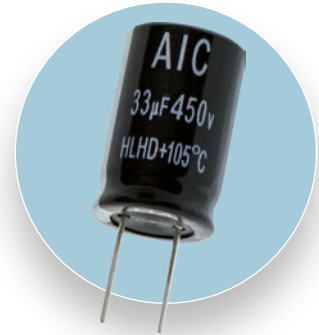


HLHD · Radial · 12000 h/105 °C

High Ripple Current · High Voltage · Long-Life

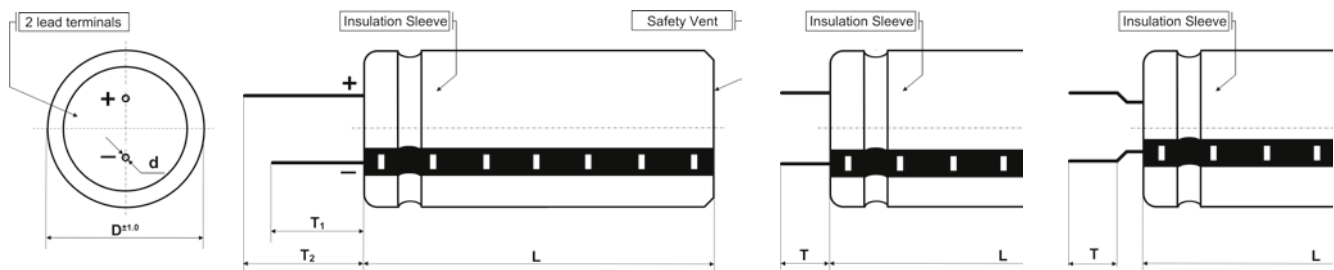
> Specifications · Spezifikationen

Items	Characteristics
Temperature range	-40 °C ~ + 105 °C
Capacitance tolerance (at 20 °C)	Standard +/- 20% at 20 °C
Surge voltage	Repetitive max. 30 sec per 6 Minutes, 1000 times
Leakage current max. I_L (20 °C, 1 min)	Refer to the specific item value in product table
Useful life	10 000 hours at 105 °C; I_r, V_r for Diam = 8.0–10.0 mm 12 000 hours at 105 °C; I_r, V_r for Diam ≥ 12.5 mm
Shelf life	1000 hours at 105 °C, $I_r = V_r = 0$
Reference standards	IEC 60384-4
Vibration	0.75 mm, 10...55 Hz, 10 g, 3x2 h
Product Compliance	RoHS, REACH, Conflict Minerals a.o. - refer to p. 14–15



> Outline Drawings · Bauformen

Refer to page 7 for available terminal shapes and dimensions. · Auf Seite 7 finden Sie die verfügbaren Bauformen und Maße.



> Product Code · Bestellbezeichnung

Example: Series HLHD · 450 V · 180 µF ± 20 % · 18x45 mm · Long Lead · without plate

HLHD

Series name

2W

181

Capacitance code

The first two digits are significant.
The last digit indicates the number
of following zeros in µF.

M

Capacitance tolerance

M : ± 20 %
K : ± 10 %
Q : -10 % +30 %
R : -0 % +20 %
L : ± 15 %
V : -10 % +20 %

L

Terminal code

L: long lead
C: cut 4.5 mm
D: cut 4.0 mm
E: cut 3.5 mm
F: cut 3.0 mm
T: Taped

V S6

WPEC

Outer design code

WPEC: PET sleeve without plate
(standard)

[with plate available on request]

Rated voltage code

Code	L	Code	L
2C	160V	2G	400V
2K	180V	2P	415V
2D	200V	2X	420V
2E	250V	2W	450V
2V	350V	2H	500V
2J	385V		

Dimension

Diameter (mm)		Length (mm)	
Q	8	S0	< 16
R	10	S1	20–24
S	12.5	S2	25–29
U	16	S3	30–34
V	18	S4	35–39
W	20	S5	40–44
X	22	S6	45
		S7	50

