



MRFIC1505

Integrated GPS Downconverter

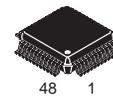
This integrated circuit is intended for GPS receiver applications. The dual conversion design is implemented in Motorola's low-cost, high-performance MOSAIC 5™ silicon bipolar process and is packaged in a low-cost surface mount LQFP-48 package. In addition to the mixers, a VCO, PLL, Crystal Oscillator, A/D converter and a loop filter are integrated on-chip. Output IF is nominally 4.1 MHz.

- 105 dB Typical Conversion Gain
- 2.7 V Operation
- 28 mA Typical Current Consumption
- Low-Cost, Low-Profile Plastic LQFP Package

MOSAIC 5 is a trademark of Motorola, Inc.

1.575 GHz GPS DOWNCONVERTER

SEMICONDUCTOR TECHNICAL DATA

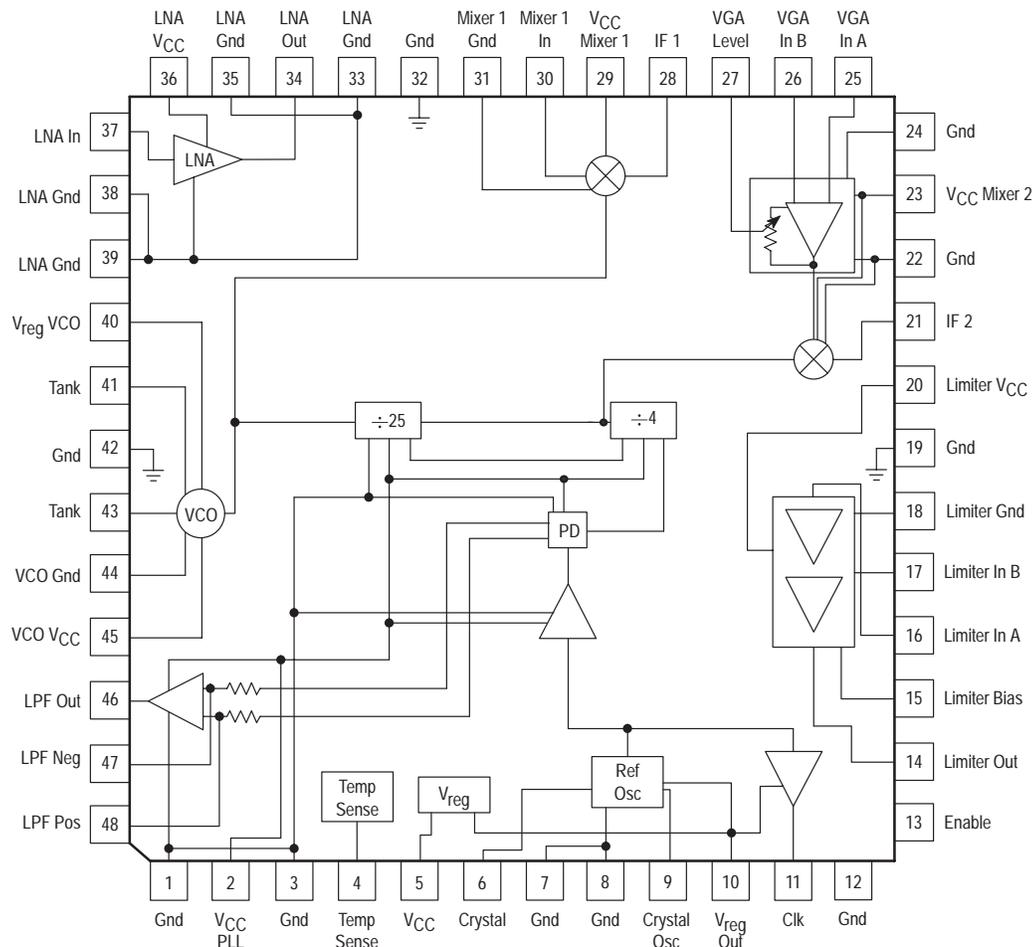


PLASTIC PACKAGE
CASE 932
(LQFP-48)

