

## Aluminum Capacitors 105 °C, Miniature, Radial Lead


**FEATURES**

- Improved SMPS output capacitors
- Highest ripple current ratings per case size
- High CV
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



QUICK REFERENCE DATA	
DESCRIPTION	VALUE
Nominal case size Ø D x L in inches [mm]	0.394 x 0.472 [10.0 x 12.0] to 0.709 x 1.575 [18.0 x 40.0]
Operating temperature	- 55 °C to +105 °C
Rated capacitance range, C <sub>R</sub>	33 µF to 6800 µF
Tolerance on C <sub>R</sub>	± 20 %
Rated voltage range, U <sub>R</sub>	6.3 WV <sub>DC</sub> to 63 WV <sub>DC</sub>
Termination	2 and 3 radial leads and axial mount.
Life validation test at 105 °C	4000 h (≥ 0.512" [13.0] diameter): 3000 h (0.394" [10.0] diameter): ΔCAP ≤ 20 % (6.3 WV <sub>DC</sub> to 25 WV <sub>DC</sub> ), ≤ 15 % (40 WV <sub>DC</sub> to 63 WV <sub>DC</sub> ) from initial measurement. ΔESR ≤ 1.3 x initial specified limit. ΔDCL ≤ 2 x initial specified limit.
Shelf life at 105 °C	1000 h: ΔCAP ≤ 20 % (6.3 WV <sub>DC</sub> to 25 WV <sub>DC</sub> ), ≤ 15 % (40 WV <sub>DC</sub> to 63 WV <sub>DC</sub> ) from initial measurements. ΔESR ≤ 1.3 x initial specified limit.
DC leakage current	I = 0.01 CV (2 min charge time) I = 0.03 CV (1 min charge time) I in µA, C in µF, V in Volts

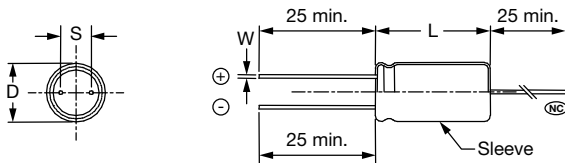
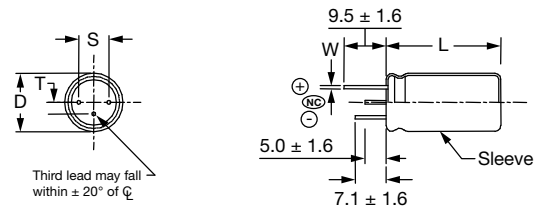
RIPPLE CURRENT MULTIPLIERS					
TEMPERATURE					
AMBIENT TEMPERATURE		MULTIPLIERS			
+105 °C		1.0			
+85 °C		2.2			
+75 °C		2.7			
≤ +65 °C		3.0			
FREQUENCY (Hz)					
WV <sub>DC</sub>	50 TO 60	100 TO 120	300 TO 400	1K TO 19K	20K TO 200K
6.3 to 63	0.60	0.70	0.75	0.82	1.0

LOW TEMPERATURE PERFORMANCE				
CAPACITANCE RATIO C <sup>-55 °C</sup> /C <sup>+25 °C</sup> MINIMUM AT 120 Hz				
MAXIMUM CAPACITANCE CHANGE	VOLTAGE	MULTIPLIER		
	6.3 V to 16 V	0.75		
25 V to 63 V	0.85			
MAXIMUM IMPEDANCE CHANGE	VOLTAGE	MULTIPLIER		
	6.3 V to 16 V	2.0		
25 V to 63 V	1.5			
ESL (TYPICAL VALUES AT 1 MHz TO 10 MHz)				
NOMINAL DIAMETER	0.394 [10.0]	0.512 [13.0]	0.630 [16.0]	0.709 [18.0]
TYPICAL ESL (nH)	4.0	7.0	10.0	12.0

**BULK SPECIFICATIONS** in millimeters

**TERMINAL CODE C**

**TERMINAL CODE D**

**TERMINAL CODE J <sup>(1)</sup>**

**TERMINAL CODE O <sup>(2)</sup>**

**Notes**

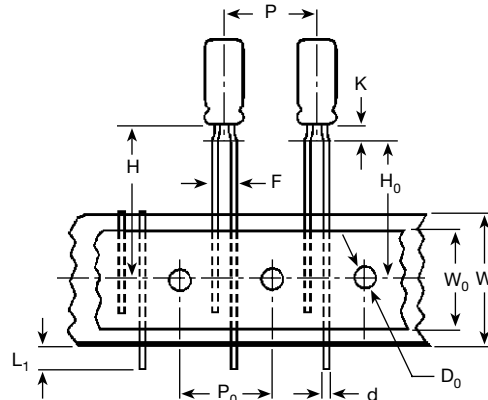
- ⊕ Positive terminal
- ⊖ Negative terminal
- Ⓝ No charge potential

