MMIC SURFACE MOUNT

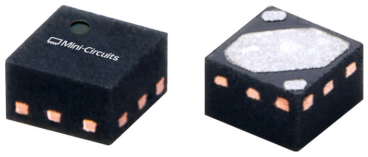
# Fixed Attenuator

# XAT-15+

50Ω DC to 45 GHz 2 W 15 dB

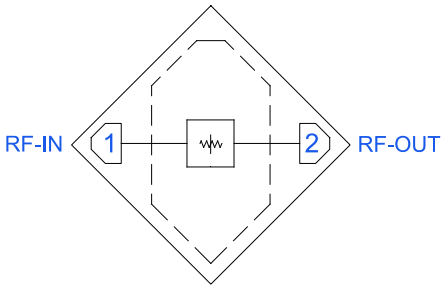
## THE BIG DEAL

- Wideband, DC to 45 GHz
- High Power Handling, 2 W
- Excellent Return Loss, Typ. 15 dB
- 1×1 mm, 2-Lead QFN-Style Package



*Generic photo used for illustration purposes only*

## FUNCTIONAL DIAGRAM (TOP VIEW)




## APPLICATIONS

- Test & Measurement Equipment
- Satellite Communications
- Radar, EW, and ECM Defense Systems
- Telecom Infrastructure
- 5G sub-6 GHz and mmW

## PRODUCT OVERVIEW

The XAT-15+ sets a new benchmark in RF component miniaturization as the smallest MMIC attenuator by virtue of its 2-lead, 1×1 mm QFN package, which enables unprecedented space savings in next-generation high-density PCB designs. Fabricated on a robust GaAs semiconductor process, its bidirectional, fully absorptive design delivers exceptional passband flatness, maintains excellent return loss throughout the entire band, and delivers consistent and repeatable performance from DC to 45 GHz. With up to 2 W input power handling, the XAT-15+ is perfectly suited for space-constrained, high frequency applications, including Test & Measurement, Satellite Communications, Radar Systems, EW/ECM Defense Systems, Telecom Infrastructure, and 5G networks.

## KEY FEATURES

| Features | Advantages |
|---|---|
| Maximum Design Flexibility | XAT-15+ maintains pin compatibility across the entire XAT family, enabling seamless interchangeability of attenuation values on the PCB without layout changes. |
| Wideband Operation, DC to 45 GHz | Flat attenuation response from DC to 45 GHz supports a wide array of applications including Test & Measurement Equipment, Satellite Communications, Radar, EW, ECM Defense Systems, Telecom, & 5G applications. |
| Excellent Return Loss | Excellent Return Loss across the entire passband minimizes reflections and enables flexibility to implement anywhere within wideband signal chains. |
| 1×1 mm 2-Lead QFN-Style Package | Ultra-compact footprint saves space in dense layouts while providing low inductance and excellent thermal contact to the PCB. Innovative industry-leading packaging allows for ease of assembly in high-volume manufacturing processes. |

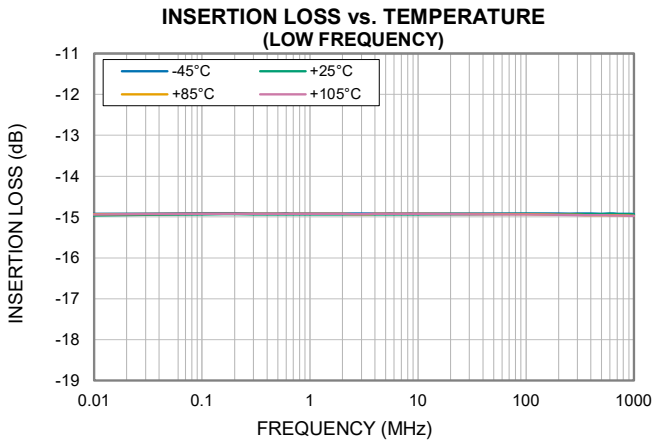
REV. OR
ECO-030292
XAT-15+
MCL NY
260701

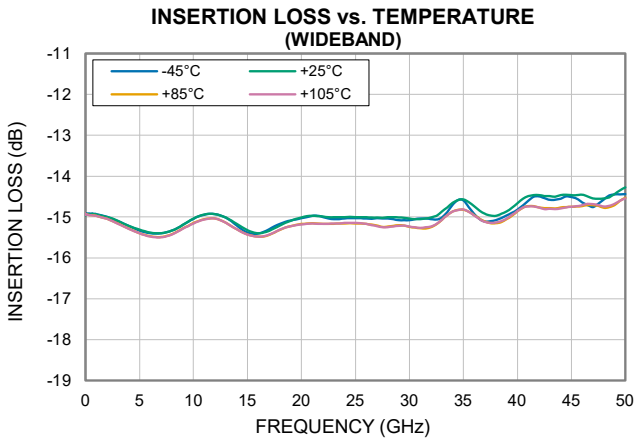
## ELECTRICAL SPECIFICATIONS[1,2] AT +25 °C, 50Ω, UNLESS NOTED OTHERWISE

