



TAI-SAW TECHNOLOGY CO., LTD.

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Product Specifications Approval Sheet

Product Name: GPS and GLONASS LNA Module 2.5x2.5mm

TST Parts No.: TN0081A

Customer Parts No.: _____

Company: _____
Division: _____
Approved by : _____
Date: _____

Checked by: _____ Jacky Huang *Jacky Huang*

Approval by: _____ Jacky Huang *Jacky Huang*

Date: _____ 2014/4/9

1. Customer signed back is required before TST can proceed with sample build and receive orders.
2. Orders received without customer signed back will be regarded as agreement on the specifications.
3. Any specifications changes must be approved upon by both parties and a new revision of specifications shall be released to reflect the changes



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GPS and GLONASS Front-End Module

MODEL NO.: TN0081A

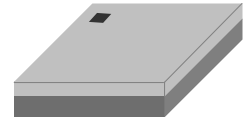
REV. NO.:2

GENERAL DESCRIPTION

The TN0081A is a front-end module (FEM) designed for GPS and GLONASS applications. The TN0081A offers high gain, low noise figure, high linearity and very high out-band rejection characteristics brought by included high performance pre- SAW filter, low noise amplifier (LNA) and post- SAW filter. The TN0081A can be operated from 1.5V to 3.3V single voltage.

The TN0081A offers very small mounting area by included two SAW filters, only two external components and very small HFFP10-CD package that is 2.5x2.5mm.

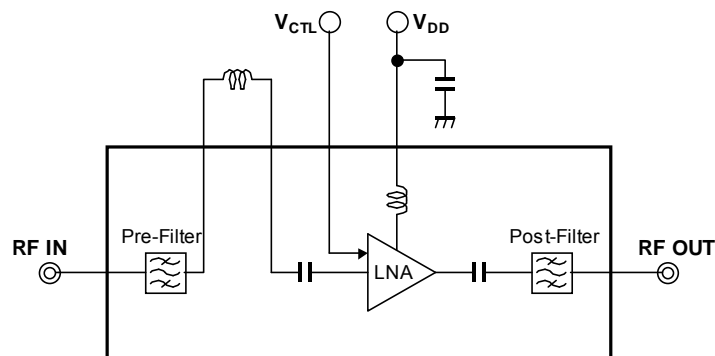
PACKAGE OUTLINE



TN0081A

FEATURES

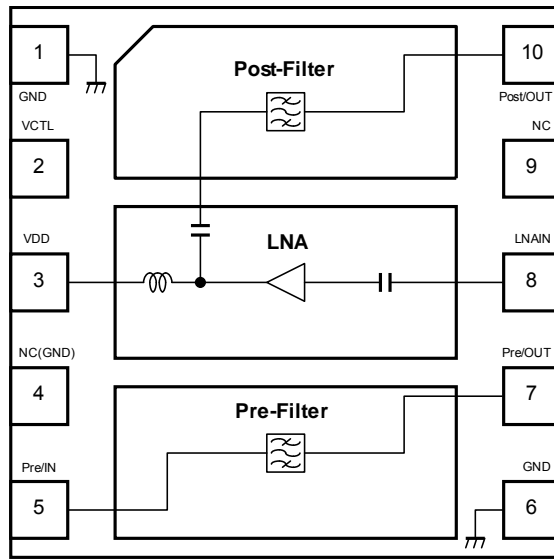
- Available for GPS and GLONASS
- Low supply voltage 1.8/ 2.8V typ.
- Low current consumption 2.6/3.3mA typ. @V_{DD}=1.8/ 2.8V, V_{CTL}=1.8V
- High gain 0.1µA typ. @V_{DD}=1.8/ 2.8V, V_{CTL}=0V (Stand-by mode)
- Low noise figure 17.5/18.5dB typ. @V_{DD}=1.8/ 2.8V, V_{CTL}=1.8V, f=1575MHz, 1597~1606MHz
- High out band rejection 1.65/1.60dB typ. @V_{DD}=1.8/ 2.8V, V_{CTL}=1.8V, f=1575MHz
- Small package size 1.75/1.70dB typ. @V_{DD}=1.8/ 2.8V, V_{CTL}=1.8V, f=1597~1606MHz
- RoHS compliant and Halogen Free, MSL1 85dBc typ. f=704~915MHz, relative to 1575MHz
- 75dBc typ. f=1710~1980MHz, relative to 1575MHz
- HFFP10-CD: 2.5mmx2.5mmx0.63mm max.



Functional Blockdiagram

■ PIN CONFIGURATION

(Top View)



Pin connection

1. GND
2. VCTL
3. VDD
4. NC(GND)
5. PreIN
6. GND
7. PreOUT
8. LNAIN
9. NC
10. PostOUT

Exposed pad: GND

■ TRUTH TABLE

“H”= $V_{CTL}(H)$, “L”= $V_{CTL}(L)$

VCTL	Mode
H	Active mode
L	Stand-by mode

■ ABSOLUTE MAXIMUM RATINGS

$T_a=+25^{\circ}\text{C}$, $Z_s=Z_l=50$

PARAMETERS	SYMBOL	CONDITIONS	RATINGS	UNITS
Supply voltage	V_{DD}		5.0	V
Control voltage	V_{CTL}		5.0	V
Input power	P_{IN} (inband)	$V_{DD}=2.8\text{V}$, $f=1575, 1597\sim 1606\text{MHz}$	+15	dBm
	P_{IN} (outband)	$V_{DD}=2.8\text{V}$, $f=50\sim 1460, 1710\sim 4000\text{MHz}$	+27	dBm
Power dissipation	P_D	4-layer FR4 PCB with through-hole (101.5x114.5mm), $T_j=100^{\circ}\text{C}$	510	mW
Operating temperature	T_{opr}		-40~+85	$^{\circ}\text{C}$
Storage temperature	T_{stg}		-40~+100	$^{\circ}\text{C}$

■ ELECTRICAL CHARACTERISTICS 1 (DC)

(General conditions: $T_a=+25^{\circ}\text{C}$)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage	V_{DD}		1.5	-	3.3	V
Control Voltage (High)	$V_{CTL(H)}$		1.5	1.8	3.3	V
Control Voltage (Low)	$V_{CTL(L)}$		0	0	0.3	V
Supply Current 1	I_{DD1}	RF OFF, $V_{DD}=2.8\text{V}$, $V_{CTL}=1.8\text{V}$	-	3.3	7.5	mA
Supply Current 2	I_{DD2}	RF OFF, $V_{DD}=1.8\text{V}$, $V_{CTL}=1.8\text{V}$	-	2.6	6.5	mA
Supply Current 3	I_{DD3}	RF OFF, $V_{DD}=2.8\text{V}$, $V_{CTL}=0\text{V}$	-	0.1	5.0	μA
Supply Current 4	I_{DD4}	RF OFF, $V_{DD}=1.8\text{V}$, $V_{CTL}=0\text{V}$	-	0.1	5.0	μA
Control Current	I_{CTL}	$V_{CTL}=1.8\text{V}$	-	5.0	15.0	μA

ELECTRICAL CHARACTERISTICS 2 (RF)

General conditions: $V_{DD}=2.8V$, $V_{CTL}=1.8V$, $f_{RF}=1575MHz$, $1597\sim 1606MHz$, $T_a=+25^{\circ}C$, $Z_s=Z_l=50ohm$, with application circuit

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Small Signal Gain (GPS)1	GainGPS1	f=1575MHz (GPS) Exclude PCB, Connector Losses	17.0	18.5	-	dB
Small Signal Gain (GLONASS)1	GainGLN1	f=1597~1606MHz (GLONASS) Exclude PCB, Connector Losses	17.0	18.5	-	dB
Noise Figure (GPS)1	NFGPS1	f=1575MHz (GPS) Exclude PCB, Connector Losses	-	1.6	2.1	dB
Noise Figure (GLONASS)1	NFGLN1	f=1597~1606MHz (GLONASS) Exclude PCB, Connector Losses	-	1.7	2.2	dB
Input Power at 1dB Gain Compression Point 1	P-1dB(IN)1	f=1575, 1597~1606MHz	-	-15.0	-	dBm
Input 3rd Order Intercept Point 1	IIP3_1	f1=1575MHz, f2=f1+/- 1MHz, Pin=-30dBm	-	-3.0	-	dBm
Out of Band Input 2nd Order Intercept Point 1	IIP2_OB1	f1=824.6MHz at +15dBm, f2=2400MHz at +15dBm, fmeas=1575.4MHz	-	+72	-	dBm
Out of Band Input 3rd Order Intercept Point 1	IIP3_OB1	f1=1712.7MHz at +15dBm, f2=1850MHz at +15dBm, fmeas=1575.4MHz	-	+50	-	dBm
700MHz Harmonic1	2fo1	Input jammer tone: 787.76MHz at +15dBm Measure the harmonic tone at 1575.52MHz	-	-30	-	dBm
Out-of-Band Input Power 1dB Compression 1	P-1dB(IN)_OB1-1	fjam=900MHz, fmeas=1575MHz at Pin=-40dBm	-	+24	-	dBm
	P-1dB(IN)_OB1-2	fjam=1710MHz, fmeas=1575MHz at Pin=-40dBm	-	+24	-	dBm
Low Band Rejection 1	BR_L1	f=704~915MHz, relative to 1575MHz	-	85	-	dBc
High Band Rejection 1	BR_H1	f=1710~1980MHz, relative to 1575MHz	-	75	-	dBc
WLAN Band Rejection 1	BR_W1	f=2400~2500MHz, relative to 1575MHz	-	72	-	dBc
RF IN Return Loss (GPS)1	RLiGPS1	f=1575MHz (GPS)	-	7.5	-	dB
RF IN Return Loss (GLONASS)1	RLiGLN1	f=1597~1606MHz (GLONASS)	-	7.5	-	dB
RF OUT Return Loss (GPS)1	RLoGPS1	f=1575MHz (GPS)	-	11	-	dB
RF OUT Return Loss (GLONASS)1	RLoGLN1	f=1597~1606MHz (GLONASS)	-	15	-	dB
Group Delay Time Deviation 1	GDT1	f=1597~1606MHz (GLONASS)	-	8.0	-	ns

