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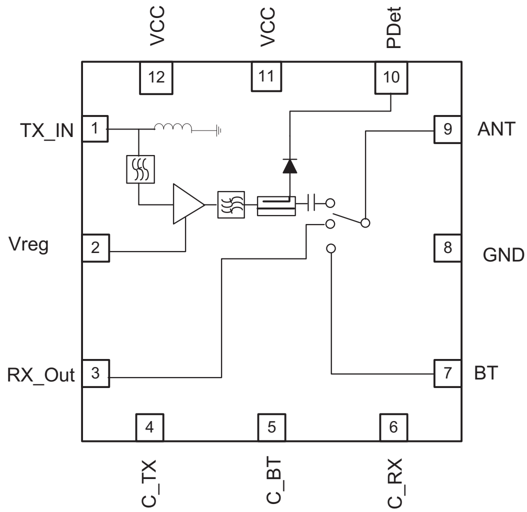
RF5375

2.4GHz TO 2.5GHz, 802.11b/g/n WiFi FRONT END MODULE

Package: QFN, 12-Pin, 2.5mmx2.5mmx0.5mm



Functional Block Diagram

Features

- Integrated 2.4GHz to 2.4GHz b/g/n Amplifier, SP3T Switch, and Power Detector Coupler
- Single Supply Voltage 3.0V to 4.8V
- Output Power: 11b=21dBm Meeting Spectral Mask 11n=18dBm at <2.5% EVM
- Low Height Package, Suited for SiP and CoB Designs

Applications

- Cellular handsets
- Mobile devices
- Tablets
- Consumer electronics
- Gaming
- Netbooks/Notebooks
- TV/monitors/video
- SmartEnergy

Product Description

The RF5375 provides an integrated front end solution for WiFi 802.11b/g/n and *Bluetooth*® systems. The ultra-small form factor package and integrated matching greatly reduces the number of external components and layout area in the customer application. This simplifies the total front end solution by reducing the bill of materials, system footprint, and assembly cost.

The RF5375 integrates a 2.4GHz power amplifier (PA), 2170MHz notch filter for coexistence with cellular radios, second harmonic attenuation, power detector coupler for improved accuracy, and an SP3T switch capable of simultaneous reception for WiFi and Bluetooth®. The device is provided in a 2.5mmx2.5mmx0.5mm, 12-pin package. This module meets or exceeds the RF front end needs of IEEE 802.11b/g/n WiFi RF systems.

Ordering Information

RF5375SQ	Standard 25 piece bag
RF5375SR	Standard 100 piece reel
RF5375TR7	Standard 2500 piece reel
RF5375PCK-410	Fully Assembled Evaluation Board with 5 piece Sample

Optimum Technology Matching® Applied

☐ GaAs HBT	☐ SiGe BiCMOS	☑ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	☐ Si CMOS	☐ RF MEMS
☑ InGaP HBT	☐ SiGe HBT	☐ Si BJT	☐ LDMOS

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Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +5.4	V_{DC}
PA Regulated Voltage (V_{REG})	-0.5 to 3.5	V_{DC}
DC Supply Current	500	mA
Maximum TX and RX Input Power (no damage)	0	dBm
Operating Case Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C
Moisture Sensitivity	MSL2	

Caution! ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EUDirective2002/95/EC (at time of this document revision).

