

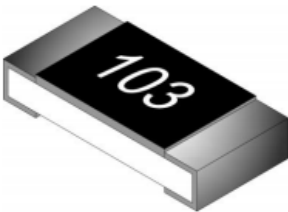


**Thin Film Technology Corp.**

**Product Family:** Automotive Anti-Sulfur Thick Film Chip Resistors

**Part Number Series:** KGAS Series

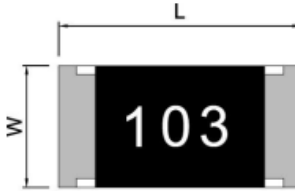
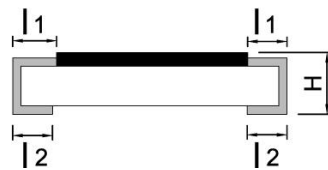
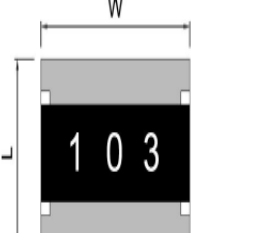
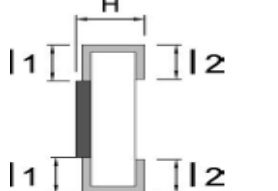


|                                                                                   |                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Construction:</b></p> <ul style="list-style-type: none"> <li>Alumina substrate</li> <li>Highly reliable and stable thick film resistive element</li> <li>Wrap around electrodes</li> <li>RoHS 2011/65/EU compliant and Pb free (100% tin terminations)</li> <li>EIA-977-B 105°C Anti-Sulfur Resistant</li> </ul> | <p><b>Features:</b></p> <ul style="list-style-type: none"> <li>0402, 0603, 0805, 1206, 1210, 1218, 1812, 2010, and 2512 English case sizes</li> <li>Resistances from 1Ω to 10MΩ</li> <li>Tolerance of ±0.5%, ±1.0% and ±5.0%</li> <li>Jumpers Available</li> <li>AEC-Q200 Qualified</li> </ul> |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Description:

These precision chip resistors are sulfur resistant making them an excellent choice for industrial control applications, navigation applications, measuring applications and telecommunication applications. High volume manufacturing allows for lower costs for the customer.

### Product Dimensions:

|                                                                                                    |                                                                                                     |                                                                                                              |                                                                                                                |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
|  <p>Top View</p> |  <p>Side View</p> |  <p>KGAS1218 Top View</p> |  <p>KGAS1218 Side View</p> |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|

All dimensions are shown in inches, mm in parentheses.

