# MRFIC1505/MRFIC1505A Integrated GPS Downconverter

## 1.575 GHz 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

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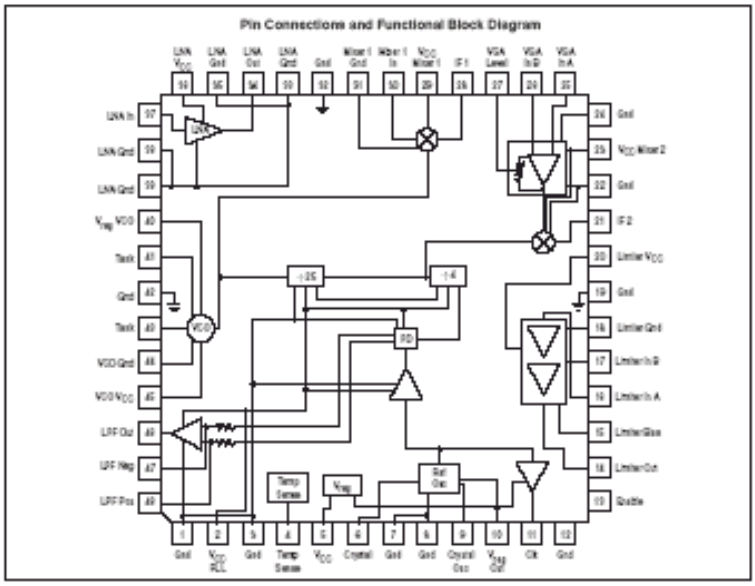
### Ordering Information

| Device | Operating Temperature Range | Package |
|---|---|---|
| MRFIC1505R2 | $T_A$ = –40 to 85°C | LQFP-48 |
| MRFIC1505AR2 | $T_A$ = –40 to 85°C | LQFP-48 |


Plastic Package
Case 932
(LQFP-48)



## 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 | – | 260 | °C |

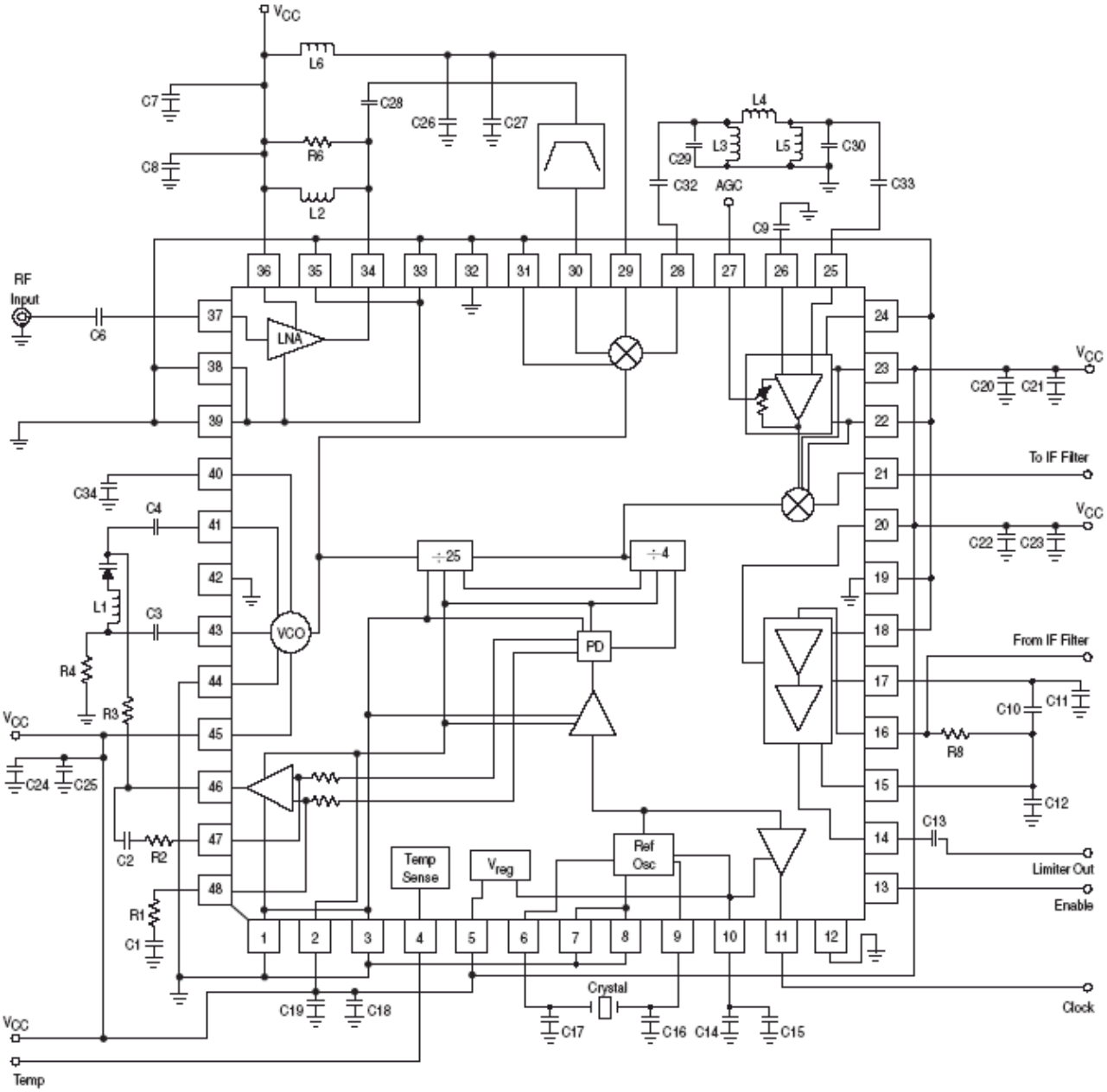
**Note:** Maximum Ratings are those values beyond which damage to the device may occur.
Functional operation should be restricted to the limits in the Electrical Characteristics tables.

