1.5/1.9GHz BAND LOW NOISE AMPLIFIER GaAs MMIC

■GENERAL DESCRIPTION

NJG1107KB2 is a Low Noise Amplifier GaAs MMIC designed for 1.5GHz and 1.9GHz band digital cellular phone and Japanese PHS handsets. This amplifier provides low noise figure, high gain and high IP3 operated by single low positive power supply.

This amplifier includes internal self-bias circuit and input DC blocking capacitor.

An ultra small and ultra thin package of FLP6 is adopted.

■PACKAGE OUTLINE

NJG1107KB2

■APPLICATIONS

Cellular phone and Japanese PHS handsets

GNSS application, like GPS, Galileo, GLONASS and COMPASS

Note: For GNSS application please refer to Application Note

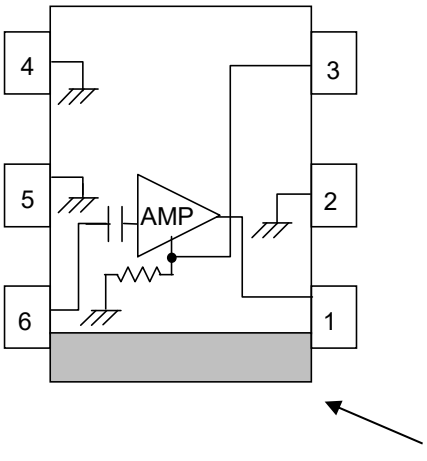
■FEATURES

●Low voltage operation	+2.7V typ.
●Low current consumption	3.0mA typ.
●High small signal gain	17dB typ. @f=1.49GHz 15dB typ. @f=1.96GHz
●Low noise figure	1.2dB typ. @f=1.49GHz 1.2dB typ. @f=1.96GHz
●High Input IP3	-4.0dBm typ. @f=1.4900+1.4901GHz -2.0dBm typ. @f=1.9600+1.9601GHz
●Ultra small & ultra thin package	FLP6-B2 (Mount Size: 2.1x2.0x0.75mm)

● This amplifier can be tuned into various frequency range.(Best for 1.5GHz or 1.9GHz Band)

■PIN CONFIGURATION

KB2 Type
(Top View)



PIN Connection
1.RFout
2.GND
3.EXTCAP
4.GND
5.GND
6.RFin

Note: Specifications and description listed in this catalog are subject to change without prior notice.

■ABSOLUTE MAXIMUM RATINGS

(T_a=+25°C, Z_s=Z_l=50Ω)

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNIT
Drain Voltage	V_{DD}		6.0	V
Input Power	Pin	V_{DD}=2.7V	+15	dBm
Power Dissipation	P_D		450	mW
Operating Temp.	T_{opr}		-40~+85	°C
Storage Temp.	T_{stg}		-55~+125	°C

■ELECTRICAL CHARACTERISTICS 1 (1.5GHz Band)

(V_{DD}=2.7V, f=1.49GHz, T_a=+25°C, Z_s=Z_l=50Ω, TEST CIRCUIT1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Frequency	freq1		1.47	1.49	1.51	GHz
Drain Voltage	V_{DD}		2.5	2.7	5.5	V
Operating Current	I_{DD}	RF OFF	-	3.0	3.8	mA
Small Signal Gain	Gain		15.0	17.0	19.0	dB
Gain Flatness	G_{flat}	f=1.47~1.51GHz	-	0.5	1.0	dB
Noise Figure	NF		-	1.2	1.4	dB
Pout at 1dB Gain Compression point	P_{-1dB}		-6.0	-2.0	-	dBm
Input 3rd Order Intercept Point	IIP3	f=1.49+1.4901GHz RFin=-35dBm	-6.0	-4.0	-	dBm
RF Input Port VSWR	$VSWR_i$		-	1.6	2.2	
RF Output Port VSWR	$VSWR_o$			1.6	2.2	

■ELECTRICAL CHARACTERISTICS 2 (1.9GHz Band)

(V_{DD}=2.7V, f=1.96GHz, T_a=+25°C, Z_s=Z_l=50Ω, TEST CIRCUIT1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Frequency	freq2		1.89	1.96	1.99	GHz
Drain Voltage	V_{DD}		2.5	2.7	5.5	V
Operating Current	I_{DD}	RF OFF	-	3.0	3.8	mA
Small Signal Gain	Gain		13.0	15.0	17.0	dB
Gain Flatness	G_{flat}	f=1.89~1.99GHz	-	0.5	1.0	dB
Noise Figure	NF		-	1.2	1.4	dB
Pout at 1dB Gain Compression point	P_{-1dB}		-3.0	+1.0	-	dBm
Input 3rd order Intercept Point	IIP3	f=1.96+1.9601GHz RFin=-30dBm	-6.0	-2.0	-	dBm
RF Input Port VSWR	$VSWR_i$		-	1.6	2.2	
RF Output Port VSWR	$VSWR_o$		-	1.6	2.2	

■**ELECTRICAL CHARACTERISTICS 3 (1.8GHz Band)**

(V_{DD}=2.7V, f=1.76GHz, T_a=+25°C, Z_s=Z_l=50Ω, TEST CIRCUIT1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Frequency	freq3		1.75	1.76	1.78	GHz
Drain Voltage	V_{DD}		2.5	2.7	5.5	V
Operating Current	I_{DD}	RF OFF	-	3.0	3.8	mA
Small Signal Gain	Gain		-	16.0	-	dB
Gain Flatness	G_{flat}	f=1.75~1.78GHz	-	0.5	-	dB
Noise Figure	NF		-	1.2	-	dB
Pout at 1dB Compression point	P_{-1dB}		-	1.1	-	dBm
Input 3rd order Intercept Point	IIP3	f=1.76+1.7601GHz RFin=-35dBm	-	-2.0	-	dBm
RF Input Port VSWR	$VSWR_i$		-	1.6	-	-
RF Output Port VSWR	$VSWR_o$		-	1.6	-	-

■**ELECTRICAL CHARACTERISTICS 4 (1.5GHz Band ,Low Gain Version)**

(V_{DD}=2.7V, f=1.49GHz, T_a=+25°C, Z_s=Z_l=50Ω, TEST CIRCUIT2)

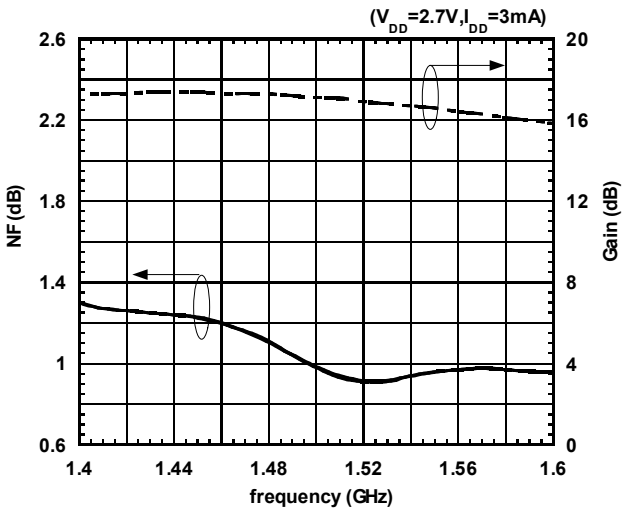
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Operating Frequency	freq4		1.47	1.49	1.51	GHz
Drain Voltage	V_{DD}		2.5	2.7	5.5	V
Operating Current	I_{DD}	RF OFF	-	3.0	3.8	mA
Small Signal Gain	Gain		-	14.0	-	dB
Gain Flatness	G_{flat}	f=1.47~1.51GHz	-	0.5	-	dB
Noise Figure	NF		-	1.2	-	dB
Pout at 1dB Compression point	P_{-1dB}		-	0.0	-	dBm
Input 3rd order Intercept Point	IIP3	f=1.49+1.4901GHz RFin=-35dBm	-	-3.0	-	dBm
RF Input Port VSWR	$VSWR_i$		-	1.6	-	
RF Output Port VSWR	$VSWR_o$		-	1.6	-	

■PIN CONFIGURATION

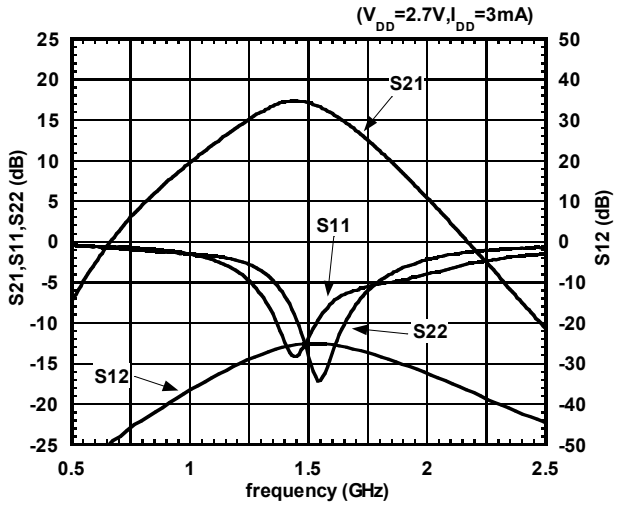
Pin	Function	Description
1	RFout	RF output and voltage supply pin. External matching circuits and a bypass capacitor is required. L3 is a RF choke inductor and C1 is a DC blocking capacitor. These elements are used as output matching circuit. C2 is a bypass capacitor. (Please refer to “TEST CIRCUIT”)
2,4,5	GND	Ground pin. To keep good RF grounding performance, please use multiple via holes to connect with ground plane and this pin.
3	EXTCAP	An external bypass capacitor is required. (Please refer to “TEST CIRCUIT”)
6	RFin	RF input pin. A DC blocking capacitor is not required. An external matching circuit is required. (Please refer to “TEST CIRCUIT”)

