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# Aluminum Capacitors



## FEATURES

- Load life: 2000 h at 105 °C
- Miniature dimension
- SMD style
- Reflow soldering
- Polarized aluminum electrolytic capacitors
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

## APPLICATIONS

- Industrial electronics, automotive electronics, telecommunication systems
- Smoothing and filtering
- Miniature power supply units, dc-to-dc converters

## PACKAGING

Supplied in blister tape.

QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case size (Ø D x L in mm)	4 x 5.3 to 12.5 x 13.5
Rated capacitance range, C <sub>R</sub>	10 µF to 2200 µF
Capacitance tolerance	± 20 %
Rated voltage range	6.3 V to 50 V
Category temperature range	-40 °C to 105 °C
Load life	2000 h
Based on sectional specification	IEC 60384-4 / EN130300
Climatic category IEC 60068	40 / 105 / 56

SELECTION CHART FOR C <sub>R</sub> , U <sub>R</sub> , AND RELEVANT NOMINAL CASE SIZES (Ø D x L in mm)						
C <sub>R</sub> (µF)	RATED VOLTAGE (V)					
	6.3	10	16	25	35	50
10	→	→	4 x 5.3	→	5 x 5.3	6.3 x 5.8
22	→	→	→	6.3 x 5.8	6.3 x 5.8	8 x 6.2
33	→	→	6.3 x 5.8	6.3 x 5.8	8 x 6.2	8 x 10
47	5 x 5.3	→	6.3 x 5.8	8 x 6.2	8 x 10	10 x 10
100	→	6.3 x 5.8	→	8 x 10	→	10 x 10
220	→	8 x 10	10 x 10	→	10 x 10	12.5 x 13.5
330	8 x 10	→	10 x 10	10 x 10	12.5 x 13.5	-
470	→	10 x 10	10 x 10	10 x 10	12.5 x 13.5	-
680	→	→	→	12.5 x 13.5	-	-
1000	→	10 x 10	12.5 x 13.5	-	-	-
1500	10 x 10	12.5 x 13.5	-	-	-	-
2200	12.5 x 13.5	-	-	-	-	-

DIMENSIONS in millimeters									
CASE SIZE CODE	D ± α	L ± α	A ± α	B ± α	C ± α	E ± α	R	N	P
BB	4 ± 0.5	5.3 ± 0.2	1.9 ± 0.2	4.3 ± 0.2	4.3 ± 0.2	1.0 ± 0.2	0.5 to 0.8	0.3	0.5
BC	5 ± 0.5	5.3 ± 0.2	2.3 ± 0.2	5.3 ± 0.2	5.3 ± 0.2	1.4 ± 0.2	0.5 to 0.8	0.3	0.5
AD	6.3 ± 0.5	5.8 ± 0.3	2.4 ± 0.2	6.6 ± 0.2	6.6 ± 0.2	2.2 ± 0.2	0.5 to 0.8	0.3	0.5
BM	6.3 ± 0.5	7.7 ± 0.4	2.4 ± 0.2	6.6 ± 0.2	6.6 ± 0.2	2.2 ± 0.2	0.5 to 0.8	0.3	0.5
AE	8 ± 0.5	6.2 ± 0.4	3.3 ± 0.2	8.3 ± 0.2	8.3 ± 0.2	2.3 ± 0.2	0.5 to 0.8	0.3	0.5
AF	8 ± 0.5	10 ± 0.5	2.9 ± 0.2	8.3 ± 0.2	8.3 ± 0.2	3.1 ± 0.2	0.8 to 1.1	0.3	0.5
AG	10 ± 0.5	10 ± 0.5	3.2 ± 0.2	10.3 ± 0.2	10.3 ± 0.2	4.5 ± 0.2	0.8 to 1.1	0.3	0.5
AH	12.5 ± 0.5	13.5 ± 0.5	4.6 ± 0.2	12.8 ± 0.2	12.8 ± 0.2	4.5 ± 0.2	1.1 to 1.4	0.3	0.5

ELECTRICAL DATA	
SYMBOL	DESCRIPTION
$U_R$	Rated voltage
$C_R$	Rated capacitance at 120 Hz
$\tan \delta$	Max. dissipation factor at 120 Hz
$R_{ESR}$	Max. equivalent series resistance at 120 Hz
$I_R$	Rated alternating current at 120 Hz and upper category temperature

**Note**

- Unless otherwise specified, all electrical values apply at  $T_{amb} = 20\text{ }^\circ\text{C}$ ,  $P = 86\text{ kPa}$  to  $106\text{ kPa}$ ,  $RH = 45\%$  to  $75\%$ .