<sup>(1)</sup> Available for 12.5 mm, 16 mm, and 18 mm diameter units

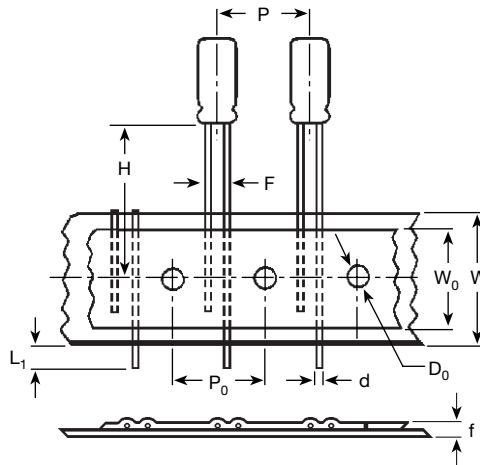
<sup>(2)</sup> Available for 12.5 mm, 16 mm, and 18 mm diameter units with epoxy end-seal

<b>DIMENSIONS</b> in inches [millimeters]										
CASE CODE	NOMINAL		STYLES 2 AND 4		STYLES 3 AND 5		LEAD SPACING		LEAD DIAMETER	
	D	L	D (max.)	L (max.)	D (max.)	L (max.)	S ± 0.024 [0.60]	T ± 0.020 [0.50]	NOMINAL	AWG
CC	0.394 [10.0]	0.512 [13.0]	0.413 [10.5]	0.563 [14.3]	0.413 [10.5]	0.630 [16.0]	0.197 [5.0]	n/a	0.025 [0.63]	22
CD	0.394 [10.0]	0.630 [16.0]	0.413 [10.5]	0.669 [17.0]	0.413 [10.5]	0.740 [18.8]	0.197 [5.0]	n/a	0.025 [0.63]	22
CG	0.394 [10.0]	0.787 [20.0]	0.413 [10.5]	0.846 [21.5]	0.413 [10.5]	0.906 [23.0]	0.197 [5.0]	n/a	0.025 [0.63]	22
DG	0.492 [12.5]	0.787 [20.0]	0.512 [13.0]	0.846 [21.5]	0.512 [13.0]	0.906 [23.0]	0.197 [5.0]	0.098 [2.5]	0.032 [0.81]	20
DK	0.492 [12.5]	0.984 [25.0]	0.512 [13.0]	1.043 [26.5]	0.512 [13.0]	1.142 [29.0]	0.197 [5.0]	0.098 [2.5]	0.032 [0.81]	20
DM	0.492 [12.5]	1.043 [26.5]	0.512 [13.0]	1.102 [28.0]	0.512 [13.0]	1.161 [29.5]	0.197 [5.0]	0.098 [2.5]	0.032 [0.81]	20
DT	0.492 [12.5]	1.319 [33.5]	0.512 [13.0]	1.346 [34.2]	0.512 [13.0]	1.417 [36.0]	0.197 [5.0]	0.098 [2.5]	0.032 [0.81]	20
DS	0.492 [12.5]	1.673 [42.5]	0.512 [13.0]	1.720 [43.7]	0.512 [13.0]	1.791 [45.5]	0.197 [5.0]	0.098 [2.5]	0.032 [0.81]	20
EK	0.630 [16.0]	0.984 [25.0]	0.650 [16.5]	1.031 [26.2]	0.650 [16.5]	1.098 [27.9]	0.295 [7.5]	0.150 [3.8]	0.032 [0.81]	20
EN	0.630 [16.0]	1.260 [32.0]	0.650 [16.5]	1.319 [33.5]	0.650 [16.5]	1.417 [36.0]	0.295 [7.5]	0.150 [3.8]	0.032 [0.81]	20
ER	0.630 [16.0]	1.417 [36.0]	0.650 [16.5]	1.476 [37.5]	0.650 [16.5]	1.575 [40.0]	0.295 [7.5]	0.150 [3.8]	0.032 [0.81]	20
EU	0.630 [16.0]	1.575 [40.0]	0.650 [16.5]	1.642 [41.7]	0.650 [16.5]	1.669 [42.4]	0.295 [7.5]	0.150 [3.8]	0.032 [0.81]	20
FR	0.709 [18.0]	1.417 [36.0]	0.728 [18.5]	1.476 [37.5]	0.728 [18.5]	1.575 [40.0]	0.295 [7.5]	0.150 [3.8]	0.032 [0.81]	20
FV	0.709 [18.0]	1.575 [40.0]	0.728 [18.5]	1.653 [42.0]	0.728 [18.5]	1.693 [43.0]	0.295 [7.5]	0.150 [3.8]	0.032 [0.81]	20