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Compliance					IEEE802.11b/g/n Standards; FCC CFG 15.247, .205, .209; EN and JDEC.
Operating Conditions					V_{CC}=3.0V to 4.8V; V_{REG}=2.8V to 2.9V; Switch Control voltage=2.7V to 3.6V; Temp=-10°C to +70°C (Spec Compliant); Temp=-40°C to -10°C and +70°C to +85°C (Reduced Performance); Unless noted otherwise
Frequency Range	2.4		2.5	GHz	
Power Supply	3.0	3.3	4.8	V	
	2.7			V	Derated performance
V_{REG} Voltage					
ON	2.80	2.85	2.90	V	PA in “ON” state
OFF	0		0.2	V	PA in “OFF” state
Output Power					
11n	16.5	17		dBm	$V_{CC}\geq$3.0V OFDM 54Mbps
11n	17.5	18		dBm	$V_{CC}\geq$3.3V OFDM 54Mbps
11g	18	18.5		dBm	$V_{CC}\geq$3.3V OFDM 54Mbps
11b	19.5	21		dBm	11Mbps, CCK, $V_{CC}\geq$3.3V
EVM					
11g			4	%	18dBm, OFDM 54Mbps, V_{CC}=3.3V to 4.8V, all temperature
11n		2.5	3.0	%	17.5dBm, OFDM 54Mbps, V_{CC}=3.3V to 4.8V, all temperature
			3.0	%	16.5dBm, OFDM 54Mbps, V_{CC} = 3.0V_{DC}, all temperature
Adjacent Channel Power					P_{OUT}=21Bm, Vcc=3.3v, 11Mbps CCK signal. See note 2
ACP1		-36	-33	dBc	+/- 11MHz Offset from carrier
ACP2		-56	-52	dBc	+/- 22MHz Offset from carrier
Gain	23	25	29	dB	At rated P_{OUT}
Gain Variance Slope					
Channel 40MHz BW	-1.0		+1.0	dB	
Channel 20MHz BW	-0.5		+0.5	dB	
Frequency 100MHz BW	-2		+2	dB	In-Band variance 2.4GHz to 2.5GHz
Out of Band Rejection					
2170MHz	6	8		dBc	CW Signal

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Compliance, cont.					
Power Detector					
Output Power Range	0		23	dBm	
Voltage Range	0.1		1.5	V_{DC}	
Voltage at POUT=18dBm	0.6	0.65	0.7	dB	11g; 50Ω; V_{CC}=3.0V to 4.8V
Filter Bandwidth		0.1		MHz	
Sensitivity					
P_{OUT}<.5V	10			mV/dB	
P_{OUT}>.5V	20			mV/dB	
Voltage Target at 23dBm P_{OUT}		1.2		V	Vcc=3.3v, Temp=25°C
Load Variation			±200	mV	up to 3:1 VSWR
Current Consumption					
Quiescent		135	180	mA	V_{CC}=3.0V to 4.8V, All Temp
Operating		170	200	mA	V_{CC}≤4.2V_{DC}, P_{OUT}=18dBm, 11n, 50Ω, Temp=25°C
Operating			220	mA	V_{CC}≤4.8V_{DC}, P_{OUT}=17.5dBm, 11n, 50Ω, All Temp
Operating		210	270	mA	V_{CC}≤4.2V_{DC}, P_{OUT}=21dBm, 11b, 50Ω, All Temp
V_{REG}		3	5	mA	T=25°C
FEM Leakage			500	nA	V_{CC}="ON", V_{REG}=0.2V_{DC}, RF OFF
V_{REG} Leakage			50	nA	
Noise Figure		8	9	dB	
Input Return Loss	8	10		dB	
Thermal Resistance		52		°C/W	V_{CC}=4.8V, V_{REG}=2.95V, C_TX=3.3, C_RX=C_BT=GND, P_{OUT}=18dBm, Modulation=OFDM 11g, Freq=2.45GHz, DC=100%, T=85°C
Harmonics					P_{OUT}=21dBm, 1Mbps, CCK BW=1MHz, up to 3:1 load
Second			-15	dBm	4.80GHz to 5.00GHz, V_{CC}=3.3V, Temp=25°C
Third			-20	dBm	7.20GHz to 7.50GHz, V_{CC}=3.3V, Temp=25°C
Stability					PA must be stable from 0 dBm to 21dBm. CW Signal, No spurs above -41.25dBm for non-harmonic related signals.
Output VSWR	4:1				All phase angles, no spurious or oscillations.
Ruggedness					No Damage Conditions over Voltage and Temperature
Output VSWR	10:1				
Input Power			0	dBm	CW Input Power
Input Port Impedance		50		Ω	
Turn-On/Off Time			1	usec	Output stable to within 90% of final gain
2.4GHz Receive					
Frequency	2.4		2.5	GHz	
Insertion Loss		.08	1.2	dB	
Input P1dB	22			dBm	
Passband Ripple					
WiFi RX Mode	-0.2		+0.2	dB	
WiFi RX/BT Mode	-0.2		+0.2	dB	
WiFi RX Port Return Loss	10	12		dB	
WiFi RX Port Impedance		50		Ω	

