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BLC8G09XS-400AVT

Power LDMOS transistor

Rev. 2 — 24 November 2017

AMMPLION

Product data sheet

1. Product profile

1.1 General description

400 W LDMOS packaged asymmetric Doherty power transistor for base station applications at frequencies from 791 MHz to 960 MHz.

Table 1. Typical performance

Typical RF performance at $T_{case} = 25\text{ °C}$ in an asymmetrical Doherty production test circuit.

$V_{DS} = 32\text{V}$; $I_{Dq} = 880\text{ mA}$ (main); $V_{GS(amp)peak} = 0.8\text{ V}$, 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 | 791 to 821 | 32 | 93 | 17.2 | 46 | -34 [1] |

[1] Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 9.6 dB at 0.01 % probability on CCDF.

1.2 Features and benefits

- Excellent ruggedness
- High efficiency
- Low thermal resistance providing excellent thermal stability
- 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 791 MHz to 960 MHz frequency range

2. Pinning information

Table 2. Pinning

| Pin | Description | Simplified outline | Graphic symbol |
|-----|----------------------------|--------------------|-------------------|
| 1 | drain2 (peak) | | <p>aaa-014884</p> |
| 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 |
| BLC8G09XS-400AVT | - | air cavity plastic earless flanged package; 6 leads | SOT1258-4 |

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 | | -6 | +13 | V |
| $V_{GS(amp)peak}$ | peak amplifier gate-source voltage | | -6 | +13 | V |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| T_j | junction temperature | | [1] | 225 | °C |
| T_{case} | case temperature | operating | [1] | +125 | °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 | $V_{DS} = 32\text{ V}; I_{Dq} = 880\text{ mA (main)};$ $V_{GS(amp)peak} = 0,5\text{ V}; T_{case} = 80\text{ °C}$ | | |
| | | $P_L = 93\text{ W}$ | 0.27 | k/W |
| | | $P_L = 117\text{ W}$ | 0.24 | 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 | $V_{GS} = 0\text{ V}; I_D = 2.2\text{ mA}$ | 65 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS} = 10\text{ V}; I_D = 220\text{ mA}$ | 1.5 | 1.9 | 2.3 | V |
| V_{GSq} | gate-source quiescent voltage | $V_{DS} = 32\text{ V}; I_D = 880\text{ mA}$ | - | 2.1 | - | V |
| I_{DSS} | drain leakage current | $V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}$ | - | - | 2.8 | μA |
| I_{DSX} | drain cut-off current | $V_{GS} = V_{GS(th)} + 3.75\text{ V}$ | - | 37 | - | A |
| I_{GSS} | gate leakage current | $V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$ | - | - | 280 | nA |
| g_{fs} | forward transconductance | $V_{DS} = 10\text{ V}; I_D = 11\text{ A}$ | - | 14.3 | - | S |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 7.7\text{ A}$ | - | 92 | 151 | m Ω |
| Peak device | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{GS} = 0\text{ V}; I_D = 3.5\text{ mA}$ | 65 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $V_{DS} = 10\text{ V}; I_D = 350\text{ mA}$ | 1.5 | 1.9 | 2.3 | V |
| V_{GSq} | gate-source quiescent voltage | $V_{DS} = 32\text{ V}; I_D = 2000\text{ mA}$ | - | 2.1 | - | V |
| I_{DSS} | drain leakage current | $V_{GS} = 0\text{ V}; V_{DS} = 28\text{ V}$ | - | - | 2.8 | μA |
| I_{DSX} | drain cut-off current | $V_{GS} = V_{GS(th)} + 3.75\text{ V}$ | - | 56 | - | A |
| I_{GSS} | gate leakage current | $V_{GS} = 11\text{ V}; V_{DS} = 0\text{ V}$ | - | - | 280 | nA |
| g_{fs} | forward transconductance | $V_{DS} = 10\text{ V}; I_D = 17.5\text{ A}$ | - | 22 | - | S |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS} = V_{GS(th)} + 3.75\text{ V}; I_D = 12.25\text{ A}$ | - | 61 | 99 | m Ω |

Table 7. RF characteristics

Test signal: 1-carrier W-CDMA; PAR = 9.6 dB at 0.01 % probability on the CCDF; 3GPP test model 1; 1 to 64 DPCH; $f_1 = 791\text{ MHz}$; $f_2 = 821\text{ MHz}$; RF performance at $V_{DS} = 32\text{ V}$; $I_{Dq} = 880\text{ mA}$ (main); $V_{GS(amp)peak} = 0.8\text{ V}$; $T_{case} = 25\text{ °C}$; unless otherwise specified; in an asymmetrical Doherty production test circuit at frequencies from 791 MHz to 821 MHz.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-----------|------------------------------|---------------------------|-----|-----|-----|------|
| G_p | power gain | $P_{L(AV)} = 93\text{ W}$ | 16 | 17 | - | dB |
| RL_{in} | input return loss | $P_{L(AV)} = 93\text{ W}$ | - | -16 | -12 | dB |
| η_D | drain efficiency | $P_{L(AV)} = 93\text{ W}$ | 42 | 46 | - | % |
| ACPR | adjacent channel power ratio | $P_{L(AV)} = 93\text{ W}$ | - | -33 | -29 | dBc |

Table 8. RF characteristics

Test signal: 1-carrier W-CDMA; PAR = 9.6 dB at 0.01 % probability on the CCDF; 3GPP test model 1; 1 to 64 DPCH; $f = 791\text{ MHz}$; RF performance at $V_{DS} = 32\text{ V}$; $I_{Dq} = 880\text{ mA}$ (main); $V_{GS(amp)peak} = 0.8\text{ V}$; $T_{case} = 25\text{ °C}$; unless otherwise specified; in an asymmetrical Doherty production test circuit at a frequency of 791 MHz.

