

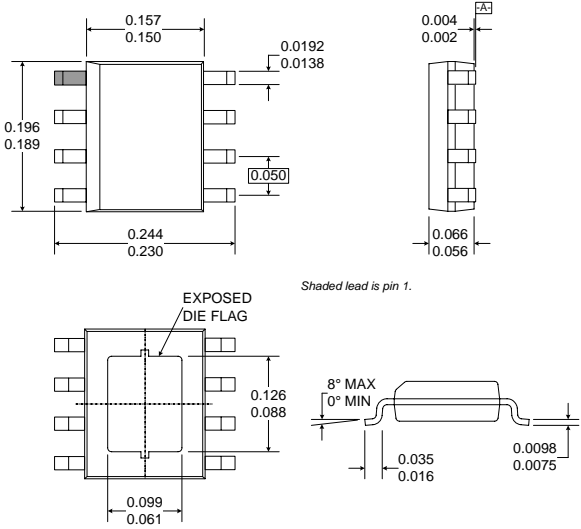
RoHS Compliant & Pb-Free Product

Typical Applications

- GaAs Pre-Driver for Basestation Amplifiers
- PA Stage for Commercial Wireless Infrastructure
- Class AB Operation for NMT, GSM, DCS, PCS, and UMTS Transceiver Applications

Product Description

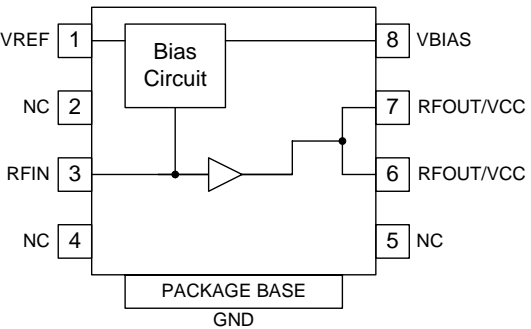
The RF3809 is a GaAs pre-driver power amplifier, specifically designed for wireless infrastructure applications. Using a highly reliable GaAs HBT fabrication process, this high-performance single-stage amplifier achieves high output power over a broad frequency range. The RF3809 also provides excellent efficiency and thermal stability through the use of a thermally-enhanced surface-mount plastic-slug package. Ease of integration is accomplished through the incorporation of an optimized evaluation board design provided to achieve proper 50Ω operation. Various evaluation boards are available to address a broad range of wireless infrastructure applications: NMT 450MHz; GSM850MHz; GSM900MHz; DCS1800MHz; PCS1900MHz; and, UMTS2200MHz.



Package Style: SOIC-8

Optimum Technology Matching® Applied

- | | | |
|-------------------------------------|--|---------------------------------------|
| <input type="checkbox"/> Si BJT | <input checked="" type="checkbox"/> GaAs HBT | <input type="checkbox"/> GaAs MESFET |
| <input type="checkbox"/> Si Bi-CMOS | <input type="checkbox"/> SiGe HBT | <input type="checkbox"/> Si CMOS |
| <input type="checkbox"/> InGaP/HBT | <input type="checkbox"/> GaN HEMT | <input type="checkbox"/> SiGe Bi-CMOS |



Functional Block Diagram

Features

- High Output Power of 2.0W P1dB
- High Linearity
- High Power-Added Efficiency
- Thermally-Enhanced Packaging
- Broadband Platform Design Approach, 450MHz to 2500MHz

Ordering Information

RF3809	GaAs HBT Pre-Driver Amplifier
RF3809PCK-410	Fully Assembled Evaluation Board, 450MHz
RF3809PCK-411	Fully Assembled Evaluation Board, 869MHz to 894MHz
RF3809PCK-412	Fully Assembled Evaluation Board, 920MHz to 960MHz
RF3809PCK-413	Fully Assembled Evaluation Board, 1800MHz to 1880MHz
RF3809PCK-414	Fully Assembled Evaluation Board, 1930MHz to 1990MHz
RF3809PCK-415	Fully Assembled Evaluation Board, UMTS

RF Micro Devices, Inc. Tel (336) 664 1233
 7628 Thorndike Road Fax (336) 664 0454
 Greensboro, NC 27409, USA <http://www.rfmd.com>

RF3809

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	9.0	V
RF - Input Power	See below	
Operating Current	750	mA
Load VSWR	4:1	
Operating Temperature	-40 to +85	°C
Storage Temperature	-40 to +105	°C



Caution! ESD sensitive device.

RF Micro Devices believes the furnished information is correct and accurate at the time of this printing. RoHS marking based on EU Directive 2002/95/EC (at time of this printing). However, RF Micro Devices reserves the right to make changes to its products without notice. RF Micro Devices does not assume responsibility for the use of the described product(s).

Parameter	Specification			Unit	Condition	
	Min.	Typ.	Max.			
Overall - 450MHz						
Frequency	420		480	MHz	I _{REF} =15mA, V _{CC} =8V, V _{REF} =8V, V _{BIAS} =8V, Temp=+25°C	
P1dB	+32.0	+33.0	+34.5	dBm		
P _{IN} , Maximum			24.0	dBm		
Total Efficiency	38.0	45.0	53.0	%		@ P1dB
Total Power Added Efficiency	37.0	44.0	52.0	%		@ P1dB
Gain (S21)	14	13	12	dB		
Second Harmonic (2fo)	-32	-27	-19	dBc		@ P1dB
Third Harmonic (3fo)	-38	-36	-30	dBc		@ P1dB
Input Return Loss (S11)	-20	-16	-11	dB		
Output Return Loss (S22)	-6.5	-5.5	-4.0	dB		
Two-Tone Specification						
OIP3	43.0	46.5	48.0	dBm	19dBm/tone	
	44.0	48.0	51.0	dBm	21 dBm/tone	
	44.5	50.0	53.0	dBm	23dBm/tone	
	45.0	48.0	52.0	dBm	25dBm/tone	

Parameter	Specification			Unit	Condition	
	Min.	Typ.	Max.			
Overall - GSM800						
Frequency	869		894	MHz	$I_{REF}=15\text{mA}$, $V_{CC}=8\text{V}$, $V_{REF}=8\text{V}$, $V_{BIAS}=8\text{V}$, Temp= $+25^{\circ}\text{C}$	
P1dB	+34.5	+35.5	+36.5	dBm		
P_{IN} , Maximum			24	dBm		
Total Efficiency	48.0	50.5	55.0	%		@ P1dB
Total Power Added Efficiency	47.0	49.5	54.0	%		@ P1dB
Gain (S21)	13.0	13.5	14.5	dB		
Second Harmonic (2fo)	-32.0	-28.0	-26.0	dBc		@ P1dB
Third Harmonic (3fo)	-44.0	-38.0	-35.0	dBc		@ P1dB
Input Return Loss (S11)	-26.0	-18.0	-12.0	dB		
Output Return Loss (S22)	-20.0	-13.0	-9.0	dB		
Two-Tone Specification						
OIP3	44.5	45.5	48.0	dBm	19 dBm/tone	
	45.0	46.5	48.0	dBm	21 dBm/tone	
	46.0	47.0	49.0	dBm	23 dBm/tone	
	46.0	48.0	51.0	dBm	25 dBm/tone	
Overall - GSM900						
Frequency	920		960	MHz	$I_{REF}=14\text{mA}$, $V_{CC}=8\text{V}$, $V_{REF}=8\text{V}$, $V_{BIAS}=8\text{V}$, Temp= $+25^{\circ}\text{C}$	
P1dB	+34.0	+34.5	+35.0	dBm		
P_{IN} , Maximum			24	dBm		
Total Efficiency	43.0	49.0	54.0	%		@ P1dB
Total Power Added Efficiency	42.0	48.0	53.0	%		@ P1dB
Gain (S21)	13.0	13.5	14.0	dB		
Second Harmonic (2fo)	-30.0	-28.0	-26.5	dBc		@ P1dB
Third Harmonic (3fo)	-44.0	-29.5	-37.0	dBc		@ P1dB
Input Return Loss (S11)	-29.0	-21.0	-9.0	dB		
Output Return Loss (S22)	-9.5	-8.0	-7.0	dB		
Two-Tone Specification						
OIP3	46.5	48.5	50.5	dBm	19 dBm/tone	
	46.0	48.0	51.0	dBm	21 dBm/tone	
	45.0	47.0	50.0	dBm	23 dBm/tone	
	46.0	47.5	49.0	dBm	25 dBm/tone	

