SIVACON

Reactive power compensation systems – Modules and accessories

SIVACON COMPONENTS

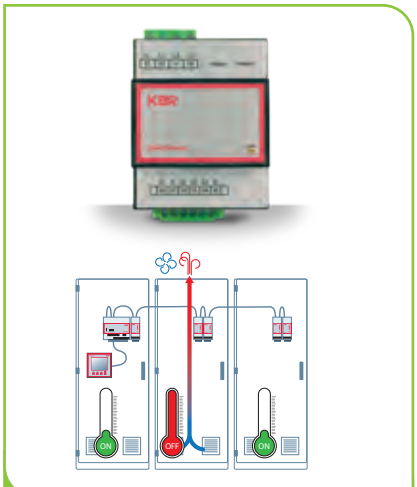
Made in Germany!

One System. Best Solutions.

KBR Energy Management

POWER QUALITY

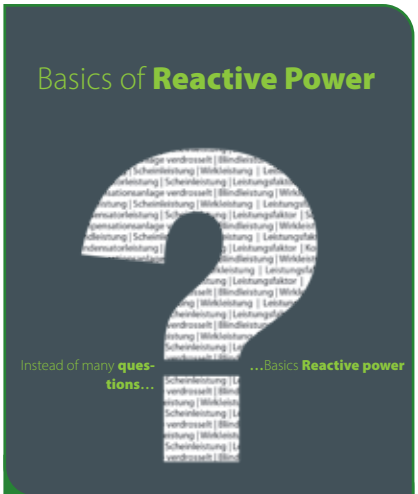
MADE IN GERMANY



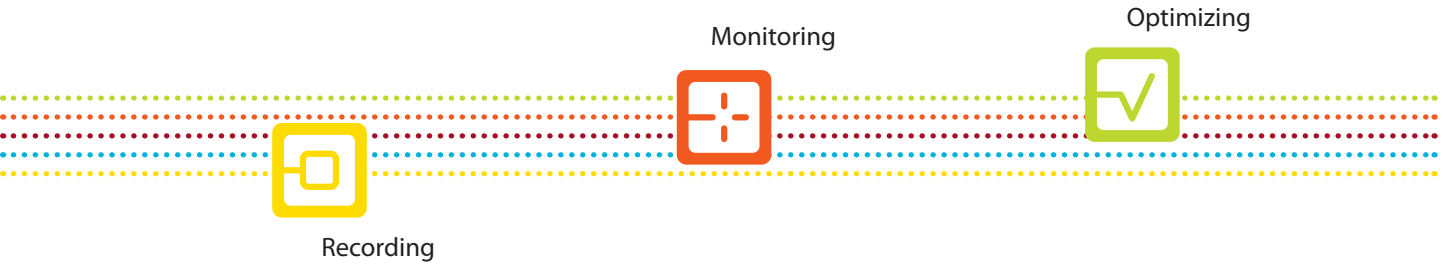
PREMIUM QUALITY
„Made in Schwabach“
ALL FROM A SINGLE SOURCE.

PRODUCTS AND SOLUTIONS
FOR CONTEMPORARY
ENERGY MANAGEMENT

MADE IN
GERMANY



SIEMENS AND KBR – TWO STRONG BRANDS HELPING YOU SUCCEED

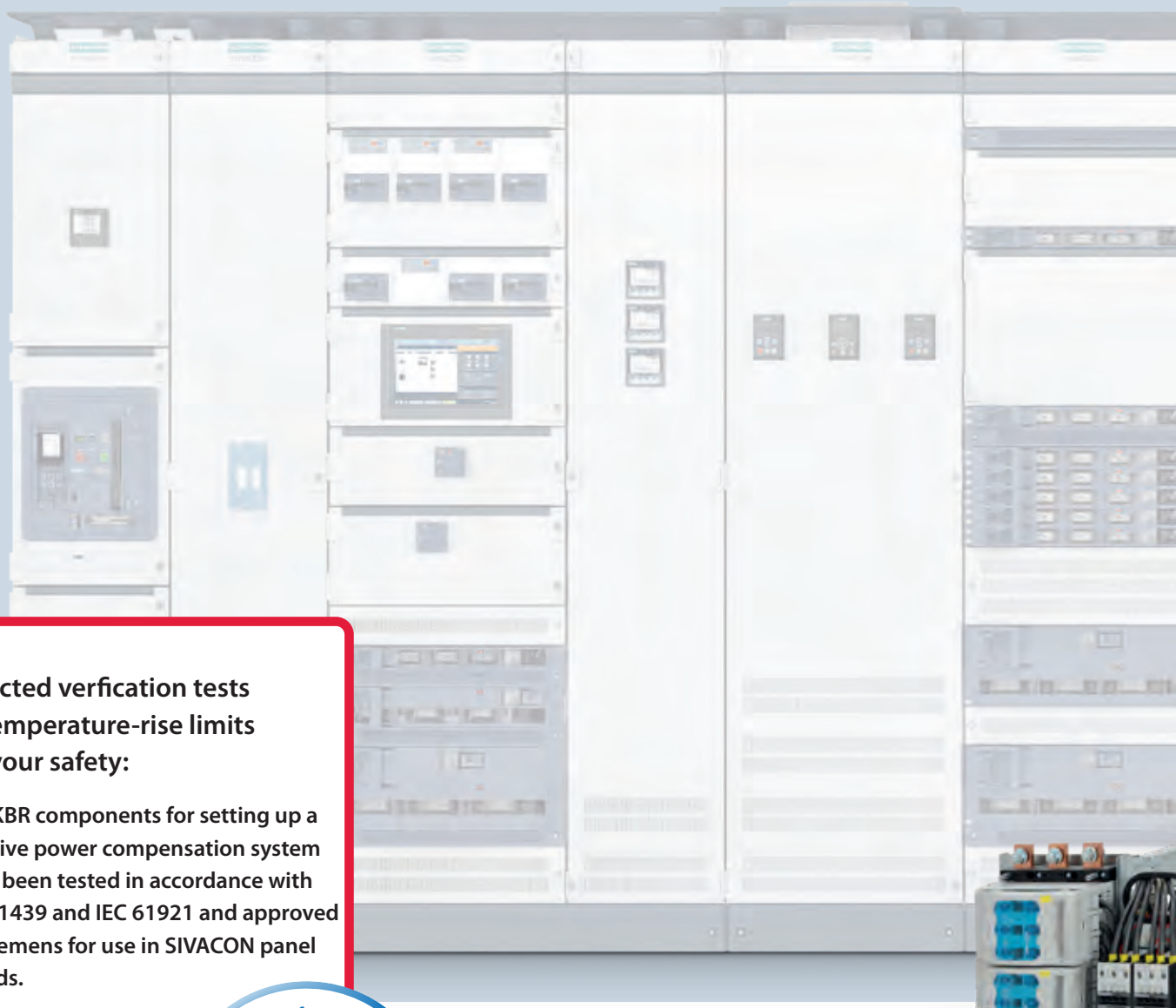


As a partner of Siemens, we provide you with all the components for setting up a reactive power compensation system in a SIVACON switchgear panel.

Easy and fast installation were strongly emphasized in the modules' development.

All components are designed for longevity, temperature resistance, and reliability.

Our reactive power controller can be adapted to any network situation and is especially user-friendly in application.



Selected verfication tests of temperature-rise limits for your safety:

The KBR components for setting up a reactive power compensation system have been tested in accordance with IEC 61439 and IEC 61921 and approved by Siemens for use in SIVACON panel boards.

IEC 61439 TESTED IEC 61921

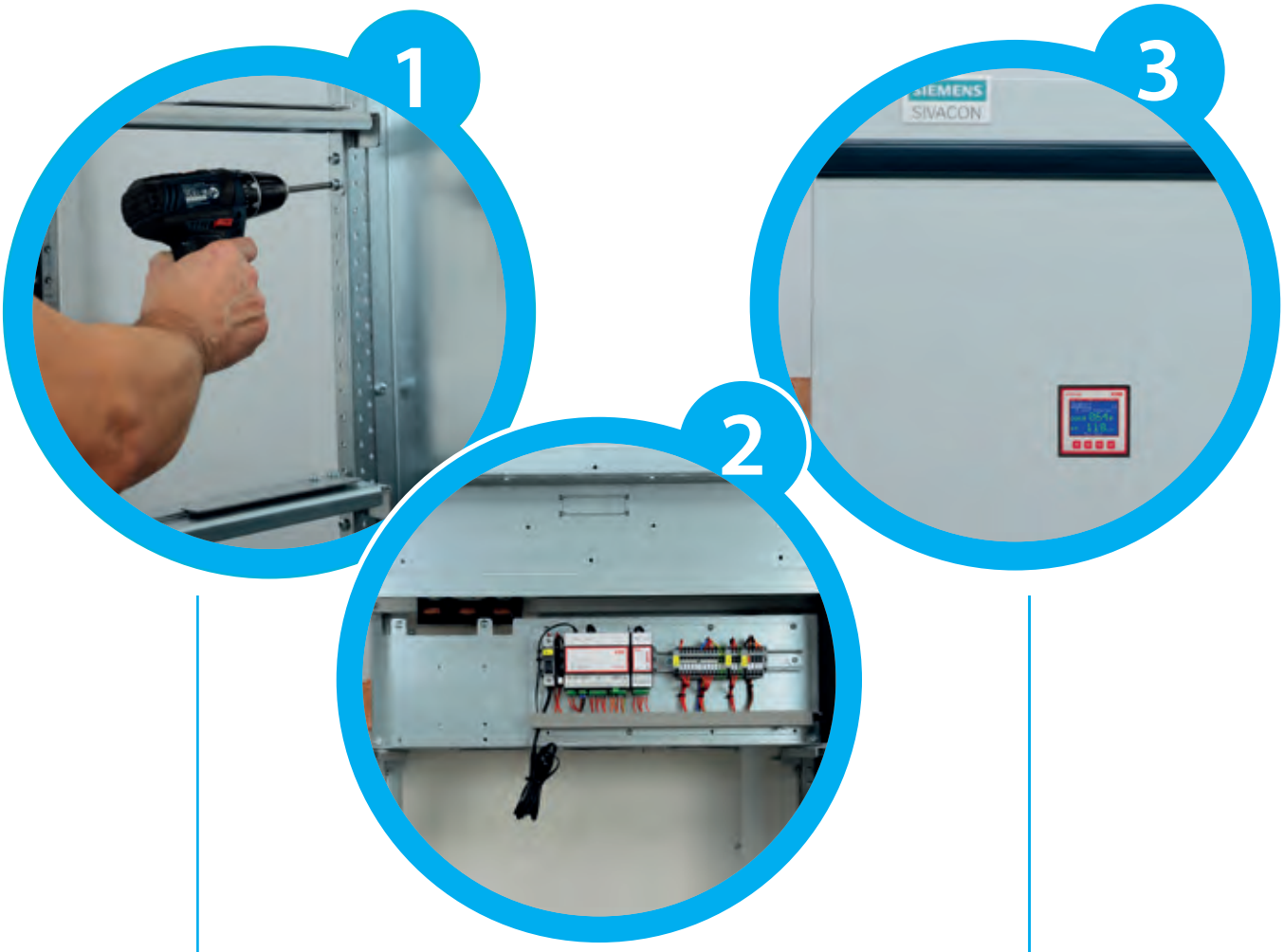
Our customer service hotline experts are always there for you to help you immediately in case of an emergency or provide support with technical issues.

