

# Product Standards

Part No.	AN26218A
Package Code No.	XLGA011-W-1216AKA

Semiconductor Company  
Panasonic Corporation

Established by	Applied by	Checked by	Prepared by
	M.Hiramatsu	H.Takahashi	M.Iwaida

	<h1>Product Standards</h1>	<b>AN26218A</b>	
		Total Pages	Page
		32	2

## Contents

■ Overview .....	3
■ Features .....	3
■ Applications .....	3
■ Package .....	3
■ Type .....	3
■ Application Circuit Example (Block Diagram).....	4
■ Pin Descriptions .....	5
■ Absolute Maximum Ratings .....	6
■ Operating Supply Voltage Range .....	6
■ Allowable Current and Voltage Range.....	7
■ Electrical Characteristics .....	8
■ Electrical Characteristics (Referred design parameters) .....	12
■ Control Pins Mode Table .....	25
■ Test Circuit Diagram .....	26
■ Technical Data .....	30
• I/O block circuit diagrams and pin function descriptions .....	30
■ Usage Notes .....	32

2011-07-20		
Established	Revised	

# AN26218A

## UMTS triple band LNA-IC

### ■ Overview

- AN26218A is LNA-IC for 800 MHz / 1.7 GHz / 2.1 GHz Band Applications.
- 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.

### ■ Features

- Low voltage operation +2.8 V typ.
- Low current consumption 3.3 mA typ. (High-Gain mode)  
11 μA typ. 2.1 GHz (Low-Gain mode)  
25 μA typ. 800 MHz / 1.7 GHz (Low-Gain mode)
- High gain(Gain) 16.7 dB typ. fRX = 2140 MHz (High-Gain mode)  
16.7 dB typ. fRX = 884.5 MHz (High-Gain mode)  
16.5 dB typ. fRX = 1862.5 MHz (High-Gain mode)
- Low noise figure(NF) 1.75 dB typ. fRX = 2140 MHz (High-Gain mode)  
1.80 dB typ. fRX = 884.5 MHz (High-Gain mode)  
1.65 dB typ. fRX = 1862.5 MHz (High-Gain mode)
- Low distortion 0.0 dBm typ. fRX = 2140 MHz (High-Gain mode)  
(IIP3 +10 MHz offset) -5.0 dBm typ. fRX = 884.5 MHz (High-Gain mode)  
-3.0 dBm typ. fRX = 1862.5 MHz (High-Gain mode)
- Small package(WLCSP)

### ■ Applications

- UMTS triple-band handset

### ■ Package

- 11 pin Wafer level chip size package (WLCSP)  
Size : 1.16 mm × 1.56 mm (0.4 mm pitch)

### ■ Type

- Bi-CMOS IC

# Product Standards

AN26218A

Total Pages

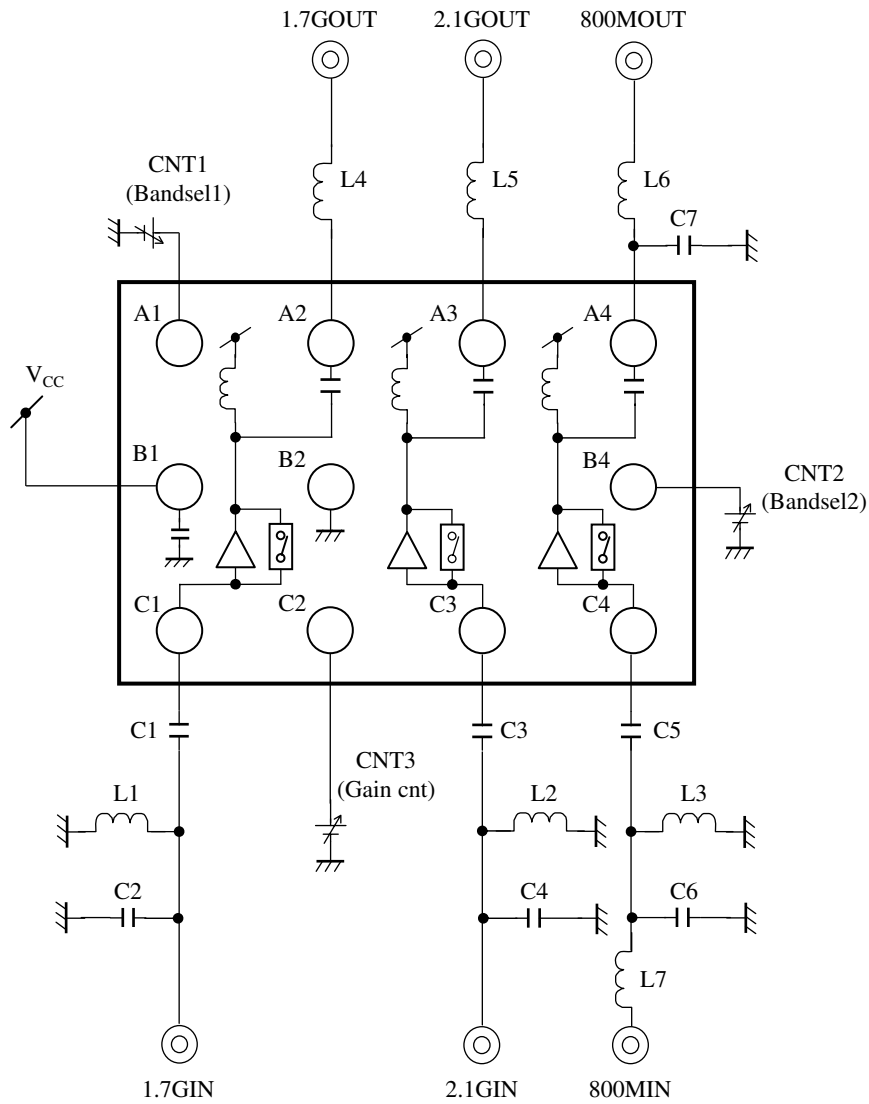
Page

32

4

## ■ Application Circuit Example (Block Diagram)

(Top View)



- Notes
- This application circuit is an example. The operation of mass production set is not guaranteed. You should perform enough evaluation and verification on the design of mass production set. You are fully responsible for the incorporation of the above application circuit and information in the design of your equipment.
  - This block diagram is for explaining functions. Part of the block diagram may be omitted, or it may be simplified.
  - External components : See page 29.

