

# BLL9G1214L-600; BLL9G1214LS-600

LDMOS L-band radar power transistor

Rev. 1 — 27 November 2017

AMPLEON

Product data sheet

## 1. Product profile

### 1.1 General description

600 W LDMOS power transistor for L-band radar applications in the frequency range from 1.2 GHz to 1.4 GHz.

**Table 1. Typical performance**

Typical RF performance at  $T_{case} = 25\text{ }^{\circ}\text{C}$ ;  $t_p = 300\text{ }\mu\text{s}$ ;  $\delta = 10\%$ ;  $I_{Dq} = 400\text{ mA}$ ; in a class-AB demo test circuit.

| Test signal | f          | V <sub>DS</sub> | P <sub>L(3dB)</sub> | G <sub>p</sub> | $\eta_D$ |
|-------------|------------|-----------------|---------------------|----------------|----------|
|             | (GHz)      | (V)             | (W)                 | (dB)           | (%)      |
| pulsed RF   | 1.2 to 1.4 | 32              | 600                 | 19             | 60       |

### 1.2 Features and benefits

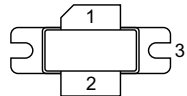
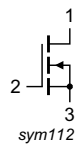
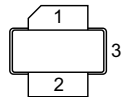
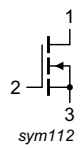
- High efficiency
- Excellent ruggedness
- Designed for L-band operation
- Excellent thermal stability
- Easy power control
- Integrated dual sided ESD protection enables excellent off-state isolation
- High flexibility with respect to pulse formats
- Internally matched for ease of use
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

### 1.3 Applications

- L-band radar applications in the frequency range from 1.2 GHz to 1.4 GHz

## 2. Pinning information

**Table 2. Pinning**

| Pin                       | Description           | Simplified outline                                                                  | Graphic symbol                                                                                |
|---------------------------|-----------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| BLL9G1214L-600 (SOT502A)  |                       |                                                                                     |                                                                                               |
| 1                         | drain                 |  | <br>sym112 |
| 2                         | gate                  |                                                                                     |                                                                                               |
| 3                         | source <sup>[1]</sup> |                                                                                     |                                                                                               |
| BLL9G1214LS-600 (SOT502B) |                       |                                                                                     |                                                                                               |
| 1                         | drain                 |  | <br>sym112 |
| 2                         | gate                  |                                                                                     |                                                                                               |
| 3                         | source <sup>[1]</sup> |                                                                                     |                                                                                               |

[1] Connected to flange.

## 3. Ordering information

**Table 3. Ordering information**

| Type number     | Package |                                                    |         |
|-----------------|---------|----------------------------------------------------|---------|
|                 | Name    | Description                                        | Version |
| BLL9G1214L-600  | -       | flanged ceramic package; 2 mounting holes; 2 leads | SOT502A |
| BLL9G1214LS-600 | -       | earless flanged ceramic package; 2 leads           | SOT502B |

## 4. Limiting values

**Table 4. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol    | Parameter                           | Min | Max  | Unit |
|-----------|-------------------------------------|-----|------|------|
| $V_{DS}$  | drain-source voltage                | -   | 65   | V    |
| $V_{GS}$  | gate-source voltage                 | -6  | +13  | V    |
| $T_{stg}$ | storage temperature                 | -65 | +150 | °C   |
| $T_j$     | junction temperature <sup>[1]</sup> | -   | 225  | °C   |

[1] Continuous use at maximum temperature will affect the reliability. For details refer to the online MTF calculator.

## 5. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol         | Parameter                                                  | Conditions                                    | Typ  | Unit |
|----------------|------------------------------------------------------------|-----------------------------------------------|------|------|
| $Z_{th(j-mb)}$ | transient thermal impedance from junction to mounting base | $T_{case} = 85\text{ °C}; P_L = 600\text{ W}$ |      |      |
|                |                                                            | $t_p = 100\text{ }\mu\text{s}; \delta = 10\%$ | 0.11 | K/W  |
|                |                                                            | $t_p = 300\text{ }\mu\text{s}; \delta = 10\%$ | 0.15 | K/W  |
|                |                                                            | $t_p = 500\text{ }\mu\text{s}; \delta = 10\%$ | 0.17 | K/W  |
|                |                                                            | $t_p = 100\text{ }\mu\text{s}; \delta = 20\%$ | 0.15 | K/W  |