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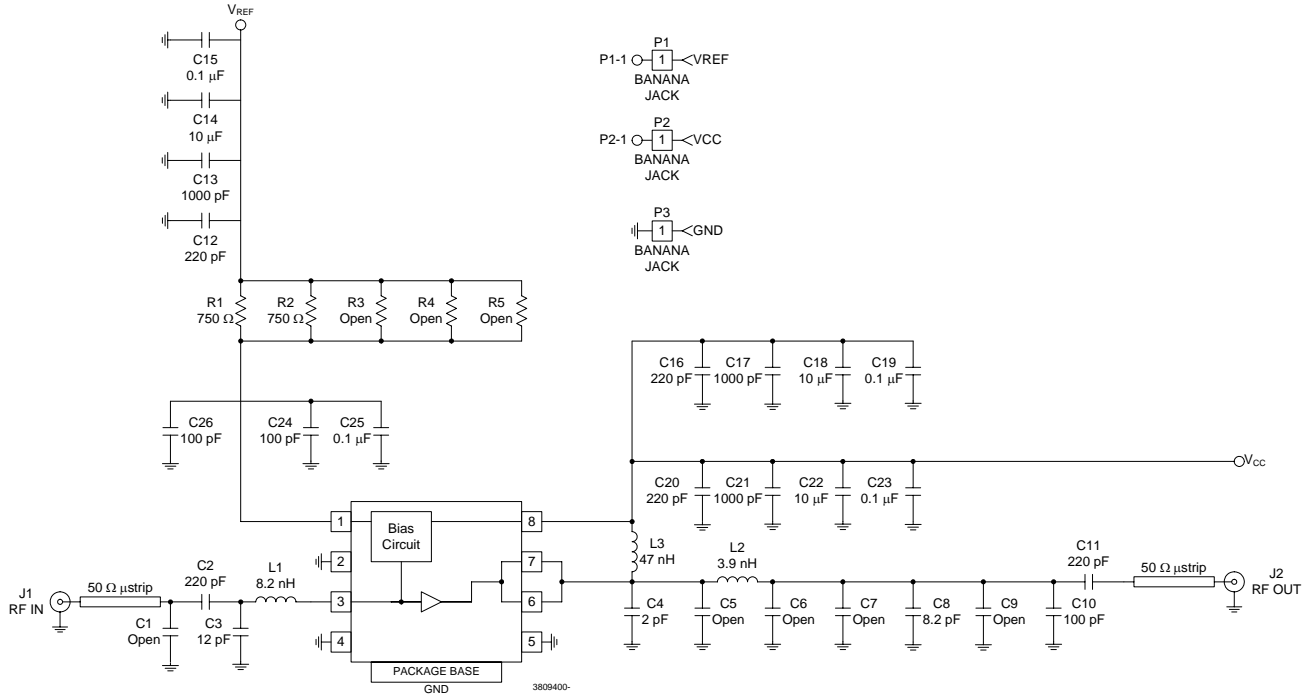
Parameter	Specification			Unit	Condition	
	Min.	Typ.	Max.			
Overall - DCS1800						
Frequency	1805		1880	MHz	$I_{REF}=15\text{mA}$, $V_{CC}=8\text{V}$, $V_{REF}=8\text{V}$, $V_{BIAS}=8\text{V}$, Temp=+25°C	
P1dB	+32.5	+34.0	+35.0	dBm		
P_{IN} , Maximum			26	dBm		
Total Efficiency	47.5	50.0	55.0	%		@ P1dB
Total Power Added Efficiency	46.5	49.0	54.0	%		@ P1dB
Gain (S21)	10.5	11.5	12.5	dB		
Second Harmonic (2fo)	-32.0	-24.0	-20.0	dBc		@ P1dB
Third Harmonic (3fo)	-58.0	-48.0	-44.0	dBc		@ P1dB
Input Return Loss (S11)	-25.0	-15.0	-8.0	dB		
Output Return Loss (S22)	-20.0	-12.0	-7.0	dB		
Two-Tone Specification						
OIP3	44.0	45.5	48.0	dBm	15 dBm/tone	
	44.5	46.5	49.0	dBm	17 dBm/tone	
	45.5	47.0	49.0	dBm	19 dBm/tone	
	45.5	48.0	51.0	dBm	21 dBm/tone	
Overall - PCS1900						
Frequency	1930		1990	MHz	$I_{REF}=15\text{mA}$, $V_{CC}=8\text{V}$, $V_{REF}=8\text{V}$, $V_{BIAS}=8\text{V}$, Temp=+25°C	
P1dB	+32.0	+32.5	+34.0	dBm		
P_{IN} , Maximum			26	dBm		
Total Efficiency	46.0	47.5	55.0	%		@ P1dB
Total Power Added Efficiency	45.0	46.5	54.5	%		@ P1dB
Gain (S21)	10.0	10.5	11.5	dB		
Second Harmonic (2fo)	-35.0	-26.0	-21.0	dBc		@ P1dB
Third Harmonic (3fo)	-85.0	-65.0	-55.0	dBc		@ P1dB
Input Return Loss (S11)	-28.0	-12.0	-8.0	dB		
Output Return Loss (S22)	-12.0	-9.0	-6.0	dB		
Two-Tone Specification						
OIP3	43.5	45.5	48.0	dBm	19 dBm/tone	
	44.0	45.5	48.0	dBm	21 dBm/tone	
	44.5	46.0	49.0	dBm	23 dBm/tone	
	46.5	48.0	51.0	dBm	25 dBm/tone	

Parameter	Specification			Unit	Condition	
	Min.	Typ.	Max.			
UMTS 2100						
Frequency	2110		2170	MHz	$I_{REF}=15\text{mA}$, $V_{CC}=8\text{V}$, $V_{REF}=8\text{V}$, $V_{BIAS}=8\text{V}$, Temp= $+25^{\circ}\text{C}$	
P1dB	+32.0	+32.5	+33.5	dBm		
P_{IN} , Maximum			26	dBm		
Total Efficiency	41.5	47.5	51.5	%		@ P1dB
Total Power Added Efficiency	40.5	46.5	50.5	%		@ P1dB
Gain (S21)	9.5	10.5	11.0	dB		
Second Harmonic (2fo)	-35.0	-32.0	-26.5	dBc		@ P1dB
Third Harmonic (3fo)	-56.0	-52.0	-42.0	dBc		@ P1dB
Input Return Loss (S11)	-25.0	-15.0	-8.0	dB		
Output Return Loss (S22)	-20.0	-11.0	-6.0	dB		
Two-Tone Specification						
OIP3	43.5	44.5	46.0	dBm	19 dBm/tone	
	44.0	44.5	46.0	dBm	21 dBm/tone	
	44.5	45.5	47.0	dBm	23 dBm/tone	
	43.5	46.5	49.0	dBm	25 dBm/tone	
Power Supply						
Power Supply Voltage	7	8	9	V		
Supply Current ($I_{CC}+I_{BIAS}$)	245	270	316	mA	I_{CCQ} for best IP3 and efficiency	
Control Current (I_{REF})	14	15	16	mA	$V_{REF}=8\text{V}$, $V_{CC}=8\text{V}$	
Power Down Current			30	μA	$V_{REF}=0\text{V}$, $V_{CC}=8\text{V}$	

