

AC Power Capacitors

Ideal for Power Factor and Harmonic Filter Systems



**Safer, Stronger
AC Power Capacitors**

Safer, Stronger AC Power Capacitors

Achieve reliability and long life expectancy for your capacitor system

With over 85 years of experience producing capacitors, plus decades of leadership in the European market for power factor systems, **FRAKO** knows what it takes to produce capacitors that are highly reliable in real world applications for power factor and harmonic filter systems. **FRAKO** developed the LKT -DD60 and -DP60 ranges of dry type capacitors with a combination of safety features and strong ratings to assure satisfactory operation and life expectancy in power factor and harmonic filter systems.

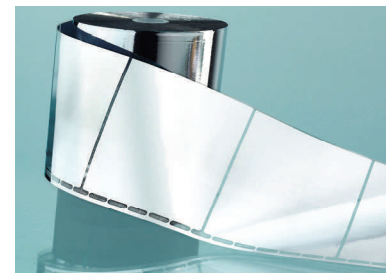
Self-healing, Segmented Metalized Film

All metalized polypropylene capacitors offer self healing features to extend the life of a capacitor when it has been subjected to transients. When exposed to severe, transients, the dielectric strength of the winding is weakened and a short circuit occurs in the capacitor winding. For severe transients, or strenuous applications, the short circuit may penetrate multiple layers of the capacitor winding, resulting the catastrophic failure of a capacitor.

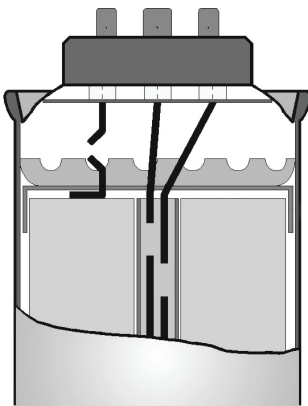


Self-healing event in typical metalized film

FRAKO introduced segmented self-healing metalized film in 2008 to protect against catastrophic failures of capacitors. Segmented film serves to limit the amount of energy available during the self-healing process and will completely isolate the localized short circuit before it can grow to affect multiple layers. The use of segmented film achieves maximum protection against bursting capacitors.



FRAKO Segmented, self-healing metalized film



3-phase over-pressure Disconnection

3-phase Overpressure Disconnection

Metalized polypropylene capacitors are required to provide an internal method of disconnecting the capacitor in case of excessive internal pressure. Since the requirement is not specific, many 3-phase capacitors disconnect only two phases, which is sufficient to stop current flow. However, this method leaves voltage applied to one winding which may still result in a safety hazard. **FRAKO** capacitors feature an overpressure disconnection method that will disconnect all three phases (windings) in case of excessive internal pressure. This is another technique that **FRAKO** employs to maximize protection against catastrophic failures which may result in bursting capacitors.

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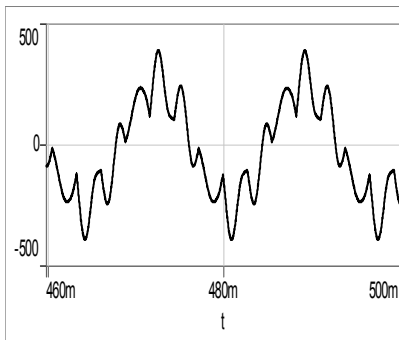
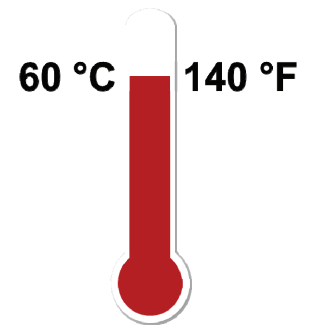
Achieve reliability and long life expectancy for your capacitor system

Power systems today demand a stronger capacitor than in the past. Most electrical power systems have harmonic voltage and current distortion, which will cause higher capacitor currents and raise the internal temperatures within the capacitor system enclosure. **FRAKO** developed the type DD60 and DP60 capacitors with a combination of safety features and strong ratings to assure reliability and long life expectancy within power systems that have current and voltage distortion. These capacitors are uniquely designed for long life in power factor and harmonic filter systems.

High Ambient Temperature Capability

Inside of electrical enclosures for power factor capacitors or harmonic filters, temperatures may be 10°C to 20°C degrees hotter than the ambient room air. Many capacitors require derating whenever the air temperature around the capacitor exceeds 35°C to 46°C.

