Power Quality Solution

SIEMENS

Index

Introduction

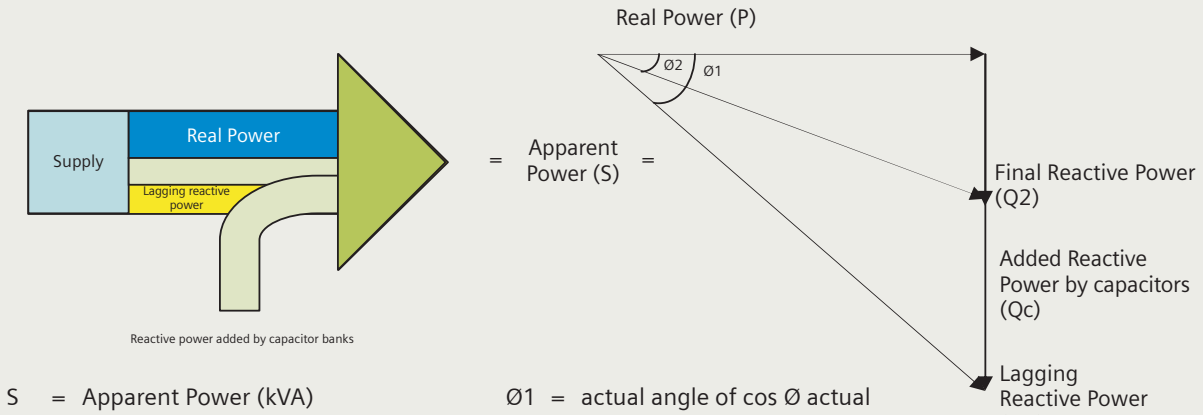
For electricity consumer lagging reactive power generated from inductive loads is one of the major causes of power and financial losses i.e. poor power factor (non-unity). Incorporating power factor correction devices in the network helps in generating leading reactive power to compensate lagging reactive power. This techniques helps consumer to achieve power factor (cos Ø) close to unity. Fig 1

The necessary leading power can be produced by LV capacitor connected in parallel to the supply network close to the lagging power source (like induction motors, MCC panels etc)

The capacitors connected can be fixed type for given fixed lagging pf of the system at a point in power system or variable in steps for a changing connected load. Fig 2

Advantages of power factor corrections:

- Reduction of reactive power in system
- Low cost of energy levied at better pf
- Improved voltage quality
- Reduced voltage drops
- Optimum cable design
- Reduced transmission losses

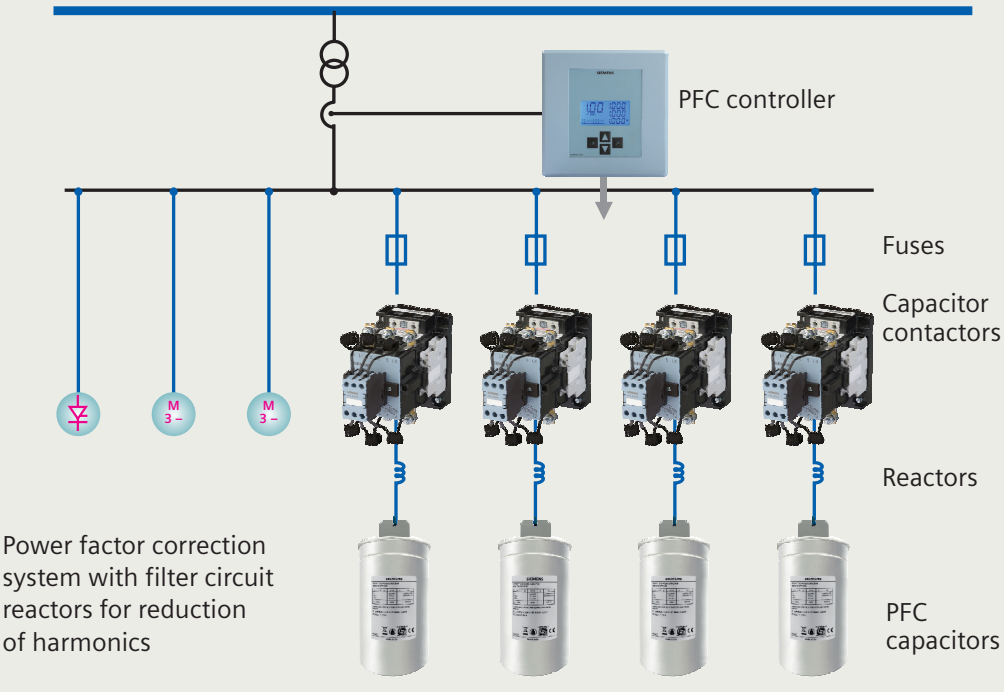


S = Apparent Power (kVA)
P = Active Power/ Real Power (kW)
Q = Reactive Power (kvar)
Qc = Reactive Power Capacitor (kvar)

Ø1 = actual angle of cos Ø actual
Ø2 = target angle of cos Ø actual
Qc = Q1 – Q2 = P. (tan Ø1- tan Ø2)

Fig 1

Typical power factor correction circuit diagram



Power factor correction system with filter circuit reactors for reduction of harmonics

SIECAP™ LV Capacitors

Capacitor

SIEMENS SIECAP™ range of capacitors can withstand high inrush currents caused during individual switching operation (>100I_N) and also while connected in parallel, i.e. as banks when the inrush current is increased to ≥150 · I_N. The high inrush is because the charging current comes from the power line as well as from other capacitors connected parallel in the bank.

SIEMENS capacitor range is broadly classified in three variants:

SIECAP™ ND [Normal Duty]	SIECAP™ HD [Heavy Duty]	SIECAP™ SHD [Super Heavy Duty]
		

SIECAP™ range of capacitor is based on MPP technology [Metalized of Zinc Al alloy over Polypropelyne dielectric] of film making with an impregnation of semi-dry biodegradable soft resin.

Special film-cutting technique (optimized combination of wavy and smooth cuts) & heavy edge produces a maximum effective surface for the metal spraying or contacting process, Fig 3.

SIECAP™ capacitors are most compact and light in weight.

Wavy cut design

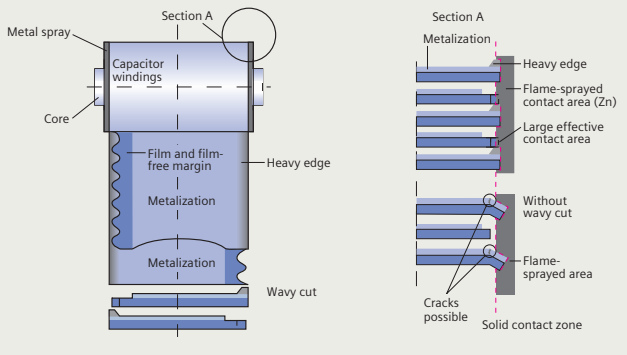
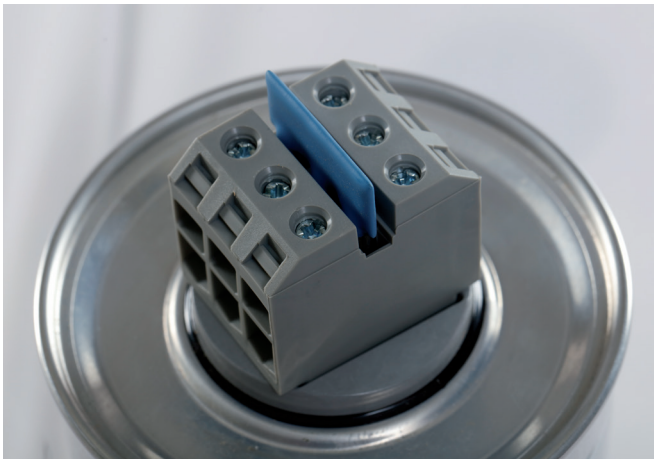
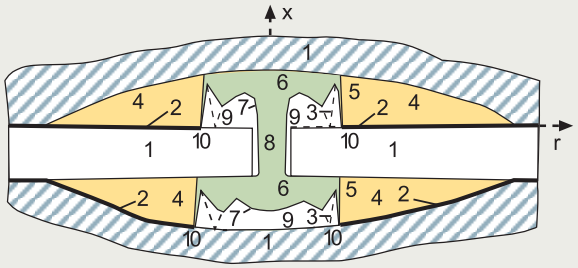


Fig 3



Self-healing properties

Self-healing



1 Dielectric
2 Metalized electrodes
3 Material displacing shock wave
4 Air gap with metal vapor
5,6 Plasma zone
7 Boundary layer between gas phase dielectric and plasma
8 Breakdown channel
9 Gas phase dielectric
10 Zone of displaced metalization and dielectric (isolating region)

Fig 4

In case of electrical overload the dielectric in the breakdown channel is broken down into highly compressed plasma that explodes out of the breakdown channel and pushes the dielectric layers apart. The discharge continues within the spreading plasma via the metal layers so that the metal surrounding the faulty area is completely burnt out. This produces perfect isolation of the faulty area within microseconds. The self-healing process results in negligible capacitance loss less than 100 pF per event. The capacitor remains fully functional during the entire process, Fig 4

Overpressure disconnector

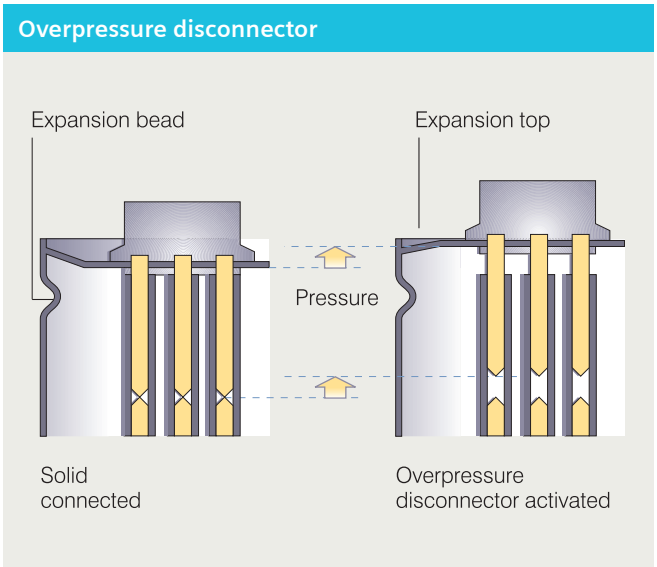


Fig 5

At the end of the capacitor's service life or when a high pressure forms inside the can, the overpressure disconnector is activated. The specially designed cover with an expansion bead moves upwards. Expansion beyond a certain degree will separate the wires and disconnect the capacitor safely from the line. The disconnector is separated at its breakpoint (small notch) and the flow of current to the capacitor windings is interrupted. Fig 5

Sigut terminals

SIECAP™ range of capacitors come with SIGUT terminals with electric shock protection (IP20).

These terminal provides finger touch protection for users.

These also ensure reliable connection.

Applications

- Power Factor Correction (PFC)
- Automatic capacitor banks
- Fixed PFC applications, e.g. motor compensation
- Detuned PFC systems
- Dynamic PFC systems
- Heavy Industries

Key Features

- Compact design in cylindrical aluminum can with stud
- Stacked winding
- MPP technology
- Voltage range 415 ... 690 V
- Output range 0.9 ... 33.1 kvar

Electrical

- Up to 33.1 kvar per phase for three-phase applications
- Long life expectancy
- High pulse current withstand capability

Mechanical and maintenance

- Reduced mounting costs, easy installation and connection
- Low weight and compact volume
- Maintenance-free

Safety

- Self-healing
- Overpressure disconnector
- Fast On & Shock hazard protected SIGUT- terminals

Technical specifications

		SIECAP™ SHD	SIECAP™ HD	SIECAP™ ND
Standards		IEC 60831–1/2 Edition 3.0 (2014), IS 13340–1/2 (2012)		
Approvals		CE, ISI		
Overvoltage	V_{max}	V_N +10% (up to 8 h daily) V_N +15% (up to 30 min. daily) V_N +20% (up to 5 min. daily) V_N +30% (up to 1 min. daily)		
Overcurrent	I_{max}	Up to 1.6 ...2.0 • I_N (A)	Up to 1.8 • I_N (A)	Up to 1.3 ...1.5 • I_N (A)
		(including combined effects of harmonics, overvoltages and capacitance tolerance)		
Max. Inrush current	Is	≤ 500 I_N (A)	≤ 250 • I_N (A)	≤ 200 I_N (A)
Losses				
• Dielectric		0.2 W/ kvar	≤ 0.2 W / kvar	
• Total [1]		0.45 W/ kVar	≤ 0.5 W / kvar	
Rated frequency	f	50 / 60* Hz		
Capacitance tolerance		–5 % / +5 %	–5 / +10%	–5 / +10%
Connection		D (Delta)		
Test voltage, terminal / terminal	V_{TT}	2.15 * V_N V AC / 50 Hz, 2s		
Test voltage, terminal / case	V_{TC}			
• Up to V_N = 525 V AC		3600 V AC / 50 Hz, 2 s		
• V_N = 690 V AC		6000 VAC / 50 Hz, 2 s	NA	NA
Mean life expectancy	t_{LD}	Upto 200 000 hours (temperature class –40/D)$	Up to 130 000 hours (temperature class –25/D)	Up to 100 000 hours (temperature class –25/D)
Number of switching operations		Max. 15000 switching's per year	Max. 7500 switching's per year	Max. 5000 switching's per year
Ambient temperature		Class -40/60 Max. short time: + 60°C; max. mean 24h: +45°C; max. mean 1 year: +35°C; lowest temperature: - 40°C	Class -25/D Max. short time: +55 °C; max. mean 24 h: +45 °C; max. mean 1 year: +35 °C; lowest temperature: - 25 °C	
Storage temperature		- 40°C .... + 85°C	-25 °C to +85 °C	
Max. hotspot temperature		85 °C		
Cooling		Natural or Forced air cooling		
Humidity	H_{rel}	max. 95 %		
Altitude		max. 4000 m above sea level		
Mounting position		Upright / horizontal	Vertical	
Mounting		Fixing: Threaded bolt M12 except M8 for d = 53 mm; Max. torque (Al can stud): 10 Nm except 4 Nm for d = 53 mm		Fixing: Threaded bolt M12 except M8 for d = 50 mm; Max. torque (Al can stud): 10 Nm except 4 Nm for d = 50 mm
Safety		Self-healing technology, overpressure disconnector		
Discharge module		External discharge module included with capacitor		
Max. discharge resistor time		≤ 3 min (75 V or less)		
Case		Extruded aluminium cane		
Enclosure degree of protection		IP20		
Dielectric		Polypropylene film		
Impregnation		Non PCB, biodegradable soft resin, semi-dry		
Terminals		Fast-on or SIGUT		

1) Without discharge resistor

* Estimated values available

$ Mean life expectancy is up to 180 000 hours (temperature class –40/60)

Terminals

SIECAP™ ND		
Degree of protection	IP20	
Up to 7 kvar	6.3 mm fast-on terminals	
Creepage distance (min)	12.7 mm	
Clearance (min)	9.6 mm	
Above 7 kvar	Sigut terminals	
Max. torque	1.2 Nm	
Cable cross section	16 mm^2 (without cable and lug)	
Maximum terminal current	50 A	
Creepage distance (min)	12.7 mm	
Clearance (min)	9.6 mm	

SIECAP™ HD		
Degree of protection	IP20	
Plastic top – 1 to 6.3 kvar	6.3 mm fast-on	
	Ø 53 mm diameter	Ø 63.5 mm diameter
Creepage distance	10.5 mm	10.0 mm
Clearance	13.0 mm	16.5 mm
Above 7 kvar	Sigut terminals	
	up to Ø 90 mm	above Ø 90 mm
Max. torque	1.2 Nm	2.0 Nm
Cable cross section	16 mm^2 (without cable and lug)	25 mm^2 (without cable and lug)
Maximum terminal current	50 A	80 A
Creepage distance (min)	12.7 mm	
Clearance (min)	9.6 mm	

SIECAP™ SHD			
Protection degree	IP20		
Terminal Type	Terminal Type A & C	Terminal Type B & D	Terminal Type E
Max. torque	1.2 Nm	2.0 Nm	–
Terminal cross section	16 mm^2 (without cable and lug)	25 mm^2 (without cable and lug)	–
Maximum terminal current	50 A	80 A	–
Creepage distance (min)	12.7 mm		10.5 mm (For d = 53) 10.0 mm (For d = 63.5)
Clearance (min)	9.6 mm		13.0 mm (For d = 53) 16.5 mm (For d = 63.5)