## 6. Characteristics

**Table 6. DC characteristics**

$T_j = 25\text{ °C}$  unless otherwise specified.

| Symbol        | Parameter                        | Conditions                                                  | Min | Typ   | Max | Unit          |
|---------------|----------------------------------|-------------------------------------------------------------|-----|-------|-----|---------------|
| $V_{(BR)DSS}$ | drain-source breakdown voltage   | $V_{GS} = 0\text{ V}; I_D = 4.5\text{ mA}$                  | 65  | -     | -   | V             |
| $V_{GS(th)}$  | gate-source threshold voltage    | $V_{DS} = 10\text{ V}; I_D = 450\text{ mA}$                 | 1.5 | 2     | 2.5 | V             |
| $I_{DSS}$     | drain leakage current            | $V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}$                 | -   | -     | 5   | $\mu\text{A}$ |
| $I_{DSX}$     | drain cut-off current            | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; V_{DS} = 10\text{ V}$ | -   | 87    | -   | A             |
| $I_{GSS}$     | gate leakage current             | $V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$                 | -   | -     | 400 | nA            |
| $g_{fs}$      | forward transconductance         | $V_{DS} = 10\text{ V}; I_D = 450\text{ mA}$                 | -   | 4.2   | -   | S             |
| $R_{DS(on)}$  | drain-source on-state resistance | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 15.75\text{ A}$ | -   | 0.026 | -   | $\Omega$      |

**Table 7. RF characteristics**

Test signal: pulsed RF;  $t_p = 300\text{ }\mu\text{s}; \delta = 10\%$ ; RF performance at  $V_{DS} = 32\text{ V}; I_{DQ} = 400\text{ mA}; T_{case} = 25\text{ °C}$ ; unless otherwise specified, in a class-AB production circuit.

| Symbol             | Parameter                             | Conditions           | Min  | Typ | Max | Unit |
|--------------------|---------------------------------------|----------------------|------|-----|-----|------|
| $G_p$              | power gain                            | $P_L = 600\text{ W}$ | 16.8 | 19  | -   | dB   |
| $\eta_D$           | drain efficiency                      | $P_L = 600\text{ W}$ | 56   | 60  | -   | %    |
| $RL_{in}$          | input return loss                     | $P_L = 600\text{ W}$ | -    | -7  | -   | dB   |
| $P_{droop(pulse)}$ | pulse droop power                     | $P_L = 600\text{ W}$ | -    | 0.2 | 0.5 | dB   |
| $t_r$              | rise time                             | $P_L = 600\text{ W}$ | -    | 6   | 50  | ns   |
| $t_f$              | fall time                             | $P_L = 600\text{ W}$ | -    | 6   | 50  | ns   |
| $P_{L(2dB)}$       | output power at 2 dB gain compression |                      | -    | 575 | -   | W    |

## 7. Test information

### 7.1 Ruggedness in class-AB operation

The BLL9G1214L-600 and BLL9G1214LS-600 are capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions:  $V_{DS} = 32$  V;  $I_{DQ} = 400$  mA;  $P_L = 600$  W;  $t_p = 300$   $\mu$ s;  $\delta = 10$  %.

### 7.2 Impedance information

Table 8. Typical impedance

| f<br>(GHz) | $Z_S$<br>( $\Omega$ ) | $Z_L$<br>( $\Omega$ ) |
|------------|-----------------------|-----------------------|
| 1.2        | $1.23 - j5.79$        | $1.14 - j1.39$        |
| 1.3        | $7.10 - j3.33$        | $1.62 - j1.63$        |
| 1.4        | $1.31 - j1.89$        | $2.36 - j1.56$        |

