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DATA SHEET

SKY65009-70LF: 250 to 2500 MHz Linear Power Amplifier Driver

Applications

- UHF television, CATV, DBS
- TETRA radio
- GSM, GPRS, CDMA, WCDMA
- AMPS, PCS,DCS
- ISM band transmitters
- Fixed WCS
- WLAN, WiMAX
- RFID

Features

- Wideband frequency range: 250 to 2500 MHz
- High linearity OIP3: +40 dBm
- Output P1 dB > +25 dBm
- High efficiency: PAE 40%
- Single DC supply: 3.3 V or 5 V
- On-chip bias circuit
- Low power consumption
- SOT-89 (4-pin 2.4 x 4.5 mm) Pb-free, ROHS-compliant package (MSL1, 260 °C per JEDEC J-STD-0-20)

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04–0074.

Description

Skyworks SKY65009-70LF is a high-performance, ultra-wideband power amplifier (PA) driver with superior output power, noise figure, linearity, and efficiency. The high linearity and superior adjacent channel power rejection/adjacent channel leakage ratio (ACPR/ACLR) performance make the SKY65009-LF ideal for use in the driver stage of infrastructure transmit chains.

The SKY65045-70LF is fabricated with Skyworks high-reliability Aluminum (Al) Gallium Arsenide (GaAs) Heterojunction Bipolar Transistor (HBT) process, which allows for single-supply operation while maintaining high efficency and good linearity. The device uses low-cost surface-mount technology (SMT) in the form of a 2.4 x 4.5 mm small outline transistor (SOT-89) package.

The module can operate over a temperature range of –40 °C to +85 °C. A populated Evaluation Board is available upon request.

A functional block diagram is provided in Figure 1.

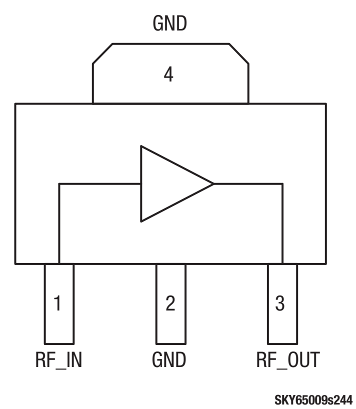

Figure 1. SKY65009-70LF Functional Block Diagram

Technical Description

The SKY65009-70LF is a single-stage, wideband PA in a low-cost surface-mount package. The device operates with a single 3 V or 5 V power supply connected though an RF choke (L1) to the output pin. Capacitors C7, C8, and C9 provide DC bias decoupling for VCC.

The bias current is set by the on-chip active bias composed of current mirror and reference voltage transistors, allowing for excellent gain tracking over temperature and voltage variations. The part is externally RF matched using surface mount components to facilitate operation over a frequency range of 250 MHz to 2500 MHz.

Pin 1 is the RF input and pin 3 is the RF output. External DC blocking is required for both input and output, but can be implemented as part of the RF matching circuit. Pin 2 and the package backside metal, pin 4, provide the DC and RF ground.

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions for the SKY65009 are provided in Table 1. The absolute maximum ratings are provided in Table 2, and the recommended operating conditions in Table 3. Electrical characteristics for the SKY65009 are provided in Table 4.

Typical performance characteristics of the SKY65009 are illustrated in Figures 2 through 92.

Package and Handling Information

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The SKY65009 is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, Solder Reflow Information, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

Table 1. SKY65009 Signal Descriptions[1]

Pin	Name	Description
1	RF_IN	RF input
2	GND	Ground
3	RF_OUT	RF output/VCC
4	GND	Center ground

[1] Center attachment pad must have low inductance and low thermal resistance connections to the customer's printed circuit board ground plane.

Table 2. SKY65009 Absolute Maximum Ratings
(T_A = +25 °C, Unless Otherwise Noted) [1]

Parameter	Symbol	Value	Units
RF output power	P_{OUT}	+26	dBm
Supply voltage	VCC	6	V
Supply current	I_{CC}	300	mA
Power dissipation	P_D	1.1	W
Operating case temperature range	T_C	-40 to +85	°C
Storage temperature range	T_{ST}	-55 to +125	°C
Junction temperature	T_J	150	°C

[1] Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

***ESD HANDLING**: Although this device is designed to be as robust as possible, electrostatic discharge (ESD) can damage this device. This device must be protected at all times from ESD when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

Table 3. SKY65009 Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Units
Supply voltage	VCC		5	5.5	V
Operating frequency	f_0	100		2500	MHz
Operating case temperature	T_C	–40	+25	+85	°C
Thermal resistance (junction to case)	θ_{JC}		20		°C/W

Table 4. SKY65009 Electrical Characteristics[1] (1 of 3)
(VCC = 5.0 V, Output Impedance = 50 Ω, T_C = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typical	Max	Units
Test Frequency = 450 MHz						
Frequency	f			450		MHz
Small signal gain	S21	P_{IN} = –15 dBm		22		dB
Input return loss	S11	Small signal		14.5		dB
Output return loss	S22	Small signal		11.5		dB
1 dB output compression point	OP1db	CW		+26.8		dBm
Power-added efficiency	PAE	@ P1dB		38.5		%
Third order output intercept point	OIP3	P_{IN}/tone = 0 dBm, Δf = 1 MHz		+35		dBm
Noise figure	NF	P_{IN} = –15 dBm		6.5		dB
Quiescent current	I_{CCQ}	No RF		100		mA

Table 4. SKY65009 Electrical Characteristics[1] (2 of 3)
(VCC = 5.0 V, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typical	Max	Units
Test Frequency = 900 MHz						
Frequency	f			900		MHz
Small signal gain	S21	PIN = –15 dBm		17		dB
Input return loss	S11	Small signal		9		dB
Output return loss	S22	Small signal		7.5		dB
1 dB output compression point	P1db	CW		+25.0		dBm
Power-added efficiency	PAE	@ P1dB		33		%
Third order output intercept point	OIP3	PIN/tone = 0 dBm, Δf = 1 MHz		+41		dBm
Power out @ ACPR = –45 dBc	ACPR	IS-95, 750 kHz offset		19		dBm
Noise figure	NF	Small signal		5		dB
Quiescent current	ICCQ	No RF		100		mA
Test Frequency = 1960 MHz						
Frequency	f	Best OIP3 match		1960		MHz
Small signal gain	S21	PIN = –15 dBm	10.5	12		dB
Input return loss	S11	Small signal		19		dB
Output return loss	S22	Small signal		10.5		dB
1 dB output compression point	OP1db	CW	+26	+27		dBm
Power-added efficiency	PAE	@ P1dB	40	47		%
Third order output intercept point	OIP3	PIN/tone = 0 dBm, Δf = 1 MHz	+37	+42		dBm
Power out @ ACPR = –45 dBc	ACPR	IS-95, 885 kHz offset	+18	+20		dBm
Noise figure	NF	PIN = –15 dBm		4.3	5.5	dB
Quiescent current	ICCQ	No RF		100	130	mA
Test Frequency = 2140 MHz						
Frequency	f			2140		MHz
Small signal gain	S21	Small signal		11.5		dB
Input return loss	S11	Small signal		20		dB
Output return loss	S22	Small signal		9.5		dB
1 dB output compression point	OP1db	CW		+26.7		dBm
Power-added efficiency	PAE	@ P1dB		48		%
Third order output intercept point	OIP3	PIN/tone = 0 dBm, Δf = 1 MHz		+42.5		dBm
Power out @ ACPR = –45 dBc	ACPR	3G WCDMA, downlink 64 DPCH, 5 MHz offset		+18		dBm
Noise figure	NF	PIN = –15 dBm		18		dB
Quiescent current	ICCQ	PIN = –15 dBm		100		mA

Table 4. SKY65009 Electrical Characteristics[1] (3 of 3)
(VCC = 5.0 V, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Conditions	Min	Typical	Max	Units
Test Frequency = 2450 MHz						
Frequency	f			2450		MHz
Small signal gain	S21	P_{IN} = –15 dBm		10.3		dB
Input return loss	S11	Small signal		22		dB
Output return loss	S22	Small signal		15		dB
1 dB output compression point	OP1db	CW		+25.5		dBm
Power-added efficiency	PAE	@ P1dB		38.7		%
Third order output intercept point	OIP3	P_{IN}/tone = 0 dBm, Δf = 1 MHz		+40		dBm
Noise figure	NF	Small signal		4.1		dB
Quiescent current	I_{CCQ}	P_{IN} = –15 dBm		100		mA

[1] Performance is guaranteed only under the conditions listed in this table.

Typical Performance Data

(VCC = 5 V, f = 450 MHz, CW, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

