2.1GHz/2.1GHz /900MHz Bands Application

2-1 Summary

The characterisitics of Band1, 4, 8 have evaluated as follows. The evaluation circuit structure and measured data are reviewed.

2-2-1 Measurement data of assembled evaluation board

DC Characteristics

General condition : V_{DD}=2.8V, Ta=+25°C

Parameter	Condition	Symbol	Measurement Data	Units
Supply Voltage		V_{DD}	2.8	V
Control Voltage 1 (High)		$V_{CTL}1(H)$	1.8	V
Control Voltage 1 (Low)		$V_{CTL}1(L)$	0	V
Control Voltage 2 (High)		$V_{CTL}2(H)$	1.8	V
Control Voltage 2 (Low)		$V_{CTL}2(L)$	0	V
Control Voltage 3 (High)		$V_{CTL}3(H)$	1.8	V
Control Voltage 3 (Low)		$V_{CTL}3(L)$	0	V
Operating Current 1 (Band1 High Gain Mode)	RF OFF, $V_{CTL}1$=0V, $V_{CTL}2$=0V, $V_{CTL}3$=1.8V	$I_{DD}1$	2.35	mA
Operating Current 2 (Band 8 High Gain Mode)	RF OFF, $V_{CTL}1$=1.8V, $V_{CTL}2$=0V, $V_{CTL}3$=1.8V	$I_{DD}2$	2.40	mA
Operating Current 3 (Band 4 High Gain Mode)	RF OFF, $V_{CTL}1$=0V, $V_{CTL}2$=1.8V, $V_{CTL}3$=1.8V	$I_{DD}3$	2.23	mA
Operating Current 4 (Low Gain mode)	RF OFF, $V_{CTL}3$=0V	$I_{DD}7$	31.9	uA
Control Current 1	$V_{CTL}1$=1.8V	$I_{CTL}1$	4.8	uA
Control Current 2	$V_{CTL}2$=1.8V	$I_{CTL}2$	4.9	uA
Control Current 3	$V_{CTL}3$=1.8V	$I_{CTL}3$	5.0	uA

2-2-2 Measurement data of assembled evaluation board

RF Characteristics 1 (Band 1, High Gain Mode)

General condition : V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=0V, V_{CTL}3=1.8V, fRF=2110~2170MHz,
Ta=+25°C, Zs=Zl=50Ω, with application circuit

Parameter	Condition	Symbol	Measurement Data	Units
Small Signal Gain	Exclude Input & Output PCB, Connector Losses (0.45dB)	Gain	15.8 ~ 16.0	dB
Noise Figure	Exclude PCB, Connector Losses (0.09dB)	NF	1.30 ~ 1.37	dB
Input Power 1dB Compression		P-1dB(IN)	-8.7 ~ -7.7	dBm
Input 3rd Order Intercept Point	f1=fRF, f2=fRF+100kHz, Pin=-30dBm	IIP3	+0.4 ~ +0.9	dBm
RF IN VSWR		VSWRi	1.47 ~ 1.71	
RF OUT VSWR		VSWRo	1.84 ~ 1.93	

RF Characteristics 2 (Band 1, Low Gain Mode)

General condition : V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=0V, V_{CTL}3=0V, fRF=2110~2170MHz,
Ta=+25°C, Zs=Zl=50Ω, with application circuit

Parameter	Condition	Symbol	Measurement Data	Units
Small Signal Gain	Exclude Input & Output PCB, Connector Losses (0.45dB)	Gain	-3.6 ~ -3.4	dB
Noise Figure	Exclude PCB, Connector Losses (0.09dB)	NF	3.5 ~ 4.4	dB
Input Power 1dB Compression		P-1dB(IN)	+14.0 ~ +14.3	dBm
Input 3rd Order Intercept Point	f1=fRF, f2=fRF+100kHz, Pin=-16dBm	IIP3	+11.9 ~ +12.8	dBm
RF IN VSWR		VSWRi	1.22 ~ 1.48	
RF OUT VSWR		VSWRo	1.72 ~ 1.91	

2-2-3 Measurement data of assembled evaluation board

RF Characteristics 3 (Band 8, High Gain Mode)

General condition : V_{DD}=2.7V, V_{CTL}1=1.8V, V_{CTL}2=0V, V_{CTL}3=1.8V, fRF=925~960MHz,
Ta=+25°C, Zs=Zl=50Ω, with application circuit

Parameter	Condition	Symbol	Measurement Data	Units
Small Signal Gain	Exclude Input & Output PCB, Connector Losses (0.22dB)	Gain	15.9 ~ 16.2	dB
Noise Figure	Exclude PCB, Connector Losses (0.06dB)	NF	1.37 ~ 1.46	dB
Input Power 1dB Compression		P-1dB(IN)	-8.0 ~ -7.5	dBm
Input 3rd Order Intercept Point	f1=fRF, f2=fRF+100kHz, Pin=-30dBm	IIP3	+1.6 ~ +2.0	dBm
RF IN VSWR		VSWRi	1.70 ~ 1.83	
RF OUT VSWR		VSWRo	1.49 ~ 1.80	

RF Characteristics 4 (Band 8, Low Gain Mode)

General condition : V_{DD}=2.7V, V_{CTL}1=1.8V, V_{CTL}2=0V, V_{CTL}3=0V, fRF=925~960MHz,
Ta=+25°C, Zs=Zl=50Ω, with application circuit

Parameter	Condition	Symbol	Measurement Data	Units
Small Signal Gain	Exclude Input & Output PCB, Connector Losses (0.22dB)	Gain	-3.8 ~ -3.7	dB
Noise Figure	Exclude PCB, Connector Losses (0.06dB)	NF	2.6 ~ 4.6	dB
Input Power 1dB Compression		P-1dB(IN)	+17.1 ~ +17.5	dBm
Input 3rd Order Intercept Point	f1=fRF, f2=fRF+100kHz, Pin=-20dBm	IIP3	+14.0 ~ +14.9	dBm
RF IN VSWR		VSWRi	1.70 ~ 1.80	
RF OUT VSWR		VSWRo	2.69 ~ 2.80	

2-2-4 Measurement data of assembled evaluation board

RF Characteristics 5 (Band 4, High Gain Mode)

General condition : V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=1.8V, V_{CTL}3=1.8V, fRF=2110~2155MHz,
Ta=+25°C, Zs=Zl=50Ω, with application circuit

Parameter	Condition	Symbol	Measurement Data	Units
Small Signal Gain	Exclude Input & Output PCB, Connector Losses (0.40dB)	Gain	14.4 ~ 14.7	dB
Noise Figure	Exclude PCB, Connector Losses (0.12dB)	NF	1.60 ~ 1.67	dB
Input Power 1dB Compression		P-1dB(IN)	-7.6 ~ -7.4	dBm
Input 3rd Order Intercept Point	f1=fRF, f2=fRF+100kHz, Pin=-30dBm	IIP3	+1.9 ~ +2.2	dBm
RF IN VSWR		VSWRi	1.67 ~ 1.69	
RF OUT VSWR		VSWRo	1.85 ~ 1.94	

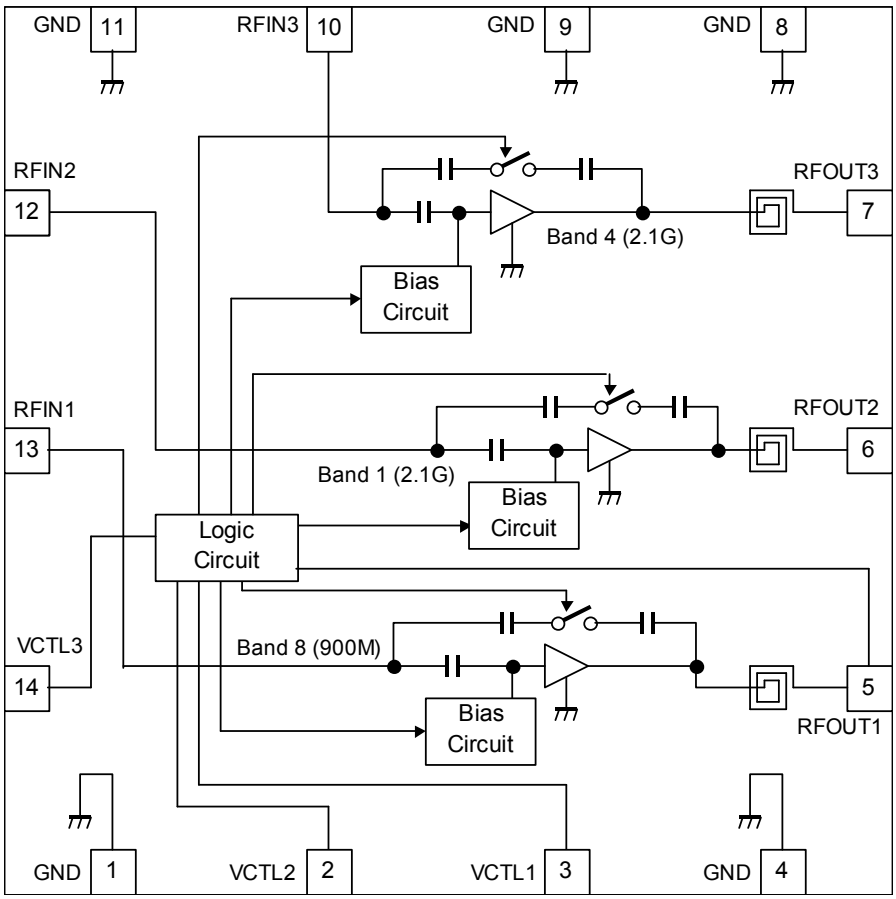
RF Characteristics 6 (Band 4, Low Gain Mode)

General condition : V_{DD}=2.8V, V_{CTL}1=0V, V_{CTL}2=1.8V, V_{CTL}3=0V, fRF=2110~2155MHz,
Ta=+25°C, Zs=Zl=50Ω, with application circuit

Parameter	Condition	Symbol	Measurement Data	Units
Small Signal Gain	Exclude Input & Output PCB, Connector Losses (0.40dB)	Gain	-5.4 ~ -5.4	dB
Noise Figure	Exclude PCB, Connector Losses (0.12dB)	NF	4.8 ~ 6.1	dB
Input Power 1dB Compression		P-1dB(IN)	+17.1 ~ +17.8	dBm
Input 3rd Order Intercept Point	f1=fRF, f2=fRF+100kHz, Pin=-16dBm	IIP3	+16.3 ~ +16.8	dBm
RF IN VSWR		VSWRi	2.65 ~ 2.68	
RF OUT VSWR		VSWRo	3.37 ~ 3.39	

2-3 Pin configuration

(Top View)



VCTL terminal function

VCTL1, VCTL2：Band Select (Band 1 or 4 or 8)

VCTL3：RX ATT Select (High Gain mode or Low Gain mode)

2-4 Truth table

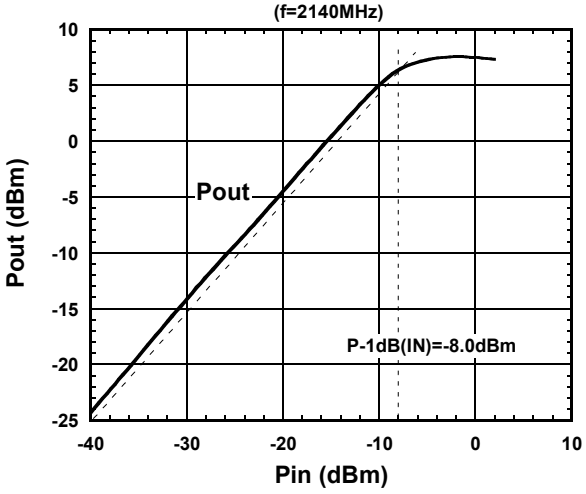
Control Voltage			State					
$V_{CTL}1$ (Band Sel1)	$V_{CTL}2$ (Band Sel2)	$V_{CTL}3$ (RX ATT)	Band 1 (2.1GHz)		Band 8 (900MHz)		Band 4 (2.1GHz)	
			LNA I_{DD}	Bypass	LNA I_{DD}	Bypass	LNA I_{DD}	Bypass
L	L	L	OFF	ON	OFF	ON	OFF	ON
L	L	H	ON	OFF	OFF	OFF	OFF	OFF
H	L	L	OFF	ON	OFF	ON	OFF	ON
H	L	H	OFF	OFF	ON	OFF	OFF	OFF
L	H	L	OFF	ON	OFF	ON	OFF	ON
L	H	H	OFF	OFF	OFF	OFF	ON	OFF
H	H	L	OFF	ON	OFF	ON	OFF	ON
H	H	H	OFF	OFF	OFF	OFF	ON	OFF