2011-07-20		
Established	Revised	

# Product Standards

AN26218A

Total Pages

Page

32

5

## ■ Pin Descriptions

Pin No.	Pin name	Type	Description
A1	CNT1	Input	Band Selective SW1
A2	OUT1	Output	1.7 GHz RF Output
A3	OUT2	Output	2.1 GHz RF Output
A4	OUT3	Output	800 MHz RF Output
B1	V <sub>CC</sub>	Power Supply	V <sub>CC</sub>
B2	GND	Ground	GND
B4	CNT2	Input	Band Selective SW2
C1	IN1	Input	1.7 GHz RF Input
C2	CNT3	Input	High-Gain / Low-Gain Selective SW
C3	IN2	Input	2.1 GHz RF Input
C4	IN3	Input	800 MHz RF Input

2011-07-20

Established

Revised

	<h1>Product Standards</h1>	<b>AN26218A</b>	
		Total Pages	Page
		32	6

## ■ Absolute Maximum Ratings

Note) Absolute maximum ratings are limit values which do not result in damages to this IC, and IC operation is not guaranteed at these limit values.

A No.	Parameter	Symbol	Rating	Unit	Notes
1	Supply voltage	$V_{CC}$	3.6	V	*1
2	Supply current	$I_{CC}$	20	mA	—
3	Power dissipation	$P_D$	50.8	mW	*2
4	Operating ambient temperature	$T_{opr}$	-30 to +85	°C	*3
5	Storage temperature	$T_{stg}$	-55 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 the  $P_D$ - $T_a$  diagram of the package standard 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	$V_{CC}$	2.7 to 2.875	V	*1

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

2011-07-20		
Established	Revised	

# Product Standards

AN26218A

Total Pages

Page

32

7

## ■ Allowable Current and Voltage Range

- Notes) • Allowable current and voltage ranges are limit ranges which do not result in damages to this IC, and IC operation is not guaranteed within these limit ranges.  
 • Voltage values, unless otherwise specified, are with respect to GND.  
 • Do not apply external currents or voltages to any pin not specifically mentioned.

Pin No.	Pin name	Rating	Unit	Notes
A1	CNT1	-0.3 to ( $V_{CC} + 0.3$ )	V	*2
A2	OUT1	-0.3 to ( $V_{CC} + 0.3$ )	V	*2
A3	OUT2	-0.3 to ( $V_{CC} + 0.3$ )	V	*2
A4	OUT3	-0.3 to ( $V_{CC} + 0.3$ )	V	*2
B4	CNT2	-0.3 to ( $V_{CC} + 0.3$ )	V	*2
C1	IN1	—	V	*1
C2	CNT3	-0.3 to ( $V_{CC} + 0.3$ )	V	*2
C3	IN2	—	V	*1
C4	IN3	—	V	*1

Notes) \*1 : Do not apply more than 0 dBm at high gain mode (5 dBm at low gain mode) to RF input.

This is a RF signal input pin. Do not apply DC.

\*2 : ( $V_{CC} + 0.3$ ) V must not be exceeded 3.6 V.

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

8

## ■ Electrical Characteristics at $V_{CC} = 2.80\text{ V}$

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

B No.	Parameter	Symbol	Test Circuit	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
DC electrical characteristics									
DC-1	Circuit current HG (2.1 GHz)	IccHSa	1	$V_{CC}$ current at 2.1 GHz , High-Gain mode. No input signal.	—	3.3	4.25	mA	—
DC-2	Circuit current HG (800 MHz)	IccHSb	2	$V_{CC}$ current at 800 MHz , High-Gain mode. No input signal.	—	3.3	4.25	mA	—
DC-3	Circuit current HG (1.7 GHz)	IccHSc	3	$V_{CC}$ current at 1.7 GHz , High-Gain mode. No input signal.	—	3.3	4.25	mA	—
DC-4	Circuit current LG (2.1 GHz)	IccLSa	1	$V_{CC}$ current at 2.1 GHz , Low-Gain mode. No input signal.	—	11	35	$\mu\text{A}$	—
DC-5	Circuit current LG (800 MHz)	IccLSb	2	$V_{CC}$ current at 800 MHz , Low-Gain mode. No input signal.	—	25	50	$\mu\text{A}$	—
DC-6	Circuit current LG (1.7 GHz)	IccLSc	3	$V_{CC}$ current at 1.7 GHz , Low-Gain mode. No input signal.	—	25	50	$\mu\text{A}$	—
DC-7	SW voltage (High)	VIHS	1	—	2.16	—	2.875	V	—
DC-8	SW voltage (Low)	VILS	1	—	0	—	0.6	V	—
DC-9	SW Current (High)	IIHS	1	Current at SW pin VIHS = 2.9 V	—	10	20	$\mu\text{A}$	—
DC-10	SW Current (Low)	IILS	1	Current at SW pin VILS = 0 V	—	10	20	$\mu\text{A}$	—

