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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
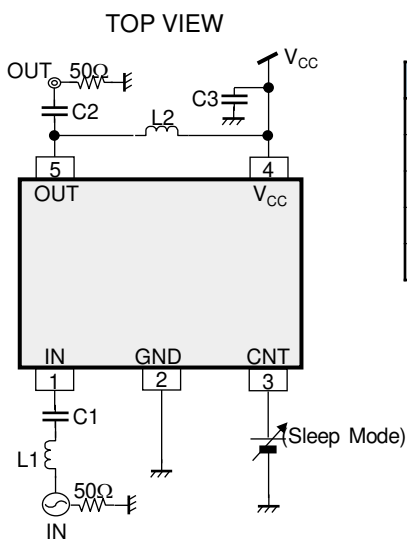 (SMINI Type)

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

TOP VIEW

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 Ta = 25°C.
     *3:RF signal input pin. Do not apply DC current.
     *4:(Vcc + 0.15) V must not be exceeded 3.6 V
     *5:(Vcc + 0.3) V must not be exceeded 3.6 V

POWER DISSIPATION RATING

PACKAGE	θ_{JA}	PD (Ta=25 °C)	PD (Ta=75 °C)
SSMINI-5DC	833.3°C/W	0.12W	0.06W

Note). For the actual usage, please refer to the PD-Ta 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.

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ELECRTRICAL CHARACTERISTICS

Note) Vcc = 2.85 V, Ta = 25°C±2°C unless otherwise specified.

Parameter	Symbol	Conditions	Limits			Unit	Note
			Min	Typ	Max		
DC electrical characteristics							
Supply current	IccHA	Vcc current at Active mode No input signal	—	4.5	6.5	mA	—
Sleep current	IccSA	Vcc current at Sleep mode No input signal	—	2.5	8	μA	—
CNT current (On)	IcntHA	CNT current at Active mode No input signal (VIHA = Vcc)	—	14	25	μA	—
CNT voltage (On)	VIHA	—	1.6	1.8	3.0	V	—
CNT voltage (Sleep)	VILA	—	—	0	0.37	V	—

ELECRTRICAL CHARACTERISTICS (continued)

Note) Vcc = 1.8 V, Ta = 25°C±2°C unless otherwise specified.

Parameter		Symbol	Conditions	Limits			Unit	Note
				Min	Typ	Max		
DC electrical characteristics								
	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	μA	—
	CNT voltage (On)	VIHB	—	1.6	1.8	1.95	V	—
	CNT voltage (Sleep)	VILB	—	—	0	0.37	V	—

ELECRTRICAL CHARACTERISTICS (continued)

Note) Vcc = 2.85 V, Ta = 25°C±2°C, fRX = 1 575 MHz, PRX = –30 dBm, CW unless otherwise specified.

Parameter	Symbol	Conditions	Limits			Unit	Note
			Min	Typ	Max		
LNA AC electrical characteristics							
Power Gain	PGSA	f = 1 575 MHz PRX = –30 dBm	17	19	21	dB	—
IIP3 +10 MHz offset	IIP31SA	f1 = fRX + 10 MHz f2 = fRX + 20 MHz Input 2 signals (f1, f2)	–3	1.5	—	dBm	—

ELECRTRICAL CHARACTERISTICS (continued)

Note) Vcc = 1.8 V, Ta = 25°C±2°C, fRX = 1 575 MHz, PRX = –30 dBm, CW unless otherwise specified.

Parameter	Symbol	Conditions	Limits			Unit	Note
			Min	Typ	Max		
LNA AC electrical characteristics							
Power Gain	PGSB	f = 1 575 MHz PRX = –30 dBm	16.6	18.6	20.6	dB	—
IIP3 +10 MHz offset	IIP31SB	f1 = fRX + 10 MHz f2 = fRX + 20 MHz Input 2 signals (f1, f2)	–6	–1.5	—	dBm	—

APPLICATION INFORMATION
REFERENCE VALUES FOR DESIGN

Notes) Vcc = 2.85 V, Ta = 25°C±2°C, fRX = 1575 MHz, PRX = –30 dBm, CW unless otherwise specified.