| Dimension (Metric) | KGAS0402 (1005)           | KGAS0603 (1608)           | KGAS0805 (2012)           | KGAS1206 (3216)           | KGAS1210 (3225)           | KGAS1218 (3245)           | KGAS1812 (4532)           | KGAS2010 (5025)           | KGAS2512 (6332)           |
|--------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| L                  | 0.039 ±0.004 (1.00 ±0.10) | 0.063 ±0.008 (1.60 ±0.20) | 0.079 ±0.008 (2.00 ±0.20) | 0.120 ±0.004 (3.05 ±0.10) | 0.120 ±0.004 (3.05 ±0.10) | 0.122 ±0.004 (3.10 ±0.10) | 0.177 ±0.004 (4.50 ±0.10) | 0.197 ±0.008 (5.00 ±0.20) | 0.248 ±0.008 (6.30 ±0.20) |
| W                  | 0.020 ±0.002 (0.50 ±0.05) | 0.031 ±0.006 (0.80 ±0.15) | 0.049 ±0.006 (1.25 ±0.15) | 0.063 ±0.008 (1.60 ±0.20) | 0.099 ±0.008 (2.50 ±0.20) | 0.181 ±0.004 (4.60 ±0.10) | 0.122 ±0.004 (3.10 ±0.10) | 0.099 ±0.008 (2.50 ±0.20) | 0.126 ±0.008 (3.20 ±0.20) |
| H                  | 0.012 ±0.002 (0.30 ±0.05) | 0.016 ±0.004 (0.40 ±0.10) | 0.020 ±0.006 (0.50 ±0.15) | 0.022 ±0.006 (0.55 ±0.15) | 0.022 ±0.006 (0.55 ±0.15) | 0.022 ±0.002 (0.55 ±0.05) | 0.022 ±0.002 (0.55 ±0.05) | 0.022 ±0.004 (0.55 ±0.10) | 0.022 ±0.004 (0.55 ±0.10) |
| l1                 | 0.006 ±0.004 (0.15 ±0.10) | 0.012 ±0.008 (0.30 ±0.20) | 0.012 ±0.006 (0.30 ±0.15) | 0.016 ±0.008 (0.40 ±0.20) | 0.020 ±0.008 (0.50 ±0.20) | 0.016 ±0.008 (0.40 ±0.20) | 0.022 ±0.008 (0.55 ±0.20) | 0.024 ±0.008 (0.60 ±0.20) | 0.024 ±0.008 (0.60 ±0.20) |
| l2                 | 0.008 ±0.004 (0.20 ±0.10) | 0.012 ±0.004 (0.30 ±0.10) | 0.016 ±0.006 (0.40 ±0.15) | 0.020 ±0.008 (0.50 ±0.20) | 0.020 ±0.008 (0.50 ±0.20) | 0.020 ±0.008 (0.50 ±0.20) | 0.028 ±0.008 (0.70 ±0.20) | 0.024 ±0.008 (0.60 ±0.20) | 0.024 ±0.008 (0.60 ±0.20) |

**Part Numbering:** Ex: KGAS0603R1001F-T5

| Product Designator | English Size (Metric)                                                                                                               | Temp. Coefficient of Resistance (TCR)                                                                         | Resistance Value                                                                                                                                      | Resistance Tolerance                 | T&R Packaging Quantity                                                                                          |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| KGAS               | 0402 (1005)<br>0603 (1608)<br>0805 (2012)<br>1206 (3216)<br>1210 (3225)<br>1218 (3245)<br>1812 (4532)<br>2010 (5025)<br>2512 (6332) | R = ±100 ppm/°C<br>W = See Charts<br><br>(TCR value is determined by resistance value. See electrical tables) | 4 digits with the first 3 being significant. The last digit specifies the number of zeros. "R" denotes decimal position as necessary<br>Jumper = JUMP | D = ±0.5%<br>F = ±1.0%*<br>J = ±5.0% | -T4 = 4,000<br>-T5 = 5,000<br>-T10 = 10,000<br><br>See electrical tables for available options versus case size |

\* Note: Use "F" resistance tolerance code for all Jumper products indicating max resistance of 50mΩ.

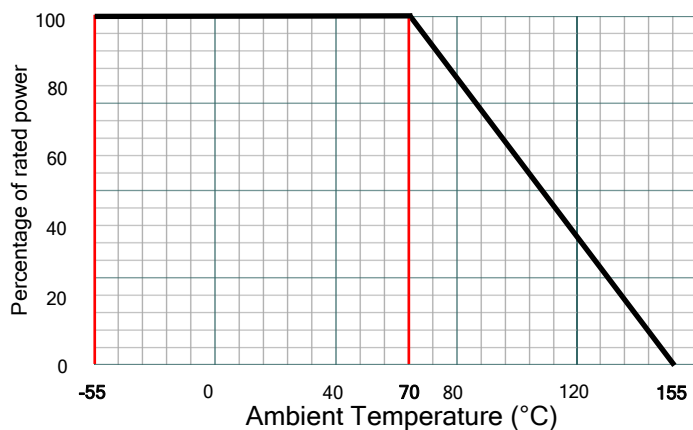
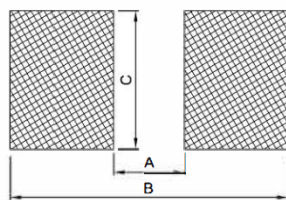
**Electrical Specifications:**

