

# B11G3338N81D

LDMOS 3-stage integrated Doherty MMIC

Rev. 1 — 14 November 2022

AMPLEON

Product data sheet

## 1. Product profile

### 1.1 General description

The B11G3338N81D is a dual section 3-stage fully integrated Doherty MMIC solution using Ampleon's state of the art LDMOS technology. The carrier and peaking device, input splitter, output combiner and pre-match are integrated in each section. This multiband device is perfectly suited as general purpose driver in the frequency range 3300 MHz to 3800 MHz. Available in PQFN outline.

**Table 1. Application performance**

Typical RF performance at  $T_{case} = 25\text{ °C}$ ;  $I_{Dq} = 220\text{ mA}$  (carrier and peaking);

$V_{GSq(peaking)} = V_{GSq(carrier)} - 0.65\text{ V}$ . Test signal: 1-carrier LTE 20 MHz; PAR = 7.6 dB measured in an Ampleon  $f = 3600\text{ MHz}$  combined integrated Doherty application circuit.

Test signal	f	V <sub>DS</sub>	P <sub>L(AV)</sub>	G <sub>p</sub>	η <sub>D</sub>
	(MHz)	(V)	(W)	(dB)	(%)
1-carrier LTE 20 MHz PAR = 7.6 dB	3600	28	5	33	21.5

### 1.2 Features and benefits

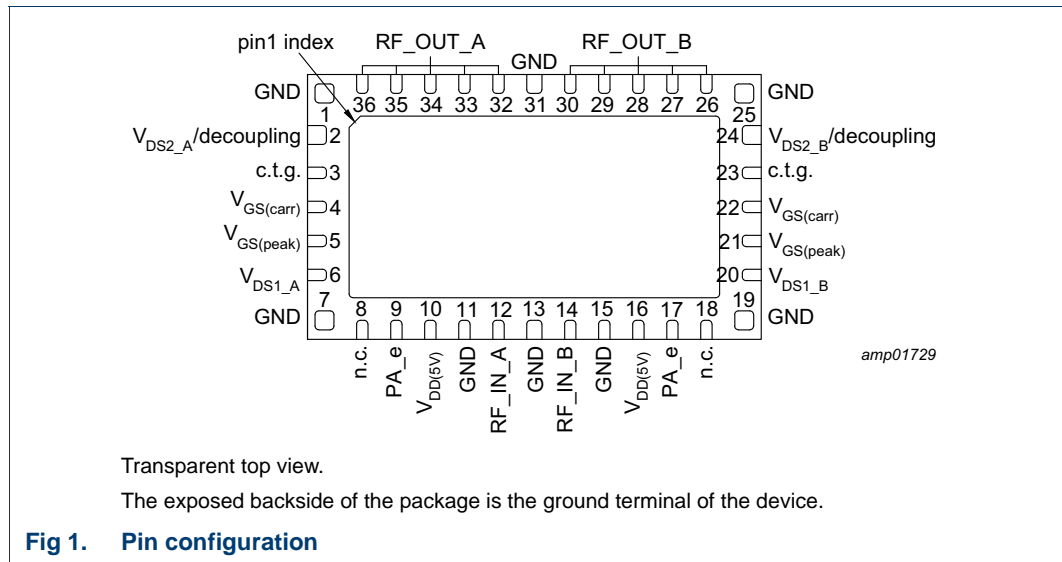
- Integrated input splitter
- Integrated output combiner
- 25 Ω output impedance thanks to integrated pre-match
- Designed for large RF and instantaneous bandwidth operation
- High linearity
- Independent control of carrier and peaking bias
- Integrated ESD protection
- Integrated bias gate switch
- Source impedance 50 Ω; high power gain
- For RoHS compliance see the product details on the Ampleon website

### 1.3 Applications

- Macrocell base station driver
- Microcell base station
- 5G mMIMO
- W-CDMA/LTE
- Active antenna
- General purpose applications