Parameter	Symbol	Conditions	Reference values			Unit	Note
			Min	Typ	Max		
LNA AC electrical characteristics							
Noise Figure	NFA	f = fRX	—	0.95	1.35	dB	*1 , *2
Reverse Isolation	ISOA	f = fRX	21	29	—	dB	*1
Input Return Loss	S11A	f = fRX	8	10.5	—	dB	*1
Output Return Loss	S22A	f = fRX	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) Vcc = 1.8 V, Ta = 25°C±2°C, fRX = 1575 MHz, PRX = –30 dBm, CW unless otherwise specified.

Parameter	Symbol	Conditions	Reference values			Unit	Note
			Min	Typ	Max		
LNA AC electrical characteristics							
Noise Figure	NFB	f = fRX	—	0.95	1.35	dB	*1 , *2
Reverse Isolation	ISOB	f = fRX	21	29	—	dB	*1
Input Return Loss	S11B	f = fRX	8	11	—	dB	*1
Output Return Loss	S22B	f = fRX	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) Vcc = 2.7 V to 3.0 V, Ta = –30°C to 75°C, unless otherwise specified.

Parameter	Symbol	Conditions	Reference values			Unit	Note
			Min	Typ	Max		
DC electrical characteristics							
Supply current	IccHTA	Vcc current No input signal	—	4.5	7	mA	*1
Sleep current	IccSTA	Vcc current at Sleep mode No input signal	—	2.5	10	μA	*1
CNT current (On)	IcntHTA	CNT current at Active mode No input signal	—	14	30	μA	*1

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

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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		
DC electrical characteristics								
	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) Vcc= 2.7 V to 3.0 V
Ta = –30°C to 75°C, fRX = 1 575 MHz, PRX = –30 dBm, CW unless otherwise specified.

Parameter	Symbol	Conditions	Reference Values			Unit	Note
			Min	Typ	Max		
LNA AC electrical characteristics							
Power Gain	GTA	f = fRX	16	19	22	dB	*1
Noise Figure	NFTA	f = fRX	—	0.95	1.6	dB	*1 , *2
IIP3 +10 MHz offset	IIP31TA	f1 = fRX + 10 MHz f2 = fRX + 20 MHz Input 2 signals (f1, f2)	–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) Vcc = 1.65 V to 1.95 V

Ta = −30°C to 75°C, fRX = 1 575 MHz, PRX = −30 dBm, CW unless otherwise specified.

Parameter	Symbol	Conditions	Reference Values			Unit	Note
			Min	Typ	Max		
LNA AC electrical characteristics							
Power Gain	GTB	f = fRX	15.6	18.6	21.6	dB	*1
Noise Figure	NFTB	f = fRX	—	0.95	1.6	dB	*1 , *2
IIP3 +10 MHz offset	IIP31TB	f1 = fRX + 10 MHz f2 = fRX + 20 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.
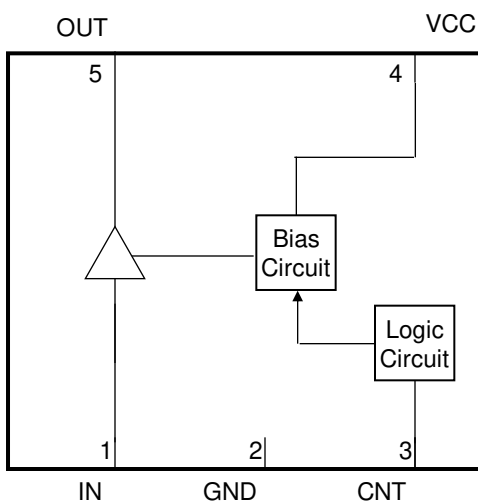
PIN CONFIGURATION