| Type                  |                      | KGAS0402       |            | KGAS0603  |               | KGAS0805  |            | KGAS1206  |            |
|-----------------------|----------------------|----------------|------------|-----------|---------------|-----------|------------|-----------|------------|
| Metric Size           |                      | 1005           |            | 1608      |               | 2012      |            | 3216      |            |
| Power                 |                      | 1/16 Watt      |            | 1/10 Watt |               | 1/8 Watt  |            | 1/4 Watt  |            |
| Max Operating Voltage |                      | 50V            |            | 75V       |               | 150V      |            | 200V      |            |
| Max Overload Voltage  |                      | 100V           |            | 150V      |               | 300V      |            | 400V      |            |
| TCR ppm/°C (code)     |                      | ±400(W)        | ±100(R)    | ±400(W)   | ±100(R)       | ±400(W)   | ±100(R)    | ±400(W )  | ±100(R)    |
| Tolerance % (code)    | ±0.5%(D)             | -              | 10Ω ~ 1MΩ  | -         | 10Ω ~ 1MΩ     | -         | 10Ω ~ 1MΩ  | -         | 10Ω ~ 1MΩ  |
|                       | ±1.0%(F)<br>±5.0%(J) | 1Ω ~ 9.9Ω      | 10Ω ~ 10MΩ | 1Ω ~ 9.9Ω | 10Ω ~ 10MΩ    | 1Ω ~ 9.9Ω | 10Ω ~ 10MΩ | 1Ω ~ 9.9Ω | 10Ω ~ 10MΩ |
| Operating Temp. Range |                      | -55°C ~ 155°C  |            |           |               |           |            |           |            |
| Packaging             |                      | 10,000pcs/reel |            |           | 5,000pcs/reel |           |            |           |            |

| Type                  |                   | KGAS1210      |            | KGAS1218      |            | KGAS1812  |            | KGAS2010  |            | KGAS2512  |            |
|-----------------------|-------------------|---------------|------------|---------------|------------|-----------|------------|-----------|------------|-----------|------------|
| Metric Size           |                   | 3225          |            | 3245          |            | 4532      |            | 5025      |            | 6332      |            |
| Power                 |                   | 1/2 Watt      |            | 1 Watt        |            | 3/4 Watt  |            | 3/4 Watt  |            | 1 Watt    |            |
| Max Operating Voltage |                   | 200V          |            |               |            |           |            |           |            |           |            |
| Max Overload Voltage  |                   | 400V          |            |               |            |           |            |           |            |           |            |
| TCR ppm/°C (code)     |                   | ±400(W)       | ±100(R)    | ±400(W)       | ±100(R)    | ±400(W)   | ±100(R)    | ±400(W)   | ±100(R)    | ±400(W)   | ±100(R)    |
| Tolerance % (code)    | ±0.5%(D)          | -             | 10Ω ~ 1MΩ  | -             | 10Ω ~ 1MΩ  | -         | 10Ω ~ 1MΩ  | -         | 10Ω ~ 1MΩ  | -         | 10Ω ~ 1MΩ  |
|                       | ±1.0%(F) ±5.0%(J) | 1Ω ~ 9.9Ω     | 10Ω ~ 10MΩ | 1Ω ~ 9.9Ω     | 10Ω ~ 10MΩ | 1Ω ~ 9.9Ω | 10Ω ~ 10MΩ | 1Ω ~ 9.9Ω | 10Ω ~ 10MΩ | 1Ω ~ 9.9Ω | 10Ω ~ 10MΩ |
| Operating Temp. Range |                   | -55°C ~ 155°C |            |               |            |           |            |           |            |           |            |
| Packaging             |                   | 5,000pcs/reel |            | 4,000pcs/reel |            |           |            |           |            |           |            |

**Conditions for Jumper:**

| Type                  | KGAS0402          | KGAS0603 | KGAS0805 | KGAS1206 | KGAS1210 | KGAS1218 | KGAS1812 | KGAS2010 | KGAS2512 |
|-----------------------|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Resistance            | MAX 0.050Ω (50mΩ) |          |          |          |          |          |          |          |          |
| Rated Current         | 1A                |          |          |          | 2A       |          |          |          |          |
| Operating Temp. Range | -55°C ~ 155°C     |          |          |          |          |          |          |          |          |