ELECTRICAL CHARACTERISTICS 3 (RF)

General conditions: $V_{DD}=1.8V$, $V_{CTL}=1.8V$, $f_{RF}=1575MHz$, $1597\sim 1606MHz$, $T_a=+25^{\circ}C$, $Z_s=Z_L=50ohm$, with application circuit

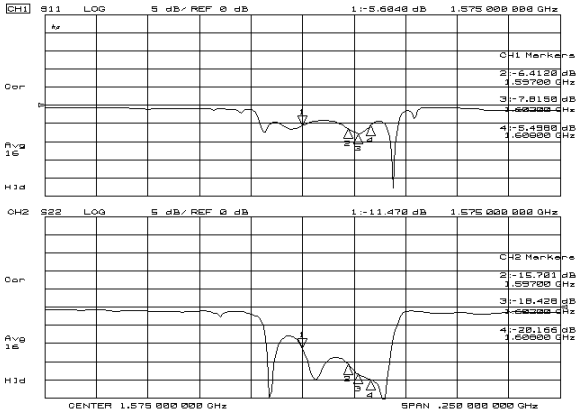
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Small Signal Gain (GPS) ₂	GainGPS2	f=1575MHz (GPS) Exclude PCB, Connector Losses	15.5	17.5	-	dB
Small Signal Gain (GLONASS) ₂	GainGLN2	f=1597~1606MHz (GLONASS) Exclude PCB, Connector Losses	15.5	17.5	-	dB
Noise Figure (GPS) ₂	NFGPS2	f=1575MHz (GPS) Exclude PCB, Connector Losses	-	1.65	2.20	dB
Noise Figure (GLONASS) ₂	NFGPS2	f=1597~1606MHz (GLONASS) Exclude PCB, Connector Losses	-	1.75	2.35	dB
Input Power at 1dB Gain Compression Point 2	P-1dB(IN) ₂	f=1575, 1597~1606MHz	-	-17.0	-	dBm
Input 3rd Order Intercept Point 2	IIP3_2	f1=1575MHz, f2=f1+/- 1MHz, Pin=-30dBm	-	-6.0	-	dBm
Out of Band Input 2nd Order Intercept Point 1	IIP2_OB2	f1=824.6MHz at +15dBm, f2=2400MHz at +15dBm, fmeas=1575.4MHz	-	+72	-	dBm
Out of Band Input 3rd Order Intercept Point 2	IIP3_OB2	f1=1712.7MHz at +15dBm, f2=1850MHz at +15dBm, fmeas=1575.4MHz	-	+50	-	dBm
700MHz Harmonic ₂	2fo ₂	Input jammer tone: 787.76MHz at +15dBm Measure the harmonic tone at 1575.52MHz	-	-30	-	dBm
Out-of-Band Input Power 1dB Compression 2	P-1dB(IN)_OB1-2	fjam=900MHz, fmeas=1575MHz at Pin=-40dBm	-	+24	-	dBm
	P-1dB(IN)_OB2-2	fjam=1710MHz, fmeas=1575MHz at Pin=-40dBm	-	+24	-	dBm
Low Band Rejection 2	BR_L2	f=704~915MHz, relative to 1575MHz	-	85	-	dBc
High Band Rejection 2	BR_H2	f=1710~1980MHz, relative to 1575MHz	-	75	-	dBc
WLAN Band Rejection 2	BR_W2	f=2400~2500MHz, relative to 1575MHz	-	72	-	dBc
RF IN Return Loss (GPS) ₂	RLiGPS2	f=1575MHz (GPS)	-	7.5	-	dB
RF IN Return Loss (GLONASS) ₂	RLiGLN2	f=1597~1606MHz (GLONASS)	-	7.5	-	dB
RF OUT Return Loss (GPS) ₂	RLoGPS2	f=1575MHz (GPS)	-	10	-	dB
RF OUT Return Loss (GLONASS) ₂	RLoGLN2	f=1597~1606MHz (GLONASS)	-	13	-	dB
Group Delay Time Deviation 2	GDT2	f=1597~1606MHz (GLONASS)	-	8.0	-	ns

■ TERMINAL INFORMATION

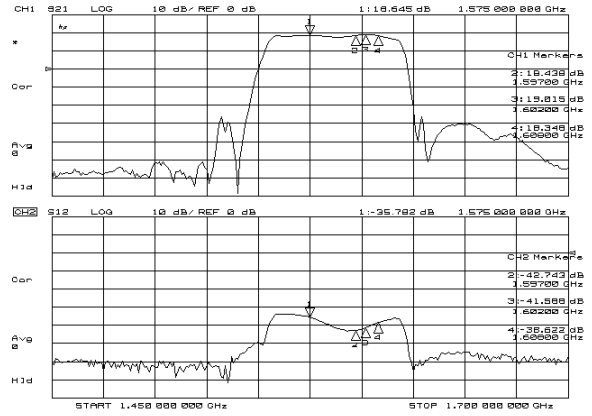
No.	SYMBOL	DESCRIPTION
1	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
2	VCTL	Control voltage terminal.
3	VDD	Supply voltage terminal. Please connect bypass capacitor C1 with ground as close as possible.
4	NC(GND)	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.
5	PreIN	RF input terminal. This terminal connects to input of pre-SAW filter.
6	GND	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
7	PreOUT	Pre-SAW filter output terminal. This terminal connects to LNAIN with L1.
8	LNAIN	RF input terminal. This terminal requires only a matching inductor L1, and does not require DC blocking capacitor because of integrated capacitor.
9	NC(GND)	Ground terminal. This terminal should be connected to the ground plane as close as possible for excellent RF performance.
10	PostOUT	RF output terminal. This terminal requires no DC blocking capacitor since this terminal has integrated SAW that also works as DC blocking capacitor in nature.
Exposed Pad	GND	Ground terminal.

ELECTRICAL CHARACTERISTICS

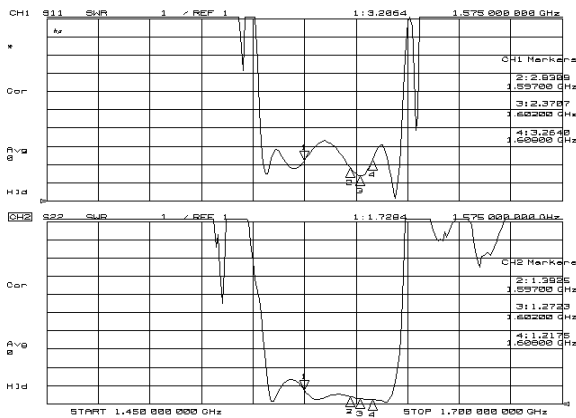
Conditions: $V_{DD}=2.8V$, $V_{CTL}=1.8V$, $T_a=25^\circ C$, $Z_s=Z_l=50\ \text{ohm}$, with application circuit



