DC FILTERING

FFLK 900V to 3800Vdc* RoHS Compliant

The FFLK series is specifically designed for DC filtering applications such as DC link in power converters.

This range offers solutions for voltage up to 3800Vdc.

The Controlled Self Healing Technology, essential to ensure a safe and reliable behaviour, is achieved using dry or wet solutions: segmented metallized film for voltage up to 1900V and metallized film and oil (without free oil) for higher voltages.

Standard designs proposed in this catalogue are covering a wide range of voltage and capacitance values.

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

PACKAGING MATERIAL

- Aluminium cylindrical case filled with thermosetting resin.
- Self extinguishing thermosetting resin (V-0 : in accordance with UL94; certified classifications according to EN 45545-2)
- Self extinguishing plastic cover (V0 : in accordance with UL94; certified classifications according to EN 45545-2)
- RoHS components
- M6/10 Female connections or M8/20 Male connections

STANDARDS

IEC 61071 : Power electronic capacitors
IEC 61881 : Railway applications, rolling stock equipment, capacitors for power electronics
IEC 60068-2 : Environmental testing
IEC 61373 : Shock and vibrations
UL 94 : Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

HOW TO ORDER

FFLK	6	A	0537	K	--
Series	**Dielectric** 6 = Polypropylene	**Voltage** A = 900V B = 1000V C = 1100V D = 1250V E = 1400V F = 1500V G = 1750V H = 1900V I = 2000V J = 2150V K = 2300V L = 2550V M = 2800V N = 3000V O = 3500V P = 3800V	**Capacitance EIA Code**	**Tolerances** K = ±10%	**Terminal Code** Male threaded = -- Female threaded = JE

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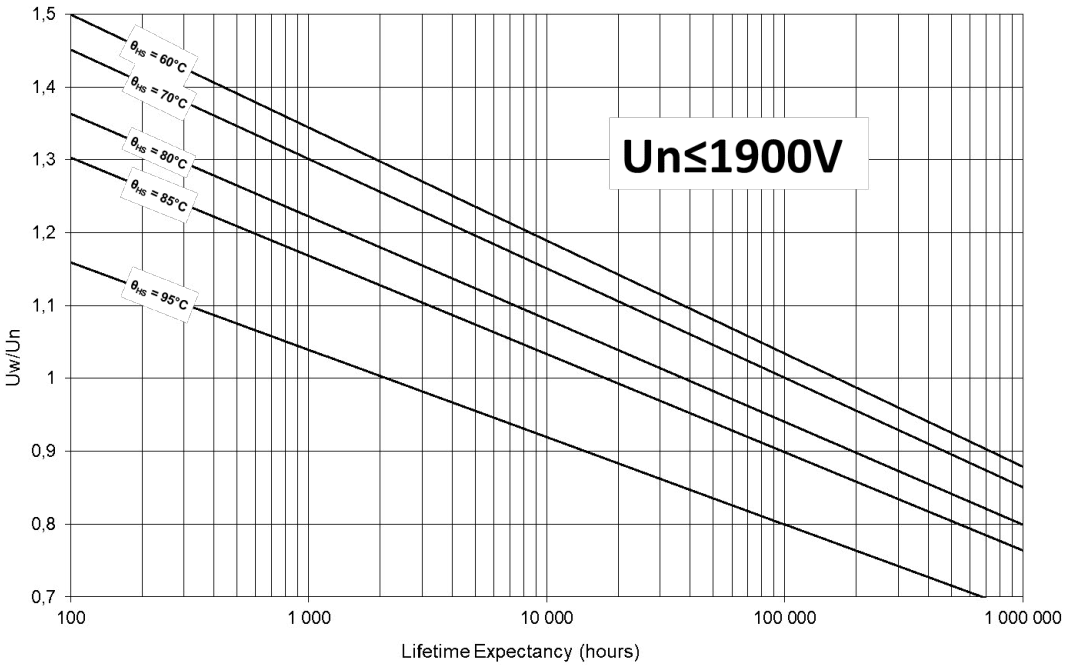
DEFINITIONS