**Power Derating Curve:****Recommended Land Pattern and Dimensions:**

All dimensions in mm.

| Type | 0402 | 0603 | 0805 | 1206 | 1210 | 1218 | 1812 | 2010 | 2512 |
|------|------|------|------|------|------|------|------|------|------|
| A    | 0.60 | 0.80 | 1.30 | 2.20 | 2.00 | 2.04 | 3.11 | 3.80 | 4.90 |
| B    | 1.60 | 2.40 | 2.90 | 4.20 | 4.40 | 4.24 | 4.91 | 6.60 | 8.10 |
| C    | 0.70 | 1.00 | 1.40 | 1.70 | 2.70 | 4.80 | 3.00 | 2.70 | 3.40 |

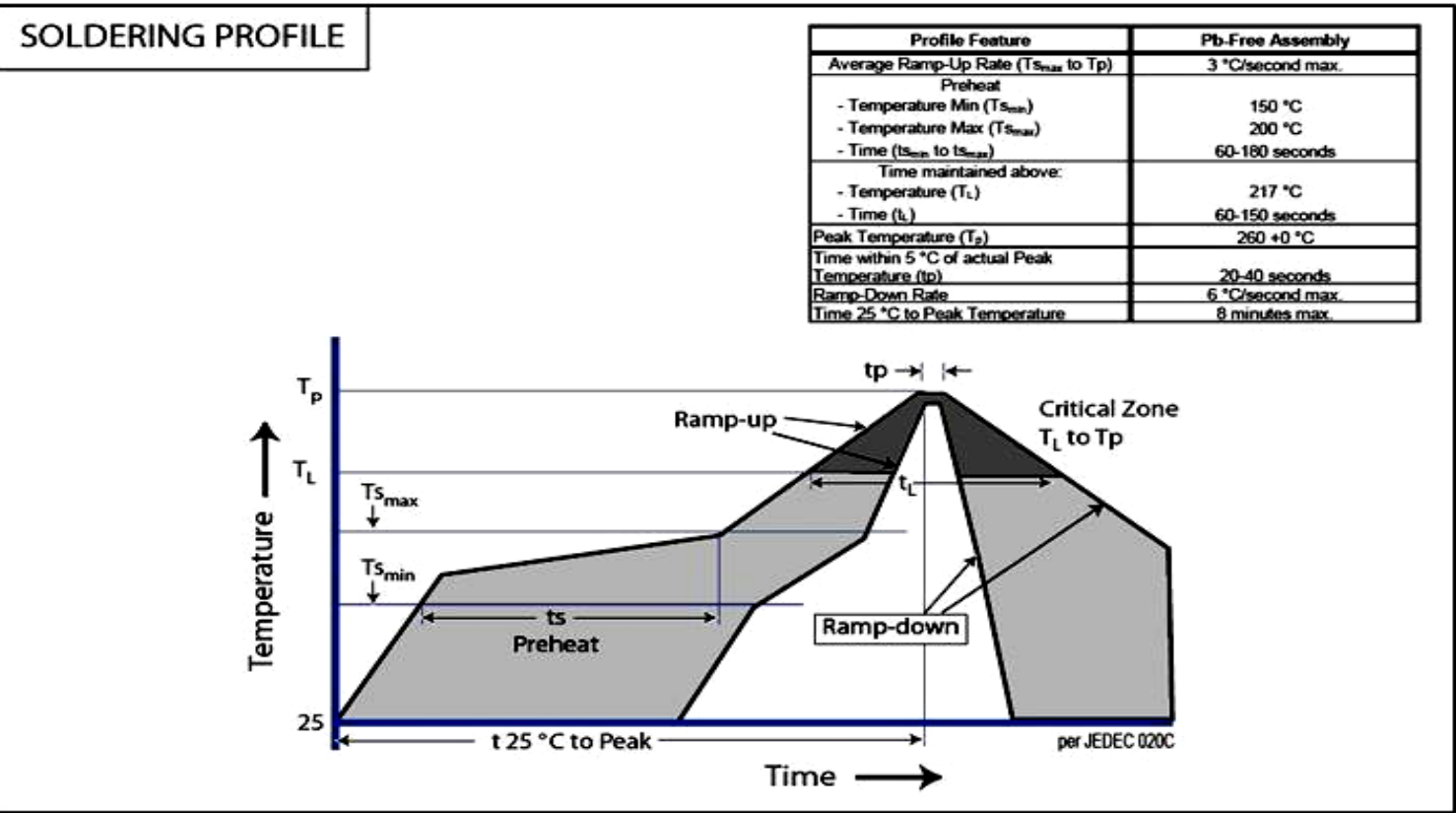
**Reliability Specifications:**

| Test                                                                    | Procedure                                                                                                                          | Specification                                                                                                                               |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Temperature Coefficient of Resistance</b><br>JIS C 5201-1 clause 4.8 | Tested at 25°C and 125°C, with 25°C being the reference temperature                                                                | Refer to Ratings                                                                                                                            |
| <b>Short Time Overload</b><br>JIS C 5201-1 clause 4.13                  | 2.5x Rated Power or Max. Overload voltage whichever is less for 5 seconds.                                                         | 1% : $\pm(1.0\%+0.05\ \Omega)$<br>5% : $\pm(2.0\%+0.10\ \Omega)$                                                                            |
| <b>Leaching</b><br>Sony SS-00254-9                                      | 260 $\pm$ 5°C for 30 seconds.                                                                                                      | >95% Coverage                                                                                                                               |
| <b>Resistance to Soldering Heat</b><br>JIS C 5201-1 clause 4.18         | 260 $\pm$ 5°C for 10 seconds.                                                                                                      | 1%: $\pm(0.5\%+0.05\ \Omega)$<br>5%: $\pm(1.0\%+0.05\ \Omega)$                                                                              |
