

2.1GHz Band LNA GaAs MMIC

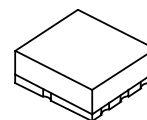
GENERAL DESCRIPTION

NJG1126HB6 is a LNA IC designed for 2.1GHz band W-CDMA cellular phone. This IC has the function which bypasses LNA, and high gain mode or low gain mode can be chosen.

High IIP3 and a low noise are achieved at the High gain mode. And low current consumption can be achieved at the low gain mode because LNA enters the state of the standby.

A small and thin package of USB8 is adopted.

PACKAGE OUTLINE

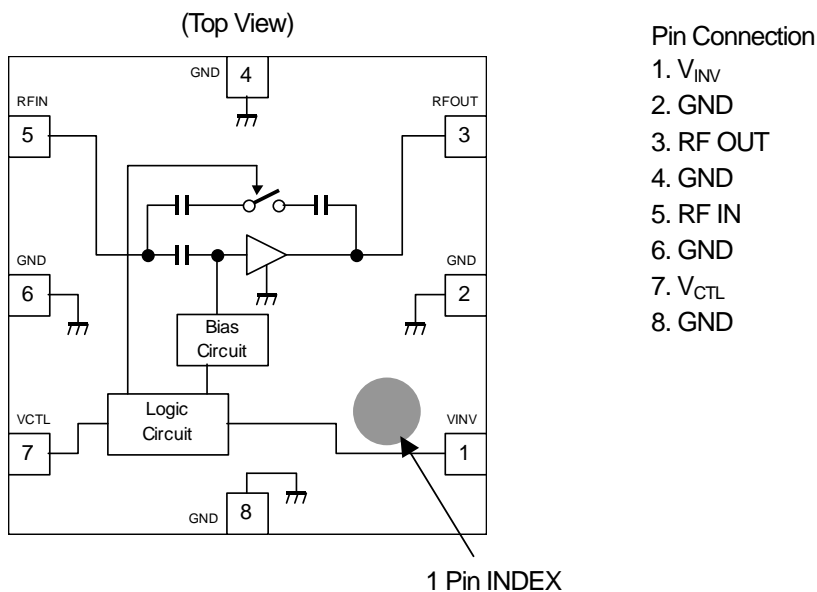


NJG1126HB6

FEATURES

- | | | |
|-------------------------------------|---|--|
| ● Low voltage operation | +2.7V typ. | |
| ● Low CTL voltage operation | +1.85V typ. | |
| ● Low current consumption | 2.2mA typ. | @V _{CTL} =1.85V |
| | 1uA typ. | @V _{CTL} =0V |
| ● High gain | 16.5dB typ. | @V _{CTL} =1.85V, f _{RF} =2140MHz |
| ● Low noise figure | 1.4dB typ. | @V _{CTL} =1.85V, f _{RF} =2140MHz |
| ● Pin at 1dB Gain Compression point | -12.0dBm typ. | @V _{CTL} =1.85V, f _{RF} =2140MHz |
| | +11.0dBm typ. | @V _{CTL} =0V, f _{RF} =2140MHz |
| ● High input IP3 | 0dBm typ. | @V _{CTL} =1.85V, f _{RF} =2140MHz |
| | +16.0dBm typ. | @V _{CTL} =0V, f _{RF} =2140MHz |
| ● Small package | USB8-B6 (Package size: 1.5mmx1.5mmx0.55mm typ.) | |

PIN CONFIGURATION



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

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■ABSOLUTE MAXIMUM RATINGS

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

| PARAMETERS | SYMBOL | CONDITIONS | RATINGS | UNITS |
|-------------------------|-----------|--|----------|--------------------|
| Supply voltage | V_{DD} | | 5.0 | V |
| Inverter supply voltage | V_{INV} | | 5.0 | V |
| Control voltage | V_{CTL} | | 5.0 | V |
| Input power | P_{in} | $V_{DD}=2.85\text{V}$ | +15 | dBm |
| Power dissipation | P_D | on PCB board, $T_{jmax}=150^{\circ}\text{C}$ | 135 | mW |
| Operating temperature | T_{opr} | | -40~+85 | $^{\circ}\text{C}$ |
| Storage temperature | T_{stg} | | -55~+150 | $^{\circ}\text{C}$ |

■ELECTRICAL CHARACTERISTICS 1 (DC)

(General Conditions: $V_{DD}=V_{INV}=2.85\text{V}$, $T_a=+25^{\circ}\text{C}$, $Z_s=Z_l=50\Omega$)

| PARAMETERS | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|--|--------------|--------------------------------|-----|------|---------------|---------------|
| Operating voltage | V_{DD} | | 2.5 | 2.85 | 3.2 | V |
| Inverter supply voltage | V_{INV} | | 2.5 | 2.85 | 3.2 | V |
| Control voltage (High) | $V_{CTL(H)}$ | | 1.5 | 1.85 | $V_{INV}+0.3$ | V |
| Control voltage (Low) | $V_{CTL(L)}$ | | 0 | 0 | 0.3 | V |
| Operating current1 (LNA High Gain Mode) | I_{DD1} | RF OFF, $V_{CTL}=1.85\text{V}$ | - | 2.2 | 3.2 | mA |
| Operating current2 (LNA High Gain Mode) | I_{DD2} | RFOFF, $V_{CTL}=0\text{V}$ | - | 1 | 5 | μA |
| Inverter current1 (LNA High Gain Mode) | I_{INV1} | RF OFF, $V_{CTL}=1.85\text{V}$ | - | 90 | 150 | μA |
| Inverter current2 (LNA High Gain Mode) | I_{INV2} | RF OFF, $V_{CTL}=0\text{V}$ | - | 16 | 50 | μA |
| Control current | I_{CTL} | RF OFF, $V_{CTL}=1.85\text{V}$ | - | 5 | 20 | μA |

■ELECTRICAL CHARACTERISTICS 2 (LNA High Gain Mode)

(General Conditions: $V_{DD}=V_{INV}=2.7V$, $V_{CTL}=1.85V$, $freq=2140MHz$, $T_a=+25^{\circ}C$, $Z_s=Z_f=50\Omega$)

| PARAMETERS | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------------------------------|-----------------|---|-------|-------|------|-------|
| Small signal gain1 | Gain1 | | 15.0 | 16.5 | 19.0 | dB |
| Noise figure1 | NF1 | Exclude PCB & connector losses (IN: 0.09dB) | - | 1.4 | 1.7 | dB |
| 1dB gain compression output power1 | $P_{-1dB(IN)1}$ | | -15.5 | -12.0 | - | dBm |
| 3rd order Input Intercept Point1 | IIP3_1 | $f1=f_{RF}$, $f2=f_{RF}+100kHz$, $P_{in}=-32dBm$ | -5.0 | 0 | - | dBm |
| RF IN VSWR1 | $VSWR_{i1}$ | | - | 1.6 | 2.2 | - |
| RF OUT VSWR1 | $VSWR_{o1}$ | | - | 1.5 | 2.2 | - |

■ELECTRICAL CHARACTERISTICS 2 (LNA Low Gain Mode)