Support hotline:
+49 (0) 9122 6373-700

info@kbr.de


SIVACON

Installing in a SIVACON S8 switchgear panel



Fasten mounting rails for the modules and control modules in the cabinet.

Install control module (mount a load break switch on the control module if needed).

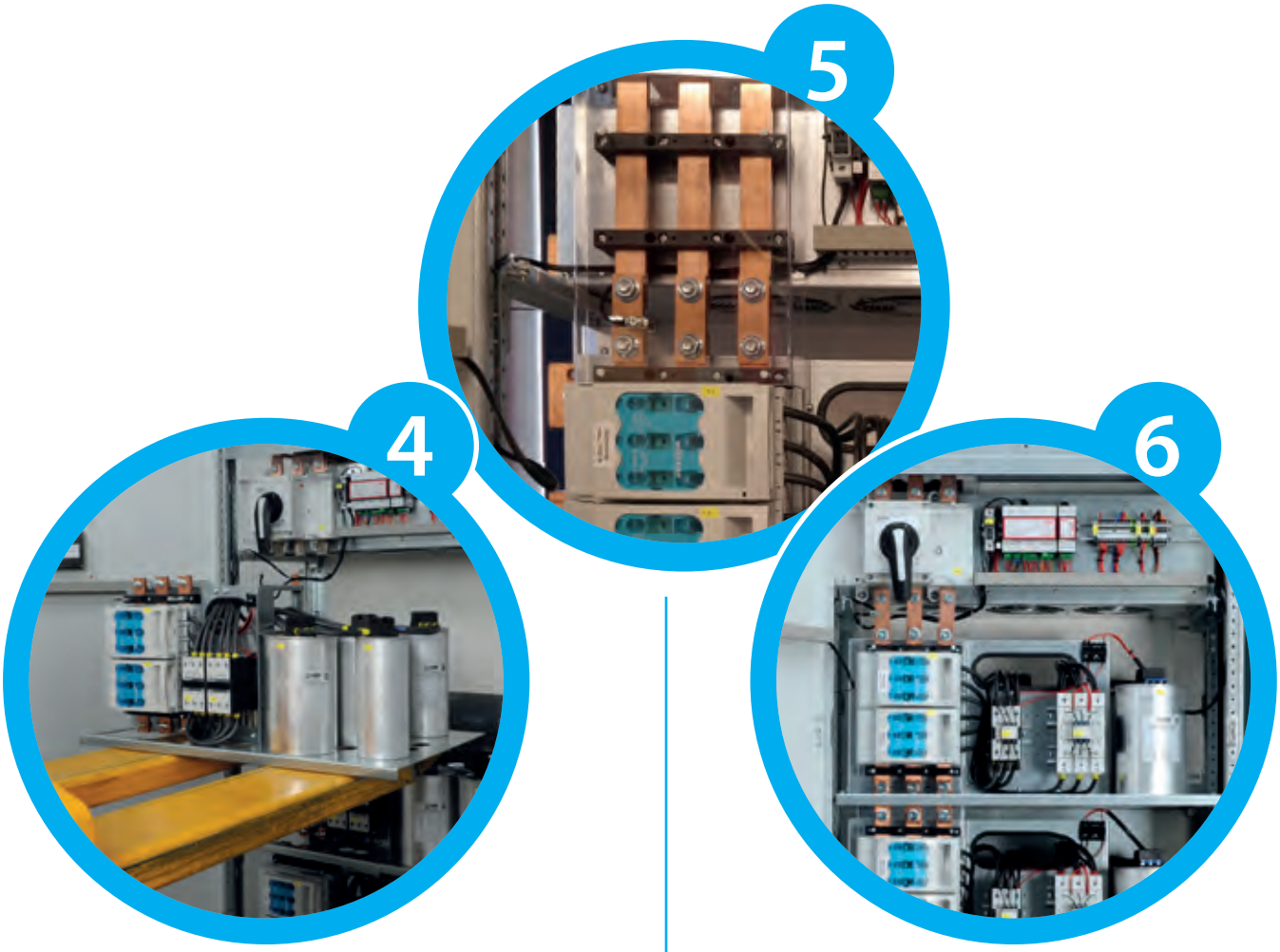
Insert display for the reactive power controller in the door. Use the enclosed bus cable to connect the reactive power controller.

Mounting rails
(see page 19)

Control module includes fan and control transformer if needed
(see page 10)

Optional:
Load break switch
(see page 19)

in six steps:



Insert compensation modules and connect the copper rails to each other.

Connect to the busbar system using the copper rails enclosed.

Establish control of the compensation module by the control module.

Connection module to the rail system
(see page 19)

Reactive power modules
(see page 14)

MULTICOMP D6:

THE REACTIVE POWER CONTROLLER FOR EVERY NEED

- Easy intuitive operation
- Various languages: DE, EN, FR, ES, PT
- No control line wiring in door
- RS -485 interface for Modbus and eBus
- The network analysis and limit monitoring function for the protection of capacitors from overvoltages, overcurrents and excessive harmonic load.
- Colored TFT display
- ... and much more

Our customer service hotline experts are always there for you to help you immediately in case of an emergency or provide support with technical issues.

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+49 (0) 9122 6373-700

info@kbr.de

The efficiency of a reactive power compensation system's compensation is dependent on the controller's mode of operation and variability. Thanks to its modular structure, the reactive power controller multicomp meets every need.

Available in two language packages: DE/EN/FR or EN/ES/PT

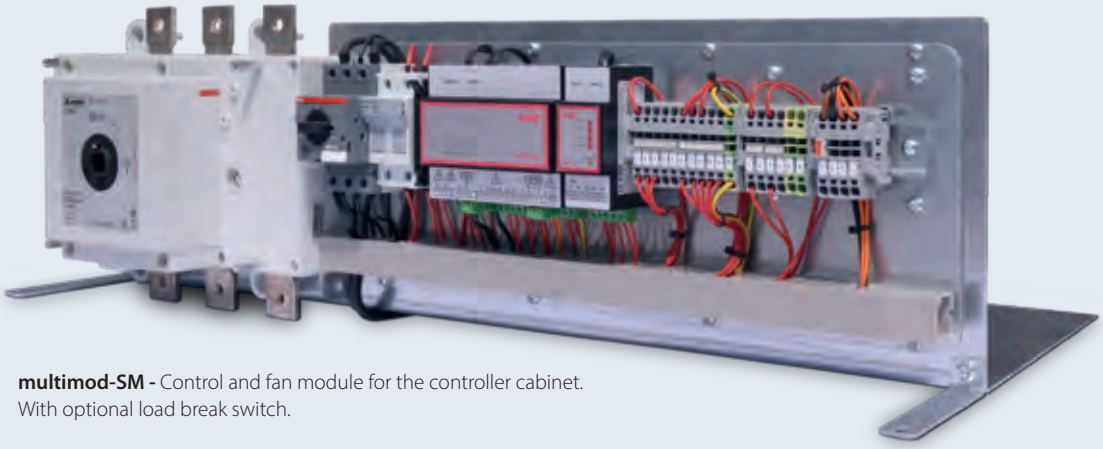
No need for control wiring in the door. The display is controlled by means of the bus cable enclosed.

One controller for every application. Whether you intend to use a conventional system that draws from the network or a generator system for compensation, the reactive power controller multicomp D6 can be adapted to any situation. It can control with both capacitive and inductive stages alike and on all network levels.

Through the integrated temperature measurement input, the ambient temperature in the reactive power compensation system is also monitored and if a predefined limit temperature is exceeded, the fan is switched on. The reactive power controller also has an RS-485 interface with Modbus and eBus protocol for easy connection to software systems on site. With the help of error message management, messages and alarms can be reported through the collective error message contact or the bus interface.

Especially appealing is the application's intuitiveness and ease of use.

Control modules



multimod-SM - Control and fan module for the controller cabinet.
With optional load break switch.

multicomp F96-DS-TFT

multimod-SM - Control and fan module for the controller cabinet.
With optional control transformer.

Control and fan modules

Highlights

- → The controller's switching stages are modularly expandable
- → Display connects with the pre-configured bus cable
- → Expansion cabinet is controlled with a bus cable
- → Controller is already wired for control module
- → Fan unit already mounted and wired for control module
- → Can be expanded with safety and maintenance module
- → Load break switch mounted on control module

The control and fan modules **multimod-SM** consist of reactive power controller, display unit and connection cable – equipped with control fuse, temperature sensor, connection clamps for compensation modules, current transformer, and fans. With the control transformer required for voltage levels above 400V. The modular construction enables quick and easy assembly. The controller and display unit are not needed with control and fan modules for expansions.

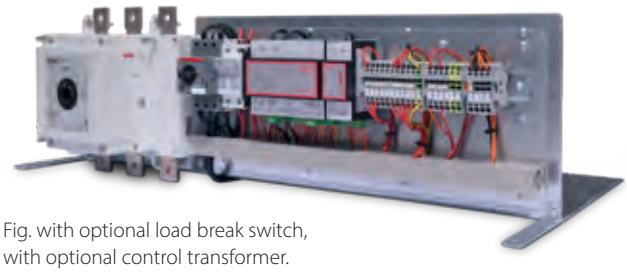


Fig. with optional load break switch,
with optional control transformer.

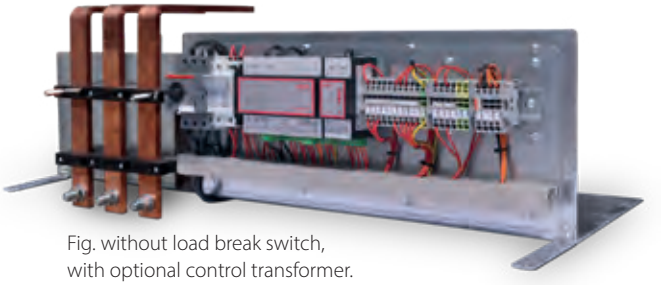


Fig. without load break switch,
with optional control transformer.

Control and fan modules: Control cabinet

multimod-SM - Control and fan module for the controller cabinet include the reactive power controller multicomp D6, controller cable, temperature sensor, fans, terminal blocks, guide rail set, and control transformer if needed.

U_n in V (50 Hz)	SWITCHING STAGES	CONTROL TRANSFORMER	KBR ITEM NO.	SIEMENS ITEM NO.	ITEM NAME
400	4	—	25883		multimod-SM08-R04-G-400V-SIVACON
400	8	—	25891		multimod-SM08-R08-G-400V-SIVACON
400	12	—	25894		multimod-SM08-R12-G-400V-SIVACON
525	4	✓	25895		multimod-SM08-R04-G-525V-SIVACON
525	8	✓	25896		multimod-SM08-R08-G-525V-SIVACON
525	12	✓	25897		multimod-SM08-R12-G-525V-SIVACON
690	4	✓	25898		multimod-SM08-R04-G-690V-SIVACON
690	8	✓	25899		multimod-SM08-R08-G-690V-SIVACON
690	12	✓	25900		multimod-SM08-R12-G-690V-SIVACON

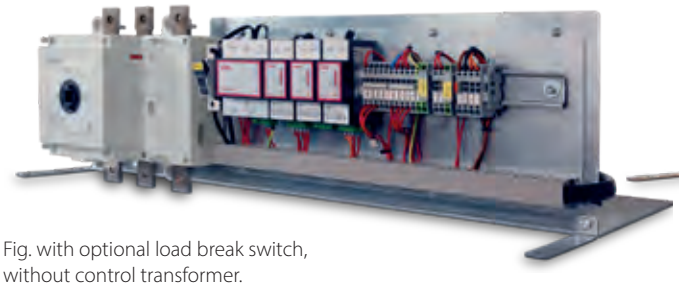


Fig. with optional load break switch,
without control transformer.