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|------------|------------------------------|----------------------------|-----|-----|-----|------|
| PAR_O | output peak-to-average ratio | $P_{L(AV)} = 120\text{ W}$ | 6.0 | 6.6 | - | dB |
| $P_{L(M)}$ | peak output power | $P_{L(AV)} = 120\text{ W}$ | 470 | 540 | - | W |

7. Test information

7.1 Ruggedness in Doherty operation

The BLC8G09XS-400AVT is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: $V_{DS} = 32\text{ V}$; $I_{Dq} = 880\text{ mA}$; $V_{GS(amp)peak} = 0.8\text{ V}$; $f = 791\text{ MHz}$; $P_L = 170\text{ W}$ (5 dB OBO); 1-carrier W-CDMA. Test signal: 3GPP test model 1; 1 to 64 DPCH; PAR = 9.6 dB at 0.01 % probability on CCDF per carrier

7.2 Impedance information

Table 9. Typical impedance of main device

Measured load-pull data of main device; $I_{Dq} = 1300\text{ mA}$ (main); $V_{DS} = 32\text{ V}$; pulsed CW ($t_p = 100\text{ }\mu\text{s}$; $\delta = 10\%$).

| f (MHz) | Z _S [1] (Ω) | Z _L [1] (Ω) | P _L [2] (W) | η _D [2] (%) | G _p [2] (dB) |
|--------------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|
| Maximum power load | | | | | |
| 800 | 2.8 – j2.6 | 1.7 – j1.3 | 280 | 60.4 | 18.0 |
| 810 | 2.8 – j2.7 | 1.7 – j1.3 | 280 | 60.6 | 17.9 |
| 820 | 2.8 – j3.1 | 1.7 – j1.3 | 280 | 60.5 | 17.9 |
| 869 | 2.9 – j3.7 | 1.7 – j1.7 | 270 | 61.3 | 17.5 |
| 890 | 3.1 – j3.9 | 1.3 – j1.5 | 270 | 56.0 | 16.7 |
| 920 | 3.8 – j4.1 | 1.3 – j1.5 | 280 | 57.6 | 16.7 |
| 940 | 4.0 – j4.7 | 1.4 – j1.5 | 280 | 58.9 | 16.6 |
| 960 | 4.2 – j4.9 | 1.3 – j1.5 | 285 | 59.4 | 16.5 |
| Maximum drain efficiency load | | | | | |
| 800 | 2.8 – j2.6 | 2.7 – j2.6 | 218 | 69.7 | 19.5 |
| 810 | 2.8 – j2.7 | 3.2 – j2.4 | 200 | 69.8 | 19.8 |
| 820 | 2.8 – j3.1 | 3.2 – j2.4 | 200 | 69.5 | 19.7 |
| 869 | 2.9 – j3.7 | 4.0 – j2.9 | 170 | 69.4 | 19.4 |
| 890 | 3.1 – j3.9 | 3.6 – j2.0 | 190 | 70.2 | 19.2 |
| 920 | 3.8 – j4.1 | 3.7 – j1.3 | 190 | 72.1 | 19.1 |
| 940 | 4.0 – j4.7 | 3.8 – j1.3 | 185 | 72.3 | 19.0 |
| 960 | 4.2 – j4.9 | 3.0 – j1.2 | 210 | 71.8 | 18.6 |

[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; $I_{Dq} = 1900 \text{ mA (peak)}$; $V_{DS} = 32 \text{ V}$; pulsed CW ($t_p = 100 \mu\text{s}$; $\delta = 10 \%$).

| f (MHz) | Z _S [1] (Ω) | Z _L [1] (Ω) | P _L [2] (W) | η _D [2] (%) | G _p [2] (dB) |
|--------------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|
| Maximum power load | | | | | |
| 800 | 2.3 – j4.3 | 1.0 – j1.5 | 430 | 58.0 | 16.4 |
| 810 | 2.3 – j4.4 | 1.0 – j1.5 | 430 | 58.0 | 16.4 |
| 820 | 2.7 – j4.7 | 1.0 – j1.5 | 430 | 58.0 | 16.3 |
| 869 | 2.9 – j5.5 | 1.0 – j1.5 | 420 | 57.8 | 15.8 |
| 890 | 3.2 – j5.9 | 1.0 – j1.5 | 420 | 58.6 | 15.6 |
| 920 | 3.8 – j6.3 | 1.0 – j1.5 | 425 | 59.5 | 15.5 |
| 940 | 4.5 – j6.9 | 0.9 – j1.6 | 425 | 56.4 | 14.8 |
| 960 | 4.8 – j7.0 | 0.9 – j1.6 | 425 | 56.8 | 14.7 |
| Maximum drain efficiency load | | | | | |
| 800 | 2.3 – j4.3 | 2.4 – j2.7 | 265 | 69.6 | 18.5 |
| 810 | 2.3 – j4.4 | 2.3 – j2.2 | 305 | 70.0 | 18.2 |
| 820 | 2.7 – j4.7 | 2.3 – j2.2 | 305 | 69.8 | 18.1 |
| 869 | 2.9 – j5.5 | 2.8 – j2.5 | 255 | 69.4 | 17.6 |
| 890 | 3.2 – j5.9 | 2.5 – j1.9 | 285 | 69.9 | 17.3 |
| 920 | 3.8 – j6.3 | 2.6 – j1.5 | 280 | 71.5 | 17.2 |
| 940 | 4.5 – j6.9 | 2.7 – j1.5 | 275 | 71.4 | 16.9 |
| 960 | 4.8 – j7.0 | 2.6 – j1.2 | 270 | 71.6 | 16.8 |