## 2. Pinning information

### 2.1 Pinning



### 2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
GND	1	ground
$V_{DS2\_A}/decoupling$	2	drain-source voltage of final stages of section A
c.t.g.	3	connect to ground
$V_{GS(carr)}$	4	gate-source voltage of carrier <a href="#">[1]</a>
$V_{GS(peak)}$	5	gate-source voltage of peaking <a href="#">[2]</a>
$V_{DS1\_A}$	6	drain-source voltage of driver stages of section A
GND	7	ground
n.c.	8	not connected
PA_e	9	PA enable trigger signal, 0 V to 5 V, $I_{Dq}$ -bias ON/OFF corresponds to logic HIGH/LOW <a href="#">[3]</a>
$V_{DD(5V)}$	10	supply voltage (5 V) <a href="#">[4]</a>
GND	11	ground
RF_IN_A	12	RF input of section A
GND	13	ground
RF_IN_B	14	RF input of section B
GND	15	ground
$V_{DD(5V)}$	16	supply voltage (5 V) <a href="#">[4]</a>
PA_e	17	PA enable trigger signal, 0 V to 5 V, $I_{Dq}$ -bias ON/OFF corresponds to logic HIGH/LOW <a href="#">[3]</a>
n.c.	18	not connected
GND	19	ground

Table 2. Pin description ...continued

Symbol	Pin	Description
$V_{DS1\_B}$	20	drain-source voltage of driver stages of section B
$V_{GS(peak)}$	21	gate-source voltage of peaking [2]
$V_{GS(carr)}$	22	gate-source voltage of carrier [1]
c.t.g.	23	connect to ground
$V_{DS2\_B}/decoupling$	24	drain-source voltage of final stages of section B
GND	25	ground
RF_OUT_B	26, 27, 28, 29, 30	RF output of section B
GND	31	ground
RF_OUT_A	32, 33, 34, 35, 36	RF output of section A

- [1] Pins connected together.
- [2] Pins connected together.
- [3] Pins connected together.
- [4] Pins connected together.

### 3. Ordering information

Table 3. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
PQFN-12x7-36-1	B11G3338N81DX	9349 606 38525	TR13; 1500-fold; 24 mm; dry pack	1500
PQFN-12x7-36-1	B11G3338N81DYZ	9349 606 38535	TR7; 300-fold; 24 mm; dry pack	300

### 4. Block diagram

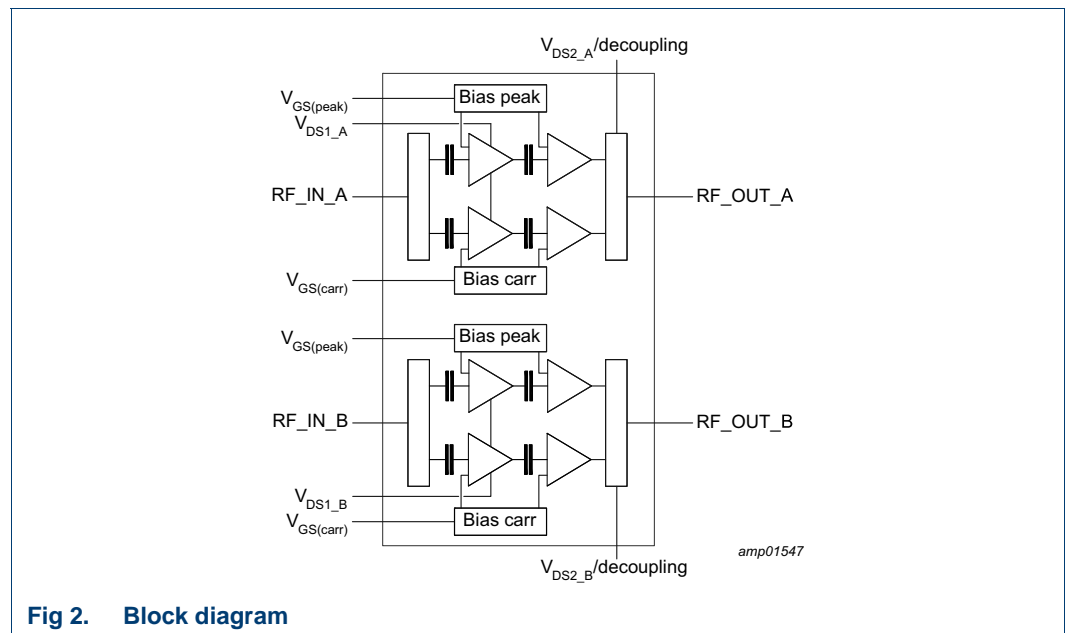


Fig 2. Block diagram

## 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		-0.5	+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**

Measured for total device.

