# 2 Way-90° Power Splitter

## QCS-152+

50Ω 820 to 1600 MHz

CASE STYLE: GE0805C-1

## The Big Deal

- High Power handling (15W)
- Low Unbalance, 0.5 dB & 4 deg. typ.
- Industry leading combination of size/bandwidth

## Product Overview

Mini-Circuits new 90° Power Splitter, model: QCS-152+, offers an industry leading combination of operating bandwidth and size; supporting nearly an octave band in a miniature EIA-0805 form factor. The outstanding phase and amplitude unbalance make this component a versatile building block for use in a variety of systems and sub-system designs.

## Key Features

| Feature | Advantages |
|---|---|
| Small Size | Offered in the EIA-0805 package size, the QCS-152+ offers an industry leading combination of size, bandwidth and frequency. The small footprint (2.0mm x1.25mm) allows for reduced parasitics in systems with improved performance and simplified layout. |
| Low Phase and Amplitude Unbalance | Supporting 4 deg. and 0.5 dB unbalance make this 90° hybrid applicable for use in higher level integrated components such as image reject mixers, single sideband modulators, phase shifters, variable attenuators, and balance amplifiers. |
| High Power Handling | Capable of operating up to 15W, the LTCC construction of the QCS-152+ makes this 90° hybrid a robust, rugged product that can be used effectively in either the transmit or receive paths. |

Notes
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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/MCLStore/terms.jsp

*Ultra-Small Ceramic LTCC*

# Power Splitter/Combiner

## QCS-152+

2 Way-90° 50Ω 820 to 1600 MHz

*Generic photo used for illustration purposes only*

CASE STYLE: GE0805C-1

**+RoHS Compliant**

*The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications*

*Available Tape and Reel at no extra cost*

| Reel Size | Devices/Reel |
|---|---|
| 7" | 20, 50, 100, 200, 500,1000, 2000 |

### Maximum Ratings

| | |
|---|---|
| Operating Temperature | -55°C to 100°C |
| Storage Temperature | -55°C to 100°C |
| Power Input (as a splitter) | 15W* max. |

*Derate linearly to 7W at 100°C ambient.

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

### Pin Connections

| | |
|---|---|
| SUM PORT | 1 |
| PORT 1 (0°) | 4 |
| PORT 2 (+90°) | 6 |
| GROUND | 2,5 |
| 50 OHM TERM EXTERNAL | 3 |

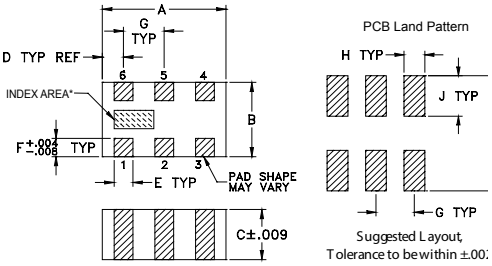
### Features

- Low insertion loss, 0.5 dB typ.
- High isolation, 19 dB typ.
- Miniature size, 0.079"x0.049"x0.033"
- LTCC construction
- High power

### Applications

- Balanced amplifiers
- Modulators
- DCS, PCS, UMTS
- WiMax
- WiFi • ISM
- Phase Shifter
- Attenuator
- Point to Point

### Outline Drawing




### Outline Dimensions (inch / mm)

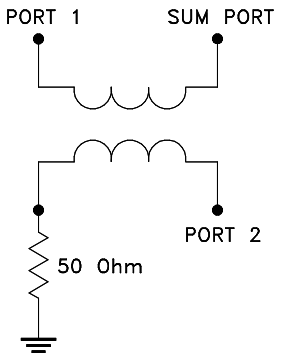
| A | B | C | D | E | F |
|---|---|---|---|---|---|
| .079 | .049 | .033 | .014 | .012 | .012 |
| 2.01 | 1.24 | 0.84 | 0.36 | 0.30 | 0.30 |

| G | H | J | K | wt |
|---|---|---|---|---|
| .026 | .014 | .039 | .110 | grams |
| 0.66 | 0.36 | 1.00 | 2.80 | .008 |

