C4H2327N110A

Power GaN transistor

Rev. 1 — 23 December 2021

AMPLEON

Product data sheet

1. Product profile

1.1 General description

100 W GaN packaged Doherty power transistor for base station applications at frequencies from 2300 MHz to 2700 MHz.

Table 1. Typical performance

Typical RF performance at T_{case} = 25 °C in a Doherty application demo circuit, unless otherwise specified.

Test signal	I_{Dq} (mA)	V_{DS} (V)	$V_{GS(amp)peak}$ (V)	$P_{L(AV)}$ (dBm)	G_p (dB)	η_D (%)	ACPR (dBc)	$P_{L(5dB)}$ (dBm)
f = 2300 MHz to 2400 MHz								
1-carrier W-CDMA [1]	40	50	–7.0	41.5	14.9	57.1	–24.8	-
pulsed CW [2]	40	50	–7.0	-	-	-	-	50.5
f = 2496 MHz to 2690 MHz								
1-carrier W-CDMA [1]	50	50	–5.1	41.5	15.0	57.0	–27.1	-
pulsed CW [2]	50	50	–5.1	-	-	-	-	50.5

[1] Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 10.5 dB at 0.01 % probability on CCDF.

[2] Test signal: pulsed CW; t_p = 30 μs; δ = 35 %.

1.2 Features and benefits

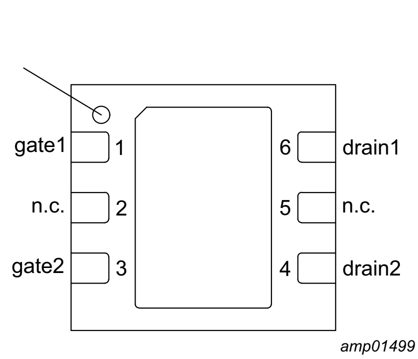
- Excellent digital pre-distortion capability
- High efficiency
- Designed for broadband operation
- Lower output capacitance for improved performance in Doherty applications
- Internally matched for ease of use
- For RoHS compliance see the product details on the Ampleon website

1.3 Applications

- RF power amplifier for base stations and multi carrier applications in the 2300 MHz to 2700 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.

Fig 1. Pin configuration

2.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
gate1	1	gate 1
n.c.	2	not connected
gate2	3	gate 2
drain2	4	drain 2
n.c.	5	not connected
drain1	6	drain 1

3. Ordering information

Table 3. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
DFN-7x6.5-6-1	C4H2327N110AZ	9349 604 22515	TR7; 1000-fold; 16 mm; dry pack	1000
	C4H2327N110AX	9349 604 22525	TR13; 3000-fold; 16 mm; dry pack	3000

4. Limiting values

Table 4. Limiting values
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DD}	supply voltage	operating	-	52	V
V_{DS}	drain-source voltage	V_{GS} = –8 V	-	150	V
$V_{GS(amp)main}$	main amplifier gate-source voltage		–15	+2	V
$V_{GS(amp)peak}$	peak amplifier gate-source voltage		–15	+2	V
$I_{GF(amp)main}$	main amplifier forward gate current		-	4.8	mA
$I_{GF(amp)peak}$	peak amplifier forward gate current		-	7.2	mA
T_{stg}	storage temperature		–65	+150	°C
T_{ch}	active die channel temperature	[1]	-	275	°C
T_{case}	case temperature	operating [1]	–40	+140	°C

[1] Continuous use at maximum temperature will affect the reliability, for details refer to the online MTF calculator.

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(s-c)(IR)}$ [1]	thermal resistance from active die surface to case by Infrared measurement	T_{case} = 90 °C; $P_{dis(main)}$ = 9 W; $P_{dis(peak)}$ = 2.5 W	4.00	K/W
$R_{th(ch-c)(FEA)}$ [2]	thermal resistance from active die channel to case by Finite Element Analysis	T_{case} = 90 °C; $P_{dis(main)}$ = 9 W; $P_{dis(peak)}$ = 2.5 W	6.20	K/W

[1] Infrared (IR) thermal values are for reference only and cannot be used to determine performance or reliability.

[2] Finite Element Analysis (FEA) thermal values have been used for the online MTF calculator.