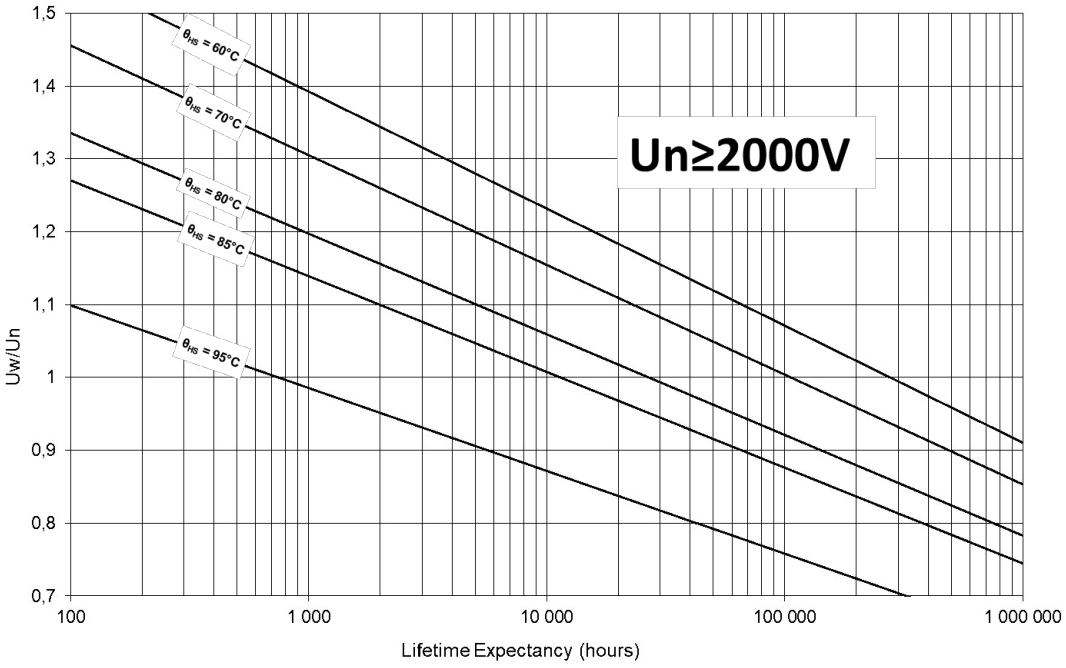
C_n (µF)	capacitance	nominal value of the capacitance measured at θ_{amb} = 25 ± 10°C
U_n (V)	rated DC voltage	maximum operating peak voltage of either polarity (non-reversing type waveform), for which the capacitor has been designed for continuous operation
U_w (V)	working voltage	value of the maximum 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 measured @ 1MHz
R_s (mΩ)	series resistance	capacitor series resistance due to galvanic circuit
I_{rms} Thermal 1 (A)	RMS current	RMS current value for continuous operation under natural convection generating 40°C overheating
I_{rms} Thermal 2 (A)	RMS current	RMS current value for continuous operation under forced air generating 40°C overheating
θ_{amb} (°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} (°C)	hot spot temperature	highest temperature obtained inside the case of the capacitor in thermal equilibrium
I^2t (A^2s)	integral of action	maximum repetitive integral of action that galvanic circuit is able to withstand
Ipeak (A)	Peak current	maximum repetitive peak current

CHARACTERISTICS

Capacitance range C_n	25µF to 3020µF
Tolerance on C_n	±10%
Rated DC voltage U_n	900 to 3800V
Lifetime at U_n and 70°C hot-spot temperature and ΔC / C < 2%	100,000h
FIT @ Undc and 70°C hot spot temperature	<50 FIT
Parasitic inductance L_s (measurement @ 1MHz)	45 to 60nH
Maximum rms current I_{rms}	up to 132A_{rms}
Test voltage between terminals @ 25°C	1.5 x U_n for 10s
Test voltage between terminals and Case @ 25°C	9kV_{rms} @ 50Hz for 10s
Dielectric	polypropylene
Climatic Category	40 / 95 / 56 (IEC 60068)
Working temperature	-40°C / +95°C (according to the power dissipated)
Storage temperature	-40°C / +95°C
Calorific value	40 MJ/kg

LIFETIME EXPECTANCY VS HOT SPOT TEMPERATURE AND VOLTAGE





FAILURE MODE

Main failure mode, due to the KYOCERA AVX's Controlled Self-Healing Technology, is only a loss of capacitance. Thanks to the Controlled Self-Healing solution to interrupt self-healing process. This prevents avalanche effect due to the polypropylene molecular cracking producing gas and leading to a potential explosion in confined box for the none Controlled Self-Healing capacitors.

