

BLC9G20LS-470AVT

Power LDMOS transistor

Rev. 2 — 2 December 2016

AMMPLION

Product data sheet

1. Product profile

1.1 General description

470 W LDMOS packaged asymmetric Doherty power transistor for base station applications at frequencies from 1805 MHz to 1990 MHz.

Table 1. Typical performance

Typical RF performance at $T_{case} = 25\text{ °C}$ in an asymmetrical Doherty production test circuit. $V_{DS} = 28\text{ V}$; $I_{Dq} = 500\text{ mA}$ (main); $V_{GS(amp)peak} = 0.5\text{ V}$, unless otherwise specified.

| Test signal | f | V_{DS} | $P_{L(AV)}$ | G_p | η_D | ACPR |
|------------------|--------------|----------|-------------|-------|----------|-------------------------|
| | (MHz) | (V) | (W) | (dB) | (%) | (dBc) |
| 1-carrier W-CDMA | 1805 to 1880 | 28 | 80 | 16 | 49 | -35 [1] |

[1] Test signal: 3GPP test model 1; 64 DPCH; PAR = 7.2 dB at 0.01% probability on CCDF per carrier.

1.2 Features and benefits

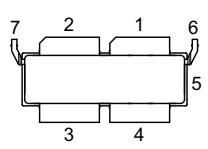
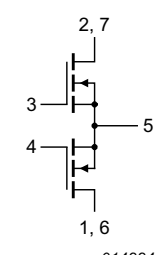
- Excellent ruggedness
- High-efficiency
- Low thermal resistance providing excellent thermal stability
- Designed for broadband operation (1805 MHz to 1990 MHz)
- Asymmetric design to achieve optimum efficiency across the band
- Lower output capacitance for improved performance in Doherty applications
- Designed for low memory effects providing excellent digital pre-distortion capability
- Internally matched for ease of use
- Integrated ESD protection
- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

1.3 Applications

- RF power amplifiers for base stations and multi carrier applications in the 1805 MHz to 1990 MHz frequency range

2. Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline | Graphic symbol |
|-----|----------------------------|--|---|
| 1 | drain2 (peak) |  |  |
| 2 | drain1 (main) | | |
| 3 | gate1 (main) | | |
| 4 | gate2 (peak) | | |
| 5 | source [1] | | |
| 6 | video decoupling (peak) | | |
| 7 | video decoupling (main) | | |

[1] Connected to flange.

3. Ordering information

Table 3. Ordering information

| Type number | Package | | |
|------------------|---------|---|-----------|
| | Name | Description | Version |
| BLC9G20LS-470AVT | - | air cavity plastic earless flanged package; 6 leads | SOT1258-3 |

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 | | - | 65 | V |
| $V_{GS(amp)main}$ | main amplifier gate-source voltage | | -5 | +13 | V |
| $V_{GS(amp)peak}$ | peak amplifier gate-source voltage | | -5 | +13 | V |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| T_j | junction temperature | [1] | - | 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 |
|---------------|--|---|------|------|
| $R_{th(j-c)}$ | thermal resistance from junction to case | $V_{DS} = 28\text{ V}; I_{Dq} = 400\text{ mA (main)};$ $V_{GS(amp)peak} = 0.5\text{ V}; T_{case} = 80\text{ °C}$ | | |
| | | $P_L = 49\text{ dBm}$ | 0.26 | K/W |
| | | $P_L = 51\text{ dBm}$ | 0.20 | K/W |

