B10G3336N16DL

LDMOS 3-stage integrated Doherty MMIC

AMPLEON

Rev. 1 — 28 September 2023

Product data sheet

1. Product profile

1.1 General description

The B10G3336N16DL is a 3-stage 16 W fully integrated Doherty MMIC solution using Ampleon's state of the art LDMOS technology. The carrier and peaking device, input splitter, output combiner, and output matching are integrated in a single package. This multiband device is perfectly suited as a general-purpose device in the frequency range from 3300 MHz to 3600 MHz. Available in LGA outline.

Table 1. Performance

Typical RF performance at T_{case} = 25 °C; I_{Dq} = 31 mA (driver and final stages); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.4$ V; measured in an Ampleon application circuit.

Test signal	f	V_{DS}	$P_{L(AV)}$	G_p	η_D	$ACPR_{5M}$
	(MHz)	(V)	(W)	(dB)	(%)	(dBc)
single carrier W-CDMA [1]	3450	26	1.585	34.5	34	–33
			1.995	34.5	36	–33
	3450	28	1.585	35	33	–33
			1.995	35	35	–33

[1] Test signal: 1-carrier W-CDMA; PAR = 9.9 dB.

1.2 Features and benefits

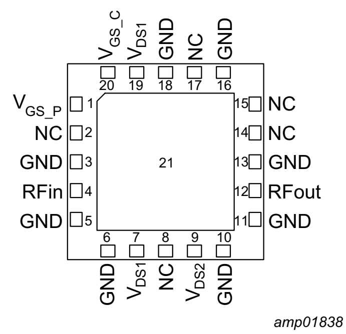
- Integrated input splitter
- Integrated output combiner
- Very high efficiency
- Designed for broadband operation (frequency 3300 MHz to 3600 MHz)
- Designed for ultra VBW
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- High power gain, input and output matched to impedance 50 Ω
- 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, LTE and NR small cell base stations in the 3300 MHz to 3600 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.
RFout is DC grounded.

Fig 1. Pin configuration

2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
V_{GS_P}	1	gate-source voltage of peaking
NC	2	not connected (connection to ground is allowed)
GND	3	ground (connection to ground is required)
RFin	4	RF input
GND	5	ground (connection to ground is required)
GND	6	ground (connection to ground is required)
V_{DS1}	7	drain-source voltage of driver stages
NC	8	not connected (connection to ground is allowed)
V_{DS2}	9	drain-source voltage of final stages
GND	10	ground (connection to ground is required)
GND	11	ground (connection to ground is required)
RFout	12	RF output
GND	13	ground (connection to ground is required)
NC	14	not connected (connection to ground is allowed)
NC	15	not connected (connection to ground is allowed)
GND	16	ground (connection to ground is required)
NC	17	not connected (connection to ground is allowed)
GND	18	ground (connection to ground is required)

Table 2. Pin description *...continued*

Symbol	Pin	Description
V_{DS1}	19	drain-source voltage of driver stages
V_{GS_C}	20	gate-source voltage of carrier
GND	21	RF ground (connection to ground is required)

3. Ordering information

Table 3. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
LGA-7x7-20-2	B10G3336N16DLX	9349 606 42525	TR13; 3000-fold; 16 mm; dry pack	3000
	B10G3336N16DLZ	9349 606 42515	TR13; 1000-fold; 16 mm; dry pack	1000

4. Block diagram

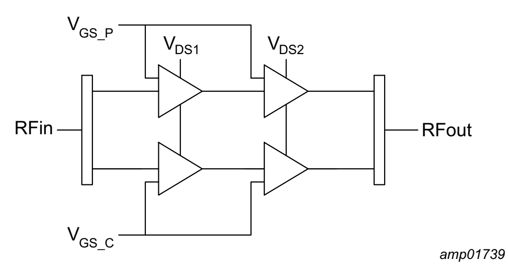


Fig 2. Block diagram

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	+11	V
T_{stg}	storage temperature		–55	+125	°C
T_j	junction temperature	[1]	-	175	°C
T_{case}	case temperature	[1]	-	125	°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
Measured for total device.

