RM806

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

The dual-mode RM806 Power Amplifier (PA) is a fully matched, 6-pin, surface mount module designed for Time Division Multiple Access (TDMA) and Advanced Mobile Phone Service (AMPS) mobile units operating in the 824-849 MHz cellular bandwidth.

This device meets stringent IS-136 linearity requirements beyond 30 dBm output power and can be driven to power output levels beyond 31 dBm for high efficiency FM mode operation. A single GaAs (GaAs) Microwave Monolithic Integrated Circuit (MMIC) contains all active circuitry in the module. The MMIC contains onboard bias circuitry as well as input and interstage matching circuits. The output match is realized off-chip within the module package to optimize efficiency and power performance into a 50 ohm load. This device is manufactured using Skyworks' GaAs Heterojunction Bipolar Transistor (HBT) process, which provides for all positive voltage DC supply operation while maintaining high efficiency and good linearity. Primary bias to the RM806 can be supplied directly from a three-cell nickel cadmium, a single-cell lithium-ion battery, or any other suitable battery with output in the 3 to 4 volts range. Power down is accomplished by setting 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.

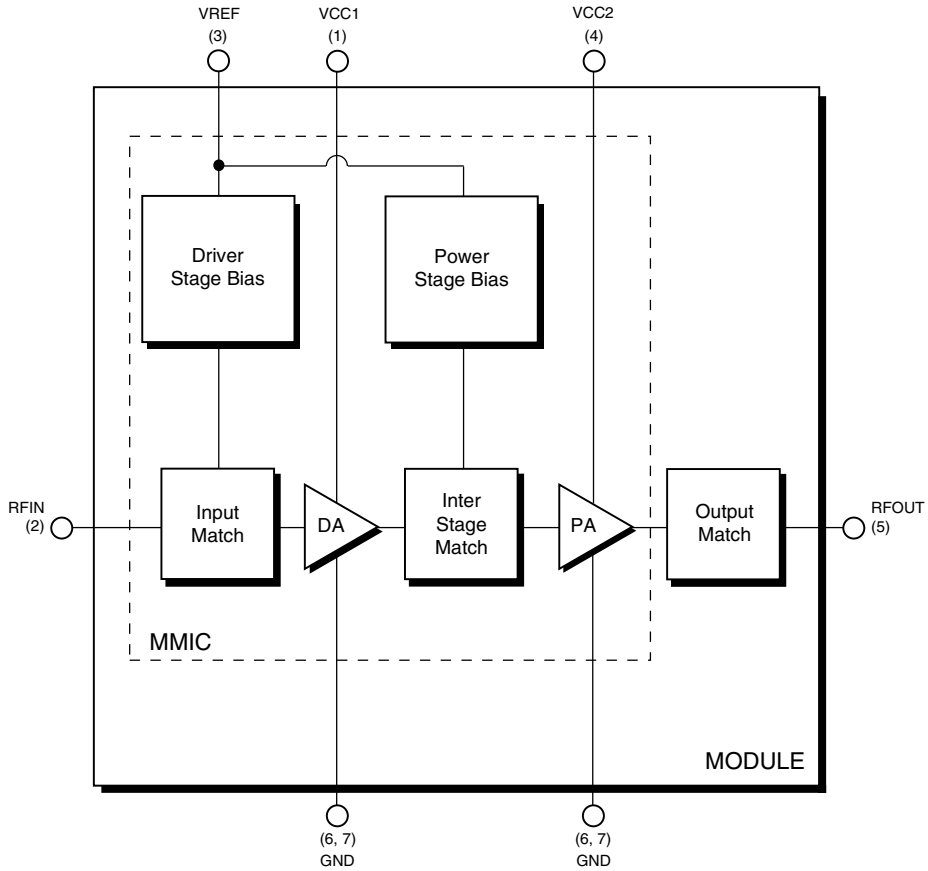
Distinguishing Features

- Low voltage positive bias supply
- Good linearity
- High efficiency
- Dual mode operation
- Large dynamic range
- 6-pin package (6 mm x 6mm x 1.5 mm)
- Power down control

Applications

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

Functional Block Diagram



Electrical Specifications

The following tables list the electrical characteristics for the RM806 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 4.

Table 1. Absolute Maximum Ratings(1)

Parameter	Symbol	Minimum	Nominal	Maximum	Unit
RF Input Power	Pin	—	3.0	8.0	dBm
Supply Voltage	Vcc	—	3.4	5.0(2)	Volts
Reference Voltage	Vref	—	3.1	3.3	Volts
Case Operating Temperature	Tc	–30	+25	+110	°C
Storage Temperature	Tstg	–55	—	+125	°C

NOTE(S):
(1) No damage assuming only one parameter is set at limit at a time with all other parameters set at or below nominal value.
(2) Under pulsed TDMA modulated mode, operation at maximum supply voltage of 6.2 V up to 100 ms.

Table 2. Recommended Operating Conditions

Parameter	Symbol	Minimum	Nominal	Maximum	Unit
Supply Voltage	Vcc	3.0	3.4	4.2	Volts
Reference Voltage	Vref	3.0	3.1	3.3	Volts
Operating Frequency	Fo	824	836.5	849	MHz
Operating Temperature	To	–30	+25	+85	°C

