Aluminum Electrolytic Capacitors
Axial Miniature High Voltage for E.L.B.

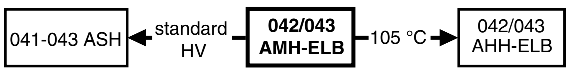


Fig. 1

FEATURES

RoHS COMPLIANT

- Useful life: 20 000 h at +85 °C
- Stable under overvoltage conditions: 550 V for 24 h at 85 °C
- High ripple current capability
- Smallest dimensions
- Taped versions up to case Ø 15 mm x 30 mm available for automatic insertion
- Polarized aluminum electrolytic capacitors, non-solid electrolyte
- Axial leads, cylindrical aluminum case, insulated with a blue sleeve
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- Electronic lighting ballast, power supply
- Smoothing, filtering, buffering at high voltages
- Boards with restricted mounting height, vibration, and shock resistant

QUICK REFERENCE DATA

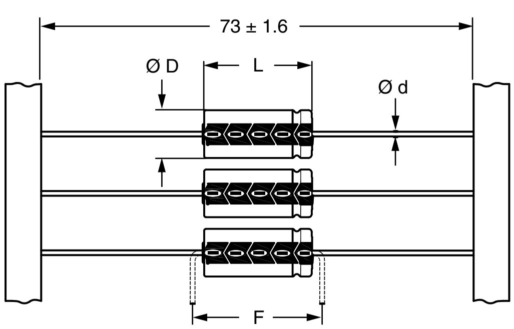
DESCRIPTION	VALUE
Nominal case sizes (Ø D x L in mm)	12.5 x 30 to 18 x 38
Rated capacitance range, C_R	6.8 µF to 33 µF
Tolerance on C_R	-10 % to +50 %
Rated voltage, U_R	450 V
Category temperature range	-25 °C to +85 °C
Endurance test at 85 °C	8000 h
Useful life at 85 °C	20 000 h
Useful life at 70 °C, I_R applied	100 000 h
Shelf life at 0 V, 85 °C	500 h
Based on sectional specification	IEC 60384-4 / EN 130300
Climatic category IEC 60068	25 / 085 / 56

MARKING

The capacitors are marked (where possible) with the following information:

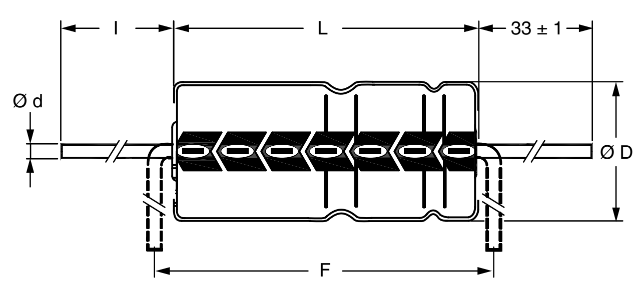
- Rated capacitance (in µF)
- Tolerance on rated capacitance, code letter in accordance with IEC 60062 (T for -10 % to +50 %)
- Rated voltage (in V)
- Upper category temperature (85 °C)
- Date code in accordance with IEC 60062
- Code for factory of origin
- Name of manufacturer
- Negative terminal identification
- Series number (042 or 043)

DIMENSIONS in millimeters AND AVAILABLE FORMS



Form BR: Taped on reel
Case Ø D x L = 6.5 mm x 18 mm to 15 mm x 30 mm

Fig. 2 - **Form BR**



Form AA: Axial in box
Case Ø D x L = 10 mm x 30 mm to 21 mm x 38 mm

Fig. 3 - **Form AA**

Table 1

AXIAL; DIMENSIONS in millimeters, MASS AND PACKAGING QUANTITIES									
NOMINAL CASE SIZE Ø D x L (mm)	CASE CODE	AXIAL: FORM AA AND BR					MASS (g)	PACKAGING QUANTITIES	
		Ø d	l	Ø $D_{max.}$	$L_{max.}$	$F_{min.}$		FORM AA	FORM BR
12.5 x 30	01	0.8	55 ± 1	13.0	30.5	35	≈ 6.1	260	400
15 x 30	02	0.8	55 ± 1	15.5	30.5	35	≈ 8.3	200	250
18 x 30	03	0.8	55 ± 1	18.5	30.5	35	≈ 11.6	120	-
18 x 38	04	0.8	34 ± 1	18.5	39.5	44	≈ 16.0	125	-