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

[2] At 3 dB gain compression.

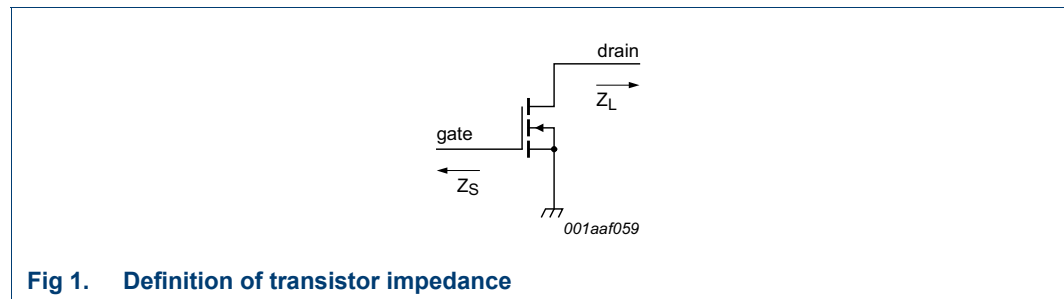


Fig 1. Definition of transistor impedance

7.3 Recommended impedances for Doherty design

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

Measured load-pull data of main device; $I_{Dq} = 1300$ mA (main); $V_{DS} = 32$ V; pulsed CW ($t_p = 100$ μ s; $\delta = 10$ %).

| f | Z _S [1] | Z _L [1] | P _{L(3dB)} [2] | η_D [2] | G _p [2] |
|-------|--------------------|--------------------|-------------------------|--------------|--------------------|
| (MHz) | (Ω) | (Ω) | (W) | (%) | (dB) |
| 869 | 3.1 – j3.9 | 2.0 – j1.6 | 215 | 41.8 | 19.5 |
| 890 | 3.0 – j4.1 | 1.9 – j1.2 | 215 | 42.3 | 19.7 |

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

[2] At P_{L(AV)} = 93 W.

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

Measured load-pull data of main device; $I_{Dq} = 1300$ mA (main); $V_{DS} = 32$ V; pulsed CW ($t_p = 100$ μ s; $\delta = 10$ %).

| f | Z _S [1] | Z _L [1] | P _{L(3dB)} [2] | η_D [2] | G _p [2] |
|-------|--------------------|--------------------|-------------------------|--------------|--------------------|
| (MHz) | (Ω) | (Ω) | (W) | (%) | (dB) |
| 869 | 3.1 – j3.9 | 4.9 – j1.7 | 120 | 59.2 | 21.5 |
| 890 | 3.0 – j4.1 | 4.8 – j1.5 | 120 | 59.5 | 21.4 |

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

[2] At P_{L(AV)} = 93 W.

Table 13. Typical impedance of peak device at 1 : 1 load

Measured load-pull data of peak device; $I_{Dq} = 1900$ mA (peak); $V_{DS} = 32$ V; pulsed CW ($t_p = 100$ μ s; $\delta = 10$ %).

| f | Z _S [1] | Z _L [1] | P _{L(3dB)} [2] | η_D [2] | G _p [2] |
|-------|--------------------|--------------------|-------------------------|--------------|--------------------|
| (MHz) | (Ω) | (Ω) | (W) | (%) | (dB) |
| 869 | 3.3 – j5.1 | 1.3 – j1.9 | 315 | 33.4 | 18.3 |
| 890 | 3.5 – j5.5 | 1.2 – j1.6 | 320 | 34.0 | 18.4 |

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

[2] At P_{L(AV)} = 93 W.

