

# Precision Thin Film Nichrome Chip Resistors

## PCF Series

- Precision thin film technology
- Extended ohmic range 1R - 3M
- Precision to  $\pm 0.01\%$  and 5ppm/ $^{\circ}\text{C}$
- Passivated range for superior humidity performance
- Load life stability and humidity to 0.05%
- Pb-free standard with SnPb option
- AEC-Q200 grade available



 All Pb-free parts comply with EU Directive 2011/65/EU (RoHS2)

## Electrical Data - Standard Range

| Type    | TCR<br>(ppm/°C) | Power<br>(W) | Limiting Element<br>Voltage (V) | Ohmic Value Range <sup>1</sup> |       |                       |          |           |
|---------|-----------------|--------------|---------------------------------|--------------------------------|-------|-----------------------|----------|-----------|
|         |                 |              |                                 | 1% & 0.5%                      | 0.25% | 0.1%                  | 0.05%    | 0.01%     |
| PCF0201 | 50              | 0.031        | 15                              | 49R9-33K                       | -     |                       |          |           |
|         | 25              |              |                                 | 49R9-5K                        |       |                       |          |           |
| PCF0402 | 50              | 0.063        | 25                              | 4R7 - 511K                     |       | 10R - 255K            | -        |           |
|         | 25              |              |                                 |                                |       |                       |          |           |
|         | 15              |              |                                 | -                              |       | 49R9-33K              |          |           |
|         | 10              |              |                                 |                                |       | 49R9-12K              |          |           |
|         | 5               |              |                                 |                                |       | 49R9-5K               |          |           |
| PCF0603 | 50              | 0.063        | 50                              | 1R - 1M                        |       | 4R7-1M                | 4R7-332K | -         |
|         | 25              |              |                                 |                                |       | 4R7-332K              |          | 24R9-100K |
|         | 15              |              |                                 | -                              |       | 24R9-15K              |          |           |
|         | 10              |              |                                 |                                |       |                       |          |           |
|         | 5               |              |                                 |                                |       |                       |          |           |
| PCF0805 | 50              | 0.1          | 100                             | 1R-2M                          |       | 4R7-2M                | 4R7 - 1M | -         |
|         | 25              |              |                                 |                                |       | 4R7-511K              |          | 4R7-511K  |
|         | 15              |              |                                 | -                              |       | 24R9-30K <sup>2</sup> |          | 24R9-30K  |
|         | 10              |              |                                 |                                |       |                       |          |           |
|         | 5               |              |                                 |                                |       |                       |          |           |
| PCF1206 | 50              | 0.125        | 150                             | 1R-2M5                         |       | 4R7-2M5               | 4R7 - 1M | -         |
|         | 25              |              |                                 |                                |       | 4R7-1M                |          | 4R7-511K  |
|         | 15              |              |                                 | -                              |       | 24R9-50K <sup>2</sup> |          | 24R9-50K  |
|         | 10              |              |                                 |                                |       |                       |          |           |
|         | 5               |              |                                 |                                |       |                       |          |           |
| PCF1210 | 50              | 0.2          | 150                             | 1R-2M5                         |       | 4R7-2M5               | 4R7-1M   | -         |
|         | 25              |              |                                 |                                |       | 4R7-1M                |          | 24R9-500K |
|         | 15              |              |                                 | -                              |       | 24R9-50K <sup>2</sup> |          | 24R9-50K  |
|         | 10              |              |                                 |                                |       |                       |          |           |
|         | 5               |              |                                 |                                |       |                       |          |           |
| PCF2010 | 50              | 0.25         | 150                             | 1R-3M                          |       | 4R7-3M                | 4R7-1M   | -         |
|         | 25              |              |                                 |                                |       | 4R7-1M                |          | 24R9-500K |
|         | 15              |              |                                 | -                              |       | 24R9-100K             |          |           |
|         | 10              |              |                                 |                                |       |                       |          |           |
|         | 5               |              |                                 |                                |       |                       |          |           |
| PCF2512 | 50              | 0.5          | 150                             | 1R-3M                          |       | 4R7-3M                | 4R7-1M   | -         |
|         | 25              |              |                                 |                                |       | 4R7-1M                |          | 24R9-500K |
|         | 15              |              |                                 | -                              |       | 24R9-100K             |          |           |
|         | 10              |              |                                 |                                |       |                       |          |           |
|         | 5               |              |                                 |                                |       |                       |          |           |

Note 1: Standard values E24 or E96. Other values may be available by request.

