



Mini-Circuits

MICROWAVE PRECISION

# Fixed Attenuator

**QAT-6+**

50Ω 1.6W 6 dB DC to 50 GHz

## THE BIG DEAL

- Small package, 2x2mm MCLP™
- Super Wide bandwidth, DC to 50 GHz
- Excellent VSWR, 1.1:1 typ. at 25 GHz
- High Power Handling, 1.6W
- Protected by US Patent 11,784,146



Generic photo used for illustration purposes only

CASE STYLE: MC3000

## +RoHS Compliant

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

## APPLICATIONS

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

## PRODUCT OVERVIEW

QAT-6+ is an absorptive fixed attenuator fabricated using highly reliable and repeatable GaAs MMIC IPD\* process. The model operates from DC to 50 GHz. It achieves outstanding attenuation accuracy and flatness while maintains excellent VSWR throughout the entire band. The model can also handle input power up to 1.6W, which makes this model an ideal choice for a wide range of applications.

## KEY FEATURES

| Feature                                                                         | Advantages                                                                                                                                                                                  |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wideband operation, From DC to 50 GHz                                           | Supports a wide array of applications including 5G, wireless infrastructure, microwave communications, satellite, defense and aerospace, medical broadband and optic applications.          |
| Small Size and simple to use (2x2mm)                                            | As a single chip solution, the QAT series occupies less board space than a lumped element approach, minimizes component count and ensures repeatable performance over wide frequency range. |
| Wide range of nominal attenuation values (0,1,2,3,4,5,6,7,8,9,10,12,15,20 & 30) | Small increment offering enables circuit designer to change attenuation values without motherboard redesign making the QAT series ideal for select at test application.                     |
| MCLP™ Package                                                                   | Low Inductance, repeatable transitions, excellent thermal path make the QAT series an ideal solution as an alternative to "do it yourself" lumped element-based approach.                   |

\* IPD - Integrated Passive Device.

REV. C  
ECO-022420  
QAT-6+  
MCL NY  
240716





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# Fixed Attenuator

**QAT-6+****50Ω 1.6W 6 dB DC to 50 GHz****ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C, 50Ω, UNLESS NOTED OTHERWISE**

| Parameter       | Condition (GHz) | Min. | Typ. | Max. | Unit |
|-----------------|-----------------|------|------|------|------|
| Frequency Range |                 | DC   | —    | 50   | GHz  |
| Attenuation     | 0.01 - 5        | 5.6  | 6.0  | 6.3  | dB   |
|                 | 5 - 10          | 5.7  | 6.1  | 6.4  |      |
|                 | 10 - 20         | 5.7  | 6.1  | 6.4  |      |
|                 | 20 - 30         | 5.6  | 6.1  | 6.9  |      |
|                 | 30 - 40         |      | 6.2  |      |      |
|                 | 40 - 50         |      | 6.4  |      |      |
| VSWR            | 0.01 - 5        |      | 1.08 | 1.3  | :1   |
|                 | 5 - 10          |      | 1.18 | 1.5  |      |
|                 | 10 - 20         |      | 1.09 | 1.5  |      |
|                 | 20 - 30         |      | 1.14 |      |      |
|                 | 30 - 40         |      | 1.29 |      |      |
|                 | 40 - 50         |      | 1.49 |      |      |

1. Tested on Mini-Circuits test board TB-QAT-6C+. See Characterization/Application Circuit in Fig. 1. Bi-directional RF-IN and RF-OUT ports can be interchanged. See S-Parameters for actual performance

**ABSOLUTE MAXIMUM RATINGS<sup>2</sup>**

| Parameter                   | Ratings           |
|-----------------------------|-------------------|
| Operating Case Temperature  | -55°C to 105°C    |
| Storage Temperature         | -65°C to 150°C    |
| RF Input Power <sup>3</sup> | 1.6W <sup>3</sup> |

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

3. Power rating derated to 1W at 85°C and 0.8W at 105°C.





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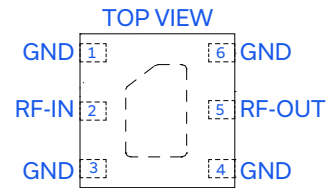
# Fixed Attenuator

