

# 2 Way-90° Power Splitter

QCS-312+

50Ω 1700 to 3100 MHz

## The Big Deal

- High Power handling (8W)
- Low Unbalance, 0.5 dB & 4 deg. typ.
- Industry leading combination of size/bandwidth



CASE STYLE: GE0805C-1

## Product Overview

Mini-Circuits new 90° Power Splitter, model: QCS-312+, 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-312+ offers an industry leading combination of size, bandwidth and frequency. The small footprint (2.0mm x 1.25mm) 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 8W, the LTCC construction of the QCS-312+ makes this 90° hybrid a robust, rugged product that can be used effectively in either the transmit or receive paths.                                                                  |

### 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/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)



# Power Splitter/Combiner

QCS-312+

2 Way-90° 50Ω 1700 to 3100 MHz

## Maximum Ratings

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

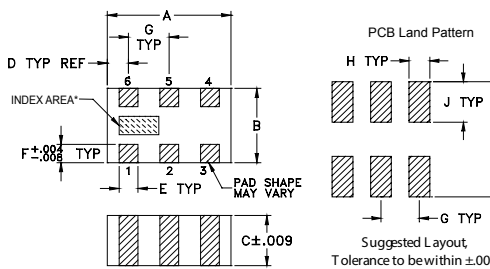
\*Derate linearly to 7W at 100°C ambient.

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   |

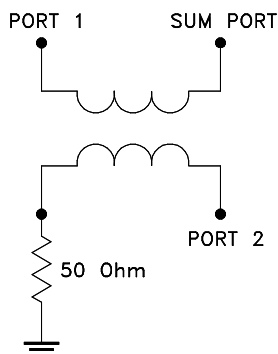
## Outline Drawing



## 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 Schematic



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## Features

- Low insertion loss, 0.5 dB typ.
- High isolation, 25 dB typ.
- Miniature size, 0.079"x0.049"x0.033"
- LTCC construction
- High power

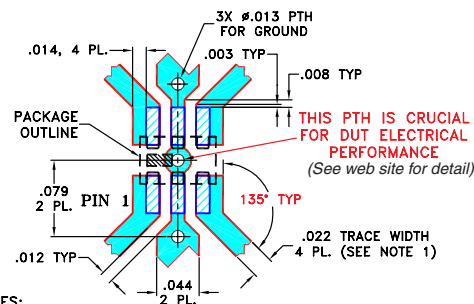
## Applications

- Balanced amplifiers
- Modulators
- DCS, PCS, UMTS
- ISM
- WiMAX
- Phase Shifter
- Attenuator

## Electrical Specifications at 25°C

| Parameter                                              | Frequency (MHz)                                                            | Min.                             | Typ.                                   | Max.                                   | Unit   |
|--------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------|----------------------------------------|----------------------------------------|--------|
| Frequency                                              |                                                                            | 1700                             |                                        | 3100                                   | MHz    |
| Insertion Loss<br>(Avg. Of Coupled Outputs) above 3 dB | 1700-1850<br>1850-1990<br>1990-2170<br>2170-2400<br>2400-2700<br>2700-3100 |                                  | 0.4<br>0.4<br>0.5<br>0.5<br>0.5<br>0.6 | 0.6<br>0.6<br>0.7<br>0.7<br>0.7<br>0.8 | dB     |
| Isolation                                              | 1700-1850<br>1850-1990<br>1990-2170<br>2170-2400<br>2400-2700<br>2700-3100 | 17<br>18<br>18<br>18<br>18<br>18 | 23<br>24<br>25<br>25<br>25<br>25       |                                        | dB     |
| Phase Unbalance                                        | 1700-1850<br>1850-1990<br>1990-2170<br>2170-2400<br>2400-2700<br>2700-3100 |                                  | 2.0<br>2.0<br>2.0<br>2.0<br>2.0<br>2.0 | 7.0<br>7.0<br>7.0<br>7.0<br>7.0<br>7.0 | Degree |
| Amplitude Unbalance                                    | 1700-1850<br>1850-1990<br>1990-2170<br>2170-2400<br>2400-2700<br>2700-3100 |                                  | 0.6<br>0.2<br>0.5<br>0.5<br>0.5<br>0.7 | 1.2<br>0.7<br>1.0<br>1.0<br>1.0<br>1.2 | dB     |
| VSWR                                                   | 1700-3100                                                                  |                                  | 1.2                                    |                                        | :1     |

