

## TDMA ANTENNA SWITCH GaAs MMIC

### ■GENERAL DESCRIPTION

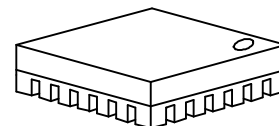
NJG1521PE1 is an antenna switch IC for a digital cellular phone of 800MHz and 1.5GHz band.

The parallel control signals of three bits connect T/R circuits to internal two antennas or external two antennas.

The termination ports with external matching circuits make low interference between diversity antennas.

The Ultra small & thin FFP24-E1 package is applied.

### ■PACKAGE OUTLINE



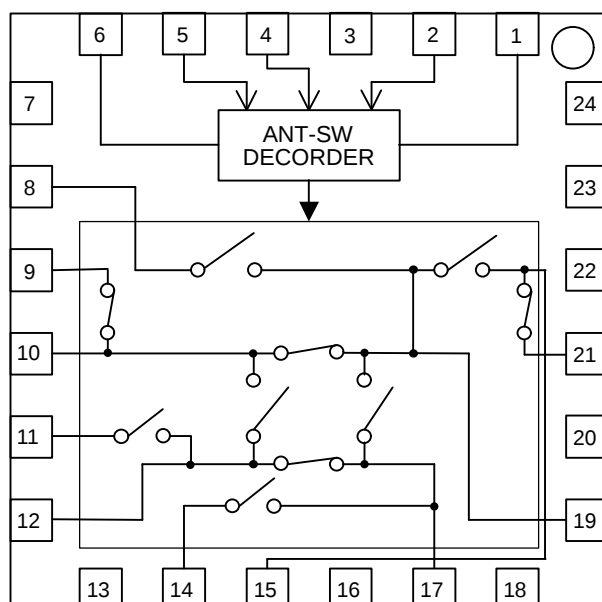
NJG1521PE1

### ■FEATURES

- Low voltage operation -2.5V(TX only) and +3.5V
- Low current consumption 10μA Typ.(TX Mode,  $P_{in}=30\text{dBm}$ ) 2μA Typ.(RX Mode, No RF Signal)
- Low insertion loss 0.45dB Typ. @(TX-ANT1, TX-EXT1)  $f_{in}=940\text{MHz}$ ,  $P_{in}=30\text{dBm}$   
0.55dB Typ. @(TX-ANT1, TX-EXT1)  $f_{in}=1453\text{MHz}$ ,  $P_{in}=30\text{dBm}$
- Low Adjacent Channel Leakage Power -63dBc Typ. @  $V_{DD}=+3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ ,  $f_{in}=940\text{MHz}$ ,  $P_{in}=30\text{dBm}$   
-64dBc Typ. @  $V_{DD}=+3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ ,  $f_{in}=1453\text{MHz}$ ,  $P_{in}=30\text{dBm}$
- Ultra small & thin package FFP24-E1 (Mount Size: 3.5x3.5x0.85mm)

### ■PIN CONFIGURATION

FFP24 Type  
(Top View)



Pin Connection

|             |          |
|-------------|----------|
| 1. $V_{DD}$ | 13. GND  |
| 2. CTL1     | 14. TER2 |
| 3. GND      | 15. ANT2 |
| 4. CTL2     | 16. GND  |
| 5. CTL3     | 17. ANT1 |
| 6. $V_{SS}$ | 18. GND  |
| 7. GND      | 19. RX   |
| 8. EXT2     | 20. GND  |
| 9. GND      | 21. TER1 |
| 10. EXT1    | 22. GND  |
| 11. GND     | 23. GND  |
| 12. TX      | 24. GND  |

# NJG1521PE1

## ■ABSOLUTE MAXIMUM RATINGS

(T<sub>a</sub>=+25°C)

| PARAMETER             | SYMBOL           | CONDITONS                                                                 | RATINGS  | UNITS |
|-----------------------|------------------|---------------------------------------------------------------------------|----------|-------|
| Supply Voltage 1      | V <sub>DD</sub>  | V <sub>DD</sub> Terminal                                                  | 6.0      | V     |
| Supply Voltage 2      | V <sub>SS</sub>  | V <sub>SS</sub> Terminal                                                  | -4.0     | V     |
| Control Voltage       | V <sub>CTL</sub> | CTL1, CTL2, CTL3 Terminals                                                | 6.0      | V     |
| Input Power           | P <sub>in</sub>  | TX, ANT1, EXT1 Terminals<br>V <sub>DD</sub> =3.5V, V <sub>SS</sub> =-2.5V | 37       | dBm   |
|                       |                  | RX, ANT2, EXT2 Terminals<br>V <sub>DD</sub> =3.5V, V <sub>SS</sub> =0.0V  | 28       | dBm   |
| Power Dissipation     | P <sub>D</sub>   |                                                                           | 600      | mW    |
| Operating Temperature | T <sub>opr</sub> |                                                                           | -40~+85  | °C    |
| Storage Temperature   | T <sub>stg</sub> |                                                                           | -55~+125 | °C    |

## ■ELECTRICAL CHARACTERISTICS 1 [DC CHARACTERISTICS]

General Conditions : T<sub>a</sub>=+25°C, V<sub>DD</sub>=3.5V, V<sub>SS</sub>=-2.5V

TX, RX, ANT1, ANT2, EXT1, EXT2: terminated (50Ω)

TER1: grounded by 5pF capacitor, TER2: grounded by 10pF capacitor

| PARAMETER                        | SYMBOL              | CONDITIONS                                                                             | MIN  | TYP  | MAX             | UNITS |
|----------------------------------|---------------------|----------------------------------------------------------------------------------------|------|------|-----------------|-------|
| Positive Supply Voltage          | V <sub>DD</sub>     | V <sub>DD</sub> Terminal                                                               | 2.7  | 3.5  | 5.0             | V     |
| Negative Supply Voltage          | V <sub>SS</sub>     | V <sub>SS</sub> Terminal                                                               | -3.5 | -2.5 | -2.0            | V     |
| Current Consumption 1            | I <sub>DD1</sub>    | V <sub>DD</sub> Terminal<br>RX Mode, No RF Signal                                      | -    | 2.0  | 5.0             | μA    |
| Current Consumption 2            | I <sub>SS1</sub>    | V <sub>SS</sub> Terminal<br>RX Mode, No RF Signal                                      | -0.1 | -    | 0               | μA    |
| Current Consumption 3            | I <sub>DD2</sub>    | V <sub>DD</sub> Terminal, f <sub>in</sub> =0.1~2GHz<br>TX Mode, P <sub>in</sub> =30dBm | -    | 10   | 50              | μA    |
| Current Consumption 4            | I <sub>SS2</sub>    | V <sub>SS</sub> Terminal, f <sub>in</sub> =0.1~2GHz<br>TX Mode, P <sub>in</sub> =30dBm | -50  | -10  | -               | μA    |
| Control Voltage (H)              | V <sub>CTL(H)</sub> | CTL1, CTL2, CTL3 Terminals                                                             | 2.0  | 3.0  | V <sub>DD</sub> | V     |
| Control Voltage (L)              | V <sub>CTL(L)</sub> | CTL1, CTL2, CTL3 Terminals                                                             | 0    | 0    | 0.6             | V     |
| Control Current                  | I <sub>CTL</sub>    | CTL1, CTL2, CTL3=V <sub>DD</sub><br>or CTL1, CTL2, CTL3=0V                             | -1.3 | -    | 1.3             | μA    |
| Control terminal Input Impedance | R <sub>in</sub>     | CTL1, CTL2, CTL3 Terminals                                                             | 4    | -    | -               | MΩ    |

## ■ELECTRICAL CHARACTERISTICS 2 [800MHz TX Mode]

General Conditions:  $T_a=+25^{\circ}\text{C}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ ,  $f_{in}=940\text{MHz}$

Tested on PCB circuit as shown below.

Insertion loss of each connectors, striplines, and capacitors are excluded.

TX, RX, ANT1, ANT2, EXT1, EXT2: terminated ( $50\Omega$ )

TER1: grounded by 5pF capacitor, TER2: grounded by 10pF capacitor.

| PARAMETER                          | SYMBOL                 | CONDITION                                                                                            | MIN  | TYP  | MAX  | UNITS |
|------------------------------------|------------------------|------------------------------------------------------------------------------------------------------|------|------|------|-------|
| Frequency range 1                  | $f_{in1}$              |                                                                                                      | 885  | -    | 960  | MHz   |
| TX-ANT1 Insertion Loss             | LOSS1                  | $P_{in}=30\text{dBm}$                                                                                | -    | 0.45 | 0.60 | dB    |
| TX-EXT1 Insertion Loss             | LOSS2                  | $P_{in}=30\text{dBm}$                                                                                | -    | 0.50 | 0.65 | dB    |
| TX-RX Isolation                    | ISL1                   | $P_{in}=30\text{dBm}$<br>TX-ANT1, TX-EXT1 passing                                                    | 24   | 29   | -    | dB    |
| TX-ANT1 Isolation                  | ISL2                   | $P_{in}=30\text{dBm}$<br>TX-EXT1 passing                                                             | 22   | 27   | -    | dB    |
| TX-ANT2 Isolation                  | ISL3                   | $P_{in}=30\text{dBm}$<br>TX-ANT1, TX-EXT1 passing                                                    | 20   | 25   | -    | dB    |
| TX-EXT1 Isolation                  | ISL4                   | $P_{in}=30\text{dBm}$<br>TX-ANT1 passing                                                             | 20   | 25   | -    | dB    |
| TX-EXT2 Isolation                  | ISL5                   | $P_{in}=30\text{dBm}$<br>TX-ANT1, TX-EXT1 passing                                                    | 32   | 37   | -    | dB    |
| Input Power at 0.5dB Compression 1 | $P_{-0.5\text{dB}}(1)$ | TX-ANT1, TX-EXT1 passing                                                                             | 33.5 | 35.5 | -    | dBm   |
| Adjacent Channel Leakage Power 1   | ACP1                   | PDC Standard, $\pm 50\text{kHz}$ offset<br>$P_{in}=30\text{dBm}$<br>Input Signal ACP=-64dBc @ 30dBm  | -    | -63  | -60  | dBc   |
| Adjacent Channel Leakage Power 2   | ACP2                   | PDC Standard, $\pm 100\text{kHz}$ offset<br>$P_{in}=30\text{dBm}$<br>Input Signal ACP=-76dBc @ 30dBm | -    | -74  | -70  | dBc   |
| 2nd Harmonics 1                    | $2f_o(1)$              | $P_{in}=30\text{dBm}$<br>Input Signal 2nd Harmonics=-70dBc                                           | -    | -65  | -63  | dBc   |
| 3rd Harmonics 1                    | $3f_o(1)$              | $P_{in}=30\text{dBm}$<br>Input Signal 3rd Harmonics=-100dBc                                          | -    | -64  | -62  | dBc   |
| VSWR 1                             | VSWR1                  | TX-ANT1, TX-EXT1 passing                                                                             | -    | 1.2  | 1.5  |       |
| Switching Time 1                   | $T_{D1}$               | CTL1~3                                                                                               | -    | 120  | 500  | nsec  |

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## ■ELECTRICAL CHARACTERISTICS 3 [800MHz RX Mode]

General Conditions:  $T_a=+25^{\circ}\text{C}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=0\text{V}$ ,  $f_{in}=885\text{MHz}$

Tested on PCB circuit as shown below.