Rated Voltage (Surge Voltage) V_r [V DC]	Capacitance C_r [μ F]	Ripple Current at 105°C/100Hz I_r [A RMS]	ESR (typ) at 20°C/100Hz [Ω]	ESR max at 20°C/100Hz [Ω]	Dissipation Factor at 20°C/100Hz Tan δ	Leakage current after 1min at 20°C I_{leak} [mA]	DxL [mm]	Product Code # = variable value, see terminal code in the product code
160 VDC Code: 2C Surge Voltage 200 VDC	10	0.32	8.00	19.90	0.15	0.16	10x16	HLHD2C100M#RS0WPEC
	22	0.50	3.60	9.00	0.15	0.24	10x20	HLHD2C220M#RS1WPEC
	33	0.65	2.40	6.00	0.15	0.31	10x20	HLHD2C330M#RS1WPEC
	47	0.75	1.70	4.20	0.15	0.40	10x20	HLHD2C470M#RS1WPEC
	68	1.18	1.20	2.90	0.15	0.54	12.5x20	HLHD2C680M#SS1WPEC
		1.18	1.20	2.90	0.15	0.54	16x20	HLHD2C680M#US1WPEC
	100	1.42	0.80	2.00	0.15	0.74	12.5x25	HLHD2C101M#SS2WPEC
		1.42	0.80	2.00	0.15	0.74	16x20	HLHD2C101M#US1WPEC
	150	1.89	0.50	1.30	0.15	1.06	16x25.5	HLHD2C151M#US2WPEC
	220	2.37	0.40	0.90	0.15	1.51	18x25.5	HLHD2C221M#VS2WPEC
330	3.22	0.20	0.60	0.15	2.21	18x31.5	HLHD2C331M#VS3WPEC	
200 VDC Code: 2D Surge Voltage 250 VDC	4.7	0.16	16.90	42.30	0.15	0.14	8x11.5	HLHD2D4R7M#QS0WPEC
	6.8	0.20	11.70	29.30	0.15	0.16	10x12.5	HLHD2D6R8M#RS0WPEC
	10	0.22	8.00	19.90	0.15	0.18	8x11.5	HLHD2D100M#QS0WPEC
		0.28	8.00	19.90	0.15	0.18	10x12.5	HLHD2D100M#RS0WPEC
	22	0.40	3.60	9.00	0.15	0.28	10x12.5	HLHD2D220M#RS0WPEC
		0.50	3.60	9.00	0.15	0.28	10x20	HLHD2D220M#RS1WPEC
	33	0.65	2.40	6.00	0.15	0.36	10x20	HLHD2D330M#RS1WPEC
	47	0.98	1.70	4.20	0.15	0.48	12.5x20	HLHD2D470M#SS1WPEC