### Electrical Specifications at 25°C

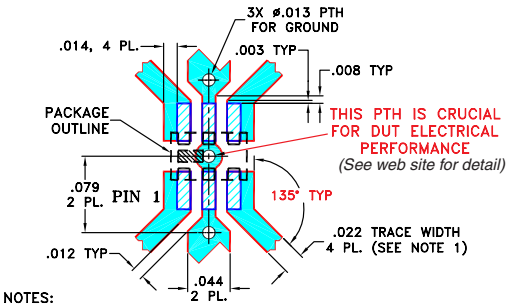
| Parameter | Frequency (MHz) | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| **Frequency** | | 820 | | 1600 | MHz |
| **Insertion Loss (Avg. Of Coupled Outputs) above 3 dB** | 820-1000 | — | 0.5 | 0.8 | dB |
| | 1000-1200 | — | 0.5 | 0.7 | |
| | 1200-1400 | — | 0.5 | 0.7 | |
| | 1400-1600 | — | 0.6 | 0.9 | |
| **Isolation** | 820-1000 | 15 | 17 | — | dB |
| | 1000-1200 | 16 | 19 | — | |
| | 1200-1400 | 17 | 20 | — | |
| | 1400-1600 | 18 | 21 | — | |
| **Phase Unbalance** | 820-1000 | — | 5 | 7 | Degree |
| | 1000-1200 | — | 4 | 6 | |
| | 1200-1400 | — | 4 | 6 | |
| | 1400-1600 | — | 3 | 5 | |
| **Amplitude Unbalance** | 820-1000 | — | 1.0 | 1.5 | dB |
| | 1000-1200 | — | 0.5 | 0.8 | |
| | 1200-1400 | — | 0.5 | 0.8 | |
| | 1400-1600 | — | 1.0 | 1.5 | |
| **VSWR (Port S)** | 820-1600 | — | 1.3 | 1.5 | :1 |
| **VSWR (Port 1-2)** | 820-1600 | — | 1.4 | 1.6 | :1 |

### Electrical Schematic




***Demo Board MCL P/N: TB-489-152+***

***Suggested PCB Layout (PL-304)***




NOTES:

1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010" ± .001"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH 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

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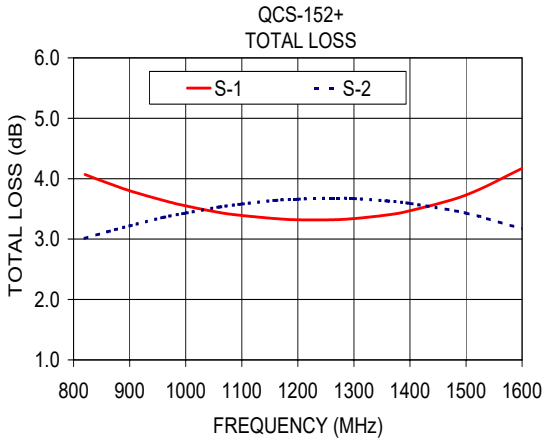
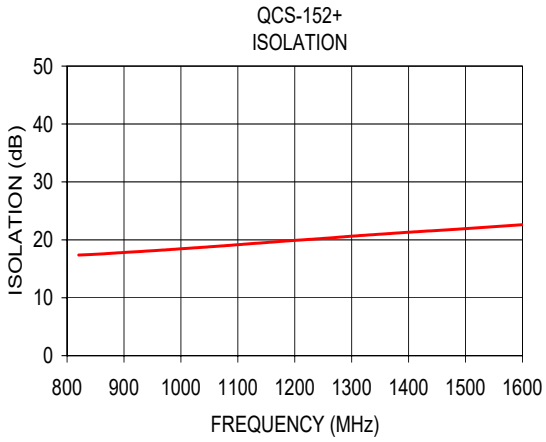
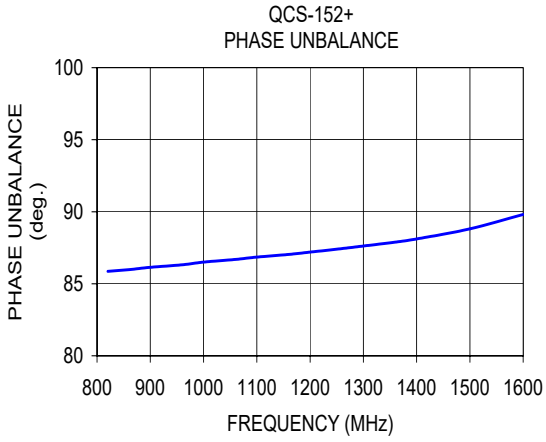
## Typical Performance Data

