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Preliminary

SPF-5043Z

50MHz to 4000MHz, GaAs pHEMT LOW NOISE MMIC AMPLIFIER

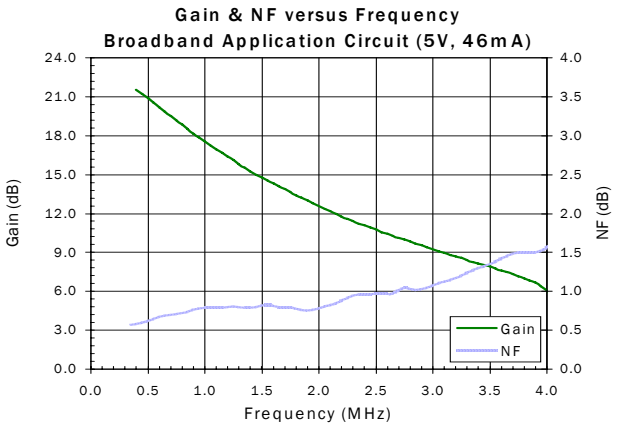
RoHS Compliant and Pb-Free Product

Product Description

The SPF-5043Z is a high performance pHEMT MMIC LNA designed for operation from 50MHz to 4000MHz. The on-chip active bias network provides stable current over temperature and process threshold voltage variations. The SPF-5043Z offers ultra-low noise figure and high linearity performance in a gain block configuration. Its single-supply operation and integrated matching networks make implementation remarkably simple. A high maximum input power specification make it ideal for high dynamic range receivers.

Optimum Technology Matching® Applied

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



Features

- Ultra-Low Noise Figure=0.8dB @ 900MHz
- Gain=18.2dB @ 900MHz
- High Linearity: OIP3=35dBm @ 1900MHz
- P_{1dB}=21dBm @ 1900MHz
- Single-Supply Operation: 5V @ I_{DQ}=46mA
- Flexible Biasing Options: 3V to 5V, Adjustable Current
- Broadband Internal Matching

Applications

- Cellular, PCS, W-CDMA, ISM, WiMAX Receivers
- Low Noise, High Linearity Gain Block Applications

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Small Signal Power Gain		18.2		dB	0.9GHz
		12.9		dB	1.96GHz
Output Power at 1dB Compression		20.0		dBm	0.9GHz
		21.0		dBm	1.9GHz
Output Third Order Intercept Point		33.0		dBm	0.9GHz
		35.0		dBm	1.9GHz
Noise Figure		0.80		dB	0.9GHz
		0.80		dB	1.9GHz
Input Return Loss		-16.0		dB	0.9GHz
		-17.5		dB	1.9GHz
Output Return Loss		-17.5		dB	0.9GHz
		-16.5		dB	1.9GHz
Reverse Isolation		-23.5		dB	0.9GHz
		-19.0		dB	1.9GHz
Device Operating Voltage		5.00	5.25	V	
Device Operating Current (Quiescent)		46		mA	
Thermal Resistance (junction to lead)		125		°C/W	

Test Conditions: V_D=5V, I_{DQ}=46mA, OIP_3 Tone Spacing=1MHz, P_{OUT} per tone=0dBm
Z_S=Z_L=50Ω, 25°C, Broadband Application Circuit

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Absolute Maximum Ratings

Parameter	Rating	Unit
Max Device Current (I_D)	60	mA
Max Device Voltage (V_D)	5.5	V
Max RF Input Power	25	dBm
Max Dissipated Power	330	mW
Max Junction Temperature (T_J)	150	°C
Operating Temperature Range (T_L)	-40 to + 85	°C
Max Storage Temperature	-65 to +150	°C
ESD Rating - Human Body Model (HBM)	Class 1A	
Moisture Sensitivity (MSL)	MSL 1	

Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation, the device voltage and current must not exceed the maximum operating values specified in the table on page one.

Bias Conditions should also satisfy the following expression: $I_D V_D < (T_J - T_L)/R_{TH}$, j-l and T_L=Source lead Temperature

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).

Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=46mA

Parameter	Unit	0.1 GHz*	0.4 GHz	0.9 GHz	1.5 GHz	1.9 GHz	2.2 GHz	2.5 GHz	3.5 GHz	3.8 GHz
Small Signal Gain	dB	23.5	21.6	18.2	14.8	13.1	11.9	10.8	8.0	7.0
Noise Figure	dB	0.65	0.61	0.74	0.82	0.78	0.84	0.96	1.34	1.49
Output IP3	dBm	30.5	31.0	33.0	34.5	35.0	35.5	36.5	38.5	37.5
Output P1dB	dBm	18.5	18.9	19.9	20.7	21.0	21.4	21.7	22.3	22.0
Input Return Loss	dB	-13.0	-12.5	-15.5	-18.0	-17.5	-17.0	-16.0	-11.5	-10.5
Output Return Loss	dB	-22.0	-17.5	-20.0	-18.0	-17.0	-17.0	-16.5	-16.0	-13.5
Reverse Isolation	dB	-27.0	-26.0	-23.5	-20.5	-19.0	-18.0	-17.5	-15.0	-15.0

