

# CX74037

## *Transmit RF IC for TDMA or AMPS Applications*

Conexant's CX74037 Transmit RF Application-Specific Integrated Circuit (ASIC) is a triple-mode, dual-band transmitter intended for use in IS-136 compliant cellular phones. As a dual mode IC, it can be used in Time Division Multiple Access (TDMA) mode or Advanced Mobile Phone System (AMPS) mode. The device is available in a 48-pin 7x7 Land Grid Array (LGA) package with downset paddle.

The CX74037 RF IC device includes the following functional components:

- In-Phase and Quadrature (I/Q) modulator
- Two Intermediate Frequency (IF) Voltage Controlled Oscillator (VCO) inputs
- IF Variable Gain Amplifier (VGA)
- Two upconverters
- Two drivers for external Power Amplifiers (PAs).

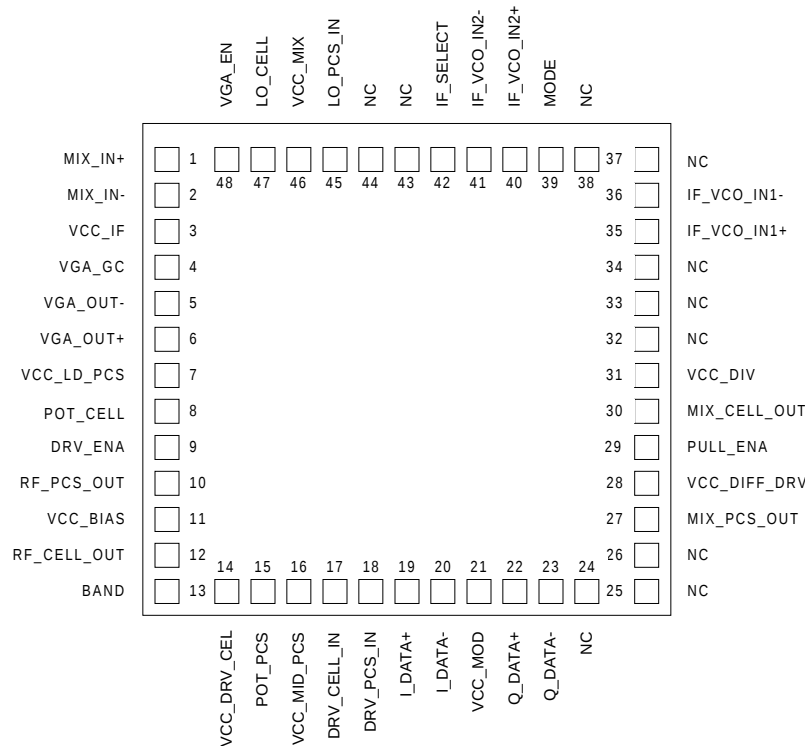
The CX74037 48-pin, 7x7 LGA package pin configuration is shown in Figure 1. A CX74037 block diagram is shown in Figure 2.

### Features

- Sectional enable lines for independent control of circuits within the chip
- 90 dB IF VGA range
- Separate IF frequencies can be used for the 800 MHz (AMPS) and 1900 MHz Bands (PCS)
- Dual drivers for 800 MHz and 1900 MHz
- PA driver is deactivated by using the Driver Enable signal when there is no transmission
- Available in a 48-pin, 7x7 LGA package with downset paddle

### Applications

- Cellular and/or PCS-band phones
- TDMA and/or AMPS-mode phones
- Portable battery powered equipment



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**Figure 1. CX74037 48-Pin, 7x7 LGA Package Pin Configuration**

