

# Voltage Controlled Oscillator

# ROS-4303-119+

5V Tuning for PLL IC's 4195 to 4415 MHz

## Features

- low phase noise
- low pulling
- low pushing
- aqueous washable



CASE STYLE: CK605

## Applications

- wireless communications
- WiMAX

**+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 |     |      |      | TUNING |                   |       |                     | NON HARMONIC SPURIOUS (dBc) | HARMONICS (dBc) |                            | PULLING pk-pk @ 12 dB (MHz) | PUSHING (MHz/V) | DC OPERATING POWER |      |      |      |             |              |
|---------------|-------------|------|--------------------|---------------------------------------------------|-----|------|------|--------|-------------------|-------|---------------------|-----------------------------|-----------------|----------------------------|-----------------------------|-----------------|--------------------|------|------|------|-------------|--------------|
|               | Min.        | Max. |                    | Typ.                                              | 1   | 10   | 100  | 1000   | VOLTAGE RANGE (V) |       | PORT TIVITY (MHz/V) |                             | 3 dB CAP (pF)   | MODULATION BANDWIDTH (MHz) |                             |                 | Typ.               | Typ. | Typ. | Typ. | Vcc (volts) | Current (mA) |
|               |             |      |                    |                                                   |     |      |      |        | Min.              | Max.  |                     |                             |                 |                            |                             |                 |                    |      |      |      |             |              |
| ROS-4303-119+ | 4195        | 4415 | +4.6               | -69                                               | -96 | -117 | -137 | 0.5    | 4.5               | 78-90 | 10                  | 150                         | -90             | -25                        | -15                         | 3               | 2.5                | 5    | 50   |      |             |              |

## 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) | 7V             |
| All specifications                   | 50 ohm system  |

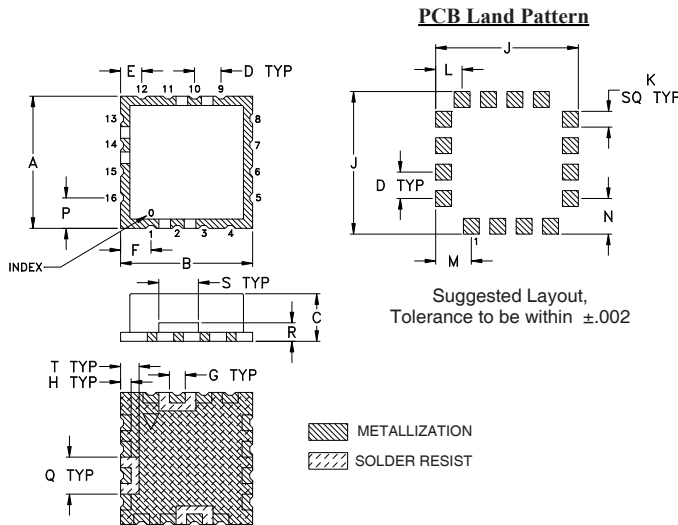
Permanent damage may occur if any of these limits are exceeded.

## Tape & Reel: F37

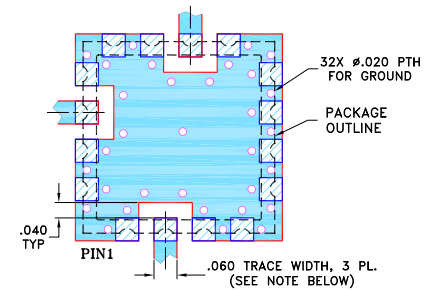
7" Reels with 10, 20, 50, 100 devices  
13" Reels with 200, 500 devices

