



## CERAMIC BALUN

# RF Transformer

# TCW4-262+

Mini-Circuits

50Ω 2300 to 2600 MHz 1:4 Ratio

### THE BIG DEAL

- Miniature size 0603 (0.063" [1.6mm] x 0.031" [0.8mm] x 0.024" [0.6mm])
- Low cost
- Aqueous washable



Generic photo used for illustration purposes only

CASE STYLE: JC0603C

### APPLICATIONS

- ISM Band
- WLAN
- Bluetooth
- Zigbee

#### +RoHS Compliant

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

### PRODUCT OVERVIEW

Mini-Circuits' TCW4-262+ is a tiny ceramic RF balun transformer with an impedance ratio of 1:4, covering a variety of wireless communications applications from 2300 to 2600 MHz. This model provides low insertion loss, low phase unbalance (relative to 180°), low amplitude unbalance, and RF input power handling up to 2W. It provides DC isolation from input to output allowing it to be used for DC biasing of external circuits at the output. Fabricated using LTCC technology, the unit comes housed in a tiny, rugged ceramic package (0.06 x 0.03 x 0.02") suitable for harsh operating environments.

### KEY FEATURES

| Feature                          | Advantages   |
|----------------------------------|--|
| 2W power handling                | Supports a wide range of power requirements  |
| DC Isolated from input to output | Can be used to DC bias external circuits at the output.  |
| Tiny size, 0603                  | Accommodates tight space requirements for dense PCB layouts.   |
| LTCC construction                | LTCC process enables tiny size and low cost, suitable for high-volume production. Rugged ceramic package provides excellent reliability in harsh operating environments. |

REV. A  
ECO-010443  
TCW4-262+  
AVB/CP/AM  
221006





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50Ω 2300 to 2600 MHz 1:4 Ratio

### ELECTRICAL SPECIFICATIONS AT 25°C

| Parameter                            | Frequency (GHz) | Min. | Typ. | Max. | Units  |
|--------------------------------------|-----------------|------|------|------|--------|
| Impedance Ratio (Secondary/ Primary) |                 |      | 4    |      |        |
| Frequency Range                      |                 | 2300 |      | 2600 | MHz    |
| Insertion Loss Loss <sup>1</sup>     | 2300-2600       | —    | 1.3  | 1.7  | dB     |
| Amplitude Unbalance                  | 2300-2600       | —    | 0.6  | 1    | dB     |
| Phase Unbalance <sup>2</sup>         | 2300-2600       | —    | —    | 13   | Degree |
| Unbalance Return Loss                | 2300-2600       | 9.5  | 12.5 | —    | dB     |

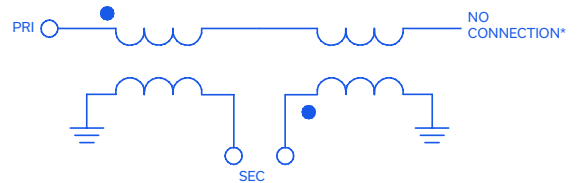
1. Tested on Evaluation Board TB-TCW4-262+
2. Relative to 180°

### MAXIMUM RATINGS

| Parameter                        | Ratings        |
|----------------------------------|----------------|
| Operating Temperature            | -55°C to 125°C |
| Storage Temperature <sup>3</sup> | -55°C to 125°C |
| RF Power <sup>4</sup>            | 2W             |

3. Refer to product storage temperature after installation. Suggestion for T&R unused product storage condition: +5~+35°C, Humidity 45~75%RH, 12 Month max.
  4. Derate linearly to 0.5W at 125°C.
- Permanent damage may occur if any of these limits are exceeded.