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

Characteristics	Condition	Symbol	Minimum(2)	Typical	Maximum(2)	Unit
Quiescent current	—	I_q	—	150.0	165.0	mA
Reference current	Po ≤ 32 dBm	I_{ref}	—	6.3	7.0	mA
Leakage current	PA Off	—	—	2.0	25.0	uA
Gain–Analog	Po = 0 dBm Po = 31 dBm	G G_p	29.5 28.5	30.5 30.0	32.0 31.0	dB dB
Gain–Digital	Po = 0 dBm Po = 30 dBm	G G_p	29.5 28.5	30.5 30.0	32.0 31.0	dB dB
Power Added Efficiency						
Analog Mode	Po = 31 dBm	PAEa	43.0	45.0	—	%
Digital Mode	Po = 30 dBm	PAEd	38.0	42.0	—	%
Adjacent Channel Power (3)						
30 kHz Offset	Po ≤ 30 dBm	ACP1	—	–30.5	–29.0	dBc
60 kHz Offset	Po ≤ 30 dBm	ACP2	—	–52.5	–50.0	dBc
90 kHz Offset	Po ≤ 30 dBm	ACP3	—	–62.0	–52.0	dBc
Harmonics						
Second	Po ≤ 31 dBm	H2	—	–50	–43.0	dBc
Third	Po ≤ 31 dBm	H3	—	–42	–40.0	dBc
PA “Turn Off Time”	—	—	—	10	—	µs
PA “Turn On Time”	—	—	—	10	—	µs
Noise Power in RX Band 869-894 MHz(4)	Po ≤ 31 dBm	Np	—	–136.5	–133.0	dBm/Hz
Noise Figure	—	NF	—	5.5	7.0	dB
Input VSWR	—	VSWR	—	1.5:1	1.6:1	—
Stability (Spurious output)	5:1 VSWR All phases	S	—	—	–60	dBc
Ruggedness—No damage	Po ≤ 31 dBm	Ru	—	—	8:1	VSWR

NOTE(S):

(1) Vcc = +3.4 V, Vref = +3.1 V, Freq = 836.5 MHz, Tc = 25 °C.

(2) Min/Max values indicate performance over process corners and conditions specified in note 1 above unless otherwise detailed.

(3) Also meets same linearity for Po ≤ 28.5 dBm @ Vcc = +3.0 V.

(4) With NADC modulation applied.

Table 4. Electrical Specifications for TDMA / AMPS Nominal Operating Conditions(1)

Characteristics	Condition	Symbol	Minimum(2)	Typical	Maximum(2)	Unit
Quiescent current	—	I_q	—	150.0	185.0	mA
Reference current	Po ≤ 32 dBm	I_{ref}	—	6.3	7.6	mA
Leakage current(4)	PA Off	—	—	2.0	25.0	uA
Gain–Analog	Po = 0 dBm Po = 31 dBm	G G_p	27.5 26.0	30.5 30.0	33.0 33.0	dB dB
Gain–Digital	Po = 0 dBm Po = 30 dBm	G G_p	27.5 26.0	30.5 30.0	32.5 32.5	dB dB
Power Added Efficiency						
Analog Mode	Po = 31 dBm	PAEa	41.0	45.0	—	%
Digital Mode	Po = 30 dBm	PAEd	37.0	42.0	—	%
Adjacent Channel Power (2)						
30 kHz Offset	Po ≤ 30 dBm	ACP1	—	–30.5	–27.0	dBc
60 kHz Offset	Po ≤ 30 dBm	ACP2	—	–52.5	–46.0	dBc
90 kHz Offset	Po ≤ 30 dBm	ACP3	—	–62.0	–50.0	dBc
Harmonics						
Second	Po ≤ 31 dBm	H2	—	–50	–35.0	dBc
Third	Po ≤ 31 dBm	H3	—	–42	–35.0	dBc
PA “Turn Off Time”	—	—	—	10.0	30.0	µs
PA “Turn On Time”	—	—	—	10.0	30.0	µs
Noise Power in RX Band 869-894 MHz(3)	Po ≤ 31 dBm	Np	—	–136.5	–132.0	dBm/Hz
Noise Figure	—	NF	—	5.5	8.0	dB
Input VSWR	—	VSWR	—	1.5:1	2.0:1	—
Stability (Spurious output)(4)	5:1 VSWR All phases	S	—	—	–60	dBc
Ruggedness—No damage(4)	Po ≤ 31 dBm	Ru	—	—	8:1	VSWR

NOTE(S):

1. Min/Max values indicate performance over process corners and conditions specified in note (1) below unless otherwise detailed.

(1) Per Table 3 with Vcc = +3.4 V.

(2) Also meets same linearity for Po ≤ 28.5 dBm @ Vcc = +3.0 V and as further specified in note (1) above.

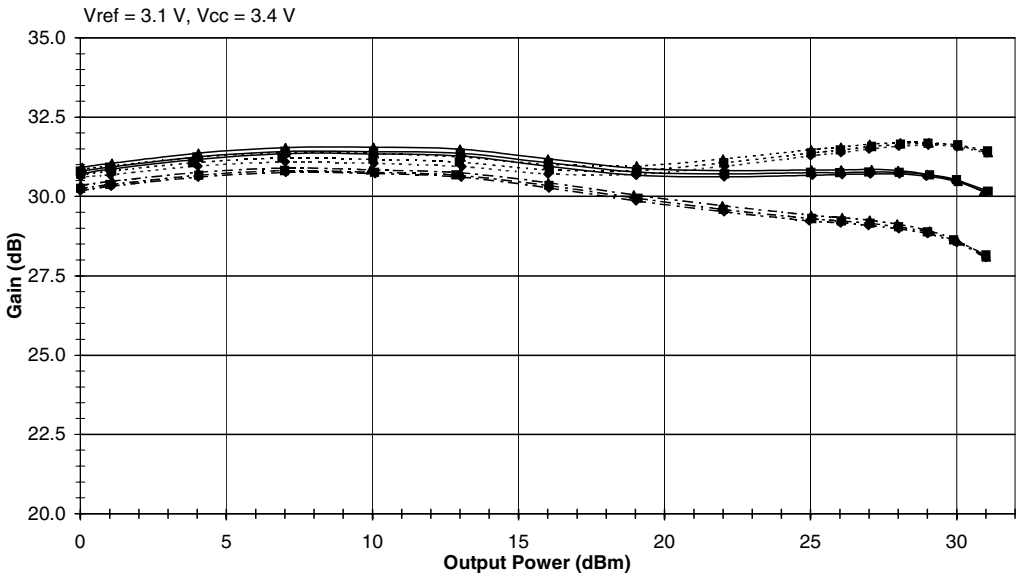
(3) With NADC modulation applied. Tc = 25 °C

(4) Tc = 25 °C

Characterization Data

The following graphs illustrate characteristics for a typical RM806 Power Amplifier. The amplifier was selected by characterizing a group of devices and selecting a part having average electrical performance both at nominal and worst case. Figures 1 through 5 illustrate the digital signal characteristics and Figures 6 through 9 illustrate the analog characteristics for the RM806.

