

# DATA SHEET

|                  |                   |
|------------------|-------------------|
| Part No.         | AN26102A          |
| Package Code No. | ALGA011-W-0912ANB |

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# AN26102A

## SiGe Linear Power Amplifier for 2.4 GHz Band Applications

### ■ Overview

- AN26102A is Power amplifier IC for 2.4 GHz band (2 400 MHz to 2 500 MHz) applications.
- Realizing high performance by using 0.25  $\mu\text{m}$  Bi-CMOS process ( $f_T = 50 \text{ GHz}$ ,  $f_{\text{max}} = 60 \text{ GHz}$ ).
- Achieving miniaturization by using chip size package.

### ■ Features

- Operating voltage  $V_{CC} = PAV_{CC} = +3.30 \text{ V typ.}$
- Low current consumption 145 mA typ. @Pout = +18 dBm
- High gain 30 dB typ. @fTX = 2450 MHz, Pout = +18 dBm
- Chip size package (11-pin WLCSP)

### ■ Applications

- 2.4 GHz band (2 400 MHz to 2 500 MHz) applications

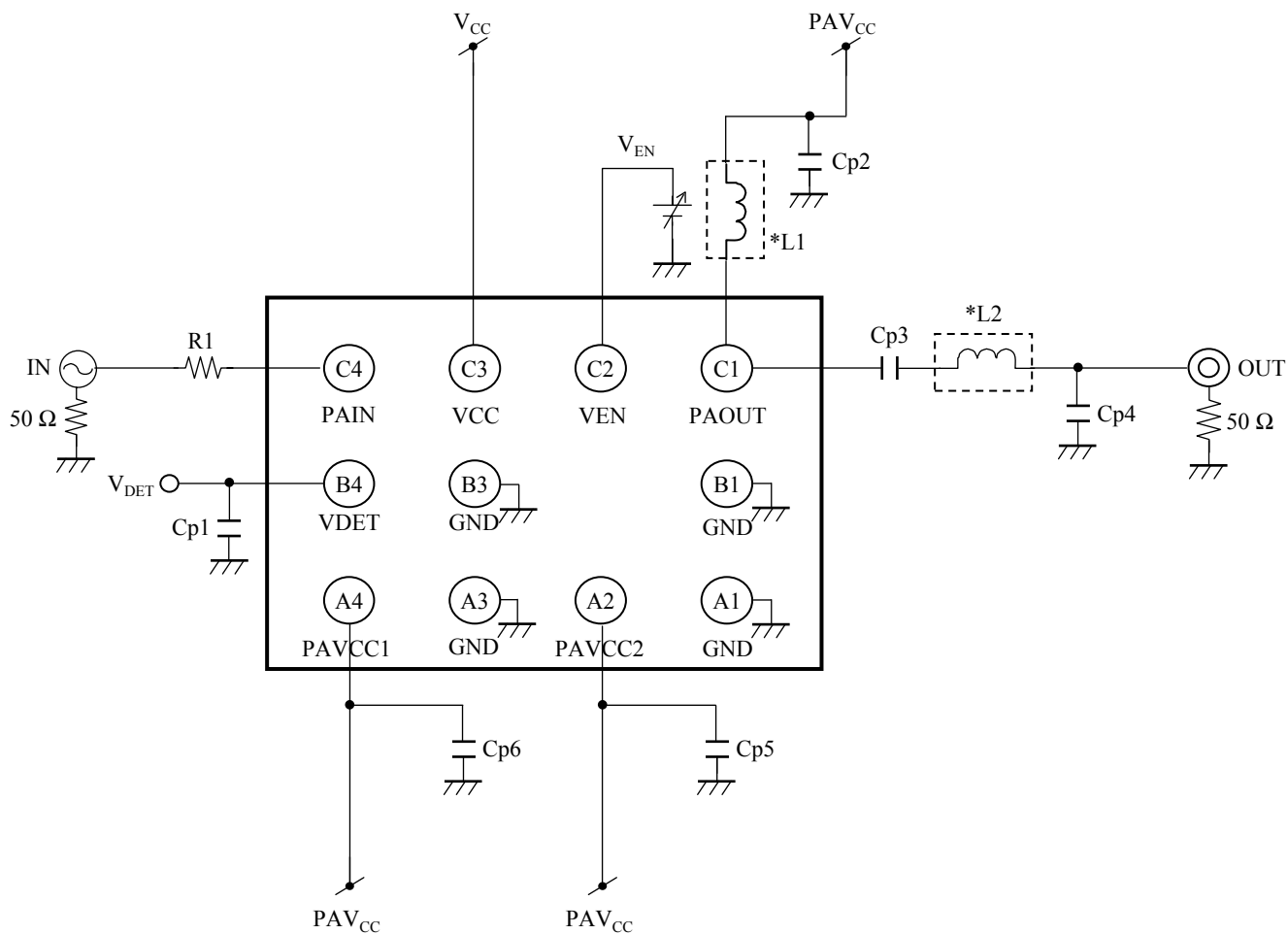
### ■ Package

- 11 pin Wafer Level Chip Size Package (WLCSP)  
Size : 1.16 mm  $\times$  0.86 mm (0.3mm pitch)

