EFX2A

Automotive metalized polypropylene film EMI suppression capacitors

Product features

- High stability of capacitance
- Self-healing property
- Over voltage stress withstanding
- Flame-retardant plastic case and resin
- AEC-Q200
- THB Grade IIIB

Applications

- Class X2 for interference suppression
- EMI filtering in across-the-line applications
- xEV traction inverter
- On board charger (OBC)
- xEV DC/DC converter
- Solar inverter
- UPS
- AC motor drive
- Air conditioner
- Switch mode power supplies

Environmental compliance and general specifications

- Operating temperature range: -40 °C to +110 °C

Agency information

Approval mark	Standard	File number
	UL 60384-14 CAN/CSA-E60384-14	E529574
	IEC 60384-14:2013 IEC 60384-14:2013/AMD1:2016	40055954
	IEC 60384-14:2013+AMD1:2016 CQC11-471112-2015	CQC22001363202

Powering Business Worldwide

Part number system

EF	X2	A	30	K	104	B01	2L	H
Capacitor type	**Family**	**Grade**	**Voltage (Vac)**	**Tolerance**	**Capacitance (pF)**	**Size code**	**Terminal code**	**Lead length code**
EF = film capacitors	X2	A = automotive grade	30 = 305	K = ±10% M = ±20%	First two digits= significant figures, third digit = number of zeros example: 104 = 100000 pF	Refer to size code table	Refer to terminal code table	Refer to lead length code table

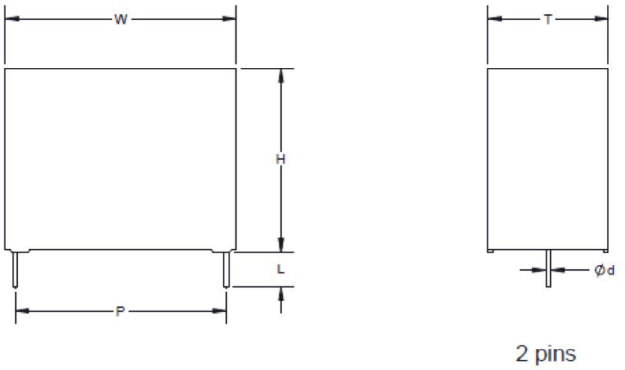
Terminal code table

Digit one (Lead/terminal type)		Digit two (Lead Ipsilateral)	
Straight cut	2	N/A	L
Taping straight	V	-	-

Lead length code table

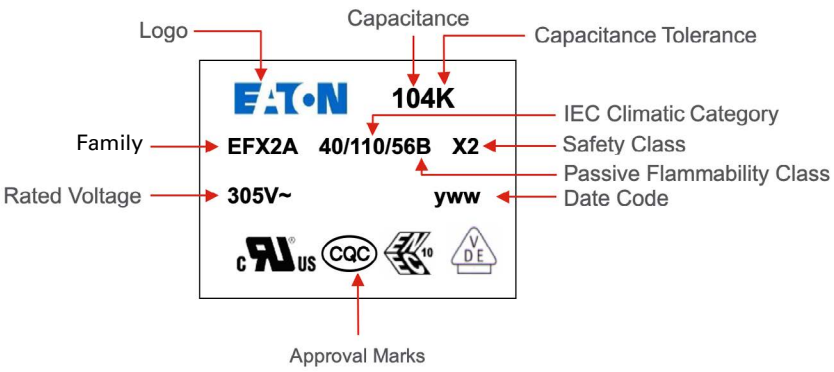
Lead length	
3.0±0.5 mm (Bulk)	D
3.5±0.5 mm (Bulk)	E
4.0±0.5 mm (Bulk)	F
4.5±0.5 mm (Bulk)	G
5.0±0.5 mm (Bulk)	H
25±2 mm (Ammo)	T