### CONFIGURATION J



\*Internal open circuit





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# TCW4-262+

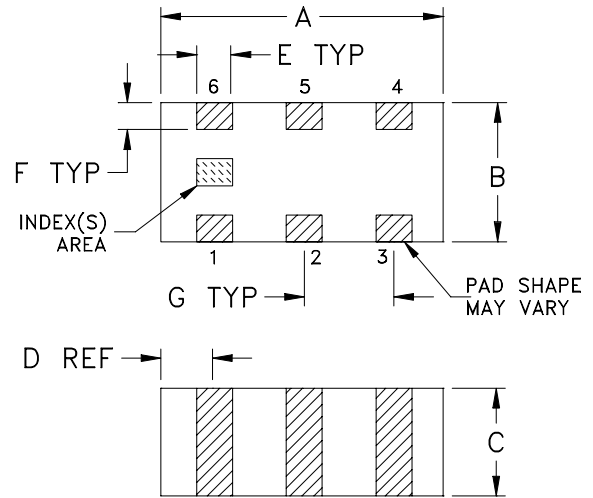


50Ω 2300 to 2600 MHz 1:4 Ratio

### PAD CONNECTIONS

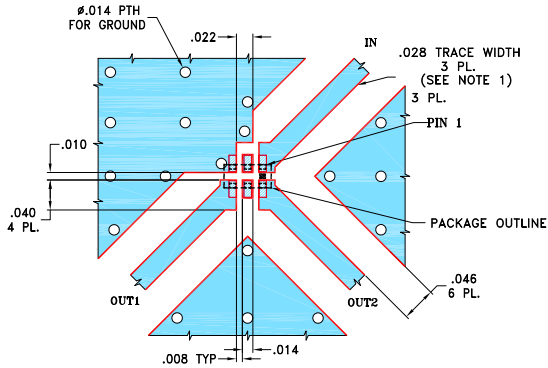
|                          |     |
|--------------------------|-----|
| PRIMARY DOT              | 1   |
| GND or DC feed           | 3   |
| SECONDARY DOT (Balanced) | 4   |
| SECONDARY (Balanced)     | 6   |
| NO CONNECTION            | 2,5 |

### OUTLINE DRAWING



PRODUCT MARKING: N/A

### DEMO BOARD MCL P/N: TB-TCW4-262+ SUGGESTED PCB LAYOUT (PL-559)



**NOTES:**

- TRACE WIDTH IS SHOWN FOR FR4, GRADE IT-180TC (ITEQ CORP.) WITH DIELECTRIC THICKNESS .016±.0015. COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH & GAP MAY NEED TO BE MODIFIED.
  - 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.

### OUTLINE DIMENSIONS (Inches mm)

| A    | B    | C    | D    | E    | F    | G    | wt    |
|------|------|------|------|------|------|------|-------|
| .063 | .031 | .024 | .012 | .008 | .006 | .020 | grams |
| 1.60 | 0.79 | 0.61 | 0.30 | 0.20 | 0.15 | 0.51 | 0.005 |

### TAPE & REEL INFORMATION: F114





# CERAMIC BALUN

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# TCW4-262+

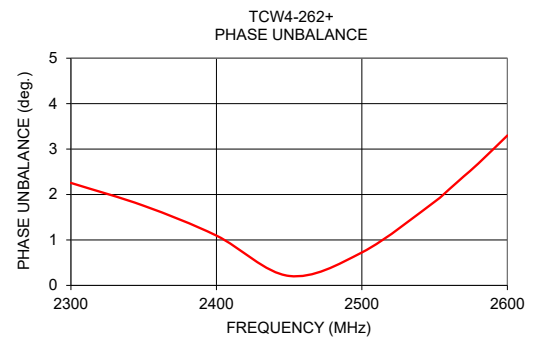
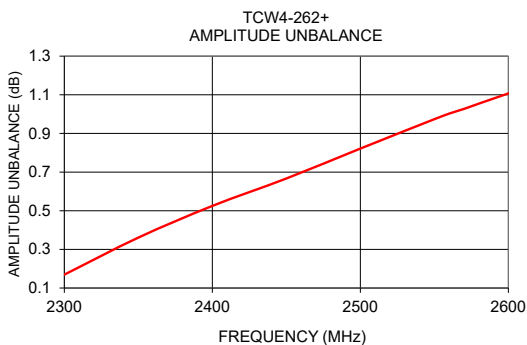
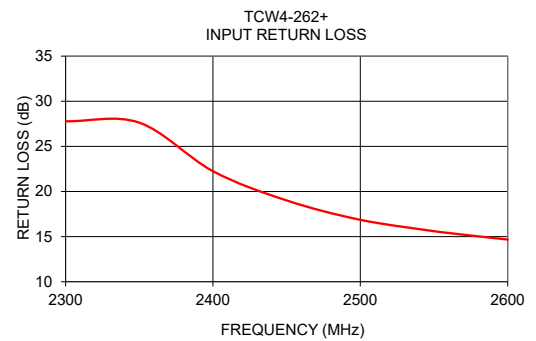
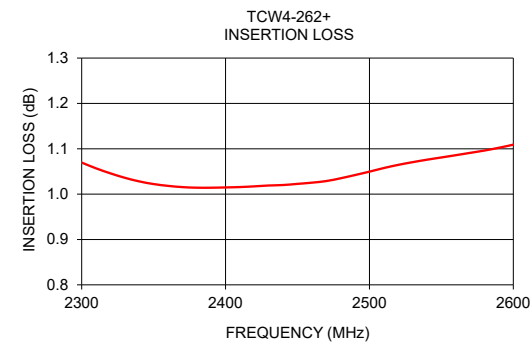