“L”=0～0.3V、“H”=1.36～1.9V

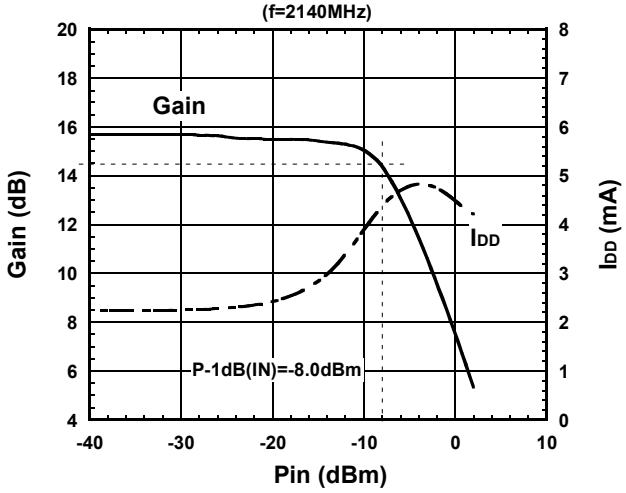
2-5-1 Typical characteristics (Band 1, High Gain Mode)

Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=0V, V_{CTL}3=1.8V

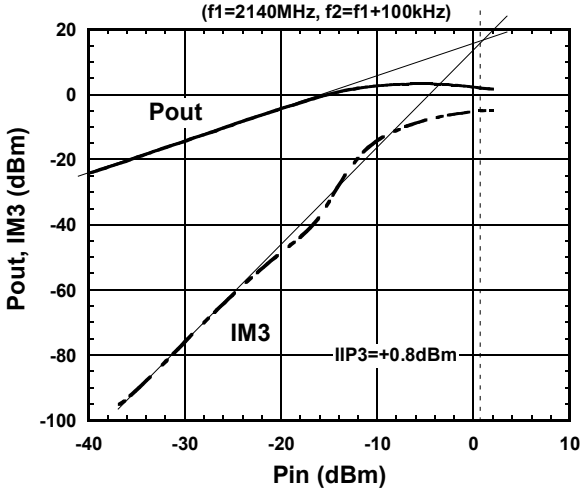
2.1GHz (Band 1) @High Gain
Pout vs. Pin
(f=2140MHz)



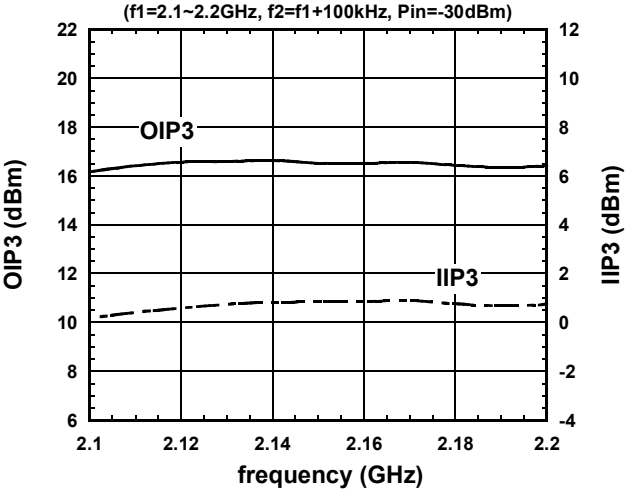
2.1GHz (Band 1) @High Gain
Gain, I_{DD} vs. Pin
(f=2140MHz)



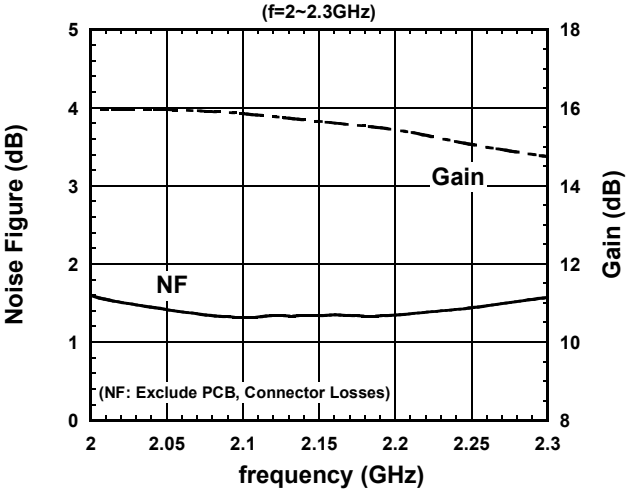
2.1GHz (Band 1) @High Gain
Pout, IM3 vs. Pin
(f1=2140MHz, f2=f1+100kHz)



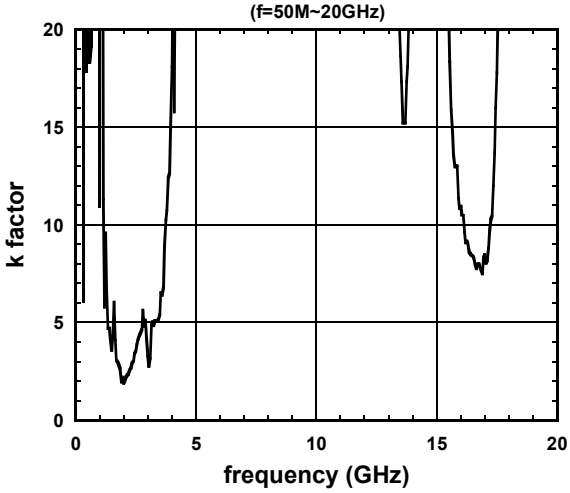
2.1GHz (Band 1) @High Gain
OIP3, IIP3 vs. frequency
(f1=2.1~2.2GHz, f2=f1+100kHz, Pin=-30dBm)



2.1GHz (Band 1) @High Gain
NF, Gain vs. frequency
(f=2~2.3GHz)

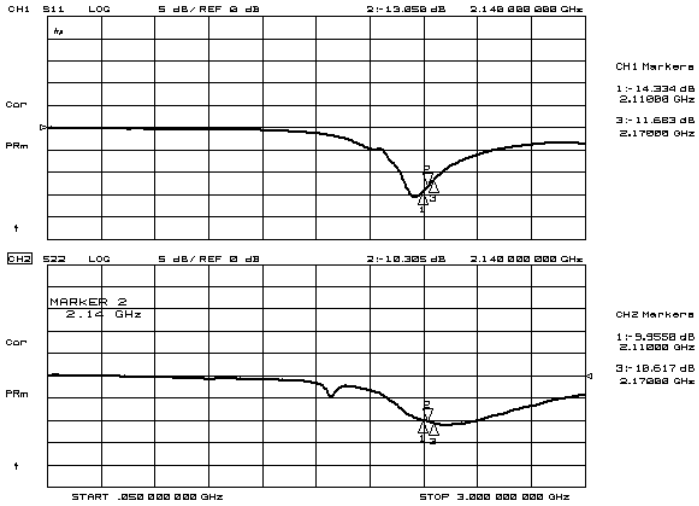


2.1GHz (Band 1) @High Gain
k factor vs. frequency
(f=50M~20GHz)

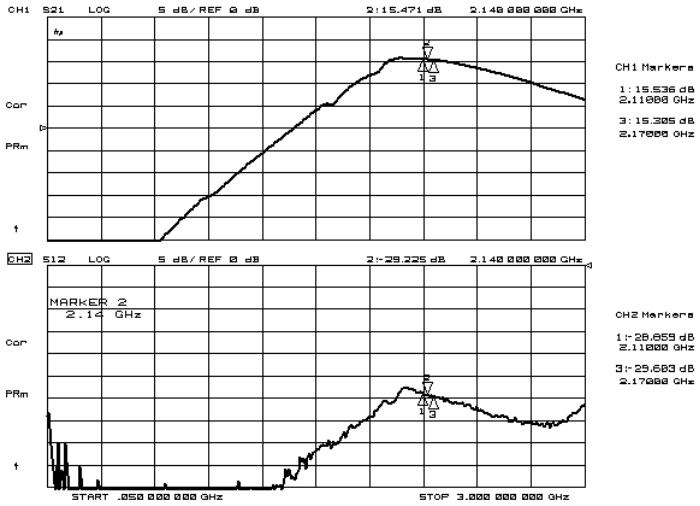


2-5-2 Typical characteristics (Band 1, High Gain Mode)

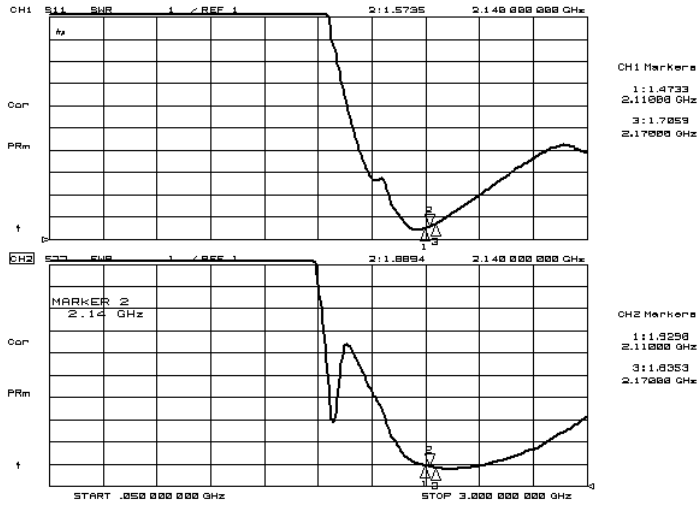
Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=0V, V_{CTL}3=1.8V



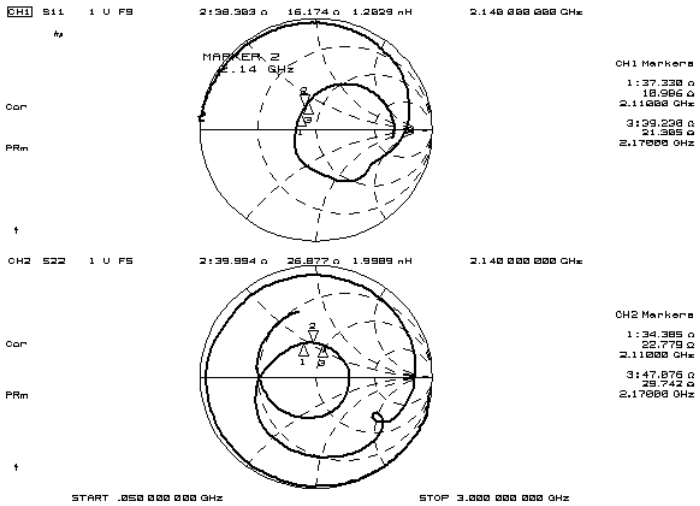
S11, S22



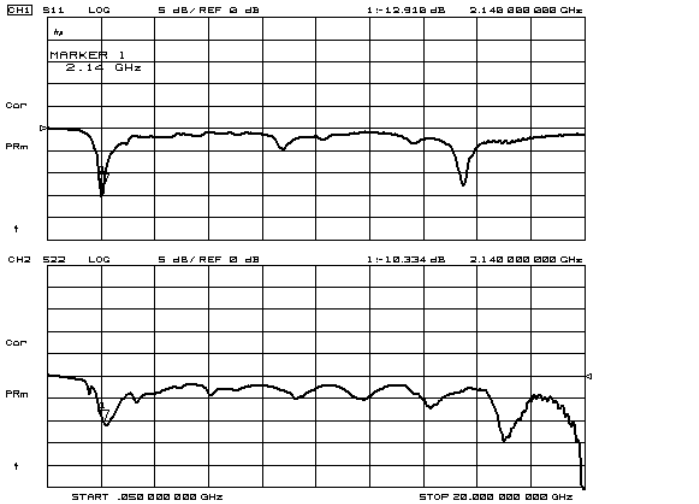
S21, S12



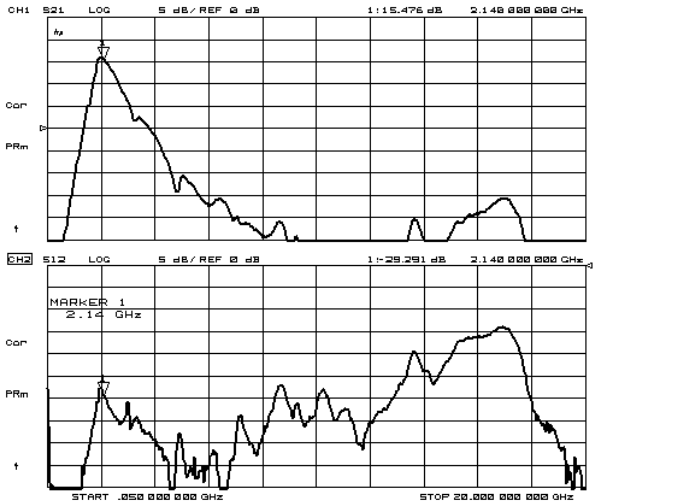
VSWR



Zin, Zout



S11, S22 (50M~20GHz)