Dimensions-mm



2 pins

Part marking



Size code table

Size	Dimension-mm						Pitch-mm		Lead wire-mm		Lead length
Code	W	Tolerance (±)	H	Tolerance (±)	T	Tolerance (±)	P	Tolerance (±)	Ød	Tolerance (±)	L
B01	18	0.5	11	0.5	5	0.5	15	0.5	0.6	0.05	Refer to Lead Length Code Table, Pitch 27.5 and 37.5 without Ammo package
B02	18	0.5	12	0.5	6	0.5	15	0.5	0.6	0.05	
B07	18	0.5	13.5	0.5	7.5	0.5	15	0.5	0.8	0.05	
B09	18	0.5	14.5	0.5	8.5	0.5	15	0.5	0.8	0.05	
B11	18	0.5	16	0.5	10	0.5	15	0.5	0.8	0.05	
B16	18	0.5	19	0.5	11	0.5	15	0.5	0.8	0.05	
C02	26	0.5	16.5	0.5	7	0.5	22.5	0.5	0.8	0.05	
C04	26	0.5	19	0.5	10	0.5	22.5	0.5	0.8	0.05	
C05	26	0.5	20	0.5	11	0.5	22.5	0.5	0.8	0.05	
C06	26	0.5	22	0.5	12	0.5	22.5	0.5	0.8	0.05	
C07	26	0.5	23	0.5	13	0.5	22.5	0.5	0.8	0.05	
C10	26	0.5	29.5	0.5	14.5	0.5	22.5	0.5	0.8	0.05	
D02	32	0.8	18	0.8	9	0.8	27.5	0.5	0.8	0.05	
D03	32	0.8	20	0.8	11	0.8	27.5	0.5	0.8	0.05	
D05	32	0.8	24	0.8	14	0.8	27.5	0.5	0.8	0.05	
D06	32	0.8	24.5	0.8	13	0.8	27.5	0.5	0.8	0.05	
D09	32	0.8	28	0.8	18	0.8	27.5	0.5	0.8	0.05	
D12	32	0.8	33	0.8	18	0.8	27.5	0.5	0.8	0.05	
D13	32	0.8	37	0.8	22	0.8	27.5	0.5	0.8	0.05	
D14	32	0.8	31	0.8	23	0.8	27.5	0.5	0.8	0.05	
E10	42	1	32	1	19	1	37.5	0.5	1	0.05	
E11	42	1	37	1	22	1	37.5	0.5	1	0.05	
E14	42	1	43	1	28	1	37.5	0.5	1	0.05	
E16	42	1	45	1	30	1	37.5	0.5	1	0.05	

Case color is black.

