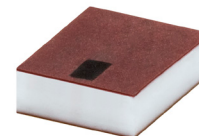




### THE BIG DEAL

- Low Insertion Loss, 0.4 dB Typ.
- Return Loss, 13 dB Typ.
- 1210 Surface Mount Footprint
- Versatile "Place Holder" for Mini-Circuits LTCC Filters
- Power Handling: 6 W



Generic photo used for illustration purposes only

### APPLICATIONS

- Test and Measurement Equipment
- Communication, EW, Radar, and ECM Defense Systems
- 5G MIMO and Back Haul Radio Systems
- Satellite Communications

### FUNCTIONAL DIAGRAM



### PRODUCT OVERVIEW

TPCV-333+ is a miniature low temperature co-fired ceramic (LTCC) 50 Ohm transmission line, with low insertion loss through 33 GHz that supports a variety of applications. This model provides 0.4 dB typical insertion loss over a wide band due to its rugged monolithic construction. Housed in a 1210 ceramic form factor which is ideal for dense signal chain PCB layouts, where it complements MMIC size and performance. The LTCC fabrication process assures minimal RF performance variation while delivering a product that is well suited for environmental extremes of high humidity and temperature.

### KEY FEATURES

| Features                         | Advantages                                                                                                                                                                                                                                                                           |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Footprint Compatible "Thru-Line" | Enables system designers the flexibility to plan to add LTCC filters to the PCB layout at a later stage in the design process, after system test results are available. Compatible with Mini-Circuits low pass filters (LFCV series), with identical case style and pad connections. |
| LTCC Construction                | The use of LTCC technology allows for repeatable performance in a rugged ceramic package, well suited for tough environments such as high humidity and temperature extremes. See Mini-Circuits Environmental Rating ENV06T10 for more information.                                   |
| Small Size, 1210                 | 1210 package allows for space to be saved in dense circuit board layouts, while also minimizing the effects of parasitics.                                                                                                                                                           |
| Rugged Power Handling, 6 W       | Handles up to 6 Watts in a small 1210 package.                                                                                                                                                                                                                                       |



LTCC SURFACE MOUNT

Thru-Line

TPCV-333+

Mini-Circuits

50Ω DC to 33 GHz

ELECTRICAL SPECIFICATIONS<sup>1,2</sup> AT +25°C

| Parameter |                | F#    | Frequency (GHz) | Min. | Typ. | Max. | Units |
|-----------|----------------|-------|-----------------|------|------|------|-------|
| Passband  | Insertion Loss | DC-F1 | DC - 19         | —    | 0.3  | 0.7  | dB    |
|           |                | F1-F2 | 19 - 28         | —    | 0.4  | 0.9  |       |
|           |                | F2-F3 | 28 - 33         | —    | 0.8  | —    |       |
|           | Return Loss    | DC-F1 | DC - 19         | —    | 16   | —    | dB    |
|           |                | F1-F2 | 19 - 28         | —    | 13   | —    |       |
|           |                | F2-F3 | 28 - 33         | —    | 13   | —    |       |
|           | Group Delay    | DC-F3 | DC - 33         | —    | 25   | —    | psec  |

1. Tested on Evaluation Board P/N TB-TPCV-333+

2. Bi-directional RF1 and RF2 ports can be interchanged.

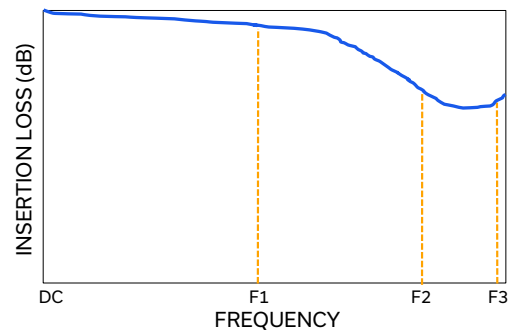
ABSOLUTE MAXIMUM RATINGS<sup>3</sup>

| Parameter                | Ratings         |
|--------------------------|-----------------|
| Operating Temperature    | -55°C to +125°C |
| Storage Temperature      | -55°C to +125°C |
| Input Power <sup>4</sup> | 6 W @ +25°C     |

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

4. Power rating applies only to signals within the passband. Power rating above +25°C operating temperature decreases linearly to 1.5 W at +125°C.