Note 2: Higher values available on request.

### General Note

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## Electrical Data - AEQ-Q200 Grade - Standard Range

| Type        | TCR<br>(ppm/°C) | Power<br>(W) | Limiting<br>Element<br>Voltage (V) | Ohmic Value Range * |      |       |      |            |
|-------------|-----------------|--------------|------------------------------------|---------------------|------|-------|------|------------|
|             |                 |              |                                    | 1%                  | 0.5% | 0.25% | 0.1% | 0.05%      |
| PCF0402...A | 50<br>25        | 0.063        | 25                                 | 49R9 – 100K         |      |       |      | 49R9 – 10K |
| PCF0603...A | 50<br>25        | 0.063        | 50                                 | 10R – 332K          |      |       |      | 10R – 49K9 |
| PCF0805...A | 50<br>25        | 0.1          | 100                                | 10R – 1M0           |      |       |      | 10R – 100K |
| PCF1206...A | 50<br>25        | 0.125        | 150                                |                     |      |       |      | 10R – 200K |
| PCF1210...A | 50<br>25        | 0.25         | 150                                |                     |      |       |      | 10R – 499K |
| PCF2010...A | 50<br>25        | 0.25         | 150                                |                     |      |       |      |            |
| PCF2512...A | 50<br>25        | 0.5          | 150                                |                     |      |       |      |            |

\* Standard values E24 or E96.

## Electrical Data - High Power Range

| Type     | TCR<br>(ppm/°C) | Power<br>(W) | Limiting<br>Element<br>Voltage (V) | Ohmic Value Range * |       |          |          |           |
|----------|-----------------|--------------|------------------------------------|---------------------|-------|----------|----------|-----------|
|          |                 |              |                                    | 0.5%                | 0.25% | 0.1%     | 0.05%    | 0.01%     |
| PCF0603H | 50              | 0.1          | 75                                 | 4R7-1M              |       |          | 4R7-332K | 24R9-100K |
|          | 25              |              |                                    |                     |       |          |          |           |
|          | 15              |              |                                    | 4R7-332K            |       |          |          |           |
|          | 10              |              |                                    |                     |       |          |          |           |
|          | 5               |              |                                    |                     |       |          | 24R9-15K |           |
| PCF0805H | 50              | 0.125        | 150                                | 1R-1M               |       | 4R7-1M   | 4R7-511K | 24R9-200K |
|          | 25              |              |                                    |                     |       |          |          |           |
|          | 15              |              |                                    | 4R7-1M              |       |          |          |           |
|          | 10              |              |                                    | 4R7-511K            |       |          |          |           |
|          | 5               |              |                                    |                     |       | 24R9-30K |          |           |
| PCF1206H | 50              | 0.25         | 200                                | 4R7-1M              |       |          |          | 24R9-500K |
|          | 25              |              |                                    |                     |       |          |          |           |
|          | 15              |              |                                    |                     |       |          |          |           |
|          | 10              |              |                                    |                     |       |          |          |           |
|          | 5               |              |                                    | 24R9-50K            |       |          |          |           |
| PCF1210H | 50              | 0.33         | 200                                | 4R7-1M              |       |          |          | 24R9-500K |
|          | 25              |              |                                    |                     |       |          |          |           |
|          | 15              |              |                                    |                     |       |          |          |           |
|          | 10              |              |                                    |                     |       |          |          |           |
|          | 5               |              |                                    | 24R9-50K            |       |          |          |           |
| PCF2010H | 50              | 0.33         | 200                                | 4R7-1M              |       |          |          | 24R9-500K |
|          | 25              |              |                                    |                     |       |          |          |           |
|          | 15              |              |                                    |                     |       |          |          |           |
|          | 10              |              |                                    |                     |       |          |          |           |
|          | 5               |              |                                    | 24R9-50K            |       |          |          |           |
| PCF2512H | 50              | 0.75         | 200                                | 1R-2K               |       | 4R7-2K   |          | 24R9-2K   |
|          | 25              |              |                                    |                     |       |          |          |           |
|          | 15              |              |                                    |                     |       |          |          |           |
|          | 10              |              |                                    |                     |       |          |          |           |
|          | 5               |              |                                    |                     |       | 24R9-50K |          |           |