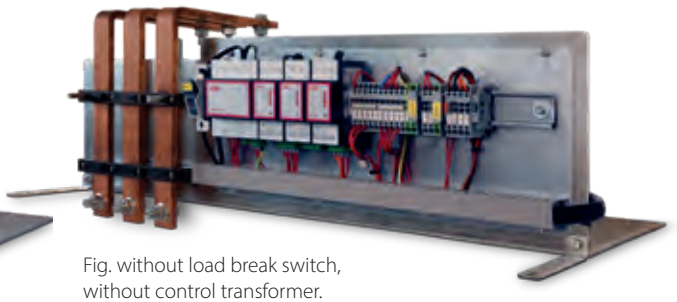


Fig. without load break switch,
without control transformer.

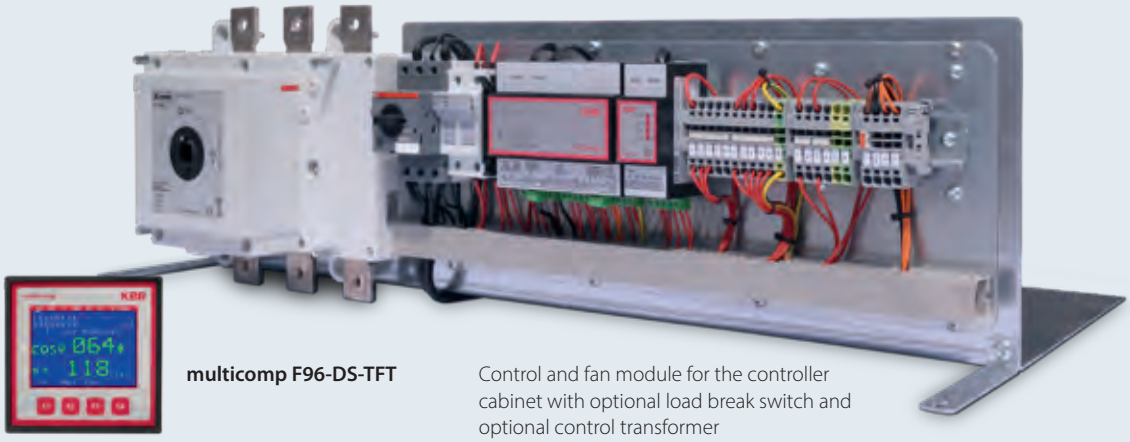
Control and fan modules: Expansion cabinet

multimod-SM - Control and fan modules for the expansion cabinet include the multisio relay modules, cable set, temperature sensor, fans, terminal blocks, guide rail set, and control transformer if needed.

U_n in V (50 Hz)	SWITCHING STAGES	CONTROL TRANSFORMER	KBR ITEM NO.	SIEMENS ITEM NO.	ITEM NAME
400	4	—	25901		multimod-SM08-E04-G-400V-SIVACON
400	8	—	25902		multimod-SM08-E08-G-400V-SIVACON
400	12	—	25903		multimod-SM08-E12-G-400V-SIVACON
525	4	✓	25904		multimod-SM08-E04-G-525V-SIVACON
525	8	✓	25905		multimod-SM08-E08-G-525V-SIVACON
525	12	✓	25906		multimod-SM08-E12-G-525V-SIVACON
690	4	✓	25907		multimod-SM08-E04-G-690V-SIVACON
690	8	✓	25908		multimod-SM08-E08-G-690V-SIVACON
690	12	✓	25909		multimod-SM08-E12-G-690V-SIVACON

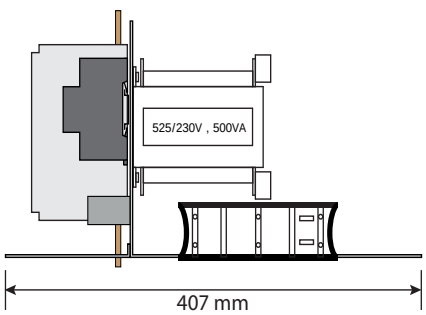
multimod-SM Control and fan modules

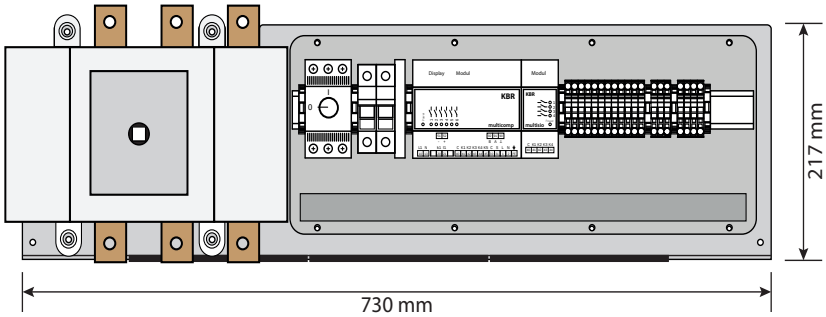
EXAMPLE: MULTIMOD-SM08-R08-G-525V-SIVACON WITH LOAD BREAK SWITCH



multicomp F96-DS-TFT

Control and fan module for the controller cabinet with optional load break switch and optional control transformer





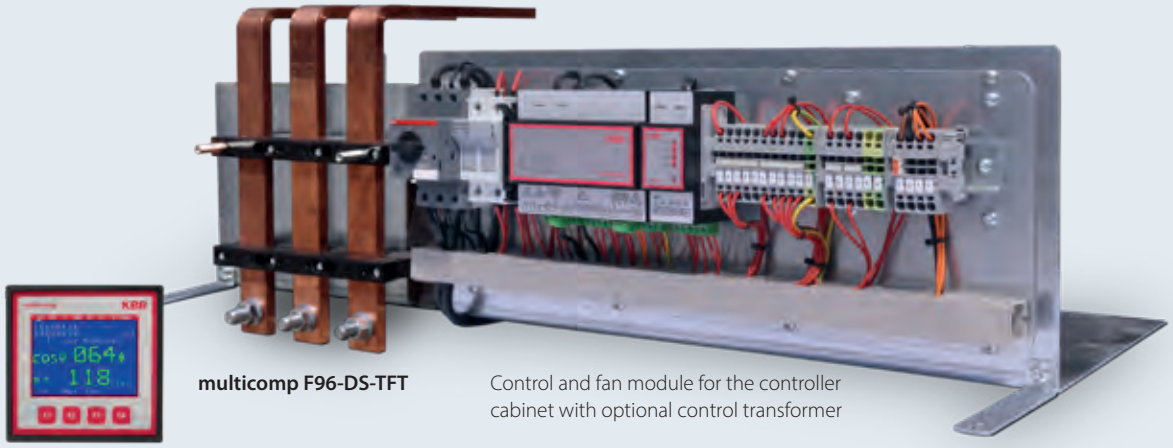
multimod SM - Control and fan module for the controller cabinet.

multimod-SM - View from rear without control transformer.

multimod-SM - Control and fan module for the controller cabinet. With optional control transformer.

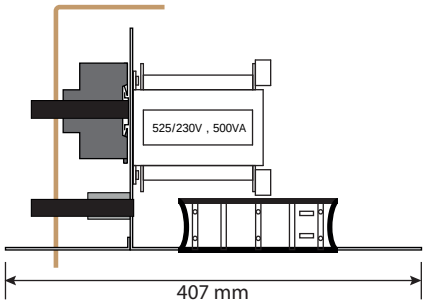
Fans can be replaced during operation

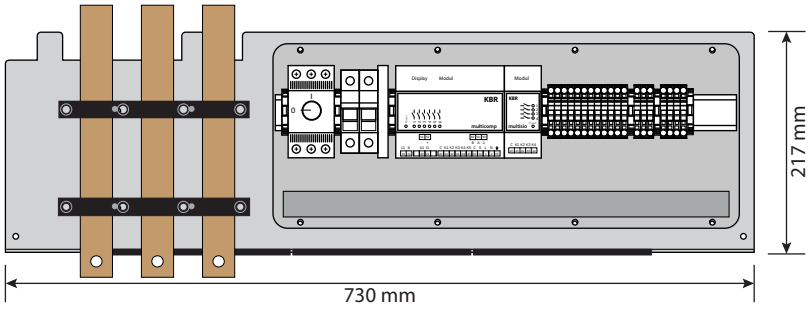
EXAMPLE: MULTIMOD-SM08-E08-G-525V-SIVACON WITHOUT LOAD BREAK SWITCH

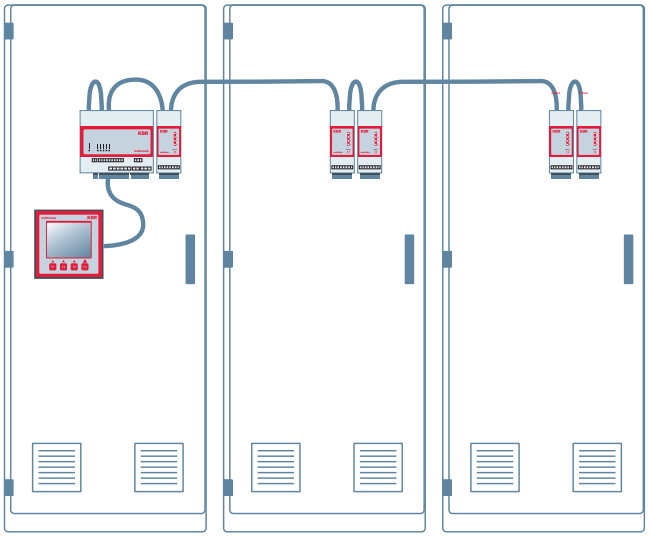


multicomp F96-DS-TFT

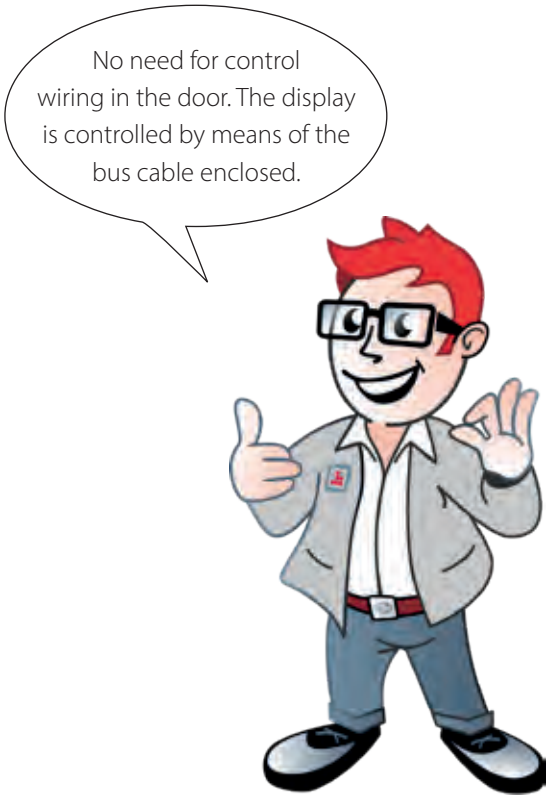
Control and fan module for the controller cabinet with optional control transformer