**ORDERING EXAMPLE**

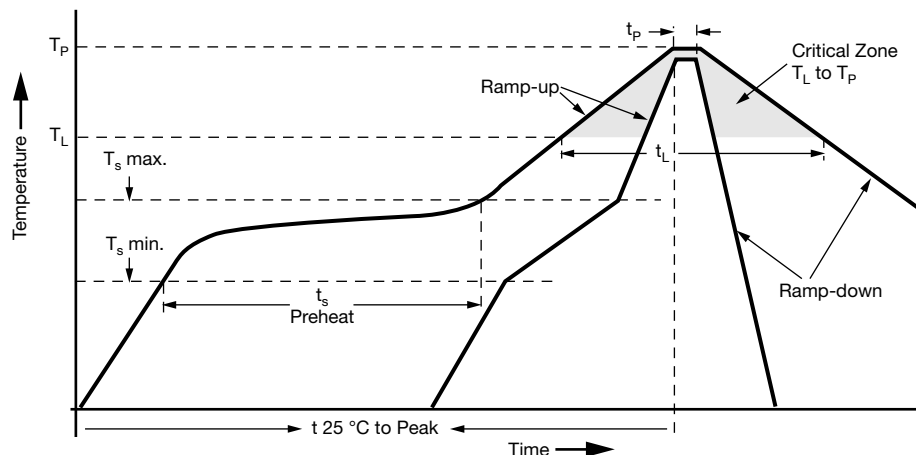
 ECV 220  $\mu\text{F}$  / 35 V,  $\pm 20\%$ , size 10 mm x 10 mm

Ordering code: MALSECV00AG322FARK

For Standard Packaging Quantity (SPQ) and Minimum Order Quantity (MOQ) please refer to our price list or contact customer service.

ELECTRICAL DATA AND ORDERING INFORMATION							
$U_R$ (V)	$C_R$ 120 Hz ( $\mu\text{F}$ )	DIMENSIONS D x L (mm)	$\tan \delta$ 120 Hz	$R_{ESR}$ 120 Hz / 20 $^\circ\text{C}$ ( $\Omega$ )	$I_R$ 120 Hz / 105 $^\circ\text{C}$ (mA)	WEIGHT (g)	CATALOG NUMBER
6.3	47	5 x 5.3	0.22	6.21	36	0.17	MALSECV00BC247BARK
	330	8 x 10	0.28	1.13	288	1.00	MALSECV00AF333BARK
	1500	10 x 10	0.28	0.25	560	1.21	MALSECV00AG415BARK
	2200	12.5 x 13.5	0.28	0.17	730	2.00	MALSECV00AH422BARK
10	100	6.3 x 5.8	0.19	2.52	60	0.30	MALSECV00AD310CARK
	220	8 x 10	0.24	1.45	173	1.00	MALSECV00AF322CARK
	470	10 x 10	0.24	0.68	351	1.21	MALSECV00AG347CARK
	1000	10 x 10	0.24	0.32	550	1.21	MALSECV00AG410CARK
	1500	12.5 x 13.5	0.24	0.21	650	2.00	MALSECV00AH415CARK
16	10	4 x 5.3	0.16	21.22	17	0.12	MALSECV00BB210DARK
	33	6.3 x 5.8	0.16	6.43	40	0.30	MALSECV00AD233DARK
	47	6.3 x 5.8	0.16	4.52	50	0.30	MALSECV00AD247DARK
	220	10 x 10	0.20	1.21	330	1.21	MALSECV00AG322DARK
	330	10 x 10	0.20	0.80	441	1.21	MALSECV00AG333DARK
	470	10 x 10	0.20	0.56	489	1.21	MALSECV00AG347DARK
	1000	12.5 x 13.5	0.20	0.27	600	2.00	MALSECV00AH410DARK

