

**TELEDYNE  
RELAYS**

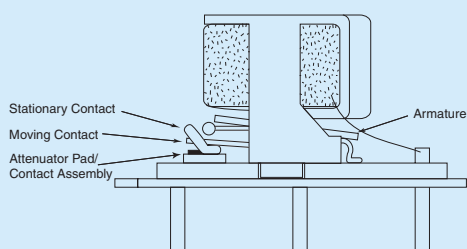
*A Unit of Teledyne Electronics and Communications*

## ULTRAMINIATURE BROADBAND ATTENUATOR RELAYS

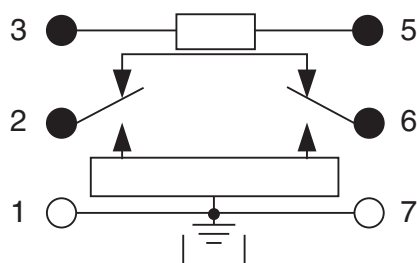
# SERIES A150

| SERIES DESIGNATION | RELAY TYPE              |
|--------------------|-------------------------|
| A150               | Attenuator Relay series |

### INTERNAL CONSTRUCTION



### SCHEMATIC DIAGRAM



Terminal view. Case ground.

### DESCRIPTION

The Series A150 ultraminiature Attenuator Relays are designed for attenuating RF signals in 50-ohm systems over a frequency range from DC to 3 GHz. Their low profile and small grid spacing makes them ideal for use when packaging density is a prime consideration. The A150 relays eliminate the need for additional external resistors.

These single section, switchable attenuator relays have internal matched thin film attenuator pads in "L," "T" or "Pi" configurations, as applicable. Relays are available in fixed increments of 1, 2, 3, 4, 5, 6, 8, 10, 16 and 20 dB, which can be used singly or in combination to achieve the attenuation levels desired.

The A150 attenuator relay features:

- Unique uni-frame motor design which provides high magnetic efficiency and mechanical rigidity.
- Minimum mass components and welded construction for maximum resistance to shock and vibration.
- Advanced cleaning techniques which assures internal cleanliness.
- Gold plated, precious metal contacts, which provide excellent intermodulation performance.
- Flat amplitude vs. frequency response.
- High isolation between control and signal path.
- Stable attenuation vs. temperature.
- Excellent phase linearity.
- Highly resistant to ESD.

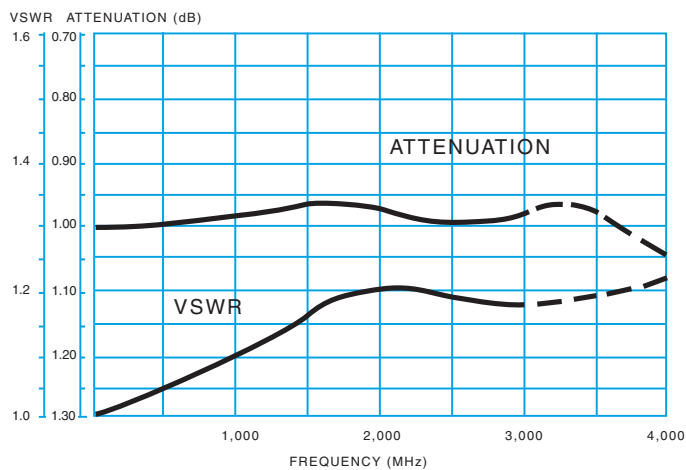
**Patent No. 5,315,273**

### ENVIRONMENTAL AND PHYSICAL SPECIFICATIONS

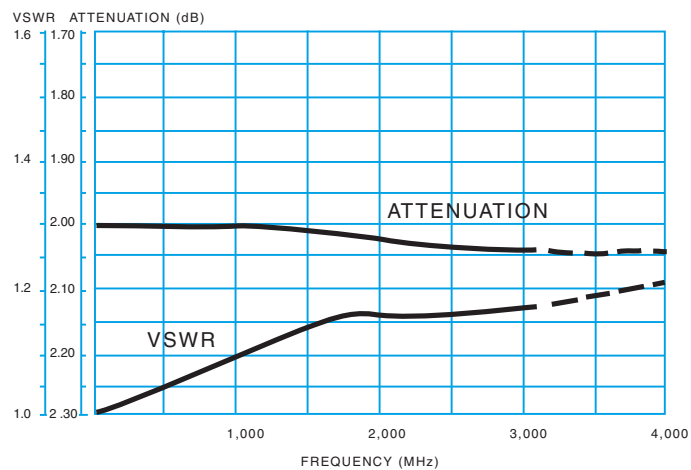
|                                      |                  |                              |
|--------------------------------------|------------------|------------------------------|
| <b>Temperature</b><br>(Ambient)      | <b>Storage</b>   | -65°C to +125°C              |
|                                      | <b>Operating</b> | -55°C to +85°C               |
| <b>Vibration</b><br>(General Note 1) |                  | 10 g's to 500 Hz             |
| <b>Shock</b><br>(General Note 1)     |                  | 30 g's,<br>6 msec, half-sine |
| <b>Enclosure</b>                     |                  | Hermetically sealed          |
| <b>Weight</b>                        |                  | 0.11 oz. (3.12g) max.        |