**QAT-6+**

50Ω 1.6W 6 dB DC to 50 GHz

## 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

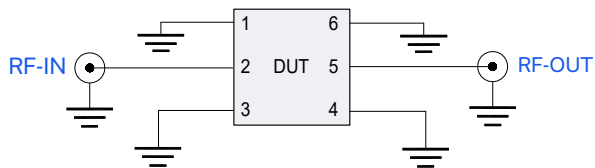
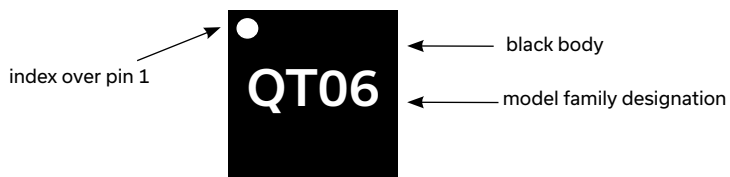


Fig 1. Block diagram of Test Circuit used for characterization, Test board TB-QAT-6C+  
Conditions: Attenuation, VSWR:  $P_{IN}=0$  dBm

## PRODUCT MARKING



Marking may contain other features or characters for internal lot control





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# Fixed Attenuator

**QAT-6+**

50Ω 1.6W 6 dB DC to 50 GHz

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. [CLICK HERE](#)

|                                                      |                                                                |
|------------------------------------------------------|----------------------------------------------------------------|
| Performance Data                                     | Data Table                                                     |
|                                                      | Swept Graphs                                                   |
