

# B10G3336N16DL

LDMOS 3-stage integrated Doherty MMIC

Rev. 1 — 28 September 2023

AMPLEON

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

Test signal	f	V <sub>DS</sub>	P <sub>L(AV)</sub>	G <sub>p</sub>	η <sub>D</sub>	ACPR <sub>5M</sub>
	(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

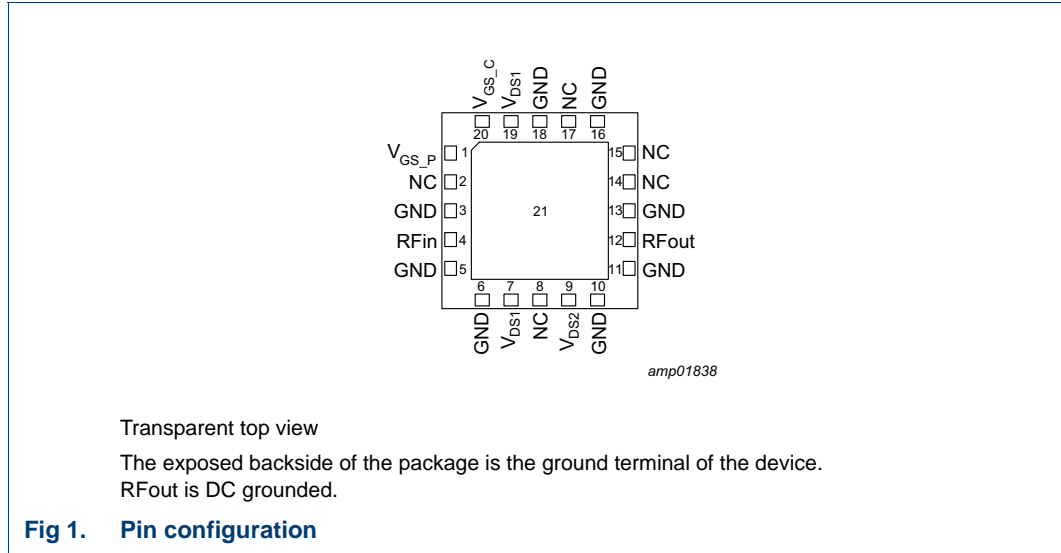
- Integrated input splitter
- Integrated output combiner
- Very high efficiency
- Designed for broadband operation (frequency 3300 MHz to 3600 MHz)
- Designed for ultra VBW
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- High power gain, input 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



### 2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
V <sub>GS_P</sub>	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 <sub>DS1</sub>	7	drain-source voltage of driver stages
NC	8	not connected (connection to ground is allowed)
V <sub>DS2</sub>	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

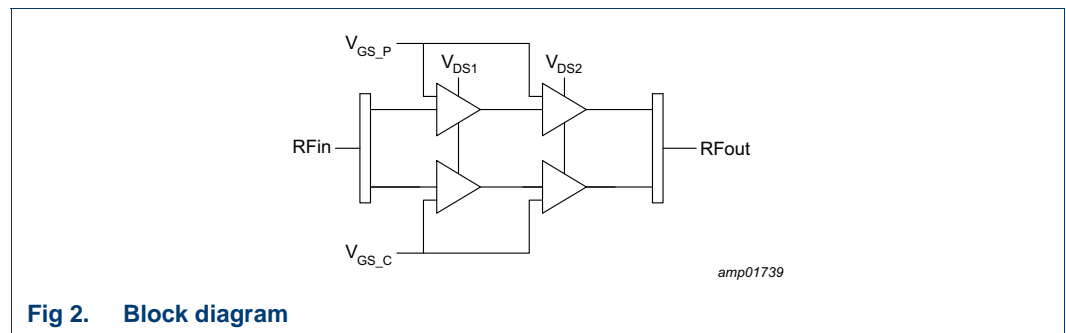
Symbol	Pin	Description
$V_{DS1}$	19	drain-source voltage of driver stages
$V_{GS\_c}$	20	gate-source voltage of carrier
GND	21	RF ground (connection to ground is required)