# SERIES A150 TYPICAL RF PERFORMANCE (Notes 2, 3 and 4)

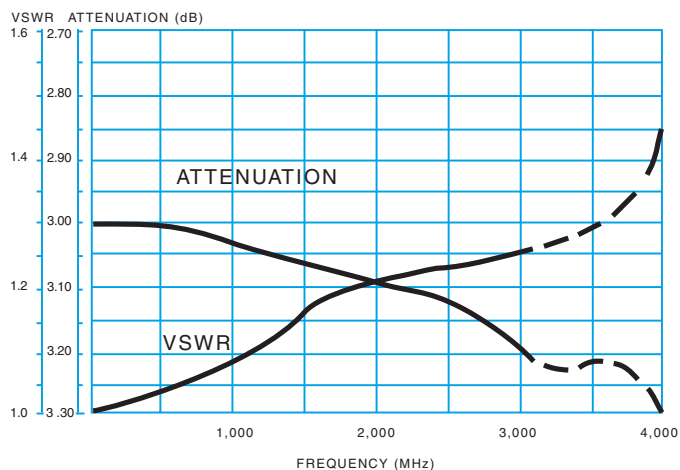
1 dB ATTENUATOR



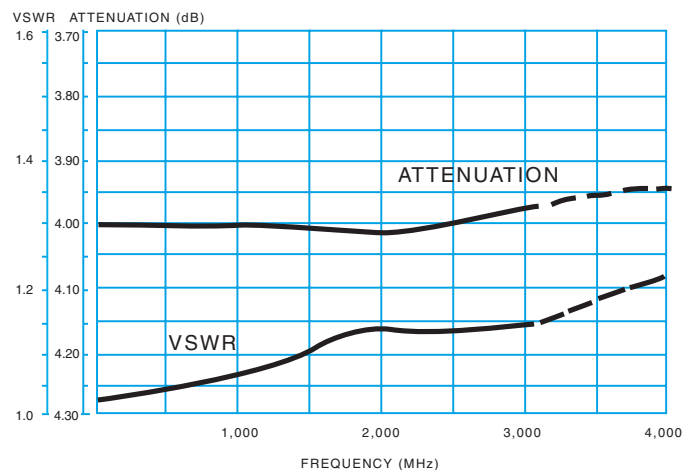
2 dB ATTENUATOR



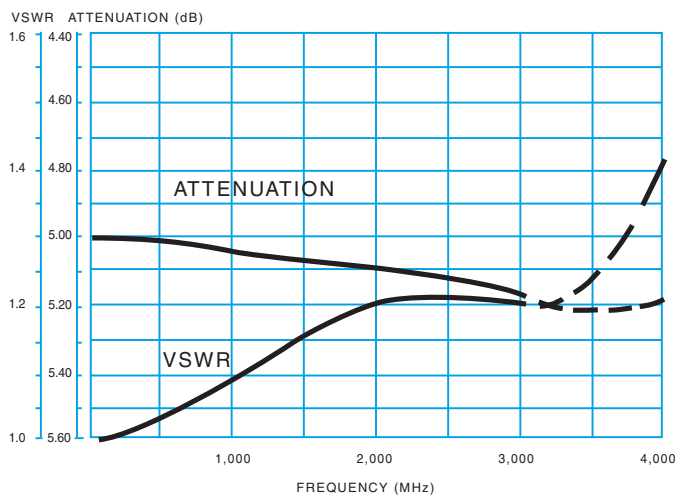
3 dB ATTENUATOR



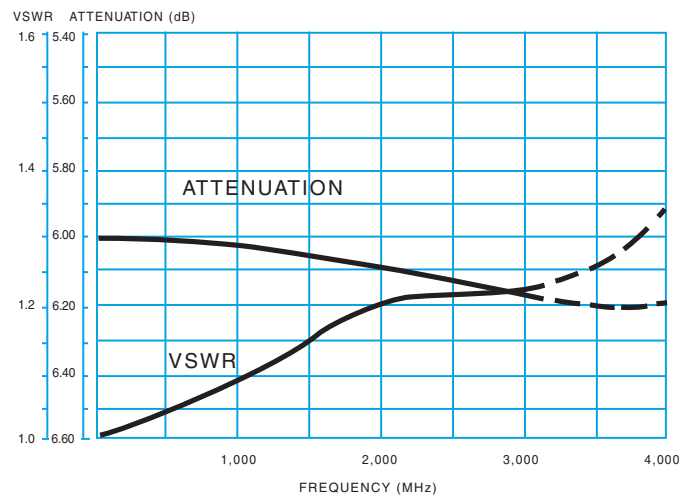
4 dB ATTENUATOR



5 dB ATTENUATOR



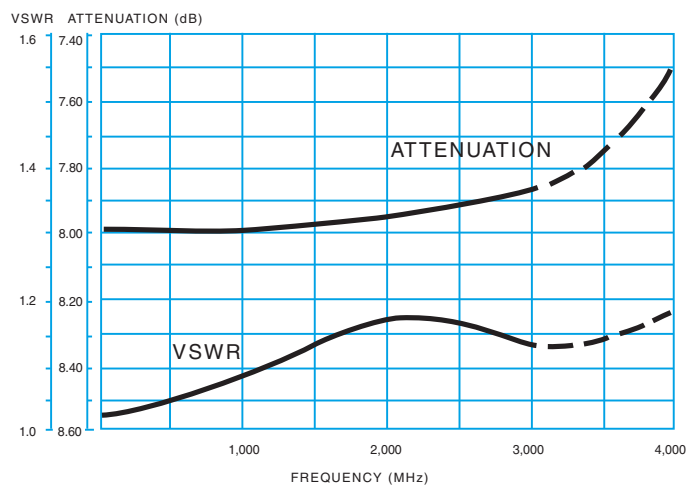
6 dB ATTENUATOR



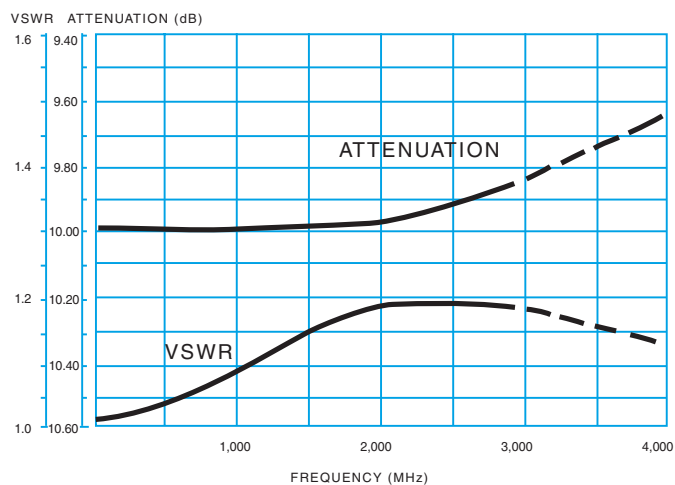
# SERIES A150

## TYPICAL RF PERFORMANCE (Notes 2, 3 and 4)

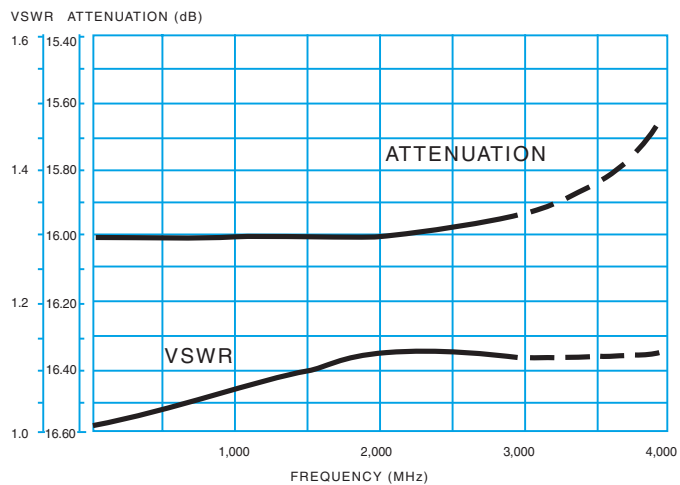
8 dB ATTENUATOR



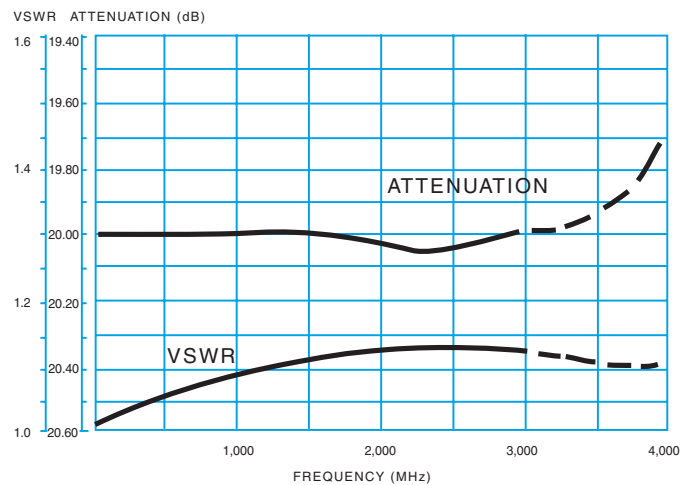
10 dB ATTENUATOR



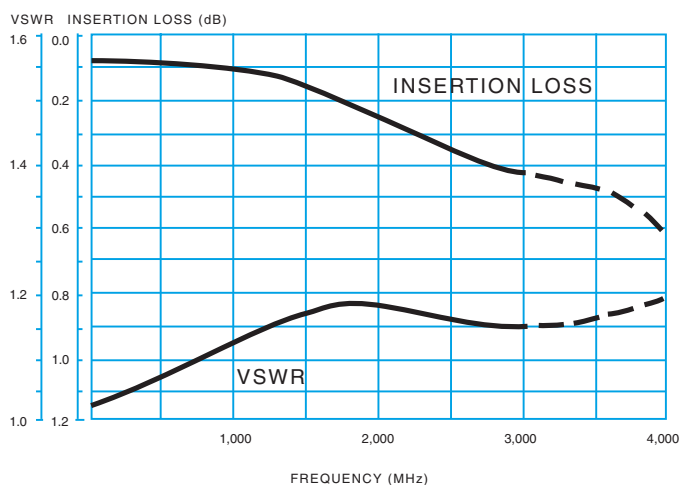
16 dB ATTENUATOR



20 dB ATTENUATOR



THROUGH PATH



## SERIES A150

## RF PERFORMANCE (–55°C to +85°C) (Notes 2, 3 and 4)

| PARAMETER              | MINIMUM | TYPICAL | MAXIMUM | UNITS | CONDITION |
|------------------------|---------|---------|---------|-------|-----------|
| Insertion Loss         |         | 0.1     | 0.25    | dB    | DC–1 GHz  |
|                        |         | 0.2     | 0.35    | dB    | 1–2 GHz   |
|                        |         | 0.3     | .055    | dB    | 2–3 GHz   |
| VSWR (Through path)    |         | 1.10    | 1.20    |       | DC–1 GHz  |
