FAIRCHILD SEMICONDUCTOR®

August 2004

RMPA2550

2.4–2.5 GHz and 5.15–5.85 GHz Dual Band InGaP HBT Linear Power Amplifier

General Description

The RMPA2550 is a dual frequency band power amplifier designed for high performance WLAN applications in the 2.4-2.5 GHz and the 5.15-5.85 GHz frequency bands. The single low profile 20 pin 3 x 4 x 0.9 mm package with internal matching on both input and output to 50Ω minimizes next level PCB space and allows for simplified integration. The two on-chip detectors provide power sensing capability while the logic control provides power saving shutdown options. The PA's low power consumption and excellent linearity are achieved using our InGaP Heterojunction Bipolar Transistor (HBT) technology.

Features

- Dual band operation in a single package design
- 26 dB modulated gain 2.4 to 2.5 GHz band
- 27 dB modulated gain 5.15 to 5.85 GHz band
- 26 dBm output power @ 1 dB compression both frequency bands
- 2.0% EVM at 18 dBm modulated Pout, 2.45 GHz
- 2.3% EVM at 18 dBm modulated Pout, 5.45 GHz
- 3.3 V single positive supply operation
- Adjustable bias current operation
- Two power saving shutdown options (bias and logic control)
- Separate integrated power detectors with 20 dB dynamic range
- Low profile 20 pin, 3 x 4 x 0.9 mm standard QFN leadless package
- Internally matched to 50 ohms
- Optimized for use in 802.11a/b/g applications

Device

Electrical Characteristics[1,3] 802.11g/a OFDM

Modulation (with 176 µs burst time, 100µs idle time) 54Mbps Data Rate, 16.7 MHz Bandwidth

Parameter	Minimum	Typical	Maximum	Minimum	Typical	Maximum	Unit
Frequency	2.4		2.5	5.15		5.85	GHz
Supply Voltage	3.0	3.3	3.6	3.0	3.3	3.6	V
Gain	24.5	26	28	25.5	27	29	dB
Total Current @ 18dBm P_{OUT}		150	182		228	260	mA
Total Current @ 19dBm P_{OUT}		157	189		235	267	mA
EVM @ 18dBm P_{OUT}[2]		2.0	2.5		2.5	3.5	%
EVM @ 19dBm P_{OUT}[2]		3.0	3.5		3.5	4.5	%
Detector Output @ 19dBm P_{OUT}		508	600		780	865	mV
Detector Threshold[4]		5.0	7.0		5.0	7.0	dBm
P_{OUT} Spectral Mask Compliance[5,7]		21.0			21.0		dBm

Electrical Characteristics[3,6] 802.11b CCK

Modulation (RF not framed) 11Mbps Data Rate, 22.0 MHz Bandwidth

Parameter	Minimum	Typical	Maximum	Unit
Frequency	2.4		2.5	GHz
Supply Voltage	3.0	3.3	3.6	V
Gain	24.5	26	28	dB
Total Current		250		mA
First Sidelobe Power			-40	dBc
Second Sidelobe Power			-55	dBc
Max P_{OUT} Spectral Mask Compliance[7]		24.0		dBm

Notes:

1: VC1 2.4 ,VC2 2.4, VM 2.4, VC1 5.0, VC2 5.0, VC3 5.0, VM13 5.0, VM2 5.0 = 3.3 Volts, T=25°C, PA is constantly biased, 50Ω system. VL adjusted for either 2.4 or 5 GHz operation.

2: Percentage includes system noise floor of EVM=0.8%.

3: Not measured 100% in production.

4: P_{OUT} measured at P_{IN} corresponding to power detection threshold.

5: Measured at P_{IN} at which Spectral Mask Compliance is satisfied. Two-sample windowing length applied.

6: VC1 2.4, VC2 2.4, VM 2.4 = 3.3 Volts, T=25°C, P_{OUT} =+23 dBm, 50Ω system. Satisfies spectral mask.

7: P_{IN} is adjusted to point where performance approaches spectral mask requirements.

Electrical Characteristics[1] Single Tone

Parameter	Minimum	Typical	Maximum	Minimum	Typical	Maximum	Unit
Frequency	2.4		2.5	5.15		5.85	GHz
Supply Voltage	3.0	3.3	3.6	3.0	3.3	3.6	V
Gain[2]	24	26	29	24	27.5	31	dB
Total Quiescent Current[2]	70	120	150	150	180	225	mA
Bias Current at pin VM[3]		13.5	18.0		15.5		mA
P1dB Compression[2]	25	26		24	26		dBm
Current @ P1dB Comp[2]		350	475		400	475	mA
Standby Current[4]		0.5			2		mA
Shutdown Current (VM=0V)		<1.0			100		µA
Input Return Loss		15			14		dB
Output Return Loss		12			16		dB
Detector Output at P1dB Comp		2.0			3.0		V
Detector P_{OUT} Threshold[9]		7.0	9.0		7.0	9.0	dBm
2nd Harmonic Output at P1dB		-45			-30		dBc
3rd Harmonic Output at P1dB		-42			-35		dBc
Logic							
Shutdown Control Pin:		VL 2.4			VL 5.0		
Device Off	2.0	2.4			0.0	0.8	V
Device On		0.0	0.8	2.0	2.4		V
Logic Current		10			100		µA
Turn-on Time[5]		<1			<1		µS
Turn-off Time		<1			<1		µS
Spurious (Stability)[6]		-65			-65		dBc