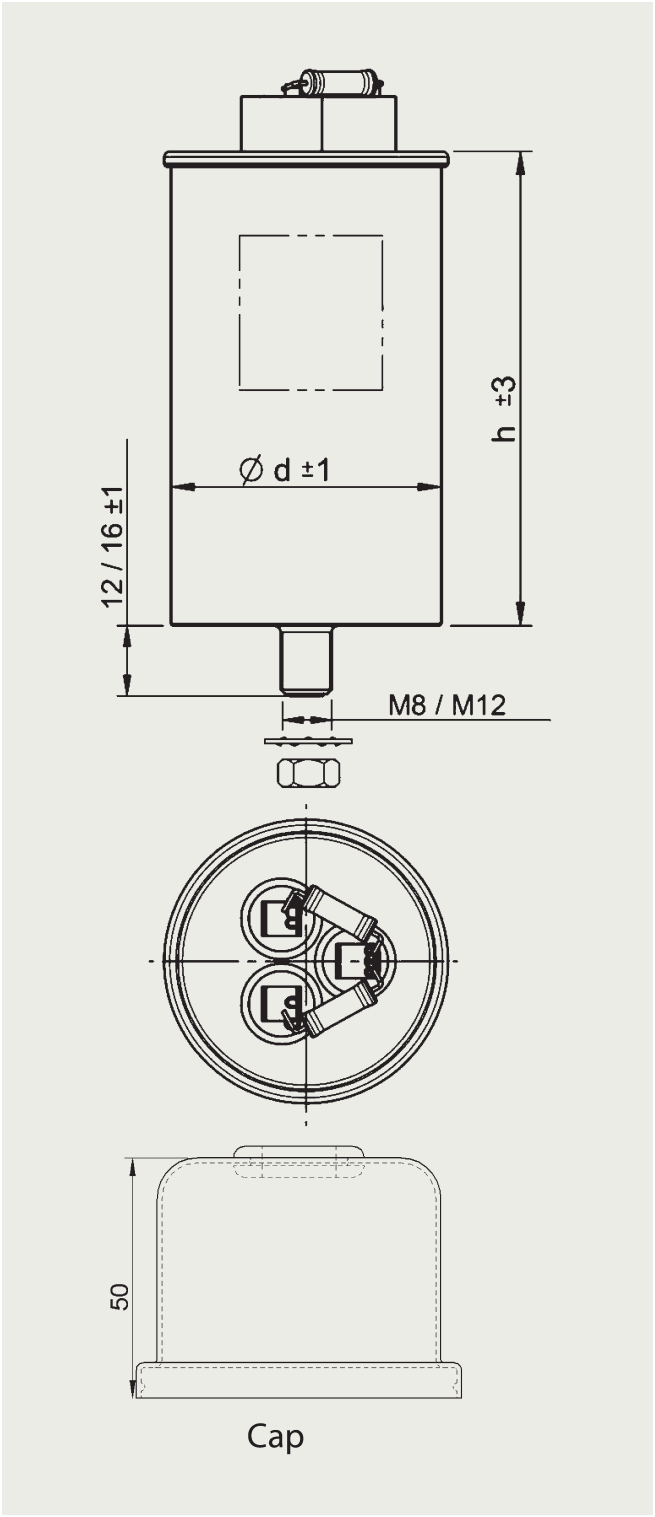
SIECAP™ ND
Ordering details

Order code	50 Hz Output (kvar)	I_R at 50 Hz and rated voltage (A)	60 Hz Output* (kvar)	Terminal	Size D (ϕ) *H (mm)	Net weight (kg)	MOQ
Rated Voltage 440V AC							
4RB2008-3EE52-8K	0.9	1.2	1.1	A	50 x 75	0.233	12
4RB2010-3EE52-8K	1	1.3	1.2	A	50 x 75	0.233	12
4RB2012-3EE52-8K	1.2	1.6	1.4	A	50 x 75	0.233	12
4RB2015-3EE52-8K	1.5	2	1.8	A	50 x 88	0.273	12
4RB2021-3EE52-8K	2.1	2.8	2.5	A	50 x 112	0.304	12
4RB2025-3EE52-8K	2.5	3.3	3	A	50 x 112	0.304	12
4RB2030-3EE52-8K	3	3.9	3.6	A	55 x 112	0.346	12
4RB2042-3EE52-8K	4.2	5.5	5	A	55 x 137	0.396	12
4RB2050-3EE52-8K	5	6.6	6	A	55 x 147	0.414	12
4RB2060-3EE52-8K	6	7.9	7.2	A	63.5 x 136	0.497	12
4RB2070-3EE52-8K	7	9.2	8.4	A	63.5 x 146	0.522	12
4RB2075-3EE52-8K	7.5	9.8	9	B	75 x 160	0.9	12
4RB2083-3EE52-8K	8.3	10.9	10	B	75 x 160	0.9	12
4RB2090-3EE52-8K	9	11.8	10.8	B	75 x 160	0.9	2
4RB2100-3EE52-8K	10	13.1	12	B	75 x 197	1.2	2
4RB2125-3EE52-8K	12.5	16.4	15	B	75 x 197	1.2	2
4RB2150-3EE52-8K	15	19.7	18	B	75 x 270	1.4	2
4RB2167-3EE52-8K	16.7	21.9	20	B	85 x 270	1.8	2
4RB2200-3EE52-8K	20	26.2	24	B	85 x 270	1.8	2
4RB2208-3EE52-8K	20.8	27.3	25	B	85 x 270	1.8	2
4RB2250-3EE52-8K	25	32.8	30	B	90 x 270	2	2
4RB2280-3EE52-8K	28	36.7	-	B	85 x 348	2.4	2
4RB2300-3EE52-8K	30	39.4	-	B	90 x 348	2.5	2
Rated Voltage 480V AC							
4RB2010-3EJ52-8K	1	1.2	1.2	A	50 x 88	0.273	12
4RB2015-3EJ52-8K	1.5	1.8	1.8	A	50 x 112	0.304	12
4RB2020-3EJ52-8K	2	2.4	2.4	A	50 x 112	0.304	12
4RB2025-3EJ52-8K	2.5	3	3	A	55 x 112	0.346	12
4RB2042-3EJ52-8K	4.2	5.1	5	A	63.5 x 136	0.497	12
4RB2050-3EJ52-8K	5	6	6	A	63.5 x 136	0.497	12
4RB2055-3EJ52-8K	5.5	6.6	6.6	A	63.5 x 136	0.497	12
4RB2083-3EJ52-8K	8.3	10	10	B	75 x 160	0.9	12
4RB2104-3EJ52-8K	10.4	12.5	12.5	B	75 x 197	1.2	2
4RB2111-3EJ52-8K	11.1	13.4	13.3	B	75 x 197	1.2	2
4RB2125-3EJ52-8K	12.5	15	15	B	75 x 197	1.2	2
4RB2138-3EJ52-8K	13.8	16.6	16.6	B	75 x 270	1.4	2
4RB2150-3EJ52-8K	15	18	18	B	75 x 270	1.4	2
4RB2167-3EJ52-8K	16.7	20.1	20	B	85 x 270	1.8	2
4RB2208-3EJ52-8K	20.8	25	25	B	85 x 270	1.8	2
4RB2250-3EJ52-8K	25	30.1	30	B	85 x 348	2.4	2
4RB2277-3EJ52-8K	27.7	33.3	-	B	90 x 348	2.5	2
4RB2300-3EJ52-8K	30	36.1	-	B	90 x 348	2.5	2

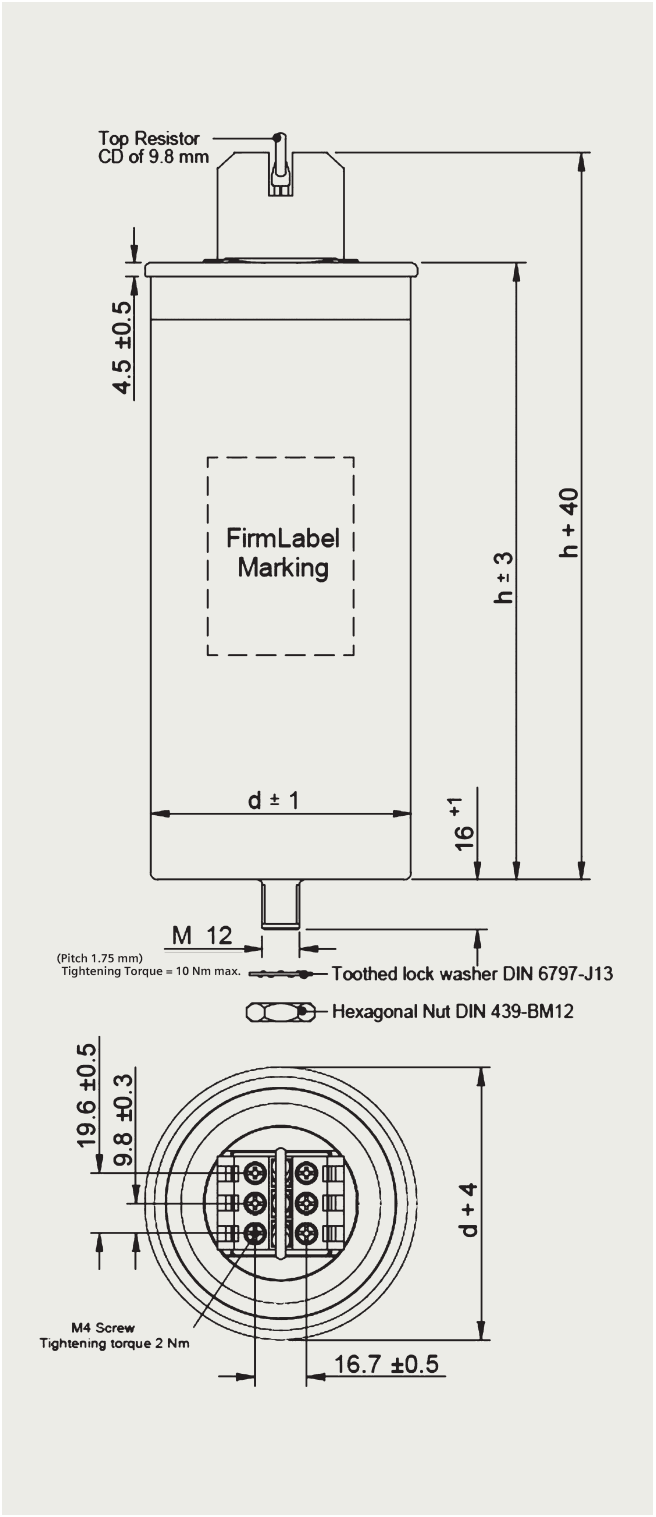
* estimated values

SIECAP™ ND
Dimension drawings

Capacitors with fast on terminals
Terminal Type A



Capacitors with Sigut terminals
Terminal Type B



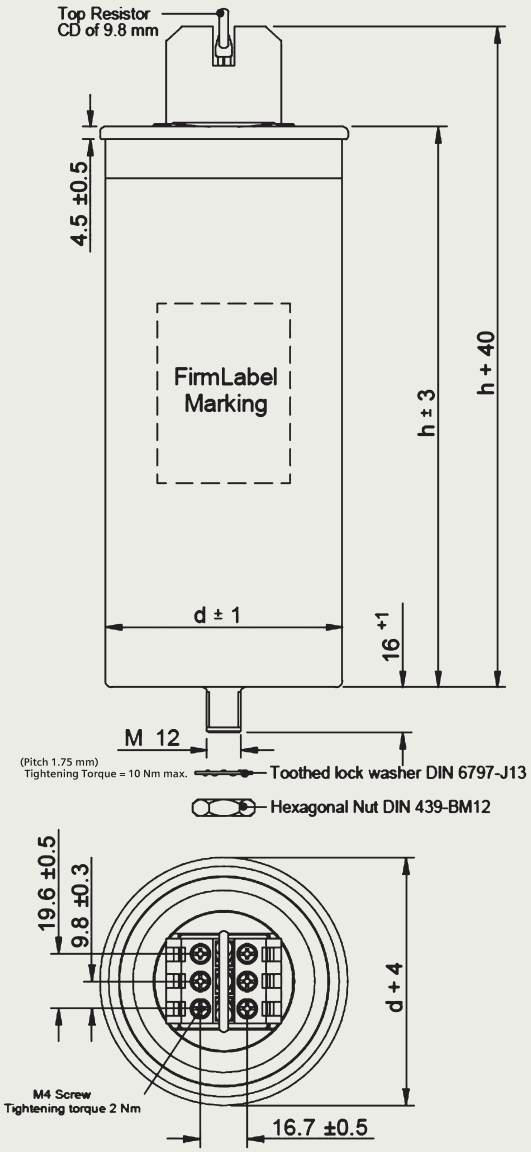
SIECAP™ HD
Ordering details

Order code	50 Hz Output (kvar)	I_R at 50 Hz and rated voltage (A)	60 Hz Output* (kvar)	Terminal	Size D (ϕ) *H (mm)	Net weight (kg)	MOQ
Rated Voltage 415V AC							
4RB2050-3EB53-8K	5	7	6	A	63.5 x 129	0.51	6
4RB2075-3EB53-8K	7.5	10.4	9	B	75 x 160	0.9	6
4RB2104-3EB53-8K	10.4	14.5	12.5	B	75 x 197	1.2	2
4RB2125-3EB53-8K	12.5	17.4	15	B	75 x 197	1.2	2
4RB2150-3EB53-8K	15	20.9	18	B	75 x 270	1.4	2
4RB2200-3EB53-8K	20	27.8	24	B	75 x 270	1.4	2
4RB2250-3EB53-8K	25	34.8	30	B	85 x 270	1.8	2
Rated Voltage 440V AC							
4RB2010-3EE53-8K	1	1.3	1.2	A	53 x 117	0.32	6
4RB2020-3EE53-8K	2	2.6	2.4	A	53 x 117	0.32	6
4RB2030-3EE53-8K	3	3.9	3.6	A	53 x 117	0.32	6
4RB2040-3EE53-8K	4	5.2	4.8	A	53 x 152	0.42	6
4RB2050-3EE53-8K	5	6.6	6	A	53 x 152	0.42	6
4RB2075-3EE53-8K	7.5	9.8	9	B	75 x 160	0.9	6
4RB2100-3EE53-8K	10	13.1	12	B	75 x 197	1.2	2
4RB2125-3EE53-8K	12.5	16.4	15	B	75 x 197	1.2	2
4RB2150-3EE53-8K	15	19.7	18	B	75 x 270	1.4	2
4RB2200-3EE53-8K	20	26.2	24	B	85 x 270	1.8	2
4RB2250-3EE53-8K	25	32.8	30	B	90 x 270	2	2
4RB2281-3EE53-8K	28.1	36.9	-	B	85 x 348	2.4	2
4RB2300-3EE53-8K	30	39.4	-	B	90 x 348	2.5	2
Rated Voltage 480V AC							
4RB2050-3EJ53-8K	5	6	6	A	63.5 x 152	0.6	6
4RB2063-3EJ53-8K	6.3	7.6	7.6	A	63.5 x 152	0.6	6
4RB2083-3EJ53-8K	8.3	10	10	B	75 x 160	0.9	6
4RB2104-3EJ53-8K	10.4	12.5	12.5	B	75 x 197	1.2	2
4RB2110-3EJ53-8K	11	13.2	13.2	B	75 x 197	1.2	2
4RB2125-3EJ53-8K	12.5	15	15	B	75 x 197	1.2	2
4RB2138-3EJ53-8K	13.8	16.6	16.6	B	75 x 270	1.4	2
4RB2150-3EJ53-8K	15	18	18	B	75 x 270	1.4	2
4RB2167-3EJ53-8K	16.7	20.1	20	B	85 x 270	1.8	2
4RB2187-3EJ53-8K	18.7	22.5	22.4	B	85 x 270	1.8	2
4RB2200-3EJ53-8K	20	24.1	24	B	85 x 270	1.8	2
4RB2220-3EJ53-8K	22	26.5	26.4	B	85 x 348	2.4	2
4RB2250-3EJ53-8K	25	30.1	30	B	85 x 348	2.4	2
4RB2281-3EJ53-8K	28.1	33.8	-	B	90 x 348	2.5	2
4RB2300-3EJ53-8K	30	36.1	-	B	90 x 348	2.5	2
Rated Voltage 525V AC							
4RB2050-3FC53-8K	5	5.5	6	A	63.5 x 152	0.6	6
4RB2063-3FC53-8K	6.3	6.9	7.6	B	75 x 160	0.9	6
4RB2083-3FC53-8K	8.3	9.1	10	B	75 x 160	0.9	6
4RB2104-3FC53-8K	10.4	11.4	12.5	B	75 x 197	1.2	2
4RB2125-3FC53-8K	12.5	13.7	15	B	85 x 197	1.23	2
4RB2132-3FC53-8K	13.2	14.6	15.8	B	75 x 270	1.4	2
4RB2150-3FC53-8K	15	16.5	18	B	85 x 270	1.8	2
4RB2167-3FC53-8K	16.7	18.4	20	B	85 x 270	1.8	2
4RB2200-3FC53-8K	20	22	24	B	90 x 270	2	2
4RB2250-3FC53-8K	25	27.5	30	B	90 x 348	2.5	2
4RB2265-3FC53-8K	26.5	29.1	31.8	B	90 x 348	2.5	2
4RB2300-3FC53-8K	30	33	-	C	116 x 280	3	2
4RB2331-3FC53-8K	33.1	36.4	-	C	116 x 280	3	2