Symbol	Parameter	Conditions		Value	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	T_{case} = 90 °C; $P_{L(AV)}$ = 1.585 W	[1]	7.9	K/W
		T_{case} = 90 °C; $P_{L(AV)}$ = 1.995 W	[1]	8.0	K/W

[1] When operated with a 1-carrier W-CDMA with PAR = 9.9 dB.

7. Characteristics

Table 6. DC characteristics
T_{case} = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Carrier						
V_{GSq}	gate-source quiescent voltage	V_{DS} = 28 V; I_D = 30 mA	1.65	2.1	2.75	V
I_{GSS}	gate leakage current	V_{GS} = +9 V/–5 V; V_{DS} = 0 V	-	-	140	nA
Peaking						
I_{GSS}	gate leakage current	V_{GS} = +9 V/–5 V; V_{DS} = 0 V	-	-	140	nA
Final stages						
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 60 V	-	-	1.4	μA
Driver stages						
I_{DSS}	drain leakage current	V_{GS} = 0 V; V_{DS} = 60 V	-	-	1.4	μA

Table 7. RF characteristics
Typical RF performance at T_{case} = 25 °C; V_{DS} = 28 V; I_{Dq} = 30 mA (carrier); $V_{GSq(peaking)}$ = $V_{GSq(carrier)}$ – 0.4 V; P_L = 1.585 W; f = 3.6 GHz. Unless otherwise specified, measured in an Ampleon production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Test signal: CW pulsed						
G_p	power gain		32	35	-	dB
η_D	drain efficiency		27	32	-	%
RL_{in}	input return loss		-	–14	–8	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		41	42.5	-	dBm

8. Application information

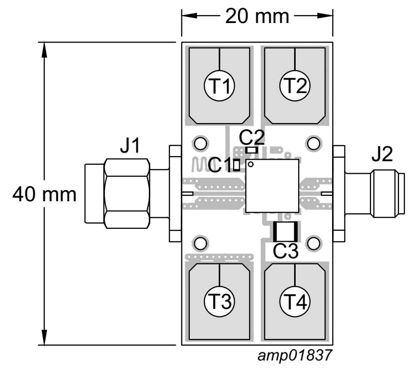
Table 8. Typical performance

I_{Dq} = 31 mA (driver and final stages); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.4$ V; Test signal: 1-carrier W-CDMA; PAR = 9.9 dB; unless otherwise specified, measured in an Ampleon 3300 MHz to 3600 MHz frequency band application circuit.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS} = 26 V							
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 3450 MHz	[1]	-	42.5	-	dBm
η_D	drain efficiency	11 dB OBO ($P_{L(AV)}$ = 32 dBm); f = 3450 MHz		-	34	-	%
		10 dB OBO ($P_{L(AV)}$ = 33 dBm); f = 3450 MHz		-	36	-	%
G_p	power gain	$P_{L(AV)}$ = 32 dBm; f = 3450 MHz		-	34.5	-	dB
		$P_{L(AV)}$ = 33 dBm; f = 3450 MHz		-	34.5	-	dB
G_{flat}	gain flatness	$P_{L(AV)}$ = 32 dBm; f = 3300 MHz to 3600 MHz		-	0.5	-	dB
		$P_{L(AV)}$ = 33 dBm; f = 3300 MHz to 3600 MHz		-	0.5	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5 MHz)	$P_{L(AV)}$ = 32 dBm; f = 3450 MHz		-	–33	-	dBc
		$P_{L(AV)}$ = 33 dBm; f = 3450 MHz		-	–33	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 3450 MHz		-	0.04	-	dB/°C
K	Rollett stability factor	T_{case} = –40 °C; f = 0.6 GHz to 8.1 GHz	[2]	-	>1	-	
V_{DS} = 28 V							
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 3450 MHz	[1]	-	43	-	dBm
η_D	drain efficiency	11 dB OBO ($P_{L(AV)}$ = 32 dBm); f = 3450 MHz		-	33	-	%
		10 dB OBO ($P_{L(AV)}$ = 33 dBm); f = 3450 MHz		-	35	-	%
G_p	power gain	$P_{L(AV)}$ = 32 dBm; f = 3450 MHz		-	35	-	dB
		$P_{L(AV)}$ = 33 dBm; f = 3450 MHz		-	35	-	dB
G_{flat}	gain flatness	$P_{L(AV)}$ = 32 dBm; f = 3300 MHz to 3600 MHz		-	0.5	-	dB
		$P_{L(AV)}$ = 33 dBm; f = 3300 MHz to 3600 MHz		-	0.5	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5 MHz)	$P_{L(AV)}$ = 32 dBm; f = 3450 MHz		-	–33	-	dBc
		$P_{L(AV)}$ = 33 dBm; f = 3450 MHz		-	–33	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 3450 MHz		-	0.04	-	dB/°C
K	Rollett stability factor	T_{case} = –40 °C; f = 0.6 GHz to 8.1 GHz	[2]	-	>1	-	

