

# AUTOMATIC POWER FACTOR CORRECTION SYSTEMS WITHOUT REACTORS

Optimised,  
thermal design



Self-healing



Low loss



Long service life



**High tolerance of start-up currents  
inrush current withstand capability**

- Optimised metal spraying process
- Wave-cut film design
- Capacitor contactors with pre-closing contacts for inrush current damping

**Long service life**

- Generous space- / power-ratio
- Generously dimensioned cooling system
- High quality capacitors

**High operational reliability**

- Capacitors with fivefold safety system
- PFC controller with 8-way alarm message
- Heavy duty sheet steel cabinets
- Optimised thermal design
- Exclusive use of quality components

## Areas of application



- Automatic Power Factor Correction (APFC)
- For use in mains supply with low harmonics distortion
- Converter power (non-linear loads) < 15% of total connection power
- Total harmonic distortion of THD-U < 3%
- No combined use in networks with de-tuned capacitors
- No use with critical ripple control systems in the range 270 to 425 Hz



## Device overview and technical data

Power factor correction without reactors		
Standards	DIN, VDE 0660 part 500, EN 60439-1 and EN 60831-1/2	
Design	DIN EN 60439 part 1, partial type-approved combination	
Construction type	Sheet steel cabinet for versions KB and ES, module for version MO	
PFC controller	Prophi® per datasheet or selection table	
Power capacitors	High quality, self-healing, polypropylene 3-phase capacitors using dry technology	
Contactors	Specific capacitor contactors with pre-charging resistors	
Capacitor protection	HRC fuses, 3-phase, per capacitor stage	
Nominal voltage	400 V, 50 Hz (other voltages on request)	
Control voltage	230 V, 50 Hz (other voltages on request)	
Output range	10 – 600 kvar (alternative staging, powers on request)	
Capacitor nominal voltage	440 V without reactors	
Voltage withstand capability of capacitors	8 h daily	484 V
	30 min daily	506 V
	5 min	528 V
	1 min	572 V
Power dissipation	Capacitors < 0.5 W/kvar, systems 4 – 7 W/kvar	
Switching cycles capacitor contactors	max. 100,000 switching cycles	
Current transformer connection	... /1 A, .../5 A	
Control ratio	See overview of variants	
Discharging	With discharge resistors per EN 60831-1/2	
Maximum altitude	Up to 2,000 m above sea level	
Ambient temperature	35 °C per DIN EN 60439 part 1 (temperature class of the capacitors should be assured with adequate ventilation/cooling at the place of installation!)	
Protection class	Cabinet version = IP32 / Slide-in module = IP00	
Type of cooling	Forced ventilation (except slide-in modules)	
Colour	Grey, RAL 7035 (other colours on request)	
Noise emission (FK)	< 60 dB with closed systems at 1 m distance	
Connection cross-section and fuse	See technical annex	

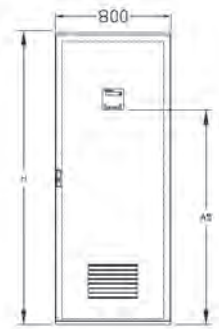
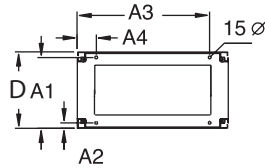
# Automatic power factor correction in modular design (up to 500 kvar ...)

## Main features

- APFC in the steel cabinet
- For free-standing installation
- Nominal voltage: 400 V, 3-phase, 50 Hz
- Protection class: IP32
- With natural convection (air exchange)
- With discharge resistors
- With power factor controller Prophi® 6R/12R



## Dimension diagrams



ES8184 (dimensions in mm):  
 H = 1820, W = 800, D = 400  
 A1 = 374, A2 = 25, A3 = 700, A4 = 100  
 A5 = 1,480