## TYPICAL FREQUENCY RESPONSE AT +25°C





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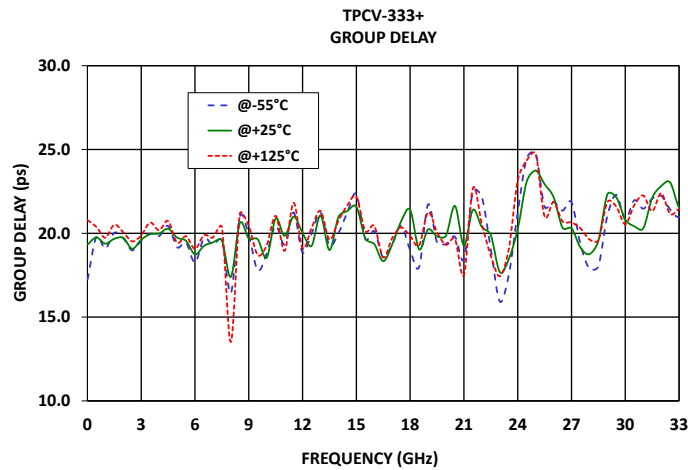
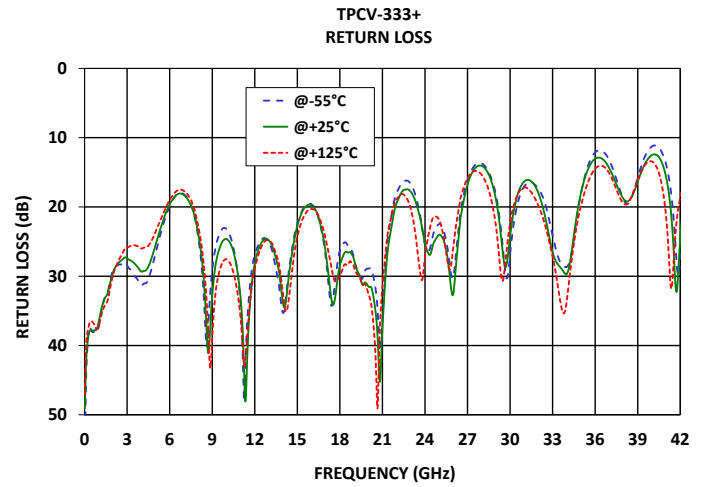
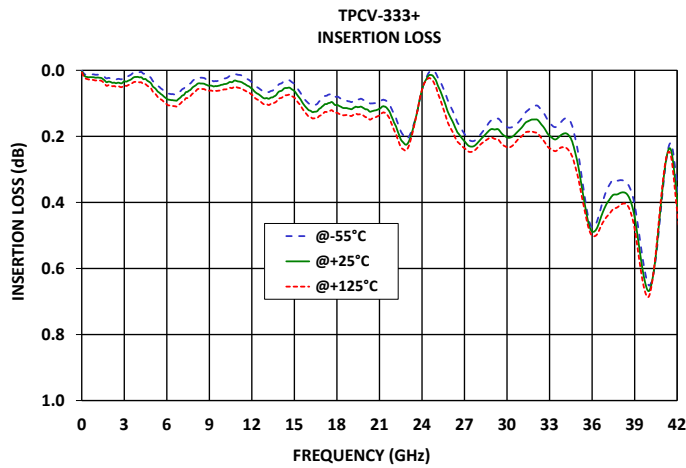
LTCC SURFACE MOUNT

# Thru-Line

## TPCV-333+

50Ω DC to 33 GHz

### TYPICAL PERFORMANCE GRAPHS





Mini-Circuits

LTCC SURFACE MOUNT

## Thru-Line

TPCV-333+

50Ω DC to 33 GHz

## FUNCTIONAL DIAGRAM

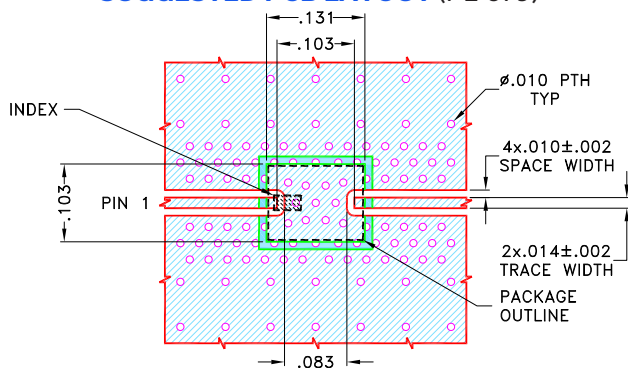


Figure 1. TPCV-333+ Functional Diagram

## PAD DESCRIPTION

| Function         | Pad Number | Description                                        |
|------------------|------------|----------------------------------------------------|
| RF1 <sup>2</sup> | 1          | Connects to RF Input Port                          |
| RF2 <sup>2</sup> | 2          | Connects to RF Output Port                         |
| GROUND           | 3          | Connects to Ground on PCB,<br>(See drawing PL-679) |