■TYPICAL CHARACTERISTICS (1.5GHz Band)

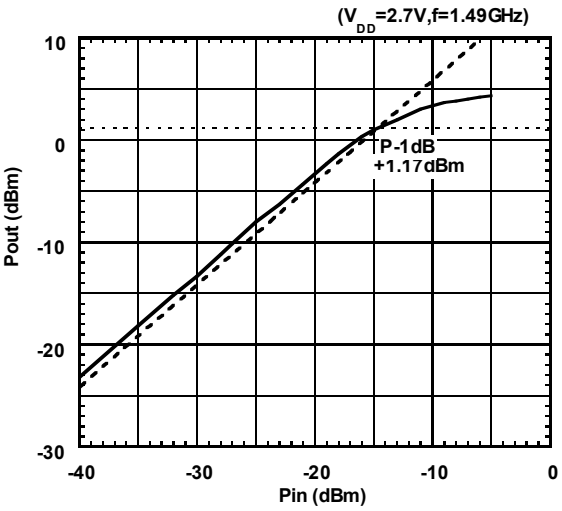
NF,Gain vs. frequency



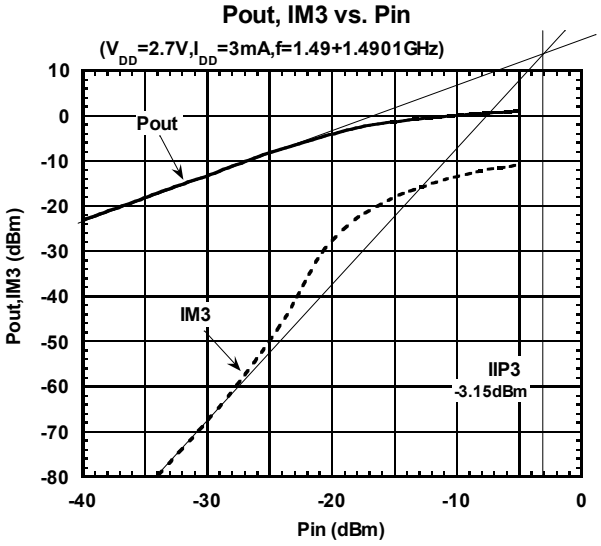
S21,S11,S22,S12 vs. frequency



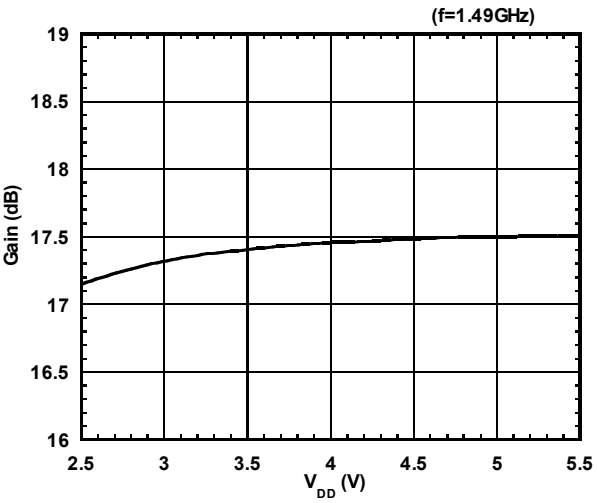
Pout vs. Pin



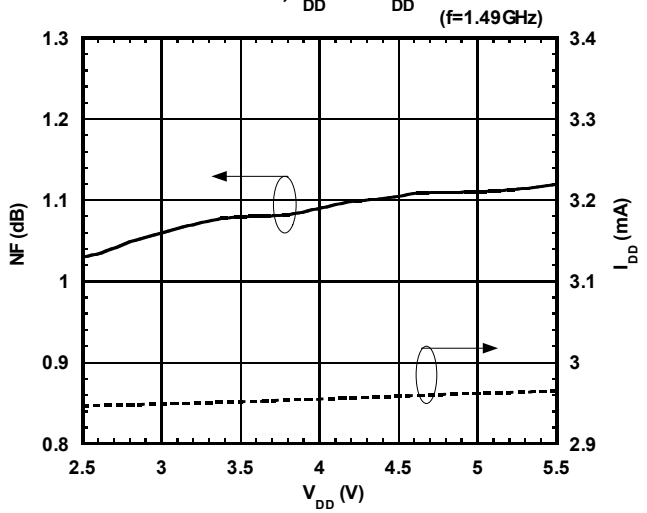
Pout, IM3 vs. Pin



Gain vs. V DD

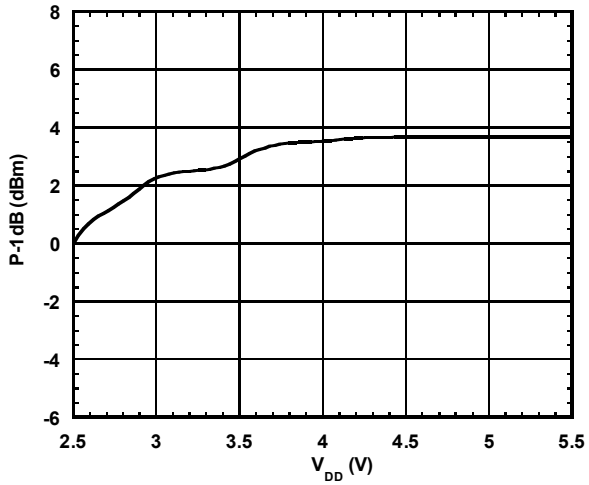


NF, I DD vs. V DD

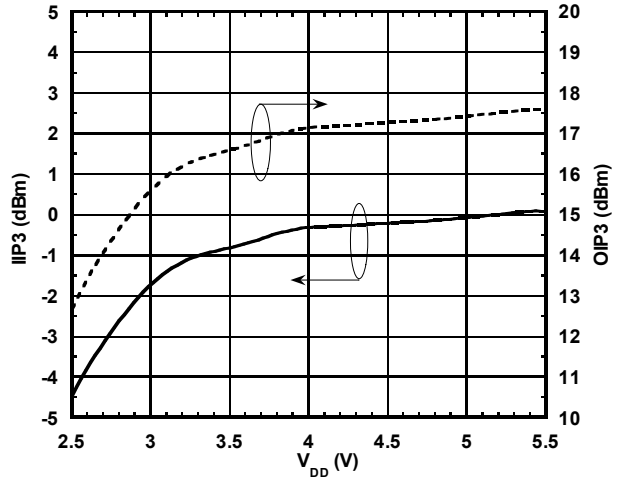


■TYPICAL CHARACTERISTICS (1.5GHz Band)

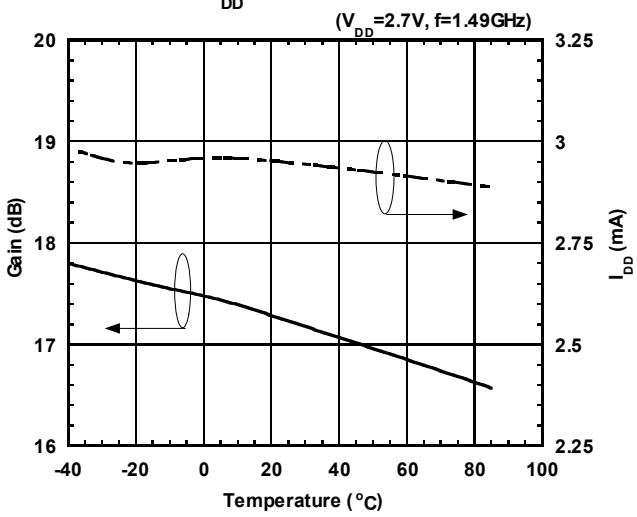
P-1dB vs. V_{DD} (f=1.49GHz)



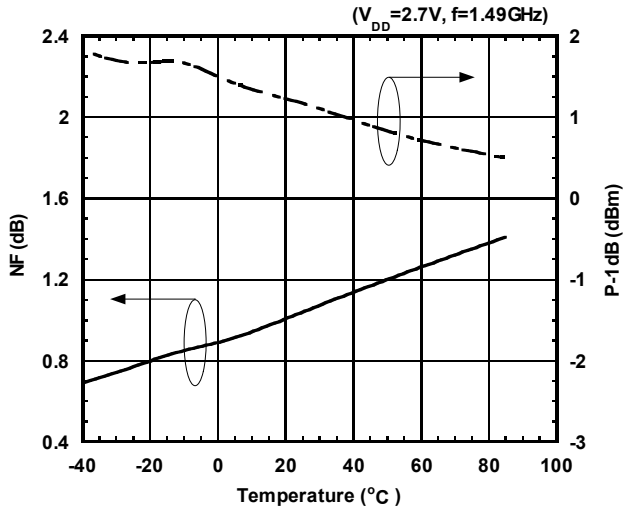
IIP3, OIP3 vs. V_{DD} (f=1.49+1.4901GHz, Pin=-35dBm)



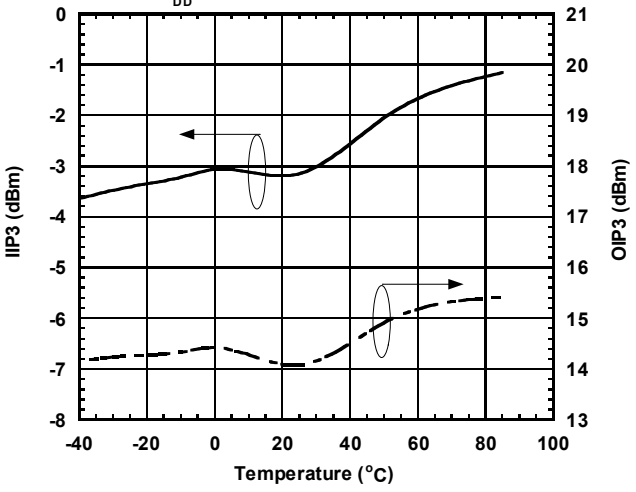
Gain, I_{DD} vs. Temperature (V_{DD}=2.7V, f=1.49GHz)



