

Low voltage operation 1.8Vtyp, LNA-IC  
for 1.5 GHz Band Applications

FEATURES

- Low voltage operation +2.85 V typ. / +1.8 V typ.
- Low current consumption 4.5 mA typ.
- High gain 19 dB typ. fRX = 1 575 MHz
- Low noise figure 0.86 dB typ. fRX = 1 575 MHz
- Low distortion 1.5 dBm typ. fRX = 1 575 MHz (IIP3 +10 MHz offset)
- Small package 5 pin Plastic Small Surface Mount Package (SMINI Type)

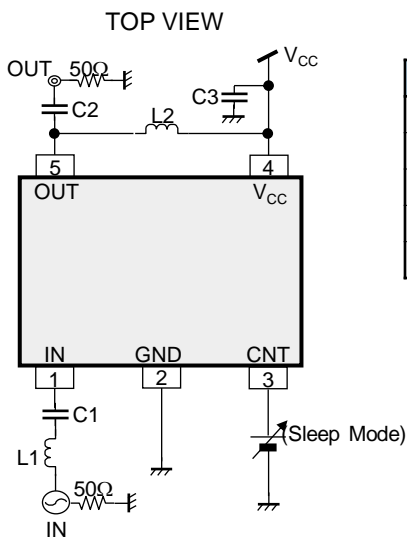
DESCRIPTION

AN26016A is a LNA-IC for 1.5 GHz Band Applications. Realizing high performance by using SiGeC Bi-CMOS process( $f_T = 90$  GHz,  $f_{max} = 140$  GHz). Sleep mode is available, controlled by integrated CMOS logic circuit. Achieving miniaturization by using small size package.

APPLICATIONS

- GPS

SIMPLIFIED APPLICATION



Components	Size	Value	Part Number	Vendor
L1	0603	5.6 nH	LQP03TN5N6H04	Murata
L2	0603	6.8 nH	LQP03TN6N8H04	Murata
C1	0603	0.01 uF	GRM033B11A103KA01	Murata
C2	0603	0.7 pF	GJM0334C1ER70BB01D	Murata
C3	0603	0.1 uF	GRM033B30J104KE18	Murata

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.

## ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit	Note
Supply voltage	$V_{CC}$	3.6	V	*1
Supply current	$I_{CC}$	18	mA	—
Operating ambient temperature	$T_{opr}$	-30 to 75	°C	*2
Operating junction temperature	$T_j$	-40 to +125	°C	*2
Storage temperature	$T_{stg}$	-55 to +125	°C	*2
Input Voltage Range	IN (Pin No.1)	—	V	*3
	CNT (Pin No.3)	-0.3 to ( $V_{CC} + 0.15$ )	V	*4
	OUT (Pin No.5)	-0.3 to ( $V_{CC} + 0.3$ )	V	*5
ESD	HBM (Human Body Model)	2	kV	—
	MM (Machine Model)	100	V	—

Notes). This product may sustain permanent damage if subjected to conditions higher than the above stated absolute maximum rating. This rating is the maximum rating and device operating at this range is not guaranteeable as it is higher than our stated recommended operating range.

When subjected under the absolute maximum rating for a long time, the reliability of the product may be affected.

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

\*2: Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for  $T_a = 25^\circ\text{C}$ .

\*3: RF signal input pin. Do not apply DC current.

\*4: ( $V_{CC} + 0.15$ ) V must not be exceeded 3.6 V

\*5: ( $V_{CC} + 0.3$ ) V must not be exceeded 3.6 V

## POWER DISSIPATION RATING

PACKAGE	$\theta_{JA}$	PD ( $T_a=25^\circ\text{C}$ )	PD ( $T_a=75^\circ\text{C}$ )
SSMINI-5DC	833.3°C/W	0.12W	0.06W

Note). For the actual usage, please refer to the PD- $T_a$  characteristics diagram in the package specification, supply voltage, load and ambient temperature conditions to ensure that there is enough margin follow the power and the thermal design does not exceed the allowable value.

**CAUTION**

Although this has limited built-in ESD protection circuit, but permanent damage may occur on it. Therefore, proper ESD precautions are recommended to avoid electrostatic damage to the MOS gates

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Supply voltage range	$V_{CC}$	1.65	2.85 / 1.8	3.0	V	*1

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

**ELECTRICAL CHARACTERISTICS**

Note)  $V_{cc} = 2.85\text{ V}$ ,  $T_a = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$  unless otherwise specified.

