

## Multilayer Ceramic Inductors

ISO 9002 CERTIFIED

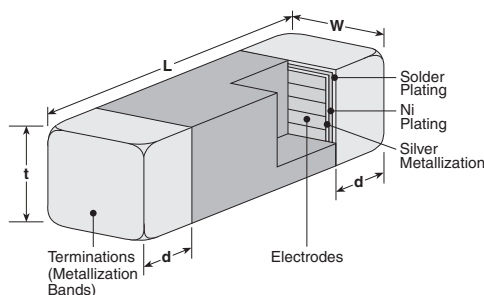
### Type MHL

#### 1. General

- Monolithic structure provides high reliability in a wide temperature and humidity range
- High quality ceramic material and unique manufacturing process provides high Q at high frequency
- Standard EIA packages: 1E, 1J, 2A
- Nickel barrier with solder overcoat for excellent solderability
- Marking: Brown body color with no marking (1E)  
White body color with with black stripe and no marking (1J)  
White body color with no marking (2A)

#### 2. Dimensions

Table 1



| Size Code                  | Dimensions inches (mm)  |                         |                              |                         |
|----------------------------|-------------------------|-------------------------|------------------------------|-------------------------|
|                            | L                       | W                       | t                            | d                       |
| <b>1E</b><br><b>(0402)</b> | .039±.004<br>(1.0±0.1)  | .02±.004<br>(0.5±0.1)   | .02±.004<br>(0.5±0.1)        | .01±.004<br>(0.25±0.1)  |
| <b>1J</b><br><b>(0603)</b> | .063±.006<br>(1.6±0.15) | .031±.006<br>(0.8±0.15) | .031±.006<br>(0.8±0.15)      | .012±.008<br>(0.30±0.2) |
| <b>2A</b><br><b>(0805)</b> | .079±.008<br>(2.0±0.2)  | .049±.008<br>(1.25±0.2) | .035±.012<=39nH<br>(0.9±0.3) | .02±.012<br>(0.50±0.3)  |
|                            |                         |                         | .039±.012>39nH<br>(1.0±0.3)  |                         |
|                            |                         |                         | .035±.012<39nH<br>(0.9±0.3)  |                         |

#### 3. Type Designation

The type designation shall be in the following form:

##### Old Type

|            |             |          |  |           |                    |           |
|------------|-------------|----------|--|-----------|--------------------|-----------|
| <b>MHI</b> | <b>0603</b> | <b>C</b> |  | <b>TE</b> | <b>3N9</b>         | <b>S</b>  |
| Type       | Size Code   | Material |  | Packaging | Nominal Inductance | Tolerance |

##### New Type

|            |                |                              |                      |                                                                                                                                                                                                                                                                                       |                            |                     |
|------------|----------------|------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------|
| <b>MHL</b> | <b>1E</b>      | <b>C</b>                     | <b>L</b>             | <b>TE</b>                                                                                                                                                                                                                                                                             | <b>3N9</b>                 | <b>S</b>            |
| Type       | Size           | Material                     | Termination Material | Packaging                                                                                                                                                                                                                                                                             | Nominal Inductance         | Tolerance           |
|            | 1E<br>1J<br>2A | Permeability Code:<br>C<br>T | L: SnPb<br>T: Sn     | TP: 7" paper tape 2mm pitch<br>(1E only - 10,000 pcs/reel)<br>TD: 7" paper tape<br>(1J - 4,000 pcs/reel)<br>TE: 7" embossed plastic<br>(2A - 1.5nH - 39nH: 4,000 pcs/reel<br>47nH - R33: 3,000 pcs/reel)<br>TEB: 13" embossed plastic<br>(1J - 12,000 pcs/reel, 2A - 10,000 pcs/reel) | 3N9 = 3.9nH<br>R10 = 100nH | S: ±0.3nH<br>J: ±5% |