(General Conditions: $V_{DD}=V_{INV}=2.7V$, $V_{CTL}=0V$, $freq=2140MHz$, $T_a=+25^{\circ}C$, $Z_s=Z_f=50\Omega$)

| PARAMETERS | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------------------------------|-----------------|---|-------|-------|------|-------|
| Small signal gain2 | Gain2 | | -10.0 | -7.0 | -5.5 | dB |
| Noise figure2 | NF2 | Exclude PCB & connector losses (IN: 0.09dB) | - | 7.0 | 10.0 | dB |
| 1dB gain compression output power2 | $P_{-1dB(IN)2}$ | | +4.5 | +11.0 | - | dBm |
| 3rd order Input Intercept Point2 | IIP3_2 | $F1=f_{RF}$, $f2=f_{RF}+100kHz$, $P_{in}=-16dBm$ | 0 | +16.0 | - | dBm |
| RF IN VSWR2 | $VSWR_{i2}$ | | - | 1.5 | 2.0 | - |
| RF OUT VSWR2 | $VSWR_{o2}$ | | - | 1.5 | 2.0 | - |

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■TERMINAL INFORMATION

| No. | SYMBOL | DESCRIPTION |
|-----|--------|---|
| 1 | VINV | Supply voltage terminal for internal logic circuit (inverter). Please place a bypass capacitor between this and GND for avoiding RF noise from outside. |
| 2 | GND | Ground terminal. |
| 3 | RFOUT | RF signal comes out from this terminal, and goes through an external matching circuit connected to this. Inductor L3 as shown in the application circuit is a part of an external matching circuit, and also provide DC power to LNA. Capacitor C2 as shown in the application circuit is a bypass capacitor. |
| 4 | GND | Ground terminal. |
| 5 | RFIN | RF input signal is input to this terminal through an external matching circuit connected to this terminal. A DC blocking capacitor is not required. |
| 6 | GND | Ground terminal. |
| 7 | VCTL | Control port. A logic control signal is required to select High or Low gain mode of LNA. This terminal is set to more than +1.5V of logical high level for High gain mode of LNA, and set to 0~+0.3V of logical low level for Low gain mode. |
| 8 | GND | Ground terminal. |

CAUTION

- 1) Ground terminal (No.2, 4, 6, 8) should be connected to the ground plane as close as possible for excellent RF performance, because distance to GND makes parasitic inductance.

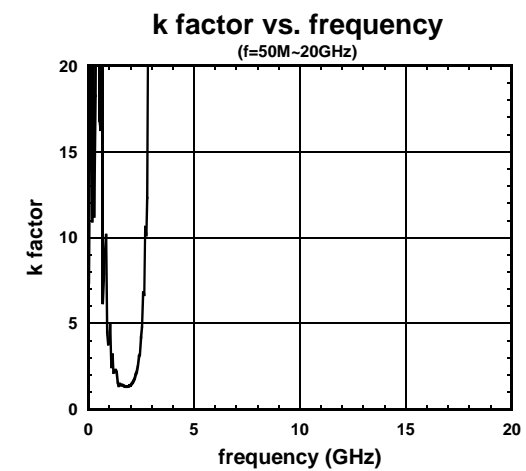
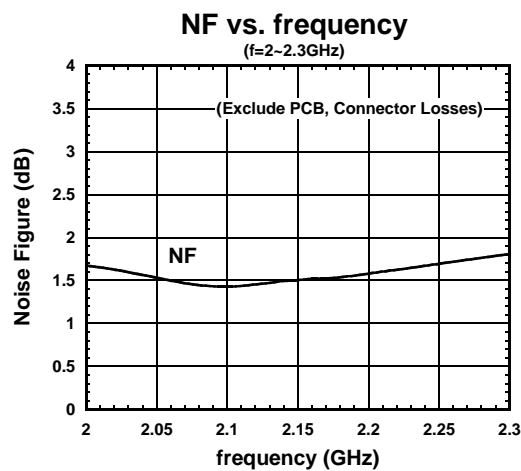
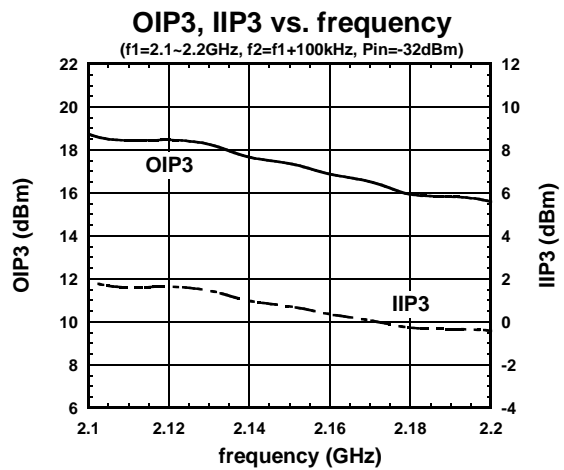
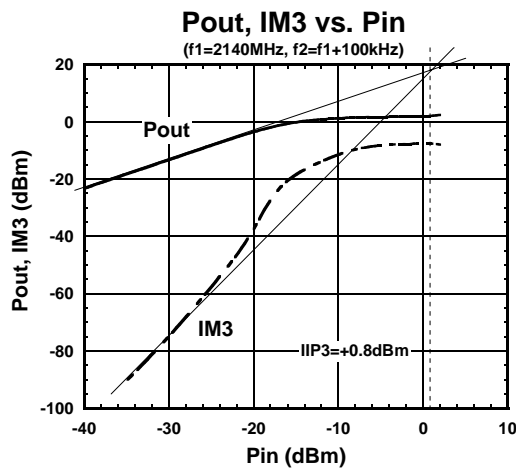
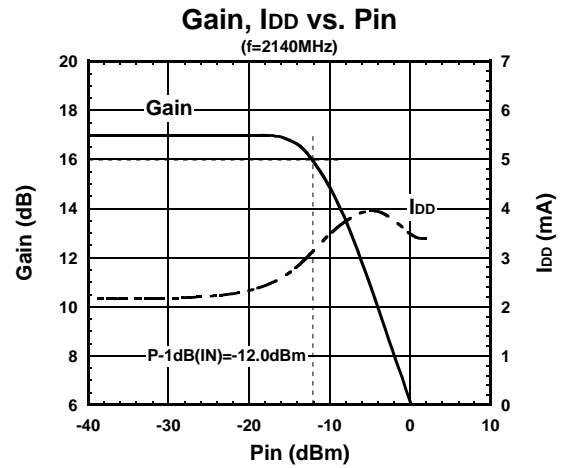
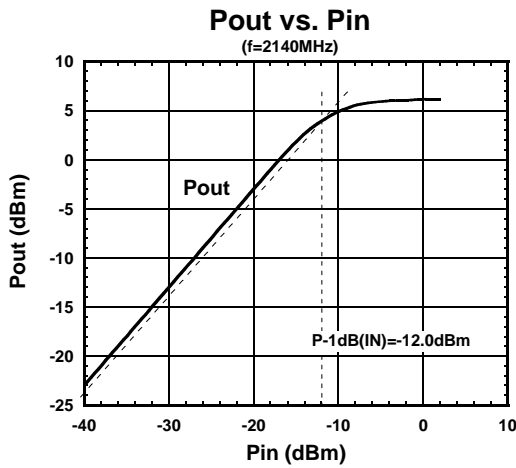
■TRUTH TABLE