|                        |         | 1.20    | 1.25    |       | 1–2 GHz   |
|                        |         | 1.25    | 1.30    |       | 2–3 GHz   |
| VSWR (Attenuated path) |         | 1.20    | 1.25    |       | DC–1 GHz  |
|                        |         | 1.30    | 1.35    |       | 1–2 GHz   |
|                        |         | 1.40    | 1.45    |       | 2–3 GHz   |

| ATTENUATION | MINIMUM | TYPICAL | MAXIMUM | UNITS | CONDITION |
|-------------|---------|---------|---------|-------|-----------|
| 1           | 0.95    | 1.0     | 1.05    | dB    | DC–1 GHz  |
|             | 0.925   | 1.0     | 1.075   | dB    | 1–2 GHz   |
|             | 0.875   | 1.0     | 1.125   | dB    | 2–3 GHz   |
| 2           | 1.9     | 2.0     | 2.1     | dB    | DC–1 GHz  |
|             | 1.85    | 2.0     | 2.15    | dB    | 1–2 GHz   |
|             | 1.75    | 2.0     | 2.25    | dB    | 2–3 GHz   |
| 3           | 2.85    | 3.0     | 3.15    | dB    | DC–1 GHz  |
|             | 2.77    | 3.0     | 3.23    | dB    | 1–2 GHz   |
|             | 2.62    | 3.0     | 3.38    | dB    | 2–3 GHz   |
| 4           | 3.8     | 4.0     | 4.2     | dB    | DC–1 GHz  |
|             | 3.7     | 4.0     | 4.3     | dB    | 1–2 GHz   |