## Demo Board MCL P/N: TB-489-312+ Suggested PCB Layout (PL-304)



### NOTES:

- 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.
- 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



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



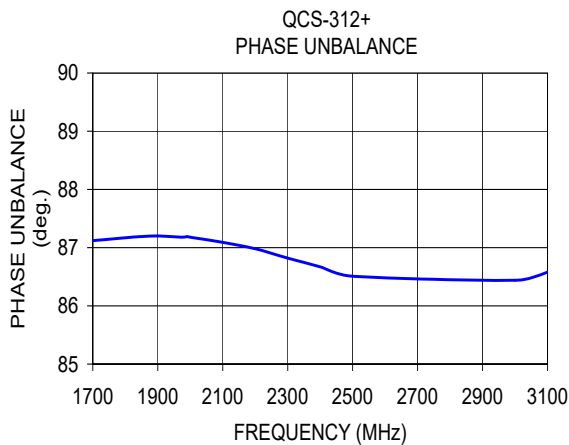
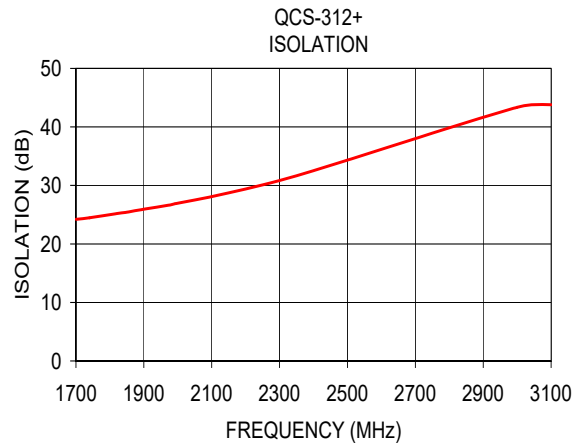
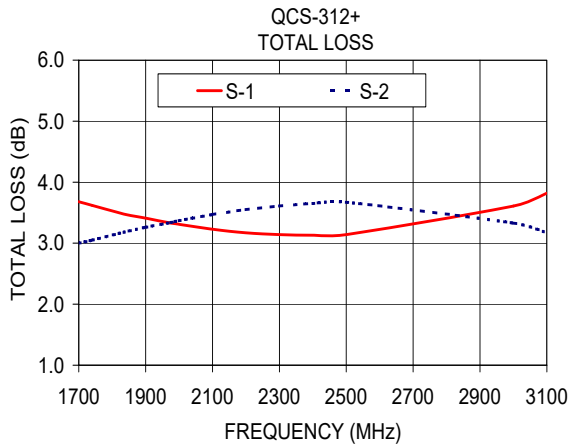
Available Tape and Reel at no extra cost