50Ω 2300 to 2600 MHz 1:4 Ratio

### TYPICAL PERFORMANCE DATA<sup>5</sup>

| Frequency (MHz) | Insertion Loss (dB) | Input Return Loss (dB) | Amplitude Unbalance (dB) | Phase Unbalance (deg) |
|-----------------|---------------------|------------------------|--------------------------|-----------------------|
| 2300            | 1.07                | 27.78                  | 0.17                     | 2.26                  |
| 2350            | 1.02                | 27.63                  | 0.36                     | 1.75                  |
| 2400            | 1.01                | 22.25                  | 0.52                     | 1.10                  |
| 2450            | 1.02                | 19.01                  | 0.67                     | 0.21                  |
| 2500            | 1.05                | 16.86                  | 0.82                     | 0.72                  |
| 2550            | 1.08                | 15.60                  | 0.97                     | 1.84                  |
| 2560            | 1.09                | 15.40                  | 1.00                     | 2.12                  |
| 2570            | 1.09                | 15.21                  | 1.03                     | 2.40                  |
| 2580            | 1.10                | 15.03                  | 1.05                     | 2.68                  |
| 2600            | 1.11                | 14.68                  | 1.11                     | 3.30                  |

5. Measured with Agilent N5242A network analyzer using impedance conversion and port extension.



- 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.
  - 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](http://www.minicircuits.com/terms/viewterm.html)