"H"= $V_{CTL}(H)$, "L"= $V_{CTL}(L)$

| V_{CTL} | Gain Mode | LNA |
|-----------|-----------|--------|
| L | Low | bypass |
| H | High | pass |

ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)

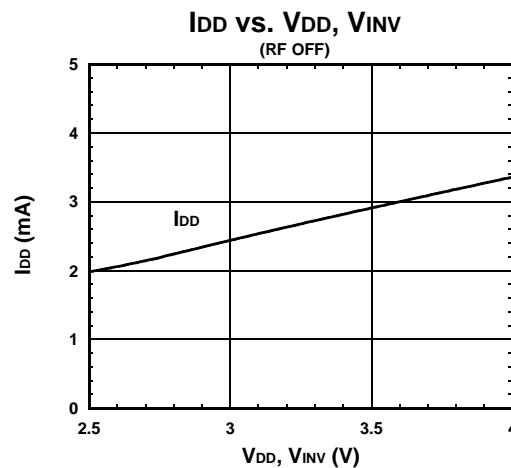
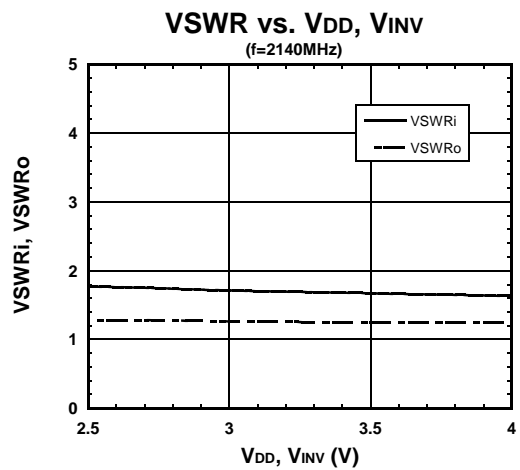
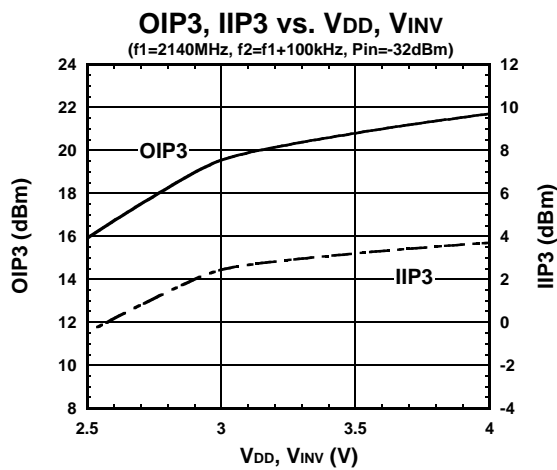
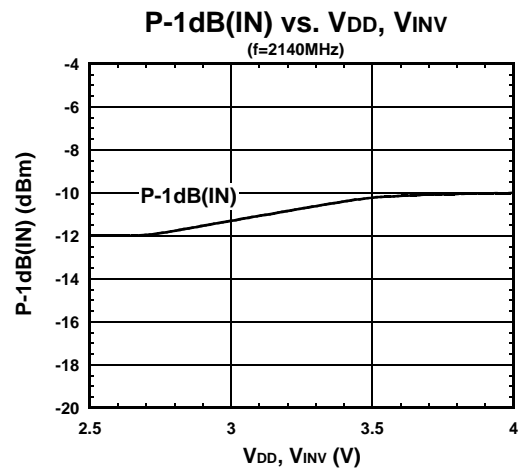
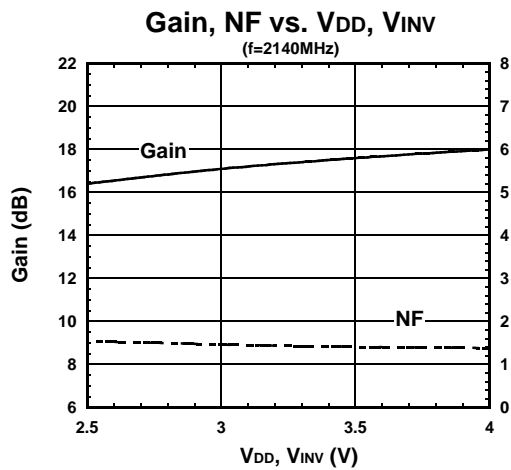
General Conditions: $T_a=+25^{\circ}\text{C}$, $V_{DD}=V_{INV}=2.7\text{V}$, $V_{CTL}=1.85\text{V}$, $Z_S=Z_L=50\Omega$



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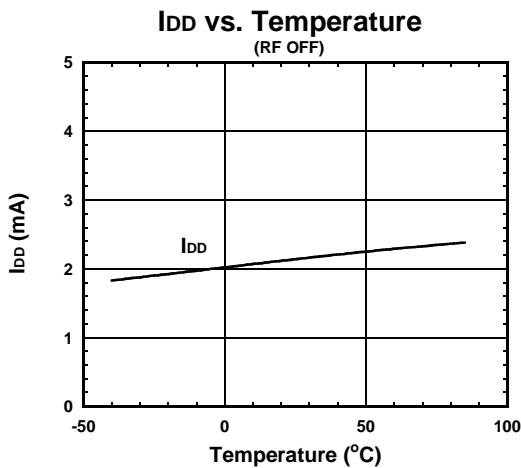
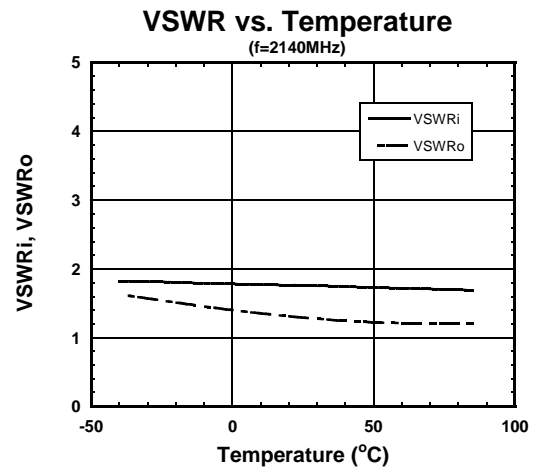
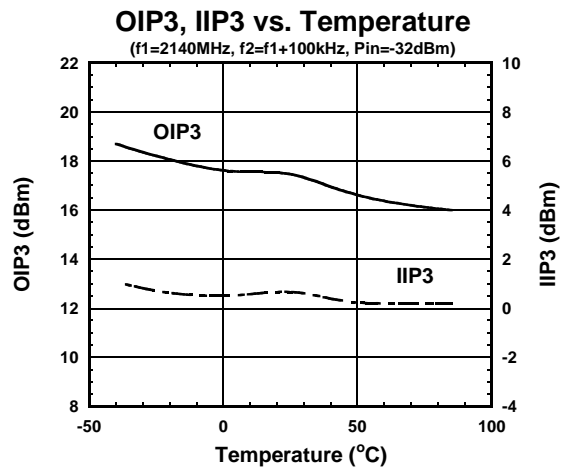
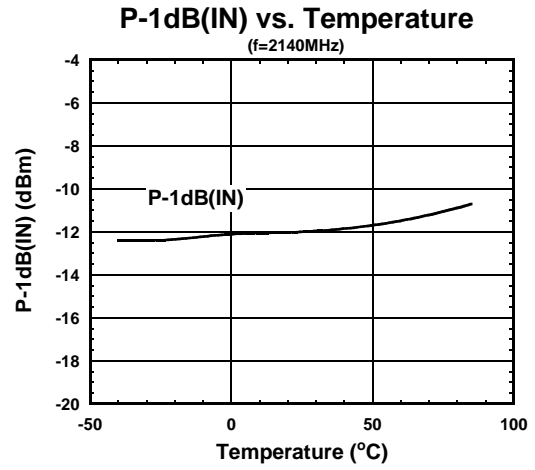
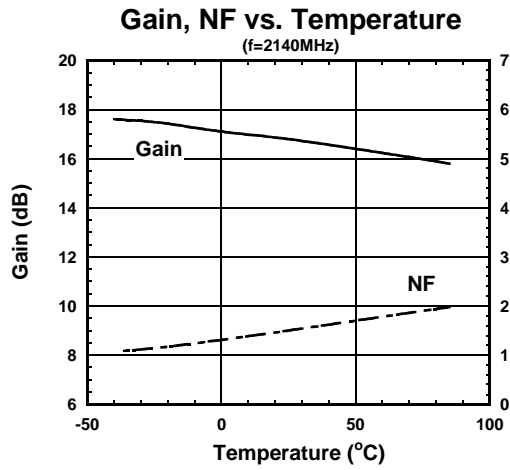
ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)