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

## Typical Performance Data

| Frequency<br>(MHz) | Total Loss <sup>1</sup><br>(dB) |      | Amplitude<br>Unbalance<br>(dB) | Isolation<br>(dB) | Phase<br>Unbalance<br>(deg.) | VSWR<br>S | VSWR<br>1 | VSWR<br>2 |
|--------------------|---------------------------------|------|--------------------------------|-------------------|------------------------------|-----------|-----------|-----------|
|                    | S-1                             | S-2  |                                |                   |                              |           |           |           |
| 1700.00            | 3.68                            | 3.00 | 0.69                           | 24.22             | 87.12                        | 1.01      | 1.30      | 1.02      |
| 1740.00            | 3.62                            | 3.05 | 0.57                           | 24.46             | 87.14                        | 1.01      | 1.29      | 1.01      |
| 1820.00            | 3.50                            | 3.16 | 0.34                           | 25.20             | 87.18                        | 1.02      | 1.28      | 1.02      |
| 1850.00            | 3.46                            | 3.20 | 0.27                           | 25.42             | 87.19                        | 1.03      | 1.27      | 1.02      |
| 1900.00            | 3.41                            | 3.26 | 0.14                           | 25.94             | 87.20                        | 1.03      | 1.26      | 1.03      |
| 1975.00            | 3.33                            | 3.34 | 0.02                           | 26.65             | 87.18                        | 1.04      | 1.25      | 1.05      |
| 1990.00            | 3.32                            | 3.36 | 0.05                           | 26.85             | 87.19                        | 1.04      | 1.24      | 1.05      |
| 2000.00            | 3.31                            | 3.37 | 0.07                           | 26.96             | 87.18                        | 1.05      | 1.24      | 1.05      |
| 2100.00            | 3.23                            | 3.47 | 0.24                           | 28.10             | 87.09                        | 1.06      | 1.22      | 1.07      |
| 2200.00            | 3.17                            | 3.55 | 0.37                           | 29.40             | 86.98                        | 1.07      | 1.20      | 1.09      |
| 2300.00            | 3.14                            | 3.61 | 0.47                           | 30.83             | 86.82                        | 1.08      | 1.17      | 1.11      |
| 2400.00            | 3.13                            | 3.65 | 0.52                           | 32.53             | 86.67                        | 1.09      | 1.15      | 1.13      |
| 2500.00            | 3.14                            | 3.67 | 0.52                           | 34.34             | 86.51                        | 1.10      | 1.13      | 1.14      |
| 3000.00            | 3.61                            | 3.33 | 0.28                           | 43.36             | 86.44                        | 1.09      | 1.04      | 1.11      |
| 3100.00            | 3.82                            | 3.17 | 0.65                           | 43.80             | 86.58                        | 1.07      | 1.04      | 1.08      |

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



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# 2 Way-90° Power Splitter/Combiner