## Environmental Ratings: ENV65

## 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" ± .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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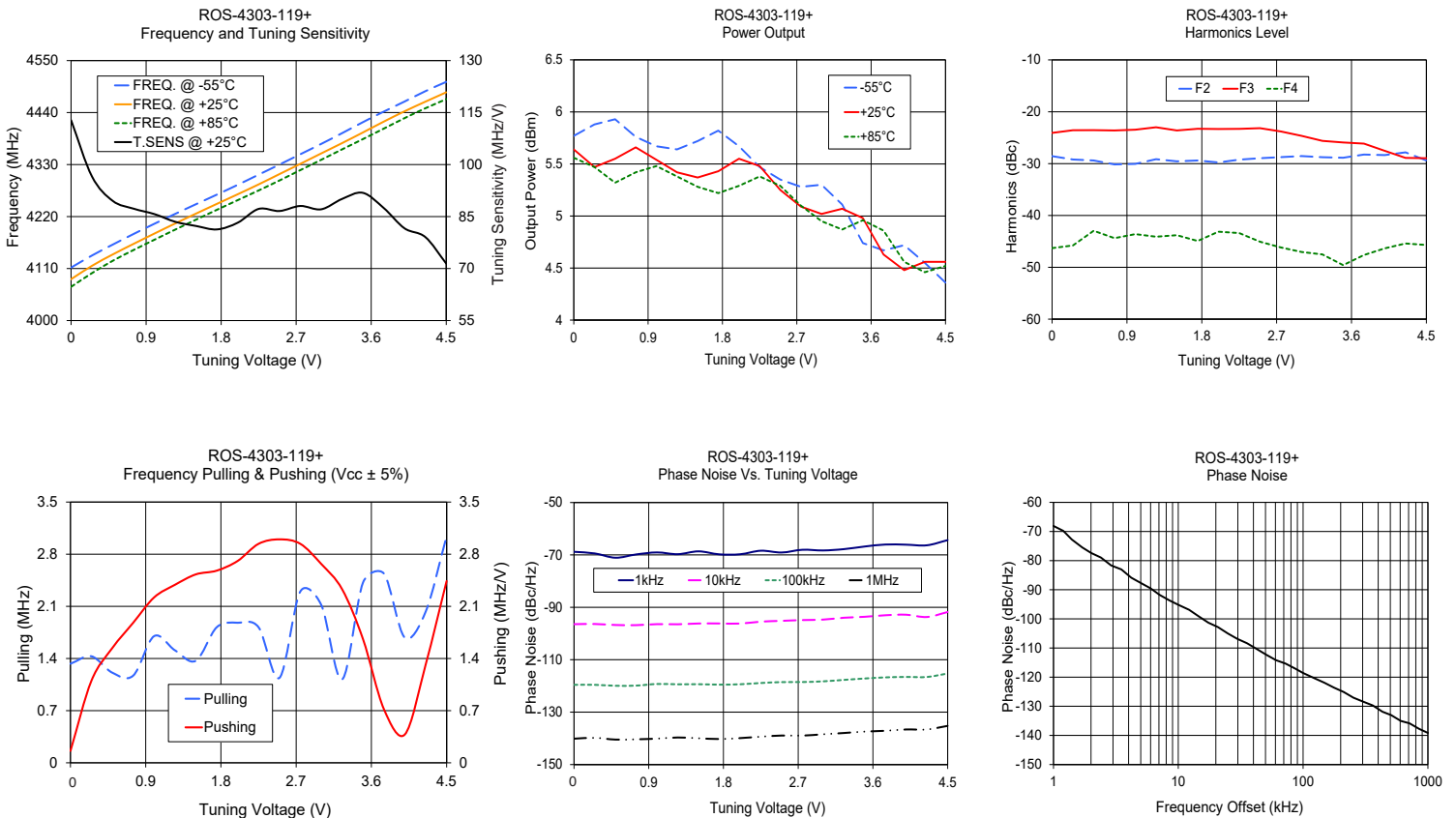