Figure 1. Digital Gain vs. Output Power



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. Digital Power Added Efficiency vs. Output Power

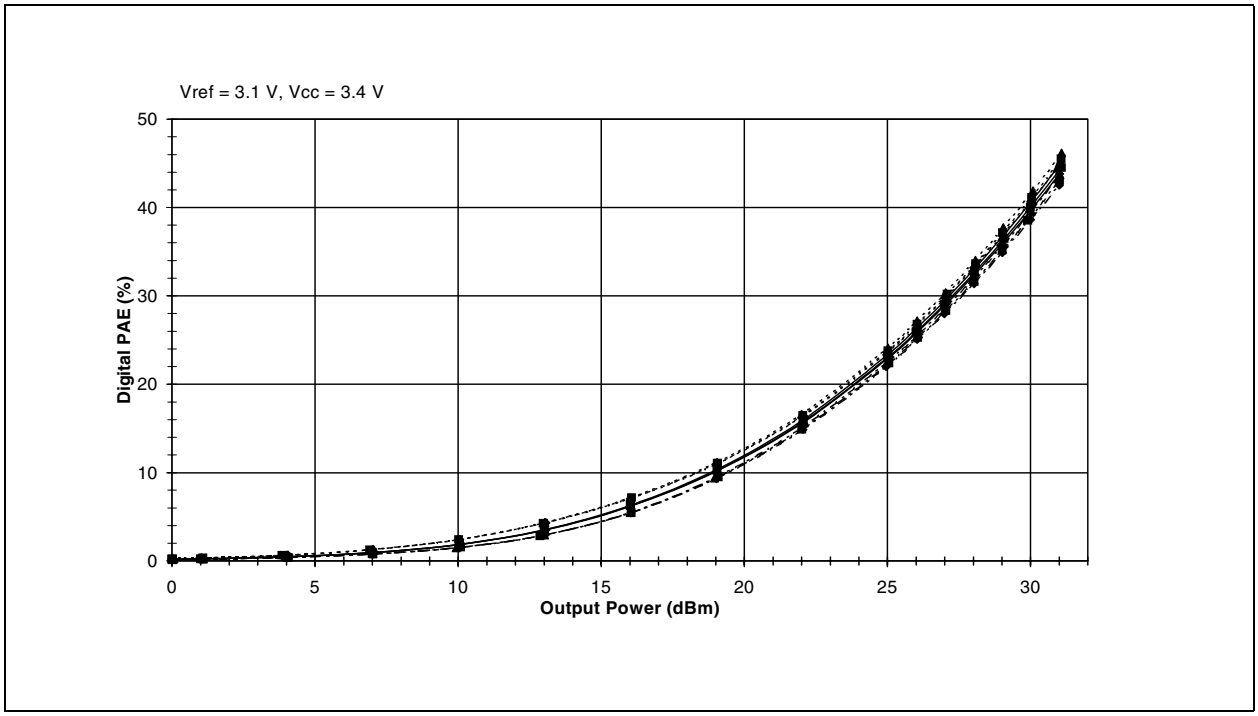
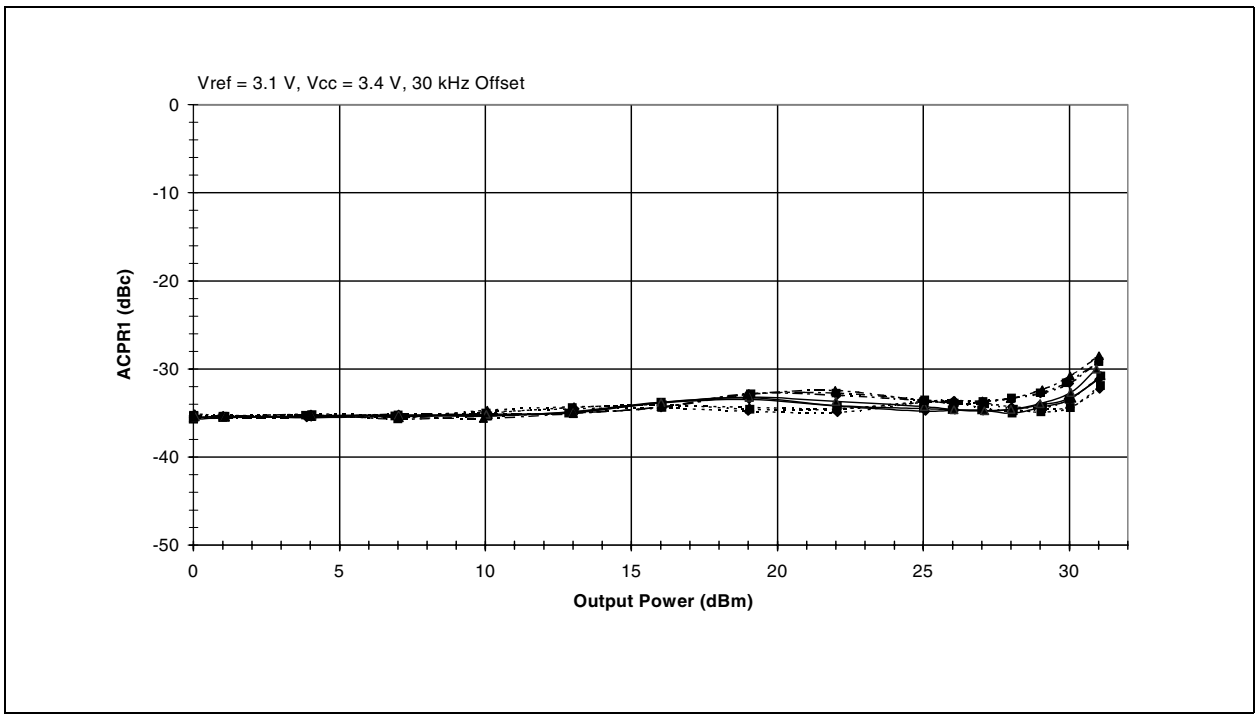