	68	1.30	1.20	2.90	0.15	0.64	12.5x25	HLHD2D680M#SS2WPEC
		1.30	1.20	2.90	0.15	0.64	16x20	HLHD2D680M#US1WPEC
	100	1.42	0.80	2.00	0.15	0.90	16x20	HLHD2D101M#US1WPEC
	150	1.89	0.50	1.30	0.15	1.30	16x25.5	HLHD2D151M#US2WPEC
	220	2.33	0.40	0.90	0.15	1.86	18x25.5	HLHD2D221M#VS2WPEC
330	3.22	0.20	0.60	0.15	1.79	18x35.5	HLHD2D331M#VS4WPEC	
250 VDC Code: 2E Surge Voltage 300 VDC	4.7	0.16	16.90	42.30	0.15	0.15	8x11.5	HLHD2E4R7M#QS0WPEC
	6.8	0.25	11.70	29.30	0.15	0.17	10x12.5	HLHD2E6R8M#RS0WPEC
	10	0.32	8.00	19.90	0.15	0.20	10x16	HLHD2E100M#RS0WPEC
	22	0.47	3.60	9.00	0.15	0.32	10x16	HLHD2E220M#RS0WPEC
		0.50	3.60	9.00	0.15	0.32	10x20	HLHD2E220M#RS1WPEC
	33	0.76	2.40	6.00	0.15	0.43	12.5x16	HLHD2E330M#SS0WPEC
		0.80	2.40	6.00	0.15	0.43	12.5x20	HLHD2E330M#SS1WPEC
	47	0.98	1.70	4.20	0.15	0.57	12.5x20	HLHD2E470M#SS1WPEC
	68	1.30	1.20	2.90	0.15	0.78	12.5x25	HLHD2E680M#SS2WPEC
		1.30	1.20	2.90	0.15	0.78	16x20	HLHD2E680M#US1WPEC
	100	1.53	0.80	2.00	0.15	1.10	16x25	HLHD2E101M#US2WPEC
		1.44	0.80	2.00	0.15	1.10	18x20.5	HLHD2E101M#VS1WPEC
	150	1.96	0.50	1.30	0.15	1.60	18x25.5	HLHD2E151M#VS2WPEC
220	2.55	0.40	0.90	0.15	2.30	18x31.5	HLHD2E221M#VS3WPEC	
350 VDC Code: 2V Surge Voltage 400 VDC	3.3	0.13	24.10	80.40	0.20	0.15	8x11.5	HLHD2V3R3M#QS0WPEC
	4.7	0.15	16.90	56.50	0.20	0.17	10x12.5	HLHD2V4R7M#RS0WPEC
	5.6	0.15	14.20	47.40	0.20	0.18	8x11.5	HLHD2V5R6M#QS0WPEC
		0.18	14.20	47.40	0.20	0.18	10x12.5	HLHD2V5R6M#RS0WPEC
	6.8	0.28	11.70	39.00	0.20	0.20	10x16	HLHD2V6R8M#RS0WPEC

