DATA SHEET

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

Contents

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 µm SiGeC Bi-CMOS process (f_T = 90 GHz, f_{max} = 140 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 µA typ.	(Low-Gain mode)	
• High gain(Gain)	16.5 dB typ.	fRX = 2140 MHz	(High-Gain mode)
	16.5 dB typ.	fRX = 881.5 MHz	(High-Gain mode)
	16.3 dB typ.	fRX = 1960 MHz	(High-Gain mode)
• Low noise figure(NF)	1.40 dB typ.	fRX = 2140 MHz	(High-Gain mode)
	1.10 dB typ.	fRX = 881.5 MHz	(High-Gain mode)
	1.40 dB typ.	fRX = 1960 MHz	(High-Gain mode)
• Low distortion	2.0 dBm typ.	fRX = 2140 MHz	(High-Gain mode)
(IIP3 +10 MHz offset)	4.0 dBm typ.	fRX = 881.5 MHz	(High-Gain mode)
	2.5 dBm typ.	fRX = 1960 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 × 1.16 mm (0.3 mm pitch)

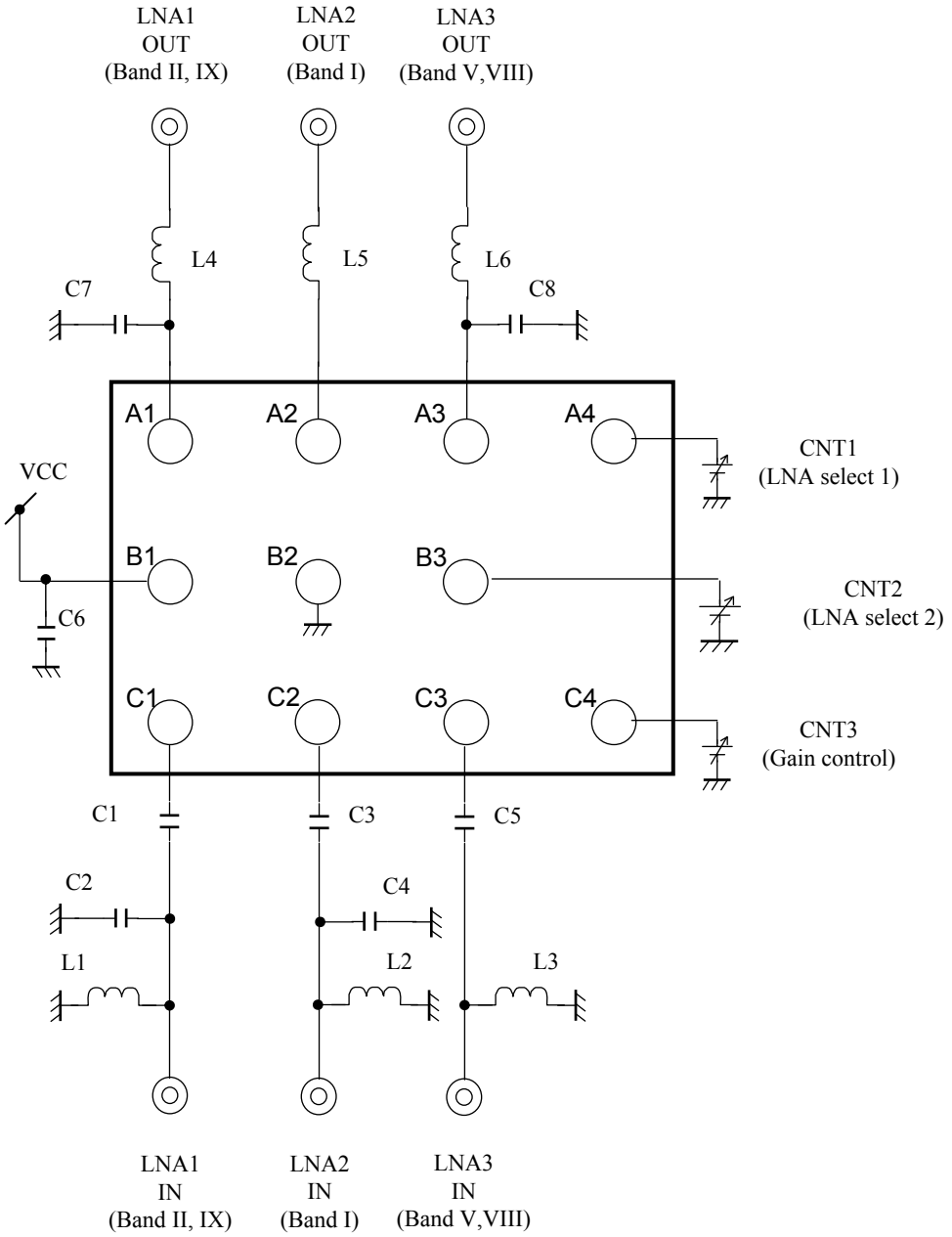
■ Type

- Bi-CMOS IC

■ Application Circuit Example 1 (Block Diagram)

Note) See "External parts 1" on Page47.

