

PDC Dual Band LNA GaAs MMIC

■ GENERAL DESCRIPTION

The NJG1110PB1 is a dual band low noise amplifier (2 input 2 output) GaAs MMIC for 800MHz and 1500MHz band. The band switching between 800MHz and 1500MHz is established by one bit control signal by using built-in inverter circuit.

An ultra small & thin FFP12 (Flip-Chip Fine package) package is adopted.

■ PACKAGE OUTLINE



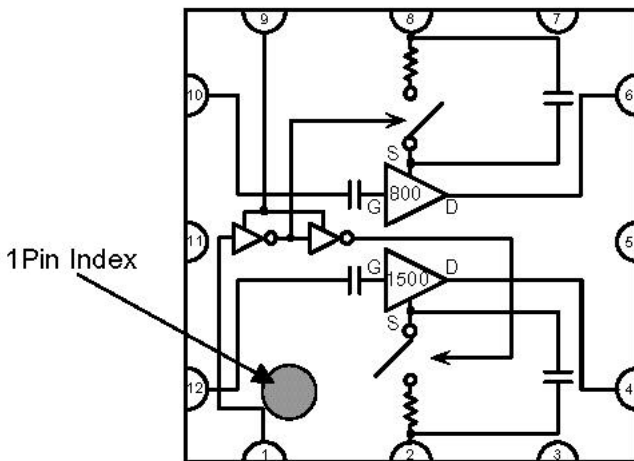
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■ FEATURES

- Low voltage operation +2.8V typ.
- Low current consumption 2.7mA typ.
- Low control current 20uA typ.
- High gain 18dB typ. @f=820MHz
16dB typ. @f=1490MHz
- Low noise figure 1.2dB typ. @f=820MHz
1.1dB typ. @f=1490MHz
- High output IP3 +10dBm typ. @f=820MHz
+13dBm typ. @f=1490MHz
- Ultra small & ultra thin package FFP12-B1 (Package size: 2.0x2.0x0.85mm)

■ PIN CONFIGURATION

PB1 Type
(Top View)



Pin connection

| | |
|----------|----------|
| 1.VCTL | 7.GND |
| 2.GND | 8.GND |
| 3.GND | 9.VINV |
| 4.RFOUT2 | 10.RFIN1 |
| 5.GND | 11.GND |
| 6.RFOUT1 | 12.RFIN2 |

Note: The 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 |
|-------------------------|-----------|----------------------|----------|------------------|
| Operating voltage | V_{DD} | | 5.0 | V |
| Control voltage | V_{CTL} | | 5.0 | V |
| Inverter supply voltage | V_{INV} | | 5.0 | V |
| Input power | P_{in} | $V_{DD}=2.8\text{V}$ | +15 | dBm |
| Power dissipation | P_D | | 300 | mW |
| Operating temperature | T_{opr} | | -40~+85 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -55~+125 | $^\circ\text{C}$ |

■ ELECTRICAL CHARACTERISTICS 1 (DC)

($T_a=+25^\circ\text{C}$, $Z_s=Z_l=50\Omega$, $V_{DD}=V_{INV}=2.8\text{V}$)

| PARAMETERS | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|-------------------------|--------------|------------------------------------|-----|-----|-----------|---------------|
| Operating voltage | V_{DD} | | 2.5 | 2.8 | 4.5 | V |
| Inverter supply voltage | V_{INV} | | 2.5 | 2.8 | 4.5 | V |
| Control voltage (High) | $V_{CTL(H)}$ | | 2.0 | 2.8 | V_{INV} | V |
| Control voltage (Low) | $V_{CTL(L)}$ | | 0.0 | 0.0 | 0.8 | V |
| Operating current | I_{DD} | No RF signal, $V_{CTL}=V_{CTL(L)}$ | - | 2.7 | 3.25 | mA |
| | | No RF signal, $V_{CTL}=V_{CTL(H)}$ | - | 2.7 | 3.25 | mA |
| Control current | I_{CTL} | No RF signal | - | 20 | 60 | μA |
| Inverter current | I_{INV} | No RF signal | - | 100 | 200 | μA |

■ELECTRICAL CHARACTERISTICS 2 (800MHz BAND RF)

($T_a=+25^{\circ}\text{C}$, $Z_s=Z_l=50\Omega$, $V_{DD}=V_{INV}=2.8\text{V}$, $V_{CTL}=V_{CTL(L)}$, $\text{freq}=810\sim 885\text{MHz}$, with application circuit)

| PARAMETERS | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------------------------|------------------------|---------------------------------------|------|------|------|-------|
| Small signal gain | Gain1 | | 16.0 | 18.0 | 19.0 | dB |
| Gain flatness | $G_{\text{flat}1}$ | freq=810~830MHz | - | - | 0.5 | dB |
| | $G_{\text{flat}2}$ | freq=838~843MHz | - | - | 0.5 | dB |
| | $G_{\text{flat}3}$ | freq=870~885MHz | - | - | 0.5 | dB |
| Noise figure | NF1 | | - | 1.2 | 1.4 | dB |
| Pin at 1dB compression point | $P_{-1\text{dB(IN)}1}$ | | -21 | -18 | - | dBm |
| Output 3rd order intercept point | OIP3_1 | f1=freq, f2=freq+100kHz Pin=-35dBm | +6 | +10 | - | dBm |
| Isolation | ISL1 | freq=680~780MHz | 25 | 30 | - | dB |
| | ISL2 | freq=1360~1560MHz | 35 | 45 | - | dB |
| | ISL3 | freq=2040~2340MHz | 45 | 55 | - | dB |
| Image suppression ratio | IMR1 | freq=582.4~657.4MHz | 4 | 6 | - | dB |
| RF INPUT1 VSWR | $VSWR_{i1}$ | | - | - | 2.2 | - |
| RF OUTPUT1 VSWR | $VSWR_{o1}$ | | - | - | 2.0 | - |

■ELECTRICAL CHARACTERISTICS 3 (1.5GHz BAND RF)

($T_a=+25^{\circ}\text{C}$, $Z_s=Z_l=50\Omega$, $V_{DD}=V_{INV}=2.8\text{V}$, $V_{CTL}=V_{CTL(H)}$, $\text{freq}=1477\sim 1501\text{MHz}$, with application circuit)

| PARAMETERS | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------------------------|------------------------|---------------------------------------|------|------|------|-------|
| Small signal gain | Gain2 | | 15.0 | 16.0 | 17.0 | dB |
| Gain flatness | $G_{\text{flat}4}$ | freq=1477~1501MHz | - | - | 0.5 | dB |
| Noise figure | NF2 | | - | 1.1 | 1.25 | dB |
| Pin at 1dB compression point | $P_{-1\text{dB(IN)}2}$ | | -20 | -17 | - | dBm |
| Output 3rd order intercept point | OIP3_2 | f1=freq, f2=freq+100kHz Pin=-35dBm | +6 | +13 | - | dBm |
| Isolation | ISL4 | freq=1580~1620MHz | 25 | 30 | - | dB |
| | ISL5 | freq=3160~3240MHz | 40 | 50 | - | dB |
| | ISL6 | freq=4740~4860MHz | 30 | 40 | - | dB |
| Image suppression ratio | IMR2 | freq=1700~1729MHz | 3 | 5 | - | dB |
| RF INPUT2 VSWR | $VSWR_{i2}$ | | - | - | 2.1 | - |
| RF OUTPUT2 VSWR | $VSWR_{o2}$ | | - | - | 2.0 | - |