Test Conditions: V_D=5V, I_{DQ}=46mA, OIP_3 Tone Spacing=1MHz, P_{OUT} per tone=0dBm, T_L=25°C, Z_S=Z_L=50Ω, *Bias Tee Data @ 100MHz

Typical RF Performance - Broadband Application Circuit with V_D=3V, I_D=25mA

Parameter	Unit	0.1 GHz*	0.4 GHz	0.9 GHz	1.5 GHz	1.9 GHz	2.2 GHz	2.5 GHz	3.5 GHz	3.8 GHz
Small Signal Gain	dB	22.6	20.9	17.7	14.4	12.7	11.5	10.5	7.6	6.7
Noise Figure	dB	0.60	0.61	0.73	0.82	0.78	0.85	0.93	1.28	1.48
Output IP3	dBm	26.5	27.0	28.5	30.0	30.5	30.5	32.0	33.5	33.0
Output P1dB	dBm	12.5	16.3	17.5	18.4	19.0	19.3	19.0	19.2	19.2
Input Return Loss	dB	-10.5	-11.0	-14.0	-16.5	-16.5	-16.0	-14.5	-10.5	-9.5
Output Return Loss	dB	-21.0	-21.5	-28.5	-24.5	-22.5	-22.5	-22.5	-20.0	-15.5
Reverse Isolation	dB	-26.0	-25.5	-22.5	-20.0	-18.0	-17.5	-16.5	-14.5	-14.0

Test Conditions: V_D=3V, I_{DQ}=25mA, OIP_3 Tone Spacing=1MHz, P_{OUT} per tone=0dBm, T_L=25°C, Z_S=Z_L=50Ω, *Bias Tee Data @ 100MHz

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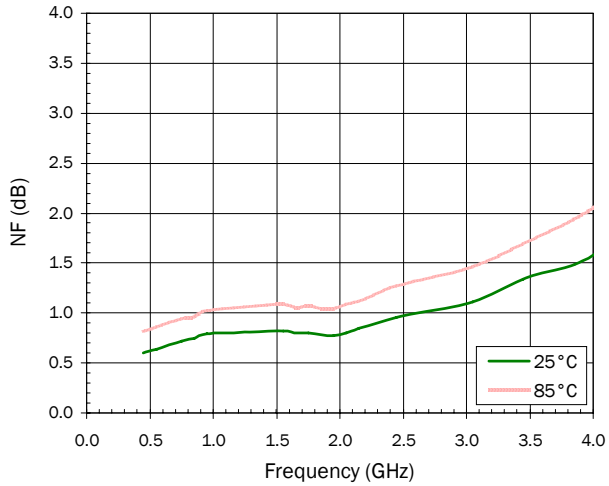
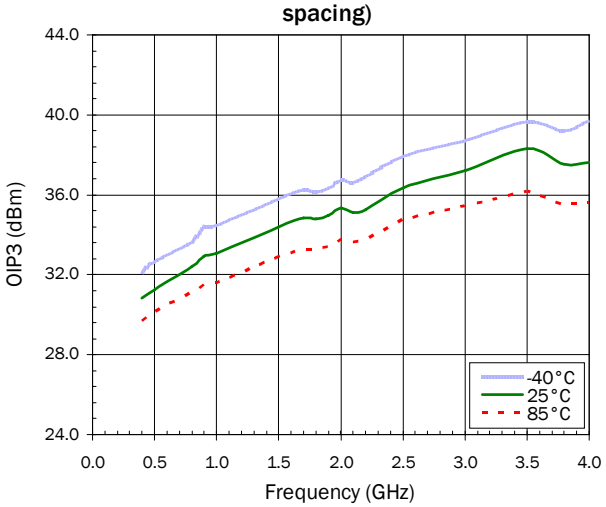
Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=46mA

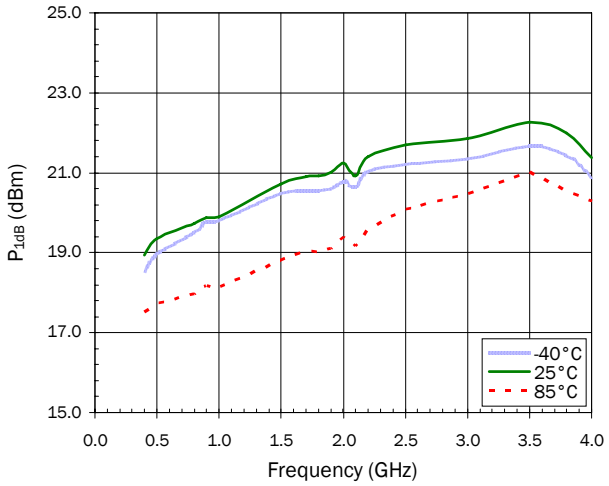
NF versus Frequency



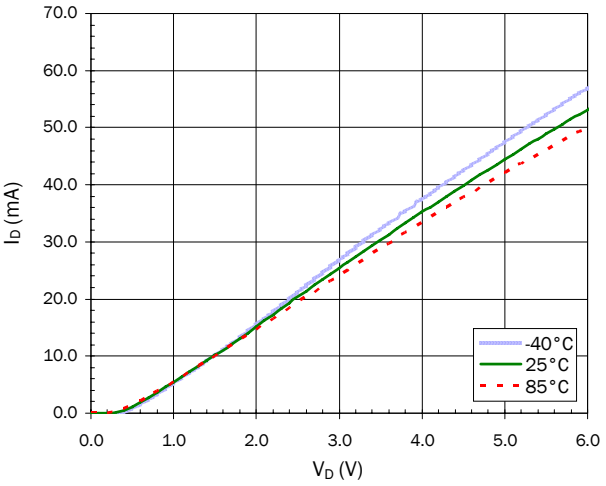
OIP3 versus Frequency (0dBm/tone, 1MHz spacing)