ORDERING INFORMATION

| Device | Operating Temperature Range | Package |
|-------------|------------------------------|---------|
| MRFIC1505R2 | T _A = -40 to 85°C | LQFP-48 |

Pin Connections and Functional Block Diagram



MRFIC1505

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|-----------|------------|------|
| DC Supply Voltage | V_{DD} | 5.0 | Vdc |
| DC Supply Current | I_{DD} | 60 | mA |
| Operating Ambient Temperature | T_A | -40 to 85 | °C |
| Storage Temperature Range | T_{stg} | -65 to 150 | °C |
| Lead Soldering Temperature Range (10 seconds) | - | 260 | °C |

NOTE: Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the limits in the Electrical Characteristics tables.

ELECTRICAL CHARACTERISTICS ($V_{CC} = 2.7$ to 3.3 V; $T_A = -40$ to 85°C ; Enable = 2.7 V unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

TOTAL DEVICE

| | | | | | |
|--|----------|-----|-----|-----|----|
| Supply Voltage | V_{CC} | 2.7 | 3.0 | 3.3 | V |
| Supply Current ($T_A = 25^\circ\text{C}$, $V_{CC} = 2.7$ V, Enable = 2.7 V) | I_{CC} | - | 28 | 36 | mA |
| Supply Current ($T_A = 25^\circ\text{C}$, $V_{CC} = 2.7$ V, Enable = 0 V) | I_{CC} | - | 2.0 | 4.0 | mA |

RF AMPLIFIER

| | | | | | |
|---|-------------|----|---------|---|----------|
| RF Input Frequency | f_{in} | - | 1575.42 | - | MHz |
| Input Impedance | Z_{in} | - | 50 | - | Ω |
| Input VSWR | $VSWR_{in}$ | - | 2.0 | - | - |
| Gain | G | 13 | 15 | - | dB |
| Noise Figure | NF | - | 2.0 | - | dB |
| 1.0 dB Compression (Measured at Output) | P_{1dB} | - | 1.0 | - | dBm |

FIRST MIXER

| | | | | | |
|---|-----------|----|---------|---|----------|
| Input Frequency | f_{in} | - | 1575.42 | - | MHz |
| Gain | G | 10 | 14 | - | dB |
| Noise Figure | NF | - | 13 | - | dB |
| 1.0 dB Compression (Measured at Output) | P_{1dB} | - | -13 | - | dBm |
| First Local Oscillator Frequency | f_{LO1} | - | 1636.8 | - | MHz |
| First Intermediate Frequency | f_{IF1} | - | 61.38 | - | MHz |
| LO Leakage at IF Port | - | - | -40 | - | dBm |
| LO Leakage at RF Port | - | - | -50 | - | dBm |
| Output Impedance | Z_{out} | - | 50 | - | Ω |

FIRST IF AMPLIFIER and SECOND MIXER

| | | | | | |
|---|-----------|----|-------|---|----------|
| Input Frequency | f_{in} | - | 61.38 | - | MHz |
| Input Impedance | Z_{in} | - | 230 | - | Ω |
| Output Impedance | Z_{out} | - | 50 | - | Ω |
| Second Local Oscillator Frequency | f_{LO2} | - | 65.47 | - | MHz |
| Second Intermediate Frequency | f_{IF2} | - | 4.092 | - | MHz |
| LO Leakage at IF Port | - | - | -40 | - | dBm |
| Gain | G | 40 | 43 | - | dB |
| Cascaded Noise Figure | NF | - | 9.3 | - | dB |
| 1.0 dB Compression Point (Measured at Output) | P_{1dB} | - | -13 | - | dBm |

MRFIC1505

ELECTRICAL CHARACTERISTICS — continued ($V_{CC} = 2.7$ to 3.3 V; $T_A = -40$ to 85°C ; Enable = 2.7 V unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|-----------|-----|-------|-----|------|
| LIMITING AMPLIFIER | | | | | |
| Second Intermediate Frequency | f_{IF2} | – | 4.092 | – | MHz |
| Input Signal Level | – | 4.0 | 11 | 31 | mV |
| Output Voltage Swing (Into 10 pF 100 k Ω) | V_{out} | 800 | – | – | mVpp |
| DC Output Level | – | – | 1.4 | – | V |
| Gain | G | – | 50 | – | dB |