Table 14. Off-state impedances of peak device

| f | Z _{off} |
|-------|------------------|
| (MHz) | (Ω) |
| 800 | 3.8 + j2.9 |
| 810 | 3.9 + j2.8 |
| 820 | 4.1 + j2.8 |
| 869 | 4.6 + j2.0 |
| 890 | 4.7 + j1.5 |
| 920 | 4.7 + j0.8 |
| 940 | 4.4 + j0.3 |
| 960 | 4.1 + j0.1 |

7.4 Test circuit

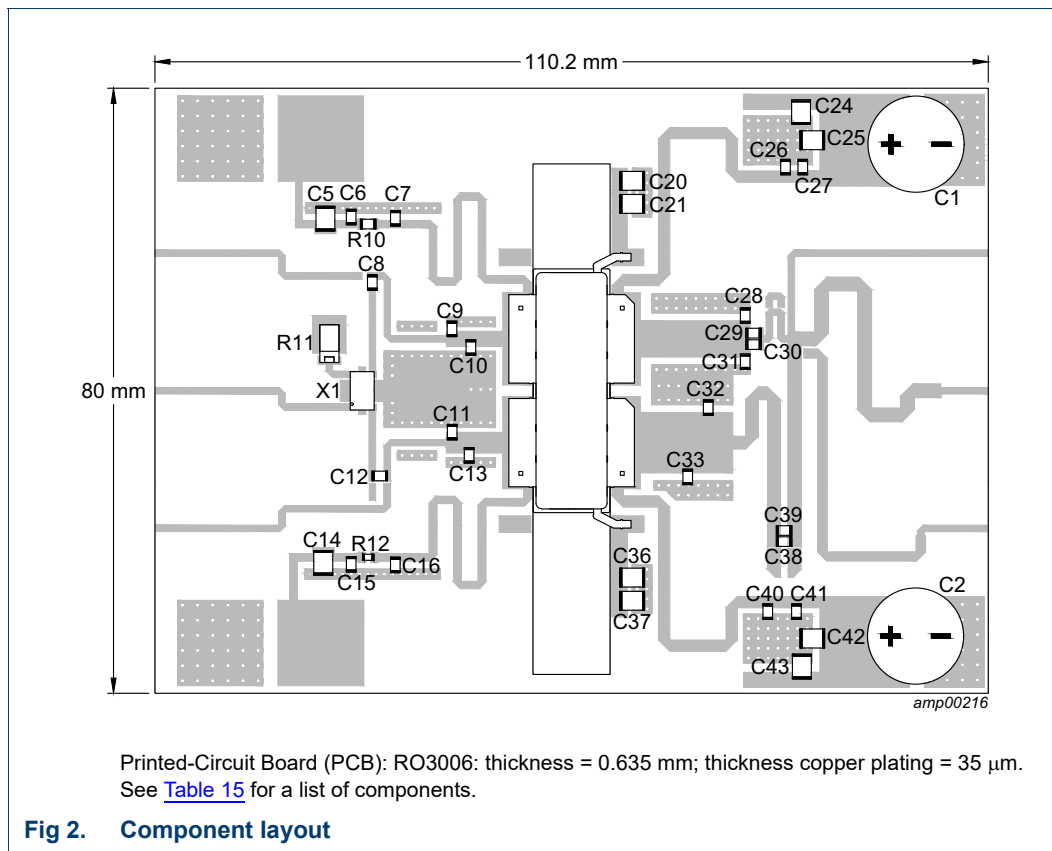


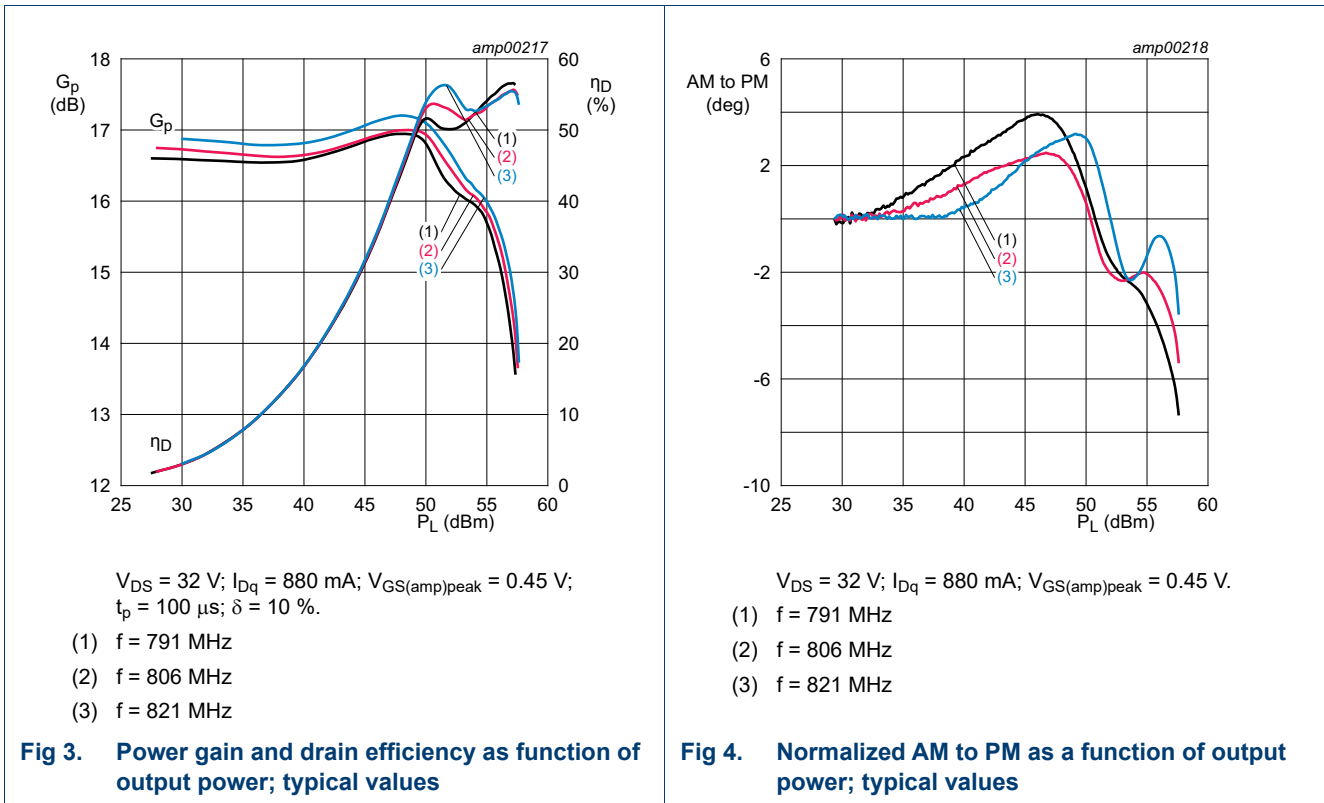
Table 15. List of components

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

| Component | Description | Value | Remarks |
|---|-----------------------------------|--------------|--------------------------------------|
| C1, C2 | electrolytic capacitor | 470 μF, 63 V | |
| C5, C14, C20, C21, C24, C25, C36, C37, C42, C43 | multilayer ceramic chip capacitor | 4.7 μF, 50 V | SMD 1210, Murata, GRM32ER71H475KA88L |
| C6, C15, C27, C41 | multilayer ceramic chip capacitor | 100 nF, 50 V | SMD 0805, Murata |
| C7, C8, C12, C16, C23, C26, C27, C34, C40 | multilayer ceramic chip capacitor | 82pF | SMD 0805, Murata Hi-Q |