## SUGGESTED PCB LAYOUT (PL-679)

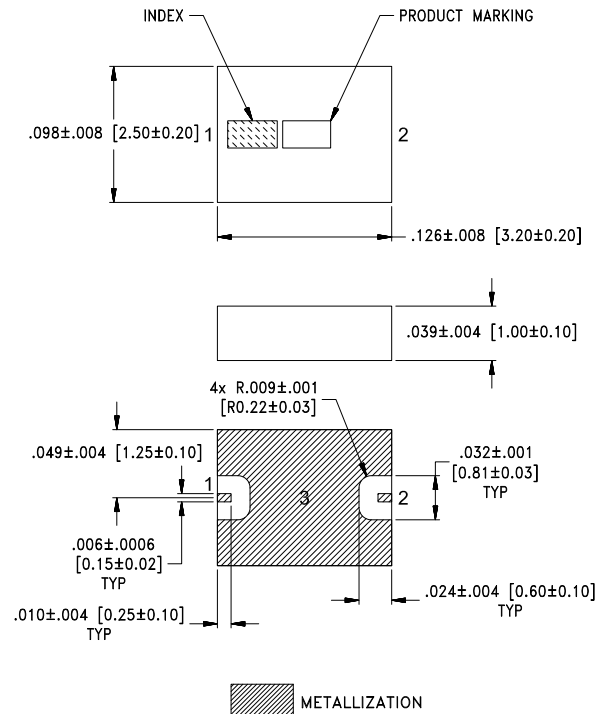


## NOTES:

1. COPLANAR WAVEGUIDE PARAMETERS ARE SHOWN FOR ROGERS (R04835 Lo Pro) WITH DIELECTRIC THICKNESS .0073±.0007. COPPER: 1/2 Oz. EACH SIDE.  
FOR OTHER MATERIALS TRACE WIDTH AND GAP MAY NEED TO BE MODIFIED.
  2. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.
-  DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)  
 DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

Figure 2. Suggested PCB Layout PL-679

## CASE STYLE DRAWING



Weight: .03 grams

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

## PRODUCT MARKING\*: WN

\*Marking may contain other features or characters for internal lot control.



Mini-Circuits

LTCC SURFACE MOUNT

# Thru-Line

TPCV-333+

50Ω DC to 33 GHz

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD. [CLICK HERE](#)

|                                 |                                                                         |
|---------------------------------|-------------------------------------------------------------------------|
| Performance Data and Graphs     | Data                                                                    |
|                                 | Graphs                                                                  |
|                                 | S-Parameter (S2P Files) Data Set (.zip file) De-embedded to device pads |
| Case Style                      | JV1210C-7    Lead Finish: Gold over Nickel Plating.                     |
| RoHS Status                     | Compliant                                                               |
| Tape and Reel                   | F74                                                                     |
| Suggested Layout for PCB Design | PL-679                                                                  |
| Evaluation Board                | TB-TPCV-333+                                                            |
|                                 | Gerber File                                                             |
| Environmental Rating            | ENV06T10                                                                |

## 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-Circuits' 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)