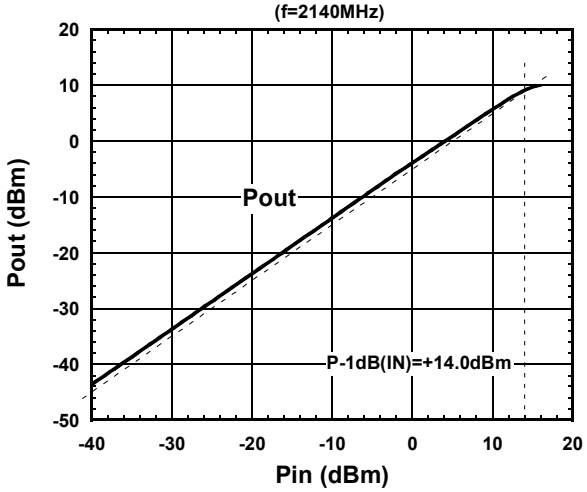


S21, S12 (50M~20GHz)

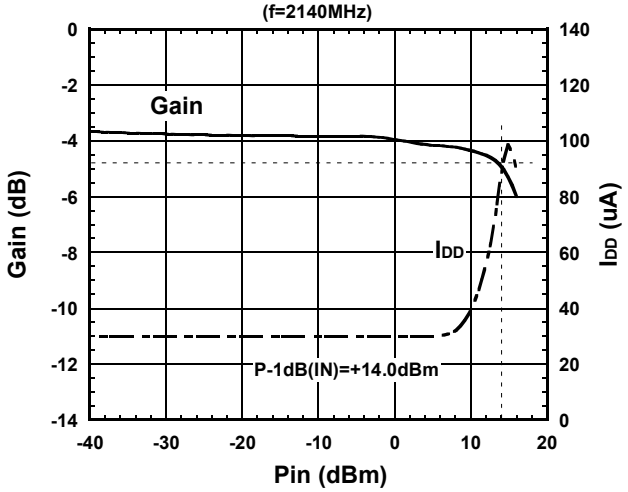
2-5-3 Typical characteristics (Band 1, Low Gain Mode)

Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=0V, V_{CTL}3=0V

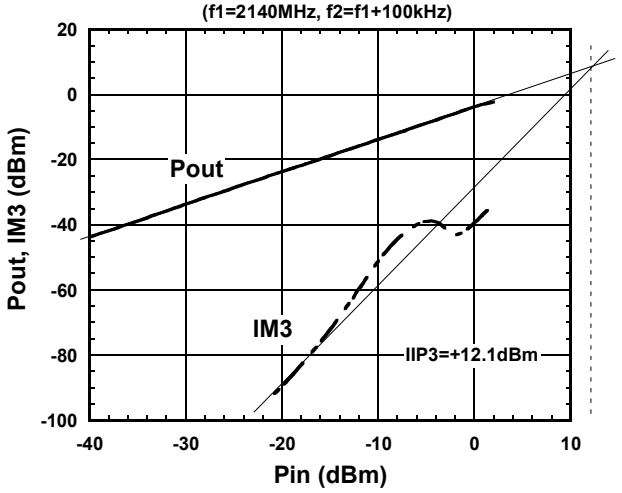
2.1GHz (Band 1) @Low Gain
Pout vs. Pin
(f=2140MHz)



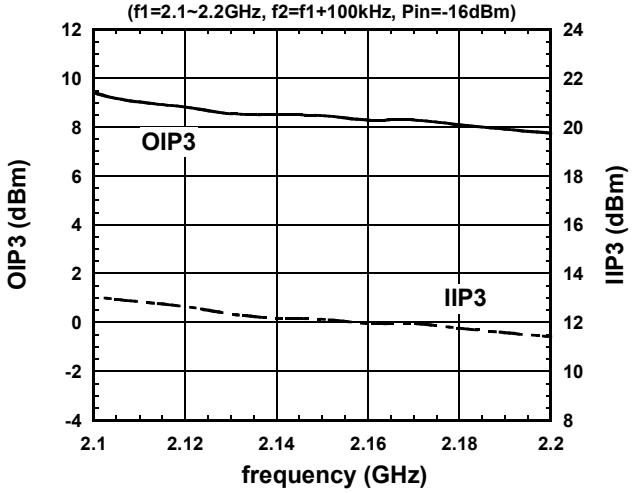
2.1GHz (Band 1) @Low Gain
Gain, IDD vs. Pin
(f=2140MHz)



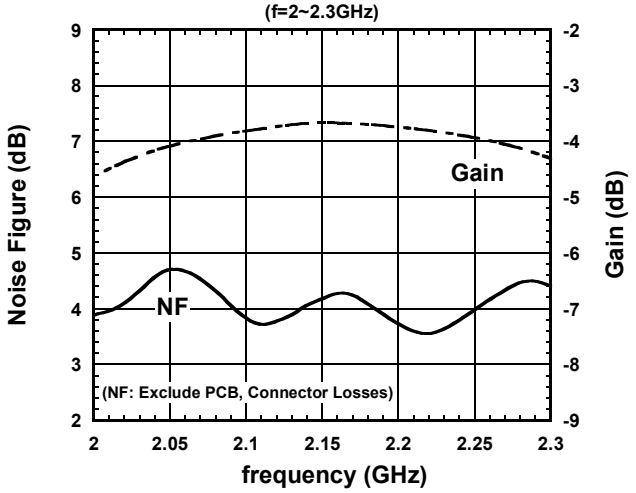
2.1GHz (Band 1) @Low Gain
Pout, IM3 vs. Pin
(f1=2140MHz, f2=f1+100kHz)



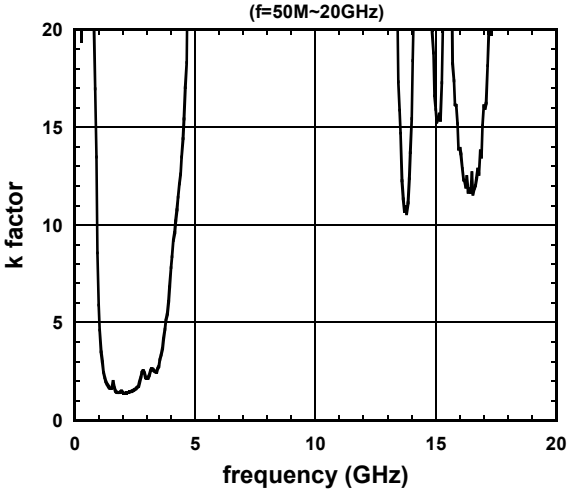
2.1GHz (Band 1) @Low Gain
OIP3, IIP3 vs. frequency
(f1=2.1~2.2GHz, f2=f1+100kHz, Pin=-16dBm)



2.1GHz (Band 1) @Low Gain
NF, Gain vs. frequency
(f=2~2.3GHz)

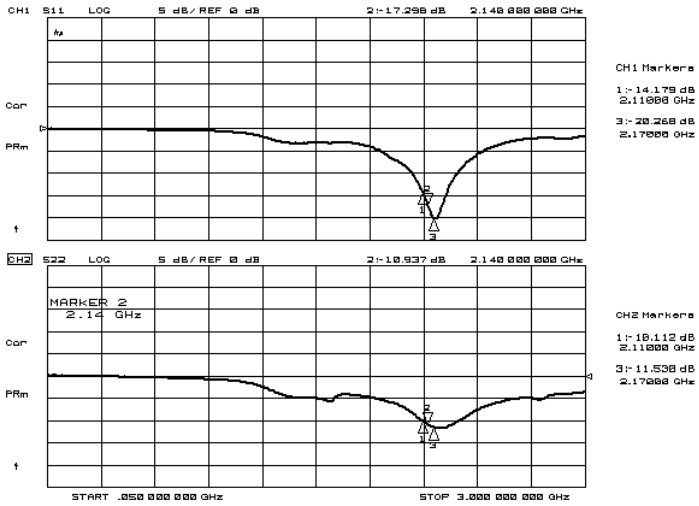


2.1GHz (Band 1) @Low Gain
k factor vs. frequency
(f=50M~20GHz)

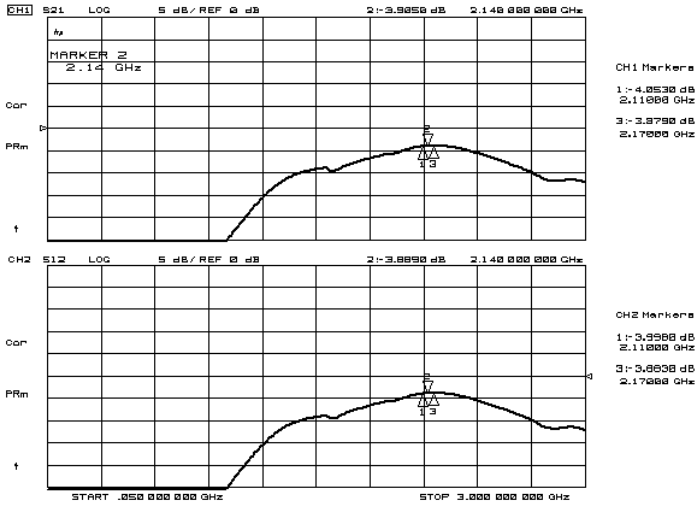


2-5-4 Typical characteristics (Band 1, Low Gain Mode)

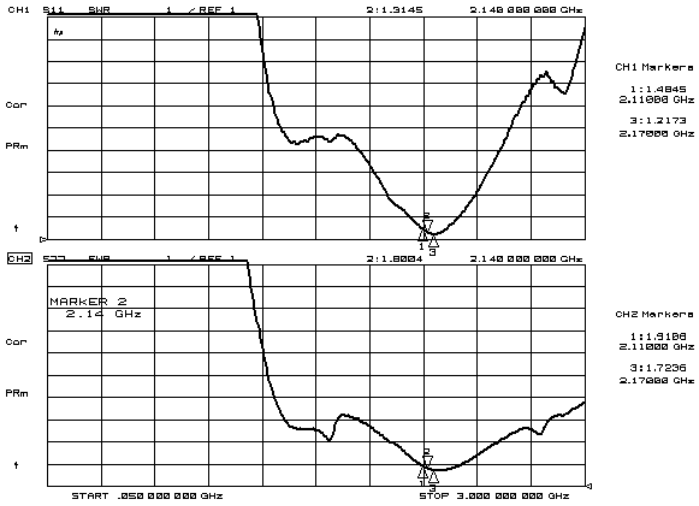
Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=0V, V_{CTL}3=0V



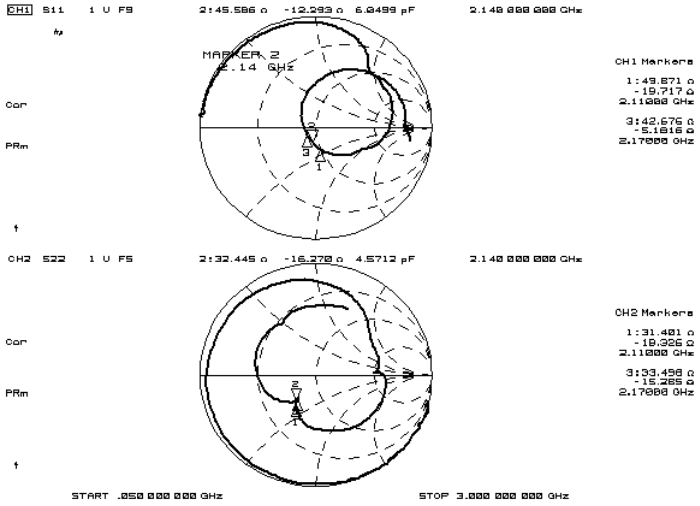
S11, S22



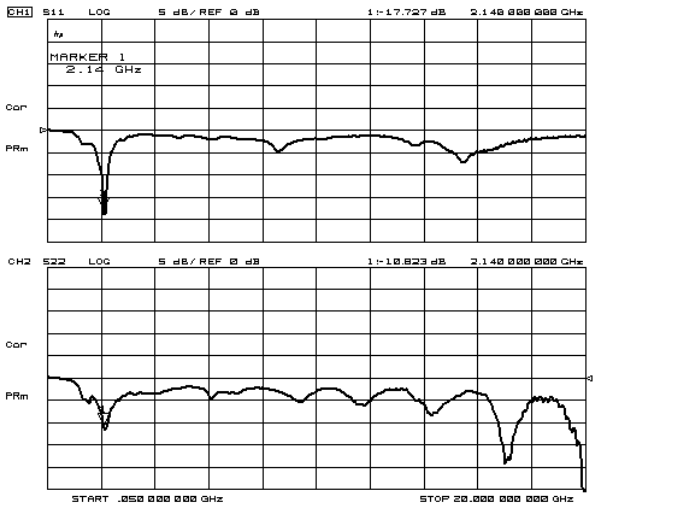
S21, S12



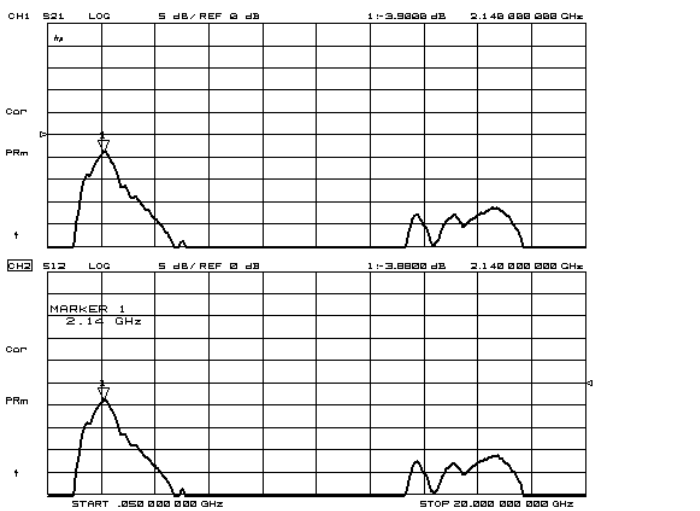
VSWR



Zin, Zout



S11, S22 (50M~20GHz)