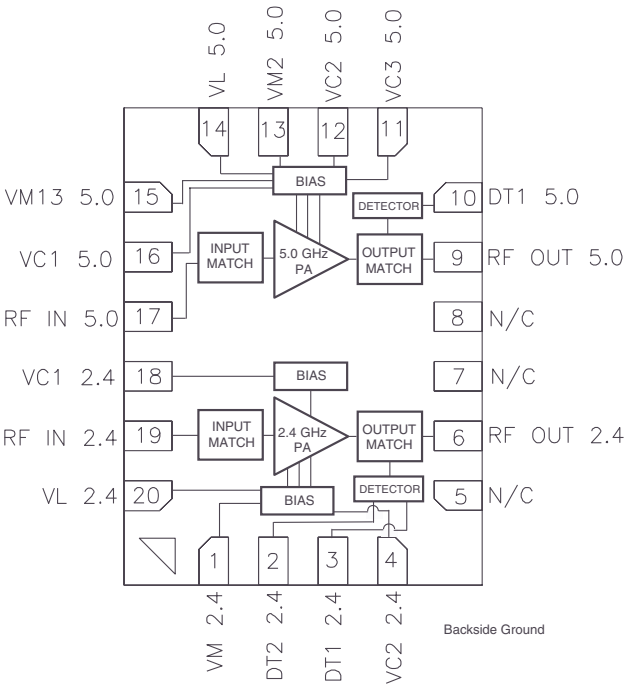
Notes:
1: VC1 2.4 ,VC2 2.4, VM 2.4, VC1 5.0, VC2 5.0, VC3 5.0, VM13 5.0, VM2 5.0 = 3.3 Volts, T=25°C, PA is constantly biased, 50Ω system. VL adjusted for either 2.4 or 5 GHz operation.
2: 100% production screened.
3: Bias current is included in the Total Quiescent Current.
4: VL is set to Logic Level for Device Off operation.
5: Measured from Device On signal turn on, to the point where RF P_{OUT} stabilizes to 0.5dB.
6: Load VSWR is set to 8:1 and the angle is varied 360 degrees. P_{OUT} = -30dBm to P1dB.
7: No permanent damage with only one parameter set at extreme limit. Other parameters set to typical values.
8: Not measured in production.
9: P_{OUT} measured at P_{IN} corresponding to power detection threshold.

Absolute Ratings[1]

Symbol	Parameter	Value	Units
VC	Positive Supply Voltage	5	V
IC2.4, IC5.0	Supply Current		
	IC2.4	820	mA
	IC5.0	700	mA
VM	Positive Bias Voltage	4.0	V
V_L	Logic Voltage	5	V
P_{IN}	RF Input Power	10	dBm
T_{CASE}	Case Operating Temperature	-40 to +85	°C
T_{STG}	Storage Temperature	-55 to +150	°C

Note:
1. No permanent damage with only one parameter set at extreme limit. Other parameters set to typical values.

Functional Block Diagram

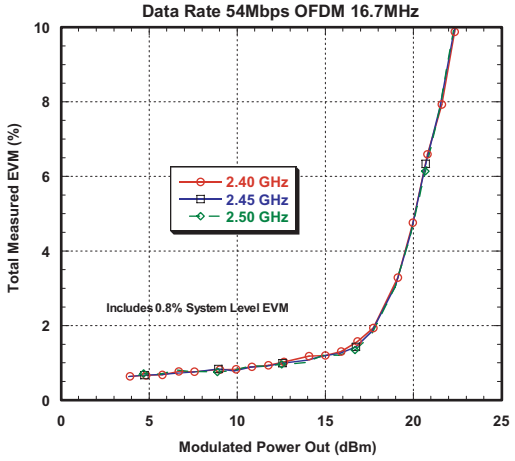


Pin	Description
1	VM 2.4
2	DT2 2.4
3	DT1 2.4 (Vdet)
4	VC2 2.4
5	N/C
6	RF OUT 2.4
7	N/C
8	N/C
9	RF OUT 5.0
10	DT1 5.0 (Vdet)
11	VC3 5.0
12	VC2 5.0
13	VM2 5.0
14	VL 5.0
15	VM13 5.0
16	VC1 5.0
17	RF IN 5.0
18	VC1 2.4
19	RF IN 2.4
20	VL 2.4

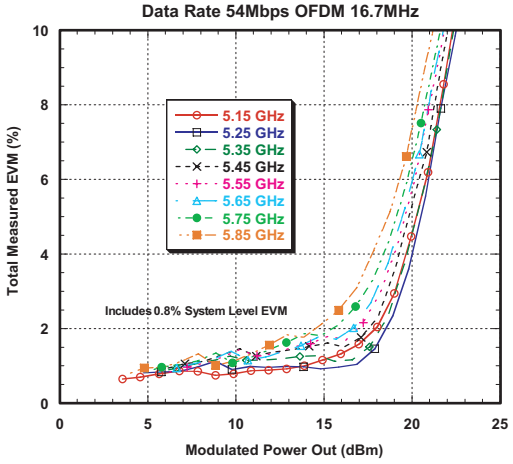
Performance Data

802.11g/a Frequency Dependency

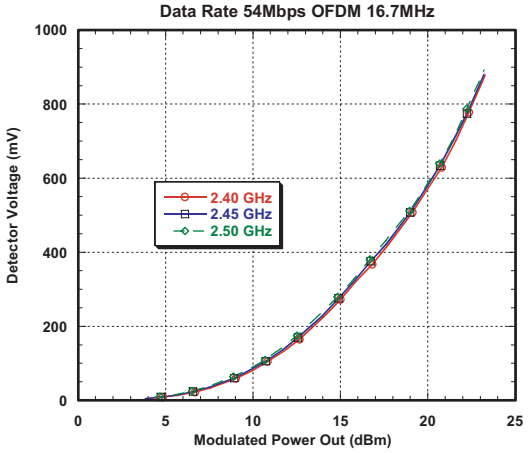
RMPA2550 Total Measured EVM Vs. Modulated Pout
2.40 to 2.50 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



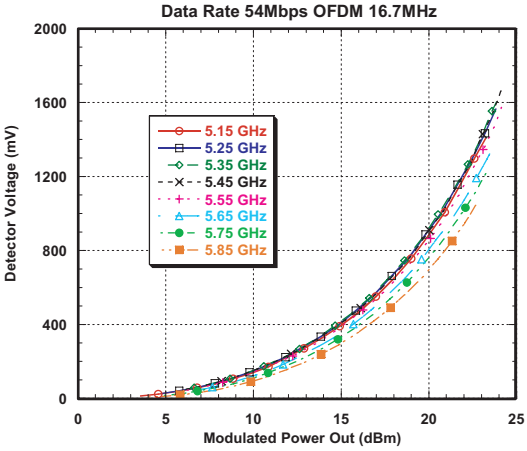
RMPA2550 Total Measured EVM Vs. Modulated Pout
5.15 to 5.85 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