P_{1dB} versus Frequency

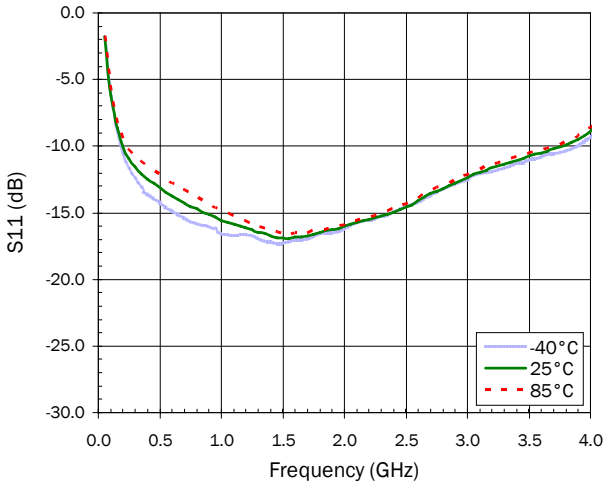


Device Current versus Voltage

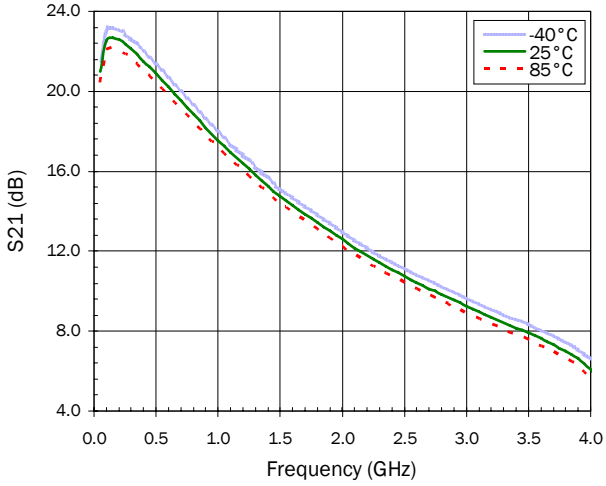


Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=46mA

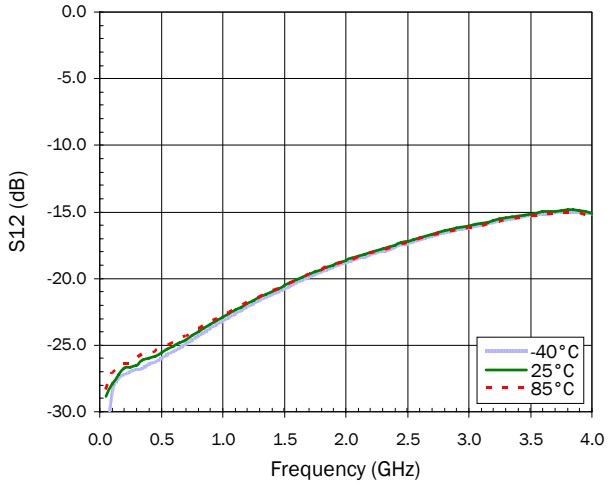
S11 versus Frequency



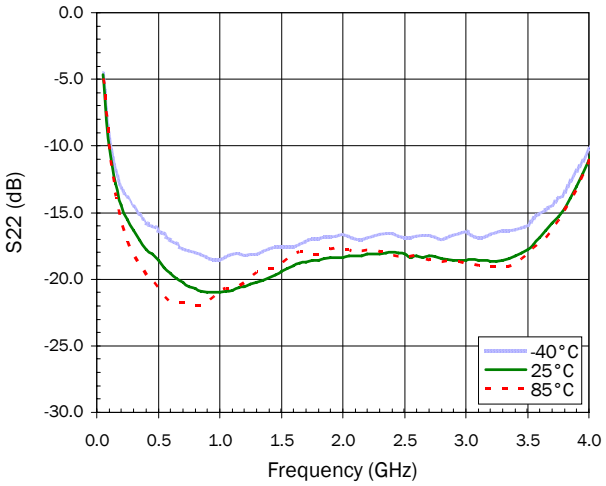
S21 versus Frequency



S12 versus Frequency



S22 versus Frequency



