacitors.

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

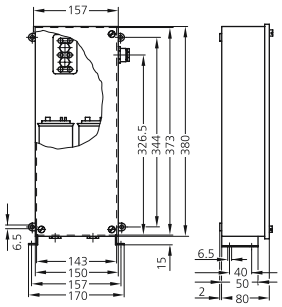
Article-No.	Type	Rated power [kvar]	Rated capacity [µF]	Dimensions Width [mm]	Height [mm]	Depth [mm]	Gland	Weight approx. [kg]	Protection IP
Power Factor Correction Capacitors in sheet steel cases, rated mains voltage: 400 V / 50 Hz									
Type series: LKN									
31-30075	LKN 7.5-400-D32	7.5	3 x 49.7	150	380	80	PG 16	5	54
31-30100	LKN 10-400-D32	10	3 x 66.3	150	380	80	PG 16	6	54
31-30125	LKN 12.5-400-D32	12.5	3 x 82.9	220	380	80	PG 29	6	54
31-30150	LKN 15-400-D32	15	3 x 99.5	220	380	80	PG 29	7	54
31-30200	LKN 20-400-D32	20	3 x 132.6	250	450	150	PG 36	10	54
31-30250	LKN 25-400-D32	25	3 x 165.8	250	450	150	PG 36	10	54
31-30300	LKN 30-400-D32	30	3 x 198.9	250	450	150	PG 36	11	54
31-30400	LKN 40-400-D32	40	3 x 265.3	410	450	150	PG 42	15	54
31-30500	LKN 50-400-D32	50	3 x 331.6	410	450	150	PG 42	15	54
31-30600	LKN 60-400-D32	60	3 x 397.9	410	450	150	PG 42	16	54
31-30603	LKN 75-400-D32	75	3 x 497.4	525	500	195	PG 42	22	54
31-30604	LKN 80-400-D32	80	3 x 530.5	525	500	195	PG 42	23	54
31-30606	LKN 85-400-D32	85	3 x 563.7	525	500	195	PG 42	23	54
31-30605	LKN 100-400-D32	100	3 x 663.2	525	500	195	PG 42	25	54
Power Factor Correction Capacitors in sheet steel cases, with switch disconnector, rated mains voltage: 400 V / 50 Hz									
Type series: LKSLT									
31-21075	LKSLT 7.5-400-D30	7.5	3 x 49.7	410	410	184	PG 16	12	20
31-21100	LKSLT 10-400-D30	10	3 x 66.3	410	410	184	PG 16	15	20
31-21125	LKSLT 12.5-400-D30	12.5	3 x 82.9	410	410	184	PG 29	13	20
31-21150	LKSLT 15-400-D30	15	3 x 99.5	410	410	184	PG 29	15	20
31-21200	LKSLT 20-400-D30	20	3 x 132.6	410	410	184	PG 36	14	20
31-21250	LKSLT 25-400-D30	25	3 x 165.8	410	410	184	PG 36	16	20
31-21300	LKSLT 30-400-D30	30	3 x 198.9	410	410	184	PG 36	17	20
31-21400	LKSLT 40-400-D30	40	3 x 265.3	410	410	184	PG 42	17	20
31-21500	LKSLT 50-400-D30	50	3 x 331.6	560	410	184	PG 42	18	20
31-21761	LKSLT 55-400-D30	55	3 x 364.7	560	410	184	PG 42	20	20
31-21600	LKSLT 60-400-D30	60	3 x 397.9	560	410	184	PG 42	20	20

Other rated voltages, frequencies and power ratings on request

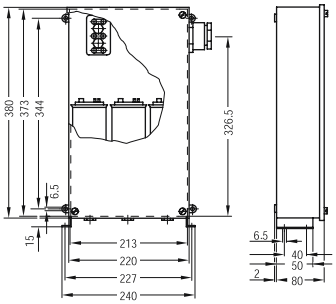
Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

2

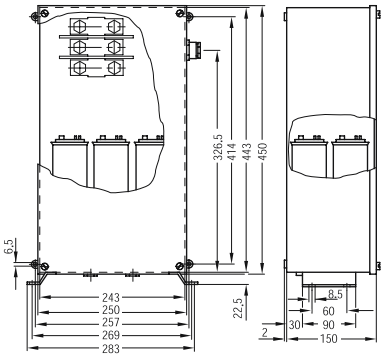
Dimensions



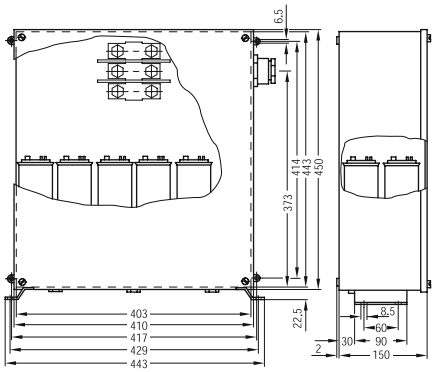
Dimensional drawing LKN
Case type 1
(7.5 to 10 kvar)



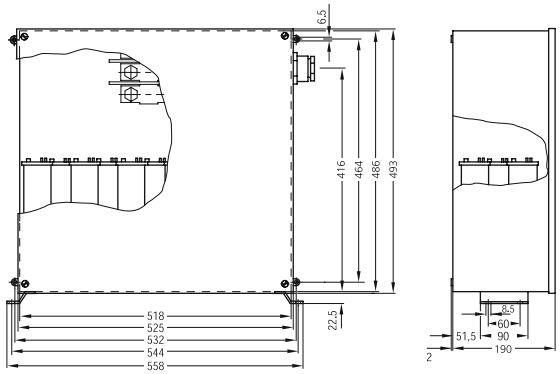
Dimensional drawing LKN
Case type 2
(12.5 to 15 kvar)



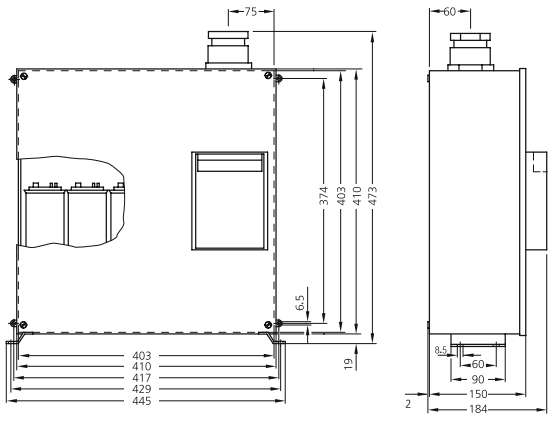
Dimensional drawing LKN
Case type 3
(20 to 30 kvar)



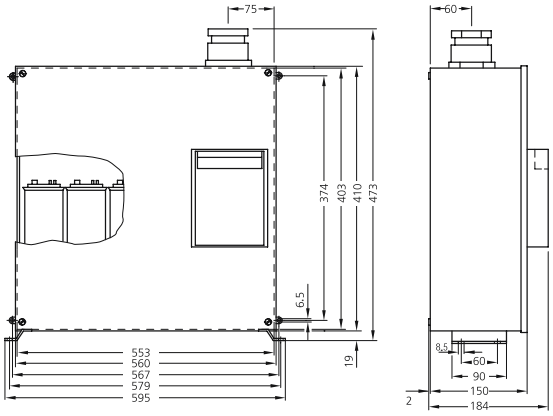
Dimensional drawing LKN
Case type 4
(40 to 60 kvar)



Dimensional drawing LKN
Case type 5
(75 to 100 kvar)



Dimensional drawing LKSLT
Case type 1 (7.5 to 40 kvar)



Dimensional drawing LKSLT
Case type 2 (50 to 60 kvar)

All dimensions in mm

Power Factor Correction Capacitors in sheet steel cases – detuned

Power Capacitors type LKND-P and LKNS-P for fixed compensation of inductive consumers in networks with high harmonic content.

	LKND-P...	LKNS-P...
		
Sheet steel case	•	•
Without capacitor switching contactors	•	
With capacitor switching contactors		•
Ingress protection IP20	•	•
Additional fuse switch (optional)	•	•
Catalogue page	Page 55 ff.	Page 55 ff.

LKND-P / LKNS-P

Power Factor Correction Capacitors in sheet steel cases – detuned

Power Capacitors type LKND-P and LKNS-P for fixed compensation of inductive consumers in networks with high harmonic content.

- Power Range: 7.5 to 50 kvar per case
- Ready for connection
- Power Factor Correction Capacitors LKT dry-type with four safety features
- Low-loss harmonic filter reactors, type: Standard

Application Recommendations

Detuned Power Factor Correction Capacitors in sheet steel cases are mainly used for fixed compensation of motors and transformers.

They are suitable for compensation in supply networks with harmonic distortion according to EN 61000-2-4 class 2.
They are available as follows:

Version	Detuning factor	Resonance frequency
P1	p = 14 %	134 Hz
P5	p = 5.67 %	210 Hz
P7	p = 7 %	189 Hz
P8	p = 8 %	177 Hz

PFC Capacitors in sheet steel cases

Power Factor Correction Capacitors in sheet steel cases – detuned

Power Range

Power Factor Correction Capacitors in sheet steel case - detuned:

- **LKND-P:** 6.25 to 50 kvar
- **LKNS-P:** 10 to 50 kvar

Construction

Sheet steel case suitable for wall mounting or as freestanding cabinet (with socket, see accessories / options).

The case contains:

- Self-healing LKT type power capacitors with low loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Low-loss harmonic filter reactors with thermal trip switch

The LKNS series furthermore contains:

- Capacitor switching contactors
- Control terminal strip with control fuse
- Control switch indicator light

Natural air cooling is ensured by appropriate cutouts in the door and on the roof.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Connection

The supply cable enters the cabinet from below and is connected to the studs of the junction plate.

Technical Data

Rated voltage	400 V / 50 Hz
Rated voltage of capacitors	440 V / 50 Hz
Ambient temperature	–10 °C to +40 °C
Humidity	Max. 90 %, no condensation
Case colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Type: LKND-P

Article-No.	Type	Rated power [kvar]	Rated capacity [µF]	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Capacitors in sheet steel cases, detuned, rated mains voltage 400 V / 50 Hz Type series: LKND ...-P1 (Detuning factor p = 14 %)								
31-22097	LKND 6,25-400-2-P1	6.25	3 x 41.5	600	850	275	48	20
31-22010	LKND 10-400-2-P1	10	3 x 66.3	600	850	275	52	20
31-22011	LKND 12,5-400-2-P1	12.5	3 x 82.9	600	850	275	55	20
31-22012	LKND 15-400-2-P1	15	3 x 99.5	600	850	275	57	20
31-22013	LKND 20-400-2-P1	20	3 x 132.6	600	850	275	63	20
31-22014	LKND 25-400-2-P1	25	3 x 165.8	600	850	275	70	20
31-22015	LKND 30-400-2-P1	30	3 x 198.9	600	850	275	74	20
31-22016	LKND 40-400-2-P1	40	3 x 265.3	600	850	275	89	20
31-22017	LKND 50-400-2-P1	50	3 x 331.6	600	850	275	94	20
Power Factor Correction Capacitors in sheet steel cases, detuned, rated mains voltage 400 V / 50 Hz Type series: LKND ...-P7 (Detuning factor p = 7 %)								
31-22115	LKND 5-400-2-P7	5	3 x 33.2	600	850	275	47	20
31-22018	LKND 7,5-400-2-P7	7.5	3 x 49.7	600	850	275	48	20
31-22019	LKND 10-400-2-P7	10	3 x 66.3	600	850	275	49	20
31-22020	LKND 12,5-400-2-P7	12.5	3 x 82.9	600	850	275	49	20
31-22021	LKND 15-400-2-P7	15	3 x 99.5	600	850	275	54	20
31-22022	LKND 20-400-2-P7	20	3 x 132.6	600	850	275	54	20
31-22023	LKND 25-400-2-P7	25	3 x 165.8	600	850	275	57	20
31-22009	LKND 30-400-2-P7	30	3 x 198.9	600	850	275	63	20
31-22025	LKND 40-400-2-P7	40	3 x 265.3	600	850	275	65	20
31-22026	LKND 50-400-2-P7	50	3 x 331.6	600	850	275	72	20
Power Factor Correction Capacitors in sheet steel cases, detuned, rated mains voltage 400 V / 50 Hz Type series: LKND ...-P8 (Detuning factor p = 8 %)								
31-22035	LKND 7,5-400-2-P8	7.5	3 x 49.7	600	850	275	49	20
31-22072	LKND 10-400-2-P8	10	3 x 66.3	600	850	275	50	20
31-22102	LKND 12,5-400-2-P8	12.5	3 x 82.9	600	850	275	51	20
31-22071	LKND 15-400-2-P8	15	3 x 99.5	600	850	275	56	20
31-22080	LKND 20-400-2-P8	20	3 x 132.6	600	850	275	56	20
31-22081	LKND 25-400-2-P8	25	3 x 165.8	600	850	275	62	20
31-22046	LKND 30-400-2-P8	30	3 x 198.9	600	850	275	61	20
31-22086	LKND 40-400-2-P8	40	3 x 265.3	600	850	275	65	20
31-22063	LKND 50-400-2-P8	50	3 x 331.6	600	850	275	72	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

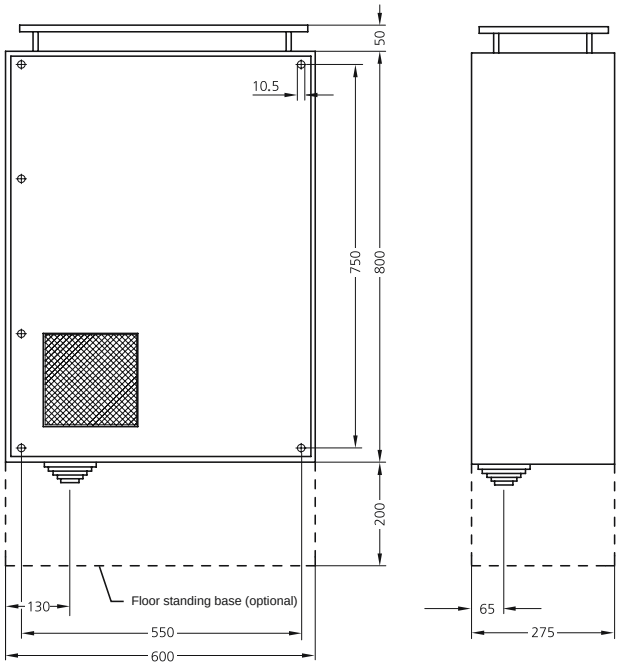
Type: LKNS-P

Article-No.	Type	Rated power [kvar]	Rated capacity [µF]	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Capacitors in sheet steel cases, detuned, rated mains voltage 400 V / 50 Hz Type series: LKNS ...-P1 (Detuning factor p = 14 %)								
31-21105	LKNS 10-400-2-P1	10	3 x 66.3	600	850	275	54	20
31-21133	LKNS 12,5-400-2-P1	12.5	3 x 82.9	600	850	275	61	20
31-21155	LKNS 15-400-2-P1	15	3 x 99.5	600	850	275	63	20
31-21212	LKNS 20-400-2-P1	20	3 x 132.6	600	850	275	65	20
31-21260	LKNS 25-400-2-P1	25	3 x 165.8	600	850	275	60	20
31-21311	LKNS 30-400-2-P1	30	3 x 198.9	600	850	275	74	20
31-21404	LKNS 40-400-2-P1	40	3 x 256.3	600	850	275	94	20
31-21505	LKNS 50-400-2-P1	50	3 x 331.6	600	850	275	98	20
Power Factor Correction Capacitors in sheet steel cases, detuned, rated mains voltage 400 V / 50 Hz Type series: LKNS ...-P7 (Detuning factor p = 7 %)								
31-21106	LKNS 10-400-2-P7	10	3 x 66.3	600	850	275	58	20
31-21127	LKNS 12,5-400-2-P7	12.5	3 x 82.9	600	850	275	58	20
31-21153	LKNS 15-400-2-P7	15	3 x 99.5	600	850	275	59	20
31-21211	LKNS 20-400-2-P7	20	3 x 132.6	600	850	275	60	20
31-21257	LKNS 25-400-2-P7	25	3 x 165.8	600	800	275	62	20
31-21309	LKNS 30-400-2-P7	30	3 x 198.9	600	850	275	64	20
31-21403	LKNS 40-400-2-P7	40	3 x 256.3	600	850	275	68	20
31-21503	LKNS 50-400-2-P7	50	3 x 331.6	600	850	275	72	20
Power Factor Correction Capacitors in sheet steel cases, detuned, rated mains voltage 400 V / 50 Hz Type series: LKNS ...-P8 (Detuning factor p = 8 %)								
31-21110	LKNS 10-400-2-P8	10	3 x 66.3	600	850	275	59	20
31-21126	LKNS 12,5-400-2-P8	12.5	3 x 82.9	600	850	275	59	20
31-21154	LKNS 15-400-2-P8	15	3 x 99.5	600	850	275	60	20
31-21216	LKNS 20-400-2-P8	20	3 x 132.6	600	850	275	61	20
31-21261	LKNS 25-400-2-P8	25	3 x 165.8	600	850	275	63	20
31-21312	LKNS 30-400-2-P8	30	3 x 198.9	600	850	275	65	20
31-21406	LKNS 40-400-2-P8	40	3 x 256.3	600	850	275	69	20
31-21504	LKNS 50-400-2-P8	50	3 x 331.6	600	850	275	63	20

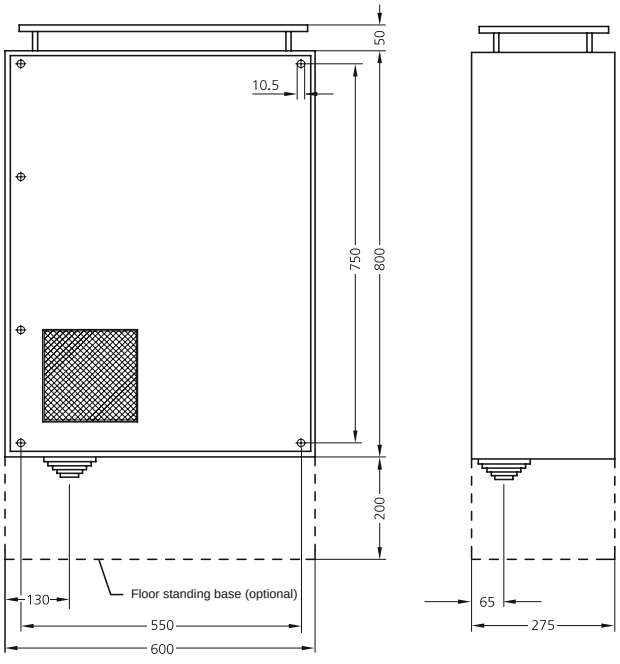
Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Dimensions



Dimensional drawing LKND-P (6.25 to 50 kvar)



Dimensional drawing LKNS-P (10 to 50 kvar)

All dimensions in mm

PFC Systems on mounting plates / Capacitor Modules

Power Factor Correction Systems on mounting plates

**PFC Systems on mounting plates for installation in standard switchboards.
Type LSPN is also suitable for installation in DIN standard distribution boards.**

	LSPN	LSP...-2...	LSP...-3...
			
Power range	17.5-60 kvar	68.75-100 kvar	112.5-200 kvar
Used for cabinets size (500 x 500 x 300 mm)	•		
Used for cabinets size (600 x 800 x 275 mm)		•	
Used for cabinets size (600 x 1200 x 300 mm)			•
Catalogue page	Page 63 ff.	Page 63 ff.	Page 63 ff.

LSPN / LSP
Power Factor Correction Systems on mounting plates

PFC System on mounting plates for installation in standard switchboards.
Type LSPN is also suitable for installation in DIN standard distribution boards.

- Power Range: 17.5 to 200 kvar
- Compact design on a mounting plate
- Ready for connection (without control relay and relay cable)
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Power Factor Correction Systems on mounting plates type LSPN / LSP are suitable for installation in standard switchboards. Type LSPN is also suitable for installation in DIN standard distribution boards. Those systems are pre-wired. One only has to connect the Power Factor Correction Relay (not included) with the terminal strip. Those systems are suitable for power factor correction in networks without harmonic distortion.

Attention: Even low harmonic levels can be amplified by network resonances. High harmonic levels can overload or damage all electrical devices and machines in the network.

Today, networks without harmonic distortion are quite rare. Therefore we generally recommend installing fixed capacitors with Harmonic Filter Reactors (page 67 ff).

Power Range

Power Factor Correction System on mounting plate:

- **LSPN -4:** 17.5 to 60 kvar
- **LSP -2:** 68.75 to 100 kvar
- **LSP -3:** 112.5 to 200 kvar

Construction

Mounting plate with mounted Power Factor Correction Capacitors. Capacitor Switching Contactors and fuses for installation in switchboards.

The system contains:

- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Capacitor Switching Contactors with leading transition contact for damping of current peaks
- Fuse links, 3-pole, size NH00
- Control terminal strip with control fuse and thermal trip switch

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Connection

The power cable is connected to the LV NH00 fuse element; The Power Factor Correction Relay (not included) as well as the cable from the current transformer has to be connected to the control terminal strip.

System Expansion

An extension of the system is possible by adding LSPZ extension units. This extension unit will be integrated in the existing control circuit via the control cable (supplied with the extension unit).

Technical Data

Rated voltage	400 V / 50 Hz
Rated voltage of capacitors	440 V / 50 Hz
Ambient temperature	–5 °C to +60 °C
Humidity	Max. 90 %, no condensation
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

The presence of inductive and capacitive reactances in the low voltage network means that the harmonics generated there, together with those fed in from the medium voltage network, can be amplified many times over due to resonance. Particularly in industrial networks with loads that generate harmonics, the use of conventional power factor correction systems without Harmonic Filter Reactors is not advisable. Instead, detuned systems should be installed. See the LSP-P series of Power Factor Correction Systems on mounting plates.

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems on mounting plates, rated mains voltage: 400 V / 50 Hz Type series: LSPN …-4									
34-57530	LSPN 17,5-2,5-111-400/440-4	17.5	2.5	1:2:4	450	450	260	13	00
34-57531	LSPN 27,5-2,5-112-400/440-4	27.5	2.5	1:2:4:4	450	450	260	14	00
34-57532	LSPN 30-5-11A-400/440-4	30	5	1:2:3	450	450	260	14	00
34-57533	LSPN 37,5-2,5-1111-400/440-4	37.5	2.5	1:2:4:8	450	450	260	16	00
34-57534	LSPN 37,5-7,5-12-400/480-4	37.5	7.5	1:2:2	450	450	260	15	00
34-57535	LSPN 43,75-6,25-111-400/440-4	43.75	6.25	1:2:4	450	450	260	15	00
34-57536	LSPN 46,88-3,13-1111-400/440-4	46.88	3.13	1:2:4:8	450	450	260	16	00
34-57537	LSPN 50-5-11A1-400/440-4	50	5	1:2:3:4	450	450	260	17	00
34-57538	LSPN 50-10-12-400/440-4	50	10	1:2:2	450	450	260	16	00
34-57539	LSPN 52,5-7,5-111-400/440-4	52.5	7.5	1:2:4	450	450	260	17	00
34-57540	LSPN 60-10-11A-400/440-4	60	10	1:2:3	450	450	260	18	00
Power Factor Correction Systems on mounting plates, rated mains voltage: 400 V / 50 Hz Type series: LSP …-2									
34-57051	LSP 68,75-6,25-112-400/440-2	68.75	6.25	1:2:4:4	550	567.5	235	23	00
34-57052	LSP 75-6,25-212-400/440-2	75	6.25	1:1:2:4:4	550	567.5	235	25	00
34-57088	LSP 75-12,5-11A-400/440-2	75	12.5	1:2:3	550	567.5	235	24	00
34-57053	LSP 75-12,5-22-400/440-2	75	12.5	1:1:2:2	550	567.5	235	24	00
34-57054	LSP 87,5-12,5-111-400/440-2	87.5	12.5	1:2:4	550	567.5	235	25	00
34-57055	LSP 93,75-6,25-1111-400/440-2	93.75	6.25	1:2:4:8	550	567.5	235	25	00
34-57056	LSP 100-12,5-211-400/440-2	100	12.5	1:1:2:4	550	567.5	235	26	00
Power Factor Correction Systems, extension units on mounting plates, rated mains voltage: 400 V / 50 Hz Type series: LSPZ …-2									
34-57100	LSPZ 50-50-1-400/440-2	50	50	1	550	567.5	235	18	00
34-57101	LSPZ 75-25-11-400/440-2	75	25	1:2	550	567.5	235	23	00
34-57102	LSPZ 100-50-2-400/440-2	100	50	1:1	550	567.5	235	25	00
Power Factor Correction Systems on mounting plates, rated mains voltage: 400 V / 50 Hz Type series: LSP …-3									
34-57060	LSP 112,5-6,25-11AB-400/440-3	112.5	6.25	1:2:3:6:6	550	1157	240	55	00
34-57061	LSP 125-12,5-221-400/440-3	125	12.5	1:1:2:2:4	550	1157	240	55	00
34-57062	LSP 143,75-6,25-1112-400/440-3	143.75	6.25	1:2:4:8:8	550	1157	240	57	00
34-57063	LSP 150-12,5-212-400/440-3	150	12.5	1:1:2:4:4	550	1157	240	56	00
34-57064	LSP 150-25-22-400/440-3	150	25	1:1:2:2	550	1157	240	58	00
34-57065	LSP 175-25-13-400/440-3	175	25	1:2:2:2	550	1157	240	60	00
34-57066	LSP 187,5-12,5-113-400/440-3	187.5	12.5	1:2:4:4:4	550	1157	240	61	00
34-57067	LSP 200-12,5-213-400/440-3	200	12.5	1:1:2:4:4:4	550	1157	240	64	00
34-57068	LSP 200-25-23-400/440-3	200	25	1:1:2:2:2	550	1157	240	64	00
Power Factor Correction Systems, extension units on mounting plates, rated mains voltage: 400 V / 50 Hz Type series: LSPZ …-3									
34-57103	LSPZ 150-50-3-400/440-3	150	50	1:1:1	550	1157	240	59	00
34-57104	LSPZ 200-50-4-400/440-3	200	50	1:1:1:1	550	1157	240	67	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

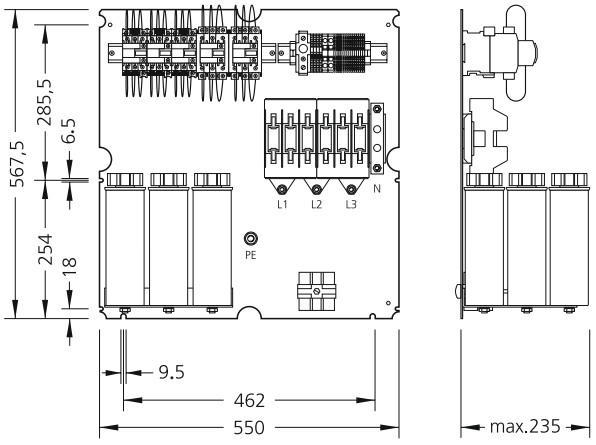
Options and accessories for Power Factor Correction Systems type LSPN / LSP 400V, 50 Hz

Accessories

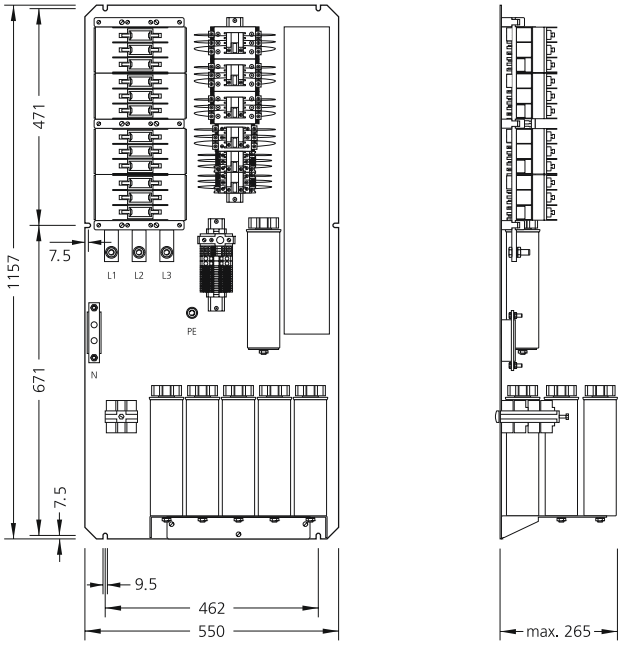
Article-No.	Type	Description
38-00100	RM 9606	Power Factor Control Relay RM 9606 - German
38-00103	RM 9606	Power Factor Control Relay RM 9606 - English
38-00300	EMR 1100 S	Power Factor Control Relay EMR 1100 S - German
38-00301	EMR 1100 S	Power Factor Control Relay EMR 1100 S - English
89-20557	RK-RM 9606-1150	Control cable for RM 9606, length = 1150 mm
89-20558	RK-RM 9606-1500	Control cable for RM 9606, length = 1500 mm
89-20622	RK-RM 9606-2600	Control cable for RM 9606, length = 2600 mm
89-20555	RK-EMR 1100 S-1150	Control cable for EMR 1100 S, length = 1150 mm
89-20556	RK-EMR 1100 S-1500	Control cable for EMR 1100 S, length = 1500 mm
89-20621	RK-EMR 1100 S-2600	Control cable for EMR 1100 S, length = 2600 mm

Other options and accessories on request

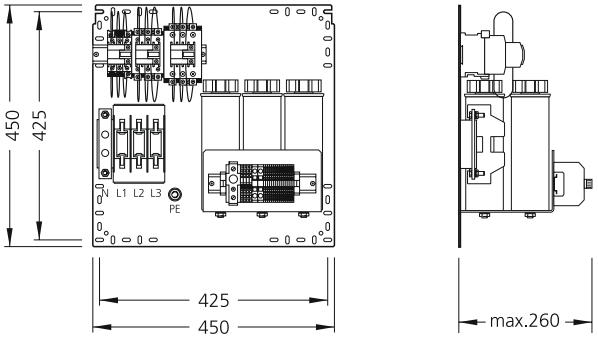
Dimensions



Dimensional drawing LSP-2 (68.75-100 kvar)



Dimensional drawing LSP-3 (112.5-200 kvar)



Dimensional drawing LSPN-4 (17.5-60 kvar)

All dimensions in mm

LSP-P

Power Factor Correction Systems on mounting plates – detuned

Detuned PFC Systems on mounting plates for installation in standard switchboards for low-voltage networks with harmonic content.

- Power range: 17.5 to 100 kvar
- Compact design on a mounting plate
- Ready for connection (without control relay and relay cable)
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Power Factor Correction Systems on mounting plates type LSP-P are suitable for installation in standard switchboards. Those systems are pre-wired. One only has to connect the Power Factor Correction Relay (not included) to the terminal strip.

They are suitable for supply networks with harmonic distortion according to EN 61000-2-4 class 2. They are available as follows:

Version	Detuning factor	Resonance frequency
P1	p = 14 %	134 Hz
P7	p = 7 %	189 Hz
P8	p = 8 %	177 Hz

Power Range

Power Factor Correction System on mounting plate - detuned:

- 17.5 to 100 kvar

Construction

Mounting plate with mounted Power Factor Correction Capacitors, Capacitor Switching Contactors and fuses for installation in switchboards.

The system contains:

- Self-healing LKT type power capacitors with low loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Heavy duty Capacitor Switching Contactors
- Harmonic Filter Reactors with overtemperature switch
- Fuse links, 3-pole, size NH00
- Control terminal strip with control fuse and thermal contact for safety shutdown

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection

The power cable is connected to the LV NH00 fuse element; The Power Factor Correction Relay (not included) as well as the cable from the current transformer has to be connected to the control terminal strip.

System Expansion

An extension of the system is possible by adding LSPZ-P extension units. This extension unit will be integrated in the existing control circuit via the control cable (supplied with the extension unit).

Technical Data

Rated voltage	400 V / 50 Hz
Rated voltage of capacitors	440 V / 50 Hz (-P5 to -P8) 480 V / 50 Hz (-P1)
Ambient temperature	–5 °C to +60 °C
Humidity	Max. 90 %, no condensation
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Version: P1 (Detuning factor p = 14 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems on mounting plates, rated mains voltage: 400 V / 50 Hz									
Type series: LSP …-3-P1									
34-57701	LSP 25-6,25-21-400/480-3-P1	25	6.25	1:1:2	550	1157	240	69	00
34-57702	LSP 31,25-6,25-12-400/480-3-P1	31.25	6.25	1:2:2	550	1157	240	75	00
34-57703	LSP 43,75-6,25-111-400/480-3- P1	43.75	6.25	1:2:4	550	1157	240	84	00
34-57704	LSP 50-6,25-211-400/480-3-P1	50	6.25	1:1:2:4	550	1157	240	98	00
34-57705	LSP 50-12,5-21-400/480-3-P1	50	12.5	1:1:2	550	1157	240	90	00
34-57706	LSP 50-50-1-400/480-3-P1	50	50	1	550	1157	240	95	00
34-57707	LSP 62,5-12,5-12-400/480-3-P1	62.5	12.5	1:2:2	550	1157	240	105	00
34-57708	LSP 68,75-6,25-112-400/480-3- P1	68.75	6.25	1:2:4:4	550	1157	240	115	00
34-57709	LSP 75-12,5-22-400/480-3-P1	75	12.5	1:1:2:2	550	1157	240	120	00
34-57852	LSP 75-12,5-11A-400/480-3-P1	75	12.5	1:2:3	550	1157	240	123	00
34-57710	LSP 75-25-11-400/480-3-P1	75	25	1:2	550	1157	240	121	00
34-57711	LSP 87,5-12,5-111-400/480-3-P1	87.5	12.5	1:2:4	550	1157	240	126	00
34-57781	LSP 100-16,67-11A-400/480-3-P1	100	16.67	1:2:3	550	1157	240	143	00
Power Factor Correction Systems, extension units on mounting plates, rated mains voltage: 400 V / 50 Hz									
Type series: LSPZ …-3-P1									
34-57900	LSPZ 50-50-1-400/480-3-P1	50	50	1	550	1157	240	83	00
34-57901	LSPZ 75-25-11-400/440-3-P1	75	25	1:2	550	1157	240	87	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P7 (Detuning factor p = 7 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems on mounting plates, rated mains voltage: 400 V / 50 Hz									
Type series: LSP …-3-P7									
34-57712	LSP 17,5-2,5-111-400/440-3-P7	17.5	2.5	1:2:4	550	1157	240	51	00
34-57713	LSP 25-5-12-400/440-3-P7	25	5	1:2:2	550	1157	240	57	00
34-57714	LSP 25-6,25-21-400/440-3-P7	25	6.25	1:1:2	550	1157	240	54	00
34-57715	LSP 30-5-11A-400/440-3-P7	30	5	1:2:3	550	1157	240	61	00
34-57716	LSP 31,25-6,25-12-400/440-3-P7	31.25	6.25	1:2:2	550	1157	240	59	00
34-57717	LSP 43,75-6,25-111-400/440-3- P7	43.75	6.25	1:2:4	550	1157	240	64	00
34-57718	LSP 50-6,25-211-400/440-3-P7	50	6.25	1:1:2:4	550	1157	240	72	00
34-57719	LSP 50-12,5-21-400/440-3-P7	50	12.5	1:1:2	550	1157	240	70	00
34-57720	LSP 50-50-1-400/440-3-P7	50	50	1	550	1157	240	75	00
34-57721	LSP 52,5-7,5-111-400/440-3-P7	52.5	7.5	1:2:4	550	1157	240	79	00
34-57722	LSP 60-10-11A-400/440-3-P7	60	10	1:2:3	550	1157	240	79	00
34-57723	LSP 62,5-12,5-12-400/440-3-P7	62.5	12.5	1:2:2	550	1157	240	77	00
34-57724	LSP 68,75-6,25-112-400/440-3- P7	68.75	6.25	1:2:4:4	550	1157	240	82	00
34-57853	LSP 75-12,5-11A-400/440-3-P7	75	12.5	1:2:3	550	1157	240	88	00
34-57725	LSP 75-12,5-22-400/440-3-P7	75	12.5	1:1:2:2	550	1157	240	86	00
34-57726	LSP 75-25-11-400/440-3-P7	75	25	1:2	550	1157	240	87	00
34-57727	LSP 87,5-12,5-111-400/440-3-P7	87.5	12.5	1:2:4	550	1157	240	89	00
34-57728	LSP 93,75-6,25-1111-400/440-3-P7	93.75	6.25	1:2:4:8	550	1157	240	96	00
34-57729	LSP 100-12,5-211-400/440-3-P7	100	12.5	1:1:2:4	550	1157	240	102	00
34-57730	LSP 100-50-2-400/440-3-P7	100	50	1:1	550	1157	240	105	00
34-57780	LSP 100-16,67-11A-400/440-3-P7	100	16.67	1:2:3	550	1157	240	102	00
34-57768	LSP 100-25-21-400/440-3-P7	100	25	1:1:2	550	1157	240	104	00
Power Factor Correction Systems, extension units on mounting plates, rated mains voltage: 400 V / 50 Hz									
Type series: LSPZ …-3-P7									
34-57902	LSPZ 50-50-1-400/440-3-P7	50	50	1	550	1157	240	65	20
34-57903	LSPZ 60-30-2-400/440-3-P7	60	30	1:1	550	1157	240	78	20
34-57904	LSPZ 75-25-11-400/440-3-P7	75	25	1:2	550	1157	240	102	20
34-57905	LSPZ 90-30-3-400/440-3-P7	90	30	1:1:1	550	1157	240	102	20
34-57906	LSPZ 100-50-2-400/440-3-P7	100	50	1:1	550	1157	240	99	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P8 (Detuning factor p = 8 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems on mounting plates, rated mains voltage: 400 V / 50 Hz Type series: LSP …-3-P8									
34-57751	LSP 17,5-2,5-111-400/440-3-P8	17.5	2.5	1:2:4	550	1157	240	52	00
34-57767	LSP 25-5-12-400/440-3-P8	25	5	1:2:2	550	1157	240	58	00
34-57827	LSP 25-6,25-21-400/440-3-P8	25	6.25	1:1:2	550	1157	240	55	00
34-57732	LSP 30-5-11A-400/440-3-P8	30	5	1:2:3	550	1157	240	62	00
34-57735	LSP 31,25-6,25-12-400/440-3-P8	31.25	6.25	1:2:2	550	1157	240	60	00
34-57750	LSP 43,75-6,25-111-400/440-3- P8	43.75	6.25	1:2:4	550	1157	240	64	00
34-57763	LSP 50-6,25-211-400/440-3-P8	50	6.25	1:1:2:4	550	1157	240	70	00
34-57747	LSP 50-12,5-21-400/440-3-P8	50	12.5	1:1:2	550	1157	240	68	00
34-57828	LSP 50-50-1-400/440-3-P8	50	50	1	550	1157	240	68	00
34-57749	LSP 52,5-7,5-111-400/440-3-P8	52.5	7.5	1:2:4	550	1157	240	75	00
34-57748	LSP 60-10-11A-400/440-3-P8	60	10	1:2:3	550	1157	240	75	00
34-57771	LSP 62,5-12,5-12-400/440-3-P8	62.5	12.5	1:2:2	550	1157	240	77	00
34-57734	LSP 68,75-6,25-112-400/440-3- P8	68.75	6.25	1:2:4:4	550	1157	240	81	00
34-57854	LSP 75-12,5-11A-400/440-3-P8	75	12.5	1:2:3	550	1157	240	91	00
34-57736	LSP 75-12,5-22-400/440-3-P8	75	12.5	1:1:2:2	550	1157	240	91	00
34-57830	LSP 75-25-11-400/440-3-P8	75	25	1:2	550	1157	240	91	00
34-57754	LSP 87,5-12,5-111-400/440-3-P8	87.5	12.5	1:2:4	550	1157	240	95	00
34-57733	LSP 93,75-6,25-1111-400/440-3-P8	93.75	6.25	1:2:4:8	550	1157	240	97	00
34-57731	LSP 100-12,5-211-400/440-3-P8	100	12.5	1:1:2:4	550	1157	240	103	00
34-57782	LSP 100-16,67-11A-400/440-3-P8	100	16.666	1:2:3	550	1157	240	106	00
34-57785	LSP 100-25-21-400/440-3-P8	100	25	1:1:2	550	1157	240	97	00
Power Factor Correction Systems, extension units on mounting plates, rated mains voltage: 400 V / 50 Hz Type series: LSPZ …-3-P8									
34-57907	LSPZ 50-50-1-400/440-3-P8	50	50	1	550	1157	240	102	00
34-57908	LSPZ 60-30-2-400/440-3-P8	60	30	1:1	550	1157	240	102	00
34-57909	LSPZ 75-25-11-400/440-3-P8	75	25	1:2	550	1157	240	99	00
34-57910	LSPZ 90-30-3-400/440-3-P8	90	30	1:1:1	550	1157	240	65	00
34-57911	LSPZ 100-50-2-400/440-3-P8	100	50	1:1	550	1157	240	79	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

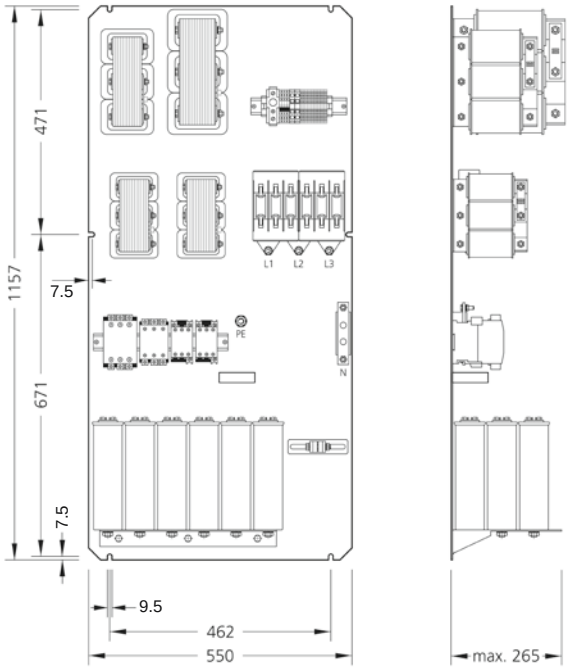
Options and accessories for Power Factor Correction Systems type LSP-P 400V, 50 Hz

Accessories

Article-No.	Type	Description
38-00100	RM 9606	Power Factor Control Relay RM 9606 - German
38-00103	RM 9606	Power Factor Control Relay RM 9606 - English
38-00300	EMR 1100 S	Power Factor Control Relay EMR 1100 S - German
38-00301	EMR 1100 S	Power Factor Control Relay EMR 1100 S - English
89-20557	RK-RM 9606-1150	Control cable for RM 9606, length = 1150 mm
89-20558	RK-RM 9606-1500	Control cable for RM 9606, length = 1500 mm
89-20622	RK-RM 9606-2600	Control cable for RM 9606, length = 2600 mm
89-20555	RK-EMR 1100 S-1150	Control cable for EMR 1100 S, length = 1150 mm
89-20556	RK-EMR 1100 S-1500	Control cable for EMR 1100 S, length = 1500 mm
89-20621	RK-EMR 1100 S-2600	Control cable for EMR 1100 S, length = 2600 mm

Other options and accessories on request

Dimensions



Dimensional drawing LSP-P (17.5-100 kvar)

All dimensions in mm

C64C / C84C
Capacitor Modules

Capacitor Modules type C64C and C84C for installation in standard switchgear systems. Suitable for low-voltage networks without harmonic distortion.

- Power Range: 25 to 100 kvar per module
- Compact design; up to 5 modules per cabinet
- Ideal for mounting in all common switchgear systems
- Easy and quick mounting with multifunctional rails
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Capacitor modules type C64C and C84C are suitable for installation in standard switchgear systems. Additional mounting rails for all common switchgear systems:

- W = 600 mm, D = 400, 500, 600 mm resp.
- W = 800 mm, D = 400, 500, 600 mm

allow an easy and quick installation of complex Power Factor Correction Systems.

They are suitable for power factor correction in supply networks without harmonic distortion.

Attention: Even low harmonic levels can be amplified by network resonances. High harmonic levels can overload or damage all electrical devices and machines in the network.

Today, networks without harmonic distortion are quite rare. Therefore we generally recommend installing fixed capacitors with harmonic filter reactors (page 81 ff.).

Power Range
Compact compensation module for installation in switchgear systems:
- 25 to 100 kvar

Construction
Sheet steel chassis with mounted power capacitors, contactors and fuses - ideal for mounting in all common switchgear systems.

The module consists of:
- Self-healing LKT type power capacitors with low loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Capacitor Switching Contactors with leading transition contacts for damping of current peaks
- Busbar system with bus-mounting fuse bases, 3-pole, size NH00
- Control circuit with female connector (wired connector for connection with terminal strip incl.)

Application / Installation
The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations
For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Installation
Specific module rails are required for installation in the switchgear system. Those module rails are available for all common switchgear systems and can be supplied as an optional accessory.

Connection
The network connection can be done either vertically or horizontally. For the horizontal connection one has to connect the cables equipped with the cable lugs to the busbar by using the M12 screws.

A bus connection bracket CU AW-1 for vertical connection is available as an option.

Additional modules can be connected directly via the busbar system.

Technical Data

Design	Sheet steel chassis for installation in switchgear cabinets C6xC… for cabinets (width = 600 mm) C8xC… for cabinets (width = 800 mm)
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz
Ambient temperature	–5 °C to +60 °C
Humidity	Max. 90 %, no condensation
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes
The presence of inductive and capacitive reactances in the low voltage network means that the harmonics generated there, together with those fed in from the medium voltage network, can be amplified many times over due to resonance. Particularly in industrial networks with loads that generate harmonics, the use of conventional power factor correction systems without Harmonic Filter Reactors is not advisable. Instead, detuned systems should be installed. See the C6xD... and C8xD... series of Capacitor Modules.

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 600 mm, rated mains voltage: 400 V / 50 Hz Type series: C64C									
34-64167	C64C 25-3,13-211-400/440-64	25	3.13	1:1:2:4	500	300	350	15	00
34-64163	C64C 25-6,25-21-400/440-64	25	6.25	1:1:2	500	300	350	15	00
34-64164	C64C 25-12,5-2-400/440-64	25	12.5	1:1	500	300	350	15	00
34-64165	C64C 25-25-1-400/440-64	25	25	1	500	300	350	16	00
34-64170	C64C 31,25-6,25-12-400/440-64	31.25	6.25	1:2:2	500	300	350	16	00
34-64180	C64C 34,38-3,13-112-400/440-64	34.38	3.13	1:2:4:4	500	300	350	16	00
34-64172	C64C 37,5-6,25-22-400/440-64	37.5	6.25	1:1:2:2	500	300	350	16	00
34-64173	C64C 37,5-12,5-11-400/440-64	37.5	12.5	1:2	500	300	350	16	00
34-64177	C64C 43,75-6,25-111-400/440-64	43.75	6.25	1:2:4	500	300	350	17	00
34-64181	C64C 46,88-3,13-1111-400/440- 64	46.88	3.13	1:2:4:8	500	300	350	17	00
34-64288	C64C 50-3,13-2111-400/440-64	50	3.13	1:1:2:4:8	500	300	350	18	00
34-64182	C64C 50-6,25-211-400/440-64	50	6.25	1:1:2:4	500	300	350	18	00
34-64185	C64C 50-12,5-21-400/440-64	50	12.5	1:1:2	500	300	350	19	00
34-64186	C64C 50-25-2-400/440-64	50	25	1:1	500	300	350	19	00
34-64187	C64C 50-50-1-400/440-64	50	50	1	500	300	350	18	00
34-64193	C64C 62,5-12,5-12-400/440-64	62.5	12.5	1:2:2	500	300	350	19	00
34-64194	C64C 68,75-6,25-112-400/440-64	68.75	6.25	1:2:4:4	500	300	350	22	00
34-64196	C64C 75-12,5-22-400/440-64	75	12.5	1:1:2:2	500	300	350	23	00
34-64200	C64C 75-25-11-400/440-64	75	25	1:2	500	300	350	23	00
34-64203	C64C 87,5-12,5-111-400/440-64	87.5	12.5	1:2:4	500	300	350	24	00
34-64845	C64C 75-12,5-11A-400/440-64	75	12.5	1:2:3	500	300	350	21	00
34-64205	C64C 93,75-6,25-1111-400/440- 64	93.75	6.25	1:2:4:8	500	300	350	24	00
34-64206	C64C 100-12,5-211-400/440-64	100	12.5	1:1:2:4	500	300	350	26	00
34-64208	C64C 100-25-21-400/440-64	100	25	1:1:2	500	300	350	29	00
34-64188	C64C 100-50-2-400/440-64	100	50	1:1	500	300	350	24	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page141 ff.)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 800 mm, rated mains voltage: 400 V / 50 Hz Type series: C84C									
34-64289	C84C 25-3,13-211-400/440-84	25	3.13	1:1:2:4	700	300	350	26	00
34-64290	C84C 25-6,25-21-400/440-84	25	6.25	1:1:2	700	300	350	26	00
34-64213	C84C 25-12,5-2-400/440-84	25	12.5	1:1	700	300	350	26	00
34-64214	C84C 25-25-1-400/440-84	25	25	1	700	300	350	27	00
34-64291	C84C 31,25-6,25-12-400/440-84	31.25	6.25	1:2:2	700	300	350	27	00
34-64292	C84C 34,38-3,13-112-400/440-84	34.38	3.13	1:2:4:4	700	300	350	26	00
34-64293	C84C 37,5-6,25-22-400/440-84	37.5	6.25	1:1:2:2	700	300	350	27	00
34-64215	C84C 37,5-12,5-11-400/440-84	37.5	12.5	1:2	700	300	350	28	00
34-64294	C84C 43,75-6,25-111-400/440-84	43.75	6.25	1:2:4	700	300	350	28	00
34-64295	C84C 46,88-3,13-1111-400/440- 84	46.88	3.13	1:2:4:8	700	300	350	29	00
34-64296	C84C 50-3,13-2111-400/440-84	50	3.13	1:1:2:4:8	700	300	350	29	00
34-64297	C84C 50-6,25-211-400/440-84	50	6.25	1:1:2:4	700	300	350	30	00
34-64217	C84C 50-12,5-21-400/440-84	50	12.5	1:1:2	700	300	350	30	00
34-64218	C84C 50-25-2-400/440-84	50	25	1:1	700	300	350	25	00
34-64219	C84C 50-50-1-400/440-84	50	50	1	700	300	350	30	00
34-64222	C84C 62,5-12,5-12-400/440-84	62.5	12.5	1:2:2	700	300	350	31	00
34-64298	C84C 68,75-6,25-112-400/440-84	68.75	6.25	1:2:4:4	700	300	350	31	00
34-64299	C84C 75-12,5-22-400/440-84	75	12.5	1:1:2:2	700	300	350	31	00
34-64224	C84C 75-25-11-400/440-84	75	25	1:2	700	300	350	31	00
34-64227	C84C 87,5-12,5-111-400/440-84	87.5	12.5	1:2:4	700	300	350	30	00
34-64229	C84C 93,75-6,25-1111-400/440- 84	93.75	6.25	1:2:4:8	700	300	350	32	00
34-64846	C84C 75-12,5-11A-400/440-84	75	12.5	1:2:3	700	300	350	31	00
34-64126	C84C 100-12,5-211-400/440-84	100	12.5	1:1:2:4	700	300	350	34	00
34-64232	C84C 100-25-21-400/440-84	100	25	1:1:2	700	300	350	37	00
34-64127	C84C 100-50-2-400/440-84	100	50	1:1	700	300	350	30	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Options and accessories for Capacitor Modules type C64C / C84C, 50 Hz

Accessories

Article-No.	Type	Description
Power Factor Control Relays		
38-00320	RM 2106	With 6 control contacts
38-00340	RM 2112	With 12 control contacts
38-00100	RM 9606	With 6 control contacts (German manual)
38-00103	RM 9606	With 6 control contacts (English manual)
38-00300	EMR 1100 S	With 12 control contacts (German manual)
38-00301	EMR 1100 S	With 12 control contacts (English manual)
20-50006	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System (German manual)
20-50008	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System (English manual)
39-29054	PROPHI 12RS	With 12 control contacts, with Profibus or Modbus interface
39-29050	RM 2012 6+6D	With 12 control contacts, 6 relays / 6 with reaction time between 20/40 ms
39-29051	RM 2012 12D	With 12 control contacts, reaction time between 20/40 ms
Power Factor Control Relay package (completely assembled and tested units)		
34-72016	STR–RM 9606	RM 9606, control terminal strip with thermal trip contact, cable length 1150 mm
34-72024	STR–EMR 1100 S	EMR 1100 S, control terminal strip with thermal trip contact, length 1150 mm
34-72002	STR–EMR 1100	EMR 1100, control terminal strip with thermal trip contact, cable length 1150 mm
Control terminal strip with thermal trip contact (premounted)		
34-80002	RKL–RM 9606	Suitable for RM 9606
34-80003	RKL–EMR 1100	Suitable for EMR 1100 / EMR 1100 S
34-80027	RKL–Z–Cabinet	For extension units (only 12 control contacts)
Control cable (prepared)		
89-20557	RK RM 9606–1150	For connection of RM 9606 with control terminal strip (length: 1000 mm, 6 control contacts)
89-20558	RK RM 9606–1500	For connection of RM 9606 with control terminal strip (length: 1500 mm, 6 control contacts)
89-20622	RK RM 9606–2600	For connection of RM 9606 with control terminal strip (length: 2600 mm, 6 control contacts)
89-20555	RK EMR 1100–1150	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1150 mm, 12- control contacts)
89-20556	RK EMR 1100–1500	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1500 mm, 12 control contacts)
89-20621	RK EMR 1100–2600	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 2600 mm, 12 control contacts)
89-20559	SS 12–6000	For connection of the 'basic unit' with the 'extension unit' (length: 6 m, 12 control contacts)
Mounting plates for control terminal strips, control transformers etc.		
34-80069	SB–C6	Cabinet width 600 mm
34-80053	SB–C8	Cabinet width 800 mm
Ventilation packages, consisting of:		
34-80096	LP–LSFC-I IP20-6/1	1 roof vent installation in cabinet, 1 air inlet filter and thermostat
34-80285	LP-LSFC-A IP43-7/1	1 roof vent installation on cabinet, 1 air inlet filter and thermostat
34-80187	LP-LSFC-A IP43-7/2	1 roof vent installation on cabinet, 2 air inlet filters and thermostat
Bus connection bracket set		
34-80006	CU AW–1	Busbar bracket set for cable connection, complete with fixing screws and protection against accidential contact
34-80302	Final cover complete	Protection against accidential contact final cover (necessary for module packages without CU-AW1)

Other accessories on request

Selection of module rails for the most common switchgear systems

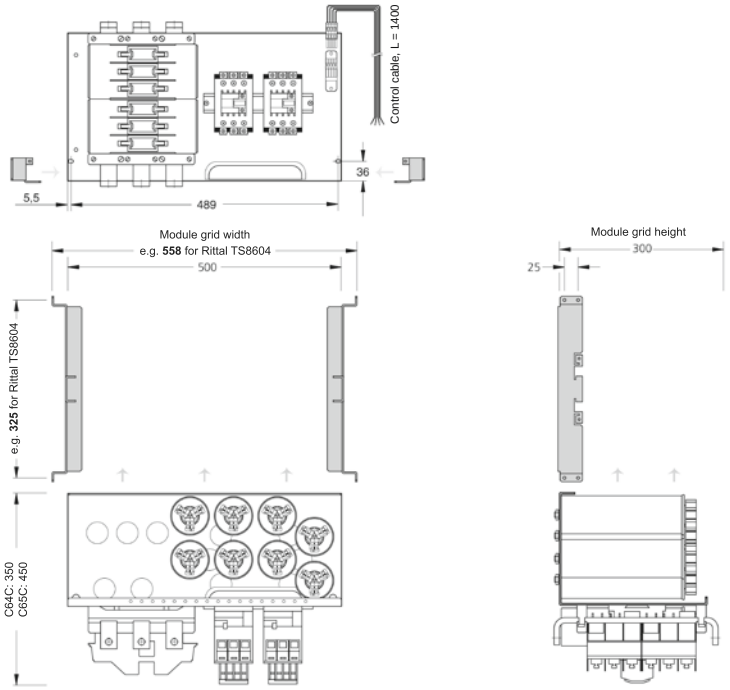
Article-No.	Manufacturer of cabinet	Cabinet type	Cabinet width [mm]	Cabinet depth [mm]
34-80051	ABB	MNS (with distribution busbars)	800	600
34-80176	ABB	MNS (without distribution busbars)	800	600
34-80128	ABB	RNS	800	600
34-80211	ABN	BST312	830	525
34-80133	AEG	EVS and SEN4000	800	400
34-80180	AEG	EVS and SEN4000	800	600
34-80071	CEGELEC	Intermas	800	500
34-80072	CEGELEC	Intermas	800	600
34-80179	DESSAUER	Dessa Norm	800	600
34-80201	DESSAUER	Dessa Norm	800	800
34-80039	EATON / MOELLER	IVS1600	800	400
34-80071	EATON / MOELLER	IVS1600	800	500
34-80072	EATON / MOELLER	IVS1600	800	600
34-80138	EATON / MOELLER	SVTL	800	400
34-80130	EATON / MOELLER	SVTL	800	600
34-80173	EATON / MOELLER	xEnergy (with distribution busbars)	800	600
34-80174	EATON / MOELLER	xEnergy (without distribution busbars)	800	600
34-80148	ELDON	MCS	800	400
34-80152	ELDON	MCS	800	500
34-80233	ELDON	MCS	800	600
34-80067	ELEK	UR / URV	800	400
34-80105	ELEK	UR / URV	800	600
34-80073	ELEK	UR / URV	800	800
34-80059	ELEK	UR / URV	850	400
34-80050	ELEK	UR / URV	850	600
34-80132	ELEK	UR / URV	850	800
34-80120	ELIN-EBG	ELIN-EBG SV	800	600
34-80120	ELIN-EBG	SVT	800	600
34-80172	ELSTEEL	Elsteel	800	600
34-80147	ELSTEEL	Elsteel	800	800
34-80238	ELSTEEL	Elsteel (with busbar space)	800	600
34-80040	FRAKO	LSFC	600/800	400
34-80041	FRAKO	LSFC	600/800	500
34-80042	FRAKO	LSFC	600/800	600
34-80253	GE	VPS STEEL	800	400
34-80181	HAGER	Hager FG22	600	600
34-80214	HAGER	Hager FG23	850	400
34-80055	HENSEL	SAS 2000 (frame assembly)	850	500
34-80168	HENSEL	SAS 2000 (M. Plate brackets reinforced assembly)	600	500
34-80190	HENSEL	SAS 2000 (M. Plate brackets reinforced assembly)	850	500
34-80154	ISA	ISA 2000	800	800
34-80119	LÖGSTRUP	Lögstrup	760	570
34-80077	LÖGSTRUP	Lögstrup	760	760
34-80227	LOHMEIER	RS	800	600
34-80228	LOHMEIER	RS	800	800

Article-No.	Manufacturer of cabinet	Cabinet type	Cabinet width [mm]	Cabinet depth [mm]
34-80198	MEHLER	ARM-C	800	400
34-80106	MEHLER	SRM-C	800	600
34-80097	MONA	MONA 5000	800	400
34-80098	MONA	MONA 5000	800	600
34-80245	MONA	MONA 5000	800	800
34-80047	RITTAL	ES4... / PS4…	600/800	400
34-80048	RITTAL	ES4... / PS4…	600/800	500
34-80049	RITTAL	ES4... / PS4…	600/800	600
34-80293	RITTAL	ES4... / PS4…	600/800	800
34-80040	RITTAL	TS8…	600/800	400
34-80041	RITTAL	TS8…	600/800	500
34-80042	RITTAL	TS8…	600/800	600
34-80137	RITTAL	TS8…	600/800	800
34-80134	SAREL	S6000	800	500
34-80237	SAREL	S6000	800	600
34-80291	SCHNEIDER	Prisma P	650	600
34-80284	SCHNEIDER	Prisma P (with busbar space)	800	600
34-80070	SIEMENS	Sivacon 8PT	800	600
34-80155	SIEMENS	Sivacon 8PT	800	800
34-80223	SIEMENS	Sivacon 8PT	850	600
34-80153	SIEMENS	Sivacon 8PT (with distribution busbars)	800	600
34-80255	SIEMENS	Sivacon S8 (Siemens S8- compensation section with busbar terminals on the rear side)	800	600
34-80252	SIEMENS	Sivacon S8 (normal section. FRAKO diassembling without busbar terminals on the rear side)	800	600
34-80076	STRIEBEL&JOHN	2/8XA4	600	400
34-80115	STRIEBEL&JOHN	2/8XA6	600	600
34-80104	STRIEBEL&JOHN	3/8XA4	850	400
34-80061	STRIEBEL&JOHN	3/8XA6	850	600
34-80222	STRIEBEL&JOHN	3/8XA8	850	800
34-80251	STRIEBEL&JOHN	Triline-R	614	425
34-80212	STRIEBEL&JOHN	Triline-R	614	625
34-80182	STRIEBEL&JOHN	Triline-R	864	425
34-80141	STRIEBEL&JOHN	Triline-R	864	625
34-80250	STRIEBEL&JOHN	Triline-R	864	825
34-80269	WEBER	MES	800	600
34-80178	WEBER	PM8	800	400
34-80129	WEBER	PM8	800	500
34-80218	WEBER	PM8	800	600

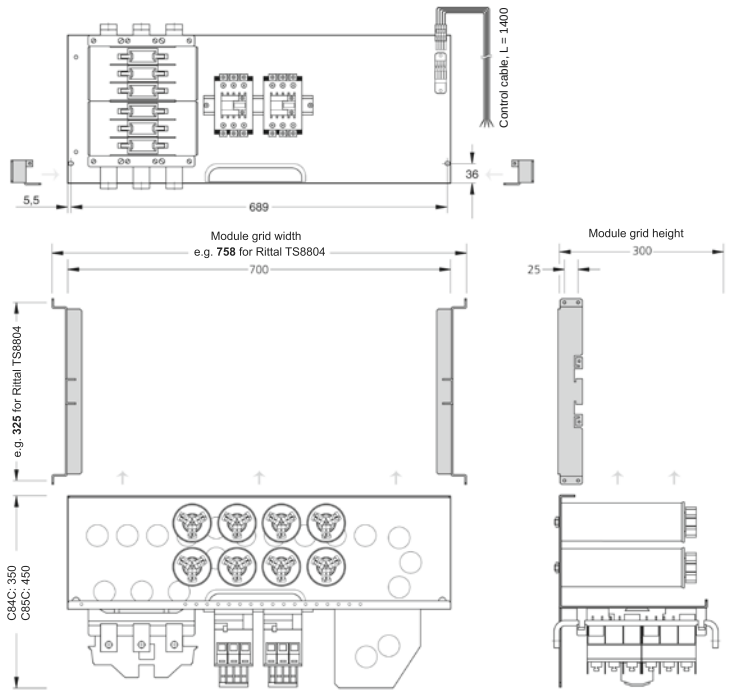
Other module rails on request

3

Dimensions



Dimensional drawing type series C64C (25 to 100 kvar)
with module rails (here: MT-C6-Rittal TS8.604)



Dimensional drawing type series C84C (25 to 100 kvar)
with module rails (here: MT-C8-Rittal TS8.804)

All dimensions in mm

C64D-P / C84D-P / C65D-P / C85D-P
Capacitor Modules – detuned

Capacitor Modules type C64D-P / C84D-P / C65D-P and C85D-P for installation in standard switchgear systems. Suitable for low-voltage networks with harmonic content.