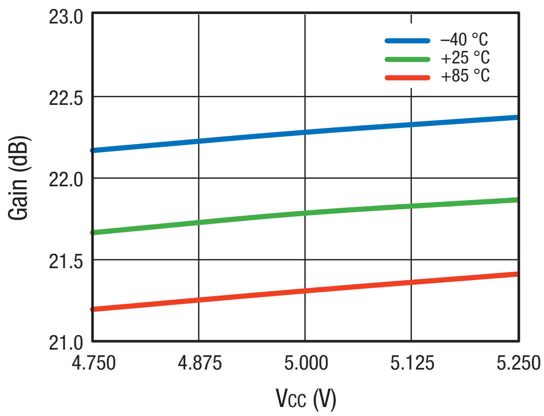

Figure 2. Gain vs VCC Across Temperature
Input Power = –15 dBm

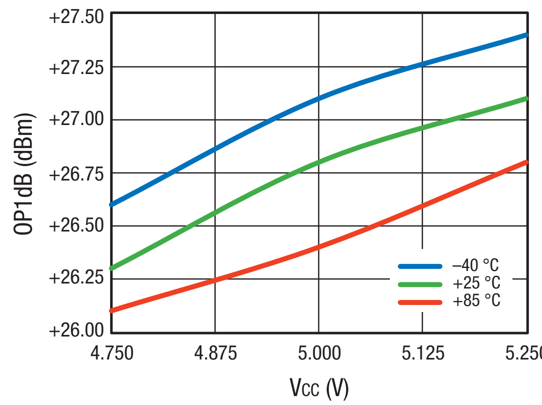

Figure 3. OP1 dB vs VCC Across Temperature

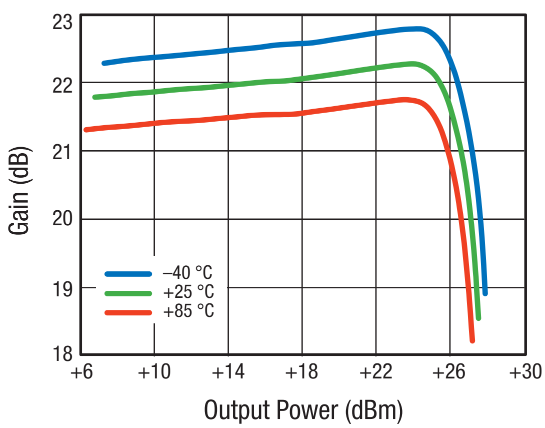

Figure 4. Gain vs Output Power Across Temperature

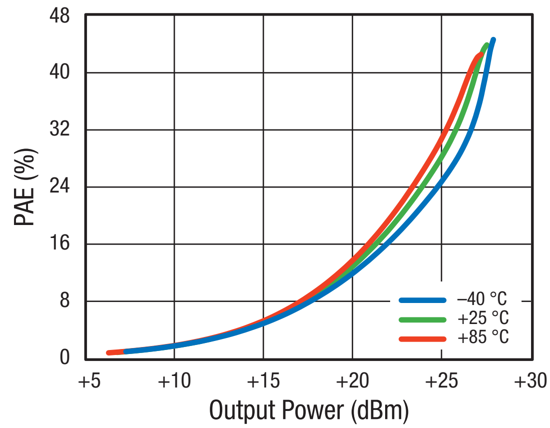

Figure 5. PAE vs Output Power Across Temperature

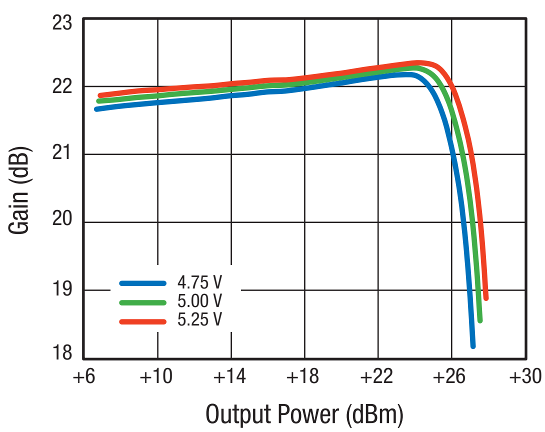

Figure 6. Gain vs Output Power Across Voltage

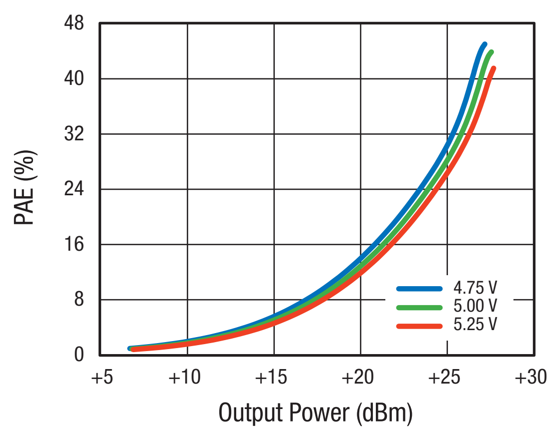

Figure 7. PAE vs Output Power Across Voltage

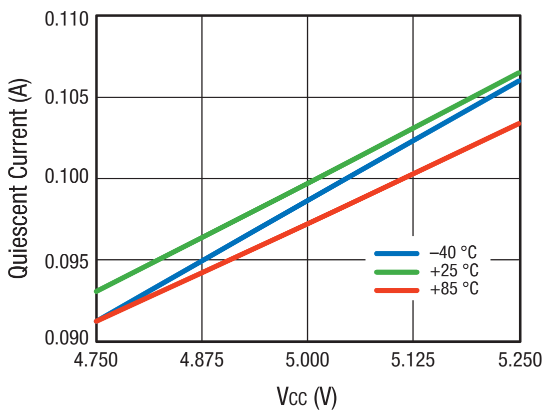

Figure 8. Quiescent Current vs VCC Across Temperature

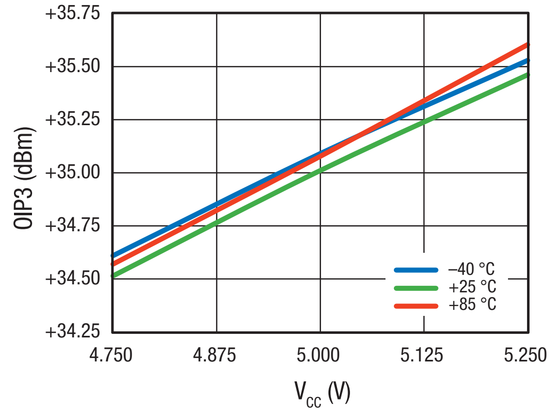

Figure 9. OIP3 vs VCC Across Temperature
Input Power/Tone = –5 dBm

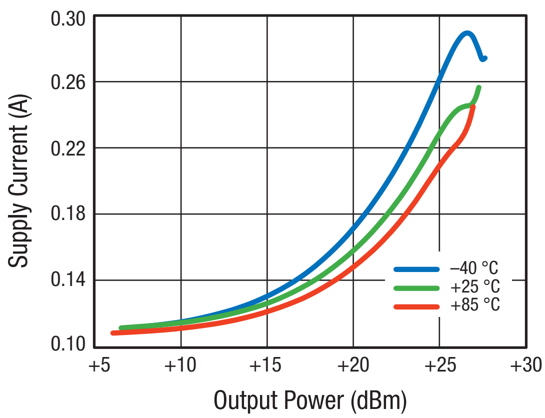

Figure 10. Supply Current vs Output Power Across Temperature

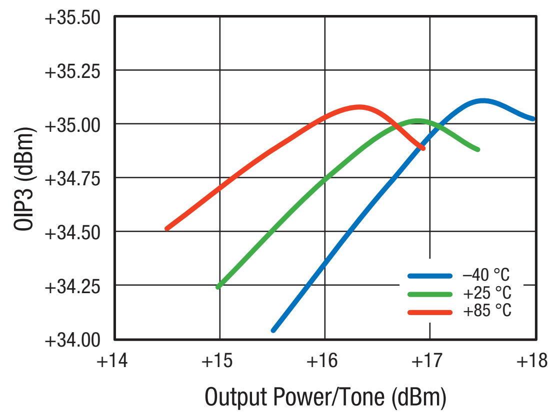

Figure 11. OIP3 vs Output Power/Tone Across Temperature

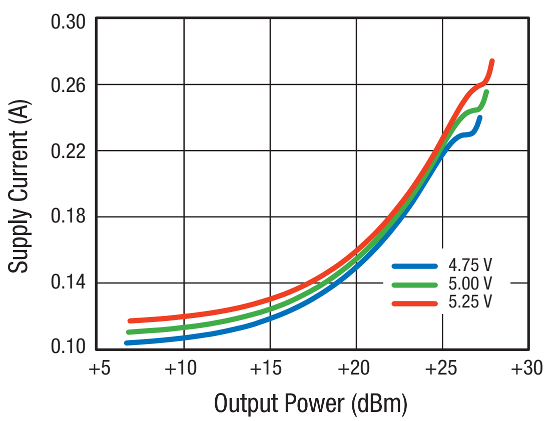

Figure 12. Supply Current vs Output Power Across Voltage

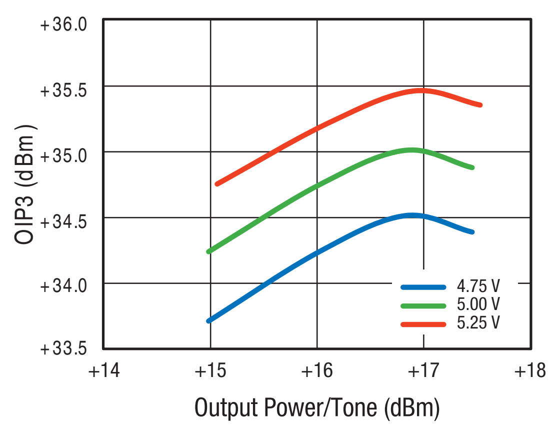

Figure 13. OIP3 vs Output Power/Tone Across Voltage

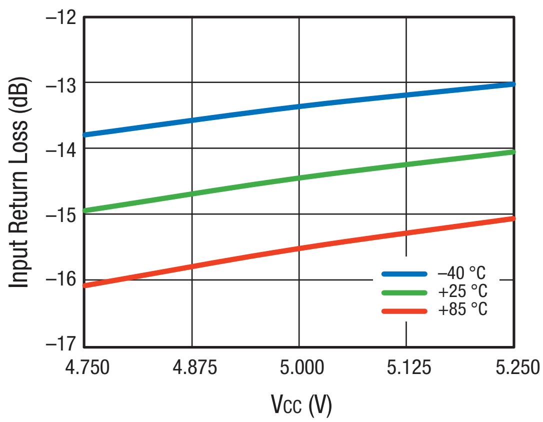

Figure 14. Input Return Loss vs VCC Across Temperature

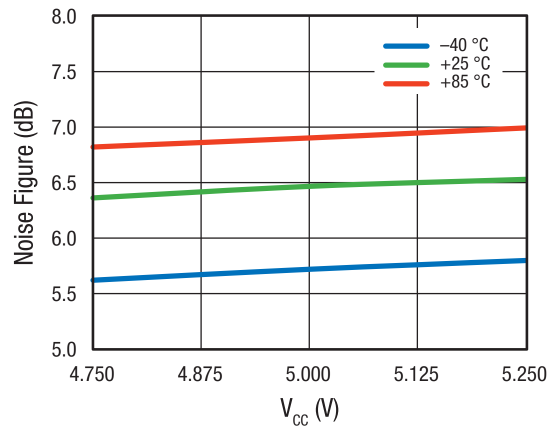

Figure 15. Noise Figure vs VCC Across Temperature

Typical Performance Data

(VCC = 5 V, f = 900 MHz, CW, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