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## Electrical Data - AEQ-Q200 Grade – High Power Range

| Type         | TCR<br>(ppm/°C) | Power<br>(W) | Limiting<br>Element<br>Voltage (V) | Ohmic Value Range * |      |       |      |            |
|--------------|-----------------|--------------|------------------------------------|---------------------|------|-------|------|------------|
|              |                 |              |                                    | 1%                  | 0.5% | 0.25% | 0.1% | 0.05%      |
| PCF0603H...A | 50<br>25        | 0.1          | 75                                 | 10R – 332K          |      |       |      | 10R – 49K9 |
| PCF0805H...A | 50<br>25        | 0.125        | 150                                | 10R – 1M0           |      |       |      | 10R – 100K |
| PCF1206H...A | 50<br>25        | 0.25         | 200                                |                     |      |       |      | 10R – 200K |
| PCF1210H...A | 50<br>25        | 0.33         | 200                                |                     |      |       |      | 10R – 499K |
| PCF2010H...A | 50<br>25        | 0.33         | 200                                |                     |      |       |      |            |

## Electrical Data - Extended High Power Range

| Type     | TCR<br>(ppm/°C) | Power<br>(W) | Limiting<br>Element<br>Voltage (V) | Ohmic Value Range * |       |          |       |       |
|----------|-----------------|--------------|------------------------------------|---------------------|-------|----------|-------|-------|
|          |                 |              |                                    | 0.5%                | 0.25% | 0.1%     | 0.05% | 0.01% |
| PCF0603X | 50<br>25        | 0.166        | 100                                | 10R-332K            |       |          |       |       |
| PCF0805X | 50<br>25        | 0.25         | 150                                | 10R-500K            |       |          |       |       |
| PCF1206X | 50<br>25        | 0.333        | 200                                | 10R-1M              |       |          |       |       |
| PCF2512X | 50<br>25        | 1            | 200                                | 1R-100R             |       | 4R7-100R |       |       |

## Electrical Data - Passivated Range

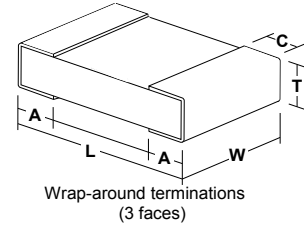
| Type     | TCR<br>(ppm/°C) | Power<br>(W) | Limiting Element<br>Voltage (V) | Ohmic Value Range * |       |      |
|----------|-----------------|--------------|---------------------------------|---------------------|-------|------|
|          |                 |              |                                 | 0.5%                | 0.25% | 0.1% |
| PCF0402P | 50<br>25        | 0.063        | 25                              | 25R-25K             |       |      |
|          | 15              |              |                                 | 49R9-12K            |       |      |
| PCF0603P | 50<br>25        | 0.063        | 50                              | 25R-332K            |       |      |
|          | 15              |              |                                 |                     |       |      |
| PCF0805P | 50<br>25        | 0.1          | 100                             | 10R - 1M            |       |      |
|          | 15              |              |                                 |                     |       |      |
| PCF1206P | 50<br>25        | 0.125        | 150                             | 10R-1M              |       |      |
|          | 15              |              |                                 |                     |       |      |
| PCF2010P | 50<br>25        | 0.25         | 150                             | 10R - 1M5           |       |      |
|          | 15              |              |                                 | 25R - 1M            |       |      |
| PCF2512P | 50<br>25        | 0.5          | 150                             | 10R - 1M5           |       |      |
|          | 15              |              |                                 | 25R - 1M            |       |      |