### 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



### 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 <sub>th(j-c)</sub>	thermal resistance from junction to case	T <sub>case</sub> = 90 °C; P <sub>L(AV)</sub> = 1.585 W [1]	7.9	K/W
		T <sub>case</sub> = 90 °C; P <sub>L(AV)</sub> = 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<sub>case</sub> = 25 °C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Carrier</b>						
V <sub>GSq</sub>	gate-source quiescent voltage	V <sub>DS</sub> = 28 V; I <sub>D</sub> = 30 mA	1.65	2.1	2.75	V
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = +9 V/-5 V; V <sub>DS</sub> = 0 V	-	-	140	nA
<b>Peaking</b>						
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = +9 V/-5 V; V <sub>DS</sub> = 0 V	-	-	140	nA
<b>Final stages</b>						
I <sub>DSS</sub>	drain leakage current	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 60 V	-	-	1.4	μA
<b>Driver stages</b>						
I <sub>DSS</sub>	drain leakage current	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 60 V	-	-	1.4	μA

**Table 7. RF characteristics**  
Typical RF performance at T<sub>case</sub> = 25 °C; V<sub>DS</sub> = 28 V; I<sub>Dq</sub> = 30 mA (carrier);  
V<sub>GSq(peaking)</sub> = V<sub>GSq(carrier)</sub> - 0.4 V; P<sub>L</sub> = 1.585 W; f = 3.6 GHz. Unless otherwise specified,  
measured in an Ampleon production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Test signal: CW pulsed</b>						
G <sub>p</sub>	power gain		32	35	-	dB
η <sub>D</sub>	drain efficiency		27	32	-	%
RL <sub>in</sub>	input return loss		-	-14	-8	dB
P <sub>L(3dB)</sub>	output power at 3 dB gain compression		41	42.5	-	dBm