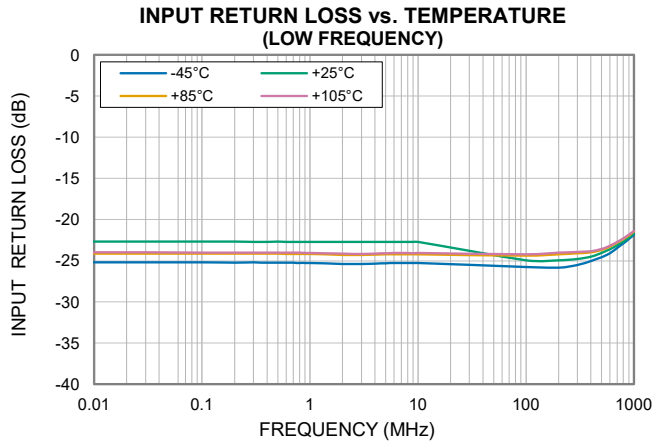
| Parameter | Condition (GHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Frequency Range | | DC | | 45 | GHz |
| Attenuation | 0.01–10 | 14.6 | 15.1 | 15.8 | dB |
| | 10–20 | 14.5 | 15.1 | 15.8 | |
| | 20–30 | 14.6 | 15.0 | 15.4 | |
| | 30–40 | 14.1 | 14.8 | 15.8 | |
| | 40–45 | | 14.5 | | |
| Input Return Loss | 0.01–10 | | 13 | | dB |
| | 10–20 | | 13 | | |
| | 20–30 | | 15 | | |
| | 30–40 | | 13 | | |
| | 40–45 | | 15 | | |
| Output Return Loss | 0.01–10 | | 13 | | dB |
| | 10–20 | | 13 | | |
| | 20–30 | | 15 | | |
| | 30–40 | | 13 | | |
| | 40–45 | | 15 | | |

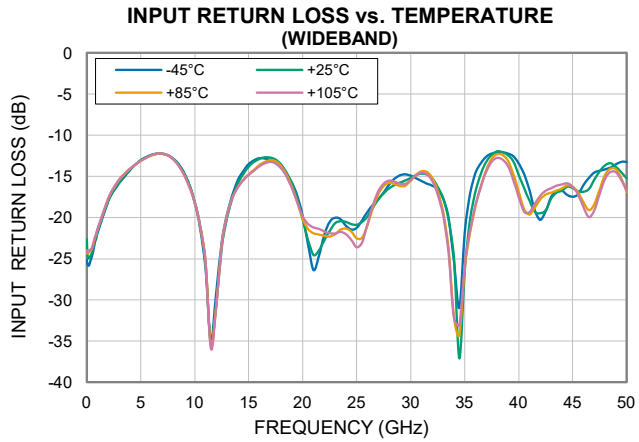
1. Tested on Mini-Circuits Characterization Test/Evaluation Board TB-XAT-15C+. See Figure 2. Board loss de-embedded to the device.
2. Bi-directional RF-IN and RF-OUT ports can be interchanged.

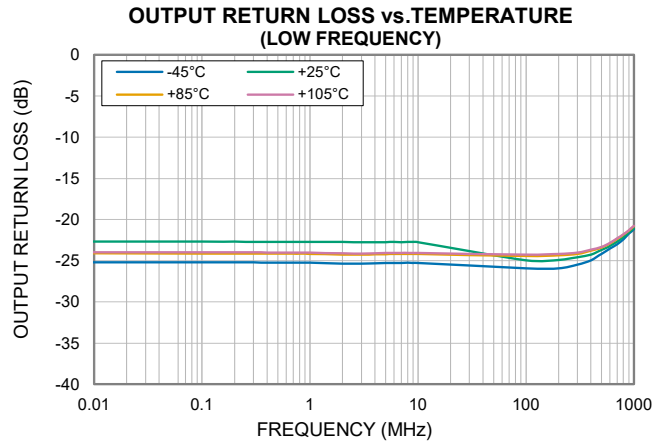
## TYPICAL PERFORMANCE GRAPHS

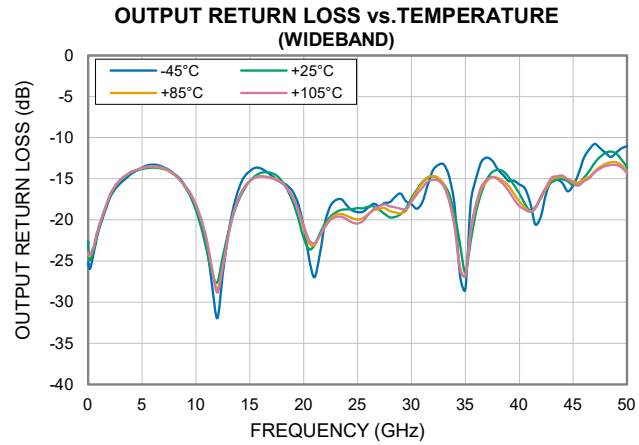


## ABSOLUTE MAXIMUM RATINGS[3]

| Parameter | Ratings |
|---|---|
| Operating Temperature | -45 °C to +105 °C |
| Storage Temperature | -65 °C to +150 °C |
| RF Input Power[4] | 2 W |

3. Permanent damage may occur if any of these limits are exceeded. Maximum ratings are not intended for continuous normal operation.
4. Power derated to 1 W at +105 °C.

## ESD RATING

| | Class | Voltage Range | Reference Standard |
|---|---|---|---|
| HBM | 1C | > 1000 V | ANSI/ESDA/JEDEC JS-001-2023 |
| CDM | C3 | > 1000 V | ANSI/ESDA/JEDEC JS-002-2022 |

ESD HANDLING PRECAUTION: This device is designed to be Class 1C for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

## MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E /JEDEC J-STD-033C

# Fixed Attenuator

# XAT-15+

50Ω DC to 45 GHz 2 W 15 dB

## FUNCTIONAL DIAGRAM (TOP VIEW)

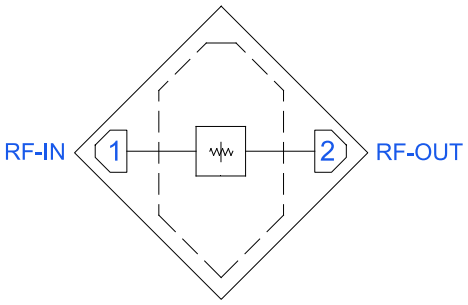



**Figure 1. XAT-15+ Functional Diagram**

## PAD DESCRIPTION

| Function | Pad # | Description (Refer to Figure 2) |
|---|---|---|
| RF-IN | 1 | RF-IN Pad connects to RF Input port. |
| RF-OUT | 2 | RF-OUT Pad connects to RF Output port. |
| GND | Paddle | Connects to ground. |