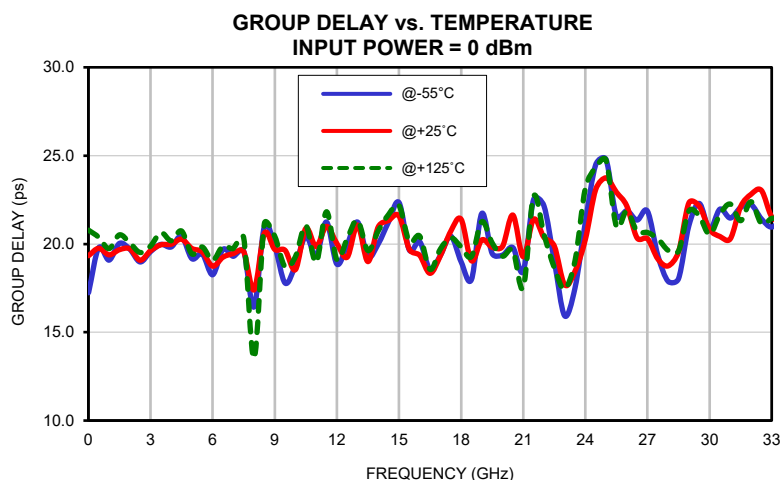
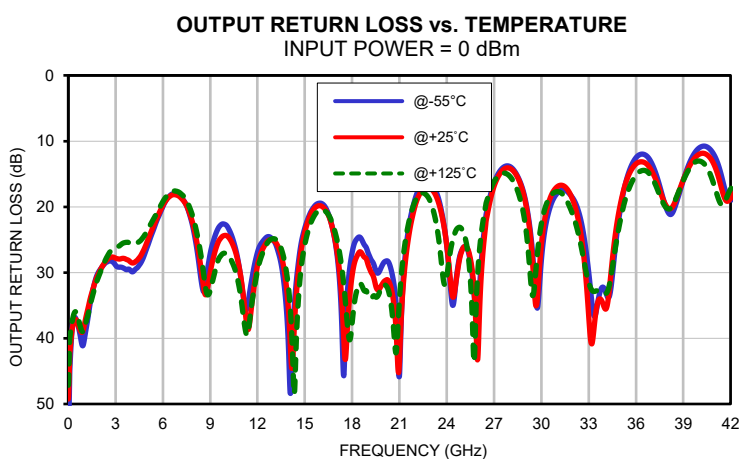
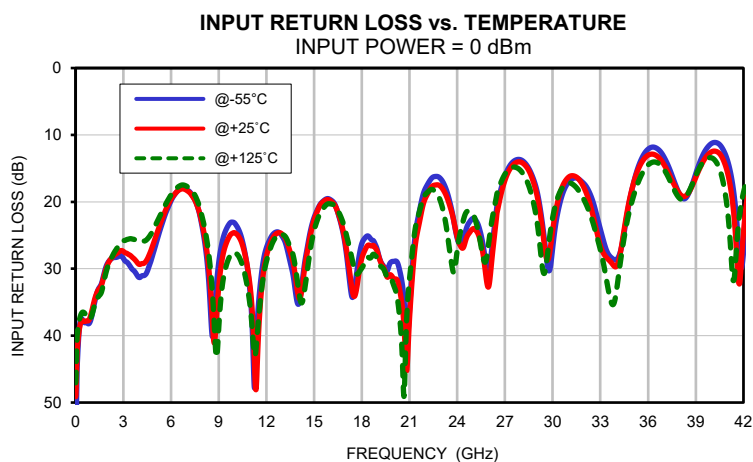
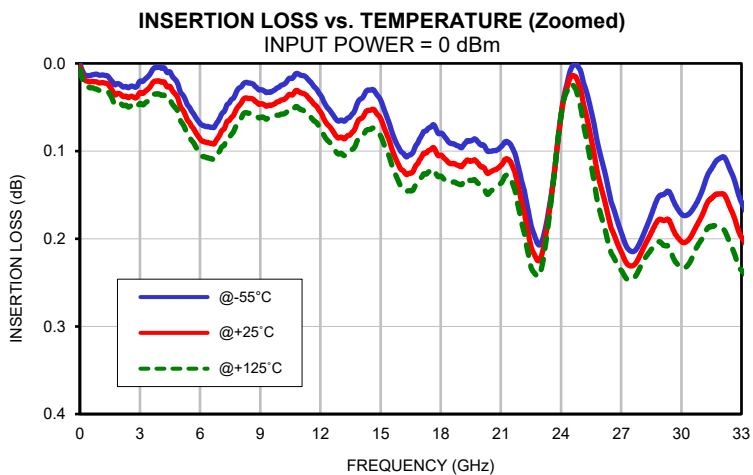
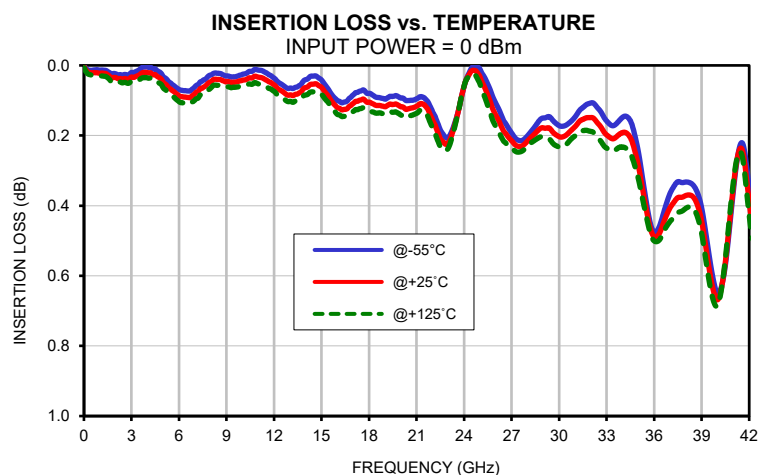
## Typical Performance Data

