

# Type MLSG – Flatpack, 5000 hr@125 °C, Aluminum Electrolytic

Available with High Vibration and High Reliability Options



With over 5000 hrs of DC life at rated voltage, 125°C, type MLSG is our longest life steel-cased Flatpack capacitor. For systems requiring the highest life expectancy, type MLSG is the best choice. Enhance the reliability of your system even further by specifying type HRMLSG for a MIL-level burn-in. This series is also available in a high vibration package up to 50g's by specifying type HVMLSG.

## Highlights

- Longest Life
- Stainless-steel case
- Withstands more than 80,000 feet altitude
- Type HV up to 50g
- Type HR, High Reliability

## Specifications

| Temperature Range               | -55 °C to +125 °C  |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
|---------------------------------|--|-------|--------|--------|-------|--------|-------------|--------|--------|--------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|--------|--------|--------|------|------|------|------|------|------|------|------|------|--|-------|-------|--------|--------|-------|-------|-------------|-----------|------|------|------|------|------|------|------|-------------|------|------|------|------|------|------|------|
| Rated Voltage Range             | 20 Vdc to 250 Vdc  |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| Capacitance Range               | 220 µF to 17,000 µF  |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| Capacitance Tolerance           | ±20%   |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| Leakage Current                 | ≤ 0.002 CV µA, @ 25 °C and 5 mins.   |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| Ripple Current Multipliers      | <p>Case Temperature</p> <table border="1"> <thead> <tr> <th>45 °C</th> <th>55 °C</th> <th>65 °C</th> <th>75 °C</th> <th>85 °C</th> <th>95 °C</th> <th>105 °C</th> <th>115 °C</th> <th>125 °C</th> </tr> </thead> <tbody> <tr> <td>1.41</td> <td>1.32</td> <td>1.22</td> <td>1.12</td> <td>1.00</td> <td>0.87</td> <td>0.71</td> <td>0.50</td> <td>0.00</td> </tr> </tbody> </table> <p>Ambient Temperature, No Heatsink</p> <table border="1"> <thead> <tr> <th>45 °C</th> <th>55 °C</th> <th>65 °C</th> <th>75 °C</th> <th>85 °C</th> <th>95 °C</th> <th>105 °C</th> <th>115 °C</th> <th>125 °C</th> </tr> </thead> <tbody> <tr> <td>0.63</td> <td>0.58</td> <td>0.54</td> <td>0.49</td> <td>0.44</td> <td>0.38</td> <td>0.31</td> <td>0.22</td> <td>0.00</td> </tr> </tbody> </table> <p>Frequency</p> <table border="1"> <thead> <tr> <th></th> <th>50 Hz</th> <th>60 Hz</th> <th>120 Hz</th> <th>360 Hz</th> <th>1 kHz</th> <th>5 kHz</th> <th>10 kHz &amp; up</th> </tr> </thead> <tbody> <tr> <th>5 to 40 V</th> <td>0.95</td> <td>0.96</td> <td>1.00</td> <td>1.03</td> <td>1.04</td> <td>1.04</td> <td>1.04</td> </tr> <tr> <th>60 to 250 V</th> <td>0.80</td> <td>0.84</td> <td>1.00</td> <td>1.18</td> <td>1.25</td> <td>1.30</td> <td>1.30</td> </tr> </tbody> </table> | 45 °C | 55 °C  | 65 °C  | 75 °C | 85 °C  | 95 °C       | 105 °C | 115 °C | 125 °C | 1.41 | 1.32 | 1.22 | 1.12 | 1.00 | 0.87 | 0.71 | 0.50 | 0.00 | 45 °C | 55 °C | 65 °C | 75 °C | 85 °C | 95 °C | 105 °C | 115 °C | 125 °C | 0.63 | 0.58 | 0.54 | 0.49 | 0.44 | 0.38 | 0.31 | 0.22 | 0.00 |  | 50 Hz | 60 Hz | 120 Hz | 360 Hz | 1 kHz | 5 kHz | 10 kHz & up | 5 to 40 V | 0.95 | 0.96 | 1.00 | 1.03 | 1.04 | 1.04 | 1.04 | 60 to 250 V | 0.80 | 0.84 | 1.00 | 1.18 | 1.25 | 1.30 | 1.30 |
| 45 °C                           | 55 °C  | 65 °C | 75 °C  | 85 °C  | 95 °C | 105 °C | 115 °C      | 125 °C |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| 1.41                            | 1.32   | 1.22  | 1.12   | 1.00   | 0.87  | 0.71   | 0.50        | 0.00   |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| 45 °C                           | 55 °C  | 65 °C | 75 °C  | 85 °C  | 95 °C | 105 °C | 115 °C      | 125 °C |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| 0.63                            | 0.58   | 0.54  | 0.49   | 0.44   | 0.38  | 0.31   | 0.22        | 0.00   |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
|                                 | 50 Hz  | 60 Hz | 120 Hz | 360 Hz | 1 kHz | 5 kHz  | 10 kHz & up |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| 5 to 40 V                       | 0.95   | 0.96  | 1.00   | 1.03   | 1.04  | 1.04   | 1.04        |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| 60 to 250 V                     | 0.80   | 0.84  | 1.00   | 1.18   | 1.25  | 1.30   | 1.30        |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| Low Temperature Characteristics | <p>Impedance ratio: <math>Z_{-55^{\circ}\text{C}}/Z_{+25^{\circ}\text{C}}</math> @ 120 Hz</p> <p>≤ 10 (5 - 60 Vdc)</p> <p>≤ 2 (61 - 250 Vdc)</p>   |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| DC Life Test                    | <p>5000 h at rated voltage &amp; 125 °C</p> <p>Δ Capacitance +/- 15% less than or equal to 60 Vdc</p> <p>Δ Capacitance +/- 10% greater than 60 Vdc</p> <p>ESR 200% of limit</p> <p>DCL 100% of limit</p>   |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| Shelf Life Test                 | <p>500 h at 125 °C</p> <p>Capacitance 100% of limit</p> <p>ESR 100% of limit</p> <p>DCL 100% of limit</p>  |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |
| Vibration                       | <p>MIL-STD-202, Meth. 204, Sine Swept, IEC 60068-2-6</p> <p>Standard MLSG Flatpack: 10g</p> <p>Type HVMLSG Flatpack 1.5" and 2.0" case length, 50g</p> <p>Type HVMLSG Flatpack 2.5" and 3.0" case length, 30g</p>  |       |        |        |       |        |             |        |        |        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |        |        |        |      |      |      |      |      |      |      |      |      |  |       |       |        |        |       |       |             |           |      |      |      |      |      |      |      |             |      |      |      |      |      |      |      |