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## Physical Data

| Dimensions (mm) and Weight (mg) |             |             |       |             |             |    |
|---------------------------------|-------------|-------------|-------|-------------|-------------|----|
|                                 | L           | W           | T max | A           | C           | Wt |
| 0201                            | 0.58 ± 0.05 | 0.29 ± 0.05 | 0.26  | 0.15 ± 0.05 | 0.12 ± 0.05 | 1  |
| 0402                            | 1.0 ± 0.05  | 0.5 ± 0.05  | 0.55  | 0.2 ± 0.1   | 0.2 ± 0.1   | 3  |
| 0603                            | 1.6 ± 0.2   | 0.8 ± 0.2   | 0.65  | 0.3 ± 0.2   | 0.3 ± 0.2   | 6  |
| 0805                            | 2.0 ± 0.2   | 1.25 ± 0.2  | 0.65  | 0.4 ± 0.25  | 0.3 ± 0.2   | 9  |
| 1206                            | 3.05 ± 0.15 | 1.55 ± 0.15 | 0.65  | 0.35 ± 0.25 | 0.42 ± 0.2  | 20 |
| 1210                            | 3.10 ± 0.15 | 2.4 ± 0.15  | 0.65  | 0.55 ± 0.25 | 0.4 ± 0.2   | 25 |
| 2010                            | 4.9 ± 0.2   | 2.4 ± 0.2   | 0.65  | 0.5 ± 0.25  | 0.6 ± 0.3   | 36 |
| 2512                            | 6.3 ± 0.2   | 3.1 ± 0.2   | 0.65  | 0.5 ± 0.25  | 0.6 ± 0.3   | 55 |



### Construction

A thin-film material is selectively deposited on a 96% alumina substrate together with metallic contacts at each end of the resistor. The unadjusted resistors are heat treated to give the required TCR and stability, then a precisely controlled laser trim process adjusts the resistance value. Epoxy protection is applied and wrap-around terminations are added and plated with Nickel then Tin. Each resistor is measured immediately before packing into tape.

### Terminations

The standard termination is 100% Sn matte plated wrap-around suitable for soldering. SnPb plated option is available for standard range PCF over the restricted range below.

## SnPb Termination Option Range

| Type    | TCR<br>(ppm/°C) | Power<br>(W) | Limiting Element<br>Voltage (V) | Ohmic Value Range |      |       |      |
|---------|-----------------|--------------|---------------------------------|-------------------|------|-------|------|
|         |                 |              |                                 | 1%                | 0.5% | 0.25% | 0.1% |
| PCF0805 | 50              | 0.1          | 100                             | 10R – 250K        |      |       |      |
|         | 25              |              |                                 | 10R – 100K        |      |       |      |
|         | 15              |              |                                 | 10R – 100K        |      |       |      |
|         | 10              |              |                                 | 10R – 5KΩ         |      |       |      |
| PCF1206 | 50              | 0.125        | 150                             | 10R – 500K        |      |       |      |
|         | 25              |              |                                 | 10R – 200K        |      |       |      |
|         | 15              |              |                                 | 10R – 200K        |      |       |      |
|         | 10              |              |                                 | 10R – 10K         |      |       |      |

## Performance Data - Standard Range

| Test Parameters            | Conditions                                | Maximum change (+0.05R)          |                         |                                  |
|----------------------------|-------------------------------------------|----------------------------------|-------------------------|----------------------------------|
|                            |                                           | >0.05% tolerance<br>0603 to 2512 | Chip size<br>0201, 0402 | ≤0.05% tolerance<br>0603 to 2512 |
| Load life                  | 1000 hours rated load @ 70°C              | 0.25%                            | 0.5%                    | 0.05%                            |
| Humidity                   | 1000 hours @ 40°C, 90 - 95%RH             | 0.3%                             | 0.3%                    | 0.05%                            |
| Short term overload        | 6.25 x rated Power, or 2 x LEV, for 5 sec | 0.5%                             | 0.5%                    | 0.05%                            |
| High temperature operation | 1000 hours at 125°C                       | 0.25%                            | 0.25%                   | 0.25%                            |
| Temperature cycle          | 5 cycles -55°C, 125°C                     | 0.1%                             | 0.1%                    | 0.05%                            |
| Resistance to solder heat  | 270°C, 10 sec                             | 0.2%                             | 0.2%                    | 0.05%                            |
| Solderability              | 235°C, 2 sec                              | 95% minimum coverage             |                         |                                  |