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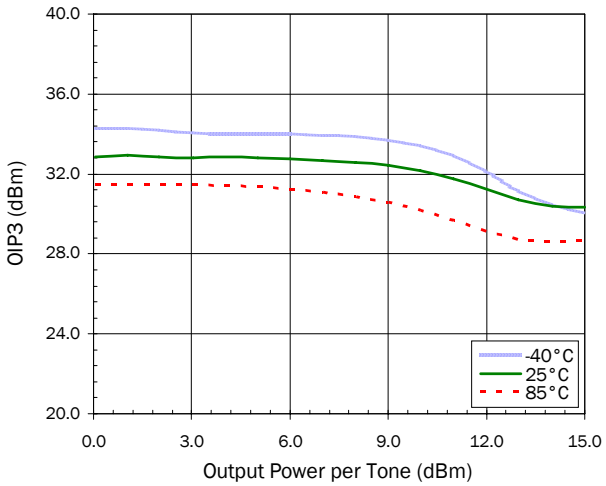
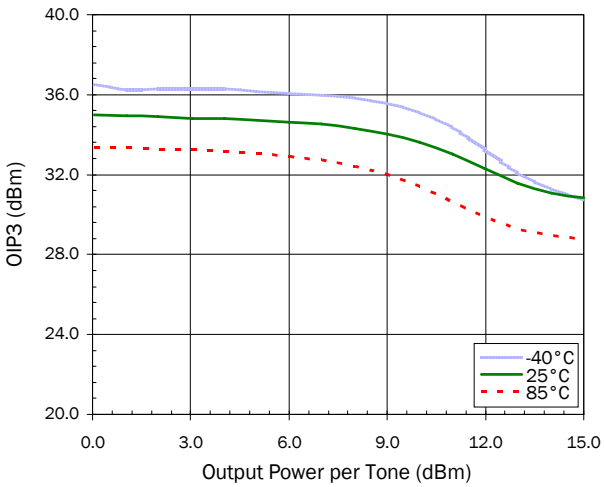
Typical RF Performance - Broadband Application Circuit with V_D=5V, I_D=46mA

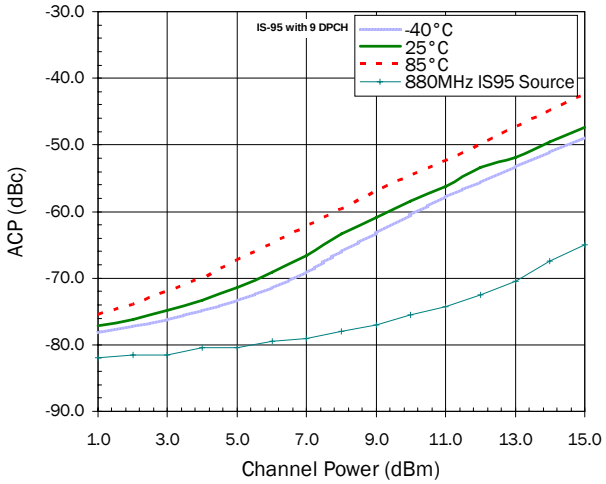
OIP3 versus Power (900MHz, 1MHz spacing)



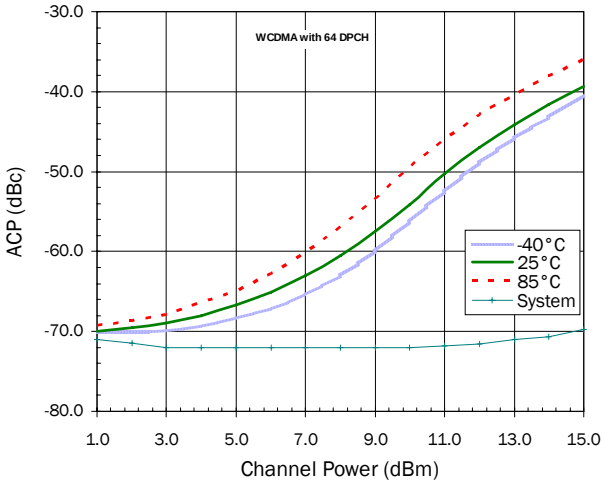
OIP3 versus Power (1900MHz, 1MHz spacing)