General Conditions: $T_a=+25^{\circ}\text{C}$, $V_{DD}=V_{INV}=2.7\text{V}$, $V_{CTL}=1.85\text{V}$, $Z_s=Z_l=50\Omega$



ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)

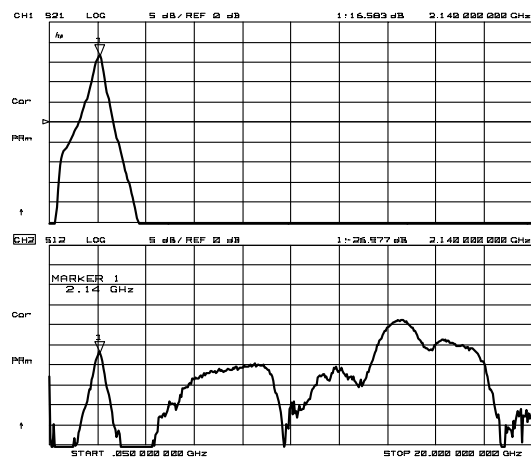
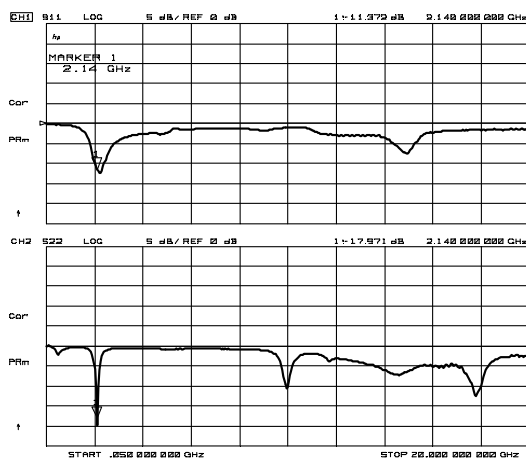
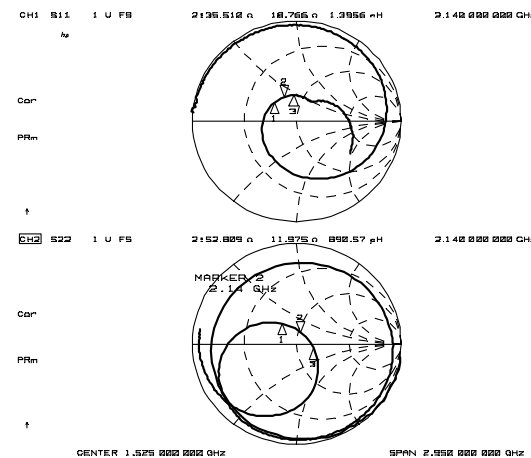
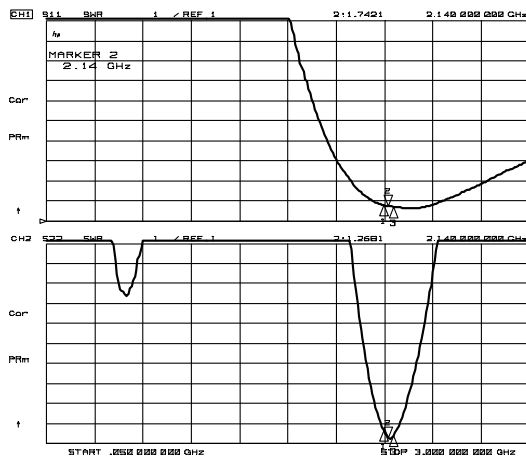
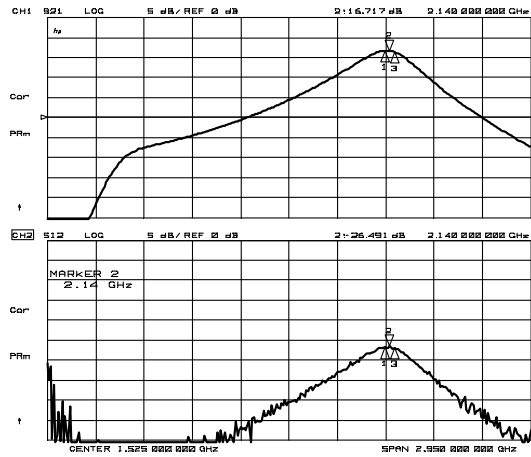
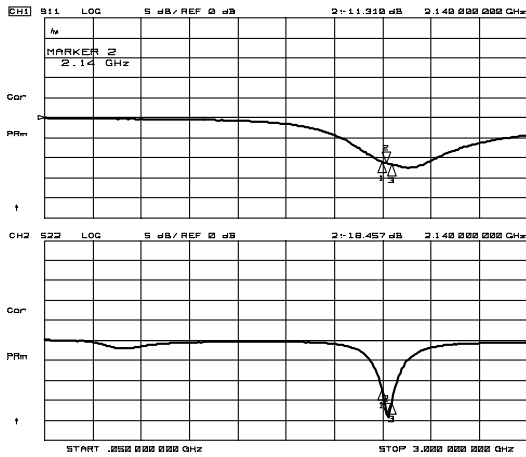
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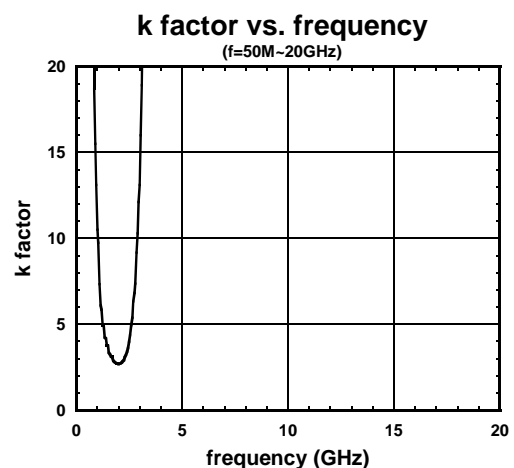
