

# DATA SHEET

|                  |                   |
|------------------|-------------------|
| Part No.         | AN26065A          |
| Package Code No. | ALGA011-W-0912ANA |

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# AN26065A

## UMTS Triple Band LNA-IC (Band I, II, IV, IX / V, XIII)

### ■ Overview

- AN26065A is LNA-IC for triple band (Band I, II, IV, IX / V, XIII) UMTS.
- Realizing high performance by using 0.18  $\mu\text{m}$  SiGeC Bi-CMOS process ( $f_T = 90 \text{ GHz}$ ,  $f_{\text{max}} = 140 \text{ GHz}$ ).
- Each Band is selectable and High/Low Gain-mode is changeable, controlled by integrated CMOS logic circuit.
- Achieving miniaturization by using small size package.

[ Unit: MHz ]

| Band | TX           | RX           |
|------|--------------|--------------|
| I    | 1920 to 1980 | 2110 to 2170 |
| II   | 1850 to 1910 | 1930 to 1990 |
| III  | 1710 to 1785 | 1805 to 1880 |
| IV   | 1710 to 1755 | 2110 to 2155 |
| V    | 824 to 849   | 869 to 894   |
| VI   | 830 to 840   | 875 to 885   |
| VII  | 2500 to 2570 | 2620 to 2690 |
| VIII | 880 to 915   | 925 to 960   |
| IX   | 1750 to 1785 | 1845 to 1880 |

### ■ Features

- Low voltage operation +2.85 V typ.
- Low current consumption 4.7 mA typ. (High-Gain mode)  
25  $\mu\text{A}$  typ. (Low-Gain mode)
- High gain(Gain) 16.5 dB typ.  $f_{\text{RX}} = 2140 \text{ MHz}$  (High-Gain mode)  
16.5 dB typ.  $f_{\text{RX}} = 881.5 \text{ MHz}$  (High-Gain mode)  
16.3 dB typ.  $f_{\text{RX}} = 1960 \text{ MHz}$  (High-Gain mode)
- Low noise figure(NF) 1.40 dB typ.  $f_{\text{RX}} = 2140 \text{ MHz}$  (High-Gain mode)  
1.10 dB typ.  $f_{\text{RX}} = 881.5 \text{ MHz}$  (High-Gain mode)  
1.40 dB typ.  $f_{\text{RX}} = 1960 \text{ MHz}$  (High-Gain mode)
- Low distortion 2.0 dBm typ.  $f_{\text{RX}} = 2140 \text{ MHz}$  (High-Gain mode)  
(IIP3 +10 MHz offset) 4.0 dBm typ.  $f_{\text{RX}} = 881.5 \text{ MHz}$  (High-Gain mode)  
2.5 dBm typ.  $f_{\text{RX}} = 1960 \text{ MHz}$  (High-Gain mode)
- Small package(WLCSP)

### ■ Applications

- Triple-band UMTS handset.

### ■ Package

- 11 pin Wafer level chip size package (WLCSP)  
Size : 0.86 mm  $\times$  1.16 mm (0.3 mm pitch)

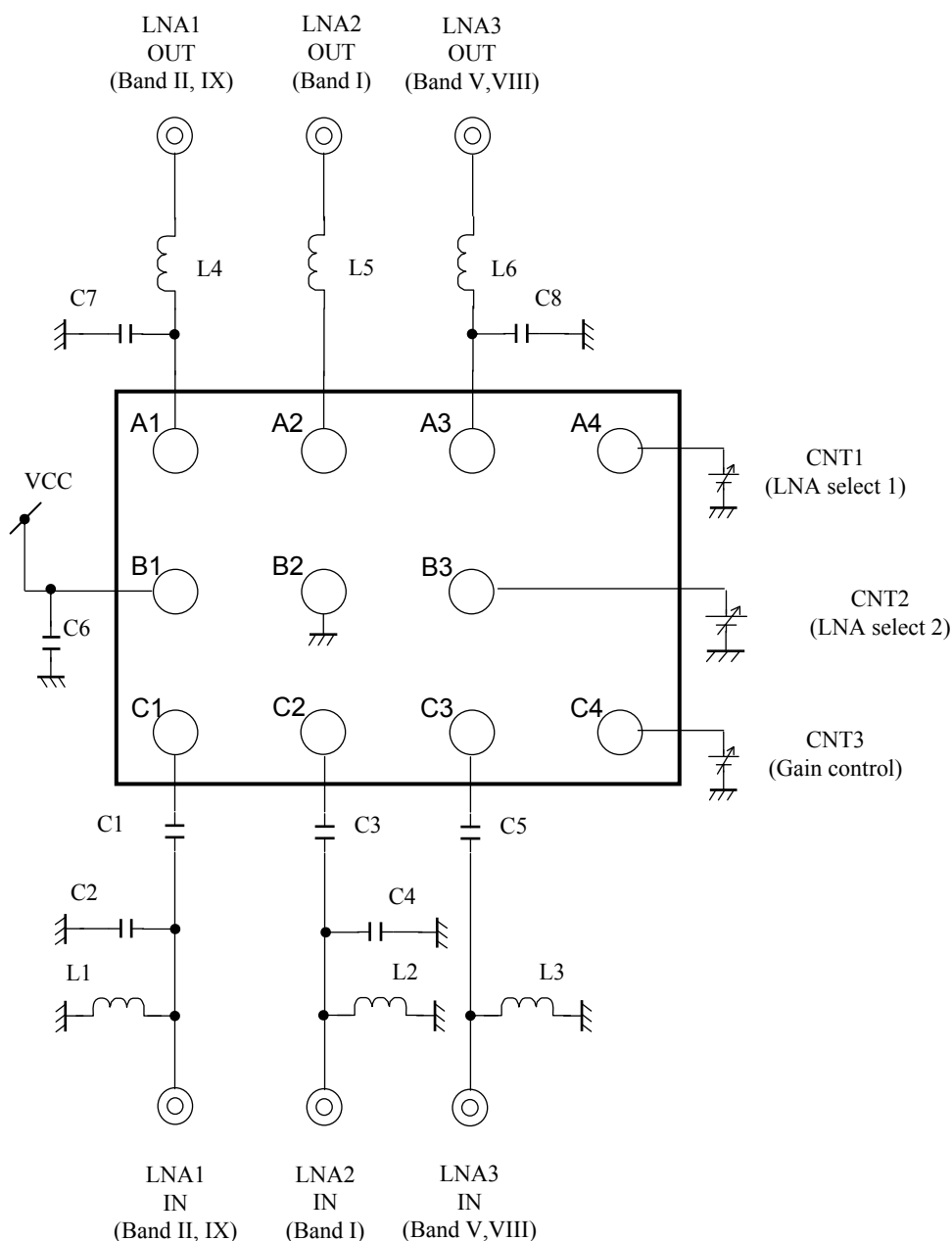
### ■ Type

- Bi-CMOS IC

# Application Circuit Example 1 (Block Diagram)

Note) See "External parts 1" on Page47.

(Top View)