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Bluetooth®					
Frequency	2.4		2.5	GHz	
Insertion Loss		0.8	1.2	dB	
Bluetooth Input P1dB	22			dBm	
Bluetooth Port Return Loss	10	12		dB	
Bluetooth Port Impedance		50		Ω	
Other Requirements					
Antenna Port Impedance		50		Ω	
Return Loss	10	12		dB	In WiFi RX or BT Mode
Isolation					
ANT to RX	20			dB	At rated P_{OUT} in TX Mode
Switch Control Voltage					
Low	0		0.2	V	
High	2.7		3.6	V	
Switch Control Current					
Low			0.5	uA	
High			100	uA	
ESD					
Human Body Model	1000			V	Pin-Ground
Charge Device Model	500			V	JESD22-C101C. Class III
Case Temperature	-10		+70	°C	Full Performance
Extreme Case Temperature	-40		+85	°C	Reduced Performance

Note 1: The PA must operate with gated bias voltage input at 1% to 99% duty cycle.
Note 2: The output power for channels 1 and 11 may be reduced to meet FCC restricted band requirements.

Switch Control Logic Truth Table

Mode	C_TX	C_RX	C_BT	VREG
Transmit	High	Low	Low	High
Receive	Low	High	Low	Low
Bluetooth	Low	Low	High	Low
Simultaneous	Low	High	High	Low

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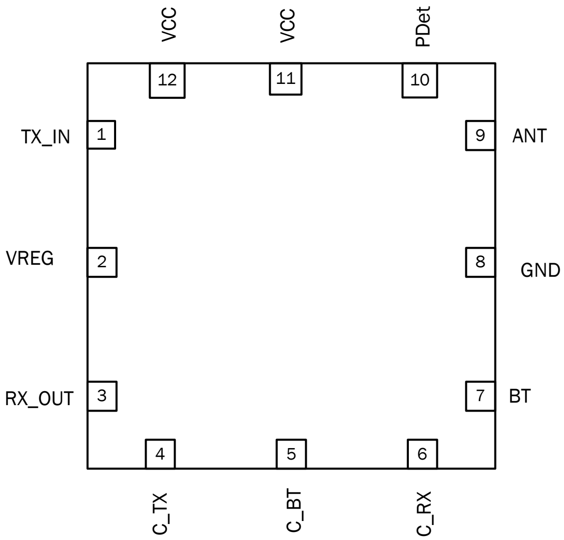
Pin	Function	Description
1	TX IN	RF input for the 802.11b/g/n PA. Input is matched to 50Ω. DC block required.
2	VREG	Regulated voltage for the PA bias control circuit. An external bypass capacitor may be needed on the VREG line for decoupling purposes.
3	RX OUT	Receive port for 802.11b/g/n band. Internally matched to 50Ω. DC block required.
4	C_TX	Control pin for WiFi Transmit Port. See truth table for proper settings.
5	C_BT	Control pin for *Bluetooth*® Port. See truth table for proper settings.
6	C_RX	Control pin for WiFi Receive Port. See truth table for proper settings.
7	BT PORT	*Bluetooth*® RF Port. DC block required.
8	GND	Ground connection.
9	ANT	Antenna port matched to 50Ω. DC block required.
10	POWER DETECT	Power detector voltage for TX section. P_{DET} voltage varies with output power. May need external decoupling.
11	VCC	Supply voltage for the FEM. See applications schematic for biasing and bypassing components.
12	VCC	Same as pin 11.
Pkg Base	GND	Ground connection. The backside of the package should be connected to the ground plane through a short path, i.e., PCB vias under the device are recommended.