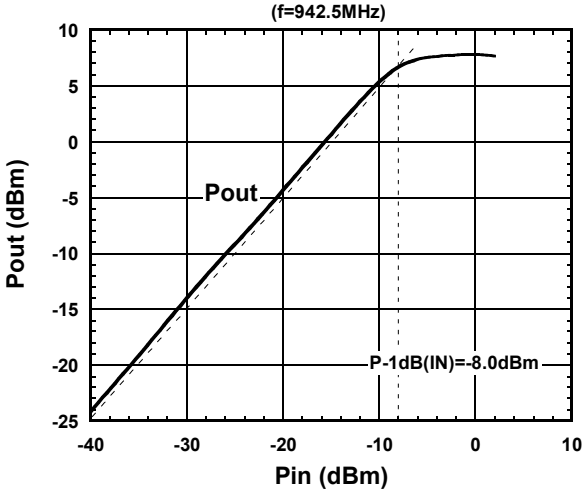


S21, S12 (50M~20GHz)

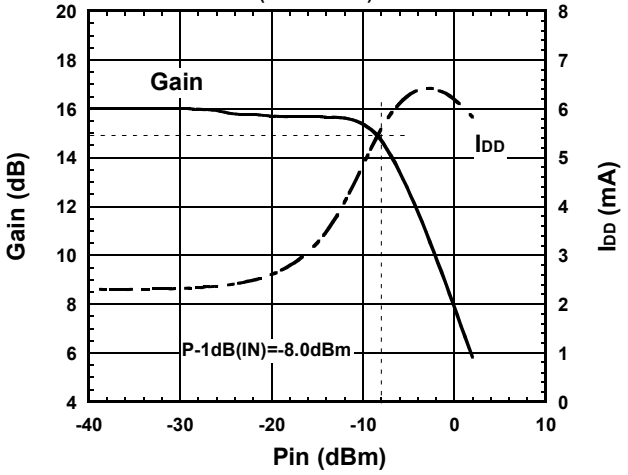
2-5-5 Typical characteristics (Band 8, High Gain Mode)

Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=1.8V, V_{CTL}2=0V, V_{CTL}3=1.8V

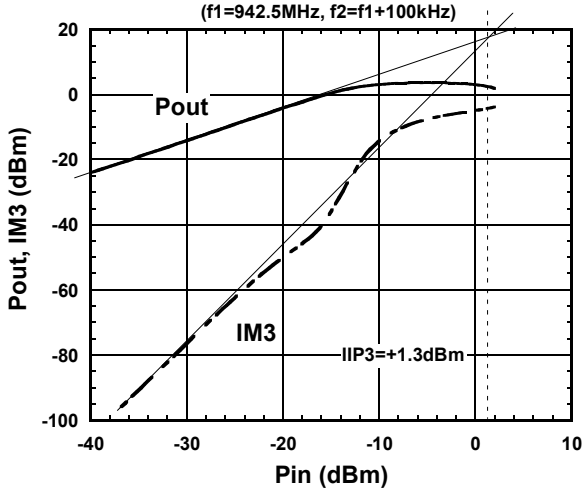
900MHz (Band 8) @High Gain
Pout vs. Pin
(f=942.5MHz)



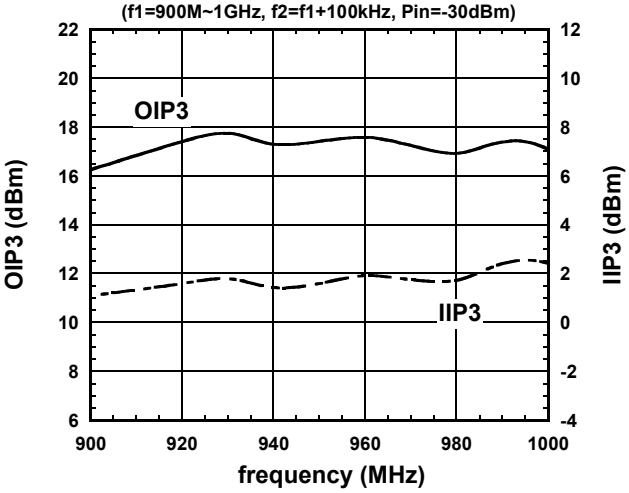
900MHz (Band 8) @High Gain
Gain, I_{DD} vs. Pin
(f=942.5MHz)



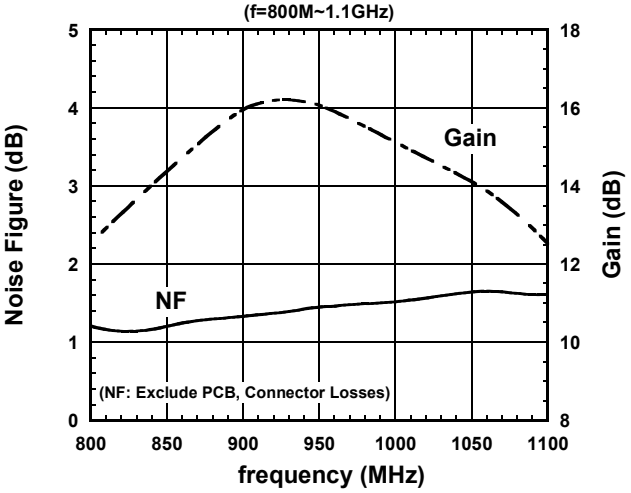
900MHz (Band 8) @High Gain
Pout, IM3 vs. Pin
(f1=942.5MHz, f2=f1+100kHz)



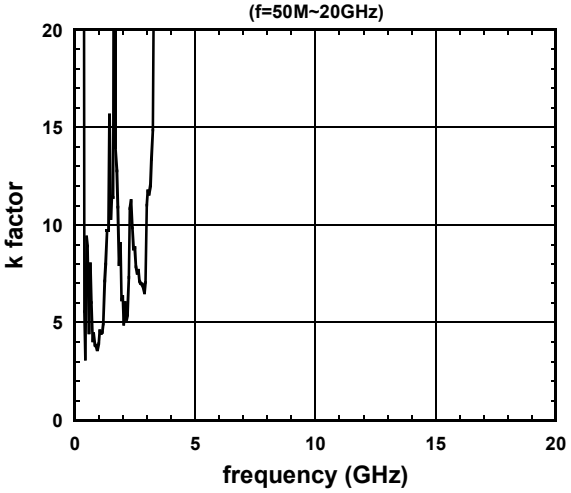
900MHz (Band 8) @High Gain
OIP3, IIP3 vs. frequency
(f1=900M~1GHz, f2=f1+100kHz, Pin=-30dBm)



900MHz (Band 8) @High Gain
NF, Gain vs. frequency
(f=800M~1.1GHz)

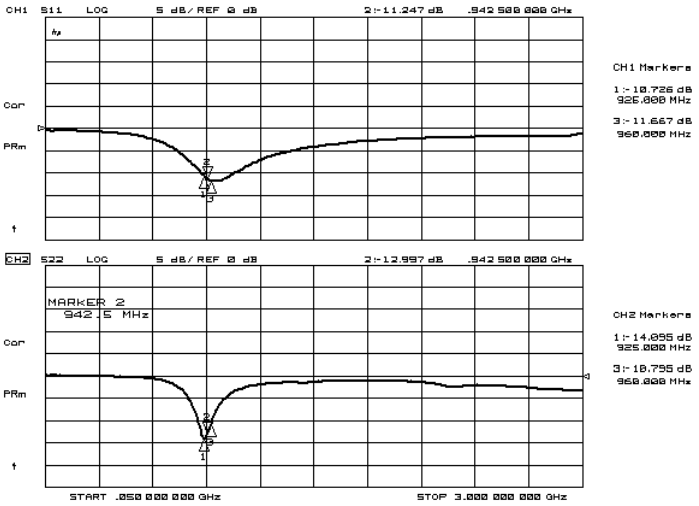


900MHz (Band 8) @High Gain
k factor vs. frequency
(f=50M~20GHz)

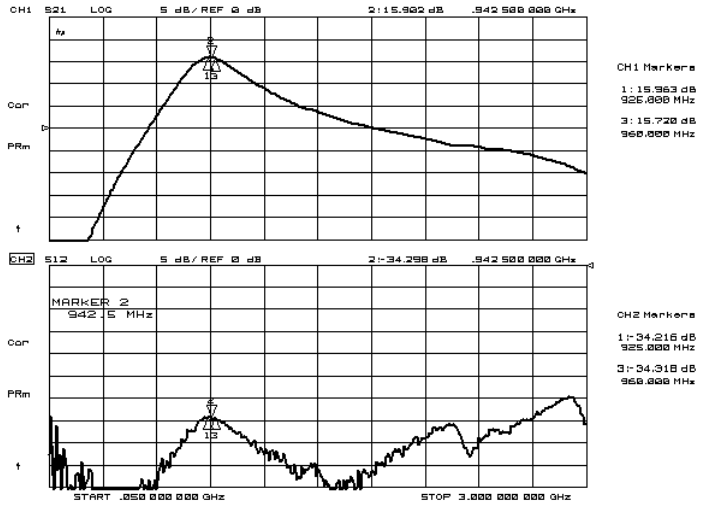


2-5-6 Typical characteristics (Band 8, High Gain Mode)

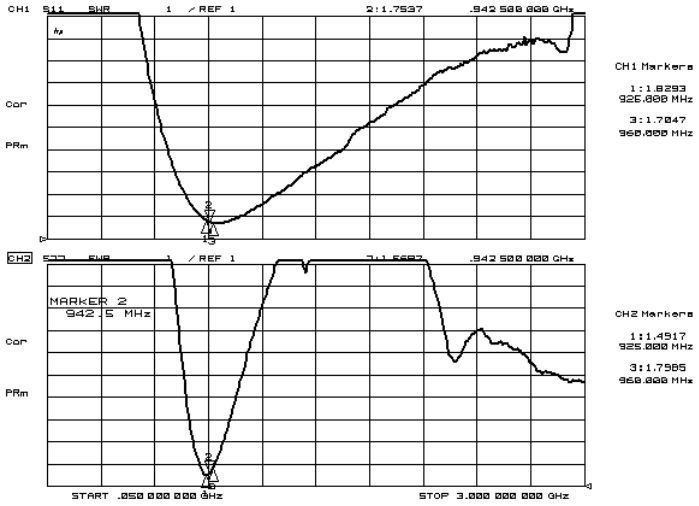
Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=1.8V, V_{CTL}2=0V, V_{CTL}3=1.8V



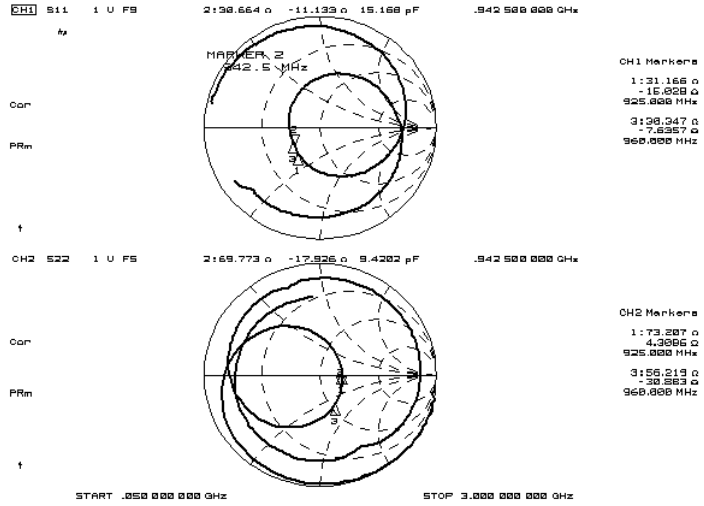
S11, S22



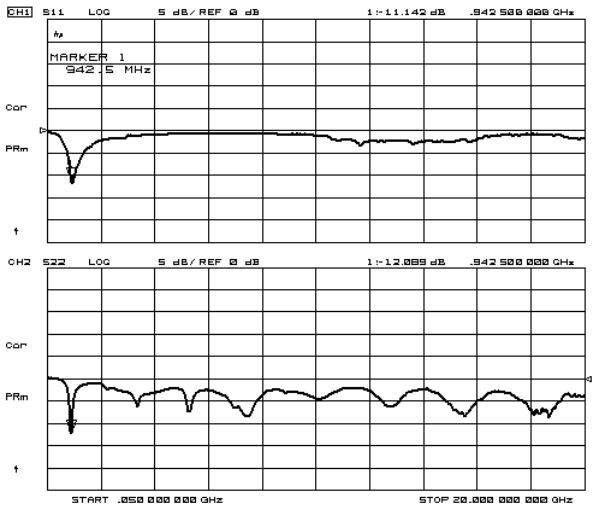
S21, S12



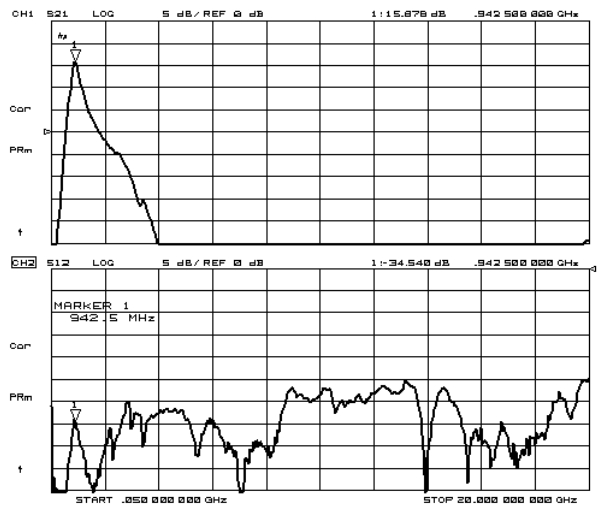
VSWR



Zin, Zout



S11, S22 (50M~20GHz)