| Frequency (MHz) | Total Loss[1] (dB) | | Amplitude Unbalance (dB) | Isolation (dB) | Phase Unbalance (deg.) | VSWR S | VSWR 1 | VSWR 2 |
|---|---|---|---|---|---|---|---|---|
| | S-1 | S-2 | | | | | | |
| 820.00 | 4.07 | 3.01 | 1.06 | 17.36 | 85.86 | 1.32 | 1.34 | 1.40 |
| 860.00 | 3.93 | 3.12 | 0.81 | 17.57 | 85.98 | 1.31 | 1.32 | 1.39 |
| 900.00 | 3.80 | 3.22 | 0.58 | 17.81 | 86.14 | 1.29 | 1.31 | 1.37 |
| 960.00 | 3.64 | 3.36 | 0.28 | 18.18 | 86.32 | 1.26 | 1.30 | 1.36 |
| 1000.00 | 3.55 | 3.43 | 0.11 | 18.45 | 86.50 | 1.24 | 1.29 | 1.34 |
| 1060.00 | 3.44 | 3.53 | 0.09 | 18.87 | 86.69 | 1.22 | 1.28 | 1.33 |
| 1100.00 | 3.39 | 3.58 | 0.19 | 19.16 | 86.85 | 1.20 | 1.27 | 1.32 |
| 1160.00 | 3.34 | 3.64 | 0.30 | 19.60 | 87.04 | 1.18 | 1.27 | 1.30 |
| 1200.00 | 3.32 | 3.66 | 0.35 | 19.91 | 87.20 | 1.17 | 1.27 | 1.29 |
| 1260.00 | 3.32 | 3.68 | 0.36 | 20.32 | 87.44 | 1.15 | 1.27 | 1.28 |
| 1300.00 | 3.34 | 3.67 | 0.33 | 20.64 | 87.62 | 1.14 | 1.28 | 1.28 |
| 1360.00 | 3.40 | 3.63 | 0.23 | 21.03 | 87.89 | 1.12 | 1.29 | 1.27 |
| 1400.00 | 3.47 | 3.59 | 0.13 | 21.32 | 88.11 | 1.12 | 1.30 | 1.28 |
| 1500.00 | 3.73 | 3.43 | 0.30 | 21.94 | 88.81 | 1.11 | 1.32 | 1.29 |
| 1600.00 | 4.17 | 3.17 | 0.99 | 22.61 | 89.81 | 1.12 | 1.36 | 1.34 |

1. Total Loss = Insertion Loss + 3dB splitter loss.

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# 2 Way-90° Power Splitter/Combiner QCS-152+

