MICROWAVE PRECISION

# Fixed Attenuator

# KAT-2+

50Ω Up to 2 W DC to 43.5 GHz

## THE BIG DEAL

- Super-Wide Bandwidth, DC to 43.5 GHz
- High Power Handling, 2 W
- Small Package, 2x2 mm MCLP™
- Excellent VSWR, 1.19:1 Typ.

*Generic photo used for illustration purposes only*

CASE STYLE: MC1630-1

**+RoHS Compliant**
The +Suffix identifies RoHS Compliance.
See our website for methodologies and qualifications

## APPLICATIONS

- 5G
- Test and Measurement
- Radar
- Communication
- Defense

## PRODUCT OVERVIEW

KAT-2+ is an absorptive fixed attenuator fabricated using highly reliable and repeatable GaAs MMIC process. The model operates from DC to 43.5 GHz. It achieves outstanding attenuation accuracy and flatness while maintaining excellent VSWR throughout the entire band. The model can also handle input power up to 2 W, which makes this model an ideal choice for a wide range of applications.

## KEY FEATURES

| Feature | Advantages |
|---|---|
| Wideband Operation, From DC to 43.5 GHz | Supports a wide array of applications including 5G, wireless infrastructure, microwave communications, satellite, defense and aerospace, medical, broadband and optical applications. |
| Small Size and Simple to Use (2x2 mm) | As a single chip solution, the KAT series occupies less board space than a lumped element approach, minimizes component count and ensures repeatable performance over a wide frequency range. |
| Wide Range of Nominal Attenuation Values (0,1,2,3,4,5,6,7,8,9,10,12,15,20 & 30) | KAT Series' identical package and footprint enables circuit designers to swap small incremental attenuation values, without board layout redesigns. |
| MCLP™ Package | Low Inductance, repeatable transitions, excellent thermal path make the KAT series an ideal solution as an alternative to "do it yourself" lumped element-based approach. |

REV. B
ECO-014625
KAT-2+
MCL NY
250904

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

| Parameter | Condition (GHz) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Frequency Range | | DC | | 43.5 | GHz |
| Attenuation | 0.01-5 | 1.6 | 2.0 | 2.3 | dB |
| | 5-10 | 1.6 | 2.0 | 2.3 | |
| | 10-20 | 1.5 | 2.0 | 2.8 | |
| | 20-30 | 1.5 | 2.2 | 3.0 | |
| | 30-40 | | 2.1 | | |
| | 40-43.5 | | 1.6 | | |
| VSWR | 0.01-5 | | 1.07 | 1.3 | :1 |
| | 5-10 | | 1.10 | 1.6 | |
| | 10-20 | | 1.19 | 1.9 | |
| | 20-30 | | 1.38 | | |
| | 30-40 | | 1.38 | | |
| | 40-43.5 | | 1.71 | | |

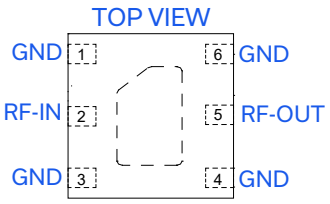
1. Tested on Mini-Circuits test board TB-934-2C+. See Characterization/Application Circuit in Fig. 1.

## ABSOLUTE MAXIMUM RATINGS[2]

| Parameter | Ratings |
|---|---|
| Operating Case Temperature | -40°C to +85°C |
| Storage Temperature | -65°C to +150°C |
| RF Input Power | 2 W[3] |

2. Permanent damage may occur if any of these limits are exceeded.
3. Power rating derated to 1 W at +85°C.

## PAD DESCRIPTION




| Function | Pad Number | Description |
|---|---|---|
| RF-IN | 2 | RF input pad |
| RF-OUT | 5 | RF output pad |
| GND | 1,3,4,6 & Paddle | Ground |

## CHARACTERIZATION TEST CIRCUIT

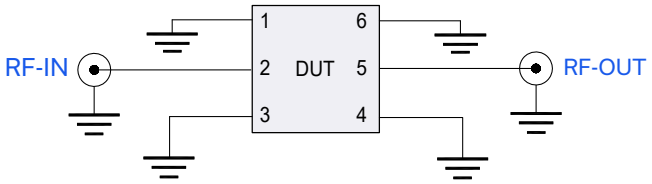
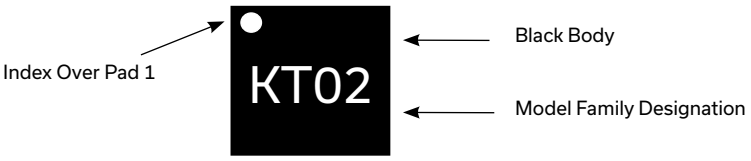



