



TPC
High Power Capacitors
For Power Electronics

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Capacitors for High Power Electronics

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TPC (acquired by AVX Corporation in 1979) has been at the forefront of high performance film capacitor technology improvements for over 20 years.

In 1979 they developed **CONTROLLED SELF-HEALING** technology specifically to enhance the performance of film power capacitors. This enabled the capacitor to continue to function without catastrophic failure by insulating the weak points of the dielectric material. During operation, the capacitor behaves like a battery. It will consume capacitance via the gradual breakdown of individual cells until it decreases down to 2% of the original value.

Further improvements were made in 1988 for DC filtering applications. The **TRAFIM** series (polypropylene Film, Impregnated and Metallized with aluminum) provided superior energy density due to impregnation with rape seed oil thereby enabling more compact capacitor designs.

DC filtering technologies:

TRAFIM, FILFIM and CAPAFIM

Energy storage and discharge technologies:

DISFIM

(LCC and Thomson Passive Components were recognized trading names until the AVX acquisition took place.)

This present catalog doesn't include DISFIM products, if you are interested in energy storage or discharge capacitors, please contact AVX sales for more information.

The DISFIM Products guide for customer's specific requirements is presented on page 31.

Characteristics

ELECTRICAL CHARACTERISTICS FOR DC FILTERING

Capacitance C_n	Nominal value of the capacitance.
Working current I_{rms}	r.m.s. value current for continuous operation.
Maximum current I_{max}	Maximum r.m.s. current for continuous operation.
DC voltage	Continuous voltage value.
Rated DC voltage V_n	Maximum operating peak voltage of either polarity (non-reversing type waveform), for which the capacitor has been designed for continuous operation.
Working voltage V_w	Value of the maximum operating recurrent voltage for a given hot spot temperature and expected lifetime.
Ripple voltage V_r	Peak-to-peak alternating component of the unidirectional voltage.
Working frequency f	Ripple voltage frequency.
Equivalent series resistance R_s	An effective resistance which, if connected in series with an ideal capacitor of capacitance value equal to that of the capacitor in question, would have a power loss equal to active power dissipated in that capacitor under specified operating conditions.
Stray inductance L_s	Capacitor serial self-inductance.
Tangent of loss angle $\tan \delta$	Ratio between the equivalent series resistance and the capacitive reactance of a capacitor at a specified sinusoidal alternating voltage and frequency.
Insulation voltage V_i	r.m.s. rated value of the insulation voltage of capacitive elements and terminals to case.

THERMAL CHARACTERISTICS

Cooling air temperature θ_{amb} (°C):	Temperature of the cooling air measured at the hottest position in the bank, under steady-state conditions, midway between two units. If only one is involved, it is the temperature measured at a point approximately x 0.1m away from the capacitor container and two-thirds of the height from its base.
Hot spot temperature θ_{HS} (°C):	Highest temperature obtained inside the case of the capacitor in thermal equilibrium.
Operating temperature θ (°C):	Temperature of the hottest point on the case of the capacitor in thermal equilibrium.
Minimum operating temperature θ (°C):	Lowest temperature of the case at which the capacitor may be energized.
Maximum operating temperature θ_{max} (°C):	Highest temperature of the case at which the capacitor may operate.

DC FILTERING

V_N DETERMINATION

The choice is based upon the operating voltage:

$$V_w = \text{DC voltage} + V_r/2$$

where

$$V_r = \sqrt{2} \times I_{\text{rms}} / (\pi f C_n) \text{ with } V_r \text{ limited to } 0.45 \times V_N \text{ maximum}$$

According to the tables of values, you should find a capacitor with required capacitance C_n and voltage V_n (provided that $V_n \geq V_w$) is recommended. Choosing $V_n < V_w$ will significantly decrease the expected lifetime. You must also verify that the maximum r.m.s. current for continuous operation can be accepted by the capacitor: I_{max} depends on the terminal or specified on the tables.

CHARACTERISTICS

Test voltage between terminals:

$$V_t = 1.5 V_n \text{ during } 10 \text{ s}$$

Test voltage between shorted terminals and case:

$V_{t\text{-case}} = 6$ or $10 \text{ kV}_{\text{rms}}$ or more depending of nominal voltage (at 50 Hz during 60s)

Maximum permissible voltage:

These capacitors may be subjected to the following surge voltages without any significant reduction in lifetime expectancy.

Repetitive surge voltage	Maximum duration per day
1.10 V_n	30% of on-load duration
1.15 V_n	30 min
1.20 V_n	5 min
1.30 V_n	1 min
1.50 V_n	100 ms

Capacitance between terminals and case:

$$C_{t\text{-case}} < 5 \text{ nF}$$

Minimum working temperature:

$$\theta_{\text{min}} = -55^\circ\text{C}$$

Maximum hot spot temperature:

It depends on lifetime expectancy.
See Curves 1 and 2.

Storage temperature:

$$\text{Range} = [-55^\circ\text{C to } +85^\circ\text{C}]$$

Normative measurement temperature:

The capacitance value is given at
 $\theta_{\text{amb}} = 25 \pm 10^\circ\text{C}$

HOT SPOT TEMPERATURE CALCULATION

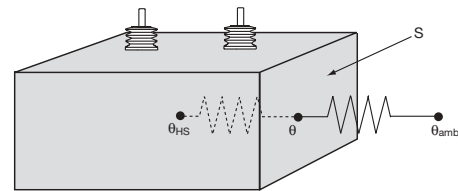
Total losses are calculated as follow:

$$P = S \times h \times (\theta - \theta_{\text{amb}})$$

where

h is the exchange coefficient.

S is the exchange surface of case. See dm^2 in table of values.



A formula can be deduced:

$$P = S \times h \times \frac{(\theta_{\text{HS}} - \theta_{\text{amb}})}{2} = \frac{(I_{\text{rms}})^2}{C_n \omega} \times \text{tg} \delta$$

$$\text{where } \text{tg} \delta = \text{tg} \delta_0 + R_s C_n \omega$$

$\text{tg} \delta_0$ represents the dielectric losses of the polypropylene + rapeseed oil ($\text{tg} \delta_0 = 4 \times 10^{-4}$)

for natural convection $h = 0.125 \text{ W/dm}^2/^\circ\text{C}$

for forced air (velocity > 2m/s) $h = 0.157 \text{ W/dm}^2/^\circ\text{C}$

So a formula giving the hot spot temperature is:

$$\theta_{\text{HS}} = \theta_{\text{amb}} + 2 \times \left[R_s + \frac{\text{tg} \delta_0}{2\pi f C_n} \right] \times \frac{(I_{\text{rms}})^2}{S \times h}$$

where

I_{rms} (A)	θ ($^\circ\text{C}$)
R_s (Ω)	C_n (F)
S (dm^2)	f (Hz)

MTBF CALCULATION

Based on 10 years of tests results, we have established the following relationship.

The failure rate λ_B depends on the hot spot temperature θ_{HS} and the charge ratio ρ :

$$\rho = V_w/V_n$$

$$\lambda_B = 10^{4.425(\rho - 1)} \times e^{\left[2.087 \left(\frac{\theta_{HS} + 273}{343}\right)^{15}\right]} \times 10^{-9}$$

in failures/hour

GENERAL FAILURE RATE

$$\lambda = \lambda_B \times \pi_Q \times \pi_B \times \pi_E \text{ failures/hour}$$

Where π_Q , π_B and π_E are factors found in the following tables.

MEAN TIME BETWEEN FAILURE (MTBF)

$$M.T.B.F. = 1/\lambda \text{ hours}$$

SURVIVAL FUNCTION

$$N = N_0 \cdot \exp(-\lambda t)$$

N is the number of pieces still working after t hours, N_0 is the number of pieces at the origin (t=0).

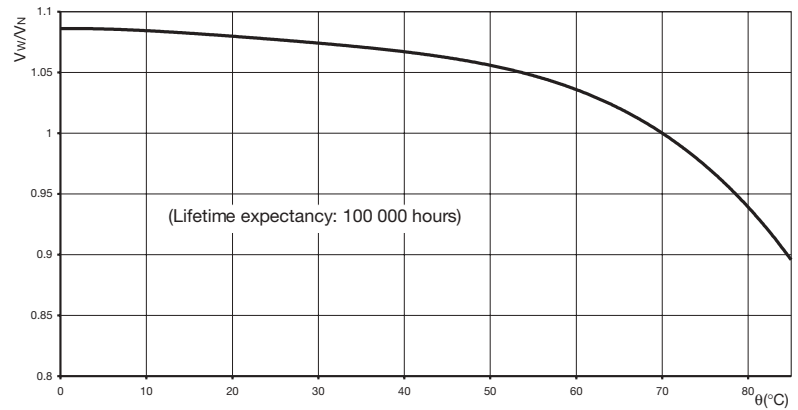
Qualification	Qualification factor π_Q
Product qualified on IEC 61071 and internal qualification	1
Product qualified on IEC 61071	2
Product answering on another norm	5
Product without qualification	15

Environment	Environment factor π_E
On ground (good conditions)	1
On ground (fixed materials)	2
On ground (on board)	4
On ship	9
On plane	15

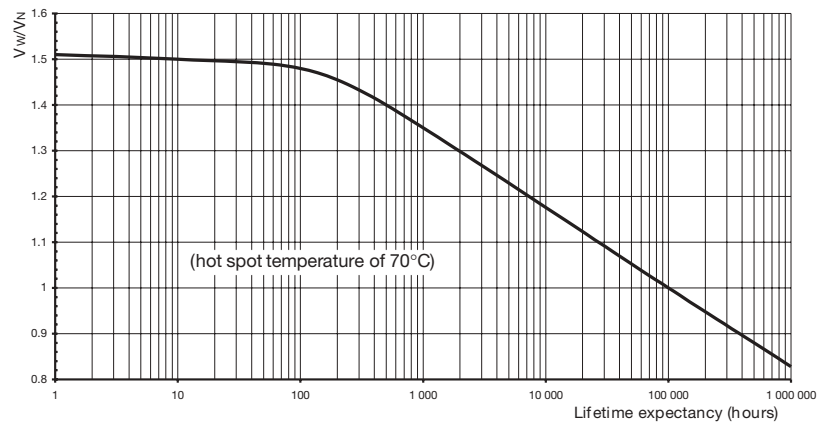
Environment	Environment factor π_B
Favorable	1
Unfavorable	5

Typical Curves

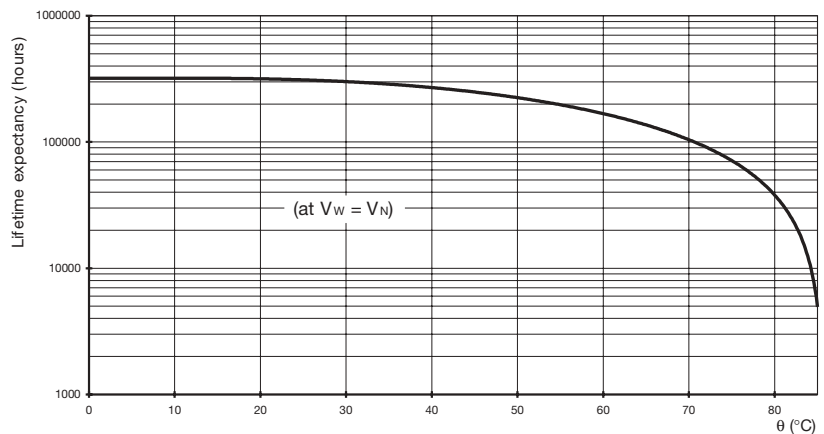
CURVE 1
 V_w/V_n vs Hot spot temperature