Figure 3. Digital Adjacent Channel Power vs. Output Power



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. Digital Alternate1 Channel Power vs. Output Power

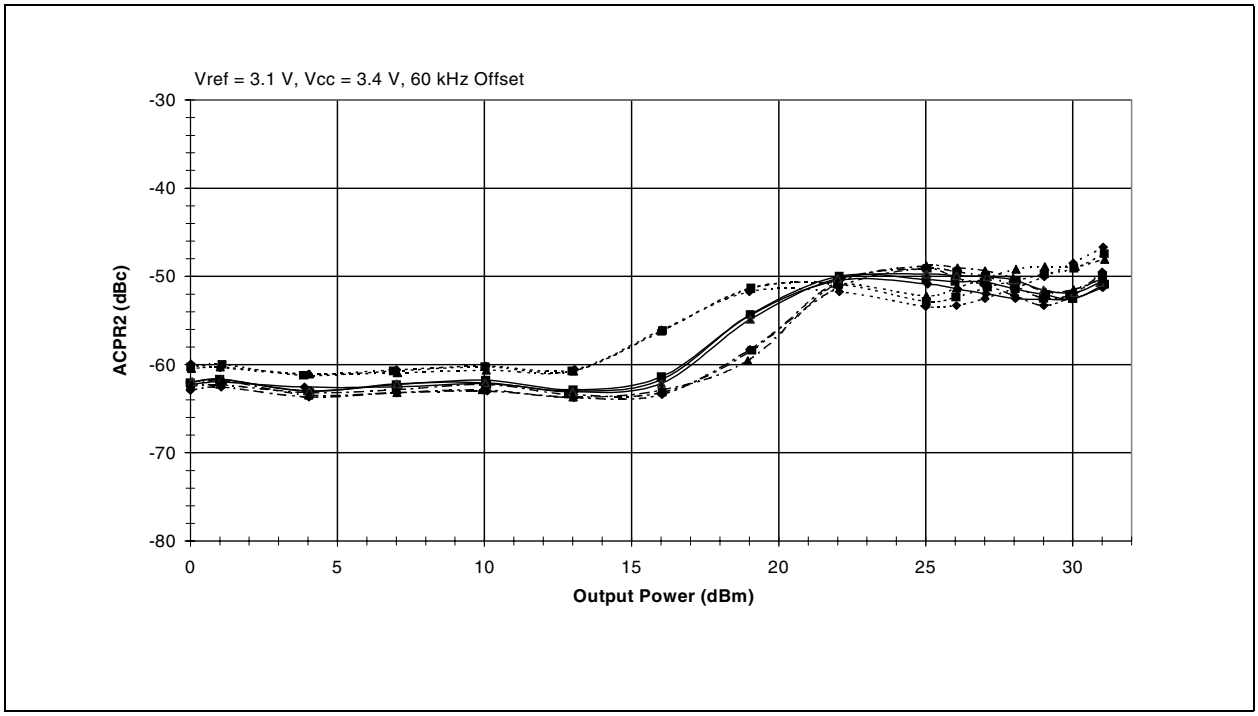
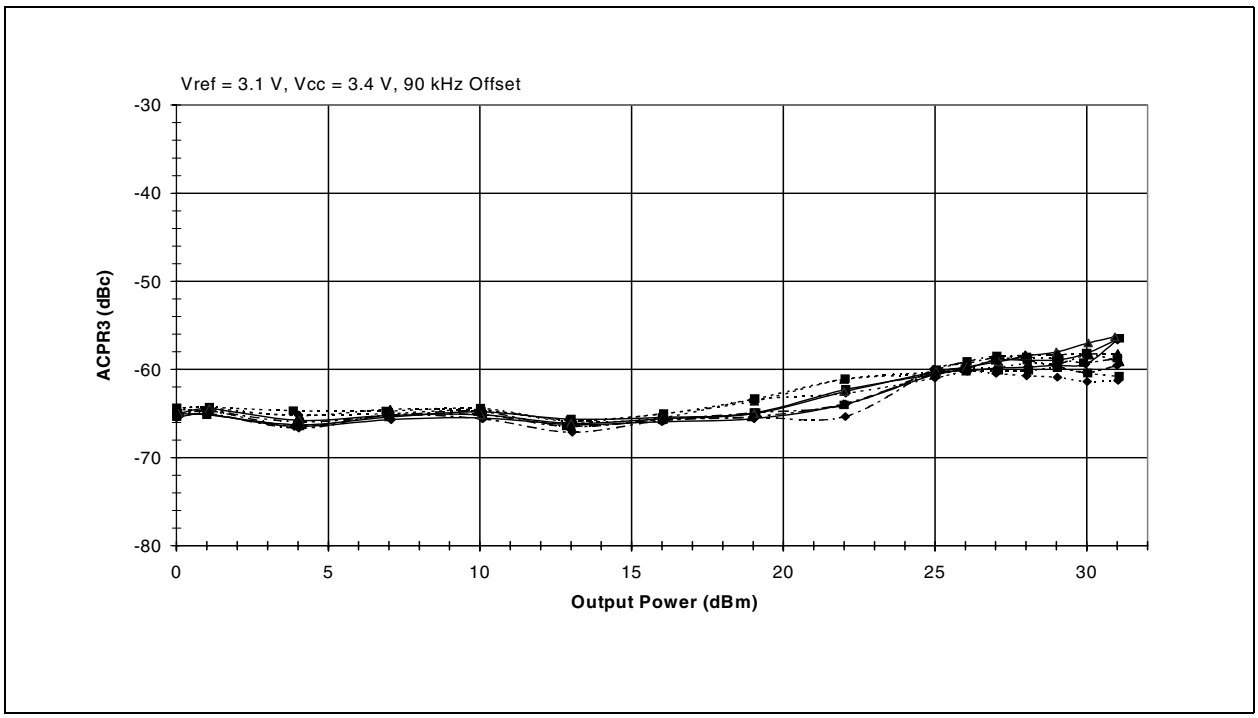