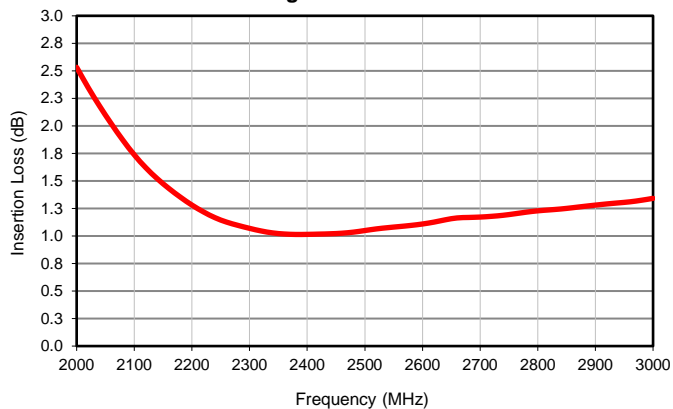
## Typical Performance Data

| FREQUENCY<br>(MHz) | AVERAGE<br>INSERTION LOSS<br>(dB) | INPUT<br>RETURN LOSS<br>(dB) | AMPLITUDE<br>UNBALANCE<br>(dB) | PHASE<br>UNBALANCE <sup>(1)</sup><br>(deg.) |
|--------------------|-----------------------------------|------------------------------|--------------------------------|---|
| 2000               | 2.53                              | 7.19                         | 1.25                           | 2.90  |
| 2020               | 2.35                              | 7.78                         | 1.13                           | 2.96  |
| 2040               | 2.18                              | 8.40                         | 1.01                           | 3.00  |
| 2060               | 2.02                              | 9.09                         | 0.91                           | 3.04  |
| 2080               | 1.87                              | 9.84                         | 0.80                           | 3.07  |
| 2100               | 1.74                              | 10.69                        | 0.70                           | 3.08  |
| 2120               | 1.62                              | 11.62                        | 0.59                           | 3.08  |
| 2140               | 1.52                              | 12.63                        | 0.49                           | 3.06  |
| 2160               | 1.43                              | 13.74                        | 0.40                           | 3.02  |
| 2180               | 1.35                              | 14.96                        | 0.30                           | 2.97  |
| 2200               | 1.28                              | 16.36                        | 0.21                           | 2.92  |
| 2220               | 1.22                              | 18.00                        | 0.13                           | 2.84  |
| 2240               | 1.17                              | 19.93                        | 0.05                           | 2.74  |
| 2260               | 1.13                              | 22.20                        | 0.02                           | 2.61  |
| 2280               | 1.10                              | 24.87                        | 0.09                           | 2.45  |
| 2300               | 1.07                              | 27.78                        | 0.17                           | 2.26  |
| 2320               | 1.05                              | 29.76                        | 0.24                           | 2.06  |
| 2340               | 1.03                              | 28.82                        | 0.32                           | 1.87  |
| 2360               | 1.02                              | 26.33                        | 0.40                           | 1.64  |
| 2380               | 1.01                              | 24.06                        | 0.46                           | 1.39  |
| 2400               | 1.01                              | 22.25                        | 0.52                           | 1.10  |
| 2420               | 1.02                              | 20.79                        | 0.58                           | 0.75  |
| 2440               | 1.02                              | 19.55                        | 0.64                           | 0.39  |
| 2460               | 1.03                              | 18.49                        | 0.70                           | 0.02  |
| 2480               | 1.03                              | 17.60                        | 0.76                           | 0.34  |
| 2500               | 1.05                              | 16.86                        | 0.82                           | 0.72  |
| 2520               | 1.06                              | 16.28                        | 0.89                           | 1.14  |
| 2540               | 1.08                              | 15.81                        | 0.95                           | 1.59  |
| 2560               | 1.09                              | 15.40                        | 1.00                           | 2.12  |
| 2580               | 1.10                              | 15.03                        | 1.05                           | 2.68  |
| 2600               | 1.11                              | 14.68                        | 1.11                           | 3.30  |
| 2620               | 1.13                              | 14.37                        | 1.17                           | 3.94  |
| 2640               | 1.15                              | 14.14                        | 1.23                           | 4.58  |
| 2660               | 1.16                              | 13.98                        | 1.31                           | 5.16  |
| 2680               | 1.17                              | 13.82                        | 1.38                           | 5.71  |
| 2700               | 1.17                              | 13.68                        | 1.44                           | 6.31  |
| 2720               | 1.18                              | 13.55                        | 1.51                           | 6.99  |
| 2740               | 1.19                              | 13.43                        | 1.58                           | 7.75  |
| 2760               | 1.20                              | 13.37                        | 1.65                           | 8.54  |
| 2780               | 1.22                              | 13.35                        | 1.73                           | 9.33  |
| 2800               | 1.23                              | 13.35                        | 1.81                           | 10.10                                       |
| 2820               | 1.24                              | 13.36                        | 1.90                           | 10.85                                       |
| 2840               | 1.25                              | 13.36                        | 1.98                           | 11.58                                       |
| 2860               | 1.26                              | 13.36                        | 2.07                           | 12.31                                       |
| 2880               | 1.27                              | 13.39                        | 2.17                           | 13.08                                       |
| 2900               | 1.28                              | 13.47                        | 2.27                           | 13.84                                       |
| 2920               | 1.29                              | 13.59                        | 2.37                           | 14.60                                       |
| 2940               | 1.30                              | 13.73                        | 2.47                           | 15.38                                       |
| 2960               | 1.31                              | 13.84                        | 2.58                           | 16.17                                       |
| 2980               | 1.32                              | 13.92                        | 2.69                           | 16.95                                       |
| 3000               | 1.34                              | 13.99                        | 2.81                           | 17.67                                       |

