



LTCC SURFACE MOUNT

Thru-Line

TPCW-233+

50Ω DC to 23 GHz

THE BIG DEAL

- Low Insertion Loss, 0.15dB Typ.
- Return Loss, 21dB Typ.
- 0603 Surface Mount Footprint
- Versatile "Place Holder" for Mini-Circuits LTCC Filters
- Power Handling: 7 Watts

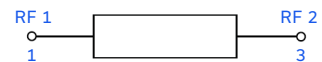


Generic photo used for illustration purposes only

APPLICATIONS

- Test and Measurement Equipment
- Communication, EW, Radar and ECM Defense Systems
- 5G MIMO and Back Haul Radio Systems
- Satellite Communications

FUNCTIONAL DIAGRAM



PRODUCT OVERVIEW

TPCW-233+ is a miniature low temperature co-fired ceramic (LTCC) 50 Ohm transmission line with low insertion loss through 23 GHz acting as a place holder for Mini-Circuits HPF filters, on customer PCB. This model provides 0.15 dB typical insertion loss over a wide band due to its rugged monolithic construction. Housed in a tiny 0603 ceramic form factor with inspectable wrap-around terminations, the transmission line is ideal for dense signal chain PCB layouts where it complements MMIC size and performance. The LTCC fabrication process assures minimal RF performance variation while delivering a product that is well suited for environmental extremes of high humidity and temperature.

KEY FEATURES

| Features | Advantages |
|--|---|
| Footprint Compatible "Thru-Line" for Mini-Circuits, High Pass (HFCW series) filters in Case Style JC0603C with same pad connections as TPCW. | Enables system designers the flexibility to plan to add LTCC filters to the PCB layout at a later stage in the design process, after system test results are available. |
| Good power handling, 7W | This enables the device to be used in high power applications |
| LTCC Construction | Provides repeatable performance in a rugged, ceramic package well suited for tough environments such as high humidity and temperature extremes. |
| Tiny size, 0603 | Saves space in dense circuit board layouts and minimizes the effects of parasitics. |
| Wrap-around terminations | Provides excellent solderability and easy visual inspection. |
| Rugged Power handling | Handles up to 7 Watts in a small 0603 package. |



ELECTRICAL SPECIFICATIONS^{1,2,3} AT +25°C

| Parameter | | F# | Frequency (GHz) | Min. | Typ. | Max. | Units |
|-------------|----------------|---------|-----------------|------|------|------|-------|
| Pass Band | Insertion Loss | DC-F1 | DC - 10 | — | 0.15 | 0.4 | dB |
| | | F1-F2 | 10 - 16 | — | 0.5 | 1.0 | |
| | | F2-F3 | 16 - 23 | — | 0.9 | — | |
| | Return Loss | DC-F1 | DC - 10 | — | 21 | — | dB |
| | | F1-F2 | 10 - 16 | — | 14 | — | |
| | | F2-F3 | 16 - 23 | — | 10 | — | |
| Group Delay | DC-F3 | DC - 23 | — | 50 | — | psec | |

1. DC blocking capacitors are required in applications where DC voltage and/or current is present at either input or output ports. Please contact Mini-Circuits for alternatives if DC pass from IN-OUT is required.

2. Measured on Mini-Circuits Evaluation Board TB-TPCW-233+

3. Bi Directional, RF1 and RF2 ports can be interchanged, see S-parameters for actual performance

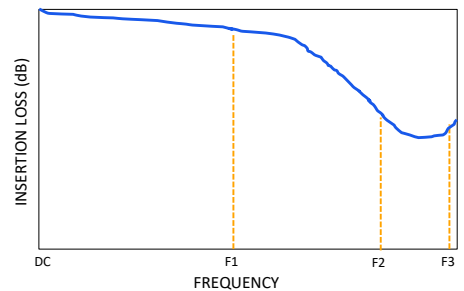
ABSOLUTE MAXIMUM RATINGS⁴

| Parameter | Ratings |
|--------------------------|-------------------|
| Operating Temperature | -55 °C to +125 °C |
| Storage Temperature | -55 °C to +125 °C |
| Input Power ⁵ | 7W @25°C |

4. Permanent damage may occur if any of these limits are exceeded.

5. Power rating applies only to signals within the passband. Power rating above +25°C operating temperature decreases linearly to 2.3 W at +125°C.

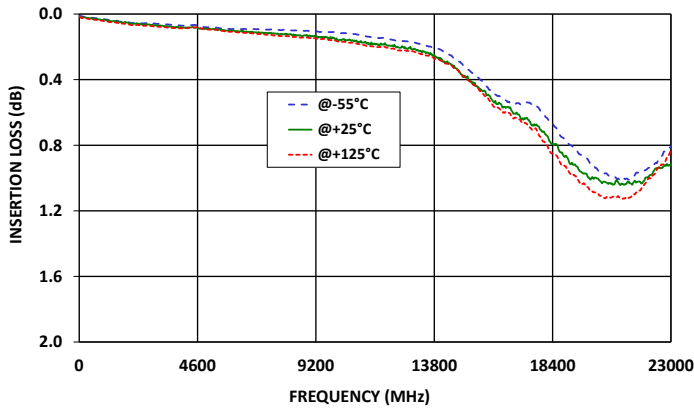
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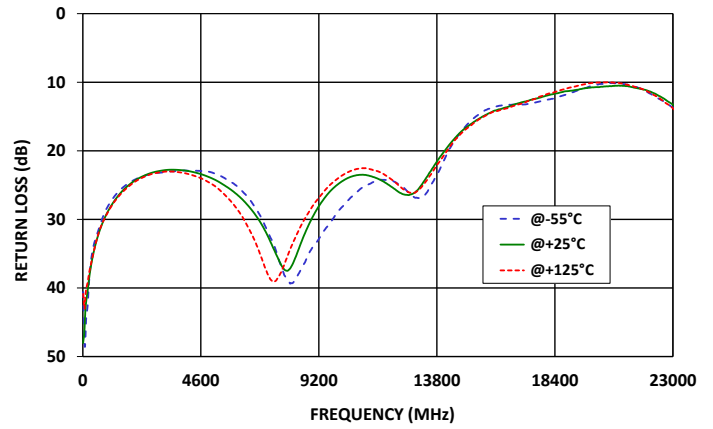