[1] Pulsed CW power sweep measurement (δ = 10 %, t_p = 100 μs).

[2] S-parameters measured in a demo circuit.



Printed-Circuit Board (PCB): Rogers 4350B; ε_r = 3.66; thickness = 0.254 mm; thickness of copper plating = 35 μm.

Fig 3. Component layout

Table 9. Demo test circuit list of components

See Figure 3 for component layout.

Component	Description	Value	Remarks
C1, C2	multilayer ceramic chip capacitor	1 μF [1]	
C3	multilayer ceramic chip capacitor	10 μF [1]	
J1	coaxial panel connector male		Huber+Suhner: 13_SMA-50-0-2-/111_N
J2	coaxial panel connector female		Huber+Suhner: 23_SMA-50-0-2-/111_N
T1, T2, T3, T4	PCB terminal	6.3 mm x 0.81 mm, 4.1 mm	TE connectivity

[1] Murata or capacitor of same quality.

8.1 Ruggedness in a Doherty operation

8.1.1 Output mismatch ruggedness

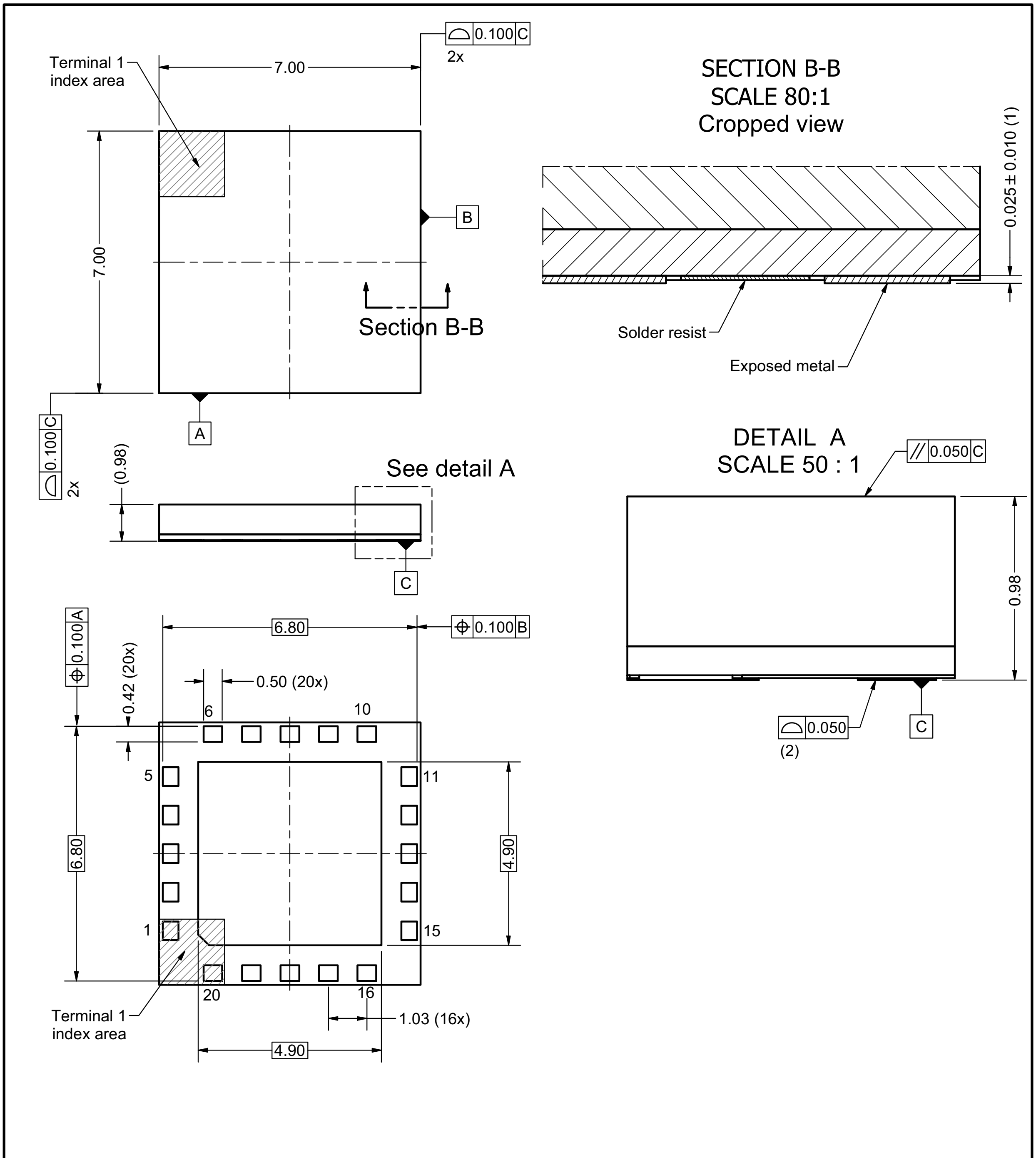
The B10G3336N16DL is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: V_{DS} = 32 V; I_{Dq} = 32 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.4$ V; P_i corresponding to $P_{L(3dB)}$ – 5 dB under Z_S = 50 Ω load; f = 3600 MHz (1-carrier W-CDMA); T_{case} = 25 °C.

