

# Product Standards

Part No.	<b>AN26014A</b>
Package Code No.	<b>SSMINI-5DC</b>

Semiconductor Company  
Panasonic Corporation

Established by	Applied by	Checked by	Prepared by
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	<b>Product Standards</b>	<b>AN26014A</b>	
		Total Pages	Page
		16	2

## Contents

■ Overview .....	3
■ Features .....	3
■ Applications .....	3
■ Package .....	3
■ Type .....	3
■ Application Circuit Example .....	4
■ Pin Descriptions .....	5
■ Absolute Maximum Ratings .....	6
■ Operating Supply Voltage Range .....	6
■ Allowable Current and Voltage Range .....	7
■ Electrical Characteristics .....	8
■ Electrical Characteristics (Reference values for design) .....	10
■ Control Pins Mode Table .....	13
■ Test Circuit Diagram .....	14
■ Technical Data .....	15
• I/O block circuit diagram & pin function descriptions .....	15
■ Usage Notes .....	16
• Special attention and precaution in using .....	16

2008-12-08	2009-10-09	
Established	Revised	

	<b>Product Standards</b>	<b>AN26014A</b>	
		Total Pages	Page
		16	3

# AN26014A

## LNA-IC for 1.5 GHz Band Applications

### ■ Overview

- AN26014A is LNA-IC for 1.5 GHz Band Applications.
- Realizing high performance by using 0.18  $\mu\text{m}$  SiGeC Bi-CMOS process ( $f_T = 90 \text{ GHz}$ ,  $f_{\text{max}} = 140 \text{ GHz}$ ).
- Sleep mode is available, controlled by integrated CMOS logic circuit.
- Achieving miniaturization by using small size package.

### ■ Features

- Low voltage operation      +2.85 V typ.
- Low current consumption    9.5 mA typ.
- High gain                      19 dB typ.      fRX = 1 575 MHz
- Low noise figure            1.0 dB typ.      fRX = 1 575 MHz
- Low distortion              +4 dBm typ.      fRX = 1 575 MHz  
(IIP3 +10 MHz offset)
- Small package

### ■ Applications

- 1.5 GHz Band Applications

### ■ Package

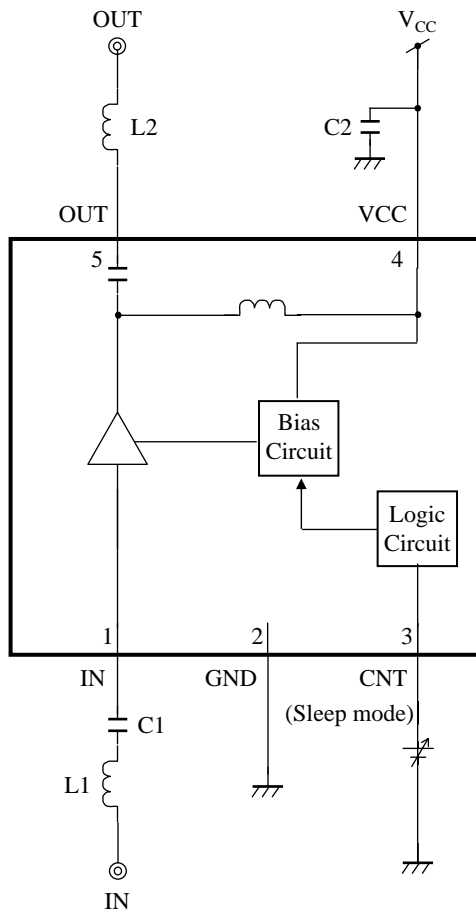
- 5 pin Plastic Small Surface Mount Package (SMINI Type)

### ■ Type

- Bi-CMOS IC

2008-12-08	2009-10-09	
Established	Revised	

■ Application Circuit Example



• External Components

Components	Chip Size [mm]	Value	Model	Manufacturer
L1	0603	3.0 nH	LQP03T3N0B04	Murata
L2	0603	5.6 nH	LQP03T5N6H04	Murata
C1	0603	1 000 pF	GRM033B11C102KD01	Murata
C2	0603	0.1 $\mu$ F	GRM33B30J104KE18	Murata

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

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	5

■ Pin Descriptions

Pin No.	Pin name	Type	Description
1	IN	Input	RF Input
2	GND	Ground	GND
3	CNT	Input	CNT (Sleep mode)
4	VCC	Power supply	V <sub>CC</sub>
5	OUT	Output	RF Output

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<b>AN26014A</b>	
		Total Pages	Page
		16	6

## ■ 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	$I_{CC}$	18	mA	—
3	Power dissipation	$P_D$	64.8	mW	*2
4	Operating ambient temperature	$T_{opr}$	-20 to +70	°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  $T_a = 70^\circ\text{C}$  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	$V_{CC}$	2.70 to 3.00	V	*1

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

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	7

### ■ Allowable Current and Voltage Range

- Notes)
- Allowable current and voltage ranges are limit ranges which are not destructed, and are not the ranges to which operation is guaranteed.
  - Voltage values, unless otherwise specified, are with respect to GND.
  - Do not apply external currents or voltages to any pin not specifically mentioned.
  - For the circuit currents, "+" denotes current flowing into the IC, and "-" denotes current flowing out of the IC.