ACP vs. Channel Power @880MHz

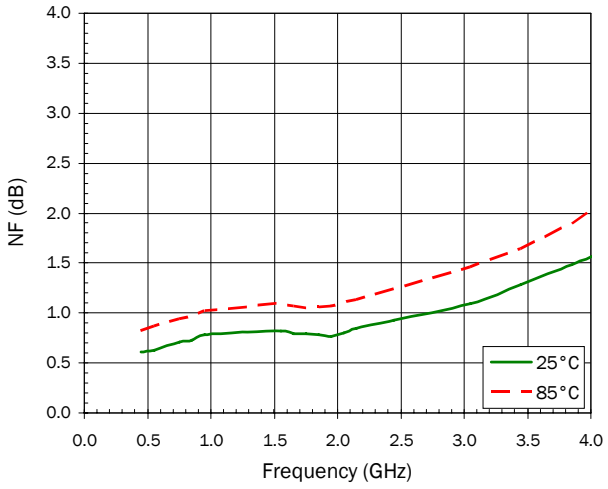


ACP vs. Channel Power @2140MHz

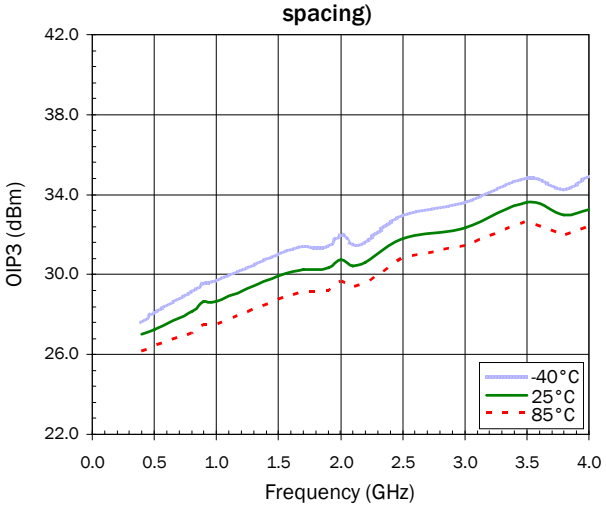


Typical RF Performance - Broadband Application Circuit with V_D=3V, I_D=25mA

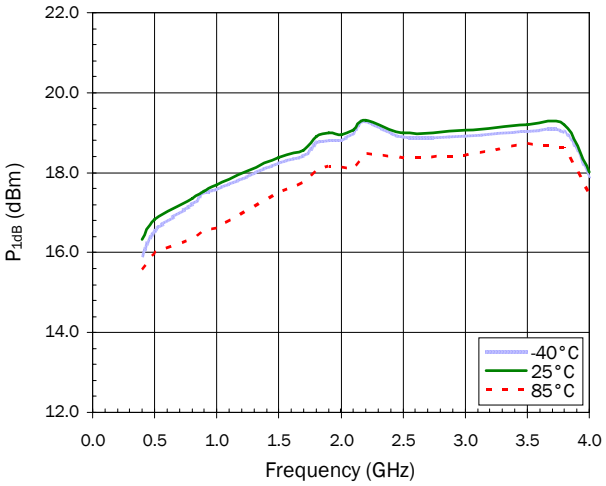
NF vs. Frequency



OIP3 versus Frequency (0dBm/tone, 1MHz spacing)



P_{1dB} versus Frequency



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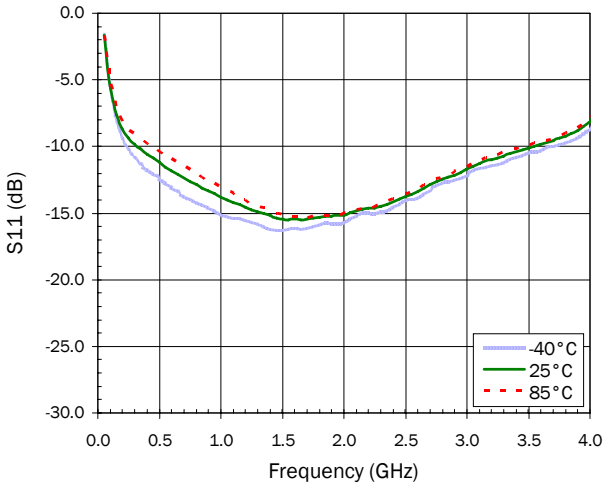
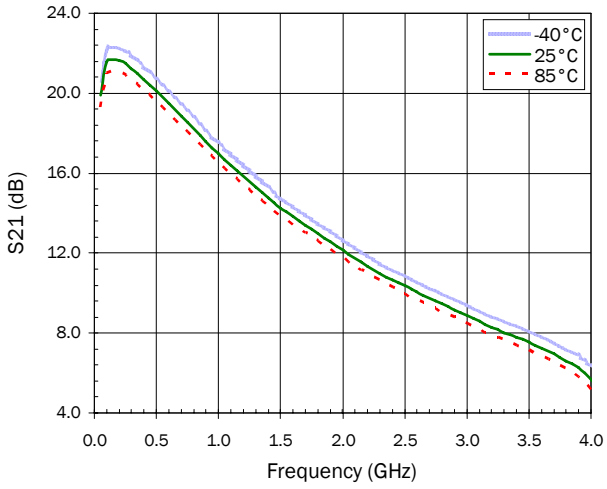
Typical RF Performance - Broadband Application Circuit with V_D=3V, I_D=25mA