**TAPE AND REEL, SPECIFICATIONS TO EIA-468D** in inches [millimeters]

**Formed Leads**


<b>DIMENSIONS</b> in inches [millimeters] <b>AND PACKAGING QUANTITIES</b>		
<b>CASE SIZE</b>	<b>F LEAD SPACING</b>	<b>STD. QTY/REEL</b>
0.236 x 0.453 [6.0 x 11.0]	0.197 [5.0]	800
0.315 x 0.472 [8.0 x 12.0]	0.197 [5.0]	700

**Unformed (Straight) Leads**


<b>DIMENSIONS</b> in inches [millimeters] <b>AND PACKAGING QUANTITIES</b>		
<b>CASE SIZE</b>	<b>F LEAD SPACING</b>	<b>STD. QTY/REEL</b>
0.236 x 0.453 [6.0 x 11.0]	0.098 [2.5]	800
0.315 x 0.472 [8.0 x 12.0]	0.140 <sup>(1)</sup> [3.5]	700
0.394 x 0.512 [10.0 x 13.0]	0.197 [5.0]	500
0.394 x 0.630 [10.0 x 16.0]	0.197 [5.0]	500
0.394 x 0.787 [10.0 x 20.0]	0.197 [5.0]	500

**Note**
<sup>(1)</sup> Available as special order.



DIMENSIONS in inches [millimeters]					
ITEM	CASE SIZE (DIAMETER x LENGTH)				
	0.236 x 0.433 [6.0 x 11.0]	0.315 x 0.472 [8.0 x 12.0]	0.394 x 0.512 [10.0 x 13.0]	0.394 x 0.630 [10.0 x 16.0]	0.394 x 0.787 [10.0 x 20.0]
d - Lead-wire diameter	0.025 [0.63]	0.025 [0.63]	0.025 [0.63]	0.025 [0.63]	0.025 [0.63]
P - Pitch of component	0.500 [12.7]	0.500 [12.7]	0.500 [12.7]	0.500 [12.7]	0.500 [12.7]
P <sub>0</sub> - Feed hole pitch	0.500 [12.7]	0.500 [12.7]	0.500 [12.7]	0.500 [12.7]	0.500 [12.7]
F - Lead-to-lead distance	0.197 [5.0]	0.197 [5.0]	0.197 [5.0]	0.197 [5.0]	0.197 [5.0]
K - Clinch height	0.098 [2.5]	0.157 [4.0]	n/a	n/a	n/a
H - Height of component from tape center	0.728 [18.5]	0.787 [20.0]	0.906 [23.0]	0.906 [23.0]	0.906 [23.0]
H <sub>0</sub> - Lead-wire clinch height	0.630 [16.0]	0.630 [16.0]	n/a	n/a	n/a
W - Tape width	0.709 [18.0]	0.709 [18.0]	0.709 [18.0]	0.709 [18.0]	0.709 [18.0]
W <sub>0</sub> - Hold down tape width	0.591 [15.0]	0.591 [15.0]	0.591 [15.0]	0.591 [15.0]	0.591 [15.0]
D <sub>0</sub> - Feed hole diameter	0.157 [4.0]	0.157 [4.0]	0.157 [4.0]	0.157 [4.0]	0.157 [4.0]
t - Total tape thickness	0.028 [0.7]	0.028 [0.7]	0.028 [0.7]	0.028 [0.7]	0.028 [0.7]
L <sub>1</sub> - Maximum lead protrusion	0.118 [3.0]	0.118 [3.0]	0.118 [3.0]	0.118 [3.0]	0.118 [3.0]

**Note**

- Terminal code "I" = tape and reel. Terminal code "+" = tape and ammo.  
Positive leader is standard. Negative leader is available by special order.