| FREQ. | INSERTION LOSS |        |         | INPUT RETURN LOSS |        |         | OUTPUT RETURN LOSS |        |         |
|-------|----------------|--------|---------|-------------------|--------|---------|--------------------|--------|---------|
| (GHz) | (dB)           |        |         | (dB)              |        |         | (dB)               |        |         |
|       | @-55°C         | @+25°C | @+125°C | @-55°C            | @+25°C | @+125°C | @-55°C             | @+25°C | @+125°C |
| 0.01  | 0.00           | 0.00   | 0.01    | 56.14             | 49.13  | 47.06   | 56.95              | 49.24  | 47.15   |
| 0.10  | 0.01           | 0.01   | 0.02    | 44.83             | 42.37  | 40.00   | 44.90              | 42.38  | 40.04   |
| 0.20  | 0.01           | 0.02   | 0.02    | 40.14             | 39.75  | 38.17   | 40.18              | 39.67  | 38.17   |
| 0.30  | 0.01           | 0.02   | 0.03    | 37.76             | 38.29  | 37.12   | 37.53              | 37.96  | 36.86   |
| 0.40  | 0.01           | 0.02   | 0.03    | 37.48             | 37.78  | 36.58   | 36.81              | 37.20  | 36.09   |
| 0.50  | 0.01           | 0.02   | 0.03    | 37.93             | 37.81  | 36.51   | 37.08              | 37.18  | 36.02   |
| 0.60  | 0.01           | 0.02   | 0.03    | 38.07             | 37.87  | 36.72   | 37.83              | 37.72  | 36.63   |
| 0.70  | 0.01           | 0.02   | 0.03    | 38.07             | 37.79  | 37.07   | 38.84              | 38.45  | 37.59   |
| 0.80  | 0.01           | 0.02   | 0.03    | 38.23             | 37.78  | 37.50   | 40.12              | 38.99  | 38.46   |
| 0.90  | 0.01           | 0.02   | 0.03    | 38.01             | 37.37  | 37.55   | 41.12              | 39.05  | 38.99   |
| 1.00  | 0.01           | 0.02   | 0.03    | 37.29             | 36.55  | 37.10   | 40.50              | 38.25  | 38.70   |
| 2.00  | 0.02           | 0.03   | 0.04    | 29.25             | 29.49  | 29.87   | 29.64              | 29.79  | 30.17   |
| 3.00  | 0.02           | 0.03   | 0.05    | 28.43             | 27.40  | 25.81   | 28.87              | 27.80  | 26.26   |
| 4.00  | 0.00           | 0.02   | 0.04    | 31.30             | 29.34  | 26.00   | 29.81              | 28.48  | 25.63   |
| 5.00  | 0.03           | 0.05   | 0.06    | 26.76             | 25.52  | 23.63   | 26.17              | 25.34  | 23.63   |
| 6.00  | 0.07           | 0.09   | 0.10    | 19.86             | 19.60  | 18.97   | 19.97              | 19.79  | 19.22   |
| 7.00  | 0.06           | 0.08   | 0.10    | 18.17             | 18.30  | 17.69   | 18.21              | 18.35  | 17.75   |
| 8.00  | 0.03           | 0.05   | 0.06    | 24.25             | 23.73  | 22.64   | 24.21              | 23.53  | 22.36   |
| 9.00  | 0.03           | 0.05   | 0.06    | 29.16             | 32.81  | 39.06   | 27.18              | 30.09  | 32.75   |
| 10.00 | 0.03           | 0.04   | 0.06    | 23.17             | 24.62  | 27.55   | 22.76              | 24.36  | 27.06   |
| 10.50 | 0.02           | 0.04   | 0.05    | 25.93             | 26.49  | 29.52   | 25.41              | 26.12  | 29.02   |
| 11.00 | 0.01           | 0.03   | 0.05    | 34.25             | 33.15  | 36.02   | 31.78              | 31.60  | 34.71   |
| 11.50 | 0.02           | 0.04   | 0.06    | 35.42             | 40.09  | 37.75   | 33.12              | 37.74  | 37.45   |
| 12.00 | 0.04           | 0.06   | 0.07    | 26.89             | 28.14  | 28.93   | 26.94              | 28.93  | 29.71   |
| 12.50 | 0.05           | 0.07   | 0.09    | 24.66             | 25.06  | 25.61   | 24.79              | 25.69  | 26.09   |
| 13.00 | 0.06           | 0.08   | 0.10    | 25.17             | 24.85  | 24.87   | 25.07              | 25.08  | 24.85   |
| 13.50 | 0.06           | 0.08   | 0.10    | 29.04             | 27.52  | 26.80   | 28.66              | 27.33  | 26.34   |
| 14.00 | 0.04           | 0.06   | 0.08    | 35.31             | 33.98  | 32.70   | 43.68              | 36.97  | 33.02   |