|                                                      | S-Parameter (S2P Files) Data Set (.zip file)                   |
| Case Style                                           | MC3000 Plastic package, Terminal finish: Matte Tin             |
| Tape & Reel<br>Standard quantities available on reel | F66<br>7" reels with 20, 50, 100, 200, 500 or 2K devices       |
| Suggested Layout for PCB Design                      | PL-676                                                         |
| Evaluation Board                                     | TB-QAT-6+ (without connectors)<br>TB-QAT-6C+ (with connectors) |
| Environmental Ratings                                | ENV08T1                                                        |

## ESD RATING

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

## MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

## NOTES

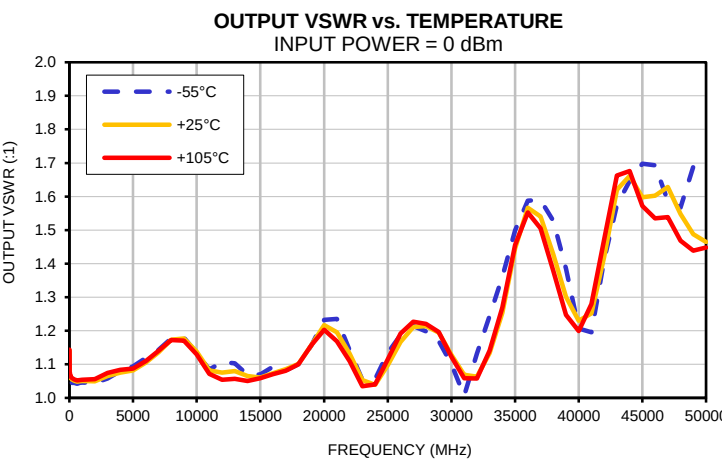
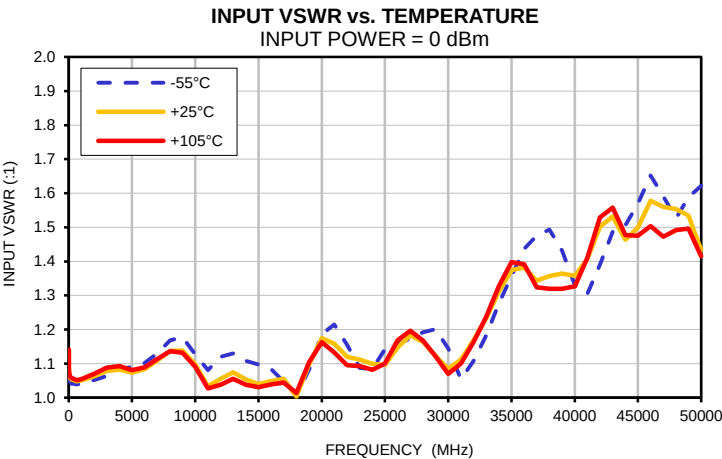
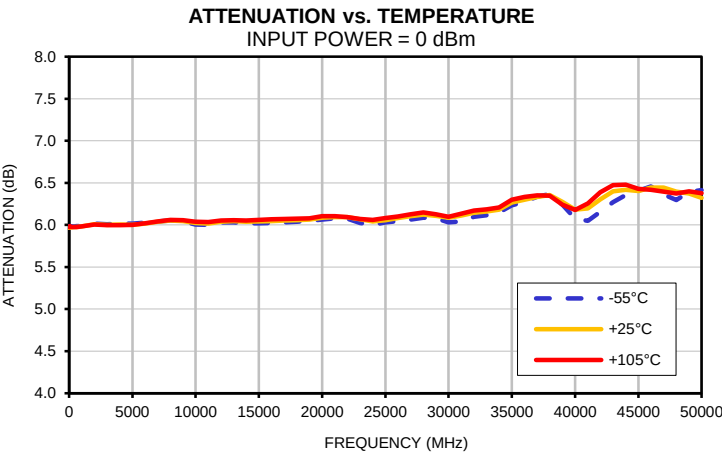
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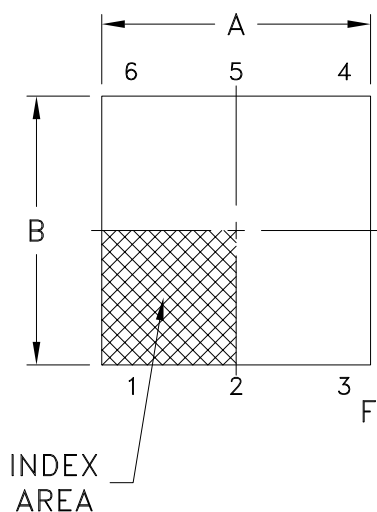
## Typical Performance Data