The display unit and expansion cabinet are wired using the enclosed bus cable.



multimod-F rack-mounted design

Untuned version	
Power	50 – 150 kvar
Detuned version	
Power	50 – 100 kvar
Detuning factors	5.5, 7 or 14 %

Reactive power compensation systems in rack-mounted design

Highlights

- → Quick and easy installation
- → Capacitor operating life >250,000 h
- → Made in Germany
- → Up to 400 kvar detuned incl. load break switch for each cabinet
- → Easy system cabinet assembly thanks to KBR matrix
- → Modules and ventilation developed for optimal temperature management
- → Up to 4 modules per cabinet

Modules in rack-mounted design Versions: non-detuned, 5.5, 7, or 14 % detuned
Rated voltage: 400 V | 50 Hz

DETUNINGin %	**POWER**[1] in kvar	**STAGES** in kvar	**KBR** Item no.	**SIEMENS** Item no.	**ITEM NAME**
untuned	50	50	25747		multimod-F 050/01-1000-00-86GH-400V-SIVACON
untuned	50	25 / 25	25750		multimod-F 050/02-1100-00-86GH-400V-SIVACON
untuned	50	12.5/12.5/25	25751		multimod-F 050/04-1120-00-86GH-400V-SIVACON
untuned	100	100	25752		multimod-F 100/01-1000-00-86GH-400V-SIVACON
untuned	100	50 / 50	25753		multimod-F 100/02-1100-00-86GH-400V-SIVACON
untuned	100	25/25/50	25754		multimod-F 100/04-1120-00-86GH-400V-SIVACON
untuned	150	25 / 25 / 50 / 50	26062		multimod-F 150/06-1122-00-86GH-400V-SIVACON
untuned	150	50/50/50	26063		multimod-F 150/03-1110-00-86GH-400V-SIVACON
5.5	50	50	25768		multimod-F 050/01-1000-05-86GH-400V-SIVACON
5.5	50	25 / 25	25771		multimod-F 050/02-1100-05-86GH-400V-SIVACON
5.5	100	100	25772		multimod-F 100/01-1000-05-86GH-400V-SIVACON
5.5	100	50 / 50	25774		multimod-F 100/02-1100-05-86GH-400V-SIVACON
7	50	50	25755		multimod-F 050/01-1000-07-86GH-400V-SIVACON
7	50	25 / 25	25756		multimod-F 050/02-1100-07-86GH-400V-SIVACON
7	100	100	25757		multimod-F 100/01-1000-07-86GH-400V-SIVACON
7	100	50 / 50	25758		multimod-F 100/02-1100-07-86GH-400V-SIVACON
7	100	25/25/50	25759		multimod-F 100/04-1120-07-86GH-400V-SIVACON
14	50	50	25760		multimod-F 050/01-1000-14-86GB-400V-SIVACON
14	50	25 / 25	25761		multimod-F 050/02-1100-14-86GB-400V-SIVACON
14	100	100	25762		multimod-F 100/01-1000-14-86GB-400V-SIVACON
14	100	50 / 50	25763		multimod-F 100/02-1100-14-86GB-400V-SIVACON

[1]Power at 400 V, 50 Hz. For a sample order, see page 20

Modules in rack-mounted design Versions: non-detuned, 5.5, 7, or 14 % detuned
Rated voltage: 525 V | 50 Hz

DETUNINGin %	**POWER**[1] in kvar	**STAGES** in kvar	**KBR** Item no.	**SIEMENS** Item no.	**ITEM NAME**
untuned	50	50	25915		multimod-F 050/01-1000-00-86GB-525V-SIVACON
untuned	50	25 / 25	25916		multimod-F 050/02-1100-00-86GB-525V-SIVACON
untuned	100	100	25917		multimod-F 100/01-1000-00-86GB-525V-SIVACON
untuned	100	50 / 50	25918		multimod-F 100/02-1100-00-86GB-525V-SIVACON
untuned	150	25 / 25 / 50 / 50	26067		multimod-F 150/06-1122-00-86GB-525V-SIVACON
untuned	150	50/50/50	26069		multimod-F 150/03-1110-00-86GB-525V-SIVACON
5.5	50	50	25924		multimod-F 050/01-1000-05-86GD-525V-SIVACON
5.5	50	25 / 25	25936		multimod-F 050/02-1100-05-86GD-525V-SIVACON
5.5	100	100	25952		multimod-F 100/01-1000-05-86GD-525V-SIVACON
5.5	100	50 / 50	25964		multimod-F 100/02-1100-05-86GD-525V-SIVACON
7	50	50	25925		multimod-F 050/01-1000-07-86GD-525V-SIVACON
7	50	25 / 25	25926		multimod-F 050/02-1100-07-86GD-525V-SIVACON
7	100	100	25937		multimod-F 100/01-1000-07-86GD-525V-SIVACON
7	100	50 / 50	25939		multimod-F 100/02-1100-07-86GD-525V-SIVACON
14	50	50	26076		multimod-F 050/01-1000-14-86GD-525V-SIVACON

[1]Power at 525 V, 50 Hz. For a sample order, see page 20

The modules include the mounting rail set and housing covers.
Other levels, rated voltages, 60 Hz version available on request.

Mounting rail sets for modules can also be ordered individually, e.g., for pre-installation without a module.
Item number: 25734

multimod-F rack-mounted design

Modules in rack-mounted design Versions: non-detuned, 5.5, 7, or 14 % detuned
Rated voltage: 690 V | 50 Hz

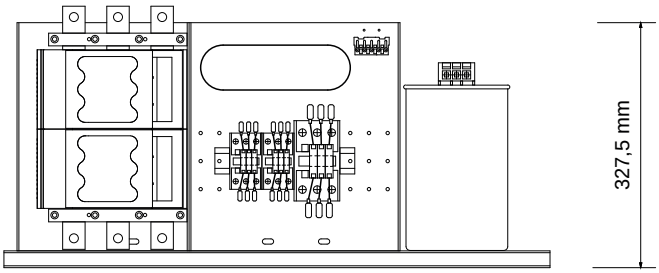
DETUNING in %	**POWER**[1] in kvar	**STAGES** in kvar	**KBR** Item no.	**SIEMENS** Item no.	**ITEM NAME**
untuned	50	50	25919		multimod-F 050/01-1000-00-86GD-690V-SIVACON
untuned	50	25 / 25	25920		multimod-F 050/02-1100-00-86GD-690V-SIVACON
untuned	100	100	25921		multimod-F 100/01-1000-00-86GD-690V-SIVACON
untuned	100	50 / 50	25922		multimod-F 100/02-1100-00-86GD-690V-SIVACON
untuned	150	25 / 25 / 50 / 50	26070		multimod-F 150/06-1122-00-86GD-690V-SIVACON
untuned	150	50/50/50	26071		multimod-F 150/03-1110-00-86GD-690V-SIVACON
5.5	50	50	25965		multimod-F 050/01-1000-05-86GS-690V-SIVACON
5.5	50	25 / 25	25945		multimod-F 050/02-1100-05-86GS-690V-SIVACON
5.5	100	100	25966		multimod-F 100/01-1000-05-86GS-690V-SIVACON
5.5	100	50 / 50	25967		multimod-F 100/02-1100-05-86GS-690V-SIVACON
7	50	50	25927		multimod-F 050/01-1000-07-86GS-690V-SIVACON
7	50	25 / 25	25929		multimod-F 050/02-1100-07-86GS-690V-SIVACON
7	100	100	25930		multimod-F 100/01-1000-07-86GS-690V-SIVACON
7	100	50 / 50	25931		multimod-F 100/02-1100-07-86GS-690V-SIVACON
14	50	50	26077		multimod-F 050/01-1000-14-86GS-690V-SIVACON

[1]Power at 690 V, 50 Hz. For a sample order, see page 20

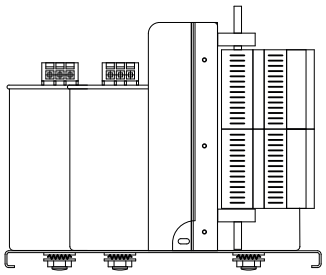
The modules include the mounting rail set and housing covers.
Other levels, rated voltages, 60 Hz version available on request.

Mounting rail sets for modules can also be ordered individually, e.g., for pre-installation without a module.
Item number: 25734

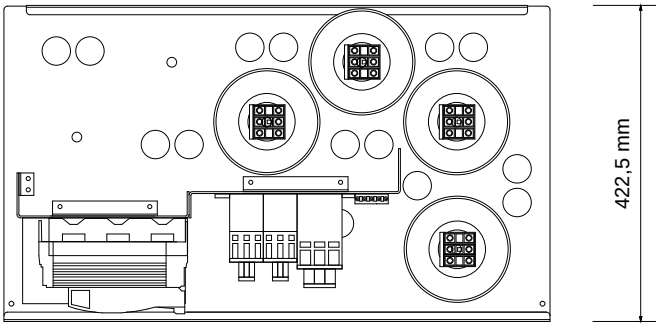
EXAMPLE: MULTIMOD-F 100/04-1120-00-86GH-400-SIVACON, UNTUNED



Frontal view



Side view

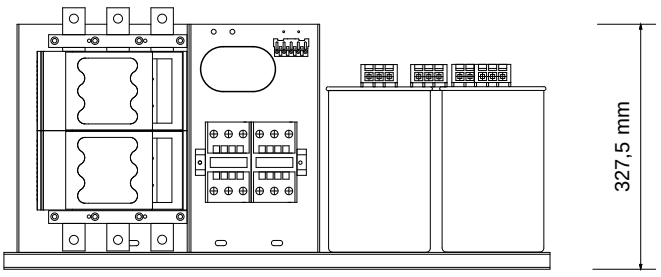


Top view

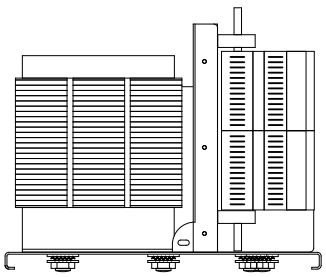
TECHNICAL DETAILS

TYPE	NON-DETUNED 400 V, 525 V, 690 V	5.5 or 7 % 400 V, 525 V, 690 V	14 % 400 V, 525 V, 690 V
Rated voltage U_n | Frequency	U_n = 400 V, 525 V, 690 V | 50 Hz		
Maximum permissible operating voltage	U_n ± 10%		
Maximum permissible operating current	1.3 x I_n permanently		
SWITCH ELEMENT	Capacitor contactors		
Control voltage	$U_{Control}$ = 230 V, 50 Hz		
	Control voltage transformer required for deviating operating voltage		
Switching delay	60 s	60 s	60 s
CAPACITORS	Low-loss **multicond premium** power capacitors, MTK technology.		
Capacitor rated voltage (for voltage levels 400 V | 525 V | 690 V)	440 V | 525 V | 690 V	440 V | 690 V | 800 V	525 V | 690 V | 800 V
Discharge of capacitors	Discharge resistance t < 60 s optional discharge reactors < 3 s		
FILTER CIRCUIT INDUCTORS	Linear filter circuit reactors to avoid resonances in networks with harmonics, with built-in temperature monitoring.		
Detuning factors	—	5.5 or 7 %	14 %
MODULE VERSION	Module plates galvanized		
PROTECTION TYPE	IP 00, the components used correspond to BGV-A2.		
AMBIENT TEMPERATURES	+40 °C maximum, short-term +35 °C 24-hour average +20 °C annual average -10 °C low		
FUSE	Group fusing with NH isolators and NH fuses.		