### ■ Type

- Bi-CMOS IC

■ Application Circuit Example (Block Diagram)



- 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. The part of the block diagram may be omitted, or it may be simplified.
  - \*L1, \*L2 is a substrate pattern L.

## ■ Pin Descriptions

| Pin No. | Pin name | Type         | Description                                      |
|---------|----------|--------------|--------------------------------------------------|
| A1      | GND      | Ground       | GND                                              |
| A2      | PAVCC2   | Power Supply | 2nd stage amplifier collector supply             |
| A3      | GND      | Ground       | GND                                              |
| A4      | PAVCC1   | Power Supply | 1st stage amplifier collector supply             |
| B1      | GND      | Ground       | GND                                              |
| B3      | GND      | Ground       | GND                                              |
| B4      | VDET     | Output       | Power detector output                            |
| C1      | PAOUT    | Output       | RF output , 3rd stage amplifier collector supply |
| C2      | VEN      | Input        | Bias circuit control                             |
| C3      | VCC      | Power Supply | Bias circuit supply                              |
| C4      | PAIN     | Input        | RF input, DC block required                      |

## ■ 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                | $V_{CC}$   | 4.5         | V    | *1    |
|       |                               | $PAV_{CC}$ | 4.5         | V    | *1    |
| 2     | Supply current                | $I_{CC}$   | 300         | mA   | *1    |
| 3     | Power dissipation             | $P_D$      | 50          | mW   | *2    |
| 4     | Operating ambient temperature | $T_{opr}$  | −30 to +85  | °C   | *3    |
| 5     | Storage temperature           | $T_{stg}$  | −40 to +150 | °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 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  $T_a = 25^\circ\text{C}$ .

## ■ Operating Supply Voltage Range

| Parameter            | Symbol     | Range        | Unit | Notes |
|----------------------|------------|--------------|------|-------|
| Supply voltage range | $V_{CC}$   | 2.95 to 4.20 | V    | *1    |
|                      | $PAV_{CC}$ | 2.95 to 4.20 | V    | *1    |

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

## ■ 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.
  - $PAV_{CC}$  is voltage for  $PAVCC1$ ,  $PAVCC2$ ,  $PAOUT$
  - Do not apply external currents or voltages to any pin not specifically mentioned.

| Pin No. | Pin name | Range               | Unit | Notes |
|---------|----------|---------------------|------|-------|
| C2      | VEN      | – 0.3 to 4.0        | V    | —     |
| C1      | PAOUT    | – 0.3 to $PAV_{CC}$ | V    | *1    |
| A4      | $PAVCC2$ | – 0.3 to $PAV_{CC}$ | V    | —     |
| A2      | $PAVCC1$ | – 0.3 to $PAV_{CC}$ | V    | —     |
| C4      | PAIN     | —                   | V    | *2    |

Notes) \*1 : RF signal output pin. (Maximum output power is 23.5 dBm.)

\*2 : RF signal input pin. (Maximum input power is –2 dBm.) Do not apply DC current.

■ Electrical Characteristics at  $V_{EN} = 2.85\text{ V}$ ,  $V_{CC} = PAV_{CC} = 3.3\text{ V}$

Note) Unless otherwise specified,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $ZS = ZL = 50\ \Omega$ .

| B No.                         | Parameter                    | Symbol            | Conditions                                               | Limits |      |      | Unit | Notes |
|-------------------------------|------------------------------|-------------------|----------------------------------------------------------|--------|------|------|------|-------|
|                               |                              |                   |                                                          | Min    | Typ  | Max  |      |       |
| DC electrical characteristics |                              |                   |                                                          |        |      |      |      |       |
| DC-1                          | Supply current (Active mode) | I <sub>CC</sub> H | Current at Active mode<br>(No RF signal input)           | —      | 85   | 135  | mA   | —     |
| DC-2                          | Supply current (Sleep mode)  | I <sub>CC</sub> L | Current at Sleep mode<br>(No RF signal input)            | —      | 20   | 30   | μA   | —     |
| DC-3                          | SW voltage<br>(Active mode)  | V <sub>I</sub> H  | V <sub>EN</sub> for Active mode                          | 2.70   | 2.85 | 3.40 | V    | —     |
| DC-4                          | SW voltage<br>(Sleep mode)   | V <sub>I</sub> L  | V <sub>EN</sub> for Sleep mode                           | —      | 0.0  | 0.30 | V    | —     |
| DC-5                          | SW current (Active mode)     | I <sub>I</sub> H  | Current at VEN pin<br>V <sub>I</sub> H = V <sub>EN</sub> | —      | 1.5  | 3.5  | mA   | —     |