Figure 5. Digital Alternate2 Channel Power vs. Output Power



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 6. Analog Gain vs. Output Power

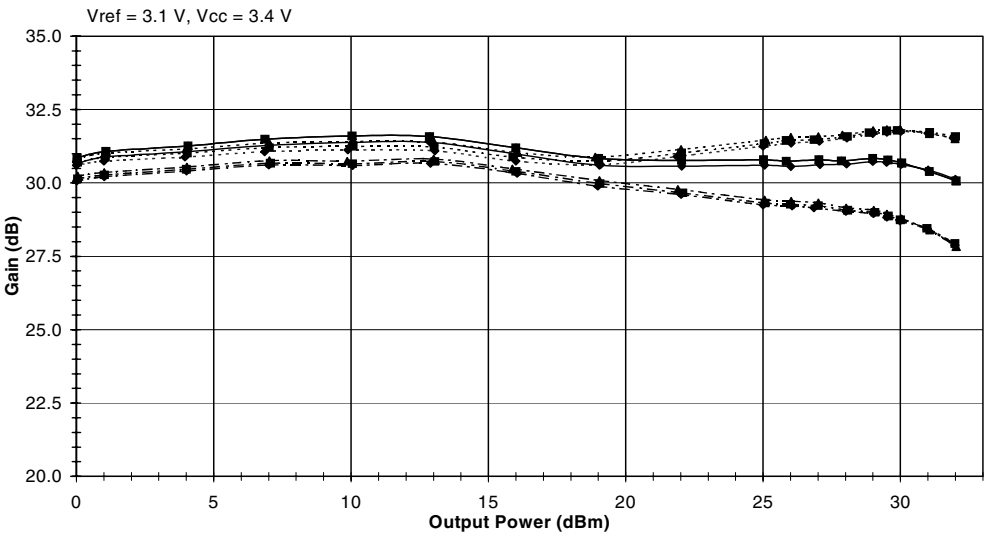
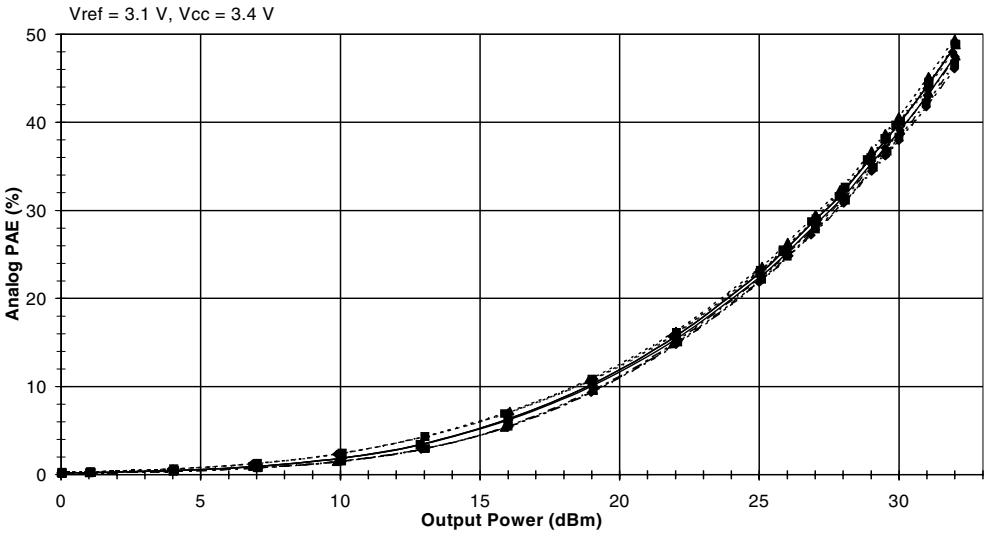


Figure 7. Analog Power Added Efficiency vs. Output Power



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 8. Analog Second Order Harmonic vs. Output Power

