

Medium Power Film Capacitors

FFPP 900Vdc to 2300Vdc



GENERAL DESCRIPTION

The FFPP series is specifically designed for DC filtering applications such as DC link or resonant filters for voltages up to 2300V.

The safe and reliable **Controlled Self-Healing Technology** makes this series particularly suitable for power converters in traction, drives and renewable energy areas.

FFPP use a wet solution (without free oil) with polypropylene metallized film and offers high specific energy up to 360J/l.

These standard designs in plastic cases proposed in this catalogue are covering a wide range of voltage and capacitance values.

In case of specific requirements about shape and performances, feel free to contact your local KYOCERA AVX representative.

PACKAGING MATERIAL

Rectangular resin filled plastic cases (3 formats)

Self extinguishing thermosetting resin (V-0: in accordance with UL94; certified classifications according to EN 45545-2)

Self extinguishing plastic case

4 female terminals M10x15mm

STANDARDS

All formats

IEC 61071: Capacitors for power electronics

IEC 61881: Railway applications - Rolling stock equipment - Capacitors for power electronics

IEC 61373: Railway applications - Rolling stock equipment - Shock and vibrations

IEC 60068-1: Environmental testing – Part 1: general and guidance

UL 94: Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (Protection resin)

EN 45545: Railway applications – Fire protection on railway vehicles (Protection resin)

Format 1

EN 45545: Railway applications – Fire protection on railway vehicles (Plastic case)

HOW TO ORDER

D T	FFPP T	A T	4307 T	K T	1 T	F T
Series		Voltage	Capacitance EIA code	Capacitance Tolerance K = ±10%	Format 1 = 166x176 H187 2 = 166x176 H262.5 3 = 288x147 H187	Terminal Code F = Female Threaded
		A = 900V G = 1700V B = 1000V H = 1900V C = 1100V I = 2000V D = 1250V J = 2150V E = 1400V K = 2300V F = 1500V				

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DEFINITIONS

C_n (μF)	capacitance	nominal value of the capacitance measured at $\theta_{\text{amb}} = 25 \pm 10^\circ\text{C}$
U_n (V)	rated DC voltage	maximum operating peak voltage of either polarity (non-reversing type waveform), for which the capacitor has been designed for continuous operation
U_w (V)	working voltage	value of the maximum operating recurrent voltage for a given hot spot temperature and an expected lifetime
U_r (V)	ripple voltage	peak-to-peak alternating component of the unidirectional voltage
L_s (nH)	parasitic inductance	capacitor series self-inductance
R_s (m Ω)	series resistance	capacitor series resistance due to galvanic circuit
$I_{\text{rms Thermal 1}}$ (A)	RMS current	rms current value for continuous operation under natural convection generating 20°C overheating
$I_{\text{rms Thermal 2}}$ (A)	RMS current	rms current value for continuous operation under forced air generating 20°C overheating
θ_{amb} ($^\circ\text{C}$)	cooling air temperature	temperature of the cooling air measured at the hottest position of the capacitor, under steady-state conditions, midway between two units NOTE: If only one unit is involved, it is the temperature measured at a point approximately 0.1 m away from the capacitor container and at two-thirds of the height from its base
θ_{HS} ($^\circ\text{C}$)	hot spot temperature	highest temperature obtained inside the case of the capacitor in thermal equilibrium

