Freescale Semiconductor, Inc.

Order this document by MRFIC1504/D

MOTOROLA

ARCHIVED BY FREESCALE SEMICONDUCTOR, INC. 2005

MRFIC1504

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

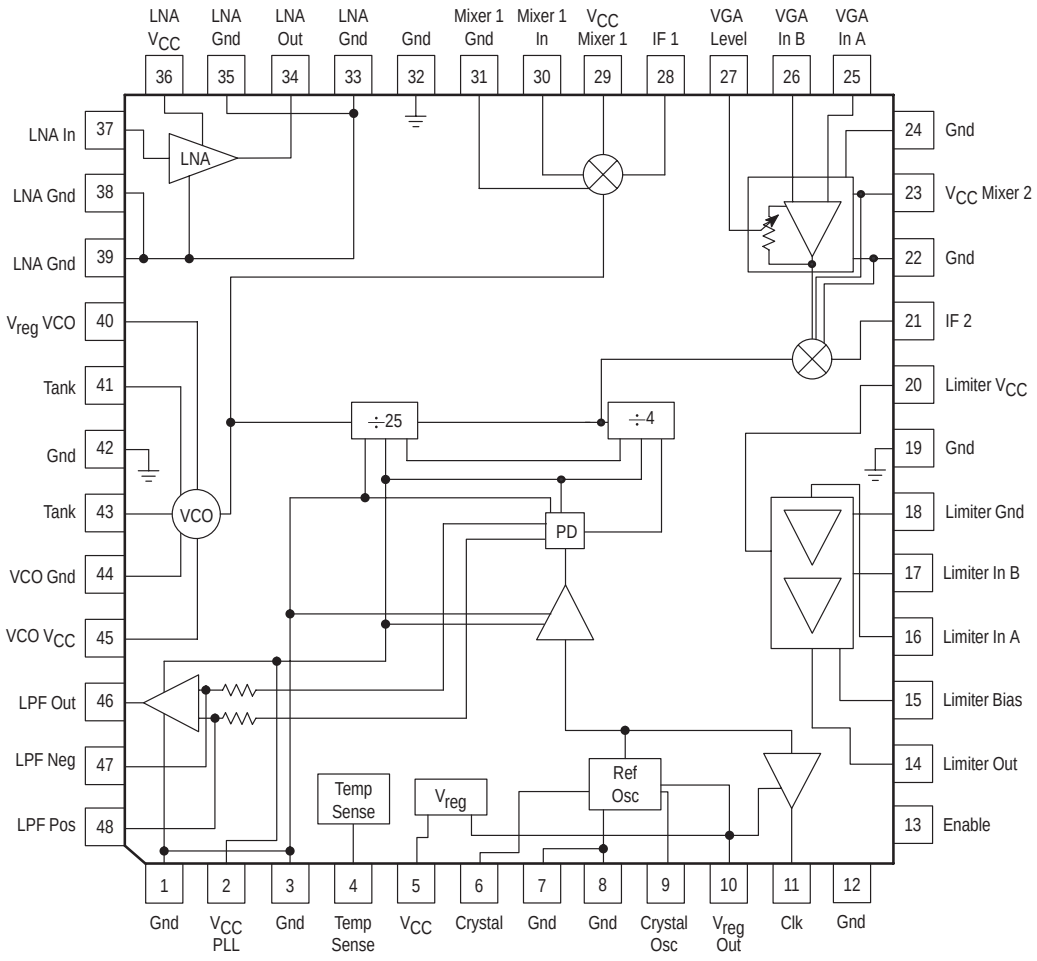
SEMICONDUCTOR TECHNICAL DATA

PLASTIC PACKAGE
CASE 932
(LQFP–48)

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MRFIC1504R2	T_A = –40 to 85°C	LQFP–48

Pin Connections and Functional Block Diagram



© Motorola, Inc. 2000

Rev 1

For More Information On This Product,
Go to: www.freescale.com

ARCHIVED BY FREESCALE SEMICONDUCTOR, INC. 2005

Freescale Semiconductor, Inc.

) BY FREESCALE SEMICONDUCTOR, INC. 2005

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°C, V_{CC} = 2.7 V, Enable = 2.7 V)	I_{CC}	–	28	36	mA
Supply Current (T_A = 25°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
Imput 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

Freescale Semiconductor, Inc.

