# BLA6H0912-500

## LDMOS avionics radar power transistor

Rev. 04 — 10 May 2010 Product data sheet

## 1. Product profile

### 1.1 General description

500 W LDMOS power transistor intended for avionics transmitter applications in the 960 MHz to 1215 MHz range such as Mode-S, TCAS, JTIDS, DME and TACAN.

**Table 1. Test information**

*Typical RF performance at $T_{case}$ = 25 °C; $t_p$ = 128 μs; δ = 10 %; $I_{Dq}$ = 100 mA; in a class-AB production test circuit.*

| Mode of operation | f (MHz) | $V_{DS}$ (V) | $P_L$ (W) | $G_p$ (dB) | $\eta_D$ (%) | $t_r$ (ns) | $t_f$ (ns) |
|---|---|---|---|---|---|---|---|
| pulsed RF | 960 to 1200 | 50 | 450 | 17 | 50 | 20 | 6 |

**CAUTION**

This device is sensitive to ElectroStatic Discharge (ESD). Therefore care should be taken during transport and handling.

### 1.2 Features and benefits

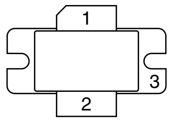
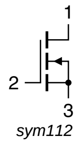
- Typical pulsed RF performance at a frequency of 960 MHz to 1215 MHz, a supply voltage of 50 V, an $I_{Dq}$ of 100 mA, a $t_p$ of 128 μs with δ of 10 %:
  - Output power = 450 W
  - Power gain = 17 dB
  - Efficiency = 50 %
- Easy power control
- Integrated ESD protection
- High flexibility with respect to pulse formats
- Excellent ruggedness
- High efficiency
- Excellent thermal stability
- Designed for broadband operation (960 MHz to 1215 MHz)
- Internally matched for ease of use
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

### 1.3 Applications

- A-band power amplifiers for radar applications in the 960 MHz to 1215 MHz frequency range

## 2. Pinning information

**Table 2. Pinning**

| Pin | Description | Simplified outline | Graphic symbol |
|---|---|---|---|
| 1 | drain |  |  |
| 2 | gate | | |
| 3 | source [1] | | |

[1] Connected to flange.

## 3. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BLA6H0912-500 | - | flanged ceramic package; 2 mounting holes; 2 leads | SOT634A |

## 4. Limiting values

**Table 4. Limiting values**

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

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | - | 100 | V |
| $V_{GS}$ | gate-source voltage | | –0.5 | +13 | V |
| $I_D$ | drain current | | - | 54 | A |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | | - | 200 | °C |

## 5. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $Z_{th(j-c)}$ | transient thermal impedance from junction to case | $T_{case}$ = 85 °C; $P_L$ = 450 W | | |
| | | $t_p$ = 32 μs; δ = 2 % | 0.03 | K/W |
| | | $t_p$ = 128 μs; δ = 10 % | 0.08 | K/W |
| | | $t_p$ = 2400 μs; δ = 6.4 % | 0.2 | K/W |

# 6. Characteristics

**Table 6. DC characteristics**

*$T_j$ = 25 °C unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS}$ = 0 V; $I_D$ = 2.7 mA | 100 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS}$ = 10 V; $I_D$ = 270 mA | 1.3 | 1.8 | 2.2 | V |
| $I_{DSS}$ | drain leakage current | $V_{GS}$ = 0 V; $V_{DS}$ = 50 V | - | - | 3.6 | μA |
| $I_{DSX}$ | drain cut-off current | $V_{GS} = V_{GS(th)}$ + 3.75 V; $V_{DS}$ = 10 V | 53.5 | 64 | - | A |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 11 V; $V_{DS}$ = 0 V | - | - | 360 | nA |
| $g_{fs}$ | forward transconductance | $V_{DS}$ = 10 V; $I_D$ = 405 mA | 2.50 | 3.5 | 4.55 | S |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = V_{GS(th)}$ + 3.75 V; $I_D$ = 14.18 A | - | 70 | 85 | mΩ |