Symbol	Parameter	Conditions	Value	Unit	
$R_{th(j-c)}$	thermal resistance from junction to case	$T_{case} = 90\text{ °C}$			
		$P_L = 5\text{ W}$	[1]	1.7	K/W
		$P_L = 10\text{ W}$	[1]	1.4	K/W

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

## 7. Characteristics

**Table 6. DC characteristics**

$T_{case} = 25\text{ °C}$ ;  $V_{DD(5V)} = 5\text{ V}$ ;  $V_{on(PA_e)} = 5\text{ V}$ .

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Carrier</b>						
$V_{GSq}$	gate-source quiescent voltage	$V_{DS} = 28\text{ V}$ ; $I_D = 210\text{ mA}$	1.6	2.1	2.7	V
$I_{GSS}$	gate leakage current	$V_{GS} = 2\text{ V}$ ; $V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Peaking</b>						
$I_{GSS}$	gate leakage current	$V_{GS} = 2\text{ V}$ ; $V_{DS} = 0\text{ V}$	-	-	140	nA
<b>Final stages</b>						
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 28\text{ V}$	-	-	1.4	μA
<b>Driver stages</b>						
$I_{DSS}$	drain leakage current	$V_{GS} = 0\text{ V}$ ; $V_{DS} = 28\text{ V}$	-	-	1.4	μA

**Table 7. RF characteristics**

Typical RF performance at  $T_{case} = 25\text{ °C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 210\text{ mA}$  (carrier);  $f = 3550\text{ MHz}$ ;  $V_{DD(5V)} = 4.8\text{ V}$ ;  $V_{on(PA_e)} = 5\text{ V}$ ;  $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.65\text{ V}$ ;  $P_{L(AV)} = 5\text{ W}$ ; unless otherwise specified, measured in an Ampleon combined production circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Test signal: pulsed CW [1]</b>						
$G_p$	power gain	$P_L = 5\text{ W}$ (37 dBm)	31	34	38	dB
$\eta_D$	drain efficiency	$P_L = 5\text{ W}$ (37 dBm)	18	25	-	%
		$P_L = P_{L(3dB)}$	30	40	-	%
$RL_{in}$	input return loss		-	-15	-10	dB
$P_{L(3dB)}$	output power at 3 dB gain compression		48	49	-	dBm