8.1.2 Wideband noise ruggedness

The B10G3336N16DL is capable of withstanding an AWGN (Additive White Gaussian Noise) with 11.2 dB PAR, OBW (Occupied BandWidth) of 900 MHz, under the following conditions: V_{DS} = 32 V; I_{Dq} = 32 mA (carrier); $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.4$ V; 3 dB P_i overdrive from P_L = 34 dBm (corresponding to $P_{L(3dB)}$ – 9 dB); f = 3450 MHz; T_{case} = 25 °C.

9. Package outline

LGA-7x7-20-2



Package outline drawing: LGA-7x7-20-2 Publication	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.10 Angle: ± 1°	Revision: 2 Revision date: 30-Dec-19
		Third angle projection	Sheet 1 of 2

Fig 4. Package outline LGA-7x7-20-2 (sheet 1 of 2)

LGA-7x7-20-2

Drawing Notes	
Item	Description
1	Metal thickness of solder pads.
2	Flatness with respect to exposed metal

Package outline drawing: LGA-7x7-20-2	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.10 Angle: ± 1°	Revision: 2 Revision date: 30-Dec-19
		Third angle projection	Sheet 2 of 2

Fig 5. Package outline LGA-7x7-20-2 (sheet 2 of 2)

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 10. ESD sensitivity

ESD model	Class
Charged Device Model (CDM); According to ANSI/ESDA/JEDEC standard JS-002	C1 [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1B [2]

[1] CDM classification C1 is granted to any part that passes after exposure to an ESD pulse of 250 V.

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

11. Abbreviations

Table 11. Abbreviations

Acronym	Description
CW	Continuous Wave
ESD	ElectroStatic Discharge
GSM	Global System for Mobile Communications
LDMOS	Laterally Diffused Metal Oxide Semiconductor
LTE	Long Term Evolution
MMIC	Monolithic Microwave Integrated Circuit
MTF	Median Time to Failure
NR	New Radio
OBO	Output Back Off
PAR	Peak-to-Average Ratio
RoHS	Restriction of Hazardous Substances
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

12. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
B10G3336N16DL v.1	20230928	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”.