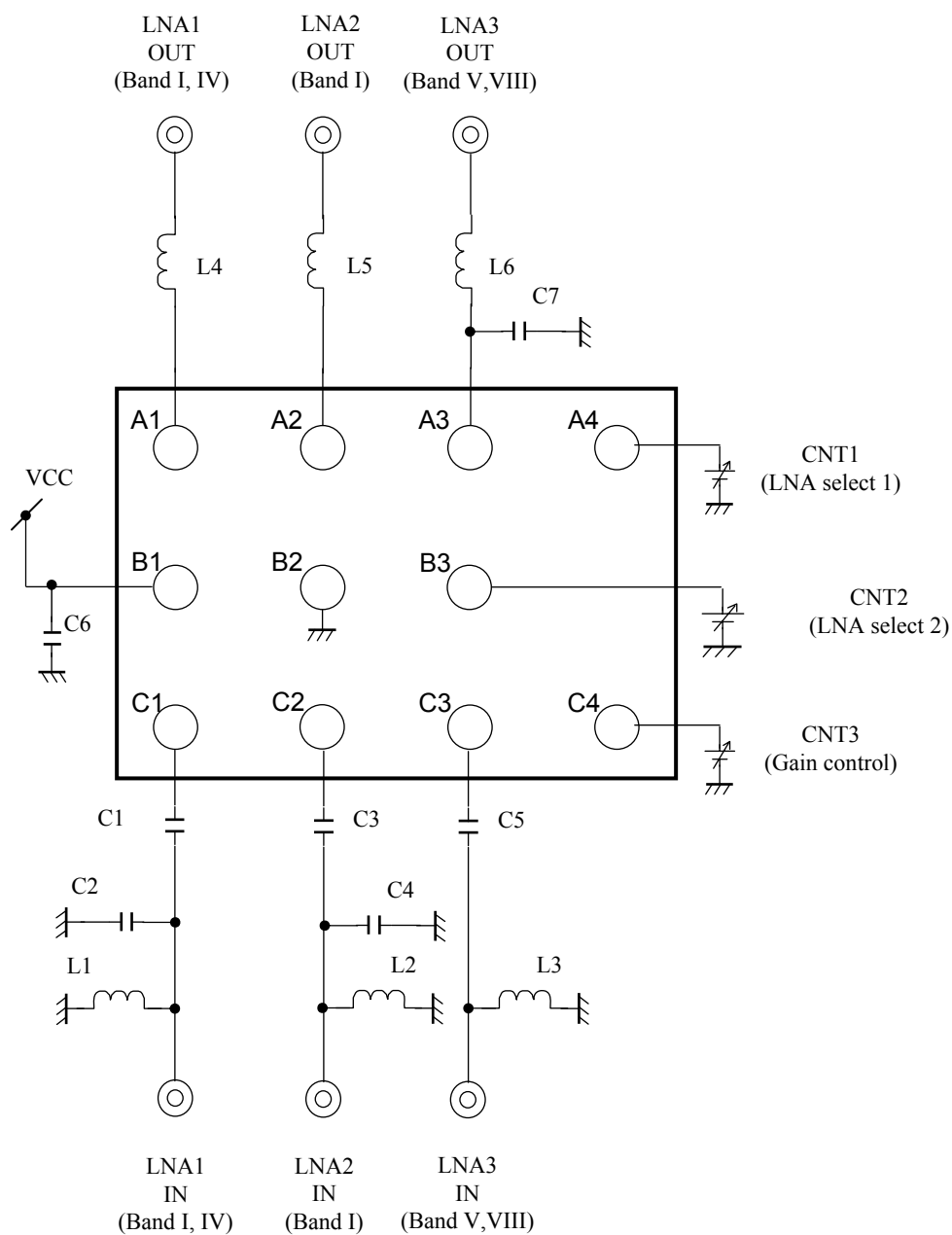


- Notes)
- This application circuit is shown as an example but does not guarantee the design for mass production set.
  - This block diagram is for explaining functions. The part of the block diagram may be omitted, or it may be simplified.

# Application Circuit Example 2 (Block Diagram)

Note) See "External parts 2" on Page48.

(Top View)



- Notes)
- This application circuit is shown as an example but does not guarantee the design for mass production set.
  - This block diagram is for explaining functions. The part of the block diagram may be omitted, or it may be simplified.

## ■ Pin Descriptions

| Pin No. | Pin name | Type         | Description                         |
|---------|----------|--------------|-------------------------------------|
| A1      | OUT1     | Output       | LNA1 RF Output (Band I, II, IV, IX) |
| A2      | OUT2     | Output       | LNA2 RF Output (Band I)             |
| A3      | OUT3     | Output       | LNA3 RF Output (Band V, VIII)       |
| A4      | CNT1     | Input        | LNA select SW input 1               |
| B1      | VCC      | Power Supply | V <sub>CC</sub>                     |
| B2      | GND      | Ground       | GND                                 |
| B3      | CNT2     | Input        | LNA select SW input 2               |
| B4      | N.C.     | —            | N.C.                                |
| C1      | IN1      | Input        | LNA1 RF Input (Band I, II, IV, IX)  |
| C2      | IN2      | Input        | LNA2 RF Input (Band I)              |
| C3      | IN3      | Input        | LNA3 RF Input (Band V, VIII)        |
| C4      | CNT3     | Input        | High-Gain / Low-Gain SW input       |

### ■ Current and Voltage Ranges for Pins

Note) • The ranges on the list are the voltages of respective pins in relation to GND.

- Do not apply the voltages or the currents from external into the pins which are not on the list.
- The values shows voltage to the GND unless otherwise specified. (+) is inlet current and (–) is outlet current in the circuit.
- Voltage applying exceeding below ratings leads to the malfunction and the damage of the device.
- Below ratings are specified regarding malfunction and stress, not for operation guaranty.

| Pin No. | Pin name | Range                 | Unit | Note |
|---------|----------|-----------------------|------|------|
| A1      | OUT1     | – 0.3 to ( $V_{CC}$ ) | V    | —    |
| A2      | OUT2     | – 0.3 to ( $V_{CC}$ ) | V    | —    |
| A3      | OUT3     | – 0.3 to ( $V_{CC}$ ) | V    | —    |
| A4      | CNT1     | – 0.3 to ( $V_{CC}$ ) | V    | —    |
| B1      | VCC      | 0 to 3.0              | V    | —    |
| B2      | GND      | 0                     | V    | *1   |
| B3      | CNT2     | – 0.3 to ( $V_{CC}$ ) | V    | —    |
| B4      | N.C.     | —                     | V    | —    |
| C1      | IN1      | —                     | V    | *2   |
| C2      | IN2      | —                     | V    | *2   |
| C3      | IN3      | —                     | V    | *2   |
| C4      | CNT3     | – 0.3 to ( $V_{CC}$ ) | V    | —    |

Notes) \*1 : Same as GND pin.

\*2 : RF signal input pin. (Maximum input power is 0dBm.) Do not apply DC voltages.

## ■ Absolute Maximum Ratings

Note) Absolute maximum ratings are limit values which are not destructed, and are not the values to which operation is guaranteed.

| A No. | Parameter                     | Symbol    | Rating      | Unit | Notes |
|-------|-------------------------------|-----------|-------------|------|-------|
| 1     | Supply voltage                | $V_{CC}$  | 3.6         | V    | *1    |
| 2     | Supply current                | $I_{CC}$  | 10          | mA   | —     |
| 3     | Power dissipation             | $P_D$     | 31          | mW   | *2    |
| 4     | Operating ambient temperature | $T_{opr}$ | −30 to +85  | °C   | *3    |
| 5     | Storage temperature           | $T_{stg}$ | −40 to +125 | °C   | *3    |

Notes) \*1 : The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

\*2 : The power dissipation shown is the value at  $T_a = 85^\circ\text{C}$  for the independent (unmounted) IC package without a heat sink.

When using this IC, refer to •  $P_D - T_a$  diagram in the ■ Technical Data and design the heat radiation with sufficient margin so that the allowable value might not be exceeded based on the conditions of power supply voltage, load, and ambient temperature.

\*3 : Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for  $T_a = 25^\circ\text{C}$ .

## ■ Operating Supply Voltage Range

| Parameter            | Symbol   | Range        | Unit | Notes |
|----------------------|----------|--------------|------|-------|
| Supply voltage range | $V_{CC}$ | 2.65 to 3.00 | V    | *1    |

Note) \*1 : The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

# ■ Electrical Characteristics at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$  unless otherwise specified.

| B No.                         | Parameter                 | Symbol | Conditions                                                         | Limits |     |     | Unit | Notes |
|-------------------------------|---------------------------|--------|--------------------------------------------------------------------|--------|-----|-----|------|-------|
|                               |                           |        |                                                                    | Min    | Typ | Max |      |       |
| DC electrical characteristics |                           |        |                                                                    |        |     |     |      |       |
| DC-1                          | Circuit current HG (LNA2) | IccHa  | V <sub>CC</sub> current at LNA2 High-Gain mode.<br>No input signal | —      | 4.7 | 6.3 | mA   | —     |
| DC-2                          | Circuit current HG (LNA3) | IccHb  | V <sub>CC</sub> current at LNA3 High-Gain mode.<br>No input signal | —      | 4.1 | 5.5 | mA   | —     |
| DC-3                          | Circuit current HG (LNA1) | IccHc  | V <sub>CC</sub> current at LNA1 High-Gain mode.<br>No input signal | —      | 4.7 | 6.3 | mA   | —     |
| DC-4                          | Circuit current LG (LNA2) | IccLa  | V <sub>CC</sub> current at LNA2 Low-Gain mode.<br>No input signal  | —      | 11  | 60  | μA   | —     |
| DC-5                          | Circuit current LG (LNA3) | IccLb  | V <sub>CC</sub> current at LNA3 Low-Gain mode.<br>No input signal  | —      | 25  | 80  | μA   | —     |
| DC-6                          | Circuit current LG (LNA1) | IccLc  | V <sub>CC</sub> current at LNA1 Low-Gain mode.<br>No input signal  | —      | 25  | 80  | μA   | —     |
| DC-7                          | SW voltage (High)         | VIH    | —                                                                  | 1.60   | —   | —   | V    | —     |
| DC-8                          | SW voltage (Low)          | VIL    | VIL = V <sub>CC</sub> × 0.20                                       | 0.0    | —   | 0.6 | V    | —     |
| DC-9                          | SW current (High)         | IIH    | Current at CNT pin<br>VIH = V <sub>CC</sub>                        | —      | 10  | 20  | μA   | —     |