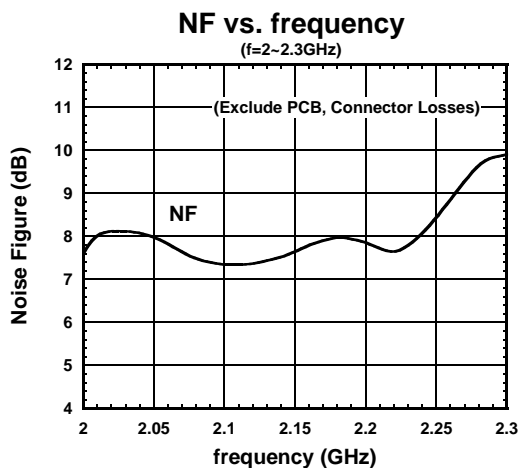
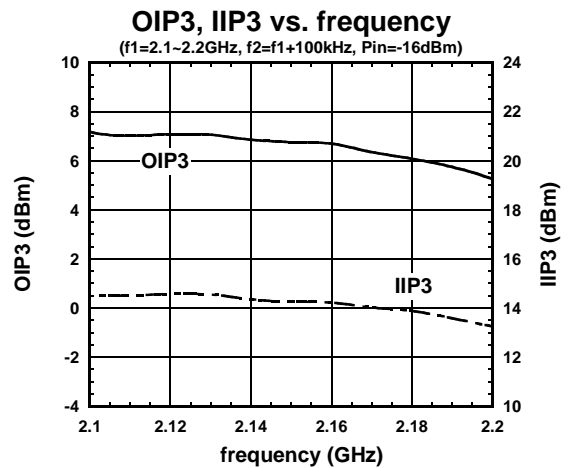
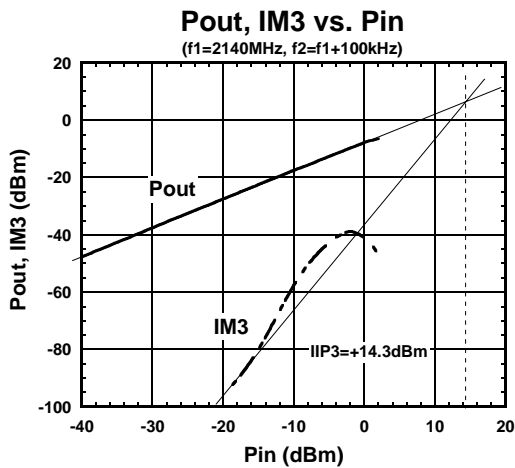
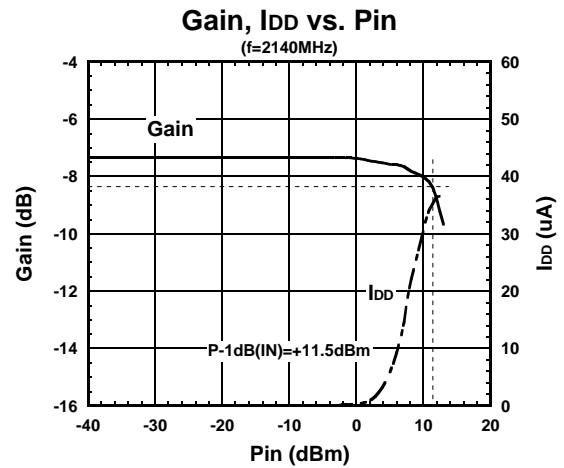
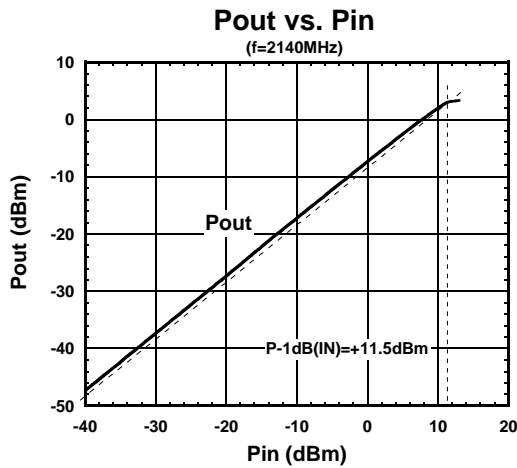
ELECTRICAL CHARACTERISTICS (LNA High Gain Mode)

General Conditions: $T_a=+25^{\circ}\text{C}$, $V_{DD}=V_{INV}=2.7\text{V}$, $V_{CTL}=1.85\text{V}$, $Z_s=Z_l=50\Omega$



ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)