■ Electrical Characteristics (continued) at  $V_{EN} = 2.85 \text{ V}$ ,  $V_{CC} = PAV_{CC} = 3.3 \text{ V}$

Note) Unless otherwise specified,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{TX} = 2450 \text{ MHz}$ , CW,  $Z_S = Z_L = 50 \Omega$ .

| B No.                                         | Parameter                              | Symbol | Conditions                                    | Limits |      |       | Unit | Notes |
|-----------------------------------------------|----------------------------------------|--------|-----------------------------------------------|--------|------|-------|------|-------|
|                                               |                                        |        |                                               | Min    | Typ  | Max   |      |       |
| Power amplifier AC electrical characteristics |                                        |        |                                               |        |      |       |      |       |
| A-1                                           | Operation current<br>(Signal : CW)     | IDS    | Active mode,<br>f = fTX, CW<br>Pout = +18 dBm | —      | 150  | 200   | mA   | —     |
| A-2                                           | Power gain<br>(Signal : CW)            | GDS    | Active mode,<br>f = fTX, CW<br>Pout = +18 dBm | 26     | 30   | 33.5  | dB   | —     |
| A-3                                           | 2nd harmonics                          | HF2S   | Active mode,<br>f = fTX<br>Pout = +18 dBm     | —      | −50  | −40   | dBc  | —     |
| A-4                                           | DET output voltage<br>(Pout = +18 dBm) | DET1S  | Active mode,<br>Pout = +18 dBm                | 0.3    | 0.43 | 0.495 | V    | —     |
| A-5                                           | DET output voltage<br>(Pout = +22 dBm) | DET2S  | Active mode,<br>Pout = +22 dBm                | 0.485  | 0.58 | 0.72  | V    | —     |
| A-6                                           | Delta DET voltage                      | DDET   | Active mode                                   | 0.02   | 0.15 | 0.22  | V    | —     |

**■ Control Pin Mode Table**

Note) See parameters B No. DC-3 / B No. DC-4 in the Electrical Characteristics for control voltage relation ranges.

| Pin No. | Descriptions           | Voltage |        | Note |
|---------|------------------------|---------|--------|------|
|         |                        | Low     | High   |      |
| C3      | Active/Sleep switching | Sleep   | Active | —    |

**■ Truth Table**

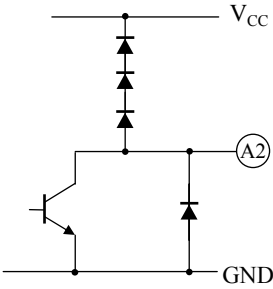
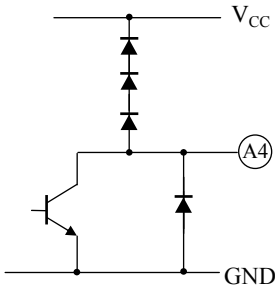
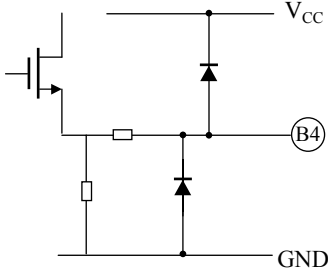
Note) See parameters B No. DC-3 / B No. DC-4 in the Electrical Characteristics for control voltage relation ranges.

| CNT  | PA     | Mode      |
|------|--------|-----------|
| High | Active | PA Active |
| Low  | Sleep  | PA Sleep  |

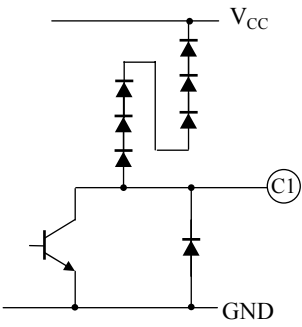
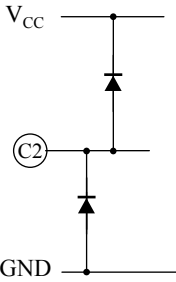
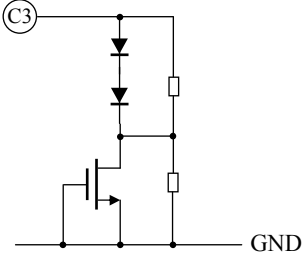
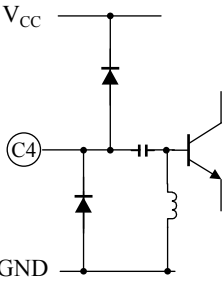
■ Technical Data

- 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.