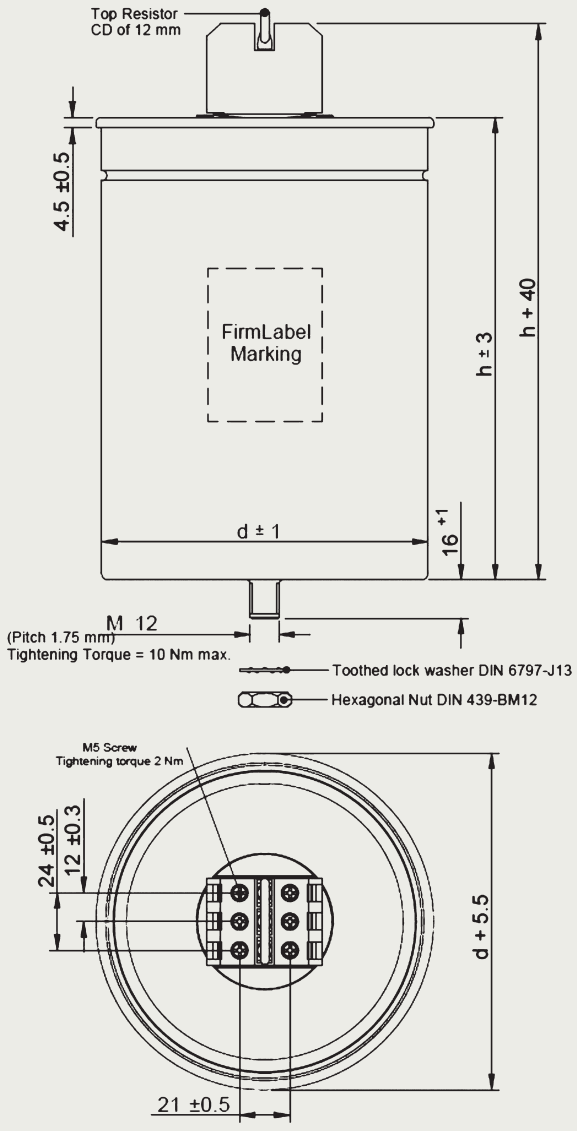
* estimated values

SIECAP™ HD
Dimension drawings

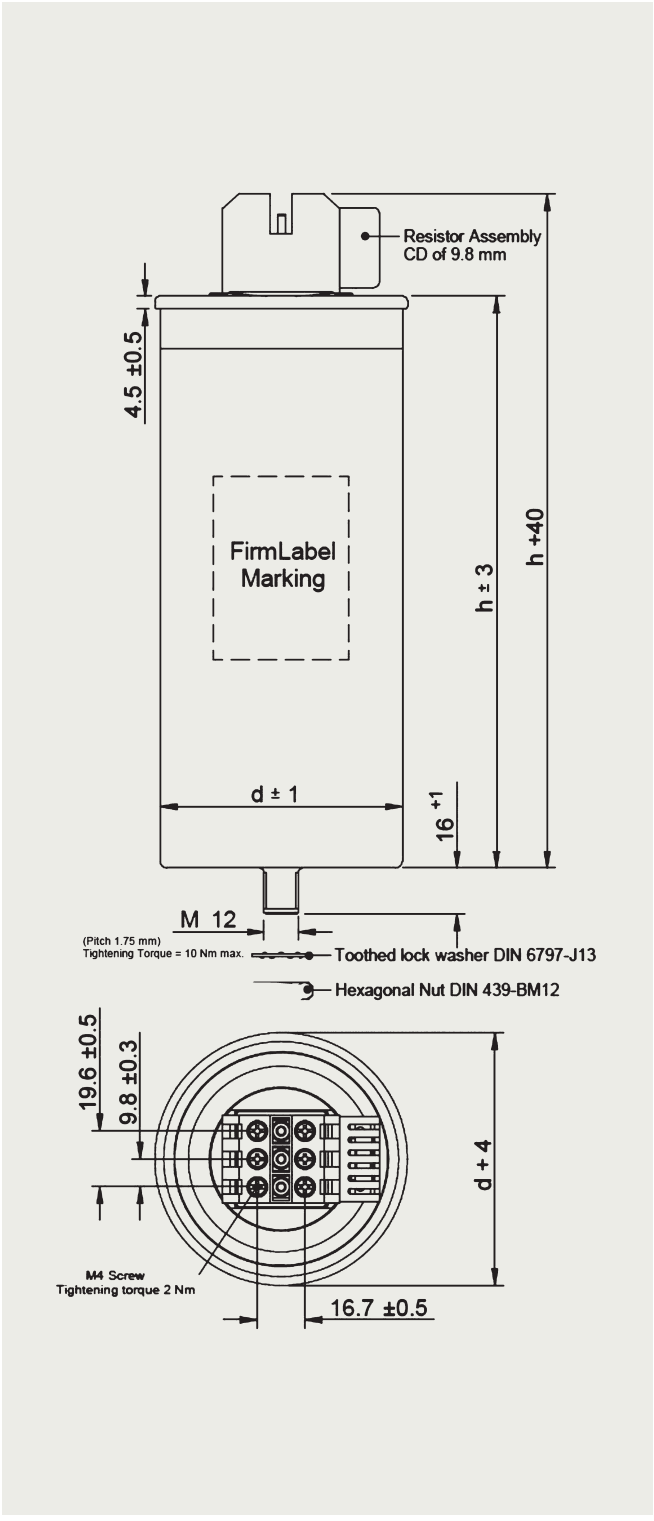
Terminal Type A



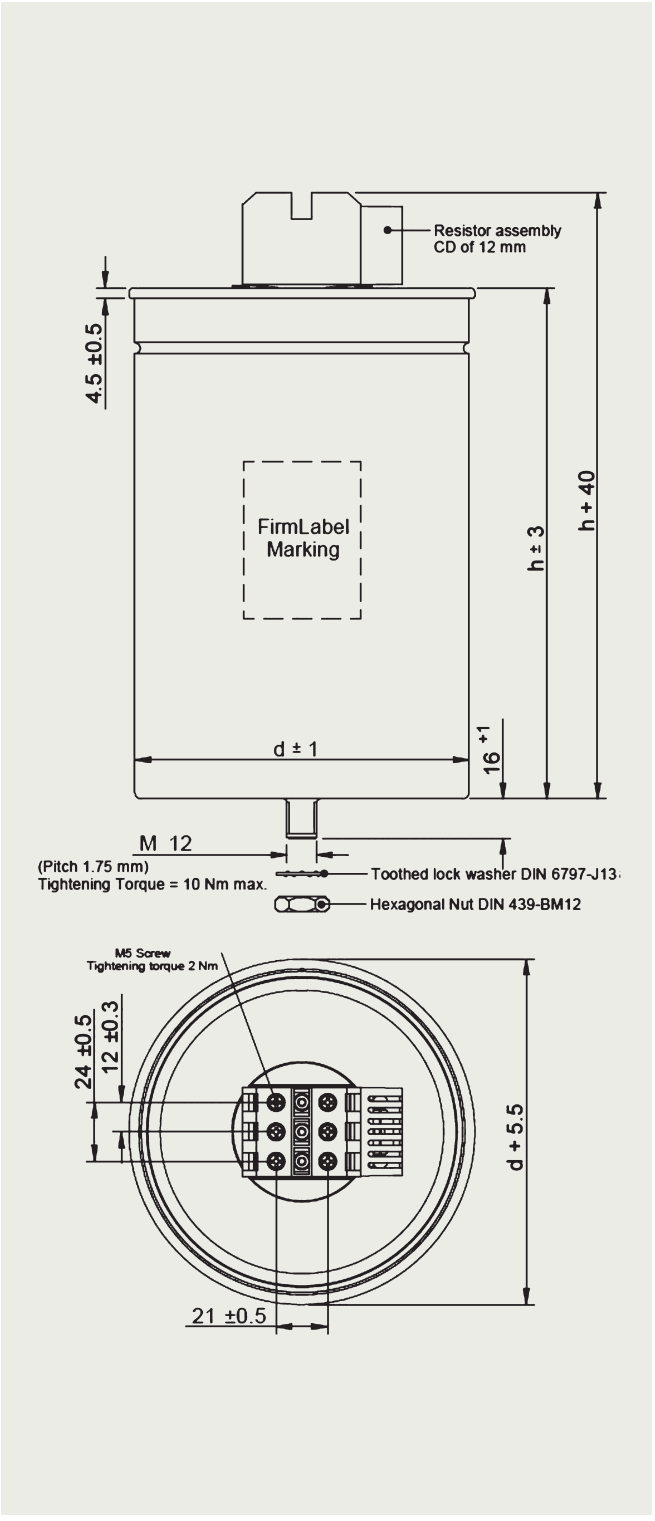
Terminal Type B



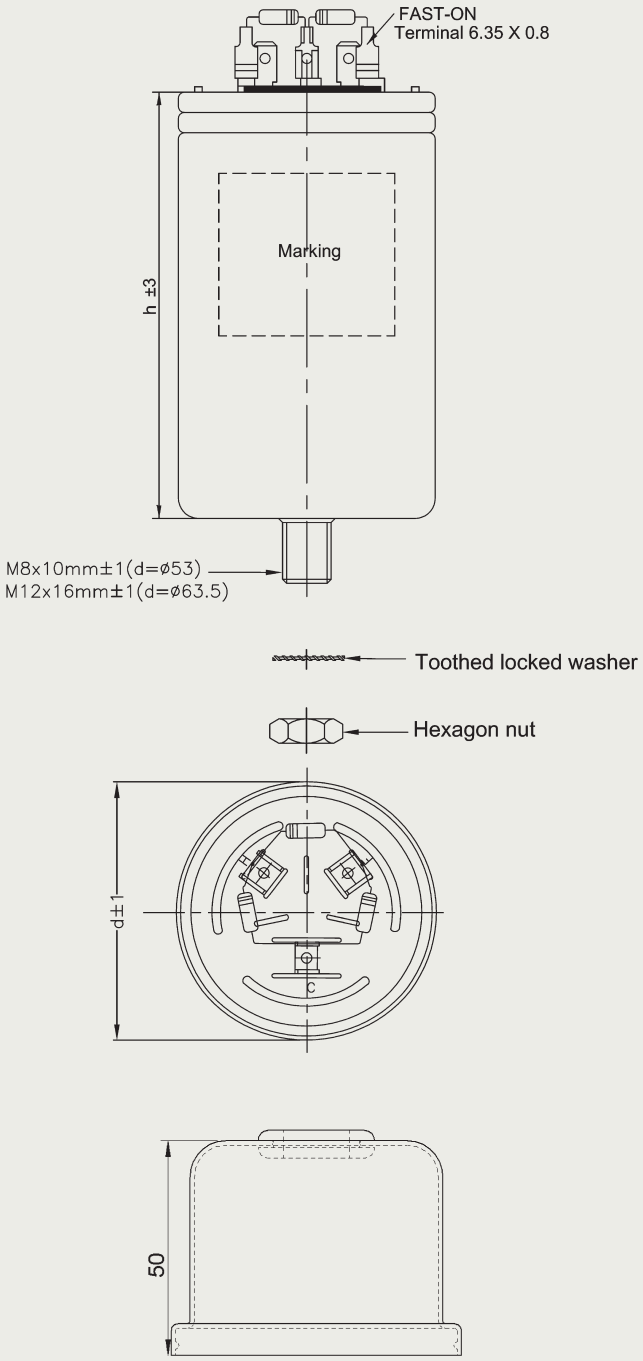
Terminal type C



Terminal type D



Terminal type E



SIECAP™ SHD
Ordering details

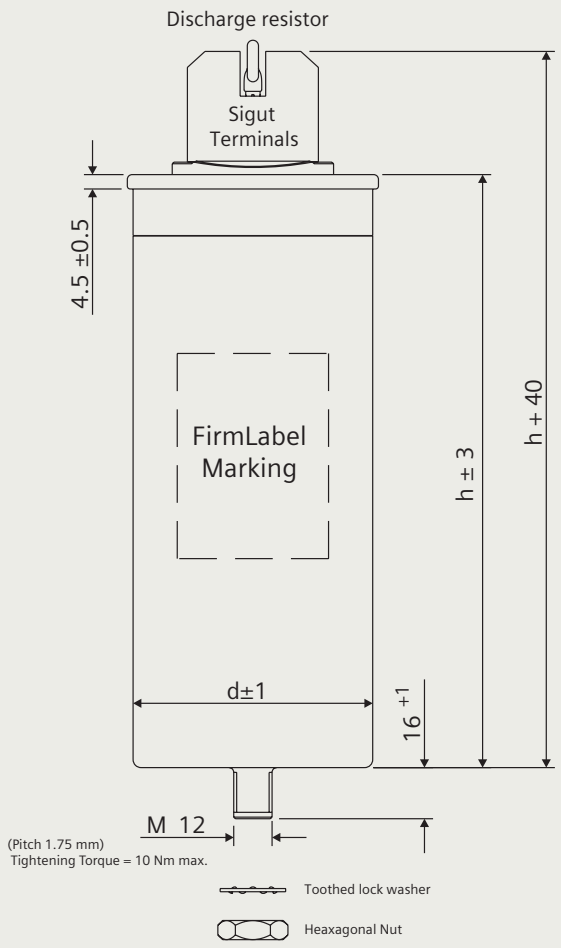
50 Hz Output in kVar	60 Hz Output* in kVar	Capacity in uF 3 x	Terminal Type	Dimensions D * H mm Ø	Order No	PU Unit (s)	MOQ Unit (s)	Weight per PU Kg approx
Rated Voltage 415 V AC								
5	6	30.8	A	75 x 164	**4RB1050-3EB50-8K**	1	4	0.95
6.3	7.6	38.8	A	75 x 164	**4RB1063-3EB50-8K**	1	4	0.95
7.5	9	46.2	A	75 x 200	**4RB1075-3EB50-8K**	1	4	1.16
10.4	12.5	64.1	A	75 x 200	**4RB1104-3EB50-8K**	1	4	1.16
12.5	15	77	A	85 x 200	**4RB1125-3EB50-8K**	1	4	1.48
15	18	92.4	A	85 x 200	**4RB1150-3EB50-8K**	1	4	1.48
20	24	123.2	B	100 x 207	**4RB1200-3EB50-8K**	1	4	2.13
25	30	154	B	116 x 192	**4RB1250-3EB50-8K**	1	4	2.65
28.1	-	173.1	B	116 x 207	**4RB1281-3EB50-8K**	1	4	2.86
30	-	184.8	B	116 x 207	**4RB1300-3EB50-8K**	1	4	2.86
33	-	203.3	B	116 x 224	**4RB1330-3EB50-8K**	1	4	3.09
Rated Voltage 440 V AC								
1	1.2	5.5	E	53 x 117	**4RB1010-3EE50-8K**	1	4	0.44
2	2.4	11	E	53 x 129	**4RB1020-3EE50-8K**	1	12	0.44
3	3.6	16.4	E	53 x 129	**4RB1030-3EE50-8K**	1	4	0.44
4	4.8	21.9	E	63.5 x 152	**4RB1040-3EE50-8K**	1	4	0.66
5	6	27.4	A	75 x 164	**4RB1050-3EE50-8K**	1	4	0.95
7.5	9	41.1	A	75 x 200	**4RB1075-3EE50-8K**	1	4	1.16
10	12	54.8	A	75 x 200	**4RB1100-3EE50-8K**	1	4	1.16
10.4	12.5	57	A	85 x 200	**4RB1104-3EE50-8K**	1	4	1.48
12.5	15	68.5	A	85 x 200	**4RB1125-3EE50-8K**	1	4	1.48
15	18	82.2	A	85 x 218	**4RB1150-3EE50-8K**	1	4	1.62
16.7	20	91.5	B	100 x 207	**4RB1167-3EE50-8K**	1	4	2.13
20	24	109.6	B	100 x 207	**4RB1200-3EE50-8K**	1	4	2.13
25	30	137	B	116 x 192	**4RB1250-3EE50-8K**	1	4	2.65
28.1	-	154	B	116 x 207	**4RB1281-3EE50-8K**	1	4	2.86
30	-	164.4	B	125 x 192	**4RB1300-3EE50-8K**	1	4	3.09
33.1	-	181.4	B	116 x 224	**4RB1331-3EE50-8K**	1	4	3.09
Rated Voltage 480 V AC								
5	6	23	A	75 x 164	**4RB1050-3EJ50-8K**	1	4	0.95
6.3	7.6	29	A	75 x 164	**4RB1063-3EJ50-8K**	1	4	0.95
8.3	10	38.2	A	75 x 200	**4RB1083-3EJ50-8K**	1	4	1.16
10.4	12.5	47.9	A	75 x 200	**4RB1104-3EJ50-8K**	1	4	1.16
11	13.2	50.7	A	85 x 200	**4RB1111-3EJ50-8K**	1	4	1.48
12.5	15	57.6	A	85 x 200	**4RB1125-3EJ50-8K**	1	4	1.48
13.8	16.6	63.5	A	85 x 200	**4RB1138-3EJ50-8K**	1	4	1.48
15	18	69.1	B	100 x 207	**4RB1150-3EJ50-8K**	1	4	2.13
16.7	20	76.9	B	100 x 207	**4RB1167-3EJ50-8K**	1	4	2.13
18.7	22.4	86.1	B	100 x 207	**4RB1187-3EJ50-8K**	1	4	2.13
20	24	92.1	B	100 x 207	**4RB1200-3EJ50-8K**	1	4	2.13
22	26.4	101.3	B	116 x 207	**4RB1220-3EJ50-8K**	1	4	2.86
25	30	115.1	B	116 x 192	**4RB1250-3EJ50-8K**	1	4	2.65
28.1	-	129.4	B	116 x 207	**4RB1281-3EJ50-8K**	1	4	2.86
30	-	138.1	B	125 x 192	**4RB1300-3EJ50-8K**	1	4	3.09
31	-	142.7	B	116 x 224	**4RB1310-3EJ50-8K**	1	4	3.09
33	-	152	B	116 x 224	**4RB1330-3EJ50-8K**	1	4	3.09