**Table 7. RF characteristics**

*Mode of operation: pulsed RF; f = 960 MHz to 1215 MHz; $t_p$ = 128 μs; δ = 10 %; RF performance at $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA; $T_{case}$ = 25 °C; unless otherwise specified, in a class-AB production test circuit.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $P_L$ | output power | | - | 450 | - | W |
| $V_{DS}$ | drain-source voltage | $P_L$ = 450 W | - | - | 50 | V |
| $G_p$ | power gain | $P_L$ = 450 W | 16 | 17 | - | dB |
| $RL_{in}$ | input return loss | $P_L$ = 450 W | 7 | 11 | - | dB |
| $\eta_D$ | drain efficiency | $P_L$ = 450 W | 45 | 50 | - | % |
| $P_{droop(pulse)}$ | pulse droop power | $P_L$ = 450 W | - | 0 | 0.3 | dB |
| $t_r$ | rise time | $P_L$ = 450 W | - | 20 | 50 | ns |
| $t_f$ | fall time | $P_L$ = 450 W | - | 6 | 50 | ns |

## 6.1 Ruggedness in class-AB operation

The BLA6H0912-500 is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: f = 960 MHz, 1030 MHz, 1090 MHz or 1215 MHz. $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA; $P_L$ = 450 W; $t_p$ = 128 μs; δ = 10 %.

# 7. Application information

## 7.1 Impedance information

**Table 8. Typical impedance**

*Typical values per section unless otherwise specified.*

| f<br>MHz | $Z_S$<br>Ω | $Z_L$<br>Ω |
|---|---|---|
| 960 | 1.36 – j1.45 | 1.49 – j1.48 |
| 1030 | 1.54 – j1.25 | 1.51 – j1.45 |
| 1090 | 1.67 – j1.22 | 1.36 – j1.47 |
| 1140 | 1.68 – j1.29 | 1.15 – j1.41 |
| 1215 | 1.43 – j1.42 | 0.79 – j1.17 |

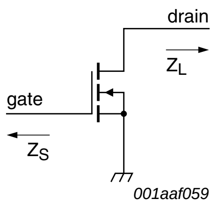
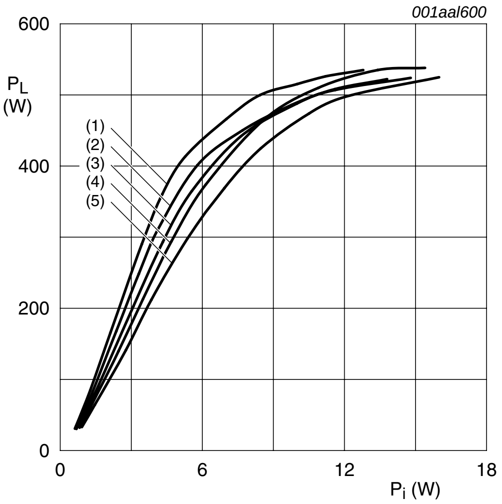



**Fig 1. Definition of transistor impedance**

## 7.2 Performance curves




$V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA; $t_p$ = 128 μs; δ = 10 %.

(1) f = 960 MHz

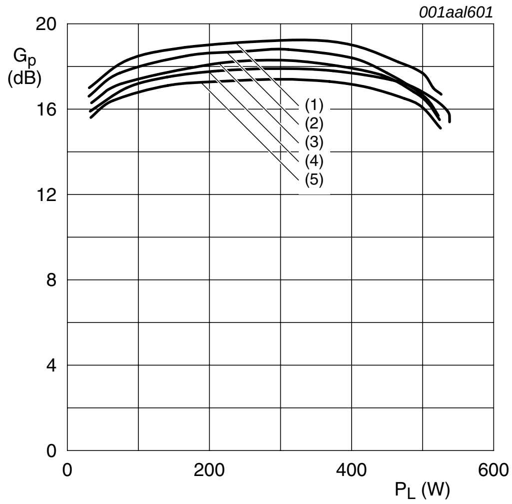
(2) f = 1030 MHz

(3) f = 1090 MHz

(4) f = 1140 MHz

(5) f = 1215 MHz

**Fig 2. Load power as a function of input power; typical values**




$V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA; $t_p$ = 128 μs; δ = 10 %.