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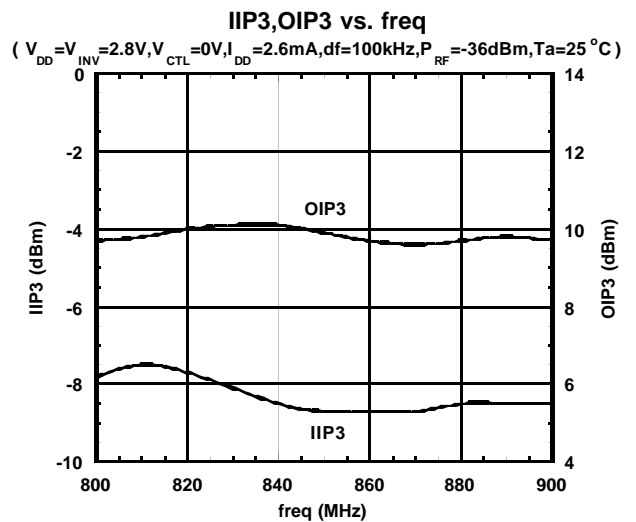
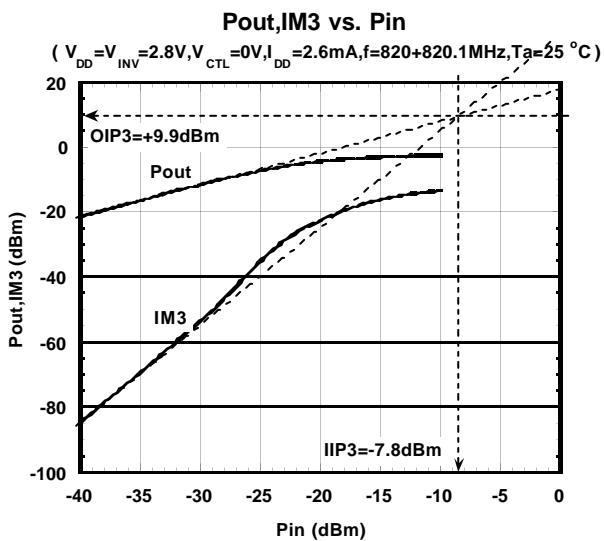
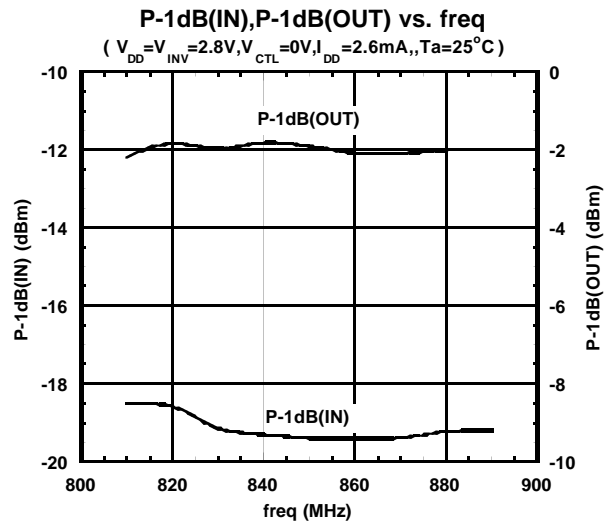
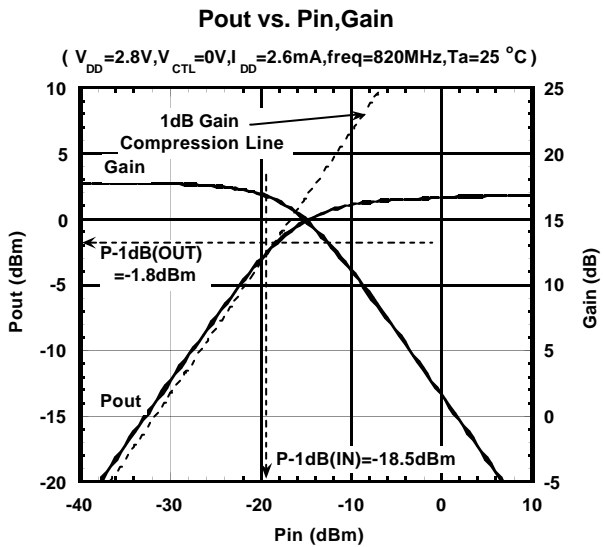
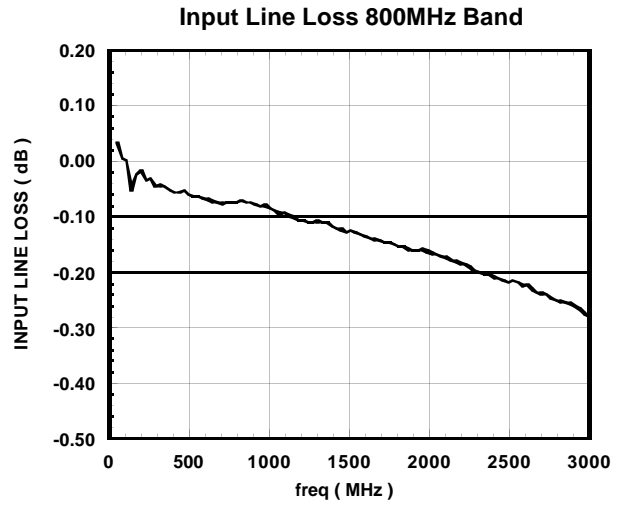
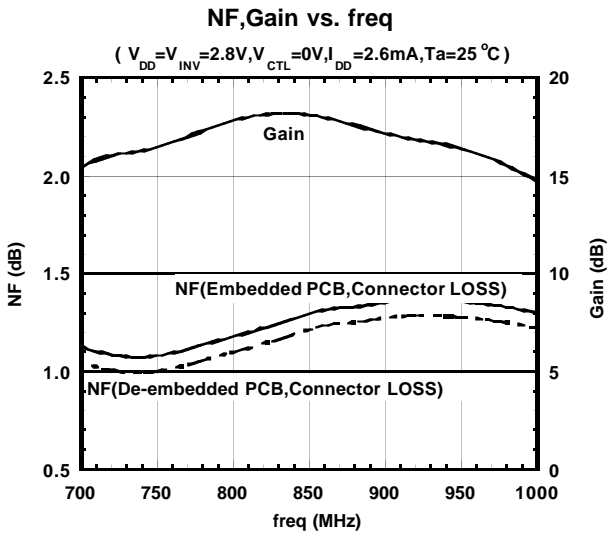
■ TERMINAL INFORMATION

| Pin | Symbol | Description |
|-----|--------|---|
| 1 | VCTL | Control Voltage terminal to select 800MHz band or 1.5GHz band to select. |
| 2 | GND | Ground terminal (0V). |
| 3 | GND | Ground terminal (0V). |
| 4 | RFOUT2 | Output terminal of 1.5GHz band. This terminal is also the power supply terminal of the LNA, please use inductor (L5) to connect power supply. (Please see application circuit.) |
| 5 | GND | Ground terminal (0V). |
| 6 | RFOUT1 | Output terminal of 800MHz band. This terminal is also the power supply terminal of the LNA, please use inductor (L3) to connect power supply. (Please see application circuit.) |
| 7 | GND | Ground terminal (0V). |
| 8 | GND | Ground terminal (0V). |
| 9 | VINV | Power supply terminal of the inverter circuit. |
| 10 | RFIN1 | Output terminal of 800MHz band. The DC blocking capacitor is not required. |
| 11 | GND | Ground terminal (0V). |
| 12 | RFIN2 | Output terminal of 1.5GHz band. The DC blocking capacitor is not required. |

NOTE:

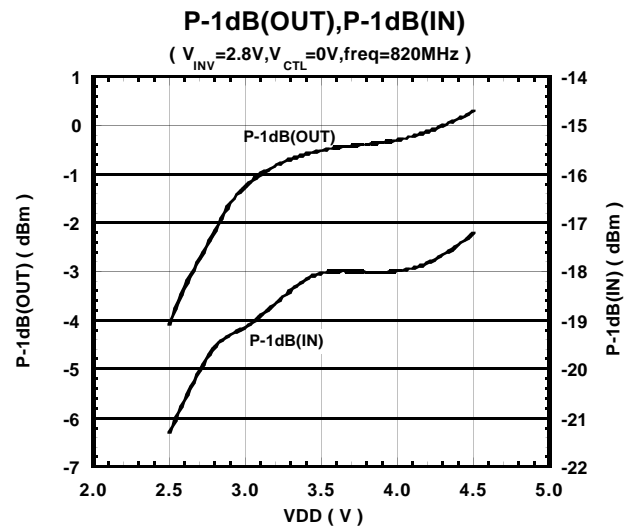
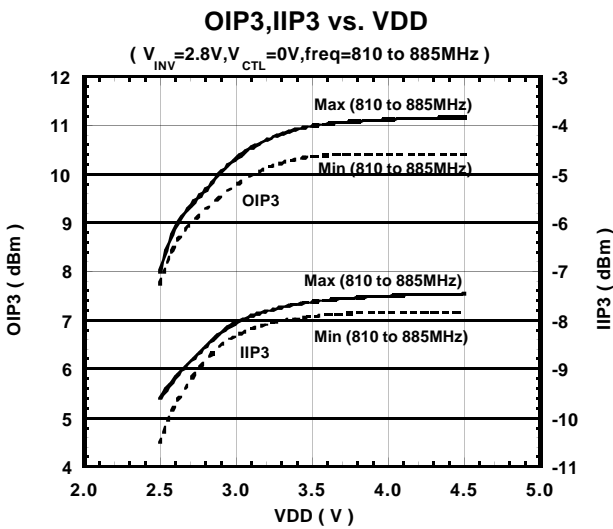
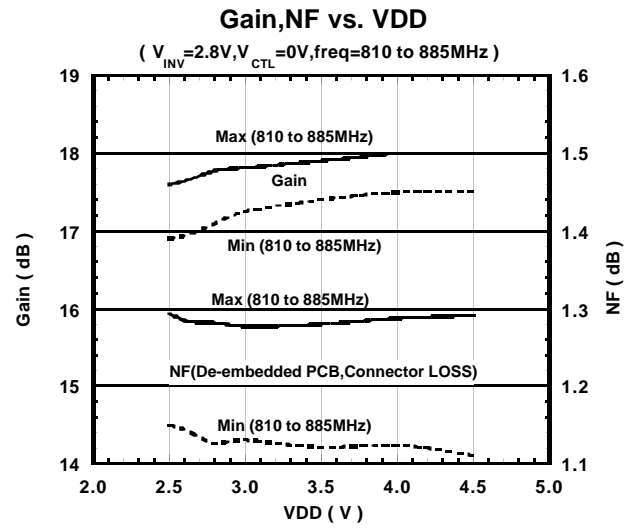
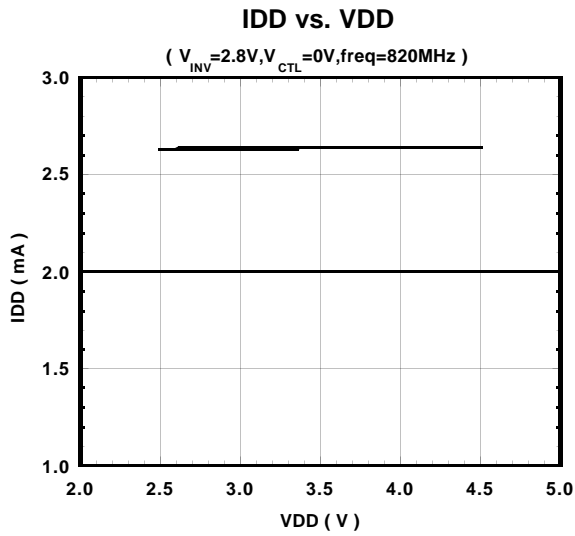
- 1) Ground terminal (2, 3, 5, 8, 11pin) should be connected to ground plane by multiple via holes for good grounding.
- 2) Please connect bypass capacitors possible close to inductors (L3, L5)..

■ TYPICAL CHARACTERISTICS (800MHz Band)

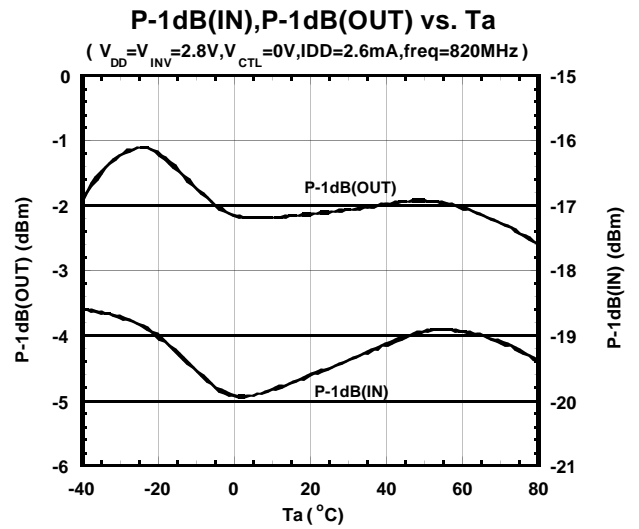
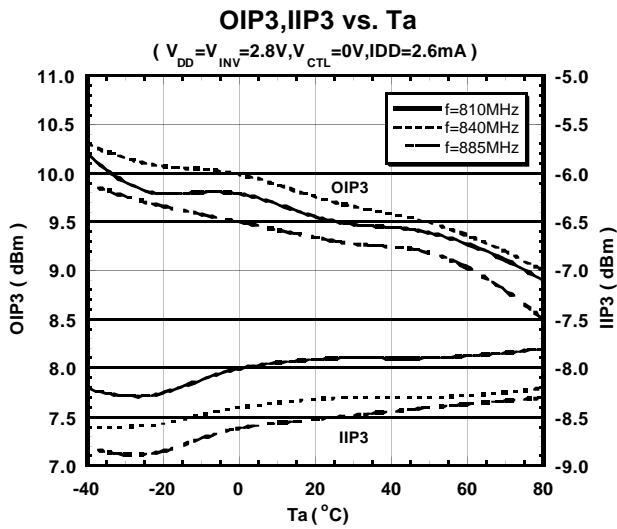
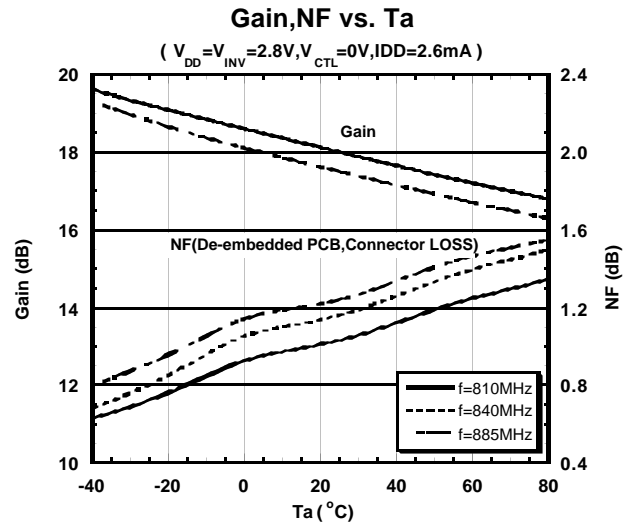
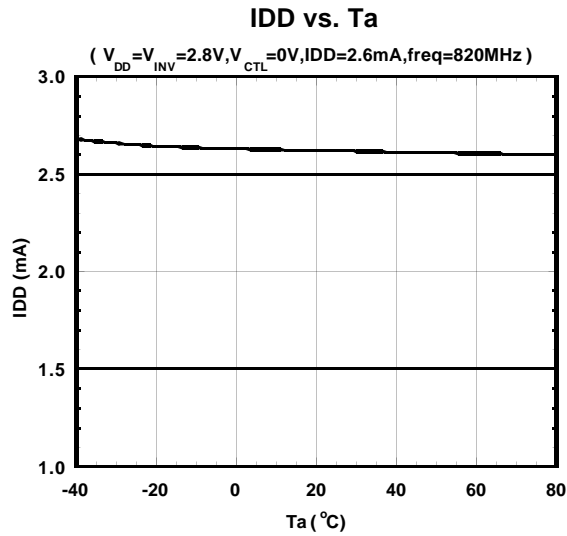


