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APPLICATION NOTE

DEMOBOARD FOR

BGA2031 “PCS1900 CDMA”

Summary:

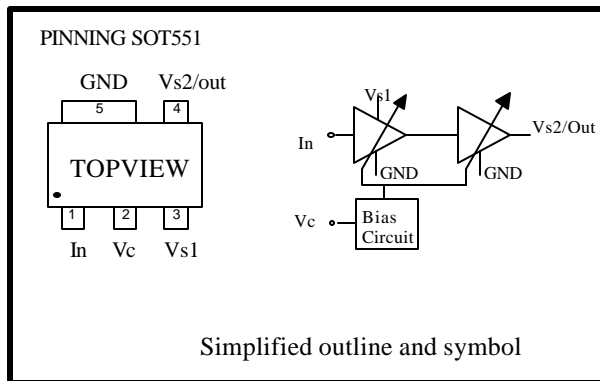
- **Description of product**
BGA2031 is a 2-stage variable gain amplifier (MMIC) that can be used as a pre-driver for the power amplifier in applications that require high linearity, like CDMA.
- **Application Area**
Suitable for PA driver for systems like AMPS and CDMA with low component count.
- **Presented Application**
The application presents a driver for PCS band (1900 MHz) at 3.0 Volt supply voltage and 46 mA current typ.
- **Main results**
The amplifier has a gain of 25 dB typically at $f=1.88\text{GHz}$, $V_{\text{supply}}=3.0\text{V}$ and $V_{\text{ctrl}}=2.6\text{V}$, $\text{IRL}<-12\text{ dB}$, $\text{ORL}<-10.5\text{dB}$, $P_{1\text{dB}}=12.0\text{dBm}$, H2 and H3 rejection $>-50\text{dBc}$ at P1dB.



Package and pinning

The BGA2031 is packaged in a SOT551 package.

The name and function of the pins:



Pin	Function	Comments
1	In	RF input 50 Ω
2	Vc	Control Voltage (+)
3	Vs1	Supply Voltage
4	Vs2/RFout	RF output 50 Ω
		Supply Voltage
5	GND	ground

Measurements

A short description of the measured data is given in the next table.

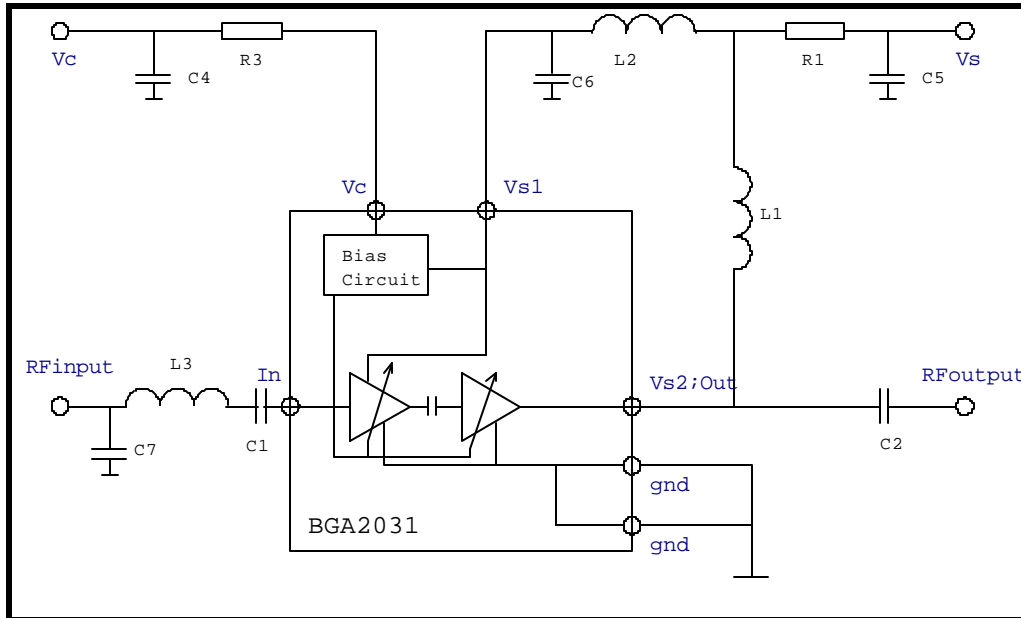
Freq=1880 MHz, $T_{amb}=25\text{ }^{\circ}\text{C}$