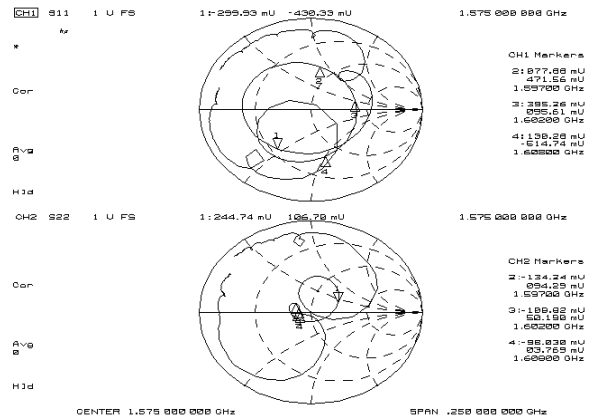
S11, S22



S21, S12



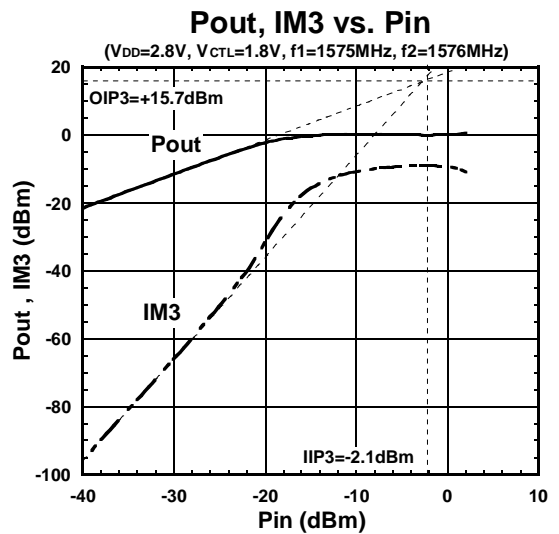
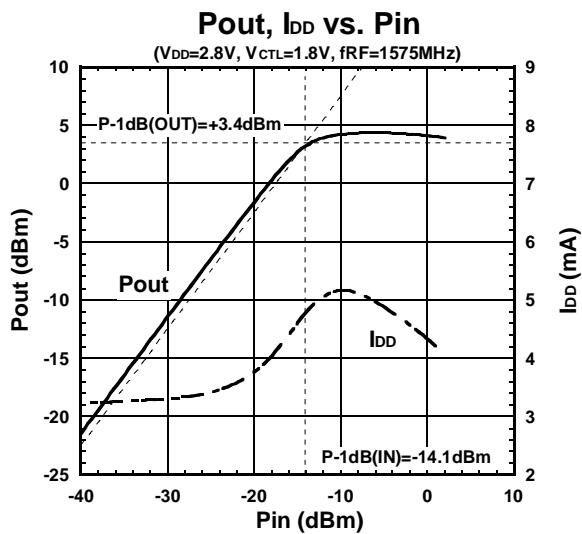
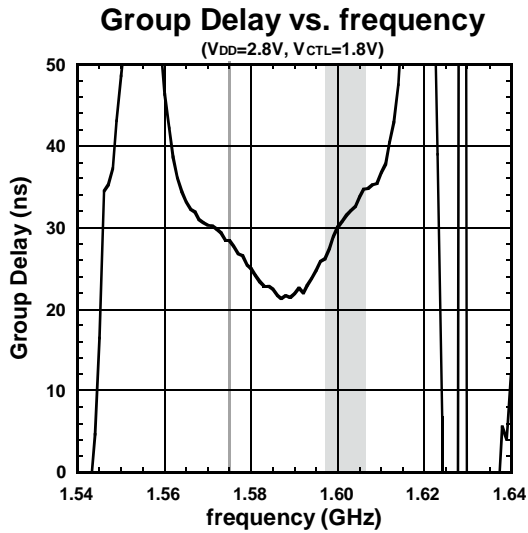
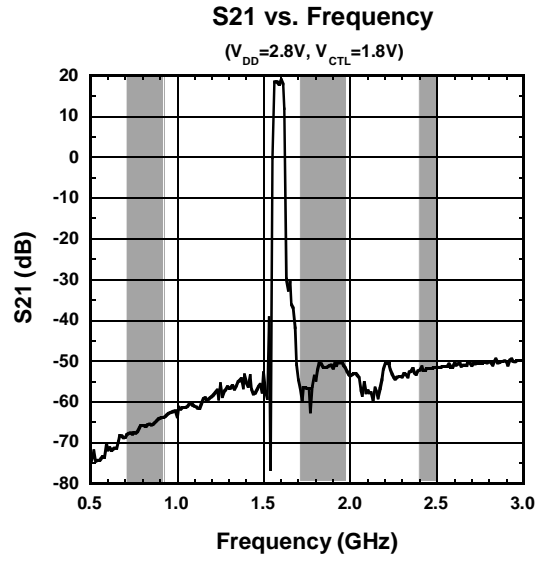
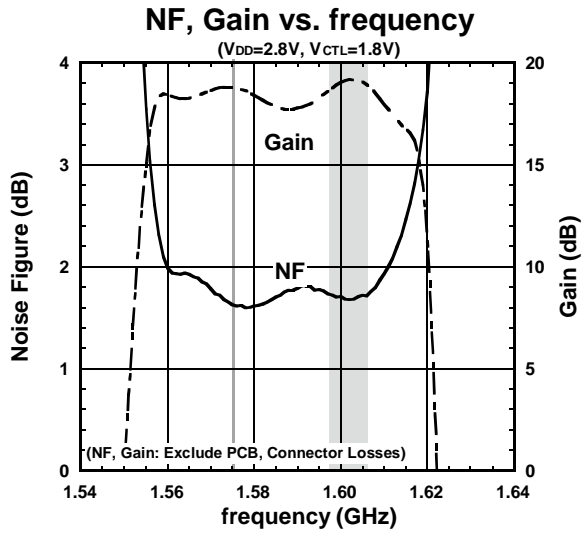
VSWR



Zin, Zout

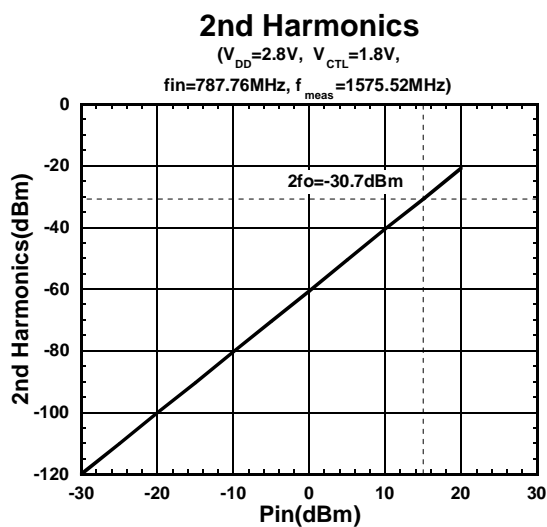
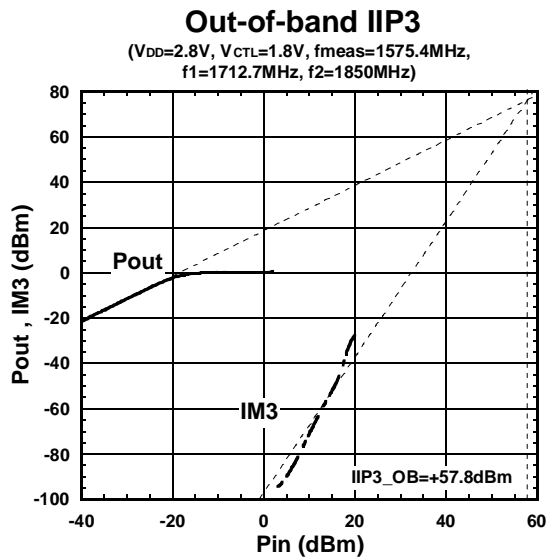
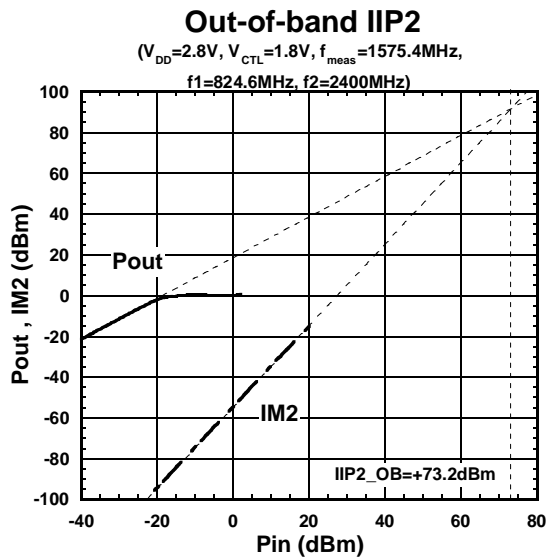
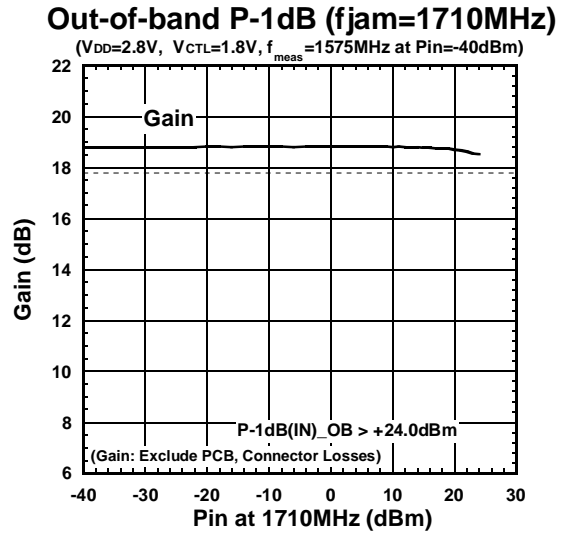
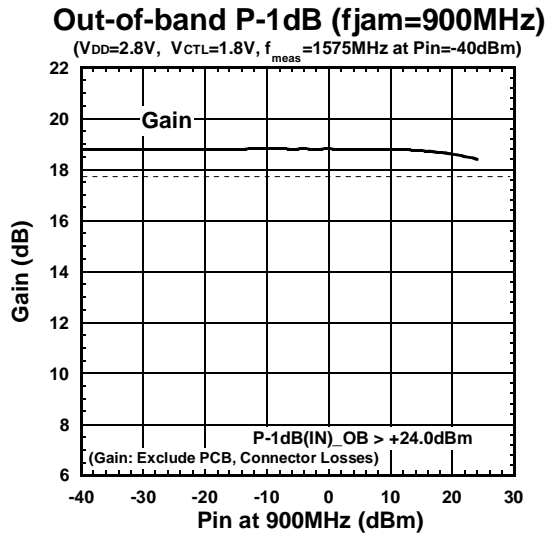
ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD}=2.8V$, $V_{CTL}=1.8V$, $T_a=25^\circ C$, $Z_s=Z_l=50\ \text{ohm}$, with application circuit



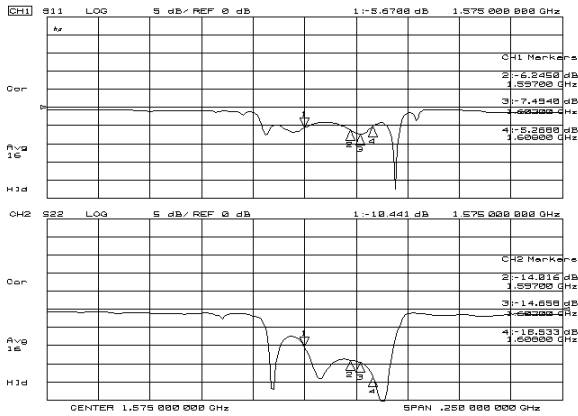
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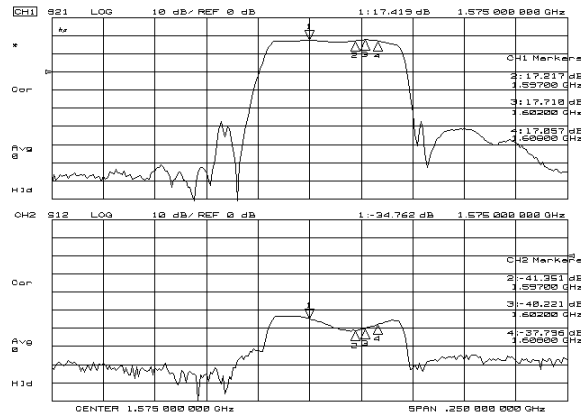