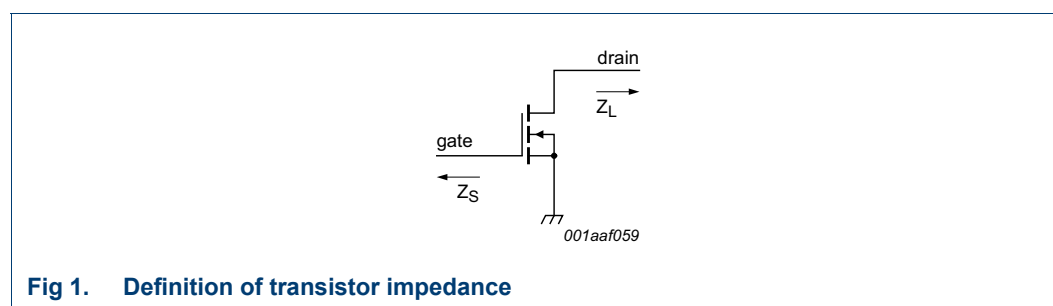
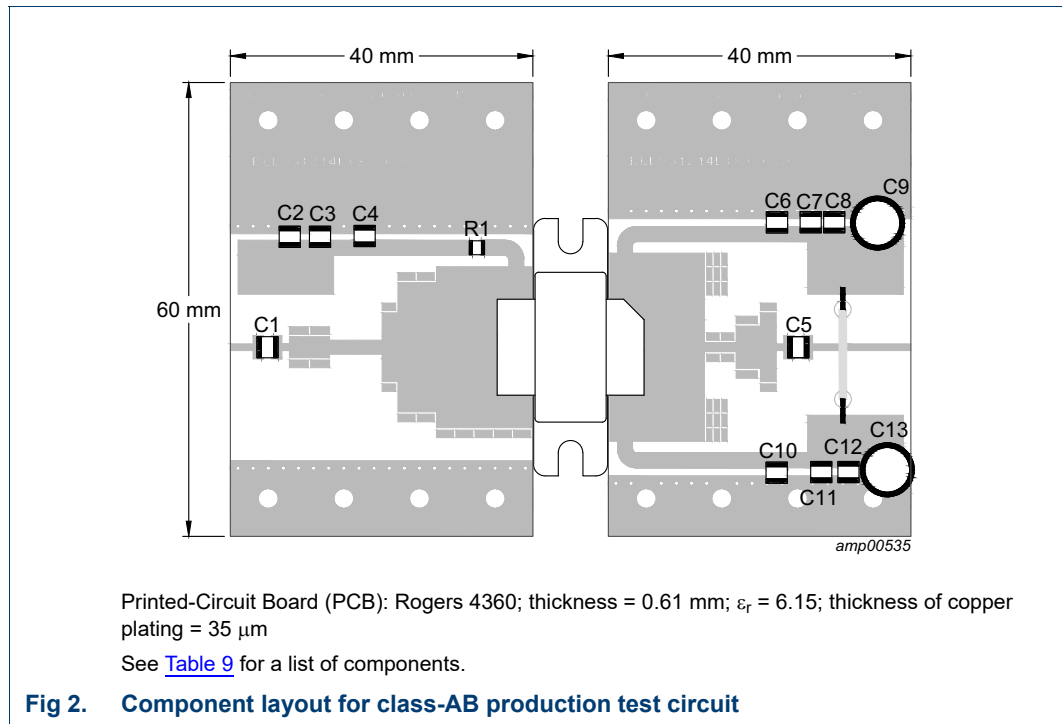


Fig 1. Definition of transistor impedance

### 7.3 Test circuit

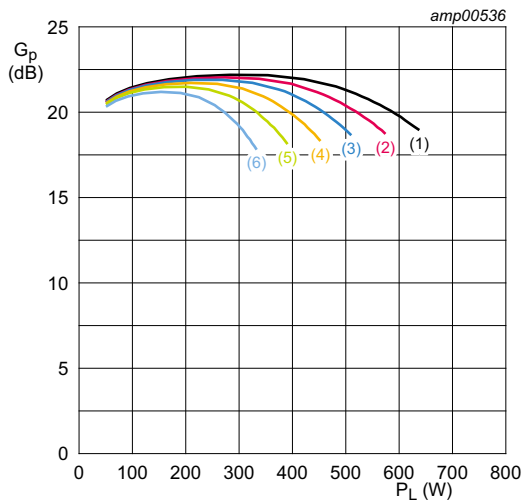


**Table 9. List of components**

For test circuit see [Figure 2](#).

