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RM914

Power Amplifier Module for AMPS Applications (824–849 MHz)

The RM914 Advanced Mobile Phone Service (AMPS) Power Amplifier is a fully matched 6-pin surface mount module designed for mobile units operating in the 824-849 MHz cellular bandwidth. This device can be driven to power output levels beyond 31 dBm for high efficiency FM mode operation. A single GaAs Microwave Monolithic Integrated Circuit (MMIC) contains all active circuitry in the module. The MMIC contains on-board bias circuitry as well as input and interstage matching circuits. The output match is realized off-chip and within the module package to optimize efficiency and power performance into a 50 Ω load. This device is manufactured with Skyworks's GaAs HBT process that provides for all positive voltage DC supply operation while maintaining high efficiency. Primary bias to the RM914 can be supplied directly from a three cell nickel-cadmium, single cell lithium-ion, or other suitable battery with output in the 3-4 volt range. Power down is accomplished by setting the voltage on the low current reference pin to zero volts. No external supply side switch is needed as typical "off" leakage is a few microamperes with full primary voltage supplied from the battery.

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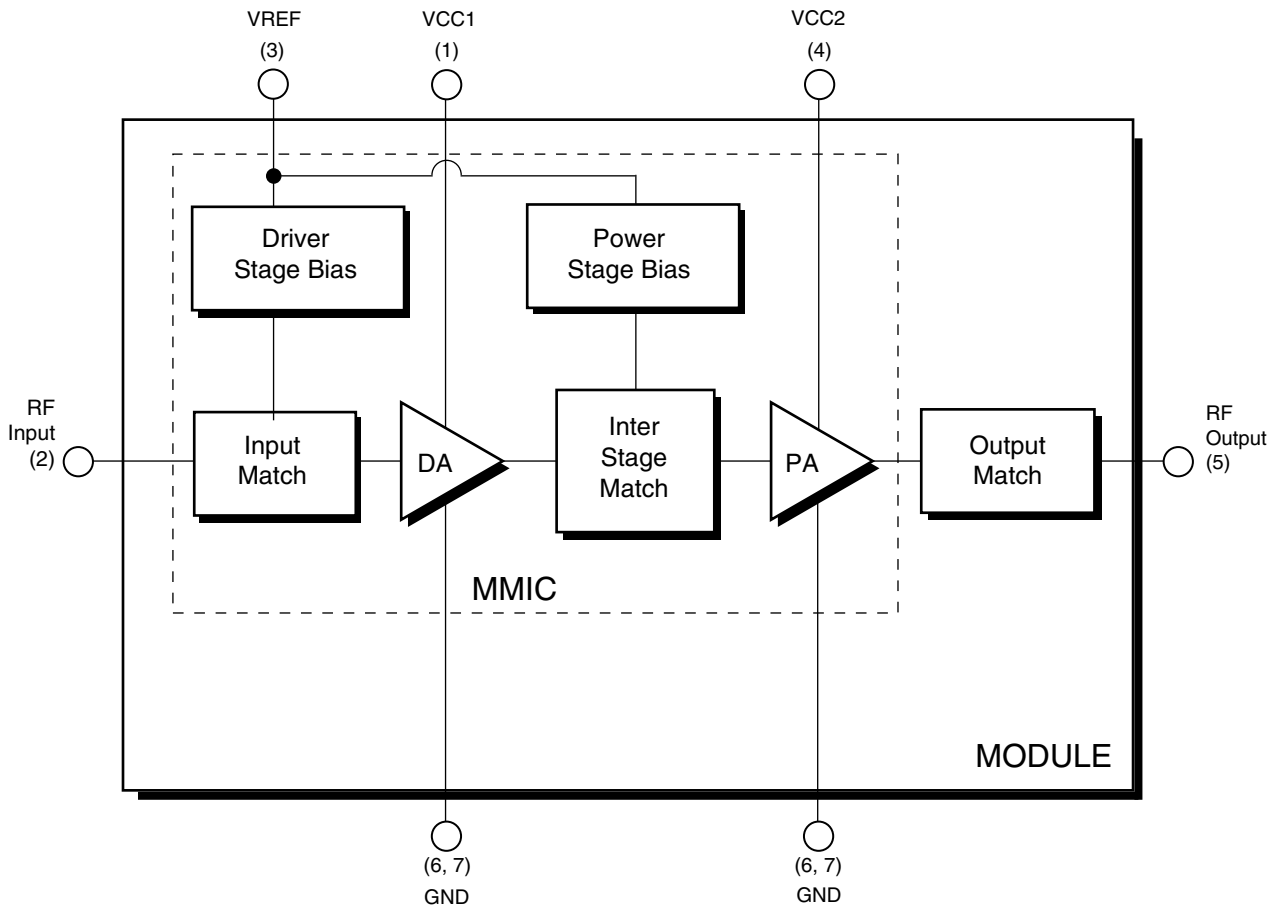
Distinguishing Features

- Low voltage positive bias supply (3 to 4 Volts, typical)
- High efficiency
- Large dynamic range
- 6-pin package (6mm x 6mm x 1.5 mm)
- Power down control

Applications

- Analog cellular (AMPS)
- Wireless local loop (WLL)

Functional Block Diagram



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Electrical Specifications

The following tables list the electrical characteristics of the RM914 Power Amplifier. Table 1 lists the absolute maximum rating for continuous operation. Table 2 lists the recommended operating conditions for achieving the electrical performance listed in Table 3. Table 3 lists the electrical performance of the RM914 Power Amplifier over the recommended operating conditions.

Table 1. Absolute Maximum Ratings(1)

Parameter	Symbol	Minimum	Nominal	Maximum	Unit
RF Input Power	Pin	—	3.0	6.0	dBm
Supply Voltage	Vcc	—	3.4	6.0	Volts
Reference Voltage	Vref	—	3.0	3.3	Volts
Case Operating Temperature	Tc	–30	25	+110	°C
Storage Temperature	Tstg	–55	—	+125	°C

NOTE(S):
No damage assuming only one parameter is set at limit at a time with all other parameters set at or below nominal value.

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Table 2. Recommended Operating Conditions

Parameter	Symbol	Minimum	Nominal	Maximum	Unit
Supply Voltage	Vcc	3.2	3.4	4.2	Volts
Reference Voltage	Vref	2.9	3.0	3.1	Volts
Operating Frequency	Fo	824.0	836.5	849.0	MHz
Operating Temperature	To	–30	+25	+85	°C

Table 3. Electrical Specifications for AMPS Nominal Operating Conditions(1)

Characteristics	Condition	Symbol	Minimum	Typical	Maximum	Unit
Quiescent current	Vref = 3.0 Vref = 2.9	Iq Iq	60.0 —	100.0 80.0	130.0 —	mA mA
Leakage Current	Vref = 0 V Vcc = 3.4 V	I_{LK}	—	—	5.0	µA
Gain	Po = 0 dBm Po = 31 dBm	G Gp	— 29.0	32.5 31.0	— 33.0	dB dB
Power Added Efficiency	Po = 31 dBm	PAEa	48.5	51.0	—	%
Harmonic Suppression Second Third	 Po ≤ 31 dBm Po ≤ 31 dBm	 AFo2 AFo3	 — —	 –43.0 –41.0	 –36.0 –34.0	 dBc dBc
Noise Power in RX Band 869-894 MHz	Po ≤ 31 dBm	RxBN	—	–136.0	–133.0	dBm/Hz
Noise Figure	—	NF	—	7.0	—	dB
Input Voltage Standing Wave Ratio	—	VSWR	—	1.4:1	1.5:1	—
Stability (Spurious output)	5:1 VSWR All phases	S	—	—	–60.0	dBc
Ruggedness – No damage	Po ≤ 31 dBm	Ru	10:1	—	—	VSWR

NOTE(S):
(1) Vcc = +3.4 V, Vref = +3.0 V, Freq = 836.5 MHz, Tc = 25 °C, unless otherwise specified.