## Performance Data - High Power Range/Extended High Power Range

| Test Parameters            | Conditions                                | Maximum change (+0.05R) |       |
|----------------------------|-------------------------------------------|-------------------------|-------|
|                            |                                           | 0.5%                    | 0.05% |
| Load life                  | 1000 hours rated load @ 70°C              | 0.5%                    | 0.05% |
| Humidity                   | 1000hrs @ 40°C, 90 - 95%RH                | 0.5%                    | 0.05% |
| Short term overload        | 6.25 x rated Power, or 2 x LEV, for 5 sec | 0.5%                    | 0.05% |
| High temperature operation | 1000 hours at 155°C                       | 0.5%                    | 0.05% |
| Temperature cycle          | 5 cycles -55°C, 150°C                     | 0.25%                   | 0.05% |
| Resistance to solder heat  | 270°C, 10 sec                             | 0.2%                    | 0.05% |
| Solderability              | 235°C, 2 sec                              | 95% minimum coverage    |       |

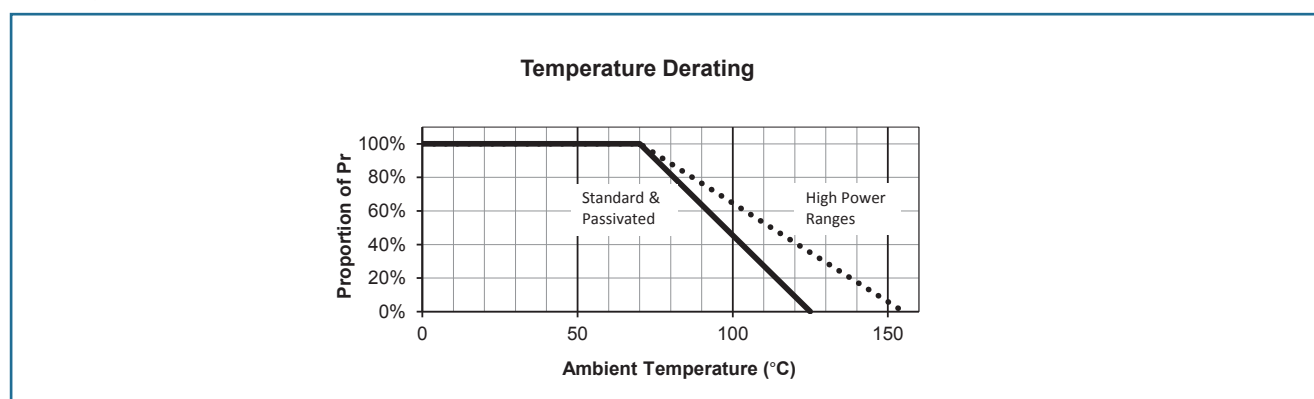
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## Performance Data - Passivated Range

| Test Parameters            | Conditions                                | Maximum change (+0.05R) |       |
|----------------------------|-------------------------------------------|-------------------------|-------|
|                            |                                           | 0603 to 2512            | 0402  |
| Load life                  | 1000 hours rated load @ 70°C              | 0.05%                   | 0.25% |
| Humidity                   | 1000hrs @ 40°C, 90 - 95%RH                | 0.05%                   | 0.5%  |
| Short term overload        | 6.25 x rated Power, or 2 x LEV, for 5 sec | 0.02%                   | 0.1%  |
| High temperature operation | 1000 hours at 125°C                       | 0.05%                   | 0.5%  |
| Temperature cycle          | 5 cycles -55 C, 125°C                     | 0.02%                   | 0.1%  |
| Resistance to solder heat  | 270°C, 10 sec                             | 0.02%                   | 0.1%  |
| Solderability              | 235°C, 2 sec                              | 95% minimum coverage    |       |

### Derating Curve



### Solderability

The terminations have an electroplated nickel barrier and tin coating. This ensures excellent 'leach' resistance properties and solderability.

### Packaging

PCF Resistors are supplied taped and reeled as as per IEC 286-3. Sizes 2010 and 2512 are in embossed plastic tape. Smaller sizes are in paper tape.

### Application Notes

PCF resistors are ideally suited for handling by automatic methods due to their rectangular shape and the small dimensional tolerances. Electrical connection to a ceramic substrate or to a printed circuit board can be made by reflow or wave soldering of wrap-around terminations.