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■ TYPICAL CHARACTERISTICS (800MHz Band)



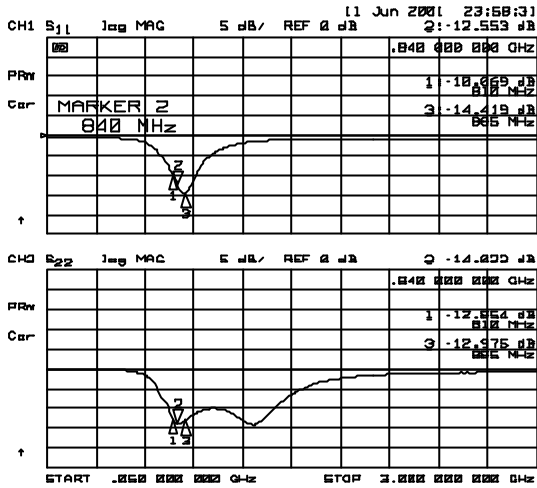
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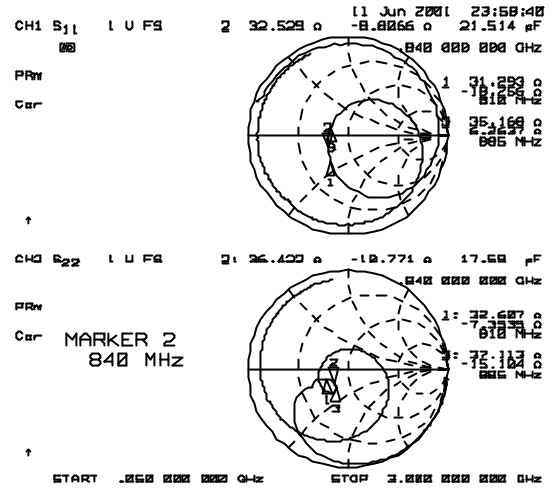
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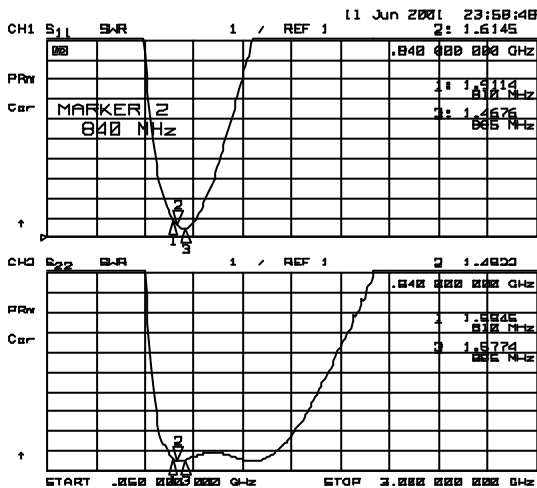
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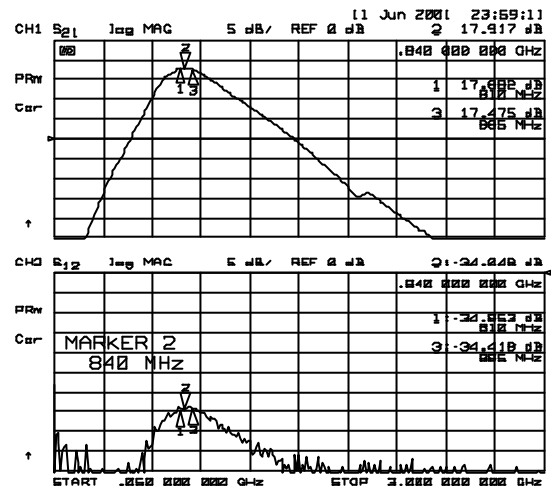
S11, S22



Zin, Zout

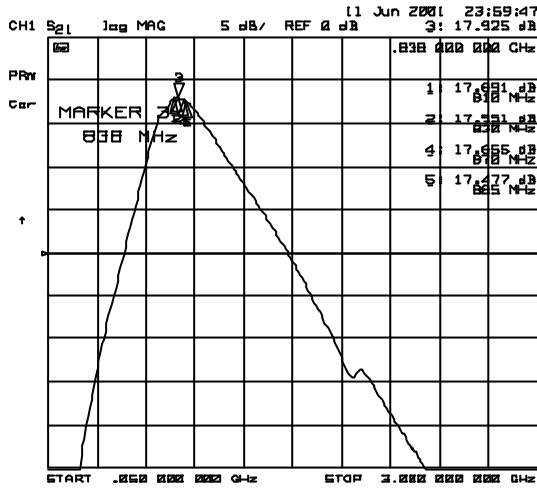


VSWR

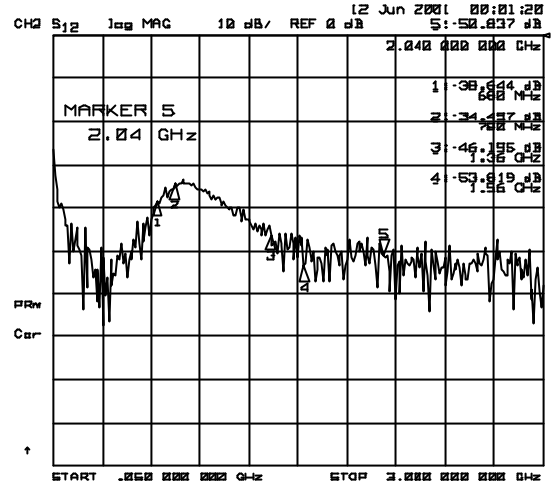


S21, 12

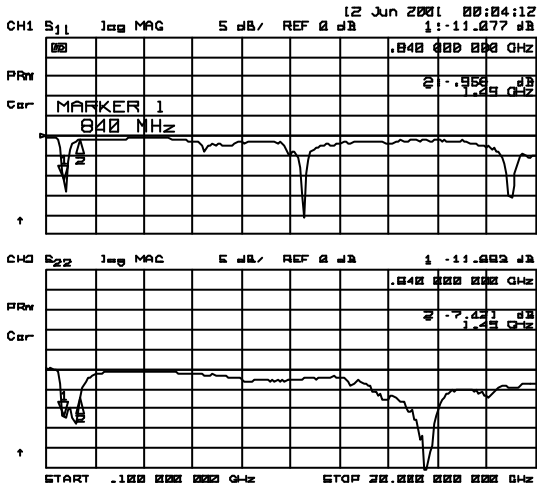
TYPICAL CHARACTERISTICS (800MHz Band)