FRAKO capacitors are rated for continuous use in an ambient temperature of up to 60°C degrees (no derating necessary).



High Harmonic Current Capability

Whether a capacitor is used in a power factor system or in a harmonic filter, today's capacitor installations are typically subjected to harmonics. System harmonics can increase the capacitor current above its rated capability and will also increase the capacitor internal temperature. This contributes to shortened capacitor life.

FRAKO capacitors are designed and rated for high harmonic current and can continuously carry up to 165 % of their nominal capacitor current.

Secure, Maintenance Free Terminals

Terminals are a common failure point in capacitor systems because over time the typical screw terminals can loosen, resulting in a high resistance connection and ultimate failure of the wiring or terminal.

FRAKO -DD60 and -DP60 capacitors are supplied with (factory installed) screwless terminations that secure wiring with a maintenance free, anti-vibration connection. Not only are they easy to wire, but they also maintain terminal pressure for the lifetime of the capacitor.



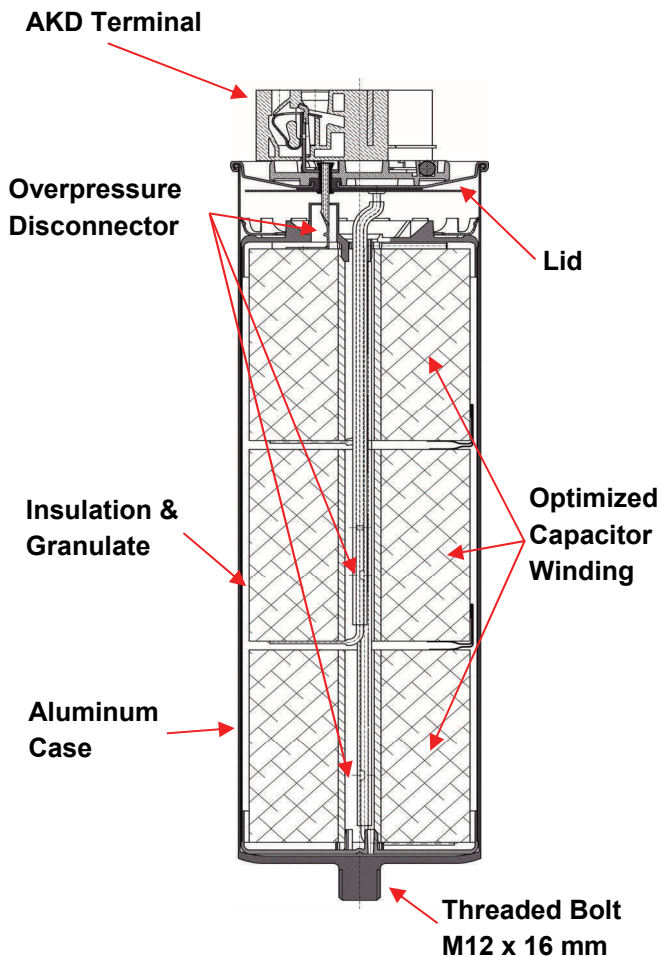
Suitable for 14 to 6 AWG solid, stranded or fine stranded (CU) copper wires



LKT 3-phase Dry-Type Capacitors

Construction Details

FRAKO produces AC Power Capacitors using their unique Dry-Type construction to provide high reliability in rigorous applications of power factor and harmonic filter systems. For best capacitor performance and longest life expectancy, **FRAKO** combines optimized winding construction for low internal heating with unique heat removal techniques.



Optimized Winding Geometry

FRAKO produces capacitor windings using relatively short coils with moderate diameters because this coil geometry is known to generate much less internal heat than other winding construction methods.

Oiled Polypropylene Film

FRAKO applies a thin film of vegetable oil to the entire surface of each winding to facilitate heat transfer and to prevent oxidation of the metalized winding surface.

Absorbent Granulate


FRAKO capacitors are filled with dry absorbent granulate to assure the absence of liquid (oil), for heat dissipation and for improved safety by enabling overpressure disconnection to occur at lower internal pressure.