Rating and part number

Rated voltage 305 Vac/630 Vdc

	Dimensions							
Capacitance value (µF)	W (mm)	H (mm)	T (mm)	P (mm)	Peak current (A)	Surge current (A)	dv/dt (V/µs)	Part number[1]
0.1	18	11	5	15	40	120	400	EFX2A30K104B012LH
0.15	18	12	6	15	60	180	400	EFX2A30K154B022LH
0.22	18	13.5	7.5	15	88	264	400	EFX2A30K224B072LH
0.27	18	14.5	8.5	15	108	324	400	EFX2A30K274B092LH
0.33	18	14.5	8.5	15	132	396	400	EFX2A30K334B092LH
0.47	18	16	10	15	188	564	400	EFX2A30K474B112LH
0.56	18	19	11	15	224	672	400	EFX2A30K564B162LH
0.68	18	19	11	15	272	816	400	EFX2A30K684B162LH
0.33	26	16.5	7	22.5	66	198	200	EFX2A30K334C022LH
0.47	26	16.5	7	22.5	94	282	200	EFX2A30K474C022LH
0.56	26	19	10	22.5	112	336	200	EFX2A30K564C042LH
0.68	26	19	10	22.5	136	408	200	EFX2A30K684C042LH
1	26	20	11	22.5	200	600	200	EFX2A30K105C052LH
1.2	26	22	12	22.5	240	720	200	EFX2A30K125C062LH
1.5	26	23	13	22.5	300	900	200	EFX2A30K155C072LH
1.8	26	29.5	14.5	22.5	360	1080	200	EFX2A30K185C102LH
2	26	29.5	14.5	22.5	400	1200	200	EFX2A30K205C102LH
2.2	26	29.5	14.5	22.5	440	1320	200	EFX2A30M225C102LH*
0.68	32	18	9	27.5	102	306	150	EFX2A30K684D022LH
0.82	32	18	9	27.5	123	369	150	EFX2A30K824D022LH
1	32	20	11	27.5	150	450	150	EFX2A30K105D032LH
1.2	32	20	11	27.5	180	540	150	EFX2A30M125D032LH*
1.5	32	24.5	13	27.5	225	675	150	EFX2A30K155D062LH
1.8	32	24.5	13	27.5	270	810	150	EFX2A30K185D062LH
2.2	32	24	14	27.5	330	990	150	EFX2A30M225D052LH*
2.7	32	28	18	27.5	405	1215	150	EFX2A30K275D092LH
3.3	32	33	18	27.5	495	1485	150	EFX2A30K335D122LH
3.9	32	31	23	27.5	585	1755	150	EFX2A30K395D142LH
4.7	32	37	22	27.5	705	2115	150	EFX2A30K475D132LH
4.7	42	32	19	37.5	470	1410	100	EFX2A30K475E102LH
5.6	42	32	19	27.5	560	1680	100	EFX2A30K565E102LH
6.8	42	37	22	37.5	680	2040	100	EFX2A30K685E112LH
10	42	43	28	37.5	1000	3000	100	EFX2A30K106E142LH
12	42	45	30	37.5	1200	3600	100	EFX2A30K126E162LH
15	42	45	30	37.5	1500	4500	100	EFX2A30K156E162LH

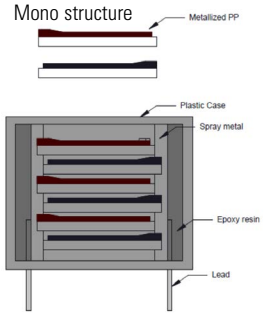
1. Standard part numbers listed---addition confirgurations available for tolerance, terminal and lead length. See part number system for available tolerances and terminal and lead length tables for available options.

* Only available M = 20% tolerance, otherwise both K =10% and M = 20% available

General information

Application	Interference suppression \ Across-the-line (Class X2)
Dielectric	Metallized Polypropylene Film
Reference standard	IEC 60384-14; UL 60384-14; GB/T 6346.14-2015, AEC-Q200D
Climatic category	40/110/56 IEC60068-1
Passive flammability class	B
Operating temperature range	-40 °C to +110 °C
Protection	Solvent resistant plastic case UL94 V-0, Thermosetting resin sealing UL 94V-0 compliant
Installation	Any position
Packaging	Packed in cardboard boxes with protection for the terminals
Storage conditions	Storage time: ≤24 months from the date marked on the label package, Average relative humidity per year ≤70%, RH≤85% for 30 days in one year, Dew is absent, Temperature: -40°C ~ +85°C
RoHS compliant	Compliant with the restricted substance requirements of Directive 2011/65/EU
Flame retardant grade	Flame retardant performance accords with horizontal combustion grade HB and vertical combustion grade V-0