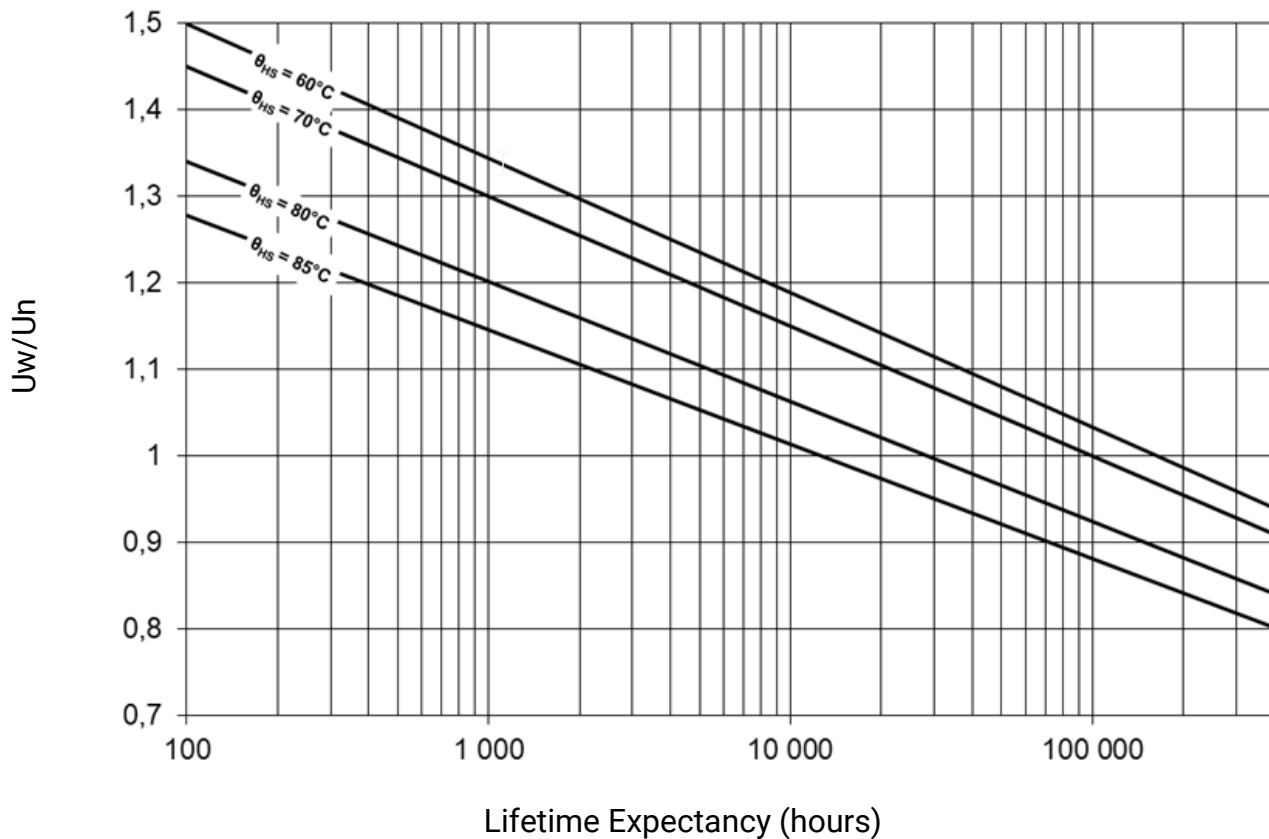
CHARACTERISTICS

Capacitance range C_n	700 μF to 6600 μF
Tolerance on C_n	$\pm 10\%$
Rated DC voltage U_n	900 to 2300V
Lifetime at U_n and 70°C hot-spot temperature and $\Delta C/C < 2\%$	100,000h
FIT @ U_{ndc} and 70°C hot spot temperature	<100 FIT
Parasitic inductance L_s (measurement @ 1MHz)	25nH to 30nH
Maximum rms current I_{rms}	up to 245A _{rms}
Test voltage between terminals @ 25°C	1.5 x U_n for 10s
Test voltage between terminals and Case @ 25°C (only for tyoe test)	9 kV _{rms} @ 50Hz for 10s
Dielectric	polypropylene
Climatic Category	40 / 85 / 56 (IEC 60068)
Working temperature	-40°C / $+85^\circ\text{C}$ (according to the power dissipated)
Storage temperature	-40°C / $+85^\circ\text{C}$
Calorific value	40 MJ/kg

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LIFETIME EXPECTANCY VS HOT SPOT TEMPERATURES



HOW TO CHOOSE THE RIGHT CAPACITOR

The capacitor lifetime depends on the working voltage and the hot spot temperature.

