DATA SHEET

POWER CAPACITOR

General Data

*** POWER FACTOR CORRECTION**

The power factor of a load is defined as the ratio of active power to apparent power, i.e. kW : kVA and is referred to as cos φ. The closer cos φ is to unity, the less reactive power is drawn from the supply.

For system with a low power factor the transmission of electric power in accordance with existing standards results in higher expenses both for the supply distribution companies and the consumer.

In general terms, as the power factor of a three phase system decreases, the current rises. The heat dissipation in the system rises proportionately by a factor equivalent to the spare of the current.

Types of Power Factor Correction :

- Single or Fixed PFC, compensating for the reactive power of individual inductive loads at the point of connection so reducing the load in the connecting cables (typical for single, permanently operated loads with a constant power)

- Group PFC, connecting on fixed capacitor to a group simultaneously operated inductive loads (e.g. group of motors, discharge lamp)

- Bulk PFC, typical for large electrical systems with fluctuating load where it is common to connect a number of capacitors to 3 main power distribution station or substation. The capacitors are controlled by a microprocessor based relay which continuously monitors the reactive power demand on the supply. The relay connects or disconnects the capacitors to compensate for the actual reactive power of the total load and to reduce the overall demand of the supply.

* CALCULATION OF REQUIRED CAPACITOR POWER

The reactive power which is necessary to achieve to desired power factor is calculated by the following formula :

Cos φ 1 … original power factor before connection

Cos φ 2 … target power factor

Original Power Factor		multiplication factor ($\tan\varphi_1$ - $\tan\varphi_2$)for a target power factor									
$\cos\varphi_1$	$\tan\varphi_2$	$\cos\varphi_2$									
		0.70	0.75	0.80	0.85	0.90	0.92	0.94	0.96	0.98	1.00
0.20	4.899	3.879	4.017	4.149	4.279	4.415	4.473	4.536	4.607	4.696	4.899
0.25	3.873	2.853	2.991	3.123	3.253		3.447	3.510	3.581	3.670	3.873
0.30	3.180	2.160	2.298	2.430	2.560	2.695	2.754	2.817	2.888	2.977	3.180
0.35	2.676	1.656	1.795	1.926	2.057		2.250	2.313	2.385	2.473	2.676
0.40	2.291	1.271	1.409	1.541	1.672	1.807	1.865	1.928	2.000	2.088	2.291
0.45	1.985	0.964	1.103	1.235	1.365		1.559	1.622	1.693	1.781	1.985
0.50	1.732	0.712	0.85	0.982	1.112	1.248	1.306	1.369	1.440	1.529	1.732
0.55	1.518	0.498	0.637	0.768	0.899		1.092	1.156	1.227	1.315	1.518
0.60	1.333	0.313	0.451	0.583	0.714	0.849	0.907	0.97	1.042	1.130	1.333
0.65	1.169	0.149	0.287	0.419	0.549	0.685	0.743	0.806	0.877	0.966	1.169
0.70		1.020	0.138	0.27	0.4	0.536	0.594	0.657	0.729	0.817	1.020
0.75			0.882	0.132	0.262	0.398	0.456	0.519	0.59	0.679	0.882
0.80				0.75	0.13	0.266	0.324	0.387	0.458	0.547	0.75
0.85					0.62	0.135	0.194	0.257	0.328	0.417	0.62
0.90						0.484	0.058	0.121	0.193	0.281	0.484
0.95								0.329	0.037	0.126	0.329

a. Consumption of active energy: E_W = 300 000kWh
b. Consumption ofreactive energy: E_B = 400 000 kvarh
c. Number of working hours: t = 600 h

Resulting average active power: $P = \frac{300\,000 \text{ kWh}}{600 \text{ h}} = 500 \text{ kW}$

Calculation of the original power factor : $\cos\varphi_1$

$$\cos\varphi_1 = \frac{1}{\sqrt{\left(\frac{E_B}{E_W}\right)^2 + 1}} = \frac{}{\sqrt{\left(\frac{400\,000 \text{ kvarh}}{300\,000 \text{ kW}}\right)^2 + 1}} = 0.6$$