## *Typical Performance Data*

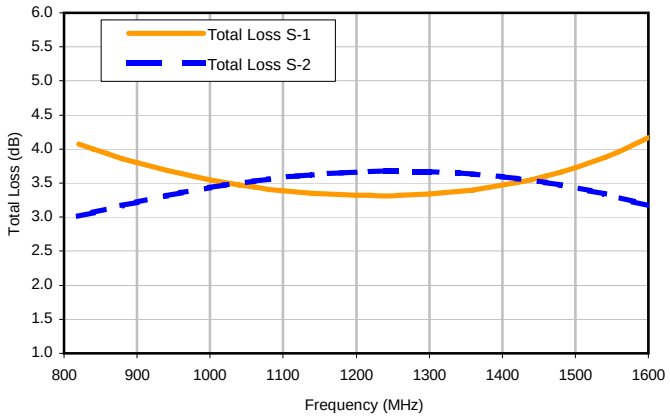
| FREQ. (MHz) | TOTAL LOSS[1] (dB) S-1 | TOTAL LOSS[1] (dB) S-2 | AMP. UNBAL. (dB) | ISOLATION (dB) 1-2 | PHASE UNBAL. (Deg.) | FREQ. (MHz) | VSWR (:1) S | VSWR (:1) 1 | VSWR (:1) 2 |
|---|---|---|---|---|---|---|---|---|---|
| 820.0 | 4.07 | 3.01 | 1.06 | 17.36 | 85.86 | 820.0 | 1.32 | 1.34 | 1.40 |
| 840.0 | 4.00 | 3.07 | 0.93 | 17.46 | 85.93 | 840.0 | 1.32 | 1.33 | 1.40 |
| 860.0 | 3.93 | 3.12 | 0.81 | 17.57 | 85.98 | 860.0 | 1.31 | 1.32 | 1.39 |
| 880.0 | 3.86 | 3.17 | 0.69 | 17.69 | 86.06 | 880.0 | 1.30 | 1.32 | 1.38 |
| 900.0 | 3.80 | 3.22 | 0.58 | 17.81 | 86.14 | 900.0 | 1.29 | 1.31 | 1.37 |
| 920.0 | 3.74 | 3.27 | 0.47 | 17.94 | 86.21 | 920.0 | 1.28 | 1.31 | 1.37 |
| 940.0 | 3.69 | 3.31 | 0.38 | 18.06 | 86.27 | 940.0 | 1.27 | 1.30 | 1.37 |
| 960.0 | 3.64 | 3.36 | 0.28 | 18.18 | 86.32 | 960.0 | 1.26 | 1.30 | 1.36 |
| 980.0 | 3.59 | 3.40 | 0.20 | 18.32 | 86.41 | 980.0 | 1.26 | 1.29 | 1.35 |
| 1000.0 | 3.55 | 3.43 | 0.11 | 18.45 | 86.50 | 1000.0 | 1.24 | 1.29 | 1.34 |
| 1020.0 | 3.51 | 3.47 | 0.04 | 18.59 | 86.58 | 1020.0 | 1.23 | 1.28 | 1.34 |
| 1040.0 | 3.47 | 3.50 | 0.03 | 18.72 | 86.65 | 1040.0 | 1.23 | 1.28 | 1.33 |
| 1060.0 | 3.44 | 3.53 | 0.09 | 18.87 | 86.69 | 1060.0 | 1.22 | 1.28 | 1.33 |
| 1080.0 | 3.41 | 3.56 | 0.14 | 19.01 | 86.77 | 1080.0 | 1.21 | 1.28 | 1.32 |
| 1100.0 | 3.39 | 3.58 | 0.19 | 19.16 | 86.85 | 1100.0 | 1.20 | 1.27 | 1.32 |
| 1120.0 | 3.37 | 3.60 | 0.24 | 19.31 | 86.93 | 1120.0 | 1.20 | 1.27 | 1.31 |
| 1140.0 | 3.35 | 3.62 | 0.27 | 19.45 | 87.00 | 1140.0 | 1.19 | 1.27 | 1.30 |
| 1160.0 | 3.34 | 3.64 | 0.30 | 19.60 | 87.04 | 1160.0 | 1.18 | 1.27 | 1.30 |
| 1180.0 | 3.33 | 3.65 | 0.33 | 19.76 | 87.13 | 1180.0 | 1.17 | 1.27 | 1.30 |
| 1200.0 | 3.32 | 3.66 | 0.35 | 19.91 | 87.20 | 1200.0 | 1.17 | 1.27 | 1.29 |
| 1220.0 | 3.32 | 3.67 | 0.36 | 20.05 | 87.28 | 1220.0 | 1.16 | 1.27 | 1.29 |
| 1240.0 | 3.31 | 3.68 | 0.36 | 20.18 | 87.37 | 1240.0 | 1.15 | 1.27 | 1.28 |
| 1260.0 | 3.32 | 3.68 | 0.36 | 20.32 | 87.44 | 1260.0 | 1.15 | 1.27 | 1.28 |
| 1280.0 | 3.33 | 3.67 | 0.35 | 20.48 | 87.54 | 1280.0 | 1.14 | 1.28 | 1.28 |
| 1300.0 | 3.34 | 3.67 | 0.33 | 20.64 | 87.62 | 1300.0 | 1.14 | 1.28 | 1.28 |
| 1320.0 | 3.36 | 3.66 | 0.31 | 20.78 | 87.71 | 1320.0 | 1.13 | 1.28 | 1.27 |
| 1340.0 | 3.38 | 3.65 | 0.27 | 20.91 | 87.81 | 1340.0 | 1.13 | 1.28 | 1.27 |
| 1360.0 | 3.40 | 3.63 | 0.23 | 21.03 | 87.89 | 1360.0 | 1.12 | 1.29 | 1.27 |
| 1380.0 | 3.43 | 3.61 | 0.18 | 21.18 | 88.01 | 1380.0 | 1.12 | 1.29 | 1.27 |
| 1400.0 | 3.47 | 3.59 | 0.13 | 21.32 | 88.11 | 1400.0 | 1.12 | 1.30 | 1.28 |
| 1420.0 | 3.51 | 3.57 | 0.06 | 21.45 | 88.22 | 1420.0 | 1.12 | 1.30 | 1.28 |
| 1440.0 | 3.55 | 3.54 | 0.01 | 21.56 | 88.36 | 1440.0 | 1.11 | 1.30 | 1.28 |
| 1460.0 | 3.60 | 3.51 | 0.10 | 21.67 | 88.48 | 1460.0 | 1.11 | 1.31 | 1.28 |
| 1480.0 | 3.66 | 3.47 | 0.19 | 21.81 | 88.65 | 1480.0 | 1.11 | 1.32 | 1.29 |
| 1500.0 | 3.73 | 3.43 | 0.30 | 21.94 | 88.81 | 1500.0 | 1.11 | 1.32 | 1.29 |
| 1520.0 | 3.80 | 3.39 | 0.41 | 22.08 | 88.97 | 1520.0 | 1.11 | 1.33 | 1.30 |
| 1540.0 | 3.88 | 3.34 | 0.54 | 22.21 | 89.16 | 1540.0 | 1.11 | 1.33 | 1.31 |
| 1560.0 | 3.96 | 3.29 | 0.68 | 22.33 | 89.33 | 1560.0 | 1.11 | 1.34 | 1.32 |
| 1580.0 | 4.06 | 3.23 | 0.83 | 22.46 | 89.57 | 1580.0 | 1.12 | 1.35 | 1.33 |
| 1600.0 | 4.17 | 3.17 | 0.99 | 22.61 | 89.81 | 1600.0 | 1.12 | 1.36 | 1.34 |