**■ Electrical Characteristics (continued) at  $V_{CC} = 2.85\text{ V}$** 

Notes) • All parameters are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXa} = 2\,140\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

- Input/output connector & substrate loss (0.34 dB/0.34 dB) included.

| B No.                                           | Parameter                   | Symbol   | Conditions                                                                             | Limits |      |      | Unit | Notes |
|-------------------------------------------------|-----------------------------|----------|----------------------------------------------------------------------------------------|--------|------|------|------|-------|
|                                                 |                             |          |                                                                                        | Min    | Typ  | Max  |      |       |
| LNA2 : AC electrical characteristics ( BAND I ) |                             |          |                                                                                        |        |      |      |      |       |
| A-1                                             | Power Gain HG               | GHSa     | High-Gain mode<br>f = fRXa                                                             | 15.0   | 16.5 | 18.0 | dB   | —     |
| A-2                                             | Power Gain LG               | GLSa     | Low-Gain mode<br>f = fRXa                                                              | −9.0   | −7.0 | −5.0 | dB   | —     |
| A-3                                             | IIP3<br>+10 MHz detuning HG | IIP3H1Sa | High-Gain mode<br>f1 = fRXa + 10 MHz<br>f2 = fRXa + 20 MHz<br>Input 2 signals (f1, f2) | −2.5   | 2.0  | —    | dBm  | —     |
| A-4                                             | IIP3<br>−10 MHz detuning HG | IIP3H2Sa | High-Gain mode<br>f1 = fRXa − 10 MHz<br>f2 = fRXa − 20 MHz<br>Input 2 signals (f1, f2) | −1.5   | 3.0  | —    | dBm  | —     |

# ■ Electrical Characteristics (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXb} = 881.5\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

- Input/output connector & substrate loss (0.15 dB/0.15 dB) included.

| B No.                                           | Parameter                   | Symbol   | Conditions                                                                             | Limits |      |      | Unit | Notes |
|-------------------------------------------------|-----------------------------|----------|----------------------------------------------------------------------------------------|--------|------|------|------|-------|
|                                                 |                             |          |                                                                                        | Min    | Typ  | Max  |      |       |
| LNA3 : AC electrical characteristics ( BAND V ) |                             |          |                                                                                        |        |      |      |      |       |
| B-1                                             | Power Gain HG               | GHSb     | High-Gain mode<br>f = fRXb                                                             | 15.0   | 16.5 | 17.7 | dB   | —     |
| B-2                                             | Power Gain LG               | GLSb     | Low-Gain mode<br>f = fRXb                                                              | −7.5   | −5.5 | −3.5 | dB   | —     |
| B-3                                             | IIP3<br>+10 MHz detuning HG | IIP3H1Sb | High-Gain mode<br>f1 = fRXb + 10 MHz<br>f2 = fRXb + 20 MHz<br>Input 2 signals (f1, f2) | − 0.5  | 4.0  | —    | dBm  | —     |
| B-4                                             | IIP3<br>−10 MHz detuning HG | IIP3H2Sb | High-Gain mode<br>f1 = fRXb − 10 MHz<br>f2 = fRXb − 20 MHz<br>Input 2 signals (f1, f2) | − 0.5  | 3.0  | —    | dBm  | —     |

# ■ Electrical Characteristics (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc} = 1\,960\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• Input/output connector & substrate loss (0.32 dB/0.32 dB) included.

| B No.                                            | Parameter                   | Symbol               | Conditions                                                                                                     | Limits |      |      | Unit | Notes |
|--------------------------------------------------|-----------------------------|----------------------|----------------------------------------------------------------------------------------------------------------|--------|------|------|------|-------|
|                                                  |                             |                      |                                                                                                                | Min    | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND II ) |                             |                      |                                                                                                                |        |      |      |      |       |
| C-1                                              | Power Gain HG               | GHS <sub>c</sub>     | High-Gain mode<br>f = fRX <sub>c</sub>                                                                         | 14.8   | 16.3 | 17.8 | dB   | —     |
| C-2                                              | Power Gain LG               | GLS <sub>c</sub>     | Low-Gain mode<br>f = fRX <sub>c</sub>                                                                          | −9.0   | −7.0 | −5.0 | dB   | —     |
| C-3                                              | IIP3<br>+10 MHz detuning HG | IIP3H1S <sub>c</sub> | High-Gain mode<br>f1 = fRX <sub>c</sub> + 10 MHz<br>f2 = fRX <sub>c</sub> + 20 MHz<br>Input 2 signals (f1, f2) | −1.5   | 2.5  | —    | dBm  | —     |
| C-4                                              | IIP3<br>−10 MHz detuning HG | IIP3H2S <sub>c</sub> | High-Gain mode<br>f1 = fRX <sub>c</sub> − 10 MHz<br>f2 = fRX <sub>c</sub> − 20 MHz<br>Input 2 signals (f1, f2) | 0.0    | 2.5  | —    | dBm  | —     |

# ■ Electrical Characteristics (Reference values for design) at $V_{CC} = 2.85\text{ V}$

- Notes) • All parameters are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXa} = 2\,110\text{ MHz}$  to  $2\,170\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.
- The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.
- If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.
- Input/output connector & substrate loss (0.34dB/0.34dB) included.

| B No.                                           | Parameter                                  | Symbol   | Conditions                                                                                                      | Reference values |      |      | Unit | Notes |
|-------------------------------------------------|--------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                 |                                            |          |                                                                                                                 | Min              | Typ  | Max  |      |       |
| LNA2 : AC electrical characteristics ( BAND I ) |                                            |          |                                                                                                                 |                  |      |      |      |       |
| D-1                                             | Power Gain HG                              | GHa      | High-Gain mode<br>f = fRXa                                                                                      | 15.0             | 16.5 | 18.0 | dB   | —     |
| D-2                                             | Power Gain LG                              | GLa      | Low-Gain mode<br>f = fRXa                                                                                       | −9.0             | −7.0 | −5.0 | dB   | —     |
| D-3                                             | Noise figure HG                            | NFHa     | High-Gain mode<br>f = fRXa                                                                                      | —                | 1.40 | 1.80 | dB   | —     |
| D-4                                             | Noise figure LG                            | NFLa     | Low-Gain mode<br>f = fRXa                                                                                       | —                | 7.0  | 10.0 | dB   | —     |
| D-5                                             | IIP3<br>+10 MHz detuning HG                | IIP3H1a  | High-Gain mode<br>f1 = fRXa + 10 MHz<br>f2 = fRXa + 20 MHz<br>Input 2 signals (f1, f2)                          | −2.5             | 2.0  | —    | dBm  | —     |
| D-6                                             | IIP3<br>−10 MHz detuning HG                | IIP3H2a  | High-Gain mode<br>f1 = fRXa − 10 MHz<br>f2 = fRXa − 20 MHz<br>Input 2 signals (f1, f2)                          | −1.5             | 3.0  | —    | dBm  | —     |
| D-7                                             | IIP3<br>+10 MHz detuning LG                | IIP3L1a  | Low-Gain mode<br>f1 = fRXa + 10 MHz<br>f2 = fRXa + 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2)  | 20               | 25   | —    | dBm  | —     |
| D-8                                             | IIP3<br>−10 MHz detuning LG                | IIP3L2a  | Low-Gain mode<br>f1 = fRXa − 10 MHz<br>f2 = fRXa − 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2)  | 20               | 26   | —    | dBm  | —     |
| D-9                                             | Input P1dB                                 | IP1dBH1a | High-Gain mode<br>f = fRXa                                                                                      | -22              | −16  | —    | dBm  | —     |
| D-10                                            | Input P1dB<br>TX undesired signal input HG | IP1dBH2a | High-Gain mode<br>f1 = fRXa<br>PRX1 = −40 dBm<br>f2 = fRXa − 190 MHz<br>PRX2 : Var.<br>Input 2 signals (f1, f2) | −17              | −10  | —    | dBm  | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXa} = 2\ 110\text{ MHz}$  to  $2\ 170\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.34 dB/0.34 dB) included.