6. Characteristics

Table 6. DC characteristics
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Main device						
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 10 V; I_D = 4.8 mA	–3.27	–2.87	–2.47	V
V_{GSq}	gate-source quiescent voltage	V_{DS} = 48 V; I_D = 96 mA	–3.02	–2.62	–2.22	V
$I_{D(leak)}$	drain leakage current	V_{GS} = –10 V; V_{DS} = 50 V	-	-	1.16	mA
I_{GSS}	gate leakage current	V_{GS} = –8 V; V_{DS} = 0 V	-	-	0.23	mA
Peak device						
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 10 V; I_D = 7.2 mA	–3.20	–2.80	–2.40	V
V_{GSq}	gate-source quiescent voltage	V_{DS} = 48 V; I_D = 144 mA	–3.02	–2.62	–2.22	V
$I_{D(leak)}$	drain leakage current	V_{GS} = –10 V; V_{DS} = 50 V	-	-	1.74	mA
I_{GSS}	gate leakage current	V_{GS} = –8 V; V_{DS} = 0 V	-	-	0.35	mA

Table 7. RF characteristics

Test signal: pulsed CW; t_p = 50 μs; δ = 1.38 %; f_1 = 2496 MHz; f_2 = 2690 MHz; RF performance at V_{DS} = 48 V; I_{Dq1} = 50 mA; I_{Dq2} = 70 mA; T_{case} = 25 °C; unless otherwise specified; in a class-AB production RF test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Main device						
G_p	power gain	$P_{L(AV)}$ = 14.1 W	16.0	18.2	-	dB
η_D	drain efficiency	$P_{L(AV)}$ = 14.1 W	32.0	36.0	-	%
$P_{L(3dB)}$	output power at 3 dB gain compression		43.0	46.0	-	dBm
Peak device						
G_p	power gain	$P_{L(AV)}$ = 14.1 W	16.0	18.5	-	dB
η_D	drain efficiency	$P_{L(AV)}$ = 14.1 W	27.0	31.0	-	%
$P_{L(3dB)}$	output power at 3 dB gain compression		43.0	47.0	-	dBm

7. Test information

7.1 Ruggedness in Doherty operation

7.1.1 At f = 2300 MHz; tested on the Doherty application demo board

The C4H2327N110A is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: V_{DS} = 50 V; I_{Dq} = 30 mA; $V_{GS(amp)peak}$ = –5.6 V; P_L = 100 W (pulsed CW; t_p = 100 μs; δ = 10 %).

7.1.2 At f = 2496 MHz; tested on the Doherty development RF test circuit

The C4H2327N110A is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions: V_{DS} = 50 V; I_{Dq} = 50 mA; $V_{GS(amp)peak}$ = –5.3 V; P_L = 95 W (pulsed CW; t_p = 100 μs; δ = 10 %).

7.2 Impedance information

Table 8. Typical impedance of maximum power and drain efficiency

Measured load-pull data (main device); all data measured on a harmonic impedance optimized load-pull fixture; I_{Dq} = 45 mA; V_{DS} = 50 V; test signal: pulsed CW; t_p = 100 μs; δ = 10 %; typical values unless otherwise specified.

f	Z_S [1]	Z_L [1]	P_L [2]		η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	dBm)	(W)	(%)	(dB)
Maximum power load						
2300	7.0 – j16.0	13.7 + j9.7	47.3	54	67.4	18.9
2350	7.0 – j16.0	14.7 + j8.0	47.4	55	65.5	18.5
2400	7.0 – j16.0	15.7 + j8.7	47.4	55	67.6	18.7
2500	14.0 – j35.1	12.8 + j9.1	47.2	52	68.0	18.7
2600	28.8 – j47.6	12.8 + j9.0	47.4	55	67.0	17.8
2700	89.5 – j56.8	12.8 + j9.1	47.1	51	69.0	17.6
Maximum drain efficiency load						
2300	7.0 – j16.0	12.1 + j16.9	46.2	42	77.5	20.6
2350	7.0 – j16.0	10.4 + j18.2	45.3	34	78.1	21.3

Table 8. Typical impedance of maximum power and drain efficiency *…continued*

Measured load-pull data (main device); all data measured on a harmonic impedance optimized load-pull fixture; I_{Dq} = 45 mA; V_{DS} = 50 V; test signal: pulsed CW; t_p = 100 μs; δ = 10 %; typical values unless otherwise specified.

