

# B10G2022N10DL

LDMOS 2-stage integrated Doherty MMIC

Rev. 1 — 20 March 2024

AMPLEON

Product data sheet

## 1. Product profile

### 1.1 General description

The B10G2022N10DL is a 2-stage 10 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 2110 MHz to 2170 MHz. Available in a 7 mm × 7 mm LGA outline.

**Table 1. Performance**

Typical RF performance at  $T_{case} = 25\text{ °C}$ ;  $I_{DQ} = 22\text{ mA}$  (driver and final stages);

$V_{GSq(peaking)} = V_{GSq(carrier)} - 0.45\text{ V}$ ; 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]	2140	26	1.26	31.3	46.6	-29.8
	2140	28	1.26	31.7	45.2	-31.0

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

### 1.2 Features and benefits

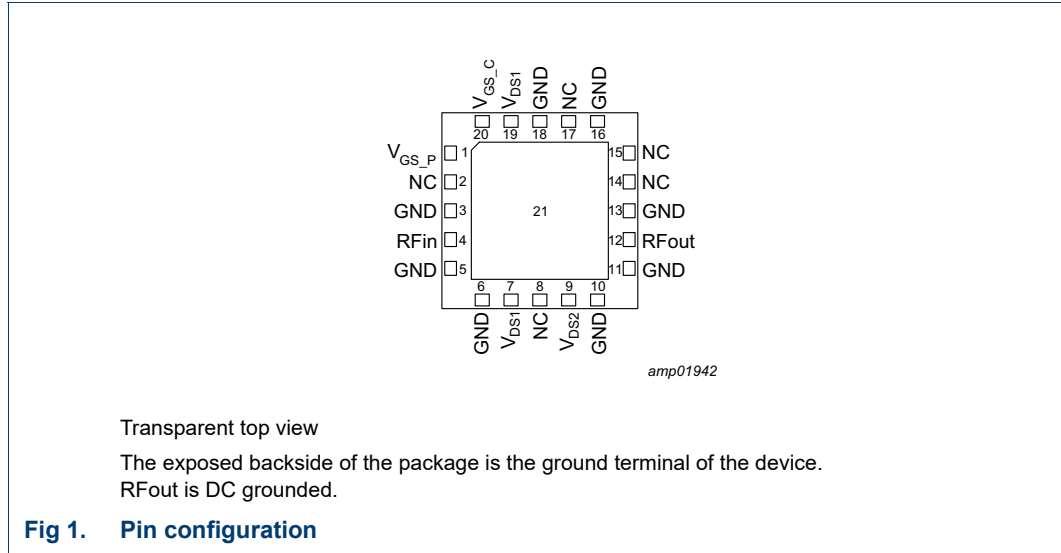
- Integrated input splitter
- Integrated output combiner
- Very high efficiency
- Designed to operate in the frequency range from 2110 MHz to 2170 MHz
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Excellent thermal stability
- High power gain, input and output matched 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 2110 MHz to 2170 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
GND	3	ground
RFin	4	RF input
GND	5	ground
GND	6	ground [1]
V <sub>DS1</sub>	7	drain-source voltage of driver stages
NC	8	not connected
V <sub>DS2</sub>	9	drain-source voltage of final stages
GND	10	ground [2]
GND	11	ground
RFout	12	RF output
GND	13	ground
NC	14	not connected
NC	15	not connected
GND	16	ground [2]
NC	17	not connected
GND	18	ground [1]

Table 2. Pin description ...continued

Symbol	Pin	Description
V <sub>DS1</sub>	19	drain-source voltage of driver stages
V <sub>GS_c</sub>	20	gate-source voltage of carrier
GND	21	RF ground

[1] To be externally connected to ground.

[2] Internally not connected to ground.