Additional designs on request · Weitere Designs auf Anfrage

Rated Voltage (Surge Voltage) V_r [V DC]	Capacitance C_r [μ F]	Ripple Current at 105°C/100Hz I_r [A RMS]	ESR (typ) at 20°C/100Hz [Ω]	ESR max at 20°C/100Hz [Ω]	Dissipation Factor at 20°C/100Hz Tan δ	Leakage current after 1min at 20°C I_{leak} [mA]	DxL [mm]	Product Code # = variable value, see terminal code in the product code
350 VDC Code: 2V Surge Voltage 400 VDC	10	0.28	8.00	26.50	0.20	0.24	10x12.5	HLHD2V100M#RS0WPEC
		0.35	8.00	26.50	0.20	0.24	10x20	HLHD2V100M#RS1WPEC
	22	0.65	3.60	12.10	0.20	0.41	12.5x20	HLHD2V220M#SS1WPEC
	33	0.85	2.40	8.00	0.15	0.56	12.5x25	HLHD2V330M#SS2WPEC
		0.90	2.40	8.00	0.20	0.56	16x20	HLHD2V330M#US1WPEC
	47	1.08	1.70	5.60	0.20	0.76	16x20	HLHD2V470M#US1WPEC
	68	1.35	1.20	3.90	0.15	1.05	18x20.5	HLHD2V680M#VS1WPEC
		1.47	1.20	3.90	0.20	1.05	18x25.5	HLHD2V680M#VS2WPEC
82	1.53	0.97	3.20	0.20	1.25	18x25.5	HLHD2V820M#VS2WPEC	
400 VDC Code: 2G Surge Voltage 450 VDC	1.5	0.08	53.10	177.00	0.20	0.12	8x11.5	HLHD2G1R5M#QS0WPEC
	2.2	0.10	36.20	121.00	0.20	0.14	8x11.5	HLHD2G2R2M#QS0WPEC
		0.14	36.20	121.00	0.20	0.14	10x12.5	HLHD2G2R2M#RS0WPEC
	3.3	0.15	24.10	80.40	0.20	0.15	10x12.5	HLHD2G3R3M#RS0WPEC
		0.18	24.10	80.40	0.20	0.15	10x16	HLHD2G3R3M#RS0WPEC
	4.7	0.16	16.90	56.50	0.20	0.18	8x11.5	HLHD2G4R7M#QS0WPEC
		0.22	16.90	56.50	0.20	0.18	10x16	HLHD2G4R7M#RS0WPEC
	5.6	0.20	14.20	47.40	0.20	0.19	10x12.5	HLHD2G5R6M#RS0WPEC
	6.8	0.22	11.70	39.00	0.20	0.21	10x16	HLHD2G6R8M#RS0WPEC
		0.28	11.70	39.00	0.20	0.21	10x20	HLHD2G6R8M#RS1WPEC
	10	0.35	8.00	26.50	0.20	0.26	10x20	HLHD2G100M#RS1WPEC
	15	0.50	5.30	17.70	0.15	0.34	12.5x16	HLHD2G150M#SS0WPEC
		0.55	5.30	17.70	0.20	0.34	12.5x20	HLHD2G150M#SS1WPEC
	22	0.65	3.60	12.10	0.20	0.45	12.5x20	HLHD2G220M#SS1WPEC
		0.76	3.60	12.10	0.20	0.45	12.5x25	HLHD2G220M#SS2WPEC
		0.76	3.60	12.10	0.20	0.45	16x20	HLHD2G220M#US1WPEC
	33	0.90	2.40	8.00	0.20	0.63	16x20	HLHD2G330M#US1WPEC
		47	1.18	1.70	5.60	0.20	0.85	16x25.5
	1.18		1.70	5.60	0.20	0.85	18x20.5	HLHD2G470M#VS1WPEC
	68	1.47	1.20	3.90	0.20	1.19	18x25	HLHD2G680M#VS2WPEC
82	1.60	1.00	3.20	0.20	1.41	18x31.5	HLHD2G820M#VS3WPEC	
100	1.78	0.80	2.70	0.20	1.70	18x36	HLHD2G101M#VS4WPEC	
450 VDC Code: 2W Surge Voltage 500 VDC	2.2	0.09	36.20	121.00	0.20	0.14	8x11.5	HLHD2W2R2M#QS0WPEC
		0.09	36.20	121.00	0.20	0.14	10x12.5	HLHD2W2R2M#RS0WPEC
	3.3	0.18	24.10	80.40	0.20	0.16	10x12.5	HLHD2W3R3M#RS0WPEC
		0.19	24.10	80.40	0.20	0.16	10x16	HLHD2W3R3M#RS0WPEC
	4.7	0.21	16.90	56.50	0.20	0.18	10x16	HLHD2W4R7M#RS0WPEC
	5.6	0.20	14.20	47.40	0.20	0.20	10x16	HLHD2W5R6M#RS0WPEC
	6.8	0.23	11.70	39.00	0.20	0.22	10x16	HLHD2W6R8M#RS0WPEC
		0.28	11.70	39.00	0.20	0.22	10x20	HLHD2W6R8M#RS1WPEC
	10	0.30	8.00	26.50	0.20	0.28	10x20	HLHD2W100M#RS1WPEC
	15	0.45	5.30	17.70	0.20	0.37	12.5x20	HLHD2W150M#SS1WPEC
	22	0.60	3.60	12.10	0.20	0.50	12.5x25	HLHD2W220M#SS2WPEC
		0.73	3.60	12.10	0.20	0.50	16x20	HLHD2W220M#US1WPEC
33	0.98	2.40	8.00	0.20	0.69	16x25	HLHD2W330M#US2WPEC	