**ORDERING EXAMPLE**

Electrolytic capacitor 678D series: 678D 108 M 6R3 DG 3 D

DESCRIPTION	
CODE	EXPLANATION
678D	Product type
108	Capacitance value (1000 µF)
M	Tolerance (M = ± 20 %)
6R3	Voltage rating at 105 °C (6R3 = 6.3 V)
DG	Can size (see Dimensions table)
3	Sleeve and sealing (3 = P.V.C. sleeve w/epoxy end seal)
D	Terminal code/package (D = bulk; straight leads)

**Note**

- For lead (Pb)-free / RoHS compliant products add suffix "E3" to part number.  
Example: 678D108M6R3DG3DE3

ELECTRICAL DATA AND ORDERING INFORMATION						
CAPACITANCE (µF)	PART NUMBER	NOMINAL CASE SIZE D x L	MAX. ESR AT +25 °C (Ω)		MAX. RIPPLE AT +105 °C (A) 20 kHz to 100 kHz	MAX. IMPEDANCE AT +25 °C (Ω) 100 kHz
			20 Hz	20 kHz		
<b>6.3 WV<sub>DC</sub> at 105 °C, SURGE = 9 V</b>						
330.0	678D337M6R3CC3D	0.394 x 0.512 [10.0 x 13.0]	0.540	0.213	0.36	0.213
470.0	678D477M6R3CD3D	0.394 x 0.630 [10.0 x 16.0]	0.340	0.133	0.49	0.132
1000.0	678D108M6R3DG3D	0.492 x 0.787 [12.5 x 20.0]	0.200	0.071	0.83	0.070
2200.0	678D228M6R3EK3D	0.630 x 0.984 [16.0 x 25.0]	0.110	0.041	1.36	0.045
3300.0	678D338M6R3DS3D	0.492 x 1.673 [12.5 x 42.5]	0.067	0.031	1.67	0.032
4700.0	678D478M6R3FR3D	0.709 x 1.417 [18.0 x 36.0]	0.066	0.029	2.02	0.031
<b>10 WV<sub>DC</sub> AT 105 °C, SURGE = 13 V</b>						
330.0	678D337M010CD3D	0.394 x 0.630 [10.0 x 16.0]	0.350	0.135	0.46	0.134
470.0	678D477M010CG3D	0.394 x 0.787 [10.0 x 20.0]	0.235	0.092	0.63	0.090
1000.0	678D108M010DM3D	0.492 x 1.043 [12.5 x 26.5]	0.120	0.062	0.98	0.061
2200.0	678D228M010EK3D	0.630 x 0.984 [16.0 x 25.0]	0.115	0.042	1.52	0.046
3300.0	678D338M010EN3D	0.630 x 1.260 [16.0 x 32.0]	0.085	0.038	1.56	0.041
4700.0	678D487M010FR3D	0.709 x 1.417 [18.0 x 36.0]	0.070	0.031	1.97	0.033