Pin Out



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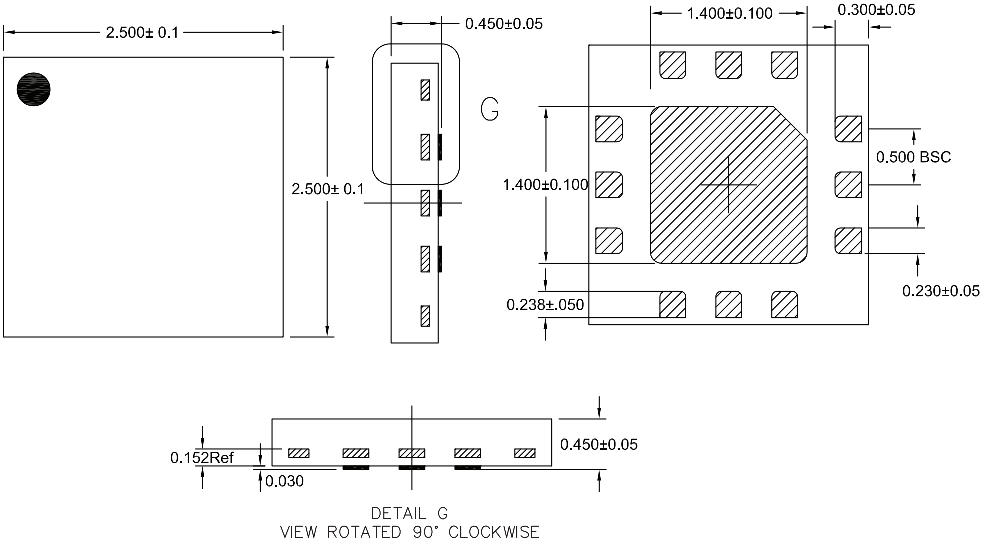
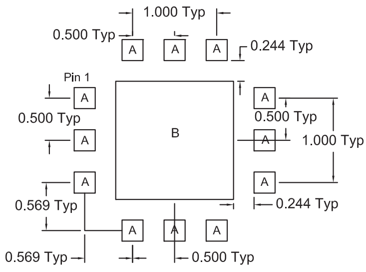
Package Outline Drawing



1) PIN 1 INDICATOR SHADED AREA
2) CHAMFERRED AREA IS PIN 1 INDICATOR

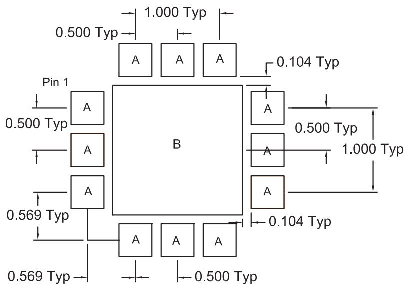
PCB Recommendations

A = 0.250 x 0.250 mm Typ
B = 1.400 x 1.400 mm 10% Rounded Rectangle



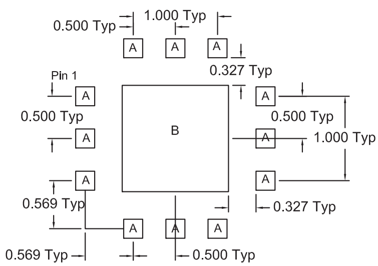
PCB METAL LAND PATTERN

A = 0.390 x 0.390 mm Typ
B = 1.540 x 1.540 mm 10% Rounded Rectangle



PCB SOLDER MASK LAND PATTERN

A = 0.225 x 0.225 mm Typ
B = 1.260 x 1.260 mm 10% Rounded Rectangle



PCB STENCIL PATTERN

PCB land patterns for RFMD 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.

Thermal vias for center slug "B" should be incorporated into the PCB design. The number and size of thermal vias will depend on the application. Example of the number and size of vias can be found on the RFMD evaluation board layout.