**Vibration**  
*Mounting: Vibration capability is dependent upon mounting restraint. The optional welded mounting tabs, alone, are not capable of sustaining the high vibration levels. To achieve the high vibration levels as published on right, additional mounting restraint is required.*

# Type MLSG – Flatpack, 5000 hr@125 °C, Aluminum Electrolytic

## Available with High Vibration and High Reliability Options

| <p><b>Vibration Test</b></p>                | <p><b>Level</b><br/>The specimens, while deenergized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency range, and duration specified for each case size.</p> <p><b>Amplitude</b><br/>The specimens shall be subjected to a simple harmonic motion having an amplitude of either 0.06-inch double amplitude (maximum total excursion) or peak level specified above (XXg peak), whichever is less. The tolerance on vibration amplitude shall be ±10 percent.</p> <p><b>Frequency Range</b><br/>The vibration frequency shall be varied logarithmically between the approximate limits of 10 to 2,000 Hz.</p> <p><b>Sweep Time and Duration</b><br/>The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met.</p> |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
|---|---|------------------------|------------------------|------|------|------|------|------|------|-----|------|-----|-----|-----|-----------|-----|-----|-----|------|------|-----|-----|-----|-----------|-----|-----|-----|
| <p><b>High Reliability Test/Burn-in</b></p> | <p>Established Reliability capacitors shall be subjected to a minimum of 100 percent of the dc rated voltage at 85 °C for 48 hours minimum but not to exceed 96 hours. During this test, capacitors shall be adequately protected against temporary voltage surges of 10 percent or more of the test voltage. After burn-in, the capacitors shall be returned to room ambient conditions and the dc leakage, capacitance, and ESR shall be measured with respect to specified limits.</p>   |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>Thermal Resistance</b></p>            | <table border="1"> <thead> <tr> <th rowspan="2">Large Sides Heatsinked</th> <th rowspan="2">Case Length Insulation</th> <th>1.5"</th> <th>2.0"</th> <th>3.0"</th> </tr> <tr> <th>°C/W</th> <th>°C/W</th> <th>°C/W</th> </tr> </thead> <tbody> <tr> <td rowspan="2">one</td> <td>None</td> <td>4.3</td> <td>3.1</td> <td>2.0</td> </tr> <tr> <td>Polyester</td> <td>4.7</td> <td>3.4</td> <td>2.2</td> </tr> <tr> <td rowspan="2">both</td> <td>None</td> <td>2.8</td> <td>2.0</td> <td>1.3</td> </tr> <tr> <td>Polyester</td> <td>3.0</td> <td>2.2</td> <td>1.4</td> </tr> </tbody> </table>  | Large Sides Heatsinked | Case Length Insulation | 1.5" | 2.0" | 3.0" | °C/W | °C/W | °C/W | one | None | 4.3 | 3.1 | 2.0 | Polyester | 4.7 | 3.4 | 2.2 | both | None | 2.8 | 2.0 | 1.3 | Polyester | 3.0 | 2.2 | 1.4 |
| Large Sides Heatsinked                      | Case Length Insulation  |                        |                        | 1.5" | 2.0" | 3.0" |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
|   |   | °C/W                   | °C/W                   | °C/W |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| one   | None  | 4.3                    | 3.1                    | 2.0  |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
|   | Polyester   | 4.7                    | 3.4                    | 2.2  |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| both  | None  | 2.8                    | 2.0                    | 1.3  |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
|   | Polyester   | 3.0                    | 2.2                    | 1.4  |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>ESL</b></p>                           | <p>≤30 nH measured 1/4" from case at 1 MHz</p>  |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>Weight</b></p>                        | <p>Case EK 48g typical<br/>Case EA 63g typical<br/>Case EH 78g typical<br/>Case EB 93g typical</p>  |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>Terminals</b></p>                     | <p>18 AWG copper wire with 60/40 tin-lead electroplate, 20 amps max</p>   |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>Ripple Current Capability</b></p>     | <p>The ripple current capability is set by the maximum permissible internal core temperature, 125 °C.</p>   |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>Air Cooled</b></p>                    | <p>The ripple currents in the ratings tables are for 85 °C case temperatures. For air temperatures without a heatsink use the multipliers Ambient Temperature, No Heatsink.</p>   |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>Heatsink Cooled</b></p>               | <p>Temperature rise from the internal hottest spot, the core, to ambient air is</p> $\Delta T = I^2(ESR)(\theta_{cc} + \theta_{ca}), \text{ recommended max } \Delta T \text{ of } 30 \text{ } ^\circ\text{C}$ <p>where <math>\theta_{cc}</math> is the thermal resistance from core to case and <math>\theta_{ca}</math> from case to ambient. To calculate maximum ripple capability with the MLS attached to a heatsink use the maximum core temperature and the values for <math>\theta_{cc}</math>.</p>  |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |
| <p><b>Example</b></p>                       | <p>As an illustration, suppose you operate an insulated MLSG332M060EB1C in 65 °C air and attach it to a commercial heatsink with a free-air thermal resistance of 2.7 °C/W. Use a good thermal grease between the MLS and the heatsink, and the total thermal resistance is 2.3 + 2.2 or 4.5 °C/W. The power which would heat the core to 125 °C is (125 - 65)/4.5 or 13.3 W. For an ESR of 31 mΩ, 13.3 W equates to a ripple current of 20.7 A, however, the wire leads are rated for only 20 A.</p>   |                        |                        |      |      |      |      |      |      |     |      |     |     |     |           |     |     |     |      |      |     |     |     |           |     |     |     |