| Component           | Description                       | Value                    | Remarks                       |
|---------------------|-----------------------------------|--------------------------|-------------------------------|
| C1, C4, C5, C6, C10 | multilayer ceramic chip capacitor | 56 pF                    | ATC 100B                      |
| C2, C8, C12         | multilayer ceramic chip capacitor | 10 $\mu\text{F}$         | Murata:<br>GRM55DR61H106KA88L |
| C3, C7, C11         | multilayer ceramic chip capacitor | 910 pF                   | ATC 100B                      |
| C9, C13             | electrolytic capacitor            | 100 $\mu\text{F}$ , 63 V |                               |
| R1                  | resistor                          | 5 $\Omega$               | SMD 0603                      |

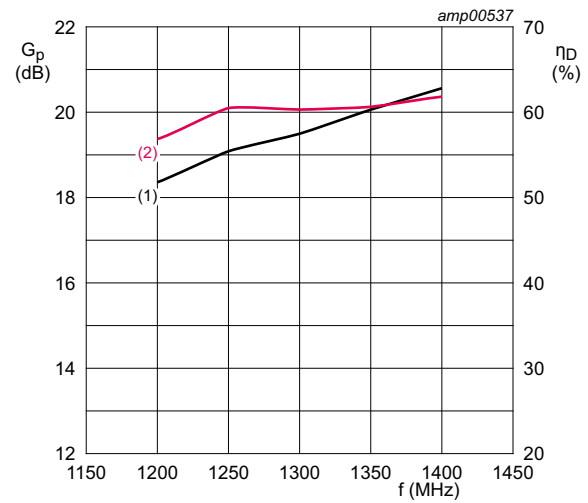
## 7.4 Graphical data



$I_{DQ} = 400 \text{ mA}$ ;  $t_p = 300 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ }\%$ ;  $f = 1300 \text{ MHz}$ .

- (1)  $V_{DS} = 32 \text{ V}$
- (2)  $V_{DS} = 30 \text{ V}$
- (3)  $V_{DS} = 28 \text{ V}$
- (4)  $V_{DS} = 26 \text{ V}$
- (5)  $V_{DS} = 24 \text{ V}$
- (6)  $V_{DS} = 22 \text{ V}$

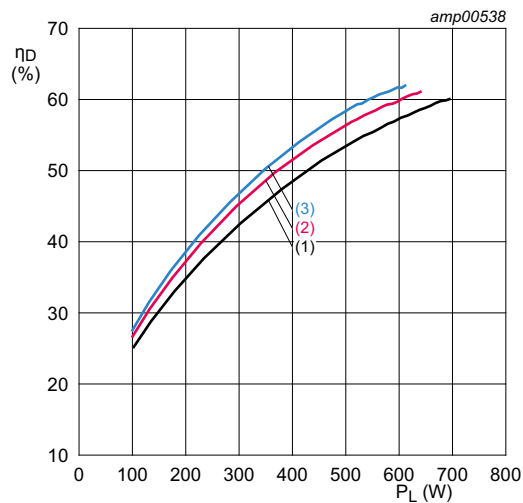
**Fig 3. Power gain as a function of output power; typical values**



$V_{DS} = 32 \text{ V}$ ;  $I_{DQ} = 400 \text{ mA}$ ;  $t_p = 300 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ }\%$ ;  $P_L = 60 \text{ W}$ .

- (1) gain
- (2) efficiency

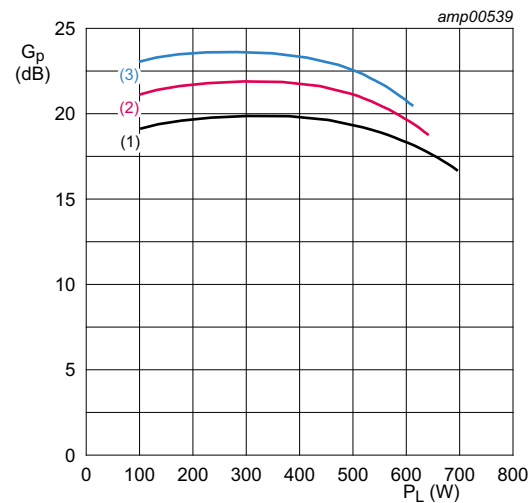
**Fig 4. Power gain and drain efficiency as function of frequency; typical values**



$V_{DS} = 32 \text{ V}$ ;  $I_{DQ} = 400 \text{ mA}$ ;  $t_p = 300 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ }\%$ .