Insertion loss of each connectors, striplines, and capacitors are excluded.

TX, RX, ANT1, ANT2, EXT1, EXT2: terminated ( $50\Omega$ )

TER1: grounded by 5pF capacitor, TER2: grounded by 10pF capacitor.

| PARAMETER                        | SYMBOL               | CONDITION                                                  | MIN | TYP  | MAX  | UNITS |
|----------------------------------|----------------------|------------------------------------------------------------|-----|------|------|-------|
| Frequency range 2                | $f_{in2}$            |                                                            | 810 | -    | 885  | MHz   |
| RX-ANT1 Insertion Loss           | LOSS3                | $P_{in}=10\text{dBm}$                                      | -   | 0.55 | 0.70 | dB    |
| RX-ANT2 Insertion Loss           | LOSS4                | $P_{in}=10\text{dBm}$                                      | -   | 0.45 | 0.60 | dB    |
| RX-EXT1 Insertion Loss           | LOSS5                | $P_{in}=10\text{dBm}$                                      | -   | 0.80 | 0.95 | dB    |
| RX-EXT2 Insertion Loss           | LOSS6                | $P_{in}=10\text{dBm}$                                      | -   | 0.80 | 0.95 | dB    |
| RX-ANT1 Isolation                | ISL6                 | $P_{in}=10\text{dBm}$<br>RX-ANT2, RX-EXT1, RX-EXT2 passing | 21  | 24   | -    | dB    |
| RX-ANT2 Isolation                | ISL7                 | $P_{in}=10\text{dBm}$<br>RX-ANT1, RX-EXT1, RX-EXT2 passing | 22  | 25   | -    | dB    |
| RX-EXT1 Isolation                | ISL8                 | $P_{in}=10\text{dBm}$<br>RX-ANT1, RX-ANT2, RX-EXT2 passing | 22  | 25   | -    | dB    |
| RX-EXT2 Isolation                | ISL9                 | $P_{in}=10\text{dBm}$<br>RX-ANT1, RX-ANT2, RX-EXT1 passing | 20  | 23   | -    | dB    |
| Input Power at 1dB Compression 1 | $P_{-1\text{dB}}(1)$ | RX-ANT1, RX-ANT2, RX-EXT1, RX-EXT2 passing                 | 20  | 26   | -    | dBm   |
| VSWR 2                           | VSWR2                | RX-ANT1, RX-ANT2, RX-EXT1, RX-EXT2 passing                 | -   | 1.2  | 1.6  |       |
| Switching Time 2                 | $T_{D2}$             | CTL1~3                                                     | -   | 120  | 500  | nsec  |

## ■ELECTRICAL CHARACTERISTICS 4 [1.5GHz TX Mode]

General Conditions:  $T_a=+25^{\circ}\text{C}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ ,  $f_{in}=1453\text{MHz}$

Tested on PCB circuit as shown below.

Insertion loss of each connectors, striplines, and capacitors are excluded.

TX, RX, ANT1, ANT2, EXT1, EXT2: terminated ( $50\Omega$ )

TER1: grounded by 5pF capacitor, TER2: grounded by 10pF capacitor.

| PARAMETER                          | SYMBOL                 | CONDITION                                                                                            | MIN  | TYP  | MAX  | UNITS |
|------------------------------------|------------------------|------------------------------------------------------------------------------------------------------|------|------|------|-------|
| Frequency range 3                  | $f_{in3}$              |                                                                                                      | 1429 | -    | 1453 | MHz   |
| TX-ANT1 Insertion Loss             | LOSS7                  | $P_{in}=30\text{dBm}$                                                                                | -    | 0.55 | 0.70 | dB    |
| TX-EXT1 Insertion Loss             | LOSS8                  | $P_{in}=30\text{dBm}$                                                                                | -    | 0.65 | 0.80 | dB    |
| TX-RX Isolation                    | ISL10                  | $P_{in}=30\text{dBm}$<br>TX-ANT1, TX-EXT1 passing                                                    | 28   | 33   | -    | dB    |
| TX-ANT1 Isolation                  | ISL11                  | $P_{in}=30\text{dBm}$<br>TX-EXT1 passing                                                             | 25   | 30   | -    | dB    |
| TX-ANT2 Isolation                  | ISL12                  | $P_{in}=30\text{dBm}$<br>TX-ANT1, TX-EXT1 passing                                                    | 20   | 24   | -    | dB    |
| TX-EXT1 Isolation                  | ISL13                  | $P_{in}=30\text{dBm}$<br>TX-ANT1 passing                                                             | 20   | 24   | -    | dB    |
| TX-EXT2 Isolation                  | ISL14                  | $P_{in}=30\text{dBm}$<br>TX-ANT1, TX-EXT1 passing                                                    | 35   | 40   | -    | dB    |
| Input Power at 0.5dB Compression 2 | $P_{-0.5\text{dB}(2)}$ | TX-ANT1, TX-EXT1 passing                                                                             | 33.5 | 35.5 | -    | dBm   |
| Adjacent Channel Leakage Power 3   | ACP3                   | PDC Standard, $\pm 50\text{kHz}$ offset<br>$P_{in}=30\text{dBm}$<br>Input Signal ACP=-67dBc @ 30dBm  | -    | -64  | -60  | dBc   |
| Adjacent Channel Leakage Power 4   | ACP4                   | PDC Standard, $\pm 100\text{kHz}$ offset<br>$P_{in}=30\text{dBm}$<br>Input Signal ACP=-76dBc @ 30dBm | -    | -72  | -70  | dBc   |
| 2nd Harmonics 2                    | $2f_0(2)$              | $P_{in}=30\text{dBm}$<br>Input Signal 2nd Harmonics =-80dBc                                          | -    | -65  | -61  | dBc   |
| 3rd Harmonics 2                    | $3f_0(2)$              | $P_{in}=30\text{dBm}$<br>Input Signal 3rd Harmonics =-110dBc                                         | -    | -63  | -61  | dBc   |
| VSWR 3                             | VSWR3                  | TX-ANT1, TX-EXT1 Passing                                                                             | -    | 1.2  | 1.6  |       |
| Switching Time 3                   | $T_{D3}$               | CTL1~3                                                                                               | -    | 120  | 500  | nsec  |

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## ■ELECTRICAL CHARACTERISTICS 5 [1.5GHz RX Mode]

General Conditions:  $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=0\text{V}$ ,  $f_{in}=1501\text{MHz}$

Tested on PCB circuit as shown below.

Insertion loss of each connectors, striplines, and capacitors are excluded.

TX, RX, ANT1, ANT2, EXT1, EXT2: terminated ( $50\Omega$ )