[1]Total Loss = Insertion Loss + 3dB Splitter Loss

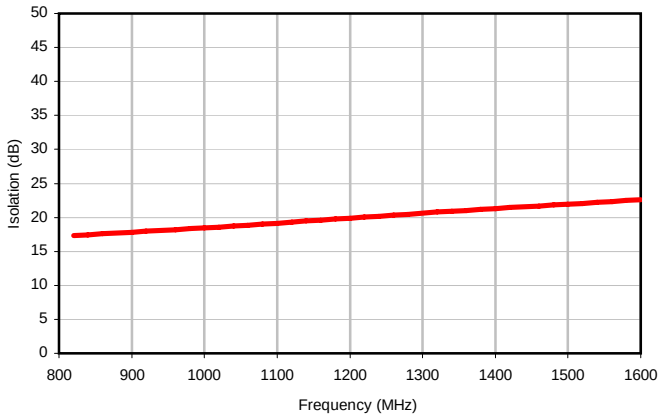
# 2 Way-90° Power Splitter/Combiner QCS-152+

## *Typical Performance Curves*

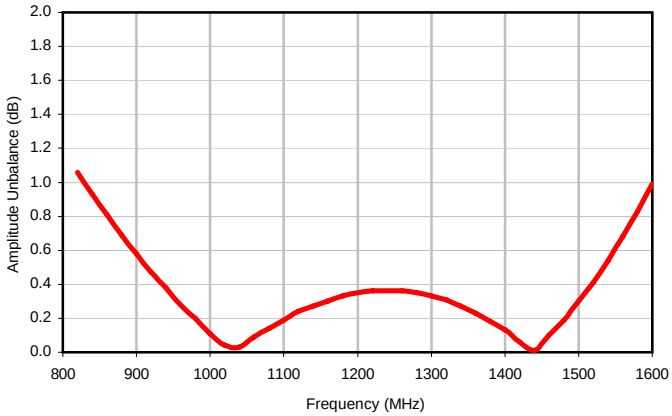
**Total Loss**



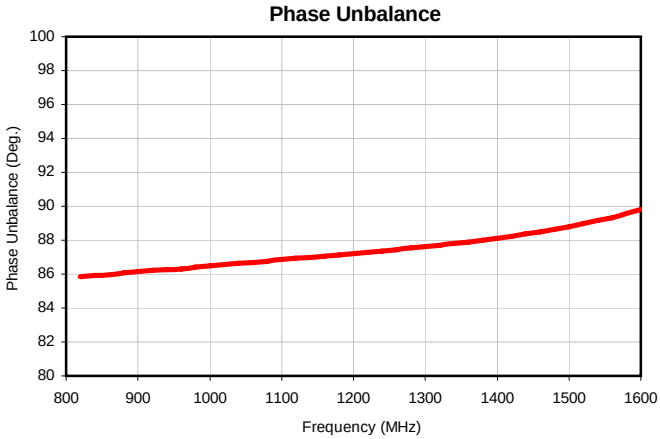

**Isolation**



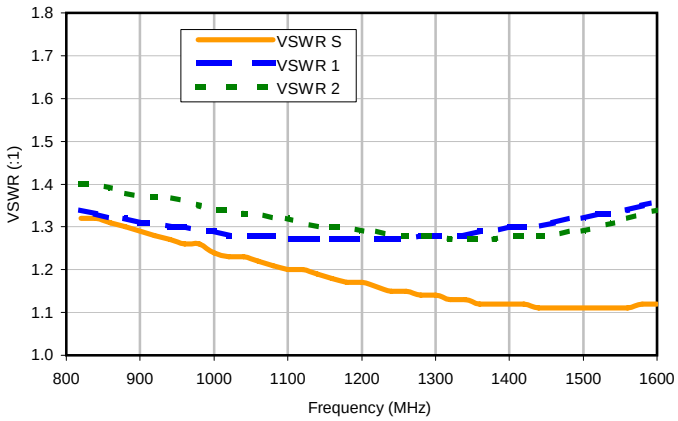

**Amplitude Unbalance**




**Phase Unbalance**

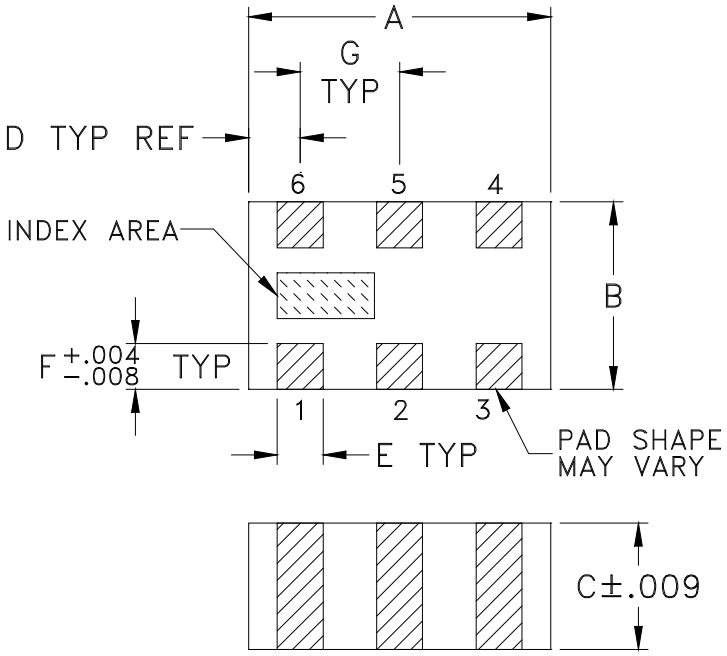



**VSWR**

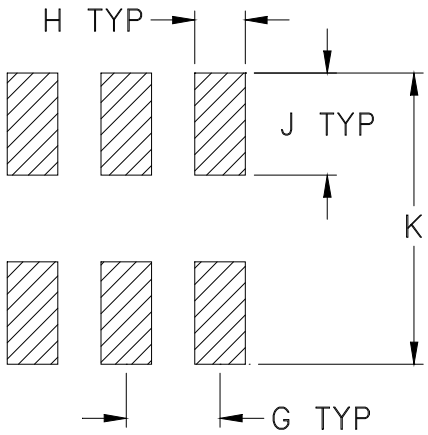


**GE0805C-1**

## Outline Dimensions




### PCB Land Pattern




Suggested Layout,
Tolerance to be within ±.002

| CASE # | A | B | C | D | E | F | G | H | J | K | WT. GRAM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GE0805C-1 | .079 (2.00) | .049 (1.25) | .033 (0.84) | .014 (0.35) | .012 (0.30) | .012 (0.30) | .026 (0.65) | .014 (0.35) | .039 (1.00) | .110 (2.80) | .008 |