|             | 3.5     | 4.0     | 4.5     | dB    | 2–3 GHz   |
| 5           | 4.75    | 5.0     | 5.25    | dB    | DC–1 GHz  |
|             | 4.62    | 5.0     | 5.38    | dB    | 1–2 GHz   |
|             | 4.37    | 5.0     | 5.63    | dB    | 2–3 GHz   |
| 6           | 5.7     | 6.0     | 6.3     | dB    | DC–1 GHz  |
|             | 5.55    | 6.0     | 6.45    | dB    | 1–2 GHz   |
|             | 5.25    | 6.0     | 6.75    | dB    | 2–3 GHz   |
| 8           | 7.88    | 8.0     | 8.12    | dB    | DC–1 GHz  |
|             | 7.76    | 8.0     | 8.24    | dB    | 1–2 GHz   |
|             | 7.52    | 8.0     | 8.48    | dB    | 2–3 GHz   |
| 10          | 9.85    | 10.0    | 10.15   | dB    | DC–1 GHz  |
|             | 9.7     | 10.0    | 10.3    | dB    | 1–2 GHz   |
|             | 9.4     | 10.0    | 10.6    | dB    | 2–3 GHz   |
| 16          | 15.76   | 16.0    | 16.24   | dB    | DC–1 GHz  |
|             | 15.52   | 16.0    | 16.48   | dB    | 1–2 GHz   |
|             | 15.04   | 16.0    | 16.96   | dB    | 2–3 GHz   |
| 20          | 19.8    | 20.0    | 20.2    | dB    | DC–1 GHz  |
|             | 19.6    | 20.0    | 20.4    | dB    | 1–2 GHz   |
|             | 19.0    | 20.0    | 21.0    | dB    | 2–3 GHz   |