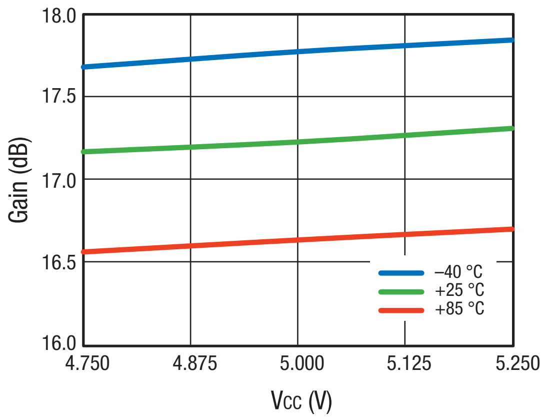

Figure 16. Gain vs VCC Across Temperature Input Power = –15 dBm

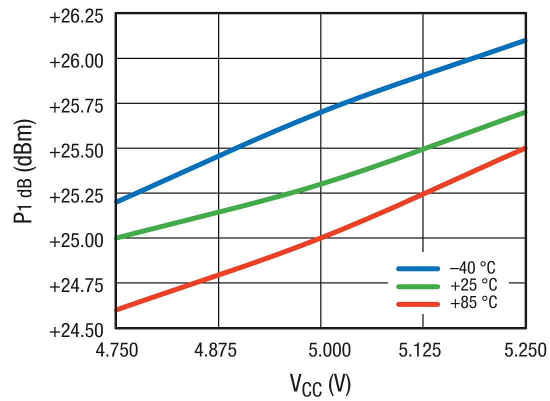

Figure 17. P1 dB vs VCC Across Temperature

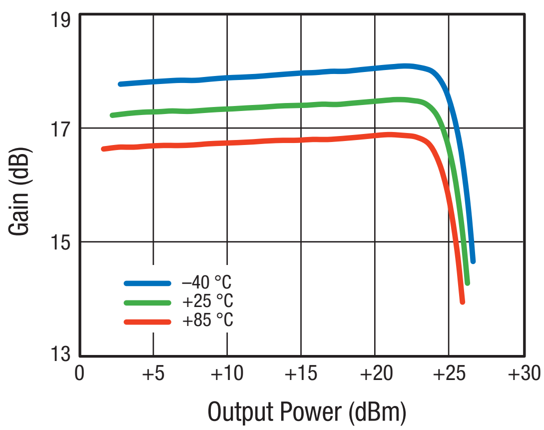

Figure 18. Gain vs Output Power Across Temperature

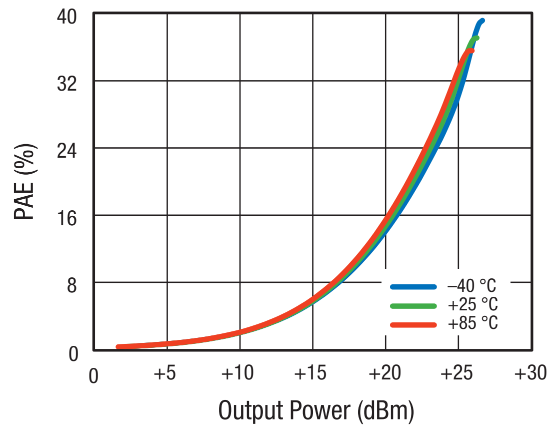

Figure 19. PAE vs Output Power Across Temperature

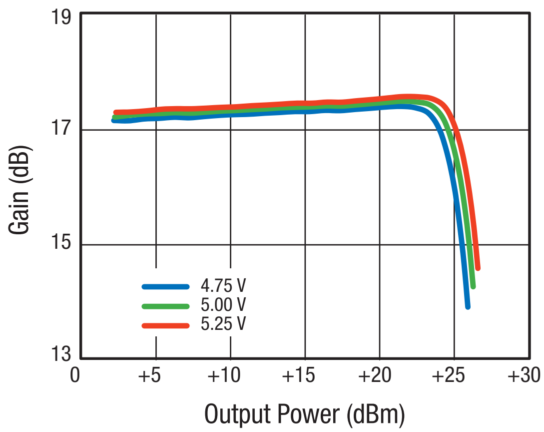

Figure 20. Gain vs Output Power Across VCC

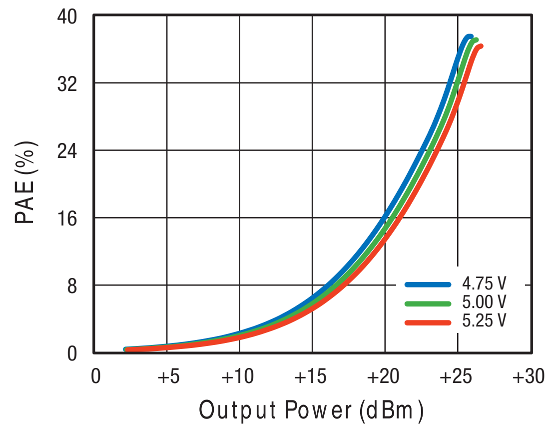

Figure 21. PAE vs Output Power Across VCC

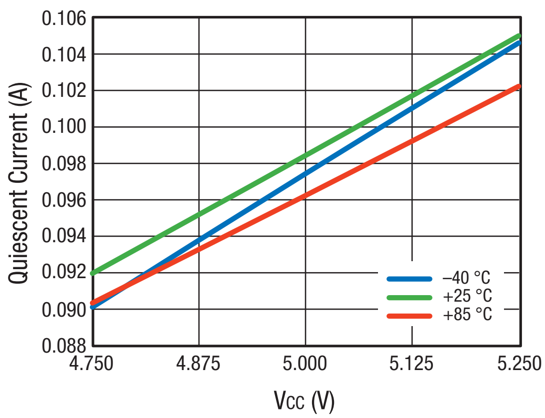

Figure 22. Quiescent Current vs VCC Across Temperature

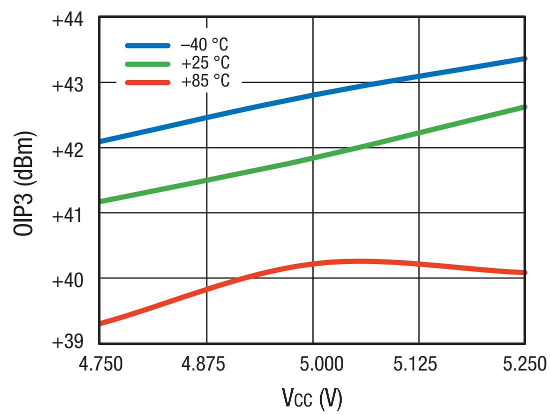

Figure 23. OIP3 vs VCC Across Temperature, Input Power/Tone = –2 dBm

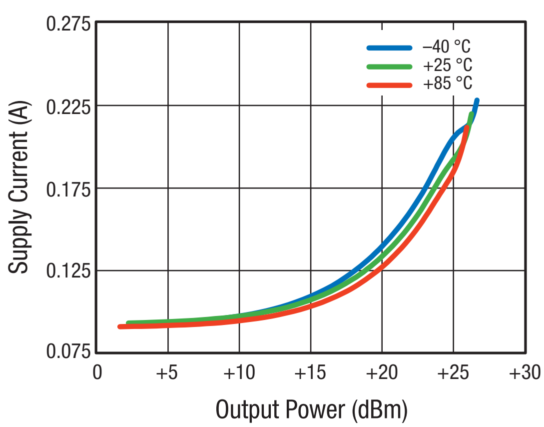

Figure 24. Supply Current vs Output Power Across Temperature

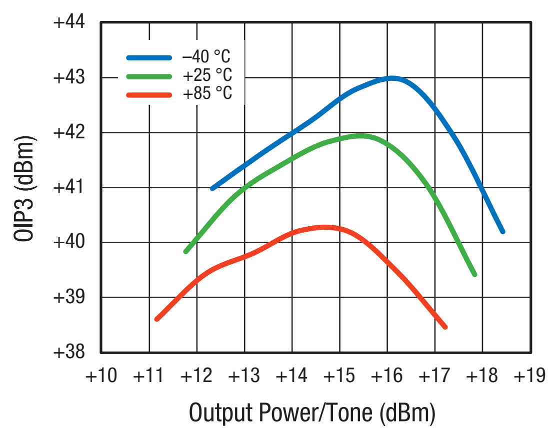

