



Mini-Circuits

SURFACE MOUNT <sup>top hat</sup>

# Directional Coupler

## RDC20-232-75X2+

75Ω 20dB 5 to 2350 MHz

### THE BIG DEAL

- Wideband 5-2350 MHz
- Low mainline loss, 0.85 dB typ. at 1800 MHz
- Good Directivity, 16 dB typ. at 1800 MHz
- Excellent Return Loss, 27 dB typ. at 1000 MHz
- Supports DOCSIS® 3.1 / 4.0 Systems
- Aqueous washable



Generic photo used for illustration purposes only

CASE STYLE: TT2315

**+RoHS Compliant**

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

### APPLICATIONS

- DOCSIS 3.1 / 4.0
- L-Band

### PRODUCT OVERVIEW

Mini-Circuits RDC20-232-75X2+ surface-mount directional coupler provides 20 dB coupling with high directivity, low mainline loss, and good return loss for 75Ω applications from 5 to 2350 MHz, supporting a variety of broadband applications including DOCSIS 3.1/4.0 systems and equipment. This model features core and wire construction with wrap-around terminations for good solderability and easy visual inspection.

### KEY FEATURES

| Feature                                       | Advantages                                                                                                                                  |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Broadband, 5 to 2350 MHz                      | Supports bandwidth requirements for DOCSIS 3.1/4.0 systems and equipment.                                                                   |
| Low mainline loss, 0.85 dB at 1800 MHz        | Provides excellent through-path signal transmission and maintains low heat dissipation, avoiding the need for special heat sinking methods. |
| Power handling, up to 1W                      | Usable in systems with a variety of signal power requirements.                                                                              |
| Excellent return loss, 27 dB typ. at 1000 MHz | Provides excellent matching for 75Ω systems.                                                                                                |
| Top Hat® feature                              | Improves speed and accuracy of pick and place assembly.                                                                                     |





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## Directional Coupler

**RDC20-232-75X2+**

75Ω    20dB    5 to 2350 MHz

## ELECTRICAL SPECIFICATIONS AT 25°C

| Parameter                  | Condition (MHz) | Min. | Typ.     | Max. | Unit |
|----------------------------|-----------------|------|----------|------|------|
| Frequency Range            |                 | 5    |          | 2350 | MHz  |
| Mainline Loss <sup>1</sup> | 5               | —    | 0.95     | 1.3  | dB   |
|                            | 40              | —    | 0.55     | 0.9  |      |
|                            | 1218            | —    | 0.65     | 1.0  |      |
|                            | 1800            | —    | 0.85     | 1.1  |      |
|                            | 2350            | —    | 1.10     | 1.4  |      |
| Nominal Coupling           | 5-1218          | —    | 21±1.5   | —    | dB   |
|                            | 40-1800         | —    | 20.5±1.0 | —    |      |
|                            | 40-2350         | —    | 20.2±1.3 | —    |      |
| Coupling Flatness(±)       | 5-1218          | —    | 1.2      | 1.9  | dB   |
|                            | 40-1800         | —    | 1.0      | 2.0  |      |
|                            | 40-2350         | —    | 1.0      | 2.4  |      |
| Directivity                | 5               | 8    | 11       | —    | dB   |
|                            | 40              | 18   | 22       | —    |      |
|                            | 1218            | 15   | 22       | —    |      |
|                            | 1800            | 10   | 16       | —    |      |
|                            | 2350            | 7    | 12       | —    |      |
| Return Loss (Input)        | 5-40            | 10   | 14       | —    | dB   |
|                            | 40-1800         | 14   | 26       | —    |      |
|                            | 1800-2350       | 12   | 20       | —    |      |
| Return Loss (Output)       | 5-40            | 11   | 14       | —    | dB   |
|                            | 40-1800         | 19   | 24       | —    |      |
|                            | 1800-2350       | 15   | 22       | —    |      |
| Return Loss (Coupled)      | 5-40            | 10   | 20       | —    | dB   |
|                            | 40-1800         | 12   | 26       | —    |      |
|                            | 1800-2350       | 10   | 24       | —    |      |
| Input Power                | 5 - 2350        |      |          | 1    | W    |