Standard Features that exceed Industry Standards

- No Leak, Dry-Type Construction
- Factory Installed Discharge Resistors
- Finger-Safe Maintenance Free Terminals
- Uniform Diameter for all Capacitors
- Compact Design
- High Current Capability
- Handles Harmonic Current
- High Temperature Rating
- Triple Safety Features
- Handles High Altitude

LKT 3-phase Dry-Type Capacitors

General Specification

Type		LKT ...-DD60	LKT ...-DP60
Safety Features		Self-healing polypropylene film, segmented metallized film 3-phase overpressure disconnecter	
Applicable Standards		UL 810, CSA 22.2 No. 190, IEC/EN 60831-1 and -2	
Agency Approvals			
Rated Voltage	V _{Nom}	240, 480 & 600 V	690 & 800 V
Maximum Voltage (continuous)	V _{Max}	110 % of Rated Voltage	100 % of Rated Voltage
Rated Frequency	f _N	60 Hz , may also be used at 50 Hz	
Tolerance (µF and KVAR)		-0 % / +5 %	
Internal Connection		delta	
Maximum Current (continuous)		165 % x I _{Nom}	150 % x I _{Nom}
Power Losses		≤ 0.2 W / kVAR (dielectric) ≤ 0.5 W / kVAR (total)	
Discharge (resistors factory installed)		≤ 50 V, within 60 seconds discharge	
Max. temporary Overvoltage		110 % V _{MAX} , 8 hours per day	110 % V _{Nom} , 8 hours per day
		115 % V _{MAX} , 30 minutes per day	115 % V _{Nom} , 30 minutes per day
		120 % V _{MAX} , 5 minutes	120 % V _{Nom} , 5 minutes
		130 % V _{MAX} , 1 minute	130 % V _{Nom} , 1 minute
Maximum Inrush Current	I _S	228 x I _{Nom}	208 x I _{Nom}
Routine Voltage Test (Terminal / Terminal)	V _{TT}	2.15 x V _{Max} , 2 seconds, plus 1.85 x V _{Max} , 18 seconds	
Routine Voltage Test (Terminal / Case)	V _{TC}	V _{Nom} < 600 V = 3,900 V, 2 seconds V _{Nom} ≥ 600 V = 4,300 V, 2 seconds	
Other Routine Tests		Case seal test, capacitance, loss factor and resistance measurement	
Ambient Temperature (continuous)		-40 °C to 60 °C	
Case Temperature (max.)		75 °C	
Storage Temperature (min. /max.)		-40 °C to 85°C	
Humidity (max.)		95 % non-condensating	
Altitude (max.)		4,000 meters above sea level	
Life Expectancy		130,000 hours (at max voltage, current, ambient) with up to 40,000 switchings per year	
Mounting and Fixing		Vertical or horizontal by M12 x 16 mm stud (15 Nm tightening torque)	
Terminals		Screwless pressure connection, 14 to 6 AWG solid or stranded CU wire	

Product Selection & Technical Data

Type DD60 Capacitors for 240 V / 60 Hz System Voltage

FRAKO type LKT -DD60 240V capacitors are multi-purpose capacitors for use in Power Factor and Harmonic Filter Systems.

Continuous voltage capability of 110% rated voltage makes them suitable for use with or without a series (tuning, de-tuning or filter) reactor.

Permitted operating & overvoltages	
Max. Voltage (continuous)	264 V
8 hours / day	290 V
30 minutes / day	304 V
5 minutes	317 V
1 minute	343 V

Product Selection Chart

Catalogue No.	Power	Power	Capacitance	Current		ESR	Dimensions	Weight	Part No.
	Q _C	w/ 7%		I _{Nom}	I _{Max}				
	[kVAR]	[kVAR]	[μF]	[A]	[A]	[mΩ]	[mm]	[kg]	