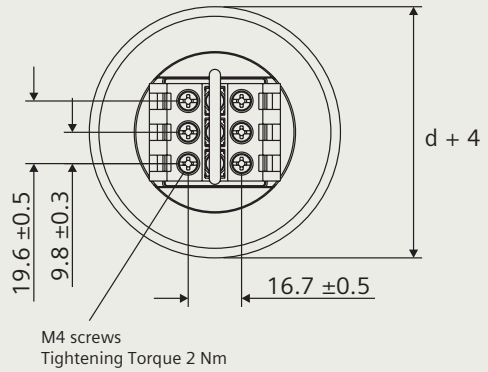
50 Hz Output in kVar	60 Hz Output* in kVar	Capacity in uF 3 x	Terminal Type	Dimensions D * H mm Ø	Order No	PU Unit (s)	MOQ Unit (s)	Weight per PU Kg approx
Rated Voltage 525 V AC								
5	6	19.2	A	75 x 164	**4RB1050-3FC50-8K**	1	6	0.95
6.3	7.6	24.2	A	75 x 164	**4RB1063-3FC50-8K**	1	6	0.95
8.3	10	31.9	A	75 x 200	**4RB1083-3FC50-8K**	1	6	1.16
10.4	12.5	40	A	85 x 185	**4RB1104-3FC50-8K**	1	9	1.37
12.5	15	48.1	A	85 x 200	**4RB1125-3FC50-8K**	1	9	1.48
13.2	15.8	50.8	A	85 x 200	**4RB1132-3FC50-8K**	1	9	1.48
15	18	57.7	A	85 x 218	**4RB1150-3FC50-8K**	1	4	1.62
16.7	20	64.3	B	100 x 207	**4RB1167-3FC50-8K**	1	6	2.13
20	24	77	B	100 x 224	**4RB1200-3FC50-8K**	1	4	2.3
25	30	96.2	B	116 x 207	**4RB1250-3FC50-8K**	1	4	2.86
26.5	31.8	102	B	116 x 207	**4RB1265-3FC50-8K**	1	4	2.86
30	-	115.5	B	125 x 207	**4RB1300-3FC50-8K**	1	4	3.1
33.1	-	127.4	B	136 x 192	**4RB1331-3FC50-8K**	1	4	3.65
Rated Voltage 690 V AC								
5.3	6.4	11.8	C	75 x 185	**4RB1053-3GK50-8K**	1	6	1.16
6.9	8.3	15.4	C	75 x 200	**4RB1068-3GK50-8K**	1	6	1.16
10.4	12.5	23.2	C	75 x 200	**4RB1104-3GK50-8K**	1	6	1.16
12.5	15	27.9	C	85 x 200	**4RB1125-3GK50-8K**	1	9	1.48
14.6	17.5	32.5	D	100 x 207	**4RB1146-3GK50-8K**	1	6	2.13
20	24	44.6	D	100 x 207	**4RB1200-3GK50-8K**	1	6	2.13
25	30	55.7	D	116 x 192	**4RB1250-3GK50-8K**	1	4	2.65

* estimated values

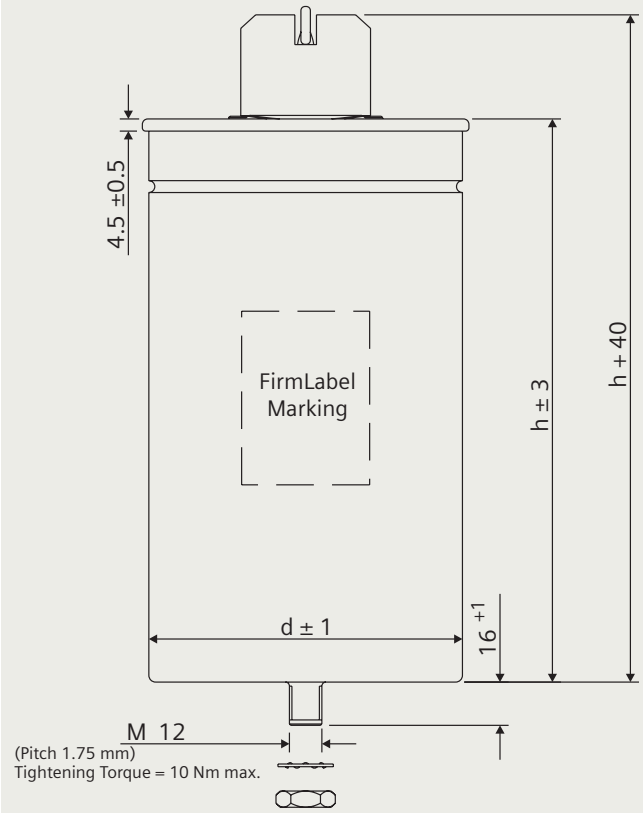
SIECAP™ SHD
Dimension drawings

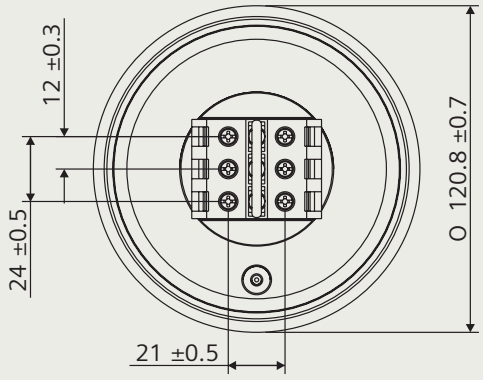
Terminal Type A



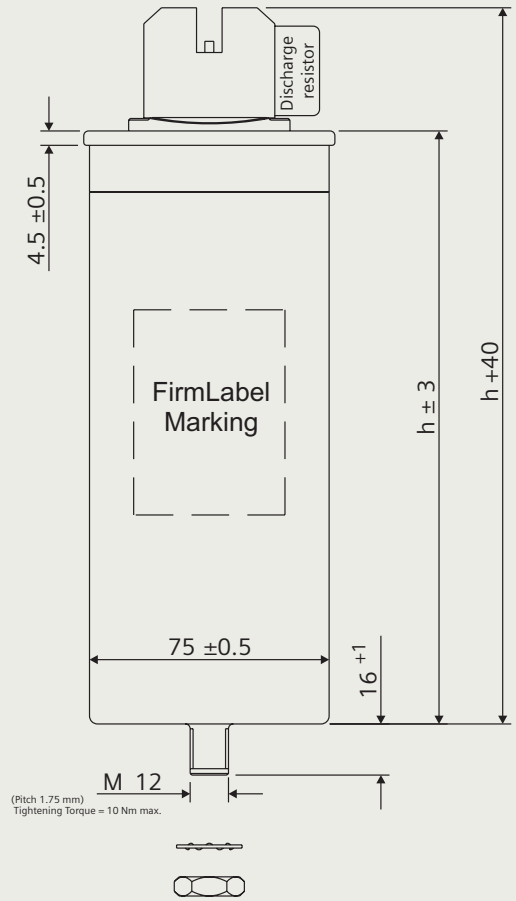


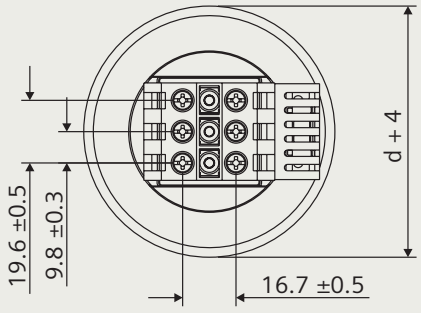
Terminal Type B



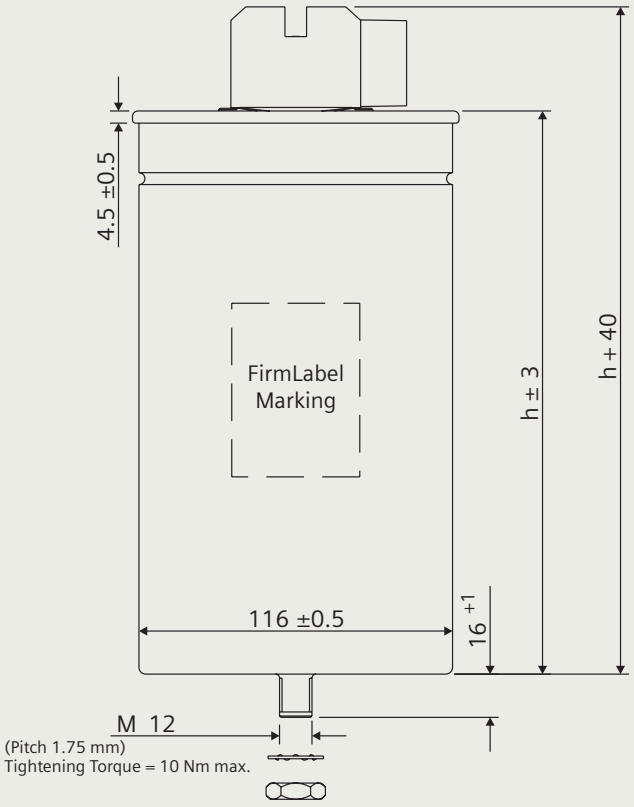


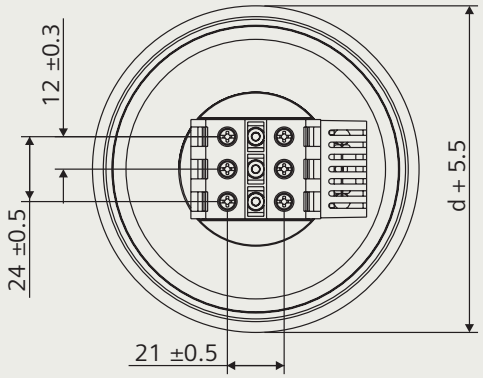
Terminal Type C



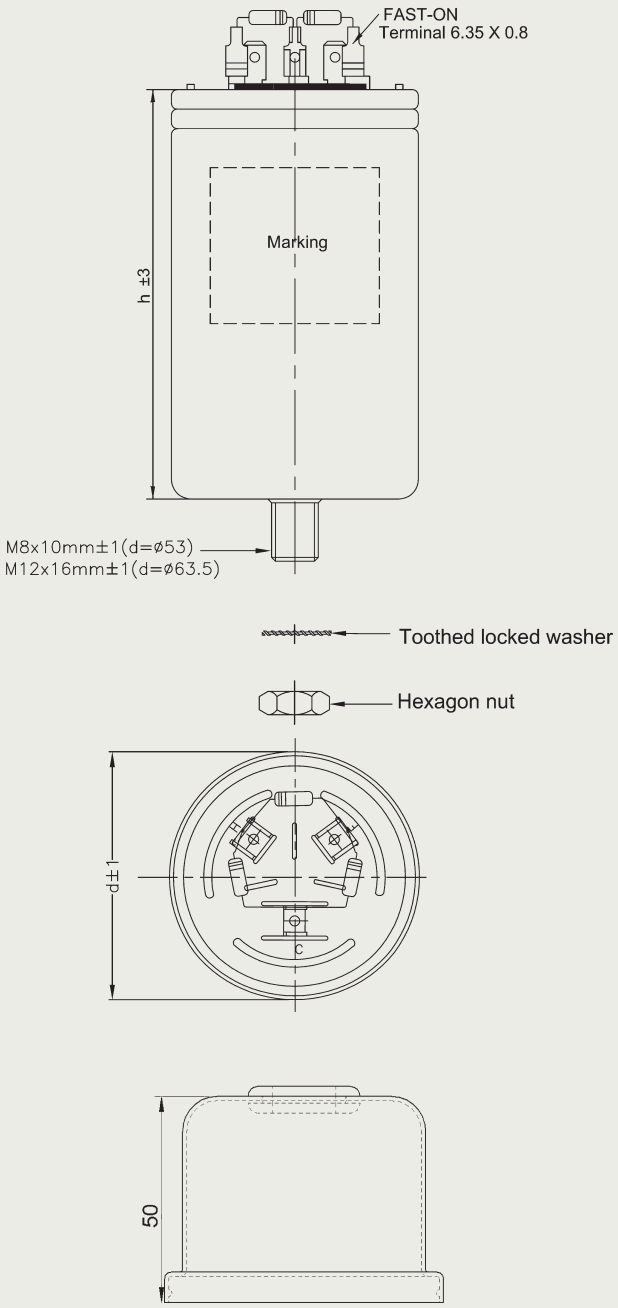


Terminal Type D





Terminal Type E



Detuned reactor

Overview

In past few years the use of power electronics equipment's like drives, SMPS, UPS etc has increased tremendously. These devices distort the pure sinusoidal waveform of power supply. These distortions can be called as harmonics. When a capacitor is used for power factor correction, it might create a resonating circuit with the feeding transformer. The resonance frequency is generally from 250Hz to 500Hz, that means 5th to 7th harmonics. This resonance is undesired condition and it might lead to

- Overloading of capacitors- reduce the life of capacitor
- Overloading of transformer, cables and other switchgear elements in the circuit- reduces life of all components
- Voltage distortion
- Increased power losses
- Nuisance tripping of protection equipment

This resonance can be avoided by putting a detuned reactor in series with the capacitor. The reactor shall be such that the tuning frequency with capacitor shall be less than the dominant harmonics. This combination of power factor correction capacitor and detuned reactors behaves inductively to frequencies above tuning frequency. Thus provide high impedance path to harmonics present in the system.

Detuning factor

Detuning factor can be defined by following formula:-

$$\frac{X_L}{X_C} * 100 = p\%$$

Where

X_L = Inductive reactance

X_C = Capacitive reactance

p = detuning factor in percentage

Tuning frequency of LC filtercan be calculated by below formula:-

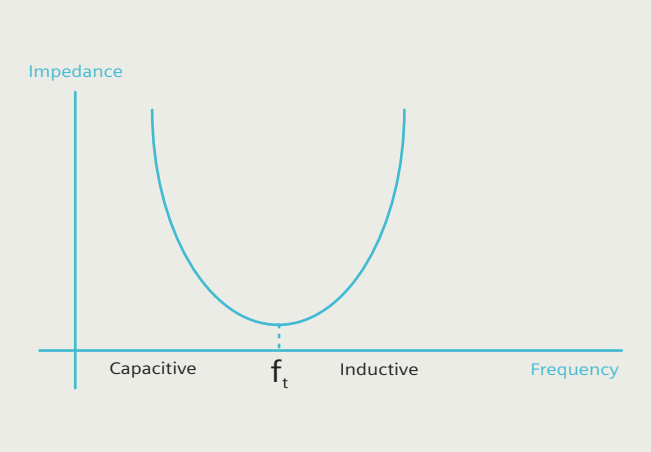
$$f_t = \frac{f_s}{\sqrt{\frac{p}{100}}}$$

Where

f_t = tuning frequency

f_s = supply frequency

p = detuning factor in percentage



This combination of detuned LC filter will act capacitive for frequency below ft and inductive for frequency above ft. Thus for base frequency of 50 or 60Hz this detune filter will act as capacitive and improves the power factor. This LC detuned filter is selected such that the tuning frequency is much less than the dominant harmonic frequency. Thus harmonics always seeshigher impedance and the condition of resonance with feeding transformeris avoided.

For example if the dominant harmonics is 5th harmonic and base frequency is 50Hz, a 7% detuned reactor shall be selected. The tuning frequency of this filter will be

$$f_t = \frac{f_s}{\sqrt{\frac{p}{100}}}$$

$$f_t = \frac{50}{\sqrt{\frac{7}{100}}} => 189 \text{ Hz}$$

189Hz, the tuning frequency in this case is lesser then 250Hz, the harmonic frequency. Hence there will not be a situation of resonance between the feeding transformer and capacitor.

