CERAMIC BALUN

# RF Transformer

# TCW1-392+

50Ω 3300 to 3900 MHz 1:1 Ratio

## FEATURES

- Miniature Size 0603 (1.6 × 0.8 mm)
- LTCC Construction
- Low Cost

*Generic photo used for illustration purposes only*

CASE STYLE: JC0603C

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

## APPLICATIONS

- LTE
- 5G
- A/D Conversion

## ELECTRICAL SPECIFICATIONS AT +25 °C

| Parameter | Frequency (MHz) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Impedance Ratio | | | 1 | | |
| Frequency Range | | 3300 | | 3900 | MHz |
| Avg. Insertion Loss[1] | 3300–3900 | – | 0.8 | 1.5 | dB |
| Amplitude Unbalance | 3300–3900 | – | 0.6 | 1.5 | dB |
| Phase Unbalance[2] | 3300–3900 | – | 5 | 15 | Degree |
| VSWR | 3300–3900 | – | 1.7 | – | (:1) |

1. Reference demo board TB-TCW1-392+.
2. Relative to 180°.

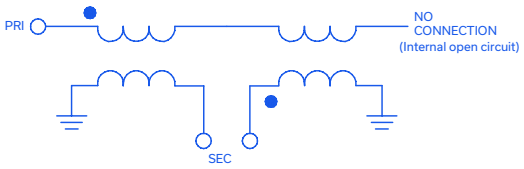
## ABSOLUTE MAXIMUM RATINGS

| Parameter | Ratings |
|---|---|
| Operating Temperature | -55 °C to +100 °C |
| Storage Temperature | -55 °C to +100 °C |
| RF Power Input[3] | 1 W at +25 °C |

3. Passband rating.

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

## CONFIGURATION J




REV. D
ECO-030282
TCW1-392+
MCL NY
260630

CERAMIC BALUN

# RF Transformer

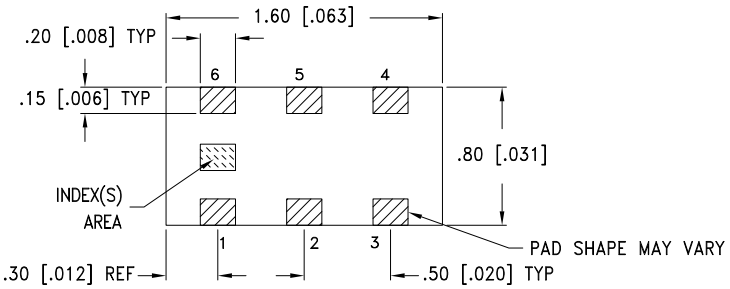
# TCW1-392+

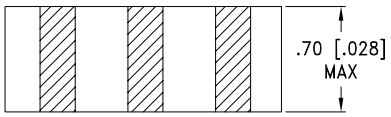
50Ω 3300 to 3900 MHz 1:1 Ratio

## PAD CONNECTIONS

| | |
|---|---|
| PRIMARY DOT | 1 |
| RF GROUND | 2 |
| SECONDARY DOT | 4 |
| SECONDARY | 3 |
| NO CONNECTION | 6 |
| RF GROUND | 5 |

## OUTLINE DRAWING



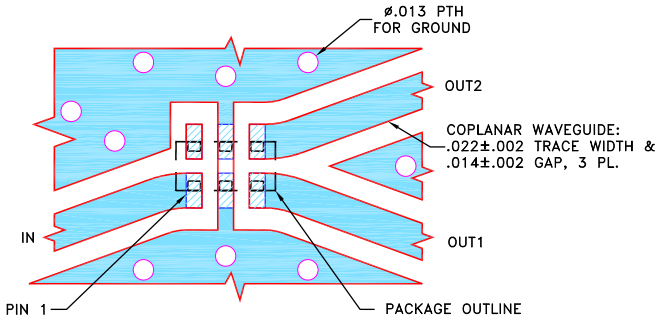

METALLIZATION

Weight: .005 grams
Dimensions are in mm [inch]. Tolerances: ±0.13 mm

## PRODUCT MARKING: N/A

## DEMO BOARD MCL P/N: TB-TCW1-392+

## SUGGESTED PCB LAYOUT (PL-513)




1. TRACE WIDTH AND GAP PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010"±.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 LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).

DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

## TAPE & REEL INFORMATION: F114

# RF Transformer

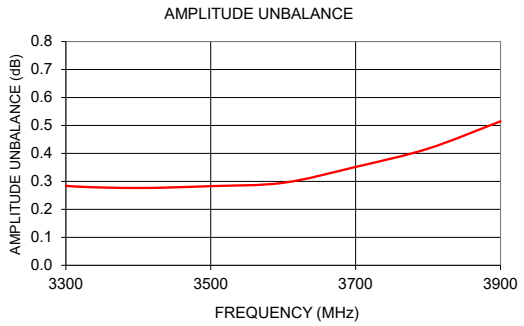
# TCW1-392+

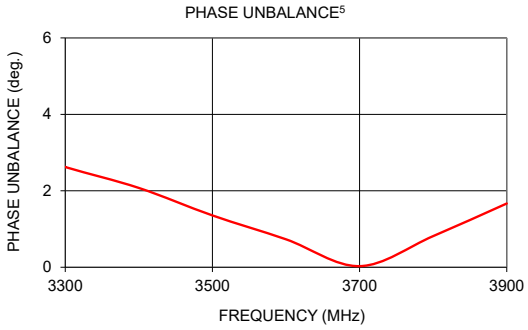
50Ω 3300 to 3900 MHz 1:1 Ratio

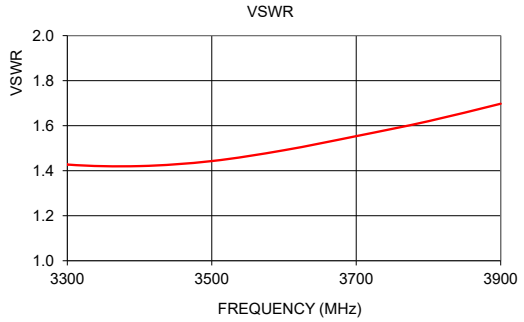
## TYPICAL PERFORMANCE DATA[4]

| Frequency (MHz) | Insertion Loss (dB) | VSWR (:1) | Amplitude Unbalance (dB) | Phase Unbalance[5] (deg) |
|---|---|---|---|---|
| 3300 | 1.07 | 1.43 | 0.28 | 2.62 |
| 3200 | 1.10 | 1.47 | 0.31 | 3.22 |
| 3300 | 1.07 | 1.43 | 0.28 | 2.62 |
| 3400 | 1.06 | 1.42 | 0.28 | 2.07 |
| 3500 | 1.08 | 1.44 | 0.28 | 1.36 |
| 3600 | 1.10 | 1.49 | 0.29 | 0.73 |
| 3700 | 1.14 | 1.55 | 0.35 | 0.03 |
| 3800 | 1.18 | 1.62 | 0.42 | 0.81 |
| 3900 | 1.24 | 1.70 | 0.51 | 1.67 |

