

# Industrial Axial Cemented Wirewound Resistors



The Z300 series, is the perfect choice for high power, high current applications. This product series is tested to meet challenging operating and ambient conditions. Typical applications include but are not limited to home appliances, lighting ballast, etc.

## FEATURES

- All welded construction
- Non flammable cement coating
- Ceramic core
- Various kinds of lead forming available
- Pure tin plating provides compatibility with lead (Pb)-free and lead containing soldering processes
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**  
**GREEN**  
(5-2008)

## APPLICATIONS

- Appliances (washing machine, ovens)
- Ballast
- TV
- Power supply

## STANDARD ELECTRICAL SPECIFICATIONS

| TYPE    | POWER RATING<br>$P_{40}$ | RESISTANCE RANGE                 | TEMPERATURE<br>COEFFICIENT | RESISTANCE<br>TOLERANCE   |
|---------|--------------------------|----------------------------------|----------------------------|---------------------------|
| Z301    | 1 W                      | 0.30 $\Omega$ to 270 $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 10\%$ ,<br>$\pm 5\%$ |
|         |                          | 0.68 $\Omega$ to 2 k $\Omega$    | 100 ppm/K to 180 ppm/K     |                           |
| ZDA0411 | 2 W                      | 0.47 $\Omega$ to 560 $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 10\%$ ,<br>$\pm 5\%$ |
|         |                          | 1.50 $\Omega$ to 4.30 k $\Omega$ | 100 ppm/K to 180 ppm/K     |                           |
| ZDV0411 | 2 W                      | 0.47 $\Omega$ to 560 $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 10\%$ ,<br>$\pm 5\%$ |
|         |                          | 1.50 $\Omega$ to 4.30 k $\Omega$ | 100 ppm/K to 180 ppm/K     |                           |
| Z302    | 3 W                      | 0.10 $\Omega$ to 510 $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 10\%$                |
|         |                          | 1.80 $\Omega$ to 3.30 k $\Omega$ | 100 ppm/K to 180 ppm/K     |                           |
|         |                          | 0.10 $\Omega$ to 510 $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 5\%$                 |
|         |                          | 24 $\Omega$ to 3.30 k $\Omega$   | 100 ppm/K to 180 ppm/K     |                           |
|         |                          | 0.22 $\Omega$ to 510 $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 2\%$                 |
|         |                          | 1 $\Omega$ to 510 $\Omega$       | -10 ppm/K to -80 ppm/K     | $\pm 1\%$                 |
| Z303    | 4 W                      | 0.10 $\Omega$ to 1 k $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 10\%$                |
|         |                          | 1.80 $\Omega$ to 3.90 k $\Omega$ | 100 ppm/K to 180 ppm/K     |                           |
|         |                          | 0.10 $\Omega$ to 1 k $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 5\%$                 |
|         |                          | 12 $\Omega$ to 3.90 k $\Omega$   | 100 ppm/K to 180 ppm/K     |                           |
|         |                          | 0.10 $\Omega$ to 1 k $\Omega$    | -10 ppm/K to -80 ppm/K     | $\pm 2\%$                 |
| Z305    | 6 W                      | 1 $\Omega$ to 1 k $\Omega$       | -10 ppm/K to -80 ppm/K     | $\pm 1\%$                 |
|         |                          | 0.10 $\Omega$ to 2.4 k $\Omega$  | -10 ppm/K to -80 ppm/K     | $\pm 10\%$ ,<br>$\pm 5\%$ |
|         |                          | 3.90 $\Omega$ to 10 k $\Omega$   | 100 ppm/K to 180 ppm/K     |                           |
|         |                          | 0.62 $\Omega$ to 2.4 k $\Omega$  | -10 ppm/K to -80 ppm/K     | $\pm 2\%$ ,<br>$\pm 1\%$  |
| Z306    | 8 W                      | 0.13 $\Omega$ to 4.7 k $\Omega$  | -10 ppm/K to -80 ppm/K     | $\pm 10\%$ ,<br>$\pm 5\%$ |
|         |                          | 6.80 $\Omega$ to 16 k $\Omega$   | 100 ppm/K to 180 ppm/K     |                           |
|         |                          | 1 $\Omega$ to 4.7 k $\Omega$     | -10 ppm/K to -80 ppm/K     | $\pm 2\%$                 |
|         |                          | 2.2 $\Omega$ to 4.7 k $\Omega$   | -10 ppm/K to -80 ppm/K     |                           |
| Z307    | 10 W                     | 0.20 $\Omega$ to 8.2 k $\Omega$  | -10 ppm/K to -80 ppm/K     | $\pm 10\%$ ,<br>$\pm 5\%$ |
|         |                          | 12 $\Omega$ to 30 k $\Omega$     | 100 ppm/K to 180 ppm/K     |                           |
|         |                          | 1.80 $\Omega$ to 8.2 k $\Omega$  | -10 ppm/K to -80 ppm/K     | $\pm 2\%$                 |
|         |                          | 3.30 $\Omega$ to 8.2 k $\Omega$  | -10 ppm/K to -80 ppm/K     |                           |



