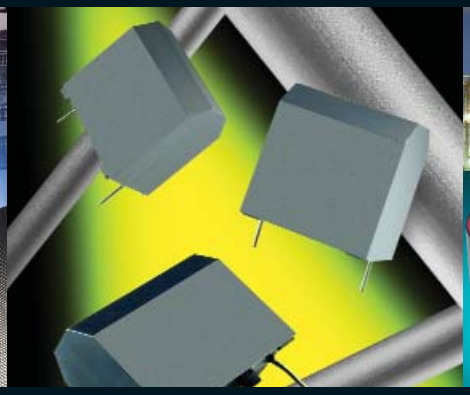
AVX **Medium Power Film Capacitors for Power Applications**



Version 13.8

A KYOCERA GROUP COMPANY

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Contents

Capacitors for Power Electronics

* RoHS Compliant series as standard.

In 1979, TPC (formerly LCC, then THOMSON-CSF PASSIVE COMPONENTS) developed **CONTROLLED SELF-HEALING technology** for medium power capacitors.

These capacitors made great advances over previous technologies by combining the benefits of Controlled Self-Healing process with superior energy densities, making it one of the most compact capacitors on the market for 1/2 CV^2.

TPC produces both dry-wound and impregnated capacitors for medium voltage filtering, covering the whole spectrum from 75Vdc to 3kVdc.

With CONTROLLED SELF-HEALING, the capacitance is divided into several million elementary capacitor elements protected by “fuse gates”. Weak points of the dielectric are insulated and the capacitor continues functioning normally without any short circuit or explosion.

The capacitor acts like a battery. It “consumes” a certain amount of the capacitance through the gradual breakdown of the individual capacitance cells. Over the operating life of the capacitor, the capacitance gradually decreases. At the end of the capacitor’s life, the nominal capacitance will decrease down to either 2%, 5% or can be determined per customer requirements.

Medium Power Film Capacitors

General Description

DC FILTERING

The series uses a dry-wound (non-oil-filled) segmented metallized polypropylene or polyester dielectric, which features the controlled self-healing process, specially treated to have a very high dielectric strength in operating conditions up to 85°C, and up to 105°C for the FFB series.

For more information on how segmented metallized films and controlled self-healing works see a complete presentation.

AN ALTERNATIVE TO ELECTROLYTICS

FF series capacitors are an ideal alternative to electrolytic capacitors, because they can withstand much higher levels of surge voltage, very high rms currents and offer longer lifetimes (see section on lifetime as well as determination tables and application notes).

APPLICATIONS

The FF series capacitors are specifically designed for DC filtering and low reactive power. Main applications are: power supplies, motors, drives, electric utilities, induction heating, people movers, tramways, metro systems, unit supported power supplies, etc.

LIFETIME EXPECTANCY

One unique feature of the segmented metallized technology is how the capacitor acts at the end of its lifetime. Unlike electrolytic capacitors, which are a short circuit failure mode, film capacitors only experience a parametric loss of capacitance of about 2%, with no catastrophic failure mode. The capacitor gradually loses capacitance over its lifetime (like a battery), and eventually becomes an open circuit.

Lifetime, therefore, as it is defined here, is a function of several elements:

- Decrease in capacitance limit (-2% in the example above)
- Average applied voltage (expressed as a ratio vs nominal rated voltage)
- Average hot spot temperature

By changing any of these parameters we can change the defined “lifetime” of the capacitor. The capacitor will continue to function even beyond the preestablished limit for capacitance decrease. See lifetime expectancy tables in the individual series0 data sheets to help in this determination.

STANDARDS

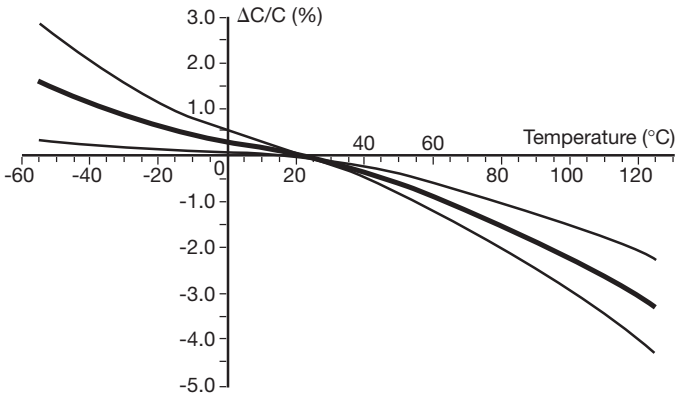
IEC 61071-1, IEC 61071-2:	Power electronic capacitors
IEC 60068-1:	Environmental testing
IEC 60077:	Rules for electric traction equipment
UL 94:	Fire requirements
NF F 16-101:	Fire and smoke requirements
NF F 16-102:	Fire and smoke requirements
IEC 60384-2:	Fixed metallized polyester capacitors
IEC 61881:	Railway applications, rolling stock equipment, capacitors for power electronics

ELECTRICAL CHARACTERISTICS FOR POLYPROPYLENE AND POLYESTER DIELECTRIC

CAPACITANCE FOR POLYPROPYLENE DIELECTRIC

Polypropylene has a constant dielectric constant, irrespective of frequency up to 1 MHz: $\varepsilon_r = 2.2$

POLYPROPYLENE DIELECTRIC CAPACITANCE vs TEMPERATURE



GRAPH 1

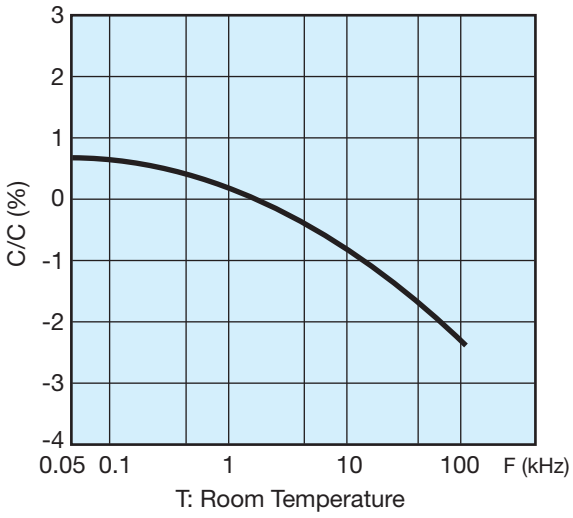
TANGENT OF LOSS ANGLE (TAN δ_0) FOR POLYPROPYLENE DIELECTRIC

Polypropylene has a constant dielectric loss factor of 2×10^{-4} irrespective of temperature and frequency (up to 1 MHz).

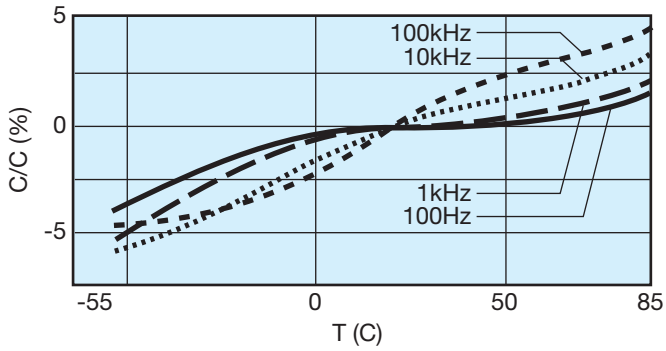
General Description

CAPACITANCE FOR POLYESTER DIELECTRIC

Capacitance of polyester capacitors is a function of temperature and frequency (see the curves).



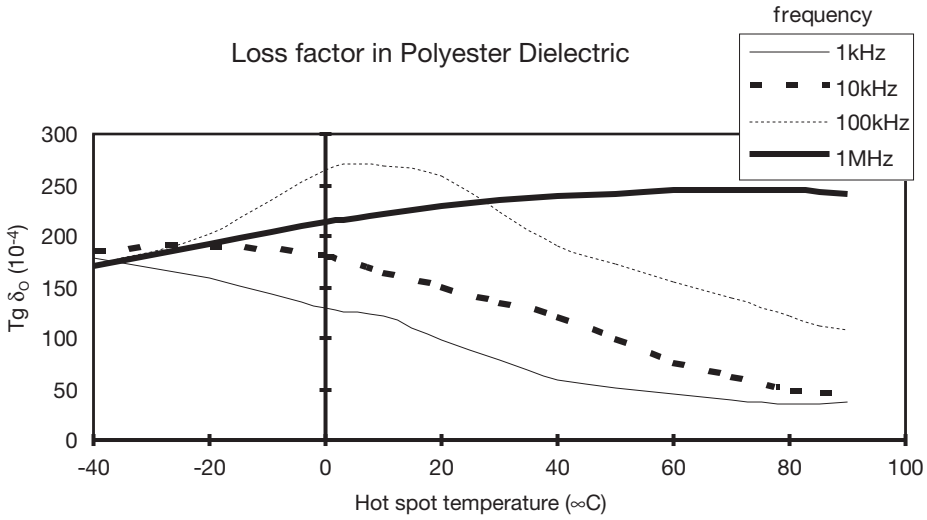
GRAPH 2



GRAPH 3

TANGENT OF LOSS ANGLE (TANδ_0) FOR POLYESTER DIELECTRIC

Dielectric loss factor of polyester is a function of temperature and frequency (see the curves).



GRAPH 4

HOT SPOT TEMPERATURE

The maximum operating (hot spot) temperature of film capacitors can be calculated in the following manner:

The loss factor of the capacitor is made up of the sum of two components. The first represents electrical losses in the dielectric and the second component represents the Joule heating effect in the external connection and foils (Rs.C.2 π f).

For all applications, the temperature in the hot spot must be lower than the maximum operating temperature for the particular capacitor series.

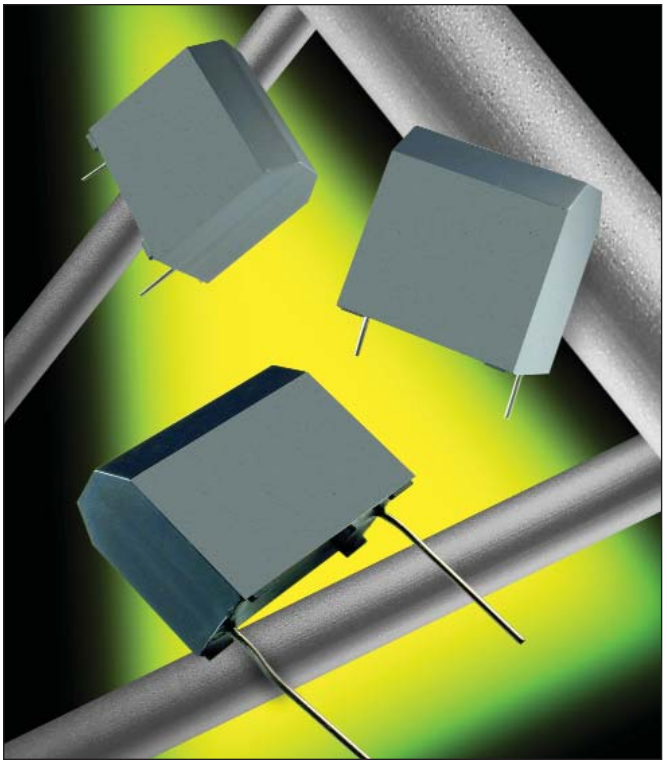
$$\theta_{hot\ spot} = \theta_{ambient} + [tg\delta_0 \cdot Q + R_s \cdot (I_{rms})^2] \cdot R_{th}$$

With:

Q : Reactive power in Var
R_s in Ohm
I_{rms} in Ampere
R_{th} : Rth ambient / hot spot in °C/W
tg $\delta_0 \cdot (10^{-4})$ is the tangent of loss angle [see tan δ_0 page 2 (polypropylene) and graph 4 above (polyester)]

Medium Power Film Capacitors

FFB (RoHS Compliant)



PACKAGING MATERIAL

Self-extinguishing plastic case (V0 = in accordance with UL 94) filled thermosetting resin.

Self-extinguishing thermosetting resin (V0 = in accordance with UL 94; I3F2 = in accordance with NF F 16-101).

STANDARDS

IEC 61071-1, IEC 61071-2:	Power electronic capacitors
IEC 60384-16:	Fixed metallized polypropylene film dielectric DC capacitors
IEC 60384-16-1:	Fixed metallized polypropylene film dielectric DC capacitors Assessment level E
IEC 60384-17:	Fixed metallized polypropylene film dielectric AC and pulse capacitors
IEC 60384-17-1:	Fixed metallized polypropylene film dielectric AC and pulse capacitors Assessment level E
IEC 60384-2:	Fixed metallized polyester capacitors

The FFB series uses a non-impregnated metallized polypropylene or polyester dielectric with the controlled self-healing process, specially treated to have a very high dielectric strength in operating conditions up to 105°C.

The FFB has been designed for printed circuit board mounting. Furthermore, their performances allow to be a very interesting alternative to electrolytic technology because they can withstand much higher levels of surge voltage.

APPLICATIONS

The FFB capacitor is particularly designed for DC filtering, low reactive power.

HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

$\theta_{hot\ spot} = \theta_{ambient} + (P_d + P_t) \times R_{th}$

with P_d (Dielectric losses) = $Q \times tg\delta_0$

$Q \times tg\delta_0 \Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times tg\delta_0$

$tg\delta_0$ (tan delta)

For polypropylene, $tg\delta_0 = 2 \times 10^{-4}$ for frequencies up to 1MHz and is independent of temperatures.

For polyester, $tg\delta_0$ values are shown in graph 4 on page 3.

P_t (Thermal losses) = $R_s \times (I_{rms})^2$

where C_n in Farad, I_{rms} in Ampere, f in Hertz, V in Volt, R_s in Ohm, θ in °C, R_{th} in °C/W

WORKING TEMPERATURE

(according to the power to be dissipated) -55°C to +105°C

LIFETIME EXPECTANCY

One unique feature of this technology (as opposed to electrolytics) is how the capacitor reacts at the end of its lifetime. Unlike aluminum, electrolytics film capacitors do not have a catastrophic failure mode. Film capacitors simply experience a parametric loss of capacitance of about 2%, with no risk of short circuit.

Please note that this is theoretical, however, as the capacitor continues to be functional even after this 2% decrease.

Medium Power Film Capacitors

FFB (RoHS Compliant)

HOW TO ORDER

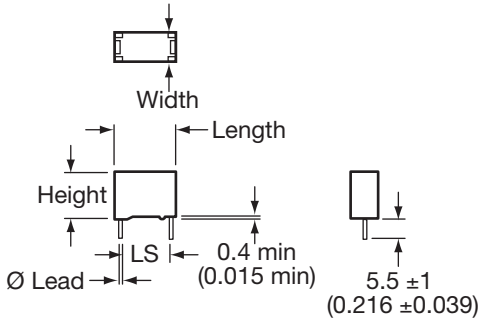
FFB	1	4	D	0336	K	– –
Series	**Case Size** 1 2 3 4 5	**Dielectric** 4 = Polyester 6 = Polypropylene	**Voltage Code** D = 75Vdc E = 100Vdc H = 300Vdc I = 400Vdc J = 525Vdc A = 720Vdc C = 900Vdc L = 1100Vdc	**Capacitance Code** 0 + pF code 0336 = 33µF 0686 = 68µF 0117 = 110µF etc.	**Capacitance Tolerances** K = ±10%	**Lead Styles** – – = 2 Leaded JC = 4 Leaded **Consult Factory for Special Options**

RoHS COMPLIANT

GENERAL DESCRIPTION

CASE STYLE: P0; 18; 19; 26; R68

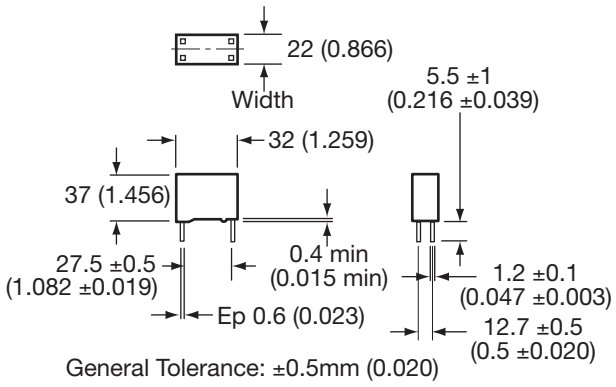
2 LEADED STYLE



General Tolerance: ±0.5mm (0.020)

CASE STYLE: R68

4 LEADED STYLE



General Tolerance: ±0.5mm (0.020)

DIMENSIONS: millimeters (inches)

Case Size	Case Style	Length mm ±0.40 (inches)	Width mm ±0.40 (inches)	Height mm ±0.30 (inches)	Dimensions lead mm +10% -0.05 (inches)	LS mm ±0.40 (inches)
1	**PO**	31.1 (1.230)	13.0 (0.510)	22.4 (0.880)	Ø 0.80 (0.031)	27.5 (1.083)
2	**18**	31.1 (1.230)	14.6 (0.580)	25.7 (1.010)	Ø 0.80 (0.031)	27.5 (1.083)
3	**19**	31.1 (1.230)	17.3 (0.680)	29.8 (1.170)	Ø 0.80 (0.031)	27.5 (1.083)
4	**26**	31.1 (1.230)	20.8 (0.820)	31.3 (1.230)	Ø 1.00 (0.039)	27.5 (1.083)
5	**R68 2 Leaded Style**	32.0 (1.260)	22.0 (0.870)	37.0 (1.460)	Ø 1.00 (0.039)	27.5 (1.083)
	R68 4 Leaded Style	32.0 (1.260)	22.0 (0.870)	37.0 (1.460)	1.20 x 0.60 (0.047 x 0.023)	27.5 (1.083)

Medium Power Film Capacitors

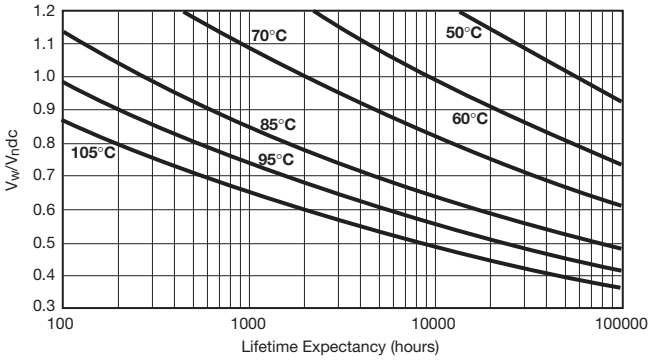
FFB (RoHS Compliant) – Polyester Dielectric

POLYESTER DIELECTRIC FOR LOW VOLTAGE DC FILTERING

ELECTRICAL CHARACTERISTICS – POLYESTER DIELECTRIC

Climatic category	55/105/56 (IEC 60068)
Test voltage between terminals @ 25°C	1.5 x $V_n$dc
Capacitance range C_n	6.2µF to 110µF
Tolerance on C_n	±10%
Rated DC voltage $V_n$dc	75 to 400 V
Dielectric	polyester
Max Stray Inductance	20nH

LIFETIME EXPECTANCY vs VOLTAGE AND HOT SPOT TEMPERATURE – POLYESTER DIELECTRIC



Vw = Permanent working or operating DC voltage.

RATINGS AND PART NUMBER REFERENCE – POLYESTER DIELECTRIC

Part Number	Capacitance (µF)	Case Style	I_{rms} max. (A)	R_s (mΩ)	R_{th} (°C/W)	Typical Weight (g)
$V_n$dc 75V Vrms max.: 45 volts Voltage Code: D						
FFB14D0336K--	33	PO	3	3	40.7	15
FFB24D0476K--	47	18	4.3	2	33.3	20
FFB34D0686K--	68	19	6.2	1.7	29.9	25
FFB44D0826K--	82	26	7.4	1.6	26.7	32
FFB54D0117K--	110	R68 (2 terminals)	10	1.4	22.9	40
FFB54D0117KJC	110	R68 (4 terminals)	10	1.4	22.9	40
$V_n$dc 100V Vrms max.: 60 volts Voltage Code: E						
FFB14E0206K--	20	PO	2.6	3	40.5	15
FFB24E0276K--	27	18	3.5	2.5	33.3	20
FFB34E0396K--	39	19	5	2	29.8	25
FFB44E0476K--	47	26	6	1.7	26.6	32
FFB54E0686K--	68	R68 (2 terminals)	9	1.4	22.8	40
FFB54E0686KJC	68	R68 (4 terminals)	9	1.4	22.8	40
$V_n$dc 300V Vrms max.: 90 volts Voltage Code: H						
FFB14H0755K--	7.5	PO	2.4	16	40.7	15
FFB24H0116K--	11	18	3.6	11	33.5	20
FFB34H0166K--	16	19	5.2	8	29.9	25
FFB44H0186K--	18	26	6	7	27.1	32
FFB54H0276K--	27	R68 (2 terminals)	9	5	22.9	40
FFB54H0276KJC	27	R68 (4 terminals)	9	5	22.9	40
$V_n$dc 400V Vrms max.: 105 volts Voltage Code: I						
FFB14I0625K--	6.2	PO	2.5	17	40.5	15
FFB24I0755K--	7.5	18	3.1	14	33.5	20
FFB34I0126K--	12	19	5	9	29.9	25
FFB44I0156K--	15	26	6.2	7	26.4	32
FFB54I0206K--	20	R68 (2 terminals)	8.2	5.5	22.8	40
FFB54I0206KJC	20	R68 (4 terminals)	8.2	5.5	22.8	40

Medium Power Film Capacitors

FFB (RoHS Compliant) – Polypropylene Dielectric

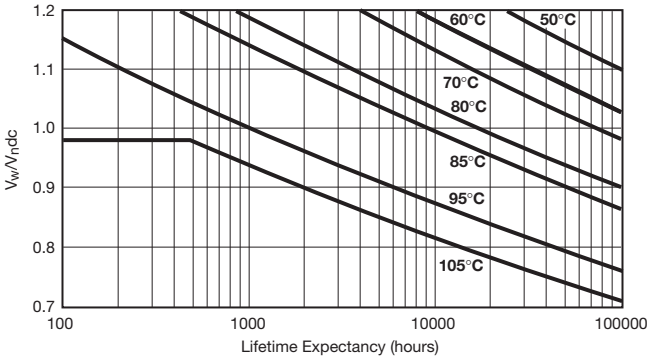
POLYPROPYLENE DIELECTRIC FOR INDUSTRIAL DC FILTERING

These capacitors have been designed principally for high and medium power DC filtering applications.

ELECTRICAL CHARACTERISTICS – POLYPROPYLENE DIELECTRIC

Climatic category	55/105/56 (IEC 60068)
Test voltage between terminals @ 25°C	1.5 x $V_n$dc
Capacitance range C_n	1.5µF to 13µF
Tolerance on C_n	±10%
Rated DC voltage $V_n$dc	525 to 1100 V
Dielectric	polypropylene

LIFETIME EXPECTANCY vs VOLTAGE AND HOT SPOT TEMPERATURE – POLYPROPYLENE DIELECTRIC



Vw = Working DC Voltage • Vn = Rated DC Voltage

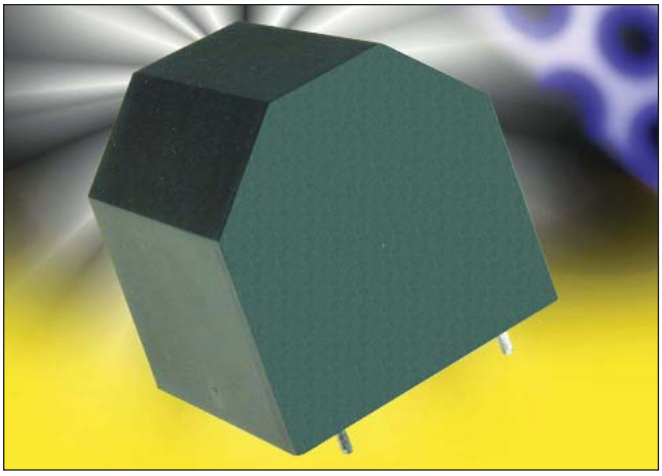
RATINGS AND PART NUMBER REFERENCE – POLYPROPYLENE DIELECTRIC

Part Number	Capacitance (µF)	Case Style	I_{rms} max. (A)	R_S (mΩ)	R_{th} (°C/W)	Typical Weight (g)
$V_n$dc 525V Vrms max.: 105 volts Voltage Code: J						
FFB16J0395K--	3.9	PO	5.1	30	45.7	15
FFB26J0565K--	5.6	18	7.4	21	36.4	20
FFB36J0825K--	8.2	19	10.9	15	32.6	25
FFB46J0106K--	10	26	12	12	29.8	32
FFB56J0136K--	13	R68 (2 terminals)	12	9	24.3	40
FFB56J0136KJC	13	R68 (4 terminals)	16.7	9	24.3	40
$V_n$dc 720V Vrms max.: 120 volts Voltage Code: A						
FFB16A0335K--	3.3	PO	5.0	31	45.0	15
FFB26A0435K--	4.3	18	6.5	24	36.2	20
FFB36A0625K--	6.2	19	9.4	17	32.7	25
FFB46A0755K--	7.5	26	11.4	14	29.9	32
FFB56A0106K--	10	R68 (2 terminals)	12	11	24.2	40
FFB56A0106KJC	10	R68 (4 terminals)	15.2	11	24.2	40
$V_n$dc 900V Vrms max.: 150 volts Voltage Code: C						
FFB16C0205K--	2	PO	3.6	41	45.7	15
FFB26C0275K--	2.7	18	4.9	30	36.6	20
FFB36C0395K--	3.9	19	7.2	21	32.9	25
FFB46C0515K--	5.1	26	9.3	16	29.7	32
FFB56C0685K--	6.8	R68 (2 terminals)	12	12	24.1	40
FFB56C0685KJC	6.8	R68 (4 terminals)	12.5	12	24.1	40
$V_n$dc 1100V Vrms max.: 180 volts Voltage Code: L						
FFB16L0155K--	1.5	PO	3.3	45	45.2	15
FFB26L0185K--	1.8	18	3.9	40	36.5	20
FFB36L0245K--	2.4	19	5.3	28	33.4	25
FFB46L0305K--	3	26	6.6	23	30.2	32
FFB56L0475K--	4.7	R68 (2 terminals)	10.3	15	24.1	40
FFB56L0475KJC	4.7	R68 (4 terminals)	10.3	15	24.1	40

Medium Power Film Capacitors

FFV3 (RoHS Compliant)

DC FILTERING



APPLICATIONS

The FFV3 capacitors are particularly designed for DC filtering, low reactive power.

STANDARDS

IEC 61071-1, IEC 61071-2: Power electronic capacitors
IEC 60384-16: Fixed metallized polypropylene film dielectric DC capacitors
IEC 60384-16-1: Fixed metallized polypropylene film dielectric DC capacitors Assessment level E
IEC 60384-17: Fixed metallized polypropylene film dielectric AC and pulse capacitors
IEC 60384-17-1: Fixed metallized polypropylene film dielectric AC and pulse capacitors Assessment level E
IEC 60384-2: Fixed metallized polyester capacitors

LIFETIME EXPECTANCY

One unique feature of this technology (as opposed to electrolytics) is how the capacitor reacts at the end of its lifetime. Unlike aluminum, electrolytics film capacitors do not have a catastrophic failure mode. Film capacitors simply experience a parametric loss of capacitance of about 2%, with no risk of short circuit.

Please note that this is theoretical, however, as the capacitor continues to be functional even after this 2% decrease.

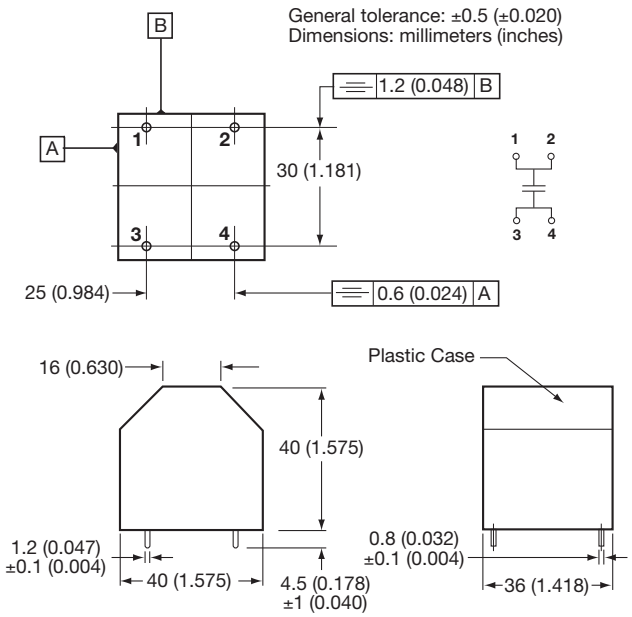
PACKAGING MATERIAL

Self-extinguishing plastic case (V0 = in accordance with UL 94) filled thermosetting resin.

Self-extinguishing thermosetting resin (V0 = in accordance with UL 94; I3F2 = in accordance with NF F 16-101).

The series uses a non-impregnated metallized polypropylene or polyester dielectric, with the controlled self-healing process, specially treated to have a very high dielectric strength in operating conditions up to 105°C.

The FFV3 has been designed for printed circuit board mounting.



HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

$\theta_{hot\ spot} = \theta_{ambient} + (P_d + P_t) \times (R_{th} + 7.4)$

$\theta_{hot\ spot} = \theta_{case} + (P_d + P_t) \times R_{th}$

with P_d (Dielectric losses) $= Q \times tg\delta_0$

$\Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times tg\delta_0$

$tg\delta_0$ (tan delta)

For polypropylene, $tg\delta_0 = 2 \times 10^{-4}$ for frequencies up to 1MHz and is independent of temperatures.

For polyester, $tg\delta_0$ values are shown in graph 4 on page 3.

P_t (Thermal losses) $= R_s \times (I_{rms})^2$

where C_n in Farad, I_{rms} in Ampere, f in Hertz
V in Volt, R_s in Ohm, θ in °C
R_{th} in °C/W, R_{th} : R_{th} case/hot spot in °C/W

Medium Power Film Capacitors

FFV3 (RoHS Compliant) for Low Voltage Applications

HOW TO ORDER

FFV3	4	D	K	– –
Series	Dielectric 4 = Polyester 6 = Polypropylene	Voltage Code D = 75Vdc E = 100Vdc F = 160Vdc H = 300Vdc I = 400Vdc J = 500Vdc A = 700Vdc C = 900Vdc L = 1100Vdc	Capacitance Tolerances K = ±10%	Lead Styles – – = Standard Consult Factory for Special Options

RoHS COMPLIANT

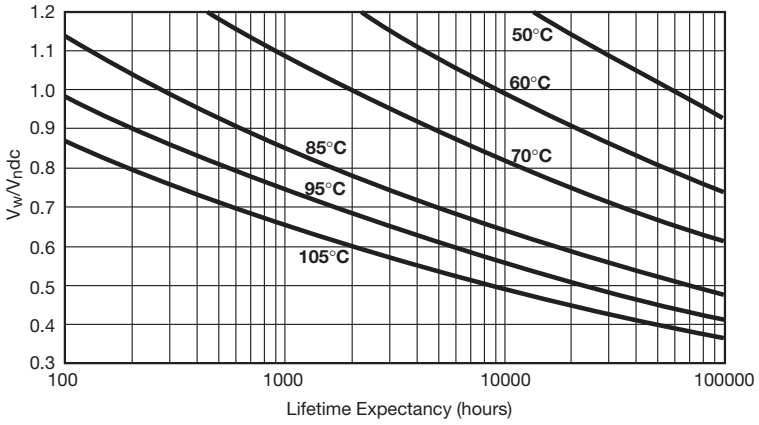
ELECTRICAL CHARACTERISTICS – POLYESTER DIELECTRIC

Climatic category	40/105/56 (IEC 60068)
Test voltage between terminals @ 25°C	1.5 x $V_n$dc during 10s
Test voltage between terminals and case @ 25°C “	@ 4 kVrms @ 50 Hz during 1 min.
Capacitance range C_n	30µF to 160µF
Tolerance on C_n	±10%
Rated DC voltage $V_n$dc	75 to 400 V
Dielectric	polyester
Max Stray Inductance	15nH

RATINGS AND PART NUMBER REFERENCE – POLYESTER DIELECTRIC

Part Number	Capacitance (µF)	$I_{rms\ max.}$ (A)	$(I^2t)_{10\ shots}$ (A^2s)	$(I^2t)_{1000\ shots}$ (A^2s)	R_s (mΩ)	R_{th} (°C/W)	Typical Weight (g)
$V_n$dc = 75 V Vrms = 45 v max Voltage Code: D							
FFV34D0137K--	130	23	370	37	0.56	5.60	90
FFV34D0167K--	160	28	560	56	0.47	5.00	90
$V_n$dc = 100 V Vrms = 60 v max Voltage Code: E							
FFV34E0806K--	80	19	250	25	0.67	6.16	90
FFV34E0107K--	100	24	390	39	0.55	5.42	90
$V_n$dc = 160 V Vrms = 75 v max Voltage Code: F							
FFV34F0556K--	55	17	180	18	0.77	6.56	90
FFV34F0656K--	65	20	260	26	0.66	5.97	90
$V_n$dc = 300 V Vrms = 90 v max Voltage Code: H							
FFV34H0406K--	40	20	150	15	2.80	9.58	90
FFV34H0506K--	50	26	230	23	2.25	8.46	90
$V_n$dc = 400 V Vrms = 105 v max Voltage Code: I							
FFV34I0306K--	30	17	110	11	2.93	9.92	90
FFV34I0406K--	40	23	200	20	2.21	8.41	90

LIFETIME EXPECTANCY vs V_W/V_n AND HOT SPOT TEMPERATURE POLYESTER DIELECTRIC



Vw = Permanent working or operating DC voltage.