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.ampleon.com.

13.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. Ampleon does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local Ampleon sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between Ampleon and its customer, unless Ampleon and customer have explicitly agreed otherwise in writing. An agreement according to which the functions and qualities of Ampleon products exceed those described in the Product data sheet is invalid.

13.3 Disclaimers

Maturity — After the relevant product(s) have passed the Release Gate in Ampleon's release process, Ampleon will confirm the final version in writing.

Limited warranty and liability — Ampleon uses its best efforts to keep the information in this document accurate and reliable. However, Ampleon gives no representations or warranties, expressed or implied, as to the accuracy or completeness of such information and assumes no liability for the consequences of the use of such information. Ampleon is not liable for content provided by an external information source.

In no event and irrespective of the legal basis (contract, tort (including negligence) statutory liability, misrepresentation, indemnity or any other area of law) shall Ampleon be liable for any indirect, incidental, punitive, special or consequential damages (including but without limitation loss of profit or revenue, loss of use or loss of production, loss of data, cost of capital, cost of substitute goods, property damage external to the Ampleon products and any damage, expenditure or loss arising out of such damage, business interruption, costs related to the removal or replacement of any products or rework charges) or any of the foregoing suffered by any third party.

Notwithstanding any damages that customer might incur for any reason whatsoever, Ampleon’s aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the *Terms and conditions of commercial sale* of Ampleon.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or

Right to make changes — Ampleon reserves the right to change information including but without limitation specifications and product descriptions published in this document at any time and without notice. This document supersedes and replaces all information regarding these products supplied prior to the publication hereof.

Suitability for use — Ampleon products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an Ampleon product can reasonably be expected to result in personal injury, death or severe property or environmental damage. Insofar as a customer or another party nevertheless uses Ampleon products unlawfully for such purposes, Ampleon and its suppliers are not liable for any damages.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. Ampleon makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Customers are responsible for the design and operation of their applications and products using Ampleon products, and Ampleon is not liable for any assistance with applications or customer product design. It is customer’s sole responsibility to determine whether the Ampleon product is suitable and fit for the customer’s applications and products planned, as well as for the planned application and use of customer’s third party customer(s). Customers shall provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Ampleon is not liable related to any default, damage, costs or problem which is based on any weakness or default in the customer’s applications or products, or the application or use by customer’s third party customer(s). Customer is responsible for and shall do all necessary testing for the customer’s applications and products using Ampleon products in order to avoid a default of the applications and the products or of the application or use by customer’s third party customer(s). Ampleon is not liable in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not guaranteed. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — Ampleon products are sold subject to the general terms and conditions of commercial sale, as published at http://www.ampleon.com/terms, unless otherwise agreed in a valid written individual agreement. In the event of signing an individual agreement the terms and conditions of the respective agreement shall apply. Ampleon hereby expressly objects to and rejects the validity of customer's terms and conditions regarding the purchase of Ampleon products by customer.

other industrial or intellectual property rights.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Non-automotive qualified products — Unless this data sheet expressly states that this specific Ampleon product is automotive qualified, the product is not suitable for automotive use. It is neither qualified nor tested in accordance with automotive testing or application requirements. Ampleon is not liable for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer breaches this and uses the products for design and use in automotive applications in accordance with automotive specifications and standards, (a) Ampleon gives no warranty, representation or other guarantees of any kind with respect to such automotive applications, use and specifications, and (b) such use is solely and exclusively at customer's own risk, and (c) customer fully indemnifies Ampleon against any and all liability, damages or failed product claims, including against third parties, arising out of customer's design and use of the product for automotive applications.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

13.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

14. Contact information

For more information, please visit: **http://www.ampleon.com**

For sales office addresses, please visit: **http://www.ampleon.com/sales**

15. Contents

Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

For more information, please visit: http://www.ampleon.com
For sales office addresses, please visit: http://www.ampleon.com/sales

Date of release: 28 September 2023
Document identifier: B10G3336N16DL