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 100000 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.

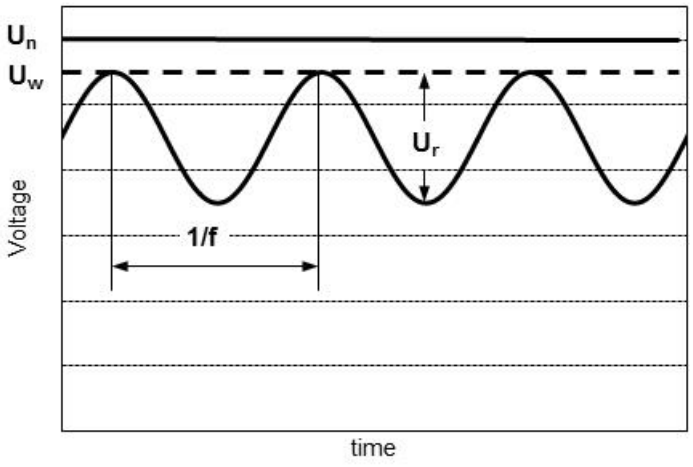
1. From the tables, select a capacitor with required capacitance C_n and voltage U_n.

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}



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 : $P_d = Q \times tg\delta_0$ with

- Q(reactive power) = $\frac{I_{rms}^2}{C\,2\pi f}$ for a sinusoidal waveform

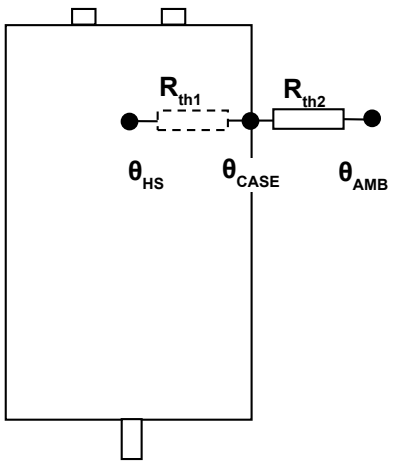
- $tg\delta_0 = 2 \times 10^{-4}$ (dielectric losses of polypropylene)

Hot spot temperature will be:
$\theta_{HS} = \theta_{amb} + (P_j + P_d) \times (R_{th1} + R_{th2})$

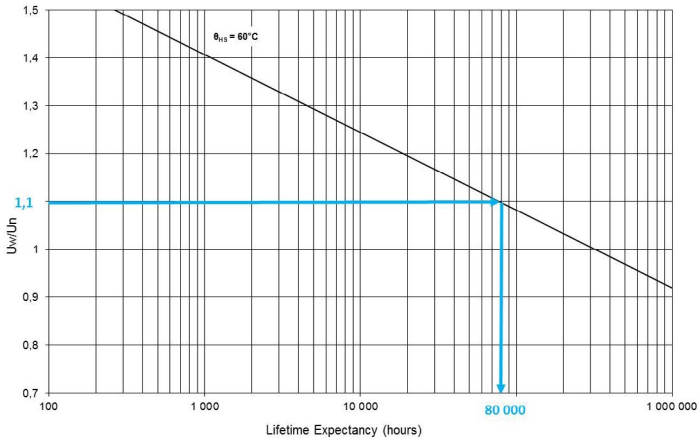
θ_{HS} absolute maximum is 95°C

If temperature is higher than 95°C, come back to #1 and start again with another selection.