f	Z_S [1]	Z_L [1]	P_L [2]		η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	dBm)	(W)	(%)	(dB)
2400	7.0 – j16.0	9.1 + j16.8	45.6	36	77.9	21.7
2500	14.0 – j35.1	8.5 + j14.7	46.0	40	80.0	20.9
2600	28.8 – j47.6	10.2 + j15.5	46.0	40	78.7	19.0
2700	89.5 – j56.8	9.4 + j15.8	45.7	37	79.6	18.9

[1] Z_S and Z_L defined in Figure 2.

[2] At 3 dB gain compression.

Table 9. Typical impedance of maximum power and drain efficiency

Measured load-pull data (peak device); all data measured on a harmonic impedance optimized load-pull fixture; I_{Dq} = 70 mA; V_{DS} = 50 V; test signal: pulsed CW; t_p = 100 μs; δ = 10 %; typical values unless otherwise specified.

f	Z_S [1]	Z_L [1]	P_L [2]		η_D [2]	G_p [2]
(MHz)	(Ω)	(Ω)	(dBm)	(W)	(%)	(dB)
Maximum power load						
2300	4.8 – j7.6	10.0 + j5.7	49.5	90	67.7	18.5
2350	4.8 – j7.6	7.9 + j6.9	49.6	91	70.7	19.5
2400	4.8 – j7.6	7.8 + j6.8	49.5	90	70.2	20.4
2500	3.1 – j9.5	8.8 + j4.7	49.3	85	64.5	18.3
2600	7.5 – j15.7	8.5 + j5.8	49.3	83	66.1	18.8
2700	6.4 – j8.9	7.4 + j5.4	49.2	84	64.3	17.7
Maximum drain efficiency load						
2300	4.8 – j7.6	6.2 + j10.3	48.8	76	76.4	19.9
2350	4.8 – j7.6	7.3 + j11.9	47.9	61	77.6	20.9
2400	4.8 – j7.6	7.6 + j11.6	47.9	61	76.6	21.8
2500	3.1 – j9.5	6.5 + j9.8	47.9	61	76.3	19.8
2600	7.5 – j15.7	6.5 + j9.8	48.0	63	74.7	20.1
2700	6.4 – j8.9	6.4 + j9.8	48.1	64	74.3	18.5

[1] Z_S and Z_L defined in Figure 2.

[2] At 3 dB gain compression.

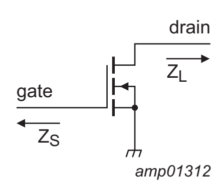
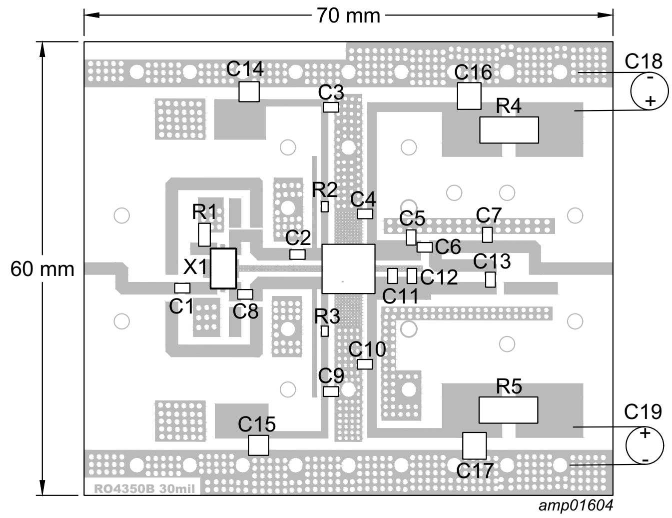


Fig 2. Definition of transistor impedance

7.3 Test circuit



Printed-Circuit Board (PCB): Rogers RO4350B; thickness = 0.762 mm.
See Table 10 for a list of components.