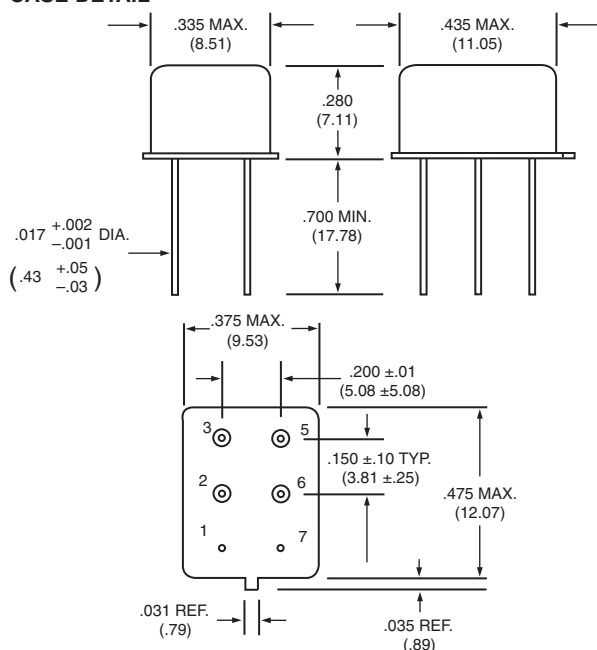
**SERIES A150**  
**GENERAL PERFORMANCE (–55°C TO +85°C)**

| PARAMETER                    | MINIMUM | TYPICAL | MAXIMUM | UNITS |
|------------------------------|---------|---------|---------|-------|
| Operating Frequency (Note 2) | 0.0     |         | 3.0     | GHz   |
| Power (Notes 5 and 6)        |         |         | 1.0     | Watt  |
| Impedance                    |         | 50      |         | Ohms  |

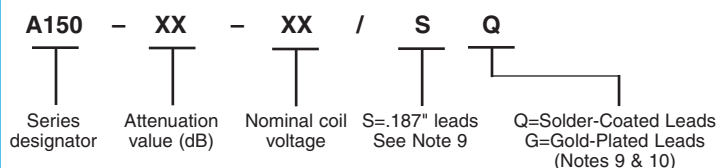
| PARAMETER           | Typical at low level |
|---------------------|----------------------|
| Contact life rating | 10,000,000 cycles    |

**ELECTRICAL SPECIFICATION (–55°C TO +85°C, unless otherwise specified)**

| PART NUMBER (Note 7)            |       | A150-dB-5                                               | A150-dB-12 | A150-dB-15 | A150-dB-26 |
|---------------------------------|-------|---------------------------------------------------------|------------|------------|------------|
| Coil Voltage Vdc (Note 6)       | Nom.  | 5                                                       | 12         | 15         | 26.5       |
|                                 | Max.  | 5.8                                                     | 16.0       | 20.0       | 32.0       |
| Coil Resistance Ohms $\pm 20\%$ | @25°C | 50                                                      | 390        | 610        | 1,560      |
| Pick-up Voltage Vdc Max.        | @25°C | 3.8                                                     | 9.0        | 11.3       | 18.0       |
| Switching Time ms (Note 8)      | Max.  | 4.0                                                     |            |            |            |
|                                 | Typ.  | 2.0                                                     |            |            |            |
| Insulation Resistance           |       | 1,000 M $\Omega$ typical (all mutually isolated points) |            |            |            |
| Dielectric strength             |       | 300 VRMS / 60 Hz typical (at sea level)                 |            |            |            |