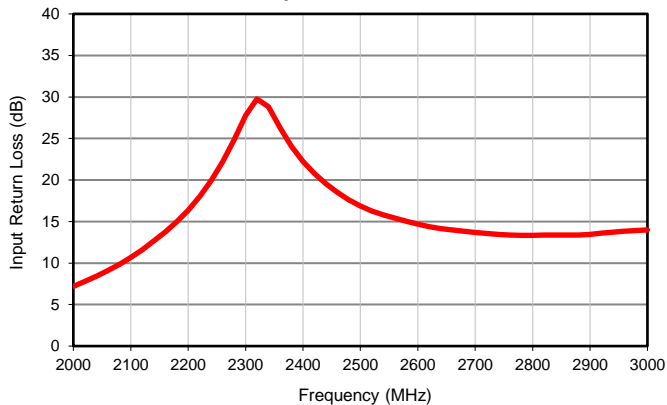
<sup>(1)</sup> Relative to 180°

## Typical Performance Data

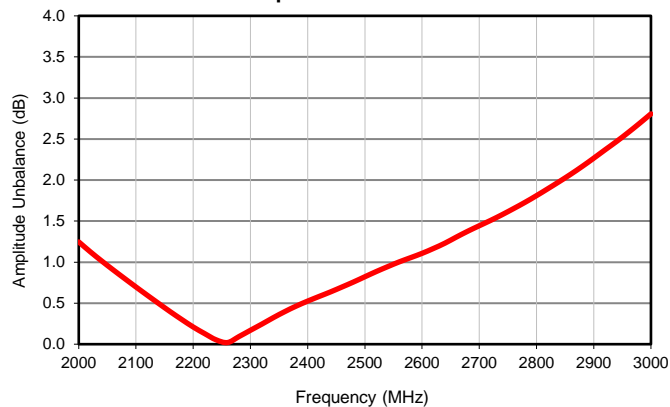
### Average Insertion Loss



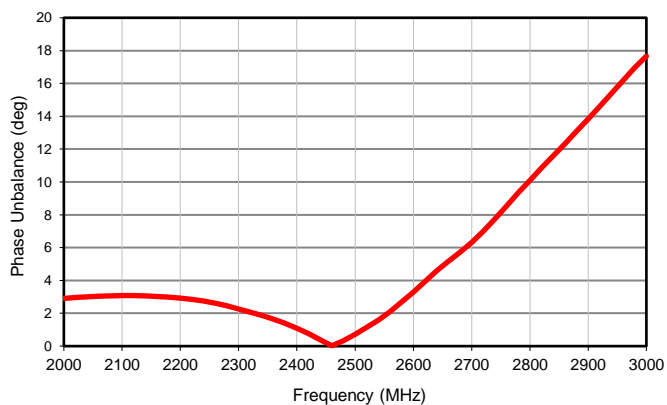