R_{th1} : thermal resistance between hot spot and case
R_{th2} : thermal resistance between case and ambient air



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



eg: rated voltage 2000V
working voltage 2200V
ρ = 1,1 ⇒ lifetime 80 000hours @ 60°C hot spot temperature
a calculation form is available last page

THERMAL RESISTANCES

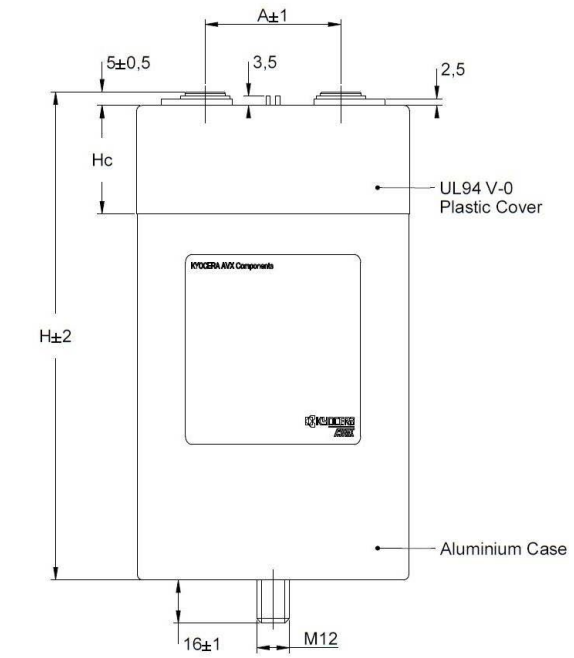
R_{th1} (°C/W): Thermal resistance between hot spot and case
R_{th2} (°C/W): Thermal resistance between case and ambient air under natural convection and forced air

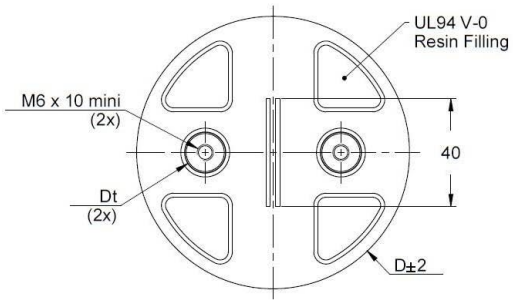
D (mm)	H (mm)	R_{th1} (°C/W)	R_{th2} (°C/W)	
			Natural air cooling	Forced air cooling >2m/s
85	130	1,6	2,4	1,1
85	180	1,2	2,1	0,9
100	130	1,5	2,1	1,0
100	180	1,2	1,9	0,9
116	130	1,4	2,0	0,9
116	180	1,2	1,8	0,8
116	240	1,6	1,6	0,7
116	340	1,3	1,2	0,5

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

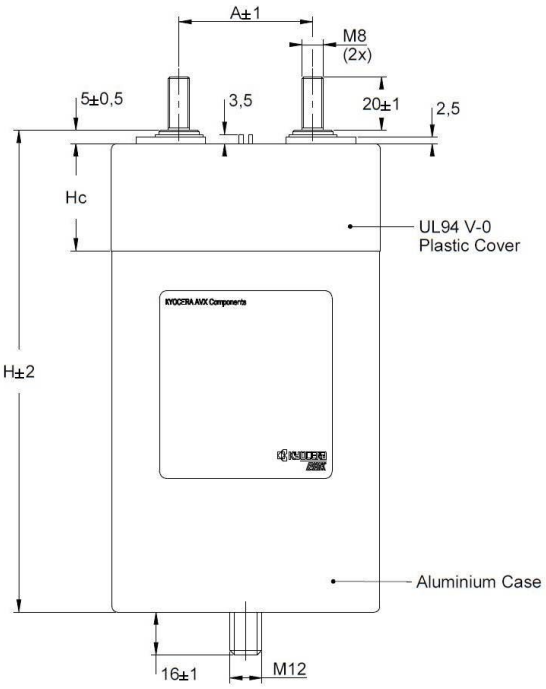
DIMENSIONS

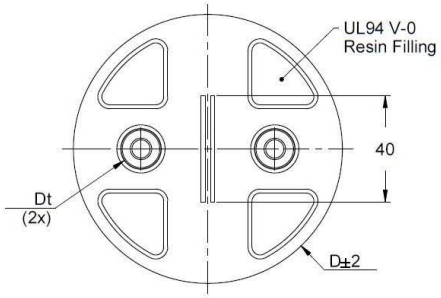
FEMALE TERMINALS





MALE TERMINALS





D (mm)	85	100	116	116
A (mm)	32	50	50	50
Dt (mm)	12	15	15	15
Hc (mm)	30	40	40	40

	Max Torque (Nm)
M6	4,5
M8	8,5
M12	15

	Distance terminal to terminal (mm)		Distance terminal to case (mm)	
D (mm)	creepage	clearance	creepage	clearance
85	40	19	52	50
100	55	34	59	57
116	55	34	67	65

MECHANICAL MOUNTING

Capacitors enclosure presents a M12 x 16 bolt in order to fix the capacitor. Over height (H) more than 1.5 x D (diameter of tube), we recommend to clamp (constraint < 35daN), just below the plastic cover, the capacitor in order to limit oscillations in case of potential Shock & Vibration stress.