# Performance Data & Curves\*

# ROS-4303-119+

| V TUNE | TUNE SENS (MHz/V) | FREQUENCY (MHz) |        |        | POWER OUTPUT (dBm) |       |       | Icc (mA) | HARMONICS (dBc) |       |       | FREQ. PUSH (MHz/V) | FREQ. PULL (MHz) | PHASE NOISE (dBc/Hz) at offsets |       |        |        | FREQ OFFSET (KHz) | PHASE NOISE at 4303 MHz (dBc/Hz) |
|--------|-------------------|-----------------|--------|--------|--------------------|-------|-------|----------|-----------------|-------|-------|--------------------|------------------|---------------------------------|-------|--------|--------|-------------------|----------------------------------|
|        |                   | -55°C           | +25°C  | +85°C  | -55°C              | +25°C | +85°C |          | F2              | F3    | F4    |                    |                  | 1kHz                            | 10kHz | 100kHz | 1MHz   |                   |                                  |
| 0.00   | 112.80            | 4112.1          | 4087.5 | 4071.4 | 5.77               | 5.64  | 5.56  | 42.04    | -28.6           | -24.1 | -46.3 | 0.16               | 1.33             | -68.81                          | -96.4 | -119.6 | -140.1 | 1.0               | -68.08                           |
| 0.25   | 96.58             | 4137.6          | 4115.7 | 4100.3 | 5.88               | 5.47  | 5.47  | 42.05    | -29.2           | -23.6 | -45.8 | 1.10               | 1.43             | -69.43                          | -96.4 | -119.6 | -139.8 | 2.0               | -77.37                           |
| 0.50   | 89.52             | 4160.7          | 4139.9 | 4126.5 | 5.93               | 5.55  | 5.32  | 42.09    | -29.4           | -23.5 | -43.0 | 1.54               | 1.21             | -71.07                          | -96.8 | -119.9 | -140.5 | 3.5               | -83.03                           |
| 0.75   | 87.28             | 4183.2          | 4162.2 | 4149.3 | 5.76               | 5.66  | 5.42  | 42.07    | -30.2           | -23.6 | -44.4 | 1.88               | 1.17             | -69.81                          | -96.8 | -119.9 | -140.4 | 6.0               | -89.52                           |
| 1.00   | 85.71             | 4204.8          | 4184.1 | 4171.0 | 5.67               | 5.54  | 5.48  | 42.04    | -30.1           | -23.5 | -43.6 | 2.22               | 1.70             | -69.05                          | -96.4 | -119.3 | -140.1 | 8.5               | -93.67                           |
| 1.25   | 83.49             | 4225.8          | 4205.5 | 4192.5 | 5.64               | 5.42  | 5.38  | 42.03    | -29.2           | -23.0 | -44.1 | 2.39               | 1.51             | -69.72                          | -96.5 | -119.4 | -139.7 | 10.0              | -95.17                           |
| 1.50   | 82.28             | 4246.3          | 4226.4 | 4213.6 | 5.72               | 5.37  | 5.28  | 42.02    | -29.6           | -23.6 | -43.8 | 2.53               | 1.37             | -68.64                          | -96.2 | -119.3 | -140.0 | 20.8              | -102.83                          |
| 1.75   | 81.30             | 4266.5          | 4246.9 | 4234.4 | 5.82               | 5.43  | 5.22  | 42.02    | -29.4           | -23.3 | -44.9 | 2.58               | 1.82             | -69.78                          | -96.2 | -119.5 | -140.3 | 35.5              | -108.37                          |
| 2.00   | 83.25             | 4287.2          | 4267.3 | 4254.8 | 5.67               | 5.55  | 5.29  | 41.96    | -29.8           | -23.3 | -43.1 | 2.71               | 1.88             | -69.75                          | -96.2 | -119.4 | -139.9 | 60.7              | -114.19                          |
| 2.25   | 87.22             | 4308.7          | 4288.1 | 4275.3 | 5.47               | 5.48  | 5.38  | 41.89    | -29.2           | -23.3 | -43.4 | 2.94               | 1.82             | -68.40                          | -95.5 | -118.9 | -139.4 | 86.7              | -117.10                          |
| 2.50   | 86.60             | 4330.1          | 4309.9 | 4296.4 | 5.35               | 5.25  | 5.29  | 41.82    | -29.0           | -23.2 | -45.1 | 3.00               | 1.14             | -69.08                          | -95.2 | -118.5 | -138.9 | 100.0             | -118.58                          |
| 2.75   | 88.06             | 4351.9          | 4331.5 | 4318.3 | 5.28               | 5.09  | 5.10  | 41.76    | -28.8           | -23.8 | -46.2 | 2.94               | 2.30             | -68.04                          | -94.9 | -118.5 | -139.0 | 148.1             | -121.92                          |
| 3.00   | 87.10             | 4373.7          | 4353.5 | 4340.1 | 5.30               | 5.02  | 4.95  | 41.66    | -28.5           | -24.7 | -47.1 | 2.67               | 2.12             | -68.30                          | -94.7 | -118.3 | -138.5 | 177.0             | -123.62                          |
| 3.25   | 90.08             | 4396.4          | 4375.3 | 4362.1 | 5.11               | 5.07  | 4.87  | 41.54    | -28.8           | -25.6 | -47.5 | 2.33               | 1.12             | -67.80                          | -94.0 | -117.7 | -138.0 | 211.6             | -125.12                          |
| 3.50   | 91.85             | 4419.7          | 4397.8 | 4383.8 | 4.74               | 4.98  | 4.96  | 41.41    | -28.9           | -25.9 | -49.6 | 1.66               | 2.42             | -66.80                          | -93.6 | -117.2 | -137.4 | 361.5             | -129.72                          |
| 3.75   | 87.49             | 4442.0          | 4420.8 | 4406.0 | 4.67               | 4.63  | 4.86  | 41.30    | -28.3           | -26.1 | -47.6 | 0.72               | 2.54             | -66.04                          | -93.0 | -116.7 | -137.1 | 507.5             | -133.05                          |
| 4.00   | 81.61             | 4463.4          | 4442.7 | 4428.2 | 4.72               | 4.48  | 4.56  | 41.20    | -28.4           | -27.5 | -46.3 | 0.38               | 1.68             | -66.10                          | -92.8 | -116.6 | -136.6 | 606.7             | -135.05                          |
| 4.25   | 79.08             | 4485.3          | 4463.1 | 4449.2 | 4.55               | 4.56  | 4.46  | 41.09    | -27.8           | -28.9 | -45.4 | 1.32               | 2.03             | -66.33                          | -93.7 | -116.6 | -136.6 | 851.6             | -137.79                          |
| 4.50   | 71.46             | 4504.9          | 4482.8 | 4468.4 | 4.36               | 4.56  | 4.52  | 40.98    | -29.4           | -29.0 | -45.7 | 2.44               | 3.04             | -64.36                          | -91.8 | -115.3 | -135.3 | 1000.0            | -139.14                          |

