

Surface Mount

# Voltage Controlled Oscillator

ROS-2015+

5V Tuning for PLL IC's 1975 to 2015 MHz

## Features

- linear tuning characteristics
- low phase noise
- low pulling
- low pushing
- aqueous washable

## Applications

- wireless communication
- point-to-point radio



CASE STYLE: CK605

### +RoHS Compliant

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

## Electrical Specifications

| MODEL NO. | FREQ. (MHz) |      | POWER OUTPUT (dBm) | PHASE NOISE dBc/Hz SSB at offset frequencies,kHz<br><br>Typ. |      |      |      | TUNING            |                       |               |                                 | NON HARMONIC SPURIOUS (dBc) | HARMONICS (dBc) |      | PULLING pk-pk @12 dB <sub>r</sub> (MHz) | PUSHING (MHz/V) | DC OPERATING POWER      |              |    |
|-----------|-------------|------|--------------------|--------------------------------------------------------------|------|------|------|-------------------|-----------------------|---------------|---------------------------------|-----------------------------|-----------------|------|-----------------------------------------|-----------------|-------------------------|--------------|----|
|           |             |      |                    |                                                              |      |      |      | VOLTAGE RANGE (V) | SENSI- TIVITY (MHz/V) | PORT CAP (pF) | 3 dB MODULATION BANDWIDTH (MHz) |                             |                 |      |                                         |                 | V <sub>cc</sub> (volts) | Current (mA) |    |
|           | Min.        | Max. | Typ.               | 1                                                            | 10   | 100  | 1000 | Min.              | Max.                  | Typ.          | Typ.                            | Typ.                        | Typ.            | Max. | Typ.                                    | Typ.            | Max.                    |              |    |
| ROS-2015+ | 1975        | 2015 | +7.5               | -85                                                          | -108 | -129 | -149 | 0.5               | 5                     | 16-18         | 20                              | 110                         | -90             | -30  | -20                                     | 0.6             | 1                       | 5            | 35 |

## Pin Connections

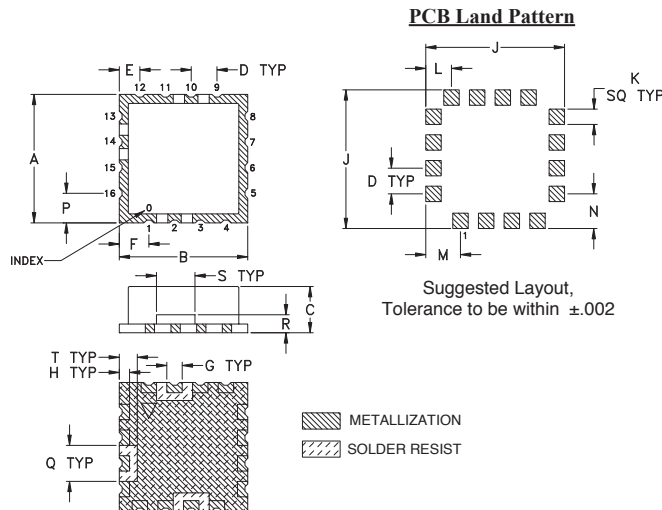
|        |                                |
|--------|--------------------------------|
| RF OUT | 10                             |
| VCC    | 14                             |
| V-TUNE | 2                              |
| GROUND | 1,3,4,5,6,7,8,9,11,12,13,15,16 |

## Maximum Ratings

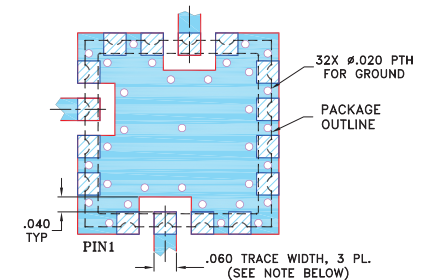
|                                      |                |
|--------------------------------------|----------------|
| Operating Temperature                | -55°C to 85°C  |
| Storage Temperature                  | -55°C to 100°C |
| Absolute Max. Supply Voltage (Vcc)   | 6.5V           |
| Absolute Max. Tuning Voltage (Vtune) | 7.0V           |
| All specifications                   | 50 ohm system  |