Wrap-around terminations provide good leach properties and ensure reliable contact. Due to the robust construction, the PCF can be immersed in the solder bath for 30 seconds at 260 C. This enables the resistor to be mounted on one side of a printed circuit board and wire-led components applied on the other side.

PCF resistors themselves can operate at a maximum temperature of 125 C (see performance above) (155 C for High Power grades). For soldered resistors, the joint temperature should not exceed 110 C. This condition is met when the stated power levels at 70 C are used.

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## Ordering Procedure

This product has two valid part numbers:

**European (Welwyn) Part Number\*\*:** PCF0603-11-1K54BI (0603, standard, 15ppm/°C, 1.54 kilohm ±0.1%, Pb-free)

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | C | F | 0 | 6 | 0 | 3 | - | 1 | 1 | - | 1 | K | 5 | 4 | B | I |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |   |   |   |   |   |   |   |   |   |   |

| 1<br>Type | 2<br>Size | 3<br>Range        | 4<br>TCR        | 5<br>Value           | 6<br>Tolerance | 7<br>Termination & Packing         |
|-----------|-----------|-------------------|-----------------|----------------------|----------------|------------------------------------|
| PCF       | 0201      | Omit for Standard | -13 = ±5ppm/°C  | E24 = 3/4 characters | L = ±0.01%     | A = AEC-Q200 grade, Pb-free        |
|           | 0402      |                   | -12 = ±10ppm/°C | E96 = 3/4 characters | W = ±0.05%     | I = Standard grade, Pb-free        |
|           | 0603      | H = High Power    | -11 = ±15ppm/°C | R = ohms             | B = ±0.1%      | Standard Packing                   |
|           | 0805      | X = Extended      | R = ±25ppm/°C   | K = kilohms          | C = ±0.25%     | 0201, 0402 10,000/reel             |
|           | 1206      | P = Passivated    | -02 = ±50ppm/°C | M = megohms          | D = ±0.5%      | 0603 to 1210 5000/reel             |
|           | 1210      |                   |                 |                      | F = ±1%        | 2010, 2512 4000/reel               |
|           | 2010      |                   |                 |                      |                | T1* = Pb-free, 1K reel             |
|           | 2512      |                   |                 |                      |                | 0201 to 1206, 2010, 2512 1000/reel |
|           |           |                   |                 |                      |                | PB = SnPb, 1K reel                 |
|           |           |                   |                 |                      |                | 0805, 1206 1000/reel               |

\* Non-standard; enquire to confirm availability

\*\* Applies to all Ranges, Termination and Packing options.

**USA (IRC) Part Number\*:** PCF-W0603LF-11-1541-B-P-LT (0603, standard, 15ppm/°C, 1.54 kilohm ±0.1%, Pb-free)

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P | C | F | - | W | 0 | 6 | 0 | 3 | L | F | - | 1 | 1 | - | 1 | 5 | 4 | 1 | - | B | - | P | - | L | T |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

| 1<br>Type | 2<br>Model | 3<br>Termination      | 4<br>TCR       | 5<br>Value                    | 6<br>Tolerance | 7<br>Tape                 | 8<br>Packing           |
|-----------|------------|-----------------------|----------------|-------------------------------|----------------|---------------------------|------------------------|
| PCF       | W0201      | LF = Pb-free (100%Sn) | 13 = ±5ppm/°C  | 3 digits + multiplier         | T = ±0.01%     | P = Paper (0201 to 1210)  | LT = Tape & Reel       |
|           | W0402      |                       | 12 = ±10ppm/°C | R = ohms for values <100 ohms | A = ±0.05%     |                           | 0201, 0402 10,000/reel |
|           | W0603      |                       | 11 = ±15ppm/°C |                               | B = ±0.1%      | E = Embossed (2010, 2512) | 0603 to 1210 5000/reel |
|           | W0805      |                       | 03 = ±25ppm/°C |                               | C = ±0.25%     |                           | 2010, 2512 4000/reel   |
|           | W1206      |                       | 02 = ±50ppm/°C |                               | D = ±0.5%      |                           |                        |
|           | W1210      |                       |                |                               | F = ±1%        |                           |                        |
|           | W2010      |                       |                |                               |                |                           |                        |
|           | W2512      |                       |                |                               |                |                           |                        |

\* Applies only to Standard Range, Pb-Free parts

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