ELECTRICAL CHARACTERISTICS

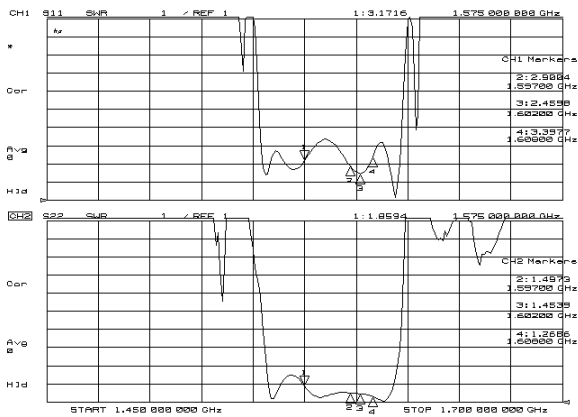
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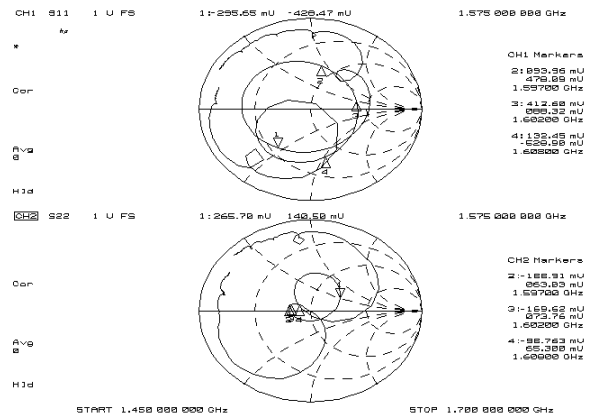
S11, S22



S21, S12



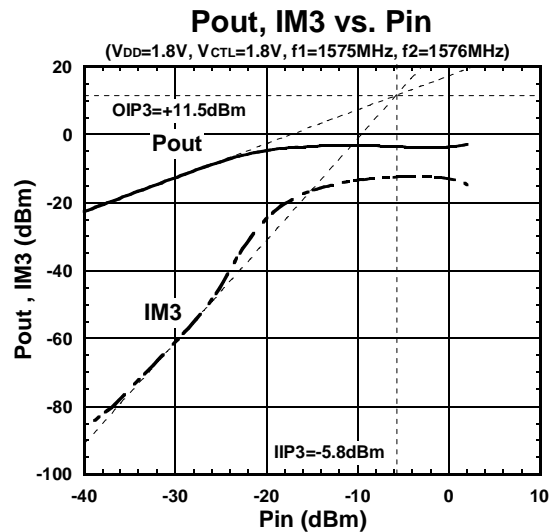
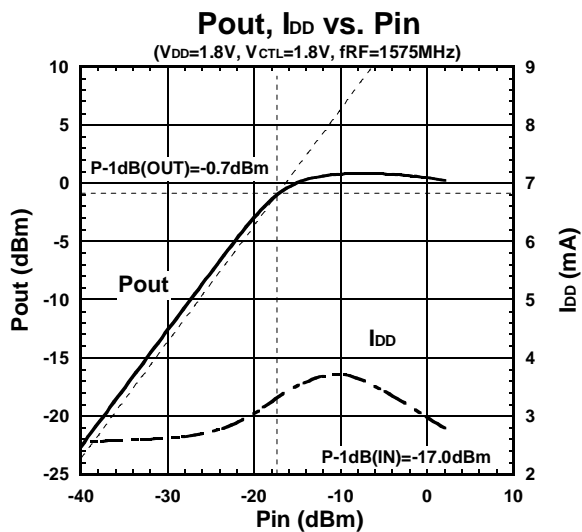
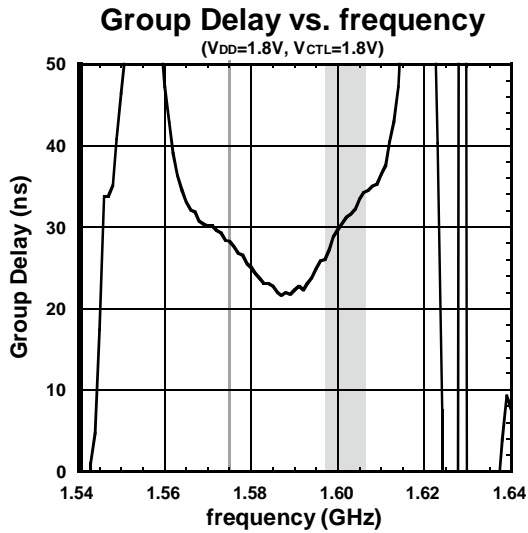
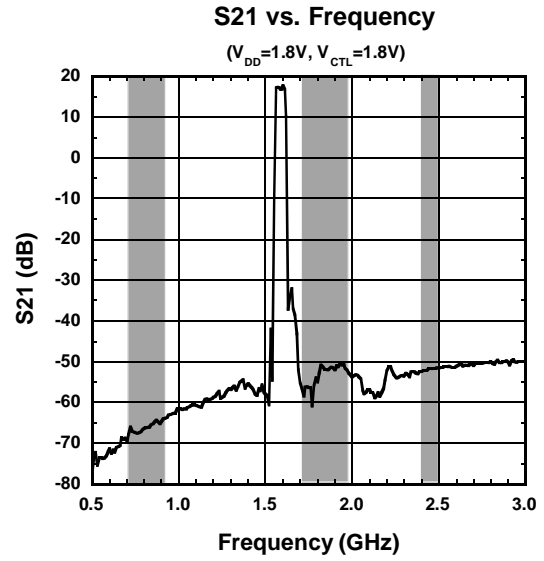
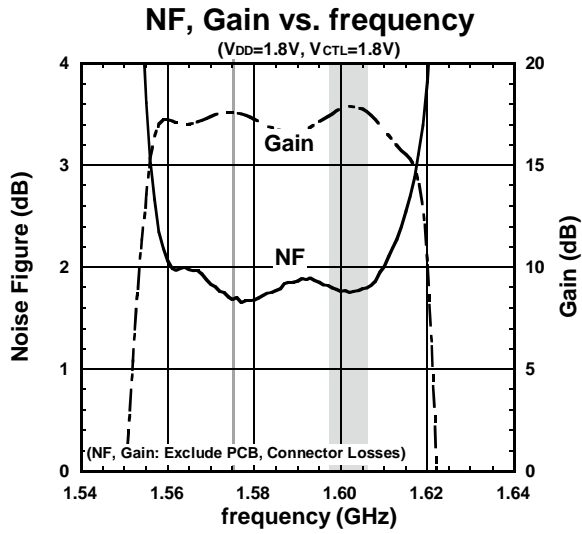
VSWR



Zin, Zout

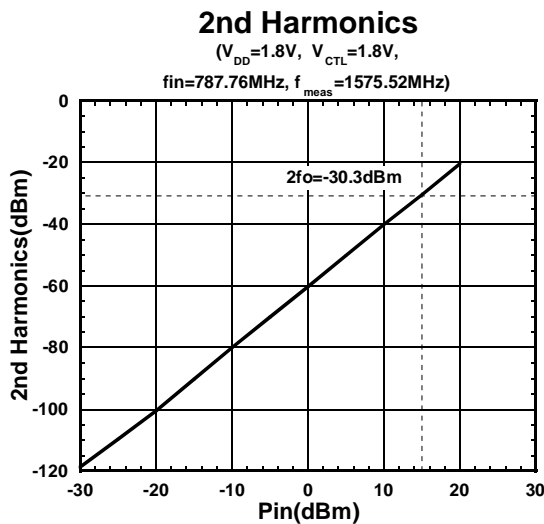
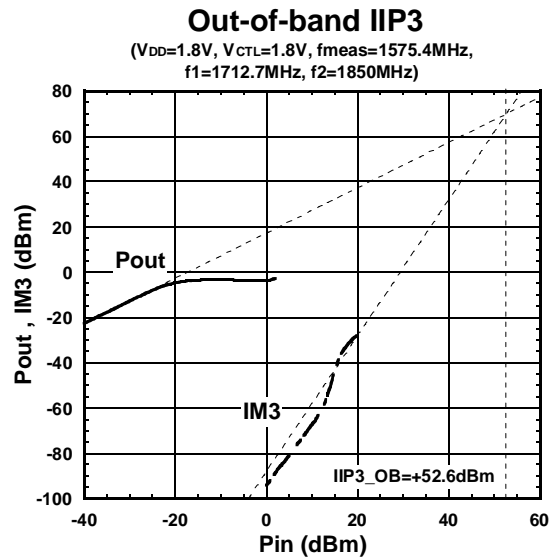
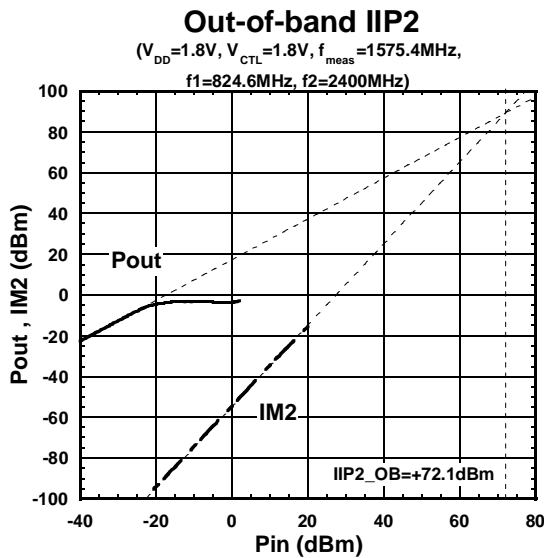
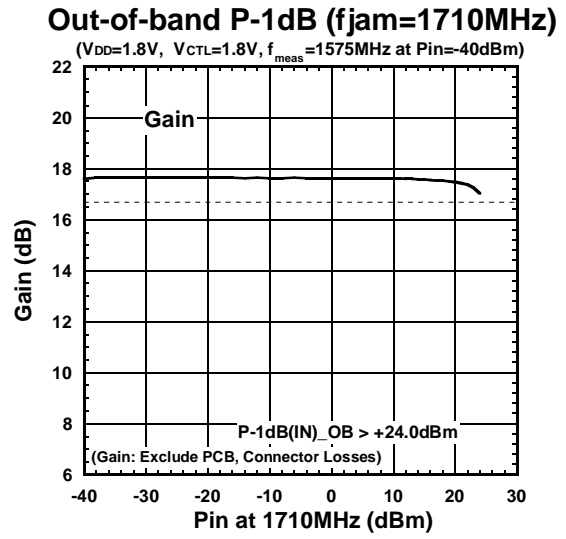
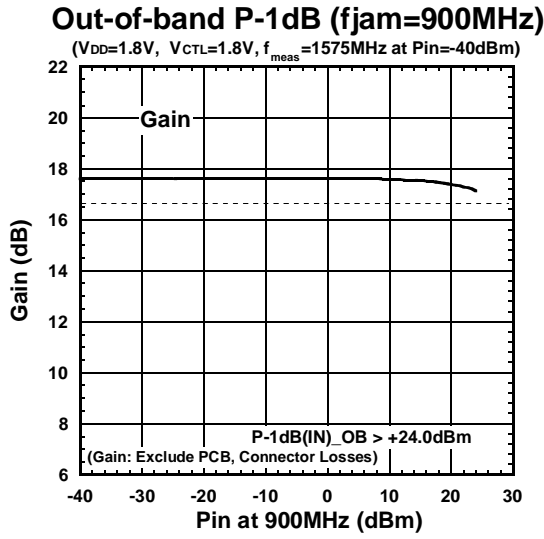
ELECTRICAL CHARACTERISTICS

