VFL · Screw-Terminal · 12000 h/85 °C

Long Life · Bottom cooling design · Smaller Size

Optional design for permanent and deep charge-discharge application with high voltage hub and pulsed operation mode upon request.

Spezielles Design für häufige und tiefe Lade-, Entladeanwendungen mit hohem Spannungshub und Impulsbetrieb auf Anfrage erhältlich.

› Specifications · Spezifikationen

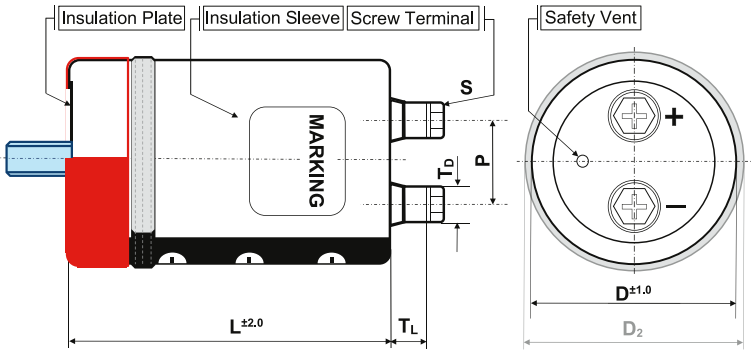
Items	Characteristics
Temperature range	-40°C ~ + 85°C
Capacitance tolerance (at 20°C)	Standard +/- 20%, -10/+30% on request
Surge voltage / Ripple voltage	Repetitive max. 30 sec per 6 Minutes / ≤ 50V
Leakage current max. I_L (20°C, 5 min)	0.01 • C • V_r [µA] or 5 mA, which is smaller.
Useful life	12 000 hours at 85°C
Field failure rate	0.5 FIT = 0.5 • 10^{-9} Failures/hour
Reference standards	IEC 60384-4, JIS C 5101-4
Vibration	0.75mm, 10…55Hz, 10g, 3x2h
Outer materials	UL94-V0 / UL224-VW1 certified (cap / sleeve)
Sleeve withstanding voltage	4000 Vac / 1min between terminals bundled and plate*
Product Compliance	RoHS, REACH, Conflict Minerals a.o. – refer to p. 12–13

* Typical value

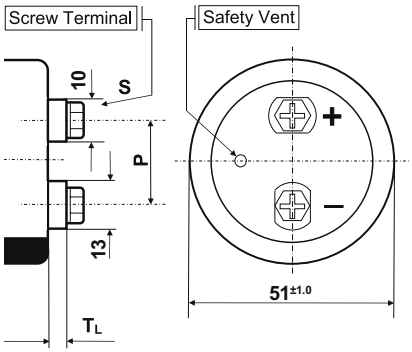
› Shape designation · Formbezeichnung

- additional information on p. 10–11 · Zusatzinformationen auf S. 10–11
- mounting accessories from p. 189 · Montagezubehör ab S. 189

Diameter 64 mm to 90 mm



Diameter 51 mm



Shape code Features	B Bolt	I / Y double sleeve for 2/3 points metal Bracket	N + suffix WC blank bottom + seating ring	N standard
outer insulation sleeve	•	•	•	•
insulation plate	•	•		•
stud bolt	•			
bottom double sleeve		•		
integrated seating ring			•	

diameter code	ØD	available shape	P	S	T_L	T_D	Cap material
C	51	B, N, I, Y	22.0	M5x10	4.5	13/10	PH
D	64	B, N, I, Y	28.6	M5x10	8.0	11	PH
E	77	B, N, I, Y, WC	31.5	M5x10	8.0	11	PH
				M6x12	9.0	12	PH
F	90	B, N, I, Y, WC	31.5	M5x10	7.0	11	PH
				M6x12	8.0	12	PH

Size in mm. First listed terminal is standard.