- Power Range: 25 to 100 kvar per module
- Compact design - up to 5 modules per cabinet
- Ideal for mounting in all common switchgear systems
- Easy and quick mounting with multifunctional rails
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Capacitor modules type C64D-P, C65D-P, C84D-P and C85D-P are suitable for installation in standard switchgear systems. Additional mounting rails for all common switchgear systems:

- W = 600 mm, T = 400, 500, 600 mm resp.
- W = 800 mm, T = 400, 500, 600 mm

allow an easy and quick installation of complex Power Factor Correction Systems.

Suitable for supply networks with harmonic distortion according to EN 61000-2-4 class 2.

Available in the following versions:

Version	Detuning factor	Resonance frequency
P1	p = 14 %	134 Hz
P7	p = 7 %	189 Hz
P8	p = 8 %	177 Hz

Power Range
Compact compensation module ideal for mounting in switchgear systems:
- 25 to 100 kvar

Construction
Sheet steel chassis with mounted power capacitors, contactors and fuses - ideal for mounting in all common switchgear systems.

The module consists of:
- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Heavy duty Capacitor Switching Contactors
- Low-loss Harmonic Filter Reactors with temperature switches
- Busbar system with bus-mounting fuse base, 3-pole, size NH 00
- Control circuit with female connector (wired connector for connection with terminal strip incl.)

Installation Site
The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations
For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Installation
Specific module rails are required for installation in the switchgear system. Those module rails are available for all common switchgear systems and can be supplied as an optional accessory.

Connection
The network connection can be done either vertically or horizontally. For the horizontal connection one has to connect the cables equipped with the cable lugs to the busbar by using the M12 screws.

A bus connection bracket CU AW-1 for vertical connection is available as an option.

Additional modules can be connected directly via the busbar system.

Technical Data

Design	Sheet steel chassis for installation in switch-gear cabinets C6xD… for cabinets (width = 600 mm) C8xD… for cabinets (width = 800 mm)
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz (-P5 to -P8) 480 V/50 Hz (-P1)
Ambient temperature	–5 °C to +60 °C
Humidity	Max. 90 %, no condensation
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes
For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Version: P1 (Detuning factor p = 14 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 600 mm, rated mains voltage: 400 V / 50 Hz Type series: C6xD …-P1									
34-64264	C64D 25-6,25-21-400/480-64-P1	25	6.25	1:1:2	500	300	350	57	00
34-64242	C64D 25-12,5-2-400/480-64-P1	25	12.5	1:1	500	300	350	45	00
34-64243	C64D 25-25-1-400/480-64-P1	25	25	1	500	300	350	49	00
34-65013	C65D 50-50-1-400/480-65-P1	50	50	1	500	300	450		00
Capacitor Modules for installation in switchgear systems with a width of 800 mm, rated mains voltage: 400 V / 50 Hz Type series: C8xD …-P1									
34-64069	C84D 25-6,25-21-400/480-84-P1	25	6.25	1:1:2	700	300	350	47	00
34-64070	C84D 25-12,5-2-400/480-84-P1	25	12.5	1:1	700	300	350	47	00
34-64039	C84D 25-25-1-400/480-84-P1	25	25	1	700	300	350	51	00
34-64271	C84D 31,25-6,25-12-400/480-84-P1	31.25	6.25	1:2:2	700	300	350	46	00
34-64374	C84D 37,5-6,25-22-400/480-84-P1	37.5	6.25	1:1:2:2	700	300	350	52	00
34-64018	C84D 37,5-12,5-11-400/480-84-P1	37.5	12.5	1:2	700	300	350	45	00
34-64002	C84D 43,75-6,25-111-400/480-84-P1	43.75	6.25	1:2:4	700	300	350	78	00
34-64003	C84D 50-12,5-21-400/480-84-P1	50	12.5	1:1:2	700	300	350	83	00
34-64004	C84D 50-25-2-400/480-84-P1	50	25	1:1	700	300	350	80	00
34-64005	C84D 50-50-1-400/480-84-P1	50	50	1	700	300	350	69	00
34-65011	C85D 75-25-11-400/480-85-P1	75	25	1:2	700	300	450		00
34-64040	C85D 100-50-2-400/480-85-P1	100	50	1:1	700	300	450	118	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P7 (Detuning factor p = 7 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 600 mm, rated mains voltage: 400 V / 50 Hz Type series: C6xD …-P7									
34-64300	C64D 25-3,13-211-400/440-64-P7	25	3.13	1:1:2:4	500	300	350	44	00
34-64257	C64D 25-6,25-21-400/440-64-P7	25	6.25	1:1:2	500	300	350	44	00
34-64262	C64D 25-12,5-2-400/440-64-P7	25	12.5	1:1	500	300	350	44	00
34-64245	C64D 25-25-1-400/440-64-P7	25	25	1	500	300	350	33	00
34-64301	C64D 31,25-6,25-12-400/440-64-P7	31.25	6.25	1:2:2	500	300	350	45	00
34-64389	C64D 34,38-3,13-112-400/440-64-P7	34.38	3.13	1:2:4:4	500	300	350	46	00
34-64246	C64D 37,5-12,5-11-400/440-64-P7	37.5	12.5	1:2	500	300	350	44	00
34-64247	C64D 43,75-6,25-111-400/440-64-P7	43.75	6.25	1:2:4	500	300	350	54	00
34-64248	C64D 50-12,5-21-400/440-64-P7	50	12.5	1:1:2	500	300	350	55	00
34-64249	C64D 50-25-2-400/440-64-P7	50	25	1:1	500	300	350	47	00
34-64250	C64D 50-50-1-400/440-64-P7	50	50	1	500	300	350	49	00
34-64261	C65D 75-25-11-400/440-65-P7	75	25	1:2	500	300	450	65	00

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 800 mm, rated mains voltage: 400 V / 50 Hz Type series: C8xD …-P7									
34-64071	C84D 25-6,25-21-400/440-84-P7	25	6.25	1:1:2	700	300	350	46	00
34-64072	C84D 25-12,5-2-400/440-84-P7	25	12.5	1:1	700	300	350	46	00
34-64015	C84D 25-25-1-400/440-84-P7	25	25	1	700	300	350	38	00
34-64339	C84D 31,25-6,25-12-400/440-84-P7	31.25	6.25	1:2:2	700	300	350	47	00
34-64303	C84D 34,38-3,13-112-400/440-84-P7	34.38	3.13	1:2:4:4	700	300	350	48	00
34-64211	C84D 37,5-12,5-11-400/440-84-P7	37.5	12.5	1:2	700	300	350	48	00
34-64304	C84D 37,5-6,25-22-400/440-84-P7	37.5	6.25	1:1:2:2	700	300	350	49	00
34-64073	C84D 43,75-6,25-111-400/440-84-P7	43.75	6.25	1:2:4	700	300	350	52	00
34-64305	C84D 46,88-3,13-1111-400/440-84-P7	46.88	3.13	1:2:4:8	700	300	350	57	00
34-64007	C84D 50-6,25-211-400/440-84-P7	50	6.25	1:1:2:4	700	300	350	50	00
34-64008	C84D 50-12,5-21-400/440-84-P7	50	12.5	1:1:2	700	300	350	60	00
34-64009	C84D 50-25-2-400/440-84-P7	50	25	1:1	700	300	350	55	00
34-64010	C84D 50-50-1-400/440-84-P7	50	50	1	700	300	350	52	00
34-64041	C84D 62,5-12,5-12-400/440-84-P7	62.5	12.5	1:2:2	700	300	350	55	00
34-64074	C84D 68,75-6,25-112-400/440-84-P7	68.75	6.25	1:2:4:4	700	300	350	56	00
34-64075	C84D 75-12,5-22-400/440-84-P7	75	12.5	1:1:2:2	700	300	350	59	00
34-64011	C84D 75-25-11-400/440-84-P7	75	25	1:2	700	300	350	71	00
34-64848	C84D 75-12,5-11A-400/440-84-P7	75	12.5	1:2:3	700	300	350	62	00
34-64012	C84D 87,5-12,5-111-400/440-84-P7	87.5	12.5	1:2:4	700	300	350	75	00
34-64648	C85D 100-12,5-211-400/440-85-P7	100	12.5	1:1:2:4	700	300	450	93	00
34-64013	C84D 100-25-21-400/440-84-P7	100	25	1:1:2	700	300	350	90	00
34-64014	C84D 100-50-2-400/440-84-P7	100	50	1:1	700	300	350	84	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P8 (Detuning factor p = 8 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 600 mm, rated mains voltage: 400 V / 50 Hz Type series: C6xD …-P8									
34-64651	C64D 25-3,13-211-400/440-64-P8	25	3.13	1:1:2:4	500	300	350	47	00
34-64358	C64D 25-6,25-21-400/440-64-P8	25	6.25	1:1:2	500	300	350	47	00
34-64322	C64D 25-12,5-2-400/440-64-P8	25	12.5	1:1	500	300	350	48	00
34-64359	C64D 25-25-1-400/440-64-P8	25	25	1	500	300	350	36	00
34-64652	C64D 31,25-6,25-12-400/440-64-P8	31.25	6.25	1:2:2	500	300	350	48	00
34-64653	C64D 34,38-3,13-112-400/440- 64-P8	34.38	3.13	1:2:4:4	500	300	350	49	00
34-64654	C64D 37,5-12,5-11-400/440-64- P8	37.5	12.5	1:2	500	300	350	50	00
34-64649	C64D 43,75-6,25-111-400/440- 64-P8	43.75	6.25	1:2:4	500	300	350	53	00
34-64286	C64D 50-12,5-21-400/440-64-P8	50	12.5	1:1:2	500	300	350	61	00
34-64273	C64D 50-25-2-400/440-64-P8	50	25	1:1	500	300	350	48	00
34-64274	C64D 50-50-1-400/440-64-P8	50	50	1	500	300	350	58	00
34-64474	C65D 75-25-11-400/440-65-P8	75	25	1:2	500	300	450	70	00
Capacitor Modules for installation in switchgear systems with a width of 800 mm, rated mains voltage: 400 V / 50 Hz Type series: C8xD …-P8									
34-64499	C84D 18,75-6,25-11-400/440-84-P8	18.75	6.25	1:2	700	300	350	35	00
34-64655	C84D 25-3,13-211-400/440-84-P8	25	3.13	1:1:2:4	700	300	350	49	00
34-64656	C84D 25-6,25-21-400/440-84-P8	25	6.25	1:1:2	700	300	350	49	00
34-64454	C84D 25-12,5-2-400/440-84-P8	25	12.5	1:1	700	300	350	49	00
34-64016	C84D 25-25-1-400/440-84-P8	25	25	1	700	300	350	38	00
34-64526	C84D 31,25-6,25-12-400/440-84-P8	31.25	6.25	1:2:2	700	300	350	50	00
34-64657	C84D 34,38-3,13-112-400/440- 84-P8	34.38	3.13	1:2:4:4	700	300	350	51	00
34-64658	C84D 37,5-6,25-22-400/440-84-P8	37.5	6.25	1:1:2:2	700	300	350	52	00
34-64659	C84D 43,75-6,25-111-400/440- 84-P8	43.75	6.25	1:2:4	700	300	350	55	00
34-64660	C84D 46,88-3,13-1111-400/440- 84-P8	46.88	3.13	1:2:4:8	700	300	350	55	00
34-64051	C84D 50-6,25-211-400/440-84-P8	50	6.25	1:1:2:4	700	300	350	62	00
34-64063	C84D 50-12,5-21-400/440-84-P8	50	12.5	1:1:2	700	300	350	62	00
34-64054	C84D 50-25-2-400/440-84-P8	50	25	1:1	700	300	350	53	00
34-64114	C84D 50-50-1-400/440-84-P8	50	50	1	700	300	350	60	00
34-64117	C84D 62,5-12,5-12-400/440-84- P8	62.5	12.5	1:2:2	700	300	350	64	00
34-64350	C84D 68,75-6,25-112-400/440- 84-P8	68.75	6.25	1:2:4:4	700	300	350	56	00
34-64093	C84D 75-12,5-22-400/440-84-P8	75	12.5	1:1:2:2	700	300	350	70	00
34-64052	C84D 75-25-11-400/440-84-P8	75	25	1:2	700	300	350	70	00
34-64484	C84D 87,5-12,5-111-400/440-84-P8	87.5	12.5	1:2:4	700	300	350	79	00
34-64849	C84D 75-12,5-11A-400/440-84-P8	75	12.5	1:2:3	700	300	350	73	00
34-64644	C85D 100-12,5-211-400/440-85-P8	100	12.5	1:1:2:4	700	300	450	92	00
34-64053	C84D 100-25-21-400/440-84-P8	100	25	1:1:2	700	300	350	88	00
34-64017	C84D 100-50-2-400/440-84-P8	100	50	1:1	700	300	350	86	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

C84D-P5 / C85D-P5
Capacitor Modules – detuned

Capacitor modules type C84D-P5 and C85D-P5 for installation in standard switchgear systems. Suitable for low-voltage networks with harmonic content.

- Power Range: 25 to 100 kvar per module
- Compact design - up to 5 modules per cabinet
- Ideal for mounting in all common switchgear systems
- Easy and quick mounting with multifunctional rails
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Capacitor modules type C84D-P5 and C85D-P5 are suitable for installation in standard switchgear systems. Additional mounting rails for all common switchgear systems:

- W = 600 mm, T = 400, 500, 600 mm resp.
- W = 800 mm, T = 400, 500, 600 mm

allow an easy and quick installation of complex Power Factor Correction Systems.

Suitable for supply networks with harmonic distortion according to EN 61000-2-4 class 2.

Available in the following versions:

Version	Detuning factor	Resonance frequency
P5	p = 5.67 %	210 Hz

Power Range
Compact compensation module ideal for mounting in switchgear systems:
- 25 to 100 kvar

Construction
Sheet steel chassis with mounted power capacitors, contactors and fuses - ideal for mounting in all common switchgear systems.

The module consists of:
- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Heavy duty Capacitor Switching Contactors
- Low-loss Harmonic Filter Reactors with temperature switches
- Busbar system with bus-mounting fuse base, 3-pole, size NH 00
- Control circuit with female connector (wired connector for connection with terminal strip incl.)

Installation Site
The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations
For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Installation
Specific module rails are required for installation in the switchgear system. Those module rails are available for all common switchgear systems and can be supplied as an optional accessory.

Connection
The network connection can be done either vertically or horizontally. For the horizontal connection one has to connect the cables equipped with the cable lugs to the busbar by using the M12 screws.

A bus connection bracket CU AW-1 for vertical connection is available as an option.

Additional modules can be connected directly via the busbar system.

Technical Data

Design	Sheet steel chassis for installation in switchgear cabinets C6xD… for cabinets (width = 600 mm) C8xD… for cabinets (width = 800 mm)
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz (-P5 to -P8) 480 V/50 Hz (-P1)
Ambient temperature	–5 °C to +60 °C
Humidity	Max. 90 %, no condensation
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes
For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Version: P5 (Detuning factor p = 5.67 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Dimensions Height [mm]	Dimensions Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 800 mm, rated mains voltage: 400 V / 50 Hz Type series: C8xD …-P5									
34-64969	C84D 25-25-1-400/440-84-P5	25	25	1	700	300	350	58	00
34-64970	C84D 50-50-1-400/440-84-P5	50	50	1	700	300	350	67	00
34-64971	C84D 50-25-2-400/440-84-P5	50	25	1:1	700	300	350	80	00
34-64972	C84D 75-25-11-400/440-84-P5	75	25	1:2	700	300	350	98	00
34-64973	C85D 100-50-2-400/440-85-P5	100	50	1:1	700	300	450	120	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Options and accessories for Capacitor Modules type C64D-P / C84D-P / C65D-P / C85D-P, 50 Hz

Accessories

Article-No.	Type	Description
Power Factor Control Relay		
38-00320	RM 2106	With 6 control contacts
38-00340	RM 2112	With 12 control contacts
38-00100	RM 9606	With 6 control contacts (German manual)
38-00103	RM 9606	With 6 control contacts (English manual)
38-00300	EMR 1100 S	With 12 control contacts (German manual)
38-00301	EMR 1100 S	With 12 control contacts (English manual)
20-50006	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System (German manual)
20-50008	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System (English manual)
39-29054	PROPHI 12RS	With 12 control contacts, with Profibus or Modbus interface
39-29050	RM 2012 6+6D	With 12 control contacts, 6 relays / 6 with reaction time between 20/40 ms
39-29051	RM 2012 12D	With 12 control contacts, reaction time between 20/40 ms
Power Factor Control Relay package (completely assembled and tested units)		
34-72016	STR–RM 9606	RM 9606, control terminal strip with thermal trip contact, cable length 1150 mm
34-72024	STR–EMR 1100 S	EMR 1100 S, control terminal strip with thermal trip contact, cable length 1150 mm
34-72002	STR–EMR 1100	EMR 1100, control terminal strip with thermal trip contact, cable length 1150 mm
Control terminal strip with thermal trip contact (pre-mounted)		
34-80002	RKL–RM 9606	Suitable for RM 9606
34-80003	RKL–EMR 1100	Suitable for EMR 1100 / EMR 1100 S
34-80027	RKL–Z–Cabinet	For extension units (only 12 control contacts)
Control cable (prepared)		
89-20557	RK RM 9606–1150	For connection of RM 9606 with control terminal strip (length: 1000 mm, 6 control contacts)
89-20558	RK RM 9606–1500	For connection of RM 9606 with control terminal strip (length: 1500 mm, 6 control contacts)
89-20622	RK RM 9606–2600	For connection of RM 9606 with control terminal strip (length: 2600 mm, 6 control contacts)
89-20555	RK EMR 1100–1150	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1150 mm, 12 control contacts)
89-20556	RK EMR 1100–1500	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1500 mm, 12 control contacts)
89-20621	RK EMR 1100–2600	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 2600 mm, 12 control contacts)
89-20559	SS 12–6000	For connection of the 'basic unit' with the 'extension unit' (length: 6 m, 12 control contacts)
Mounting plates for control terminal strips, control transformers etc.		
34-80069	SB–C6	Cabinet width 600 mm
34-80053	SB–C8	Cabinet width 800 mm
Ventilation packages, consisting of:		
34-80096	LP–LSFC-I IP20-6/1	1 roof vent installation in cabinet, 1 air inlet filter and thermostat
34-80285	LP-LSFC-A IP43-7/1	1 roof vent installation on cabinet, 1 air inlet filter and thermostat
34-80187	LP-LSFC-A IP43-7/2	1 roof vent installation on cabinet, 2 air inlet filters and thermostat
Bus connection bracket set		
34-80006	CU AW–1	Bus connection bracket set for cable connection, complete with fixing screws and protection against accidental contact
34-80114	Final cover complete	Protection against accidental contact final cover (necessary for module packages without CU-AW1)

Further accessories on request

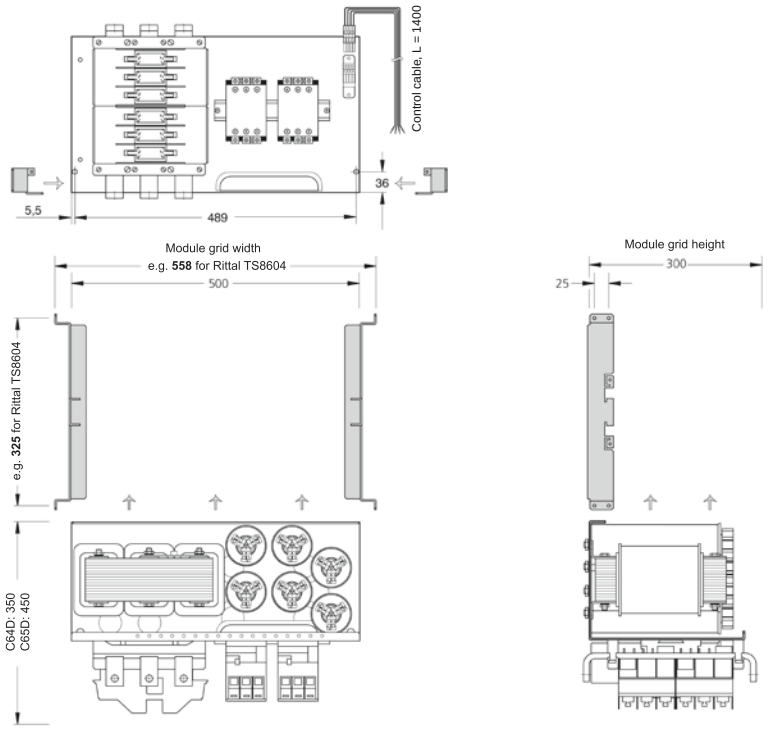
Selection of module rails for the most common switchgear systems

Article-No.	Manufacturer of cabinet	Cabinet type	Cabinet width [mm]	Cabinet depth [mm]
34-80051	ABB	MNS (with distribution busbars)	800	600
34-80176	ABB	MNS (without distribution busbars)	800	600
34-80128	ABB	RNS	800	600
34-80211	ABN	BST312	830	525
34-80133	AEG	EVS and SEN4000	800	400
34-80180	AEG	EVS and SEN4000	800	600
34-80071	CEGELEC	Intermas	800	500
34-80072	CEGELEC	Intermas	800	600
34-80179	DESSAUER	Dessa Norm	800	600
34-80201	DESSAUER	Dessa Norm	800	800
34-80071	EATON / MOELLER	GU	800	500
34-80072	EATON / MOELLER	GU	800	600
34-80043	EATON / MOELLER	ID 2000	800	500
34-80044	EATON / MOELLER	ID 2000	800	650
34-80039	EATON / MOELLER	IVS1600	800	400
34-80071	EATON / MOELLER	IVS1600	800	500
34-80072	EATON / MOELLER	IVS1600	800	600
34-80057	EATON / MOELLER	MODAN 2000	800	400
34-80045	EATON / MOELLER	MODAN 2000/6000 (without busbars)	800	600
34-80066	EATON / MOELLER	MODAN 6000 (with busbars)	800	600
34-80046	EATON / MOELLER	MODAN 6000 (with busbars)	800	800
34-80138	EATON / MOELLER	SVTL	800	400
34-80130	EATON / MOELLER	SVTL	800	600
34-80173	EATON / MOELLER	xEnergy (with distribution busbars)	800	600
34-80174	EATON / MOELLER	xEnergy (without distribution busbars)	800	600
34-80148	ELDON	MCS	800	400
34-80152	ELDON	MCS	800	500
34-80233	ELDON	MCS	800	600
34-80067	ELEK	UR / URV	800	400
34-80105	ELEK	UR / URV	800	600
34-80073	ELEK	UR / URV	800	800
34-80059	ELEK	UR / URV	850	400
34-80050	ELEK	UR / URV	850	600
34-80132	ELEK	UR / URV	850	800
34-80120	ELIN-EBG	ELIN-EBG SV	800	600
34-80120	ELIN-EBG	SVT	800	600
34-80172	ELSTEEL	Elsteel	800	600
34-80147	ELSTEEL	Elsteel	800	800
34-80238	ELSTEEL	Elsteel (with busbar space)	800	600
34-80040	FRAKO	LSFC	600/800	400
34-80041	FRAKO	LSFC	600/800	500
34-80042	FRAKO	LSFC	600/800	600
34-80253	GE	VPS STEEL	800	400
34-80181	HAGER	Hager FG22	600	600
34-80214	HAGER	Hager FG23	850	400
34-80055	HENSEL	SAS 2000 (frame assembly)	850	500

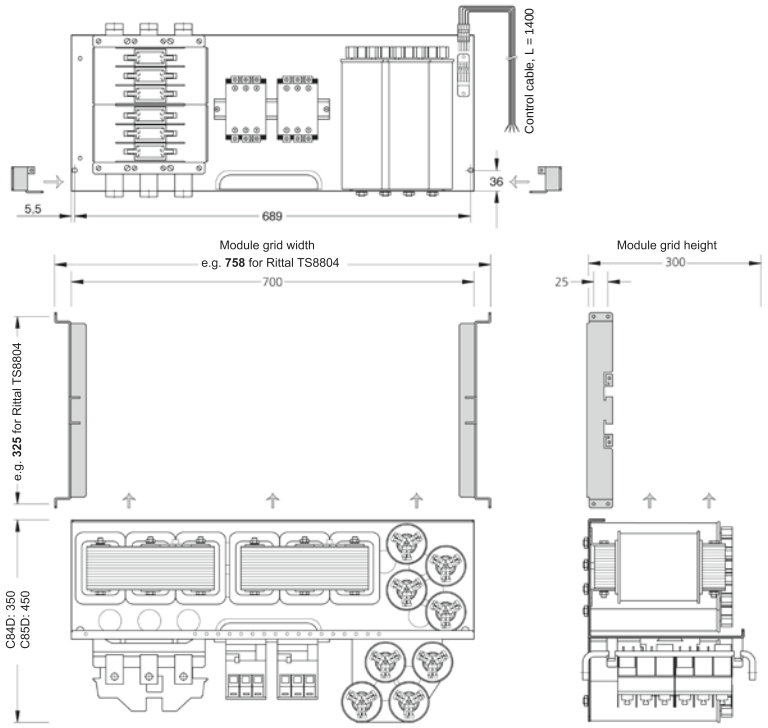
Article-No.	Manufacturer of cabinet	Cabinet type	Cabinet width [mm]	Cabinet depth [mm]
34-80168	HENSEL	SAS 2000 (M. Plate brackets reinforced assembly)	600	500
34-80190	HENSEL	SAS 2000 (M. Plate brackets reinforced assembly)	850	500
34-80154	ISA	ISA 2000	800	800
34-80119	LÖGSTRUP	Lögstrup	760	570
34-80077	LÖGSTRUP	Lögstrup	760	760
34-80227	LOHMEIER	RS	800	600
34-80228	LOHMEIER	RS	800	800
34-80198	MEHLER	ARM-C	800	400
34-80106	MEHLER	SRM-C	800	600
34-80047	RITTAL	ES4... / PS4…	600/800	400
34-80048	RITTAL	ES4... / PS4…	600/800	500
34-80049	RITTAL	ES4... / PS4…	600/800	600
34-80293	RITTAL	ES4... / PS4…	600/800	800
34-80040	RITTAL	TS8…	600/800	400
34-80041	RITTAL	TS8…	600/800	500
34-80042	RITTAL	TS8…	600/800	600
34-80137	RITTAL	TS8…	600/800	800
34-80134	SAREL	S6000	800	500
34-80237	SAREL	S6000	800	600
34-80291	SCHNEIDER	Prisma P	650	600
34-80284	SCHNEIDER	Prisma P (with busbar space)	800	600
34-80070	SIEMENS	Sivacon 8PT	800	600
34-80155	SIEMENS	Sivacon 8PT	800	800
34-80223	SIEMENS	Sivacon 8PT	850	600
34-80153	SIEMENS	Sivacon 8PT (with distribution busbars)	800	600
34-80255	SIEMENS	Sivacon S8 (Siemens S8- compensation section with busbar terminals on the rear side)	800	600
34-80252	SIEMENS	Sivacon S8 (normal section. FRAKO diassembling without busbar terminals on the rear side)	800	600
34-80076	STRIEBEL&JOHN	2/8XA4	600	400
34-80115	STRIEBEL&JOHN	2/8XA6	600	600
34-80104	STRIEBEL&JOHN	3/8XA4	850	400
34-80061	STRIEBEL&JOHN	3/8XA6	850	600
34-80222	STRIEBEL&JOHN	3/8XA8	850	800
34-80251	STRIEBEL&JOHN	Triline-R	614	425
34-80212	STRIEBEL&JOHN	Triline-R	614	625
34-80182	STRIEBEL&JOHN	Triline-R	864	425
34-80141	STRIEBEL&JOHN	Triline-R	864	625
34-80250	STRIEBEL&JOHN	Triline-R	864	825
34-80097	WAGNER	MONA 5000	800	400
34-80098	WAGNER	MONA 5000	800	600
34-80245	WAGNER	MONA 5000	800	800
34-80269	WEBER	MES	800	600
34-80178	WEBER	PM8	800	400
34-80129	WEBER	PM8	800	500
34-80218	WEBER	PM8	800	600

Other module rails on request

Dimensions



Dimensional drawing type series C64D (25 to 100 kvar)
with module rails (here: MT-C6-Rittal TS8.604)



Dimensional drawing type series C84D (25 to 100 kvar)
with module rails (here: MT-C8-Rittal TS8.804)

All dimensions in mm

Accessory equipment for PFC Systems on mounting plates

Additional to Capacitor Modules type C or Power Factor Correction Systems on mounting plates type LSP, further components are required to assemble a Power Factor Correction System.
FRAKO offers accessory packages which contain all necessary components to assemble such a PFC-System. Those packages include:

- Power Factor Control Relays and accessories
- Mounting plates
- Module rails
- Ventilation packages
- Bus connection bracket

Power Factor Control Relays and accessories
For technical details on our Power Factor Control Relays please refer to chapter “Power Factor Control Relays”.
For the relays, FRAKO recommends to use suitable control terminal strips with control fuse and thermal trip contact for monitoring the cabinet temperature as well as the connecting cables for the relay.
All items can be ordered as single components or as a complete power factor control relay package.

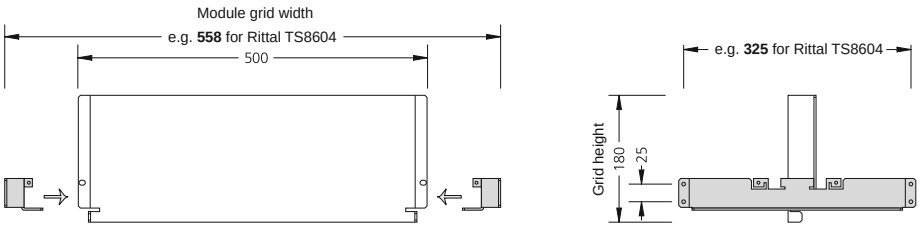
The following chart shows the different types of relays as well as the suitable accessories for the assembly and the connection of the devices.

Article-No.	Type	Description
Power Factor Control Relays		
38-00320	RM 2106	With 6 control contacts
38-00100 / 38-00103	RM 9606	With 6 control contacts (German/English version)
38-00340	RM 2112	With 12 control contacts
38-00300 / 38-00301	EMR 1100 S	With 12 control contacts (German/English version)

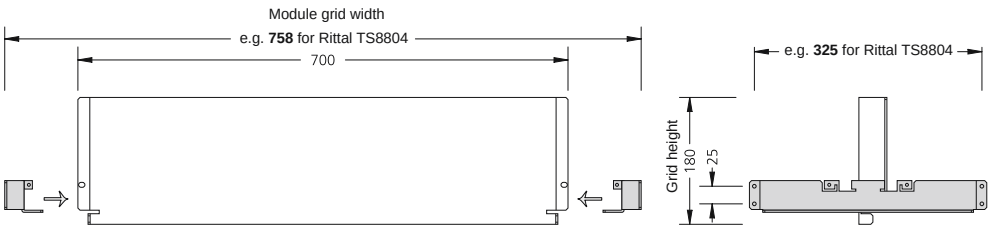
Article-No.	Type	Description
20-50008	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System
20-50013		Software upgrade EMR 1100 S to full version EMR 1100
Control terminal strip RKL with thermal trip contact, premounted		
34-80002	RKL–RM 9606	Suitable for RM 9606
34-80003	RKL–EMR 1100	Suitable for EMR 1100 / EMR 1100 S
34-80027	RKL–Z–cabinet	For extension units (only 12 control contacts)
Control cable, prepared:		
89-20557	RK RM 9606–1150	For connection of RM 9606 with control terminal strip (length: 1.00 m, 6 control contacts)
89-20558	RK RM 9606–1500	For connection of RM 9606 with control terminal strip (length: 1.50 m, 6 control contacts)
89-20555	RK EMR 1100–1150	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1.15 m, 12 control contacts)
89-20556	RK EMR 1100–1500	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1.50 m, 12 control contacts)
89-20559	SS 12–6000	For connection of the 'basic unit' with the 'extension unit' (length: 6 m, 12 control contacts)
Power Factor Control Relay package Completely assembled and tested units comprising: Power Factor Control Relay, control cable (length: 1.15 m), Control terminal strip RKL with control fuse and thermal trip contact		
34-72016	STR–RM 9606	RM 9606
34-72024	STR–EMR 1100 S	EMR 1100 S
34-72002	STR–EMR 1100	EMR 1100

Mounting Plates

Article-No.	Type	When using
34-80069	SB-C6	C64-Modules, cabinet width 600 mm
34-80053	SB-C8	C84-Modules, cabinet width 800 mm



Dimensional drawing SB-C6 with module rail (here: MT-C6-Rittal TS8604)



Dimensional drawing SB-C8 with module rail (here: MT-C8-Rittal TS8804)

All dimensions in mm

Module Rails for various cabinet manufacturers

- FRAKO: Mounting rails for FRAKO standard cabinets, Depth 400 and 500mm
- Siemens: Mounting rails for Siemens cabinets type SIKUS 3200, SIVACON PT, 8 MF and PU 8
- Moeller: Mounting rails for Moeller cabinets type MODAN 2000, MODAN 6000, ID 2000, GU, SVTL, X-Energy and IVS
- Rittal: Mounting rails for Rittal cabinets type TS 8, ES and PS
- Elek: Mounting rails for Elek cabinets type UR and URV
- ABB: Mounting rails for ABB cabinets type MNS and RNS
- Hensel: Mounting rails for Hensel cabinets type SAS 2000
- Striebel & John: Mounting rails for Striebel & John cabinets type XA and Triline R
- Lögstrup: Mounting rails for Lögstrup cabinets
- Mona 5000: Mounting rails for Mona 5000 cabinets
- Mehler: Mounting rails for Mehler- cabinets type ARM and SRM
- Leukhardt: Mounting rails for Leukhardt cabinets type TN
- Elin-EBG: Mounting rails for Elin cabinets type SV
- Weber: Mounting rails for Weber cabinets type PM 8
- AEG: Mounting rails for AEG cabinets type EVS and SEN
- Sarel: Mounting rails for Sarel cabinets type S 6000
- Elsteel: Mounting rails for Elsteel cabinets
- Eldon: Mounting rails for Eldon cabinets type MCS
- ISA 2000: Mounting rails for ISA 2000 cabinets
- Dessauer: Mounting rails for Dessauer cabinets type Dessa Norm
- Hager: Mounting rails for Hager cabinets type FG 22
- ABN: Mounting rails for ABN cabinets
- Lohmeier: Mounting rails for Lohmeier cabinets
- GE VPS Steel: Mounting rails for GE VPS Steel-cabinets
- Natus Energon: Mounting rails for Natus cabinets type Energon

Ventilation Packages

Article-No.	Type	Ventilation package, consisting of
34-80096	LP-LSFC-I-IP20-6/1	Roof vent, installation in cabinet, 1 air inlet filter and thermostat
34-80192	LP-LSFC-A-IP43-6/1	Roof vent, installation on cabinet, 1 air inlet filter and thermostat

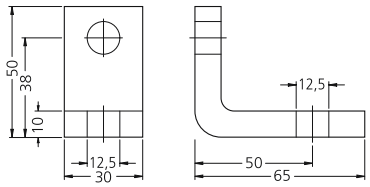
Busbar Sets

The copper busbar sets are used for vertical connection to the busbar system.

Article-No.	Type	Application
34-80006	CU AW-1	Vertical connection for C-Module

Bus Connection Bracket

The Bus Connection Brackets are delivered with fastening screws M12 and protection against accidental contact.



Dimensional drawing CU AW-1

All dimensions in mm

PFC Systems

Power Factor Correction Systems

Ready to connect, automatic Power Factor Correction Systems in sheet steel cabinets for wall mounting or floor installation.

- Power Range: 17.5 to 500 kvar per cabinet
- Ready for connection
- Fully automatic and intelligent Power Factor Control Relay
- Power Factor Correction Capacitors LKT dry type with four safety features

Application Recommendations

Power Factor Correction Systems are suitable for networks without harmonic distortion.

Attention: Even low harmonic levels can be amplified by network resonances. High harmonic levels can overload or damage all electrical devices and machines in the network.

Nowadays networks without harmonic distortion are quite rare. Therefore we generally recommend installing fixed capacitors with harmonic filter reactors (page 113 ff.).

	LSK	LSKI	LSFC
			
Power range [kvar]	17.5 - 200	17.5 - 52.5	100 - 500
System design	Compact	Compact	Modular
Enclosure	Wall-mounting	Wall-mounting	Floor-standing
Enclosure material	Sheet steel	Insulation material	Sheet steel
Power Factor Control Relay	RM 9606	RM 9606	RM 9606 / EMR 1100-S
Connection option from below	•	•	•
Connection option from top (optional)	-	-	•
Extension unit	LSKZ	LSKIZ	LSFCZ
Catalogue page	Page 101 ff.	Page 101 ff.	Page 107 ff.

LSK / LSKI
Power Factor Correction Systems

Ready to connect, automatic Power Factor Correction Systems in sheet steel cabinets for wall mounting. Suitable for networks without harmonic distortion.

- Power Range: 17.5 to 200 kvar per cabinet
- Compact design in sheet steel or insulated enclosures
- Ready for connection
- Fully automatic and intelligent Power Factor Control Relay
- Power Factor Correction Capacitors LKT dry type with four safety features

Application Recommendations

Power Factor Correction Systems type LSK and LSKI are a perfect solution for small and medium-sized firms and buildings.

Power Factor Correction Systems type LSK /LSKI are suitable for power factor correction in networks without harmonic distortion.

Attention: Even low harmonic levels can be amplified by network resonances. High harmonic levels can overload or damage all electrical devices and machines in the network.

Today, networks without harmonic distortion are quite rare. Therefore we generally recommend installing fixed capacitors with Harmonic Filter Reactors (page 113 ff.).

Power Range

Power Factor Correction System in sheet steel cabinet:

- **LSK ...-4:** 17.5 to 60 kvar
- **LSK ...-2:** 68.75 to 100 kvar
- **LSK ...-3:** 112.5 to 200 kvar

Power Factor Correction System in insulation material housing:

- **LSKI ...-4:** 17.5 to 52.5 kvar

Construction

The ready-for-connection Power Factor Correction System consists of a pre-assembled mounting plate, type LSPN or LSP and suitable sheet steel or insulated enclosures.

The cabinet contains:

- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Capacitor Switching Contactors with leading transition contact for damping of current peaks
- Fuse links, 3-pole, size NH00
- Control terminal strip with control fuse and thermal trip contact for safety shutdown
- Intelligent Power Factor Control Relay RM 9606

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection

The power supply cable and the current transformer cable enter the bottom of the cabinet through a sliding gland plate and a cable clamp rail, the power supply being connected to the busbar system and the current transformer cable to the terminal strip provided.

System Expansion

An extension of the system is possible by adding LSKZ or LSKIZ extension units. This extension unit will be integrated in the existing control circuit via the control cable (supplied with the extension unit).

Technical Data

Design	LSK Sheet steel wall cabinet LSKI Insulated wall cabinet LSK/LSKI …-4 with door left hinged LSK …-2 /…-3 with door right hinged
Rated voltage	400 V / 50 Hz
Rated voltage of capacitors	440 V / 50 Hz
Ambient temperature	–5 °C to +35 °C
Humidity	Max. 90 %, no condensation
Cabinet colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

The presence of inductive and capacitive reactances in the low voltage network means that the harmonics generated there, together with those fed in from the medium voltage network, can be amplified many times over due to resonance. Particularly in industrial networks with loads that generate harmonics, the use of conventional power factor correction systems without Harmonic Filter Reactors is not advisable. Instead, detuned systems should be installed. See the LSK-P series of Power Factor Correction Systems.

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

FRAKO systems are designed for connecting 5 core cables. If a 4-core cable is used, a jumper must be fitted to connect PE and N, or a control transformer must be installed.

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSK …-4									
34-13645	LSK 17,5-2,5-111-400-4-606-54	17.5	2.5	1:2:4	500	500	300	26	54
34-13650	LSK 27,5-2,5-112-400-4-606-54	27.5	2.5	1:2:4:4	500	500	300	29	54
34-13644	LSK 30-5-11A-400-4-606-54	30	5	1:2:3	500	500	300	29	54
34-13646	LSK 37,5-2,5-1111-400-4-606-54	37.5	2.5	1:2:4:8	500	500	300	31	54
34-13655	LSK 37,5-7,5-12-400-4-606-54	37.5	7.5	1:2:2	500	500	300	29	54
34-13661	LSK 43,75-6,25-111-400-4-606- 54	43.75	6.25	1:2:4	500	500	300	30	54
34-13693	LSK 46,88-3,13-1111-400-4-606-54	46.88	3.13	1:2:4:8	500	500	300	31	54
34-13647	LSK 50-5-11A1-400-4-606-54	50	5	1:2:3:4	500	500	300	32	54
34-13671	LSK 50-10-12-400-4-606-54	50	10	1:2:2	500	500	300	30	54
34-13648	LSK 52,5-7,5-111-400-4-606-54	52.5	7.5	1:2:4	500	500	300	31	54
34-13679	LSK 60-10-11A-400-4-606-54	60	10	1:2:3	500	500	300	33	54
Power Factor Correction Systems in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSK …-2									
34-14802	LSK 68,75-6,25-112-400-2-606	68.75	6.25	1:2:4:4	600	811	286	43	20
34-14803	LSK 75-6,25-212-400-2-606	75	6.25	1:1:2:4:4	600	811	286	44	20
34-14804	LSK 75-12,5-11A-400-2-606	75	12.5	1:2:3	600	811	286	44	20
34-14805	LSK 87,5-12,5-111-400-2-606	87.5	12.5	1:2:4	600	811	286	45	20
34-14806	LSK 93,75-6,25-1111-400-2-606	93.75	6.25	1:2:4:8	600	811	286	46	20
34-14807	LSK 100-12,5-211-400-2-606	100	12.5	1:1:2:4	600	811	286	49	20
Power Factor Correction Systems, extension units in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSKZ …-2									
34-14080	LSKZ 50-50-1-400-2	50	50	1	600	811	286	42	20
34-14078	LSKZ 75-25-11-400-2	75	25	1:2	600	811	286	51	20
34-14076	LSKZ 100-50-2-400-2	100	50	1:1	600	811	286	55	20
Power Factor Correction System in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSK …-3									
34-13653	LSK 112,5-6,25-11AB-400-3-606	112.5	6.25	1:2:3:6:6	600	1211	311	88	20
34-13619	LSK 125-12,5-221-400-3-606	125	12.5	1:1:2:2:4	600	1211	311	88	20
34-13688	LSK 143,75-6,25-1112-400-3-606	143.75	6.25	1:2:4:8:8	600	1211	311	91	20
34-13652	LSK 150-12,5-212-400-3-606	150	12.5	1:1:2:4:4	600	1211	311	92	20
34-13658	LSK 150-25-22-400-3-606	150	25	1:1:2:2	600	1211	311	90	20
34-13724	LSK 175-25-13-400-3-606	175	25	1:2:2:2	600	1211	311	94	20
34-13642	LSK 187,5-12,5-113-400-3-606	187.5	12.5	1:2:4:4:4	600	1211	311	101	20
34-13659	LSK 200-12,5-213-400-3-606	200	12.5	1:1:2:4:4:4	500	1211	311	93	20
34-13673	LSK 200-25-23-400-3-606	200	25	1:1:2:2:2	600	1211	311	98	20
Power Factor Correction Systems, extension units in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSKZ …-3									
34-14054	LSKZ 150-50-3-400-3	150	50	1:1:1	600	1211	311	91	20
34-14074	LSKZ 200-50-4-400-3	200	50	1:1:1:1	600	1211	311	97	20

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Systems in insulation material housing, rated mains voltage: 400 V / 50 Hz Type series: LSKI …-4									
34-13725	LSKI 17,5-2,5-111-400-4-606-54	17.5	2.5	1:2:4	500	500	300	26	54
34-13691	LSKI 27,5-2,5-112-400-4-606-54	27.5	2.5	1:2:4:4	500	500	300	28	54
34-13672	LSKI 30-5-11A-400-4-606-54	30	5	1:2:3	500	500	300	25	54
34-13694	LSKI 30-5-11A-400-4-111-54	30	5	1:2:3	500	500	300	25	54
34-13651	LSKI 37,5-2,5-1111-400-4-606- 54	37.5	2.5	1:2:4:8	500	500	300	28	54
34-13670	LSKI 37,5-7,5-12-400-4-606-54	37.5	7.5	1:2:2	500	500	300	24	54
34-13668	LSKI 43,75-6,25-111-400-4-606-54	43.75	6.25	1:2:4	500	500	300	25	54
34-13722	LSKI 46,88-3,13-1111-400-4-606-54	46.88	3.13	1:2:4:8	500	500	300	26	54
34-13682	LSKI 50-5-11A1-400-4-606-54	50	5	1:2:3:4	500	500	300	30	54
34-13726	LSKI 50-10-12-400-4-606-54	50	10	1:2:2	500	500	300	29	54
34-13656	LSKI 52,5-7,5-111-400-4-606-54	52.5	7.5	1:2:4	500	500	300	30	54

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Options and accessories for Power Factor Correction Systems type LSK / LSKI 400V, 50 Hz

Options, mounted and wired ready for operation

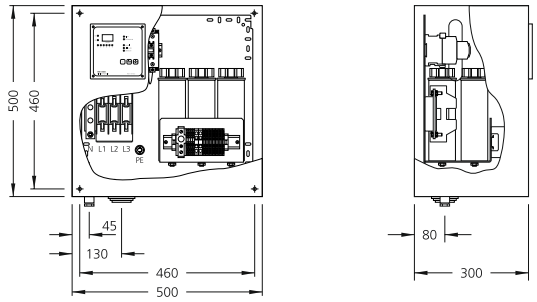
Article-No.	Type	Description	LSKI ...-4	LSK ...-4	LSK ...-3	LSK ...-2
S34-5502	-111- (instead of -606)	Power Factor Control Relay EMR 1100 S instead of RM 9606	•	•	•	•
S34-5500	-112- (instead of -606)	Power Factor Control Relay EMR 1100 instead of RM 9606	•	•	•	•
S34-5508	-Li	Cabinet with door left hinged			•	•
S34-0060	-SO	Special painting outside (RAL-Scale)		•	•	•
S34-5032	-54	Ingress protection IP 54			•	
S34-5511	-S131	Fuse switch disconnector instead of fuse base per 50 kvar		1 pc.		2 pcs.
S34-5511	-S131	Fuse switch disconnector instead of fuse base, power < 150 kvar			3 pcs.	
S34-5511	-S131	Fuse switch disconnector instead of fuse base, power ≥ 150 kvar			4 pcs.	
S34-0103	-SLA	Switch disconnector* three-pole, 160 A in cable entry compartment			•	
S34-5538	-SLA	Switch disconnector* three-pole, 250 A in cable entry compartment, size of the cabinet changes for LSK…-3				•
S34-0105	-SLA	Switch disconnector* three-pole, 400 A in cable entry compartment			•	
34-90011	-S56	Circuit breaker and control switch (On/Off) (option for Switzerland)	•	•	•	•
S34-5535	-S19	Control phase + N via a protective motor switch (option for France)	•	•	•	•
S34-5537	-S119 (+ Power)	Control transformer set 315 VA incl. primary and secondary fuses	•	•	•	•
S34-5073	-SO (+ Description)	Voltage meter with switch	•	•	•	•
S34-0040	-S66	Summation current transformer 5+5/5A	•	•	•	•
S34-0081	-S66	Summation current transformer 5+5+5/5A	•	•	•	•

*) Switch disconnector can be operated from the outside

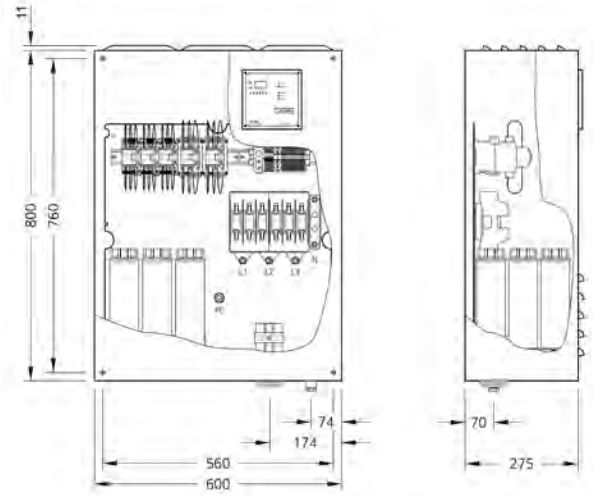
Accessories

Article-No.	Type	Description	LSKI ...-4	LSK ...-4	LSK ...-3	LSK ...-2
34-80021	WB LSK-10	Wall distance assembly set 10 mm		•	•	•
34-80018	WB LSK-40	Wall distance assembly set 40 mm		•	•	•
34-80195	KR-LSK-2-200	Floor standing base (Height = 200 mm; Depth = 275 mm)				•
34-80194	KR-LSK-3-200	Floor standing base (Height = 200 mm; Depth = 300 mm)			•	

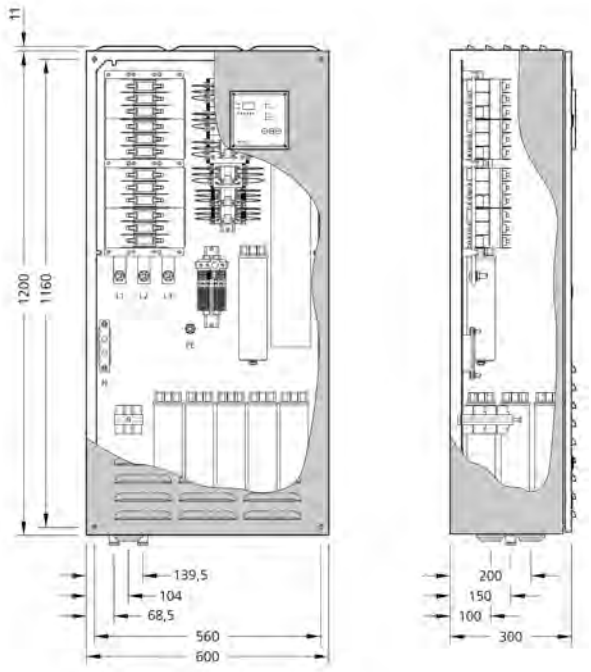
Dimensions



Dimensional drawing LSK-4 (17.5 to 60 kvar)



Dimensional drawing LSK-2 (68.75 to 100 kvar)



Dimensional drawing LSK-3 (112.5 to 200 kvar)

All dimensions in mm

LSFC
Power Factor Correction Systems

Ready to connect, automatic Power Factor Correction Systems in sheet steel cabinets for floor installation. Suitable for networks without harmonic distortion.

- Power Range: 100 to 500 kvar
- Modular construction in freestanding sheet steel cabinet
- Ready for connection
- Fully automatic and intelligent Power Factor Control Relay
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Power Factor Correction Systems, type LSFC are suitable for compensation in networks without harmonic distortion.

Attention: Even low harmonic levels can be amplified by network resonances. For Power Factor Correction Systems with a power >150 kvar this effect will amplify even more. This is because the PFC-System, together with the transformer, generates resonance frequencies in the network, which are within the range of the low frequency, energy-intensive harmonics. High harmonic levels can overload or damage all electrical devices and machines in the network.

Today, networks without harmonic distortion are quite rare. Therefore we generally recommend installing fixed capacitors with Harmonic Filter Reactors (page 113 ff.).

Power Range

Power Factor Correction System in sheet steel cabinet:

- 100 to 500 kvar

Construction

The ready-for-connection Power Factor Correction System consists of pre-assembled capacitor-reactor modules type C64C… and the suitable sheet steel cabinet.

The cabinet contains:

- Self-healing LKT type power capacitors with low loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Capacitor Switching Contactors with leading transition contact for damping of current peaks
- Fuse links, 3-pole, size NH00
- Control terminal strip with control fuse and thermal trip contact for safety shutdown
- Intelligent Power Factor Control Relay RM 9606 or EMR 1100 S

Application / Installation

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection

The power supply cable and the current transformer cable enter the bottom of the cabinet through a sliding gland plate and a cable clamp rail, the power supply being connected to the busbar system and the current transformer cable to the terminal strip provided.

System Expansion

An extension of the system is possible by adding LSFCZ extension units. This extension unit will be integrated in the existing control circuit via the control cable (supplied with the extension unit).

Technical Data

Design	Sheet steel cabinet with door right hinged
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz
Ambient temperature	–5 °C to +40 °C
Humidity	Max. 90 %, no condensation
Cabinet colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

The presence of inductive and capacitive reactances in the low voltage network means that the harmonics generated there, together with those fed in from the medium voltage network, can be amplified many times over due to resonance. Particularly in industrial networks with loads that generate harmonics, the use of conventional power factor correction systems without Harmonic Filter Reactors is not advisable. Instead, detuned systems should be installed. See the LSFC-P series of Power Factor Correction Systems.

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

FRAKO systems are designed for connecting 5 core cables. If a 4-core cable is used, a jumper must be fitted to connect PE and N, or a control transformer must be installed.

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Dimensions Height [mm]	Dimensions Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz									
Type series: LSFC									
34-19420	LSFC 100-12,5-211-400-64-606	100	12.5	1:1:2:4	600	2000	400	120.5	30
34-19421	LSFC 100-25-21-400-64-606	100	25	1:1:2	600	2000	400	116	30
34-19422	LSFC 125-12,5-221-400-64-606	125	12.5	1:1:2:2:4	600	2000	400	136	30
34-19423	LSFC 125-25-12-400-64-606	125	25	1:2:2	600	2000	400	132	30
34-19424	LSFC 150-12,5-212-400-64-606	150	12.5	1:1:2:4:4	600	2000	400	137	30
34-19425	LSFC 150-25-22-400-64-606	150	25	1:1:2:2	600	2000	400	135	30
34-19426	LSFC 150-25-6-400-64-606	150	25	1:1:1:1	600	2000	400	136	30
34-21451	LSFC 175-12,5-11A2-400-64-606	175	12.5	1:2:3:4	600	2000	400	139	30
34-19428	LSFC 175-25-13-400-64-606	175	25	1:2:2:2	600	2000	400	138	30
34-19429	LSFC 200-12,5-213-400-64-606	200	12.5	1:1:2:4	600	2000	400	141	30
34-19430	LSFC 200-25-23-400-64-606	200	25	1:1:2:2	600	2000	400	143	30
34-19431	LSFC 200-25-8-400-64-111	200	25	1:1:1:1	600	2000	400	149	30
34-19432	LSFC 225-12,5-223-400-64-111	225	12.5	1:1:2:2:4	600	2000	400	156	30
34-19433	LSFC 225-25-14-400-64-606	225	25	1:2:2:2	600	2000	400	152	30
34-19434	LSFC 225-25-9-400-64-111	225	25	1:1:1:1	600	2000	400	154	30
34-19435	LSFC 250-12,5-214-400-64-111	250	12.5	1:1:2:4	600	2000	400	158	30
34-19436	LSFC 250-25-24-400-64-606	250	25	1:1:2:2	600	2000	400	157	30
34-19437	LSFC 250-25-0-400-64-111	250	25	1:1:1:1	600	2000	400	159	30
34-19391	LSFC 250-50-5-400-64-606	250	50	1:1:1:1	600	2100	400	156	30
34-19616	LSFC 275-25-15-400-64-606	275	25	1:2:2:2	600	2000	400	166	30
34-19438	LSFC 300-12,5-215-400-64-111	300	12.5	1:1:2:4	600	2000	400	166	30
34-19394	LSFC 300-25-25-400-64-111	300	25	1:1:2:2	600	2000	400	163	30
34-19439	LSFC 300-25-0-400-64-111	300	25	1:1:1:1	600	2000	400	236	30
34-19440	LSFC 300-50-6-400-64-606	300	50	1:1:1:1	600	2000	400	164	30
34-19617	LSFC 325-25-16-400-64-111	325	25	1:2:2:2	600	2000	400	174	20
34-19384	LSFC 350-25-26-400-64-111	350	25	1:1:2:2	600	2000	400	183	20
34-19441	LSFC 350-50-7-400-64-111	350	50	1:1:1:1	600	2000	400	181	20
34-19618	LSFC 375-25-17-400-64-111	375	25	1:2:2:2	600	2000	400	190	20
34-19442	LSFC 400-25-27-400-64-111	400	25	1:1:2:2	600	2000	400	188	20
34-19443	LSFC 400-50-8-400-64-111	400	50	1:1:1:1	600	2000	400	173	20
34-20282	LSFC 500-50-0-400-64-111	500	50	1:1:1:1...	600	2000	400	293	20
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz									
Type series: LSFCZ									
34-16235	LSFCZ 100-50-2-400-64	100	50	1:1	600	2000	400	137	30
34-16236	LSFCZ 150-50-3-400-64	150	50	1:1:1	600	2000	400	125	30
34-16237	LSFCZ 200-50-4-400-64	200	50	1:1:1:1	600	2000	400	142	30
34-16238	LSFCZ 250-50-5-400-64	250	50	1:1:1:1	600	2000	400	157	30
34-16239	LSFCZ 300-50-6-400-64	300	50	1:1:1:1	600	2000	400	180	30
34-16240	LSFCZ 350-50-7-400-64	350	50	1:1:1:1	600	2000	400	183	20
34-16241	LSFCZ 400-50-8-400-64	400	50	1:1:1:1	600	2000	400	185	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Systems > 300 kvar with internal roof vent

Options and accessories for Power Factor Correction Systems type LSFC 400 V, 50 Hz

Options, mounted and wired ready for operation

Article-No.	Type	Description	for System type
S34-5502	-111- (instead of -606)	Power Factor Control Relay EMR 1100 S instead of RM 9606	all
S34-5500	-112- (instead of -606)	Power Factor Control Relay EMR 1100 instead of RM 9606	all
S34-5519	-66- (instead of -64-)	FRAKO LSFC-66 WxHxD: 600x2000x600 mm (without floor standing base and roof)	LSFC-64
S34-5528	-66- (instead of -84-)	FRAKO LSFC-66 WxHxD: 600x2000x600 mm (without floor standing base and roof)	LSFC-84
S34-5503	-84- (instead of -64-)	FRAKO LSFC-84 WxHxD: 800x2000x400 mm (without floor standing base and roof)	LSFC-64
S34-5524	-85- (instead of -84-)	FRAKO LSFC-85 WxHxD: 800x2000x500 mm (without floor standing base and roof)	LSFC-84
S34-5517	-86- (instead of -84/85-)	FRAKO LSFC-86 WxHxD: 800x2000x600 mm (without floor standing base and roof)	LSFC-84/-85
S34-5504	-27- (instead of -64-)	Rittal TS 8604, WxHxD: 600x2000x400 mm (without floor standing base and roof)	LSFC-64
S34-5518	-43- (instead of -84/85-)	Rittal TS 8606 WxHxD: 600x2000x600 mm (without floor standing base and roof)	LSFC-84/-85
S34-5505	-29- (instead of -84-)	Rittal TS 8804, WxHxD: 800x2000x400 mm (without floor standing base and roof)	LSFC-84
S34-5506	-24- (instead of -85-)	Rittal TS 8805, WxHxD: 800x2000x500 mm (without floor standing base and roof)	LSFC-85
S34-5527	-10- (instead of -84-)	Rittal TS 8806, WxHxD: 800x2000x600 mm (without floor standing base and roof)	LSFC-84
S34-5507	-10- (instead of -85-)	Rittal TS 8806, WxHxD: 800x2000x600 mm (without floor standing base and roof)	LSFC-85
S34-5509	-Li	Cabinet door with door left hinged	all type FRAKO LSFC
S34-5510	-Li	Cabinet door with door left hinged	all type Rittal TS
S34-5023	-S60	Pivoting lever closure for mounting a semiprofile cylinder	all
S34-0060	-SO (+ Description)	Special painting outside (RAL-Scale)	all
S34-0010	-S1	Cable entry through the cabinet roof with connection on top	up to 400 kvar/cabinet
S34-5512	-54	Ingress protection IP54	≤ 300 kvar/cabinet
S34-5513	-54	Ingress protection IP54	> 300 ≤ 400 kvar/cabinet
S34-0054	-S80	Ingress protection IPX1 with dust cover roof W x H x D: 520 x 300 x 50 mm; RAL 7035	all FRAKO LSFC
S34-5523	S34-5523	Ingress protection IP41, roof vent installation on cabinet instead of a roof vent installation in cabinet	≤ 400 kvar/cabinet
S34-5511	-SLT	Fuse switch disconnector instead of fuse base per 50 kvar	all
S34-5514	-SLA	Fuse switch disconnector in cable entry compartment	≤ 200 kvar/cabinet
S34-5515	-SLA	Fuse switch disconnector in cable entry compartment	≤ 300 kvar/cabinet
S34-0109	-SLA	Switch disconnector* three-pole, 400 A in cable entry compartment, for cabinet width 600 mm	≤ 200 kvar/cabinet
S34-0108	-SLA	Switch disconnector* three-pole, 400 A in cable entry compartment, for cabinet width 800 mm	≤ 200 kvar/cabinet
S34-0107	-SLA	Switch disconnector* three-pole, 630 A in cable entry compartment, for cabinet width 600 mm	≤ 300 kvar/cabinet
S34-0106	-SLA	Switch disconnector* three-pole, 630 A in cable entry compartment, for cabinet width 800 mm	≤ 300 kvar/cabinet
34-90011	-S56	Circuit breaker and control switch (On/Off) (option for Switzerland)	all

Article-No.	Type	Description	for System type
S34-5535	-S19	Control phase + N via a protective motor switch (option for France)	all
S34-5536	-S119	Control transformer set 500 VA incl. primary and secondary fuses	≤ 500 kvar
S34-5526	-S119	Control transformer set 800 VA incl. primary and secondary fuses	> 500 ≤ 900 kvar
S34-5069	-S53	3 ammeter incl. current transformer	all
S34-5073	-SO (+ Description)	Voltage meter with switch	all
S34-5077	-SO (+ Description)	kvar-Meter incl. current transformer; measuring range up to 300 kvar, 400 V	all
S34-5057	-SO (+ Description)	Measuring transducer 4-20 mA for power factor	all
S34-0067	-S255	EM-PQ 1500 with current transformer without EM-FD 1500	all
S34-0066	-S255	EM-PQ 1500 with current transformer with EM-FD 1500	all
S34-5050	-S255	EMA 1101 with current transformer	all
S34-0040	-S66	Summation current transformer 5+5/5A	all
S34-0081	-S66	Summation current transformer 5+5+5/5A	all
S34-5049	-S145	Switch cabinet lighting with power outlet and position switch	all

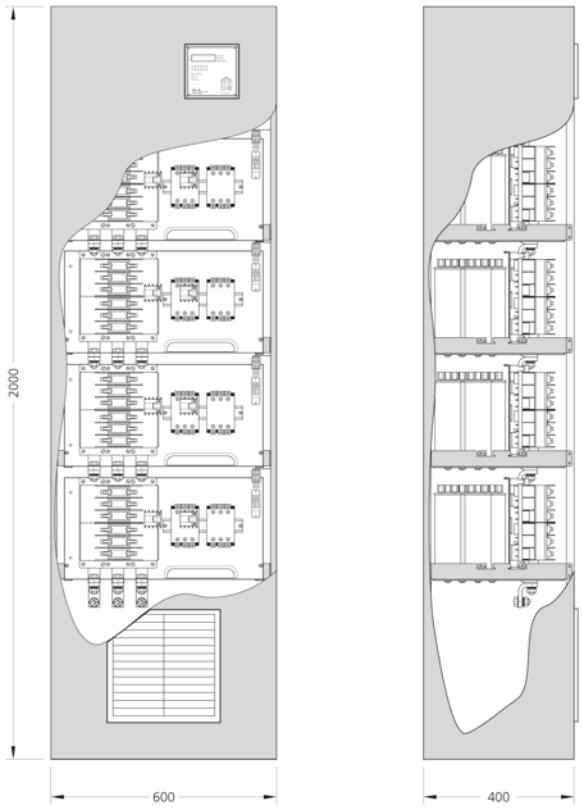
*) Switch disconnector can be operated from the outside

Accessories

Article-No.	Type	Description	for System type
34-80090	KR-LSFC-64-100	Floor standing base (h = 100 mm)	LSFC-64
34-80175	KR-LSFC-64-200	Floor standing base (h = 200 mm)	LSFC-64
34-80122	KR-LSFC-66-100	Floor standing base (h = 100 mm)	LSFC-66
34-80125	KR-LSFC-66-200	Floor standing base (h = 200 mm)	LSFC-66
34-80091	KR-LSFC-84-100	Floor standing base (h = 100 mm)	LSFC-84
34-80113	KR-LSFC-84-200	Floor standing base (h = 200 mm)	LSFC-84
34-80079	KR-LSFC-85-100	Floor standing base (h = 100 mm)	LSFC-85
34-80075	KR-LSFC-85-200	Floor standing base (h = 200 mm)	LSFC-85
34-80092	KR-LSFC-86-100	Floor standing base (h = 100 mm)	LSFC-86
34-80112	KR-LSFC-86-200	Floor standing base (h = 200 mm)	LSFC-86

Other options and accessories on request

Dimensions



Dimensional drawing LSFC (100 bis 400 kvar)

All dimensions in mm

Power Factor Correction Systems – detuned

Ready to connect, automatic Power Factor Correction Systems in sheet steel cabinets for wall mounting or floor installation. Detuned – for low-voltage networks with harmonic content.