(1) f = 960 MHz

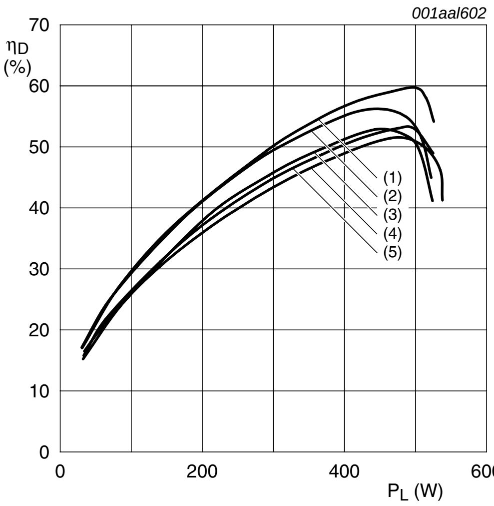
(2) f = 1030 MHz

(3) f = 1090 MHz

(4) f = 1140 MHz

(5) f = 1215 MHz

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




$V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA; $t_p$ = 128 μs; δ = 10 %.

(1) f = 960 MHz

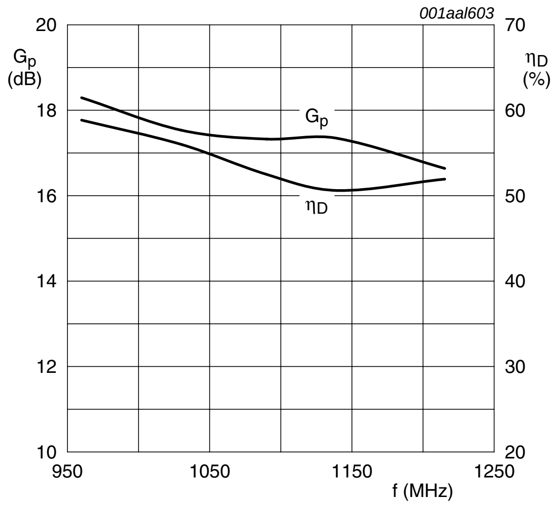
(2) f = 1030 MHz

(3) f = 1090 MHz

(4) f = 1140 MHz

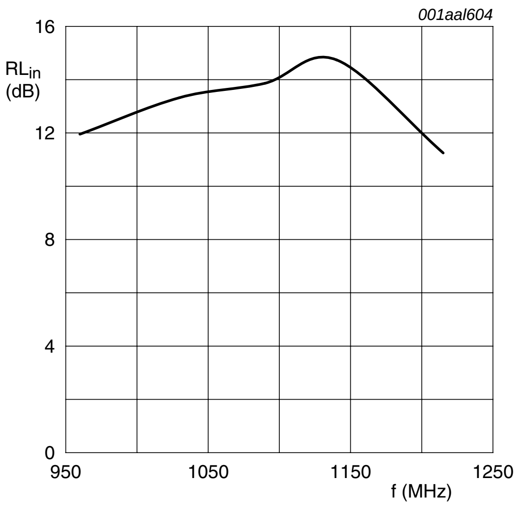
(5) f = 1215 MHz

**Fig 4. Drain efficiency as a function of load power; typical values**




$V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA; $t_p$ = 128 μs; δ = 10 %.

