



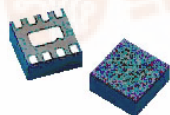
rfmd.com

Preliminary

SPF-5122Z

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

RoHS Compliant and Pb-Free Product

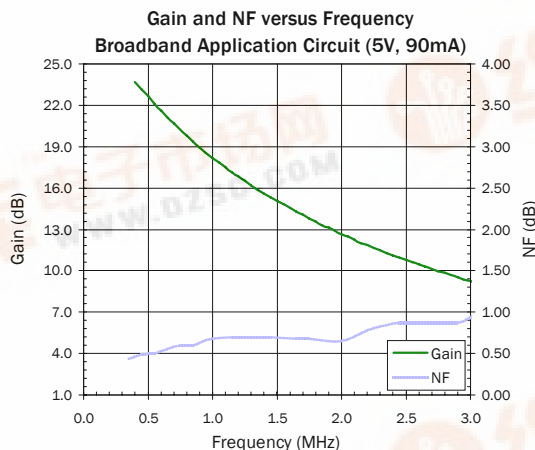


Product Description

The SPF-5122Z 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-5122Z 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=0.60dB @ 900MHz
- Gain=18.9dB @ 900MHz
- High Linearity: OIP3=40.5dBm @ 1900MHz
- Channel Power=13.4dBm (-65dBc IS95 ACPR, 880MHz)
- P_{1dB} =23.4dBm @ 1900MHz
- Single-Supply Operation: 5V @ I_{DQ} =90mA
- Flexible Biasing Options: 3-5V, Adjustable Current
- Broadband Internal Matching

Applications

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

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Small Signal Power Gain		18.9		dB	0.9GHz
		12.9		dB	1.96GHz
Output Power at 1dB Compression		23.0		dBm	0.9GHz
		23.4		dBm	1.9GHz
Output Third Order Intercept Point		37.9		dBm	0.9GHz
		40.5		dBm	1.9GHz
Noise Figure		0.59		dB	0.9GHz
		0.64		dB	1.9GHz
Input Return Loss		-14.6		dB	0.9 GHz
		-21.0		dB	1.9GHz
Output Return Loss		-16.8		dB	0.9GHz
		-13.0		dB	1.9GHz
Reverse Isolation		-24.1		dB	0.9GHz
		-18.4		dB	1.9GHz
Device Operating Voltage		5.00	5.25	V	
Device Operating Current		90		mA	Quiescent
Thermal Resistance		65		°C/W	Junction to lead

Test Conditions: V_D =5V, I_{DQ} =90mA, OIP₃ Tone Spacing=1MHz, P_{OUT} per tone=0dBm
 Z_S = Z_L =50Ω, 25°C, Broadband Application Circuit



Absolute Maximum Ratings

Parameter	Rating	Unit
Max Device Current (I_D)	120	mA
Max Device Voltage (V_D)	5.5	V
Max RF Input Power	27	dBm
Max Dissipated Power	660	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 1B	
Moisture Sensitivity Level (MSL)	MSL 1	

**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 EU Directive 2002/95/EC (at time of this document revision).

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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:

$$I_D V_D < (T_J - T_L) / R_{TH}, j-I \text{ and } T_L = T_{LEAD}$$

Typical RF Performance - Broadband Application Circuit with $V_D=5V$, $I_D=90mA$

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	27.0	24.0	19.0	15.0	13.0	12.0	11.0	6.0	7.0
Noise Figure	dB	0.42	0.47	0.59	0.70	0.64	0.73	0.86	1.35	1.27
Output IP3	dBm	33.0	36.0	38.0	39.5	40.5	41.0	41.5	40.5	41.5
Output P1dB	dBm	22.3	22.7	23.0	23.2	23.4	23.7	23.9	22.2	22.9
Input Return Loss	dB	-9.5	-10.0	-14.5	-20.0	-21.0	-22.0	-22.5	-15.0	-11.5
Output Return Loss	dB	-29.0	-19.5	-17.0	-14.0	-13.0	-12.5	-12.5	-7.5	-15.5
Reverse Isolation	dB	-32.0	-29.0	-24.0	-20.0	-18.5	-17.5	-16.5	-15.5	-13.5

Test Conditions: $V_D=5V$, $I_{DQ}=90mA$, OIP₃ Tone Spacing=1MHz, P_{OUT} per tone=0dBm, $T_L=25^\circ C$, $Z_S=Z_L=50\Omega$, *Bias Tee Data @ 100MHz

1. Input RL can be improved in the 800MHz to 1000MHz band by adding a series inductor between the DC block and device input.