| B No.                                           | Parameter               | Symbol  | Conditions                                                                                          | Reference values |      |      | Unit | Notes |
|-------------------------------------------------|-------------------------|---------|-----------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                 |                         |         |                                                                                                     | Min              | Typ  | Max  |      |       |
| LNA2 : AC electrical characteristics ( BAND I ) |                         |         |                                                                                                     |                  |      |      |      |       |
| D-11                                            | IIP2                    | IIP2H1a | High-Gain mode<br>f1 = fRXa – 190 MHz<br>f2 = 190 MHz<br>Input 2 signals (f1, f2)                   | 10               | 15   | —    | dBm  | —     |
| D-12                                            | IIP2                    | IIP2H2a | High-Gain mode<br>f1 = fRXa – 190 MHz<br>f2 = 2 × fRXa – 190 MHz<br>Input 2 signals (f1, f2)        | 10               | 16   | —    | dBm  | —     |
| D-13                                            | K-factor                | KHa     | High-Gain mode<br>f = 0 to 6 GHz                                                                    | 2.0              | 4.0  | —    | —    | —     |
| D-14                                            | Reverse isolation<br>HG | ISOHa   | High-Gain mode<br>f = fRXa                                                                          | —                | –30  | –20  | dB   | —     |
| D-15                                            | Reverse isolation<br>LG | ISOLa   | Low-Gain mode<br>f = fRXa                                                                           | —                | –7.0 | –4.0 | dB   | —     |
| D-16                                            | Band to band isolation  | BISa    | LNA1 / LNA3 :High-Gain mode<br>LNA2:off<br>LNA2 input → LNA2 output<br>f = fRXa                     | —                | –30  | -27  | dB   | —     |
| D-17                                            | Input return loss HG    | S11Ha   | High-Gain mode<br>f = fRXa                                                                          | 6.5              | 9.5  | —    | dB   | —     |
| D-18                                            | Input return loss LG    | S11La   | Low-Gain mode<br>f = fRXa                                                                           | 8.5              | 9.5  | —    | dB   | —     |
| D-19                                            | Output return loss HG   | S22Ha   | High-Gain mode<br>f = fRXa                                                                          | 8.5              | 9.5  | —    | dB   | —     |
| D-20                                            | Output return loss LG   | S22La   | Low-Gain mode<br>f = fRXa                                                                           | 8.5              | 9.5  | —    | dB   | —     |
| D-21                                            | Gain Changing Time      | TCGa    | Low → High / High → Low<br>f = 2 170 MHz<br>Gain Error < 1 dB                                       | —                | 7    | 16   | μs   | —     |
| D-22                                            | Band Changing Time      | BCGa    | LNA3 → LNA2<br>f = 2 170 MHz<br>LNA1 → LNA2<br>f = 2 170 MHz<br>High Gain Mode<br>Gain Error < 1 dB | —                | 7    | 16   | μs   | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

- Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXb1} = 869\text{ MHz}$  to  $894\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.  
 • The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.  
 If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.  
 • Input/output connector & substrate loss (0.15 dB/0.15 dB) included.

| B No.                                           | Parameter                                  | Symbol    | Conditions                                                                                                       | Reference values |      |      | Unit | Notes |
|-------------------------------------------------|--------------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                 |                                            |           |                                                                                                                  | Min              | Typ  | Max  |      |       |
| LNA3 : AC electrical characteristics ( BAND V ) |                                            |           |                                                                                                                  |                  |      |      |      |       |
| E-1                                             | Power Gain HG                              | GHb1      | High-Gain mode<br>f = fRXb1                                                                                      | 15.0             | 16.5 | 17.7 | dB   | —     |
| E-2                                             | Power Gain LG                              | GLb1      | Low-Gain mode<br>f = fRXb1                                                                                       | −7.5             | −5.5 | −3.5 | dB   | —     |
| E-3                                             | Noise figure HG                            | NFHb1     | High-Gain mode<br>f = fRXb1                                                                                      | —                | 1.10 | 1.35 | dB   | —     |
| E-4                                             | Noise figure LG                            | NFLb1     | Low-Gain mode<br>f = fRXb1                                                                                       | —                | 5.5  | 8.5  | dB   | —     |
| E-5                                             | IIP3<br>+10 MHz detuning HG                | IIP3H1b1  | High-Gain mode<br>f1 = fRXb1 + 10 MHz<br>f2 = fRXb1 + 20 MHz<br>Input 2 signals (f1, f2)                         | − 0.5            | 4.5  | —    | dBm  | —     |
| E-6                                             | IIP3<br>−10 MHz detuning HG                | IIP3H2b1  | High-Gain mode<br>f1 = fRXb1 − 10 MHz<br>f2 = fRXb1 − 20 MHz<br>Input 2 signals (f1, f2)                         | − 0.5            | 3.0  | —    | dBm  | —     |
| E-7                                             | IIP3<br>+10 MHz detuning LG                | IIP3L1b1  | Low-Gain mode<br>f1 = fRXb1 + 10 MHz<br>f2 = fRXb1 + 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 18               | 22   | —    | dBm  | —     |
| E-8                                             | IIP3<br>−10 MHz detuning LG                | IIP3L2b1  | Low-Gain mode<br>f1 = fRXb1 − 10 MHz<br>f2 = fRXb1 − 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 18               | 23   | —    | dBm  | —     |
| E-9                                             | Input P1dB                                 | IP1dBH1b1 | High-Gain mode<br>f = fRXb1                                                                                      | −21              | −14  | —    | dBm  | —     |
| E-10                                            | Input P1dB<br>TX undesired signal input HG | IP1dBH2b1 | High-Gain mode<br>f1 = fRXb1<br>PRX1 = −40 dBm<br>f2 = fRXb1 − 45 MHz<br>PRX2 : Var.<br>Input 2 signals (f1, f2) | −20              | −13  | —    | dBm  | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXb1} = 869\text{ MHz}$  to  $894\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.15 dB/0.15 dB) included.

| B No.                                           | Parameter              | Symbol   | Conditions                                                                                   | Reference values |      |      | Unit | Notes |
|-------------------------------------------------|------------------------|----------|----------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                 |                        |          |                                                                                              | Min              | Typ  | Max  |      |       |
| LNA3 : AC electrical characteristics ( BAND V ) |                        |          |                                                                                              |                  |      |      |      |       |
| E-11                                            | IIP2                   | IIP2H1b1 | High-Gain mode<br>f1 = fRXb1 – 45 MHz<br>f2 = 45 MHz<br>Input 2 signals (f1, f2)             | 12               | 17   | —    | dBm  | —     |
| E-12                                            | IIP2                   | IIP2H2b1 | High-Gain mode<br>f1 = fRXb1 – 45 MHz<br>f2 = 2 × fRXb1 – 45 MHz<br>Input 2 signals (f1, f2) | −1.5             | 2.5  | —    | dBm  | —     |
| E-13                                            | K-factor               | KHb1     | High-Gain mode<br>f = 0 to 6 GHz                                                             | 1.5              | 2.0  | —    | —    | —     |
| E-14                                            | Reverse isolation HG   | ISOHb1   | High-Gain mode<br>f = fRXb1                                                                  | —                | −24  | −18  | dB   | —     |
| E-15                                            | Reverse isolation LG   | ISOLb1   | Low-Gain mode<br>f = fRXb1                                                                   | —                | −6.0 | −3.0 | dB   | —     |
| E-16                                            | Band to band isolation | BISb1    | LNA2 :High-Gain mode<br>LNA3:off<br>LNA3 input → LNA3 output<br>f = fRXb1                    | —                | −24  | −20  | dB   | —     |
| E-17                                            | Input return loss HG   | S11Hb1   | High-Gain mode<br>f = fRXb1                                                                  | 8                | 9.5  | —    | dB   | —     |
| E-18                                            | Input return loss LG   | S11Lb1   | Low-Gain mode<br>f = fRXb1                                                                   | 6                | 6.5  | —    | dB   | —     |
| E-19                                            | Output return loss HG  | S22Hb1   | High-Gain mode<br>f = fRXb1                                                                  | 8.5              | 9.5  | —    | dB   | —     |
| E-20                                            | Output return loss LG  | S22Lb1   | Low-Gain mode<br>f = fRXb1                                                                   | 8.5              | 9.5  | —    | dB   | —     |
| E-21                                            | Gain Changing Time     | TCGb1    | Low → High / High → Low<br>f = 960 MHz<br>Gain Error < 1 dB                                  | —                | 7.5  | 18   | μs   | —     |
| E-22                                            | Band Changing Time     | TCBb1    | LNA2 → LNA3<br>f = 960 MHz<br>High Gain Mode<br>Gain Error < 1 dB                            | —                | 7.5  | 18   | μs   | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXb2} = 925\text{ MHz}$  to  $960\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.15 dB/0.15 dB) included.