- (1)  $f = 1200 \text{ MHz}$
- (2)  $f = 1300 \text{ MHz}$
- (3)  $f = 1400 \text{ MHz}$

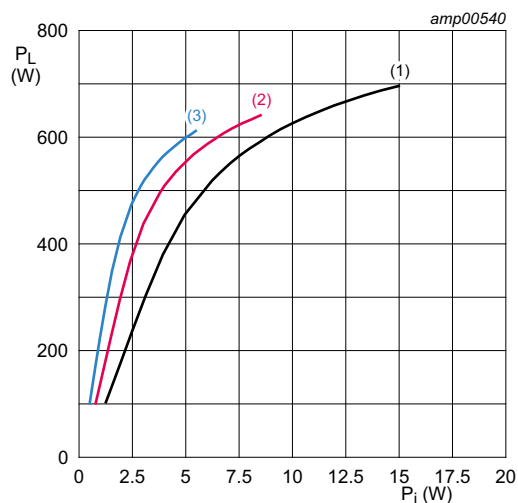
**Fig 5. Drain efficiency as a function of output power; typical values**



$V_{DS} = 32 \text{ V}$ ;  $I_{DQ} = 400 \text{ mA}$ ;  $t_p = 300 \text{ }\mu\text{s}$ ;  $\delta = 10 \text{ }\%$ .

- (1)  $f = 1200 \text{ MHz}$
- (2)  $f = 1300 \text{ MHz}$
- (3)  $f = 1400 \text{ MHz}$

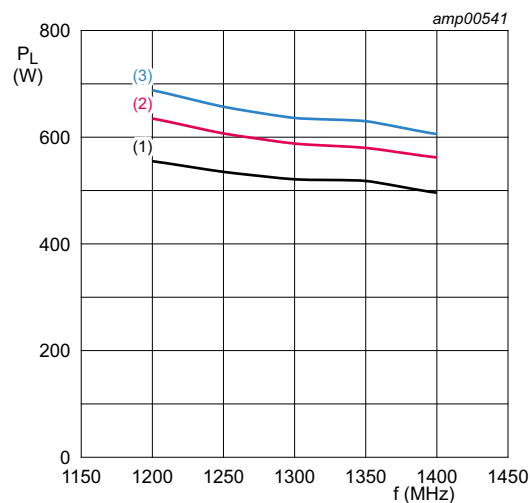
**Fig 6. Power gain as a function of output power; typical values**



$V_{DS} = 32 \text{ V}$ ;  $I_{Dq} = 400 \text{ mA}$ ;  $t_p = 300 \text{ } \mu\text{s}$ ;  $\delta = 10 \text{ } \%$ .

- (1)  $f = 1200 \text{ MHz}$
- (2)  $f = 1300 \text{ MHz}$
- (3)  $f = 1400 \text{ MHz}$

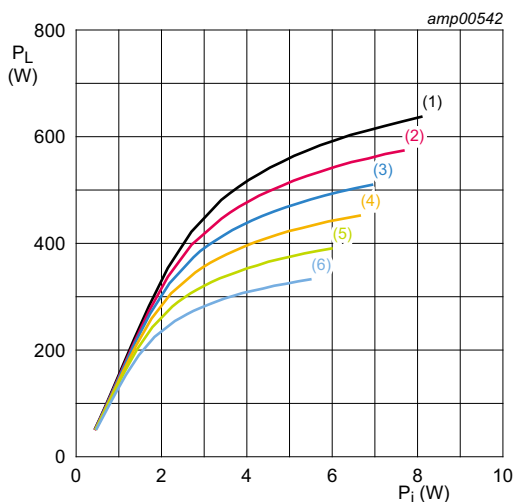
**Fig 7. Output power as a function of input power; typical values**



$V_{DS} = 32 \text{ V}$ ;  $I_{Dq} = 400 \text{ mA}$ ;  $t_p = 300 \text{ } \mu\text{s}$ ;  $\delta = 10 \text{ } \%$ .