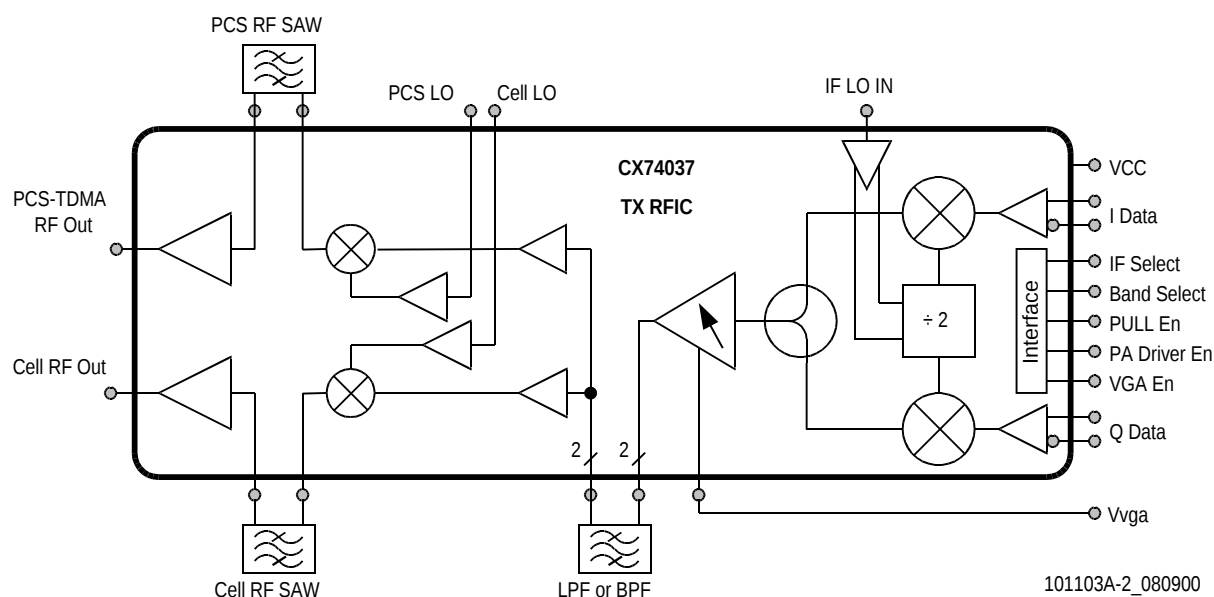


Figure 2. CX74037 Functional Block Diagram

## Technical Description

The CX74037 is a TDMA transmitter for the 800 MHz and 1900 MHz bands. It also can be used as an FM transmitter in AMPS mode at the 800 MHz band. A band select command chooses between the 800 MHz band and the 1900 MHz band. A mode select command chooses between TDMA and AMPS mode. The chip consists of an I/Q modulator, IF LO input buffer, IF VGA, two upconverters for the 800 MHz and 1900 MHz bands, and two PA drivers for the 800 MHz and the 1900 MHz bands.

**I/Q Modulator.** The I/Q modulator converts the incoming I/Q signal to an IF signal using one of the two local oscillator inputs. This signal is fed directly to the VGA amplifier.

**Variable Gain Amplifier.** The VGA is a differential amplifier that receives its signal from the I/Q modulator, amplifies it, and then is taken off-chip to be filtered before routing it to the upconverter. A dynamic range of 90 dB is available on the amplifier. A DC voltage of 0.2 to 2.5 V is needed to control the gain of the amplifier.

**Upconverters.** The 800 MHz and 1900 MHz upconverters receive the IF signal from the VGA amplifier. Each upconverter requires an external LO controlled by an external Phase Locked Loop (PLL). The band select command switches between the 800 MHz and the 1900 MHz bands.

**PA Drivers.** Two PA drivers are included, the 800 MHz driver and the 1900 MHz driver. Each driver takes its input from the upconverter after passing through an image rejection filter. The driver amplifies the signal and sends it to an external PA.

## Electrical and Mechanical Specifications

The signal pin assignments and functional pin descriptions are found in Table 1. The absolute maximum ratings of the CX74037 are provided in Table 2, the recommended operating conditions are specified in Table 3. Electrical characteristics for the CX74037 are shown in Table 4. Table 5 defines the control signal logic.

Figure 3 provides the package dimensions for the 48-pin, 7x7 LGA package.

## ESD Sensitivity

The CX74037 is a static-sensitive electronic device. Do not operate or store near strong electrostatic fields. Take proper ESD precautions.