Fig 1. Block diagram of Test Circuit used for characterization, Test board TB-934-2C+
Conditions: Attenuation, VSWR: $P_{IN}$ = 0 dBm

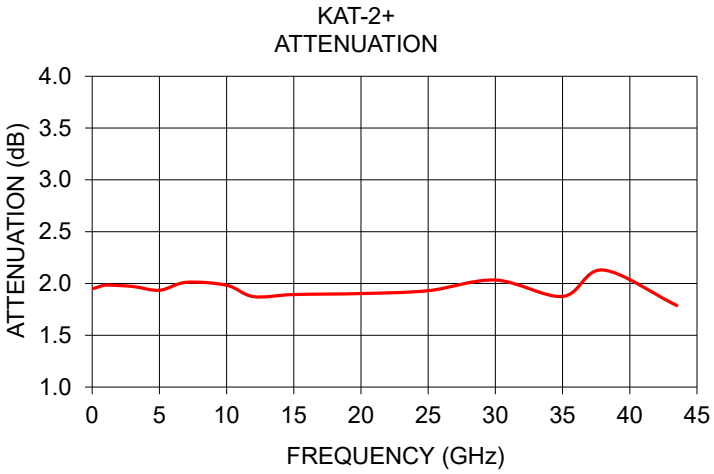
## PRODUCT MARKING

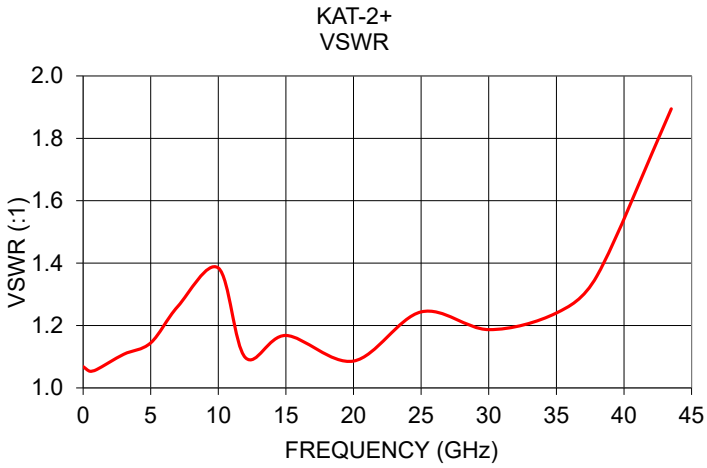



Marking may contain other features or characters for internal lot control.

## TYPICAL PERFORMANCE DATA AT +25°C

| Frequency (GHz) | Attenuation (dB) | VSWR (:1) |
|---|---|---|
| 0.01 | 1.95 | 1.07 |
| 0.5 | 1.97 | 1.05 |
| 1.0 | 1.98 | 1.06 |
| 3.0 | 1.97 | 1.11 |
| 5.0 | 1.93 | 1.14 |
| 7.0 | 2.01 | 1.26 |
| 10.0 | 1.98 | 1.38 |
| 12.0 | 1.87 | 1.10 |
| 15.0 | 1.89 | 1.17 |
| 20.0 | 1.90 | 1.09 |
| 25.0 | 1.93 | 1.24 |
| 30.0 | 2.03 | 1.19 |
| 35.0 | 1.87 | 1.24 |
| 38.0 | 2.13 | 1.36 |
| 43.5 | 1.79 | 1.89 |



**ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. TO ACCESS CLICK HERE**

| | |
|---|---|
| **Performance Data** | Data Table<br>Swept Graphs |
| **Case Style** | MC1630-1 Plastic package, Terminal Finish: Matte Tin |
| **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-586 |
| **Evaluation Board** | TB-934-2C+ |
| **Environmental Ratings** | ENV08T1 |