Construction

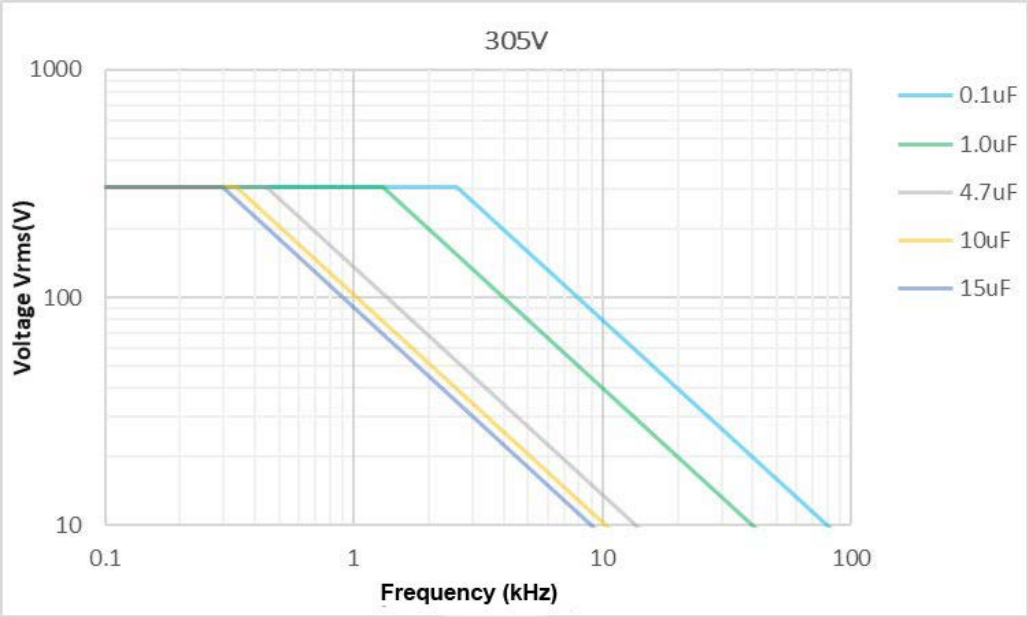
Metallized film	OPP & Al/Zn
Metal sprayed	Sn/Zn Alloy
Connection electrode	(0.6 mm to 0.8 mm) Tinned copper clad steel wire (1.0 mm to 1.2 mm) Tinned copper wires
Plastic case	Plastic case (UL94V-0)
Filling	Epoxy resin (UL94V-0)
Film construction	