# Type MLSG – Flatpack, 5000 hr@125 °C, Aluminum Electrolytic

Available with High Vibration and High Reliability Options

## Part Numbering System

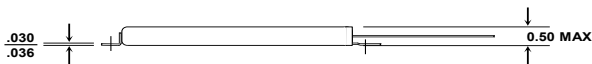
| HV                            | HR                              | MLSG         | 821  | M                   | 200                  | EB  | 0   | A  |
|-------------------------------|---------------------------------|--------------|--|---------------------|----------------------|---|---|--|
| Optional<br>High<br>Vibration | Optional<br>High<br>Reliability | Type<br>MLSG | Capacitance<br>821=820 μF<br>102 = 1000 μF | Tolerance<br>M=±20% | Rated Voltage<br>Vdc | Case Code<br>EK, L=1.5 in.<br>EA, L=2.0 in.<br>EH, L=2.5 in.<br>EB, L=3.0 in.<br>* other sizes<br>available | Insulation<br>0 = bare can<br>1 = polyester | Mounting Style<br>A = mounting tabs<br>C = two leads/no tabs<br>D = hook leads/tabs<br>* other mounting tab<br>options available |

**Examples:**  
 Standard MLSG: MLSG821M200EB0C  
 High Reliability: HRMLSG821M200EB0C  
 High Vibration: HVMLSG821M200EB0C  
 High Reliability, High Vibration: HVHRMLSG821M200EB0C

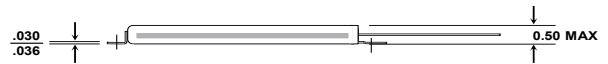
## Outline Drawings

Note: The polyester tape wrap may add up to 0.020 inches to the thickness and width of the capacitor.