Fig 3. Component layout for test circuit

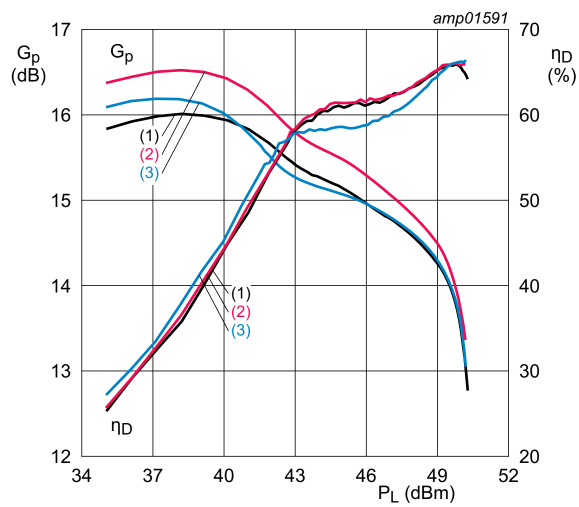
Table 10. List of components
See Figure 3 for component layout.

Component	Description	Value	Remarks
C1, C3, C9	multilayer ceramic chip capacitor	8.2 pF	ATC 600F
C2, C8	multilayer ceramic chip capacitor	1.8 pF	ATC 600F
C4	multilayer ceramic chip capacitor	7.5 pF	ATC 600F
C5	multilayer ceramic chip capacitor	1.2 pF	ATC 600F
C6, C13	multilayer ceramic chip capacitor	1.5 pF	ATC 600F
C7	multilayer ceramic chip capacitor	0.9 pF	ATC 600F
C10	multilayer ceramic chip capacitor	7.5 pF	ATC 600F
C11	multilayer ceramic chip capacitor	2.0 pF	ATC 600F
C12	multilayer ceramic chip capacitor	0.3 pF	ATC 600F
C14, C15	multilayer ceramic chip capacitor	10 μF, 100 V	Murata: GRM32EC72A106KE05L
C16, C17	multilayer ceramic chip capacitor	10 μF, 100 V	Murata: KRM55QR72A106KH01L
C18, C19	electrolytic capacitor	1000 μF, 100 V	Murata
R1	resistor	51 Ω	SMD 0805
R2, R3	resistor	5.1 Ω	SMD 0603
R4, R5	high precision current sense resistor	0.1 Ω	Bourns: CRM2512-FX-R100ELF
X1	hybrid coupler	2 dB, 90°	Anaren: X3C25F1-02S

7.4 Graphical data

All the data are measured on the Doherty RF test circuit.

7.4.1 Pulsed CW



V_{DS} = 50 V; I_{Dq} = 30 mA; $V_{GS(amp)peak}$ = –5.5 V;
t_p = 50 μs; δ = 5 %.

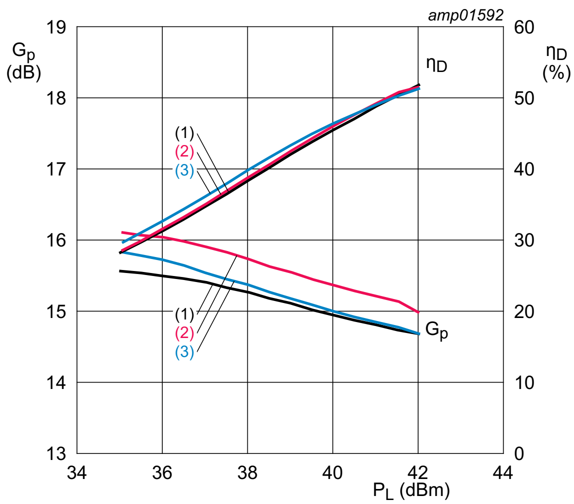
(1) f = 2496 MHz

(2) f = 2596 MHz

(3) f = 2690 MHz

Fig 4. Power gain and drain efficiency as function of output power; typical values

7.4.2 1-Carrier W-CDMA



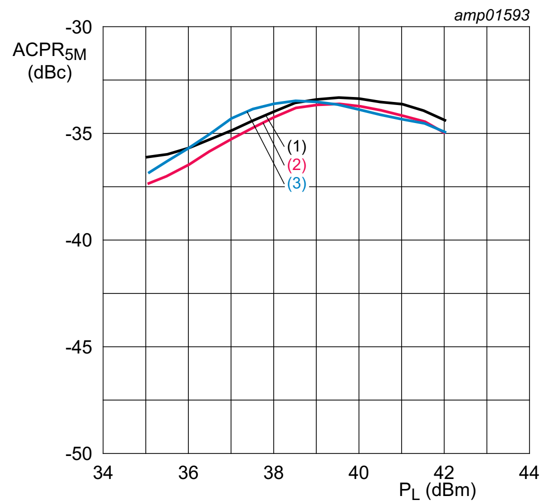
V_{DS} = 50 V; I_{Dq} = 30 mA; $V_{GS(amp)peak}$ = –5.5 V.