| PACKAGING |      |             |          |                                               |                       |         |                          |
|-----------|------|-------------|----------|-----------------------------------------------|-----------------------|---------|--------------------------|
| TYPE      | CODE | DESCRIPTION | QUANTITY | PACKAGING STYLE                               | WIDTH                 | PITCH   | DIMENSIONS               |
| Z301      | 21   | A1 G53      | 1000     | Taped acc. to IEC 60286-1 fan-folded in a box | 53 mm                 | 5 mm    | 324 mm x 79 mm x 75 mm   |
|           | D2   | R2 R53      | 2000     | Taped acc. to IEC 60286-2 in a reel           | 53 mm                 | 5 mm    | 260 mm x 260 mm x 95 mm  |
| ZDA0411   | 41   | A1 G73      | 1000     | Taped acc. to IEC 60286-1 fan-folded in a box | 73 mm                 | 5 mm    | 324 mm x 101 mm x 64 mm  |
| ZDV0411   | 40   | A2 G73      | 2000     | Taped acc. to IEC 60286-1 fan-folded in a box | -                     | 12.7 mm | 334 mm x 157 mm x 53 mm  |
| Z302      | 2C   | AC G53      | 500      | Taped acc. to IEC 60286-1 fan-folded in a box | 53 mm                 | 5 mm    | 324 mm x 82 mm x 49 mm   |
|           | 24   | A4 G53      | 4000     | Taped acc. to IEC 60286-1 fan-folded in a box | 53 mm                 | 5 mm    | 380 mm x 75 mm x 170 mm  |
|           | 25   | A4 G63      | 4000     | Taped acc. to IEC 60286-1 fan-folded in a box | 63 mm                 | 5 mm    | 380 mm x 85 mm x 200 mm  |
|           | 4C   | AC G73      | 500      | Taped acc. to IEC 60286-1 fan-folded in a box | 73 mm                 | 5 mm    | 324 mm x 101 mm x 49 mm  |
|           | 6C   | AC G83      | 500      | Taped acc. to IEC 60286-1 fan-folded in a box | 83 mm                 | 10 mm   | 324 mm x 111 mm x 75 mm  |
|           | D2   | R2 R53      | 2000     | Taped acc. to IEC 60286-2 in a reel           | 53 mm                 | 5 mm    | 260 mm x 260 mm x 95 mm  |
|           | H1   | R1 R83      | 1000     | Taped acc. to IEC 60286-2 in a reel           | 83 mm                 | 10 mm   | 260 mm x 260 mm x 125 mm |
|           | LC   | LC          | 500      | Bulk Packing                                  | 94 mm <sup>(1)</sup>  | -       | 225 mm x 140 mm x 140 mm |
| Z303      | 2C   | AC G53      | 500      | Taped acc. to IEC 60286-1 fan-folded in a box | 53 mm                 | 5 mm    | 324 mm x 79 mm x 75 mm   |
|           | 6C   | AC G83      | 500      | Taped acc. to IEC 60286-1 fan-folded in a box | 83 mm                 | 10 mm   | 324 mm x 111 mm x 90 mm  |
|           | LC   | LC          | 500      | Bulk Packing                                  | 94 mm <sup>(1)</sup>  | -       | 225 mm x 140 mm x 140 mm |
|           | D1   | R1 R53      | 1000     | Taped acc. to IEC 60286-2 in a reel           | 53 mm                 | 10 mm   | 260 mm x 260 mm x 125 mm |
|           | H1   | R1 R83      | 1000     | Taped acc. to IEC 60286-2 in a reel           | 83 mm                 | 10 mm   | 260 mm x 260 mm x 95 mm  |
| Z305      | 6A   | AA G83      | 100      | Taped acc. to IEC 60286-1 fan-folded in a box | 83 mm                 | 10 mm   | 324 mm x 111 mm x 75 mm  |
|           | 6B   | AB G83      | 250      | Taped acc. to IEC 60286-1 fan-folded in a box | 83 mm                 | 10 mm   | 324 mm x 111 mm x 75 mm  |
|           | HC   | RC R83      | 500      | Taped acc. to IEC 60286-2 in a reel           | 83 mm                 | 10 mm   | 260 mm x 260 mm x 125 mm |
| Z306      | 6B   | AB G83      | 250      | Taped acc. to IEC 60286-1 fan-folded in a box | 83 mm                 | 10 mm   | 324 mm x 111 mm x 75 mm  |
|           | HC   | RC R83      | 500      | Taped acc. to IEC 60286-2 in a reel           | 83 mm                 | 10 mm   | 260 mm x 260 mm x 125 mm |
| Z307      | LJ   | LJ          | 200      | Bulk Packing                                  | 120 mm <sup>(1)</sup> | -       | 225 mm x 140 mm x 140 mm |