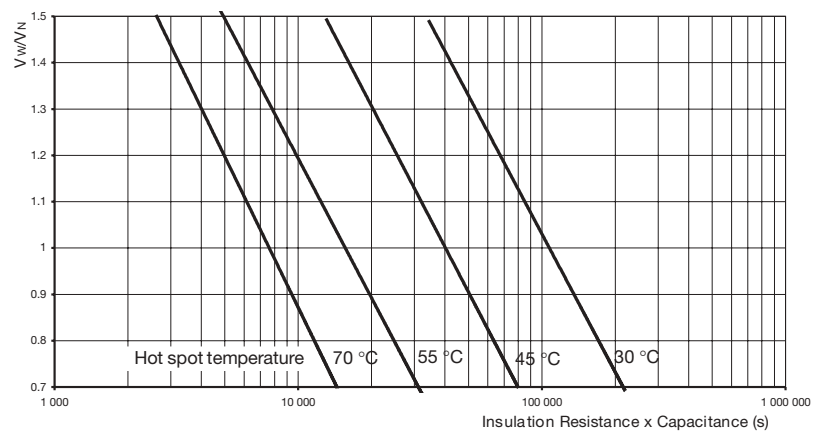
CURVE 2
 V_w/V_n vs Lifetime expectancy



CURVE 3
 Lifetime expectancy vs
 Hot spot temperature

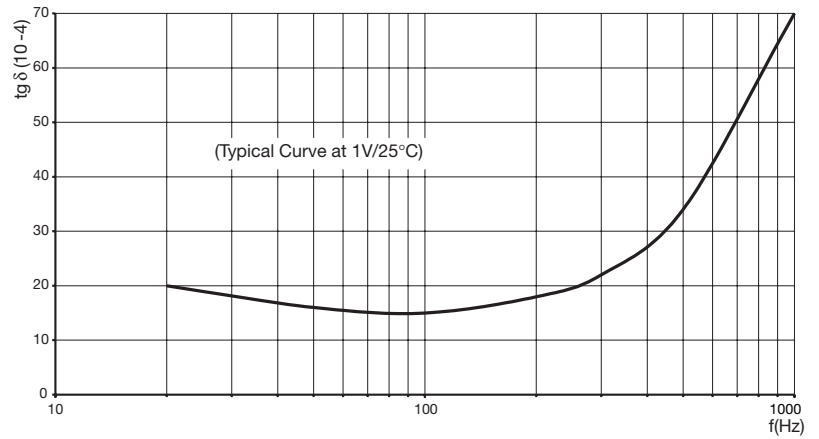


CURVE 4
 V_w/V_n vs Insulation resistance



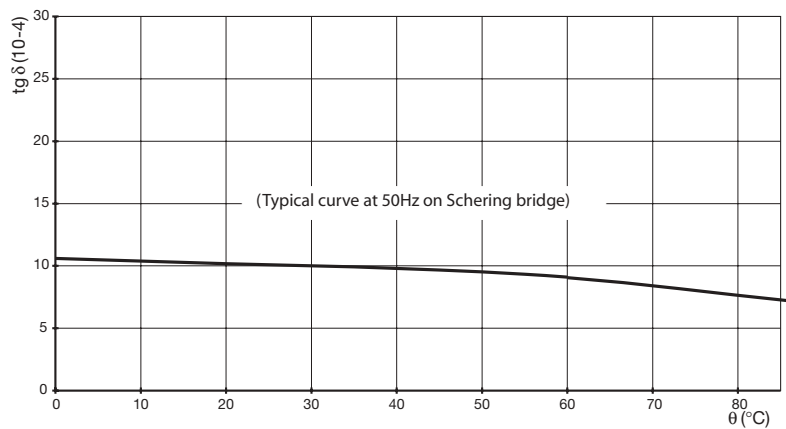
CURVE 5

Tangent of loss angle vs frequency



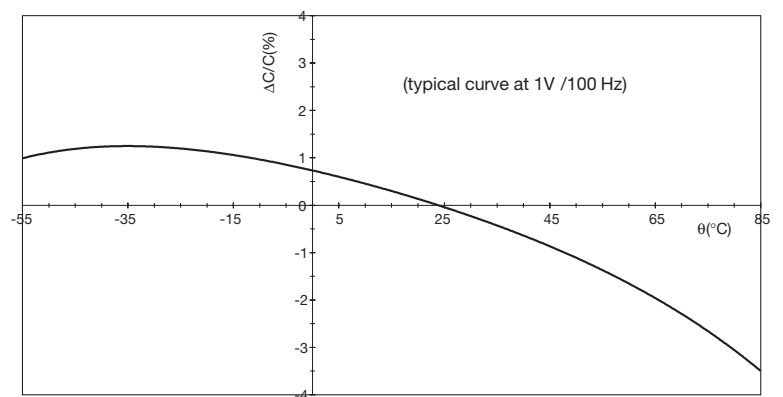
CURVE 6

Tangent of loss angle vs temperature



CURVE 7

$\Delta C/C$ vs Hot spot temperature



DIMENSIONS

Dimensions are indicated in the value tables as well as the weight.

Dimensional tolerances are:

$$H \pm 3\text{mm}, W \pm 3\text{mm}$$

Initially, the large faces of the capacitor may be slightly convex. At delivery the maximum width is:

$$W'_{\text{max}} = W + 15\text{mm}$$

Standard material is stainless steel. Aluminum is available for specific requirement to reduce the weight or induction effect.

MOUNTING

Vertical mounting is the preferred and horizontal is acceptable. Please contact AVX for up-side down mounting configuration.

HANDLING

When unpacking, it is important that no mechanical shocks occur that might deform the cans and damage the output connection.

The capacitors include, unless otherwise specified, one or several gripping elements (mass screws, jack rings or other hoisting devices); they should be exclusively handled by means of these elements.

In no case should the electrical output terminals be used to lift the capacitor.

The grounding wire should be kept in place until the capacitor is mounted.

ASSEMBLY AND INSTALLATION

To check for the absence of excessive mechanical stresses.

The mechanical stresses in assembly should remain compatible with the characteristics of the capacitor.

The method of mounting should not lead to the deformation of the capacitor case.

Tightening torques are given below:

Output through threaded connections:

$$\text{max} = 25 \text{ N}\cdot\text{m}$$

Mechanical mounting

Moreover vertical position is the preferential one and horizontal is accepted.

In order to enable air convection, it is necessary to maintain at least 40mm between the large faces of adjacent capacitors.

Connections

They should not induce any force on the output terminals. Flexible connections should be used (braided or thin metal).

The cross section should not be less than:

$$S = 0.2 \times I_{\text{max}} \text{ where } S \text{ (mm}^2\text{) and } I_{\text{max}} \text{ (A)}$$

The skin effect, which occurs vs frequency, must also be taken into account.

MARKING

The label is usually located 50mm from the top of the case and centered to the length:

TPC or AVX Logo	Test voltage between terminals and case
Part number	Batch and serial number
Capacitance and tolerance	Date of manufacture
Rated voltage in clear	

SAFETY

The FIM technology provides excellent safety; there is no risk of explosion in case of defect throughout the life of the capacitor. This explains why there is no need to equip these capacitors with pressure switch. Rapeseed oil is not explosive or flammable at normal conditions, therefore capacitors can be transported without being subjected to safety rules. Rapeseed oil flash point is about 317°C and the polypropylene flash point is near 300°C, so the melting certifies a temperature of security above 300°C.

In case of fire above this temperature, it is recommended to use dust or CO₂. The use of water is contra-indicated. The possible rejected products during fire are CO₂, H₂O, CO (in case of non-complete combustion), Hydrocarbons and some other gases. Carrying mask is required for protection.

OIL

The only impregnant used in TRAFIM capacitors is rapeseed oil (otherwise known as Canola oil) and then is fully environmentally compatible. It does not emit toxic or carcinogenic gases, nor is it harmful to soil, water or humans in the event of accidental spillages. As a natural product derived from foodstuff, it is even edible.

Of all the vegetable oils, rapeseed oil has one of the best thermal stabilities and lowest acidity levels.

NON-TOXIC COMPOSITION

Our capacitors are free of:

Arsenic, Asbestos, Beryllium, Brominated flame retardants (PBB and PBDE), Cadmium, CFC, HCFC, Cobalt, Formaldehyde, Halon, Isocyanatos, Mercury, Nickel PCB, PCT, Polyaromatic Hydrocarbons (PAH), Phtalates, PVC, PTFE and Thirams.

Lead is only found in soldering (for approximately 0.3% of the capacitor weight).

Free of SF6.

CALORIFIC VALUE

A formula that gives the calorific value of a standard TRAFIM capacitor is:

$$CV \text{ (MJ)} = L \times [4 \times 10^{-5} \times W \times H - 1.3 \times 10^{-5} \times H + 8 \times 10^{-4} \times W + 4.55 \times 10^{-2}] + 3.75 \times N$$

where H, L, W, are Height, Length and Width in millimeters, and N is the number of terminals.

DESTROYING CAPACITORS

The destruction of the capacitors are subject to the laws in force in each country.

In practice, today, please contact AVX for a list of companies who can take charge of the products to be destroyed.

APPLICATIONS

DC filtering for all types of application

PACKAGING

Rectangular stainless steel sandblasted case. Grounding is via a plug on the top of the case.

PRESENTATION



ELECTRICAL CHARACTERISTICS

Capacitance range C_n	88 μ F to 1620 μ F
Tolerance on C_n	\pm 10%
DC voltage range	1200V to 3900V
Maximum hot-spot temperature	75°C
Life duration at nominal voltage and 75°C hot-spot temperature	100000 hours
Stray inductance	<400nH
Test voltage between terminals	1.5V _n during 10s
Test voltage between short terminals and case	6kV _{rms} (at 50Hz during 1mn)
Standard reference	Conforms with 61071 and 61881, IEC 60068 and IEC 60077

This catalog presents standard products, for specific products; please fill out the Guide for Customer's Specific Requirement on page 30.

Table of Values

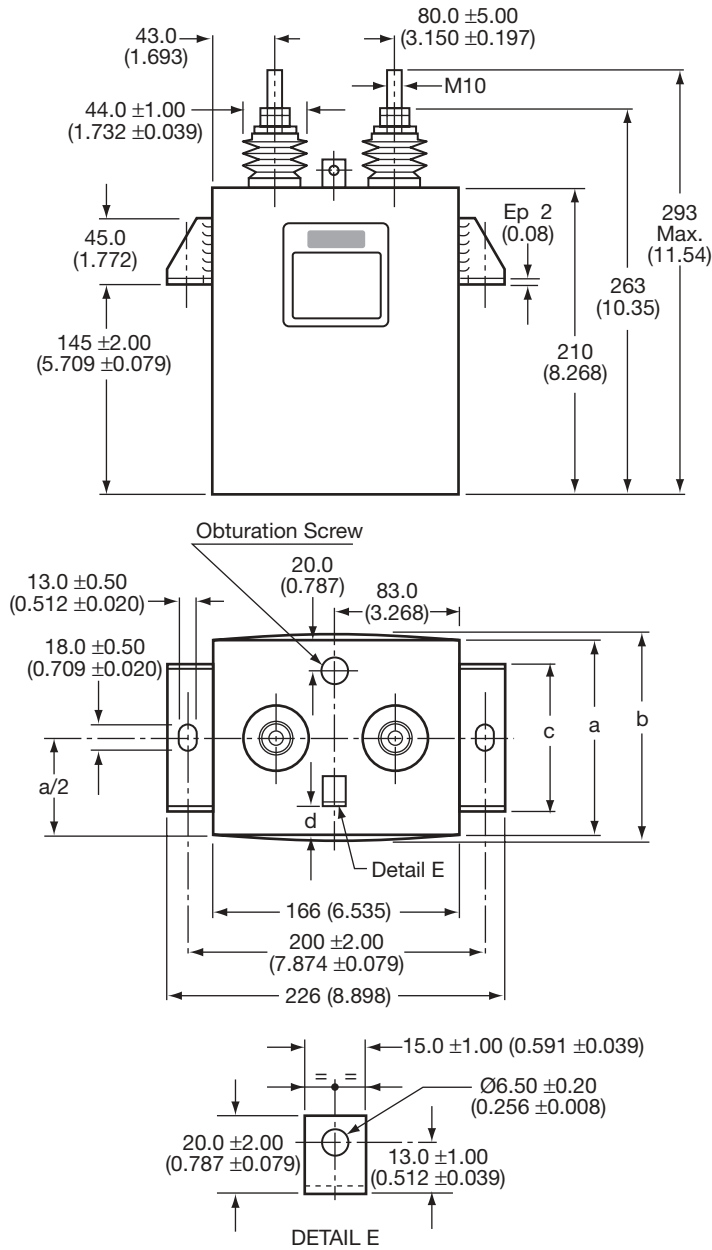
Type A	Vn (V)	C (µF)	I _{max} (A)	V _{r max} (V)	Rs (mΩ)	Part Number
		1200 → 1400	650	56	678	3.48
166	1800	426	46	837	4.35	DNCFM1K8A4266
	2000	338	40	939	5.33	DNCFM2K0A3386
X	2200	288	36	1018	5.66	DNCFM2K2A2886
	2400	228	32	1142	6.14	DNCFM2K4A2286
70	2600	192	30	1244	6.49	DNCFM2K6A1926
	2900	162	28	1357	6.83	DNCFM2K9A1626
X	3100	144	26	1436	7.08	DNCFM3K1A1446
	3300	126	24	1538	7.35	DNCFM3K3A1266
210	3500	112	22	1629	7.59	DNCFM3K5A1126
	3700	100	20	1719	7.83	DNCFM3K7A0107
	3900	88	18	1832	8.1	DNCFM3K9A0886