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

## 8. Application information

### 8.1 Typical performance

**Table 8. Typical performance**

$T_{case} = 25\text{ °C}$ ;  $V_{DS} = 28\text{ V}$ ;  $I_{Dq} = 220\text{ mA}$  (carrier and peaking);  $V_{GSq(peaking)} = V_{GSq(carrier)} - 0.65\text{ V}$ ;  $V_{DD(5V)} = 5\text{ V}$ ;  $V_{on(PA_e)} = 5\text{ V}$ . Test signal: 1-carrier W-CDMA; PAR = 9.9 dB; unless otherwise specified, measured in an Ampleon 3300 MHz to 3800 MHz frequency band combined application circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{L(1dB)}$	output power at 1 dB gain compression	$f = 3600\text{ MHz}$ [1]	-	48.7	-	dBm
$\varphi_{s21}/\varphi_{s21(norm)}$	normalized phase response	at 1 dB compression point; $f = 3600\text{ MHz}$ [2]	-	-16	-	°
$\eta_D$	drain efficiency	12.2 dB OBO ( $P_{L(AV)} = 37\text{ dBm}$ ); $f = 3600\text{ MHz}$	-	22	-	%
$G_p$	power gain	$P_{L(AV)} = 37\text{ dBm}$ ; $f = 3600\text{ MHz}$	-	33	-	dB
$B_{video}$	video bandwidth	$P_{L(AV)} = 37\text{ dBm}$ set to obtain IMD3 = -45 dBc; $f = 3600\text{ MHz}$	-	350	-	MHz
$G_{flat}$	gain flatness	$P_{L(AV)} = 37\text{ dBm}$ ; $f = 3300\text{ MHz}$ to 3800 MHz	-	0.6	-	dB
ACPR <sub>5M</sub>	adjacent channel power ratio (5 MHz)	$P_{L(AV)} = 37\text{ dBm}$ ; $f = 3600\text{ MHz}$	-	-39	-	dBc
$\Delta G/\Delta T$	gain variation with temperature	$f = 3600\text{ MHz}$	-	0.068	-	dB/°C
K	Rollett stability factor	$T_{case} = -40\text{ °C}$ to $+125\text{ °C}$ ; $f = 0.1\text{ GHz}$ to $8\text{ GHz}$ [3]	-	>1	-	
<b>Bias gate switch</b>						
$t_r$	rise time	$Z_S = 500\text{ }\Omega$ (max); $T_{case} = -40\text{ °C}$ to $+120\text{ °C}$ ; $V_{on(PA_e)} \geq 4.8\text{ V}$ [4]	-	200	-	ns
$t_f$	fall time	$T_{case} = -40\text{ °C}$ to $+120\text{ °C}$ ; $V_{off(PA_e)} \leq 1\text{ V}$ [5]	-	80	-	ns

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

[2] 25 ms CW power sweep measurement.

[3] With input VSWR better than 30 : 1 and output VSWR better than 80 : 1.

[4] RF output rise time 10 % to 90 % RF power.

[5] RF output fall time 90 % to 10 % RF power.