Parameter	Value (typ)	Unit	Conditions
P_{1dB} output	12.0	dBm	1dB compression point, $V_c=2.6$ Volt
G_{power}	24.5	dB	at $V_c=2.6$ Volt, $P_{Drive}=-14$ dBm
S_{21}	25.5	dB	at $V_c=2.6$ Volt, $P_{Drive}=-30$ dBm
IRL	<-12		at $V_c=2.6$ Volt, $P_{Drive}=-30$ dBm
ORL	<-10.5		at $V_c=2.6$ Volt, $P_{Drive}=-30$ dBm
ACPR $_{+/-1.23}$ MHz	-48.5	dBc	at $V_c=2.6$ Volt, $P_{Drive}=-14$ dBm, $P_{load}=10.5$ dBm
ACPR $_{+/-1.23}$ MHz	-48.5	dBc	at $V_c=2.6$ Volt, $P_{Drive}=-11.5$ dBm, $P_{load}=3$ dBm
V_{supply}	3.0	V	
I_{supply}	46	mA	at $V_c=2.6$ Volt, $P_{Drive}=-14$ dBm
$I_{control}$	845	μ A	at $V_c=2.6$ Volt, $P_{Drive}=-14$ dBm

The measured data are with respect to the application schematic (demoboard)



Application schematic

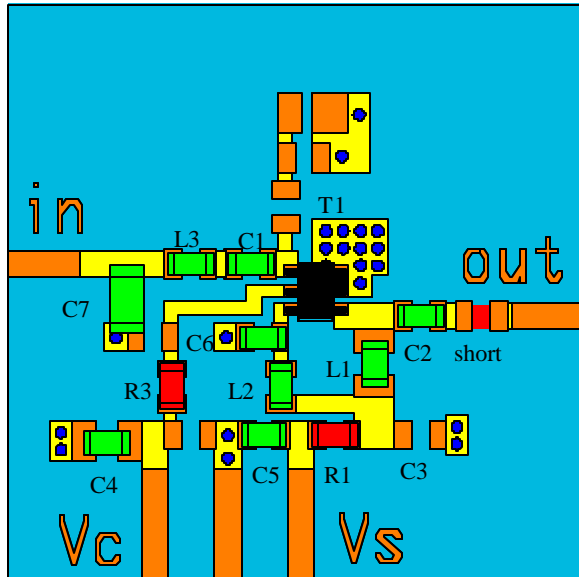


Schematic diagram of the "CDMA" application BGA2031

Layout demoboard

The ground pin should be connected to the system ground (ground plane) with minimum inductance. This can be achieved with a number of vias close to the solder point, all other ground connections should be placed as close to the component as possible.

With attention to the above mentioned points, we get following PCB.



