

# Surface Mount Voltage Controlled Oscillator

## JTOS-1950

### Linear Tuning 1550 to 1950 MHz

#### Features

- linear tuning characteristics, 22-30 MHz/V typ.
- wide frequency range, 1550 to 1950 MHz
- low phase noise, -144 dBc/Hz at 1 MHz offset, typ.
- aqueous washable
- protected by US patent 6,549,084

#### Applications

- PCS
- DCS
- communication systems



CASE STYLE: BK377

#### Electrical Specifications

| FREQUENCY (MHz) |      | POWER OUTPUT (dBm) | TUNING VOLTAGE (V) |      | PHASE NOISE (dBc/Hz) |        |         |       | PULLING pk-pk @ 12 dB (MHz) | PUSHING (MHz/V) | TUNING SENSITIVITY (MHz/V) | HARMONICS (dBc) |      | 3 dB MODULATION BANDWIDTH (MHz) | DC OPERATING POWER      |                   |
|-----------------|------|--------------------|--------------------|------|----------------------|--------|---------|-------|-----------------------------|-----------------|----------------------------|-----------------|------|---------------------------------|-------------------------|-------------------|
| Min.            | Max. | Typ.               | Min.               | Max. | 1 kHz                | 10 kHz | 100 kHz | 1 MHz | Typ.                        | Typ.            | Typ.                       | Typ.            | Max. | Typ.                            | V <sub>cc</sub> (Volts) | Current (mA) Max. |
| 1550            | 1950 | +10                | 0.5                | 20   | -70                  | -98    | -122    | -144  | 7                           | 1.0             | 22-30                      | -14             | -8   | 100                             | 12                      | 35                |

#### Pin Connections

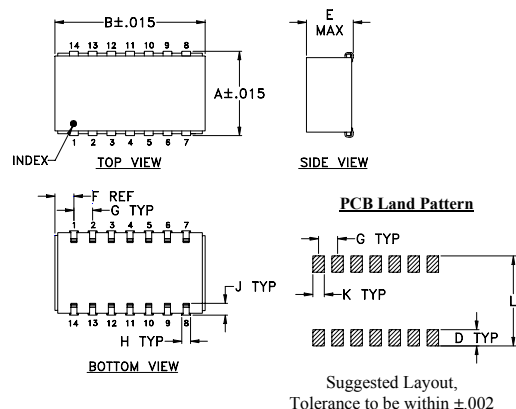
|        |                           |
|--------|---------------------------|
| RF OUT | 13                        |
| VCC    | 2                         |
| V-TUNE | 5                         |
| GROUND | 1,3,4,6,7,8,9,10,11,12,14 |

#### Maximum Ratings

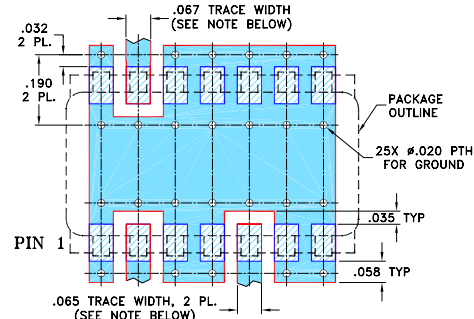
|                                                   |                |
|---------------------------------------------------|----------------|
| Operating Temperature                             | -55°C to 85°C  |
| Storage Temperature                               | -55°C to 100°C |
| Absolute Max. Supply Voltage (V <sub>cc</sub> )   | +13V           |
| Absolute Max. Tuning Voltage (V <sub>tune</sub> ) | +22V           |

all specifications: 50 ohm system  
Permanent damage may occur if any of these limits are exceeded.

#### Outline Drawing



Demo Board MCL PIN: TB-04  
Suggested PCB Layout (PL-005)



- 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. BOTTOM SIDE OF THE PCB IS CONTINUOUS GROUND PLANE.