## 4. Standard Applications

| Part Designation | Inductance L (nH) | Inductance Tolerance | Q                |                  |                  | Self Resonant Frequency Typical (MHz) | DC Resistance Maximum (Ω) | Allowable DC Current Maximum (mA) | Operating Temperature Range |                 |       |
|------------------|-------------------|----------------------|------------------|------------------|------------------|---------------------------------------|---------------------------|-----------------------------------|-----------------------------|-----------------|-------|
|                  |                   |                      | Minimum (100MHz) | Typical (100MHz) | Typical (800MHz) |                                       |                           |                                   |                             |                 |       |
| MHL1EC*TP1N0**   | 1.0               | S: ±0.3nH            | 8                | 11               | 34               | >15000                                | 0.12                      | 300                               | -40°C to +125°C             |                 |       |
| MHL1EC*TP1N2**   | 1.2               |                      |                  |                  |                  |                                       |                           |                                   |                             |                 |       |
| MHL1EC*TP1N5**   | 1.5               |                      |                  |                  |                  |                                       | 0.13                      |                                   |                             |                 |       |
| MHL1EC*TP1N8**   | 1.8               |                      |                  |                  | 30               | 14000                                 | 0.14                      |                                   |                             |                 |       |
| MHL1EC*TP2N2**   | 2.2               |                      |                  | 10               | 29               | 12000                                 | 0.16                      |                                   |                             |                 |       |
| MHL1EC*TP2N7**   | 2.7               |                      |                  |                  |                  | 9500                                  | 0.17                      |                                   |                             |                 |       |
| MHL1EC*TP3N3**   | 3.3               |                      |                  |                  | 28               |                                       | 8500                      |                                   |                             | 0.19            |       |
| MHL1EC*TP3N9**   | 3.9               |                      |                  |                  |                  |                                       | 7000                      |                                   |                             | 0.22            |       |
| MHL1EC*TP4N7**   | 4.7               |                      |                  |                  |                  |                                       | 6000                      |                                   |                             | 0.24            |       |
| MHL1EC*TP5N6**   | 5.6               |                      |                  |                  |                  |                                       | 5400                      |                                   |                             | 0.27            |       |
| MHL1EC*TP6N8**   | 6.8               |                      |                  |                  |                  | 5000                                  | 0.32                      |                                   |                             |                 |       |
| MHL1EC*TP8N2**   | 8.2               |                      |                  |                  |                  | 4600                                  | 0.37                      |                                   |                             |                 |       |
| MHL1EC*TP10N**   | 10                | 30                   |                  |                  | 3700             | 0.42                                  |                           |                                   |                             |                 |       |
| MHL1EC*TP12N**   | 12                | 11                   |                  | 31               | 3200             | 0.50                                  |                           |                                   |                             |                 |       |
| MHL1EC*TP15N**   | 15                |                      |                  | 30               |                  | 3100                                  | 0.55                      |                                   |                             |                 |       |
| MHL1EC*TP18N**   | 18                |                      |                  |                  |                  | 2900                                  | 0.65                      |                                   |                             |                 |       |
| MHL1EC*TP22N**   | 22                |                      |                  |                  |                  | 2100                                  | 0.8                       |                                   |                             |                 |       |
| MHL1EC*TP27N**   | 27                |                      |                  |                  | 27               | 1900                                  | 0.9                       |                                   |                             |                 |       |
| MHL1EC*TP33N**   | 33                |                      |                  | 25               |                  | 1600                                  | 1.0                       |                                   |                             |                 |       |
| MHL1EC*TP39N**   | 39                |                      |                  |                  |                  | 24                                    | 1400                      | 1.2                               |                             |                 |       |
| MHL1EC*TP47N**   | 47                |                      |                  |                  |                  | 23                                    | 1200                      | 1.3                               |                             |                 |       |