Type B	Vn (V)	C (µF)	I _{max} (A)	V _{r max} (V)	Rs (mΩ)	Part Number
		1200 → 1400	975	84	678	2.6
166	1800	639	69	837	3.17	DNCFM1K8B6396
	2000	507	60	939	3.49	DNCFM2K0B5076
X	2200	432	54	1018	3.71	DNCFM2K2B4326
	2400	342	48	1142	4.03	DNCFM2K4B3426
102	2600	288	45	1244	4.77	DNCFM2K6B2886
	2900	243	42	1357	5	DNCFM2K9B2436
X	3100	216	39	1436	5.16	DNCFM3K1B2166
	3300	189	36	1538	5.34	DNCFM3K3B1896
210	3500	168	33	1629	5.51	DNCFM3K5B1686
	3700	150	30	1719	5.67	DNCFM3K7B0157
	3900	132	27	1832	5.98	DNCFM3K9B1326

Type C	Vn (V)	C (µF)	I _{max} (A)	V _{r max} (V)	Rs (mΩ)	Part Number
		1200 → 1400	1300	112	678	1.99
166	1800	852	92	837	2.43	DNCFM1K8C8526
	2000	676	80	939	2.83	DNCFM2K0C6766
X	2200	576	72	1018	3	DNCFM2K2C5766
	2400	456	64	1142	3.24	DNCFM2K4C4566
134	2600	384	60	1244	3.41	DNCFM2K6C3846
	2900	324	56	1357	3.58	DNCFM2K9C3246
X	3100	288	52	1436	3.71	DNCFM3K1C2886
	3300	252	48	1538	3.84	DNCFM3K3C2526
210	3500	224	44	1629	4.47	DNCFM3K5C2246
	3700	200	40	1719	4.59	DNCFM3K7C0207
	3900	176	36	1832	4.72	DNCFM3K9C1766

Type D	Vn (V)	C (µF)	I _{max} (A)	V _{r max} (V)	Rs (mΩ)	Part Number
		1200 → 1400	1620	140	678	1.74
166	1800	1060	115	837	2.09	DNCFM1K8D1067
	2000	845	100	939	2.28	DNCFM2K0D8456
X	2200	720	90	1018	2.41	DNCFM2K2D0727
	2400	570	80	1142	2.77	DNCFM2K4D0577
166	2600	480	75	1244	2.91	DNCFM2K6D0487
	2900	405	70	1357	3.05	DNCFM2K9D4056
X	3100	360	65	1436	3.15	DNCFM3K1D0367
	3300	315	60	1538	3.25	DNCFM3K3D3156
210	3500	280	55	1629	3.35	DNCFM3K5D0287
	3700	250	50	1719	3.45	DNCFM3K7D0257
	3900	220	45	1832	4.06	DNCFM3K9D0227

millimeters (inches)



Terminals: Creepage distance 77 (3.031)
Air distance 40 (1.575)

Type	a	b	c	d	Weight (kg)
A	70 (2.756)	85 (3.346)	50 (1.969)	10 (0.394)	4.5
B	102 (4.016)	117 (4.606)	50 (1.969)	10 (0.394)	6
C	134 (5.276)	149 (5.866)	100 (3.937)	20 (0.787)	7.5
D	166 (6.535)	181 (7.126)	100 (3.937)	20 (0.787)	9

Capacitor Design

V_N DETERMINATION

The design is based upon the operating voltage V_w

$$V_w = V + V_r/2$$

where

$$V_r = \sqrt{2} \times I_{rms} / (\pi f C_n)$$

According to the tables of values, you should find a capacitor with required capacitance C_n and voltage V_n (provided that V_n ≥ V_w).

You must also verify that the working current and the ripple voltage can be accepted by the capacitor.

THERMAL DESIGN

Total losses are calculated as follows:

$$P = I_{rms}^2 (tg\delta_0 / C_n 2\pi f + R_s)$$

(tgδ₀ = 3 × 10⁻⁴ represents the dielectric losses of the polypropylene + rapeseed oil)

Calculate the hot-spot temperature:

$$\theta_{HS} = \theta_{amb} + R_{th}P$$

(R_{th} is the thermal resistance between hot-spot and ambient) (see the table value below)

Hot-spot temperature must be below 75°C.

If hot-spot temperature is higher, then chose another type and start again the calculation.

	R _{th} (°C/W)
Type A	1.44
Type B	1.24
Type C	1.08
Type D	0.96

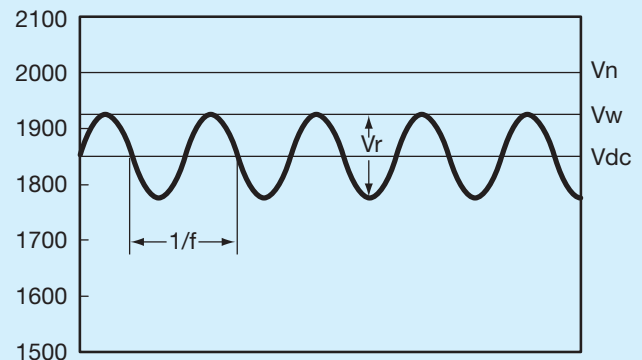
Example:

You need:

C = 500 μF
 DC voltage = 1850 V
 f = 300 Hz
 I_{rms} = 50 A
 θ_{amb} = 50°C

According to data:

V_r = 150 V peak-to-peak
 V_w = 1850 + 150/2 = 1925 V
 ⇒ capacitor type B
 V_n = 2000 V
 C = 507 μF
 I_{rms} < I_{max}
 V_r ≤ V_{max}



Thermal Calculation:

Total losses

$$P = 50^2 \times (3 \times 10^{-4} / (507 \times 10^{-6} \times 2\pi \times 300)) + 3.49 \times 10^{-3} = 9.5W$$

The hot-spot temperature in this example is therefore:

$$\theta_{HS} = 50 + 1.24 \times 9.5 = 61.8^\circ C$$

$$\theta_{HS} < 75^\circ C$$

⇒ Part number DNCFM2K0B5076

Standard

APPLICATIONS

DC voltage filtering for:

- DC link
- Resonant filtering
- Active correction (FACTS, UPFC, DVR...)
- Speed converters (drives and traction)
- Windmills
- Substation

PACKAGING

Rectangular stainless steel case sandblasted. Grounding is via a threaded screw located on the cover of the case.

PRESENTATION



ELECTRICAL CHARACTERISTICS

Capacitance range C_n	610 μ F to 15600 μ F
Tolerance on C_n	$\pm 10\%$
DC voltage range	1200V to 5000V
Maximum hot-spot temperature	85°C
Life duration at nominal voltage and 70°C hot-spot temperature	100000 hours
Stray inductance	<400nH
Test voltage between terminals	1.5V $_n$ during 10s
Test voltage between short terminals and case	10kV $_{rms}$ (at 50Hz during 1mn)
Standard reference	Conforms with IEC 61071 and 61881, 61373, 60068 and 60077

This catalog presents standard products, for specific products; please fill out the Guide for Customer's Specific Requirement on page 30.

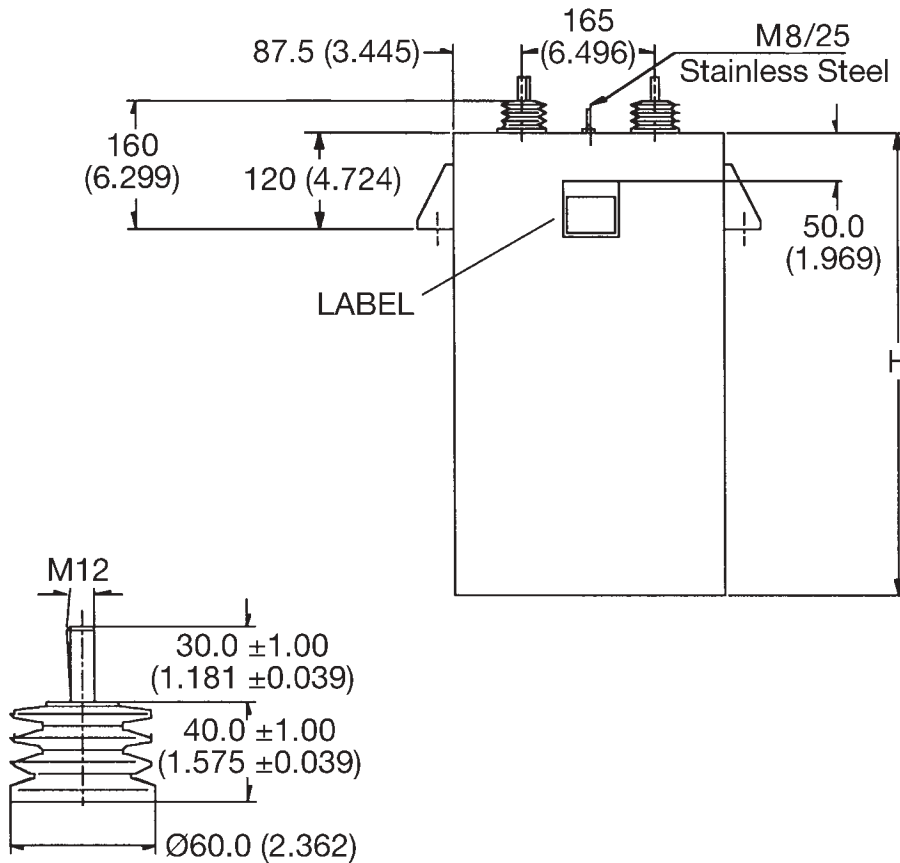
Standard

In the top of each cell is the part number that can be used to order these capacitors.