RATINGS AND PART NUMBER REFERENCE

Part Number	Un (V)	C (µF)	D (mm)	H (mm)	Rs (mΩ)	Ls (nH)	I_{rms} Thermal 1 (A)	I_{rms} Thermal 2 (A)	I²t (A²s)	Ipeak (A)	Weight (kg)
FFLK6A0537K**	900	530	85	130	2,3	45	67	82	27	2650	0,95
FFLK6A0827K**	900	820	85	180	3,3	60	61	75	27	2670	1,25
FFLK6A0787K**	900	780	100	130	1,7	45	82	99	58	3905	1,35
FFLK6A1207K**	900	1200	100	180	2,4	60	73	90	58	3910	1,75
FFLK6A1087K**	900	1080	116	130	1,3	45	96	117	110	5405	1,80
FFLK6A1687K**	900	1680	116	180	1,8	60	86	106	113	5475	2,30
FFLK6A1967K**	900	1960	116	240	1,0	40	112	132	116	9810	3,00
FFLK6A3027K**	900	3020	116	340	1,4	60	109	127	119	9840	4,30
FFLK6B0437K**	1000	430	85	130	2,5	45	64	78	22	2395	0,95
FFLK6B0667K**	1000	660	85	180	3,7	60	58	71	22	2395	1,25
FFLK6B0627K**	1000	620	100	130	1,9	45	78	95	45	3455	1,35
FFLK6B0967K**	1000	960	100	180	2,7	60	70	86	46	3485	1,75
FFLK6B0877K**	1000	870	116	130	1,4	45	93	113	89	4850	1,80
FFLK6B1357K**	1000	1350	116	180	2,0	60	82	101	91	4900	2,30
FFLK6B1587K**	1000	1580	116	240	1,0	40	109	128	73	8810	3,00
FFLK6B2447K**	1000	2440	116	340	1,5	60	106	123	74	8860	4,30
FFLK6C0357K**	1100	350	85	130	2,7	45	61	75	18	2175	0,95
FFLK6C0547K**	1100	540	85	180	4,0	60	55	68	18	2175	1,25
FFLK6C0517K**	1100	510	100	130	2,0	45	75	91	38	3170	1,35
FFLK6C0797K**	1100	790	100	180	2,9	60	67	82	38	3185	1,75
FFLK6C0717K**	1100	710	116	130	1,5	45	89	109	74	4410	1,80
FFLK6C1107K**	1100	1100	116	180	2,2	60	79	97	74	4435	2,30
FFLK6C1297K**	1100	1290	116	240	1,1	40	106	124	61	8020	3,00
FFLK6C2007K**	1100	2000	116	340	1,6	60	102	120	61	8060	4,30
FFLK6D0287K**	1250	280	85	130	3,0	45	58	71	14	1940	0,95
FFLK6D0437K**	1250	430	85	180	4,5	60	52	65	14	1935	1,25
FFLK6D0417K**	1250	410	100	130	2,2	45	71	87	31	2845	1,35
FFLK6D0637K**	1250	630	100	180	3,2	60	64	78	30	2835	1,75
FFLK6D0577K**	1250	570	116	130	1,7	45	85	104	59	3955	1,80
FFLK6D0887K**	1250	880	116	180	2,4	60	75	92	59	3960	2,30
FFLK6D1047K**	1250	1040	116	240	1,2	40	102	120	49	7210	3,00
FFLK6D1607K**	1250	1600	116	340	1,7	60	99	115	49	7200	4,30
FFLK6E0207K**	1400	200	85	130	3,5	45	54	66	10	1660	0,95
FFLK6E0327K**	1400	320	85	180	5,1	60	49	61	11	1695	1,25
FFLK6E0307K**	1400	300	100	130	2,5	45	67	82	23	2490	1,35
FFLK6E0477K**	1400	470	100	180	3,6	60	60	74	24	2490	1,75
FFLK6E0427K**	1400	420	116	130	1,9	45	81	99	46	3485	1,80
FFLK6E0667K**	1400	660	116	180	2,7	60	72	88	46	3500	2,30
FFLK6E0767K**	1400	760	116	240	1,3	40	98	115	38	3610	3,00
FFLK6E1207K**	1400	1200	116	340	1,8	60	94	110	38	6360	4,30
FFLK6F1856K**	1500	185	85	130	3,6	45	53	65	10	1620	0,95
FFLK6F0297K**	1500	290	85	180	5,3	60	48	60	10	1620	1,25
FFLK6F0277K**	1500	270	100	130	2,6	45	66	80	21	2360	1,35
FFLK6F4256K**	1500	425	100	180	3,7	60	59	72	21	2375	1,75
FFLK6F3756K**	1500	375	116	130	2,0	45	79	96	41	3280	1,80
FFLK6F0597K**	1500	590	116	180	2,8	60	70	85	41	3300	2,30
FFLK6F0687K**	1500	680	116	240	1,4	40	96	112	34	5950	3,00
FFLK6F1077K**	1500	1070	116	340	1,9	60	92	108	34	5980	4,30