Technical Specifications

7% Cu Reactor										
Technical Data										
De-tuning factor	%	7%	7%	7%	7%	7%	7%	7%	7%	7%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	76.5	172	191	229.5	306	382.5	765	1147	1530
Inductivity L	mH	3 X 9.28	3 X 4.64	3 X 3.71	3 X 3.1	3 X 2.32	3 X 1.86	3 X 0.93	3 X 0.62	3 X 0.46
Linear up to	A	11.4	22.7	28.4	34	45.4	57	113.5	170.3	227
Effective current Irms	A	7.45	14.9	18.61	22.34	29.78	37.2	74.45	111.7	148.9
Temperature protection (NC)		yes								
Total losses P D	W	45	75	80	90	100	120	210	275	350
Total weight	kg	7	9	10	15	16	17	26	42	50
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	175	175	225	225	225	260	300	310
Height	mm	158	160	160	230	205	205	240	270	270
Width	mm	100	125	125	145	155	155	215	180	205

14%, Cu reactors										
Technical Data										
De-tuning factor	%	14%	14%	14%	14%	14%	14%	14%	14%	14%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	70.7	141.5	176.8	212.2	282.9	356.7	707.4	1061	1061
Inductivity L	mH	3 X 20.06	3 X 10.03	3 X 8.03	3 X 6.69	3 X 5.02	3 X 4.01	3 X 2.01	3 X 1.34	3 X 1
Linear up to	A	9.38	18.76	23.45	28.15	37.53	46.91	93.82	140.7	187.6
Effective current Irms	A	7.01	14.03	17.53	21.04	28.05	35.07	70.13	105.2	140.3
Temperature protection (NC)		yes								
Total losses P D	W	80	105	120	150	180	210	270	375	500
Total weight	kg	9	15	16	18	26	27	45	75	84
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	225	225	225	260	260	310	375	375
Height	mm	156	205	205	205	232	240	270	300	300
Width	mm	125	155	155	155	210	210	204	235	235

Technical Specifications

5.67%, Cu reactors										
Technical Data										
De-tuning factor	%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	77.6	155.2	191	232.8	310.4	387.9	775.9	1164	1552
Inductivity L	mH	3 X 7.41	3 X 3.7	3 X 2.96	3 X 2.47	3 X 1.85	3 X 1.48	3 X 0.74	3 X 0.49	3 X 0.37
Linear up to	A	13.65	27.3	34.12	40.94	54.59	68.23	136.5	204.7	272.9
Effective current Irms	A	8.37	16.74	20.93	25.11	33.48	41.85	83.71	125.6	167.4
Temperature protection (NC)		yes								
Total losses P D	W	45	75	80	90	100	120	210	275	350
Total weight	kg	7	9	10	15	16	17	26	42	50
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	175	175	175	225	225	225	260	300	310
Height	mm	158	160	160	230	205	205	240	270	270
Width	mm	100	125	125	145	155	155	215	180	205

7%, Al reactors										
Technical Data										
De-tuning factor	%	7%	7%	7%	7%	7%	7%	7%	7%	7%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	76.5	172	191	229.5	306	382.5	765	1147	1530
Inductivity L	mH	3 X 9.28	3 X 4.64	3 X 3.71	3 X 3.1	3 X 2.32	3 X 1.86	3 X 0.93	3 X 0.62	3 X 0.46
Linear up to	A	11.4	22.7	28.4	34	45.4	57	113.5	170.3	227
Effective current Irms	A	7.45	14.9	18.61	22.34	29.78	37.2	74.45	111.7	148.9
Temperature protection (NC)		yes								
Total losses P D	W	50	83	85	100	110	130	240	285	380
Total weight	kg	7	9	10	15	16	17	26	42	50
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	190	190	190	225	225	240	275	310	335
Height	mm	158	160	160	230	205	205	238	270	270
Width	mm	100	125	125	155	175	175	230	180	185

Technical Specifications

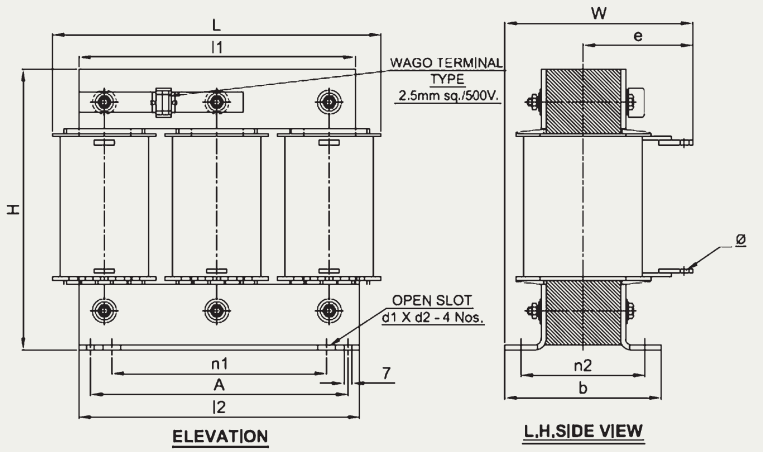
14%, Al reactors								
Technical Data								
De-tuning factor	%	14%	14%	14%	14%	14%	14%	14%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50
Rated voltage VR	V	440						
Rated frequency	Hz	50						
Ambient temperature / Insulation class:		40 °C/H						
Capacitance C delta	µF	70.7	176.8	176.8	212.2	282.9	353.7	707.4
Inductivity L	mH	3 X 20.06	3 X 10.03	3 X 8.03	3 X 6.69	3 X 5.02	3 X 4.01	3 X 2.01
Linear up to	A	9.38	18.76	23.45	28.15	37.53	46.91	93.82
Effective current Irms	A	7.01	14.03	17.53	21.04	28.05	35.07	70.13
Temperature protection (NC)		yes						
Total losses P D	W	80	105	120	150	200	210	380
Total weight	kg	9	15	16	18	25	28	42
Connection								
Line		1U1-1V1-1W1						
Capacitors		1U2-1V2-1W2						
Temperature control:		1-2						
Dimension								
Length	mm	175	225	225	225	285	285	335
Height	mm	156	205	205	205	210	230	270
Width	mm	125	155	155	155	188	188	190

5.67%, Al reactors										
Technical Data										
De-tuning factor	%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%	5.67%
Effective filter output QC	kVAr	5	10	12.5	15	20	25	50	75	100
Rated voltage VR	V	440								
Rated frequency	Hz	50								
Ambient temperature / Insulation class:		40 °C/H								
Capacitance C delta	µF	77.6	155.2	194	232.8	310.4	387.9	775.9	1164	1552
Inductivity L	mH	3 X 7.41	3 X 3.7	3 X 2.96	3 X 2.47	3 X 1.85	3 X 1.48	3 X 0.74	3 X 0.49	3 X 0.37
Linear up to	A	13.65	27.3	34.12	40.94	54.59	68.23	136.5	204.7	272.9
Effective current Irms	A	8.37	16.74	20.93	25.11	33.48	41.85	83.71	125.6	167.4
Temperature protection (NC)		yes								
Total losses P D	W	55	85	88	105	115	135	250	290	390
Total weight	kg	8	10	11	16	18	20	27	43	51
Connection										
Line		1U1-1V1-1W1								
Capacitors		1U2-1V2-1W2								
Temperature control:		1-2								
Dimension										
Length	mm	190	190	190	225	225	240	275	310	335
Height	mm	158	160	160	230	205	205	238	270	270
Width	mm	100	125	125	155	175	175	230	180	185

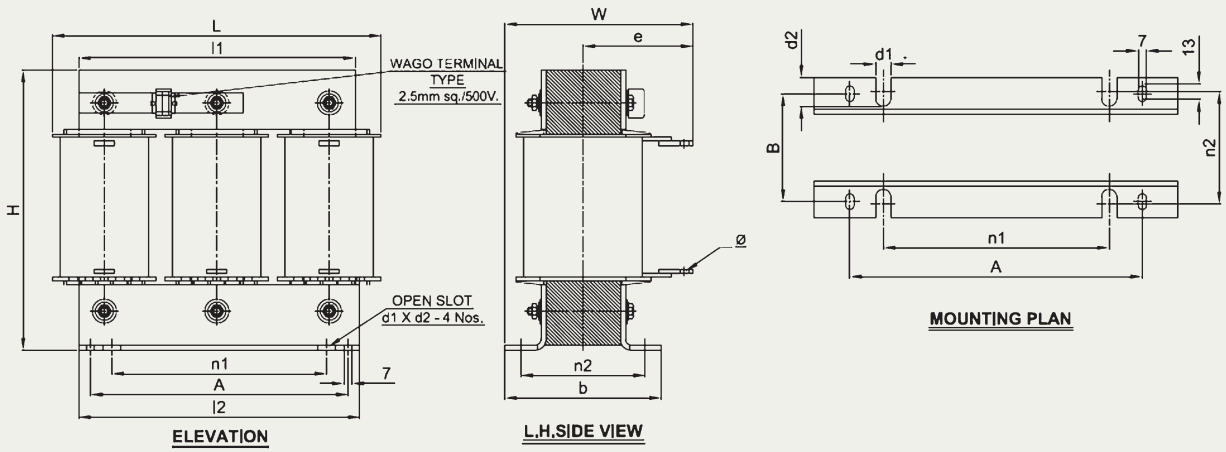
Ordering Information

Bank Size	Type	Detuning Factor	Voltage	Material
5kVAr	4KA1220-1AA01-0AA0	7%	440V AC	Cu
10kVAr	4KA1220-3AA01-0AA0	7%	440V AC	Cu
12.5kVAr	4KA1220-4AA01-0AA0	7%	440V AC	Cu
15kVAr	4KA1220-5AA01-0AA0	7%	440V AC	Cu
20kVAr	4KA1220-6AA01-0AA0	7%	440V AC	Cu
25kVAr	4KA1220-7AA01-0AA0	7%	440V AC	Cu
50kVAr	4KA1220-2BA01-0AA0	7%	440V AC	Cu
75kVAr	4KA1220-3BA03-0AA0	7%	440V AC	Cu
100kVAr	4KA1220-4BA03-0AA0	7%	440V AC	Cu
5kVAr	4KA1220-1AB01-0AA0	14%	440V AC	Cu
10kVAr	4KA1220-3AB01-0AA0	14%	440V AC	Cu
12.5kVAr	4KA1220-4AB01-0AA0	14%	440V AC	Cu
15kVAr	4KA1220-5AB01-0AA0	14%	440V AC	Cu
20kVAr	4KA1220-6AB01-0AA0	14%	440V AC	Cu
25kVAr	4KA1220-7AB01-0AA0	14%	440V AC	Cu
50kVAr	4KA1220-2BB01-0AA0	14%	440V AC	Cu
75kVAr	4KA1220-3BB03-0AA0	14%	440V AC	Cu
100kVAr	4KA1220-4BB03-0AA0	14%	440V AC	Cu
5kVAr	4KA1220-1AC01-0AA0	5.67%	440V AC	Cu
10kVAr	4KA1220-3AC01-0AA0	5.67%	440V AC	Cu
12.5kVAr	4KA1220-4AC01-0AA0	5.67%	440V AC	Cu
15kVAr	4KA1220-5AC01-0AA0	5.67%	440V AC	Cu
20kVAr	4KA1220-6AC01-0AA0	5.67%	440V AC	Cu
25kVAr	4KA1220-7AC01-0AA0	5.67%	440V AC	Cu
50kVAr	4KA1220-2BC01-0AA0	5.67%	440V AC	Cu
75kVAr	4KA1220-3BC03-0AA0	5.67%	440V AC	Cu
100kVAr	4KA1220-4BC03-0AA0	5.67%	440V AC	Cu
5kVAr	4KA1420-1AA01-0AA0	7%	440V AC	Al
10kVAr	4KA1420-3AA01-0AA0	7%	440V AC	Al
12.5kVAr	4KA1420-4AA01-0AA0	7%	440V AC	Al
15kVAr	4KA1420-5AA01-0AA0	7%	440V AC	Al
20kVAr	4KA1420-6AA01-0AA0	7%	440V AC	Al
25kVAr	4KA1420-7AA01-0AA0	7%	440V AC	Al
50kVAr	4KA1420-2BA01-0AA0	7%	440V AC	Al
75kVAr	4KA1420-3BA03-0AA0	7%	440V AC	Al
100kVAr	4KA1420-4BA03-0AA0	7%	440V AC	Al
5kVAr	4KA1420-1AB01-0AA0	14%	440V AC	Al
10kVAr	4KA1420-3AB01-0AA0	14%	440V AC	Al
12.5kVAr	4KA1420-4AB01-0AA0	14%	440V AC	Al
15kVAr	4KA1420-5AB01-0AA0	14%	440V AC	Al
20kVAr	4KA1420-6AB01-0AA0	14%	440V AC	Al
25kVAr	4KA1420-7AB01-0AA0	14%	440V AC	Al
50kVAr	4KA1420-2BB01-0AA0	14%	440V AC	Al
5kVAr	4KA1420-1AC01-0AA0	5.67%	440V AC	Al
10kVAr	4KA1420-3AC01-0AA0	5.67%	440V AC	Al
12.5kVAr	4KA1420-4AC01-0AA0	5.67%	440V AC	Al
15kVAr	4KA1420-5AC01-0AA0	5.67%	440V AC	Al
20kVAr	4KA1420-6AC01-0AA0	5.67%	440V AC	Al
25kVAr	4KA1420-7AC01-0AA0	5.67%	440V AC	Al
50kVAr	4KA1420-2BC01-0AA0	5.67%	440V AC	Al
75kVAr	4KA1420-3BC03-0AA0	5.67%	440V AC	Al
100kVAr	4KA1420-4BC03-0AA0	5.67%	440V AC	Al

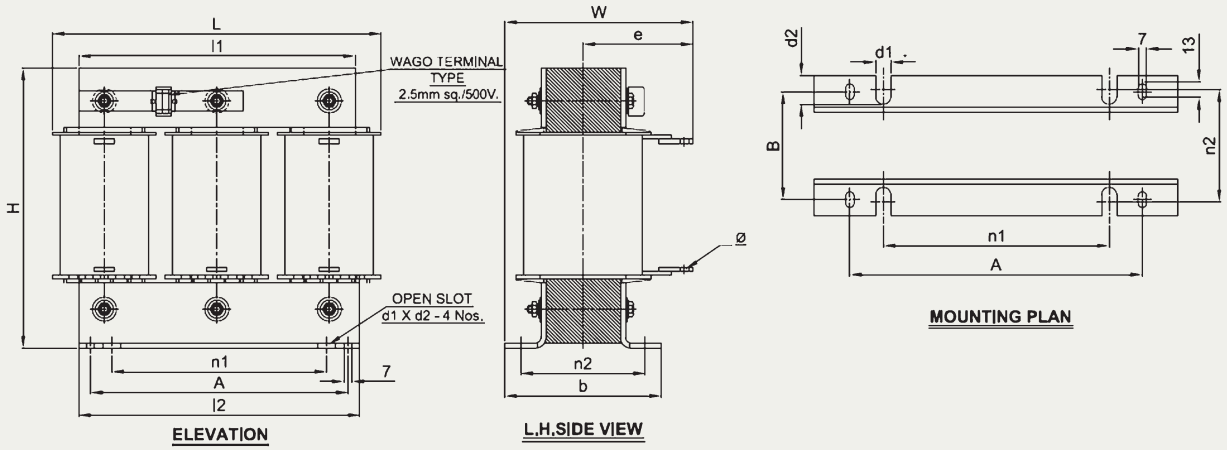
Dimension drawing



7% Cu detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	**4KA1220-1AA01-0AA0**	175	158	100	150	150	100	62	78	62	10.8	15.5	125	58	6.5
10	**4KA1220-3AA01-0AA0**	175	160	125	150	150	100	83	98	76	10.8	15.5	125	78	6.5
12.5	**4KA1220-4AA01-0AA0**	175	160	125	150	150	100	83	98	76	10.8	15.5	125	78	6.5
15	**4KA1220-5AA01-0AA0**	225	230	145	190	190	150	73	90	97	10.8	15.5	175	71.5	8.5
20	**4KA1220-6AA01-0AA0**	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
25	**4KA1220-7AA01-0AA0**	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
50	**4KA1220-2BA01-0AA0**	260	240	215	220	220	150	168	185	118	10.8	15.5	175	165	8.5
75	**4KA1220-3BA03-0AA0**	300	270	180	250	250	150	136.5	150	97	10.8	15.5	175	132	10.5
100	**4KA1220-4BA03-0AA0**	310	270	205	265	265	150	162.5	178	110	10.8	15.5	175	159	10.5
7% Al detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	**4KA1420-1AA01-0AA0**	190	158	100	165	165	60	61.5	78	63	10.8	15.5	85	59	6.5
10	**4KA1420-3AA01-0AA0**	190	160	125	165	165	60	82.5	98	76	10.8	15.5	85	79	6.5
12.5	**4KA1420-4AA01-0AA0**	190	160	125	165	165	60	82.5	98	76	10.8	15.5	85	79	6.5
15	**4KA1420-5AA01-0AA0**	225	230	155	190	190	150	73	90	105	10.8	15.5	175	71.5	8.5
20	**4KA1420-6AA01-0AA0**	225	205	175	190	190	150	97.8	112	115	10.8	15.5	175	95	8.5
25	**4KA1420-7AA01-0AA0**	240	205	175	205	205	150	97.8	112	115	10.8	15.5	175	95	8.5
50	**4KA1420-2BA01-0AA0**	275	238	230	235	235	150	168	185	135	10.8	15.5	175	165	8.5
75	**4KA1420-3BA03-0AA0**	310	270	180	265	265	150	135	150	99	10.8	15.5	175	132	10.5
100	**4KA1420-4BA03-0AA0**	335	270	185	285	285	150	136.5	150	97	10.8	15.5	175	132	10.5