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Table 4. Electrical Specifications Limits for AMPS Recommended Operating Conditions(1)

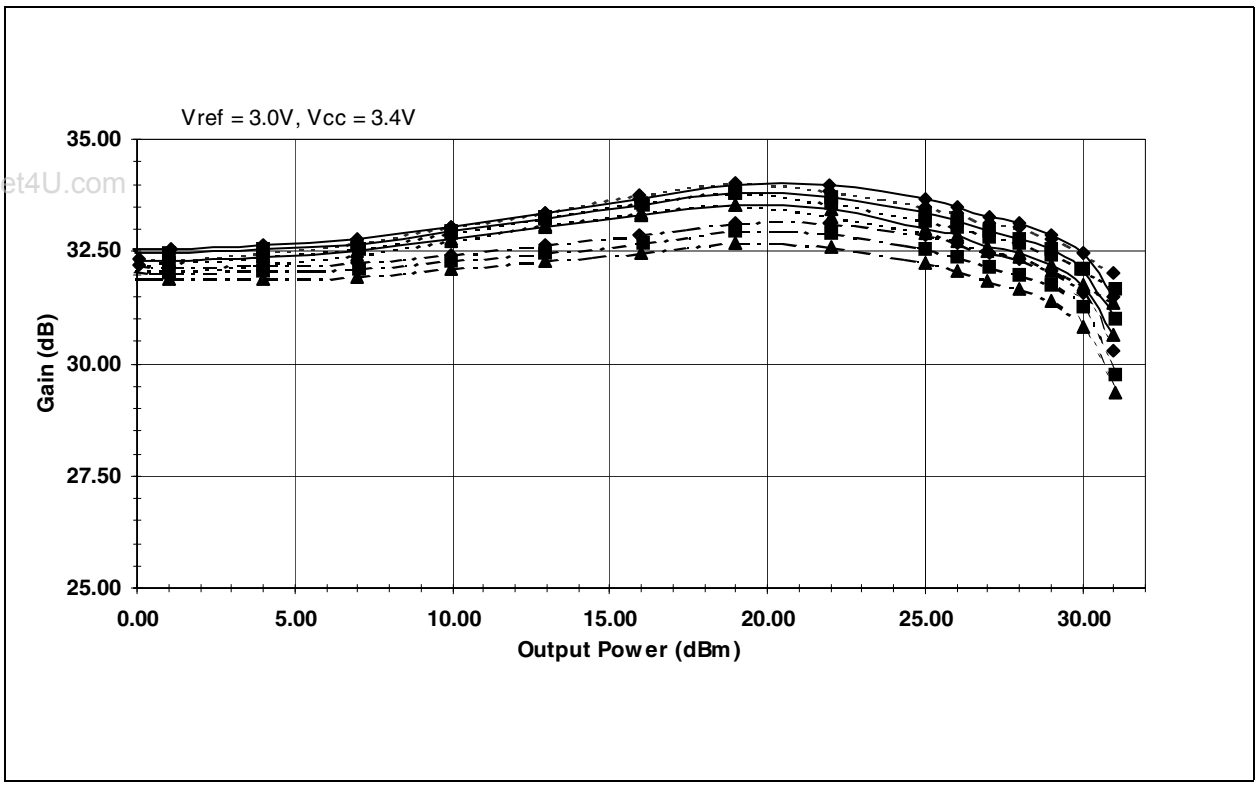
Characteristics	Condition	Symbol	Minimum	Maximum	Unit
Quiescent current	Vref = 3.0 Vref = 2.9	Iq Iq	— —	170.0 150.0	mA mA
Gain	Po = 31 dBm	Gp	25.0	35.5	dB
Power Added Efficiency	Po = 31 dBm	PAEa	48.0	—	%
Harmonic Suppression Second Third	 Po ≤ 31 dBm Po ≤ 31 dBm	 AFo2 AFo3	 — —	 –35.0 –30.0	 dBc dBc
Noise Power in RX Band 869-894 MHz	Po ≤ 31 dBm	RxBN	—	–130.0	dBm/Hz
Input Voltage Standing Wave Ratio	—	VSWR	—	2:1	—
Stability (Spurious output)	5:1 VSWR All phases	S	—	–60.0	dBc
Ruggedness – No damage	Po ≤ 31 dBm	Ru	10:1	—	VSWR

NOTE(S):
(1) Per Table 2

Characterization Data

The following charts illustrate the characteristics of a typical RM914 Power Amplifier tested in the evaluation board described in the following section. The amplifier was selected by characterizing a group of devices and choosing a part with average electrical performance at both nominal and worst case (limit) conditions. Figures 1 through 2 illustrate the analog characteristics of the RM914.

Figure 1. Analog Gain vs. Output Power



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Legend

824 MHz @ –30 °C	824 MHz @ +25 °C	824 MHz @ +85 °C
837 MHz @ –30 °C	837 MHz @ +25 °C	837 MHz @ +85 °C
849 MHz @ –30 °C	849 MHz @ +25 °C	849 MHz @ +85 °C

