DYNAMIC POWER FACTOR CORRECTION SYSTEMS (REAL TIME PFC)

Optimised, thermal design

De-tuned version

Long service life

Minimised grid distortion

Hardly any mains supply distortion
- Switching at zero point transition
- No inrush currents
- Stabilisation of the mains supply voltage
- Reduction of harmonics distortion
- Switching times < 20 ms

Long service life
- Generous space- / power-ratio
- Generously dimensioned cooling system
- High quality capacitors and filter circuit reactors

High operational reliability
- Capacitors with fivefold safety
- PFC controller with 8-way alarm message
- Filter circuit reactors with high linearity and 100% duty cycle
- Optimised thermal design
- Exclusive use of quality components
- Thyristor switch for capacitor connection without mains supply distortion

Areas of application

- Use in applications with fast and high load changes
- APFC in LVDB
- For use in mains supply with harmonics burden
- Converter power (non-linear loads) > 15% of the connection power
- Total harmonic distortion of THD-U > 3%
- Harmonics filtering and improvement of power quality
- Reduction in reactive current costs
- Stabilisation of the mains supply voltage

Typical applications

- Automotive industry (welding systems, presses, etc.)
- Lift systems and cranes
- Start-up compensation for large motors
- Drilling rigs in oil production
- Wind turbines
- Welding technology
- Steel production
- Plastic injection moulding systems
- Fishing vessels

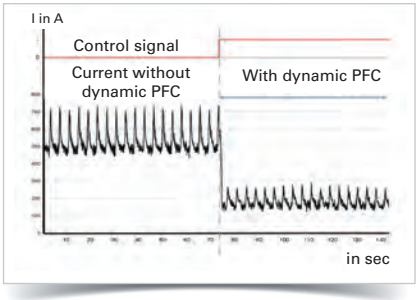


Fig.: Current reduction by means of dynamic PFC

Particular advantages

- Improved power quality, i.e. avoidance of high start-up currents for the power capacitors
- Significant extending the service life for the PFC system
- Safety of the complete system is significantly increased (i.e. avoidance of damages through defective contactors and subsequent exploding capacitors)
- Ultra-fast compensation of power factor, resulting in a reduction in the reactive current costs and kWh losses
- Voltage stabilisation (e.g. contactors support during the start-up phase of large motors)
- Improved utilisation of the energy distribution (transformers, cabling, switchgear, etc.) through the elimination of power peaks
- Shortening of process times (e.g. welding) due to stabilized voltage

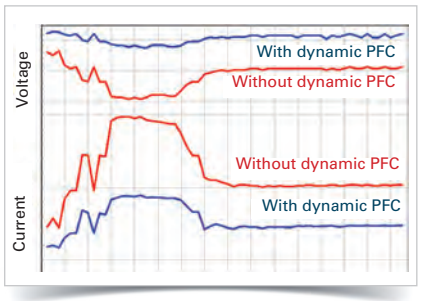


Fig.: Comparison of current and voltage with and without dynamic PFC when starting up a large motor

Device overview and technical data

Dynamic power factor correction				
Technical data				
Standards	DIN, VDE 0660 part 500, EN 60439-1 and EN 60831-1/2			
Design in accordance with	DIN EN 60439 part 1, partial type-approved combination			
Construction type	Sheet steel cabinet for versions KB and ES, module for version MO			
Dynamic power factor controller	Prophi®T version per datasheet or selection table			
Power capacitors	High quality, self-healing, polypropylene 3-phase capacitors using dry technology			
Filter circuit reactors	Low-loss 3-phase reactors with high linearity, 7%, 14% (other reactor ratings on request)			
Electronic switch (t < 20 ms)	Thyristor actuator for switching in the zero point transition (to avoid network disturbances)			
Capacitor protection	Ultra-fast electronic fuses			
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, outputs on request)			
Capacitor nominal voltage	440 V with out reactors and 5.67 – 7% (choked), 525 V with 14% (reactors)			
Voltage withstand capability of capacitors	At p = 5.67 – 7%	440 V	At p = 14%	525 V
	8 h daily	484 V		577 V
	30 min daily	506 V		604 V
	5 min	528 V		630 V
	1 min	572 V		682 V
Power dissipation	Capacitors < 0.5 W/kvar, systems 4 – 7 W/kvar			
System design	**Permissible harmonics currents**		**Harmonics voltage**	
	I 250 Hz	I 350 Hz	U 250 Hz	U 350 Hz
FK 5.67	0.565 IN	0.186 IN	5%	5%
FK 7	0.31 IN	0.134 IN	5%	5%
FK 14	0.086 IN	0.051 IN	5%	5%
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			
Noise emission (FK)	< 60 dB with closed systems at 1 m distance			
Connection cross-section and fuse	See technical annex			