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

## Outline Drawing



## Demo Board MCL P/N: TB-10 Suggested PCB Layout (PL-012)



### NOTES:

1. TRACE WIDTH IS SHOWN FOR FR4 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 BOTTOM 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    | M    | N    | P    | Q    | R    | S    | T    | wt.   |
|-------|-------|------|------|------|------|------|------|-------|------|------|------|------|------|------|------|------|------|-------|
| .500  | .500  | .180 | .100 | .080 | .115 | .060 | .040 | .540  | .060 | .100 | .135 | .135 | .115 | .140 | .070 | .150 | .070 | grams |
| 12.70 | 12.70 | 4.57 | 2.54 | 2.03 | 2.92 | 1.52 | 1.02 | 13.72 | 1.52 | 2.54 | 3.43 | 3.43 | 2.92 | 3.56 | 1.78 | 3.81 | 1.78 | 1.0   |

### Notes

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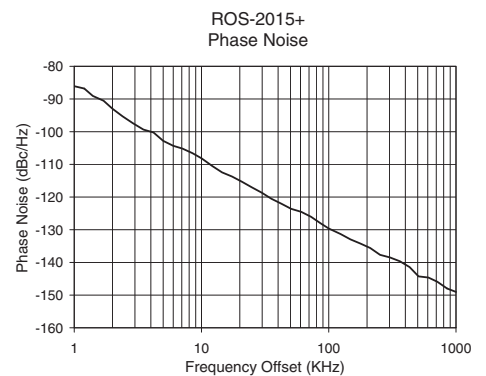
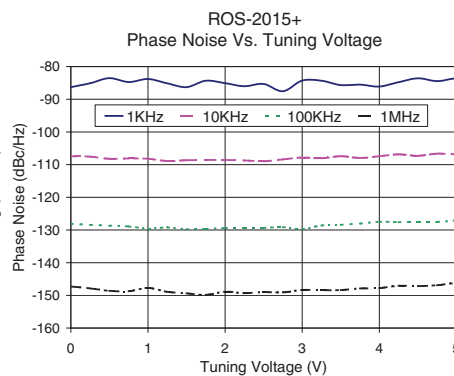
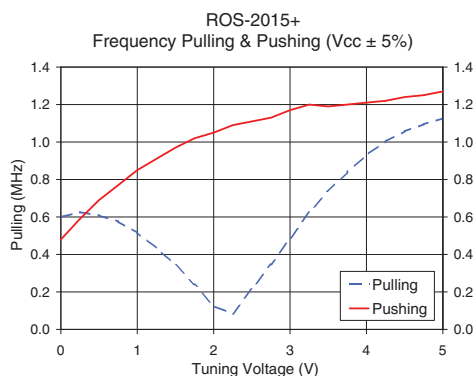
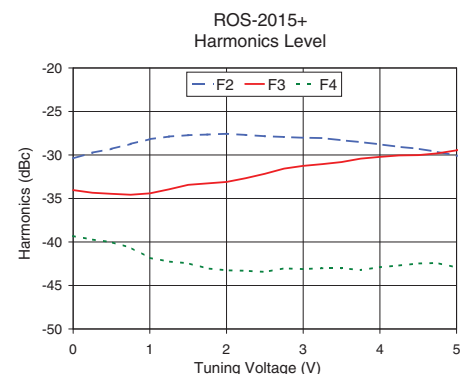
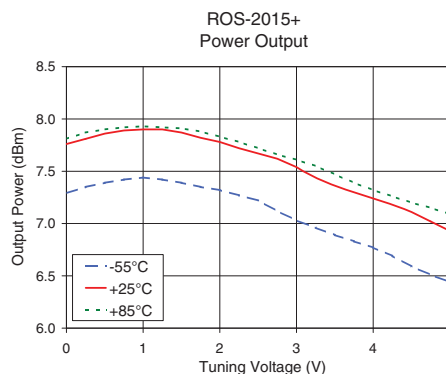
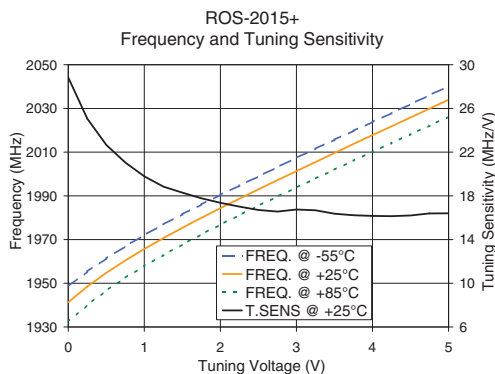
REV. A  
M151108  
EDR-7916F1  
ROS-2015+  
RAV  
150521  
Page 1 of 2