Note
- For detailed tape dimensions please refer to packaging information: www.vishay.com/doc?28361

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
C_R	Rated capacitance at 100 Hz, tolerance -10 % to +50 %
I_R	Rated RMS ripple current at 10 kHz, 85 °C
I_{L5}	Max. leakage current after 5 min at U_R
ESR	Typ. / max. equivalent series resistance at 100 Hz
Z	Typ. / max. impedance at 10 kHz

Note
- Unless otherwise specified, all electrical values in Table 2 apply at T_{amb} = 20 °C, P = 86 kPa to 106 kPa, RH = 45 % to 75 %.

ORDERING EXAMPLE

Electrolytic capacitor 042 series

10 µF / 450 V; -10 % / +50 %

Nominal case size: Ø 12.5 mm x 30 mm; Form BR

Ordering code: MAL204282109E3
Former 12NC: 2222 042 82109

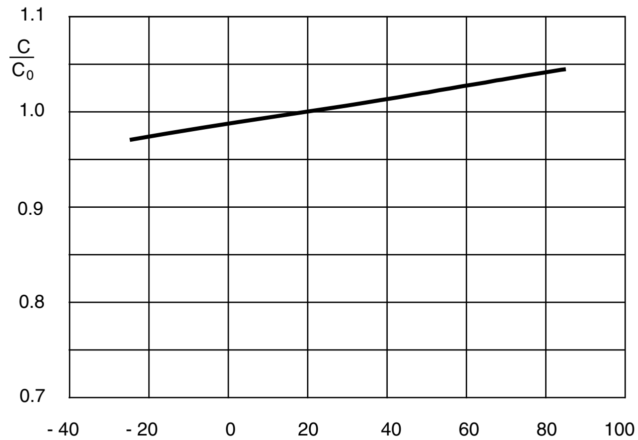
Table 2

ELECTRICAL DATA AND ORDERING INFORMATION										
U_R (V)	C_R 100 Hz (µF)	NOMINAL CASE SIZE Ø D x L (mm)	I_R 10 kHz 85 °C (mA)	I_{L5} 5 min (µA)	ESR TYP. 100 Hz (Ω)	ESR MAX. 100 Hz (Ω)	Z TYP. 10 kHz (Ω)	Z MAX. 10 kHz (Ω)	ORDERING CODE MAL2.......... AXIAL IN BOX FORM AA	ORDERING CODE MAL2.......... AXIAL TAPED ON REEL FORM BR
450	6.8	12.5 x 30	540	106	3.8	8.3	2.8	4.8	04281688E3	04282688E3
	10	12.5 x 30	710	110	2.6	5.6	1.8	3.1	04281109E3	04282109E3
	15	15 x 30	910	115	1.7	3.7	1.2	2.1	04281159E3	04282159E3
	22	18 x 30	1190	120	1.1	2.4	0.9	1.4	04281229E3	-
	33	18 x 38	1610	130	0.8	1.7	0.6	1.0	04381339E3	-

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
Voltage		
Surge voltage	U_R = 450 V	$U_s \leq$ 550 V
Overvoltage test	24 h at 85 °C	550 V (1)
Reverse voltage		$U_{rev} \leq$ 1 V
Current		
Leakage current	After 1 min	$I_{L1} \leq 0.009 \times C_R \times U_R + 200$ µA
	After 5 min	$I_{L5} \leq 0.002 \times C_R \times U_R + 100$ µA
Inductance		
Equivalent series inductance	Case Ø D x L in mm:	
	12.5 x 30	Typ. 46 nH
	15 x 30	Typ. 48 nH
	18 x 30	Typ. 50 nH
	18 x 38	Typ. 54 nH

Note
(1) Test conditions on request.