## Electrical Characteristics (VCC = 2.7 to 3.3 V; TA = –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 (TA = 25°C, VCC = 2.7 V, Enable = 2.7V) | $I_{CC}$ | – | 28 | 36 | mA |
| Supply Current (TA = 25°C, VCC = 2.7 V, Enable = 2.7V) | $I_{CC}$ | – | 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 Frequenc | $f_{IF1}$ | – | 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 |
| **Limiting Amplifier** | | | | | |
| Second Intermediate Frequency | $f_{IF2}$ | – | 4.092 | – | MHz |
| Input Signal Level | – | 4.0 | 11 | 31 | Mv |
| Output Voltage Swing (into 10 pf ll100 kΩ | $V_{out}$ | 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 |

**Electrical Characteristics** (VCC = 2.7 to 3.3 V; TA = –40 to 85°C; Enable = 2.7 V unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Reference Oscillator Output Voltage Level (Into 15 pf II 10 kΩ) | – | 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) | – | – | 200 | – | MHz/V |
| **Enable** | | | | | |
| Enable Active Level | – | 0.8 x $V_{CC}$ | $V_{CC}$ | – | V |
| Disable Active Level | – | – | 0 | 0.2 x $V_{CC}$ | 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 |
| **MRFIC505 Temperature Sense Specs** | | | | | |
| Temperature Sensor Output Voltage @ 25°C | – | 1.2 | 1.28 | 1.375 | V |
| Temperature Sensor Slope over Temperature | – | – | 5.0 | – | mV/°C |
| **MRFIC505A Temperature Sense Specs** | | | | | |
| Temperature Sensor Output Voltage @ 25°C | – | 1.270 | 1.395 | 1.463 | V |
| Temperature Sensor Slope over Temperature | – | – | 5.0 | – | mV/°C |