Medium Power Film Capacitors

FFV3 (RoHS Compliant) DC for Medium and High Voltage Applications

DC FILTERING

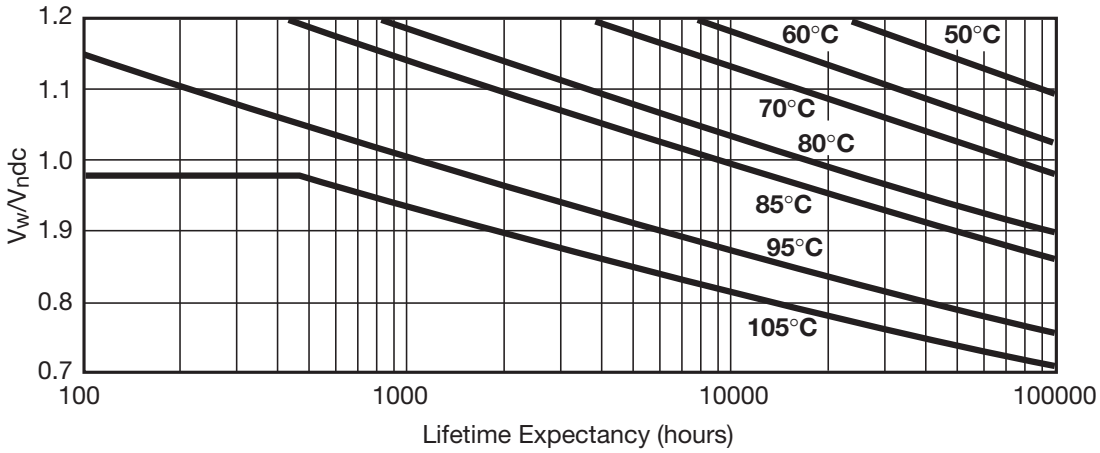
ELECTRICAL CHARACTERISTICS – POLYPROPYLENE DIELECTRIC

Climatic category	40/105/56 (IEC 60068)
Test voltage between terminals @ 25°C	1.5 x $V_n$dc during 10s
Test voltage between terminals and case @ 25°C “	@ 4 kVrms @ 50 Hz during 1 min.
Capacitance range C_n	6µF to 25µF
Tolerance on C_n	±10%
Rated DC voltage $V_n$dc	500 to 1100 V
Dielectric	polypropylene
Max Stray Inductance	15nH

RATINGS AND PART NUMBER REFERENCE – POLYESTER DIELECTRIC

Part Number	Capacitance (µF)	$I_{rms\ max.}$ (A)	$(I^2t)_{10\ shots}$ (A^2s)	$(I^2t)_{1000\ shots}$ (A^2s)	R_s (mΩ)	R_{th} (°C/W)	Typical Weight (g)
$V_n$dc = 500 V Vrms = 105 v max Voltage Code: J							
FFV36J0206K--	20	27	3200	320	5.88	3.53	90
FFV36J0256K--	25	33	5000	500	4.72	3.14	90
$V_n$dc = 700 V Vrms = 120 v max Voltage Code: A							
FFV36A0146K--	14	21	2000	200	7.34	3.73	90
FFV36A0206K--	20	30	4200	420	5.15	3.05	90
$V_n$dc = 900 V Vrms = 150 v max Voltage Code: C							
FFV36C0106K--	10	19	1600	160	8.21	3.37	90
FFV36C0136K--	13	25	2800	280	6.33	2.91	90
$V_n$dc = 1100 V Vrms = 180 v max Voltage Code: L							
FFV36L0605K--	6	13	800	80	11.4	3.71	90
FFV36L0905K--	9	20	1900	190	7.61	2.92	90

LIFETIME EXPECTANCY vs V_W/V_n AND HOT SPOT TEMPERATURE POLYPROPYLENE DIELECTRIC



Vw = Permanent working or operating DC voltage.

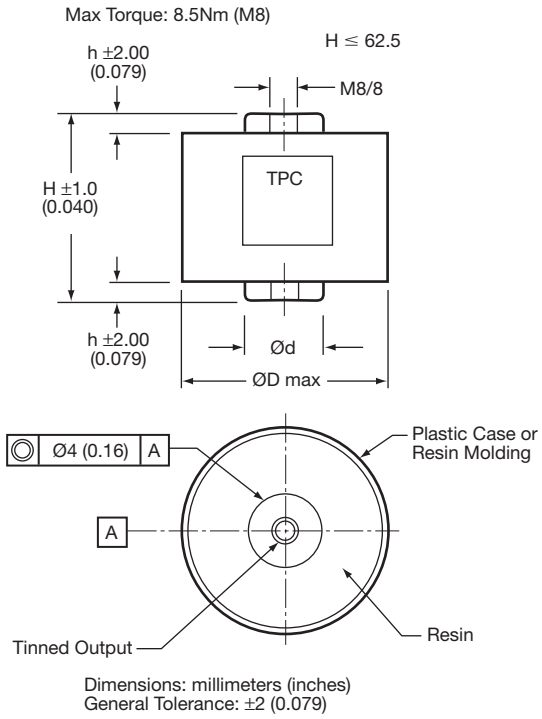
Medium Power Film Capacitors

FFG Design (FFH-RoHS Compliant)

DC FILTERING

DIMENSIONS (CASE SIZES)

plastic case – Outputs: threaded insert M8 filled with thermosetting resin



Dimensions: millimeters (inches)
General Tolerance: ±2 (0.079)

GENERAL DESCRIPTION

The FFG series uses a non-impregnated metallized dielectric, which features a controlled self-healing process.

PACKAGING MATERIAL

Self-extinguishing plastic case (V0 = in accordance with UL 94) filled thermosetting resin.Self-extinguishing thermosetting resin (V0 = in accordance with UL 94; I3F1 = in accordance with NF F 16-101).

STANDARDS

IEC 61071-1, IEC 61071-2: Power electronic capacitors
IEC 60068-1: Environmental testing
UL 94: Fire requirement

HOT SPOT CALCULATION

$\theta_{hot\ spot} = \theta_{terminal} + (P_d + P_t) \times R_{th}$

with P_d (Dielectric losses) = Q x $tg\delta_0$ and $tg\delta_0 = 2.10$, where $Q = \frac{I^2_{rms}}{C.2.\pi.f}$

P_t (Thermal losses) = $R_s \times I_{rms}^2$

where C_n in Farad, V in Volt, R_{th} in °C/W; I_{rms} in Ampere, R_s in Ohm; f in Hertz, θ in °C

HOW TO ORDER

FFG	8	6	K	0376	K	– –
Series	**Case Size**	**Dielectric**	**Voltage Code**	**Capacitance Code**	**Capacitance Tolerances**	**Voltage Range**
FFG = Standard FFH = RoHS Compliant	8	6 = Polypropylene	K = 600Vdc B = 800Vdc C = 900Vdc L = 1000Vdc U = 1200Vdc N = 1900Vdc	0 + pF code 0376 = 36µF 0256 = 25µF 0505 = 5µF etc.	K = ±10%	– – = < 1kV J7 = ≥ 1kV

Not RoHS Compliant

RoHS COMPLIANT

Please select correct termination style.

Medium Power Film Capacitors

FFG (FFH RoHS Compliant)

ELECTRICAL CHARACTERISTICS

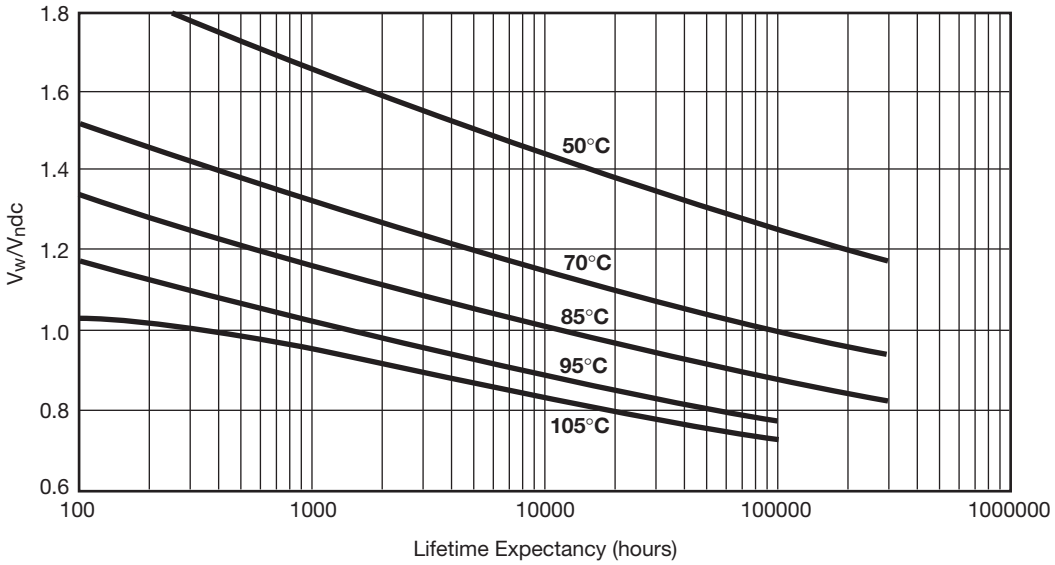
Operating temperature:	–40°C + 105°C
Storage temperature:	–55°C + 85°C
Capacitance range:	5µF to 160µF
Rated DC voltage Vndc:	600 to 900 V
Capacitance tolerance:	±10%
Test voltage between terminals:	@ 25°C: 1.5 x $U_n$dc during 10s
Test voltage between terminals and case:	@ 25°C: @ 4 kVrms @ 50 Hz during 1 mn (test type)
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE (600V TO 900V)

Part Number	Cn (µF)	Height ±1 (±0.039)	h ±2 (±0.079)	D max)	d ±0.50	I^2t max (±0.020)	I_{rms} max (A^2s)	R_s (mΩ) (A)	R_{th} (°C/W)	Typical Weight (g
$U_n$dc 600 V (Voltage Code K)										
FFG86K0376K--	37	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	4	28	1.3	10.1	190
FFG86K0586K--	58	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	10	44	1	6.4	260
FFG86K0806K--	80	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	20	61	0.7	4.9	320
FFG86K0167K--	160	62.5 (2.461)	5 (0.197)	92 (3.622)	22 (0.866)	32	76	0.8	5.8	475
$U_n$dc 800 V (Voltage Code B)										
FFG86B0236K--	23	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	3	26	1.7	10.1	190
FFG86B0376K--	37	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	8	43	1.2	6.5	260
FFG86B0516K--	51	52 (2.072)	5 (0.197)	82 (3.228	22 (0.866)	15	59	0.9	4.8)	320
FFG86B0107K--	100	62.5 (2.461)	5 (0.197)	92 (3.622)	22 (0.866)	24	73	1	5.9	475
$U_n$dc 900 V (Voltage Code C)										
FFG86C0166K--	16	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	2.8	27	2	9.8	190
FFG86C0266K--	26	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	7	44	1.3	6.5	260
FFG86C0356K--	35	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	13	60	1	4.8	320
FFG86C0706K--	70	62.5 (2.461)	5 (0.197)	92 (3.622)	22 (0.866)	20	75	1.2	5.8	475

Dimensions millimeters (inches)

LIFETIME EXPECTANCY vs HOT SPOT TEMPERATURE AND VOLTAGE



Vw = Permanent working or operating DC voltage.

Medium Power Film Capacitors

FFG (FFH RoHS Compliant)

ELECTRICAL CHARACTERISTICS

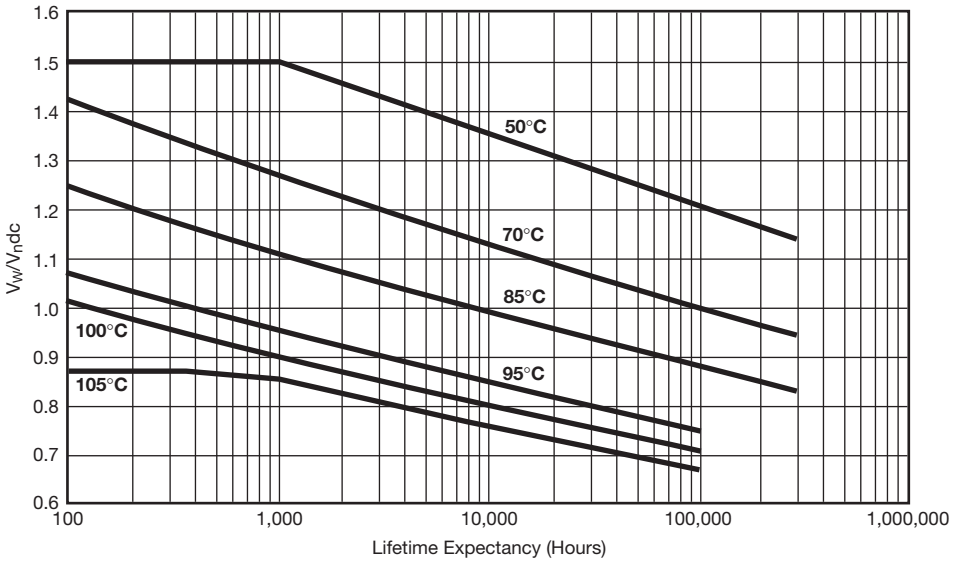
Operating temperature:	–40°C + 105°C
Storage temperature:	–55°C + 85°C
Capacitance range:	5µF to 160µF
Rated DC voltage Vndc:	1000 to 1900 V
Capacitance tolerance:	±10%
Test voltage between terminals:	@ 25°C: 1.5 x $U_n$dc during 10s
Test voltage between terminals and case:	@ 25°C: @ 4 kVrms @ 50 Hz during 1 mn (test type)
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE (600V TO 900V)

Part Number	Cn (µF)	Height ±1 (±0.039)	h ±2 (±0.079)	D max)	d ±0.50	I^2t max (±0.020)	I_{rms} max (A^2s)	R_s (mΩ) (A)	R_{th} (°C/W)	Typical Weight (g
$U_n$dc 1000 V (Voltage Code K)										
FFG86L0256KJ7	25	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	1.9	21	3.6	9.9	190
FFG86L0406KJ7	40	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	5	34	2.32	6.4	260
FFG86L0556KJ7	55	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	9.5	46	1.74	4.7	320
FFG86L0117KJ7	110	62.5 (2.461)	5 (0.197)	92 (3.622)	22 (0.866)	14.9	58	1.86	5.7	475
$U_n$dc 1200 V (Voltage Code U)										
FFG86U0176KJ7	17	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	1.3	19	4.33	9.9	190
FFG86U0276KJ7	27	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	3.3	30	2.8	6.5	260
FFG86U0376KJ7	37	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	6.2	41	2.1	4.8	320
FFG86U0766KJ7	76	62.5 (2.461)	5 (0.197)	92 (3.622)	22 (0.866)	10.3	53	2.2	5.6	475
$U_n$dc 1900 V (Voltage Code N)										
FFG86N0505KJ7	5	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	1.7	19	2.77	11.3	190
FFG86N0905KJ7	9	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	5.5	35	1.63	6.6	260
FFG86N0126KJ7	12	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	9.9	46	1.27	5	320
FFG86N0256KJ7	25	62.5 (2.461)	5 (0.197)	92 (3.622)	22 (0.866)	18	63	1.2	5.2	475

Dimensions millimeters (inches)

LIFETIME EXPECTANCY vs HOT SPOT TEMPERATURE AND VOLTAGE



Vw = Permanent working or operating DC voltage.

Medium Power Film Capacitors

FFVE/FFVI (FFWE/FFWI RoHS Compliant)

Not RoHS Compliant

RoHS COMPLIANT

Please select correct termination style.

GENERAL DESCRIPTION

The FFV capacitor is specifically designed for DC filtering, low reactive power.

The series uses a non-impregnated metallized polypropylene or polyester dielectric, which features a controlled self-healing process, specially treated to have a very high dielectric strength in operating conditions up to 105°C.

The FFV special design gives this series a very low level of stray inductance (18 nH to 40 nH).

Furthermore, the performance levels of the FFVE capacitor makes them a very interesting alternative to electrolytic technology, because they can withstand much higher levels of surge voltage, very high rms current ratings, and longer lifetimes.

PACKAGING MATERIAL

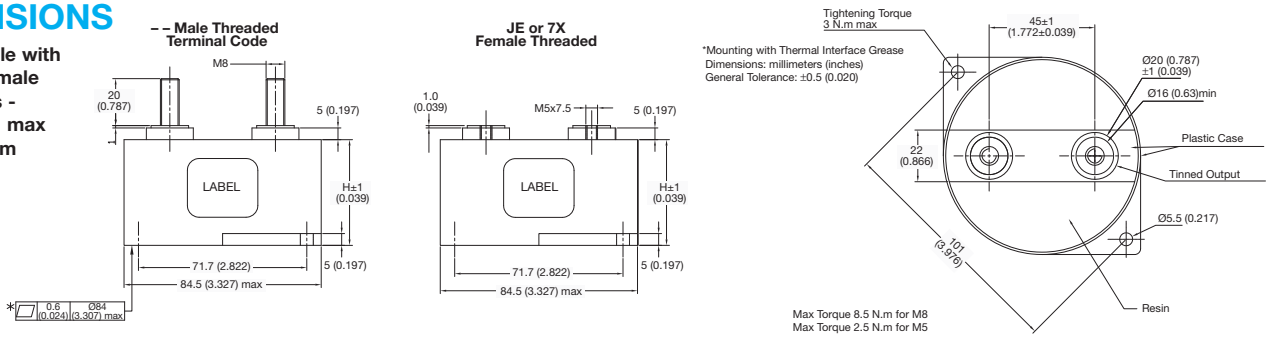
Self-extinguishing plastic case (V0 = in accordance with UL 94) filled thermosetting resin.

Self-extinguishing thermosetting resin (V0 = in accordance with UL 94; I3F1 = in accordance with NF F 16-101).

FFVE capacitors meet the Level 2 requirement of the fire behavior standard NF F 16-102.

DIMENSIONS

Also available with threaded female connections - M5 x 7.5mm max Torque 2.5Nm



HOW TO ORDER

FFVE	4	H	0187	K	– –

Series
FFVE = Standard
FFVI = Standard
FFWE = RoHS Compliant
FFWI = RoHS Compliant

Dielectric
4 = Polyester
6 = Polypropylene

Voltage Code
H = 300V L = 1000V
I = 400V (FFVE/FFWE)
J = 500V L = 1100V
K = 600V (FFVI/FFWI)
A = 700V U = 1200V
B = 800V N = 1900V
C = 900V

Capacitance Code
0 + pF code
0187 = 180µF
0356 = 35µF
etc.

Capacitance Tolerances
K = ±10%

Terminal Code
– – or J7 = Male Threaded
JE or 7X = Female Threaded
See Ratings and Part Reference Tables for details

HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

$\theta_{hot\ spot} = \theta_{case} + (P_d + P_t) \times R_{th}$

with P_d (Dielectric losses) = $Q \times tg\delta_0$

$Q \times tg\delta_0 \Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times tg\delta_0$

$tg\delta_0$ (tan delta)

For polypropylene, $tg\delta_0 = 2 \times 10^{-4}$ for frequencies up to 1MHz and is independent of temperatures. For polyester, $tg\delta_0$ values are shown in graph 4 on page 3.

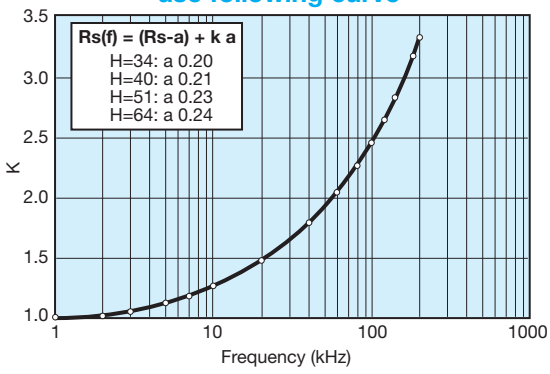
P_t (Thermal losses) = $R_s \times (I_{rms})^2$

where C_n in Farad, I_{rms} in Ampere, f in Hertz, V in Volt, R_s in Ohm, θ in °C, R_{th} in °C/W

θ_{case} = bottom center of case

Rs(f) vs FREQUENCY

For frequency higher than 1 kHz use following curve



Medium Power Film Capacitors

FFVE/FFVI (FFWE/FFWI RoHS Compliant)

ELECTRICAL CHARACTERISTICS – FFVE/FFWE POLYESTER DIELECTRIC

The FFVE for low voltage DC filtering are polyester dielectric capacitors.

Working temperature	-40°C to +105°C (according to the power to be dissipated)
Capacitance range	100µF to 400µF
Capacitance tolerance	±10%
Rated DC voltage	300 to 400 V
Test voltage between terminals @ 25°C	1.5 x $V_n$dc 10s
Insulation voltage between shorted terminals and earth	7 kVrms/60sec/50Hz
Dielectric	Polyester

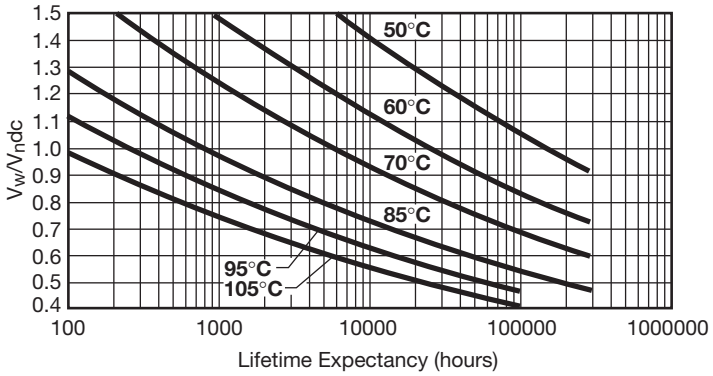
RATINGS AND PART NUMBER REFERENCE – POLYESTER DIELECTRIC

Part Number*	Capacitance (µF)	Height	Irms max. (A)	Ls max. (nH)	Rs (mΩ)	Rth (°C/W)	Typical Weight (g)
$V_n$dc 300 volts (Voltage Code H)							
FFVE4H0187K--	180	34 (1.339)	100	18	0.8	4.7	300
FFVE4H1956K--	195	34 (1.339)	100	18	0.8	4.4	300
FFVE4H0257K--	250	40 (1.575)	100	25	0.6	5.2	350
FFVE4H0357K--	350	51 (2.008)	100	32	0.8	7.2	420
FFVE4H0407K--	400	51 (2.008)	110	32	0.8	7.1	420
$V_n$dc 400 volts (Voltage Code I)							
FFVE4I0107K--	100	34 (1.339)	80	18	0.7	4.7	300
FFVE4I0127K--	120	34 (1.339)	100	18	0.6	4.1	300
FFVE4I0157K--	150	40 (1.575)	100	25	0.7	5.0	350
FFVE4I0187K--	180	51 (2.008)	80	32	1.0	8.5	420
FFVE4I0227K--	220	51 (2.008)	100	32	0.9	7.2	420

*Change "--" to "JE" for female connectors M5 x 7.5mm

Dimensions millimeters (inches)

LIFETIME EXPECTANCY FFVE POLYESTER



V_W: permanent working or operating DC voltage.

Medium Power Film Capacitors

FFVE/FFVI (FFWE/FFWI RoHS Compliant)

ELECTRICAL CHARACTERISTICS – FFVE/FFWE POLYPROPYLENE DIELECTRIC

The FFVE for low voltage DC filtering are polyester dielectric capacitors.

Working temperature	-40°C to +105°C (according to the power to be dissipated)
Capacitance range	12µF to 220µF
Capacitance tolerance	±10%
Rated DC voltage	600 to 1900 V
Test voltage between terminals @ 25°C	1.5 x $V_n$dc 10s
Insulation voltage between shorted terminals and earth	7 kVrms/60sec/50Hz
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE – POLYPROPYLENE DIELECTRIC

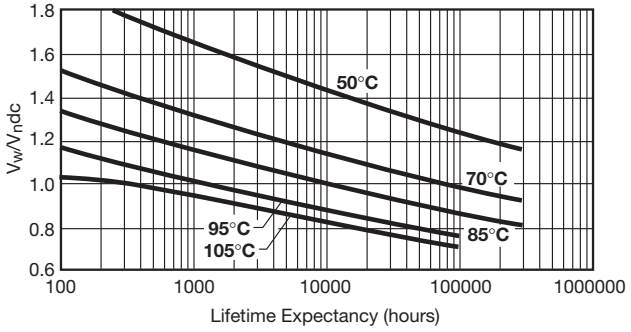
Part Number*	Capacitance (µF)	Height	Irms max. (A)	Ls max. (nH)	Rs (mΩ)	Rth (°C/W)	Typical Weight (g)
$V_n$dc 600 volts (Voltage Code K)							
FFVE6K0256K--	25	34 (1.339)	90	18	0.7	4.3	300
FFVE6K0107K--	100	40 (1.575)	100	25	0.6	4.8	350
FFVE6K0157K--	150	51 (2.008)	110	32	0.9	6.9	420
FFVE6K0227K--	220	64 (2.520)	100	40	1.0	8.4	500
$V_n$dc 800 volts (Voltage Code B)							
FFVE6B0666K--	66	40 (1.575)	100	25	0.7	4.7	350
FFVE6B0107K--	100	51 (2.008)	90	32	1.0	6.7	420
FFVE6B0147K--	140	64 (2.520)	100	40	1.3	8.4	500
$V_n$dc 900 volts (Voltage Code C)							
FFVE6C0126K--	12	34 (1.339)	70	18	0.9	4.4	300
FFVE6C0386K--	38	34 (1.339)	100	18	1.6	3.9	300
FFVE6C0476K--	47	40 (1.575)	100	25	0.8	4.6	350
FFVE6C0706K--	70	51 (2.008)	100	32	1.2	6.7	420
FFVE6C0107K--	100	64 (2.520)	90	40	1.1	8.2	500
$V_n$dc 1000 volts (Voltage Code L)							
FFVE6L0666KJ7	66	40 (1.575)	70	25	1.5	5.1	350
FFVE6L0107KJ7	100	51 (2.008)	64	32	2.0	7.3	420
FFVE6L0147KJ7	140	64 (2.520)	51	40	2.5	9.2	500
$V_n$dc 1200 volts (Voltage Code U)							
FFVE6U0476KJ7	47	40 (1.575)	66	25	1.7	4.9	350
FFVE6U0706KJ7	70	51 (2.008)	59	32	2.4	7.2	420
FFVE6U0107KJ7	100	64 (2.520)	49	40	2.9	8.9	500
$V_n$dc 1900 volts (Voltage Code N)							
FFVE6N0156KJ7	15	40 (1.575)	73	25	1.1	5.2	350
FFVE6N0246KJ7	24	51 (2.008)	73	32	1.3	6.5	420
FFVE6N0356KJ7	35	64 (2.520)	67	40	1.6	8.4	500

*Change "--" to "JE" for female connectors M5 x 7.5mm
*Change "J7" to "7X" for female connectors M5 x 7.5mm

Dimensions millimeters (inches)

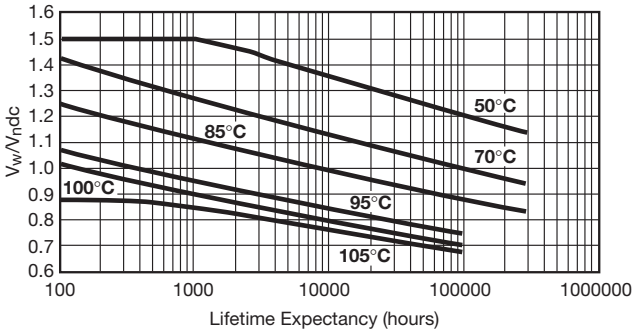
LIFETIME EXPECTANCY FOR FFVE POLYPROPYLENE

-- and JE



V_W: permanent working or operating DC-voltage.

J7 and 7X



V_W: permanent working or operating DC-voltage.

Medium Power Film Capacitors

FFVE/FFVI (FFWE/FFWI RoHS Compliant)

ELECTRICAL CHARACTERISTICS – FFVI/FFWI POLYPROPYLENE DIELECTRIC

The FFVE for low voltage DC filtering are polyester dielectric capacitors.

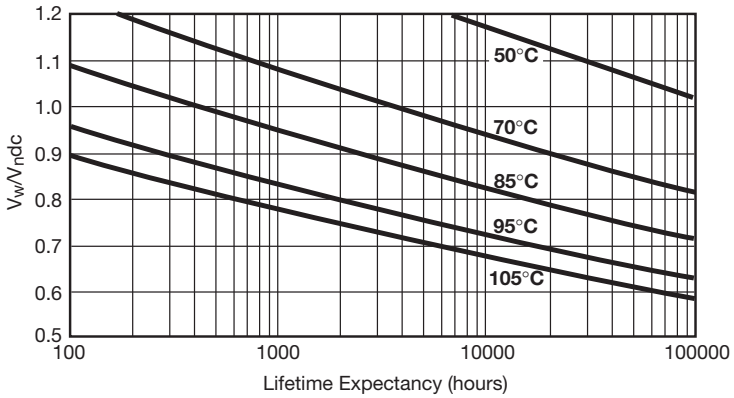
Working temperature	-40°C to +105°C (according to the power to be dissipated)
Capacitance range	47µF to 275µF
Capacitance tolerance	±10%
Rated DC voltage	500 to 1100V
Test voltage between terminals @ 25°C	1.25 x $V_n$dc 10s
Insulation voltage between shorted terminals and earth	7 kVrms/60sec/50Hz
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE – POLYPROPYLENE DIELECTRIC

Part Number*	Capacitance (µF)	Height	Irms max. (A)	Ls max. (nH)	Rs (mΩ)	Rth (°C/W)	Typical Weight (g)
$V_n$dc 500 volts (Voltage Code J)							
FFVI6J1256K--	125	40 (1.575)	90	25	0.6	5.0	350
FFVI6J0207K--	200	51 (2.008)	90	32	0.8	6.7	420
FFVI6J2756K--	275	64 (2.520)	90	40	0.9	8.7	500
$V_n$dc 700 volts (Voltage Code A)							
FFVI6A0107K--	100	40 (1.575)	100	25	0.6	4.8	350
FFVI6A0157K--	150	51 (2.008)	100	32	0.9	6.9	420
FFVI6A0227K--	220	64 (2.520)	100	40	1.0	8.4	500
$V_n$dc 900 volts (Voltage Code C)							
FFVI6C0666K--	66	40 (1.575)	100	25	0.7	4.7	350
FFVI6C0107K--	100	51 (2.008)	90	32	1.0	6.7	420
FFVI6C0147K--	140	64 (2.520)	100	40	1.3	8.4	500
$V_n$dc 1100 volts (Voltage Code L)							
FFVI6L0476K--	47	40 (1.575)	100	25	0.8	4.6	350
FFVI6L0706K--	70	51 (2.008)	100	32	1.2	6.7	420
FFVI6L0107K--	100	64 (2.520)	90	40	1.1	8.2	500

Dimensions millimeters (inches)

LIFETIME EXPECTANCY FOR FFVI



V_W: permanent working or operating DC-voltage.

Medium Power Film Capacitors

FFVS (RoHS Compliant)
Low Inductance Range Capacitor for Power Electronics

FFVS series is a specific range of DC filtering capacitors designed for use in high frequency, high ripple applications beyond the limits of standard FFVE or FFVI.

Typical applications include DC power supply for induction heating, resonant DC power supply for scanner, X-ray machines, etc.

Due to the sophisticated internal design, stray inductance is extremely low, between 8 and 13nH.

FFVS products are RoHs compliant.

PACKAGING MATERIAL

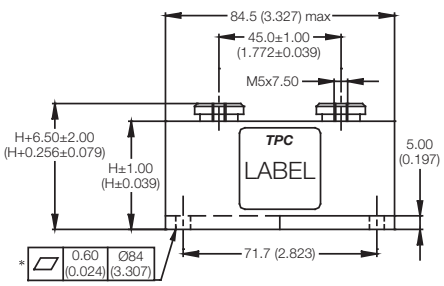
Self extinguishing plastic case (V0: in accordance with UL 94) filled thermosetting resin.

Self extinguishing thermosetting resin (V0: in accordance with UL 94; I3F1: in accordance with NF F 16-101).

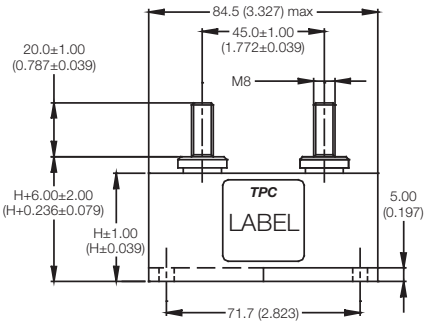
DIMENSIONS

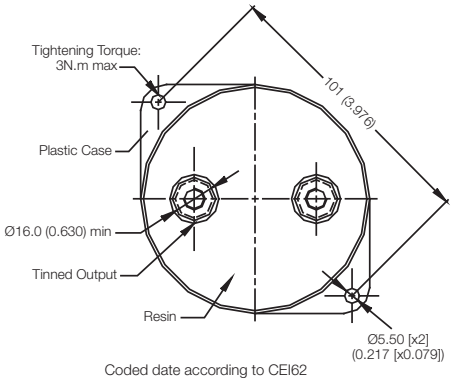
Threaded female terminals version M5 x 7.5mm are also available, To order, the suffix becomes "JE" instead of "--"

Threaded Female Terminal Code JE



Threaded Male Terminal Code --





Coded date according to CEI62
Max Torque M5: 2.5Nm
Max Torque M8: 8.5Nm
* Mounting with Thermal interface Grease
Dimensions in millimeters (inches)
General Tolerance ±0.5 (±0.002)

HOW TO ORDER

FFVS	6	K	0226	K	– –
Series	**Dielectric**	**Voltage Code**	**Capacitance Code**	**Capacitance Tolerances**	**Terminal Code**
	6 = Polypropylene	K = 600V B = 800V C = 900V L = 1000V U = 1200V N = 1900V	Capacitance Values with 2 significant digits: 0 + pF code 0226 = 22µF 0147 = 140µF etc. Capacitance Values with 3 significant digits: 1956 = 195µF 1286 = 138µF 1356 = 135µF	K = ±10%	– – = Male Threaded JE = Female Threaded

RoHS COMPLIANT

HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

$\theta_{hot\ spot} = \theta_{case} + (P_d + P_t) \times R_{th}$

with P_d (Dielectric losses) = $Q \times tg\delta_0$

$Q \times tg\delta_0 \Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times tg\delta_0$

$tg\delta_0$ (tan delta)

For polypropylene, $tg\delta_0 = 2 \times 10^{-4}$ for frequencies up to 1MHz and is independent of temperatures.

For polyester, $tg\delta_0$ values are shown in graph 4 on page 3.

P_t (Thermal losses) = $R_s \times (I_{rms})^2$

where C_n in Farad, V in Volt, R_{th} in °C/W, I_{rms} in Ampere, R_s in Ohm, f in Hertz, θ in °C

θ_{case} = bottom center of case

Medium Power Film Capacitors

FFVS (RoHS Compliant)
Low Inductance Range Capacitor for Power Electronics

ELECTRICAL CHARACTERISTICS

Working temperature	-40°C +105°C (according to the power to be dissipated)
Capacitance range C_N	22 µF to 200 µF
Tolerance on C_N	± 10 %
Rated dc voltage U_N dc	600V to 1900V
Test voltage between terminals @ 25°C: 1.5 x $U_N$dc during 10s	
Insulation voltage between shorted terminals and earth (type test) @ 4 kVrms @ 50Hz during 1 min.	