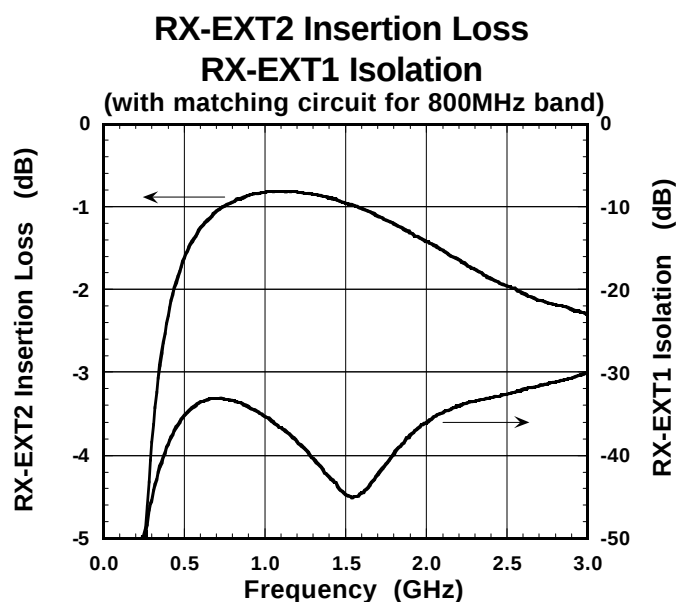
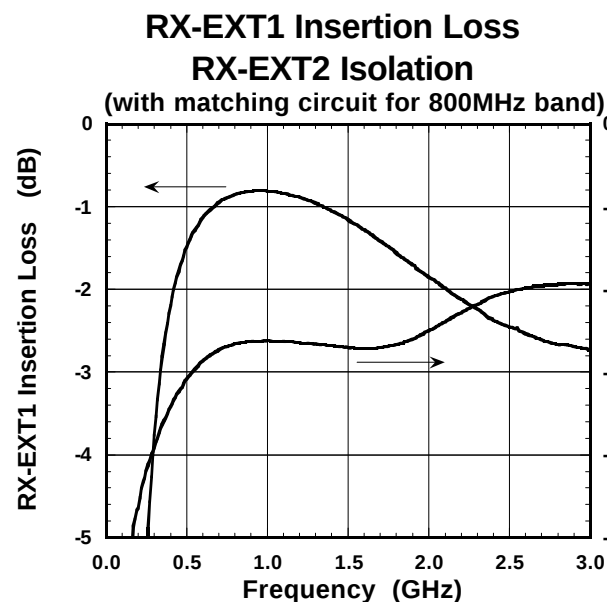
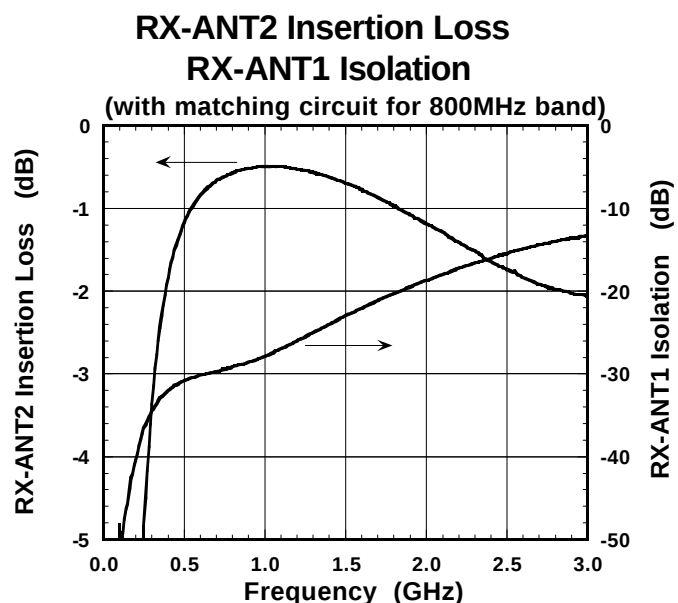
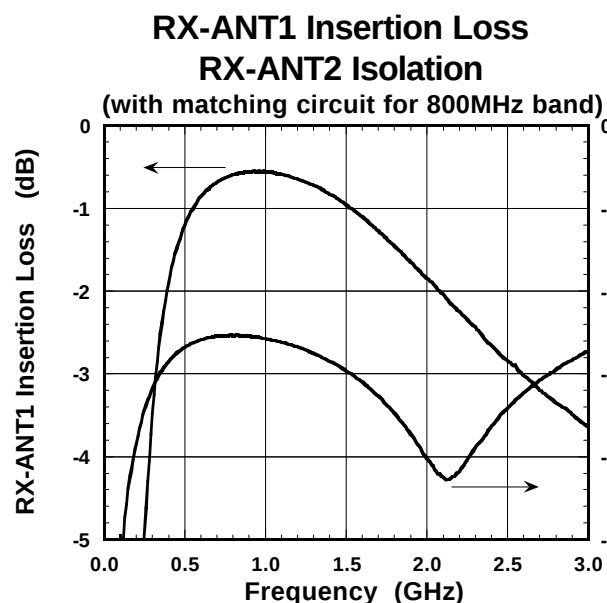
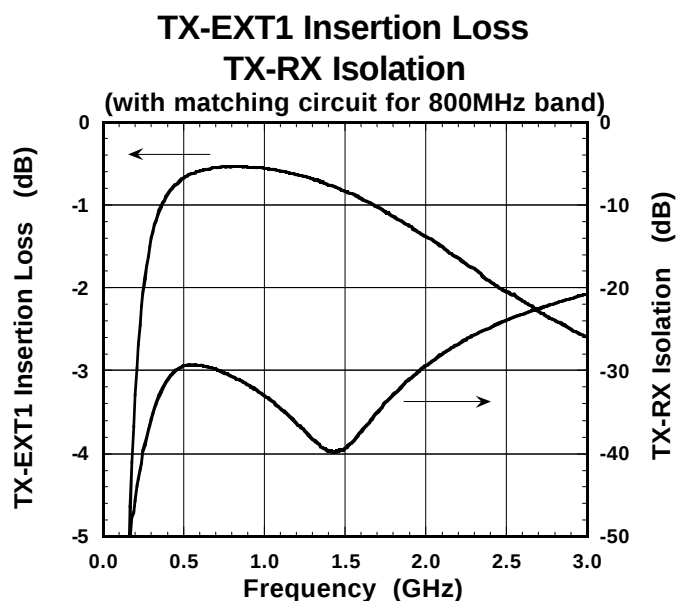
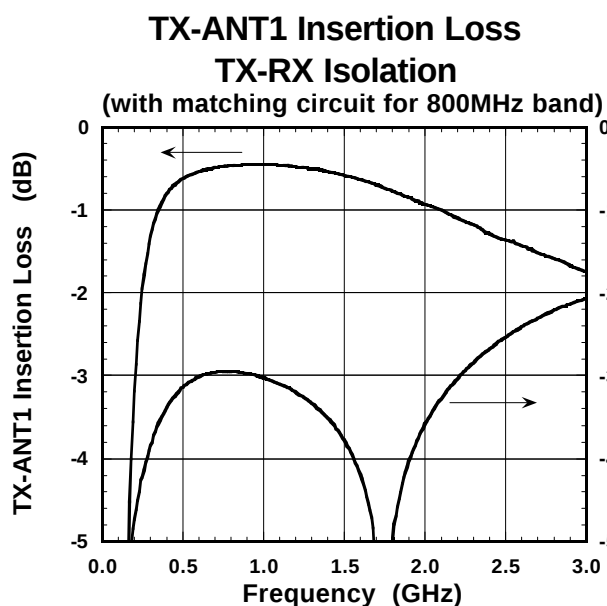
TER1: grounded by 5pF capacitor, TER2: grounded by 10pF capacitor.

| PARAMETER                        | SYMBOL               | CONDITION                                                  | MIN  | TYP  | MAX  | UNITS |
|----------------------------------|----------------------|------------------------------------------------------------|------|------|------|-------|
| Frequency range 4                | $f_{in4}$            |                                                            | 1477 | -    | 1501 | MHz   |
| RX-ANT1 Insertion Loss           | LOSS9                | $P_{in}=10\text{dBm}$                                      | -    | 0.75 | 0.85 | dB    |
| RX-ANT2 Insertion Loss           | LOSS10               | $P_{in}=10\text{dBm}$                                      | -    | 0.65 | 0.75 | dB    |
| RX-EXT1 Insertion Loss           | LOSS11               | $P_{in}=10\text{dBm}$                                      | -    | 1.00 | 1.15 | dB    |
| RX-EXT2 Insertion Loss           | LOSS12               | $P_{in}=10\text{dBm}$                                      | -    | 0.95 | 1.10 | dB    |
| RX-ANT1 Isolation                | ISL15                | $P_{in}=10\text{dBm}$<br>RX-ANT2, RX-EXT1, RX-EXT2 passing | 18   | 22   | -    | dB    |
| RX-ANT2 Isolation                | ISL16                | $P_{in}=10\text{dBm}$<br>RX-ANT1, RX-EXT1, RX-EXT2 passing | 20   | 24   | -    | dB    |
| RX-EXT1 Isolation                | ISL17                | $P_{in}=10\text{dBm}$<br>RX-ANT1, RX-ANT2, RX-EXT2 Passing | 23   | 28   | -    | dB    |
| RX-EXT2 Isolation                | ISL18                | $P_{in}=10\text{dBm}$<br>RX-ANT1, RX-ANT2, RX-EXT1 passing | 19   | 24   | -    | dB    |
| Input Power at 1dB Compression 2 | $P_{-1\text{dB}}(2)$ | RX-ANT1, RX-ANT2, RX-EXT1,<br>RX-EXT2 passing              | 20   | 26   | -    | dBm   |
| VSWR 4                           | VSWR4                | RX-ANT1, RX-ANT2, RX-EXT1,<br>RX-EXT2 passing              | -    | 1.2  | 1.6  |       |
| Switching Time 4                 | $T_D4$               | CTL1~3                                                     | -    | 120  | 500  | nsec  |

## ■ TERMINAL INFORMATION

| PIN No.                                        | SYMBOL          | DESCRIPTIONS                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                              | V <sub>DD</sub> | Positive voltage supply terminal. The positive voltage (+2.7~+5.0V) have to be supplied. Please connect a bypass capacitor with GND terminal for excellent RF performance.                                                                                                                                                                                                      |
| 2                                              | CTL1            | High-impedance C-MOS input terminal. This terminal is set to High-Level(+2V~V <sub>DD</sub> ) or Low-Level(+0.6V~0V). If the voltage level of this terminal is unstable, please connect a resistor(100kΩ) with GND terminal or V <sub>DD</sub> terminal.                                                                                                                        |
| 4                                              | CTL2            | High-impedance C-MOS input terminal. This terminal is set to High-Level(+2V~V <sub>DD</sub> ) or Low-Level(+0.6V~0V). If the voltage level of this terminal is unstable, please connect a resistor(100kΩ) with GND terminal or V <sub>DD</sub> terminal.                                                                                                                        |
| 5                                              | CTL3            | High-impedance C-MOS input terminal. This terminal is set to High-Level(+2V~V <sub>DD</sub> ) or Low-Level(+0.6V~0V). If the voltage level of this terminal is unstable, please connect a resistor(100kΩ) with GND terminal or V <sub>DD</sub> terminal.                                                                                                                        |
| 6                                              | V <sub>SS</sub> | Negative voltage supply terminal. Please supply negative voltage of -3.5~-2.0V on transmitting state. On receiving state, this terminal is internally disconnected, so the voltage of this terminal(negative, short, or open) does not affect to receiving signal quality. The bypass capacitor should be connected between this terminal and GND for excellent RF performance. |
| 8                                              | EXT2            | RF receiving port. An external capacitor of 56pF~100pF is required to block DC voltage (V <sub>DD</sub> ).                                                                                                                                                                                                                                                                      |
| 10                                             | EXT1            | RF transmitting/receiving port. An external capacitor of 56pF~100pF is required to block DC voltage (V <sub>DD</sub> ).                                                                                                                                                                                                                                                         |
| 12                                             | TX              | RF transmitting port. An external capacitor of 56pF~100pF is required to block DC voltage (V <sub>DD</sub> ).                                                                                                                                                                                                                                                                   |
| 14                                             | TER2            | ANT2 termination port. Please connect this port and GND by appropriate capacitor(10pF) to suppress the interference of ANT1 port signal to ANT2 port. The capacitor works as DC voltage (V <sub>DD</sub> ) blocking.                                                                                                                                                            |
| 15                                             | ANT2            | RF receiving port. An external capacitor(56pF~100pF) is required to block DC voltage (V <sub>DD</sub> ) .                                                                                                                                                                                                                                                                       |
| 17                                             | ANT1            | RF transmitting/receiving port. An external capacitor(56pF~100pF) is required to block DC voltage (V <sub>DD</sub> ) .                                                                                                                                                                                                                                                          |
| 19                                             | RX              | RF receiving port. An external capacitor(56pF~100pF) is required to block DC voltage (V <sub>DD</sub> ) .                                                                                                                                                                                                                                                                       |
| 21                                             | TER1            | ANT1 termination port. Please connect this port and GND by appropriate capacitor(5pF) to suppress the interference of ANT2 port signal to ANT1 port. The capacitor works as DC voltage (V <sub>DD</sub> ) blocking. .                                                                                                                                                           |
| 3, 7, 9, 11,<br>13,16, 18,<br>20, 22,23,<br>24 | GND             | Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.                                                                                                                                                                                                                                                              |