TYPICAL PERFORMANCE GRAPHS

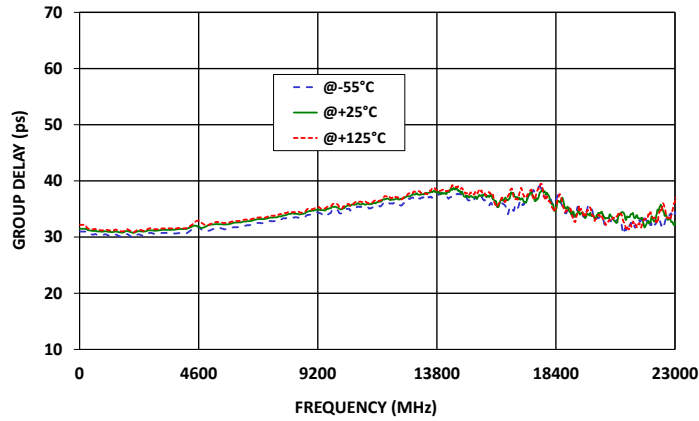
TPCW-233+
INSERTION LOSS



TPCW-233+
RETURN LOSS



TPCW-233+
GROUP DELAY





FUNCTIONAL DIAGRAM

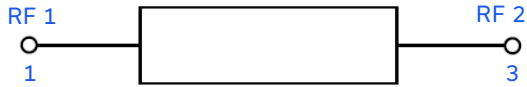
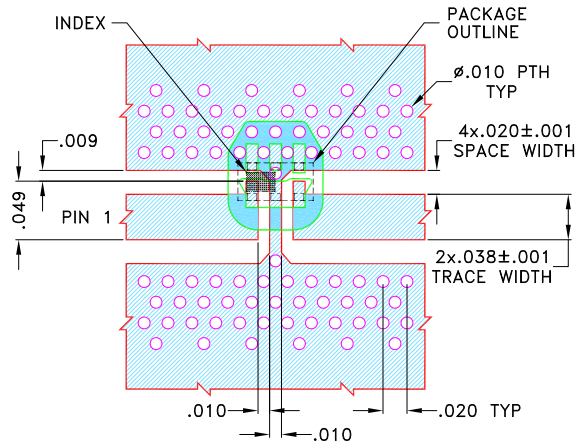


Figure 1. TPCW-233+ Functional Diagram

PAD DESCRIPTION

| Function | Pad Number | Description |
|-------------------------|------------|--|
| RF1 ^(Note 2) | 1 | Connects to RF Input Port |
| RF2 ^(Note 2) | 3 | Connects to RF Output Port |
| GROUND | 2,4,5,6 | Connects to Ground on PCB, (See drawing PL-704) |
| NC | - | No connection, not used internally. See drawing PL-704 for connection to PCB |

SUGGESTED PCB LAYOUT (PL-704)

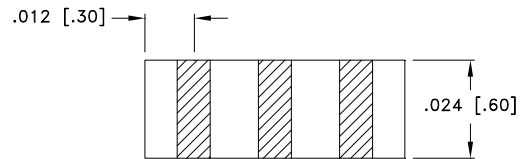
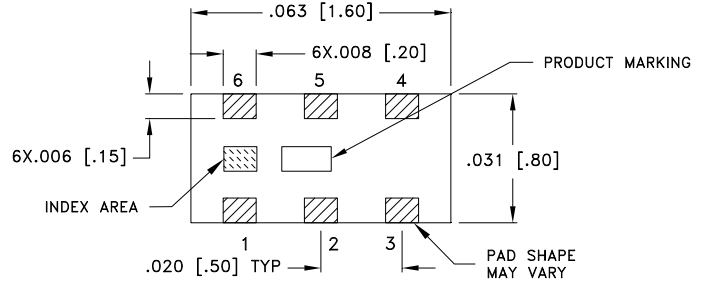


NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (R03003) WITH DIELECTRIC THICKNESS .020±.001 COPPER: 1/2 Oz. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
 2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
- DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 □ DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

Figure 2. Suggested PCB Layout PL-704

CASE STYLE DRAWING



Weight: .005 grams.

Dimensions are in inches (mm). Tolerances: 2Pl. ± .01; 3 Pl. ± .005

PRODUCT MARKING*: VP

*Marking may contain other features or characters for internal lot control.