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

■ DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

#### Outline Dimensions (inch/mm)

| A     | B     | C  | D    | E    | F    | G    | H    | J    | K    | L     | wt    |
|-------|-------|----|------|------|------|------|------|------|------|-------|-------|
| .505  | .800  | -- | .100 | .250 | .100 | .100 | .047 | .065 | .065 | .525  | grams |
| 12.83 | 20.32 | -- | 2.54 | 6.35 | 2.54 | 2.54 | 1.19 | 1.65 | 1.65 | 13.34 | 3.0   |

#### 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.
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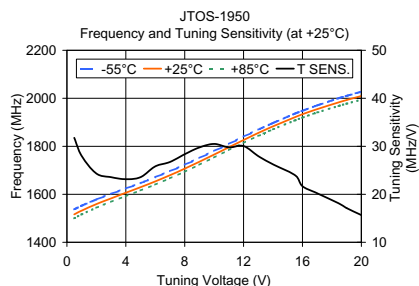


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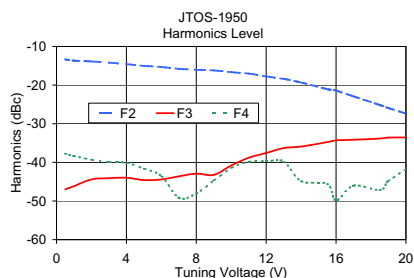
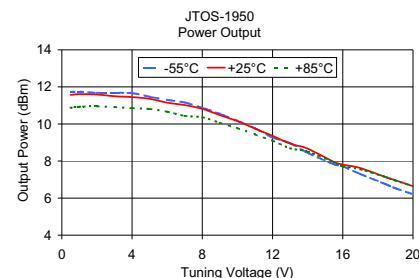
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Page 1 of 2

# Performance Data & Curves

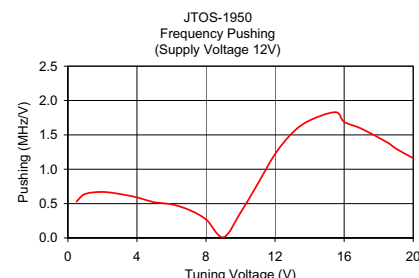
# JTOS-1950



| V<br>TUNE | TUNING<br>SENS.<br>(MHz/V) | FREQUENCY (MHz) |         |         | POWER OUTPUT (dBm) |       |       |
|-----------|----------------------------|-----------------|---------|---------|--------------------|-------|-------|
|           |                            | -55°C           | +25°C   | +85°C   | -55°C              | +25°C | +85°C |
| 0.50      | 31.77                      | 1537.19         | 1516.19 | 1499.79 | 11.73              | 11.57 | 10.88 |
| 1.00      | 27.99                      | 1552.49         | 1532.07 | 1516.26 | 11.74              | 11.61 | 10.93 |
| 2.00      | 24.34                      | 1578.22         | 1559.00 | 1543.90 | 11.68              | 11.59 | 10.95 |
| 3.00      | 23.56                      | 1601.85         | 1582.91 | 1568.57 | 11.68              | 11.50 | 10.91 |
| 4.00      | 23.15                      | 1624.28         | 1606.37 | 1592.28 | 11.66              | 11.45 | 10.85 |
| 5.00      | 23.56                      | 1646.84         | 1629.54 | 1615.97 | 11.47              | 11.36 | 10.81 |
| 6.00      | 25.82                      | 1671.25         | 1653.56 | 1640.11 | 11.30              | 11.15 | 10.66 |
| 7.00      | 26.73                      | 1696.35         | 1679.60 | 1666.23 | 11.16              | 11.02 | 10.44 |
| 8.00      | 28.36                      | 1723.00         | 1706.80 | 1693.60 | 10.88              | 10.82 | 10.36 |
| 9.00      | 29.76                      | 1751.20         | 1735.56 | 1722.69 | 10.55              | 10.48 | 10.07 |
| 10.00     | 30.50                      | 1780.56         | 1765.66 | 1753.00 | 10.17              | 10.15 | 9.77  |
| 11.00     | 29.77                      | 1809.95         | 1796.00 | 1783.86 | 9.77               | 9.75  | 9.44  |
| 12.00     | 30.05                      | 1840.11         | 1825.94 | 1813.79 | 9.27               | 9.36  | 9.09  |
| 13.00     | 27.95                      | 1869.34         | 1855.67 | 1843.31 | 8.97               | 8.94  | 8.69  |
| 14.00     | 26.23                      | 1897.22         | 1883.15 | 1870.75 | 8.44               | 8.67  | 8.51  |
| 15.50     | 23.95                      | 1936.57         | 1921.51 | 1907.93 | 7.83               | 7.95  | 7.94  |
| 16.00     | 21.68                      | 1948.09         | 1933.49 | 1919.58 | 7.71               | 7.81  | 7.73  |
| 17.00     | 20.21                      | 1970.58         | 1954.72 | 1940.89 | 7.30               | 7.62  | 7.55  |
| 18.50     | 18.05                      | 2001.05         | 1983.99 | 1968.91 | 6.73               | 7.11  | 7.12  |
| 19.00     | 17.13                      | 2010.21         | 1993.02 | 1977.63 | 6.53               | 6.96  | 6.95  |
| 20.00     | 15.66                      | 2027.45         | 2009.78 | 1994.09 | 6.21               | 6.64  | 6.64  |