Figure 2. Analog Power Added Efficiency vs. Output Power

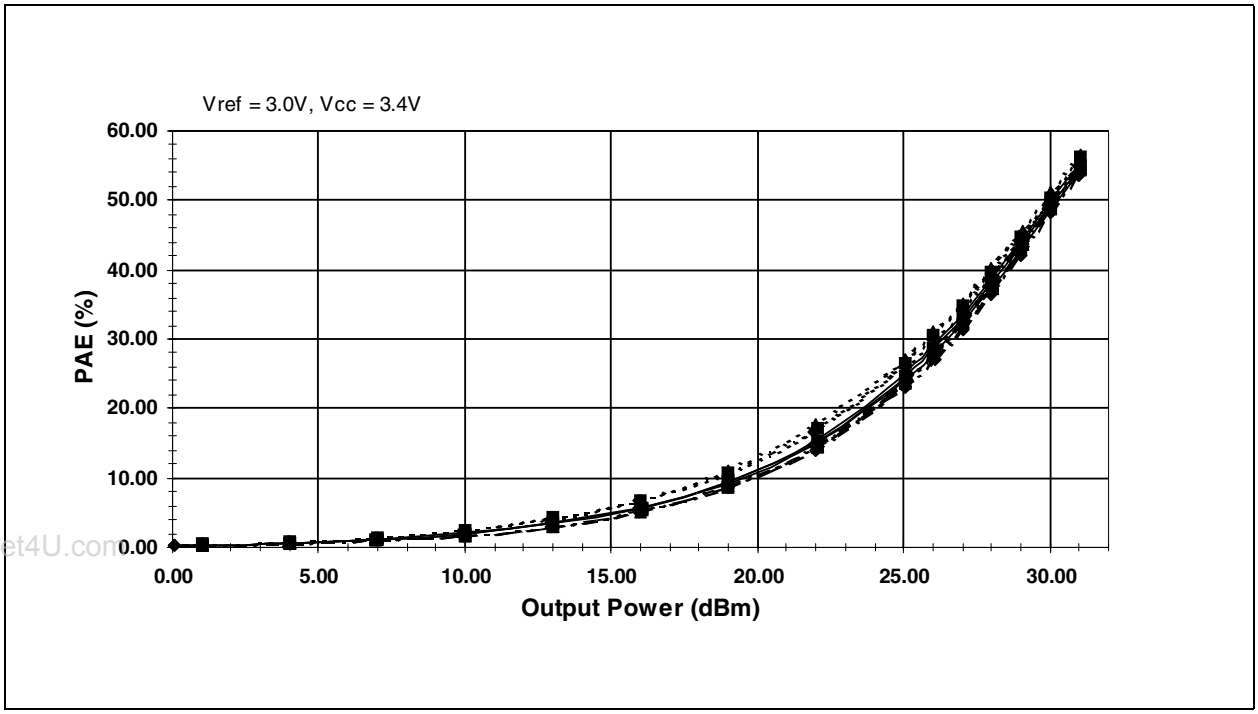

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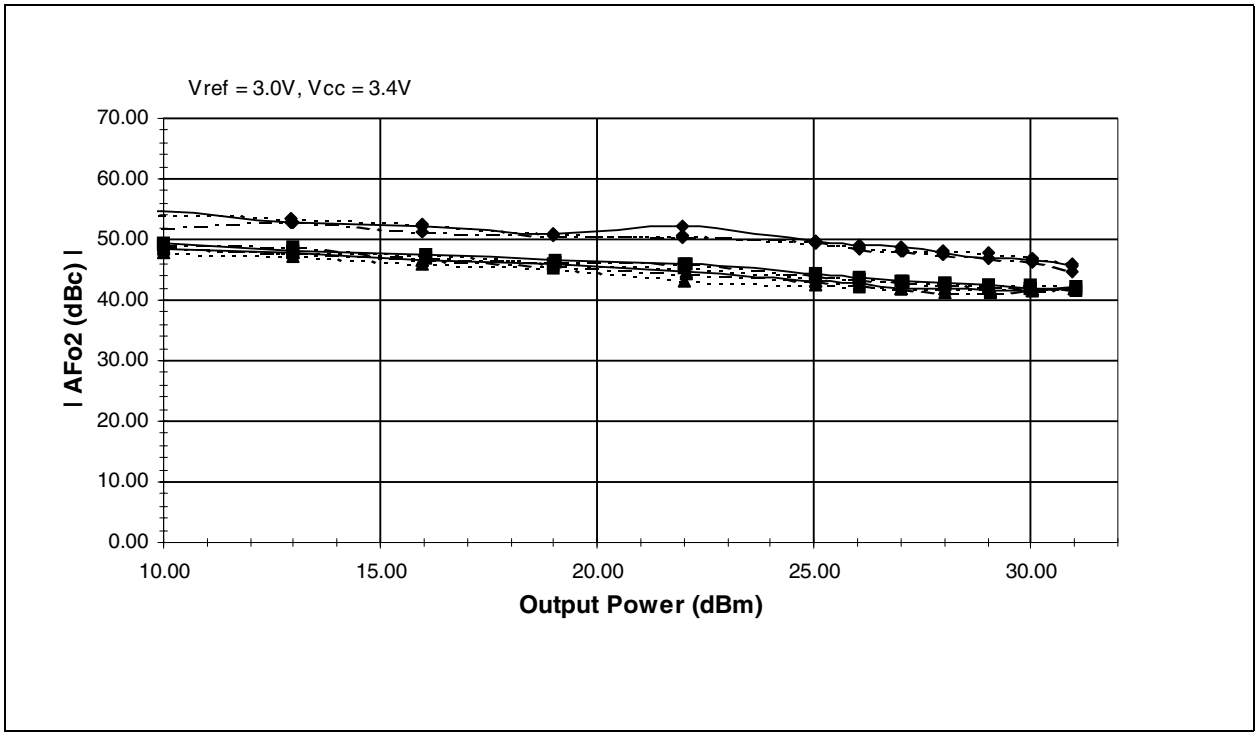
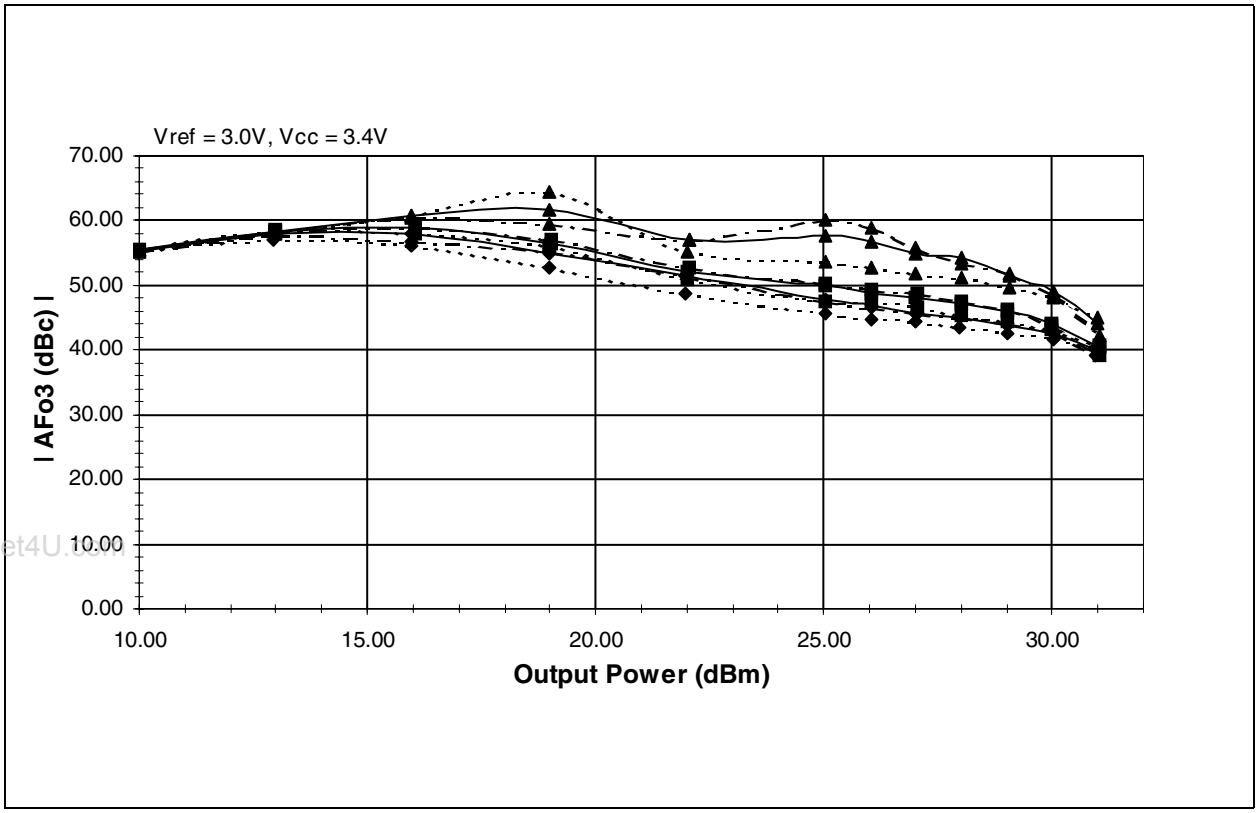
Figure 3. Analog Second Order Harmonic Suppression Magnitude