2011-07-20

Established

Revised



# Product Standards

AN26218A

Total Pages

Page

32

9

## ■ Electrical Characteristics (continued) $V_{CC} = 2.80\text{ V}$

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

B No.	Parameter	Symbol	Test Circuit	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
2.1 GHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
A-1	Gain Step	GΔSa	1	$G\Delta Sa = GHSa - GLSa$	18.2	21.7	23.5	dB	—
2.1 GHz : LNA AC characteristics (High-gain mode)									
A-2	Power gain	GHSa	1	$f1 = f_{RXa}$ $f2 = f_{RXa} - 190\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals (f1, f2)	15.3	16.7	18.0	dB	—
A-3	IIP3	IIP3H1Sa	1	$f1 = f_{RXa} + 10\text{ MHz}$ $f2 = f_{RXa} + 20\text{ MHz}$ Input 2 signals (f1, f2)	-10	0	—	dBm	—
2.1 GHz : LNA AC characteristics (Low-gain mode)									
A-4	Power gain	GLSa	1	$f1 = f_{RXa}$ $f2 = f_{RXa} - 190\text{ MHz}$ $PRX1 = -24\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals (f1, f2)	-6.1	-5.0	-4.0	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

10

## ■ Electrical Characteristics (continued) $V_{CC} = 2.80\text{ V}$

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

B No.	Parameter	Symbol	Test Circuit	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
800 MHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
B-1	Gain Step	GASb	2	$GASb = GHSb - GLSb$	18.2	22.2	23.8	dB	—
800 MHz : LNA AC characteristics (High-gain mode)									
B-2	Power gain	GHSb	2	$f1 = f_{RXb}$ $f2 = f_{RXb} - 45\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	15.5	16.7	18.0	dB	—
B-3	IIP3	IIP3H1Sb	2	$f1 = f_{RXb} + 10\text{ MHz}$ $f2 = f_{RXb} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-10	-5	—	dBm	—
800 MHz : LNA AC characteristics (Low-gain mode)									
B-4	Power gain	GLSb	2	$f1 = f_{RXb}$ $f2 = f_{RXb} - 45\text{ MHz}$ $PRX1 = -24\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	-5.9	-5.5	-4.0	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

11

## ■ Electrical Characteristics (continued) $V_{CC} = 2.80\text{ V}$

Note) All parameters are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc} = 1862.5\text{ MHz}$ ,  $PRXc = -30\text{ dBm}$ , CW unless otherwise specified.

B No.	Parameter	Symbol	Test Circuit	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
1.7 GHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
C-1	Gain Step	$G\Delta Sc$	3	$G\Delta Sc = GHSc - GLSc$	17.9	21.5	23.7	dB	—
1.7 GHz : LNA AC characteristics (High-gain mode)									
C-2	Power gain	$GHSc$	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	15.0	16.5	17.8	dB	—
C-3	IIP3	$IIP3H1Sc$	3	$f1 = f_{RXc} + 10\text{ MHz}$ $f2 = f_{RXc} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-7.5	-3	—	dBm	—
1.7 GHz : LNA AC characteristics (Low-gain mode)									
C-4	Power gain	$GLSc$	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX1 = -24\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	-6.0	-5.0	-4.0	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

12

## ■ Electrical Characteristics (Reference values for design) at $V_{CC} = 2.8\text{ V}$

- Notes) • All characteristics are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXa} = 2110\text{ MHz}$  to  $2170\text{ MHz}$ ,  $PRXa = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
2.1 GHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
D-1	Gain Step	$G\Delta a$	1	$G\Delta a = G_{Ha} - G_{La}$	18.2	21.7	23.5	dB	—
D-2	In - band gain deviation	$G_{ch}\Delta a$	1	—	—	—	1.8	dB	—
2.1 GHz : LNA AC characteristics (High-gain mode)									
D-3	Input VSWR	$V_{swr\_inHa}$	1	—	—	—	2.1	—	—
D-4	Output VSWR	$V_{swr\_outHa}$	1	—	—	—	2.3	—	—
D-5	Power gain	$G_{Ha}$	1	$f1 = f_{RXa}$ $f2 = f_{RXa} - 190\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	15.3	16.7	18.0	dB	—
D-6	Noise figure	$NF_{Ha}$	1	$f1 = f_{RXa}$ $f2 = f_{RXa} - 190\text{ MHz}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	—	1.75	1.95	dB	—
D-7	IIP3	$IIP3H1a$	1	$f1 = f_{RXa} + 10\text{ MHz}$ $f2 = f_{RXa} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-10	0	—	dBm	—
D-8	Reverse isolation	$Ris\_H1a$	1	2.1GHz band Output → 2.1GHz band input $f = 1920\text{ to }2170\text{ MHz}$	—	-34	-30	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

13

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.8\text{ V}$

- Notes) • All characteristics are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXa} = 2110\text{ MHz}$  to  $2170\text{ MHz}$ ,  $PRXa = -30\text{ dBm}$ , CW
- 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
2.1 GHz : LNA AC characteristics (Low-gain mode)									
D-9	Input VSWR	Vswr_inLa	1	—	—	—	2.1	—	—
D-10	Output VSWR	Vswr_outLa	1	—	—	—	2.5	—	—
D-11	Power gain	GLa	1	f1 = fRXa f2 = fRXa - 190 MHz PRX1 = -24 dBm PRX2 = -24 dBm Input 2 signals (f1, f2)	-6.1	-5.0	-4.0	dB	—
D-12	Noise figure	NFLa	1	f1 = fRXa f2 = fRXa - 190 MHz PRX2 = -24 dBm Input 2 signals (f1, f2)	—	5	6.8	dB	—
D-13	IIP3	IIP3_LGa	1	f1 = fRXa + 3.5 MHz f2 = fRXa + 6.5 MHz PRX1 = -15 dBm PRX2 = -15 dBm Input 2 signals (f1, f2)	2	20	—	dBm	—
D-14	Reverse isolation	Ris_L1a	1	2.1GHz band Output → 2.1 GHz band input	-6.1	-5.0	-4.0	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