### 3. Ordering information

Table 3. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
LGA-7x7-20-2	B10G2022N10DLX	9349 607 17525	TR13; 3000-fold; 16 mm; dry pack	3000
	B10G2022N10DLZ	9349 607 17515	TR13; 1000-fold; 16 mm; dry pack	1000

### 4. Block diagram

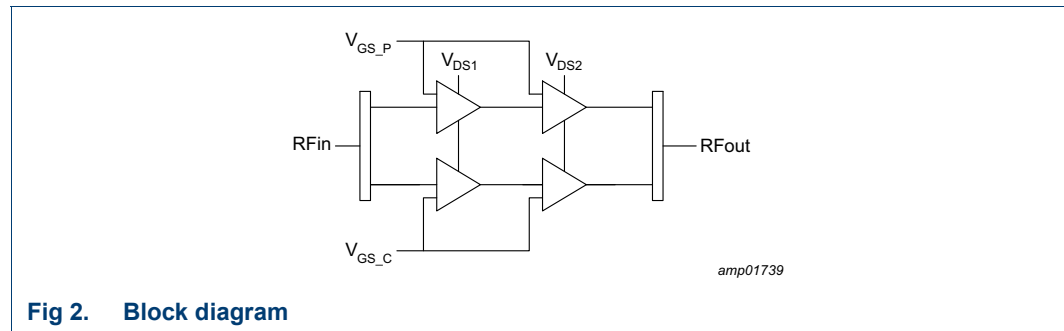


Fig 2. Block diagram

### 5. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>DS</sub>	drain-source voltage		-	65	V
V <sub>GS</sub>	gate-source voltage		-6	+11	V
T <sub>stg</sub>	storage temperature		-55	+125	°C
T <sub>j</sub>	junction temperature		[1]	175	°C
T <sub>case</sub>	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	$T_{case} = 90\text{ °C}; P_{L(AV)} = 1.26\text{ W}$ [1]	10.79	K/W

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

## 7. Characteristics

**Table 6. DC characteristics**

$T_{case} = 25\text{ °C}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Carrier</b>						
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 26\text{ V}; I_D = 22\text{ mA}$	1.6	2.2	2.6	V
$I_{GSS}$	gate leakage current	$V_{GS} = +9\text{ V} / -5\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Peaking</b>						
$I_{GSS}$	gate leakage current	$V_{GS} = +9\text{ V} / -5\text{ V}; V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Final stages</b>						
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 60\text{ V}$	-	-	1.4	$\mu\text{A}$
<b>Driver stages</b>						
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}; V_{DS} = 60\text{ V}$	-	-	1.4	$\mu\text{A}$

**Table 7. RF characteristics**

Typical RF performance at  $T_{case} = 25\text{ °C}$ ;  $V_{DS} = 26\text{ V}$ ;  $I_{Dq} = 22\text{ mA}$  (carrier);

$V_{GSq(peaking)} = V_{GSq(carrier)} - 0.45\text{ V}$ ;  $P_L = 1.26\text{ W}$ ;  $f = 2170\text{ MHz}$ ; unless otherwise specified, measured in an Ampleon production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Test signal: CW pulsed</b>						
$G_p$	power gain		27.5	30.5	-	dB
$\eta_D$	drain efficiency		42.5	48.5	-	%
$RL_{in}$	input return loss		-	-20	-10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		38.6	39.5	-	dBm