\*at 25°C unless mentioned otherwise



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ROS-4303-119+

## Typical Performance Data

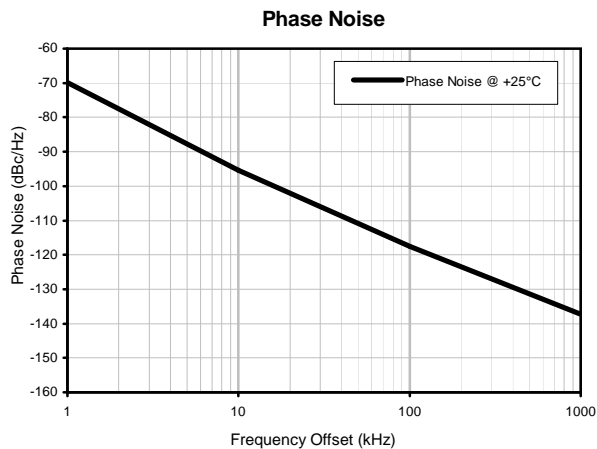
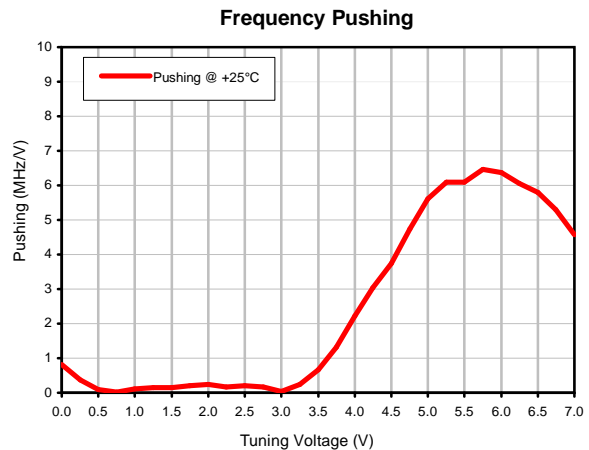
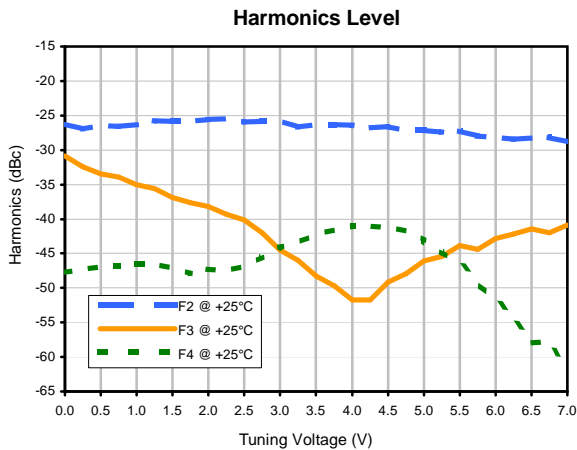
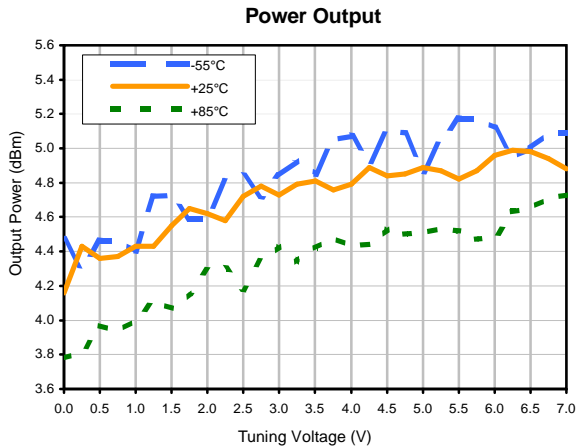
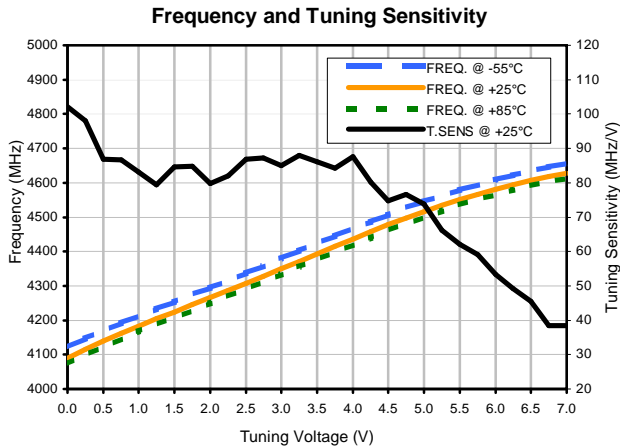
| V<br>TUNE | TUNE<br>SENS<br>(MHz/V) | FREQUENCY<br>(MHz) |         |         | POWER OUTPUT<br>(dBm) |       |       | HARMONICS (dBc) |        |        | FREQ.<br>PUSH<br>(MHz/V) | FREQ<br>OFFSET<br>(KHz) | PHASE<br>NOISE<br>(dBc/Hz) |
|-----------|-------------------------|--------------------|---------|---------|-----------------------|-------|-------|-----------------|--------|--------|--------------------------|-------------------------|----------------------------|
|           |                         | -55°C              | +25°C   | +85°C   | -55°C                 | +25°C | +85°C | F2              | F3     | F4     |                          |                         |                            |
| 0.0       | 102.21                  | 4121.35            | 4089.69 | 4072.32 | 4.47                  | 4.16  | 3.78  | -26.24          | -30.89 | -47.71 | 0.81                     | 1                       | -70                        |
| 0.3       | 97.96                   | 4146.94            | 4115.24 | 4098.62 | 4.30                  | 4.43  | 3.81  | -26.99          | -32.47 | -47.27 | 0.37                     | 10                      | -95                        |
| 0.5       | 86.91                   | 4169.50            | 4139.73 | 4122.59 | 4.46                  | 4.36  | 3.97  | -26.50          | -33.45 | -46.87 | 0.09                     | 100                     | -118                       |
| 0.8       | 86.67                   | 4191.61            | 4161.45 | 4146.04 | 4.46                  | 4.37  | 3.94  | -26.55          | -33.94 | -46.82 | 0.01                     | 1000                    | -137                       |
| 1.0       | 83.18                   | 4212.01            | 4183.12 | 4167.00 | 4.40                  | 4.43  | 4.00  | -26.35          | -35.01 | -46.55 | 0.12                     |                         |                            |
| 1.3       | 79.40                   | 4232.68            | 4203.92 | 4188.18 | 4.72                  | 4.43  | 4.11  | -25.75          | -35.59 | -46.56 | 0.14                     |                         |                            |
| 1.5       | 84.62                   | 4254.14            | 4223.77 | 4208.56 | 4.73                  | 4.55  | 4.07  | -25.84          | -36.85 | -47.21 | 0.14                     |                         |                            |
| 1.8       | 84.84                   | 4274.95            | 4244.92 | 4227.96 | 4.59                  | 4.65  | 4.16  | -25.86          | -37.64 | -47.96 | 0.20                     |                         |                            |
| 2.0       | 79.72                   | 4293.86            | 4266.13 | 4249.17 | 4.59                  | 4.62  | 4.29  | -25.62          | -38.19 | -47.30 | 0.24                     |                         |                            |
| 2.3       | 81.95                   | 4315.29            | 4286.06 | 4270.27 | 4.81                  | 4.58  | 4.30  | -25.49          | -39.35 | -47.47 | 0.17                     |                         |                            |
| 2.5       | 86.85                   | 4337.28            | 4306.55 | 4290.20 | 4.84                  | 4.72  | 4.18  | -25.92          | -40.12 | -46.82 | 0.20                     |                         |                            |
| 2.8       | 87.28                   | 4358.34            | 4328.26 | 4310.59 | 4.72                  | 4.78  | 4.35  | -25.83          | -41.97 | -45.52 | 0.16                     |                         |                            |