| MHL1EC*TP56N**   | 56                |                      |                  |                  |                  | 21                                    | 1100                      | 1.4                               |                             |                 |       |
| MHL1EC*TP68N**   | 68                | J: ±5%               |                  | 9                |                  | 9                                     | 1000                      | 2.2                               |                             |                 |       |
| MHL1EC*TP82N**   | 82                |                      |                  |                  |                  | 5                                     | 900                       | 2.5                               |                             |                 |       |
| MHL1EC*TPR10**   | 100               |                      |                  |                  |                  | 3                                     | 850                       |                                   |                             |                 |       |
|                  |                   |                      |                  |                  |                  |                                       |                           |                                   |                             |                 | 100   |
| MHL1JC*TE1N0**   | 1.0               | S: ±0.3nH            | 8                | 12               | 40               | >17000                                | 0.10                      | 300                               |                             | -40°C to +125°C |       |
| MHL1JC*TD1N2**   | 1.2               |                      |                  |                  |                  |                                       |                           |                                   |                             |                 |       |
| MHL1JC*TD1N5**   | 1.5               |                      |                  |                  |                  |                                       |                           |                                   |                             |                 |       |
| MHL1JC*TD1N8**   | 1.8               |                      |                  |                  |                  | 36                                    |                           |                                   |                             |                 | 13000 |
| MHL1JC*TD2N2**   | 2.2               |                      |                  |                  | 37               | 12000                                 |                           |                                   |                             |                 |       |
| MHL1JC*TD2N7**   | 2.7               |                      |                  | 13               | 41               |                                       | 8600                      |                                   |                             |                 |       |
| MHL1JC*TD3N3**   | 3.3               |                      |                  |                  |                  |                                       | 6500                      |                                   |                             |                 | 0.12  |
| MHL1JC*TD3N9**   | 3.9               |                      |                  |                  |                  |                                       | 6300                      |                                   |                             |                 | 0.14  |
| MHL1JC*TD4N7**   | 4.7               |                      |                  |                  |                  |                                       | 5400                      |                                   |                             |                 | 0.16  |
| MHL1JC*TD5N6**   | 5.6               |                      |                  |                  |                  | 42                                    | 4600                      |                                   |                             |                 | 0.18  |
| MHL1JC*TD6N8**   | 6.8               | 14                   |                  | 43               |                  | 4500                                  | 0.22                      |                                   |                             |                 |       |
| MHL1JC*TD8N2**   | 8.2               |                      |                  |                  |                  | 3800                                  | 0.24                      |                                   |                             |                 |       |
| MHL1JC*TD10N**   | 10                |                      |                  |                  |                  | 3700                                  | 0.26                      |                                   |                             |                 |       |
| MHL1JC*TD12N**   | 12                |                      |                  |                  |                  | 3200                                  | 0.28                      |                                   |                             |                 |       |
| MHL1JC*TD15N**   | 15                | 15                   |                  |                  |                  | 2900                                  | 0.32                      |                                   |                             |                 |       |
| MHL1JC*TD18N**   | 18                |                      |                  |                  |                  |                                       | 0.35                      |                                   |                             |                 |       |
| MHL1JC*TD22N**   | 22                |                      |                  |                  | 16               |                                       | 2100                      | 0.40                              |                             |                 |       |
| MHL1JC*TD27N**   | 27                |                      |                  |                  |                  | 2000                                  | 0.45                      |                                   |                             |                 |       |
| MHL1JT*TD27N**   | 27                |                      |                  | 1400             |                  | 0.55                                  |                           |                                   |                             |                 |       |
| MHL1JC*TD33N**   | 33                | 17                   |                  | 44               | 1600             |                                       |                           |                                   |                             |                 |       |