Our caps are designed to meet 100,000 hours lifetime at rated voltage and 70°C hot spot temperature. In accordance with operating conditions, please calculate the hot spot temperature and deduce from this calculation if the obtained lifetime can suit the application.

1- From the tables, select a capacitor with required capacitance C_n and voltage U_n .

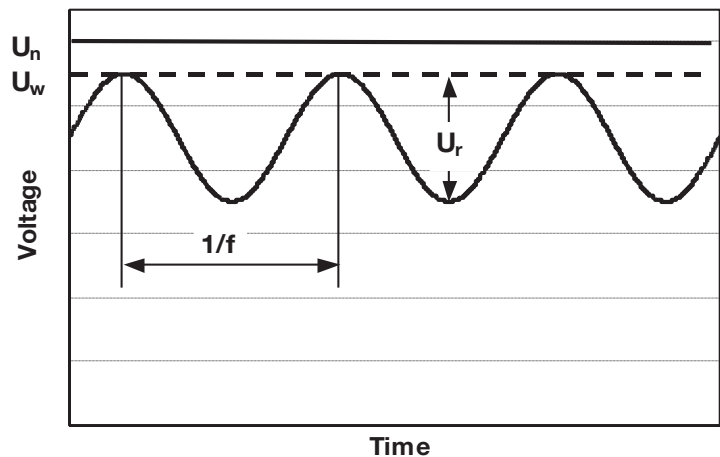
Calculate the maximum ripple voltage allowed for the selected cap : $U_{rmax} = 0,2U_n$

If $U_r > U_{rmax}$, select a capacitor with higher rated voltage

Make sure $I_{rms\ application} < I_{rms\ table}$

Copy out:

- serial resistance R_s : see table of values
- thermal resistance R_{th1} & R_{th2} : see table of values



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2- Hot spot temperature calculation

Total losses are calculated as follow: $P_t = P_j + P_d$

Joule losses: $P_j = R_s \times I_{rms}^2$

Dielectric losses: $P_d = Q \times \text{tg}\delta_0$ with

- Q (reactive power) = $\frac{(I_{rms})^2}{C2\pi f}$ for a waveform of f frequency

- $\text{tg}\delta_0 = 2 \times 10^{-4}$ (dielectric losses of polypropylene)

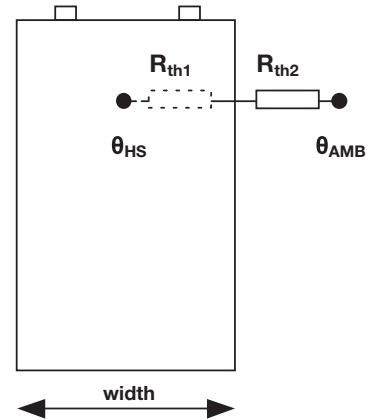
Hot spot temperature will be:

$$\theta_{HS} = \theta_{amb} + (P_j + P_d) \times (R_{th1} + R_{th2})$$

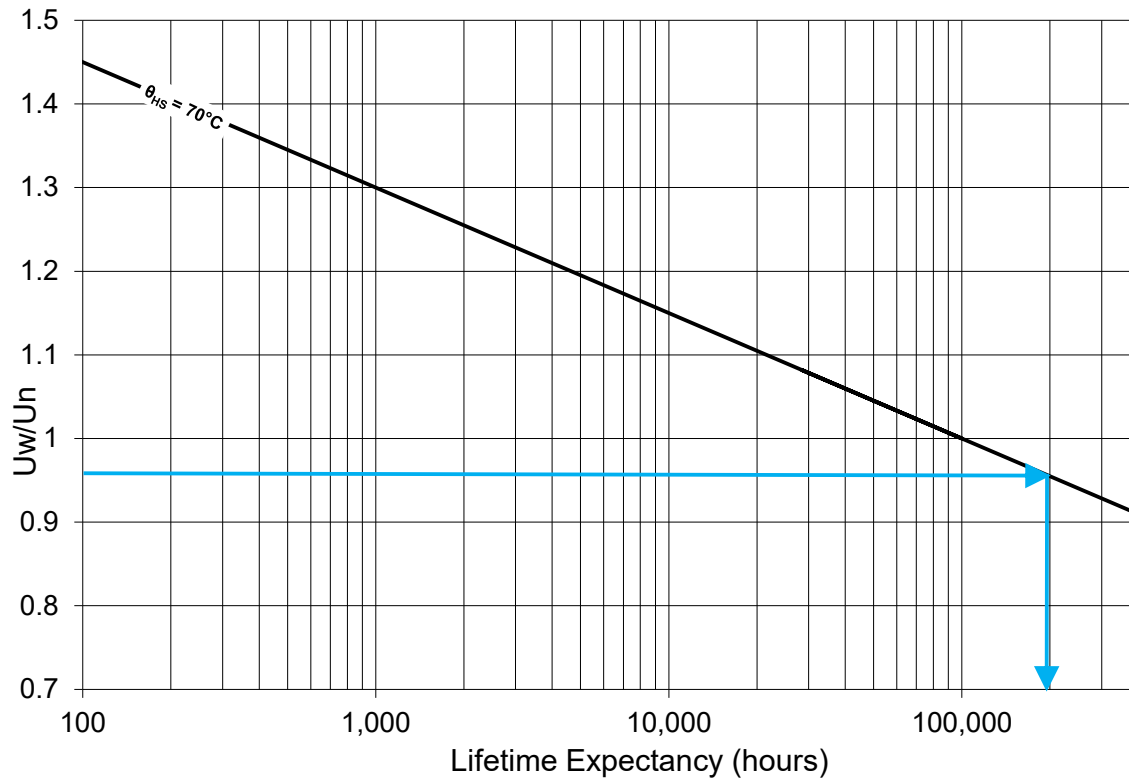
θ_{HS} absolute maximum is 85°C

If temperature is higher than 85°C, come back to #1 and start again with another selection.

R_{th} : thermal resistance between hot spot and ambient air



3- Refer to the curve and deduce the lifetime vs U_w/U_n ratio



Eg: rated voltage 2000V
 working voltage 1900V
 $\rho = U_w / U_n = 0,95$ lifetime is 200 000hours @ 70°C hot spot temperature

Calculation form can be found available on the last page of the catalog.

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THERMAL RESISTANCE

R_{th1} (°C/W): Thermal resistance between hot spot and case

R_{th2} (°C/W): Thermal resistance between case and ambient temperature

Height (mm)	R _{th1} (°C/W)	R _{th2} (°C/W)	
		Natural Air Cooling	Forced Air Cooling >2m/s
109	2,9	1,1	0,6
187	2,2	0,8	0,4
262,5	1,4	0,8	0,4



For confined area, capacitor working in a closed cabinet, a thermal test under real conditions is necessary to evaluate the thermal resistance.

PARASITIC INDUCTANCE

Measurement @ 1MHz

Format	Typical L _s (nH)
1	25
2	30
3	25

WEIGHT/CREEPAGE AND CLEARANCE DISTANCE

Format	Weight (kg)	Creepage and Clearance Distance (mm)
1	6,5	58
2	8,9	58
3	9,6	43

FAILURE MODE

The FFPP series main failure mode is only a loss of capacitance, thanks to the **KYOCERA AVX's Controlled Self-Healing Technology**.

Designed to limit the self healing energy, the **Controlled Self Healing technology** is the efficient solution providing the best safety level by preventing any avalanche effect.