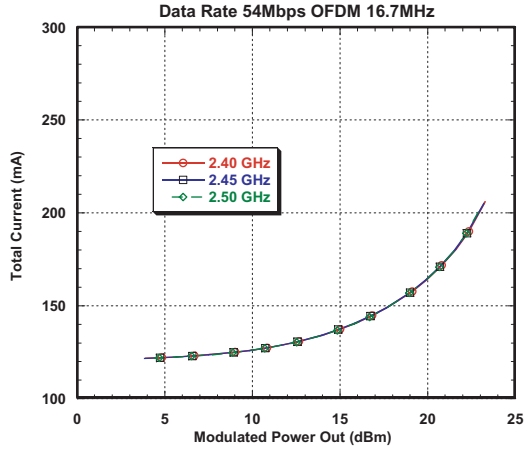
RMPA2550 Detector Voltage Vs. Modulated Pout
2.40 to 2.50 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



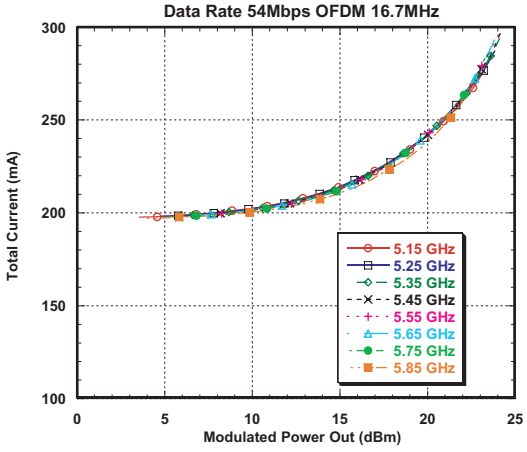
RMPA2550 Detector Voltage Vs. Modulated Pout
5.15 to 5.85 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



RMPA2550 Total Current Vs. Modulated Pout
2.40 to 2.50 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



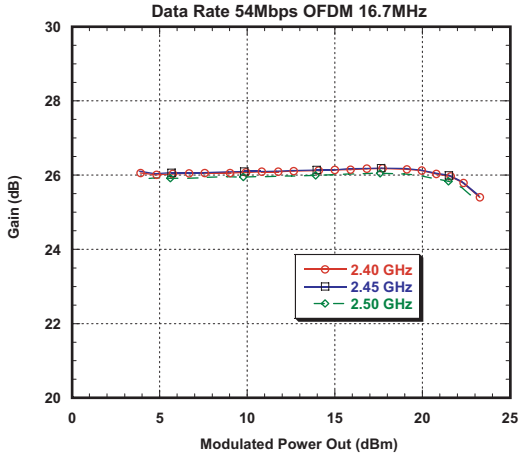
RMPA2550 Total Current Vs. Modulated Pout
5.15 to 5.85 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



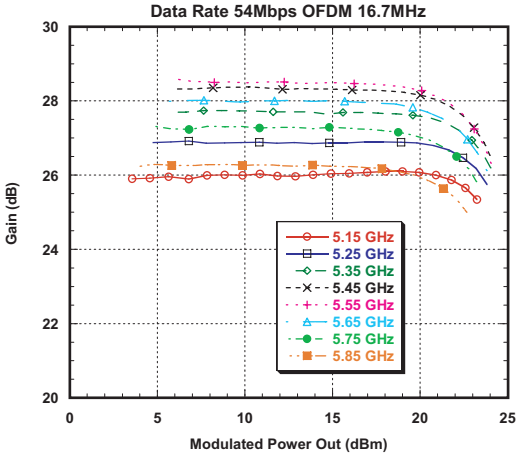
Performance Data (Continued)

802.11g/a Frequency Dependency (continued)

RMPA2550 Gain Vs. Modulated Pout
2.40 to 2.50 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz

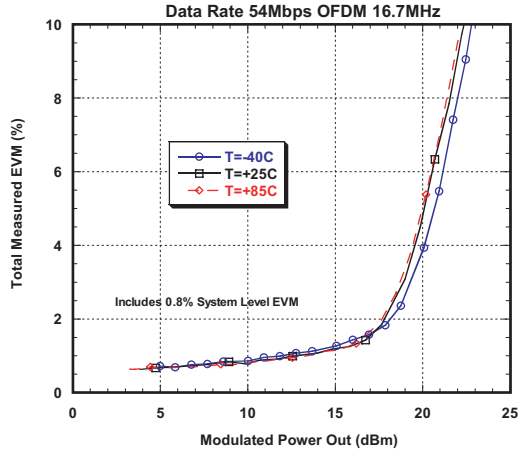


RMPA2550 Gain Vs. Modulated Pout
5.15 to 5.85 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz

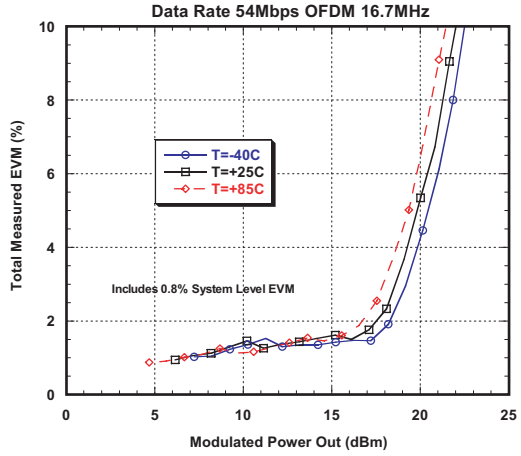


802.11g/a Temperature Dependency

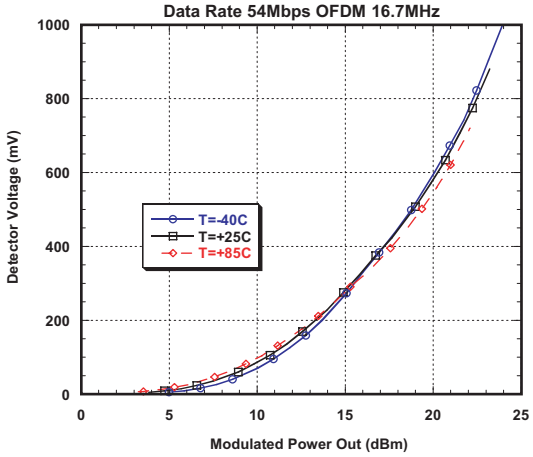
RMPA2550 Total Measured EVM Vs. Modulated Pout
2.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz



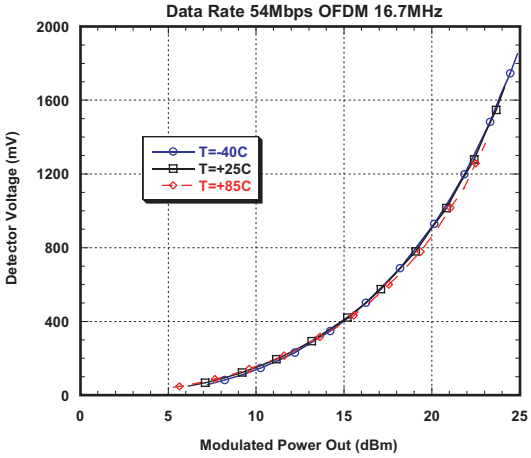
RMPA2550 Total Measured EVM Vs. Modulated Pout
5.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz



RMPA2550 Detector Voltage Vs. Modulated Pout
2.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz



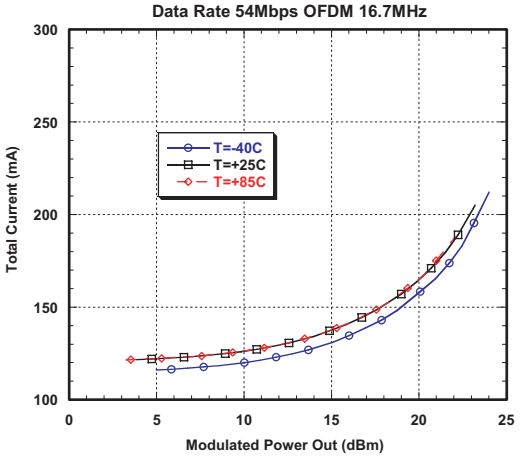
RMPA2550 Detector Voltage Vs. Modulated Pout
5.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz



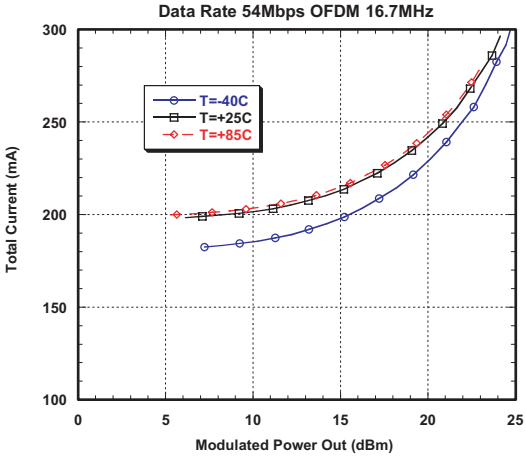
Performance Data (Continued)

802.11g/a Temperature Dependency (continued)

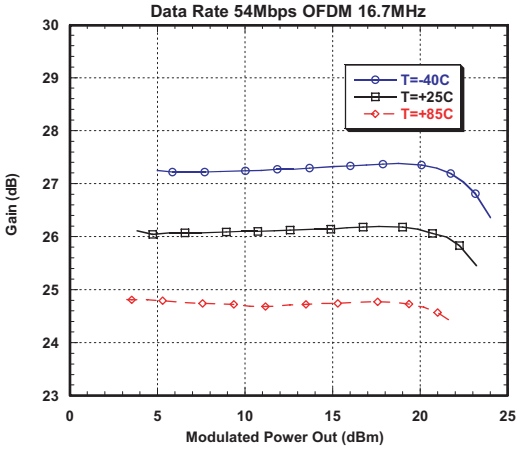
RMPA2550 Total Current Vs. Modulated Pout
2.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz



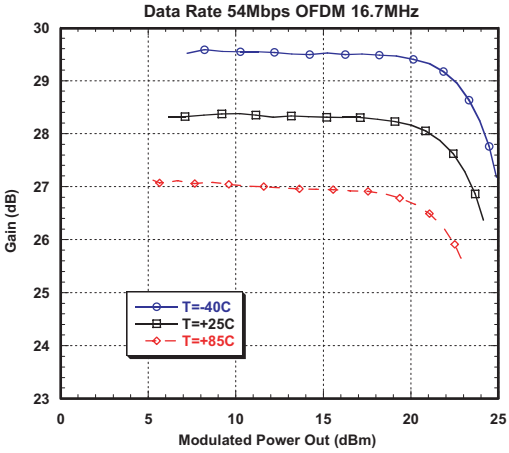
RMPA2550 Total Current Vs. Modulated Pout
5.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz



RMPA2550 Gain Vs. Modulated Pout
2.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz

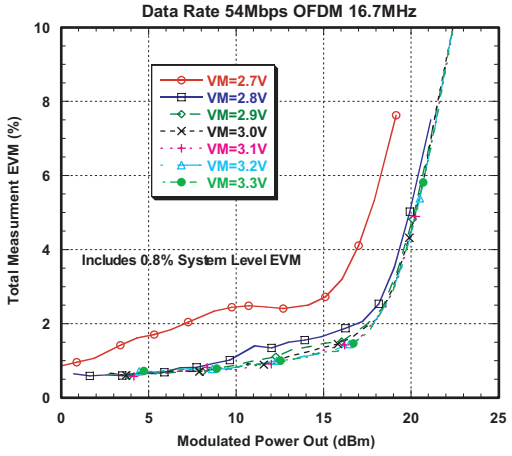


RMPA2550 Gain Vs. Modulated Pout
5.45 GHz VM, VC=3.3V T=-40, +25, +85C
Data Rate 54Mbps OFDM 16.7MHz

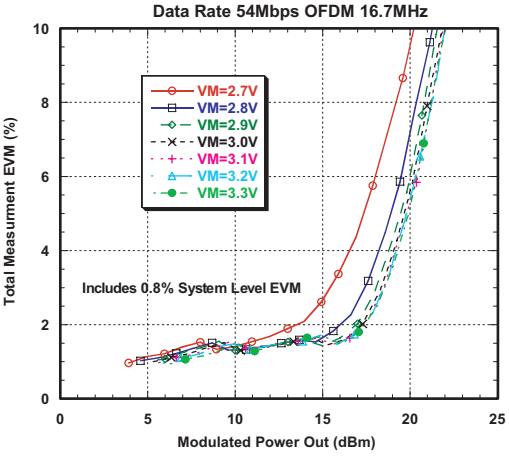


802.11g/a VM Dependency

RMPA2550 Total Measured EVM Vs. Modulated Pout
2.45 GHz VM=2.7 to 3.3V, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