(Top View)



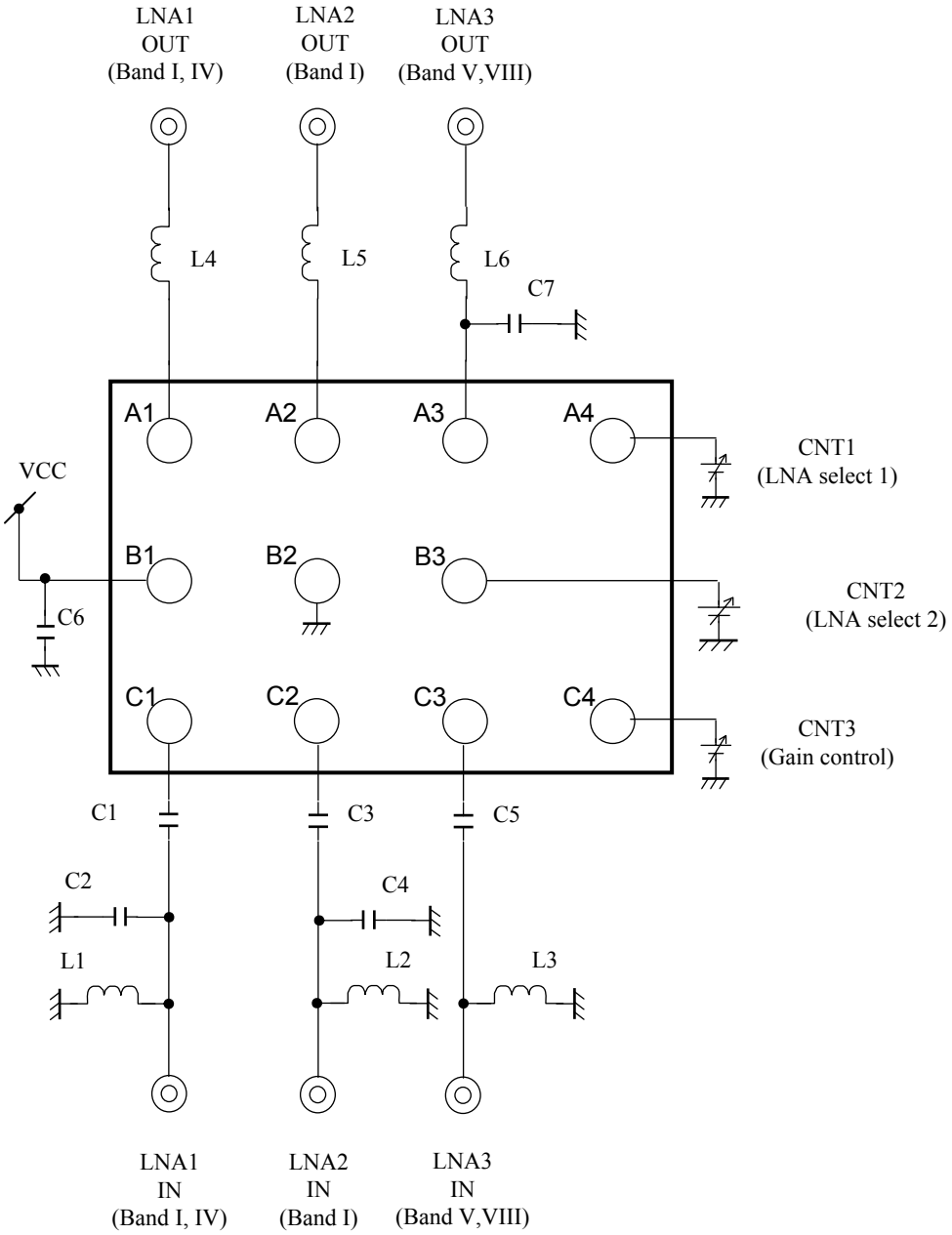
Notes) • This application circuit is shown as an example but does not guarantee the design for mass production set.

• 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_{CC}
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°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°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 V

Notes) • All parameters are specified under T_a = 25°C±2°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_{CC} current at LNA2 High-Gain mode. No input signal	—	4.7	6.3	mA	—
DC-2	Circuit current HG (LNA3)	IccHb	V_{CC} current at LNA3 High-Gain mode. No input signal	—	4.1	5.5	mA	—
DC-3	Circuit current HG (LNA1)	IccHc	V_{CC} current at LNA1 High-Gain mode. No input signal	—	4.7	6.3	mA	—
DC-4	Circuit current LG (LNA2)	IccLa	V_{CC} current at LNA2 Low-Gain mode. No input signal	—	11	60	µA	—
DC-5	Circuit current LG (LNA3)	IccLb	V_{CC} current at LNA3 Low-Gain mode. No input signal	—	25	80	µA	—
DC-6	Circuit current LG (LNA1)	IccLc	V_{CC} current at LNA1 Low-Gain mode. No input signal	—	25	80	µA	—
DC-7	SW voltage (High)	VIH	—	1.60	—	—	V	—
DC-8	SW voltage (Low)	VIL	VIL = $V_{CC} \times 0.20$	0.0	—	0.6	V	—
DC-9	SW current (High)	IIH	Current at CNT pin VIH = V_{CC}	—	10	20	µA	—