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

**Notes:**

1. Open style, ceramic base.
2. Termination finish: For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.
   For RoHS-5 Case Style: Tin-lead plate. All models, no (+) suffix.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# Tape & Reel Packaging TR-F74

## DEVICE ORIENTATION IN T&R

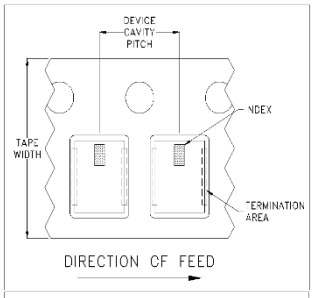


**ILLUSTRATION 1**

| Applicable Case Styles |
|---|
| GE0805C-1 |
| GE0805C-1AP |
| JV1210C-1 |
| GU2939 |

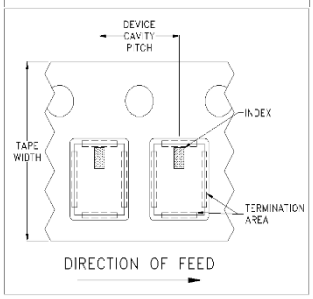


**ILLUSTRATION 2**

| Applicable Case Styles |
|---|
| JV1210C |
| JV1210C-2 |
| JV1210C-3 |
| JV1210C-4 |
| JV1210C-5 |
| JV1210C-6 |
| JV1210C-11 |

