

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

Test signal	f	V _{DS}	P _{L(AV)}	G _p	η_D
	(MHz)	(V)	(W)	(dB)	(%)
1-carrier LTE 20 MHz (3600 MHz) PAR = 7.6 dB	3600	28	7.94	34	37

1.2 Features and benefits

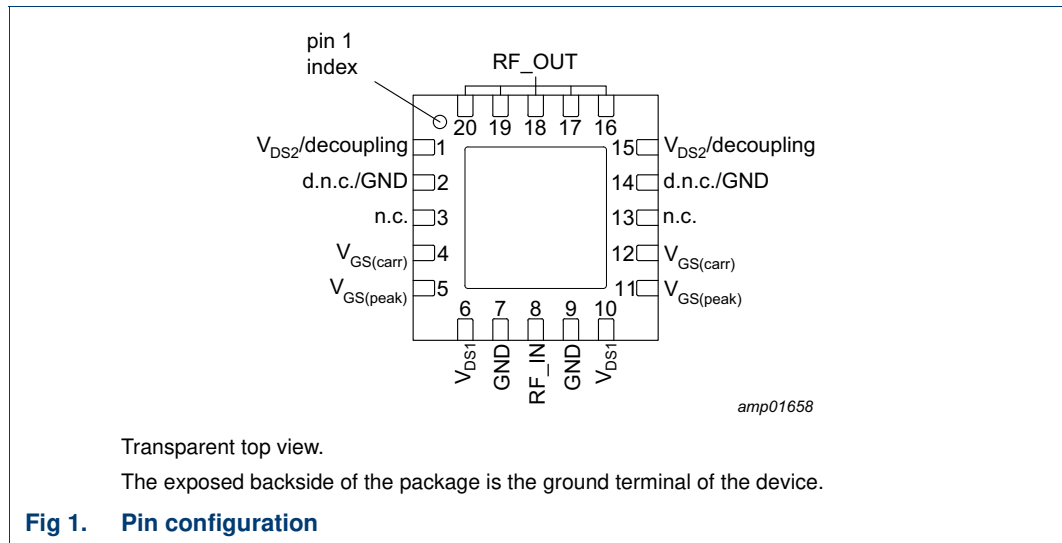
- Integrated input splitter
- Integrated output combiner
- 30 Ω output impedance thanks to integrated pre-match
- Very high efficiency thanks to asymmetry
- Designed for wideband operation (frequency 3400 MHz to 3800 MHz)
- Independent control of carrier and peaking bias
- Integrated ESD protection
- 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



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

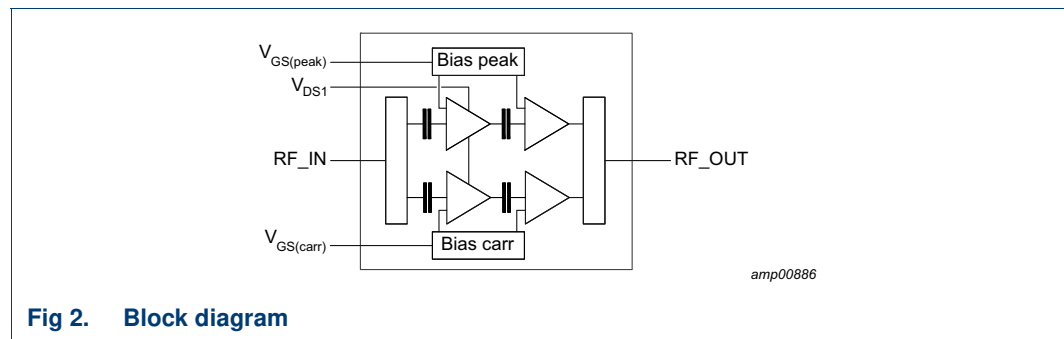


Fig 2. Block diagram

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	$T_{case} = 90\text{ °C}; P_L = 10\text{ W}$	[1]	2.45	K/W
		$T_{case} = 90\text{ °C}; P_L = 6.3\text{ W}$	[1]	2.88	K/W

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

7. Characteristics

Table 6. DC characteristics

$T_{case} = 25\text{ }^{\circ}\text{C}$.