Rated Voltage: 240 V / 60 Hz

LKT 1.0-240-DD60	1.00	1.07	3 x 15.3	2.4	4.0	3 x 3.5	85 x 198	1.20	31-10901
LKT 1.5-240-DD60	1.50	1.61	3 x 23.0	3.6	5.9	3 x 2.3	85 x 198	1.20	31-10902
LKT 2.0-240-DD60	2.00	2.15	3 x 30.7	4.8	7.9	3 x 1.7	85 x 198	1.20	31-10903
LKT 2.5-240-DD60	2.50	2.68	3 x 38.3	6.0	9.9	3 x 1.4	85 x 198	1.20	31-10904
LKT 3.0-240-DD60	3.00	3.22	3 x 46.0	7.2	11.9	3 x 1.2	85 x 198	1.20	31-10905
LKT 4.0-240-DD60	4.00	4.30	3 x 61.4	9.6	15.8	3 x 0.9	85 x 198	1.20	31-10906
LKT 5.0-240-DD60	5.00	5.37	3 x 76.7	12.0	19.8	3 x 0.7	85 x 198	1.20	31-10907
LKT 6.0-240-DD60	6.00	6.45	3 x 92.1	14.4	23.8	3 x 0.6	85 x 198	1.20	31-10908
LKT 7.5-240-DD60	7.50	8.06	3 x 115.0	18.0	29.7	3 x 0.5	85 x 198	1.20	31-10909
LKT 8.33-240-DD60	8.33	8.94	3 x 127.8	20.0	33.0	3 x 0.4	85 x 198	1.20	31-10910
LKT 10.0-240-DD60	10.00	10.75	3 x 153.4	24.0	39.8	3 x 0.3	85 x 198	1.20	31-10911
LKT 11.7-240-DD60	11.70	12.57	3 x 179.0	28.0	46.4	3 x 0.3	85 x 250	1.55	31-10912
LKT 12.5-240-DD60	12.50	13.44	3 x 191.7	30.0	49.7	3 x 0.3	85 x 250	1.55	31-10913
LKT 15.0-240-DD60	15.00	16.12	3 x 230.1	36.0	59.6	3 x 0.2	85 x 250	1.55	31-10914
LKT 16.7-240-DD60	16.70	17.95	3 x 255.7	40.0	66.3	3 x 0.2	85 x 250	1.55	31-10915
LKT 17.5-240-DD60	17.50	18.80	3 x 266.4	42.0	69.1	3 x 0.2	85 x 313	1.90	31-10916
LKT 20.0-240-DD60	20.00	21.50	3 x 306.8	48.0	79.4	3 x 0.2	85 x 313	1.90	31-10917

Product Selection & Technical Data

Type DD60 Capacitors for 480 V / 60 Hz System Voltage

FRAKO type LKT -DD60 480V capacitors are multi-purpose capacitors for use in Power Factor and Harmonic Filter Systems.

Continuous voltage capability of 110% rated voltage makes them suitable for use with or without a series (tuning, de-tuning or filter) reactor.

Permitted operating & overvoltages	
Max. Voltage (continuous)	528 V
8 hours / day	581 V
30 minutes / day	607 V
5 minutes	634 V
1 minute	686 V

Product Selection Chart

Catalogue No.	Power	Power	Capacitance	Current		ESR	Dimensions	Weight	Part No.
	Q _C	w/ 7%		I _{Nom}	I _{Max}				
	[kVAR]	[kVAR]	C _N Δ [μF]	[A]	[A]	at 1 kHz [mΩ]	d x h [mm]	[kg]	

Rated Voltage: 480 V / 60 Hz

LKT 1.0-480-DD60	1.00	1.07	3 x 3.8	1.2	2.0	3 x 14.0	85 x 198	1.20	31-10918
LKT 1.5-480-DD60	1.50	1.61	3 x 5.8	1.8	3.0	3 x 9.2	85 x 198	1.20	31-10919
LKT 2.0-480-DD60	2.00	2.15	3 x 7.7	2.4	4.0	3 x 6.9	85 x 198	1.20	31-10920
LKT 2.5-480-DD60	2.50	2.68	3 x 9.6	3.0	5.0	3 x 5.5	85 x 198	1.20	31-10921
LKT 3.0-480-DD60	3.00	3.22	3 x 11.5	3.6	5.9	3 x 4.6	85 x 198	1.20	31-10922
LKT 4.0-480-DD60	4.00	4.30	3 x 15.4	4.8	7.9	3 x 3.4	85 x 198	1.20	31-10923
LKT 5.0-480-DD60	5.00	5.37	3 x 19.2	6.0	9.9	3 x 2.8	85 x 198	1.20	31-10924
LKT 6.0-480-DD60	6.00	6.45	3 x 23.1	7.2	11.9	3 x 2.3	85 x 198	1.20	31-10925
LKT 7.5-480-DD60	7.50	8.06	3 x 28.9	9.0	14.9	3 x 1.8	85 x 198	1.20	31-10926
LKT 9.4-480-DD60	9.40	10.10	3 x 35.9	11.3	18.6	3 x 1.5	85 x 198	1.20	31-10927
LKT 10.0-480-DD60	10.00	10.75	3 x 38.5	12.0	19.8	3 x 1.4	85 x 198	1.20	31-10928
LKT 11.7-480-DD60	11.70	12.57	3 x 44.9	14.0	23.3	3 x 1.2	85 x 250	1.55	31-10929
LKT 12.5-480-DD60	12.50	13.44	3 x 48.1	15.0	24.8	3 x 1.1	85 x 250	1.55	31-10930
LKT 15.0-480-DD60	15.00	16.12	3 x 57.4	18.0	29.7	3 x 0.9	85 x 250	1.55	31-10931
LKT 16.7-480-DD60	16.70	17.95	3 x 64.2	20.0	33.2	3 x 0.8	85 x 250	1.55	31-10932
LKT 17.5-480-DD60	17.50	18.80	3 x 67.0	21.0	34.7	3 x 0.8	85 x 313	1.90	31-10933
LKT 18.8-480-DD60	18.80	20.21	3 x 72.2	22.6	37.3	3 x 0.7	85 x 313	1.90	31-10934
LKT 20.0-480-DD60	20.00	21.50	3 x 76.7	24.0	39.8	3 x 0.7	85 x 313	1.90	31-10935
LKT 22.5-480-DD60	22.50	24.19	3 x 86.3	27.0	44.7	3 x 0.6	85 x 313	1.90	31-10936
LKT 23.4-480-DD60	23.40	25.15	3 x 89.8	28.1	46.4	3 x 0.6	85 x 313	1.90	31-10937
LKT 25.0-480-DD60	25.00	26.88	3 x 95.9	30.0	49.7	3 x 0.6	85 x 355	2.20	31-10938