| V<br>TUNE | HARMONICS (dBc) |        |        | FREQ. PUSHING<br>(MHz/V) |
|-----------|-----------------|--------|--------|--------------------------|
|           | F2              | F3     | F4     |                          |
| 0.50      | -13.34          | -46.96 | -37.74 | 0.53                     |
| 1.00      | -13.68          | -46.13 | -38.35 | 0.64                     |
| 2.00      | -13.89          | -44.42 | -39.31 | 0.67                     |
| 3.00      | -14.19          | -44.09 | -39.91 | 0.64                     |
| 4.00      | -14.57          | -43.98 | -40.11 | 0.59                     |
| 5.00      | -15.03          | -44.58 | -41.61 | 0.52                     |
| 6.00      | -15.31          | -44.42 | -43.54 | 0.49                     |
| 7.00      | -15.80          | -43.62 | -49.17 | 0.41                     |
| 8.00      | -16.05          | -42.92 | -48.07 | 0.27                     |
| 9.00      | -16.19          | -43.23 | -44.72 | 0.01                     |
| 10.00     | -16.66          | -40.81 | -41.46 | 0.37                     |
| 11.00     | -17.02          | -38.79 | -39.84 | 0.79                     |
| 12.00     | -17.76          | -37.58 | -39.74 | 1.22                     |
| 13.00     | -18.39          | -36.30 | -39.81 | 1.53                     |
| 14.00     | -19.34          | -35.91 | -44.84 | 1.71                     |
| 15.50     | -21.06          | -34.75 | -45.58 | 1.83                     |
| 16.00     | -21.42          | -34.31 | -49.84 | 1.69                     |
| 17.00     | -22.93          | -34.14 | -46.02 | 1.59                     |
| 18.50     | -25.14          | -33.85 | -47.16 | 1.39                     |
| 19.00     | -25.95          | -33.58 | -44.81 | 1.30                     |
| 20.00     | -27.37          | -33.55 | -41.76 | 1.16                     |



## Notes

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# Voltage Controlled Oscillator