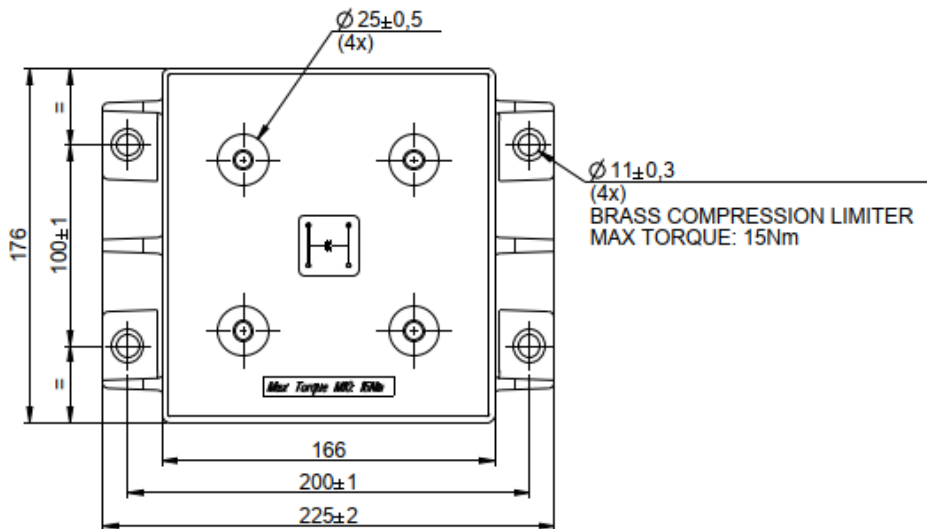
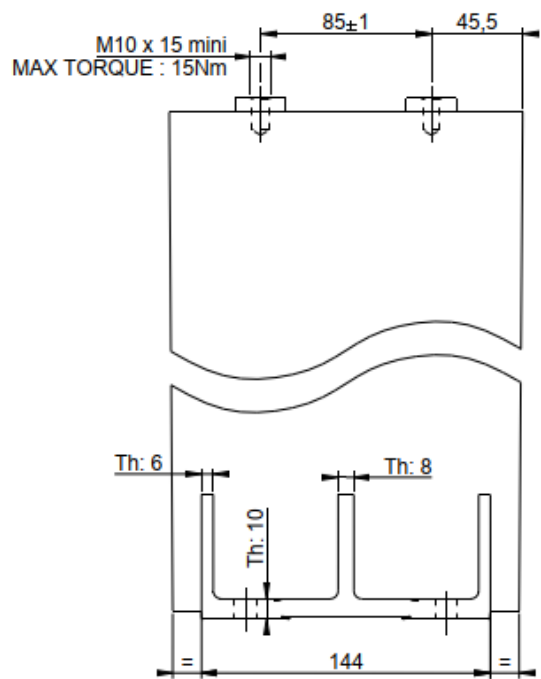
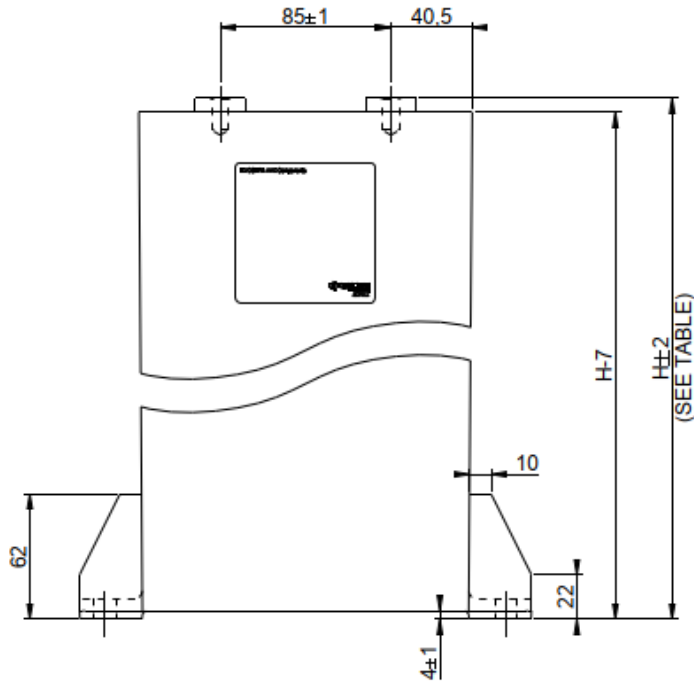
The main feature of the **Controlled Self Healing technology** is to avoid the worst consequences of an avalanche process contrary to basic film capacitors where this avalanche process may cause an explosion due to an excessive gas production in a confined operating environment.