■ Electrical Characteristics (continued) at V_{CC} = 2.85 V

Notes) • All parameters are specified under T_a = 25°C±2°C, fRXa = 2 140 MHz, PRX = –30 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 f = fRXa	15.0	16.5	18.0	dB	—
A-2	Power Gain LG	GLSa	Low-Gain mode f = fRXa	–9.0	–7.0	–5.0	dB	—
A-3	IIP3 +10 MHz detuning HG	IIP3H1Sa	High-Gain mode f1 = fRXa + 10 MHz f2 = fRXa + 20 MHz Input 2 signals (f1, f2)	–2.5	2.0	—	dBm	—
A-4	IIP3 –10 MHz detuning HG	IIP3H2Sa	High-Gain mode f1 = fRXa – 10 MHz f2 = fRXa – 20 MHz Input 2 signals (f1, f2)	–1.5	3.0	—	dBm	—

■ Electrical Characteristics (continued) at V_{CC} = 2.85 V

Notes) • All parameters are specified under T_a = 25°C±2°C, fRXb = 881.5 MHz, PRX = –30 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 f = fRXb	15.0	16.5	17.7	dB	—
B-2	Power Gain LG	GLSb	Low-Gain mode f = fRXb	–7.5	–5.5	–3.5	dB	—
B-3	IIP3 +10 MHz detuning HG	IIP3H1Sb	High-Gain mode f1 = fRXb + 10 MHz f2 = fRXb + 20 MHz Input 2 signals (f1, f2)	– 0.5	4.0	—	dBm	—
B-4	IIP3 –10 MHz detuning HG	IIP3H2Sb	High-Gain mode f1 = fRXb – 10 MHz f2 = fRXb – 20 MHz Input 2 signals (f1, f2)	– 0.5	3.0	—	dBm	—

■ Electrical Characteristics (continued) at V_{CC} = 2.85 V

Notes) • All parameters are specified under T_a = 25°C±2°C, fRXc = 1 960 MHz, PRX = –30 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	GHSc	High-Gain mode f = fRXc	14.8	16.3	17.8	dB	—
C-2	Power Gain LG	GLSc	Low-Gain mode f = fRXc	–9.0	–7.0	–5.0	dB	—
C-3	IIP3 +10 MHz detuning HG	IIP3H1Sc	High-Gain mode f1 = fRXc + 10 MHz f2 = fRXc + 20 MHz Input 2 signals (f1, f2)	–1.5	2.5	—	dBm	—
C-4	IIP3 –10 MHz detuning HG	IIP3H2Sc	High-Gain mode f1 = fRXc – 10 MHz f2 = fRXc – 20 MHz Input 2 signals (f1, f2)	0.0	2.5	—	dBm	—

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

Notes) • All parameters are specified under T_a = 25°C±2°C, fRXa = 2 110 MHz to 2 170 MHz, PRX = –30 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 f = fRXa	15.0	16.5	18.0	dB	—
D-2	Power Gain LG	GLa	Low-Gain mode f = fRXa	–9.0	–7.0	–5.0	dB	—
D-3	Noise figure HG	NFHa	High-Gain mode f = fRXa	—	1.40	1.80	dB	—
D-4	Noise figure LG	NFLa	Low-Gain mode f = fRXa	—	7.0	10.0	dB	—
D-5	IIP3 +10 MHz detuning HG	IIP3H1a	High-Gain mode f1 = fRXa + 10 MHz f2 = fRXa + 20 MHz Input 2 signals (f1, f2)	–2.5	2.0	—	dBm	—
D-6	IIP3 –10 MHz detuning HG	IIP3H2a	High-Gain mode f1 = fRXa – 10 MHz f2 = fRXa – 20 MHz Input 2 signals (f1, f2)	–1.5	3.0	—	dBm	—
D-7	IIP3 +10 MHz detuning LG	IIP3L1a	Low-Gain mode f1 = fRXa + 10 MHz f2 = fRXa + 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	20	25	—	dBm	—
D-8	IIP3 –10 MHz detuning LG	IIP3L2a	Low-Gain mode f1 = fRXa – 10 MHz f2 = fRXa – 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	20	26	—	dBm	—
D-9	Input P1dB	IP1dBH1a	High-Gain mode f = fRXa	-22	–16	—	dBm	—
D-10	Input P1dB TX undesired signal input HG	IP1dBH2a	High-Gain mode f1 = fRXa PRX1 = –40 dBm f2 = fRXa – 190 MHz PRX2 : Var. Input 2 signals (f1, f2)	–17	–10	—	dBm	—