14

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.8\text{ V}$

- Notes) • All characteristics are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXb} = 869\text{ MHz}$  to  $895\text{ MHz}$ ,  $PRXb = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
800 MHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
E-1	Gain Step	$G\Delta b$	2	$G\Delta b = GHb - GLb$	18.2	22.2	23.8	dB	—
E-2	In - band gain deviation	$Gch\Delta b$	2	—	—	—	1.8	dB	—
800 MHz : LNA AC characteristics (High-gain mode)									
E-3	Input VSWR	$V_{swr\_inHb}$	2	—	—	—	1.8	—	—
E-4	Output VSWR	$V_{swr\_outHb}$	2	—	—	—	2.0	—	—
E-5	Power gain	$GHb$	2	$f1 = f_{RXb}$ $f2 = f_{RXb} - 45\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	15.5	16.7	18.0	dB	—
E-6	Noise figure	$NFHb$	2	$f1 = f_{RXb}$ $f2 = f_{RXb} - 45\text{ MHz}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	—	1.8	2.0	dB	—
E-7	IIP3	$IIP3H1b$	2	$f1 = f_{RXb} + 10\text{ MHz}$ $f2 = f_{RXb} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-10	-5	—	dBm	—
E-8	Reverse isolation	$Ris\_H2b$	2	800 MHz band Output $\rightarrow$ 800 MHz band input $f = 830\text{ to }885\text{ MHz}$	—	-26	-21.5	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

15

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.8\text{ V}$

- Notes) • All characteristics are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXb} = 869\text{ MHz}$  to  $895\text{ MHz}$ ,  $PRXb = -30\text{ dBm}$ , CW
- 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
800 MHz : LNA AC characteristics (Low-gain mode)									
E-9	Input VSWR	Vswr_inLb	2	—	—	—	1.8	—	—
E-10	Output VSWR	Vswr_outLb	2	—	—	—	1.8	—	—
E-11	Power gain	GLb	2	f1 = fRXb f2 = fRXb - 45 MHz PRX1 = -24 dBm PRX2 = -24 dBm Input 2 signals (f1, f2)	-5.9	-5.5	-4.2	dB	—
E-12	Noise figure	NFLb	2	f1 = fRXb f2 = fRXb - 45 MHz PRX2 = -24 dBm Input 2 signals (f1, f2)	—	5.5	7	dB	—
E-13	IIP3	IIP3_LGb	2	f1 = fRXb + 3.5 MHz f2 = fRXb + 6.5 MHz PRX1 = -15 dBm PRX2 = -15 dBm Input 2 signals (f1, f2)	2	20	—	dBm	—
E-14	Reverse isolation	Ris_L2b	2	800 MHz band Output → 800 MHz band input	-5.9	-5.5	-4.2	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

16

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.8\text{ V}$

- Notes) • All characteristics are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc} = 1844.9\text{ MHz}$  to  $1879.9\text{ MHz}$ ,  $PRXc = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
1.7 GHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
F-1	Gain Step	$G\Delta c$	3	$G\Delta c = GHc - GLc$	17.9	21.5	23.7	dB	—
F-2	In - band gain deviation	$Gch\Delta c$	3	—	—	—	1.8	dB	—
1.7 GHz : LNA AC characteristics (High-gain mode)									
F-3	Input VSWR	$V_{swr\_inHc}$	3	—	—	—	2.0	—	—
F-4	Output VSWR	$V_{swr\_outHc}$	3	—	—	—	2.1	—	—
F-5	Power gain	$GHc$	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	15.0	16.5	17.8	dB	—
F-6	Noise figure	$NFHc$	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	—	1.65	1.85	dB	—
F-7	IIP3	$IIP3H1c$	3	$f1 = f_{RXc} + 10\text{ MHz}$ $f2 = f_{RXc} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-7.5	-3	—	dBm	—
F-8	Reverse isolation	$Ris\_H3c$	3	1.7 GHz band Output → 1.7 GHz band input $f = 1745\text{ to }1880\text{ MHz}$	—	-37	-32	dB	—

2011-07-20

Established

Revised



# Product Standards

AN26218A

Total Pages

Page

32

17

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.8\text{ V}$

- Notes) • All characteristics are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RXc} = 1844.9\text{ MHz}$  to  $1879.9\text{ MHz}$ ,  $PRXc = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
1.7 GHz : LNA AC characteristics (Low-gain mode)									
F-9	Input VSWR	Vswr_inLc	3	—	—	—	1.8	—	—
F-10	Output VSWR	Vswr_outLc	3	—	—	—	2.4	—	—
F-11	Power gain	GLc	3	f1 = fRXc f2 = fRXc - 95 MHz PRX1 = -24 dBm PRX2 = -24 dBm Input 2 signals (f1, f2)	-6.0	-5.0	-4.0	dB	—
F-12	Noise figure	NFLc	3	f1 = fRXc f2 = fRXc - 95 MHz PRX2 = -24 dBm Input 2 signals (f1, f2)	—	5.0	6.8	dB	—
F-13	IIP3	IIP3_LGc	3	f1 = fRXc + 3.5 MHz f2 = fRXc + 6.5 MHz PRX1 = -15 dBm PRX2 = -15 dBm Input 2 signals (f1, f2)	2.0	20	—	dBm	—
F-14	Reverse isolation	Ris_L3c	3	1.7 GHz band Output → 1.7 GHz band input	-6.0	-5.0	-4.0	dB	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

18

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.7\text{ V}$ to $2.875\text{ V}$

Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C}$  to  $85^\circ\text{C}$ , 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
DC electrical characteristics									
DCT-1	Circuit current HG (2.1 GHz)	IccHTa	1	$V_{CC}$ current at 2.1 GHz , High-Gain mode. No input signal.	—	3.3	4.5	mA	—
DCT-2	Circuit current HG (800 MHz)	IccHTb	2	$V_{CC}$ current at 800 MHz , High-Gain mode. No input signal.	—	3.3	4.5	mA	—
DCT-3	Circuit current HG (1.7 GHz)	IccHTc	3	$V_{CC}$ current at 1.7 GHz , High-Gain mode. No input signal.	—	3.3	4.5	mA	—
DCT-4	Circuit current LG (2.1 GHz)	IccLTa	1	$V_{CC}$ current at 2.1 GHz , Low-Gain mode. No input signal.	—	11	40	$\mu\text{A}$	—
DCT-5	Circuit current LG (800 MHz)	IccLTb	2	$V_{CC}$ current at 800 MHz , Low-Gain mode. No input signal.	—	25	60	$\mu\text{A}$	—
DCT-6	Circuit current LG (1.7 GHz)	IccLTc	3	$V_{CC}$ current at 1.7 GHz , Low-Gain mode. No input signal.	—	25	60	$\mu\text{A}$	—
DCT-7	SW voltage (High)	VIHT	1	—	2.16	—	2.875	V	—
DCT-8	SW voltage (Low)	VILT	1	—	0	—	0.6	V	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

19

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.7\text{ V}$ to $2.875\text{ V}$

- Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $f_{RXa} = 2110\text{ MHz}$  to  $2170\text{ MHz}$ ,  $PRXa = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
2.1 GHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
G-1	Gain Step	$G\Delta T_a$	1	$G\Delta T_a = GHT_a - GLT_a$	17.2	21.7	24.5	dB	—
G-2	In - band gain deviation	$Gch\Delta T_a$	1	—	—	—	2	dB	—
2.1 GHz : LNA AC characteristics (High-gain mode)									
G-3	Power gain	$GHT_a$	1	$f1 = f_{RXa}$ $f2 = f_{RXa} - 190\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals (f1, f2)	14.2	16.7	19.2	dB	—
G-4	Noise figure	$NFHT_a$	1	$f1 = f_{RXa}$ $f2 = f_{RXa} - 190\text{ MHz}$ $PRX2 = -24\text{ dBm}$ Input 2 signals (f1, f2)	—	1.75	2.6	dB	—
G-5	IIP3	$IIP3H1T_a$	1	$f1 = f_{RXa} + 10\text{ MHz}$ $f2 = f_{RXa} + 20\text{ MHz}$ Input 2 signals (f1, f2)	-11	0	—	dBm	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

20

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.7\text{ V}$ to $2.875\text{ V}$

- Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $f_{RXa} = 2110\text{ MHz}$  to  $2170\text{ MHz}$ ,  $PRXa = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
2.1 GHz : LNA AC characteristics (Low-gain mode)									
G-6	Power gain	GLTa	1	f1 = fRXa f2 = fRXa - 190 MHz PRX1 = -24 dBm PRX2 = -24 dBm Input 2 signals (f1, f2)	-6.5	-5.0	-3.5	dB	—
G-7	Noise figure	NFLTa	1	f1 = fRXa f2 = fRXa - 190 MHz PRX2 = -24 dBm Input 2 signals (f1, f2)	—	5	8	dB	—
G-8	IIP3	IIP3_LGTa	1	f1 = fRXa + 3.5 MHz f2 = fRXa + 6.5 MHz PRX1 = -15 dBm PRX2 = -15 dBm Input 2 signals (f1, f2)	0	20	—	dBm	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

21

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.7\text{ V}$ to $2.875\text{ V}$

- Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $f_{RXb} = 869\text{ MHz}$  to  $895\text{ MHz}$ ,  $PRXb = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
800 MHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
I-1	Gain Step	$G\Delta T_b$	2	$G\Delta T_b = GHT_b - GLT_b$	17.2	22.2	24.5	dB	—
I-2	In - band gain deviation	$Gch\Delta T_b$	2	—	—	—	2	dB	—
800 MHz : LNA AC characteristics (High-gain mode)									
I-3	Power gain	$GHT_b$	2	$f1 = f_{RXb}$ $f2 = f_{RXb} - 45\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	14.2	16.7	19.2	dB	—
I-4	Noise figure	$NFHT_b$	2	$f1 = f_{RXb}$ $f2 = f_{RXb} - 45\text{ MHz}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	—	1.8	2.6	dB	—
I-5	IIP3	$IIP3H1T_b$	2	$f1 = f_{RXb} + 10\text{ MHz}$ $f2 = f_{RXb} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-11	-5	—	dBm	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

22

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.7\text{ V}$ to $2.875\text{ V}$

- Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $f_{RXb} = 869\text{ MHz}$  to  $895\text{ MHz}$ ,  $PRXb = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
800 MHz : LNA AC characteristics (Low-gain mode)									
I-6	Power gain	GLTb	2	f1 = fRXb f2 = fRXb - 45 MHz PRX1 = -24 dBm PRX2 = -24 dBm Input 2 signals (f1, f2)	-6.5	-5.5	-3.5	dB	—
I-7	Noise figure	NFLTb	2	f1 = fRXb f2 = fRXb - 45 MHz PRX2 = -24 dBm Input 2 signals (f1, f2)	—	5.5	8.5	dB	—
I-8	IIP3	IIP3_LGTb	2	f1 = fRXb + 3.5 MHz f2 = fRXb + 6.5 MHz PRX1 = -15 dBm PRX2 = -15 dBm Input 2 signals (f1, f2)	0	20	—	dBm	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

23

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.7\text{ V}$ to $2.875\text{ V}$

- Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $f_{RXc} = 1884.9\text{ MHz}$  to  $1879.9\text{ MHz}$ ,  $PRXc = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
1.7 GHz : LNA AC characteristics (High-gain mode / Low-gain mode)									
H-1	Gain Step	$G\Delta Tc$	3	$G\Delta Tc = GHTc - GLTc$	17.2	21.5	24.5	dB	—
H-2	In - band gain deviation	$Gch\Delta Tc$	3	—	—	—	2	dB	—
1.7 GHz : LNA AC characteristics (High-gain mode)									
H-3	Power gain	$GHTc$	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX1 = -30\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	14	16.5	19	dB	—
H-4	Noise figure	$NFHTc$	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX2 = -24\text{ dBm}$ Input 2 signals ( $f1, f2$ )	—	1.65	2.5	dB	—
H-5	IIP3	$IIP3H1Tc$	3	$f1 = f_{RXc} + 10\text{ MHz}$ $f2 = f_{RXc} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-8	-3	—	dBm	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

24

## ■ Electrical Characteristics (Reference values for design) (continued) at $V_{CC} = 2.7\text{ V}$ to $2.875\text{ V}$

- Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C}$  to  $85^\circ\text{C}$ ,  $f_{RXc} = 1884.9\text{ MHz}$  to  $1879.9\text{ MHz}$ ,  $PRXc = -30\text{ dBm}$ , CW  
 • 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, we will respond in good faith to user concerns.