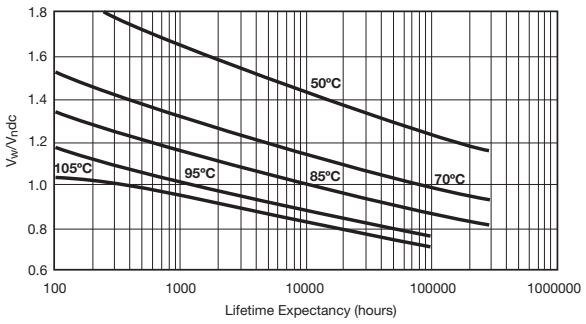
RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (µF)	Height mm (inches)	I_{rms} (A)	I^2t (A^2s)	L_s max. (nH)	R_S (mΩ)	R_{th} (°C/W)	Typical Weight (g)
$U_n$dc 600 volts (Voltage Code K)								
FFVS6K0226K--	22	34 (1.339)	78	11.5	8	0.74	4.2	320
FFVS6K0906K--	90	40 (1.575)	84	24	9	0.60	4.9	345
FFVS6K0147K--	140	51 (2.008)	82	23.5	11	0.83	6.8	405
FFVS6K1956K--	195	64 (2.520)	84	24	13	1.04	8.6	475
$U_n$dc 800 volts (Voltage Code B)								
FFVS6B0586K--	58	40 (1.575)	83	19	9	0.72	4.9	345
FFVS6B0926K--	92	51 (2.008)	83	19	11	0.99	6.7	405
FFVS6B1286K--	128	64 (2.520)	84	19.5	13	1.25	8.5	475
$U_n$dc 900 volts (Voltage Code C)								
FFVS6C0306K--	30	34 (1.339)	56	7	8	1.55	4.2	320
FFVS6C0406K--	40	40 (1.575)	85	16.5	9	0.85	5.0	345
FFVS6C0656K--	65	51 (2.008)	86	17	11	1.15	6.7	405
FFVS6C0906K--	90	64 (2.520)	87	17	13	1.46	8.5	475
$U_n$dc 1000 volts (Voltage Code L)								
FFVS6L0536K--	53	40 (1.575)	61	9.5	9	1.56	4.9	345
FFVS6L0956K--	95	51 (2.008)	63	11	11	1.98	6.7	405
FFVS6L1356K--	135	64 (2.520)	65	11.5	13	2.42	8.3	475
$U_n$dc 1200 volts (Voltage Code U)								
FFVS6U0406K--	40	40 (1.575)	57	7.5	9	1.77	4.9	345
FFVS6U0656K--	65	51 (2.008)	57	7.5	11	2.38	6.8	405
FFVS6U0866K--	86	64 (2.520)	58	7	13	3.02	8.5	475
$U_n$dc 1900 volts (Voltage Code N)								
FFVS6N0146K--	14	40 (1.575)	66	12.5	10	1.05	4.9	345
FFVS6N0226K--	22	51 (2.008)	68	13.5	13	1.26	6.3	405
FFVS6N0326K--	32	64 (2.520)	68	13.5	16	1.58	8.1	475

Dimensions millimeters (inches)

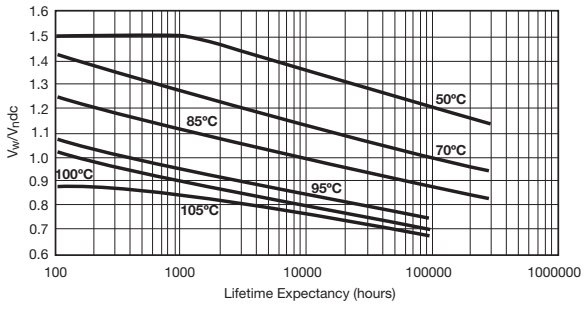
LIFETIME EXPECTANCY

FFVS for 600V, 800V and 900V



V_W: permanent working or operating DC-voltage.

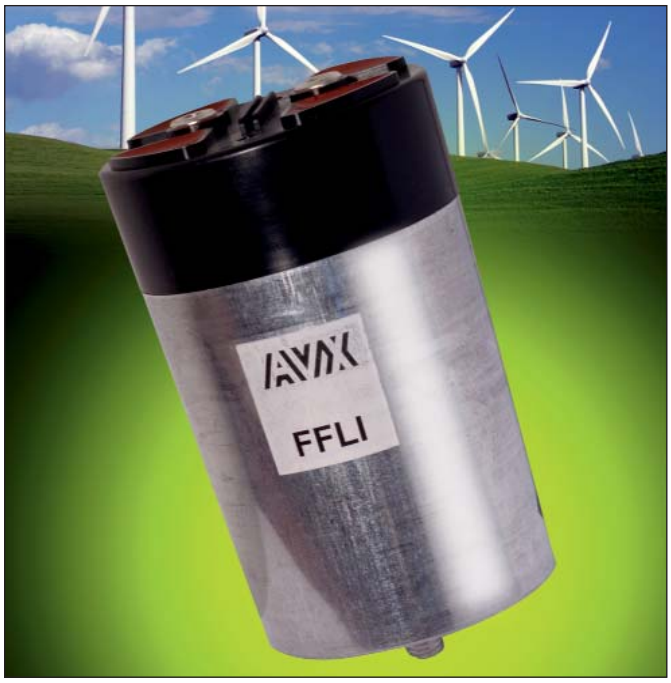
FFVS for 1000V, 1200V and 1900V



V_W: permanent working or operating DC-voltage.

Capacitors for Power Electronics

FFLI (RoHS Compliant)



USUAL APPLICATIONS

The FFLI capacitor is specifically designed for DC filtering,

PACKAGING MATERIAL

Aluminium cylindrical case filled thermosetting resin.

Self extinguishing thermosetting resin (V0 : in accordance with UL 94 ; M2F1 : in accordance with NF F 16-101).

Self extinguishing plastic cover (V0 : in accordance with UL 94)

ROHS components

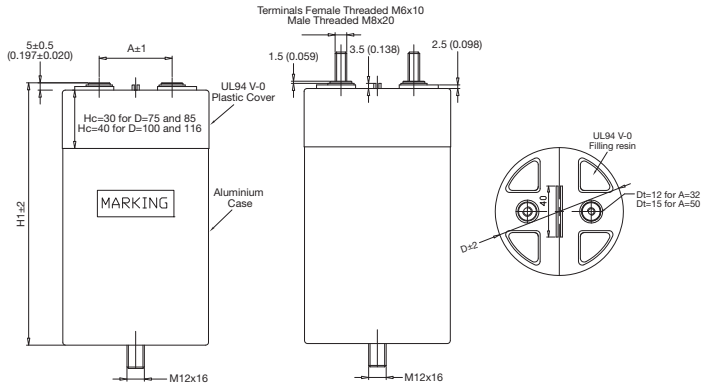
LIFETIME EXPECTANCY

One unique feature of this technology (as opposed to electrolytics) is how the capacitor reacts at the end of its lifetime. Whereas with an electrolytic there is a strong risk of explosion of the case. However with our line of film capacitors, the capacitor will simply experience at the end of life a loss of capacitance of about 5%, with no risk of explosion.

Please note that this is theoretical, however, as the capacitor continues to be functional even after this 5% decrease.

Expected life time for FFLI range:
100 000 Hrs / $U_n$dc / Hot-spot temperature = 65°C.

DIMENSIONS



STANDARDS

IEC 61071: Power electronic capacitors

IEC 60068-1: Environmental testing

IEC 61373: Shocks and vibrations

UL 94: Fire requirements

UL810: Capacitors

HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

For all applications, the hot spot temperature must be lower than 95°C.

$$\theta_{hot\ spot} = \theta_{ambient} + [tg\delta \cdot Q + R_S \cdot (I_{rms})^2] \cdot R_{th}$$

With:

Q : Reactive power in Var
R_S in Ohm
I_{rms} in Ampere
R_{th} : Rth ambient / hot spot in °C/W
tg $\delta_0 \cdot (10^{-4})$ is the tangent of loss angle for polypropylene dielectric. Polypropylene has a constant dielectric losses factor of $2x10^{-4}$ irrespective of temperature and frequency (up to 1 MHz).
θ Ambient : Ambient Temperature in ºC

MARKING

Capacitance value
Nominal dc voltage
Maximum rms current
Batch number
Coded date according IEC62

Max Torque M6 = 4.5.Nm
Max Torque M8 = 8.5Nm
Max Torque M12 = 15Nm

HOW TO ORDER

FFLI	6	L	0337	K	– –
Series	**Dielectric** 6 = Polypropylene	**Voltage Code** B = 800V L = 1000V U = 1150V Q = 1400V	**Capacitance Code** Capacitance Values with 2 significant digits: 0 + pF code 0397 = 390µF 0167 = 160µF etc.	**Capacitance Tolerances** K = ±10%	**Terminal Code** – – = Male Threaded JE = Female Threaded

RoHS COMPLIANT

Capacitors for Power Electronics

FFLI Design

ELECTRICAL CHARACTERISTICS

Dry with controlled self-healing metallized polypropylene dielectric.

Climatic Category	40/95/56 (IEC68)
Working temperature	-40°C / + 95°C (according to the power dissipated)
Storage temperature	-40°C / +85°C
Test voltage between terminals	@ 25°C: 1.5 x $U_n$dc during 10s
Test voltage between terminals and case	@ 25°C:@ 4 kVrms @ 50Hz during 1 min.
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (µF)	D	H1	A	I_{rms} (A)	I^2t (A^2s)	L_s max. (nH)	R_s (mΩ)	R_{th} (°C/W)	Typical Weight (g)
$U_n$dc 800V										
FFLI6B0297K--	290	75 (2.953)	105 (4.134)	32 (1.260)	50	13	60	4.1	4.1	600
FFLI6B0397K--	390	85 (3.346)	105 (4.134)	32 (1.260)	62	23	60	2.9	3.6	700
FFLI6B0507K--	500	75 (2.953)	155 (6.102)	32 (1.260)	45	13	85	5.6	3.6	850
FFLI6B0687K--	680	85 (3.346)	155 (6.102)	32 (1.260)	53	24	85	4.3	3.3	1100
FFLI6B0817K--	810	85 (3.346)	180 (7.087)	32 (1.260)	50	23	100	5.1	3.1	1300
FFLI6B1007K--	1000	100 (3.937)	155 (6.102)	50 (13.78)	65	52	85	3.2	3.0	1500
FFLI6B1207K--	1200	100 (3.937)	180 (7.087)	50 (13.78)	61	52	100	3.7	2.9	1800
FFLI6B1357K--	1350	116 (4.567)	155 (6.102)	50 (13.78)	77	95	85	2.5	2.6	2000
FFLI6B1607K--	1600	116 (4.567)	180 (7.087)	50 (13.78)	72	93	100	3.0	2.6	2400
FFLI6B1907K--	1900	116 (4.567)	240 (9.449)	50 (13.78)	110	300	140	1.4	2.4	3200
FFLI6B2407K--	2400	116 (4.567)	290 (11.42)	50 (13.78)	100	300	170	1.6	2.2	3900
FFLI6B3007K--	3000	116 (4.567)	340 (13.39)	50 (13.78)	100	320	200	1.9	2.0	4500
$U_n$dc 1000V										
FFLI6L0197K--	190	75 (2.953)	105 (4.134)	32 (1.260)	46	8	60	4.5	4.1	600
FFLI6L0267K--	260	85 (3.346)	105 (4.134)	32 (1.260)	56	15	60	3.4	3.6	700
FFLI6L0337K--	330	75 (2.953)	155 (6.102)	32 (1.260)	40	8	85	6.8	3.6	850
FFLI6L0457K--	450	85 (3.346)	155 (6.102)	32 (1.260)	48	16	85	5.2	3.3	1100
FFLI6L0547K--	540	85 (3.346)	180 (7.087)	32 (1.260)	45	16	100	6.1	3.1	1300
FFLI6L0657K--	650	100 (3.937)	155 (6.102)	50 (13.78)	60	33	85	3.8	3.0	1500
FFLI6L0787K--	780	100 (3.937)	180 (7.087)	50 (13.78)	55	33	100	4.5	2.9	1800
FFLI6L0907K--	900	116 (4.567)	155 (6.102)	50 (13.78)	72	64	85	2.9	2.6	2000
FFLI6L1107K--	1100	116 (4.567)	180 (7.087)	50 (13.78)	68	66	100	3.4	2.6	2400
FFLI6L1307K--	1300	116 (4.567)	240 (9.449)	50 (13.78)	100	210	140	1.5	2.4	3200
FFLI6L1607K--	1600	116 (4.567)	290 (11.42)	50 (13.78)	95	200	170	1.9	2.2	3900
FFLI6L2007K--	2000	116 (4.567)	340 (13.39)	50 (13.78)	95	200	200	2.2	2.0	4500
$U_n$dc 1150V										
FFLI6U0157K--	150	75 (2.953)	105 (4.134)	32 (1.260)	44	6	60	5.0	4.1	600
FFLI6U0207K--	200	85 (3.346)	105 (4.134)	32 (1.260)	53	11	60	3.9	3.6	700
FFLI6U0267K--	260	75 (2.953)	155 (6.102)	32 (1.260)	39	7	85	7.4	3.6	850
FFLI6U0357K--	350	85 (3.346)	155 (6.102)	32 (1.260)	45	12	85	5.9	3.3	1100
FFLI6U0437K--	430	85 (3.346)	180 (7.087)	32 (1.260)	43	12	100	6.8	3.1	1300
FFLI6U0537K--	530	100 (3.937)	155 (6.102)	50 (13.78)	57	27	85	4.1	3.0	1500
FFLI6U0637K--	630	100 (3.937)	180 (7.087)	50 (13.78)	53	27	100	4.9	2.9	1800
FFLI6U0727K--	720	116 (4.567)	155 (6.102)	50 (13.78)	69	51	85	3.2	2.6	2000
FFLI6U0867K--	860	116 (4.567)	180 (7.087)	50 (13.78)	64	50	100	3.8	2.6	2400
FFLI6U1007K--	1000	116 (4.567)	240 (9.449)	50 (13.78)	95	160	140	1.7	2.4	3200
FFLI6U1307K--	1300	116 (4.567)	290 (11.42)	50 (13.78)	90	160	170	2.0	2.2	3900
FFLI6U1607K--	1600	116 (4.567)	340 (13.39)	50 (13.78)	90	160	200	2.3	2.0	4500
$U_n$dc 1400V										
FFLI6Q1056K--	105	75 (2.953)	105 (4.134)	32 (1.260)	41	5	60	5.8	4.1	600
FFLI6Q0147K--	140	85 (3.346)	105 (4.134)	32 (1.260)	50	8	60	4.5	3.6	700
FFLI6Q1856K--	185	75 (2.953)	155 (6.102)	32 (1.260)	35	5	85	8.8	3.6	850
FFLI6Q0257K--	250	85 (3.346)	155 (6.102)	32 (1.260)	42	9	85	6.7	3.3	1100
FFLI6Q0307K--	300	85 (3.346)	180 (7.087)	32 (1.260)	40	9	100	7.9	3.1	1300
FFLI6Q0367K--	360	100 (3.937)	155 (6.102)	50 (13.78)	52	18	85	4.8	3.0	1500
FFLI6Q0447K--	440	100 (3.937)	180 (7.087)	50 (13.78)	50	19	100	5.6	2.9	1800
FFLI6Q0507K--	500	116 (4.567)	155 (6.102)	50 (13.78)	65	36	85	3.7	2.6	2000
FFLI6Q0607K--	600	116 (4.567)	180 (7.087)	50 (13.78)	60	35	100	4.3	2.6	2400
FFLI6Q0707K--	700	116 (4.567)	240 (9.449)	50 (13.78)	90	120	140	1.9	2.4	3200
FFLI6Q0907K--	900	116 (4.567)	290 (11.42)	50 (13.78)	90	120	170	2.3	2.2	3900
FFLI6Q1107K--	1100	116 (4.567)	340 (13.39)	50 (13.78)	85	120	200	2.7	2.0	4500

*Change "--" to "JE" for female terminals

Dimensions millimeters (inches)

Medium Power Film Capacitors

FFLC

DC FILTERING

APPLICATIONS

FFLC series is specifically designed for DC filtering, low reactive power.

PACKAGING MATERIAL

Non-painted rectangular resin filled aluminum case

FFLC capacitors meet the level 2 requirement of flammability standard NF F 16 102.

4 x M10 terminals*

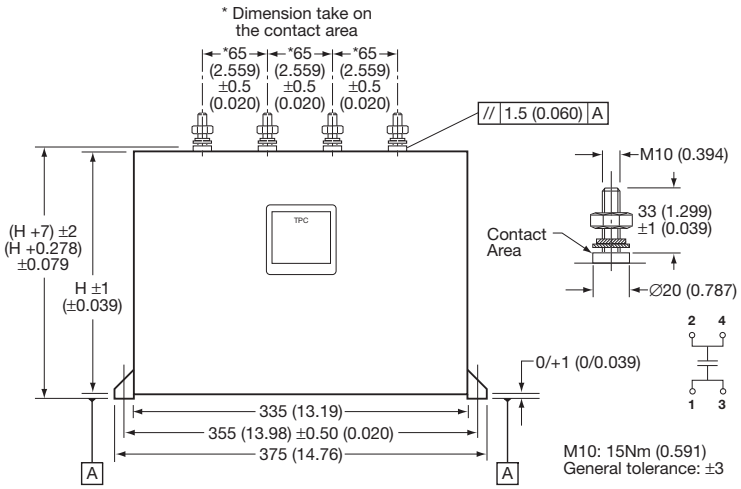
NEW *Available with M10 X 12 female terminal upon request*

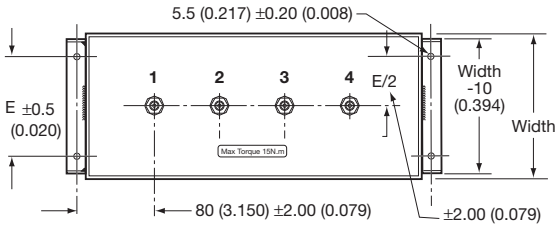
STANDARDS

IEC 61071-1: Power electronic capacitors
IEC 61071-2: Power electronic capacitors
IEC 60068-1: Environmental testing
IEC 60077: Rules for electric traction equipment
UL 94: Fire requirements
NF F 16-101
NF F 16-102: Fire and smoke requirements
IEC 61881: Railway applications, rolling stock equipment, capacitors for power electronics

DIMENSIONS

Terminal Code – – for male threaded
Terminal Code JE for female threaded





Width	E
170	100
145	100
95	50

HOW TO ORDER

FFLC	6	A	8807	K	– –
Series	**Dielectric** 6 = Polypropylene	**Voltage Code** A = 680Vdc L = 1000Vdc U = 1200Vdc	**Capacitance Code** 4 digit pF code 1st 3 digits are capacitance, last digit is multiplier, e.g. 8807 = 8800µF 5067 = 5060µF 2247 = 2240µF etc.	**Capacitance Tolerances** K = ±10%	**Terminal Code** – – = Male Terminal JE = Female Terminal

RoHS COMPLIANT

Medium Power Film Capacitors

FFLC

ELECTRICAL CHARACTERISTICS

Climatic Category	40/85/56 (IEC 60068)	
Test Voltage Between Terminals	@ 25°C: 1.5 x $U_N$dc for 10s	
Test Voltage Between Terminals and Case	@ 25°C: @ 4 kVrms @ 50Hz for 1 min.	
Capacitance range C_n	1120µF to 8800µF (other values available upon request)	
Tolerance on C_n	±10%	
Rated DC voltage $V_n$dc	680 to 1200 V	
FFLC overvoltage:	(V_S): V_S = 2 $V_n$dc and limited at 1800V	
Maximum overvoltage	Peak value	Maximum duration
	1.67 Vndc	100 ms 1 time per week
	1.25 Vndc	100 ms 1 time per day
	1.1 Vndc	1 min 1 time per day
Maximum rms current I_{rms} max	140 Arms to 300 Arms	
Stray inductance L_S*	28 nH to 40 nH	
Dielectric	Polypropylene	

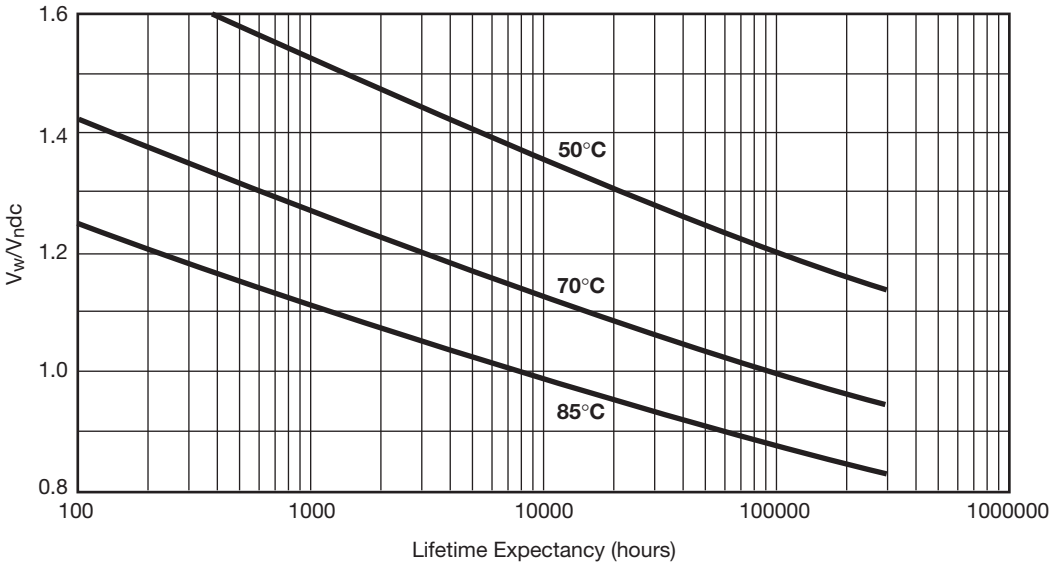
RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (µF)	Height mm (in)	Width mm (in)	Irms (A)	Ls* (nH)	Rs (mΩ)	Rth (°C/W)	Typical Weight (g)
$U_N$dc 680 V (Voltage Code A)								
FFLC6A8807K--	8800	240 (9.449)	170 (6.693)	220	40	0.58	1.2	18000
FFLC6A7157K--	7150	240 (9.449)	145 (5.709)	230	38	0.50	1.2	13200
FFLC6A6507K--	6500	240 (9.449)	145 (5.709)	210	38	0.55	1.3	15500
FFLC6A5607K--	5600	170 (6.693)	170 (6.693)	140	35	0.88	1.8	15500
FFLC6A4557K--	4550	170 (6.693)	145 (5.709)	150	30	0.77	1.8	11300
FFLC6A4187K--	4180	240 (9.449)	95 (3.740)	300	35	0.34	1.0	10300
FFLC6A2667K--	2660	170 (6.693)	95 (3.740)	170	28	0.49	1.6	7300
$U_N$dc 1000 V (Voltage Code L)								
FFLC6L5067K--	5060	240 (9.449)	170 (6.693)	250	40	0.61	1.2	17200
FFLC6L3207K--	3200	170 (6.693)	170 (6.693)	150	35	0.89	1.9	12400
FFLC6L4307K--	4300	240 (9.449)	145 (5.709)	300	38	0.52	1.1	15500
FFLC6L2737K--	2730	170 (6.693)	145 (5.709)	170	30	0.75	1.6	11300
FFLC6L2537K--	2530	240 (9.449)	95 (3.740)	300	35	0.36	0.8	10300
FFLC6L1607K--	1600	170 (6.693)	95 (3.740)	170	28	0.51	1.2	7300
$U_N$dc 1200 V (Voltage Code U)								
FFLC6U3527K--	3520	240 (9.449)	170 (6.693)	250	40	0.71	1.2	18800
FFLC6U2247K--	2240	170 (6.693)	170 (6.693)	150	35	1.1	1.9	12700
FFLC6U3007K--	3000	240 (9.449)	145 (5.709)	300	38	0.60	1.1	15500
FFLC6U1907K--	1900	170 (6.693)	145 (5.709)	170	30	0.87	1.6	11300
FFLC6U1757K--	1750	240 (9.449)	95 (3.740)	300	35	0.41	0.8	10300
FFLC6U1127K--	1120	170 (6.693)	95 (3.740)	170	28	0.59	1.2	7300

*Very low stray inductance for high frequency applications on request.

Dimensions millimeters (inches)

LIFETIME EXPECTANCY vs HOT SPOT TEMPERATURE AND VOLTAGE



V_W: permanent working or operating DC-voltage.

HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

$$\theta_{hot\ spot} = \theta_{ambient} + (P_d + P_t) \times R_{th}$$

with P_d (Dielectric losses) = $Q \times tg\delta_0$

$$\Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times (2 \times 10^{-4})$$

P_t (Thermal losses) = $R_s \times (I_{rms})^2$

where C_n in Farad, I_{rms} in Ampere, f in Hertz
V in Volt, R_s in Ohm, θ in °C
R_{th} in °C/W

Medium Power Film Capacitors

FSM (FSN RoHS Compliant)
New Design can use FFV Range

APPLICATIONS

Recovery capacitor for G.T.O. switching (secondary snubber or clamp capacitor).

High current DC filtering.

FEATURES

Metallized polypropylene dielectric specially treated to withstand high DC voltage stresses up to 85°C.

Controlled self-healing.

Internal geometry and connections specially developed for high currents (Irms up to 100 A).

No liquid impregnant.

Special metallization for DC voltage and high currents.

PACKAGING MATERIAL

Self-extinguishing rectangular plastic case (in accordance with UL 94 VO) (12 kV/50 Hz isolation).

Filled with thermosetting resin.

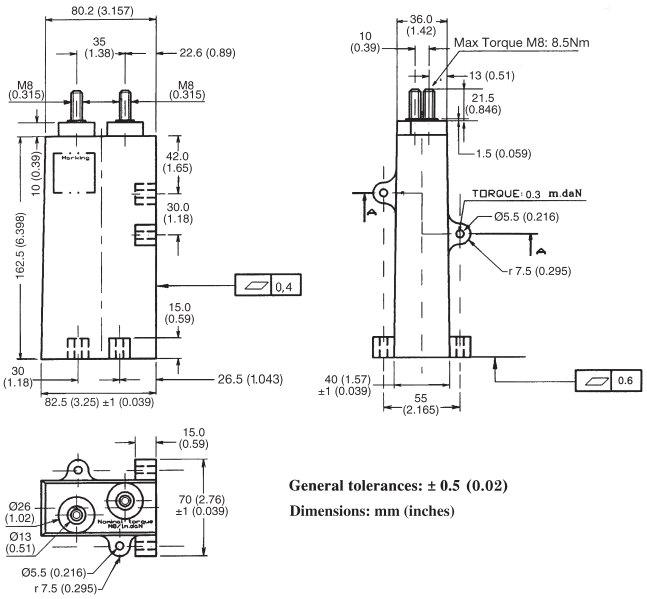
M8 outputs.

Fixing in two planes.

Vibrations and shocks resistant to IEC 60077.

Average weight 0.95 kg.

DIMENSIONS



General tolerances: ± 0.5 (0.02)

Dimensions: mm (inches)

ELECTRICAL CHARACTERISTICS

Climatic category	40/085/56
Working temperature	-40°C to +85°C (according to the power to be dissipated)
Capacitance range C_n	20µF to 54µF
Tolerance on C_n	±10%
Rated DC voltage $V_n$dc	750 to 1350 V
Allowable overvoltages	V_s = 1.1 $V_n$dc – 1/3 of the time 1.3 $V_n$dc – 1 min./day 2 $V_n$dc – 100 ms/day for $V_n$dc = ≤ 1150 V 1.75 $V_n$dc – 100 ms/day for $V_n$dc = 1350 V
DC test voltage between terminals	10s at 20°C ± 15°C $V_e$dc – 1.5 $V_n$dc (IEC 61071)
RMS current	Irms max. = 65 to 105 A
Impulse current	I^2.t max. = 100 to 270 A^2s
Tangent of loss angle	Tgδ: see table of values
Series inductance L_s	≤ 25 nH
Thermal resistance	Rth ambient/hot spot = 9.2°C/W Rth case/hot spot = 3.3°C/W
Dielectric	Polypropylene

MARKING

Logo TPC
FSM
Capacitance and tolerance in clear
Nominal voltage in clear
RMS current in clear
Date of manufacture (IEC coding)

HOW TO ORDER

FSM	2	6	A	0546	K	– –
Series FSM = Standard FSN = RoHS Compliant	**Case Size** 2 = Standard	**Dielectric** 6 = Polypropylene	**Voltage Code** A = 750Vdc C = 900Vdc L = 1000Vdc U = 1150Vdc V = 1350Vdc	**Capacitance Code** 0 + pF code 0546 = 54µF 0336 = 33µF 0206 = 20µF etc.	**Capacitance Tolerances** K = ±10%	**Terminal Code** – – = Standard (Male Threaded)

Not RoHS Compliant

RoHS COMPLIANT

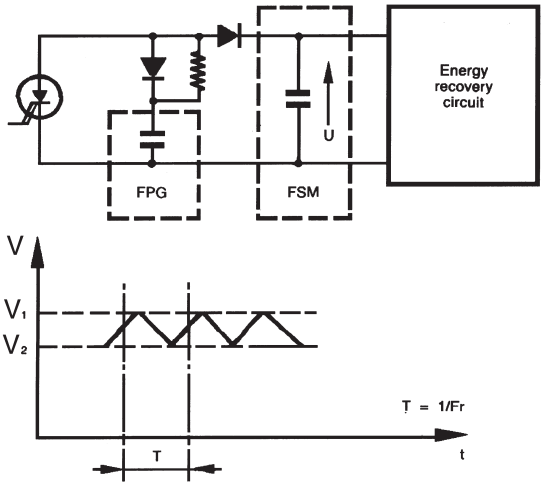
Please select correct termination style.

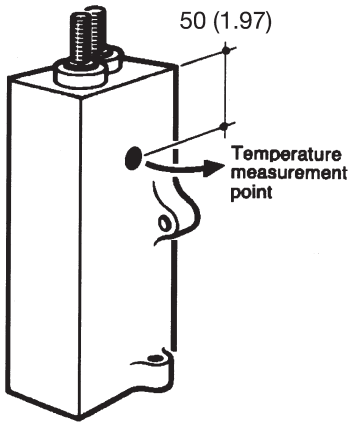
Medium Power Film Capacitors

FSM (FSN RoHS Compliant)
New Design can use FFV Range

1) RECOVERY OF G.T.O. SWITCHING ENERGY

Typical application





Choice of voltage:
$V_1 \leq V_n dc$

Repetitive surge:
1.1 $V_n dc$ – 1/3 of the time

Non-repetitive surge:
1.3 $V_n dc$ – 1 min./day

Occasional max. surge:
2 $V_n dc$ – 100 ms/day for $V_n dc = \leq 1150$ V
1.75 $V_n dc$ – 100 ms/day for $V_n dc = 1350$ V

RMS current limits:
The currents given in the tables are maximum. The thermal limits of the dielectric (85°C) must be respected.

The self-heating can be calculated from the series resistance, Tgδ and the thermal resistance given in the table of values

$\Delta Ø = P \times Rth \leq 85°C - Ø$ ambient

Rth: is given for still air with the capacitor not being subjected to any other heat source.

$$P = (I_{rms})^2 \times R_s + \frac{\pi}{2} \times C \times (V_1 - V_2)^2 \times f_r \times 10^{-4}$$

Temperature measuring point*
Measurement of the case temperature (ΘB) together with the losses gives the temperature of the hot spot.

$\Theta = (RthB \times P) + \Theta B \leq 85°C$

*Important for series/parallel operations.

Important

Due to the modular nature of this capacitors series parallel assemblies can be made to increase the capacitance and/or voltage.

Ensure that suitable sized connections are used so that the capacitors will not be overheated. The inductance of the connections must be low enough to ensure equal current sharing of capacitors in parallel.

For series assemblies, connect resistor across each capacitor. Optimal resistance value will be:

R # 30 MΩ/C in µF
(1.5 MΩ for C = 20 µF).

2) DC FILTERING

Nominal Capacitance

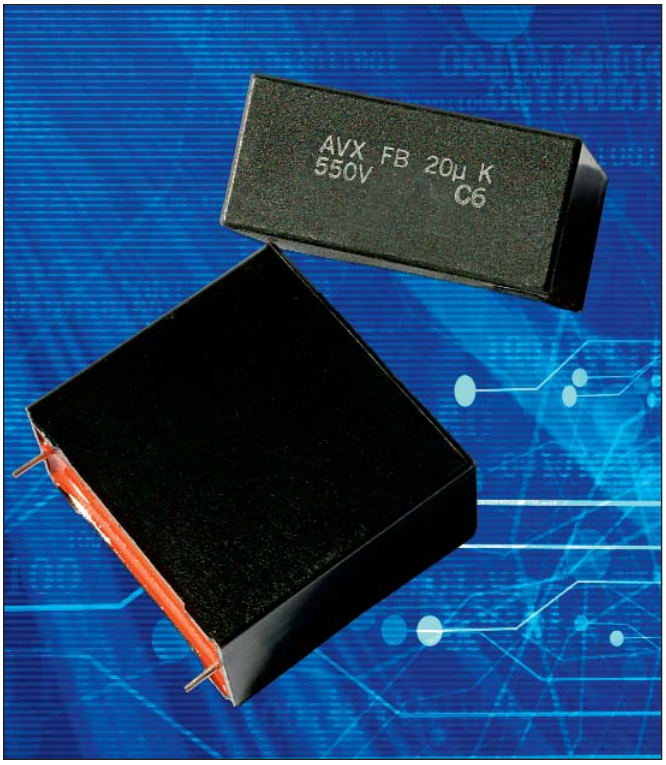
RATINGS AND PART NUMBER REFERENCE – POLYESTER DIELECTRIC

Part Number	Capacitance (µF)	$V_n dc$ (V)	Irms max.* (A)	($I^2.t$) max. (A^2s)	Tgδ (f→kHz) (10^{-4})	Rs (mΩ)	Typical Weight (g)
FSM26A0546K--	54	750	105	270	2 + 3.4 f	1	9500
FSM26C0446K--	42	900	100	220	2 + 2.8 f	1.05	9500
FSM26L0336K--	33	1000	95	170	2 + 2.3 f	1.1	9500
FSM26U0286K--	28	1150	85	150	2 + 2 f	1.15	9500
FSM26V0206K--	20	1350	65	100	2 + 1.6 f	1.25	9500

*Function of power dissipation

Medium Power Film Capacitors

FB (RoHS Compliant)



The FB series uses a non-impregnated metallized polypropylene dielectric specially treated to have a very high dielectric strength in operating conditions up to 100°C.