**QCS-312+**

## Typical Performance Data

| FREQ.<br>(MHz) | TOTAL LOSS <sup>1</sup> |      | AMP.<br>UNBAL.<br>(dB) | ISOLATION<br>(dB) | PHASE<br>UNBAL.<br>(Deg.) | FREQ.<br>(MHz) | VSWR |      |      |
|----------------|-------------------------|------|------------------------|-------------------|---------------------------|----------------|------|------|------|
|                | (dB)                    |      |                        |                   |                           |                | (:1) |      |      |
|                | S-1                     | S-2  |                        |                   |                           |                | S    | 1    | 2    |
| 1700.0         | 3.68                    | 3.00 | 0.69                   | 24.22             | 87.12                     | 1700.0         | 1.01 | 1.30 | 1.02 |
| 1720.0         | 3.65                    | 3.02 | 0.63                   | 24.34             | 87.13                     | 1720.0         | 1.01 | 1.30 | 1.01 |
| 1740.0         | 3.62                    | 3.05 | 0.57                   | 24.46             | 87.14                     | 1740.0         | 1.01 | 1.29 | 1.01 |
| 1760.0         | 3.59                    | 3.08 | 0.51                   | 24.61             | 87.15                     | 1760.0         | 1.01 | 1.29 | 1.01 |
| 1780.0         | 3.56                    | 3.11 | 0.45                   | 24.82             | 87.17                     | 1780.0         | 1.02 | 1.28 | 1.01 |
| 1800.0         | 3.53                    | 3.13 | 0.40                   | 25.02             | 87.18                     | 1800.0         | 1.02 | 1.28 | 1.01 |
| 1820.0         | 3.50                    | 3.16 | 0.34                   | 25.20             | 87.18                     | 1820.0         | 1.02 | 1.28 | 1.02 |
| 1840.0         | 3.48                    | 3.19 | 0.29                   | 25.34             | 87.20                     | 1840.0         | 1.02 | 1.27 | 1.02 |
| 1850.0         | 3.46                    | 3.20 | 0.27                   | 25.42             | 87.19                     | 1850.0         | 1.03 | 1.27 | 1.02 |
| 1900.0         | 3.41                    | 3.26 | 0.14                   | 25.94             | 87.20                     | 1900.0         | 1.03 | 1.26 | 1.03 |
| 1950.0         | 3.35                    | 3.32 | 0.03                   | 26.40             | 87.18                     | 1950.0         | 1.04 | 1.25 | 1.04 |
| 1975.0         | 3.33                    | 3.34 | 0.02                   | 26.65             | 87.18                     | 1975.0         | 1.04 | 1.25 | 1.05 |
| 1990.0         | 3.32                    | 3.36 | 0.05                   | 26.85             | 87.19                     | 1990.0         | 1.04 | 1.24 | 1.05 |
| 2000.0         | 3.31                    | 3.37 | 0.07                   | 26.96             | 87.18                     | 2000.0         | 1.05 | 1.24 | 1.05 |
| 2050.0         | 3.26                    | 3.42 | 0.16                   | 27.58             | 87.14                     | 2050.0         | 1.05 | 1.23 | 1.06 |
| 2100.0         | 3.23                    | 3.47 | 0.24                   | 28.10             | 87.09                     | 2100.0         | 1.06 | 1.22 | 1.07 |
| 2150.0         | 3.20                    | 3.51 | 0.31                   | 28.78             | 87.03                     | 2150.0         | 1.07 | 1.21 | 1.08 |
| 2200.0         | 3.17                    | 3.55 | 0.37                   | 29.40             | 86.98                     | 2200.0         | 1.07 | 1.20 | 1.09 |
| 2250.0         | 3.16                    | 3.58 | 0.43                   | 30.21             | 86.92                     | 2250.0         | 1.08 | 1.19 | 1.10 |
| 2300.0         | 3.14                    | 3.61 | 0.47                   | 30.83             | 86.82                     | 2300.0         | 1.08 | 1.17 | 1.11 |
| 2400.0         | 3.13                    | 3.65 | 0.52                   | 32.53             | 86.67                     | 2400.0         | 1.09 | 1.15 | 1.13 |
| 2450.0         | 3.14                    | 3.66 | 0.53                   | 33.25             | 86.61                     | 2450.0         | 1.10 | 1.14 | 1.13 |
| 2500.0         | 3.14                    | 3.67 | 0.52                   | 34.34             | 86.51                     | 2500.0         | 1.10 | 1.13 | 1.14 |
| 2550.0         | 3.16                    | 3.67 | 0.51                   | 35.05             | 86.48                     | 2550.0         | 1.11 | 1.11 | 1.14 |
| 2600.0         | 3.18                    | 3.66 | 0.48                   | 36.05             | 86.39                     | 2600.0         | 1.11 | 1.10 | 1.14 |
| 2800.0         | 3.33                    | 3.56 | 0.23                   | 39.38             | 86.29                     | 2800.0         | 1.11 | 1.06 | 1.14 |
| 3000.0         | 3.61                    | 3.33 | 0.28                   | 43.36             | 86.44                     | 3000.0         | 1.09 | 1.04 | 1.11 |
| 3100.0         | 3.82                    | 3.17 | 0.65                   | 43.80             | 86.58                     | 3100.0         | 1.07 | 1.04 | 1.08 |