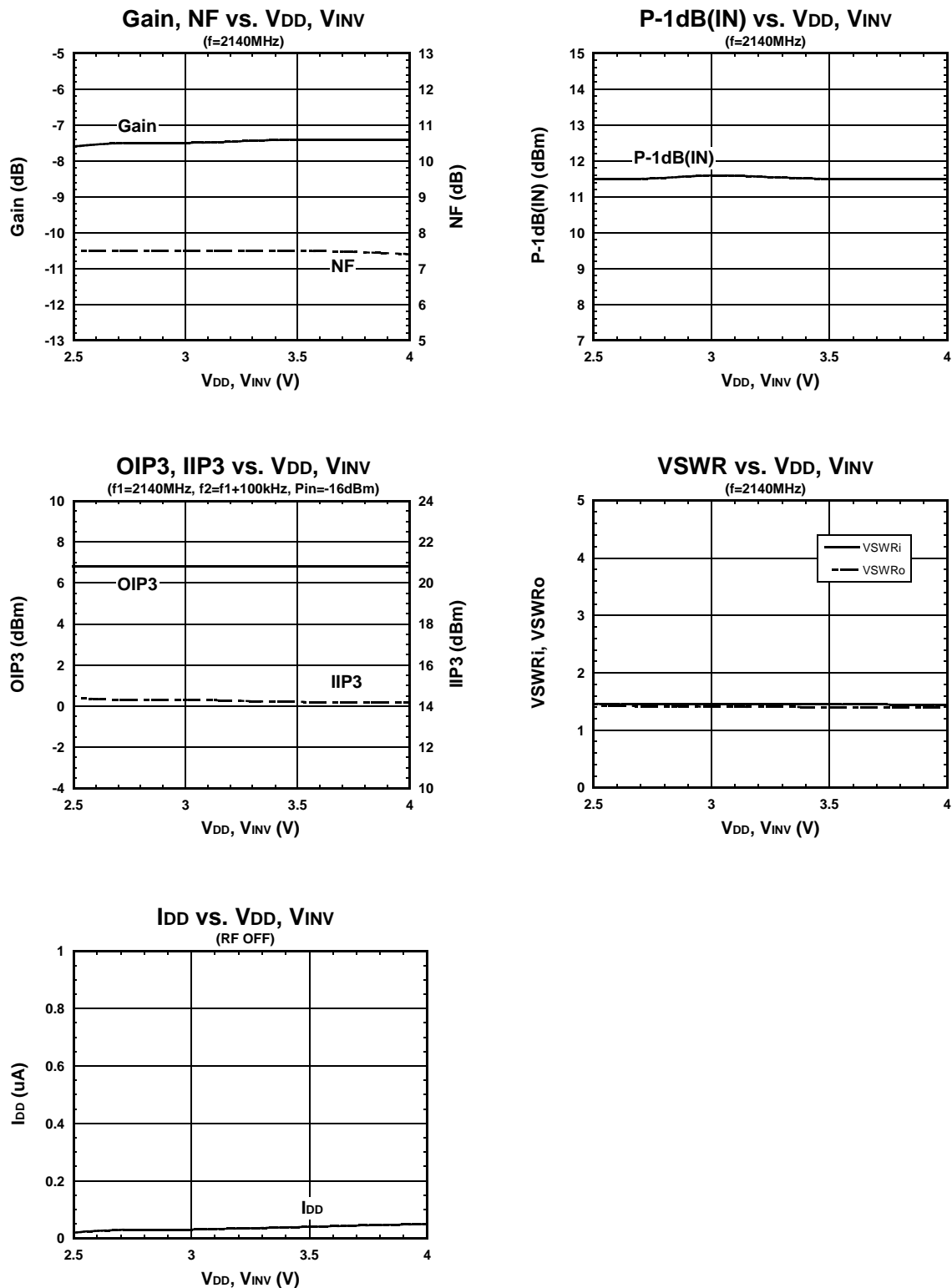
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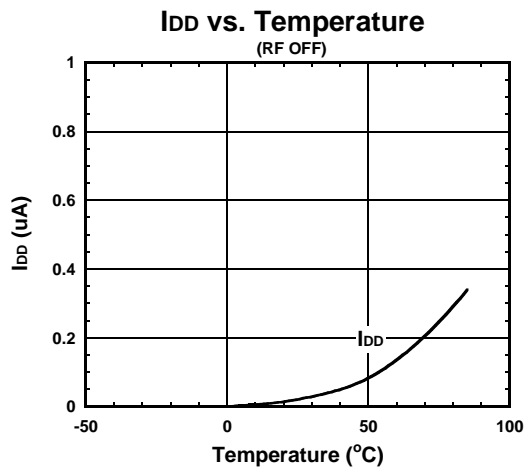
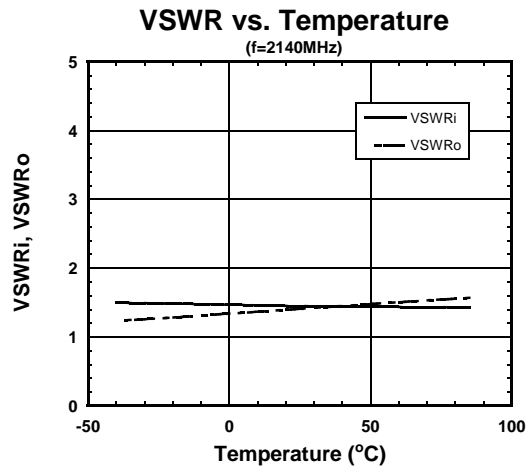
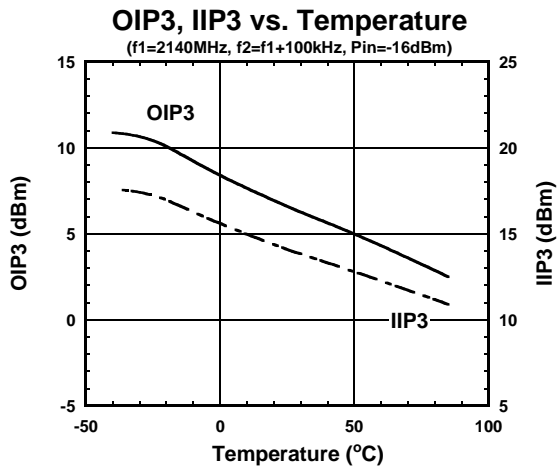
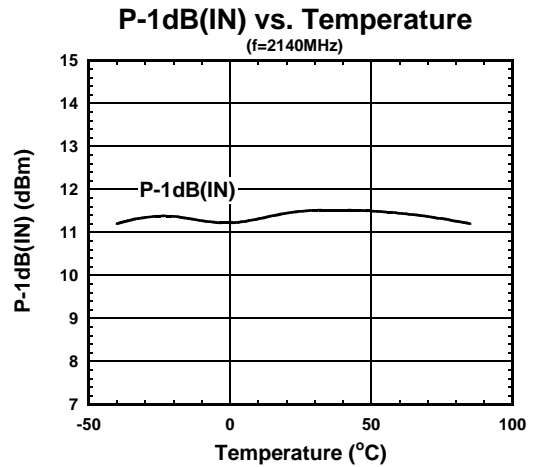
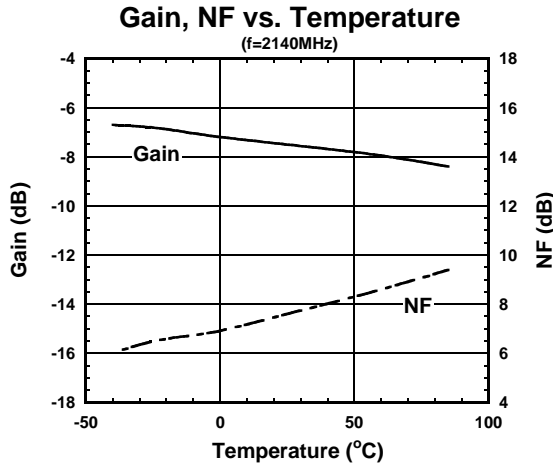
ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)

General Conditions: $T_a=+25^{\circ}\text{C}$, $V_{DD}=V_{INV}=2.7\text{V}$, $V_{CTL}=0\text{V}$, $Z_S=Z_L=50\Omega$



ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)