# Performance Data & Curves\*

# ROS-2015+

| V<br>TUNE | TUNE<br>SENS<br>(MHz/V) | FREQUENCY<br>(MHz) |        |        | POWER OUTPUT<br>(dBm) |       |       | Icc<br>(mA) | HARMONICS (dBc) |       |       | FREQ.<br>PUSH<br>(MHz/V) | FREQ.<br>PULL<br>(MHz) | PHASE NOISE (dBc/Hz)<br>at offsets |        |        |        | FREQ<br>OFFSET<br>(KHz) | PHASE<br>NOISE at<br>1989 MHz<br>(dBc/Hz) |
|-----------|-------------------------|--------------------|--------|--------|-----------------------|-------|-------|-------------|-----------------|-------|-------|--------------------------|------------------------|------------------------------------|--------|--------|--------|-------------------------|-------------------------------------------|
|           |                         | -55°C              | +25°C  | +85°C  | -55°C                 | +25°C | +85°C |             | F2              | F3    | F4    |                          |                        | 1kHz                               | 10kHz  | 100kHz | 1MHz   |                         |                                           |
| 0.00      | 28.83                   | 1948.5             | 1941.3 | 1932.4 | 7.29                  | 7.76  | 7.81  | 28.39       | -30.4           | -34.0 | -39.3 | 0.48                     | 0.60                   | -86.3                              | -107.5 | -128.1 | -147.3 | 1.0                     | -86.07                                    |
| 0.50      | 22.66                   | 1961.4             | 1954.8 | 1946.6 | 7.39                  | 7.86  | 7.90  | 28.57       | -29.3           | -34.5 | -40.0 | 0.69                     | 0.61                   | -83.6                              | -108.2 | -128.7 | -148.6 | 2.0                     | -93.00                                    |
| 0.75      | 21.06                   | 1966.9             | 1960.4 | 1952.5 | 7.42                  | 7.89  | 7.92  | 28.63       | -28.7           | -34.6 | -40.7 | 0.77                     | 0.58                   | -84.7                              | -108.1 | -128.9 | -148.7 | 3.5                     | -99.35                                    |
| 1.00      | 19.79                   | 1972.1             | 1965.7 | 1957.9 | 7.44                  | 7.90  | 7.93  | 28.69       | -28.2           | -34.4 | -41.8 | 0.85                     | 0.52                   | -83.8                              | -108.2 | -129.6 | -147.7 | 6.0                     | -104.33                                   |
| 1.25      | 18.85                   | 1976.9             | 1970.6 | 1962.9 | 7.42                  | 7.90  | 7.92  | 28.74       | -27.9           | -34.0 | -42.3 | 0.91                     | 0.43                   | -85.1                              | -108.9 | -129.2 | -148.9 | 8.5                     | -106.57                                   |
| 1.50      | 18.29                   | 1981.6             | 1975.4 | 1967.7 | 7.39                  | 7.87  | 7.91  | 28.78       | -27.7           | -33.4 | -42.5 | 0.97                     | 0.34                   | -86.3                              | -108.7 | -129.8 | -149.4 | 10.0                    | -108.14                                   |
| 1.75      | 17.78                   | 1986.1             | 1979.9 | 1972.4 | 7.35                  | 7.82  | 7.88  | 28.81       | -27.7           | -33.3 | -43.0 | 1.02                     | 0.24                   | -84.3                              | -108.6 | -129.7 | -149.9 | 20.8                    | -115.32                                   |
| 2.00      | 17.37                   | 1990.5             | 1984.4 | 1976.8 | 7.32                  | 7.78  | 7.83  | 28.84       | -27.6           | -33.1 | -43.3 | 1.05                     | 0.12                   | -85.1                              | -108.6 | -129.4 | -148.9 | 35.5                    | -120.54                                   |