B No.	Parameter	Symbol	Test Circuit	Conditions	Reference values			Unit	Notes
					Min	Typ	Max		
1.7 GHz : LNA AC characteristics (Low-gain mode)									
H-6	Power gain	GLTc	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX1 = -24\text{ dBm}$ $PRX2 = -24\text{ dBm}$ Input 2 signals (f1, f2)	-6.5	-5.0	-3.5	dB	—
H-7	Noise figure	NFLTc	3	$f1 = f_{RXc}$ $f2 = f_{RXc} - 95\text{ MHz}$ $PRX2 = -24\text{ dBm}$ Input 2 signals (f1, f2)	—	5.0	8.0	dB	—
H-8	IIP3	IIP3_LGTc	3	$f1 = f_{RXc} + 3.5\text{ MHz}$ $f2 = f_{RXc} + 6.5\text{ MHz}$ $PRX1 = -15\text{ dBm}$ $PRX2 = -15\text{ dBm}$ Input 2 signals (f1, f2)	0	20	—	dBm	—

2011-07-20

Established

Revised



# Product Standards

AN26218A

Total Pages

Page

32

25

## ■ Control Pins Mode Table

Note) Control voltage range : See B No. DC-7 / B No. DC-8 at page 8.

CNT1 (Band Select1) (A1)	CNT2 (Band Select2) (B4)	CNT3 (Gain Control) (C2)	Band1 (2.1 GHz)	Band2 (800 MHz)	Band3 (1.7 GHz)	Mode
Low	Low	High	High-Gain	Off	Off	2.1 GHz High-Gain
		Low	Low-Gain	Off	Off	2.1 GHz Low-Gain
High	Low	High	Off	High-Gain	Off	800 MHz High-Gain
		Low	Off	Low-Gain	Off	800 MHz Low-Gain
Low	High	High	Off	Off	High-Gain	1.7 GHz High-Gain
		Low	Off	Off	Low-Gain	1.7 GHz Low-Gain
High	High	—	—	—	—	—

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

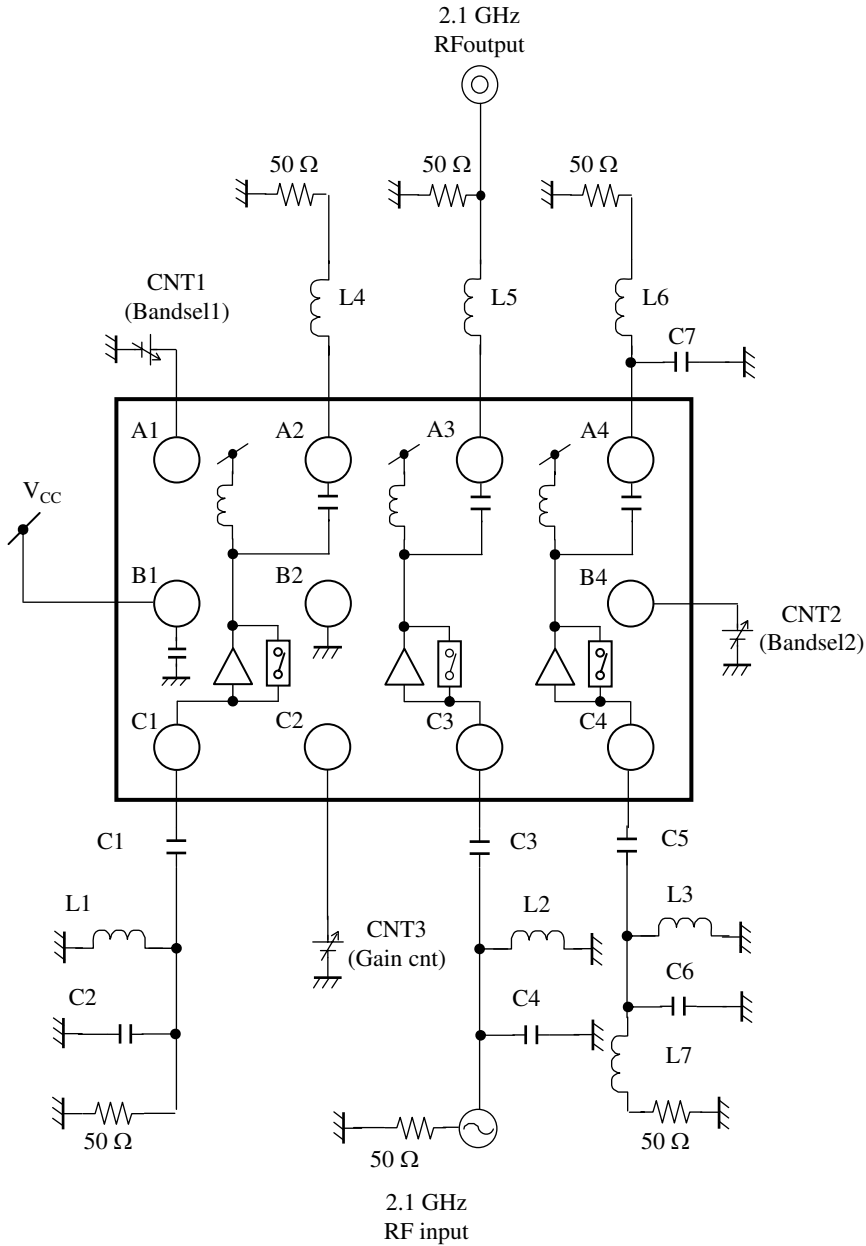
32

26

## ■ Test Circuit Diagram

### • Test Circuit 1

(Top View)