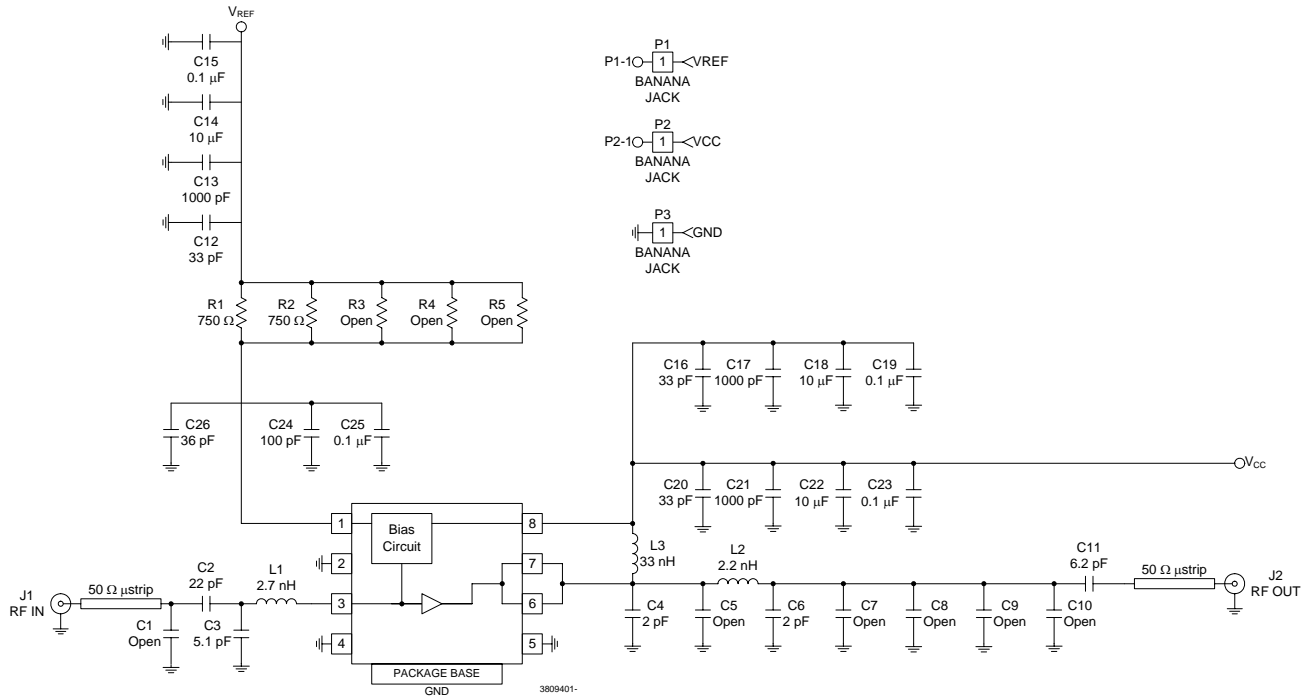
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Pin	Function	Description
1	VREF	Control input to internal bias circuitry.
2	NC	No connection.
3	RFIN	Input for RF signal.
4	NC	No connection.
5	NC	No connection.
6	RFOUT/VCC	RF output pin and V _{CC} supply pin.
7	RFOUT/VCC	RF output pin and V _{CC} supply pin.
8	VBIAS	RF supply to internal bias circuitry.
Pkg Base	GND	Backside of package should be connected to a short path to ground.

Evaluation Board Schematic 400MHz (RF3809410)

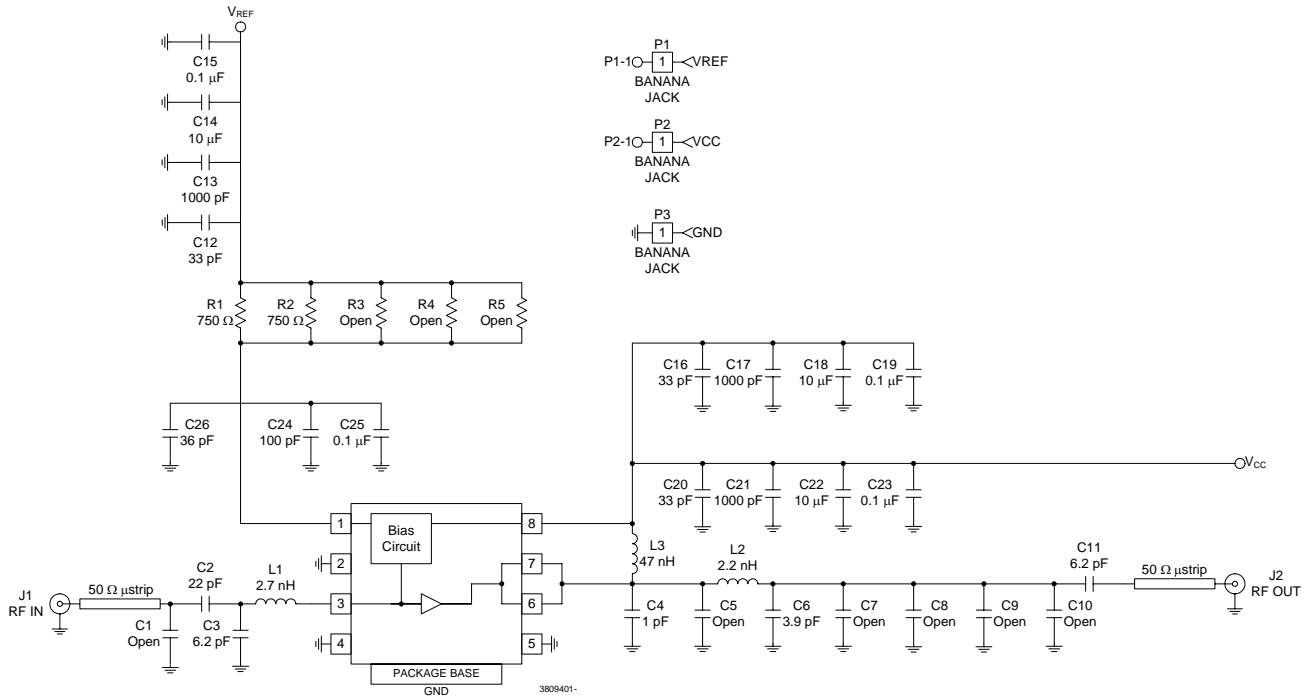


Evaluation Board Schematic 800MHz to 1000MHz (CDMA800, ISM, EGSM)