(1) f = 2496 MHz

(2) f = 2596 MHz

(3) f = 2690 MHz

Fig 5. Power gain and drain efficiency as function of average output power; typical values



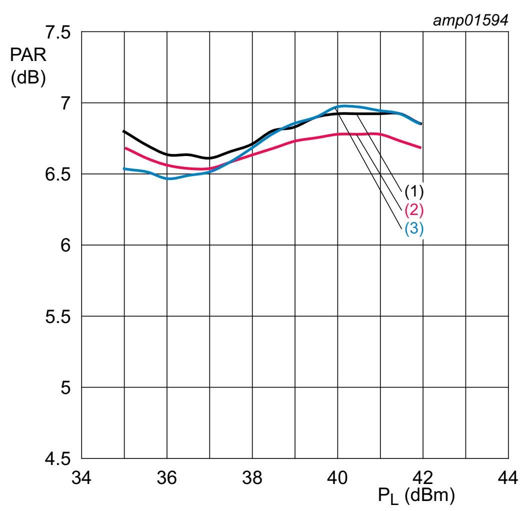
V_{DS} = 50 V; I_{Dq} = 30 mA; $V_{GS(amp)peak}$ = –5.5 V.

(1) f = 2496 MHz

(2) f = 2596 MHz

(3) f = 2690 MHz

Fig 6. Adjacent channel power ratio (5 MHz) as a function of output power; typical values



V_{DS} = 50 V; I_{Dq} = 30 mA; $V_{GS(amp)peak}$ = –5.5 V.

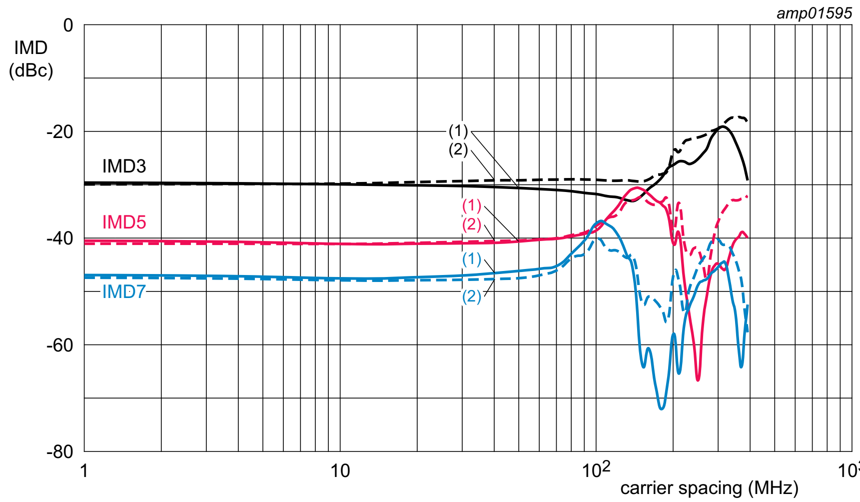
(1) f = 2496 MHz

(2) f = 2596 MHz

(3) f = 2690 MHz

Fig 7. Peak-to-average power ratio as a function of output power; typical values

7.4.3 2-Tone VBW



V_{DS} = 50 V; I_{Dq} = 30 mA; $V_{GS(amp)peak}$ = –5.5 V; P_L = 41.9 dBm; f = 2600 MHz.