Legend

824 MHz @ –30 °C	824 MHz @ +25 °C	824 MHz @ +85 °C
837 MHz @ –30 °C	837 MHz @ +25 °C	837 MHz @ +85 °C
849 MHz @ –30 °C	849 MHz @ +25 °C	849 MHz @ +85 °C

Figure 4. Analog Third Order Harmonic Suppression Magnitude



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Legend

824 MHz @ –30 °C	824 MHz @ +25 °C	824 MHz @ +85 °C
837 MHz @ –30 °C	837 MHz @ +25 °C	837 MHz @ +85 °C
849 MHz @ –30 °C	849 MHz @ +25 °C	849 MHz @ +85 °C

Figure 5. Analog Gain vs. Output Power

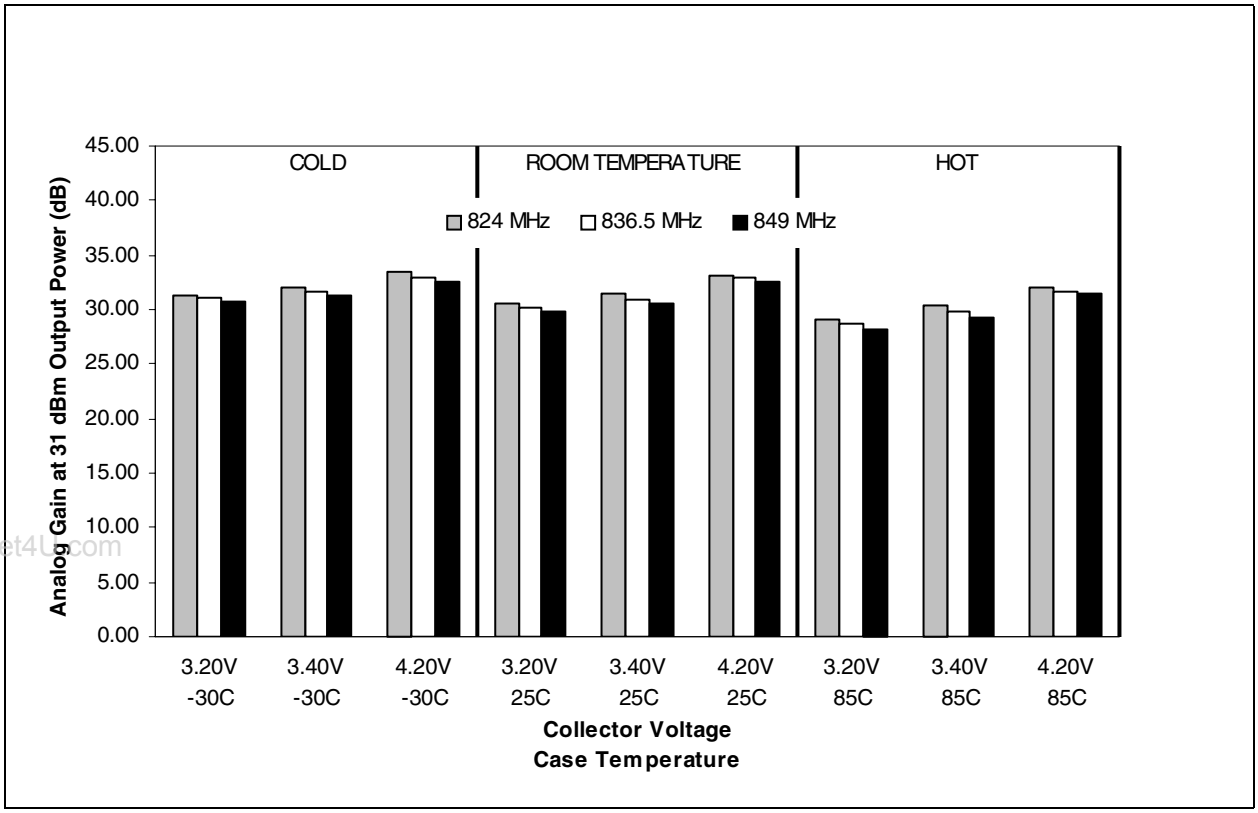

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Figure 6. Analog Second Harmonic Suppression Magnitude