JTOS-1950

## Typical Performance Data

| V<br>TUNE | TUNE<br>SENS<br>(MHz/V) | FREQUENCY<br>(MHz) |        |        | POWER OUTPUT<br>(dBm) |       |       | HARMONICS (dBc) |       |       | FREQ.<br>PUSH<br>(MHz/V) | FREQ<br>OFFSET<br>(KHz) | PHASE<br>NOISE<br>(dBc/Hz) |
|-----------|-------------------------|--------------------|--------|--------|-----------------------|-------|-------|-----------------|-------|-------|--------------------------|-------------------------|----------------------------|
|           |                         | -55°C              | +25°C  | +85°C  | -55°C                 | +25°C | +85°C | F2              | F3    | F4    |                          |                         |                            |
| 0.0       | 41.32                   | 1518.1             | 1495.5 | 1477.4 | 11.65                 | 11.46 | 10.72 | -13.1           | -47.7 | -38.3 | 0.04                     | 1                       | -70                        |
| 0.5       | 31.77                   | 1537.2             | 1516.2 | 1499.8 | 11.73                 | 11.57 | 10.88 | -13.3           | -47.0 | -37.7 | 0.53                     | 10                      | -99                        |
| 1.0       | 27.99                   | 1552.5             | 1532.1 | 1516.3 | 11.74                 | 11.61 | 10.93 | -13.7           | -46.1 | -38.4 | 0.64                     | 100                     | -122                       |
| 1.5       | 25.86                   | 1565.9             | 1546.1 | 1530.6 | 11.73                 | 11.60 | 10.95 | -13.6           | -45.9 | -38.7 | 0.67                     | 1000                    | -145                       |
| 2.0       | 24.34                   | 1578.2             | 1559.0 | 1543.9 | 11.68                 | 11.59 | 10.95 | -13.9           | -44.4 | -39.3 | 0.67                     |                         |                            |
| 2.5       | 23.48                   | 1590.2             | 1571.2 | 1556.5 | 11.68                 | 11.55 | 10.94 | -14.2           | -44.7 | -39.1 | 0.65                     |                         |                            |
| 3.0       | 23.56                   | 1601.8             | 1582.9 | 1568.6 | 11.68                 | 11.50 | 10.91 | -14.2           | -44.1 | -39.9 | 0.64                     |                         |                            |
| 3.5       | 23.37                   | 1613.2             | 1594.7 | 1580.4 | 11.69                 | 11.46 | 10.86 | -14.4           | -43.9 | -40.0 | 0.62                     |                         |                            |
| 4.0       | 23.15                   | 1624.3             | 1606.4 | 1592.3 | 11.66                 | 11.45 | 10.85 | -14.6           | -44.0 | -40.1 | 0.59                     |                         |                            |
| 4.5       | 23.19                   | 1635.4             | 1617.9 | 1604.1 | 11.57                 | 11.42 | 10.84 | -14.8           | -43.5 | -40.4 | 0.56                     |                         |                            |
| 5.0       | 23.56                   | 1646.8             | 1629.5 | 1616.0 | 11.47                 | 11.36 | 10.81 | -15.0           | -44.6 | -41.6 | 0.52                     |                         |                            |
| 5.5       | 24.48                   | 1658.8             | 1641.3 | 1627.9 | 11.31                 | 11.27 | 10.75 | -15.4           | -44.2 | -42.0 | 0.50                     |                         |                            |
| 6.0       | 25.82                   | 1671.3             | 1653.6 | 1640.1 | 11.30                 | 11.15 | 10.66 | -15.3           | -44.4 | -43.5 | 0.49                     |                         |                            |
| 6.5       | 26.26                   | 1683.6             | 1666.5 | 1652.8 | 11.27                 | 11.02 | 10.55 | -15.4           | -43.7 | -46.3 | 0.47                     |                         |                            |
| 7.0       | 26.73                   | 1696.4             | 1679.6 | 1666.2 | 11.16                 | 11.02 | 10.44 | -15.8           | -43.6 | -49.2 | 0.41                     |                         |                            |
| 7.5       | 27.67                   | 1709.5             | 1693.0 | 1679.8 | 11.05                 | 10.94 | 10.44 | -15.9           | -43.1 | -49.9 | 0.36                     |                         |                            |
| 8.0       | 28.36                   | 1723.0             | 1706.8 | 1693.6 | 10.88                 | 10.82 | 10.36 | -16.1           | -42.9 | -48.1 | 0.27                     |                         |                            |
| 8.5       | 29.17                   | 1737.0             | 1721.0 | 1707.9 | 10.72                 | 10.65 | 10.24 | -16.1           | -44.3 | -45.5 | 0.15                     |                         |                            |