ELECTRICAL DATA AND ORDERING INFORMATION							
$U_R$ (V)	$C_R$ 120 Hz ( $\mu$ F)	DIMENSIONS D x L (mm)	$\tan \delta$ 120 Hz	$R_{ESR}$ 120 Hz / 20 °C ( $\Omega$ )	$I_R$ 120 Hz / 105 °C (mA)	WEIGHT (g)	CATALOG NUMBER
25	22	6.3 x 5.8	0.14	8.44	38	0.30	MALSECV00AD222EARK
	33	6.3 x 5.8	0.14	5.63	48	0.30	MALSECV00AD233EARK
	47	8 x 6.2	0.16	4.52	79	0.55	MALSECV00AE247EARK
	100	8 x 10	0.16	2.12	181	1.00	MALSECV00AF310EARK
	330	10 x 10	0.16	0.64	372	1.21	MALSECV00AG333EARK
	470	10 x 10	0.16	0.45	450	1.21	MALSECV00AG347EARK
	680	12.5 x 13.5	0.16	0.31	500	2.00	MALSECV00AH368EARK
35	10	5 x 5.3	0.12	15.92	24	0.17	MALSECV00BC210FARK
	22	6.3 x 5.8	0.12	7.23	42	0.30	MALSECV00AD222FARK
	33	8 x 6.2	0.13	5.22	76	0.55	MALSECV00AE233FARK
	47	8 x 10	0.13	3.67	124	1.00	MALSECV00AF247FARK
	220	10 x 10	0.13	0.78	450	1.21	MALSECV00AG322FARK
	330	12.5 x 13.5	0.13	0.52	500	2.00	MALSECV00AH333FARK
	470	12.5 x 13.5	0.13	0.37	600	2.00	MALSECV00AH347FARK
50	10	6.3 x 5.8	0.10	13.26	30	0.30	MALSECV00AD210HARK
	22	8 x 6.2	0.12	7.23	67	0.55	MALSECV00AE222HARK
	33	8 x 10	0.12	4.82	133	1.00	MALSECV00AF233HARK
	47	10 x 10	0.12	3.39	180	1.21	MALSECV00AG247HARK
	100	10 x 10	0.12	1.59	310	1.21	MALSECV00AG310HARK
	220	12.5 x 13.5	0.12	0.72	480	2.00	MALSECV00AH322HARK

**REFLOW SOLDERING CONDITIONS FOR SMD ALUMINUM ELECTROLYTIC CAPACITORS**


PROFILE FEATURE	SOLDERING CONDITION		
	$\varnothing$ 4 TO $\varnothing$ 10	$\varnothing$ 12.5	$\varnothing$ 16
Average ramp-up rate ( $T_L$ to $T_p$ )	3 °C/s max.	3 °C/s max.	
Preheat			
Temperature min. ( $T_s$ min.)	150 °C	150 °C	
Temperature max. ( $T_s$ max.)	200 °C	200 °C	
Time ( $T_s$ min. to $T_s$ max.)	60 s to 150 s	40 s to 120 s	40 s to 100 s
$T_s$ max. to $T_L$			
Ramp-up rate	3 °C/s max.	3 °C/s max.	
Time maintained above temperature ( $T_L$ )	217 °C	217 °C	
Time ( $t_L$ )	60 s to 90 s	40 s to 60 s	
Peak / classification temperature ( $T_p$ )	250 °C	240 °C	230 °C
Time within 5 °C of actual peak temperature ( $T_p$ )	10 s max.	10 s max.	
Ramp-down rate	3 °C/s max.	3 °C/s max.	
Time 25 °C to peak temperature	8 min max.	8 min max.	



RESISTANCE TO SOLDERING HEAT	
Leakage current	Less than specified value
Capacitance value	Within $\pm 10\%$ of initial value
$\tan \delta$	Less than specified value

LOW TEMPERATURE BEHAVIOR (at 120 Hz)						
IMPEDANCE RATIO (Z) T2/(Z) T1	RATED VOLTAGE (V)					
	6.3	10	16	25	35	50
T2/T1						
-25 °C / +20 °C	3	3	2	2	2	2
-40 °C / +20 °C	8	5	4	3	3	3

ADDITIONAL ELECTRICAL DATA		
PARAMETER	CONDITIONS	VALUE
<b>Current</b>		
Leakage current (test conditions: $U_R$ , 20 °C)	After 2 min at $U_R$	$I_{L2} \leq 0.01 \times C_R \times U_R$ or $3 \mu A$ for $U_R \leq 100 V$ (whichever is greater)
<b>Resistance</b>		
Equivalent series resistance (ESR)	Calculated from $\tan \delta_{max}$ .	$ESR = \tan \delta / 2 \pi f C_R$

MULTIPLIER OF RIPPLE CURRENT ( $I_R$ ) AS A FUNCTION OF FREQUENCY	
FREQUENCY (Hz)	$I_R$ MULTIPLIER FOR $U_R \leq 100 V$
50	0.70
120	1.00
300	1.17
1000	1.36
$\geq 10\,000$	1.50

TEST PROCEDURES AND REQUIREMENTS		
TEST	PROCEDURE (quick reference)	REQUIREMENTS
Load life	$T_{amb} = 105\text{ °C}$ $U_R$ and $I_R$ applied After 2000 h	$\Delta C/C: \pm 20\%$ of initial value $I_L \leq \text{spec. limit}$ $\tan \delta \leq 2 \times \text{spec. limit}$
Shelf life	No voltage applied After 1000 h After test: $U_R$ to be applied for 30 min 24 h to 48 h before measurement	$\Delta C/C: \pm 20\%$ of initial value $I_L \leq \text{spec. limit}$ $\tan \delta \leq 2 \times \text{spec. limit}$

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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