Typical RF Performance - Broadband Application Circuit with $V_D=3V$, $I_D=58mA$

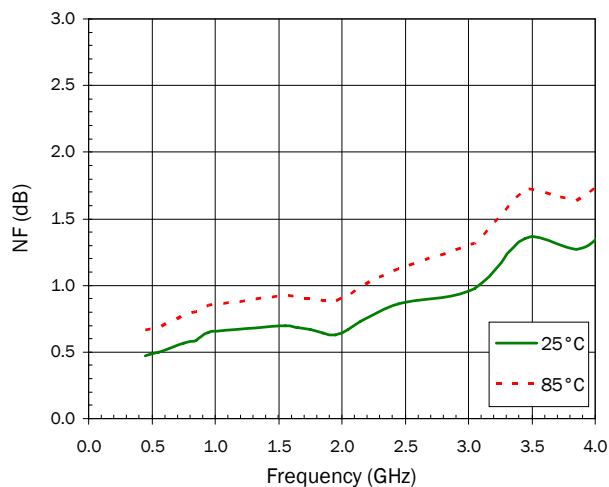
Parameter	Unit	0.1 GHz*	0.4 GHz	0.9 GHz	1.5 GHz	1.9 GHz	2.2 GHz	2.5 GHz	3.5 GHz	3.8 GHz
Small Signal Gain	dB	26.0	23.0	18.5	14.5	12.5	11.5	10.5	6.0	6.5
Noise Figure	dB	0.35	0.44	0.58	0.65	0.61	0.69	0.79	1.25	1.19
Output IP3	dBm	31.5	33.0	34.5	36.0	36.5	37.0	37.5	37.0	37.5
Output P1dB	dBm	18.8	18.9	19.1	19.4	19.9	20.2	20.1	18.9	19.2
Input Return Loss	dB	-8.0	-9.0	-13.0	-16.5	-18.5	-19.0	-19.0	-13.5	-10.0
Output Return Loss	dB	-26.0	-28.5	-23.5	-18.0	-16.5	-16.0	-15.5	-9.0	-14.0
Reverse Isolation	dB	-31.0	-28.0	-23.0	-19.0	-17.5	-16.0	-15.0	-14.5	-12.5

Test Conditions: $V_D=3V$, $I_{DQ}=58mA$, OIP₃ Tone Spacing=1MHz, P_{OUT} per tone=0dBm, $T_L=25^\circ C$, $Z_S=Z_L=50\Omega$, *Bias Tee Data @ 100MHz

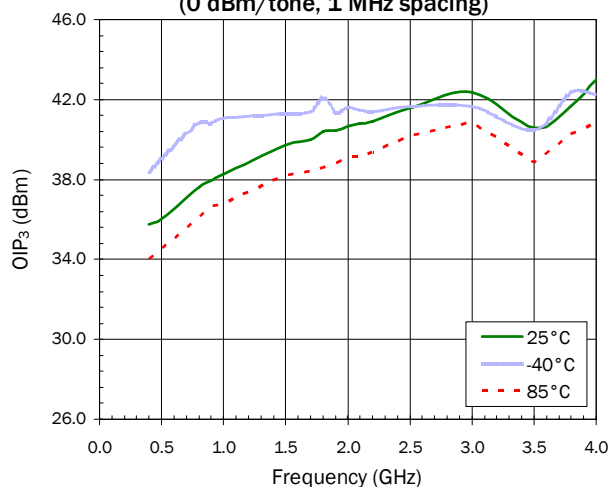
1. Input RL can be improved in the 800MHz to 1000MHz band by adding a series inductor between the DC block and device input.

Typical RF Performance - Broadband Application Circuit with $V_D = 5V$, $I_D = 90mA$

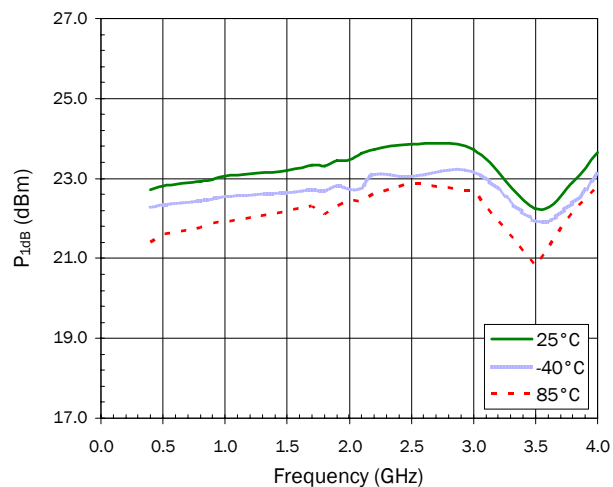
NF versus Frequency



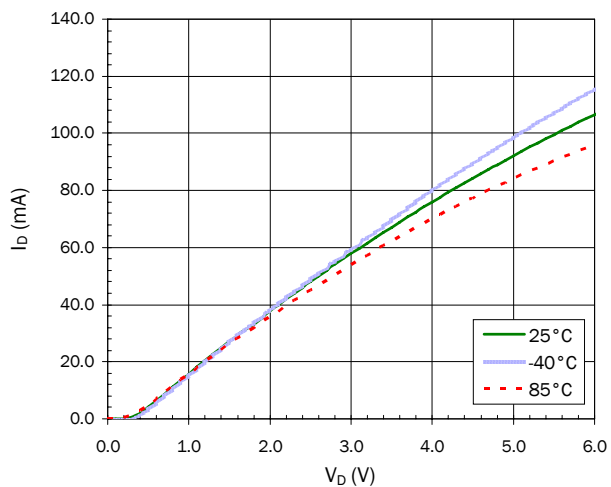
OIP₃ versus Frequency
(0 dBm/tone, 1 MHz spacing)