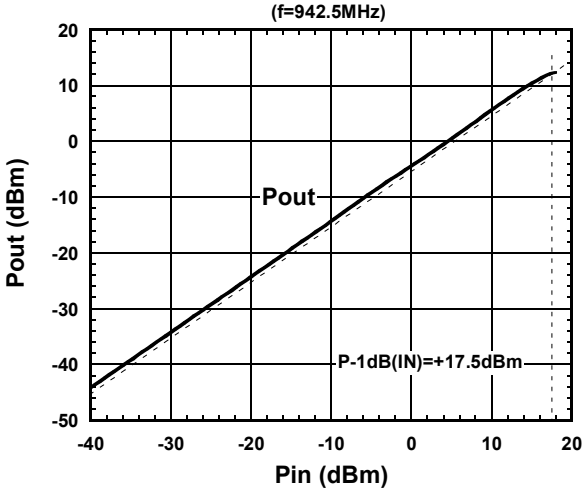


S21, S12 (50M~20GHz)

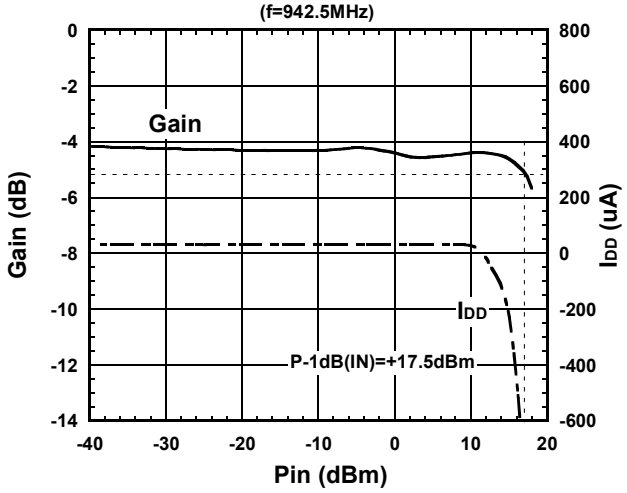
2-5-7 Typical characteristics (Band 8, Low Gain Mode)

Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=1.8V, V_{CTL}2=0V, V_{CTL}3=0V

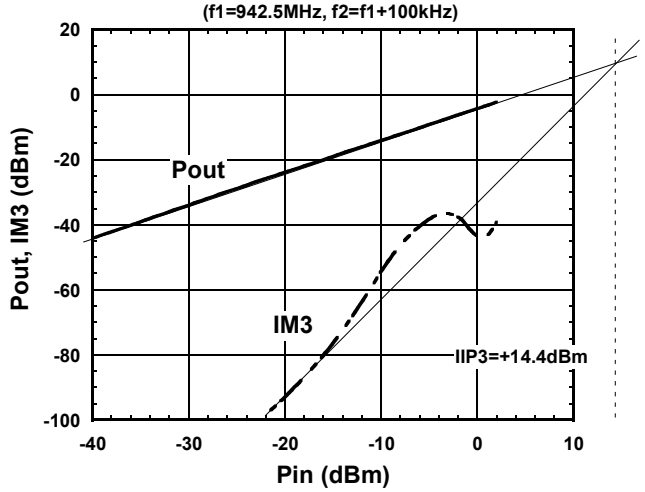
900MHz (Band 8) @Low Gain
Pout vs. Pin
(f=942.5MHz)



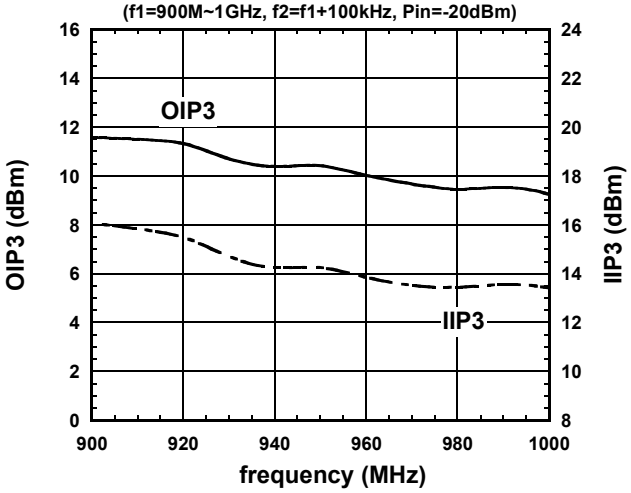
900MHz (Band 8) @Low Gain
Gain, I_{DD} vs. Pin
(f=942.5MHz)



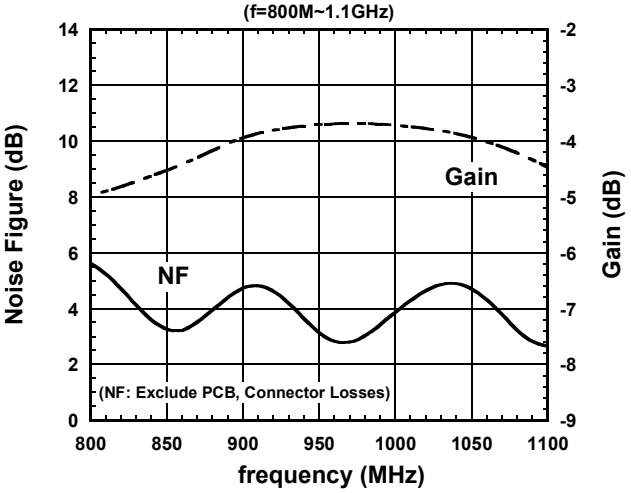
900MHz (Band 8) @Low Gain
Pout, IM3 vs. Pin
(f1=942.5MHz, f2=f1+100kHz)



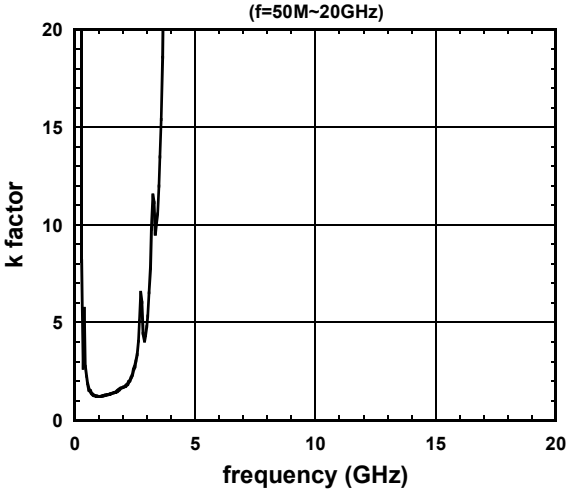
900MHz (Band 8) @Low Gain
OIP3, IIP3 vs. frequency
(f1=900M~1GHz, f2=f1+100kHz, Pin=-20dBm)



900MHz (Band 8) @Low Gain
NF, Gain vs. frequency
(f=800M~1.1GHz)

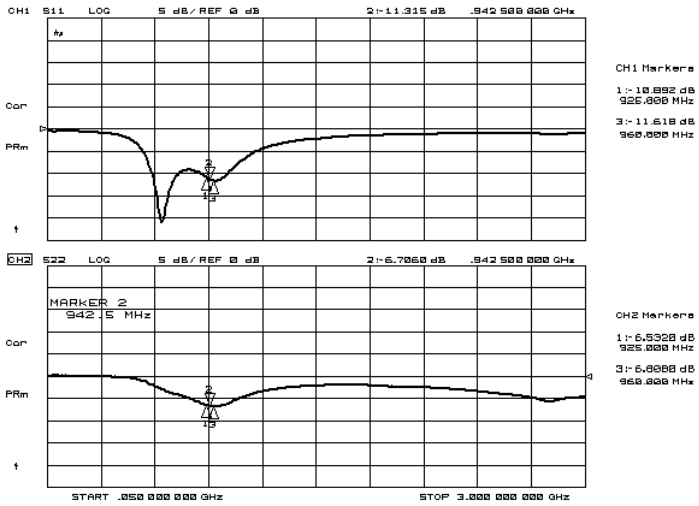


900MHz (Band 8) @Low Gain
k factor vs. frequency
(f=50M~20GHz)

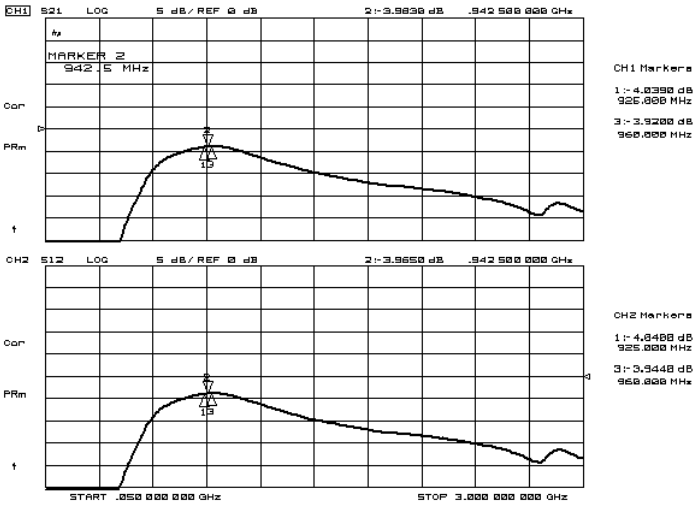


2-5-8 Typical characteristics (Band 8, Low Gain Mode)

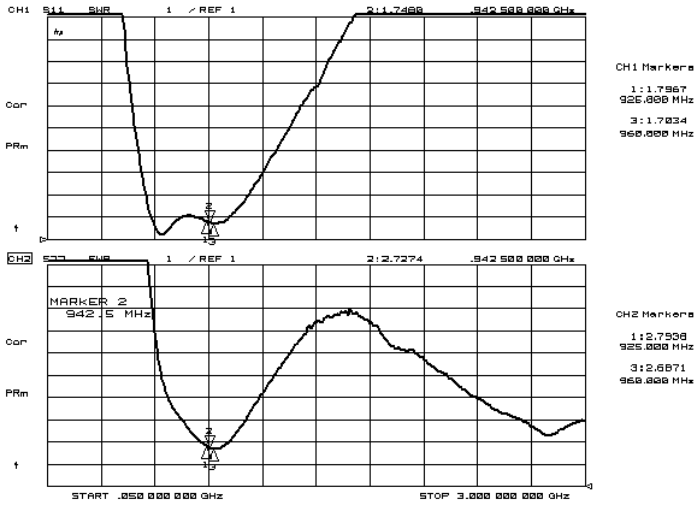
Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=1.8V, V_{CTL}2=0V, V_{CTL}3=0V