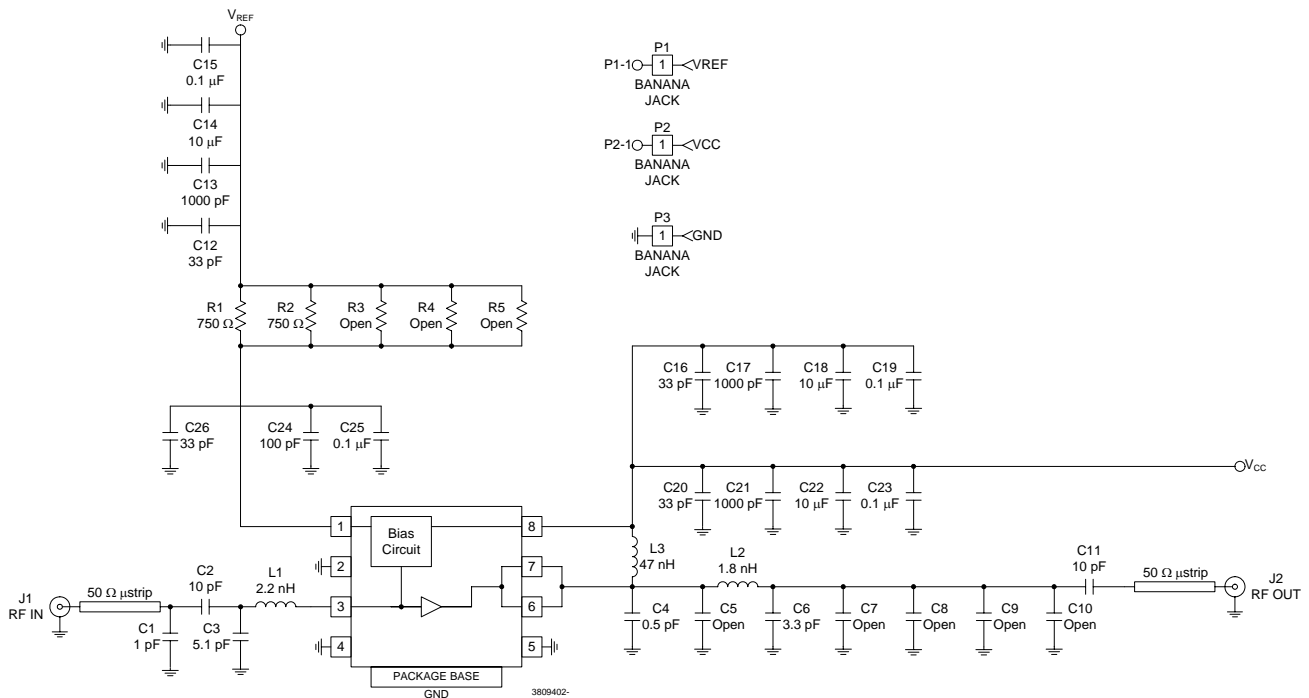


RF3809

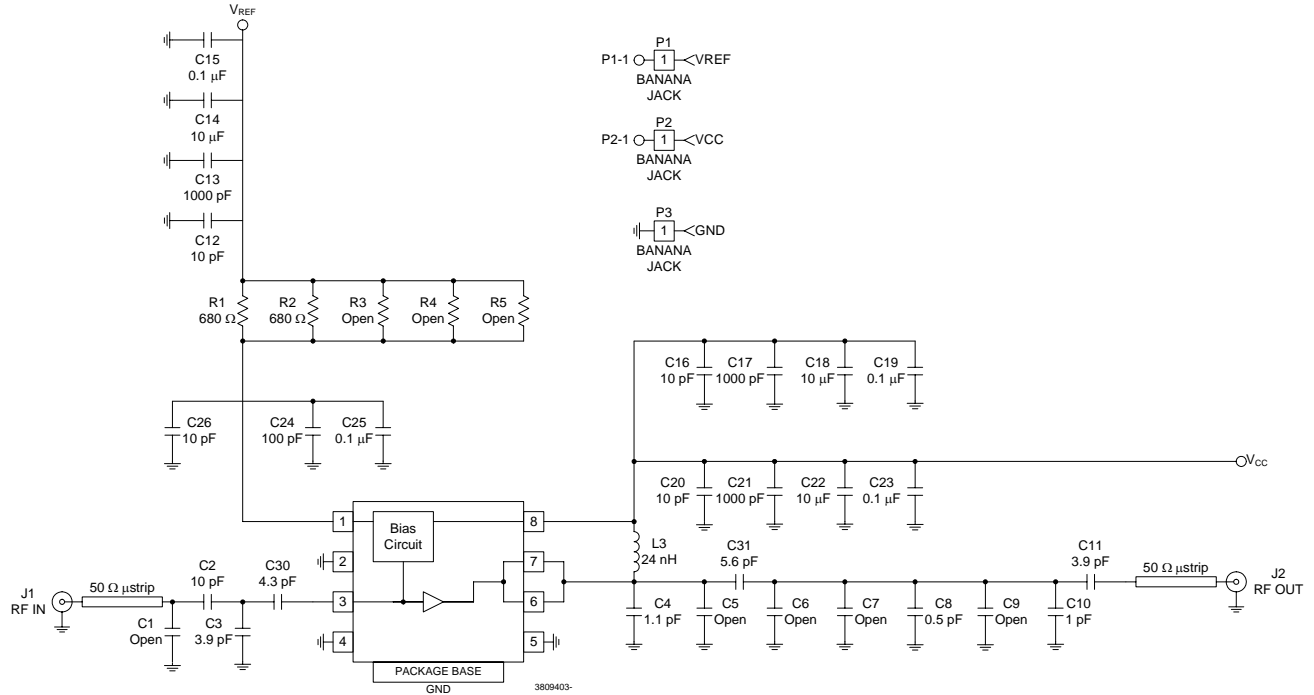
Evaluation Board Schematic 869MHz to 894MHz (GSM800) (RF3809411)



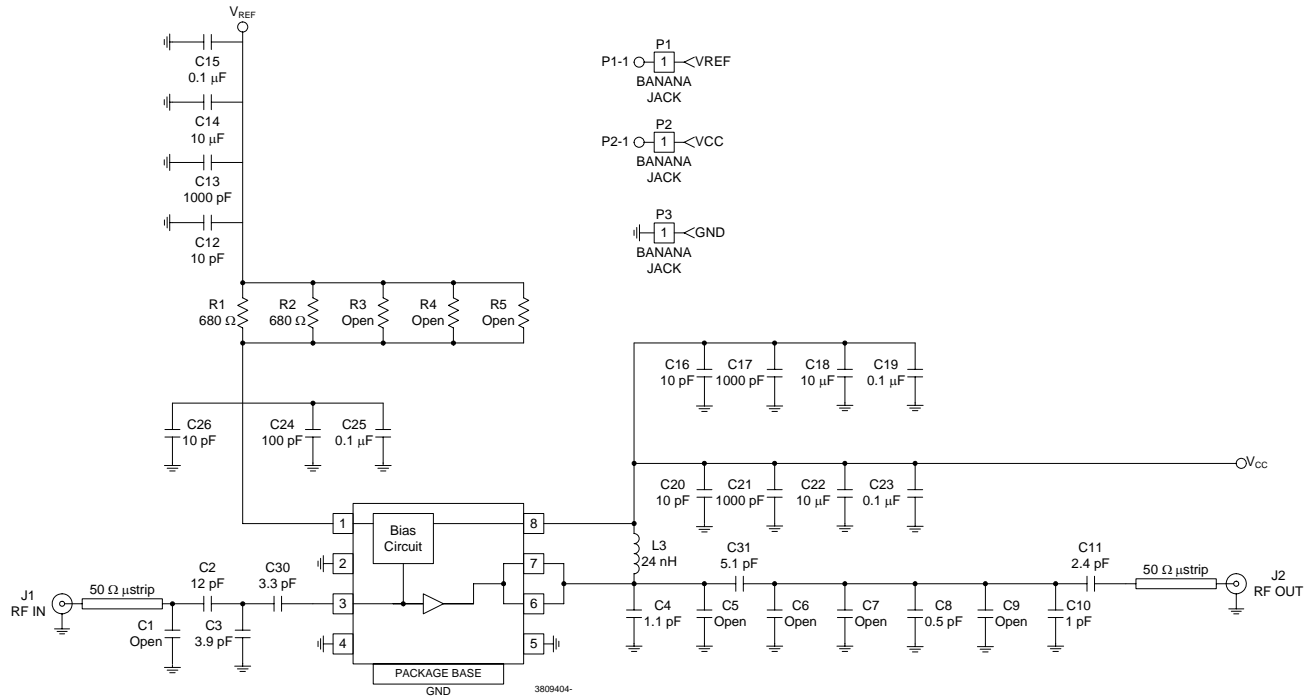
Evaluation Board Schematic 920MHz to 960MHz (GSM900) (RF3809412)



Evaluation Board Schematic 1805MHz to 1880MHz (DCS1800) (RF3809413)