NF, P-1dB vs. Temperature (V_{DD}=2.7V, f=1.49GHz)



IIP3, OIP3 vs. Temperature (V_{DD}=2.7V, f=1.49+1.4901GHz, Pin=-35dBm)



Equations of OIP3 and IIP3

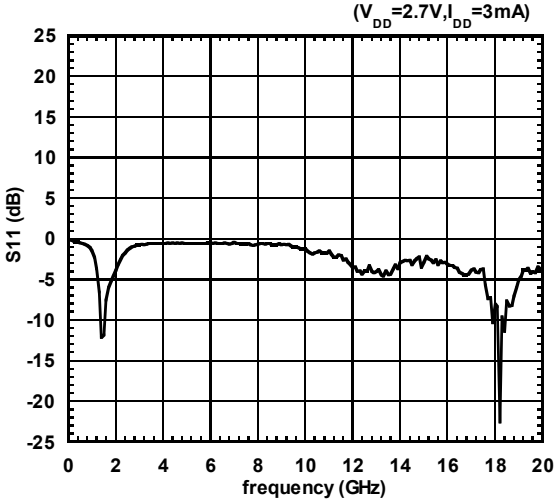
$$OIP3 = \frac{3 \times Pout - IM3}{2}$$

IIP3 = OIP3 - Gain @ Pin=-35dBm

■TYPICAL CHARACTERISTICS (1.5GHz Band)

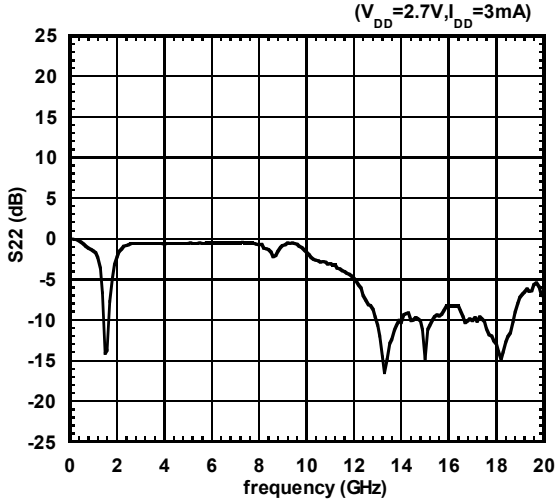
S11 vs. frequency (to 20GHz)

(V_{DD}=2.7V,I_{DD}=3mA)



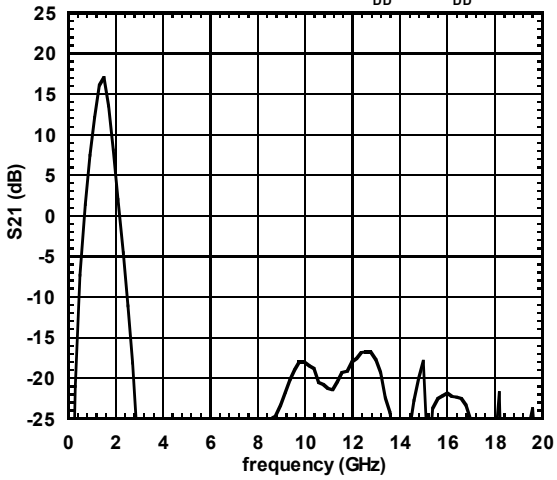
S22 vs. frequency (to 20GHz)

(V_{DD}=2.7V,I_{DD}=3mA)



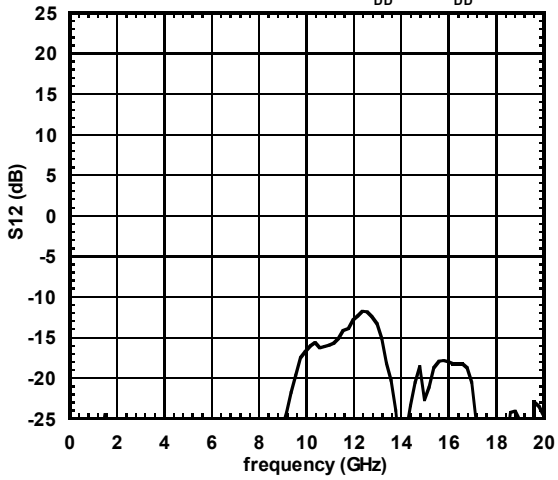
S21 vs. frequency (to 20GHz)

(V_{DD}=2.7V,I_{DD}=3mA)



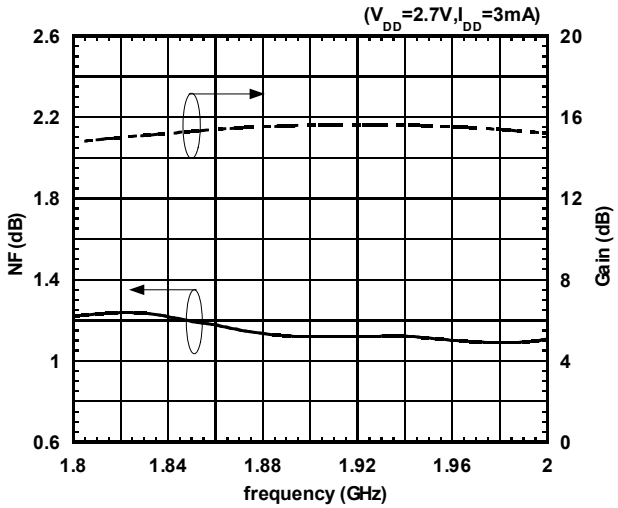
S12 vs. frequency (to 20GHz)

(V_{DD}=2.7V,I_{DD}=3mA)

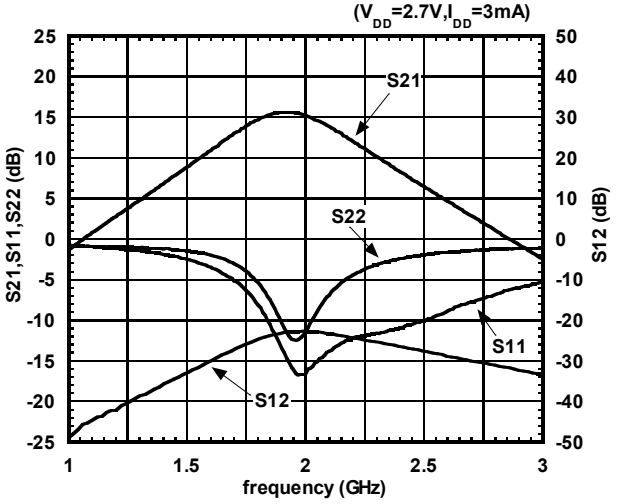


■TYPICAL CHARACTERISTICS (1.9GHz Band)