P_{1dB} versus Frequency



Device Current versus Voltage



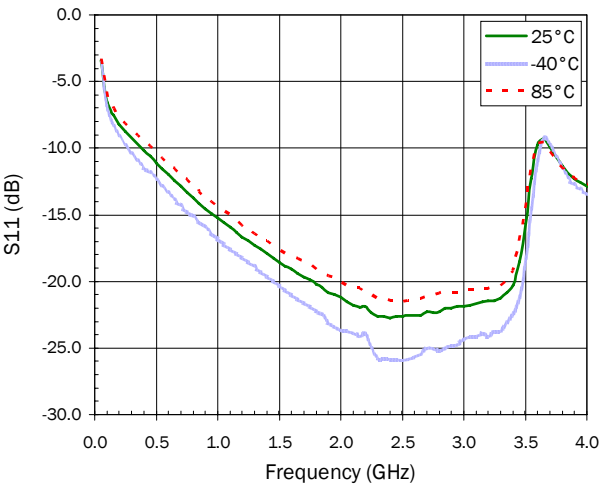
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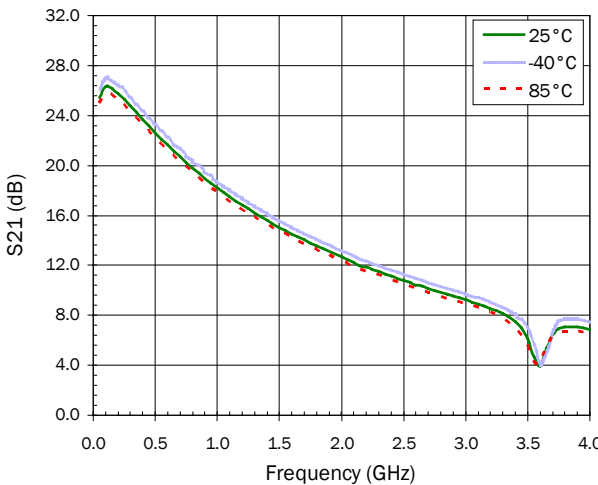