## CHARACTERIZATION TEST BOARD

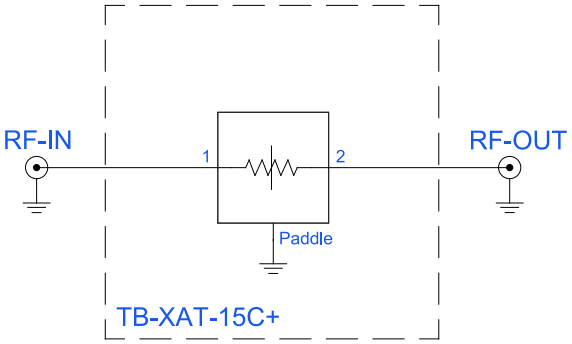



**Figure 2. XAT-15+ Characterization and Application Circuit.**

**Electrical Parameters and Conditions**
Insertion Loss and Return Loss are measured using N5247B PNA-X microwave network analyzer.

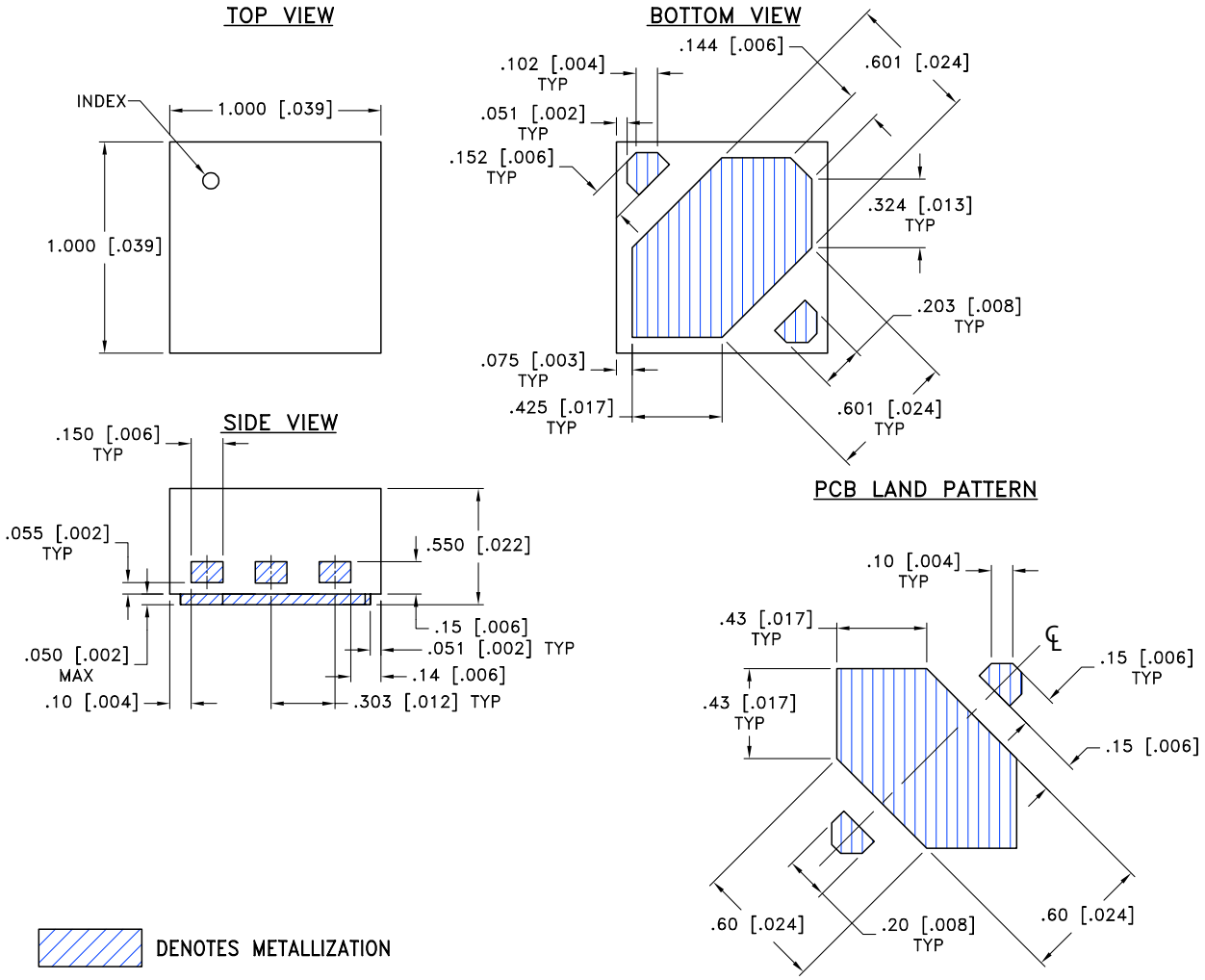
Conditions:
1. Insertion Loss and Return Loss: $P_{IN}$ = -5 dBm

# Fixed Attenuator

# XAT-15+

50Ω DC to 45 GHz 2 W 15 dB

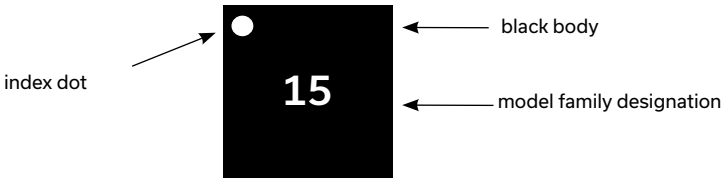
## CASE STYLE DRAWING




SUGGESTED PCB LAND PATTERN
Tolerance to be within ±.05

Weight: 0.002 grams
Dimensions are in mm [inches]. Tolerances: 3 Pl.±0.050 mm

## PRODUCT MARKING




Marking may contain other features or characters for internal lot control

## ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD CLICK HERE

| | |
|---|---|
| **Performance Data** | Data<br><br>Graphs<br><br>S-Parameter (S2P Files) Data Set (.zip file) |
| **Case Style** | BBS3016 Plastic package, exposed paddle, lead finish: Matte-Tin |
| **RoHS Status** | Compliant |
| **Tape & Reel**<br>**Standard quantities available on reel** | F66<br>7″ reels with 20, 50, 100, 200, 500, 1000, 2000, or 3000 devices |
| **Suggested Layout for PCB Design** | PL-861 |
| **Evaluation Board** | TB-XAT-15C+<br>Gerber File |
| **Environmental Ratings** | ENV08T1 |