4. Measured with Agilent N5242A network analyzer using impedance conversion and port extension.
5. Relative to 180°.




**NOTES**

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# RF Transformer TCW1-392+

*Typical Performance Data*

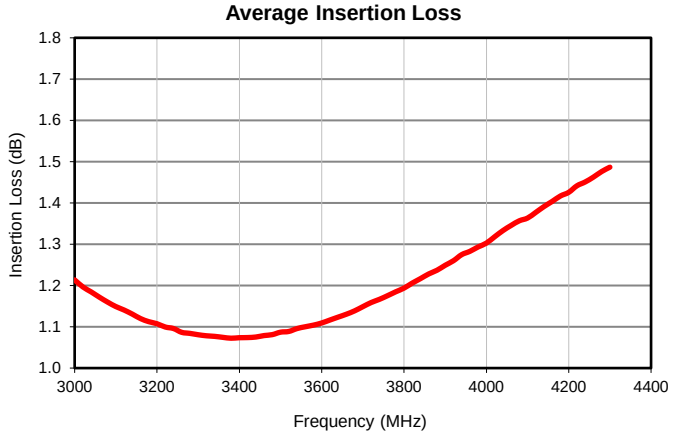
| FREQUENCY (MHz) | AVERAGE INSERTION LOSS* (dB) | INPUT RETURN LOSS (dB) | AMPLITUDE UNBALANCE (dB) | PHASE UNBALANCE** (deg.) |
|---|---|---|---|---|
| 3000 | 1.21 | 12.40 | 0.39 | 4.16 |
| 3020 | 1.20 | 12.64 | 0.38 | 4.05 |
| 3040 | 1.18 | 12.86 | 0.37 | 3.95 |
| 3060 | 1.17 | 13.07 | 0.36 | 3.89 |
| 3080 | 1.16 | 13.27 | 0.36 | 3.79 |
| 3100 | 1.15 | 13.52 | 0.35 | 3.69 |
| 3120 | 1.14 | 13.72 | 0.34 | 3.60 |
| 3140 | 1.13 | 13.91 | 0.33 | 3.52 |
| 3160 | 1.12 | 14.12 | 0.33 | 3.36 |
| 3180 | 1.11 | 14.31 | 0.31 | 3.28 |
| 3200 | 1.11 | 14.45 | 0.31 | 3.22 |
| 3220 | 1.10 | 14.63 | 0.31 | 3.07 |
| 3240 | 1.10 | 14.84 | 0.30 | 2.93 |
| 3260 | 1.09 | 14.90 | 0.29 | 2.86 |
| 3280 | 1.08 | 15.02 | 0.30 | 2.75 |
| 3300 | 1.08 | 15.09 | 0.28 | 2.62 |
| 3320 | 1.08 | 15.18 | 0.29 | 2.56 |
| 3340 | 1.08 | 15.24 | 0.28 | 2.39 |
| 3360 | 1.07 | 15.26 | 0.28 | 2.28 |
| 3380 | 1.07 | 15.26 | 0.27 | 2.18 |
| 3400 | 1.07 | 15.20 | 0.28 | 2.07 |
| 3420 | 1.07 | 15.16 | 0.28 | 1.90 |
| 3440 | 1.08 | 15.14 | 0.27 | 1.80 |
| 3460 | 1.08 | 15.11 | 0.28 | 1.70 |
| 3480 | 1.08 | 14.96 | 0.28 | 1.56 |
| 3500 | 1.09 | 14.83 | 0.28 | 1.36 |
| 3520 | 1.09 | 14.69 | 0.27 | 1.30 |