Electrical and general characteristics

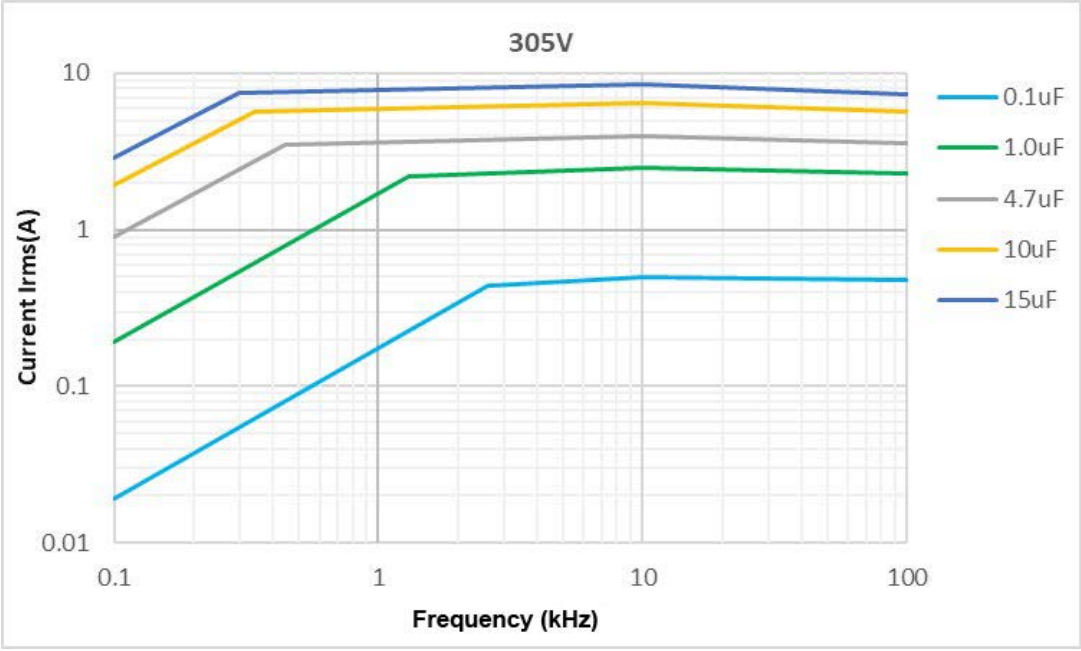
Voltage range (U_R)	305 Vac, 50/60 Hz
Recommended DC voltage	630 Vdc
Capacitance range	0.1 µF to 15.0 µF
Capacitance tolerance	±10% or ±20% at +20 °C
Capacitance	Measuring frequency at 1 KHz, +20 °C Measuring voltage: 1 ±0.2 V
Standard atmospheric conditions for static test	Ambient temperature +15 °C to +35 °C Relative humidity 45% to 75% Air pressure 86 kPa to 106 kPa.
Withstanding DC voltage between terminals U_{TT}	DC Voltage: 4.3 x UR for 60 seconds (at +20 ±2 °C) *The U_R in this DC test is the rated AC voltage value
Withstanding AC voltage between terminal and case U_{TC}	$2U_R$ + 1500 Vac, 60 s (at +20+/-2°C)
Dissipation factor	≤20 * 10^{-4} at 10 kHz. (C ≤ 1 µF) at +20 °C ≤10 * 10^{-4} at 1 kHz. (C > 1 µF) at +20 °C
Insulation resistance	R between leads, for C ≤ 0.33 µF at 100 V, +20 °C; 1 minute > 15 000 MΩ RC between leads, for C > 0.33 µF at 100 V, +20 °C; 1 minute > 5000 MΩ * µF
Life expectancy	100,000 hours (U_R hotspot = +85 °C) (△C/C≤10%)
Failure rate	100 FIT
Maximum altitude	2000 m