## 8. Application information

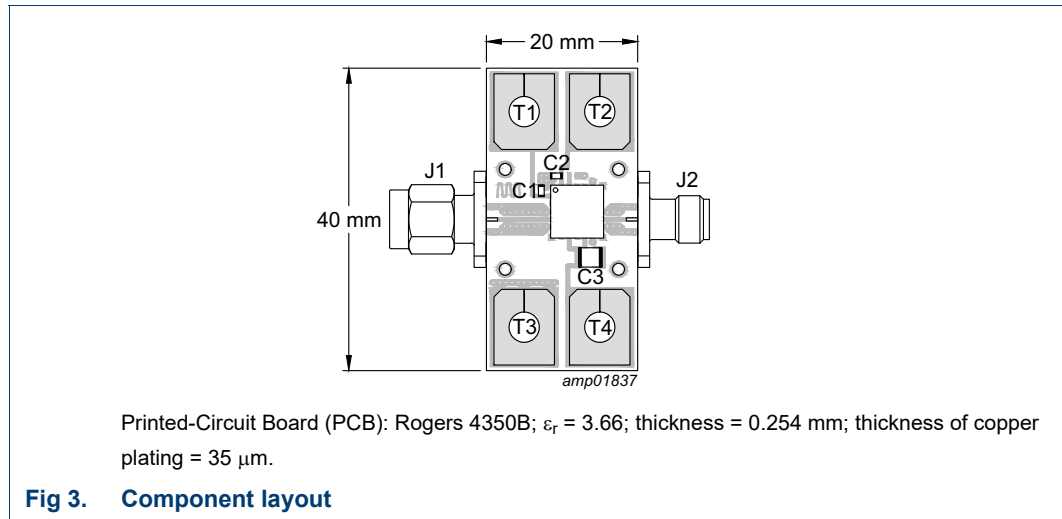
**Table 8. Typical performance**

$T_{case} = 25\text{ °C}$ ;  $I_{DQ} = 22\text{ mA}$  (driver and final stages);  $V_{GSQ(peak)} = V_{GSQ(carrier)} - 0.45\text{ V}$ ; test signal: 1-carrier W-CDMA;  $PAR = 9.9\text{ dB}$ ; unless otherwise specified, measured in an Ampleon 2110 MHz to 2170 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 = 2140 MHz <a href="#">[1]</a>	-	40.0	-	dBm
$\eta_D$	drain efficiency	9 dB OBO ( $P_{L(AV)} = 31\text{ dBm}$ ); f = 2140 MHz	-	46.6	-	%
$G_p$	power gain	$P_{L(AV)} = 31\text{ dBm}$ ; f = 2140 MHz	-	31.3	-	dB
$G_{flat}$	gain flatness	$P_{L(AV)} = 31\text{ dBm}$ ; f = 2110 MHz to 2170 MHz	-	0.09	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5 MHz)	$P_{L(AV)} = 31\text{ dBm}$ ; f = 2140 MHz	-	-29.8	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 2140 MHz <a href="#">[2]</a>	-	0.05	-	dB/°C
K	Rollett stability factor	$T_{case} = -40\text{ °C}$ ; f = 1 GHz to 6.5 GHz <a href="#">[2]</a>	-	>1	-	
<b><math>V_{DS} = 28\text{ V}</math></b>						
$P_{L(3dB)}$	output power at 3 dB gain compression	f = 2140 MHz <a href="#">[1]</a>	-	40.5	-	dBm
$\eta_D$	drain efficiency	9.5 dB OBO ( $P_{L(AV)} = 31\text{ dBm}$ ); f = 2140 MHz	-	44.8	-	%
$G_p$	power gain	$P_{L(AV)} = 31\text{ dBm}$ ; f = 2140 MHz	-	31.7	-	dB
$G_{flat}$	gain flatness	$P_{L(AV)} = 31\text{ dBm}$ ; f = 2110 MHz to 2170 MHz	-	0.06	-	dB
$ACPR_{5M}$	adjacent channel power ratio (5 MHz)	$P_{L(AV)} = 31\text{ dBm}$ ; f = 2140 MHz	-	-31.0	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	f = 2140 MHz <a href="#">[2]</a>	-	0.05	-	dB/°C
K	Rollett stability factor	$T_{case} = -40\text{ °C}$ ; f = 1 GHz to 6.5 GHz <a href="#">[2]</a>	-	>1	-	

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

[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 B10G2022N10DL is capable of withstanding a load mismatch corresponding to  $V_{\text{SWR}} = 10 : 1$  through all phases under the following conditions:  $V_{\text{DS}} = 32 \text{ V}$ ;  $I_{\text{Dq}} = 22 \text{ mA}$  (carrier);  $V_{\text{GSq(peak)}} = V_{\text{GSq(carrier)}} - 0.45 \text{ V}$ ;  $P_i$  corresponding to  $P_{\text{L}(3\text{dB})} - 5 \text{ dB}$  under  $Z_{\text{S}} = 50 \Omega$  load;  $f = 2140 \text{ MHz}$  (1-carrier W-CDMA);  $T_{\text{case}} = 25 \text{ }^\circ\text{C}$ .

### 8.1.2 Wideband noise ruggedness

The B10G2022N10DL is capable of withstanding an AWGN (Additive White Gaussian Noise) with 11.4 dB PAR, OBW (Occupied BandWidth) of 400 MHz, under the following conditions:  $V_{\text{DS}} = 32 \text{ V}$ ;  $I_{\text{Dq}} = 22 \text{ mA}$  (carrier);  $V_{\text{GSq(peak)}} = V_{\text{GSq(carrier)}} - 0.45 \text{ V}$ ; 3 dB  $P_{\text{L}}$  overdrive from  $P_{\text{L}} = 31 \text{ dBm}$  (corresponding to  $P_{\text{L}(3\text{dB})} - 9 \text{ dB}$ );  $f = 2140 \text{ MHz}$ ;  $T_{\text{case}} = 25 \text{ }^\circ\text{C}$ .