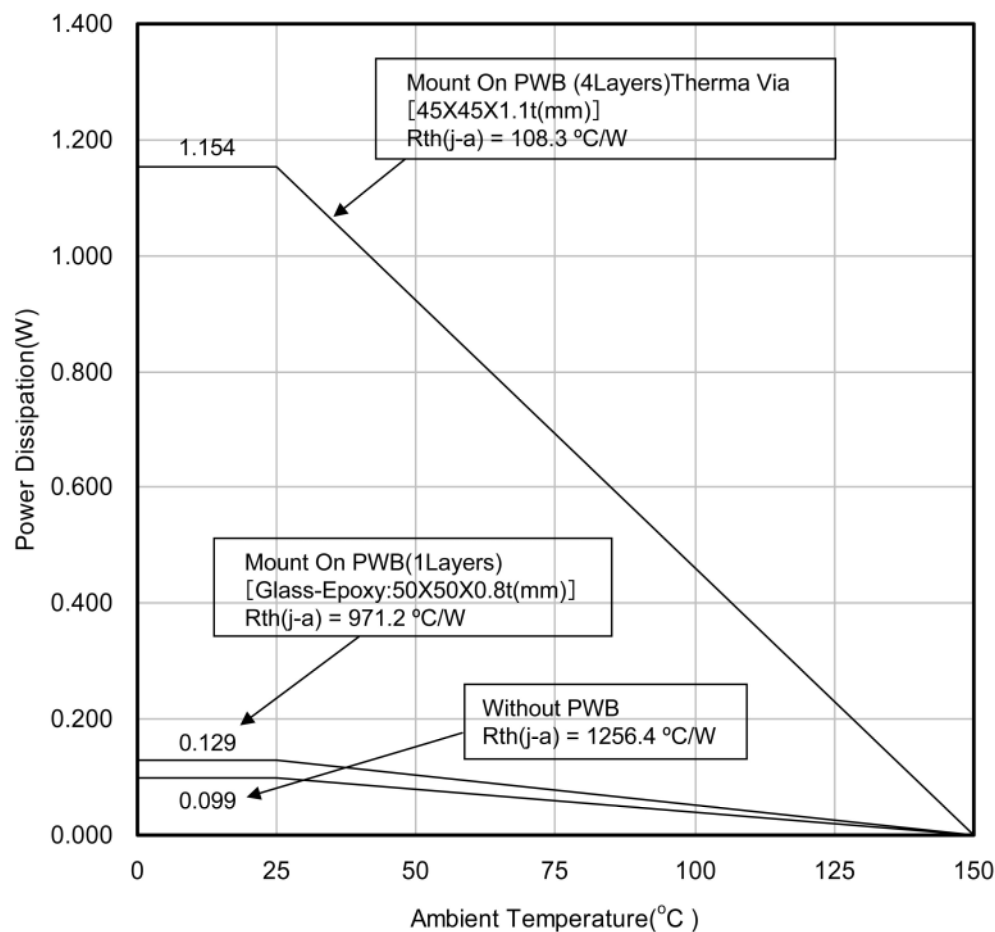
| Pin No. | Voltage | Internal circuit                                                                    | Descriptions                                              |
|---------|---------|-------------------------------------------------------------------------------------|-----------------------------------------------------------|
| A1      | 0.00 V  | —                                                                                   | GND                                                       |
| A2      | 3.30 V  |    | 2nd stage amplifier collector supply (PAV <sub>CC</sub> ) |
| A3      | 0.00 V  | —                                                                                   | GND                                                       |
| A4      | 3.30 V  |   | 1st stage amplifier collector supply (PAV <sub>CC</sub> ) |
| B1      | 0.00 V  | —                                                                                   | GND                                                       |
| B3      | 0.00 V  | —                                                                                   | GND                                                       |
| B4      | —       |  | Power detector output                                     |

■ 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                                                                    | Descriptions                                                                             |
|---------|---------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| C1      | 3.30 V  |    | RF Output<br>3rd stage amplifier collector supply (PAV <sub>CC</sub> )                   |
| C2      | —       |   | Active/Sleep SW Input<br>Less than 0.30 V : Sleep mode<br>More than 2.70 V : Active mode |
| C3      | 3.30 V  |  | Voltage supply (V <sub>CC</sub> )                                                        |
| C4      | —       |  | PA 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 [2.4 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- $V_{CC}$  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.

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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.  
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- (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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