	LSK-P	LSFC-P
		
Sheet steel cabinet for wall-mounting	•	-
Sheet steel cabinet for floor installation	-	•
System design	Compact	Modular
Power range up to [kvar]	100	500
With Power Factor Control Relay	•	•
Connection option from below	•	•
Connection option from top (optional)	-	•
Version (P...)	P7 / P8 / P1	P7 / P8 / P1
Extension unit	LSKZ-P	LSFCZ-P...
Catalogue page	Page 115 ff.	Page 121 ff.

LSK-P
Power Factor Correction Systems – detuned

Ready to connect, automatic Power Factor Correction Systems in sheet steel cabinets for wall mounting. Detuned – for low-voltage networks with harmonic content.

- Power Range: 17.5 to 100 kvar
- Compact design in sheet steel cabinet for wall-mounting
- Ready for connection
- Fully automatic and intelligent Power Factor Control Relay
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Power Factor Correction Systems type LSK-P are a perfect solution for small and medium-sized firms and buildings and also for power factor correction at sub-distribution boards.

They are suitable for supply networks with harmonic distortion according to EN 61000-2-4 class 2. They are available as follows:

Version	Detuning factor	Resonance frequency
P1	p = 14 %	134 Hz
P7	p = 7 %	189 Hz
P8	p = 8 %	177 Hz

Power Range

Power Factor Correction System in sheet steel cabinet:

- 17.5 to 100 kvar

Construction

The ready-for-connection Power Factor Correction System consists of a pre-assembled mounting plate, type LSP-P and the suitable sheet steel cabinet.

The LSK-P contains:

- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Heavy duty Capacitor Switching Contactors
- Harmonic Filter Reactors with overtemperature switch
- Fuse links, 3-pole, size NH00
- Control terminal strip with control fuse and thermal trip contact for safety shutdown
- Intelligent Power Factor Control Relay RM 9606

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection

The power cable and the CT cable enter the bottom of the cabinet through cable glands or rubber sleeves. The power cable is connected directly to the NH fuse base, the cable from the current transformer to the terminal strip.

System Expansion

An extension of the system is possible by adding LSKZ-P extension units. This extension unit will be integrated in the existing control circuit via the control cable (supplied with the extension unit).

Technical Data

Design	Sheet steel wall cabinet with door right hinged
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz
Ambient temperature	–5 °C to +35 °C
Humidity	Max. 90 %, no condensation
Cabinet colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

FRAKO systems are designed for connecting 5 core cables. If a 4-core cable is used, a jumper must be fitted to connect PE and N, or a control transformer must be installed.

Version: P1 (Detuning factor p = 14 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Dimensions Height [mm]	Dimensions Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSK …-3-P1									
34-13978	LSK 21,88-3,13-111-400-3-606-P1	21.88	3.13	1:2:4	600	1211	311	97	20
34-13800	LSK 25-6,25-21-400-3-606-P1	25	6.25	1:1:2	600	1211	311	102	20
34-13896	LSK 31,25-6,25-12-400-3-606-P1	31.25	6.25	1:2:2	600	1211	311	105	20
34-13967	LSK 34,38-3,13-112-400-3-606-P1	34.38	3.13	1:2:4:4	600	1211	311	109	20
34-13885	LSK 43,75-6,25-111-400-3-606-P1	43.75	6.25	1:2:4	600	1211	311	119	20
34-14490	LSK 46,88-3,13-1111-400-3-606-P1	46.88	3.13	1:2:4:8	600	1211	311	125	20
34-13860	LSK 50-6,25-211-400-3-606-P1	50	6.25	1:1:2:4	600	1211	311	130	20
34-13882	LSK 50-12,5-21-400-3-606-P1	50	12.5	1:1:2	600	1211	311	125	20
34-13928	LSK 50-50-1-400-3-606-P1	50	50	1	600	1211	311	130	20
34-13934	LSK 62,5-12,5-12-400-3-606-P1	62.5	12.5	1:2:2	600	1211	311	138	20
34-13849	LSK 68,75-6,25-112-400-3-606-P1	68.75	6.25	1:2:4:4	600	1211	311	150	20
34-14499	LSK 75-12,5-11A-400-3-606-P1	75	12.5	1:2:3	600	1211	311	157	20
34-13870	LSK 75-12,5-22-400-3-606-P1	75	12.5	1:1:2:2	600	1211	311	153	20
34-13979	LSK 75-25-11-400-3-606-P1	75	25	1:2	600	1211	311	151	20
34-13851	LSK 87,5-12,5-111-400-3-606-P1	87.5	12.5	1:2:4	600	1211	311	159	20
34-13950	LSK 100-16,67-11A-400-3-606-P1	100	16.67	1:2:3	600	1211	311	170	20
Power Factor Correction Systems, extension units in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSKZ …-3-P1									
34-14121	LSKZ 50-50-1-400-3-P1	50	50	1	600	1211	311	119	20
34-14131	LSKZ 75-25-11-400-3-P1	75	25	1:2	600	1211	311	150	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P7 (Detuning factor p = 7 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Dimensions Height [mm]	Dimensions Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSK …-3-P7									
34-13852	LSK 17,5-2,5-111-400-3-606-P7	17.5	2.5	1:2:4	600	1211	311	85	20
34-13857	LSK 25-5-12-400-3-606-P7	25	5	1:2:2	600	1211	311	91	20
34-13975	LSK 25-6,25-21-400-3-606-P7	25	6.25	1:1:2	600	1211	311	87	20
34-13839	LSK 30-5-11A-400-3-606-P7	30	5	1:2:3	600	1211	311	94	20
34-13942	LSK 31,25-6,25-12-400-3-606-P7	31.25	6.25	1:2:2	600	1211	311	92	20
34-13832	LSK 43,75-6,25-111-400-3-606-P7	43.75	6.25	1:2:4	600	1211	311	97	20
34-14457	LSK 46,88-3,13-1111-400-3-606-P7	46.88	3.13	1:2:4:8	600	1211	311	102	20
34-13841	LSK 50-6,25-211-400-3-606-P7	50	6.25	1:1:2:4	600	1211	311	104	20
34-13861	LSK 50-12,5-21-400-3-606-P7	50	12.5	1:1:2	600	1211	311	100	20
34-13980	LSK 50-50-1-400-3-606-P7	50	50	1	600	1211	311	104	20
34-13850	LSK 52,5-7,5-111-400-3-606-P7	52.5	7.5	1:2:4	600	1211	311	107	20
34-13867	LSK 60-10-11A-400-3-606-P7	60	10	1:2:3	600	1211	311	111	20
34-13872	LSK 62,5-12,5-12-400-3-606-P7	62.5	12.5	1:2:2	600	1211	311	107	20
34-13831	LSK 68,75-6,25-112-400-3-606-P7	68.75	6.25	1:2:4:4	600	1211	311	117	20
34-14500	LSK 75-12,5-11A-400-3-606-P7	75	12.5	1:2:3	600	1211	311	117	20
34-13855	LSK 75-12,5-22-400-3-606-P7	75	12.5	1:1:2:2	600	1211	311	122	20
34-13981	LSK 75-25-11-400-3-606-P7	75	25	1:2	600	1211	311	112	20
34-13833	LSK 87,5-12,5-111-400-3-606-P7	87.5	12.5	1:2:4	600	1211	311	122	20
34-13863	LSK 93,75-6,25-1111-400-3-606-P7	93.75	6.25	1:2:4:8	600	1211	311	131	20
34-13835	LSK 100-12,5-211-400-3-606-P7	100	12.5	1:1:2:4	600	1211	311	134	20
34-13971	LSK 100-16,67-11A-400-3-606-P7	100	16.67	1:2:3	600	1211	311	135	20
34-13918	LSK 100-25-21-400-3-606-P7	100	25	1:1:2	600	1211	311	129	20
Power Factor Correction Systems, extension units in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSKZ …-3-P7									
34-14127	LSKZ 50-50-1-400-3-P7	50	50	1	600	1211	311	100	20
34-14128	LSKZ 60-30-2-400-3-P7	60	30	1:1	600	1211	311	109	20
34-14120	LSKZ 75-25-11-400-3-P7	75	25	1:2	600	1211	311	113	20
34-14129	LSKZ 90-30-3-400-3-P7	90	30	1:1:1	600	1211	311	115	20
34-14130	LSKZ 100-50-2-400-3-P7	100	50	1:1	600	1211	311	120	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P8 (Detuning factor p = 8 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Dimensions Height [mm]	Dimensions Depth [mm]	Weight approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSK …-3-P8									
34-13875	LSK 17,5-2,5-111-400-3-606-P8	17.5	2.5	1:2:4	600	1211	311	84	20
34-13912	LSK 25-5-12-400-3-606-P8	25	5	1:2:2	600	1211	311	88	20
34-14433	LSK 25-6,25-21-400-3-606-P8	25	6.25	1:1:2	600	1211	311	87	20
34-13908	LSK 30-5-11A-400-3-606-P8	30	5	1:2:3	600	1211	311	96	20
34-13846	LSK 31,25-6,25-12-400-3-606-P8	31.25	6.25	1:2:2	600	1211	311	91	20
34-13880	LSK 43,75-6,25-111-400-3-606-P8	43.75	6.25	1:2:4	600	1211	311	98	20
34-13973	LSK 46,88-3,13-1111-400-3-606-P8	46.88	3.13	1:2:4:8	600	1211	311	102	20
34-13911	LSK 50-6,25-211-400-3-606-P8	50	6.25	1:1:2:4	600	1211	311	104	20
34-13986	LSK 50-12,5-21-400-3-606-P8	50	12.5	1:1:2	600	1211	311	101	20
34-14435	LSK 50-50-1-400-3-606-P8	50	50	1	600	1211	311	101	20
34-13988	LSK 52,5-7,5-111-400-3-606-P8	52.5	7.5	1:2:4	600	1211	311	108	20
34-13956	LSK 60-10-11A-400-3-606-P8	60	10	1:2:3	600	1211	311	112	20
34-13976	LSK 62,5-12,5-12-400-3-606-P8	62.5	12.5	1:2:2	600	1211	311	115	20
34-13845	LSK 68,75-6,25-112-400-3-606-P8	68.75	6.25	1:2:4:4	600	1211	311	115	20
34-14501	LSK 75-12,5-11A-400-3-606-P8	75	12.5	1:2:3	600	1211	311	122	20
34-13853	LSK 75-12,5-22-400-3-606-P8	75	12.5	1:1:2:2	600	1211	311	122	20
34-14436	LSK 75-25-11-400-3-606-P8	75	25	1:2	600	1211	311	124	20
34-13968	LSK 87,5-12,5-111-400-3-606-P8	87.5	12.5	1:2:4	600	1211	311	127	20
34-13932	LSK 93,75-6,25-1111-400-3-606-P8	93.75	6.25	1:2:4:8	600	1211	311	132	20
34-13854	LSK 100-12,5-211-400-3-606-P8	100	12.5	1:1:2:4	600	1211	311	134	20
34-13977	LSK 100-16,67-11A-400-3-606-P8	100	16.67	1:2:3	600	1211	311	135	20
34-14426	LSK 100-25-21-400-3-606-P8	100	25	1:1:2	600	1211	311	133	20
Power Factor Correction Systems, extension units in sheet steel wall cabinets, rated mains voltage: 400 V / 50 Hz Type series: LSKZ …-3-P8									
34-14140	LSKZ 50-50-1-400-3-P8	50	50	1	600	1211	311	108	20
34-14141	LSKZ 60-30-2-400-3-P8	60	30	1:1	600	1211	311	119	20
34-14142	LSKZ 75-25-11-400-3-P8	75	25	1:2	600	1211	311	123	20
34-14143	LSKZ 90-30-3-400-3-P8	90	30	1:1:1	600	1211	311	126	20
34-14138	LSKZ 100-50-2-400-3-P8	100	50	1:1	600	1211	311	132	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

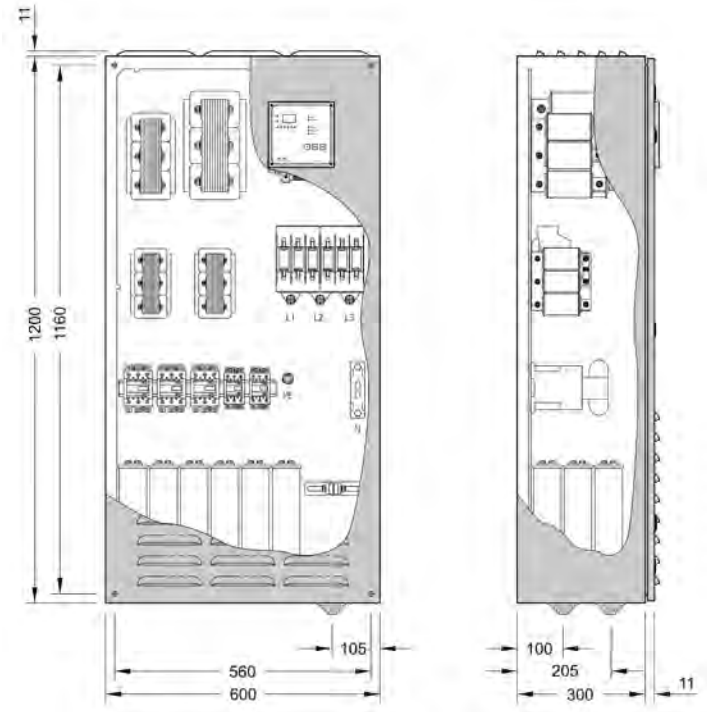
Options and accessories for Power Factor Correction Systems type LSK-P 400V, 50 Hz

Article-No.	Type	Description
Options, mounted and wired ready for operation		
S34-5502	-111- (instead of -606)	Power Factor Control Relay EMR 1100S instead of RM 9606
S34-5500	-112- (instead of -606)	Power Factor Control Relay EMR 1100 instead of RM 9606
S34-5508	-Li	Cabinet door with door left hinged
S34-0060	-SO	Special painting outside (RAL-Scale)
S34-5032	-54	Ingress protection IP54
S34-5511	-SLT	With connection at the top instead of fuse base ≤ 60 kvar = 1 pc. > 60 kvar = 2 pcs
S34-0103	-SLA	Switch disconnector* three-pole, 160 A in cable entry compartment ≤ 60 kvar
S34-0104	-SLA	Switch disconnector* three-pole, 160 A in cable entry compartment > 60 kvar
34-90011	-S56	Circuit breaker and control switch (On/Off) (option for Switzerland)
S34-5535	-S19	Control phase + N via a protective motor switch (option for France)
S34-5537	-S119 (+ Power)	Control transformer set 315 VA incl. primary and secondary fuses
S34-5073	-SO (+ Description)	Voltage meter with switch
S34-0040	-S66	Summation current transformer 5+5/5A
S34-0081	-S66	Summation current transformer 5+5+5/5A
Accessories, loose		
34-80021	WB LSK-10	Wall distance assembly set 10 mm
34-80018	WB LSK-40	Wall distance assembly set 40 mm
34-80194	KR-LSK-3-200	Fixed base (Height = 200 mm; Depth = 300 mm)

*) Switch disconnector can be operated from the outside

Other options and accessories on request

Dimensions



Dimensional drawing LSK-P (17.5 bis 100 kvar)

All dimensions in mm

LSFC-P
Power Factor Correction Systems – detuned

Ready to connect, automatic Power Factor Correction Systems in sheet steel cabinets for floor installation. Detuned – for low-voltage networks with harmonic content.

- Power Range: 75 to 500 kvar
- Modular construction in freestanding sheet steel cabinet
- Ready for connection
- Fully automatic and intelligent Power Factor Control Relay
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Power Factor Correction Systems, type LSFC-P are suitable for compensation in networks with harmonic distortion according to EN 61000-2-4 class 2.

They are available as follows:

Version	Detuning factor	Resonance frequency
P1	p = 14 %	134 Hz
P7	p = 7 %	189 Hz
P8	p = 8 %	177 Hz

Power Range

Power Factor Correction System in sheet steel cabinet:

- 75 to 500 kvar

Design

The ready-for-connection Power Factor Correction System consists of pre-assembled capacitor-reactor modules, type C6XD… or C8XD… and the suitable sheet steel cabinet.

The cabinet contains:

- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Heavy duty Capacitor Switching Contactors
- Harmonic Filter Reactors with overtemperature switch
- Fuse links, 3-pole, size NH00
- Control terminal strip with control fuse and thermal trip contact for safety shutdown
- Intelligent Power Factor Control Relay RM 9606 or EMR 1100 S
- Thermostatically controlled motor fan

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection

The power supply cable and the current transformer cable enter the bottom of the cabinet through a sliding gland plate and a cable clamp rail, the power supply being connected to the busbar system and the current transformer cable to the terminal strip provided.

System Expansion

An extension of the system is possible by adding LSFCZ-P extension units. This extension unit will be integrated in the existing control circuit via the control cable (supplied with the extension unit).

Technical Data

Design	Sheet steel cabinet with door right hinged
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz
Ambient temperature	–5 °C to +40 °C
Humidity	Max. 90 %, no condensation
Cabinet colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

FRAKO systems are designed for connecting 5 core cables. If a 4-core cable is used, a jumper must be fitted to connect PE and N, or a control transformer must be installed.

Version: P1 (Detuning factor p = 14 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P1									
34-19409	LSFC 75-6,25-212-400-64-606-P1	75	6.25	1:1:2:4	600	2000	400	189	20
34-21484	LSFC 75-12,5-11A-400-64-606-P1	75	12.5	1:2:3	600	2000	400	198	20
34-19410	LSFC 75-12,5-22-400-64-606-P1	75	12.5	1:1:2	600	2000	400		20
34-22300	LSFC 87,5-6,25-211A-400-64-606-P1	87.5	6.25	1:1:2:4:6	600	2000	400		20
34-22301	LSFC 87,5-12,5-21A-400-64-606-P1	87.5	12.5	1:1:2:3	600	2000	400		20
34-22302	LSFC 100-6,25-213-400-64-606-P1	100	6.25	1:1:2:4	600	2000	400		20
34-22291	LSFC 100-12,5-23-400-64-606-P1	100	12.5	1:1:2	600	2000	400		20
34-22295	LSFC 100-25-4-400-64-606-P1	100	25	1:1:1	600	2000	400		20
34-22296	LSFC 112,5-12,5-11B-400-64-606-P1	112.5	12.5	1:2:3	600	2000	400		20
34-22297	LSFC 125-12,5-21B-400-64-606-P1	125	12.5	1:1:2:3	600	2000	400		20
34-22298	LSFC 150-37,5-4-400-64-606-P1	150	37.5	1:1:1	600	2000	400		20
34-22294	LSFC 150-25-22-400-66-606-P1	150	25	1:1:2	600	2000	400		20
34-22293	LSFC 175-25-13-400-66-606-P1	175	25	1:2:2	600	2000	600		20
34-22292	LSFC 200-50-4-400-66-606-P1	200	50	1:1:1	600	2000	600		20
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P1									
34-16666	LSFCZ 150-50-3-400-66-P1	150	50	1:1:1	600	2000	600		20
34-16667	LSFCZ 200-50-4-400-66-P1	200	50	1:1:1:1	600	2000	600		20
Power Factor Correction Systems in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P1									
34-19103	LSFC 100-12,5-211-400-85-606-P1	100	12.5	1:1:2:4	800	2110	500	257	41
34-19104	LSFC 100-25-21-400-85-606-P1	100	25	1:1:2	800	2110	500	251	41
34-19105	LSFC 125-12,5-221-400-85-606-P1	125	12.5	1:1:2:2:4	800	2110	500	282	41
34-19106	LSFC 125-25-12-400-85-606-P1	125	25	1:2:2	800	2110	500	264	41
34-19107	LSFC 150-12,5-212-400-85-606-P1	150	12.5	1:1:2:4	800	2110	500	309	41
34-19108	LSFC 150-25-22-400-85-606-P1	150	25	1:1:2:2	800	2110	500	301	41
34-19109	LSFC 175-25-13-400-85-606-P1	175	25	1:2:2:2	800	2110	500	328	41
34-19304	LSFC 200-12,5-213-400-85-606-P1	200	12.5	1:1:2:4	800	2110	500	340	41
34-19110	LSFC 200-25-23-400-85-606-P1	200	25	1:1:2:2	800	2110	500	371	41
34-19111	LSFC 225-25-14-400-85-606-P1	225	25	1:2:2:2	800	2110	500	382	41
34-19112	LSFC 250-25-24-400-85-606-P1	250	25	1:1:2:2	800	2110	500	416	41
34-19113	LSFC 250-50-5-400-85-606-P1	250	50	1:1:1:1	800	2110	500	403	41
34-19114	LSFC 275-25-15-400-85-606-P1	275	25	1:2:2:2	800	2110	500	427	41
34-19115	LSFC 300-25-25-400-85-111-P1	300	25	1:1:2:2	800	2110	500	470	41
34-19116	LSFC 300-50-6-400-85-606-P1	300	50	1:1:1:1	800	2110	500	466	41
34-19117	LSFC 325-25-16-400-85-111-P1	325	25	1:2:2:2	800	2110	500	444	41
34-19118	LSFC 350-25-26-400-85-111-P1	350	25	1:1:2:2	800	2110	500	533	41
34-19119	LSFC 350-50-7-400-85-111-P1	350	50	1:1:1:1	800	2110	500	516	41
34-19120	LSFC 375-25-17-400-85-111-P1	375	25	1:2:2:2	800	2110	500	534	41
34-19121	LSFC 400-50-8-400-85-111-P1	400	50	1:1:1:1	800	2110	500	573	41
34-21844	LSFC 500-50-0-400-86-111-P1	500	50	1:1:1:1	800	2110	600	670	41

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P1									
34-16209	LSFCZ 100-50-2-400-85-P1	100	50	1:1	800	2110	500	230	41
34-16210	LSFCZ 150-50-3-400-85-P1	150	50	1:1:1	800	2110	500	338	41
34-16211	LSFCZ 200-50-4-400-85-P1	200	50	1:1:1:1	800	2110	500	354	41
34-16212	LSFCZ 250-50-5-400-85-P1	250	50	1:1:1:1	800	2110	500	397	41
34-16213	LSFCZ 300-50-6-400-85-P1	300	50	1:1:1:1	800	2110	500	460	41
34-16214	LSFCZ 350-50-7-400-85-P1	350	50	1:1:1:1	800	2110	500	503	41
34-16215	LSFCZ 400-50-8-400-85-P1	400	50	1:1:1:1	800	2110	500	579	41

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P7 (Detuning factor p = 7 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P7									
34-19396	LSFC 75-6,25-212-400-64-606-P7	75	6.25	1:1:2:4	600	2000	400	174	20
34-21485	LSFC 75-12,5-11A-400-64-606-P7	75	12.5	1:2:3	600	2000	400	174	20
34-19397	LSFC 75-12,5-22-400-64-606-P7	75	12.5	1:1:2:2	600	2000	400	181	20
34-19398	LSFC 93,75-6,25-1111-400-64-606-P7	93.75	6.25	1:2:4:8	600	2000	400	184	20
34-19399	LSFC 100-12,5-211-400-64-606-P7	100	12.5	1:1:2:4	600	2000	400	188	20
34-19400	LSFC 100-25-21-400-64-606-P7	100	25	1:1:2	600	2000	400	191	20
34-19401	LSFC 125-12,5-221-400-64-606-P7	125	12.5	1:1:2:2:4	600	2000	400	216	20
34-19402	LSFC 125-25-12-400-64-606-P7	125	25	1:2:2	600	2000	400	204	20
34-19403	LSFC 150-12,5-212-400-64-606-P7	150	12.5	1:1:2:4	600	2000	400	233	20
34-19404	LSFC 150-25-22-400-64-606-P7	150	25	1:1:2:2	600	2000	400	228	20
34-19405	LSFC 175-25-13-400-64-606-P7	175	25	1:2:2:2	600	2000	400	243	20
34-19406	LSFC 200-12,5-213-400-64-606-P7	200	12.5	1:1:2:4	600	2000	400	274	20
34-19407	LSFC 200-25-23-400-64-606-P7	200	25	1:1:2:2	600	2000	400	268	20
34-19408	LSFC 200-50-4-400-64-606-P7	200	50	1:1:1:1	600	2000	400	268	20
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P7									
34-16221	LSFCZ 100-50-2-400-64-P7	100	50	1:1	600	2000	400	181	20
34-16222	LSFCZ 150-50-3-400-64-P7	150	50	1:1:1	600	2000	400	226	20
34-16223	LSFCZ 200-50-4-400-64-P7	200	50	1:1:1:1	600	2000	400	193	20
Power Factor Correction Systems in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P7									
34-19077	LSFC 100-12,5-211-400-84-606-P7	100	12.5	1:1:2:4	800	2000	400	213	20
34-20482	LSFC 100-12,5-211-400-85-606-P7	100	12.5	1:1:2:4	800	2000	500	202	20
34-19078	LSFC 100-25-21-400-84-606-P7	100	25	1:1:2	800	2000	400	189	20
34-19079	LSFC 125-12,5-221-400-84-606-P7	125	12.5	1:1:2:2:4	800	2000	400	218	20
34-19080	LSFC 125-25-12-400-84-606-P7	125	25	1:2:2	800	2000	400	214	20
34-19081	LSFC 150-12,5-212-400-84-606-P7	150	12.5	1:1:2:4	800	2000	400	234	20
34-19082	LSFC 150-25-22-400-84-606-P7	150	25	1:1:2:2	800	2000	400	234	20

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
34-19083	LSFC 175-25-13-400-84-606-P7	175	25	1:2:2:2	800	2000	400	247	20
34-19084	LSFC 187,5-12,5-113-400-84-606-P7	187.5	12.5	1:2:4:4	800	2000	400	260	20
34-20483	LSFC 200-12,5-213-400-85-606-P7	200	12.5	1:1:2:4	800	2000	500	288	20
34-19085	LSFC 200-25-23-400-84-606-P7	200	25	1:1:2:2	800	2000	400	263	20
34-19086	LSFC 225-25-14-400-84-606-P7	225	25	1:2:2:2	800	2000	400	294	20
34-19087	LSFC 250-25-24-400-84-606-P7	250	25	1:1:2:2	800	2000	400	314	20
34-19088	LSFC 250-50-5-400-84-606-P7	250	50	1:1:1:1	800	2000	400	308	20
34-19089	LSFC 275-25-15-400-84-606-P7	275	25	1:2:2:2	800	2000	400	326	20
34-19090	LSFC 300-25-25-400-84-111-P7	300	25	1:1:2:2	800	2000	400	347	20
34-19091	LSFC 300-50-6-400-84-606-P7	300	50	1:1:1:1	800	2000	400	343	20
34-19092	LSFC 325-25-16-400-84-111-P7	325	25	1:2:2:2	800	2000	400	369	20
34-19093	LSFC 350-25-26-400-84-111-P7	350	25	1:1:2:2	800	2000	400	384	20
34-19072	LSFC 350-50-7-400-84-111-P7	350	50	1:1:1:1	800	2000	400	384	20
34-19094	LSFC 375-25-17-400-84-111-P7	375	25	1:2:2:2	800	2000	400	404	20
34-19095	LSFC 400-25-27-400-84-111-P7	400	25	1:1:2:2:2:2:2:2:2	800	2000	400	420	20
34-19096	LSFC 400-50-8-400-84-111-P7	400	50	1:1:1:1:1:1:1:1	800	2000	400	417	20
34-20757	LSFC 500-50-0-400-85-111-P7	500	50	1:1:1:1:1:1:1:1:1:1	800	2110	500	509	41
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P7									
34-16202	LSFCZ 100-50-2-400-84-P7	100	50	1:1	800	2000	400	187	20
34-16203	LSFCZ 150-50-3-400-84-P7	150	50	1:1:1	800	2000	400	229	20
34-16204	LSFCZ 200-50-4-400-84-P7	200	50	1:1:1:1	800	2000	400	261	20
34-16205	LSFCZ 250-50-5-400-84-P7	250	50	1:1:1:1	800	2000	400	279	20
34-16206	LSFCZ 300-50-6-400-84-P7	300	50	1:1:1:1	800	2000	400	345	20
34-16207	LSFCZ 350-50-7-400-84-P7	350	50	1:1:1:1	800	2000	400	387	20
34-16208	LSFCZ 400-50-8-400-84-P7	400	50	1:1:1:1	800	2000	400	418	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P8 (Detuning factor p = 8 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P8									
34-20489	LSFC 75-6,25-212-400-64-606-P8	75	6.25	1:1:2:4	600	2000	400	163	20
34-21486	LSFC 75-12,5-11A-400-64-606-P8	75	12.5	1:1:3	600	2000	400		20
34-20063	LSFC 75-12,5-22-400-64-606-P8	75	12.5	1:1:2:2	600	2000	400	171	30
34-20490	LSFC 93,75-6,25-1111-400-64-606-P8	93.75	6.25	1:2:4:8	600	2000	400	175	20
34-19573	LSFC 100-12,5-211-400-64-606-P8	100	12.5	1:1:2:4	600	2000	400	182	20
34-20491	LSFC 100-25-21-400-64-606-P8	100	25	1:1:2	600	2000	400	184	20
34-20492	LSFC 125-12,5-221-400-64-606-P8	125	12.5	1:1:2:2:4	600	2000	400	206	20
34-20210	LSFC 125-25-12-400-64-606-P8	125	25	1:2:2	600	2000	400	197	20
34-19578	LSFC 150-12,5-212-400-64-606-P8	150	12.5	1:1:2:4	600	2000	400	235	20
34-20380	LSFC 150-25-22-400-64-606-P8	150	25	1:1:2:2	600	2000	400	226	20

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
34-20493	LSFC 175-25-13-400-64-606-P8	175	25	1:2:2:2	600	2000	400	240	20
34-19579	LSFC 200-12,5-213-400-64-606-P8	200	12.5	1:1:2:4	600	2000	400	271	20
34-20402	LSFC 200-25-23-400-64-606-P8	200	25	1:1:2:2	600	2000	400	265	20
34-20494	LSFC 200-50-4-400-64-606-P8	200	50	1:1:1:1	600	2000	400	256	20
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P8									
34-16309	LSFCZ 100-50-2-400-64-P8	100	50	1:1	600	2000	400	184	20
34-16392	LSFCZ 150-50-3-400-64-P8	150	50	1:1:1	600	2000	400	167	20
34-16276	LSFCZ 200-50-4-400-64-P8	200	50	1:1:1:1	600	2000	400	189	20
Power Factor Correction Systems in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P8									
34-20503	LSFC 100-12,5-211-400-84-606-P8	100	12.5	1:1:2:4	800	2000	400	215	20
34-20745	LSFC 100-12,5-211-400-85-606-P8	100	12.5	1:1:2:4	800	2000	500	202	20
34-20170	LSFC 100-25-21-400-84-606-P8	100	25	1:1:2	800	2000	400	189	20
34-19590	LSFC 125-12,5-221-400-84-606-P8	125	12.5	1:1:2:2:4	800	2000	400	220	20
34-19559	LSFC 125-25-12-400-84-606-P8	125	25	1:2:2	800	2000	400	222	20
34-19768	LSFC 150-12,5-212-400-84-606-P8	150	12.5	1:1:2:4	800	2000	400	233	20
34-19123	LSFC 150-25-22-400-84-606-P8	150	25	1:1:2:2	800	2000	400	230	20
34-19238	LSFC 175-25-13-400-84-606-P8	175	25	1:2:2:2	800	2000	400	251	20
34-19911	LSFC 187,5-12,5-113-400-84-606-P8	187.5	12.5	1:2:4:4	800	2000	400	256	20
34-20545	LSFC 200-12,5-213-400-85-606-P8	200	12.5	1:1:2:4	800	2000	500	275	20
34-19248	LSFC 200-25-23-400-84-606-P8	200	25	1:1:2:2	800	2000	400	272	20
34-19261	LSFC 225-25-14-400-84-606-P8	225	25	1:2:2:2	800	2000	400	295	20
34-19864	LSFC 250-25-24-400-84-606-P8	250	25	1:1:2:2	800	2000	400	309	20
34-20383	LSFC 250-50-5-400-84-606-P8	250	50	1:1:1:1	800	2000	400	318	20
34-19458	LSFC 275-25-15-400-84-606-P8	275	25	1:2:2:2	800	2000	400	323	20
34-19264	LSFC 300-25-25-400-84-111-P8	300	25	1:1:2:2	800	2000	400	360	20
34-19203	LSFC 300-50-6-400-84-606-P8	300	50	1:1:1:1	800	2000	400	340	20
34-20495	LSFC 325-25-16-400-84-111-P8	325	25	1:2:2:2	800	2000	400	374	20
34-19639	LSFC 350-25-26-400-84-111-P8	350	25	1:1:2:2	800	2000	400	391	20
34-20496	LSFC 350-50-7-400-84-111-P8	350	50	1:1:1:1	800	2000	400	387	20
34-20179	LSFC 375-25-17-400-84-111-P8	375	25	1:2:2:2	800	2000	400	418	20
34-19257	LSFC 400-25-27-400-84-111-P8	400	25	1:1:2:2	800	2000	400	421	20
34-19204	LSFC 400-50-8-400-84-111-P8	400	50	1:1:1:1	800	2000	400	417	20
34-20935	LSFC 500-50-0-400-85-111-P8	500	50	1:1:1:1	800	2110	500	530	41
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P8									
34-16277	LSFCZ 100-50-2-400-84-P8	100	50	1:1	800	2000	400	183	20
34-16380	LSFCZ 150-50-3-400-84-P8	150	50	1:1:1	800	2000	400	235	20
34-16338	LSFCZ 200-50-4-400-84-P8	200	50	1:1:1:1	800	2000	400	268	20
34-16285	LSFCZ 250-50-5-400-84-P8	250	50	1:1:1:1	800	2000	400	275	20
34-16301	LSFCZ 300-50-6-400-84-P8	300	50	1:1:1:1	800	2000	400	350	20
34-16393	LSFCZ 350-50-7-400-84-P8	350	50	1:1:1:1	800	2000	400	399	20
34-16374	LSFCZ 400-50-8-400-84-P8	400	50	1:1:1:1	800	2000	400	429	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

LSFC-P5
Power Factor Correction Systems – detuned

Ready to connect, automatic Power Factor Correction Systems in sheet steel cabinets for floor installation. Detuned – for low-voltage networks with special requirements.

- Power Range: 100 to 500 kvar
- Modular construction in freestanding sheet steel cabinet
- Ready for connection
- Fully automatic and intelligent Power Factor Control Relay
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Power Factor Correction Systems, type LSFC-P are suitable for compensation in networks with harmonic distortion according to EN 61000-2-4 class 2.

They are available as follows:

Version	Detuning factor	Resonance frequency
P5	p = 5.67 %	210 Hz

Further series resonance frequencies are available on request.

Power Range
Power Factor Correction System in sheet steel cabinet:
- 100 to 500 kvar

Design
The ready-for-connection Power Factor Correction System consists of pre-assembled capacitor-reactor modules, type C6XD… or C8XD… and the suitable sheet steel cabinet.

The cabinet contains:
- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Heavy duty Capacitor Switching Contactors
- Harmonic Filter Reactors with overtemperature switch
- Fuse links, 3-pole, size NH00
- Control terminal strip with control fuse and thermal trip contact for safety shutdown
- Intelligent Power Factor Control Relay RM 9606 or EMR 1100 S
- Thermostatically controlled motor fan

Installation Site
The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations
For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection
The power supply cable and the current transformer cable enter the bottom of the cabinet through a sliding gland plate and a cable clamp rail, the power supply being connected to the busbar system and the current transformer cable to the terminal strip provided.

System Expansion
An extension of the system is possible by adding LSFCZ-P extension units. This extension unit will be integrated in the existing control circuit via the control cable (supplied with the extension unit).

Technical Data

Design	Sheet steel cabinet with door right hinged
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz
Ambient temperature	–5 °C to +40 °C
Humidity	Max. 90 %, no condensation
Cabinet colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes
For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Version: P5 (Detuning factor p = 5.67 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P5									
34-22157	LSFC 100-25-21-400-64-111-P5	100	25	1:1:2	600	2000	400	210	20
34-22158	LSFC 125-25-12-400-64-111-P5	125	25	1:2:2	600	2000	400	240	20
34-22159	LSFC 150-25-22-400-64-111-P5	150	25	1:1:2:2	600	2000	400	280	20
34-22160	LSFC 175-25-13-400-64-111-P5	175	25	1:2:2:2	600	2000	400	303	20
34-22161	LSFC 200-50-4-400-64-111-P5	200	50	1:1:1:1	600	2000	400	318	20
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P5									
34-16641	LSFCZ 100-50-2-400-64-P5	100	50	1:1	600	2000	400	185	20
34-16642	LSFCZ 150-50-3-400-64-P5	150	50	1:1:1	600	2000	400	248	20
34-16643	LSFCZ 200-50-4-400-64-P5	200	50	1:1:1:1	600	2000	400	310	20
Power Factor Correction Systems in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFC …-P5									
34-22140	LSFC 100-25-21-400-85-111-P5	100	25	1:1:2	800	2110	500	195	41
34-22141	LSFC 125-25-12-400-85-111-P5	125	25	1:2:2	800	2110	500	230	41
34-22142	LSFC 150-25-22-400-85-111-P5	150	25	1:1:2:2	800	2110	500	250	41
34-22143	LSFC 175-25-13-400-85-111-P5	175	25	1:2:2:2	800	2110	500	285	41
34-22144	LSFC 200-25-23-400-85-111-P5	200	25	1:1:2:2	800	2110	500	305	41
34-22145	LSFC 225-25-14-400-85-111-P5	225	25	1:2:2:2	800	2110	500	330	41
34-22146	LSFC 250-25-24-400-85-111-P5	250	25	1:1:2:2	800	2110	500	344	41
34-22147	LSFC 250-50-5-400-85-111-P5	250	50	1:1:1:1	800	2110	500	396	41
34-22148	LSFC 275-25-15-400-85-111-P5	275	25	1:2:2:2	800	2110	500	422	41
34-22149	LSFC 300-25-25-400-85-111-P5	300	25	1:1:2:2	800	2110	500	435	41
34-22150	LSFC 300-50-6-400-85-111-P5	300	50	1:1:1:1	800	2110	500	422	41
34-22151	LSFC 325-25-16-400-85-111-P5	325	25	1:2:2:2	800	2110	500	460	41
34-22152	LSFC 350-25-26-400-85-111-P5	350	25	1:1:2:2	800	2110	500	520	41
34-22153	LSFC 350-50-7-400-85-111-P5	350	50	1:1:1:1	800	2110	500	526	41
34-22154	LSFC 375-25-17-400-85-111-P5	375	25	1:2:2:2	800	2110	500	555	41
34-22155	LSFC 400-50-8-400-85-111-P5	400	50	1:1:1:1	800	2110	500	565	41
34-22156	LSFC 500-50-0-400-86-111-P5	500	50	1:1:1:1	800	2110	600	640	41
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz Type series: LSFCZ …-P5									
34-16634	LSFCZ 100-50-2-400-85-P5	100	50	1:1	800	2110	500	220	41
34-16635	LSFCZ 150-50-3-400-85-P5	150	50	1:1:1	800	2110	500	260	41
34-16636	LSFCZ 200-50-4-400-85-P5	200	50	1:1:1:1	800	2110	500	300	41
34-16637	LSFCZ 250-50-5-400-85-P5	250	50	1:1:1:1	800	2110	500	350	41
34-16638	LSFCZ 300-50-6-400-85-P5	300	50	1:1:1:1	800	2110	500	410	41
34-16639	LSFCZ 350-50-7-400-85-P5	350	50	1:1:1:1	800	2110	500	460	41
34-16640	LSFCZ 400-50-8-400-85-P5	400	50	1:1:1:1	800	2110	500	510	41

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Options and accessories for Power Factor Correction Systems type LSFC-P 400 V, 50 Hz

Options, mounted and wired ready for operation

Article-No.	Type	Description	for System type
S34-5502	-111- (instead of -606)	Power Factor Control Relay EMR 1100 S instead of RM 9606	all
S34-5500	-112- (instead of -606)	Power Factor Control Relay EMR 1100 instead of RM 9606	all
S34-5519	-66- (instead of -64-)	FRAKO LSFC-66, WxHxD: 600x2000x600 mm (without floor standing base and roof)	LSFC-64
S34-5528	-66- (instead of -84-)	FRAKO LSFC-66, WxHxD: 600x2000x600 mm (without floor standing base and roof)	LSFC-84
S34-5503	-84- (instead of -64-)	FRAKO LSFC-84, WxHxD: 800x2000x400 mm (without floor standing base and roof)	LSFC-64
S34-5524	-85- (instead of -84-)	FRAKO LSFC-85, WxHxD: 800x2000x500 mm (without floor standing base and roof)	LSFC-84
S34-5517	-86- (instead of -84/85-)	FRAKO LSFC-86, WxHxD: 800x2000x600 mm (without floor standing base and roof)	LSFC-84/-85
S34-5504	-27- (instead of -64-)	Rittal TS 8604, WxHxD: 600x2000x400 mm (without floor standing base and roof)	LSFC-64
S34-5518	-43- (instead of -84/85-)	Rittal TS 8606 WxHxD: 600x2000x600 mm (without floor standing base and roof)	LSFC-84/-85
S34-5505	-29- (instead of -84-)	Rittal TS 8804, WxHxD: 800x2000x400 mm (without floor standing base and roof)	LSFC-84
S34-5506	-24- (instead of -85-)	Rittal TS 8805, WxHxD: 800x2000x500 mm (without floor standing base and roof)	LSFC-85
S34-5527	-10- (instead of -84-)	Rittal TS 8806, WxHxD: 800x2000x600 mm (without floor standing base and roof)	LSFC-84
S34-5507	-10- (instead of -85-)	Rittal TS 8806, WxHxD: 800x2000x600 mm (without floor standing base and roof)	LSFC-85
S34-5509	-Li	Cabinet door with door left hinged	all type FRAKO LSFC
S34-5510	-Li	Cabinet door with door left hinged	all type Rittal TS
S34-5023	-S60	Pivoting lever closure for mounting a semiprofile cylinder	all
S34-0060	-SO (+ Description)	Special painting outside (RAL-Scale)	all
S34-0010	-S1	Cable entry through the switch cabinet roof with connection at the top	up to 400 kvar/Cabinet
S34-5512	-54	Ingress protection IP54	≤ 300 kvar/Cabinet
S34-5513	-54	Ingress protection IP54	> 300 ≤ 400 kvar/Cabinet
S34-0054	-S80	Ingress protection IPX1 with dust cover roof W x H x D (mm) 520 x 300 x 50; RAL 7035	all FRAKO LSFC
S34-5523	S34-5523	Ingress protection IP41, roof vent installation on cabinet instead of a roof vent installation in cabinet	≤ 400 kvar/Cabinet
S34-5511	-SLT	Fuse switch disconnector instead of fuse base per 50 kvar	all
S34-5514	-SLA	Fuse switch disconnector in cable entry compartment	≤ 200 kvar/Cabinet
S34-5515	-SLA	Fuse switch disconnector in cable entry compartment	≤ 300 kvar/Cabinet
S34-0109	-SLA	Switch disconnector* three-pole, 400 A in cable entry compartment, for cabinet width 600 mm	≤ 200 kvar/Cabinet
S34-0108	-SLA	Switch disconnector* three-pole, 400 A in cable entry compartment, for cabinet width 800 mm	≤ 200 kvar/Cabinet
S34-0107	-SLA	Switch disconnector* three-pole, 630 A in cable entry compartment, for cabinet width 600 mm	≤ 300 kvar/Cabinet
S34-0106	-SLA	Switch disconnector* three-pole, 630 A in cable entry compartment, for cabinet width 800 mm	≤ 300 kvar/Cabinet
34-90011	-S56	Circuit breaker and control switch (On/Off) (option for Switzerland)	all
S34-5535	-S19	Control phase + N via a protective motor switch (option for France)	all
S34-5536	-S119	Control transformer set 500 VA primary and secondary fuses	≤ 500 kvar

Article-No.	Type	Description	for System type
S34-5526	-S119	Control transformer set 800 VA incl. primary and secondary fuses	> 500 ≤ 900 kvar
S34-5069	-S53	3 ammeter incl. current transformer	all
S34-5073	-SO (+ Description)	Voltage meter with switch	all
S34-5077	-SO (+ Description)	kvar-Meter incl. current transformer; measuring range up to 300 kvar, 400 V	all
S34-5057	-SO (+ Description)	Measuring transducer 4-20 mA or power factor	all
S34-5067	-S255	EM-PQ 1500 with current transformer, without EM-FD 1500	all
S34-5066	-S255	EM-PQ 1500 with current transformer, with EM-FD 1500	all
S34-5050	-S255	EMA 1101 with current transformer	all
S34-0040	-S66	Summation current transformer 5+5/5A	all
S34-0081	-S66	Summation current transformer 5+5+5/5A	all
S34-5049	-S145	Switch cabinet lighting with power outlet and position switch	all

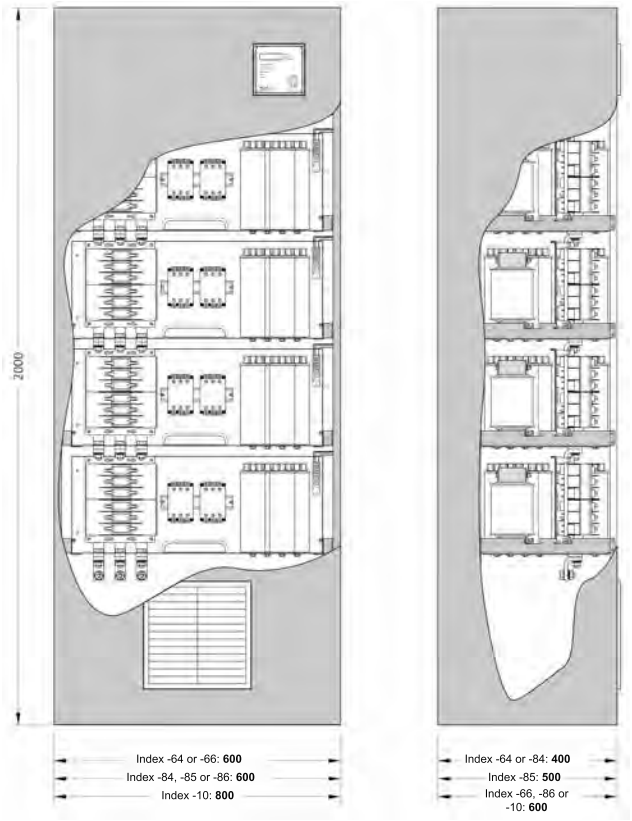
*) Switch disconnector can be operated from the outside

Accessories

Article-No.	Type	Description	for System type
34-80090	KR-LSFC-64-100	Floor standing base (h = 100 mm)	LSFC-64
34-80175	KR-LSFC-64-200	Floor standing base (h = 200 mm)	LSFC-64
34-80122	KR-LSFC-66-100	Floor standing base (h = 100 mm)	LSFC-66
34-80125	KR-LSFC-66-200	Floor standing base (h = 200 mm)	LSFC-66
34-80091	KR-LSFC-84-100	Floor standing base (h = 100 mm)	LSFC-84
34-80113	KR-LSFC-84-200	Floor standing base (h = 200 mm)	LSFC-84
34-80079	KR-LSFC-85-100	Floor standing base (h = 100 mm)	LSFC-85
34-80075	KR-LSFC-85-200	Floor standing base (h = 200 mm)	LSFC-85
34-80092	KR-LSFC-86-100	Floor standing base (h = 100 mm)	LSFC-86
34-80112	KR-LSFC-86-200	Floor standing base (h = 200 mm)	LSFC-86

Other options and accessories on request

Dimensions



Dimensional drawing LSFC-P (100 to 500 kvar)

All dimensions in mm

MCS
Modular Construction System

The FRAKO Modular Construction System MCS is a modular system, with which a skilled switchgear manufacturer can design a technically high-quality Power Factor Correction System. However, knowing our “Manual of Power Factor Correction” is absolutely important to design such a Power Factor Correction System. In this manual one will find all the necessary planning information as well as all the important technical data. You can download the manual free of charge from our website or order it free of charge from your local FRAKO partner.

The FRAKO MCS consists of selected and tested components for designing Power Factor Correction Systems. FRAKO uses these components for its own production of Power Factor Correction Systems in Teningen. This way the skilled switchgear manufacturer can gain from an experience and application know-how of more than 85 years.

The FRAKO Modular Construction System contains the following components:

- Power Factor Control Relay
- Control terminal strip for Power Factor Control Relay and Power Factor Correction Systems
- Control wires
- Busbar holders
- NH-fuse base and NH-isolating switch
- NH-fuse links
- Contactors
- Discharge Reactors
- Harmonic Filter Reactors
- Power Factor Correction Capacitors
- Thyristor switches

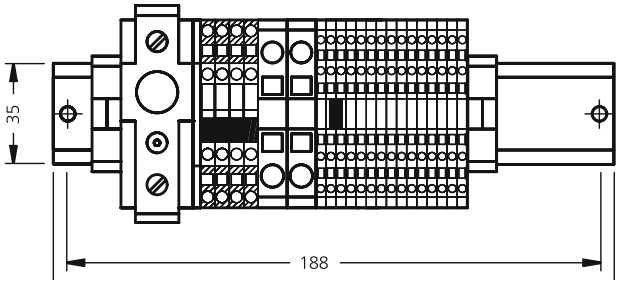
Technical Data

- **Power Factor Control Relays and accessories**

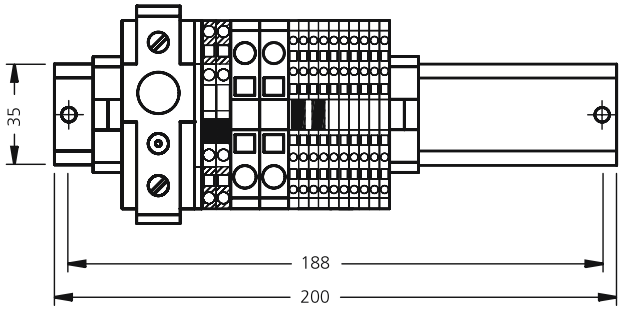
For technical details on our Power Factor Control Relays we would like to refer you to chapter “Power Factor Control Relays”
For the relays, FRAKO recommends to use the suitable control terminal strips, the thermal trip contact for the monitoring of the cabinet temperature as well as the prepared control cables. All items can be ordered as single components or as a complete control relay package.

The following chart shows the different types of relays as well as the suitable accessories for the assembly and the connection of the devices:

Article-No.	Type	Description
Power Factor Control Relays		
38-00320	RM 2106	With 6 control contacts
38-00100 / 38-00103	RM 9606	With 6 control contacts (German/English version)
38-00340	RM 2112	With 12 control contacts
38-00300 / 38-00301	EMR 1100 S	With 12 control contacts (German/English version)
20-50008	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System
20-50013		Software-Upgrade EMR 1100 S to full version EMR 1100
Control terminal strip with thermal trip contact, pre-mounted		
34-80002	RKL–RM 9606	Suitable for RM 9606
34-80003	RKL–EMR 1100	Suitable for EMR 1100 / EMR 1100 S
34-80027	RKL–Z–cabinet	For extension units (only 12 control contacts)
Control cable, prepared, for connection of Power Factor Control Relay with control terminal strip RKL:		
89-20557	RK RM 9606–1150	For connection of RM 9606 with control terminal strip (length: 1.15 m, 6 control contacts)
89-20558	RK RM 9606–1500	For connection of RM 9606 with control terminal strip (length: 1.50 m, 6 control contacts)
89-20555	RK EMR 1100–1150	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1.15 m, 12 control contacts)
89-20556	RK EMR 1100–1500	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1.50 m, 12 control contacts)
89-20559	SS 12–6000	Control cable for connection of control terminal strip with module: for connection of the “basic unit” with the “extension unit” (length: 6 m, 12 control contacts)
Reactive Power Factor Control Relay package Completely assembled and tested units comprising: Power Factor Control Relay, control cable (length: 1.15 m), control terminal strip RKL with NH-fuse and thermal trip contact		
34-72016	STR–RM 9606	RM 9606
34-72024	STR–EMR 1100 S	EMR 1100 S
34-72002	STR–EMR 1100	EMR 1100



RKL-EMR 1100
All dimensions in mm



RKL-RM 9606

Technical Data

For the design of Power Factor Correction Systems **FRAKO** recommends to use the below-mentioned devices and fuses.

- **Busbar Holders**

The busbar holders have a centre to centre distance of 60 mm to the single copper busbars. The copper busbars have either dimensions of 30 × 5 mm or 30 × 10 mm, depending on the total power of the Power Factor Correction System.

Article-No.	Description
34-80375	Busbar holder with a bar centre to centre distance of 60 mm, Cu 30 x 10 mm

34-80375

- **NH-Isolating Switch**

NH-isolating switch size 00. Applicable up to a mains rated voltage of 690 V AC. Available as NH-bus-mounting isolating switches for direct mounting on a busbar system with 60 mm bar centre to centre distance or for mounting on mounting plates.

Article-No.	Description
34-80374	NH-isolating switch for plate mounting, size 00, 160 A, 690 V AC
34-80282	NH-isolating switch for plate mounting, size 00, 160 A, 690 V AC
34-80281	NH-bus-mounting isolating switch, size 00, 160 A, 690 V AC

34-80281

34-80282

34-80374

- **NH-Fuse Holders**

To assemble reasonably priced Power Factor Correction Systems, NH-fuse holders size 00 up to a mains rated voltage of 690 V AC, can be used. These NH-fuse holders are also available as bus-mounting fuse holders for direct mounting on a busbar system with a bar centre to centre distance of 60 mm, or for mounting on mounting plates.

Article-No.	Description
34-80372	NH-bus-mounting fuse base, size 00, 160 A, 690 V AC
34-80280	NH-bus-mounting fuse base, size 00, 160 A, 690 V AC
34-80272	NH-fuse base for plate mounting, size 00, 160 A, 690 V AC
34-80283	NH-fuse base for plate mounting, size 00, 160 A, 690 V AC
34-80373	Cover for NH-fuses with nonisolated grip lugs

34-80283

34-80280

34-80272

34-80372

When operating the above mentioned devices, please note that special attention has to be paid to the corresponding safety regulations, especially the regulations concerning accident prevention!

- **Fuses**

Article-No.	Description
90-00061	D0-fuse NEOZED 2 A, E14
90-00041	D0-fuse NEOZED 4 A, E14
90-00092	D0-fuse NEOZED 6 A, E14
90-00229	Fuse link with nonisolated metal grip lugs 25 A, 500 V AC
90-00062	Fuse link with isolated metal grip lugs 25 A, 500 V AC
90-00131	Fuse link with nonisolated metal grip lugs 35 A, 500 V AC
90-00056	Fuse link with isolated metal grip lugs 35 A, 500 V AC
90-00130	Fuse link with nonisolated metal grip lugs 50 A, 500 V AC
90-00055	Fuse link with isolated metal grip lugs 50 A, 500 V AC
90-00125	Fuse link with nonisolated metal grip lugs 63 A, 500 V AC
90-00054	Fuse link with isolated metal grip lugs 63 A, 500 V AC
90-00124	Fuse link with nonisolated metal grip lugs 80 A, 500 V AC
90-00053	Fuse link with isolated metal grip lugs 80 A, 500 V AC
90-00126	Fuse link with nonisolated metal grip lugs 100 A, 500 V AC
90-00052	Fuse link with isolated metal grip lugs 100 A, 500 V AC
90-00051	Fuse link with isolated metal grip lugs 125 A, 500 V AC
90-00050	Fuse link with isolated metal grip lugs 160 A, 500 V AC
90-00230	Fuse link with isolated metal grip lugs 35 A, 690 V AC
90-00132	Fuse link with isolated metal grip lugs 40 A, 690 V AC
90-00111	Fuse link with isolated metal grip lugs 50 A, 690 V AC
90-00133	Fuse link with isolated metal grip lugs 63 A, 690 V AC

Ordering examples

Ordering example 1

- **Description**

Example: assembly of a Power Factor Correction System with the following specification:

— **Total power: 350 kvar, 400 V, 50 Hz**
Step rating: 2 × 25 kvar and 6 × 50 kvar
— **12-step Power Factor Control Relay with switching times of 10 seconds**

- **1. :**

The system has 8 switching stages and requires a 12-step Power Factor Control Relay. Please select a Reactive Power Factor Control Relay package with relay EMR 1100 S, consisting of the relay, temperature switch for the monitoring of the cabinet temperature, terminal strip with control system fuse and connecting cables.

- **2. :**

The system requires 2 contactors for 25 kvar, 400 V, 50 Hz and 6 contactors for 50 kvar, 400 V and 50 Hz. Please select contactors with series resistors:

25 kvar steps: Contactors, Type: K3-32K00
50 kvar steps: Contactors, Type: K3-62K00

- **3. :**

Choose the Power Factor Correction Capacitors: Please select standard Power Factor Correction Capacitors with a rated voltage of 400 V for a mains rated voltage of 400 V.

For the 25 kvar step rating, depending on the construction and the available space, one can choose between 2 pcs. of LKT 12,5-400-DP or 1 pc. of LKT 25,0-400-DP.

For the 50 kvar step one can choose between 4 pcs. of LKT 12,5-400-DP or 2 pcs. of LKT 25,0-400-DP.

For the complete system one requires either 28 pcs. of capacitor LKT 12,5-400-DP or 14 pcs. of LKT 25,0-400-DP.

We also recommend to use our patented plug-in type connection terminal for capacitors (AKD)

- **4. :**

The short switching times given, require a discharge of the capacitors by means of discharge reactors.