8.2 PCB layout and electrical schematic

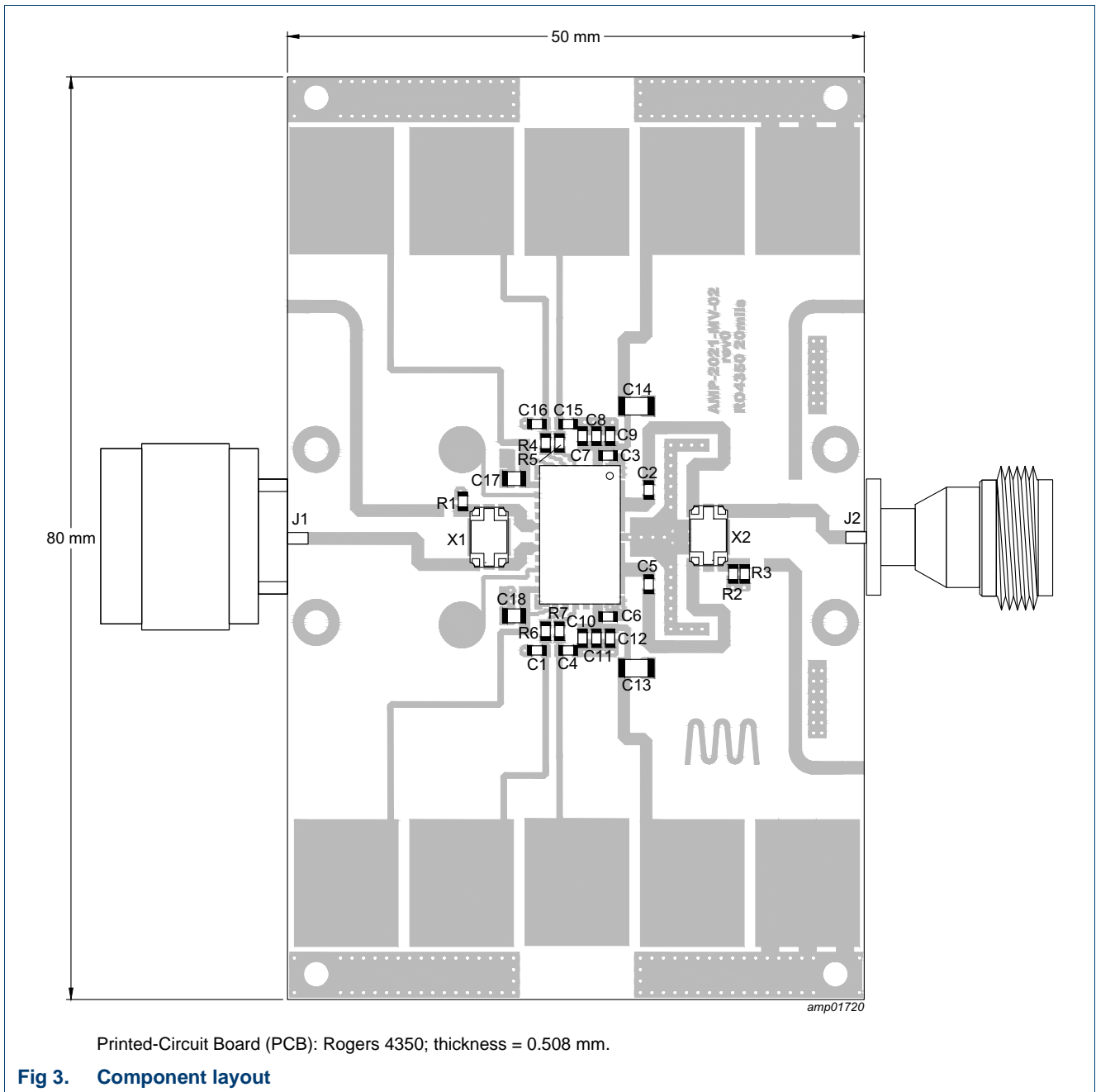


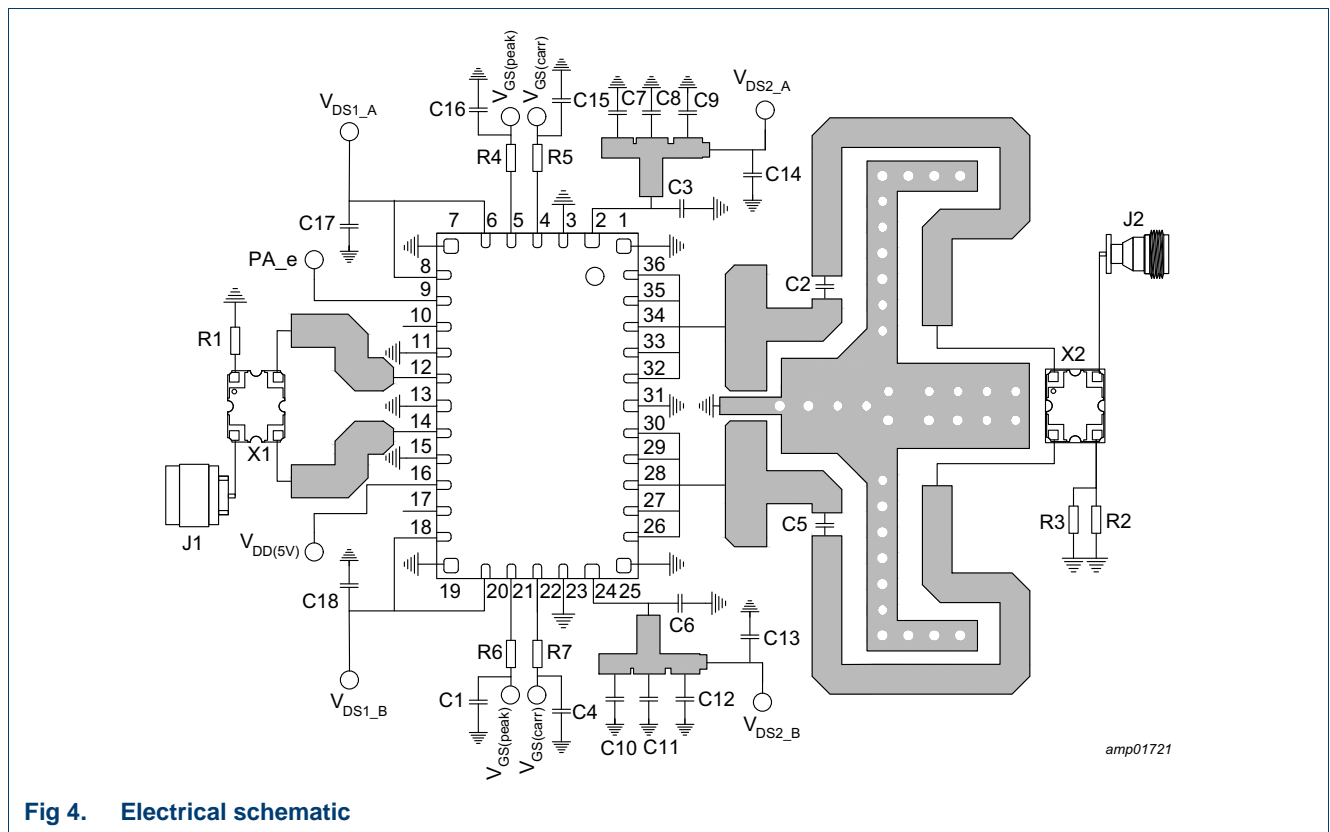
Table 9. Demo test circuit list of components