## ESD RATING

Human Body Model (HBM): Class 2 (Pass 2000 V) per ANSI/ESD STM 5.1 - 2001

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-Circuit's applicable established test performance criteria and measurement instructions.
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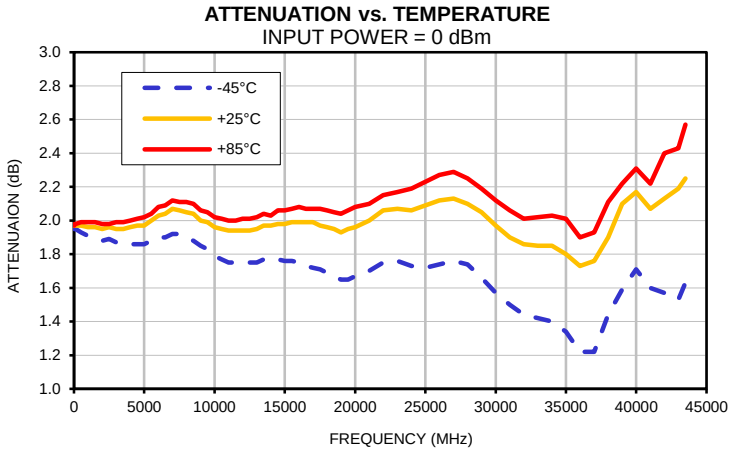
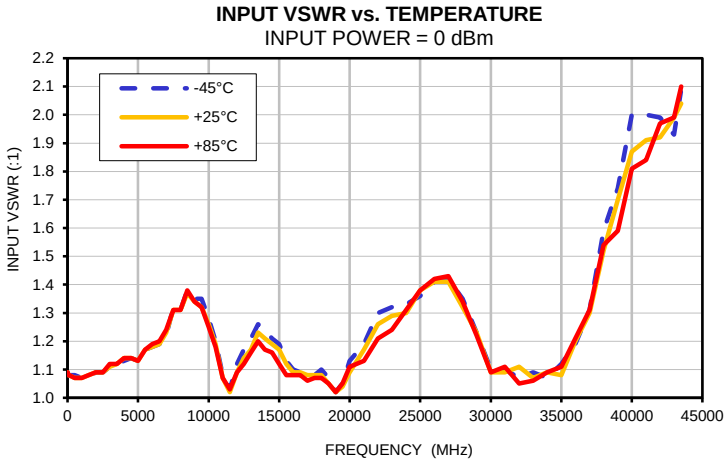
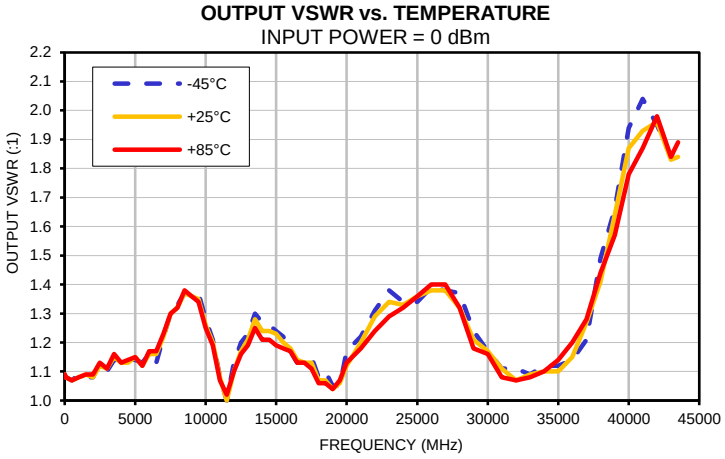
*Typical Performance Data*