| <b>Temperature Cycling</b><br>JIS C 5201-1 clause 4.19                  | -55°C to +155°C, 5 cycles                                                                                                          | 0.5% $\pm(0.5\%+0.05\ \Omega)$<br>1%: $\pm(0.5\%+0.05\ \Omega)$<br>5%: $\pm(1.0\%+0.10\ \Omega)$                                            |
| <b>Resistance to Solvent</b><br>JIS C 5201-1 clause 4.29                | The tested resistor be immersed into isopropyl alcohol of 20- 25°C for 60 secs. Then the resistor is left in the room for 48 hrs.  | 1% : $\pm(0.5\%+0.05\ \Omega)$<br>5% : $\pm(0.5\%+0.05\ \Omega)$                                                                            |
| <b>Load Life in Humidity</b><br>JIS C 4201-1- clause 4.24               | 40 $\pm$ 2°C , 90-95% R.H. Rated Power or Max. working voltage whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" . | 0.5% $\pm(1.0\%+0.05\ \Omega)$<br>1%: $\pm(1.0\%+0.05\ \Omega)$<br>5%: $\pm(2.0\%+0.05\ \Omega)$<br><1 $\Omega$ : $\pm(2.0\%+0.05\ \Omega)$ |
| <b>Load Life (Endurance)</b><br>JIS C 5201-1 clause 4.25                | 70 $\pm$ 2°C, Rated Power or Max Working voltage whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF".                | 0.5% $\pm(1.0\%+0.05\ \Omega)$<br>1%: $\pm(1.0\%+0.05\ \Omega)$<br>5%: $\pm(3.0\%+0.05\ \Omega)$<br><1 $\Omega$ : $\pm(3.0\%+0.05\ \Omega)$ |
| <b>Terminal Bending Strength</b><br>JIS C 5201-1 clause 4.33            | Bending once for 5 seconds<br>D: 0402, 0603, 0805 = 5mm<br>1206, 1210, 1812 = 3mm<br>1218, 2010, 2512 = 2mm                        | 1% : $\pm(1.0\%+0.05\ \Omega)$<br>5%: $\pm(1.0\%+0.05\ \Omega)$                                                                             |
| <b>Sulfur Test</b><br>ASTM-B-809-95                                     | 60 $\pm$ 2°C, no rating power for 1000 hrs                                                                                         | $\Delta R$ : $\pm(1.0\%+0.05\ \Omega)$                                                                                                      |
|                                                                         | 105 $\pm$ 2°C, no rating power for 1000 hrs                                                                                        | $\Delta R$ : $\pm(4.0\%+0.05\ \Omega)$                                                                                                      |