| FREQ. | ATTENUATION |       |         | INPUT VSWR |       |         | OUTPUT VSWR |       |         |
|-------|-------------|-------|---------|------------|-------|---------|-------------|-------|---------|
| (MHz) | (dB)        |       |         | (:1)       |       |         | (:1)        |       |         |
|       | @-55°C      | @25°C | @+105°C | @-55°C     | @25°C | @+105°C | @-55°C      | @25°C | @+105°C |
| 10    | 5.97        | 5.97  | 5.98    | 1.13       | 1.14  | 1.14    | 1.14        | 1.14  | 1.14    |
| 20    | 5.99        | 5.97  | 5.98    | 1.08       | 1.08  | 1.09    | 1.08        | 1.09  | 1.09    |
| 30    | 5.98        | 5.97  | 5.98    | 1.06       | 1.07  | 1.07    | 1.07        | 1.07  | 1.08    |
| 40    | 5.99        | 5.97  | 5.98    | 1.06       | 1.07  | 1.07    | 1.06        | 1.07  | 1.07    |
| 50    | 5.98        | 5.97  | 5.98    | 1.05       | 1.06  | 1.07    | 1.06        | 1.07  | 1.07    |
| 60    | 5.99        | 5.98  | 5.98    | 1.05       | 1.06  | 1.07    | 1.06        | 1.06  | 1.07    |
| 70    | 5.98        | 5.98  | 5.98    | 1.05       | 1.06  | 1.06    | 1.05        | 1.06  | 1.07    |
| 80    | 5.98        | 5.98  | 5.98    | 1.05       | 1.06  | 1.06    | 1.05        | 1.06  | 1.07    |
| 90    | 5.99        | 5.98  | 5.98    | 1.05       | 1.06  | 1.06    | 1.05        | 1.06  | 1.06    |
| 100   | 5.98        | 5.97  | 5.98    | 1.05       | 1.06  | 1.06    | 1.05        | 1.06  | 1.06    |
| 200   | 5.98        | 5.97  | 5.98    | 1.04       | 1.05  | 1.06    | 1.05        | 1.06  | 1.06    |
| 400   | 5.98        | 5.98  | 5.97    | 1.04       | 1.05  | 1.06    | 1.05        | 1.05  | 1.06    |
| 600   | 5.99        | 5.98  | 5.98    | 1.04       | 1.05  | 1.05    | 1.04        | 1.05  | 1.05    |
| 800   | 5.99        | 5.98  | 5.98    | 1.04       | 1.05  | 1.05    | 1.04        | 1.05  | 1.05    |
| 1000  | 5.99        | 5.98  | 5.98    | 1.04       | 1.05  | 1.05    | 1.05        | 1.05  | 1.05    |
| 2000  | 6.01        | 6.01  | 6.01    | 1.05       | 1.06  | 1.07    | 1.05        | 1.05  | 1.06    |
| 3000  | 6.01        | 6.00  | 6.00    | 1.06       | 1.08  | 1.09    | 1.06        | 1.07  | 1.07    |
| 4000  | 6.02        | 6.00  | 6.00    | 1.08       | 1.08  | 1.09    | 1.08        | 1.08  | 1.08    |
| 5000  | 6.02        | 6.00  | 6.00    | 1.09       | 1.07  | 1.08    | 1.09        | 1.08  | 1.09    |
| 6000  | 6.03        | 6.02  | 6.02    | 1.10       | 1.08  | 1.09    | 1.12        | 1.11  | 1.11    |
| 7000  | 6.04        | 6.04  | 6.04    | 1.13       | 1.11  | 1.11    | 1.14        | 1.14  | 1.14    |
| 8000  | 6.05        | 6.05  | 6.06    | 1.17       | 1.14  | 1.14    | 1.18        | 1.17  | 1.17    |
| 9000  | 6.04        | 6.05  | 6.06    | 1.18       | 1.14  | 1.13    | 1.18        | 1.18  | 1.17    |
| 10000 | 6.01        | 6.02  | 6.04    | 1.13       | 1.10  | 1.09    | 1.13        | 1.14  | 1.13    |
| 11000 | 6.00        | 6.02  | 6.04    | 1.08       | 1.03  | 1.03    | 1.08        | 1.08  | 1.07    |
| 12000 | 6.03        | 6.04  | 6.05    | 1.12       | 1.06  | 1.04    | 1.11        | 1.08  | 1.05    |
| 13000 | 6.03        | 6.04  | 6.06    | 1.13       | 1.07  | 1.06    | 1.10        | 1.08  | 1.06    |
| 14000 | 6.02        | 6.04  | 6.05    | 1.11       | 1.05  | 1.04    | 1.07        | 1.06  | 1.05    |
| 15000 | 6.02        | 6.04  | 6.06    | 1.10       | 1.04  | 1.03    | 1.07        | 1.06  | 1.06    |
| 16000 | 6.02        | 6.05  | 6.07    | 1.08       | 1.05  | 1.04    | 1.09        | 1.07  | 1.07    |