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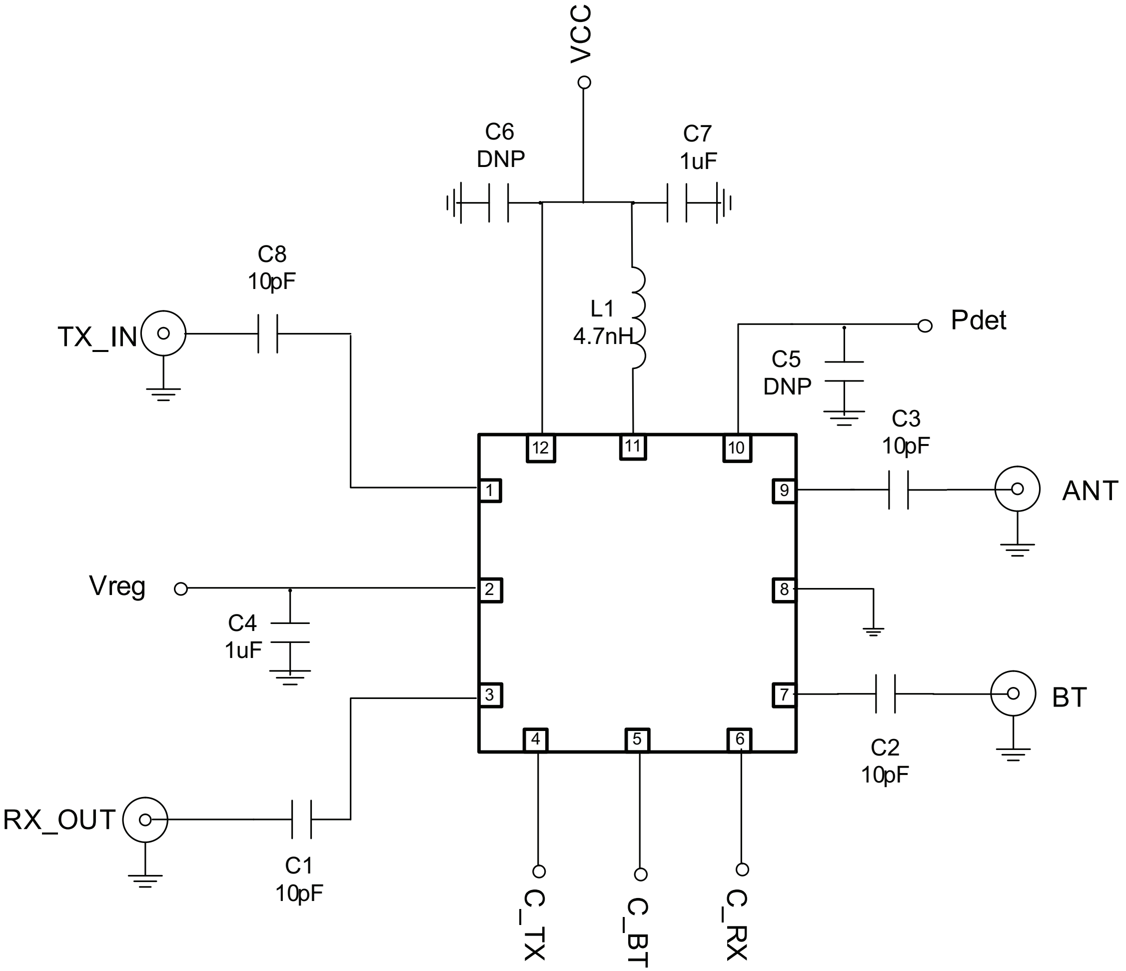
Evaluation Board Schematic

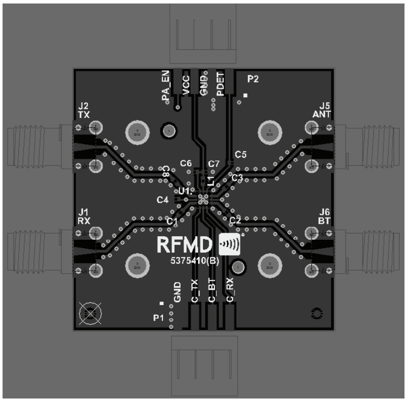


Note: Components C5 and C6 may not be needed in the final schematic. This will be dependent on board layout and noise coupling to these pins. TX input connects directly to the transceiver. If no DC is present on this pin, C8 may also be eliminated.