LTCC SURFACE MOUNT

Thru-Line

TPCW-233+

Mini-Circuits

50Ω DC to 23 GHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD. [CLICK HERE](#)

| | |
|---------------------------------|---|
| Performance Data and Graphs | Data |
| | Graphs S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads |
| Case Style | JC0603C Lead Finish: Nickel-Tin |
| RoHS Status | Compliant |
| Tape and Reel | TR-F114 |
| Suggested Layout for PCB Design | 98-PL-704 |
| Evaluation Board | TB-TPCW-233+ |
| | Gerber File |
| Environmental Rating | ENV126 |

NOTES

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuits' applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits' standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html



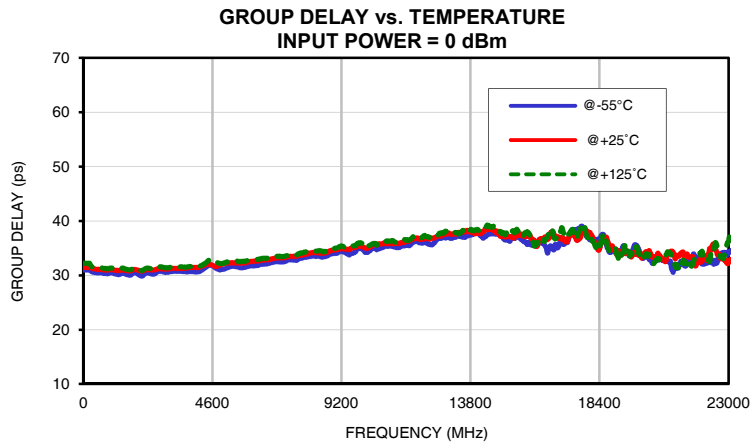
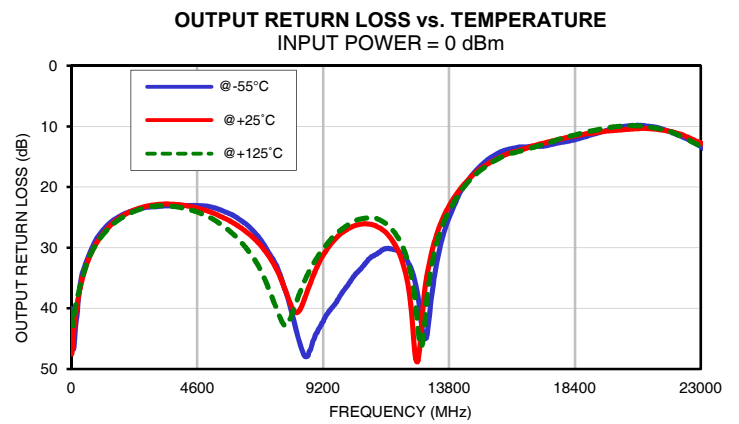
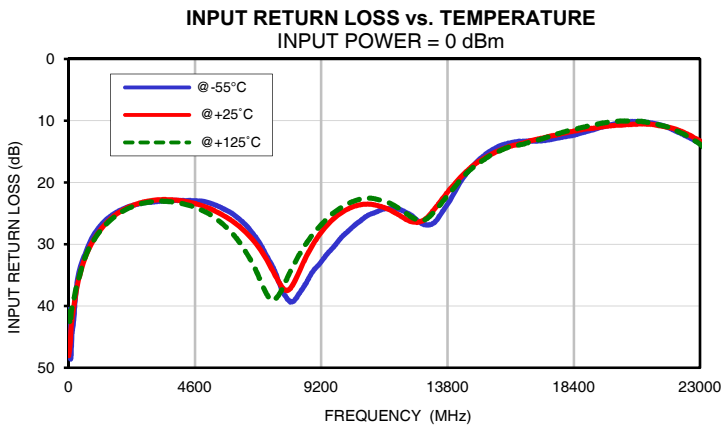
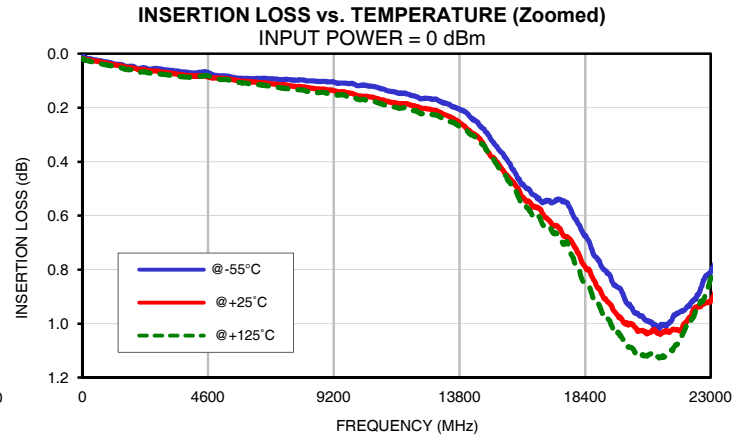
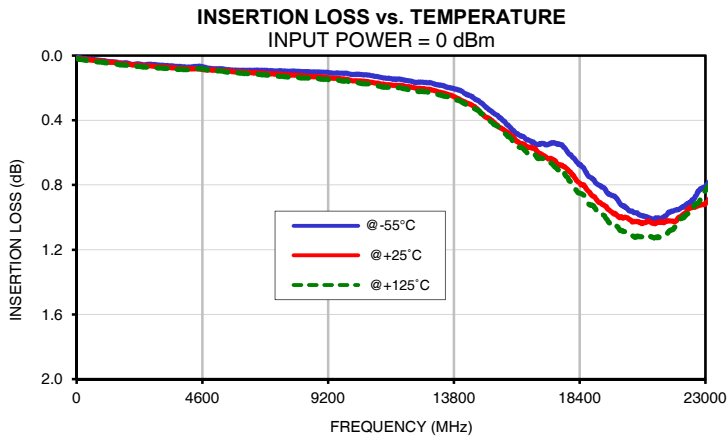
Typical Performance Data