Product Selection & Technical Data

DD60 Capacitors for 600 V / 60 Hz System Voltage

FRAKO type LKT -DD60 600V capacitors are multi-purpose capacitors for use in Power Factor and Harmonic Filter Systems.

Continuous voltage capability of 110% rated voltage makes them suitable for use with or without a series (tuning, de-tuning or filter) reactor.

Permitted operating & overvoltages	
Max. Voltage (continuous)	660 V
8 hours / day	726 V
30 minutes / day	759 V
5 minutes	792 V
1 minute	858 V

Product Selection Chart

Catalogue No.	Power	Power	Capacitance	Current		ESR	Dimensions	Weight	Part No.
	Q _C	w/ 7%		I _{Nom}	I _{Max}				
	[kVAR]	[kVAR]	[μF]	[A]	[A]	[mΩ]	[mm]	[kg]	

Rated Voltage: 600 V / 60 Hz

LKT 1.0-600-DD60	1.00	1.07	3 x 2.4	1.0	1.6	3 x 22.1	85 x 250	1.55	31-10939
LKT 1.5-600-DD60	1.50	1.61	3 x 3.7	1.5	2.4	3 x 14.3	85 x 250	1.55	31-10940
LKT 2.0-600-DD60	2.00	2.15	3 x 4.9	1.9	3.2	3 x 10.8	85 x 250	1.55	31-10941
LKT 2.5-600-DD60	2.50	2.68	3 x 6.1	2.4	4.0	3 x 8.7	85 x 250	1.55	31-10942
LKT 3.0-600-DD60	3.00	3.22	3 x 7.3	2.9	4.8	3 x 7.3	85 x 250	1.55	31-10943
LKT 4.0-600-DD60	4.00	4.30	3 x 9.7	3.8	6.4	3 x 5.5	85 x 250	1.55	31-10944
LKT 5.0-600-DD60	5.00	5.37	3 x 12.4	4.8	7.9	3 x 4.3	85 x 250	1.55	31-10945
LKT 6.0-600-DD60	6.00	6.45	3 x 14.8	5.8	9.5	3 x 3.6	85 x 250	1.55	31-10946
LKT 7.5-600-DD60	7.50	8.06	3 x 18.5	7.2	11.9	3 x 2.9	85 x 250	1.55	31-10947
LKT 10.0-600-DD60	10.00	10.75	3 x 24.6	9.6	15.9	3 x 2.2	85 x 250	1.55	31-10948
LKT 11.7-600-DD60	11.70	12.57	3 x 28.8	11.3	18.6	3 x 1.8	85 x 250	1.55	31-10949
LKT 12.5-600-DD60	12.50	13.44	3 x 30.7	12.0	19.8	3 x 1.7	85 x 250	1.55	31-10950
LKT 15.0-600-DD60	15.00	16.12	3 x 36.9	14.4	23.8	3 x 1.4	85 x 313	1.90	31-10951
LKT 16.7-600-DD60	16.70	17.95	3 x 41.0	16.1	26.6	3 x 1.3	85 x 313	1.90	31-10952
LKT 17.5-600-DD60	17.50	18.80	3 x 43.0	16.8	27.8	3 x 1.2	85 x 313	1.90	31-10953
LKT 20.0-600-DD60	20.00	21.5	3 x 49.1	19.2	31.7	3 x 1.1	85 x 313	1.90	31-10954
LKT 22.5-600-DD60	22.50	24.19	3 x 55.2	21.7	35.7	3 x 1.0	85 x 355	2.20	31-10955
LKT 23.4-600-DD60	23.40	25.15	3 x 57.4	22.5	37.2	3 x 0.9	85 x 355	2.20	31-10956
LKT 25.0-600-DD60	25.00	26.88	3 x 61.5	24.1	39.7	3 x 0.9	85 x 355	2.20	31-10957