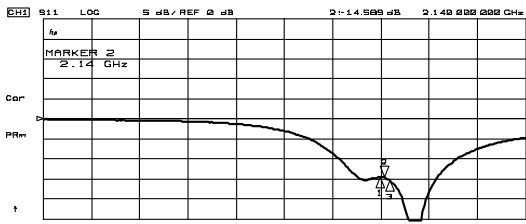
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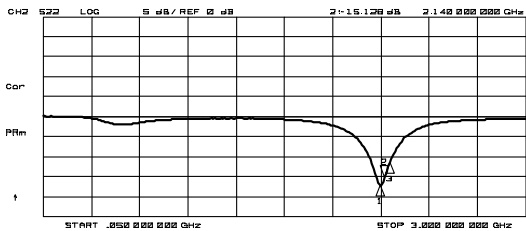
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ELECTRICAL CHARACTERISTICS (LNA Low Gain Mode)

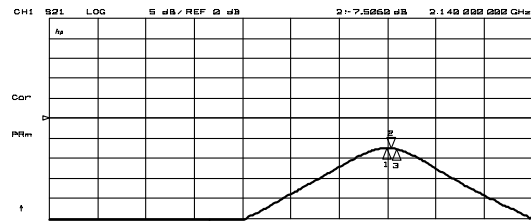
General Conditions: $T_a=+25^{\circ}\text{C}$, $V_{DD}=V_{INV}=2.7\text{V}$, $V_{CTL}=0\text{V}$, $Z_S=Z_L=50\Omega$



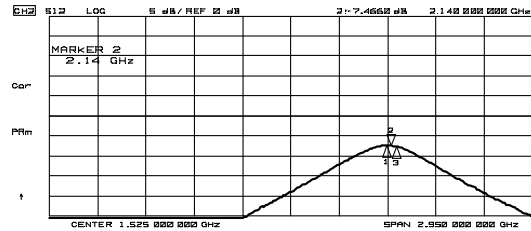
CH1 Markers
 1: -14.447 dB
 2: 11000 GHz
 3: -15.361 dB
 4: 17000 GHz



CH2 Markers
 1: -17.023 dB
 2: 11000 GHz
 3: -11.481 dB
 4: 17000 GHz



CH1 Markers
 1: -7.4482 dB
 2: 11000 GHz
 3: -7.7142 dB
 4: 17000 GHz



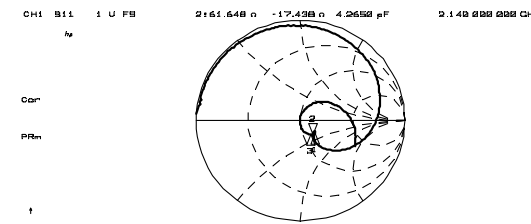
CH2 Markers
 1: -7.4480 dB
 2: 11000 GHz
 3: -7.7138 dB
 4: 17000 GHz



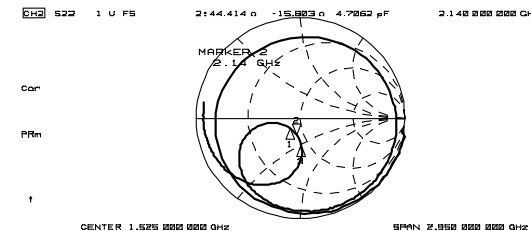
CH1 Markers
 1: 1.4668
 2: 11000 GHz
 3: 1.4195
 4: 17000 GHz



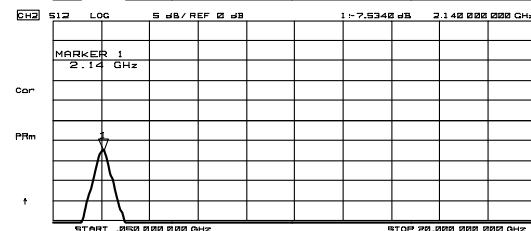
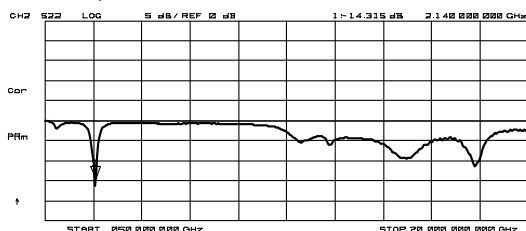
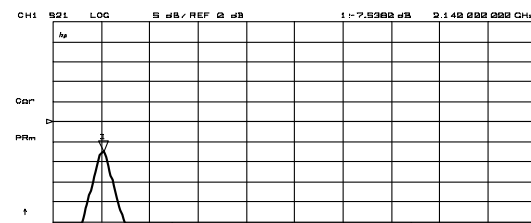
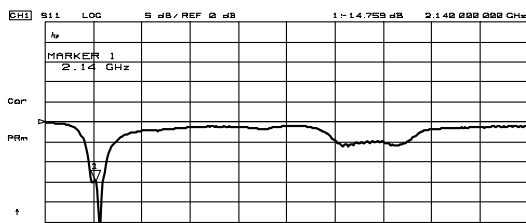
CH2 Markers
 1: 1.3256
 2: 11000 GHz
 3: 1.7265
 4: 17000 GHz



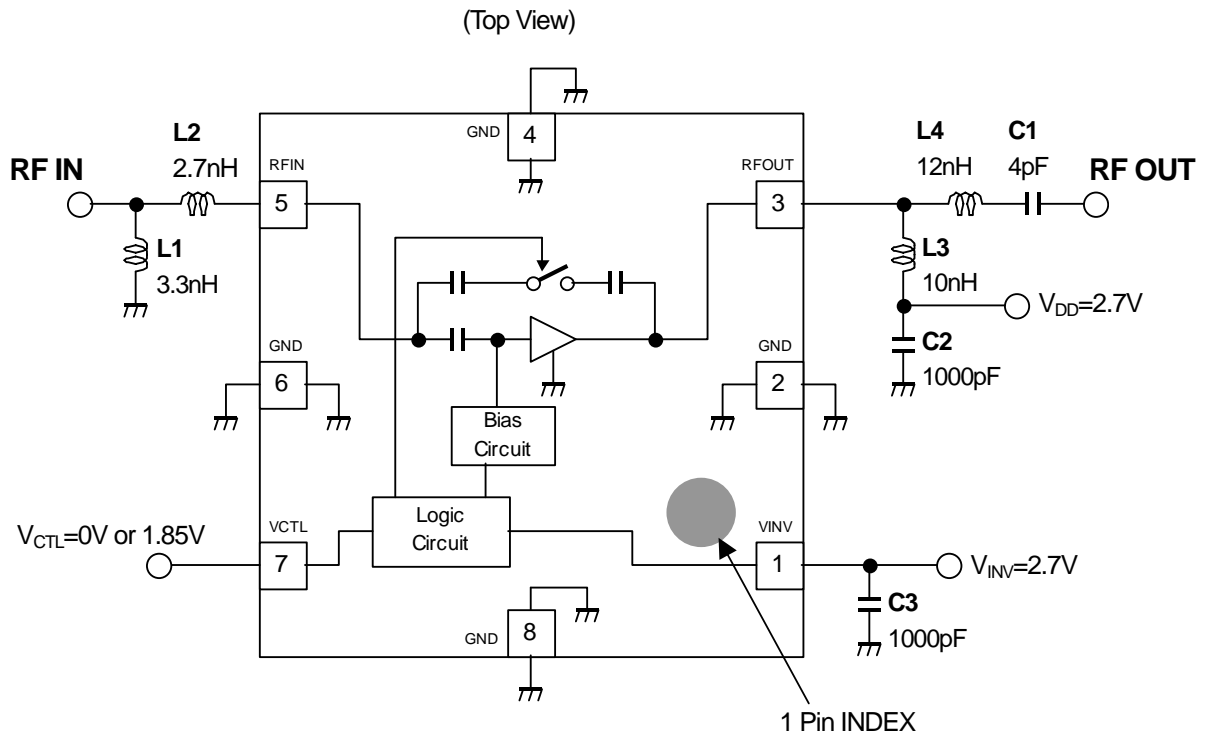
CH1 Markers
 1: 64.816 n
 2: -16.822 pF
 3: 58.572 n
 4: -16.568 pF