| 3.0       | 84.90                   | 4379.82            | 4350.08 | 4332.66 | 4.84                  | 4.73  | 4.43  | -25.72          | -44.51 | -44.16 | 0.04                     |                         |                            |
| 3.3       | 88.02                   | 4402.01            | 4371.31 | 4354.75 | 4.93                  | 4.79  | 4.34  | -26.68          | -45.94 | -43.42 | 0.24                     |                         |                            |
| 3.5       | 86.15                   | 4423.37            | 4393.31 | 4375.72 | 4.85                  | 4.81  | 4.42  | -26.30          | -48.30 | -42.26 | 0.67                     |                         |                            |
| 3.8       | 84.27                   | 4445.60            | 4414.85 | 4397.71 | 5.05                  | 4.76  | 4.48  | -26.29          | -49.71 | -41.57 | 1.32                     |                         |                            |
| 4.0       | 87.52                   | 4466.79            | 4435.92 | 4419.32 | 5.07                  | 4.79  | 4.43  | -26.43          | -51.75 | -41.07 | 2.23                     |                         |                            |
| 4.3       | 80.13                   | 4486.54            | 4457.80 | 4440.35 | 4.91                  | 4.89  | 4.44  | -26.80          | -51.73 | -41.11 | 3.04                     |                         |                            |
| 4.5       | 74.80                   | 4506.61            | 4477.83 | 4461.71 | 5.10                  | 4.84  | 4.53  | -26.62          | -49.14 | -41.15 | 3.74                     |                         |                            |
| 4.8       | 76.68                   | 4526.32            | 4496.53 | 4481.10 | 5.09                  | 4.85  | 4.50  | -27.14          | -47.97 | -41.69 | 4.74                     |                         |                            |
| 5.0       | 73.76                   | 4545.00            | 4515.70 | 4499.35 | 4.86                  | 4.89  | 4.51  | -27.17          | -46.09 | -43.11 | 5.62                     |                         |                            |
| 5.3       | 66.11                   | 4562.11            | 4534.14 | 4517.85 | 5.05                  | 4.87  | 4.53  | -27.39          | -45.42 | -44.75 | 6.10                     |                         |                            |
| 5.5       | 62.05                   | 4579.13            | 4550.67 | 4535.48 | 5.17                  | 4.82  | 4.52  | -27.25          | -43.84 | -46.35 | 6.10                     |                         |                            |
| 5.8       | 59.12                   | 4594.59            | 4566.18 | 4551.23 | 5.17                  | 4.87  | 4.47  | -27.97          | -44.37 | -49.26 | 6.47                     |                         |                            |
| 6.0       | 53.41                   | 4609.15            | 4580.96 | 4565.49 | 5.12                  | 4.96  | 4.48  | -28.13          | -42.86 | -51.67 | 6.37                     |                         |                            |
| 6.3       | 49.19                   | 4621.90            | 4594.31 | 4579.28 | 4.95                  | 4.99  | 4.63  | -28.46          | -42.16 | -54.63 | 6.05                     |                         |                            |
| 6.5       | 45.44                   | 4634.08            | 4606.61 | 4591.75 | 5.00                  | 4.98  | 4.65  | -28.31          | -41.46 | -57.92 | 5.80                     |                         |                            |
| 6.8       | 38.38                   | 4646.05            | 4617.97 | 4602.93 | 5.09                  | 4.94  | 4.71  | -28.18          | -42.03 | -57.90 | 5.29                     |                         |                            |
| 7.0       | 38.38                   | 4656.18            | 4627.56 | 4613.00 | 5.09                  | 4.88  | 4.73  | -28.80          | -40.84 | -62.02 | 4.57                     |                         |                            |