**Note**

<sup>(1)</sup> For bulk packing, defined width is end-to-end length and not inner tape width.

**PART NUMBER AND PRODUCT DESCRIPTION**Part Number: **Z32041411509K2C000**

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Z | 3 | 2 | 0 | 4 | 1 | 4 | 1 | 1 | 5 | 0 | 9 | K | 2 | C | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| TYPE                                                                                                                                                                                                       | TCR / MATERIAL                                                                                                                               | VALUE                                                                                                                                                                                                                                     | TOLERANCE CODE                                                                                        | PACKAGING CODE        | SPECIAL                                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Z310309</b> = Z301<br><b>ZDA0411</b> = ZDA0411<br><b>ZDV0411</b> = ZDV0411<br><b>Z320414</b> = Z302<br><b>Z330617</b> = Z303<br><b>Z350922</b> = Z305<br><b>Z360933</b> = Z306<br><b>Z370947</b> = Z307 | <b>1</b> = -10 ... -80 ppm/K<br>WM 50<br>Class 1<br><b>3</b> = 100 ... 180 ppm/K<br>WM 110<br>Class 3<br><b>4</b> = SWI<br>(special winding) | 3 digit value<br>1 digit multiplier<br><b>MULTIPLIER</b><br><b>7</b> = $\times 10^{-3}$<br><b>8</b> = $\times 10^{-2}$<br><b>9</b> = $\times 10^{-1}$<br><b>0</b> = $\times 10^0$<br><b>1</b> = $\times 10^1$<br><b>2</b> = $\times 10^2$ | <b>F</b> = $\pm 1.0\%$<br><b>G</b> = $\pm 2.0\%$<br><b>J</b> = $\pm 5.0\%$<br><b>K</b> = $\pm 10.0\%$ | (see Packaging table) | The 5 digit BV number will be encoded using a 36 character code. This code contains numbers 0...9 and letters A...Z (36 characters total) and allows to encode at least 46 655 five digit BV numbers.<br><b>000</b> = standard |

Product Description: **Z302 1 15R 10 % AC G53**

| Z302                                                               | 1              | 15R        | 10 %                      | AC G53                                                                                                                                                                         |
|--------------------------------------------------------------------|----------------|------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TYPE                                                               | TCR / MATERIAL | VALUE      | TOLERANCE CODE            | PACKAGING DESCRIPTION                                                                                                                                                          |
| Z301<br>ZDA0411<br>ZDV0411<br>Z302<br>Z303<br>Z305<br>Z306<br>Z307 |                | 2K0<br>4K3 | 1 %<br>2 %<br>5 %<br>10 % | A1 G53      AC G83<br>R2 R53      R1 R83<br>A1 G73      LC<br>A2 G73      AC G83<br>AC G53      R1 R53<br>A4 G53      AA G83<br>A4 G63      AB G83<br>AC G73      RC R83<br>LJ |



## DESCRIPTION

Wirewound resistors are best suited for use in high power, high current applications. The silicon cement lacquer coating enables Z300 to withstand challenging operating and environmental conditions.

The coating is resistant to cleaning solvents specified in IEC 60115-1 <sup>(1)</sup>. Production is strictly controlled and follows an extensive set of instructions established for reproducibility. The winding is done with a specific material on a specially developed fine ceramic body ( $\text{Al}_2\text{O}_3$ ). The ceramic meets the highest requirements against mechanical resistance, thermal shocks, dielectric strength, and insulation resistance at high temperatures. With different diameters and turn spacing's, a large ohmic value range can be covered. The resistors are marked with resistance and tolerance.