) BY FREESCALE SEMICONDUCTOR, INC. 2005

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

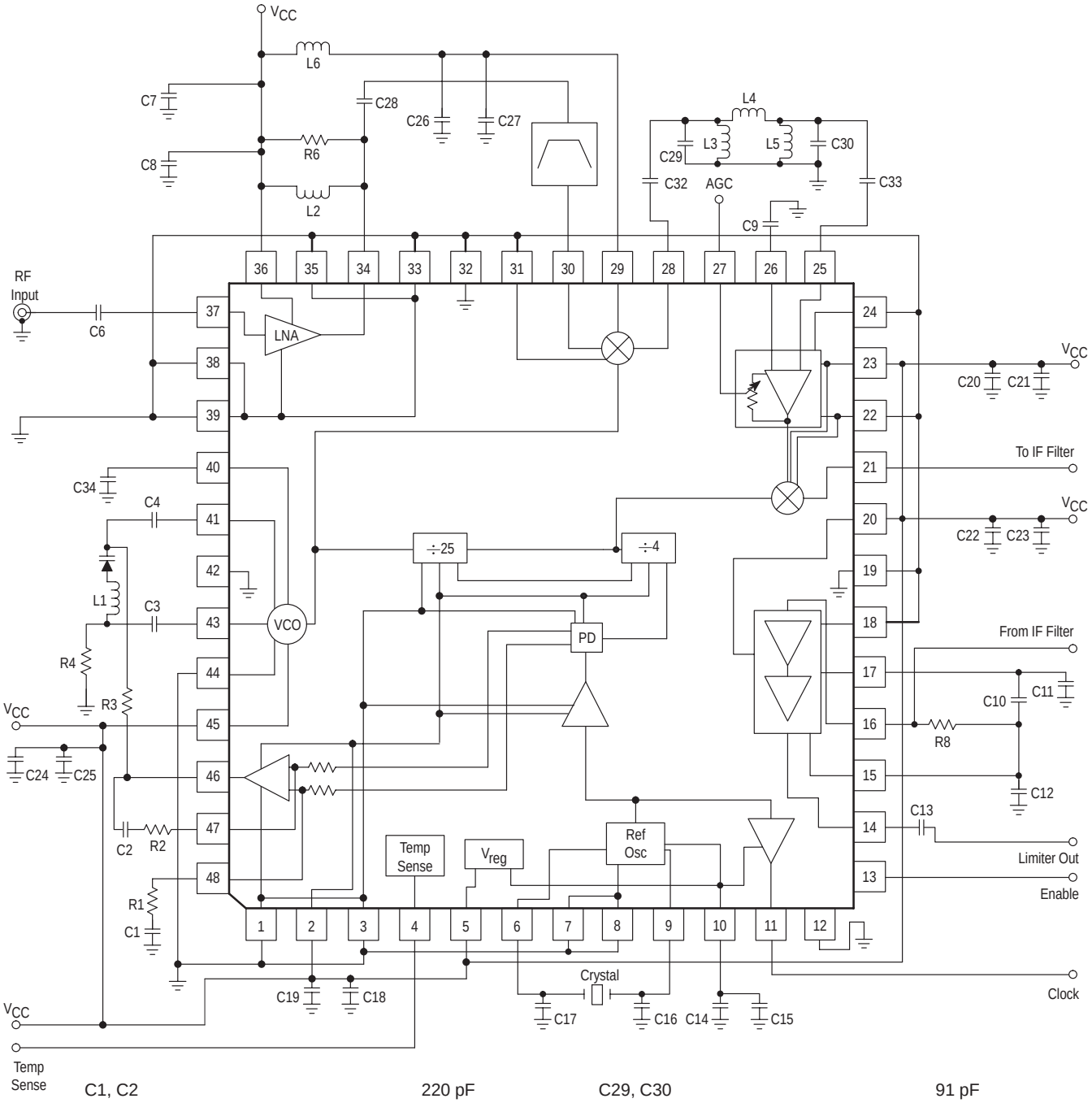
Characteristic	Symbol	Min	Typ	Max	Unit
LIMITING AMPLIFIER					
Second Intermediate Frequency	f_{IF2}	–	4.092	–	MHz
Input Signal Level	–	4.0	11	31	mV
Output Voltage Swing (Into 10 pf ‖ 100 kΩ)	V_{out}	800	–	–	mVpp
DC Output Level	–	–	1.4	–	V
Gain	G	–	50	–	dB
REFERENCE OSCILLATOR					
Reference Frequency	f_r	–	16.368	–	MHz
Reference Frequency Input Level (Crystal Output Pin)	–	–	500	–	mVpp
Reference Oscillator Output Voltage Level (Into 15 pF ‖ 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)	–	–	20	–	MHz/V
ENABLE					
Enable Active Level	–	0.8 × V_{CC}	V_{CC}	–	V
Disable Active Level	–	–	0	0.2 × 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/°C

Freescale Semiconductor, Inc.