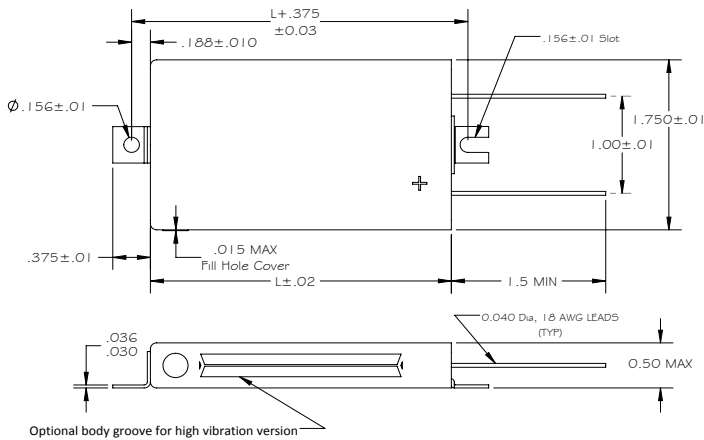
Standard Type MLSG



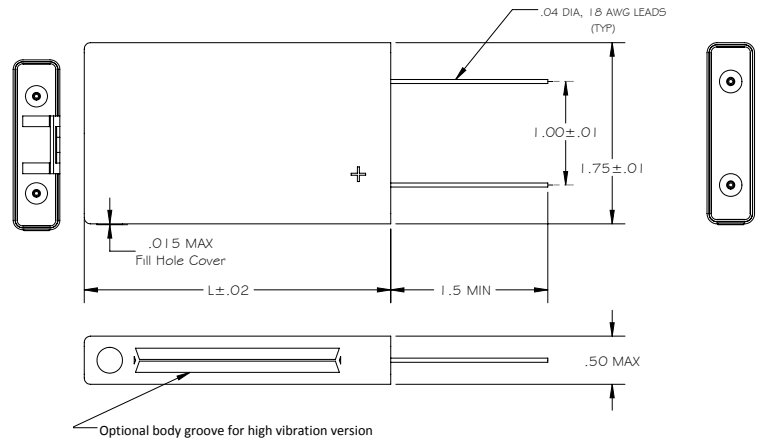
Type HV, Rilled Construction



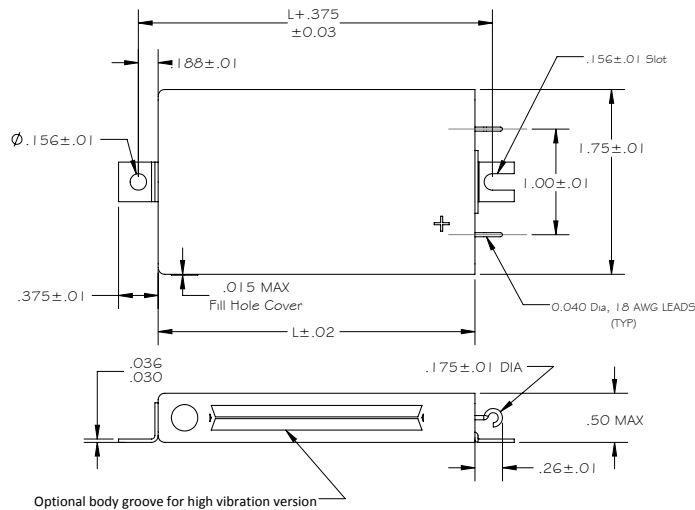
Style A: Mounting Tabs



Style C: No Tabs



Style D: Hook Leads

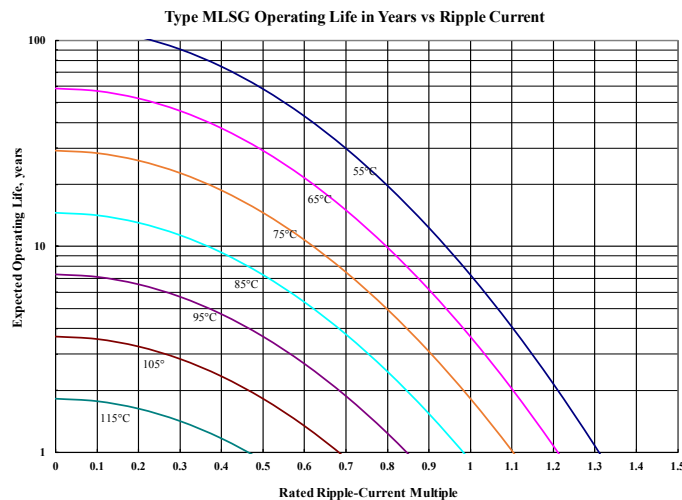
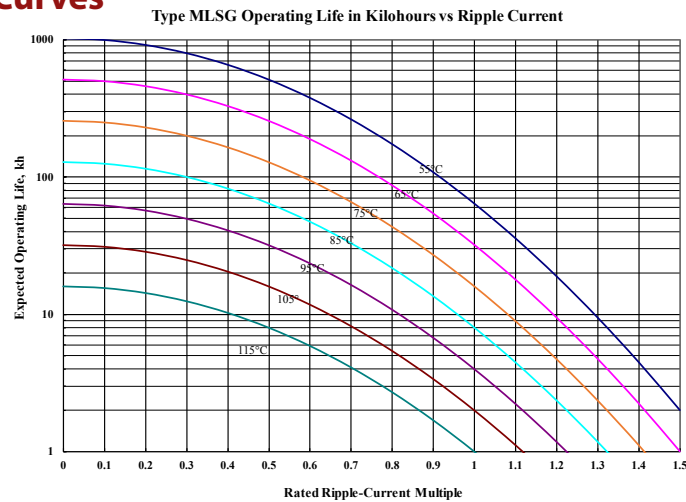


Mounting tabs are welded to the case.