## Technical data

APFC in modular design ES8184							
Nominal output kvar	Stage power kvar	Control ratio	Type	Width in mm	Weight in kg	Item no.	
150	25/25/50/50	1:1:2:2	JF440/150ER6ES8184**	800	208	50.81.400	
150	12.5/12.5/25/50/50	1:1:2:4:4	JF440/150ER12ES8184**	800	208	50.81.415	
150	25/25/25...	1:1:1:1:1:1	JF440/150ER6ES8184**	800	208	50.81.425	
160	20/20/40...	1:1:2:2:2	JF440/160ER8ES8184**	800	209	50.81.450	
175	25/50/50/50	1:2:2:2	JF440/175ER7ES8184**	800	210	50.81.475	
175	12.5/12.5/25/25/50...	1:1:2:2:4:4	JF440/175ER14ES8184***	800	210	50.81.490	
180	20/40/40...	1:2:2:2:2	JF440/180ER9ES8184**	800	211	50.81.515	
200	50/50...	1:1:1:1	JF440/200ER4ES8184**	800	212	50.81.540	
200	25/25/50...	1:1:2:2:2	JF440/200ER8ES8184**	800	212	50.81.550	
200	12.5/12.5/25/50...	1:1:2:4:4...	JF440/200/ER16ES8184**	800	212	50.81.560	
200	20/20/40...	1:1:2:2:2:2	JF440/200ER10ES8184**	800	212	50.81.570	
240	20/20/40...	1:1:2:2...	JF440/240ER12ES8184***	800	232	50.81.600	
250	50...	1:1:1:1:1	JF440/250ER5ES8184**	800	233	50.81.625	
250	25/25/50...	1:1:2:2...	JF440/250ER10ES8184**	800	233	50.81.635	
250	12.5/12.5/25/50...	1:1:2:4:4...	JF440/250ER20ES8184***	800	233	50.81.645	
300	50/50...	1:1:1:1:1:1	JF440/300ER6ES8184**	800	236	50.81.670	
300	25/25/50...	1:1:2:2...	JF440/300ER12ES8184***	800	236	50.81.680	
300	12.5/12.5/25/50...	1:1:2:4:4...	JF440/300ER24ES8184***	800	236	50.81.690	
400	50/50/50...	1:1...	JF440/400ER8ES8184**	2 x 800	475	50.81.693	
500	50/50/50...	1:1...	JF440/500ER10ES8184***	2 x 800	500	50.81.696	
Accessories							
Socket 100 mm high	SO 100/800/400				5	29.03.317	
Socket 200 mm high	SO 200/800/400				10	29.03.322	

\*\* With power factor controller Prophi® 6R  
 \*\*\* With power factor controller Prophi® 12R

Other rated voltages, frequencies, kvar-outputs, mechanical configurations or variants with circuit breakers on request. Expansion units, systems in ISO housing as well as audio frequency blocking devices on request.

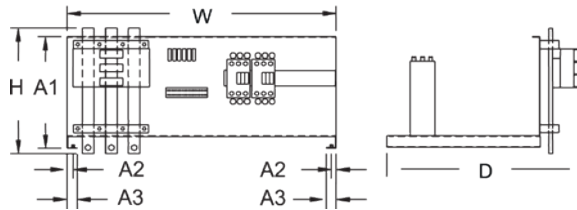
# Automatic power factor correction on extractable module, up to 100 kvar

## Main features

- Ready-to-install PFC slide-in modules without reactors
- For cabinet installation
- Nominal voltage: 400 V, 3-phase, 50 Hz
- Protection class: IP00
- With natural convection (air exchange)
- With discharge resistors



## Dimension diagrams



MO84 (dimensions in mm):  
 H = 330, W = 703, D = 333  
 A1 = 290, A2 = 14, A3 = 26.5



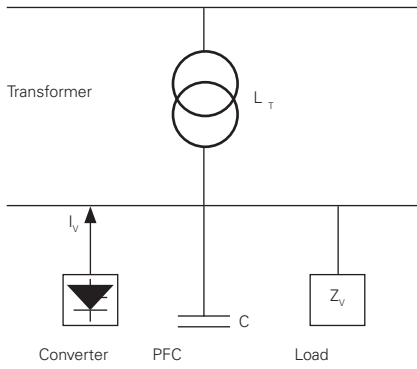
## Technical data

PFC module M084					
Nominal output kvar	Stage power kvar	Control ratio	Type	Weight in kg	Item no.
50	50		JF440/50EK1MO84	22	50.80.700
50	25/25	1:1	JF440/50/2EK2MO84	22	50.80.740
50	10/20/20	1:2:2	JF440/50/3EK5MO84	22	50.80.770
50	12.5/12.5/25	1:1:2	JF440/50/3/EK4MO84	22	50.80.774
60	20/40	1:2	JF440/60/2EK3MO84	23	50.80.775
60	10/10/20/20	1:1:2:2	JF440/60/4EK6MO84	23	50.80.776
75	25/50	1:2	JF440/75/2EK3MO84	24	50.80.800
75	25/25/25	1:1:1	JF440/75/3EK3MO84	24	50.80.810
75	12.5/12.5/25/25	1:1:2:2	JF440/75/4EK6MO84	24	50.80.811
80	40/40	1:1	JF440/80/2EK2MO84	24	50.80.835
80	20/20/40	1:1:2	JF440/80/3EK4MO84	24	50.80.837
100	50/50	1:1	JF440/100/2EK2MO84	25	50.80.875
100	25/25/50	1:1:2	JF440/100/3EK4MO84	25	50.80.880
100	25/25/25/25	1:1:1:1	JF440/100/4EK4MO84	25	50.80.900
100	20/40/40	1:2:2	JF440/100/3EK5MO84	25	50.80.902
100	12.5/12.5/25/50	1:1:2:4	JF440/100/4EK8MO84	25	50.80.903
<b>Control module with Prophi® 6R controller</b> MCCB, CT terminals and 2 m connection cable (mounted on the capacitor module)					50.80.003
<b>Control module with Prophi® 12R controller</b> MCCB, CT terminals and 2 m connection cable (mounted on the capacitor module)					50.80.004
<b>Accessories</b> Set module fixing rail for Rittal cabinets, left/right, with accessories (for Rittal cabinet MO84)					50.00.100