9. Package outline

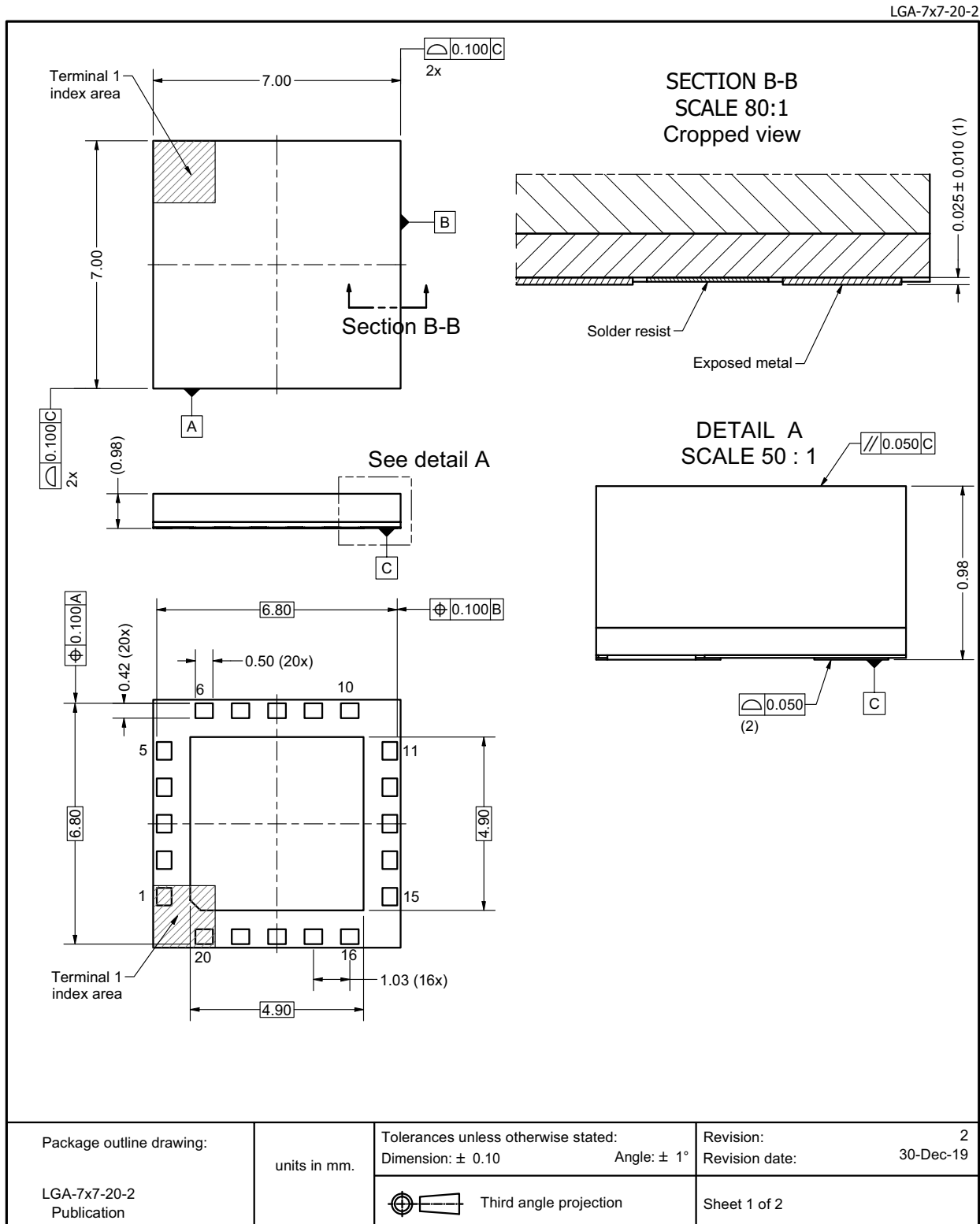


Fig 4. Package outline LGA-7x7-20-2 (sheet 1 of 2)