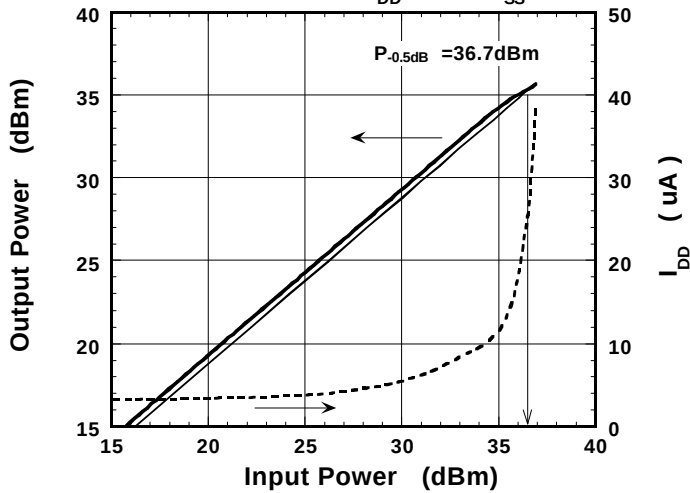
## ■ TYPICAL CHARACTERISTICS (800MHz Band: Measured on the PCB evaluation circuit)



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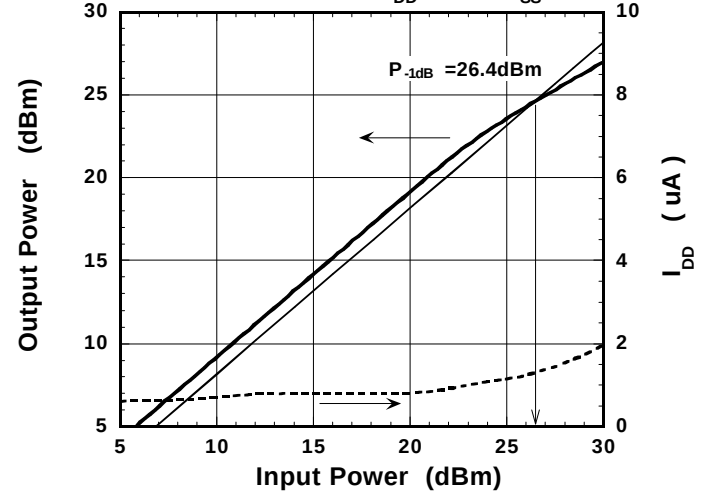
### Output Power, $I_{DD}$ vs. Input Power

(TX-ANT1,  $f=940\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ )



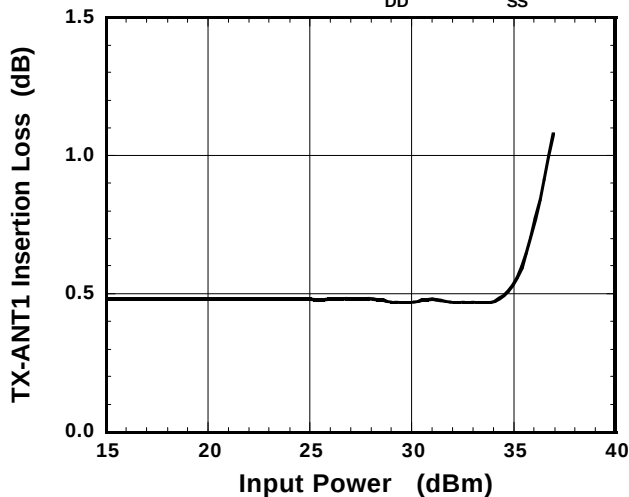
### Output Power, $I_{DD}$ vs. Input Power

(RX-ANT1,  $f=885\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=0\text{V}$ )



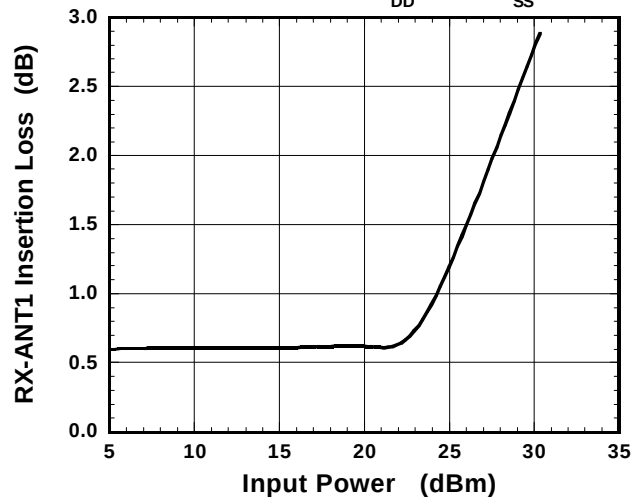
### Insertion Loss vs. Input Power

(TX-ANT1,  $f=940\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ )



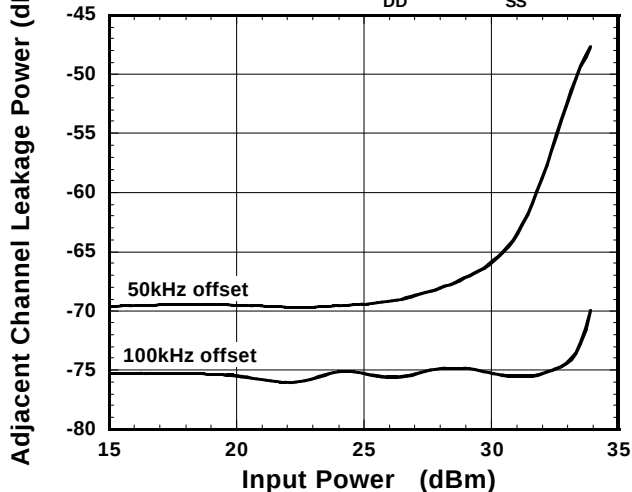
### Insertion Loss vs. Input Power

(RX-ANT1,  $f=885\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=0\text{V}$ )



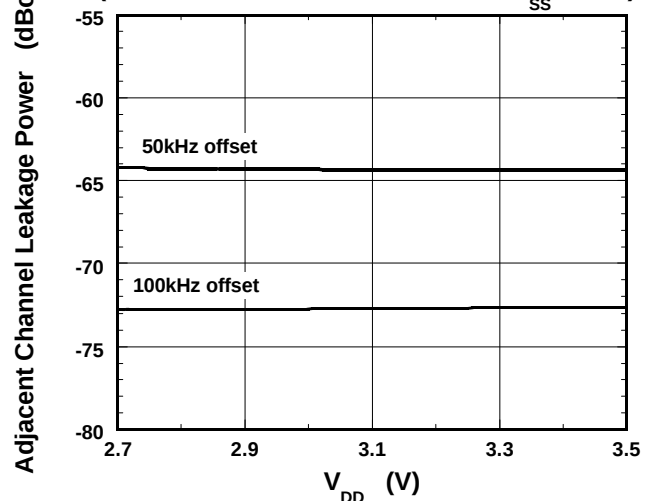
### ACP vs. Input Power

(TX-ANT1,  $f=940\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ )



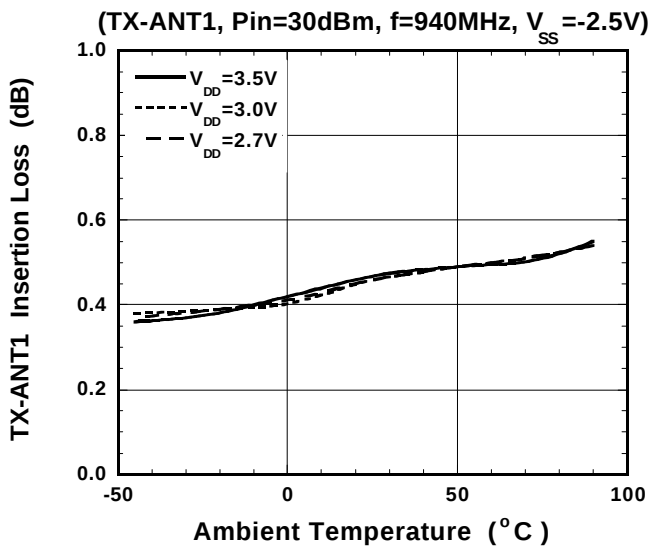
### ACP vs. $V_{DD}$

(TX-ANT1,  $f=940\text{MHz}$ ,  $P_{in}=30\text{dBm}$ ,  $V_{SS}=-2.5\text{V}$ )