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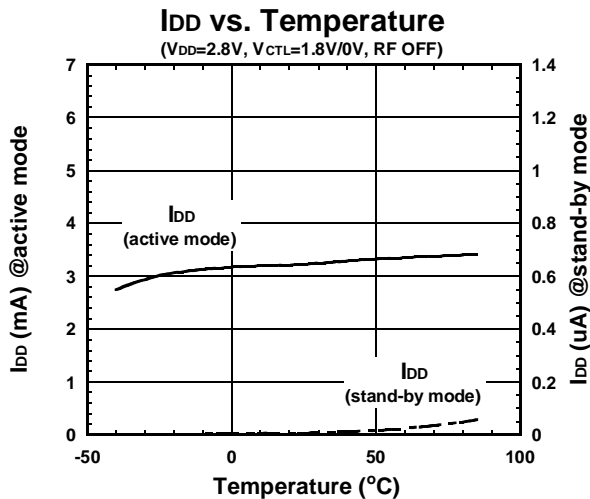
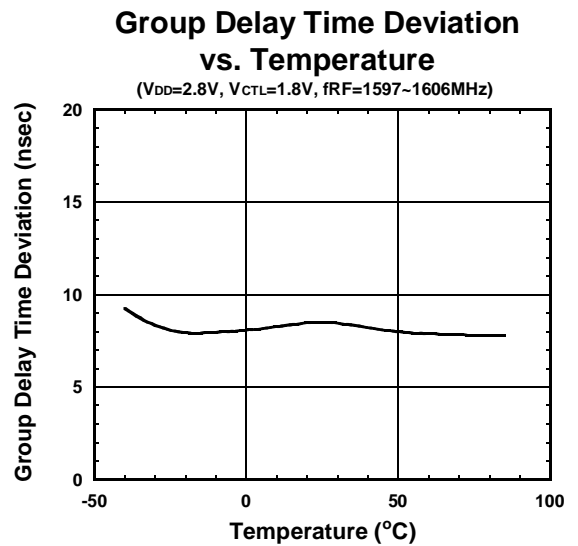
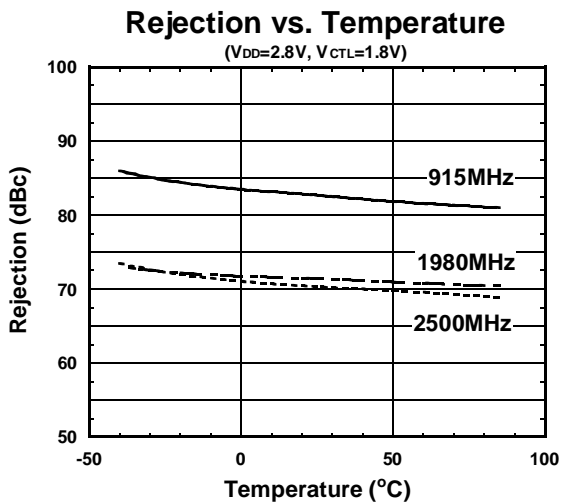
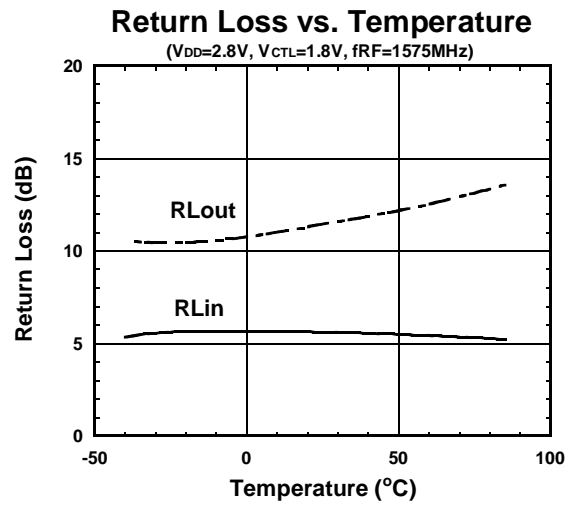
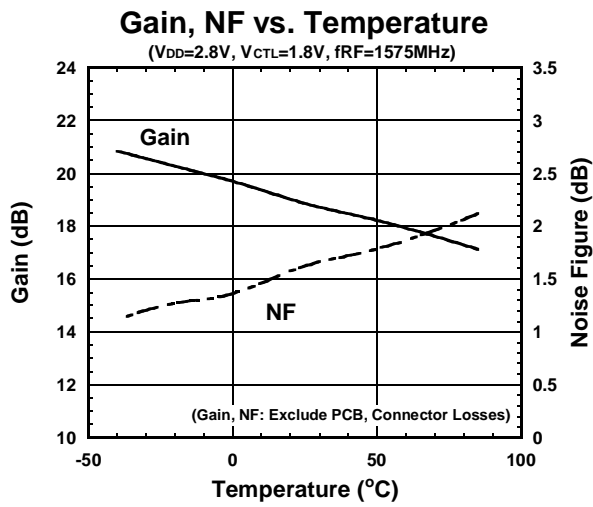
ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD}=1.8V$, $V_{CTL}=1.8V$, $T_a=25^\circ C$, $Z_s=Z_l=50\text{ ohm}$, with application circuit



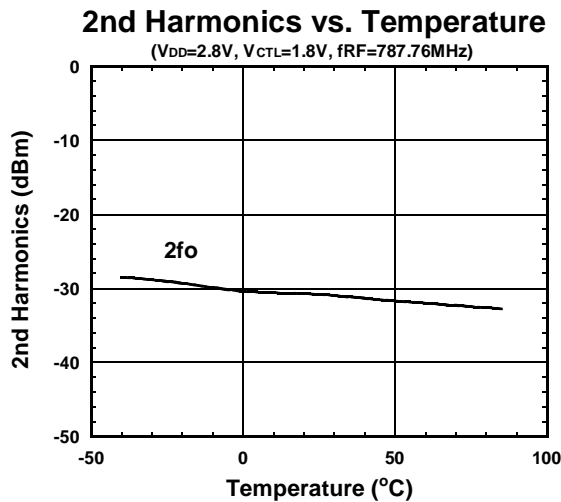
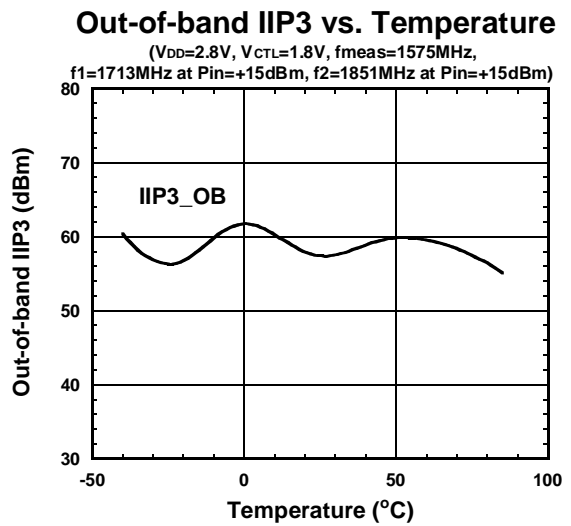
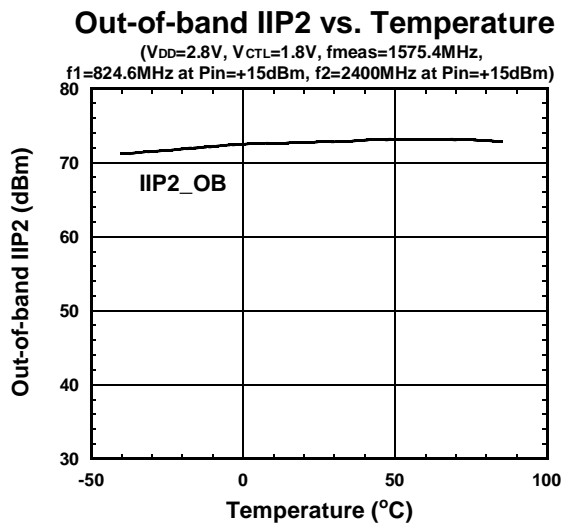
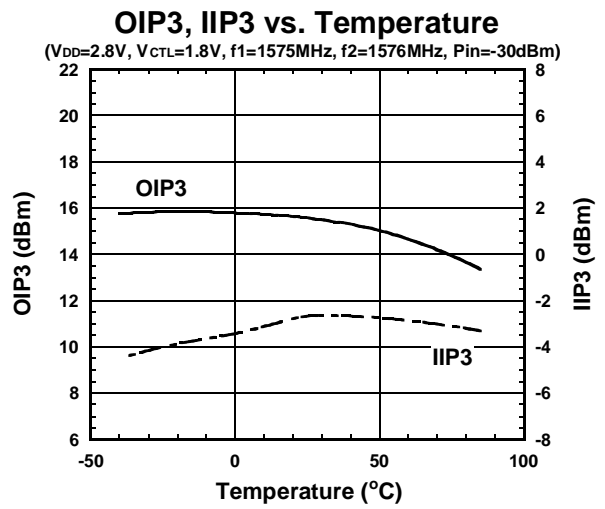
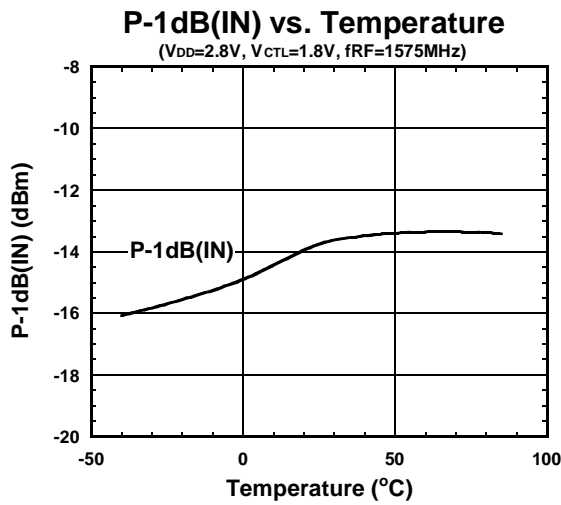
ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD}=2.8V$, $V_{CTL}=1.8V$, $Z_S=Z_L=50\ \text{ohm}$, with application circuit