### Input Return Loss



### Amplitude Unbalance



### Phase Unbalance

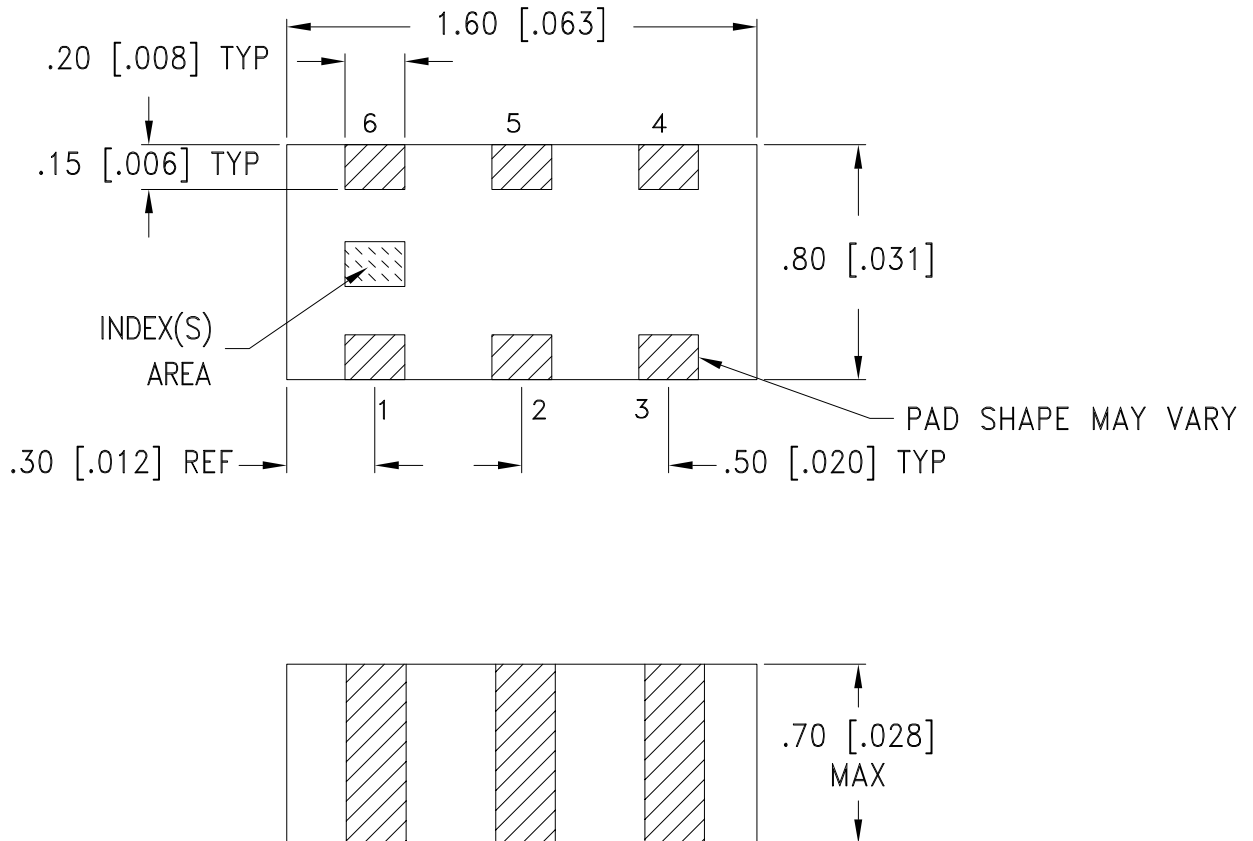


# Case Style

JC

## Outline Dimensions

JC0603C



Weight: .005 grams

Dimensions are in mm [inch]. Tolerances:  $\pm 0.13$  