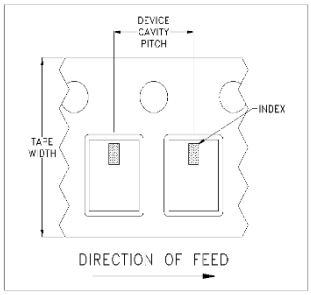


**ILLUSTRATION 3**

| Applicable Case Styles |
|---|
| JC0603C-8 |
| JC0603C-9 |
| JV1210C-7 |
| JV1210C-8 |
| JV1210C-9 |
| JV1210C-10 |
| JV1210C-13 |
| GE0805C-13 |
| GE0805C-19 |
| GE0805C-20 |

| Tape Width, mm | Device Cavity Pitch, mm | Real Size, inches | Devices per Reel | |
|---|---|---|---|---|
| 8 | 4 | 7 | Small quantity standards **(see note)** | 20 |
| | | | | 50 |
| | | | | 100 |
| | | | | 200 |
| | | | | 500 |
| | | | | 1000 |
| | | | Standard | 2000 |
| | | | | 4000 |

Note: Small reel availability varies by model. Refer to pricing and availability on individual model dashboard.

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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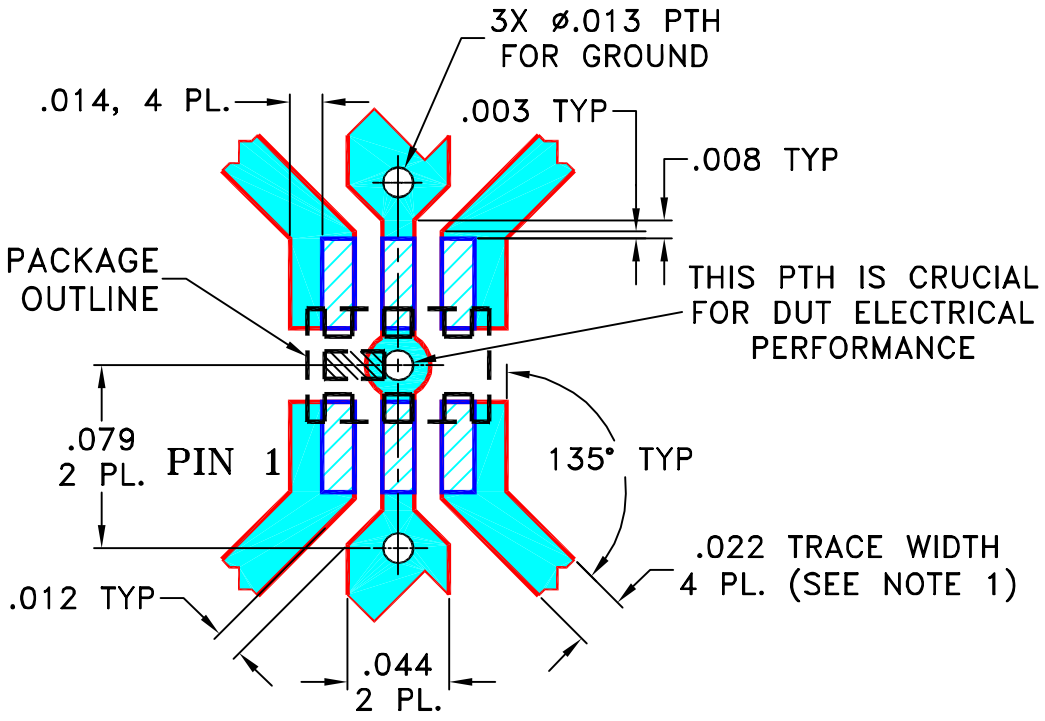
THIRD ANGLE PROJECTION

| REVISIONS | | | | | |
|---|---|---|---|---|---|
| REV | ECN No. | DESCRIPTION | DATE | DR | AUTH |
| OR | M122595 | NEW RELEASE | 04/27/09 | MMG | ABD |

# SUGGESTED MOUNTING CONFIGURATION FOR GE0805C-1 CASE STYLE, "06SQ07" PIN CODE




NOTES:
1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .010" ± .001"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH 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 | MMG | 04/27/09 |
| TOLERANCES ON: | CHECKED | AV | 04/27/09 |
| 2 PL DECIMALS ± | APPROVED | ABD | 04/27/09 |
| 3 PL DECIMALS ± .005 | | | |
| ANGLES ± 1° | | | |
| FRACTIONS ± | | | |