** Insert - - for male terminals or JE for female terminals

RATINGS AND PART NUMBER REFERENCE

Part Number	Un (V)	C (µF)	D (mm)	H (mm)	Rs (mΩ)	Ls (nH)	I_{rms} Thermal 1 (A)	I_{rms} Thermal 2 (A)	I²t (A²s)	Ipeak (A)	Weight (kg)
FFLK6G1356K**	1750	135	85	130	4,2	45	50	61	7	1385	0,95
FFLK6G2156K**	1750	215	85	180	6,0	60	45	56	8	1410	1,25
FFLK6G0207K**	1750	200	100	130	2,9	45	62	75	16	2050	1,35
FFLK6G0317K**	1750	310	100	180	4,3	60	55	67	16	2030	1,75
FFLK6G2756K**	1750	275	116	130	2,2	45	74	90	30	2820	1,80
FFLK6G4356K**	1750	435	116	180	3,2	60	65	80	31	2850	2,30
FFLK6G0507K**	1750	500	116	240	1,5	40	91	107	25	5130	3,00
FFLK6G0797K**	1750	790	116	340	2,1	60	88	103	25	5180	4,30
FFLK6H0127K**	1900	120	85	130	4,3	45	49	60	7	1320	0,95
FFLK6H1856K**	1900	185	85	180	6,5	60	43	54	6	1300	1,25
FFLK6H0177K**	1900	170	100	130	3,2	45	59	72	13	1870	1,35
FFLK6H0277K**	1900	270	100	180	4,6	60	53	65	14	1900	1,75
FFLK6H0247K**	1900	240	116	130	2,3	45	72	88	26	2645	1,80
FFLK6H0387K**	1900	380	116	180	3,4	60	64	78	27	2675	2,30
FFLK6H0447K**	1900	440	116	240	1,6	40	89	105	22	4850	3,00
FFLK6H0697K**	1900	690	116	340	2,2	60	86	100	22	4850	4,30
FFLK6I0117K**	2000	110	85	130	3,8	45	52	64	6	1245	0,95
FFLK6I1756K**	2000	175	85	180	5,5	60	47	58	7	1265	1,25
FFLK6I0167K**	2000	160	100	130	2,7	45	64	79	13	1810	1,35
FFLK6I0257K**	2000	250	100	180	4,0	60	57	70	13	1805	1,75
FFLK6I2256K**	2000	225	116	130	2,0	45	78	95	27	2545	1,80
FFLK6I0357K**	2000	350	116	180	3,0	60	68	83	26	2530	2,30
FFLK6I0407K**	2000	400	116	240	1,4	40	94	110	21	4530	3,00
FFLK6I0647K**	2000	640	116	340	2,0	60	91	106	22	4630	4,30
FFLK6J0956K**	2150	95	85	130	4,1	45	50	62	5	1145	0,95
FFLK6J0157K**	2150	150	85	180	6,0	60	45	56	5	1155	1,25
FFLK6J0147K**	2150	140	100	130	2,9	45	62	76	12	1685	1,35
FFLK6J0227K**	2150	220	100	180	4,3	60	55	68	12	1690	1,75
FFLK6J1956K**	2150	195	116	130	2,2	45	75	91	23	2350	1,80
FFLK6J0317K**	2150	310	116	180	3,1	60	66	81	23	2385	2,30
FFLK6J0367K**	2150	360	116	240	1,5	40	93	109	19	4330	3,00
FFLK6J0567K**	2150	560	116	340	2,1	60	88	103	19	4310	4,30
FFLK6K0856K**	2300	85	85	130	4,3	45	49	60	5	1085	0,95
FFLK6K1356K**	2300	135	85	180	6,3	60	44	55	5	1100	1,25
FFLK6K1256K**	2300	125	100	130	3,0	45	61	74	10	1595	1,35
FFLK6K1956K**	2300	195	100	180	4,5	60	54	66	10	1590	1,75
FFLK6K1756K**	2300	175	116	130	2,3	45	74	90	20	2235	1,80
FFLK6K2756K**	2300	275	116	180	3,3	60	64	79	21	2245	2,30
FFLK6K0327K**	2300	320	116	240	1,5	40	91	107	17	4080	3,00
FFLK6K0507K**	2300	500	116	340	2,2	60	86	101	17	4080	4,30
FFLK6L0656K**	2550	65	85	130	4,6	45	47	58	4	990	0,95
FFLK6L1056K**	2550	105	85	180	6,9	60	42	52	4	995	1,25
FFLK6L0956K**	2550	95	100	130	3,3	45	59	72	9	1450	1,35
FFLK6L0157K**	2550	150	100	180	5,0	60	51	63	8	1425	1,75
FFLK6L0137K**	2550	130	116	130	2,5	45	70	85	16	1980	1,80
FFLK6L0217K**	2550	210	116	180	3,7	60	61	75	16	1995	2,30
FFLK6L0247K**	2550	240	116	240	1,6	40	87	103	14	3660	3,00
FFLK6L0387K**	2550	380	116	340	2,4	60	83	97	13	3610	4,30