| FREQ. | ATTENUATION | | | INPUT VSWR | | | OUTPUT VSWR | | |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dB) | | | (:1) | | | (:1) | | |
| | @-45˚C | @25°C | @+85°C | @-45˚C | @25°C | @+85°C | @-45˚C | @25°C | @+85°C |
| 10 | 1.95 | 1.97 | 1.97 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 | 1.09 |
| 50 | 1.95 | 1.97 | 1.98 | 1.08 | 1.08 | 1.08 | 1.08 | 1.08 | 1.08 |
| 100 | 1.95 | 1.97 | 1.98 | 1.08 | 1.08 | 1.08 | 1.08 | 1.08 | 1.08 |
| 500 | 1.93 | 1.97 | 1.99 | 1.08 | 1.07 | 1.07 | 1.07 | 1.07 | 1.07 |
| 1000 | 1.91 | 1.96 | 1.99 | 1.07 | 1.07 | 1.07 | 1.09 | 1.08 | 1.08 |
| 1500 | 1.89 | 1.96 | 1.99 | 1.07 | 1.08 | 1.08 | 1.08 | 1.09 | 1.09 |
| 2000 | 1.88 | 1.95 | 1.98 | 1.09 | 1.09 | 1.09 | 1.08 | 1.08 | 1.09 |
| 2500 | 1.89 | 1.96 | 1.98 | 1.09 | 1.09 | 1.09 | 1.13 | 1.12 | 1.13 |
| 3000 | 1.87 | 1.95 | 1.99 | 1.11 | 1.11 | 1.12 | 1.10 | 1.11 | 1.11 |
| 3500 | 1.86 | 1.95 | 1.99 | 1.12 | 1.12 | 1.12 | 1.14 | 1.15 | 1.16 |
| 4000 | 1.86 | 1.96 | 2.00 | 1.13 | 1.14 | 1.14 | 1.14 | 1.13 | 1.13 |
| 4500 | 1.86 | 1.97 | 2.01 | 1.14 | 1.14 | 1.14 | 1.14 | 1.13 | 1.14 |
| 5000 | 1.86 | 1.97 | 2.02 | 1.13 | 1.13 | 1.13 | 1.14 | 1.15 | 1.15 |
| 5500 | 1.88 | 2.00 | 2.04 | 1.17 | 1.17 | 1.17 | 1.13 | 1.12 | 1.12 |
| 6000 | 1.90 | 2.03 | 2.08 | 1.18 | 1.18 | 1.19 | 1.16 | 1.16 | 1.17 |
| 6500 | 1.90 | 2.04 | 2.09 | 1.19 | 1.19 | 1.20 | 1.13 | 1.16 | 1.17 |
| 7000 | 1.92 | 2.07 | 2.12 | 1.22 | 1.23 | 1.24 | 1.22 | 1.22 | 1.23 |
| 7500 | 1.92 | 2.06 | 2.11 | 1.32 | 1.31 | 1.31 | 1.30 | 1.30 | 1.30 |
| 8000 | 1.90 | 2.05 | 2.11 | 1.31 | 1.31 | 1.31 | 1.33 | 1.32 | 1.32 |
| 8500 | 1.88 | 2.04 | 2.10 | 1.38 | 1.37 | 1.38 | 1.37 | 1.37 | 1.38 |
| 9000 | 1.85 | 2.00 | 2.06 | 1.35 | 1.34 | 1.34 | 1.37 | 1.36 | 1.36 |
| 9500 | 1.83 | 1.99 | 2.05 | 1.35 | 1.32 | 1.32 | 1.37 | 1.35 | 1.34 |
| 10000 | 1.79 | 1.96 | 2.02 | 1.28 | 1.26 | 1.25 | 1.28 | 1.26 | 1.25 |
| 10500 | 1.77 | 1.95 | 2.01 | 1.20 | 1.19 | 1.18 | 1.21 | 1.20 | 1.19 |
| 11000 | 1.75 | 1.94 | 2.00 | 1.08 | 1.07 | 1.07 | 1.08 | 1.08 | 1.07 |
| 11500 | 1.75 | 1.94 | 2.00 | 1.03 | 1.02 | 1.03 | 1.00 | 1.00 | 1.02 |
| 12000 | 1.75 | 1.94 | 2.01 | 1.12 | 1.09 | 1.09 | 1.13 | 1.10 | 1.10 |
| 12500 | 1.75 | 1.94 | 2.01 | 1.17 | 1.14 | 1.12 | 1.20 | 1.17 | 1.16 |
| 13000 | 1.75 | 1.95 | 2.02 | 1.21 | 1.17 | 1.16 | 1.23 | 1.21 | 1.19 |
| 13500 | 1.77 | 1.97 | 2.04 | 1.26 | 1.23 | 1.20 | 1.30 | 1.28 | 1.25 |
| 14000 | 1.76 | 1.97 | 2.03 | 1.24 | 1.21 | 1.17 | 1.27 | 1.24 | 1.21 |
| 14500 | 1.77 | 1.98 | 2.06 | 1.21 | 1.19 | 1.16 | 1.26 | 1.24 | 1.21 |