See Figure 3 for component layout.

Component	Description	Value	Remarks
C1, C4, C15, C16	multilayer ceramic chip capacitor	1 $\mu$ F, 50 V	Murata: C1608X5R1H105K080AB
C2, C5	multilayer ceramic chip capacitor	1.6 pF, $\pm$ 0.1 %	Murata: GQM1875C2E1R6BB12
C3, C6	multilayer ceramic chip capacitor	4.3 pF, $\pm$ 0.1 %	Murata: GQM1875C2E4R3BB12

**Table 9. Demo test circuit list of components ...continued**  
See [Figure 3](#) for component layout.

Component	Description	Value	Remarks
C7, C8, C9, C10, C11, C12	multilayer ceramic chip capacitor	100 nF, 50 V	Murata: 06035C104KAT2A
C13, C14, C17, C18	multilayer ceramic chip capacitor	10 $\mu$ F, 50 V	Murata: GRM21BR6YA106KE43
R1	resistor	49.9 $\Omega$ , $\pm 1\%$ , 100 mW	Multicomp Pro: MCWF06R49R9BTL
R2, R3	resistor	100 $\Omega$ , $\pm 1\%$ , 200 mW	Multicomp Pro: MP001293
R4, R5, R6, R7	resistor	1 k $\Omega$ , $\pm 1\%$ , 100 mW	Multicomp Pro: MCSR06X1001FTL
X1, X2	hybrid coupler	3.3 GHz – 3.8 GHz, 25 W	Anaren: X3C35F1-03S
J1	N Coaxial panel connector male		Radiall: R161.438.200
J2	N Coaxial panel connector female		Huber & Suhner: 23_N-50-0-16/133_NE



**Fig 4. Electrical schematic**

### 8.3 Recommendations

- RC circuit at gate bias must be implemented to insure improved linearity and stability of the circuit. The implementation has to be symmetrical between both amplifier sections Pin 5/21 and Pin 4/22.
- In TDD mode controlled by an external bias switch, the outputs of the switches must be connected on both amplifier sections. As shown in Fig.4, gate bias supply must be connected before RC circuit of Pin 5/21 and Pin 4/22 respectively by default.

## 8.4 Ruggedness in a Doherty operation

### 8.4.1 Output mismatch ruggedness

The B11G3338N81D is capable of withstanding a load mismatch corresponding to  $V_{SWR} = 10 : 1$  through all phases under the following conditions:  $V_{DS} = 32 \text{ V}$ ;  $I_{Dq} = 105 \text{ mA}$  (carrier);  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.65 \text{ V}$ ;  $V_{DD(5V)} = 5 \text{ V}$ ;  $V_{on(PA_e)} = 5 \text{ V}$ ;  $P_i$  corresponding to  $P_{L(3dB)} - 9 \text{ dB}$  under  $Z_S = 50 \Omega$  load;  $f = 3800 \text{ MHz}$  (1-carrier W-CDMA);  $T_{case} = 25 \text{ }^\circ\text{C}$ ; per section.