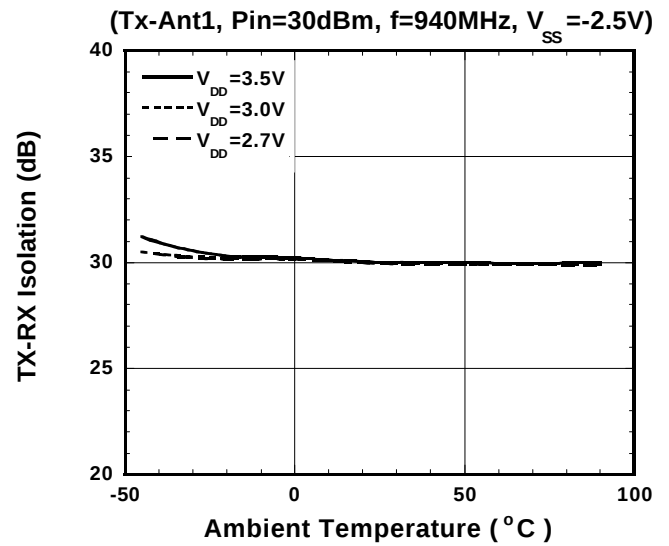


## ■ TYPICAL CHARACTERISTICS (800MHz Band: Measured on the PCB evaluation circuit)

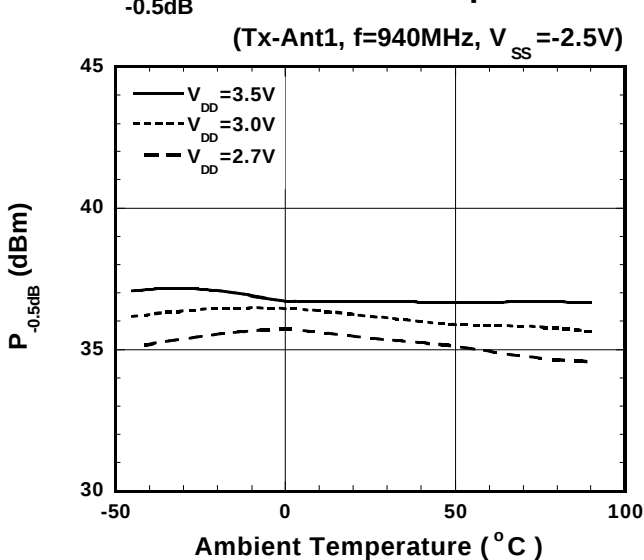
### Loss vs. Ambient Temperature



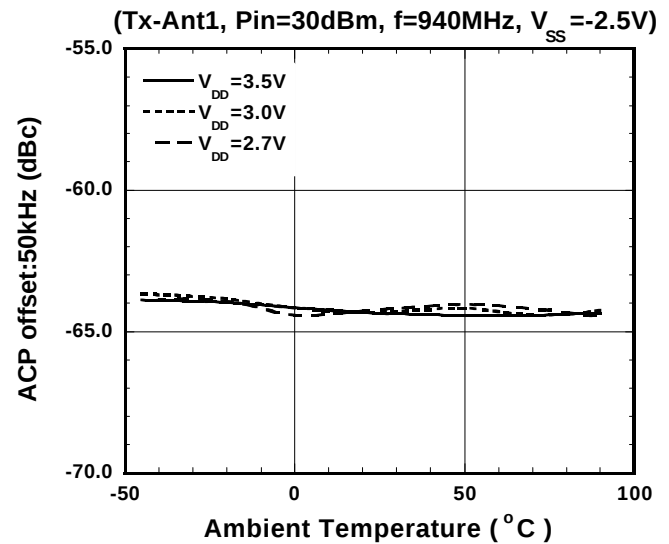
### RX Isolation vs. Ambient Temperature



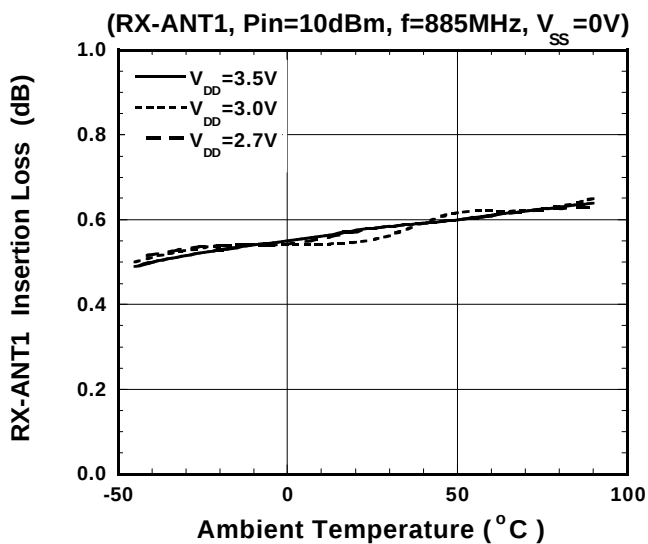
### $P_{-0.5dB}$ vs. Ambient Temperature



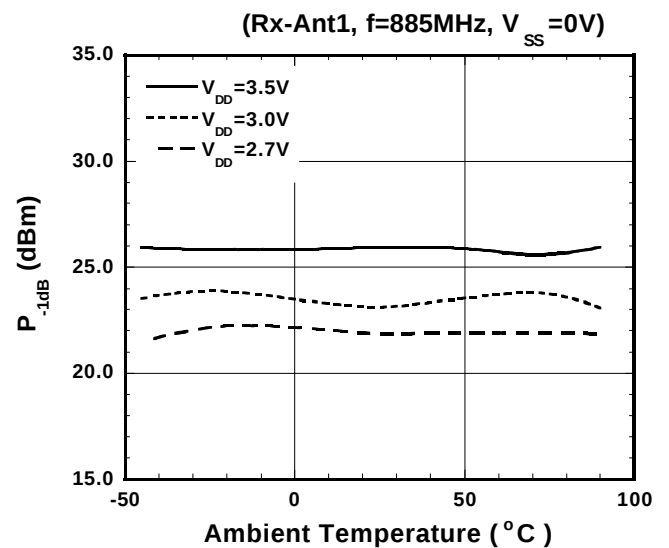
### ACP(offset:50kHz) vs. Ambient Temperature



### Loss vs. Ambient Temperature



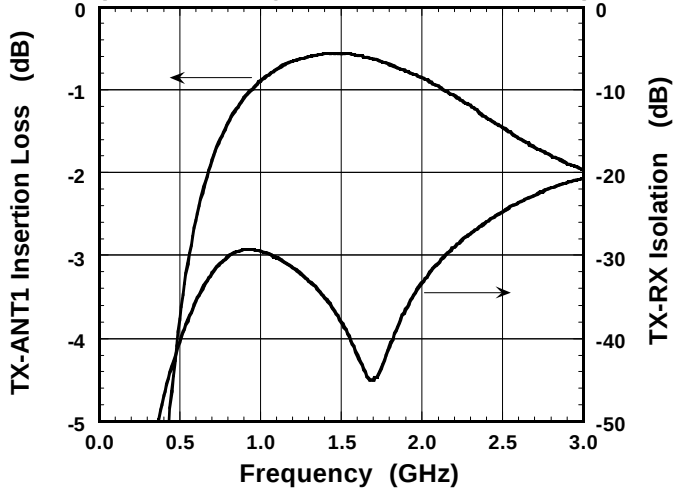
### $P_{-1dB}$ vs. Ambient Temperature



■ TYPICAL CHARACTERISTICS (1.5GHz Band: Measured on the PCB evaluation circuit)

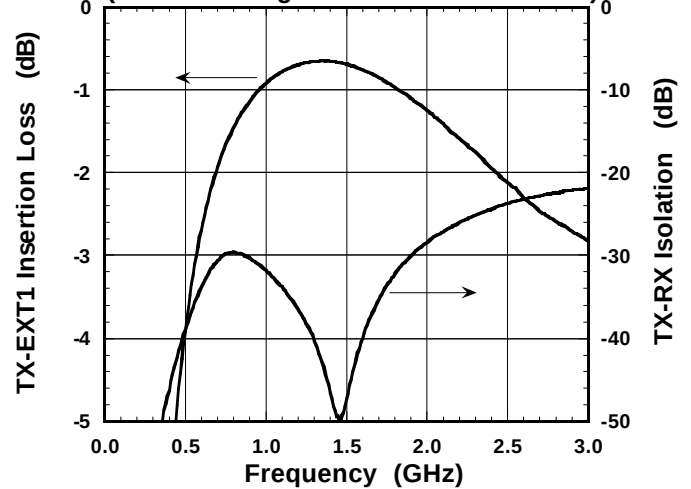
**TX-ANT1 Insertion Loss  
TX-RX Isolation**

(with matching circuit for 1.5GHz band)



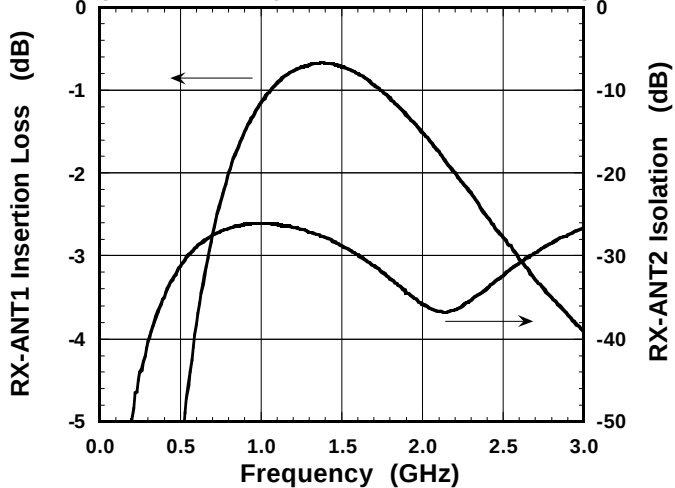
**TX-EXT1 Insertion Loss  
TX-RX Isolation**

(with matching circuit for 1.5GHz band)