The FB has been designed for printed circuit board mounting. FB series performance characteristics make them a viable alternative to aluminum electrolytic technology due to much lower ESR and much higher surge voltage capability (dv/dt).

APPLICATIONS

The FB capacitor is particularly designed for DC filtering, low reactive power.

HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

$\theta_{hot\ spot} = \theta_{ambient} + (P_d + P_t) \times R_{th}$

with P_d (Dielectric losses) = $Q \times tg\delta_0$

$Q \times tg\delta_0 \Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times tg\delta_0$

$tg\delta_0$ (tan delta)

For polypropylene, $tg\delta_0 = 2 \times 10^{-4}$ for frequencies up to 1MHz and is independent of temperatures.

P_t (Thermal losses) = $R_s \times (I_{rms})^2$

where C_n in Farad, I_{rms} in Ampere, f in Hertz, V in Volt, R_s in Ohm, θ in °C, R_{th} in °C/W

OPERATING TEMPERATURE RANGE

Operating temperature range: -40ºC to +100ºC

LIFETIME EXPECTANCY

One unique feature of this technology (versus aluminum electrolytics) is how the capacitor reacts at the end of its lifetime.

Unlike aluminum electrolytic, film capacitors do not have a catastrophic failure mode. Film capacitors simply experience a parametric loss of capacitance of about 2% of initial value, with no risk of a short circuit.

The capacitor continues to be functional even after this 2% decrease.

PACKAGING MATERIAL

Self-extinguishing plastic case (V0 = in accordance with UL 94) filled thermosetting resin.

Self-extinguishing thermosetting resin (V0 = in accordance with UL 94; I3F2 = in accordance with NF F 16-101).

STANDARDS

IEC 61071-1, IEC 61071-2:	Power electronic capacitors
IEC 60384-16:	Fixed metallized polypropylene film dielectric DC capacitors
IEC 60384-16-1:	Fixed metallized polypropylene film dielectric DC capacitors Assessment level E
IEC 60384-17:	Fixed metallized polypropylene film dielectric AC and pulse capacitors
IEC 60384-17-1:	Fixed metallized polypropylene film dielectric AC and pulse capacitors Assessment level E

Medium Power Film Capacitors

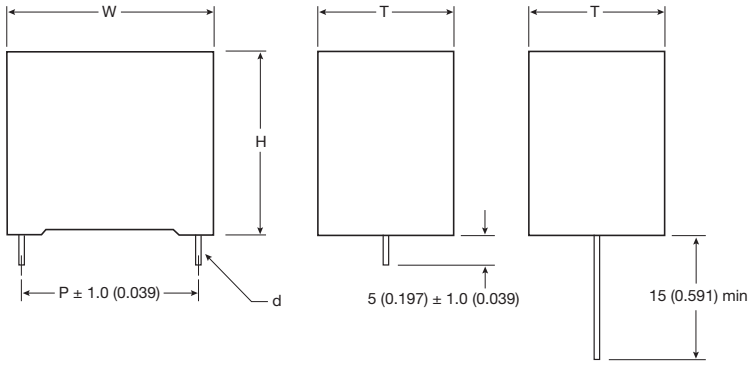
FB (RoHS Compliant)

HOW TO ORDER

FB	27	A	6	K	0335	K	L
Series	**Pitch**	**Case**	**Dielectric**	**Voltage**	**Cap**	**Tolerance**	**Lead Length**
FB	27 37 52	A H B J C K D L E M S N F P G	6 = Polypropylene	I = 450V J = 550V A = 700V B = 800V C = 900V K = 1000V L = 1100V P = 1200V	µF Code	J = ±5% K = ±10% M = ±20%	L = 15mm

RoHS COMPLIANT

DIMENSIONS: millimeters (inches)



millimeters (inches)

Case Size	W	H	T	P	d
A	32.0 (1.260)	20.0 (0.787)	11.0 (0.433)	27.5 (1.083)	0.80 (0.031)
B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5.0 (1.083)	1.00 (0.039)
C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	1.00 (0.039)
D	32.0 (1.260)	25.0 (0.984)	16.0 (0.630)	27.5 (1.083)	1.20 (0.047)
E	32.0 (1.260)	28.0 (1.102)	14.0 (0.551)	27.5 (1.083)	1.20 (0.047)
S	32.0 (1.260)	28.0 (1.102)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)
F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	1.20 (0.047)
G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	1.20 (0.047)
H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.20 (0.047)
J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	1.20 (0.047)
K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	1.20 (0.047)
L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	1.20 (0.047)
M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)
N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)
P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)

POLYPROPYLENE DIELECTRIC FOR INDUSTRIAL DC FILTERING

These capacitors have been designed primarily for high and medium power DC filtering applications.

ELECTRICAL CHARACTERISTICS – POLYPROPYLENE DIELECTRIC

Climatic category	40/100/56 (IEC 60068)
Test voltage between terminals @ 25°C	1.5 x $V_n$dc
Capacitance range C_n	0.68µF to 75µF
Tolerance on C_n	±5%, ±10%, ±20%
Rated DC voltage $V_n$dc	450 to 1200 V
Dielectric	Polypropylene
Insulation Resistance:	>3,000 MΩ.uF/C after 1 minute electrification @ 100 Vdc & 25ºC
Lifetime (ΔC/C ≤ 5%):	100,000hrs @ Ur & 70ºC

Medium Power Film Capacitors

FB (RoHS Compliant)

RATINGS AND PART NUMBER REFERENCE – POLYPROPYLENE DIELECTRIC

Cap (µF)	Rated Voltage (V)	AVX Part Number	Case Size	W ±0.50 (0.020)	H ±0.50 (0.020)	T ±0.50 (0.020)	P ±1.00 (0.039)	d ±0.05 (0.002)	dv/dt Volt/usec	I peak Amps	I rms Amps	ESR mOhms	Ls nH	Rth °C/W	Packaging Qty.
Voltage $V_n$dc 450V Voltage Code: I															
10.0	450	FB27S6I0106*C	S	32.0 (1.260)	28.0 (1.102)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	75.0	89.1	9.0	8.0	25.0	23.2	95
Voltage $V_n$dc 550V Voltage Code: J															
3.3	550	FB27A6J0335*C	A	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	27.0	89.1	5.0	22.0	25.0	27.3	150
5.0	550	FB27B6J0505*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	27.0	135.0	6.0	16.5	25.0	25.3	130
6.8	550	FB27C6J0685*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	27.0	183.6	7.0	11.0	25.0	27.8	110
7.5	550	FB27E6J0755*C	E	32.0 (1.260)	28.0 (1.102)	14.0 (0.551)	27.5 (1.083)	0.80 (0.031)	27.0	202.5	8.0	10.0	25.0	23.4	110
10	550	FB27F6J0106*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	27.0	270.0	10.0	8.0	27.0	18.8	95
12	550	FB27F6J0126*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	27.0	324.0	11.0	7.0	27.0	17.7	95
15	550	FB27G6J0156*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	27.0	405.0	12.0	6.0	27.0	17.4	80
20	550	FB37K6J0206*C	K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	1.00 (0.039)	19.0	380.0	11.5	7.0	30.0	16.2	56
25	550	FB37J6J0256*C	J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	1.00 (0.039)	19.0	475.0	12.0	6.5	30.0	16.0	35
30	550	FB37J6J0306*C	J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	1.00 (0.039)	19.0	570.0	13.5	6.0	30.0	13.7	35
35	550	FB37M6J0356*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	19.0	665.0	15.0	5.5	33.0	12.1	44
40	550	FB37M6J0406*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	19.0	760.0	15.0	5.5	33.0	12.1	44
50	550	FB52N6J0506*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	12.5	625.0	14.0	6.5	35.0	11.8	25
60	550	FB52N6J0606*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	12.5	750.0	15.0	6.0	35.0	11.1	25
75	550	FB52P6J0756*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	12.5	937.5	16.0	5.5	37.0	10.7	20
Voltage $V_n$dc 700V Voltage Code: A															
2.5	700	FB27A6A0255*C	A	32.0 (1.260)	20.0 (0.787)	11.0 (0.433)	27.5 (1.083)	0.80 (0.031)	31.0	77.5	3.5	28.0	25.0	43.7	150
3.3	700	FB27B6A0335*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	31.0	102.3	4.5	22.0	25.0	33.7	130
4.7	700	FB27C6A0475*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	31.0	145.7	5.5	15.0	25.0	33.1	110
10	700	FB27F6A0106*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	31.0	310.0	10.0	7.0	27.0	21.4	95
12	700	FB27G6A0126*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	31.0	372.0	11.5	6.0	27.0	18.9	80
15	700	FB37H6A0156*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	21.0	315.0	9.0	9.0	30.0	20.9	49
20	700	FB37J6A0206*C	J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	1.00 (0.039)	21.0	420.0	11.0	7.0	30.0	17.7	35
22	700	FB37L6A0226*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.984)	37.5 (1.476)	1.00 (0.039)	21.0	462.0	13.0	6.0	30.0	14.8	42
25	700	FB37L6A0256*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.984)	37.5 (1.476)	1.00 (0.039)	21.0	525.0	13.5	5.5	30.0	15.0	42
30	700	FB37M6A0306*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	21.0	630.0	16.0	4.5	33.0	13.0	44
40	700	FB52N6A0406*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	14.5	580.0	13.0	6.5	35.0	13.7	25
45	700	FB52N6A0456*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	14.5	652.5	14.5	6.0	35.0	11.9	25
50	700	FB52P6A0506*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	14.5	725.0	15.0	5.5	37.0	12.1	20
55	700	FB52P6A0556*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	14.5	797.5	17.0	5.0	37.0	10.4	20
60	700	FB52P6A0606*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	14.5	870.0	18.0	4.5	37.0	10.3	20
Voltage $V_n$dc 800V Voltage Code: B															
2.2	800	FB27A6B0225*C	A	32.0 (1.260)	20.0 (0.787)	11.0 (0.433)	27.5 (1.083)	0.80 (0.031)	36.0	79.2	4.0	30.0	25.0	31.3	150
3.0	800	FB27C6B0305*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	36.0	108.0	4.5	21.0	25.0	35.3	110
4.0	800	FB27B6B0405*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	36.0	144.0	5.5	16.0	25.0	31.0	130
5.0	800	FB27D6B0505*C	D	32.0 (1.260)	25.0 (0.984)	16.0 (0.630)	27.5 (1.083)	0.80 (0.031)	36.0	180.0	7.0	13.0	25.0	23.5	100
6.8	800	FB27F6B0685*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	36.0	244.8	8.5	12.0	27.0	17.3	95
7.5	800	FB27F6B0755*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	36.0	270.0	9.5	11.0	27.0	15.1	95
10	800	FB27G6B0106*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	36.0	360.0	10.5	10.0	27.0	13.6	80
12	800	FB37H6B0126*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	24.0	288.0	8.5	11.0	30.0	18.9	49
15	800	FB37K6B0156*C	K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	1.00 (0.039)	24.0	360.0	10.0	11.0	30.0	13.6	56
20	800	FB37L6B0206*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.984)	37.5 (1.476)	1.00 (0.039)	24.0	480.0	13.0	6.0	30.0	14.8	42
22	800	FB37M6B0226*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	24.0	528.0	14.5	5.5	33.0	13.0	44
25	800	FB37M6B0256*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	24.0	600.0	15.5	5.0	33.0	12.5	44
30	800	FB52N6B0306*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	16.5	495.0	12.0	8.0	35.0	13.0	25
40	800	FB52P6B0406*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	16.5	660.0	14.5	6.0	37.0	11.9	20
47	800	FB52P6B0476*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	16.5	775.5	16.5	5.5	37.0	10.0	20
Voltage $V_n$dc 900V Voltage Code: C															
2.2	900	FB27B6C0225*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	41.5	91.3	3.7	30.0	25.0	36.5	130
2.5	900	FB27B6C0255*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	41.5	103.8	4.3	26.0	25.0	31.2	130
3.0	900	FB27C6C0305*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	41.5	124.5	5.0	21.0	25.0	28.6	110
3.3	900	FB27E6C0335*C	E	32.0 (1.260)	28.0 (1.102)	14.0 (0.551)	27.5 (1.083)	0.80 (0.031)	41.5	137.0	5.0	20.0	25.0	30.0	110
7.5	900	FB27G6C0755*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	41.5	311.3	9.5	15.0	27.0	11.1	80
10	900	FB37H6C0106*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	28.0	280.0	8.5	12.0	30.0	17.3	49
15	900	FB37L6C0156*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.984)	37.5 (1.476)	1.00 (0.039)	28.0	420.0	11.0	8.0	30.0	15.5	42
20	900	FB37M6C0206*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	28.0	560.0	14.0	6.0	33.0	12.8	44
25	900	FB52N6C0256*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	18.5	462.5	11.0	10.0	35.0	12.4	25
35	900	FB52P6C0356*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	18.5	647.5	14.5	7.0	37.0	10.2	20

Dimensions in millimeters (inches)
* Insert K for 10% capacitance tolerance (standard): J = +5% and M = +20% tolerances available on request.
Last character C denotes 5.00mm (0.197in) lead length (standard). For L option (15mm (0.591in)) contact factory for availability.
Values outside this standard range may be available – please contact AVX for any special requirements.
AVX reserves the right to supply capacitors to a tighter capacitance tolerance or higher voltage rating, in the same case size.

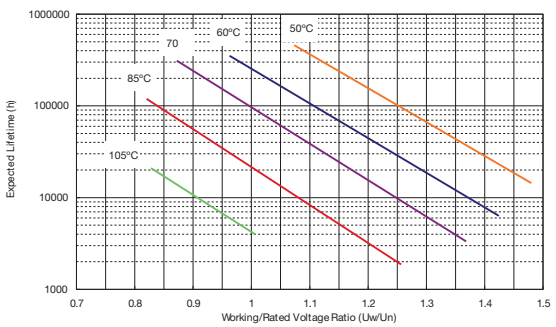
Medium Power Film Capacitors

FB (RoHS Compliant)

Cap (µF)	Rated Voltage (V)	AVX Part Number	Case Size	W ±0.50 (0.020)	H ±0.50 (0.020)	T ±0.50 (0.020)	P ±1.00 (0.039)	d ±0.05 (0.002)	dv/dt Volt/usec	I peak Amps	I rms Amps	ESR mOhms	Ls nH	Rth °C/W	Packaging Qty.
Voltage $V_n$dc 1000V Voltage Code: K															
1.5	1000	FB27A6K0155*C	A	32.0 (1.260)	20.0 (0.787)	11.0 (0.433)	27.5 (1.083)	0.80 (0.031)	47.0	70.5	4.5	42.3	25.0	17.5	150
2.0	1000	FB27B6K0205*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	47.0	94.0	5.5	38.5	25.0	12.9	130
2.5	1000	FB27C6K0255*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	47.0	117.5	6.0	22.6	25.0	18.4	110
3.0	1000	FB27E6K0305*C	E	32.0 (1.260)	28.0 (1.102)	14.0 (0.551)	27.5 (1.083)	0.80 (0.031)	47.0	141.0	7.0	18.4	25.0	16.6	110
4.7	1000	FB27F6K0475*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	47.0	220.9	9.0	16.1	27.0	11.5	95
5.0	1000	FB27F6K0505*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	47.0	235.0	9.0	15.0	27.0	12.3	95
6.8	1000	FB27G6K0685*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	47.0	319.6	11.0	14.0	27.0	8.9	80
7.5	1000	FB37H6K0755*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	31.0	232.5	10.0	14.0	30.0	10.7	49
9.0	1000	FB37K6K0905*C	K	42.5 (1.673)	40.0 (1.57)	20.0 (0.787)	37.5 (1.476)	1.00 (0.039)	31.0	279.0	11.0	13.4	30.0	9.3	56
10	1000	FB37K6K0106*C	K	42.5 (1.673)	40.0 (1.57)	20.0 (0.787)	37.5 (1.476)	1.00 (0.039)	31.0	310.0	11.0	12.8	30.0	9.7	56
12	1000	FB37L6K0126*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	1.00 (0.039)	31.0	372.0	12.0	9.4	30.0	11.1	42
15	1000	FB37M6K0156*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	31.0	465.0	14.0	8.0	33.0	9.6	44
22	1000	FB52N6K0226*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	21.0	462.0	13.0	7.5	35.0	11.8	25
30	1000	FB52P6K0306*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	21.0	630.0	14.0	7.0	37.0	10.9	20
Voltage $V_n$dc 1100V Voltage Code: L															
1.2	1100	FB27A6L0125*C	A	32.0 (1.260)	20.0 (0.787)	11.0 (0.433)	27.5 (1.083)	0.80 (0.031)	70.0	84.0	3.4	40.5	25.0	33.0	150
1.5	1100	FB27B6L0155*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	70.0	105.0	3.8	34.3	25.0	31.1	130
2.0	1100	FB27C6L0205*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	70.0	140.0	4.5	23.0	25.0	32.2	110
2.2	1100	FB27C6L0225*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	70.0	154.0	4.9	21.6	25.0	28.7	110
2.5	1100	FB27E6L0255*C	E	32.0 (1.260)	28.0 (1.102)	14.0 (0.551)	27.5 (1.083)	0.80 (0.031)	70.0	175.0	5.3	19.3	25.0	28.3	110
3.3	1100	FB27F6L0335*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	70.0	231.0	6.8	14.0	27.0	23.2	95
4.0	1100	FB27F6L0405*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	70.0	280.0	8.0	11.5	27.0	20.4	95
4.7	1100	FB27G6L0475*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	70.0	329.0	8.6	10.0	27.0	20.3	80
6.8	1100	FB37H6L0685*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	45.0	306.0	11.0	14.0	30.0	8.9	49
7.5	1100	FB37H6L0755*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	45.0	337.5	11.5	12.0	30.0	9.5	49
10	1100	FB37L6L0106*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	1.00 (0.039)	45.0	450.0	14.0	9.0	30.0	8.5	42
12	1100	FB37M6L0126*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	45.0	540.0	15.5	7.5	33.0	8.3	44
20	1100	FB52N6L0206*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	23.0	460.0	14.0	9.0	35.0	8.5	25
22	1100	FB52P6L0226*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	23.0	506.0	15.5	8.0	38.0	7.8	20
25	1100	FB52P6L0256*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	23.0	575.0	16.0	7.0	38.0	8.4	20
Voltage $V_n$dc 1200V Voltage Code: P															
0.68	1200	FB27A6P0684*C	A	32.0 (1.260)	20.0 (0.787)	11.0 (0.433)	27.5 (1.083)	0.80 (0.031)	80.0	54.4	2.2	65.4	25.0	47.4	150
1.0	1200	FB27B6P0105*C	B	32.0 (1.260)	22.0 (0.866)	13.0 (0.512)	27.5 (1.083)	0.80 (0.031)	80.0	80.0	3.0	43.0	25.0	38.8	130
1.5	1200	FB27C6P0155*C	C	32.0 (1.260)	24.5 (0.965)	15.0 (0.591)	27.5 (1.083)	0.80 (0.031)	80.0	120.0	4.0	32.3	25.0	29.1	110
2.0	1200	FB27F6P0205*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	80.0	160.0	5.0	21.5	27.0	27.9	95
2.2	1200	FB27F6P0225*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	80.0	176.0	5.5	19.8	27.0	25.1	95
2.5	1200	FB27F6P0255*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	80.0	200.0	5.8	18.0	27.0	24.8	95
3.0	1200	FB27F6P0305*C	F	32.0 (1.260)	33.0 (1.299)	18.0 (0.709)	27.5 (1.083)	0.80 (0.031)	80.0	240.0	6.5	14.5	27.0	24.5	95
3.3	1200	FB27G6P0335*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	80.0	264.0	7.2	13.0	27.0	22.3	80
4.0	1200	FB27G6P0405*C	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	0.80 (0.031)	80.0	320.0	8.0	11.0	27.0	21.3	80
4.7	1200	FB37H6P0475*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	55.0	258.5	6.3	20.0	30.0	18.9	49
5.0	1200	FB37H6P0505*C	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	1.00 (0.039)	55.0	275.0	6.5	17.0	30.0	20.9	49
6.8	1200	FB37L6P0685*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	1.00 (0.039)	55.0	374.0	8.0	14.3	30.0	16.4	42
7.5	1200	FB37L6P0755*C	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	1.00 (0.039)	55.0	412.5	8.8	11.3	30.0	17.2	42
10	1200	FB37M6P0106*C	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	1.20 (0.047)	55.0	550.0	11.0	8.5	33.0	14.6	44
12	1200	FB52N6P0126*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	35.0	420.0	9.0	14.0	35.0	13.2	25
15	1200	FB52N6P0156*C	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	1.20 (0.047)	35.0	525.0	10.0	11.0	35.0	13.6	25
20	1200	FB52P6P0206*C	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	1.20 (0.047)	35.0	700.0	13.0	8.5	38.0	10.4	20

Dimensions in millimeters (inches)
* Insert K for 10% capacitance tolerance (standard): J = +5% and M = +20% tolerances available on request.
Last character C denotes 5.00mm (0.197in) lead length (standard). For L option (15mm (0.591in)) contact factory for availability.
Values outside this standard range may be available – please contact AVX for any special requirements.
AVX reserves the right to supply capacitors to a tighter capacitance tolerance or higher voltage rating, in the same case size.

Typical Lifetime* Characteristics



*Lifetime is the number of operating hours required for the capacitor to lose 3% of its initial value.

Medium Power Film Capacitors

FE (RoHS Compliant)

The FE series uses a non-impregnated metallized polypropylene dielectric specially treated to have a very high dielectric strength in operating conditions up to 100°C.

The FE has been designed for printed circuit board mounting. FE series performance characteristics make them a viable alternative to aluminum electrolytic technology due to much lower ESR and much higher surge voltage capability (dv/dt).

APPLICATIONS

The FE capacitor is particularly designed for DC filtering, low reactive power.

HOT SPOT CALCULATION

See Hot Spot Temperature, page 3.

$$\theta_{hot\ spot} = \theta_{ambient} + (P_d + P_t) \times R_{th}$$

with P_d (Dielectric losses) = $Q \times tg\delta_0$

$Q \times tg\delta_0 \Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times tg\delta_0$

$tg\delta_0$ (tan delta)

For polypropylene, $tg\delta_0 = 2 \times 10^{-4}$ for frequencies up to 1MHz and is independent of temperatures.

P_t (Thermal losses) = $R_s \times (I_{rms})^2$

where C_n in Farad, I_{rms} in Ampere, f in Hertz, V in Volt, R_s in Ohm, θ in °C, R_{th} in °C/W

OPERATING TEMPERATURE RANGE

Operating temperature range: -40ºC to +100ºC

LIFETIME EXPECTANCY

One unique feature of this technology (versus aluminum electrolytics) is how the capacitor reacts at the end of its lifetime.

Unlike aluminum electrolytic film capacitors do not have a catastrophic failure mode. Film capacitors simply experience a parametric loss of capacitance of about 2% from initial value, with no risk of short circuit.

The capacitor continues to be functional even after this 2% decrease.

PACKAGING MATERIAL

Self-extinguishing plastic case (V0 = in accordance with UL 94) filled thermosetting resin.

Self-extinguishing thermosetting resin (V0 = in accordance with UL 94; I3F2 = in accordance with NF F 16-101).

STANDARDS

IEC 61071-1, IEC 61071-2:	Power electronic capacitors
IEC 60384-16:	Fixed metallized polypropylene film dielectric DC capacitors
IEC 60384-16-1:	Fixed metallized polypropylene film dielectric DC capacitors Assessment level E
IEC 60384-17:	Fixed metallized polypropylene film dielectric AC and pulse capacitors
IEC 60384-17-1:	Fixed metallized polypropylene film dielectric AC and pulse capacitors Assessment level E

Medium Power Film Capacitors

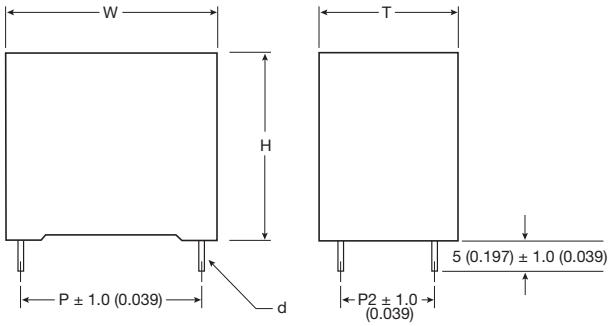
FE (RoHS Compliant)

HOW TO ORDER

FE	27	G	6	K	0685	K	A
Series	**Pitch**	**Case**	**Dielectric**	**Voltage**	**Cap**	**Tolerance**	**Pitch P2**
FE	27 = 27.5 (1.083) 37 = 37.5 (1.476) 52 = 52.5 (2.067)	G L H M J N K P	6 = Polypropylene	J = 550V A = 700V B = 800V C = 900V K = 1000V L = 1100V P = 1200V	µF Code	J = ±5% K = ±10% M = ±20%	A = 10.2 (0.402) B = 20.3 (0.799)

RoHS COMPLIANT

DIMENSIONS: millimeters (inches)



millimeters (inches)

Case Size	W	H	T	P	P2	d
G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	1.20 (0.047)
H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)
J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)
K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)
L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)
M	42.5 (1.673)	45.0 (1.771)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)
N	57.5 (2.264)	45.0 (1.771)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)
P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)

POLYPROPYLENE DIELECTRIC FOR INDUSTRIAL DC FILTERING

These capacitors have been designed principally for high and medium power DC filtering applications.

ELECTRICAL CHARACTERISTICS – POLYPROPYLENE DIELECTRIC

Climatic category	40/100/56 (IEC 60068)
Test voltage between terminals @ 25°C	1.5 x $V_n$dc
Capacitance range C_n	3.3µF to 75µF
Tolerance on C_n	±5%, ±10%, ±20%
Rated DC voltage $V_n$dc	550V to 1200V
Dielectric	Polypropylene
Insulation Resistance:	>3,000 MΩ.µF/C after 1 minute electrification @ 100 Vdc & 25ºC
Lifetime (ΔC/C ≤ 5%):	100,000hrs @ Ur & 70ºC

Medium Power Film Capacitors

FE (RoHS Compliant)

RATINGS AND PART NUMBER REFERENCE – POLYPROPYLENE DIELECTRIC

Cap (µF)	Rated Voltage (V)	AVX Part Number	Case Size	W ±0.50 (0.020)	H ±0.50 (0.020)	T ±0.50 (0.020)	P ±1.00 (0.039)	P2 ±1.00 (0.039)	d ±0.05 (0.002)	dv/dt Volt/usec	I peak Amps	I rms Amps	ESR mOhms	Ls nH	Rth °C/W	Packaging Qty.
Voltage V,DC 550V Voltage Code: J																
15	550	FE27G6J0156*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	27.0	475.0	13.0	5.5	27.0	16.1	80
20	550	FE37K6J0206*A	K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	19.0	380.0	12.5	6.5	30.0	14.8	56
25	550	FE37J6J0256*A	J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	19.0	475.0	13.0	6.0	30.0	14.8	35
30	550	FE37J6J0306*A	J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	19.0	570.0	14.5	5.5	30.0	13.0	35
35	550	FE37M6J0356*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	19.0	665.0	16.0	5.0	33.0	11.7	44
40	550	FE37M6J0406*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	19.0	760.0	16.0	5.0	33.0	11.7	44
50	550	FE52N6J0506*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	12.5	625.0	15.0	6.0	35.0	11.1	25
60	550	FE52N6J0606*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	12.5	750.0	16.0	5.5	35.0	10.7	25
75	550	FE52P6J0756*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	12.5	937.5	17.0	5.0	37.0	10.4	20
Voltage V,dc 700V Voltage Code: A																
12	700	FE27G6A0126*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	31.0	372.0	12.5	5.5	27.0	17.5	80
15	700	FE37H6A0156*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	21.0	315.0	10.0	8.0	30.0	18.8	49
20	700	FE37J6A0206*A	J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	21.0	420.0	12.0	6.0	30.0	17.4	35
22	700	FE37L6A0226*A	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	21.0	462.0	14.0	5.5	30.0	13.9	42
25	700	FE37L6A0256*A	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	21.0	525.0	14.5	5.0	30.0	14.3	42
30	700	FE37M6A0306*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	21.0	630.0	17.0	4.0	33.0	13.0	44
40	700	FE52N6A0406*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	14.5	580.0	14.0	6.0	35.0	12.8	25
45	700	FE52N6A0456*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	14.5	652.5	15.5	5.5	35.0	11.4	25
50	700	FE52P6A0506*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	14.5	725.0	16.0	5.0	37.0	11.7	20
55	700	FE52P6A0556*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	14.5	797.5	18.0	4.5	37.0	10.3	20
60	700	FE52P6A0606*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	14.5	870.0	19.0	4.0	37.0	10.4	20
Voltage V,dc 800V Voltage Code: B																
10	800	FE27G6B0106*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	36.0	360.0	11.5	9.5	27.0	11.9	80
12	800	FE37H6B0126*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	24.0	288.0	9.5	10.5	30.0	15.8	49
15	800	FE37K6B0156*A	K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	24.0	360.0	11.0	10.5	30.0	11.8	56
20	800	FE37L6B0206*A	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	24.0	480.0	14.0	5.5	30.0	13.9	42
22	800	FE37M6B0226*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	24.0	528.0	15.5	5.0	33.0	12.5	44
25	800	FE37M6B0256*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	24.0	600.0	16.5	4.5	33.0	12.2	44
30	800	FE52N6B0306*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	16.5	495.0	13.0	7.5	35.0	11.8	25
40	800	FE52P6B0406*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	16.5	660.0	15.5	5.5	37.0	11.4	20
47	800	FE52P6B0476*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	16.5	775.5	17.5	5.0	37.0	9.8	20
Voltage V,dc 900V Voltage Code: C																
7.5	900	FE27G6C0755*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	41.5	311.3	10.5	14.5	27.0	9.4	80
10	900	FE37H6C0106*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	28.0	280.0	9.5	11.5	30.0	14.5	49
15	900	FE37L6C0156*A	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	28.0	420.0	12.0	7.5	30.0	13.9	42
20	900	FE37M6C0206*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	28.0	560.0	15.0	5.5	33.0	12.1	44
25	900	FE52N6C0256*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	18.5	462.5	12.0	9.5	35.0	11.0	25
35	900	FE52P6C0356*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	18.5	647.5	15.5	6.5	37.0	9.6	20
Voltage V,dc 1000V Voltage Code: K																
6.8	1000	FE27G6K0685*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	47.0	319.6	12.0	13.5	27.0	7.7	80
7.5	1000	FE37H6K0755*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	31.0	232.5	11.0	13.5	30.0	9.2	49
9.0	1000	FE37K6K0905*A	K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	31.0	279.0	12.0	13.0	30.0	8.0	56
10	1000	FE37K6K0106*A	K	42.5 (1.673)	40.0 (1.575)	20.0 (0.787)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	31.0	310.0	12.0	12.5	30.0	8.3	56
12	1000	FE37L6K0126*A	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	31.0	372.0	13.0	9.0	30.0	9.9	42
15	1000	FE37M6K0156*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	31.0	465.0	15.0	7.5	33.0	8.9	44
22	1000	FE52N6K0226*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	21.0	462.0	14.0	7.0	35.0	10.9	25
30	1000	FE52P6K0306*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	21.0	630.0	15.0	6.5	37.0	10.3	20
Voltage V,dc 1100V Voltage Code: L																
4.7	1100	FE27G6L0475*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	70.0	329.0	9.6	9.5	27.0	17.1	80
5.0	1100	FE27G6L0505*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	70.0	350.0	13.0	6.1	27.0	14.6	80
6.8	1100	FE37H6L0685*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	45.0	306.0	12.0	13.5	30.0	7.7	49
7.5	1100	FE37H6L0755*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	45.0	337.5	12.5	11.5	30.0	8.3	49
10	1100	FE37L6L0106*A	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	45.0	450.0	15.0	8.5	30.0	7.8	42
12	1100	FE37M6L0126*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	45.0	540.0	16.5	7.0	33.0	7.9	44
20	1100	FE52N6L0206*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	23.0	460.0	15.0	8.5	35.0	7.8	25
22	1100	FE52P6L0226*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	23.0	506.0	16.5	7.5	38.0	7.3	20
25	1100	FE52P6L0256*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	23.0	575.0	17.0	6.5	38.0	8.0	20
30	1100	FE52N6L0306*B	N	57.5 (2.26)	45.0 (1.77)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	35.0	1050	12.0	15.0	15.0	7.0	25

Dimensions in millimeters (inches)
* Insert K for 10% capacitance tolerance (standard): J = +5% and M = +20% tolerances available on request.
Values outside this standard range may be available – please contact AVX for any special requirements.
AVX reserves the right to supply capacitors to a tighter capacitance tolerance or higher voltage rating, in the same case size.

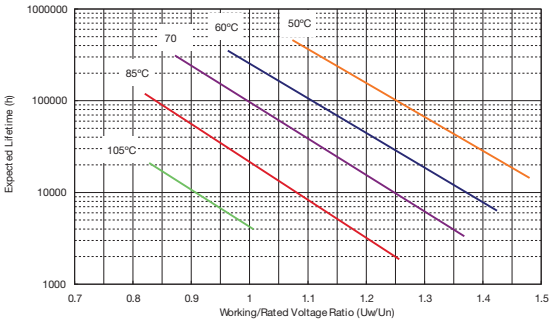
Medium Power Film Capacitors

FE (RoHS Compliant)

Cap (µF)	Rated Voltage (V)	AVX Part Number	Case Size	W ±0.50 (0.020)	H ±0.50 (0.020)	T ±0.50 (0.020)	P ±1.00 (0.039)	P2 ±1.00 (0.039)	d ±0.05 (0.002)	dv/dt Volt/usec	I peak Amps	I rms Amps	ESR mOhms	Ls nH	Rth °C/W	Packaging Qty.
Voltage V,dc 1200V Voltage Code: P																
3.3	1200	FE27G6P0335*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	80.0	264.0	8.2	12.5	27.0	17.8	80
4.0	1200	FE27G6P0405*A	G	32.0 (1.260)	37.0 (1.457)	22.0 (0.866)	27.5 (1.083)	10.2 (0.402)	0.80 (0.031)	80.0	320.0	9.0	10.5	27.0	17.6	80
4.7	1200	FE37H6P0475*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	55.0	258.5	7.3	19.5	30.0	14.4	49
5.0	1200	FE37H6P0505*A	H	42.5 (1.673)	33.5 (1.319)	22.0 (0.866)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	55.0	275.0	7.5	16.5	30.0	16.2	49
6.8	1200	FE37L6P0685*A	L	42.5 (1.673)	44.0 (1.732)	24.0 (0.945)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	55.0	374.0	9.0	14.0	30.0	13.2	42
7.5	1200	FE37J6P0755*A	J	42.5 (1.673)	37.0 (1.457)	28.0 (1.102)	37.5 (1.476)	10.2 (0.402)	1.20 (0.047)	55.0	412.5	9.8	11.0	30.0	14.2	35
10	1200	FE37M6P0106*B	M	42.5 (1.673)	45.0 (1.772)	30.0 (1.181)	37.5 (1.476)	20.3 (0.799)	1.20 (0.047)	55.0	550.0	12.0	8.0	35.0	13.0	44
12	1200	FE52N6P0126*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	35.0	420.0	10.0	13.5	35.0	11.1	25
15	1200	FE52N6P0156*B	N	57.5 (2.264)	45.0 (1.772)	30.0 (1.181)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	35.0	525.0	11.0	10.5	35.0	11.8	25
20	1200	FE52P6P0206*B	P	57.5 (2.264)	50.0 (1.969)	35.0 (1.378)	52.5 (2.067)	20.3 (0.799)	1.20 (0.047)	35.0	700.0	14.0	8.0	35.0	9.6	20

Dimensions in millimeters (inches)
* Insert K for 10% capacitance tolerance (standard): J = +5% and M = +20% tolerances available on request.
Values outside this standard range may be available – please contact AVX for any special requirements.
AVX reserves the right to supply capacitors to a tighter capacitance tolerance or higher voltage rating, in the same case size.