| 3540 | 1.10 | 14.56 | 0.29 | 1.17 |
| 3560 | 1.10 | 14.44 | 0.29 | 0.97 |
| 3580 | 1.10 | 14.32 | 0.29 | 0.86 |
| 3600 | 1.11 | 14.11 | 0.29 | 0.73 |
| 3620 | 1.12 | 13.91 | 0.31 | 0.62 |
| 3640 | 1.12 | 13.76 | 0.32 | 0.43 |
| 3660 | 1.13 | 13.64 | 0.33 | 0.26 |
| 3680 | 1.14 | 13.49 | 0.34 | 0.16 |
| 3700 | 1.15 | 13.28 | 0.35 | 0.03 |
| 3720 | 1.16 | 13.10 | 0.35 | 0.20 |
| 3740 | 1.17 | 12.94 | 0.37 | 0.29 |
| 3760 | 1.18 | 12.76 | 0.39 | 0.48 |
| 3780 | 1.18 | 12.66 | 0.40 | 0.64 |
| 3800 | 1.19 | 12.52 | 0.42 | 0.81 |
| 3820 | 1.21 | 12.32 | 0.44 | 0.96 |
| 3840 | 1.22 | 12.13 | 0.45 | 1.16 |
| 3860 | 1.23 | 12.01 | 0.47 | 1.32 |
| 3880 | 1.24 | 11.88 | 0.50 | 1.49 |
| 3900 | 1.25 | 11.75 | 0.51 | 1.67 |
| 3920 | 1.26 | 11.60 | 0.53 | 1.87 |
| 3940 | 1.27 | 11.46 | 0.56 | 2.00 |
| 3960 | 1.28 | 11.35 | 0.58 | 2.23 |
| 3980 | 1.29 | 11.24 | 0.61 | 2.38 |
| 4000 | 1.30 | 11.17 | 0.64 | 2.59 |
| 4020 | 1.32 | 11.03 | 0.66 | 2.75 |
| 4040 | 1.33 | 10.88 | 0.70 | 2.97 |
| 4060 | 1.35 | 10.77 | 0.72 | 3.16 |
| 4080 | 1.36 | 10.71 | 0.76 | 3.32 |
| 4100 | 1.36 | 10.63 | 0.80 | 3.58 |
| 4120 | 1.38 | 10.57 | 0.83 | 3.79 |
| 4140 | 1.39 | 10.48 | 0.86 | 3.96 |
| 4160 | 1.40 | 10.38 | 0.91 | 4.16 |
| 4180 | 1.42 | 10.28 | 0.94 | 4.47 |
| 4200 | 1.43 | 10.24 | 0.97 | 4.63 |
| 4220 | 1.44 | 10.19 | 1.02 | 4.85 |
| 4240 | 1.45 | 10.11 | 1.07 | 5.11 |
| 4260 | 1.46 | 10.03 | 1.11 | 5.38 |
| 4280 | 1.48 | 9.97 | 1.15 | 5.55 |
| 4300 | 1.49 | 9.96 | 1.21 | 5.79 |