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› Product Code · Bestellbezeichnung

Example: Series VFL · 12000 µF +/- 20 % · 400 V · D = 90 mm · L = 150 mm with Y-Bracket

VFL | **2G** | **123** | **Y** | **F** | **150**

- **VFL** – Series name
- **123** – Capacitance code
- **Y** – Shape code
- **F** – Diameter code
- **150** – Capacitance tolerance: Ø : ± 20 % / Q : -10 % ~ + 30 %; Case length code – length in mm (3 digits)
- Specific features (e.g. M6 …)

Rated voltage code					
Code	Voltage	Code	Voltage	Code	Voltage
2V	350	2W	450	2L	550
2G	400	2H	500	600V	600

Rated VoltageCode (Surge Voltage) V_r [V DC]	Capacitance C_r [µF]	Ripple Current at 85°C/120Hz I_r [A RMS]	Ripple Current at 40°C/120Hz [A RMS]	ESR (typ) at 20°C/100Hz [mΩ]	Zmax at 20°C/10kHz [mΩ]	ESL (typ) [nH]	Dissipation Factor at 20°C/120Hz Tan δ	DxL [mm]	Product Code # = variable value, see fixing code in the product code
350 VDC Code: 2V Surge Voltage 400 VDC	**1 800**	7.4	15.6	55	58	17	0.20	51x75	VFL2V182#C075
	2 200	8.5	17.9	45	47	17	0.20	51x96	VFL2V222#C096
	2 700	9.8	20.6	37	39	17	0.20	51x109	VFL2V272#C109
	3 300	11.2	23.6	30	32	17	0.20	51x125	VFL2V332#C125
		12.6	26.5	30	32	18	0.20	64x94	VFL2V332#D094
	4 700	15.1	31.7	21	22	18	0.20	64x94	VFL2V472#D094
	5 600	16.9	35.5	18	19	18	0.20	64x107	VFL2V562#D107
	6 800	18.7	39.3	15	15	18	0.20	64x123	VFL2V682#D123
		20.9	43.9	15	15	20	0.20	77x95	VFL2V682#E095
	8 200	20.2	42.4	12	15	18	0.20	64x147	VFL2V822#D147
		22.9	48.1	12	15	20	0.20	77x108	VFL2V822#E108
		26.5	55.7	12	15	20	0.20	90x97	VFL2V822#F097
	10 000	22.9	48.1	10	15	18	0.20	64x187	VFL2V103#D187
		25.9	54.4	10	15	20	0.20	77x124	VFL2V103#E124
		29.3	61.5	10	15	20	0.20	90x97	VFL2V103#F097
	12 000	27.8	58.4	8	13	20	0.20	77x148	VFL2V123#E148
		31.7	66.6	8	13	20	0.20	90x126	VFL2V123#F126
	15 000	31.9	67.0	7	10	20	0.20	77x188	VFL2V153#E188
		35.2	73.9	7	10	20	0.20	90x150	VFL2V153#F150
	18 000	36.0	75.6	7	10	20	0.20	77x228	VFL2V183#E228
		37.9	79.6	7	10	20	0.20	90x167	VFL2V183#F167
	22 000	41.1	86.3	6	9	20	0.20	90x230	VFL2V223#F230
	27 000	43.0	90.3	5	7	20	0.20	90x268	VFL2V273#F268
400 VDC Code: 2G Surge Voltage 450 VDC	**1 500**	6.8	14.3	68	73	17	0.20	51x75	VFL2G152#C075
	1 800	7.9	16.6	57	61	17	0.20	51x96	VFL2G182#C096
	2 200	9.1	19.2	47	50	17	0.20	51x109	VFL2G222#C109
	2 700	10.2	21.5	38	41	17	0.20	51x125	VFL2G272#C125
	3 300	12.7	26.7	30	31	18	0.20	64x94	VFL2G332#D094
		14.6	30.7	30	31	20	0.20	77x95	VFL2G332#E095
	3 900	13.8	29.0	26	28	18	0.20	64x94	VFL2G392#D094
	4 700	15.5	32.6	21	22	18	0.20	64x107	VFL2G472#D107
		17.4	36.5	21	22	20	0.20	77x95	VFL2G472#E095