| 2.25      | 17.01                   | 1994.7             | 1988.7 | 1981.2 | 7.27                  | 7.72  | 7.78  | 28.86       | -27.7           | -32.7 | -43.3 | 1.09                     | 0.08                   | -86.0                              | -108.7 | -129.3 | -149.3 | 60.7                    | -124.52                                   |
| 2.50      | 16.71                   | 1998.9             | 1993.0 | 1985.5 | 7.22                  | 7.67  | 7.72  | 28.87       | -27.9           | -32.2 | -43.4 | 1.11                     | 0.22                   | -85.3                              | -109.0 | -129.4 | -149.0 | 86.7                    | -128.09                                   |
| 2.75      | 16.56                   | 2003.1             | 1997.1 | 1989.7 | 7.12                  | 7.62  | 7.66  | 28.89       | -27.9           | -31.6 | -43.0 | 1.13                     | 0.35                   | -87.5                              | -108.4 | -129.1 | -149.1 | 100.0                   | -129.62                                   |
| 3.00      | 16.75                   | 2007.4             | 2001.3 | 1993.8 | 7.03                  | 7.54  | 7.61  | 28.90       | -28.0           | -31.3 | -43.1 | 1.17                     | 0.48                   | -84.3                              | -107.9 | -129.7 | -148.3 | 148.1                   | -132.96                                   |
| 3.25      | 16.68                   | 2011.6             | 2005.5 | 1997.9 | 6.96                  | 7.44  | 7.55  | 28.91       | -28.1           | -31.1 | -43.0 | 1.20                     | 0.62                   | -84.3                              | -108.1 | -128.6 | -148.4 | 177.0                   | -134.20                                   |
| 3.50      | 16.36                   | 2015.7             | 2009.6 | 2002.0 | 6.89                  | 7.36  | 7.47  | 28.92       | -28.3           | -30.8 | -43.0 | 1.19                     | 0.74                   | -85.7                              | -107.4 | -128.4 | -148.4 | 211.6                   | -135.58                                   |
| 3.75      | 16.22                   | 2019.7             | 2013.7 | 2006.1 | 6.83                  | 7.30  | 7.39  | 28.93       | -28.5           | -30.4 | -43.2 | 1.20                     | 0.84                   | -85.5                              | -108.0 | -128.0 | -147.9 | 302.4                   | -138.47                                   |
| 4.00      | 16.16                   | 2023.8             | 2017.8 | 2010.2 | 6.77                  | 7.24  | 7.32  | 28.93       | -28.8           | -30.2 | -42.9 | 1.21                     | 0.93                   | -86.1                              | -107.4 | -127.5 | -147.8 | 361.5                   | -139.63                                   |
| 4.25      | 16.14                   | 2027.8             | 2021.8 | 2014.2 | 6.69                  | 7.18  | 7.26  | 28.94       | -29.1           | -30.1 | -42.7 | 1.22                     | 1.00                   | -84.8                              | -106.9 | -127.6 | -147.1 | 507.5                   | -144.28                                   |
| 4.50      | 16.20                   | 2031.9             | 2025.9 | 2018.2 | 6.59                  | 7.11  | 7.20  | 28.95       | -29.3           | -30.0 | -42.5 | 1.24                     | 1.06                   | -83.6                              | -107.3 | -127.7 | -147.2 | 606.7                   | -144.63                                   |
| 4.75      | 16.39                   | 2036.1             | 2029.9 | 2022.2 | 6.51                  | 7.02  | 7.15  | 28.95       | -29.7           | -29.8 | -42.4 | 1.25                     | 1.10                   | -84.5                              | -106.7 | -127.5 | -146.9 | 851.6                   | -147.99                                   |
| 5.00      | 16.40                   | 2040.1             | 2034.0 | 2026.2 | 6.44                  | 6.93  | 7.09  | 28.96       | -30.1           | -29.5 | -42.9 | 1.27                     | 1.13                   | -83.6                              | -106.9 | -127.1 | -146.3 | 1000.0                  | -149.02                                   |