<sup>1</sup>Total Loss = Insertion Loss + 3dB Splitter Loss



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IF/RF MICROWAVE COMPONENTS

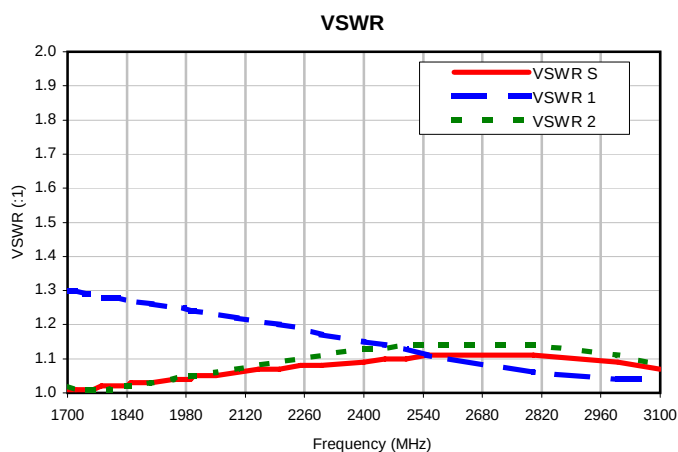
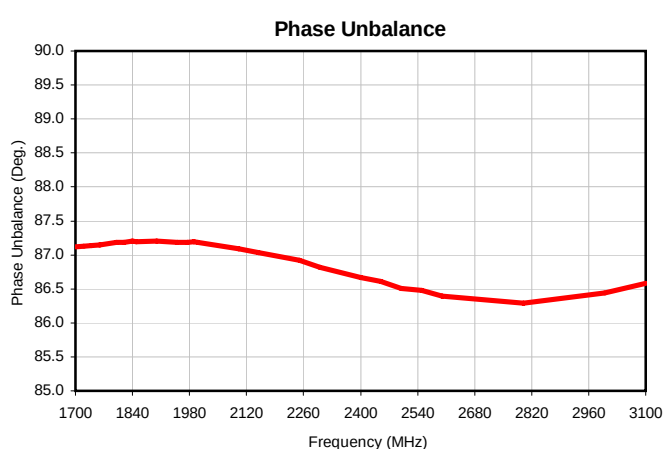
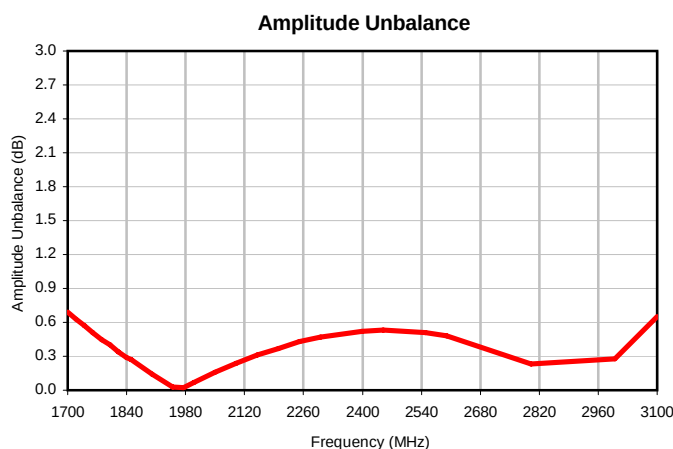
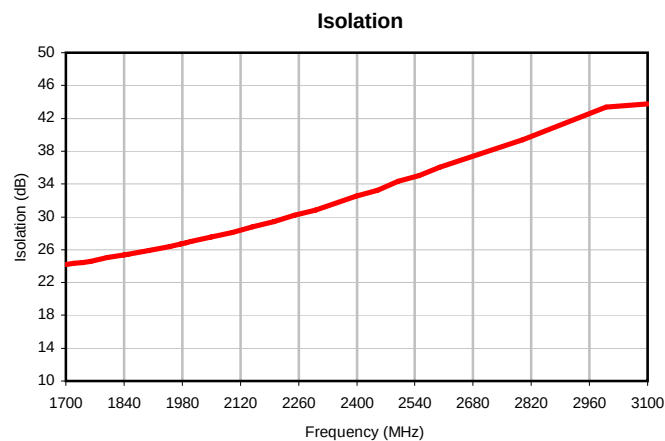
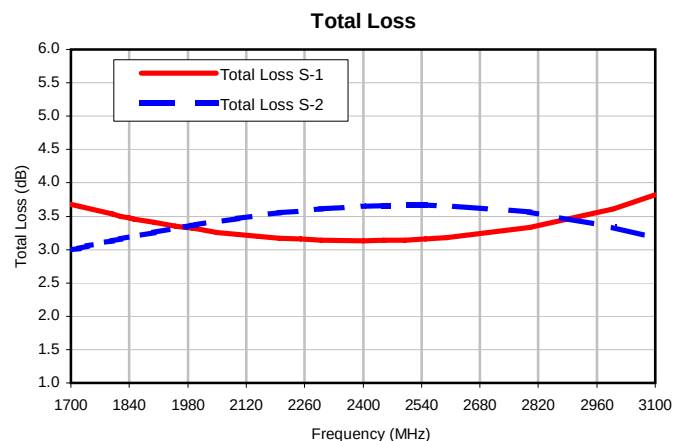