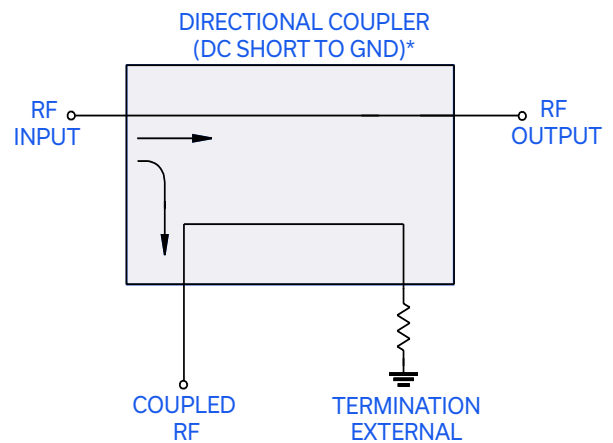
1. Mainline loss includes theoretical power loss at coupled port.

## MAXIMUM RATINGS

| Parameter             | Ratings        |
|-----------------------|----------------|
| Operating Temperature | -40°C to 85°C  |
| Storage Temperature   | -55°C to 100°C |

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

## ELECTRICAL SCHEMATIC



\*Electrical schematic is for Directional coupler with internal transformer(s) and external termination

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## Directional Coupler

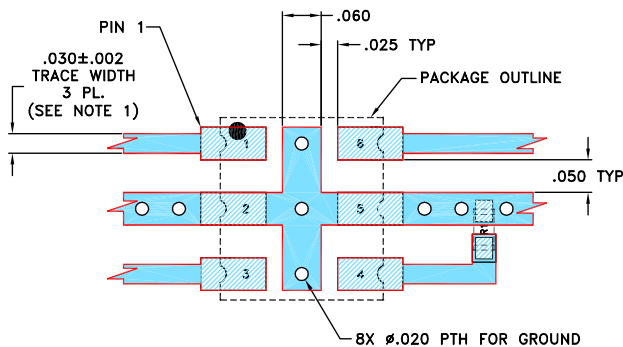
**RDC20-232-75X2+**

75Ω 20dB 5 to 2350 MHz

## PIN CONNECTIONS

| Function             | Pad Number |
|----------------------|------------|
| INPUT                | 1          |
| OUTPUT               | 6          |
| COUPLED              | 3          |
| GROUND               | 2          |
| 75Ω TERM EXTERNAL    | 4          |
| ISOLATE (DO NOT USE) | 5          |

PRODUCT MARKING: WW

DEMO BOARD MCL P/N: TB-917+  
SUGGESTED PCB LAYOUT (PL-452)

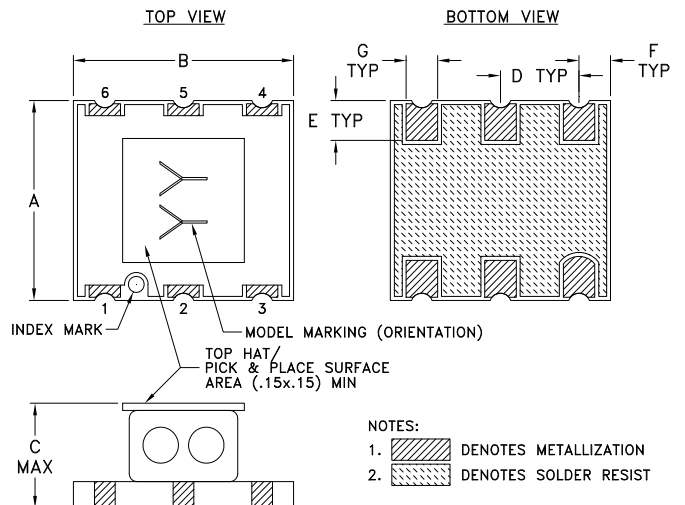
## NOTES:

- TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS  $.030" \pm .002"$ ; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
- .0603 SIZE CHIP RESISTOR FOOT PRINT SHOWN FOR REFERENCE, FOR RESISTOR VALUE REFER TO TB-917+.
- BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

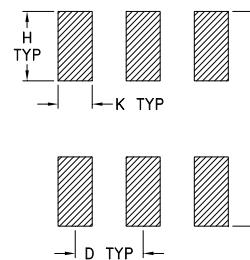
 DENOTES PCB COPPER LAYOUT WITH SMOBC (SOLDER MASK OVER BARE COPPER)

 DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

## OUTLINE DRAWING



## PCB Land Pattern

Suggested Layout,  
Tolerance to be within  $\pm .002$ OUTLINE DIMENSIONS (Inches)  
mm

| A    | B    | C    | D    | E    | F    | G    | H    | J    | K    |
|------|------|------|------|------|------|------|------|------|------|
| .250 | .280 | .140 | .100 | .050 | .040 | .040 | .100 | .310 | .050 |
| 6.35 | 7.11 | 3.56 | 2.54 | 1.27 | 1.02 | 1.02 | 2.54 | 7.87 | 1.27 |

Weight: 0.35 grams

## TAPE &amp; REEL INFORMATION: F34

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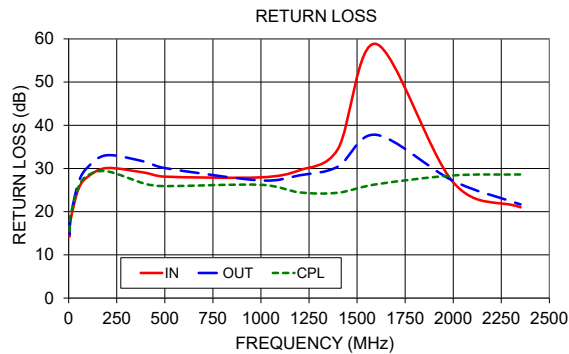
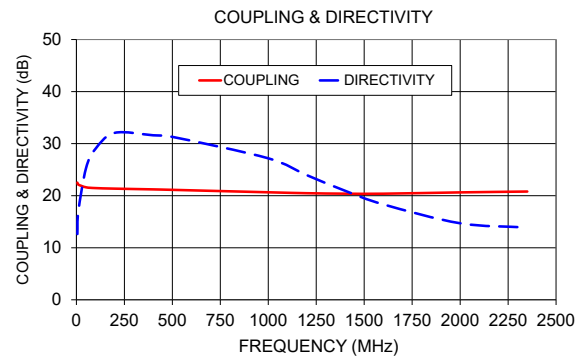
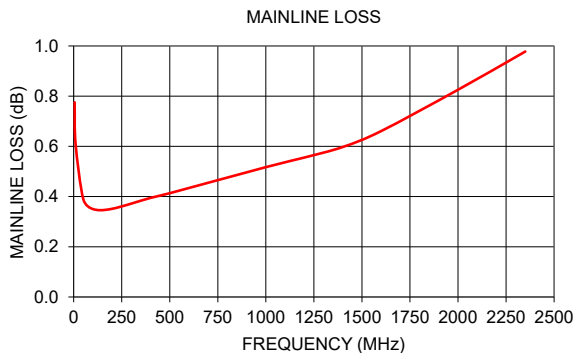
# Directional Coupler