\*at 25°C unless mentioned otherwise



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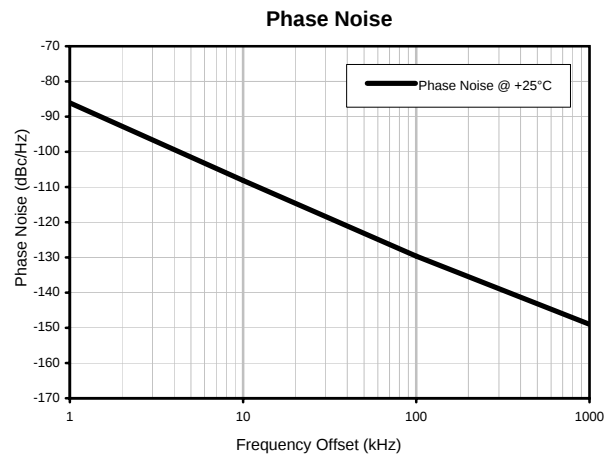
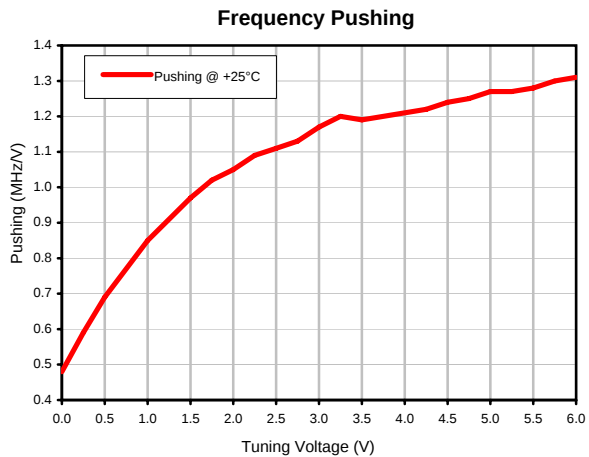
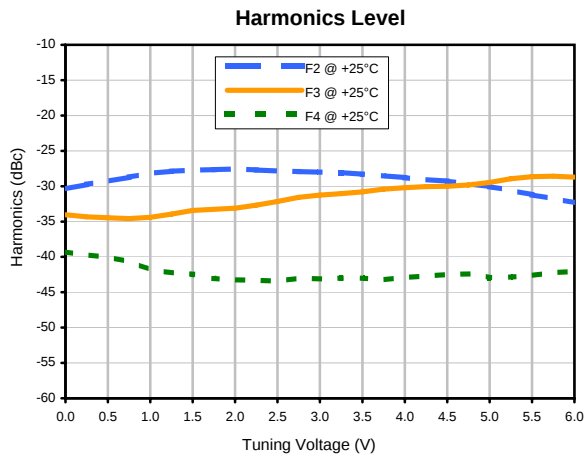
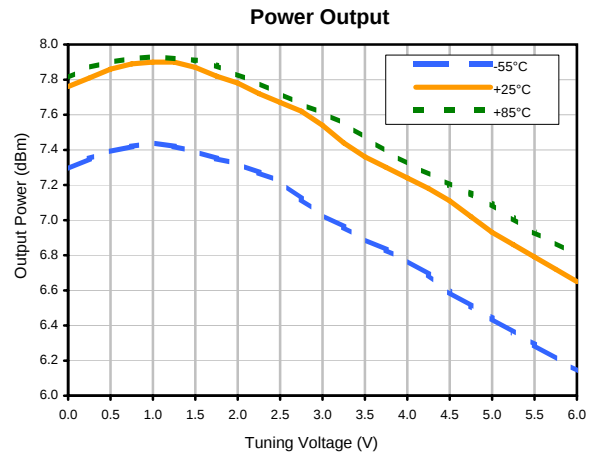
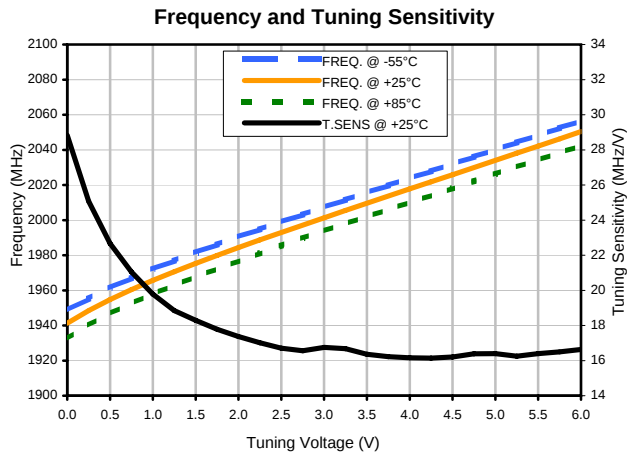
## Typical Performance Data