6. Characteristics

Table 6. DC characteristics

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------|----------------------------------|---|-----|------|------|------------------|
| Main device | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS} = 0\text{ V}; I_D = 1.44\text{ mA}$ | 65 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS} = 10\text{ V}; I_D = 144\text{ mA}$ | 1.5 | 2 | 2.5 | V |
| V_{GSq} | gate-source quiescent voltage | $V_{DS} = 30\text{ V}; I_D = 864\text{ mA}$ | 1.8 | 2.1 | 2.35 | V |
| I_{DSS} | drain leakage current | $V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}$ | - | - | 2.8 | μA |
| I_{DSX} | drain cut-off current | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; V_{DS} = 10\text{ V}$ | - | 31.5 | - | A |
| I_{GSS} | gate leakage current | $V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$ | - | - | 280 | nA |
| g_{fs} | forward transconductance | $V_{DS} = 10\text{ V}; I_D = 5.04\text{ A}$ | - | 10.2 | - | S |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 5.04\text{ A}$ | - | 99 | 165 | $\text{m}\Omega$ |
| Peak device | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS} = 0\text{ V}; I_D = 2.6\text{ mA}$ | 65 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS} = 10\text{ V}; I_D = 260\text{ mA}$ | 1.5 | 2 | 2.5 | V |
| V_{GSq} | gate-source quiescent voltage | $V_{DS} = 30\text{ V}; I_D = 1560\text{ mA}$ | 1.4 | 1.85 | 2.25 | V |
| I_{DSS} | drain leakage current | $V_{GS} = 0\text{ V}; V_{DS} = 32\text{ V}$ | - | - | 2.8 | μA |
| I_{DSX} | drain cut-off current | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; V_{DS} = 10\text{ V}$ | - | 49 | - | A |
| I_{GSS} | gate leakage current | $V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$ | - | - | 280 | nA |
| g_{fs} | forward transconductance | $V_{DS} = 10\text{ V}; I_D = 9.1\text{ A}$ | - | 17.3 | - | S |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 9.1\text{ A}$ | - | 51 | 85 | $\text{m}\Omega$ |

Table 7. RF characteristics

Test signal: 1-carrier W-CDMA; PAR = 7.2 dB at 0.01 % probability on the CCDF; 3GPP test model 1; 1 to 64 DPCH; RF performance at $V_{DS} = 28\text{ V}; I_{Dq} = 400\text{ mA}$ (main); $V_{GS(amp)peak} = 0.5\text{ V}; T_{case} = 25\text{ °C}$; unless otherwise specified; in an asymmetrical Doherty production test circuit at frequencies from 1805 MHz to 1880 MHz.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|------------------------------|---------------------------|------|------|-----|------|
| G_p | power gain | $P_{L(AV)} = 80\text{ W}$ | 14.5 | 15.7 | - | dB |
| RL_{in} | input return loss | $P_{L(AV)} = 80\text{ W}$ | - | -10 | -6 | dB |
| η_D | drain efficiency | $P_{L(AV)} = 80\text{ W}$ | 42.5 | 47.5 | - | % |
| ACPR | adjacent channel power ratio | $P_{L(AV)} = 80\text{ W}$ | - | -33 | -28 | dBc |

Table 8. RF characteristics

Test signal: pulsed CW; $t_p = 100\text{ }\mu\text{s}$; $\delta = 10\text{ %}$; RF performance at $V_{DS} = 28\text{ V}; I_{Dq} = 400\text{ mA}$ (main); $V_{GS(amp)peak} = 0.5\text{ V}; T_{case} = 25\text{ °C}$; unless otherwise specified; in an asymmetrical Doherty production test circuit at frequencies from 1805 MHz to 1880 MHz.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------|-------------------|------------|-----|-----|-----|------|
| $P_{L(M)}$ | peak output power | | 380 | 425 | - | W |

7. Test information

7.1 Ruggedness in Doherty operation

The BLC9G20LS-470AVT is capable of withstanding a load mismatch corresponding to a VSWR = 10 : 1 through all phases under the following conditions: $V_{DS} = 28$ V; $I_{Dq} = 400$ mA (main); $V_{GS(amp)peak} = 0.5$ V; $P_L = 250$ W (CW); $f = 1805$ MHz.