Parameter	Symbol	Conditions	Limits			Unit	Note
			Min	Typ	Max		
<b>DC electrical characteristics</b>							
Supply current	I <sub>ccHA</sub>	V <sub>cc</sub> current at Active mode No input signal	—	4.5	6.5	mA	—
Sleep current	I <sub>ccSA</sub>	V <sub>cc</sub> current at Sleep mode No input signal	—	2.5	8	μA	—
CNT current (On)	I <sub>cntHA</sub>	CNT current at Active mode No input signal (V <sub>IHA</sub> = V <sub>cc</sub> )	—	14	25	μA	—
CNT voltage (On)	V <sub>IHA</sub>	—	1.6	1.8	3.0	V	—
CNT voltage (Sleep)	V <sub>I LA</sub>	—	—	0	0.37	V	—

## ELECTRICAL CHARACTERISTICS (continued)

Note)  $V_{cc} = 1.8\text{ V}$ ,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$  unless otherwise specified.

Parameter	Symbol	Conditions	Limits			Unit	Note
			Min	Typ	Max		
<b>DC electrical characteristics</b>							
Supply current	IccHB	Vcc current at Active mode No input signal	—	4.3	6.3	mA	—
Sleep current	IccSB	Vcc current at Sleep mode No input signal	—	1.5	6	$\mu\text{A}$	—
CNT voltage (On)	VIHB	—	1.6	1.8	1.95	V	—
CNT voltage (Sleep)	VILB	—	—	0	0.37	V	—

**ELECTRICAL CHARACTERISTICS (continued)**

Note)  $V_{cc} = 2.85\text{ V}$ ,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RX} = 1\,575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

Parameter	Symbol	Conditions	Limits			Unit	Note
			Min	Typ	Max		
<b>LNA AC electrical characteristics</b>							
Power Gain	PGSA	$f = 1\,575\text{ MHz}$ $PRX = -30\text{ dBm}$	17	19	21	dB	—
IIP3 +10 MHz offset	IIP31SA	$f1 = f_{RX} + 10\text{ MHz}$ $f2 = f_{RX} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-3	1.5	—	dBm	—

## ELECTRICAL CHARACTERISTICS (continued)

Note)  $V_{cc} = 1.8\text{ V}$ ,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RX} = 1\,575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

Parameter	Symbol	Conditions	Limits			Unit	Note
			Min	Typ	Max		
<b>LNA AC electrical characteristics</b>							
Power Gain	PGSB	$f = 1\,575\text{ MHz}$ $PRX = -30\text{ dBm}$	16.6	18.6	20.6	dB	—
IIP3 +10 MHz offset	IIP31SB	$f_1 = f_{RX} + 10\text{ MHz}$ $f_2 = f_{RX} + 20\text{ MHz}$ Input 2 signals ( $f_1, f_2$ )	-6	-1.5	—	dBm	—

**APPLICATION INFORMATION**

**REFERENCE VALUES FOR DESIGN**

Notes)  $V_{cc} = 2.85\text{ V}$ ,  $T_a = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ,  $f_{RX} = 1575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

Parameter	Symbol	Conditions	Reference values			Unit	Note
			Min	Typ	Max		
<b>LNA AC electrical characteristics</b>							
Noise Figure	NFA	$f = f_{RX}$	—	0.95	1.35	dB	*1, *2
Reverse Isolation	ISOA	$f = f_{RX}$	21	29	—	dB	*1
Input Return Loss	S11A	$f = f_{RX}$	8	10.5	—	dB	*1
Output Return Loss	S22A	$f = f_{RX}$	8.5	11	—	dB	*1

Note) \*1 : Checked by design, not production tested.  
 \*2 : Connector & substrate loss (0.09 dB) included.

**APPLICATION INFORMATION (continued)**

**REFERENCE VALUES FOR DESIGN (continued)**

Notes)  $V_{cc} = 1.8\text{ V}$ ,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RX} = 1575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

Parameter	Symbol	Conditions	Reference values			Unit	Note
			Min	Typ	Max		
<b>LNA AC electrical characteristics</b>							
Noise Figure	NFB	$f = f_{RX}$	—	0.95	1.35	dB	*1, *2
Reverse Isolation	ISOB	$f = f_{RX}$	21	29	—	dB	*1
Input Return Loss	S11B	$f = f_{RX}$	8	11	—	dB	*1
Output Return Loss	S22B	$f = f_{RX}$	8	10.5	—	dB	*1

Note) \*1 : Checked by design, not production tested.

\*2 : Connector & substrate loss (0.09 dB) included.



**APPLICATION INFORMATION (continued)**  
**REFERENCE VALUES FOR DESIGN (continued)**

Notes)  $V_{cc} = 2.7\text{ V to }3.0\text{ V}$ ,  $T_a = -30^\circ\text{C to }75^\circ\text{C}$ , unless otherwise specified.