Figure 25. OIP3 vs Output Power/Tone Across Temperature

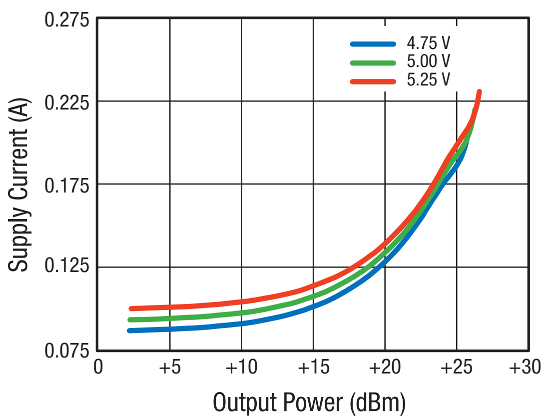

Figure 26. Supply Current vs Output Power Across VCC

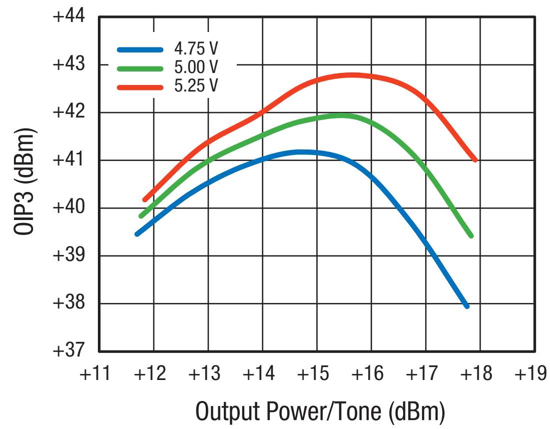

Figure 27. OIP3 vs Output Power/Tone Across VCC

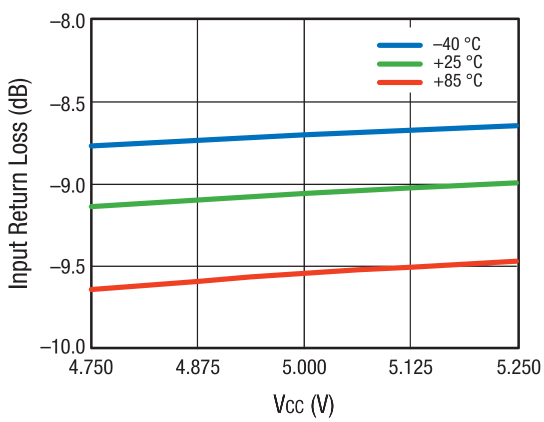

Figure 28. Input Return Loss vs VCC Across Temperature

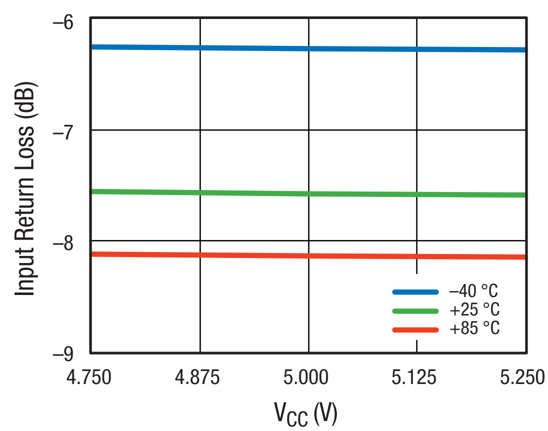

Figure 29. Input Return Loss vs VCC Across Temperature

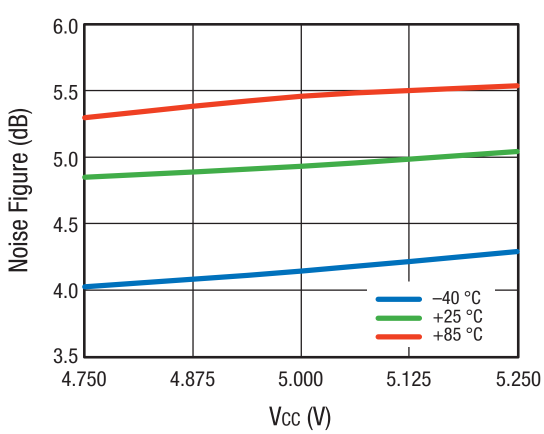

Figure 30. Noise Figure vs VCC Across Temperature

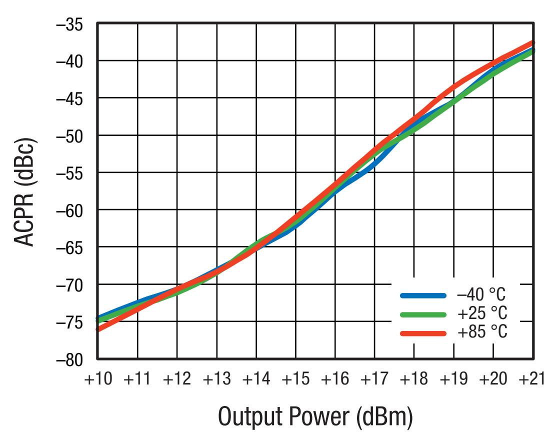

Figure 31. ACPR vs Output Power Across Temperature

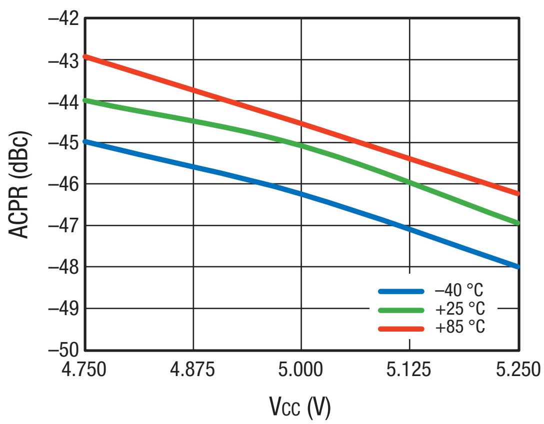

Figure 32. ACPR vs VCC Across Temperature @ Output Power = +19 dBm

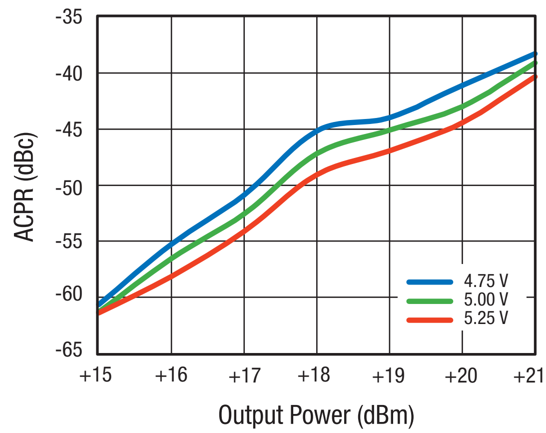

Figure 33. ACPR vs Output Power Across VCC

Typical Performance Data

(VCC = 5 V, f = 1960 MHz (Best OIP3 Match), CW, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