Pin No.	Pin name	Rating	Unit	Notes
1	IN	—	V	*1
3	CNT	- 0.3 to (V <sub>CC</sub> + 0.3)	V	*2
5	OUT	- 0.3 to (V <sub>CC</sub> + 0.3)	V	*2

- Notes)
- \*1 : RF signal input pin. Do not apply DC current.
  - \*2 : (V<sub>CC</sub> + 0.3) V must not be exceeded 3.6 V.

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<b>AN26014A</b>	
		Total Pages	Page
		16	8

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

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

B No.	Parameter	Symbol	Test Circuit	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
DC electrical characteristics									
DC-1	Supply current	IccH	1	$V_{CC}$ current at Active mode No input signal	—	9.5	13.0	mA	—
DC-2	Sleep current	IccS	1	$V_{CC}$ current at Sleep mode No input signal	—	1	10	$\mu\text{A}$	—
DC-3	CNT current (On)	IcntH	1	CNT current at Active mode No input signal	—	5	35	$\mu\text{A}$	—
DC-4	CNT current (Sleep)	IcntL	1	CNT current at Sleep mode No input signal	—	0.5	10	$\mu\text{A}$	—
DC-5	CNT voltage (On)	VIH	1		2.57	2.85	—	V	—
DC-6	CNT voltage (Sleep)	VIL	1		—	0	0.37	V	—

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	9

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

Note)  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RX} = 1\,575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

B No.	Parameter	Symbol	Test Circuit	Conditions	Limits			Unit	Notes
					Min	Typ	Max		
LNA AC electrical characteristics									
A-1	Power Gain	PGS	1	$f = 1\,575\text{ MHz}$ , $PRX = -30\text{ dBm}$	16.7	19.0	20.7	dB	—
A-2	IIP3 +10 MHz offset	IIP31S	1	$f1 = f_{RX} + 10\text{ MHz}$ $f2 = f_{RX} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	0	4.0	—	dBm	—
A-3	IIP3 -10 MHz offset	IIP32S	1	$f1 = f_{RX} - 10\text{ MHz}$ $f2 = f_{RX} - 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	0	4.0	—	dBm	—

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	10

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

Notes) • All characteristics are specified under  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RX} = 1575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , 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		
LNA AC electrical characteristics									
B-1	Noise Figure	NF	1	$f = f_{RX}$	—	1.0	1.4	dB	*1
B-2	Reverse Isolation	ISO	1	$f = f_{RX}$	—	-32	-21	dB	—
B-3	Input Return Loss	S11	1	$f = f_{RX}$	7	9.5	—	dB	—
B-4	Output Return Loss	S22	1	$f = f_{RX}$	10	13	—	dB	—

Note) \*1 : Connector & substrate loss (0.14 dB) included.

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	11

■ **Electrical Characteristics** (Reference values for design) (continued) at  $V_{CC} = 2.7\text{ V to }3.0\text{ V}$

Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C to }70^\circ\text{C}$ ,  $f_{RX} = 1\,575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , 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		
DC electrical characteristics									
DCT-1	Supply current	IccHT	1	$V_{CC}$ current No input signal	—	9.5	14.0	mA	—
DCT-2	Sleep current	IccST	1	$V_{CC}$ current at Sleep mode No input signal	—	1	12	$\mu\text{A}$	—
DCT-3	CNT current (On)	IcntHT	1	CNT current at Active mode No input signal	—	5	40	$\mu\text{A}$	—
DCT-4	CNT current (Sleep)	IcntLT	1	CNT current at Sleep mode No input signal	—	0.5	12	$\mu\text{A}$	—

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	12

■ **Electrical Characteristics** (Reference values for design) (continued) at  $V_{CC} = 2.7\text{ V to }3.0\text{ V}$