For 25 and 50 kvar the same discharge reactor can be selected. The 8 capacitor steps require 8 discharge reactors.

- **5. :**

One 25 kvar step has a rated current of 36.1 A at 400 V, 50 Hz. This requires a protection with a 63 A gl fuse.

One 50 kvar step has a rated current of 72.2 A at 400 V, 50 Hz. This requires a protection with a 100 A gl fuse.

For this system we would need altogether 6 pcs. NH-fuses NH 00, 63 A, 500 V, gl and 18 pcs NH-fuses NH, size 00, 100 A, 500 V, gl. FRAKO recommends to use NH-fuses with isolated grip lugs.

- **6. :**

For the fuse links, NH-bus-mounting isolating switches size 00 should be selected.

For the 8 steps, 8 pcs. of bus-mounting isolating switches will be needed.

- **7. :**

For the assembly of the busbar system FRAKO recommends a maximum space of 250 mm for the busbar holders. So 8 pieces of busbar holders are needed for the busbar system.
Due to the total rated current of the system of 505 A, copper busbars with 30 x 10 mm are required.

- **8. :**

Ordering chart

Article-No.	Description	Qty
34-72024	Complete Power Factor Control Relay package EMR 1100 S	1
89-00278	Contactor K3-32K00	2
89-00276	Contactor K3-62K00	6
31-10502	Capacitor LKT 12,5-400-DP	28
31-08000	Plug-in type connecting terminal for capacitors AKD 25/3	28
88-02013	Discharge Reactor	8
90-00054	NH-fuse, size 00, 63 A, 500 V, gl	6
90-00052	NH-fuse, size 00, 100 A, 500 V, gl	18
90-00166	NH-bus-mounting isolating switch size 00, 160 A	8
90-00046	Busbar holder, 60 mm, 30 x 10 mm	8

Ordering example 2

- **Description**

Example: assembly of a Power Factor Correction System with the following specification

— **Total power: 375 kvar, 400 V, 50 Hz**
Series Resonance Frequency: 189 Hz (7 %)
— **Step rating: 1 × 25 kvar and 7 × 50 kvar**
— **Power Factor Control Relay with 12 control contacts**

- **1. :**

The system has 8 switching stages and requires a 12-step Power Factor Control Relay. We select a complete Power Factor Control Relay package with a relay EMR 1100 S, consisting of the relay, temperature switch for the monitoring of the cabinet temperature, clamp with control fuse and connecting cables.

- **2. :**

The system requires one contactor for 25 kvar, 400 V, 50 Hz and 7 contactors for 50 kvar, 400 V and 50 Hz. Please select contactors without series resistors.

25 kvar step: Contactor, Type: K3-32A00,
50 kvar step: Contactor, Type: K3-62A00,

- **3. :**

Choose the Power Factor Correction Capacitors:
Please select Standard Power Factor Correction Capacitors with a rated voltage of 440 V or Premium capacitors with a rated voltage of 400 V for a mains rated voltage of 400 V.

Depending on the construction and the available space the 25 kvar step one can choose between 2 pcs. of LKT 11,7-400-DL or 1 pc. of LKT 28,2-440-DP.

The 50 kvar rated step requires 4 pcs. of LKT 11,7-400-DL or 4 pcs. of LKT 28,2-440-DP.

The complete Power Factor Control System requires either 30 pcs. of LKT 11,7-400-DL or 15 pcs. of LKT 28,2-440-DP. We also recommend to use our patented plug-in type connection terminal for capacitors (AKD).

- **4. :**

The 25 kvar step requires one 25 kvar reactor[1)] and the 7 x 50 kvar steps require 7 x 50 kvar reactors[2)].

- **5. :**

One 25 kvar step has a rated current of 36.1 A at 400 V, 50 Hz. This requires a protection with a 63 A gl fuse.

One 50 kvar step has a rated current of 72.2 A at 400 V, 50 Hz. This requires a protection with a 100 A gl fuse.

For this system we would need altogether 3 pcs. NH-fuses, 63 A, 500 V, gl and 21 pcs. NH-fuses 100 A, 500 V, gl. FRAKO recommends to use NH-fuses with isolated grip lugs.

- **6. :**

For the fuse links, NH-bus-mounting isolating switches size 00 should be selected. For the 8 steps, 8 pcs. NH-bus-mounting isolating switches would be needed.

- **7. :**

For the assembly of a busbar system FRAKO recommends a maximum space of 250 mm for the busbar holders. So 8 pieces of busbar holders are needed for the busbar system.

Due to the total rated current of the system of 542 A, copper busbars with 30 x 10 mm are required.

- **8. :**

Ordering chart

Article-No.	Description	Qty
34-72024	Power Factor Control Relay package EMR 1100 S	1
89-00290	Contactor K3-32A00	1
89-00292	Contactor K3-62A00	7
31-10604	Capacitor LKT 11,7-400-DL	30
88-01768	Harmonic Filter Reactor FDR 25-400-P7	1[1)]
88-01769	Harmonic Filter Reactor FDR 50-400-P7	7[2)]
90-00054	NH-fuse, size 00, 63 A, 500 V, gl	3
90-00052	NH-fuse, size 00, 100 A, 500 V, gl	21
90-00166	NH-bus-mounting-isolating switch size 00, 160 A	8
90-00046	Busbar holder, 60 mm, 30 x 10 mm	8

Technical Annex

Supply Lead Cross Sections

Page 141

Guide to selection: Harmonic Filter Reactors → Capacitors

Page 143

Supply lead cross sections for Power Factor Correction Systems

Connection, fuses and supply lead cross sections
When installation work is carried out, the regulations VDE 0100 and VDE 0105, of the German Association for Electrical, Electronic & Information Technologies, the general guidelines of the BDEW (German Association of Energy and Water Industries) and the conditions of supply of the utility company concerned must be complied with. EN 60831-1 resp. VDE 0560 Part 46 state that capacitor units must be suitable for a continuous r.m.s. current of 1.3 times the current that is drawn at the sinusoidal rated voltage and rated frequency. If the capacitance tolerance of 1.1 × C_N is also taken into account, the maximum allowable current can reach values of up to 1.43 × I_N. This overload capability together with the high in-rush current to the capacitors must be taken into account when designing protective devices and cable cross sections.

Note! FRAKO power capacitors offer a current load capacity of 1.5 up to 2.7 × I_N at rated voltage.

FRAKO Power Factor Correction Capacitors with terminal base ensure a maintenance free electrical contact with the connecting wire by using the patented spring clamp technology! The terminal base provides protection against accidental contact! The connecting wires have to be flexible in order not to hinder the proper function of the overpressure disconnector.

Please note that the current transformer, needed for the operation of the system, is not included with delivery.

Rated mains voltage: 400 V / 50 Hz

Power rating [kvar]	Rated current [A]	Fuse gL/gG [A]	Supply lead cross section[1] (4-wire) [mm]	Supply lead cross section[1] (5-wire) [mm]
7.50	11	16	4 x 2.5	5 x 2.5
10.00	14	20	4 x 2.5	5 x 2.5
12.50	18	25	4 x 4	5 x 4
15.00	22	35	4 x 6	5 x 6
17.50	25	35	4 x 6	5 x 6
20.00	29	50	4 x 10	4 x 10/ 10
25.00	36	50	4 x 16	4 x 16/ 16
27.50	40	63	4 x 16	4 x 16/ 16
30.00	43	63	4 x 16	4 x 16/ 16
31.25	45	63	4 x 16	4 x 16/ 16
37.50	54	80	3 x 25/16	4 x 25/ 16
40.00	58	80	3 x 25/16	4 x 25/ 16
43.75	63	100	3 x 35/16	4 x 35/ 16
46.88	68	100	3 x 35/16	4 x 35/ 16
50.00	72	100	3 x 35/16	4 x 35/ 16
52.50	76	125	3 x 50/25	4 x 50/ 25
60.00	87	125	3 x 50/25	4 x 50/ 25
62.50	90	125	3 x 50/25	4 x 50/ 25
68.75	99	160	3 x 70/35	4 x 70/ 35
75.00	108	160	3 x 70/35	4 x 70/ 35
80.00	115	160	3 x 70/35	4 x 70/ 35
93.75	135	200	3 x 95/50	4 x 95/ 50
100.00	144	200	3 x 95/50	4 x 95/ 50
112.50	162	250	3 x 120/70	4 x 120/ 70
125.00	180	250	3 x 120/70	4 x 120/ 70
143.75	207	315	3 x 185/95	4 x 185/ 95
150.00	217	315	3 x 185/95	4 x 185/ 95
175.00	253	400	2 x 3 x 95/50	2 x 4 x 95/ 50
187.50	271	400	2 x 3 x 95/50	2 x 4 x 95/ 50
200.00	289	400	2 x 3 x 95/50	2 x 4 x 95/ 50
225.00	325	500	2 x 3 x 120/70	2 x 4 x 120/ 70
250.00	361	500	2 x 3 x 120/70	2 x 4 x 120/ 70
275.00	397	630	2 x 3 x 185/95	2 x 4 x 185/ 95
300.00	433	630	2 x 3 x 185/95	2 x 4 x 185/ 95
325.00	469	800	2 x 3 x 240/120	2 x 4 x 240/ 120
350.00	505	800	2 x 3 x 240/120	2 x 4 x 240/ 120
375.00	541	800	2 x 3 x 240/120	2 x 4 x 240/ 120
400.00	577	800	2 x 3 x 240/120	2 x 4 x 240/ 120
450.00	650	1000	3 x 3 x 185/95	3 x 4 x 185/ 95
500.00	722	1000	3 x 3 x 185/95	3 x 4 x 185/ 95

[1] Recommended supply lead cross section according to VDE 0298, table 4, installation type C

Harmonic Filter Reactors (Basic / Standard)
Guide to selection: Harmonic Filter Reactors → Capacitors

Guide to selection: Harmonic Filter Reactors → Capacitors

Basic Harmonic Filter Reactors
Detuning factor p = 7 %

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 10-525-DP Article-No. 31-10517	LKT 11,7-400-DL Article-No. 31-10604	LKT 28,2-440-DP Article-No. 31-10535								
FDKT: V_N = 400 V / 50 Hz														
88-02103	FDKT 6.25-400-P7	6.3	3 x 38.5	1										
88-02045	FDKT 12.5-400-P7	12.5	3 x 77.6		1									
88-02046	FDKT 25-400-P7	25.0	3 x 155.2		2	1								
88-02047	FDKT 50-400-P7	50.0	3 x 310.4		4	2								
88-02093	FDKT 75-400-P7	75.0	3 x 465.6		6	3								
88-02094	FDKT 100-400-P7	100.0	3 x 620.8		8	4								

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 15,5-480-DP Article-No. 31-10382										
FDKT: V_N = 415 V / 50 Hz														
88-02098	FDKT 12,5-415-P7	12.5	3 x 71.4	1										
88-02099	FDKT 25-415-P7	25.0	3 x 142.8	2										
88-02100	FDKT 50-415-P7	50.0	3 x 285.6	4										
88-02101	FDKT 75-415-P7	75.0	3 x 428.4	6										
88-02190	FDKT 100-415-P7	100.0	3 x 572.3	8										

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 20-690-DP Article-No. 31-10564										
FDKT: V_N = 525 V / 50 Hz														
88-02146	FDKT 12,5-525-P7	12.5	3 x 44.7	1										
88-02147	FDKT 25-525-P7	25.0	3 x 89.4	2										
88-02148	FDKT 50-525-P7	50.0	3 x 178.8	4										
88-02149	FDKT 75-525-P7	75.0	3 x 268.2	6										
88-02150	FDKT 100-525-P7	100.0	3 x 357.6	8										
88-02151	FDKT 150-525-P7	150.0	3 x 536.4	12										
88-02152	FDKT 200-525-P7	200.0	3 x 715.2	16										

Detuning factor p = 14 %

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 15,5-480-DP Article-No. 31-10382										
FDKT: V_N = 400 V / 50 Hz														
88-02095	FDKT 12,5-400-P1	12.5	3 x 71.4	1										
88-02096	FDKT 25-400-P1	25.0	3 x 142.8	2										
88-02097	FDKT 50-400-P1	50.0	3 x 285.6	4										

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required
FDKT: V_N = 525 V / 50 Hz				
88-02153	FDKT 12,5-525-P1	12.5	3 x 41.1	
88-02154	FDKT 25-525-P1	25.0	3 x 82.2	
88-02155	FDKT 50-525-P1	50.0	3 x 164.4	
88-02156	FDKT 75-525-P1	75.0	3 x 246.6	Type and quantity of the capacitors required on request
88-02157	FDKT 100-525-P1	100.0	3 x 328.8	
88-02158	FDKT 150-525-P1	150.0	3 x 439.2	
88-02159	FDKT 200-525-P1	200.0	3 x 657.6	

Standard Harmonic Filter Reactors

Detuning factor p = 5.67 %

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required	
				LKT 11,7-400-DL Article-No. 31-10604	LKT 28,2-440-DP Article-No. 31-10535
FDR: V_N = 400 V / 50 Hz					
88-02141	FDR 25-400-P5	25.0	3 x 155.2	2	1
88-02142	FDR 50-400-P5	50.0	3 x 310.4	4	2

Detuning factor p = 7 %

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required											
				LKT 10-440-DP Article-No. 31-10508	LKT 10-525-DP Article-No. 31-10517	LKT 10-400-DP Article-No. 31-10380	LKT 12,5-400-DP Article-No. 31-10502								
FDR/FKD: V_N = 230 V / 50 Hz															
88-01980	FDR 5-230-P7	5.0	3 x 93.3	1	1										
88-01575	FKD 10-230-P7	10.0	3 x 200.0			3									
88-01974	FDR 12,5-230-P7	12.5	3 x 232.1			1	2								
88-01583	FKD 16,7-230-P7	16.7	3 x 334.0				4								
88-01576	FKD 20-230-P7	20.0	3 x 400.0			6									
88-01943	FDR 25-230-P7	25.0	3 x 464.2			2	4								
88-01568	FKD 33-230-P7	33.0	3 x 668.0				8								

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required												
				LKT 3,6-480-DL Article-No. 31-10613	LKT 4,5-480-DL Article-No. 31-10388	LKT 9,3-400-DL Article-No. 31-10602	LKT 7,2-480-DL Article-No. 31-10615	LKT 7,6-440-DL Article-No. 31-10608	LKT 9,1-440-DL Article-No. 31-10387	LKT 10-400-DL Article-No. 31-10603	LKT 11,7-400-DL Article-No. 31-10604		LKT 28,2-440-DP Article-No. 31-10535	LKT 12,5-440-DP Article-No. 31-10507		
FKD/FDR: V_N = 400 V / 50 Hz																
88-01640	FKD 2,5-400-P7	2.5	3 x 16.6	1												
88-01719	FKD 3,13-400-P7	3.13	3 x 19.9		1											
88-01481	FKD 5-400-P7	5.0	3 x 33.2				1									
88-01410	FKD 6.25-400-P7	6.25	3 x 41.5					1								
88-01482	FKD 7.5-400-P7	7.5	3 x 49.7						1							
88-01479	FKD 10-400-P7	10.0	3 x 66.3							1						
88-01767	FDR 12.5-400-P7	12.5	3 x 77.1								1					
88-01362	FKD 15-400-P7	15.0	3 x 99.5						2							
88-01922	FDR 16.7-400-P7	16.7	3 x 102.9			1		1								
88-01363	FKD 20-400-P7	20.0	3 x 132.6							2						
88-01768	FDR 25-400-P7	25.0	3 x 154.2								2	or	1			
88-01484	FKD 30-400-P7	30.0	3 x 198.9							3						
88-01923	FDR 33.3-400-P7	33.3	3 x 205.8											3		
88-02053	FDR 37.5-400-P7	37.5	3 x 213.9								3					
88-01782	FDR 40-400-P7	40.0	3 x 248.8			3										
88-01769	FDR 50-400-P7	50.0	3 x 308.4								4	or	2			

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 7,8-480-DL Article-No. 31-10616
FDR: V_N = 415 V / 50 Hz				
88-02034	FDR 6,25-415-P7	6.3	3 x 35.9	1
88-01937	FDR 12,5-415-P7	12.5	3 x 71.4	2
88-01938	FDR 25-415-P7	25.0	3 x 142.8	4
88-01930	FDR 50-415-P7	50.0	3 x 285.6	8

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 8,33-525-DL Article-No. 31-10622
FDR/FKD: V_N = 440 V / 50 Hz				
88-02160	FDR 6,25-440-P7	6.3	3 x 32.1	1
88-02161	FDR 12,5-440-P7	12.5	3 x 64.2	2
88-01008	FKD 25-440-P7	25.0	3 x 132.8	4
88-01124	FKD 50-440-P7	50.0	3 x 265.6	8

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 4,17-525-DL Article-No. 31-10619	LKT 5,9-525-DL Article-No. 31-10620	LKT 7,7-525-DL Article-No. 31-10621
FDR/FKD: V_N = 525 V / 50 Hz						
88-01801	FDR 6,25-525-P7	6.3	3 x 22.9		1	
88-01802	FDR 12,5-525-P7	12.5	3 x 45.8		2	
88-01080	FKD 20-525-P7	20.0	3 x 80.5	1		2
88-01838	FDR 25-525-P7	25.0	3 x 89.5			3
88-01837	FDR 50-525-P7	50.0	3 x 179.0			6
88-01872	FDR 50-525-P7	50.0	3 x 179.0			6

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required											
				LKT 13,3-800-DP Article-No. 31-10572	LKT 28,2-760-DP Article-No. 31-10569										
FKD/FDR: V_N = 690 V / 50 Hz															
88-01825	FKD 10-690-P7	10.0	3 x 22.1	1											
88-01932	FDR 25-690-P7	25.0	3 x 51.5		2										
88-01933	FDR 50-690-P7	50.0	3 x 103.1		4										

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required											
				LKT 10-525-DP Article-No. 31-10517	LKT 11,7-400-DL Article-No. 31-10604	LKT 10-400-DP Article-No. 31-10380	LKT 12,5-400-DP Article-No. 31-10502								
FDR: V_N = 230 V / 60 Hz															
88-01996	FDR 2,5-230-P7-60	2.5	3 x 38.5	1											
88-01997	FDR 5-230-P7-60	5.0	3 x 77.3		1										
88-01998	FDR 10-230-P7-60	10.0	3 x 154.6		2										
88-02140	FDR 12,5-230-P7-60	12.5	3 x 194.3	*											
88-02001	FDR 20-230-P7-60	20.0	3 x 309.2		4										
88-01892	FDR 25-230-P7-60	25.0	3 x 385.5			2	3								

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required											
				LKT 15,5-480-DP Article-No. 31-10382											
FDR: V_N = 380 V / 60 Hz															
88-02179	FDR 12,5-380-P7-60	12.5	3 x 71.4	1											
88-02180	FDR 25-380-P7-60	25.0	3 x 142.8	2											
88-02181	FDR 50-380-P7-60	50.0	3 x 285.6	4											

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 8,33-525-DL Article-No. 31-10622
FDR: V_N = 400 V / 60 Hz				
88-01963	FDR 12,5-400-P7-60	12.5	3 x 64.2	2
88-01964	FDR 25-400-P7-60	25.0	3 x 128.1	4
88-01965	FDR 50-400-P7-60	50.0	3 x 256.9	8

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 7,7-525-DL Article-No. 31-10621	LKT 8,33-525-DL Article-No. 31-10622	LKT 5,9-525-DL Article-No. 31-10620	LKT 15,5-480-DP Article-No. 31-10382	LKT 7,8-480-DL Article-No. 31-10616
FKD/FDR: V_N = 440 V / 60 Hz								
88-01914	FKD 6,25-440-P7-60	6.3	3 x 29.9	1				
88-01795	FDR 7,5-440-P7-60	7.5	3 x 32.0		1			
88-01883	FDR 12,5-440-P7-60	12.5	3 x 54.8		1	1		
88-01796	FDR 15-440-P7-60	15.0	3 x 64.0		2			
88-01884	FDR 25-440-P7-60	25.0	3 x 107.2				1	1
88-01875	FDR 50-440-P7-60	50.0	3 x 214.2				3	

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 5-690-DP Article-No. 31-10560	LKT 4,5-480-DL Article-No. 31-10614	LKT 10-525-DP Article-No. 31-10517	LKT 12,5-525-DP Article-No. 31-10516
FKD/FDR: V_N = 460 V / 60 Hz							
88-02123	FKD 2,5-460-P7-60	2.5	3 x 11.1	1			
88-02124	FKD 5-460-P7-60	5.0	3 x 20.7		1		
88-02125	FDR 10-460-P7-60	10.0	3 x 38.5			1	
88-01854	FDR 12,5-460-P7-60	12.5	3 x 48.1				1
88-01855	FDR 25-460-P7-60	25.0	3 x 96.2				2
88-01856	FDR 50-460-P7-60	50.0	3 x 192.4				4

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 5,9-525-DL Article-No. 31-10620	LKT 7,7-525-DL Article-No. 31-10621	LKT 8,33-525-DL Article-No. 31-10622								
FDR/FKD: V_N = 480 V / 60 Hz														
88-01962	FDR 12,5-480-P7-60	12.5	3 x 45.6	2										
88-02056	FDR 25-480-P7-60	25.0	3 x 89.7		3									
88-01732	FKD 50-480-P7-60	50.0	3 x 192.0			6								

Detuning factor p = 8 %

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required												
				LKT 3,6-480-DL Article-No. 31-10613	LKT 4,5-480-DL Article-No. 31-10388	LKT 9,3-400-DL Article-No. 31-10602	LKT 7,2-480-DL Article-No. 31-10615	LKT 7,6-440-DL Article-No. 31-10608	LKT 9,1-440-DL Article-No. 31-10387	LKT 10-400-DL Article-No. 31-10603	LKT 11,7-400-DL Article-No. 31-10604		LKT 28,2-440-DP Article-No. 31-10535	LKT 12,5-440-DP Article-No. 31-10507	
FKD/FDR: V_N = 400 V / 50 Hz																
88-01678	FKD 2,5-400-P8	2.5	3 x 16.6	1												
88-01941	FKD 3,13-400-P8	3.1	3 x 19.9		1											
88-01518	FKD 5-400-P8	5.0	3 x 33.2				1									
88-01492	FKD 6,25-400-P8	6.25	3 x 41.5					1								
88-01519	FKD 7,5-400-P8	7.5	3 x 49.7						1							
88-01520	FKD 10-400-P8	10.0	3 x 66.3							1						
88-01770	FDR 12,5-400-P8	12.5	3 x 77.1								1					
88-01381	FKD 15-400-P8	15.0	3 x 99.5						2							
88-01926	FDR 16,7-400-P8	16.7	3 x 102.9			1		1								
88-01382	FKD 20-400-P8	20.0	3 x 132.6							2						
88-01771	FDR 25-400-P8	25.0	3 x 154.2								2	or	1			
88-01387	FKD 30-400-P8	30.0	3 x 198.9							3						
88-01927	FDR 33,3-400-P8	33.3	3 x 205.9											3		
88-02054	FDR 37,5-400-P8	37.5	3 x 231.9								3					
88-01781	FDR 40-400-P8	40.0	3 x 248.8			3										
88-01772	FDR 50-400-P8	50.0	3 x 308.4								4	or	2			

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 7,8-480-DL Article-No. 31-10616										
FDR: V_N = 480 V / 50 Hz														
88-01985	FDR 25-480-P8	25.0	3 x 107.4	3										
88-01986	FDR 50-480-P8	50.0	3 x 214.8	6										

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 4,17-525-DL Article-No. 31-10619	LKT 7,7-525-DL Article-No. 31-10621	LKT 8,33-525-DL Article-No. 31-10622								
FKD/FDR: V_N = 525 V / 50 Hz														
88-01845	FKD 20-525-P8	20.0	3 x 80.5	1	2									
88-01840	FDR 25-525-P8	25.0	3 x 89.5		3									
88-01846	FDR 30-525-P8	30.0	3 x 112.7	1		3								
88-01839	FDR 50-525-P8	50.0	3 x 179.0		6									
88-01871	FDR 50-525-P8	50.0	3 x 179.0		6									

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required: LKT 28,2-760-DP Article-No. 31-10569	LKT 6,7-800-DP Article-No. 31-10570	LKT 26,7-800-DP Article-No. 31-10574								
FKD/FDR: V_N = 690 V / 50 Hz														
88-01807	FKD 25-690-P8	25.0	3 x 55.3		1	2								
88-01912	FDR 50-690-P8	50.0	3 x 103.1	4										

Detuning factor p = 14 %

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 10-400-DP Article-No. 31-10380	LKT 9,3-400-DL Article-No. 31-10602	LKT 12,5-400-DP Article-No. 31-10502								
FDR: V_N = 230 V / 50 Hz														
88-02020	FDR 15-230-P1	15.0	3 x 260.3	3	1									
88-01868	FDR 30-230-P1	30.0	3 x 519.9	4		3								

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 3,6-480-DL Article-No. 31-10613	LKT 7,8-480-DL Article-No. 31-10616	LKT 7,6-440-DL Article-No. 31-10608	LKT 12,5-525-DP Article-No. 31-10516	LKT 9,1-440-DL Article-No. 31-10387	LKT 12,1-440-DL Article-No. 31-10610	LKT 12,5-480-DP Article-No. 31-10390				
FDR: V_N = 400 V / 50 Hz														
88-01834	FDR 3,13-400-P1	3.13	3 x 16.6	1										
88-02186	FDR 6,25-400-P1	6.25	3 x 35.9		1									
88-01695	FDR 10-400-P1	10.0	3 x 59.8							1				
88-01168	FDR 12.5-400-P1	12.5	3 x 71.4		2									
88-02187	FDR 15-400-P1	15.0	3 x 89.6			1	1							
88-02177	FDR 16,7-400-P1	16.7	3 x 95.8				2							
88-01038	FDR 20-400-P1	20.0	3 x 113.1							2				
88-01171	FDR 25-400-P1	25.0	3 x 142.8				3							
88-01039	FDR 30-400-P1	30.0	3 x 174.3							3				
88-01925	FDR 33,3-400-P1	33.3	3 x 190.7						2	1				
88-02176	FDR 37,5-400-P1	37.5	3 x 214.2					2		2				
88-02175	FDR 40-400-P1	40.0	3 x 232.4							4				
88-02174	FDR 50-400-P1	50.0	3 x 285.6							5				

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 7,2-480-DL Article-No. 31-10615										
FDR: V_N = 415 V / 50 Hz														
88-01956	FDR 25-415-P1	25.0	3 x 132.6	4										
88-01957	FDR 50-415-P1	50.0	3 x 265.2	8										

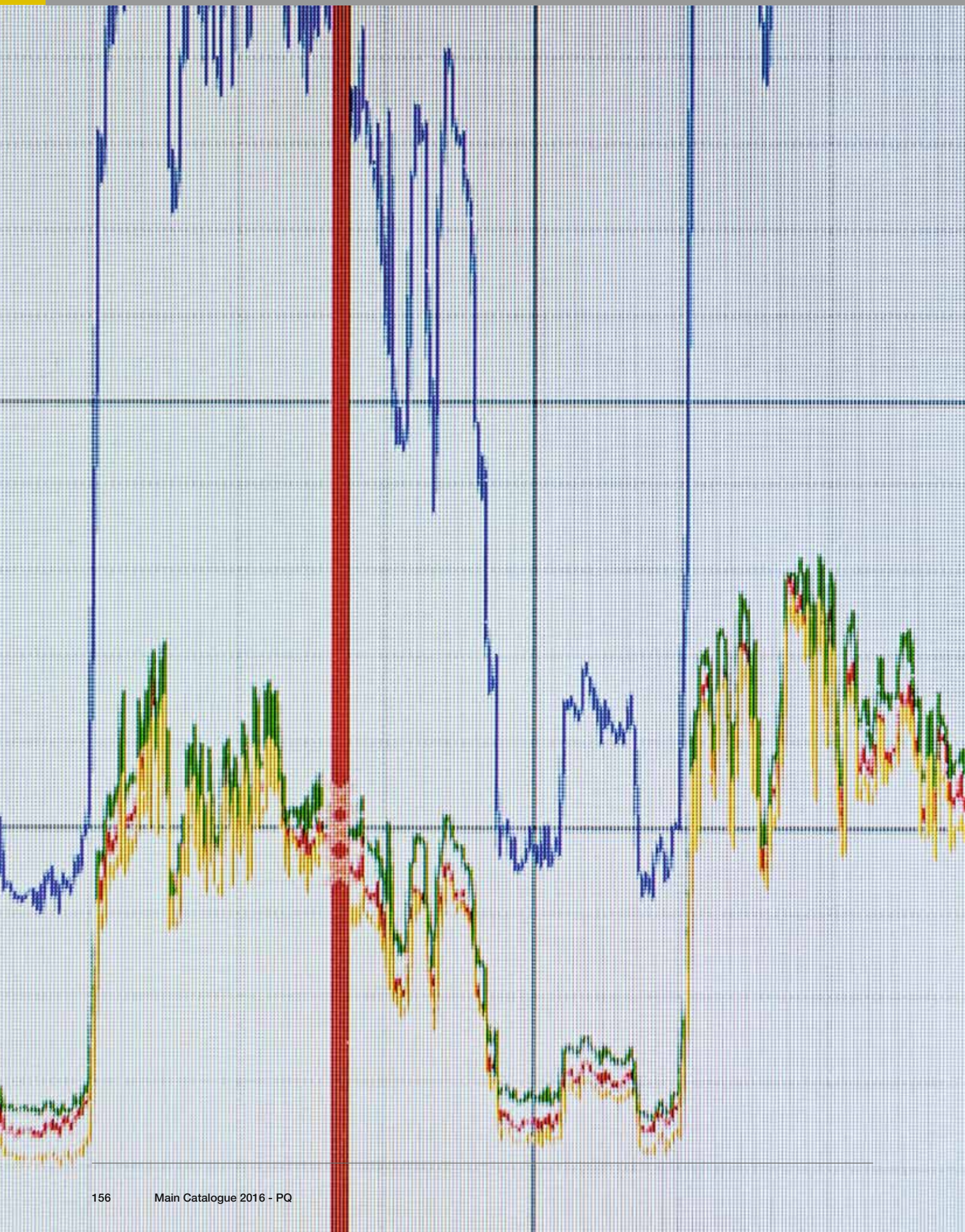
Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 7,7-525-DL Article-No. 31-10621	LKT 12,5-525-DP Article-No. 31-10516									
FDR: V_N = 440 V / 50 Hz														
88-02041	FDR 25-440-P1	25.0	3 x 118.0	4										
88-02007	FDR 50-440-P1	50.0	3 x 240.5		5									

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 15-690-DP Article-No. 31-10563										
FDR: V_N = 480 V / 50 Hz														
88-02143	FDR 25-480-P1	25.0	3 x 100.2	3										
88-02144	FDR 50-480-P1	50.0	3 x 199.3	6										

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required										
				LKT 5,9-525-DL Article-No. 31-10620	LKT 7,7-525-DL Article-No. 31-10621	LKT 8,33-525-DL Article-No. 31-10622								
FDR: V_N = 525 V / 50 Hz														
88-02039	FDR 12,5-525-P1	12.5	3 x 45.4	2										
88-01960	FDR 25-525-P1	25.0	3 x 84.4	1	1	1								
88-01900	FDR 50-525-P1	50.0	3 x 168.8	2	2	2								

Article-No.	Type	Q [kvar]	C [µF]	Type and quantity of the capacitors required											
				LKT 4,8-480-EP Article-No. 31-10515	LKT 6-480-EP Article-No. 31-10514	LKT 8,33-525-EP Article-No. 31-10385	LKT 3,6-480-EP Article-No. 31-10531								
FDR: V_N = 690 V / 50 Hz															
88-02122	FDR 12,5-690-P1	12.5	3 x 22.1	3											
88-02120	FDR 20-690-P1	20.0	3 x 38.7	3			3								
88-01842	FDR 25-690-P1	25.0	3 x 50.0	3	3										
88-01843	FDR 50-690-P1	50.0	3 x 99.9			9									

* Type and quantity of the capacitors required on request



1

Dynamic Power Factor Correction Systems

Dynamic Power Factor Correction Systems in sheet steel cabinets

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Dynamic Capacitor Modules – detuned

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LSFC-E
Dynamic Power Factor Correction Systems in sheet steel cabinets

The SBS dynamic Power Factor Correction System from FRAKO switches without delay at the next voltage zero at the thyristor switch and thus avoids any peak inrush current. Wear-free switching. The solid-state switches function without any problems even when the capacitors are not discharged and without causing peak inrush currents.

Description
The FRAKO LSFC-E Dynamic Power Factor Correction System provides switching of the capacitor stages with complete elimination of contact wear and network perturbation.

Together with the RM 2012 fast-acting control relay and/or the **SBS** Dynamic Power Factor Corection Unit, systems of the LSFC–E series are used in low voltage networks:
- with low short-circuit capacities where disruptions occur when large consumers are switched on
- where a fast-acting Power Factor Correction System and a large number of switching cycles are necessary
- where Power Factor Correction is required for only a few supply cycles at a time

Power Range
LSFC-E: 100 to 300 kvar

Construction
Sheet steel cabinet with door and lifting lugs. Ventilation via air inlet filter in the cabinet door and electric fan. Modular construction combining up to three type C-E capacitor-reactor modules.
The components comprise:
- Self-healing LKT type power capacitors with low loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Electronic switching assemblies designed for 100 % operating time
- Fuselinks, 3-pole, size NH00
- Busbar system
- Control terminal strip with control circuit fuse and thermal switch
- The basic units are equipped with an RM 9606 Reactive Power Control Relay with reaction times about 5 seconds. All systems can also be supplied with EMR 1100 S, EMR 1100 or RM 2012 Control Relays
- Fan, air inlet filter and temperature controller

- Low-loss Harmonic Filter Reactors with thermal trip switch for the following series resonance frequencies:

Version	Resonance frequency	Detuning factor	For mains with utility audio frequency [1]
P1	134 Hz	p = 14 %	≥ 166 Hz
P8	177 Hz	p = 8 %	≥ 217 Hz
P7	189 Hz	p = 7 %	≥ 228 Hz

[1] Utility company specifications inconsistent with the above must be taken into account.
In addition, also note version specifications given in our Manual of Power Factor Correction.

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Connection

The power supply cable enters the bottom of the cabinet through a sliding gland plate and a cable clamp rail, and is connected directly to the busbar system. The control cables are connected to the terminal strip provided for them.

System Expansion

The easy-to-maintain design simplifies the task of extending existing installations with less than three modules in one cabinet at a later date. It is also always possible to extend existing systems by installing an additional cabinet, type LSFCZ-E (extension unit without control relays).

Accessories / Options

- RM 2012 fast-acting Reactive Power Control Relay with reaction times of 20 to 40 ms (order code -212 instead of -606; see chapter Power Factor Control Relays) instead of RM 9606 (order code -606)
- SBS control package with reaction times of 3 to 24 ms (order code -SBS) installed and connected, consisting of:
  - AC adapter
  - 16 digital inputs wired to terminals
  - 14 digital outputs
  - Non-volatile program memory
  - Programming according to prior project work
- SBS extension module for an additional 16 digital inputs wired to terminals (order code -SBS2)
- LV HBC switch-disconnectors instead of LV HBC fuselinks for group overcurrent protection
- Customized colour to specified RAL standard
- Additional floor standing base (height: 100 or 200 mm), not fitted
- System installation in cabinet provided free issue by customer (types on request)

Technical Data

Enclosure	Sheet steel cabinet with internal fan at top, door right hinged
Rated voltage	400 V / 50 Hz
Rated capacitor voltage	440 V / 50 Hz (-P8, -P7, -P5) 480 V / 50 Hz (-P1)
Ingress protection	IP20 as per EN 60529
Ambient temperature	–5 °C to +40 °C as per VDE 0660 Part 500
Relative humidity	Max. 90 %, no condensation
Discharge	With discharge resistors acc. to VDE 0560 Part 46
Cabinet colour	RAL 7035
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

FRAKO systems are designed for connecting 5 core cables. If a 4-core cable is used, a jumper must be fitted to connect PE and N, or a control transformer must be installed.

Version: P1 (Detuning factor p = 14 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz									
Type series: LSFC …-P1-E									
34-22351	LSFC 200-25-23-400-86-606-P1-E	200	25	1:1:2:2:2	800	2110	600	533	41
34-22352	LSFC 200-50-4-400-86-606-P1-E	200	50	1:1:1:1	800	2110	600	526	41
34-22353	LSFC 225-25-14-400-86-606-P1-E	225	25	1:2:2:2:2	800	2110	600	552	41
34-22354	LSFC 250-25-24-400-86-606-P1-E	250	25	1:1:2:2:2:2	800	2110	600	580	41
34-22355	LSFC 250-50-5-400-86-606-P1-E	250	50	1:1:1:1:1	800	2110	600	573	41
34-22356	LSFC 275-25-15-400-86-606-P1-E	275	25	1:2:2:2:2:2	800	2110	600	632	41
34-22357	LSFC 300-50-6-400-86-606-P1-E	300	50	1:1:1:1:1:1	800	2110	600	653	41
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 800 mm), rated mains voltage: 400 V / 50 Hz									
Type series: LSFCZ …-P1-E									
34-16652	LSFCZ 100-50-2-400-86-P1-E	100	50	1:1	800	2110	600	246	41
34-16653	LSFCZ 150-50-3-400-86-P1-E	150	50	1:1:1	800	2110	600	442	41
34-16654	LSFCZ 200-50-4-400-86-P1-E	200	50	1:1:1:1	800	2110	600	508	41
34-16655	LSFCZ 250-50-5-400-86-P1-E	250	50	1:1:1:1:1	800	2110	600	548	41
34-16656	LSFCZ 300-50-6-400-86-P1-E	300	50	1:1:1:1:1:1	800	2110	600	628	41

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P7 (Detuning factor p = 7 %)

Article-No.	Type	Rated power [kvar]	Stage power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Power Factor Correction Systems in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz									
Type series: LSFC …-P7-E									
34-19661	LSFC 200-25-23-400-85-606-P7-E	200	25	1:1:2:2:2	800	2000	500	*	20
34-19662	LSFC 200-50-4-400-85-606-P7-E	200	50	1:1:1:1	800	2000	500	*	20
34-19663	LSFC 225-25-14-400-85-606-P7-E	225	25	1:2:2:2:2	800	2000	500	*	20
34-19664	LSFC 250-25-24-400-85-606-P7-E	250	25	1:1:2:2:2:2	800	2000	500	*	20
34-19665	LSFC 250-50-5-400-85-606-P7-E	250	50	1:1:1:1:1	800	2000	500	*	20
34-19666	LSFC 275-25-15-400-85-606-P7-E	275	25	1:2:2:2:2:2	800	2000	500	*	20
34-19667	LSFC 300-50-6-400-85-606-P7-E	300	50	1:1:1:1:1:1	800	2000	500	*	20
Power Factor Correction Systems, extension units in sheet steel cabinets (width = 600 mm), rated mains voltage: 400 V / 50 Hz									
Type series: LSFCZ …-P7-E									
34-16244	LSFCZ 100-50-2-400-85-P7-E	100	50	1:1	800	2000	500	*	20
34-16245	LSFCZ 150-50-3-400-85-P7-E	150	50	1:1:1	800	2000	500	*	20
34-16246	LSFCZ 200-50-4-400-85-P7-E	200	50	1:1:1:1	800	2000	500	*	20
34-16247	LSFCZ 250-50-5-400-85-P7-E	250	50	1:1:1:1:1	800	2000	500	*	20
34-16248	LSFCZ 300-50-6-400-85-P7-E	300	50	1:1:1:1:1:1	800	2000	500	*	20

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

* on request

Specimen orders

Specimen order 1

- Dynamic Power Factor Correction System in sheet steel cabinet for applications with no contact wear or network perturbation, with reaction times ≥ 5 seconds; 250 kvar, switched in 5 stages of 50 kvar, 400 V / 50 Hz with 7 % detuning factor (fr = 189 Hz).
  Type **LSFC 250–50–5–400–85–606–P7–E**

Specimen order 2

- Dynamic Power Factor Correction System in sheet steel cabinet for applications with no contact wear or network perturbation, with reaction times ≥ 20 ms; 300 kvar, switched in 6 stages of 50 kvar, 400 V / 50 Hz with 14 % detuning factor (fr = 134 Hz).
  Type **LSFC 300–50–6–400–85–212–P1–E**

Specimen order 3

- Dynamic Power Factor Correction System in sheet steel cabinet for applications with no contact wear or network perturbation, with reaction times in the range of 3 to 24 ms and control of the base load in a range ≥ 5 seconds; 300 kvar, switched in 6 stages of 50 kvar, 400 V / 50 Hz with 7 % detuning factor (fr = 189 Hz).
  Type **LSFC 300–50–6–400–85–606–P7–E–SBS**

The stages in the extension unit can be connected to the terminal strip of the basic unit using the control cable supplied with the extension unit.

Specimen order 4

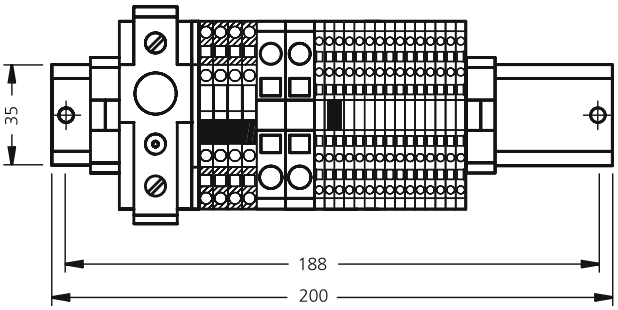
- Dynamic PFC extension unit in sheet steel cabinet for applications with no contact wear or network perturbation, 300 kvar, switched in 6 stages of 50 kvar, 400 V / 50 Hz with 7 % detuning factor (fr = 189 Hz).
  Type **LSFCZ 300–50–6–400–85–P7–E**

Accessories

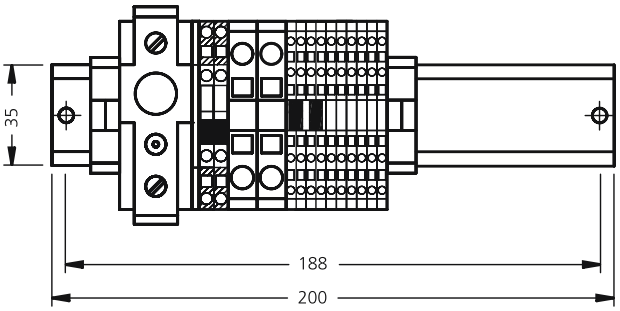
- **Control Terminal Strips**

Terminal blocks mounted on a DIN top hat rail and labelled, with thermal trip switch and D0 fuse for the control voltage. The cable from the control relay and the cable leading to the module are connected to the control terminal strip. Terminals S1 and S2 are provided for connecting the current transformer cables.

Article-No.	Type	Version	For Power Factor Control Relay type
34-80002	RKL-RM 9606	6-stufig	RM 9606
34-80003	RKL-EMR 1100	12-stufig	EMR 1100 S
34-80003	RKL-EMR 1100	12-stufig	EMR 1100
34-80027	RKL-Z-cabinet	12-stufig	for extension units



Dimensional drawing RKL-EMR 1100



Dimensional drawing RKL-RM 9606

All dimensions in mm

- **Control Relay Connecting Cable**

Connecting cable with appropriate connectors to join the Power Factor Control Relay to the RKL control terminal strip.

Length l = 1150 mm

Article-No.	Type	Version	For Power Factor Control Relay type
89-20557	RK RM 9606-1150	6-stages	RM 9606
89-20555	RK EMR 1100-1150	12-stages	EMR 1100 S
89-20555	RK EMR 1100-1150	12-stages	EMR 1100

Length l = 1500 mm

Article-No.	Type	Version	For Power Factor Control Relay type
89-20558	RK RM 9606-1500	6-stages	RM 9606
89-20556	RK EMR 1100-1500	12-stages	EMR 1100 S
89-20556	RK EMR 1100-1500	12-stages	EMR 1100

- **Control Cable**

Control cable to connect the control terminal strip to the module.

Length l = 1600 mm

Article-No.	Type	Version	To connect
89-20777	included in module	up to 3 or 7 stages	RKL → C64, C84

Length l = 6000 mm

Article-No.	Type	Version	To connect
89-20559	SS 12-6000	12-stages	RKL → RKL-Z-cabinet

- **Mounting Plates**

The dimensions of the mounting plates are selected to suit the size of the modules concerned. They provide space for fitting terminal strips, thermostats, control transformers, etc.

Article-No.	Type	Suitable for
34-80069	SB-C6	C64 modules, cabinet width 600 mm
34-80053	SB-C8	C84 modules, cabinet width 800 mm

- **Power Factor Control Relay Package**

Complete pre-assembled and tested units consisting of:

— Power Factor Control Relay
— Control relay connecting cable (length = 1150 mm)
— RKL control terminal strip with control circuit fuse and thermal trip switch

Article-No.	Type	With Power Factor Control Relay
34-72016	STR-RM 9606	RM 9606
34-72024	STR-EMR 1100 S	EMR 1100 S
34-72002	STR-EMR 1100	EMR 1100

- **Bus Connection Bracket Sets**

The copper Bus Connection Bracket Sets provide a vertical connection to busbar systems.

Article-No.	Type	Application
34-80006	CU AW-1	Vertical connection for C-module

The connecting brackets are supplied complete with M12 retaining screws and touch guards.

- **Ventilation Package**

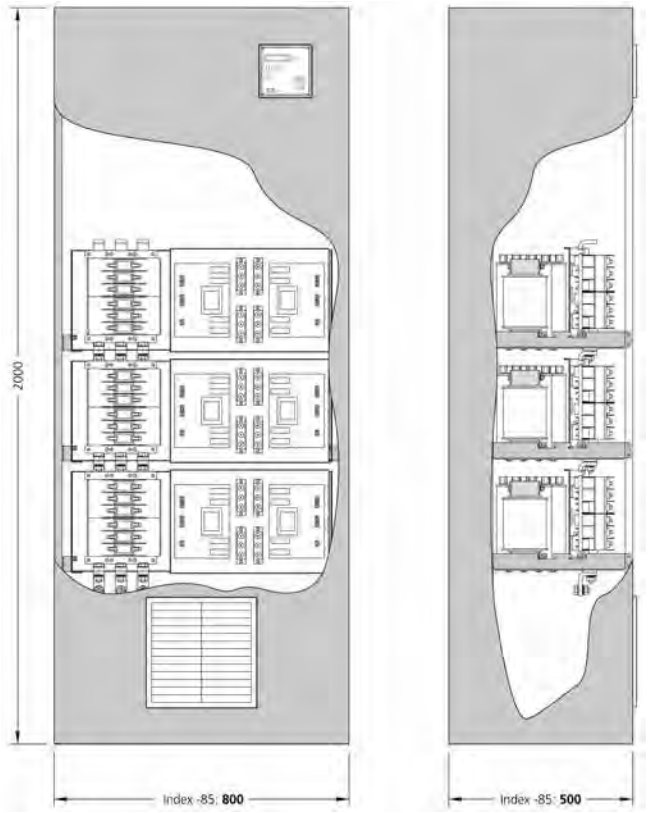
In the case of systems designed for ambient temperatures in excess of 40 °C or with IP54 ingress protection, or for detuned systems, it can be essential to install fan/filter units. The fan motor runs at the control system voltage supplied through the control system fuse. It is activated by an adjustable thermostat, which should be set at 30 °C. Effective ventilation is only ensured when the filter mats are clean. It is therefore necessary to clean these regularly, the frequency depending on the amount of dust present at the location.

Article-No.	Type	Ventilation package, consisting of
34-80096	LP-LSFC-I-IP20-6/1	Roof vent, installation in cabinet, 1 air inlet filter and thermostat
34-80285	LP-LSFC-A-IP43-7/1	Roof vent, installation on cabinet, 1 air inlet filter and thermostat

- **Capacitor Switching Contactors**

– Control voltage 230 V / 50 Hz
– For DIN rail or plate mounting
– For applications without detuning, with leading auxiliary contacts to limit inrush current peaks (type K3-..K..)
– For applications with detuning, but without series resistors (type K3-...A...)

Dimensions



Dimensional drawing LSFC-E (100 to 300 kvar)

All dimensions in mm

C84D-P-E / C85D-P-E / C86D-P-E
Dynamic Capacitor Modules – detuned

FRAKO's dynamic Capacitor Modules are suitable for installation in standard switchgear systems. Avoiding of inrush current peaks through instantaneous zero-cross switching – therefore free of wear switching even when capacitors are not discharged.

- Power Range: 25 to 100 kvar per module
- Compact design - up to 5 modules per cabinet
- Ideal for mounting in all common switchgear systems
- Easy and quick mounting with multifunctional rails
- Power Factor Correction Capacitors LKT dry-type with four safety features

Application Recommendations

Capacitor modules type C84D-P-E, C85D-P-E and C86D-P-E are suitable for installation in standard switchgear systems. Additional mounting rails for all common switchgear systems:

- W = 800 mm, T = 400, 500, 600 mm

allow an easy and quick installation of complex Power Factor Correction Systems.

Suitable for supply networks with harmonic distortion according to EN 61000-2-4 class 2.

Available in the following versions:

Version	Detuning factor	Resonance frequency
P1	p = 14 %	134 Hz
P5	p = 5.67 %	210 Hz
P7	p = 7 %	189 Hz
P8	p = 8 %	177 Hz

Power Range

Compact compensation module ideal for mounting in switchgear systems:

- 25 to 100 kvar

Construction

Sheet steel chassis with mounted power capacitors, contactors and fuses - ideal for mounting in all common switchgear systems.

The module consists of:

- Self-healing LKT type power capacitors with low-loss self-healing dielectric made from segmented metallised polypropylene film. Filled with a PCB-free filler. With discharge resistors, as per EN 60831-1 and -2 as well as IEC 60831-1 and -2
- Heavy duty Capacitor Switching Contactors
- Low-loss Harmonic Filter Reactors with temperature switches
- Busbar system with bus-mounting fuse base, 3-pole, size NH 00
- Control circuit with female connector (wired connector for connection with terminal strip incl.)

Installation Site

The place of installation must comply with the requirements of the ingress protection and ambient temperature concerned.

Regulations

For installation and connection of Power Factor Correction Capacitors in Germany the following regulations must be complied with: VDE 0100, VDE 0105, VDE 0560 Part 46 and VDE 0106 Part 100 (German Association of Electrical Engineers). In other countries the equivalent local regulations must be followed.

Installation

Specific module rails are required for installation in the switchgear system. Those module rails are available for all common switchgear systems and can be supplied as an optional accessory.

Connection

The network connection can be done either vertically or horizontally. For the horizontal connection one has to connect the cables equipped with the cable lugs to the busbar by using the M12 screws.

A bus connection bracket CU AW-1 for vertical connection is available as an option.

Additional modules can be connected directly via the busbar system.

Technical Data

Design	Sheet steel chassis for installation in switchgear cabinets C6xD… for cabinets (width = 600 mm) C8xD… for cabinets (width = 800 mm)
Rated voltage	400 V/50 Hz
Rated voltage of capacitors	440 V/50 Hz (-P5 to -P8) 480 V/50 Hz (-P1)
Ambient temperature	–5 °C to +60 °C
Humidity	Max. 90 %, no condensation
Standards	EN 60831-1 and -2 IEC 60831-1 and -2 EN 61921 IEC 61921 EN 61439-1 and -2 IEC 61439-1 and 2

Important Notes

For further information on power factor correction and harmonics please refer to our “Manual of Power Factor Correction”.

Version: P1 (Detuning factor p = 14 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 800 mm, rated mains voltage: 400 V / 50 Hz Type series: C8xD …-P1-E									
34-64857	C84D 25-25-1-400/480-84-P1-E	25	25	1	700	300	350	58	00
34-65016	C85D 37,5-12,5-11-400/480-85- P1-E	37.5	12.5	1:2	700	300	450	*	00
34-65015	C85D 50-25-2-400/480-85-P1-E	50	25	1:1	700	300	450	*	00
34-64886	C84D 50-50-1-400/480-84-P1-E	50	50	1	700	300	350	*	00
34-64376	C85D 75-25-11-400/480-85-P1-E	75	25	1:2	700	300	450	*	00
34-65012	C86D 100-50-2-400/480-86-P1-E	100	50	1:1	700	300	550	*	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

Version: P7 (Detuning factor p = 7 %)

Article-No.	Type	Rated power [kvar]	Step power [kvar]	Switching sequence	Dimensions Width [mm]	Height [mm]	Depth [mm]	Weight (gross) approx. [kg]	Protection IP
Capacitor Modules for installation in switchgear systems with a width of 800 mm, rated mains voltage: 400 V / 50 Hz Type series: C6xD …-P7-E									
34-64028	C84D 25-25-1-400/440-84-P7-E	25	25	1	700	300	350	*	00
34-64061	C84D 37,5-12,5-11-400/440-84-P7-E	37.5	12.5	1:2	700	300	350	*	00
34-64029	C84D 50-25-2-400/440-84-P7-E	50	25	1:1	700	300	350	*	00
34-64030	C84D 50-50-1-400/440-84-P7-E	50	50	1	700	300	350	*	00
34-64031	C85D 75-25-11-400/440-85-P7-E	75	25	1:2	700	300	450	*	00
34-64032	C85D 100-50-2-400/440-85-P7-E	100	50	1:1	700	300	450	97	00

Other rated voltages, frequencies and power ratings on request

Recommended supply lead cross sections: please refer to the technical annex (page 141 ff.)

* on request

Options and accessories for Capacitor Modules type C84D-P-E / C85D-P-E / C86D-P-E, 50 Hz

Accessories

Article-No.	Type	Description
Power Factor Control Relay		
38-00320	RM 2106	with 6 control contacts
38-00340	RM 2112	with 12 control contacts
38-00100	RM 9606	with 6 control contacts (German manual)
38-00103	RM 9606	with 6 control contacts (English manual)
38-00300	EMR 1100 S	with 12 control contacts (German manual)
38-00301	EMR 1100 S	With 12 control contacts (English manual)
20-50006	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System (German manual)
20-50008	EMR 1100	With 12 control contacts and bus interface to FRAKO Energy Management System (Engl. manual)
39-29054	PROPHI 12RS	With 12 control contacts, with Profibus or Modbus interface
39-29050	RM 2012 6+6D	With 12 control contacts, 6 relays / 6 with reaction time between 20/40 ms
39-29051	RM 2012 12D	With 12 control contacts, reaction time between 20/40 ms

Power Factor Control Relay package (completely assembled and tested units)

Accessories

Article-No.	Type	Description
34-72016	STR–RM 9606	RM 9606, control terminal strip with thermal trip contact, cable length 1150 mm
34-72024	STR–EMR 1100 S	EMR 1100 S, control terminal strip with thermal trip contact, cable length 1150 mm
34-72002	STR–EMR 1100	EMR 1100, control terminal strip with thermal trip contact, cable length 1150 mm
Control terminal strip with thermal trip contact (pre-mounted)		
34-80002	RKL–RM 9606	Suitable for RM 9606
34-80003	RKL–EMR 1100	Suitable for EMR 1100 / EMR 1100 S
34-80027	RKL–Z–Cabinet	For extension units (only 12 control contacts)
Control cable (prepared)		
89-20557	RK RM 9606–1150	For connection of RM 9606 with control terminal strip (length: 1000 mm, 6 control contacts)
89-20558	RK RM 9606–1500	For connection of RM 9606 with control terminal strip (length: 1500 mm, 6 control contacts)
89-20622	RK RM 9606–2600	For connection of RM 9606 with control terminal strip (length: 2600 mm, 6 control contacts)
89-20555	RK EMR 1100–1150	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1150 mm, 12 control contacts)
89-20556	RK EMR 1100–1500	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 1500 mm, 12 control contacts)
89-20621	RK EMR 1100–2600	For connection of EMR 1100 / EMR 1100 S with control terminal strip (length: 2600 mm, 12 control contacts)
89-20559	SS 12–6000	For connection of the 'basic unit' with the 'extension unit' (length: 6 m, 12 control contacts)
Mounting plates for control terminal strips, control transformers etc.		
34-80069	SB–C6	Cabinet width 600 mm
34-80053	SB–C8	Cabinet width 800 mm
Ventilation packages, consisting of:		
34-80096	LP–LSFC-I IP30-6/1	1 roof vent installation in cabinet, 1 air inlet filter and thermostat
34-80285	LP-LSFC-A IP43-7/1	1 roof vent installation on cabinet, 1 air inlet filter and thermostat
34-80187	LP-LSFC-A IP43-7/2	1 roof vent installation on cabinet, 2 air inlet filters and thermostat
Bus connection bracket set		
34-80006	CU AW–1	Bus connection bracket set for cable connection, complete with fixing screws and protection against accidental contact
34-80302	Final cover complete	Protection against accidental contact final cover (necessary for module packages without CU-AW1)

Further accessories on request

Selection of module rails for the most common switchgear systems

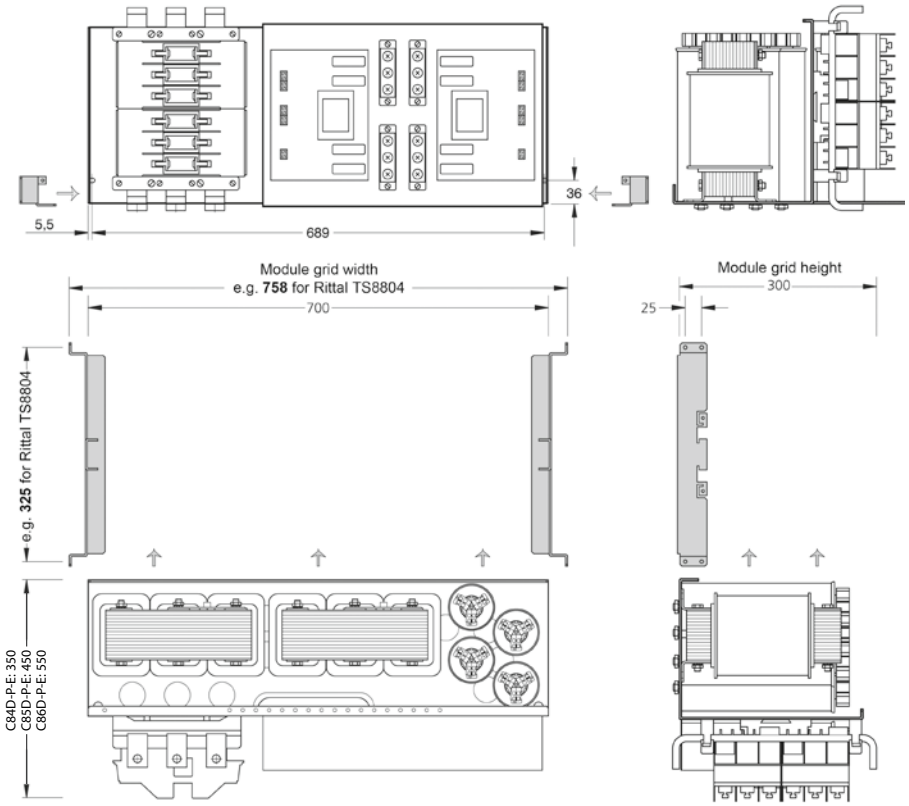
Article-No.	Manufacturer of cabinet	Cabinet type	Cabinet width [mm]	Cabinet depth [mm]
34-80051	ABB	MNS (with distribution busbars)	800	600
34-80176	ABB	MNS (without distribution busbars)	800	600
34-80128	ABB	RNS	800	600
34-80211	ABN	BST312	830	525
34-80133	AEG	EVS and SEN4000	800	400
34-80180	AEG	EVS and SEN4000	800	600
34-80071	CEGELEC	Intermas	800	500
34-80072	CEGELEC	Intermas	800	600
34-80179	DESSAUER	Dessa Norm	800	600
34-80201	DESSAUER	Dessa Norm	800	800

Article-No.	Manufacturer of cabinet	Cabinet type	Cabinet width [mm]	Cabinet depth [mm]
34-80039	EATON / MOELLER	IVS1600	800	400
34-80071	EATON / MOELLER	IVS1600	800	500
34-80072	EATON / MOELLER	IVS1600	800	600
34-80138	EATON / MOELLER	SVTL	800	400
34-80130	EATON / MOELLER	SVTL	800	600
34-80173	EATON / MOELLER	xEnergy (with distribution busbars)	800	600
34-80174	EATON / MOELLER	xEnergy (without distribution busbars)	800	600
34-80148	ELDON	MCS	800	400
34-80152	ELDON	MCS	800	500
34-80233	ELDON	MCS	800	600
34-80067	ELEK	UR / URV	800	400
34-80105	ELEK	UR / URV	800	600
34-80073	ELEK	UR / URV	800	800
34-80059	ELEK	UR / URV	850	400
34-80050	ELEK	UR / URV	850	600
34-80132	ELEK	UR / URV	850	800
34-80120	ELIN-EBG	ELIN-EBG SV	800	600
34-80120	ELIN-EBG	SVT	800	600
34-80172	ELSTEEL	Elsteel	800	600
34-80147	ELSTEEL	Elsteel	800	800
34-80238	ELSTEEL	Elsteel (with busbar space)	800	600
34-80040	FRAKO	LSFC	600/800	400
34-80041	FRAKO	LSFC	600/800	500
34-80042	FRAKO	LSFC	600/800	600
34-80253	GE	VPS STEEL	800	400
34-80181	HAGER	Hager FG22	600	600
34-80214	HAGER	Hager FG23	850	400
34-80055	HENSEL	SAS 2000 (frame assembly)	850	500
34-80168	HENSEL	SAS 2000 (M. Plate brackets reinforced assembly)	600	500
34-80190	HENSEL	SAS 2000 (M. Plate brackets reinforced assembly)	850	500
34-80154	ISA	ISA 2000	800	800
34-80119	LÖGSTRUP	Lögstrup	760	570
34-80077	LÖGSTRUP	Lögstrup	760	760
34-80227	LOHMEIER	RS	800	600
34-80228	LOHMEIER	RS	800	800
34-80198	MEHLER	ARM-C	800	400
34-80106	MEHLER	SRM-C	800	600
34-80097	MONA	MONA 5000	800	400
34-80098	MONA	MONA 5000	800	600
34-80245	MONA	MONA 5000	800	800
34-80047	RITTAL	ES4... / PS4…	600/800	400
34-80048	RITTAL	ES4... / PS4…	600/800	500
34-80049	RITTAL	ES4... / PS4…	600/800	600
34-80293	RITTAL	ES4... / PS4…	600/800	800
34-80040	RITTAL	TS8…	600/800	400

Article-No.	Manufacturer of cabinet	Cabinet type	Cabinet width [mm]	Cabinet depth [mm]
34-80041	RITTAL	TS8…	600/800	500
34-80042	RITTAL	TS8…	600/800	600
34-80137	RITTAL	TS8…	600/800	800
34-80134	SAREL	S6000	800	500
34-80237	SAREL	S6000	800	600
34-80291	SCHNEIDER	Prisma P	650	600
34-80284	SCHNEIDER	Prisma P (with busbar space)	800	600
34-80070	SIEMENS	Sivacon 8PT	800	600
34-80155	SIEMENS	Sivacon 8PT	800	800
34-80223	SIEMENS	Sivacon 8PT	850	600
34-80153	SIEMENS	Sivacon 8PT (with distribution busbars)	800	600
34-80255	SIEMENS	Sivacon S8 (Siemens S8- compensation section with busbar terminals on the rear side)	800	600
34-80252	SIEMENS	Sivacon S8 (normal section. FRAKO diassembling without busbar terminals on the rear side)	800	600
34-80076	STRIEBEL&JOHN	2/8XA4	600	400
34-80115	STRIEBEL&JOHN	2/8XA6	600	600
34-80104	STRIEBEL&JOHN	3/8XA4	850	400
34-80061	STRIEBEL&JOHN	3/8XA6	850	600
34-80222	STRIEBEL&JOHN	3/8XA8	850	800
34-80251	STRIEBEL&JOHN	Triline-R	614	425
34-80212	STRIEBEL&JOHN	Triline-R	614	625
34-80182	STRIEBEL&JOHN	Triline-R	864	425
34-80141	STRIEBEL&JOHN	Triline-R	864	625
34-80250	STRIEBEL&JOHN	Triline-R	864	825
34-80269	WEBER	MES	800	600
34-80178	WEBER	PM8	800	400
34-80129	WEBER	PM8	800	500
34-80218	WEBER	PM8	800	600

Other module rails on request

Dimensions



Dimensional drawing type C84D-P-E / C85D-P-E / C86D-P-E (25 to 100 kvar)
with module rails (here: MT-C8-Rittal TS8.804)

All dimensions in mm

Passive Filters

2

Passive Filter Systems in sheet steel cabinets

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LSFC-P4
Passive Filter Systems in sheet steel cabinets

Passive Filter Systems in sheet steel cabinets for low voltage networks heavily contaminated with harmonics but with a relatively low reactive power demand. Customized filter circuits with intelligent control systems are a reliable means of reducing current and voltage harmonics and offer an excellent cost-benefit ratio.