## 8. Application information

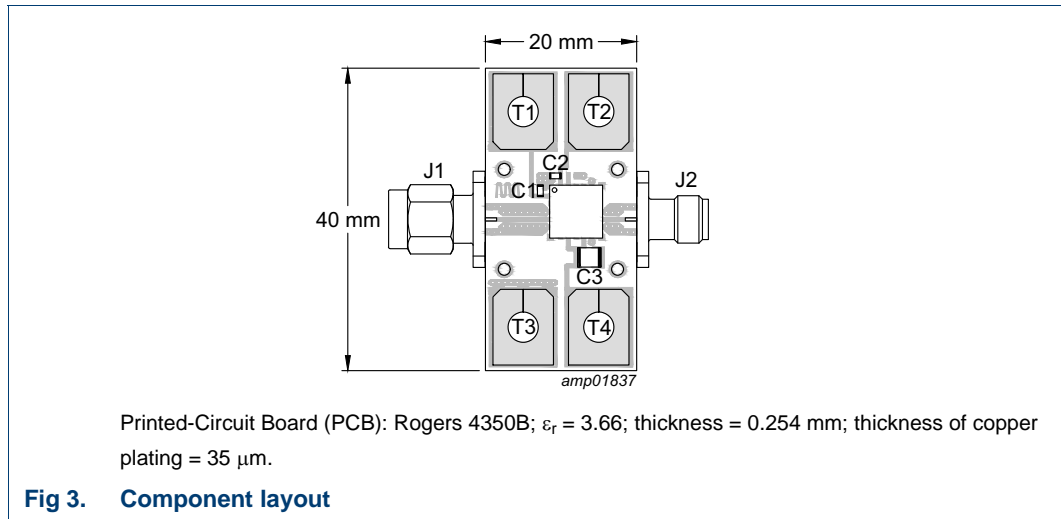
**Table 8. Typical performance**

$I_{Dq} = 31 \text{ mA}$  (driver and final stages);  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.4 \text{ V}$ ; 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
<b><math>V_{DS} = 26 \text{ V}</math></b>						
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 3450 MHz [1]	-	42.5	-	dBm
$\eta_D$	drain efficiency	11 dB OBO ( $P_{L(AV)} = 32 \text{ dBm}$ ); f = 3450 MHz	-	34	-	%
		10 dB OBO ( $P_{L(AV)} = 33 \text{ dBm}$ ); f = 3450 MHz	-	36	-	%
$G_p$	power gain	$P_{L(AV)} = 32 \text{ dBm}$ ; f = 3450 MHz	-	34.5	-	dB
		$P_{L(AV)} = 33 \text{ dBm}$ ; f = 3450 MHz	-	34.5	-	dB
$G_{flat}$	gain flatness	$P_{L(AV)} = 32 \text{ dBm}$ ; f = 3300 MHz to 3600 MHz	-	0.5	-	dB
		$P_{L(AV)} = 33 \text{ dBm}$ ; f = 3300 MHz to 3600 MHz	-	0.5	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5 MHz)	$P_{L(AV)} = 32 \text{ dBm}$ ; f = 3450 MHz	-	-33	-	dBc
		$P_{L(AV)} = 33 \text{ dBm}$ ; f = 3450 MHz	-	-33	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 3450 MHz	-	0.04	-	dB/°C
K	Rollett stability factor	$T_{case} = -40 \text{ °C}$ ; f = 0.6 GHz to 8.1 GHz [2]	-	>1	-	
<b><math>V_{DS} = 28 \text{ V}</math></b>						
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 3450 MHz [1]	-	43	-	dBm
$\eta_D$	drain efficiency	11 dB OBO ( $P_{L(AV)} = 32 \text{ dBm}$ ); f = 3450 MHz	-	33	-	%
		10 dB OBO ( $P_{L(AV)} = 33 \text{ dBm}$ ); f = 3450 MHz	-	35	-	%
$G_p$	power gain	$P_{L(AV)} = 32 \text{ dBm}$ ; f = 3450 MHz	-	35	-	dB
		$P_{L(AV)} = 33 \text{ dBm}$ ; f = 3450 MHz	-	35	-	dB
$G_{flat}$	gain flatness	$P_{L(AV)} = 32 \text{ dBm}$ ; f = 3300 MHz to 3600 MHz	-	0.5	-	dB
		$P_{L(AV)} = 33 \text{ dBm}$ ; f = 3300 MHz to 3600 MHz	-	0.5	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5 MHz)	$P_{L(AV)} = 32 \text{ dBm}$ ; f = 3450 MHz	-	-33	-	dBc
		$P_{L(AV)} = 33 \text{ dBm}$ ; f = 3450 MHz	-	-33	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 3450 MHz	-	0.04	-	dB/°C
K	Rollett stability factor	$T_{case} = -40 \text{ °C}$ ; f = 0.6 GHz to 8.1 GHz [2]	-	>1	-	

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

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



**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 $\mu\text{F}$ <a href="#">[1]</a>	
C3	multilayer ceramic chip capacitor	10 $\mu\text{F}$ <a href="#">[1]</a>	
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  $V_{\text{SWR}} = 10 : 1$  through all phases under the following conditions:  $V_{\text{DS}} = 32 \text{ V}$ ;  $I_{\text{Dq}} = 32 \text{ mA}$  (carrier);  $V_{\text{GSq(peak)}} = V_{\text{GSq(carrier)}} - 0.4 \text{ V}$ ;  $P_i$  corresponding to  $P_{\text{L}(3\text{dB})} - 5 \text{ dB}$  under  $Z_{\text{S}} = 50 \Omega$  load;  $f = 3600 \text{ MHz}$  (1-carrier W-CDMA);  $T_{\text{case}} = 25 \text{ }^\circ\text{C}$ .

### 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:  $V_{\text{DS}} = 32 \text{ V}$ ;  $I_{\text{Dq}} = 32 \text{ mA}$  (carrier);  $V_{\text{GSq(peak)}} = V_{\text{GSq(carrier)}} - 0.4 \text{ V}$ ; 3 dB  $P_i$  overdrive from  $P_{\text{L}} = 34 \text{ dBm}$  (corresponding to  $P_{\text{L}(3\text{dB})} - 9 \text{ dB}$ );  $f = 3450 \text{ MHz}$ ;  $T_{\text{case}} = 25 \text{ }^\circ\text{C}$ .