For the improvement of the power factor from 0.6 to 0.9 w read the factor 0.849 from the chart above.
The required capacitor power is: Qc = 500 kW 0.849 = 425 Kvar

Based On GAE Datasheet

*** INFLUENCE OF HARMONIC, HARMONIC FILTERING**

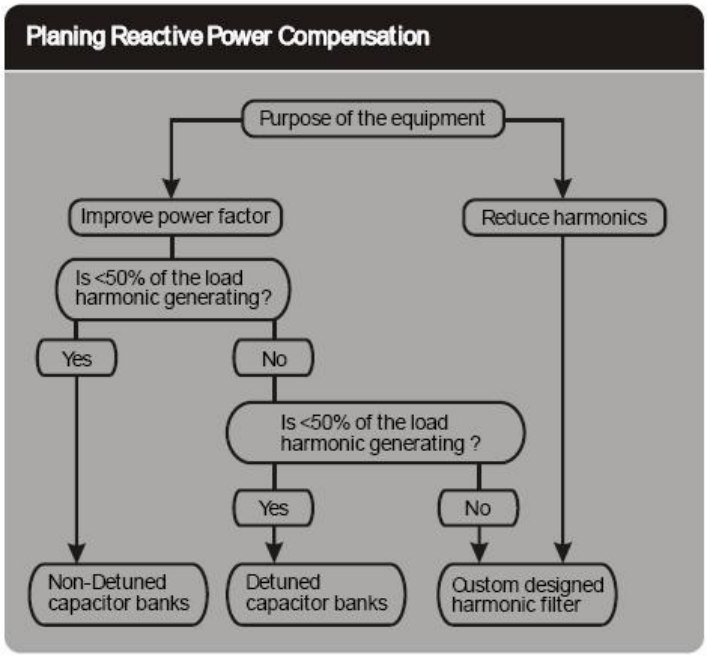
A resonating circuit between the power factor correction capacitors, the inductance of the feeding transformers and the mains may occur. If the frequency of such a resonating circuit is close enough to a harmonic frequency, the resulting circuit amplifies the oscillation and leads to immense over-currents and over-voltages.

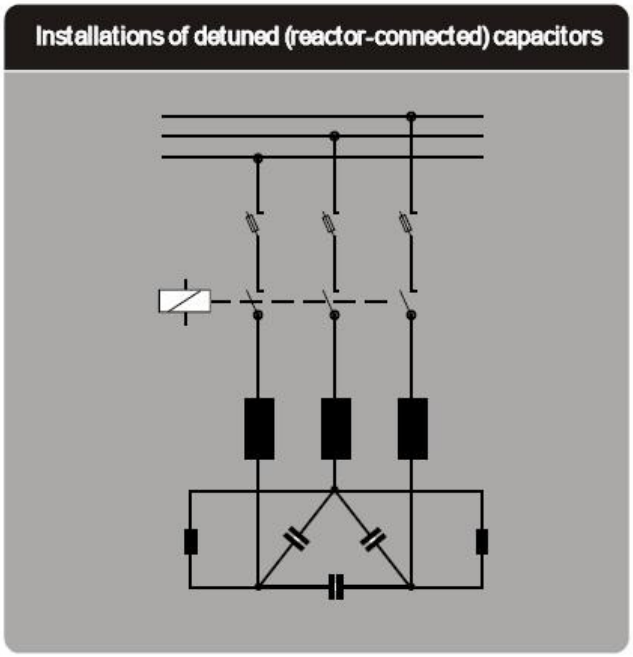
Harmonic distortion of an AC supply can result in any or all of the following :

- Premature failure of capacitors.
- Nuisance tripping of circuit breakers and other protective devices.
- Failure or mal operation of computers, motor drives, lighting circuits and other sensitive toads.

The installation of detuned (reactor-connected) capacitors is designed to force the resonant frequency of the network below the frequency of the lowest harmonic present, thereby ensuring no resonant circuit and, by implication, no amplification of harmonic currents. Such an installation also has a partial filtering effect, reducing the level of voltage distortion on the supply, and is recommended for all cases where the share of harmonic-generating loads is more than 20% of the overall load to the compensated. The resonance frequency of a detuned capacitor is always below the frequency of the fifth harmonic.