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

Table 7. RF Characteristics

Typical RF performance at $T_{case} = 25\text{ }^{\circ}\text{C}$; $V_{DS} = 28\text{ V}$; $I_{Dq} = 70\text{ mA}$ (carrier);

$V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5\text{ V}$; $P_{L(AV)} = 39\text{ W}$. Test signal: pulsed CW ($\delta = 10\%$; $t_p = 100\text{ }\mu\text{s}$); $f = 3600\text{ MHz}$ measured in an Ampleon production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_p	power gain	$P_L = 7.94\text{ W}$ (39 dBm)	31.1	33.7	36.1	dB
η_D	drain efficiency	$P_L = 7.94\text{ W}$ (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

$T_{case} = 25\text{ °C}$; $V_{DS} = 28\text{ V}$; $I_{Dq} = 75\text{ mA}$ (driver and final stages); $V_{GSq(peak)} = V_{GSq(carrier)} - 0.5\text{ V}$. Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB at 0.01 % probability CCDF; measured in an Ampleon $f = 3400\text{ MHz}$ 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	$f = 3600\text{ MHz}$ [1]	-	47.5	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	at 3 dB compression point; $f = 3600\text{ MHz}$ [2]	-	-50	-	°
η_D	drain efficiency	8 dB OBO ($P_{L(AV)} = 39\text{ dBm}$); $f = 3600\text{ MHz}$	-	37	-	%
G_p	power gain	$P_{L(AV)} = 39\text{ dBm}$; $f = 3600\text{ MHz}$	-	34	-	dB
B_{video}	video bandwidth	$P_{L(AV)} = 37\text{ dBm}$; 2-tone CW; $f = 3600\text{ MHz}$	-	400	-	MHz
G_{flat}	gain flatness	$P_{L(AV)} = 39\text{ dBm}$; $f = 3400\text{ MHz}$ to 3800 MHz	-	1.2	-	dB
$\Delta G/\Delta T$	gain variation with temperature	$f = 3600\text{ MHz}$ [3]	-	0.074	-	dB/°C
ACPR _{20M}	adjacent channel power ratio (20 MHz)	$P_{L(AV)} = 39\text{ dBm}$; $f = 3600\text{ MHz}$	-	-26	-	dBc
K	Rollett stability factor	$T_{case} = -40\text{ °C}$ to $+125\text{ °C}$; $f = 1.5\text{ GHz}$ to 4.5 GHz [3]	-	>1	-	

[1] Pulsed CW power sweep measurement ($\delta = 10\%$; $t_p = 100\text{ }\mu\text{s}$).

[2] 25 ms CW power sweep measurement.