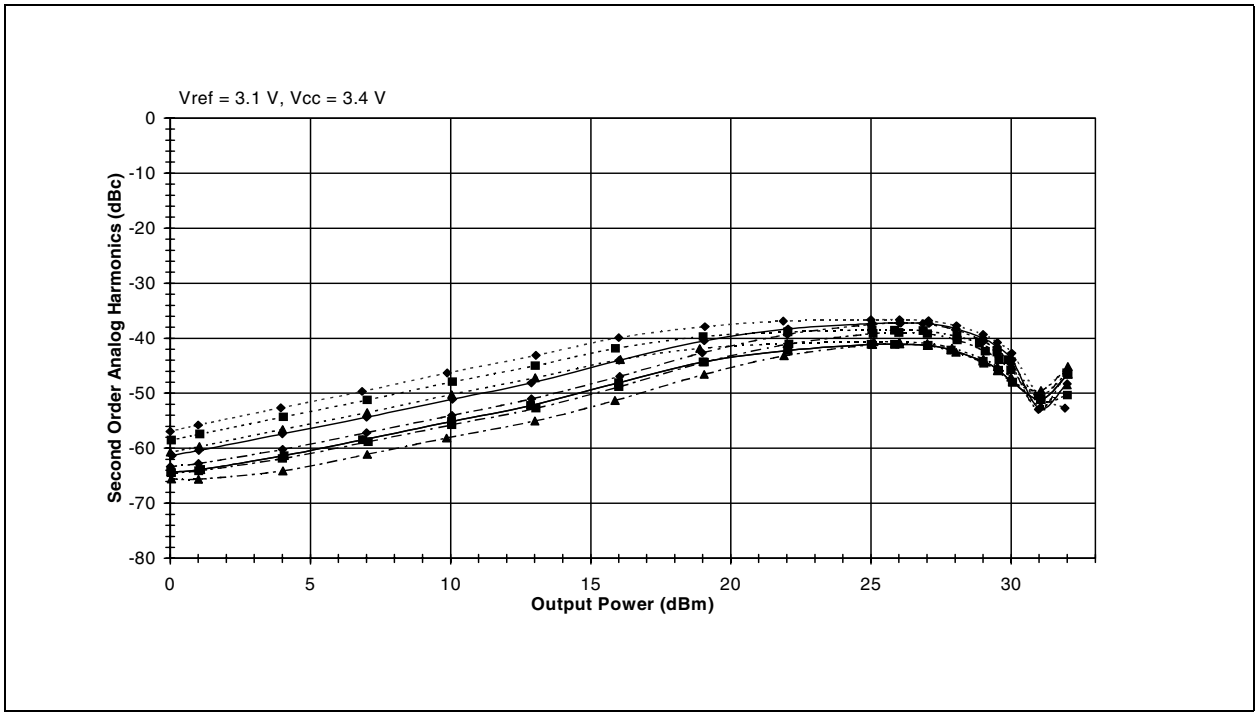
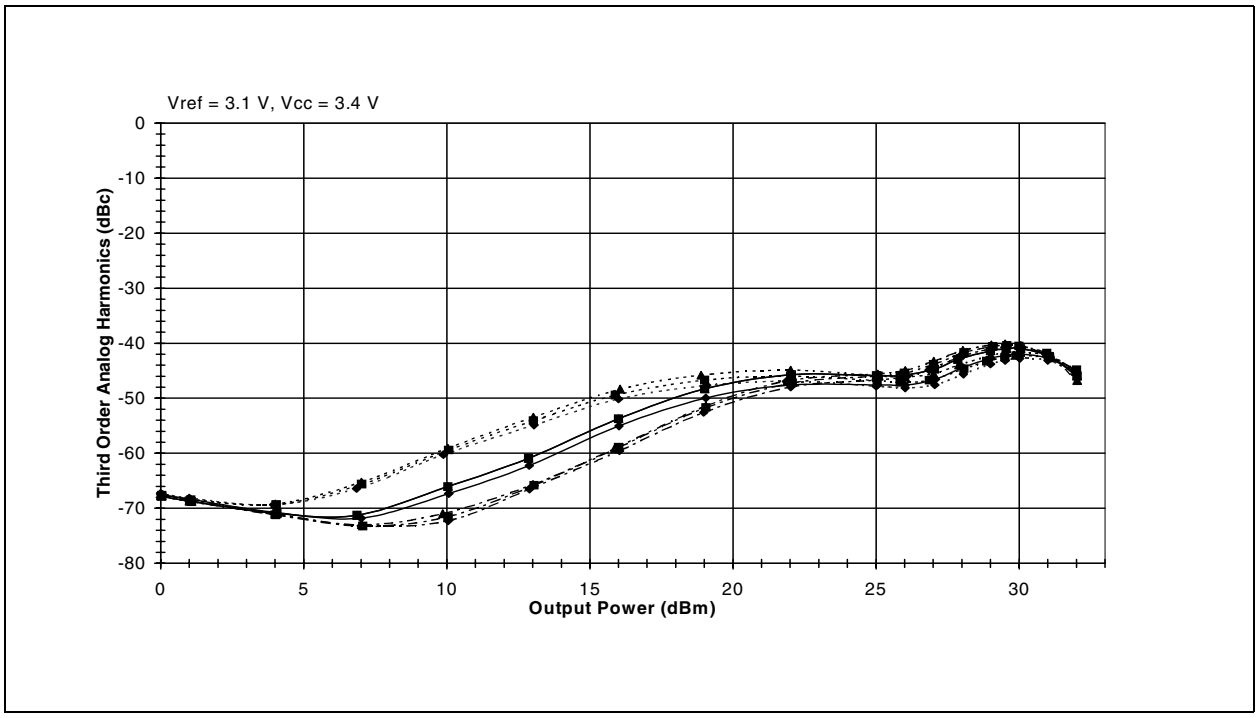