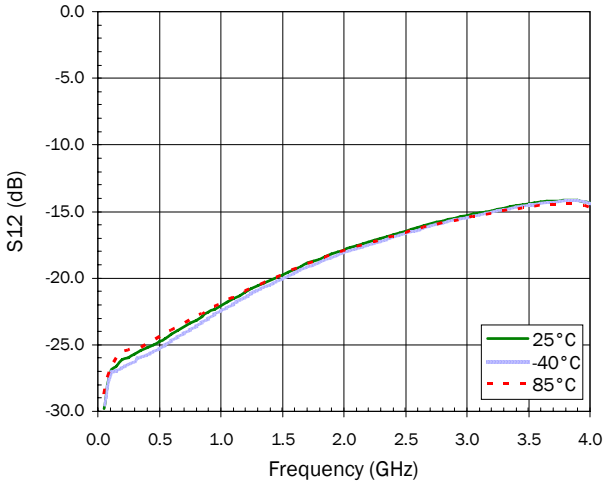
S11 versus Frequency



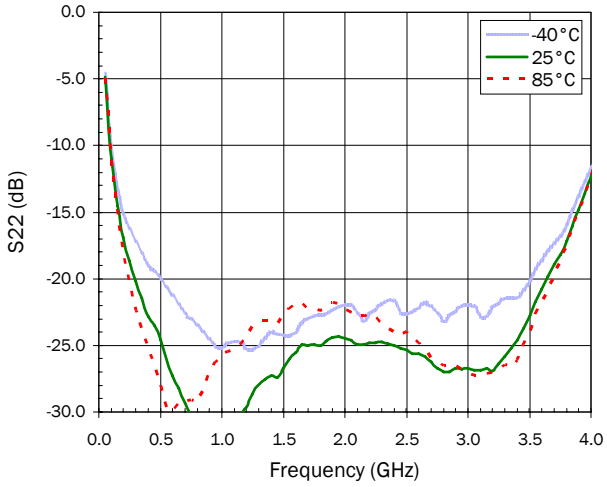
S21 versus Frequency



S12 versus Frequency

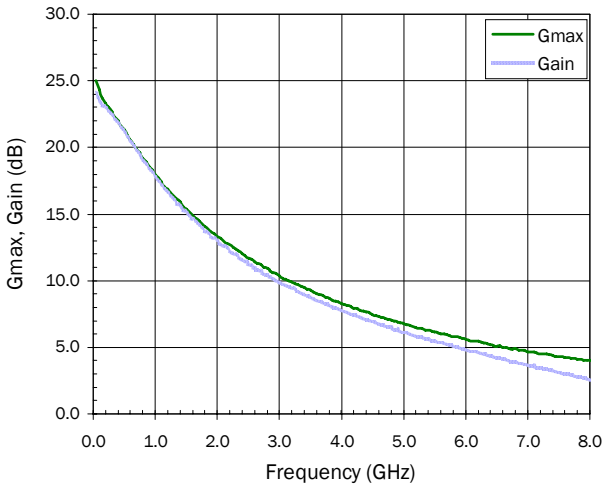


S22 versus Frequency

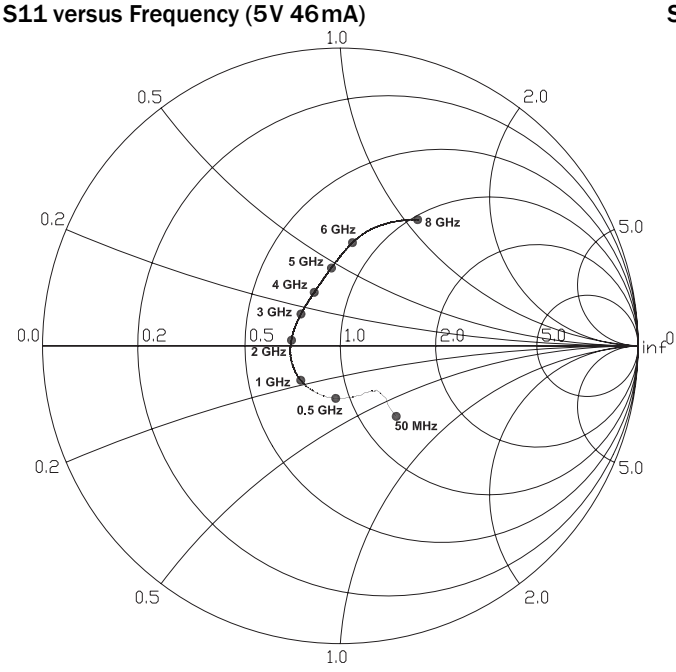


De-embedded Device S-parameters (Bias Tee Data)

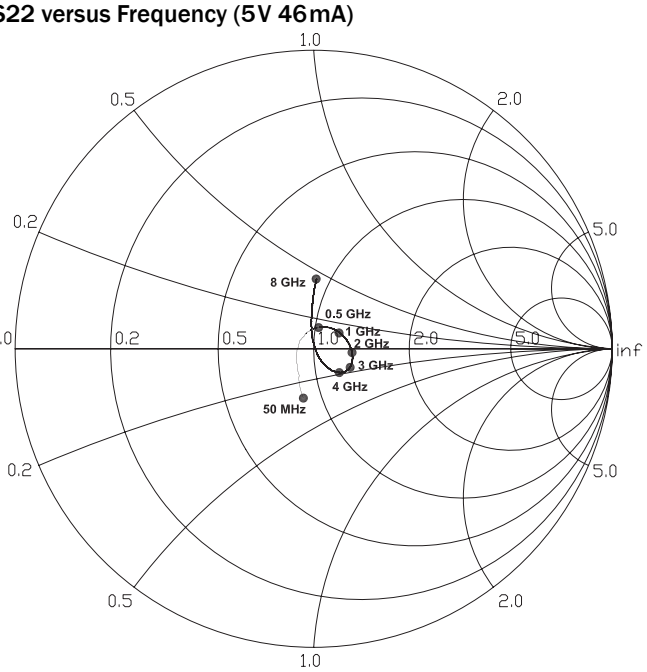
Gmax versus Frequency (5V,46mA)



S11 versus Frequency (5V 46mA)



S22 versus Frequency (5V 46mA)