Parameter	Symbol	Conditions	Reference values			Unit	Note
			Min	Typ	Max		
<b>DC electrical characteristics</b>							
Supply current	I <sub>ccHTA</sub>	V <sub>cc</sub> current No input signal	—	4.5	7	mA	*1
Sleep current	I <sub>ccSTA</sub>	V <sub>cc</sub> current at Sleep mode No input signal	—	2.5	10	μA	*1
CNT current (On)	I <sub>cntHTA</sub>	CNT current at Active mode No input signal	—	14	30	μA	*1

Note) \*1 : Checked by design, not production tested.

**APPLICATION INFORMATION (continued)**

**REFERENCE VALUES FOR DESIGN (continued)**

Notes) Vcc = 1.65 V to 1.95 V, Ta = -30°C to 75°C, unless otherwise specified.

Parameter	Symbol	Conditions	Reference values			Unit	Note
			Min	Typ	Max		
<b>DC electrical characteristics</b>							
Supply current	IccHTB	Vcc current No input signal	—	4.3	6.8	mA	*1
Sleep current	IccSTB	Vcc current at Sleep mode No input signal	—	1.5	8	μA	*1

Note) \*1 : Checked by design, not production tested.

**APPLICATION INFORMATION (continued)**  
**REFERENCE VALUES FOR DESIGN (continued)**

Notes)  $V_{CC} = 2.7\text{ V to }3.0\text{ V}$   
 $T_a = -30^\circ\text{C to }75^\circ\text{C}$ ,  $f_{RX} = 1\ 575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

Parameter	Symbol	Conditions	Reference Values			Unit	Note
			Min	Typ	Max		
<b>LNA AC electrical characteristics</b>							
Power Gain	GTA	$f = f_{RX}$	16	19	22	dB	*1
Noise Figure	NFTA	$f = f_{RX}$	—	0.95	1.6	dB	*1, *2
IIP3 +10 MHz offset	IIP31TA	$f_1 = f_{RX} + 10\text{ MHz}$ $f_2 = f_{RX} + 20\text{ MHz}$ Input 2 signals ( $f_1, f_2$ )	-4.5	1.5	—	dBm	*1

Note) \*1 : Checked by design, not production tested.  
 \*2 : Connector & substrate loss (0.09 dB) included.

**APPLICATION INFORMATION (continued)**  
**REFERENCE VALUES FOR DESIGN (continued)**

Notes)  $V_{cc} = 1.65\text{ V to }1.95\text{ V}$

$T_a = -30^\circ\text{C to }75^\circ\text{C}$ ,  $f_{RX} = 1\,575\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

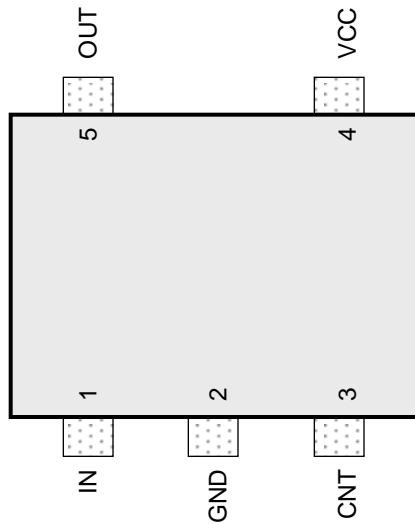
Parameter	Symbol	Conditions	Reference Values			Unit	Note
			Min	Typ	Max		
<b>LNA AC electrical characteristics</b>							
Power Gain	GTB	$f = f_{RX}$	15.6	18.6	21.6	dB	*1
Noise Figure	NFTB	$f = f_{RX}$	—	0.95	1.6	dB	*1, *2
IIP3 +10 MHz offset	IIP31TB	$f1 = f_{RX} + 10\text{ MHz}$ $f2 = f_{RX} + 20\text{ MHz}$ Input 2 signals ( $f1, f2$ )	-9	-1.5	—	dBm	*1

Note) \*1 : Checked by design, not production tested.

\*2 : Connector & substrate loss (0.09 dB) included.