TABLE OF VALUES

L x Wmm (inches)		Base 340 (13.386) x 165 (6.496)			
Hmm (inches)	330 (12.992)	485 (19.094)	640 (25.197)	830 (32.677)	
Weight (kg)	25.5	35.5	46	58.5	
S (dm ²)	39	54.5	70.5	89.4	
Vn (V)	Part Number C (μF) Rs (mΩ)	Part Number C (μF) Rs (mΩ)	Part Number C (μF) Rs (mΩ)	Part Number C (μF) Rs (mΩ)	
1200 → 1400	DKTFM1K405477 5470 0.66	DKTFM1K401057 1050 0.58	DKTFM1K401178 11700 0.56	DKTFM1K401568 15600 0.55	
2000	DKTFM2K002857 2850 0.85	DKTFM1K408607 8600 0.71	DKTFM2K006127 6120 0.66	DKTFM2K008167 8160 0.64	
2400	DKTFM2K401927 1920 0.97	DKTFM2K403037 3030 0.78	DKTFM2K404127 4120 0.72	DKTFM2K405507 5500 0.68	
2900	DKTFM2K901367 1360 1.07	DKTFM2K902147 2140 0.85	DKTFM2K902927 2920 0.77	DKTFM2K903897 3890 0.72	
3300	DKTFM3K301067 1060 1.14	DKTFM3K301667 1660 0.90	DKTFM3K302277 2270 0.80	DKTFM3K303037 3030 0.75	
4200	DKTFM4K200677 670 1.29	DKTFM4K201057 1050 0.99	DKTFM4K201437 1430 0.87	DKTFM4K201917 1910 0.81	
5000	DKTFM5K000617 610 1.47	DKTFM5K000717 710 1.11	DKTFM5K000977 970 0.96	DKTFM5K001297 1290 0.87	

Hmm (inches)	330 (12.992)	485 (19.094)	640 (25.197)	830 (32.677)
Ls (nH)	180	210	235	270

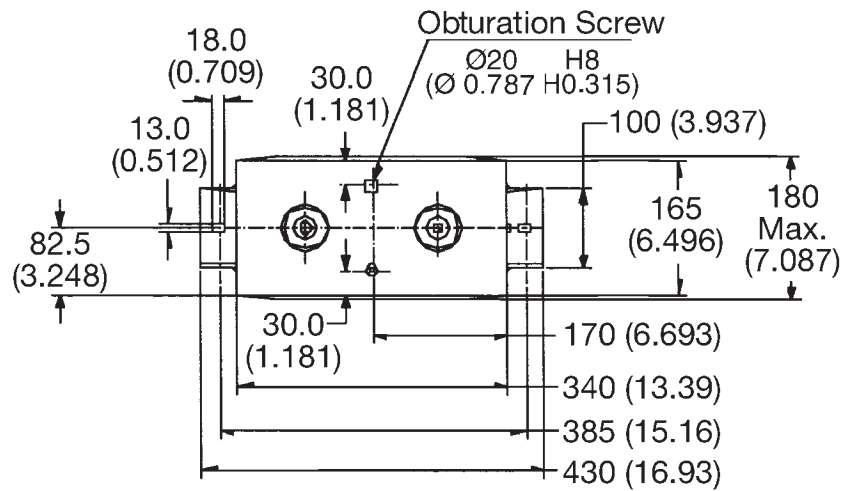


Creepage Distance:

78.0 (3.071)

Air Distance:

50.0 (1.969)



Standard

DESIGN EXAMPLE

Previously, we gave all the basic information to design a capacitor. Now we apply these formulations on an example.

V_n DETERMINATION (see page 4)

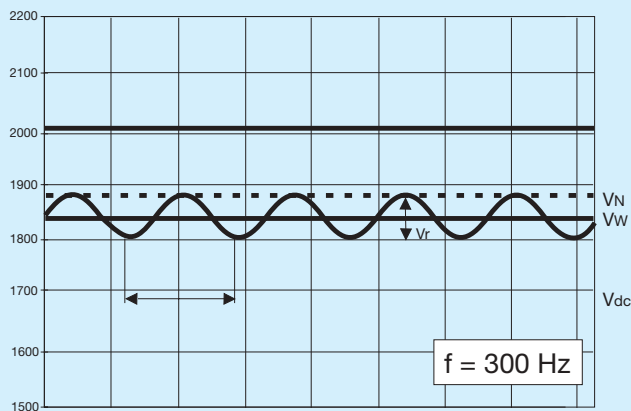
C = 6000 μF
 DC voltage = 1850 V
 f = 300 Hz
 I_{rms} = 208 A

According to data:

V_r = 52 V peak-to-peak
 V_w = 1850 + 52/2 = 1876 V

Example:

C_n = 6120 μF (page 13)
 V_n = 2000 V
 H = 640mm



HOT SPOT TEMPERATURE CALCULATION (see page 4)

Using the previous example:

C_n = 6120 μF
 V_n = 2000 V
 V_w = 1876 V
 f = 300 Hz
 I_{rms} = 208 A

The cooling air temperature:

θ_{amb} = 50°C

From the tables find the following constants:

S = 70.5 dm² (find in the table)
 R_s = 0.66 mΩ

The hot spot temperature in this example is therefore:

θ_{HS} = 56.8°C

MTBF CALCULATION (see page 5)

For a train application (4) in favorable conditions (1) in accordance to IEC 61071 (2)

V_w = 0.9 V_n (400,000 h of expected lifetime)

θ_{HS} = 56.8°C

$$\lambda = \lambda_B \times 2 \times 4 \times 1$$

$$\lambda = 9 \times 10^{-9} \text{ failures/hour}$$

MTBF = 111 x 10⁶ hours

CALORIFIC VALUE (see page 8)

L = 340 (13.386) millimeters (inches)
 W = 165 (6.496)
 H = 640 (25.197)
 N = 2

CV#1506MJ

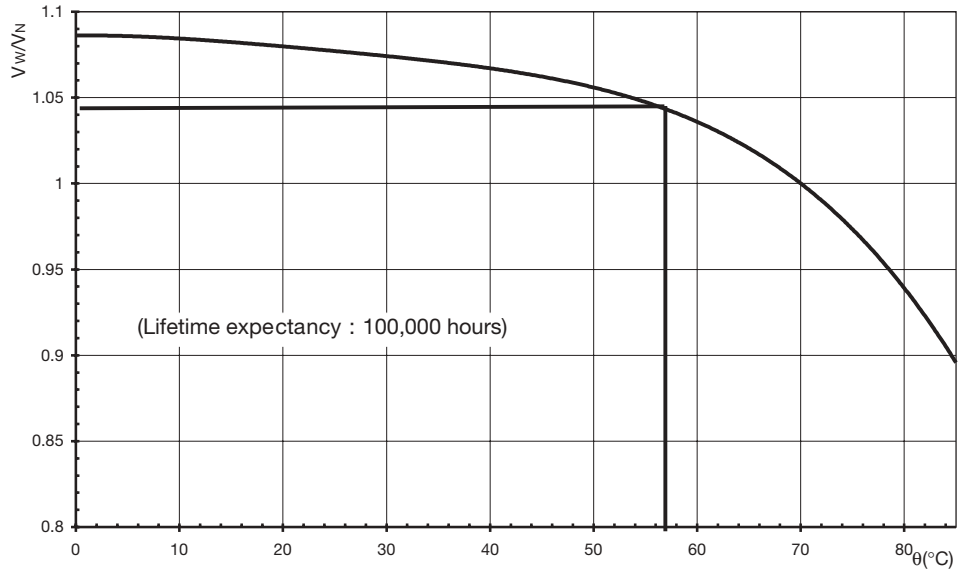
P/N TO ORDER

DKTFM2K006127

LIFETIME EXPECTANCY DESIGN

CURVE 1

V_w/V_n vs
Hot spot temperature



The highest V_w/V_n ratio ($= \rho_{max}$) for a lifetime of 100,000 hours can be deduced from Curve 1.

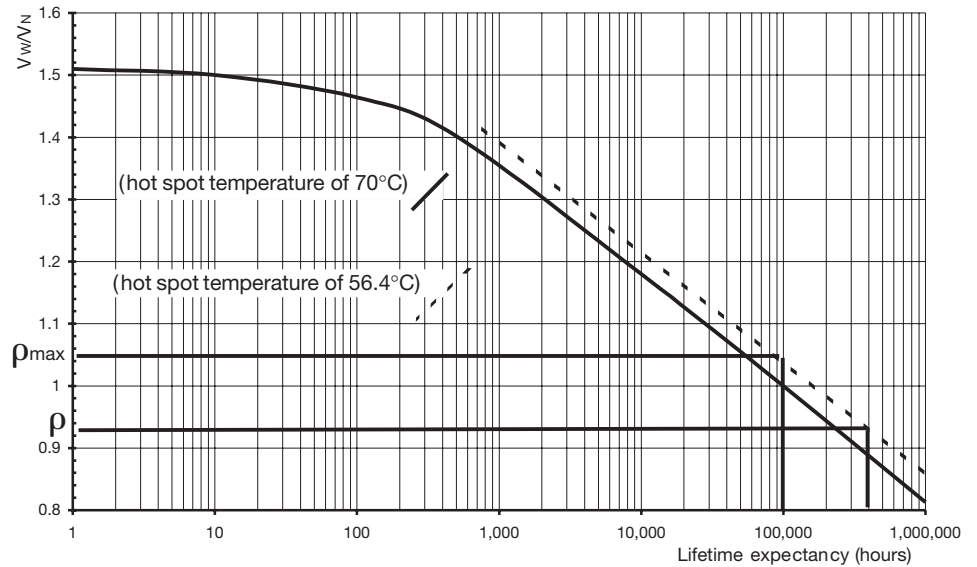
$$\rho_{max} = V_{wmax}/V_n = 1.040$$

$$\text{so } V_{wmax} = 2080 \text{ V } (= 1.040 \times 2000)$$

(for $\theta_{HS} = 56.8^\circ\text{C}$ and 100,000 hours)

CURVE 2

V_w/V_n vs Lifetime
expectancy



According to Curve 2, theoretical lifetime expectancy at $V_w = 1876 \text{ V}$ and $\theta_{HS} = 56.8^\circ\text{C}$ can be determined.

This gives a lifetime of **400,000 hours** for this capacitor under working conditions. This value is explained by the choice of $V_n \gg V_w$.

APPLICATIONS

DC voltage filtering for:

- DC link
- Resonant filtering
- Active correction (*FACTS, UPFC, DVR...*)
- Speed converters (drives and traction)
- Windmills
- Substation

PACKAGING

Rectangular stainless steel case sandblasted. Grounding is via a threaded screw located on the cover of the case.

PRESENTATION



ELECTRICAL CHARACTERISTICS

Capacitance range C_n	83 μ F to 15300 μ F
Tolerance on C_n ($\pm 5\%$ or $\pm 2\%$ available for specific requirements)	$\pm 10\%$
DC voltage range	1200V to 6000V
Maximum hot-spot temperature	85°C
Life duration at nominal voltage and 70°C hot-spot temperature	100,000 hours
Stray inductance	200nH to 430nH
On option low inductance for IGBT and other applications	down to 40nH
Test voltage between terminals	1.5 V_n during 10s
Test voltage between short terminals and case	10kV _{rms} (at 50Hz during 1mn)
Standard reference	Conforms with IEC 61071, 61881 and 61373, IEC 60068 and IEC 60077

For specific products out of this catalog, please fill out the Guide for Customer's Specific Requirement on page 30.