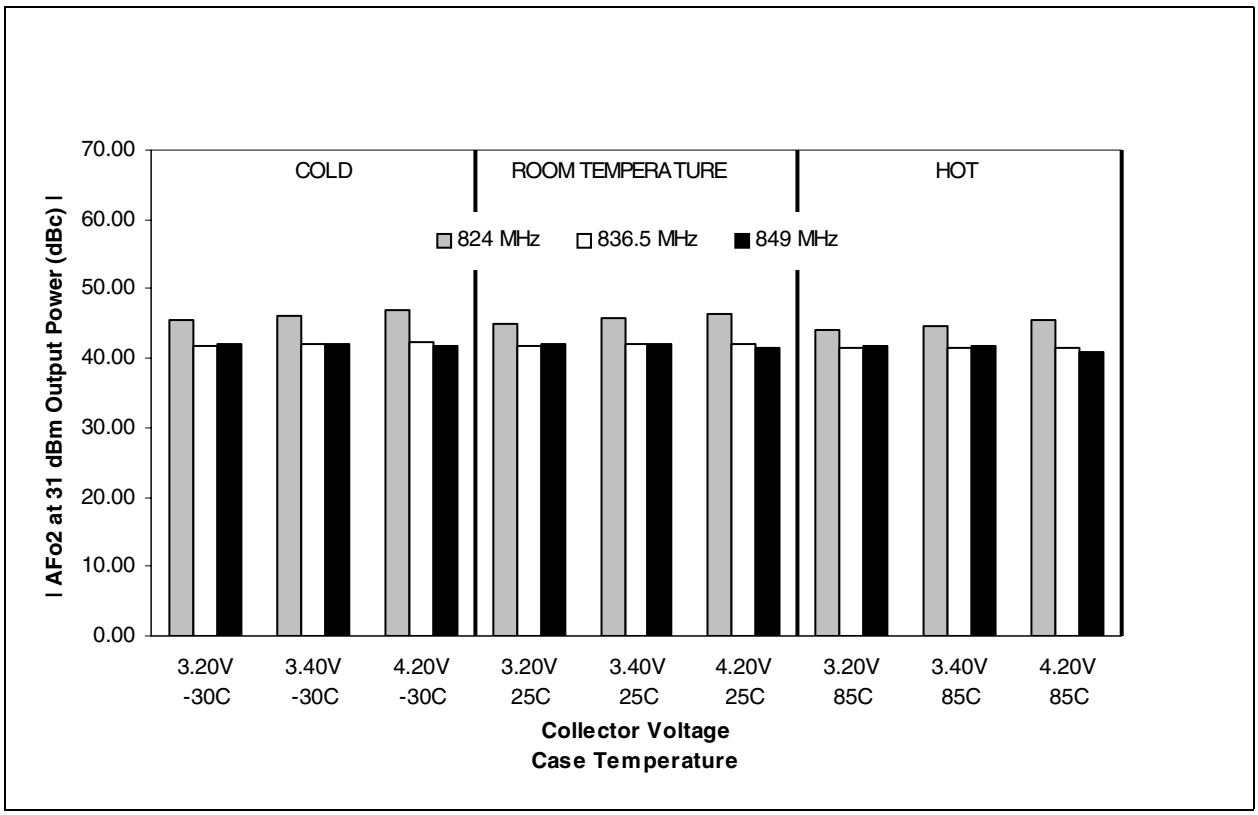

Figure 7. Analog Third Order Harmonic Suppression Magnitude

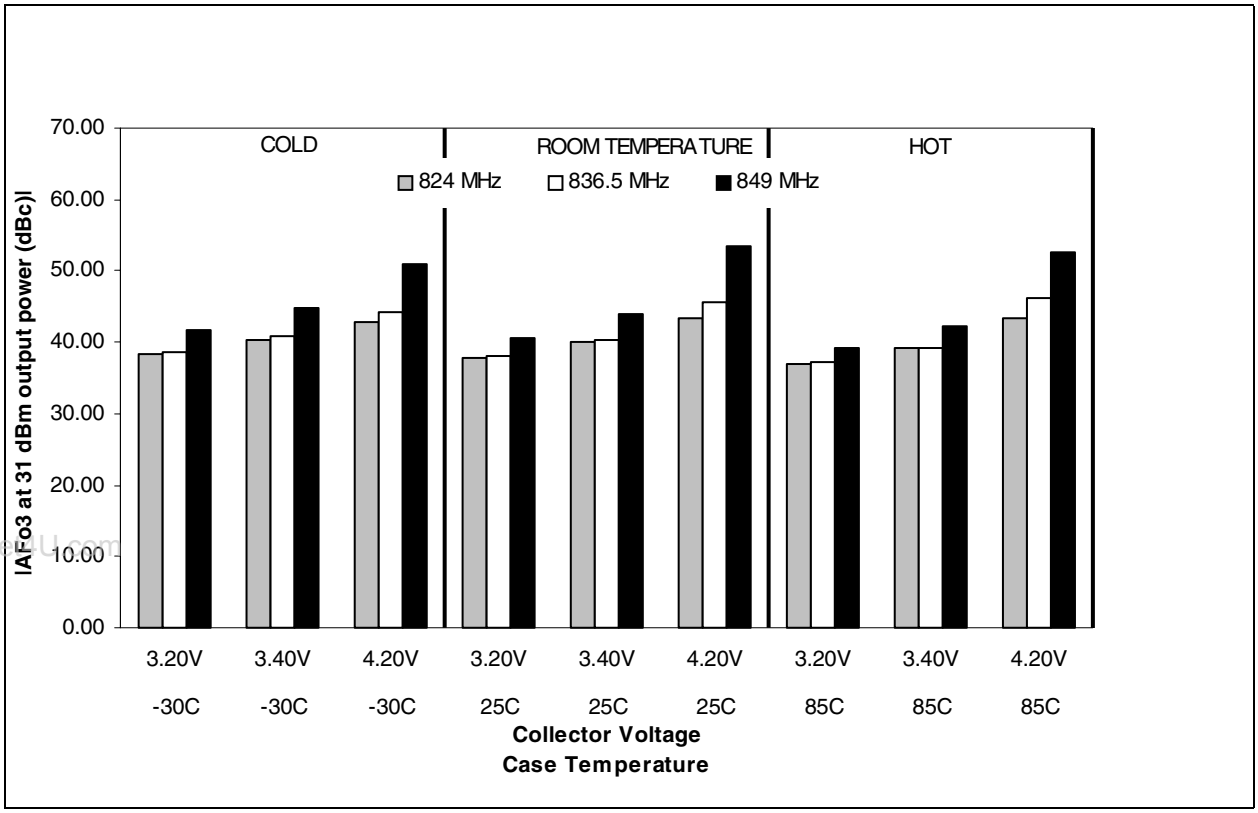

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Figure 8. Noise Figure Variation Over Recommended Operating Conditions