\* Add termination material character (L, T)

\*\* Add tolerance character (S, J)

## 4. Standard Applications (continued)

| Part Designation | Inductance L (nH) | Inductance Tolerance | Q                |                  |                  | Self Resonant Frequency Typical (MHz) | DC Resistance Maximum (Ω) | Allowable DC Current Maximum (mA) | Operating Temperature Range |      |      |
|------------------|-------------------|----------------------|------------------|------------------|------------------|---------------------------------------|---------------------------|-----------------------------------|-----------------------------|------|------|
|                  |                   |                      | Minimum (100MHz) | Typical (100MHz) | Typical (800MHz) |                                       |                           |                                   |                             |      |      |
| MHL1JC*TD39N**   | 39                | J: ±5%               | 10               | 17               | 40               | 1500                                  | 0.60                      | 300                               | -40°C to +125°C             |      |      |
| MHL1JT*TD39N**   | 39                |                      | 12               |                  | 15               |                                       | 1400                      |                                   |                             | 0.65 |      |
| MHL1JC*TD47N**   | 47                |                      |                  |                  |                  |                                       | 35                        |                                   |                             | 1200 | 0.70 |
| MHL1JC*TD56N**   | 56                |                      |                  |                  |                  | 12                                    | 1100                      |                                   |                             | 0.75 |      |
| MHL1JC*TD68N**   | 68                |                      |                  |                  |                  | 5                                     | 1000                      |                                   |                             | 0.85 |      |
| MHL1JC*TD82N**   | 82                |                      |                  | 8                |                  | 14                                    | —                         |                                   |                             | 850  | 0.95 |
| MHL1JC*TDR10**   | 100               |                      |                  |                  |                  |                                       |                           |                                   |                             | 750  | 1.2  |
| MHL1JC*TDR12**   | 120               |                      | 700              |                  | 1.3              |                                       |                           |                                   |                             |      |      |
| MHL1JC*TDR15**   | 150               |                      | 650              |                  | 1.4              |                                       |                           |                                   |                             |      |      |
| MHL1JC*TDR18**   | 180               |                      | 550              |                  | 1.5              |                                       |                           |                                   |                             |      |      |
| MHL1JC*TDR22**   | 220               |                      | 12               |                  | 450              | 1.7                                   |                           |                                   |                             |      |      |
| MHL2AC*TE1N5**   | 1.5               | S: ±0.3nH            | 8                | 18               | 60               | >6000                                 | 0.10                      | 300                               | -40°C to +125°C             |      |      |
| MHL2AC*TE1N8**   | 1.8               |                      |                  |                  | 55               |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE2N2**   | 2.2               |                      |                  |                  | 53               |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE2N7**   | 2.7               |                      | 12               | 16               | 54               | 5600                                  | 0.13                      |                                   |                             |      |      |
| MHL2AC*TE3N3**   | 3.3               |                      |                  | 18               |                  | 5500                                  | 0.15                      |                                   |                             |      |      |
| MHL2AC*TE3N9**   | 3.9               |                      |                  | 20               |                  | 60                                    | 4700                      |                                   |                             | 0.23 |      |
| MHL2AC*TE4N7**   | 4.7               |                      | 63               |                  | 3900             | 0.25                                  |                           |                                   |                             |      |      |
| MHL2AC*TE5N6**   | 5.6               | 60                   | 3200             |                  | 0.28             |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE6N8**   | 6.8               |                      | 3100             |                  | 0.30             |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE8N2**   | 8.2               |                      | 2800             |                  | 0.35             |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE10N**   | 10                |                      | 2400             |                  | 0.40             |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE12N**   | 12                |                      | 2100             |                  | 0.45             |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE15N**   | 15                | 22                   | 2000             | 0.50             |                  |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE18N**   | 18                |                      | 58               | 1800             | 0.55             |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE22N**   | 22                | 15                   | 23               | 55               | 1700             | 0.60                                  |                           |                                   |                             |      |      |
| MHL2AC*TE27N**   | 27                |                      |                  | 47               | 1400             | 0.65                                  |                           |                                   |                             |      |      |
| MHL2AC*TE33N**   | 33                |                      |                  | 43               | 1200             | 0.70                                  |                           |                                   |                             |      |      |
| MHL2AC*TE39N**   | 39                |                      |                  | 39               | 1000             | 0.75                                  |                           |                                   |                             |      |      |
| MHL2AC*TE47N**   | 47                |                      |                  | 30               | 900              | 0.80                                  |                           |                                   |                             |      |      |
| MHL2AC*TE56N**   | 56                |                      |                  | 21               | 900              | 0.90                                  |                           |                                   |                             |      |      |
| MHL2AC*TE68N**   | 68                |                      |                  |                  | 700              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TE82N**   | 82                | 13                   | 20               | 600              | 0.95             |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER10**   | 100               |                      |                  | 500              | 1.0              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER12**   | 120               |                      |                  | 430              | 1.1              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER15**   | 150               | 12                   | 19               | 400              | 1.2              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER18**   | 180               |                      |                  | 340              | 1.3              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER22**   | 220               |                      |                  | 320              | 1.5              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER27**   | 270               | 10                   | 16               | 270              | 1.6              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER33**   | 330               |                      |                  | 250              | 1.8              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER39**   | 390               |                      |                  | 230              | 2.5              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER47**   | 470               | 14                   | —                | 180              | 3.0              |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER56**   | 560               |                      |                  |                  |                  |                                       |                           |                                   |                             |      |      |
| MHL2AC*TER68**   | 680               |                      |                  |                  |                  |                                       |                           |                                   |                             |      |      |