A close-tuned filter circuit however is tuned to a certain harmonic frequency and presents a very low impedance to the individual harmonic current, diverting the majority of the current into the filter bank rather than the supply.





Based On GAE Datasheet

Picture

Technical Specification

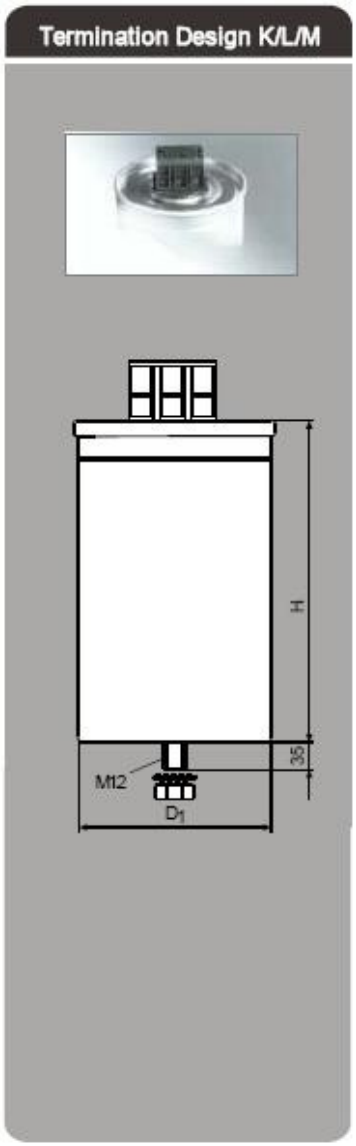
*** TERMINATION DESIGN**

DESIGN K, L, M :

Easy of Assembly with Hight Degree of Protection

The design K, L, M guarantee optimum sealing of the capacitors, and offer convenient connection of cables up to 5 mm². A special spring system guarantees reliable and durable operation of the clamp.

Designs L and M also permit the direct connection of discharge reactors and discharge resistor modules, as well as easy parallel connection of additional capacitors.



Based On GAE Datasheet

CAPASITORS WITH A DIAMETER OF 60 … 85 mm

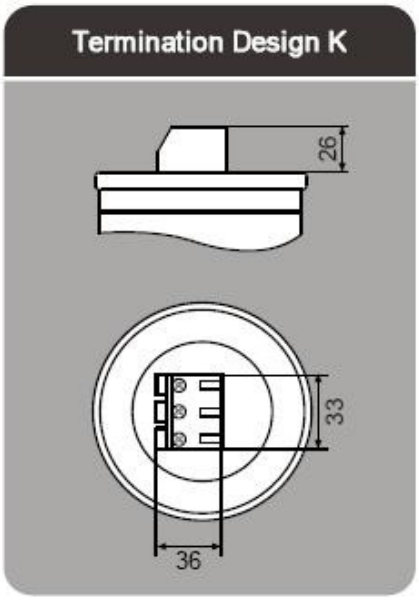
Case : pressed aluminium with base mounting stud M12, hermetically sealed by aluminium lid (press-railed)

Terminal block :

Max. cable cross selection : 1 x 10 mm² per contact (with ferrule 6 mm²)

Max. current : up to 25 A / phase

Discharge resistors : internal (installed as standard for discharge < 50V within 60s)



CAPASITORS WITH A DIAMETER OF 85 … 116 mm / 100 … 136 mm

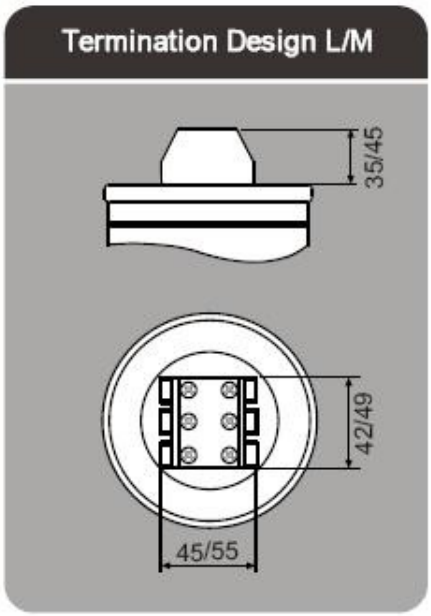
Case : pressed aluminium with base mounting stud M12, hermetically sealed by aluminium lid (press-railed)