REV. X2  
 QCS-312+  
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# 2 Way-90° Power Splitter/Combiner

QCS-312+

## Typical Performance Curves



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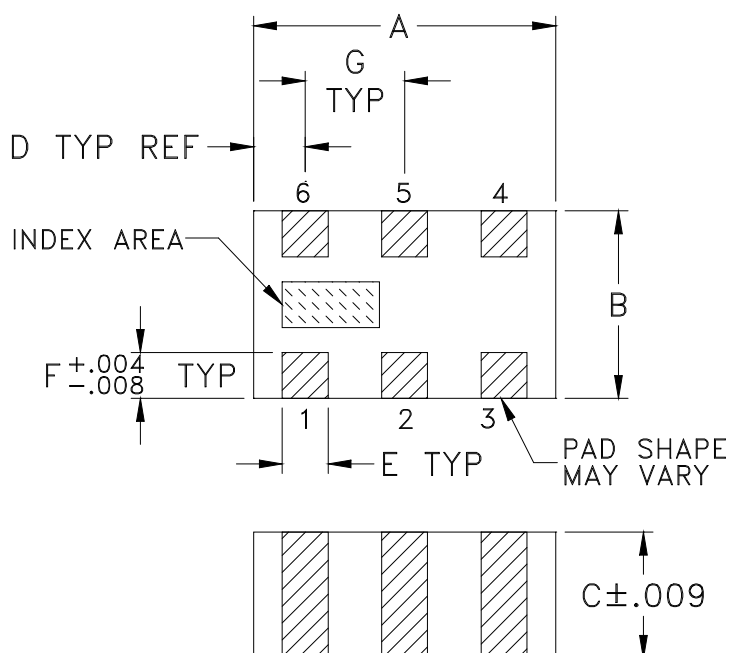


IF/RF MICROWAVE COMPONENTS

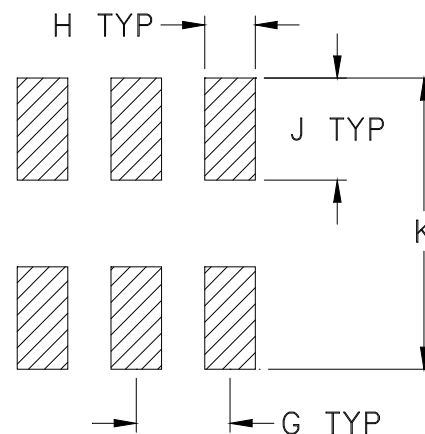
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QCS-312+  
8/5/2010  
Page 1 of 1

### Outline Dimensions



### PCB Land Pattern



Suggested Layout,  
Tolerance to be within  $\pm .002$

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

Dimensions are in inches (mm). Tolerances: 2Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$

### Notes:

- Open style, ceramic base.
- 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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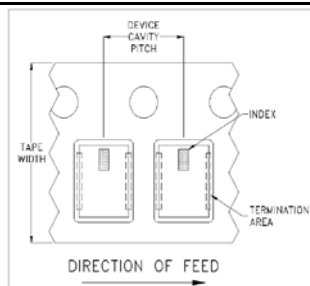


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RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F74

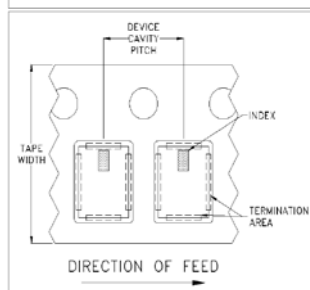
## DEVICE ORIENTATION IN T&R



**ILLUSTRATION 1**

### Applicable Case Styles

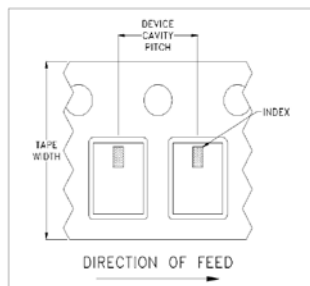
GE0805C-1  
GE0805C-1AP  
JV1210C-1  
GU2939