Additional designs on request · Weitere Designs auf Anfrage

Rated Voltage (Surge Voltage) V_r [V DC]	Capacitance C_r [μ F]	Ripple Current at 105°C/100Hz I_r [A RMS]	ESR (typ) at 20°C/100Hz [Ω]	ESR max at 20°C/100Hz [Ω]	Dissipation Factor at 20°C/100Hz Tan δ	Leakage current after 1min at 20°C I_{leak} [mA]	DxL [mm]	Product Code # = variable value, see terminal code in the product code	
450 VDC Code: 2W Surge Voltage 500 VDC	47	1.09	1.70	5.60	0.20	0.95	16x25	HLHD2W470M#US2WPEC	
		1.20	1.70	5.60	0.20	0.95	18x25.5	HLHD2W470M#VS2WPEC	
	68	1.44	1.20	3.90	0.20	1.32	18x25.5	HLHD2W680M#VS2WPEC	
		1.58	1.20	3.90	0.20	1.32	18x31.5	HLHD2W680M#VS3WPEC	
	82	1.60	1.00	3.20	0.20	1.58	18x31.5	HLHD2W820M#VS3WPEC	
		1.68	1.00	3.20	0.20	1.58	18x36	HLHD2W820M#VS4WPEC	
	100	1.70	0.80	2.70	0.20	1.90	18x31.5	HLHD2W101M#VS3WPEC	
		1.73	0.80	2.70	0.20	1.90	18x36	HLHD2W101M#VS4WPEC	
	120	1.75	0.70	2.20	0.20	2.26	18x36	HLHD2W121M#VS4WPEC	
		1.82	0.70	2.20	0.20	2.26	18x40	HLHD2W121M#VS5WPEC	
	150	2.02	0.50	1.80	0.20	2.80	18x40	HLHD2W151M#VS5WPEC	
		2.14	0.50	1.80	0.20	2.80	18x45	HLHD2W151M#VS6WPEC	
	180	2.38	0.40	1.50	0.20	3.34	18x45	HLHD2W181M#VS6WPEC	
		2.46	0.40	1.50	0.20	3.34	18x50	HLHD2W181M#VS7WPEC	
	220	2.60	0.36	1.20	0.20	4.06	18x50	HLHD2W221M#VS7WPEC	
	500 VDC Code: 2H Surge Voltage 550 VDC	10	0.36	9.30	26.50	0.20	0.30	12.5x20	HLHD2H100M#SS1WPEC
		15	0.48	6.20	17.70	0.20	0.40	12.5x25	HLHD2H150M#SS2WPEC
		22	0.58	4.20	12.10	0.20	0.54	16x25.5	HLHD2H220M#US2WPEC
33		0.72	2.80	8.00	0.20	0.76	16x31.5	HLHD2H330M#US3WPEC	
47		0.90	2.00	5.60	0.20	1.04	18x31.5	HLHD2H470M#VS3WPEC	
56		0.98	1.60	4.80	0.20	1.22	18x31.5	HLHD2H560M#VS3WPEC	
68		1.25	1.40	3.90	0.20	1.46	18x36	HLHD2H680M#VS4WPEC	
82		1.33	1.10	3.20	0.20	1.74	18x40	HLHD2H820M#VS5WPEC	
100		1.43	0.90	2.70	0.20	2.10	18x45	HLHD2H101M#VS6WPEC	
		1.45	0.90	2.70	0.20	2.10	20x41	HLHD2H101M#VS5WPEC	
120		1.64	0.80	2.30	0.20	2.50	18x50	HLHD2H121M#VS7WPEC	
150		1.95	0.50	1.80	0.20	3.10	22x45	HLHD2H151M#XS6WPEC	