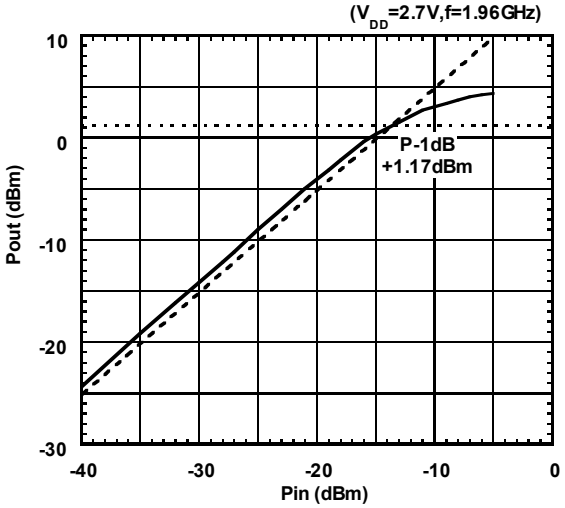
NF,Gain vs. frequency



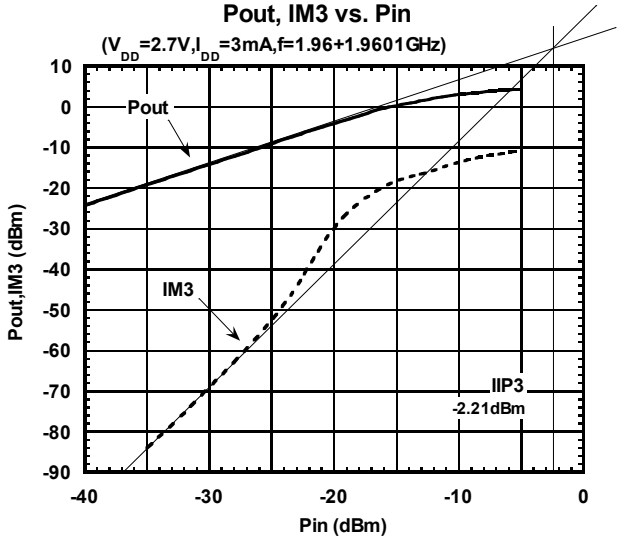
S21,S11,S22,S12 vs. frequency



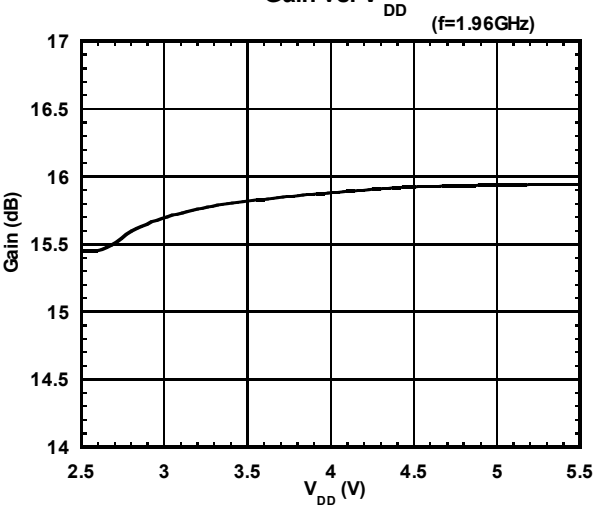
Pout vs. Pin



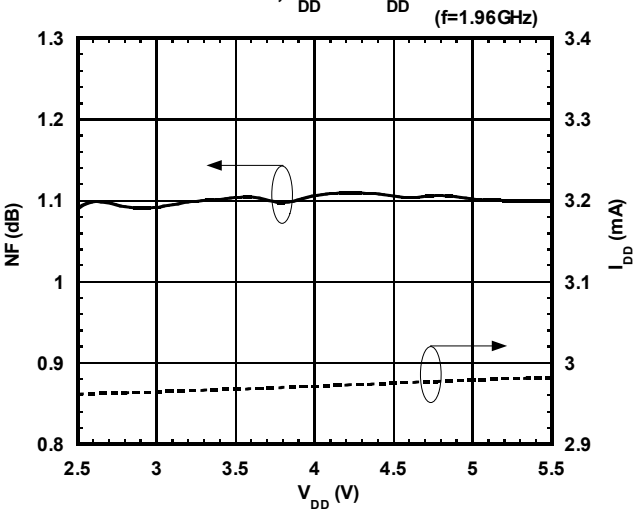
Pout, IM3 vs. Pin



Gain vs. V_{DD}

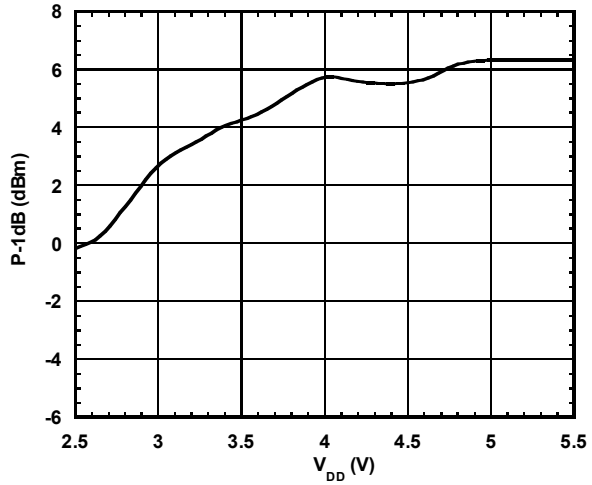


NF, I_{DD} vs. V_{DD}

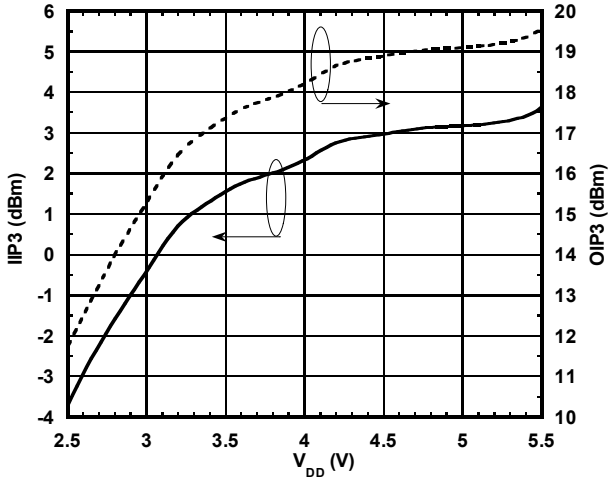


■TYPICAL CHARACTERISTICS (1.9GHz Band)

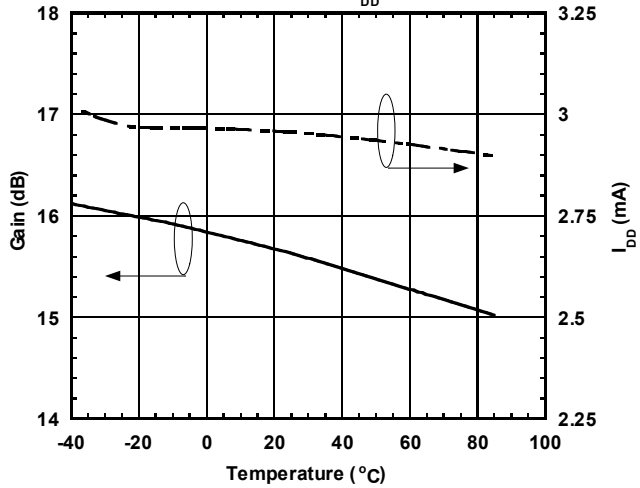
P-1dB vs. V_{DD} (f=1.96GHz)



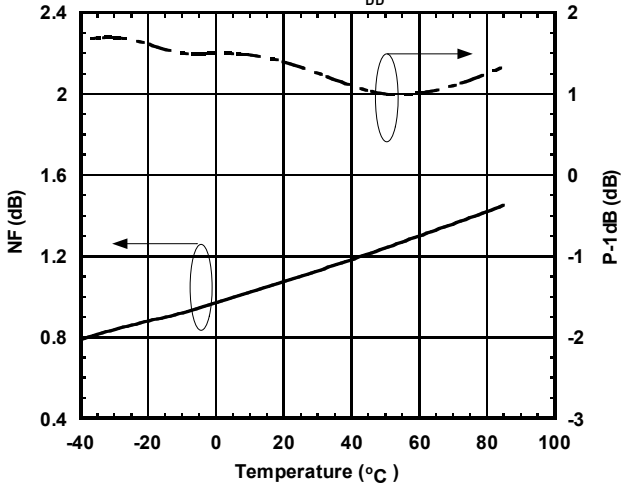
IIP3, OIP3 vs. V_{DD} (f=1.96+1.9601GHz, Pin=-30dBm)



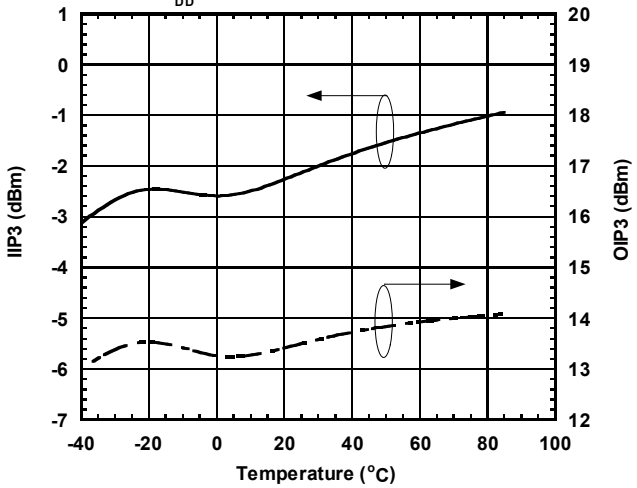
Gain, I_{DD} vs. Temperature (V_{DD}=2.7V, f=1.96GHz)



NF, P-1dB vs. Temperature (V_{DD}=2.7V, f=1.96GHz)



IIP3, OIP3 vs. Temperature (V_{DD}=2.7V, f=1.96+1.9601GHz, Pin=-30dBm)



Equations of OIP3 and IIP3

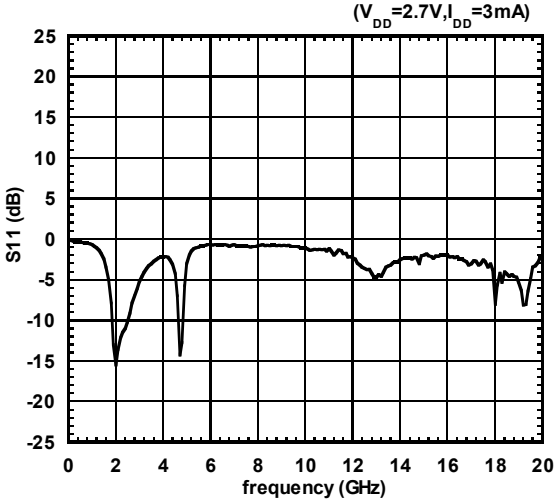
$$OIP3 = \frac{3 \times Pout - IM3}{2}$$

IIP3 = OIP3 - Gain @ Pin=-30dBm

■TYPICAL CHARACTERISTICS (1.9GHz Band)

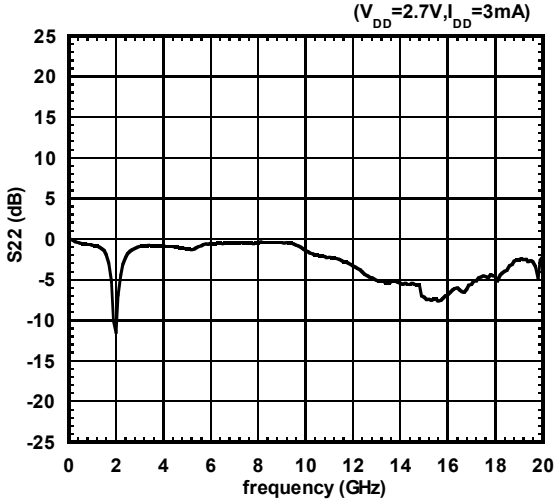
S11 vs. frequency (to 20GHz)