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

Notes) • All parameters are specified under T_a = 25°C±2°C, fRXa = 2 110 MHz to 2 170 MHz, PRX = –30 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 f1 = fRXa – 190 MHz f2 = 190 MHz Input 2 signals (f1, f2)	10	15	—	dBm	—
D-12	IIP2	IIP2H2a	High-Gain mode f1 = fRXa – 190 MHz f2 = 2 × fRXa – 190 MHz Input 2 signals (f1, f2)	10	16	—	dBm	—
D-13	K-factor	KHa	High-Gain mode f = 0 to 6 GHz	2.0	4.0	—	—	—
D-14	Reverse isolation HG	ISOHa	High-Gain mode f = fRXa	—	–30	–20	dB	—
D-15	Reverse isolation LG	ISOLa	Low-Gain mode f = fRXa	—	–7.0	–4.0	dB	—
D-16	Band to band isolation	BISa	LNA1 / LNA3 :High-Gain mode LNA2:off LNA2 input → LNA2 output f = fRXa	—	–30	-27	dB	—
D-17	Input return loss HG	S11Ha	High-Gain mode f = fRXa	6.5	9.5	—	dB	—
D-18	Input return loss LG	S11La	Low-Gain mode f = fRXa	8.5	9.5	—	dB	—
D-19	Output return loss HG	S22Ha	High-Gain mode f = fRXa	8.5	9.5	—	dB	—
D-20	Output return loss LG	S22La	Low-Gain mode f = fRXa	8.5	9.5	—	dB	—
D-21	Gain Changing Time	TCGa	Low → High / High → Low f = 2 170 MHz Gain Error < 1 dB	—	7	16	µs	—
D-22	Band Changing Time	BCGa	LNA3 → LNA2 f = 2 170 MHz LNA1 → LNA2 f = 2 170 MHz High Gain Mode Gain Error < 1 dB	—	7	16	µs	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXb1 = 869 MHz to 894 MHz, PRX = –30 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 f = fRXb1	15.0	16.5	17.7	dB	—
E-2	Power Gain LG	GLb1	Low-Gain mode f = fRXb1	–7.5	–5.5	–3.5	dB	—
E-3	Noise figure HG	NFHb1	High-Gain mode f = fRXb1	—	1.10	1.35	dB	—
E-4	Noise figure LG	NFLb1	Low-Gain mode f = fRXb1	—	5.5	8.5	dB	—
E-5	IIP3 +10 MHz detuning HG	IIP3H1b1	High-Gain mode f1 = fRXb1 + 10 MHz f2 = fRXb1 + 20 MHz Input 2 signals (f1, f2)	– 0.5	4.5	—	dBm	—
E-6	IIP3 –10 MHz detuning HG	IIP3H2b1	High-Gain mode f1 = fRXb1 – 10 MHz f2 = fRXb1 – 20 MHz Input 2 signals (f1, f2)	– 0.5	3.0	—	dBm	—
E-7	IIP3 +10 MHz detuning LG	IIP3L1b1	Low-Gain mode f1 = fRXb1 + 10 MHz f2 = fRXb1 + 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	18	22	—	dBm	—
E-8	IIP3 –10 MHz detuning LG	IIP3L2b1	Low-Gain mode f1 = fRXb1 – 10 MHz f2 = fRXb1 – 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	18	23	—	dBm	—
E-9	Input P1dB	IP1dBH1b1	High-Gain mode f = fRXb1	–21	–14	—	dBm	—
E-10	Input P1dB TX undesired signal input HG	IP1dBH2b1	High-Gain mode f1 = fRXb1 PRX1 = –40 dBm f2 = fRXb1 – 45 MHz PRX2 : Var. Input 2 signals (f1, f2)	–20	–13	—	dBm	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXb1 = 869 MHz to 894 MHz, PRX = –30 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 f1 = fRXb1 – 45 MHz f2 = 45 MHz Input 2 signals (f1, f2)	12	17	—	dBm	—
E-12	IIP2	IIP2H2b1	High-Gain mode f1 = fRXb1 – 45 MHz f2 = 2 × fRXb1 – 45 MHz Input 2 signals (f1, f2)	–1.5	2.5	—	dBm	—
E-13	K-factor	KHb1	High-Gain mode f = 0 to 6 GHz	1.5	2.0	—	—	—
E-14	Reverse isolation HG	ISOHb1	High-Gain mode f = fRXb1	—	–24	–18	dB	—
E-15	Reverse isolation LG	ISOLb1	Low-Gain mode f = fRXb1	—	–6.0	–3.0	dB	—
E-16	Band to band isolation	BISb1	LNA2 :High-Gain mode LNA3:off LNA3 input → LNA3 output f = fRXb1	—	–24	–20	dB	—
E-17	Input return loss HG	S11Hb1	High-Gain mode f = fRXb1	8	9.5	—	dB	—
E-18	Input return loss LG	S11Lb1	Low-Gain mode f = fRXb1	6	6.5	—	dB	—
E-19	Output return loss HG	S22Hb1	High-Gain mode f = fRXb1	8.5	9.5	—	dB	—
E-20	Output return loss LG	S22Lb1	Low-Gain mode f = fRXb1	8.5	9.5	—	dB	—
E-21	Gain Changing Time	TCGb1	Low → High / High → Low f = 960 MHz Gain Error < 1 dB	—	7.5	18	µs	—
E-22	Band Changing Time	TCBb1	LNA2 → LNA3 f = 960 MHz High Gain Mode Gain Error < 1 dB	—	7.5	18	µs	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXb2 = 925 MHz to 960 MHz, PRX = –30 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 f = fRXb2	14.7	16.2	17.4	dB	—
F-2	Power Gain LG	GLb2	Low-Gain mode f = fRXb2	–7.5	–5.5	–3.5	dB	—
F-3	Noise figure HG	NFHb2	High-Gain mode f = fRXb2	—	1.10	1.35	dB	—
F-4	Noise figure LG	NFLb2	Low-Gain mode f = fRXb2	—	5.5	8.5	dB	—
F-5	IIP3 +10 MHz detuning HG	IIP3H1b2	High-Gain mode f1 = fRXb2 + 10 MHz f2 = fRXb2 + 20 MHz Input 2 signals (f1, f2)	–1.0	4.0	—	dBm	—
F-6	IIP3 –10 MHz detuning HG	IIP3H2b2	High-Gain mode f1 = fRXb2 – 10 MHz f2 = fRXb2 – 20 MHz Input 2 signals (f1, f2)	– 0.5	3.0	—	dBm	—
F-7	IIP3 +10 MHz detuning LG	IIP3L1b2	Low-Gain mode f1 = fRXb2 + 10 MHz f2 = fRXb2 + 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	17	22	—	dBm	—