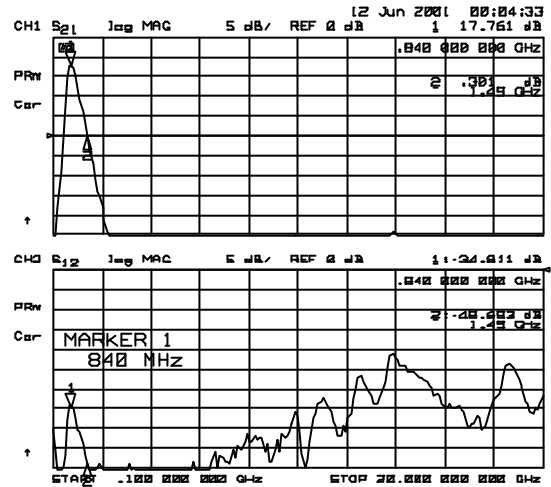
S21



S12



S11, S22

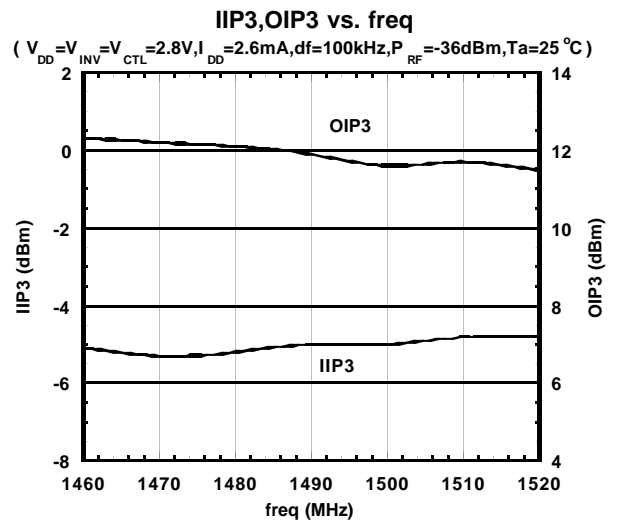
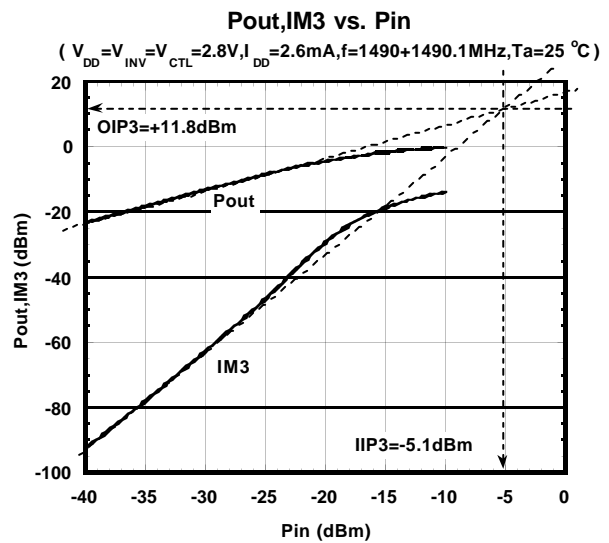
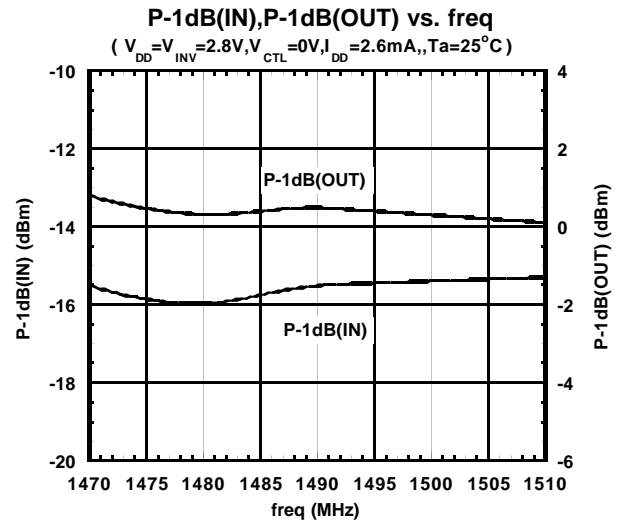
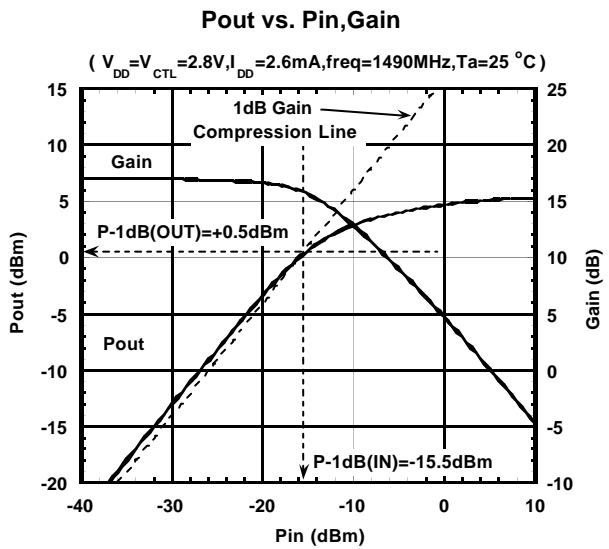
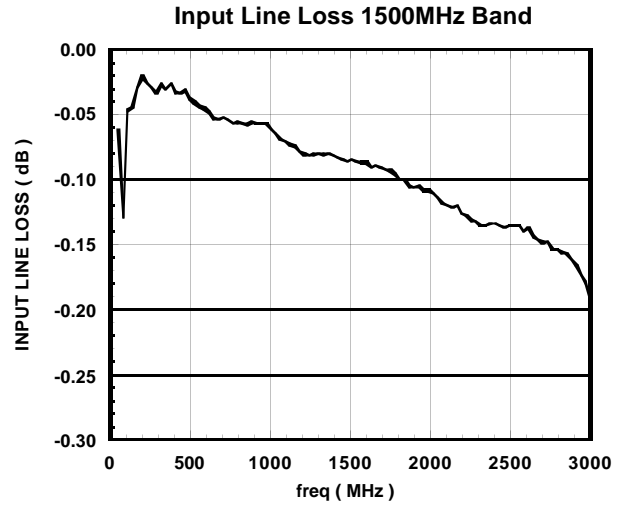
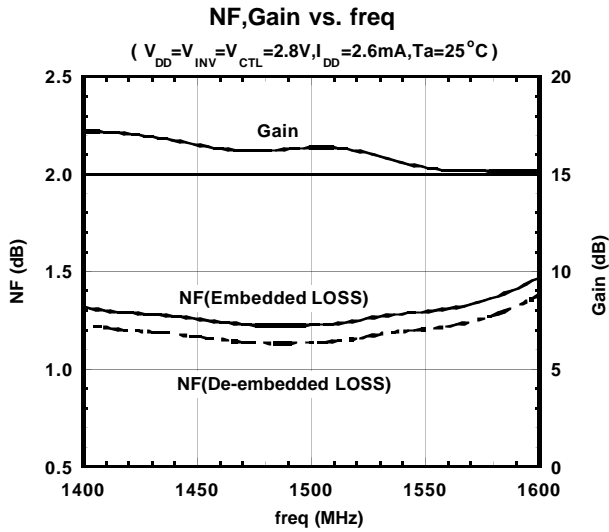