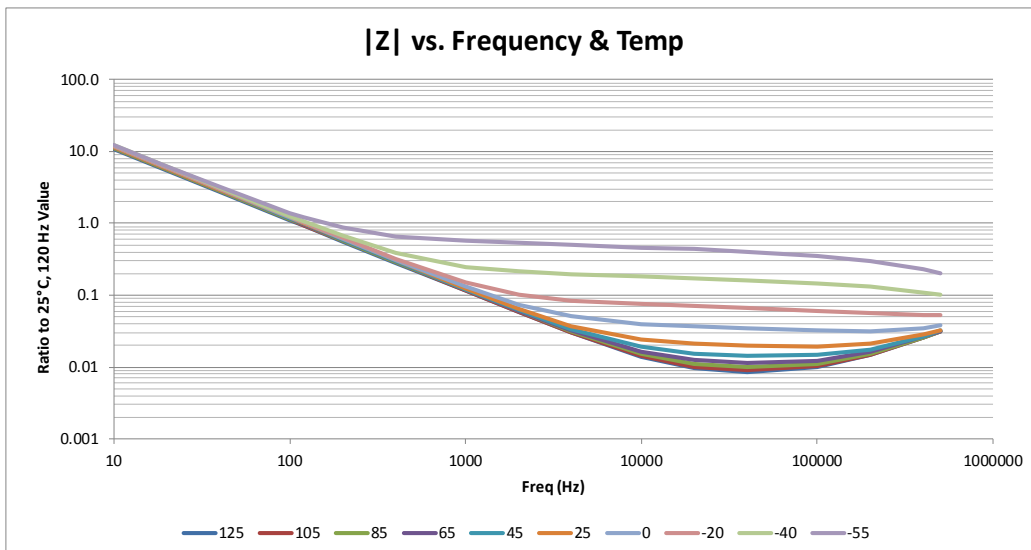
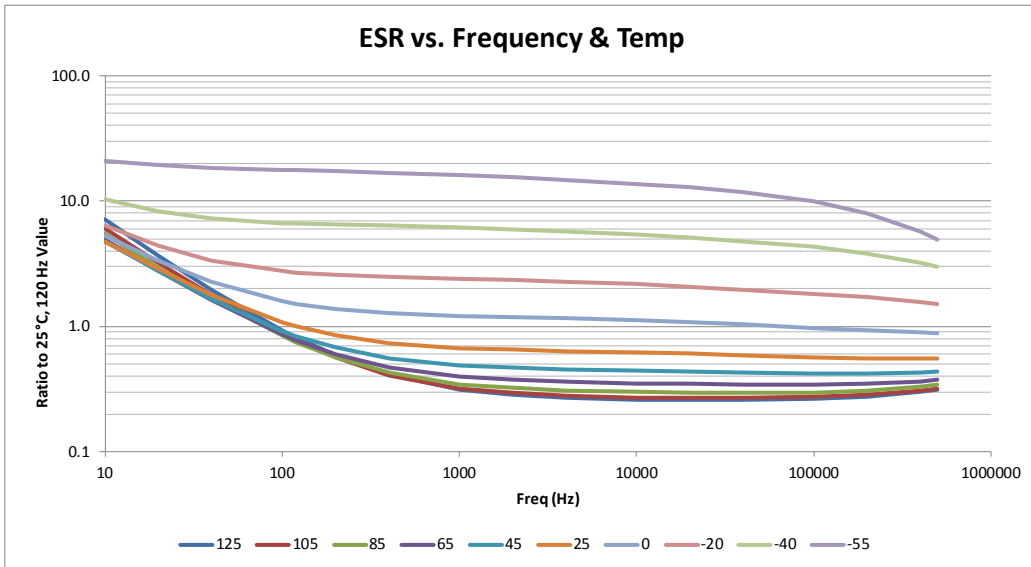
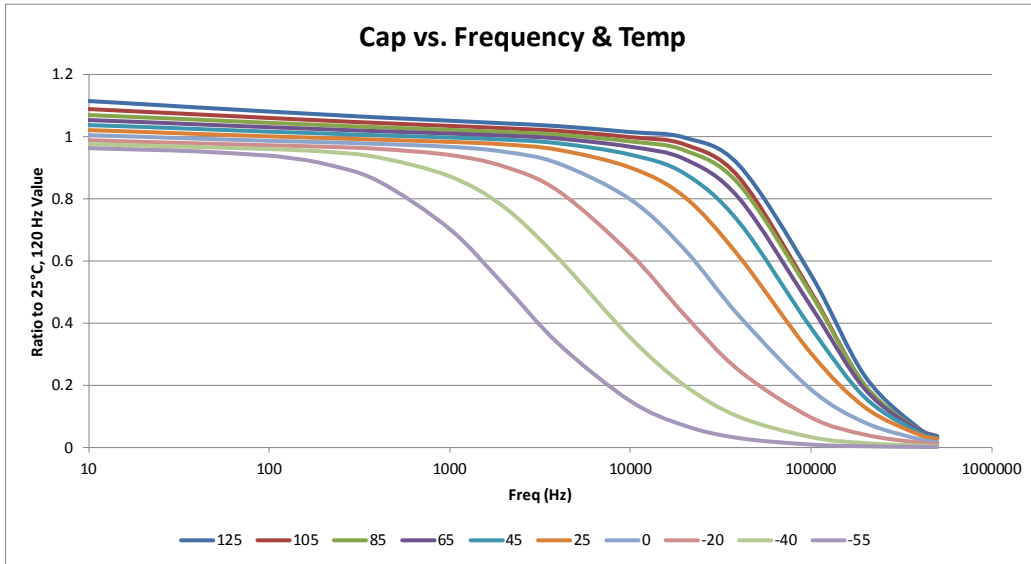
# Type MLSG – Flatpack, 5000 hr@125 °C, Aluminum Electrolytic Ratings