14% Cu detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	**4KA1220-1AB01-0AA0**	175	156	125	150	150	100	84	100	76	10.8	15.5	125	81	6.5
10	**4KA1220-3AB01-0AA0**	225	205	155	190	190	150	97.5	112	96	10.8	15.5	175	95	6.5
12.5	**4KA1220-4AB01-0AA0**	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	6.5
15	**4KA1220-5AB01-0AA0**	225	205	155	190	190	150	97.5	112	100	10.8	15.5	175	95	8.5
20	**4KA1220-6AB01-0AA0**	260	232	210	220	220	150	168	185	120	10.8	15.5	175	165	8.5
25	**4KA1220-7AB01-0AA0**	260	240	210	220	220	150	168	185	116	10.8	15.5	175	165	8.5
50	**4KA1220-2BB01-0AA0**	310	270	204	265	265	150	135	150	120	10.8	15.5	175	132	8.5
75	**4KA1220-3BB03-0AA0**	375	300	235	330	330	200	195	210	130	10.8	15.5	225	192	10.5
100	**4KA1220-4BB03-0AA0**	375	300	235	330	330	200	195	210	130	10.8	15.5	225	192	10.5
14% Al detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	**4KA1420-1AB01-0AA0**	175	156	125	150	150	100	84	100	76	10.8	15.5	125	81	6.5
10	**4KA1420-3AB01-0AA0**	225	205	155	190	190	150	97.5	112	96	10.8	15.5	175	95	6.5
12.5	**4KA1420-4AB01-0AA0**	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	6.5
15	**4KA1420-5AB01-0AA0**	225	205	155	190	190	150	97.5	112	100	10.8	15.5	175	95	8.5
20	**4KA1420-6AB01-0AA0**	285	210	188	235	235	150	168	185	92	10.8	15.5	175	165	8.5
25	**4KA1420-7AB01-0AA0**	285	230	188	235	235	150	168	185	95	10.8	15.5	175	165	8.5
50	**4KA1420-2BB01-0AA0**	335	270	190	285	285	150	136	150	99	10.8	15.5	175	132	10.5



5.67% Cu detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	**4KA1220-1AC01-0AA0**	175	158	100	150	150	100	61.5	78	62	10.8	15.5	125	58	6.5
10	**4KA1220-3AC01-0AA0**	175	160	125	150	150	100	82.5	98	75	10.8	15.5	125	78	6.5
12.5	**4KA1220-4AC01-0AA0**	175	160	125	150	150	100	82.5	98	75	10.8	15.5	125	78	6.5
15	**4KA1220-5AC01-0AA0**	225	230	145	190	190	150	73	90	97	10.8	15.5	175	71.5	8.5
20	**4KA1220-6AC01-0AA0**	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
25	**4KA1220-7AC01-0AA0**	225	205	155	190	190	150	98	112	100	10.8	15.5	175	95	8.5
50	**4KA1220-2BC01-0AA0**	260	240	215	220	220	150	168	185	118	10.8	15.5	175	165	8.5
75	**4KA1220-3BC03-0AA0**	300	270	180	250	250	150	136	150	97	10.8	15.5	175	132	10.5
100	**4KA1220-4BC03-0AA0**	310	270	205	265	265	150	163	178	110	10.8	15.5	175	159	10.5
5.67% Al detuned reactor (all dimensions in mm)															
kVAr	Type	L	H	W	l1	l2	n1	n2	b	e	d1	d2	A	B	Ø
5	**4KA1420-1AC01-0AA0**	190	158	100	165	165	60	61.5	78	64	10.8	15.5	85	59	6.5
10	**4KA1420-3AC01-0AA0**	190	160	125	165	165	60	82	98	76	10.8	15.5	85	79	6.5
12.5	**4KA1420-4AC01-0AA0**	190	160	125	165	165	60	82	98	76	10.8	15.5	85	79	6.5
15	**4KA1420-5AC01-0AA0**	225	230	155	190	190	150	73	90	105	10.8	15.5	175	71.5	8.5
20	**4KA1420-6AC01-0AA0**	225	205	175	190	190	150	97.8	112	115	10.8	15.5	175	95	8.5
25	**4KA1420-7AC01-0AA0**	240	205	175	205	205	150	98	112	115	10.8	15.5	175	95	8.5
50	**4KA1420-2BC01-0AA0**	275	238	230	235	235	150	168	185	135	10.8	15.5	175	165	8.5
75	**4KA1420-3BC03-0AA0**	310	270	180	265	265	150	135	150	99	10.8	15.5	175	132	10.5
100	**4KA1420-4BC03-0AA0**	335	270	185	285	285	150	137	150	97	10.8	15.5	175	132	10.5

Smart.
Easy.
Reliable.

Automatic Power Factor Controller Relay 7UG05 for optimized power need.

7UG05 Automatic power factor correction relay

- Controls the required Power factor
- Manage capacitor bank switching
- Monitors power quality
- Communication capable
- Common relay for three CT and Single CT connection

Overview

7UG0572-1GT21

- Intelligent 12 stage relay controls
- Confirms to IEC 60947-5-1, carry CE and RoHS Compliant
- 4 digit 7 segment LED display
- Universal control supply – optimizing the no of variants
- Automatic / Linear / rotational switching of banks
- Power factor settable-0.8 lag -- 0.8 Lead
- Selectable 1A /5A current input

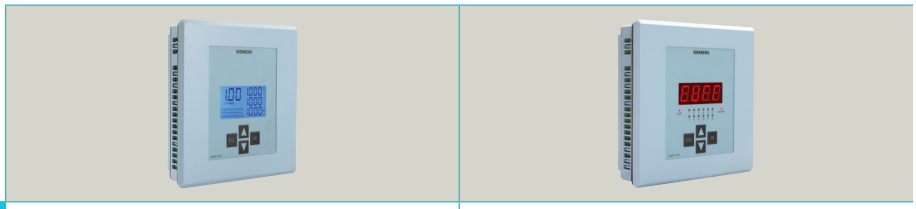
7UG0572-1GT20

- Intelligent 12 stage relay controls
- Confirms to IEC 60947-5-1, carry CE and RoHS Compliant
- Dual colour Backlight LCD display
- Universal control supply – optimizing the no of variants
- Automatic / Linear / rotational switching of banks
- Power factor settable-0.8 lag – 0.8 Lead
- Selectable 1A /5A current input
- Measurement and display of key parameters viz: Voltage, Current, Power factor, THDI etc
- RS485 Communication MODBUS RTU Protocol

7UG0571-1FT20

- Intelligent 08 stage relay controls
- Confirms to IEC 60947-5-1, carry CE and RoHS Compliant
- Dual colour Backlight LCD display
- Universal control supply – optimizing the no of variants
- Automatic / Linear / rotational switching of banks
- Power factor settable-0.8 lag -- 0.8 Lead
- Selectable 1A /5A current input
- Measurement and display of key parameters viz: Voltage, Current, Power factor, THDI etc
- RS485 Communication MODBUS RTU Protocol

APFC relay: Technical data

		
Type	**7UG0571-1FT20 (8 step) / 7UG0572-1GT20 (12 step)**	**7UG0572-1GT21**
Display	LCD with dual color backlight 3 line 4 digit & Programable Scrolling (Auto / Manual / Default) to show electrical parameters	4 digit 7 segment LED (No display scrolling, only PF is displyed)
INPUT		
Rated operational voltage [Ue]	415V	
Rated Insulation Voltage [Ui]	600V	
Rated Impulse Withstand Voltage [Uimp]	6kV	
Overvoltage category	III	
Control supply AC	90 to 250 VAC	
Power consumption	15VA	
Frequency HZ	50/60Hz	
Mains		
L-N AC	30 to 250 VAC	
L-L AC	50 to 440 VAC	
Current AC	5A AC	
Frequency HZ	50/60Hz	
Digital input	Yes	NA
Wiring input	3P 4W / 3P 3W / 2P 2W / 1P 2W	
Environment condition		
Temperature (operating)	0°C to +60°C	
Temperature (storage)	-20°C to +60°C	
Humidity	0 % to 95 %, without moisture condensation	
Pollution Degree	PCB: 2 Product: 3	
IP Protection	IP20	
Accuracy		
Voltage	± 0.5% of full range	NA
Current	± 0.5% of full range	NA
Power factor	± 0.01	
Frequency	± 0.1% of full range	NA
Power (KW, KVA, KVAr)	± 1% of full range	NA
Energy (KWh, KVAh, KVArh)	± 1% of full range	NA
Resolution		
Energy (kWh)	0.01k, 0.1k, 1k, 0.01M, 0.1M, 1M	NA
Power factor	For average PF: 0.01 For phase PF: 0.001	0.001
Voltage, current & power	Auto	NA
Measurement parameters		
Power factor	√	√
True RMS voltage	√	x
Current	√	x
Frequency	√	x
Power (KW, KVA, KVAr)	√	x
Energy (KWh, KVArh)	√	x
Temperature	√	x

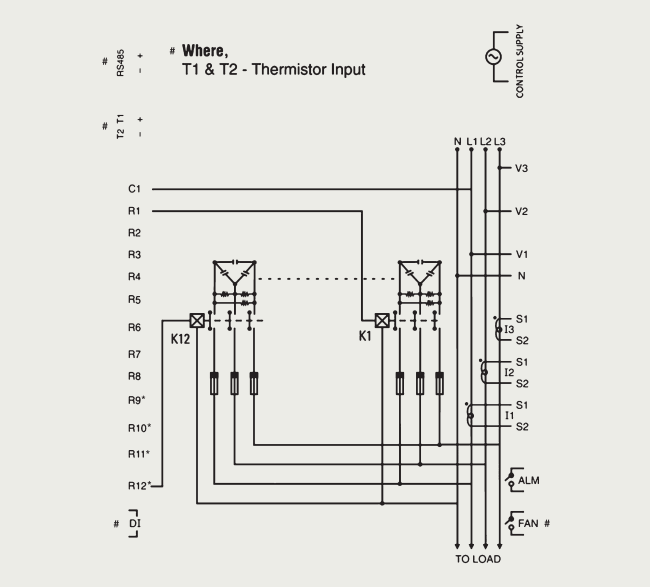
Setting		
Power factor (settable)	0.8 lag --- 0.8 Lead	
Reconnection time (sec)	Reconnection time is same as discharge time	
Step switching time (sec)	1 - 999 (Default is 5 sec)	
Discharge time (sec)	1 - 9999 (Default is 180 sec)	
No voltage release	Instantaneous** (Voltage failure) 90 sec (Voltage restoration)	
Control sensitivity	55 -- 100%	
Switching	Automatic / Linear / rotational	
Control	Automatic / Manual	
CT (programable)	Pri: 1A / 5A upto 9999A Sec: 1A/ 5A	
CT Burden	20 mohms	
PT (programable)	Pri: 100 V - 500KV Sec: 100 V - 500V	NA
Alarm Indication		
% THDI	20 -100% / OFF	NA
Over Voltage AC	(L-N) 50 - 277V (L-L) 85 - 480V	
Under Voltage AC	(L-N) 50 - 240V (L-L) 85 - 415V	
No Voltage	ON / OFF	
Over compensate	ON / OFF	
Under compensate	ON / OFF	
CT Polarity error	ON / OFF	
Step error	20 -- 80% or OFF	
Over Temperature	0--100°C, ON /OFF	NA
Current absent indication	NA	CURR
Fan setting	ON/OFF	NA
Test mode Facility	YES	
Display		
% THDI	20 - 100%	NA for LED variant
Harmonics Resolutions	Upto 31st Harmonics	NA for LED variant
Active Power	4 digit	NA for LED variant
Reactive Power	4 digit	NA for LED variant
Apparent Power	4 digit	NA for LED variant
Voltage	100V - 500kV	NA for LED variant
Current	1 - 9999A	NA for LED variant
Temperature	0 - 100°C	NA for LED variant
Frequency	45 - 65 Hz	NA for LED variant
Power factor	-1.00 to 1.00	
Mechanical		
Mounting	Panel	
Dimension(WxHxD)	144 X 144 X 50 MM	
Net weight	635gms (Final packing with accessories)	610gms (Final packing with accessories)
Termination for Control supply, Measuring circuit, output relays		
Conductor cross section (solid) sq.mm.	1x (0.75 to 2.5) 2x 0.5 to 2x 1.5	1 x (0.75 to 2.5) 2x 0.5 to 2x 1.5
Conductor cross section (stranded with end sleeve) sq.mm.	1 x (0.5 to 2.5) 2x (0.5 to 1.5)	1 x (0.5 to 2.5) 2x (0.5 to 1.5)
Tightening torque	0.5 Nm	0.5 Nm
Termination for RS485, T1, T2		
Conductor cross section (solid / stranded)	1x 0.5	1x 0.5
Tightening torque	0.4 Nm	0.4 Nm
Output		
Relay Contacts	NO, one common point max fuse 6A	
Ie (AC12 @ 250VAC)	5A* @ 250VAC	
Ie (AC15 @ 250VAC)	1A @ 250VAC	
Password protection	YES	
Communication	RS 485 & Modbus-RTU communication	NA
Standards	IEC 60947-5-1	
Markings	CE & RoHS	

* 5A rating is for each relay contact. If multiple relays are getting switched simultaneously, relay rating will be derated to 1.2A @ 250V
** Response time is 3-5 sec