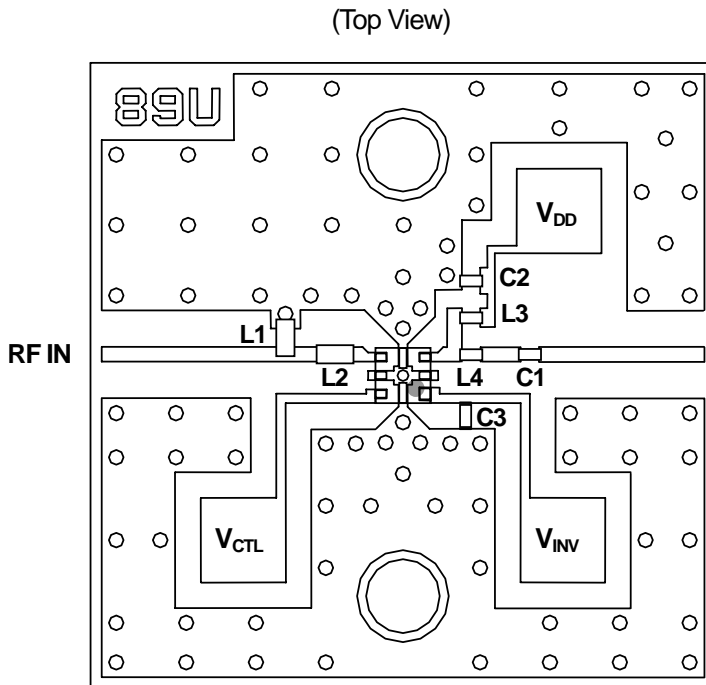
CH2 Markers
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 2: -8.822 pF
 3: 44.195 n
 4: -28.348 pF



APPLICATION CIRCUIT



TEST PCB LAYOUT



PARTS LIST

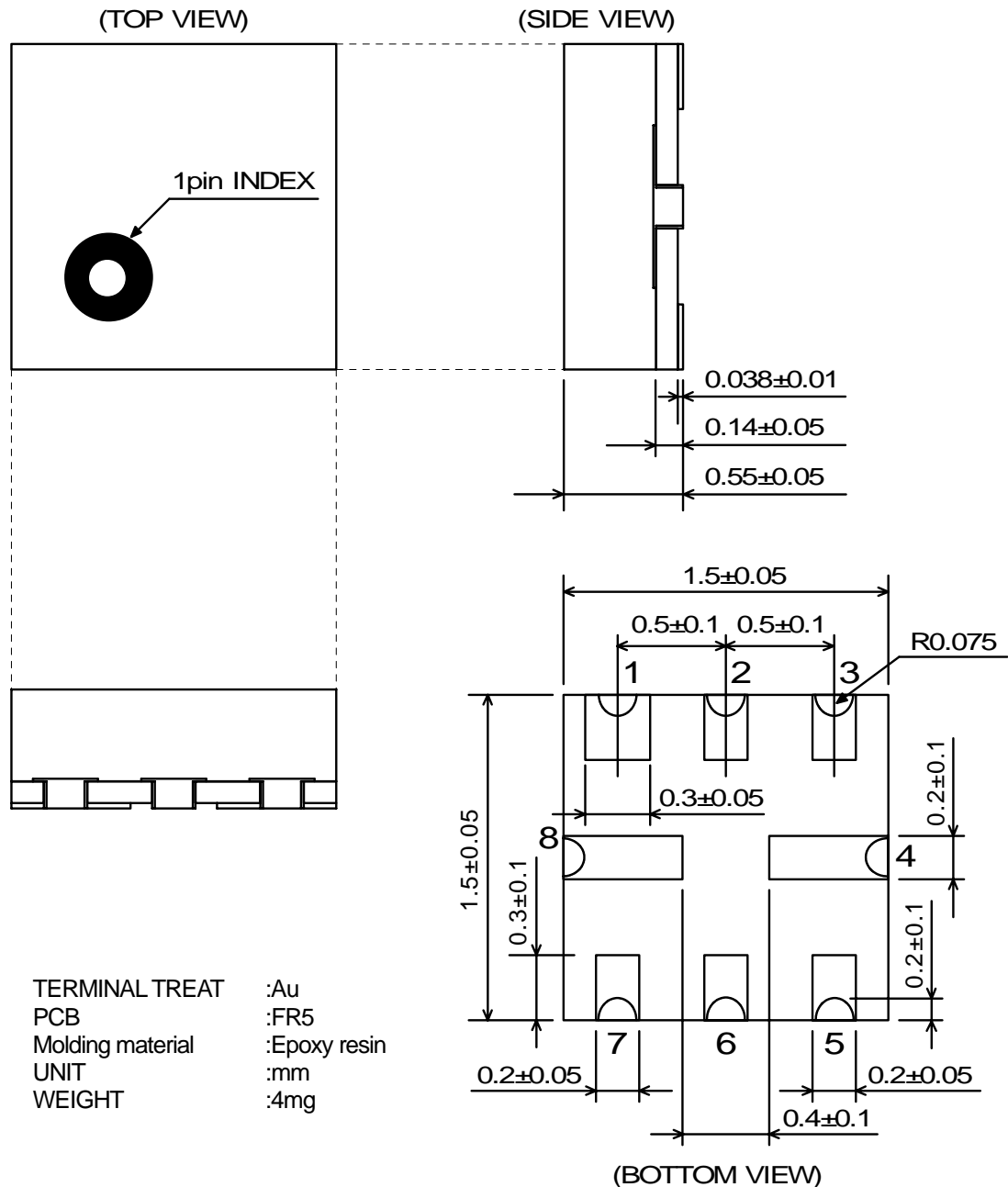
| Parts ID | Comment |
|----------|----------------------|
| L1, L2 | TAIYO-YUDEN (HK1005) |
| L3, L4 | TDK (MLG0603Q) |
| C1~C3 | MURATA (GRM03) |

RF OUT

PCB (FR-4)
 $t=0.2\text{mm}$
 MICROSTRIP LINE WIDTH
 $=0.4\text{mm}$ ($Z_0=50\Omega$)
 PCB SIZE= $17.0\text{mm} \times 17.0\text{mm}$

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PACKAGE OUTLINE (USB8-B6)



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.

[CAUTION]

The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.

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