### 8.4.2 Wideband noise ruggedness

The B11G3338N81D 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:  $V_{DS} = 32 \text{ V}$ ;  $I_{Dq} = 105 \text{ mA}$  (carrier);  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.65 \text{ V}$ ;  $V_{DD(5V)} = 5 \text{ V}$ ;  $V_{on(PA_e)} = 5 \text{ V}$ ; 3 dB  $P_i$  overdrive from  $P_{L(AV)} = 34 \text{ dBm}$  (corresponding to  $P_{L(3dB)} - 12 \text{ dB}$ );  $f = 3550 \text{ MHz}$  as central frequency;  $T_{case} = 25 \text{ }^\circ\text{C}$ ; per section.

## 8.5 Impedance information

**Table 10. Typical impedance for optimum Doherty operation**

Measured load-pull data per section; test signal: pulsed CW;  $T_{case} = 25 \text{ }^\circ\text{C}$ ;  $V_{DS} = 28 \text{ V}$ ;  $I_{Dq} = 105 \text{ mA}$  (carrier);  $V_{DD(5V)} = 5 \text{ V}$ ;  $V_{on(PA_e)} = 5 \text{ V}$ ;  $V_{GSq(peak)} = V_{GSq(carrier)} - 0.65 \text{ V}$ ;  $t_p = 100 \mu\text{s}$ ;  $\delta = 10 \%$ .

f (MHz)	tuned for optimum Doherty operation				
	$Z_L$ [1] ( $\Omega$ )	$P_{L(1dB)}$ (dBm)	$G_{p(max)}$ (dB)	$\eta_{add}$ [2] (%)	$\eta_{add}$ [3] (%)
3300	21.5 – j19.3	46.34	34.9	44.1	22.1
3400	21.4 – j17.2	46.30	35.3	44.3	22.7
3500	22.3 – j16.4	46.50	35.7	45.2	22.9
3600	23.9 – j13.4	46.30	35.7	44.3	23.7
3700	24.0 – j13.4	46.30	35.3	44.6	23.3
3800	22.7 – j11.4	46.20	35.0	44.1	23.4

[1] Reference package plane.

[2] At  $P_{L(1dB)}$ .

[3] At 34 dBm.