** Insert - - for male terminals or JE for female terminals

RATINGS AND PART NUMBER REFERENCE

Part Number	Un (V)	C (µF)	D (mm)	H (mm)	Rs (mΩ)	Ls (nH)	I_{rms} Thermal 1 (A)	I_{rms} Thermal 2 (A)	I²t (A²s)	Ipeak (A)	Weight (kg)
FFLK6M0506K**	2800	50	85	130	5,4	45	44	53	3	840	0,95
FFLK6M0856K**	2800	85	85	180	7,7	60	40	50	3	890	1,25
FFLK6M0756K**	2800	75	100	130	3,7	45	55	67	7	1260	1,35
FFLK6M1256K**	2800	125	100	180	5,4	60	49	61	7	1305	1,75
FFLK6M1056K**	2800	105	116	130	2,7	45	67	81	13	1765	1,80
FFLK6M1756K**	2800	175	116	180	3,9	60	59	72	14	1830	2,30
FFLK6M0197K**	2800	190	116	240	1,8	40	83	97	10	1595	3,00
FFLK6M0327K**	2800	320	116	340	2,5	60	80	94	11	1675	4,30
FFLK6N0456K**	3000	45	85	130	5,5	45	43	53	3	825	0,95
FFLK6N0706K**	3000	70	85	180	8,5	60	38	47	3	800	1,25
FFLK6N0656K**	3000	65	100	130	3,9	45	54	65	6	1195	1,35
FFLK6N1056K**	3000	105	100	180	5,8	60	47	58	6	1200	1,75
FFLK6N0906K**	3000	90	116	130	2,9	45	65	79	11	1650	1,80
FFLK6N1456K**	3000	145	116	180	4,3	60	56	69	11	1655	2,30
FFLK6N0167K**	3000	160	116	240	1,9	40	80	94	9	2940	3,00
FFLK6N0267K**	3000	260	116	340	2,8	60	77	90	9	2970	4,30
FFLK6O0306K**	3500	30	85	130	4,1	45	50	61	7	1340	0,95
FFLK6O0506K**	3500	50	85	180	5,4	60	47	59	8	1365	1,25
FFLK6O0456K**	3500	45	100	130	2,8	45	63	76	17	2015	1,35
FFLK6O0756K**	3500	75	100	180	3,8	60	58	72	17	2045	1,75
FFLK6O0656K**	3500	65	116	130	2,1	45	77	94	35	2910	1,80
FFLK6O1056K**	3500	105	116	180	2,8	60	69	85	34	2865	2,30
FFLK6O0117K**	3500	110	116	240	1,5	40	91	107	25	4930	3,00
FFLK6O0197K**	3500	190	116	340	1,9	60	92	108	28	5180	4,30
FFLK6P0256K**	3800	25	85	130	4,5	45	47	58	6	1200	0,95
FFLK6P0456K**	3800	45	85	180	5,6	60	47	58	7	1315	1,25
FFLK6P0406K**	3800	40	100	130	2,9	45	62	75	15	1920	1,35
FFLK6P0656K**	3800	65	100	180	4,0	60	57	70	15	1905	1,75
FFLK6P0556K**	3800	55	116	130	2,2	45	74	90	29	2645	1,80
FFLK6P0906K**	3800	90	116	180	3,0	60	67	82	28	2635	2,30
FFLK6P0107K**	3800	100	116	240	1,5	40	90	106	24	4810	3,00
FFLK6P0167K**	3800	160	116	340	2,1	60	89	103	22	4690	4,30