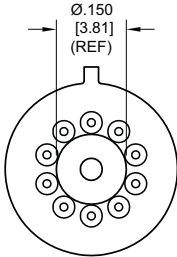
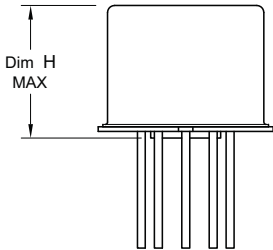
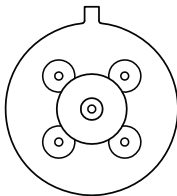
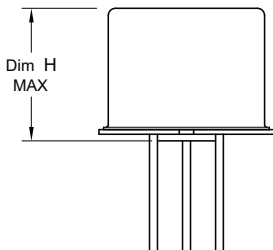
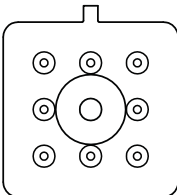
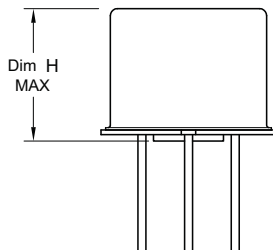
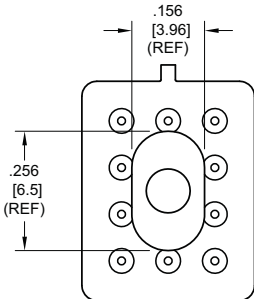
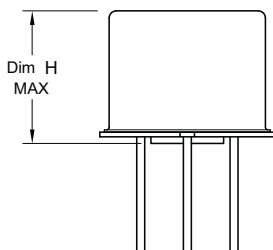
**OUTLINE DIMENSIONS**
**CASE DETAIL**


Dimensions are shown in inches (millimeters).  
 Terminal numbers shown are for reference only.  
 Leads 1 and 7 are grounded to the case.

**TELEDYNE RELAYS PART NUMBERING SYSTEM FOR A150 ATTENUATOR RELAYS**

**GENERAL NOTES:**

1. Contacts will exhibit no contact chatter in excess of 10  $\mu$ s or transfer in excess of 1  $\mu$ s.
2. Relays may be operated at higher frequencies with reduced RF performance.
3. For optimal RF performance, solder case to RF ground plane.
4. Attenuation values shown are with reference to the through path (low loss state).
5. Power handling for case temperatures of –55°C to +55°C is 1 Watt. Derate power handling 25 mW/°C above +55°C. Case measurement point is adjacent to the relay tab.
6. Do not operate coil at maximum coil voltage continuously.
7. Insert attenuation value, see part numbering system.
8. Switching time includes bounce.
9. The slash and characters appearing after the slash are not marked on the relay.
10. Unless otherwise specified, relays will be supplied with either gold-plated or solder-coated leads.

# Appendix A: Spacer Pads

| Pad designation and bottom view dimensions                                                                         | Height                                                                              | For use with the following:                                                                  | Dim. H Max.  |
|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------|
|  <p>“M4” Pad for TO-5</p>         |    | ER411T<br>ER412, ER412D, ER412DD                                                             | .295 (7.49)  |
|                                                                                                                    |                                                                                     | 712, 712D, 712TN,<br>RF300, RF310, RF320                                                     | .300 (7.62)  |
|                                                                                                                    |                                                                                     | ER420, ER422D, ER420DD, 421,<br>ER421D, ER421DD, ER422, ER422D,<br>ER422DD, 722, 722D, RF341 | .305 (7.75)  |
|                                                                                                                    |                                                                                     | ER431T, ER432T,<br>ER432, ER432D, ER432DD                                                    | .400 (10.16) |
|                                                                                                                    |                                                                                     | 732, 732D, 732TN, RF303, RF313,<br>RF323                                                     | .410 (10.41) |
|                                                                                                                    |                                                                                     | RF312                                                                                        | .350 (8.89)  |
|  <p>“M4” Pad for TO-5</p>         |    | ER411, ER411D, ER411DD                                                                       | .295 (7.49)  |
|                                                                                                                    |                                                                                     | ER431, ER431D, ER431DD                                                                       | .400 (10.16) |
|                                                                                                                    |                                                                                     | RF311                                                                                        | .300 (7.62)  |
|                                                                                                                    |                                                                                     | RF331                                                                                        | .410 (10.41) |
|  <p>“M4” Pad for Centigrid®</p> |  | 172, 172D                                                                                    | .305 (7.75)  |
|                                                                                                                    |                                                                                     | ER114, ER114D, ER114DD,<br>J114, J114D, J114DD                                               | .300 (7.62)  |
|                                                                                                                    |                                                                                     | ER134, ER134D, ER134DD,<br>J134, J134D, J134DD                                               | .400 (10.16) |
|                                                                                                                    |                                                                                     | RF100                                                                                        | .315 (8.00)  |
|                                                                                                                    |                                                                                     | RF103                                                                                        | .420 (10.67) |
|  <p>“M9” Pad for Centigrid®</p> |  | 122C, A152                                                                                   | .320 (8.13)  |
|                                                                                                                    |                                                                                     | ER116C, J116C                                                                                | .300 (7.62)  |
|                                                                                                                    |                                                                                     | ER136C, J136C                                                                                | .400 (10.16) |
|                                                                                                                    |                                                                                     | RF180                                                                                        | .325 (8.25)  |
|                                                                                                                    |                                                                                     | A150                                                                                         | .305 (7.75)  |