Charcteristics curves

Maximum voltage (V_{rms}) vs frequency

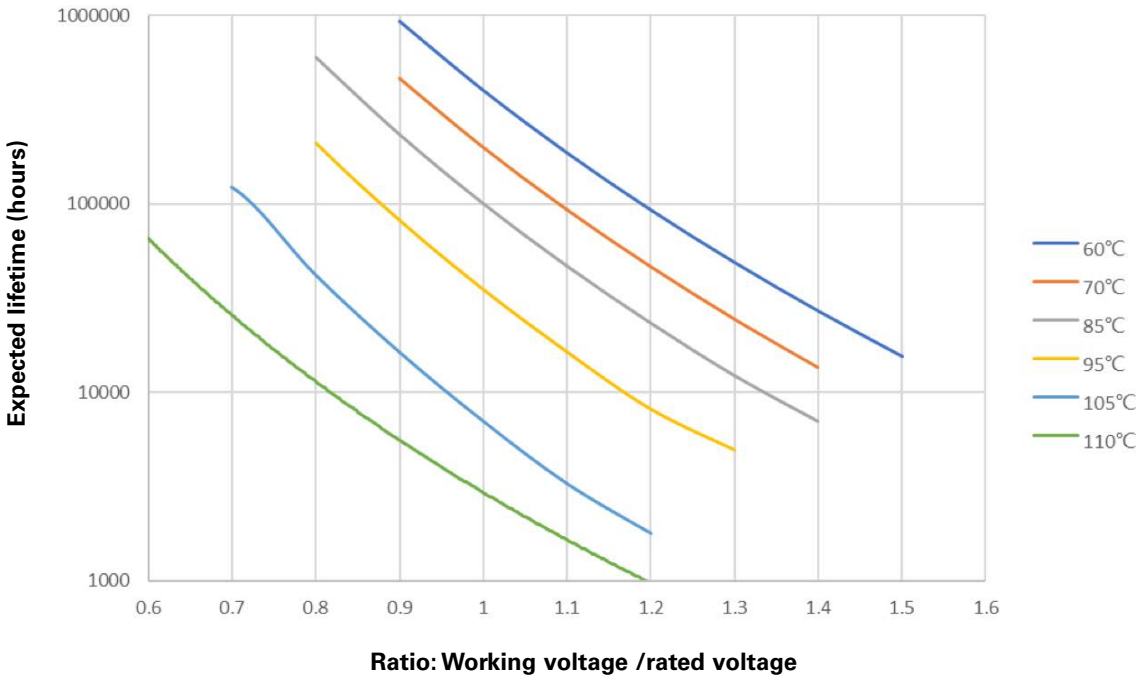


Maximum current (I_{rms}) vs frequency

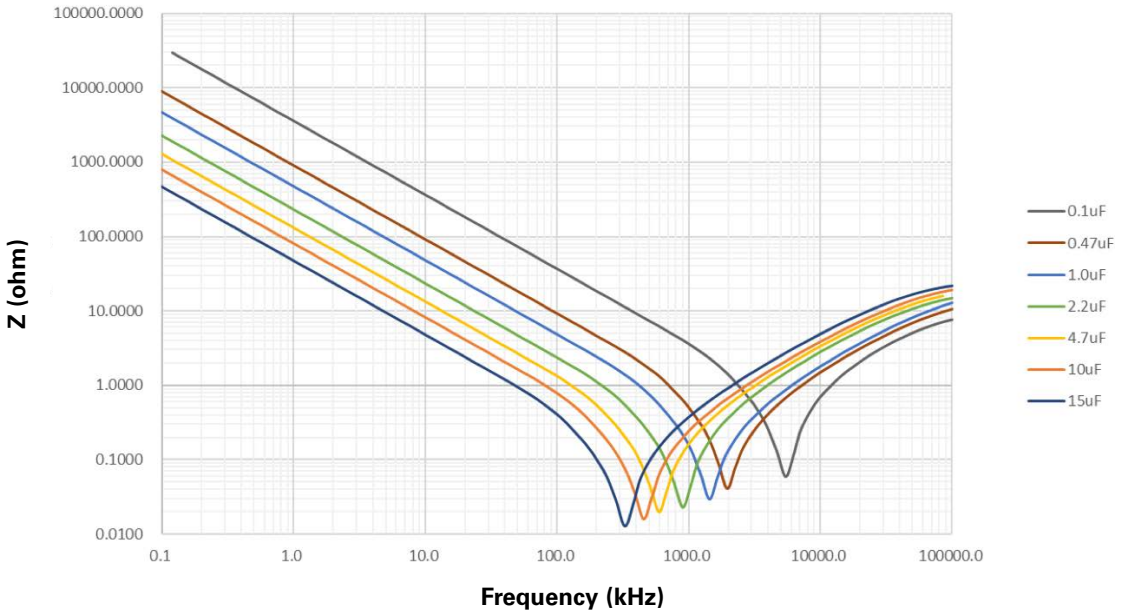


Charcteristics curves

Expected life curve



Impedance vs frequency



Environmental test

Test	Test condition	Performance
High temperature exposure	Reference: MIL-STD-202 Method 108, +110 +/- 2 °C 1000 hours	Capacitance change rate (ΔC/C) : ≤±3% DF change (Δtg δ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtg): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Temperature cycling	Reference: JESD22 Method JA-104, High temperature: +110 +/-5 °C, Low lemperature: -40 +/-5 °C, 1000 cycles, 30 minutes for each temperature	Capacitance change rate (ΔC/C) : ≤±3% DF change (Δtg δ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtg): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Moisture resistance	Reference: MIL-STD-202 Method 106 (+25 °C to 65 °C for 2.5 hours) , (+65 °C for 3 hours) , (+65 °C to +25 °C for 2.5 hours) , (+25 °C to +65 °C for 2.5 hours) , (+65 °C for 3 hours) , (+65 °C to +25 °C for 2.5 hours) , (+25 °C for 8 hours) Keep humidity 90%~100% for 10 cycles	Capacitance change rate (ΔC/C) : ≤±5% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Biased humidity 1	Reference: MIL-STD-202 Method 103, 60 °C + 95% R.H, Rated voltage, 1000 hours	Capacitance change rate (ΔC/C) : ≤±5% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Biased humidity 2	Reference: MIL-STD-202 Method 103, 85 °C + 85% R.H, Rated voltage, 1000 hours	Capacitance change rate (ΔC/C) : ≤±10% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Operational life	Testing method per IEC 60384-14, Test temperature: +110 +/-2 °C., Apply 125% of rated voltage for 1,000 +24/-0 hours. Each of these voltages shall be applied to each capacitor individually through a resistor of 47Ω ±5%. Once every hour the voltage is increased to 1000 V rms, for 0,1 seconds.	Capacitance change rate (ΔC/C) : ≤±10% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Terminal strength (leaded)	Tension: 0.50 < D ≤0.80, 10 N, 0.80 < D ≤ 1.25, 20 N Bending force: 0.50 < D ≤ 0.80, 5 N, 0.80 < D ≤ 1.25, 10 N Make two successive bends in each direction	Shall be no abnormality