F-8	IIP3 –10 MHz detuning LG	IIP3L2b2	Low-Gain mode f1 = fRXb2 – 10 MHz f2 = fRXb2 – 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	17	22	—	dBm	—
F-9	Input P1dB	IP1dBH1b2	High-Gain mode f = fRXb2	–21	–14	—	dBm	—
F-10	Input P1dB TX undesired signal input HG	IP1dBH2b2	High-Gain mode f1 = fRXb2 PRX1 = –40 dBm f2 = fRXb2 – 45 MHz PRX2 : Var. Input 2 signals (f1, f2)	–17	–10	—	dBm	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXb2 = 925 MHz to 960 MHz, PRX = –30 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 f1 = fRXb2 – 45 MHz f2 = 45 MHz Input 2 signals (f1, f2)	12	17	—	dBm	—
F-12	IIP2	IIP2H2b2	High-Gain mode f1 = fRXb2 – 45 MHz f2 = 2 × fRXb2 – 45 MHz Input 2 signals (f1, f2)	–1.5	3.5	—	dBm	—
F-13	K-factor	KHb2	High-Gain mode f = 0 to 6 GHz	1.5	2.0	—	—	—
F-14	Reverse isolation HG	ISOHb2	High-Gain mode f = fRXb2	—	–24	–18	dB	—
F-15	Reverse isolation LG	ISOLb2	Low-Gain mode f = fRXb2	—	–6.0	–3.0	dB	—
F-16	Band to band isolation	BISb2	LNA2 :High-Gain mode LNA3:off LNA3 input → LNA3 output f = fRXb2	—	–24	–20	dB	—
F-17	Input return loss HG	S11Hb2	High-Gain mode f = fRXb2	8.5	9.5	—	dB	—
F-18	Input return loss LG	S11Lb2	Low-Gain mode f = fRXb2	5.5	6.0	—	dB	—
F-19	Output return loss HG	S22Hb2	High-Gain mode f = fRXb2	8.5	9.5	—	dB	—
F-20	Output return loss LG	S22Lb2	Low-Gain mode f = fRXb2	8.5	9.5	—	dB	—
F-21	Gain Changing Time	TCGb2	Low → High / High → Low f = 960 MHz Gain Error < 1 dB	—	7.5	18	µs	—
F-22	Band Changing Time	TCBb2	LNA2 → LNA3 f = 960 MHz High Gain Mode Gain Error < 1 dB	—	7.5	18	µs	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXc1 = 2 110 MHz to 2 170 MHz, PRX = –30 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 f = fRXc1	14.6	16.1	17.8	dB	—
G-2	Power Gain LG	GLc1	Low-Gain mode f = fRXc1	–9.0	–7.0	–5.0	dB	—
G-3	Noise figure HG	NFHc1	High-Gain mode f = fRXc1	—	1.50	2.00	dB	—
G-4	Noise figure LG	NFLc1	Low-Gain mode f = fRXc1	—	7.0	10.0	dB	—
G-5	IIP3 +10 MHz detuning HG	IIP3H1c1	High-Gain mode f1 = fRXc1 + 10 MHz f2 = fRXc1 + 20 MHz Input 2 signals (f1, f2)	–1.5	2.5	—	dBm	—
G-6	IIP3 –10 MHz detuning HG	IIP3H2c1	High-Gain mode f1 = fRXc1 – 10 MHz f2 = fRXc1 – 20 MHz Input 2 signals (f1, f2)	0.0	2.5	—	dBm	—
G-7	IIP3 +10 MHz detuning LG	IIP3L1c1	Low-Gain mode f1 = fRXc1 + 10 MHz f2 = fRXc1 + 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	19	24	—	dBm	—
G-8	IIP3 –10 MHz detuning LG	IIP3L2c1	Low-Gain mode f1 = fRXc1 – 10 MHz f2 = fRXc1 – 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	20	25	—	dBm	—
G-9	Input P1dB	IP1dBH1c1	High-Gain mode f = fRXc1	–21	–14	—	dBm	—
G-10	Input P1dB TX undesired signal input HG	IP1dBH2c1	High-Gain mode f1 = fRXc1 PRX1 = –40 dBm f2 = fRXc1 – 190 MHz PRX2 : Var. Input 2 signals (f1, f2)	–16	–9	—	dBm	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXc1 = 2 110 MHz to 2 170 MHz, PRX = –30 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 f1 = fRXc1 – 190 MHz f2 = 190 MHz Input 2 signals (f1, f2)	11	19	—	dBm	—
G-12	IIP2	IIP2H2c1	High-Gain mode f1 = fRXc1 – 190 MHz f2 = 2 × fRXc1 – 190 MHz Input 2 signals (f1, f2)	10	18	—	dBm	—
G-13	K-factor	KHc1	High-Gain mode f = 0 to 6 GHz	1.5	2.0	—	—	—
G-14	Reverse isolation HG	ISOHc1	High-Gain mode f = fRXc1	—	–30	–20	dB	—
G-15	Reverse isolation LG	ISOLc1	Low-Gain mode f = fRXc1	—	–7.0	–4.0	dB	—
G-16	Band to band isolation	BISc1	LNA2 :High-Gain mode LNA1:off LNA1 input → LNA1 output f = fRXc1	—	–26	–23	dB	—
G-17	Input return loss HG	S11Hc1	High-Gain mode f = fRXc1	8.5	9.5	—	dB	—
G-18	Input return loss LG	S11Lc1	Low-Gain mode f = fRXc1	8.5	9.5	—	dB	—
G-19	Output return loss HG	S22Hc1	High-Gain mode f = fRXc1	8.5	9.5	—	dB	—
G-20	Output return loss LG	S22Lc1	Low-Gain mode f = fRXc1	8.5	9.5	—	dB	—
G-21	Gain Changing Time	TCGc1	Low → High / High → Low f = 2170 MHz Gain Error < 1 dB	—	7	16	µs	—
G-22	Band Changing Time	TCBc1	LNA2 → LNA1 f = 2170 MHz High Gain Mode Gain Error < 1 dB	—	7	16	µs	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXc2 = 1 930 MHz to 1 990 MHz, PRX = –30 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 f = fRXc2	14.8	16.3	17.8	dB	—
H-2	Power Gain LG	GLc2	Low-Gain mode f = fRXc2	–9.0	–7.0	–5.0	dB	—
H-3	Noise figure HG	NFHc2	High-Gain mode f = fRXc2	—	1.40	1.80	dB	—
H-4	Noise figure LG	NFLc2	Low-Gain mode f = fRXc2	—	7.0	10.0	dB	—