<-----20mm----->

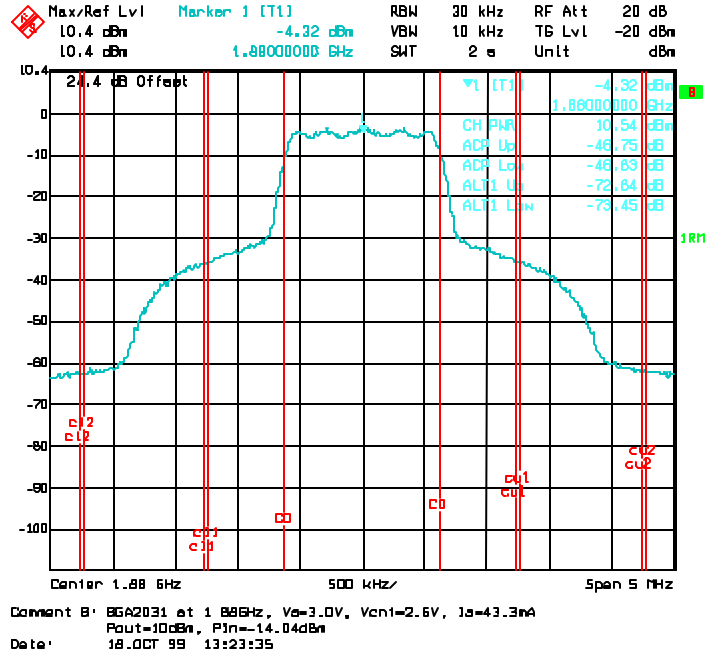
List of components

Component	Value	size - manufact.	Purpose, comment
T1	BGA2031	SOT551 Philips	Variable gain amplifier
C1	470pF	0603 Philips	Input match, DC-decoupling
C2	82pF *	0603 Philips	Output match, DC-decoupling
C3	-	-	-
C4	100nF	0603 Philips	LF-decoupling for Vc
C5	100nF	0603 Philips	LF-decoupling for Vs
C6	1nF	0603 Philips	Interstage match
C7	0.68pF *	0603 Philips	Input match
L1	15nH *	0603 TDK type MLG1608	Output match, DC-feed
L2	100nH	0603 TDK type MLG1608	Interstage match
L3	1.5nH	0603 TDK type MLG1608	Input match
R1	2.4Ω	0603 Philips	Determines dissipation
R3	22Ω	0603 Philips	LF-decoupling for Vc
PCB	-	FR4	$\epsilon_R \sim 4.6$, H = 0.5 mm

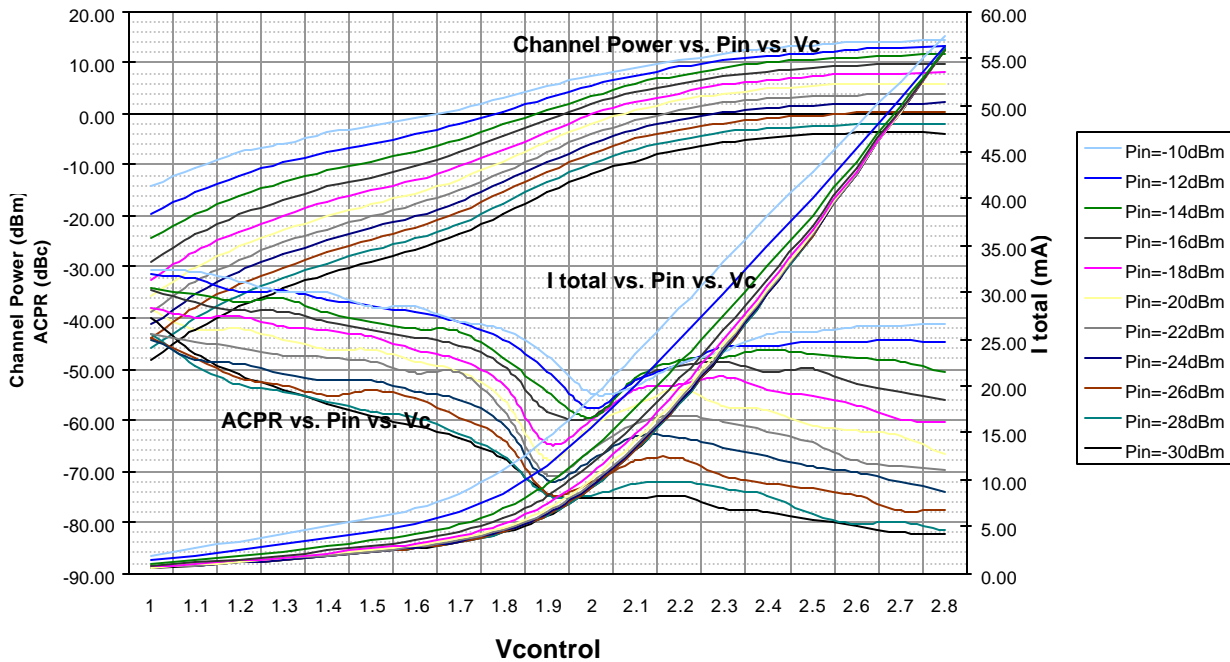
* Gain and Output return loss can be improved by changing C7 into 1pF, C2 into 5.6pF and L1 into 18nH. This has some negative influence on the ACPR (about 2dB).