\* Add termination material character (L, T)

\*\* Add tolerance character (S, J)

## 5. Characteristics

| Item                             | Requirement                                                                                                                                                                                                              | Conditions                                                                                                                                                                                                                                                                                                                                                                          |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------|------|----|---|-----|----|-----|--------------------|----|-----|--------------------|----|-----|--------------------|
| Operating Temperature            | -40°C to +125°C                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                     |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Storage Temperature              | 40°C @ 70% Humidity                                                                                                                                                                                                      | Sealed plastic bags with desiccant shall be used to reduce the potential of oxidation on the terminations during storage.                                                                                                                                                                                                                                                           |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Resistance to Solder Heat        | <b>Change in Impedance:</b> Relative to value before test $\pm 20\%$ .<br><b>Appearance:</b> There shall be no cracking<br><b>Solder Coverage:</b> More than 75% of the terminal electrode shall be covered with solder. | <b>Flux:</b> 5-10 sec dip<br><b>After Flux:</b> Air dry for 15 sec<br><b>Preheat:</b> 150°C $\pm 10^\circ\text{C}$<br><b>Preheat Time:</b> 60 sec<br><b>Solder Temp:</b> 260°C $\pm 5^\circ\text{C}$<br><b>Dip Time:</b> 10 $\pm 1$ sec                                                                                                                                             |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Solderability                    | <b>Solder Coverage:</b> More than 95% of the termination shall be covered with solder.                                                                                                                                   | <b>Flux:</b> 5-10 sec dip<br><b>After Flux:</b> Air dry for 15 sec<br><b>Solder Temp:</b> 245°C $\pm 5^\circ\text{C}$<br><b>Dip Time:</b> 5 $\pm 0.5$ sec                                                                                                                                                                                                                           |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Leach Resistance                 | <b>Appearance:</b> There shall be no visible signs of physical or mechanical damage (i.e. no cracks)<br><b>Terminations:</b> Termination must not be leached away for more than 5%.                                      | The bead shall be subjected to the following 5 steps for the period of time shown below. The 5 steps constitute one (1) rotation. 4 rotations shall be carried out.<br>1) <b>Flux:</b> 5-10 sec<br>2) <b>After Flux:</b> Air dry for 15 sec<br>3) <b>Solder Temp:</b> 230°C $\pm 5^\circ\text{C}$<br>4) <b>Dip Time:</b> 5 $\pm 0.5$ sec<br>5) <b>Cool:</b> Air cool for 60 seconds |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Insulation Resistance            | <b>Insulation Resistance:</b> Min 1G ohms                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                     |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Solvent Resistance               | <b>Change in Impedance:</b> Relative to value before test $\pm 10\%$ .                                                                                                                                                   | Cleaning by: <b>Washer:</b> Ultrasonic washer (100W)<br><b>Solvent:</b> Isopropyl alcohol<br><b>Time:</b> 3 minutes                                                                                                                                                                                                                                                                 |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Terminal Strength (hanging test) | <b>Appearance:</b> The terminal electrode shall not break off, nor shall there be damage to the body.                                                                                                                    | <table> <tr> <th>Type</th><th>W(kgf)</th><th>Time</th></tr> <tr> <td>1E</td><td>—</td><td>N/A</td></tr> <tr> <td>1J</td><td>0.5</td><td>30 sec <math>\pm 2</math> sec</td></tr> <tr> <td>2A</td><td>1.0</td><td>30 sec <math>\pm 2</math> sec</td></tr> <tr> <td>2B</td><td>1.5</td><td>30 sec <math>\pm 2</math> sec</td></tr> </table>                                            | Type | W(kgf) | Time | 1E | — | N/A | 1J | 0.5 | 30 sec $\pm 2$ sec | 2A | 1.0 | 30 sec $\pm 2$ sec | 2B | 1.5 | 30 sec $\pm 2$ sec |
| Type                             | W(kgf)                                                                                                                                                                                                                   | Time                                                                                                                                                                                                                                                                                                                                                                                |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 1E                               | —                                                                                                                                                                                                                        | N/A                                                                                                                                                                                                                                                                                                                                                                                 |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 1J                               | 