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

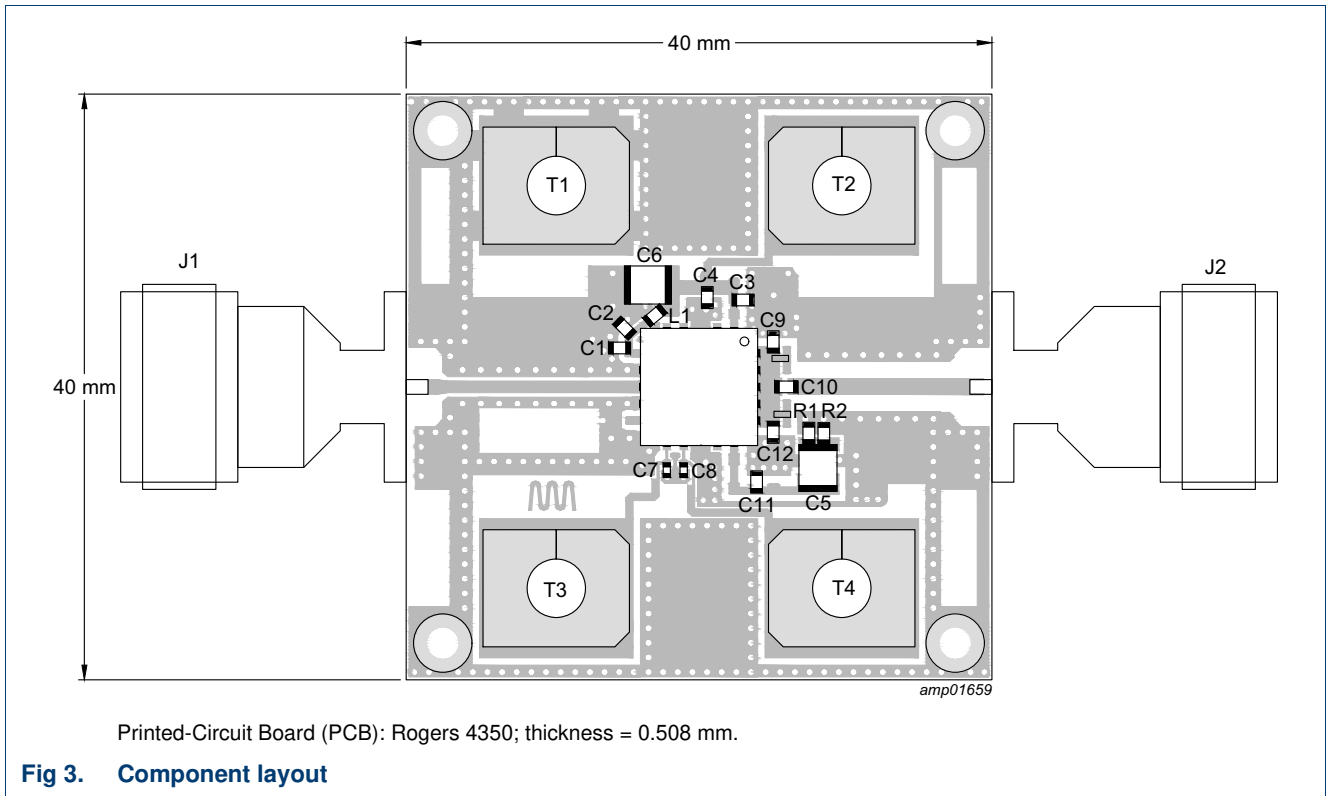


Table 9. Demo test circuit list of components

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 μ F, 50 V	Murata: GRM21BR6YA106KE43
C7, C8	multilayer ceramic chip capacitor	4.7 μ F, 6.3 V	Murata: GRM155R60J475ME47D
C3	multilayer ceramic chip capacitor	3 pF \pm 0.1 %	Murata: GQM1875C2E3R0BB12
C10	multilayer ceramic chip capacitor	1.5 pF \pm 0.1 %	Murata: GQM1875C2E1R6BB12
C11	SMA Coaxial panel connector male	3 pF \pm 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 \pm 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 \times 0.81 mm, 4.1 mm	TE connectivity:141879-1

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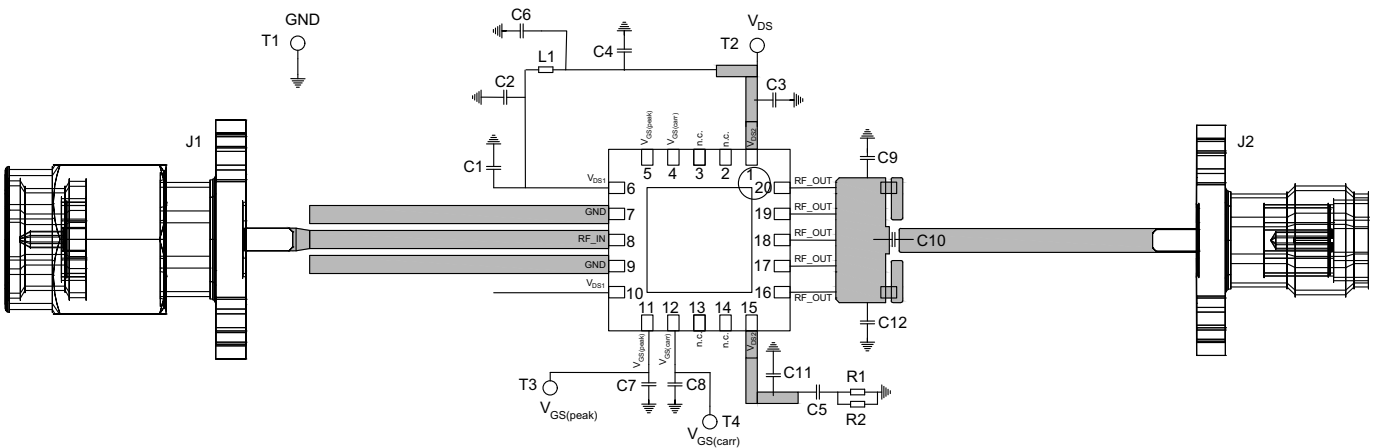


Fig 4. Electrical schematic

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: $V_{DS} = 32\text{ V}$; $I_{Dq} = 70\text{ mA}$ (carrier); $V_{GSq(carrier)} - V_{GSq(peaking)} = 0.5\text{ V}$; P_1 corresponding to $P_{L(3dB)} - 5\text{ dB}$ under $Z_S = 50\ \Omega$ load; $f = 3800\text{ MHz}$ (1-carrier W-CDMA PAR 9.9 signal is used during the stress); $T_{case} = 25\text{ }^\circ\text{C}$.