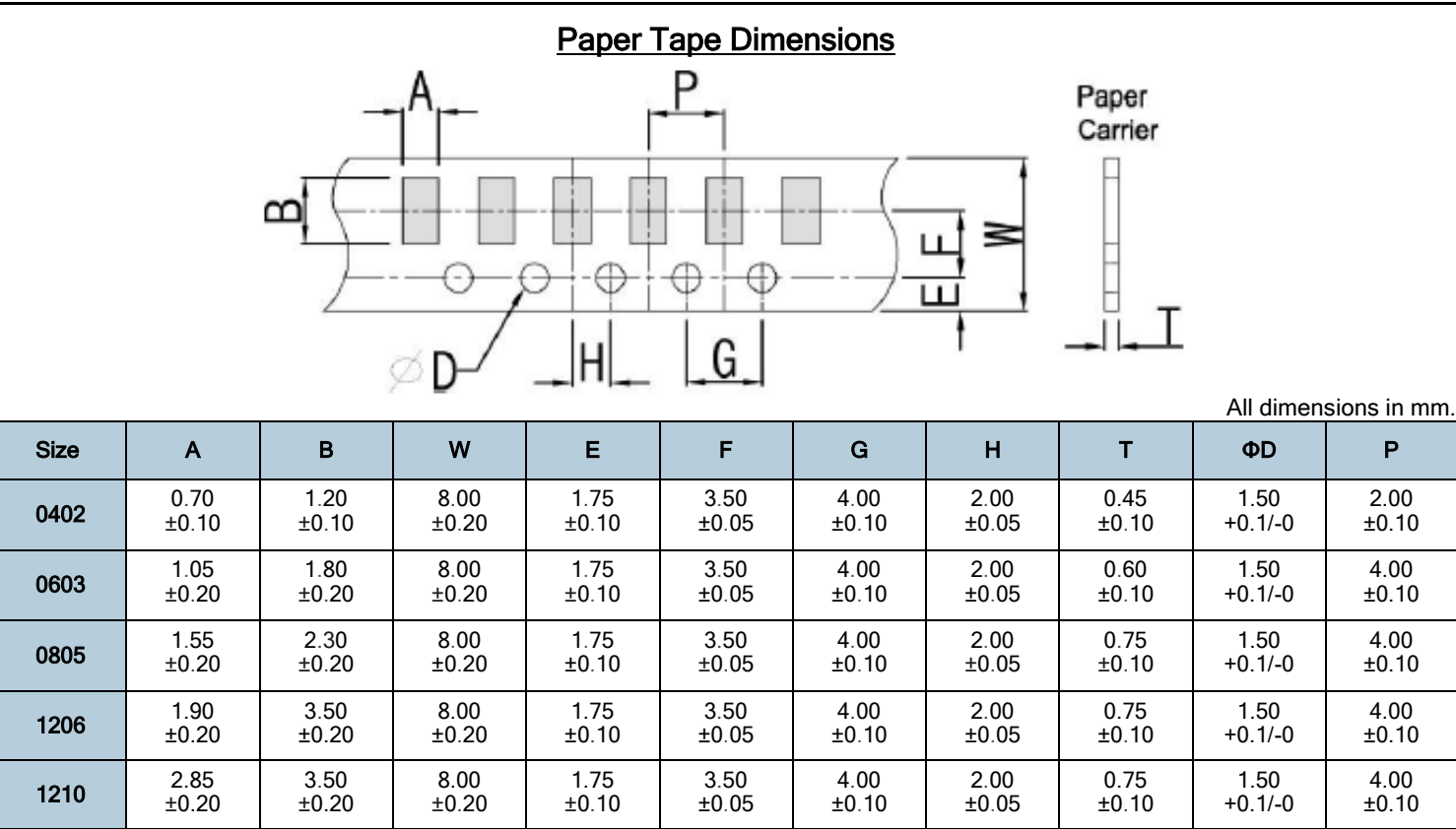
**AEC-Q200 Testing Specifications:**

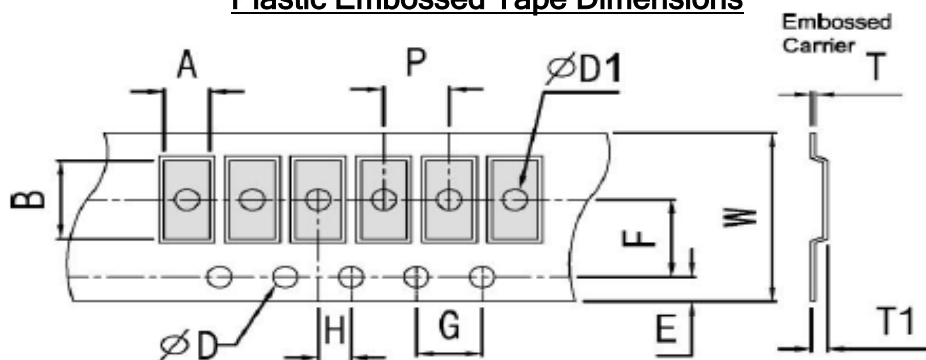
| Test                            | Requirements                                                                                                       | Specification                            |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| High Temp. Exposure (Storage)   | Test Temperature: 125°C ± 2°C<br>Test period: 1,000 hours<br>No electrical load                                    | ±(0.5%+0.05Ω)<br>MIL-STD-202 Method 108  |
| Temperature Cycling             | Repeat 1,000 cycles as follows:<br>-55 ±3°C (30 min.) / +155 ±3°C (30 min.)<br>Transition time of 1 minute maximum | ±(0.5%+0.05Ω)<br>JESD22 Method JA-104    |
| Thermal Shock                   | Repeat 300 cycles as follows:<br>-40±3°C (30 min) / + 125±3°C (30 min)                                             | ±(1.0%+0.001Ω)<br>MIL-STD-202 Method 107 |
| Biased Humidity                 | Test Condition: 85°C/85% RH<br>10% of rated power.<br>Test period: 1,000 hours                                     | ±(1.0%+0.05Ω)<br>MIL-STD-202 Method 103  |
| Load Life<br>(Operational Life) | Test Temperature: 70°C ± 3°C<br>Applied voltage: rated power<br>Test period: 1,000 hours                           | ±(1.0%+0.05Ω)<br>MIL-STD-202 Method 108  |
| Resistance to solvents          | 3 minute soak<br>2-3 ounce force<br>10 strokes / repetition<br>3 repetitions                                       | ±(0.5%+0.05Ω)<br>MIL-STD-202 Method 215  |