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ROS-4303-119+

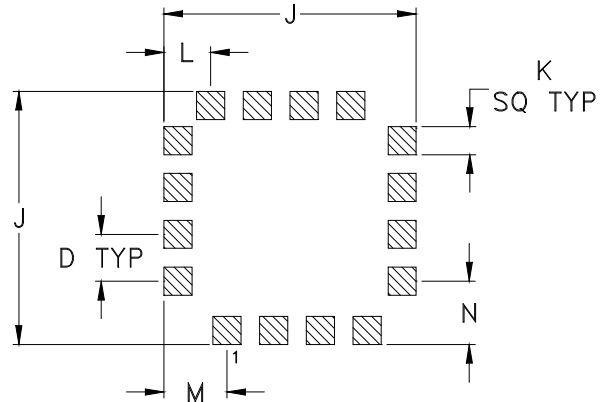
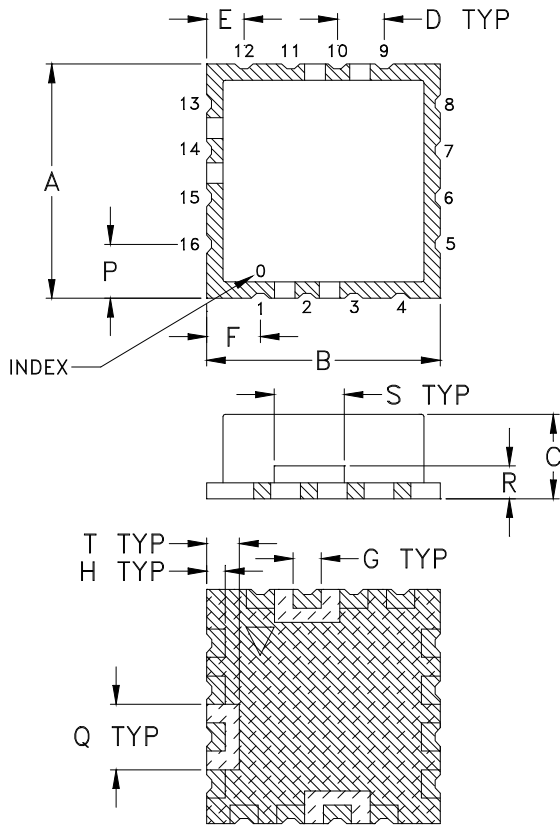
## Typical Performance Data