** Insert - - for male terminals or JE for female terminals

CALCULATION FORM SPECIFICATION

Capacitance	C (µF)	
Working voltage	U_w (V)	
RMS current	I_{rms} (Arms)	
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)	

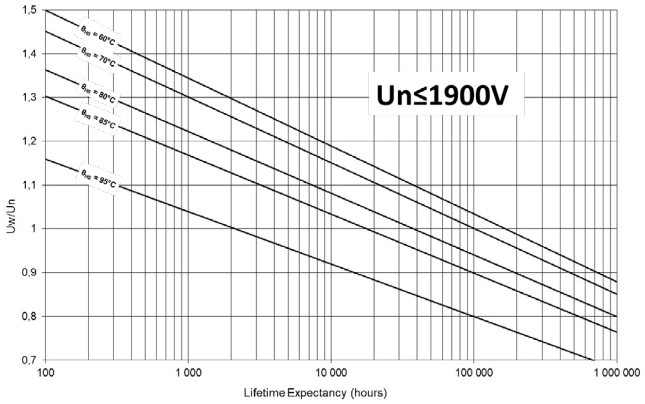
Your choice

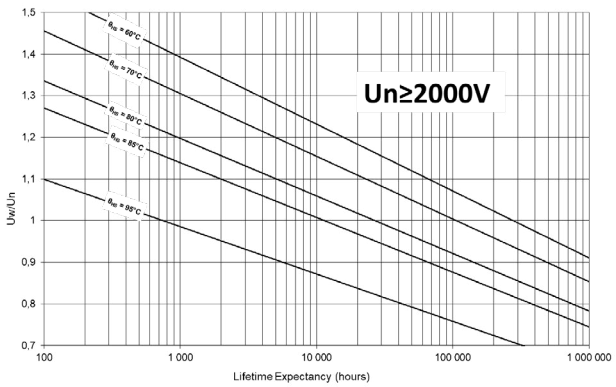
PN		
Capacitance	C (µF)	
Rated voltage	U_n (V)	
Serial resistance	R_s (mΩ)	
Thermal resistance between hot spot and case	R_{th1} (°C/W)	
Thermal resistance between case and ambient air	R_{th2} (°C/W)	

CALCULATIONS

Maximum ripple voltage	$U_{rmax} = 0.2 \times U_n$	U_{rmax} =	V
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	$P_j = R_s \times I_{rms2}$	P_j =	W
Dielectric losses	$P_d = Q \times tg\delta 0 = Q \times 2.10^{-4}$	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 95°C			

LIFETIME EXPECTANCY VS HOT SPOT TEMPERATURE AND VOLTAGE





Expected lifetime at hot spot calculated at U_w	