Product Selection & Technical Data

DP60 Capacitors with 690 and 800 V / 60Hz rated Voltage

FRAKO type LKT -DP60 690V and 800V capacitors are multi-purpose capacitors for use in Power Factor and Harmonic Filter Systems.

These are typically used in 600V class applications where the voltage or current are abnormally high or where high impedance reactors are used in series with capacitors.

Permitted operating-& overvoltages	
Rated Voltage	690 V / 800 V
8 hours / day	759 V / 880 V
30 minutes / day	794 V / 920 V
5 minutes	828 V / 960 V
1 minute	897 V / 1040 V

Product Selection Chart

Catalogue No.	Power	Power	Capacitance	Current		ESR	Dimensions	Weight	Part No.
	Q_C	Q_C 600 V		I_{Nom}	I_{Max}				
	[kVAR]	[kVAR]	$C_N \Delta$ [μF]	[A]	[A]	at 1 kHz [mΩ]	d x h [mm]	[kg]	

Rated Voltage: 690 V / 60 Hz

LKT 12.5-690-DP60	12.50	9.50	3 x 23.2	10.5	15.7	3 x 2.3	85 x 250	1.55	31-10958
LKT 15.0-690-DP60	15.00	11.30	3 x 27.9	12.6	18.8	3 x 1.9	85 x 250	1.55	31-10959
LKT 20.0-690-DP60	20.00	15.10	3 x 37.1	16.7	25.1	3 x 1.4	85 x 250	1.55	31-10960
LKT 22.1-690-DP60	22.10	16.70	3 x 41.0	18.5	27.7	3 x 1.3	85 x 313	1.90	31-10961
LKT 25.0-690-DP60	25.00	18.90	3 x 46.4	20.9	31.4	3 x 1.1	85 x 313	1.90	31-10962
LKT 30.0-690-DP60	30.00	22.70	3 x 55.7	25.1	37.7	3 x 1.0	85 x 355	2.20	31-10963

Rated Voltage: 800 V / 60 Hz

LKT 8.0-800-DP60	8.00	4.50	3 x 11.0	5.8	8.7	3 x 4.8	85 x 250	1.55	31-10964
LKT 12.6-800-DP60	12.60	7.10	3 x 17.4	9.1	13.7	3 x 3.0	85 x 250	1.55	31-10965
LKT 16.0-800-DP60	16.00	9.00	3 x 22.1	11.5	17.3	3 x 2.4	85 x 250	1.55	31-10966
LKT 25.2-800-DP60	25.20	14.20	3 x 34.8	18.6	27.3	3 x 1.5	85 x 313	1.90	31-10967

Technical Data

Dimensional Data

As a convenience for panel builders and assembly, all type DD60 and DP60 capacitors are produced with a common diameter of 85 mm (3.35"). Depending on the kVAR rating, the height of the capacitors varies from 198 mm (7.79") to 355 mm (13.97").

Capacitor Weight

FRAKO capacitors vary in weight depending on their height. There are four different heights and four corresponding weights.