Table 1. CX74037 Signal Definition (1 of 2)

| Pin NO. | Name         | Description                                                                                                                                                                                              |
|---------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Mix_IN+      | Input to RF Upconverters. Internally AC coupled, high impedance.                                                                                                                                         |
| 2       | Mix_IN-      | Input to RF Upconverters. Internally AC coupled, high impedance.                                                                                                                                         |
| 3       | VCC_IF       | Supply voltage for the AGC amplifier.                                                                                                                                                                    |
| 4       | VGA_GC       | The input pin for AGC gain control. A DC control voltage should be applied to this pin to vary the gain of the IF amplifier.                                                                             |
| 5       | VGA_OUT-     | VGA Output, open collector. External resistive (300 ohms) pull up to Vcc required.                                                                                                                       |
| 6       | VGA_OUT+     | VGA Output, open collector. External resistive (300 ohms) pull up to Vcc required.                                                                                                                       |
| 7       | VCC_LD_PCS   | Supply voltage for the PCS last stage driver amplifier.                                                                                                                                                  |
| 8       | POT_CELL     | This pin is connected to an external resistor. The value of the resistor will vary the bias current of the cellular driver.                                                                              |
| 9       | DRV_ENA      | This is the input pin for the upconverter and the driver control signal. When the pin is low the driver and the upconverter are deactivated.                                                             |
| 10      | RF_PCS_OUT   | Output pin for the PCS driver amplifier. Impedance matching is required.                                                                                                                                 |
| 11      | VCC_BIAS     | Supply voltage of bias cells.                                                                                                                                                                            |
| 12      | RF_CELL_OUT  | Output pin for the cellular driver amplifier. Impedance matching is required.                                                                                                                            |
| 13      | BAND         | This is a control signal input pin. It selects between cellular band and PCS band. When the input is low, the cellular band is chosen. When the input is high, the PCS band is chosen.                   |
| 14      | VCC_DRV_CEL  | Supply voltage for the driver of the cellular band.                                                                                                                                                      |
| 15      | POT_PCS      | This pin is connected to an external resistor. The value of the resistor will vary the bias current of the PCS driver.                                                                                   |
| 16      | VCC_MID_PCS  | Supply voltage for the first amplifier in the PCS driver block.                                                                                                                                          |
| 17      | DRV_CELL_IN  | The Cellular driver amplifier input pin. Impedance matching is required.                                                                                                                                 |
| 18      | DRV_PCS_IN   | The PCS driver amplifier input pin. Impedance matching is required.                                                                                                                                      |
| 19      | I_DATA+      | The baseband input for I channel. This is a balanced input. A DC bias has to be supplied to the pin.                                                                                                     |
| 20      | I_DATA-      | Same as pin 20, except complementary input. This pin should be pull low (0 V) in FM mode.                                                                                                                |
| 21      | VCC_MOD      | Supply voltage for the I/Q modulator.                                                                                                                                                                    |
| 22      | Q_DATA+      | The baseband input for Q channel. This is a balanced input. A DC bias has to be supplied to the pin.                                                                                                     |
| 23      | Q_DATA-      | Same as pin 23, except complementary input.                                                                                                                                                              |
| 24      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 25      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 26      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 27      | MIX_PCS_OUT  | Output of the PCS upconverter. Impedance matching required.                                                                                                                                              |
| 28      | VCC_DIFF_DRV | Supply voltage for a differential amplifier in the upconverter block.                                                                                                                                    |
| 29      | PULL_ENA     | This is a control signal input pin. When the input is low, the IF VCOs, RF Mixer and buffers, and divide by 2 sections will be disabled. When the input is high, the mentioned sections will be enabled. |
| 30      | MIX_CELL_OUT | Output of the Cellular upconverter. Impedance matching required.                                                                                                                                         |
| 31      | VCC_DIV      | Supply voltage for the dividers and VCO buffer.                                                                                                                                                          |
| 32      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 33      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 34      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 35      | IF VCO IN1+  | Input pin for the modulator LO signal. The frequency is 2xIF. Can be used single-ended. AC ground the unused pin.                                                                                        |
| 36      | IF VCO IN1-  | Input pin for the modulator LO signal. The frequency is 2xIF. Can be used single-ended. AC ground the unused pin.                                                                                        |
| 37      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 38      | NC           | There is no connection on this pin. Should be tied to ground.                                                                                                                                            |
| 39      | MODE         | This is a control signal input pin. When the input is low, the AMPS mode is selected. If the input is high, TDMA mode is selected. FM output is 9 dB higher at the modulator output.                     |
| 40      | IF VCO IN2+  | Input pin for the modulator LO signal. The frequency is 2xIF. Can be used single-ended. AC ground the unused pin.                                                                                        |
| 41      | IF VCO IN2-  | Input pin for the modulator LO signal. The frequency is 2xIF. Can be used single-ended. AC ground the unused pin.                                                                                        |
| 42      | IF_SELECT    | Control signal to select IF VCO INPUT1 or INPUT2. "1" will select IF VCO INPUT1 and "0" will select IF VCO INPUT2.                                                                                       |