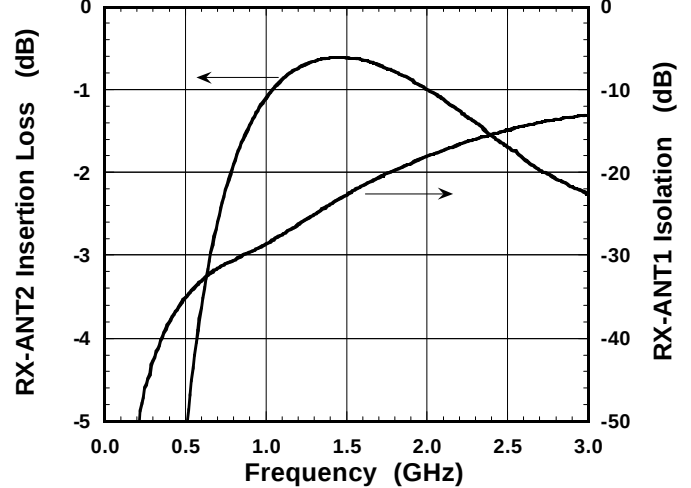
**RX-ANT1 Insertion Loss  
RX-ANT2 Isolation**

(with matching circuit for 1.5GHz band)



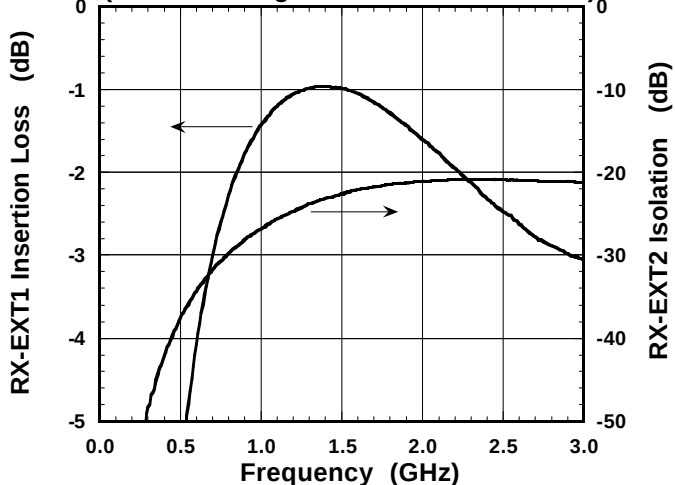
**RX-ANT2 Insertion Loss  
RX-ANT1 Isolation**

(with matching circuit for 1.5GHz band)



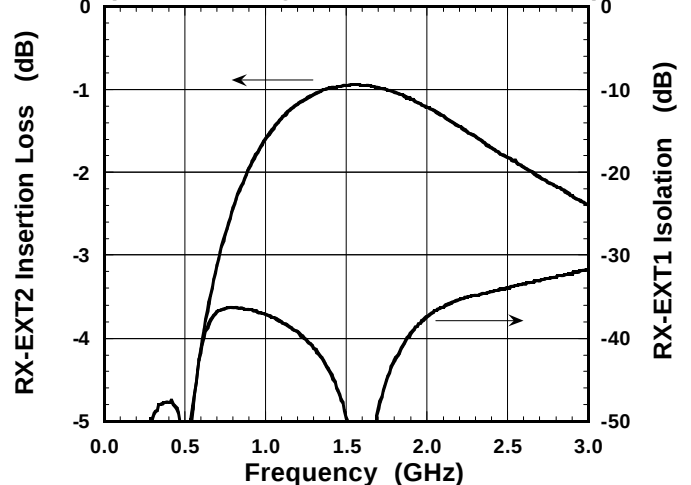
**RX-EXT1 Insertion Loss  
RX-EXT2 Isolation**

(with matching circuit for 1.5GHz band)



**RX-EXT2 Insertion Loss  
RX-EXT1 Isolation**

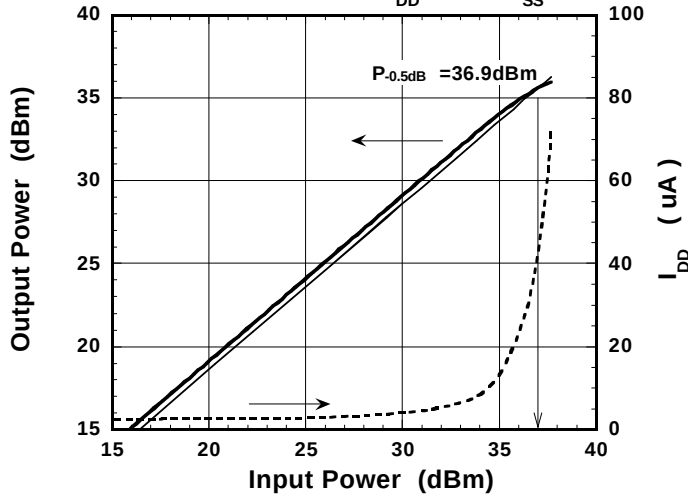
(with matching circuit for 1.5GHz band)



## ■ TYPICAL CHARACTERISTICS (1.5GHz Band: Measured on the PCB evaluation circuit)

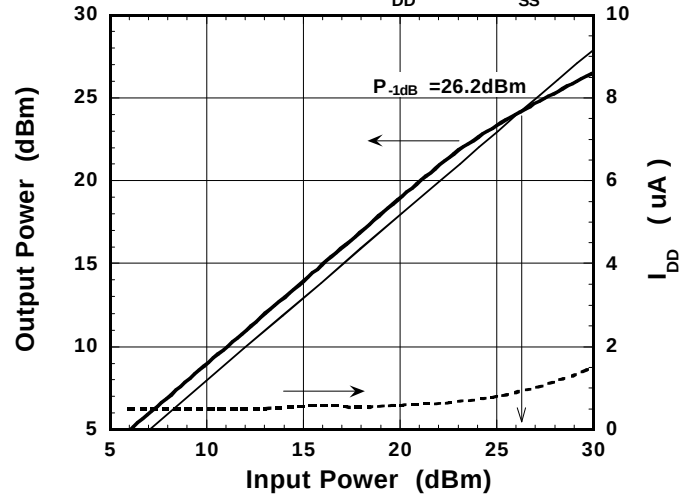
### Output Power, $I_{DD}$ vs. Input Power

(TX-ANT1,  $f=1453\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ )



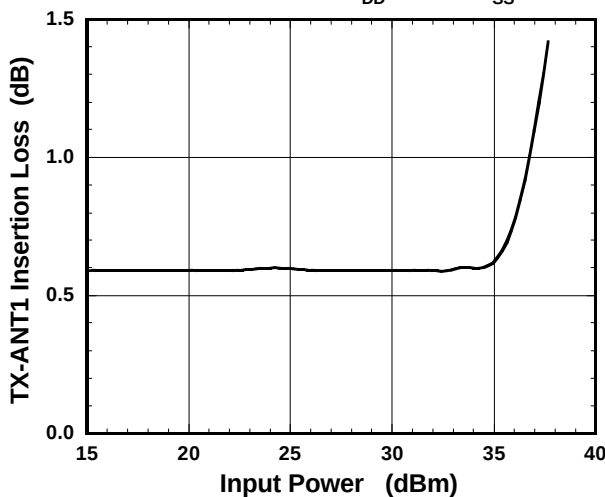
### Output Power, $I_{DD}$ vs. Input Power

(RX-ANT1,  $f=1501\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=0\text{V}$ )



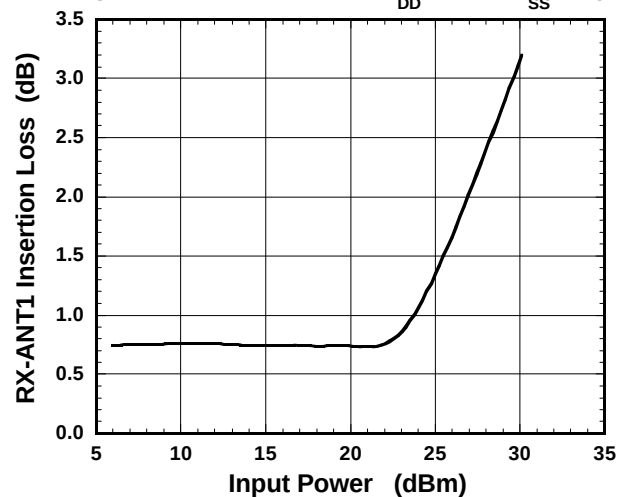
### Insertion Loss vs. Input Power

(TX-ANT1,  $f=1453\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ )



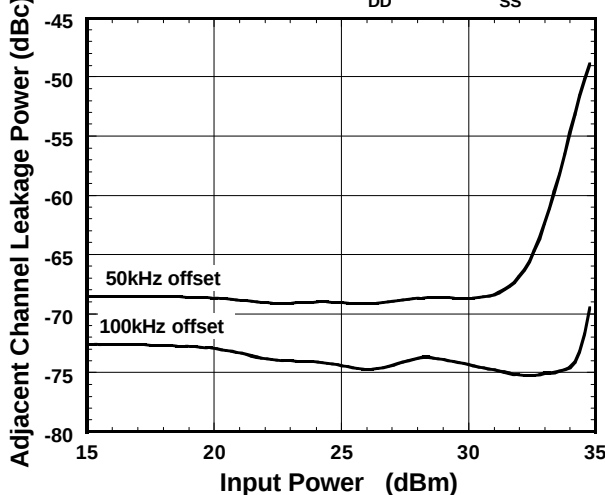
### Insertion Loss vs. Input Power

(RX-ANT1,  $f=1501\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=0\text{V}$ )



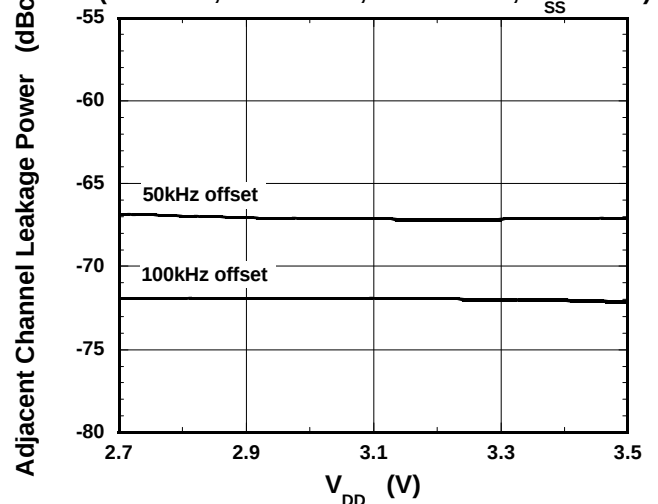
### ACP vs. Input Power

(TX-ANT1,  $f=1453\text{MHz}$ ,  $V_{DD}=3.5\text{V}$ ,  $V_{SS}=-2.5\text{V}$ )