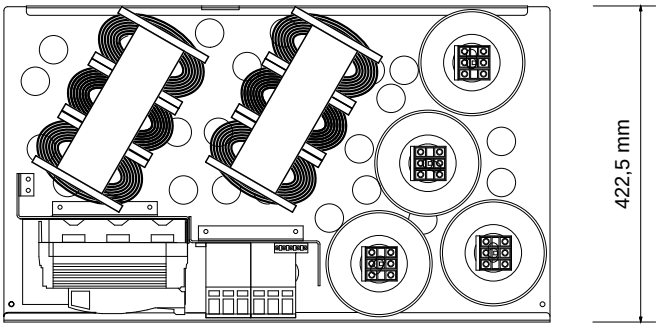
EXAMPLE: MULTIMOD-F 100/02-1100-05-86GH-400-SIVACON, DETUNED



Frontal view



Side view



Top view

The flexible solution for every customer's needs

Display
multicomp F96-DS-TFT

- Switchboard installation, 96 x 96 mm
- Connect to the controller using the enclosed bus cable with RJ12 connector

Reactive power controller
multicomp D6

- DIN rail housing, 6 horizontal pitch
- 6 relay outputs (fans, error message contact, and compensation stages), can be expanded to 24 stages
- Cabinet temperature measurement
- Modularly expandable

Relay output module
multisio D2-4RO

- DIN rail housing, 2 horizontal pitch
- 4 relay outputs for controlling compensation stages

Temperature module
multisio D2-1TI2RO

- DIN rail housing, 2 horizontal pitch
- For expansion cabinets
- Cabinet temperature measurement
- Cabinet ventilation control

Measuring module
multimess D4-BS

- DIN rail housing, 4 horizontal pitch
- Measuring module for the safety and maintenance module

Analog output module
multisio D2-2AO

- DIN rail housing, 2 horizontal pitch
- 2 analog outputs for controlling electronic reactive power stages

Analog input module
multisio D2-4AI

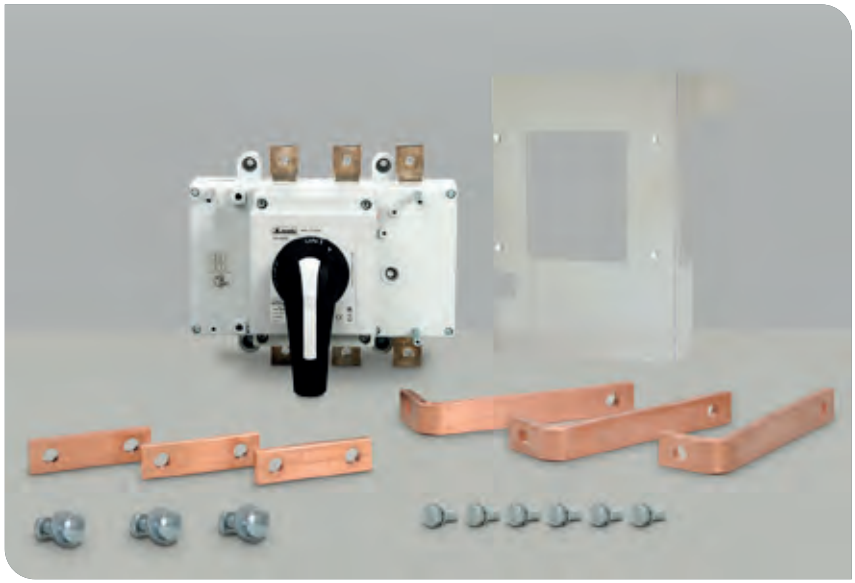
- DIN rail housing, 2 horizontal pitch
- 4 analog inputs for defining the cosφ

Digital input module
multisio D2-4DI

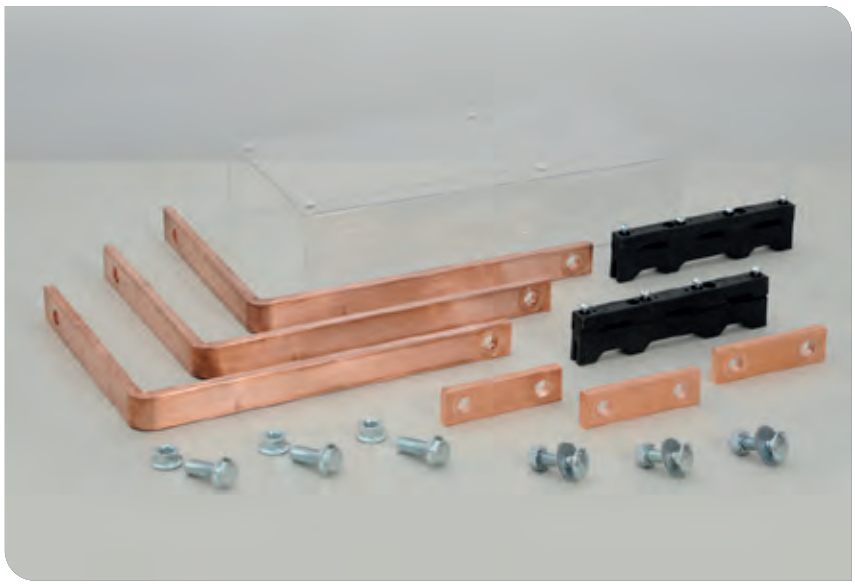
- DIN rail housing, 2 horizontal pitch
- Digital input module multisio D2-4DI

Accessories

Connection set
with load break switch
for SIVACON
Item no. 26010



Connection set
without load break switch
for SIVACON
Item no. 26009



Mounting rail set for modules,
e.g., for pre-installation without
a module.
Item number: 25734

Note: The mounting rail set
is included in the scope of delivery with
all modules and control modules.

Ordering process

How to choose your compensation set:

1. Select the matrix according to your network voltage level
2. Determine the reactive power you require
3. Determine your desired stage power (lowest switching stage)
4. Choose the detuning you require
5. You can now find the six-digit order number for the set you need in the table

400 V | 50 HZ		SET NUMBER				MODULE ALLOCATION				CONTROLLER STAGES
POWER KVAR	KVAR LEVEL	NON-DETUNED	DETUNING 5.5 %	7 %	14 %	1	2	3	4	
100	12.5	410121	—	—	—	12.5/12.5/25	25 / 25	—	—	8
	25	410211	—	410213	—	25/25/50	—	—	—	4
		—	410222	—	410224	25 / 25	50	—	—	4
150	12.5	415121	—	—	—	12.5/12.5/25	25/25/50	—	—	8
	25	415211	—	—	—	25 / 25 / 50 / 50	—	—	—	4
		—	415222	415223	415224	25 / 25	50 / 50	—	—	4

On the right side of the table you can find the module allocation, individual stage powers, and the number of controller stages.

Sample order: Customer requires the following reactive power compensation system:

1. Rated network voltage 400V
2. Total power 300 kvar
3. Stage power 25 kvar
4. Detuning 14%

400 V | 50 HZ		SET NUMBER				MODULE ALLOCATION				CONTROLLER STAGES
POWER KVAR	KVAR LEVEL	NON-DETUNED	DETUNING 5.5 %	7 %	14 %	1	2	3	4	
300	25	430221	—	—	—	25 / 25 / 50 / 50	50/50/50	—	—	8
		—	—	430233		25/25/50	50 / 50	50 / 50		8
		—	430242	—	430244	25 / 25	50 / 50	50 / 50	50	8
	50	430321	—	—	—	50/50/50	50/50/50	—	—	8
		—	430332	430333	430334	50 / 50	50 / 50	50 / 50	—	8

- This results in the **set number 430244** with all the components the customer needs included.
- The system has a control and fan module with 8 controller stages and 4 modules with the following stage power: 25/25 | 50/50 | 50/50 | 50

Please also indicate whether you need a load break switch.
Please also indicate whether you need the safety and maintenance module.

The set number 430244 includes the following components:

5x mounting rail set

1x connection set

1x control module (with optional load break switch)

4x module

Select from standard systems:

400 V | 50 HZ		SET NUMBER				MODULE ALLOCATION				CONTROLLER STAGES
POWER KVAR	KVAR LEVEL	NON-DETUNED	DETUNING 5.5 %	7 %	14 %	1	2	3	4	
100	12.5	410121	—	—	—	12.5/12.5/25	25 / 25	—	—	8
	25	410211	—	410213	—	25/25/50	—	—	—	4
		—	410222	—	410224	25 / 25	50	—	—	4
150	12.5	415121	—	—	—	12.5/12.5/25	25/25/50	—	—	8
	25	415211	—	—	—	25 / 25 / 50 / 50	—	—	—	4
		—	415222	415223	415224	25 / 25	50 / 50	—	—	4
200	12.5	420121	—	—	—	12.5/12.5/25	25 / 25 / 50 / 50	—	—	8
	25	420221	—	420223	—	25/25/50	50 / 50	—	—	8
		—	420232	—	420234	25 / 25	50 / 50	50	—	8
	50	420321	420322	420323	420324	50 / 50	50 / 50	—	—	4
250	25	425221	—	—	—	25 / 25 / 50 / 50	50 / 50	—	—	8
		—	425232	425233	425234	25 / 25	50 / 50	50 / 50		8
	50	425321	—	—	—	50/50/50	50 / 50	—	—	8
		—	425332	425333	425334	50 / 50	50 / 50	50	—	8
300	25	430221	—	—	—	25 / 25 / 50 / 50	50/50/50	—	—	8
		—	—	430233	—	25/25/50	50 / 50	50 / 50	—	8
		—	430242	—	430244	25 / 25	50 / 50	50 / 50	50	8
	50	430321	—	—	—	50/50/50	50/50/50	—	—	8
		—	430332	430333	430334	50 / 50	50 / 50	50 / 50	—	8
350	25	435231	—	—	—	25 / 25 / 50 / 50	50 / 50	50 / 50	—	8
		—	435242	435243	435244	25 / 25	50 / 50	50 / 50	50 / 50	8
	50	435331	—	—	—	50/50/50	50 / 50	50 / 50	—	8
		—	435342	435343	435344	50 / 50	50 / 50	50 / 50	50	8
400	25	440231	—	—	—	25 / 25 / 50 / 50	50/50/50	50 / 50	—	12
		—	—	440243	—	25/25/50	50 / 50	50 / 50	50 / 50	12
	50	440331	—	—	—	50/50/50	50/50/50	50 / 50	—	8
		—	440342	440343	440344	50 / 50	50 / 50	50 / 50	50 / 50	8
450	25	445231	—	—	—	25 / 25 / 50 / 50	50/50/50	50/50/50	—	12
	50	445331	—	—	—	50/50/50	50/50/50	50/50/50	—	12
500	25	450241	—	—	—	25 / 25 / 50 / 50	50/50/50	50 / 50	50 / 50	12
	50	450341	—	—	—	50/50/50	50/50/50	50 / 50	50 / 50	12

Note: Not all power levels are listed or feasible with all stages or for all detuning levels.
Talk to your contact partner for more information about this.

