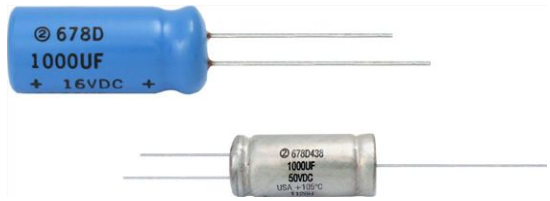
# Aluminum Capacitors
# 105 °C, Miniature, Radial Lead




## 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

Pb-free Available

## QUICK REFERENCE DATA

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



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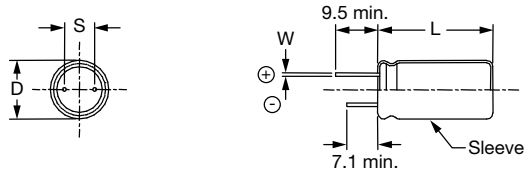
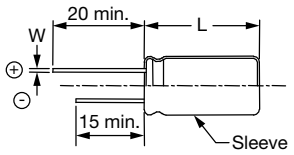
## **BULK SPECIFICATIONS** in millimeters

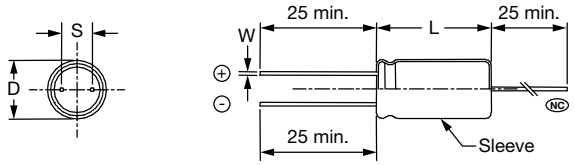
### TERMINAL CODE C



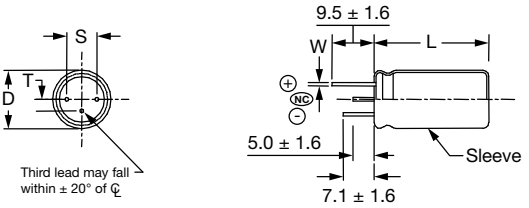

### TERMINAL CODE D




### TERMINAL CODE J




### TERMINAL CODE O




**Notes**

⊕ Positive terminal
⊖ Negative terminal
NC No charge potential

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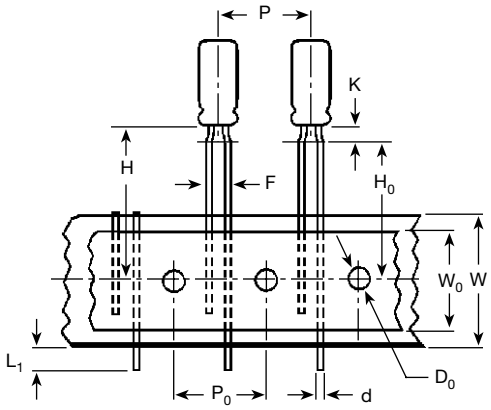
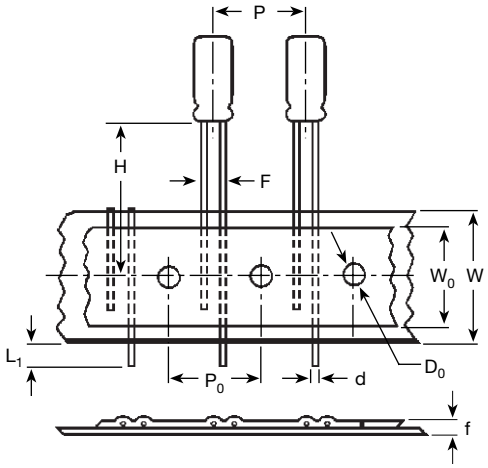
## TAPE AND REEL, SPECIFICATIONS TO EIA-468D in inches [millimeters]

**Formed Leads**




| **DIMENSIONS** in inches [millimeters] **AND PACKAGING QUANTITIES** | | |
|---|---|---|
| **CASE SIZE** | **F LEAD SPACING** | **STD. QTY/REEL** |
| 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**




| **DIMENSIONS** in inches [millimeters] **AND PACKAGING QUANTITIES** | | |
|---|---|---|
| **CASE SIZE** | **F LEAD SPACING** | **STD. QTY/REEL** |
| 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 (1) [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**

(1) Available as special order.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| 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] |
| $P_0$ - 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] |
| $H_0$ - 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] |
| $W_0$ - Hold down tape width | 0.591 [15.0] | 0.591 [15.0] | 0.591 [15.0] | 0.591 [15.0] | 0.591 [15.0] |
| $D_0$ - 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] |
| $L_1$ - 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/packaging (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 (mΩ) | | MAX. RIPPLE AT + 105 °C (A) | MAX. IMPEDANCE AT + 25 °C (mΩ) 100 Hz |
| | | | 20 Hz | 20 kHz | 20 kHz to 100 kHz | |
| 6.3 $WV_{DC}$ at 105 °C, SURGE = 9 V | | | | | | |
| 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 |
| 10 $WV_{DC}$ AT 105 °C, SURGE = 13 V | | | | | | |
| 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 (1) | 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 |


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## ELECTRICAL DATA AND ORDERING INFORMATION

| CAPACITANCE (µF) | PART NUMBER | NOMINAL CASE SIZE D x L | MAX. ESR AT + 25 °C (mΩ) | | MAX. RIPPLE AT + 105 °C (A) | MAX. IMPEDANCE AT + 25 °C (mΩ) 100 Hz |
|---|---|---|---|---|---|---|
| | | | 20 Hz | 20 kHz | 20 kHz to 100 kHz | |
| **16 $WV_{DC}$ AT 105 °C, SURGE = 20 V** | | | | | | |
| 220.0 (1) | 678D227M016CC3D | 0.394 x 0.512 [10.0 x 13.0] | 0.585 | 0.217 | 0.40 | 0.217 |
| 330.0 (1) | 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 (1) | 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 |
| **20 $WV_{DC}$ AT 105 °C, SURGE = 30 V** | | | | | | |
| 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 |
| **25 $WV_{DC}$ AT 105 °C, SURGE = 35 V** | | | | | | |
| 100.0 (1) | 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 (1) | 678D337M025DG3D | 0.492 x 0.787 [12.5 x 20.0] | 0.270 | 0.078 | 0.79 | 0.076 |
| 470.0 (1) | 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 |
| **40 $WV_{DC}$ AT 105 °C, SURGE = 55 V** | | | | | | |
| 47.0 | 678D476M040CC3D | 0.394 x 0.512 [10.0 x 13.0] | 0.950 | 0.265 | 0.28 | 0.265 |
| 100.0 (1) | 678D107M040CD3D | 0.394 x 0.630 [10.0 x 16.0] | 0.580 | 0.165 | 0.38 | 0.165 |
| 330.0 (1) | 678D337M040DM3D | 0.492 x 1.043 [12.5 x 26.5] | 0.200 | 0.068 | 0.93 | 0.070 |
| 470.0 (1) | 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 |
| **50 $WV_{DC}$ AT 105 °C, SURGE = 75 V** | | | | | | |
| 47.0 | 678D476M050CC3D | 0.394 x 0.512 [10.0 x 13.0] | 1.250 | 0.275 | 0.28 | 0.275 |
| 100.0 (1) | 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 |
| **63 $WV_{DC}$ AT 105 °C, SURGE = 80 V** | | | | | | |
| 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 (1) | 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 |

**Note**

(1) These values are normally stocked.


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