TABLE OF VALUES

L x Wmm (inches)		Base 166 (6.535) x 152 (5.984) Stainless Steel Case						
Hmm (inches)	250 (9.843)	340 (13.386)	435 (17.126)	530 (20.866)	620 (24.409)	715 (28.150)	805 (31.693)	855 (33.661)
Weight (kg)	10.5	13	16	19	22	25	28	29.5
S (dm ²)	18	24	30	36	44.5	48	54	57
Vn (V)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)	$I_{max}^{(A)}$ C (μF) Rs (mΩ)
1200 →1400	1580 1.41	2210 1.17	3160 1.01	3790 0.96	4740 0.92	5370 0.91	6320 0.90	6640 0.89
1800	⁽²⁰²⁾ 1040 1.64	1460 1.33	2080 1.13	2500 1.06	3120 1.01	3540 0.99	4160 0.97	4370 0.97
2000	⁽¹⁸⁰⁾ 825 1.79	⁽²⁵²⁾ 1160 1.44	1650 1.20	1980 1.13	2480 1.06	2810 1.04	3300 1.01	3470 1.01
2200	⁽¹⁶⁶⁾ 700 1.91	⁽²³²⁾ 980 1.52	1400 1.26	1680 1.18	2100 1.10	2380 1.07	2800 1.05	2940 1.04
2450	⁽¹⁴⁸⁾ 560 2.09	⁽²⁰⁷⁾ 780 1.65	1120 1.36	1340 1.25	1680 1.17	1900 1.13	2240 1.10	2350 1.09
2650	⁽¹³⁵⁾ 470 2.24	⁽¹⁹⁰⁾ 655 1.76	940 1.43	1130 1.32	1410 1.22	1600 1.18	1880 1.14	1980 1.13
2900	⁽¹²⁴⁾ 395 2.41	⁽¹⁷¹⁾ 550 1.88	⁽²⁴⁹⁾ 790 1.52	950 1.39	1180 1.28	1340 1.23	1580 1.19	1600 1.18
3100	⁽¹¹⁷⁾ 350 2.53	⁽¹⁶⁴⁾ 490 1.97	⁽²³⁴⁾ 700 1.58	840 1.44	1050 1.32	1190 1.27	1400 1.22	1470 1.21
3300	⁽¹⁰⁹⁾ 305 2.68	⁽¹⁵³⁾ 430 2.07	⁽²¹⁹⁾ 610 1.65	735 1.50	915 1.37	1040 1.31	1220 1.26	1290 1.25
3500	⁽¹⁰³⁾ 275 2.81	⁽¹⁴⁵⁾ 385 2.17	⁽²⁰⁷⁾ 550 1.72	⁽²⁴⁸⁾ 660 1.56	825 1.41	935 1.36	1100 1.30	1150 1.29
3650	⁽⁹⁸⁾ 245 2.94	⁽¹³⁷⁾ 345 2.26	⁽¹⁹⁶⁾ 490 1.78	⁽²³⁵⁾ 590 1.61	735 1.46	835 1.40	980 1.33	1030 1.32
4000	⁽¹⁸⁰⁾ 194 1.80	⁽²⁵⁰⁾ 272 1.45	388 1.21	465 1.13	582 1.07	660 1.04	776 1.02	815 1.01
4350	⁽¹⁶⁶⁾ 165 1.92	⁽²³³⁾ 231 1.53	330 1.27	396 1.18	495 1.11	561 1.08	660 1.05	693 1.05
4900	⁽¹⁴⁸⁾ 131 2.11	⁽²⁰⁷⁾ 183 1.67	262 1.37	313 1.26	392 1.17	444 1.14	524 1.11	548 1.10
5300	⁽¹³⁵⁾ 110 2.26	⁽¹⁹⁰⁾ 154 1.77	220 1.44	264 1.33	330 1.23	374 1.19	440 1.15	462 1.14
5800	⁽¹²⁴⁾ 93 2.43	⁽¹⁷⁴⁾ 130 1.90	186 1.53	222 1.40	277 1.28	315 1.24	372 1.20	391 1.18
6000	⁽¹¹⁷⁾ 83 2.54	⁽¹⁶⁴⁾ 116 1.98	166 1.59	198 1.45	248 1.33	280 1.28	332 1.23	349 1.22

Unless specified $I_{max} = 255A$

TABLE OF VALUES

L x Wmm (inches)		Base 340 (13.386) x 125 (4.921) Stainless Steel Case						
Hmm (inches)	250 (9.843)	340 (13.386)	435 (17.126)	530 (20.866)	620 (24.409)	715 (28.150)	805 (31.693)	855 (33.661)
Weight (kg)	16	21	26	31	35.5	40.5	45	47.5
S (dm ²)	27.5	36	45	54	62	71	79	84
Vn (V)	^{(I_{max}(A))} C (μF) Rs (mΩ)	^{(I_{max}(A))} C (μF) Rs (mΩ)	^{(I_{max}(A))} C (μF) Rs (mΩ)	^{(I_{max}(A))} C (μF) Rs (mΩ)	^{(I_{max}(A))} C (μF) Rs (mΩ)	^{(I_{max}(A))} C (μF) Rs (mΩ)	^{(I_{max}(A))} C (μF) Rs (mΩ)	^{(I_{max}(A))} C (μF) Rs (mΩ)
1200 → 1400	2370 1.07	3790 0.85	5220 0.77	6640 0.73	7590 0.71	9000 0.70	10500 0.69	10900 0.69
1800	1560 1.23	2500 0.95	3430 0.84	4370 0.78	5000 0.76	5930 0.74	6870 0.73	7180 0.73
2000	⁽²⁵⁰⁾ 1240 1.33	1980 1.01	2730 0.88	3470 0.82	3970 0.80	4710 0.77	5460 0.76	5710 0.75
2200	⁽²³²⁾ 1050 1.41	1680 1.06	2310 0.92	2940 0.85	3360 0.82	4000 0.79	4620 0.78	4830 0.77
2450	⁽²⁰⁶⁾ 835 1.53	1340 1.14	1840 0.98	2340 0.89	2680 0.86	3180 0.83	3680 0.81	3840 0.80
2650	⁽¹⁹⁰⁾ 705 1.63	1130 1.20	1550 1.02	1980 0.93	2260 0.89	2680 0.86	3100 0.83	3250 0.83
2900	⁽¹⁷⁴⁾ 590 1.74	945 1.27	1300 1.07	1660 0.97	1890 0.93	2250 0.89	2600 0.86	2720 0.85
3100	⁽¹⁶⁴⁾ 526 1.82	845 1.32	1160 1.11	1480 1.00	1690 0.95	2010 0.91	2320 0.88	2430 0.87
3300	⁽¹⁵³⁾ 460 1.926	⁽²⁴⁴⁾ 735 1.38	1010 1.16	1290 1.04	1470 0.99	1750 0.94	2030 0.90	2120 0.90
3500	⁽¹⁴⁴⁾ 410 2.00	⁽²³¹⁾ 655 1.44	900 1.19	1150 1.07	1310 1.01	1560 0.96	1800 0.92	1890 0.92
3650	⁽¹³⁷⁾ 367 2.10	⁽²¹⁹⁾ 590 1.49	810 1.24	1030 1.10	1180 1.04	1400 0.98	1620 0.95	1690 0.94
4000	⁽²⁵⁰⁾ 290 1.34	465 1.02	640 0.89	810 0.82	930 0.80	1100 0.77	1280 0.76	1340 0.76
4350	⁽²³⁰⁾ 247 1.42	395 1.07	543 0.93	690 0.85	790 0.82	940 0.80	1090 0.78	1140 0.78
4900	⁽²⁰⁵⁾ 196 1.54	315 1.14	430 0.98	550 0.90	630 0.86	745 0.83	865 0.81	905 0.81
5300	⁽¹⁹⁰⁾ 165 1.64	265 1.21	365 1.03	465 0.93	530 0.90	630 0.86	730 0.84	760 0.83
5800	⁽¹⁷⁴⁾ 139 1.75	222 1.28	305 1.08	389 0.98	445 0.93	528 0.89	612 0.86	640 0.86
6000	⁽¹⁶⁴⁾ 124 1.83	198 1.33	273 1.12	347 1.00	397 0.96	472 0.91	546 0.88	570 0.88

Unless specified I_{max} = 255A

TABLE OF VALUES

L x Wmm (inches)		Base 340 (13.386) x 152 (5.984) Stainless Steel Case						
Hmm (inches)	250 (9.843)	340 (13.386)	435 (17.126)	530 (20.866)	620 (24.409)	715 (28.150)	805 (31.693)	855 (33.661)
Weight (kg)	19	24.5	30.5	36	41.5	47.5	53	56
S (dm ²)	30	39	48	57	66	76	84	89
Vn (V)	(I _{max} (A)) C (μF) Rs (mΩ)	(I _{max} (A)) C (μF) Rs (mΩ)	(I _{max} (A)) C (μF) Rs (mΩ)	(I _{max} (A)) C (μF) Rs (mΩ)	(I _{max} (A)) C (μF) Rs (mΩ)	(I _{max} (A)) C (μF) Rs (mΩ)	(I _{max} (A)) C (μF) Rs (mΩ)	(I _{max} (A)) C (μF) Rs (mΩ)
1200 → 1400	3160 0.92	4420 0.79	6320 0.72	7580 0.69	9480 0.67	10800 0.67	12700 0.66	13300 0.66
1800	2080 1.03	2920 0.88	4160 0.78	5000 0.74	6240 0.72	7080 0.71	8320 0.70	8740 0.69
2000	1650 1.11	2320 0.93	3300 0.81	3960 0.77	4960 0.74	5620 0.73	6600 0.72	6940 0.72
2200	1400 1.17	1960 0.97	2800 0.84	3360 0.80	4200 0.76	4760 0.75	5600 0.74	5880 0.73
2450	1120 1.26	1560 1.04	2240 0.89	2680 0.84	3360 0.80	3800 0.78	4480 0.76	4700 0.76
2650	940 1.33	1310 1.09	1880 0.93	2260 0.87	2820 0.82	3200 0.80	3760 0.78	3960 0.78
2900	⁽²⁴⁸⁾ 790 1.41	1100 1.15	1580 0.97	1900 0.91	2360 0.85	2680 0.83	3160 0.81	3320 0.80
3100	⁽²³⁴⁾ 700 1.48	980 1.20	1400 1.00	1680 0.93	2100 0.87	2380 0.85	2800 0.82	2940 0.82
3300	⁽²¹⁸⁾ 610 1.55	860 1.25	1220 1.04	1470 0.96	1830 0.90	2080 0.87	2440 0.84	2580 0.84
3500	⁽²⁰⁶⁾ 550 1.61	770 1.29	1100 1.07	1320 0.99	1650 0.92	1870 0.89	2200 0.86	2300 0.85
3650	⁽¹⁹⁶⁾ 490 1.68	690 1.34	980 1.11	1180 1.02	1470 0.94	1670 0.91	1960 0.88	2060 0.87
4000	388 1.11	544 0.94	776 0.82	930 0.78	1160 0.75	1320 0.73	1550 0.72	1630 0.72
4350	330 1.17	462 0.98	660 0.85	792 0.80	990 0.77	1120 0.75	1320 0.74	1390 0.74
4900	262 1.26	366 1.04	524 0.89	626 0.84	784 0.77	888 0.78	1050 0.76	1100 0.76
5300	220 1.34	308 1.10	440 0.93	528 0.88	660 0.82	748 0.80	880 0.79	924 0.78
5800	186 1.43	260 1.16	372 0.98	444 0.91	554 0.85	630 0.83	742 0.81	782 0.80
6000	⁽²³⁵⁾ 166 1.48	232 1.20	332 1.01	396 0.94	496 0.87	560 0.85	664 0.83	698 0.82

Unless specified I_{max} = 255A

TABLE OF VALUES

L x Wmm (inches)		Base 340 (13.386) x 165 (6.496) Stainless Steel Case						
Hmm (inches)	250 (9.843)	340 (13.386)	435 (17.126)	530 (20.866)	620 (24.409)	715 (28.150)	805 (31.693)	855 (33.661)
Weight (kg)	20.5	26	32.5	38.5	44.5	51	57	60
S (dm ²)	31	40	50	59	68	79	87	92
Vn (V)	$I_{max(A)}$ C (μF) Rs (mΩ)	$I_{max(A)}$ C (μF) Rs (mΩ)	$I_{max(A)}$ C (μF) Rs (mΩ)	$I_{max(A)}$ C (μF) Rs (mΩ)	$I_{max(A)}$ C (μF) Rs (mΩ)	$I_{max(A)}$ C (μF) Rs (mΩ)	$I_{max(A)}$ C (μF) Rs (mΩ)	$I_{max(A)}$ C (μF) Rs (mΩ)
1200 → 1400	3820 0.83	5350 0.73	6880 0.69	9170 0.66	10700 0.65	13000 0.64	14500 0.64	15300 0.63
1800	2510 0.93	3520 0.80	4520 0.74	6030 0.70	7040 0.68	8540 0.67	9540 0.67	10100 0.67
2000	2000 0.99	2800 0.85	3600 0.78	4800 0.73	5600 0.71	6800 0.69	7600 0.69	8000 0.69
2200	1700 1.04	2380 0.88	3060 0.81	4080 0.75	4760 0.73	5780 0.71	6460 0.70	6800 0.70
2450	1350 1.11	1890 0.94	2430 0.84	3240 0.78	3780 0.76	4590 0.74	5130 0.73	5400 0.72
2650	1140 1.18	1590 0.98	2050 0.88	2720 0.81	3180 0.78	3860 0.76	4310 0.75	4540 0.74
2900	950 1.24	1330 1.03	1710 0.92	2280 0.84	2660 0.81	3230 0.78	3610 0.77	3800 0.76
3100	850 1.29	1190 1.06	1530 0.95	2040 0.86	2380 0.82	2890 0.79	3230 0.78	3400 0.78
3300	740 1.36	1040 1.11	1340 0.98	1780 0.88	2070 0.85	2520 0.81	2810 0.80	2960 0.79
3500	660 1.41	925 1.15	1190 1.01	1590 0.91	1850 0.87	2250 0.83	2510 0.81	2640 0.81
3650	⁽²⁴⁴⁾ 590 1.47	830 1.19	1070 1.05	1430 0.93	1660 0.89	2020 0.85	2260 0.83	2370 0.82
4000	470 1.00	655 0.85	845 0.78	1120 0.73	1310 0.71	1600 0.70	1780 0.69	1870 0.69
4350	400 1.04	560 0.89	720 0.81	960 0.75	1120 0.73	1360 0.71	1520 0.71	1600 0.70
4900	315 1.12	445 0.94	570 0.85	760 0.78	885 0.76	1080 0.74	1200 0.73	1270 0.73
5300	266 1.18	375 0.99	480 0.89	640 0.81	750 0.78	905 0.76	1010 0.75	1070 0.74
5800	224 1.25	313 1.04	403 0.93	540 0.84	630 0.81	760 0.78	850 0.77	895 0.76
6000	200 1.30	280 1.07	360 0.95	480 0.86	560 0.83	680 0.80	760 0.78	800 0.78

Unless specified $I_{max} = 255A$

Custom

DESIGN EXAMPLE

Previously, we gave all the basic information to design a capacitor. Now we apply these formulations on an example.