| FREQ. (MHz) | INSERTION LOSS | | | INPUT RETURN LOSS | | | OUTPUT RETURN LOSS | | |
|----------------|----------------|--------|---------|-------------------|--------|---------|--------------------|--------|---------|
| | (dB) | | | (dB) | | | (dB) | | |
| | @-55°C | @+25°C | @+125°C | @-55°C | @+25°C | @+125°C | @-55°C | @+25°C | @+125°C |
| 10 | 0.01 | 0.02 | 0.02 | 40.59 | 48.03 | 40.87 | 40.04 | 47.54 | 41.32 |
| 100 | 0.02 | 0.02 | 0.02 | 47.51 | 43.14 | 41.06 | 45.94 | 42.93 | 40.99 |
| 200 | 0.02 | 0.02 | 0.03 | 41.90 | 39.98 | 38.89 | 41.33 | 39.83 | 38.78 |
| 250 | 0.02 | 0.02 | 0.03 | 38.74 | 38.45 | 37.69 | 38.62 | 38.33 | 37.62 |
| 300 | 0.02 | 0.02 | 0.03 | 36.75 | 37.19 | 36.81 | 36.71 | 37.08 | 36.71 |
| 350 | 0.02 | 0.03 | 0.03 | 35.21 | 36.10 | 35.94 | 35.33 | 36.02 | 35.88 |
| 400 | 0.02 | 0.03 | 0.03 | 34.16 | 35.16 | 35.11 | 34.28 | 35.10 | 35.05 |
| 500 | 0.02 | 0.03 | 0.03 | 32.76 | 33.57 | 33.51 | 32.87 | 33.53 | 33.49 |
| 550 | 0.02 | 0.03 | 0.03 | 32.20 | 32.89 | 32.81 | 32.29 | 32.86 | 32.79 |
| 600 | 0.03 | 0.03 | 0.04 | 31.66 | 32.27 | 32.16 | 31.74 | 32.24 | 32.17 |
| 650 | 0.03 | 0.03 | 0.04 | 31.08 | 31.70 | 31.59 | 31.16 | 31.67 | 31.60 |
| 700 | 0.03 | 0.03 | 0.04 | 30.51 | 31.17 | 31.09 | 30.60 | 31.14 | 31.11 |
| 750 | 0.03 | 0.03 | 0.04 | 29.95 | 30.68 | 30.63 | 30.05 | 30.65 | 30.66 |
| 800 | 0.03 | 0.03 | 0.04 | 29.45 | 30.22 | 30.22 | 29.54 | 30.19 | 30.24 |
| 850 | 0.03 | 0.04 | 0.04 | 29.01 | 29.80 | 29.85 | 29.09 | 29.77 | 29.86 |
| 900 | 0.03 | 0.04 | 0.04 | 28.62 | 29.40 | 29.49 | 28.67 | 29.37 | 29.48 |
| 950 | 0.03 | 0.04 | 0.04 | 28.27 | 29.03 | 29.14 | 28.31 | 28.99 | 29.12 |
| 1000 | 0.03 | 0.04 | 0.04 | 27.93 | 28.68 | 28.79 | 27.97 | 28.64 | 28.78 |
| 1050 | 0.03 | 0.04 | 0.04 | 27.63 | 28.35 | 28.47 | 27.67 | 28.31 | 28.46 |
| 1100 | 0.04 | 0.04 | 0.05 | 27.33 | 28.04 | 28.16 | 27.37 | 28.00 | 28.15 |
| 1150 | 0.04 | 0.04 | 0.05 | 27.06 | 27.74 | 27.87 | 27.10 | 27.70 | 27.86 |
| 1200 | 0.04 | 0.04 | 0.05 | 26.81 | 27.46 | 27.60 | 26.85 | 27.42 | 27.59 |
| 2000 | 0.05 | 0.06 | 0.07 | 24.25 | 24.41 | 24.59 | 24.30 | 24.40 | 24.62 |
| 2500 | 0.06 | 0.06 | 0.07 | 23.54 | 23.45 | 23.62 | 23.58 | 23.45 | 23.66 |
| 3000 | 0.06 | 0.07 | 0.08 | 23.19 | 22.93 | 23.14 | 23.27 | 22.95 | 23.18 |
| 3500 | 0.06 | 0.08 | 0.08 | 22.99 | 22.76 | 23.03 | 23.09 | 22.80 | 23.10 |
| 4000 | 0.07 | 0.08 | 0.09 | 22.89 | 22.88 | 23.28 | 23.01 | 22.94 | 23.37 |
| 4500 | 0.07 | 0.08 | 0.08 | 22.92 | 23.29 | 23.85 | 23.03 | 23.34 | 23.95 |
| 5000 | 0.08 | 0.09 | 0.09 | 23.13 | 23.97 | 24.80 | 23.17 | 23.98 | 24.88 |
| 5500 | 0.09 | 0.10 | 0.10 | 23.93 | 24.99 | 26.30 | 23.85 | 24.93 | 26.25 |
| 6000 | 0.09 | 0.10 | 0.11 | 25.13 | 26.34 | 28.42 | 24.89 | 26.13 | 28.13 |
| 6500 | 0.09 | 0.11 | 0.12 | 27.08 | 28.25 | 31.56 | 26.55 | 27.77 | 30.72 |
| 7000 | 0.09 | 0.11 | 0.12 | 30.09 | 30.94 | 35.99 | 29.23 | 30.06 | 34.51 |
| 7500 | 0.10 | 0.12 | 0.13 | 34.25 | 34.81 | 39.01 | 32.99 | 33.55 | 40.08 |
| 8000 | 0.10 | 0.12 | 0.13 | 39.02 | 37.45 | 35.13 | 39.71 | 39.19 | 41.71 |
| 8500 | 0.10 | 0.13 | 0.14 | 37.33 | 33.47 | 30.94 | 47.67 | 38.73 | 35.75 |
| 9000 | 0.10 | 0.13 | 0.15 | 33.86 | 29.35 | 27.83 | 43.77 | 32.95 | 31.47 |
| 9500 | 0.11 | 0.14 | 0.15 | 31.16 | 26.51 | 25.49 | 40.00 | 29.29 | 28.52 |
| 10000 | 0.12 | 0.15 | 0.17 | 28.61 | 24.72 | 23.87 | 36.79 | 27.20 | 26.57 |
| 10500 | 0.12 | 0.16 | 0.18 | 26.62 | 23.72 | 22.85 | 33.83 | 26.17 | 25.34 |
| 11000 | 0.13 | 0.17 | 0.19 | 25.12 | 23.51 | 22.53 | 31.40 | 26.19 | 25.01 |
| 11500 | 0.14 | 0.18 | 0.20 | 24.25 | 24.07 | 22.98 | 30.14 | 27.52 | 26.02 |
| 12000 | 0.15 | 0.19 | 0.21 | 24.30 | 25.18 | 24.09 | 30.72 | 31.13 | 28.85 |
| 12500 | 0.17 | 0.20 | 0.22 | 25.37 | 26.35 | 25.62 | 34.46 | 44.60 | 36.54 |
| 13000 | 0.17 | 0.21 | 0.23 | 26.83 | 25.88 | 25.97 | 44.31 | 34.43 | 38.16 |
| 13500 | 0.19 | 0.24 | 0.25 | 25.47 | 23.26 | 23.80 | 29.34 | 25.92 | 27.08 |
| 14000 | 0.22 | 0.27 | 0.28 | 22.05 | 20.52 | 21.07 | 22.96 | 21.66 | 22.36 |
| 14500 | 0.26 | 0.31 | 0.32 | 18.47 | 18.16 | 18.47 | 18.91 | 18.84 | 19.19 |
| 15000 | 0.32 | 0.38 | 0.39 | 16.09 | 16.44 | 16.65 | 16.33 | 16.84 | 17.09 |
| 15500 | 0.39 | 0.45 | 0.45 | 14.54 | 15.19 | 15.30 | 14.67 | 15.51 | 15.60 |
| 16000 | 0.47 | 0.51 | 0.54 | 13.65 | 14.21 | 14.31 | 13.74 | 14.40 | 14.54 |
| 16500 | 0.52 | 0.57 | 0.60 | 13.33 | 13.67 | 13.83 | 13.38 | 13.76 | 13.96 |
| 17000 | 0.54 | 0.61 | 0.63 | 13.28 | 13.05 | 13.22 | 13.29 | 13.07 | 13.29 |
| 17500 | 0.54 | 0.65 | 0.69 | 13.08 | 12.53 | 12.58 | 13.03 | 12.48 | 12.61 |
| 18000 | 0.61 | 0.71 | 0.77 | 12.65 | 12.04 | 11.85 | 12.57 | 11.94 | 11.84 |
| 18500 | 0.69 | 0.80 | 0.86 | 12.21 | 11.61 | 11.29 | 12.08 | 11.51 | 11.30 |
| 19000 | 0.79 | 0.89 | 0.95 | 11.55 | 11.24 | 10.77 | 11.36 | 11.11 | 10.75 |
| 20000 | 0.93 | 1.00 | 1.09 | 10.39 | 10.72 | 10.07 | 10.13 | 10.60 | 9.99 |
| 21000 | 1.01 | 1.03 | 1.12 | 10.20 | 10.50 | 10.17 | 9.93 | 10.32 | 10.00 |
| 23000 | 0.81 | 0.91 | 0.83 | 13.71 | 13.27 | 13.81 | 13.29 | 12.73 | 13.37 |