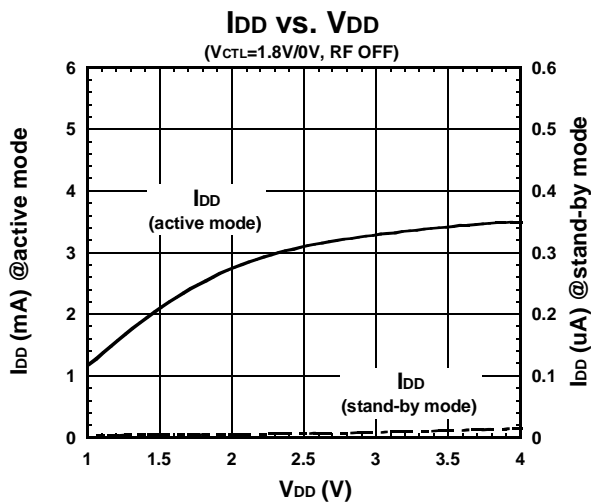
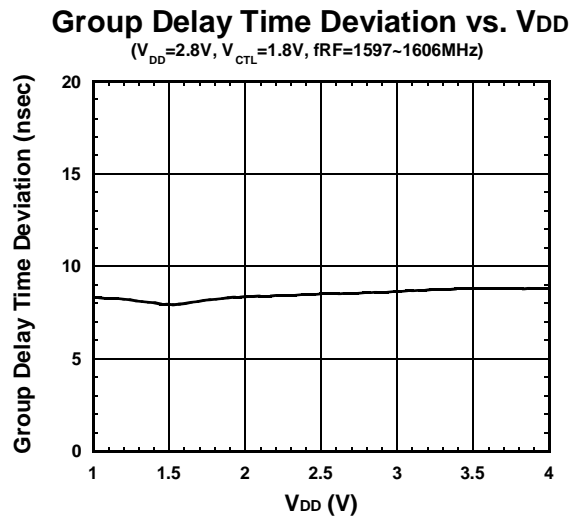
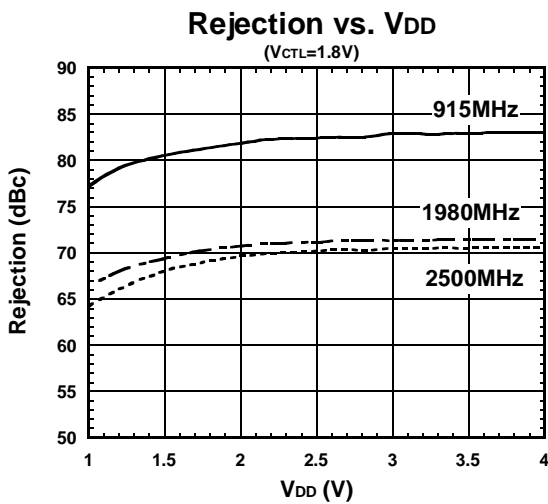
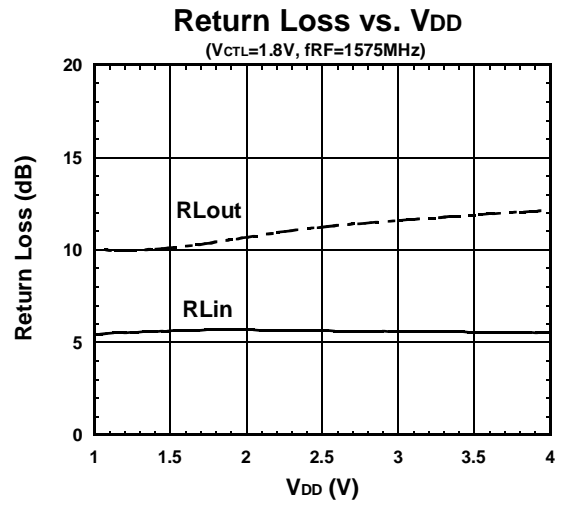
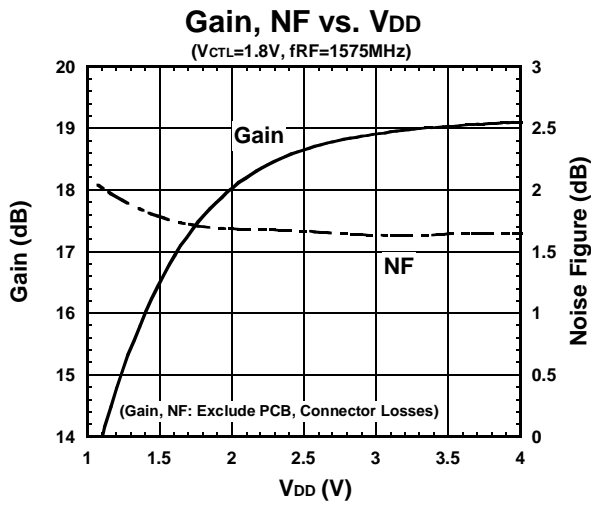
ELECTRICAL CHARACTERISTICS

Conditions: $V_{DD}=2.8V$, $V_{CTL}=1.8V$, $Z_S=Z_I=50\text{ ohm}$, with application circuit



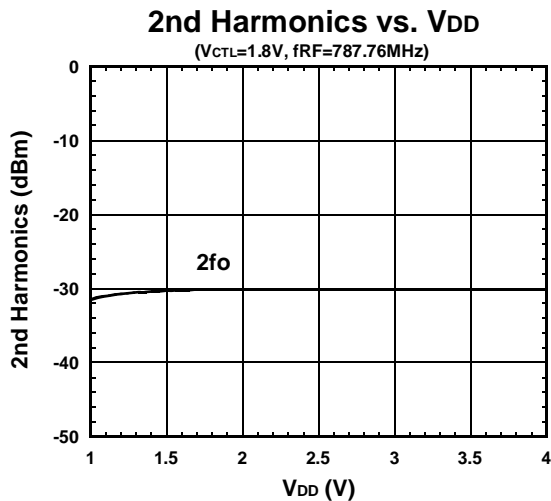
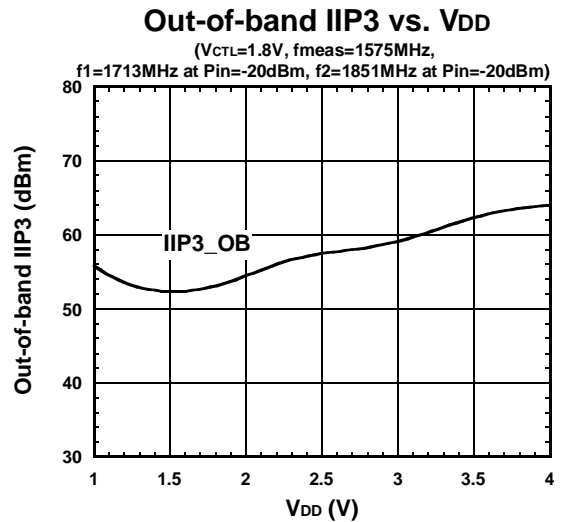
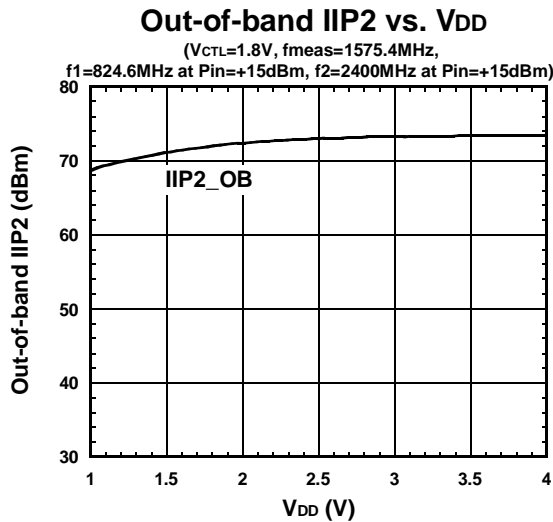
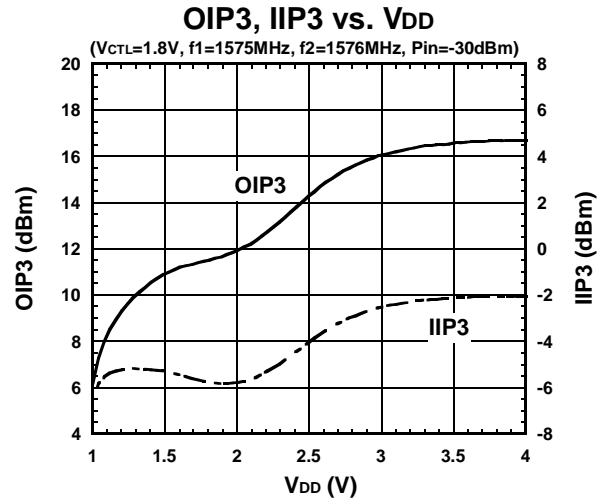
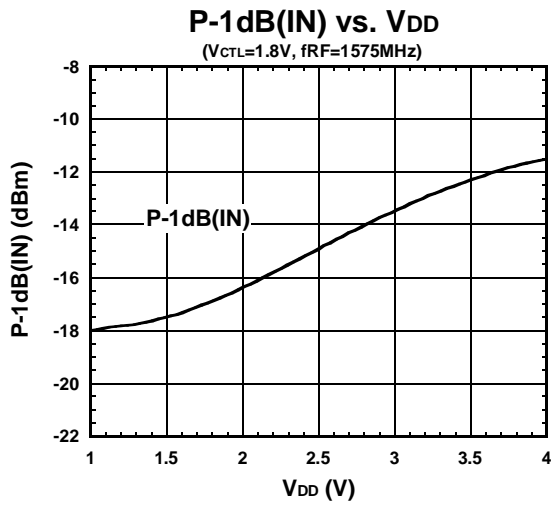
ELECTRICAL CHARACTERISTICS