Additional designs on request · Weitere Designs auf Anfrage

Rated VoltageCode (Surge Voltage) V_r [V DC]	Capacitance C_r [µF]	Ripple Current at 85°C/120Hz I_r [A RMS]	Ripple Current at 40°C/120Hz [A RMS]	ESR (typ) at 20°C/100Hz [mΩ]	Zmax at 20°C/10kHz [mΩ]	ESL (typ) [nH]	Dissipation Factor at 20°C/120Hz Tan δ	DxL [mm]	Product Code # = variable value, see fixing code in the product code
400 VDC Code: 2G Surge Voltage 450 VDC	**5 600**	16.9	35.5	18	19	18	0.20	64x123	VFL2G562#D123
		19.0	39.9	18	19	20	0.20	77x95	VFL2G562#E095
	6 800	18.4	38.6	15	15	18	0.20	64x147	VFL2G682#D147
		20.8	43.7	15	15	20	0.20	77x108	VFL2G682#E108
		24.2	50.8	15	15	18	0.20	90x97	VFL2G682#F097
	8 200	20.8	43.7	12	15	18	0.20	64x187	VFL2G822#D187
		23.5	49.4	12	15	20	0.20	77x124	VFL2G822#E124
		26.6	55.9	12	15	20	0.20	90x97	VFL2G822#F097
	10 000	25.4	53.3	10	15	20	0.20	77x148	VFL2G103#E148
		28.9	60.7	10	15	20	0.20	90x126	VFL2G103#F126
	12 000	28.5	59.9	8	13	20	0.20	77x188	VFL2G123#E188
		31.3	65.7	8	13	20	0.20	90x143	VFL2G123#F143
		31.5	66.2	8	13	20	0.20	90x150	VFL2G123#F150
	15 000	32.9	69.1	8	10	20	0.20	77x228	VFL2G153#E228
		35.2	73.9	8	10	20	0.20	90x150	VFL2G153#F150
	18 000	37.2	78.1	6	9	20	0.20	90x230	VFL2G183#F230
	22 000	38.9	81.7	5	7	20	0.20	90x268	VFL2G223#F268
450 VDC Code: 2W Surge Voltage 500 VDC	**1 200**	6.3	13.3	86	90	17	0.20	51x75	VFL2W122#C075
	1 500	7.5	15.8	69	72	17	0.20	51x96	VFL2W152#C096
	1 800	8.4	17.7	57	60	17	0.20	51x109	VFL2W182#C109
	2 200	9.4	19.8	47	50	17	0.20	51x125	VFL2W222#C125
	2 700	11.7	24.6	38	40	18	0.20	64x94	VFL2W272#D094
	3 300	13.3	27.9	30	35	18	0.20	64x107	VFL2W332#D107
		14.9	31.3	30	33	20	0.20	77x95	VFL2W332#E095
		15.1	31.7	30	33	20	0.20	77x139	VFL2W332#E139
	3 900	14.5	30.5	27	32	18	0.20	64x123	VFL2W392#D123
		16.2	34.0	27	32	20	0.20	77x95	VFL2W392#E095
	4 700	15.6	32.8	21	21	18	0.20	64x147	VFL2W472#D147
		17.8	37.4	21	21	20	0.20	77x108	VFL2W472#E108
		18.1	38.0	21	21	20	0.20	77x139	VFL2W472#E139R
	5 600	17.5	36.8	20	20	18	0.20	64x164	VFL2W562#D164
		19.9	41.8	20	20	20	0.20	77x124	VFL2W562#E124
		22.5	47.3	20	20	20	0.20	90x97	VFL2W562#F097
	6 300	21.2	44.3	18	19	20	0.20	77x139	VFL2W632#E139
	6 800	19.4	40.7	15	18	18	0.20	64x187	VFL2W682#D187
		21.4	44.9	15	18	20	0.20	77x148	VFL2W682#E148
		24.6	51.7	15	18	20	0.20	90x110	VFL2W682#F110
	8 200	24.0	50.4	14	16	20	0.20	77x165	VFL2W822#E165
		26.8	56.3	14	16	20	0.20	90x126	VFL2W822#F126
	10 000	26.7	56.1	10	15	20	0.20	77x188	VFL2W103#E188
		29.4	61.7	10	15	20	0.20	90x150	VFL2W103#F150
	12 000	30.2	63.4	9	12	20	0.20	77x228	VFL2W123#E228
		31.7	67.0	9	12	20	0.20	90x167	VFL2W123#F167