Product quality is verified by testing procedures, performed on all individual resistors. Resistance is measured on the lead wires at a distance of 6 mm from the resistor body. If a greater length of lead wire is used in the application, the user may need to consider the additional wire resistance, particularly with low resistance products.

## MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein <sup>(2)</sup>
- The Global Automotive Declarable Substance List (GADSL) <sup>(3)</sup>
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) <sup>(4)</sup> for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see [www.vishay.com/how/leadfree](http://www.vishay.com/how/leadfree). Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at [www.vishay.com/doc?49037](http://www.vishay.com/doc?49037).

## Notes

- <sup>(1)</sup> Other cleaning solvents with aggressive chemicals should be evaluated in actual cleaning process for their suitability
- <sup>(2)</sup> The IEC 62474 list of declarable substances is maintained in a dedicated database, which is available at <http://std.iec.ch/iec62474>
- <sup>(3)</sup> The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council and available at [www.gadsl.org](http://www.gadsl.org)
- <sup>(4)</sup> The SVHC list is maintained by the European Chemical Agency (ECHA) and available at <http://echa.europa.eu/candidate-list-table>

## ASSEMBLY

The resistors are axial leaded for soldering. The terminals of the resistors are completely lead (Pb)-free, the special tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes.

Special lead forms may be available on request, please inquire at [ww1resistors@vishay.com](mailto:ww1resistors@vishay.com).

These components are high dissipation power resistors, customers are advised to use a high melting point solder.

## APPLICATION INFORMATION

The power dissipation of the resistor generates a temperature rise with respect to the ambient. The permissible dissipation is derated for temperatures above 40 °C, as shown in the derating diagram, in order to avoid overheating of the resistor. The heat dissipated from the resistor may affect adjacent components, hence proper clearance will be required in order to avoid overheating. The resistive wire is hermetically encapsulated.

All materials used are non-flammable and inorganic.

These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.

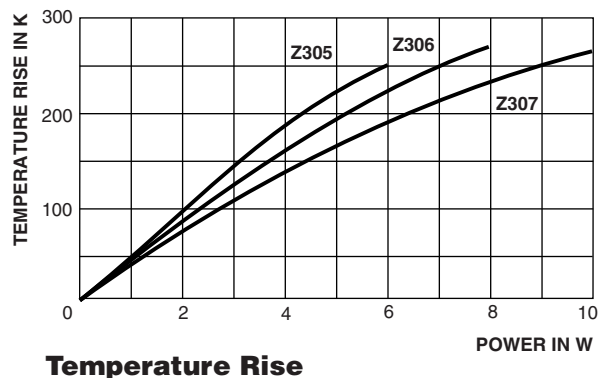
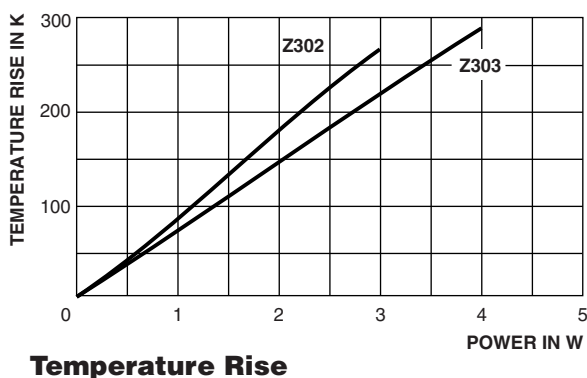
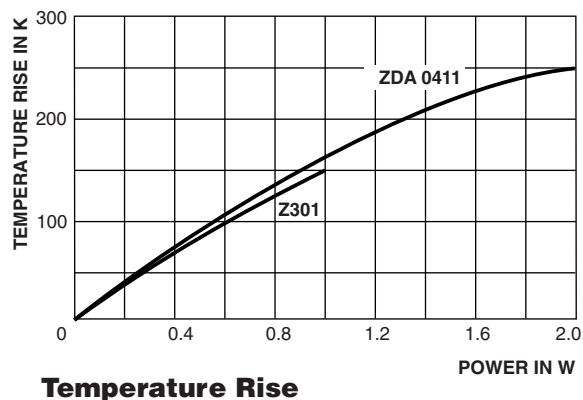
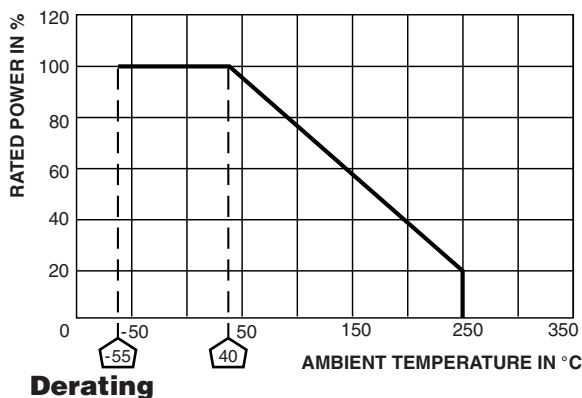
## RELATED PRODUCTS