Table 1. CX74037 Signal Definition (2 of 2)

| Pin No. | Name      | Description                                                                                                                                                                     |
|---------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 43      | NC        | Connect to ground.                                                                                                                                                              |
| 44      | NC        | Connect to ground.                                                                                                                                                              |
| 45      | LO_PCS_IN | This is the input pin for the local oscillator for the PCS band. It is internally matched.                                                                                      |
| 46      | VCC_MIX   | Supply voltage for the mixer in the upconverter block and for the LO buffer.                                                                                                    |
| 47      | LO_CELL   | This is the input pin for the local oscillator for the cellular band. It is internally matched.                                                                                 |
| 48      | VGA_EN    | This is a control signal input pin. When the input is low, the VGA and I/Q Modulator sections will be disabled. When the input is high, the mentioned sections will be enabled. |

Table 2. Absolute Maximum Ratings

| Parameter                     | Symbol | Minimum | Typical | Maximum | Units |
|-------------------------------|--------|---------|---------|---------|-------|
| Supply voltage                | VCC    | −0.3    |         | +5.0    | V     |
| Input voltage range           |        | −0.3    |         | VCC     | V     |
| Power dissipation             |        |         |         | 600     | mW    |
| Ambient operating temperature |        | −30     |         | +80     | °C    |
| Storage temperature           |        | −40     |         | +125    | °C    |

Table 3. CX74037 Recommended Operating Conditions

| Parameter                                     | Symbol | Minimum | Typical | Maximum | Units |
|-----------------------------------------------|--------|---------|---------|---------|-------|
| Supply voltage                                |        | 2.7     | 3.0     | 3.6     | V     |
| Logic level high                              |        | 1.9     |         |         | V     |
| Logic level low                               |        |         |         | 0.8     | V     |
| Supply current in 800 MHz TDMA @ 7 dBm        |        |         | 75      |         | mA    |
| Supply current in 800 MHz AMPS @ 7 dBm        |        |         | 75      |         | mA    |
| Supply current in 800 MHz (DRV_ENA off)       |        |         | 45      |         | mA    |
| Supply current in 1900 MHz TDMA @ 8.0 dBm     |        |         | 84      |         | mA    |
| Supply current in 1900 MHz TDMA (DRV_ENA off) |        |         | 48      |         | mA    |
| Supply current in sleep mode                  |        |         |         | 20      | μA    |

**Table 4. CX74037 Electrical Characteristics (1 of 3)**  
VCC = 3.0 V, T<sub>A</sub> = 25 °C, PLO = -10 dBm, input externally matched