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FORMATS 1&2 DIMENSIONS

Format 1: H=187mm
 Format 2: H=262,5mm
 General tolerances ± 3

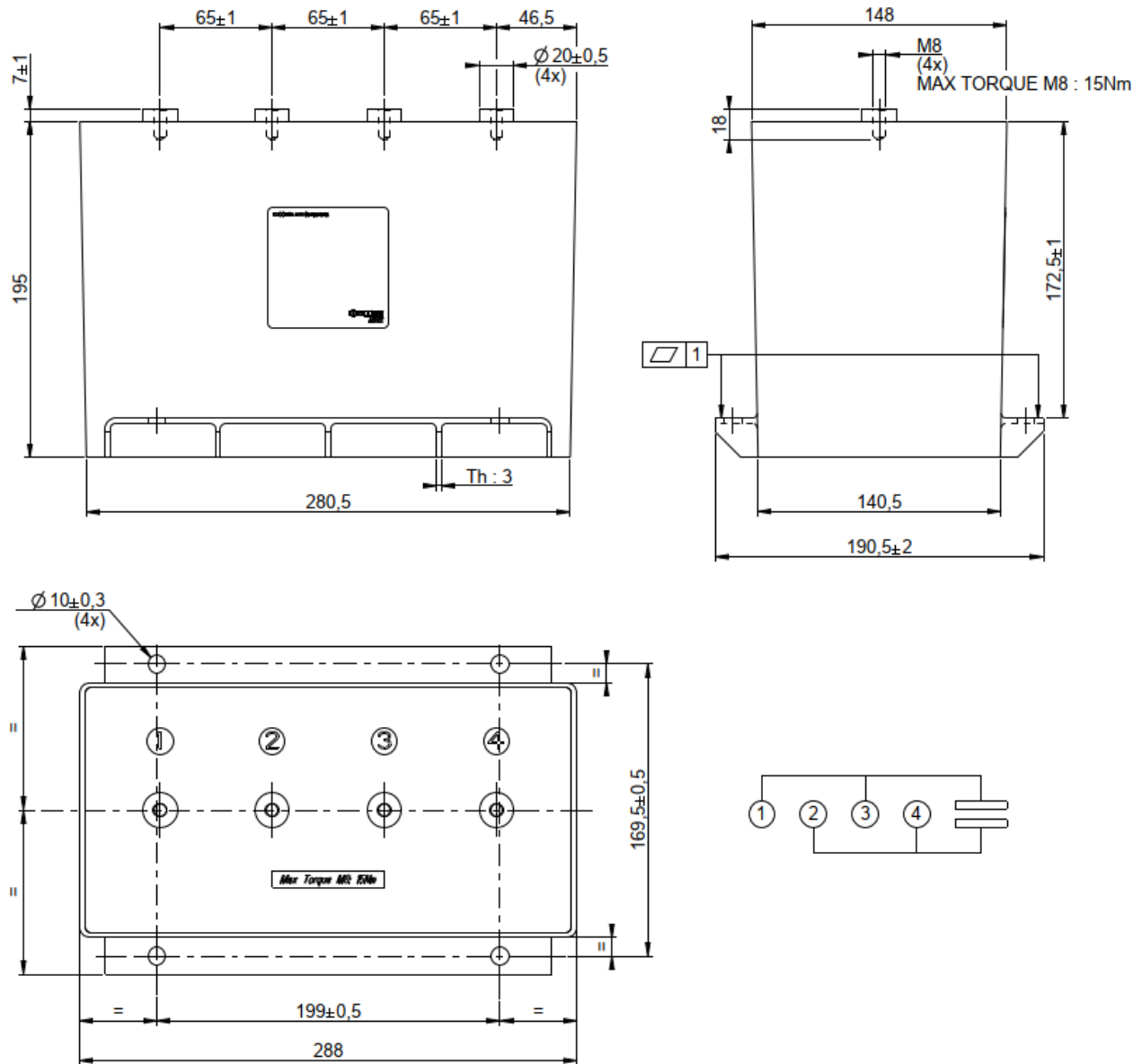


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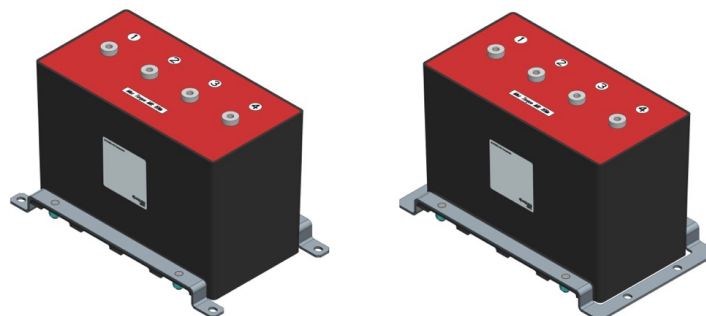
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FORMAT 3 DIMENSIONS

General tolerances ± 3



Special stainless steel brackets can be added to fit your mounting constraints. More information on demand.



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TABLE OF VALUES

Part Number	Un (V)	C _n (μF)	Format	Rs (mΩ)	I _{rms} Thermal 1 (A)	I _{rms} Thermal 2 (A)
DFFPPA4307K1F	900	4300	1	0,61	130	155
DFFPPA6607K2F	900	6600	2	0,43	180	215
DFFPPA6507K3F	900	6500	3	0,35	205	245
DFFPPB3507K1F	1000	3500	1	0,67	125	150
DFFPPB5307K2F	1000	5300	2	0,47	170	200
DFFPPB5207K3F	1000	5200	3	0,38	195	235
DFFPPC2907K1F	1100	2900	1	0,73	120	145
DFFPPC4307K2F	1100	4300	2	0,51	160	190
DFFPPC4257K3F	1100	4250	3	0,41	190	225
DFFPPD2307K1F	1250	2300	1	0,81	115	135
DFFPPD3507K2F	1250	3500	2	0,56	160	180
DFFPPD3407K3F	1250	3400	3	0,44	180	215