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](http://www.minicircuits.com/pages/pdfs/tape.pdf)



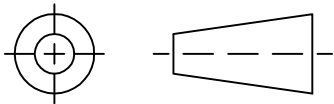
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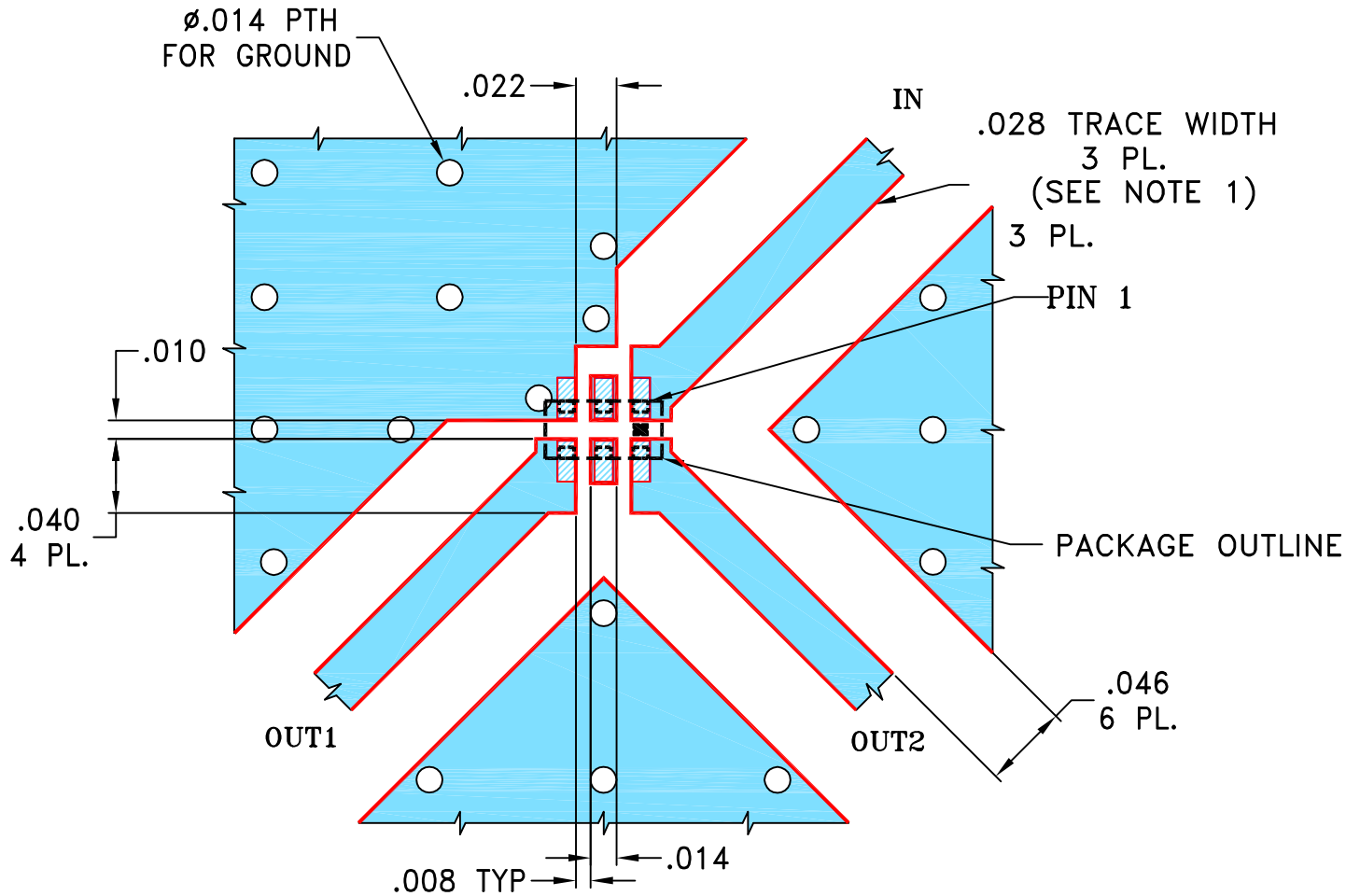
THIRD ANGLE PROJECTION