Figure 9. Analog Third Order Harmonic vs. Output Power



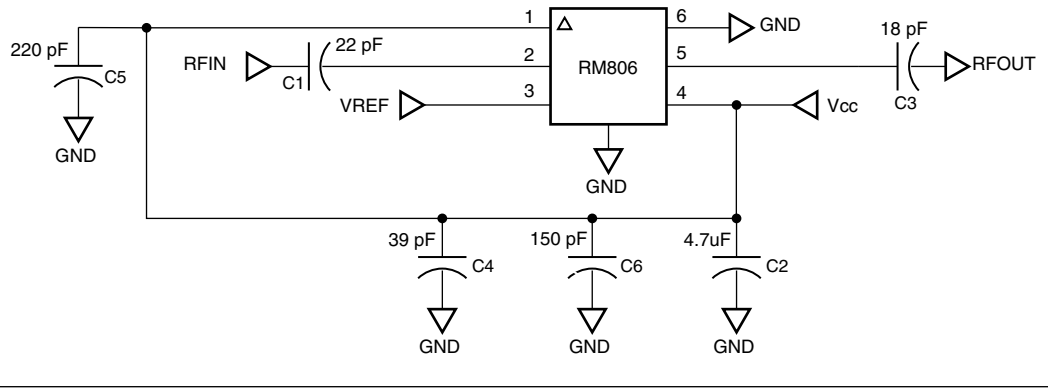
Legend

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

Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the RM806, 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



Notes:
1) Bottom of the package [pin 7] is GND and must be soldered.
2) Input and Output DC Blocking caps are required for TDMA Cellular
3) All external components must be located no greater than 90 mils [2.29mm] from edge of Module.
4) Vcc line should have ground layer isolation from RFIN and VREF
5) Application PCB and Production Test PCB require the same schematic.

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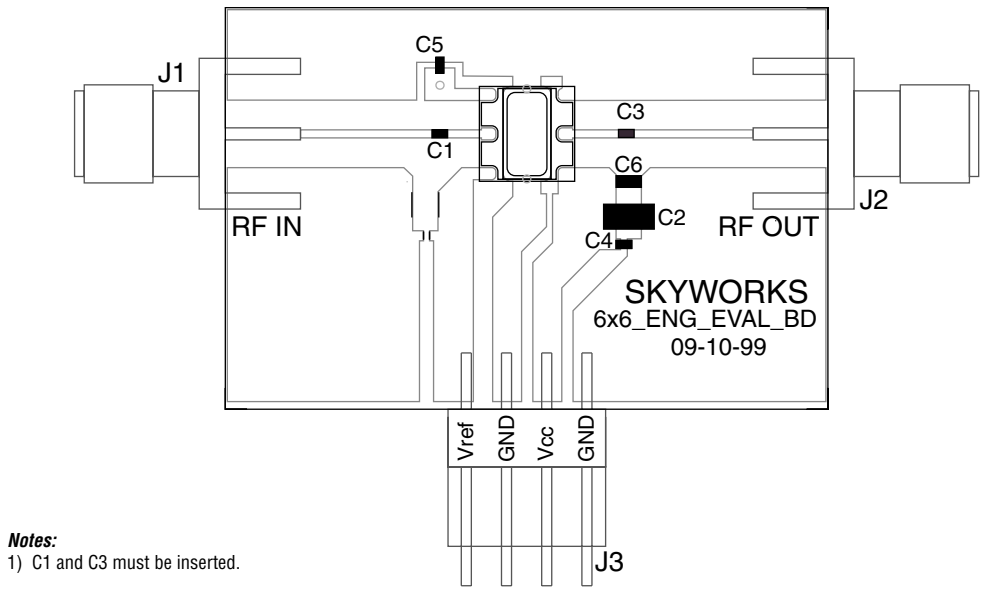
Figure 11. Evaluation Board Diagram



Notes:
1) C1 and C3 must be inserted.

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Package Dimensions and Pin Description

The RM806 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board.