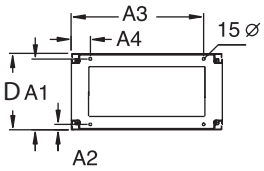
The following reactors can be used in mains supply with ripple control systems:		
Mains supply ripple control frequency	**De-tuning factor**	**Filter series resonant frequency**
< 168 Hz	p = 14%	fr = 134 Hz
168 – 183 Hz	p = 14 / 5.67%	fr = 134 / 210 Hz
> = 216.67	p = 8%	fr = 177 Hz
> 228 Hz	p = 7%	fr = 189 Hz
> 350 Hz	p = 5.67%	fr = 210 Hz

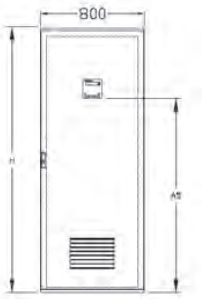
7% de-tuned dynamic power factor correction, extractable design ES8206 FKTh

Main features

- Dynamic (t < 20 ms), de-tuned APFC in extractable design in steel cabinet
- Modular cabinet for free-standing mounting (expandable in output)
- Nominal voltage: 400 V, 3-phase, 50 Hz
- Reactors: 7% (189 Hz series resonant frequency)
- Protection class: IP32
- Ventilation: From 120 kvar with fan in PFC cabinet door for forced cooling
- With power factor controller Prophi® 6T / 12T

Dimension diagrams





ES8206 (dimensions in mm):
H = 2,020, W = 800, D = 600, A1 = 537
A2 = 63, A3 = 737, A4 = 62, A5 = 1,480

Technical data

Nominal output kvar	Stage power kvar	Control ratio	Type	Width in mm	Weight in kg	Item no.
60	10/20/30	1:2:3	JF440/60ER6ES8206FK7Th**	800	290	**50.19.040**
75	12.5/12.5/25/25	1:1:2:2	JF440/75ER6ES8206FK7Th**	800	290	**50.19.080**
100	25/25/50	1:1:2	JF440/100ER4ES8206FK7Th**	800	306	**50.19.120**
120	20/20/40/40	1:1:2:2	JF440/120/ER6ES8206FK7Th**	800	306	**50.19.320**
100	12.5/12.5/25/50	1:1:2:4	JF440/100ER8ES8206FK7Th**	800	380	**50.19.200**
125	12.5/25/37.5/50	1:2:3:4	JF440/125ER10ES8206FK7Th**	800	390	**50.19.325**
150	12.5/12.5/25/50...	1:1:2:4...	JF440/150ER12ES8206FK7Th**	800	410	**50.19.330**
150	25/25/50/50	1:1:2:2	JF440/150ER6ES8206FK7Th**	800	410	**50.19.400**
175	12.5/25/37.5/50...	1:2:3:4...	JF440/175ERES8206FK7Th**	800	420	**50.19.440**
200	50/50/50/50	1:1:1:1	JF440/200ER4ES8206FK7Th**	800	430	**50.19.480**
200	25/25/50...	1:1:2...	JF440/200ER8ES8206FK7Th**	800	430	**50.19.520**
200	12.5/12.5/25/50...	1:1:2:4...	JF440/200ER16ES8206FK7Th**	800	435	**50.19.560**
250	50/50...	1:1...	JF440/250ER5ES8206FK7Th**	800	478	**50.19.600**
250	25/25/50...	1:1:2...	JF440/250ER10ES8206FK7Th**	800	490	**50.19.640**
250	12.5/12.5/25/50...	1:1:2:4...	JF440/250ER20ES8206FK7Th***	800	495	**50.19.645**
300	50/50...	1:1...	JF440/300ER6ES8206FK7Th**	800	500	**50.19.685**
300	25/25/50...	1:1:2...	JF440/300ER12ES8206FK7Th***	800	500	**50.19.690**
400	50/50...	1:1...	JF440/400ER8ES8206FK7Th***	1,600	2 x 421	**50.19.742**
500	50/50...	1:1...	JF440/500ER10ES8206FK7Th***	1,600	500 / 421	**50.19.800**
600	50/50...	1:1...	JF440/600ER12ES8206FK7Th***	1,600	2 x 500	**50.19.820**
Accessories						
100 mm high socket for easy supply cable connection		SO 100 / 800 / 600			5	**50.00.150**
200 mm high socket for easy supply cable connection		SO 200 / 800 / 600			10	**50.00.151**