Additional designs on request · Weitere Designs auf Anfrage

> Ripple Current Multiplier · Wechselstrommultiplikator

Frequency [Hz]	50/60	100–120	500	1 k	10 k	100 k
Multiplier for capacitance 1–5.6 µF	0.07	0.20	0.38	0.55	0.78	1.00
Multiplier for capacitance 6.8–15 µF	0.10	0.30	0.50	0.65	0.85	1.00
Multiplier for capacitance 22–82 µF	0.20	0.40	0.58	0.73	0.90	1.00
Multiplier for capacitance 100–330 µF	0.27	0.45	0.61	0.75	0.90	1.00

Temperature [°C]		40	45	50	55	60	65	70	75	80	85	90	95	100	105
Multiplier I_r at 100 kHz	diameter D 8.0–10.0 mm	2.20	2.15	2.10	2.05	2.00	1.95	1.90	1.82	1.75	1.60	1.45	1.30	1.15	1.00
	diameter D ≥ 12.5 mm	2.20	2.20	2.15	2.10	2.05	2.00	2.00	1.95	1.90	1.82	1.75	1.60	1.30	1.00

> Impedance Stability · Impedanz Stabilität

Rated Voltage [V]	160	200	250	350	400	450	500
$Z_{-25^\circ\text{C}} / Z_{+20^\circ\text{C}}$ at 120 Hz	3			6			
$Z_{-40^\circ\text{C}} / Z_{+20^\circ\text{C}}$ at 120 Hz	6			8		10	

> Life Time Tests and Requirements · Anforderungen Brauchbarkeitsdauer

Life time test		Test procedure	Life time criteria
Endurance test	D = 8.0–10.0 mm D ≥ 12.5 mm	$T_a = 105^\circ\text{C}; V_r, I_r$ applied 8000 hours $T_a = 105^\circ\text{C}; V_r, I_r$ applied 10000 hours	$\Delta C/C \leq 20\%$ (of initial value) $\text{Tan}\delta \leq 200\%$ (of specified value) $I_L \leq$ specified value
Useful life	D = 8.0–10.0 mm D ≥ 12.5 mm	$T_a = 105^\circ\text{C}; V_r, I_r$ applied 10000 hours $T_a = 105^\circ\text{C}; V_r, I_r$ applied 12000 hours	$\Delta C/C \leq 30\%$ (of initial value) $\text{Tan}\delta < 300\%$ (of specified value) $I_L \leq$ specified value