| 14.50 | 0.03           | 0.05   | 0.08    | 27.78             | 28.46  | 31.57   | 30.51              | 32.33  | 38.25   |
| 15.00 | 0.04           | 0.06   | 0.08    | 22.36             | 22.73  | 24.29   | 23.25              | 23.89  | 25.80   |
| 15.50 | 0.07           | 0.09   | 0.11    | 20.04             | 20.15  | 21.24   | 20.30              | 20.60  | 21.81   |
| 16.00 | 0.10           | 0.12   | 0.14    | 19.63             | 19.81  | 20.30   | 19.45              | 19.84  | 20.46   |
| 16.50 | 0.10           | 0.13   | 0.15    | 21.66             | 21.61  | 21.31   | 21.10              | 21.28  | 21.20   |
| 17.00 | 0.08           | 0.11   | 0.13    | 27.18             | 26.59  | 24.65   | 26.45              | 26.12  | 24.59   |
| 17.50 | 0.07           | 0.10   | 0.12    | 33.62             | 34.11  | 29.76   | 44.71              | 41.41  | 32.47   |
| 18.00 | 0.08           | 0.10   | 0.13    | 26.25             | 28.43  | 29.91   | 27.00              | 30.49  | 37.74   |
| 18.50 | 0.09           | 0.11   | 0.14    | 25.35             | 26.51  | 28.40   | 24.63              | 26.85  | 31.64   |
| 19.00 | 0.10           | 0.12   | 0.14    | 27.40             | 27.62  | 28.69   | 26.89              | 28.69  | 33.42   |
| 19.50 | 0.09           | 0.11   | 0.13    | 30.27             | 30.65  | 30.75   | 29.71              | 32.03  | 33.72   |
| 20.00 | 0.09           | 0.12   | 0.14    | 28.90             | 31.47  | 32.44   | 28.52              | 31.44  | 31.84   |
| 20.50 | 0.10           | 0.12   | 0.15    | 31.61             | 34.84  | 40.93   | 29.82              | 32.62  | 35.36   |
| 21.00 | 0.10           | 0.12   | 0.14    | 36.25             | 37.53  | 31.54   | 45.81              | 43.65  | 34.33   |
| 21.50 | 0.09           | 0.11   | 0.13    | 22.80             | 24.50  | 22.50   | 24.66              | 25.97  | 23.50   |
| 22.00 | 0.13           | 0.15   | 0.18    | 17.99             | 19.43  | 18.89   | 18.77              | 19.81  | 19.12   |
| 22.50 | 0.18           | 0.21   | 0.23    | 16.27             | 17.56  | 18.23   | 16.38              | 17.29  | 17.89   |
| 23.00 | 0.21           | 0.22   | 0.24    | 16.67             | 17.81  | 20.29   | 16.36              | 17.21  | 19.43   |
| 24.00 | 0.06           | 0.06   | 0.06    | 25.45             | 25.24  | 27.26   | 25.88              | 25.81  | 30.68   |
| 25.00 | 0.01           | 0.03   | 0.05    | 22.46             | 24.02  | 21.87   | 26.39              | 26.46  | 23.54   |
| 26.00 | 0.11           | 0.14   | 0.17    | 30.06             | 32.47  | 25.77   | 35.84              | 41.75  | 28.91   |
| 27.00 | 0.19           | 0.22   | 0.24    | 16.14             | 16.79  | 15.86   | 16.36              | 16.89  | 16.18   |
| 28.00 | 0.20           | 0.22   | 0.23    | 13.72             | 14.07  | 15.36   | 13.86              | 14.14  | 15.36   |
| 29.00 | 0.15           | 0.18   | 0.21    | 18.23             | 18.87  | 22.69   | 19.10              | 19.43  | 23.04   |
| 29.50 | 0.15           | 0.18   | 0.22    | 26.01             | 26.82  | 30.60   | 28.74              | 30.51  | 33.28   |
| 30.00 | 0.17           | 0.20   | 0.23    | 26.94             | 24.32  | 22.38   | 28.17              | 25.84  | 22.61   |
| 30.50 | 0.17           | 0.20   | 0.22    | 19.79             | 18.45  | 18.34   | 20.48              | 19.08  | 18.65   |
| 31.00 | 0.15           | 0.18   | 0.20    | 17.04             | 16.32  | 17.18   | 17.96              | 16.96  | 17.70   |
| 31.50 | 0.12           | 0.15   | 0.19    | 16.44             | 16.31  | 17.89   | 17.46              | 16.96  | 18.58   |
| 32.00 | 0.11           | 0.15   | 0.19    | 17.36             | 18.02  | 19.83   | 18.70              | 18.99  | 21.24   |
| 32.50 | 0.12           | 0.17   | 0.21    | 19.72             | 21.67  | 22.85   | 21.99              | 24.03  | 25.74   |
| 33.00 | 0.16           | 0.20   | 0.24    | 24.09             | 26.53  | 27.15   | 29.90              | 36.50  | 31.51   |