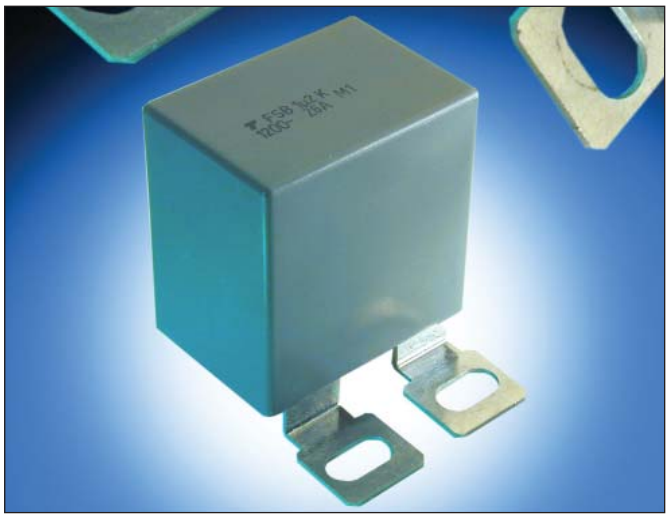
Typical Lifetime* Characteristics



*Lifetime is the number of operating hours required for the capacitor to lose 3% of its initial value.

Medium Power Film Capacitors

FSB (RoHS Compliant)



GENERAL DESCRIPTION

Metallized polypropylene dielectric capacitor with controlled self-healing.

Reinforced metallization developed for high impulse currents.

APPLICATIONS

- IGBT protection
- IGBT clamping

PACKAGING MATERIAL

- Plastic case backfilled with thermosetting resin

PROTECTION

HOW TO ORDER

FSB	1	6	U	0154	J	– –
Series	**Case Size** 1 = PO Style 2 = 18 Style 3 = 19 Style 4 = 26 style 5 = R28 Style (2 terminal or 4 terminal)	**Dielectric** 6 = Polypropylene	**Voltage Code** B = 850Vdc U = 1200Vdc M = 1600Vdc N = 2000Vdc	**Capacitance Code** 0 + pF code 0154 = 0.15µF 0334 = 0.33µF 0255 = 2.5µF etc.	**Capacitance Tolerances** J = ± 5% K = ±10% (Case size 6 only)	**Terminal Code** – – = 2 Terminal JC = 4 Terminal (Case Size 5 option only)

RoHS COMPLIANT

ELECTRICAL CHARACTERISTICS

Capacitance Range C_n	0.10µF to 2.5µF
Tolerance on C_n	±5%: FSB1...5 ±10%: FSB6
Rated DC Voltage $V_n$dc	850 to 2000 V
Stray Inductance	≤ 25 nH
RMS Current	I_{rms} max. = up to 28A The currents shown in the tables are maximum. It is necessary to maintain operation within the maximum temperature of the dielectric 85°C. See “Hot spot temperature calculation”
Insulation Resistance	R_i x C ≥ 30,000 s
Impulse Current	$I^2.t$ max. = up to 1.69 A^2s Spikes or peak currents in the capacitors may cause a deterioration of the bonding between the metallization and the connections. These bonds are capable of withstanding only a limited amount of energy for each spike. The table shows the maximum energy permitted in the form ($I^2.t$), where I is in Amperes, and t is in seconds.

Note: The formula ($I^2.t$) replaces dv/dt which is less easy to use as it is not an expression of energy (I = C.dv/dt). This type of capacitor has been designed to withstand high ($I^2.t$) values.

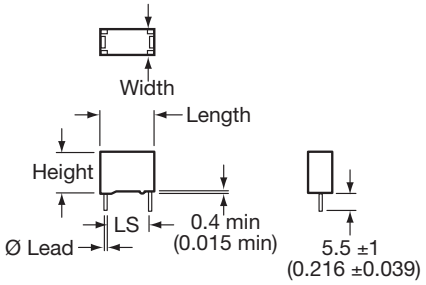
Variation of Capacitance with Temperature	$\frac{\Delta C}{C}$ ≤ ±2% between -40 and +85°C
Climatic Category	40/085/56 (IEC 68)
Test Voltage Between Terminals @ 25°C	1.6 $V_n$dc during 10s
Withstanding Voltage Between Terminals and Case @ 25°C	@ 3 kVrms @ 50Hz during 1 min.

Medium Power Film Capacitors

FSB (RoHS Compliant)

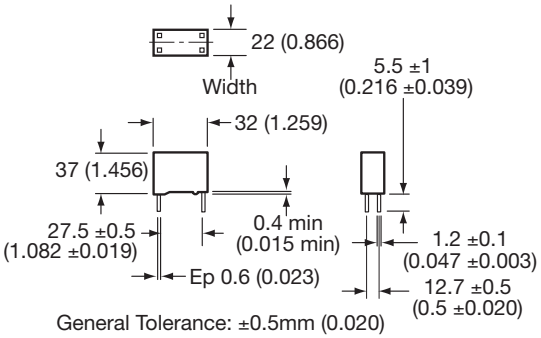
GENERAL DESCRIPTION

STYLE: P0; 18; 19; 26; R68
ALL CASE SIZES
2 TERMINALS VERSION



General Tolerance: ±0.5mm (0.020)

STYLE: R68
CASE SIZE 5 ONLY
4 TERMINALS VERSION



General Tolerance: ±0.5mm (0.020)

DIMENSIONS: millimeters (inches)

Case Size	Case Style	Length mm ±0.40 (inches)	Width mm ±0.40 (inches)	Height mm ±0.30 (inches)	Dimensions lead mm +10% -0.05 (inches)	LS mm ±0.40 (inches)
1	**P0**	31.1 (1.230)	13.0 (0.051)	22.4 (0.880)	Ø 0.80 (0.031)	27.5 (1.083)
2	**18**	31.1 (1.230)	14.6 (0.580)	25.7 (1.010)	Ø 0.80 (0.031)	27.5 (1.083)
3	**19**	31.1 (1.230)	17.3 (0.068)	29.8 (1.170)	Ø 0.80 (0.031)	27.5 (1.083)
4	**26**	31.1 (1.230)	20.8 (0.820)	31.3 (1.230)	Ø 1.00 (0.039)	27.5 (1.083)
5	**R68 2 Terminals Version**	32.5 (1.280)	22.0 (0.870)	37.0 (1.460)	Ø 1.00 (0.039)	27.5 (1.083)
	R68 4 Terminals Version	32.5 (1.280)	22.0 (0.870)	37.0 (1.460)	1.20 x 0.60 (0.047 x 0.023)	27.5 (1.083)

RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (µF)	Case Style	(I²t) (A²s)	Irms (A)	Rs (mΩ)	Rth (hotspot/amb.)	Typical Weight (g)
$U_N$dc = 1200V Vpeak = 1600V Vrms = 560V Vs = 2000V (Voltage Code U)							
FSB16U0154J--	0.15	P0	0.05	3	14.3	45.9	15
FSB26U0274J--	0.27	18	0.15	7.6	8.4	36.8	20
FSB36U0394J--	0.39	19	0.31	11	6.2	32.2	25
FSB46U0474J--	0.47	26	0.41	12	5.6	29.4	32
FSB56U0684J--	0.68	R68 (2 terminals)	0.94	12	3.8	23.7	40
FSB56U0684JJC	0.68	R68 (4 terminals)	0.94	16.7	3.8	23.7	40
$U_N$dc = 1600V Vpeak = 2000V Vrms = 630V Vs = 2300V (Voltage Code M)							
FSB16M0134J--	0.13	P0	0.05	4.6	13.3	44.9	15
FSB26M0184J--	0.18	18	0.1	6.4	9.9	35.9	20
FSB36M0244J--	0.24	19	0.18	8.5	7.8	32.4	25
FSB46M0334J--	0.33	26	0.35	11.7	5.6	28.6	32
FSB56M0434J--	0.43	R68 (2 terminals)	0.59	12	4.6	23.8	40
FSB56M0434JJC	0.43	R68 (4 terminals)	0.59	15.2	4.6	23.8	40
$U_N$dc = 2000V Vpeak = 2400V Vrms = 700V Vs = 2600V (Voltage Code N)							
FSB16N0104J--	0.1	P0	0.05	4.2	14.3	44.6	15
FSB26N0134J--	0.13	18	0.08	5.5	11.3	35.7	20
FSB36N0184J--	0.18	19	0.15	7.6	8.5	32.1	25
FSB46N0224J--	0.22	26	0.22	9.3	6.8	29.1	32
FSB56N0304J--	0.3	R68 (2 terminals)	0.41	12	5.3	23.8	40
FSB56N0304JJC	0.3	R68 (4 terminals)	0.41	12.7	5.3	23.8	40

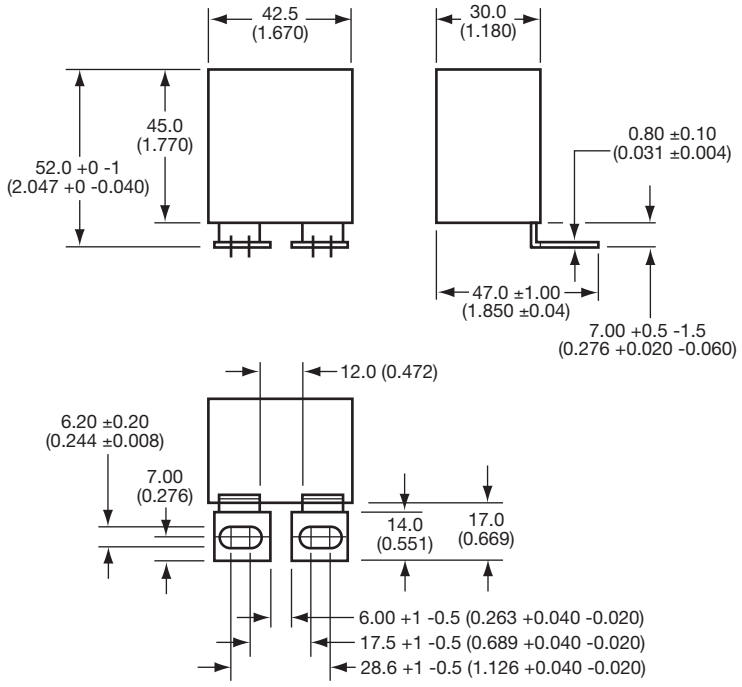
Medium Power Film Capacitors

FSB (RoHS Compliant)

CASE SIZE 6

Plastic case resin filled

Dimensions: millimeters (inches)



GENERAL TOLERANCES: ±0.50mm (±0.020 inches)

RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (µF)	(I²t) (A²s)	$I_{rms\ max.}$ (A)	R_s (mΩ)	R_{th} (°C/W)	Typical Weight (g)
FSB 850V $V_n$dc = 850V V_{peak} = 1200V V_{rms} = 450V V_S = 1500V (Voltage Code B)						
FSB66B0205K--	2	0.99	25	3.4	19.1	87
FSB66B0225K--	2.2	1.19	28	3.1	18.6	87
FSB66B0255K--	2.5	1.54	28	2.7	17.8	87
FSB 1200V $V_n$dc = 1200V V_{peak} = 1600V V_{rms} = 560V V_S = 2000V (Voltage Code U)						
FSB66U0105K--	1	1.47	25	3.6	17.2	87
FSB66U0125K--	1.2	1.69	26	3.4	17.5	87
FSB66U0155K--	1.5	1	26	3.4	17.5	87
FSB 2000V $V_n$dc = 2000V V_{peak} = 2400V V_{rms} = 700V V_S = 2600V (Voltage Code N)						
FSB66N0474K--	0.47	0.41	22	6.3	19.4	87
FSB66N0564K--	0.56	0.62	23	5.2	17.9	87
FSB66N0684K--	0.68	0.91	24	4.4	17.3	87

Medium Power Film Capacitors

FSB (RoHS Compliant)

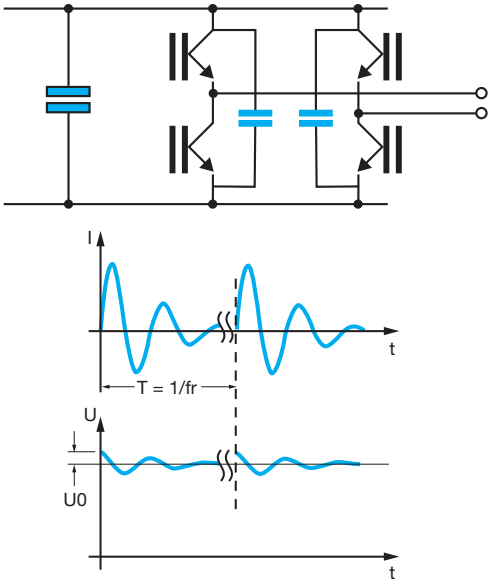
STANDARDS

IEC 61071-1, IEC 61071-2: Power electronic capacitors

TANGENT OF LOSS ANGLE (TANδ_0) FOR POLYPROPYLENE DIELECTRIC

Polypropylene has a constant dielectric loss factor of $2x10^{-4}$ irrespective of temperature and frequency (up to 1 MHz).

IGBT SNUBBER



With

L = stray inductance IGBT + capacitor

R = serial resistance IGBT + capacitor

HOT SPOT TEMPERATURE CALCULATION

See Hot Spot Temperature, page 3.

$\theta_{hot\ spot} = \theta_{ambient} + (P_d + P_t) \times R_{th}$

with P_d (Dielectric losses) = Q x $tg\delta_0$

$\Rightarrow [\frac{1}{2} \times C_n \times (V_{ripple\ peak\ to\ peak})^2 \times f] \times (2 \times 10^{-4})$

P_t (Thermal losses) = $R_s \times (I_{rms})^2$

Rth : Rth ambient / hot spot in °C/W

where C_n in Farad, I_{rms} in Ampere, f in Hertz, V in Volt, R_s in Ohm, θ in °C

Due to the design of the capacitor and its technology, the thermal impedance between the terminations and the core of the capacitor is low, it is necessary to take care that the capacitor is never overheated by use of wrongly sized connections.

Do not use the capacitor as a heat sink.

Due to the complexity of the IGBT / capacitor thermal exchanges, we recommend that thermal measurements shall be made on the different components. We would be pleased to advise you on specific applications.

WORKING TEMPERATURE

(according to the power to be dissipated) -40°C to +85°C

MARKING

TPC logo

Capacitance and tolerance in clear

Nominal DC voltage in clear

RMS current in clear

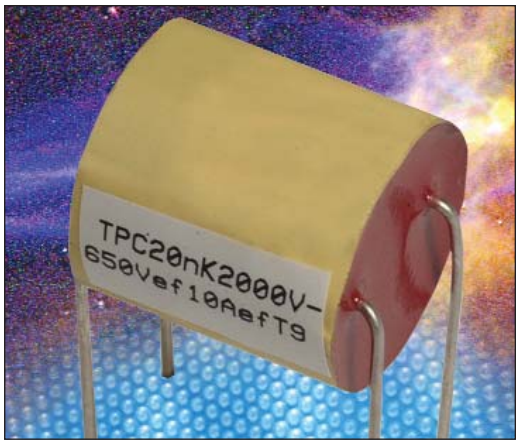
Date of manufacture (IEC coding)

$$Ieff = \sqrt{\left[\frac{C\beta_0^2 \times U_0}{2j\beta}\right]^2 \times \frac{1}{T} \times \left[\frac{e^{-2\alpha \times T}}{\beta^2 + \alpha^2} \times [\beta \sin(2\beta \times T) - \alpha \times \cos(2\beta \times T)] + \frac{1}{\alpha} \times e^{-2\alpha \times T} + \frac{\alpha}{\beta^2 + \alpha^2} - \frac{1}{\alpha}\right]}$$

with $\beta 0 = \sqrt{\frac{1}{LC}}$; $\alpha = \frac{R}{2L}$; $\beta = \sqrt{\beta_0^2 - \alpha^2}$

Medium Power Film Capacitors

FSV (RoHS Compliant)



GENERAL DESCRIPTION

Metallized dielectric capacitor and metal foil, low serial inductance and high RMS current.

APPLICATIONS

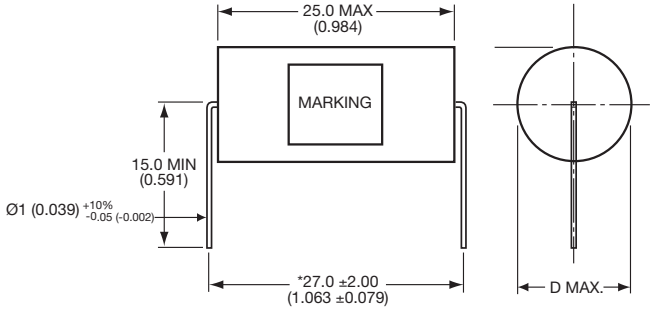
- Protection of semi conductors
- High frequency decoupling
- Tuning

PACKAGING MATERIAL

- Cylindrical with polyester tape wrapping, sealed with polyurethane resin
- Radial connections

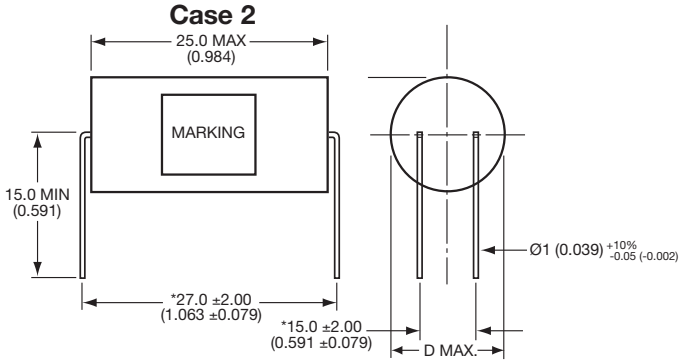
DIMENSIONS

Case 1



*PITCH DIMENSION AT 2.00mm (0.079) LENGTH OF LEADS

Case 2



*PITCH DIMENSION AT 2.00mm (0.079) LENGTH OF LEADS

HOW TO ORDER

FSV	1	6	K	0683	K	– –
Series	**Case Size** Case Size 1 Case Size 2	**Dielectric** 6 = Polypropylene	**Voltage Code** K = 600Vdc B = 800Vdc L = 1000Vdc U = 1200Vdc R = 1500Vdc N = 2000Vdc	**Capacitance Code** 0 + pF code 0683 = 0.068µF 0333 = 0.033µF 0203 = 0.020µF etc.	**Capacitance Tolerances** K = ±10%	**Terminal Code** – – = Standard

RoHS COMPLIANT

Medium Power Film Capacitors

FSV (RoHS Compliant)

PROTECTION

ELECTRICAL CHARACTERISTICS

Capacitance Range Cn	0.010µF to 0.15µF
Tolerance on Cn	10%
Rated DC Voltage Vndc	600 to 2000 V
Rated AC Voltage	300 to 650 Vrms
Test Voltage between terminals @ 25°C	1.5 Vndc during 10s
High dV/dt	10000 V/µs
RMS Current	Irms max = up to 23A The currents shown in the tables are maximum. It is necessary to respect the thermal limits of the dielectric 85°C See "Hot spot temperature calculation"
Working Temperature	-40°C +85°C (according to the power to be dissipated)
Climatic Category	40/085/56 (IEC 60068)
Hot Spot Calculation	*See Hot Spot Temperature page 3* For all applications, the temperature in the hot spot capacitor must be lower than 85°C Θ Hot spot = Θ ambient + ($\tan\delta_0$ x Q + Rs I_{rms}^2) x Rth With tg δ *o* = 2.10^{-4} Q in vars Rs in Ω Irms in A Rth in °C/W
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (µF)	D max. mm (in)	Irms A	Rs (mΩ)	Rth °C/W	Typical Weight (g)
FSV 600 V Vndc = 600V Vrms = 300V (Voltage Code K)						
FSV16K0683K--	0.068	22 (0.866)	10	2.5	35	15
FSV26K0104K--	0.10	25 (0.984)	15	2.1	25	25
FSV26K0154K--	0.15	30 (1.181)	23	1.8	17	25
FSV 800 V Vndc = 800V Vrms = 400V (Voltage Code B						
FSV16B0473K--	0.047	22 (0.866)	10	2.6	33	15
FSV26B0683K--	0.068	25 (0.984)	15	2.2	23	25
FSV26B0823K--	0.082	28 (1.102)	18	2.1	21	25
FSV26B0104K--	0.100	30 (1.181)	23	1.9	16	25
FSV 1000 V Vndc = 1000V Vrms = 450V (Voltage Code L)						
FSV16L0333K--	0.033	22 (0.866)	8	2.8	31	15
FSV26L0473K--	0.047	25 (0.984)	12	2.3	22	25
FSV26L0683K--	0.068	30 (1.181)	17	2.0	16	25
FSV 1200 V Vndc = 1200V Vrms = 500V (Voltage Code U)						
FSV16U0223K--	0.022	22 (0.866)	7	3.2	34	15
FSV26U0333K--	0.033	25 (0.984)	10	2.2	23	25
FSV26U0473K--	0.047	30 (1.181)	14	2.1	16	25
FSV 1500 V Vndc = 1500V Vrms = 600V (Voltage Code R)						
FSV16R0153K--	0.015	22 (0.866)	5	3.5	34	15
FSV26R0223K-	0.022	25 (0.984)	8	2.8	22	25
FSV26R0333K-	0.033	30 (1.181)	12	2.2	16	25
FSV 2000 V Vndc = 2000V Vrms = 650V (Voltage Code N)						
FSV16N0103K--	0.010	22 (0.866)	5	3.4	34	15
FSV26N0153K--	0.015	25 (0.984)	7	2.9	21	25
FSV26N0203K--	0.020	27 (1.063)	10	2.4	16	25
FSV26N0223K--	0.022	30 (1.181)	11	2.4	14	25

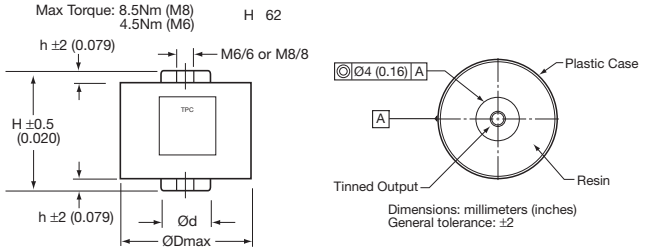
Medium Power Film Capacitors

FPX/FPY (RoHS Compliant)

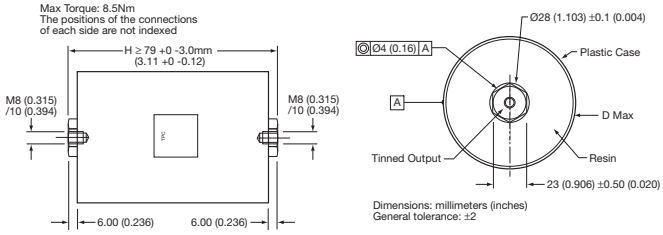
PROTECTION

DIMENSIONS

Plastic Case Style M6 / 6 or M8 / 8



Plastic Case Style M8 / 10



MARKING

Logo

Withstanding surge voltage

Capacitance and tolerance in clear

Nominal DC voltage in clear

RMS current in clear

Date of manufacture (IEC coding)

APPLICATIONS

Protection of thyristors.

Protection of gate turn-off thyristor (G.T.O.).

Clamping (Secondary snubber).

TECHNOLOGY

Metallized polypropylene dielectric capacitor with controlled self-healing.

Reinforced metallization developed for high impulse currents.

Axial connections specially developed to reduce series inductance and to provide rigid mechanical mounting.

PACKAGING MATERIAL

Cylindrical in plastic case filled with thermosetting resin.

Outputs: threaded inserts either M6 or M8.

HOT SPOT TEMPERATURE CALCULATION

See Hot Spot Temperature page 3.

$$\theta_{hot\ spot} = \theta_{terminals} + (P_d + P_t) \times R_{th}$$

with

P_d (Dielectric losses) $= Q \times tg\delta_0$

$\Rightarrow [\ ½ \times C_n \times (V_{peak\ to\ peak})^2 \times f\ ] \times (2 \times 10^{-4})$

P_t (Thermal losses) $= R_s \times (I_{rms})^2$

where

C_n	in Farads
V	in Volts
I_{rms}	in Amperes
R_s	in Ohms
f	in Hertz
θ	in °C
R_{th}	in °C/W

Due to the design of the capacitor and its technology, the thermal impedance between the terminations and the core of the capacitor is low, it is necessary to take care that the capacitor is never overheated by use of incorrect sized connections.

In the case where the series diodes are screwed to the capacitor, cooling of the diodes must be taken in account.

Do not use the capacitor as a heat sink.

Due to the complexity of the diode/capacitor thermal exchanges, we recommend that thermal measurements shall be made on the different components. We would be pleased to advise you on specific problems.

WORKING TEMPERATURE

(according to the power to be dissipated) -40°C to +85°C

HOW TO ORDER

FPX	6	6	N	0105	J	– –
Series	**Case Size**	**Dielectric**	**Voltage Code**	**Capacitance Code**	**Capacitance Tolerances**	**Terminal Code**
FPX = Standard FPY = RoHS Compliant	Case Size 6 Case Size 8 (See Case Style)	6 = Polypropylene	N = 2000V P = 2500V X = 3500V Z = 4500V Y = 4600V	0 + pF code 0105 = 1.0µF 0335 = 3.5µF 0504 = 0.5µF etc.	J = ±5%	– – = Standard

Not RoHS Compliant

RoHS COMPLIANT

Please select correct termination style.

Medium Power Film Capacitors

FPX/FPY (RoHS Compliant)

ELECTRICAL CHARACTERISTICS

Capacitance range C_n	0.5µF to 6µF
Tolerance on C_n	±5%
Rated DC voltage $V_n$dc Peak voltage V_{peak} Allowable overvoltage V_s (for 10 s/day)	1000 to 3000 V 1600 to 4000 V 2000 to 4600 V
Stray inductance	5 to 20 nH
RMS current	I_{rms} max. = up to 160 A The currents shown in the tables are maximum. It is necessary to respect the thermal limits of the dielectric 85°C see “Hot spot temperature calculation”
Insulation resistance	R_i x C ≥ 30,000 s
Impulse current	I^2.t maxi. = up to 729 A^2.s Spikes or peak currents in the capacitors may cause a deterioration of the bonding between the metallization and the connections. These bonds are capable of withstanding only a limited amount of energy for each spike. The table shows the maximum energy permitted in the form (I^2.t), where I is in Ampere, and t is in seconds.
Note: The formula (I^2.t) replaces dV/dt which is less easy to use as it is not an expression of energy (I = C.dV/dt). This type of capacitor has been designed to withstand high (I^2.t) values.	
Variation of capacitance with temperature	$\frac{\Delta C}{C}$ ≤ ±2% between -40 and 85°C
Climatic category	40/085/56 (IEC 60068)
Test voltage between terminals @ 25°C	V_s for 10s
Test voltage between terminals and case @ 25°C (Type test)	@ 7 kVrms @ 50 Hz for 1 min.
Dielectric	Polypropylene

Medium Power Film Capacitors

FPX/FPY (RoHS Compliant) Table of Values

PROTECTION

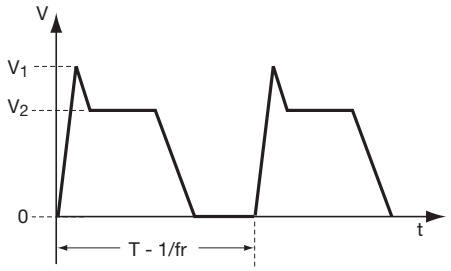
Dimensions: millimeters (inches)

Part Number	Cn (µF)	Dimensions					I²t max. (A²s)	Irms max. (A)	Rs (mΩ)	Rth (°C/W)	Typical Weight (g)
		Case Style	H* ±0.5 (±0.020)	h ±2 (±0.079)	D max.	d ±0.5 (±0.020)					
FPX 2000V $V_n$dc = 1000V V_{peak} = 1600V V_{rms} = 560V V_s = 2000V (Voltage Code N)											
FPX66N0105J--	1	Plastic case M6/6	52 (2.072)	5 (0.197)	40 (1.575	18 (0.709)	2	15	2.4	14)	120
FPX86N0205J--	2	Plastic case M8/8	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	8	30	1.2	6.1	190
FPX86N0305J--	3	Plastic case M8/8	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	18	45	0.9	4.5	260
FPX86N0355J--	3.5	Plastic case M8/8	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	25	50	0.85	4.5	260
FPX86N0405J--	4	Plastic case M8/8	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	32	60	0.75	3.5	320
FPX86N0505J--	5	Plastic case M8/8	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	50	70	0.65	2.5	320
FPX 2500V $V_n$dc = 1300V V_{peak} = 2000V V_{rms} = 700V V_s = 2500V (Voltage Code P)											
FPX66P0504J--	0.5	Plastic case M6/6	52 (2.072)	5 (0.197)	40 (1.575)	18 (0.709)	1	15	3	14	120
FPX86P0105J--	1	Plastic case M8/8	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	3	20	2.3	10.5	190
FPX86P0155J--	1.5	Plastic case M8/8	52 (2.072)	5 (0.197)	60 (2.362)	22 (0.866)	7	30	1.5	6.1	190
FPX86P0205J--	2	Plastic case M8/8	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	12.7	40	1.1	4.5	260
FPX86P0255J--	2.5	Plastic case M8/8	52 (2.072)	5 (0.197)	72 (2.835)	22 (0.866)	20	60	0.89	3.7	260
FPX86P0305J--	3	Plastic case M8/8	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	28	60	0.85	3.2	320
FPX86P0355J--	3.5	Plastic case M8/8	52 (2.072)	5 (0.197)	82 (3.228)	22 (0.866)	39	65	0.78	2.9	320
FPX 3500V $V_n$dc = 2000V V_{peak} = 2400V V_{rms} = 850V V_s = 3500V (Voltage Code X)											
FPX86X0205J--	2	Plastic case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	23	41	1.24	6.1	310
FPX86X0305J--	3	Plastic case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	50	62	0.92	3.9	475
FPX86X0355J--	3.5	Plastic case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	70	72	0.83	3.4	475
FPX86X0405J--	4	Plastic case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	85	80	0.78	3.1	475
FPX 4500V $V_n$dc = 2500V V_{peak} = 3200V V_{rms} = 1130V V_s = 4500V (Voltage Code Z)											
FPX86Z0904J--	0.9	Plastic case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	15	40	1.5	6.2	310
FPX86Z0105J--	1	Plastic case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	15	38	1.4	6.2	310
FPX86Z0205J--	2	Plastic case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	70	75	0.85	3.1	475
FPX 4600V $V_n$dc = 3000V V_{peak} = 4000V V_{rms} = 1400V V_s = 4600V (Voltage Code Y)											
FPX86Y0504J--	0.5	Plastic case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	7	40	1.7	12	310
FPX86Y0684J--	0.68	Plastic case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	14	35	1.59	6.2	310
FPX86Y1254J--	1.25	Plastic case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	50	65	1	3.3	475
FPX86Y0155J--	1.5	Plastic case M8/10	79 (3.110)	6 (0.236)	98 (3.858)	–	32	60	1.4	8.3	630
FPX86Y0175J--	1.7	Plastic case M8/10	79 (3.110)	6 (0.236)	98 (3.858)	–	40	70	1.3	7.4	630
FPX86Y0205J--	2	Plastic case M8/10	79 (3.110)	6 (0.236)	98 (3.858)	–	56	80	1.1	6.3	630
FPX86Y0255J--	2.5	Plastic case M8/10	118 (4.646)	6 (0.236)	98 (3.858)	–	200	130	0.8	1.1	1020
FPX86Y0275J--	2.7	Plastic case M8/10	118 (4.646)	6 (0.236)	98 (3.858)	–	232	140	0.7	1.1	1020
FPX86Y0305J--	3	Plastic case M8/10	143 (5.630)	6 (0.236)	98 (3.858)	–	128	100	0.9	1.5	1280
FPX86Y0355J--	3.5	Plastic case M8/10	143 (5.630)	6 (0.236)	98 (3.858)	–	170	110	0.8	1.4	1280
FPX86Y0405J--	4	Plastic case M8/10	143 (5.630)	6 (0.236)	98 (3.858)	–	224	115	0.8	1.4	1280
FPX86Y0455J--	4.5	Plastic case M8/10	163 (6.417)	6 (0.236)	98 (3.858)	–	522	120	0.6	1.7	1500
FPX86Y0505J--	5	Plastic case M8/10	163 (6.417)	6 (0.236)	98 (3.858)	–	600	130	0.6	1.7	1500
FPX86Y0605J--	6	Plastic case M8/10	163 (6.417)	6 (0.236)	98 (3.858)	–	729	160	0.5	1.7	1500

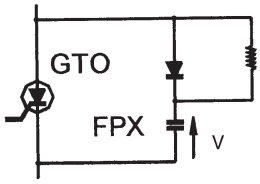
* Tol: +0 / -3mm for H ≥ 118mm

PROTECTION

G.T.O.

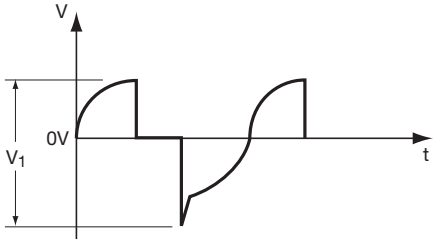


Choice of voltage: $V_1 \leq V_{peak}$
$V_2 \leq V_n dc$



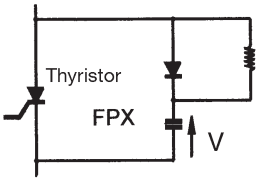
Nominal DC voltage ($V_n dc$) and peak voltage (V_{peak}) are given in the tables.