For More Information On This Product,
Go to: www.freescale.com

D BY FREESCALE SEMICONDUCTOR, INC. 2005

Figure 1. Applications Schematic (1636.8 MHz LO)



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

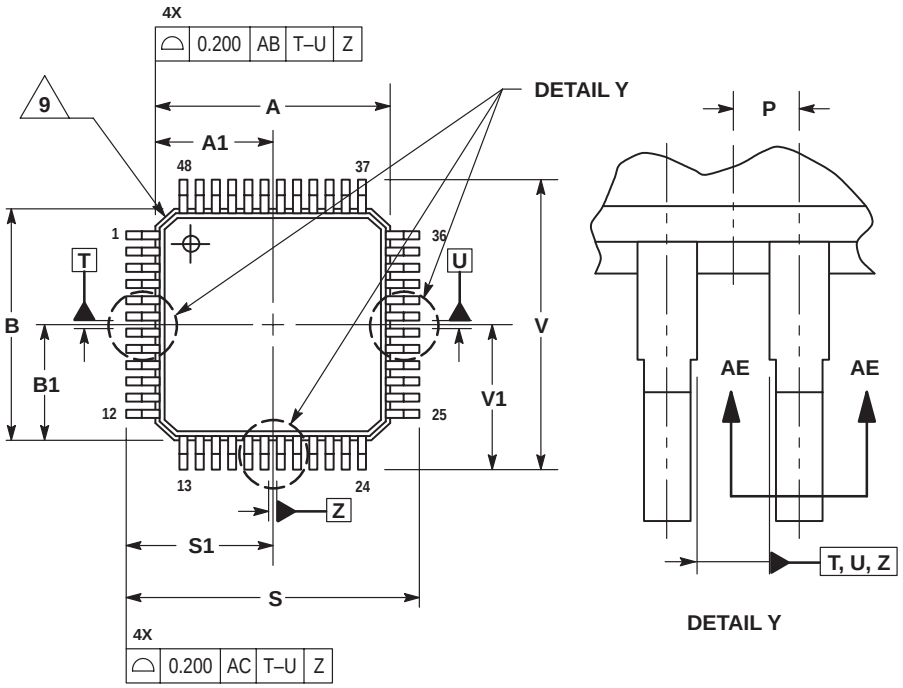
NOTES: 1. R8 must be set to match your 2nd IF filter impedance.
2. Layout of capacitors C10, C11, C12 is critical for stability of Limiter.

Freescale Semiconductor, Inc.

) BY FREESCALE SEMICONDUCTOR, INC. 2005

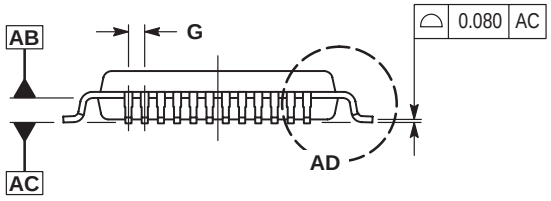
OUTLINE DIMENSIONS

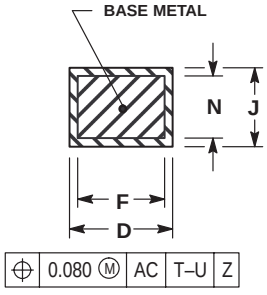
PLASTIC PACKAGE
CASE 932–03
(LQFP–48)
ISSUE F



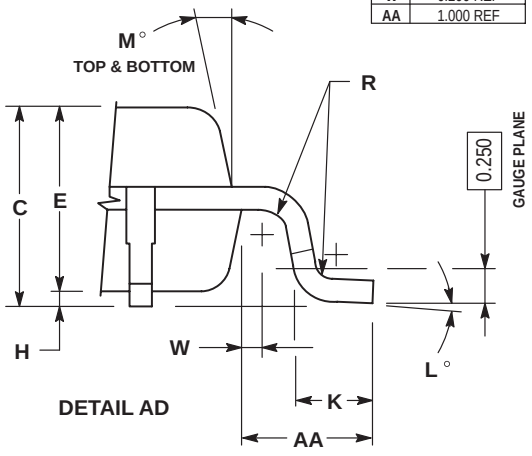
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DATUM PLANE AB IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
4. DATUMS T, U, AND Z TO BE DETERMINED AT DATUM PLANE 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	





SECTION AE–AE



DETAIL AD

Freescale Semiconductor, Inc.

For More Information On This Product,
Go to: www.freescale.com

) BY FREESCALE SEMICONDUCTOR, INC. 2005

NOTES

Freescale Semiconductor, Inc.

) BY FREESCALE SEMICONDUCTOR, INC. 2005

NOTES

Freescale Semiconductor, Inc.

) BY FREESCALE SEMICONDUCTOR, INC. 2005

Freescale Semiconductor, Inc.

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. “Typical” parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including “Typicals” must be validated for each customer application by customer’s technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and Ⓜ are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

How to reach us:
USA / EUROPE / Locations Not Listed: Motorola Literature Distribution;
P.O. Box 5405, Denver, Colorado 80217. 1–303–675–2140 or 1–800–441–2447

Technical Information Center: 1–800–521–6274

JAPAN: Motorola Japan Ltd.; SPS, Technical Information Center, 3–20–1, Minami–Azabu. Minato–ku, Tokyo 106–8573 Japan. 81–3–3440–3569

ASIA / PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Centre, 2, Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong. 852–26668334

HOME PAGE: http://www.motorola.com/semiconductors/