| 17000 | 6.03        | 6.05  | 6.07    | 1.05       | 1.06  | 1.04    | 1.08        | 1.09  | 1.08    |
| 18000 | 6.04        | 6.06  | 6.07    | 1.01       | 1.00  | 1.01    | 1.10        | 1.10  | 1.10    |
| 19000 | 6.05        | 6.07  | 6.08    | 1.08       | 1.10  | 1.10    | 1.16        | 1.16  | 1.16    |
| 20000 | 6.06        | 6.08  | 6.11    | 1.19       | 1.17  | 1.16    | 1.23        | 1.22  | 1.20    |
| 21000 | 6.08        | 6.09  | 6.11    | 1.21       | 1.16  | 1.13    | 1.24        | 1.20  | 1.17    |
| 22000 | 6.07        | 6.09  | 6.09    | 1.16       | 1.12  | 1.10    | 1.14        | 1.13  | 1.11    |
| 23000 | 6.02        | 6.07  | 6.07    | 1.09       | 1.11  | 1.09    | 1.05        | 1.05  | 1.03    |
| 24000 | 6.00        | 6.04  | 6.06    | 1.08       | 1.10  | 1.08    | 1.06        | 1.04  | 1.04    |
| 25000 | 6.03        | 6.06  | 6.08    | 1.14       | 1.10  | 1.10    | 1.13        | 1.10  | 1.12    |
| 26000 | 6.05        | 6.08  | 6.10    | 1.16       | 1.15  | 1.17    | 1.19        | 1.17  | 1.19    |
| 27000 | 6.07        | 6.10  | 6.13    | 1.17       | 1.18  | 1.20    | 1.21        | 1.21  | 1.23    |
| 28000 | 6.09        | 6.12  | 6.15    | 1.19       | 1.16  | 1.17    | 1.20        | 1.21  | 1.22    |
| 29000 | 6.08        | 6.11  | 6.13    | 1.20       | 1.12  | 1.12    | 1.17        | 1.19  | 1.20    |
| 30000 | 6.03        | 6.09  | 6.10    | 1.14       | 1.08  | 1.07    | 1.10        | 1.13  | 1.12    |
| 31000 | 6.04        | 6.11  | 6.13    | 1.05       | 1.11  | 1.10    | 1.01        | 1.07  | 1.06    |
| 32000 | 6.10        | 6.14  | 6.17    | 1.11       | 1.17  | 1.16    | 1.13        | 1.06  | 1.06    |
| 33000 | 6.12        | 6.16  | 6.19    | 1.18       | 1.23  | 1.24    | 1.24        | 1.13  | 1.14    |
| 34000 | 6.15        | 6.18  | 6.21    | 1.28       | 1.31  | 1.33    | 1.36        | 1.25  | 1.27    |
| 35000 | 6.23        | 6.27  | 6.30    | 1.36       | 1.37  | 1.40    | 1.50        | 1.45  | 1.46    |
| 36000 | 6.28        | 6.30  | 6.33    | 1.44       | 1.38  | 1.39    | 1.59        | 1.57  | 1.55    |
| 37000 | 6.34        | 6.33  | 6.35    | 1.48       | 1.34  | 1.32    | 1.59        | 1.54  | 1.51    |
| 38000 | 6.37        | 6.36  | 6.35    | 1.49       | 1.36  | 1.32    | 1.53        | 1.43  | 1.38    |
| 39000 | 6.24        | 6.27  | 6.24    | 1.43       | 1.36  | 1.32    | 1.39        | 1.30  | 1.25    |
| 40000 | 6.07        | 6.18  | 6.18    | 1.33       | 1.36  | 1.33    | 1.21        | 1.23  | 1.20    |
| 41000 | 6.05        | 6.20  | 6.25    | 1.30       | 1.41  | 1.41    | 1.20        | 1.25  | 1.28    |
| 42000 | 6.16        | 6.30  | 6.39    | 1.39       | 1.50  | 1.53    | 1.41        | 1.42  | 1.47    |
| 43000 | 6.27        | 6.40  | 6.47    | 1.49       | 1.53  | 1.56    | 1.57        | 1.62  | 1.66    |
| 44000 | 6.35        | 6.42  | 6.48    | 1.51       | 1.46  | 1.48    | 1.65        | 1.66  | 1.68    |
| 45000 | 6.41        | 6.40  | 6.43    | 1.57       | 1.50  | 1.48    | 1.70        | 1.60  | 1.57    |
| 46000 | 6.46        | 6.44  | 6.42    | 1.65       | 1.58  | 1.50    | 1.69        | 1.60  | 1.54    |
| 47000 | 6.36        | 6.44  | 6.40    | 1.59       | 1.56  | 1.47    | 1.59        | 1.63  | 1.54    |
| 48000 | 6.30        | 6.40  | 6.37    | 1.53       | 1.55  | 1.49    | 1.57        | 1.55  | 1.47    |
| 49000 | 6.39        | 6.37  | 6.40    | 1.59       | 1.53  | 1.50    | 1.69        | 1.49  | 1.44    |
| 50000 | 6.41        | 6.32  | 6.38    | 1.62       | 1.43  | 1.41    | 1.71        | 1.46  | 1.45    |