REFERENCE OSCILLATOR

| | | | | | |
|--|-------|-----|--------|------|------|
| Reference Frequency | f_r | – | 16.368 | – | MHz |
| Reference Frequency Input Level (Crystal Output Pin) | – | – | 500 | – | mVpp |
| Reference Oscillator Output Voltage Level (Into 15 pF 10 k Ω) | – | 750 | – | – | mVpp |
| Reference Clock Input Drive Level | – | 400 | 800 | 1500 | mVpp |

PLL

| | | | | | |
|-----------------------------------|-----------|---|--------|---|--------|
| First Local Oscillator Frequency | f_{LO1} | – | 1636.8 | – | MHz |
| Second Local Oscillator Frequency | f_{LO2} | – | 65.47 | – | MHz |
| VCO C/N (at 10 kHz Offset) | – | – | –80 | – | dBc/Hz |
| VCO Gain (TBD Varactor) | – | – | 20 | – | MHz/V |

ENABLE

| | | | | | |
|----------------------|---|---------------------|----------|---------------------|---|
| Enable Active Level | – | $0.8 \times V_{CC}$ | V_{CC} | – | V |
| Disable Active Level | – | – | 0 | $0.2 \times V_{CC}$ | V |

VOLTAGE REGULATOR

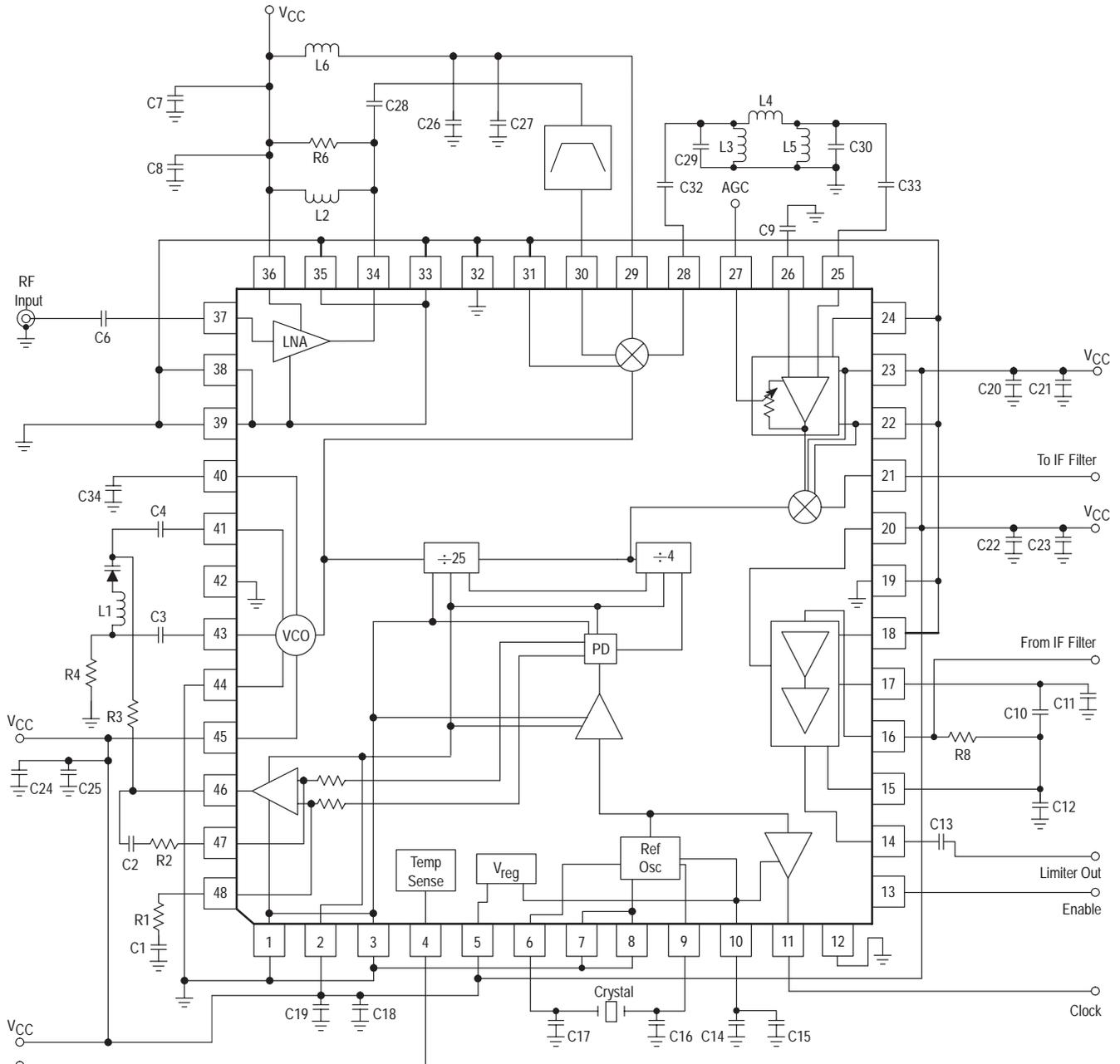
| | | | | | |
|--|-------|-----|-----|-----|---|
| Regulator Output Voltage ($V_{CC} = 2.7$ to 3.3 V, $I_{out} = 3.0$ mA) | V_o | 2.1 | 2.3 | 2.5 | V |
|--|-------|-----|-----|-----|---|