## Notes:

1. Spacer pad material: Polyester film.
2. To specify an “M4” or “M9” spacer pad, refer to the mounting variants portion of the part numbering example in the applicable datasheet.
3. Dimensions are in inches (mm).
4. Unless otherwise specified, tolerance is  $\pm .010$  (.25).
5. Add 10 mΩ to the contact resistance show in the datasheet.
6. Add 0.01 oz. (0.25 g) to the weight of the relay assembly shown in the datasheet.

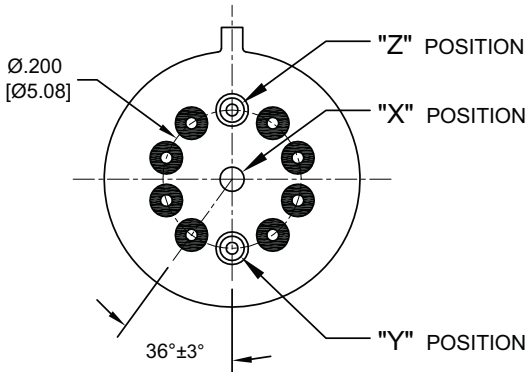
# Appendix A: Spreader Pads

| Pad designation and bottom view dimensions    | Height | For use with the following:                                                                                         | Dim. H Max.  |
|-----------------------------------------------|--------|---------------------------------------------------------------------------------------------------------------------|--------------|
| <p>“M” Pad <u>5/</u> <u>6/</u></p>            |        | ER411T, J411T, ER412, ER412D<br>ER412DD, J412, J412D, J412DD<br>ER412T, J412T                                       | .388 (9.86)  |
|                                               |        | 712, 712D, 712TN                                                                                                    | .393 (9.99)  |
|                                               |        | ER431T, J431T, ER432, ER432D<br>ER432DD, J432, J432D, J432DD<br>ER432T, J432T                                       | .493 (12.52) |
|                                               |        | 732, 732D, 732TN                                                                                                    | .503 (12.78) |
|                                               |        | ER420, J420, ER420D, J420D<br>ER420DD, J420DD, ER421, J421<br>ER421D, J421D, ER421DD<br>J422D, ER422DD, J422DD, 722 | .398 (10.11) |
| <p>“M2” Pad <u>7/</u> <u>8/</u></p>           |        | ER411T<br>ER412, ER412D, ER412DD<br>J412, J412D, J412DD                                                             | .441 (11.20) |
|                                               |        | 712, 712D                                                                                                           | .451 (11.46) |
|                                               |        | ER421, ER421D, ER421DD<br>722, 732D                                                                                 | .451 (11.46) |
|                                               |        | ER431T<br>ER432, ER432D, ER432DD                                                                                    | .546 (13.87) |
|                                               |        | 732, 732D                                                                                                           | .556 (14.12) |
| <p>“M3” Pad <u>5/</u> <u>6/</u> <u>9/</u></p> |        | ER411, ER411D, ER411DD<br>ER411TX<br>ER412X, ER412DX, ER412DDX<br>ER412TX                                           | .388 (9.86)  |
|                                               |        | 712X, 712DX, 712TNX                                                                                                 | .393 (9.99)  |
|                                               |        | ER420X, ER420DX, ER420DDX<br>ER421X, ER421DX, ER421DDX<br>ER422X, ER422DX<br>ER422DDX, 722X, 722DDX                 | .398 (10.11) |
|                                               |        | ER431, ER431D, ER431DD<br>ER431TX<br>ER432X, ER432DX, ER432DDX<br>ER432TX                                           | .493 (12.52) |
|                                               |        | 732X, 732DX, 732TNX                                                                                                 | .503 (12.78) |