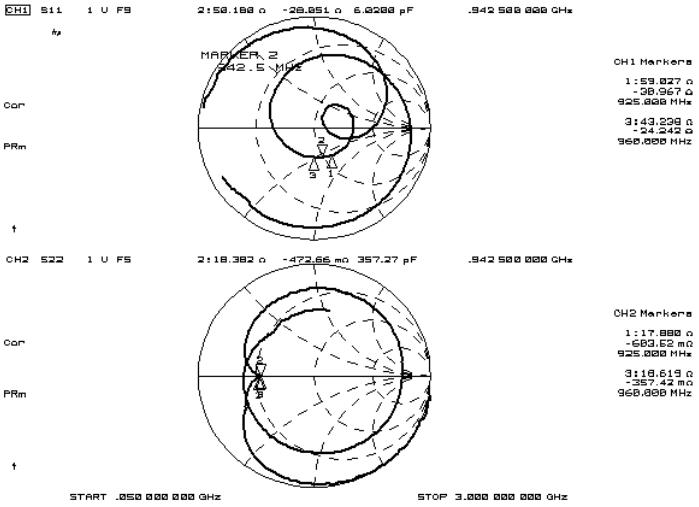
S11, S22



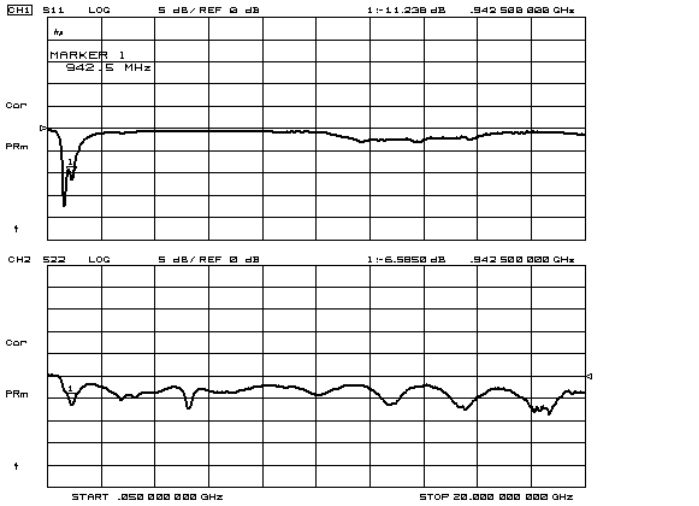
S21, S12



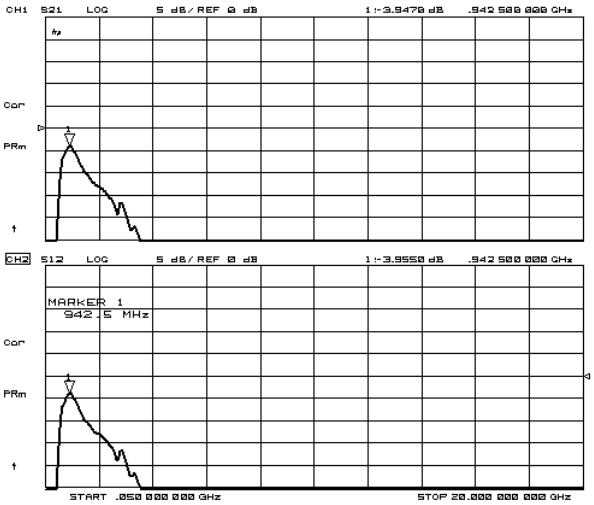
VSWR



Zin, Zout



S11, S22 (50M~20GHz)

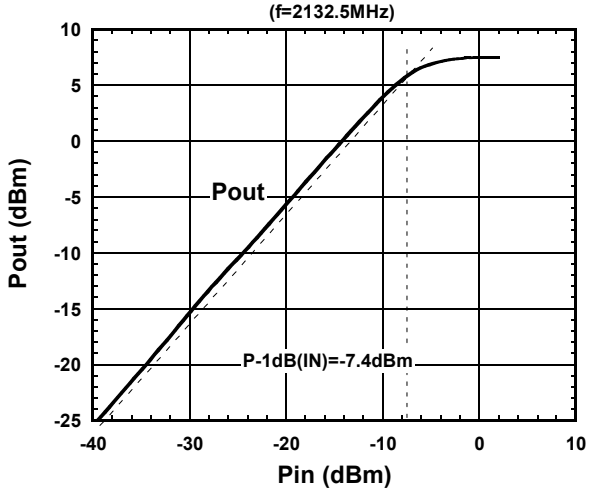


S21, S12 (50M~20GHz)

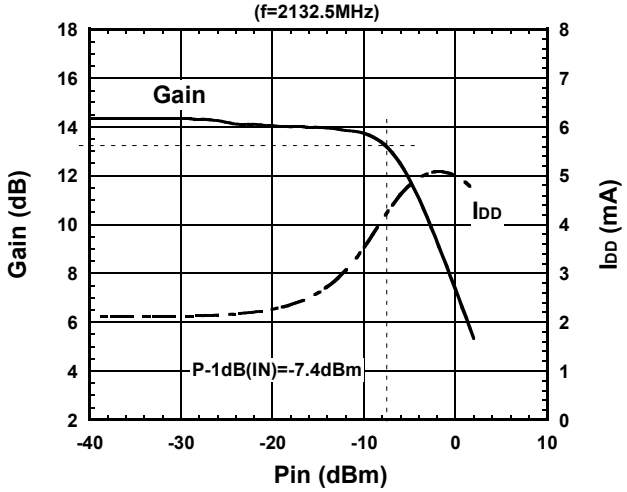
2-5-9 Typical characteristics (Band 4, High Gain Mode)

Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=1.8V, V_{CTL}3=1.8V

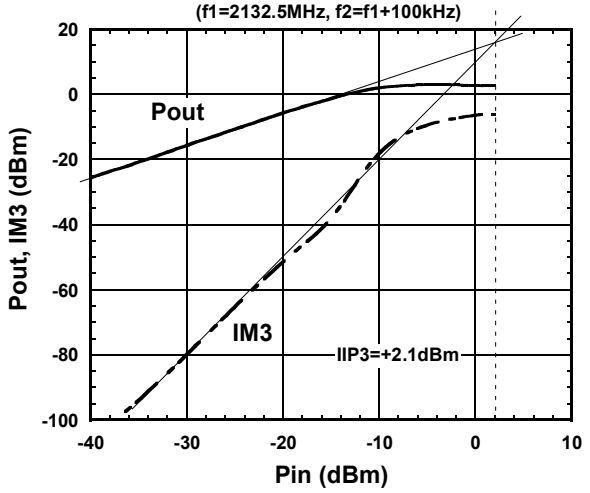
2.1GHz (Band 4) @High Gain
Pout vs. Pin
(f=2132.5MHz)



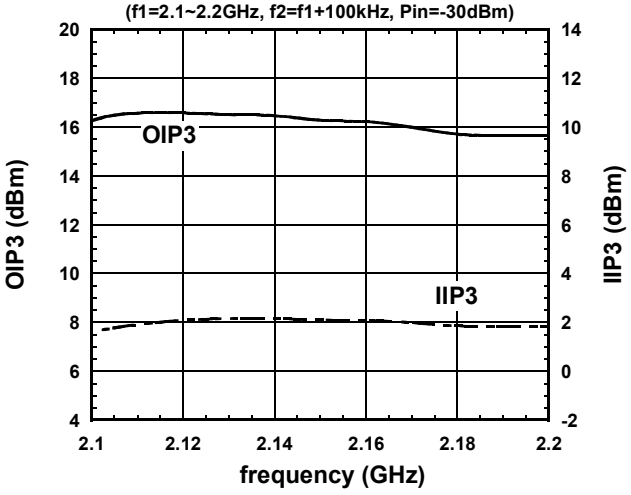
2.1GHz (Band 4) @High Gain
Gain, I_{DD} vs. Pin
(f=2132.5MHz)



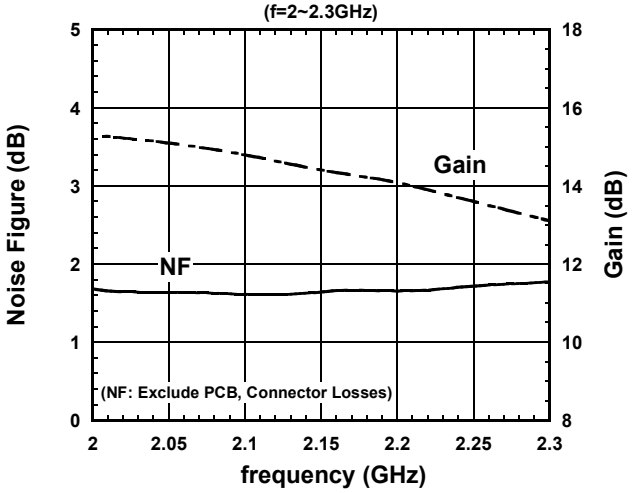
2.1GHz (Band 4) @High Gain
Pout, IM3 vs. Pin
(f1=2132.5MHz, f2=f1+100kHz)



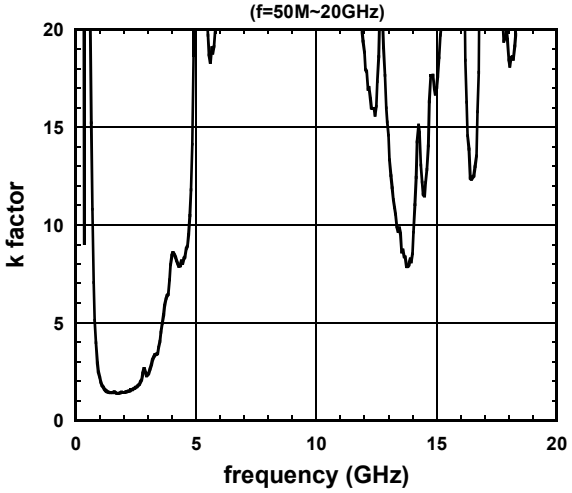
2.1GHz (Band 4) @High Gain
OIP3, IIP3 vs. frequency
(f1=2.1~2.2GHz, f2=f1+100kHz, Pin=-30dBm)



2.1GHz (Band 4) @High Gain
NF, Gain vs. frequency
(f=2~2.3GHz)

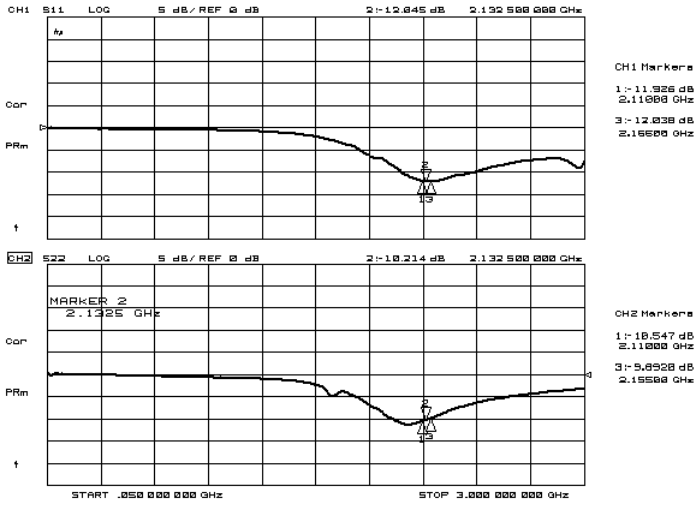


2.1GHz (Band 4) @High Gain
k factor vs. frequency
(f=50M~20GHz)

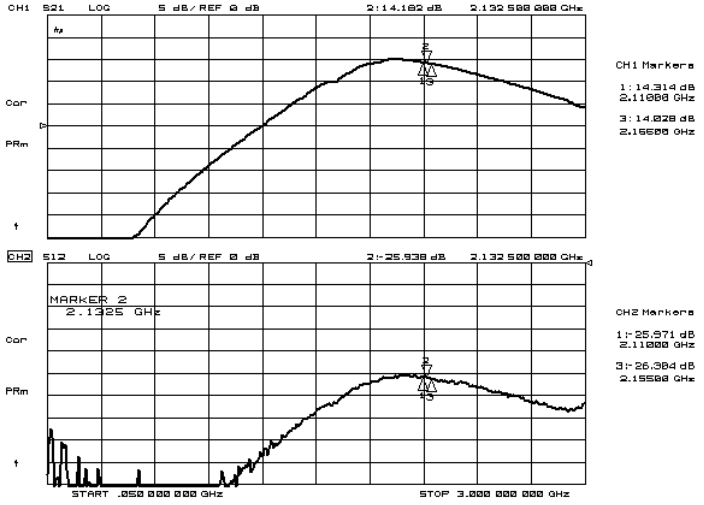


2-5-10 Typical characteristics (Band 4, High Gain Mode)

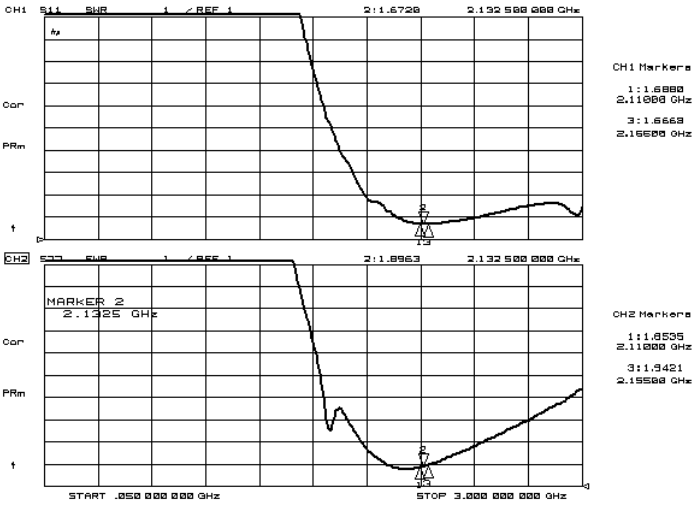
Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=1.8V, V_{CTL}3=1.8V