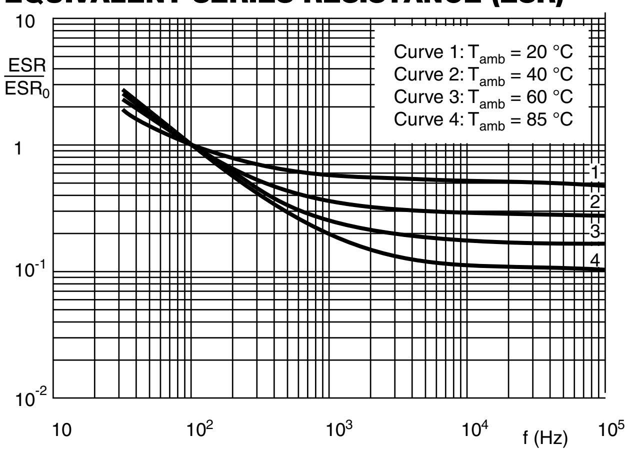
CAPACITANCE (C)



C_0 = Capacitance at 20 °C, 100 Hz T_{amb} = 20 °C

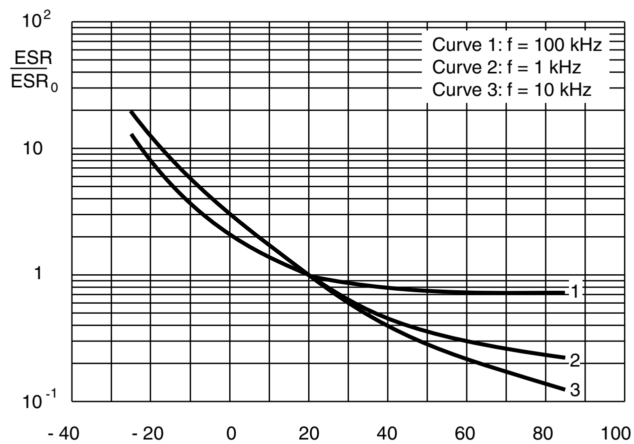
Fig. 4 - Typical multiplier of capacitance as a function of ambient temperature

EQUIVALENT SERIES RESISTANCE (ESR)



ESR_0 = Typical at 20 °C, 100 Hz

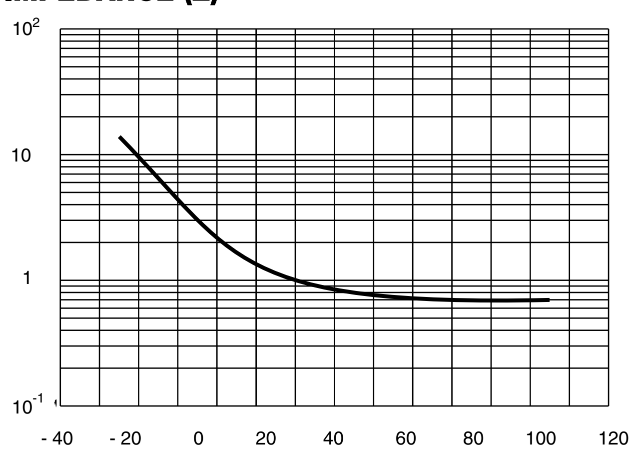
Fig. 5 - Typical multiplier of ESR as a function of frequency at different ambient temperatures



ESR_0 = Typical at 20 °C, 100 Hz T_{amb} (°C)

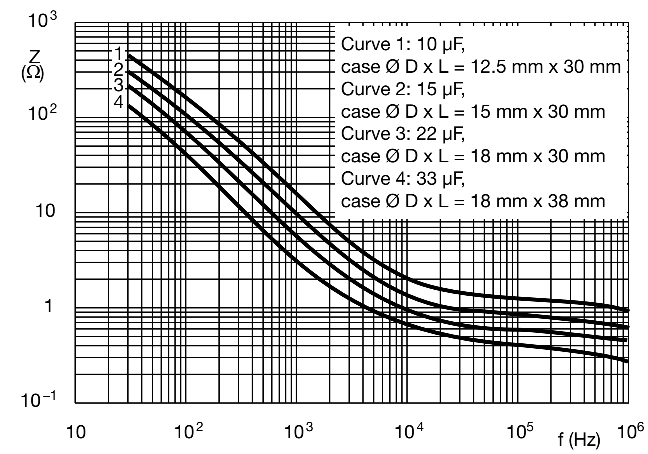
Fig. 6 - Typical multiplier of ESR as a function of ambient temperature at different frequencies