Resistance to solvents	Reference: MIL-STD-202 Method 215, Solvent: propanol, Immersion time: 3 minutes, Drying time: 5 minutes, Mechanical treatment: 10 rubbing (toothbrush), 3 cycles	Capacitance change rate (ΔC/C) : ≤±1% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Mechanical shock	Reference: MIL-STD-202 Method 213, Pulse-shape: half-sine wave, Acceleration: 100 g, Duration of pulse: 6 ms, 18 times	Capacitance change rate (ΔC/C) : ≤±3% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Vibration	Reference: MIL-STD-202 Method 204, Frequency Change: 10 ~ 2000 Hz. 5 g force, 20 minutes, Direction: X, Y, Z, 12 cycles in each direction	Capacitance change rate (ΔC/C) : ≤±3% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Resistance to soldering heat	Reference: MIL-STD-202 Method 210, +260 +/- 5 °C 1.5 mm from roots	Capacitance change rate (ΔC/C) : ≤±2% DF change (Δtgδ: : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Solderability	Reference: J-STD-002, Soldering temperature: +245 +/-5 °C	More than 95% of circumferential surface of lead wire shall be covered with new solder

Environmental test

Test	Test condition	Performance
Electrical characterization	Parametrically test per lot at room, -40 °C, +110 °C	Electrical performance within specifications
Passive flammability class B	Test duration for actual volume V V ≤ 250 for 10 s 250 < V ≤ 500 for 20 s 500 < V ≤ 1750 for 30 s V > 1750 for 60 s	After removing test flame from capacitor, the capacitor must not continue to burn for more than 10 seconds. No burning particle must drop from the sample.
Humidity resistance	Reference: MIL-STD-202 Method 106, 40 +/-2 °C 90% to 95% R.H, 56 days	Capacitance change rate (ΔC/C) : ≤±5% DF change (Δtgδ): : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Active flammability	20 cycles of 2.5 kV discharges on the test capacitor connected to U_R	The cheese cloth around the capacitors shall not burn with a flame. No electrical measurements are required