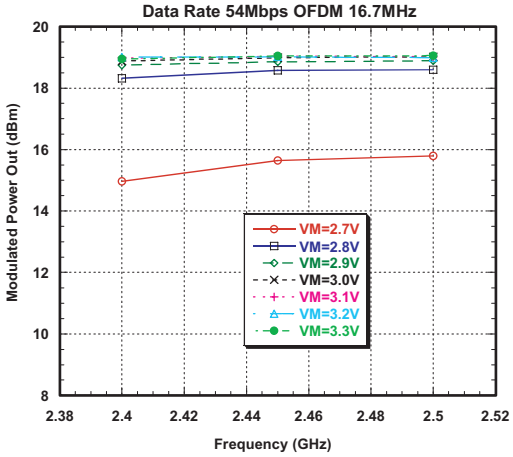
RMPA2550 Total Measured EVM Vs. Modulated Pout
5.45 GHz VM=2.7 to 3.3V, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



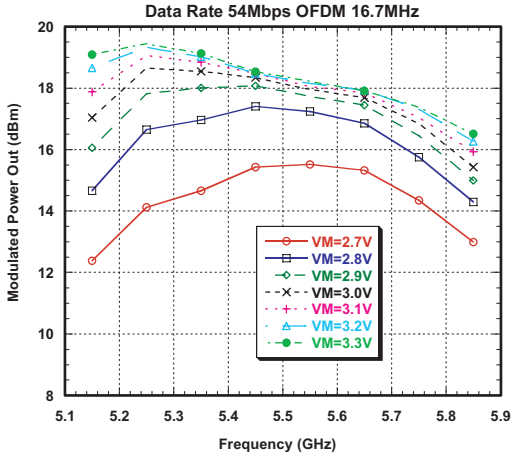
Performance Data (Continued)

802.11g/a VM Dependency (continued)

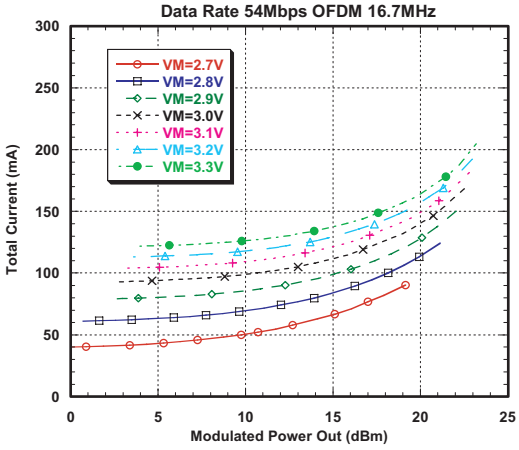
RMPA2550 Modulated Pout for 3% Total System EVM
for VM=2.7 to 3.3V, VC=3.3V, T=25C
Data Rate 54Mbps OFDM 16.7MHz



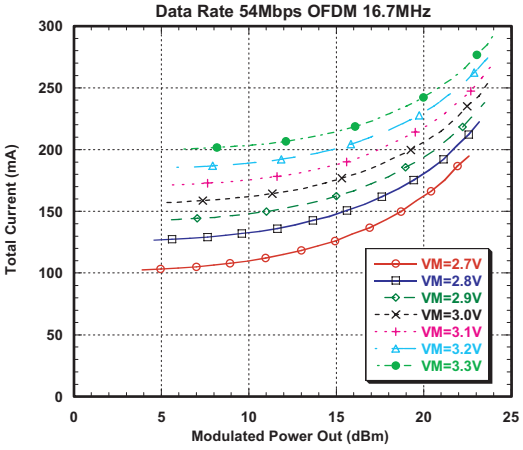
RMPA2550 Modulated Pout for 3% Total System EVM
for VM=2.7 to 3.3V, VC=3.3V, T=25C
Data Rate 54Mbps OFDM 16.7MHz



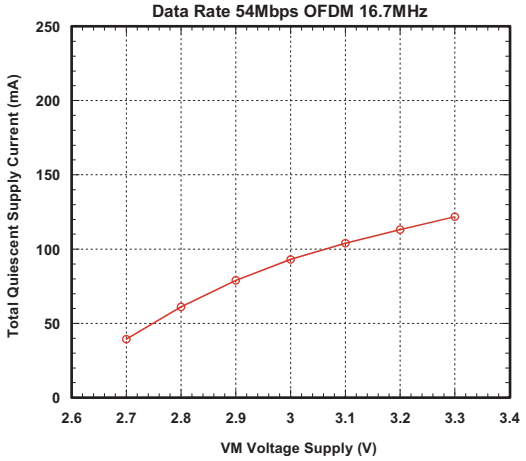
RMPA2550 Total Current Vs. Modulated Pout
2.45 GHz VM=2.7 to 3.3V, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



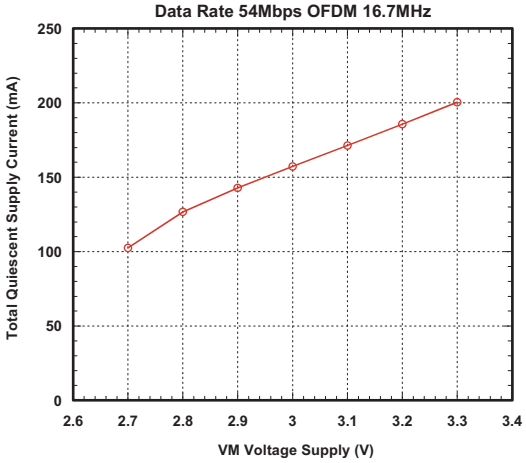
RMPA2550 Total Current Vs. Modulated Pout
5.45 GHz VM=2.7 to 3.3V, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



RMPA2550 Total Quiescent Bias Current Vs. VM Voltage
2.45 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



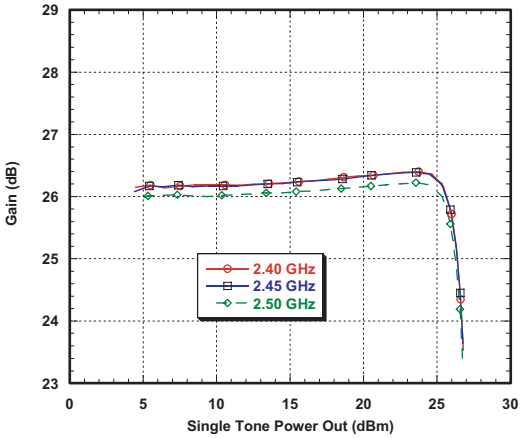
RMPA2550 Total Quiescent Bias Current Vs. VM Voltage
5.45 GHz VM, VC=3.3V T=25C
Data Rate 54Mbps OFDM 16.7MHz