**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  
JV1210C-7  
JV1210C-8  
JV1210C-9  
JV1210C-10  
JV1210C-13  
GE0805C-13

| Tape Width,<br>mm | Device Cavity Pitch,<br>mm | Real Size,<br>inches | Devices per Reel                             |      |
|-------------------|----------------------------|----------------------|----------------------------------------------|------|
| 8                 | 4                          | 7                    | Small<br>quantity<br>standards<br>(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](http://www.minicircuits.com/pages/pdfs/tape.pdf)



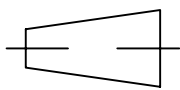
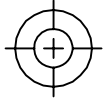
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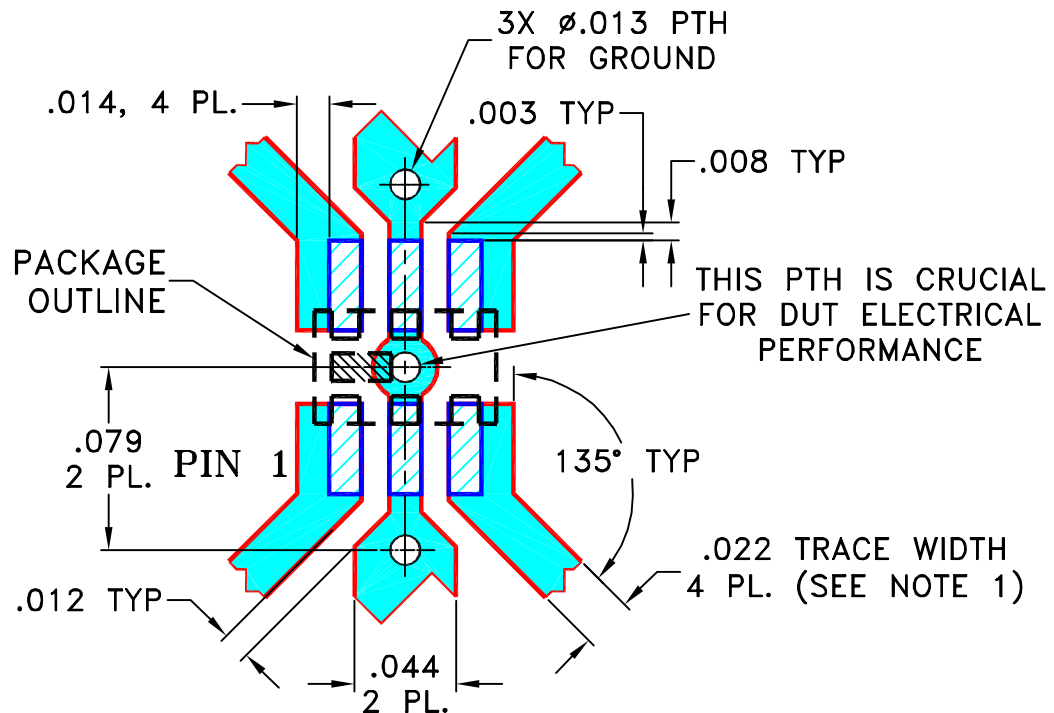
## THIRD ANGLE PROJECTION



## 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"  $\pm$  .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

TOLERANCES ON:

2 PL DECIMALS  $\pm$   
3 PL DECIMALS  $\pm$  .005  
ANGLES  $\pm$  1°  
FRACTIONS  $\pm$

DRAWN

MMG

04/27/09

CHECKED

AV

04/27/09

APPROVED

ABD

04/27/09

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Brooklyn NY 11235

PL, 06SQ07, GE0805C-1, TB-489+

SIZE  
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CODE IDENT  
15542

DRAWING NO:  
98-PL-304

REV:  
OR

FILE: 98PL304

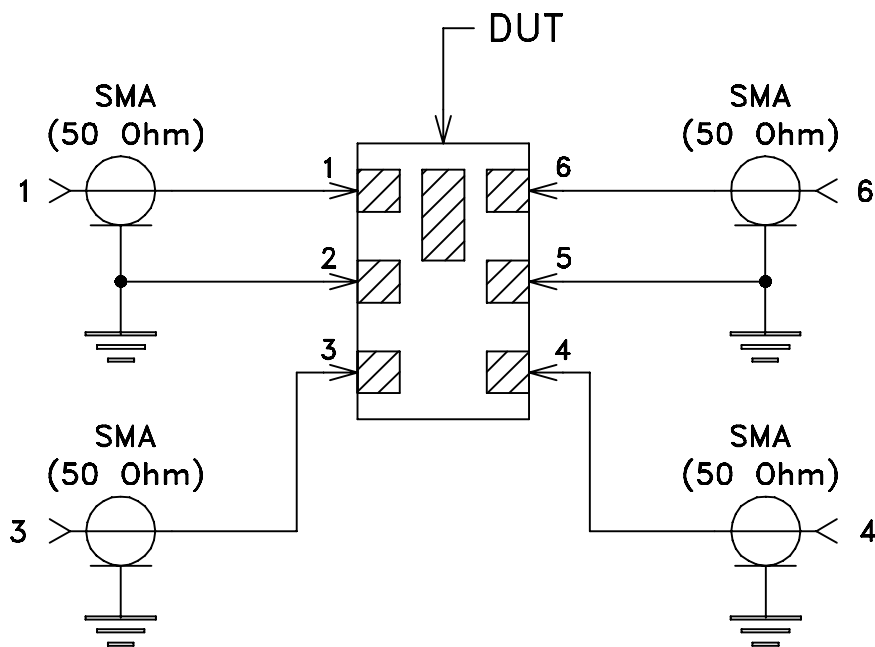
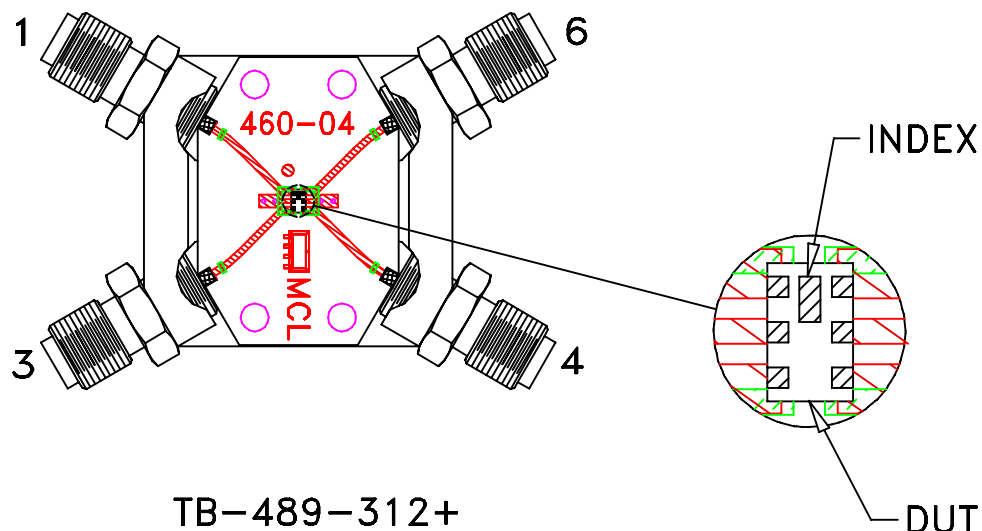
SCALE: 12:1

SHEET: 1 OF 1



# Evaluation Board and Circuit

For Pin Connections refer to Data Sheet of the DUT



Schematic Diagram

## Notes:

1. 50 Ohm SMA Female connectors.
2. PCB Material: Rogers RO4350 or equivalent,  
Dielectric Constant=3.5, Thickness=.010 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      | -55° to 100°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 |
| 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, 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                                                                 |