| Parameter                                                        | Symbol | Test Conditions | Min       | Typical   | Max       | Units    |
|------------------------------------------------------------------|--------|-----------------|-----------|-----------|-----------|----------|
| <b>IF VCO Input</b>                                              |        |                 |           |           |           |          |
| Input frequency range (2X IF frequency)                          |        |                 | 100       |           | 640       | MHz      |
| Input signal level                                               |        |                 | -10       | -3        | +3        | dBm      |
| <b>I/Q Modulator (Output Not Measurable)</b>                     |        |                 |           |           |           |          |
| Input voltage level, differential                                |        |                 |           | 1.4       |           | Vp-p     |
| Common mode input voltage level                                  |        |                 | 1.4       | 1.85      | 2.1       | V        |
| Input DC offset                                                  |        |                 |           |           | 4         | mV       |
| Input impedance                                                  |        |                 | 100K      |           |           | Ω        |
| Gain variation over process, temperature, VCC                    |        |                 |           | 0.4       |           | dB       |
| I/Q gain mismatch                                                |        |                 |           | 0.3       | 0.4       | dB       |
| I/Q phase imbalance                                              |        |                 |           | 2         | 4         | degrees  |
| <b>Transmit VGA</b>                                              |        |                 |           |           |           |          |
| VGA frequency range (-1 dB bandwidth)                            |        |                 | 50        |           | 320       | MHz      |
| VGA gain (with a 600 Ω differential load):<br>Maximum<br>Minimum |        |                 | 22<br>-64 | 24<br>-62 | 26<br>-60 | dB<br>dB |
| VGA gain variation with VCC 3.0 to 3.6 V @ VCTRL 2 V             |        |                 | -3        |           | +3        | dB       |
| Gain variation with temperature                                  |        |                 | -1.0      |           | +1.0      | dB       |
| Gain control input impedance                                     |        |                 |           | 40K       |           | Ω        |
| VGA gain slope                                                   |        |                 | 45        | 50        | 55        | dB/V     |
| VGA gain control range                                           |        |                 | 0.5       |           | 2.5       | V        |
| Gain slope variation over any 6 dB segment                       |        |                 | -3        |           | +3        | dB/V     |
| Output power level @ 20 dB gain                                  |        |                 |           | -13       |           | dBm      |
| P1dB @ 22 dB gain                                                |        |                 |           | -3        |           | dBm      |
| NF @ 22 dB gain                                                  |        |                 |           |           | 6         | dB       |
| NF at -52 dB gain                                                |        |                 |           | 52        | 53        | dB       |
| Operating temperature range                                      |        |                 | -30       | +25       | +80       | °C       |
| <b>Cellular Upconverter</b>                                      |        |                 |           |           |           |          |
| LO frequency range                                               |        |                 | 1017      |           | 1043      | MHz      |
| LO input return loss (reference to 50 Ω)                         |        |                 |           | -10       |           | dB       |
| Output frequency                                                 |        |                 | 824       |           | 849       | MHz      |
| Output return loss from 824 MHz to 849 MHz (reference to 50 Ω)   |        |                 |           |           | -15       | dB       |
| Conversion gain                                                  |        |                 | 7         | 8         | 9         | dB       |
| Gain degradation @ VCC 2.7 V                                     |        |                 |           | 0.1       |           | dB       |
| ACPR in 30 kHz at 30 kHz offset @ -5 dBm output; cascaded        |        |                 |           | -33       |           | dBc      |
| ACPR in 30 kHz at 60 kHz offset @ -5 dBm output; cascaded        |        |                 |           | -56       |           | dBc      |

Table 4. RF150 Electrical Characteristics (2 of 3)

 $V_{DD} = 2.7\text{ V}$ ,  $-40\text{ }^{\circ}\text{C} < T_A < +85\text{ }^{\circ}\text{C}$ , unless specified