DFFPPE1707K1F	1400	1700	1	0,92	110	130
DFFPPE2607K2F	1400	2600	2	0,64	145	175
DFFPPE2557K3F	1400	2550	3	0,49	170	200
DFFPPF1507K1F	1500	1500	1	0,97	105	125
DFFPPF2307K2F	1500	2300	2	0,67	145	170
DFFPPF2307K3F	1500	2300	3	0,51	165	200
DFFPPG1107K1F	1750	1100	1	1,12	95	115
DFFPPG1707K2F	1750	1700	2	0,77	135	160
DFFPPG1657K3F	1750	1650	3	0,59	155	185
DFFPPH0957K1F	1900	950	1	1,21	95	110
DFFPPH1457K2F	1900	1450	2	0,82	130	155
DFFPPH1457K3F	1900	1450	3	0,62	150	180
DFFPPI0887K1F	2000	880	1	1,17	95	110
DFFPPI1357K2F	2000	1350	2	0,81	130	155
DFFPPI1307K3F	2000	1300	3	0,60	155	190
DFFPPJ0787K1F	2150	780	1	1,24	90	110
DFFPPJ1207K2F	2150	1200	2	0,85	125	150
DFFPPJ1157K3F	2150	1150	3	0,63	155	185
DFFPPK0707K1F	2300	700	1	1,31	90	105
DFFPPK1057K2F	2300	1050	2	0,90	125	145
DFFPPK1037K3F	2300	1030	3	0,66	150	180

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CALCULATION FORM

Specification

Capacitance	C (μF)	
Working voltage	U _w (V)	
Rms current	I _{rms} (A _{rms})	
Frequency	f (Hz)	
Ripple voltage	U _r (V)	
Ambient temperature	Θ _{amb} (°C)	
Lifetime @ U _w , I _{rms} and Θ _{amb}	hours	
Parasitic inductance	L (nH)	
Cooling conditions		