| 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    |                          |                         |                            |
| 0.00      | 28.83                   | 1948.5             | 1941.3 | 1932.4 | 7.29                  | 7.76  | 7.81  | -30.4           | -34.0 | -39.3 | 0.48                     | 1                       | -86.1                      |
| 0.25      | 25.07                   | 1955.4             | 1948.5 | 1940.1 | 7.35                  | 7.81  | 7.87  | -29.7           | -34.3 | -39.7 | 0.59                     | 10                      | -108.1                     |
| 0.50      | 22.66                   | 1961.4             | 1954.8 | 1946.6 | 7.39                  | 7.86  | 7.90  | -29.3           | -34.5 | -40.0 | 0.69                     | 100                     | -129.6                     |
| 0.75      | 21.06                   | 1966.9             | 1960.4 | 1952.5 | 7.42                  | 7.89  | 7.92  | -28.7           | -34.6 | -40.7 | 0.77                     | 1000                    | -149.0                     |
| 1.00      | 19.79                   | 1972.1             | 1965.7 | 1957.9 | 7.44                  | 7.90  | 7.93  | -28.2           | -34.4 | -41.8 | 0.85                     |                         |                            |
| 1.25      | 18.85                   | 1976.9             | 1970.6 | 1962.9 | 7.42                  | 7.90  | 7.92  | -27.9           | -34.0 | -42.3 | 0.91                     |                         |                            |
| 1.50      | 18.29                   | 1981.6             | 1975.4 | 1967.7 | 7.39                  | 7.87  | 7.91  | -27.7           | -33.4 | -42.5 | 0.97                     |                         |                            |
| 1.75      | 17.78                   | 1986.1             | 1979.9 | 1972.4 | 7.35                  | 7.82  | 7.88  | -27.7           | -33.3 | -43.0 | 1.02                     |                         |                            |
| 2.00      | 17.37                   | 1990.5             | 1984.4 | 1976.8 | 7.32                  | 7.78  | 7.83  | -27.6           | -33.1 | -43.3 | 1.05                     |                         |                            |
| 2.25      | 17.01                   | 1994.7             | 1988.7 | 1981.2 | 7.27                  | 7.72  | 7.78  | -27.7           | -32.7 | -43.3 | 1.09                     |                         |                            |
| 2.50      | 16.71                   | 1998.9             | 1993.0 | 1985.5 | 7.22                  | 7.67  | 7.72  | -27.9           | -32.2 | -43.4 | 1.11                     |                         |                            |
| 2.75      | 16.56                   | 2003.1             | 1997.1 | 1989.7 | 7.12                  | 7.62  | 7.66  | -27.9           | -31.6 | -43.0 | 1.13                     |                         |                            |
| 3.00      | 16.75                   | 2007.4             | 2001.3 | 1993.8 | 7.03                  | 7.54  | 7.61  | -28.0           | -31.3 | -43.1 | 1.17                     |                         |                            |
| 3.25      | 16.68                   | 2011.6             | 2005.5 | 1997.9 | 6.96                  | 7.44  | 7.55  | -28.1           | -31.1 | -43.0 | 1.20                     |                         |                            |
| 3.50      | 16.36                   | 2015.7             | 2009.6 | 2002.0 | 6.89                  | 7.36  | 7.47  | -28.3           | -30.8 | -43.0 | 1.19                     |                         |                            |
| 3.75      | 16.22                   | 2019.7             | 2013.7 | 2006.1 | 6.83                  | 7.30  | 7.39  | -28.5           | -30.4 | -43.2 | 1.20                     |                         |                            |
| 4.00      | 16.16                   | 2023.8             | 2017.8 | 2010.2 | 6.77                  | 7.24  | 7.32  | -28.8           | -30.2 | -42.9 | 1.21                     |                         |                            |
| 4.25      | 16.14                   | 2027.8             | 2021.8 | 2014.2 | 6.69                  | 7.18  | 7.26  | -29.1           | -30.1 | -42.7 | 1.22                     |                         |                            |
| 4.50      | 16.20                   | 2031.9             | 2025.9 | 2018.2 | 6.59                  | 7.11  | 7.20  | -29.3           | -30.0 | -42.5 | 1.24                     |                         |                            |
| 4.75      | 16.39                   | 2036.1             | 2029.9 | 2022.2 | 6.51                  | 7.02  | 7.15  | -29.7           | -29.8 | -42.4 | 1.25                     |                         |                            |
| 5.00      | 16.40                   | 2040.1             | 2034.0 | 2026.2 | 6.44                  | 6.93  | 7.09  | -30.1           | -29.5 | -42.9 | 1.27                     |                         |                            |
| 5.25      | 16.25                   | 2044.2             | 2038.1 | 2030.2 | 6.36                  | 6.86  | 7.01  | -30.6           | -28.9 | -42.9 | 1.27                     |                         |                            |
| 5.50      | 16.40                   | 2048.3             | 2042.2 | 2034.3 | 6.29                  | 6.79  | 6.93  | -31.2           | -28.7 | -42.6 | 1.28                     |                         |                            |
| 5.75      | 16.50                   | 2052.4             | 2046.3 | 2038.3 | 6.21                  | 6.72  | 6.87  | -31.8           | -28.6 | -42.2 | 1.30                     |                         |                            |
| 6.00      | 16.63                   | 2056.6             | 2050.4 | 2042.4 | 6.14                  | 6.65  | 6.80  | -32.4           | -28.7 | -42.0 | 1.31                     |                         |                            |