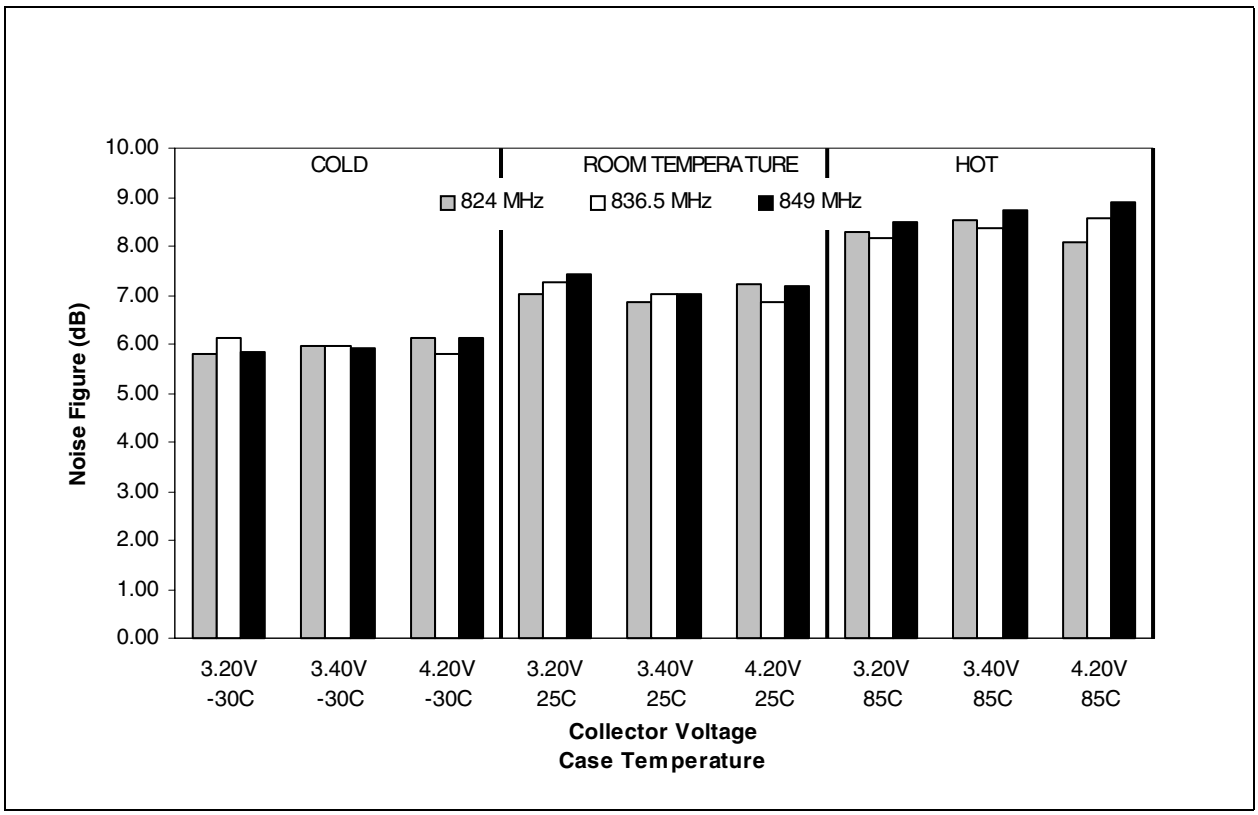
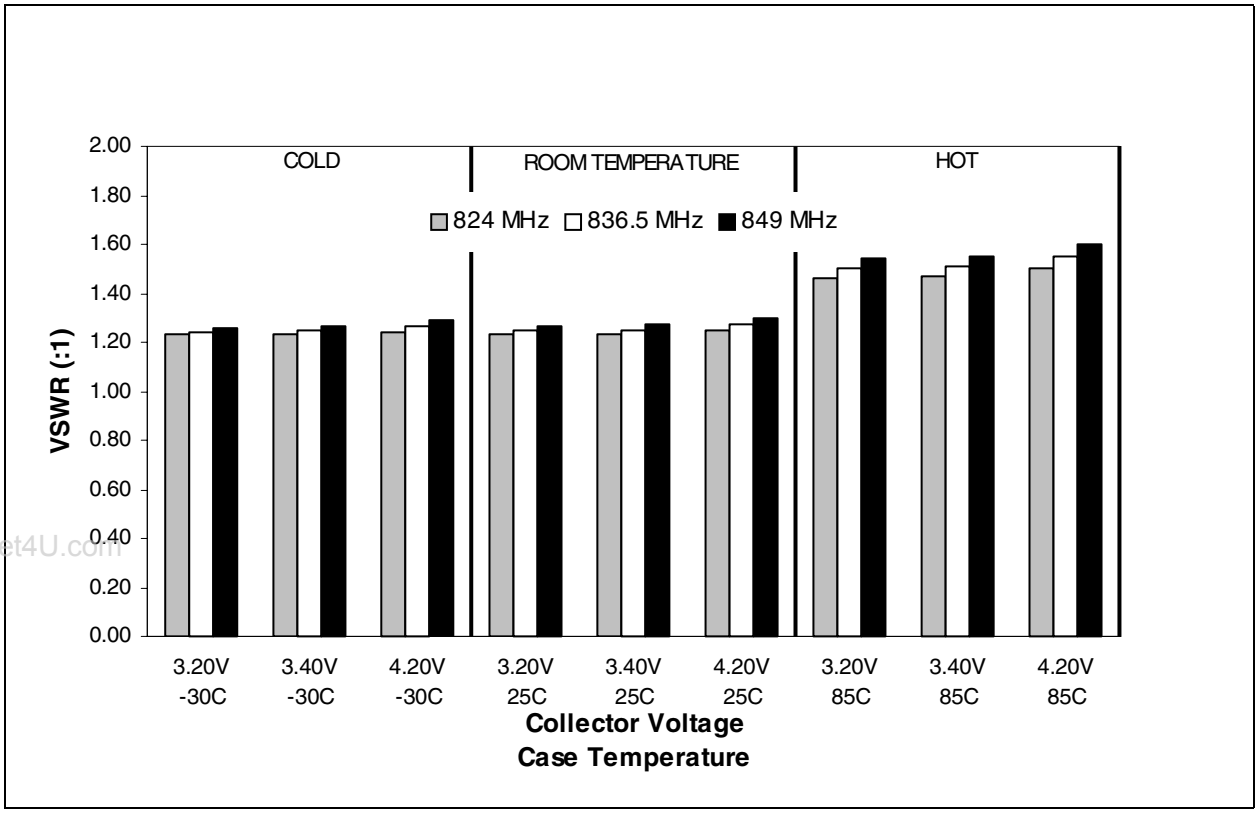


Figure 9. Voltage Standing Wave Ratio Variation Over Recommended Operating Conditions



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Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the RM914, the evaluation board schematic and diagrams are included for preliminary analysis and design. Figure 10 shows the basic schematic of the board for the 824 MHz to 849 MHz range. Figure 11 illustrates the board layout.