7.2 Impedance information

Table 9. Typical impedance of main device

Measured load-pull data of main device; $I_{Dq} = 400$ mA (main); $V_{DS} = 28$ V.

| f (MHz) | Z_S [1] (Ω) | Z_L [1] (Ω) | P_L [2] (W) | η_D [2] (%) | G_p [2] (dB) |
|--------------------------------------|---------------------------|---------------------------|------------------|---------------------|-------------------|
| Maximum power load | | | | | |
| 1805 | 1.03 – j4.87 | 1.22 – j3.6 | 206.0 | 60.0 | 15.16 |
| 1843 | 2.10 – j4.50 | 1.22 – j3.6 | 200.0 | 60.0 | 14.93 |
| 1880 | 1.58 – j5.07 | 1.22 – j3.6 | 200.4 | 60.3 | 15.34 |
| Maximum drain efficiency load | | | | | |
| 1805 | 1.03 – j4.87 | 2.31 – j2.74 | 142.5 | 68.12 | 17.44 |
| 1843 | 2.10 – j4.50 | 2.08 – j2.55 | 137.0 | 68.24 | 17.06 |
| 1880 | 1.58 – j5.07 | 1.90 – j2.76 | 146.0 | 67.8 | 17.30 |

[1] Z_S and Z_L defined in [Figure 1](#).

[2] at 3 dB gain compression.

Table 10. Typical impedance of peak device

Measured load-pull data of peak device; $I_{Dq} = 1300$ mA (peak); $V_{DS} = 28$ V.

| f (MHz) | Z_S [1] (Ω) | Z_L [1] (Ω) | P_L [2] (W) | η_D [2] (%) | G_p [2] (dB) |
|--------------------------------------|---------------------------|---------------------------|------------------|---------------------|-------------------|
| Maximum power load | | | | | |
| 1805 | 1.06 – j5.55 | 2.0 – j3.8 | 322.8 | 56.90 | 15.60 |
| 1843 | 1.89 – j5.55 | 2.0 – j3.8 | 315.5 | 56.18 | 15.16 |
| 1880 | 1.86 – j6.21 | 2.2 – j4.1 | 313.3 | 55.30 | 15.74 |
| Maximum drain efficiency load | | | | | |
| 1805 | 1.06 – j5.55 | 2.76 – j2.70 | 267.9 | 64.5 | 17.23 |
| 1843 | 1.89 – j5.55 | 2.68 – j2.24 | 234.4 | 63.5 | 17.04 |
| 1880 | 1.86 – j6.21 | 2.68 – j2.24 | 230.7 | 63.5 | 17.79 |

[1] Z_S and Z_L defined in [Figure 1](#).

[2] at 3 dB gain compression.

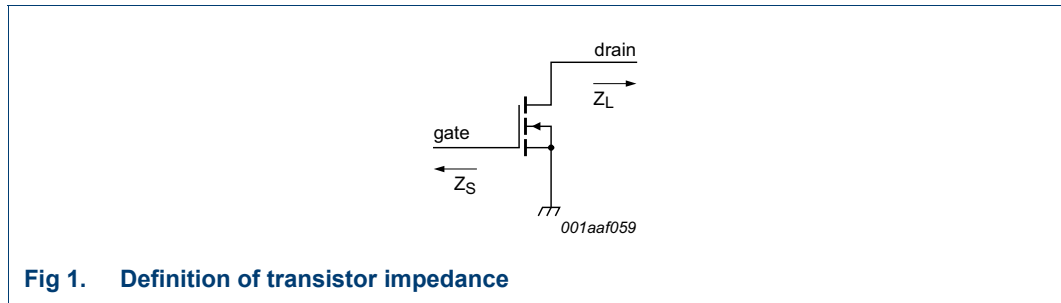


Fig 1. Definition of transistor impedance

7.3 Recommended impedances for Doherty design

Table 11. Typical impedance of main device at 1 : 1 load

Measured load-pull data of main device; $I_{Dq} = 400 \text{ mA (main)}$; $V_{DS} = 28 \text{ V}$.

| f (MHz) | Z_S [1] (Ω) | Z_L [1] (Ω) | P_L [2] (dBm) | η_D [3] (%) | G_p [3] (dB) |
|------------|---------------------------|---------------------------|--------------------|---------------------|-------------------|
| 1805 | 1.03 – j4.87 | 1.83 – j3.50 | 52.6 | 46.5 | 19.1 |
| 1843 | 2.10 – j4.50 | 1.67 – j3.30 | 52.7 | 47.0 | 19.2 |
| 1880 | 1.58 – j5.07 | 1.50 – j3.12 | 52.8 | 48.1 | 19.4 |

[1] Z_S and Z_L defined in [Figure 1](#).