Other rated voltages, frequencies, outputs, mechanical configurations or variants with circuit breakers on request.

# De-tuned power factor correction (passive harmonics filter)

Schematic diagram



Equivalent circuit diagram

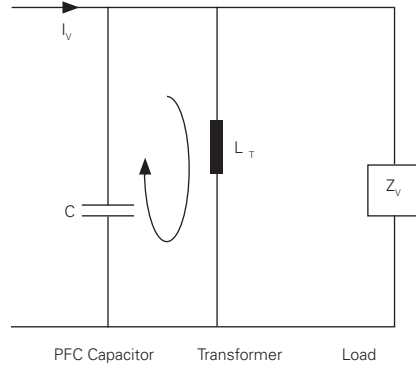


Fig.: Parallel resonant circuit between transformer and capacitors without reactors

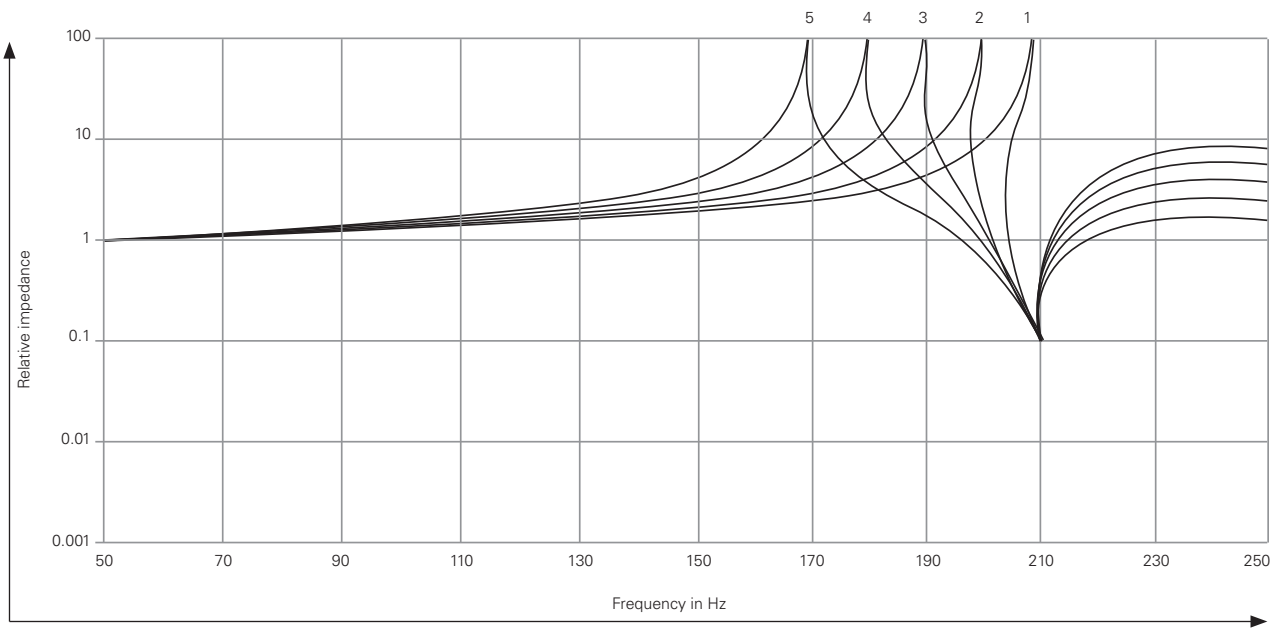


Fig.: Relative impedance progression for parallel resonant circuit with detuned capacitor and transformer

- $U_k = 4\%$
- $p = 5.67\%$
- 1...  $Q_C / S_N = 5\%$
- 2...  $Q_C / S_N = 15\%$
- 3...  $Q_C / S_N = 30\%$
- 4...  $Q_C / S_N = 50\%$
- 5...  $Q_C / S_N = 80\%$
- $Q_C = \text{PFC output}$
- $S_N = \text{Apparent power of transformer}$