Figure 10. Evaluation Board Schematic

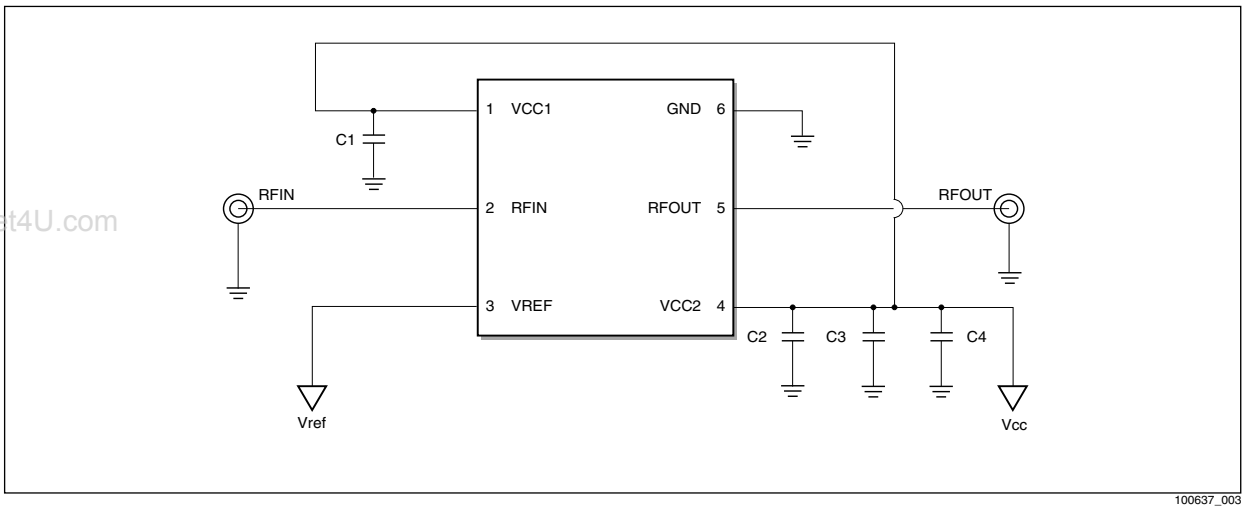

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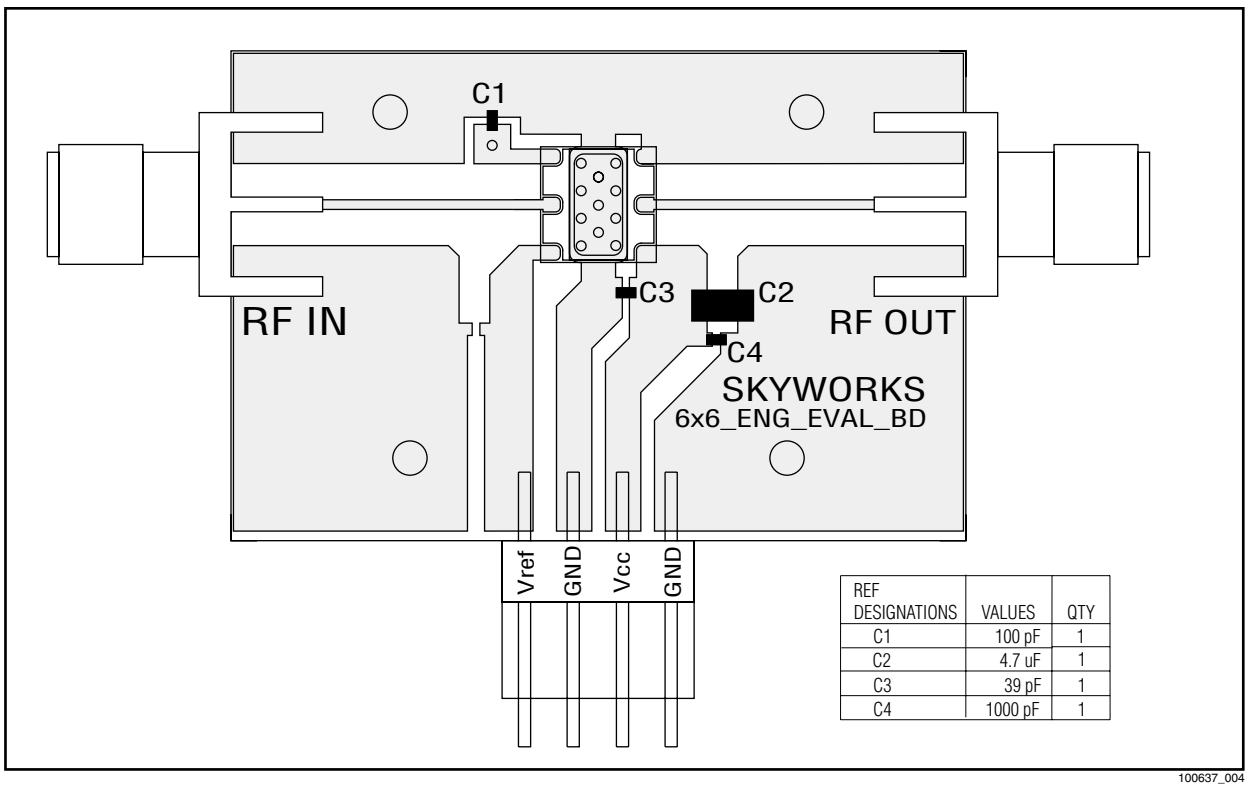
Figure 11. Evaluation Board Assembly Diagram



REF DESIGNATIONS	VALUES	QTY
C1	100 pF	1
C2	4.7 uF	1
C3	39 pF	1
C4	1000 pF	1

Package Dimensions and Pin Descriptions

The RM914 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board. Figure 12 is a mechanical drawing of the pad layout for this package and Figure 13 illustrates typical case markings. The pin numbering convention starts with pin 1 in the upper left, as indicated in Figure 12, and increments counter-clockwise around the package. Table 5 describes each pin function.

Figure 12. RM914 Package Drawing

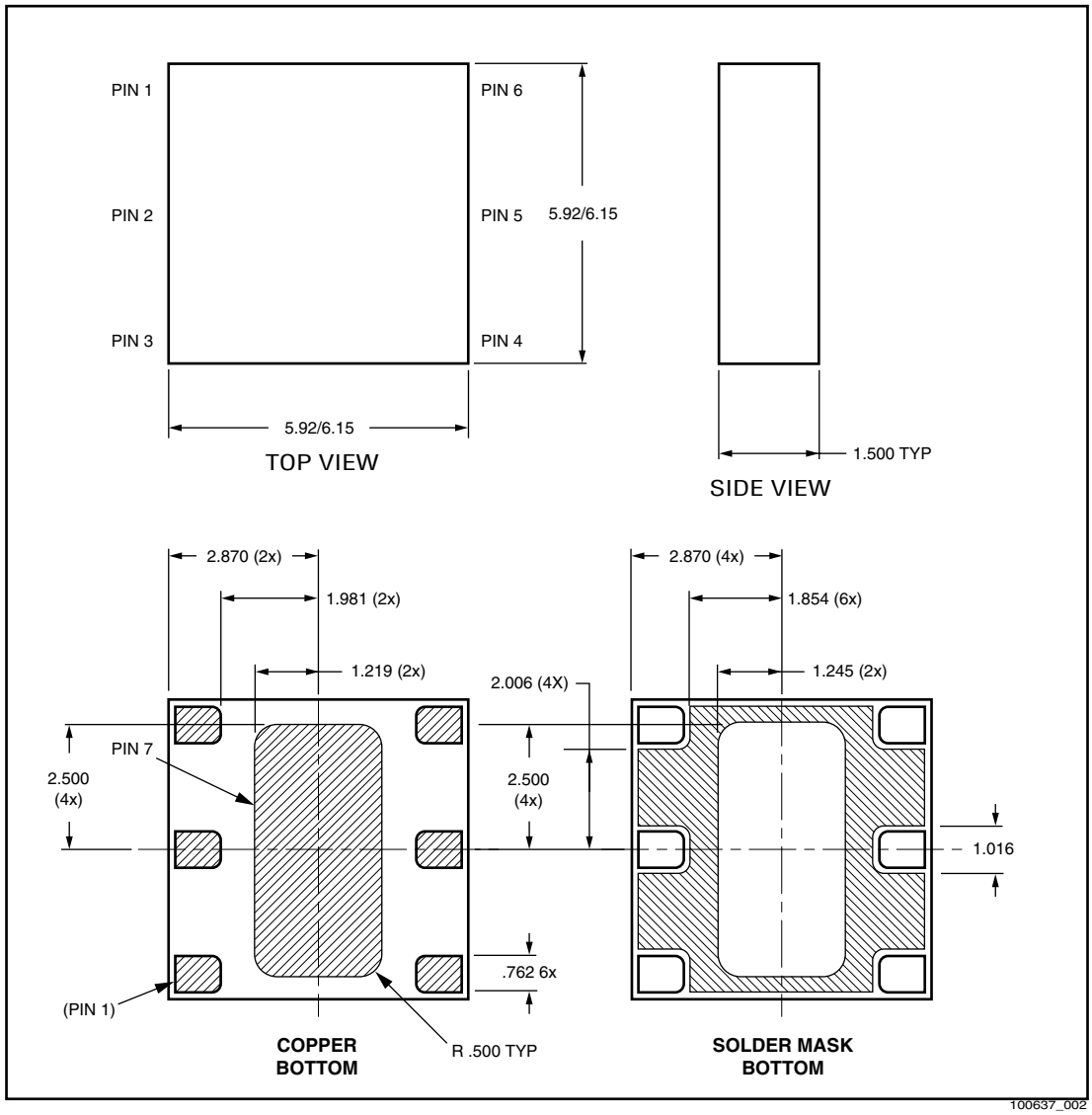


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Table 5. Pin Description

Pin #	Function
1	VCC1[1]
2	RF Input
3	VREF
4	VCC2[1]
5	RF Output
6	GND
7	GND[2]

NOTE(S):
(1) All supply pins may be connected together at the supply.
(2) Package underside is GND.