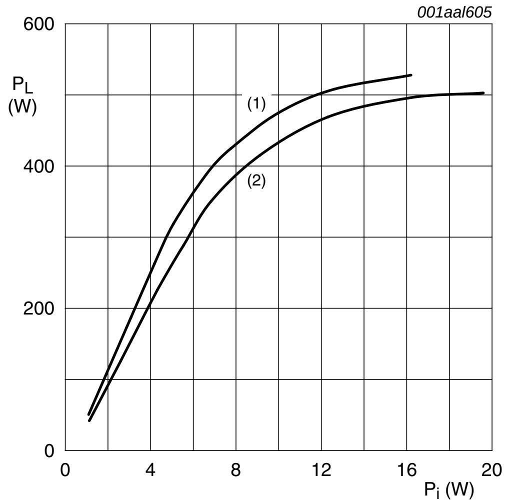
**Fig 5. Power gain and drain efficiency as function of frequency; typical values**




$P_L$ = 500 W; $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA; $t_p$ = 128 μs; δ = 10 %.

**Fig 6. Input return loss as a function of frequency; typical values**

## 7.3 Curves measured under Mode-S ELM pulse-conditions

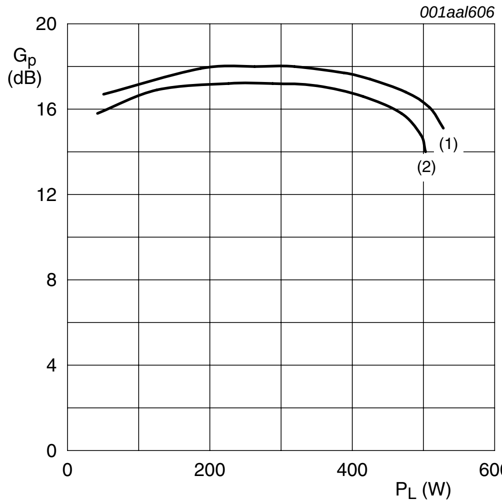



f = 1030 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA.

(1) $T_h$ = 25 °C

(2) $T_h$ = 65 °C

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

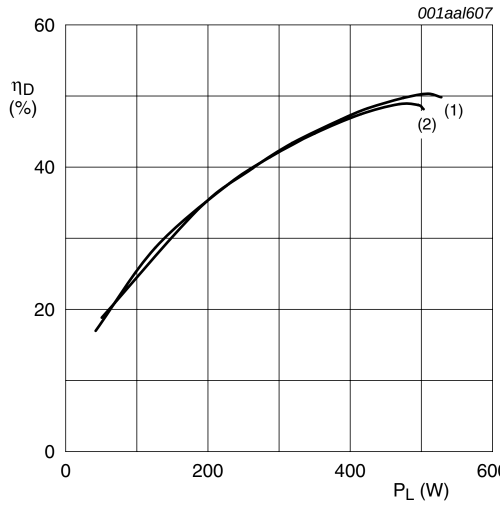



f = 1030 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA.

(1) $T_h$ = 25 °C

(2) $T_h$ = 65 °C

**Fig 8. Power gain as a function of load power; typical values**



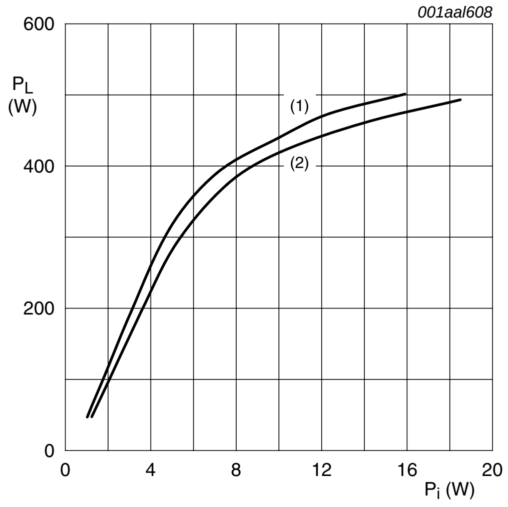

f = 1030 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA.