| B No.                                              | Parameter                                  | Symbol    | Conditions                                                                                                       | Reference values |      |      | Unit | Notes |
|----------------------------------------------------|--------------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                    |                                            |           |                                                                                                                  | Min              | Typ  | Max  |      |       |
| LNA3 : AC electrical characteristics ( BAND VIII ) |                                            |           |                                                                                                                  |                  |      |      |      |       |
| F-1                                                | Power Gain HG                              | GHb2      | High-Gain mode<br>f= fRXb2                                                                                       | 14.7             | 16.2 | 17.4 | dB   | —     |
| F-2                                                | Power Gain LG                              | GLb2      | Low-Gain mode<br>f= fRXb2                                                                                        | −7.5             | −5.5 | −3.5 | dB   | —     |
| F-3                                                | Noise figure HG                            | NFHb2     | High-Gain mode<br>f= fRXb2                                                                                       | —                | 1.10 | 1.35 | dB   | —     |
| F-4                                                | Noise figure LG                            | NFLb2     | Low-Gain mode<br>f= fRXb2                                                                                        | —                | 5.5  | 8.5  | dB   | —     |
| F-5                                                | IIP3<br>+10 MHz detuning HG                | IIP3H1b2  | High-Gain mode<br>f1 = fRXb2 + 10 MHz<br>f2 = fRXb2 + 20 MHz<br>Input 2 signals (f1, f2)                         | −1.0             | 4.0  | —    | dBm  | —     |
| F-6                                                | IIP3<br>−10 MHz detuning HG                | IIP3H2b2  | High-Gain mode<br>f1 = fRXb2 − 10 MHz<br>f2 = fRXb2 − 20 MHz<br>Input 2 signals (f1, f2)                         | − 0.5            | 3.0  | —    | dBm  | —     |
| F-7                                                | IIP3<br>+10 MHz detuning LG                | IIP3L1b2  | Low-Gain mode<br>f1 = fRXb2 + 10 MHz<br>f2 = fRXb2 + 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 17               | 22   | —    | dBm  | —     |
| F-8                                                | IIP3<br>−10 MHz detuning LG                | IIP3L2b2  | Low-Gain mode<br>f1 = fRXb2 − 10 MHz<br>f2 = fRXb2 − 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 17               | 22   | —    | dBm  | —     |
| F-9                                                | Input P1dB                                 | IP1dBH1b2 | High-Gain mode<br>f= fRXb2                                                                                       | −21              | −14  | —    | dBm  | —     |
| F-10                                               | Input P1dB<br>TX undesired signal input HG | IP1dBH2b2 | High-Gain mode<br>f1 = fRXb2<br>PRX1 = −40 dBm<br>f2 = fRXb2 − 45 MHz<br>PRX2 : Var.<br>Input 2 signals (f1, f2) | −17              | −10  | —    | dBm  | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXb2} = 925\text{ MHz}$  to  $960\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.15 dB/0.15 dB) included.

| B No.                                              | Parameter              | Symbol   | Conditions                                                                                   | Reference values |      |      | Unit | Notes |
|----------------------------------------------------|------------------------|----------|----------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                    |                        |          |                                                                                              | Min              | Typ  | Max  |      |       |
| LNA3 : AC electrical characteristics ( BAND VIII ) |                        |          |                                                                                              |                  |      |      |      |       |
| F-11                                               | IIP2                   | IIP2H1b2 | High-Gain mode<br>f1 = fRXb2 – 45 MHz<br>f2 = 45 MHz<br>Input 2 signals (f1, f2)             | 12               | 17   | —    | dBm  | —     |
| F-12                                               | IIP2                   | IIP2H2b2 | High-Gain mode<br>f1 = fRXb2 – 45 MHz<br>f2 = 2 × fRXb2 – 45 MHz<br>Input 2 signals (f1, f2) | −1.5             | 3.5  | —    | dBm  | —     |
| F-13                                               | K-factor               | KHb2     | High-Gain mode<br>f = 0 to 6 GHz                                                             | 1.5              | 2.0  | —    | —    | —     |
| F-14                                               | Reverse isolation HG   | ISOHb2   | High-Gain mode<br>f = fRXb2                                                                  | —                | −24  | −18  | dB   | —     |
| F-15                                               | Reverse isolation LG   | ISOLb2   | Low-Gain mode<br>f = fRXb2                                                                   | —                | −6.0 | −3.0 | dB   | —     |
| F-16                                               | Band to band isolation | BISb2    | LNA2 :High-Gain mode<br>LNA3:off<br>LNA3 input → LNA3 output<br>f = fRXb2                    | —                | −24  | −20  | dB   | —     |
| F-17                                               | Input return loss HG   | S11Hb2   | High-Gain mode<br>f = fRXb2                                                                  | 8.5              | 9.5  | —    | dB   | —     |
| F-18                                               | Input return loss LG   | S11Lb2   | Low-Gain mode<br>f = fRXb2                                                                   | 5.5              | 6.0  | —    | dB   | —     |
| F-19                                               | Output return loss HG  | S22Hb2   | High-Gain mode<br>f = fRXb2                                                                  | 8.5              | 9.5  | —    | dB   | —     |
| F-20                                               | Output return loss LG  | S22Lb2   | Low-Gain mode<br>f = fRXb2                                                                   | 8.5              | 9.5  | —    | dB   | —     |
| F-21                                               | Gain Changing Time     | TCGb2    | Low → High / High → Low<br>f = 960 MHz<br>Gain Error < 1 dB                                  | —                | 7.5  | 18   | μs   | —     |
| F-22                                               | Band Changing Time     | TCBb2    | LNA2 → LNA3<br>f = 960 MHz<br>High Gain Mode<br>Gain Error < 1 dB                            | —                | 7.5  | 18   | μs   | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85 \text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc1} = 2110 \text{ MHz}$  to  $2170 \text{ MHz}$ ,  $PRX = -30 \text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.34 dB/0.34 dB) included.

| B No.                                           | Parameter                                  | Symbol    | Conditions                                                                                                        | Reference values |      |      | Unit | Notes |
|-------------------------------------------------|--------------------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                 |                                            |           |                                                                                                                   | Min              | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND I ) |                                            |           |                                                                                                                   |                  |      |      |      |       |
| G-1                                             | Power Gain HG                              | GHc1      | High-Gain mode<br>f = fRXc1                                                                                       | 14.6             | 16.1 | 17.8 | dB   | —     |
| G-2                                             | Power Gain LG                              | GLc1      | Low-Gain mode<br>f = fRXc1                                                                                        | −9.0             | −7.0 | −5.0 | dB   | —     |
| G-3                                             | Noise figure HG                            | NFHc1     | High-Gain mode<br>f = fRXc1                                                                                       | —                | 1.50 | 2.00 | dB   | —     |
| G-4                                             | Noise figure LG                            | NFLc1     | Low-Gain mode<br>f = fRXc1                                                                                        | —                | 7.0  | 10.0 | dB   | —     |
| G-5                                             | IIP3<br>+10 MHz detuning HG                | IIP3H1c1  | High-Gain mode<br>f1 = fRXc1 + 10 MHz<br>f2 = fRXc1 + 20 MHz<br>Input 2 signals (f1, f2)                          | −1.5             | 2.5  | —    | dBm  | —     |
| G-6                                             | IIP3<br>−10 MHz detuning HG                | IIP3H2c1  | High-Gain mode<br>f1 = fRXc1 − 10 MHz<br>f2 = fRXc1 − 20 MHz<br>Input 2 signals (f1, f2)                          | 0.0              | 2.5  | —    | dBm  | —     |
| G-7                                             | IIP3<br>+10 MHz detuning LG                | IIP3L1c1  | Low-Gain mode<br>f1 = fRXc1 + 10 MHz<br>f2 = fRXc1 + 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2)  | 19               | 24   | —    | dBm  | —     |
| G-8                                             | IIP3<br>−10 MHz detuning LG                | IIP3L2c1  | Low-Gain mode<br>f1 = fRXc1 − 10 MHz<br>f2 = fRXc1 − 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2)  | 20               | 25   | —    | dBm  | —     |
| G-9                                             | Input P1dB                                 | IP1dBH1c1 | High-Gain mode<br>f = fRXc1                                                                                       | −21              | −14  | —    | dBm  | —     |
| G-10                                            | Input P1dB<br>TX undesired signal input HG | IP1dBH2c1 | High-Gain mode<br>f1 = fRXc1<br>PRX1 = −40 dBm<br>f2 = fRXc1 − 190 MHz<br>PRX2 : Var.<br>Input 2 signals (f1, f2) | −16              | −9   | —    | dBm  | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85 \text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc1} = 2110 \text{ MHz}$  to  $2170 \text{ MHz}$ ,  $PRX = -30 \text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.34 dB/0.34 dB) included.