[2] at 3 dB gain compression.

[3] at $P_{L(AV)} = 49 \text{ dBm}$.

Table 12. Typical impedance of main device at 1 : 2.5 load

Measured load-pull data of main device; $I_{Dq} = 400 \text{ mA (main)}$; $V_{DS} = 28 \text{ V}$.

| f (MHz) | Z_S [1] (Ω) | Z_L [1] (Ω) | P_L [2] (dBm) | η_D [3] (%) | G_p [3] (dB) |
|------------|---------------------------|---------------------------|--------------------|---------------------|-------------------|
| 1805 | 1.03 – j4.87 | 2.56 – j1.80 | 50.48 | 63.6 | 21.2 |
| 1843 | 2.10 – j4.50 | 2.84 – j1.96 | 50.46 | 64.0 | 21.4 |
| 1880 | 1.58 – j5.07 | 3.14 – j2.12 | 50.40 | 64.0 | 21.5 |

[1] Z_S and Z_L defined in [Figure 1](#).

[2] at 3 dB gain compression.

[3] at $P_{L(AV)} = 49 \text{ dBm}$.

7.4 Test circuit

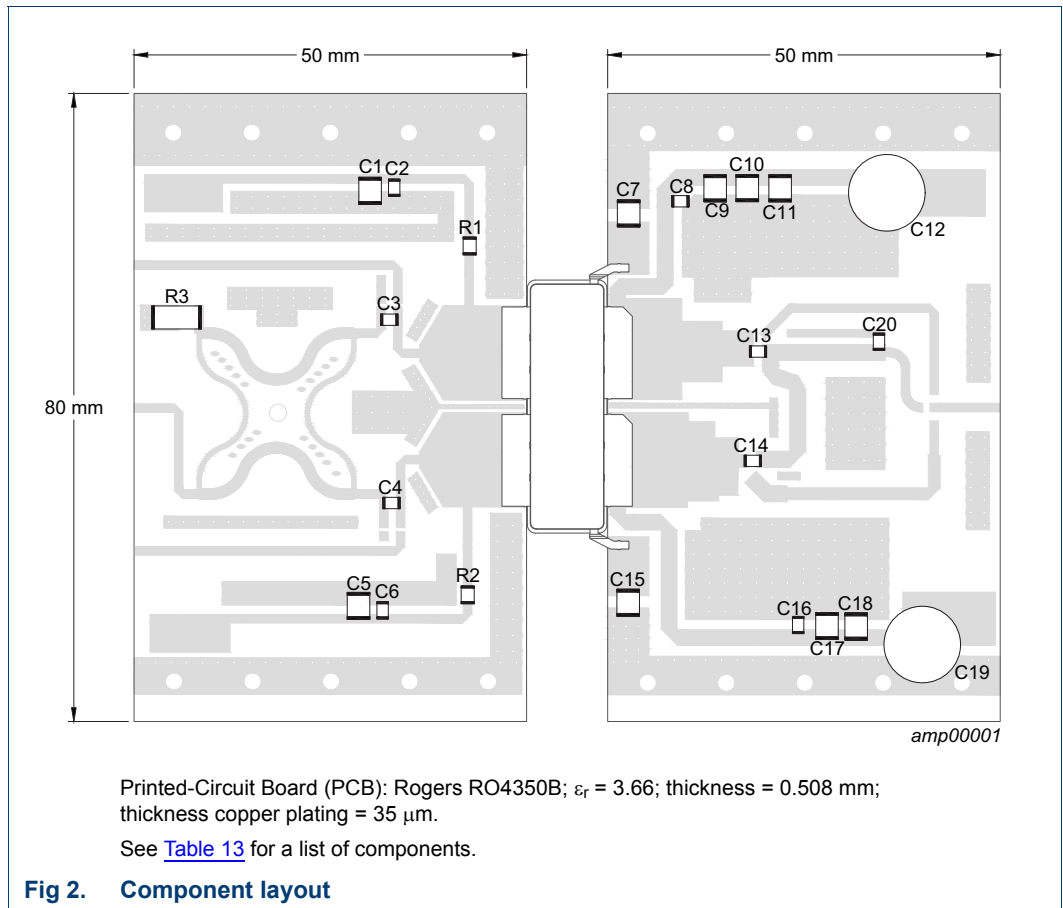


Table 13. List of components

See [Figure 2](#) for component layout.