Notes) • All characteristics are specified under  $T_a = -20^\circ\text{C to }70^\circ\text{C}$ ,  $f_{RX} = 1\,575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , 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		
<b>LNA AC electrical characteristics</b>									
C-1	Power Gain	GT	1	$f = f_{RX}$	16.0	19.0	21.5	dB	—
C-2	Noise Figure	NFT	1	$f = f_{RX}$	—	1.0	1.6	dB	*1
C-3	IIP3 +10 MHz offset	IIP31T	1	$f1 = f_{RX} + 10\text{ MHz}$ $f2 = f_{RX} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-1.0	4.0	—	dBm	—
C-4	IIP3 -10 MHz offset	IIP32T	1	$f1 = f_{RX} - 10\text{ MHz}$ $f2 = f_{RX} - 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-1.0	4.0	—	dBm	—

Note) \*1 : Connector & substrate loss (0.14 dB) included.

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<b>AN26014A</b>	
		Total Pages	Page
		16	13

■ Control Pins Mode Table

Note) Control voltage range : See B No. DC-5 / B No. DC-6 at page 8

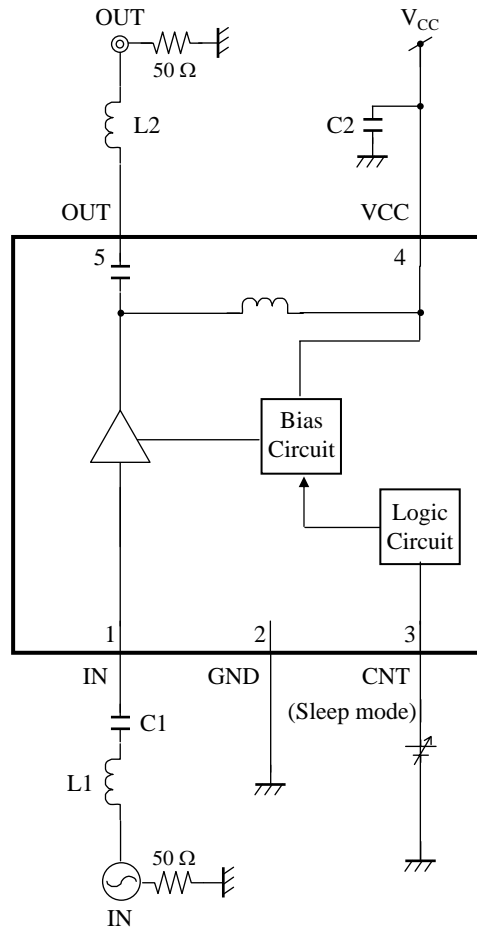
Pin No.	Description	Pin voltage		Remarks
		Low	High	
3	On/Off switch	Sleep mode	On mode	—

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	14

■ Test Circuit Diagram

- Test Circuit 1



• External Components

Components	Chip Size [mm]	Value	Model	Manufacturer
L1	0603	3.0 nH	LQP03T3N0B04	Murata
L2	0603	5.6 nH	LQP03T5N6H04	Murata
C1	0603	1 000 pF	GRM033B11C102KD01	Murata
C2	0603	0.1 $\mu$ F	GRM33B30J104KE18	Murata

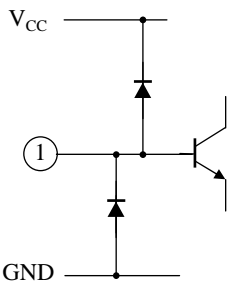
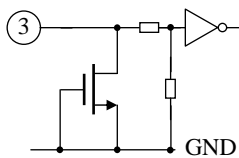
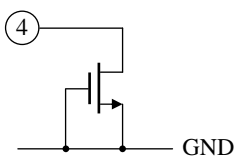
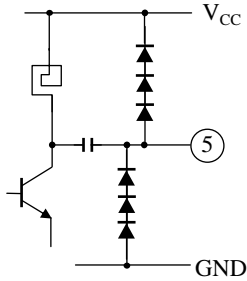
2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<b>AN26014A</b>	
		Total Pages	Page
		16	15

■ **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	Impedance	Descriptions
1	0.85 V		—	LNA input
2	0.0 V	—	—	GND
3	—		Z : 820 kΩ	Sleep mode SW input.
4	2.85 V		—	Voltage supply
5	—		—	LNA output

2008-12-08	2009-10-09	
Established	Revised	

	<h1>Product Standards</h1>	<h2>AN26014A</h2>	
		Total Pages	Page
		16	16

### ■ Usage Notes

#### • Special attention and precaution in using

1. This IC is intended to be used for general electronic equipment [1.5 GHz Band Applications].  
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 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<sub>CC</sub> 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.

2008-12-08	2009-10-09	
Established	Revised	