*Typical Performance Data*

| FREQ. | GROUP DELAY |        |         |
|-------|-------------|--------|---------|
| (GHz) | (psec)      |        |         |
|       | @-55°C      | @+25°C | @+125°C |
| 0.01  | 17.24       | 19.33  | 20.78   |
| 0.10  | 18.53       | 18.53  | 18.53   |
| 0.50  | 19.79       | 19.75  | 20.38   |
| 1.00  | 19.08       | 19.38  | 19.74   |
| 2.00  | 19.71       | 19.73  | 20.06   |
| 3.00  | 19.56       | 19.62  | 19.88   |
| 4.00  | 19.83       | 19.98  | 20.18   |
| 5.00  | 19.17       | 19.75  | 19.43   |
| 6.00  | 18.26       | 18.74  | 19.07   |
| 7.00  | 19.30       | 19.46  | 19.74   |
| 8.00  | 16.43       | 17.40  | 13.52   |
| 9.00  | 19.90       | 19.69  | 20.44   |
| 10.00 | 18.80       | 18.55  | 19.28   |
| 11.00 | 19.33       | 19.85  | 18.96   |
| 12.00 | 18.86       | 20.03  | 19.12   |
| 13.00 | 21.24       | 21.07  | 21.34   |
| 14.00 | 20.01       | 20.97  | 20.75   |
| 15.00 | 22.35       | 21.59  | 22.18   |
| 16.00 | 20.13       | 19.36  | 20.44   |
| 17.00 | 19.36       | 19.34  | 19.71   |
| 18.00 | 18.99       | 21.40  | 19.84   |
| 19.00 | 21.73       | 20.23  | 21.26   |
| 20.00 | 19.37       | 19.86  | 19.31   |
| 21.00 | 18.45       | 19.28  | 17.52   |
| 22.00 | 22.16       | 20.37  | 20.55   |
| 23.00 | 15.93       | 17.69  | 17.44   |
| 24.00 | 21.24       | 20.25  | 23.16   |
| 25.00 | 24.78       | 23.74  | 24.74   |
| 26.00 | 21.89       | 22.15  | 21.86   |
| 27.00 | 21.85       | 20.30  | 20.65   |
| 28.00 | 17.88       | 18.76  | 19.64   |
| 28.50 | 18.04       | 19.55  | 19.60   |
| 29.00 | 21.04       | 22.32  | 21.86   |
| 29.50 | 22.30       | 22.14  | 21.59   |
| 30.00 | 20.83       | 20.83  | 20.54   |
| 30.50 | 21.97       | 20.42  | 21.68   |
| 31.00 | 21.47       | 20.29  | 22.26   |
| 31.50 | 22.06       | 22.11  | 21.32   |
| 32.00 | 22.24       | 22.81  | 22.39   |
| 32.50 | 21.42       | 23.03  | 21.15   |
| 33.00 | 20.96       | 21.54  | 21.45   |