# Voltage Controlled Oscillator

ROS-2015+

## Typical Performance Data



## Outline Dimensions

CK605

## PCB Land Pattern



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

| CASE # | A               | B               | C              | D              | E              | F              | G              | H              | J               | K              |
|--------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|----------------|
| CK605  | .500<br>(12.70) | .500<br>(12.70) | .180<br>(4.57) | .100<br>(2.54) | .080<br>(2.03) | .115<br>(2.92) | .060<br>(1.52) | .040<br>(1.02) | .540<br>(13.72) | .060<br>(1.52) |

| CASE # | L              | M              | N              | P              | Q              | R              | S              | T              | WT. GRAM            |
|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| CK605  | .100<br>(2.54) | .135<br>(3.43) | .135<br>(3.43) | .115<br>(2.92) | .140<br>(3.56) | .070<br>(1.78) | .150<br>(3.81) | .070<br>(1.78) | 1.2<br>+0.5<br>-0.0 |

Dimensions are in inches (mm). Tolerances: 2 Pl.  $\pm .03$ ; 3Pl.  $\pm .015$

### Notes:

- Case material: Nickel-Silver alloy.
- Base: Printed wiring laminate.
- Termination finish:  
For RoHS Case Styles: 3-5  $\mu$  inch (.08-.13 microns) Gold over 120-240  $\mu$  inch (3.05-6.10 microns) Nickel plate.  
All models, (+) suffix.



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RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F37



| Tape Width,<br>mm | Device Cavity<br>Pitch, mm | Reel Size,<br>inches | Devices per Reel                             |     |
|-------------------|----------------------------|----------------------|----------------------------------------------|-----|
| 24                | 16                         | 7                    | Small<br>quantity<br>standards<br>(see note) | 10  |
|                   |                            |                      |                                              | 20  |
|                   |                            |                      |                                              | 50  |
|                   |                            |                      |                                              | 100 |
|                   |                            | 13                   | Standard                                     | 200 |
|                   |                            |                      |                                              | 500 |

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 |
|-----|---------|---------------------------|----------|-----|------|
| E   | M105563 | ADDED "rl" PIN CONNECTION | 06/02/06 | MMG | DJ   |
| F   | M105640 | CORRECTED NOTE 2          | 06/08/06 | MMG | MM   |
| G   | M124395 | ADDED "RAMP"              | 09/09    | EM  | HH   |
| G   | R77589  | ADDED "RAMP"              | 09/09    | EM  | HH   |

SUGGESTED MOUNTING CONFIGURATION FOR  
CK605 CASE STYLE, "kg/rl/16AM01" PIN CONNECTION

NOTES:

- TRACE WIDTH IS SHOWN FOR FR4 WITH DIELECTRIC THICKNESS .030"  $\pm$  .002"; COPPER: 1/2 OZ. EACH SIDE. FOR OTHER MATERIALS TRACE WIDTH MAY NEED TO BE MODIFIED.
- BOTTOM SIDE OF THE BOTTOM 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

AV

08/07/00

CHECKED

SK

08/08/00

APPROVED

DB

08/08/00

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



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

PL,kg/rl/16AM01,CK605,ROS/LAVI/RAMP

SIZE  
A

CODE IDENT  
15542

DRAWING NO:  
98-PL-012

REV:  
G

FILE: 98PL012

SCALE: 5:1

SHEET: 1 OF 1

# 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                                                                              |