| C9, C11, C32 | multilayer ceramic chip capacitor | 6.8 pF | SMD 0805, Murata Hi-Q |
| C10, C32 | multilayer ceramic chip capacitor | 5.1 pF | SMD 0805, Murata Hi-Q |
| C28 | multilayer ceramic chip capacitor | 5.6 pF | SMD 0805, Murata Hi-Q |
| C29, C30 | multilayer ceramic chip capacitor | 100 pF | SMD 0805, Murata Hi-Q |
| C31 | multilayer ceramic chip capacitor | 4.3 pF | SMD 0805, Murata Hi-Q |
| C33 | multilayer ceramic chip capacitor | 12 pF | SMD 0805, Murata Hi-Q |
| C38, C39 | multilayer ceramic chip capacitor | 68 pF | SMD 0805, Murata Hi-Q |
| R10, R12 | resistor | 2.0 Ω, 1 % | SMD 0805 |
| R11 | resistor | 50 Ω, 25 W | Anaren, C16A50Z4 |
| X1 | hybrid coupler | 2 dB | Anaren Xinger III, X3C20F1-02S |

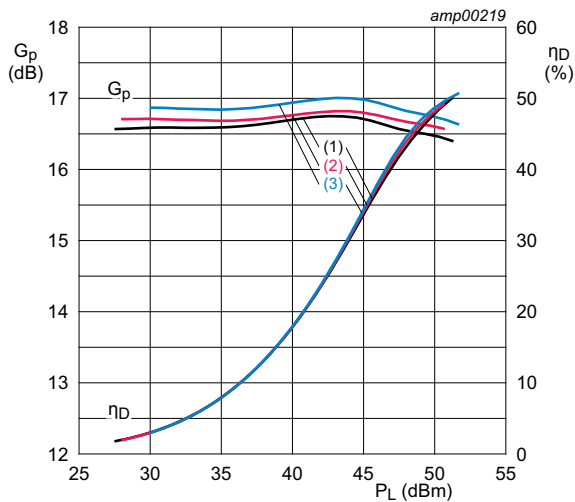
7.5 Graphical data

7.5.1 Pulsed CW



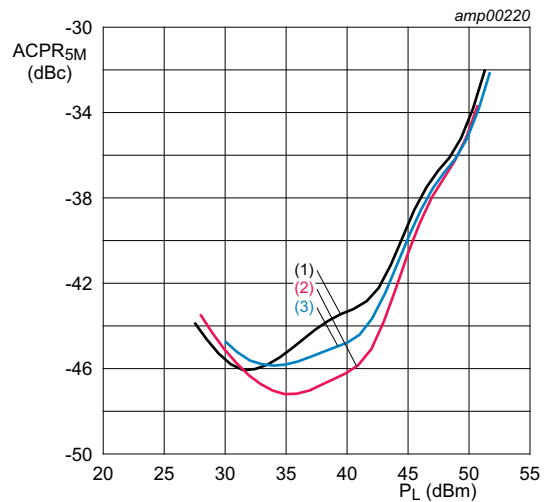
7.5.2 1-Carrier W-CDMA

Test signal: 3GPP test model 1; 1 to 64 DPCH (100 % clipping): PAR = 7.5 dB per carrier at 0.01 % probability on CCDF per carrier.