Additional designs on request · Weitere Designs auf Anfrage

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Rated VoltageCode (Surge Voltage) V_r [V DC]	Capacitance C_r [µF]	Ripple Current at 85°C/120Hz I_r [A RMS]	Ripple Current at 40°C/120Hz [A RMS]	ESR (typ) at 20°C/100Hz [mΩ]	Zmax at 20°C/10kHz [mΩ]	ESL (typ) [nH]	Dissipation Factor at 20°C/120Hz Tan δ	DxL [mm]	Product Code # = variable value, see fixing code in the product code
450 VDC Code: 2W Surge Voltage 500 VDC	**14 000**	34.5	72.5	8	11	20	0.20	90x190	VFL2W143#F190
	15 000	34.8	73.1	7	10	20	0.20	90x230	VFL2W153#F230
	17 000	37.0	77.7	6	8	20	0.20	90x230	VFL2W173#F230
	18 000	37.6	79.0	6	8	20	0.20	90x268	VFL2W183#F268
500 VDC Code: 2H Surge Voltage 550 VDC	**820**	4.7	9.9	117	110	17	0.20	51x75	VFL2H821#C075
	1 000	5.6	11.8	96	90	17	0.20	51x96	VFL2H102#C096
	1 200	6.3	13.3	80	75	17	0.20	51x109	VFL2H122#C109
	1 500	7.2	15.2	64	60	17	0.20	51x125	VFL2H152#C125
	1 800	9.1	19.1	53	50	18	0.20	64x94	VFL2H182#D094
	2 200	10.3	21.6	40	35	18	0.20	64x107	VFL2H222#D107
	2 700	11.5	24.2	37	33	18	0.20	64x123	VFL2H272#D123
		12.9	27.1	37	33	20	0.20	77x95	VFL2H272#E095
	3 300	12.5	26.3	36	32	18	0.20	64x147	VFL2H332#D147
		14.2	29.8	36	32	20	0.20	77x108	VFL2H332#E108
	3 900	13.9	29.2	27	29	18	0.20	64x164	VFL2H392#D164
		15.8	33.2	27	29	20	0.20	77x124	VFL2H392#E124
		17.9	37.6	27	29	20	0.20	90x97	VFL2H392#F097
	4 700	15.4	32.3	25	25	20	0.20	64x187	VFL2H472#D187
		17.0	35.7	25	25	20	0.20	77x148	VFL2H472#E148
		19.5	41.0	25	25	20	0.20	90x110	VFL2H472#F110
	5 600	18.9	39.7	23	21	20	0.20	77x165	VFL2H562#E165
		21.1	44.3	23	21	20	0.20	90x126	VFL2H562#F126
	6 800	20.9	43.9	20	18	20	0.20	77x188	VFL2H682#E188
		23.1	48.5	20	18	20	0.20	90x150	VFL2H682#F150
	8 200	25.0	52.5	17	16	20	0.20	90x167	VFL2H822#F167
	10 000	27.8	58.4	14	12	20	0.20	90x190	VFL2H103#F190
	12 000	29.6	62.2	12	10	20	0.20	90x230	VFL2H123#F230
	15 000	32.7	68.7	10	8	20	0.20	90x268	VFL2H153#F268
550 VDC Code: 2L Surge Voltage 600 VDC	**560**	3.9	8.2	200	215	17	0.20	51x75	VFL2L561#C075
	680	4.2	8.8	165	177	17	0.20	51x75	VFL2L681#C075
	820	5.0	10.5	137	147	17	0.20	51x96	VFL2L821#C096
	1 000	5.6	11.8	112	120	17	0.20	51x109	VFL2L102#C109
	1 200	6.4	13.4	93	100	17	0.20	51x125	VFL2L122#C125
		7.3	15.3	93	100	18	0.20	64x94	VFL2L122#D094
	1 500	8.1	17.0	74	80	18	0.20	64x94	VFL2L152#D094
	1 800	9.1	19.1	61	50	18	0.20	64x107	VFL2L182#D107
		10.3	21.6	61	50	20	0.20	77x95	VFL2L182#E095
	2 200	10.1	21.2	53	50	18	0.20	64x123	VFL2L222#D123
		11.4	23.9	53	50	20	0.20	77x95	VFL2L222#E095
	2 700	11.0	23.1	40	35	18	0.20	64x147	VFL2L272#D147
		12.5	26.3	40	35	20	0.20	77x108	VFL2L272#E108
		14.5	30.5	40	35	20	0.20	90x97	VFL2L272#F097
	3 300	12.5	26.3	38	32	18	0.20	64x164	VFL2L332#D164
		14.2	29.8	38	32	20	0.20	77x124	VFL2L332#E124
		16.1	33.8	38	32	20	0.20	90x97	VFL2L332#F097