(V_{DD}=2.7V,I_{DD}=3mA)



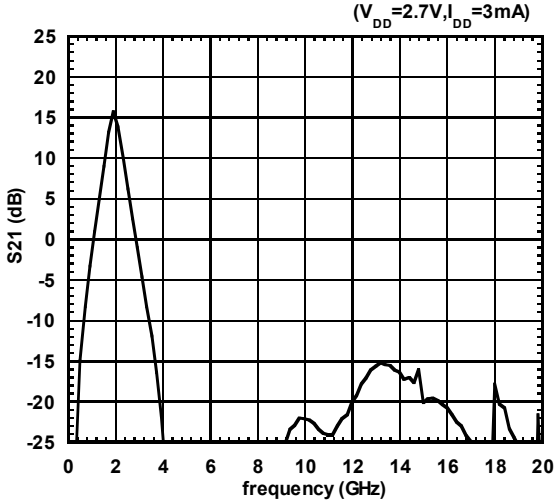
S22 vs. frequency (to 20GHz)

(V_{DD}=2.7V,I_{DD}=3mA)



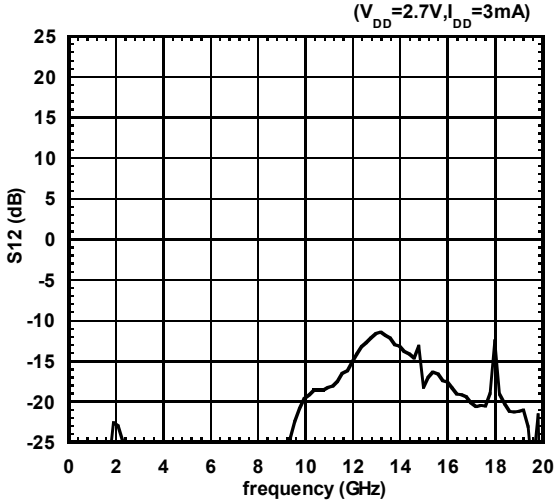
S21 vs. frequency (to 20GHz)

(V_{DD}=2.7V,I_{DD}=3mA)



S12 vs. frequency (to 20GHz)

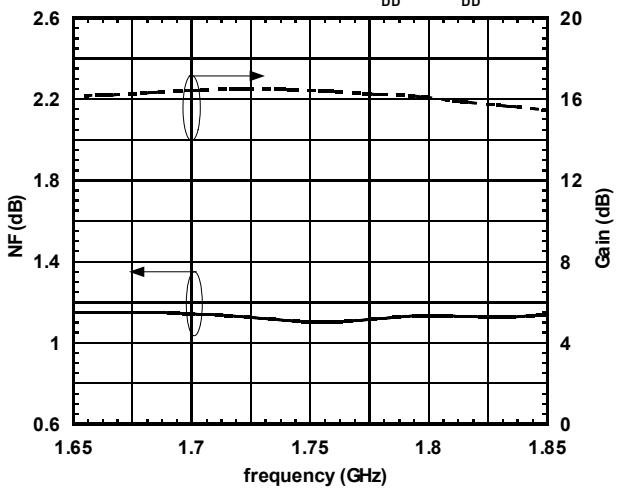
(V_{DD}=2.7V,I_{DD}=3mA)



■TYPICAL CHARACTERISTICS (1.8GHz Band)

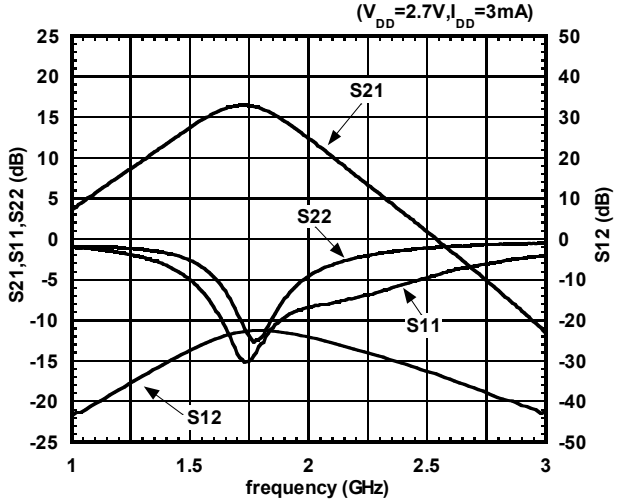
NF,Gain vs. frequency

(V_{DD}=2.7V,I_{DD}=3mA)



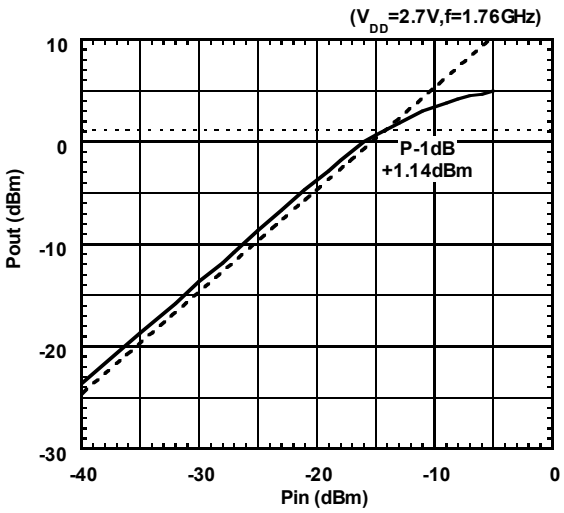
S21,S11,S22,S12 vs. frequency

(V_{DD}=2.7V,I_{DD}=3mA)



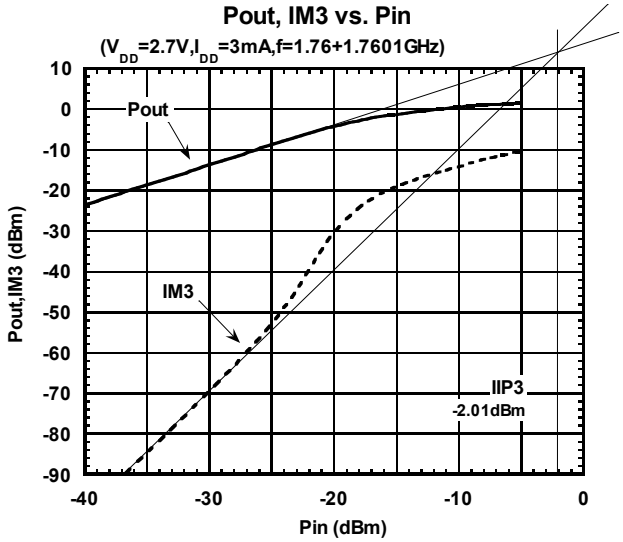
Pout vs. Pin

(V_{DD}=2.7V,f=1.76GHz)



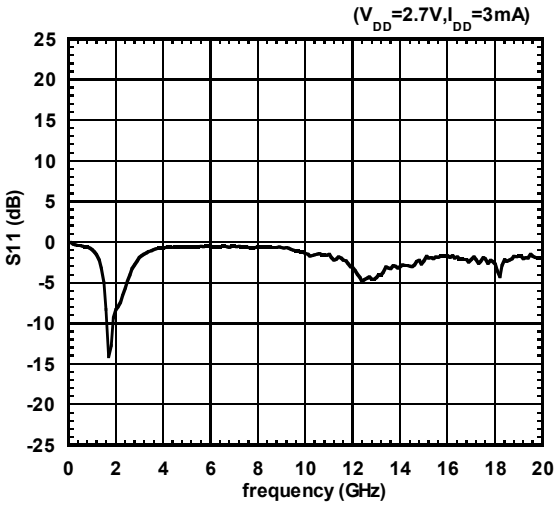
Pout, IM3 vs. Pin

(V_{DD}=2.7V,I_{DD}=3mA,f=1.76+1.7601GHz)

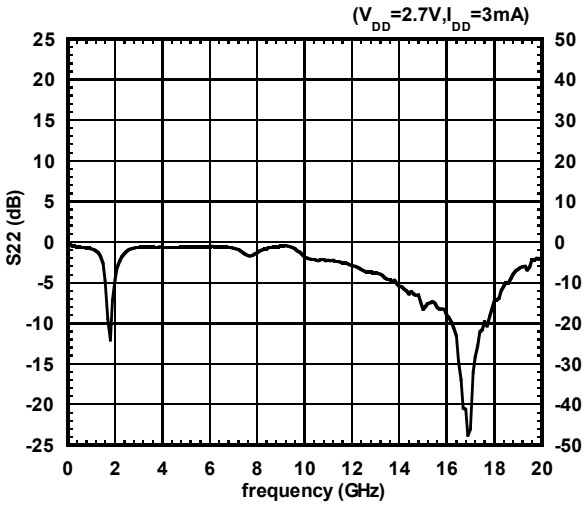


■TYPICAL CHARACTERISTICS (1.8GHz Band)

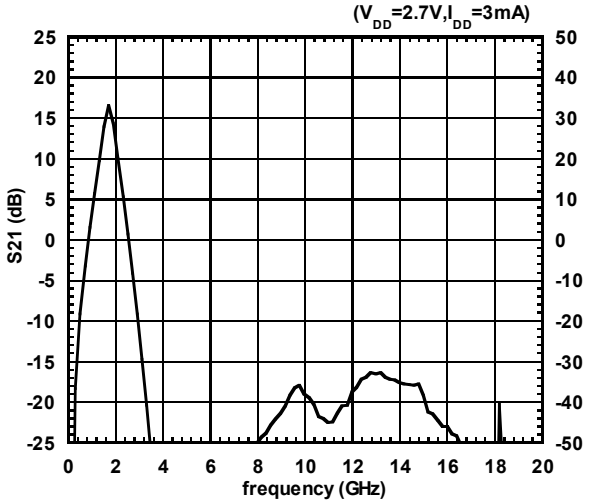
S11 vs. frequency (to 20GHz)