In similar applications and high dissipation conditions, see the datasheets:

- AC Series - Cemented Wirewound Resistors  
[www.vishay.com/doc?28730](http://www.vishay.com/doc?28730)
- Z300-Cxx - High Surge Axial Cemented Wirewound Resistors  
[www.vishay.com/doc?21027](http://www.vishay.com/doc?21027)

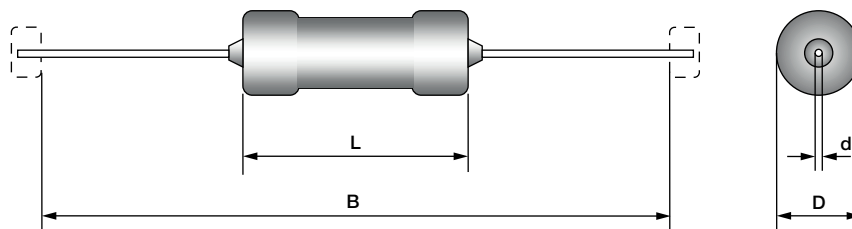
For precision applications, there is the cement coated PAC series, see the datasheet:

- PAC Series - Cemented Wirewound Precision Resistors  
[www.vishay.com/doc?28731](http://www.vishay.com/doc?28731)

**FUNCTIONAL PERFORMANCE****TEST PROCEDURES AND REQUIREMENTS**

| IEC 60115-1<br>CLAUSE | IEC 60068-2<br>TEST<br>METHOD | TEST                               | PROCEDURE                                                            | REQUIREMENTS<br>PERMISSIBLE CHANGE ( $\Delta R_{MAX}$ ) |
|-----------------------|-------------------------------|------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------|
| 4.13                  | -                             | Short time overload                | Room temperature;<br>10x rated power $P_{40}$ ;<br>5 s               | $\pm (1 \% R + 0.1 \Omega)$                             |
| 4.16                  | 21 (Ua)<br>21 (Ub)<br>21 (Uc) | Robustness of<br>terminations      | Tensile, bending and torsion                                         | No damage<br>$\pm (0.5 \% R + 0.05 \Omega)$             |
| 4.18                  | 20 (Tb)                       | Resistance to<br>soldering heat    | Unmounted components<br>( $260 \pm 5$ ) °C; ( $10 \pm 1$ ) s         | $\pm (0.5 \% R + 0.05 \Omega)$                          |
| 4.24                  | 78 (Cab)                      | Damp heat,<br>(steady state)       | 56 days; ( $40 \pm 2$ ) °C;<br>( $93 \pm 3$ ) % RH                   | $\pm (3 \% R + 0.1 \Omega)$                             |
| 4.25.2                | -                             | Endurance<br>(at room temperature) | 1000 h;<br>loaded with 116 % of $P_{70}$ ;<br>1.5 h ON and 0.5 h OFF | $\pm (3 \% R + 0.1 \Omega)$                             |
| 4.25.3                | -                             | Endurance<br>(at 200 °C)           | 1000 h; without load                                                 | $\pm (3 \% R + 0.1 \Omega)$                             |