## 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.



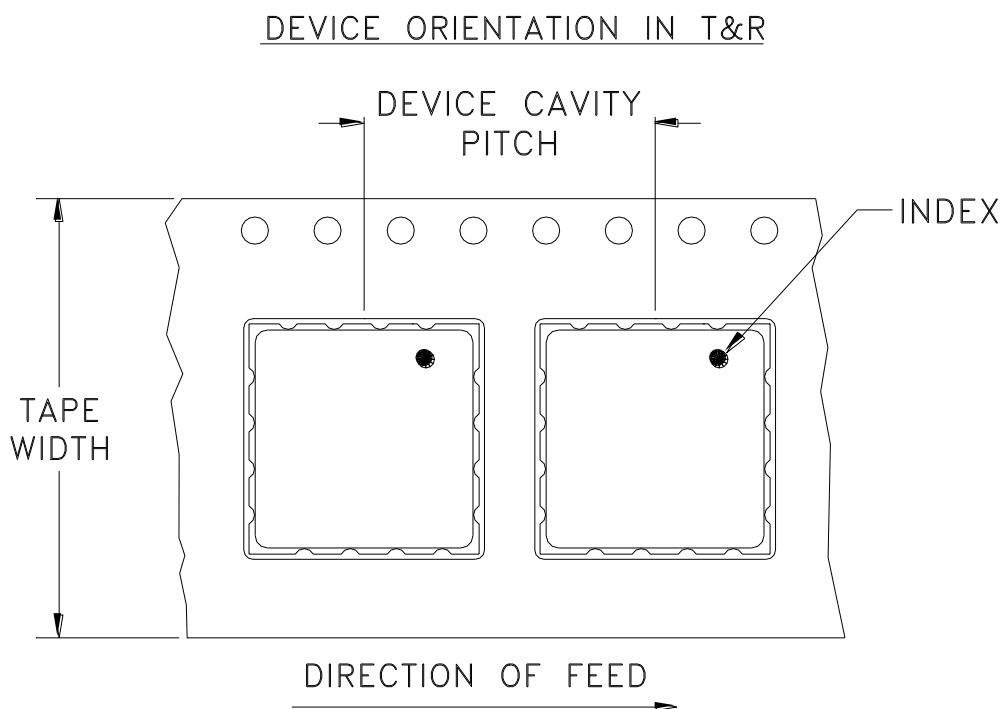
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661 For detailed performance specs & shopping online see Mini-Circuits web site



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

RF/IF MICROWAVE COMPONENTS

# Tape & Reel Packaging TR-F37



| Tape Width, mm | Device Cavity Pitch, mm | Reel Size, inches | Devices per Reel                    |     |
|----------------|-------------------------|-------------------|-------------------------------------|-----|
| 24             | 16                      | 7                 | Small quantity standards (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.

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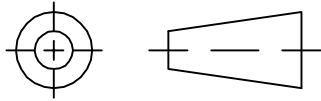
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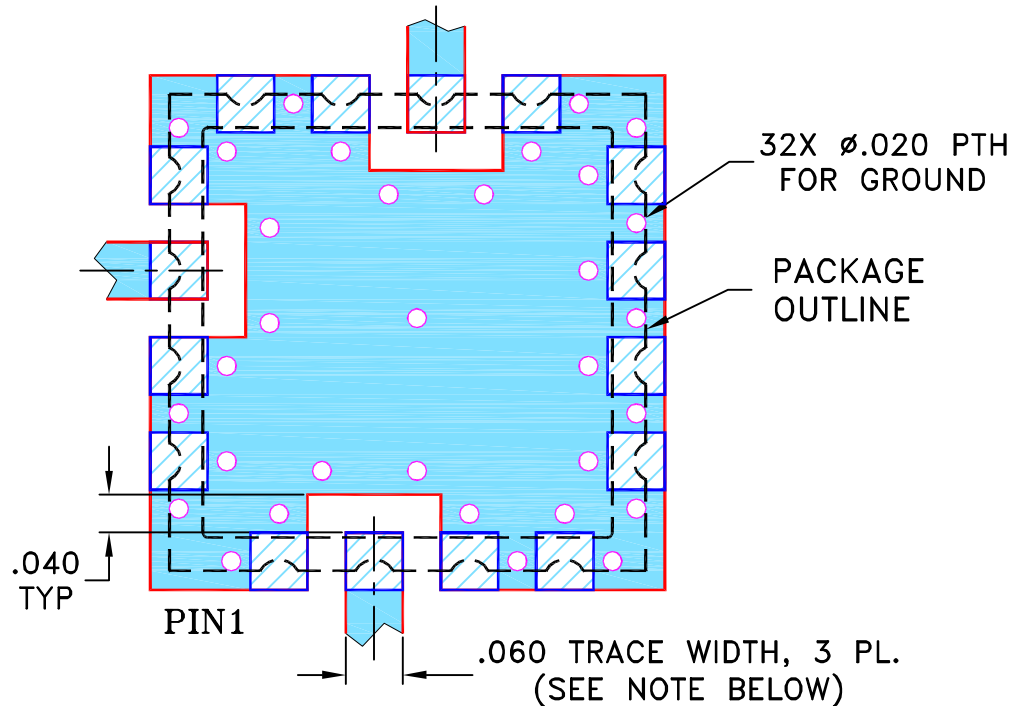
THIRD ANGLE PROJECTION