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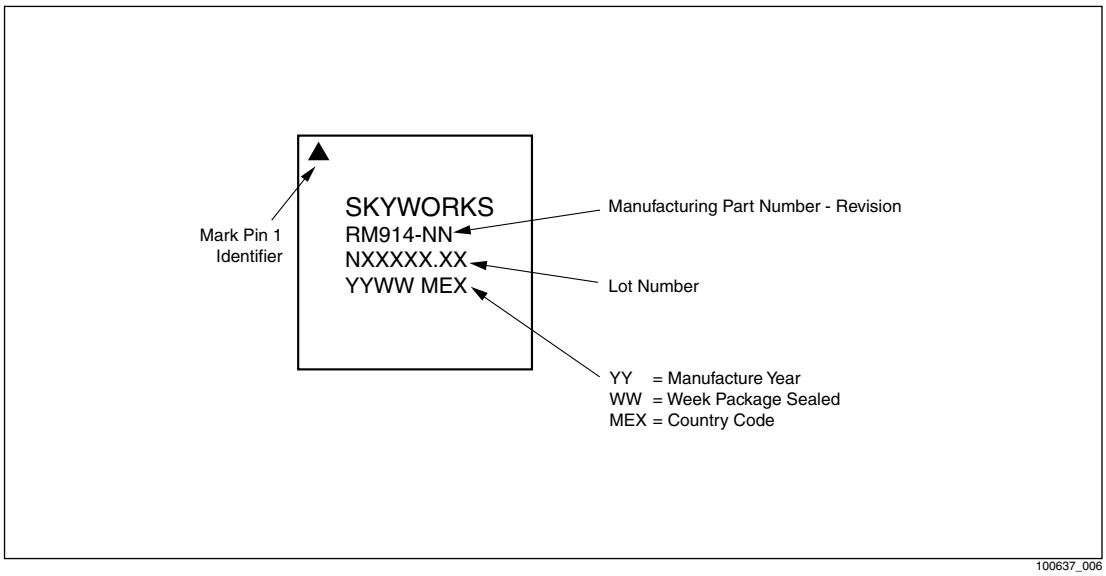
Figure 13. Typical Case Markings



Package and Handling Information

Because of its sensitivity to moisture absorption, this device package is baked and vacuum packed prior to shipment. Instructions on the shipping container label must be followed regarding exposure to moisture after the container seal is broken, otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The RM914 is capable of withstanding an MSL 3/225 °C solder reflow. Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. If the part is attached in a reflow oven, the temperature ramp rate should not exceed 5 °C per second; maximum temperature should not exceed 225 °C. If the part is manually attached, precaution should be taken to insure that the part is not subjected to temperatures exceeding 225 °C for more than 10 seconds. For details on both attachment techniques, precautions, and handling procedures recommended by Conexant, please refer to *Application Note: PCB Design and SMT Assembly/Rework, Document Number 101752*. Additional information on standard SMT reflow profiles can also be found in the *JEDEC Standard J–STD–020A*.

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Production quantities of this product are shipped in the standard tape-and-reel format. For packaging details, refer to *Application Note: Tape and Reel, Document Number 101568*.

Electrostatic Discharge Sensitivity

The RM914 is a Class I device. Figure 14 lists the Electrostatic Discharge (ESD) immunity level for each pin of the RM914 product. The numbers in Figure 14 specify the ESD threshold level for each pin where the I-V curve between the pin and ground starts to show degradation. The ESD testing was performed in compliance with MIL-STD-883E Method 3015.7 using the Human Body Model. Since 2000 volts represents the maximum measurement limit of the test equipment used, pins marked > 2000 V pass 2000V ESD stress.

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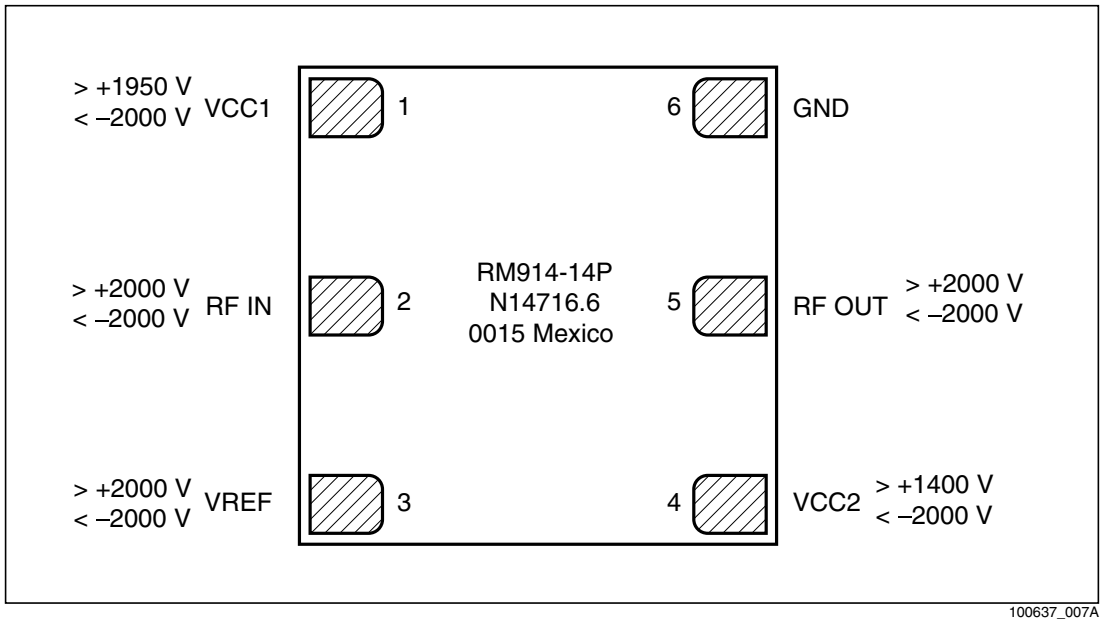
Figure 14. ESD Sensitivity Areas



Various failure criteria can be utilized when performing ESD testing. Many vendors employ relaxed ESD failure standards which fail devices only after “the pin fails the electrical specification limits” or “the pin becomes completely non-functional”. Skyworks employs the most stringent criteria and fails devices as soon as the pin begins to show any degradation on a curve tracer. To avoid ESD damage, latent or visible, it is very important the Class-1 ESD handling precautions listed in Table 6 be used in the product assembly and test areas follow.

Table 6. Precautions for GaAs ICs with ESD Thresholds Greater Than 200V But Less Than 2000V

Personnel Grounding	**Facility**
Wrist Straps Conductive Smocks, Gloves and Finger Cots Antistatic ID Badges	Relative Humidity Control and Air Ionizers Dissipative Floors (less than 10^9 Ω to GND)
Protective Workstation	**Protective Packaging & Transportation**
Dissipative Table Tops Protective Test Equipment (Properly Grounded) Grounded Tip Soldering Irons Conductive Solder Suckers Static Sensors	Bags and Pouches (Faraday Shield) Protective Tote Boxes (Conductive Static Shielding) Protective Trays Grounded Carts Protective Work Order Holders

Ordering Information

Model Number	Manufacturing Part Number	Product Revision	Package	Operating Temperature
RM914	RM914-13	13	6x6LM-6	–30 °C to +85 °C

Revision History

Revision	Level	Date	Description
A		September 2000	Initial Release
B		December 2000	Add Solder Reflow, Temperature Guidelines Revised data Table 1, Table 4; Revised Figure 13
C		August 2001	Revise: Table 3, Leakage Current.
D		March 22, 2002	Revise: Tables 3 and 4. Add: Reference Documents

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References

Application Note: Tape and Reel, Document Number 101568.
Application Note: PCB Design and SMT Assembly/Rework, Document Number 101752
JEDEC Standard J–STD–020A

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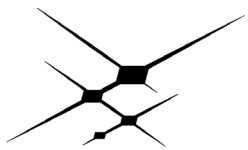

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