Passive Filter Systems for low voltage networks heavily contaminated with harmonics but needing relatively little reactive power.

- Power range up to 460 A_{rms} per cabinet unit
- Modular construction in freestanding sheet steel cabinet
- LKT power capacitors with dry design and fourfold safety features
- Highly linear filter reactors
- Tuning frequency (detuning factor) individually adjustable for specific network
- Control and self-monitoring system individually configurable via harmonic voltage and filter current, making measurement by external current transformer unnecessary
- Permanent network monitoring by continuous network analysis
- Complete system ready to install

The essential differences between a conventional Power Factor Correction System and a Passive Filter System:

Power Factor Correction System (detuning factor 7 % to 14 %):

- Installation where a large reactive power demand exists
  but
- Harmonic levels are ‘normal’
  (as per EN 50160 or EN 61000-2-4, Class 2)
- Stages switched in and out depending on power factor (cos φ)

Passive Filter System (adjusted detuning factor):

- Installation where harmonic levels are ‘high’
  (as per EN 61000-2-4, Class 3 or higher)
  but
- Reactive power demand is low
- Stages switched in and out depending on voltage and current harmonic levels

Passive Filters

Passive Filter System in sheet steel cabinets

Design and operating principle:

The power circuit of the Passive Filter System consists of power capacitors in series with highly linear filter reactors, the power rating and series resonant frequency of the individual filter circuit stages being carefully adjusted and monitored to suit the characteristics of the particular network.

The system includes the following components:

- Self-healing LKT-type power capacitors with low-loss dielectric – made from segmented metallised polypropylene film – overpressure disconnection, solder-free design and PCB-free filler material;
- LKT series with discharge resistors to EN 60831-1 and -2 / IEC 60831-1 and -2
- Heavy duty capacitor contactors with precharging contacts
- Highly linear filter reactors with thermal trip switch
- Fuse links, 3-pole, size NH00
- Control terminal strip with control circuit fuse and thermal trip contact
- EM-PQ 2300 Power Quality Analyzer as intelligent control unit
- Thermostat-controlled electric cooling fan or natural ventilation

The capacitor stages are switched in by the control unit according to appropriate voltage parameters, such as:

- The levels of individual harmonics or
- The THDv (geometric sum of all voltage harmonics)

The capacitor stages are switched out according to current parameters measured in the filter system, such as:

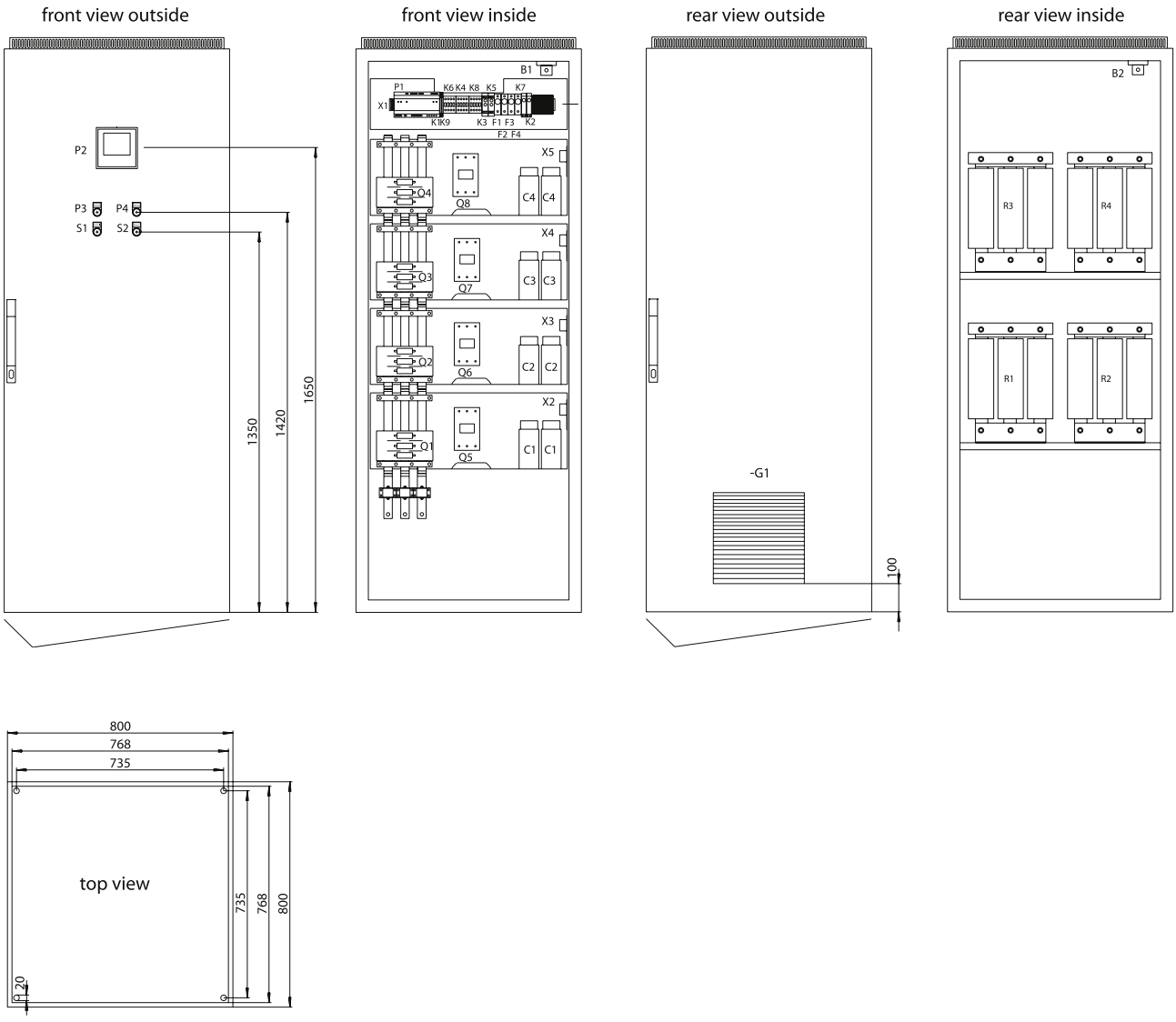
- The levels of individual harmonics or
- The THDi (geometric sum of all current harmonics)

The control unit is also able to monitor the network for compliance with the relevant power quality standards and send an alarm signal via an Ethernet interface if the monitored parameters go beyond set limits!

Options:

- Power capacitors with up to 909 V overvoltage capacity (continuous)
- Design with modules tuned for several different harmonics — with interlock circuit and monitoring for reliable operation of the complete system
- Compensation circuits for the identification and monitoring of unbalance
- Automatic resonance detuning
- Installation possible in a wide variety of cabinet systems

Dimensions



All dimensions in mm

Active Filters

OSFS, OSFD

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OSFS

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OSFD

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OSFS, OSFD
Active Filters

Active harmonics filter in freestanding or wall-mounting cabinet, for three-phase low voltage networks with a neutral conductor for the compensation of harmonic currents up to the 50th harmonic, the correction of reactive power at the fundamental frequency and for balancing loads.

A host of problems...

The quality of a power supply is reduced considerably by loads that generate harmonics. These can cause electronically controlled devices to fail, break down or exhibit “inexplicable malfunction”.

- Sporadic upsets and defects in electronic control systems and devices
- Sporadic tripping of circuit breakers for no apparent reason
- Cables - especially transformers and induction motors - get too hot
- Motor power drops
- Power factor correction systems are overloaded
- The neutral conductor is overloaded
- Flicker in the supply network
- Disrupting effects on the medium voltage network

THE solution

If the operation of loads causing serious harmonics problems calls for an improvement of the network quality, FRAKO Active Filters should be installed.

The harmful effects of harmonics from single loads, load groups or a complete electrical system can be mitigated down to an acceptable degree, if not removed totally from the network.

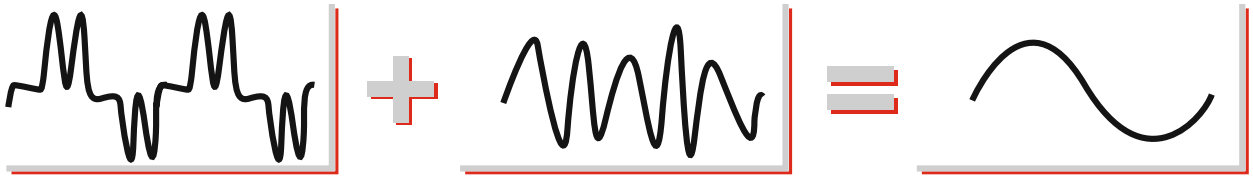
OSFS and OSFD Active Filters combine numerous advantages. They are top-of-the-range instruments hallmarked by extremely short reaction times and selective control up to the 50th harmonic, without current error or phase displacement. The degree of compensation and the control dynamics can be optimized to suit local conditions.

In addition to harmonics compensation, these filters are also suitable for extremely fast control of fundamental-frequency reactive power and for balancing asymmetrical loads. This also reduces the amount of flicker in the network.

Essential operating principle of Active Filters

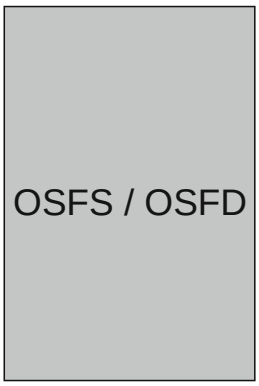
OSFS and OSFD Active Filters are operated in parallel with the loads that generate the harmonics.
The Active Filter analyses the harmonic current caused by nonlinear loads and supplies a compensating current in phase opposition, either over the entire spectrum or with only selected harmonics targeted. The harmonic currents are therefore completely neutralized at the point of connection.

The number, size and location in the circuit of Active Filters depend on the local harmonic spectrum and the specific duties.



Load current | Active Filter compensating current | The result

CNC machine tool



Active Filter

Transformator

	OSFS	OSFD
		
Web server	•	-
Remote control	•	-
Interfaces	Ethernet TCP/IP Ethernet (Modbus TCP)	Ethernet TCP/IP Modbus RTU RS-485
Resonance detection	•	•
3-wire units [A]	70, 100, 110, 120, 130, 150, 240, 300, 360, 450	30, 50, 100, 120, 200, 250, 300
4-wire units [A]	100	30, 60, 100, 120, 200, 250, 300
690 V (3-wire) units [A]	90, 140, 180, 270, 280, 420	-
UL certified (3-wire) units [A]	90, 110, 180, 220, 270, 330	200, 250, 300
Catalogue page	Page 179 ff.	Page 193 ff.

OSFS
Active Filters

OSFS – The highly dynamic Active Filter
OSFS units encompass a broad range of state-of-the-art Active Filters with a web server function. The product range is characterized in particular by its variety of options for high-power applications plus a large selection of 690 V units and a special filter.

The OSFS range

–F **Fixed-rating unit:**
For wall mounting

–FS **Fixed-rating unit:**
In freestanding cabinet

–M **Modular unit:**
In freestanding cabinet with up to 3 modules per cabinet

–W **Water cooling:**
Modular unit in freestanding cabinet, water-cooled

–V **Voltage-controlled:**
Voltage-controlled Active Filter

–3 **3-wire:**
For compensating three phases without a neutral conductor

-4 **4-wire:**
For compensating three phases and the neutral conductor

–UL UL certificate

The OSFS-V voltage-controlled Active Filter

The OSFS-V is an Active Filter that compensates for harmonics in the range 50 Hz–5 kHz (up to the 100th harmonic). It is the fastest dynamic Active Filter worldwide, and also features resonance detection and suppression. It operates either with current transformers or it can be operated voltage-regulated without current transformers. This greatly simplifies its installation in existing networks.

Characteristics:

- High-speed Active Filter (Response time <20 µs)
- Reduction of interharmonics
- 50 Hz - 5 kHz bandwidth
- Voltage and current compensation
- Advanced digital control
- Easy installation
- Insensitive to network conditions
- Harmonics elimination
- Resonance elimination
- Can compensate for harmonics without current transformers
- Cannot be overloaded
- Available for 380 V – 480 V

Technical Data

OSFS-F (3-wire fixed-rating unit), 400 V

Type	OSFS 70-400-3-F	OSFS 100-400-3-F	OSFS 130-400-3-F
Article-No.	39-22402	39-22400	39-22403
Power rating	59 kVA	84 kVA	109 kVA
Compensating current per phase at 50/60 Hz	70 A_{rms}	100 A_{rms}	130 A_{rms}
System voltage	400 V ± 10 %		
Nominal frequency	50/60 Hz ± 2 %		
Number of phases	3		
Phase connections	3 phases without neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 49th harmonic		
Degree of compensation	> 98 %		
Correction of power factor cos φ	Up to 1.0		
Parallel operation	OSFS-F Active Filters can be operated in parallel		
Response time	< 1 ms		
Power loss	< 1200 W	< 1800 W	< 2400 W
Maximum air flow requirements	600 m^3/h		
Noise level	< 70 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level		
Operating temperature	0 up to 40 °C, < 25 °C recommended		
Dimensions (W x H x D) [mm]	230 x 2 040 x 400		
Weight [kg]	120 kg		
Cabinet colour	RAL 7035, RAL 5017 (blue)		
Ingress protection	IP 20 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		
Interfaces	Web server, Ethernet (Modbus TCP)		

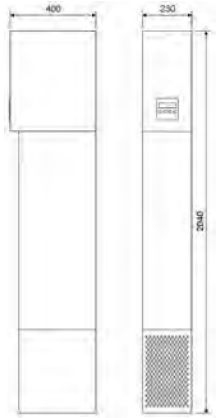
The units can be installed in parallel and are available as standard versions from 208 V to 480 V. Other voltages on request.

OSFS ordering example

Requirement: Active Harmonic Filter with a compensation current of I_h = 170 A.

- Parallel connection of the following OSFS Active Filters
  - OSFS 70-400-3-F
  - OSFS 100-400-3-F

Dimensions



All dimensions in mm

Technical Data

OSFS-F (4-wire fixed rating unit), 400 V

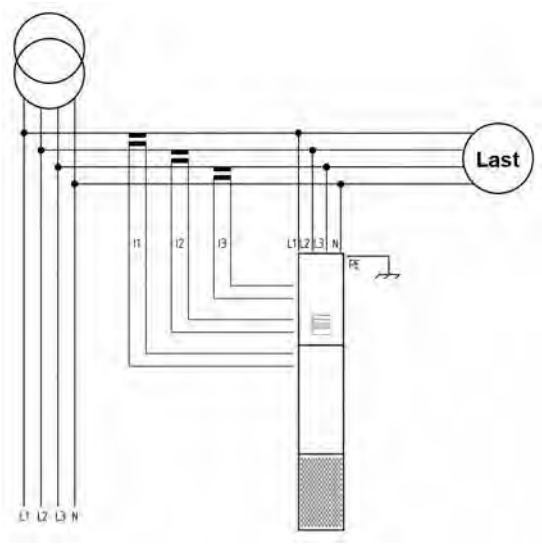
Type	OSFS 100-400-4-F
Article-No.	39-22429
Power Rating	70 kVA
Compensating current at 50/60 Hz	phase current 100 A_{rms} / neutral current 300 A_{rms}
System voltage*	400 V ± 10 %
Nominal frequency *	50/60 Hz ± 2 %
Number of phases	3
Phase connections	3 phases with neutral conductor (TN,TT,IT)
Harmonics compensation	individual compensation up to 49th order
Degree of compensation	> 98 %
Correction of power factor cos ϕ	Up to 1.0
Upgradeability	OSFS Active Filters can be operated in parallel
Response time	< 1 msec
Power loss	< 2235 W
Maximum air flow requirements	600 m³/h
Noise level	< 70 dB(A)
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level
Operating temperature	0 bis 50 °C, up to 40 °C without performance reduction
Dimensions (W x H x D) [mm]	230 x 2 040 x 470
Weight [kg]	160
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 5017 (blue)
Ingress protection	IP20 nach IEC 529
Environmental conditions	Class 3C2 (chemical), class 3S2 (mechanical)
Electromagnetic compatibility (EMV)	EN 61000-6-2, EN 61000-6-4
Certificates	CE
Interfaces	Web server, Ethernet (Modbus TCP)**

The units can be installed in parallel and are available as standard versions from 208 - 480 V. Other voltages on request.

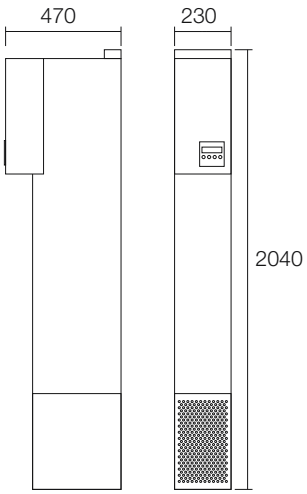
* When ordering, please indicate the mains voltage and the mains frequency.

** further interfaces on request.

Connection diagram (example)



Dimensions



All dimensions in mm

Technical Data

OSFS-FS (4-wire fixed rating unit), 400 V

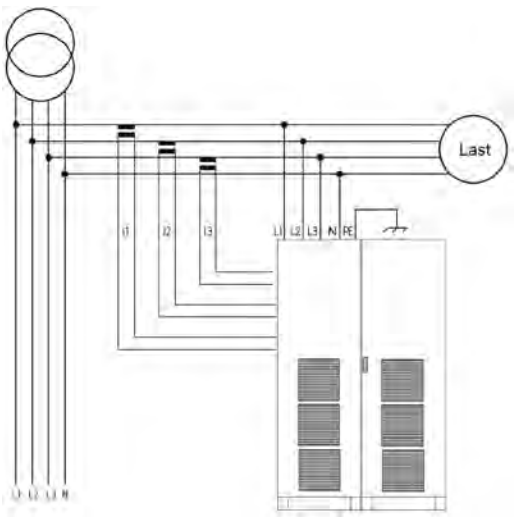
Type	OSFS 100-400-4-FS	OSFS 200-400-4-FS	OSFS 300-400-4-FS
Article-No.	39-22430	39-22431	39-22432
Power Rating	70 kVA	139 kVA	208 kVA
Compensating current at 50/60 Hz	phase current 100 A_{rms} / neutral current 300 A_{rms}	phase current 200 A_{rms} / neutral current 600 A_{rms}	phase current 300 A_{rms} / netural current 900 A_{rms}
System voltage*	400 V + 10 %		
Nominal frequency *	50/60 Hz + 2 %		
Number of phases	3		
Phase connections	3 phases with neutral conductor (TN,TT,IT)		
Harmonics compensation	individual compensation up to 49th order		
Degree of compensation	> 98 %		
Correction of power factor cos ϕ	Up to 1.0		
Upgradeability	OSFS Active Filters can be operated in parallel		
Response time	< 1 msec		
Power loss	< 2235 W	< 4470 W	< 6800 W
Maximum air flow requirements	600 m³/h	1200 m³/h	1800 m³/h
Noise level	< 70 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level		
Operating temperature	0 up to 50 °C, up to 40 °C without performance reduction	0 up to 40 °C, < 25 °C recommended	0 up to 40 °C, < 25 °C recommended
Dimensions (W x H x D) [mm]	1200 x 2000 x 610		
Weight [kg]	360	525	690
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)		
Ingress protection	IP20 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMV)	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		
Interfaces	Web server, Ethernet (Modbus TCP)**		

The units can be installed in parallel and are available as standard versions from 208 - 480 V. Other voltages on request.

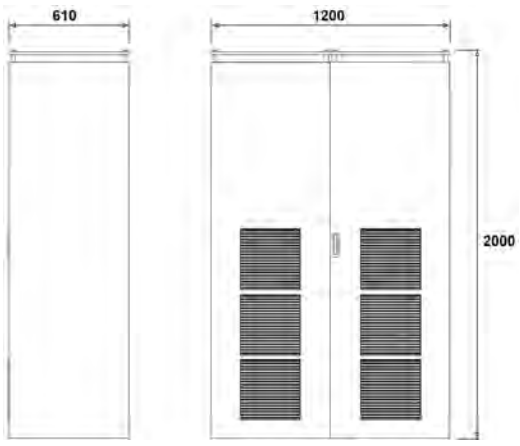
* When ordering, please indicate the mains voltage and the mains frequency.

** further interfaces on request.

Connection diagram (example)



Dimensions



All dimensions in mm

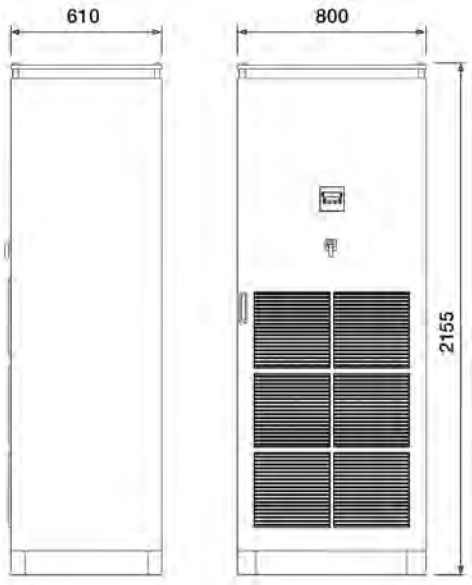
Technical Data

OSFS-M (3-wire modular unit), 400 V

Type	OSFS 120-400-3-M	OSFS 240-400-3-M	OSFS 360-400-3-M
Article-No.	39-22405	39-22401	39-22406
Power rating	83 kVA	166 kVA	249 kVA
Compensating current per phase at 50/60 Hz	120 A_{rms}	240 A_{rms}	360 A_{rms}
System voltage	400 V ± 10 %		
Nominal frequency	50/60 Hz ± 2 %		
Number of phases	3		
Phase connections	3 phases without neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 49th harmonic		
Degree of compensation	> 98 %		
Correction of power factor cos φ	Up to 1.0		
Parallel operation	OSFS-M Active Filters can be operated in parallel		
Response time	< 1 ms		
Power loss	< 2725 W	< 5325 W	< 7925 W
Maximum air flow requirements	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level		
Operating temperature	0 up to 40 °C, < 25 °C recommended		
Dimensions (W x H x D) [mm]	800 x 2155 x 610		
Weight [kg]	335 kg	472 kg	609 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)		
Ingress protection	IP 20 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		
Interfaces	Web server, Ethernet (Modbus TCP)		

The units can be installed in parallel and are available as standard versions from 208 V to 480 V. Other voltages on request.

Dimensions



All dimensions in mm

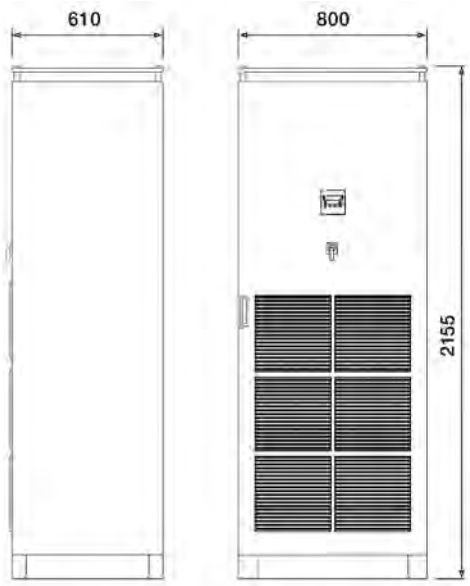
Technical Data

OSFS-M (3-wire modular unit), 690 V

Type	OSFS 90-690-3-M	OSFS 180-690-3-M	OSFS 270-690-3-M
Article-No.	39-22410	39-22411	39-22412
Power rating	108 kVA	215 kVA	323 kVA
Compensating current per phase at 50/60 Hz	90 A_{rms}	180 A_{rms}	270 A_{rms}
System voltage	690 V ± 10 %		
Nominal frequency	50/60 Hz ± 2 %		
Number of phases	3		
Phase connections	3 phases without neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 49th harmonic		
Degree of compensation	> 98 %		
Correction of power factor cos φ	Up to 1.0		
Parallel operation	OSFS-M Active Filters can be operated in parallel		
Response time	< 1 ms		
Power loss	< 2969 W	< 5813 W	< 8657 W
Maximum air flow requirements	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level		
Operating temperature	0 up to 40 °C, < 25 °C recommended		
Dimensions (W x H x D) [mm]	800 x 2155 x 610		
Weight [kg]	351 kg	495 kg	639 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)		
Ingress protection	IP 20 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		
Interfaces	Web server, Ethernet (Modbus TCP)		

The units can be installed in parallel and are available as standard versions from 480 V to 690 V. Other voltages on request.

Dimensions



All dimensions in mm

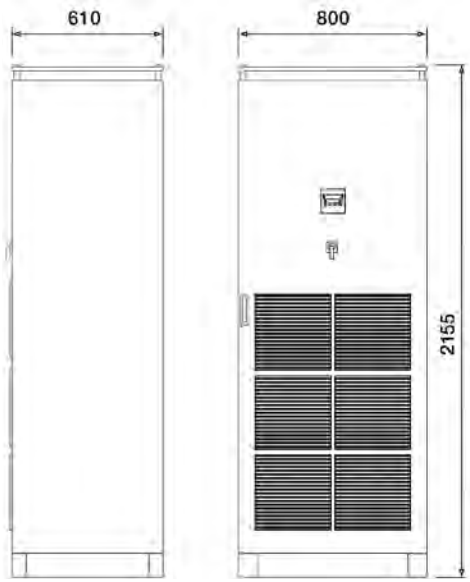
Technical Data

OSFS-4-M (4-wire modular unit), 400 V

Type	OSFS 100-400-4-M
Article-No.	39-22416
Power rating	70 kVA
Compensating current per phase at 50/60 Hz	100 A_{rms}
Compensating current in neutral at 50/60 Hz	300 A_{rms}
System voltage	400 V ± 10 %
Nominal frequency	50/60 Hz ± 2 %
Number of phases	3
Phase connections	3 phases with neutral conductor (TN, TT, IT)
Harmonics compensation	Individually up to the 49th harmonic, 19th order in the neutral conductor
Degree of compensation	> 98 %
Correction of power factor cos φ	Up to 1.0
Parallel operation	OSFS-4-M Active Filters can be operated in parallel
Response time	< 1 ms
Power loss	< 3800 W
Maximum air flow requirements	1200 m^3/h
Noise level	< 60 dB
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level
Operating temperature	0 up to 40 °C, < 25 °C recommended
Dimensions (W x H x D) [mm]	800 x 2155 x 610
Weight [kg]	430 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)
Ingress protection	IP 20 according to IEC 529
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4
Certificates	CE
Interfaces	Web server, Ethernet (Modbus TCP)

The units can be installed in parallel and are available as standard versions from 208 V to 480 V. Other voltages on request.

Dimensions



All dimensions in mm

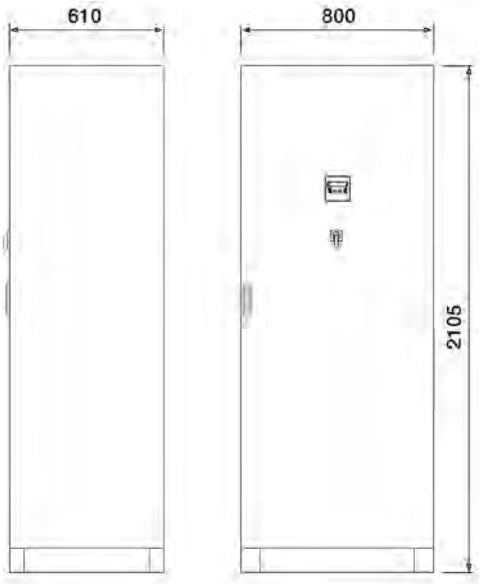
Technical Data

OSFS-W (3-wire modular unit, water-cooled), 400 V

Type	OSFS 150-400-3-W	OSFS 300-400-3-W	OSFS 450-400-3-W
Article-No.	39-22407	39-22408	39-22409
Power rating	104 kVA	208 kVA	312 kVA
Compensating current per phase at 50/60 Hz	150 A_{rms}	300 A_{rms}	450 A_{rms}
System voltage	400 V ± 10 %		
Nominal frequency	50/60 Hz ± 2 %		
Number of phases	3		
Phase connections	3 phases without neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 49th harmonic		
Degree of compensation	> 98 %		
Correction of power factor cos φ	Up to 1.0		
Parallel operation	OSFS-W Active Filters can be operated in parallel		
Response time	< 1 ms		
Power loss	< 2550 W	< 5100 W	< 7650 W
Required cooling water supply	ΔP = 66 kPa at 21 l/min		
Noise level	< 60 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing		
Operating temperature	0 up to 50 °C ambient and max. 38°C water temperature		
Dimensions (W x H x D) [mm]	800 x 2105 x 610		
Weight [kg]	367 kg	500 kg	633 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)		
Ingress protection	IP 54 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		
Interfaces	Web server, Ethernet (Modbus TCP)		

The units can be installed in parallel and are available as standard versions from 208 V to 480 V. Other voltages on request.

Dimensions



All dimensions in mm

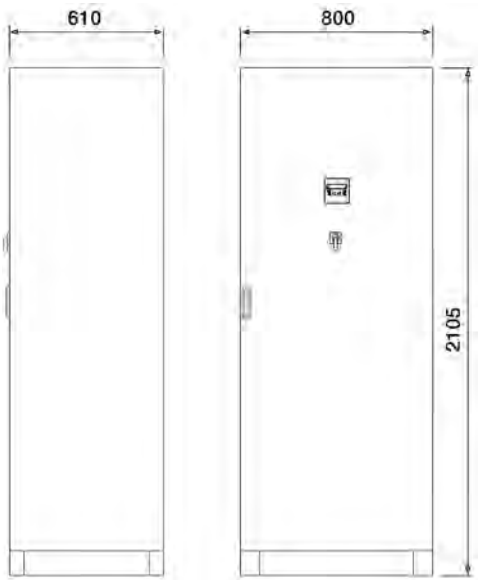
Technical Data

OSFS-W (3-wire modular unit, water-cooled), 690 V

Type	OSFS 140-690-3-W	OSFS 280-690-3-W	OSFS 420-690-3-W
Article-No.	39-22413	39-22414	39-22415
Power rating	168 kVA	335 kVA	312 kVA
Compensating current per phase at 50/60 Hz	140 A_{rms}	280 A_{rms}	450 A_{rms}
System voltage	690 V ± 10 %		
Nominal frequency	50/60 Hz ± 2 %		
Number of phases	3		
Phase connections	3 phases without neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 49th harmonic		
Degree of compensation	> 98 %		
Correction of power factor cos φ	Up to 1.0		
Parallel operation	OSFS-W Active Filters can be operated in parallel		
Response time	< 1 ms		
Power loss	< 3600 W	< 7200 W	< 10800 W
Required cooling water supply	ΔP = 66 kPa at 21 l/min		
Noise level	< 60 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing		
Operating temperature	0 up to 50 °C ambient and max. 38°C water temperature		
Dimensions (W x H x D) [mm]	800 x 2105 x 610		
Weight [kg]	372 kg	510 kg	648 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)		
Ingress protection	IP 54 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		
Interfaces	Web server, Ethernet (Modbus TCP)		

The units can be installed in parallel and are available as standard versions from 480 V to 690 V. Other voltages on request.

Dimensions



All dimensions in mm

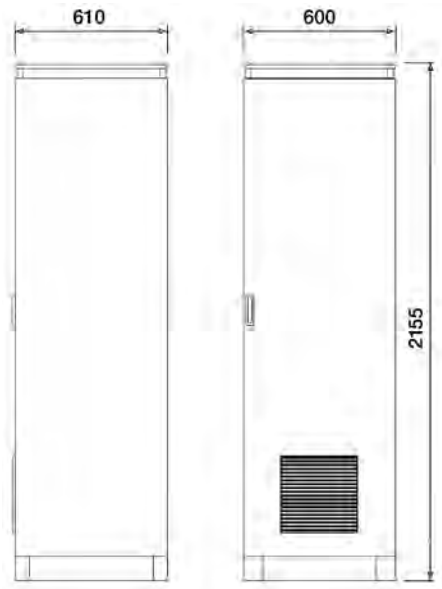
Technical Data

OSFS-V (3-wire unit, voltage-controlled), 400 V

Type	OSFS 100-400-3-V
Article-No.	39-22404
Power rating	70 kVA
Compensating current per phase at 50/60 Hz	100 A_{rms}
System voltage	400 V ± 10 %
Nominal frequency	50/60 Hz ± 2 %
Number of phases	3
Phase connections	3 phases without neutral conductor (TN, TT, IT)
Harmonics compensation	Compensation curve for harmonics and interharmonics up to 5 kHz (100th order)
Degree of compensation	> 97 %
Correction of power factor cos φ	Up to 1.0
Parallel operation	OSFS-V Active Filters can be operated in parallel
Response time	< 20 µs
Power loss	< 1200 W
Maximum air flow requirements	600 m^3/h
Noise level	< 60 dB
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level
Operating temperature	0 up to 40 °C, < 25 °C recommended
Dimensions (W x H x D) [mm]	800 x 2155 x 610
Weight [kg]	232 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)
Ingress protection	IP 20 according to IEC 529
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4
Certificates	CE
Interfaces	Web server, Ethernet (Modbus TCP)

The units can be installed in parallel and are available as standard versions from 380 V to 480 V. Other voltages on request.

Dimensions



All dimensions in mm

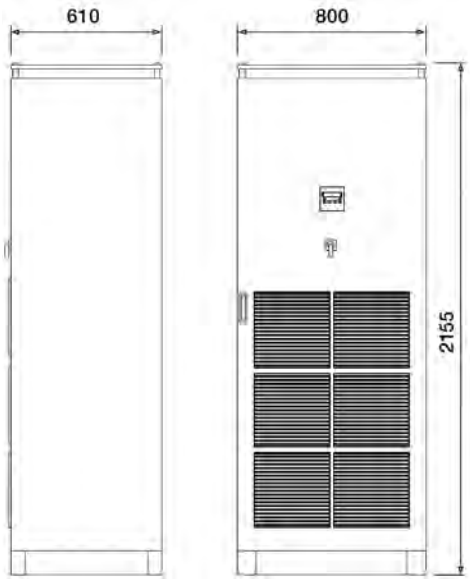
Technical Data

OSFS-UL (3-wire modular device, UL), 480 V

Type	OSFS 110-480-3-UL	OSFS 220-480-3-UL	OSFS 330-480-3-UL
Article-No.	39-22423	39-22424	39-22425
Power rating	76 kVA	152 kVA	229 kVA
Compensating current per phase at 50/60 Hz	110 A_{rms}	220 A_{rms}	330 A_{rms}
System voltage	400 V ± 10 %		
Nominal frequency	50/60 Hz ± 2 %		
Number of phases	3		
Phase connections	3 phases without neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 49th harmonic		
Degree of compensation	> 98 %		
Correction of power factor cos φ	Up to 1.0		
Parallel operation	OSFS-UL Active Filters can be operated in parallel		
Response time	< 1 ms		
Power loss	< 2480 W	< 4835 W	< 7190 W
Maximum air flow requirements	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level		
Operating temperature	0 up to 40 °C, < 25 °C recommended		
Dimensions (W x H x D) [mm]	800 x 2155 x 610		
Weight [kg]	335 kg	472 kg	609 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)		
Ingress protection	IP 20 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4		
Certificates	UL, cUL		
Interfaces	Web server, Ethernet (Modbus TCP)		

The units can be installed in parallel and are available as standard versions from 208 V to 480 V. Other voltages on request.

Dimensions



All dimensions in mm

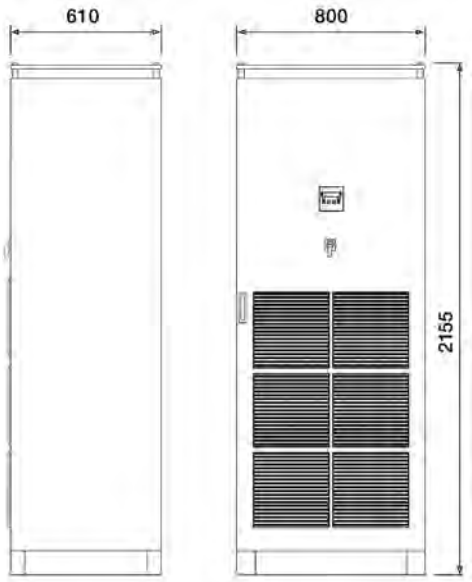
Technical Data

OSFS-UL (3-wire modular device, UL), 600 V

Type	OSFS 90-600-3-UL	OSFS 180-600-3-UL	OSFS 270-600-3-UL
Article-No.	39-22426	39-22427	39-22428
Power rating	94 kVA	187 kVA	281 kVA
Compensating current per phase at 50/60 Hz	90 A_{rms}	180 A_{rms}	270 A_{rms}
System voltage	600 V ± 10 %		
Nominal frequency	50/60 Hz ± 2 %		
Number of phases	3		
Phase connections	3 phases without neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 49th harmonic		
Degree of compensation	> 98 %		
Correction of power factor cos φ	Up to 1.0		
Parallel operation	OSFS-UL Active Filters can be operated in parallel		
Response time	< 1 ms		
Power loss	< 2836 W	< 5547 W	< 8258 W
Maximum air flow requirements	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dB		
Ambient conditions	0 up to 95 % relative humidity, non-condensing, max. altitude: 1000 m above sea level		
Operating temperature	0 up to 40 °C, < 25 °C recommended		
Dimensions (W x H x D) [mm]	800 x 2155 x 610		
Weight [kg]	351 kg	495 kg	639 kg
Cabinet colour	Cabinet: RAL 7035 (grey), Base: RAL 7022 (dark grey)		
Ingress protection	IP 20 according to IEC 529		
Environmental conditions	Class 3C3 (chemical), class 3S3 (mechanical)		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4		
Certificates	UL, cUL		
Interfaces	Web server, Ethernet (Modbus TCP)		

The units can be installed in parallel and are available as standard versions from 480 V to 600 V. Other voltages on request.

Dimensions



All dimensions in mm

OSFD
Active Filters

OSFD – The compact Active Filter, particularly suitable for low-power applications, with a variety of options and a large selection of 4-wire units.

Technical Data

OSFD (3-wire compact unit), 400 V

Type	OSFD 30-480-3	OSFD 50-480-3	OSFD 100-480-3	OSFD 120-480-3
Article-No.	39-22205	39-22200	39-22201	39-22215
Power rating	25 kVA	35 kVA	70 kVA	83 kVA
Compensating current per phase at 50/60 Hz	30 A_{rms}	50 A_{rms}	100 A_{rms}	120 A_{rms}
Rated voltage	380 V (AC) ± 15 % … 480 V (AC) ± 10 %			
Supply frequency	50/60 Hz ± 3 %			
Number of phases	3-wire and PE			
Phase connections	3 phases without neutral conductor (TN, TT, IT)			
Harmonics compensation	Individually up to the 50th order			
Switching frequency	16 kHz			
Max. current	Limited to nominal current			
Current transformer	50 : 5 up to 50.000 : 5			
Parallel operation	Up to 5 OSFD Active Filters			
Response time	300 µs			
Controller topology	Digital with FFT analysis			
Power loss	< 900 W	< 1300 W	< 2200 W	< 2500 W
Cooling air required	< 350 m^3/h	< 550 m^3/h	< 1400 m^3/h	< 1400 m^3/h
Noise level (1 m)	65 dB(A)		68 dB(A)	
Ambient conditions as per EN 50178	Pollution degree: 2; Relative humidity < 95 %; Climatic conditions in operation class 3K3; non-condensing, Temperature: Storage -25 °C up to +55 °C, 1K3, 1K4 – Transportation -25 °C up to +70 °C, 2K3			
Operating temperature	0 up to 40 °C[1]			0 up to 30 °C[2]
Dimensions (W x H x D) [mm]	358 x 615 x 288	358 x 615 x 288	469 x 972 x 412	469 x 972 x 412
Weight [kg]	47 kg	47 kg	105 kg	105 kg
Ingress protection	Standard IP 20, optional IP 54			
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4, EN 61800-3 (C2)			
Certificates	CE			
Interfaces	Modbus RTU (RS-485), Modbus TCP/IP (Ethernet), digital input for remote switching, digital alarm output, digital ON/OFF signal, digital derated capacity signal			

[1] from 40 °C to 55 °C derated by 2 % / K, no derating from 30 °C to 40 °C

[2] from 30 °C derated by 1.2 % / K

Technical Data

OSFD (3-wire industrial unit, water-cooled), 400 V

Type	OSFD 200-415-3	OSFD 250-415-3	OSFD 300-415-3	OSFD 200-415-3-UL	OSFD 250-415-3-UL	OSFD 300-415-3-UL
Article-No.	39-22206	39-22208	39-22203	39-22212	39-22213	39-22214
Power rating	139 kVA	173 kVA	208 kVA	139 kVA	173 kVA	208 kVA
Compensating current per phase at 50/60 Hz	200 A_{rms}	250 A_{rms}	300 A_{rms}	200 A_{rms}	250 A_{rms}	300 A_{rms}
Rated voltage	50Hz: 380 V (AC) ± 15 % … 415 V (AC) ± 10 %, 60Hz: 480 V (AC) ± 10 %					
Supply frequency	50/60 Hz ± 3 %					
Number of phases	3-wire and PE					
Phase connections	3 phases without neutral conductor (TN, TT, IT)					
Harmonics compensation	Individually up to the 50th order					
Switching frequency	16 kHz					
Max. current	Limited to nominal current					
Current transformer	50 : 5 up to 50.000 : 5					
Parallel operation	Up to 5 OSFD Active Filters					
Response time	300 µs					
Controller topology	Digital with FFT analysis					
Power loss	< 5000 W	< 6000 W	< 7500 W	< 5000 W	< 6000 W	< 7500 W
Cooling air required	< 2600 m^3/h	< 3100 m^3/h	< 3400 m^3/h	< 2600 m^3/h	< 3100 m^3/h	< 3400 m^3/h
Noise level (1 m)	70 dB(A)					
Ambient conditions as per EN 50178	Pollution degree: 2; Relative humidity < 95 %; Climatic conditions in operation class 3K3; non-condensing, Temperature: Storage -25 °C up to +55 °C, 1K3, 1K4 – Transportation -25 °C up to +70 °C, 2K3					
Operating temperature	0 up to 40 °C[1)]					
Dimensions (W x H x D) [mm]	808 x 2105 x 760					
Weight [kg]	440 kg					
Ingress protection	IP 54					
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4, EN 61800-3 (C2)					
Certificates	CE			UL		
Interfaces	Modbus RTU (RS-485), Modbus TCP/IP (Ethernet), digital input for remote switching, digital alarm output, digital ON/OFF signal, digital derated capacity signal					

[1)] from 40 °C to 55 °C derated by 2 % / K, no derating from 30 °C to 40 °C

Technical Data

OSFD (4-wire compact unit), 400 V

Type	OSFD 30-415-4	OSFD 60-415-4	OSFD 100-415-4	OSFD 120-415-4
Article-No.	39-22210	39-22211	39-22202	39-22216
Power rating	25 kVA	42 kVA	70 kVA	83 kVA
Compensating current per phase at 50/60 Hz	30 A_{rms}	60 A_{rms}	100 A_{rms}	120 A_{rms}
Compensating current in neutral conductor	90 A	180 A	300 A	300 A
Rated voltage	380 V (AC) ± 15 % … 480 V (AC) ± 10 %			
Supply frequency	50/60 Hz ± 3 %			
Number of phases	3-wire, neutral conductor and PE			
Phase connections	3 phases with neutral conductor (TN, TT, IT)			
Harmonics compensation	Individually up to the 50th order			
Switching frequency	16 kHz			
Max. current	Limited to nominal current			
Current transformer	50 : 5 up to 50.000 : 5			
Parallel operation	Up to 5 OSFD Active Filters			
Response time	300 µs			
Controller topology	Digital with FFT analysis			
Power loss	< 950 W	< 1800 W	< 3000 W	
Cooling air required	< 400 m^3/h	< 600 m^3/h	< 1700 m^3/h	
Noise level (1 m)	63 dB(A)		69 dB(A)	
Ambient conditions as per EN 50178	Pollution degree: 2; Relative humidity < 95 %; Climatic conditions in operation class 3K3; non-condensing, Temperature: Storage -25 °C up to +55 °C, 1K3, 1K4 – Transportation -25 °C up to +70°C, 2K3			
Operating temperature	0 up to 40 °C[1]	0 up to 30 °C[2]	0 up to 40 °C[1]	0 up to 30 °C[2]
Dimensions (W x H x D) [mm]	415 x 842 x 296		469 x 1460 x 412	
Weight [kg]	70 kg		145 kg	
Ingress protection	Standard IP 20, optional IP 54			
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4, EN 61800-3 (C2)			
Certificates	CE			
Interfaces	Modbus RTU (RS-485), Modbus TCP/IP (Ethernet), digital input for remote switching, digital alarm output, digital ON/OFF signal, digital derated capacity signal			

[1] from 40 °C to 55 °C derated by 2 % / K, no derating from 30 °C to 40 °C

[2] from 30 °C derated by 1.2 % / K

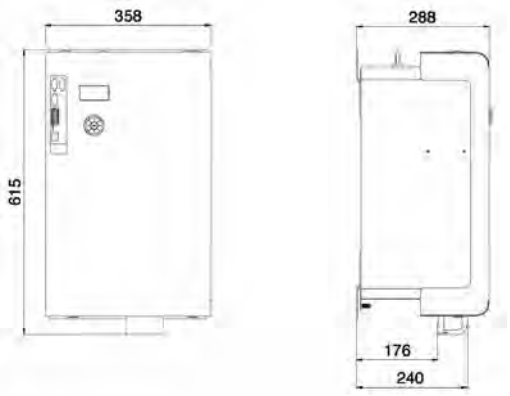
Technical Data

OSFD (4-wire industrial unit, water-cooled), 400 V

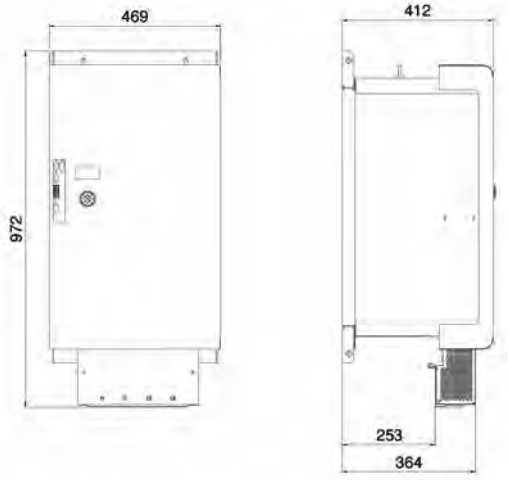
Type	OSFD 200-415-4	OSFD 250-415-4	OSFD 300-415-4
Article-No.	39-22207	39-22209	39-22204
Power rating	139 kVA	173 kVA	208 kVA
Compensating current per phase at 50/60 Hz	200 A_{rms}	250 A_{rms}	300 A_{rms}
Compensating current in neutral conductor	600 A	750 A	
Rated voltage	50Hz: 380 V (AC) ± 15 % … 415 V (AC) ± 10 %, 60 Hz: 480 V (AC) ± 10 %		
Supply frequency	50/60 Hz ± 3 %		
Number of phases	3-wire, neutral conductor and PE		
Phase connections	3 phases with neutral conductor (TN, TT, IT)		
Harmonics compensation	Individually up to the 50th order		
Switching frequency	16 kHz		
Max. current	Limited to nominal current		
Current transformer	50 : 5 up to 50.000 : 5		
Parallel operation	Up to 5 OSFD Active Filters		
Response time	300 µs		
Controller topology	Digital with FFT analysis		
Power loss	< 5500 W	< 6300 W	< 8500 W
Cooling air required	< 2800 m^3/h	< 3300 m^3/h	< 3600 m^3/h
Noise level (1 m)	70 dB(A)		
Ambient conditions as per EN 50178	Pollution degree: 2, Relative humidity < 95 %; Climatic conditions in operation class 3K3; non-condensing, Temperature: Storage -25 °C up to +55 °C, 1K3, 1K4 – Transportation -25 °C up to +70 °C, 2K3		
Operating temperature	0 up to 40 °C[1)]		
Dimensions (W x H x D) [mm]	808 x 2105 x 760	808 x 2105 x 760	808 x 2105 x 760
Weight [kg]	525 kg		
Ingress protection	IP 54		
Electromagnetic compatibility (EMC)	EN 61000-6-2, EN 61000-6-4, EN 61800-3 (C2)		
Certificates	CE		
Interfaces	Modbus RTU (RS-485), Modbus TCP/IP (Ethernet), digital input for remote switching, digital alarm output, digital ON/OFF signal, digital derated capacity signal		

[1)] from 40 °C to 55 °C derated by 2 % / K

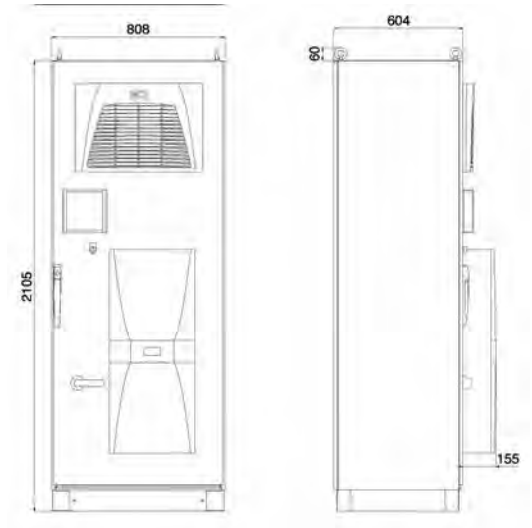
Dimensions



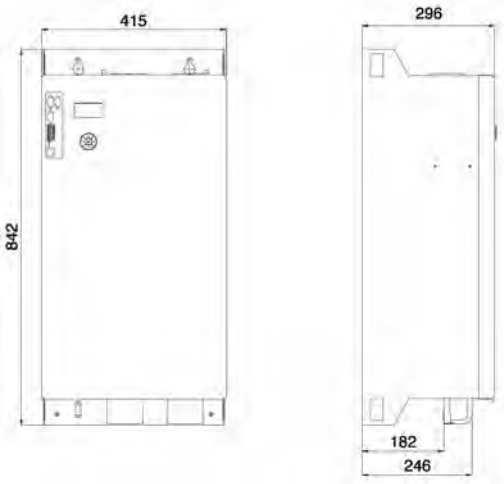
Dimensional drawing OSFD 30-480-3, OSFD 50-480-3



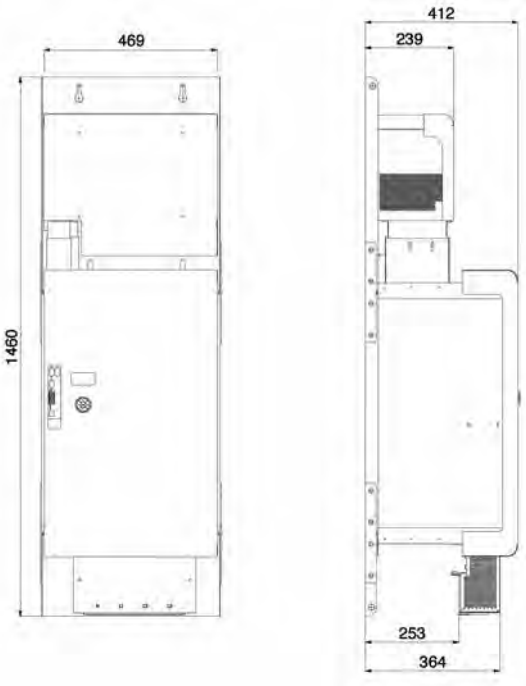
Dimensional drawing OSFD 100-480-3, OSFD 120-480-3



Dimensional drawing:
OSFD 200-415-3, OSFD 250-415-3, OSFD 300-415-3,
OSFD 200-415-3-UL, OSFD 250-415-3-UL, OSFD 300-415-3-UL,
OSFD 200-415-4, OSFD 250-415-4, OSFD 300-415-4



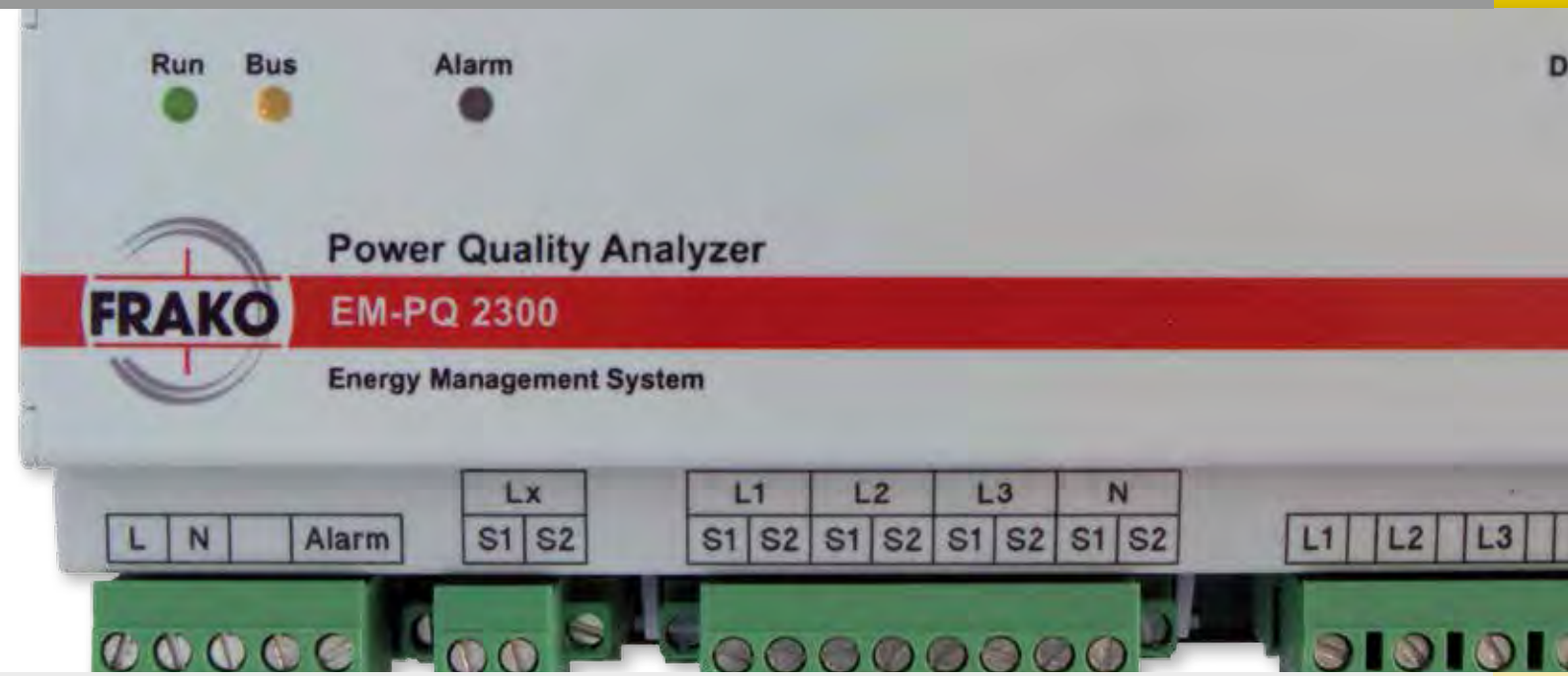
Dimensional drawing OSFD 30-415-4, OSFD 60-415-4



Dimensional drawing OSFD 100-415-4, OSFD 120-415-4

All dimensions in mm

Mains Monitoring



Mains Analysis Devices for DIN rail mounting

The power quality of the electrical supply networks plays an increasingly important role for the operational safety of electrical installations and equipment. Therefore it becomes more and more important to take appropriate measures to monitor the power quality.

In contrast to the past it is obvious that it is not sufficient to do a single measurement and then disregard the mains quality if the measurement showed unproblematic values.

Due to complex production processes, changing load conditions and a steady progress in the degree of automation it became important to permanently monitor the quality of electrical power supply.

Thus one can acquire energy know-how and define critical values for measurement variables such as voltage, current and harmonics.

Automatic alarms via different information channels such as e-mail, SMS, warning lights, etc. allow the control of compliance with the now specified critical values.

Of course, critical values predefined by standards and regulations can also be signalled via these channels.

FRAKO Mains Monitoring devices can handle all these operations.

Depending on type and version this can be achieved already by a single device or – even better - in combination with the FRAKO Energy Management System.

Monitoring of transformers, measurements at low voltage distribution boards as well as monitoring of individual machines and consumers …. FRAKO has the solution for every application.

	EM-PQ 2300	EM-PQ 2200	EM-PQ 2100	EM-PQ 1500 M
				
Voltage	90-267 V AC or 100-360 V DC	95-240 V AC; 135-340 V DC ± 10 %	95-240 V AC; 135-340 V DC ± 10 %	withdrawn from mains voltage
Frequency	45...65 Hz	45/65 Hz	45/65 Hz	50 Hz
Power consumption	Max. 8 W	Max. 9 VA	Max. 9 VA	Max. 7 VA
Contact temination 3/4/5-wire	• / • / •	• / • / -	• / • / -	• / • / -
Current measurements	5 x X/5A	4 x X/1A, X/5A	4 x X/1A, X/5A	3 x X/5A (error current > 6 mA), galvanically isolated
Voltage measurements	400/600 V AC (L-N/L-L) 3-phases 5-wire system	277/480 V AC (L-N/L-L) 3-phases 4-wire system 480 V AC (L-L) 3-phases 3-wire system	277/480 V AC (L-N/L-L) 3-phases 4-wire system 480 V AC (L-L) 3-phases 3-wire system	3 x 57-230 V AC ± 10 % (external/neutral conductor) 3 x 100-400 V AC ± 10 % (external/external conductor)
Harmonics V/A	1-51	1-63	1-40	-
Short term interruptions	•	•	•	-
Active energy class	1	0.5 (.../5A); 1 (.../1A)	0.5 (.../5A); 1 (.../1A)	1
Analogue In-/Outputs	- / 2 (0-10 V or 0-20 mA or 4-20 mA)	1 temperature / -	1 temperature / -	- / 1 (max. 30 V DC, 100 mA), (4-20 mA DC passive)
Digital In-/Outputs	4 / 2	2 / 2	2 / 2	- / 1 (max. 48 V DC, 100 mA); 1 (max. 30 V DC, 100 mA)
Memory Min./Max. values	•	•	•	•
Memory size	256 MB	128 MB	128 MB	-
Interfaces				
Ethernet	•	•	•	-
FRAKO Energy Management System	• via FRAKO Starkstrombus® Intranet (Ethernet) Modbus/TCP	• Connection via - Modbus RTU (RS-485) or - Modbus TCP (Ethernet)	• Connection via - Modbus RTU (RS-485) or - Modbus TCP (Ethernet)	• via FRAKO Starkstrombus®
RS-232 / RS-485	- / •	• / •	• / •	- / -
Profibus DP	-	•	-	-
Webserver / E-Mail / SNMP	• / • / •	• / •	• / •	- / -
Recommended applications	Transformer monitoring with PE measurement	Transformer monitoring	Machine disposals	Machine disposals
Catalogue Page	Page 203 ff.	Page 209 ff.	Page 213 ff.	Page 217 ff.

EM-PQ 2300
Power Quality Analyzer

The power quality of electrical supply networks is of ever increasing importance for the operational reliability of electrical installations and appliances. It is therefore becoming increasingly essential to take appropriate measures to monitor supply network power quality.