## RDC20-232-75X2+

75Ω 20dB 5 to 2350 MHz

### TYPICAL PERFORMANCE DATA AT 25°C

| Frequency<br>(MHz) | Mainline Loss<br>(dB)<br>In-Out | Coupling<br>(dB)<br>In-Cpl | Directivity<br>(dB) | Return Loss<br>(dB) |       |       |
|--------------------|---------------------------------|----------------------------|---------------------|---------------------|-------|-------|
|                    |                                 |                            |                     | In                  | Out   | Cpl   |
| 5                  | 0.78                            | 22.51                      | 12.63               | 14.26               | 14.78 | 15.48 |
| 10                 | 0.61                            | 22.13                      | 16.96               | 18.04               | 18.71 | 19.06 |
| 50                 | 0.39                            | 21.61                      | 25.27               | 25.14               | 26.62 | 25.59 |
| 100                | 0.35                            | 21.46                      | 29.03               | 28.09               | 30.33 | 28.41 |
| 200                | 0.35                            | 21.35                      | 32.08               | 30.10               | 33.07 | 29.34 |
| 400                | 0.39                            | 21.21                      | 31.60               | 28.99               | 31.52 | 26.42 |
| 500                | 0.41                            | 21.12                      | 31.30               | 28.11               | 30.09 | 25.91 |
| 1000               | 0.52                            | 20.65                      | 27.18               | 27.95               | 27.23 | 26.22 |
| 1200               | 0.56                            | 20.48                      | 23.96               | 29.58               | 28.41 | 24.47 |
| 1400               | 0.60                            | 20.39                      | 20.95               | 34.48               | 30.42 | 24.38 |
| 1600               | 0.66                            | 20.38                      | 18.33               | 58.81               | 37.79 | 26.34 |
| 2000               | 0.83                            | 20.63                      | 14.70               | 26.78               | 27.12 | 28.39 |
| 2350               | 0.98                            | 20.80                      | 13.88               | 21.01               | 21.68 | 28.61 |



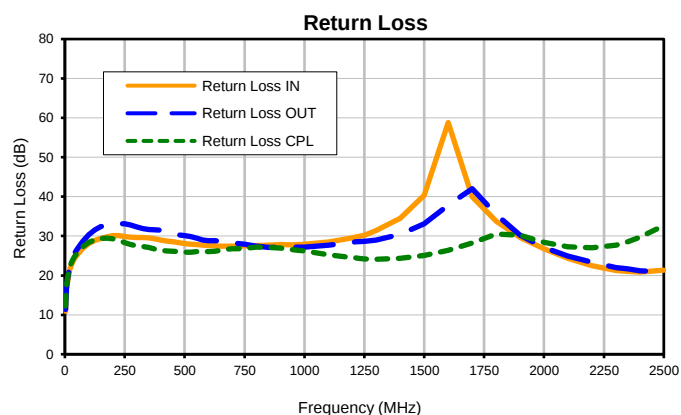
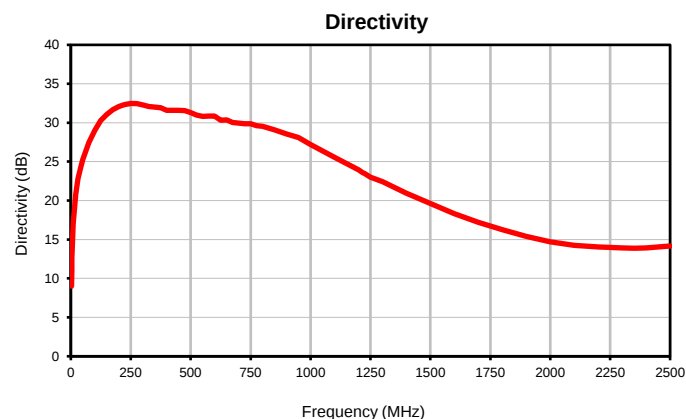
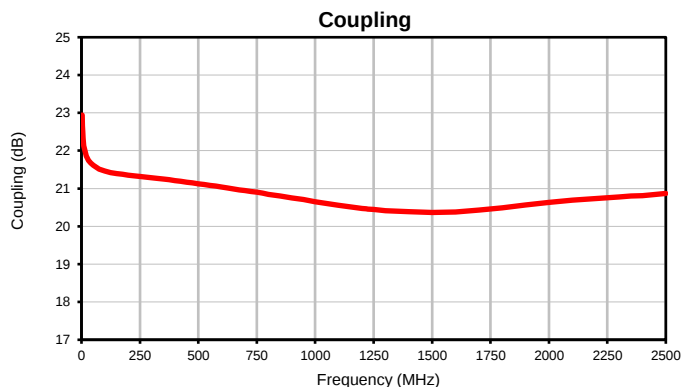
- NOTES**
- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
  - Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
  - 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)