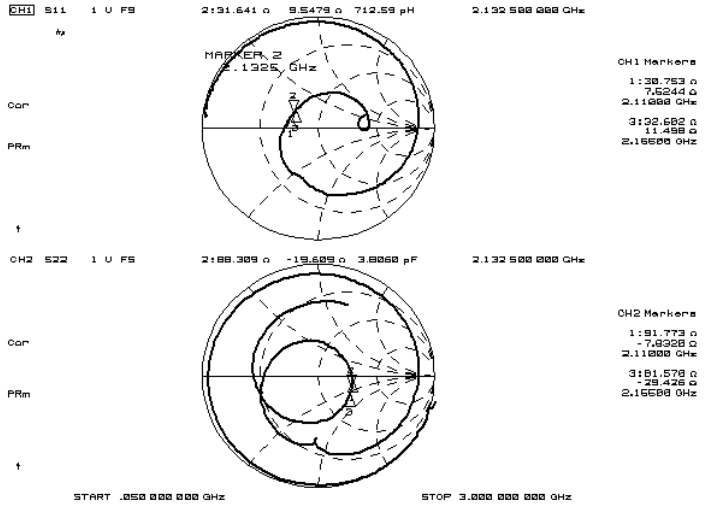
S11, S22



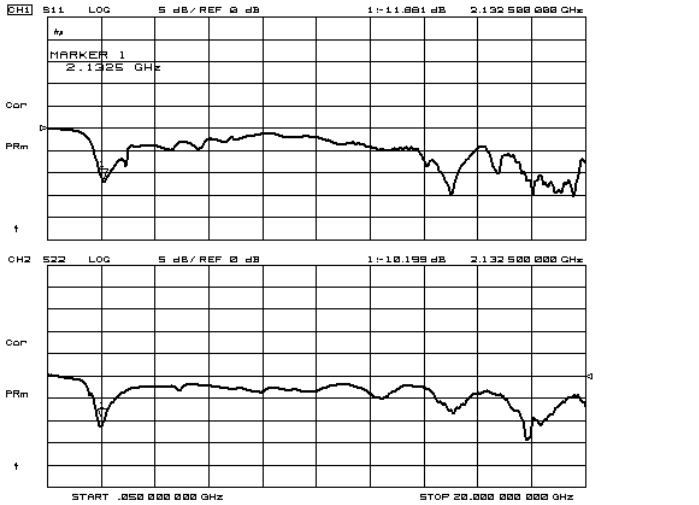
S21, S12



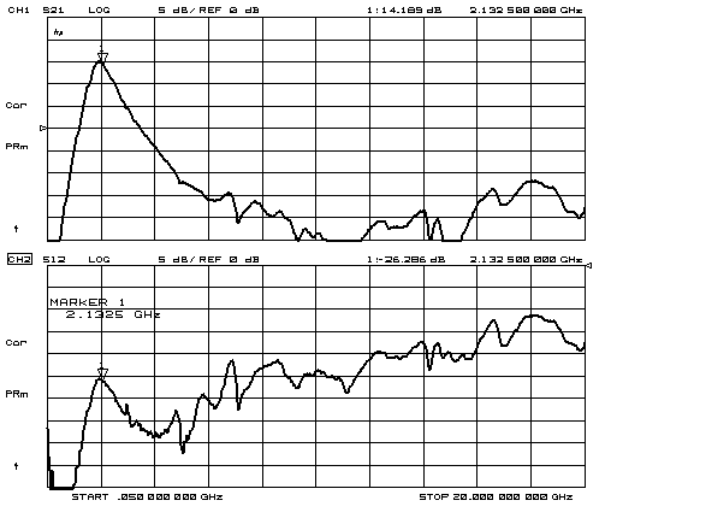
VSWR



Zin, Zout



S11, S22 (50M~20GHz)

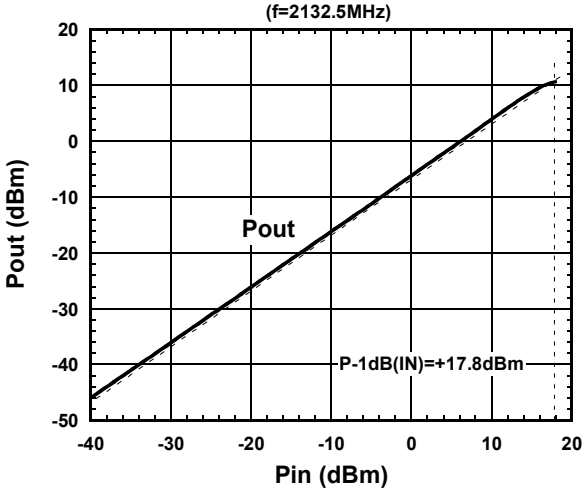


S21, S12 (50M~20GHz)

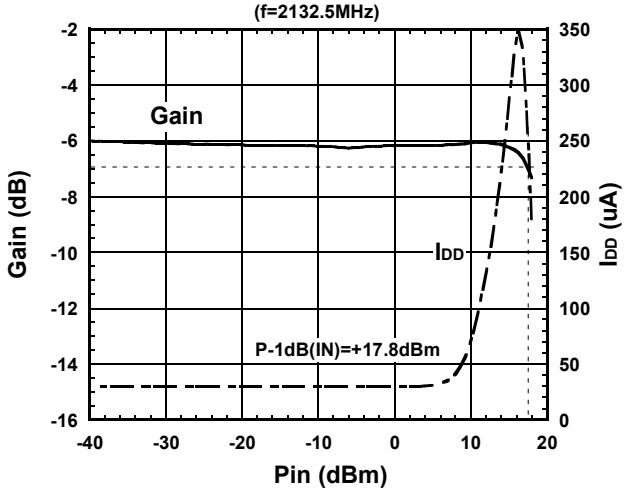
2-5-11 Typical characteristics (Band 4, Low Gain Mode)

Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=1.8V, V_{CTL}3=0V

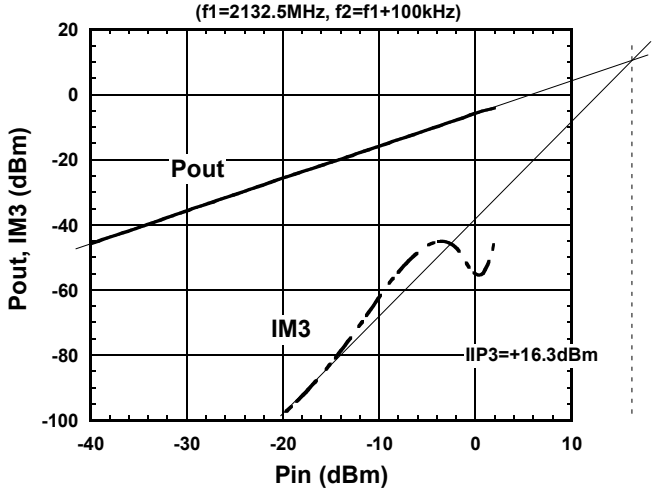
2.1GHz (Band 4) @Low Gain
Pout vs. Pin
(f=2132.5MHz)



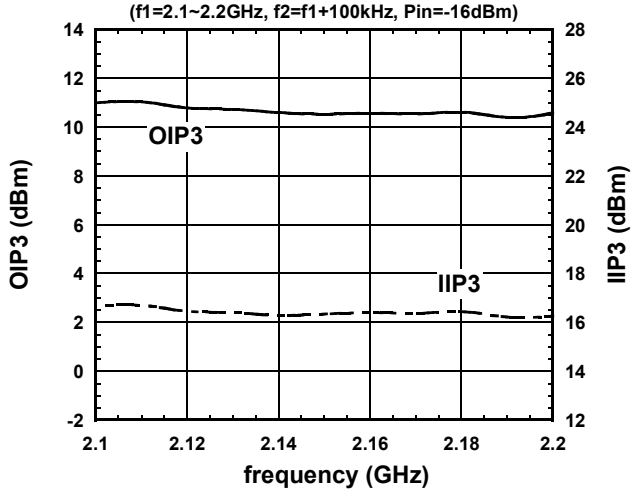
2.1GHz (Band 4) @Low Gain
Gain, I_{DD} vs. Pin
(f=2132.5MHz)



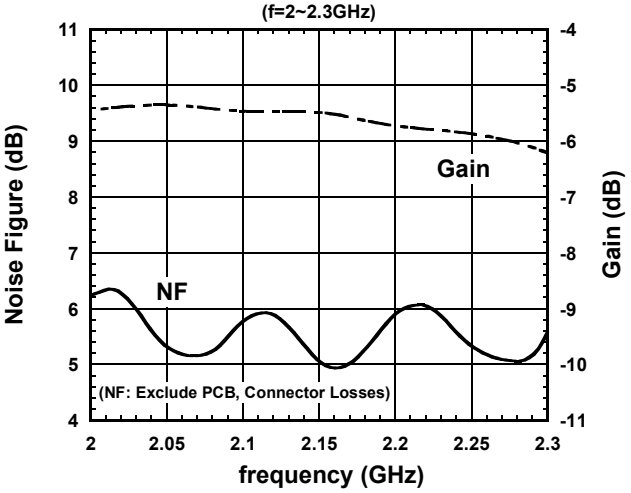
2.1GHz (Band 4) @Low Gain
Pout, IM3 vs. Pin
(f1=2132.5MHz, f2=f1+100kHz)



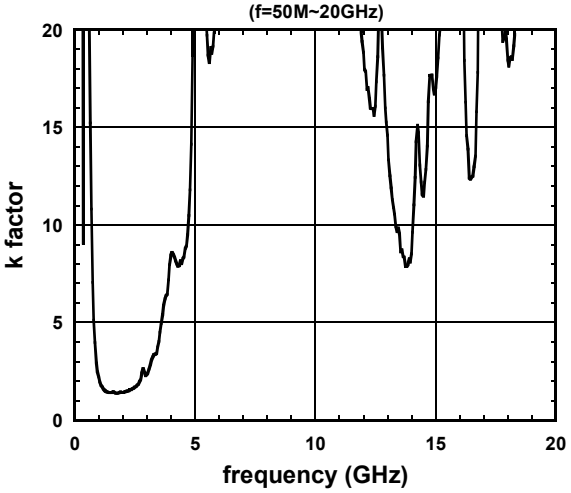
2.1GHz (Band 4) @Low Gain
OIP3, IIP3 vs. frequency
(f1=2.1~2.2GHz, f2=f1+100kHz, Pin=-16dBm)



2.1GHz (Band 4) @Low Gain
NF, Gain vs. frequency
(f=2~2.3GHz)

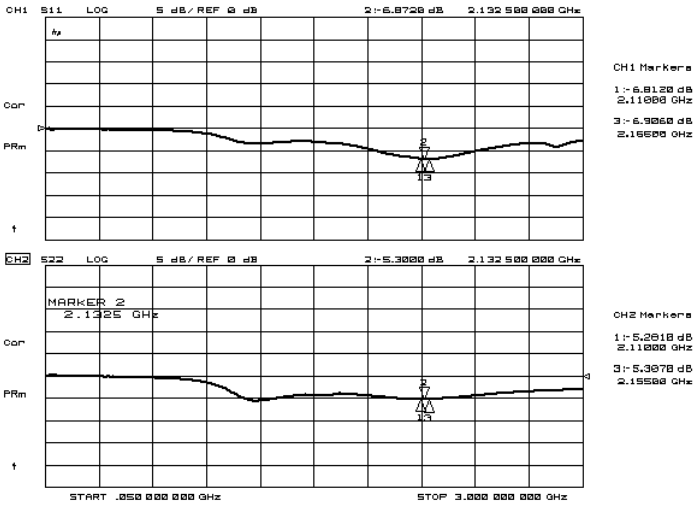


2.1GHz (Band 4) @Low Gain
k factor vs. frequency
(f=50M~20GHz)

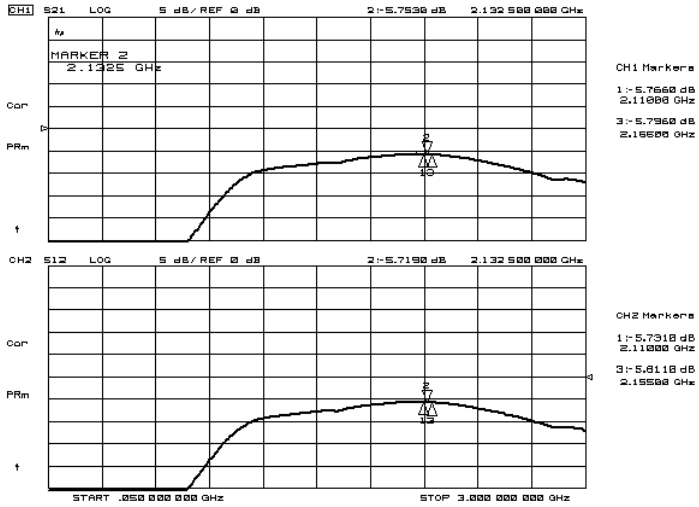


2-5-12 Typical characteristics (Band 4, Low Gain Mode)