## Typical Performance Curves

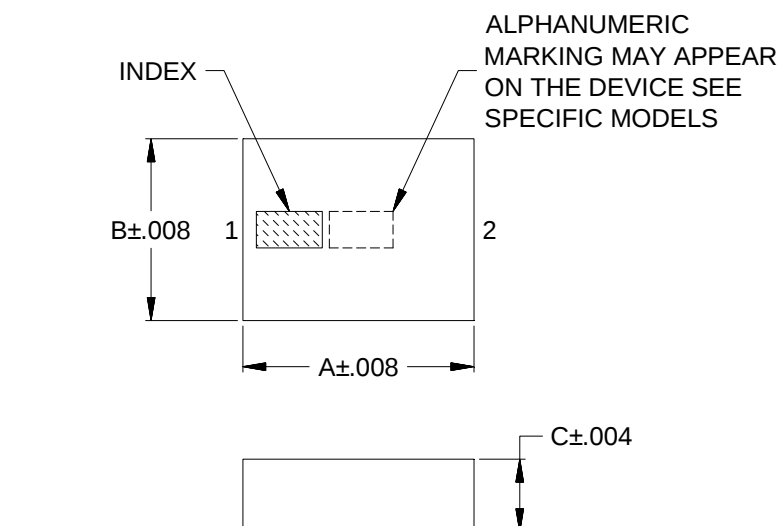


# Case Style

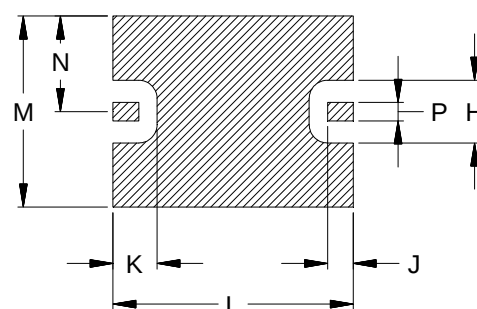
JV

## Outline Dimensions

JV1210C-7

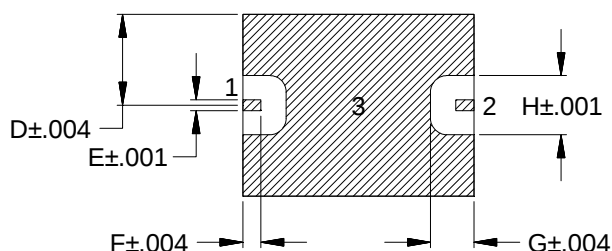


## PCB LAND PATTERN



## SUGGESTED LAYOUT

TOLERANCE TO BE WITHIN ±.002



 METALLIZATION

| CASE#     | A              | B              | C              | D              | E              | F              | G              | H              | J              | K              | L              | M              | N              | P              | WT.GRAM |
|-----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------|
| JV1210C-7 | .126<br>(3.20) | .098<br>(2.50) | .039<br>(1.00) | .049<br>(1.25) | .006<br>(0.15) | .010<br>(0.25) | .024<br>(0.60) | .032<br>(0.81) | .014<br>(0.36) | .024<br>(0.61) | .131<br>(3.33) | .103<br>(2.63) | .052<br>(1.31) | .010<br>(0.25) | 0.03    |

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

## Notes:

1. Open style, Ceramic base.
2. Termination finish: **as shown below or indicated on Data Sheet.**  
For RoHS Case Styles: Gold plate over Nickel plate. All models, (+) suffix.
3. Pad tolerance is non-cumulative. Minimum spacing between each pad is .004.

 **Mini-Circuits®**  
ISO 9001 ISO 14001 CERTIFIED

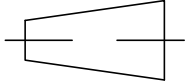
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RFIIF MICROWAVE COMPONENTS



| REV | ECN No.    | DESCRIPTION      | DATE   | DR  | AUTH |
|-----|------------|------------------|--------|-----|------|
| OR  | ECO-003129 | NEW RELEASE      | JUL 20 | DDR | VC   |
| OR1 | ECO-019409 | JV1210C-13 ADDED | OCT 23 | AGS | VC   |
|     |            |                  |        |     |      |

INDEX

PIN 1

.131

.103

.103

.083

Ø.010 PTH TYP

4x.010±.002 SPACE WIDTH

2x.014±.002 TRACE WIDTH

PACKAGE OUTLINE

 DENOTES PCB COPPER PATTERN WITH SMOBC (SOLDER MASK OVER BARE COPPER)  
 DENOTES PCB COPPER PATTERN FREE OF SOLDERMASK

| UNLESS OTHERWISE SPECIFIED | INITIALS |     | DATE      |
|----------------------------|----------|-----|-----------|
| DIMENSIONS ARE IN INCHES   | DRAWN    | DDR | 02 JUL 20 |
| TOLERANCES ON:             | CHECKED  | RV  | 02 JUL 20 |
| 2 PL DECIMALS ±            | APPROVED | RKS | 02 JUL 20 |
| 3 PL DECIMALS ± .005"      |          |     |           |
| ANGLES ±                   |          |     |           |
| FRACTIONS ±                |          |     |           |



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Brooklyn NY 11235

PL, JV1210C-7, JV1210C-13, TB-LFCV-X+

|           |                     |                          |                  |
|-----------|---------------------|--------------------------|------------------|
| SIZE<br>A | CODE IDENT<br>15542 | DRAWING NO:<br>98-PL-679 | REV:<br>OR1      |
| FILE:     | 98PL679             | SCALE:<br>9:1            | SHEET:<br>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 | -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 245° - 250°C peak | J-STD-020C, Table 4-1, 4-2 and 5-2, Figure 5-1                                                       |
| Solderability         | 10X Magnification                                                      | J-STD-002, Test B,B1, 95% Coverage                                                                   |
| Thermal Shock         | -55° to +125°C, 15 min dwell,250 cycles                                | MIL-STD-202, Method 107                                                                              |
| Bend Test             | 1mm, deflection for 5 seconds<br>Span of bending: 2.75"                | --                                                                                                   |
| High Temp Storage     | 125°C to 1000 Hrs                                                      | ---                                                                                                  |