Typical RF Performance - Broadband Application Circuit with $V_D=5V$, $I_D=90mA$

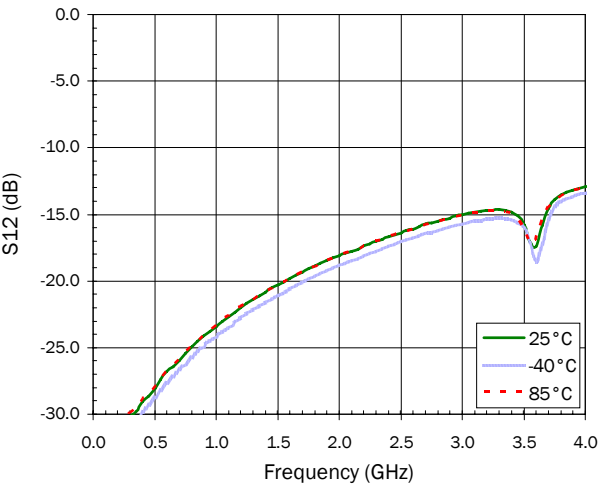
S11 versus Frequency



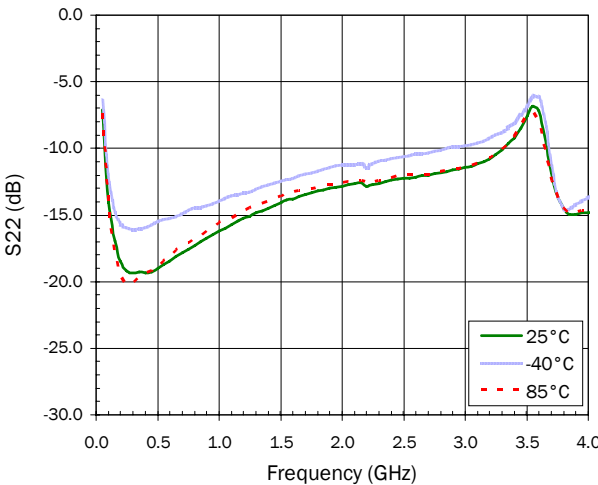
S21 versus Frequency



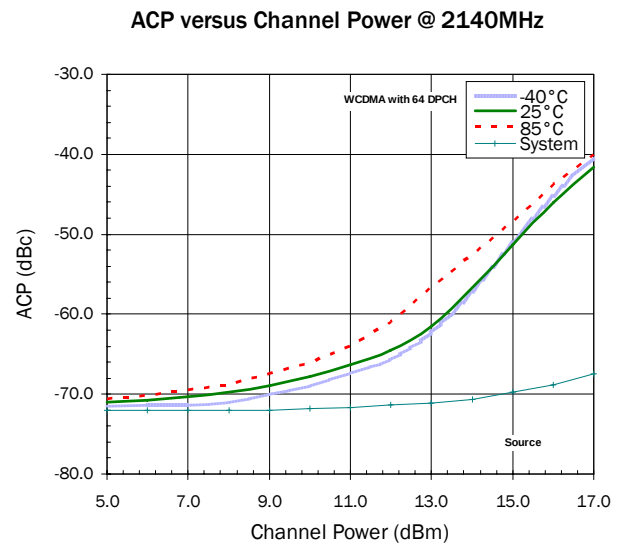
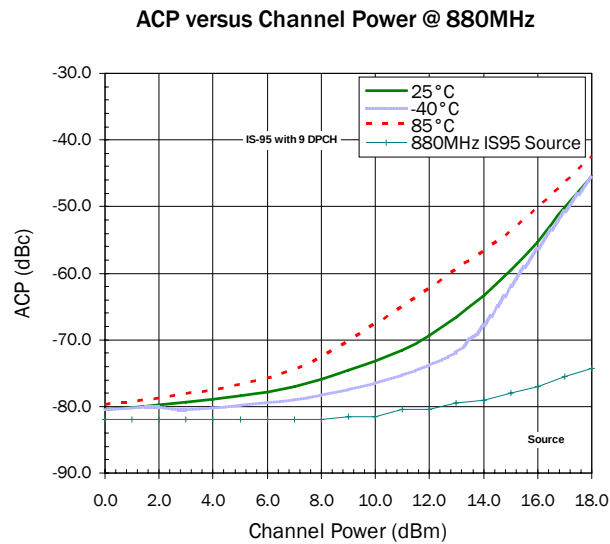
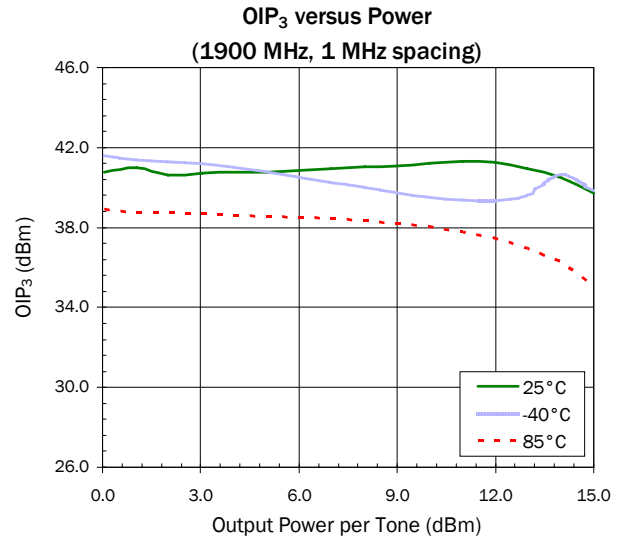
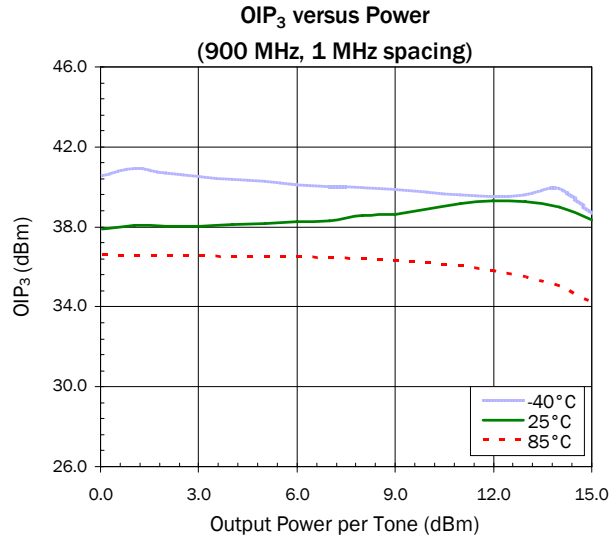
S12 versus Frequency