PIN CONFIGURATION

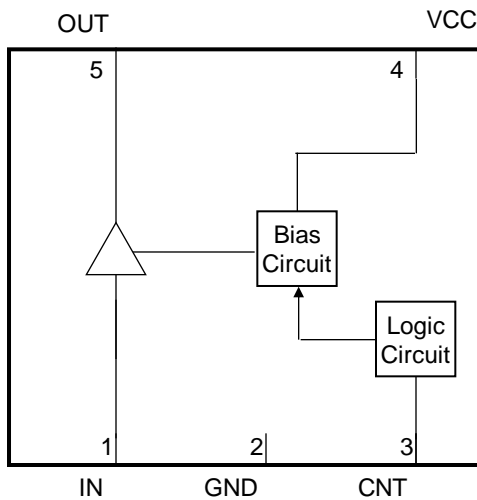
Top View



PIN FUNCTIONS

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

FUNCTIONAL BLOCK DIAGRAM

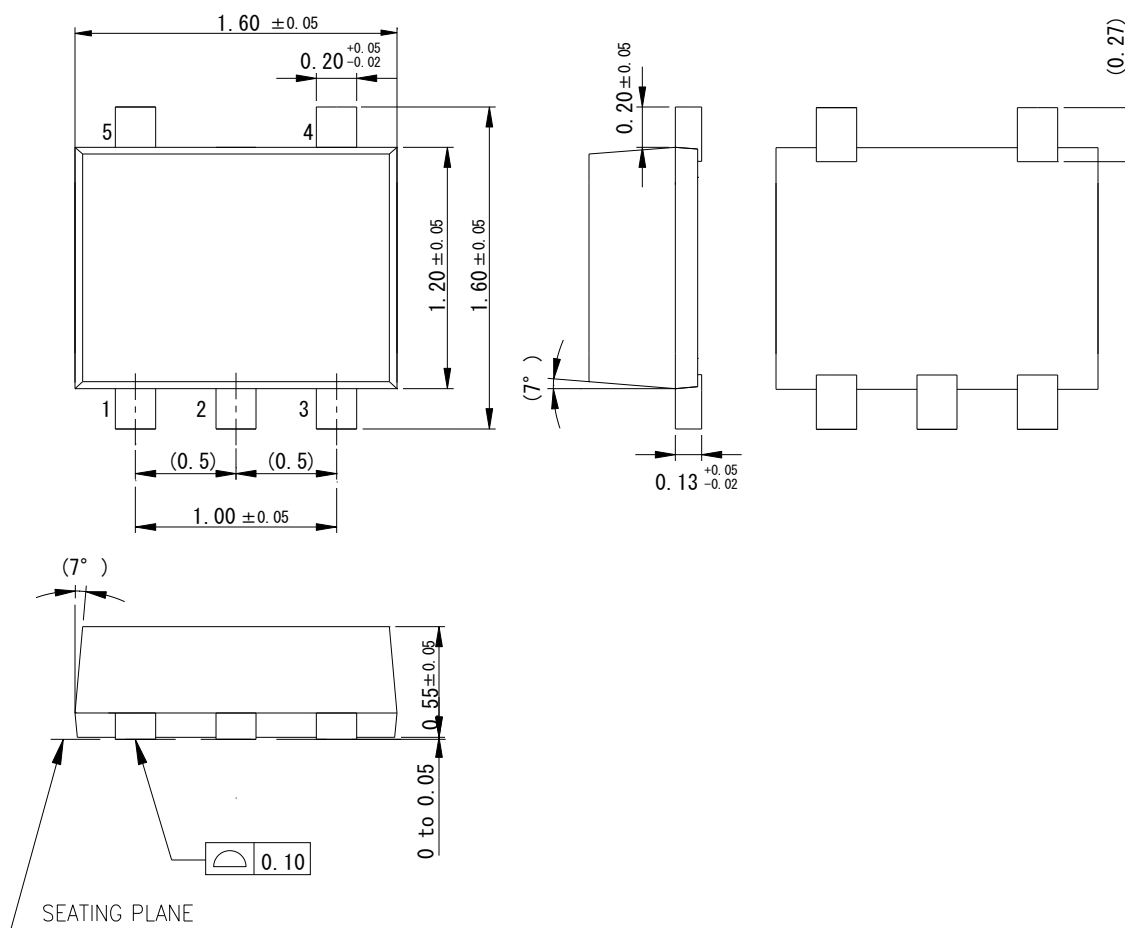


Notes) This block diagram is for explaining functions. Part of the block diagram may be omitted, or it may be simplified.

PACKAGE INFORMATION ( Reference Data )

Package Code:SSMINI-5DC

Unit:mm



Body Material	: Br / Sb Free Epoxy Resin
Lead Material	: Cu Alloy
Lead Finish Method	: SnBi Plating

**IMPORTANT NOTICE**

1. The products and product specifications described in this book are subject to change without notice for modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.
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3. When the application system is designed by using this LSI, be sure to confirm notes in this book.  
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  - (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 requiredIt 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 LSI described in this book for any special application, unless our company agrees to your using the LSI in this book for any special application.
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**USAGE NOTES**

1. 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.

2. 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.
3. 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.
4. 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.
5. 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.
6. Take notice in the use of this product that it might break or occasionally smoke when an abnormal state occurs such as output pin-VCC 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.