Note) External components : See page 29

2011-07-20	
Established	Revised

# Product Standards

AN26218A

Total Pages

Page

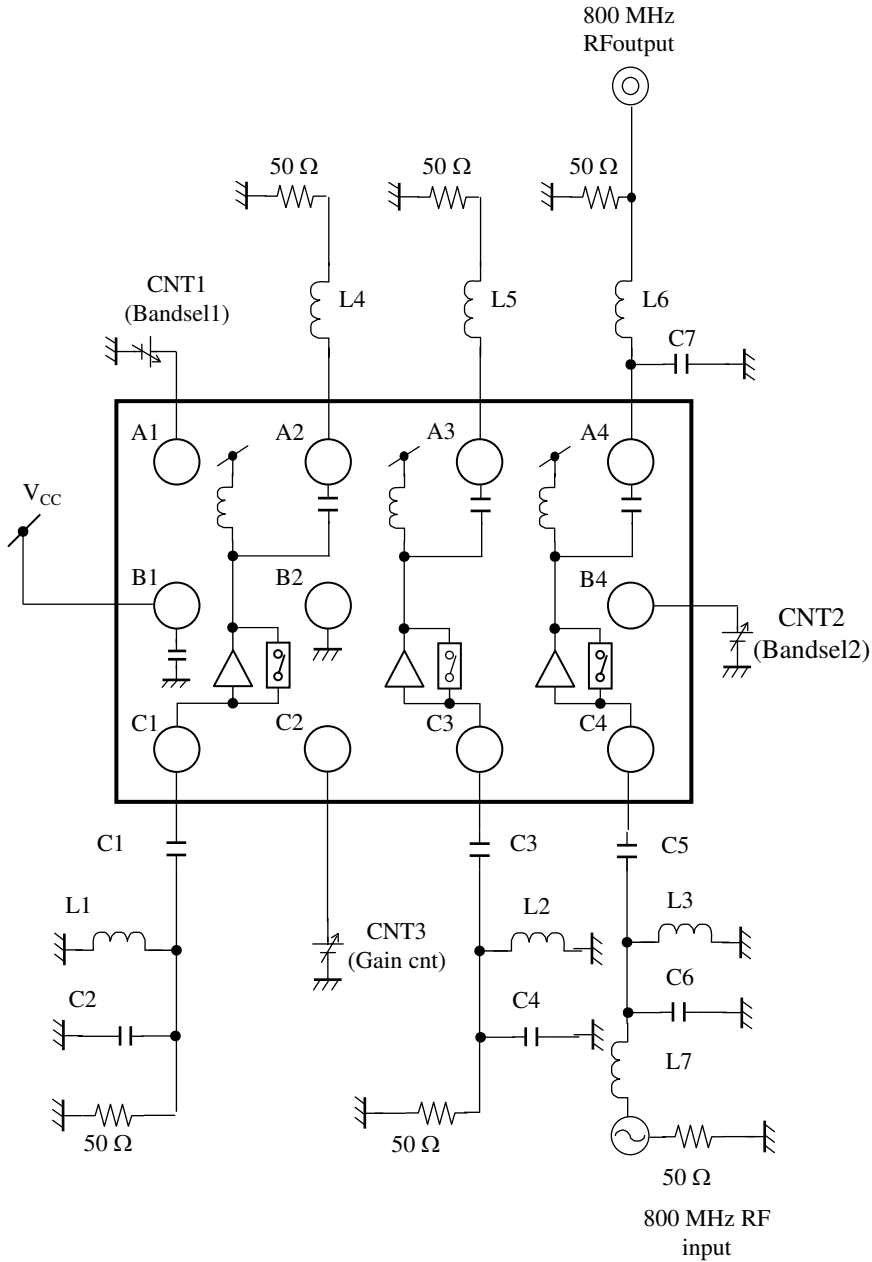
32

27

■ Test Circuit Diagram (continued)

• Test Circuit 2

(Top View)