- (1)  $P_{L(1dB)}$
- (2)  $P_{L(2dB)}$
- (3)  $P_{L(3dB)}$

**Fig 8. Output power as a function of frequency; typical values**



$I_{Dq} = 400 \text{ mA}$ ;  $t_p = 300 \text{ } \mu\text{s}$ ;  $\delta = 10 \text{ } \%$ ;  $f = 1300 \text{ MHz}$ .

- (1)  $V_{DS} = 32 \text{ V}$
- (2)  $V_{DS} = 30 \text{ V}$
- (3)  $V_{DS} = 28 \text{ V}$
- (4)  $V_{DS} = 26 \text{ V}$
- (5)  $V_{DS} = 24 \text{ V}$
- (6)  $V_{DS} = 22 \text{ V}$

**Fig 9. Output power as a function of input power; typical values**

8. Package outline

Flanged ceramic package; 2 mounting holes; 2 leads

SOT502A

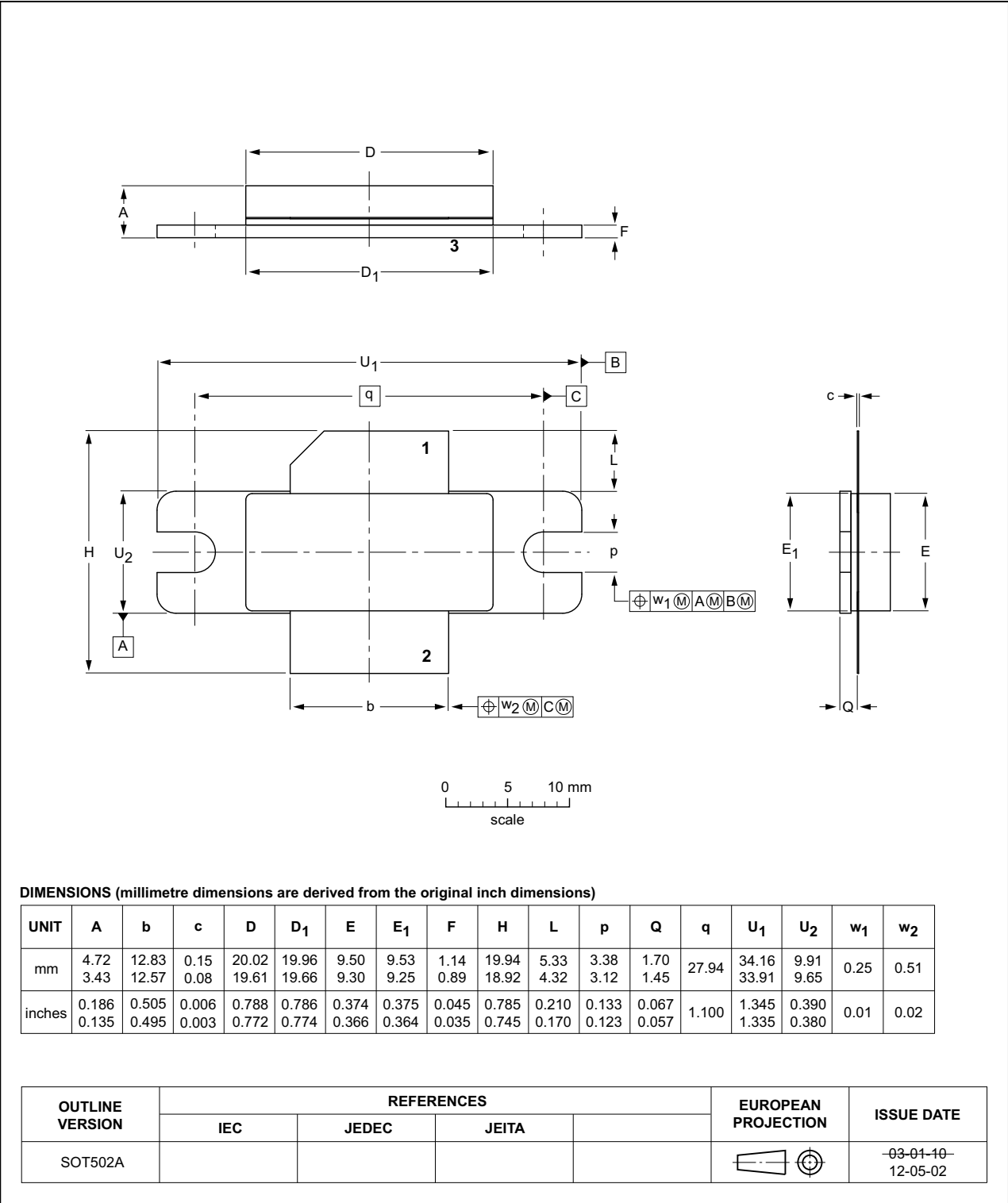
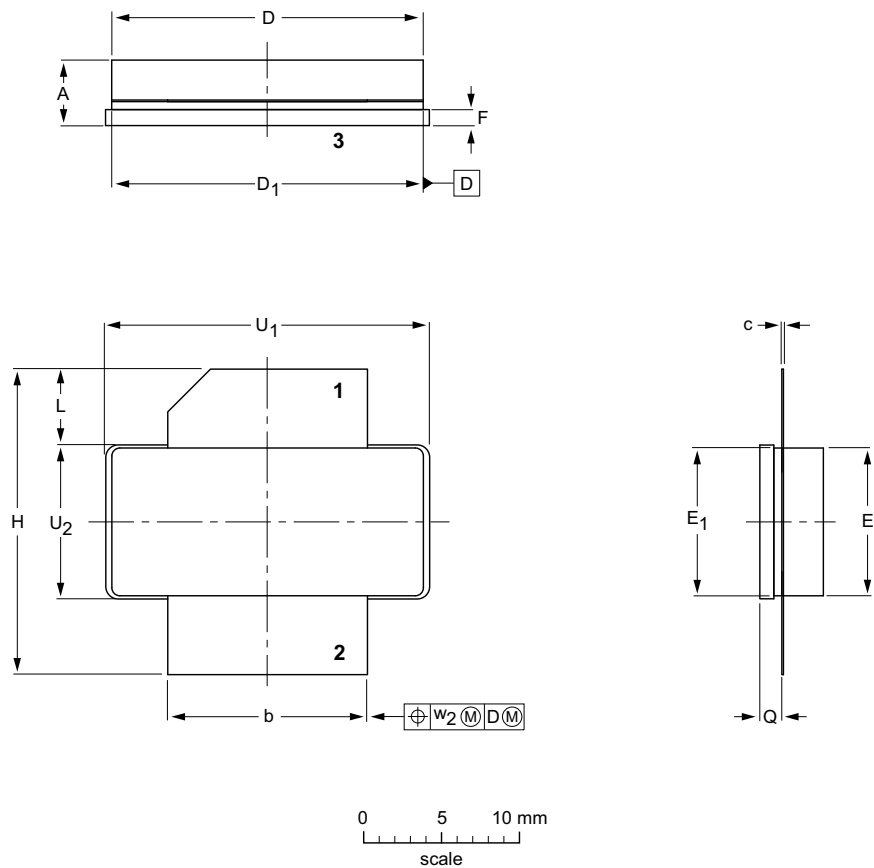