H-5	IIP3 +10 MHz detuning HG	IIP3H1c2	High-Gain mode f1 = fRXc2 + 10 MHz f2 = fRXc2 + 20 MHz Input 2 signals (f1, f2)	–1.5	2.5	—	dBm	—
H-6	IIP3 –10 MHz detuning HG	IIP3H2c2	High-Gain mode f1 = fRXc2 – 10 MHz f2 = fRXc2 – 20 MHz Input 2 signals (f1, f2)	0.0	2.5	—	dBm	—
H-7	IIP3 +10 MHz detuning LG	IIP3L1c2	Low-Gain mode f1 = fRXc2 + 10 MHz f2 = fRXc2 + 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	19	24	—	dBm	—
H-8	IIP3 –10 MHz detuning LG	IIP3L2c2	Low-Gain mode f1 = fRXc2 – 10 MHz f2 = fRXc2 – 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	19	24	—	dBm	—
H-9	Input P1dB	IP1dBH1c2	High-Gain mode f = fRXc2	–20	–13	—	dBm	—
H-10	Input P1dB TX undesired signal input HG	IP1dBH2c2	High-Gain mode f1 = fRXc2 PRX1 = –40 dBm f2 = fRXc2 – 80 MHz PRX2 : Var. Input 2 signals (f1, f2)	–18	–11	—	dBm	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXc2 = 1 930 MHz to 1 990 MHz, PRX = –30 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 f1 = fRXc2 – 80 MHz f2 = 80 MHz Input 2 signals (f1, f2)	20	26	—	dBm	—
H-12	IIP2	IIP2H2c2	High-Gain mode f1 = fRXc2 – 80 MHz f2 = 2 × fRXc2 – 80 MHz Input 2 signals (f1, f2)	12	19	—	dBm	—
H-13	K-factor	KHc2	High-Gain mode f = 0 to 6 GHz	1.5	2.0	—	—	—
H-14	Reverse isolation HG	ISOHc2	High-Gain mode f = fRXc2	—	–30	–20	dB	—
H-15	Reverse isolation LG	ISOLc2	Low-Gain mode f = fRXc2	—	–7.0	–4.0	dB	—
H-16	Band to band isolation	BISc2	LNA2 :High-Gain mode LNA1:off LNA1 input → LNA1 output f = fRXc2	—	–29	–26	dB	—
H-17	Input return loss HG	S11Hc2	High-Gain mode f = fRXc2	7.5	9.5	—	dB	—
H-18	Input return loss LG	S11Lc2	Low-Gain mode f = fRXc2	8.5	9.5	—	dB	—
H-19	Output return loss HG	S22Hc2	High-Gain mode f = fRXc2	8.5	9.5	—	dB	—
H-20	Output return loss LG	S22Lc2	Low-Gain mode f = fRXc2	8.5	9.5	—	dB	—
H-21	Gain Changing Time	TCGc2	Low → High / High → Low f = 1 990 MHz Gain Error < 1 dB	—	7	16	µs	—
H-22	Band Changing Time	TCBc2	LNA2 → LNA1 f = 1 990 MHz High Gain Mode Gain Error < 1 dB	—	7	16	µs	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXc3 = 2 110 MHz to 2 155 MHz, PRX = –30 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 f = fRXc3	14.6	16.1	17.8	dB	—
I-2	Power Gain LG	GLc3	Low-Gain mode f = fRXc3	–9.0	–7.0	–5.0	dB	—
I-3	Noise figure HG	NFHc3	High-Gain mode f = fRXc3	—	1.50	2.00	dB	—
I-4	Noise figure LG	NFLc3	Low-Gain mode f = fRXc3	—	7.0	10.0	dB	—
I-5	IIP3 +10 MHz detuning HG	IIP3H1c3	High-Gain mode f1 = fRXc3 + 10 MHz f2 = fRXc3 + 20 MHz Input 2 signals (f1, f2)	–1.5	2.5	—	dBm	—
I-6	IIP3 –10 MHz detuning HG	IIP3H2c3	High-Gain mode f1 = fRXc3 – 10 MHz f2 = fRXc3 – 20 MHz Input 2 signals (f1, f2)	0.0	2.5	—	dBm	—
I-7	IIP3 +10 MHz detuning LG	IIP3L1c3	Low-Gain mode f1 = fRXc3 + 10 MHz f2 = fRXc3 + 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	19	24	—	dBm	—
I-8	IIP3 –10 MHz detuning LG	IIP3L2c3	Low-Gain mode f1 = fRXc3 – 10 MHz f2 = fRXc3 – 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	19	24	—	dBm	—
I-9	Input P1dB	IP1dBH1c3	High-Gain mode f = fRXc3	–21	–14	—	dBm	—
I-10	Input P1dB TX undesired signal input HG	IP1dBH2c3	High-Gain mode f1 = fRXc3 PRX1 = –40 dBm f2 = fRXc3 – 400 MHz PRX2 : Var. Input 2 signals (f1, f2)	–21	–14	—	dBm	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXc3 = 2 110 MHz to 2 155 MHz, PRX = –30 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 f1 = fRXc3 – 400 MHz f2 = 400 MHz Input 2 signals (f1, f2)	7	12	—	dBm	—
I-12	IIP2	IIP2H2c3	High-Gain mode f1 = fRXc3 – 400 MHz f2 = 2 × fRXc3 – 400 MHz Input 2 signals (f1, f2)	9	14	—	dBm	—
I-13	K-factor	KHc3	High-Gain mode f = 0 to 6 GHz	1.5	2.0	—	—	—
I-14	Reverse isolation HG	ISOHc3	High-Gain mode f = fRXc3	—	–30	–20	dB	—
I-15	Reverse isolation LG	ISOLc3	Low-Gain mode f = fRXc3	—	–7.0	–4.0	dB	—
I-16	Band to band isolation	BISc3	LNA2 : High-Gain mode LNA1: off LNA1 input → LNA1 output f = fRXc3	—	–27	–24	dB	—
I-17	Input return loss HG	S11Hc3	High-Gain mode f = fRXc3	8.5	9.5	—	dB	—
I-18	Input return loss LG	S11Lc3	Low-Gain mode f = fRXc3	8.5	9.5	—	dB	—
I-19	Output return loss HG	S22Hc3	High-Gain mode f = fRXc3	8.5	9.5	—	dB	—
I-20	Output return loss LG	S22Lc3	Low-Gain mode f = fRXc3	8.5	9.5	—	dB	—
I-21	Gain Changing Time	TCGc3	Low → High / High → Low f = 2170 MHz Gain Error < 1 dB	—	7	16	µs	—
I-22	Band Changing Time	TCBc3	LNA2 → LNA1 f = 2170 MHz High Gain Mode Gain Error < 1 dB	—	7	16	µs	—