### ACP vs. $V_{DD}$

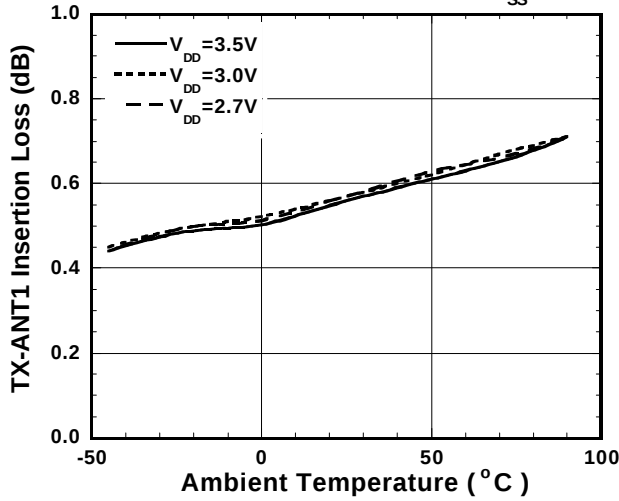
(TX-ANT1,  $f=1453\text{MHz}$ ,  $P_{in}=30\text{dBm}$ ,  $V_{SS}=-2.5\text{V}$ )



## ■ TYPICAL CHARACTERISTICS (1.5GHz Band: Measured on the PCB evaluation circuit)

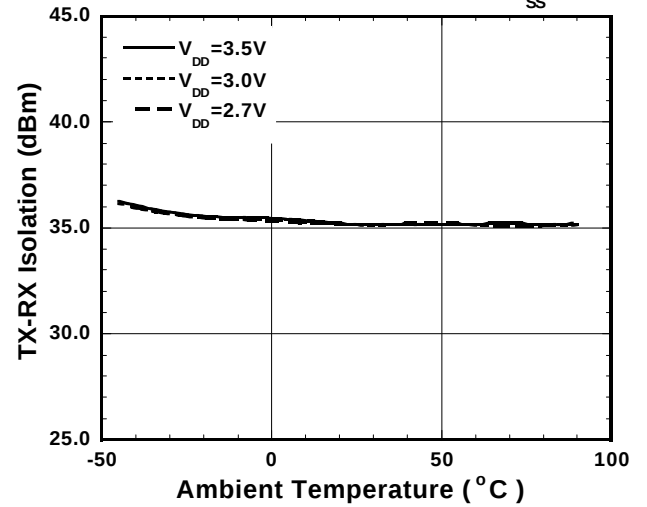
### Loss vs. Ambient Temperature

(TX-ANT1, Pin=30dBm, f=1453MHz,  $V_{SS} = -2.5V$ )



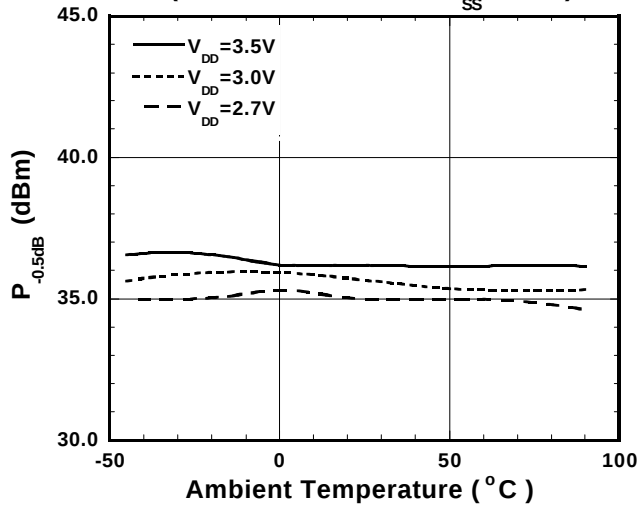
### RX Isolation vs. Ambient Temperature

(TX-ANT1, Pin=30dBm, f=1453MHz,  $V_{SS} = -2.5V$ )



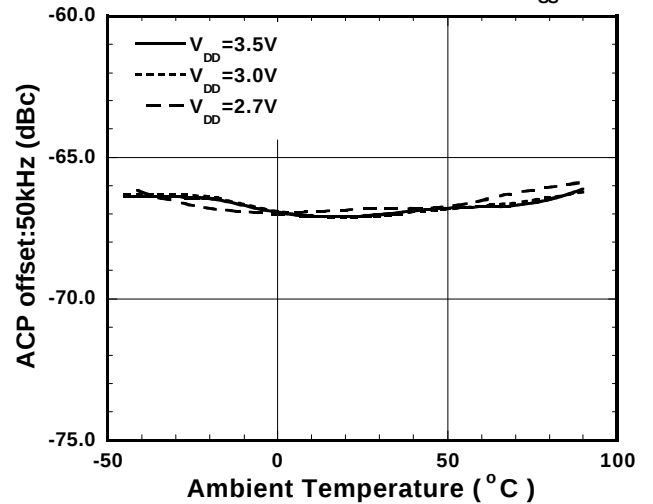
### $P_{-0.5dB}$ vs. Ambient Temperature

(Tx-Ant1, f=1453MHz,  $V_{SS} = -2.5V$ )



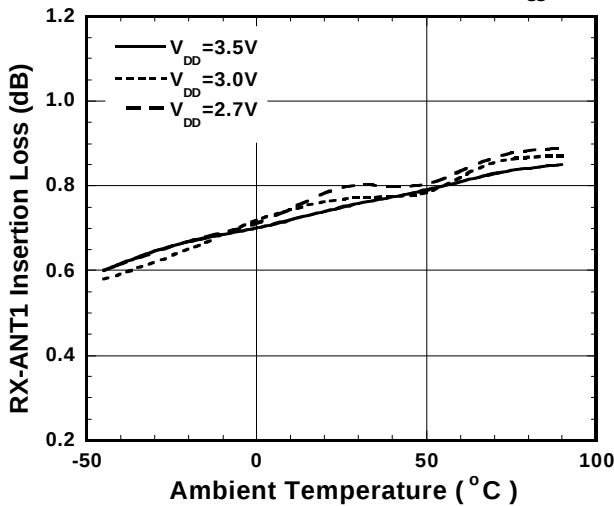
### ACP(offset:50kHz) vs. Ambient Temperature

(TX-ANT1, Pin=30dBm, f=1453MHz,  $V_{SS} = -2.5V$ )



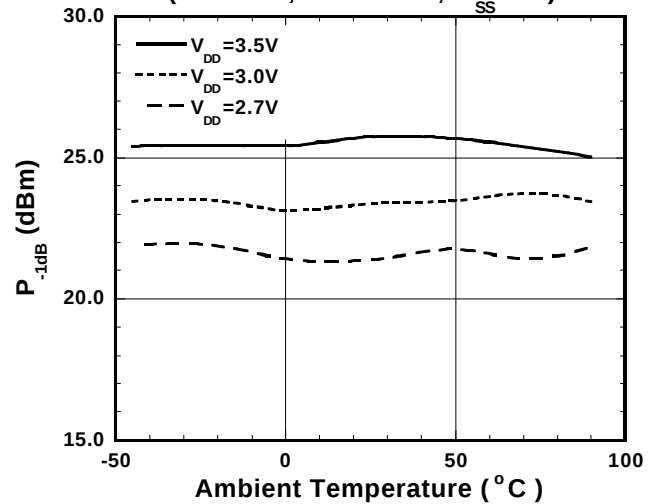
### Loss vs. Ambient Temperature

(RX-ANT1, Pin=10dBm, f=1501MHz,  $V_{SS} = 0V$ )



### $P_{-1dB}$ VS. Ambient Temperature

(RX-ANT1, f=1501MHz,  $V_{SS} = 0V$ )