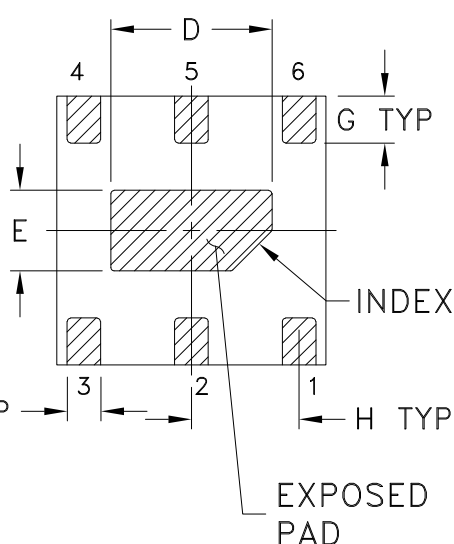
Typical Performance Curves



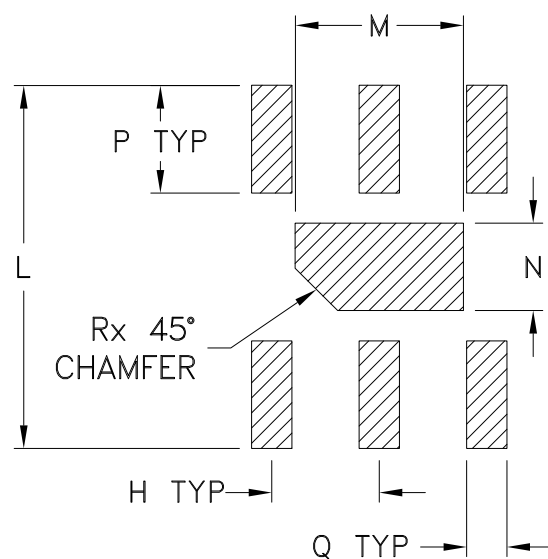
TOP VIEW



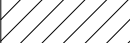
BOTTOM VIEW



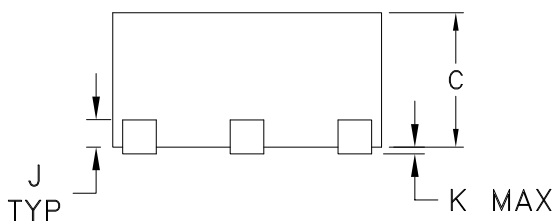
PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm 0.002$

 DENOTES METALLIZATION

SIDE VIEW



| CASE#  | A              | B              | C              | D              | E             | F             | G             | H             | J             | K             | L              | M              | N             |
|--------|----------------|----------------|----------------|----------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|---------------|
| MC3000 | .079<br>(2.00) | .079<br>(2.00) | .039<br>(1.00) | .047<br>(1.20) | .024<br>(.60) | .010<br>(.25) | .014<br>(.35) | .031<br>(.80) | .008<br>(.20) | .002<br>(.05) | .106<br>(2.70) | .049<br>(1.25) | .026<br>(.65) |
| CASE # | P              | Q              | R              | WT, GRAM       |               |               |               |               |               |               |                |                |               |
| MC3000 | .031<br>(.80)  | .012<br>(.30)  | .012<br>(.30)  | .006           |               |               |               |               |               |               |                |                |               |

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm 0.01$ ; 3 Pl.  $\pm 0.005$

Notes:

- Case material: Plastic.
- Termination finish:

For RoHS Case Styles: Tin-Silver over Nickel plated or Matte-Tin plated (See Data sheet).

All models, (+) suffix.

- Lead #1 identifier shall be located in the cross-hatched area shown.  
Identifier may be either a molded or marked feature.

 **Mini-Circuits**  
ISO 9001 ISO 14001 CERTIFIED

ALL NEW  
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RF/IF MICROWAVE COMPONENTS

| REV | ECN No.    | DESCRIPTION          | DATE     | DR  | AUTH |
|-----|------------|----------------------|----------|-----|------|
| OR  | ECO-002800 | NEW RELEASE          | 04/14/20 | ITG | CC   |
| A   | ECO-003941 | UPDATED DUT ROTATION |          | CA  |      |
|     |            |                      |          |     |      |

Ø.008 PTH FOR GROUND

Ø.008 PTH, PLUGGED WITH EPOXY AND CAPPED WITH COPPER FROM TOP SIDE, 13 PL.