REVISIONS



| REV | ECN No. | DESCRIPTION | DATE     | DR | AUTH |
|-----|---------|-------------|----------|----|------|
| OR  | M168200 | NEW RELEASE | 05/31/18 | NP | SL   |
|     |         |             |          |    |      |
|     |         |             |          |    |      |

**SUGGESTED MOUNTING CONFIGURATION  
FOR JC0603C CASE STYLE, "06TJ06" PIN CODE**




**NOTES:**

1. TRACE WIDTH IS SHOWN FOR FR4, GRADE IT-180TC (ITEQ CORP.) WITH DIELECTRIC THICKNESS  $.016 \pm .0015$ . 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.

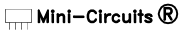
-  DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER).
-  DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK.

| UNLESS OTHERWISE SPECIFIED | INITIALS | DATE     |
|----------------------------|----------|----------|
| DRAWN                      | NP       | 05/30/18 |
| CHECKED                    | GF       | 05/30/18 |
| APPROVED                   | SL       | 05/31/18 |

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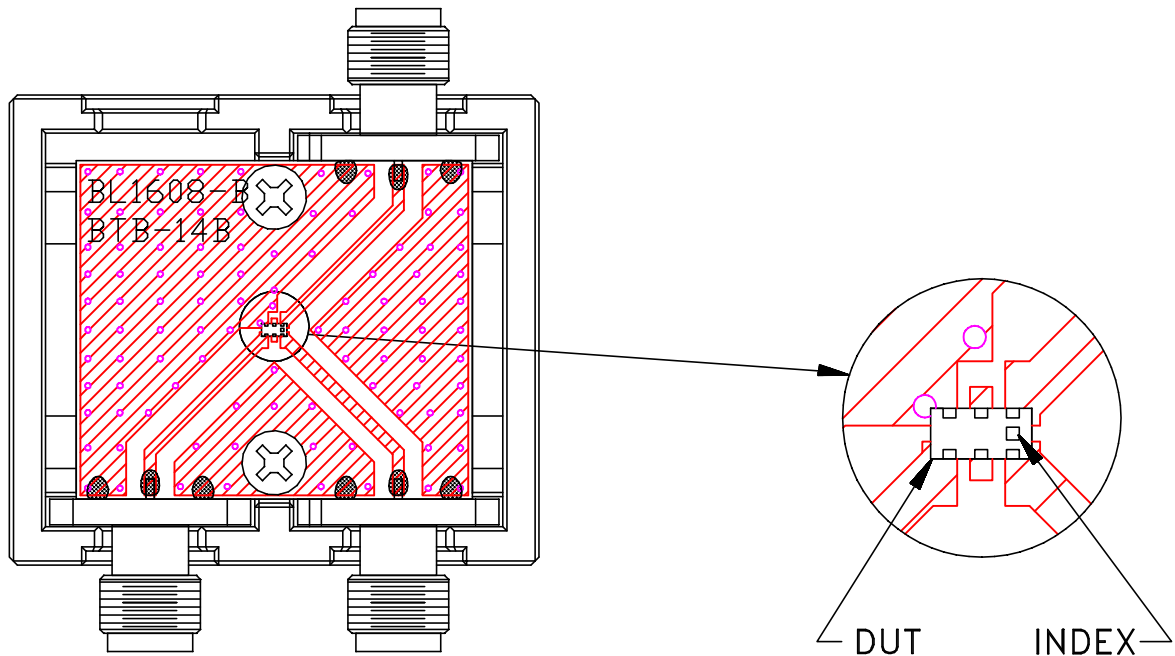
**PL, 06TJ06, JC0603C, TB-1013+**

|                  |                     |                          |            |
|------------------|---------------------|--------------------------|------------|
| SIZE<br>A        | CODE IDENT<br>15542 | DRAWING NO:<br>98-PL-559 | REV:<br>OR |
| FILE:<br>98PL559 | SCALE:<br>10:1      | SHEET:<br>1 OF 1         |            |

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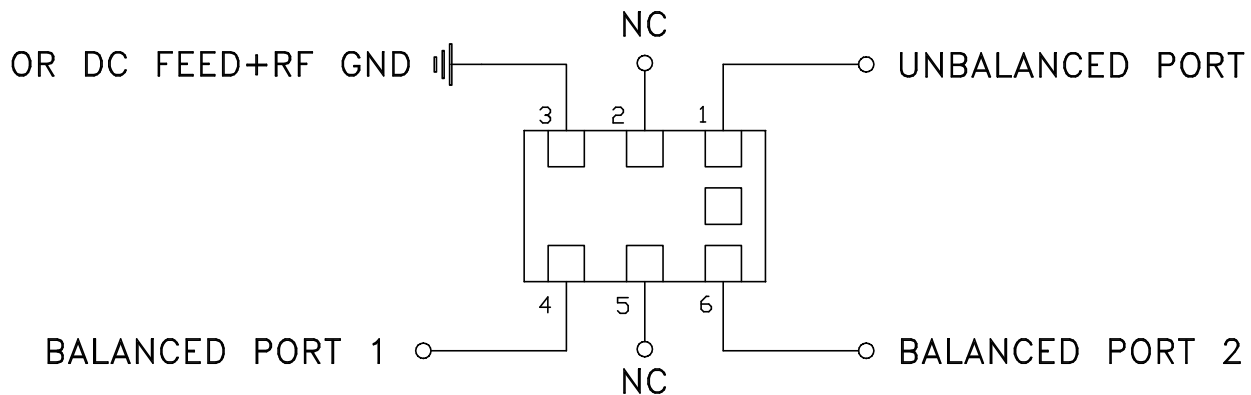
# Evaluation Board and Circuit

UNBALANCED PORT



BALANCED PORT 1      BALANCED PORT 2

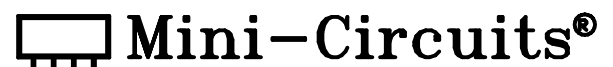
TB-1013+



Schematic Diagram

**Notes:**

1. 50 Ohm SMA Female connectors.
2. PCB Material: FR4 or equivalent,  
Dielectric Constant=4.5, Thickness=.016 inch.





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<br>Ambient Environment   | Individual Model Data Sheet  |
| Storage Temperature        | -55° to 125° 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 |
| Solder Reflow Heat         | Sn-Pb Eutectic Process: 225°C peak<br>Pb-Free Process: 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   |