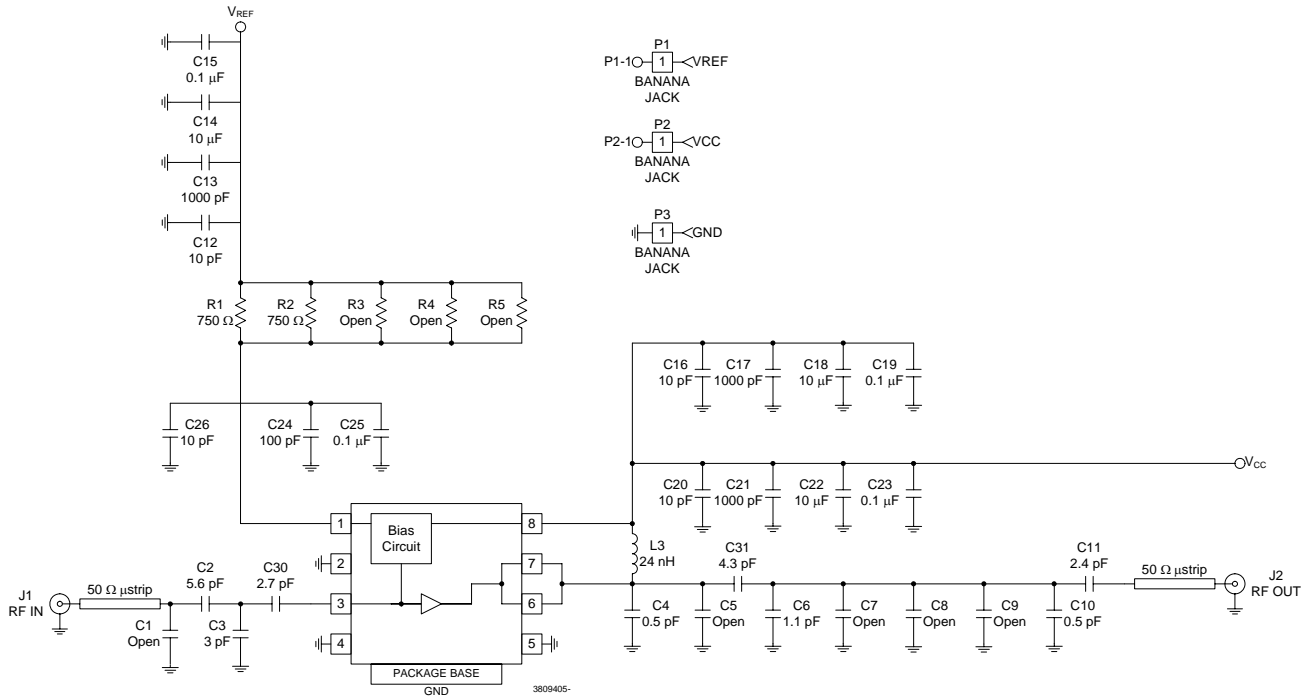


Evaluation Board Schematic 1930MHz to 1990MHz (PCS1900) (RF3809414)



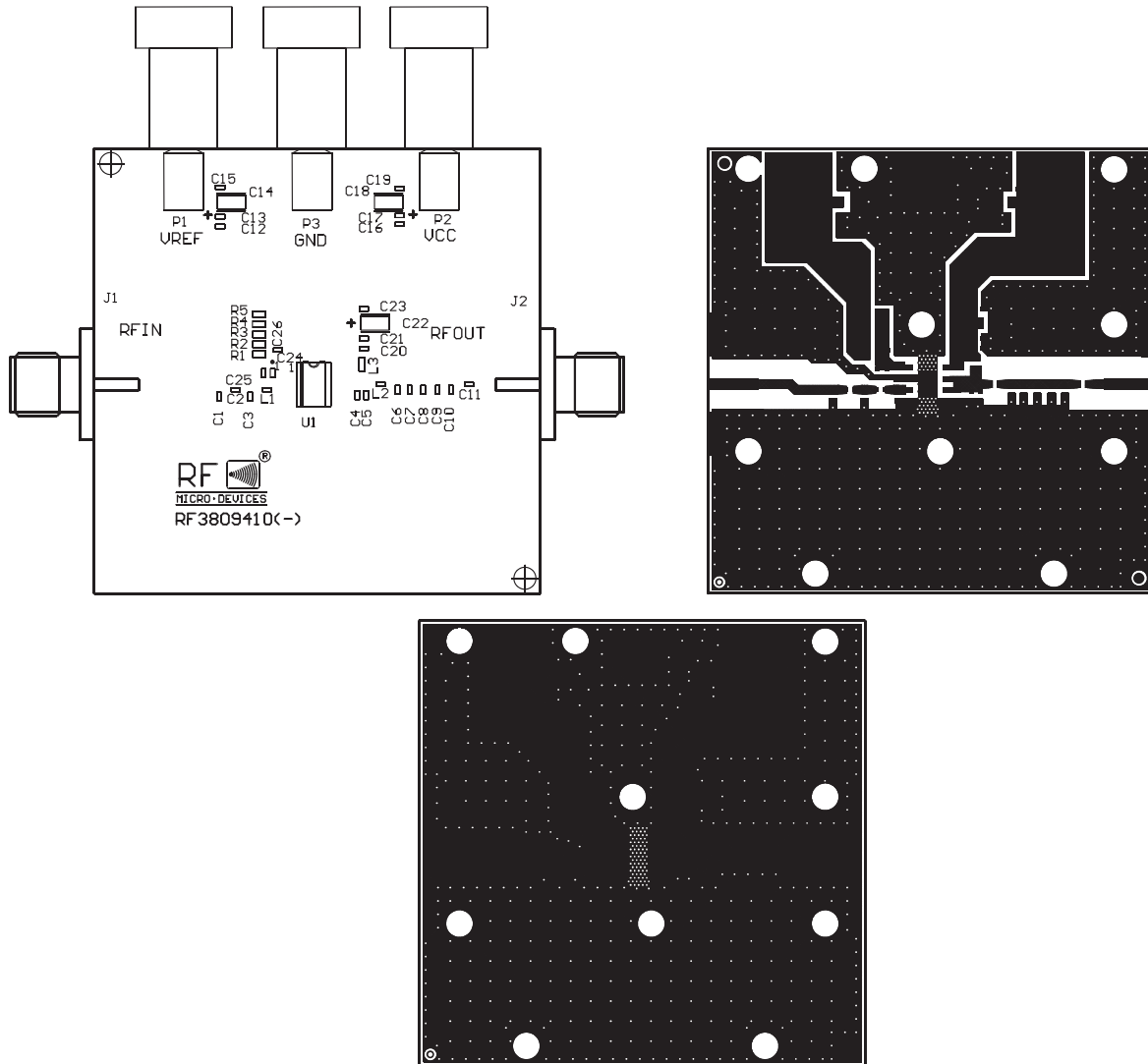
RF3809

Evaluation Board Schematic UMTS (RF3809415)



Evaluation Board Layout
Board Size 2.0" x 2.0"

Board Thickness 0.023", Board Material Rogers 4530



PCB Design Requirements

PCB Surface Finish

The PCB surface finish used for RFMD's qualification process is electroless nickel, immersion gold. Typical thickness is 3μinch to 8μinch gold over 180μinch nickel.

PCB Land Pattern Recommendation

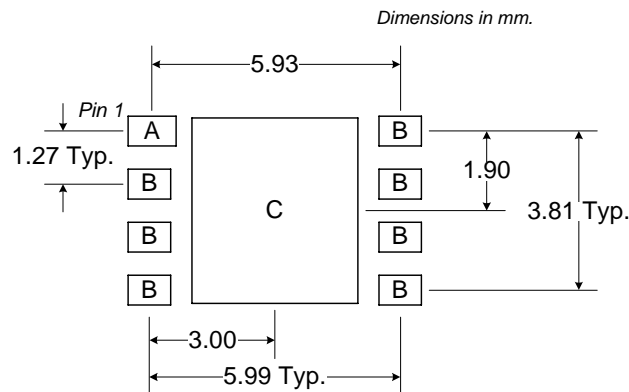
PCB land patterns for PFMD components are based on IPC-7351 standards and RFMD empirical data. The pad pattern shown has been developed and tested for optimized assembly at RFMD. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.