The approach used in the past, i.e. simply taking some measurements and then disregarding the power quality issue if these did not appear unusual, is no longer sufficient.

Highly complex manufacturing processes and new power demand profiles, together with ever more sophisticated automation systems, make it today more important than ever to monitor the quality of the power supply on a continuous basis.

This allows the user to accumulate 'energy expertise' and specify sensible alarm settings for parameters such as voltage, current and harmonics.

An automatic alarm function using various means of communication, such as e-mails or alarm annunciators, makes it easier to keep these parameters under control within their specified limits.

The limiting values called for by electrical standards and regulations can, of course, also be monitored in this way.

FRAKO power quality analysis instruments can do all of these things. Depending on instrument type and specifications, these functions can be performed by a single device alone or in combination with a FRAKO Energy Management System.

Whether the duty is to manage a transformer, take measurements at a low voltage main or secondary distribution board, or monitor individual electrical machines or loads, FRAKO has the right instrument for every application.

Description
Power supply monitoring instrument for the acquisition, monitoring and analysis of electrical data in networks up to 690 V (phase/phase optional with article No. 20-30243), with 5 current transformer inputs and 4 voltage inputs.

Permanent and simultaneous monitoring of up to 250 measurement points. The instrument offers more than 600 measurement points to be selected from. Its power failure detection function enables a supply failure of up to one second to be buffered, so that those short dips of particular interest can also be recorded by the EM-PQ 2300 even if the instrument's own power supply is disrupted by this event.

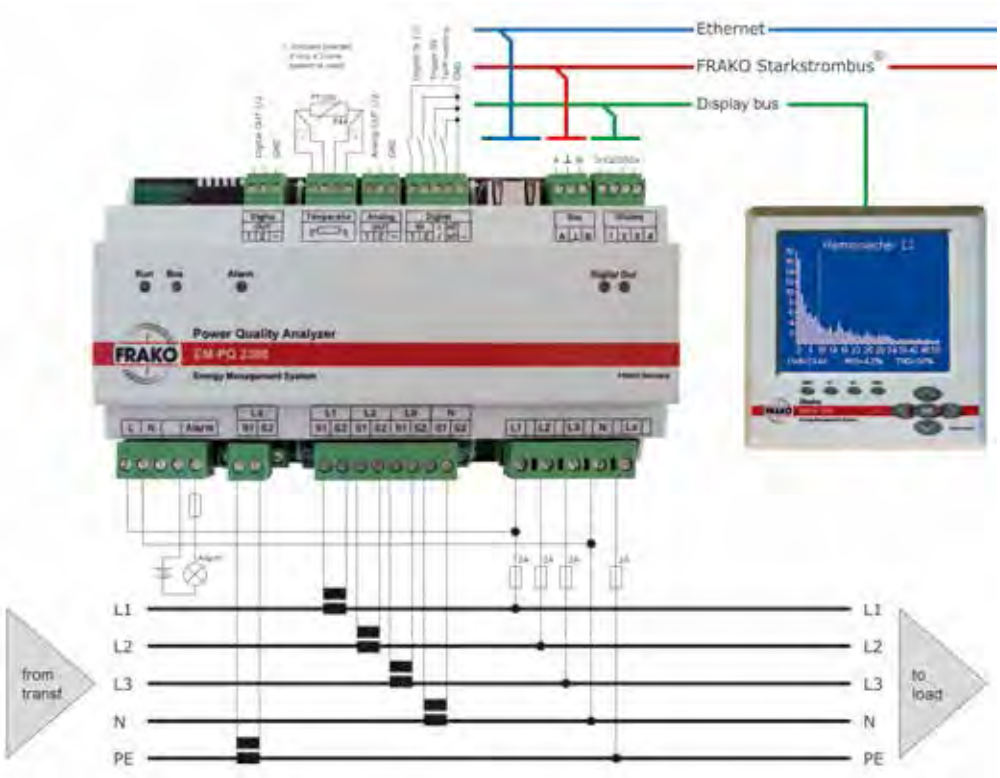
Integrated firewall-friendly web interface. The monitoring function enables an entire building, for example, to be continuously checked for the presence of earth fault currents automatically. This means that incipient insulation faults can be detected at a very early stage and reported to the office responsible for electrical safety.

In many companies, manufacturing automation and IT are still two different worlds. The EM-PQ 2300 solves this problem with the Simple Network Management Protocol (SNMP), an integrated communications interface that enables measurement data from the automation area to be automatically transferred to the IT area.

- Long-term network analysis to EN 50160 or EN 61000-2-4
- Monitoring of supply voltage dips
- Monitoring of earth conductor current and residual current detection
- User-selectable data recording, e.g. analysis of power demand curve profile
- Display of measurement readings and curves at the optional EM-FD 2500 display, connected to the EM-PQ 2300 Power Quality Analyzer by a 4-core cable. One display can indicate the data from up to 7 EM-PQ 2300 instruments.
- Inputs:
  - 5 current transformer inputs for L1 to L3/N/(PE)
  - 4 voltage inputs for L1 to L3/N and Lx/N up to 690 V (extension option)
  - 3 freely assignable S0 pulse inputs for status signals, energy metering and power calculation, or to synchronize metering with the power supplier
  - 1 S0 pulse input for tariff switching
  - 1 Pt100/1000 4-wire resistance temperature detector input, automatic probe type identification
- Outputs:
  - 1 alarm contact rated at up to 250 V AC
  - 2 digital outputs for alarm purposes. The outputs are electrically isolated and are rated up to 30 V DC
  - 2 analogue outputs for any 2 desired measurement readings, as 0–20 mA, 4–20 mA or 0-10 V signal, internal instrument voltage source, automatic voltage/current identification
- Interfaces:
  - RS-485 bus, for connection to FRAKO Energy Management System
  - Ethernet (RJ45 jack) for connection to FRAKO Energy Management System
  - Modbus (TCP) slave, SNMP agent: the internal alarm system can transmit e-mails via Ethernet
- Software (Device Manager) included for configuration and display of the stored measurement readings via Ethernet

Data acquisition and recording:

- Acquisition and recording of the minimum, maximum and average values of the measurement readings and acquisition intervals defined by the user over parameterized periods of time
- Detection of under- and overvoltages V_{rms}
- Detection of voltage failures V_{rms}
- Detection of inrush currents (10 ms)
- Energy meter (active and reactive power, consumed and fed into network)
- Internal data storage: 256 MB flash memory



EM-PQ 2300 wiring diagram

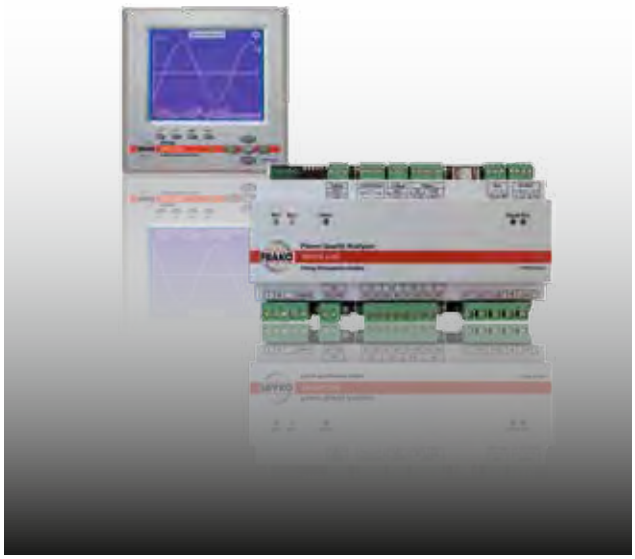
Easy installation with the DIN rail-mounted enclosure
The EM-PQ 2300 is housed in an enclosure with a pin strip underneath it.

This system, consisting of pin and socket strips and DIN rail bus connectors, enables the individual modules to be easily fitted and connected to one another.

All connections are also available at external terminals for conventional wiring. Use of the 16-pin DIN rail bus connector provides automatic contact from instrument to instrument.

The bus connector enables the FRAKO Starkstrombus®, extension bus and display bus to be connected. The pin and socket strips on the DIN rail ensure quick and easy installation of the instruments in parallel.

It is possible to plug individual instruments in or remove them without dismantling the modular assembly.



Data display on the EM-FD 2500
The EM-FD 2500 has been developed as a physically separate LCD display and operator panel to work with all FRAKO Energy Management devices of the new generation that require this, such as the EM-PQ 2300 and EM-MC 2200 instruments.

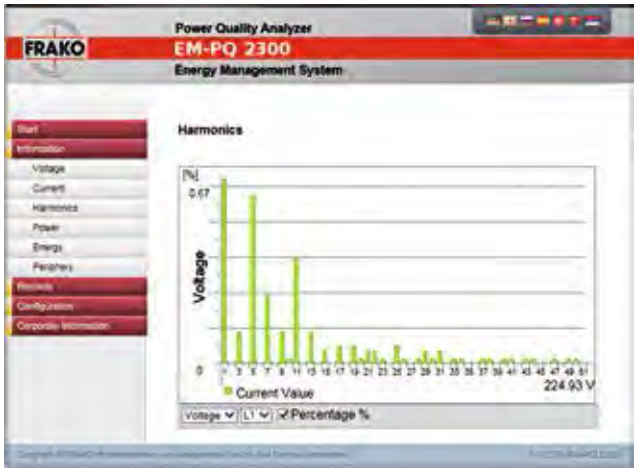
The Display is connected to the EM instrument via 4 terminals: two wires for the instrument power supply and two for data transfer. A maximum of 8 instruments can be connected to a common display bus, with a bus length of up to 40 m to the Display.

The Display is mounted on the control cabinet door or wall through a Ø 22.5 mm hole, thus greatly simplifying installation. Its orientation is fixed by a screw through the wall into a threaded bush.

Alternatively, the Display can also be mounted in any available 144 x 144 mm cut-out.

Web interface to display the momentary measurement readings and the event list

- Web server for the configuration and online display of all measurement readings
- Every user at any PC can view the most important measurement data via the intranet

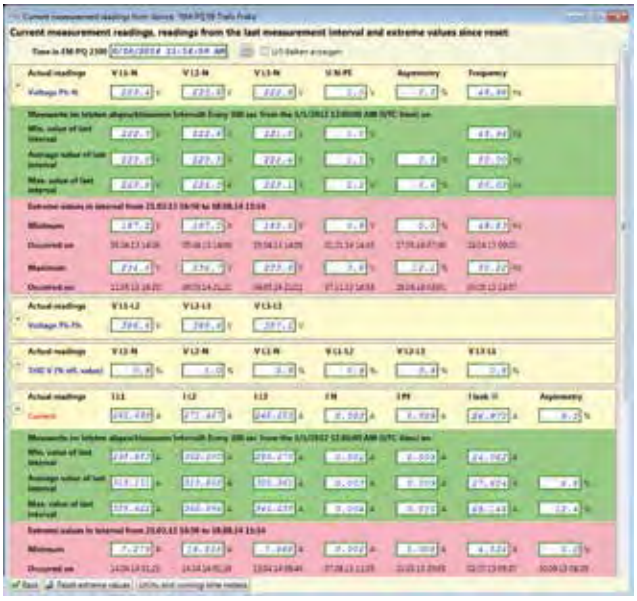


Device Manager –
Clear overview and straightforward programming

- **Momentary measurement readings**
  All key measurement data from the EM-PQ 2300 are displayed in a clear overview.

  With most measurement points, each individual section can be expanded to display the extreme values in the last interval and the extreme values since the last reset.

  The V/I bar graph indicator, which ranges from 0 to full scale value, offers a quick check on the extent to which the current and voltage measurement ranges are being used. This shows immediately whether the current transformers are correctly dimensioned.



- **Continuous data recording**
  The continuous data recording function of the EM-PQ 2300 can be configured as desired.

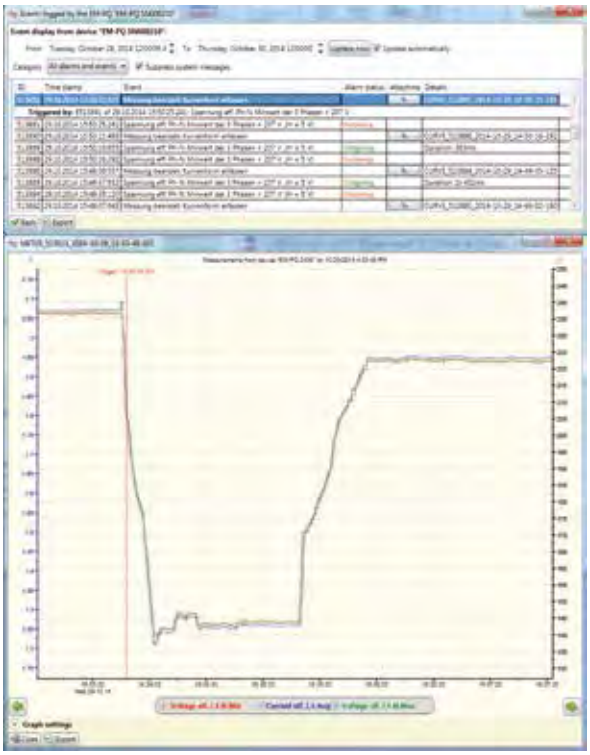
  Up to 250 data points can be recorded, the time interval and the type of reading (minimum, average or maximum value) being specified for each data point.

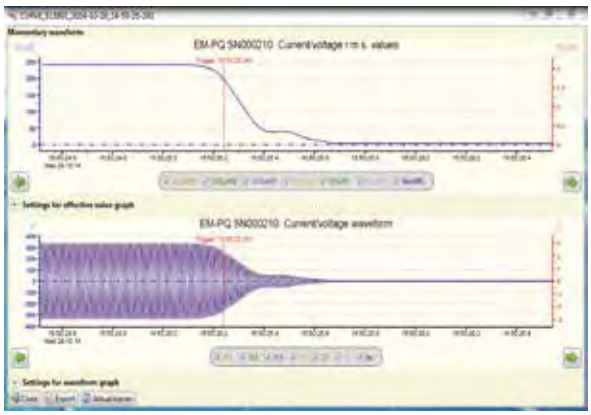
  In addition, the option of defining charts and assigning data points to them is also given, so that when the EM-PQ 2300 is accessed, regardless of which PC Device Manager is installed on, the same charts will always be available.

- **Event-driven data recording including the period prior to the triggering event**
  Various events can trigger the recording of data for a limited time independently of the continuous recording function. The user is free to define which measurements are recorded and for how long.

  This ‘pretrigger’ function also enables the measurements from the time leading up to the triggering event to be recorded. If this is set at 25%, and the duration of the recording period at one hour, the EM-PQ 2300 will record the measurements made over the 15 minutes before the triggering event and the 45 minutes after it. The EM-PQ 2300 does this by continuously recording the measurements in a small circular buffer. When the recording period is over, the data from before and after the event are saved in a file, and the message ‘Measurement completed’ appears as a new entry in the event report.

  Clicking the button in the ‘Att.’ (Attachment) column will display the measurement.

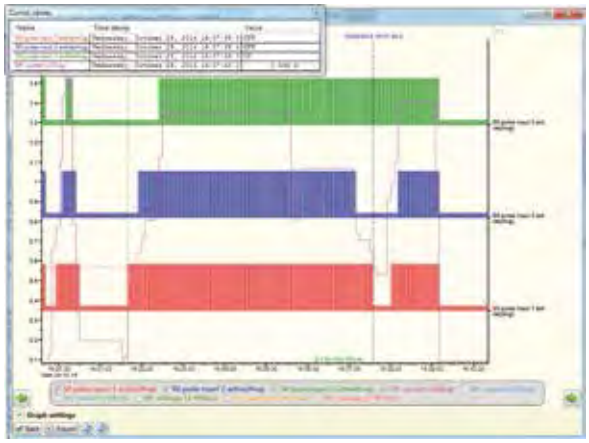




Apart from the user-defined measurements, predefined short-term measurements covering periods of 2 or 6 seconds can also be triggered, the current and voltage measurements being saved both as root-mean-square values over 10 ms intervals and as waveform curves.

An additional feature is that an e-mail can be sent after a measurement is completed. Clicking the e-mail attachment on any PC on which Device Manager or FRAKO-NET is installed will display the measurement.

Analysis to EN 50160 or IEC 61000-2-4
The EM-PQ 2300 can be configured so that it carries out an analysis every week, saving this as a results file, which can then be loaded via the event report.



- **Energy meter for each phase**
  The EM-PQ 2300 meters the energy of each phase in addition to the total energy. Two resettable energy meters and one non-resettable meter are available for each phase. Resetting can be performed manually or automatically at any desired interval.

- **User-friendly evaluation in the chart with cursor values and display of min. and max. readings**
  By activating the cursor lines, the readings can be displayed in a table and time differences can be measured.

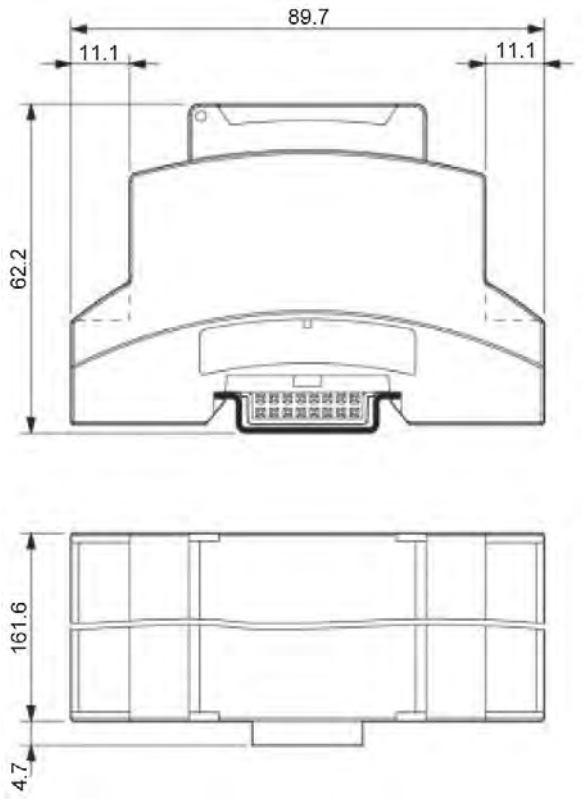
  The min./max. display enables the user to find minimum and maximum values over long periods and to display them on an enlarged scale.

  The min./max. display can also be used with an energy meter to determine the energy consumption over a set period. This is displayed directly in the ‘Max - Min’ column.

Technical Data

Power supply	
Voltage	90-267 V AC or 100-360 V DC
Frequency	45...65 Hz
Power consumption	Max. 8 W
Measurement inputs	
Connection w. Cat. 3/4/5 cable	•/•/•
Current measurement inputs	5 x X/5A
Voltage measurement inputs	4 x 400/600 V AC (L-N/L-L); 3-phase 5-wire system
Inputs and outputs	
Analogue inputs and outputs	- / 2 (0-10 V or 0-20 mA or 4-20 mA)
Digital inputs and outputs	4/2
Temperature	PT100/1000 4-wire system
Interfaces	
Ethernet	•
FRAKO Energy Management System	FRAKO Starkstrombus® Intranet (Ethernet), Modbus (TCP), SNMP (agent)
RS-232 / RS-485	- / •
Profibus DP	-
Web server / e-mail	• / •
Display and operation	
	Operation via EM-FD 2500 Display / 5 LEDs on EM-PQ 2300
Article-No.	20-30240
Connections	
	Pin and socket strips
Mechanical construction	
Dimensions (W x H x D)	161.6 x 89.7 x 60.5 mm
Ingress protection	Enclosure /terminals: IP 30 / IP 20 according to EN 60529
Protection class	Class 1 according to EN 61140
Enclosure	Flame retardant V0 to UL94
Mounting	On standard 35 mm DIN rail to EN 50022
Weight	Approx. 0.5 kg
Operating conditions	
Ambient temperature	-20 °C...+60 °C
Article-No.	20-30241

Dimensions



Dimensional drawing EM-PQ 2300

All dimensions in mm

EM-PQ 2200
Power Quality Analyzer

Power Quality Analyzer with 4 current transformer inputs and 4 voltage inputs for DIN rail mounting to detect, control and analyze electrical measurements in mains up to 480 V (Phase/Phase) (Power quality measurement according to DIN EN 61000-4-30:2009 Kl. S, analysis and evaluation according to DIN EN 50160).

Direct connection to the FRAKO Energy Management System via integrated interfaces RS-485 (Modbus RTU) or Ethernet (Modbus TCP/IP).

Description

Measuring functions:

- Frequency of fundamental from 15 Hz to 440 Hz
- Measuring intervals from 10/12 (50/60 Hz) periods (200 ms)
- Continuous scanning with 20 kHz per channel and calculation of the following measurement readings:
  - Voltage L-N, neutral point displacement voltage
  - Voltage imbalance L1 ... L3
  - Voltage L-L
  - Frequency (equally for all channels)
  - Current, total current L1 ... L3, total current L1 ... L3+N
  - Power (active, reactive, apparent power, power factor, distortion reactive power)
  - Fundamental power (active, reactive, apparent power, cos phi, phase shift)
  - Summation L1 ... L3 of the above mentioned performance values
  - Summation L1 ... L4 (active, reactive, apparent power)
  - Active power (regenerated and consumed) of the main and ancillary system
  - Reactive power (capacitive and inductive) of the main and ancillary system
  - Fourier analysis 1st ... 63rd harmonic for current, voltage, active and reactive power as well as interharmonics for every single harmonics per phase
  - Distortion factors (THD) of current and voltage - TDD (Total Demand Distortion) L1, L2, L3
  - Current, short-term, long-term flicker
- Allocation of the measurement readings to generate protocols for voltage and costs
- Allocation of the measurement readings to generate protocols according to EN 50160, EN 61000-2-4, power quality and costs report

Detection and recording:

- Detection and recording of the minimum, maximum and average value of the measurement readings defined by the user as well as the acquisition periods for histograms of the parameterized time periods
- Detection of under- and overvoltages U_{rms}
- Detection of voltage failures U_{rms}
- Detection of inrush currents (10 ms)
- Energy meter (active and reactive power, regenerated and consumed)
- Internal data storage: 128MB Flash memory

Device equipment:

- Display (41x25 mm)
- Embedded Webserver

Technical Data

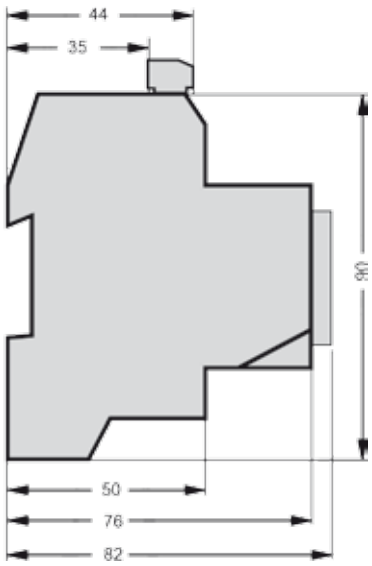
- Inputs:
  - 4 voltage measurement inputs
  - 4 current measurement inputs ../1/5A
  - 2 digital inputs: e. g. to change the tariffs, for external synchronisation and to release the records, pulse meter for external consumption meters
  - Temperature measurement input for PT100/1000 or KTY83/84
- Outputs:
  - 2 digital outputs, can also be programmed as a pulse or signal output
- Interfaces / Protocols:
  - RS-485, Protocol: Modbus RTU/Master and Slave for connecting with the FRAKO Energy Management System
  - Interface Profibus DP V0, with gateway function
  - Ethernet 10/100 TBase Modbus RTU Master/Slave for connecting with the FRAKO Energy Management System, Modbus-Gateway, BACnet / IP oder MSTP (optional)
  - All interfaces run simultaneously
  - Protocols: Modbus TCP/IP (Port 502), Modbus over TCP/IP (Port 8000), HTTP, SMTP, SNMP, SNTP, TFTP, FTP, DHCP
  - Built-in homepage for remote maintenance and diagnostics with open structure for application-specific adjustment
  - User programmable e-mail dispatch, e.g. in case of an alarm
  - Supports HTML pages, Java Applets, Flash MX and ActiveX
- Configuration and visualization software EM-PQ VIS:
  - Readout and visualization of measurement readings
  - Automatic ring buffer down load of the devices
  - Storage of data in a Derby database
  - Optional: MS SQL and MySOL database drivers
  - Graphical representation and analysis of online- and offline-measurement readings
  - Freely configurable topology with freely selectable register levels
  - Configuration of the measurement devices
  - Parameterisation, visualization, data management, analysis
  - Cost centre management
  - Report function (EN 50160, voltage and cost centres) for freely definable time periods
  - Statistics function
  - Data export into a CSV file
  - Possibility of customer specified programming (SPSfunctionality)
  - The following operating systems are supported:
    - Windows XP® (Service pack 3 or higher)
    - Windows Vista® (Service pack 1 or higher)
    - Windows 7,
    - MAC OS® (10.5 or higher),
    - Linux and Unix
- Programming:
  - Integrated Interpreter to create customized user programs, e.g. alarms, cost centre entry, operating conditions
  - Freely accessible internal variables (measurement readings ...) via reloadable user programs
  - 7 user programs can run at the same time

Overvoltage category	300 V CAT III
Rated voltage in 4-wire system	Max. 277/480 V AC, +10 %
Rated voltage in 3-wire system	Max. 480 V AC, +10 %
Frequency of fundamental	45 - 65 Hz (15 - 440 Hz)
Power consumption	0.1 VA
Auxiliary voltage	L-N 95...240 V AC; 135...340 V DC
Power consumption	9 VA
Current measurement	.../1A/5A
Minimum working current	5 mA
Power consumption	0.2 VA
Voltage	± 0.2 %
Current	± 0.2
Power	± 0.4 %
Active power	Class 0.5S at .../5A
Active power	Class 1 at .../1A
Reactive power	Class 2 at .../1/5A
Operational ambient temperature	-10°...+55 °C
Ingress protection	IP20
Dimensions	107.5 (6 HP) x 90 x 82 mm (W x H x D)
Including	Configuration and visualization software EM-PQ VIS; Patch cable, 3 m, blue. (EM-PQ - switch/hub connection); Patch cable, 2 m, twisted, grey. (EM-PQ - PC connection)
Article-No.	29-20108

Optional Accessories

Article-No.	Type	Description
29-20114	EM-PQ-VIS	Configuration and online visualisation software for Power Quality Monitor for EM-PQ 2100, 2200, 2500 and 3000.

Dimensions



Dimensional drawing EM-PQ 2200

All dimensions in mm

EM-PQ 2100
Power Quality Analyzer

Power Quality Analyzer with 4 current transformer inputs and 4 voltage inputs for DIN rail mounting to detect, control and analyze electrical measurements in mains up to 480 V (Phase/Phase) (Power quality measurement according to DIN EN 61000-4-30:2009 Kl. S).

Direct connection to the FRAKO Energy Management System via integrated interfaces RS-485 (Modbus RTU) or Ethernet (Modbus TCP/IP).

Description

Measuring functions:

- Frequency of fundamental from 45 Hz ... 65 Hz
- Measuring intervals from 10/12 (50/60 Hz) periods (200 ms)
- Continuous scanning with 20 kHz per channel and calculation of the following measurement readings:
  - Voltage L-N, neutral point displacement voltage
  - Voltage imbalance L1 ... L3
  - Voltage L-L
  - Frequency (equally for all channels)
  - Current, total current L1 ... L3, total current L1 ... L3+N
  - Power (active, reactive, apparent power, power factor, distortion reactive power)
  - Fundamental power (active, reactive, apparent power, cos phi, phase shift)
  - Summation L1 ... L3 of the above mentioned performance values
  - Summation L1 ... L4 (active, reactive, apparent power)
  - Active power (regenerated and consumed) of the main and ancillary system
  - Reactive power (capacitive and inductive) of the main and ancillary system
  - Fourier analysis 1st ... 40th harmonic for current, voltage, active and reactive power as well as interharmonics for every single harmonics per phase
  - Distortion factors (THD) of current and voltage - TDD (Total Demand Distortion) L1, L2
  - Current, short-term, long-term flicker
- Allocation of the measurement readings to generate protocols for voltage and costs
- Allocation of the measurement readings to generate protocols according to EN 50160, EN 61000-2-4

Detection and recording:

- Detection and recording of the minimum, maximum and average value of the measurement readings defined by the user as well as the acquisition periods for histograms of the parameterized time periods
- Detection of under- and overvoltages U_{rms}
- Detection of voltage failures U_{rms}
- Detection of inrush currents (10 ms)
- Energy meter (active and reactive power, regenerated and consumed) with 8 tariffs
- Internal data storage: 128 MB Flash memory

Device equipment:

- Display (41 x 25 mm)
- Embedded Webserver

Technical Data

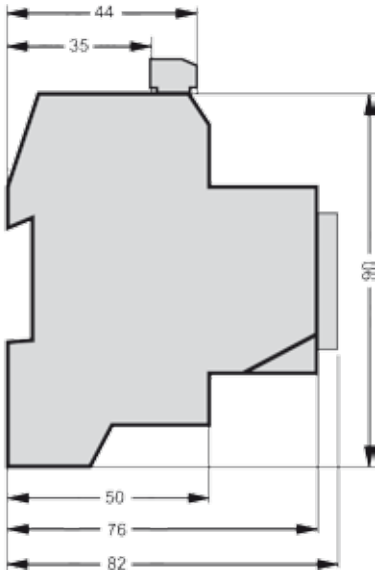
- Inputs:
  - 4 voltage measurement inputs
  - 4 current measurement inputs ../1/5A
  - 2 digital inputs: e. g. to change the tariffs, for external synchronisation and to release the records, pulse meter for external consumption meters
  - Temperature measurement input for PT100/1000 or KTY83/84
- Outputs:
  - 2 digital outputs, can also be programmed as a pulse or signal output
- Interfaces / Protocols:
  - RS-485, Protocol: Modbus RTU/Master and Slave for connecting with the FRAKO Energy Management System
  - RS-232, Protocol: Modbus RTU/Slave (only EM-PQ 2100)
  - Ethernet 10/100 TBase Modbus RTU Master/Slave for connecting with the FRAKO Energy Management System, Modbus-Gateway, BACnet / IP or MSTP (optional)
  - All interfaces run simultaneously
  - Protocols: Modbus TCP/IP (Port 502), Modbus over TCP/IP (Port 8000), HTTP, SMTP, SNMP, SNTP, TFTP, FTP, DHCP
  - Built-in homepage for remote maintenance and diagnostics with open structure for application-specific adjustment
  - User programmable e-mail dispatch, e.g. in case of an alarm
  - Supports HTML pages, Java Applets, Flash MX and ActiveX
- Configuration and visualization software EM-PQ VIS:
  - Readout and visualization of measurement readings
  - Automatic ring buffer down load of the devices
  - Storage of data in a Derby database
  - Optional: MS SQL and MySOL database drivers
  - Graphical representation and analysis of online- and offline-measurement readings
  - Freely configurable topology with freely selectable register levels
  - Configuration of the measurement devices
  - Parameterisation, visualization, data management, analysis
  - Cost centre management
  - Report function (voltage and cost centres) for freely definable time periods
  - Statistics function
  - Data export into a CSV file
  - Possibility of customer specified programming (SPS functionality)
  - The following operating systems are supported:
    - Windows XP® (Service Pack 3 or higher)
    - Windows Vista® (Service Pack 1 or higher)
    - Windows 7,
    - MAC OS® (10.5 or higher),
    - Linux and Unix
- Programming:
  - Integrated Interpreter to create customized user programs, e.g. alarms, cost centre entry, operating conditions
  - Freely accessible internal variables (measurement readings ...) via reloadable user programs
  - 7 user programs can run at the same time

Overvoltage category	300 V CAT III
Rated voltage in 4-wire system	Max. 277/480 V AC, +10 %
Rated voltage in 3-wire system	Max. 480 V AC, +10 %
Frequency of fundamental	45 - 65 Hz (15 - 440 Hz)
Power consumption	0.1 VA
Auxiliary voltage	L-N 95...240 V AC; 135...340 V DC
Power consumption	9 VA
Current measurement	.../1A/5A
Minimum working current	5 mA
Power consumption	0.2 VA
Voltage	± 0.2 %
Current	± 0.2
Power	± 0.4 %
Active power	Class 0.5S at .../5A
Active power	Class 1 at .../1A
Reactive power	Class 2 at .../1/5A
Operational ambient temperature	-10°...+55 °C
Ingress protection	IP20
Dimensions	107.5 (6 HP) x 90 x 82 mm (W x H x D)
Including	Configuration and visualization software EM-PQ VIS; Patch cable, 3 m, blue. (EM-PQ - switch/hub connection); Patch cable, 2 m, twisted, grey. (EM-PQ - PC connection)
Article-No.	29-20111

Optional Accessories

Article-No.	Type	Description
29-20114	EM-PQ-VIS	Configuration and online visualisation software for Power Quality Monitor for EM-PQ 2100, 2200, 2500 and 3000.

Dimensions



Dimensional drawing EM-PQ 2100

All dimensions in mm

EM-PQ 1500 M
Power Quality Analyzer

Power Quality measurement system to detect, analyze and monitor electrical measurement variables in 400 V low voltage mains and medium voltage mains (100 V secondary).

Description

- Monitoring and evaluation of the mains quality; measurement of all relevant mains data in low and medium voltage mains
- Energy meter for active power (input and output) and reactive power
- Different measurements over 10 periods (200 ms, see EN 61000-4-7), measuring range up to the 40th harmonic (distortion factor current/voltage, absolute value of harmonic current)
- 4 voltage and 3 current measurement inputs
- Bimetallic function
- Integrated alarm management with different output configurations: 2x contact outputs, display, LED
- Easily extendable to include up to 15 measurement units via 2 link connections (max. 40 m) for displaying all relevant data via the display EM-FD 1500
- 2 outputs: adjustable digital/analogue (digital, 4-20 mA/ alarm individually programmable)
- Connection to the FRAKO Energy Management System via FRAKO Starkstrombus® (RS 485)
- Top hat rail mounting

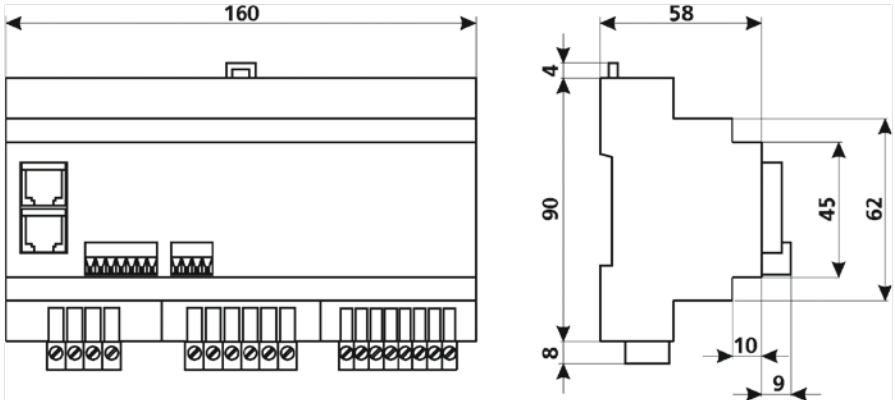
Technical Data

Measurement inputs	
Voltage path	(Phase-Zero) 3 x 57 - 230 V AC +/- 10 % (Phase-Phase) 3 x 100 - 400 V AC +/- 10 %
Frequency	50 Hz
Power consumption	Max. 7 VA
Fuse protection	Max. 2 A external protection required
Current path	3x X/5A (transformer current >6 mA)
Power consumption	Max. 1.8 VA each transformer connection
Inputs	
Display IN	24 V DC, voltage input for display units with a 24 V control unit
Outputs	
Digital OUT	Max. 48 V DC, max 100 mA DC
Digital/Analogue OUT	Max. 30 V DC, max. 100 mA (DC 4-20 mA passive)
Interfaces	
1 FRAKO Starkstrombus®	For connection to FRAKO Energy Management System, according to EN 50170 (P-Net) standardised fieldbus, RS 485 Transfer rate: 76.8 kbit/s Type/ Protocol: RS-485 / P-Net
2 Link Connections	Connection to further EM-PQ 1500 (max. 15) to display on display unit EM-FD 1500 Type/ Protocol: CAN / FRAKO internal
Display	Connection to display unit EM-FD 1500
Mechanical construction	
Dimensions	160 x 102 x 67 mm (W x H x D)
Ingress protection	Housing / terminals IP 40 / IP 20
Version	According to DIN EN 61010-1, DIN EN 61000-6-2 and DIN EN 61000-6-3
Housing	Flame-retardant UL94-V0
Installation	On standard rail 35 mm according to DIN EN 50022
Mounting position	Optional
Weight	Approx. 0.5 kg
Operating conditions	
Ambient temperature	0 °C up to +55 °C
Article-No.	20-30212

Optional Accessories

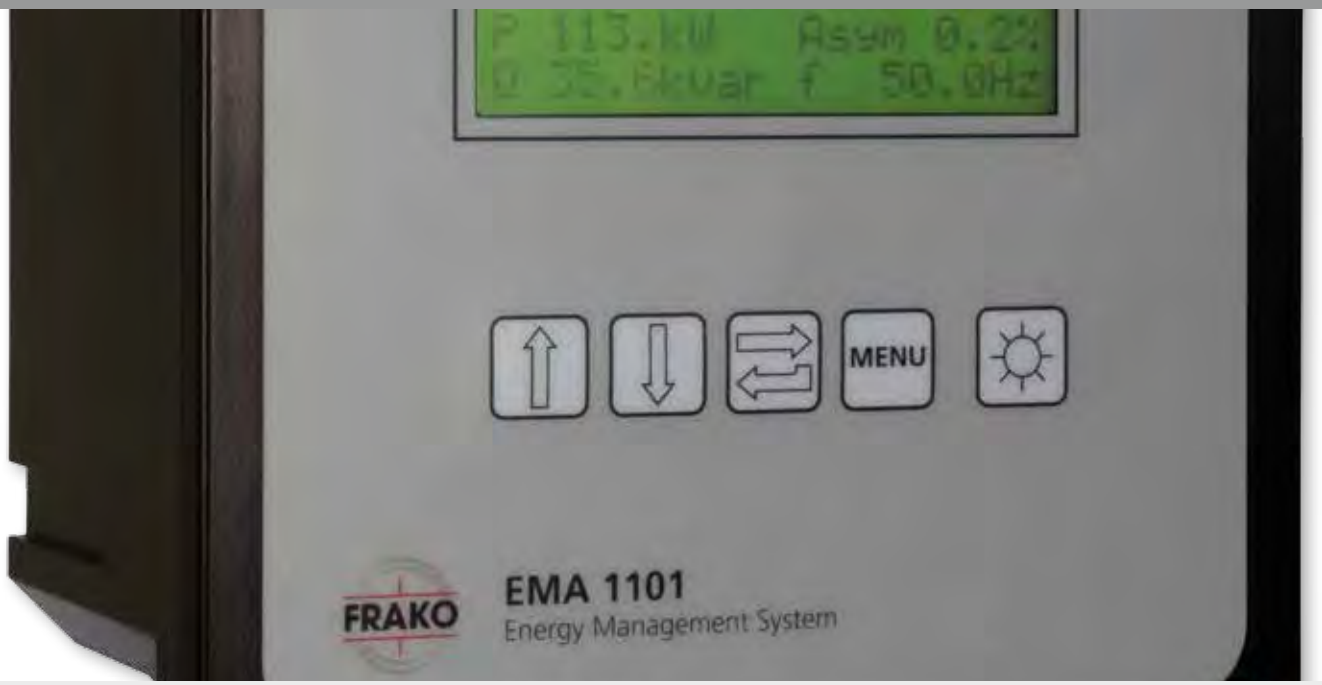
Article-No.	Type	Description
29-20073	RJ 45 patch cable for EM-PQ 1500; Length: 1 m	RJ 45 patch cable for connecting EM-PQ 1500 Power Quality Monitor with another EM-PQ 1500; Cable length: 1 m
29-20074	RJ 45 patch cable for EM-PQ 1500; Length: 3 m	RJ 45 patch cable for connecting EM-PQ 1500 Power Quality Monitor with another EM-PQ 1500; Cable length: 3 m
29-20075	RJ 45 patch cable for EM-PQ 1500; Length: 5 m	RJ 45 patch cable for connecting EM-PQ 1500 Power Quality Monitor with EM-PQ 1500; Cable length: 5 m
29-20076	RJ 45 patch cable for EM-PQ 1500; Length: 10 m	RJ 45 patch cable for connecting EM-PQ 1500 Power Quality Monitor with EM-PQ 1500; Cable length: 10 m
20-30233	Interface adapter EM-PQ-RS 232	RS-232 Adapter for PC direct access to the data of EM-PQ 1500, including display and configuration software EM-PQ-SW; Cable length: 3 m
20-10700	Mains adapter for Analogue Module EM-AM 24 V DC (can be used as well for EM-PQ 1500)	Switching power supply for DIN rail mounting 24 V DC / 0.35 A and 12 V DC / 20 mA; Mains power supply: 85 to 264 V AC
20-10317	EM-PQ-SW	Software for the configuration and online display of data from the EM-PQ 1500 Power Quality Monitor. Access via: EMIS 1500, EMP 1100, EMT 1101 and EM-PQ-RS 232 adapter. **Note:** included with FRAKO-NET when supplied on CD-ROM

Dimensions



Dimensional drawing EM-PQ 1500 M

All dimensions in mm



Mains Monitoring Instruments

The power quality of the electrical supply networks plays an increasingly important role for the operational safety of electrical installations and equipment. Therefore it becomes more and more important to take appropriate measures to monitor the power quality.

In contrast to the past it is obvious that it is not sufficient to do a single measurement and then disregard the mains quality if the measurement showed unproblematic values.

Due to complex production processes, changing load conditions and a steady progress in the degree of automation it became important to permanently monitor the quality of electrical power supply.

Thus one can acquire energy know-how and define critical values for measurement variables such as voltage, current and harmonics.

Automatic alarms via different information channels such as e-mail, SMS, warning lights, etc. allow the control of compliance with the now specified critical values.

Of course, critical values predefined by standards and regulations can also be signalled via these channels.

FRAKO Mains Monitoring devices can handle all these operations.

Depending on type and version this can be achieved already by a single device or – even better - in combination with the FRAKO Energy Management System.

Monitoring of transformers, measurements at low voltage distribution boards as well as monitoring of individual machines and consumers …. FRAKO has the solution for every application.

	EM-PQ 3000	EM-PQ 2500	EMA 1101	EMA 1496
				
Voltage	95-240 V AC; 80-340 V DC ± 10 %	95-240 V AC; 80-340 V DC ± 10 %	230 V AC ± 10 %	110-400 V AC (max. 99-440 V AC) or 120-350 V DC (max. 96-420 V DC)
Frequency	45/65 Hz	45/65 Hz	48...62 Hz	45...66 Hz
Power consumption	Max. 9 VA	Max. 9 VA	Max. 7 VA	Max. 5 VA
Contact termination 3/4/5-wire	• / • / -	• / • / -	• / • / -	• / • / - ; 2-wire and single phase
Current measurement inputs	4 x X/1A, X/5A	4 x X/1A, X/5A	3 x X/5A (Transformer current > 6 mA), electrically isolated	3 x X/5A
Voltage measurements	417/720 V AC (L-N/L-L) 3-phase 4-wire system 480 V AC (L-L) 3-phase 3-wire system	417/720 V AC (L-N/L-L) 3-phase 4-wire system 480 V AC (L-L) 3-phase 3-wire system	3 x 250-550 V AC (external/external conductor); 3 x 50-105 V AC (external/external conductor)	3 x 100-289 V AC (external/neutral conductor); 3 x 173-500 V AC (external/neutral conductor)
Harmonics V/A	1-63	1-40	1-19	-
Short term interruptions	•	•	-	-
Active energy class	0.2 (.../5A)	0.2 (.../5A)	2	2
Analogue In-/Outputs	- / -	- / -	2 temperature / -	- / -
Digital In-/Outputs	8 / 5	8 / 5	Tariff input for selection of 2 profiles / 1 alarm signalling contact 250 V DC, max. 3 A	- / optional Plug-In module for active or reactive power
Memory Min./Max. values	•	•	•	•
Memory size	256 MB	256 MB	-	-
Interfaces				
Ethernet	•	•	-	-
FRAKO Energy Management System	• Connection via - Modbus RTU (RS-485) or - Modbus TCP (Ethernet)	• Connection via - Modbus RTU (RS-485) or - Modbus TCP (Ethernet)	• via FRAKO Starkstrombus®	• optional Plug-In module enables the connection via Modbus RTU
RS-232 / RS-485	- / •	- / •	• (optional for EMA 1101, EMA 1101 105 V) / -	- / -
Profibus DP	•	•	• (only -DP - versions)	-
Webserver / E-Mail	- / -	• / •	- / -	- / -
Recommended applications	Transformer / NA	Transformer / NA	Transformer / NA	Load outgoing unit
Catalogue Page	Page 223 ff.	Page 227 ff.	Page 231 ff.	Page 235 ff.

EM-PQ 3000
Power Quality Analyzer

Mains monitoring device class A for control panel installation to detect, monitor and analyze electrical measurement variables in mains up to 720 V (phase/phase) with 4 current transformer inputs and 4 voltage inputs. Direct connection to the FRAKO Energy Management System via integrated interfaces RS-485 (Modbus RTU) or Ethernet (Modbus TCP/IP).

Description

Measuring functions:

- Frequency of fundamental 15 Hz ... 440 Hz
- Measuring intervals from 10/12 (50/60 Hz) periods (200 ms)
- Continuous scanning with 20 kHz per channel and calculation of the following measurement readings:
  - Voltage L-N, neutral point displacement voltage
  - Voltage imbalance L1 ... L3
  - Voltage L-L
  - Frequency (equally for all channels)
  - Current, total current L1 ... L3, total current L1 ... L3+N
  - Power (active, reactive, apparent power, power factor, distortion reactive power)
  - Fundamental power (active, reactive, apparent power, cos phi, phase shift)
  - Summation L1 ... L3 of the above mentioned performance values
  - Summation L1 ... L4 (active, reactive, apparent power)
  - Active power (regenerated and consumed) of the main and ancillary system
  - Reactive power (capacitive and inductive) of the main and ancillary system
  - Fourier analysis 1st ... 63rd harmonic for current, voltage, active and reactive power as well as interharmonics for every single harmonics per phase
  - Distortion factors (THD) of current and voltage
  - TDD (Total Demand Distortion) L1, L2, L3
  - Current, short-term, long-term flicker
  - Allocation of the measurement readings to generate protocols according to EN 50160, EN 61000-2-4, power quality and costs report

Detection and recording:

- Detection and recording of the minimum, maximum and average value of the measurement readings defined by the user as well as the acquisition periods for histograms of the parameterized time periods
- Detection of under- and overvoltages U_{rms}
- Detection of voltage failures U_{rms}
- Detection of inrush currents (10 ms)
- Detection of transients >50 microsec.
- Energy meter (active and reactive power, regenerated and consumed) with 8 tariffs
- Internal data storage: 256 MB Flash memory

Device equipment:

- Active matrix display (TFT B x H: 115 x 88 mm), Resolution (Pixel): 320 x 240, Brightness (cd/m²): 300, Screen diagonal: 5.7 inch
- Embedded Webserver

Technical Data

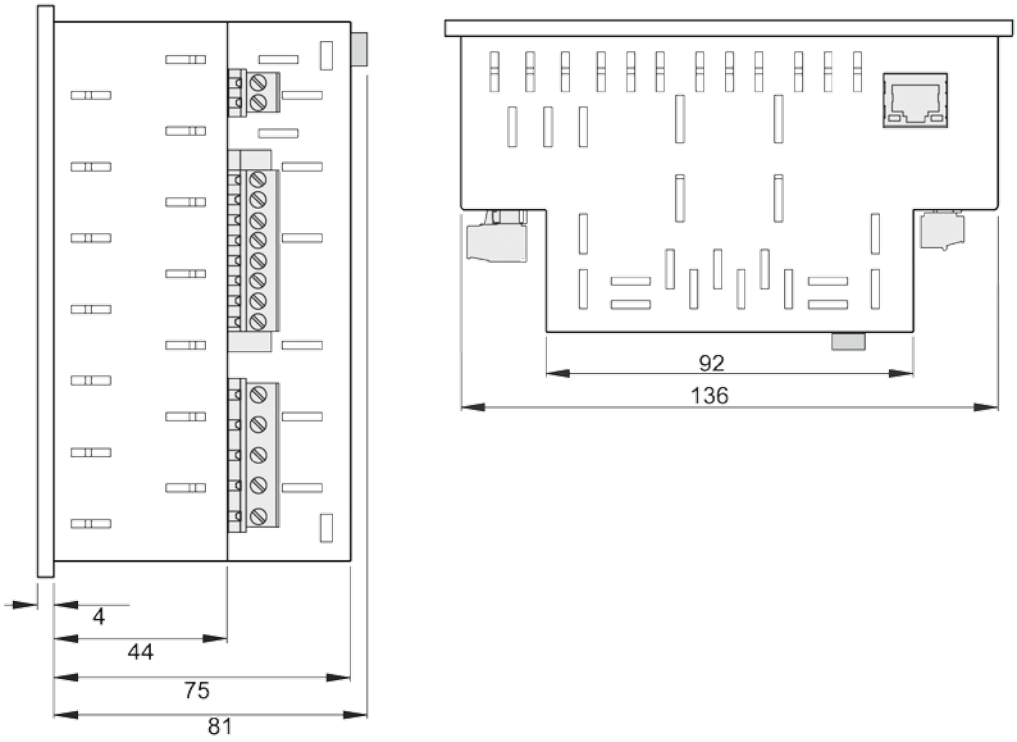
- Inputs:
  - 4 voltage measurement inputs
  - 4 current measurement inputs ../1/5A
  - 8 digital inputs: e. g. to change the tariffs, for external synchronisation and to release the records, pulse meter for external consumption meters
  - 5 digital outputs, can also be programmed as a pulse or signal output
- Interfaces / Protocols:
  - RS-485, Protocol: Modbus RTU/Master and Slave for connecting with the FRAKO Energy Management System
  - Interface Profibus DP V0, with gateway function
  - Ethernet 10/100 TBase Modbus RTU Master/Slave for connecting with the FRAKO Energy Management System, Modbus-Gateway, BACnet / IP or MSTP (optional)
  - All interfaces run simultaneously
  - Protocols: Modbus TCP/IP (Port 502), Modbus over TCP/IP (Port 8000), HTTP, SMTP, SNMP, SNTP, TFTP, FTP, DHCP
  - Built-in homepage for remote maintenance and diagnostics with open structure for application-specific adjustment
  - User programmable e-mail dispatch, e.g. in case of an alarm
  - Supports HTML pages, Java Applets, Flash MX and ActiveX
- Configuration and visualization software EM-PQ VIS:
  - Readout and visualization of measurement readings
  - Automatic ring buffer down load of the devices
  - Storage of data in a Derby database
  - Optional: MS SQL and MySOL database drivers
  - Graphical representation and analysis of online- and of-fline-measurement readings
  - Freely configurable topology with freely selectable register levels
  - Configuration of the measurement devices
  - Parameterisation, visualization, data management, analysis
  - Cost centre management
  - Reporting function (EN 50160, voltage and cost centres) for freely definable time periods
  - Statistics function
  - Data export into a CSV file
  - Possibility of customer specified programming (SPS-functionality)
  - The following operating systems are supported:
    - Microsoft® Windows XP® (Service Pack 3 or higher)
    - Microsoft® Windows Vista® (Service Pack 1 or higher)
    - Microsoft® Windows 7,
    - MAC OS® (10.5 or higher),
    - Linux and Unix
- Programming:
  - Integrated Interpreter to create customized user programs, e.g. alarms, cost centre allocation, operating conditions, ...
  - Freely accessible internal variables (measurement readings ...) via reloadable user programs
  - 7 user programs can run at the same time

Overvoltage category	600 V CAT III
Rated voltage in 4-wire system	Max. 417/720 V AC, +10 %
Rated voltage in 3-wire system	Max. 480 V AC, +10 %
Frequency of auxiliary voltage	45 - 65 Hz
Power consumption	15 VA
Auxiliary voltage	L-N 95...240 V AC; 80...340 V DC
Power consumption	15 VA
Current measurement	.../1A/5A
Minimum working current	5 mA
Power consumption	0.2 VA
Measurement method and measurement precision	Class A (according to IEC 61000-4-30)
Voltage	± 0.1 %
Current	± 0.2
Power	± 0.2 %
Active power	Class 0.2S at .../5A
Active power	Class 0.5S at .../1A
Reactive power	Class 2 at .../1/5A
Operational ambient temperature	-10 °C ...+55 °C
Relative humidity	5 up to 95 %
Ingress protection	Front IP50, rear IP20
Dimensions	144 x 144 x 81 mm (W x H x D)
Including	Configuration and visualization software EM-PQ VIS Patch cable 3 m, (EM-PQ - Switch/Hub connection) Patch cable 2 m, cross-over (EM-PQ - PC connection) Fastening clamps
Article-No.	29-20110

Optional Accessories

Article-No.	Type	Description
29-20112	Plug DB-9 WITH termination	Terminal plug DB-9 bush (with screw terminals)
29-20113	Plug DB-9 WITHOUT termination	Terminal plug DB-9 bush (with screw terminals)
29-20114	EM-PQ-VIS	Configuration and visualisation software for Power Quality Monitor for EM-PQ 2100, 2200, 2500 and 3000

Dimensions



Dimensional drawing EM-PQ 3000

All dimensions in mm

EM-PQ 2500
Power Quality Analyzer

Mains monitoring device for control panel installation to detect, monitor and analyze electrical measurement variables in mains up to 720 V (phase/phase) with 4 current transformer inputs and 4 voltage inputs. Direct connection to the FRAKO Energy Management System via integrated interfaces RS485 (Modbus RTU) or Ethernet (Modbus TCP/IP).

Description

Measuring functions:

- Frequency of fundamental 40 Hz ... 70 Hz
- Measuring intervals from 10/12 (50/60 Hz) periods (200 ms)
- Continuous scanning with 20kHz per channel and calculation of the following measurement readings:
  - Voltage L-N, neutral point displacement voltage
  - Voltage imbalance L1 ... L3
  - Voltage L-L
  - Frequency (equally for all channels)
  - Current, total current L1 ... L3, total current L1 ... L3+N
  - Power (active, reactive, apparent power, power factor, distortion reactive power)
  - Fundamental power (active, reactive, apparent power, cos phi, phase shift)
  - Summation L1 ... L3 of the above mentioned performance values
  - Summation L1 ... L4 (active, reactive, apparent power)
  - Active power (regenerated and consumed)
  - Reactive power (capacitive and inductive)
  - Fourier analyses 1st ... 40th harmonic component (harmonics) for current, voltage, active and reactive power
  - Distortion factors (THD) von current and voltage
- Allocation of the measurement readings to generate protocols for voltage and costs

Detection and recording:

- Detection and recording of the minimum, maximum and average value of the measurement readings defined by the user as well as the acquisition periods for histograms of the parameterized time periods
- Detection of under- and overvoltages U_{rms}
- Detection of voltage failures U_{rms}
- Detection of inrush currents (10 ms)
- Detection of transients >50 microsec.
- Energy meter (active and reactive power, regenerated and consumed) with 8 tariffs
- Internal data storage: 256 MB Flash memory

Device equipment:

- Active matrix display (TFT B x H: 115 x 88 mm), resolution (Pixel): 320 x 240, brightness (cd/m²): 300, screen diagonal 5.7 inch
- Embedded Webserver

Technical Data

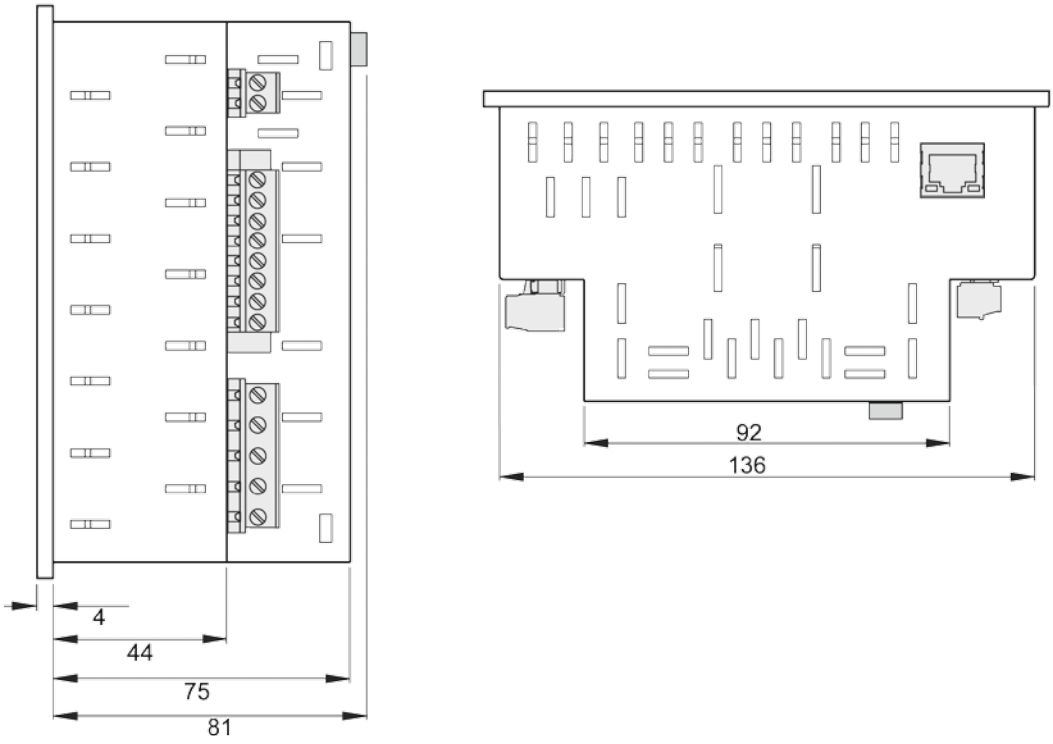
- Inputs:
  - 4 Voltage measurement inputs
  - 4 Current measurement inputs ../1/5A
  - 8 digital inputs: e. g. to change the tariffs, for external synchronisation and to release the records, pulse meter for external consumption meters
- Outputs:
  - 5 digital outputs, can also be programmed as a pulse or signal output
- Interfaces / Protocols:
  - RS-485, Protocol: Modbus RTU/Master and Slave for connecting with the FRAKO Energy Management System
  - Profibus DP V0 Interface, with gateway function
  - Ethernet 10/100 TBase Modbus RTU Master/Slave for connection to FRAKO Energy Management System, Modbus-Gateway, BACnet / IP or MSTP (optional)
  - All interfaces run simultaneously
  - Protocols: Modbus TCP/IP (Port 502), Modbus over TCP/IP (Port 8000), HTTP, SMTP, SNMP, SNTP, TFTP, FTP, DHCP
  - Built-in homepage for remote maintenance and diagnostics with open structure for application-specific adjustment
  - User programmable e-mail dispatch, e.g. in case of an alarm
  - Supports HTML pages, Java Applets, Flash MX and ActiveX
- Configuration and visualization software EM-PQ VIS:
  - Readout and visualization of measurement readings
  - Automatic ring buffer download of the devices
  - Storage of data in a Derby database
  - Optional: MS SQL and MySOL database drivers
  - Graphical representation and analysis of online- and of-fline-measurement readings
  - Freely configurable topology with freely selectable register levels
  - Configuration of the measurement devices
  - Parameterisation, visualization, data management, analysis
  - Cost centre management
  - Reporting funktion (Voltage and cost centres) for freely definable time periods
  - Statistics function
  - Data export into a CSV file
  - Possibility of customer specified programming (SPS-functionality)
  - The following operating systems are supported:
    - Microsoft® Windows XP® (Service Pack 3 or higher)
    - Microsoft® Windows Vista® (Service Pack 1 or higher)
    - Microsoft® Windows 7,
    - MAC OS® (10.5 or higher),
    - Linux and Unix
- Programming:
  - Integrated interpreter to create customized user programs, e.g. alarms, cost centre allocation, operating conditions, ...
  - Freely accessible internal variables (measurement readings…) via reloadable user programs
  - 7 user programs can run at the same time

Overvoltage category	600V CAT III
Rated voltage in 4-wire system	max. 417/720 V AC, +10 %
Rated voltage in 3-wire system	max. 480 V AC, +10 %
Frequency of auxiliary voltage	45 - 65 Hz
Power consumption	0.1VA
Auxiliary voltage	L-N 95...240 V AC; 80...340 V DC
Power consumption	15 VA
Current measurement	.../1A/5A
Minimum working current	5 mA
Power consumption	0.2 VA
Voltage	± 0.1 %
Current	± 0.2
Power	± 0.2 %
Active power	Class 0.2 at .../5A
Active power	Class 0.5 at .../1A
Reactive power	Class 2 at .../1/5A
Operational ambient temperature	-10 °C...+55 °C
Relative humidity	5 up to 95 %
Ingress protection	Front IP50, Rear IP20
Dimensions	144 x 144 x 81 mm (W x H x D)
Including	Configuration and visualization software EM-PQ VIS Patch cable 3 m, (EM-PQ - Switch/Hub connection) Patch cable 2 m, cross-over (EM-PQ - PC connection) Fastening clamps
Article-No.	29-20109

Optional Accessories

Article-No.	Type	Description
29-20112	Plug DB-9 WITH termination	Terminal plug DB-9 bush (with screw terminals)
29-20113	Plug DB-9 WITHOUT termination	Terminal plug DB-9 bush (with screw terminals)
29-20114	EM-PQ-VIS	Configuration and visualisation software for Power Quality Monitor for EM-PQ 2100, 2200, 2500 and 3000

Dimensions



Dimensional drawing EM-PQ 2500

All dimensions in mm

EMA 1101
Mains Monitoring Instrument

Microprocessor 3-phase measurement and monitoring unit with optional connection to the FRAKO Starkstrombus® to detect, analyze and monitor electrical measurement variables in 400 V and 525 V low voltage mains or medium voltage mains (100 V secondary).