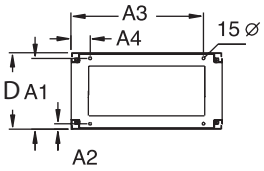
Other rated voltages, frequencies, outputs, reactors, mechanical configurations or variants with circuit breakers on request.
** With Prophi® 6T, *** With Prophi® 12T

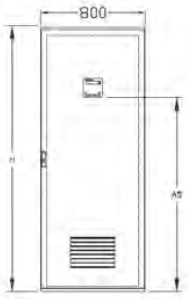
14% de-tuned dynamic power factor correction, extractable design ES8206 Th

Main features

- Dynamic (t < 20 ms), de-tuned APFC in extractable design in steel cabinet
- Modular cabinet for free-standing mounting (expandable in output)
- Nominal voltage: 400 V, 3-phase, 50 Hz
- Reactors: 14% (134 Hz series resonant frequency)
- Protection class: IP32
- Ventilation: From 120 kvar with fan in PFC cabinet door for forced cooling
- With power factor controller Prophi® 6T / 12T

Dimension diagrams





ES8206 (dimensions in mm):
H = 2,020, W = 800, D = 600, A1 = 537
A2 = 63, A3 = 737, A4 = 62, A5 = 1,480

Technical data

Nominal output kvar	Stage power kvar	Control ratio	Type	Width in mm	Weight in kg	Item no.
60	10/20/30	1:2:3	JF525/60ER6ES8206FK14Th*	800	290	**50.98.040**
75	12.5/12.5/25/25	1:1:2:2	JF525/75ER6ES8206FK14Th**	800	290	**50.98.080**
100	25/25/50	1:1:2	JF525/100ER4ES8206FK14Th**	800	306	**50.98.120**
120	20/20/40/40	1:1:2:2	JF525/120/ER6ES8206FK14Th**	800	306	**50.98.320**
100	12.5/12.5/25/50	1:1:2:4	JF525/100ER8ES8206FK14Th**	800	380	**50.98.200**
125	12.5/25/37.5/50	1:2:3:4	JF525/125ER10ES8206FK14Th**	800	390	**50.98.325**
150	12.5/12.5/25/50...	1:1:2:4...	JF525/150ER12ES8206FK14Th**	800	410	**50.98.330**
150	25/25/50/50	1:1:2:2	JF525/150ER6ES8206FK14Th**	800	410	**50.98.400**
175	12.5/25/37.5/50...	1:2:3:4...	JF525/175ERES8206FK14Th**	800	420	**50.98.440**
200	50/50/50/50	1:1:1:1	JF525/200ER4ES8206FK14Th**	800	430	**50.98.480**
200	25/25/50...	1:1:2...	JF525/200ER8ES8206FK14Th**	800	430	**50.98.520**
200	12.5/12.5/25/50...	1:1:2:4...	JF525/200ER16ES8206FK14Th**	800	435	**50.98.560**
250	50/50...	1:1...	JF525/250ER5ES8206FK14Th**	800	478	**50.98.600**
250	25/25/50...	1:1:2...	JF525/250ER10ES8206FK14Th**	800	490	**50.98.640**
250	12.5/12.5/25/50...	1:1:2:4...	JF525/250ER20ES8206FK14Th***	800	495	**50.98.645**
300	50/50...	1:1...	JF525/300ER6ES8206FK14Th**	800	500	**50.98.685**
300	25/25/50...	1:1:2...	JF525/300ER12ES8206FK14Th***	800	500	**50.98.690**
400	50/50...	1:1...	JF525/400ER8ES8206FK14Th***	1,600	2 x 421	**50.98.742**
500	50/50...	1:1...	JF525/500ER10ES8206FK14Th***	1,600	500 / 421	**50.98.800**
600	50/50...	1:1...	JF525/600ER12ES8206FK14Th***	1,600	2 x 500	**50.98.920**
Accessories						
100 mm high socket for easy supply cable connection		SO 100 / 800 / 600			5	**50.00.150**
200 mm high socket for easy supply cable connection		SO 200 / 800 / 600			10	**50.00.151**