PCB Metal Land Pattern

$$A = 1.14 \times 0.71$$

$$B = 1.02 \times 0.71 \text{ Typ.}$$

$$C = 3.96 \times 4.44$$



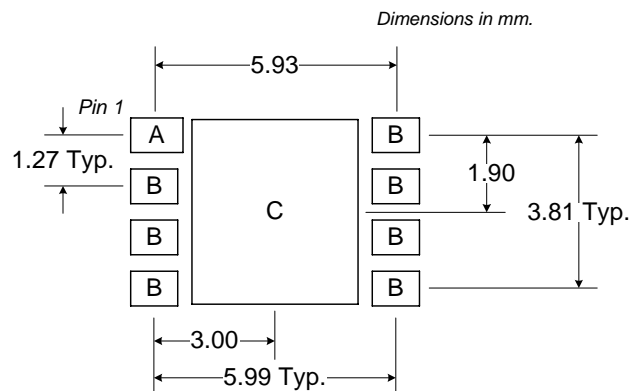
PCB Solder Mask Pattern

Liquid Photo-Imageable (LPI) solder mask is recommended. The solder mask footprint will match what is shown for the PCB metal land pattern with a 2mil to 3mil expansion to accommodate solder mask registration clearance around all pads. The center-grounding pad shall also have a solder mask clearance. Expansion of the pads to create solder mask clearance can be provided in the master data or requested from the PCB fabrication supplier.

$$A = 1.30 \times 0.86$$

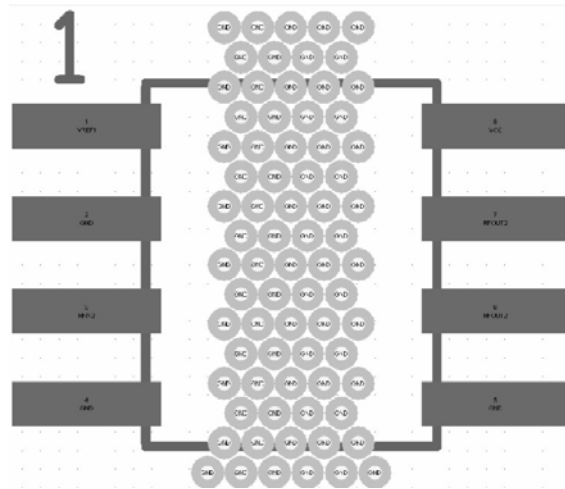
$$B = 1.17 \times 0.86 \text{ Typ.}$$

$$C = 4.11 \times 4.60$$



Thermal Pad and Via Design

The DUT must be connected to the PCB backside ground through a low inductance, low thermal resistance path. The required interface is achieved with the via pattern shown below for both low inductance as well as low thermal resistance. The footprint provided below worked well on the RFMD 20mil thick Rogers 4350 PCB and also standard FR4. The vias are 8mil vias that are partially plated through and are finished to 8mils±2mils with a minimum plating of 1.5mil. Failure to place these vias within the DUT mounting area on the PCB in this prescribed manner may result in electrical performance and/or reliability degradation.



RF3809

Tape and Reel Information

Carrier tape basic dimensions are based on EIA481. The pocket is designed to hold the part for shipping and loading onto SMT manufacturing equipment, while protecting the board and the solder terminals from damaging stresses. The individual pocket design can vary from vendor to vendor, but wide and pitch will be consistent.

Carrier tape is wound or placed on a shipping reel with a diameter of either 330mm (13inches) or 178mm (7inches). The center hub design is large enough to ensure the radius formed by the carrier tape around it does not put unnecessary stress on the parts.

Prior to shipping, moisture sensitive parts (MSL level 2a to 5a) are baked and placed into the pockets of the carrier tape. A cover tape is sealed over the top of the entire length of the carrier tape. The reel is sealed in a moisture barrier, ESD bag, which is placed in a cardboard shipping box. It is important to note that unused moisture sensitive parts need to be resealed in the moisture barrier bag. If the reels exceed the exposure limit and need to be rebaked, most carrier tape and shipping reels are not rate as bakeable at 125°C. If baking is required, devices may be baked according to section 4, table 4-1, column 8 of Joint Industry Standard IPC/JEDECJ-STD-033A.

The following table provides useful information for carrier tape and reels used for shipping the devices described in this document.

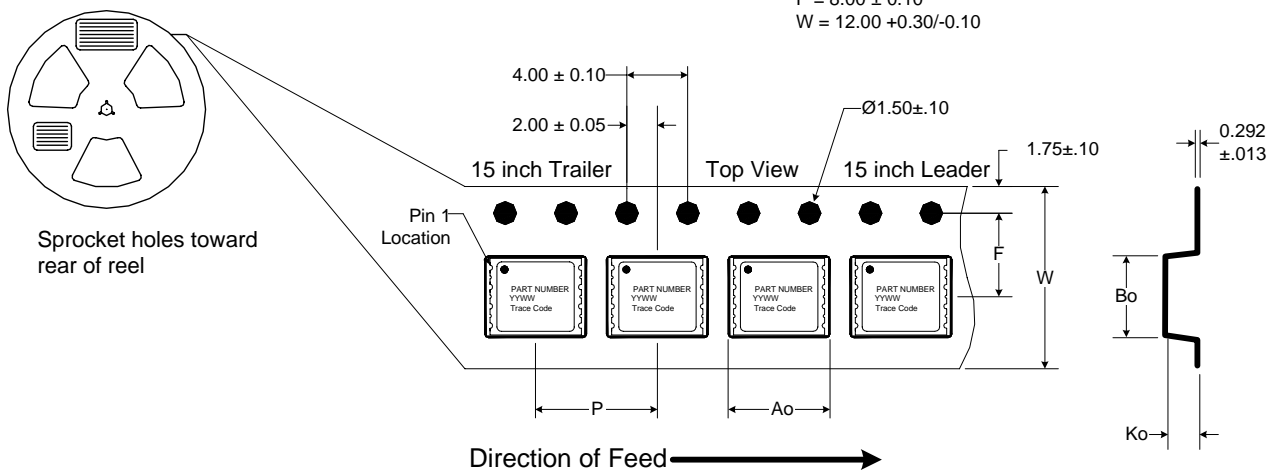
RFMD Part Number	Reel Diameter Inch (mm)	Hub Diameter Inch (mm)	Width (mm)	Pocket Pitch (mm)	Feed	Units per Reel
RF3809TR13	13 (330)	4 (102)	12	8	Single	2500
RF3809TR7	7 (178)	2.4 (61)	12	8	Single	750

Carrier Tape Drawing with Part Orientation

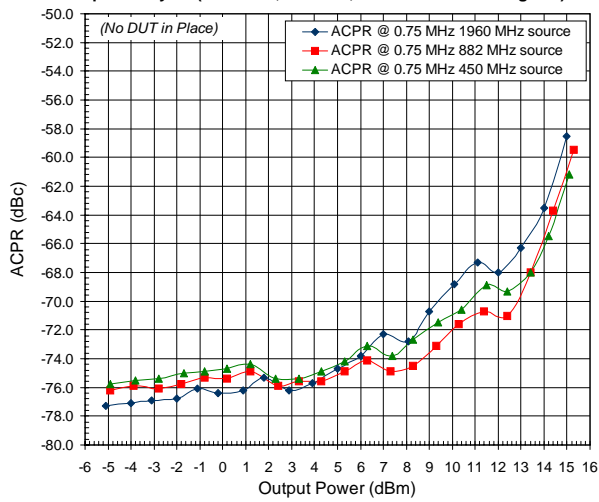
Notes:

- All dimensions are in millimeters (mm).
- Unless otherwise specified, all dimension tolerances per EIA-481.