IMPEDANCE (Z)



Z_0 = Impedance at 20 °C, 10 Hz T_{amb} (°C)

Fig. 7 - Typical multiplier of impedance as a function of ambient temperature



T_{amb} = 20 °C

Fig. 8 - Typical impedance as a function of frequency

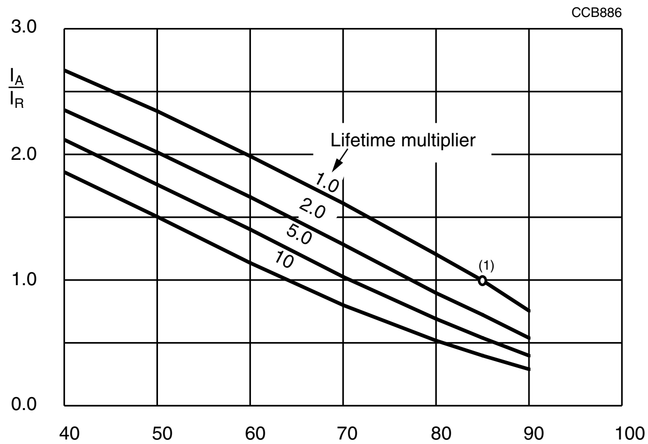
RIPPLE CURRENT AND USEFUL LIFE

Table 3

ENDURANCE TEST DURATION AND USEFUL LIFE	
ENDURANCE AT 105 °C (h)	**USEFUL LIFE AT 105 °C (h)**
8000	20 000

Note

- Multiplier of useful life code: CCB886



I_A = Actual ripple current at 10 kHz
I_R = Rated ripple current at 10 kHz, 85 °C
(1) Useful life at 85 °C and I_R applied: 20 000 h

Fig. 9 - Multiplier of useful life as a function of ambient temperature and ripple current load

Table 4

MULTIPLIER OF RIPPLE CURRENT (I_R) AS A FUNCTION OF FREQUENCY					
FREQUENCY (Hz)					
50	**100**	**300**	**1000**	**3000**	**≥ 10 000**
I_R MULTIPLIER					
0.22	0.30	0.49	0.72	0.89	1.00

Note

- Formula (1) should be used to calculate the actual ripple current at 10 kHz (see Fig. 9) when multiple frequencies are present. For an example of the values 100 Hz and 50 kHz:

$$I_A = \sqrt{\left(\frac{I(100\ Hz)}{0.30}\right)^2 + \left(\frac{I(50\ kHz)}{1.0}\right)^2} \quad (1)$$

Table 5

TEST PROCEDURES AND REQUIREMENTS			
TEST		PROCEDURE (quick reference)	REQUIREMENTS
NAME OF TEST	REFERENCE		
Endurance	IEC 60384-4 / EN 130300 subclause 4.13	T_{amb} = 85 °C; U_R applied; 8000 h	ΔC/C: ± 10 % tan δ ≤ 1.3 x spec. limit Z ≤ 2 x spec. limit I_{L5} ≤ spec. limit
Useful life	CECC 30301 subclause 1.8.1	T_{amb} = 85 °C; U_R and I_R applied; 20 000 h	ΔC/C: ± 30 % tan δ ≤ 3 x spec. limit Z ≤ 3 x spec. limit I_{L5} ≤ spec. limit No short or open circuit Total failure percentage: ≤ 3 %
Shelf life (storage at high temperature)	IEC 60384-4 / EN 130300 subclause 4.17	T_{amb} = 85 °C; no voltage applied; 500 h After test: U_R to be applied for 30 min, 24 h to 48 h before measurement	ΔC/C, tan δ, Z: for requirements see "Endurance test" above I_{L5} ≤ 2 x spec. limit

Statements about product lifetime are based on calculations and internal testing. They should only be interpreted as estimations. Also due to external factors, the lifetime in the field application may deviate from the calculated lifetime. In general, nothing stated herein shall be construed as a guarantee of durability.

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