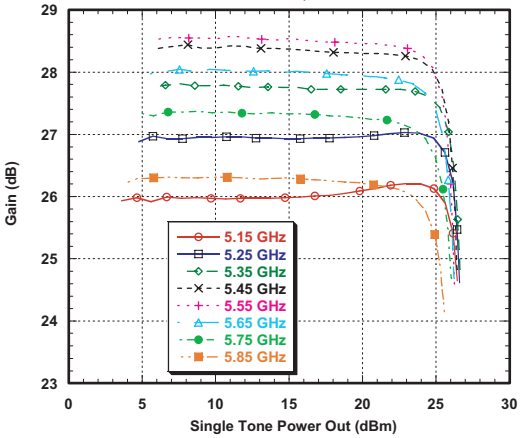
Performance Data (Continued)

Single Tone

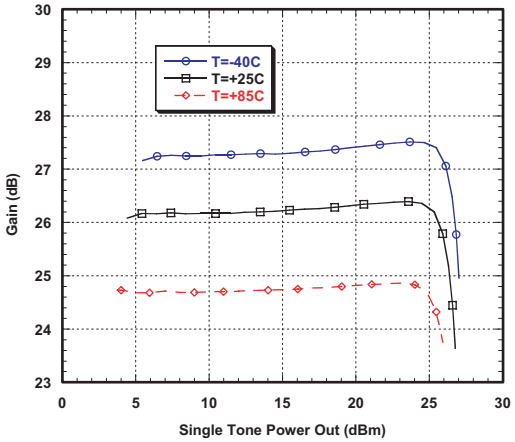
RMPA2550 Single Tone Gain Vs. Power Out
2.40 to 2.50 GHz VM, VC=3.3V T=25C



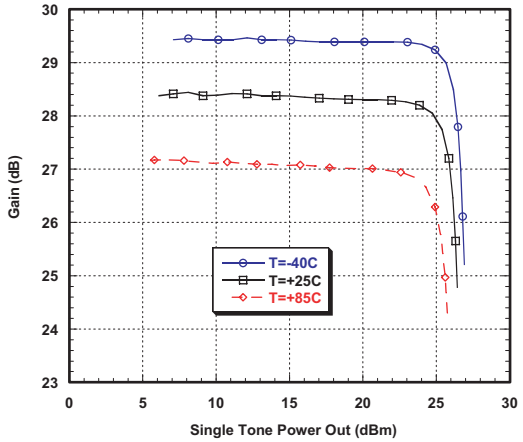
RMPA2550 Single Tone Gain Vs. Power Out
5.15 to 5.85 GHz VM, VC=3.3V T=25C



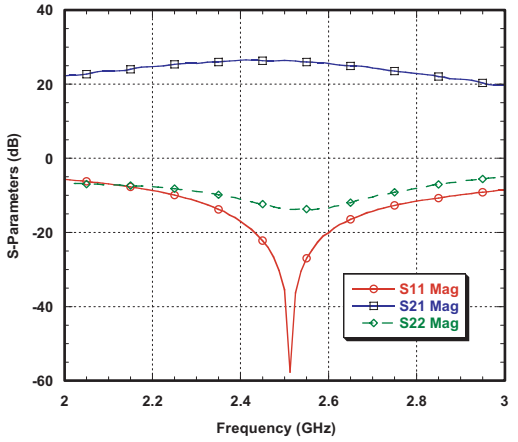
RMPA2550 Single Tone Gain Vs. Power Out
2.45 GHz VM, VC=3.3V T=-40, +25, +85C



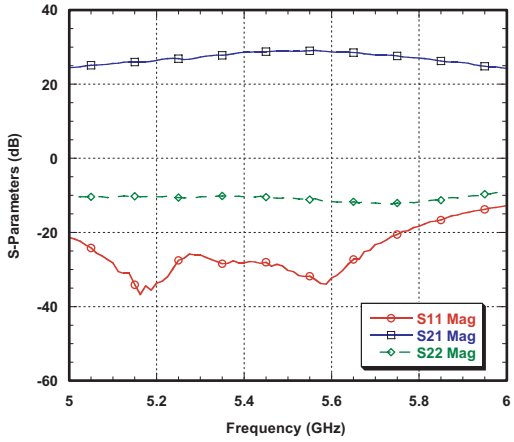
RMPA2550 Single Tone Gain Vs. Power Out
5.45 GHz VM, VC=3.3V T=-40, +25, +85C



RMPA2550 S-Parameters
2.4 GHz Band T=25C VM, VC=3.3V

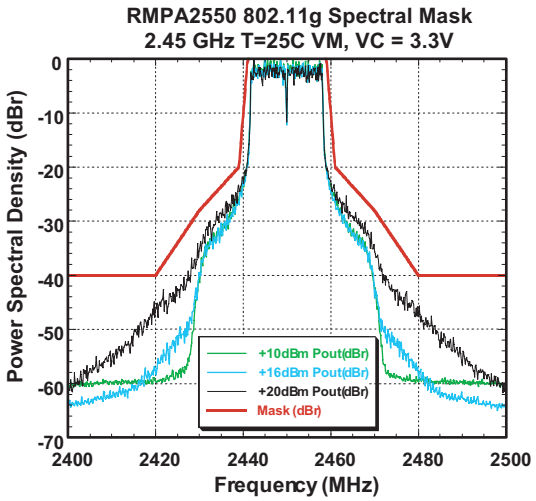


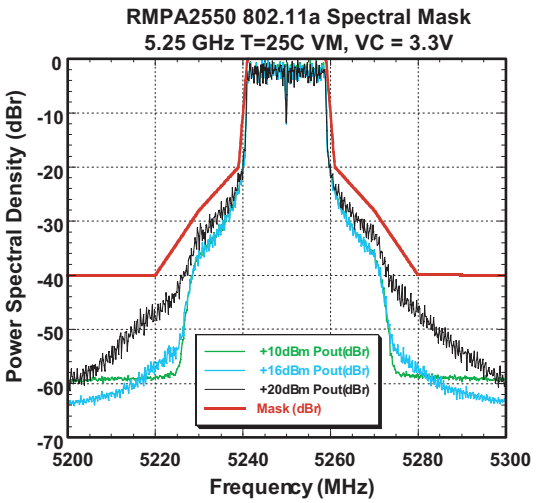
RMPA2550 S-Parameters
5.0 GHz Band T=25C VM, VC=3.3V