PIN 1

RF-IN

RF-OUT

PACKAGE OUTLINE

COPLANAR WAVEGUIDE: .010 LINE WIDTH & .0085 GAP, 2 PL. (SEE NOTE BELOW)

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

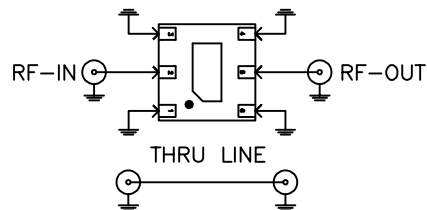
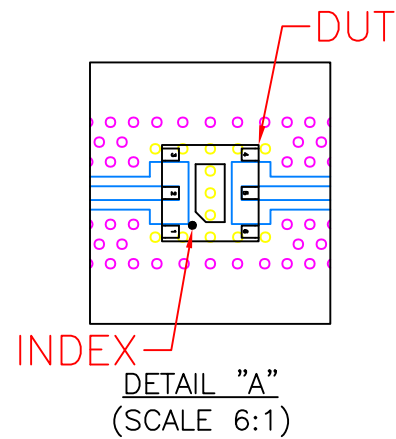
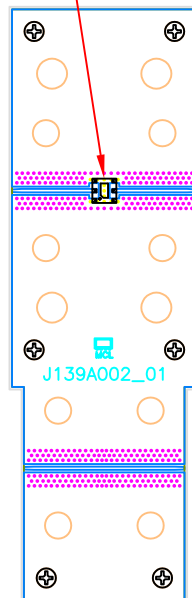
DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

SHEET: 1 OF 1



# Evaluation Board and Circuit

SEE DETAIL "A"



SCHEMATIC DIAGRAM  
(SCALE 6:1)

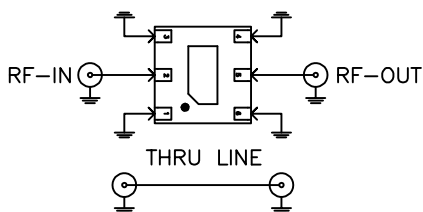
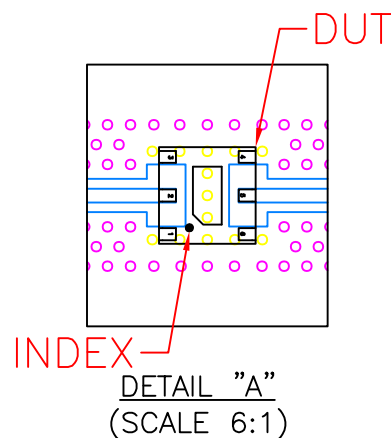
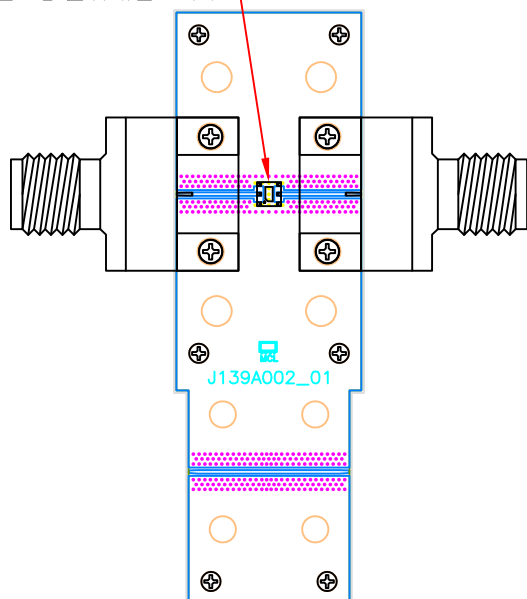
| Function | Pad     |
|----------|---------|
| RF-IN    | 2       |
| RF-OUT   | 5       |
| GND      | 1,3,4,6 |

## Notes:

1. PCB Material: Roger R04350B or equivalent,  
Dielectric constant=3.5, Thickness=0.0066 inch

# Evaluation Board and Circuit

SEE DETAIL "A"



SCHEMATIC DIAGRAM  
(SCALE 6:1)

| Function | Pad     |
|----------|---------|
| RF-IN    | 2       |
| RF-OUT   | 5       |
| GND      | 1,3,4,6 |

## Notes:

1. 2.4mm Female Connectors,
2. PCB Material: Roger R04350B or equivalent,  
Dielectric constant=3.5, Thickness=0.0066 inch

 **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          | -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                                                       |



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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