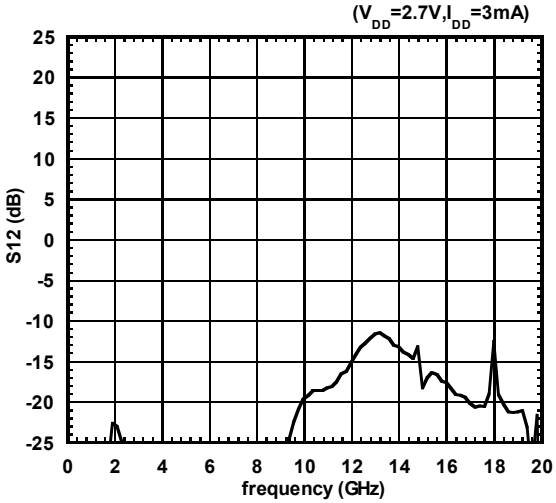
S22 vs. frequency (to 20GHz)



S21 vs. frequency (to 20GHz)

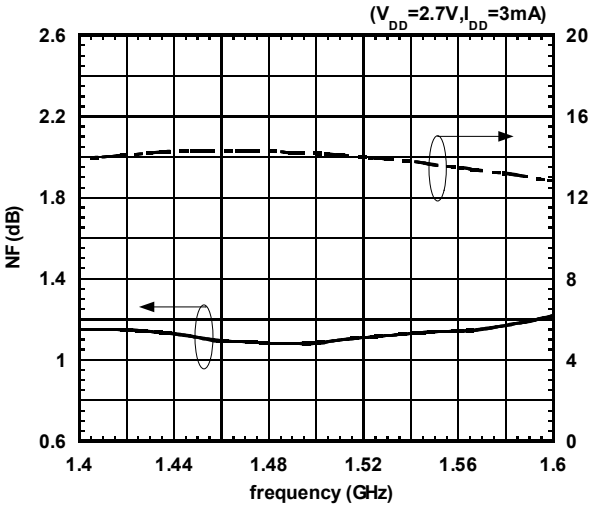


S12 vs. frequency (to 20GHz)

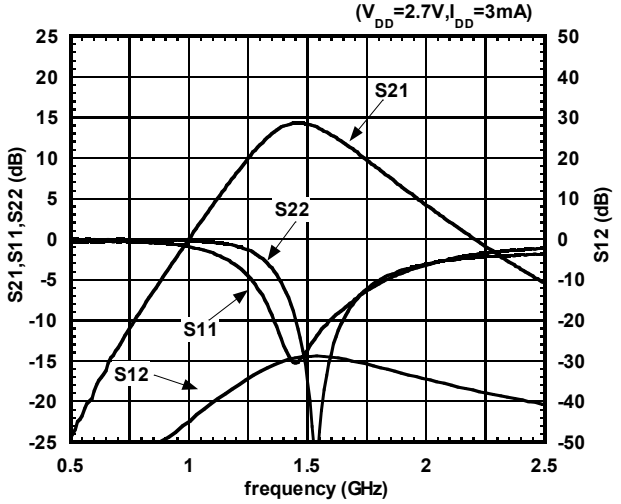


■TYPICAL CHARACTERISTICS (1.5GHz Band, Low Gain Version)

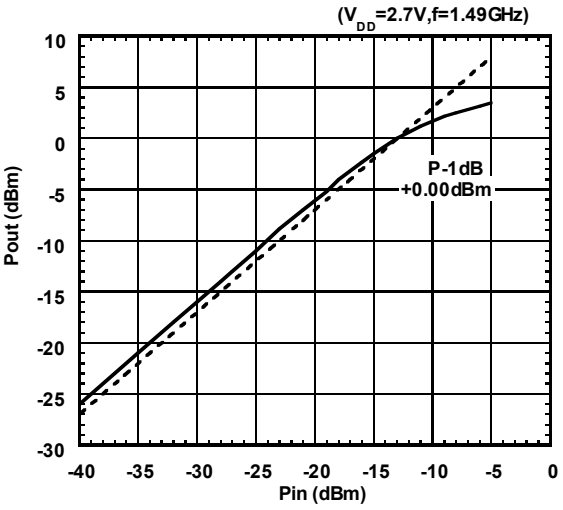
NF,Gain vs. frequency



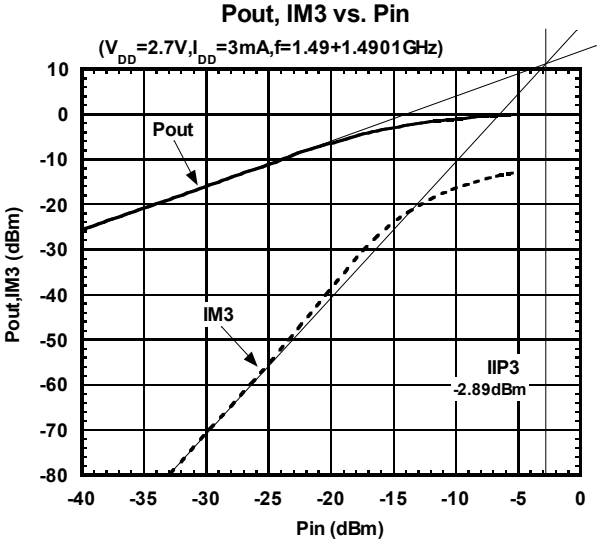
S21,S11,S22,S12 vs. frequency



Pout vs. Pin

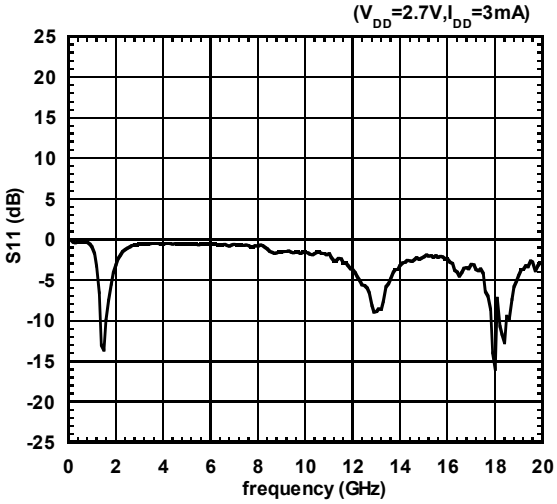


Pout, IM3 vs. Pin

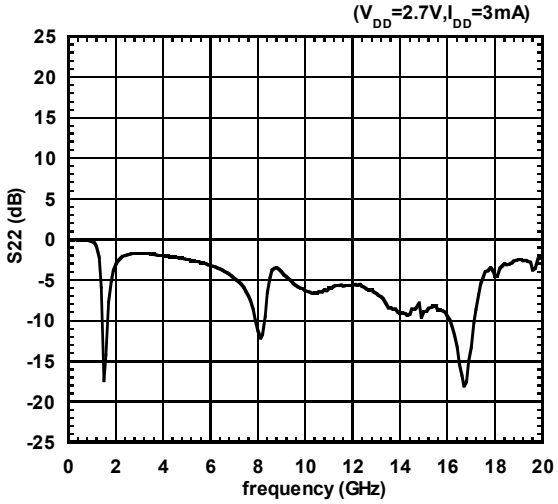


■TYPICAL CHARACTERISTICS (1.5GHz Band, Low Gain Version)

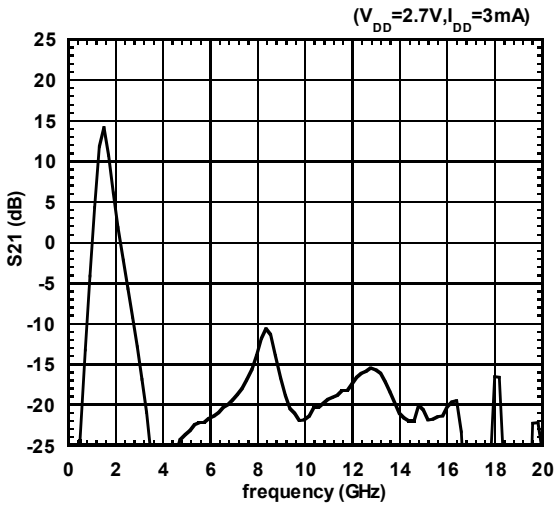
S11 vs. frequency (to 20GHz)



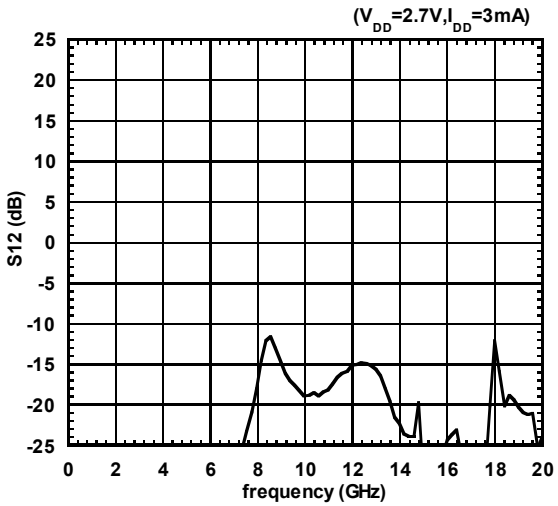
S22 vs. frequency (to 20GHz)