Typical Performance Data

| FREQ. (MHz) | GROUP DELAY | | |
|--------------------|-------------|--------|---------|
| | (psec) | | |
| | @-55°C | @+25°C | @+125°C |
| 10 | 30.98 | 31.47 | 32.18 |
| 500 | 30.45 | 31.10 | 31.40 |
| 1000 | 30.49 | 31.03 | 31.34 |
| 1500 | 30.23 | 30.88 | 31.15 |
| 2000 | 30.03 | 30.85 | 31.02 |
| 2500 | 30.19 | 30.99 | 31.13 |
| 3000 | 30.56 | 31.16 | 31.40 |
| 3500 | 30.71 | 31.27 | 31.54 |
| 4000 | 30.62 | 31.43 | 31.54 |
| 4500 | 31.86 | 32.01 | 32.82 |
| 5000 | 31.16 | 32.14 | 32.23 |
| 5500 | 31.51 | 32.26 | 32.59 |
| 6000 | 31.75 | 32.58 | 32.84 |
| 6500 | 32.13 | 32.85 | 33.12 |
| 7000 | 32.47 | 33.21 | 33.50 |
| 7500 | 32.84 | 33.52 | 33.82 |
| 8000 | 33.41 | 33.97 | 34.33 |
| 8500 | 33.34 | 34.03 | 34.43 |
| 9000 | 34.01 | 34.71 | 34.98 |
| 9500 | 33.83 | 34.78 | 35.16 |
| 10000 | 34.55 | 35.15 | 35.61 |
| 10500 | 34.95 | 35.76 | 35.80 |
| 11000 | 35.31 | 35.82 | 36.40 |
| 11500 | 35.49 | 36.22 | 36.47 |
| 12000 | 35.96 | 36.58 | 37.00 |
| 12500 | 35.99 | 36.91 | 36.93 |
| 13000 | 37.11 | 37.69 | 38.07 |
| 13500 | 37.04 | 37.91 | 38.14 |
| 14000 | 37.81 | 37.86 | 38.38 |
| 14500 | 37.62 | 38.44 | 38.87 |
| 15000 | 36.60 | 37.31 | 37.68 |
| 15500 | 37.25 | 37.36 | 38.13 |
| 16000 | 35.61 | 36.64 | 36.62 |
| 16500 | 35.09 | 36.64 | 36.71 |
| 17000 | 36.20 | 36.78 | 37.97 |
| 17500 | 38.03 | 37.20 | 37.38 |
| 18000 | 37.11 | 37.90 | 36.58 |
| 18500 | 37.52 | 36.41 | 37.13 |
| 20000 | 33.58 | 33.61 | 33.41 |
| 21000 | 30.90 | 34.42 | 32.86 |
| 23000 | 34.09 | 32.30 | 36.22 |