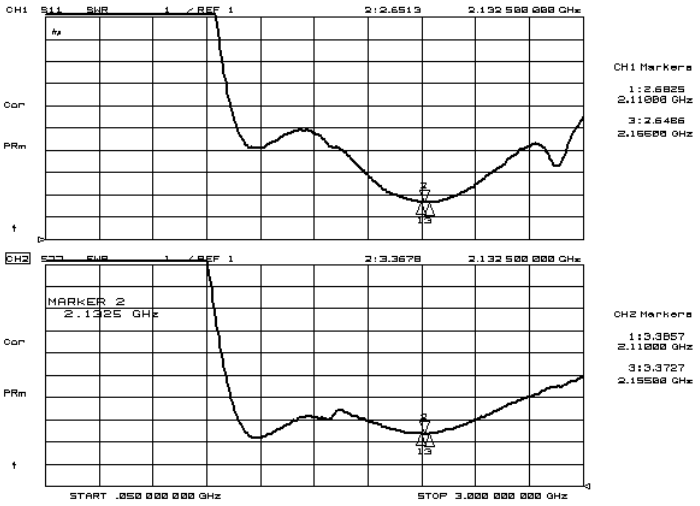
Condition: Ta=+25°C, V_{DD}=2.7V, V_{CTL}1=0V, V_{CTL}2=1.8V, V_{CTL}3=0V



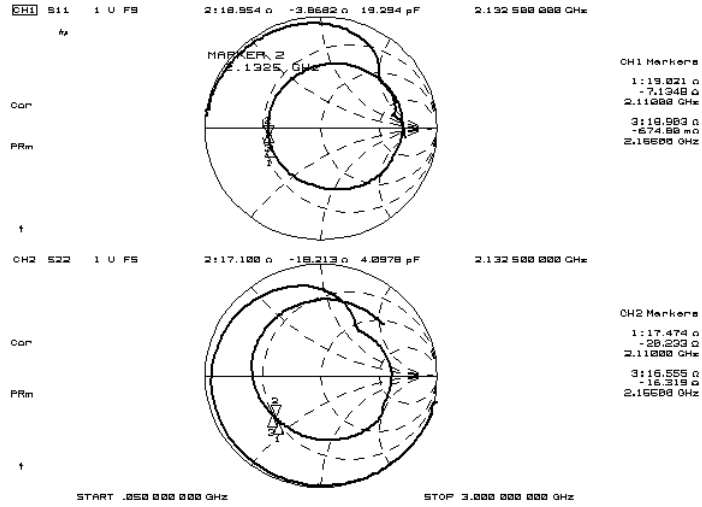
S11, S22



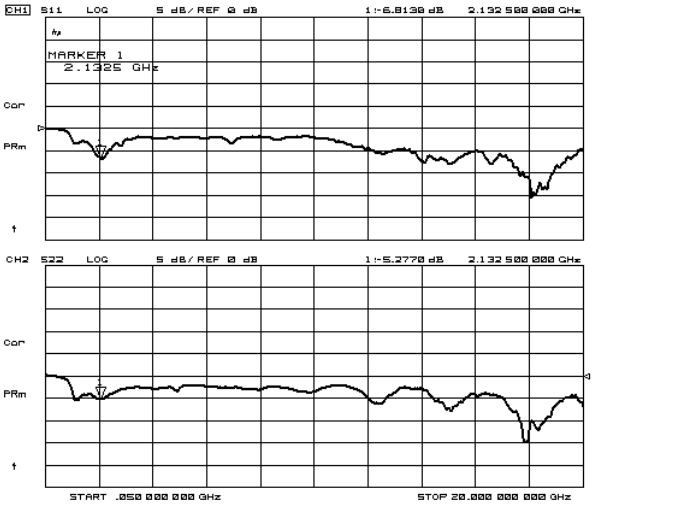
S21, S12



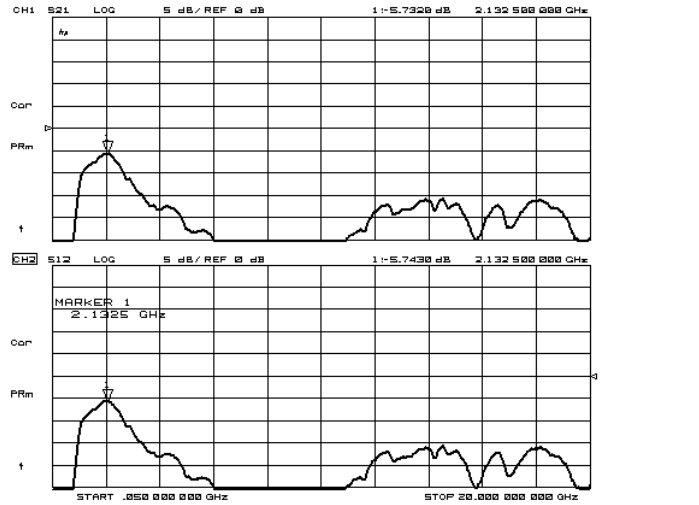
VSWR



Zin, Zout



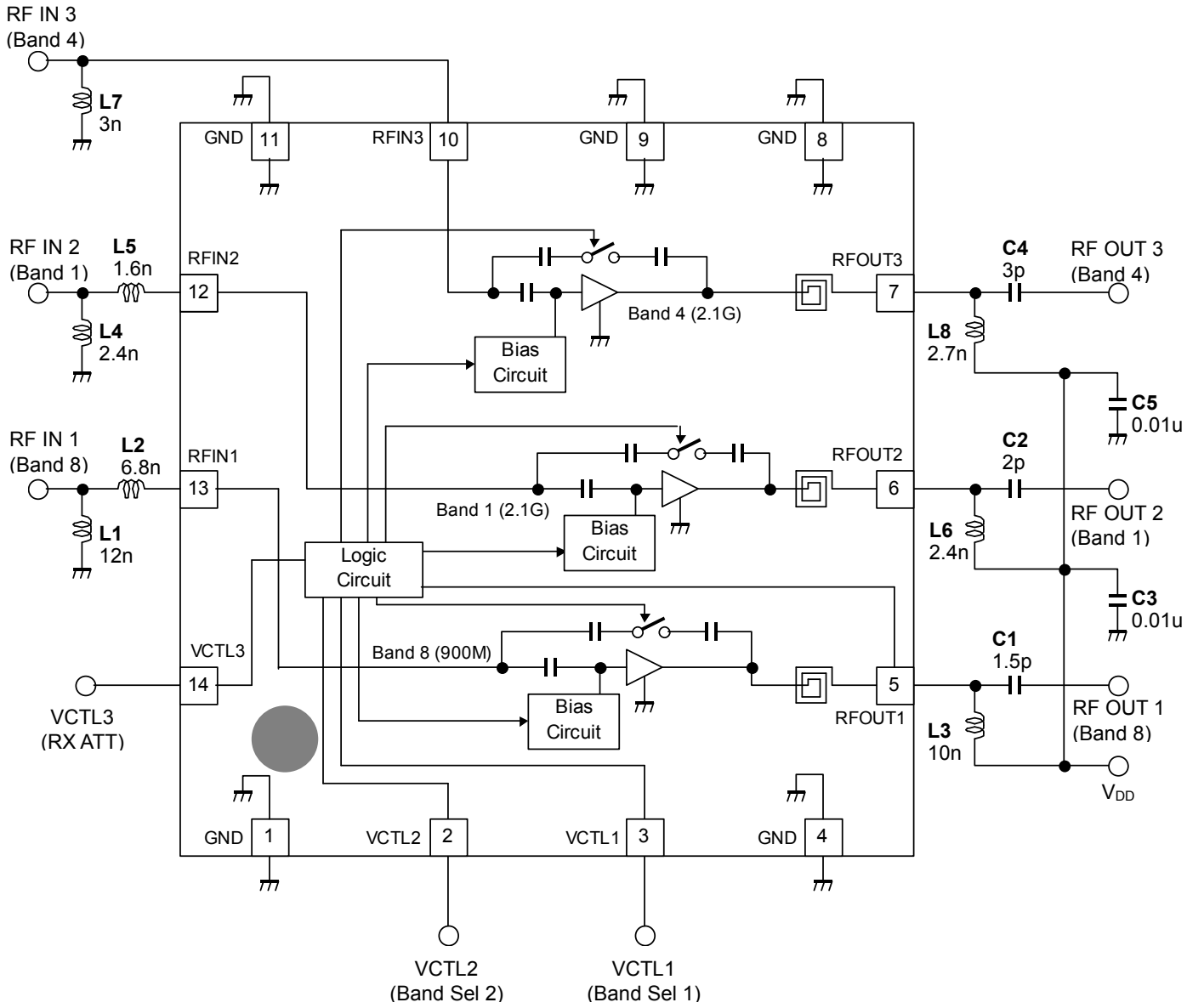
S11, S22 (50M~20GHz)



S21, S12 (50M~20GHz)

2-6 Application circuit

(Top View)

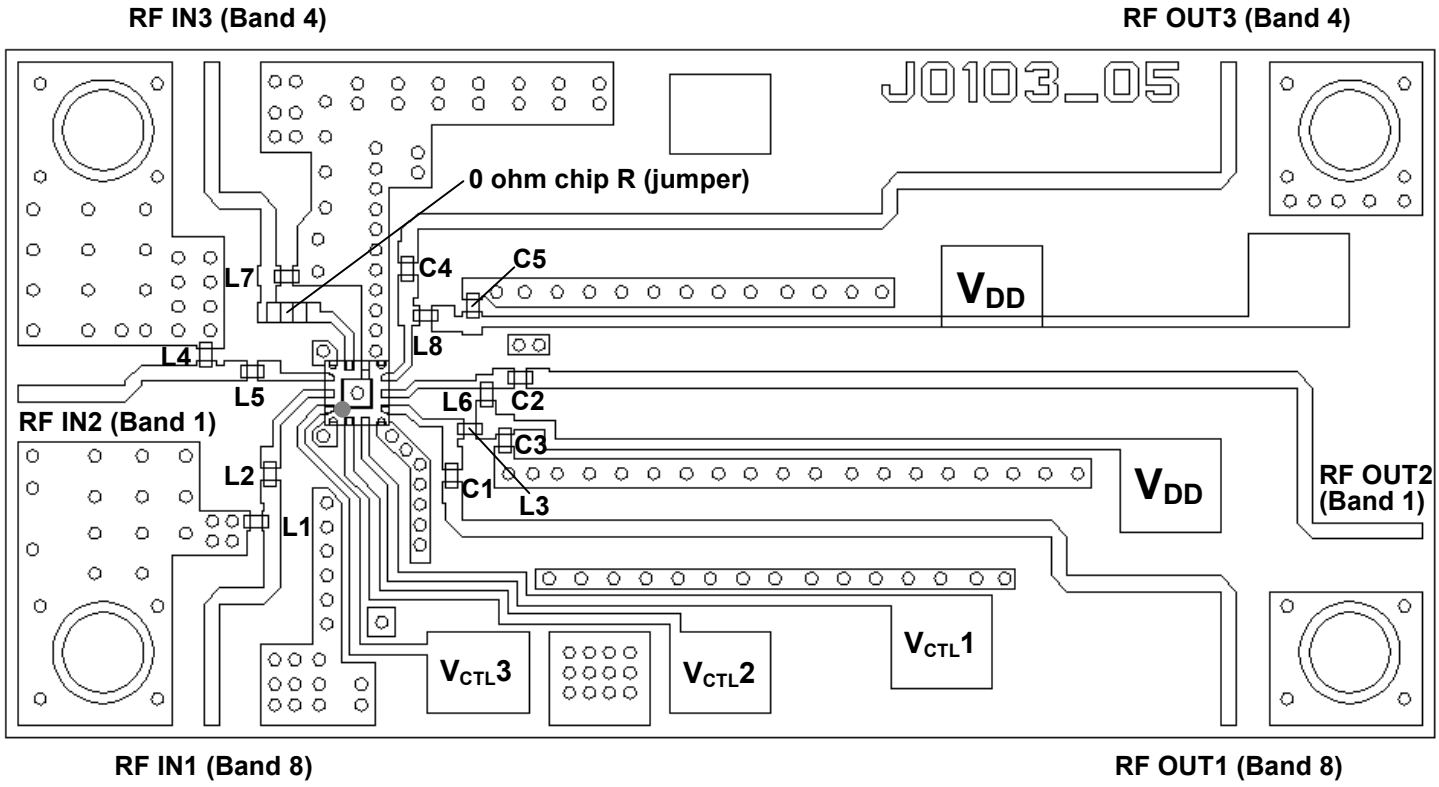


Parts list

Parts ID	Comments
L1, L2, L4~L8	MURATA LQP03T Series
L3	TDK MLK0603 Series
C1~C5	MURATA GRM03 Series

2-7 Evaluation board

(Top View)



PCB (FR-4):
t=0.2mm
MICROSTRIP LINE WIDTH=0.4mm (Z_0=50ohm)
PCB SIZE=35.4mm x 17.0mm

CAUTION

In order not to couple with terminal RFIN and RFOUT, please layout ground pattern under the IC.