* Reference Demo Board TB-828+

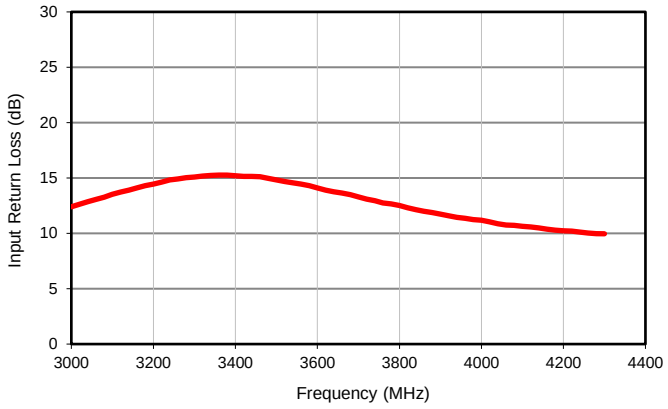
**Phase Unbalance is relative to 180˚

## *Typical Performance Data*

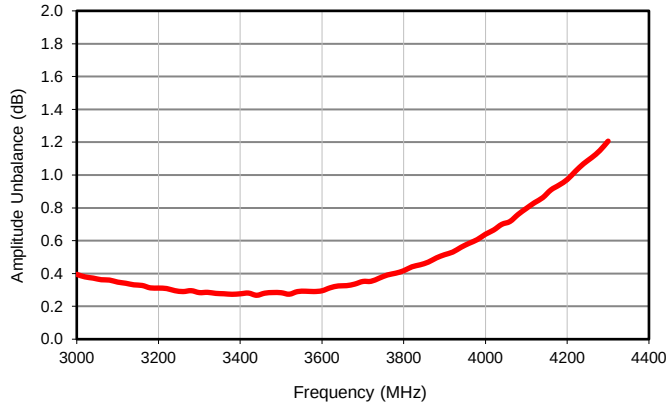
**Average Insertion Loss**



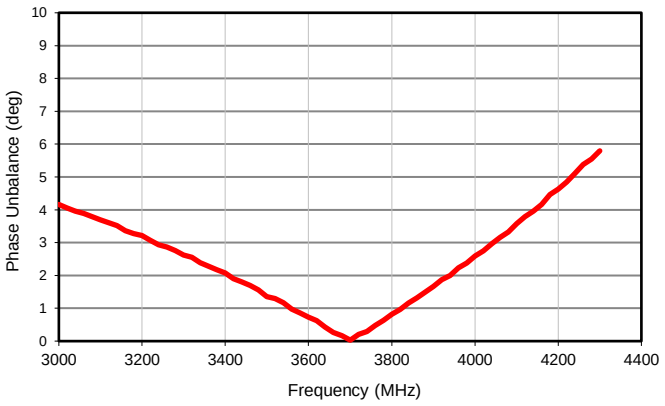

**Input Return Loss**




**Amplitude Unbalance**

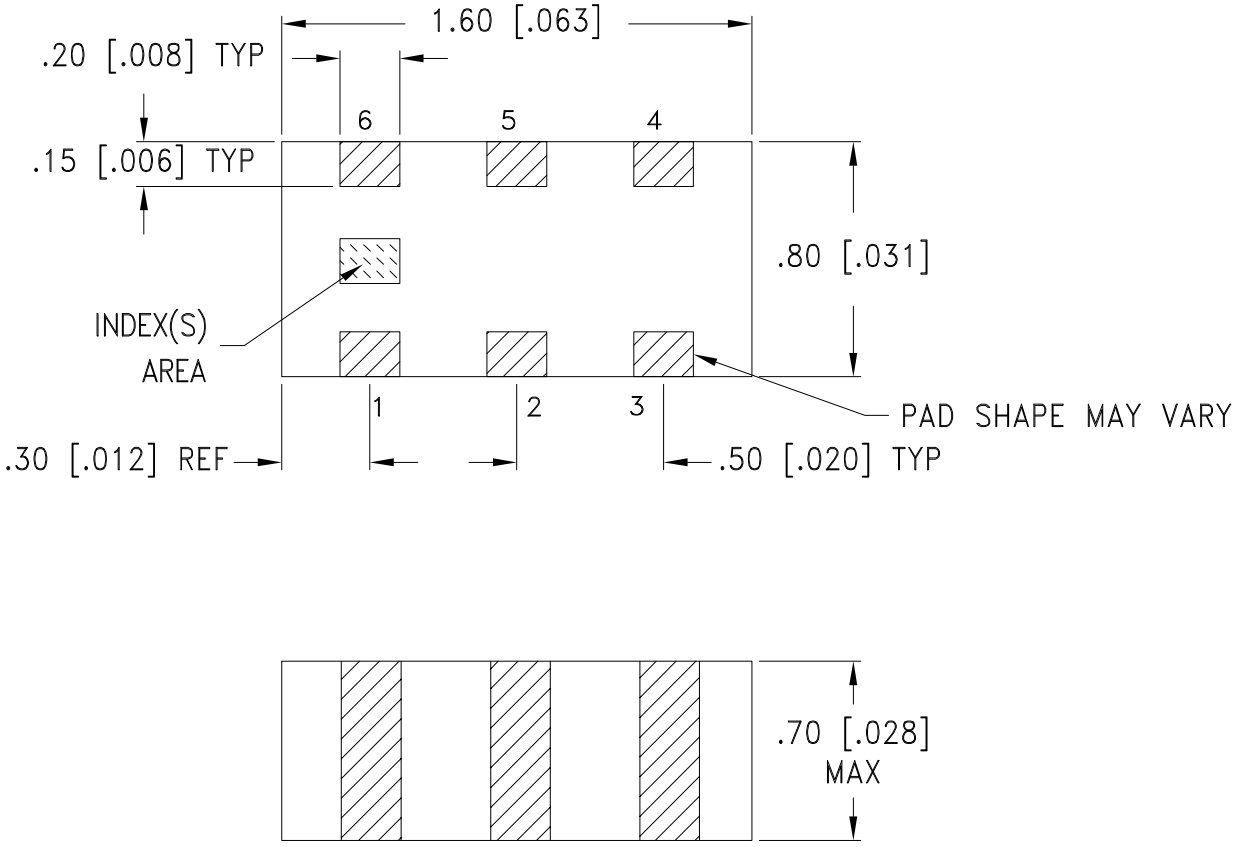



**Phase Unbalance**



# Case Style JC

## Outline Dimensions JC0603C




METALLIZATION

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.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RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F114