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

Notes) • All parameters are specified T_a = 25°C±2°C, fRXc4 = 1 845 MHz to 1 880 MHz, PRX = –30 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 f = fRXc4	15.1	16.6	17.8	dB	—
J-2	Power Gain LG	GLc4	Low-Gain mode f = fRXc4	–9.0	–7.0	–5.0	dB	—
J-3	Noise figure HG	NFHc4	High-Gain mode f = fRXc4	—	1.40	1.80	dB	—
J-4	Noise figure LG	NFLc4	Low-Gain mode f = fRXc4	—	7.0	10.0	dB	—
J-5	IIP3 +10 MHz detuning HG	IIP3H1c4	High-Gain mode f1 = fRXc4 + 10 MHz f2 = fRXc4 + 20 MHz Input 2 signals (f1, f2)	–1.5	2.5	—	dBm	—
F-6	IIP3 –10 MHz detuning HG	IIP3H2c4	High-Gain mode f1 = fRXc4 – 10 MHz f2 = fRXc4 – 20 MHz Input 2 signals (f1, f2)	–0.5	2.5	—	dBm	—
J-7	IIP3 +10 MHz detuning LG	IIP3L1c4	Low-Gain mode f1 = fRXc4 + 10 MHz f2 = fRXc4 + 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	19	24	—	dBm	—
J-8	IIP3 –10 MHz detuning LG	IIP3L2c4	Low-Gain mode f1 = fRXc4 – 10 MHz f2 = fRXc4 – 20 MHz PRX1 = PRX2 = –10 dBm Input 2 signals (f1, f2)	19	25	—	dBm	—
J-9	Input P1dB	IP1dBH1c4	High-Gain mode f = fRXc4	–21	–14	—	dBm	—
J-10	Input P1dB TX undesired signal input HG	IP1dBH2c4	High-Gain mode f1 = fRXc4 PRX1 = –40 dBm f2 = fRXc4 – 95 MHz PRX2 : Var. Input 2 signals (f1, f2)	–19	–12	—	dBm	—