Top View
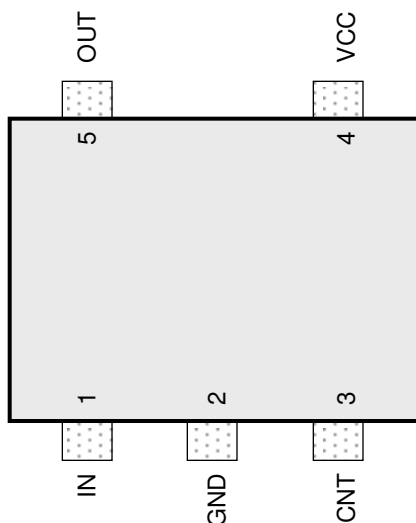
PIN FUNCTIONS

| 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_{CC}
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
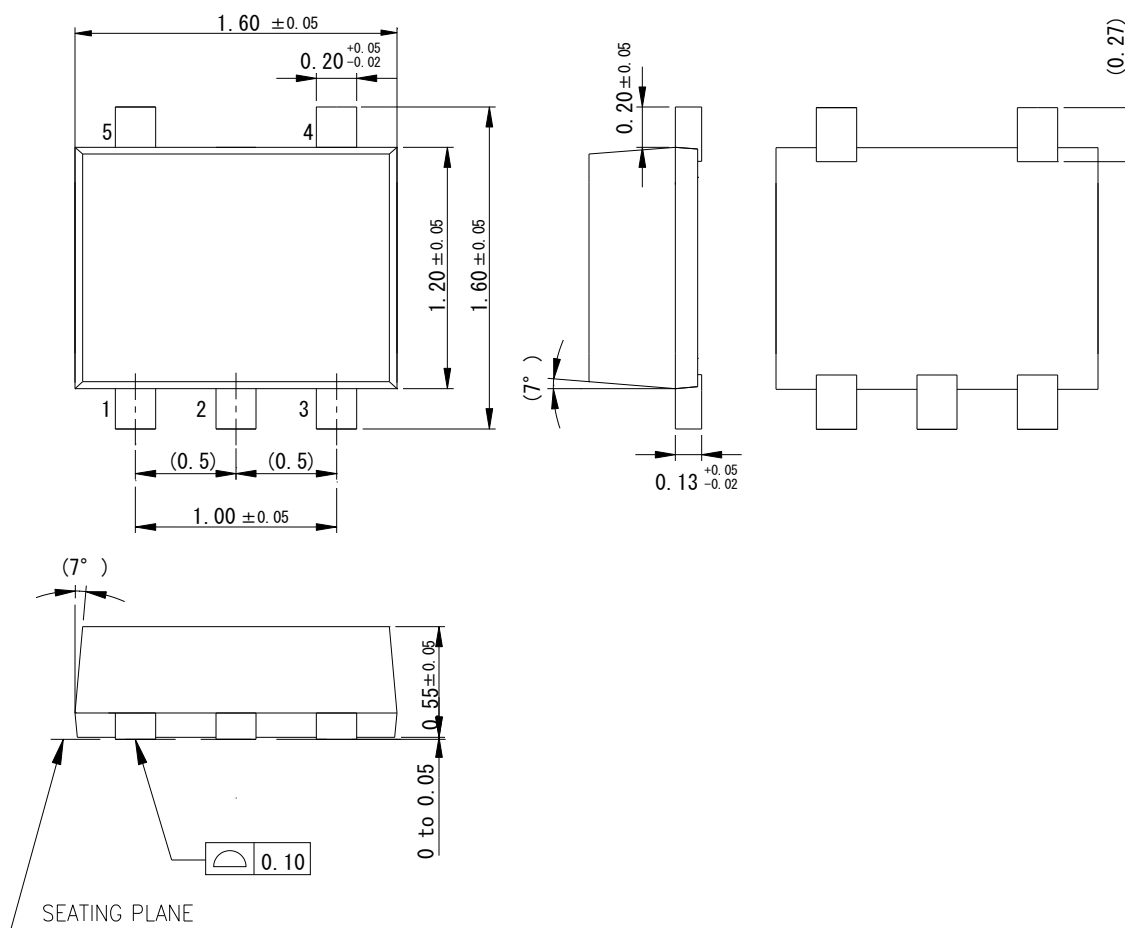
Body Material	:	Br / Sb Free Epoxy Resin
Lead Material	:	Cu Alloy
Lead Finish Method : SnBi Plating		

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   (5) Control equipment for power plant
   (6) Disaster prevention and security device
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   (8) Others : Applications of which reliability equivalent to (1) to (7) is required
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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.