Additional designs on request · Weitere Designs auf Anfrage

Rated VoltageCode (Surge Voltage) V_r [V DC]	Capacitance C_r [µF]	Ripple Current at 85°C/120Hz I_r [A RMS]	Ripple Current at 40°C/120Hz [A RMS]	ESR (typ) at 20°C/100Hz [mΩ]	Zmax at 20°C/10kHz [mΩ]	ESL (typ) [nH]	Dissipation Factor at 20°C/120Hz Tan δ	DxL [mm]	Product Code # = variable value, see fixing code in the product code
550 VDC Code: 2L Surge Voltage 600 VDC	**3 900**	13.7	28.8	30	27	18	0.20	64x187	VFL2L392#D187
		15.1	31.7	30	27	20	0.20	77x148	VFL2L392#E148
		17.4	36.5	30	27	20	0.20	90x110	VFL2L392#F110
	4 700	16.9	35.5	25	20	20	0.20	77x165	VFL2L472#E165
		18.9	39.7	25	20	20	0.20	90x126	VFL2L472#F126
	5 600	18.6	39.1	20	17	20	0.20	77x188	VFL2L562#E188
		20.5	43.1	20	17	20	0.20	90x150	VFL2L562#F150
	6 800	22.2	46.6	17	15	20	0.20	90x167	VFL2L682#F167
	8 200	24.6	51.7	14	15	20	0.20	90x190	VFL2L822#F190
	10 000	26.5	55.7	12	12	20	0.20	90x230	VFL2L103#F230
	12 000	27.4	57.5	10	10	20	0.20	90x268	VFL2L123#F268
600 VDC Code: 600V Surge Voltage 650 VDC	**470**	2.6	5.5	312	320	17	0.20	51x75	VFL600V471#C075
	560	3.0	6.1	262	268	17	0.20	51x96	VFL600V561#C096
	680	3.4	7.2	216	221	17	0.20	51x109	VFL600V681#C109
	820	3.9	8.2	179	183	17	0.20	51x125	VFL600V821#C125
	1 200	7.0	14.7	122	125	18	0.20	64x94	VFL600V122#D094
	1 500	8.0	16.8	111	114	18	0.20	64x123	VFL600V152#D123
		9.0	18.9	111	114	20	0.20	77x95	VFL600V152#E095
	1 800	8.6	18.1	99	102	18	0.20	64x147	VFL600V182#D147
		9.8	20.6	99	102	20	0.20	77x108	VFL600V182#E108
	2 200	9.8	20.6	85	87	18	0.20	64x164	VFL600V222#D164
		11.1	23.3	85	87	20	0.20	77x124	VFL600V222#E124
		12.6	26.5	85	87	20	0.20	90x97	VFL600V222#F097
	2 700	10.9	22.9	66	68	18	0.20	64x187	VFL600V272#D187
		13.8	29.0	66	68	20	0.20	90x110	VFL600V272#F110
	3 300	13.3	27.9	44	45	20	0.20	77x148	VFL600V332#E148
		15.2	31.9	44	45	20	0.20	90x126	VFL600V332#F126
	3 900	14.9	31.3	33	25	20	0.20	77x188	VFL600V392#E188
		16.4	34.4	33	25	20	0.20	90x150	VFL600V392#F150
	4 700	16.9	35.5	27	20	20	0.20	77x228	VFL600V472#E228
		17.7	37.2	27	20	20	0.20	90x167	VFL600V472#F167
	5 600	19.5	41.0	23	17	20	0.20	90x190	VFL600V562#F190
	6 800	20.9	43.9	19	14	20	0.20	90x230	VFL600V682#F230

Additional designs on request · Weitere Designs auf Anfrage

› Ripple Current Multiplier · Wechselstrommultiplikator

Frequency [Hz]	50/60	120	300	1k	≥ 10k
Multiplier	0.80	1.00	1.18	1.34	1.45

Ta (°C)	40	45	50	55	60	65	70	75	80	85
Multiplier	2.1	2.0	1.9	1.8	1.7	1.5	1.3	1.2	1.1	1.0

Forced cooling – Wind speed [m/sec]	v < 0.25	v ≥ 0.25	v ≥ 0.5	v ≥ 1.0	v ≥ 2.0	v ≥ 3.0
Multiplier	1.00	1.07	1.15	1.25	1.30	1.35