0.5                                                                                                                                                                                                                      | 30 sec $\pm 2$ sec                                                                                                                                                                                                                                                                                                                                                                  |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 2A                               | 1.0                                                                                                                                                                                                                      | 30 sec $\pm 2$ sec                                                                                                                                                                                                                                                                                                                                                                  |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 2B                               | 1.5                                                                                                                                                                                                                      | 30 sec $\pm 2$ sec                                                                                                                                                                                                                                                                                                                                                                  |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Terminal Strength (push test)    | <b>Appearance:</b> There shall be no evidence of mechanical degradations to terminals or body.                                                                                                                           | <table> <tr> <th>Type</th><th>W(kgf)</th><th>Time</th></tr> <tr> <td>1E</td><td>—</td><td>N/A</td></tr> <tr> <td>1J</td><td>1.4</td><td>60 sec</td></tr> <tr> <td>2A</td><td>1.8</td><td>60 sec</td></tr> <tr> <td>2B</td><td>2.3</td><td>60 sec</td></tr> </table>                                                                                                                 | Type | W(kgf) | Time | 1E | — | N/A | 1J | 1.4 | 60 sec             | 2A | 1.8 | 60 sec             | 2B | 2.3 | 60 sec             |
| Type                             | W(kgf)                                                                                                                                                                                                                   | Time                                                                                                                                                                                                                                                                                                                                                                                |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 1E                               | —                                                                                                                                                                                                                        | N/A                                                                                                                                                                                                                                                                                                                                                                                 |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 1J                               | 1.4                                                                                                                                                                                                                      | 60 sec                                                                                                                                                                                                                                                                                                                                                                              |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 2A                               | 1.8                                                                                                                                                                                                                      | 60 sec                                                                                                                                                                                                                                                                                                                                                                              |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| 2B                               | 2.3                                                                                                                                                                                                                      | 60 sec                                                                                                                                                                                                                                                                                                                                                                              |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |
| Bending Strength                 | <b>Appearance:</b> There shall be no physical or mechanical damage<br><b>Impedance:</b> Relative to initial value before test $\pm 10\%$                                                                                 | <b>Board:</b> 90x40x1.6mm<br><b>Bend:</b> 1mm<br><b>Time:</b> 5 sec                                                                                                                                                                                                                                                                                                                 |      |        |      |    |   |     |    |     |                    |    |     |                    |    |     |                    |