THYRISTOR



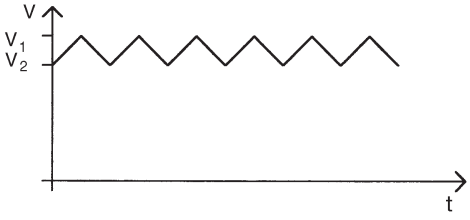
Choice of voltage: $V_1 \leq V_{peak}$

Note that V_1 is the voltage peak to peak and cannot be symmetrical vs 0 V

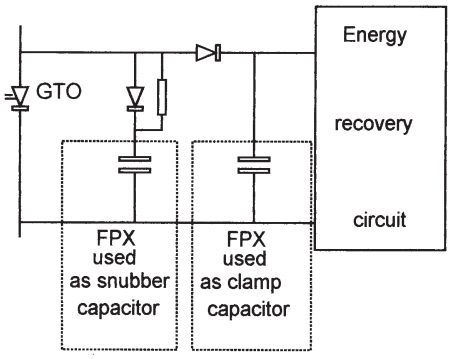


Peak voltage is given in the tables.

CLAMPING



Choice of voltage: $V_1 \leq V_{peak}$
$V_2 \leq V_n dc$

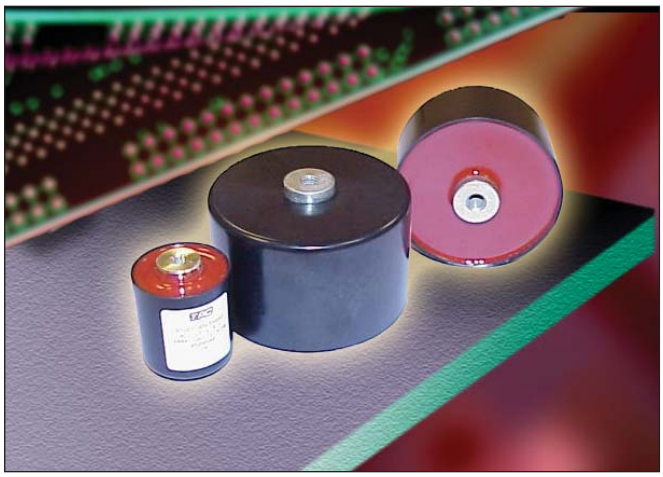


Nominal DC voltage ($V_n dc$) and peak voltage (V_{peak}) are given in the tables.

Medium Power Film Capacitors

FPG/FPH (RoHS Compliant)

PROTECTION



Metallized polypropylene dielectric capacitor with controlled self-healing.

Reinforced metallization on margins developed for high impulse currents.

Axial connections specially developed to reduce series inductance and to provide rigid mechanical mounting.

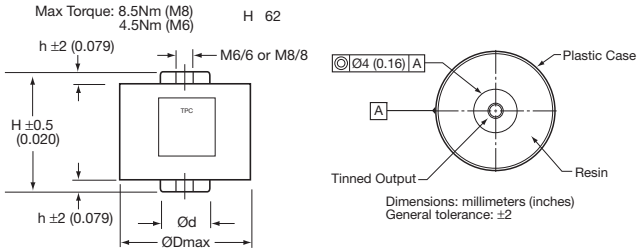
APPLICATIONS

Protection of gate turn-off thyristor (G.T.O.).

Medium frequency tuning.

DIMENSIONS

millimeters (inches)



MARKING

Logo

Withstanding surge voltage

Capacitance and tolerance in clear

Nominal DC voltage in clear

RMS current in clear

Date of manufacture (IEC coding)

PACKAGING MATERIAL

Cylindrical in plastic case filled with thermosetting resin.

Outputs: threaded inserts either M6 or M8.

HOT SPOT TEMPERATURE CALCULATION

See Hot Spot Temperature page 3.

$$\theta_{hot\ spot} = \theta_{terminals} + (P_d + P_t) \times R_{th}$$

with

P_d (Dielectric losses) = Q x $tg\delta_0$

$\Rightarrow [\frac{1}{2} \times C_n \times (V_{peak\ to\ peak})^2 \times f] \times (2 \times 10^{-4})$

P_t (Thermal losses) = $R_s \times (I_{rms})^2$

where

C_n	in Farads
V	in Volts
I_{rms}	in Amperes
R_s	in Ohms
f	in Hertz
θ	in °C
R_{th}	in °C/W

Due to the design of the capacitor and its technology, the thermal impedance between the terminations and the core of the capacitor is low, it is necessary to take care that the capacitor is never overheated by use of incorrect sized connections.

In the case where the series diodes are screwed to the capacitor, cooling of the diodes must be taken in account.

Do not use the capacitor as a heat sink.

Due to the complexity of the diode/capacitor thermal exchanges, we recommend that thermal measurements shall be made on the different components. We would be pleased to advise you on specific problems.

WORKING TEMPERATURE

(according to the power to be dissipated) -40°C to +85°C

HOW TO ORDER

FPG	8	6	R	0105	J	– –
Series	**Case Size**	**Dielectric**	**Voltage Code**	**Capacitance Code**	**Capacitance Tolerances**	**Terminal Code**
FPG = Standard FPH = RoHS Compliant	Case Size 8	6 = Polypropylene	R = 1500V N = 2000V P = 2500V W = 2600V X = 3500V Z = 4500V Y = 4600V	0 + pF code 0105 = 1.0µF 0405 = 4.0µF 0604 = 0.6µF etc.	J = ±5%	– – = Standard

Not RoHS Compliant

RoHS COMPLIANT

Please select correct termination style.

Medium Power Film Capacitors

FPG/FPH (RoHS Compliant)

ELECTRICAL CHARACTERISTICS

Capacitance range C_n	0.12µF to 6µF
Tolerance on C_n	±5%
Rated DC voltage $V_n$dc Peak voltage V_{peak} Allowable overvoltage V_s (for 10 s/day)	800 to 3000 V 1200 to 4000 V 1500 to 4600 V
Nominal RMS voltage $V_n$dc	500 to 1400 V
Stray inductance	≈ 10 nH
RMS current	I_{rms} max. = up to 80 A The currents shown in the tables are maximum. It is necessary to respect the thermal limits of the dielectric 85°C see "Hot spot temperature calculation"
Insulation resistance	R_i x C ≥ 30,000 s
Impulse current	I^2.t max. given in the tables Spikes or peak currents in the capacitors may cause a deterioration of the bonding between the metallization and the connections. These bonds are capable of withstanding only a limited amount of energy for each spike. The table shows the maximum energy permitted in the form (I^2.t), where I is in Ampere, and t is in seconds.

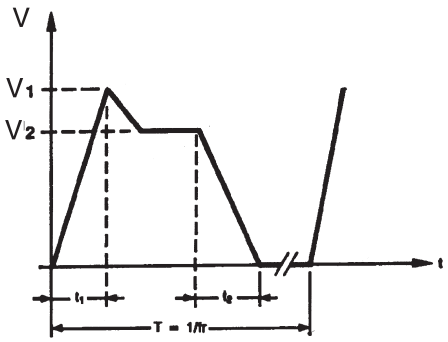
Note: The formula (I^2.t) replaces dV/dt which is less easy to use as it is not an expression of energy (I = C.dV/dt). This type of capacitor has been designed to withstand high (I^2.t) values.

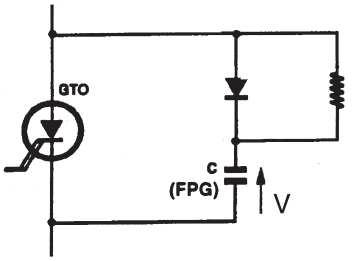
Variation of capacitance with temperature	$\frac{\Delta C}{C}$ ≤ ±2% between -40 and 85°C
Climatic category	40/085/56 (IEC 60068)
Test voltage between terminals @ 25°C	V_s during 10s
Test voltage between terminals and case @ 25°C (Type test)	@ 4 kVrms @ 50 Hz during 1 min.
Dielectric	Polypropylene

PROTECTION

APPLICATION NOTES

G.T.O. PROTECTION





FPG: Snubber capacitor

Choice of voltage: $V_1 \leq V_{peak}$
$V_2 \leq V_n$dc
Maximum overvoltage ≤ V_s (10 s/day)

Nominal DC voltage ($V_n$dc) and peak voltage (V_{peak}) are given in the table of values.

Medium Power Film Capacitors

FPG/FPH (RoHS Compliant) Table of Values

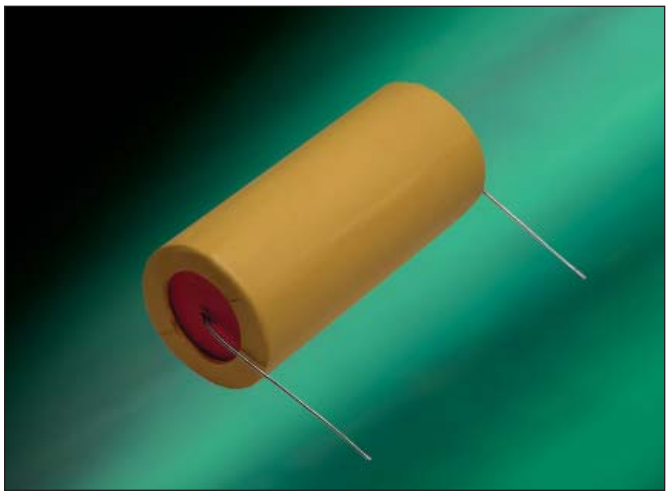
PROTECTION

Dimensions: millimeters (inches)

Part Number	Cn (µF)	Dimensions					$I^2.t$ max. ($A^2.s$)	I_{rms} max. (A)	Rs (mΩ)	Rth (°C/W)	Typical Weight (g)
		Case Style	H* ±0.5 (±0.020)	h ±2 (±0.079)	D max.	d ±0.5 (±0.020)					
FPG 1500V $V_n$dc = 800V V_{peak} = 1200V V_{rms} = 500V V_s = 1500V (Voltage Code R)											
FPG66R0105J--	1	Plastic Case M6/6	52 (2.047)	5 (0.197)	40 (1.575)	18 (0.709)	2	15	2.4	14	120
FPG66R0155J--	1.5	Plastic Case M6/6	52 (2.047)	5 (0.197)	55 (2.165)	18(0.709)	4.6	20	1.6	10.5	160
FPG86R0205J--	2	Plastic Case M8/8	52 (2.047)	5 (0.197)	60 (2.362)	22 (0.866)	8	30	1.2	6.1	190
FPG86R0305J--	3	Plastic Case M8/8	52 (2.047)	5 (0.197)	72 (2.835)	22 (0.866)	18	45	0.9	4.5	260
FPG86R0355J--	3.5	Plastic Case M8/8	52 (2.047)	5 (0.197)	72 (2.835)	22 (0.866)	25	50	0.85	4.5	260
FPG86R0405J--	4	Plastic Case M8/8	52 (2.047)	5 (0.197)	82 (1.575)	22 (0.866)	32	60	0.75	3.5	320
FPG86R0505J--	5	Plastic Case M8/8	52 (2.047)	5 (0.197)	82 (3.622)	22 (0.866)	50	70	0.65	2.5	320
FPG86R0605J--	6	Plastic Case M8/8	52 (2.047)	5 (0.197)	92 (3.622)	22 (0.866)	73	75	0.6	2.5	400
FPG 2000V $V_n$dc = 1000V V_{peak} = 1600V V_{rms} = 600V V_s = 2000V (Voltage Code N)											
FPG66N0504J--	0.5	Plastic Case M6/6	52 (2.047)	5 (0.197)	40 (1.575)	18 (0.709)	1	15	3	14	120
FPG86N0105J--	1	Plastic Case M8/8	52 (2.047)	5 (0.197)	60 (2.362)	22 (0.866)	3	20	2.3	10.5	190
FPG86N0155J--	1.5	Plastic Case M8/8	52 (2.047)	5 (0.197)	60 (2.362)	22 (0.866)	7	30	1.5	6.1	190
FPG86N0205J--	2	Plastic Case M8/8	52 (2.047)	5 (0.197)	72 (2.835)	22 (0.866)	12.7	40	1.1	4.5	260
FPG86N0255J--	2.5	Plastic Case M8/8	52 (2.047)	5 (0.197)	72 (2.835)	22 (0.866)	20	60	0.89	3.7	260
FPG86N0305J--	3	Plastic Case M8/8	52 (2.047)	5 (0.197)	82 (3.228)	22 (0.866)	28	60	0.85	3.2	320
FPG86N0355J--	3.5	Plastic Case M8/8	52 (2.047)	5 (0.197)	82 (3.228)	22 (0.866)	39	65	0.78	2.9	320
FPG86N0405J--	4	Plastic Case M8/8	52 (2.047)	5 (0.197)	92 (3.622)	22 (0.866)	50	70	0.7	2.5	400
FPG 2500V $V_n$dc = 1300V V_{peak} = 2000V V_{rms} = 700V V_s = 2500V (Voltage Code P)											
FPG66P0474J--	0.47	Plastic Case M6/6	62 (2.441)	5 (0.197)	40 (1.575)	18 (0.709)	0.7	15	6	25	160
FPG66P0105J--	1	Plastic Case M6/6	62 (2.441)	5 (0.197)	55 (2.165)	18 (0.709)	2	18	3	13	180
FPG66P0155J--	1.5	Plastic Case M6/6	62 (2.441)	5 (0.197)	60 (2.362)	22 (0.866)	4.5	25	2	10	220
FPG86P0205J--	2	Plastic Case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	8	35	1.5	6.5	310
FPG86P0255J--	2.5	Plastic Case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	12.5	40	1.3	4.8	310
FPG86P0305J--	3	Plastic Case M8/8	62 (2.441)	5 (0.197)	82 (3.228)	22 (0.866)	18	50	1.15	4.4	410
FPG86P0405J--	4	Plastic Case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	32	65	0.95	3.4	475
FPG 2600V $V_n$dc = 1750V V_{peak} = 2000V V_{rms} = 800V V_s = 2600V (Voltage Code W)											
FPG66W0474J--	0.47	Plastic Case M6/6	62 (2.441)	5 (0.197)	40 (1.575)	18 (0.709)	1.4	12	4.04	28	160
FPG66W0105J--	1	Plastic Case M6/6	62 (2.441)	5 (0.197)	55 (2.165)	18 (0.709)	5.7	21	2.17	10.9	180
FPG66W0155J--	1.5	Plastic Case M6/6	62 (2.441)	5 (0.197)	60 (2.362)	18 (0.709)	12.9	31	1.55	7.7	220
FPG86W0205J--	2	Plastic Case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	23	41	1.24	6.1	310
FPG86W0255J--	2.5	Plastic Case M8/8	62 (2.441)	5 (0.197)	82 (3.228)	22 (0.866)	36	51	1.05	4.5	410
FPG86W0305J--	3	Plastic Case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	50	62	0.92	3.9	475
FPG86W0355J--	3.5	Plastic Case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	70	72	0.83	3.4	475
FPG86W0395J--	3.9	Plastic Case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	85	80	0.78	3.1	475
FPG 3500V $V_n$dc = 2000V V_{peak} = 2400V V_{rms} = 1000V V_s = 3500V (Voltage Code X)											
FPG66X0334J--	0.33	Plastic Case M6/6	62 (2.441)	5 (0.197)	40 (1.575)	18 (0.709)	2	15	2.5	28	160
FPG66X0504J--	0.5	Plastic Case M6/6	62 (2.441)	5 (0.197)	55 (2.165)	18 (0.709)	5	19	2.5	11.2	180
FPG86X0105J--	1	Plastic Case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	15	38	1.4	6.2	310
FPG86X0155J--	1.5	Plastic Case M8/8	62 (2.441)	5 (0.197)	82 (3.228)	22 (0.866)	40	56	1.03	3.9	410
FPG86X0205J--	2	Plastic Case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	70	75	0.85	3.1	475
FPG 4500V $V_n$dc = 2500V V_{peak} = 3200V V_{rms} = 1200V V_s = 4500V (Voltage Code Z)											
FPG66Z0224J--	0.22	Plastic Case M6/6	62 (2.441)	5 (0.197)	40 (1.575)	18 (0.709)	1.5	15	3.8	25	160
FPG66Z0474J--	0.47	Plastic Case M6/6	62 (2.441)	5 (0.197)	60 (2.362)	18 (0.709)	7	24	2.16	8.5	220
FPG86Z0684J--	0.68	Plastic Case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	14	35	1.59	6.2	310
FPG86Z0105J--	1	Plastic Case M8/8	62 (2.441)	5 (0.197)	82 (3.228)	22 (0.866)	30	52	1.18	4	410
FPG86Z1254J--	1.25	Plastic Case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22 (0.866)	50	65	1	3.3	475
FPG 4600 V $V_n$dc = 3000 V V_{peak} = 4000 V V_{rms} = 1400 V V_s = 4600 V (Voltage Code Y)											
FPG66Y0124J--	0.12	Plastic Case M6/6	62 (2.441)	5 (0.197)	40 (1.575)	18 (0.709)	0.8	15	6	28	160
FPG66Y0224J--	0.22	Plastic Case M6/6	62 (2.441)	5 (0.197)	60 (2.362)	18 (0.709)	3	20	3.48	11	220
FPG86Y0334J--	0.33	Plastic Case M8/8	62 (2.441)	5 (0.197)	72 (2.835)	22 (0.866)	6.8	25	2.42	7.7	310
FPG86Y0474J--	0.47	Plastic Case M8/8	62 (2.441)	5 (0.197)	82 (3.228)	22 (0.866)	13.8	35	1.79	5.2	410
FPG86Y0604J--	0.60	Plastic Case M8/8	62 (2.441)	5 (0.197)	92 (3.622)	22(0.866)	22	45	1.47	4.2	475

Medium Power Film Capacitors

FD (RoHS Compliant)



GENERAL DESCRIPTION

FD series use metallized dielectric, controlled self-healing technology, high specific energy.

USUAL APPLICATIONS

The FD capacitors are designed for discharge applications such as Laser, electronic flash, cardiac defibrillator, etc.

FD series offer a very high specific energy level, higher than 1500J per liter for cardiac defibrillator application.

PACKAGING MATERIAL

Cylindrical with thermosetting sleeve, sealed with polyurethane resin.

HOT SPOT CALCULATION

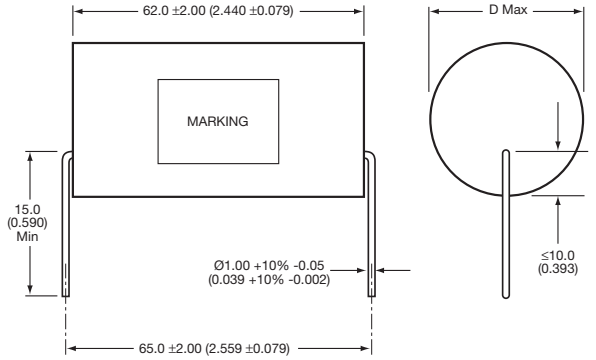
See Hot Spot Temperature page 3.

For all applications the temperature in the hot spot capacitor must be lower than 85°C

$$\theta_{hot\ spot} = \theta_{ambient} + (tg\delta_0 \times Q + R_s I_{rms}^2) \times R_{th}$$

with $tg\delta_0 = 2.10^{-4}$
Q in Vars
R_s in Ohm
I_{rms} in Ampere
R_{th} in °C/W

DIMENSIONS



DISCHARGE

HOW TO ORDER

FD	V1	6	L	0806	K	– –
Series	**Style**	**Dielectric** 6 = Polypropylene	**Voltage Code** L = 1000V Q = 1400V S = 1700V	**Capacitance Code** 0 + pF code 0806 = 80µF 0206 = 20µF 0505 = 5.0µF etc.	**Capacitance Tolerances** K = ±10%	**Terminal Code** – – = Standard

RoHS COMPLIANT

Medium Power Film Capacitors

FD (RoHS Compliant)

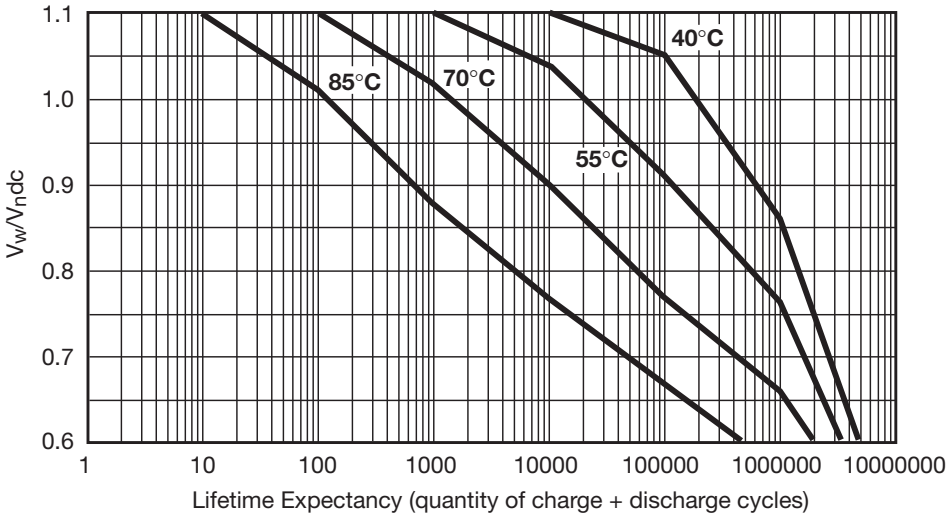
ELECTRICAL CHARACTERISTICS

Operating temperature:	–55°C to +85°C
Storage temperature:	–55°C to +85°C
Capacitance range:	5µF to 80µF other values on request
Capacitance tolerance:	±10%
Nominal charging voltage:	1kV to 1.7kV higher voltage on request
Test voltage between terminals:	@ 25°C: 1.2 x $U_N$dc during 10s
Test voltage between terminals and earth:	@ 25°C: 2 $U_N$dc during 1 min (type test)
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (µF)	Max diameter mm (in)	I peak max (A)	Irms max (A)	R_S (mΩ)	R_{th} (°C/W)	Typical Weight (g)
Uch = 1000V (Voltage Code L)							
FDV16L0806K--	80	50 (1.969)	2500	12	6	15.9	170
FDV16L0606K--	60	44 (1.732)	2000	12	7.7	17.5	135
FDV16L0406K--	40	37 (1.457)	1300	10	11	18.2	95
FDV16L0206K--	20	28 (1.102)	650	5	21.1	17.3	55
Uch = 1400V (Voltage Code Q)							
FDV16Q0506K--	50	51 (2.008)	2100	12	7.1	16	170
FDV16Q0306K--	30	41 (1.614)	1250	11.5	11.2	17.3	135
FDV16Q0206K--	20	35 (1.378)	800	7.5	16.3	18.4	95
FDV16Q0106K--	10	27 (1.063)	400	3.5	31.5	17.3	55
Uch = 1700V (Voltage Code S)							
FDV16S0356K--	35	51 (2.008)	1750	12	8.3	16	170
FDV16S0256K--	25	44 (1.732)	1250	12	11	17.2	135
FDV16S0156K--	15	35 (1.378)	750	7.5	18	18.5	95
FDV16S0505K--	5	24 (0.945)	250	2.5	51.9	15.9	55

LIFETIME EXPECTANCY vs VOLTAGE AND HOT SPOT TEMPERATURE



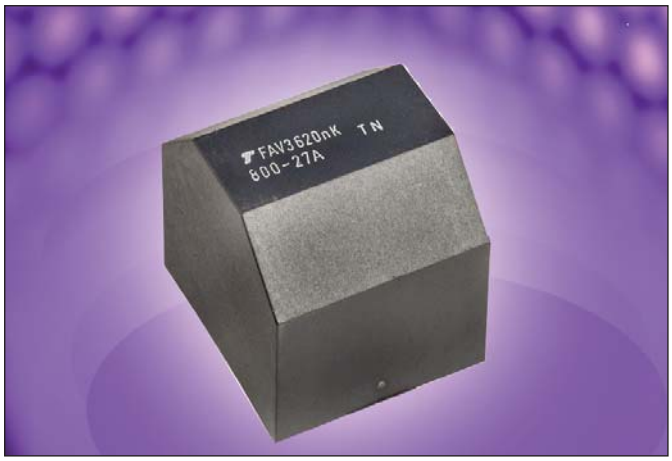
V_W: operating or working charge voltage

DISCHARGE

Medium Power Film Capacitors

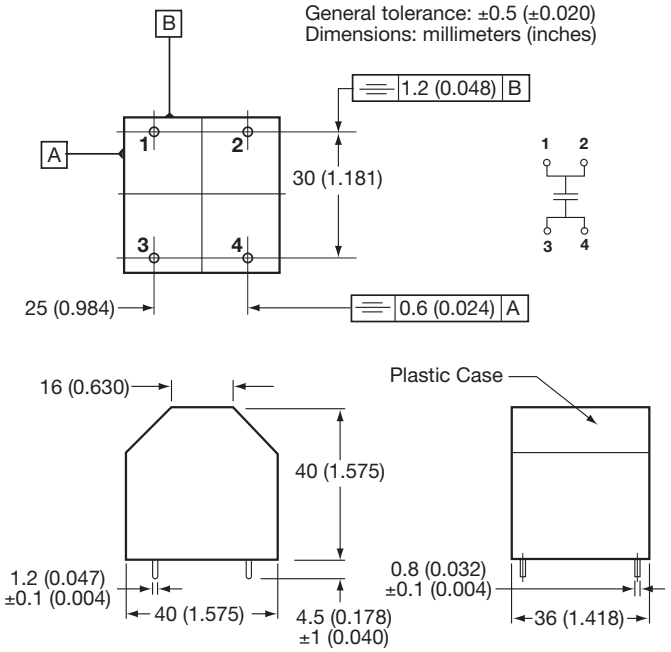
FAV (RoHS Compliant)

TUNING



DIMENSIONS

Case Size 3



APPLICATIONS

High reactive energy tuning for convertors.

Protection of semi-conductors.

TECHNOLOGY

Metallized polypropylene film and metal foil.

Dry capacitor.

PACKAGING

Rectangular resin case.

4 leads 1.2 x 0.8mm for printed circuit board mounting.

Self-extinguishing plastic case (V0 = in accordance with UL 94) filled thermosetting resin.

Self-extinguishing thermosetting resin (V0 = in accordance with UL 94; I3F2 = in accordance with NF F 16-101).

(Note that FFV3 and FAV3 are in the same packaging.)

STANDARDS

IEC 61071-1: IEC 61071-2: Power electronic capacitors

IEC 60068-1: Environmental testing

IEC 60077: Rules for electric traction equipment

UL 94: Fire requirements

NF F 16-101

NF F 16-102: Fire and smoke requirements

HOT SPOT TEMPERATURE CALCULATION

$\theta_{hot\ spot} = \theta_{ambient} + (P_d + P_t) \times (R_{th} + 7.4)$

with P_d (Dielectric losses) = Q x $tg\delta_0$

$\Rightarrow [\frac{1}{2} \times C \times (V_{peak\ to\ peak})^2 \times fr] \times 2.10^{-4}$

$\Rightarrow$ Protections applications

$\Rightarrow (V^2 \times C \times 2\pi Fr) \times 2.10^{-4}$

$\Rightarrow$ Tuning applications

Pc (Joule losses) = $R_s \times (I_{rms})^2$

where

Q in Var R_s in Ohm R_{th} in °C/W

HOW TO ORDER

FAV	3	6	K	0125	K	– –
Series	**Case Size** Case Size 3	**Dielectric** 6 = Polypropylene	**Voltage Code** K = 600Vdc B = 800Vdc L = 1000Vdc U = 1200Vdc R = 1500Vdc N = 2000Vdc	**Capacitance Code** 0 + pF code 0125 = 1.2µF (1200nF) 0105 = 1.0µF (1000nF) 0154 = 0.15µF (150nF) etc.	**Capacitance Tolerances** K = ±10%	**Terminal Code** – – = Standard

RoHS COMPLIANT

TUNING

Medium Power Film Capacitors

FAV (RoHS Compliant)

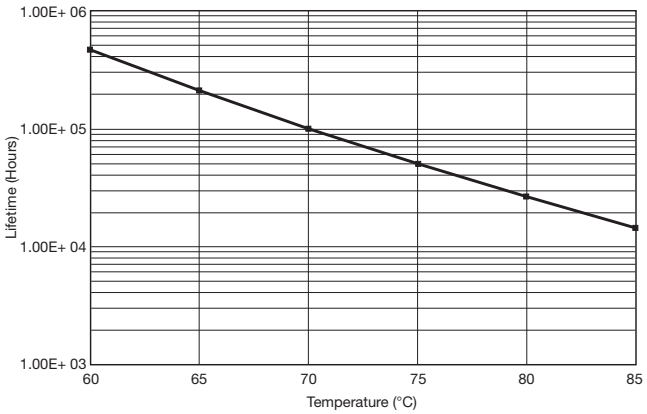
ELECTRICAL CHARACTERISTICS

Climatic category	40/085/56 (IEC 60068)
Working temperature	hot spot temperature: -40°C to +85°C
Hot spot temperature	≤85°C (must be calculated: see below)
Capacitance range C_n	80 to 1200nF
Tolerance	±10%
Rated AC voltage	$V_n$rms = 300 to 650 V
Rated DC voltage	$V_n$dc = 600 to 2000 V
Maximum rms current	Irms max = 10 to 40 Arms
Maximum reactive power	Q max = 7 to 14 kvar
Stray inductance	15 nH
Test voltage between terminals	1.5 x $V_n$dc 10s
Withstanding voltage between terminals and case	3000 Vrms 60s
Dielectric	Polypropylene

RATINGS AND PART NUMBER REFERENCE

Part Number	Capacitance (nF)	I rms max (A)	Q max (kV)	Rs (mΩ)	Ls (nH)	Rth (°C/W)	Typical Weight (g)
			$V_n$dc 600V Vrms: 300V				
FAV36K0125K--	1200	40	12	0.85	5	4	90
FAV36K0105K--	1000	32	10	1	5	4.1	90
			$V_n$dc 800V Vrms: 400V				
FAV36B0804K--	800	35	14	0.9	5	4	90
FAV36B0624K--	620	27	11	1.1	5	4.1	90
			$V_n$dc 1000V Vrms: 450V				
FAV36L0564K--	560	30	14	1	5	4	90
FAV36L0474K--	470	25	12	1.2	5	4.1	90
			$V_n$dc 1200V Vrms: 500V				
FAV36U0334K--	330	21	11	1.4	5	4.2	90
FAV36U0274K--	270	17	9	1.7	5	4.4	90
			$V_n$dc 1500V Vrms: 600V				
FAV36R0184K--	180	16	10	1.7	5	4.4	90
FAV36R0154K--	150	13	8	2	5	4.5	90
			$V_n$dc 2000V Vrms: 650V				
FAV36N0124K--	120	15	10	1.7	5	4.6	90
FAV36N0104K--	100	12	8	1.9	5	4.9	90
FAV36N0803K--	80	10	7	2	5	5.2	90

LIFETIME EXPECTANCY

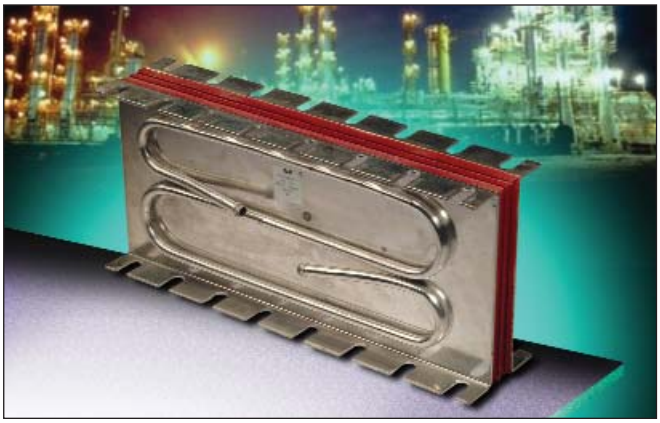


TUNING

Medium Power Film Capacitors

FAI (RoHS Compliant)

TUNING



The FAI series uses metallized polypropylene dielectric specifically designed for very high reactive power.

The FAI's special design gives to this series a very low level of stray inductance.

APPLICATIONS

These capacitors have been designed principally for:
low and medium frequency applications
(10 kHz to 500 kHz)

MAXIMUM WORKING TEMPERATURE (HOT SPOT)

+85°C: Hot spot temperature must be calculated as function of power dissipation.

HOT SPOT (THERMAL) CALCULATION

See Hot Spot Temperature page 3.

You can calculate the maximum operating (hot spot) temperature of this capacitor in the following manner:

Polypropylene has a constant loss factor ($tg\delta_0$) of $2x10^{-4}$ irrespective of temperature and frequency (up to 1 MHz).

The loss factor of the capacitor is made up of the sum of two components. The first represents electrical losses ($tg\delta_0 = 2.10^{-4}$) and the second represents Joule effect in the connection and foils: Rs.C.2πF.

For all applications, the temperature in the hot spot capacitor must be lower than 85°C.

Heating calculation of hot spot capacitor: FAI1 FAI2 FAI3

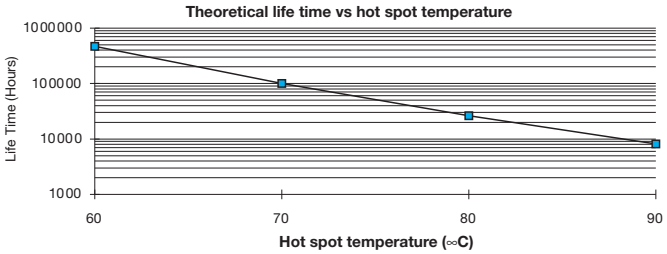
$$\theta \text{ hot spot} = \theta \text{ terminals} + (tg\delta_0 \cdot Q + R_s \cdot (I_{rms})^2) \cdot R_{th}$$

Heating calculation of hot spot capacitor: FAI6

$$\theta \text{ hot spot} = \theta \text{ water} + (tg\delta_0 Q + R_s \cdot (I_{rms})^2) \cdot R_{th}$$

With: $tg\delta_0 = 2.10^{-4}$
Q in Var
R_s in Ohms
I_{rms} in Amperes
R_{th} in °C/W (water flow = 10 dm^3/minute)

Note: The life time depends of hot spot temperature, see following curve.