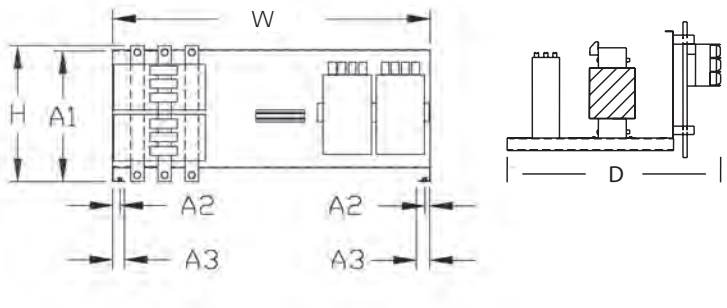
Other rated voltages, frequencies, powers, reactors, mechanical configurations or variants with circuit breakers on request.
** With Prophi® 6R, *** With Prophi® 12R

De-tuned, dynamic PFC modules extractable design

Main features

- Dynamic (t < 20 ms), de-tuned APFC in extractable desgin in steel cabinet
- For installation in existing switch gear or PFC cabinets
- Nominal voltage: 400 V, 3-phase, 50 Hz
- Reactors: 7% (189 Hz series resonant frequency),
  14% (134 Hz series resonant frequency)
- Protection class: IP32
- Ventilation: Natural cooling
  (care must be taken to ensure sufficient ventilation)
- With discharge resistors

Dimension diagrams



dimensions in mm:
H = 330, W = 703, D = 550
A1 = 290, A2 = 14, A3 = 26.5

Technical data

7% de-tuned capacitor modules MO86FK7Th (width 800 mm, depth 600 mm)					
Nominal output kvar	Stage power kvar	Control ratio	Type	Weight in kg	Item no.
10	10		JF440/10EK1MO86FK7Th	26	**50.18.650**
12.5	12.5		JF440/12.5EK1MO86FK7Th	28	**50.18.680**
20	20		JF440/20EK1MO86FK7Th	35	**50.18.710**
25	25		JF440/25/EK1MO86FK7Th	35	**50.18.740**
40	40		JF440/40EK1MO86FK7Th	45	**50.18.770**
50	50		JF440/50EK1MO86FK7Th	47	**50.18.800**
20/2	10	1:1	JF440/20/2EK2MO86FK7Th	40	**50.18.801**
25/2	12.5	1:1	JF440/25/2EK2MO86FK7Th	42	**50.18.830**
30/2	10/20	1:2	JF440/30/2EK2MO86FK7Th	46	**50.18.860**
40/2	20	1:1	JF440/40/2EK2MO86FK7Th	57	**50.18.890**
50/2	25	1:1	JF440/50/2EK2MO86FK7Th	58	**50.18.930**
75/2	25/50	1:2	JF440/75/2EK2MO86FK7Th	76	**50.18.932**
80/2	40/40	1:1	JF440/80/2EK2MO86FK7Th	77	**50.18.933**
100/2	50/50	1:1	JF440/100/2EK2MO86FK7Th	90	**50.18.931**

14% de-tuned capacitor modules MO86FK14Th (width 800 mm, depth 600 mm)					
Nominal output kvar	Stage power kvar	Control ratio	Type	Weight in kg	Item no.
10	10		JF525/10EK1MO86FK14Th	36	**50.12.650**
12.5	12.5		JF525/12.5EK1MO86FK14Th	37	**50.12.680**
20	20		JF525/20EK1MO86FK14Th	42	**50.12.710**
25	25		JF525/25EK1MO86FK14Th	43	**50.12.740**
40	40		JF525/40EK1MO86FK14Th	54	**50.12.770**
50	50		JF525/50EK1MO86FK14Th	56	**50.12.800**
20/2	10	1:1	JF525/20/2E2MO86FK14Th	57	**50.12.803**
25/2	12.5	1:1	JF525/25/2EK2MO86FK14Th	64	**50.12.804**
30/2	10/20	1:2	JF525/30/2EK2MO86FK14Th	69	**50.12.849**
40/2	20	1:1	JF525/40/2EK2MO86FK14Th	71	**50.12.850**
50/2	25	1:1	JF525/50/2EK2MO86FK14Th	73	**50.12.890**
75/2	25/50	1:2	JF525/75/2EK2MO86FK14Th	82	**50.12.893**
80/2	40/40	1:1	JF525/80/2EK2MO86FK14Th	84	**50.12.896**
100/2	50/50	1:1	JF525/100/2EK2MO86FK14Th	96	**50.12.892**

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

Communications architecture: PFC and power quality analysis combined