S21 vs. frequency (to 20GHz)



S12 vs. frequency (to 20GHz)

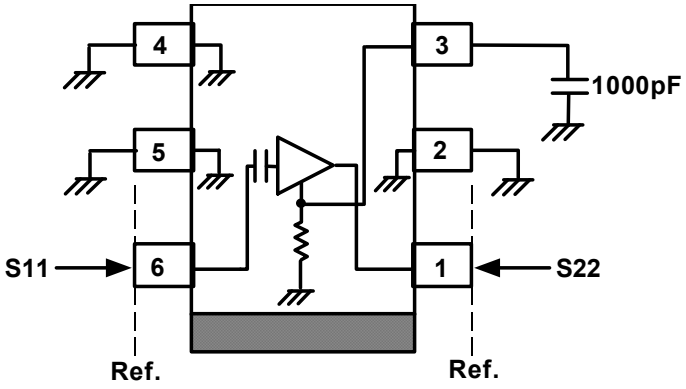


■TYPICAL CHARACTERISTICS

Scattering Parameter Table

V_{DD}=2.7V, I_{DD}=3mA, Zo=50Ω

Freq	S11		S21		S12		S22	
(GHz)	mag (units)	ang (deg)	mag (units)	ang (deg)	mag (units)	ang (deg)	mag (units)	ang (deg)
0.1	1.000	-3.130	2.094	176.987	0.012	-25.995	0.965	-1.855
0.2	0.986	-4.217	2.074	171.002	0.002	110.707	0.967	-1.782
0.3	0.986	-6.161	2.046	165.318	0.007	92.945	0.962	-3.088
0.4	0.972	-8.026	2.012	159.545	0.003	62.606	0.960	-3.801
0.5	0.965	-10.209	1.991	153.712	0.005	103.324	0.961	-5.113
0.6	0.957	-12.032	1.943	147.933	0.004	96.002	0.953	-6.159
0.7	0.943	-13.490	1.909	143.180	0.005	75.842	0.949	-7.623
0.8	0.929	-15.249	1.851	138.232	0.008	90.203	0.940	-9.144
0.9	0.910	-16.014	1.793	133.807	0.006	93.660	0.931	-9.943
1.0	0.903	-16.960	1.765	129.856	0.009	85.810	0.928	-10.876
1.1	0.894	-18.131	1.710	125.443	0.009	95.094	0.931	-12.170
1.2	0.879	-18.645	1.673	121.935	0.010	92.781	0.921	-13.089
1.3	0.864	-19.500	1.636	118.442	0.011	91.381	0.919	-14.156
1.4	0.852	-21.338	1.627	114.415	0.012	100.617	0.919	-14.843
1.5	0.843	-22.810	1.578	110.659	0.014	99.522	0.918	-16.259
1.6	0.826	-24.483	1.541	107.013	0.014	99.175	0.914	-17.088
1.7	0.818	-24.447	1.513	104.077	0.015	100.001	0.918	-18.228
1.8	0.810	-26.509	1.503	100.734	0.016	103.271	0.925	-19.508
1.9	0.801	-27.539	1.489	97.286	0.018	106.687	0.920	-20.507
2.0	0.794	-29.642	1.452	93.725	0.019	108.548	0.921	-21.024
2.1	0.783	-30.807	1.453	90.359	0.020	106.305	0.924	-22.491
2.2	0.782	-33.473	1.421	86.597	0.022	107.071	0.922	-24.160
2.3	0.770	-34.972	1.426	83.223	0.022	107.349	0.920	-25.779
2.4	0.772	-35.870	1.391	79.970	0.026	109.866	0.919	-27.462
2.5	0.760	-37.091	1.397	76.578	0.027	112.983	0.914	-29.724
2.6	0.761	-38.975	1.376	73.069	0.030	109.600	0.920	-32.086
2.7	0.757	-40.916	1.359	68.921	0.031	106.376	0.907	-35.211
2.8	0.756	-41.260	1.322	65.450	0.034	109.318	0.902	-38.255
2.9	0.757	-42.651	1.294	62.030	0.035	106.983	0.893	-41.787
3.0	0.752	-42.892	1.267	58.521	0.036	108.989	0.879	-45.326



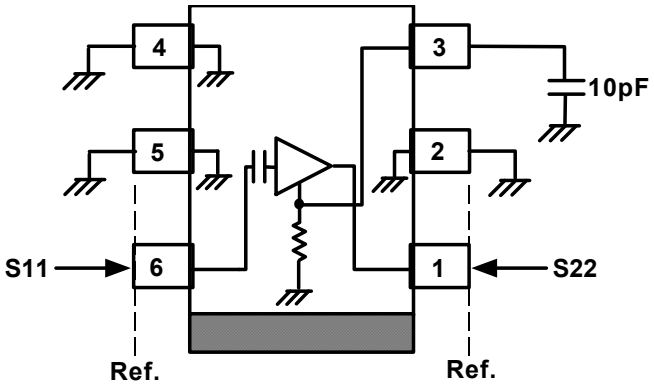
Scattering Parameter
Measurement Circuit

■TYPICAL CHARACTERISTICS (1.5GHz Band, Low Gain Version)

Scattering Parameter Table

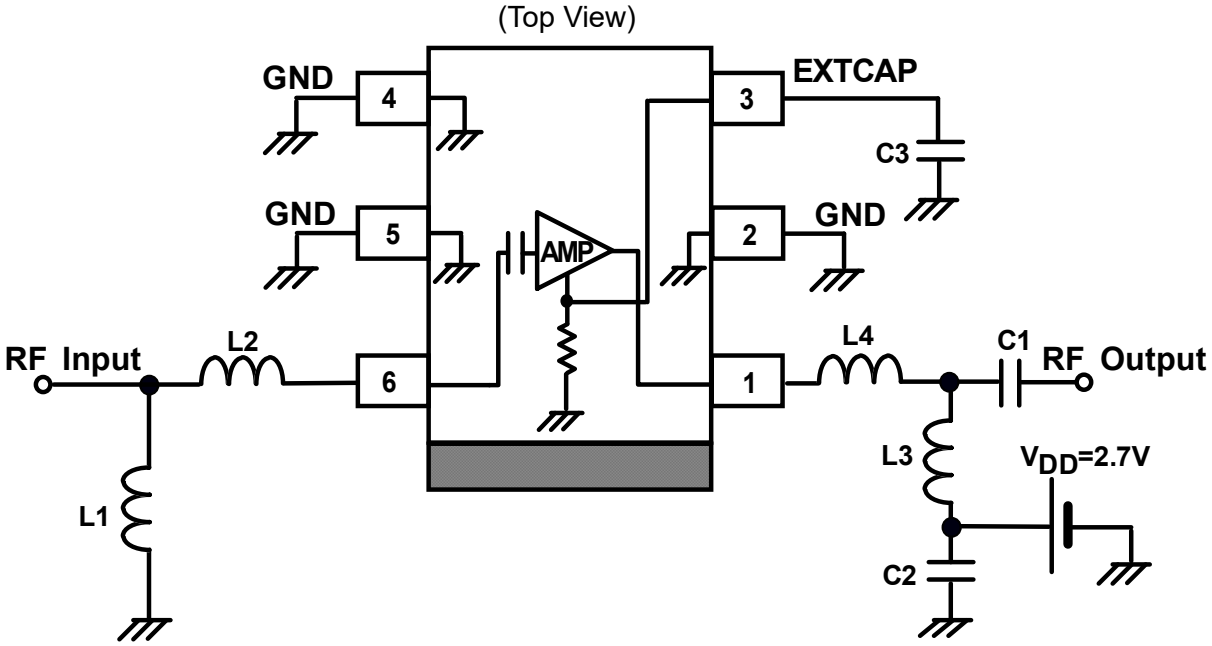
V_{DD}=2.7V, I_{DD}=3mA, Zo=50Ω

Freq	S11		S21		S12		S22	
(GHz)	mag (units)	ang (deg)	mag (units)	ang (deg)	mag (units)	ang (deg)	mag (units)	ang (deg)
0.1	1.011	-1.815	0.619	-137.421	0.006	150.071	0.998	-1.269
0.2	1.023	-4.177	1.049	-141.929	0.005	111.664	0.996	-3.638
0.3	1.027	-6.876	1.402	-152.156	0.004	72.732	0.999	-4.808
0.4	1.036	-10.171	1.681	-164.509	0.008	71.899	0.995	-6.754
0.5	1.029	-13.604	1.843	-176.486	0.006	80.582	0.993	-8.514
0.6	1.027	-17.041	1.967	172.550	0.006	96.630	0.982	-9.913
0.7	1.007	-20.090	1.997	162.037	0.010	79.136	0.983	-12.453
0.8	0.996	-22.496	1.994	153.204	0.009	78.039	0.976	-14.051
0.9	0.978	-25.098	1.967	144.936	0.009	80.635	0.967	-15.603
1.0	0.961	-27.178	1.925	137.106	0.008	73.136	0.967	-17.199
1.1	0.940	-28.800	1.857	131.070	0.010	71.678	0.961	-17.813
1.2	0.923	-30.761	1.825	124.735	0.012	76.438	0.954	-19.024
1.3	0.905	-32.462	1.785	118.431	0.011	77.174	0.948	-21.016
1.4	0.889	-33.815	1.719	113.194	0.010	78.254	0.946	-22.555
1.5	0.877	-34.976	1.679	107.647	0.014	83.456	0.947	-24.779
1.6	0.860	-36.777	1.610	102.741	0.014	73.747	0.947	-26.267
1.7	0.849	-37.774	1.568	98.621	0.014	80.053	0.942	-27.354
1.8	0.834	-39.260	1.534	94.075	0.015	85.009	0.938	-28.669
1.9	0.822	-40.858	1.490	89.890	0.015	83.753	0.939	-29.677
2.0	0.814	-42.312	1.464	85.613	0.017	88.727	0.939	-31.456
2.1	0.801	-43.887	1.435	81.588	0.017	92.695	0.938	-32.776
2.2	0.791	-45.820	1.393	77.520	0.021	98.708	0.939	-34.232
2.3	0.784	-47.584	1.365	73.663	0.019	95.532	0.936	-35.915
2.4	0.773	-49.825	1.332	69.756	0.021	93.049	0.937	-36.454
2.5	0.766	-51.948	1.311	66.211	0.024	93.358	0.940	-38.089
2.6	0.756	-54.101	1.285	62.518	0.025	97.398	0.942	-39.619
2.7	0.753	-56.479	1.260	58.997	0.028	99.809	0.946	-40.798
2.8	0.748	-59.220	1.229	55.237	0.029	93.593	0.949	-42.180
2.9	0.745	-61.715	1.213	51.930	0.031	100.273	0.947	-43.117
3.0	0.744	-64.848	1.189	48.547	0.031	97.032	0.950	-44.659