Typical Performance Curves

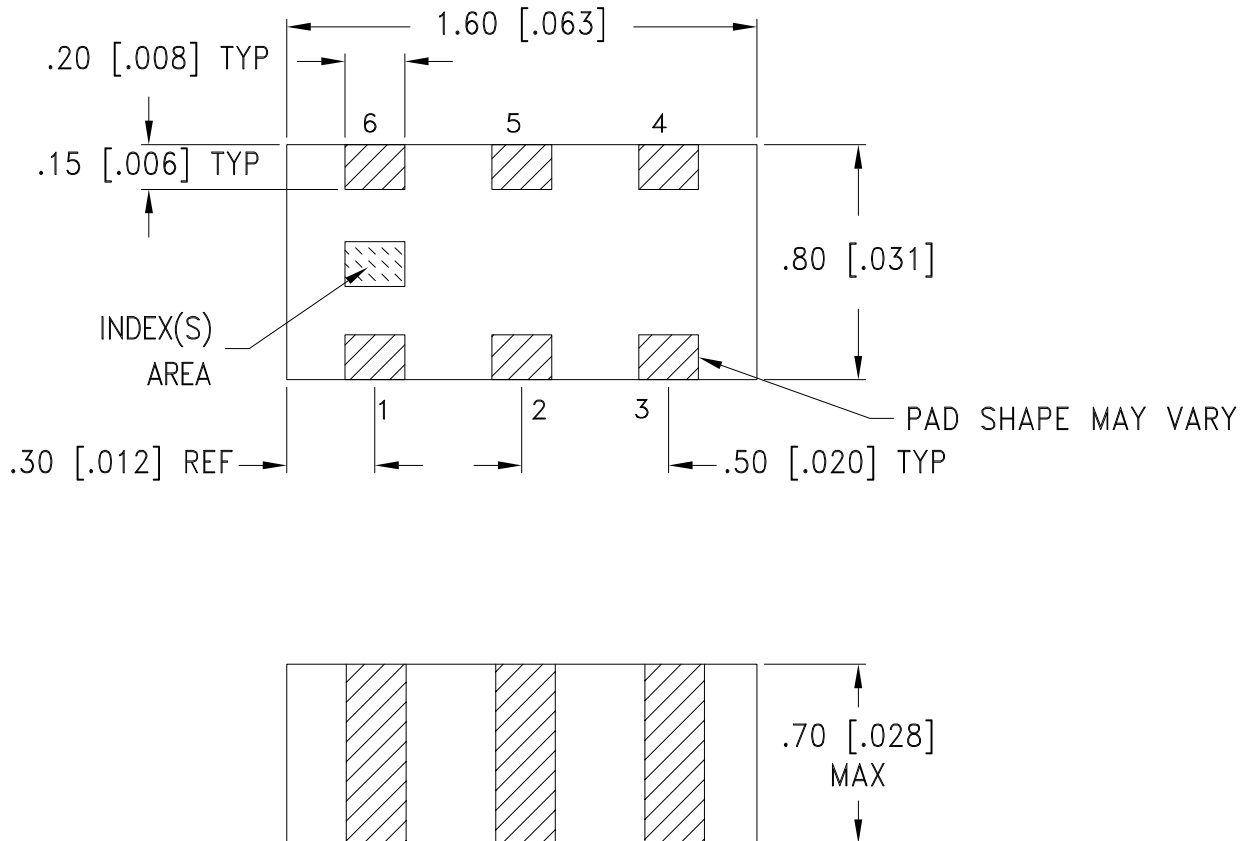


Case Style

JC

Outline Dimensions

JC0603C



Weight: .005 grams

Dimensions are in mm [inch]. Tolerances: ± 0.13 mm

Notes:

1. Open style, ceramic base.
2. Termination finish:

For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.

 **Mini-Circuits**[®]
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RF/IF MICROWAVE COMPONENTS

Tape & Reel Packaging TR-F114

DEVICE ORIENTATION IN T&R



ILLUSTRATION 1

| Applicable Case Styles | |
|------------------------|-----------|
| GE0805C | JC0603C |
| GE0805C-1 | JC0603C-4 |
| GE0805C-1AP | JC0603C-6 |
| GE0805C-7 | |
| GE0805C-9 | |
| GE0805C-10 | |
| GE0805C-11 | |
| GE0805C-12 | |

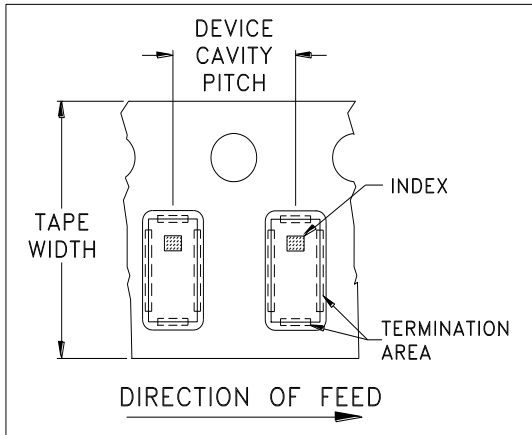


ILLUSTRATION 2

| Applicable Case Styles | |
|------------------------|-----------|
| GE0805C-2 | JC0603C-1 |
| GE0805C-3 | JC0603C-2 |
| GE0805C-4 | JC0603C-3 |
| GE0805C-5 | JC0603C-5 |
| GE0805C-6 | JC0603C-7 |
| GE0805C-8 | |
| GE0805C-15 | |

| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel | |
|----------------|-------------------------|-------------------|-------------------------------------|------|
| 8 | 4 | 7 | Small quantity standards (see note) | 20 |
| | | | | 50 |
| | | | | 100 |
| | | | | 200 |
| | | | | 500 |
| | | | Standard | 1000 |
| | | | Standard | 4000 |