V_n DETERMINATION (see page 4)

millimeters (inches)

C = 2000 μF
 DC voltage = 2800 V
 F = 33 Hz
 I_{rms} = 233 A

In accordance to data:
 V_r = 1590 V
 V_w = 2800 + 1590/2 = 3595V

Solution:

C_n = 2060μF (page 21)
 V_n = 3650 V
 V_r = 0.45 x 3650 = 1642 V max.
 L x W = 340 x 152 (13.386 x 5.984)
 H = 855 (33.661)

HOT SPOT TEMPERATURE CALCULATION (see page 4)

θ_{amb} = 50°C with natural convection

From tables of values:

S = 89dm² (Found in the table)
 R_S = 0.87mΩ (page 21)

The hot spot temperature is therefore:

θ_{HS} = 68.7°C

MTBF CALCULATION (see page 5)

For a train application (4) in favorable conditions (1) in accordance to IEC 61071 (2)
 V_w = 0.985 V_n (105,000 h of expected lifetime)
 θ_{HS} = 68.7°C

λ = λ_Bx2x4x1

λ = 49.3x10⁻⁹ failures/hour

MTBF = 20.3 x 10⁶ hours

CALORIFIC VALUE (see page 8)

millimeters (inches)

L = 340 (13.386)
 W = 152 (5.984)
 H = 855 (33.661)
 N = 2

CV#1827.5MJ

PARASITIC INDUCTANCE

Maximum inductance for products (with 2 terminals)

millimeters (inches)

L x W millimeters (inches)	Ls (nH)
166 x 152 (6.535 x 5.984)	150 (nH) + 0.45 (0.018) x H
340 x 125 (13.386 x 4.921)	150 (nH) + 0.30 (0.012) x H
340 x 152 (13.386 x 5.984)	150 (nH) + 0.23 (0.009) x H
340 x 165 (13.386 x 6.378)	150 (nH) + 0.18 (0.007) x H

This inductance can be reduced by approximately 75nH by using 4 terminals instead of 2 (see mechanical design chapter). If this solution does not reduce the inductance sufficiently, we suggest taking the low inductance option (down to 40nH).

TERMINALS AND CONNECTIONS

Epoxide terminals, mechanically assembled by O-ring. 9 solutions of terminals are offered, the most standard is type 2. On specific requirements we can propose other solutions depending on the waited function.

BRACKETS

The capacitor may or may not be equipped with mounting brackets. They are shown on page 25.

LOW INDUCTANCE OPTION

Please note that the low inductance option will increase width as well as weight:

W + 10mm

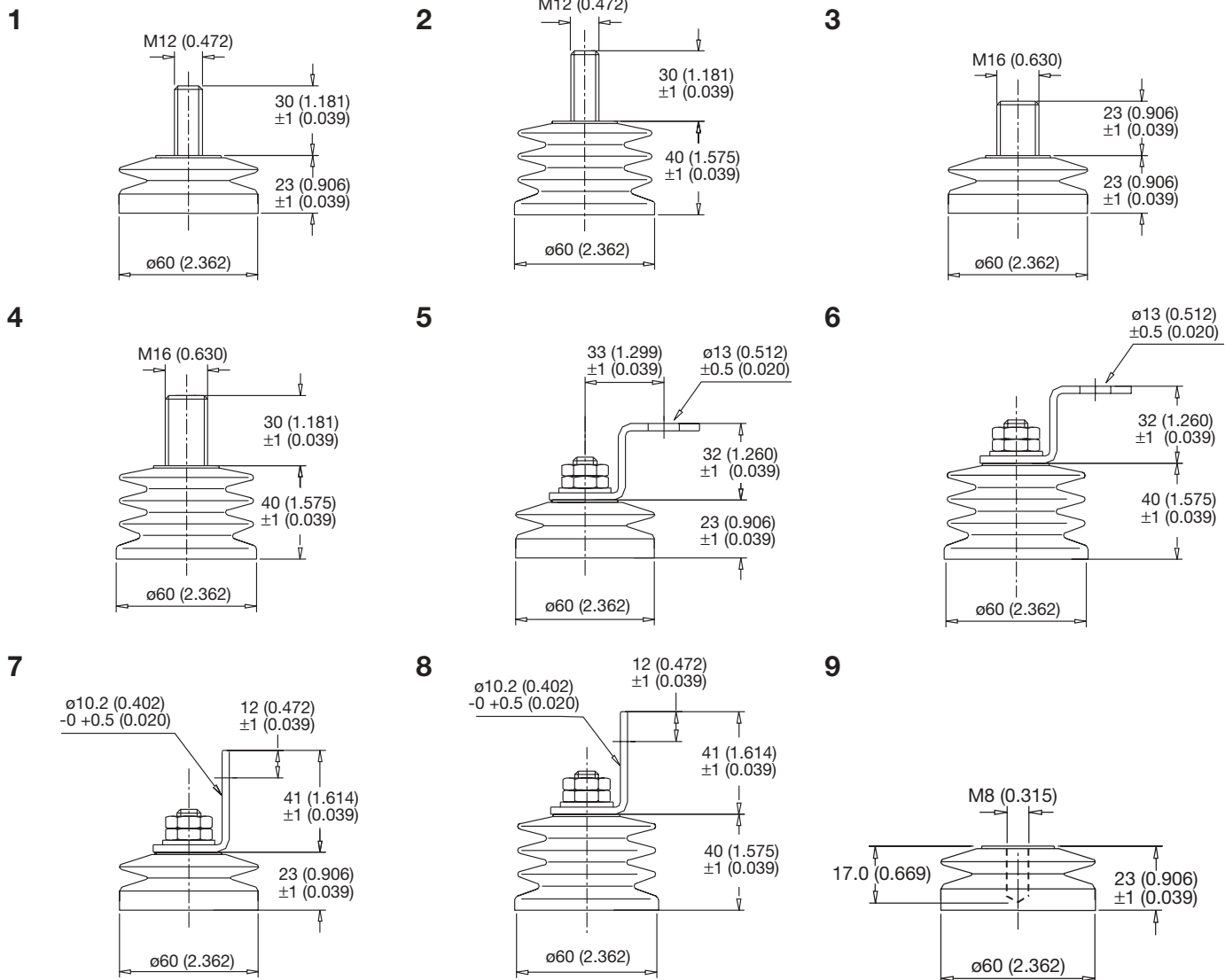
Weight +10% (approximately)

Terminals

4 terminals will be used instead of 2.

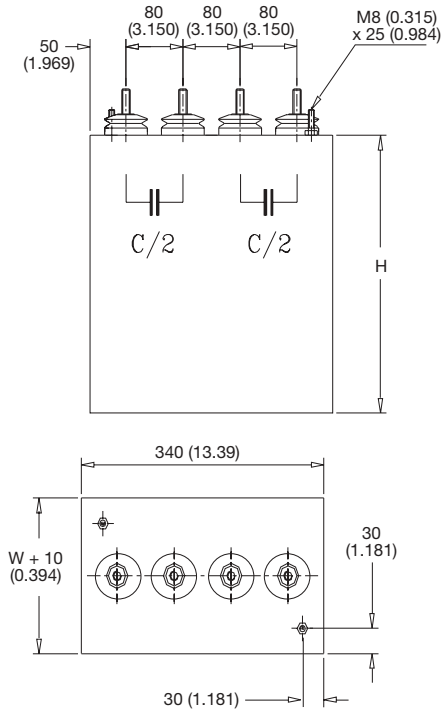
millimeters (inches)

Body	Creepage distance	Air distance
2 waves	52 (2.047)	30 (1.181)
4 waves	78 (3.071)	50 (1.969)