Description

Measuring functions:

- Frequency of fundamental from 40 Hz ... 70 Hz
- Measuring intervals from 10/12 (50/60 Hz) periods (200 ms)
- Continuous scanning with 20kHz per channel and calculation of the following measurement readings:
  - Voltage L-N, neutral point displacement voltage
  - Voltage imbalance L1 ... L3
  - Voltage L-L
  - Frequency
  - Current, total current L1 ... L3, total current L1 ... L3+N
  - Power (active, reactive, apparent power, power factor)
  - Fundamental power (active, reactive, apparent power, cos phi, phase shift)
  - Summation L1 ... L3 of the above mentioned values
  - Summation L1 ... L4 (active, reactive, apparent power)
  - Active power (regenerated and consumed)
  - Reactive power (capacitive and inductive)
  - Fourier analyses 1st ... 40th harmonic component of current, voltage, active and reactive power
  - Distortion factor (THD) of current and voltage
- Allocation of the measurement readings to generate protocols of voltage and costs
- Measurement via three external current converters
- Measurement of active demand for incoming and regenerated power
- Menu-driven in plain text and 6 parameters displayed for direct comparison
- Alarm on exceeding set limits with potential-free NO contact as well as plain text shown on a flashing backlit display
- Visualisation of the currents as a bar graph to determine the utilization capacity
- Menu-driven programming in plain text with operator guidance
- Backlit display
- Storage of all meter readings and limit values in the event of a mains failure
- Illuminated LC display of measured values

Technical Data

Power supply	
Mains voltage	230 VAC +/- 10 %
Power consumption	Max. 7 VA
Fuse protection	2 A external protection required
Measurement input	
Voltage path	3x 250 to 550 V AC (external / external conductor) Power consumption: max. 1.0 VA/external conductor Fuse protection: 2 A external protection required
Current path	3x X/ 5 A (transformer current > 6 mA) Power consumption: max. 1.8 VA/ transformer connection
Outputs	
1 Alarm signalling contact	250 V AC / max. 3 A (potential-free NO contact)
Inputs	
Tariff inputs	2 profiles selectable (e. g. HT/NT)
Interfaces (mode can be selected)	
1 FRAKO Starkstrombus®	For connection to FRAKO Energy Management System, according to EN 50170 (P-Net), standardised fieldbus, RS-485 Transfer rate: 76.8 kbit/s
RS-232 Interface	Can be directly connected with a PC via RS-232 interface Transfer rate: 19 200 Baud
Operating elements	Membrane keyboard with 5 keys
Display elements	Lid LCD (4 lines each of 20 characters)
Connections	Plug-in connecting strips (supplied)
Mechanical construction	
Dimensions	Front plate dimensions: 144 x 144 mm (DIN 43700) Switch panel aperture: 138 x 138 mm (DIN 43700) Installation depth: 105 mm
Ingress protection	Housing/Terminals IP54/20 according to VDE 0470 / EN60529
Version	According to VDE 0411 / EN 61010 Contamination level 3, EN 50081, EN 50082
Housing	Flame retardant UL94-V0
Installation	From front panel with screwdriver
Mounting position	Optional
Weight	Approx. 1.3 kg
Operating conditions	
Ambient temperature	0 °C up to +50 °C

Versions

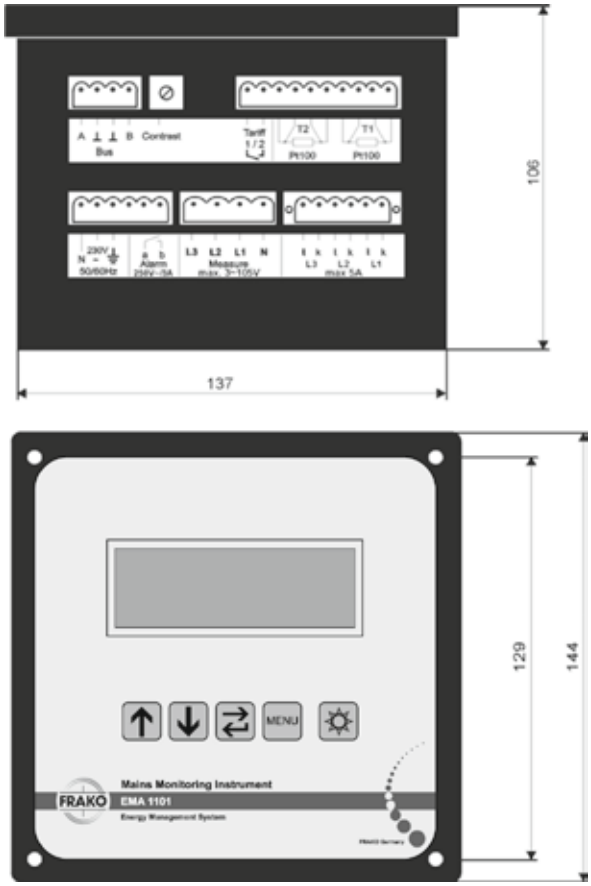
Article-No.	Type	Mains Monitoring Instrument for use in
20-30011	EMA 1101 S	3-phase 400 V and 525 V low-voltage systems
20-30005	EMA 1101	3-phase 400 V and 525 V low-voltage systems; Connection to FRAKO Starkstrombus®
20-30008	EMA 1101 105V	Medium-voltage systems (100 V secondary); Connection to FRAKO Starkstrombus®
20-30007	EMA 1101 DP	3-phase 400 V and 525 V low-voltage systemes, with Profibus-DP interface
20-30009	EMA 1101 DP 105V	Medium-voltage systems (100 V secondary), with Profibus-DP interface

	EMA 1101 S	EMA 1101	EMA 1101 105V	EMA 1101-DP	EMA 1101-DP 105V
For use in 3-phase 400 V and 525 V low-voltage systems	•	•		•	
For use in medium-voltage systems (100 V secondary)			•		•
Connection to FRAKO Starkstrombus®		•	•		
Profibus-DP interface				•	•
Determination of current in PEN (neutral conductor + PE)		•	•	•	•
Bar chart display of the currents and distortion factors		•	•	•	•
Connection to a PC or modem via RS-232 interface (optional)	•	•	•		

Optional Accessories

Article-No.	Type	Description
20-10310	EM-RS 232	RS-232 adapter for direct access via PC to the data of EMA 1101 (SW-Version 1.11 or higher), EMR 1100 (SW-Version 1.95 or higher) or EMF 1102 (SW-Version 1.0 or higher)
20-10309	EM-RS 232 for modem operation	RS-232 adapter for access to the data of EMA 1101 (SW-Version 1.11 or higher), EMR 1100 (SW-Version 1.95 or higher) or EMF 1102 (SW-Version 1.0 or higher) via modem
20-10311	EMA-SW	Software for the configuration and online-display of the Mains Monitoring Unit EMA 1101. Access via: EMIS 1500, EMP 1100, EMT 1101 and RS-232 adapter. Note: included with FRAKO-NET (when supplied on CD).

Dimensions



Dimensional drawing EMA 1101

All dimensions in mm

EMA 1496
Mains Monitoring Instrument

The unit measures and displays all major electrical and power quality parameters, including imported real and reactive energy, in terms of Wh, kWh, MWh, VArh, KVArh and MVArh for single phase, three-phase-3-wire or three-phase-4-wire supplies. In order to measure these parameters, the unit requires voltage and current inputs in addition to the supply required to power the unit. The current input (s) are obtained via current transformers (CTs).

The unit can be configured to work with a wide range of CTs, giving the unit a wide range of operation. Option modules can be fitted to provide pulse and RS-485 Modbus/JC N2 outputs.
The unit can be powered from a separate auxiliary a.c. (or d.c.). Alternatively it can be powered from the monitored supply, where appropriate.

Description

- Precise display of all major electrical and power quality parameters
- Measures 17 electrical parameters, including total harmonic distortion (THD) up to the 31st harmonic
- Energy meter for active and reactive power
- Plug-in output modules (option):
  - 1 output per module
  - Max. 2 modules possible (type, valency, duration) for active or reactive work (kWh or kvarh) for transmission to FRAKO Cost Centre and Alarm System EMF or PLC
- Plug-in output module (option) for connection to a FRAKO Energy Management System, Modbus RTU
- Front panel installation, DIN 96 enclosure

Optional Accessories

- Programmable pulse output (EMA 1496 EXT IMP): Type, valency and duration - active or reactive work (kWh or kvarh) can be provided for PLC or FRAKO EMF 1102 Cost Centre and Alarm System
- Module RS-485 (EMA 1496 EXT MODBUS): Connection of EMA 1496 to the FRAKO Energy Managment System can be realized via this interface RS-485 using the Modbus RTU or the Johnson Controls® Metasys® N2 protocol, enabling all measurement readings to be recorded and monitored.

Technical Data

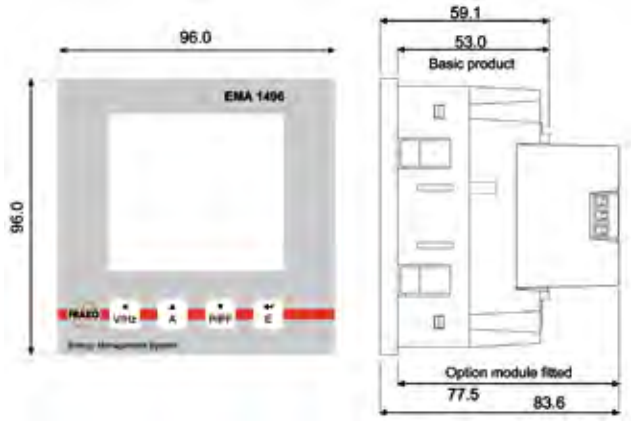
Power supply	
AC voltage	110 up to 400 V AC (max. 99 up to 440 V AC)
DC voltage	120 up to 350 V DC (max. 96 up to 420 V DC)
Frequency	45-66 Hz
Power consumption	Max. 5 VA
Measuring input	
Connection type 3/4/5-wire	•/•/- , 2-wire and single-phase
Current measurement input	3 x X/5A
Voltage measurement input	3 x 100-289 V AC (phase/neutral conductor) 3 x 173-500 V AC (phase/phase conductor)
In-/Outputs	
Analogue In-/Outputs	- / -
Digital In-/Outputs	- / optional plug-in for active and reactive energy
Interfaces	
FRAKO Energy Management System	Optional plug-in module offers connectivity via Modbus RTU
Measurement accuracy	
Current	0.5 %
Voltage	0.5 % (4 %: I2 in 3-phase 3-wire operation)
Calculated neutral current	4 %
Power factor	1 % of equality
Frequency	0.1 Hz
Active power	± 1 % of range maximum
Reactive power	± 1 % of range maximum
Apparent power	± 1 % of range maximum
Active energy	Class 1 (IEC 62053-21)
Reactive energy	± 1 % of range maximum
THD	1 % up to 31st harmonic
Response time to step input	1 s, typical to 99 % of the final value
Repetition rate recording	Max. 300 ms (maximum for %THD registration)
Operating elements	4 keys
Display elements	Backlit LCD
Connections	Covered box terminals: 0.05-2.5 mm²

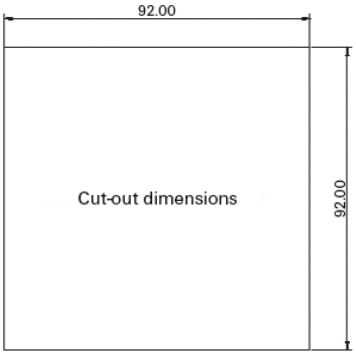
Mechanical construction	
Dimensions	96 x 96 x 64.1 (W x H x D), installation depth: 58 mm (with modules: 82.5 mm)
Ingress protection	Front: IP52 (IP54 using an additional seal) Housing: IP30
Version	IEC 61326/61010-1/62053-21
Housing	Flammability to UL 94-V0
Installation	Front panel installation
Weight	300 g
Operating conditions	
Operating temperature	–10 °C up to +55 °C
Article-No.	29-20144

Optional Accessories

Article-No.	Type	Description
29-20145	EMA 1496 EXT IMP	Configurable pulse module for Mains Monitoring Instrument EMA 1496 for passing the pulses of active and reactive power (kWh or kVArh) to a PLC or the Cost Centre and Alarm Unit EMF 1102. Type, valency and duration of the pulse output can be configured.
29-20146	EMA 1496 EXT MODBUS	Communication module for Mains Monitoring Instrument EMA 1496 for connection to the FRAKO Energy Management System via RS-485 with JBUS-/Modbus-Protocol, enabling all measurement recordings to be recorded, monitored and analyzed by PC using the visualization software EMVIS 3000. For connection to EMIS® 1500 Central Unit a Modbus coupler (Art.-Nr. 20-10220) is required.

Dimensions





Dimensional drawing EMA 1496

All dimensions in mm

Display Units

The monitoring of currents, harmonics, temperatures, etc. has now become standard practice to uphold supply network quality. The FRAKO Starkstrombus® and the other components of the system form a powerful energy information system. All data are available centrally.

	EM-FD 2500	EM-FD 1500
		
Voltage	supplied via EM device	24 V DC ± 15 % or 85-264 V AC
Frequency	-	50/60 Hz
Power consumption	Max. 3 VA	Max. 3 VA
Operating-/display element	9 buttons / bright LC display / 1 LED	9 buttons / bright LC display
Interfaces		
CAN-Bus	•	
RS-232 / RS-485	-	-
Connection with	EM-MC 2200 EM-PQ 2300	EM-PQ 1500
Catalogue page	Page 241 ff.	Page 243 ff.

EM-FD 2500
Display Unit

The EM-FD 2500 is a graphic display in DIN rail housing to display measurements and wave forms of up to 7 Energy Management devices of the latest generation (e.g. Maximum Controller EM-MC 2200 or Mains Monitoring Unit EM-PQ 2300).

Description

- Front mounting of the display with little effort by a Ø 22.5 mm fixing and a screw to prevent rotation
- Only one cable (4-pin) from the display to the EM device
- Connection of max. 8 EM devices via display bus:
  - 1 display + 7 EM devices
  - 2 displays + 6 EM devices

Technical Data

Power supply	
Voltage	11 V up to 16 V DC, reverse polarity protection, power is to be connected by the EM device
Fuse protection	Internal via 500 mA SMD fuse
Power consumption	Max. 3 VA
Connections	Via plug-in terminals
Conductor cross-section	Max. 1.5 mm²
Interfaces	
Display bus	CAN according to ISO 11898, RS-485, impedance level 120 Ohm Transfer rate: 1 Mbit/s Length of bus: max. 40 m
Mechanical construction	
Dimensions	147 × 147 × 53 mm (W × H × D) including connector, cabinet overhang 23 mm, depth cabinet max. 30 mm, including connector
Ingress protection	Front panel IP54 when using the enclosed sealing mat, housing front IP50 without sealing mat, terminals and terminal area IP20, degree of pollution 3, all data according to DIN EN 60529
Installation	In the front panel / door through a central hole Ø 22.5 mm and a hole for anti-turn locking , Ø 3.5 mm
Version	Insulated housing, Protection class 3 (SELV), working voltage up to max. 16 V
EMV	EMV according to EN 61326 -1, EN 61000-4-2 electrostatic discharge air 8 kV and conductive 4 kV with horizontal and vertical coupling plate, EN 61000-4-3 EMS radiated 80 MHz - 1GHz, horizontal and vertical, level 10 V/ m = irradation industries Class B, EN 61000-4-4 Burst 1 kV capacitive on cable, EN 55022A EMI 30 MHz - 1 GHz = irradation residential area Class A
Weight	330 g
Operating conditions	
Temperature range	0 °C up to +60 °C, no dewing
Installation height	Geographical height max. 2000 m
Article-No.	20-30240

Optional Accessories

Article-No.	Type	Description
20-30242	Adapter plate for EM-FD 2500	Adapter for installation of the EM-FD 2500 in a cabinet opening (138 x 138 mm)

EM-FD 1500
Display Unit

Display unit EM-FD 1500 for connection to Power Quality Monitor EM-PQ 1500.

Description

- Displays the data of up to 15 Power Quality Monitors EM-PQ 1500
- Only one line (max. 10 m) from the display unit to the measuring unit
- Plain text menu with illuminated display and keys
- Front mounting the display unit with little effort by only 2 × Ø 22.5 mm dia attachments
- Supply of the display via the control module

Technical Data

Connection	
Power supply (control unit)	EM-FD 1500 24 V DC: 24 V DC +/- 5 % EM-FD 1500 230 V AC: 230 V AC +/- 10 %
Control	EM-FD 1500 24 V DC: 7-wire cable, min. 0.30 mm² each conductor EM-FD 1500 230 V AC: 5-wire cable, min. 0.30 mm² each conductor
Control distance	Max. 10 m between EM-FD 1500 and EM-PQ 1500
Mechanical construction	
Dimensions	Display unit: 87 x 87 x 21 mm (W x H x D) Control unit: 75 x 58 x 37 mm (W x H x D)
Ingress protection	Display unit IP65 (after mounting)
Mounting	In the front door, max. door thickness 6 mm
Mounting position	Optional
Weight	Approx. 0.3 kg
Operating conditions	
Ambient temperature	0 °C up to +55 °C, avoid condensation

Versions

Article-No.	Type	Description
20-30230	EM-FD 1500 24 V DC-package (incl. power supply)	Display unit EM-FD 1500 for connection to Power Quality Monitor EM-PQ 1500; 24 V DC, incl. power supply
20-30231	EM-FD 1500 24 V DC-package (without power supply)	Display unit EM-FD 1500 for connection to Power Quality Monitor EM-PQ 1500; 24 V DC, without power supply
20-30232	EM-FD 1500 230 V AC-package	Display unit EM-FD 1500 for connection to Power Quality Monitor EM-PQ 1500; 230 V AC

	EM-FD 1500 24 V DC + power supply	EM-FD 1500 24 V DC	EM-FD 1500 230 V AC
Display unit EM-FD 1500	•	•	•
Module 24 V DC	•	•	
Module 230 V AC			•
Connecting cable 2.5 m (EM-PQ 1500 with 24 V DC module)	•	•	
Connecting cable 2.5 m (EM-PQ 1500 with 230 V AC module)			•
2 ferrule resistors for EM-PQ 1500	•	•	•
Power supply 24 V DC	•		

EMIS® 1500
Central Unit

A network-compatible central unit for data acquisition and data management of the measuring devices connected.

Description

The Central Unit EMIS® 1500 represents latest data collector technology. In addition to the widespread Ethernet technology with TCP/IP, the Linux operating system is used within EMIS® 1500. The measuring devices are connected via different interfaces to the EMIS® 1500 Central Unit.Several PCs can be connected online to the EMIS® 1500 simultaneously.

Data collection and storage with the following devices:
- Power Quality Analyzer series EM-PQ
- Mains Monitoring unit EMA 1101
- Power Factor Control Relay EMR 1100
- Modbus devices via Modbus coupler or Modbus TCP
- M-Bus devices via separate coupler

A comprehensive alarm functionality allows:
- that upper and/or lower alarm limits can be defined for all measured data points, accessed by EMIS® 1500 from instruments
- that individual alarms or groups of alarms can be linked to the following signalling methods: contacts at the EMIS® 1500 Central Unit, network printer, SMS-, Telefax- and E-Mail messages, alarm reports

The measuring devices can be integrated in two ways:
- via Ethernet standard (TCP/IP) to a Gateway device with FRAKO Starkstrombus® interface

or
- via the internal FRAKO Starkstrombus® interface

With a PC there are different ways to have access to the Central Unit:
- Connection via Ethernet (TCP/IP-Protocol)
- via a modem using a dial-up network

The Linux operating system installed allows simultaneous online connection to the Central Units via several PCs.

The Central Unit EMIS® 1500 is configured with the FRAKO-NET software package (included in delivery).

Each measuring device requires a certain number of system points. The devices can be used in any combination, provided that the maximum number of system points will not be exceeded.

Technical Data

Power Supply	
Supply voltage	230 V AC +/- 10 % or (switchable): 110 V AC +/- 10 %
Frequency	45 up to 65 Hz
Power consumption	Max. 50 VA
Interfaces	
1 Ethernet	RJ45, connection of LAN network Protocol: TCP/IP Transmission: 100BaseTx full duplex
2 Serial interfaces	9 pole Sub-D connector (male), RS-232 for dial-up or direct connection Transfer rate: up to 115 200 Baud
Connection to FRAKO Starkstrombus®	Electric connection: according to EIA RS-485 standard Transfer rate: 76.8 kbit/sec Protocol: FRAKO Starkstrombus®
Display-/operating elements	3 LEDs, 4 buttons, lit LC-Display
Outputs	
3 Alarm signalling contacts	Potential-free normal open contacts, freely programmable Loading: max. 48 V AC/DC, max. 1 A
Mechanical construction	
Dimensions	300 x 75 x 220 mm (W x H x D)
Ingress protection	Housing IP40, Terminals IP20
Housing material	Metal housing
Installation position	Standing / vertical
Weight	3.4 kg
Ambient temperature	0 up to +50 °C
PC requirements for FRAKO-NET software package	
Hardware	• Min. Intel Core I5 • Main memory min. 4 GB RAM • 10 GB free hard drive space • Ethernet 10/100 Mbit/s network connection or/and one free serial interface • DVD drive • SVGA graphics adapter • Colour screen with minimum resolution of 1024 x 768
Software	• Microsoft® Windows® 7 (x32/x64) • Microsoft® Windows® Server 2008 R2 • Microsoft® Windows® Server 2003 R2 • Microsoft® Internet Explorer 5.5 * Registered trademarks of Microsoft Corporation

Versions

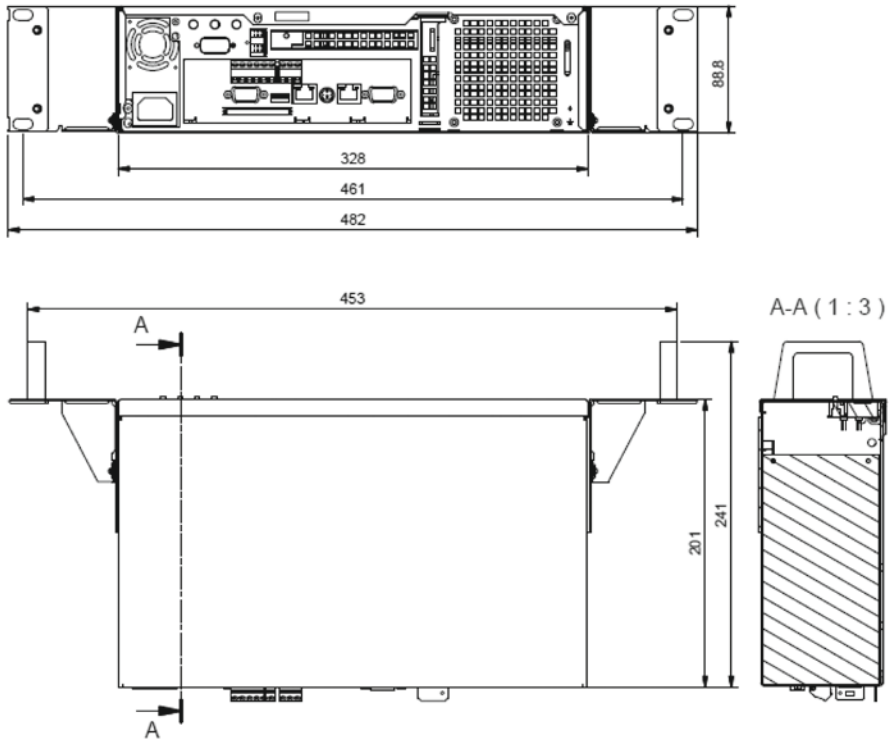
Article-No.	Type	Number of system points
20-10081	EMIS® 1500 S	50
20-10082	EMIS® 1500 M	100
20-10083	EMIS® 1500 L	200
20-10084	EMIS® 1500 XL	350
20-10085	EMIS® 1500 XXL	550

Optional accessories

Article-No.	Type	Description
20-10079	EMIS® 1500 19" installation kit	EMIS® 1500 Installation kit 2RU for installation in 19" rack, consisting of mounting frame, cage nuts and fixing screws
20-10481	EMIS® 1500 software upgrade (S auf M)	Upgrade of the EMIS® 1500 S Central Unit (50 system points) to an EMIS® 1500 M (100 system points)
20-10482	EMIS® 1500 software upgrade (M auf L)	Upgrade of the EMIS® 1500 M Central Unit (100 system points) to an EMIS® 1500 L (200 system points)
20-10483	EMIS® 1500 software upgrade (L auf XL)	Upgrade of the EMIS® 1500 L Central Unit (200 system points) to an EMIS® 1500 XL (350 system points)
20-10484	EMIS® 1500 software upgrade (XL auf XXL)	Upgrade of the EMIS® 1500 XL Central Unit (350 system points) to an EMIS® 1500 XXL (550 system points)
20-10058	Flash Card	Flash Card 256 MB, industrial version, prepared for EMIS® 1500
20-10493	EMIS® 1500 System points upgrading package	Upgrade of the EMIS® 1500 Central Unit (50 system points)
29-20064	EM-PC modem	Telephone modem for remote data transmission (serial interface) between PC and EMIS® 1500, EML or EMP. Analogue connection to the telephone network.

System points per integrated device	Upper limits
30 System points per EML 1101	max. 4 units EML 1101 per EMIS 1500
30 System points per EM-MC 2200	max. 4 units EM-MC 2200 per EMIS 1500
15 System points per EM-PQ 2100	
15 System points per EM-PQ 2200	
15 System points per EM-PQ 2300	max. 32 units EM-PQ 2300 per EMG in Slavemode, or max. 8 in Mastermode
15 System points per EM-PQ 2500	
15 System points per EM-PQ 3000	
15 System points per EMA 1101	max. 32 units EMA 1101 per EMG 1500-PN
5 System points per EMR 1100	max. 32 units EMR 1100 per EMG 1500-PN
7 System points per EM-PQ 1500	max. 32 units EM-PQ 1500 per EMG 1500-PN
3 System points per PL-SENSOR	max. 8 units PL-Master per EMIS 1500
1 System point per channel of EML 1101, EMA 1101, EM-PQ or EMF 1102	max. 550 metering-, analogue-, status- or alarm channels per EMG 1500-PN

Dimensions



Dimensional drawing EMIS® 1500

All dimensions in mm

FRAKO-NET

- The “operating system”
- Contains all the tools needed to configure FRAKO instruments
- Also contains a monitoring function for all instruments, for example to verify measurement readings
- Backup tools for saving data and saving the configurations of all instruments
- Informs the user, by e mail for example, if a fault occurs or an irregularity is detected in the system
- Contains an OPC client for importing data from outside the system
- Also makes it possible to import data in CSV format
- An enabling license (10 or 50 data points) is required

EMVIS 3000
System-Visualization

The FRAKO visualization software EMVIS 3000 is used to display and evaluate measurement readings, statuses and events from the entire internal utilities supply of a company.

Description
The EMVIS 3000 software is a powerful tool for displaying and documenting all the measurement data from the instruments connected to it. It comprises the following functional modules:

EMVIS 3000 Project
The project planning tool ...
- Unrestricted configuration and compilation of evaluations of all data processed by the system
- Calculation of **performance figures**
  Performance figures are virtual data points calculated from other data points
- Creation of **benchmarking** charts
  Benchmarking makes a direct comparison of measurement data or performance figures possible
- Creation of **Sankey** diagrams
  A Sankey diagram gives a clear overview of any type of flow, e.g. the flow of utilities. The width of each stream into and out of a location is proportional to the quantity flowing, absolute and percentage values also being stated
- Easy Customizing - individual planning of views - simple and intuitive (the basic package includes 3 views with up to 20 online data points in total)

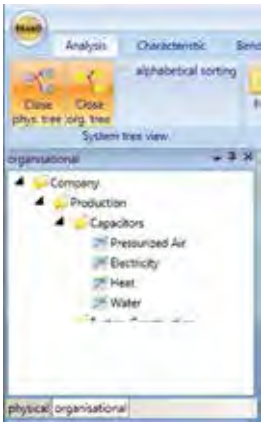
EMVIS 3000 Report
The reporting tool ...
- To simplify navigation, a clear overview of the entire system is displayed in two system trees, either of which can be selected:
  – **Physical:** standard evaluations of all the instruments and channels registered with the system
  – **Organizational:** all evaluations that have been compiled with EMVIS 3000 Project
- Presentation of historical data for analysis and comparison purposes, e.g. different locations or different periods of time
- The historical data can be exported directly from the chart or consumption table for further processing
- Direct access to the momentary readings of the connected instruments
- Readout of the events that have occurred

EMVIS 3000 Live
- Views created individually - from site layout drawings right down to the distribution board
- Display of the momentary measurement readings and statuses

The EMVIS 3000 license enables the software to be installed on several PCs (server and clients) and an EMIS® 1500 Central Unit to be accessed.

In the physical system tree prepared standard evaluations are deposited for all measurement devices. This allows the user to visualize the recorded historical data.

Via physical system tree the actually measured data of all EM devices can readily be accessed.



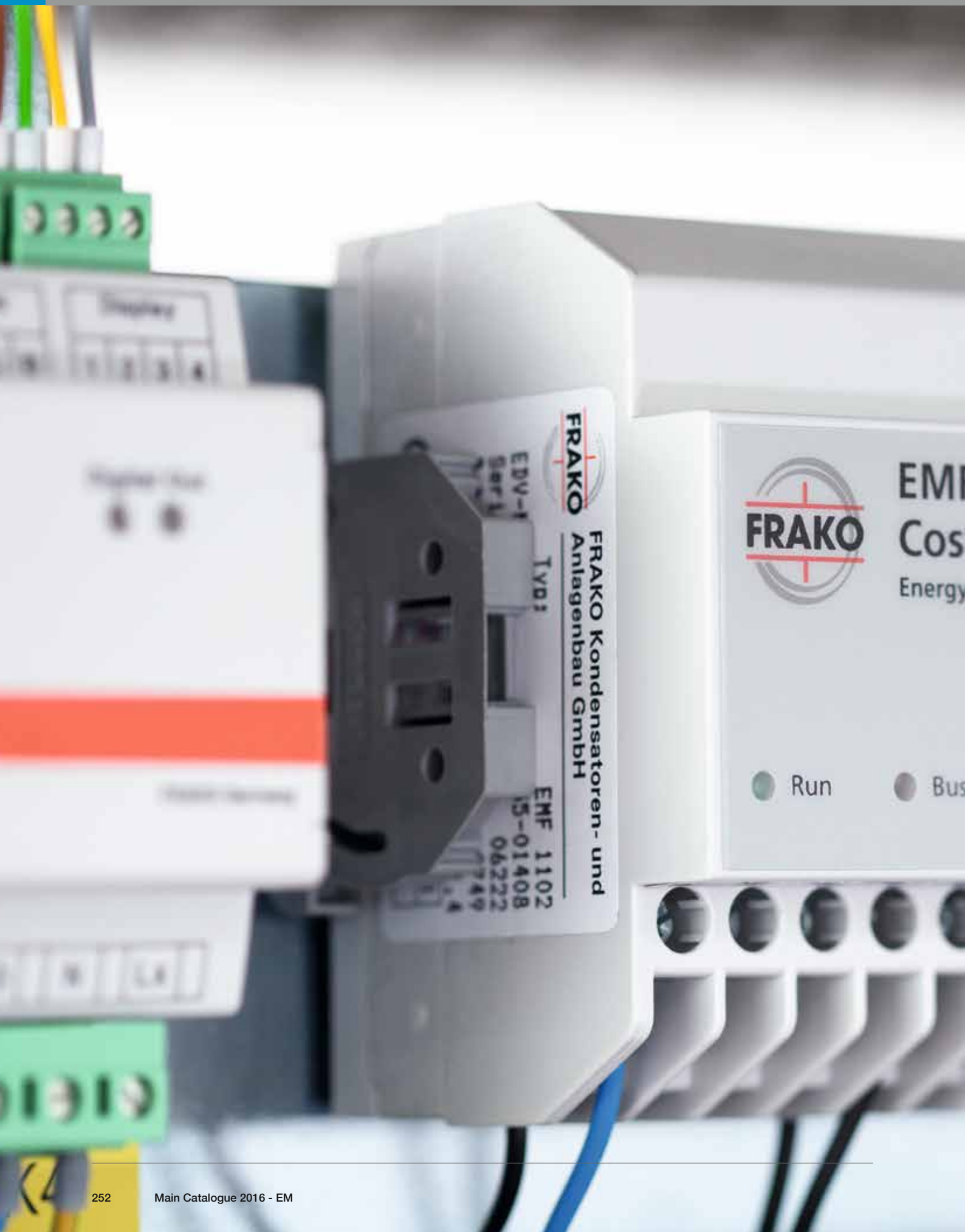
Within the organizational system tree business specific structures are deposited. The business specific structures are projected in form of individual evaluation in the organizational system tree by the customer.

Technical Data

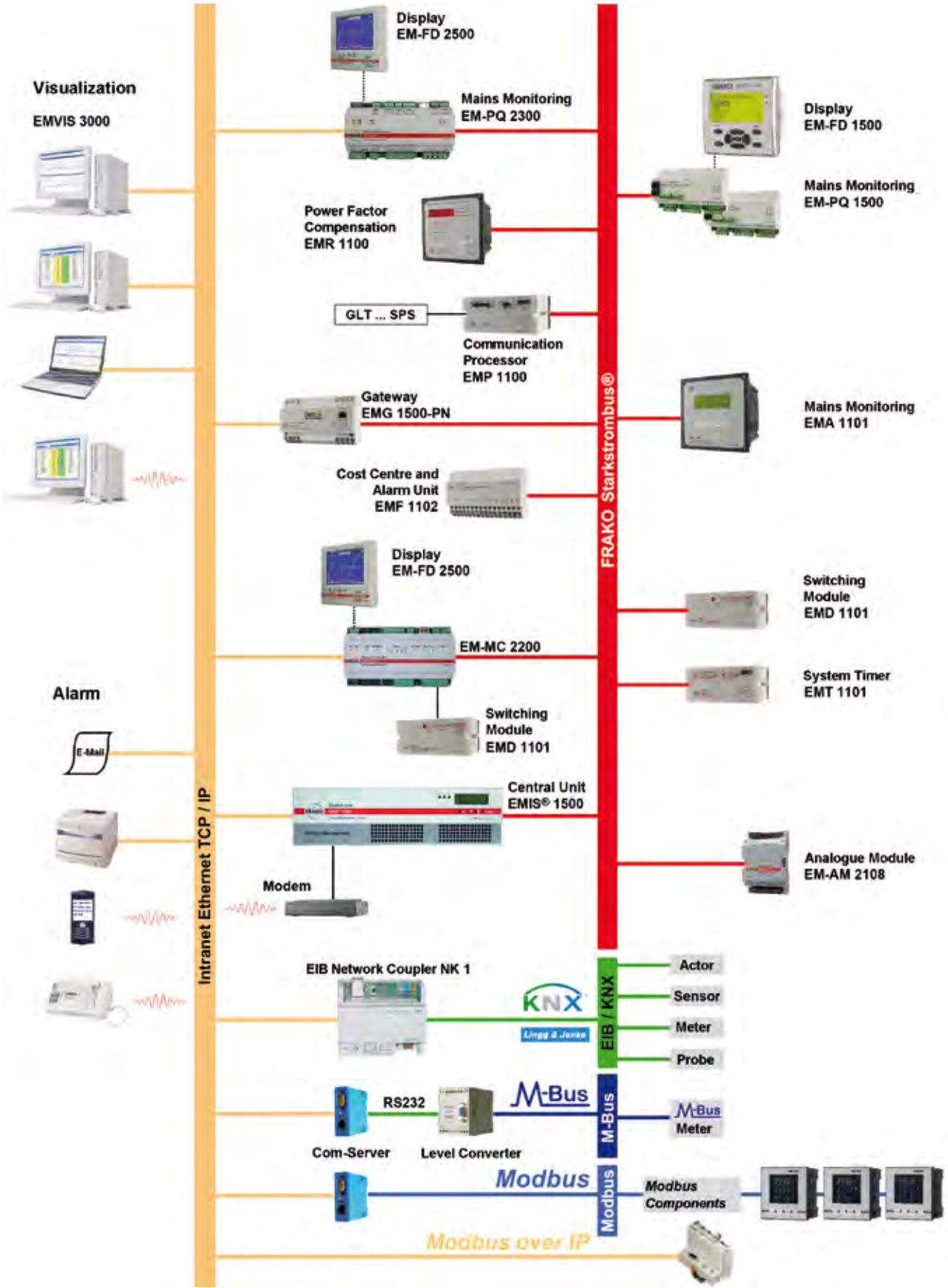
PC requirements for small and medium systems	
Hardware	• Min. Intel Core I3-Processor • User memory: 4 GB RAM • 1 GB free hard disk space • Graphics adapter: min. DirectX 9.0c support and 512 MB video memory
Software	• Microsoft® Windows®* 7 (x32/x64) Microsoft® Windows®* 8 (x32/x64) • Microsoft® Windows®* Server 2008 R2 • Microsoft® Windows®* Server 2003 R2 • .NET 4.0 FULL • .NET 3.5 • FRAKO-NET V1.26.0001 (or higher) • SQL data base Firebird 2.0 (included in FRAKO-NET) * Registered trademark of Microsoft Corporation
Article-No.	20-10649

EMVIS 3000 Extension packages

Article-No.	Type	Description
20-10485	Extension license Central Unit	Allows EMVIS 3000 the access to an additional Central Unit EMIS 1500
20-10650	EasyCustomizing-S	Individually designed views with up to 100 data points
20-10651	EasyCustomizing-M	Individually designed views with up to 200 data points
20-10652	EasyCustomizing-L	Individually designed views with up to 350 data points
20-10653	EasyCustomizing-XL	Individually designed views with up to 550 data points
20-10654	EasyCustomizing-XXL	Individually designed views with up to 1000 data points


FRAKO
FRAKO Kondensatoren- und Anlagenbau GmbH
Typ:
EMF 1102
FRAKO
Run

ENERGY MANAGEMENT


Visualization
EMVIS 3000
Alarm
E-Mail
Intranet Ethernet TCP / IP
Display
EM-FD 2500
Mains Monitoring
EM-PQ 2300
Power Factor
Compensation
EMR 1100
GLT ... SPS
Communication
Processor
EMP 1100
Gateway
EMG 1500-PN
Cost Centre and
Alarm Unit
EMF 1102
Display
EM-FD 2500
EM-MC 2200
Switching
Module
EMD 1101
Central Unit
EMIS® 1500
Modem
EIB Network Coupler NK 1
KNX
Unga & Jonke
RS232
Com-Server
Level Converter
M-Bus
Modbus
Modbus over IP
FRAKO Starkstrombus®
Display
EM-FD 1500
Mains Monitoring
EM-PQ 1500
Mains Monitoring
EMA 1101
Switching
Module
EMD 1101
System Timer
EMT 1101
Analogue Module
EM-AM 2108
EIB / KNX
Actor
Sensor
Meter
Probe
M-Bus
M-Bus
Meter
Modbus
Modbus
Components

1

System Components

Central Unit

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Gateways

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Repeater

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Switching Module

Page 267

EMIS® 1500
Central Unit

A network-compatible central unit for data acquisition and data management of the Energy Management devices connected.

Description

The well-established FRAKO Energy Management System has been steadily and systematically developed. The Central Unit EMIS® 1500 is a further example and represents state-of-the-art data collector technology.
In addition to the widespread Ethernet technology with TCP/IP, the Linux operating system is used within EMIS® 1500.
The Energy Management units are connected via the FRAKO Bus® to the EMIS® 1500 Central Unit, but can also be connected through one or more Gateways EMG 1500-PN.
Several PCs can be connected online to the EMIS® 1500 simultaneously.

Data collection and storage with the following devices:
- Maximum Controller EM-MC 2200
- Maximum Demand Controller EML 1101
- Power Quality Analyzer EM-PQ 2300
- Mains Monitoring unit EMA 1101
- Mains Monitoring unit EM-PQ 1500
- Cost Centre and Alarm Unit EMF 1102
- Power Factor Conrol Relay EMR 1100
- Modbus devices via Modbus coupler or Modbus TCP
- M-Bus devices via separate coupler
- JM transducer PL sensor

The comprehensive alarm functionality allows:
- that upper and/or lower alarm limits can be defined for all measured data points, accessed by EMIS® 1500 from instruments
- that individual alarms or groups of alarms can be linked to the following signalling methods: contacts at the EMIS® 1500 Central Unit or the EMD 1101 Switching Module, network printer, SMS-, Telefax- and E-mail messages, alarm reports

Energy Management devices can be integrated in two ways:
- via Ethernet standard (TCP/IP) to a Gateway device with FRAKO Starkstrombus® interface

or
- via the internal FRAKO Starkstrombus® interface

With a PC there are different ways to have access to the Central Unit:
- Connection via Ethernet (TCP/IP-Protocol)
- via a modem using a dial-up network

The Linux operating system installed allows simultaneous online connection to the Central Units via several PCs.

The Central Unit EMIS® 1500 is configured with the FRAKO-NET software package (included in delivery).

System Components

Central Unit

Each Energy Management device requires a certain number of system points. The devices can be used in any combination, provided that the maximum number of system points will not be exceeded.

Technical Data

Power Supply	
Supply voltage	230 V AC +/- 10 % or (switchable): 110 V AC +/- 10 %
Frequency	45 up to 65 Hz
Power consumption	Max. 50 VA
Interfaces	
1 Ethernet	RJ45, connection of LAN network Protocol: TCP/IP Tramsmission: 100BaseTx full duplex
2 Serial interfaces	9 pole Sub-D connector (male), RS-232 for dial-up or direct connection Transfer rate: up to 115 200 Baud
Connection to FRAKO Starkstrombus®	Electric connection: according to EIA RS-485 standard Transfer rate: 76.8 kbit/sec Protocol: FRAKO Starkstrombus®
Display-/operating elements	3 LEDs, 4 buttons, lit LC-Display
Outputs	
3 Alarm signalling contacts	Potential-free normal open contacts, freely programmable Loading: max. 48 V AC/DC, max.1 A
Mechanical construction	
Dimensions	300 x 75 x 220 mm (W x H x D)
Ingress protection	Housing IP40, Terminals IP20
Housing material	Metal housing
Installation position	Standing / vertical
Weight	3.4 kg
Ambient temperature	0 up to +50 °C
PC requirements for FRAKO-NET software package	
Hardware	• Min. Intel Core I5 • Main memory min. 4 GB RAM • 10 GB free hard drive space • Ethernet 10/100 MB network connection or/and one free serial interface • DVD drive • SVGA graphics adapter • Colour screen with minimum resolution of 1024 x 768
Software	• Microsoft® Windows® 7 (x32/x64) • Microsoft® Windows® Server 2008 R2 • Microsoft® Windows® Server 2003 R2 • Microsoft® Internet Explorer 5.5 *Registered trademarks of Microsoft Corporation

Versions

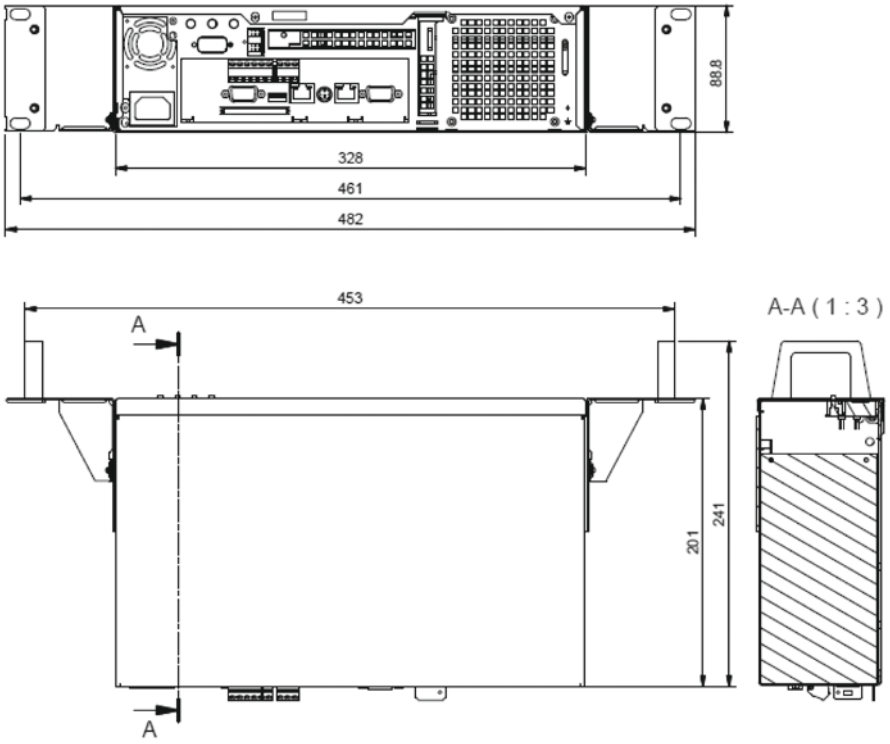
Article-No.	Type	Number of system points
20-10081	EMIS® 1500 S	50
20-10082	EMIS® 1500 M	100
20-10083	EMIS® 1500 L	200
20-10084	EMIS® 1500 XL	350
20-10085	EMIS® 1500 XXL	550

Optional accessories

Article-No.	Type	Description
20-10079	EMIS® 1500 19" installation kit	EMIS® 1500 Installation kit 2RU for installation in 19" rack, consisting of mounting frame, cage nuts and fixing screws
20-10481	EMIS® 1500 software upgrade (S auf M)	Upgrade of the EMIS® 1500 S Central Unit (50 system points) to an EMIS® 1500 M (100 system points)
20-10482	EMIS® 1500 software upgrade (M auf L)	Upgrade of the EMIS® 1500 M Central Unit (100 system points) to an EMIS® 1500 L (200 system points)
20-10483	EMIS® 1500 software upgrade (L auf XL)	Upgrade of the EMIS® 1500 L Central Unit (200 system points) to an EMIS® 1500 XL (350 system points)
20-10484	EMIS® 1500 software upgrade (XL auf XXL)	Upgrade of the EMIS® 1500 XL Central Unit (350 system points) to an EMIS® 1500 XXL (550 system points)
20-10058	Flash Card	Flash Card 256 MB, industrial version, prepared for EMIS® 1500
20-10493	EMIS® 1500 System points upgrading package	Upgrade of the EMIS® 1500 Central Unit (50 system points)
29-20064	EM-PC modem	Telephone modem for remote data transmission (serial interface) between PC and EMIS® 1500, EML or EMP. Analogue connection to the telephone network.

System points per integrated device	Upper limits
30 System points per EML 1101	max. 4 units EML 1101 per EMIS 1500
30 System points per EM-MC 2200	max. 4 units EM-MC 2200 per EMIS 1500
15 System points per EM-PQ 2100	
15 System points per EM-PQ 2200	
15 System points per EM-PQ 2300	max. 32 units EM-PQ 2300 per EMG in Slavemode, or max. 8 in Mastermode
15 System points per EM-PQ 2500	
15 System points per EM-PQ 3000	
15 System points per EMA 1101	max. 32 units EMA 1101 per EMG 1500-PN
5 System points per EMR 1100	max. 32 units EMR 1100 per EMG 1500-PN
7 System points per EM-PQ 1500	max. 32 units EM-PQ 1500 per EMG 1500-PN
3 System points per PL-SENSOR	max. 8 units PL-Master per EMIS 1500
1 System point per channel of EML 1101, EMA 1101, EM-PQ or EMF 1102	max. 550 metering-, analogue-, status- or alarm channels per EMG 1500-PN

Dimensions



Dimensional drawing EMIS® 1500

All dimensions in mm

FRAKO-NET

- The “operating system”
- Contains all the tools needed to configure FRAKO instruments
- Also contains a monitoring function for all instruments, for example to verify measurement readings
- Monitors all functions of the FRAKO EM System
- Backup tools for saving data and saving the configurations of all instruments and the FRAKO EM System
- Informs the user, by E-mail for example, if a fault occurs or an irregularity is detected in the system
- Contains an OPC client for importing data from outside the system
- Also makes it possible to import data in CSV format
- An enabling license (10 or 50 data points) is required

EMG 1500-PN
Gateway

The Gateway EMG 1500-PN is the interface between the Ethernet and the FRAKO Starkstrombus®.

Description

Several Gateways can be installed within the Ethernet system. Further Gateways (for Modbus, Profibus, MBus,etc.) can be connected to the in-house network.

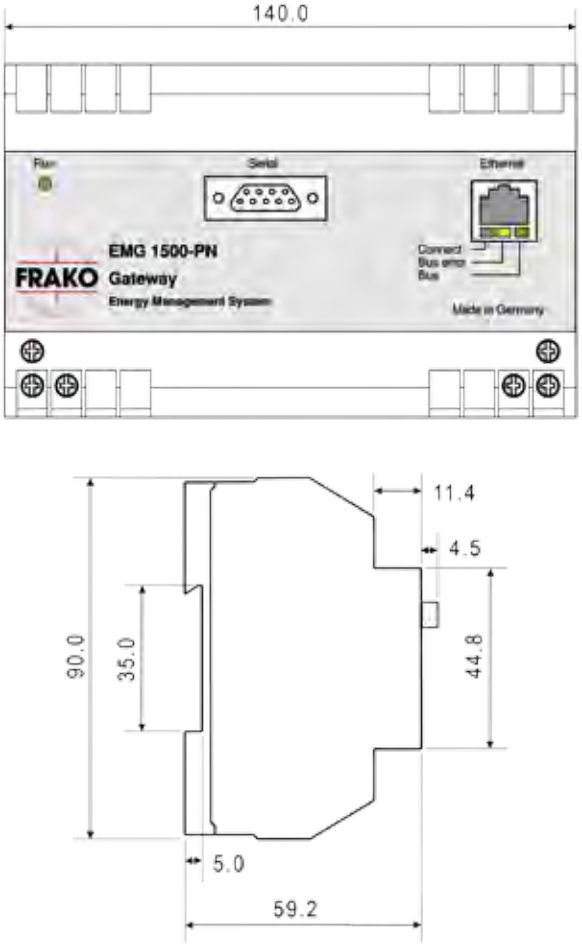
The Gateway has three ports:

- Network connection via Ethernet standard (TCP/IP)
- Interface to the FRAKO Starkstrombus®
- Interface for device configuration

Technical Data

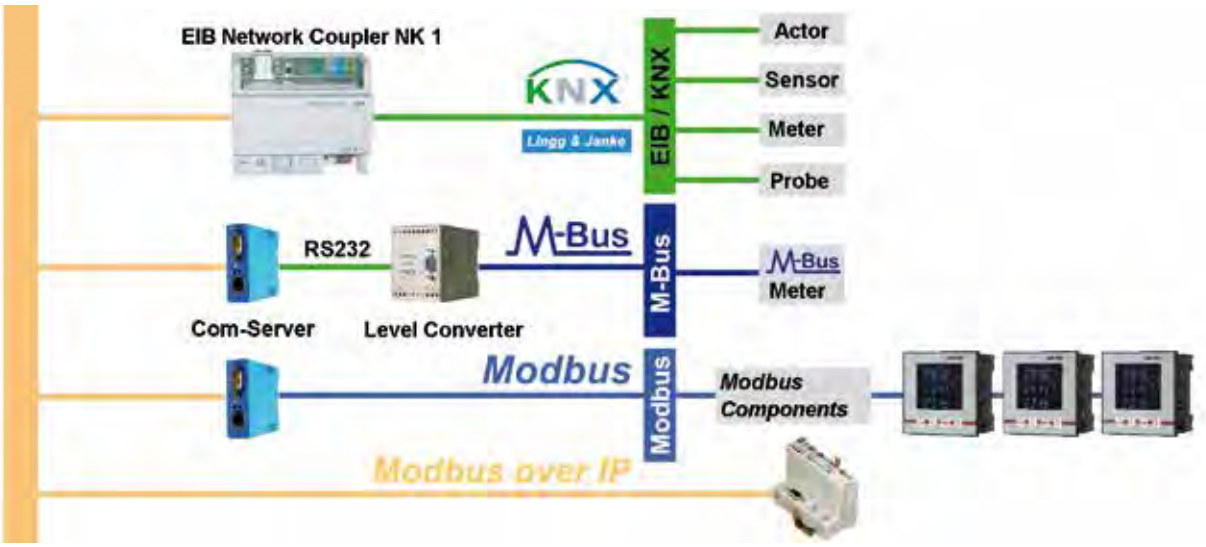
Power supply	
Mains voltage	230 V AC +/- 10 %
Frequency	45 up to 65 Hz
Power consumption	Approx. 10 VA
Fuse protection	Max. 2 A external required
Interfaces	
1 Ethernet	RJ45, for connection to LAN network Protocol: TCP/IP Transmission: 10BaseT half duplex
1 FRAKO Starkstrombus®	For connection to FRAKO Energy Management System, according to EN 50170 (P-Net) standardized fieldbus, RS-485 Transfer rate: 76.8 kbit/s
1 serial interface	9 pole Sub-D connector (male), RS-232 V.24, for the device configuration Protocol: FRAKO internal Transfer rate: 115 200 Baud, 8 Bit, 1 Stopbit, No parity
Display elements	4 LEDs
Connections	Screw-type terminals Conductor cross-section: max. 2.5 mm²
Mechanical construction	
Dimensions	140 x 90 x 59 mm (W x H x D), DIN module housing 8 HP
Ingress protection	Housing/terminals IP40/IP20
Version	Protection class II according to VDE 0411 / DIN EN 61010-1
Housing	Flammability to UL94-V0
Installation	Standard rail 35 mm according to DIN EN 50022
Mounting position	Optional
Weight	Approx. 0.5 kg
Operating conditions	
Ambient temperature	0 °C up to +50 °C
Article-No.	20-10210

Dimensions



Dimensional drawing EMG 1500-PN

All dimensions in mm



Gateways

For the connection of different bus systems for example Modbus, M-Bus, EIB/ KNX etc. various bus couplers are available. Depending on the requirement the suitable bus coupler will be selected.

EMB 1101
Repeater

The repeater EMB 1101 is designed to process and distribute signals in the FRAKO Starkstrombus®. It is necessary to use a repeater for lines with a length of over 1000 m and for bus systems where more than 32 instruments are served by one line. The EMB 1101 also allows to realize star topology.

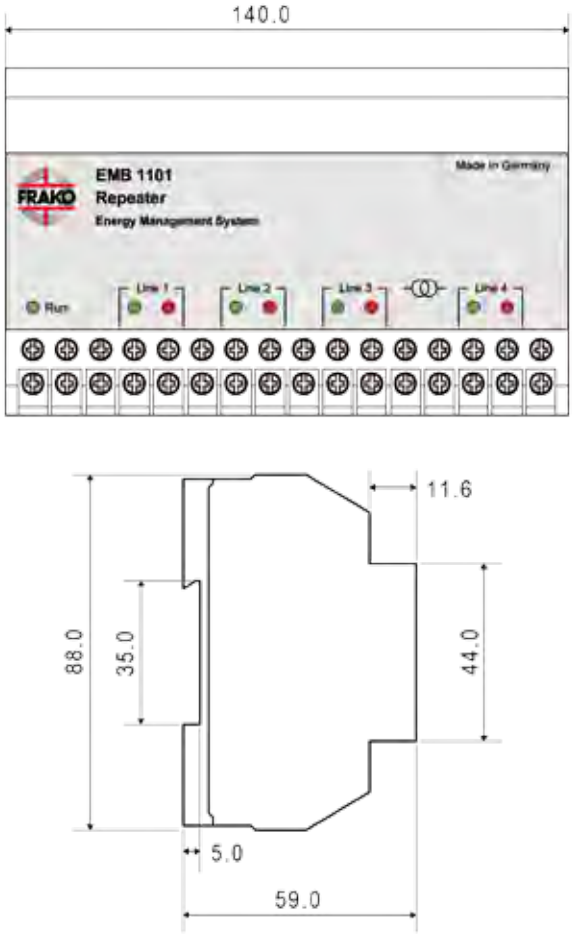
Description

- Device for conditioning and distribution of signals
- Up to 120 instruments can be operated in a bus system
- The repeater is necessary for lines with a length of over 1000 m and for bus systems where more than 32 instruments are served by one line
- Installing the repeater improves the reliability of the bus system, especially under difficult operating conditions that cause interference
- Star wiring system; up to four lines, each connected to a maximum of 32 instruments, can be wired to one repeater
- Cascading repeaters enables bus lenghts of up to 15 km to be installed
- Existing cable connections, which do not use a bus cable specified by FRAKO, can be used for distances of up to 4 km
- The repeater can electrically isolate sections of the bus system in order to prevent stray currents flowing in the FRAKO Starkstrombus®
- In case of an electrical error in the connected lines, the error will be automatically detected and displayed, and the corresponding line will be closed
- Data transmission errors are automatically detected and signalled by an LED

Technical Data

Power supply	
Supply voltage	60 V - 230 V + 15 % AC or DC
Frequency	If AC: 48 up to 62 Hz
Power consumption	Approx. 6 VA
Fuse protection	Max. 2 A external prescribed
In- / Outputs	
Quantity	4 lines, thereof 1 line galvanically separated
Protocol	FRAKO Starkstrombus®, according to EN 50170 (P-Net), standardized fieldbus, RS-485; transfer rate: 76.8 kbit/s
Display elements	
Operating (Run)	One blinking green LED
Data transfer	One green and red LED per line
Connections	Screw terminals Wire cross-section: max. 2.5 mm²
Mechanical construction	
Dimensions	140 x 90 x 59 mm (W x H x D), DIN module case 8 HP
Ingress protection	Housing IP40, terminals IP20
Version	According to VDE 0411 protection class II (also DIN EN 61010-1)
Housing	PC with 10 % GF, V-0, flammability to UL-94 V-0
Installation	On standard rail 35 mm according to DIN EN 50022
Mounting position	Optional
Weight	Approx. 0.6 kg
Operating conditions	
Ambient temperature	0 °C up to +50 °C
Article-No.	20-10600

Dimensions



Dimensional drawing EMB 1101

All dimensions in mm

EMD 1101
Switching Module

Switching module with 8 switching channels for connection to the extension bus or the FRAKO Starkstrombus®.

The extension module with 8 switching channels can optionally be connected to:

- Maximum Controller EM-MC 2200 or Maximum Demand Controller EML 1101
- System Timer EMT 1101 via FRAKO Starkstrombus®
- Central Unit EMIS® 1500 via FRAKO Starkstrombus® for alarm signalling

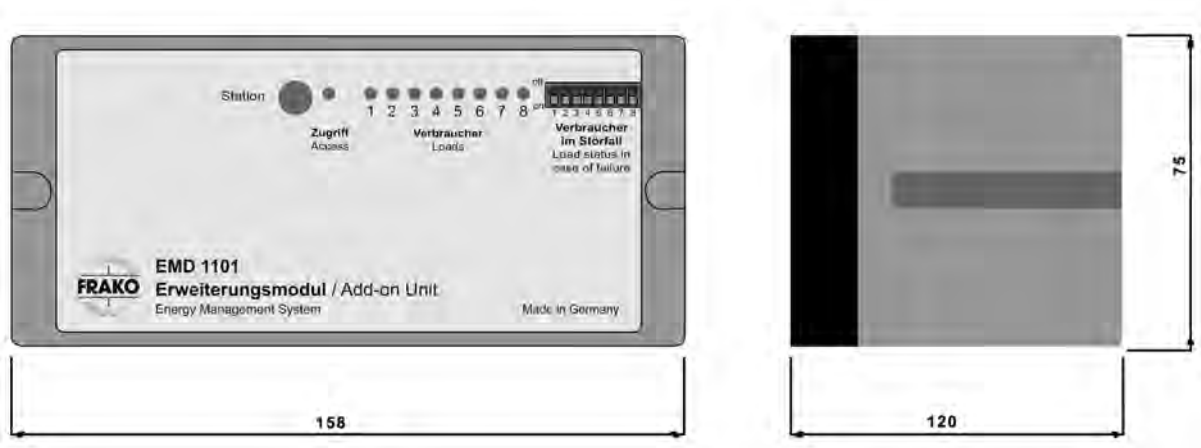
Description

- Display of the switching status via LED
- LED display for bus access
- Definition of the switching status (on/off) of the individual switching channels in case of a failure.

Technical Data

Power supply	
Mains voltage	230 V AC -15 % up to +10 %
Frequency	45 up to 65 Hz
Power consumption	4 VA
Fuse protection	Max. 2 A external prescribed
Outputs	
8 switching channels	Normal open contact 250 V AC / 4 A
1 extension bus / FRAKO Starkstrombus®	2-wire-fieldbus, RS-485
Operating elements	8-fold DIP switching series, 10-level rotary switch
Display elements	9 LEDs
Connections	Via plug-in connector blocks within housing; conductor cross-section: max. 2.5 mm²
Mechanical construction	
Dimensions	158 x 75 x 120 mm (W x H x D)
Ingress protection	IP40
Version	Protection class 2 according to DIN EN 61010
Housing	Flammability to UL94-V0 (according to the manufacturer)
Installation	Screw mounting or on standard rail 35 mm according to DIN EN 50022
Mounting position	Wall mounting, vertical
Weight	Approx. 0.8 kg
Operating conditions	
Ambient temperature	0 °C up to +45 °C
Storage temperature	-20 °C up to +60 °C
Article-No.	20-21002

Dimensions



Dimensional drawing EMD 1101

All dimensions in mm

Maximum Demand Control

2

Maximum Controller

Page 271

Switching Module

Page 277

EM-MC 2200
Maximum Controller

The contemporary styling of the EM-MC 2200 Maximum Controller accentuates its user-friendly energy management technology. It reduces power demand peaks with new additional functions. The self-adapting target demand function provides dynamic adjustment to the site's monthly operating characteristics. Reducing target demand at the beginning of the accounting period, together with automatic self-adaptation, enables additional savings to be made in months with lower demand peaks.

Designed to work as a stand-alone unit, the EM-MC 2200 is the ideal solution for small to medium-sized industrial and commercial operations, office buildings and hotels. It is also suitable for larger facilities and for integrating into a FRAKO Energy Management System with the FRAKO Starkstrombus®.
Switching off loads by intelligent terminals (Modbus over IP) or by KNX/EIB actuators and timers is only one of the helpful new features of the EM-MC 2200.
This is an investment with a short payback time even in the deregulated energy market, since exceeding the specified power peak limit still results in extra costs that can be avoided.