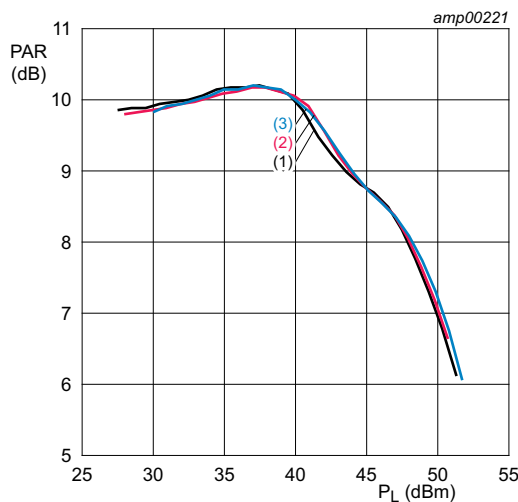
$V_{DS} = 32\text{ V}; I_{Dq} = 880\text{ mA}; V_{GS(amp)peak} = 0.45\text{ V}.$
 (1) $f = 791\text{ MHz}$
 (2) $f = 806\text{ MHz}$
 (3) $f = 821\text{ MHz}$

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



$V_{DS} = 32\text{ V}; I_{Dq} = 880\text{ mA}; V_{GS(amp)peak} = 0.45\text{ V}.$
 (1) $f = 791\text{ MHz}$
 (2) $f = 806\text{ MHz}$
 (3) $f = 821\text{ MHz}$

Fig 6. Adjacent channel power ratio (5 MHz) as a function of output power; typical values

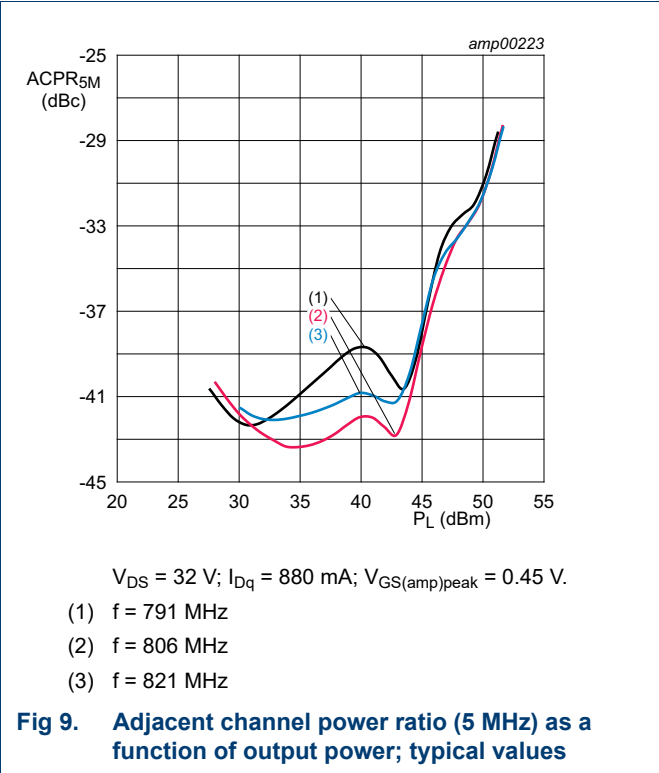
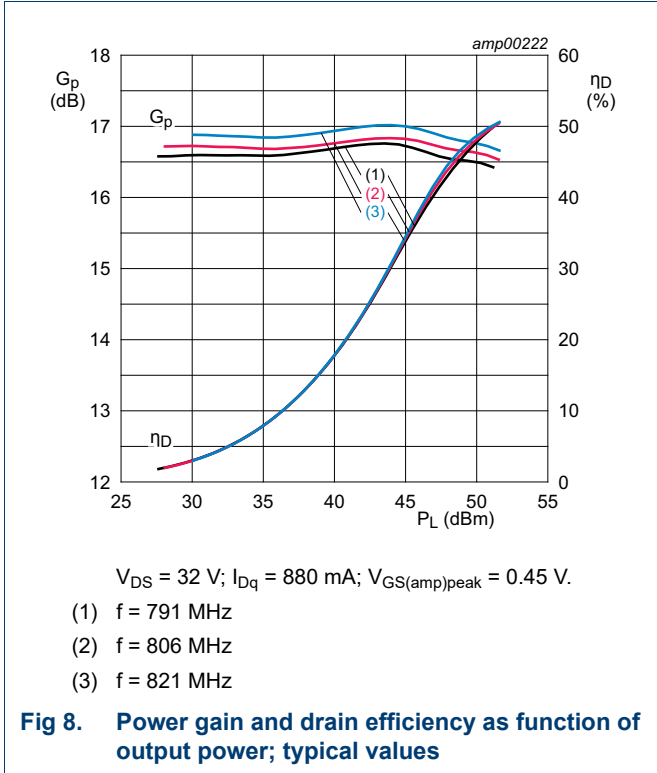


$V_{DS} = 32\text{ V}; I_{Dq} = 880\text{ mA}; V_{GS(amp)peak} = 0.45\text{ V}.$
 (1) $f = 791\text{ MHz}$
 (2) $f = 806\text{ MHz}$
 (3) $f = 821\text{ MHz}$