(1) $T_h$ = 25 °C

(2) $T_h$ = 65 °C

**Fig 9. Drain efficiency as function of load power; typical values**

## 7.4 Curves measured under Mode-S interrogator pulse-conditions

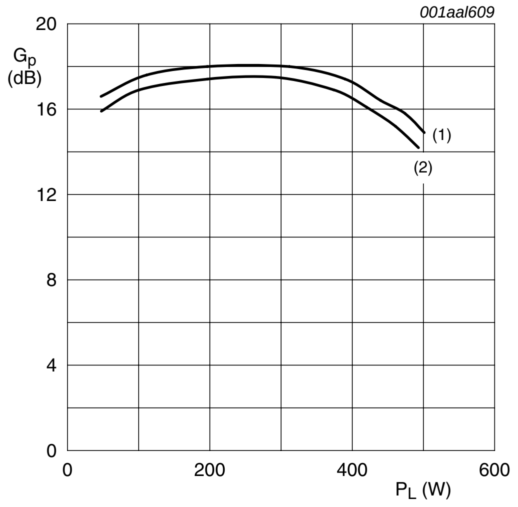



f = 1030 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA.

(1) $T_h$ = 25 °C

(2) $T_h$ = 65 °C

**Fig 10. Load Power as a function of input power; typical values**

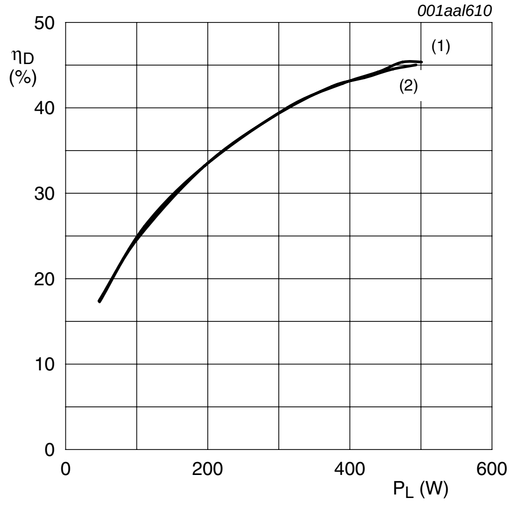



f = 1030 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA.