Compatible control and fan modules are matched automatically.

Other voltages at 60Hz on request.

Product advice:
+49 (0) 9122 6373-0

info@kbr.de

Need more information?

We will be happy to advise you personally.

Ordering process

525 V | 50 HZ		SET NUMBER				MODULE ALLOCATION				CONTROLLER STAGES
POWER KVAR	KVAR LEVEL	NON-DETUNED	DETUNING 5.5 %	DETUNING 7 %	DETUNING 14 %	1	2	3	4	
100	25	510221	510222	510223	—	25 / 25	50	—	—	4
	50	510311	510312	510313	—	50 / 50	—	—	—	4
		—	—	—	510324	50	50	—	—	4
150	25	515211	—	—	—	25 / 25 / 50 / 50	—	—	—	4
		—	515222	515223	—	25 / 25	50 / 50	—	—	4
	50	515311	—	—	—	50/50/50	—	—	—	4
		—	515322	515323	—	50 / 50	50	—	—	4
		—	—	—	515334	50	50	50	—	4
200	25	520221	—	—	—	25 / 25 / 50 / 50	50	—	—	8
		—	520232	520233	—	25 / 25	50 / 50	50	—	8
	50	520321	520322	520323	—	50 / 50	50 / 50	—	—	4
		—	—	—	520344	50	50	50	50	4
250	25	525221	—	—	—	25 / 25 / 50 / 50	50 / 50	—	—	8
		—	525232	525233	—	25 / 25	50 / 50	50 / 50	—	8
	50	525321	—	—	—	50/50/50	50 / 50	—	—	8
		—	525332	525333	—	50 / 50	50 / 50	50	—	8
300	25	530221	—	—	—	25 / 25 / 50 / 50	50/50/50	—	—	8
		—	530242	530243	—	25 / 25	50 / 50	50 / 50	50	8
	50	530321	—	—	—	50/50/50	50/50/50	—	—	8
		—	530332	530333	—	50 / 50	50 / 50	50 / 50	—	8
350	25	535231	—	—	—	25 / 25 / 50 / 50	50 / 50	50 / 50	—	8
		—	535242	535243		25 / 25	50 / 50	50 / 50	50 / 50	8
	50	535331	—	—	—	50/50/50	50 / 50	50 / 50	—	8
		—	535342	535343	—	50 / 50	50 / 50	50 / 50	50	8
400	25	540231	—	—	—	25 / 25 / 50 / 50	50/50/50	50 / 50	—	12
	50	540331	—	—	—	50/50/50	50/50/50	50 / 50	—	8
		—	540342	540343	—	50 / 50	50 / 50	50 / 50	50 / 50	8
450	25	545231	—	—	—	25 / 25 / 50 / 50	50/50/50	50/50/50	—	12
	50	545331	—	—	—	50/50/50	50/50/50	50/50/50	—	12
500	25	550241	—	—	—	25 / 25 / 50 / 50	50/50/50	50 / 50	—	12
	50	550341	—	—	—	50/50/50	50/50/50	50 / 50	—	12

Note: Not all power levels are listed or feasible with all stages or for all detuning levels.
Talk to your contact partner for more information about this.

Compatible control and fan modules are matched automatically.

Other voltages at 60Hz on request.

690 V | 50 HZ		SET NUMBER				MODULE ALLOCATION				CONTROLLER STAGES
POWER KVAR	KVAR LEVEL	NON-DETUNED	DETUNING 5.5 %	7 %	14 %	1	2	3	4	
100	25	610221	610222	610223	—	25 / 25	50	—	—	4
	50	610311	610312	610313	—	50 / 50	—	—	—	4
		—	—	—	610324	50	50	—	—	4
150	25	615211	—	—	—	25 / 25 / 50 / 50	—	—	—	4
		—	615222	615223	—	25 / 25	50 / 50	—	—	4
	50	615311	—	—	—	50/50/50	—	—	—	4
		—	615322	615323	—	50 / 50	50	—	—	4
		—	—	—	615334	50	50	50	—	4
200	25	620221	—	—	—	25 / 25 / 50 / 50	50	—	—	8
			620232	620233	—	25 / 25	50 / 50	50	—	8
	50	620321	620322	620323	—	50 / 50	50 / 50		—	4
		—	—	—	620344	50	50	50	50	4
250	25	625221	—	—	—	25 / 25 / 50 / 50	50 / 50	—	—	8
		—	625232	625233	—	25 / 25	50 / 50	50 / 50	—	8
	50	625321	—	—	—	50/50/50	50 / 50	—	—	8
		—	625332	625333	—	50 / 50	50 / 50	50	—	8
300	25	630221	—	—	—	25 / 25 / 50 / 50	50/50/50	—	—	8
		—	630242	630243	—	25 / 25	50 / 50	50 / 50	50	8
	50	630321	—	—	—	50/50/50	50/50/50	—	—	8
		—	630332	630333	—	50 / 50	50 / 50	50 / 50	—	8
350	25	635231	—	—	—	25 / 25 / 50 / 50	50 / 50	50 / 50		8
		—	635242	635243	—	25 / 25	50 / 50	50 / 50	50 / 50	8
	50	635331	—	—	—	50/50/50	50 / 50	50 / 50		8
		—	635342	635343	—	50 / 50	50 / 50	50 / 50	50	8
400	25	640231	—	—	—	25 / 25 / 50 / 50	50/50/50	50 / 50	—	12
	50	640331	—	—	—	50/50/50	50/50/50	50 / 50	—	8
		—	640342	640343	—	50 / 50	50 / 50	50 / 50	50 / 50	8
450	25	645231	—	—	—	25 / 25 / 50 / 50	50/50/50	50/50/50	—	12
	50	645331	—	—	—	50/50/50	50/50/50	50/50/50	—	12
500	25	650241	—	—	—	25 / 25 / 50 / 50	50/50/50	50 / 50	50 / 50	12
	50	650341	—	—	—	50/50/50	50/50/50	50 / 50	50 / 50	12

Note: Not all power levels are listed or feasible with all stages or for all detuning levels.
Talk to your contact partner for more information about this.

Compatible control and fan modules are matched automatically.

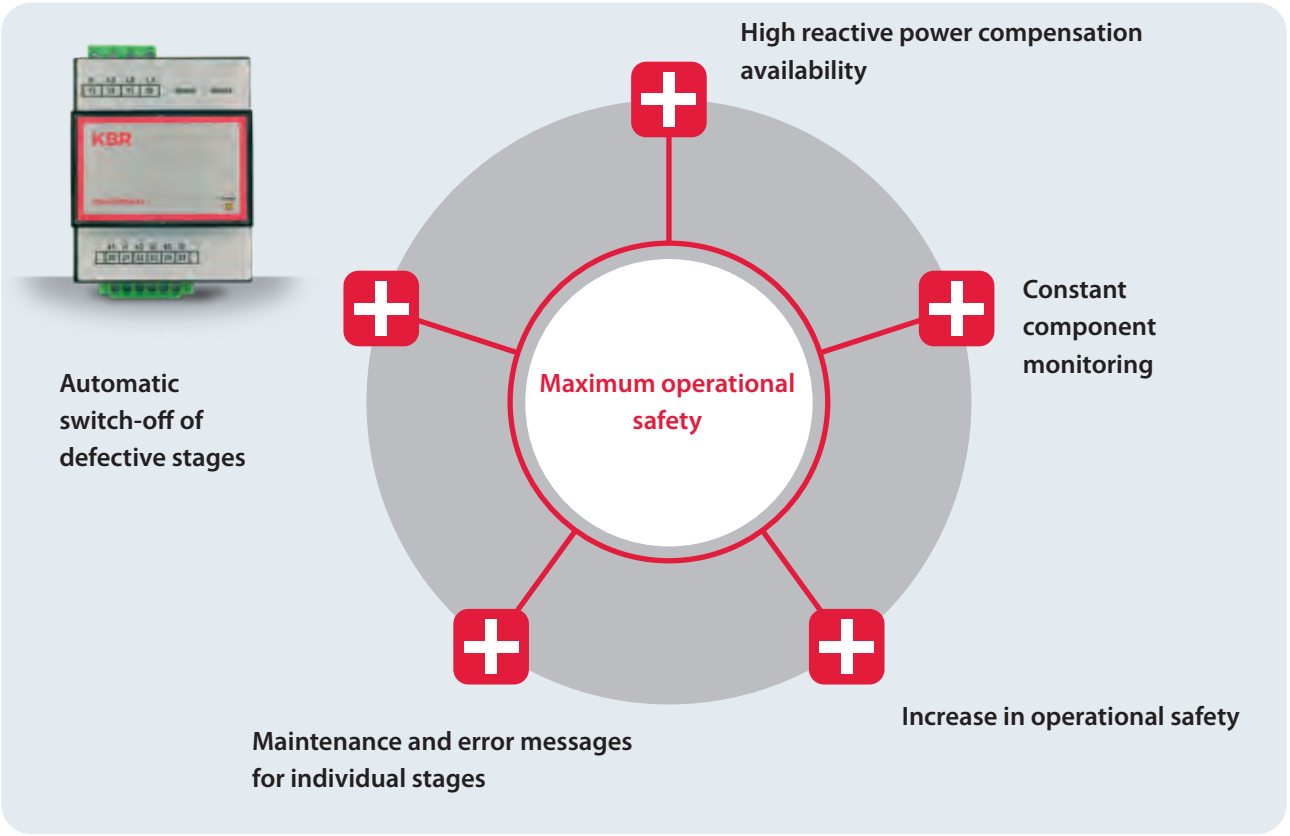
Other voltages at 60Hz on request.

Support hotline:
+49 (0) 9122 6373-700

info@kbr.de

Our customer service hotline experts are always there for you to help you immediately in case of an emergency or provide support with technical issues.