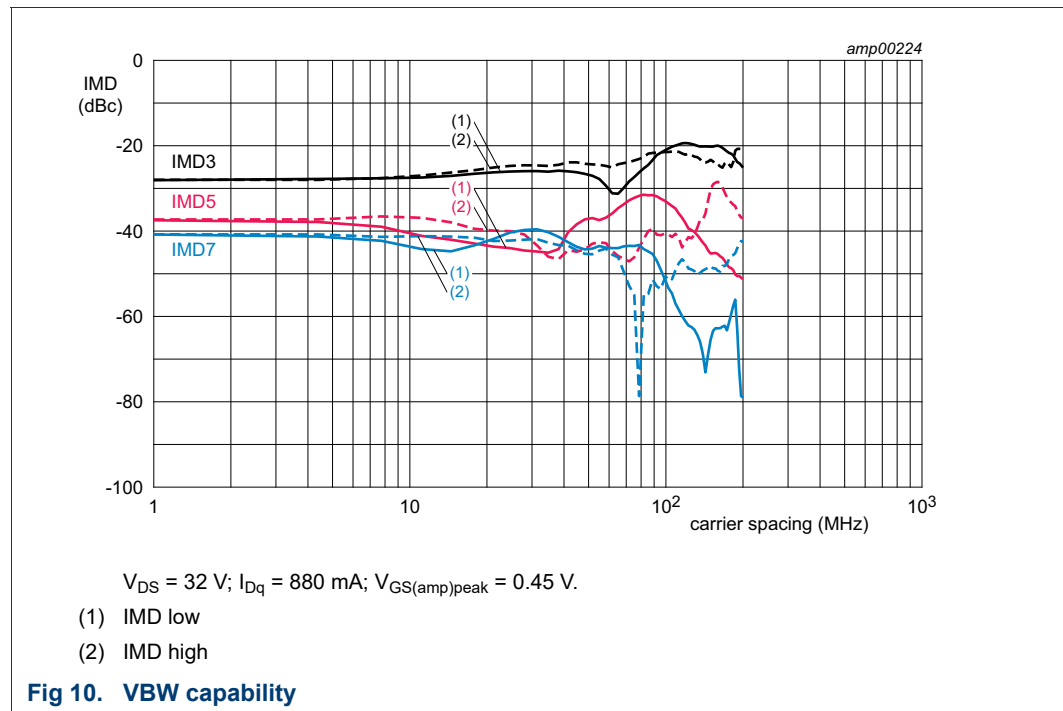
Fig 7. Peak-to-average power ratio as a function of output power; typical values

7.5.3 2-Carrier W-CDMA

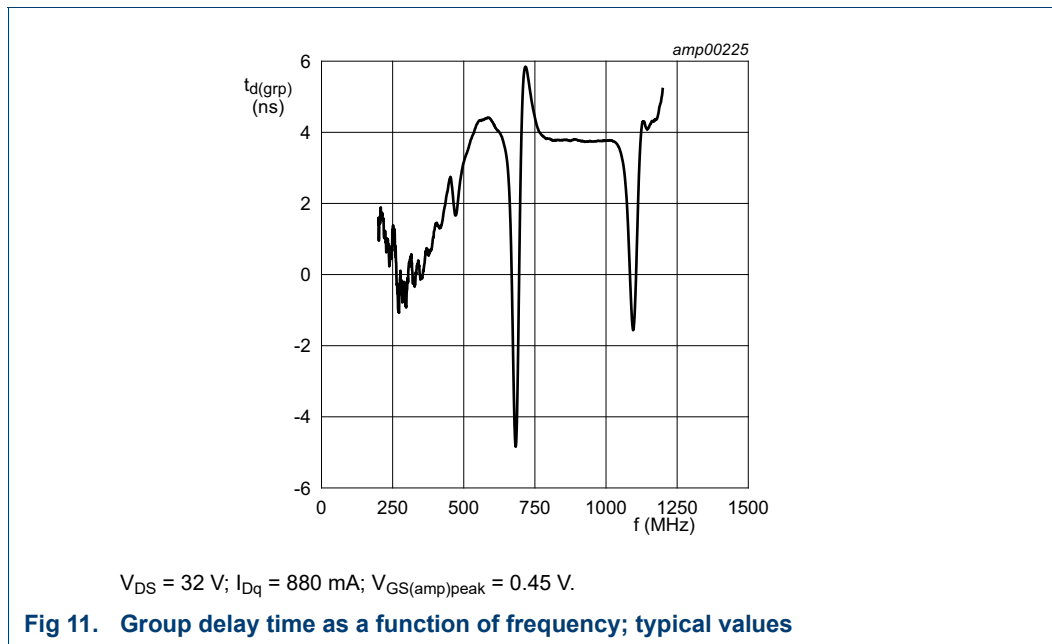
Test signal: 3GPP test model 1; 1 to 64 DPCH (46 % clipping): PAR = 7.5 dB per carrier at 0.01 % probability on CCDF per carrier.