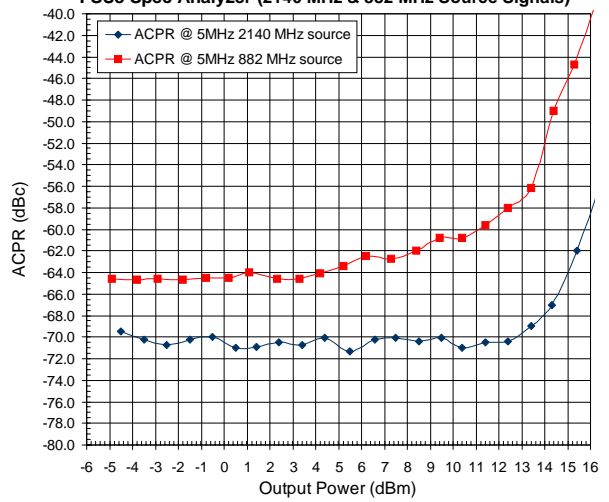
$A_o = 6.70 \pm 0.10$
 $B_o = 5.40 \pm 0.10$
 $F = 5.50 \pm 0.05$
 $K_o = 2.10 \pm 0.10$
 $P = 8.00 \pm 0.10$
 $W = 12.00 +0.30/-0.10$



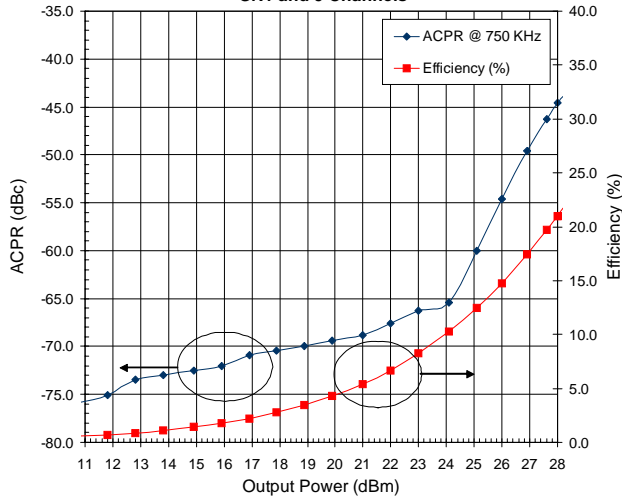
CDMA2K ACPR Performance for RS SMIQ03HD Sig Gen & FSU8 Spec Analyzer (1960 MHz, 882 MHz, & 450 MHz Source Signals)



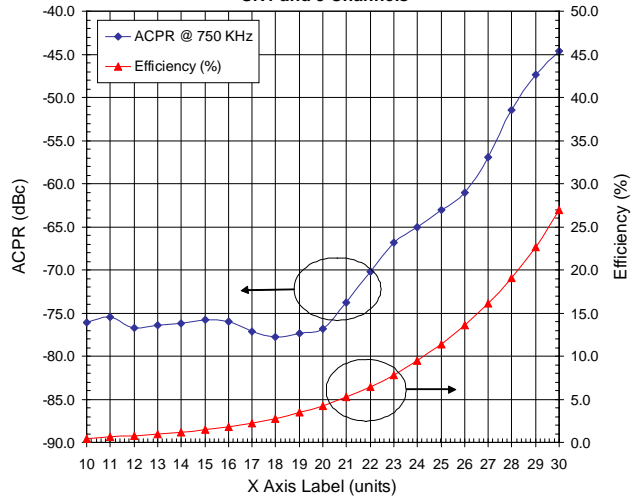
W-CDMA ACPR Performance for RS SMIQ03HD Sig Gen & FSU8 Spec Analyzer (2140 MHz & 882 MHz Source Signals)



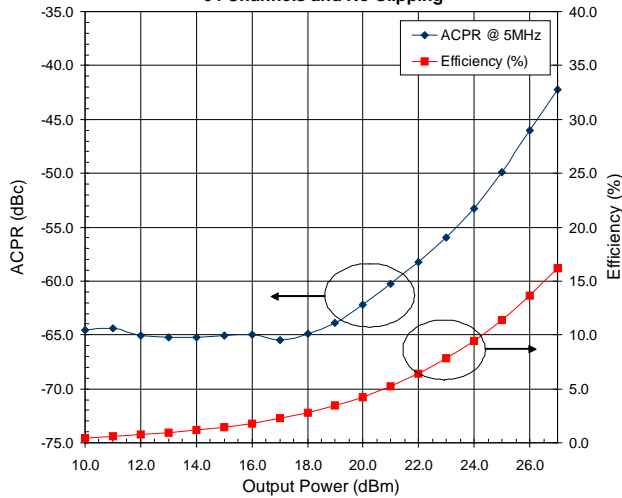
RF3809410 @ 450 MHz CDMA2K SR1 and 9 Channels