S22 versus Frequency



Typical RF Performance - Broadband Application Circuit with $V_D=5V$, $I_D=90mA$

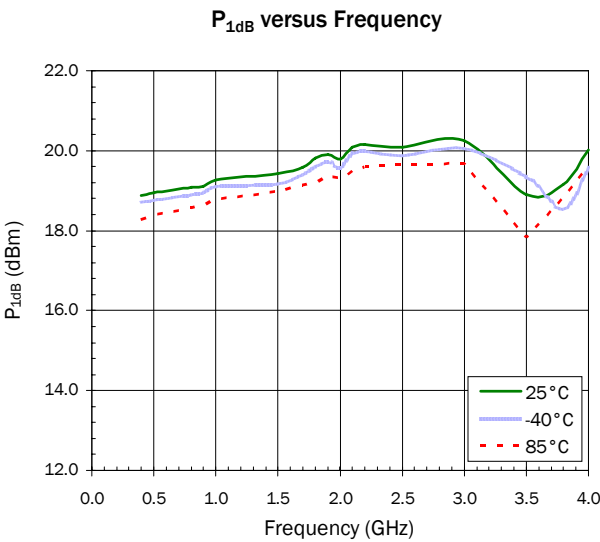
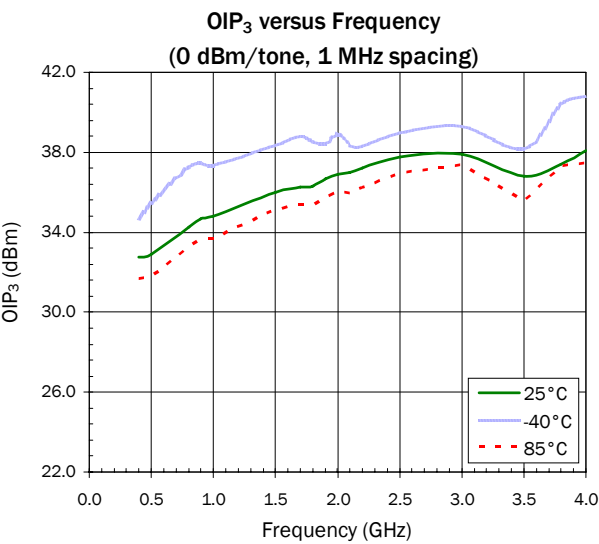
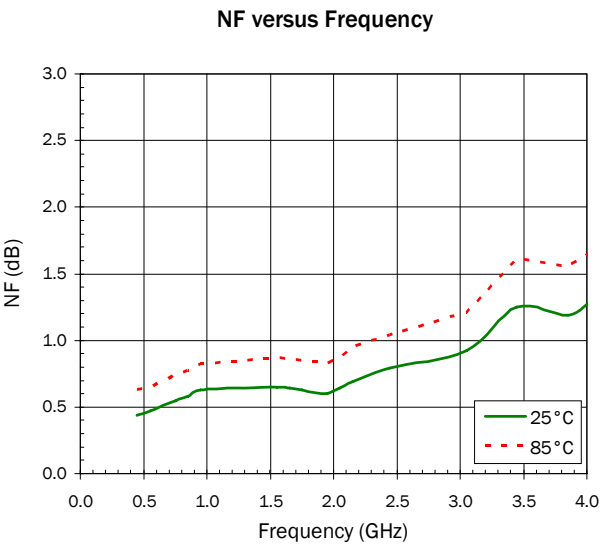


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Typical RF Performance - Broadband Application Circuit with $V_D=3V$, $I_D=58mA$



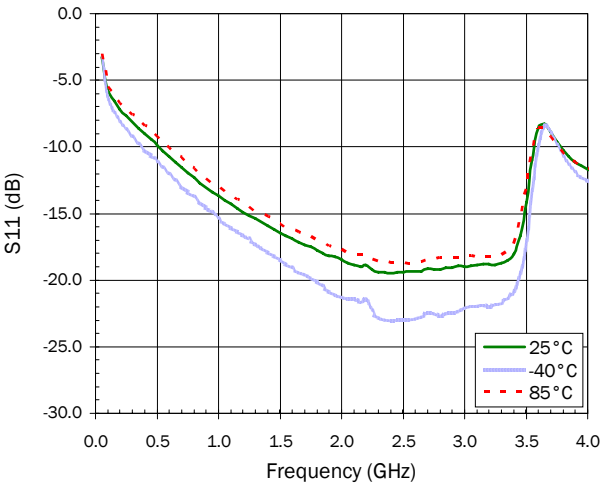
SPF-5122Z

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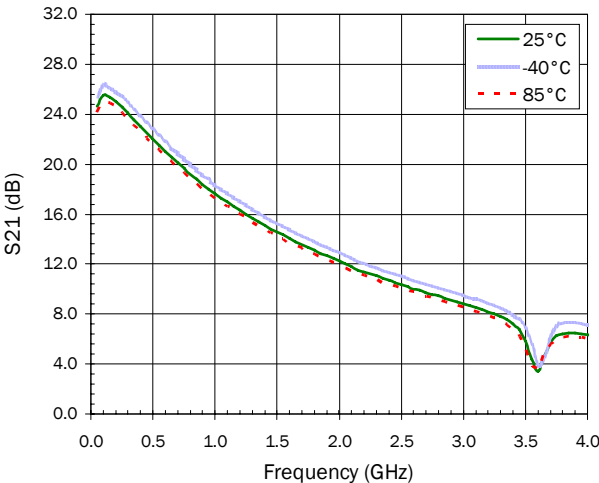