ELECTRICAL CHARACTERISTICS

Capacitance range C_n	110nF to 60µF
Tolerance	±10%
Rated AC voltage	200 to 650 Vrms
Series parasitic inductance	< 5 nH
Test voltage between terminals @ 25°C	1.2 Vrms 50/60 Hz 10s
Dielectric	Polypropylene

HOW TO ORDER

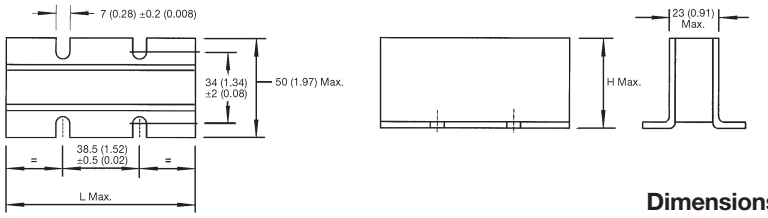
FAI	1	6	J	0114	K	– –
Series	**Case Size** 1 2 3 4 5 6	**Dielectric** 6 = Polypropylene	**Voltage Code** H = 300 Vrms I = 350 Vrms (Case size 3) I = 400 Vrms (Case size 4) J = 500 Vrms K = 60 Vrms	**Capacitance Code** 0 + pF code 0114 = 0.11µF (110nF) 0245 = 2.4µF (2400nF) 0405 = 4.0µF (4000nF) etc.	**Capacitance Tolerances** K = ±10%	**Terminal Code** – – = Standard

RoHS COMPLIANT

Medium Power Film Capacitors

FAI (RoHS Compliant)

TUNING
FAI1 STYLE
CASE SIZE 1 DIMENSIONS

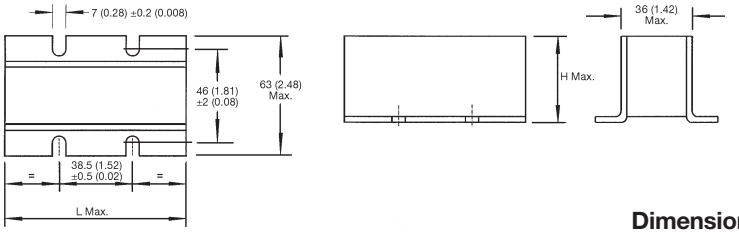


Dimensions: millimeters (inches)

Part Number	C (nF)	Irms max (A)	Vrms max (V)	Q max kVARS	Rs (mΩ)	Rth (°C/W)	L max	H max	Typical Weight (g)
FAI16J0114K--	110	180	500	100	$8 \times 10^{-4} \times \sqrt{F} + 0.19$	0.86	55 (2.165)	35 (1.378)	125
FAI16J0214K--	210	300	500	150	$5 \times 10^{-4} \times \sqrt{F} + 0.12$	0.67	75 (2.953)	40 (1.575)	195
FAI16J0334K--	330	350	500	175	$5 \times 10^{-4} \times \sqrt{F} + 0.15$	0.54	75 (2.953)	40 (1.575)	195
FAI16J0514K--	510	500	500	250	$4 \times 10^{-4} \times \sqrt{F} + 0.08$	0.49	95 (3.740)	45 (1.772)	275
FAI16J0664K--	660	600	500	300	$3.5 \times 10^{-4} \times \sqrt{F} + 0.06$	0.38	95 (3.740)	45 (1.772)	275

With F in Hz

FAI2 STYLE
CASE SIZE 2 DIMENSIONS

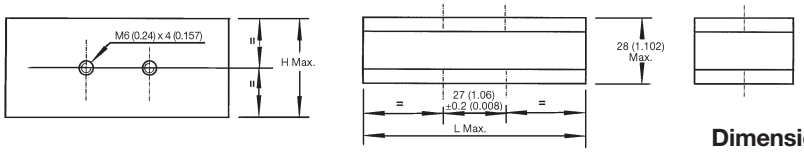


Dimensions: millimeters (inches)

Part Number	C (nF)	Irms max (A)	Vrms max (V)	Q max kVARS	Rs (mΩ)	Rth (°C/W)	L max	H max	Typical Weight (g)
FAI26J0664K--	660	300	500	180	$5 \times 10^{-4} \times \sqrt{F} + 0.25$	0.6	75 (2.953)	40 (1.575)	300
FAI26J0125K--	1200	400	500	200	$5 \times 10^{-4} \times \sqrt{F} + 0.20$	0.56	75 (2.953)	40 (1.575)	300
FAI26I0245K--	2400	500	350	175	$5 \times 10^{-4} \times \sqrt{F} + 0.17$	0.55	75 (2.953)	40 (1.575)	300

With F in Hz

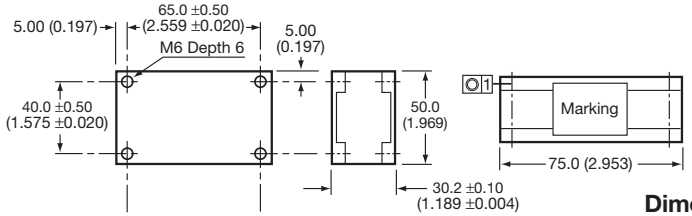
FAI3 STYLE
CASE SIZE 3 DIMENSIONS



Dimensions: millimeters (inches)

Part Number	C (nF)	Irms max (A)	Vrms max (V)	Q max kVARS	Rs (mΩ)	Rth (°C/W)	L max	H max	Typical Weight (g)
FAI36J0114K--	110	180	500	100	0.3	0.82	55 (2.165)	35 (1.378)	150
FAI36J0334K--	330	350	500	175	0.15	0.55	75 (2.953)	37 (1.457)	220
FAI36J0514K--	510	500	500	250	0.1	0.3	95 (3.740)	42 (1.654)	315
FAI36J0664K--	660	600	500	300	0.1	0.24	95 (3.740)	42 (1.654)	315

FAI4 STYLE
CASE SIZE 4 DIMENSIONS

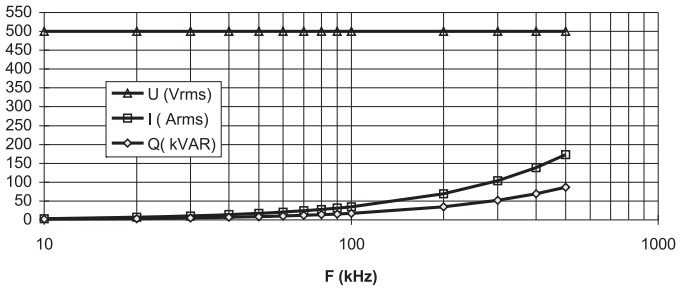


Dimensions: millimeters (inches)

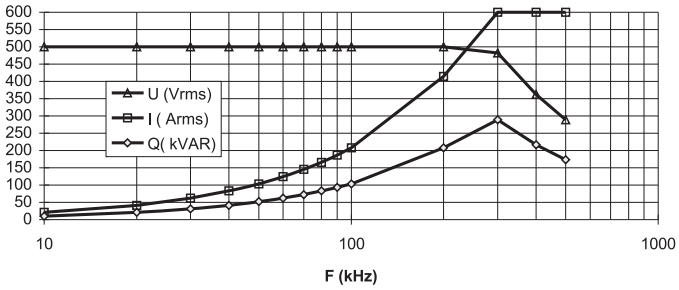
Part Number	C (nF)	Irms max (A)	Vrms max (V)	Q max kVARS	Rs (mΩ)	Rth (°C/W)	
FAI46H0405K--	4000	600	300	180	0.13	0.15	315
FAI46I0245K--	2400	500	400	200	0.15	0.20	315
FAI46J0185K--	1800	550	450	230	0.35	0.38	315
FAI46J0125K--	1200	500	500	200	0.20	0.22	315
FAI46J0664K--	660	450	500	220	0.26	0.32	315
FAI46K0334K--	330	380	600	220	0.315	0.315	315
FAI46K0284K--	280	320	600	190	0.37	0.375	315

TUNING

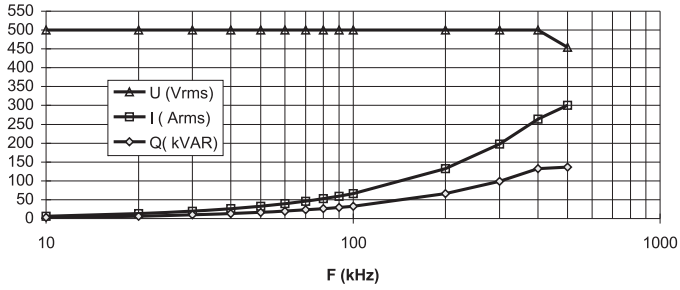
110 nF 500 Vrms
FAI16J0114K- -
FAI36J0114K- -



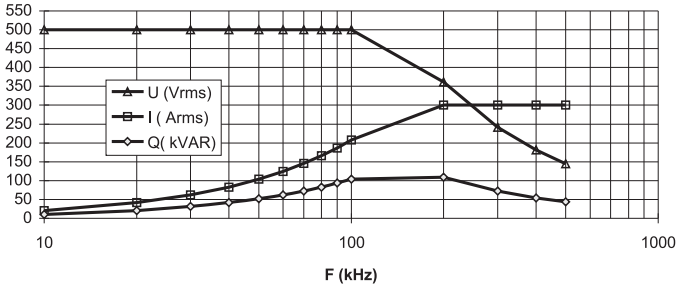
660 nF 500 Vrms
FAI16J0664K- -
FAI36J0664K- -



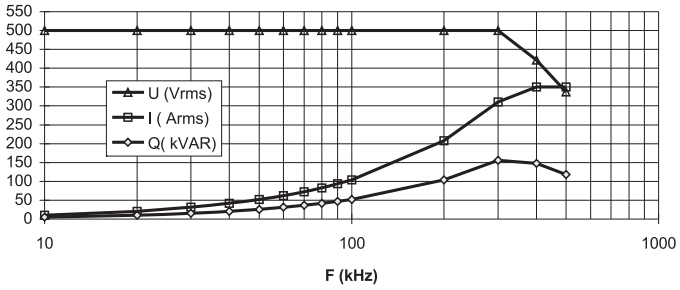
210 nF 500 Vrms
FAI16J0214K- -



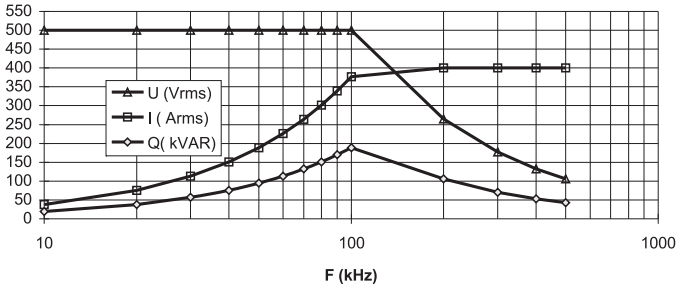
660 nF 500 Vrms
FAI26J0664K- -



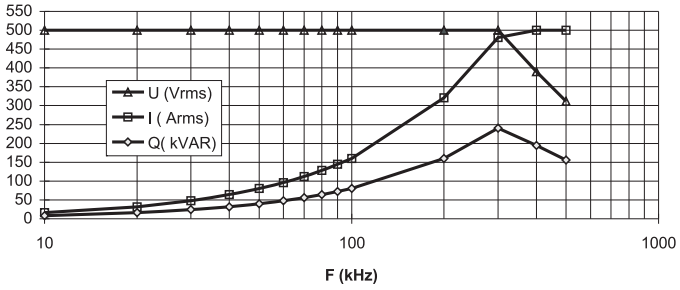
330 nF 500 Vrms
FAI16J0334K- -
FAI36J0334K- -



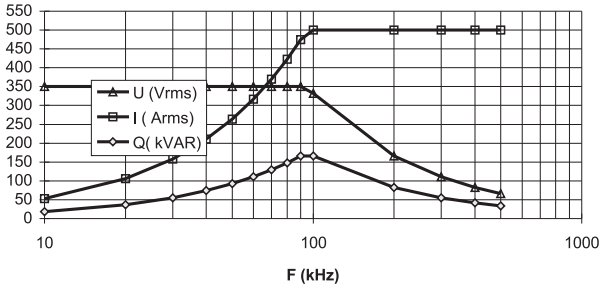
1200 nF 500 Vrms
FAI26J0125K- -



510 nF 500 Vrms
FAI16J0514K- -
FAI36J0514K- -

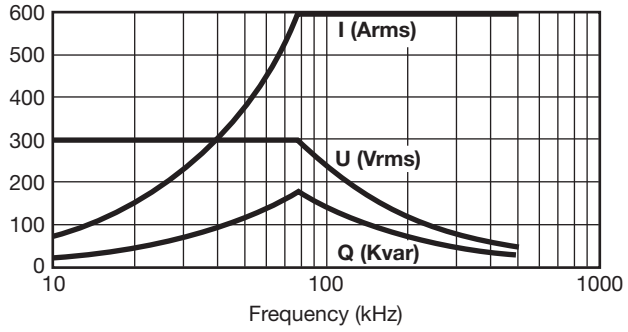


2400 nF 350 Vrms
FAI26I0245K- -

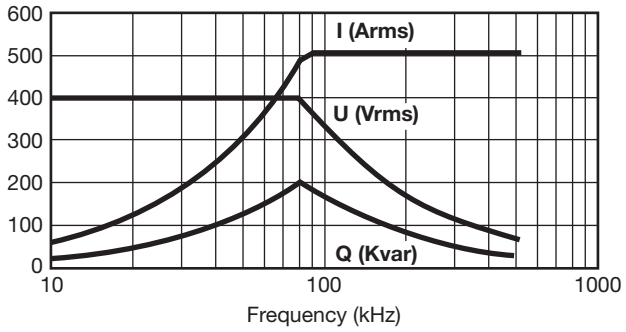


TUNING

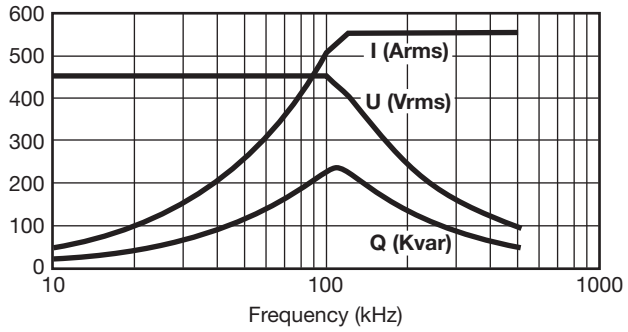
FAI46H0405K--
4000nF±10% 300Vrms



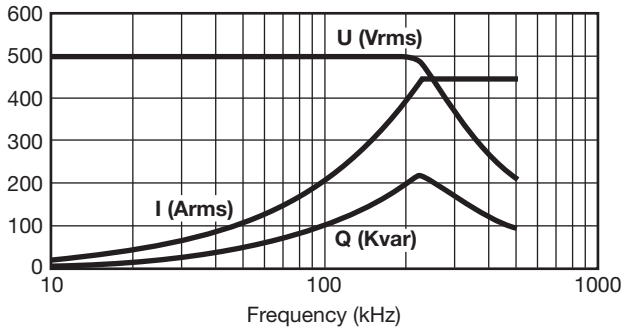
FAI46I0245K--
2400nF±10% 400Vrms



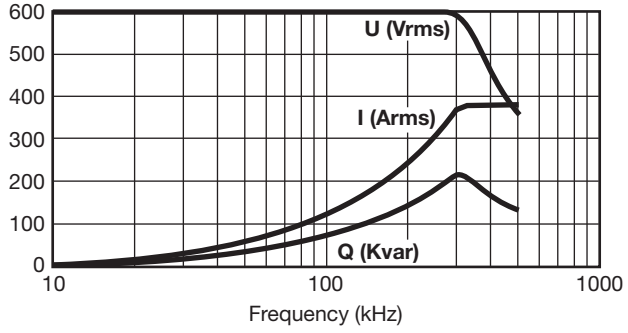
FAI46J0185K--
1800nF±10% 450Vrms



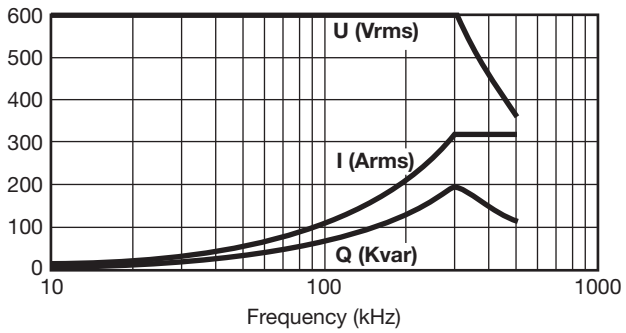
FAI46J0664K--
660nF±10% 500Vrms



FAI46J0334K--
330nF±10% 600Vrms



FAI46J0284K--
280nF±10% 600Vrms



Medium Power Film Capacitors

FAI (RoHS Compliant)

TUNING

FAI6

Dimensions: millimeters (inches)

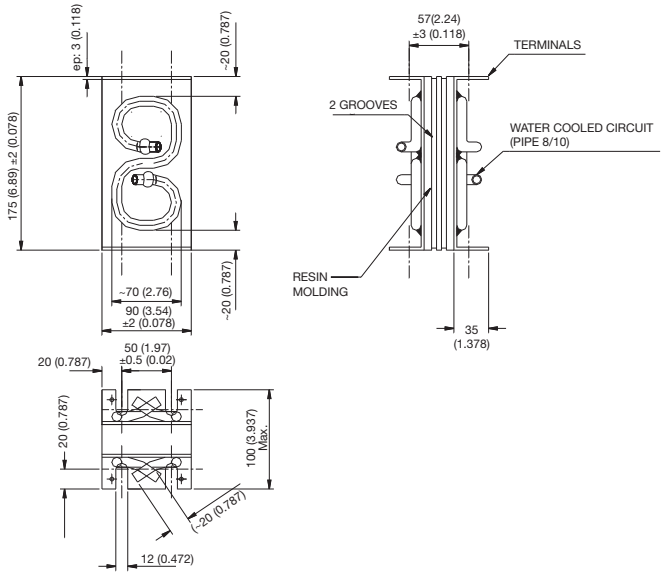
Part Number	Width	Vrms max (V)	C (µF)	Qmax (kVAR)	Irms max (A)	Rs (mΩ)	Rth (°C/W)	Typical Weight (g)
FAI66F0156K--	90 (3.543)	200	15	160	800	$5.10^{-4} \times \sqrt{f(Hz)} + 0.025$	0.104	1900
FAI66H0126K--		300	12	240	800	$5.10^{-4} \times \sqrt{f(Hz)} + 0.03$	0.104	1900
FAI66I0705K--		400	7	320	800	$5.10^{-4} \times \sqrt{f(Hz)} + 0.035$	0.114	1900
FAI66J0505K--		500	5	320	640	$5.10^{-4} \times \sqrt{f(Hz)} + 0.04$	0.114	1900
FAI66K0355K--		600	3.5	320	530	$5.10^{-4} \times \sqrt{f(Hz)} + 0.05$	0.124	1900
FAI66A0155K--		650	1.5	320	490	$5.10^{-4} \times \sqrt{f(Hz)} + 0.07$	0.134	1900
FAI66F0306K--	190 (7.480)	200	30	240	1200	$2.5.10^{-4} \times \sqrt{f(Hz)} + 0.0125$	0.079	3950
FAI66H0246K--		300	24	360	1200	$2.5.10^{-4} \times \sqrt{f(Hz)} + 0.015$	0.079	3950
FAI66I0146K--		400	14	480	1200	$2.5.10^{-4} \times \sqrt{f(Hz)} + 0.0175$	0.084	3950
FAI66J0106K--		500	10	600	1200	$2.5.10^{-4} \times \sqrt{f(Hz)} + 0.02$	0.084	3950
FAI66K0705K--		600	7	640	1070	$2.5.10^{-4} \times \sqrt{f(Hz)} + 0.025$	0.089	3950
FAI66A0305K--		650	3	640	985	$2.5.10^{-4} \times \sqrt{f(Hz)} + 0.035$	0.094	3950
FAI66F0456K--	290 (11.417)	200	45	320	1600	$2.10^{-4} \times \sqrt{f(Hz)} + 0.0083$	0.072	6100
FAI66H0366K--		300	36	480	1600	$2.10^{-4} \times \sqrt{f(Hz)} + 0.01$	0.072	6100
FAI66I0216K--		400	21	640	1600	$2.10^{-4} \times \sqrt{f(Hz)} + 0.0117$	0.075	6100
FAI66J0156K--		500	15	800	1600	$2.10^{-4} \times \sqrt{f(Hz)} + 0.0133$	0.075	6100
FAI66K1055K--		600	10.5	960	1600	$2.10^{-4} \times \sqrt{f(Hz)} + 0.0167$	0.078	6100
FAI66A0455K--		650	4.5	960	1480	$2.10^{-4} \times \sqrt{f(Hz)} + 0.0233$	0.082	6100
FAI66F0606K--	390 (15.354)	200	60	400	2000	$1.5.10^{-4} \times \sqrt{f(Hz)} + 0.00625$	0.067	8200
FAI66H0486K--		300	48	600	2000	$1.5.10^{-4} \times \sqrt{f(Hz)} + 0.0075$	0.067	8200
FAI66I0286K--		400	28	800	2000	$1.5.10^{-4} \times \sqrt{f(Hz)} + 0.00875$	0.070	8200
FAI66J0206K--		500	20	1000	2000	$1.5.10^{-4} \times \sqrt{f(Hz)} + 0.01$	0.070	8200
FAI66K0146K--		600	14	1200	2000	$1.5.10^{-4} \times \sqrt{f(Hz)} + 0.0125$	0.072	8200
FAI66A0605K--		650	6	1280	1970	$1.5.10^{-4} \times \sqrt{f(Hz)} + 0.0175$	0.075	8200

TUNING

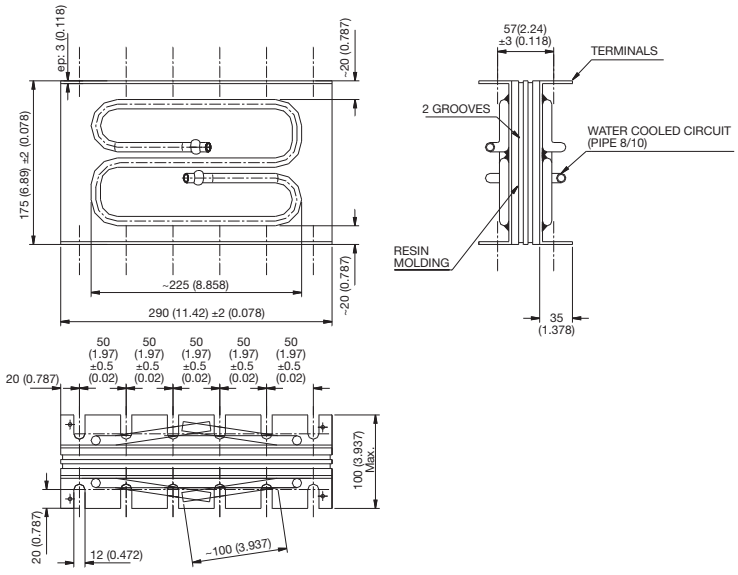
Dimensions: millimeters (inches)

CASE SIZE 6 DIMENSIONS

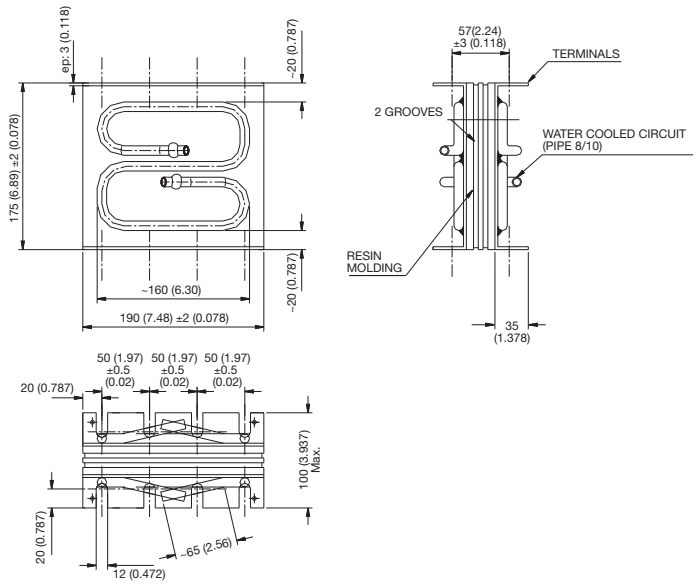
FAI6 WIDTH: 90 (3.543)



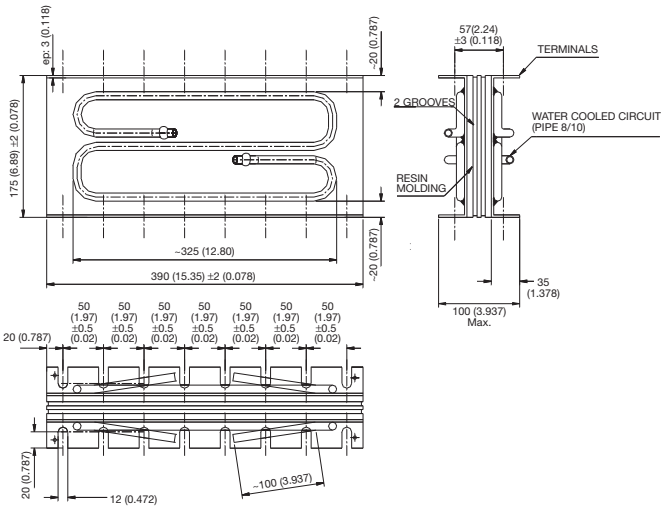
FAI6 WIDTH: 290 (11.417)



FAI6 WIDTH: 190 (7.480)

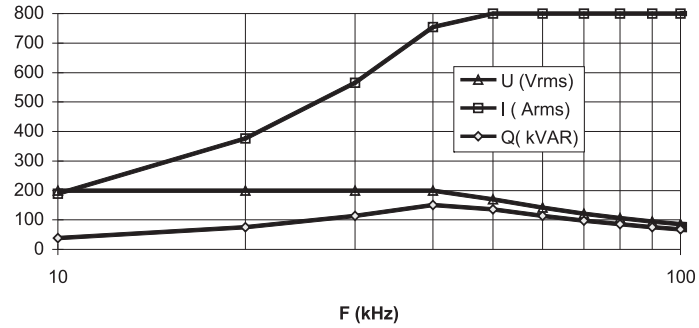


FAI6 WIDTH: 390 (15.354)

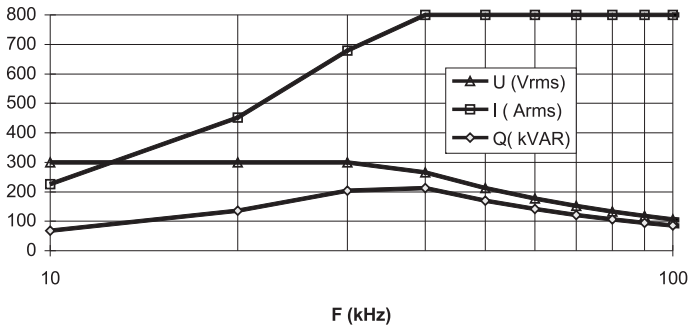


TUNING

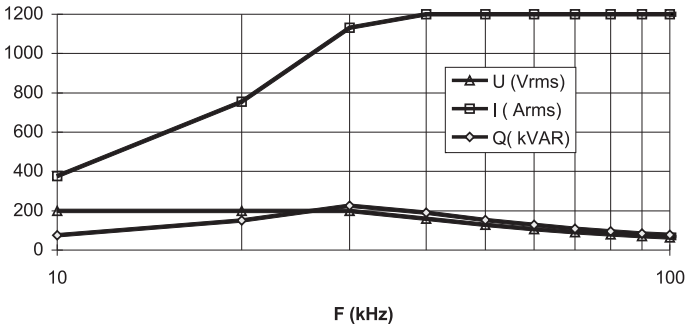
15 µF 200 Vrms Width 90 mm
FAI66F0156K- -



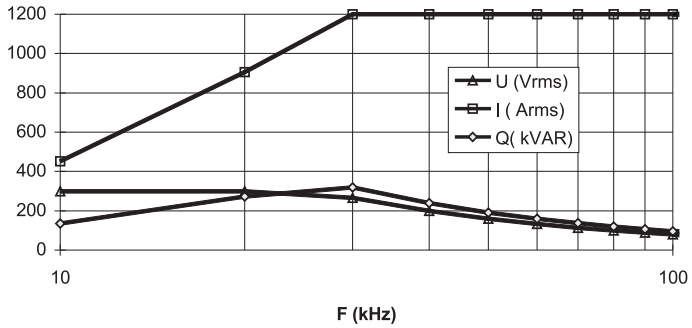
12 µF 300 Vrms Width 90 mm
FAI66H0126K- -



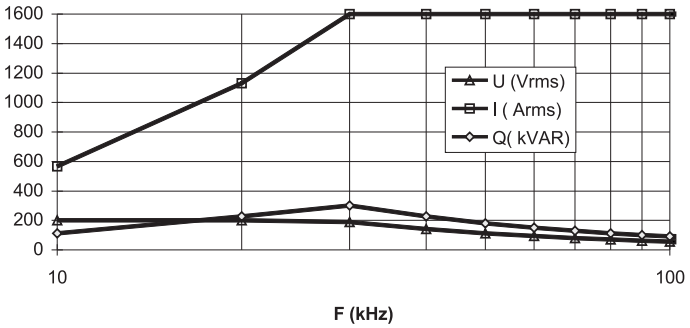
30 µF 200 Vrms Width 190 mm
FAI66F0306K- -



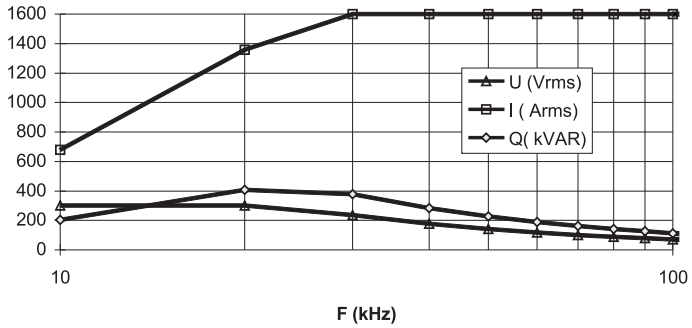
24 µF 300 Vrms Width 190 mm
FAI66H0246K- -



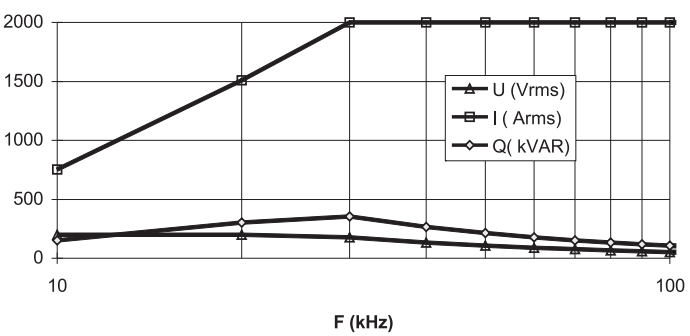
45 µF 200 Vrms Width 290 mm
FAI66F0456K- -



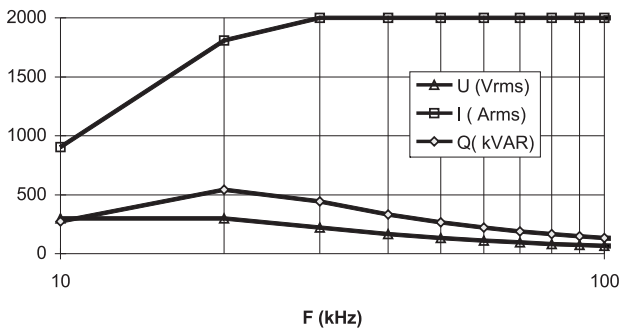
36 µF 300 Vrms Width 290 mm
FAI66H0366K- -



60 µF 200 Vrms Width 390 mm
FAI66F0606K- -

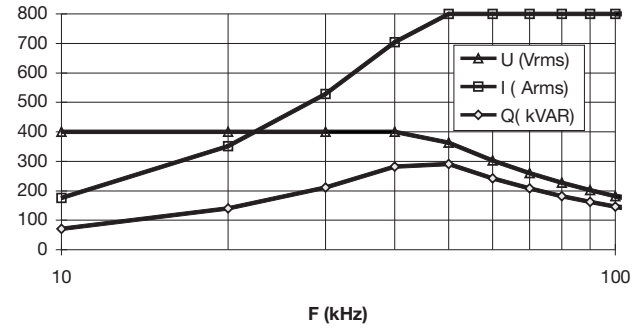


48 µF 300 Vrms Width 390 mm
FAI66H0486K- -

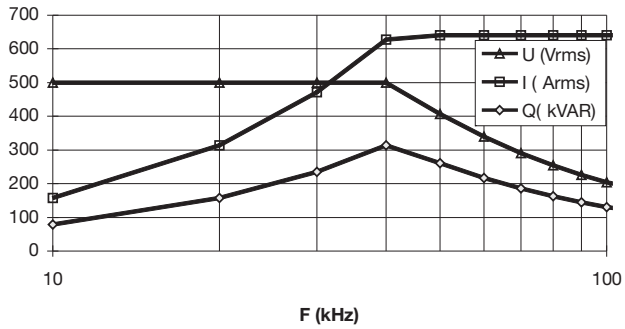


TUNING

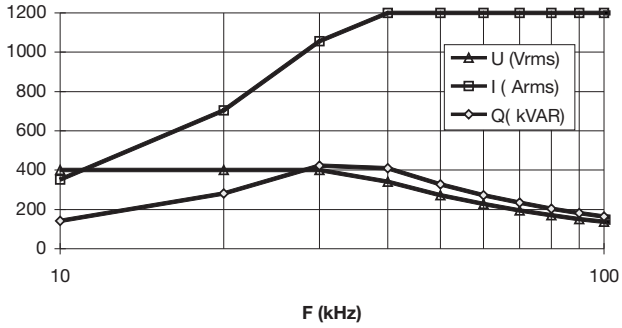
7 µF 400 Vrms Width 90 mm
FAI66I0705K- -



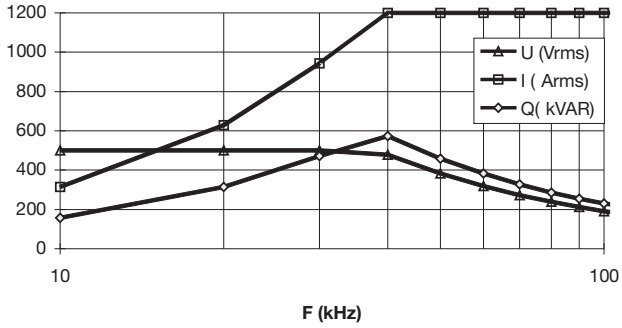
5 µF 500 Vrms Width 90 mm
FAI66J0505K- -