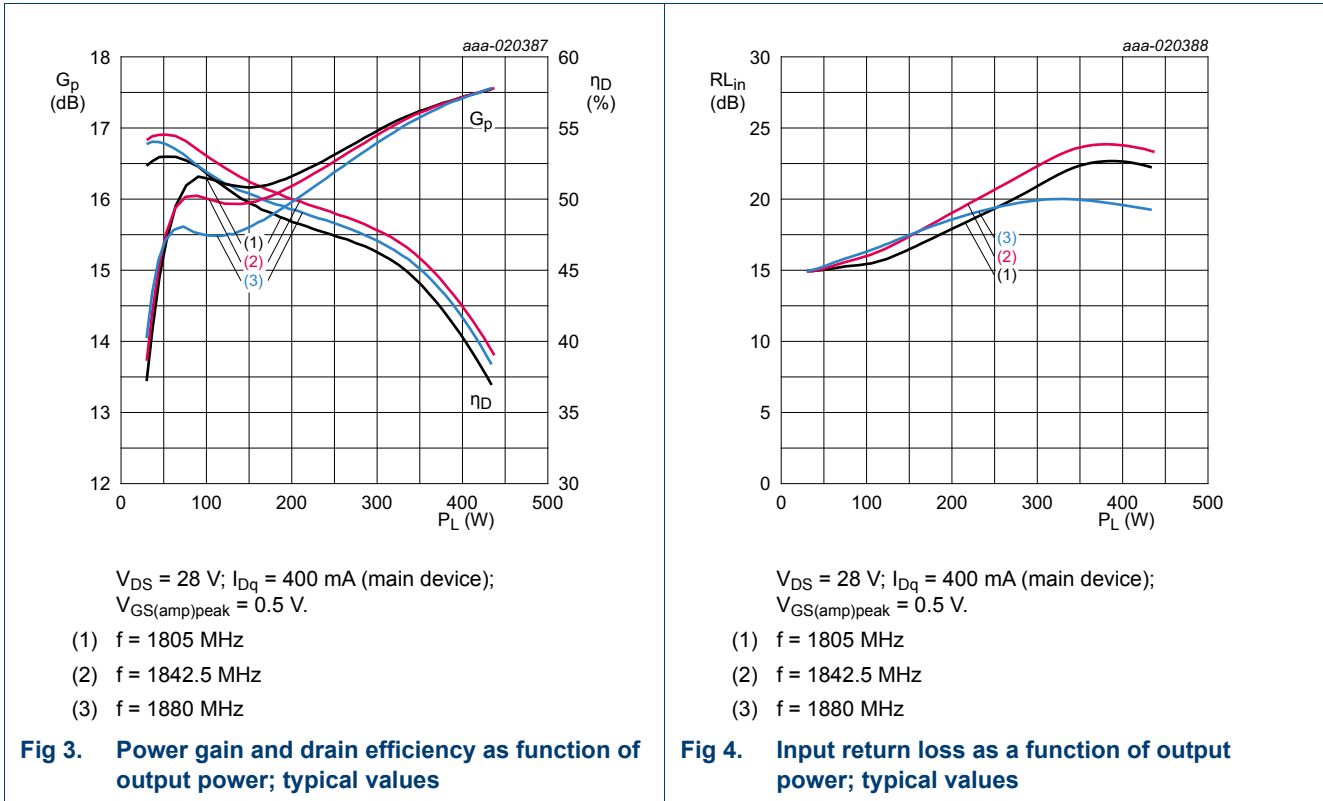
| Component | Description | Value | Remarks |
|---|-----------------------------------|---------------------------|----------|
| C1, C5, C7, C9, C10, C11, C15, C17, C18 | multilayer ceramic chip capacitor | 10 μF , 50 V | [1] |
| C2, C3, C4, C6, C8, C16 | multilayer ceramic chip capacitor | 36 pF | [2] |
| C12, C19 | electrolytic capacitor | 1000 μF , 63 V | |
| C13 | multilayer ceramic chip capacitor | 10 pF | [2] |
| C14 | multilayer ceramic chip capacitor | 27 pF | [2] |
| C20 | multilayer ceramic chip capacitor | 0.1 pF | [2] |
| R1, R2 | resistor | 5.1 Ω | SMD 0805 |
| R3 | resistor | 50 Ω | SMD 0805 |