Terminal block :

Max. cable cross selection : 2 x 25/50 mm² per contact (with ferrule 2 x 35 mm²)

Max. current : up to 43/80 A / phase

Discharge resistors : available as separate item



GAS – FILLED
415V

For operation in non-detuned or low-detuned systems 5.67% … 7% (<400V)

Permitted operating voltage

24h ..... 440 V
8h/d ..... 480 V
30min/d ..... 505 V
5min (200x) ..... 530 V
1min (200x) ..... 570 V
Max peak rating ..... 1200 V

Test voltages

U_{BB} ..... 950 V AC/2s
U_{BG} ..... 3600 V AC/2s

Temperature class ..... -40 C/D

Dissipation losses

Dielectric ..... <0.2W/kvar
Total Capacitor ..... 0.25 … 0.4 W/kvar

Life expectancy (permitted failure rated < 3 %)

Temperature category D ..... > 100.000h
Temperature category C ..... > 130.000h

Mind Mounting and Operation

Q_N (kVar)	C_N (µF)	I_N (A)	I_{max} (A)	D_1 x H (mm)	m (kg)	Design	order no.	pcs./box	Box	Resistor Module (<50V in °C)
415V 50Hz										
15	3 x 92	3 x 21.0	3 x 36	85 x 230	1.3	K	275.556-509200	5	FB9	inclusive (49)
20	3 x 123	3 x 28.0	3 x 45	95 x 230	1.5	L	275.166-512300	3	FB9	275.100-10180 (50)
25	3 x 154	3 x 35.0	3 x 56	116 x 230	2.3	L	275.186-515400	3	FB9	275.100-10120 (55)

GAS – FILLED
525V

For operation in non-detuned or low-detuned systems 5.67% … 7% (<480V)

Permitted operating voltage

24h ..... 525 V
8h/d ..... 580 V
30min/d ..... 600 V
5min (200x) ..... 630 V
1min (200x) ..... 680 V
Max peak rating ..... 1600 V

Test voltages

U_{BB} ..... 1130 V AC/2s
U_{BG} ..... 4500 V AC/2s

Temperature class ..... -40 C/D

Dissipation losses

Dielectric ..... <0.2W/kvar
Total Capacitor ..... 0.25 …0.4 W/kvar

Life expectancy (permitted failure rated < 3 %)