Typical CDMA performance



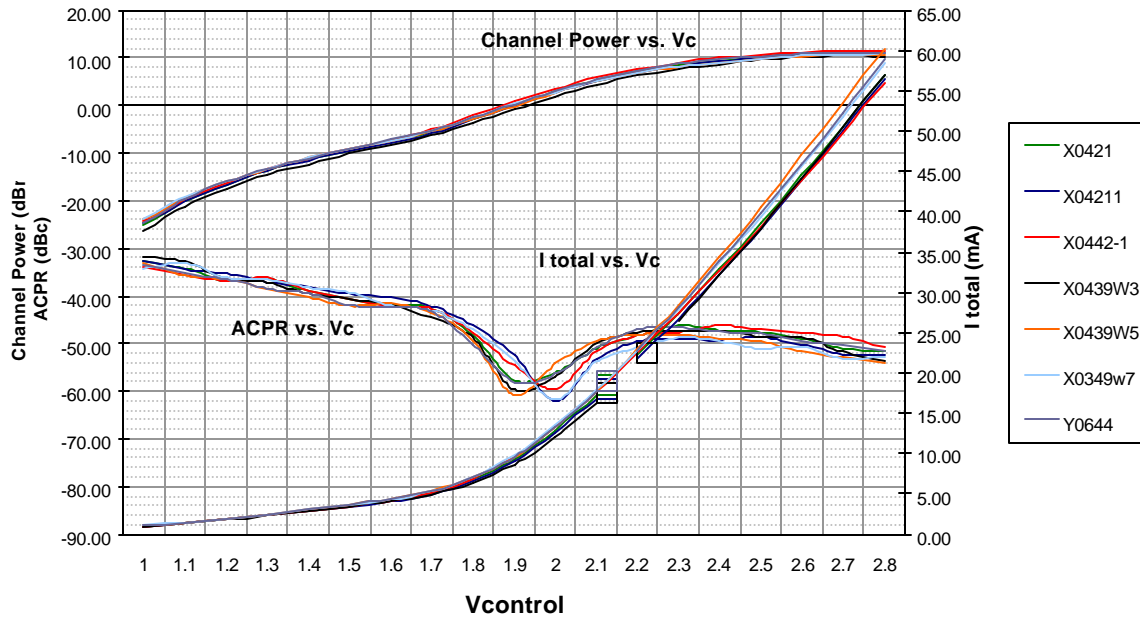
BGA2031 @ 1.88GHz, 25degC, Vs=3.0V





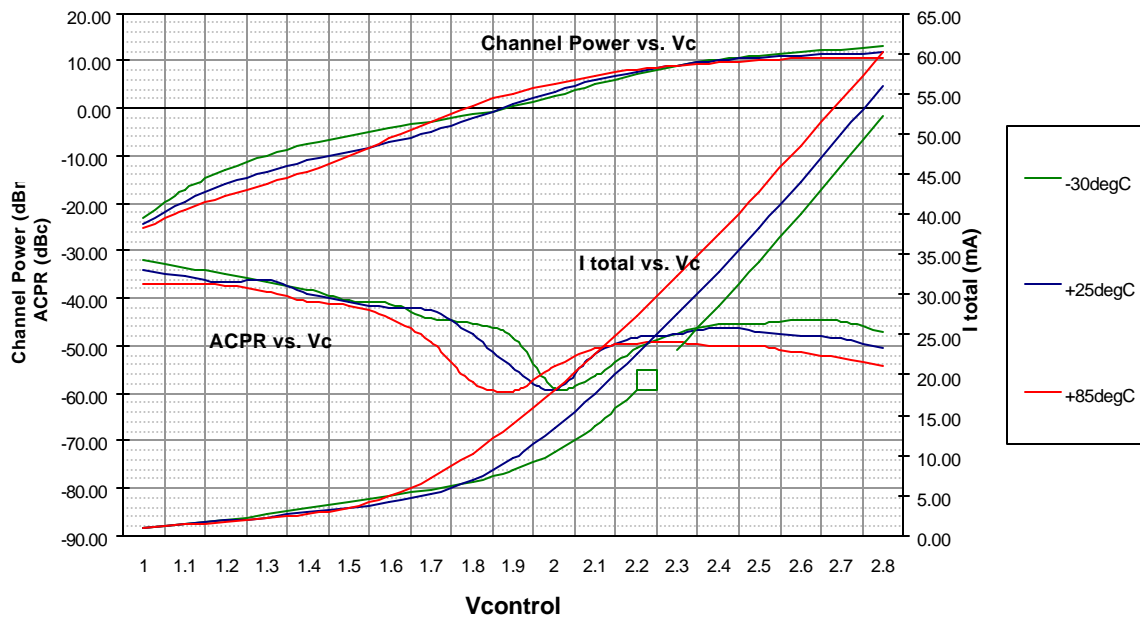
Typical CDMA performance over 7 different batches