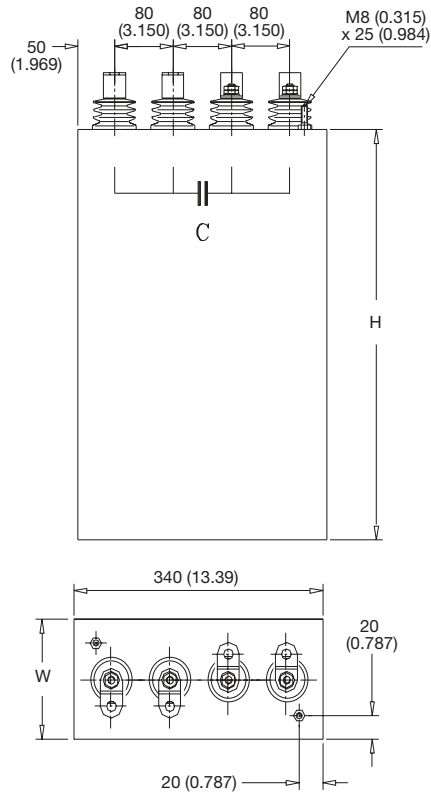


MECHANICAL DESIGN

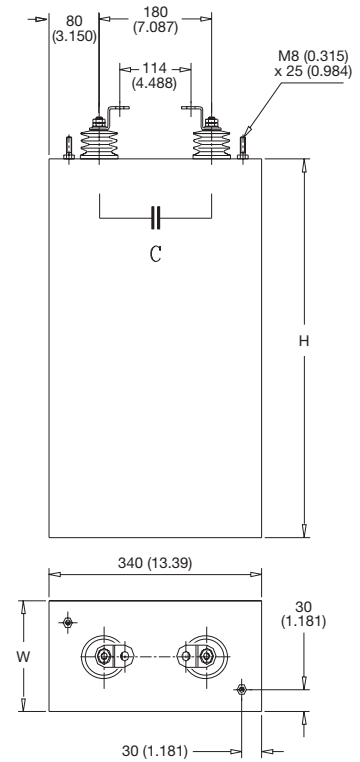
Low Inductance Option



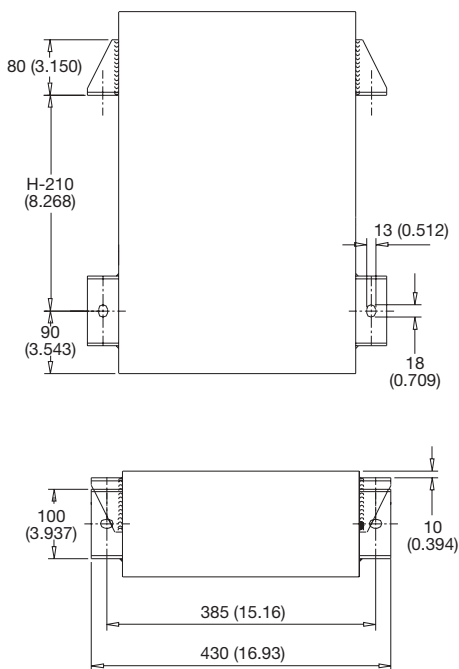
4 Terminals Option



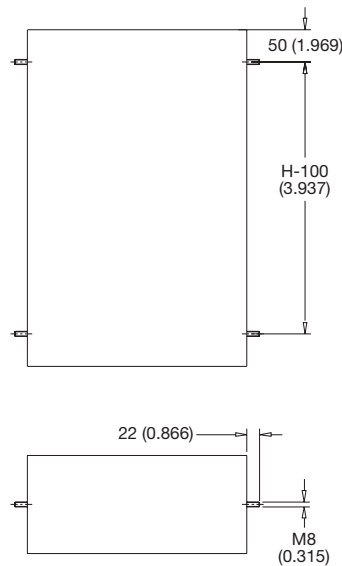
Standard Design



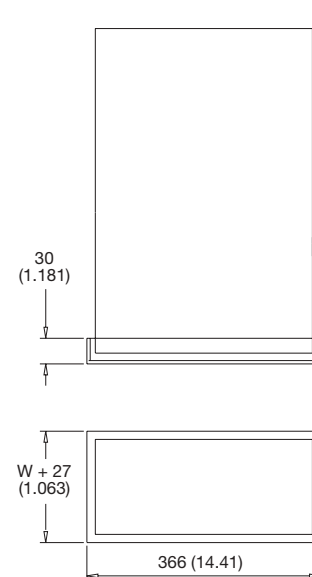
**Mounting Brackets (M)
(suggested)
Lower Brackets Removed
for H < 500 mm**



**Bolts M (B)
(possible)**



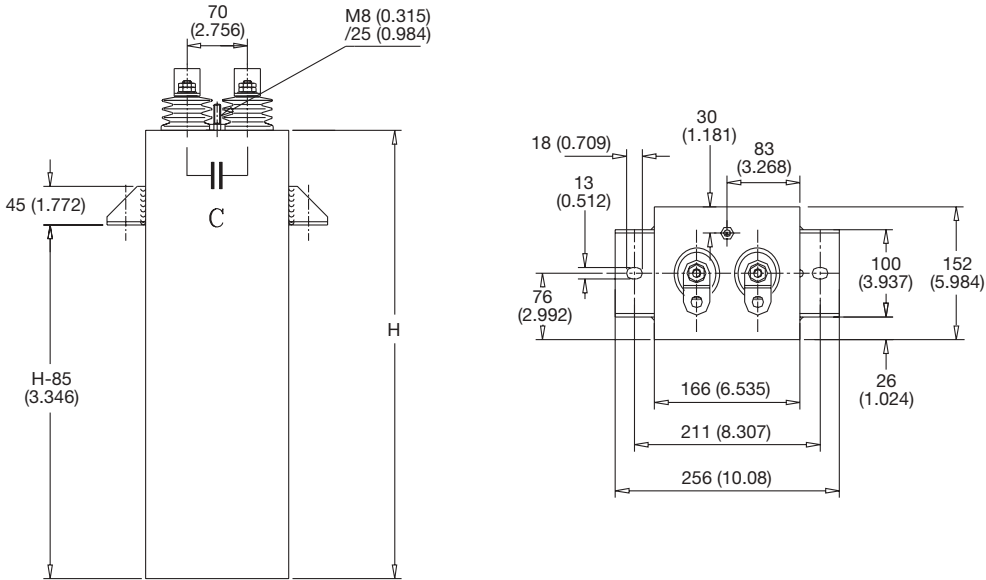
**Bed Plate (P)
(possible)**



MECHANICAL DESIGN

SMALL BASE TRAFIMS 166 x 152 (6.535 x 5.984)

These capacitors can only be equipped with two terminals and therefore are not available in low inductance four terminals version. Brackets are also specific.



APPLICATIONS

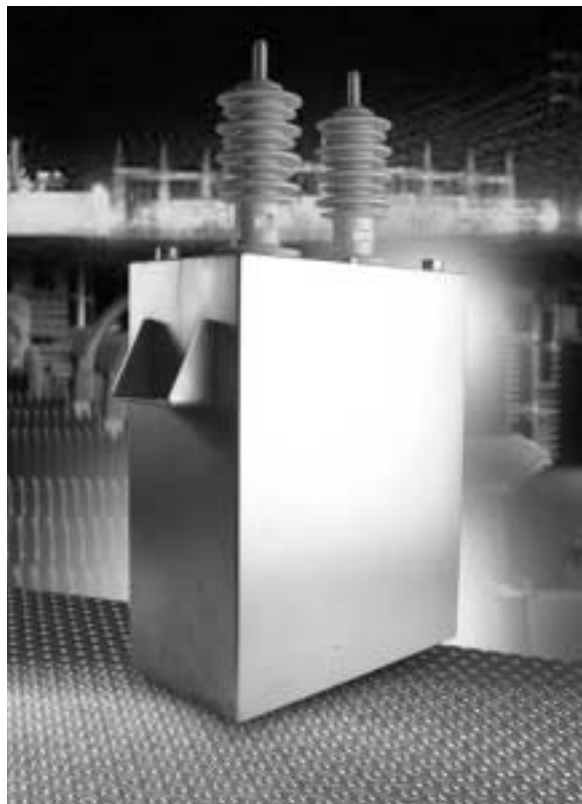
DC voltage filtering for:

- DC link
- Resonant filtering
- Active correction (*FACTS, UPFC, SVC . . .*)
- HVDC
- High Power DC Supply

PACKAGING

Rectangular stainless steel case sandblasted. Grounding is via threaded nuts located on the cover of the case.

PRESENTATION



ELECTRICAL CHARACTERISTICS

Capacitance range C_n	2.6 μ F to 612 μ F
Tolerance on C_n ($\pm 5\%$ or $\pm 2\%$ available for specific requirements)	$\pm 10\%$
DC voltage range	6500V to 75kV
Maximum hot-spot temperature	85°C
Life duration at nominal voltage and 70°C hot-spot temperature	100,000 hours
Test voltage between terminals	1.5V _n during 10s
Test voltage between short terminals and case	V _{tcase} = 1.5V for 60s
Standard reference	Conforms with IEC 61071

For specific products out of this catalog, please fill out the Guide for Customer's Specific Requirement on page 30.

Table of Values

L x Wmm (inches)		Base 350 (13.780) x 185 (7.283) Stainless Steel Case					
Hmm (inches)		315 (12.402)	410 (16.142)	500 (19.685)	595 (23.425)	685 (26.969)	770 (30.315)
Weight (kg)		29	36	43	50	57	63
S (dm ²)		40	50	60	70	80	89
V _n (V)	terminal	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)
6500	type 1	188 3.4	275 3.3	362 3.2	450 3.2	537 3.1	612 3.1
7900	type 1	126 3.6	184 3.4	242 3.3	300 3.2	359 3.2	410 3.2
9000	type 1	95 3.7	138 3.4	181 3.3	225 3.3	269 3.2	307 3.2

$$L_s = 0.166 \times H \text{ mm (inches)} + L_{\text{terminals}}$$

10500	type 1	73 5.8	107 5.0	140 4.6	174 4.4	208 4.3	237 4.3
12000	type 1	55 6.2	80 5.3	105 4.9	130 4.6	155 4.5	177 4.4
14500	type 1	37.5 5.6	55 4.9	72 4.6	89 4.4	106 4.3	121 4.2
15800	type 1	31.5 5.9	46 5.1	60.5 4.7	75 4.5	89 4.4	102.5 4.3
18000	type 2	19.5 7.8	30 6.5	45 5.9	51 5.6	62 5.4	72 5.3
28000	type 2	5.8 6.8	9 5.9	12 5.5	15.5 5.2	18.3 5.1	21.5 5.1

$$L_s = 0.166 \times H \text{ mm (inches)} + L_{\text{terminals}}$$

L x Wmm (inches)		Base 520 (20.472) x 185 (7.283) Stainless Steel Case					
Hmm (inches)		315 (12.402)	410 (16.142)	500 (19.685)	595 (23.425)	685 (26.969)	770 (30.315)
Weight (kg)		41	52	62	72	82	91
S (dm ²)		54	67	80	93	106	118
V _n (V)	terminal	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)
22000	type 2	20 8.9	31.5 7.2	42.5 6.6	54 6.2	65 6.0	75 5.9
26000	type 2	14.2 9.8	22.5 7.8	30 7.0	38 6.6	46 6.3	53 6.2
42000	type 3	3.5 5.5	5.6 8	7.7 7.2	9.8 6.9	12 6.7	14 6.6

$$L_s = 0.249 \times H \text{ mm (inches)} + L_{\text{terminals}}$$

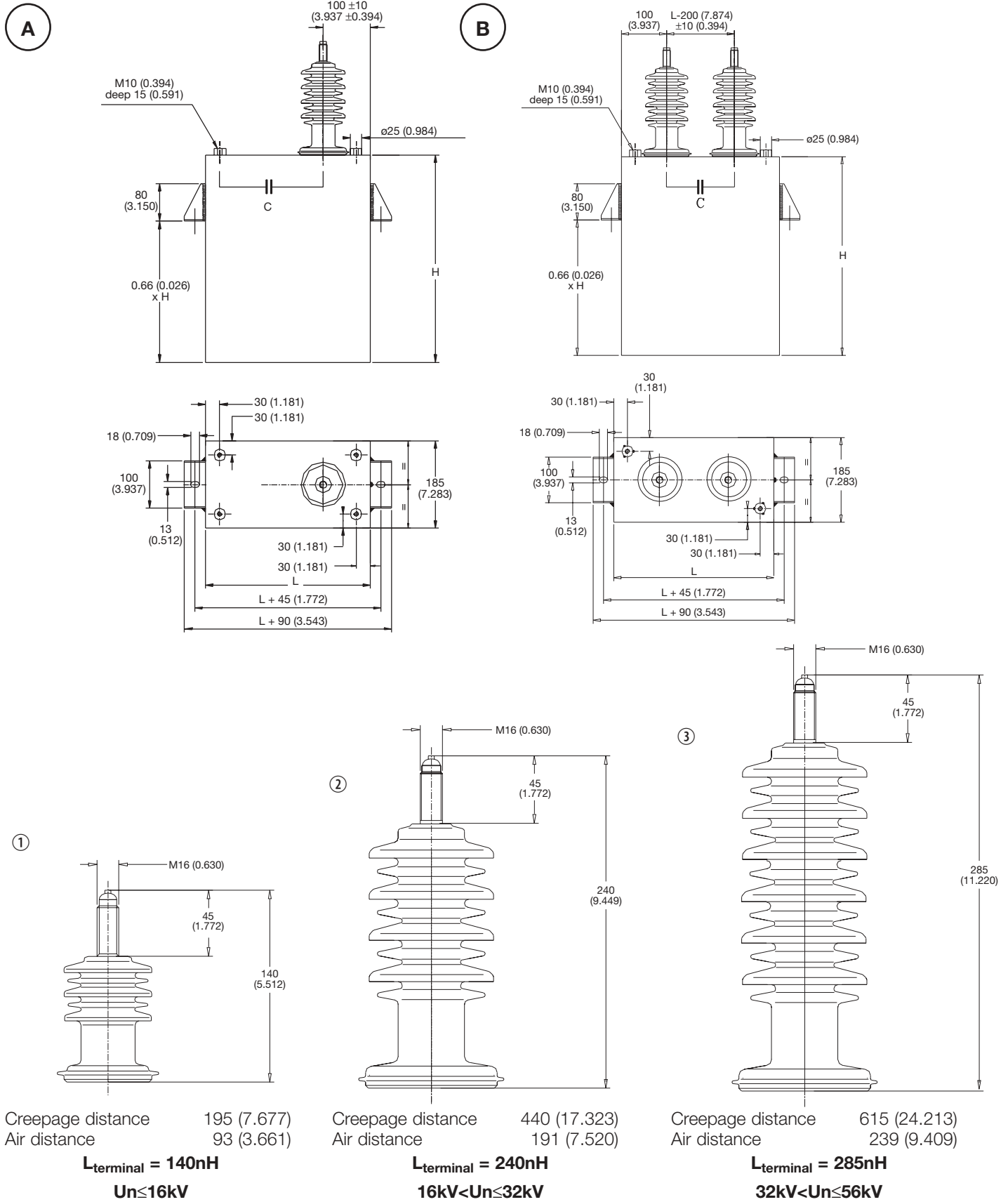
L x Wmm (inches)		Base 695 (27.362) x 185 (7.283) Stainless Steel Case					
Hmm (inches)		315 (12.402)	410 (16.142)	500 (19.685)	595 (23.425)	685 (26.969)	770 (30.315)
Weight (kg)		54	68	81	95	108	119
S (dm ²)		68	85	101	117	133	148
V _n (V)	terminal	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)	C (μF) Rs (mΩ)
32000	type 2	12.8 11.2	20 8.8	27 7.9	34 7.4	41 7.1	47 6.9
36000	type 3	9 13.5	14.2 10.5	19.3 9.3	24.8 8.6	30 8.2	35.5 7.9
56000	type 3	2.6 11.6	4.2 9.2	5.7 8.3	7.3 7.8	8.8 7.5	10.3 7.4

$$L_s = 0.332 \times H \text{ mm (inches)} + L_{\text{terminals}}$$

Unless specified I_{max} = 120A

For higher voltages (56 kV < U_n < 75kV) please fill out the FIM Products guide for customer's specific requirements on page 30.