■ Control Pin Mode Table

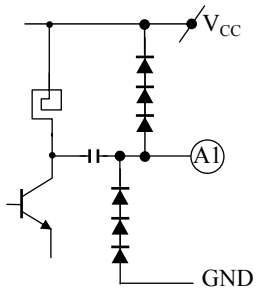
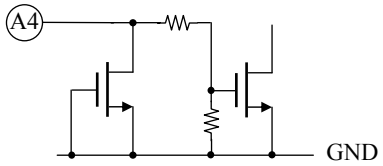
Note) See parameters B No.DC-7 to B No.DC-8 in the Electrical Characteristics for control voltage retention ranges.

CNT1 (LNA select 1)	CNT2 (LNA select 2)	CNT3 (Gain control)	LNA1 (Band I,II,IV,IX)	LNA2 (Band I)	LNA3 (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

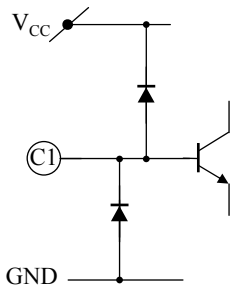
Note) The characteristics listed below are reference values based on the IC design and are not guaranteed.

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 ; LNA select SW input 1
B1	2.85 V	—	Voltage supply (V_{CC})
B2	0.0 V	—	GND
B3	—	Refer to A4	CNT2 ; LNA select SW input 2
B4	—	—	N.C.

■ Technical Data (continued)

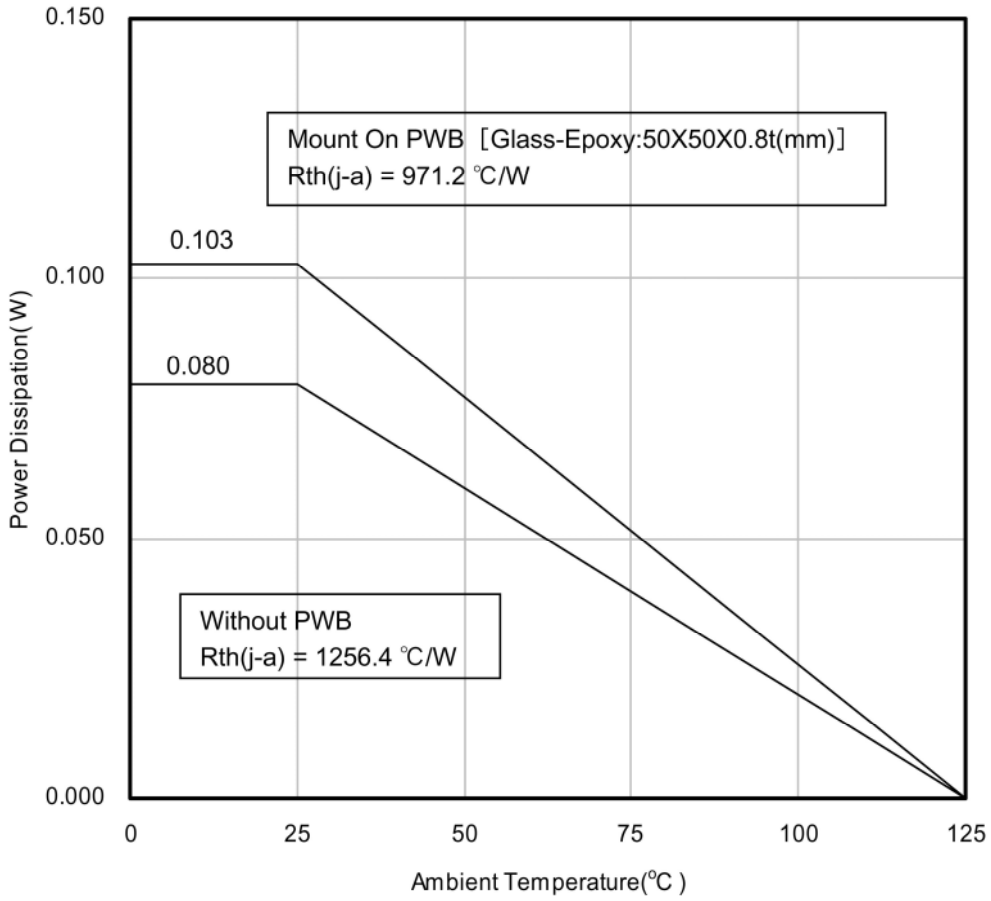
• I/O block circuit diagrams and pin function descriptions (continued)

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 ; 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 semiconductors described in this book

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Consult our sales staff in advance for information on the following applications:
- Special applications (such as for airplanes, aerospace, automotive equipment, traffic signaling equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.

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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.
Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

(6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.

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