Note) External components : See page 29

2011-07-20	
Established	Revised

# Product Standards

AN26218A

Total Pages

Page

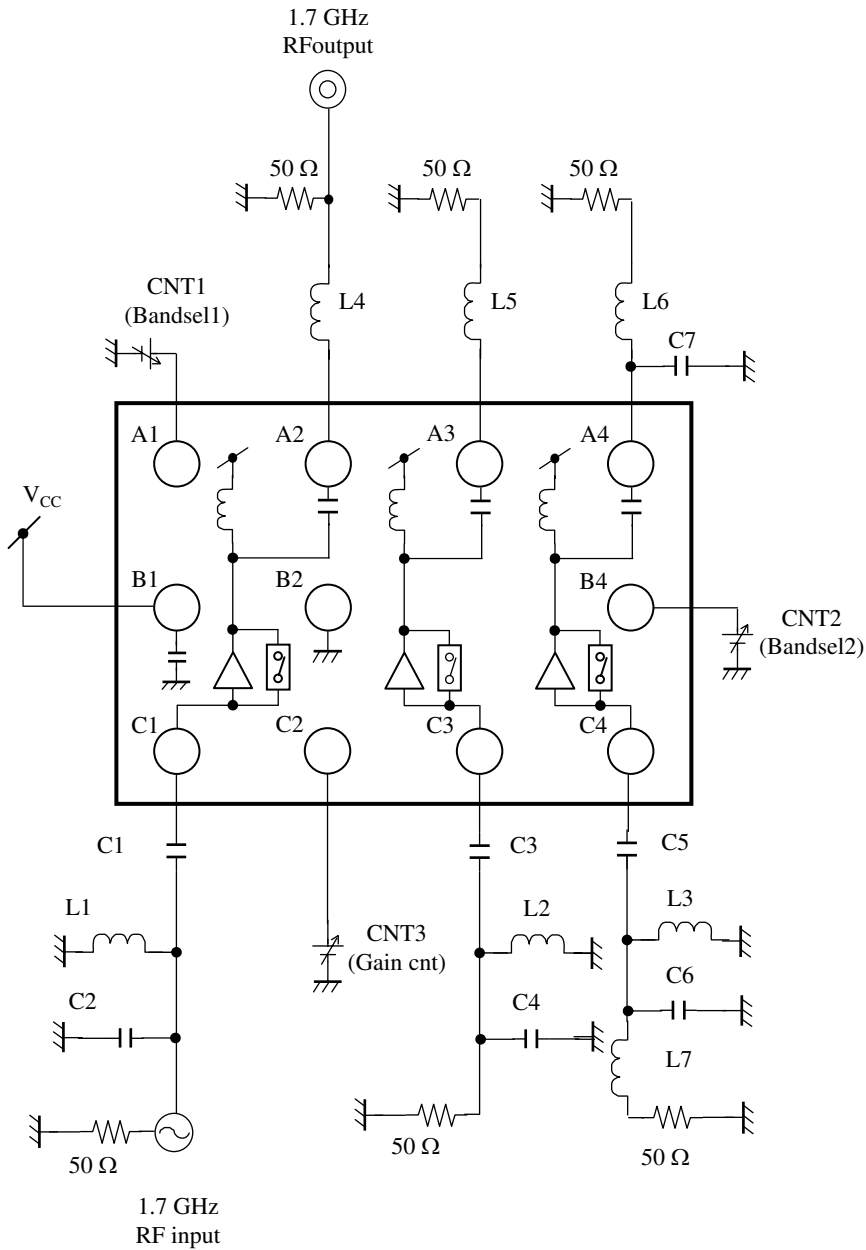
32

28

■ Test Circuit Diagram (continued)

• Test Circuit 3

(Top View)



Note) External components : See page 29

2011-07-20		
Established	Revised	

# Product Standards

AN26218A

Total Pages

Page

32

29

## ■ Test Circuit Diagram (continued)

### • External Components

Components	Size	Value	Part Number	Vendor
L1	0603	1.3 nH	LQP03T1N3B04	Murata
L2	0603	1.2 nH	LQP03T1N2B04	Murata
L3	0603	3.6 nH	LQP03T3N6B04	Murata
L4	0603	4.7 nH	LQP03T4N7H04	Murata
L5	0603	2.6 nH	LQP03T2N6B04	Murata
L6	0603	12 nH	LQP03T12NH04	Murata
L7	0603	10 nH	LQP03T10NH04	Murata
C1	0603	68 pF	GRM0332C1E680JD01	Murata
C2	0603	6.0 pF	GJM0332C1E6R0BB01	Murata
C3	0603	68 pF	GRM0332C1E680JD01	Murata
C4	0603	5.0 pF	GJM0332C1E5R0BB01	Murata
C5	0603	68 pF	GRM0332C1E680JD01	Murata
C6	0603	8.0 pF	GJM0334C1E8R0BB01	Murata
C7	0603	1.0 pF	GJM0334C1E1R0BB01	Murata

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

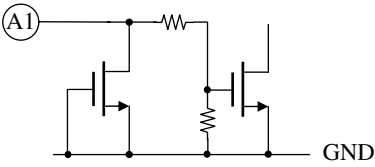
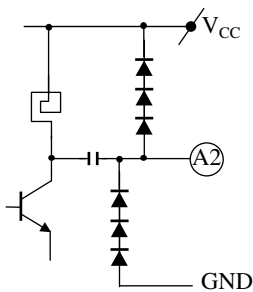
32

30

## ■ Technical Data

### • I/O block circuit diagrams and pin function descriptions

Note) The characteristics listed below are reference values derived from the design of the IC and are not guaranteed.

Pin No.	Voltage	Internal Circuit	Description
A1	—		2.1 GHz / 800 MHz / 1.7 GHz Band selective SW 1 0.60 V or less : Low 2.16 V or more : High
A2	—		1.7 GHz LNA RF Output
A3	—	Refer to A2	2.1 GHz LNA RF Output
A4	—	Refer to A2	800 MHz LNA RF Output
B1	2.8 V	—	Voltage supply ( $V_{CC}$ )
B2	0.0 V	—	GND
B4	—	Refer to A1	2.1 GHz / 800 MHz / 1.7 GHz Band selective SW 2 0.60 V or less : Low 2.16 V or more : High

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

31

## ■ Technical Data (continued)

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

Note) The characteristics listed below are reference values derived from the design of the IC and are not guaranteed.

Pin No.	Voltage	Internal Circuit	Description
C1	0.75 V		1.7 GHz LNA RF Input
C2	—	Refer to A1	High-Gain / Low-Gain selective SW 0.60 V or less : Low 2.16 V or more : High
C3	0.75 V	Refer to C1	2.1 GHz LNA RF Input
C4	0.75 V	Refer to C1	800 MHz LNA RF Input

2011-07-20

Established

Revised

# Product Standards

AN26218A

Total Pages

Page

32

32

## ■ Usage Notes

### • Special attention and precaution in using

1. This IC is intended to be used for general electronic equipment [UMTS Triple – Band 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

It is to be understood that our company shall not be held responsible for any damage incurred as a result of or in connection with your using the IC described in this book for any special application, unless our company agrees to your using the IC in this book for any special application.

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 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 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.
7. When using the LSI for new models, verify the safety including the long-term reliability for each product.
8. 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.
9. 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.
10. Basically, chip surface is ground potential. Please design to ensure no contact between chip surface and metal shielding.

2011-07-20

Established

Revised