## 5. Characteristics (continued)

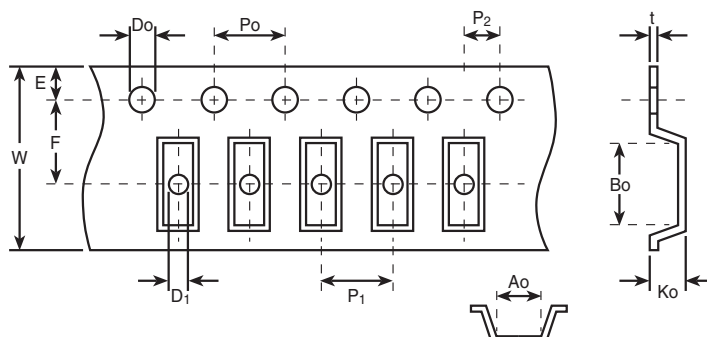
| Item             | Requirement                                                                                                                                                                                                                                                                                                                                                        | Conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|------|---------|---------------------------------------------|-------|--------|---------------------------------------------|--------------------|------------|-------|--------------|--------|----------------------------------------------|--------------------|------------|-------|--------------|
| Mechanical Shock | <b>Appearance:</b> There shall be no physical or mechanical damage<br><b>Impedance:</b> Relative to initial value before test $\pm 10\%$                                                                                                                                                                                                                           | <b>Force:</b> 50G<br><b>Time:</b> 11 msec<br>There shall be 3 shocks in each of 6 directions (18 shocks total).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| Vibration        | <b>Impedance:</b> Relative to initial value $\pm 10\%$                                                                                                                                                                                                                                                                                                             | Only endurance conditioning by sweeping shall be made. The entire frequency range from 10-2,000 Hz and return to 10 Hz in 20 minutes (this shall constitute one cycle).<br>Amplitude: 15G<br>The test shall have a 15G peak and shall be applied for a period of 4 hours (12 cycles) in each of 3 mutually perpendicular directions (a total of 36 cycles within a total of 12 hours).                                                                                                                                                                                                                                                                                                                                               |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| Thermal Shock    | <b>Appearance:</b> There shall be no physical or mechanical damage.<br><b>Impedance:</b> Relative to initial value $\pm 20\%$ .<br><b>DCR:</b> The DCR shall not exceed initial specified value.<br><br>Testing of the parts will be made at 0 hours, 250 hours and 500 hours. Before testing the parts shall be allowed to cool to room temperature for 24 hours. | <table border="1"> <thead> <tr> <th>Step</th><th>Temperature</th><th>Time</th></tr> </thead> <tbody> <tr> <td>1-start</td><td><math>-40^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></td><td>_____</td></tr> <tr> <td>2-hold</td><td><math>-40^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></td><td>30 min <math>\pm 5</math> min</td></tr> <tr> <td>3-transfer</td><td>_____</td><td>0.5 min max.</td></tr> <tr> <td>4-hold</td><td><math>+105^{\circ}\text{C} \pm 2^{\circ}\text{C}</math></td><td>30 min <math>\pm 5</math> min</td></tr> <tr> <td>5-transfer</td><td>_____</td><td>0.5 min max.</td></tr> </tbody> </table><br>Steps 1 thru 5 constitute one complete cycle and the test shall consist of a total of 500 cycles. | Step | Temperature | Time | 1-start | $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ | _____ | 2-hold | $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ | 30 min $\pm 5$ min | 3-transfer | _____ | 0.5 min max. | 4-hold | $+105^{\circ}\text{C} \pm 2^{\circ}\text{C}$ | 30 min $\pm 5$ min | 5-transfer | _____ | 0.5 min max. |
| Step             | Temperature                                                                                                                                                                                                                                                                                                                                                        | Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| 1-start          | $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$                                                                                                                                                                                                                                                                                                                        | _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| 2-hold           | $-40^{\circ}\text{C} \pm 2^{\circ}\text{C}$                                                                                                                                                                                                                                                                                                                        | 30 min $\pm 5$ min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| 3-transfer       | _____                                                                                                                                                                                                                                                                                                                                                              | 0.5 min max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| 4-hold           | $+105^{\circ}\text{C} \pm 2^{\circ}\text{C}$                                                                                                                                                                                                                                                                                                                       | 30 min $\pm 5$ min                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| 5-transfer       | _____                                                                                                                                                                                                                                                                                                                                                              | 0.5 min max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| Load Humidity    | <b>Appearance:</b> There shall be no physical or mechanical damage<br><b>Impedance:</b> Relative to initial value $\pm 15\%$<br><br>Measurements shall be taken at 0 hours, 250 hours, 500 hours and 1,000 hours and shall meet the conditions stated above.                                                                                                       | <b>Temperature:</b> $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br><b>Relative Humidity:</b> 85%<br><b>Time:</b> 1,000 hours total<br><b>Apply:</b> 100% rated current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |
| Life Test        | <b>Appearance:</b> There shall be no physical or mechanical damage<br><b>Impedance:</b> Relative to initial value $\pm 15\%$<br><br>Measurements shall be taken at 0 hours, 250 hours, 500 hours and 1,000 hours and shall meet the conditions stated above.                                                                                                       | <b>Temperature:</b> $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$<br><b>Time:</b> 1,000 hours total<br><b>Apply:</b> 100% rated current                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |      |             |      |         |                                             |       |        |                                             |                    |            |       |              |        |                                              |                    |            |       |              |

## 6. Packaging Specifications

KOA's multilayer components are provided on tape-and-reel for use in pick-and-place machines. The reel size is 7 inch.