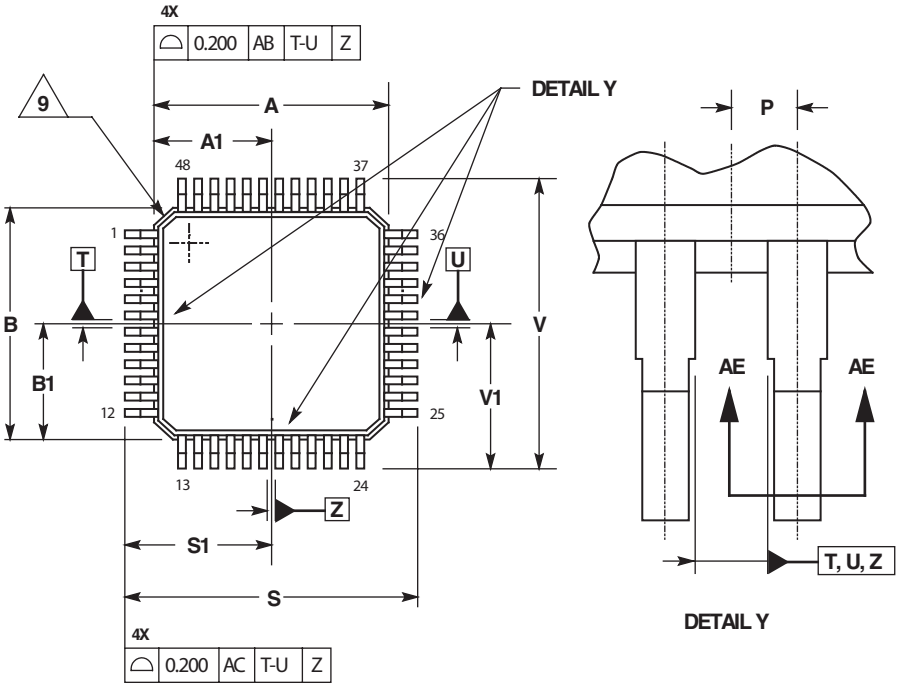

| | | | |
|---|---|---|---|
| C1, C2 | 220 pF | C29, C30 | 91 pF |
| C3, C4 | 1.7 pF | C32, C33 | 1.0 nF |
| C6 | 10 pF | L1 | 10 nH |
| C7, C14, C18, C20, C22, C24, C34 | 0.01 µF | L2 | 3.9 nH |
| C8, C15, C19, C21, C23, C25, C27 | 1000 pF | L3, L5 | 82 nH |
| C9 | 1.0 µF | L4 | 0.62 µH |
| C10, C11, C12 | 1.0 npF | 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.

**Figure 1 Applications Schematic (1636.8 MHz LO)**

# Outline Dimensions

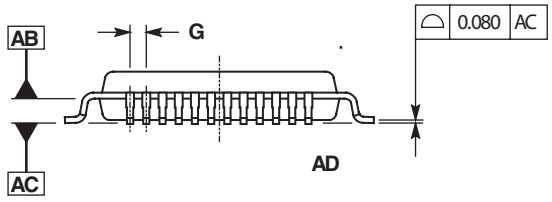
**PLASTIC PACKAGE**
**CASE 932-03**
**(LQFP-48)**
**ISSUE F**

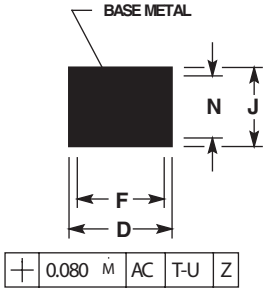


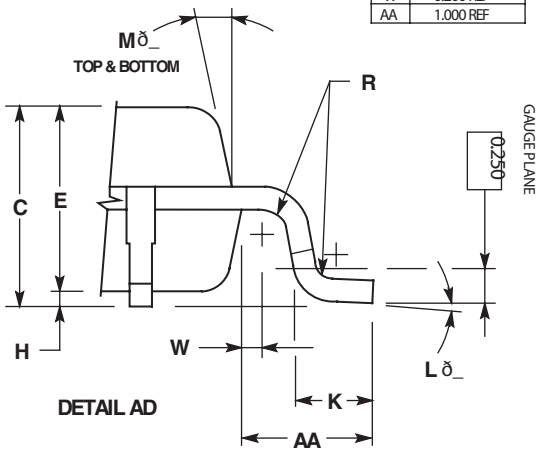

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF PARTING LINE.
4. DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
5. DIMENSIONS A AND B 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 0.370.
8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076.
9. EXACT SHAPE OF EACH CORNER IS OPTIONAL.

△

| DIM | MILLIMETERS 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 | |



# NOTES

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