Note: Please Consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: www.minicircuits.com/pages/pdfs/tape.pdf



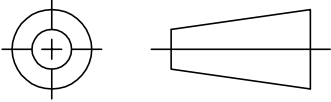
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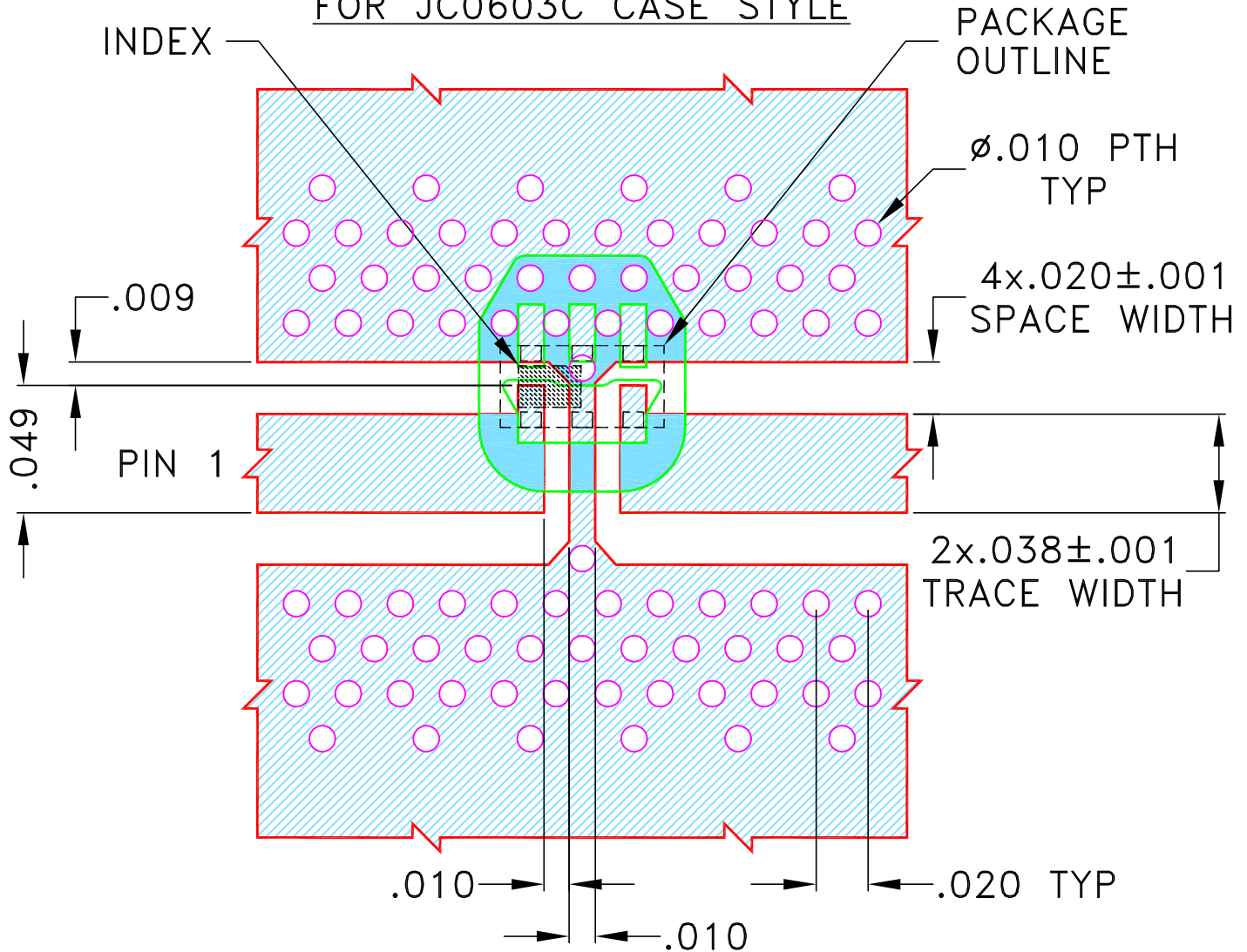
THIRD ANGLE PROJECTION



REVISIONS



| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
|-----|------------|-------------|--------|-----|------|
| OR | ECO-006344 | NEW RELEASE | FEB 21 | KKR | VC |
| | | | | | |
| | | | | | |

SUGGESTED MOUNTING CONFIGURATION
FOR JC0603C CASE STYLE



NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (R03003) WITH DIELECTRIC THICKNESS $.020 \pm .001$ COPPER: 1/2 Oz. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

 DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)
 DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

| UNLESS OTHERWISE SPECIFIED | INITIALS | DATE |
|----------------------------|-------------|-----------|
| DIMENSIONS ARE IN INCHES | DRAWN KKR | 17 FEB 21 |
| TOLERANCES ON: | CHECKED DDR | 17 FEB 21 |
| 2 PL DECIMALS ± | APPROVED RV | 17 FEB 21 |
| 3 PL DECIMALS ± .005 | | |
| ANGLES ± | | |
| FRACTIONS ± | | |