BGA2031 @ 1.88GHz, +25degC, Vs=3.0V, Pin=-14dBm



Typical CDMA performance over temperature

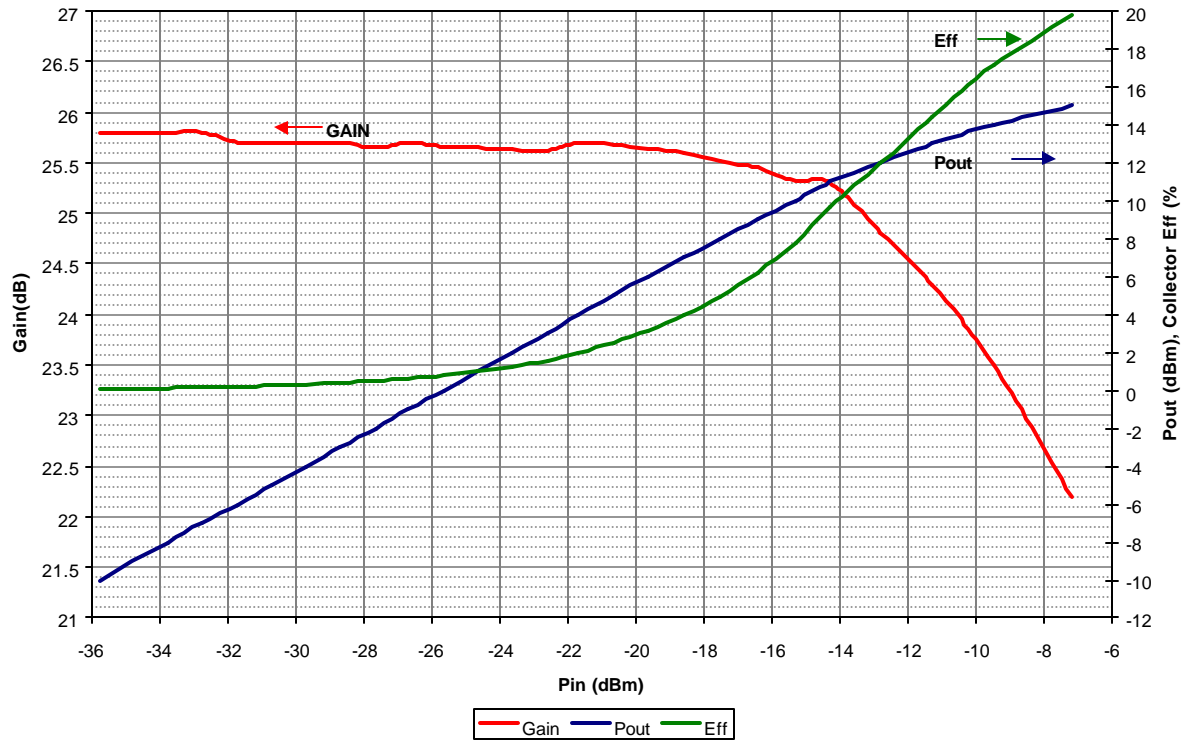
BGA2031 @ 1.88GHz over temp, Vs=3.0V, Pin=-14dBm