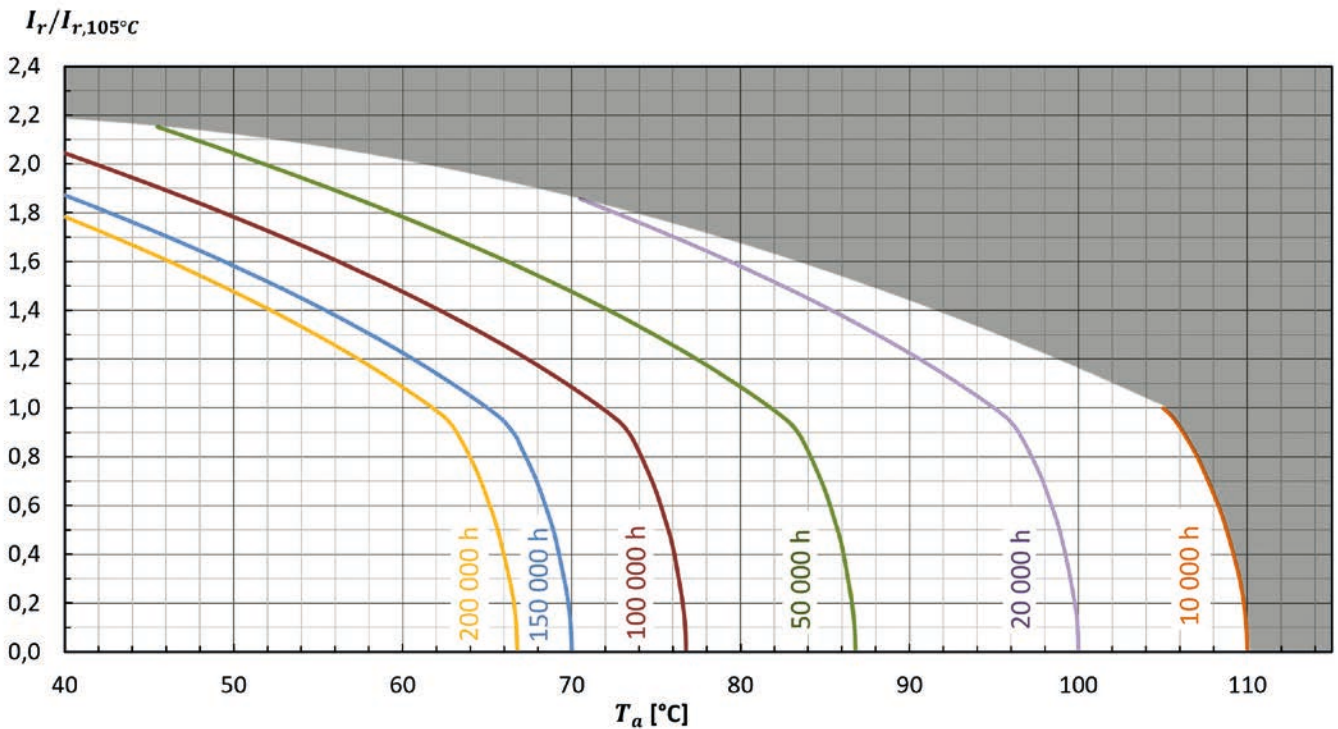
Reference Specification: IEC 60384-4

> Life Time Table and Graph · Brauchbarkeitsdauer – Tabelle und Diagramm

diameter D within 8.0–10.0mm

HLHD	Ripple Current Multiplier I _r at 100 kHz													
T _a	1.00	1.15	1.30	1.45	1.60	1.75	1.82	1.90	1.95	2.00	2.05	2.10	2.15	2.20
40°C	200	200	200	200	200	200	183	148	130	113	98	84	73	63
45°C	200	200	200	200	200	153	130	105	92	80	70	59	52	
50°C	200	200	200	200	153	108	92	74	65	57	49	42		
55°C	200	200	198	149	109	77	65	52	46	40	35			
60°C	200	181	140	105	77	54	46	37	32	28				
65°C	160	128	99	75	54	38	32	26	23					
70°C	113	90	70	53	38	27	23	19						
75°C	80	64	50	37	27	19	16							
80°C	57	45	35	26	19	14								
85°C	40	32	25	19	14									
90°C	28	23	18	13										
95°C	20	16	12											
100°C	14	11												
105°C	10													

khrs Max. value limited to 200 000 hours.



> Life Time Table and Graph · Brauchbarkeitsdauer – Tabelle und Diagramm

diameter D ≥ 12.5 mm

HLHD	Ripple Current Multiplier I _r at 100 kHz														
	T _a	1.00	1.15	1.30	1.45	1.60	1.75	1.82	1.90	1.95	2.00	2.05	2.10	2.15	2.20
40°C	200	200	200	200	200	200	200	200	178	156	136	118	101	88	76
45°C	200	200	200	200	200	184	156	126	110	96	83	71	62	54	
50°C	200	200	200	200	184	130	110	89	78	68	59	50	44		
55°C	200	200	200	179	130	92	78	63	55	48	42	36			
60°C	200	200	168	126	92	65	55	44	39	34	29				
65°C	192	154	119	89	65	46	39	31	28	24					
70°C	136	109	84	63	46	32	28	22	19	17					
75°C	96	77	60	45	33	23	19	16	14						
80°C	68	54	42	32	23	16	14	11							
85°C	48	38	30	22	16	11	10								
90°C	34	27	21	16	12	8									
95°C	24	19	15	11	8										
100°C	17	14	11												
105°C	12														

khrs Max. value limited to 200 000 hours.