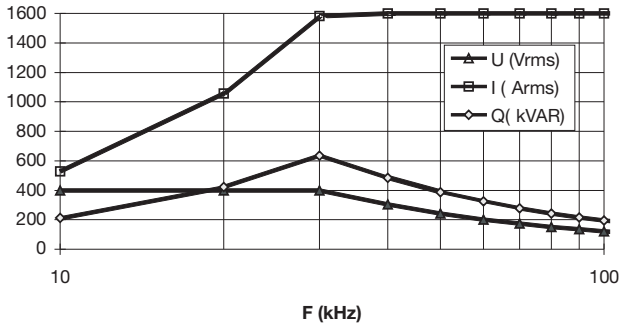
14 µF 400 Vrms Width 190 mm
FAI66I0146K- -



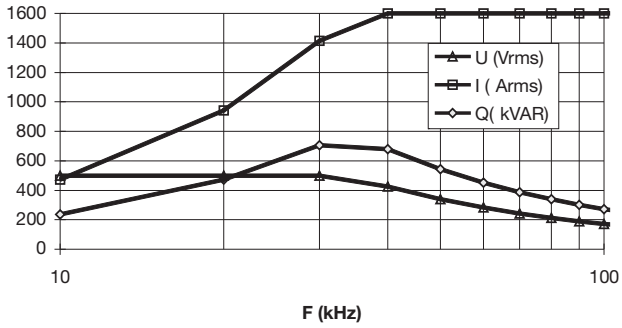
10 µF 500 Vrms Width 190 mm
FAI66J0106K- -



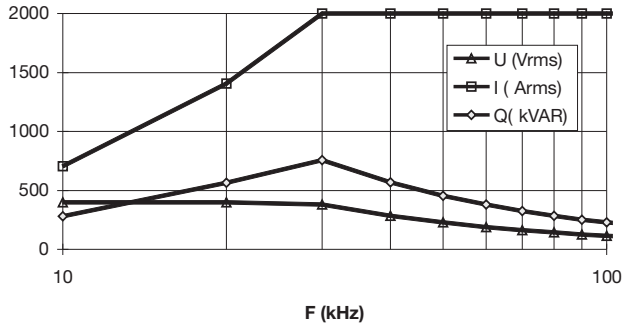
21 µF 400 Vrms Width 290 mm
FAI66I0216K- -



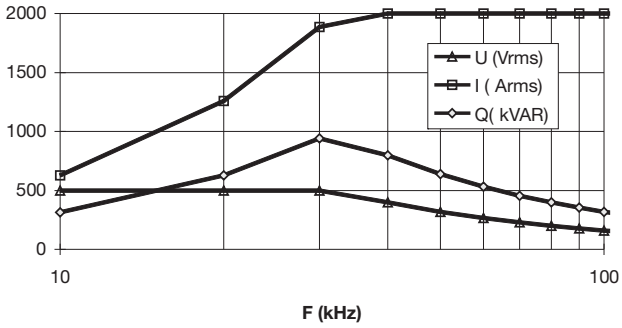
15 µF 500 Vrms Width 290 mm
FAI66J0156K- -



28 µF 400 Vrms Width 390 mm
FAI66I0286K- -



20 µF 500 Vrms Width 390 mm
FAI66J0206K- -

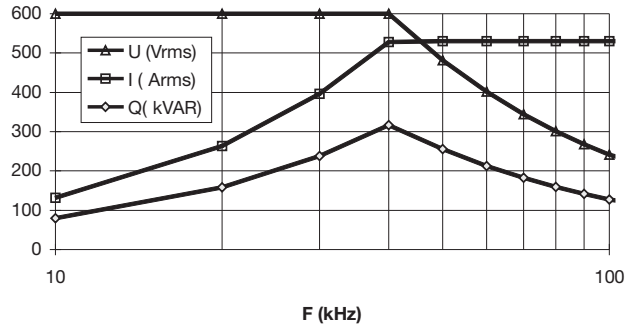


Medium Power Film Capacitors

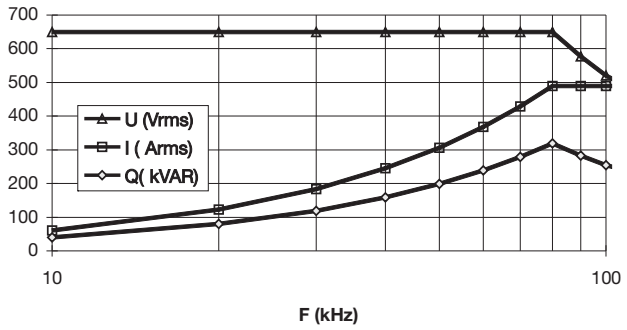
FAI (RoHS Compliant)

TUNING

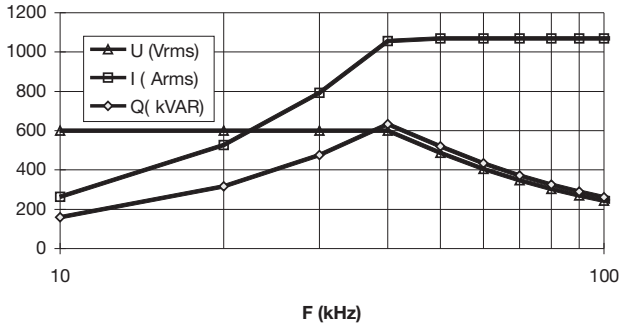
3.5 µF 600 Vrms Width 90 mm
FAI66K0355K- -



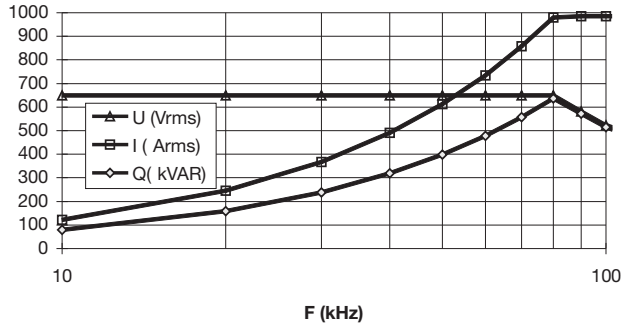
1.5 µF 650 Vrms Width 90 mm
FAI66A0155K- -



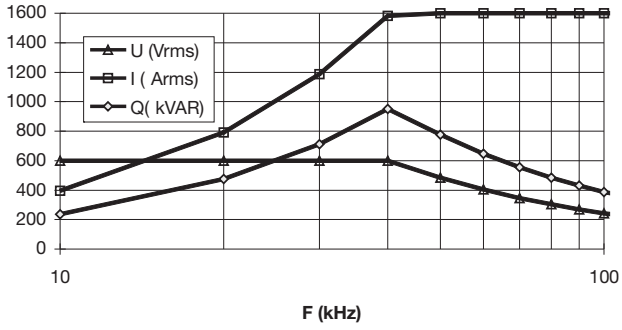
7 µF 600 Vrms Width 190 mm
FAI66K0705K- -



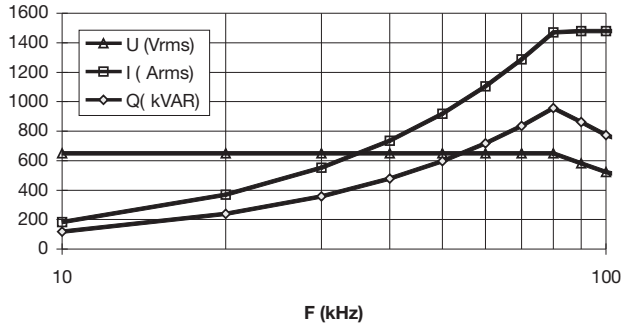
3 µF 650 Vrms Width 190 mm
FAI66A0305K- -



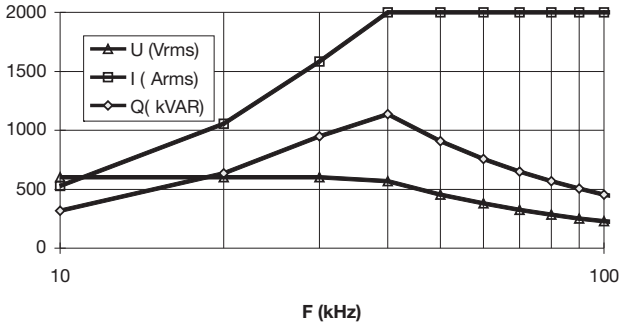
10.5 µF 600 Vrms Width 290 mm
FAI66K1055K- -



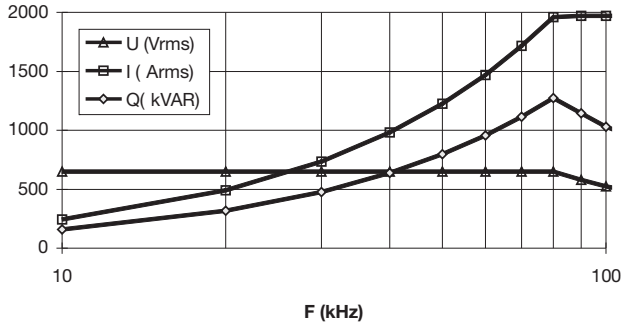
4.5 µF 650 Vrms Width 290 mm
FAI66A0455K- -



14 µF 600 Vrms Width 390 mm
FAI66K0146K- -



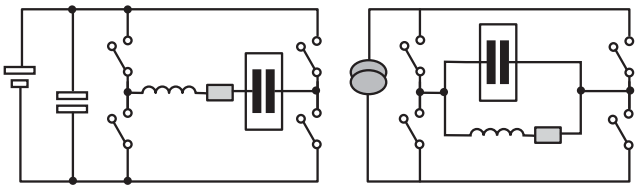
6µF 650 Vrms Width 390 mm
FAI66A0605K- -



INDUCTION HEATING

APPLICATIONS

Local thermal treatment, metallic surface hardening, pipe welding, tin coating treatment,...



FUNCTION, PRODUCTS

DC Filtering

The purpose of this filter is to smooth the low frequency ripple coming from the bridge (up to 360 Hz) and to filter the high frequency ripple coming from the converter (15/20 kHz)*.

*Frequency will be lower than capacitor resonance frequency, on request, TPC can propose specific models for high frequency.

Main criteria are: High rms. current and good behavior against overvoltage are needed.

Products to offer

FFG/FFH	5 to 160µF	600 to 1900Vdc
FFVE/FFWE	12 to 400µF	300 to 1900Vdc
FFVI/FFWI	47 to 275µF	500 to 1100Vdc
FFLI/FFLB	58 to 800µF	680 to 1900Vdc
FFLC	1120 to 8800µF	680 to 1200Vdc

Tuning

In order to obtain the requested frequency, a capacitor is needed to tune with the inductance. The main characteristic of this capacitor is the reactive power (express in kVar) versus frequency.

Products to offer

FAI6	10 kHz ≤ F ≤ 100 kHz	1.5 to 60µF 200 to 650Vrms 160 to 1280kVar
FAI1 to 4	100 kHz ≤ F ≤ 500 kHz	110 to 4000nF 300 to 600Vrms 100 to 300kVar

TRACTION

APPLICATIONS

Speed converter for power for mass transit and/or people mover system.

FUNCTION, PRODUCTS

DC Filtering

The purpose of the product is to filter the high frequency ripple coming from the converter in order to avoid rejection and perturbation on the network.

TPC has developed controlled-self healing range allowing reliable and competitive solution compare electrolytic technology.

See calculation example how to replace electrolytic technology.

Note that on new developments based on IGBT converter, manufacturer wish to have a main DC filter close to the converter and some light filters sprayed on the line.

Products to offer

Main DC Filter	***FFLC***	1120 to 8800µF	up to 1200Vdc
Additional DC Filter	***FFLI/FFLB***	58 to 800µF	up to 1900Vdc
	FFVE/FFWE	12 to 400µF	up to 1900Vdc
	FFG/FFV	5 to 160µF	up to 1900Vdc

Protection of semi-conductors

Overvoltage and clamping due to switching of semi-conductors.

Products to offer

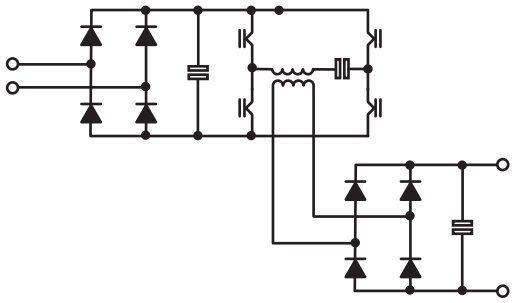
Thyristors and GTO snubbers	***FPX/FPY***	0.5µF to 6µF	up to 4600V*
IGBT clamping	***FSB***	0.1 to 2.5µF	up to 2kVdc
	FFVE	12 to 400µF	up to 1.9kVdc

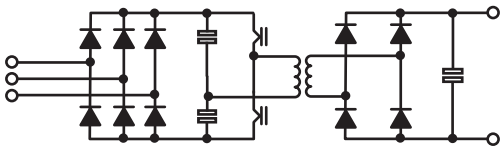
**higher voltage on request*

POWER SUPPLIES AND RESONANT CONVERTER

APPLICATIONS

Medical	X-ray, scanner power supplies
Traction	Battery charger
Industrial	All application requesting power supplies





FUNCTION, PRODUCTS

DC Filtering

The purpose of this filter is to smooth the low frequency ripple coming from the bridge (up to 360 Hz) and to filter the high frequency ripple coming from the converter (15/20 kHz).

High rms. current and good behavior against overvoltage are needed.

Products to offer

FFB/FFV3	1.5 to 160µF	75 to 1100Vdc
FFG/FFH	5 to 160µF	600 to 1900Vdc
FFVE/FFWE	12 to 400µF	300 to 1900Vdc
FFVI/FFWI	47 to 275µF	500 to 1100Vdc
FFLI/FFLB	58 to 800µF	680 to 1900Vdc

Tuning

In order to obtain the requested frequency, a capacitor is needed to tune with the inductance transformer.

The main characteristic of this capacitor is the reactive power and rms. current.

Products to offer

FAV	80 to 1200nF	up to 650Vrms
FAI1 to 4	110 to 4000nF	up to 600Vrms

Protection of semi-conductors

Overvoltage and clamping due to switching of semi-conductors.

Products to offer

IGBT clamping	***FSB***	0.1 to 3µF	up to 2kVdc
Mos-Fet transistor protection	***FSV***	10nF to 150nF	up to 2kVdc

SPEED CONVERTER

APPLICATIONS

Speed converter for medium power (20 to 100kW)

Traction: auxiliary converter for air cooling system, light,...

Industrial: speed variation

FUNCTION, PRODUCTS

DC Filtering

The purpose of this product is to filter the high frequency ripple coming from the converter in order to avoid rejection and perturbation on the network.

Due to IGBT converter, heavy rms. current and very compact product is requested; film technology is able to achieve these 2 targets.

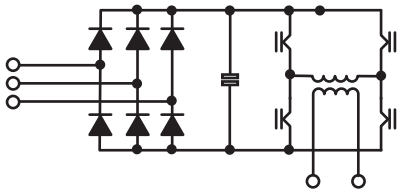
Products to offer

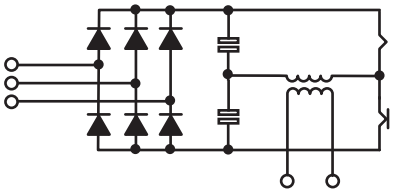
FFLI/FFLB	58 to 800µF	680 to 1900Vdc
FFVE/FFWE	12 to 400µF	300 to 1900Vdc
FFVI/FFWI	47 to 275µF	500 to 1100Vdc
FFB/FFV3	1.5 to 160µF	75 to 1100Vdc

WELDING

APPLICATIONS

Generate, out of the main supply, through a converter (chopper) and a transformer an overvoltage able to create an electrical arc.





FUNCTION, PRODUCTS

DC Filtering

The purpose of this filter is to smooth the low frequency ripple coming from the rectifier (up to 360 Hz) and to filter the high frequency ripple coming from the converter (15/20 kHz).

Products to offer

FFVE/FFWE	12 to 400µF	300 to 1900V
FFVI/FFWI	47 to 275µF	500 to 1100V
FFB/FFV3	1.5 to 160µF	75 to 1100V

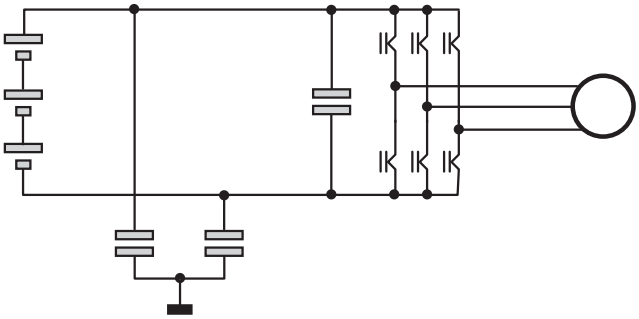
ELECTRICAL VEHICLE

APPLICATIONS

Battery powered car, electric fork lift truck and hybrid electric vehicle.

Due to high rms. current needed through the capacitor, metallized controlled self-healing technology will be an excellent solution.

See calculation example on page 66.



FUNCTION, PRODUCTS

DC Filtering

Between battery and converter, a capacitor is needed.

Its main purpose is to filter the ripple coming from the converter, to avoid damaging the battery.

Metallized Film Capacitors are able to fulfill this function using 2 or 3 cases (only electrolytic can not).

Products to offer

FFVE/FFWE	12 to 400µF	300 to 1900Vdc
FFVI/FFWI	47 to 275µF	500 to 1100Vdc

According to quantity, a custom design could be developed, achieving the total function with a single case.

WIND MILL

APPLICATIONS

Energy power supplied by the wind, new wind mill generation use electronic converter in order to control power, phase and voltage.

FUNCTION, PRODUCTS

DC Filtering

The purpose of the product is to filter voltage ripple.

TPC has developed controlled self-healing range allowing reliable and competitive solution compare electrolytic technology.

See calculation example how to replace electrolytic technology on pages 65 and 66.

Products to offer

FFLC	1120 to 8800µF	up to 1200Vdc

Protection of semi-conductors

Overvoltage and clamping due to switching of semi-conductors.

Products to offer

Snubbers	***FSB***	0.1 to 3µF	up to 2kVdc
Clamping	***FFVE/FFWE***	12 to 400µF	up to 1.9kVdc

ENERGY STORAGE

APPLICATIONS

Medical: cardiac defibrillator

Industrial and military: laser telemetry, flash lamp

FUNCTION, PRODUCTS

DC Filtering

Stored energy is used to generate electrical pulse.

Products to offer

FDV1	5 to 80µF	1000 to 1700V
FDBB	70 to 150µF	1800 to 3000V*

**Specific FDBB can be offered with energy density over more than 1.5J per cc.*

FILM TECHNOLOGY TO REPLACE ALUMINUM ELECTROLYTIC TECHNOLOGY

The trend in the industrial and traction market for power conversion is to replace electrolytic capacitors by film technology.

This trend is generated by the many advantages that film technology offers. Among these advantages, we have:

- *High rms. current capabilities up to 1Arms. per µF
- *Overvoltage withstanding up to 2 times the rated voltage
- *Handle a reversal voltage
- *High peak current capabilities
- *No acid inside
- *Long lifetime
- *No storage problem

However, this replacement is not necessarily capacitance but for capacitance by application/Function.

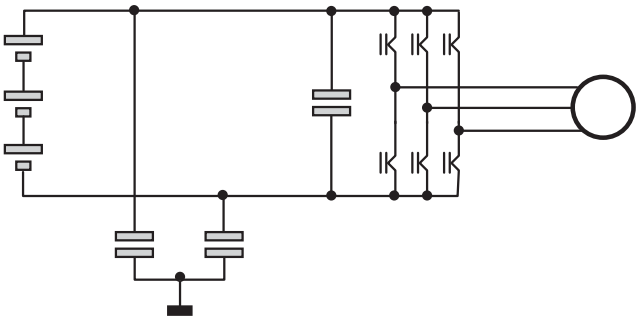
Despite the advantages of film technology, replacement solutions won't be possible for each application, there will be several approaches to do this.

In order to help the use, we will present some examples where film gives a major benefit over electrolytic technology.

1) DC LINK FILTER: HIGH CURRENT DESIGN & CAPACITANCE VALUE DESIGN

1a) Energy supplied with batteries

Applications will be: electric car
electric fork lift truck



In that case, capacitor will be used as a decoupling capacitor.

Film capacitor is particularly well adapted for this use, because main criteria for DC link capacitor will be rms. current withstanding.

It means that DC link capacitor can be designed on rms. current value.

If we take an electric car in account as example:

Requirement data:

Working voltage:	120Vdc
Ripple voltage allowed:	4Vrms
Rms. current:	80 Arms. @ 20kHz

Minimum capacitance value will be:

$$C = \frac{I_{rms}}{U_{ripple} \times 2 \times \pi \times f} = 159\mu F$$

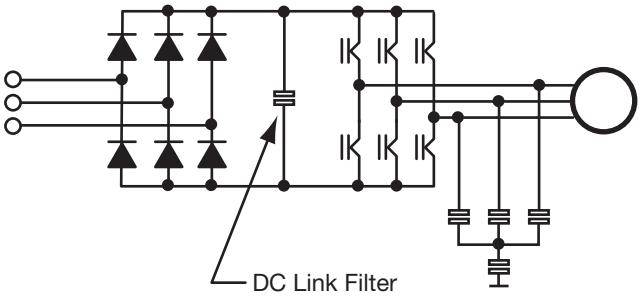
So, it will be easy to find a capacitance value close to these values.

Comparison with electrolytic capacitor.

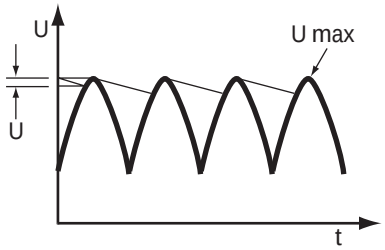
If we take in account 20mA per µF for example, in order to handle 80 Arms, capacitance value minimum would be:

$$C = \frac{80}{0.02} = 4000\mu F$$

1b) Industrial motor drive, energy supplied from supply network



DC link voltage waveform:



Capacitance value will be defined taken in account that supply frequency is lower than converter frequency.

To determine needed capacitance, we can use the following approached equation:

$$C = \frac{P_{load}}{U_{ripple} \times \left[U_{max} - \frac{U_{ripple}}{2} \right] \times F_{rectifier}}$$

Irms. through capacitor will be (approached expression):

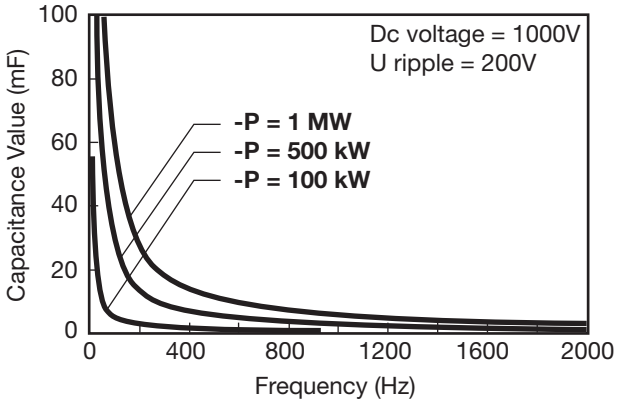
Of course this current doesn't take in account frequency converter current.

$$I_{rms} = \frac{U_{ripple}}{2 \times \sqrt{2}} \times C \times 2 \times \pi \times F_{rectifier} = \frac{P_{load} \times \pi}{\left[U_{max} - \frac{U_{ripple}}{2} \right] \sqrt{2}}$$

So, with this approximation, Irms. through the capacitor will be depending of the Power of load, Umax and U ripple.

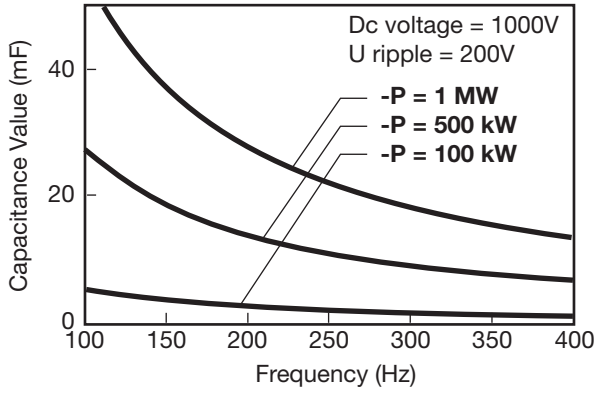
To illustrate, we will take a concrete example:

DC voltage 1000 Volts
U ripple 200 volts



P	Irms
1 MW	2468 Arms
500 kW	1234 Arms
100 kW	247 Arms

It becomes necessary to have a zoom on low frequency:



To compare with electrolytic solution, we will take a current capability of 20mA per µF for electrolytic capacitors. First case, power at 1Mwatt:

Rms. current is 2468 Arms, which would impose minimum capacitance value of 123.4mF (taking into account 0.02Arms. per µF).

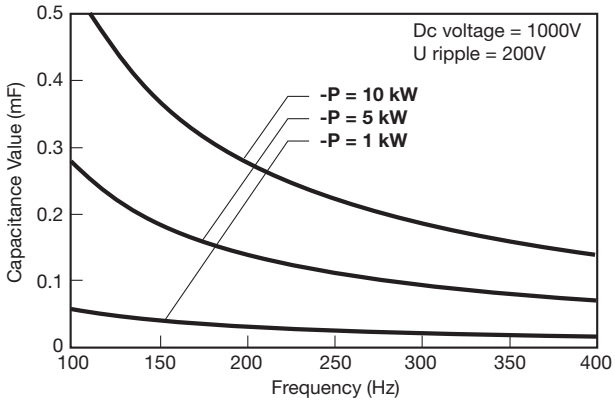
If we look at this value on the curve, we can see that this capacitance value is needed (the given example for film technology) for a rectifier frequency lower than 100Hz.

So, with 3 phases, 6 diodes rectifier, frequency will be 300Hz.

We can see on the 1 megawatt curve that capacitance needed is 18.5mF. Film solution will be almost 4 times smaller than electrolytic solution, with high reliability in addition.

Lower power will give similar results, and for power up to 10 kwatts, capacitance value becomes so small that film technology still constitutes the best solution.

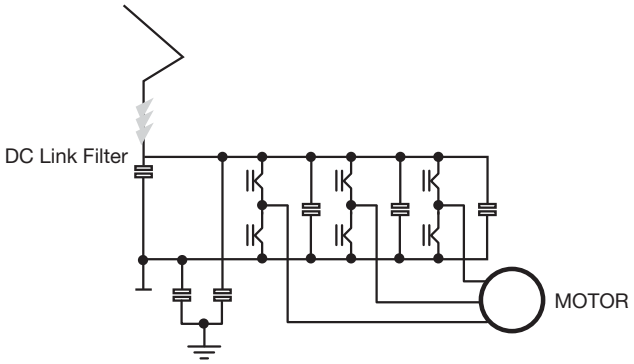
Even at 100Hz rectifier frequency, no more than 555µF are needed, supply voltage and ripple still the same than previously.

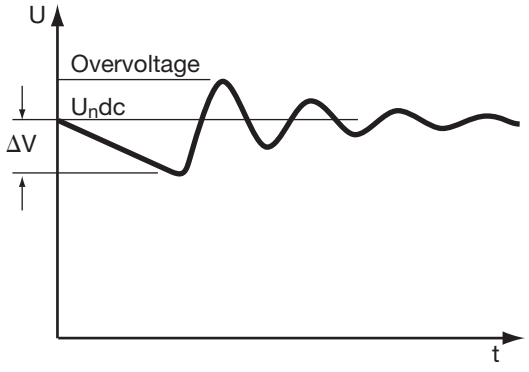


2) OVERVOLTAGE DESIGN

We will consider light traction application, like metro, tramway, electric buses, ...

DC link voltage wave form:





Due to the principle of carrying the power from the catenary to the train, some contact discontinuity appears between pantograph and catenary.

When contact is not done, energy come from DC link filter, with for effect, to decrease the voltage. So, as soon as the contact is re-established, an overvoltage appears.

$$V(t) = U_{ndc} - \Delta V \times e^{-\alpha t} \times \left(\cos \omega t + \frac{\alpha}{\omega} \sin \omega t\right)$$

with $\omega = \sqrt{\beta_0^2 - \alpha^2}$

$$\beta_0 = \frac{1}{\sqrt{L \times C}}$$

$$\alpha = \frac{R}{2 \times L}$$

Worse case would be ΔV = catenary voltage, because over-voltage could almost reach 2 times the rated voltage.

So, film capacitor can handle this kind of overvoltage.

Comparison with electrolytic technology:

Electrolytic handle 1.2 DC voltage max:

So minimum voltage that electrolytic should handle would be:

DC voltage of electrolytic technology: $\frac{2 \times 1000V}{1.2} = 1670V$

4 capacitors 450 Volts in series would be needed.

Volume occupied for 10mF with electrolytic would be: 26 l and Irms. max would be 220Arms.

With film, volume occupied would be 25 l, and rms. current capability would be higher than 500Arms.

In other hand, link to these overvoltages, peak current appear through the capacitor:

So, we have to calculate the energy generated by this over-voltage $I^2t = \int i^2(t)dt$.

$$i(t) = \frac{C\beta_0^2 V_0}{\omega} e^{-\alpha t} \sin \omega t$$

$$i^2(t) = \frac{C^2\beta_0^4 V_0^2}{\omega^2} e^{-2\alpha t} \sin^2 \omega t$$

$$\int_0^\infty i^2(t)dt = \left[\frac{1}{4} \frac{e^{-2\alpha t} C^2\beta_0^4 V_0^2 \left(-\alpha^2 - \omega^2 + \alpha^2 \cos 2\omega t - \alpha\omega \sin 2\omega t\right)}{\alpha\omega^2(\alpha^2 + \omega^2)}\right]_0^\infty$$

After few periods, current becomes null, then:

$$\int_0^\infty i^2(t)dt = [0] - \left[-\frac{1}{4} \frac{C^2\beta_0^4 V_0^2}{\alpha(\alpha^2 + \omega^2)}\right] = \frac{1}{4} \frac{C^2\beta_0^4 V_0^2}{\alpha(\alpha^2 + \omega^2)}$$

with: $\beta_0 = \frac{1}{\sqrt{L \times C}}$; $\alpha = \frac{R}{2 \times L}$; $\omega = \sqrt{\beta_0^2 - \alpha^2}$

This energy calculation will be used for short circuit discharge between terminal as well. Such discharge will generate a very high peak current and some ringing that electrolytic could not handle.

3) VOLTAGE RATING

Function of the voltage rating needed, film solution will become more and more interesting.

If high capacitance value is requested, film solution will be less competitive. Indeed, if there is no overvoltage, low rms. current, large capacitance value, it will be difficult for film technology to be competitive below 900 volts.

LIFETIME CALCULATION

Film technology allows a very long lifetime expectancy, depending on voltage load conditions (working voltage) and hot spot temperature.

For DC filtering, lifetime meets the curves shown in this catalog.

End of life criteria is a decrease of capacitance value of 2%. However, this is a theoretical end of life, because capacitor can be still used after this point. If application can allow 5% capacitance decrease, lifetime will be widely increased.

Hot spot temperature will be determined with the following expression:

$$\theta max_{hotspot} = \theta_{ambient} + I^2_{rms} \times \left[rs + \frac{1}{C \times 2 \times \pi} \times tg\delta_0\right] \times Rth$$

with: $\theta max_{hotspot}$: the maximum hot spot temperature

$tg\delta_0$: dielectric losses

Rth: Thermal resistance

Rs: Serial resistance

θhot spot will be 85°C or 105°C function of the application and the technology.

4) CONCLUSION

This document gives some ways for the engineer designer to do their choice. Of course, for each case a complete calculation will have to be done.

Anyway, if the request is only capacitance value, low voltage, low rms. Current, no overvoltage, no reversal voltage, no peak current, film technology certainly won't be a good solution.

Medium Power Film Capacitors

Worksheet for Custom Requirements

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

Company / Name / Email	Project / Quantity

Applications	DC Filtering		Discharge*		Protection*		Tuning
Capacitance (µF)							
Tolerance (%)							
Operating Voltage		Vpeak		Vch	Vpeak	Vdc	Vrms
Ripple Voltage (peak to peak)		V					
Working Frequency (Hz)							
Operating Current		Arms		Apeak		Arms	Arms
Maximum Current/Duration	Arms	s				Apeak	
Discharge			Aperiodic	Oscillatory			
Pulse Duration (5% Ipeak)							
Time to Ipeak (µs)							
Ringing Frequency (Hz)							
Reversal Voltage (%)							
Repetition Rate				shots/min/hour/day		Hz	
Hold Time @ Full Voltage (s)							
Fault Peak Current / nb shots	Apeak	shots	Apeak	shots			
Fault Reversal Voltage (%)							
Lifetime Expectancy		hours		shots		hours	hours
Maximum Inductance (nH)							
Test Voltage between Terminals (V)							
Test Voltage between Shorted Terminals and Case (V)							
Maximum Surge Voltage (MSV)							
MSV Duration / Frequency	s	/year			s	/year	

*Due to the particularities of varying waveforms in such application, more information on the exact nature of waveform is generally required for a full analysis.

Description			
Dimensions (mm) / Shape	**Operating Position**	**Terminals**	
Section: Height: rectangular, cylindrical	vertical, horizontal inclined, upside down	type	quantity

Thermal Characteristics					
Storage Temperature (°C)		**Operating Temperature (°C)**		**Cooling Method**	
min.		min.		Natural Convection	
average		average		Forced Air (m/s)	
max.		max.		Water	

Remarks

BUREAU VERITAS
Certification

C E R T I F I C A T E

awarded to

AVX TPC SA
Avenue colonel Prat
21850 Saint Apollinaire
France

BUREAU VERITAS CERTIFICATION

confirms, as an IRIS approved certification body, that the Management System of the above organization has been assessed and found to be in accordance with the

International Railway Industry Standard (IRIS)
Revision 01, November 2007

for the product category

Power systems and Auxiliary systems

Scope of supply

Design, development and manufacturing of power capacitors

Conception, développement et fabrication de condensateurs de puissance

Date of the audit: 17.10.2008

Date of issue of the certificate: 13.01.2009 Certificate valid until: 12.01.2012

Current date: 21.01.2009

Certificate-Register-No.: FRA - IR - 000 006 - 1

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