| B No.                                           | Parameter              | Symbol   | Conditions                                                                                     | Reference values |      |      | Unit | Notes |
|-------------------------------------------------|------------------------|----------|------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                 |                        |          |                                                                                                | Min              | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND I ) |                        |          |                                                                                                |                  |      |      |      |       |
| G-11                                            | IIP2                   | IIP2H1c1 | High-Gain mode<br>f1 = fRXc1 – 190 MHz<br>f2 = 190 MHz<br>Input 2 signals (f1, f2)             | 11               | 19   | —    | dBm  | —     |
| G-12                                            | IIP2                   | IIP2H2c1 | High-Gain mode<br>f1 = fRXc1 – 190 MHz<br>f2 = 2 × fRXc1 – 190 MHz<br>Input 2 signals (f1, f2) | 10               | 18   | —    | dBm  | —     |
| G-13                                            | K-factor               | KHc1     | High-Gain mode<br>f = 0 to 6 GHz                                                               | 1.5              | 2.0  | —    | —    | —     |
| G-14                                            | Reverse isolation HG   | ISOHc1   | High-Gain mode<br>f = fRXc1                                                                    | —                | −30  | −20  | dB   | —     |
| G-15                                            | Reverse isolation LG   | ISOLc1   | Low-Gain mode<br>f = fRXc1                                                                     | —                | −7.0 | −4.0 | dB   | —     |
| G-16                                            | Band to band isolation | BISc1    | LNA2 :High-Gain mode<br>LNA1:off<br>LNA1 input → LNA1 output<br>f = fRXc1                      | —                | −26  | −23  | dB   | —     |
| G-17                                            | Input return loss HG   | S11Hc1   | High-Gain mode<br>f = fRXc1                                                                    | 8.5              | 9.5  | —    | dB   | —     |
| G-18                                            | Input return loss LG   | S11Lc1   | Low-Gain mode<br>f = fRXc1                                                                     | 8.5              | 9.5  | —    | dB   | —     |
| G-19                                            | Output return loss HG  | S22Hc1   | High-Gain mode<br>f = fRXc1                                                                    | 8.5              | 9.5  | —    | dB   | —     |
| G-20                                            | Output return loss LG  | S22Lc1   | Low-Gain mode<br>f = fRXc1                                                                     | 8.5              | 9.5  | —    | dB   | —     |
| G-21                                            | Gain Changing Time     | TCGc1    | Low → High / High → Low<br>f = 2170 MHz<br>Gain Error < 1 dB                                   | —                | 7    | 16   | μs   | —     |
| G-22                                            | Band Changing Time     | TCBc1    | LNA2 → LNA1<br>f = 2170 MHz<br>High Gain Mode<br>Gain Error < 1 dB                             | —                | 7    | 16   | μs   | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85 \text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc2} = 1\,930 \text{ MHz}$  to  $1\,990 \text{ MHz}$ ,  $PRX = -30 \text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.32 dB/0.32 dB) included.

| B No.                                            | Parameter                                  | Symbol    | Conditions                                                                                                       | Reference values |      |      | Unit | Notes |
|--------------------------------------------------|--------------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                  |                                            |           |                                                                                                                  | Min              | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND II ) |                                            |           |                                                                                                                  |                  |      |      |      |       |
| H-1                                              | Power Gain HG                              | GHc2      | High-Gain mode<br>f = fRXc2                                                                                      | 14.8             | 16.3 | 17.8 | dB   | —     |
| H-2                                              | Power Gain LG                              | GLc2      | Low-Gain mode<br>f = fRXc2                                                                                       | −9.0             | −7.0 | −5.0 | dB   | —     |
| H-3                                              | Noise figure HG                            | NFHc2     | High-Gain mode<br>f = fRXc2                                                                                      | —                | 1.40 | 1.80 | dB   | —     |
| H-4                                              | Noise figure LG                            | NFLc2     | Low-Gain mode<br>f = fRXc2                                                                                       | —                | 7.0  | 10.0 | dB   | —     |
| H-5                                              | IIP3<br>+10 MHz detuning HG                | IIP3H1c2  | High-Gain mode<br>f1 = fRXc2 + 10 MHz<br>f2 = fRXc2 + 20 MHz<br>Input 2 signals (f1, f2)                         | −1.5             | 2.5  | —    | dBm  | —     |
| H-6                                              | IIP3<br>−10 MHz detuning HG                | IIP3H2c2  | High-Gain mode<br>f1 = fRXc2 − 10 MHz<br>f2 = fRXc2 − 20 MHz<br>Input 2 signals (f1, f2)                         | 0.0              | 2.5  | —    | dBm  | —     |
| H-7                                              | IIP3<br>+10 MHz detuning LG                | IIP3L1c2  | Low-Gain mode<br>f1 = fRXc2 + 10 MHz<br>f2 = fRXc2 + 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 19               | 24   | —    | dBm  | —     |
| H-8                                              | IIP3<br>−10 MHz detuning LG                | IIP3L2c2  | Low-Gain mode<br>f1 = fRXc2 − 10 MHz<br>f2 = fRXc2 − 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 19               | 24   | —    | dBm  | —     |
| H-9                                              | Input P1dB                                 | IP1dBH1c2 | High-Gain mode<br>f = fRXc2                                                                                      | −20              | −13  | —    | dBm  | —     |
| H-10                                             | Input P1dB<br>TX undesired signal input HG | IP1dBH2c2 | High-Gain mode<br>f1 = fRXc2<br>PRX1 = −40 dBm<br>f2 = fRXc2 − 80 MHz<br>PRX2 : Var.<br>Input 2 signals (f1, f2) | −18              | −11  | —    | dBm  | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85 \text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc2} = 1\,930 \text{ MHz}$  to  $1\,990 \text{ MHz}$ ,  $PRX = -30 \text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.32 dB/0.32 dB) included.

| B No.                                            | Parameter              | Symbol   | Conditions                                                                                   | Reference values |      |      | Unit | Notes |
|--------------------------------------------------|------------------------|----------|----------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                  |                        |          |                                                                                              | Min              | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND II ) |                        |          |                                                                                              |                  |      |      |      |       |
| H-11                                             | IIP2                   | IIP2H1c2 | High-Gain mode<br>f1 = fRXc2 – 80 MHz<br>f2 = 80 MHz<br>Input 2 signals (f1, f2)             | 20               | 26   | —    | dBm  | —     |
| H-12                                             | IIP2                   | IIP2H2c2 | High-Gain mode<br>f1 = fRXc2 – 80 MHz<br>f2 = 2 × fRXc2 – 80 MHz<br>Input 2 signals (f1, f2) | 12               | 19   | —    | dBm  | —     |
| H-13                                             | K-factor               | KHc2     | High-Gain mode<br>f = 0 to 6 GHz                                                             | 1.5              | 2.0  | —    | —    | —     |
| H-14                                             | Reverse isolation HG   | ISOHc2   | High-Gain mode<br>f = fRXc2                                                                  | —                | –30  | –20  | dB   | —     |
| H-15                                             | Reverse isolation LG   | ISOLc2   | Low-Gain mode<br>f = fRXc2                                                                   | —                | –7.0 | –4.0 | dB   | —     |
| H-16                                             | Band to band isolation | BISc2    | LNA2 :High-Gain mode<br>LNA1:off<br>LNA1 input → LNA1 output<br>f = fRXc2                    | —                | –29  | –26  | dB   | —     |
| H-17                                             | Input return loss HG   | S11Hc2   | High-Gain mode<br>f = fRXc2                                                                  | 7.5              | 9.5  | —    | dB   | —     |
| H-18                                             | Input return loss LG   | S11Lc2   | Low-Gain mode<br>f = fRXc2                                                                   | 8.5              | 9.5  | —    | dB   | —     |
| H-19                                             | Output return loss HG  | S22Hc2   | High-Gain mode<br>f = fRXc2                                                                  | 8.5              | 9.5  | —    | dB   | —     |
| H-20                                             | Output return loss LG  | S22Lc2   | Low-Gain mode<br>f = fRXc2                                                                   | 8.5              | 9.5  | —    | dB   | —     |
| H-21                                             | Gain Changing Time     | TCGc2    | Low → High / High → Low<br>f = 1 990 MHz<br>Gain Error < 1 dB                                | —                | 7    | 16   | μs   | —     |
| H-22                                             | Band Changing Time     | TCBc2    | LNA2 → LNA1<br>f = 1 990 MHz<br>High Gain Mode<br>Gain Error < 1 dB                          | —                | 7    | 16   | μs   | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc3} = 2\ 110\text{ MHz}$  to  $2\ 155\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.34 dB/0.34 dB) included.

| B No.                                            | Parameter                                  | Symbol    | Conditions                                                                                                        | Reference values |      |      | Unit | Notes |
|--------------------------------------------------|--------------------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                  |                                            |           |                                                                                                                   | Min              | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND IV ) |                                            |           |                                                                                                                   |                  |      |      |      |       |
| I-1                                              | Power Gain HG                              | GHc3      | High-Gain mode<br>f = fRXc3                                                                                       | 14.6             | 16.1 | 17.8 | dB   | —     |
| I-2                                              | Power Gain LG                              | GLc3      | Low-Gain mode<br>f = fRXc3                                                                                        | −9.0             | −7.0 | −5.0 | dB   | —     |
| I-3                                              | Noise figure HG                            | NFHc3     | High-Gain mode<br>f = fRXc3                                                                                       | —                | 1.50 | 2.00 | dB   | —     |
| I-4                                              | Noise figure LG                            | NFLc3     | Low-Gain mode<br>f = fRXc3                                                                                        | —                | 7.0  | 10.0 | dB   | —     |
| I-5                                              | IIP3<br>+10 MHz detuning HG                | IIP3H1c3  | High-Gain mode<br>f1 = fRXc3 + 10 MHz<br>f2 = fRXc3 + 20 MHz<br>Input 2 signals (f1, f2)                          | −1.5             | 2.5  | —    | dBm  | —     |
| I-6                                              | IIP3<br>−10 MHz detuning HG                | IIP3H2c3  | High-Gain mode<br>f1 = fRXc3 − 10 MHz<br>f2 = fRXc3 − 20 MHz<br>Input 2 signals (f1, f2)                          | 0.0              | 2.5  | —    | dBm  | —     |
| I-7                                              | IIP3<br>+10 MHz detuning LG                | IIP3L1c3  | Low-Gain mode<br>f1 = fRXc3 + 10 MHz<br>f2 = fRXc3 + 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2)  | 19               | 24   | —    | dBm  | —     |
| I-8                                              | IIP3<br>−10 MHz detuning LG                | IIP3L2c3  | Low-Gain mode<br>f1 = fRXc3 − 10 MHz<br>f2 = fRXc3 − 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2)  | 19               | 24   | —    | dBm  | —     |
| I-9                                              | Input P1dB                                 | IP1dBH1c3 | High-Gain mode<br>f = fRXc3                                                                                       | −21              | −14  | —    | dBm  | —     |
| I-10                                             | Input P1dB<br>TX undesired signal input HG | IP1dBH2c3 | High-Gain mode<br>f1 = fRXc3<br>PRX1 = −40 dBm<br>f2 = fRXc3 − 400 MHz<br>PRX2 : Var.<br>Input 2 signals (f1, f2) | −21              | −14  | —    | dBm  | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc3} = 2\text{ 110 MHz to } 2\text{ 155 MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.34 dB/0.34 dB) included.

| B No.                                            | Parameter              | Symbol   | Conditions                                                                                     | Reference values |      |      | Unit | Notes |
|--------------------------------------------------|------------------------|----------|------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                  |                        |          |                                                                                                | Min              | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND IV ) |                        |          |                                                                                                |                  |      |      |      |       |
| I-11                                             | IIP2                   | IIP2H1c3 | High-Gain mode<br>f1 = fRXc3 – 400 MHz<br>f2 = 400 MHz<br>Input 2 signals (f1, f2)             | 7                | 12   | —    | dBm  | —     |
| I-12                                             | IIP2                   | IIP2H2c3 | High-Gain mode<br>f1 = fRXc3 – 400 MHz<br>f2 = 2 × fRXc3 – 400 MHz<br>Input 2 signals (f1, f2) | 9                | 14   | —    | dBm  | —     |
| I-13                                             | K-factor               | KHc3     | High-Gain mode<br>f = 0 to 6 GHz                                                               | 1.5              | 2.0  | —    | —    | —     |
| I-14                                             | Reverse isolation HG   | ISOHc3   | High-Gain mode<br>f = fRXc3                                                                    | —                | –30  | –20  | dB   | —     |
| I-15                                             | Reverse isolation LG   | ISOLc3   | Low-Gain mode<br>f = fRXc3                                                                     | —                | –7.0 | –4.0 | dB   | —     |
| I-16                                             | Band to band isolation | BISc3    | LNA2 : High-Gain mode<br>LNA1: off<br>LNA1 input → LNA1 output<br>f = fRXc3                    | —                | –27  | –24  | dB   | —     |
| I-17                                             | Input return loss HG   | S11Hc3   | High-Gain mode<br>f = fRXc3                                                                    | 8.5              | 9.5  | —    | dB   | —     |
| I-18                                             | Input return loss LG   | S11Lc3   | Low-Gain mode<br>f = fRXc3                                                                     | 8.5              | 9.5  | —    | dB   | —     |
| I-19                                             | Output return loss HG  | S22Hc3   | High-Gain mode<br>f = fRXc3                                                                    | 8.5              | 9.5  | —    | dB   | —     |
| I-20                                             | Output return loss LG  | S22Lc3   | Low-Gain mode<br>f = fRXc3                                                                     | 8.5              | 9.5  | —    | dB   | —     |
| I-21                                             | Gain Changing Time     | TCGc3    | Low → High / High → Low<br>f = 2170 MHz<br>Gain Error < 1 dB                                   | —                | 7    | 16   | μs   | —     |
| I-22                                             | Band Changing Time     | TCBc3    | LNA2 → LNA1<br>f = 2170 MHz<br>High Gain Mode<br>Gain Error < 1 dB                             | —                | 7    | 16   | μs   | —     |

# ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.85\text{ V}$

Notes) • All parameters are specified  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc4} = 1\,845\text{ MHz}$  to  $1\,880\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

• The characteristics listed below are reference values derived from the design of the IC and are not guaranteed by inspection.

If a problem does occur related to these characteristics, Matsushita will respond in good faith to user concerns.

• Input/output connector & substrate loss (0.32 dB/0.32 dB) included.

| B No.                                            | Parameter                                  | Symbol    | Conditions                                                                                                       | Reference values |      |      | Unit | Notes |
|--------------------------------------------------|--------------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------|------------------|------|------|------|-------|
|                                                  |                                            |           |                                                                                                                  | Min              | Typ  | Max  |      |       |
| LNA1 : AC electrical characteristics ( BAND IX ) |                                            |           |                                                                                                                  |                  |      |      |      |       |
| J-1                                              | Power Gain HG                              | GHc4      | High-Gain mode<br>f = fRXc4                                                                                      | 15.1             | 16.6 | 17.8 | dB   | —     |
| J-2                                              | Power Gain LG                              | GLc4      | Low-Gain mode<br>f = fRXc4                                                                                       | −9.0             | −7.0 | −5.0 | dB   | —     |
| J-3                                              | Noise figure HG                            | NFHc4     | High-Gain mode<br>f = fRXc4                                                                                      | —                | 1.40 | 1.80 | dB   | —     |
| J-4                                              | Noise figure LG                            | NFLc4     | Low-Gain mode<br>f = fRXc4                                                                                       | —                | 7.0  | 10.0 | dB   | —     |
| J-5                                              | IIP3<br>+10 MHz detuning HG                | IIP3H1c4  | High-Gain mode<br>f1 = fRXc4 + 10 MHz<br>f2 = fRXc4 + 20 MHz<br>Input 2 signals (f1, f2)                         | −1.5             | 2.5  | —    | dBm  | —     |
| F-6                                              | IIP3<br>−10 MHz detuning HG                | IIP3H2c4  | High-Gain mode<br>f1 = fRXc4 − 10 MHz<br>f2 = fRXc4 − 20 MHz<br>Input 2 signals (f1, f2)                         | −0.5             | 2.5  | —    | dBm  | —     |
| J-7                                              | IIP3<br>+10 MHz detuning LG                | IIP3L1c4  | Low-Gain mode<br>f1 = fRXc4 + 10 MHz<br>f2 = fRXc4 + 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 19               | 24   | —    | dBm  | —     |
| J-8                                              | IIP3<br>−10 MHz detuning LG                | IIP3L2c4  | Low-Gain mode<br>f1 = fRXc4 − 10 MHz<br>f2 = fRXc4 − 20 MHz<br>PRX1 = PRX2 = −10 dBm<br>Input 2 signals (f1, f2) | 19               | 25   | —    | dBm  | —     |
| J-9                                              | Input P1dB                                 | IP1dBH1c4 | High-Gain mode<br>f = fRXc4                                                                                      | −21              | −14  | —    | dBm  | —     |
| J-10                                             | Input P1dB<br>TX undesired signal input HG | IP1dBH2c4 | High-Gain mode<br>f1 = fRXc4<br>PRX1 = −40 dBm<br>f2 = fRXc4 − 95 MHz<br>PRX2 : Var.<br>Input 2 signals (f1, f2) | −19              | −12  | —    | dBm  | —     |