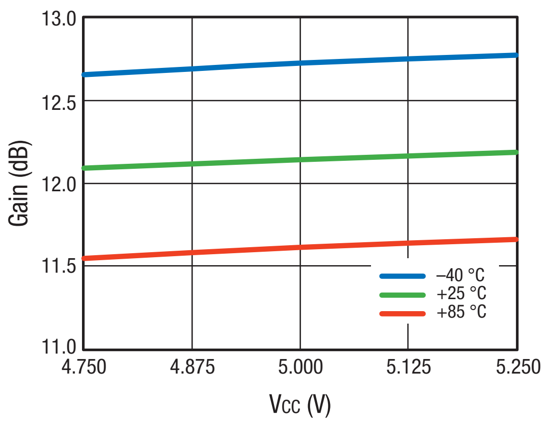

Figure 34. Gain vs VCC Across Temperature @ Input Power = –15 dBm

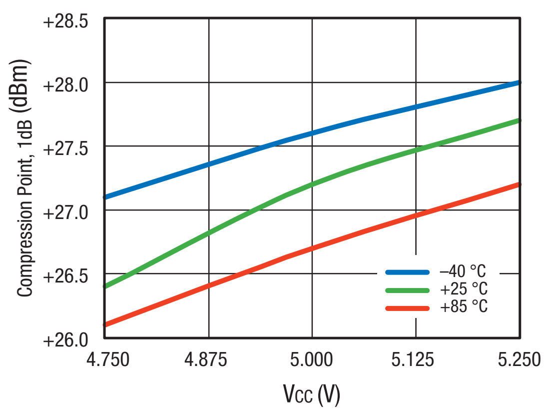

Figure 35. P1dB vs VCC Across Temperature

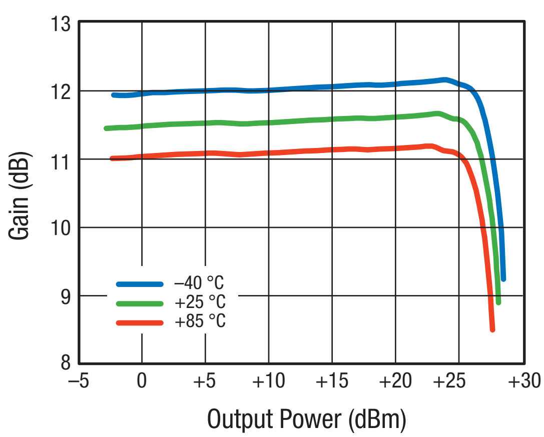

Figure 36. Gain vs Output Power Across Temperature

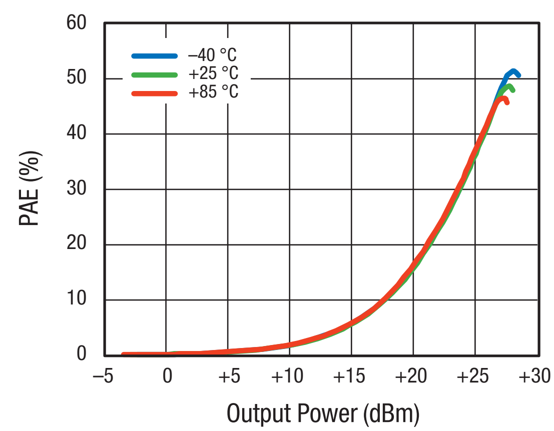

Figure 37. PAE vs Output Power Across Temperature

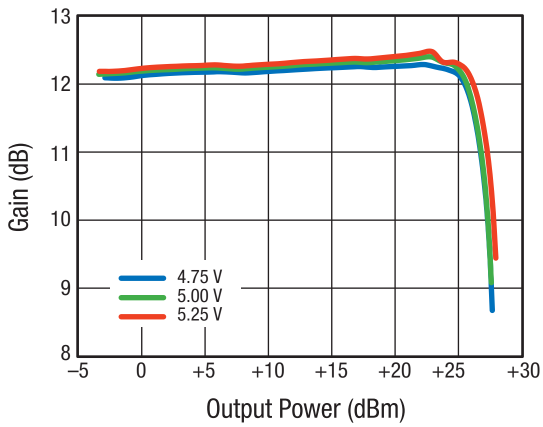

Figure 38. Gain vs Output Power Across VCC

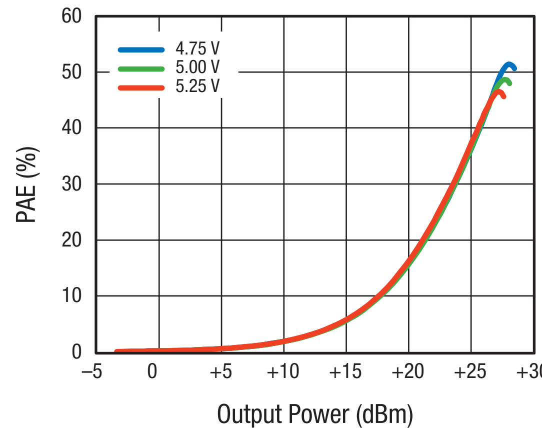

Figure 39. PAE vs Output Power Across VCC

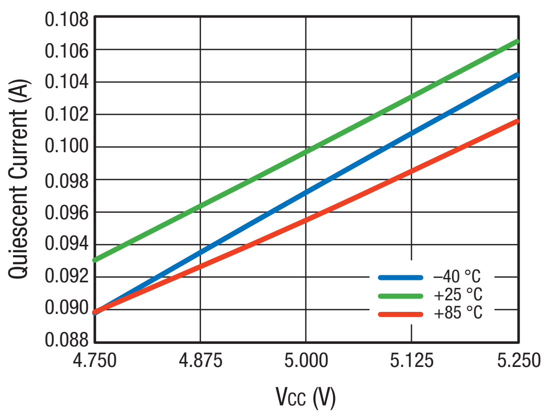

Figure 40. Quiescent Current vs VCC Across Temperature

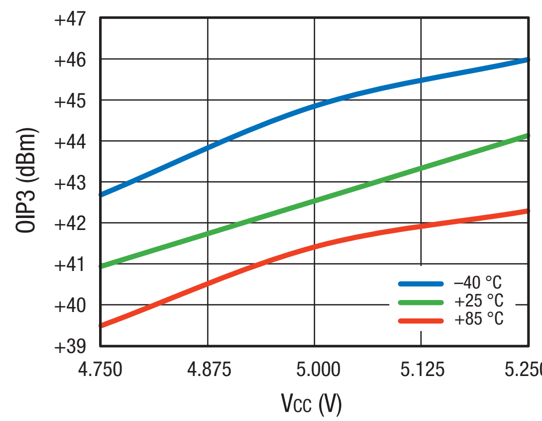

Figure 41. OIP3 vs VCC Across Temperature
Input Power/Tone = –1 dB

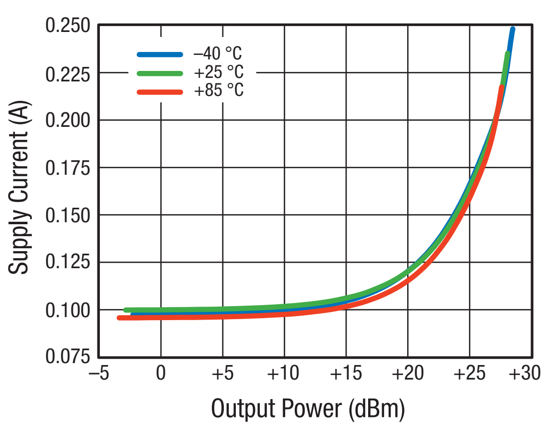

Figure 42. Supply Current vs Output Power Across Temperature

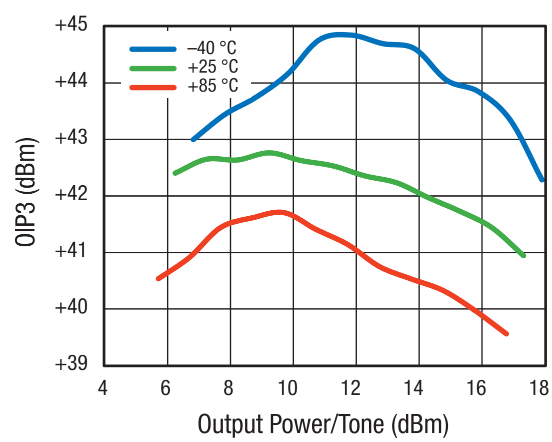

Figure 43. OIP3 vs Output Power/Tone Across Temperature

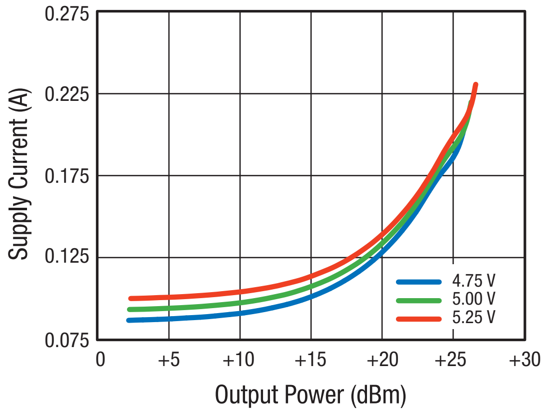

Figure 44. Supply Current vs Output Power Across VCC

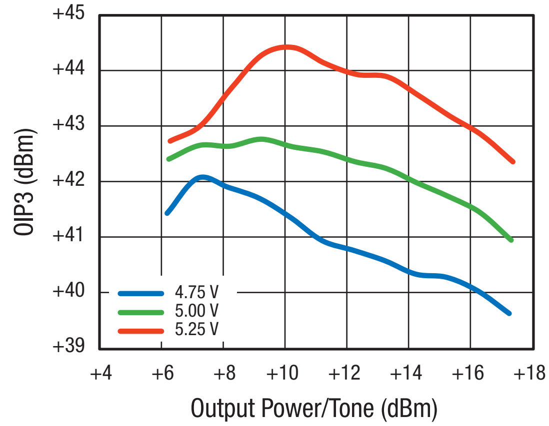

Figure 45. OIP3 vs Output Power/Tone Across VCC

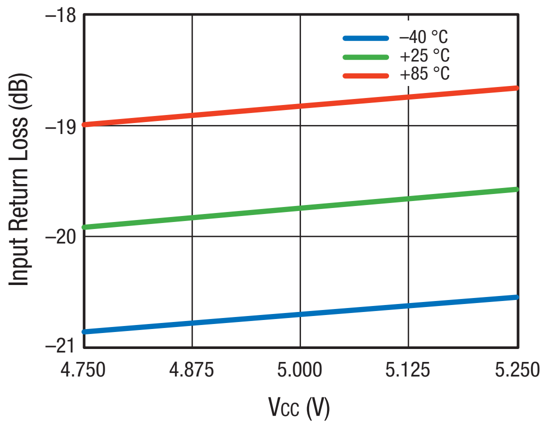

Figure 46. Input Return Loss vs VCC Across Temperature

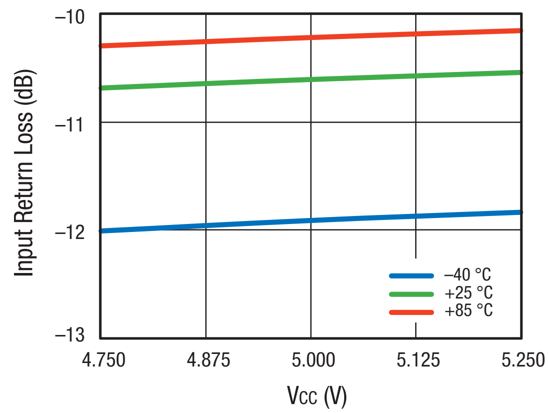

Figure 47. Input Return Loss vs VCC Across Temperature

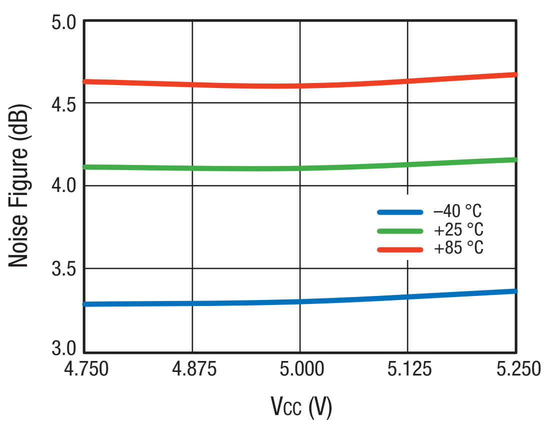

Figure 48. Noise Figure vs VCC Across Temperature

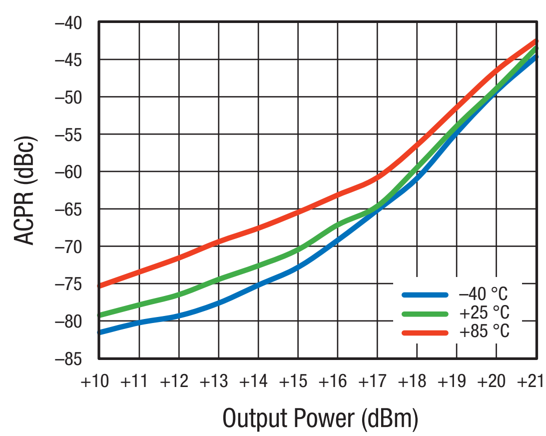

Figure 49. ACPR vs Output Power Across Temperature

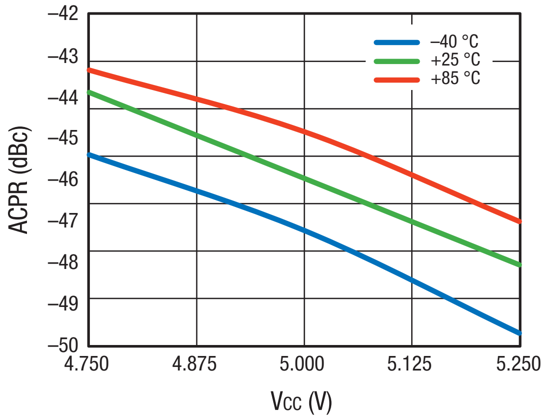

Figure 50. ACPR vs VCC Across Temperature Output Power = 20 dBm

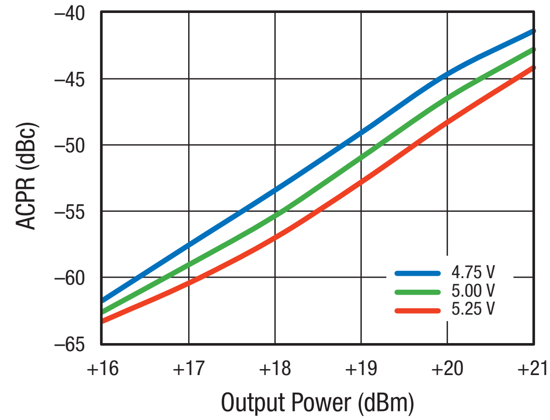

Figure 51. ACPR vs Output Power Across VCC

Typical Performance Data

(VCC = 5 V, f = 2140 MHz, CW, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