RF3809411 @ 882 MHz CDMA2K SR1 and 9 Channels

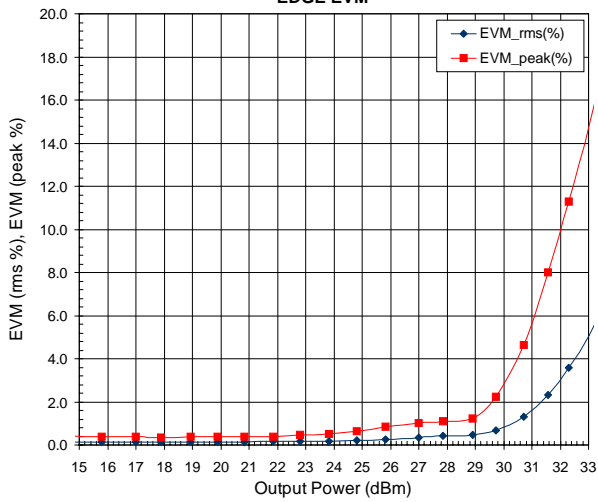


3809411 @ 882 MHz W-CDMA 64 Channels and No Clipping

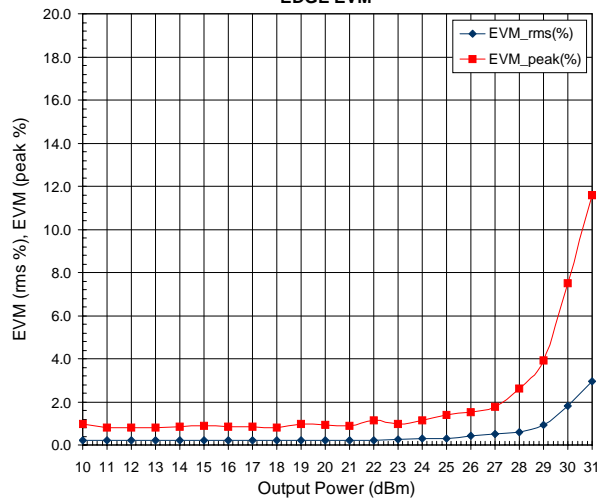


RF3809

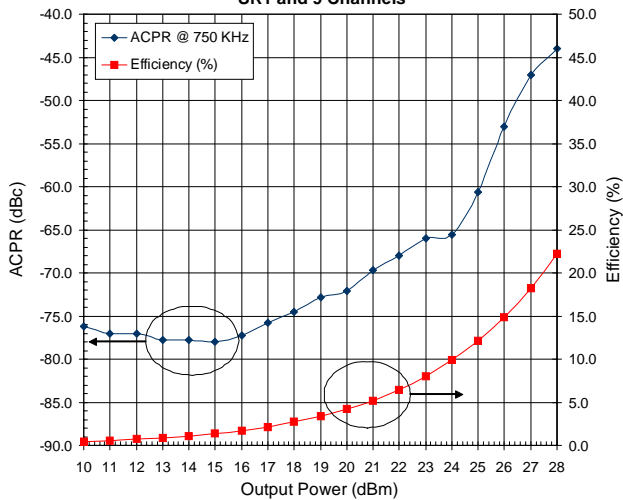
**RF3809412 @ 940 MHz
EDGE EVM**



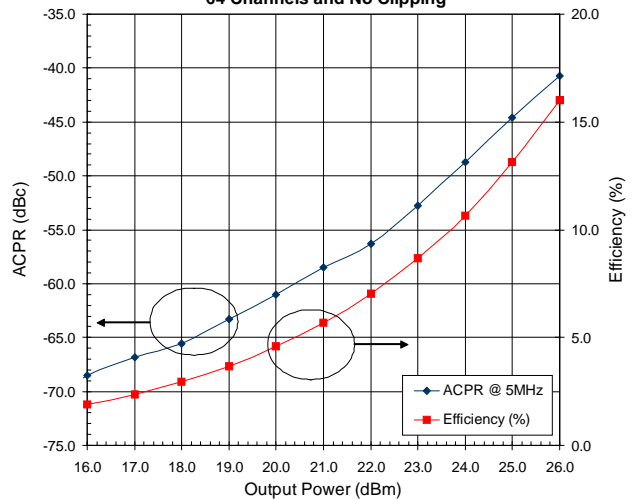
**RF3809413 @ 1840 MHz
EDGE EVM**



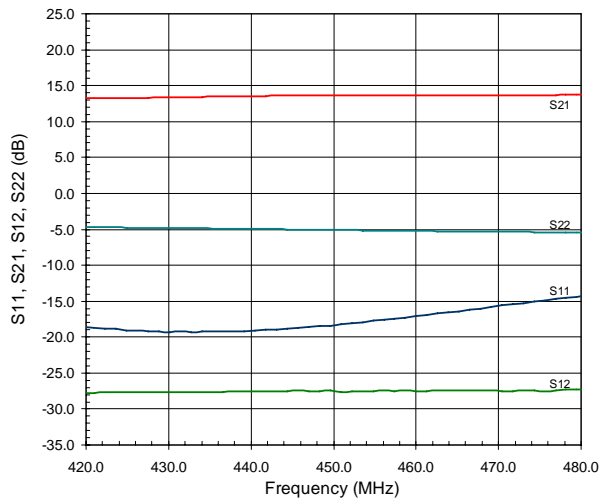
**RF3809414 @ 1960 MHz CDMA2K
SR1 and 9 Channels**



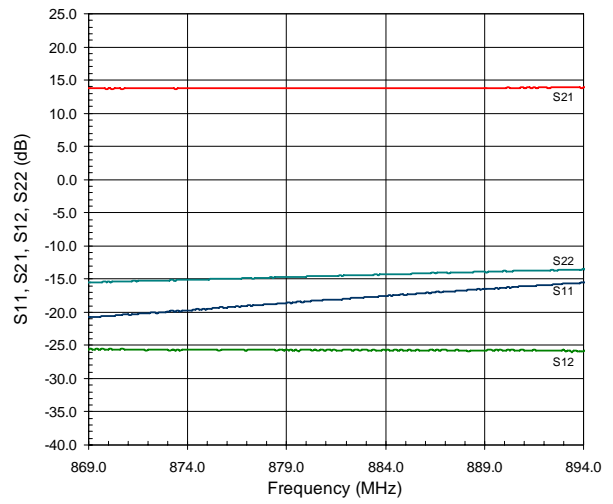
**RF3809415 @ 2140 MHz W-CDMA UMTS
64 Channels and No Clipping**



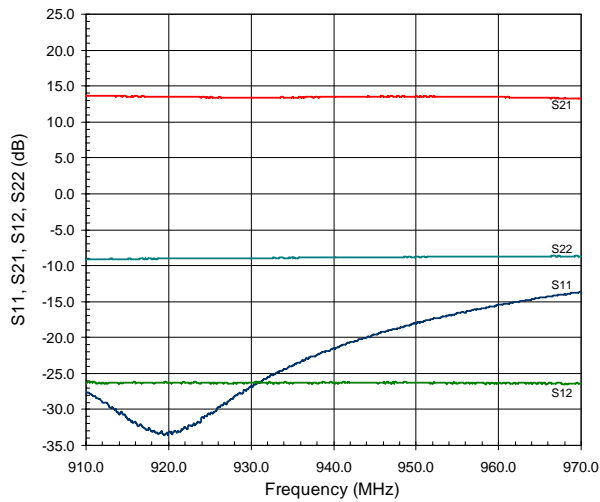
RF3809410 Evaluation Board S-Parameters



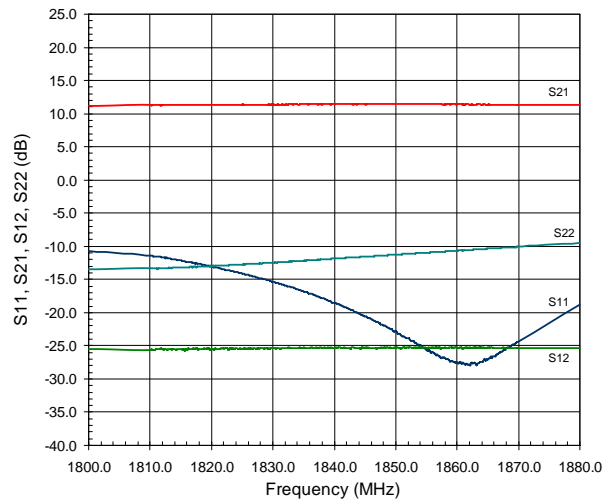
RF3809411 Evaluation Board S-Parameters



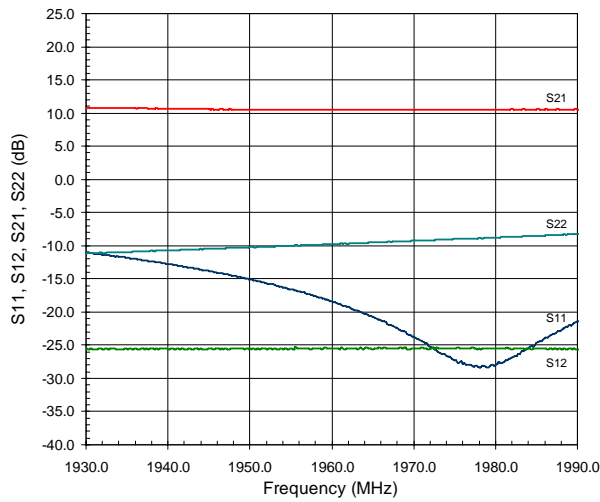
RF3809412 Evaluation Board S-Parameters



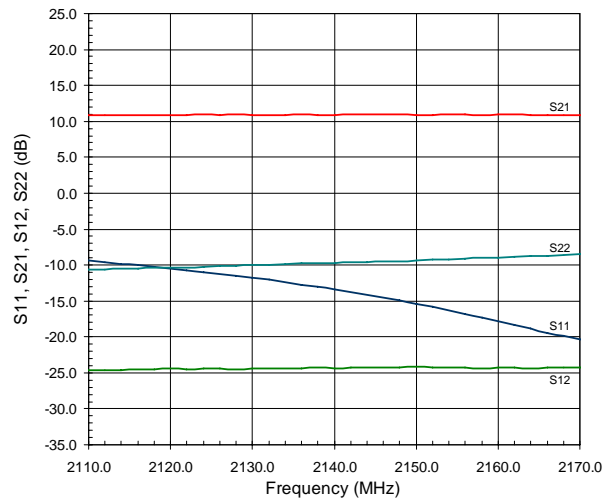
RF3809413 Evaluation Board S-Parameters



RF3809414 Evaluation Board S-Parameters

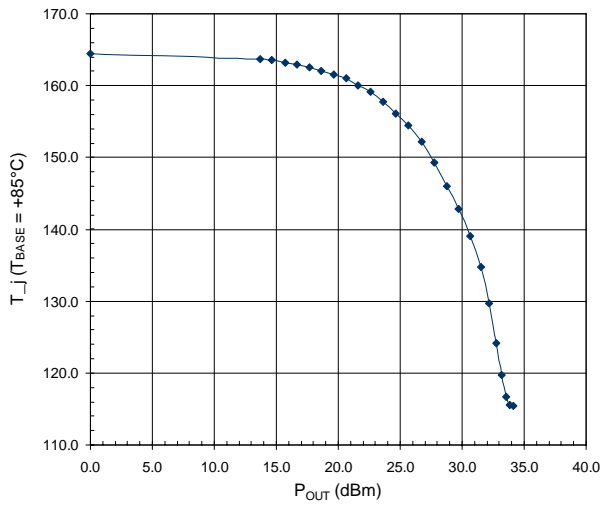


RF3809415 Evaluation Board S-Parameters



RF3809

RF3809415 Junction Temperature at 2140 MHz



Thermal Resistance of RF3809 @ 2.14 GHz