## Typical Performance Data

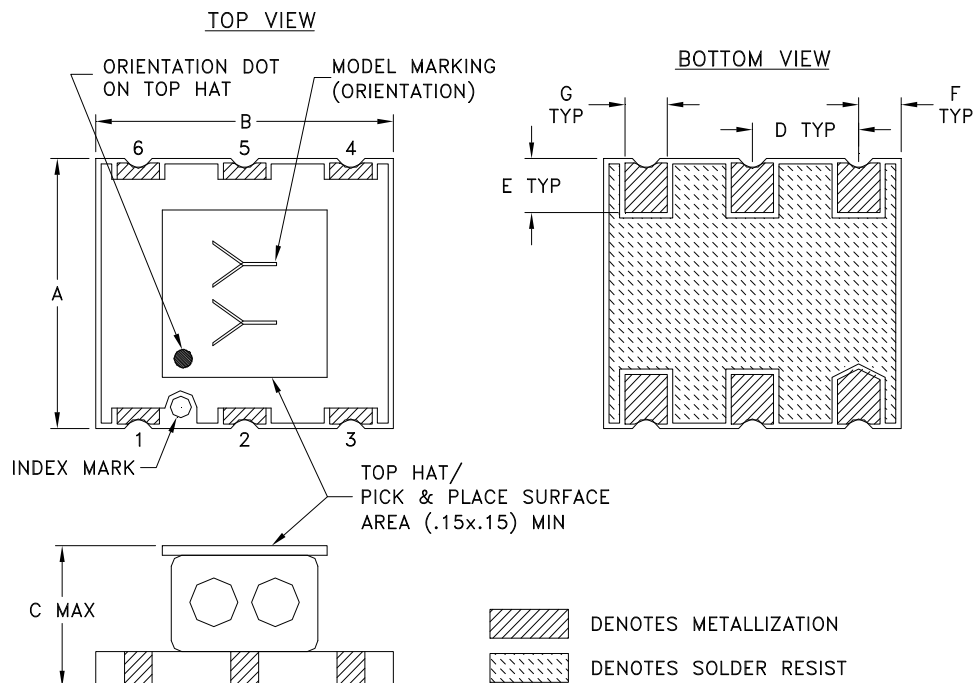
| FREQ.<br>(MHz) | INSERTION LOSS<br>(dB) | COUPLING<br>(dB) | DIRECTIVITY<br>(dB) | RETURN LOSS<br>(dB) |       |       |
|----------------|------------------------|------------------|---------------------|---------------------|-------|-------|
|                |                        |                  |                     | IN                  | OUT   | CPL   |
| 3              | 0.97                   | 22.94            | 9.01                | 10.92               | 11.37 | 12.26 |
| 4              | 0.84                   | 22.65            | 11.10               | 12.87               | 13.34 | 14.13 |
| 5              | 0.78                   | 22.51            | 12.63               | 14.26               | 14.78 | 15.48 |
| 7              | 0.69                   | 22.33            | 14.76               | 16.17               | 16.76 | 17.30 |
| 10             | 0.61                   | 22.13            | 16.96               | 18.04               | 18.71 | 19.06 |
| 20             | 0.49                   | 21.86            | 20.77               | 21.41               | 22.37 | 22.18 |
| 30             | 0.44                   | 21.74            | 22.80               | 23.11               | 24.26 | 23.67 |
| 40             | 0.41                   | 21.67            | 24.16               | 24.24               | 25.56 | 24.73 |
| 50             | 0.39                   | 21.61            | 25.27               | 25.14               | 26.62 | 25.59 |
| 75             | 0.36                   | 21.51            | 27.43               | 26.85               | 28.69 | 27.26 |
| 100            | 0.35                   | 21.46            | 29.03               | 28.09               | 30.33 | 28.41 |
| 125            | 0.34                   | 21.42            | 30.28               | 28.90               | 31.60 | 29.08 |
| 150            | 0.35                   | 21.40            | 31.06               | 29.39               | 32.42 | 29.39 |
| 175            | 0.35                   | 21.37            | 31.67               | 29.80               | 32.83 | 29.47 |
| 200            | 0.35                   | 21.35            | 32.08               | 30.10               | 33.07 | 29.34 |
| 225            | 0.36                   | 21.33            | 32.33               | 30.12               | 33.12 | 28.92 |
| 250            | 0.36                   | 21.32            | 32.47               | 29.87               | 33.10 | 28.30 |
| 275            | 0.37                   | 21.30            | 32.45               | 29.70               | 32.82 | 27.80 |
| 300            | 0.37                   | 21.28            | 32.29               | 29.62               | 32.33 | 27.53 |
| 325            | 0.38                   | 21.26            | 32.08               | 29.59               | 31.88 | 27.35 |
| 350            | 0.39                   | 21.25            | 32.02               | 29.54               | 31.65 | 27.09 |
| 375            | 0.39                   | 21.23            | 31.91               | 29.30               | 31.60 | 26.71 |
| 400            | 0.39                   | 21.21            | 31.60               | 28.99               | 31.52 | 26.42 |
| 425            | 0.40                   | 21.19            | 31.58               | 28.74               | 31.11 | 26.26 |
| 450            | 0.40                   | 21.17            | 31.58               | 28.55               | 30.62 | 26.16 |
| 475            | 0.41                   | 21.15            | 31.56               | 28.33               | 30.26 | 26.02 |
| 500            | 0.41                   | 21.12            | 31.30               | 28.11               | 30.09 | 25.91 |
| 525            | 0.42                   | 21.10            | 30.99               | 27.96               | 29.87 | 25.93 |
| 550            | 0.42                   | 21.08            | 30.80               | 27.83               | 29.43 | 26.01 |