# ■ Control Pin Mode Table

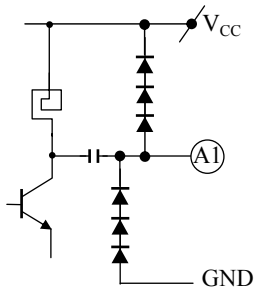
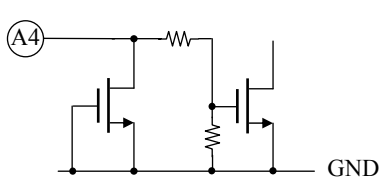
Note) See parameters B No.DC-7 to B No.DC-8 in the Electrical Characteristics for control voltage retention ranges.

| CNT1<br>(LNA select 1) | CNT2<br>(LNA select 2) | CNT3<br>(Gain control) | LNA1<br>(Band I,II,IV,IX) | LNA2<br>(Band I) | LNA3<br>(Band V,VIII) | Mode           |
|------------------------|------------------------|------------------------|---------------------------|------------------|-----------------------|----------------|
| High                   | High                   | High                   | —                         | —                | —                     | —              |
|                        |                        | Low                    | —                         | —                | —                     | —              |
| High                   | Low                    | High                   | Off                       | Off              | On                    | LNA3 High-Gain |
|                        |                        | Low                    | Off                       | Off              | On                    | LNA3 Low-Gain  |
| Low                    | High                   | High                   | On                        | Off              | Off                   | LNA1 High-Gain |
|                        |                        | Low                    | On                        | Off              | Off                   | LNA1 Low-Gain  |
| Low                    | Low                    | High                   | Off                       | On               | Off                   | LNA2 High-Gain |
|                        |                        | Low                    | Off                       | On               | Off                   | LNA2 Low-Gain  |

# ■ Technical Data

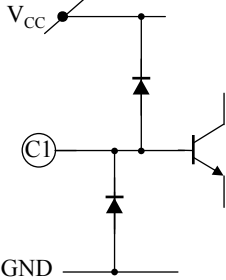
- I/O block circuit diagrams and pin function descriptions

Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

| Pin No. | Voltage | Internal Circuit                                                                    | Description                     |
|---------|---------|-------------------------------------------------------------------------------------|---------------------------------|
| A1      | —       |    | LNA1 RF Output (Band II)        |
| A2      | —       | Refer to A1                                                                         | LNA2 RF Output (Band I)         |
| A3      | —       | Refer to A1                                                                         | LNA3 RF Output (Band V)         |
| A4      | —       |  | CNT1 ;<br>LNA select SW input 1 |
| B1      | 2.85 V  | —                                                                                   | Voltage supply ( $V_{CC}$ )     |
| B2      | 0.0 V   | —                                                                                   | GND                             |
| B3      | —       | Refer to A4                                                                         | CNT2 ;<br>LNA select SW input 2 |
| B4      | —       | —                                                                                   | N.C.                            |

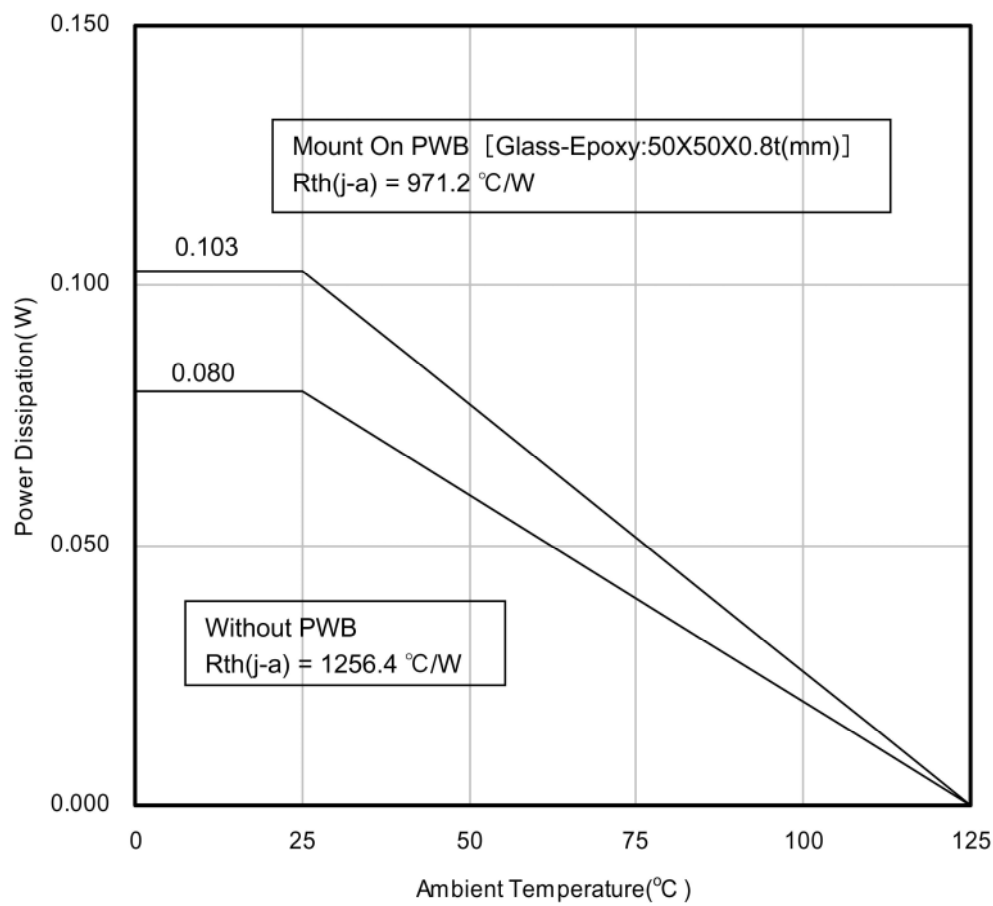
■ Technical Data (continued)  
• I/O block circuit diagrams and pin function descriptions (continued)

Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

| Pin No. | Voltage | Internal Circuit                                                                  | Description                             |
|---------|---------|-----------------------------------------------------------------------------------|-----------------------------------------|
| C1      | 0.75 V  |  | LNA1 RF Input (Band II)                 |
| C2      | 0.75 V  | Refer to C1                                                                       | LNA2 RF Input (Band I)                  |
| C3      | 0.75 V  | Refer to C1                                                                       | LNA3 RF Input (Band V)                  |
| C4      | —       | Refer to A4                                                                       | CNT3 ;<br>High-Gain / Low-Gain SW input |

■ Technical Data (continued)

- $P_D - T_a$  diagram



**■ Usage Notes****• Special attention and precaution in using**

1. This IC is intended to be used for general electronic equipment [Triple-band UMTS handset].  
Consult our sales staff in advance for information on the following applications:
  - Special applications in which exceptional quality and reliability are required, or if the failure or malfunction of this IC may directly jeopardize life or harm the human body.
  - Any applications other than the standard applications intended.
    - (1) Space appliance (such as artificial satellite, and rocket)
    - (2) Traffic control equipment (such as for automobile, airplane, train, and ship)
    - (3) Medical equipment for life support
    - (4) Submarine transponder
    - (5) Control equipment for power plant
    - (6) Disaster prevention and security device
    - (7) Weapon
    - (8) Others : Applications of which reliability equivalent to (1) to (7) is required
2. Pay attention to the direction of LSI. When mounting it in the wrong direction onto the PCB (printed-circuit-board), it might smoke or ignite.
3. Pay attention in the PCB (printed-circuit-board) pattern layout in order to prevent damage due to short circuit between pins. In addition, refer to the Pin Description (Page 5 and Page 6) for the pin configuration.
4. Perform a visual inspection on the PCB before applying power, otherwise damage might happen due to problems such as a solder-bridge between the pins of the semiconductor device. Also, perform a full technical verification on the assembly quality, because the same damage possibly can happen due to conductive substances, such as solder ball, that adhere to the LSI during transportation.
5. Take notice in the use of this product that it might break or occasionally smoke when an abnormal state occurs such as output pin- $V_{CC}$  short (Power supply fault), output pin-GND short (Ground fault), or output-to-output-pin short (load short) .  
And, safety measures such as an installation of fuses are recommended because the extent of the above-mentioned damage and smoke emission will depend on the current capability of the power supply.
6. When using the LSI for new models, verify the safety including the long-term reliability for each product.
7. When the application system is designed by using this LSI, be sure to confirm notes in this book.  
Be sure to read the notes to descriptions and the usage notes in the book.
8. Due to unshielded structure of this IC, under exposure of light, function and characteristic of the product cannot be guaranteed.  
During normal operation or even under testing condition, please ensure that IC is not exposed to light.
9. Basically, chip surface is ground potential. Please design to ensure no contact between chip surface and metal shielding.

**Request for your special attention and precautions in using the technical information and  
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- (5) When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.  
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