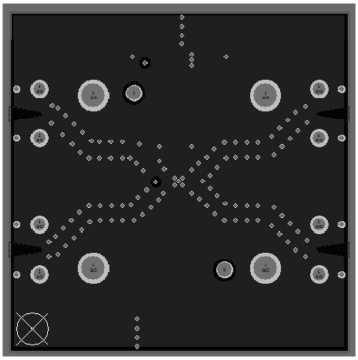
Evaluation Board Layout

Note: For best performance, it is recommended to follow the routing and grounding of the RFMD evaluation board as close as possible. At a minimum, use five ground thermal vias on the package center slug (via size: 12mil hole by 22mil capture pad).

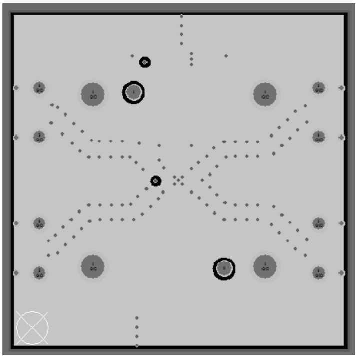
TOP LAYER



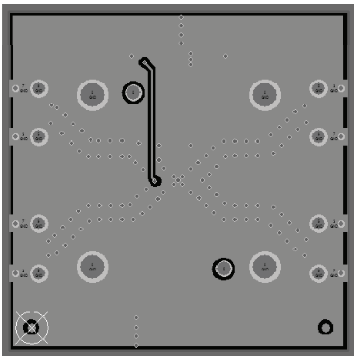
MID LAYER-1



MID LAYER-2



BOTTOM LAYER



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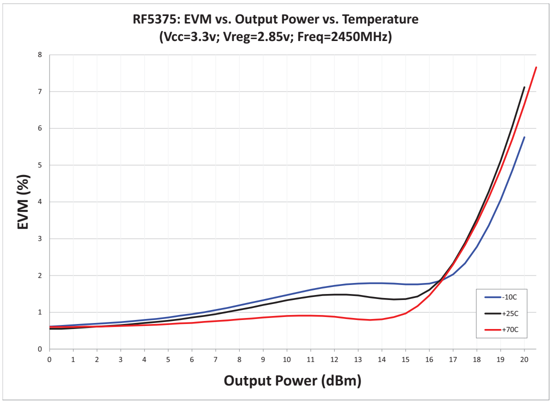
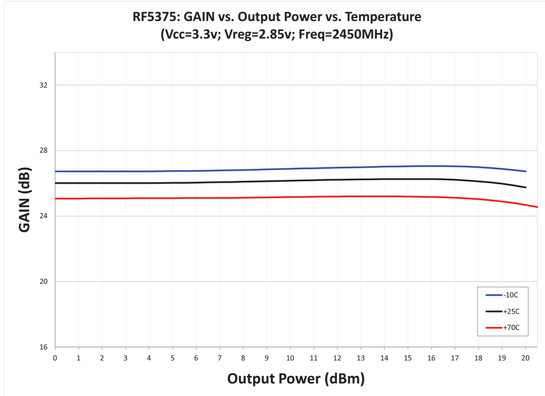
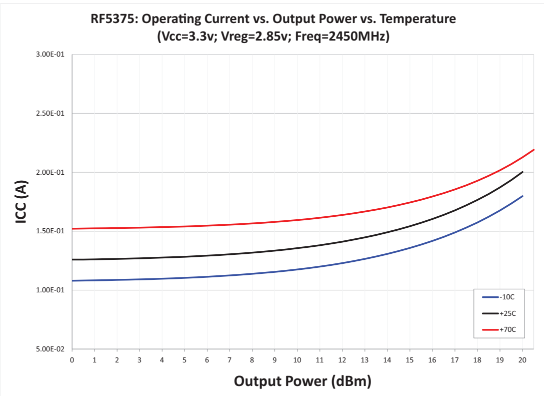
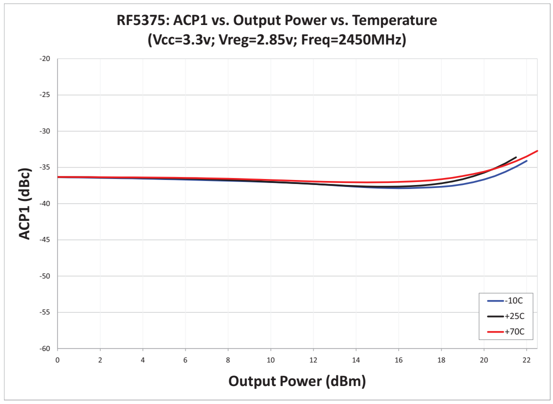
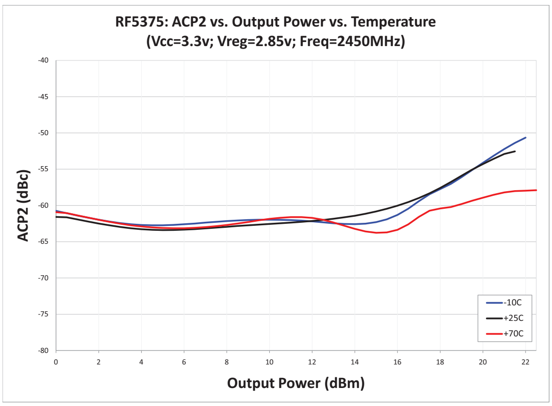
Performance Plots