7.5.4 2-Tone VBW



7.5.5 Group delay



8. Package outline

Air cavity plastic earless flanged package; 6 leads

SOT1258-4

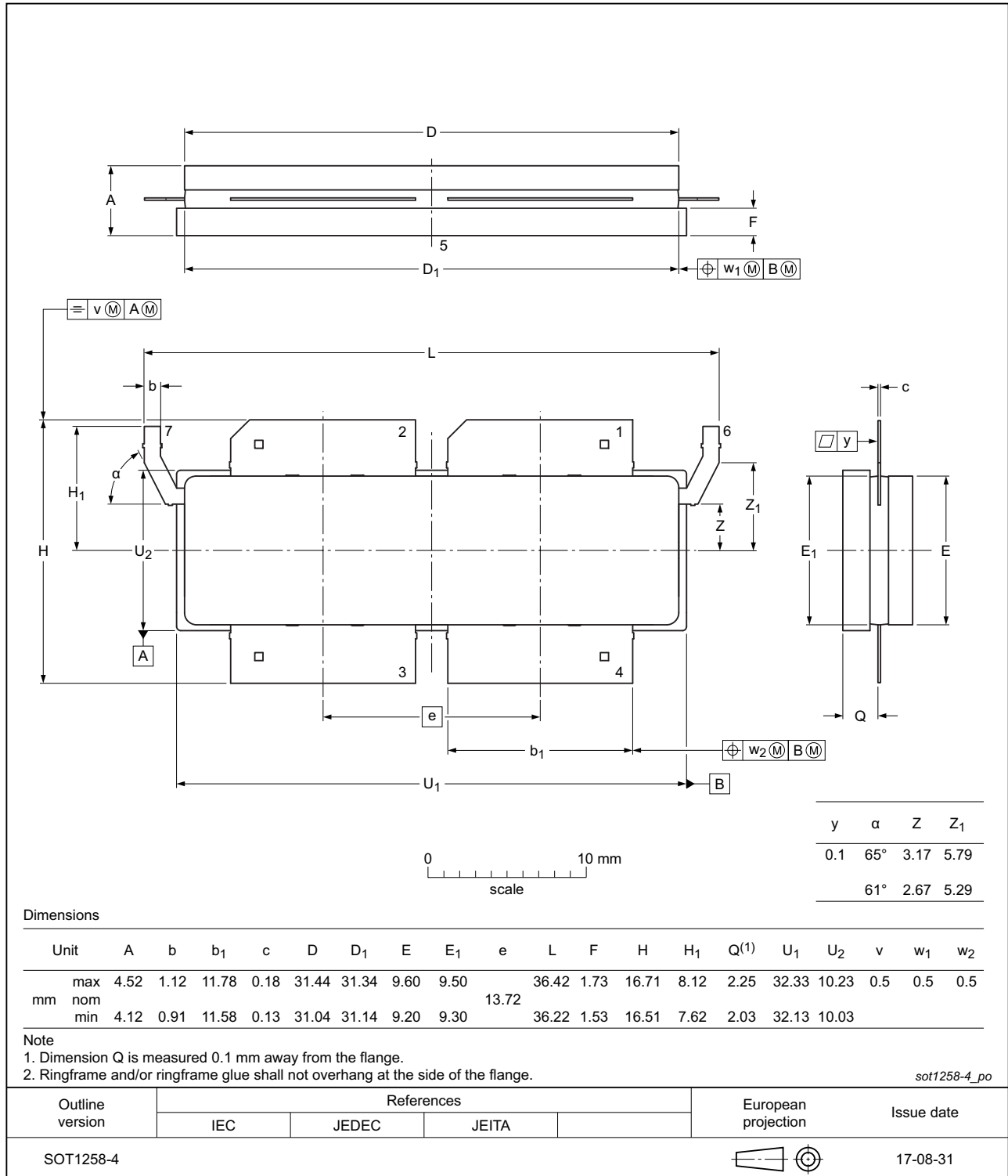


Fig 12. Package outline SOT1258-4

9. Handling information


| CAUTION | |
|---|---|
|  | <p>This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.</p> <p>Such precautions are described in the <i>ANSI/ESD S20.20</i>, <i>IEC/ST 61340-5</i>, <i>JESD625-A</i> or equivalent standards.</p> |

Table 16. 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 17. Abbreviations

| Acronym | Description |
|---------|--|
| 3GPP | 3rd Generation Partnership Project |
| AM | Amplitude Modulation |
| 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 |
| OBO | Output Back Off |
| PAR | Peak-to-Average Ratio |
| PM | Phase Modulation |
| SMD | Surface Mounted Device |
| VBW | Video BandWidth |
| VSWR | Voltage Standing Wave Ratio |
| W-CDMA | Wideband Code Division Multiple Access |

11. Revision history

Table 18. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------------|--|--------------------|---------------|----------------------|
| BLC8G09XS-400AVT v.2 | 20171124 | Product data sheet | - | BLC8G09XS-400AVT v.1 |
| Modifications: | <ul style="list-style-type: none">• Table 2 on page 2: changed simplified version drawing SOT1258-7 to SOT1258-4• Table 3 on page 2: changed version SOT1258-7 to SOT1258-4• Figure 2 on page 7: updated figure• Figure 12 on page 12: changed package outline drawing SOT1258-7 to SOT1258-4 | | | |
| BLC8G09XS-400AVT v.1 | 20170421 | 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. |
| 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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Date of release: 24 November 2017
 Document identifier: BLC8G09XS-400AVT