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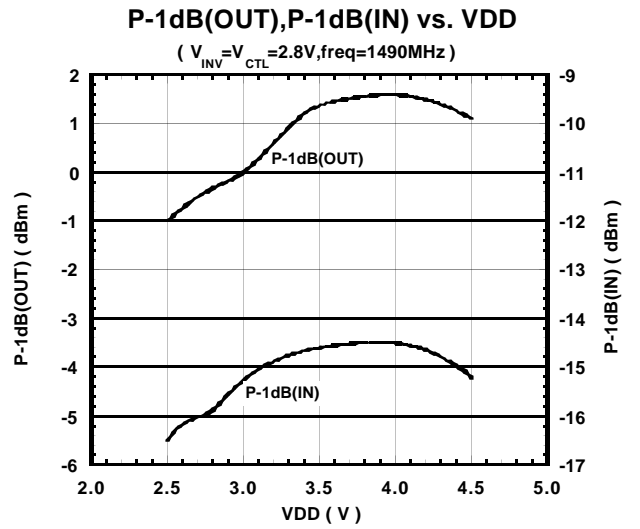
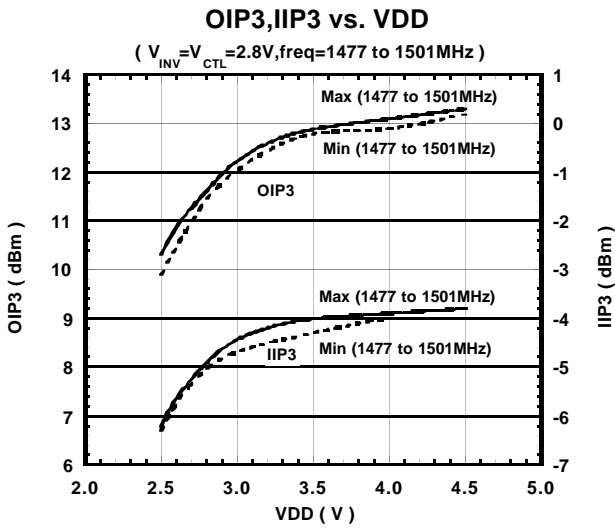
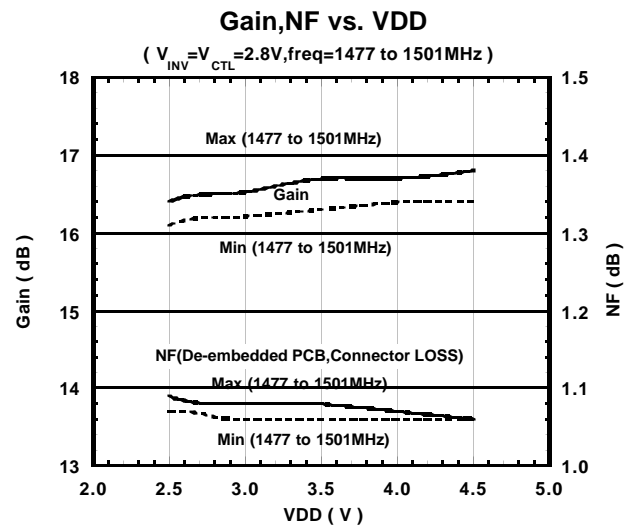
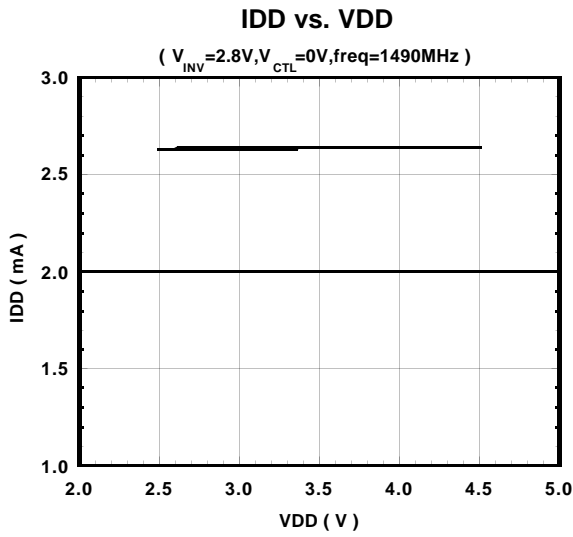
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TYPICAL CHARACTERISTICS (1.5GHz Band)



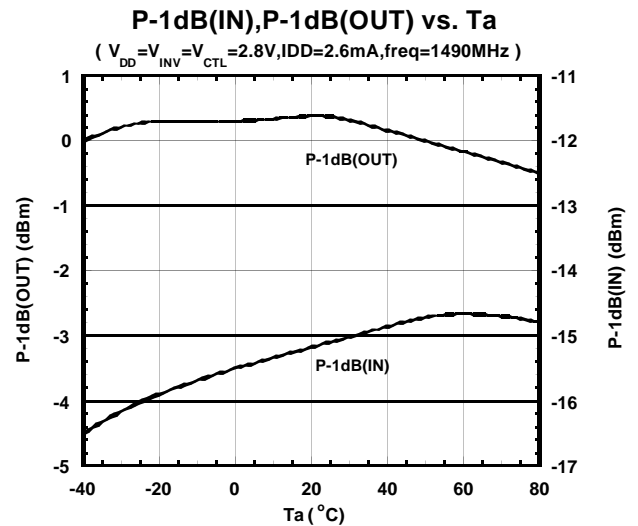
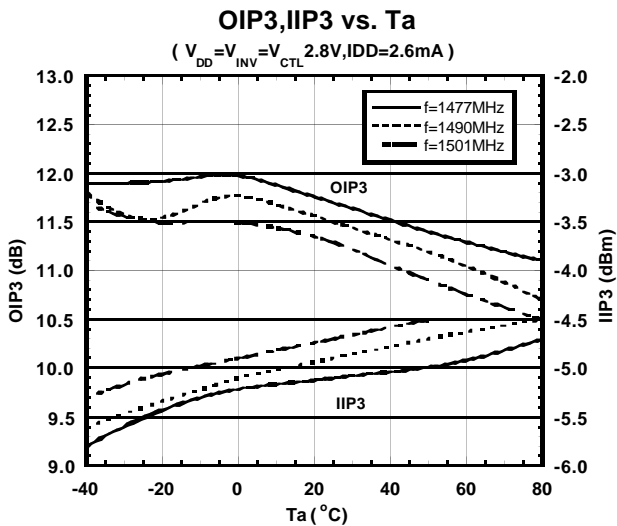
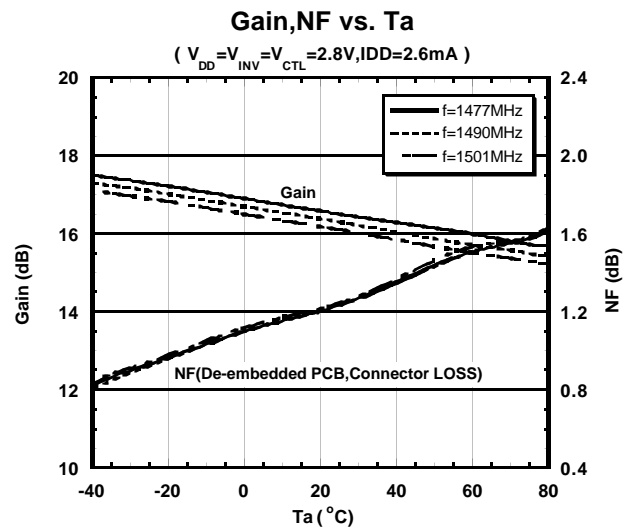
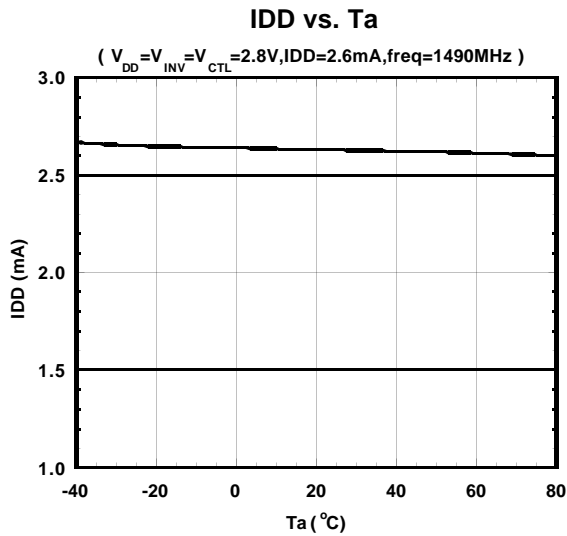
■ TYPICAL CHARACTERISTICS (1.5GHz Band)



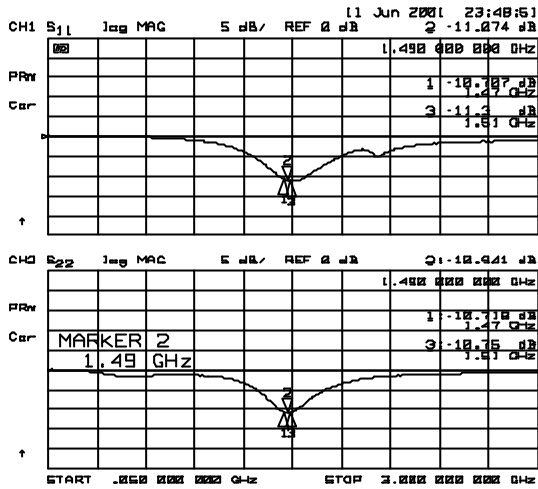
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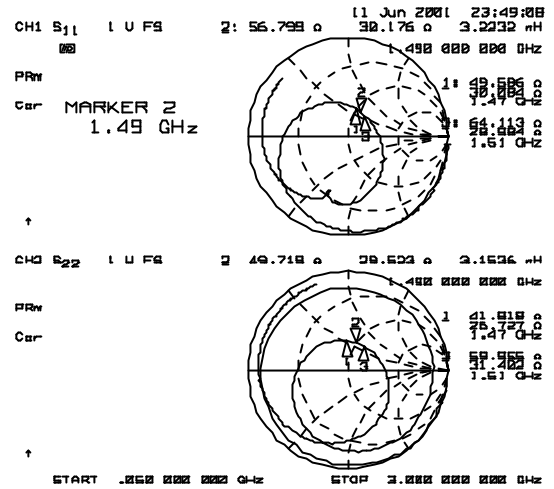
TYPICAL CHARACTERISTICS (1.5GHz Band)