[1] Murata or capacitor of same quality

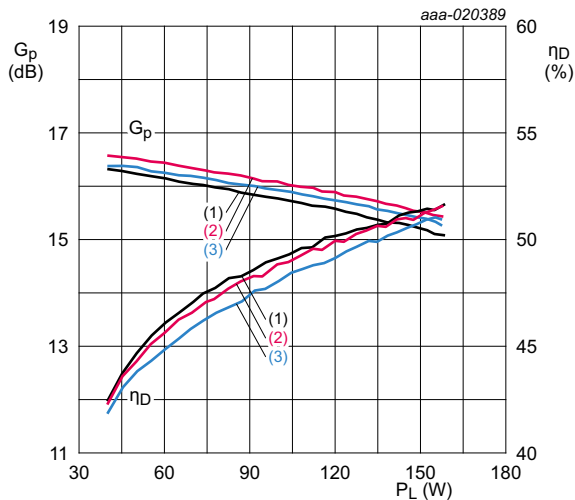
[2] American Technical Ceramics type 600F or capacitor of same quality

7.5 Graphical data

7.5.1 Pulsed CW

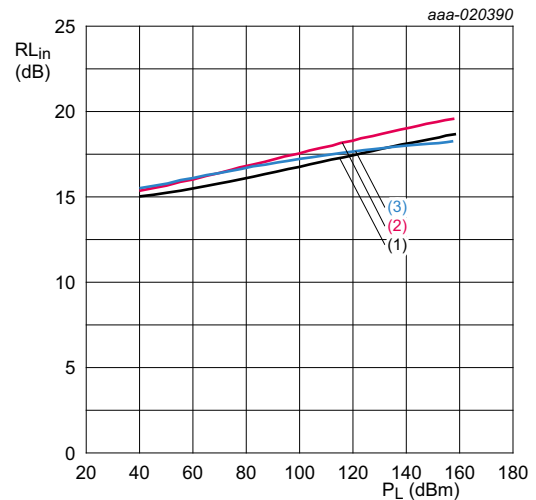


7.5.2 1-Carrier W-CDMA



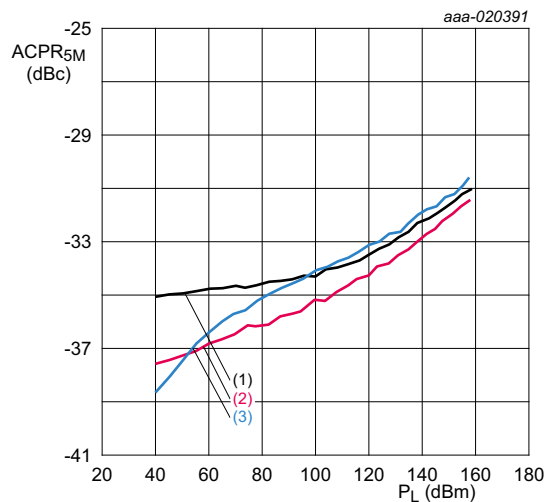
$V_{DS} = 28\text{ V}; I_{Dq} = 400\text{ mA (main device)};$
 $V_{GS(amp)peak} = 0.5\text{ V}.$
 (1) $f = 1805\text{ MHz}$
 (2) $f = 1842.5\text{ MHz}$
 (3) $f = 1880\text{ MHz}$

Fig 5. Power gain and drain efficiency as function of output power; typical values



$V_{DS} = 28\text{ V}; I_{Dq} = 400\text{ mA (main device)};$
 $V_{GS(amp)peak} = 0.5\text{ V}.$
 (1) $f = 1805\text{ MHz}$
 (2) $f = 1842.5\text{ MHz}$
 (3) $f = 1880\text{ MHz}$