| 9.0       | 29.76                   | 1751.2             | 1735.6 | 1722.7 | 10.55                 | 10.48 | 10.07 | -16.2           | -43.2 | -44.7 | 0.01                     |                         |                            |
| 9.5       | 30.44                   | 1765.8             | 1750.4 | 1737.8 | 10.39                 | 10.30 | 9.91  | -16.6           | -42.3 | -42.3 | 0.17                     |                         |                            |
| 10.0      | 30.50                   | 1780.6             | 1765.7 | 1753.0 | 10.17                 | 10.15 | 9.77  | -16.7           | -40.8 | -41.5 | 0.37                     |                         |                            |
| 10.5      | 30.18                   | 1795.3             | 1780.9 | 1768.5 | 9.98                  | 9.94  | 9.62  | -16.8           | -39.1 | -41.4 | 0.58                     |                         |                            |
| 11.0      | 29.77                   | 1810.0             | 1796.0 | 1783.9 | 9.77                  | 9.75  | 9.44  | -17.0           | -38.8 | -39.8 | 0.79                     |                         |                            |
| 11.5      | 30.11                   | 1825.0             | 1810.9 | 1799.0 | 9.55                  | 9.55  | 9.28  | -17.5           | -38.1 | -39.4 | 1.01                     |                         |                            |
| 12.0      | 30.05                   | 1840.1             | 1825.9 | 1813.8 | 9.27                  | 9.36  | 9.09  | -17.8           | -37.6 | -39.7 | 1.22                     |                         |                            |
| 12.5      | 29.42                   | 1855.0             | 1841.0 | 1828.6 | 9.11                  | 9.10  | 8.90  | -18.3           | -37.1 | -39.5 | 1.42                     |                         |                            |
| 13.0      | 27.95                   | 1869.3             | 1855.7 | 1843.3 | 8.97                  | 8.94  | 8.69  | -18.4           | -36.3 | -39.8 | 1.53                     |                         |                            |
| 13.5      | 27.01                   | 1883.4             | 1869.6 | 1857.4 | 8.75                  | 8.84  | 8.60  | -18.8           | -36.0 | -42.6 | 1.62                     |                         |                            |
| 14.0      | 26.23                   | 1897.2             | 1883.2 | 1870.7 | 8.44                  | 8.67  | 8.51  | -19.3           | -35.9 | -44.8 | 1.71                     |                         |                            |
| 14.5      | 25.49                   | 1910.7             | 1896.3 | 1883.6 | 8.17                  | 8.43  | 8.37  | -19.8           | -35.1 | -45.5 | 1.78                     |                         |                            |
| 15.5      | 23.95                   | 1936.6             | 1921.5 | 1907.9 | 7.83                  | 7.95  | 7.94  | -21.1           | -34.8 | -45.6 | 1.83                     |                         |                            |
| 16.0      | 21.68                   | 1948.1             | 1933.5 | 1919.6 | 7.71                  | 7.81  | 7.73  | -21.4           | -34.3 | -49.8 | 1.69                     |                         |                            |
| 17.0      | 20.21                   | 1970.6             | 1954.7 | 1940.9 | 7.30                  | 7.62  | 7.55  | -22.9           | -34.1 | -46.0 | 1.59                     |                         |                            |
| 17.5      | 19.53                   | 1981.2             | 1964.8 | 1950.5 | 7.10                  | 7.45  | 7.45  | -23.6           | -33.9 | -48.7 | 1.53                     |                         |                            |
| 18.5      | 18.05                   | 2001.1             | 1984.0 | 1968.9 | 6.73                  | 7.11  | 7.12  | -25.1           | -33.9 | -47.2 | 1.39                     |                         |                            |
| 19.0      | 17.13                   | 2010.2             | 1993.0 | 1977.6 | 6.53                  | 6.96  | 6.95  | -26.0           | -33.6 | -44.8 | 1.30                     |                         |                            |
| 20.0      | 15.66                   | 2027.5             | 2009.8 | 1994.1 | 6.21                  | 6.64  | 6.64  | -27.4           | -33.6 | -41.8 | 1.16                     |                         |                            |
| 20.5      | 15.11                   | 2035.5             | 2017.6 | 2001.8 | 6.08                  | 6.48  | 6.51  | -27.9           | -33.0 | -43.2 | 1.10                     |                         |                            |
| 21.5      | 13.98                   | 2050.7             | 2032.5 | 2016.2 | 5.85                  | 6.20  | 6.18  | -28.9           | -33.6 | -41.9 | 1.00                     |                         |                            |
| 22.0      | 13.98                   | 2057.9             | 2039.5 | 2023.0 | 5.76                  | 6.09  | 6.03  | -29.2           | -33.8 | -40.1 | 0.94                     |                         |                            |