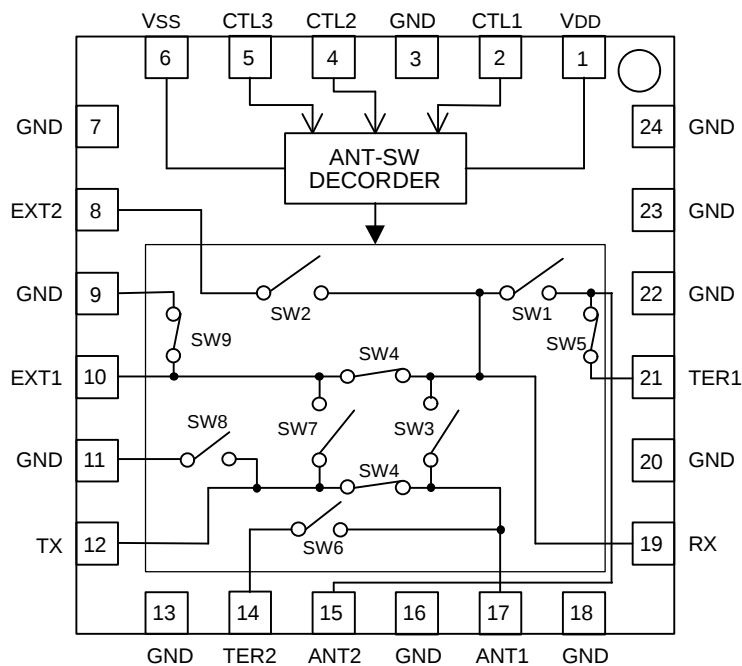
# NJG1521PE1

## TRUTH TABLE

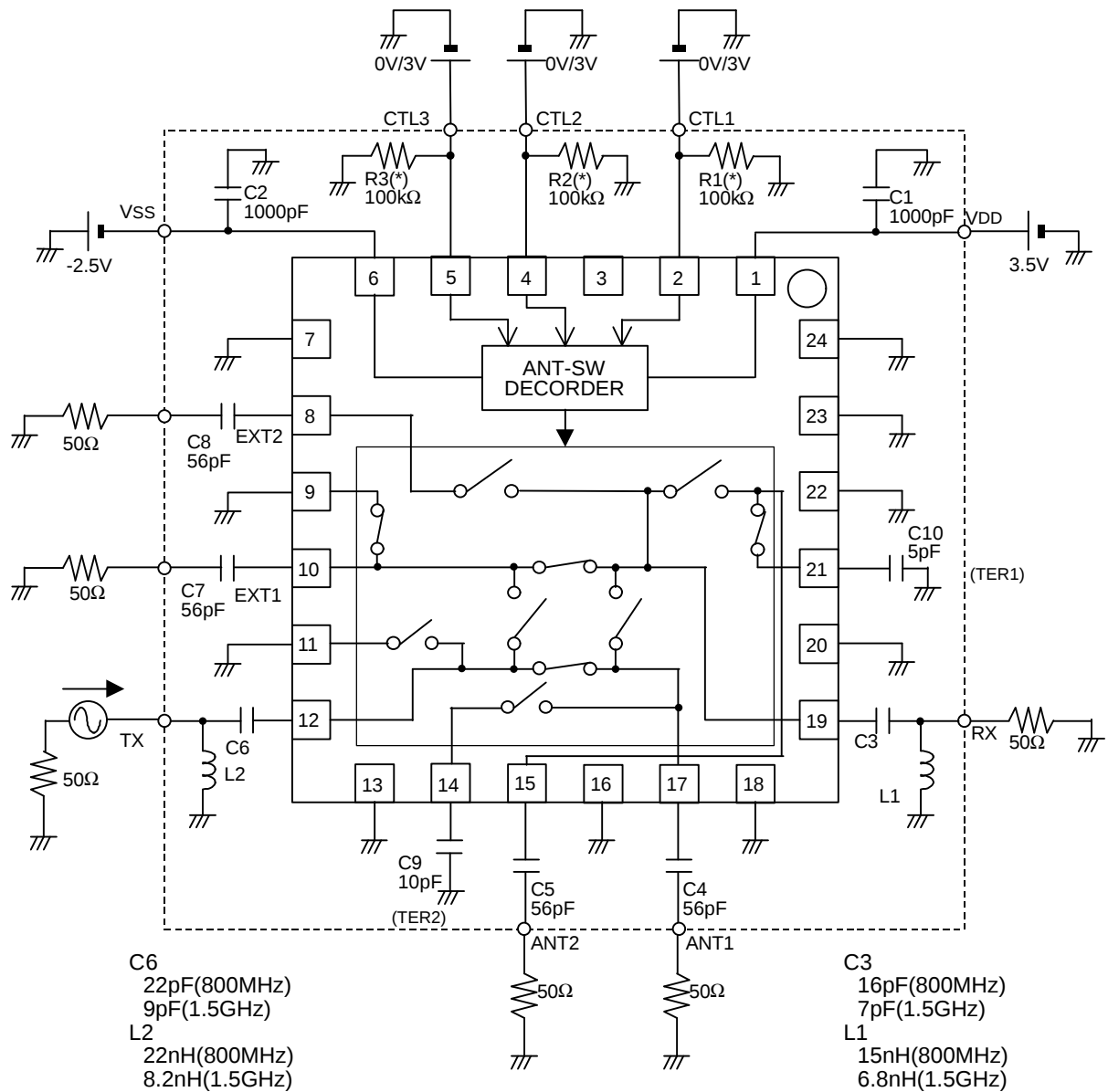
"H"= $V_{CTL(H)}$ , "L"= $V_{CTL(L)}$ , "X"=H or L

| ROUTE   | CONTROL INPUT |           |        | CONTROL OUTPUT |     |     |     |     |     |     |     |     |
|---------|---------------|-----------|--------|----------------|-----|-----|-----|-----|-----|-----|-----|-----|
|         | TX/RX         | Diversity | IN/OUT | SW1            | SW2 | SW3 | SW4 | SW5 | SW6 | SW7 | SW8 | SW9 |
|         | CTL1          | CTL2      | CTL3   |                |     |     |     |     |     |     |     |     |
| TX-ANT1 | H             | X         | H      | OFF            | OFF | OFF | ON  | ON  | OFF | OFF | OFF | ON  |
| TX-EXT1 | H             | X         | L      | OFF            | OFF | ON  | OFF | ON  | ON  | ON  | OFF | OFF |
| RX-ANT1 | L             | L         | H      | OFF            | OFF | ON  | OFF | ON  | OFF | ON  | ON  | ON  |
| RX-ANT2 | L             | H         | H      | ON             | OFF | OFF | OFF | OFF | ON  | ON  | ON  | ON  |
| RX-EXT1 | L             | L         | L      | OFF            | OFF | OFF | ON  | ON  | ON  | OFF | ON  | OFF |
| RX-EXT2 | L             | H         | L      | OFF            | ON  | OFF | OFF | ON  | ON  | ON  | ON  | ON  |

## PIN CONFIGURATION (TOP VIEW)



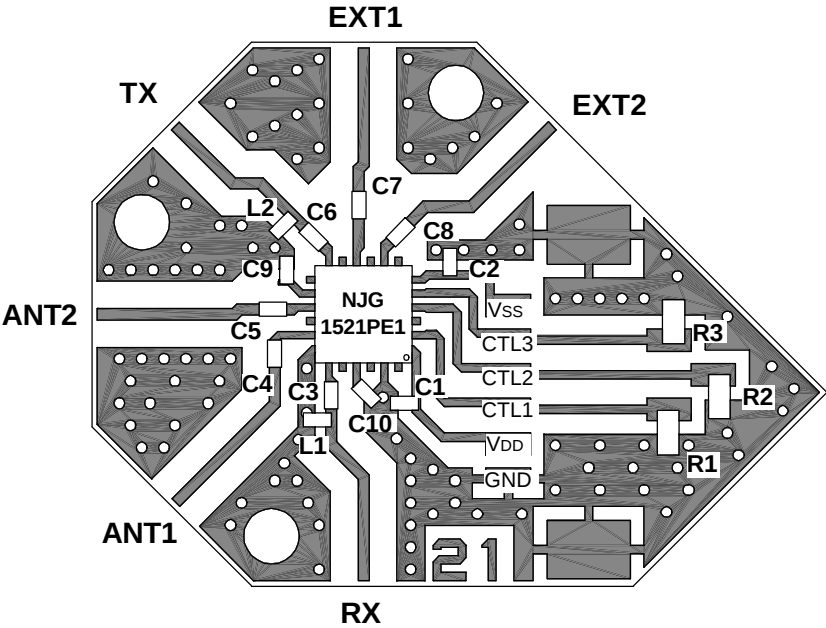
## RECOMMENDED CIRCUIT(TX-ANT1 PASSING)



(\*) If the voltage level of CTL1~CTL3 is unstable, please connect R1~R3 with GND or  $V_{DD}$  respectively.

# NJG1521PE1

## RECOMMENDED PCB DESIGN



PCB: FR-4, t= 0.2mm  
Strip width: 0.4mm

Board total Loss (Capacitor, Connector, and PCB)

| Pass route | 800MHz Band<br>(dB) | 1.5GHz Band<br>(dB) |
|------------|---------------------|---------------------|
| TX-ANT1    | 0.23                | 0.30                |
| TX-EXT1    |                     |                     |
| RX-ANT1    | 0.22                | 0.30                |
| RX-ANT2    |                     |                     |
| RX-EXT1    |                     |                     |
| RX-EXT2    |                     |                     |

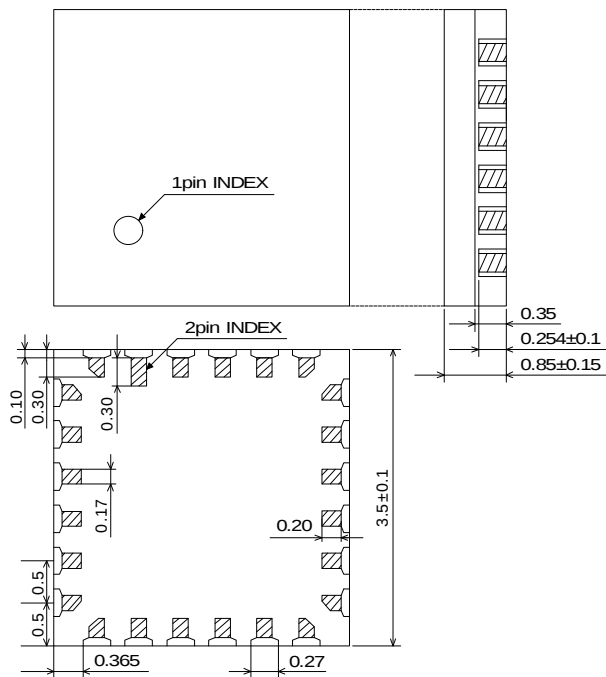
PARTS LIST

|                | VALUE       |             | COMMENT             |
|----------------|-------------|-------------|---------------------|
|                | 800MHz Band | 1.5GHz Band |                     |
| R1-R3          | 100KΩ       |             |                     |
| C1, C2         | 1000pF      |             | MURATA(GRM36)       |
| C4, C5, C7, C8 | 56pF        |             | MURATA(GRM36)       |
| C3             | 16pF        | 7pF         | MURATA(GRM36)       |
| C6             | 22pF        | 9pF         | MURATA(GRM36)       |
| C9             | 10pF        |             | MURATA(GRM36)       |
| C10            | 5pF         |             | MURATA(GRM36)       |
| L1             | 15nH        | 6.8nH       | TAIYO-YUDEN(HK1005) |
| L2             | 22nH        | 8.2nH       | TAIYO-YUDEN(HK1005) |

## PRECAUTIONS

- [1] The bypass capacitors should be connected to the  $V_{DD}$ ,  $V_{SS}$  terminals as close as possible respectively.
- [2] For good RF performance, the ground terminals should be directly connected to the ground patterns and through-holes as close as possible by using relativity wide pattern.

■PACKAGE OUTLINE (FFP24-E1)



|              |               |
|--------------|---------------|
| UNITS        | : mm          |
| PCB          | : Ceramic     |
| OVER COAT    | : Epoxy resin |
| LEAD SURFACE | : Au          |
| WEIGHT       | : 30mg        |

**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.