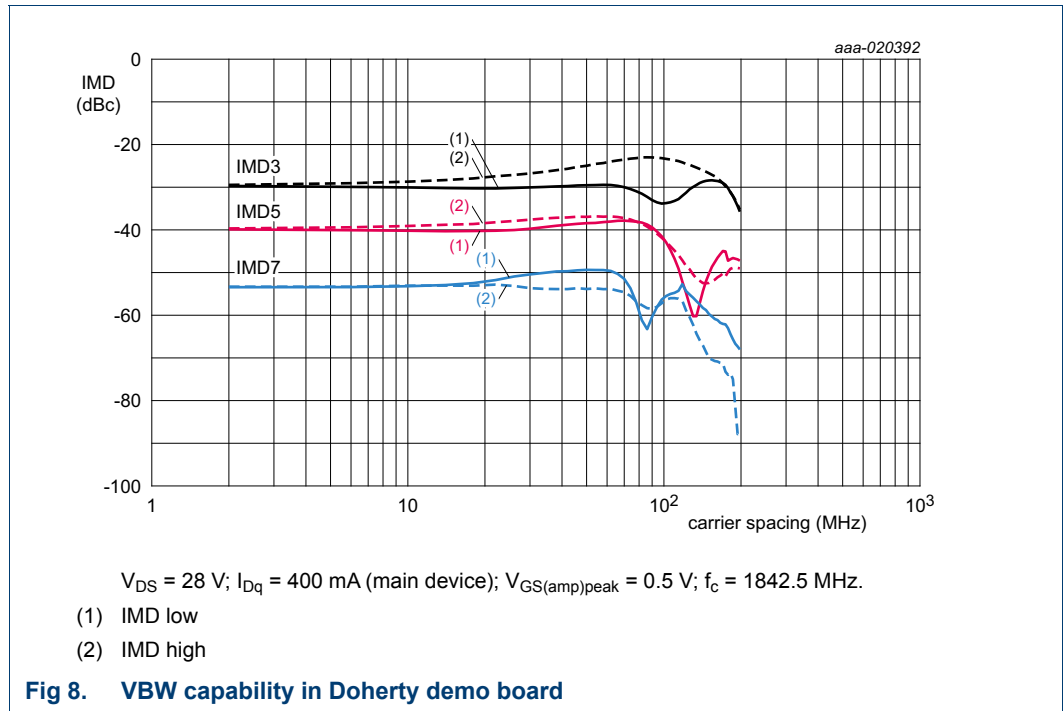
Fig 6. Input return loss as a function of output power; typical values



$V_{DS} = 28\text{ V}; I_{Dq} = 400\text{ mA (main device)};$ $V_{GS(amp)peak} = 0.5\text{ V}.$
 (1) $f = 1805\text{ MHz}$
 (2) $f = 1842.5\text{ MHz}$
 (3) $f = 1880\text{ MHz}$

Fig 7. Adjacent channel power ratio (5 MHz) as a function of output power; typical values