## Notes:

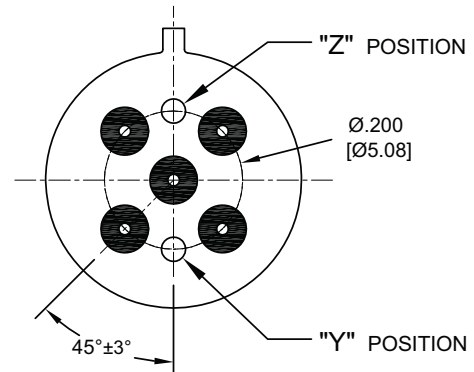
1. Spreader pad material: Diallyl Phthalate.
2. To specify an “M”, “M2” or “M3” spreader pad, refer to the mounting variants portion of the part number example in the applicable datasheet.
3. Dimensions are in inches (mm).
4. Unless otherwise specified, tolerance is  $\pm .010$ ” (0.25).
- 5/. Add 25 mΩ to the contact resistance shown in the datasheet.
- 6/. Add .01 oz. (0.25 g) to the weight of the relay assembly shown in the datasheet.
- 7/. Add 50 mΩ to the contact resistance shown in the datasheet.
- 8/. Add 0.025 oz (0.71 g) to the weight of the relay assembly shown in the datasheet.
- 9/. M3 pad to be used only when the relay has a center pin (e.g. ER411M3-12A, 722XM3-26.)

# Appendix A: Ground Pin Positions



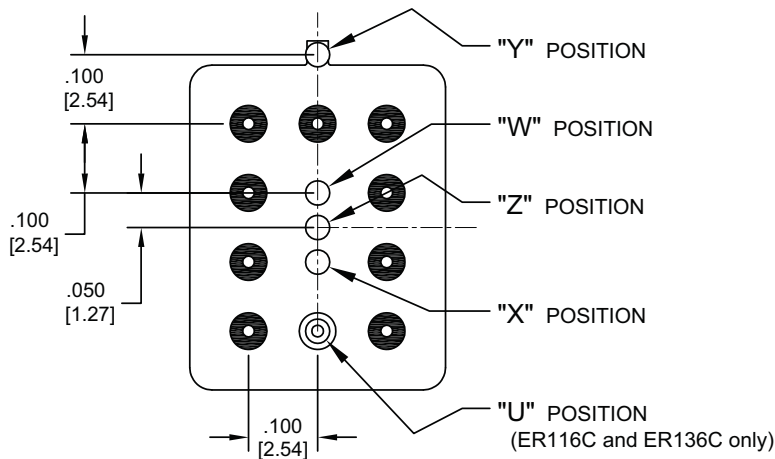
## TO-5 Relays:

ER411T, ER412, ER412T, ER420, ER421, ER422,  
ER431T, ER432, ER432T, 712, 712TN, 400H, 400K,  
400V, RF300, RF303, RF341, RF312, RF310, RF313,  
RF320, RF323



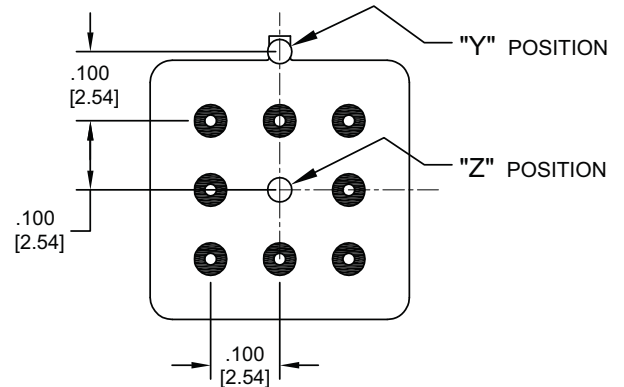
## TO-5 Relays:

ER411, ER431, RF311, RF331



## Centigrid® Relays:

RF180, ER116C, 122C, ER136C



## Centigrid® Relays:

RF100, RF103, ER114, ER134, 172

- Indicates ground pin position
- Indicates glass insulated lead position
- ⊙ Indicates ground pin or lead position depending on relay type

## NOTES

1. Terminal views shown
2. Dimensions are in inches (mm)
3. Tolerances:  $\pm .010$  ( $\pm .25$ ) unless otherwise specified
4. Ground pin positions are within .015 (0.38) dia. of true position
5. Ground pin head dia., 0.035 (0.89) ref: height 0.010 (0.25) ref.
6. Lead dia. 0.017 (0.43) nom.