| Mechanical Shock                | Force: 100G peak<br>Test Duration: 6 milliseconds<br>Half-sine waveform<br>Velocity: 12.3 ft/sec                   | ±(1.0%+0.05Ω)<br>MIL-STD-202 Method 213  |
| Vibration                       | Frequency: 10 - 2,000Hz<br>Acceleration: 5G<br>Test Duration: 20 mins / 12 Cycles                                  | ±(1.0%+0.05Ω)<br>MIL-STD-202 Method 204  |
| Resistance to Soldering Heat    | Condition B (Solder Dip - no pre-heat)<br>260°C ±5°C                                                               | ±(0.5%+0.05Ω)<br>MIL-STD-202 Method 210  |
| ESD                             | HBM, 100pF, 1.5kΩ<br>Repetition: 5 times                                                                           | ±(3.0%+0.05Ω)<br>AEC-Q200-002            |
| Solderability                   | Non-activated Flux Dip: 5-10 seconds<br>SAC Solder Dip: 2 ±0.5 seconds at 245°C ±5°C                               | The covered area ≥95%<br>J-STD-002       |
| Flammability                    | V-0 or V-1 are acceptable<br>Electrical test not required                                                          | AEC-Q200-001                             |
| Board Flex                      | 90mm span between fulcrums<br>2mm bend<br>60 sec minimum holding time.                                             | ±(1.0%+0.05Ω)<br>AEC Q200-005            |
| Terminal Strength (SMD)         | Force of 17.7N<br>60 seconds                                                                                       | ±(1.0%+0.05Ω)<br>AEC Q200-006            |