TEMPERATURE SENSE SPECS

| | | | | | |
|--|---|-----|------|-------|----------------------|
| Temperature Sensor Output Voltage @ 25°C | – | 1.2 | 1.28 | 1.375 | V |
| Temperature Sensor Slope over Temperature | – | – | 5.0 | – | mV/ $^\circ\text{C}$ |

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Figure 1. Applications Schematic (1636.8 MHz LO)



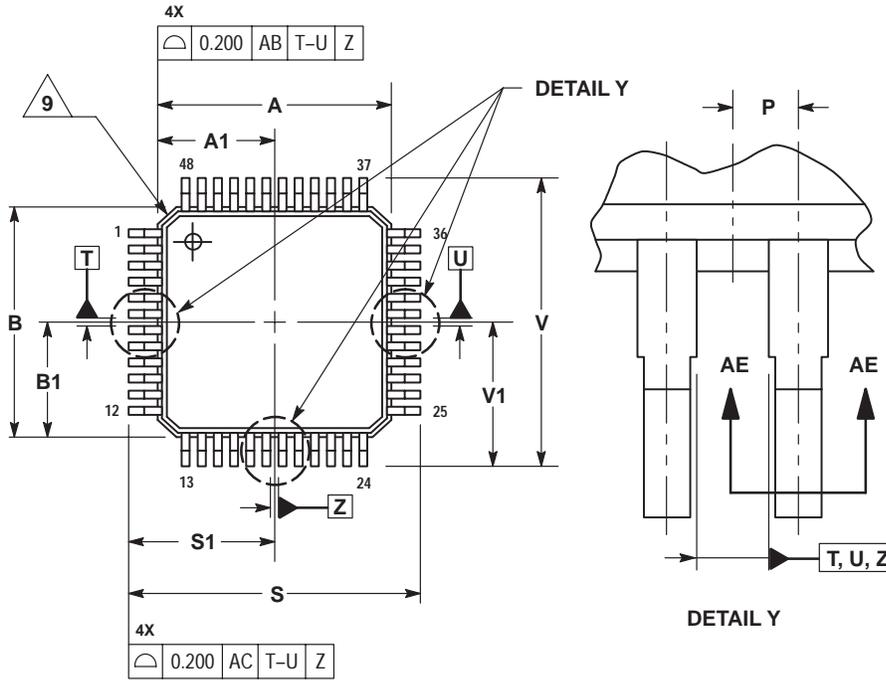
| | | | | |
|------------|----------------------------------|--------------|------------|--------------|
| Temp Sense | C1, C2 | 220 pF | C29, C30 | 91 pF |
| | C3, C4 | 1.7 pF | C32, C33 | 1.0 nF |
| | C6 | 10 pF | L1 | 10 nH |
| | C7, C14, C18, C20, C22, C24, C34 | 0.01 μ F | L2 | 3.9 nH |
| | C8, C15, C19, C21, C23, C25, C27 | 1000 pF | L3, L5 | 82 nH |
| | C9 | 1.0 μ F | L4 | 0.62 μ H |
| | C10, C11, C12 | 1.0 nF | L6 | TBD |
| | C13 | 2.7 nF | R1, R2, R4 | 10 k |
| | C16, C17 | 27 pF | R3 | 2 k |
| | C26 | 470 pF | R6 | 1.2 k |
| | C28 | 0.6 pF | R8 | 5.0 k |