## 7. Dimensions - inches (mm)

| Tape | Ao                      | Bo                       | Ko                      |
|------|-------------------------|--------------------------|-------------------------|
| 1E   | .026±.004<br>(0.67±0.1) | .046±.004<br>(1.17±0.1)  | .025±.004<br>(0.63±0.1) |
| 1J   | .045±.004<br>(1.15±0.1) | .073±.004<br>(1.85±0.1)  | .043±.004<br>(1.1±0.1)  |
| 2A   | .063±.002<br>(1.6±0.05) | .093±0.002<br>(2.4±0.05) | .046±.004<br>(1.2±0.1)  |



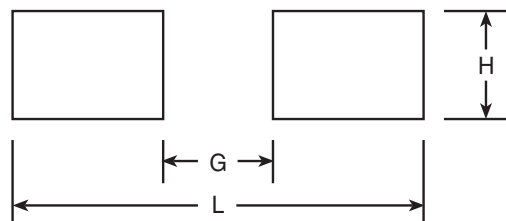
| Tape | E                        | F                       | W                      | P <sub>1</sub>          | P <sub>0</sub>         | P <sub>2</sub>          | D <sub>0</sub>              | D <sub>1</sub>          | t                        |
|------|--------------------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|-----------------------------|-------------------------|--------------------------|
| 1E   |                          |                         | .315±.008<br>(8.0±0.2) | .079±.009<br>(2.0±0.23) | .079±.004<br>(2.0±0.1) |                         |                             |                         |                          |
| 1J   | .069±.004<br>(1.75±0.10) | .138±.002<br>(3.5±0.05) | .315±.004<br>(8.0±0.1) | .157±.004<br>(4.0±0.1)  | .157±.004<br>(4.0±0.1) | .079±.002<br>(2.0±0.05) | .059±.004<br>(1.5+0.1/-0.0) | .039 min.<br>(1.0 min.) | .009±.001<br>(0.23±0.02) |
| 2A   |                          |                         |                        |                         |                        |                         |                             |                         |                          |

## 8. Chip Quantities Per Reel

| Chip Size   | Parts on<br>7 inch (178mm) Reel | Parts on<br>13 inch (330mm) Reel |
|-------------|---------------------------------|----------------------------------|
| 0402 (1005) | 10,000                          | —                                |
| 0603 (1608) | 4,000                           | 4,000                            |
| 0805 (2012) | 4,000 = 1.5nH ~ 3.5nH           | 4,000                            |
|             | 3,000 = 47nH ~ R68              |                                  |

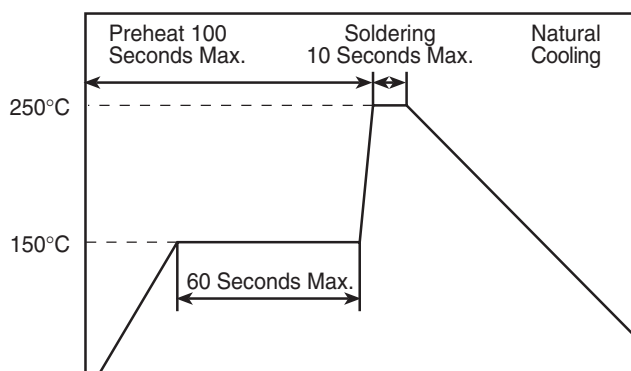
## 9. Recommended PC Board Land Patterns - inches (mm)

| Chip Size | L          | G          | H          |
|-----------|------------|------------|------------|
| 1E (0402) | .05 (1.3)  | .015 (0.4) | .019 (0.5) |
| 1J (0603) | .102 (2.6) | .023 (0.6) | .031 (0.8) |
| 2A (0805) | .118 (3.0) | .039 (1.0) | .039 (1.0) |



## 10. Recommended Temperature Profiles for Soldering

**Recommended Temperature Profile  
for Wave Soldering**



**Recommended Temperature Profile  
for Reflow Soldering**