Recommended Soldering Conditions:



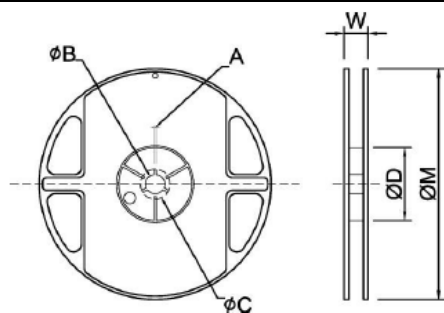
Taping Specifications:



**Taping Specifications:****Plastic Embossed Tape Dimensions**

All dimension in mm.

| Size          | A             | B             | W             | E             | F             | G             | H             | T             | ΦD              | ΦD1           | T1            | P             |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-----------------|---------------|---------------|---------------|
| 2010          | 2.80<br>±0.20 | 5.60<br>±0.20 | 12.0<br>±0.10 | 1.75<br>±0.10 | 5.50<br>±0.05 | 4.00<br>±0.10 | 2.00<br>±0.05 | 0.23<br>±0.10 | 1.50<br>+0.1/-0 | 1.50<br>±0.10 | 0.85<br>±0.15 | 4.00<br>±0.10 |
| 2512          | 3.40<br>±0.20 | 6.70<br>±0.20 | 12.0<br>±0.10 | 1.75<br>±0.10 | 5.50<br>±0.05 | 4.00<br>±0.10 | 2.00<br>±0.05 | 0.23<br>±0.10 | 1.50<br>+0.1/-0 | 1.50<br>±0.10 | 0.85<br>±0.15 | 4.00<br>±0.10 |
| 1218/<br>1812 | 3.30<br>±0.20 | 4.60<br>±0.20 | 12.0<br>±0.10 | 1.75<br>±0.10 | 5.50<br>±0.05 | 4.00<br>±0.10 | 2.00<br>±0.05 | 0.23<br>±0.23 | 1.50<br>+0.1/-0 | 1.50<br>±0.10 | 0.85<br>±0.15 | 4.00<br>±0.10 |

**Reel Specifications:**

All dimensions in mm.

| Case Size           | Size        | A         | ΦB        | ΦC        | ΦD        | W         | ΦM       |
|---------------------|-------------|-----------|-----------|-----------|-----------|-----------|----------|
| 0402                | 7" 10K/Reel | 2.00±0.50 | 13.5±1.00 | 21.0±1.00 | 60.0±1.00 | 11.5±2.00 | 178±2.00 |
| 0603/0805/1206/1210 | 7" 5K/Reel  | 2.00±0.50 | 13.5±1.00 | 21.0±1.00 | 60.0±1.00 | 11.5±2.00 | 178±2.00 |
| 1218/1812/2010/2512 | 7" 4K/Reel  | 2.00±0.50 | 13.5±1.00 | 21.0±1.00 | 60.0±1.00 | 16.0±2.00 | 178±2.00 |

**Storage Conditions:****Environment Conditions:**

Products should be stored under the following environmental conditions.

- Temperature: +5 to +40°C
- Humidity: 45 to 85% relative humidity
- Do not keep products in environments where they may be subject to particulate contamination or harmful gases such as sulfuric acid or hydrogen chloride as it may cause oxidization on electrodes, resulting in poor solderability.
- Products should be stored in a space that does not expose it to high temperatures, vibration, or direct sunlight.