| 15000 | 1.76 | 1.98 | 2.06 | 1.19 | 1.17 | 1.12 | 1.24 | 1.23 | 1.19 |
| 15500 | 1.76 | 1.99 | 2.07 | 1.13 | 1.12 | 1.08 | 1.22 | 1.20 | 1.18 |
| 16000 | 1.75 | 1.99 | 2.08 | 1.10 | 1.09 | 1.08 | 1.17 | 1.18 | 1.17 |
| 16500 | 1.73 | 1.99 | 2.07 | 1.09 | 1.09 | 1.08 | 1.13 | 1.14 | 1.13 |
| 17000 | 1.72 | 1.99 | 2.07 | 1.08 | 1.08 | 1.06 | 1.14 | 1.13 | 1.13 |
| 17500 | 1.71 | 1.97 | 2.07 | 1.08 | 1.08 | 1.07 | 1.15 | 1.13 | 1.11 |
| 18000 | 1.69 | 1.96 | 2.06 | 1.10 | 1.08 | 1.07 | 1.08 | 1.07 | 1.06 |
| 18500 | 1.67 | 1.95 | 2.05 | 1.07 | 1.05 | 1.05 | 1.10 | 1.07 | 1.06 |
| 19000 | 1.65 | 1.93 | 2.04 | 1.02 | 1.02 | 1.02 | 1.05 | 1.04 | 1.04 |
| 19500 | 1.65 | 1.95 | 2.06 | 1.05 | 1.04 | 1.05 | 1.05 | 1.06 | 1.07 |
| 20000 | 1.67 | 1.96 | 2.08 | 1.13 | 1.09 | 1.11 | 1.17 | 1.12 | 1.13 |
| 21000 | 1.70 | 2.00 | 2.10 | 1.19 | 1.17 | 1.13 | 1.22 | 1.20 | 1.18 |
| 22000 | 1.75 | 2.06 | 2.15 | 1.30 | 1.26 | 1.21 | 1.31 | 1.29 | 1.24 |
| 23000 | 1.76 | 2.07 | 2.17 | 1.32 | 1.29 | 1.24 | 1.38 | 1.34 | 1.29 |
| 24000 | 1.73 | 2.06 | 2.19 | 1.33 | 1.30 | 1.31 | 1.34 | 1.33 | 1.32 |
| 25000 | 1.72 | 2.09 | 2.23 | 1.36 | 1.38 | 1.38 | 1.34 | 1.36 | 1.36 |
| 26000 | 1.74 | 2.12 | 2.27 | 1.41 | 1.41 | 1.42 | 1.39 | 1.38 | 1.40 |
| 27000 | 1.76 | 2.13 | 2.29 | 1.42 | 1.41 | 1.43 | 1.38 | 1.38 | 1.40 |
| 28000 | 1.74 | 2.10 | 2.25 | 1.35 | 1.32 | 1.34 | 1.37 | 1.32 | 1.32 |
| 29000 | 1.66 | 2.05 | 2.19 | 1.23 | 1.23 | 1.22 | 1.24 | 1.21 | 1.18 |
| 30000 | 1.57 | 1.97 | 2.12 | 1.10 | 1.09 | 1.09 | 1.17 | 1.17 | 1.16 |
| 31000 | 1.50 | 1.90 | 2.06 | 1.10 | 1.09 | 1.11 | 1.11 | 1.11 | 1.08 |
| 32000 | 1.44 | 1.86 | 2.01 | 1.07 | 1.11 | 1.05 | 1.11 | 1.07 | 1.07 |
| 33000 | 1.42 | 1.85 | 2.02 | 1.09 | 1.07 | 1.06 | 1.09 | 1.09 | 1.08 |
| 34000 | 1.40 | 1.85 | 2.03 | 1.07 | 1.09 | 1.09 | 1.12 | 1.10 | 1.10 |
| 35000 | 1.34 | 1.80 | 2.01 | 1.12 | 1.08 | 1.11 | 1.12 | 1.10 | 1.14 |
| 36000 | 1.22 | 1.73 | 1.90 | 1.19 | 1.20 | 1.21 | 1.14 | 1.15 | 1.20 |
| 37000 | 1.22 | 1.76 | 1.93 | 1.31 | 1.30 | 1.31 | 1.21 | 1.27 | 1.28 |
| 38000 | 1.44 | 1.90 | 2.11 | 1.59 | 1.52 | 1.54 | 1.49 | 1.41 | 1.44 |
| 39000 | 1.59 | 2.10 | 2.22 | 1.74 | 1.70 | 1.59 | 1.66 | 1.64 | 1.57 |
| 40000 | 1.71 | 2.17 | 2.31 | 2.00 | 1.87 | 1.81 | 1.94 | 1.87 | 1.78 |
| 41000 | 1.60 | 2.07 | 2.22 | 2.00 | 1.91 | 1.84 | 2.04 | 1.93 | 1.87 |
| 42000 | 1.57 | 2.13 | 2.40 | 1.99 | 1.92 | 1.97 | 1.95 | 1.96 | 1.98 |
| 43000 | 1.53 | 2.19 | 2.43 | 1.93 | 1.99 | 1.99 | 1.84 | 1.83 | 1.84 |
| 43500 | 1.63 | 2.25 | 2.57 | 2.09 | 2.04 | 2.10 | 1.88 | 1.84 | 1.89 |