Safety and maintenance module (optional)



Optional: Security with automatic monitoring

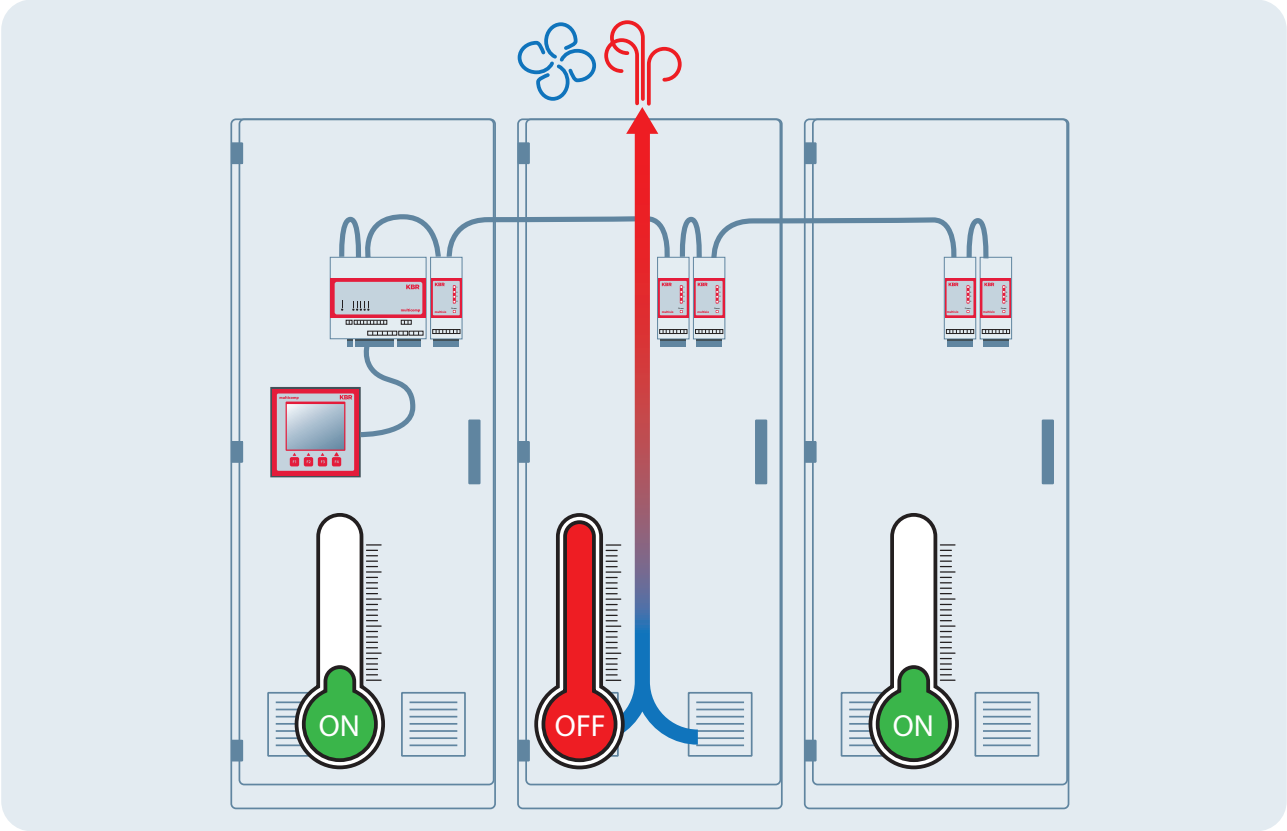
Highlights

- → Maximum availability of the system
- → High level of safety thanks to monitoring of the individual stages
- → Automatically detects and reports errors
- → Continuous system maintenance

A reactive power compensation system is key to the energy supply in networks with inductive loads. Reliable and continuous monitoring of resonance frequency, stage back-up fuses, capacitors, and contactor contacts enables maximum availability.

Since the capacitance of capacitors during operation is damaged in networks affected by harmonics, the detuning resonance frequency changes. This means that a system that was correctly set up can become a latent danger the longer it is in operation. The inevitable shift of the resonance points through loss of capacitance is accounted for by the optional safety and maintenance module, as it calculates the resulting new resonance frequency. If critical frequencies are reached, the display unit and the error message contact issue corresponding warnings that are logged in the event memory. If previously defined resonance frequencies are exceeded, the stages involved are switched off, and blocked if necessary. The safety and maintenance module also detects and reports when individual fuses blow or contactor contacts "stick."

Temperature management



The right temperature management is crucial

The operating life of a capacitor depends on the network quality and the ambient temperature. This means that the temperature of reactive power compensation systems is monitored and the cabinet has forced ventilation if necessary, or shuts off due to overtemperature.

The monitoring concept is crucial here. Conventional controllers simply switch off the entire system when they reach a limit temperature and thus put up with high apparent currents and in turn the risk of triggering load interrupter switches in the energy supply.

The temperature management system of **KBR** on the other hand, ensures that such cases are avoided as far as possible. As before, the fans are activated when the first temperature threshold is reached – separately for each cabinet, of course. If this is not sufficient, and an equivalent compensation stage is available in another cabinet, this is used as an alternative. Even if the emergency shut-off temperature is reached despite these preventative switching operations, the cabinets won't all be dropped at the same time; instead, only the cabinet with the overtemperature will be removed from the network and an error message will be sent. Thus some of the reactive power will still be available, preventing a total outage.

Product advice:
+49 (0) 9122 6373-0

info@kbr.de

Need more information?

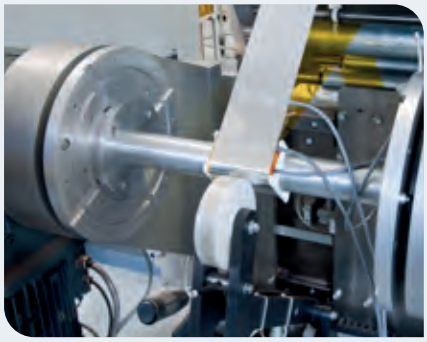
We will be happy to advise you personally.

REACTIVE POWER COMPENSATION MADE IN GERMANY:

ABOVE-AVERAGE OPERATING LIFE DUE TO...

In-house development!

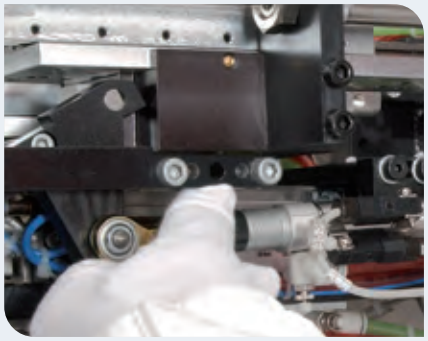
With its own hardware, firmware and software development, KBR is a highly flexible partner. Our customers' ideas are directly integrated in the product development.



In-house production of electronic devices!

In-house reactive power controller development guarantees ideal control of reactive power.

PREMIUM QUALITY
"Made in Schwabach" ALL FROM A SINGLE SOURCE.



In-house production of power capacitors!

We also produce the most important component ourselves: Power capacitors of the highest quality with high current-carrying capacity and a long operating life.

In-house production of filter circuit reactors!

The filter circuit reactors needed for the detuned reactive current compensation systems are developed and produced in-house.

The issues of "lowering energy costs" and "network quality" are becoming ever more relevant. The use of compensation and energy control systems does not only reduce costs but also the load on a company's own lines and distributions.

SAFETY AND MAINTENANCE MODULE (optional)
Diagnosis of all components

REACTIVE POWER CONTROLLER
Easy and intuitive operation

POWER CAPACITORS
250,000 operating hours

FILTER CIRCUIT REACTORS
High linearity

TEMPERATURE MANAGEMENT
Intelligent plant control

CAPACITOR SWITCHING CONTACTORS
Developed for the highest requirements

CURRENT TRANSFORMER (optional)
The right transformer for every measurement task

PRODUCTS AND SOLUTIONS
FOR CONTEMPORARY
ENERGY MANAGEMENT

MADE IN
GERMANY

Product advice:
+49 (0) 9122 6373-0

info@kbr.de

Need more information?

We will be happy to advise you personally.

multilog 3:
ANALYZE NETWORKS WITH EASE USING MOBILE DEVICES.

Clear design and standard compliance:
Assessment of the voltage quality in accordance with EN 50160 and IEC 61000-2-2

- IEC 61000-4-30 Class A
- Voltage quality in accordance with EN 50160/IEC 61000-2-2/2-4
- Oscilloscope and RMS recorder
- Analysis software for the PC
- Online readings on the smartphone
- Load analysis, energy measurements
- Ripple-control signal analysis

… and many other advantages

POWER QUALITY

MADE IN GERMANY

The multilog 3 Class A mobile network analyzer stands out with a strong performance range: Recording of more than 2000 measured values, numerous trigger functions as well as comprehensive analysis and archiving options. The device is easy to operate and mobile, which makes it perfect for measurements in public and industrial networks.

Basics of Reactive Power

Reactive power is the power required to create a magnetic field in inductive consumers like motors, transformers, ballasts, induction furnaces, etc., that is, coils of any design.

Reactive power is also known as magnetizing power. It oscillates between the consumer and the supplier (energy provider) and thus loads cables, fuses, and transformers.

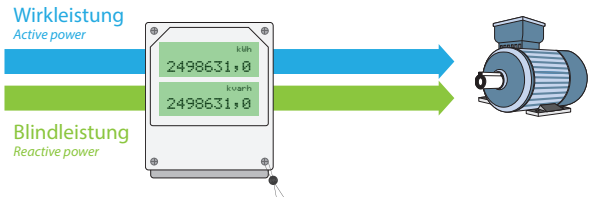
Basics of Reactive Power

In practical operation, reactive current compensation in commercial and industrial power networks is an issue that often raises many questions.

For technicians, the term compensation describes the interaction between different parameters which - in the best case scenario - cancel each other out. The goal is to offset the unwanted effect of a physical parameter by counteracting it with a second parameter. In our case, we want to compensate inductive with capacitive reactive power.

Electrical energy generated by power stations or through regenerative methods is transformed into largely usable energy such as light, heat or kinetic energy, depending on the consumer. Some consumers require inductive reactive power from the energy supply network to create a magnetic field. Typical inductive consumers are motors and transformers.

The active power resulting from the product of voltage and current is billed by the energy provider as consumed energy in kWh. Things are different with reactive power. It changes between provider and consumer and is not "consumed" in the literal sense.



Energy transfer without compensation

Why does the energy provider bill the reactive energy?

The degree of load created by network transformers, transmission lines and power plants is expressed as apparent power (S). It is calculated from the active power (P) and reactive power (Q).

$$S = \sqrt{P^2 + Q^2}$$

As can be seen from the formula, the transmission equipment of the network operator is additionally loaded by the reactive power. To keep the current-related losses to a minimum and to guarantee economic energy transport, network operators stipulate a minimum power factor cosφ. This describes the ratio of active to apparent power.

$$\cos\varphi = \frac{P}{S}$$

Energy meters for commercial and industrial use not only measure the active energy but also the reactive energy, which is billed in accordance with the electricity supply agreement. For most energy supply networks, a cosφ of 0.9 is specified. Here, 50% of the consumed active energy obtained from the power supply network may be taken as reactive energy free of charge in the billing period.

Other reasons for reactive power compensation

Thus, the main objective of reactive power compensation is to reduce the reactive power costs billed by the energy provider to "zero."

Another reason for reactive power compensation is to reduce the current load. For this, let's take a closer look at the formula for active power:

$$P = U \times I \times \cos\varphi \times \sqrt{3}$$

If we apply it to the current, this results in the following formula:

$$I = \frac{P}{U \times \cos\varphi \times \sqrt{3}}$$

The current thus depends on the power factor cosφ. Let's calculate the current reduction using an example:

An additional consumer with a power consumption of 35 A is to be connected to a sub-distribution unit with 250 A at an outgoing line. The following values were measured:

U = 400 V
I = 238 A
cosφ = 0,72

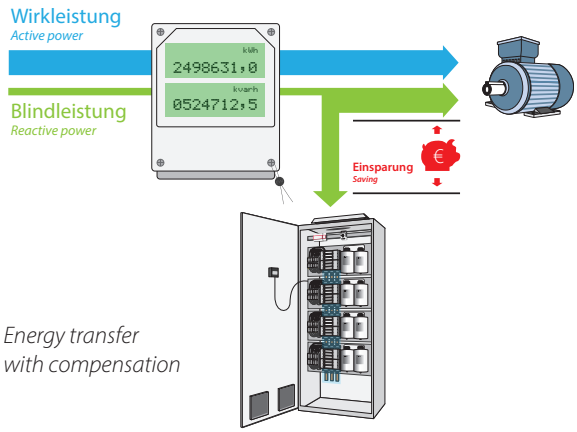
$$P = U \times I \times \cos\varphi \times \sqrt{3} = 400\,V \times 238\,A \times 0{,}72 \times \sqrt{3} = 118.700\,W$$

If you increase the power factor cosφ to 0.97 by compensation, the current is reduced from 238 A to:

$$I = \frac{P}{U \times \cos\varphi \times \sqrt{3}} = \frac{118.700\,W}{400\,V \times 0{,}97 \times \sqrt{3}} = 176\,A$$

By compensation of the reactive power, the current consumption was reduced by 62 A. Now, the consumer still required can be connected with 35 A.