REV. X2  
JTOS-1950  
101228  
Page 1 of 1



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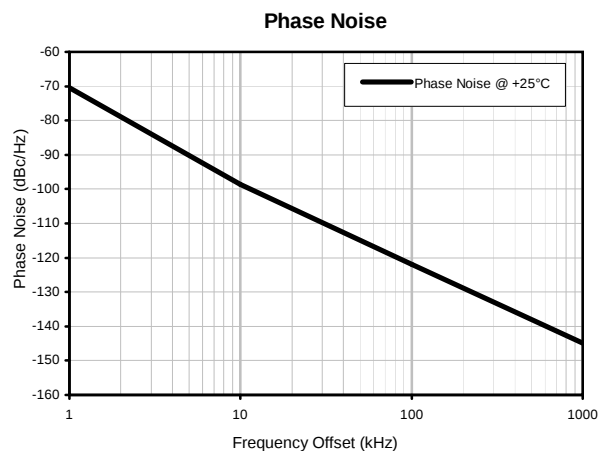
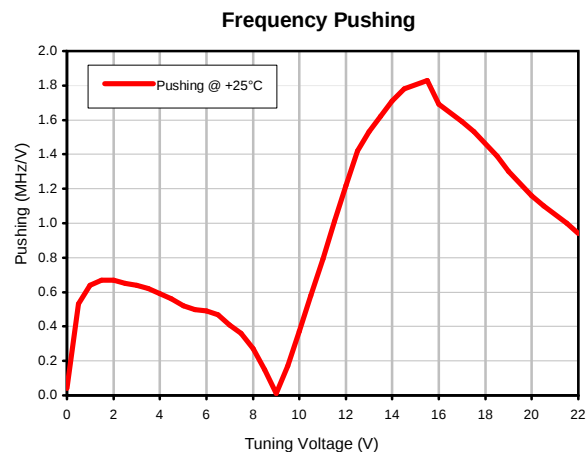
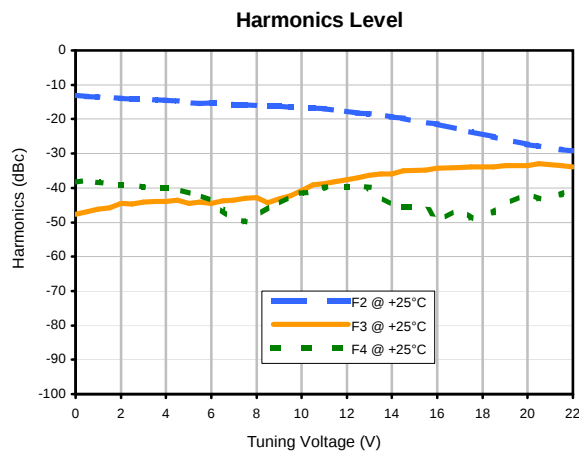
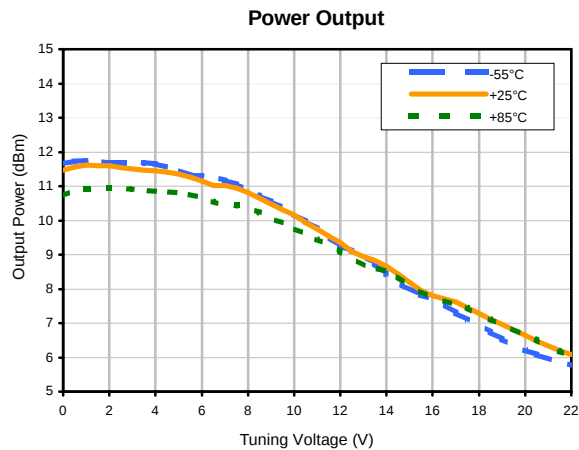
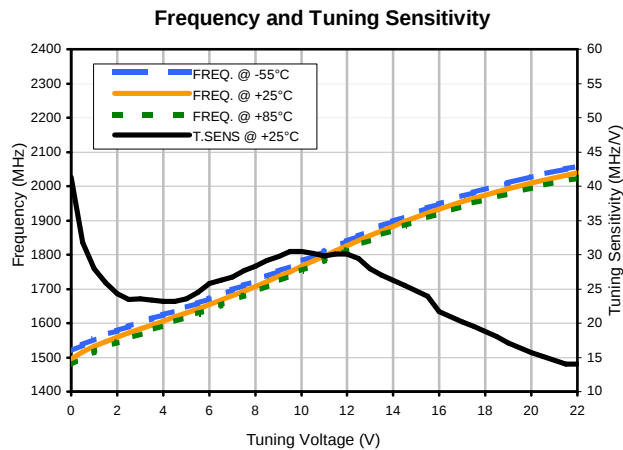
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JTOS-1950