(1) $T_h$ = 25 °C

(2) $T_h$ = 65 °C

**Fig 11. Power gain as a function of load power; typical values**



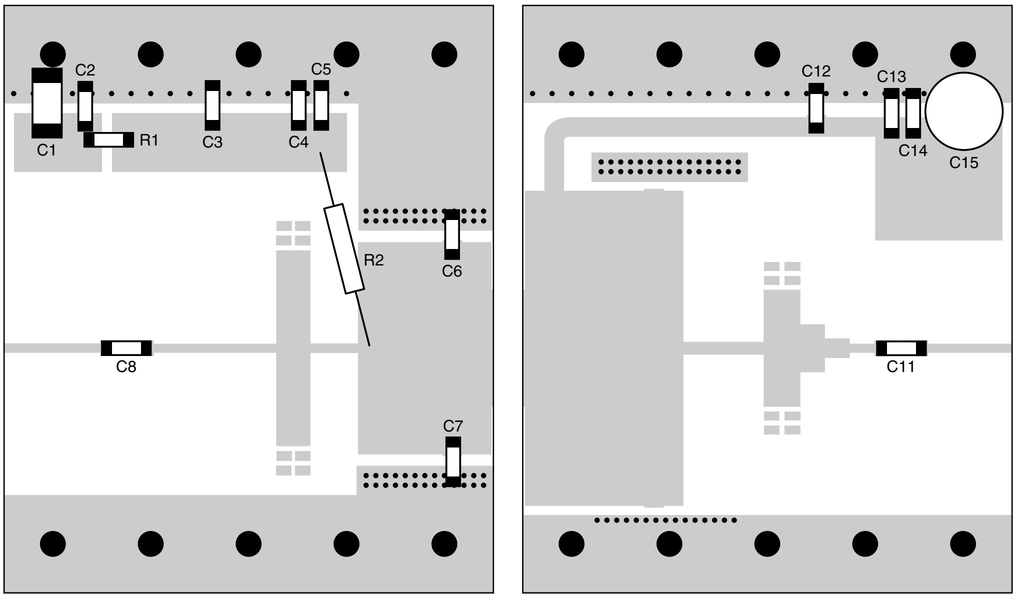

f = 1030 MHz; $V_{DS}$ = 50 V; $I_{Dq}$ = 100 mA.

(1) $T_h$ = 25 °C

(2) $T_h$ = 65 °C

**Fig 12. Drain efficiency as function of load power; typical values**

## 8. Test information




Printed-Circuit Board (PCB) material: Duroid 6006 with $\varepsilon_r$ = 6.15 and thickness = 0.64 mm.

See Table 9 for list of components.

**Fig 13. Component layout**

**Table 9. List of components**

*See Figure 13 for component layout.*

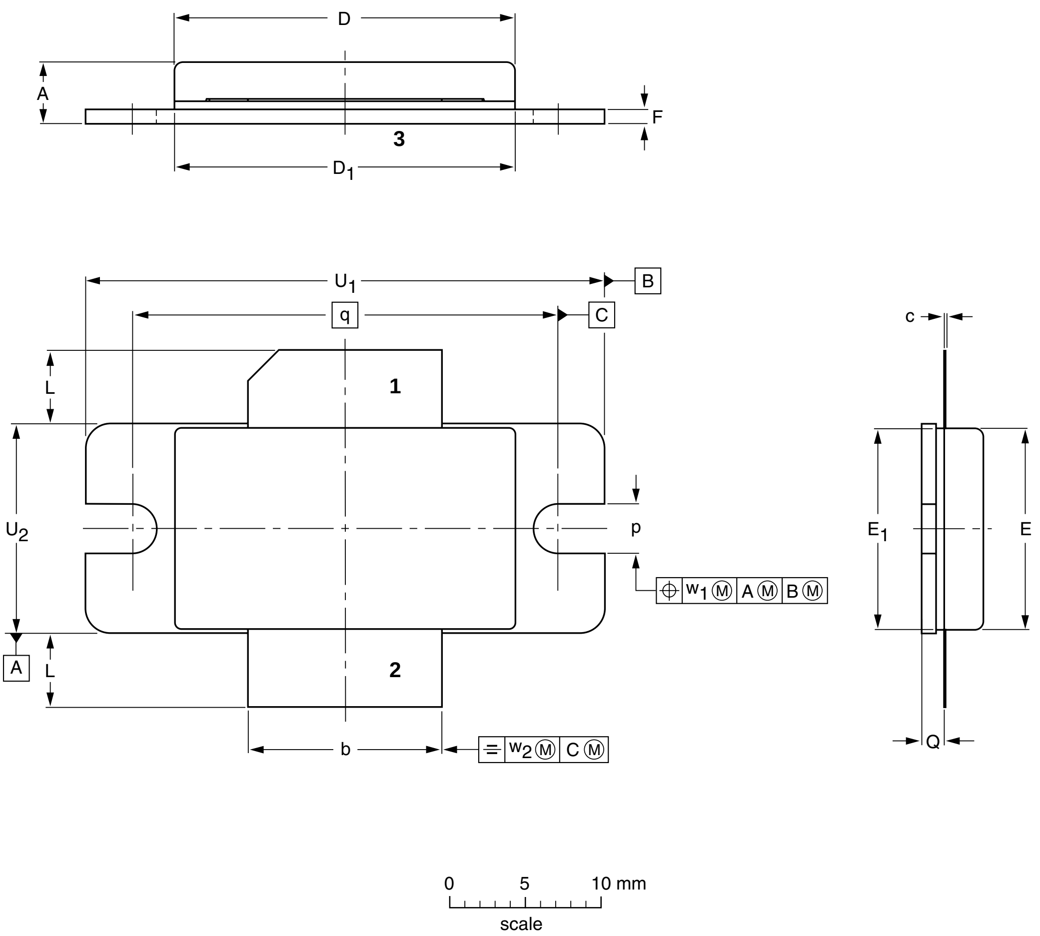
| Component | Description | Value | | Remarks |
|---|---|---|---|---|
| C1, C3 | multilayer ceramic chip capacitor | 10 μF; 35 V | | |
| C2, C3, C14 | multilayer ceramic chip capacitor | 39 pF | [1] | |
| C4, C13 | multilayer ceramic chip capacitor | 1 nF | [1] | |
| C6, C7 | multilayer ceramic chip capacitor | 6.8 pF | [2] | |
| C5, C8, C11, C12 | multilayer ceramic chip capacitor | 82 pF | [2] | |
| C15 | electrolytic capacitor | 47 μF; 63 V | | |
| R1 | SMD resistor | 56 Ω | | SMD 0603 |
| R2 | metal film resistor | 51 Ω | | |