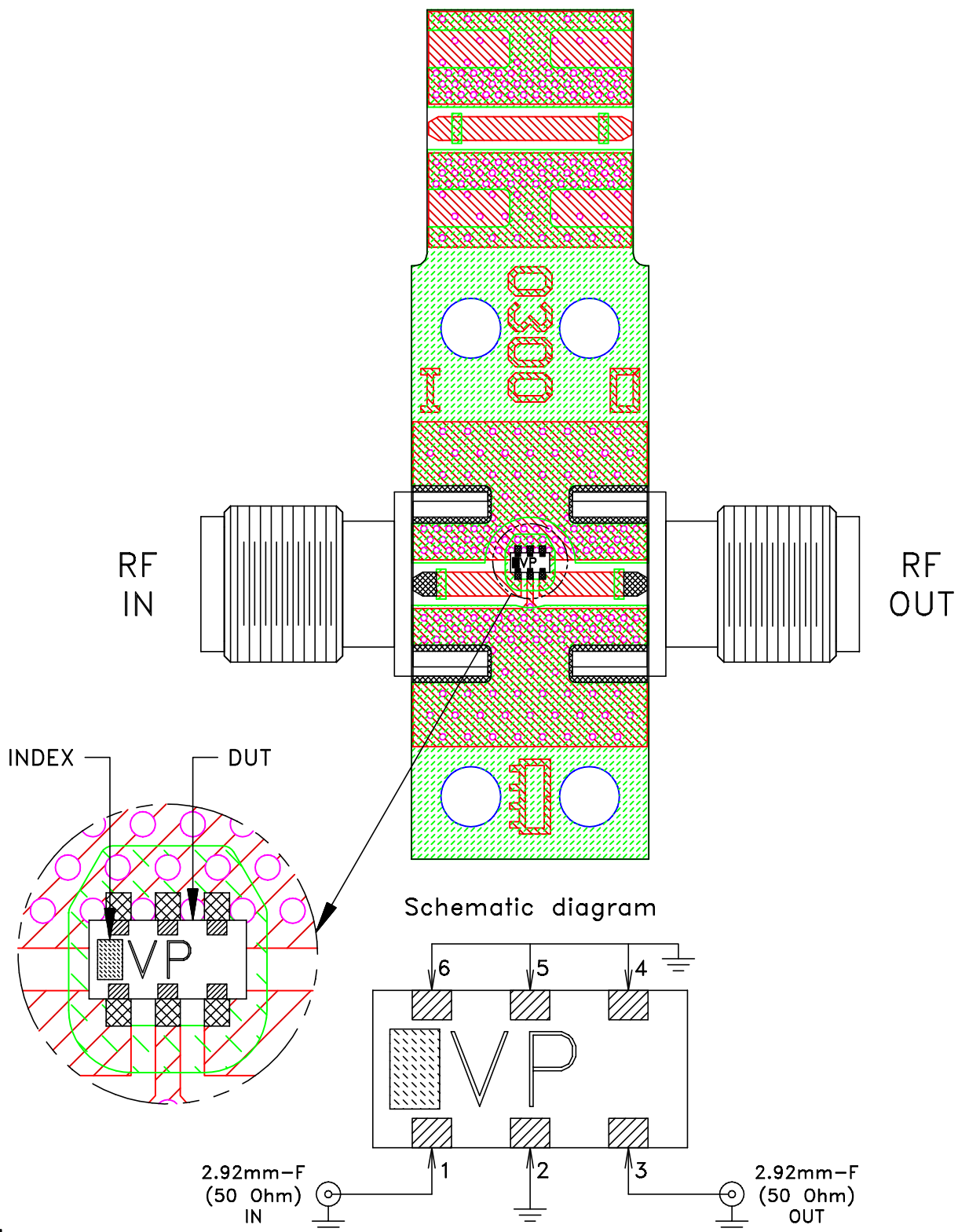
 **Mini-Circuits®** 13 Neptune Avenue
Brooklyn NY 11235

PL DWG, JC0603C C.S, 50 OHM, HFCW

| Mini-Circuits® | | SIZE | CODE IDENT | DRAWING NO: | REV: |
|---|--|-------|------------|-------------|--------------------|
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| ASHEETA1.DWG REV:A DATE:01/12/95 | | FILE: | 98PL704 | SCALE: | 15:1 SHEET: 1 OF 1 |


Evaluation Board and Circuit

TB-TPCW-233+



Notes:

1. PCB Material: ROGERS (R03003) OR Equivalent, Dielectric Constant= 3.00 ± 0.04
Dielectric Thickness: $.020 \pm 0.001$
2. 50 Ohm 2.92mm Female Connectors.
3. Connectors on the test board shall not be subjected to temperature greater than 200°C to avoid permanent damage to the connectors.

 Mini-Circuits®

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification | Test/Inspection Condition | Reference/Spec |
|----------------------------|---|--|
| Operating Temperature | -55° to 125° C Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 125° C Ambient Environment | Individual Model Data Sheet |
| Humidity | 90 to 95% RH, 240 hours, 50°C | MIL-STD-202, Method 103, Condition A, Except 50°C and end-point electrical test done within 12 hours |
| Solder Reflow Heat | Sn-Pb Eutectic Process 225°C peak Pb-Free Process 245° - 250°C peak | J-STD-020C, Table 4-1, 4-2 and 5-2, Figure 5-1 |
| Solderability | 10X Magnification | J-STD-002, Para 4.2.5, Test S, 95% Coverage |
| Vibration (High Frequency) | 20g peak, 10-2000 Hz, 12 times in each of three perpendicular directions (total 36) | MIL-STD-202, Method 204, Condition D |
| Mechanical Shock | 50g, 11 ms, 1/2-sine, 18 shocks: 3 each direction, each of 3 axes | MIL-STD-202, Method 213, Condition A |