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

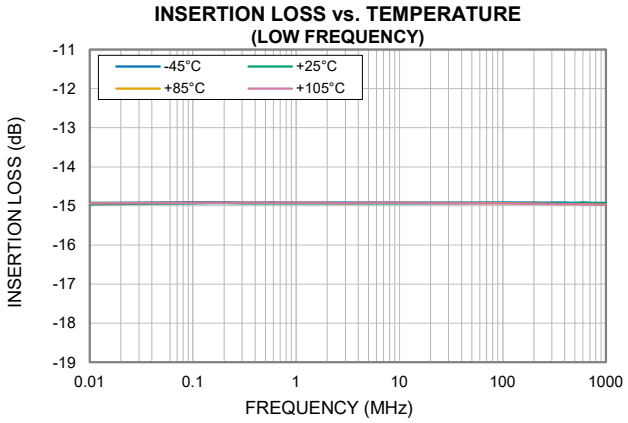
# MMIC Attenuator XAT-15+

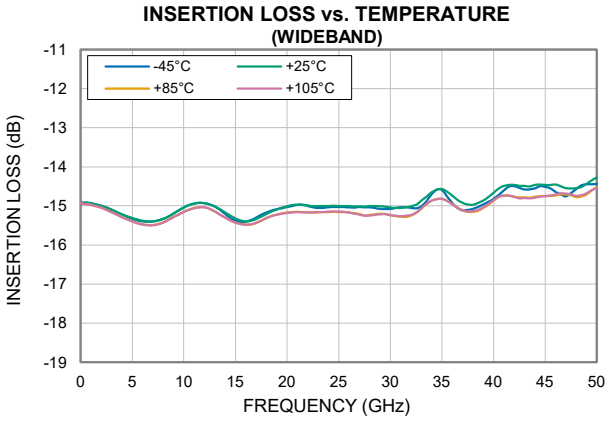
## *Typical Performance Data*

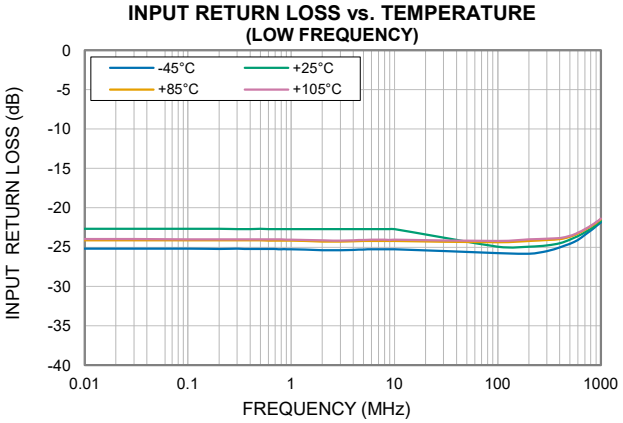
**Definitions:**
Input Return Loss = -S11 (dB)
Attenuation = -S21 (dB)
Output Return Loss = -S22 (dB)