Your Choice

PN		
Capacitance	C _n (μF)	
Rated voltage	U _n (V)	
Serial resistance	R _s (mΩ)	
Thermal resistance between hot spot and ambient air	R _{th1} (°C/W)	
Thermal resistance between case and ambient air	R _{th2} (°C/W)	

CALCULATIONS

Maximum ripple voltage	$U_{rmax} = 0,2 \times U_n$	U _{rmax} =	V
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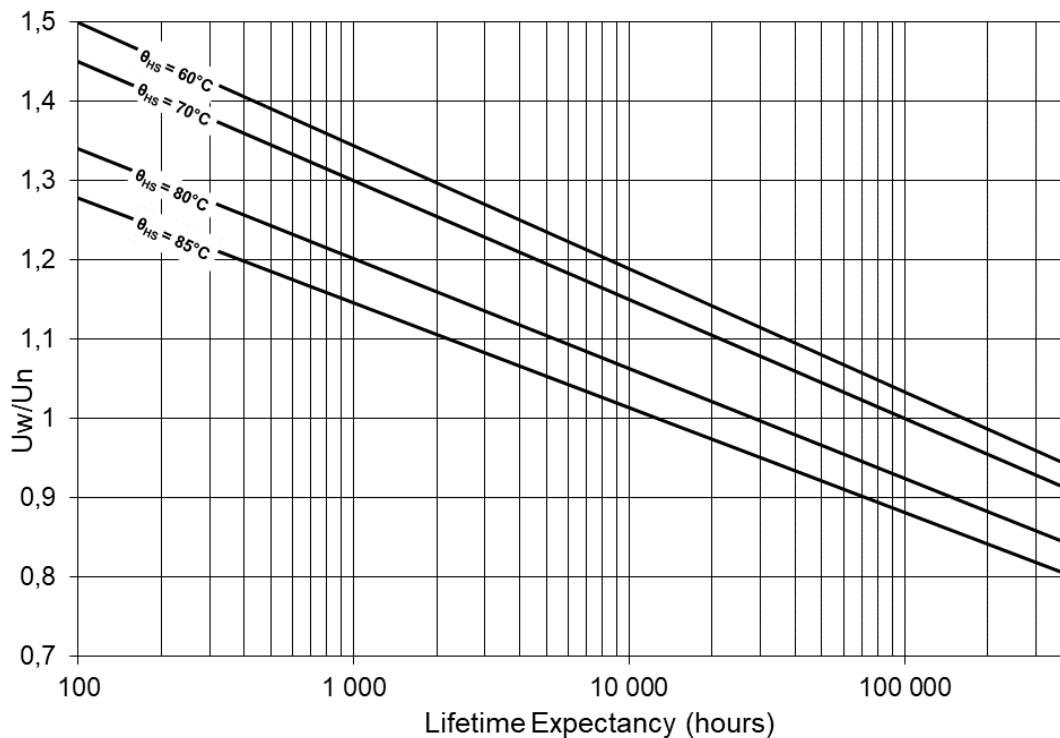
The maximum ripple voltage of the selected capacitor must be in any case higher than the ripple voltage of your application

Ratio U _w / U _n	$\rho = U_w / U_n$	ρ =	
Joule losses	$P_j = R_s \times (I_{rms})^2$	P _j =	W
Dielectric losses	$P_d = Q \times \text{tg}\delta_0 = Q \times 2.10^{-4}$	P _d =	W
Hot spot temperature	$\Theta_{HS} = \Theta_{amb} + (P_j + P_d) \times (R_{th1} + R_{th2})$	Θ _{HS} =	°C

The hot spot temperature must be in any case lower than 85°C

LIFETIME EXPECTANCY VS HOT SPOT TEMPERATURE

Expected lifetime at hot spot calculated and U=U _w	
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This questionnaire lists the information we require to prepare an offer according to your exact requirements

Company / Name / Email	Project / Quantity
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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	/years			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	Terminas
Section:	Height	vertical, horizontal, inclined, and upside down	Type
rectangular, cylindrical			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