Typical CW performance

Pout, Gain, Eff vs. Pin, BGA2031 under CW @ 1.88GHz, Vs=3.0V, Vcnt=2.6V

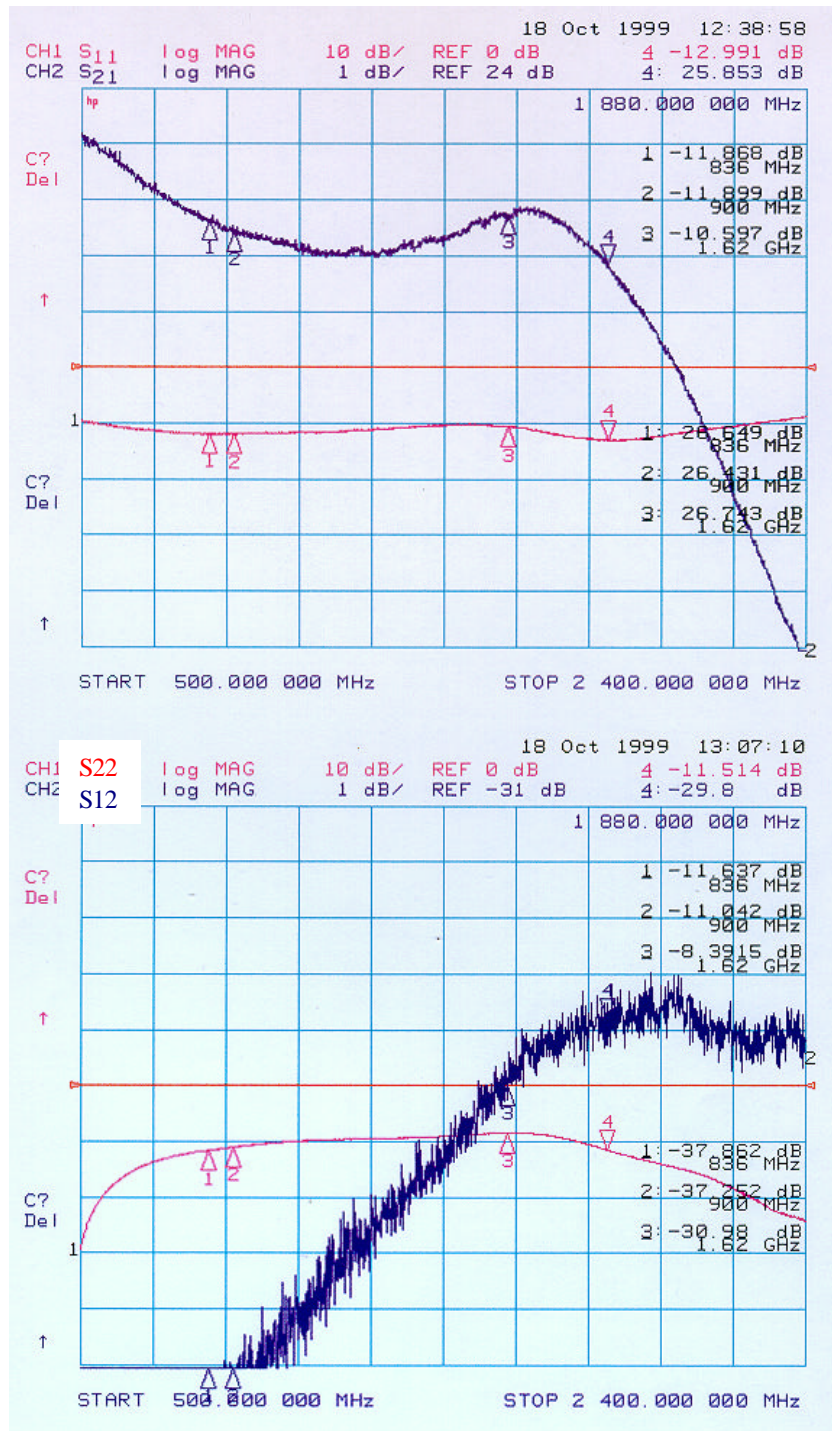


BGA2031, 1.88GHz CW mode. Vs=3.0V, Vcnt=2.6V, 25degC

Pin dBm	Pout dBm	Gain dB	Is mA	Supply Eff %	H2 dBc	H3 dBc
-35.8	-10	25.8	41.8	0.08	<-50	<-50
-34.8	-9	25.8	41.8	0.10	<-50	<-50
-33.8	-8	25.8	41.8	0.13	<-50	<-50
-32.8	-7	25.8	41.8	0.16	<-50	<-50
-31.7	-6	25.7	41.9	0.20	<-50	<-50
-30.7	-5	25.7	41.9	0.25	<-50	<-50
-29.7	-4	25.7	41.9	0.32	<-50	<-50
-28.7	-3	25.7	41.9	0.40	<-50	<-50
-27.65	-2	25.65	41.9	0.50	<-50	<-50
-26.7	-1	25.7	41.9	0.63	<-50	<-50
-25.66	0	25.66	41.95	0.79	<-50	<-50
-24.65	1	25.65	41.96	1.00	<-50	<-50
-23.63	2	25.63	41.97	1.26	<-50	<-50
-22.62	3	25.62	41.99	1.58	<-50	<-50
-21.7	4	25.7	42	1.99	<-50	<-50
-20.68	5	25.68	42	2.51	<-50	<-50
-19.64	6	25.64	42.1	3.15	<-50	<-50
-18.6	7	25.6	42.2	3.96	<-50	<-50
-17.52	8	25.52	42.3	4.97	<-50	<-50
-16.45	9	25.45	42.54	6.22	<-50	<-50
-15.32	10	25.32	42.8	7.79	<-50	<-50
-14.3	11	25.3	43.3	9.69	<-50	<-50
-12.81	12	24.81	44.2	11.95	<-50	-49
-11.3	13	24.3	46.1	14.43	-43	-45
-9.51	14	23.51	48.9	17.12	-38.5	41.2
-7.2	15	22.2	53.2	19.81	41.3	-38



Typical Small Signal performance over wideband frequency



Small signal S11, S21, S12, S22 at Vsupply=3.0V, Vcnt=2.6V, Pout≈2dBm

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