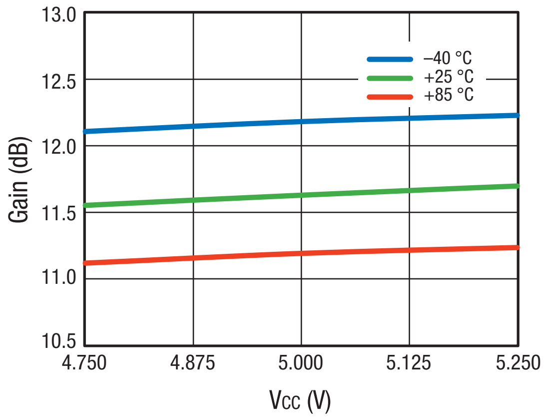

Figure 52. Gain vs VCC Across Input Power –15 dBm

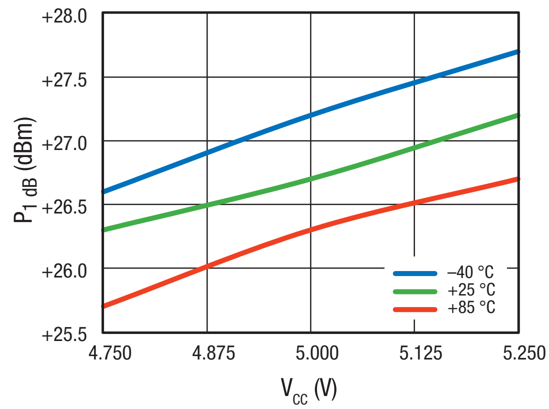

Figure 53. P1 dB vs VCC Across Temperature

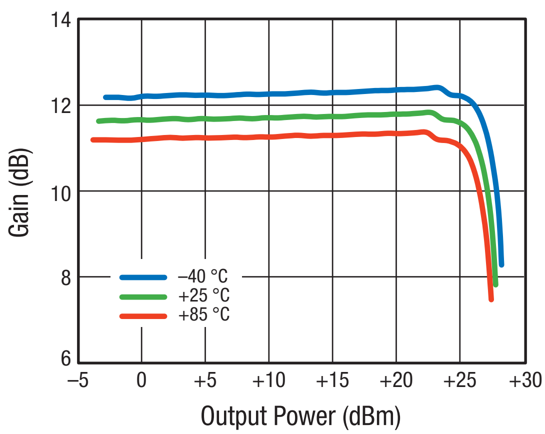

Figure 54. Gain vs Output Power Across Temperature

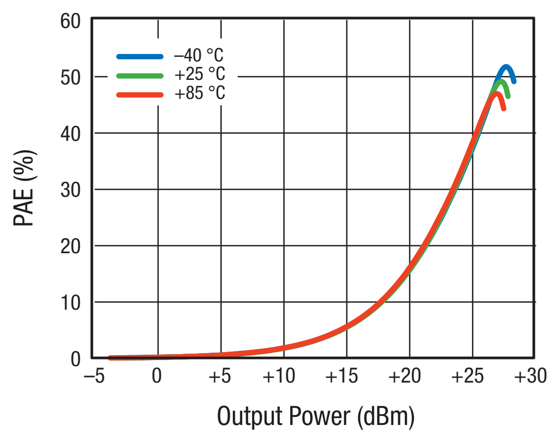

Figure 55. PAE vs Output Power Across Temperature

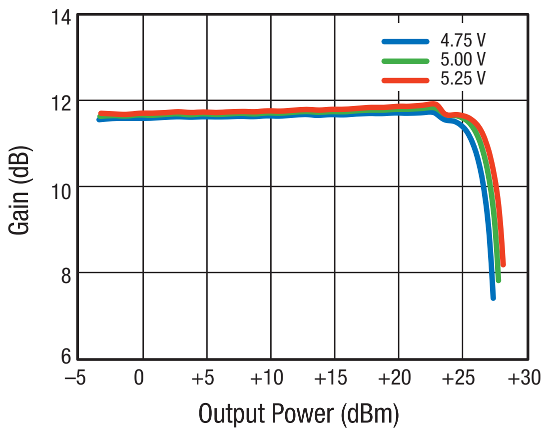

Figure 56. Gain vs Output Power Across VCC

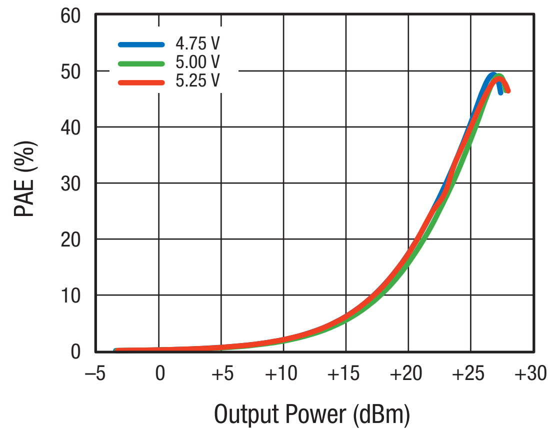

Figure 57. PAE vs Output Power Across VCC

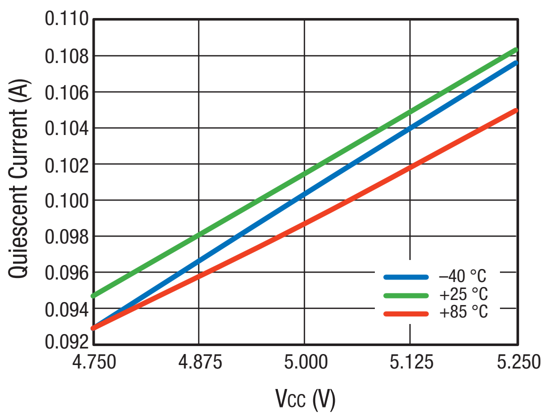

Figure 58. Quiescent Current vs VCC Across Temperature

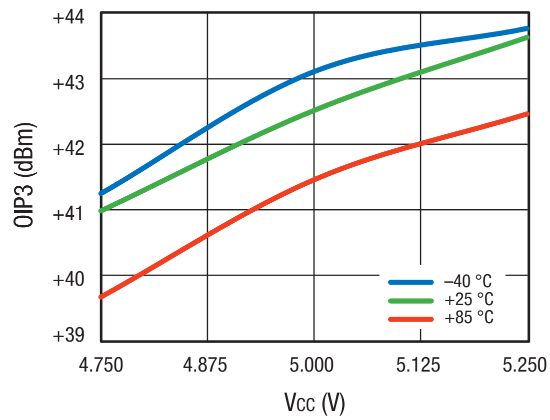

Figure 59. OIP3 vs VCC Across Temperature
Input Power/Tone = 0 dBm

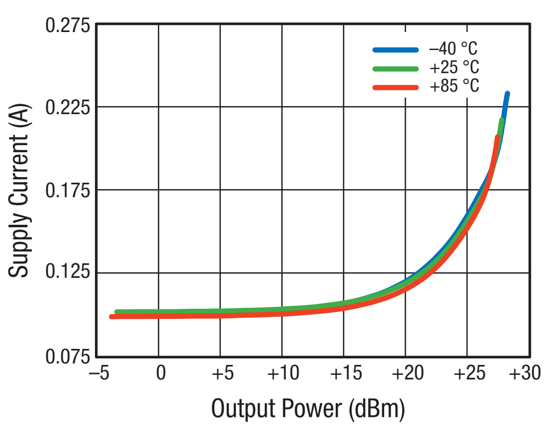

Figure 60. Supply Current vs Output Power Across Temperature

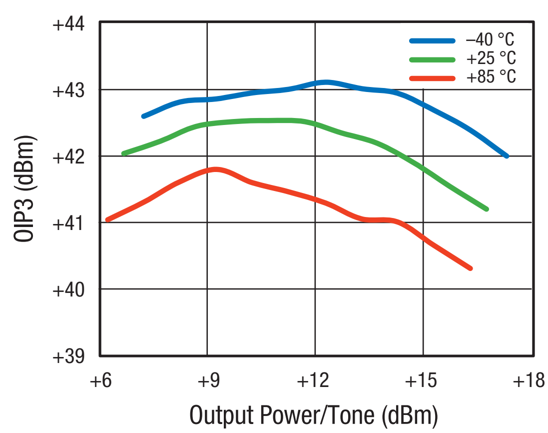

Figure 61. OIP3 vs Output Power/Tone Across Temperature

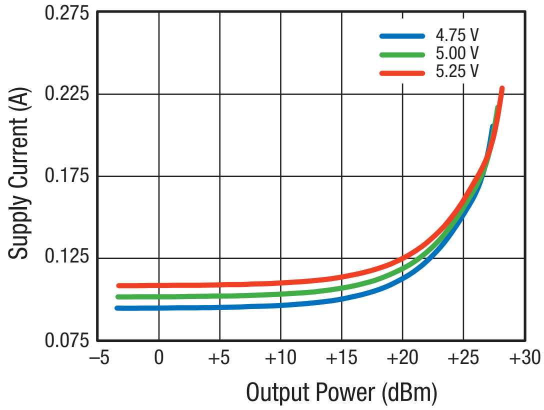

Figure 62. Supply Current vs Output Power Across VCC

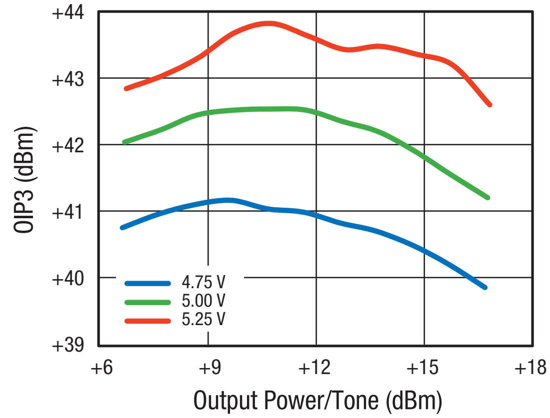

Figure 63. OIP3 vs Output Power/Tone Across VCC

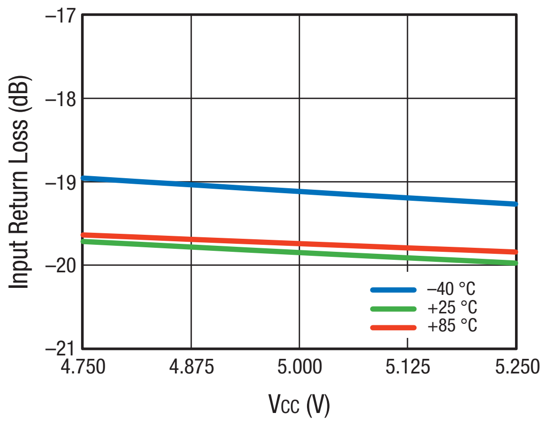

Figure 64. Input Return Loss vs VCC Across Temperature

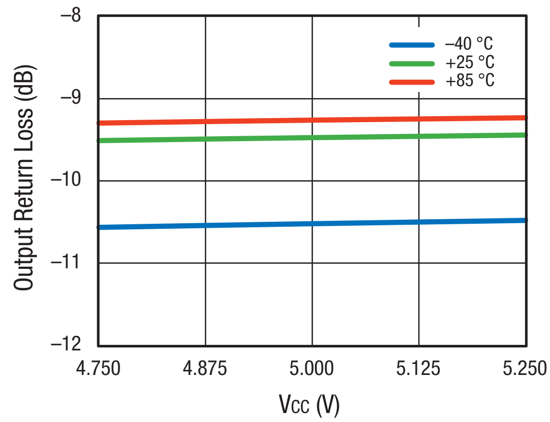

Figure 65. Output Return Loss vs VCC Across Temperature

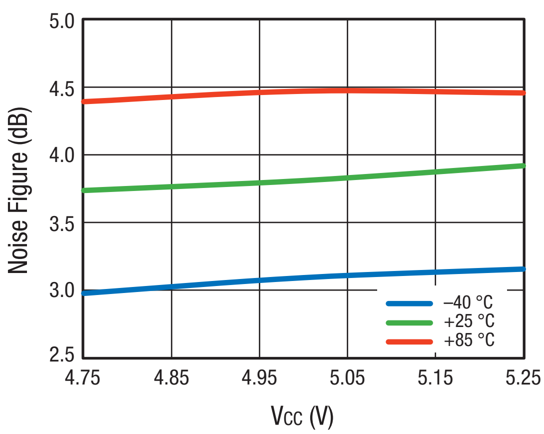

Figure 66. Noise Figure vs VCC Across Temperature

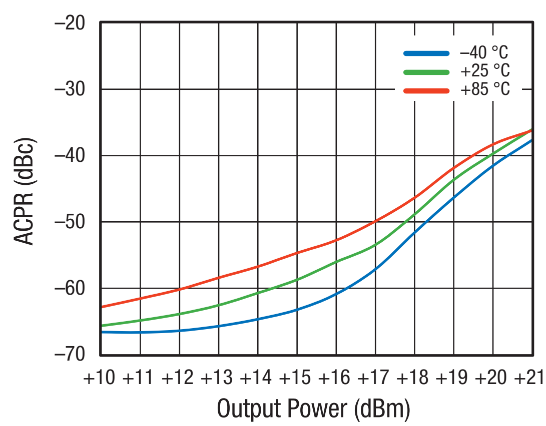

Figure 67. ACPR vs Output Power Across Temperature

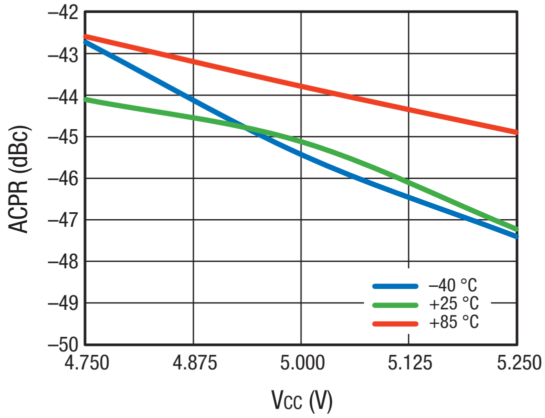

Figure 68. ACPR vs VCC Across Temperature Output Power = +18 dBm

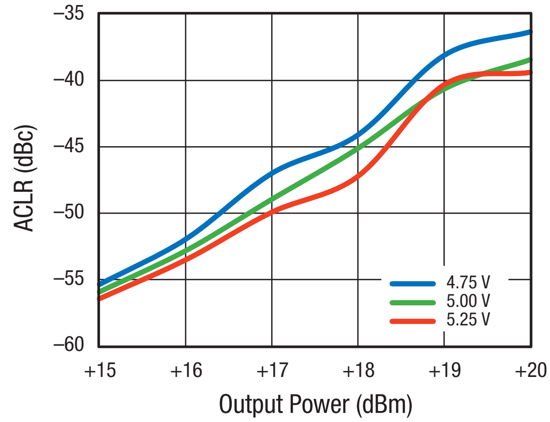

Figure 69. ACLR vs Output Power Across VCC

Typical Performance Data

(VCC = 5 V, f = 2450 MHz, CW, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