DEVICE ORIENTATION IN T&R

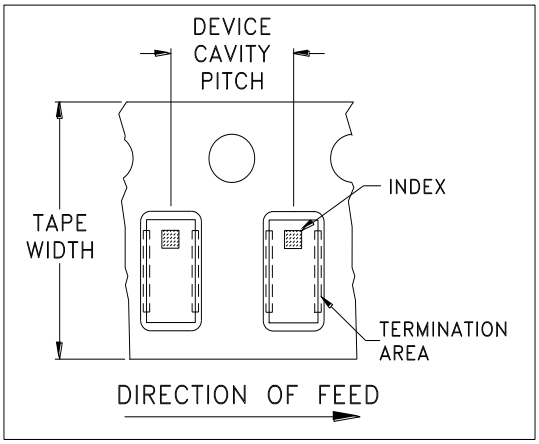


ILLUSTRATION 1

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

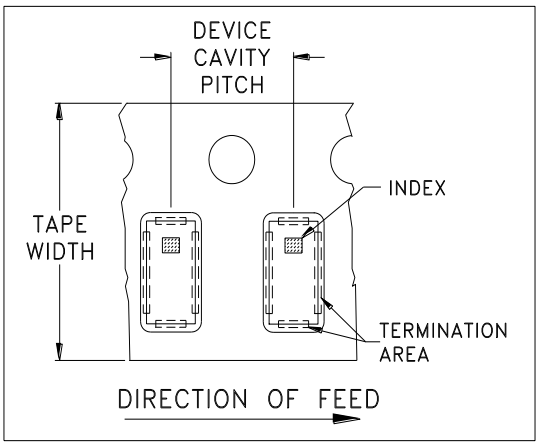


ILLUSTRATION 2

| 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 |
| | | | | 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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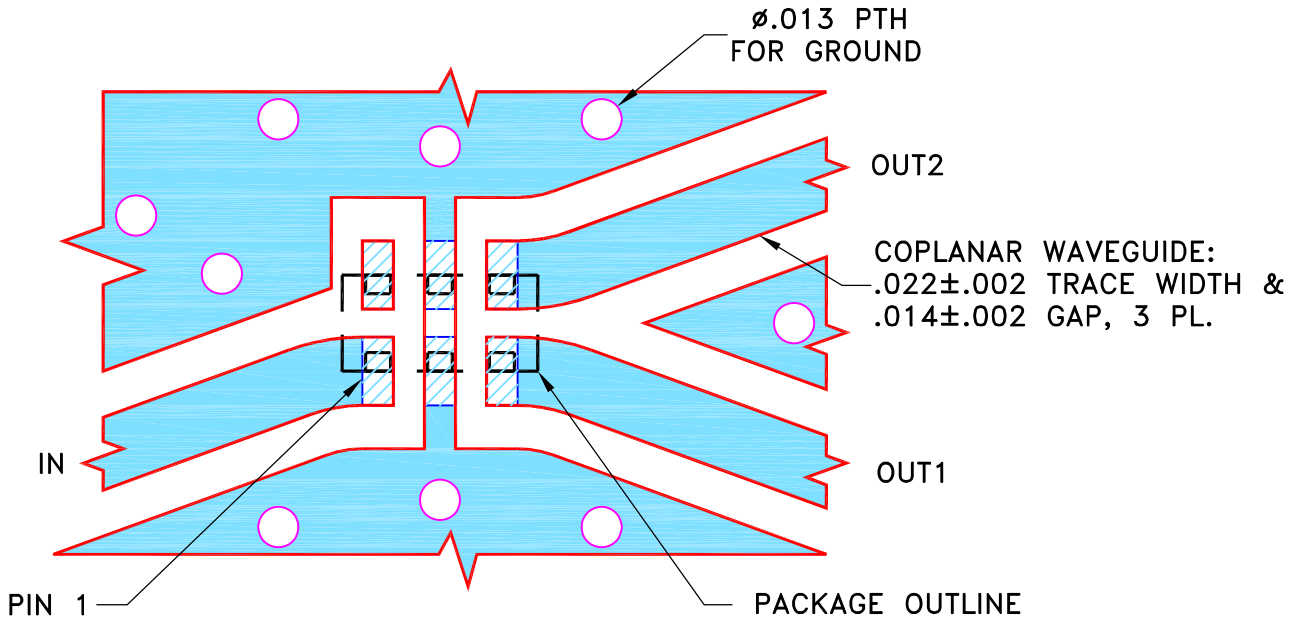
THIRD ANGLE PROJECTION