Improving network quality



Energy transfer with compensation

Reactive power compensation is also used for improving the network quality. In modern industrial installations, consumers with power electronics (e.g. frequency converters) are used for energy efficiency measures. The input current of these "linear consumers" is no longer sinusoidal. As a result, network feedback is created as harmonic voltage. This can cause malfunctions in the consumers connected to the same network.

By using a compensation system as an absorption circuit, the harmonic voltage level can be reduced, rectifying the disturbance in the consumers. The principle of an absorption circuit system corresponds to that of a detuned reactive power compensation system with the resonance frequency close to the interfering harmonic frequency.

Another possible application is renewable energy generators, such as solar and wind power plants. According to applicable laws, these energy generation plants feeding energy into the public grid with an output of more than 100 kW have to contribute to keeping the voltage constant. If the network voltage drops, the voltage can be increased by switching on capacitors. A distinction is made between medium-voltage and low-voltage systems. In low-voltage systems, a Q / P characteristic curve has to be compensated, in medium-voltage systems, a Q / U characteristic curve.

Calculating the required capacitive reactive power

The capacitive reactive power is calculated using the following formula:

$$Qc = P \times (\tan\varphi 1 - \tan\varphi 2)$$

Qc = required capacitive reactive power
P = active power
tanφ1 = tangent of the power factor cosφ prior to compensation
tanφ2 = tangent of the power factor cosφ after compensation

When calculating central compensation, we do not have the necessary values as would be specified on a motor. In practice, the compensation power required is calculated using the most recent electricity bills or by taking long-term readings (network analysis).

In the electricity bill, the energy provider provides the following values on a monthly basis.

From this, the reactive power required can already be calculated using the formula introduced earlier.

$$Q = P \times (\tan\varphi 1 - \tan\varphi 2)$$

P = the active power specified in the electricity bill
tanφ1 = tangent of the power factor cosφ before compensation
tanφ2 = tangent of the power factor cosφ after compensation

The power factor desired is defined by the operating technician. In most cases, it is between 0.92 and 0.97 inductive. In our case, we calculate the reactive power compensation at 0.95 inductive, as is common practice.

$Q = 498\ kW \times (0{,}7025 - 0{,}3287) =$ **186 kvar**

Active power taken from the electricity bill

$$\tan\varphi 1 = \frac{kvar}{kWh} = \frac{166.023\ kvar}{(78.608 + 157.716)\ kWh} = 0{,}7025$$

(values from the electricity bill)

tanφ2 of the desired cosφ 0.95

In this example, we choose the next size up for standard systems, which is 200 kvar.

Our brochure
„Reducing Energy Costs by Reactive Power Compensation" is available for download at
www.kbr.de/dienstleistungen/download-center

Basics of Reactive Power

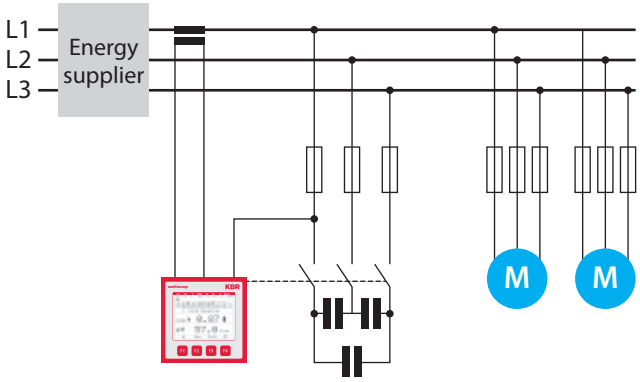
Measurement-based definition of the compensation system size

The power required can also be defined by network analysis. For this purpose, a suitable measuring device is installed in the supply line of the energy provider for one week. Installation takes place without an interruption of the energy supply. The measuring device is installed while the lines are live under voltage by a trained specialist wearing protective gear.

The measured data obtained can be used not only to define the required compensation system size but also to evaluate the network quality according to DIN EN 50160.

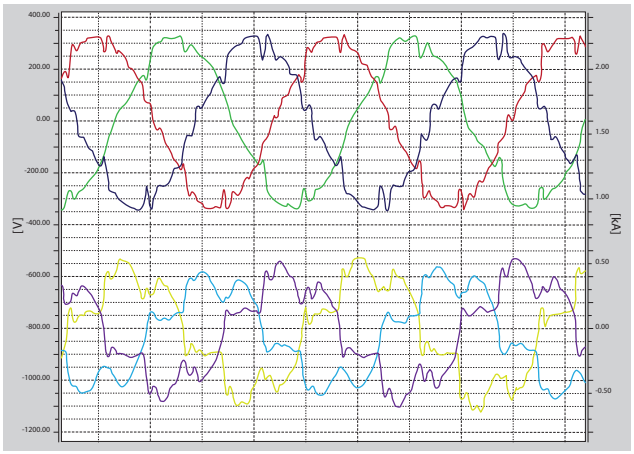
Installing reactive power compensation

Connection to the distribution is done in a similar way as for a larger consumer. The wire cross-section and back-up fuse are defined depending on the compensation selected. In our example, the 200 kvar system consumes 288 A of current (1.44 A per kvar). 3x240/120 mm^2 is chosen as the wire cross-section and 400 A for the back-up fuse.



Schematic structure of a reactive power compensation system

To enable automatic control, the instantaneous cosφ is needed for the controller. This is determined by way of a current and voltage measurement. The controller takes the measuring voltage from the supply voltage for compensation. With a current transformer installed in the supply line to the energy provider, the controller can now calculate the reactive power required and compensate the system of the customer.



Oscilloscope image of a network measurement with superimposed harmonic voltages

Amortization

The amortization period depends on the company's operating hours. It is usually between 2 and 4 years.

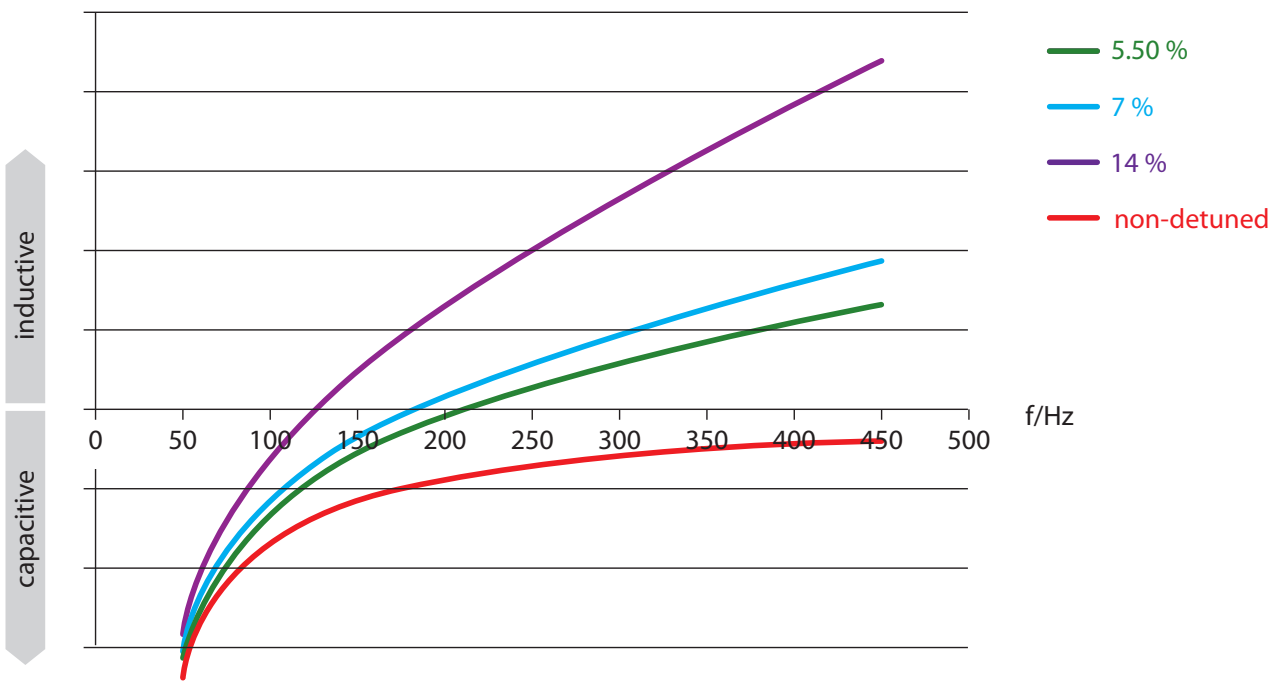
Disturbances in compensation systems

Consumers have changed in recent years. Motors are for example equipped with frequency converters, electronic control gears have become standard in illumination and clocked power supply units in power electronics. The current consumption of these consumers is not sinusoidal, creating a voltage drop at the network impedances. This drop is sinusoidal but has many times the fundamental frequency. These harmonic voltages occur with frequencies of 150 Hz, 250 Hz, 350 Hz, etc.

But how does a capacitor function in a network where harmonic voltage is present? The reactance Xc of a capacitor depends on the frequency.

$$Xc = \frac{1}{2 \times \pi \times f \times C}$$

Looking at the formula, it becomes clear that with higher frequencies, the reactance Xc of the capacitor decreases. What does this mean for us in practice? Depending on how much it is loaded with harmonic voltages, the amount of current a capacitor draws increases. This in turn results in a higher thermal load on the capacitor, leading to a shorter operating life. In an information brochure on the lifespan of power capacitors, the ZVEI (the German Electrical and Electronic Manufacturers' Association) states that a capacitor's lifespan is halved when the maximum temperature is exceeded by 7°C .



Impedance pattern of detuned compensation systems

Another problem in this context is the possible resonance in low-voltage networks. In this case, the reactance of the inductance and capacitance is the same at the resulting resonance frequency. The resonance frequency fr can be calculated using the following formula:

$$fr = \frac{1}{2 \times \pi \times \sqrt{L \times C}}$$

Detuned compensation systems

Which measures can be taken to prevent possible resonances? To deal with the continuously increasing harmonic load, detuning compensation systems have been common practice for years. But what does "detuning" mean? For detuning, each capacitor stage is set up as a series resonant circuit with an inductor connected in series.

Equivalent circuit diagram of a detuned compensation stage

The inductor connected upstream of the capacitor stage ensures a defined resonance frequency.

Common detuning factors are:

Detuning	5.5 %	7%	12.5%	14%
Resulting frequency	214 Hz	189 Hz	141 Hz	134 Hz

Below the resulting detuning frequency, the capacitor stage acts like a capacitor. Above that frequency, the stage is inductive. If you set up the series resonance frequency of the detuned compensation system below the smallest possible harmonic voltage (e.g. 150 Hz, 250 Hz, 350 Hz, etc.), there are no resonances, as two inductances cannot form a resonant circuit.

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