| 575            | 0.43                   | 21.06            | 30.85               | 27.68               | 28.99 | 26.06 |
| 600            | 0.43                   | 21.04            | 30.85               | 27.56               | 28.80 | 26.05 |
| 625            | 0.44                   | 21.01            | 30.31               | 27.48               | 28.84 | 26.14 |
| 650            | 0.44                   | 20.99            | 30.34               | 27.44               | 28.76 | 26.35 |
| 675            | 0.44                   | 20.97            | 30.03               | 27.42               | 28.51 | 26.61 |
| 700            | 0.45                   | 20.95            | 29.96               | 27.40               | 28.24 | 26.76 |
| 725            | 0.46                   | 20.92            | 29.85               | 27.42               | 28.06 | 26.80 |
| 750            | 0.46                   | 20.91            | 29.86               | 27.48               | 27.91 | 26.90 |
| 775            | 0.47                   | 20.87            | 29.63               | 27.51               | 27.71 | 27.06 |
| 800            | 0.48                   | 20.85            | 29.54               | 27.56               | 27.43 | 27.20 |
| 850            | 0.48                   | 20.80            | 29.08               | 27.69               | 27.13 | 27.15 |
| 900            | 0.50                   | 20.75            | 28.55               | 27.83               | 27.19 | 26.97 |
| 950            | 0.51                   | 20.71            | 28.12               | 27.74               | 27.20 | 26.57 |
| 1000           | 0.52                   | 20.65            | 27.18               | 27.95               | 27.23 | 26.22 |
| 1100           | 0.53                   | 20.56            | 25.56               | 28.48               | 27.72 | 25.24 |
| 1200           | 0.56                   | 20.48            | 23.96               | 29.58               | 28.41 | 24.47 |
| 1218           | 0.56                   | 20.47            | 23.59               | 29.80               | 28.54 | 24.40 |
| 1225           | 0.56                   | 20.46            | 23.50               | 29.89               | 28.57 | 24.35 |
| 1250           | 0.57                   | 20.45            | 23.02               | 30.19               | 28.63 | 24.19 |
| 1300           | 0.57                   | 20.42            | 22.43               | 31.42               | 28.98 | 24.12 |
| 1400           | 0.60                   | 20.39            | 20.95               | 34.48               | 30.42 | 24.38 |
| 1500           | 0.62                   | 20.37            | 19.61               | 40.38               | 33.10 | 25.07 |
| 1600           | 0.66                   | 20.38            | 18.33               | 58.81               | 37.79 | 26.34 |
| 1700           | 0.71                   | 20.43            | 17.20               | 39.94               | 42.02 | 28.28 |
| 1800           | 0.74                   | 20.49            | 16.25               | 33.77               | 35.46 | 30.54 |
| 1900           | 0.79                   | 20.56            | 15.41               | 29.67               | 30.22 | 30.20 |
| 2000           | 0.83                   | 20.63            | 14.70               | 26.78               | 27.12 | 28.39 |
| 2100           | 0.87                   | 20.69            | 14.26               | 24.34               | 24.89 | 27.30 |
| 2200           | 0.91                   | 20.74            | 14.05               | 22.45               | 23.35 | 27.06 |
| 2300           | 0.96                   | 20.78            | 13.90               | 21.23               | 21.98 | 27.68 |
| 2350           | 0.98                   | 20.80            | 13.88               | 21.01               | 21.68 | 28.61 |
| 2400           | 1.00                   | 20.81            | 13.91               | 20.87               | 21.18 | 29.71 |
| 2500           | 1.02                   | 20.87            | 14.18               | 21.35               | 20.97 | 32.66 |