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
| OR | M162337 | NEW RELEASE | 06/15/17 | ITG | AVB |
| | | | | | |
| | | | | | |
| | | | | | |

# SUGGESTED MOUNTING CONFIGURATION
# FOR JC0603C CASE STYLE, "06TR01" PIN CODE




1. TRACE WIDTH AND GAP PARAMETERS ARE SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010"±.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 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 | 06/14/17 |
| TOLERANCES ON: | CHECKED | GF | 06/15/17 |
| 2 PL DECIMALS ± | APPROVED | AVB | 06/15/17 |
| 3 PL DECIMALS ± .005 | | | |
| ANGLES ± | | | |
| FRACTIONS ± | | | |

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

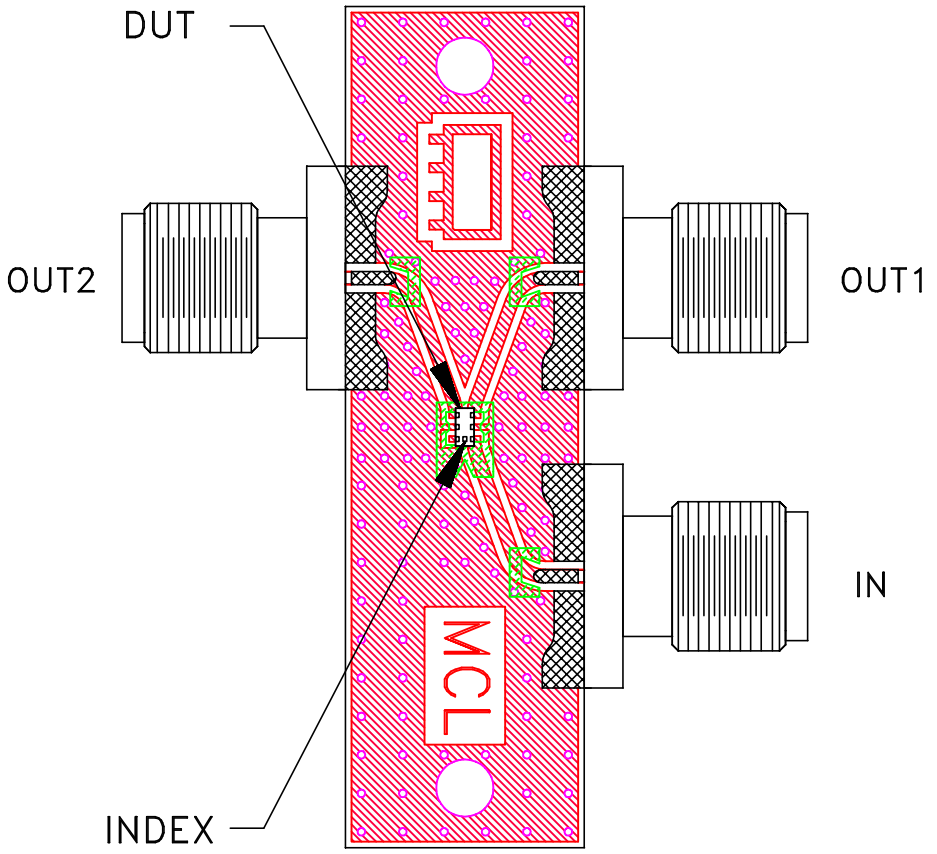
Mini-Circuits® 13 Neptune Avenue Brooklyn NY 11235