| Voltage  | Cap (μF) | Catalog Part Number | ESR max    |        | Ripple (A)  |        | Length (inches) |
|--|----------|---------------------|------------|--------|-------------|--------|-----------------|
|  |          |                     | 25 °C (mΩ) | 20 kHz | Case @ 85°C | 20 kHz |                 |
| <b>20 Vdc @ 125 °C</b><br>24 Vdc @ 105 °C<br>30 Vdc Surge @ 25 °C    | 6,800    | MLSG682M020EK0C     | 84         | 69     | 11          | 12.2   | 1.5             |
|  | 17,000   | MLSG173M020EB0A     | 33         | 27     | 17.6        | 19.5   | 3.0             |
| <b>40 Vdc @ 125 °C</b><br>48 Vdc @ 105 °C<br>60 Vdc Surge @ 25 °C    | 4,400    | MLSG442M040EK0C     | 97         | 70     | 10.3        | 12.1   | 1.5             |
|  | 6,300    | MLSG632M040EA0A     | 62         | 46     | 12.9        | 15     | 2.0             |
|  | 10,000   | MLSG103M040EB0C     | 36         | 27     | 16.9        | 19.5   | 3.0             |
| <b>60 Vdc @ 125 °C</b><br>65 Vdc @ 105 °C<br>90 Vdc Surge @ 25 °C    | 1,500    | MLSG152M060EK0A     | 106        | 77     | 9.8         | 11.5   | 1.5             |
|  | 2,100    | MLSG212M060EA0A     | 72         | 52     | 11.9        | 14.1   | 2.0             |
|  | 3,300    | MLSG332M060EB0C     | 44         | 31     | 15.3        | 18.2   | 3.0             |
| <b>100 Vdc @ 125 °C</b><br>120 Vdc @ 105 °C<br>150 Vdc Surge @ 25 °C | 500      | MLSG501M100EK0A     | 355        | 248    | 5.4         | 6.4    | 1.5             |
|  | 770      | MLSG771M100EA0C     | 238        | 166    | 6.6         | 7.8    | 2.0             |
|  | 1,300    | MLSG132M100EB0D     | 143        | 100    | 8.5         | 10.1   | 3.0             |
| <b>150 Vdc @ 125 °C</b><br>180 Vdc @ 105 °C<br>225 Vdc Surge @ 25 °C | 360      | MLSG361M150EK1A     | 388        | 253    | 5.1         | 6.4    | 1.5             |
|  | 540      | MLSG541M150EA1A     | 261        | 168    | 6.3         | 7.8    | 2.0             |
|  | 900      | MLSG901M150EB0C     | 158        | 100    | 8.1         | 10.1   | 3.0             |
| <b>200 Vdc @ 125 °C</b><br>250 Vdc @ 105 °C<br>300 Vdc Surge @ 25 °C | 280      | MLSG281M200EK1A     | 426        | 258    | 4.9         | 6.2    | 1.5             |
|  | 400      | MLSG401M200EA0A     | 285        | 172    | 6           | 7.7    | 2.0             |
|  | 720      | MLSG721M200EB0C     | 172        | 103    | 7.7         | 10     | 3.0             |
| <b>250 Vdc @ 125 °C</b><br>275 Vdc @ 105 °C<br>300 Vdc Surge @ 25 °C | 220      | MLSG221M250EK0C     | 597        | 393    | 4.1         | 5.1    | 1.5             |
|  | 560      | MLSG561M250EB0C     | 240        | 157    | 6.5         | 8.1    | 3.0             |

## Typical Performance Curves



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