## Typical Performance Curves

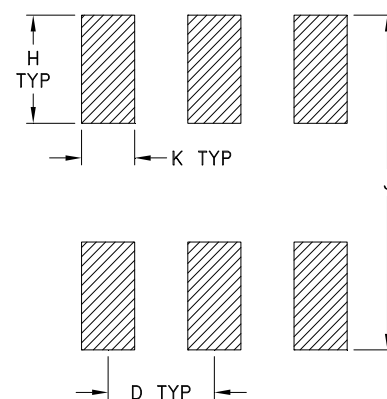


## Outline Dimensions

TT2315



## PCB Land Pattern



| CASE # | A              |  | B              | C              | D              | E              | F              | G              | H              | J              | K              | WT. GRAMS |
|--------|----------------|--|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------|
| TT2315 | .250<br>(6.35) |  | .280<br>(7.11) | .140<br>(3.56) | .100<br>(2.54) | .050<br>(1.27) | .040<br>(1.02) | .040<br>(1.02) | .100<br>(2.54) | .310<br>(7.87) | .050<br>(1.27) | .35       |

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

### Notes:

1. Open style, Base material: Printed wiring laminate.
2. Termination finish: 3-5  $\mu$  inch (.08-.13 microns) Gold over 120-240  $\mu$  inch (3.05-6.10 microns) Nickel plate.  
All models, (+) suffix.
3. Top-Hat total thickness: .013 inches MAX.
4. Orientation Dot on Top Hat & PCB corresponds to Pin #1.



P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site

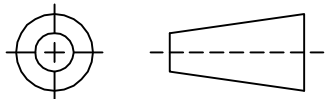


The Design Engineers Search Engine Provides ACTUAL Data Instantly From MINI-CIRCUITS At: [www.minicircuits.com](http://www.minicircuits.com)