LGA-7x7-20-2

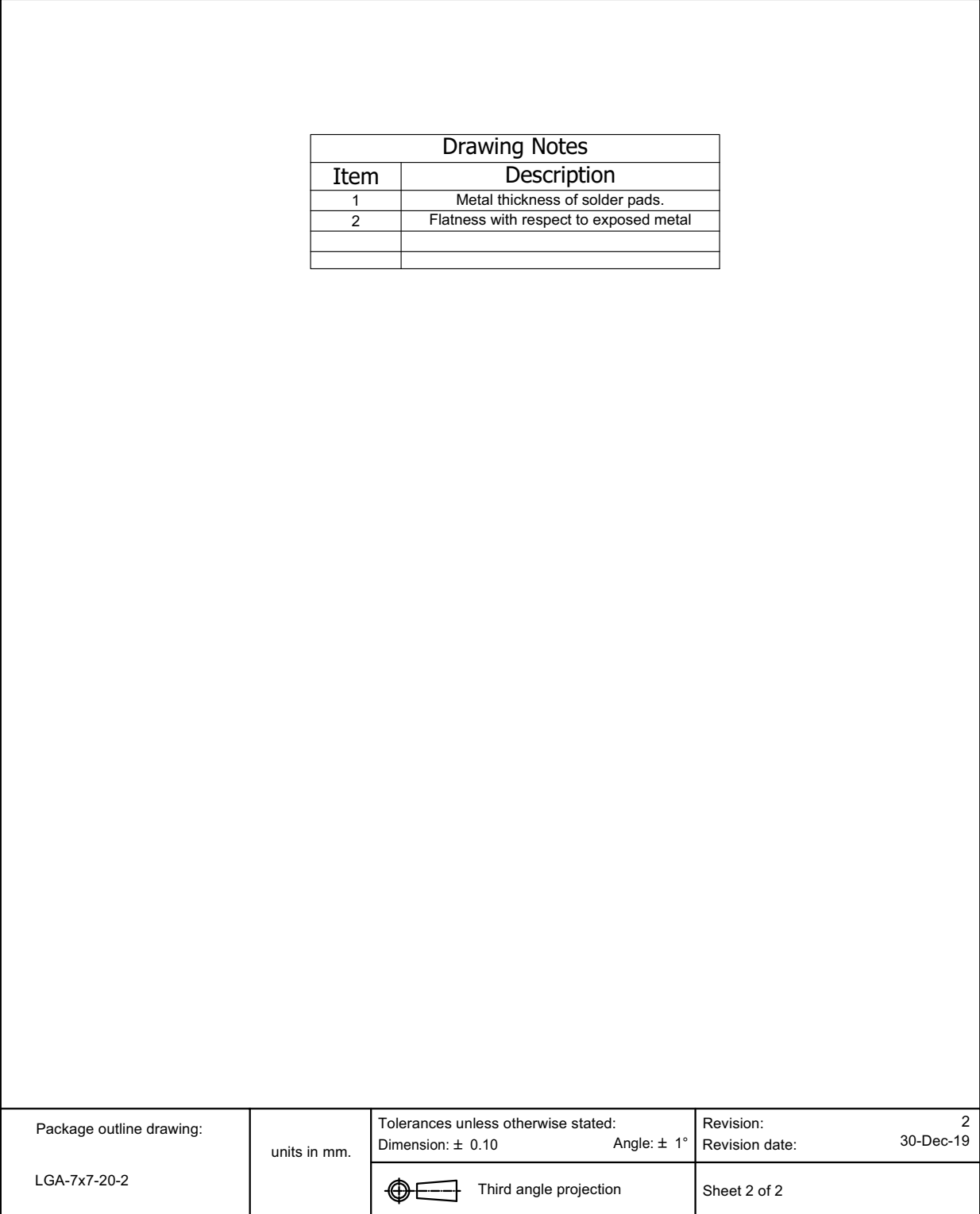



Fig 5. Package outline LGA-7x7-20-2 (sheet 2 of 2)



## 10. 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 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
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
B10G2022N10DL v.1	20240320	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.

[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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