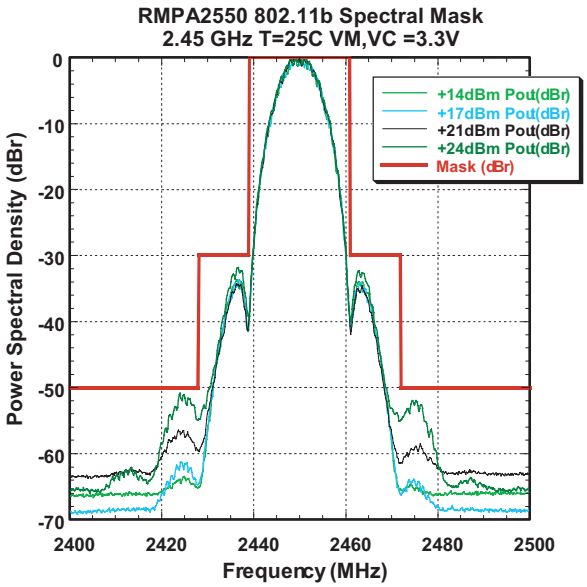


Performance Data (Continued)

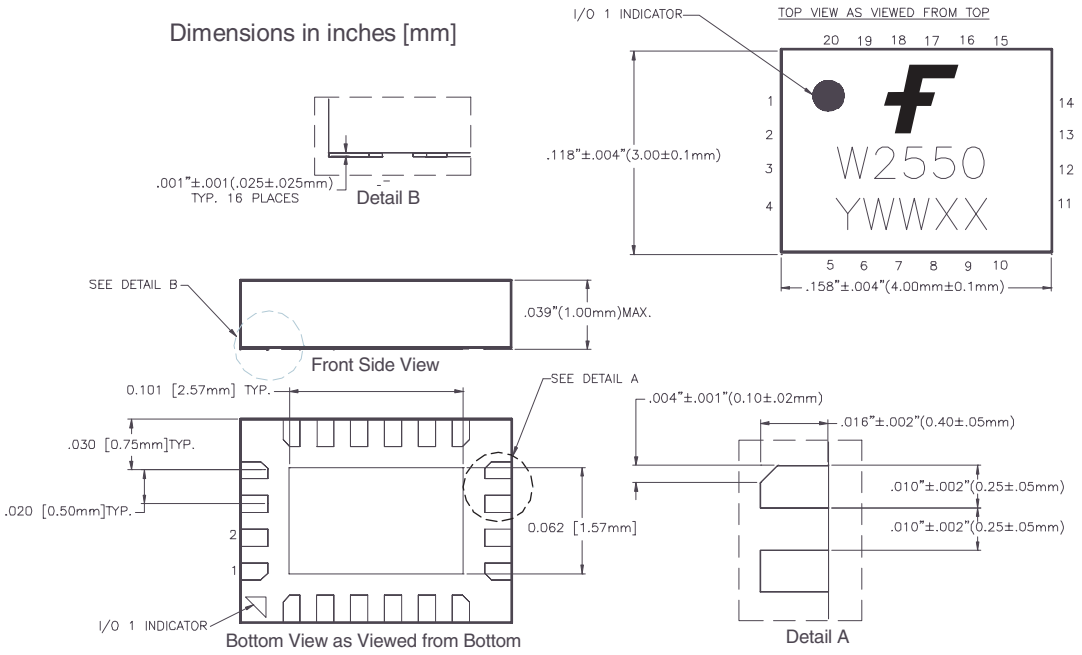
802.11g/a/b Spectral Mask



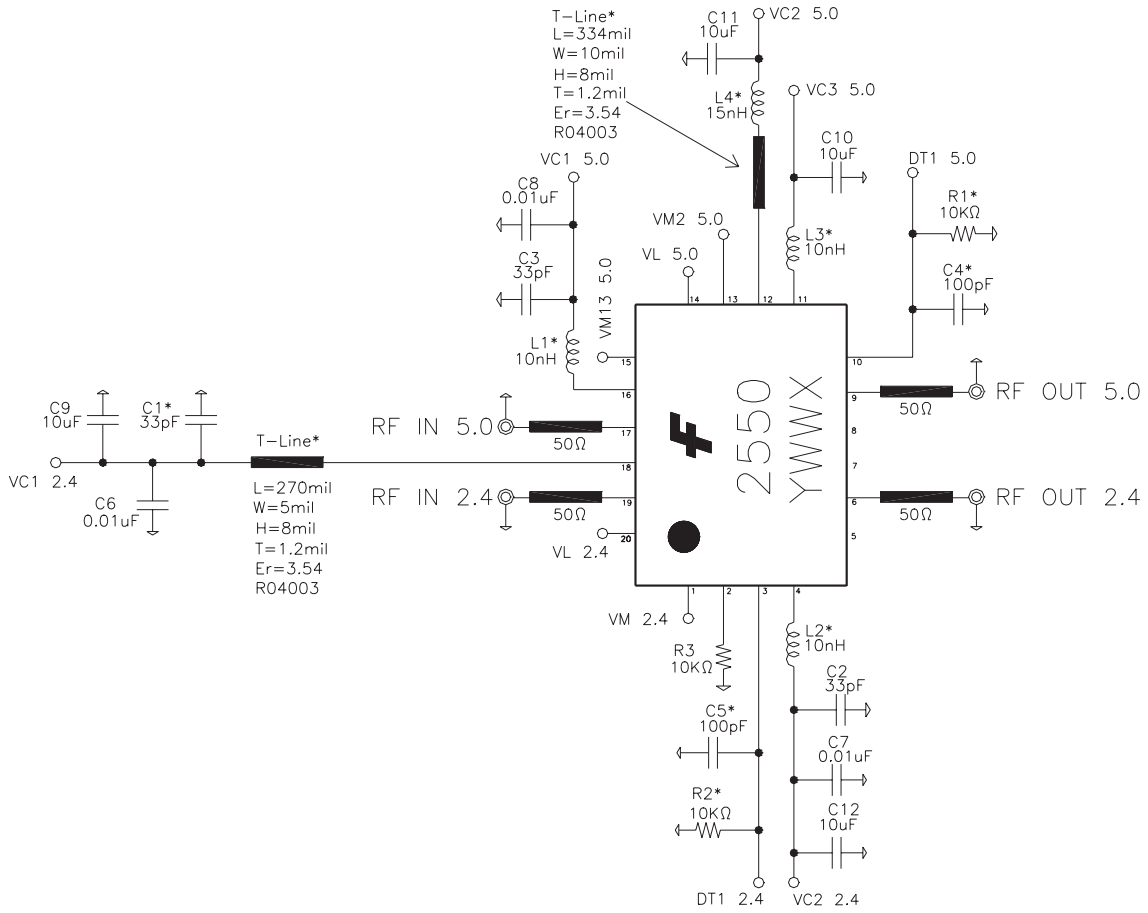




Package Outline



Evaluation Board Schematic



Evaluation Board Bill of Materials

MATERIALS LIST

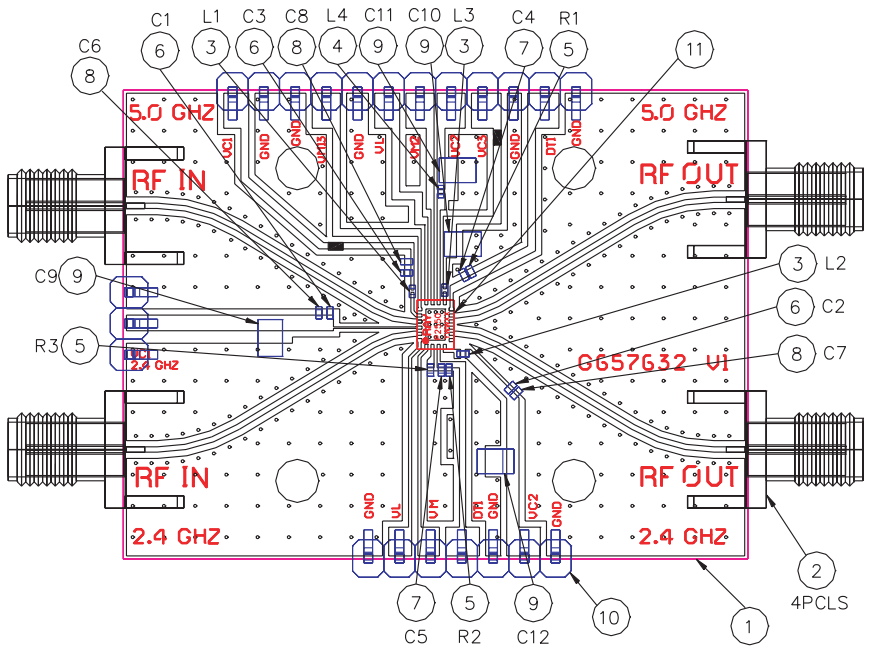
QTY	ITEM NO.	PART NUMBER	DESCRIPTION	VENDOR
1	1	G657632	PC, BOARD	
4	2	#142-0701-841	SMA CONNECTOR	JOHNSON
3	3 (L1,L2&L3)	LLV1005FB10NJ	10 nH INDUCTOR	TOKO
1	4 (L4)	LLV1005FB15NJ	15 nH INDUCTOR	TOKO
3	5 (R1,R2&R3)	RCI-0402-1002FT	10K OHM RESISTER	IMS
2	6 (C1&C2)	GRM39C0G330J050AD	33 pF CAPACITOR	MURATA
2	7 (C3&C4)	GRM36C0G101J50V	100 pF CAPACITOR	MURATA
2	8 (C5&C6)	GMC10X7R103M25NT	.01 uF CAPACITOR	MURATA
4	9 (C7,C8,C9&C10)	GRM21BR60J106KE01L	10 uF CAPACITOR (6.0V)	MURATA
A/R	10	SN63	SOLDER PASTE	INDIUM CORP
A/R	11	SN96	SOLDER PASTE	INDIUM CORP
22	12	S1322-36-ND	RIGHT ANGLE SINGLE HEADER	DIGIKEY
REF	13	G657650	ASSEMBLY, RMPA2550	

Evaluation Board Layout

Actual Board Size
= 2.0" X 1.5"

= component

= Jumper/short connection



Actual Board Size = 2.0" X 1.5"

Evaluation Board Turn-On Sequence[1]

1) Connect RF ports to RF test equipment.

2) Connect common ground terminal to the Ground (GND) pin on the board.

3) Connect terminals VC1 5.0, VC2 5.0, VC3 5.0, VC1 2.4, VC2 2.4 together and apply to positive supply (VC=3.3V).

4) Connect terminals VM 2.4, VM2 5.0 and VM13 5.0 together and connect to positive supply (VM=3.3V).