## Typical Performance Data



REV. X2  
JTOS-1950  
101228  
Page 1 of 1



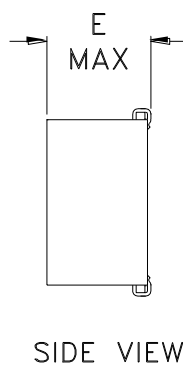
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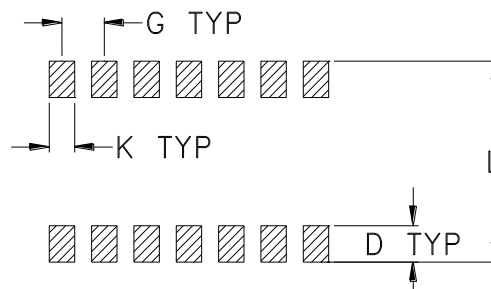
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## Outline Dimensions



## PCB Land Pattern



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

| CASE # | A               | B               | C        | D              | E              | F              | G              | H              | J              | K              | L               | WT. GRAM    |
|--------|-----------------|-----------------|----------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-------------|
| BK377  | .505<br>(12.83) | .800<br>(20.32) | --<br>-- | .100<br>(2.54) | .250<br>(6.35) | .100<br>(2.54) | .100<br>(2.54) | .047<br>(1.19) | .065<br>(1.65) | .065<br>(1.65) | .525<br>(13.34) | 2.0<br>MAX. |

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

### Notes:

- Case material: Copper Nickel alloy.
- Base material: Printed wiring laminate.
- Termination finish:
  - For RoHS Case Styles: Tin plate over Nickel plate. All models, (+) suffix.
  - For RoHS-5 Case Styles: Tin-Lead plate. All models, no (+) suffix.



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# Tape & Reel Packaging TR-F107

## DEVICE ORIENTATION IN T&R



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel                             |     |
|-------------------|----------------------------|----------------------|----------------------------------------------|-----|
| 32                | 20                         | 7                    | Small<br>quantity<br>standards<br>(see note) | 10  |
|                   |                            |                      |                                              | 20  |
|                   |                            |                      |                                              | 50  |
|                   |                            |                      |                                              | 100 |
|                   |                            | 13                   | Standard                                     | 200 |

Note: Please consult individual model data sheet to determine device per reel availability.