*Typical Performance Curves*



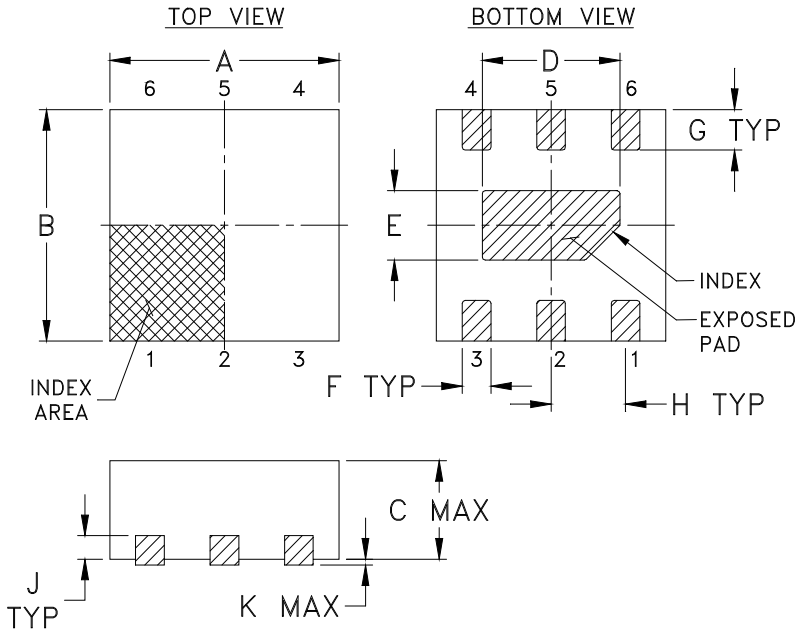



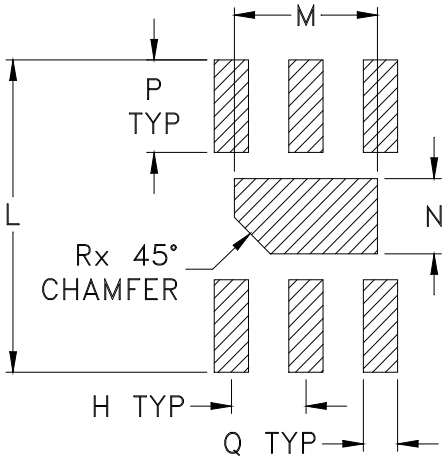
# Case Style MC

**MC1630-1**

## Outline Dimensions

**PCB Land Pattern**




Suggested Layout,
Tolerance to be within ±.002

| CASE #. | A | B | C | D | E | F | G | H | J | K | L | M | N | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MC1630-1 | .079 (2.00) | .079 (2.00) | .039 (1.00) | .047 (1.20) | .024 (.60) | .010 (.25) | .014 (.35) | .026 (.65) | .008 (.20) | .002 (.05) | .106 (2.70) | .049 (1.25) | .026 (.65) | .031 (.80) |

| CASE #. | Q | R | WT, GRAM |
|---|---|---|---|
| MC1630-1 | .012 (.30) | .012 (.30) | .010* |

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

**Notes:**

1. Case material: Plastic.
2. Termination finish:
   For RoHS Case Styles: Tin-Silver over Nickel plated or Matte-Tin plated (See Data sheet).
   All models, (+) suffix.
3. Lead #1 identifier shall be located in the cross-hatched area shown.
   Identifier may be either a molded or marked feature.
4. *Approximate weight: For the accurate weight, please see the Material Declaration.



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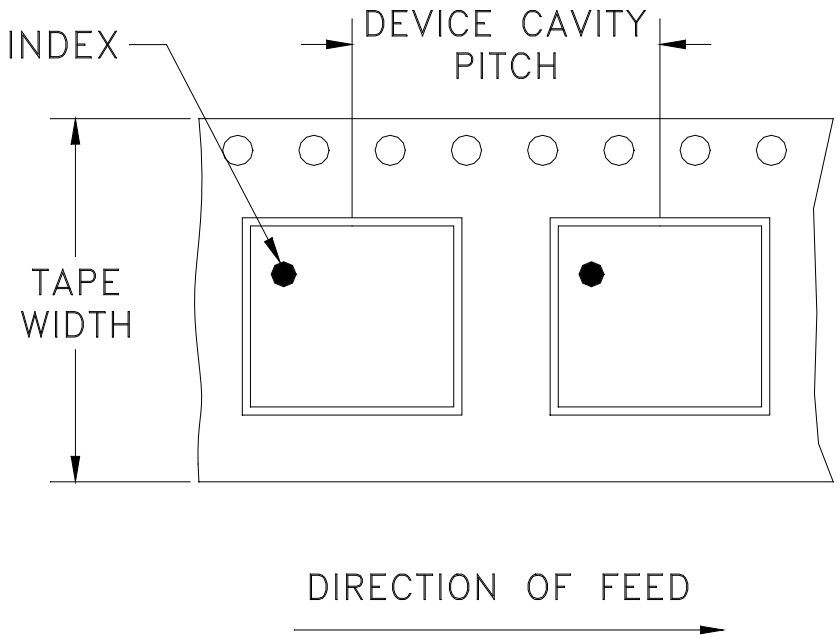
# Tape & Reel Packaging TR-F66