Typical RF Performance - Broadband Application Circuit with $V_D=3V$, $I_D=58mA$

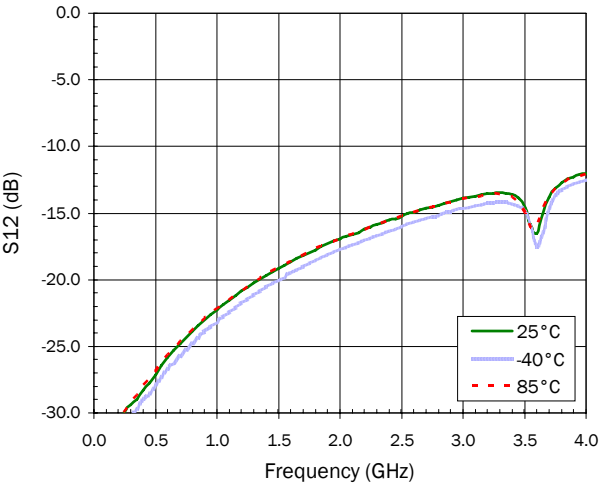
S11 versus Frequency



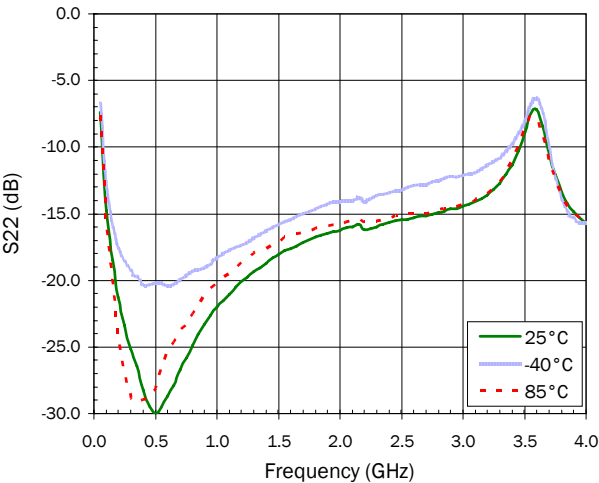
S21 versus Frequency



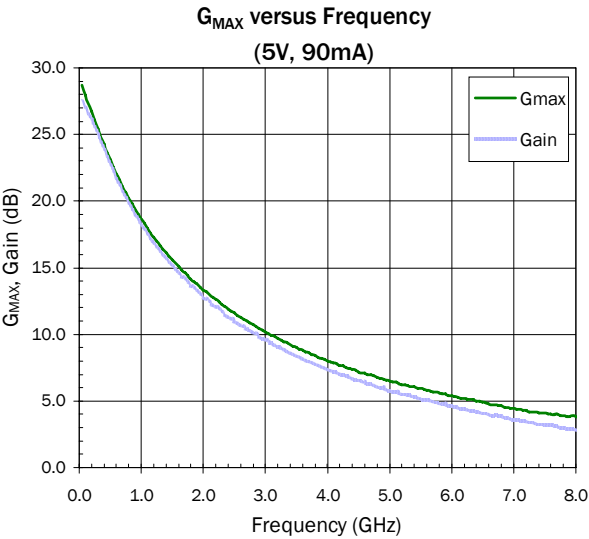
S12 versus Frequency



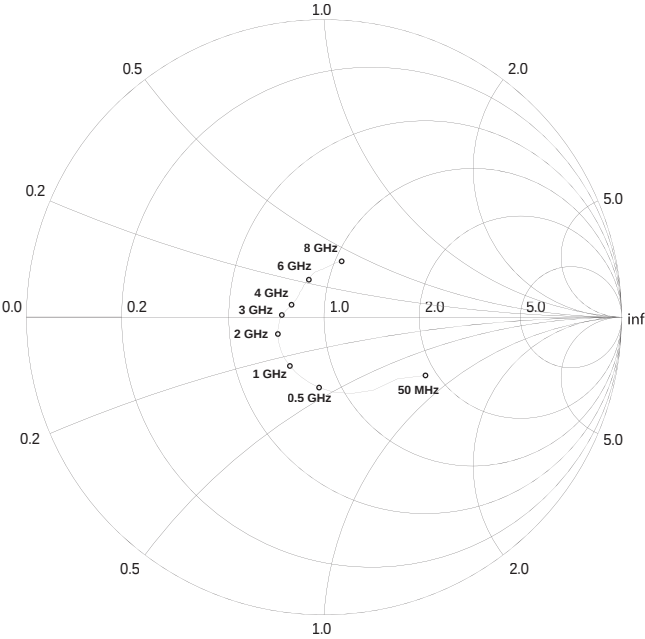
S22 versus Frequency



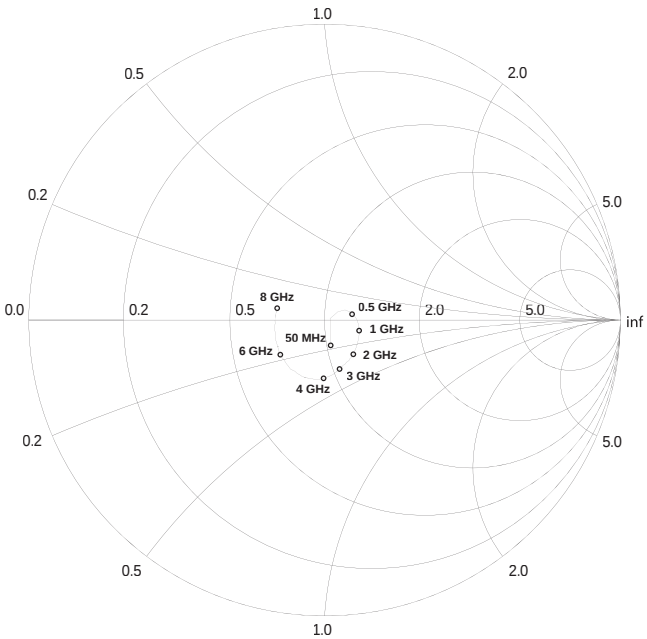
De-embedded Device S-parameters (Bias Tee Data)