8.2 Impedance information

Table 10. Typical impedance for optimum Doherty operation

Measured load-pull data; test signal: pulsed CW; $T_{case} = 25\text{ }^\circ\text{C}$; $V_{DS} = 26\text{ V}$; $I_{Dq} = 70\text{ mA}$ (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.5\text{ V}$; $t_p = 100\ \mu\text{s}$; $\delta = 10\%$.

f (MHz)	tuned for optimum Doherty operation				
	Z_L [1] (Ω)	$P_{L(3dB)}$ (dBm)	$G_{p(max)}$ (dB)	η_{add} [2] (%)	η_{add} [3] (%)
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

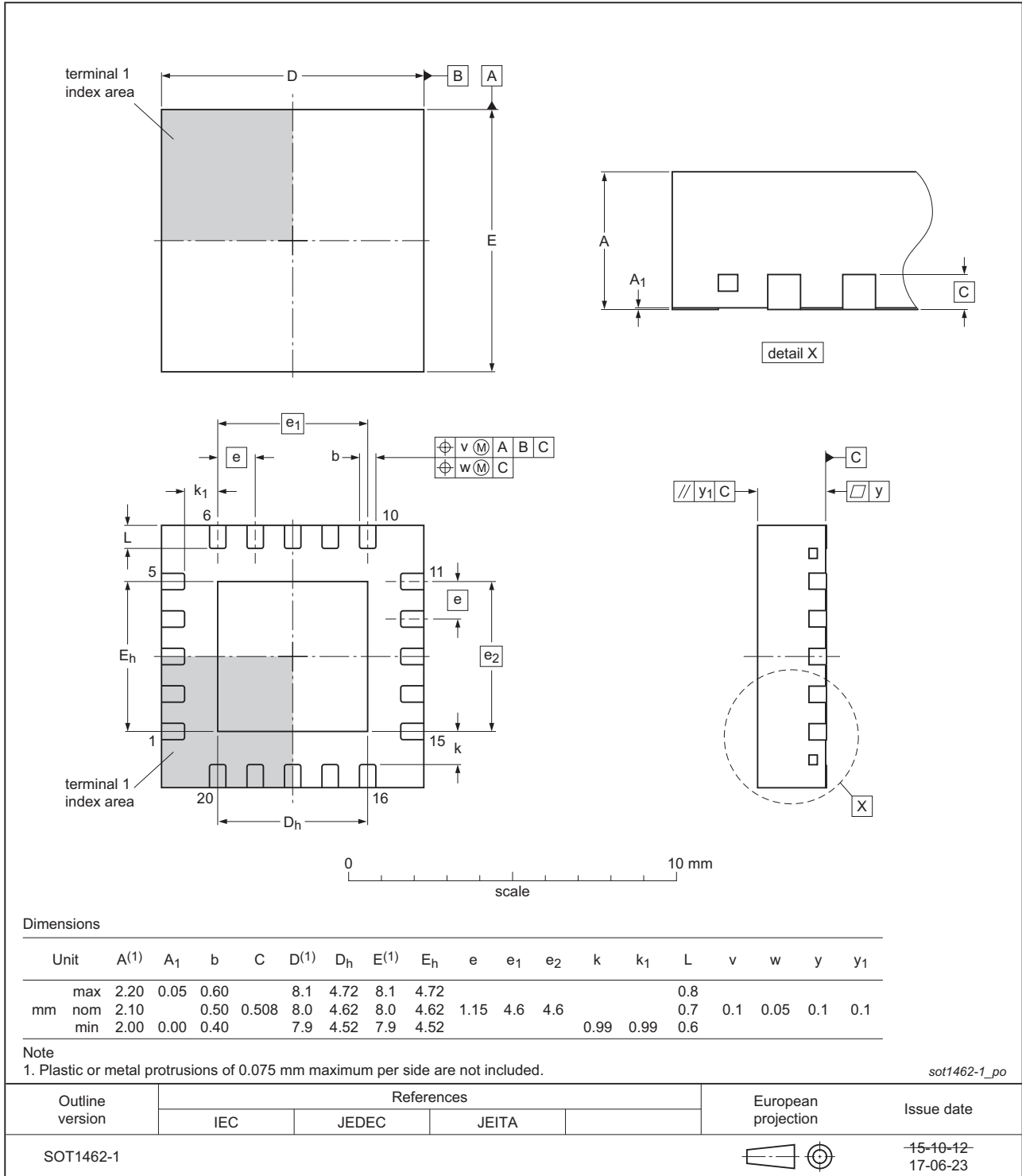


Fig 5. Package outline SOT1462-1 (PQFN20)

10. Handling information

CAUTION



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

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.
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: 5 October 2021
 Document identifier: B10G3438N55D