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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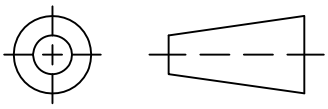
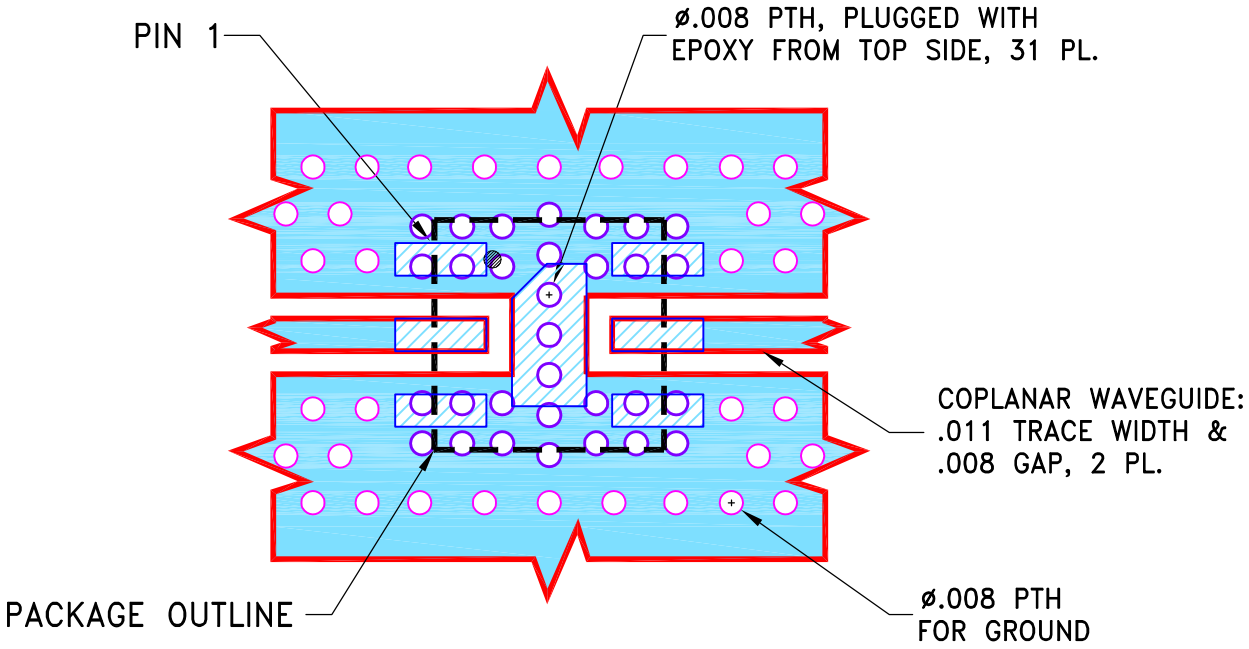
THIRD ANGLE PROJECTION



REVISIONS

| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
|---|---|---|---|---|---|
| 0R | M167874 | NEW RELEASE | 05/17/18 | ITG | RS |
| | | | | | |
| | | | | | |
| | | | | | |

# SUGGESTED MOUNTING CONFIGURATION FOR MC1630-1 CASE STYLE, "06AF04" PIN CODE




NOTES:

1. TRACE WIDTH & GAP PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .0066±.0007. COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.
2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

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 | 05/11/18 |
| TOLERANCES ON: | CHECKED | GF | 05/17/18 |
| 2 PL DECIMALS ± | APPROVED | RS | 05/17/18 |
| 3 PL DECIMALS ± .005 | | | |
| ANGLES ± | | | |
| FRACTIONS ± | | | |