ELECTRICAL DATA AND ORDERING INFORMATION						
CAPACITANCE ( $\mu$ F)	PART NUMBER	NOMINAL CASE SIZE D x L	MAX. ESR AT +25 °C ( $\Omega$ )		MAX. RIPPLE AT +105 °C (A) 20 kHz to 100 kHz	MAX. IMPEDANCE AT +25 °C ( $\Omega$ ) 100 kHz
			20 Hz	20 kHz		
<b>16 WV<sub>DC</sub> AT 105 °C, SURGE = 20 V</b>						
220.0	678D227M016CC3D	0.394 x 0.512 [10.0 x 13.0]	0.585	0.217	0.40	0.217
330.0	678D337M016CD3D	0.394 x 0.630 [10.0 x 16.0]	0.370	0.137	0.52	0.136
470.0	678D477M016CG3D	0.394 x 0.787 [10.0 x 20.0]	0.250	0.098	0.70	0.094
1000.0	678D108M016DM3D	0.492 x 1.043 [12.5 x 26.5]	0.130	0.066	1.00	0.065
2200.0	678D228M016ER3D	0.630 x 1.417 [16.0 x 36.0]	0.074	0.032	1.78	0.034
3300.0	678D338M016FR3D	0.709 x 1.417 [18.0 x 36.0]	0.074	0.032	1.94	0.034
<b>20 WV<sub>DC</sub> AT 105 °C, SURGE = 30 V</b>						
220.0	678D227M020CD3D	0.394 x 0.630 [10.0 x 16.0]	0.380	0.150	0.41	0.148
330.0	678D337M020CG3D	0.394 x 0.787 [10.0 x 20.0]	0.270	0.100	0.61	0.098
470.0	678D477M020DG3D	0.492 x 0.787 [12.5 x 20.0]	0.250	0.077	0.45	0.075
1000.0	678D108M020DT3D	0.492 x 1.280 [12.5 x 33.5]	0.115	0.048	0.78	0.045
2200.0	678D228M020ER3D	0.630 x 1.417 [16.0 x 36.0]	0.077	0.032	1.80	0.034
3300.0	678D338M020FV3D	0.709 x 1.575 [18.0 x 40.0]	0.061	0.026	2.25	0.028
<b>25 WV<sub>DC</sub> AT 105 °C, SURGE = 35 V</b>						
100.0	678D107M025CC3D	0.394 x 0.512 [10.0 x 13.0]	0.700	0.250	0.32	0.250
220.0	678D227M025CG3D	0.394 x 0.787 [10.0 x 20.0]	0.300	0.105	0.59	0.100
330.0	678D337M025DG3D	0.492 x 0.787 [12.5 x 20.0]	0.270	0.078	0.79	0.076
470.0	678D477M025DM3D	0.492 x 1.043 [12.5 x 26.5]	0.160	0.067	0.97	0.068
1000.0	678D108M025DS3D	0.492 x 1.673 [12.5 x 42.5]	0.090	0.034	1.60	0.036
2200.0	678D228M025FV3D	0.709 x 1.575 [18.0 x 40.0]	0.062	0.026	2.22	0.028
<b>40 WV<sub>DC</sub> AT 105 °C, SURGE = 55 V</b>						
47.0	678D476M040CC3D	0.394 x 0.512 [10.0 x 13.0]	0.950	0.265	0.28	0.265
100.0	678D107M040CD3D	0.394 x 0.630 [10.0 x 16.0]	0.580	0.165	0.38	0.165
330.0	678D337M040DM3D	0.492 x 1.043 [12.5 x 26.5]	0.200	0.068	0.93	0.070
470.0	678D477M040EK3D	0.630 x 0.984 [16.0 x 25.0]	0.133	0.046	1.28	0.050
1000.0	678D108M040ER3D	0.630 x 1.417 [16.0 x 36.0]	0.080	0.033	1.76	0.035
<b>50 WV<sub>DC</sub> AT 105 °C, SURGE = 75 V</b>						
47.0	678D476M050CC3D	0.394 x 0.512 [10.0 x 13.0]	1.250	0.275	0.28	0.275
100.0	678D107M050CG3D	0.394 x 0.787 [10.0 x 20.0]	0.520	0.115	0.57	0.112
220.0	678D227M050DM3D	0.472 x 1.043 [12.5 x 26.5]	0.240	0.069	0.93	0.071
330.0	678D337M050EK3D	0.630 x 0.984 [16.0 x 25.0]	0.150	0.048	1.26	0.052
470.0	678D477M050DS3D	0.492 x 1.673 [12.5 x 42.5]	0.110	0.036	1.55	0.039
1000.0	678D108M050FV3D	0.709 x 1.575 [18.0 x 40.0]	0.077	0.028	2.15	0.032
<b>63 WV<sub>DC</sub> AT 105 °C, SURGE = 80 V</b>						
33.0	678D336M063CC3D	0.394 x 0.512 [10.0 x 13.0]	1.600	0.288	0.27	0.288
47.0	678D476M063CD3D	0.394 x 0.630 [10.0 x 16.0]	1.000	0.180	0.37	0.180
100.0	678D107M063DG3D	0.492 x 0.787 [12.5 x 20.0]	0.450	0.093	0.72	0.090
220.0	678D227M063DT3D	0.492 x 1.280 [12.5 x 33.5]	0.160	0.055	1.10	0.054
220.0	678D227M063EK3D	0.630 x 0.984 [16.0 x 25.0]	0.170	0.050	1.23	0.054
330.0	678D337M063DS3D	0.492 x 1.673 [12.5 x 42.5]	0.130	0.038	1.51	0.040
470.0	678D477M063ER3D	0.630 x 1.417 [16.0 x 36.0]	0.120	0.035	1.70	0.038



## Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

## Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.**