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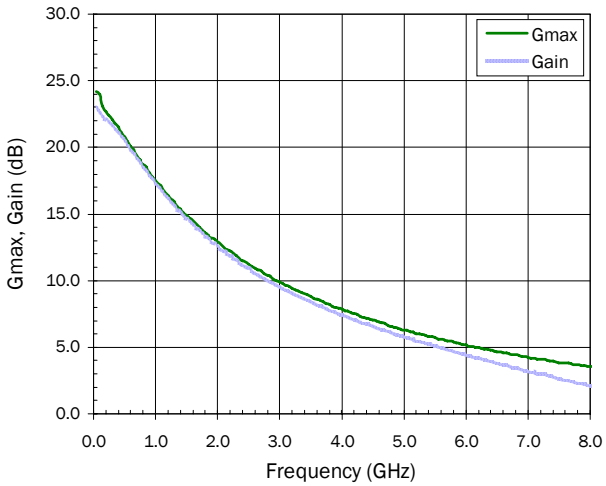
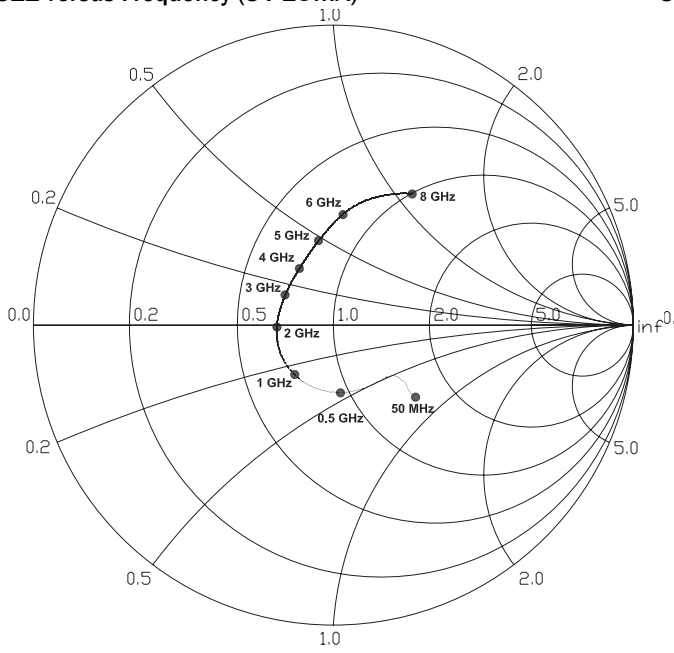
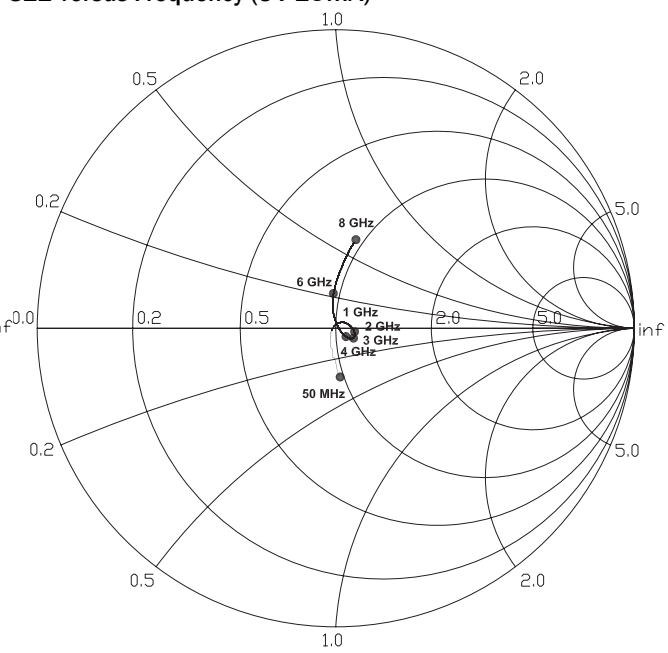
Gmax versus Frequency (3V, 25mA)



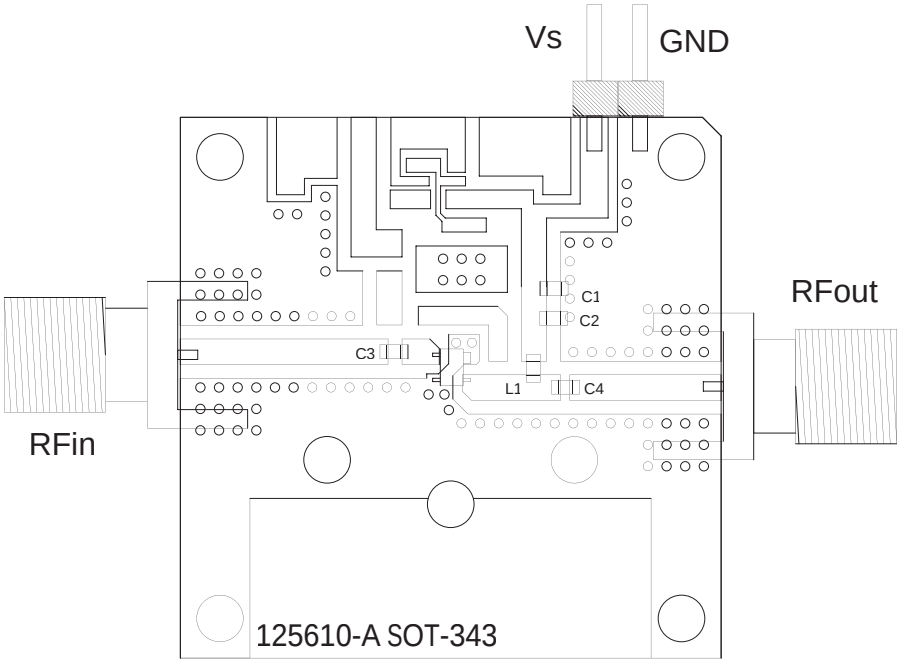
S11 versus Frequency (3V 25mA)