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

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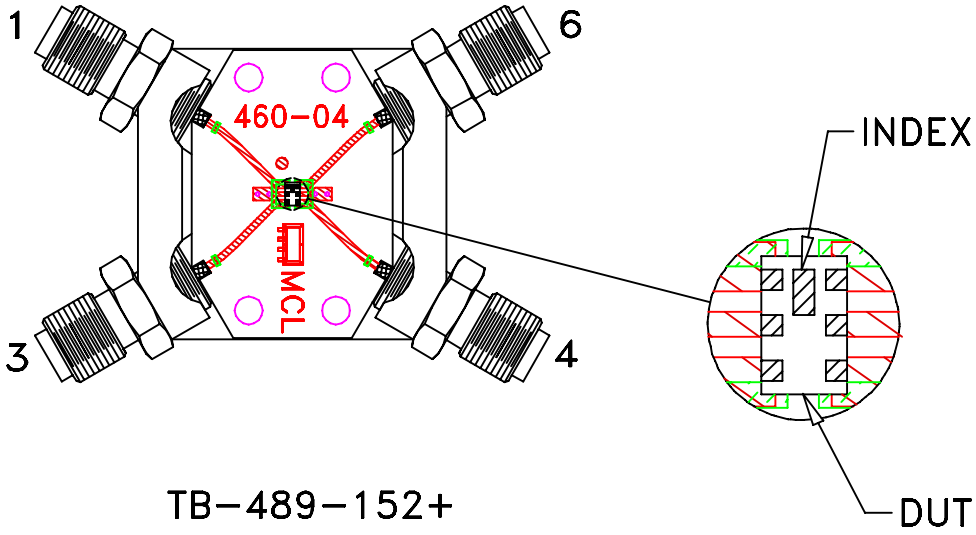
| SIZE | CODE IDENT | DRAWING NO: | REV: |
|---|---|---|---|
| A | 15542 | 98-PL-304 | OR |

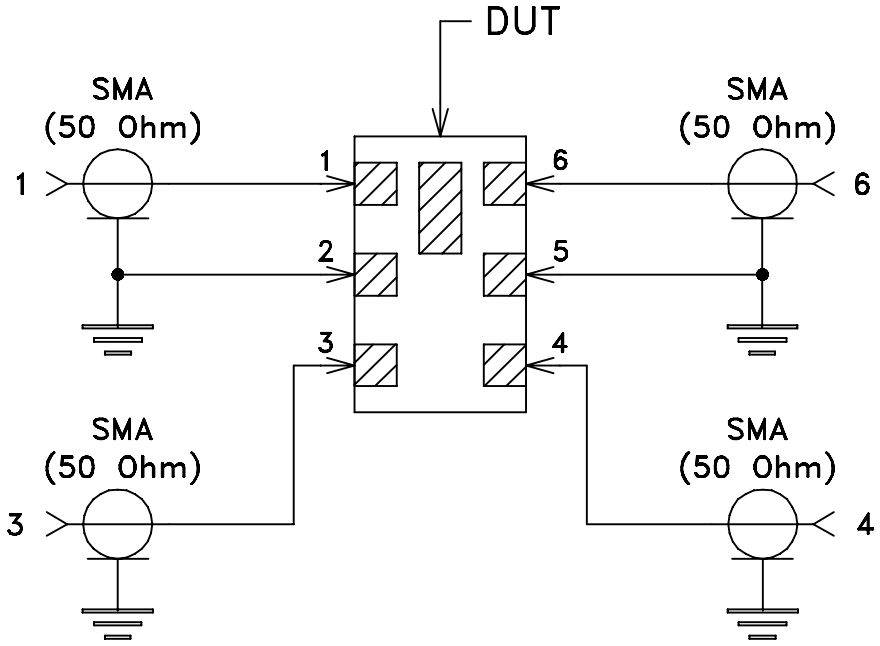
| FILE: | SCALE: | SHEET: |
|---|---|---|
| 98PL304 | 12:1 | 1 OF 1 |

# Evaluation Board and Circuit

For Pin Connections refer to Data Sheet of the DUT




TB-489-152+




Schematic Diagram

## Notes:

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

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# Environmental Specifications ENV28

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 100°C<br>Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 100° C<br>Ambient Environment | Individual Model Data Sheet |
| Barometric Pressure | 100,000 Feet | MIL-STD-202, Method 105, Condition D |
| Humidity | 90% RH, 65°C<br>Units may require bake-out after humidity to restore full performance. | MIL-STD-202, Method 103 |
| Thermal Shock | -65° to 125°C, 5 cycles | MIL-STD-202, Method 107, Condition B |
| 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 | 100g, 6ms sawtooth, 3 shocks each direction 3 axes (total 18) | MIL-STD-202, Method 213, Condition I |


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