PL, 06TR01, JC0603C, TB-828+

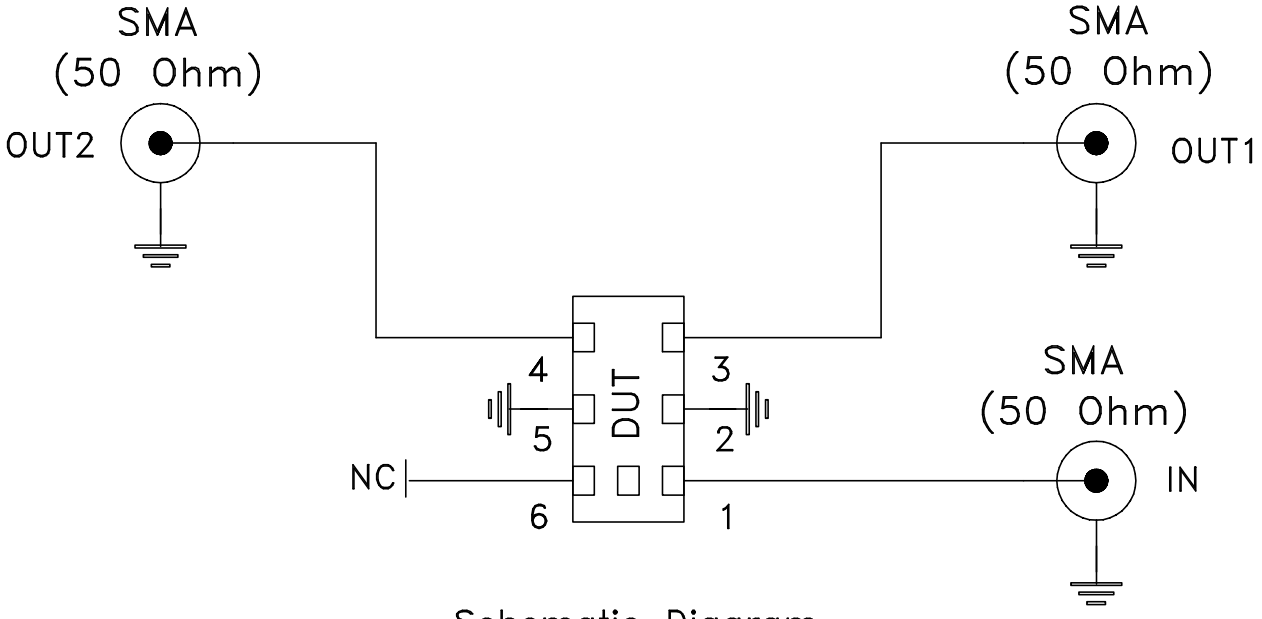
| SIZE | CODE IDENT | DRAWING NO: | REV: |
|---|---|---|---|
| A | 15542 | 98-PL-513 | OR |

| FILE: | SCALE: | SHEET: |
|---|---|---|
| 98PL513 | 16:1 | 1 OF 1 |

# Evaluation Board and Circuit




TB-828+




Schematic Diagram

Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: RO4350 or equivalent,
   Dielectric Constant=3.5, Thickness=.010 inch.

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# Environmental Specifications ENV02T1

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<br>Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 100° C<br>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 |
| Thermal Shock | -55° to 100°C, 100 cycles | MIL-STD-202, Method 107, Condition A-3, except +100°C |
| Solder Reflow Heat | Sn-Pb Eutetic Process: 225°C peak<br>Pb-Free Process 245° - 250°C peak | J-STD-020, Table 4-1, 4-2 and 5-2, Figure 5-1 |
| Solderability | 10X Magnification | J-STD-002, 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 |
| 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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