RF/IF MICROWAVE COMPONENTS



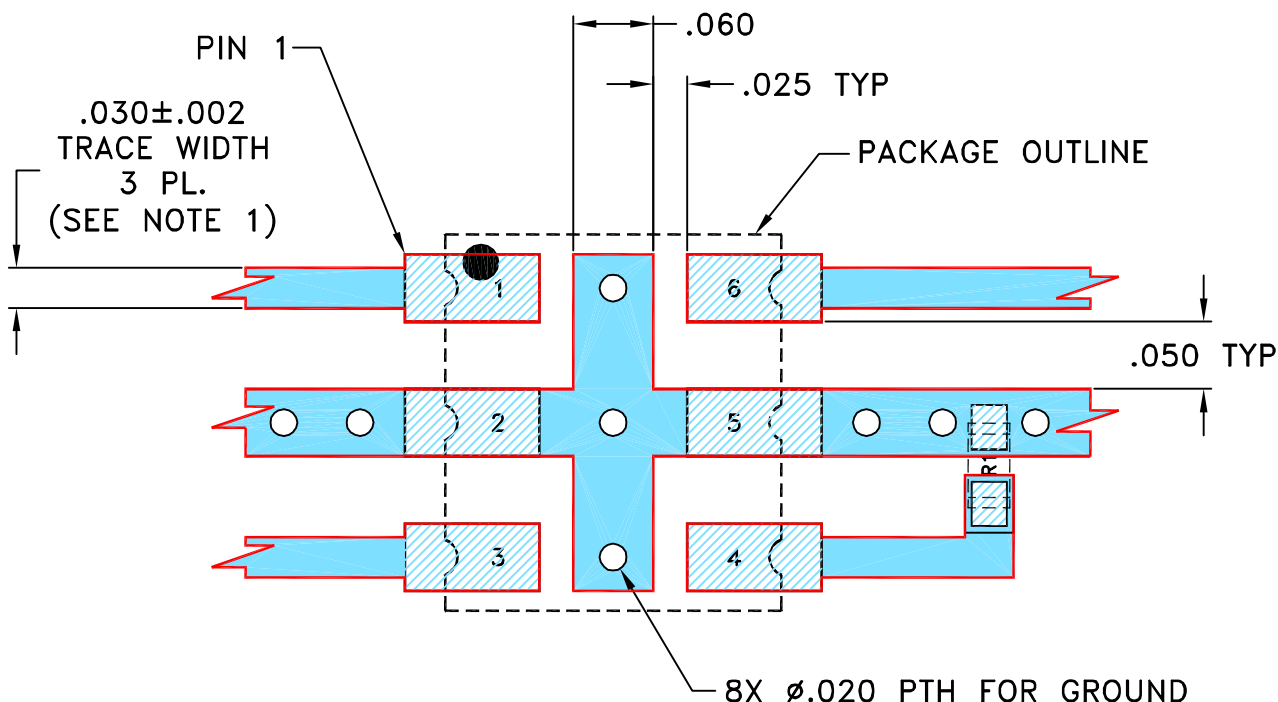
## THIRD ANGLE PROJECTION



## REVISIONS

| REV | ECN No. | DESCRIPTION | DATE     | DR | AUTH |
|-----|---------|-------------|----------|----|------|
| OR  | M158078 | NEW RELEASE | 09/16/16 | CA | IL   |
|     |         |             |          |    |      |
|     |         |             |          |    |      |

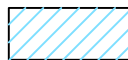
**SUGGESTED MOUNTING CONFIGURATION**  
**FOR TT2315 CASE STYLE, "06DC03" PIN CODE**

**NOTES:**

1. TRACE WIDTH IS SHOWN FOR ROGERS R04350B WITH DIELECTRIC THICKNESS .030" ± .002"; COPPER: 1/2 OZ. EACH SIDE.  
FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
2. 0603 SIZE CHIP RESISTOR FOOT PRINT SHOWN FOR REFERENCE,  
FOR RESISTOR VALUE REFER TO TB-917+.
3. 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 ±

3 PL DECIMALS ± .005

ANGLES ±

FRACTIONS ±

DRAWN

CA

09/15/16

CHECKED

IL

09/16/16

APPROVED

YL

09/16/16



Mini-Circuits®

13 Neptune Avenue  
Brooklyn NY 11235

PL, 06DC03, TT2315, TB-917+

SIZE

A

CODE IDENT

15542

DRAWING NO:

98-PL-452

REV:

OR

FILE:

98PL452

SCALE:

7:1

SHEET:

1 OF 1

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



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                                                                              |