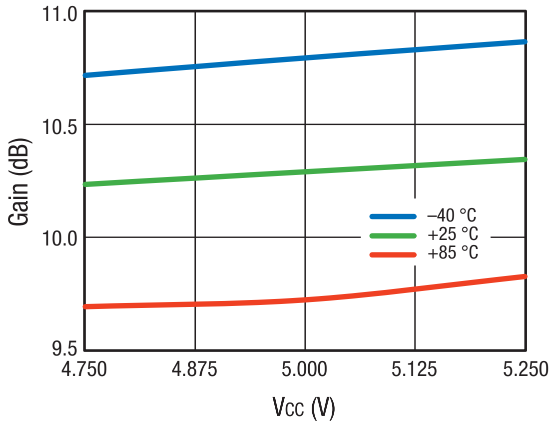

Figure 70. Gain vs VCC Across Temperature Input Power = –15 dBm

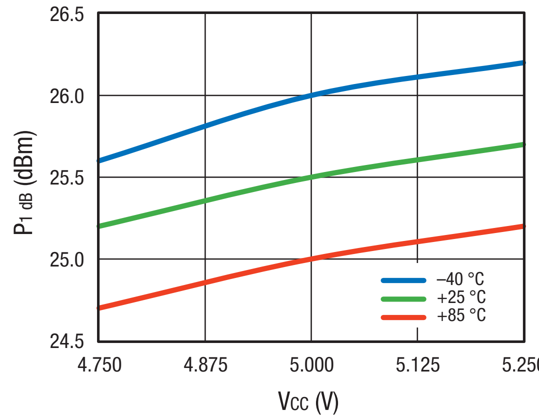

Figure 71. P1 dB vs VCC Across Temperature

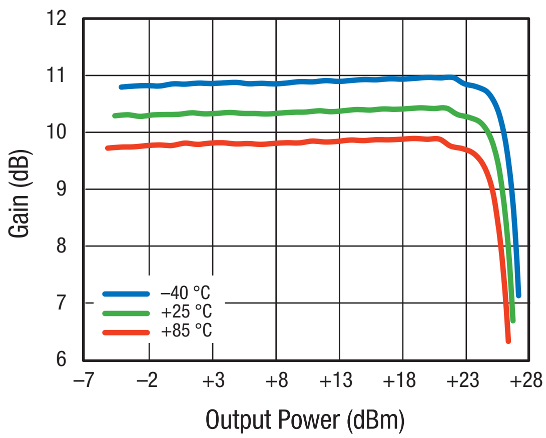

Figure 72. Gain vs Output Power Across Temperature

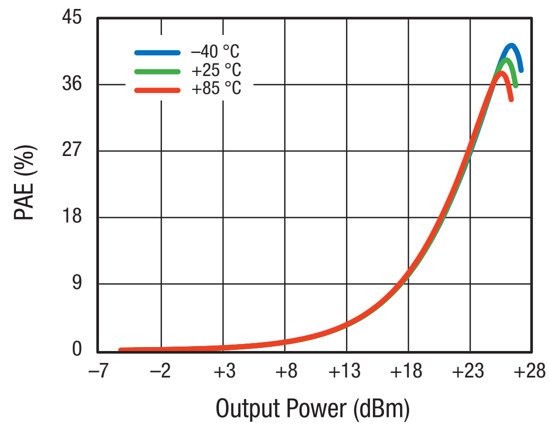

Figure 73. PAE vs Output Power Across Temperature

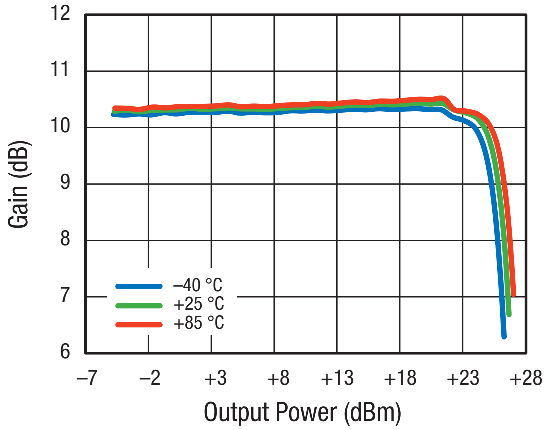

Figure 74. Gain vs Output Power Across VCC

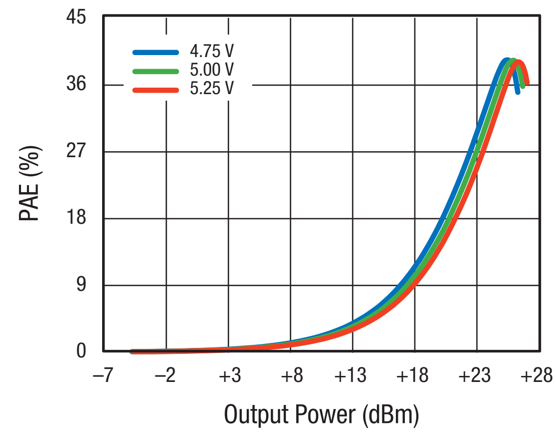

Figure 75. PAE vs Output Power Across VCC

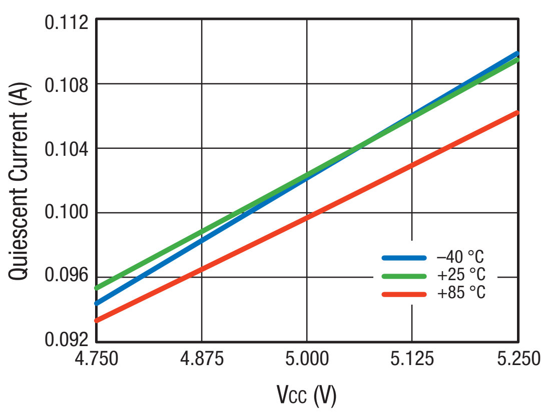

Figure 76. Quiescent Current vs VCC Across Temperature

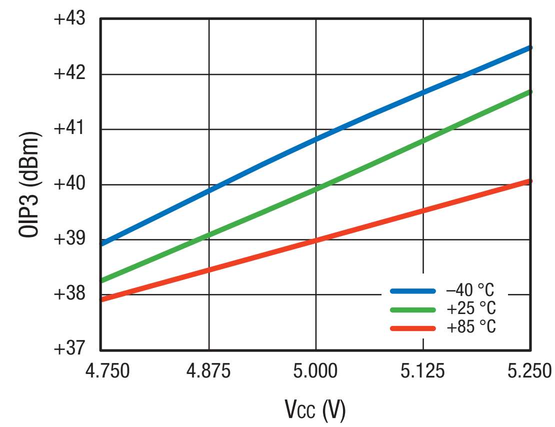

Figure 77. OIP3 vs VCC Across Temperature
Input Power/Tone = 0 dBm

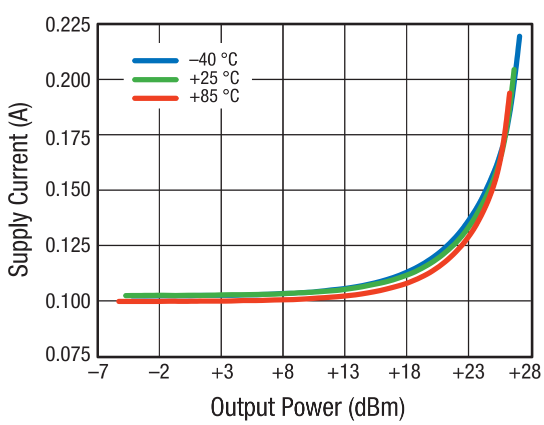

Figure 78. Supply Current vs Output Power Across Temperature

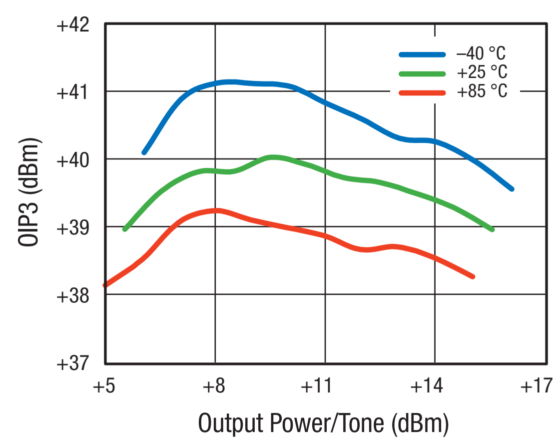

Figure 79. OIP3 vs Output Power/Tone Across Temperature

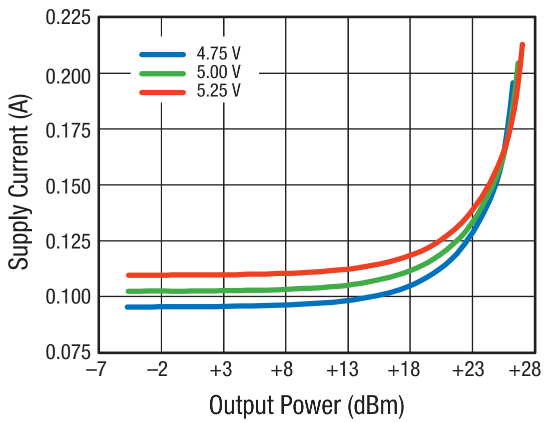

Figure 80. Supply Current vs Output Power Across VCC

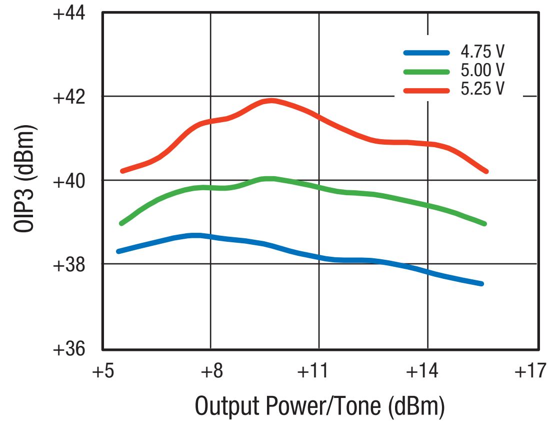

Figure 81. OIP3 vs Output Power/ToneAcross VCC

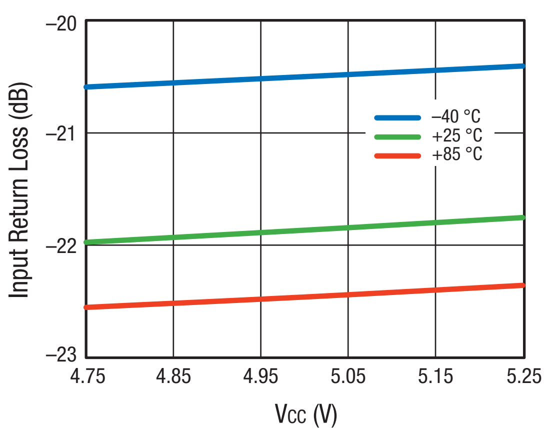