[1] American Technical Ceramics type 100B or capacitor of same quality.

[2] American Technical Ceramics type 800B or capacitor of same quality.

## 9. Package outline

**Flanged ceramic package; 2 mounting holes; 2 leads** **SOT634A**




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

| UNIT | A | b | c | D | $D_1$ | E | $E_1$ | F | L | p | Q | q | $U_1$ | $U_2$ | $w_1$ | $w_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.83<br>3.68 | 12.82<br>12.57 | 0.15<br>0.08 | 22.58<br>22.12 | 22.56<br>22.15 | 13.34<br>13.08 | 13.34<br>13.08 | 1.14<br>0.89 | 5.33<br>4.32 | 3.38<br>3.12 | 1.70<br>1.45 | 27.94 | 34.16<br>33.91 | 13.84<br>13.59 | 0.25 | 0.51 |
| inches | 0.190<br>0.145 | 0.505<br>0.495 | 0.006<br>0.003 | 0.889<br>0.871 | 0.888<br>0.872 | 0.525<br>0.515 | 0.525<br>0.515 | 0.045<br>0.035 | 0.210<br>0.170 | 0.133<br>0.123 | 0.067<br>0.057 | 1.100 | 1.345<br>1.335 | 0.545<br>0.535 | 0.010 | 0.020 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT634A | | | | | | ~~01-11-27~~<br>03-05-01 |

**Fig 14. Package outline SOT634A**

## 10. Abbreviations

Table 10. Abbreviations

| Acronym | Description |
|---|---|
| DME | Distance Measuring Equipment |
| ELM | Extended Length Message |
| JTIDS | Joint Tactical Information Distribution System |
| LDMOS | Laterally Diffused Metal-Oxide Semiconductor |
| Mode-S | Mode Select |
| RF | Radio Frequency |
| SMD | Surface Mounted Device |
| TACAN | TACtical Air Navigation |
| TCAS | Traffic Collision Avoidance System |
| VSWR | Voltage Standing-Wave Ratio |

## 11. Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BLA6H0912-500_4 | 20100510 | Product data sheet | - | BLA6H0912-500_3 |
| Modifications: | • Section 1.3 on page 2: the application has been corrected. | | | |
| BLA6H0912-500_3 | 20100330 | Product data sheet | - | BLA6H0912-500_2 |
| BLA6H0912-500_2 | 20100302 | Product data sheet | - | BLA6H0912-500_1 |
| BLA6H0912-500_1 | 20090305 | Objective data sheet | - | - |

# 12. Legal information

## 12.1 Data sheet status

| Document status[1][2] | Product status[3] | 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".

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## 14. Contents





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