S22 versus Frequency (3V 25mA)



Evaluation Board Layout and Bill of Materials

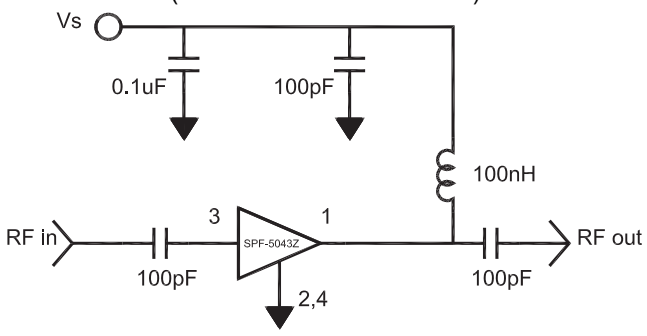


Bill of Materials (SPF-5043Z, 400-3000MHz)

C1	TAJB104KLRH, Rohm, 0.1uF
C2	MCH185A101JK, Rohm, 100pF
C3	MCH185A101JK, Rohm, 100pF
C4	MCH185A101JK, Rohm, 100pF
L1	LL1608-FSR10J, Toko, 100nH
PCB	125610-A

Application Schematic

(400MHz to 3000MHz)



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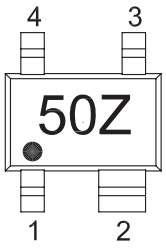
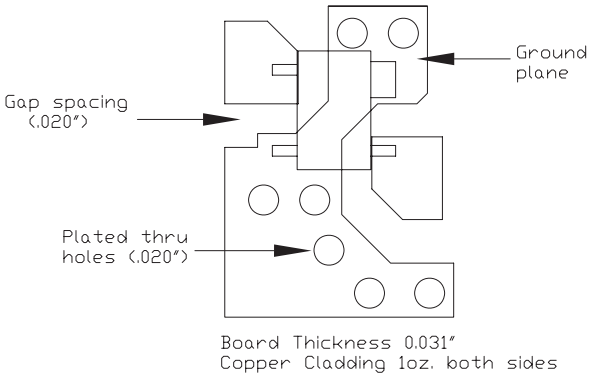
Pin	Function	Description
1	RF OUT/BIAS	RF output and Bias pin. This pin is DC coupled and matched to 50Ω. Bias is applied through this pin.
2,4	GND	Connection to ground.
3	RF IN	RF input pin. This pin is DC coupled and matched to 50Ω. An external DC block is required.

Part Identification

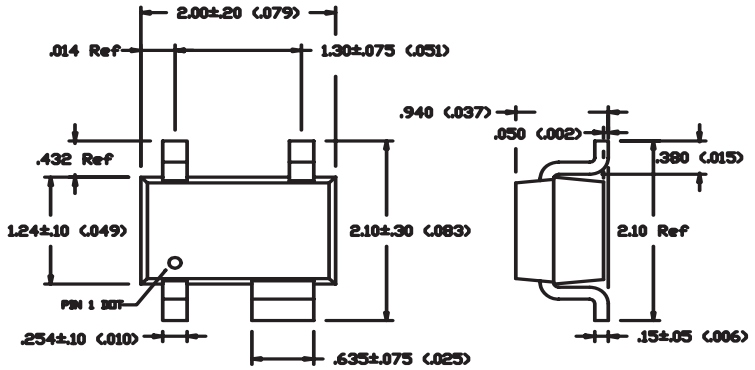


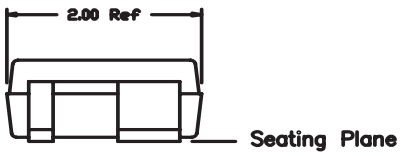
Suggested Pad Layout



Package Drawing

Dimensions in inches (millimeters)
Refer to drawing posted at www.rfmd.com for tolerances.





Scale (mm) 1:2

Notes:
1. Lead Base Metal - Copper Olin 194
2. Lead Finish
   Std PN - Sn/Pb Sn => 80%
   Z Option - 100% Matte Sn - .010 (.0004) min thk

Ordering Information

Part Number	Description	Reel Size	Devices/Reel
SPF-5043Z	Lead Free, RoHS Compliant	7"	3000
SPF-5043Z-EVB1	400MHz to 3000MHz Evaluation Board	N/A	N/A

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