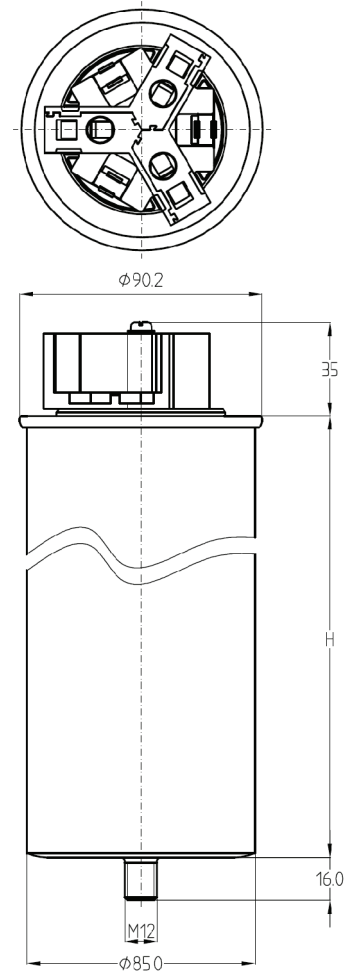
Height excluding terminal	Height including terminal	Weight including terminal
163 mm (6.42")	198 mm (7.79")	1.20 kg (2.65 lbs)
215 mm (8.46")	250 mm (9.84")	1.55 kg (3.42 lbs)
278 mm (10.94")	313 mm (12.32")	1.90 kg (4.19 lbs)
320 mm (12.6")	355 mm (13.97")	2.20 kg (4.85 lbs)

Applying capacitors to other voltages or frequencies

When applying capacitors at a lower voltage, the kVAR rating reduces. Use the factors in the table below to calculate the kVAR rating for your capacitor when used in lower system voltage.

System Voltage	Capacitor Voltage				
	240 V	480 V	600 V	690 V	800 V
208 V	0.75	0.19	0.12	0.09	0.07
240 V	1.00	0.25	0.16	0.12	0.09
380 V	-	0.63	0.40	0.30	0.23
480 V	-	1.00	0.64	0.48	0.36
600 V	-	-	1.00	0.76	0.56

When a 60 Hz rated capacitor will be operated in a 50 Hz network, the kVAR rating is reduced. Apply the factor of 0.83 to the capacitor 60 Hz kVAR rating to determine the 50 Hz kVAR rating.



Voltage example:

Operating a 25 kVAR, 480V (60Hz) capacitor in a 380V (60Hz) system:

$$25 \text{ kVAR} \times 0.63 = 15.8 \text{ kVAR}$$

Frequency example:

Operating a 25 kVAR, 60 Hz capacitor in a 50 Hz system:

$$25 \text{ kVAR} \times 0.83 = 20.8 \text{ kVAR}$$

Capacitor Calculations

Capacitance C	[F]	$C = \frac{kVAR \times 1000}{V_{LL}^2 \times 2\pi f}$
Capacitor Power Q_C	[kVAR]	$kVAR = Q_C = \frac{2\pi f \times C \times V_{LL}^2}{1000}$
Capacitor Power Q_C when operated with harmonic filter reactor	[kVAR]	$kVAR = Q_C = \left(\frac{2\pi f \times C \times V_{LL}^2}{1 - p} \right) \div 1000$
Capacitor Power Q_C when operated in lower system voltage	[kVAR]	$kVAR_{System} = kVAR_{Capacitor} \times \left(\frac{V_{System}}{V_{Capacitor}} \right)^2$
Capacitor Power Q_C when operated in a 50 Hz network	[kVAR]	$kVAR_{50Hz} = kVAR_{60Hz} \times \left(\frac{50 \text{ Hz}}{60 \text{ Hz}} \right)$
Capacitor Current I	[A]	$Amps = I = \frac{kVAR \times 1000}{V_{LL} \times \sqrt{3}}$
Voltage Boost with capacitors operated	[%]	$Voltage \ boost = \frac{Q_C \times Z_{XFMR}}{S_{XFMR}}$
Capacitive Reactance X_C	[Ohms]	$X_C = \frac{1}{2\pi f \times C}$
Resonance Frequency f_r	[Hz]	$f_r = f \times \sqrt{\frac{S_{SC}}{Q_C}}$

Key Symbols

V_{LL} = Voltage (Line-Line) [V]
 I = Current [A]
 f = Network Frequency [Hz]
 f_r = Resonance Frequency [Hz]
 C = Capacitor Capacitance [F]

Q_C = Capacitor Power [kVAR]
 p = Detuning Factor [%]
 Z_{XFMR} = Transformer Short Circuit Power [%]
 S_{XFMR} = Transformer Power [kVA]
 S_{SC} = Short Circuit Power network [MVA]