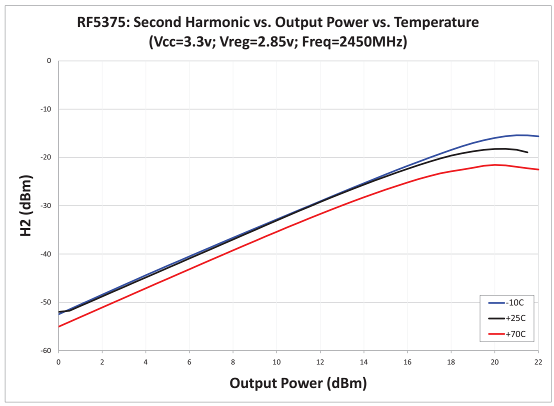












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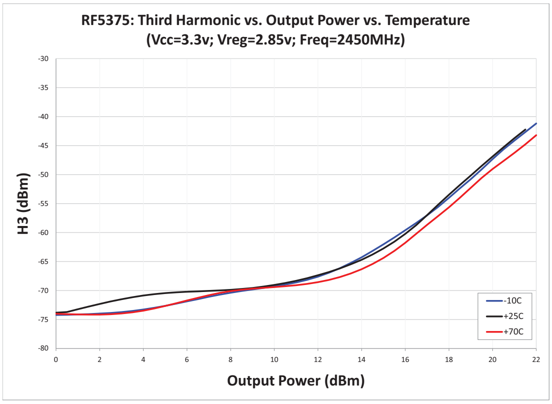

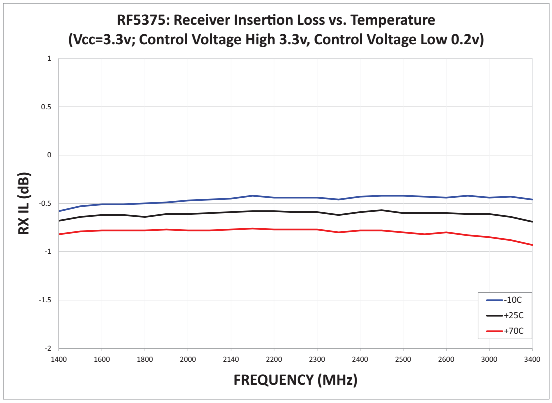

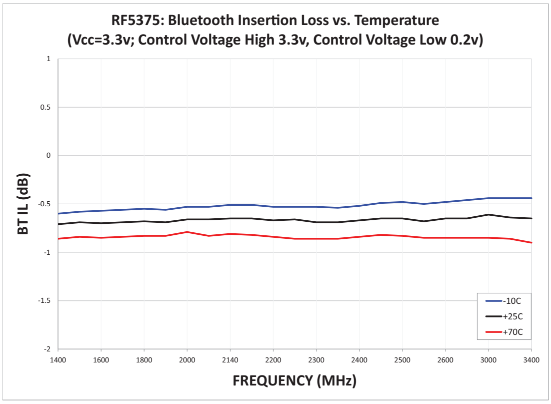

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