Mini-Circuits carrier tape materials provide protection from ESD (Electro-Static Discharge) during handling and transportation. Tapes are static dissipative and comply with industry standards EIA-481/EIA-541.

Go to: [www.minicircuits.com/pages/pdfs/tape.pdf](http://www.minicircuits.com/pages/pdfs/tape.pdf)



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## THIRD ANGLE PROJECTION



## REVISIONS

| REV | ECN No. | DESCRIPTION                | DATE     | DR  | AUTH |
|-----|---------|----------------------------|----------|-----|------|
| B   | M76077  | UPDATED DRAWING            | 04/01    | GF  | MM   |
| C   | M82575  | UPDATED DRAWING            | 08/08/02 | IL  | MM   |
| D   | M102713 | UPDATED DIMENSIONS & NOTES | 01/17/06 | MMG | IL   |
| E   | M115059 | CORRECTED NOTE 2           | 12/18/07 | MMG | IL   |

### SUGGESTED MOUNTING CONFIGURATION FOR BK377 CASE STYLE, "jc" PIN CONNECTION



- NOTES: 1. TRACE WIDTH IS SHOWN FOR ROGERS RO4350B WITH DIELECTRIC THICKNESS .030"  $\pm$  .002"; 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  $\pm$  .005ANGLES  $\pm$ FRACTIONS  $\pm$ 

DRAWN

FB

05/20/00

CHECKED

MM

05/24/00

APPROVED

DB

05/24/00



**Mini-Circuits®** 13 Neptune Avenue  
Brooklyn NY 11235

PL, jc, BK377, JTOS, TB-04

SIZE

A

CODE IDENT

15542

DRAWING NO:

98-PL-005

REV:

E

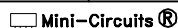
FILE: 98PL005

SCALE:

5:1

SHEET:

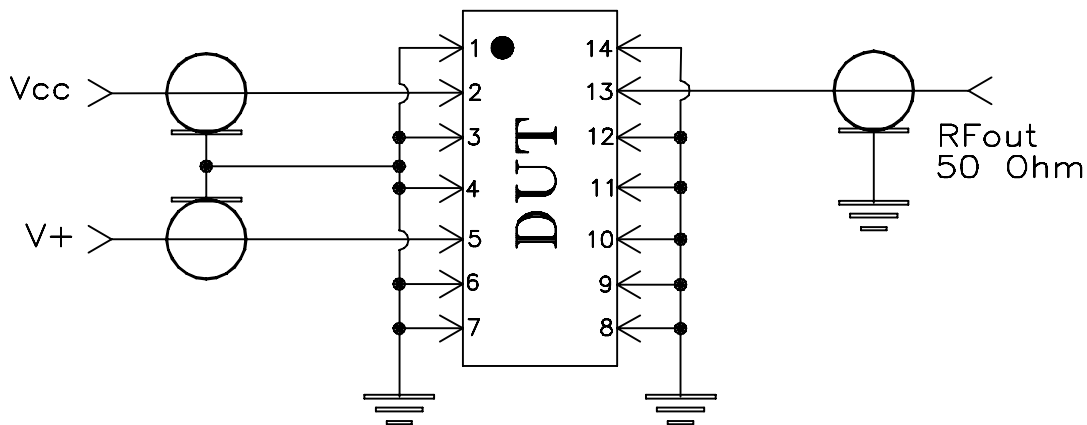
1 OF 1



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

# Evaluation Board and Circuit



Schematic Diagram

## Notes:

1. SMA Female connectors.
2. PCB Material: Rogers R04350 or equivalent,  
Dielectric Constant=3.5, Thickness=.030 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 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 Eutectic Process: 225°C peak<br>Pb-Free Process, 245°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, 20-2000 Hz, 4 times in each of three axes (total 12)                                                                                                  | MIL-STD-883, Method 2007.3, Condition A                                                              |
| 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                                                                              |