NOTES: 1. R8 must be set to match your 2nd IF filter impedance.
 2. Layout of capacitors C10, C11, C12 is critical for stability of Limiter.

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OUTLINE DIMENSIONS

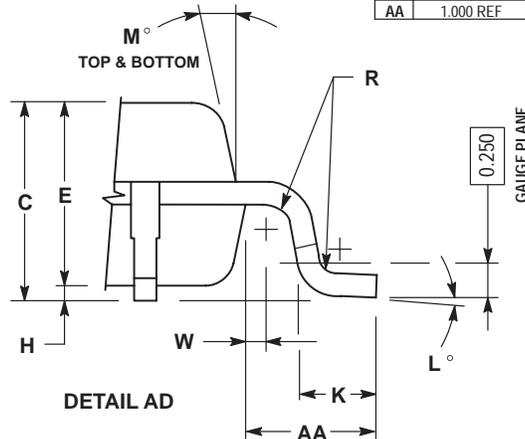
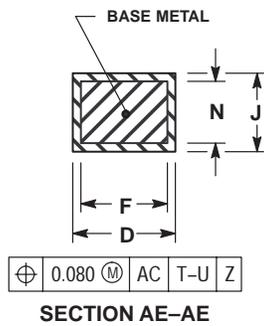
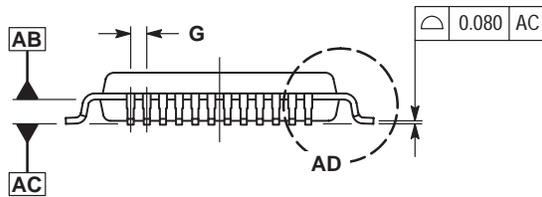
PLASTIC PACKAGE
CASE 932-03
(LQFP-48)
ISSUE F



NOTES:

- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- 2 CONTROLLING DIMENSION: MILLIMETER.
- 3 DATUM PLANE AB IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
- 4 DATUMS T, U, AND Z TO BE DETERMINED AT DATUM PLANE AB.
- 5 DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE AC.
- 6 DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE AB.
- 7 DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.350.
- 8 MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076.
- 9 EXACT SHAPE OF EACH CORNER IS OPTIONAL.

| MILLIMETERS | | |
|-------------|-------|-------|
| DIM | MIN | MAX |
| A | 7.000 | BSC |
| A1 | 3.500 | BSC |
| B | 7.000 | BSC |
| B1 | 3.500 | BSC |
| C | 1.400 | 1.600 |
| D | 0.170 | 0.270 |
| E | 1.350 | 1.450 |
| F | 0.170 | 0.230 |
| G | 0.500 | BSC |
| H | 0.050 | 0.150 |
| J | 0.090 | 0.200 |
| K | 0.500 | 0.700 |
| L | 0° | 7° |
| M | 12° | REF |
| N | 0.090 | 0.160 |
| P | 0.250 | BSC |
| R | 0.150 | 0.250 |
| S | 9.000 | BSC |
| S1 | 4.500 | BSC |
| V | 9.000 | BSC |
| V1 | 4.500 | BSC |
| W | 0.200 | REF |
| AA | 1.000 | REF |



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