Mechanical Design



Guide for Customer's Specific Requirements

This questionnaire lists the information we require to prepare an offer according to your exact requirements.

Company _____

Name _____ Phone number _____

Department _____ Fax number _____

Address _____ E-mail _____

Here is a guide to help you in making your request. Please inform the available characteristics and design specifications.

ELECTRICAL CHARACTERISTICS

Capacitance (C) _____ μ F

Tolerance (%) _____ %

DC voltage (V_{dc}) _____ V

Ripple voltage (V_r) _____ V

Working frequency (f) _____ Hz

Working current (I_{rms}) _____ A

Maximum current (I_{max}) _____ A

Maximum peak current (I_{peak}) _____ A

Maximum inductance (L_s) _____ nH

Test voltage between shorted terminals and case (V_{t-case}) _____ V

Test voltage between terminals (V_t) _____ V

Maximum surge voltages _____ V
(voltage Vs/duration t/times N) _____ s/year

Life time expectancy _____ h

THERMAL CHARACTERISTICS

Average temperature _____ $^{\circ}$ C

Operating temperature $\theta_{max}/\theta_{min}$ _____/_____ $^{\circ}$ C

Storage temperature $\theta_{smax}/\theta_{smin}$ _____/_____ $^{\circ}$ C

Natural convection

Forced air

DESCRIPTION

Required shape (rectangular or cylindrical case, mounted unit, etc.)

Max/Min Dimensions

Cross Section:

_____mm x _____mm Height: _____mm
 _____(in.) x _____(in.) Height: _____(in.)

Low inductance option yes no

Required terminals type

Number: _____ Type: (page 24) _____

Operating position

vertical horizontal inclined _____

Environment _____

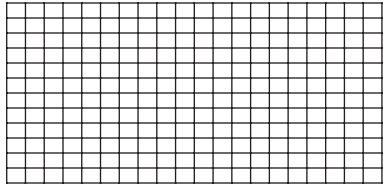
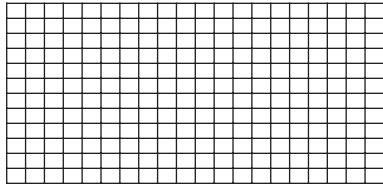
Drawing

Other information and drawing (provide if possible the block diagram of the circuit):

Please copy pages 30 and 31 to send back to your local AVX representative.

Guide for Customer's Specific Requirements

This questionnaire lists the information we require to prepare an offer according to your exact requirements.

Name: _____ Company: _____ Address: _____	Function: _____ Tel.: _____ Fax: _____ email: _____																																																																																																			
Expected dimensions Width: mm (inches) Length: mm (inches) Height: mm (inches)	Capacitance/Tolerance _____ μ F _____ % Charging voltage _____ V																																																																																																			
Expected stray inductance nH	Charging time _____ s Hold time _____ s																																																																																																			
Number of terminals:	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 20%;">Normal conditions</th> <th style="width: 20%;">Faulty conditions</th> <th style="width: 20%;"></th> </tr> </thead> <tbody> <tr> <td rowspan="2">Expected lifetime</td> <td>Hours</td> <td>_____</td> <td></td> </tr> <tr> <td>or</td> <td></td> <td></td> </tr> <tr> <td>Shots</td> <td>_____</td> <td>_____</td> <td></td> </tr> <tr> <td>Peak current</td> <td>_____</td> <td>_____</td> <td style="text-align: right;">A</td> </tr> <tr> <td>Aperiodic</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Pulse duration (5% I_{peak})</td> <td>_____</td> <td>_____</td> <td style="text-align: right;">μs</td> </tr> <tr> <td>Time to I_{max}</td> <td>_____</td> <td>_____</td> <td style="text-align: right;">μs</td> </tr> <tr> <td>Oscillatory</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Reversal voltage</td> <td>_____</td> <td>_____</td> <td style="text-align: right;">%</td> </tr> <tr> <td>Ringing frequency</td> <td>_____</td> <td>_____</td> <td style="text-align: right;">Hz</td> </tr> <tr> <td>Repetition rate</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Single shots</td> <td></td> <td></td> <td></td> </tr> <tr> <td>(Shot / min hour day)</td> <td>_____</td> <td>_____</td> <td></td> </tr> <tr> <td>Burst</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Impulses per burst</td> <td>_____</td> <td>_____</td> <td></td> </tr> <tr> <td>Impulse rep. Rate</td> <td>_____</td> <td>_____</td> <td style="text-align: right;">Hz</td> </tr> <tr> <td>Burst rep. Rate</td> <td>_____</td> <td>_____</td> <td></td> </tr> <tr> <td>(burst / s min hour)</td> <td>_____</td> <td>_____</td> <td></td> </tr> <tr> <td>Operating temperature</td> <td>from _____</td> <td>to _____</td> <td style="text-align: right;">°C</td> </tr> <tr> <td>Storage temperature</td> <td>from _____</td> <td>to _____</td> <td style="text-align: right;">°C</td> </tr> <tr> <td>Cooling conditions</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Natural convection</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Forced air</td> <td></td> <td></td> <td style="text-align: right;">m/s</td> </tr> <tr> <td>Oil</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		Normal conditions	Faulty conditions		Expected lifetime	Hours	_____		or			Shots	_____	_____		Peak current	_____	_____	A	Aperiodic				Pulse duration (5% I_{peak})	_____	_____	μ s	Time to I_{max}	_____	_____	μ s	Oscillatory				Reversal voltage	_____	_____	%	Ringing frequency	_____	_____	Hz	Repetition rate				Single shots				(Shot / min hour day)	_____	_____		Burst				Impulses per burst	_____	_____		Impulse rep. Rate	_____	_____	Hz	Burst rep. Rate	_____	_____		(burst / s min hour)	_____	_____		Operating temperature	from _____	to _____	°C	Storage temperature	from _____	to _____	°C	Cooling conditions				Natural convection				Forced air			m/s	Oil			
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Oil																																																																																																				
Capacitor operating position Upright horizontal tilted	Environment (moisture, vibrations ...)																																																																																																			
Waveforms (U/I)  	Remarks:																																																																																																			

PASSIVES

Capacitors

- Multilayer Ceramic
- Disc Ceramic
- High Voltage Ceramic Film
- Power Film
- Glass
- Microwave/RF Power
- Niobium Oxide
- Porcelain
- Pulse Supercapacitors
- Tantalum
- Trimmers

Circuit Protection

- Fuses
- Thermistors
- Transient Voltage Suppressors
- Zinc Oxide Varistors

Filters

- Ceramic
- EMI
- Low Pass
- Noise
- SAW

Integrated Passive Components

- Multi Value Capacitor Arrays
- Dual & Triple Resonance Chips
- Feedthru Arrays
- InterDigitated Capacitor Arrays
- Low Inductance Chip Arrays

Piezoelectric Acoustic Generators

Resistors

- Chips
- Networks/Arrays
- Leaded

Soft Ferrites

Thin-Film

- Directional Couplers
- Inductors

Timing Devices

- Clock Oscillators
- MHz Quartz Crystals
- Resonators

CONNECTORS

2mm Hard Metric Compact PCI

Automotive

- Plastic Optical Fiber
- Splashproof

Board-to-Board

- 0.050" Torson
- Fine Pitch SMT
- Fine Pitch Thru-Hole
- One Piece Compression

Card-Edge

DIN 41612

FFC/FPC

H Government

IDC Wire-to-Board

Memory Products

- Compact Flash
- Multimedia Card
- PCMCIA
- Secure Digital (SD)
- SIM Card
- Smart Card
- SO-DIMM

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- Battery
- MOBO™

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USA

AVX Myrtle Beach, SC
Corporate Offices
Tel: 843-448-9411
FAX: 843-448-1943

AVX North Central, IN
Tel: 317-848-7153
FAX: 317-844-9314

AVX Southwest, AZ
Tel: 480-539-1496
FAX: 480-539-1501

AVX Southeast, GA
Tel: 404-608-8151
FAX: 770-972-0766

AVX Northwest, WA
Tel: 360-699-8746
FAX: 360-699-8751

AVX Mid/Pacific, MN
Tel: 952-974-9155
FAX: 952-974-9179

AVX South Central, TX
Tel: 972-669-1223
FAX: 972-669-2090

AVX Canada
Tel: 905-564-8959
FAX: 905-564-9728

EUROPE

AVX Limited, England
European Headquarters
Tel: ++44 (0) 1252-770000
FAX: ++44 (0) 1252-770001

AVX/ELCO, England
Tel: ++44 (0) 1638-675000
FAX: ++44 (0) 1638-675001

AVX S.A., France
Tel: ++33 (1) 69-18-46-00
FAX: ++33 (1) 69-28-73-87

AVX GmbH, Germany
Tel: ++49 (0) 8131-9004-0
FAX: ++49 (0) 8131-9004-44

AVX srl, Italy
Tel: ++390 (0)2 614-571
FAX: ++390 (0)2 614-2576

AVX Czech Republic
Tel: ++420 (0) 465-358-111
FAX: ++420 (0) 465-323-010

ASIA-PACIFIC

AVX/Kyocera, Singapore
Asia-Pacific Headquarters
Tel: (65) 6286-7555
FAX: (65) 6488-9880

AVX/Kyocera, Hong Kong
Tel: (852) 2-363-3303
FAX: (852) 2-765-8185

AVX/Kyocera, Korea
Tel: (82) 2-785-6504
FAX: (82) 2-784-5411

AVX/Kyocera, Taiwan
Tel: (886) 2-2696-4636
FAX: (886) 2-2696-4237

AVX/Kyocera, China
Tel: (86) 21-6249-0314-16
FAX: (86) 21-6249-0313

AVX/Kyocera, Malaysia
Tel: (60) 4-228-1190
FAX: (60) 4-228-1196

Elco, Japan
Tel: 045-943-2906/7
FAX: 045-943-2910

Kyocera, Japan - AVX
Tel: (81) 75-604-3426
FAX: (81) 75-604-3425

Kyocera, Japan - KDP
Tel: (81) 75-604-3424
FAX: (81) 75-604-3425

AVX/Kyocera, Shanghai
Tel: 86-21 6886 1000
FAX: 86-21 6886 1010

Tianjin AVX/Kyocera
Tel: 86-22 2576 0098
FAX: 86-22 2576 0096

Contact:

