# B10G3438N55D

**LDMOS 3-stage integrated Doherty MMIC**

**Rev. 1 — 5 October 2021**

AMPLEON

**Product data sheet**

## 1. Product profile

### 1.1 General description

The B10G3438N55D is a 3-stage fully integrated asymmetrical Doherty MMIC solution using Ampleon's state of the art GEN10 LDMOS technology. The carrier and peaking device, input splitter, output combiner and pre-match are integrated in a single package. This multiband device is perfectly suited as a final stage for small cells and massive MIMO applications in the frequency range from 3400 MHz to 3800 MHz. Available in PQFN outline.

**Table 1. Application performance**

*Typical RF performance at $T_{case}$ = 25 °C; $I_{Dq}$ = 73 mA (carrier and peaking); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V. Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB at 0.01 % probability CCDF; measured in an Ampleon f = 3400 MHz to 3800 MHz integrated Doherty application circuit.*

| Test signal | f (MHz) | $V_{DS}$ (V) | $P_{L(AV)}$ (W) | $G_p$ (dB) | $\eta_D$ (%) |
|---|---|---|---|---|---|
| 1-carrier LTE 20 MHz (3600 MHz) PAR = 7.6 dB | 3600 | 28 | 7.94 | 34 | 37 |

### 1.2 Features and benefits

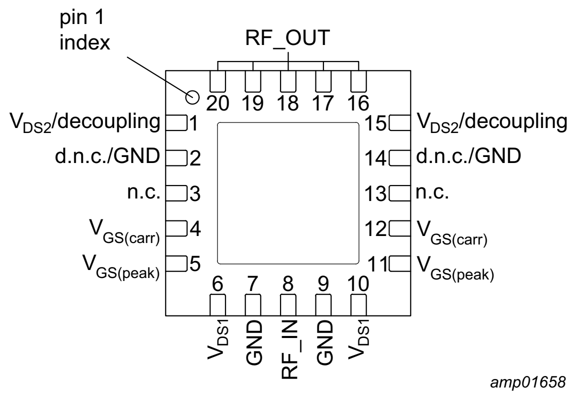
- Integrated input splitter
- Integrated output combiner
- 30 Ω output impedance thanks to integrated pre-match
- Very high efficiency thanks to asymmetry
- Designed for wideband operation (frequency 3400 MHz to 3800 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Source impedance 50 Ω; high power gain
- For RoHS compliance see the product details on the Ampleon website

### 1.3 Applications

- RF power MMIC for multi-carrier and multi-standard GSM, W-CDMA and LTE base stations in the 3400 MHz to 3800 MHz frequency range

# 2. Pinning information

## 2.1 Pinning




Transparent top view.

The exposed backside of the package is the ground terminal of the device.

**Fig 1. Pin configuration**

## 2.2 Pin description

**Table 2. Pin description**

| Symbol | Pin | Description |
|---|---|---|
| $V_{DS2}$/decoupling | 1 | drain-source voltage of final stages / video-lead for decoupling |
| d.n.c./GND | 2 | do not connect or GND |
| n.c. | 3 | not connected |
| $V_{GS(carr)}$ | 4 | gate-source voltage of carrier |
| $V_{GS(peak)}$ | 5 | gate-source voltage of peaking |
| $V_{DS1}$ | 6 | drain-source voltage of driver stages |
| GND | 7 | RF ground |
| RF_IN | 8 | RF input |
| GND | 9 | RF ground |
| $V_{DS1}$ | 10 | drain-source voltage of driver stages |
| $V_{GS(peak)}$ | 11 | gate-source voltage of peaking |
| $V_{GS(carr)}$ | 12 | gate-source voltage of carrier |
| n.c. | 13 | not connected |
| d.n.c./GND | 14 | do not connect or GND |
| $V_{DS2}$/decoupling | 15 | drain-source voltage of final stages / video-lead for decoupling |
| RF_OUT | 16 | RF output |
| RF_OUT | 17 | RF output |
| RF_OUT | 18 | RF output |
| RF_OUT | 19 | RF output |
| RF_OUT | 20 | RF output |

**Table 2. Pin description** *...continued*

| Symbol | Pin | Description |
|---|---|---|
| GND | flange | RF ground |

## 3. Ordering information

**Table 3. Ordering information**

| Package name | Orderable part number | 12NC | Packing description | Min. orderable quantity (pieces) |
|---|---|---|---|---|
| SOT1462-1 | B10G3438N55DZ | 9349 603 61515 | TR13; 500-fold; 16 mm; dry pack | 500 |

## 4. Block diagram

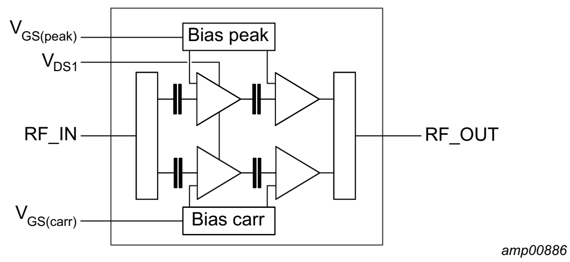



**Fig 2. Block diagram**

## 5. 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 |
| $V_{GS}$ | gate-source voltage | | –6 | +13 | V |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | [1] | - | 200 | °C |

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

## 6. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | Value | Unit |
|---|---|---|---|---|
| $R_{th(j-c)}$ | thermal resistance from junction to case | $T_{case}$ = 90 °C; $P_L$ = 10 W [1] | 2.45 | K/W |
| | | $T_{case}$ = 90 °C; $P_L$ = 6.3 W [1] | 2.88 | K/W |

[1] When operated with a 1-carrier LTE with PAR = 7.6 dB.

# 7. Characteristics

**Table 6. DC characteristics**

*$T_{case}$ = 25 °C.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Carrier** | | | | | | |
| $V_{GSq}$ | gate-source quiescent voltage | $V_{DS}$ = 28 V; $I_D$ = 70 mA | 1.8 | 2.1 | 2.55 | V |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 1 V; $V_{DS}$ = 0 V | - | - | 140 | nA |
| **Peaking** | | | | | | |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 1 V; $V_{DS}$ = 0 V | - | - | 140 | nA |
| **Final stages** | | | | | | |
| $I_{DSS}$ | drain leakage current | $V_{GS}$ = 0 V; $V_{DS}$ = 28 V | - | - | 1.4 | μA |
| **Driver stages** | | | | | | |
| $I_{DSS}$ | drain leakage current | $V_{GS}$ = 0 V; $V_{DS}$ = 28 V | - | - | 1.4 | μA |

**Table 7. RF Characteristics**

*Typical RF performance at $T_{case}$ = 25 °C; $V_{DS}$ = 28 V; $I_{Dq}$ = 70 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V; $P_{L(AV)}$ = 39 W. Test signal: pulsed CW ($\delta$ = 10 %; $t_p$ = 100 μs); f = 3600 MHz measured in an Ampleon production circuit.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $G_p$ | power gain | $P_L$ = 7.94 W (39 dBm) | 31.1 | 33.7 | 36.1 | dB |
| $\eta_D$ | drain efficiency | $P_L$ = 7.94 W (39 dBm) | 30.0 | 37.3 | - | % |
| | | $P_L = P_{L(3dB)}$ | 36 | 42 | - | % |
| $RL_{in}$ | input return loss | | - | - | −10 | dB |
| $P_{L(3dB)}$ | output power at 3 dB compression point | | 46.4 | 47.4 | - | dBm |

# 8. Application information

**Table 8. Typical performance**

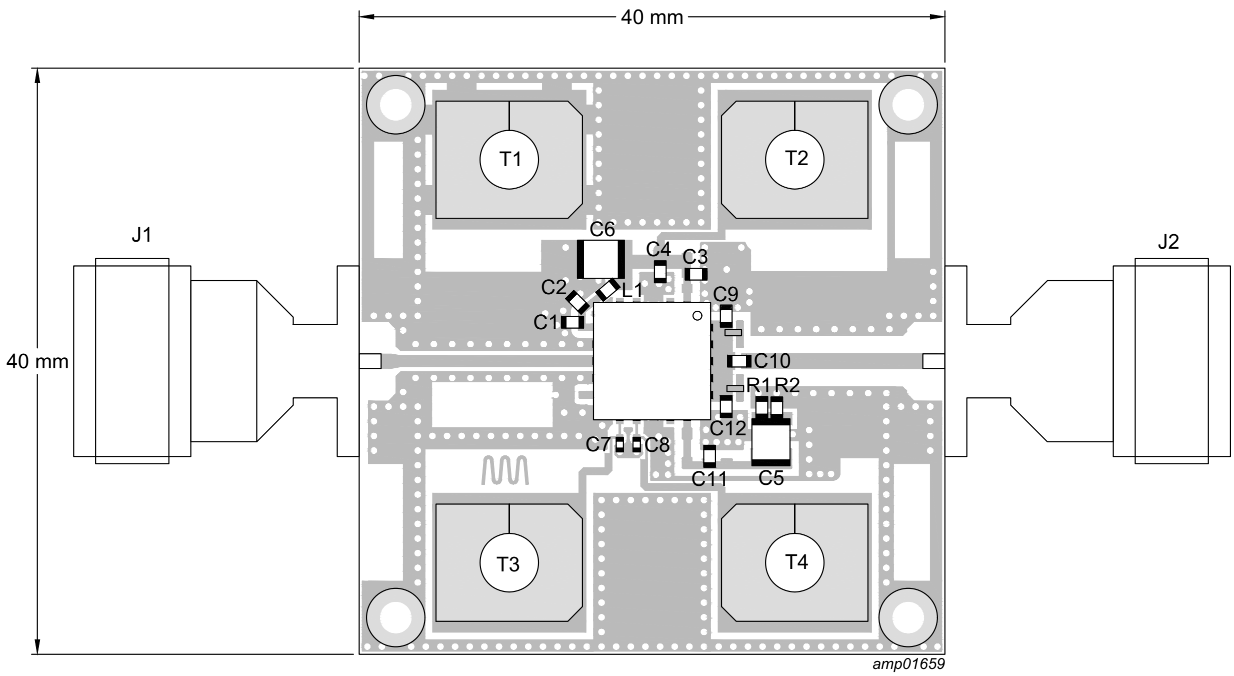
*$T_{case}$ = 25 °C; $V_{DS}$ = 28 V; $I_{Dq}$ = 75 mA (driver and final stages); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5$ V. Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB at 0.01 % probability CCDF; measured in an Ampleon f = 3400 MHz to 3800 MHz frequency band symmetrical integrated Doherty application circuit.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $P_{L(3dB)}$ | output power at 3 dB compression point | f = 3600 MHz [1] | - | 47.5 | - | dBm |
| $\varphi_{s21}/\varphi_{s21(norm)}$ | normalized phase response | at 3 dB compression point; f = 3600 MHz [2] | - | –50 | - | ° |
| $\eta_D$ | drain efficiency | 8 dB OBO ($P_{L(AV)}$ = 39 dBm); f = 3600 MHz | - | 37 | - | % |
| $G_p$ | power gain | $P_{L(AV)}$ = 39 dBm; f = 3600 MHz | - | 34 | - | dB |
| $B_{video}$ | video bandwidth | $P_{L(AV)}$ = 37 dBm; 2-tone CW; f = 3600 MHz | - | 400 | - | MHz |
| $G_{flat}$ | gain flatness | $P_{L(AV)}$ = 39 dBm; f = 3400 MHz to 3800 MHz | - | 1.2 | - | dB |
| $\Delta G/\Delta T$ | gain variation with temperature | f = 3600 MHz [3] | - | 0.074 | - | dB/°C |
| $ACPR_{20M}$ | adjacent channel power ratio (20 MHz) | $P_{L(AV)}$ = 39 dBm; f = 3600 MHz | - | –26 | - | dBc |
| K | Rollett stability factor | $T_{case}$ = –40 °C to +125 °C; f = 1.5 GHz to 4.5 GHz [3] | - | >1 | - | |

[1] Pulsed CW power sweep measurement ($\delta$ = 10 %; $t_p$ = 100 μs).

[2] 25 ms CW power sweep measurement.

[3] S-parameters measured with broadband demo board.




Printed-Circuit Board (PCB): Rogers 4350; thickness = 0.508 mm.

**Fig 3. Component layout**

**Table 9. Demo test circuit list of components**

*See Figure 3 for component layout.*

| Component | Description | Value | Remarks |
|---|---|---|---|
| C1 | multilayer ceramic chip capacitor | 15 nF, 50 V | Murata: 06035C153KAZ2A |
| C2, C4 | multilayer ceramic chip capacitor | 100 nF, 50 V | Murata: 06035C104KAT2A |
| C5, C6 | multilayer ceramic chip capacitor | 10 μF, 50 V | Murata: GRM21BR6YA106KE43 |
| C7, C8 | multilayer ceramic chip capacitor | 4.7 μF, 6.3 V | Murata: GRM155R60J475ME47D |
| C3 | multilayer ceramic chip capacitor | 3 pF ± 0.1 % | Murata: GQM1875C2E3R0BB12 |
| C10 | multilayer ceramic chip capacitor | 1.5 pF ± 0.1 % | Murata: GQM1875C2E1R6BB12 |
| C11 | SMA Coaxial panel connector male | 3 pF ± 0.1 % | Murata: GQM1875C2E3R0BB12 |
| C12, C9 | SMA Coaxial panel connector female | 0.1 pF | Murata: GQM1875CER10BB12 |
| R1, R2 | resistor | 5.1 Ω | Murata: MCWR06W5R10FTL |
| L1 | ferrite bead | 220 Ω ± 25 % (at 100 MHz) | Murata: BLM18EG221SN1 |
| J1 | SMA or N Coaxial panel connector male | | Huber & Suhner: 13_SMA-50-0-2/111_N or Radiall: R161.438.200 |
| J2 | SMA or N Coaxial panel connector female | | Huber & Suhner: 23_SMA-50-0-2/111_N or N-50-0-16/133_NE |
| T1, T2, T3, T4 | PCB Terminal | 6.35 mm × 0.81 mm, 4.1 mm | TE connectivity:141879-1 |

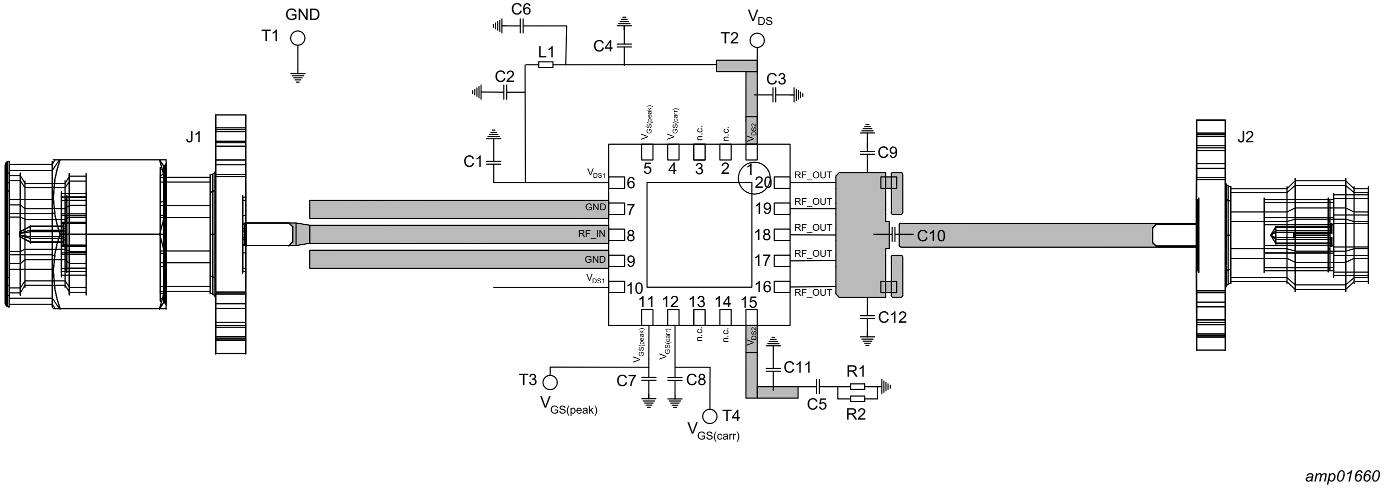



**Fig 4. Electrical schematic**

## 8.1 Ruggedness in a Doherty operation

The B10G3438N55D is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: $V_{DS}$ = 32 V; $I_{Dq}$ = 70 mA (carrier); $V_{GSq(carrier)} - V_{GSq(peaking)}$ = 0.5 V; $P_i$ corresponding to $P_{L(3dB)}$ – 5 dB under $Z_S$ = 50 Ω load; f = 3800 MHz (1-carrier W-CDMA PAR 9.9 signal is used during the stress); $T_{case}$ = 25 °C.

## 8.2 Impedance information

**Table 10. Typical impedance for optimum Doherty operation**
*Measured load-pull data; test signal: pulsed CW; $T_{case}$ = 25 °C; $V_{DS}$ = 26 V; $I_{Dq}$ = 70 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)}$ – 0.5 V; $t_p$ = 100 μs; δ = 10 %.*

| f | tuned for optimum Doherty operation | | | | |
|---|---|---|---|---|---|
| | $Z_L$ [1] | $P_{L(3dB)}$ | $G_{p(max)}$ | $\eta_{add}$ [2] | $\eta_{add}$ [3] |
| (MHz) | (Ω) | (dBm) | (dB) | (%) | (%) |
| 3400 | 10.7 – j21.2 | 47.4 | 34.2 | 38.0 | 45.2 |
| 3600 | 10.6 – j21.2 | 47.4 | 35.1 | 38.5 | 46.9 |
| 3800 | 13.8 – j24.1 | 47.3 | 34.6 | 36.5 | 46.4 |

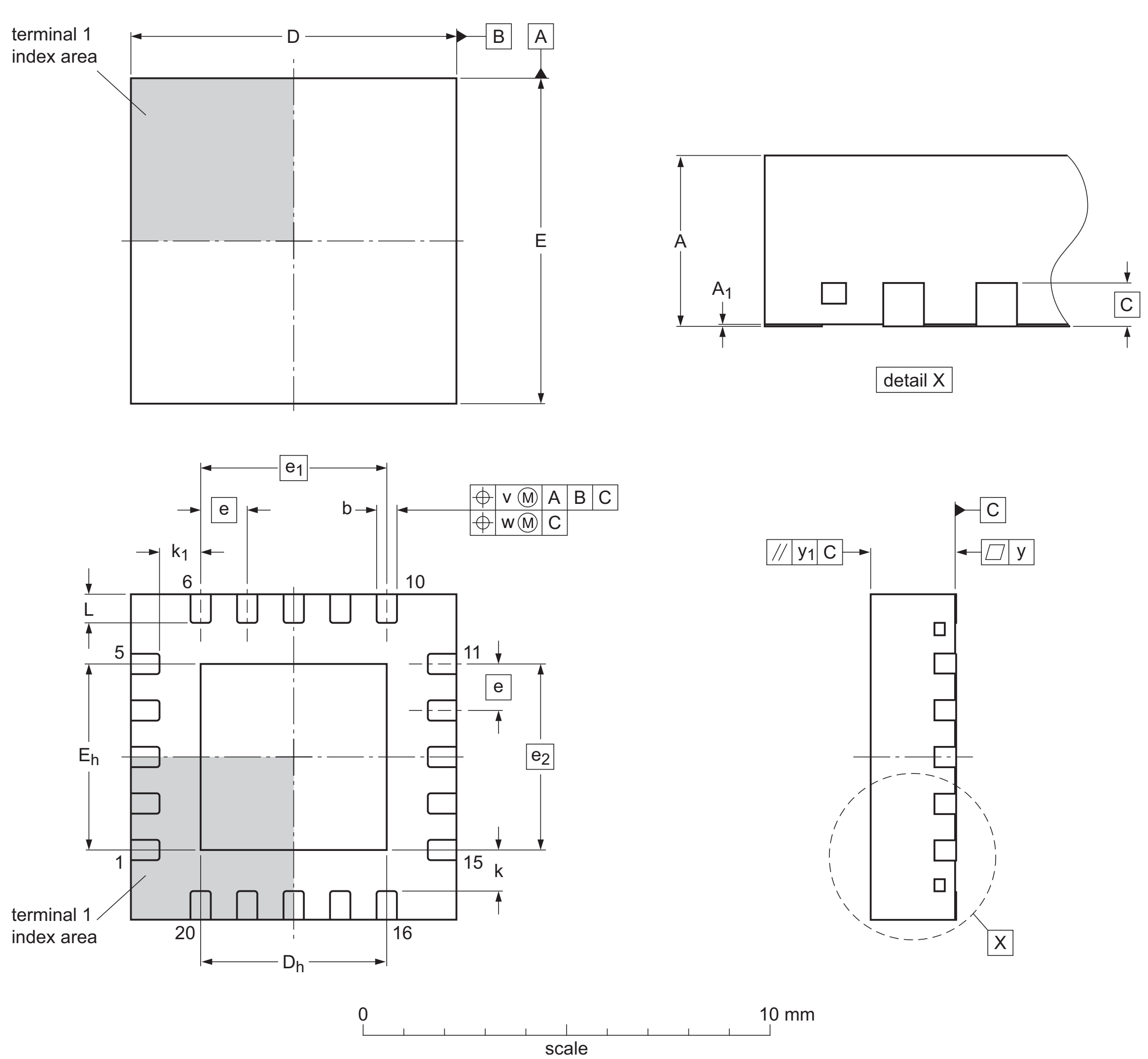
[1] Reference package plane.

[2] At 39 dBm.

[3] At $P_{L(3dB)}$.

# 9. Package outline

**PQFN20: plastic thermal enhanced quad flat package; no leads; 20 terminals; body 8.0 x 8.0 x 2.1 mm** **SOT1462-1**




Dimensions

| Unit | | $A^{(1)}$ | $A_1$ | b | C | $D^{(1)}$ | $D_h$ | $E^{(1)}$ | $E_h$ | e | $e_1$ | $e_2$ | k | $k_1$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | max | 2.20 | 0.05 | 0.60 | | 8.1 | 4.72 | 8.1 | 4.72 | | | | | | 0.8 | | | | |
| mm | nom | 2.10 | | 0.50 | 0.508 | 8.0 | 4.62 | 8.0 | 4.62 | 1.15 | 4.6 | 4.6 | | | 0.7 | 0.1 | 0.05 | 0.1 | 0.1 |
| | min | 2.00 | 0.00 | 0.40 | | 7.9 | 4.52 | 7.9 | 4.52 | | | | 0.99 | 0.99 | 0.6 | | | | |

Note
1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot1462-1_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT1462-1 | | | | | | ~~15-10-12~~<br>17-06-23 |

**Fig 5. Package outline SOT1462-1 (PQFN20)**

# 10. Handling information

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

**Table 11. 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 | 1C [2] |

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

[2] HBM classification 1C is granted to any part that passes after exposure to an ESD pulse of 1000 V.

# 11. Abbreviations

**Table 12. Abbreviations**

| Acronym | Description |
|---|---|
| CW | Continuous Wave |
| CCDF | Complementary Cumulative Distribution Function |
| ESD | ElectroStatic Discharge |
| GEN10 | Tenth Generation |
| GSM | Global System for Mobile Communications |
| LDMOS | Laterally Diffused Metal Oxide Semiconductor |
| LTE | Long Term Evolution |
| MMIC | Monolithic Microwave Integrated Circuit |
| MIMO | Multiple Input Multiple Output |
| MTF | Median Time to Failure |
| OBO | Output Back Off |
| PAR | Peak-to-Average Ratio |
| RoHS | Restriction of Hazardous Substances |
| VSWR | Voltage Standing Wave Ratio |
| W-CDMA | Wideband Code Division Multiple Access |

# 12. Revision history

**Table 13. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| B10G3438N55D v.1 | 20211005 | Product data sheet | - | - |

# 13. Legal information

## 13.1 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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[2] The term 'short data sheet' is explained in section "Definitions".

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**Date of release: 5 October 2021**
**Document identifier: B10G3438N55D**