9. Package outline

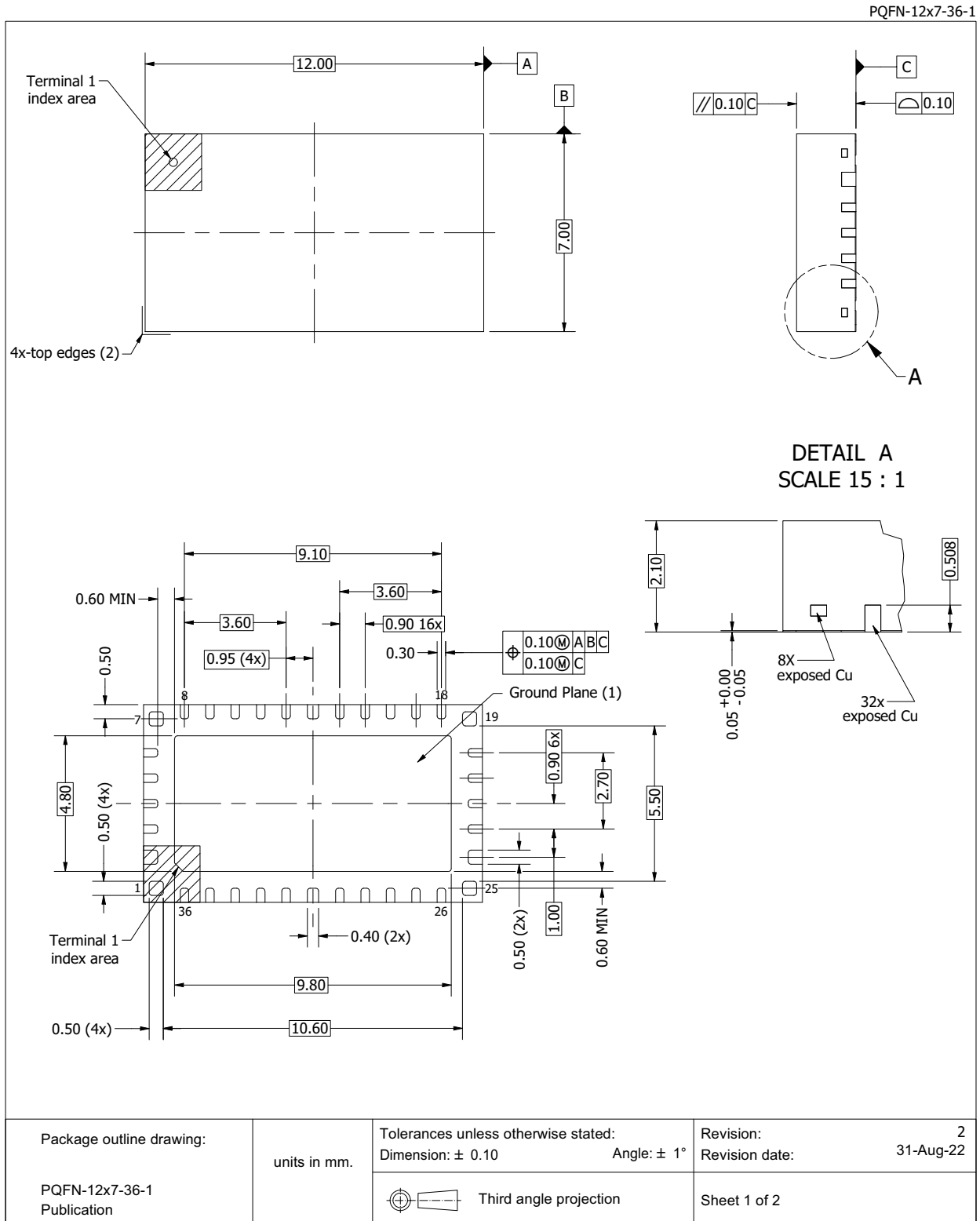


Fig 5. Package outline PQFN-12x7-36-1 (sheet 1 of 2)

PQFN-12x7-36-1

Drawing Notes	
Items	Description
(1)	Terminals (bottom View), Ground-plane (bottom View) are plated with matte Sn.
(2)	Plastic protrusions of 0.075 mm. max. per side are not included.


Package outline drawing:	units in mm.	Tolerances unless otherwise stated: Dimension: $\pm 0.10$ Angle: $\pm 1^\circ$	Revision: 2 Revision date: 31-Aug-22
PQFN-12x7-36-1 Publication		 Third angle projection	Sheet 2 of 2

Fig 6. Package outline PQFN-12x7-36-1 (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 11. 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	1C <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 1C is granted to any part that passes after exposure to an ESD pulse of 1000 V.

## 11. Abbreviations

**Table 12. Abbreviations**

Acronym	Description
5G	Fifth Generation
CW	Continuous Wave
ESD	ElectroStatic Discharge
LDMOS	Laterally Diffused Metal Oxide Semiconductor
LTE	Long Term Evolution
mMIMO	massive Multiple Input Multiple Output
MMIC	Monolithic Microwave Integrated Circuit
MTF	Median Time to Failure
OBO	Output Back Off
PA	Power Amplifier
PAR	Peak-to-Average power Ratio
RC	resistor-capacitor
RoHS	Restriction of Hazardous Substances
TDD	Time Division Duplex
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
B11G3338N81D v.1	20221114	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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For sales office addresses, please visit: <http://www.ampleon.com/sales>

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Date of release: 14 November 2022  
 Document identifier: B11G3338N81D