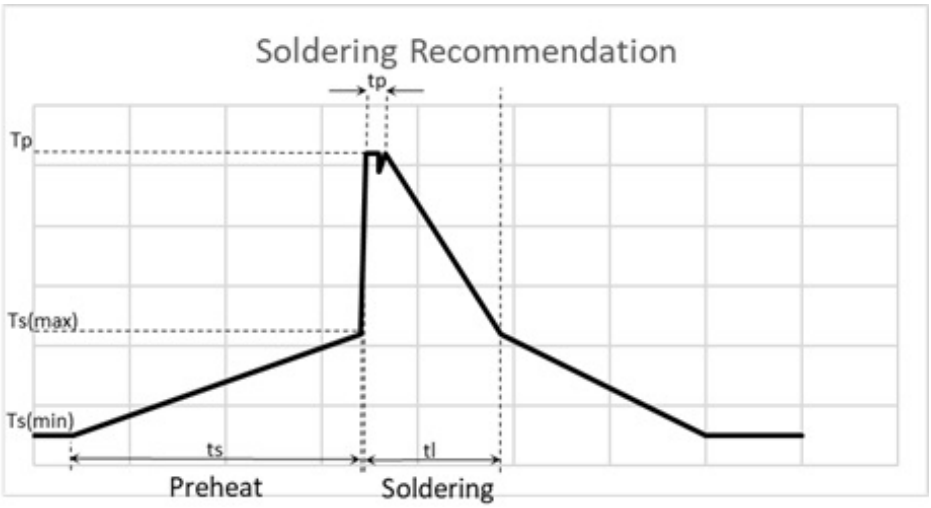
Electrical test

Test	Test condition	Performance
Charge and discharge	10000 cycles Charge to √2 x UR(DC) Charge resistance: $R = \frac{220 \times 10^{-6}}{C_N}\ \Omega$ Discharge resistance: $R = \frac{\sqrt{2} \times U_R\,(DC)}{1.25 \times C(dv/dt)}\ \Omega$	Capacitance change rate (ΔC/C) : ≤±5% DF change (Δtgδ): : ≤80*10^{-4} at 10 kHz. (C ≤ 1 µF) DF change (Δtgδ): : ≤50 * 10^{-4} at 1 kHz. (C > 1 µF) Insulation resistance: ≥50% of initial limit (T-T) test voltage: 4.3 U_R (dc)/60 s (T-C) test voltage: 2 U_R + 1500 V (ac)/60 s
Impulse voltage	3 successive impulses, full wave, peak voltage: X2: 2.5 kV for C ≤ 1 µF X2: 2.5 kV/√C for C > 1 µF 24 pulses maximum	No self-healing breakdowns or flashover

Packaging information

Pitch	SIze	Dimension-mm			Package quantity	
mm	Code	W	H	T	Bulk pack/box	Ammo pack/box
15	B01	18	11	5	1,054	680
	B02	18	12	6	867	560
	B07	18	13.5	7.5	697	450
	B09	18	14.5	8.5	612	390
	B11	18	16	10	527	340
	B16	18	19	11	476	300
22.5	C02	26	16.5	7	528	300
	C04	26	19	10	372	210
	C05	26	20	11	336	190
	C06	26	22	12	300	170
	C07	26	23	13	276	160
	C10	26	29.5	14.5	252	140
27.5	D02	32	18	9	340	NA
	D03	32	20	11	280	NA
	D05	32	24	14	220	NA
	D06	32	24.5	13	230	NA
	D09	32	28	18	170	NA
	D12	32	33	18	170	NA
	D13	32	37	22	140	NA
	D14	32	31	23	130	NA
37.5	E10	42	32	19	112	NA
	E11	42	37	22	98	NA
	E14	42	43	28	77	NA
	E16	42	45	30	70	NA

Wave solder profile



Profile feature		
Preheat	• Ts maximimum	110 °C
	• Ts minimum	NA
	• ts	< 150 seconds
Solder	• Tp	260 °C ±5 °C
	• tp	< 10 seconds
	• tl	≤60 seconds

Capacitor body maximum temperature at wave soldering ≤120 °C

Manual solder

+400 °C, 3 seconds maximum by soldering iron, generally manual, hand soldering is not recommended

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