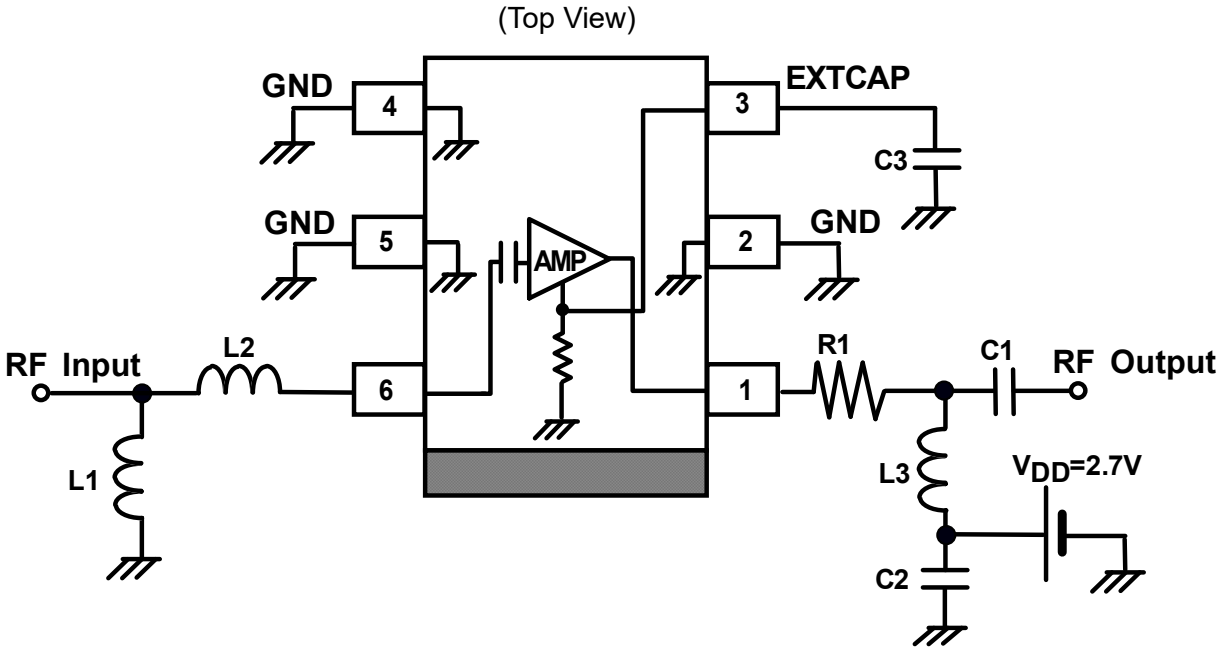


Scattering Parameter
Measurement Circuit

■TEST CIRCUIT 1 (1.5/1.8/1.9GHz Band)

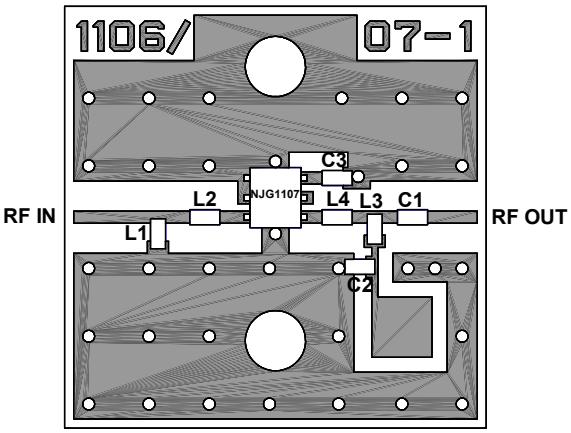


■TEST CIRCUIT 2 (1.5GHz Band, Low Gain Version)



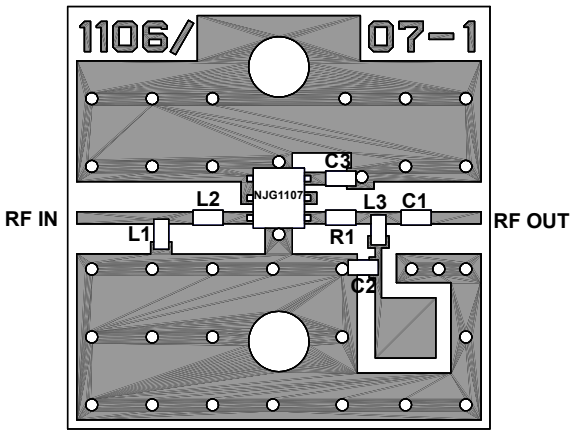
■RECOMMENDED PCB DESIGN

(Top View)



1.5/1.8/1.9GHz Band

(Top View)



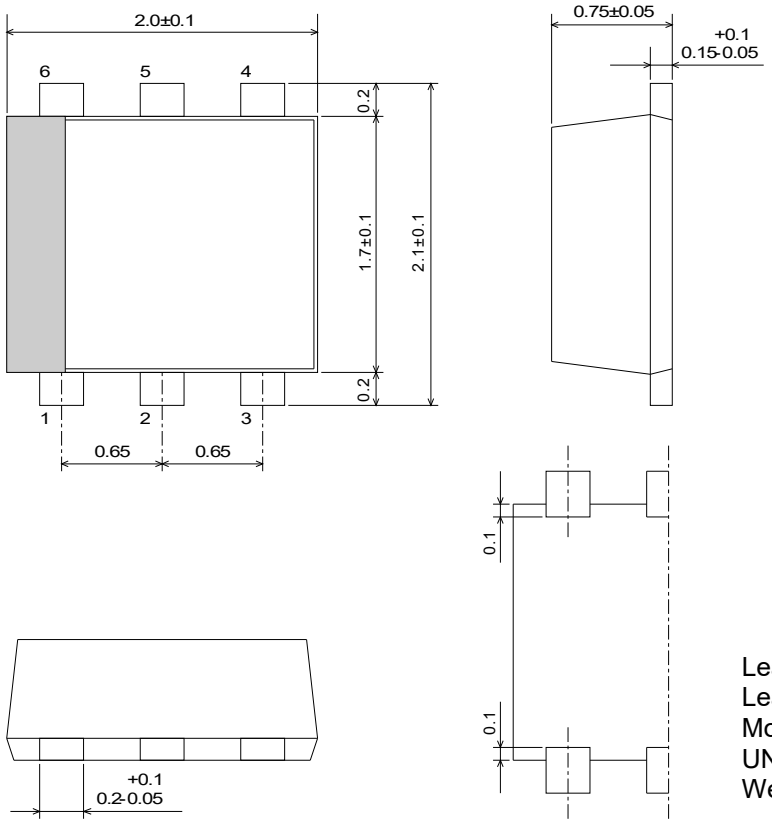
1.5GHz Band, Low Gain Version

PCB: FR4 t=0.2mm
MICROSTRIP LINE WIDTH=0.4mm(Zo=50Ω)
PCB SIZE: 14.0 x 14.0mm

Parts List

Parts ID	Constant				Comment
	1.5GHz Band	1.9GHz Band	1.8GHz Band	1.5GHzBand Low Gain	
L1	10nH	5.6nH	6.8nH	10nH	TAIYO-YUDEN HK1005 Series
L2	12nH	5.6nH	8.2nH	12nH	TAIYO-YUDEN HK1005 Series
L3	5.6nH	3.9nH	6.8nH	6.8nH	TAIYO-YUDEN HK1005 Series
L4	15nH	10nH	12nH	-	TAIYO-YUDEN HK1005 Series
C1	5pF	13pF	30pF	0.75pF	MURATA GRM36 Series
C2	1000pF	1000pF	1000pF	1000pF	MURATA GRM36 Series
C3	1000pF	1000pF	1000pF	10pF	MURATA GRM36 Series
R1	-	-	-	36Ω	

■PACKAGE OUTLINE (FLP6-B2)



Lead material : Copper
Lead surface finish : Solder plating
Molding material : Epoxy resin
UNIT : mm
Weight : 6.5mg

Cautions on using this product

This product contains Gallium-Arsenide (GaAs) which is a harmful material.

- Do NOT eat or put into mouth.
- Do NOT dispose in fire or break up this product.
- Do NOT chemically make gas or powder with this product.
- To waste this product, please obey the relating law of your country.

This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.

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    - Fire Alarms / Intruder Detectors
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    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

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8. Quality Warranty
    8-1. Quality Warranty Period
    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.
    8-2. Quality Warranty Remedies
    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.
    8-3. Remedies after Quality Warranty Period
    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
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13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

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