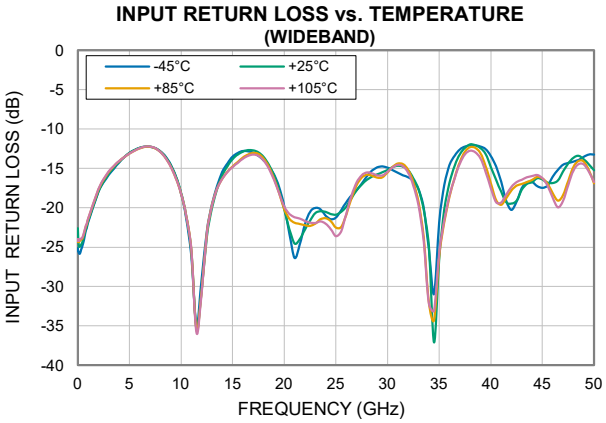
| FREQ | Attenuation | | | | Input Return Loss | | | | Output Return Loss | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -45°C | +25°C | +85°C | +105°C | -45°C | +25°C | +85°C | +105°C | -45°C | +25°C | +85°C | +105°C |
| (MHz) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) | (dB) |
| 0.009 | 14.92 | 14.96 | 14.93 | 14.94 | 25.18 | 22.63 | 24.13 | 23.96 | 25.20 | 22.67 | 24.10 | 23.96 |
| 0.5 | 14.91 | 14.94 | 14.92 | 14.92 | 25.23 | 22.69 | 24.15 | 24.01 | 25.22 | 22.70 | 24.14 | 23.99 |
| 1 | 14.91 | 14.93 | 14.92 | 14.92 | 25.26 | 22.70 | 24.17 | 24.04 | 25.24 | 22.70 | 24.17 | 24.03 |
| 5 | 14.91 | 14.94 | 14.92 | 14.92 | 25.30 | 22.70 | 24.22 | 24.08 | 25.28 | 22.73 | 24.20 | 24.06 |
| 10 | 14.91 | 14.94 | 14.92 | 14.92 | 25.28 | 22.71 | 24.21 | 24.07 | 25.25 | 22.74 | 24.17 | 24.04 |
| 100 | 14.92 | 14.93 | 14.93 | 14.94 | 25.74 | 24.93 | 24.39 | 24.22 | 25.92 | 24.93 | 24.43 | 24.26 |
| 200 | 14.92 | 14.93 | 14.94 | 14.95 | 25.84 | 24.94 | 24.21 | 24.03 | 25.93 | 24.88 | 24.33 | 24.16 |
| 400 | 14.92 | 14.93 | 14.95 | 14.96 | 25.01 | 24.48 | 23.98 | 23.84 | 24.93 | 24.24 | 23.77 | 23.65 |
| 600 | 14.92 | 14.92 | 14.95 | 14.96 | 24.07 | 23.59 | 23.27 | 23.17 | 23.53 | 23.21 | 22.90 | 22.81 |
| 800 | 14.92 | 14.93 | 14.96 | 14.96 | 22.87 | 22.65 | 22.36 | 22.26 | 22.37 | 22.11 | 21.83 | 21.77 |
| 1000 | 14.93 | 14.94 | 14.97 | 14.97 | 21.86 | 21.70 | 21.46 | 21.38 | 21.18 | 21.05 | 20.82 | 20.77 |
| 2000 | 15.00 | 15.00 | 15.05 | 15.05 | 17.99 | 17.95 | 17.71 | 17.64 | 17.39 | 17.21 | 17.10 | 17.04 |
| 4000 | 15.22 | 15.22 | 15.28 | 15.29 | 14.27 | 14.18 | 14.09 | 14.07 | 14.43 | 14.30 | 14.19 | 14.18 |
| 6000 | 15.40 | 15.38 | 15.47 | 15.48 | 12.39 | 12.38 | 12.46 | 12.44 | 13.29 | 13.66 | 13.54 | 13.50 |
| 8000 | 15.33 | 15.33 | 15.42 | 15.42 | 12.83 | 12.87 | 12.93 | 12.92 | 14.41 | 14.47 | 14.53 | 14.47 |
| 10000 | 15.04 | 15.04 | 15.15 | 15.16 | 18.14 | 18.04 | 18.17 | 18.17 | 18.25 | 18.81 | 18.21 | 18.12 |
| 12000 | 14.93 | 14.93 | 15.04 | 15.04 | 28.99 | 30.49 | 30.52 | 30.76 | 31.98 | 27.61 | 28.44 | 28.88 |
| 14000 | 15.21 | 15.17 | 15.30 | 15.30 | 15.44 | 15.90 | 16.32 | 16.34 | 16.11 | 17.50 | 17.30 | 17.23 |
| 16000 | 15.41 | 15.40 | 15.48 | 15.48 | 12.78 | 12.86 | 13.62 | 13.76 | 13.73 | 14.29 | 14.71 | 14.72 |
| 18000 | 15.17 | 15.21 | 15.31 | 15.31 | 13.96 | 13.54 | 13.73 | 13.98 | 15.48 | 15.30 | 15.49 | 15.55 |
| 20000 | 15.03 | 15.01 | 15.17 | 15.18 | 19.82 | 20.22 | 20.17 | 19.85 | 20.82 | 22.20 | 21.00 | 20.69 |
| 22000 | 15.00 | 14.99 | 15.16 | 15.17 | 22.07 | 22.74 | 22.24 | 21.67 | 20.24 | 20.43 | 20.70 | 20.86 |
| 24000 | 15.03 | 15.00 | 15.16 | 15.14 | 20.98 | 20.53 | 21.35 | 22.00 | 18.24 | 18.72 | 19.52 | 19.95 |
| 26000 | 15.04 | 15.01 | 15.17 | 15.17 | 19.29 | 19.85 | 20.89 | 20.75 | 18.48 | 18.39 | 19.29 | 19.38 |
| 28000 | 15.04 | 15.00 | 15.23 | 15.25 | 16.02 | 16.44 | 15.79 | 15.50 | 17.84 | 19.70 | 18.94 | 18.36 |
| 30000 | 15.08 | 15.04 | 15.24 | 15.23 | 14.92 | 15.20 | 15.51 | 15.42 | 18.09 | 17.34 | 17.63 | 17.79 |
| 32000 | 15.05 | 15.01 | 15.25 | 15.23 | 16.14 | 15.23 | 15.20 | 15.56 | 13.96 | 14.71 | 14.69 | 15.15 |
| 34000 | 14.70 | 14.65 | 14.87 | 14.87 | 25.28 | 24.92 | 32.01 | 32.20 | 18.27 | 19.34 | 20.66 | 20.90 |
| 36000 | 14.92 | 14.73 | 14.95 | 14.96 | 14.60 | 16.87 | 18.63 | 18.50 | 14.94 | 18.97 | 18.31 | 17.98 |
| 38000 | 15.07 | 14.97 | 15.15 | 15.13 | 12.08 | 11.96 | 12.29 | 12.73 | 13.84 | 13.93 | 14.90 | 15.08 |
| 40000 | 14.82 | 14.66 | 14.86 | 14.86 | 13.41 | 14.78 | 16.83 | 17.49 | 15.69 | 16.77 | 17.76 | 18.31 |
| 42000 | 14.49 | 14.46 | 14.76 | 14.77 | 20.28 | 19.48 | 17.78 | 17.33 | 19.55 | 17.36 | 17.22 | 17.09 |
| 43500 | 14.58 | 14.50 | 14.79 | 14.81 | 16.79 | 16.97 | 16.73 | 16.14 | 15.13 | 15.14 | 14.88 | 14.72 |
| 44000 | 14.55 | 14.46 | 14.77 | 14.79 | 16.76 | 16.73 | 16.46 | 15.98 | 15.52 | 15.06 | 14.73 | 14.62 |
| 46000 | 14.64 | 14.45 | 14.73 | 14.71 | 16.04 | 16.86 | 18.15 | 18.75 | 12.45 | 14.88 | 15.02 | 15.31 |
| 48000 | 14.57 | 14.55 | 14.77 | 14.74 | 14.13 | 13.63 | 14.81 | 15.25 | 11.86 | 11.86 | 13.19 | 13.46 |
| 50000 | 14.44 | 14.28 | 14.53 | 14.54 | 13.23 | 15.22 | 16.88 | 16.72 | 11.06 | 13.65 | 14.21 | 14.34 |