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

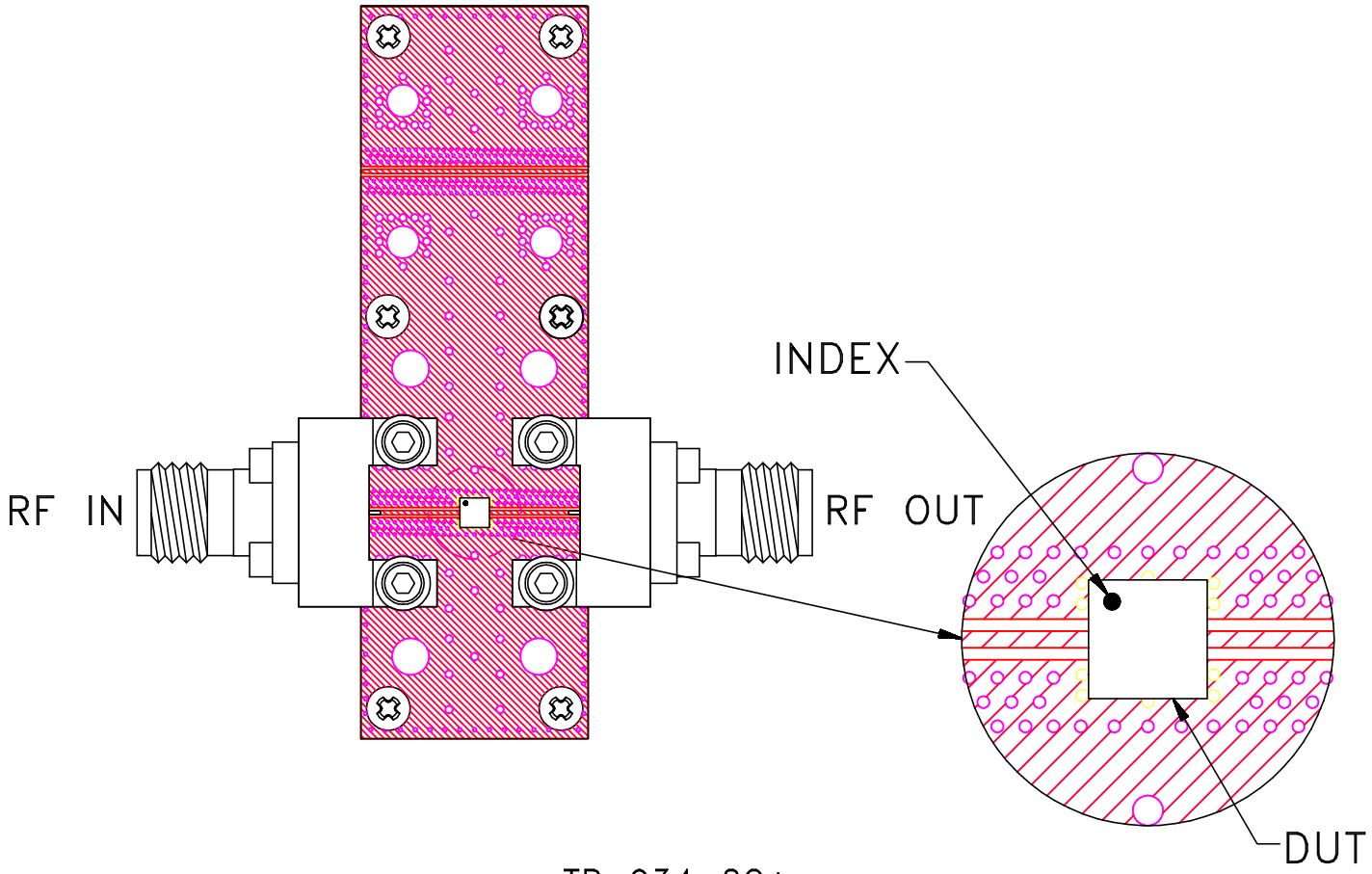
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, 06AF04, MC1630-1, TB-934-NC+

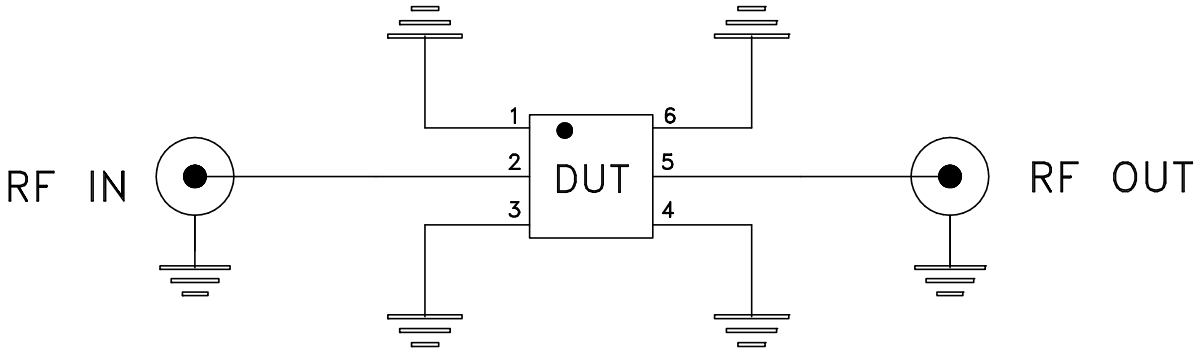
| SIZE | CODE IDENT | DRAWING NO: | REV: |
|---|---|---|---|
| A | 15542 | 98-PL-586 | 0R |

| FILE: | SCALE: | SHEET: |
|---|---|---|
| 98PL586 | 15:1 | 1 OF 1 |

# Evaluation Board and Circuit




TB-934-2C+




Schematic Diagram

Notes:

1. 50 Ohm 2.40mm Female end launch connectors.
2. PCB Material: RO4350 or equivalent,
   Dielectric Constant=3.5, Thickness=.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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| 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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