Conditions: $V_{CTL}=1.8V$, $T_a=25^{\circ}C$, $Z_s=Z_l=50\text{ ohm}$, with application circuit

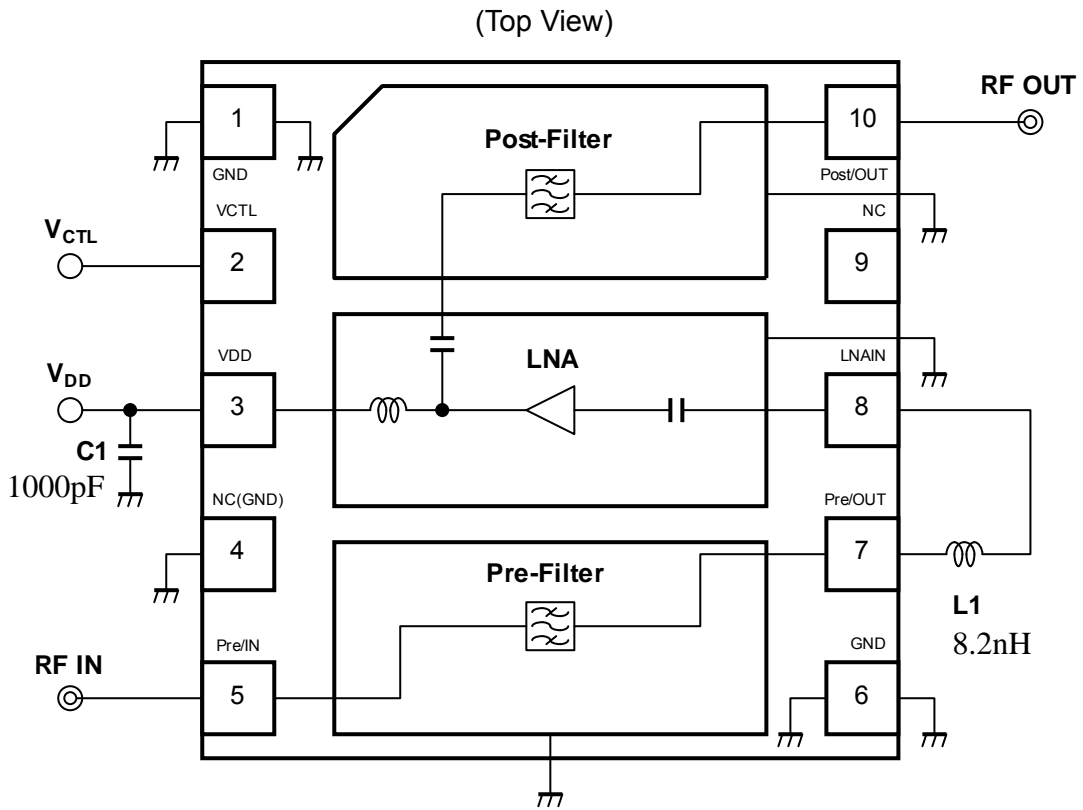


ELECTRICAL CHARACTERISTICS

Conditions: $V_{CTL}=1.8V$, $T_a=25^{\circ}C$, $Z_s=Z_l=50\text{ ohm}$, with application circuit



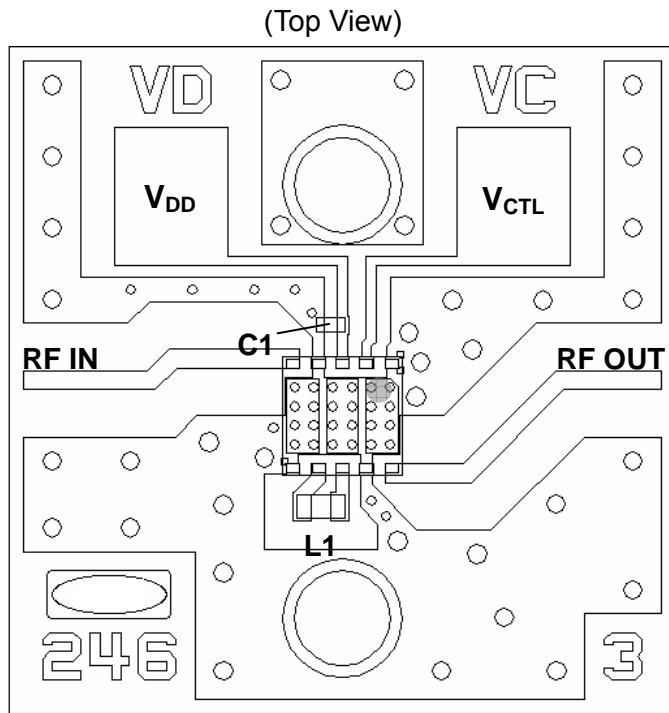
APPLICATION CIRCUIT



Parts list

Parts ID	Manufacture
L1	LQW15A Series (MURATA)
C1	GRM03 Series (MURATA)

■ Evaluation board



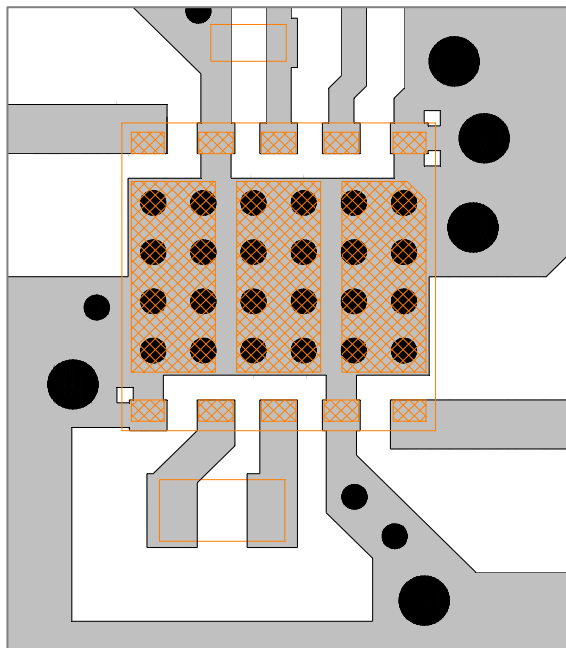
PCB





Substrate: FR-4

Thickness: 0.2mm

Microstrip line width: 0.4mm ($Z_0=50\Omega$)

<PCB LAYOUT GUIDELINE>






-  PCB
-  PKG Terminal
-  PKG Outline
-  GND Via Hole
Diameter $\phi = 0.2\text{mm}, 0.4\text{mm}$

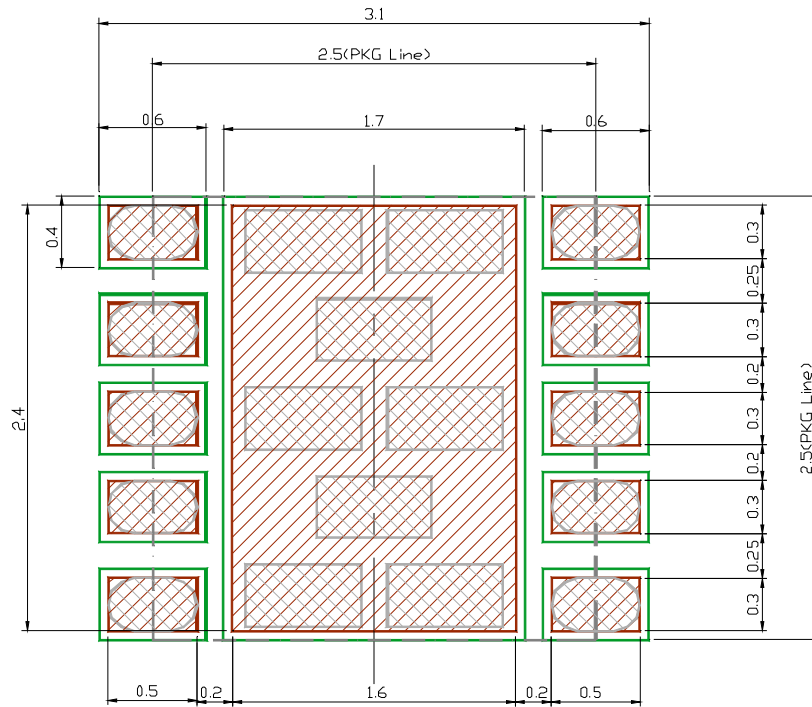
PRECAUTIONS

- Please layout ground pattern under this FEM in order not to couple with RFIN and RFOUT terminal.
- All external parts should be placed as close as possible to the FEM.
- For good RF performance, all GND terminals must be connected to PCB ground plane of substrate, and via-holes for GND should be placed near the FEM.