7.5.3 2-Tone VBW



8. Package outline

Air cavity plastic earless flanged package; 6 leads

SOT1258-3

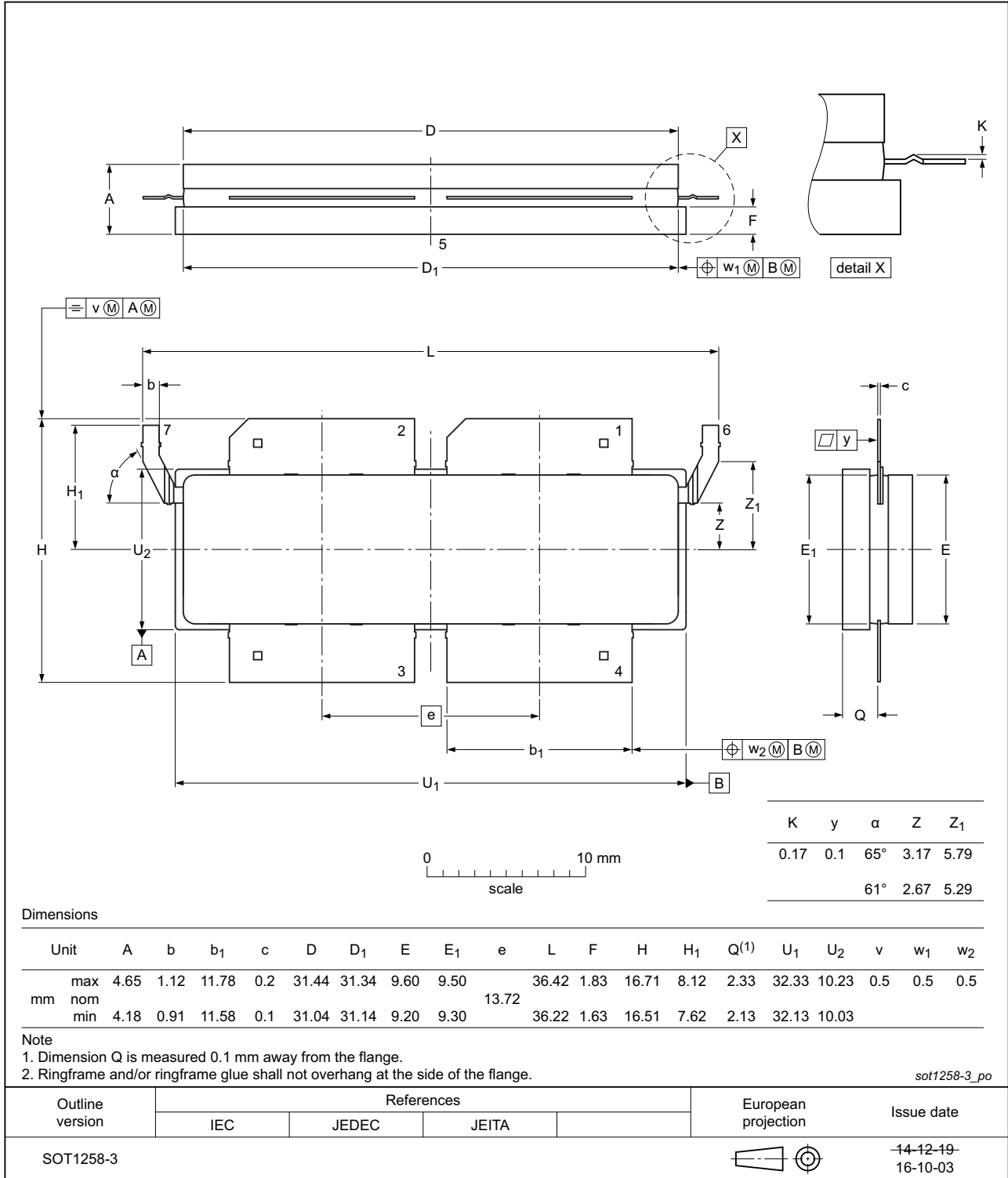


Fig 9. Package outline SOT1258-3

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 14. ESD sensitivity

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

[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 15. Abbreviations

| Acronym | Description |
|---------|--|
| 3GPP | 3rd Generation Partnership Project |
| CCDF | Complementary Cumulative Distribution Function |
| CW | Continuous Wave |
| DPCH | Dedicated Physical CHannel |
| ESD | ElectroStatic Discharge |
| LDMOS | Laterally Diffused Metal-Oxide Semiconductor |
| MTF | Median Time to Failure |
| PAR | Peak-to-Average Ratio |
| SMD | Surface Mounted Device |
| VBW | Video BandWidth |
| W-CDMA | Wideband Code Division Multiple Access |

11. Revision history

Table 16. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------------|--|--------------------|---------------|----------------------|
| BLC9G20LS-470AVT v.2 | 20161202 | Product data sheet | - | BLC9G20LS-470AVT v.1 |
| Modifications: | <ul style="list-style-type: none"> Figure 9 on page 10: updated package outline drawing SOT1258-3 Section 9 on page 11: updated Handling information | | | |
| BLC9G20LS-470AVT v.1 | 20160224 | Product 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. |
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[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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