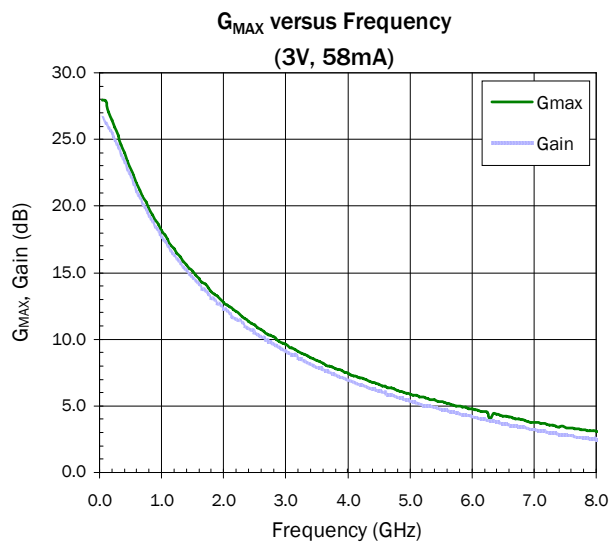


S11 versus Frequency (5V 46mA)

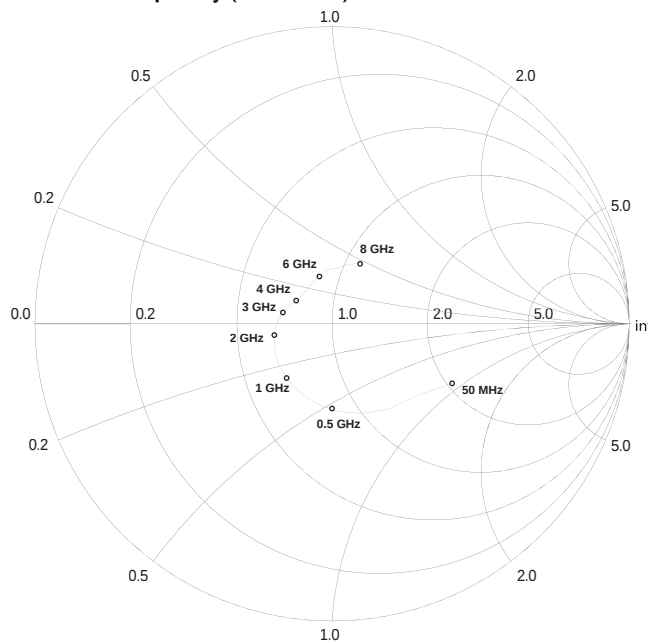


S22 versus Frequency (5V 46mA)

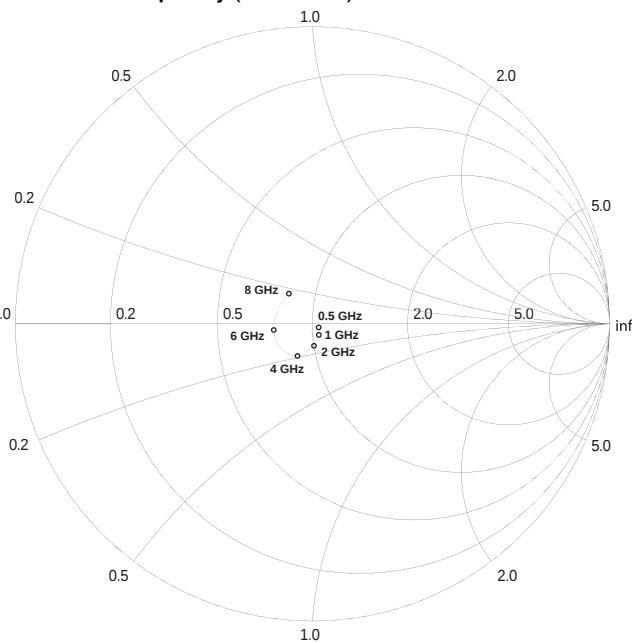




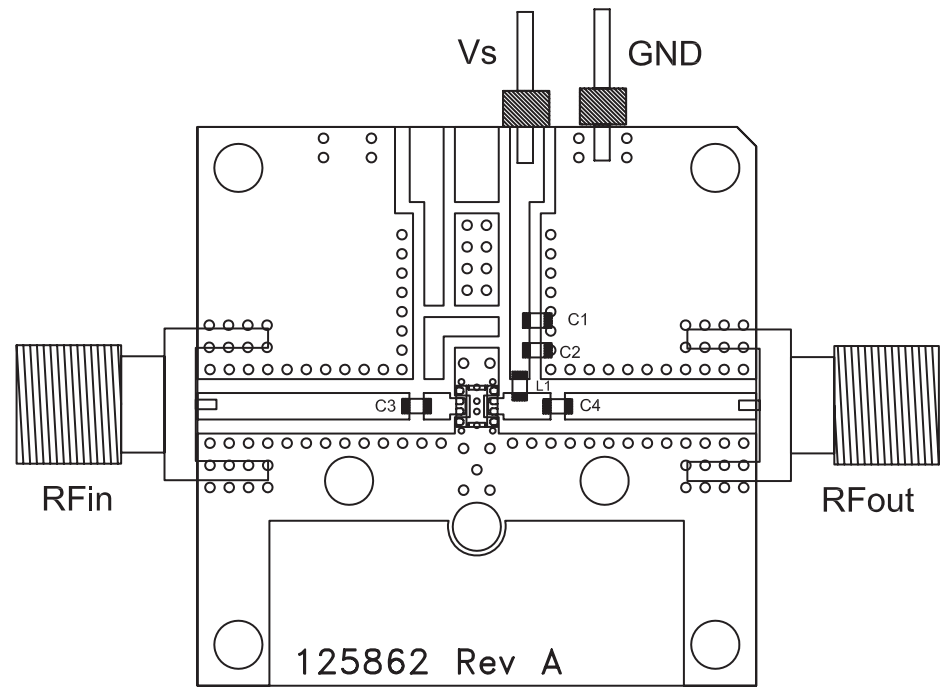
S₁₁ versus Frequency (3V 25mA)