Description
Special contract customers whose demand exceeds the agreed maximum (subscribed demand) will face increased costs through entering a higher demand category.

Do you know how many measurement intervals there are in a year?
There are some 35 000 measurement intervals in a year, or about 2 900 in a month. As a rule, the calculation determining the price paid for power in a given month is based on the measurement interval with the greatest demand in that month.

With the EM-MC 2200 Maximum Controller you can stay within the set limits, since this unit cuts demand peaks by shedding those loads assigned a low priority or not considered absolutely essential. Loads are switched off for a short time whenever the subscribed demand appears likely to be exceeded. An individual order of priorities for switching loads off ensures that normal operation can continue without disruption despite this load shedding. The result: Instead of having to pay a higher maximum demand charge, the subscribed demand can even be reduced!

The modular construction of the EM-MC 2200 makes it both simple and inexpensive to install. It is upgradable at any time by software updates and connecting local EMD 1101 add-on units.

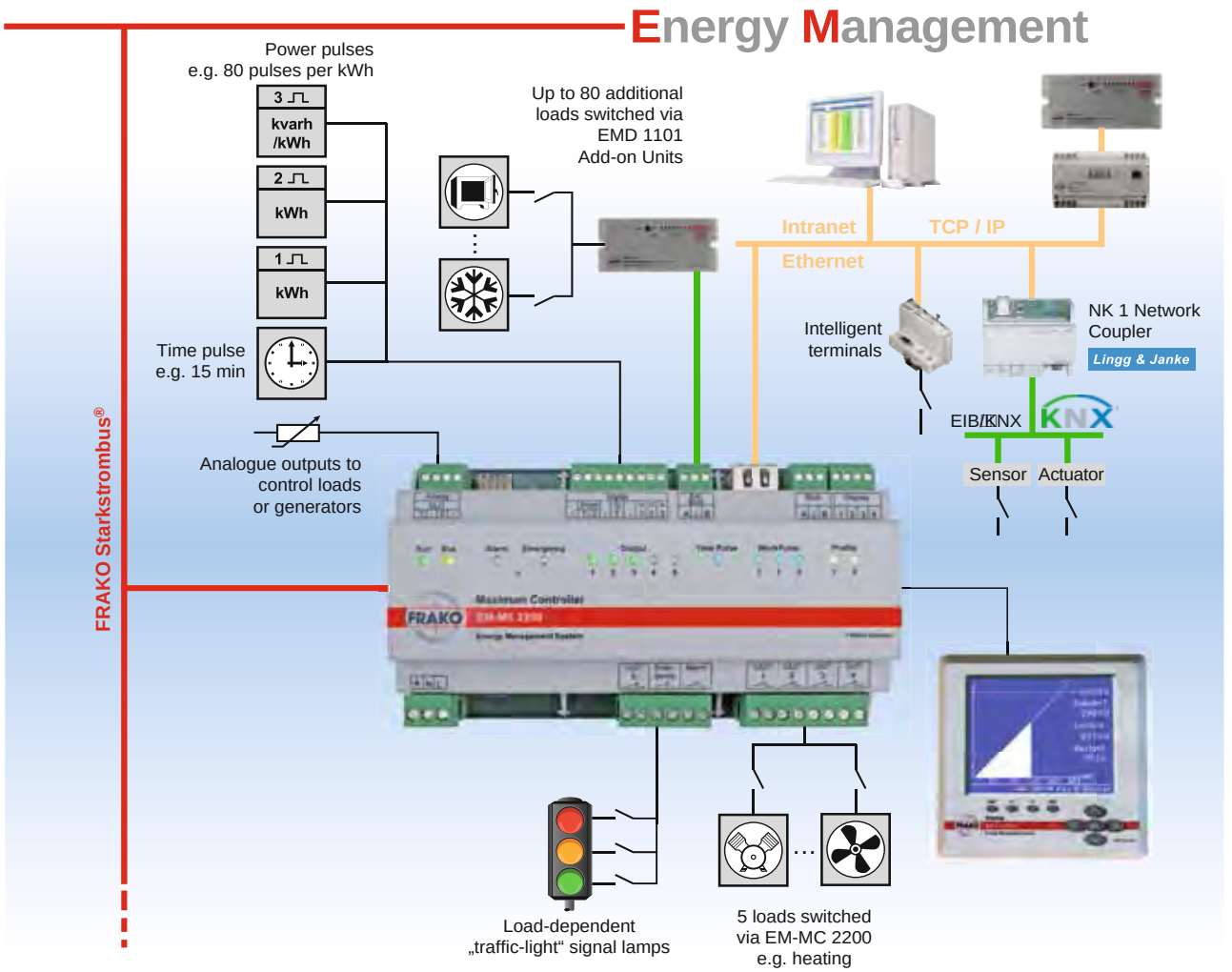
Operation is of proven simplicity with a clear, menu-driven operator dialogue in plain language at the EM-FD 2500 display or by accessing the instrument from a PC.

The scope of supply includes the Device Manager software. This is used to enter and modify parameters and to display—or when needed print out—daily demand curves, load operating times and all basic and load-specific settings.

Maximum Demand Control

Maximum Controller

- Control of demand to limit the average power consumption in a given interval to the set target demand. This is achieved by temporarily switching off individual loads
- Monitoring of demand peaks: if demand is too high, loads are immediately switched off to prevent the circuit breaker tripping
- Power-dependent control application point to prevent unnecessary load shedding at the start of the measurement
- Individual adjustment of the connected loads to suit operating conditions by setting priorities, min./max. OFF times and min. ON times per channel
- 4 profiles can be activated. Target demand and peak power, together with the load parameters priority, power, min./max. OFF times, min. ON times and priority type (time or power priority), can be set for each profile
- To make best use of seasonal demand fluctuations, the self-adapting target demand adjusts itself dynamically to suit the operating conditions of the month concerned. Reducing the target demand at the beginning of the accounting period combined with automatic self-adaptation makes additional savings possible in months with low peak loads
- Formation of switching channel groups for strict compliance with the set priorities
- 'Traffic light' function: 3 switching channels can be used for signal lamps as a visual guide to demand conditions
- Emergency load-shedding mode for keeping within maximum demand even with critical load constellations
- Connection of intelligent terminals (Wago) to switch off loads
- Connection of KNX/EIB components via FRAKO NK1 Network Coupler to switch off loads
- Timer for switching loads to a time schedule or to set time-scheduled target demands or profiles
- Storage of the following data in a ring memory:
  - Average values per interval over 20 000 intervals including the target power applicable at the end of the interval and time stamp
  - Daily maximum values over 500 days including time stamp
  - Monthly maximum values over 48 months
  - 10 000 switching cycles
- Configuration and presentation of momentary and historical measurement readings using the Device Manager software (included in scope of supply)
- Display of measurement readings and the power factor triangle (trend curve) via an integrated web interface or an EM-FD 2500 display, an optional graphic display instrument connected to the EM-MC 2200 Maximum Controller by a 4-core cable. Up to 7 additional EM devices can be viewed on one EM-FD 2500 display.



- **Inputs:**
  - 3 inputs for active energy pulses or 2 for active and 1 for reactive energy pulses. These can be added, subtracted or used as meters. The self-adapting target demand function can be reset via a volt-free contact
  - 1 input for time pulse; interval duration adjustable from 1 to 1 440 minutes
  - 2 inputs for activating the 4 profiles. These adjust the target demand and/or the settings of the connected loads to suit site-specific factors such as regular and off-peak tariffs. Profile switching can be by the internal timer or an input to the EMF 1102 Cost Centre and Alarm Unit

- **Outputs:**
  - 5 switching and 1 emergency load-shedding channel in the basic instrument (decentralized extendability: up to 85 switching channels possible by means of EMD 1101 add-on units, each with 8 relay contacts)
  - 1 alarm contact to signal faults (alarm signal also possible at any desired output)
  - 2 analogue outputs for 2 measurement readings (momentary, trend, target or corrective power, capacity utilization or remaining time) as 0/4–20 mA or 0–10 V signals, or for infinitely variable control of loads; fed by internal power supply

- **Interfaces:**
  - RS-485 bus, FRAKO Starkstrombus® protocol to connect to the FRAKO Energy Management System
  - RS-485 extension bus to connect EMD 1101 add-on units
  - Ethernet (RJ 45 jack) with the following functions:
    - Communication with the EMD 1101 add-on unit or the EMF 1102 Cost Centre and Alarm Unit via the EMG 1500-PN Gateway
    - Output of switching commands also via Modbus TCP
    - Output of switching commands via KNX/EIB (NK1 EIB Network Coupler required)
    - Communication with the EMIS® 1500 Central Unit
    - Communication with the configuration software at the PC

- The software (Device Manager) for configuring and displaying the saved measurement readings via Ethernet is included with the instrument

Easy installation with the DIN rail-mounted enclosure

The EM-MC 2200 is housed in an enclosure with a pin strip underneath it.

This system, consisting of pin and socket strips and DIN rail bus connectors, enables the individual modules to be easily fitted and connected to one another.

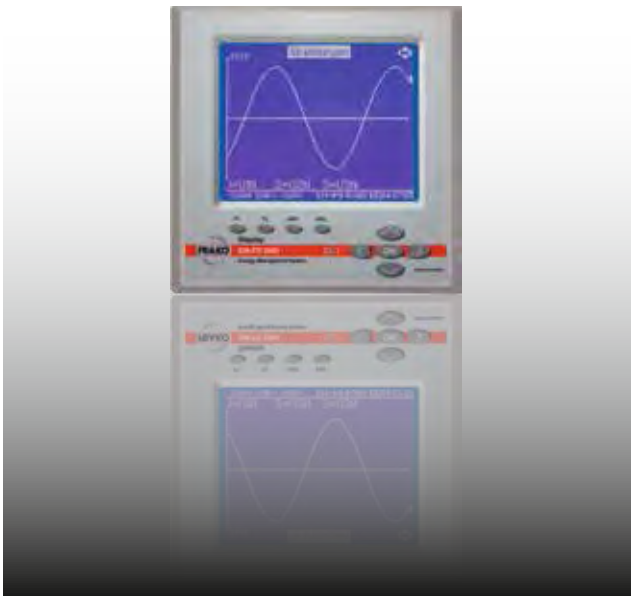
All connections are also available at external terminals for conventional wiring. Use of the 16-pin DIN rail bus connector provides automatic contact from instrument to instrument.

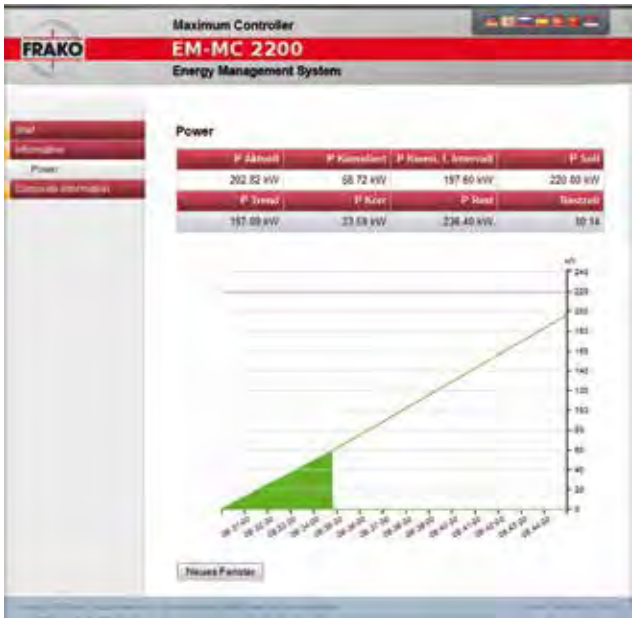
The bus connector enables the FRAKO Starkstrombus®, extension bus and display bus to be connected. The pin and socket strips on the DIN rail ensure quick and easy installation of the instruments in parallel.

It is possible to plug individual instruments in or remove them without dismantling the modular assembly.

Data display on the EM-FD 2500

The EM-FD 2500 display has been developed as a physically separate LCD display and operator panel to work with all FRAKO Energy Management devices of the new generation that require this, such as the EM-PQ 2300 and EM-MC 2200 instruments. The display is connected to the EM instrument via 4 terminals: two wires for the instrument power supply and two for data transfer. A maximum of 8 instruments can be connected to a common display bus, with a bus length of up to 40 m to the display. The display is mounted on the control cabinet door or wall through a Ø 22.5 mm hole, thus greatly simplifying installation. Its orientation is fixed by a screw through the wall into a threaded bush. Alternatively, the display can also be mounted in any available 144 x 144 mm cut-out. For this purpose suitable adapters are available.





Data display via the integrated web interface

- Web server for the configuration and online display of all measurement readings
- Each user at any PC can view the most important measurement data via the intranet.

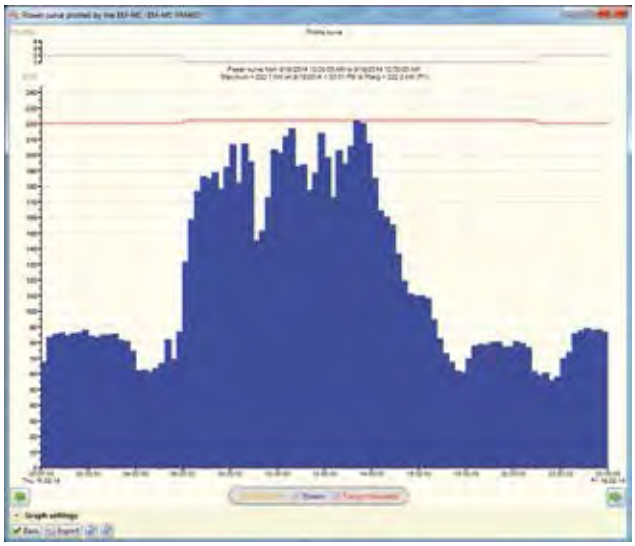
Device Manager – Clear overview and straightforward programming

- **Configuration**
  Configuration of the EM-MC 2200 is divided into two areas termed setting and configuration to distinguish them:
  – **Setting:**
  Setting covers all those adjustments that are necessary when commissioning the instrument itself or introducing add-on units.
  – **Configuration:**
  Configuration covers those adjustments that may have to be changed during ongoing operation.
  The loads can be configured in a table giving a clear overview. Settings for the individual profiles can be hidden, if desired, to simplify this overview. Channels can be copied and their settings adopted in total or per channel for all profiles.

- **Trend display**
  Device Manager is a convenient tool for displaying real-time parameters such as momentary power, cumulative power, the remaining time in the current measurement interval and the power triangle. In addition, the statuses of the loads, the current profile (regular/off-peak tariff) and the limit settings are displayed. Any alarms or faults present are immediately apparent.

- **Switched status log**
  The switched status log offers a graphical display of the last 10 000 changes in the switched status of up to 85 controlled switching channels.

- **Documentation**
  The power demand in every measurement interval over the past 200 days is displayed as a chart and documented. Similarly, the demand peaks of the past 500 days and the past 48 months are saved, as are the switched statuses of up to 10 000 switching cycles. It is also no problem to export these recorded data to a spreadsheet program such as Excel.



- **Timer**
  A weekly timer function is incorporated in the EM-MC 2200. This makes up to 400 switching times available, in order to change the status of switching channels to 'Permanently ON', 'Permanently OFF' or 'Controlled' at scheduled times. In the 'Controlled' condition, the EM-MC 2200 controls the actual condition of the load through the target demand control function and the peak demand monitoring function.

  In addition, the profile and the target demand can be controlled by the timer.

Technical Data

Power supply	
Supply voltage	100 V – 253 V AC or 100 V – 230 V DC
Frequency	45 up to 65 Hz
Power consumption	7 W / 18 VA
Overcurrent protection	Max. 2 A external fuse required
Inputs	
General	• S0 interfaces (DIN 43864) to connect volt-free contacts • Voltage with contact open: 15 V • Max. line resistance: 800 Ohm • Short circuit current: 18 mA • Pulse frequency: 0.1 to 20 Hz
3 Pulse inputs	To acquire the power data from 3 meters with pulse outputs. Input 3 can also be used for the acquisition of reactive power data.
1 Time pulse input	1...1 440 minutes
2 Profile switch inputs	To select from 4 profiles

Measurement data storage	
	256 MB onboard flash memory
Outputs	
5 Relay contacts (switching channels)	Bistable, 250 V / 2 A AC or 30 V / 2 A DC
1 Relay contact (emergency load shedding)	Bistable, 250 V / 2 A AC or 30 V / 2A DC
1 Alarm contact	NC 250 V / 2 A AC or 30 V / 2 A DC
1 Extension bus interface	• To connect up to 10 EMD 1101 • Modbus TCP output instruments (fieldbus instruments, function code 5) • EIB actuators/output instruments
2 Analogue outputs	0-10 V / 0-20 mA / 4-20 mA + Steuerung-Verbraucher
'Traffic light' signal lamps	Visual guide to demand conditions

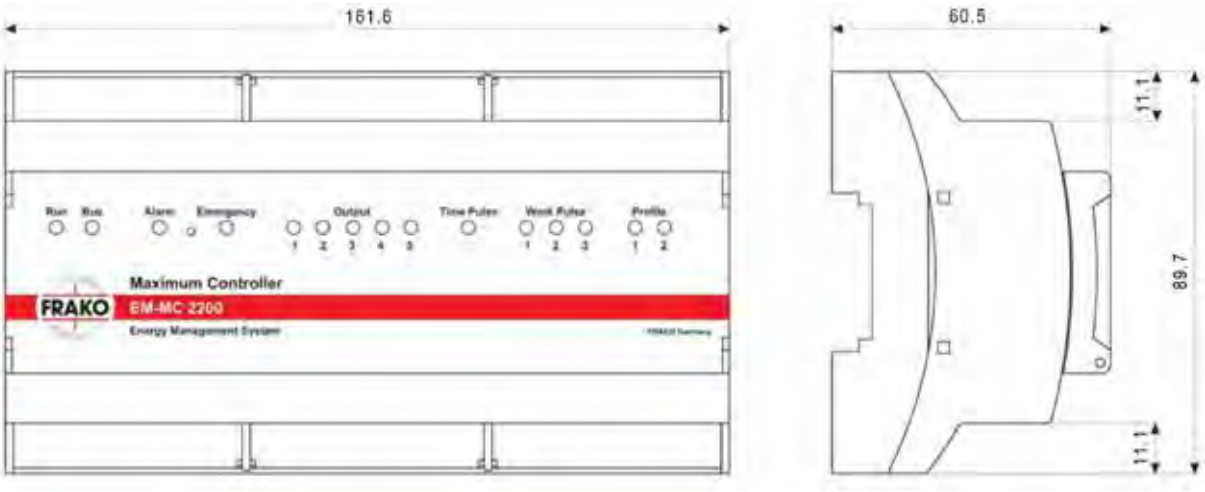
Technical Data

Interfaces	
1 FRAKO Starkstrombus® interface	To connect to the FRAKO Energy Management System
1 Display bus interface	Optional connection of to up to 2 external EM-FD 2500 display instruments
Web server / E-mail / SNMP	• / • / •
Display and operation, connections	
User interface Art.-No. 20-30240	Operation via external EM-FD 2500 display instrument
Alarm system	•
Timer function	•
Annunciators	15 LEDs
Connections	Pin and socket strips; max. core cross section: max. 1.5 mm²
Mechanical construction	
Dimensions	161.6 x 89.7 x 60.5 mm (W x H x D)
Ingress protection	IP30 (enclosure), IP10 (terminals)
Weight	Approx. 0.4 kg
Protection class	Class II according to EN 61010
Enclosure	Flame retardant UL 94-V0
Mounting	On standard 35 mm DIN rail according to EN 50022
Operating conditions	
Ambient temperature	0 °C up to +45 °C
Article No.	20-20071

Technical Data

PC requirements to run Device Manager	
Hardware	• PC: CPU mit with at least 2 GHz • 1 Gbyte RAM • 200 Mbyte free hard disc space
Software	• Microsoft® Windows®* XP, SP 2 with installed .NET-Framework 3.5 • Microsoft® Windows®* 7 (32 or 64 Bit) • Microsoft® Windows® 2008 Server R2 * Registered trademark of Microsoft Corporation

Dimensions



All dimensions in mm

EMD 1101
Switching Module

Switching module with 8 switching channels for connection to the extension bus or the FRAKO Starkstrombus®.

The extension module with 8 switching channels can be connected selectively to:

- Maximum Controller EM-MC 2200 or Maximum Demand Controller EML 1101
- System Timer EMT 1101 via FRAKO Starkstrombus®

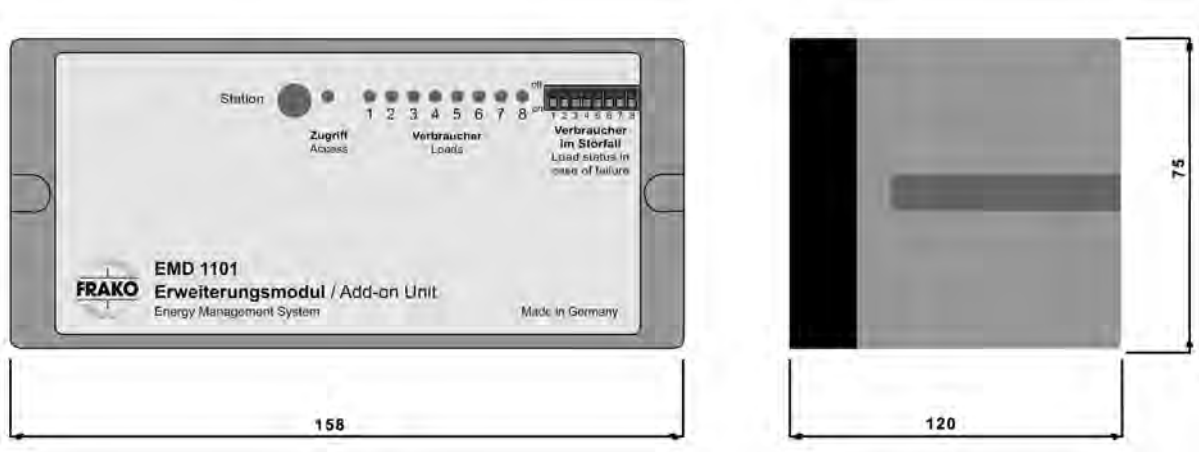
Description

- Display of the switching status via LED
- LED display for bus access
- Definition of the switching status (on/off) of the individual switching channels in case of a failure.

Technical Data

Power supply	
Mains voltage	230 V AC -15 % up to +10 %
Frequency	45 up to 65 Hz
Power consumption	4 VA
Fuse protection	Max. 2 A external prescribed
Outputs	
8 switching channels	Normal open contact 250 V AC / 4 A
1 extension bus / FRAKO Starkstrombus®	2-wire-fieldbus, RS-485
Operating elements	8-fold DIP switching series, 10-level rotary switch
Display elements	9 LEDs
Connections	Via plug-in connector blocks within housing; conductor cross-section: max. 2.5 mm²
Mechanical construction	
Dimensions	158 x 75 x 120 mm (W x H x D)
Ingress protection	IP40
Version	Protection class 2 according to DIN EN 61010
Housing	Flammability to UL94-V0 (according to the manufacturer)
Installation	Screw mounting or on standard rail 35 mm according to DIN EN 50022
Weight	Approx. 0.8 kg
Operating conditions	
Ambient temperature	0 up to +45 °C
Storage temperature	-20 up to +60 °C
Article-No.	20-21002

Dimensions



Dimensional drawing EMD 1101

All dimensions in mm

Cost Allocation / Cost Centre Acquisition

Electronic Energy Meter

Page 281

Cost Centre and Alarm Unit

Page 287

Acquisition of Process Data

Page 289

EM-EC 35 / MID, EM-EC 380 / MID, EM-PM 35, EM-PM 380 and EMC ETAR

Electronic Energy Meter

Electronic energy meter for measuring active and reactive energy.

Description

Electronic energy meters for measuring active and reactive energy, available with direct measurement or for operation with voltage/ current transformer. Impulse outputs for active and reactive energy or regenerated active energy. Depending on the type of meter, electrical parameters such as I, V, F and PF as well as P, Q, S will be displayed. Data transmission via additional communication modules is possible.

Type		EMC ETAR	EM-EC 35
Manufacturer designation		–	ECS3-5
Technical data			
Article No.		29-20107	29-20100
Measurement	active energy / reactive energy consumed	• / •	• / •
	active energy / reactive energy regenerated	– / –	• / •
Approval		–	–
Accuracy class	active energy/reactive energy	1/2	B/2
Connection type		3- / 4-wire	4-wire
Current measurement	Current transformer x / ..	1 A and 5 A	5 A
	Direct input up to	–	–
	Current transformer ratio adjustable	x / 1 or x / 5; 1 to 999 999	x/ 5; 5…10 000; smallest step: 5
	Power draw	0.8 VA/Phase	0.7 VA/Phase
	Input currents galvanically isolated	•	•
Voltage measurement	Voltage circuit	3× 57.7 / 100 V… 230 / 400 V ± 15 %	3× 230 / 400 V ± 20 %
	Power draw	<1 VA, 1 W	0.5 VA
	Frequency	50 / 60 Hz	50 Hz
Voltage supply		self-supplied from voltage input	
Standard S0 pulse output (volt-free contact)	Number/use	1/active energy consumed 1/reactive energy consumed	1/active energy consumed T1 and T2 1/reactive energy consumed T1 and T2
	Valency	0.1 Wh…100 kWh/Imp, 0.1 varh…100 kvarh/Imp	I primary 5…300 A = 100 Imp/kWh or Imp/kvarh, 301…3 000 A = 10 Imp/kWh or Imp/kvarh, 3 001…10 000 A = 1 Imp/kWh or Imp/kvarh
	Pulse duration	50 …1 500 ms	30 ± 2 ms
	Max. voltage and current	0…230 VAC / 100 mA, 0…325 VDC / 100 mA	5…230 VAC / 90 mA, 5…300 VDC / 90 mA
	LED	1 Imp/Wh / 1 Imp/varh	10 000 Imp/kWh
LC-Display	backlit	•	•
Detection of faulty connections		•	•
Tariffs		–	2
Ingress protection	Enclosure	IP51	IP51
	Terminal block with cover	IP20	IP20
Input cable cross section	Current transformer	6 mm²	6 mm²
	Direct	–	–
Dimensions	(W x H x D) [mm]	122.5 x 100 x 58.5	72 × 90 × 70
	Width in HP	7	4
Mounting	35 mm DIN rail	•	•
Weight		0.4 kg	0.4 kg
Operating temperature			-10…+55 °C
Special features		Resettable intermediate meter; Instantaneous and maximum active power; Configuration and display of measured variables also possible with power off	See next page: EM-EC 35 MID, EM-EC 380 und EM-EC 380 MID

Type		EM-EC 35 MID	EM-EC 380	EM-EC 380 MID
Manufacturer designation		ECS3-5 MID	ECS3-80	ECS3-80 MID
Technical data				
Article No.		29-20101	29-20098	29-20099
Measurement	active energy / reactive energy consumed	• / •	• / •	• / •
	active energy / reactive energy regenerated	• / •	• / •	• / •
Approval		calibrated (MID)	–	calibrated (MID)
Accuracy class	active energy/reactive energy	B/2	B/2	B/2
Connection type		4-wire	2- / 4-wire	2- / 4-wire
Current measurement	Current transformer x / ..	5 A	–	–
	Direct input up to	–	80 A	80 A
	Current transformer ratio adjustable	x / 5; 5…10 000; smallest step: 5	–	–
	Power draw	0.7 VA/Phase	0.8 VA/Phase	0.8 VA/Phase
	Input currents galvanically isolated	•	–	–
Voltage measurement	Voltage circuit	3× 230 / 400 V ± 20 %	3× 230 / 400V ± 20 %	3× 230 / 400V ± 20 %
	Power draw	0.5 VA	0.5 VA	0.5 VA
	Frequency	50 Hz	50 Hz	50 Hz
Voltage supply		self-supplied from voltage input		
Standard S0 pulse output (volt-free contact)	Number/use	1/active energy consumed T1 and T2 1/reactive energy consumed T1 and T2	1/active energy consumed T1 and T2 1/reactive energy consumed T 1and T2	
	Valency	I primary 5…300 A = 100 Imp/kWh or Imp/kvarh, 301…3 000 A = 10 Imp/kWh or Imp/kvarh, 3 001…10 000 A = 1 Imp/kWh or Imp/kvarh	500 Imp/kWh	
	Pulse duration	30 ± 2 ms	30 ± 2 ms	30 ± 2 ms
	Max. voltage and current	5…230 VAC/90 mA, 5…300 VDC/90 mA	5…230 VAC/90 mA, 5…300 VDC/90 mA	5…230 VAC/90 mA, 5…300 VDC/90 mA
	LED	10 000 Imp/kWh	1 000 Imp/kWh	1 000 Imp/kWh
LC-Display	backlit	•	•	•
Detection of faulty connections		•	•	•
Tariffs		2	2	2
Ingress protection	Enclosure	IP51	IP51	IP51
	Terminal block with cover	IP20	IP20	IP20
Input cable cross section	Current transformer	6 mm²	–	–
	Direct	–	35 mm²	35 mm²
Dimensions	(W x H x D) [mm]	72 × 90 × 70	72 × 90 × 70	72 × 90 × 70
	Width in HP	4	4	4
Mounting	35 mm DIN rail	•	•	•
Weight		0.4 kg	0.4 kg	0.4 kg
Operating temperature		-10…+55 °C	-10…+55 °C	-10…+55 °C
Special features		One impulse for consumed active energy and one impulse for consumed reactive energy; Performance measurement as value and bars; Side infrared interface for connecting communication modules Modbus RTU / M-Bus for energy and performance U, I, PF, F; KNX-EIB for energy and power		

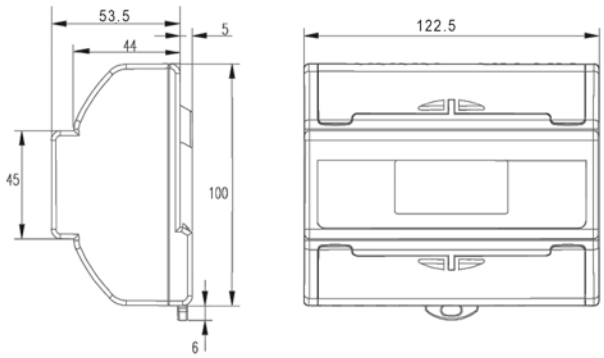
Type		EM-PM 35	EM-PM 380
Manufacturer designation		PM3-5	PM3-80
Technical data			
Article No.		29-20102	29-20103
Measurement	active energy / reactive energy consumed	• / –	• / –
	active energy / reactive energy regenerated	• / –	• / –
Approval		–	–
Accuracy class	active energy / reactive energy	B/2	B/2
Connection type		4-wire	2- / 4-wire
Current measurement	Current transformer x / ..	5 A	–
	Direct input up to	–	80 A
	Current transformer ratio adjustable	x/ 5; 5…10 000; smallest step: 5	–
	Power draw	0.7 VA/Phase	0.8 VA/Phase
	Input currents galvanically isolated	•	–
Voltage measurement	Voltage circuit	3× 230 / 400 V ± 20 %	3× 230 / 400 V ± 20 %
	Power draw	0.5 VA	0.5 VA
	Frequency	50 Hz	50 Hz
Voltage supply		self-supplied from voltage input	
Standard S0 pulse output (volt-free contact)	Number/use	1/active energy consumed 1/active energy regenerated	
	Valency	adjustable (dependant on the current transformer)	2000Imp/kWh or adjustable
	Pulse duration	30 ± 2 ms	30 ± 2 ms
	Max. voltage and current	5…230 VAC / 90 mA, 5…300 VDC / 90 mA	5…230 VAC / 90 mA, 5…300 VDC / 90 mA
	LED	10 000 Imp/kWh	1 000 Imp/kWh
LC-Display	backlit	•	•
Detection of faulty connections		•	•
Tariffs		–	–
Ingress protection	Enclosure	IP51	IP51
	Terminal block with cover	IP20	IP20
Input cable cross section	Current transformer	6 mm²	–
	Direct	–	35 mm²
Dimensions	(W x H x D) [mm]	72 × 90 × 70	72 × 90 × 70
	Width in HP	4	4
Mounting	35 mm DIN rail	•	•
Weight		0.4 kg	0.4 kg
Operating temperature		-10…+ 55 °C	-10…+ 55 °C
Special features		One impulse for consumed and regenerated active energy; Measurement of I, U (Ph/Ph), U (Ph/N), PF, F as well as all power values per phase. Side infrared interface for connecting communication modules Modbus RTU / M-Bus for above mentioned values; KNX-EIB for energy and power	

Optional Accessories

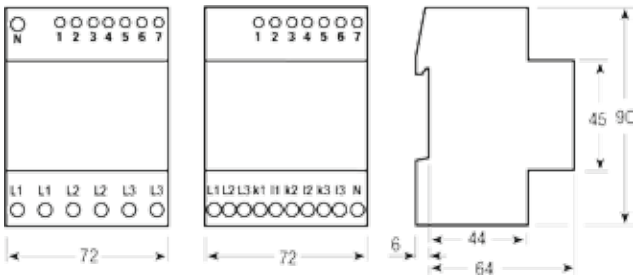
Article-No.	Type	Description
29-20104	EM-CM MODBUS / ECS MODBUS RTU	Modbus communication module. The communication between the module and the energy meter is realized via the infrared interface. Values: energy and power U, I, PF and F.
29-20105	EM-CM MBUS / ECS M-Bus	M-Bus communication module. The communication between the module and the energy meter is realized via the infrared interface. Values: energy and power U, I, PF and F.
29-20121	EM-CM SD-Card / ECS SD-Card Data logger	SD Card data logger with SD Card. The communication between the module and the energy meter is realized via the infrared interface.
29-20106	EM-CM KNX / ECS EIB-KNX	EIB/KNX communication module. The communication between the module and the energy meter is realized via the infrared interface. Values: energy and power.

Please note that optional accessories are available for all energy meters except for EMC ETAR.

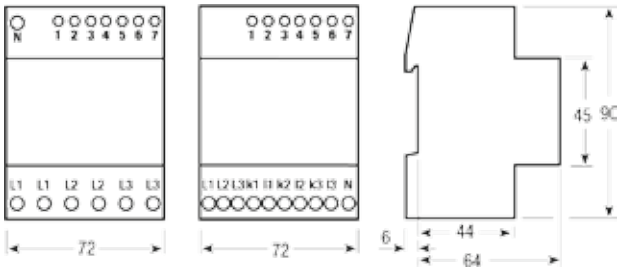
Dimensions



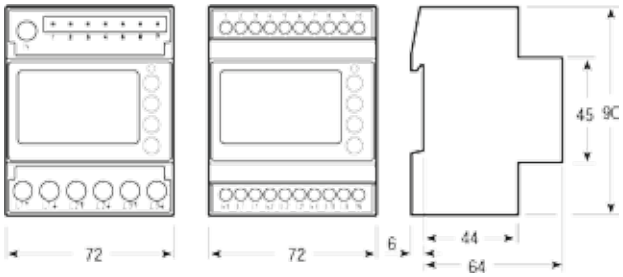
Dimensional drawing EMC ETAR



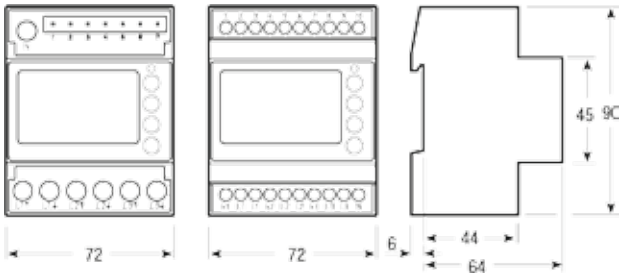
Dimensional drawing EM-EC 35, EM-EC 35 MID



Dimensional drawing EM-EC 380, EM-EC 380 MID



Dimensional drawing EM-PM 35



Dimensional drawing EM-PM 380

All dimensions in mm

EMF 1102
Cost Centre and Alarm Unit

The EMF 1102 is a compact and cost-effective system for the aquisition and storage of meter readings, switching status and alarm signals.

Description
It consists of a data acquisition and memory unit plus modular software components for easy user configuration and for the evaluation and management of the data. Remote alarms can be transmitted by SMS via modem.

The EMF 1102 can be used as a stand-alone system for the acquisition of utilities and operating data in a factory or other premises, or can be installed as an integral part of a FRAKO Energy Management System.

Data acquisition for all types of utility such as electricity, water, gas, compressed air or meter pulse inputs via an S0 interface.

- Calculation of power, energy and flow rates
- Monitoring of power, energy or flow rate with high and low alarm settings
- Determination of running time and downtime for each channel (running time meter)
- Operating cycle counter
- Monitoring of running times and downtimes with alarm settings (e.g. to detect instrument failure)
- Monitoring of key operating conditions
- Remote alarms by SMS in an event of system faults or if monitored variables exceed critical limits
- Storage of all utility data with memory for several days
- Connection:
  via RS-232 adapter with modem or COM server or direct to PC or via FRAKO Starkstrombus® to the EMP communication processor or the EMIS® 1500 central unit
- Option of visualising and evaluating the meter data via the FRAKO Energy Management System software module (EMVIS 3000)
- Option of displaying, configuring and evaluating the recorded data via the PC by means of the EMF-SW cost centre and alarm software EMF-SW (optional)

Technical Data

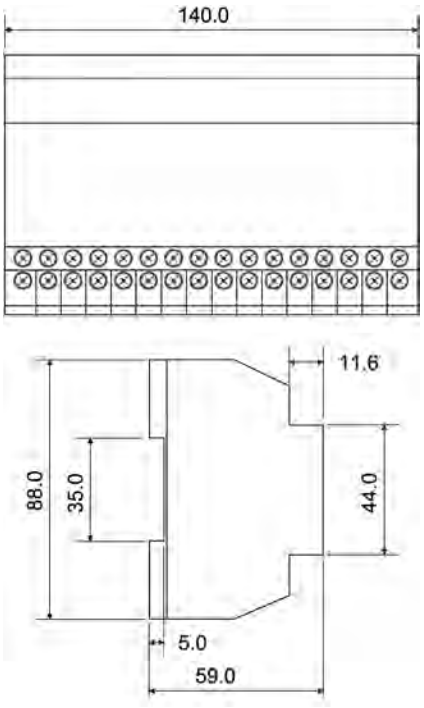
Power supply	
Mains voltage	230 V AC +/- 10 %
Frequency	45 to 65 Hz
Power consumption	Approx. 10 VA
Inputs	
General	S0-Interfaces (DIN 43864) for connection of potential-free contacts, common 'E-'-Potential switching time: >= 25 ms Voltage with open contact: 12 V DC +/- 10 % Short circuit current: 12 mA +/- 10 %
12 Pulse Inputs	Pulse frequency: max. 20 Hz Internal shifter shafts: 'Off' at approx. 3 mA, 'On' at approx. 7.5 mA
Outputs	
1 Voltage output	12 V DC, max. 50 mA
Interfaces (mode can be selected)	
1 FRAKO Starkstrombus®	For connection to FRAKO Energy Management System, according to EN 50170 (P-Net), standardized fieldbus, RS-485 Transfer rate: 76.8 kbit/s
RS-232 Interface	Optional via RS-232 Adapter direct connection to PC Tranfer rate: 19 200 Baud
Display elements	14 LEDs
Connections	Screw terminals Conductor cross-section: max. 2.5 mm²
Mechanical construction	
Dimensions	140 x 90 x 59 mm (W x H x D), DIN module cases 8 HP
Ingress protection	Housing/Terminals IP40/20
Version	Protection class II according to VDE 0411 / DIN EN 61010-1
Housing	flame retardant UL94-V0
Installation	on standard rail 35 mm according to DIN EN 50022
Mounting position	Optional
Weight	Approx. 0.6 kg
Operating conditions	
Ambient temperature	0 °C up to +60 °C
Article-No.	20-40005

Optional Accessories

Article-No.	Type	Description
20-10310	EM-RS 232	RS-232 Adapter for direct access via PC to the data of EMA 1101 (SW-Version 1.11*), EMR 1100 (SW-Version 1.95*) and EMF 1102 (SW-Version 1.0*)
20-10309	EM-RS 232 for modem operation	RS-232 Adapter for direct access via PC to the data of EMA 1101 (SW-Version 1.11*), EMR 1100 (SW-Version 1.95*) or EMF 1102 (SW-Version 1.0*) via modem
20-10319	Registration license EMF 1102	License allows EMVIS 3000 access to a Cost Centre and Alarm System EMF 1102, if this is logged by using a virtual data connector.
20-10313	EMF-SW	Display, analysis and configuration software for Cost Centre and Alarm System EMF 1102. Access via: EMIS® 1500, EMP 1100, EMT 1101 and RS-232 adapter. **Note:** included in scope of delivery of FRAKO-NET (for CD delivery)

* or higher

Dimensions



Dimensional drawing EMF 1102

All dimensions in mm

EM-UIF / EM-PTF
Frequency-Converter

The pulse output of the Frequency-Converter is connected to the Cost Centre and Alarm System EMF 1102. This offers the possibility to control, detect and visualize sensors with arbitrary output signals and temperatures with the FRAKO Energy Management System.

EM-UIF
Voltage-/Current-/Frequency Converter

For operating data acquisition of analogue signals with the FRAKO Energy Management System.

EM-PTF
Temperature-/Frequency-Converter

For acquiring operating data with the FRAKO Energy Management System, the measured inlet temperatures from –40 °C to +120 °C will be transformed into a pulse frequency from 0 to 5 Hz.

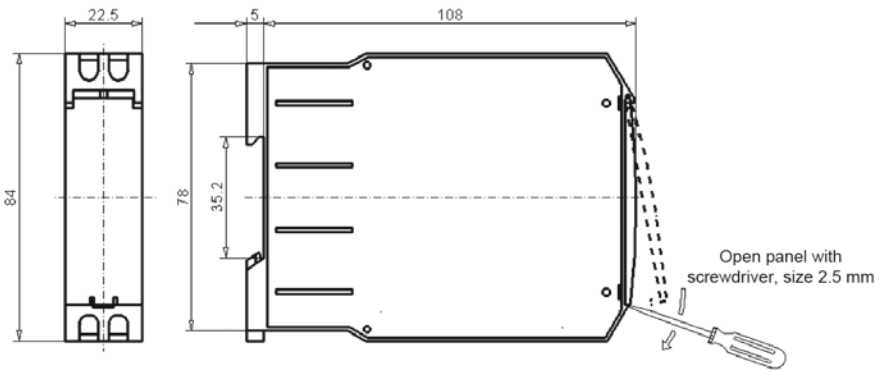
Technical Data EM-UIF

Power Supply	
Mains voltage	230 V AC +/-20 %
Frequency	45 up to 65 Hz
Power consumption	2.5 VA
Input	
Input variable	DC current or DC voltage
Rated voltage	0-20 mA, 4-20 mA, R_i = 3 Ω 0-10 V, 2-10 V, R_i = 160 kΩ
Overloading continuously	2 times at current 5 times at voltage
Surge overload	Twenty times 1 sec at current five times at voltage
Output	
Rated value	0 up to 5 Hz
OPEN collector	npn, max. 30 V, 100 mA max. loadable
Ingress protection	IP40
Version	Housing insulated, protection class 2, at rated voltage up to 300 V (net to neutral conductor), pollution degree 2, according to DIN EN 61010 Part 1 EMV according to DIN EN 50081-2 and DIN EN 61000-6-2
Installation	On standard rail 35 mm according to DIN EN 50022
Operating conditions	
Ambient temperature	-15 °C up to +55 °C
Article-No.	29-20059

Technical Data EM-PTF

Power supply	
Mains voltage	230 V AC +/-20 %
Frequency	45 bis 65 Hz
Power consumption	2.5 VA
Input	
Input variable	Resistor PT100
Rated value	-40 °C up to 120 °C, constant current via the sensor 2 mA
Types of connection	2-/3-or 4-wire, can be selected by DIP switch
2-wire circuit	Lead max. adjustment 10 Ohm via built-in potentiometer
3-wire circuit	Lead max. 100 Ohm, balanced, no adjustment required
4-wire circuit	Lead max. 100 Ohm, no adjustment required
Output	
Rated value	0 up to 5 Hz
OPEN collector	npn, max. 30 V, 100 mA load
Pulse / Pause	50/50 %
Connections	Screw terminals Conductor cross-section: max. 4 mm²
Mechanical construction	
Dimensions	22.5 x 84 x 108 mm (W x H x D)
Ingress protection	Housing/terminals IP30/IP20 according to DIN EN 60529
Version	Insulated housing, degree of polution 2, overvoltage category CAT 3 according to DIN EN 61010 part 1, EMV according to DIN EN 50081-1, DIN EN 61000-6-2
Installation	On standard rail 35 mm according to DIN EN 50022
Weight	Approx. 0.15 kg
Operating conditions	
Ambient temperature	-15 °C up to +55 °C
Article-No.	29-20049

Dimensions



Dimensional drawing EM-UIF, EM-PTF

All dimensions in mm

Accessories

EM-PT 100 Temperature Sensor
Temperature sensor in 4-wire technique for measuring temperatures using the Temperature-/Frequency-Converter EM-PTF, the Power Quality Analyzer EM-PQ 2300 or the Mains Analysis Device EMA 1101.

Technical Data

General	
Rated value	100 Ohm at 0 °C
Temperature range	-80 °C up to +260 °C
Material	Stainless steel
Dimensions	
Sensor sleeve	Diameter: 4 mm, length: 50 mm
Connecting cable	Length: 1 000 mm
Article-No.	29-20050

Optional Accessories

Article-No.	Type	Description
29-20051	EM-PT100 MF	Mounting flange for the temperature probe

EM-AM 2108
Analogue Module

Data acquisition system for 8 analogue, freely configurable input channels. This allows to detect and visualize sensors with random output signals with the FRAKO Energy Management System.

Description

- 8 analogue inputs, selectively:
  - Temperature -50 °C up to 150 °C via 5 K NTC
  - 0 / 4 to 20 mA or - 0 to 10 V
- Monitoring of temperatures and analogue signals with upper and lower alarm limit
- External supply voltage 9 to 36 V DC
- Connection via FRAKO Starkstrombus®
- Resolution temperature range: 0.1 °C; Accuracy entire temperature range: 1 °C
- Resolution voltage range: 10 mV; max. failure: 30 mV
- Resolution current range: 20 µA; max. failure: 60 µA
- Easy configuration of the EM-AM 2108 via EM-AM-SW software
- For each input of the analogue module the current measurement readings as well as the maximum and the minimum value of the last interval will be displayed by the EM-AM SW software
- By integrating the EM-AM 2108 into the FRAKO Energy Information System all temperatures and analogue signals will be captured and monitored with their upper and lower alarm limits
- The system visualization software EMVIS 3000 allows to analyse and visualize the data

Technical Data

Power Supply	
Mains voltage	9 up to 36 V DC
Power consumption	0.72 VA
Input	
Input variable	Direct current or direct current voltage
Rated value	0 to 20 mA, 4 to 20 mA, R_i = 130 Ohm, 0 to 10V, R_i = 115,13 kOhm
Overload, constant	2.5 times (current), 2.5 times (voltage)
Short-time overload	5 times 1 s (current), 5 times 1 s (voltage)
Temperature measurement	Range: -50 °C up to 150 °C Resolution: approx. 0.1 °C Accuracy: 1.5 °C (-50 °C up to -25 °C); 1.0 °C (-25 °C up to +100 °C); 2.0 °C (+100 °C up to +125 °C); 3.5 °C (+125 °C up to +150 °C)
Current measurement	Range: 0 to 20 mA; 4 to 20 mA Resolution: 20 µA; max. failure: 60 µA
Voltage measurement	Range: 0 to 10 V Resolution: 10 mV; max. failure: 30 mV
Connections	Screw terminals; Wire cross section: max. 1.4 mm²
Interface	
1 FRAKO Starkstrombus®	For connection to FRAKO Energy Management System, according to EN 50170 (P-Net), standardised fieldbus, RS-485 transfer rate: 76.8 kbit/s
Display elements	2 LEDs
Mechanical construction	
Dimensions	86 x 128 x 50 mm (W x H x D)
Ingress protection	Housing/terminals IP30/IP20 according to DIN EN 60529
Version	Housing insulated, protection class 3 (SELV), at a rated voltage up to max. 36 V, pollution degree 2, according to EN 61010 part 1 EMV according to EN 61326-1
Installation	On standard rail 35 mm according to DIN EN 50022
Weight	190 g
Operating conditions	
Ambient temperature	0 °C up to +70 °C
Article-No.	20-40009

Optional Accessories

Article-No.	Type	Description
20-10700	Power Supply for analogue module EM-AM 24V DC (also suitable for EM-PQ 1500)	AC/DC SMPS adapter, DIN rail-mounted, 24 V DC / 0.35 A and 12 V DC / 20 mA, AC power supply 85 to 264 V (also suitable for EM-PQ 1500)

Software

Visualization Software

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Software for Cost Centre Analysis

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EMG-OPC-Server

Page 301

EMVIS 3000
System visualization

The FRAKO Energy Management System is used to acquire measurement readings, statuses and events from the entire internal utilities supply of a company. These data are processed centrally and saved, and can be displayed and evaluated using the EMVIS 3000 visualization software. The EMVIS 3000 software is a powerful tool for displaying and documenting all the measurement data from the instruments connected to it.

EMVIS 3000 comprises the following functional modules:

EMVIS 3000 Project

The project planning tool ...

- Unrestricted configuration and compilation of evaluations of all data processed by the system
- Calculation of **performance figures**
  Performance figures are virtual data points calculated from other data points, an arithmetic computation from measured or imported data, e.g.: “Active energy A x factor + Water quantity B x factor + Compressed air volume C x factor / No. of items D”
- Creation of **benchmarking** charts
  Benchmarking makes a direct comparison of measurement data or performance figures possible, e.g. energy costs of products or company sites
- Creation of **Sankey** diagrams
  A Sankey diagram gives a clear overview of any type of flow, e.g. the flow of utilities. The width of each stream into and out of a location is proportional to the quantity flowing, absolute and percentage values also being stated
- Easy Customizing - individual planning of views - simple and intuitive (the basic package includes 3 views with up to 20 online data points in total)

EMVIS 3000 Report

The reporting tool ...

- To simplify navigation, a clear overview of the entire system is displayed in two system trees, either of which can be selected:
  – **Physical:** standard evaluations of all the instruments and channels registered with the system
  – **Organizational:** all evaluations that have been compiled with EMVIS 3000 Project
- Presentation of historical data for analysis and comparison purposes, e.g. different locations or different periods of time
- The historical data can be exported directly from the chart or consumption table for further processing
- Direct access to the momentary readings of the connected instruments
- Readout of the events that have occurred

EMVIS 3000 Live

- Views created individually - from site layout drawings right down to the distribution board
- Display of the momentary measurement readings and statuses

The EMVIS 3000 license enables the software to be installed on several PCs (server and clients) and an EMIS® 1500 Central Unit to be accessed.

In the physical system tree prepared standard evaluations are deposited for all Energy Management devices. This allows the user to visualize the recorded historical data.

Via physical system tree the actually measured data of all EM devices can readily be accessed.

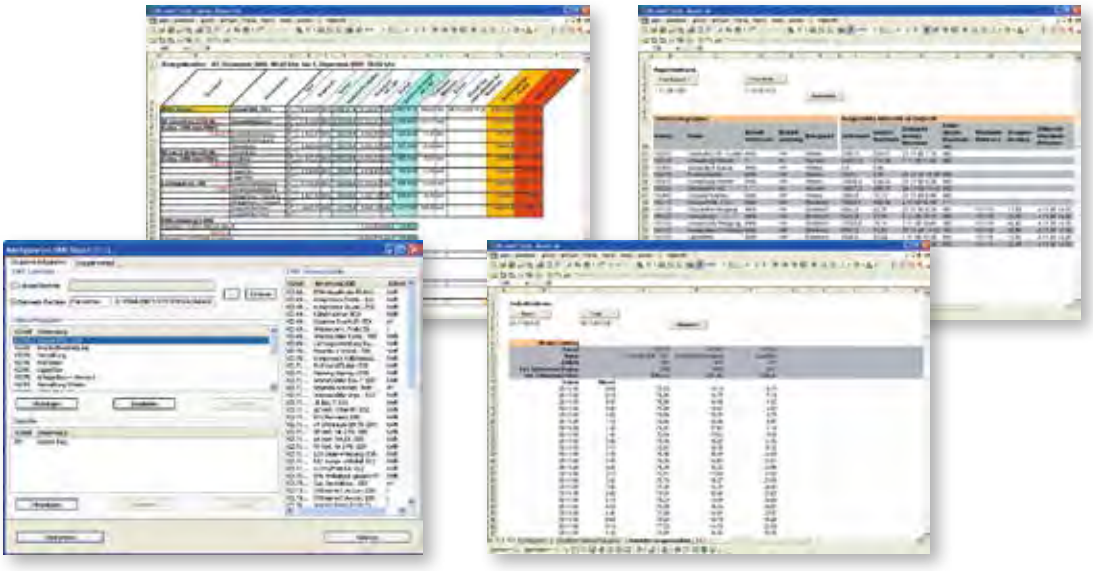
Within the organizational system tree business specific structures are deposited. The business specific structures are projected in form of individual evaluation in the organizational system tree by the customer.

Technical Data

PC requirements for small and medium systems	
Hardware	• Min. Intel Core I3-Processor • User memory: 4 GB RAM • 1 GB free hard disk space • Graphics adapter: min. DirectX 9.0c support and 512 MB video memory
Software	• Microsoft® Windows®* 7 (x32/x64) Microsoft® Windows®* 8 (x32/x64) • Microsoft® Windows®* Server 2008 R2 • Microsoft® Windows®* Server 2003 R2 • .NET 4.0 FULL • .NET 3.5 • FRAKO-NET V1.26.0001 (or higher) • SQL data base Firebird 2.0 (included in FRAKO-NET) * Registered trademark of Microsoft Corporation
Article-No.	20-10649

EMVIS 3000 Extension packages

Article-No.	Type	Description
20-10485	Extension license Central Unit	Allows EMVIS 3000 the access to an additional Central Unit EMIS 1500
20-10650	EasyCustomizing-S	Individually designed views with up to 100 data points
20-10651	EasyCustomizing-M	Individually designed views with up to 200 data points
20-10652	EasyCustomizing-L	Individually designed views with up to 350 data points
20-10653	EasyCustomizing-XL	Individually designed views with up to 550 data points
20-10654	EasyCustomizing-XXL	Individually designed views with up to 1000 data points



EMIS® Report
Software for Cost Centre Analysis

Energy analysis with EMIS® Report.
Software for automated analysis of energy consumption based on Microsoft® Excel*.
The consumption data recorded with the FRAKO Energy Management System can be imported to an Excel workbook from the SQL databases FRAKO-NET or FRAKO EMIS-DB.

The reporting period can be set as required.

Individual loads or metering units can be combined to load groups (e.g. cost centres) and evaluated with different time profiles. Customer-specific reports can easily be generated by linking to appropriate cells.
By means of that you achieve an optimum transparency of the energy flows within the company.

With EMIS® report, data from the FRAKO database can be imported to an Excel sheet and are available for a customer specific analysis. This makes it a very useful tool for the allocation of costs of the different company divisions and/or energy transfer media (electricity, gas, oil, etc.). It is also a useful data source for the financial controlling of a company.

Transparency of energy costs
- Assigning costs to the originators
- Transparency of all energy flows within the company
- Achieve the utmost efficiency
- Automatic evaluation through e-mail notification - also available as CSV-file

To achieve an optimized reduction of the energy costs it is essential to have information on how much energy was consumed when and where.

The knowledge of the energy consumption per cost centre is necessary to determine the potential for savings.

EMIS® Report provides a structured overview of the consumption of all types of energy of your company such as current, water, gas, compressed air etc. This enables you to financially evaluate those consumptions.

Individual loads or metering units can be combined into load groups or cost centres and evaluated according to different time schedules.

Thus, optimal transparency of energy flows is achieved in the company.
Functions:

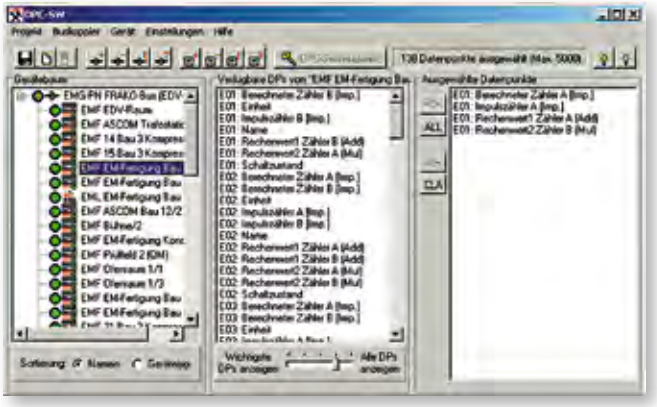
- Automatic evaluation and notification by e-mail
- Period covered by the report is freely definable (date, day, etc.)
- Determination of consumption (kWh, l, m3, ...)
- Consumption peaks within the reporting period
- Time of maximum demand (e.g. kWh)
- Demand by a load or a load group at the time of peak consumption of a reference unit
- Interval values (e. g. 15 minutes) of the reporting period for consumption or consumption rate (e.g. kW)
- Sum of the interval values of the reporting period
- Evaluation according to different time profiles

Technical Data

PC requirements	
Hardware	• Pentium, min. 2 GHz clock frequency • User memory: min. 1 GB RAM • 6 GB free hard disk space • Ethernet 10/100 Mbit/s network connection or/and one free serial interface • CD-ROM drive • SVGA graphics adapter • Colour screen, minimum resolution: 1024 x 768 Pixel
Software	• Database FRAKO-NET DB or FRAKO EMIS-DB • Microsoft® Windows®* 2000 pro (SP3 or higher) • Microsoft® Windows®* XP pro (SP1 or higher) • Microsoft® Windows®* 2003 Server (SP1 or higher) • Micosoft® Internet Explorer 5.5* • Microsoft® Excel* (Version 2000 or newer) * Registered trademark of Microsoft Corporation
Article-No.	20-10488

Optional Accessories

Article-No.	Type	Description
20-10494	Software expansion for EMIS® Report	Software update for cost centre and analysis software EMIS® Report



EMG-OPC-Server

Software interface with the current OPC server.
OPC is an open software interface standard that enables a simple standardized interchange of data to take place between automation and control applications, SCADA systems (process visualization) and office applications (e.g. Microsoft® Excel*, Access*).

FRAKO EMG-OPC Server has been developed for visualization purposes on the basis of the **OPC Data Access Specifications 1.0, 2.0 and 3.0**, and uses the Microsoft® DCOM standard.

This enables the client and server to be separated at various PCs in a network. It is recommended, however, to use client and server on the same PC.

Benefits of the OPC interface

- Easy linking of FRAKO mesurement devices, provided with the FRAKO Starkstrombus® protocol, to PC software such as visualization systems or office applications
- Data interchange between applications from various suppliers through a common interface

Operating principle

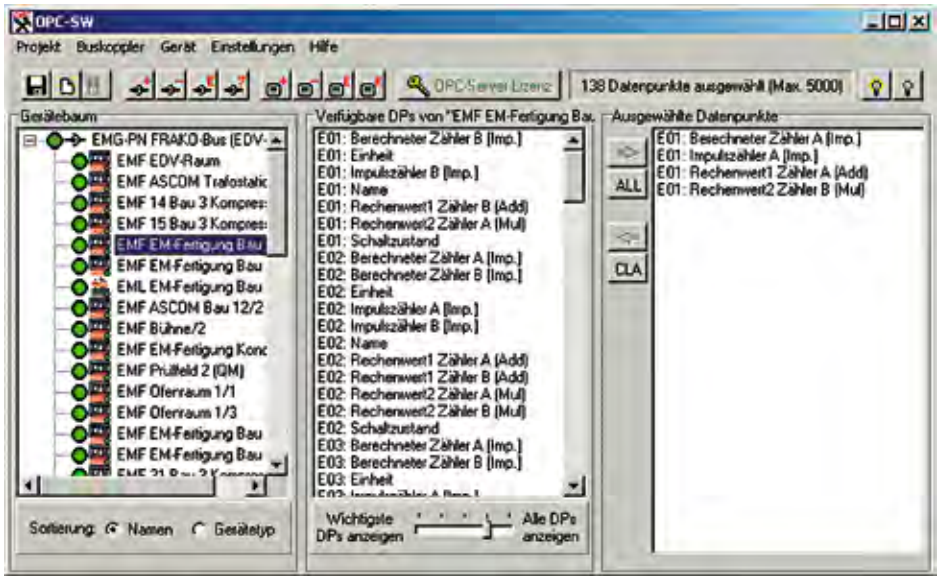
OPC works on the **client / server principle. EMG OPC Server** 'serves up' data from the FRAKO mesurement devices, provided with the FRAKO Starkstrombus® protocol, i.e. makes these available externally. The PC application as 'client' receives and processes the data.

Communication with the **FRAKO Energy Management System** is via an EMG 1500-PN Gateway or the internal gateway in the EMIS® 1500. Access to the gateways is via the site's own Ethernet network (TCP / IP).

The **OPC-SW** software creates the configuration files, which contain the data points for the namespace. This supplies a preselection of data points per gateway that can be provided by **EMG-OPC-Server**. These configuration files are loaded when **EMG-OPC-Server** is started. The OPC client then selects the data points to be provided by EMG-OPC-Server from the specified namespace.

Up to 8 EMG 1500 PN Gateways or internal gateways of the EMIS® 1500 and a maximum number of 5000 data points can be registered per **EMG-OPC-Server**. The same system requirements apply as for the **FRAKO EMVIS 3000 visualization system**.

Configuration



Technical Data

PC requirements	
Hardware	• 2 GHz Dual-Core processor • User memory: 2 GB RAM • 1 GB free hard disk sapce • Ethernet 10/100 Mbit/s network connection
Software	• Microsoft® Windows®* XP SP3 • Microsoft® Windows®* 7 (x32/x64) • Microsoft® Windows® Server (2003 R2 / 2008 R2) • .NET 1.1 • .NET 4.0 Client oder FULL * Registered trademark of Microsoft Corporation
Article-No.	20-10491

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