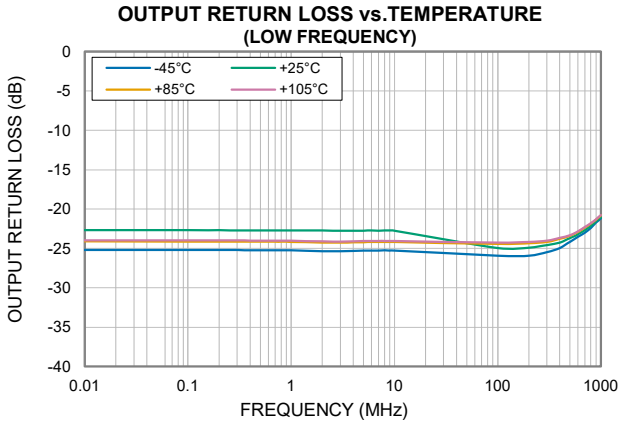
## *Typical Performance Curves*

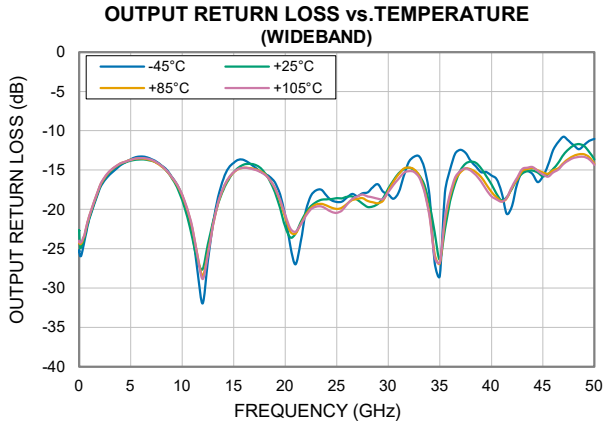


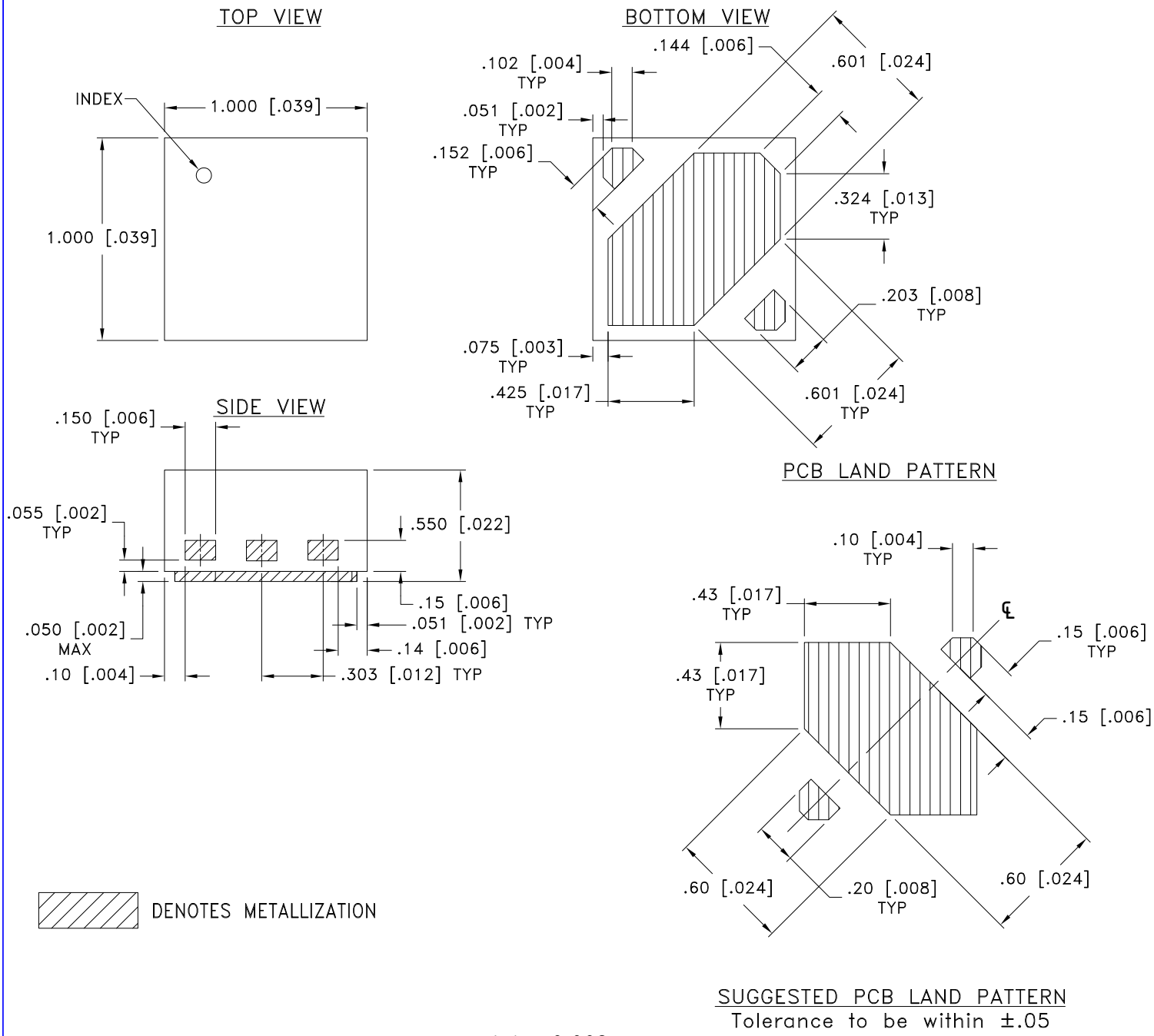



# Case Style BBS

## Outline Dimensions

**BBS3016**




Weight: 0.002 grams

Dimensions are in mm [inches]. Tolerances: 3 Pl.±0.050 mm

Notes:

1. Case material: Plastic.
2. Termination finish: Matte-Tin plated .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RF/IF MICROWAVE COMPONENTS




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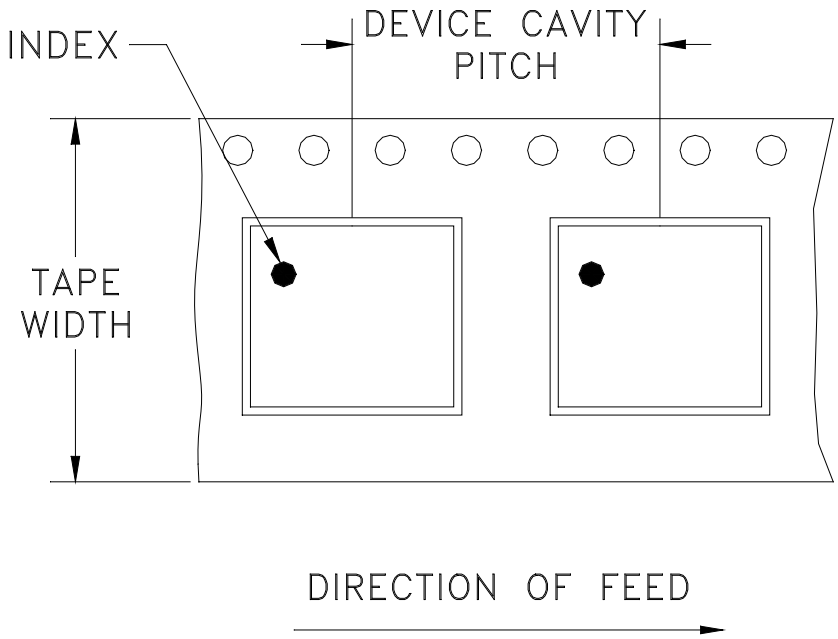
# Tape & Reel Packaging TR-F66

DEVICE ORIENTATION IN T&R




| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel see note | |
|---|---|---|---|---|
| 8 | 4 | 7 | Small quantity standard | 20 |
| | | | | 50 |
| | | | | 100 |
| | | | | 200 |
| | | | | 500 |
| | | 7 | Standard | 1000, 2000, 3000 |

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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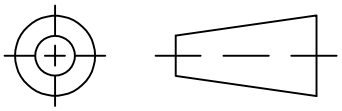
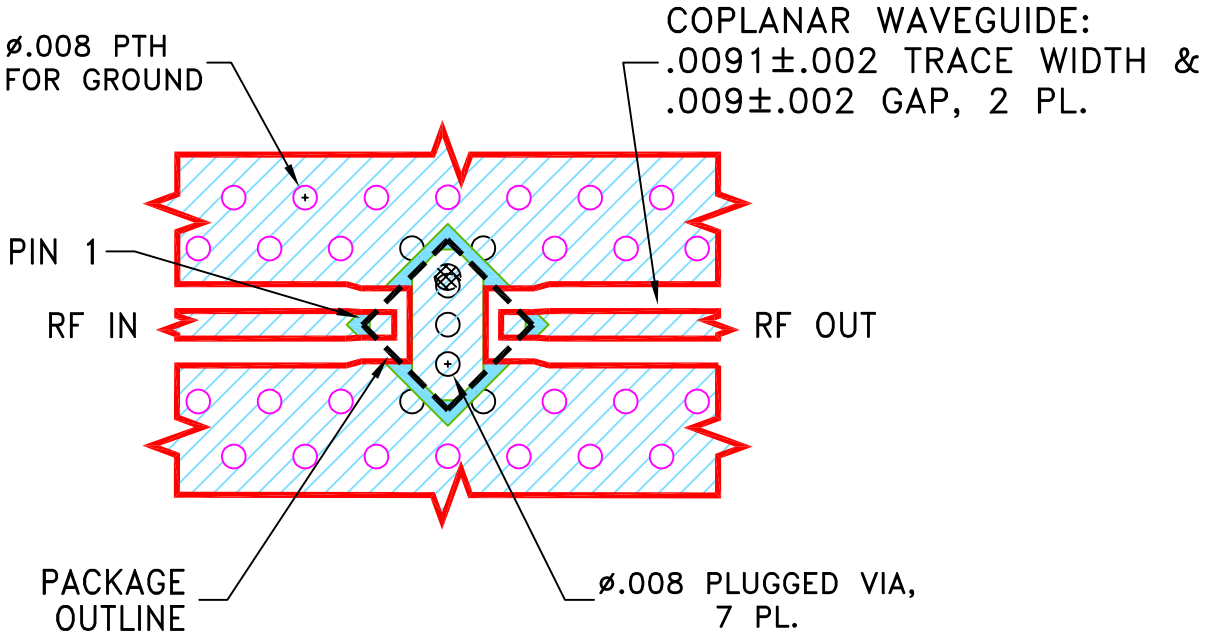
THIRD ANGLE PROJECTION



| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
| OR | ECO-029149 | NEW RELEASE | 04/17/26 | ITG | IL |
| | | | | | |
| | | | | | |
| | | | | | |

## SUGGESTED MOUNTING CONFIGURATION FOR BBS3016 CASE STYLE.




NOTES:

1. TRACE WIDTH AND GAP ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .0066"; COPPER: 1 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.
3. EVALUATION BOARD P/N: TB-XAT-XXC+ (WHERE XX= 0,3,4,5,6,7,8,9,10,12,15,20)

DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

| UNLESS OTHERWISE SPECIFIED | | INITIALS | DATE |
|---|---|---|---|
| DIMENSIONS ARE IN INCHES | DRAWN | ITG | 04/09/26 |
| TOLERANCES ON: | CHECKED | NP | 04/09/26 |
| 2 PL DECIMALS ± | APPROVED | IL | 04/09/26 |
| 3 PL DECIMALS ± .005 | | | |
| ANGLES ± | | | |
| FRACTIONS ± | | | |

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ASHEETA1.DWG REV:A DATE:01/12/95

Mini-Circuits®

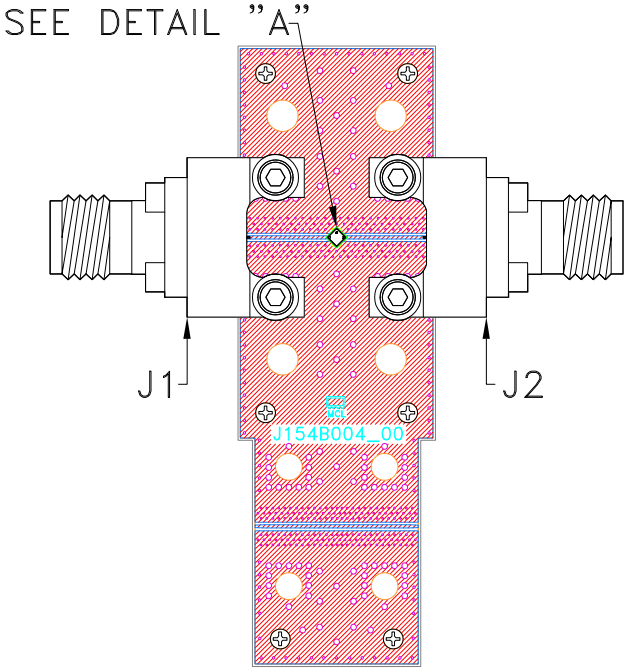
13 Neptune Avenue
Brooklyn NY 11235

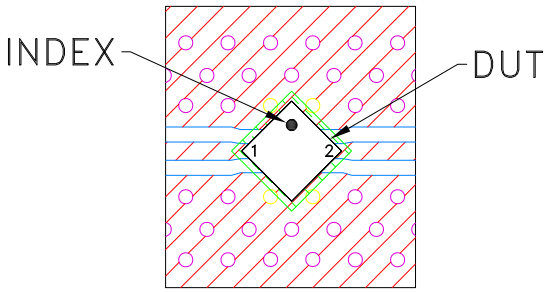
PL, BBS3016, TB-XAT-XXC+

| SIZE | CODE IDENT | DRAWING NO: | REV: |
|---|---|---|---|
| A | 15542 | 98-PL-861 | OR |

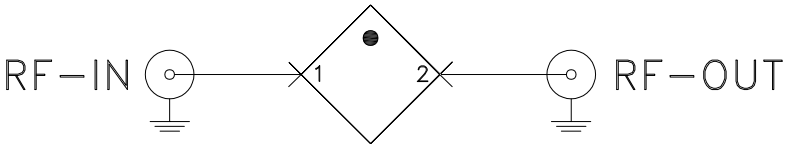
| FILE: | SCALE: | SHEET: |
|---|---|---|
| 98PL861 | 15:1 | 1 OF 1 |

# Evaluation Board and Circuit




DETAIL "A"
(SCALE 5:1)




THRU LINE

SCHEMATIC DIAGRAM
(SCALE 5:1)

| Function | Pad |
|---|---|
| RF-IN | 1 |
| RF-OUT | 2 |

| Component | Size | Value | Part Number | Manufacturer |
|---|---|---|---|---|
| J1,J2 | N/A | N/A | 1892-04A-6 | Southwest |

NOTES:

1. 1.85mm Female Connectors.
2. PCB Material: Roger RO4350B or equivalent, Dielectric constant=3.5, Thickness=0.0066 inch

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# Environmental Specifications ENV08T1

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 | -40° to 85° C or -45° to 85° C or -55° to 105° C or -40° to 105° C or -40° to 95° C<br>Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 100° C or -65° to 150°<br>Ambient Environment | Individual Model Data Sheet |
| HTOL | 1000 hours at 125°C | MIL-STD-883, Method 1005, Condition B |
| Thermal Shock | -55° to 100°C, 100 cycles | MIL-STD-202, Method 107, Condition A-3, except +100°C |
| Mechanical Shock | 1.5Kg, 0.5 ms, 5 shock pulses, Y1 direction only | MIL-STD-883, Method 2002, Condition B, except Y1 direction only |
| Vibration (Variable Frequency) | 50g peak | MIL-STD-883, Method 2007, Condition B |
| Autoclave | 15 psig, 100% RH, 121°C, 96 hours | JESD22-A102, Condition C |
| HAST | 130°C, 85% RH, 96 hours | JESD22-A110 |
| Solderability | 10X Magnification | J-STD-002, Para 4.2.5, Test S, 95% Coverage |
| Solder Reflow Heat | Sn-Pb Eutetic Process: 240°C peak<br>Pb-Free Process: 260°C peak | J-STD-020, Table 4-1, 4-2 and 5-2; Figure 5-1 |
| Moisture Sensitivity: Level 1 | Bake at 125°C for 24 hours<br>Soak at 85°C/85% RH for 168 hours, Reflow 3 cycles at 260°C peak | J-STD-020 |


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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 |
|---|---|---|
| Marking Resistance to Solvents | Isopropyl alcohol + mineral spirits at 25°C; terpene defluxer at 25°C;<br>distilled water + proylene glycol monomethyl ether + monoethanolamine at 63°C to 70°C | MIL-STD-202, Method 215 |


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