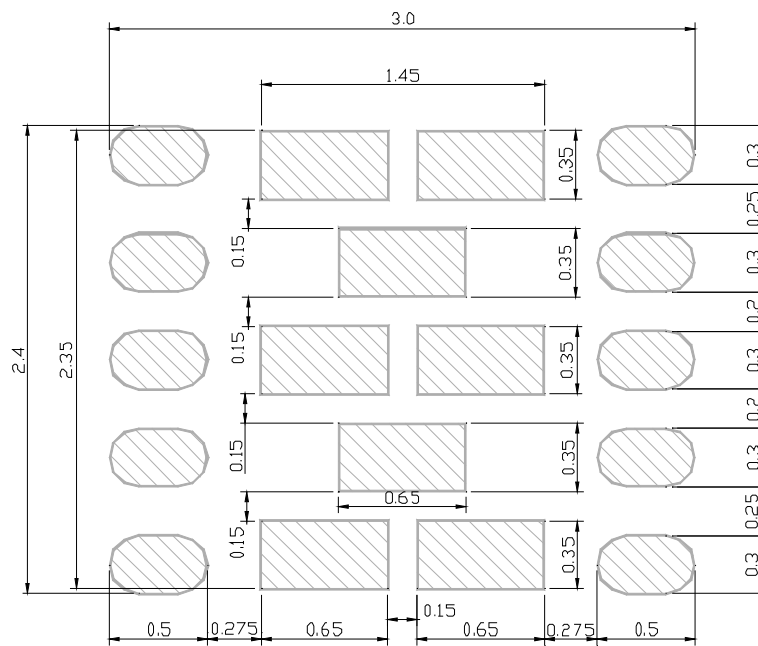
■ **RECOMMENDED FOOTPRINT PATTERN (HFFP10-CD PACKAGE) <Reference>**

PKG : 2.5mm x 2.5mm

-  : Land
-  :Mask (Open area) *Metal mask thickness : 100um
-  :Resist(Open area)



Metal MASK Detail



■ NOISE FIGURE MEASUREMENT BLOCK DIAGRAM

Measuring instruments

NF Analyzer : Agilent N8973A
 Noise Source : Agilent 346A

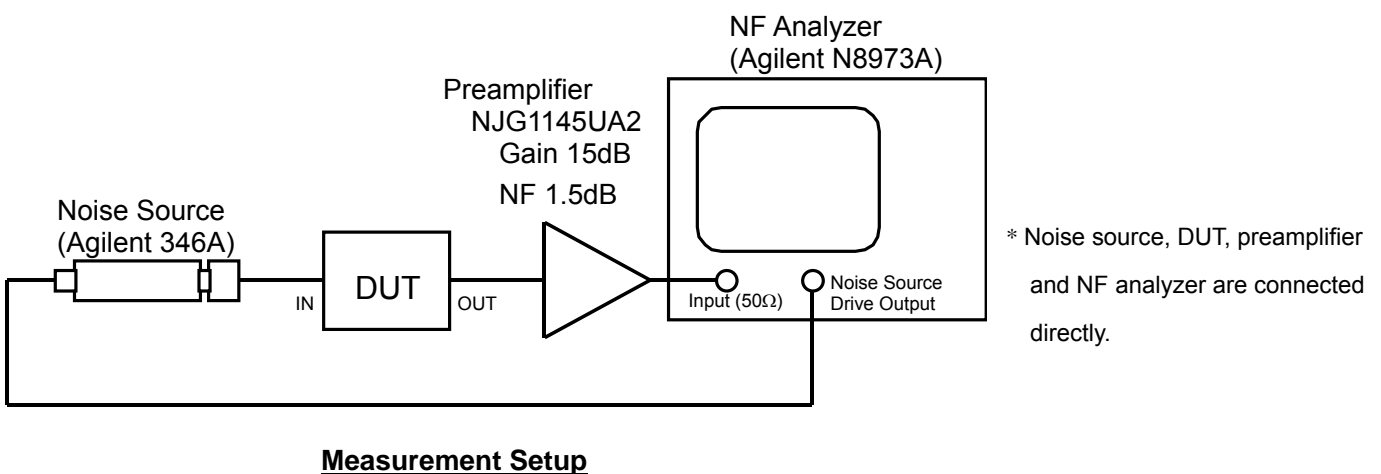
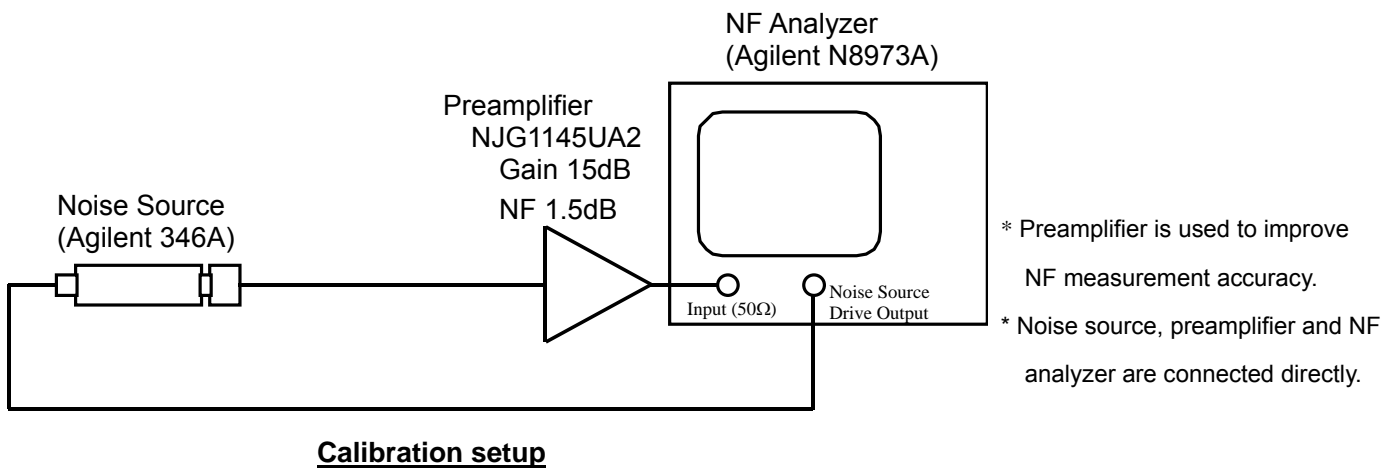
Setting the NF analyzer

Measurement mode form

Device under test : Amplifier
 System downconverter : off

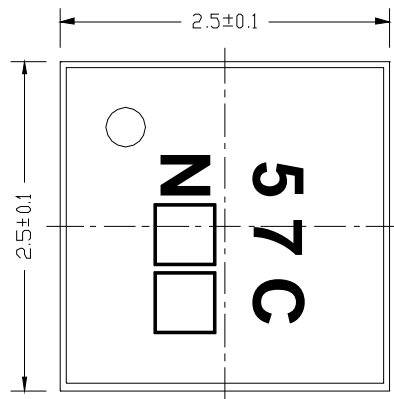
Mode setup form

Sideband : LSB
 Averages : 16
 Average mode : Point
 Bandwidth : 4MHz
 Loss comp : off
 Tcold : setting the temperature of noise source (303.15K)



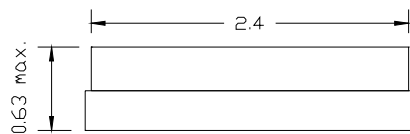
PACKAGE OUTLINE (HFFP10-CD)

TOP VIEW

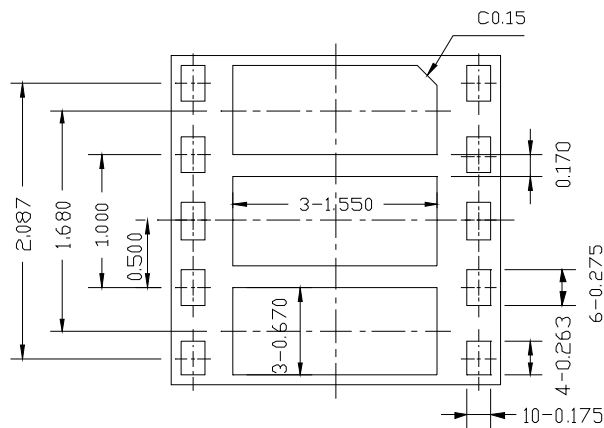


Unit : mm

SIDE VIEW



BOTTOM VIEW



Exposed PAD

Ground connection is required.

1. N : Manufacture year & month
2. □ : Lot No.
3. ○ : pin index

Manufacture year & month marking rule

Year	January	February	March	April	May	June	July	August	September	October	November	December
2014	N	P	Q	R	S	T	U	V	W	X	Y	Z
2015	a	b	c	d	e	f	g	h	j	k	l	m
2016	n	p	q	r	s	t	u	v	w	x	y	z
2017	A	B	C	D	E	F	G	H	J	K	L	M

(NOTE) Repetition evry four years

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.