S₂₂ versus Frequency (3V 25mA)



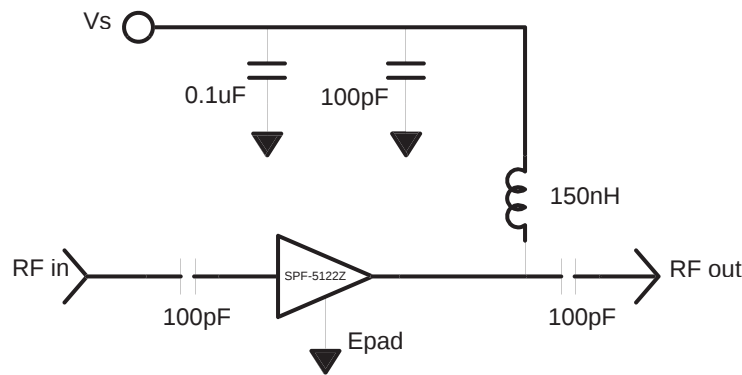
Evaluation Board Layout and Bill of Materials



Bill of Materials (SPF-5122Z, 400MHz to 3000MHz)

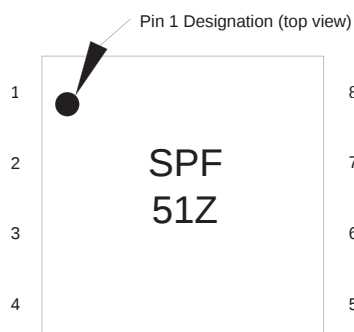
- C1 TAJB104KLRH, Rohm, 0.1uF
- C2 MCH185A101JK, Rohm, 100pF
- C3 MCH185A101JK, Rohm, 100pF
- C4 MCH185A101JK, Rohm, 100pF
- L1 LL1608-FSR15J, Toko, 150nH
- PCB 125862-A

Application Schematic
(400MHz to 3000MHz)

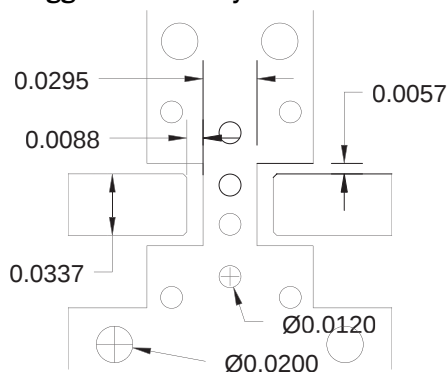


Pin	Function	Description
1,3,5,6,8	N/A	Ground or No-Connect. No connection internal
2	RF IN	RF Input, DC coupled and matched to 50Ω. An external DC block is required.
4	N/A	Ground or No-Connect. Internally Grounded.
7	RF OUT/BIAS	RF Output, Bias applied through this pin. Matched to 50Ω.
EPAD	GND	EPAD must be conductively attached to RF and DC ground.

Part Identification



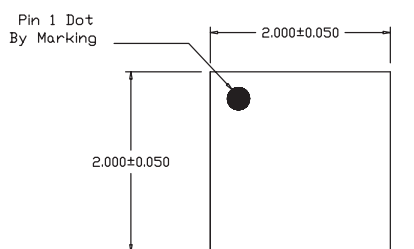
Suggested Pad Layout



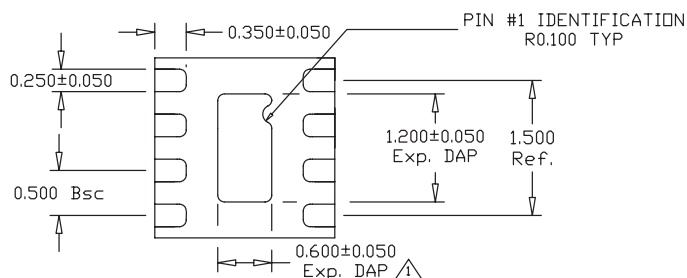
Package Drawing

Dimensions in inches (millimeters)

Refer to drawing posted at www.rfmd.com for tolerances.



TOP VIEW



BOTTOM VIEW

- Notes:
1. LF Base Metal - In 194
 2. Exterior Plating
Basic PN - Sn/Pb 85/15
Z Option - 100% Matte Sn
 3. Flammability Rating
94V0
 4. Marking
Laser or White Phenolic Ink.



SIDE VIEW

Ordering Information

Part Number	Description	Reel Size	Devices/Reel
SPF-5122Z	Lead Free, RoHS Compliant	7"	3000
SPF-5122Z-EVB1	400MHz to 3000MHz Evaluation Board	N/A	N/A

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