› Life Time Table · Brauchbarkeitsdauer – Tabelle

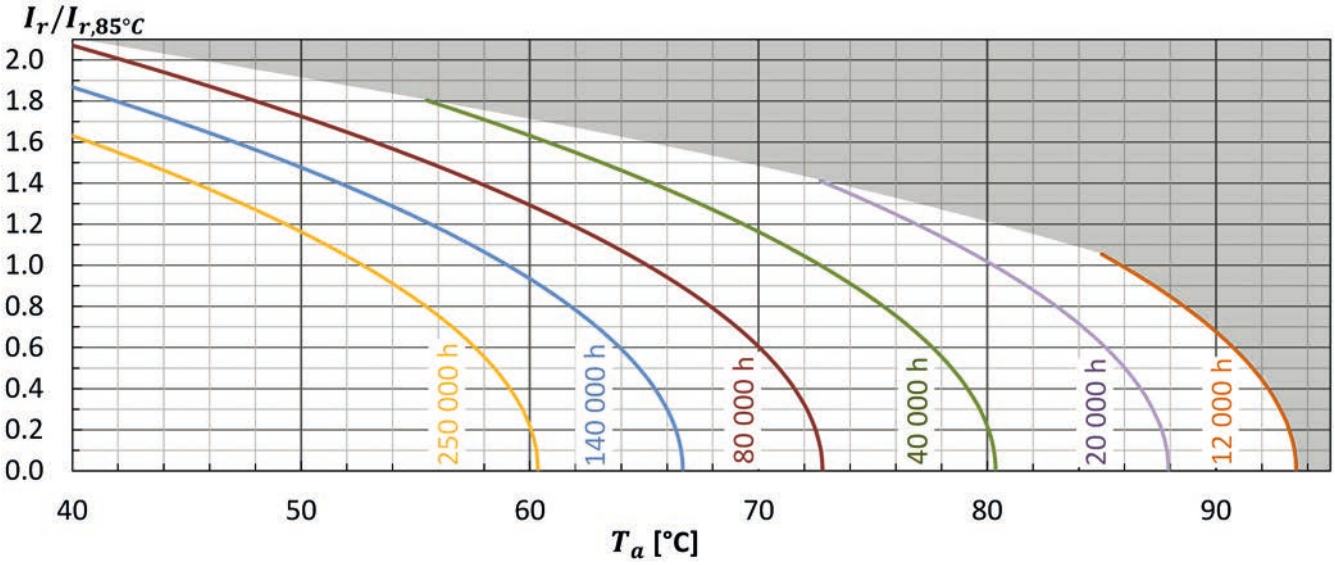
VFL	Useful life as function of ambient temperature and ripple current											
I_r at 85°C	x 1.0	x 1.1	x 1.2	x 1.3	x 1.4	x 1.5	x 1.6	x 1.7	x 1.8	x 1.9	x 2.0	x 2.1
T_a = 40°C	250	250	250	250	250	250	250	212	166	128	97	73
T_a = 45°C	250	250	250	250	250	210	169	134	105	81	61	
T_a = 50°C	250	250	235	197	163	133	107	85	66	51		
T_a = 55°C	202	174	148	124	103	84	67	53	42			
T_a = 60°C	128	110	94	79	65	53	42	34				
T_a = 65°C	81	69	59	49	41	33						
T_a = 70°C	51	44	37	31								
T_a = 75°C	32	27	23									
T_a = 80°C	20	17										
T_a = 85°C	12											

khrs Max. value limited to 250 000 hours.

› Life Time Graph · Brauchbarkeitsdauer – Diagramm

Useful life depending on ambient temperature T_a and ripple current operating conditions I_r versus rated ripple current at the upper category temperature $I_{r,\ 85°C,120Hz}$

Brauchbarkeitsdauer in Abhängigkeit von Umgebungstemperatur T_a und Wechselstrombelastung I_r im Verhältnis zur max. Wechselstrombelastung bei oberer Kategorietemperatur $I_{r,\ 85°C,120Hz}$



› Life Time Tests and Requirements · Anforderungen Brauchbarkeitsdauer

Life time test	Test procedure	Life time criteria
Endurance test	T_a = 85°C; V_r, I_r applied 8000 hours	ΔC/C ≤ 10% (of initial value) Tanδ ≤ 175% (of specified value) I_L ≤ specified value
Useful life	T_a = 85°C; V_r, I_r applied 12000 hours	ΔC/C ≤ 15% (of initial value) Tanδ < 200% (of specified value) I_L ≤ specified value

Reference Specification: JIS C 5101-4, JIS C 5102, IEC 60384-4