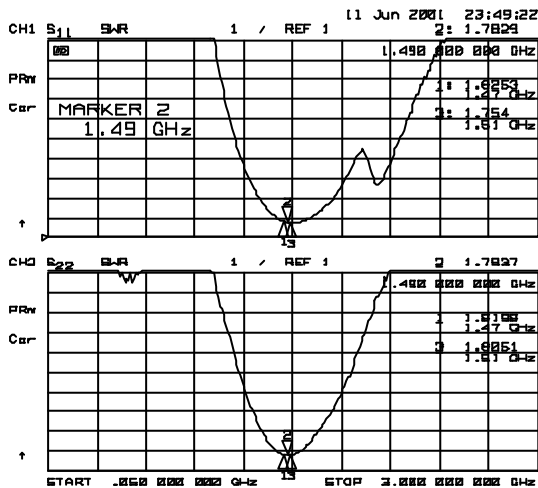
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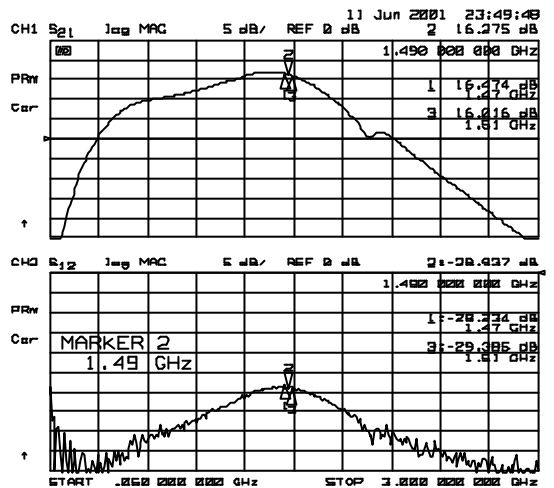
S11, S22



Zin, Zout



VSWR

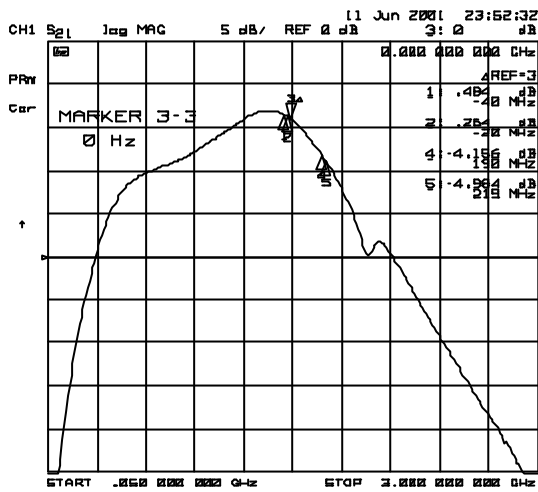


S21, 12

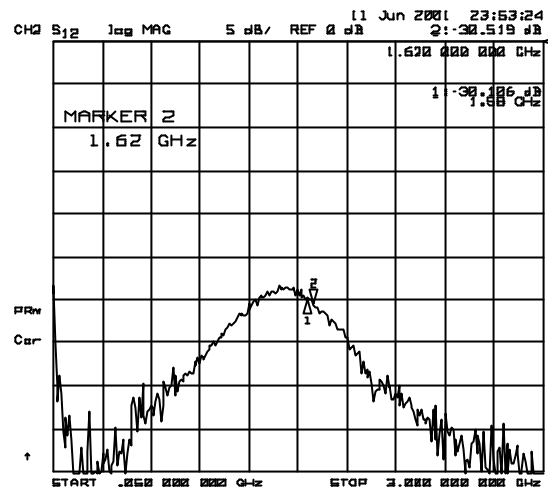
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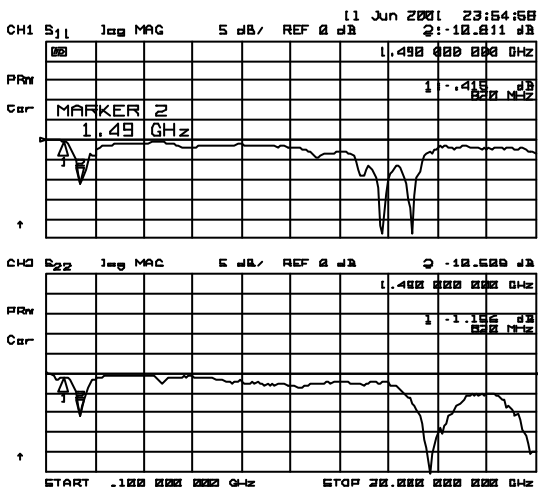
TYPICAL CHARACTERISTICS (1.5GHz Band)