| Parameter                                                        | Symbol | Test Conditions | Min  | Typical | Max  | Units              |
|------------------------------------------------------------------|--------|-----------------|------|---------|------|--------------------|
| <b>Cellular Upconverter (continued)</b>                          |        |                 |      |         |      |                    |
| Output P1dB                                                      |        |                 | 2    | 3       |      | dBm                |
| Noise figure @ 8 dB gain                                         |        |                 |      | 12      | 13   | dB                 |
| LO to RF leakage @ maximum gain,<br>LO = -10 dBm                 |        |                 |      | -35     |      | dBm                |
| Operating temperature range                                      |        |                 | -30  | +25     | +80  | $^{\circ}\text{C}$ |
| <b>PCS Upconverter</b>                                           |        |                 |      |         |      |                    |
| LO frequency range                                               |        |                 | 2078 |         | 2139 | MHz                |
| LO input return loss (reference to 50 $\Omega$ )                 |        |                 |      | -10     |      | dB                 |
| Output frequency                                                 |        |                 | 1850 |         | 1910 | MHz                |
| Conversion gain                                                  |        |                 | 8    | 9       | 10   | dB                 |
| ACPR in 30 kHz at 30 kHz offset @ -4 dBm<br>output; cascaded     |        |                 |      | -33     |      | dBc                |
| ACPR in 30 kHz at 60 kHz offset @ -4 dBm<br>output; cascaded     |        |                 |      | -57     |      | dBc                |
| Noise figure @ 9 dB gain                                         |        |                 |      | 9       | 10   | dB                 |
| P1dB                                                             |        |                 |      | 0       |      | dBm                |
| LO to RF leakage @ maximum gain,<br>LO = -15 dBm                 |        |                 |      | -35     |      | dBm                |
| Operating temperature range                                      |        |                 | -30  | +25     | +80  | $^{\circ}\text{C}$ |
| <b>Cellular PA Driver</b>                                        |        |                 |      |         |      |                    |
| Output frequency                                                 |        |                 | 824  |         | 849  | MHz                |
| Gain                                                             |        |                 | 13   | 14      | 15   | dB                 |
| Output power level @ 14 dB gain                                  |        |                 |      | 7       |      | dBm                |
| Input return loss (reference to 50 $\Omega$ )                    |        |                 |      | -15     |      | dB                 |
| Output P1dB                                                      |        |                 | 14.5 |         |      | dBm                |
| ACPR in 30 kHz band at 30 kHz offset @ 7<br>dBm output; cascaded |        |                 |      | -32     |      | dBc                |
| ACPR in 30 kHz band at 60 kHz offset @ 7<br>dBm output; cascaded |        |                 |      | -55     |      | dBc                |
| Output return loss (reference to 50 $\Omega$ )                   |        |                 |      | -15     |      | dB                 |
| Noise figure                                                     |        |                 |      | 6       | 8    | dB                 |
| Operating temperature range                                      |        |                 | -30  | +25     | +80  | $^{\circ}\text{C}$ |
| External bias resistor value for +14.5 dBm<br>P1dB               |        |                 |      | 120     |      | $\Omega$           |

**Table 4. RF150 Electrical Characteristics (3 of 3)** $V_{DD} = 2.7\text{ V}$ ,  $-40\text{ }^{\circ}\text{C} < T_A < +85\text{ }^{\circ}\text{C}$ , unless specified

| Parameter                                                       | Symbol | Test Conditions | Min  | Typical | Max  | Units              |
|-----------------------------------------------------------------|--------|-----------------|------|---------|------|--------------------|
| <b>PCS PA Driver</b>                                            |        |                 |      |         |      |                    |
| Input return loss (reference to 50 $\Omega$ )                   |        |                 |      | -15     |      | dB                 |
| Output frequency                                                |        |                 | 1850 |         | 1910 | MHz                |
| Gain                                                            |        |                 | 15   | 16      | 17   | dB                 |
| Output power level @ 16 dB gain                                 |        |                 |      | 8.0     |      | dBm                |
| Output P1dB                                                     |        |                 | 14   |         |      | dBm                |
| ACPR in 30 kHz band at 30 kHz offset @ 8.0 dBm output; cascaded |        |                 |      | -32     |      | dBc                |
| ACPR in 30 kHz band at 60 kHz offset @ 8.0 dBm output; cascaded |        |                 |      | -55     |      | dBc                |
| Output return loss (reference to 50 $\Omega$ )                  |        |                 |      | -15     |      | dB                 |
| Noise figure                                                    |        |                 |      | 9       | 10   | dB                 |
| Operating temperature range                                     |        |                 | -30  | +25     | +80  | $^{\circ}\text{C}$ |
| External bias resistor value for +16 dBm of P1dB                |        |                 |      | 130     |      | $\Omega$           |

**Table 5. Control Signal Truth Table**

| Signal Name | Logic 1    | Logic 0    | Remark                                                 |
|-------------|------------|------------|--------------------------------------------------------|
| VGA_ENA     | ON         | OFF        |                                                        |
| DRV_ENA     | ON         | OFF        | Cell and PCS band                                      |
| BAND        | PCS        | Cell       |                                                        |
| PULL_ENA    | ON         | OFF        | IF VCO, RF mixer buffers, divide-by-2                  |
| IF_Select   | IF VCO IN1 | IF VCO IN2 |                                                        |
| MODE        | TDMA       | FM         | In FM mode:<br>Normal DC bias on I+,<br>0 V bias on I- |