Temperature category D ..... > 100.000h
Temperature category C ..... > 130.000h

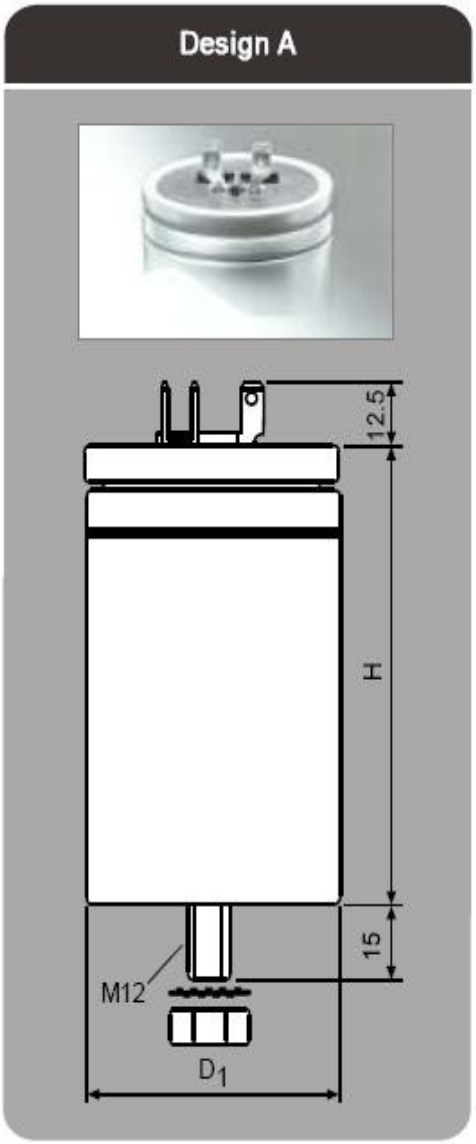
Mind Mounting and Operation

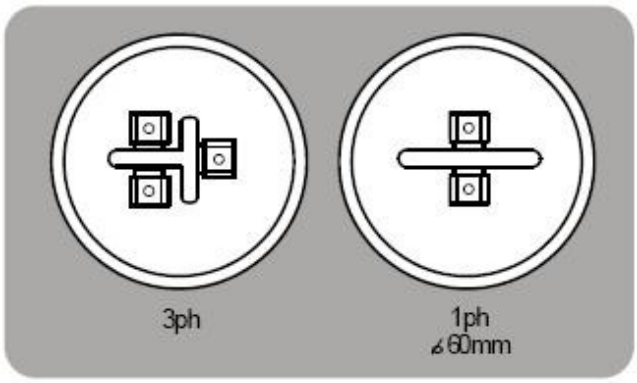
Q_N (Kvar)		C_N (µF)	I_N (A)	I_{max} (A)	D_1 - H (mm)	m (Kg)	Design	order no.	pcs/box	Box	Resistor module (<50V/in °C)
415V	525V										
10.76	17.23	3 x 68	3 x 19.5	3 x 29.0	95 x 230	1.7	L	275.166-706801	3	FB9	275.100.10180 (45)
13.45	21.53	3 x 83	3 x 23.8	3 x 36.0	116 x 230	2.3	L	275.189-708300	3	FB9	275.100-10180 (45)
25	40	3 x 154	3 x 48.0	3 x 72.0	136 x 245	3.7	M	275.398-715401	2	FB12	275.100-10120 (50)

DESIGN A :

The low-cost Alternative

The low cost alternative for single and three phase capacitors with a latc current of up to 16A/phase and diameters of up to 75 mm. Available with plastic protective cap and mounted discharge resistors.





CAPASITORS WITH A DIAMETER OF 60 … 85 mm

Case : pressed aluminium with base mounting stud M12, hermetically sealed by plastic lid with rubber gasket

Terminals : dual tab connectors 6.3 x 0.8 mm

Max. current : up to 16 A / tab

Discharge resistors : available as separate item

RESIN – FILLED
380V / 415V

For operation in non-detuned or low-detuned systems 6.67% … 7% (<400V)

Permitted operating voltage

24h ..... 440 V
8h/d ..... 480 V
30min/d ..... 505 V
5min (200x) ..... 530 V
1min (200x) ..... 570 V
Max peak rating ..... 1200 V

Test voltages

U_{BB} ..... 440 V AC/2s
U_{BG} ..... 480 V AC/2s

Temperature class ..... -40 C/D

Dissipation losses

Dielectric ..... <0.2W/kvar
Total Capacitor ..... 0.25 …0.4 W/kvar

Life expectancy (permitted failure rated < 3 %)

Temperature category D ..... > 100.000h
Temperature category C ..... > 130.000h

Mind Mounting and Operation

Q_N (kVar)	C_N (µF)	I_N (A)	I_{max} (A)	D_1 x H (mm)	m (kg)	Design	order no.	pcs./box	Box	Resistor module (<50V in °C)
415V 50Hz, 1ph										
1.67	30.9	4.0	5.2	40 x 143	0.2	A	276.016-503110	36	FB0	275.111-10301 (23)
3.33	61.5	8.0	10.4	50 x 148	0.3	A	276.036-506210	21	FB0	275.111-10301 (45)
4.17	77.1	10.0	13.0	55 x 148	0.4	A	276.046-507710	18	FB0	275.111-10301 (57)
415V 50Hz, 3ph										
2.5	3 x 15.4	3 x 3.5	3 x 6.0	50 x 151	0.3	A	276.036-501500	21	FB0	275.110-10301 (34)
5	3 x 31.0	3 x 7.0	3 x 12.0	65 x 155	0.5	A	276.066-503100	10	FB7	275.110-10201 (46)
10	3 x 62.0	3 x 13.9	3 x 20.0	75 x 215	1.0	A	276.078-506200	10	FB8	275.110-10121 (55)