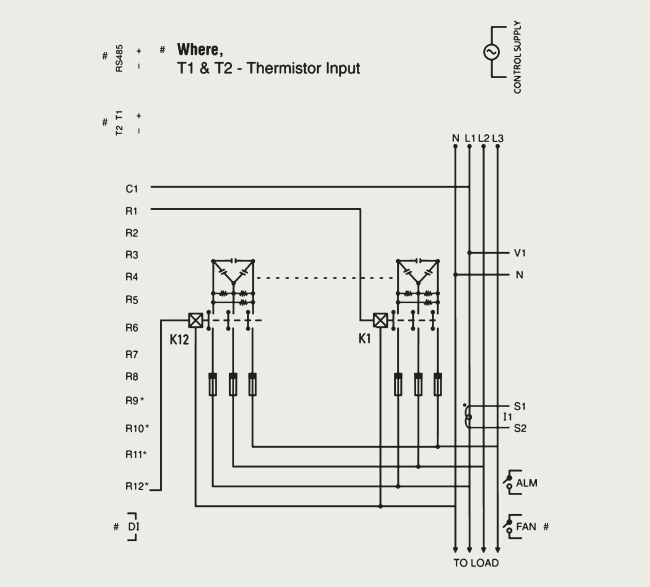
Dimensions and wiring diagram

Wiring Diagram

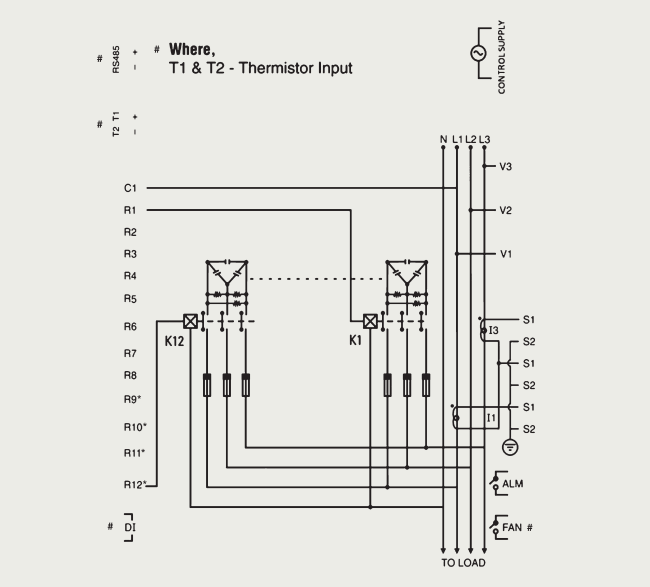
3 Phase - 4 Wire



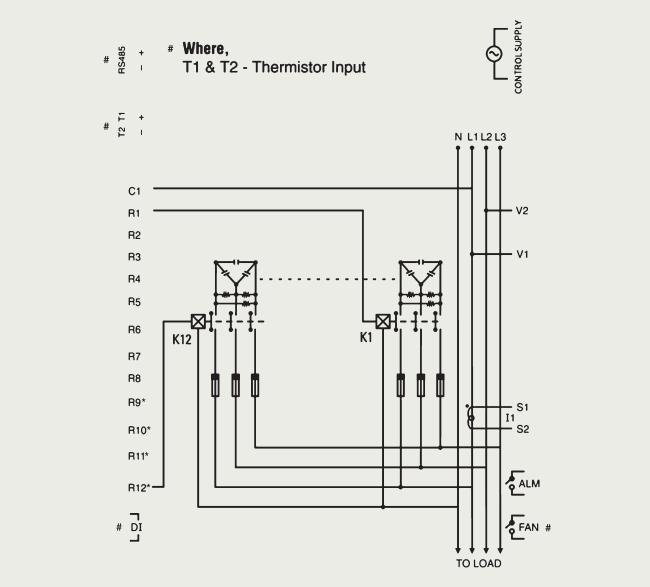
1 Phase - 2 Wire



3 Phase - 3 Wire



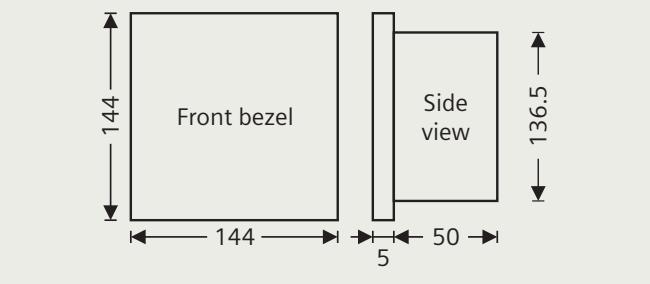
2 Phase - 2 Wire



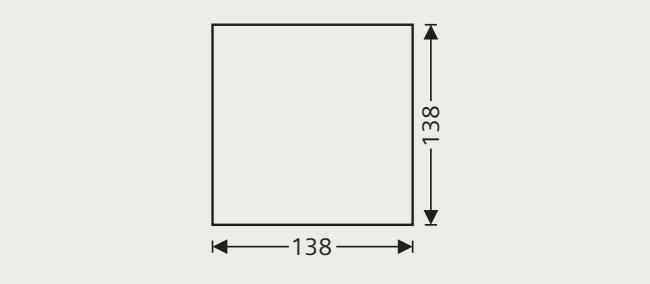
Note: • For N/W selection 2P2W voltage (V_{LL}) applied between V1 & V2 and connect CT for I1 (Do not use V3, N, I2 & I3 terminal)
• For N/W selection 1P2W voltage (V_{LN}) applied between V1 & N and connect CT for I1 (Do not use V2, V3, I2 & I3 terminal)
Only available in 7UG0571-1FT20 & 7UG0572-1GT20 variants * Not applicable for 7UG0571-1FT20

Dimensional Drawing (mm)

Outline Dimension (in mm)



Panel Cutout (in mm)

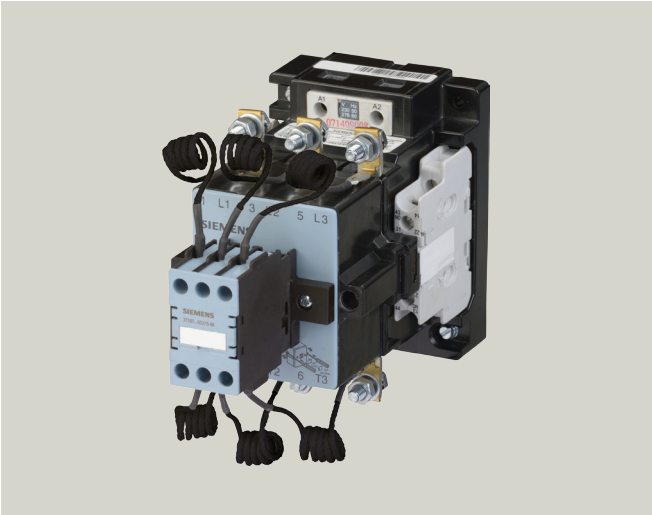


3TS Capacitor duty contactors

Overview:

For more than 125 years, Siemens has been developing and manufacturing industrial control products. We offer a wide product range which caters to fulfill the demand of our esteemed customers with satisfactory performance level and improved reliability. The new range of capacitor duty contactor has been launched to provide a reliable and economical solution for capacitor switching applications.

Capacitor Duty Contactor



Range:

- 5kVAr - 50kVAr

Features:

- Delatching operating principle
- SIGUT Termination technique
- Finger touch proof terminals $
- Compact Dimensions
- DIN / Screw mounting

Benefits:

- Reliable switching of capacitor banks
- Ease of wiring (can obviate use of lugs)
- Operator Safety
- Space saving
- Flexible mounting

Standards:

- IEC 60947-4-1

Approbations:

- CE marking

Operating Principle:

In Low Voltage industrial installations, capacitors are mainly used for reactive power correction (raising the power factor). When these capacitors are energized, overcurrents of high amplitude and high frequencies (3 to 15 kHz) occur during the transient period (~1 ms).

The amplitude of these current peaks, also known as “inrush current peaks”, depends on the following factors:

- The network inductances.
- The transformer power and short-circuit voltage.
- Type of power factor correction: fixed or automatic.
- Harmonics present in the system.

The in-rush current of such high magnitudes is undesirable and it is likely to weld main contacts of any standard contactor. Therefore, contactor for capacitor bank switching must be designed to withstand:

- Permanent current that can reach 1.5 time the nominal current of capacitor bank.
- Short but high peak current on pole closing.

Hence, capacitor duty switching device requires careful selection. It is always recommended to use dedicated capacitor duty switching contactor for switching capacitor bank, which optimizes the switchgear cost & enhances the equipment life.

Siemens 3TS capacitor duty contactor works on mechanical delatching operating principle, which ensures reliable switching of capacitors as per AC-6b utilization category.

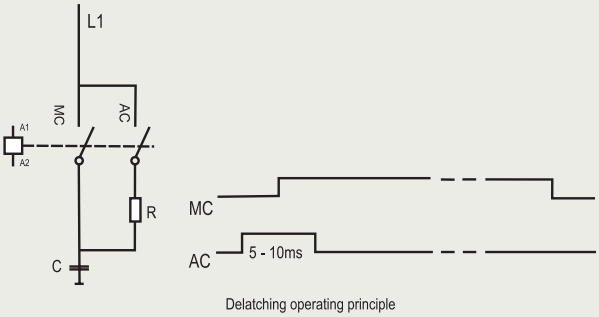
Delatching operating principle:

The front-mounted block mechanism of the 3TS capacitor duty contactors ensures:

- early making of the auxiliary contacts “AC” with respect to the main contacts “MC”
- automatic return to the open position of the auxiliary contacts after the main contacts are closed.

When the coil is energized, the early making auxiliary contacts connect the capacitor to the network via the set of 3 resistors. The damping resistors attenuate the first current peak and the second inrush current when the main contacts begin to make. Once the main contacts are in the closed position, the auxiliary contacts automatically break.

When the coil is de-energized, the main contacts break ensuring the breaking of the capacitive current. The contactor can then begin a new cycle.

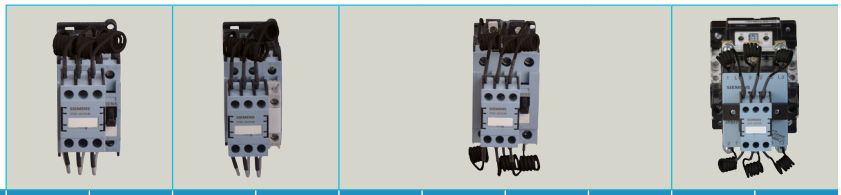


Delatching operating principle

AC = auxiliary contacts MC = main contacts

$ upto 30kVAr

Technical specifications:



Type		3TS21	3TS11	3TS22	3TS12	3TS13	3TS14	3TS15	3TS25	3TS27	3TS17
Size		1		2		3				4	
Dimensions (H x D x W) *including auxiliary switches and connecting cables* • Screw-type terminals	mm	H x D x W 115 x 125 x 45		H x D x W 115 x 136 x 45		H x D x W 120 x 148 x 55				H x D x W 117x177x90	
General technical specifications											
Conformance to		IEC-60947-4-1									
Approvals		CE									
Degree of protection acc. to IEC 60529	IP	IP 20		IP 20		IP20 for Aux block IP00 contactor				IP 00	
Storage temperature	°C	-25 to +55									
Operating temperature	°C	-25 to +40									
Altitude of site (without technical restrictions)	m	2000									
Type of mounting		DIN / Screw								Screw	
Main Circuit											
Rated insulation voltage Ui V 690	V	690									
Rated operational voltage Ue V 415 / 440	V	415 / 440									
Rated operational Current Ie (Harmonic & Safety factor excluded)	A	7	9.7	13.9	17.4	22.3	27.8	34.8	41.7	55.6	69.6
Impulse withstand voltage Uimp	kV	6									
Rated frequency	Hz	50									
Capacitor rating at rated power (utilization category AC-6b) 415/440 V, 50Hz	kVAr	5	7	10	12.5	16	20	25	30	40	50
Max. switching frequency	Cycles per hour	180								100	
Coil operating range		0.85 to 1.1Us									
Auxiliary contacts mounted		1 NO		1NO+1NC						2 NO + 2 NC	
Auxiliary contacts mountable		1NO or 1NC								–	
"Short-circuit protection device for contactors With Fuse - Operational class gG - Type 1 co-ordination (3NA7)"	A	20	20	32	32	50	50	63	80	100	125
Connecting characteristics											
Main conductors		Screw terminals									
Terminal screw size		M3.5		M4						M6	
Screw head type		Slotted Cheese Head								Hex Head	
Tightening torque Recommended	N-m	0.8 to 1.4		1 to 1.5		2.5 to 3				4 to 6	
Conductor cross-section											
Solid	mm^2	1 x (1 to 2.5)		1 x (2.5 to 6)		1 x (1 to 16)					
Finely stranded with end sleeve	mm^2	1 x (0.75 to 2.5)		1 x (1.5 to 4)		1 x (1.5 to 16)					
Finely stranded	mm^2	-		-		1 x (1.5 to 16)					
Finely stranded with pin end connector	mm^2	1 x (0.75 to 2.5)		1 x (1.5 to 4)		1 x (1.5 to 16)					
Finely stranded with ring type lug	mm^2	–								1 x35, 2 x 16	
Busbar (max width)	mm	–								12	
Auxiliary conductors *(built-in auxiliary terminals + coil terminals)*		Screw terminals									
Screw head type		Slotted Cheese Head									
Tightening torque Recommended	N-m	0.8 to 1.4									
Conductor cross-section											
Solid	mm^2	2 x (0.5 to 1, 1 to 2.5), 1 x 4									
Finely stranded with end sleeve	mm^2	2 x (0.75 to 2.5)									
Finely stranded with pin end connector	mm^2	2 x (0.75 to 2.5)									

Selection and ordering data:

Capacitor duty contactor - 3TS

For switching capacitor banks with AC coils

Capacitor kVAr 415V, 3ph, 50Hz	Built-in aux. contacts	Type@	Built-in aux. contacts	Type@	Std. pkg. (nos.)
5 kvar	1 NO	**3TS2110-0A..5-8K†**			
7 kvar	1 NO	**3TS1110-0A..5-8K†**			
10 kvar	–	**3TS2200-0A..5-8K†**	1NO+1NC	**3TS2211-0A..5-8K**	**1**
12.5 kvar	–	**3TS1200-0A..5-8K†**	1NO+1NC	**3TS1211-0A..5-8K**	**1**
16 kvar	–	**3TS1300-0A..5-8K†**	1NO+1NC	**3TS1311-0A..5-8K**	**1**
20 kvar	–	**3TS1400-0A..5-8K†**	1NO+1NC	**3TS1411-0A..5-8K**	**1**
25 kvar	–	**3TS1500-0A..5-8K†**	1NO+1NC	**3TS1511-0A..5-8K**	**1**
30 kvar	–	**3TS2500-0A..5-8K†**	1NO+1NC	**3TS2511-0A..5-8K**	**1**
40 kvar	2 NO + 2 NC	**3TS2722-0A..5-8K**			
50 kvar	2 NO + 2 NC	**3TS1722-0A..5-8K**			

@ AC 50Hz coil code - Please enter coil codes from table below

	For 3TS contactors		
Code	F0	P0	R0
Coil voltage (V)	110	230	415

† Facility to add one contact block of 1NO / 1NC

Auxiliary contact blocks

For contactor	Description	Type	Std.pkg. (nos.)
3TS1110-3TS1500	1NO	■ **3TX4010-2A**	**10**
	1NC	■ **3TX4001-2A**	**10**

3MT7 Capacitor Duty Contactors

NEW

Capacitor kvar 440V AC, 3Ph, 50Hz	Built-in aux. contacts	Type	Std. pkg. (nos.)
60kVAr	1NO+2NC	**3MT70060JA126A..**	**1**
80kVAr	1NO+2NC	**3MT70080JA126A..**	**1**
100kVAr	1NO+2NC	**3MT70100JA126A..**	**1**

Please add coil code from adjacent table

Note: For SIRIUS 3RT26 Capacitor Duty Contactors - Please contact Siemens

Coil 50/60Hz for 60 kvar contactor					
Coil Code	C2	G2	N2	P2	R2
Voltage	24V AC	110V AC	■ 220V AC	■ 240V AC	415V AC

Coil 50Hz for 80 & 100 kvar contactors				
Coil Code	F0	M0	U0	V0
Voltage	110V AC	■ 220V AC	■ 240V AC	415V AC

Spares for 3TS Contactors

Capacitor Duty

Spare coils

Contactor kVAr	Description	Type*	Std. pkg. (nos.)
5 kvar	AC 50Hz coil	**3TY74030A..**	**1**
7 kvar			
10 kvar			
12.5 kvar			
16 kvar		**3TY74430A..**	**1**
20 kvar			
25 kvar			
30 kvar			
40 kvar		**3TY7 463-0A..**	**1**
50 kvar			

* For coil, refer below table

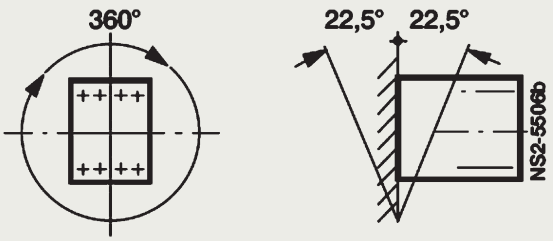
	For 3TS contactors		
Code	F0	P0	R0
Coil voltage (V)	110	230	415

Pre-charge resistor + Contact block kit

Contactor kVAr	Description	Type	Std. pkg. (nos.)
10 kvar	Pre-charge resistor + early making contact block kit + main contacts kit	**3TS9762-0SX15-8K**	**1**
12.5 kvar		**3TS9762-0SX15-8K**	**1**
16 kvar		**3TS9763-0SX15-8K**	**1**
20 kvar		**3TS9764-0SX15-8K**	**1**
25 kvar		**3TS9765-0SX15-8K**	**1**
30 kvar		**3TS9765-0SX15-8K**	**1**
40 kvar		**3TS9767-0SX15-8K**	**1**
50 kvar		**3TS9767-0SX15-8K**	**1**

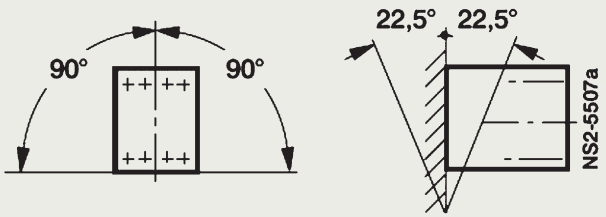
Note: Pre-charge resistor + early making contact block kit + main contacts should be replaced simultaneously

Mounting details:



Frame 1

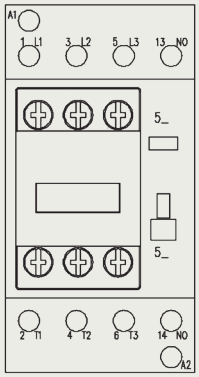
3TS21/3TS11



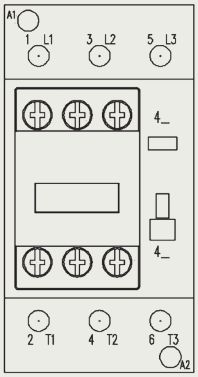
Frame 2, 3, 4

3TS22/3TS12/3TS13/3TS14/
3TS15/3TS25/3TS27/3TS17

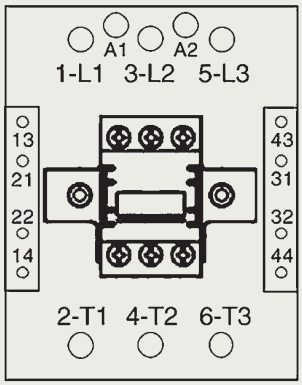
Terminal drawing:



3TS21/3TS11

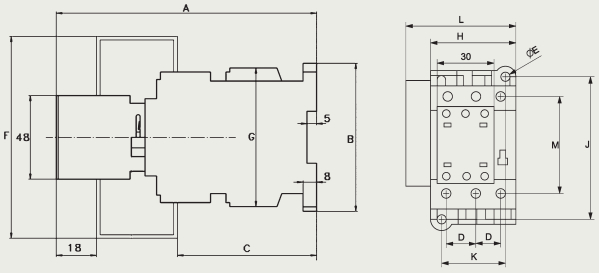


3TS22/3TS12/3TS13/
3TS14/3TS15/3TS25

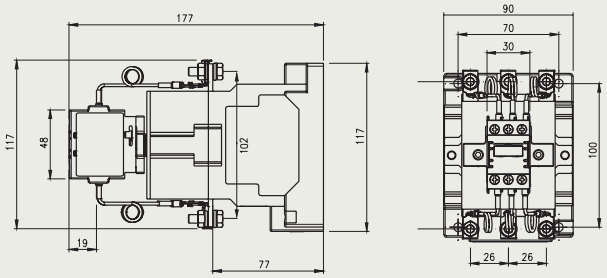


3TS27/3TS17

Dimensional drawing:



Dimensional drawing: 5,7,10,12.5,16,20,25,30 kVAr,
(3TS 21/11/22/12/13/14/15/25..-0A..5-8K)



Dimensional drawing: 40 and 50 kVAr,
(3TS 27/1722-0A..5-8K)

Capacitor kVAr 415V, 3ph, 50Hz	Type	Built-in aux. contacts	A	B	C	D	F	G	H	J	K	L	Ø E	M	Term Screw
5,7 kVAr	3TS21/3TS11	1NO	125	74	60	10	115	78	45	60	35	–	4.8	48	M3.5
10,12.5 kVAr	3TS2200/3TS1200	–	136	85	70	14.5	115	85	45	75	35	–	4.8	51	M4
16,20,25,30 kVAr	3TS1300/3TS1400/3TS1500/3TS2500	–	148	85	63	18	120	103	55	75	45	–	5	62.5	M4
10,12.5 kVAr	3TS2211/3TS1211	1NO+1NC	136	85	70	14.5	115	85	45	75	35	58	4.8	51	M4
16,20,25,30 kVAr	3TS1311/3TS1411/3TS1511/3TS2511	1NO+1NC	148	85	63	18	120	103	55	75	45	68	5	62.5	M4

Selection tables

Standard Values: Selection Tables for Cables, Cable Cross Sections and Fuses

Power kvar	Current A	Section mm²	Fuse A
Rated voltage 230 V, 60 Hz			
2.5	6.3	1.5	10
5.0	12.6	4.0	25
7.5	18.8	6.0	35
10.0	25.1	10.0	50
12.5	31.4	16.0	50
15.0	37.7	16.0	63
20.0	50.2	25.0	80
25.0	62.8	35.0	100
30.0	75.3	50.0	125
40.0	100.4	70.0	160
50.0	125.5	95.0	200
75.0	188.3	185.0	315
100.0	251.0	2× 120.0	400
125.0	–	–	–
150.0	–	–	–
175.0	–	–	–
200.0	–	–	–
Rated voltage 400 V, 50 Hz			
2.5	3.6	1.5	10
5.0	7.2	2.5	16
7.5	10.8	2.5	16
10.0	14.4	4.0	25
12.5	18.0	6.0	35
15.0	21.6	6.0	35
20.0	28.8	10.0	50
25.0	36.0	16.0	63
30.0	43.2	25.0	80
40.0	57.6	35.0	100
50.0	72.0	50.0	125
75.0	108.3	70.0	160
100.0	144.3	120.0	250
125.0	180.3	185.0	315
150.0	216.5	2× 95.0	350
175.0	252.6	2× 95.0	400
200.0	288.0	2× 120.0	500
Rated voltage 440 V, 60 Hz			
2.5	3.3	1.5	10
5.0	6.6	2.5	16
7.5	10.0	2.5	16
10.0	13.2	4.0	25
12.5	16.8	4.0	25
15.0	19.8	6.0	35
20.0	26.4	10.0	50
25.0	33.0	16.0	63
30.0	39.6	25.0	80
40.0	52.8	35.0	100
50.0	66.0	50.0	125
75.0	99.0	70.0	160
100.0	132.0	95.0	200
125.0	165.0	185.0	315
150.0	198.0	2× 95.0	350
175.0	231.0	2× 95.0	400
200.0	264.0	2× 120.0	500

The above mentioned values are guidelines for operation in normal conditions at ambient temperatures up to +35 °C.
Upgrade accordingly if conditions differ, e.g. temperature or hamonics differ. The internal wiring of a capacitor bank is sometimes possible with a smaller cross section. Various parameters such as temperature inside the cabinet, cable quality, maximum cable insulation temperature, single or multi core cable, cable length and laying system have to be considered for a proper selection. The local panelbuilder/installer is responsible for a proper selection of the cable sizes and fuses according to the valid regulations and standards in the specific country where the PFC panels are installed.

Standard Values: Selection Tables for Cables, Cable Cross Sections and Fuses

Power kvar	Current A	Section mm²	Fuse A
Rated voltage 480 V, 60 Hz			
2.5	3.0	1.5	10
5.0	6.0	2.5	16
7.5	9.0	2.5	16
10.0	12.0	4.0	25
12.5	18.0	6.0	35
15.0	21.0	6.0	35
20.0	24.0	10.0	50
25.0	30.0	10.0	50
30.0	36.0	16.0	63
40.0	48.0	25.0	80
50.0	60.0	35.0	100
75.0	90.0	70.0	160
100.0	120.0	95.0	200
125.0	150.0	120.0	250
150.0	180.0	185.0	315
175.0	210.0	2× 95.0	350
200.0	240.0	2× 95.0	400
Rated voltage 525 V, 50 Hz			
2.5	2.7	1.5	10
5.0	5.5	1.5	10
7.5	6.9	2.5	16
10.0	11.0	2.5	16
12.5	13.7	4.0	25
15.0	16.5	4.0	25
20.0	22.0	6.0	35
25.0	27.5	10.0	50
30.0	33.0	16.0	63
40.0	44.0	25.0	80
50.0	55.0	35.0	100
75.0	82.5	70.0	160
100.0	110.0	95.0	200
125.0	137.5	95.0	200
150.0	165.0	185.0	300
175.0	193.0	2× 95.0	350
200.0	220.0	2× 95.0	350
Rated voltage 690 V, 50 Hz			
2.5	2.1	1.5	10
5.0	4.2	1.5	10
7.5	6.3	1.5	10
10.0	8.4	2.5	16
12.5	10.5	2.5	16
15.0	12.6	4.0	25
20.0	16.7	4.0	25
25.0	20.9	6.0	35
30.0	25.1	10.0	50
40.0	33.5	16.0	63
50.0	41.8	25.0	80
75.0	62.8	50.0	125
100.0	83.7	70.0	160
125.0	105.0	70.0	160
150.0	126.0	95.0	200
175.0	146.0	120.0	250
200.0	167.0	128.5	315

The above mentioned values are guidelines for operation in normal conditions at ambient temperatures up to +35 °C.
Upgrade accordingly if conditions differ, e.g. temperature or hamonics differ. The internal wiring of a capacitor bank is sometimes possible with a smaller cross section. Various parameters such as temperature inside the cabinet, cable quality, maximum cable insulation temperature, single or multi core cable, cable length and laying system have to be considered for a proper selection. The local panelbuilder/installer is responsible for a proper selection of the cable sizes and fuses according to the valid regulations and standards in the specific country where the PFC panels are installed.

Calculation Table for Reactive Power Demand (Qc)

Current (ACTUAL) tan φ	cos φ	Achievable (TARGET) cos φ							Qc	TARGET cos φ = 0.96		
										cos φ ≤ 1		
										Qc = Pmot · F (0.96) = ... [kvar] 100 · 1.01 = 101.0 kvar		
		0.80	0.82	0.85	0.88	0.90	0.92	0.94		0.96	0.98	1.00
		Faktor F										
3.18	0.30	2.43	2.48	2.56	2.64	2.70	2.75	2.82		2.89	2.98	3.18
2.96	0.32	2.21	2.26	2.34	2.42	2.48	2.53	2.60		2.67	2.76	2.96
2.77	0.34	2.02	2.07	2.15	2.23	2.28	2.34	2.41		2.48	2.56	2.77
2.59	0.36	1.84	1.89	1.97	2.05	2.10	2.17	2.23		2.30	2.39	2.59
2.43	0.38	1.68	1.73	1.81	1.89	1.95	2.01	2.07		2.14	2.23	2.43
2.29	0.40	1.54	1.59	1.67	1.75	1.81	1.87	1.93		2.00	2.09	2.29
2.16	0.42	1.41	1.46	1.54	1.62	1.68	1.73	1.80		1.87	1.96	2.16
2.04	0.44	1.29	1.34	1.42	1.50	1.56	1.61	1.68		1.75	1.84	2.04
1.93	0.46	1.18	1.23	1.31	1.39	1.45	1.50	1.57		1.64	1.73	1.93
1.83	0.48	1.08	1.13	1.21	1.29	1.34	1.40	1.47		1.54	1.62	1.83
1.73	0.50	0.98	1.03	1.11	1.19	1.25	1.31	1.37		1.45	1.63	1.73
1.64	0.52	0.89	0.94	1.02	1.10	1.16	1.22	1.28		1.35	1.44	1.64
1.56	0.54	0.81	0.86	0.94	1.02	1.07	1.13	1.20		1.27	1.36	1.56
1.48	0.56	0.73	0.78	0.86	0.94	1.00	1.05	1.12		1.19	1.28	1.48
1.40	0.58	0.65	0.70	0.78	0.86	0.92	0.98	1.04		1.11	1.20	1.40
1.33	0.60	0.58	0.63	0.71	0.79	0.85	0.91	0.97		1.04	1.13	1.33
1.30	0.61	0.55	0.60	0.68	0.76	0.81	0.87	0.94		1.01	1.10	1.30
1.27	0.62	0.52	0.57	0.65	0.73	0.78	0.84	0.91		0.99	1.06	1.27
1.23	0.63	0.48	0.53	0.61	0.69	0.75	0.81	0.87		0.94	1.03	1.23
1.20	0.64	0.45	0.50	0.58	0.66	0.72	0.77	0.84		0.91	1.00	1.20
1.17	0.65	0.42	0.47	0.55	0.63	0.68	0.74	0.81		0.88	0.97	1.17
1.14	0.66	0.39	0.44	0.52	0.60	0.65	0.71	0.78		0.85	0.94	1.14
1.11	0.67	0.36	0.41	0.49	0.57	0.63	0.68	0.75		0.82	0.90	1.11
1.08	0.68	0.33	0.38	0.46	0.54	0.59	0.65	0.72		0.79	0.88	1.08
1.05	0.69	0.30	0.35	0.43	0.51	0.56	0.62	0.69		0.76	0.85	1.05
1.02	0.70	0.27	0.32	0.40	0.48	0.54	0.59	0.66		0.73	0.82	1.02
0.99	0.71	0.24	0.29	0.37	0.45	0.51	0.57	0.63		0.70	0.79	0.99
0.96	0.72	0.21	0.26	0.34	0.42	0.48	0.54	0.60		0.67	0.76	0.96
0.94	0.73	0.19	0.24	0.32	0.40	0.45	0.51	0.58		0.65	0.73	0.94
0.91	0.74	0.16	0.21	0.29	0.37	0.42	0.48	0.55		0.62	0.71	0.91
0.88	0.75	0.13	0.18	0.26	0.34	0.40	0.46	0.52		0.59	0.68	0.88
0.86	0.76	0.11	0.16	0.24	0.32	0.37	0.43	0.50		0.57	0.65	0.86
0.83	0.77	0.08	0.13	0.21	0.29	0.34	0.40	0.47		0.54	0.63	0.83
0.80	0.78	0.05	0.10	0.18	0.26	0.32	0.38	0.44		0.51	0.60	0.80
0.78	0.79	0.03	0.08	0.16	0.24	0.29	0.35	0.42		0.49	0.57	0.78
0.75	0.80		0.05	0.13	0.21	0.27	0.32	0.39		0.46	0.55	0.75
0.72	0.81			0.10	0.18	0.24	0.30	0.36		0.43	0.52	0.72
0.70	0.82			0.08	0.16	0.21	0.27	0.34		0.41	0.49	0.70
0.67	0.83			0.05	0.13	0.19	0.25	0.31		0.38	0.47	0.67
0.65	0.84			0.03	0.11	0.16	0.22	0.29		0.36	0.44	0.65
0.62	0.85				0.08	0.14	0.19	0.26		0.33	0.42	0.62
0.59	0.86				0.05	0.11	0.17	0.23		0.30	0.39	0.59
0.57	0.87					0.08	0.14	0.21		0.28	0.36	0.57
0.54	0.88					0.06	0.11	0.18		0.25	0.34	0.54
0.51	0.89					0.03	0.09	0.15		0.22	0.31	0.51
0.48	0.90						0.06	0.12		0.19	0.28	0.48
0.46	0.91						0.03	0.10		0.17	0.25	0.46
0.43	0.92							0.07		0.14	0.22	0.43
0.40	0.93							0.04		0.11	0.19	0.40
0.36	0.94									0.07	0.16	0.36
0.33	0.95										0.13	0.33

QC = PA · (tan φ1– tan φ2)
QC [kvar] = PA · F = active power [kW] · factor "F"
PA = S · cos φ = apparent power · cos φ
tan φ1 + φ2 according to cos φ values ref. table

Example:

Actual motor power	P = 100 kW
ACTUAL cos φ	0.61
TARGET cos φ	0.96
Factor F from table	1.01
Capacitor reactive power QC	
QC = 100 · 1.01 = 101.0 kvar	

Individual PFC for Motors

Approximate values (specified by the German Electricity Association VDEW) for fixed PFC of motors			
Motor nominal rating	Capacitor power rating (1500 r.p.m.*)	Capacitor power rating (1000 r.p.m.*)	Capacitor power rating (750 r.p.m.*)
kW	kvar	kvar	kvar
1 ... 1.9	0.5	0.5	0.6
2 ... 2.9	1	1.1	1.2
3 ... 3.9	1.5	1.6	1.7
4 ... 4.9	2	2.1	2.3
5 ... 5.9	2.5	2.6	2.9
6 ... 7.9	3	3.2	3.5
8 ... 10.9	4	4.2	4.6
11 ... 13.9	5	5.3	5.8
14 ... 17.9	6	6.3	6.9
18 ... 21.9	7.5	8.0	8.6
22 ... 29.9	10	10.5	11.5
30 ... 39.9	approx. 40% of the motor power		
40 and above	approx. 35% of the motor power		

*r.p.m.: revolutions per minute

The capacitor output should be approx. 90% of the apparent power of the motor when idle.

This means a power factor of 0.9% at full load and 0.95 to 0.98 during idling. Important: The capacitor output must not be rated too high for individual compensated machines where the capacitor is directly connected with the motor clamp. This especially applies when the machine has a big oscillating weight and still continues to rotate after switching off.

The capacitor placed in parallel may act as generator for the motor which will cause serious overvoltages. The consequence could be heavy damage to the capacitor as well as to the motor.

Individual PFC for Transformers

Standard values for transformer power factor correction		
Rated apparent power of transformer	Rated capacitor power for oil immersed transformers	Rated capacitor power for cast resin transformers
kVA	kvar	kvar
10	1.0	1.5
20	2.0	1.7
50	4.0	2.0
75	5.0	2.5
100	5.0	2.5
160	7.0	4.0
200	7.5	5.0
250	8.0	7.5
315	10.0	8.0
400	12.5	8.5
500	15.0	10.0
630	17.5	12.5
800	20.0	15.0
1000	25.0	16.7
1250	30.0	20.0
1600	35.0	22.0
2000	40.0	25.0
2500	50.0	35.0
3150	60.0	50.0

For an exact calculation of the right capacitor value, following formula can be used:

$$Q_C = I_0\% \cdot \frac{AN}{100}$$

Q_c = needed capacitor (kvar)

I0% = magnetising current of the transformer (AS%)

AN = apparent rated power of the transformer in kVA

There are regional differences in the guidelines of power suppliers concerning the admissible size of capacitors directly connected with a transformer. Therefore a consultation with the respective power supplier is recommended before installation of a compensation bank. Modern transformers have laminations which only need low capacity to reverse the magnetism. In case the capacitor output is too high, stress increase may occur during idling.

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