Figure 82. Input Return Loss vs VCC Across Temperature

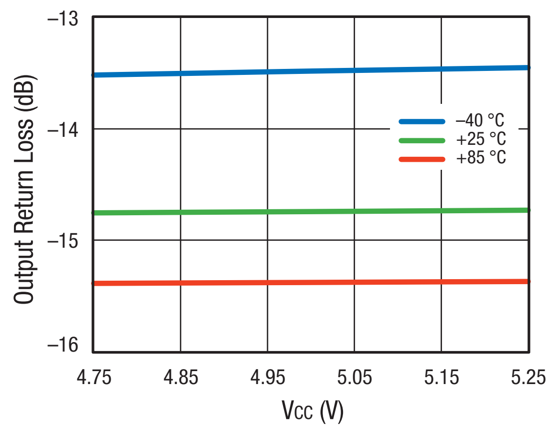

Figure 83. Output Return Loss vs VCC Across Temperature

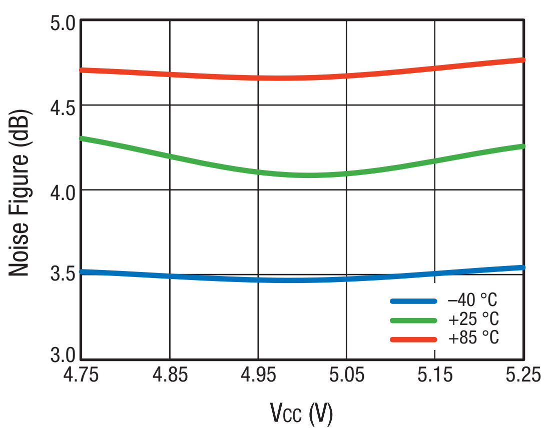

Figure 84. Noise Figure vs. VCC Across Temperature

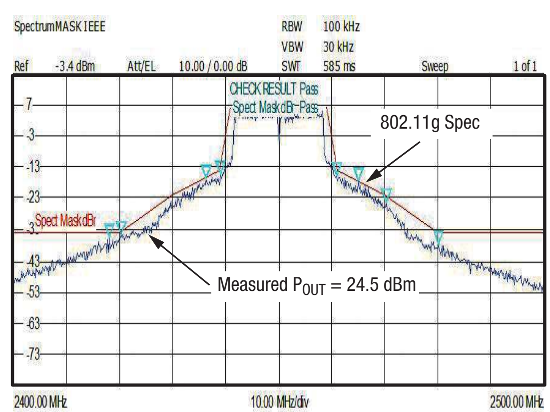

Figure 85. Spectral Response
(802.11g 64 QAM at 54 Mbps Input Signal)

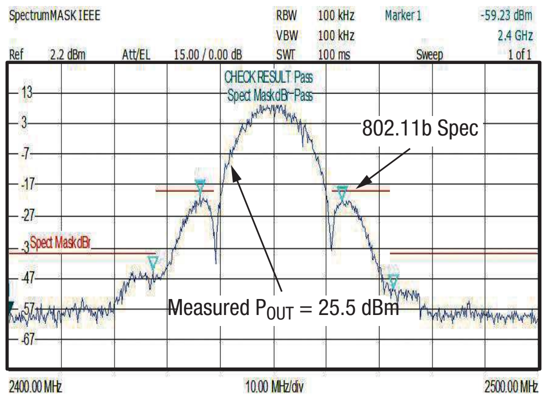

Figure 86. . Spectral Response (802.11b 64 CCK at 11 Mbps Input Signal)

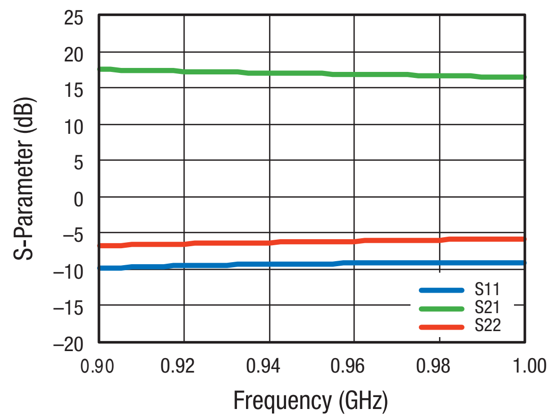

Figure 87. S-Parameter vs Frequency T = 25°C Tuned for 900 MHz

Typical Performance Data

(VCC = 5 V, MHz, CW, Output Impedance = 50 Ω, Tc = 25 °C, Unless Otherwise Noted)

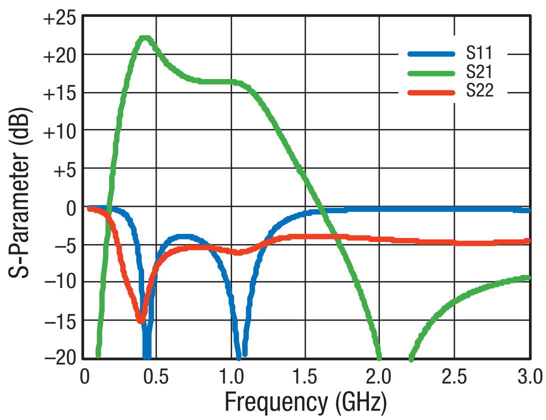

Figure 88. S-Parameter vs Frequency, Tuned for 450 MHz

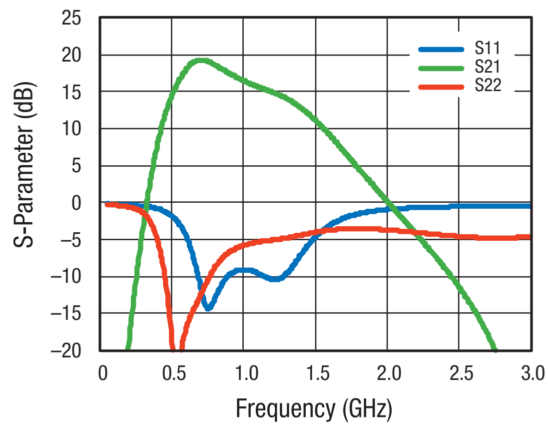

Figure 89. S-Parameter vs Frequency, Tuned for 900 MHz

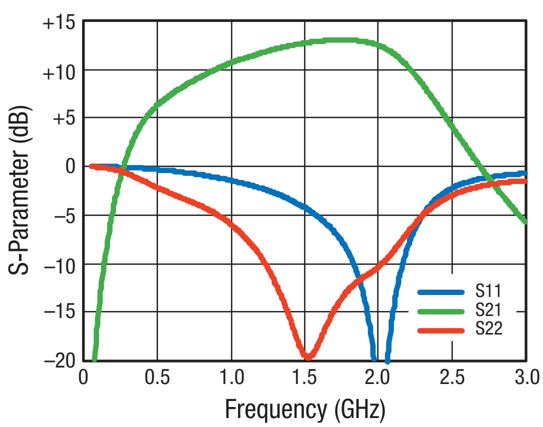

Figure 90. S-Parameter vs Frequency, Tuned for 1960 MHz

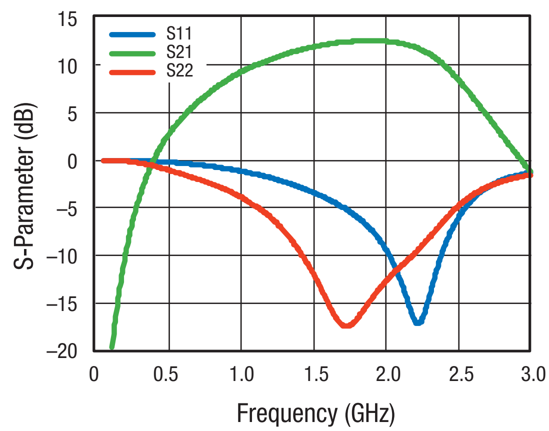

Figure 91. S-Parameter vs Frequency, Tuned for 2140 MHz

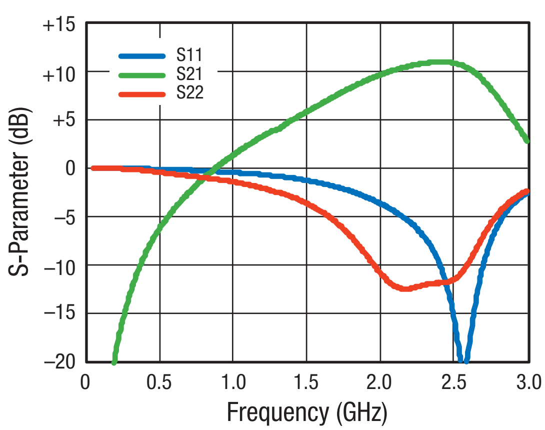

Figure 92. S-Parameters vs Frequency, Tuned for 2450 MHz