9. Package outline

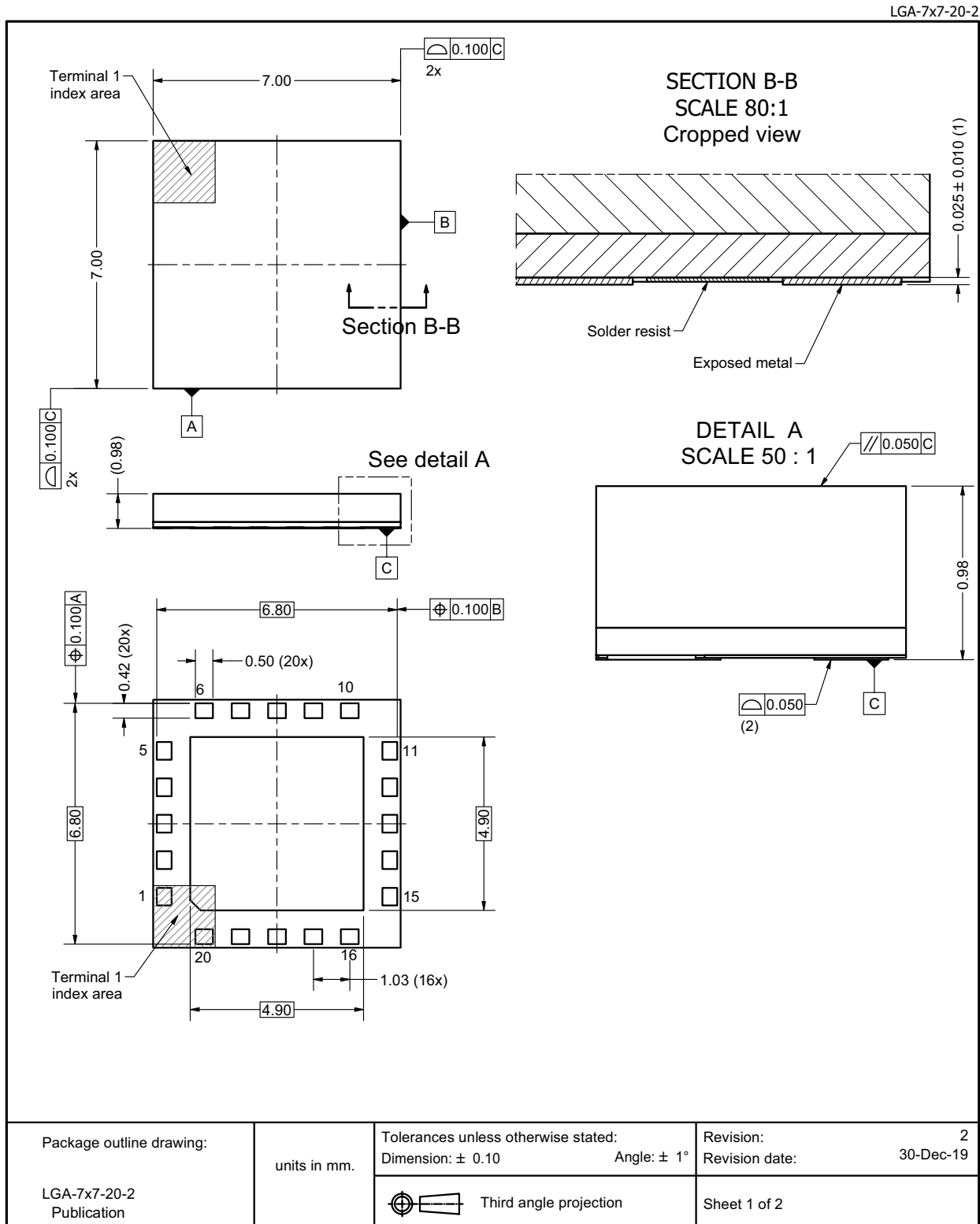


Fig 4. Package outline LGA-7x7-20-2 (sheet 1 of 2)



## 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 <a href="#">[1]</a>
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1B <a href="#">[2]</a>

[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 <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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.

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

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