Fig 10. Package outline SOT502A

Earless flanged ceramic package; 2 leads

SOT502B



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

| UNIT   | A              | b              | c              | D              | D <sub>1</sub> | E              | E <sub>1</sub> | F              | H              | L              | Q              | U <sub>1</sub> | U <sub>2</sub> | w <sub>2</sub> |
|--------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| mm     | 4.72<br>3.43   | 12.83<br>12.57 | 0.15<br>0.08   | 20.02<br>19.61 | 19.96<br>19.66 | 9.50<br>9.30   | 9.53<br>9.25   | 1.14<br>0.89   | 19.94<br>18.92 | 5.33<br>4.32   | 1.70<br>1.45   | 20.70<br>20.45 | 9.91<br>9.65   | 0.25           |
| inches | 0.186<br>0.135 | 0.505<br>0.495 | 0.006<br>0.003 | 0.788<br>0.772 | 0.786<br>0.774 | 0.374<br>0.366 | 0.375<br>0.364 | 0.045<br>0.035 | 0.785<br>0.745 | 0.210<br>0.170 | 0.067<br>0.057 | 0.815<br>0.805 | 0.390<br>0.380 | 0.010          |

| OUTLINE<br>VERSION | REFERENCES |       |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|-------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC | JEITA |  |                        |                      |
| SOT502B            |            |       |       |  |                        | 07-05-09<br>12-05-02 |

Fig 11. Package outline SOT502B

## 9. Handling information

### CAUTION



This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

Table 10. ESD sensitivity

| ESD model                                                                | Class                   |
|--------------------------------------------------------------------------|-------------------------|
| Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002 | C2A <a href="#">[1]</a> |
| Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001     | 2 <a href="#">[2]</a>   |

[1] CDM classification C2A is granted to any part that passes after exposure to an ESD pulse of 500 V, but fails after exposure to an ESD pulse of 750 V.

[2] HBM classification 2 is granted to any part that passes after exposure to an ESD pulse of 2000 V, but fails after exposure to an ESD pulse of 4000 V.

## 10. Abbreviations

Table 11. Abbreviations

| Acronym | Description                                  |
|---------|----------------------------------------------|
| ESD     | ElectroStatic Discharge                      |
| L-band  | Long wave Band                               |
| LDMOS   | Laterally Diffused Metal-Oxide Semiconductor |
| MTF     | Median Time to Failure                       |
| SMD     | Surface Mounted Device                       |
| VSWR    | Voltage Standing-Wave Ratio                  |

## 11. Revision history

Table 12. Revision history

| Document ID               | Release date | Data sheet status  | Change notice | Supersedes |
|---------------------------|--------------|--------------------|---------------|------------|
| BLL9G1214L-600_LS-600 v.1 | 20171127     | Product data sheet | -             | -          |

## 12. Legal information

### 12.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition                                                                            |
|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.ampleon.com>.

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For sales office addresses, please visit: <http://www.ampleon.com/sales>

## 14. Contents

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|           |                                  |           |
|-----------|----------------------------------|-----------|
| <b>1</b>  | <b>Product profile</b>           | <b>1</b>  |
| 1.1       | General description              | 1         |
| 1.2       | Features and benefits            | 1         |
| 1.3       | Applications                     | 1         |
| <b>2</b>  | <b>Pinning information</b>       | <b>2</b>  |
| <b>3</b>  | <b>Ordering information</b>      | <b>2</b>  |
| <b>4</b>  | <b>Limiting values</b>           | <b>2</b>  |
| <b>5</b>  | <b>Thermal characteristics</b>   | <b>3</b>  |
| <b>6</b>  | <b>Characteristics</b>           | <b>3</b>  |
| <b>7</b>  | <b>Test information</b>          | <b>4</b>  |
| 7.1       | Ruggedness in class-AB operation | 4         |
| 7.2       | Impedance information            | 4         |
| 7.3       | Test circuit                     | 5         |
| 7.4       | Graphical data                   | 6         |
| <b>8</b>  | <b>Package outline</b>           | <b>8</b>  |
| <b>9</b>  | <b>Handling information</b>      | <b>10</b> |
| <b>10</b> | <b>Abbreviations</b>             | <b>10</b> |
| <b>11</b> | <b>Revision history</b>          | <b>10</b> |
| <b>12</b> | <b>Legal information</b>         | <b>11</b> |
| 12.1      | Data sheet status                | 11        |
| 12.2      | Definitions                      | 11        |
| 12.3      | Disclaimers                      | 11        |
| 12.4      | Trademarks                       | 12        |
| <b>13</b> | <b>Contact information</b>       | <b>12</b> |
| <b>14</b> | <b>Contents</b>                  | <b>13</b> |

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