## DIMENSIONS

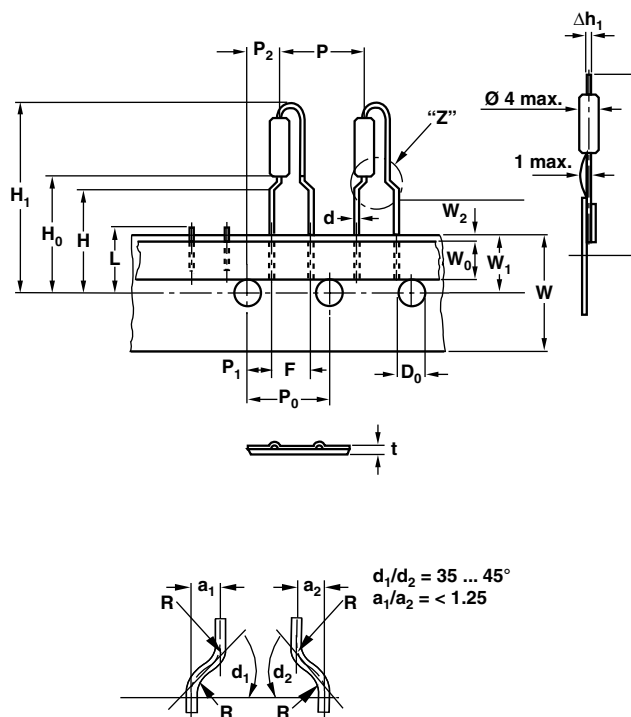


| TYPE    | DIMENSIONS in millimeters [inches] |                   |             |                                        |          |
|---------|------------------------------------|-------------------|-------------|----------------------------------------|----------|
|         | L <sub>MAX.</sub>                  | D <sub>MAX.</sub> | d           | B                                      | MASS (g) |
| Z301    | 8.5 [0.355]                        | 3 [0.118]         | 0.7 [0.027] | 53 ± 1 [2.087 ± 0.039]                 | 0.5      |
| ZDA0411 | 11 [0.433]                         | 4 [0.157]         | 0.7 [0.027] | 53 ± 1 [2.087 ± 0.039]                 | 0.8      |
| Z302    | 13 [0.512]                         | 4.8 [0.189]       | 0.8 [0.031] | 53 ± 1 [2.087 ± 0.039]                 | 1.1      |
| Z303    | 15.8 [0.622]                       | 5.5 [0.217]       | 0.8 [0.031] | 53 ± 1 [2.087 ± 0.039]                 | 1.4      |
| Z305    | 22.3 [0.878]                       | 8.7 [0.343]       | 0.8 [0.031] | 83 ± 1 [3.268 ± 0.039]                 | 3.7      |
| Z306    | 32.3 [1.272]                       | 8.7 [0.343]       | 0.8 [0.031] | 83 ± 1 [3.268 ± 0.039]                 | 5        |
| Z307    | 49.8 [1.961]                       | 9 [0.354]         | 0.8 [0.031] | 120 <sup>(1)</sup> ± 2 [4.724 ± 0.079] | 7        |

### Note

(1) For Z307, dimension "B" is resistor end-to-end length and not inner tape width.

## DIMENSIONS ZDV0411



| DIMENSIONS in millimeters                        |                 |           | TOL.        |
|--------------------------------------------------|-----------------|-----------|-------------|
| Lead Ø                                           | d               | 0.6       | -           |
| Pitch of components                              | P               | 12.7      | ± 1.0       |
| Pitch of sprocket holes <sup>(2)</sup>           | P <sub>0</sub>  | 12.7      | ± 0.3       |
| Distance between hole center and resistor center | P <sub>1</sub>  | 3.85      | ± 0.7       |
| Distance between hole center and lead center     | P <sub>2</sub>  | 6.35      | ± 0.7       |
| Lead spacing                                     | F               | 5         | +0.6, -0.1  |
| Angle of Insertion                               | Δh <sub>1</sub> | 2 max.    | -           |
| Width of carrier tape                            | W               | 18.0      | +1, -0.5    |
| Width of adhesive tape                           | W <sub>0</sub>  | 12.0      | ± 0.5       |
| Position of holes                                | W <sub>1</sub>  | 9         | +0.75, -0.5 |
| Position of adhesive tape                        | W <sub>2</sub>  | 0.5       | +0, -0.5    |
| Body to hole center                              | H               | 16.0      | ± 0.5       |
| Lead crimp to hole center <sup>(3)</sup>         | H <sub>0</sub>  | 19.5      | ± 1.0       |
| Hole Ø                                           | D <sub>0</sub>  | 4.0       | ± 0.2       |
| Thickness of tape <sup>(4)</sup>                 | t               | 0.9 max.  | -           |
| Height of cutting                                | L               | 11 max.   | -           |
| Height of insertion                              | H <sub>1</sub>  | 32.3 max. | -           |

### Notes

(2) Test over 10 holes - 9 intervals P<sub>0</sub> 12 x 9 = 114.3 ± 0.5

(3) Parallelism, < 0.5 mm

(4) Thickness of carrier tape: 0.55 mm ± 0.1



## Disclaimer

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