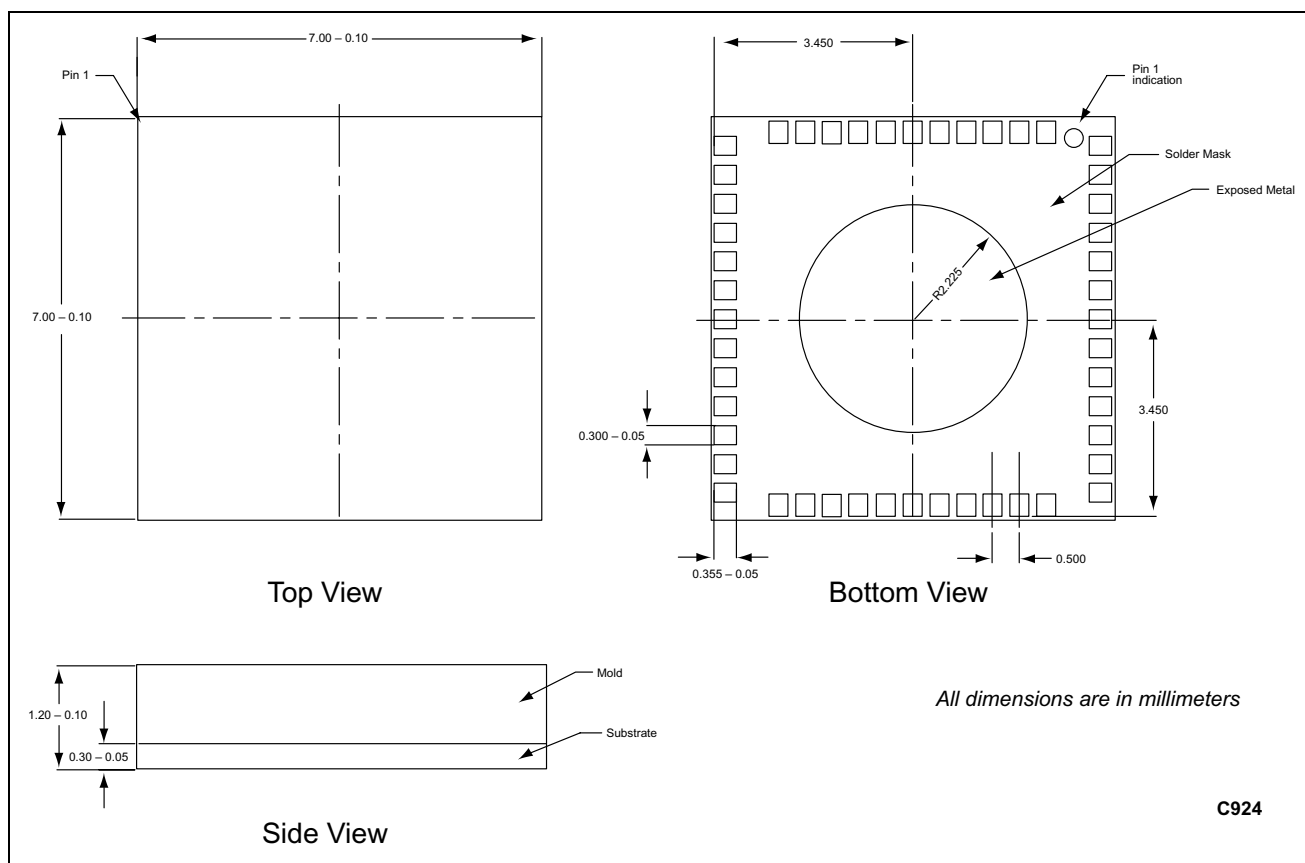


Figure 3. CX74037 Package Dimensions for a 48-Pin, 7x7 LGA Package

**Ordering Information**

| Model Name     | Manufacturing Part Number |
|----------------|---------------------------|
| Transmit RF IC | CX74037                   |

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