5) Connect voltmeter to Detector Output, pin DT1 5.0 and to DT1 2.4.

6) Connect logic control pins VL 5.0 and VL 2.4 together and apply 0V. *Now only the 2.4GHz PA is on.* Observe the following positive currents flowing into the pins:

Pin	Current
VL 2.4	<1 nA
VC (total) 2.4	80 – 110 mA
VM 2.4	12 – 15 mA

Pin	Current
VL 5.0	<1 nA
VC (total) 5.0	<1 nA
VM (total) 5.0	<1.9 mA

7) Apply positive voltage of +3.0V to logic control pins VL 5.0 and VL 2.4. *Now only the 5GHz PA is on.* Observe the following positive currents flowing into the pins:

Pin	Current
VL 5.0	~150 µA
VC (total) 5.0	~184 mA
VM 5.0	~16 mA

Pin	Current
VL 2.4	<0.25mA
VC (total) 2.4	<1 nA
VM 2.4	<0.7mA

8) Apply input RF power to SMA connector pin RF IN 2.4 or RF IN 5.0. Currents on collector pins will vary depending on the input drive level.

Recommended turn-off sequence:

Use reverse order described in the turn-on sequence on the previous page.

Note:
1. Turn on sequence is not critical and it is not necessary to sequence power supplies in actual system level design.

Application Information

Precautions to Avoid Permanent Device Damage:

Static Sensitivity: Follow ESD precautions to protect against ESD damage:

- A properly grounded static-dissipative surface on which to place devices.
- Static-dissipative floor or mat.
- A properly grounded conductive wrist strap for each person to wear while handling devices.

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Definition of Terms

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