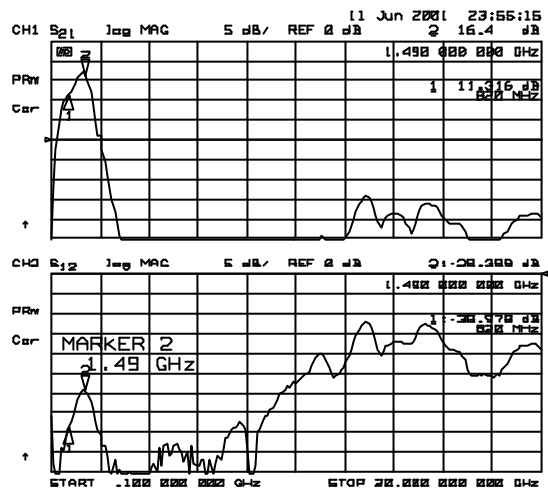
S21



S12

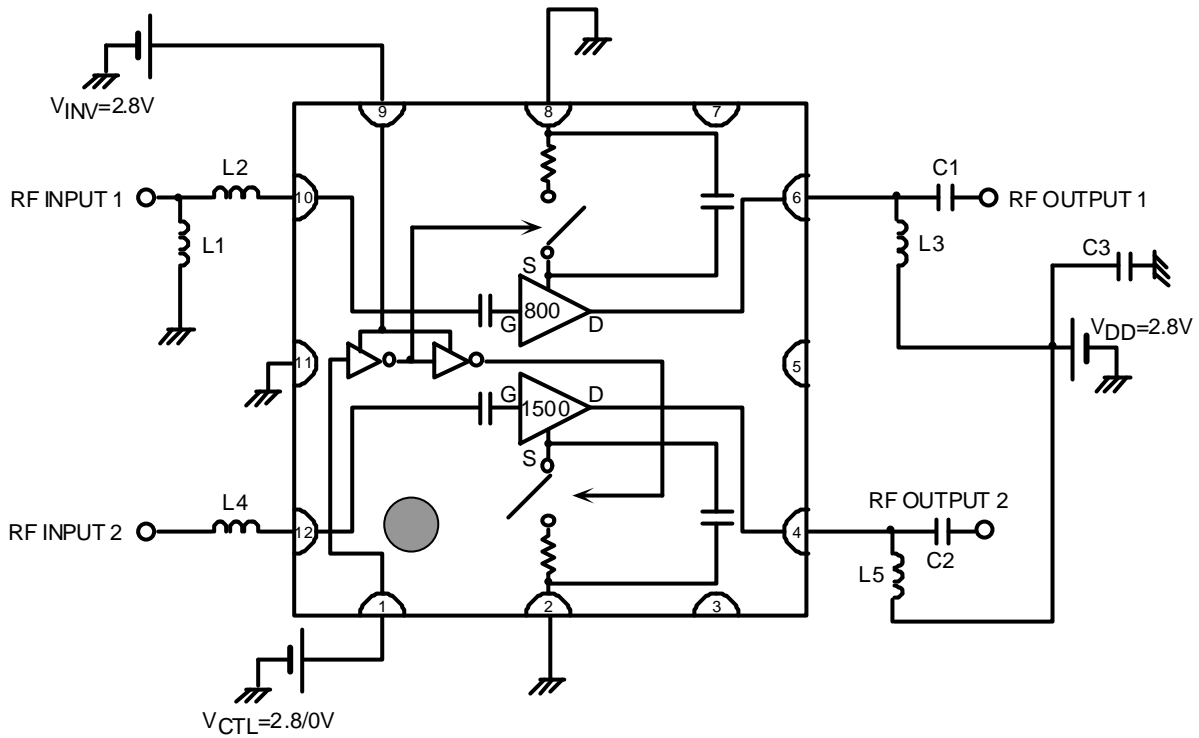


S11, S22



S21, S12

APPLICATION CIRCUIT



PARTS LIST

| Parts ID | CONSTANT | COMMENT |
|----------|----------|--------------------------------|
| L1 | 22nH | TAIYO-YUDEN (HK1005, 1005size) |
| L2 | 27nH | MEC (ELJNJ, 1608size) |
| L3 | 10nH | TAIYO-YUDEN (HK1005, 1005size) |
| L4 | 12nH | TAIYO-YUDEN (HK1005, 1005size) |
| L5 | 15nH | TAIYO-YUDEN (HK1005, 1005size) |
| C1 | 2pF | MURATA (GRM36, 1005size) |
| C2 | 6pF | MURATA (GRM36, 1005size) |
| C3 | 1000pF | MURATA (GRM36, 1005size) |

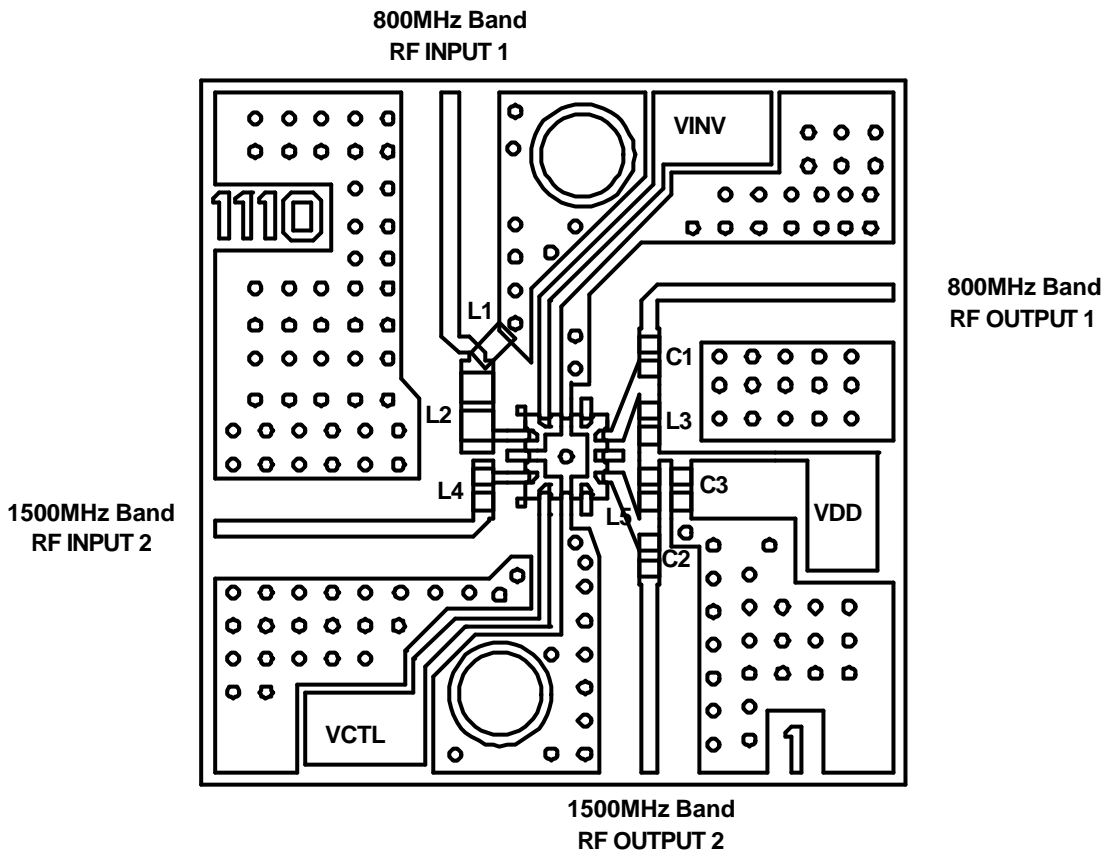
*: Please use an appropriate inductor for L2 to improve Noise Figure.

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RECOMMENDED PCB DESIGN

(Top View)



PCB (FR-4): $t=0.2\text{mm}$

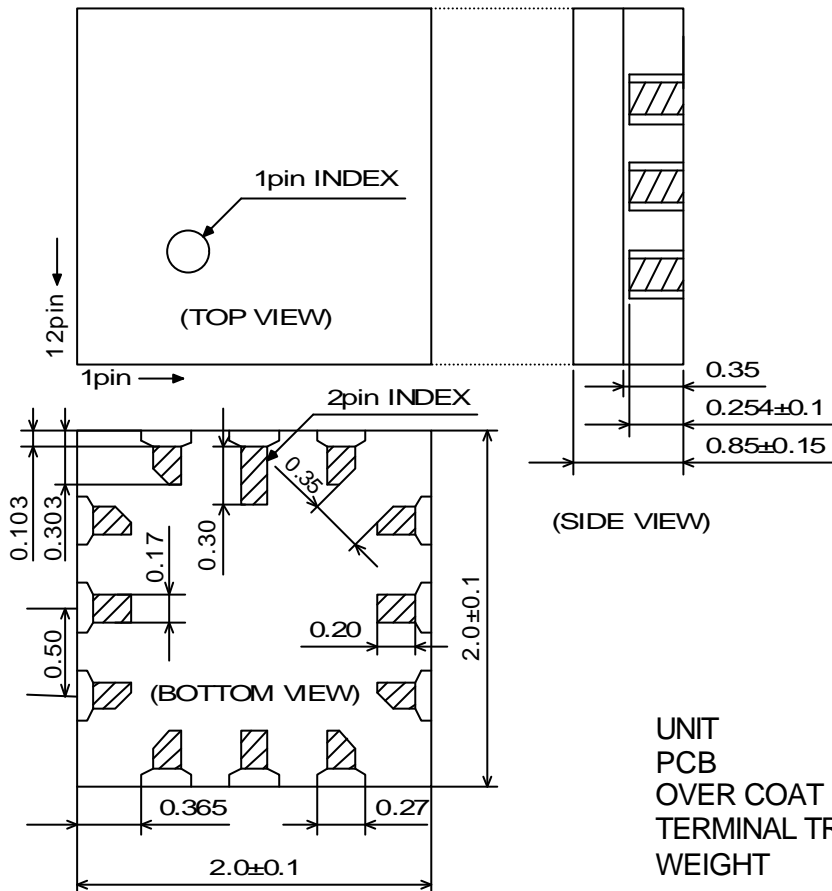
MICROSTRIP LINE WIDTH= 0.4mm ($Z_0=50\Omega$)

PCB SIZE= $17\times 17\text{mm}$

PRECAUTIONS

- [1] Please locate L2, L4, L3, and L5 close to IC.
- [2] Please locate C3 close to L3, L5.
- [3] Please layout each parts as close as possible.

PACKAGE OUTLINE (FFP12-B1)



| | |
|----------------|---------------|
| UNIT | : mm |
| PCB | : Ceramic |
| OVER COAT | : Epoxy resin |
| TERMINAL TREAT | : Au |
| WEIGHT | : 10mg |

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.