Figure 12. RM806 Package Drawing

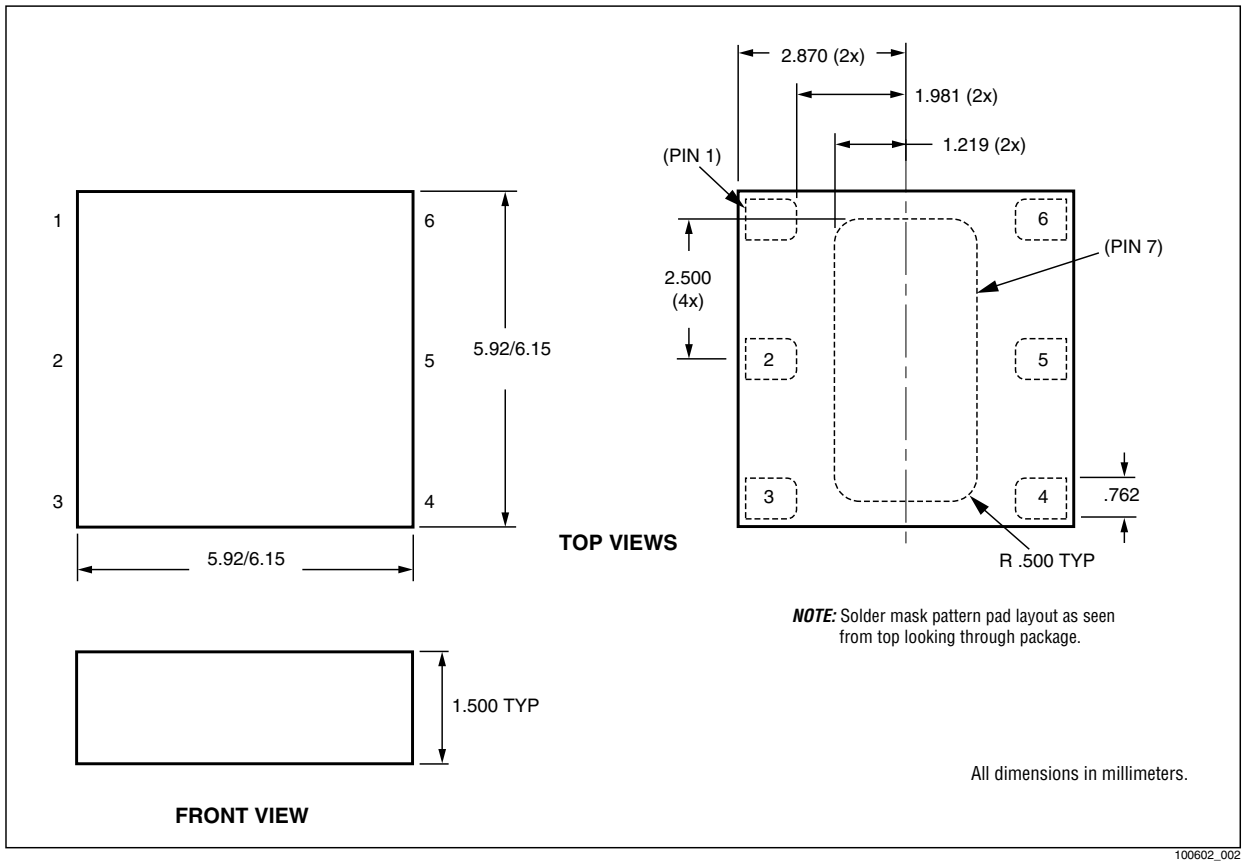


Table 5. Pin Description

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

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

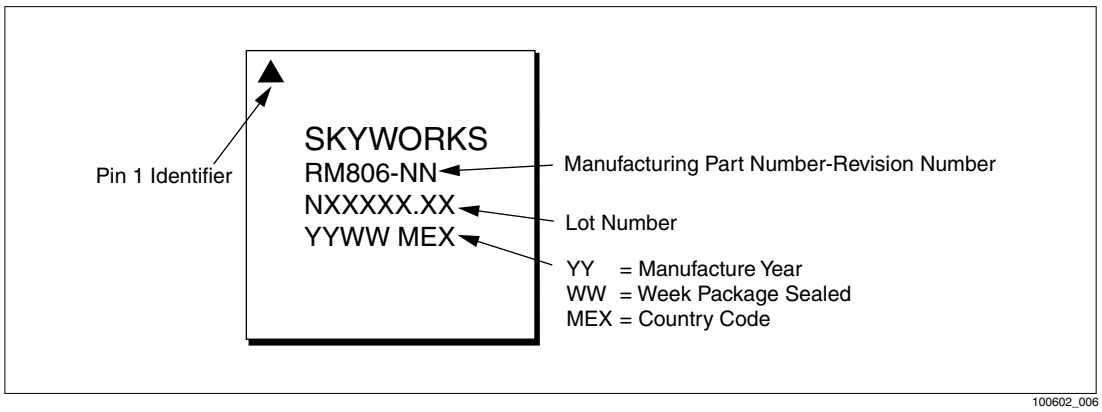
Package and Handling Information

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 RM806 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*.

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.*

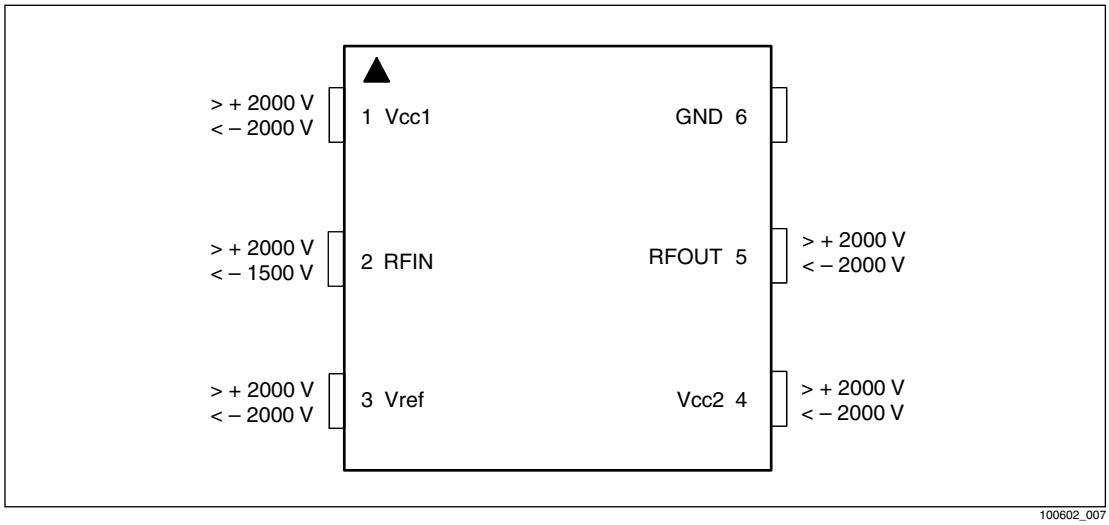
Figure 13. Typical Case Markings



Electrostatic Discharge Sensitivity

The RM806 is a Class I device. Figure 14 lists the Electrostatic Discharge (ESD) immunity level for each pin of the RM806 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.

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 most stringent criteria, 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
RM806	RM806–14	14	6X6LM–6	–30 °C to +85 °C

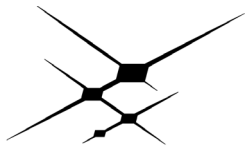
Revision History

Revision	Level	Date	Description
A		March 2000	Initial Release
B		March 2000	Updated Data Tables
C		May 2000	Updated Characterization Data
D		February 2001	Add Table 4; Revise Evaluation Board Information; Soldering & Temperature Guidelines; Revise Figures 13, 14 & Table 3.
E		March 2001	Revised: Table 3; Figure 12; Packaging & Handling Information; Manufacturing Part Number
F		September 2001	Revise: ESD data; Product Revision from 13 to 14.
G		February 7, 2002	Revise: Table 1 footnote 2.

References

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

General Information:
Skyworks Solutions, Inc.
4311 Jamboree Rd.
Newport Beach, CA. 92660-3007
www.skyworksinc.com



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