REVISIONS

| REV | ECN No. | DESCRIPTION               | DATE     | DR  | AUTH |
|-----|---------|---------------------------|----------|-----|------|
| E   | M105563 | ADDED "r1" 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

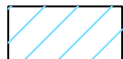


NOTES:

1. TRACE WIDTH IS SHOWN FOR FR4 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 BOTTOM IS CONTINUOUS GROUND PLANE.



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



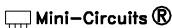
DENOTES COPPER LAND PATTERN FREE OF SOLDER MASK

| UNLESS OTHERWISE SPECIFIED | INITIALS | DATE     |
|----------------------------|----------|----------|
| DIMENSIONS ARE IN INCHES   | AV       | 08/07/00 |
| TOLERANCES ON:             | SK       | 08/08/00 |
| 2 PL DECIMALS ±            | DB       | 08/08/00 |
| 3 PL DECIMALS ± .005       |          |          |
| ANGLES ±                   |          |          |
| FRACTIONS ±                |          |          |

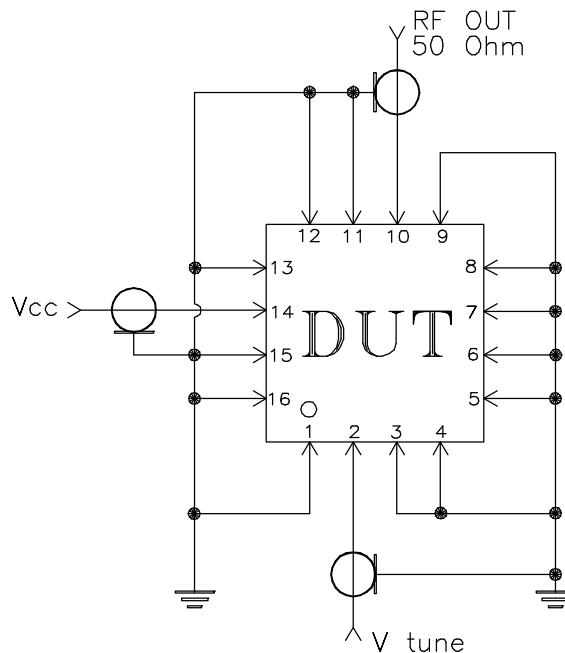
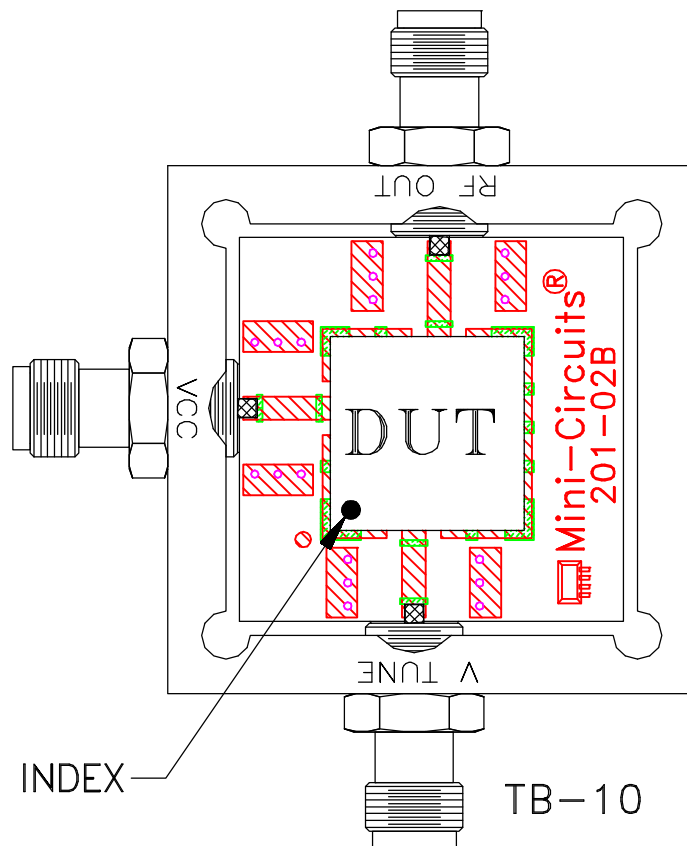
 **Mini-Circuits®** 13 Neptune Avenue  
Brooklyn NY 11235

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

|                  |                     |                          |           |
|------------------|---------------------|--------------------------|-----------|
| SIZE<br>A        | CODE IDENT<br>15542 | DRAWING NO:<br>98-PL-012 | REV:<br>G |
| FILE:<br>98PL012 | SCALE:<br>5:1       | SHEET:<br>1 OF 1         |           |

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# 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                                                                              |