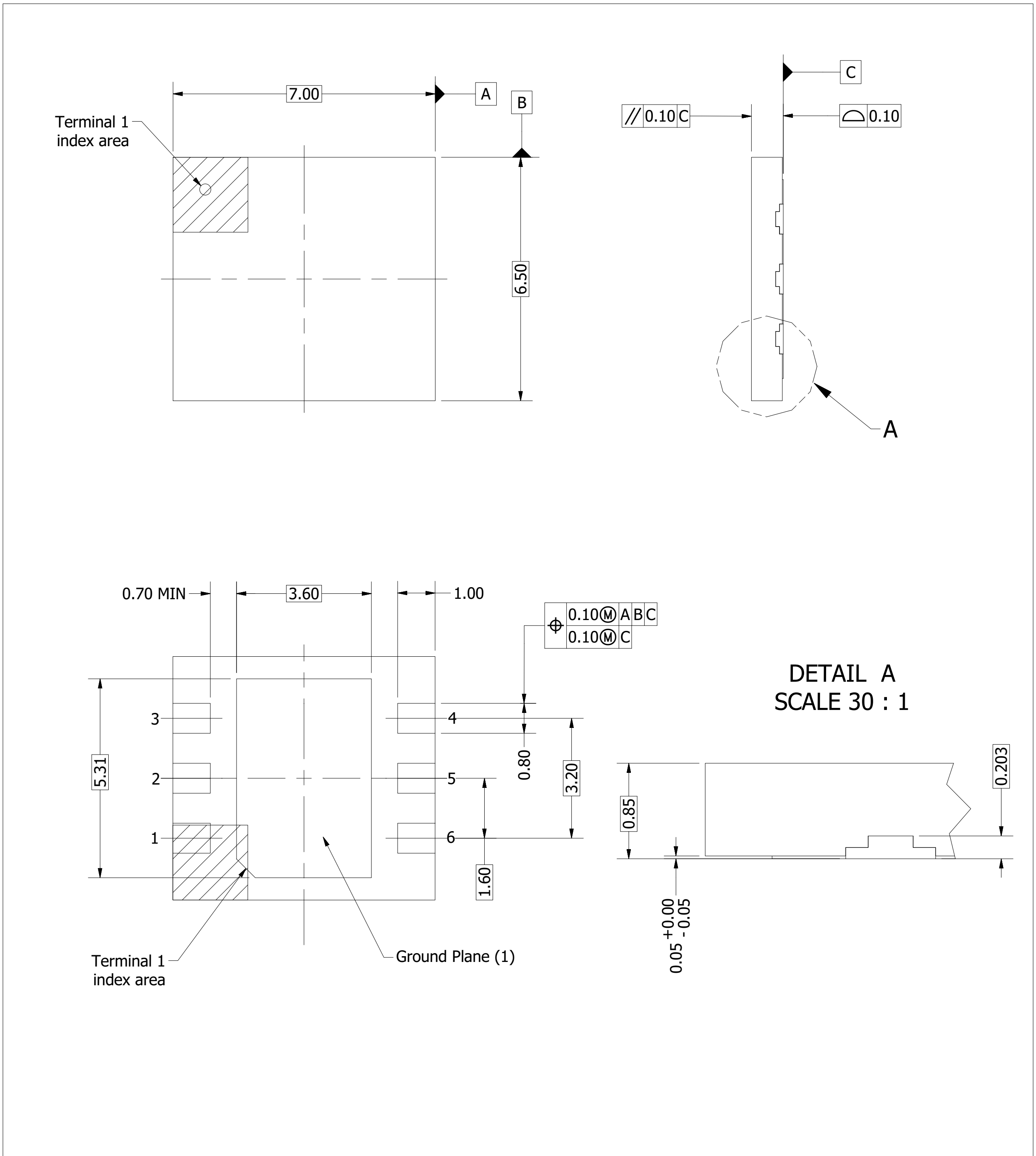
(1) IMD low

(2) IMD high

Fig 8. VBW capability

8. Package outline

DFN-7x6.5-6-1



Package outline drawing: DFN-7x6.5-6-1 Publication	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.10 Angle: ± 1°	Revision: 0 Revision date: 05/29/2020
		Third angle projection	Sheet 1 of 2

Fig 9. Package outline DFN-7x6.5-6-1 (sheet 1 of 2)

DFN-7x6.5-6-1

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

Package outline drawing: DFN-7x6.5-6-1 Publication	units in mm.	Tolerances unless otherwise stated: Dimension: ± 0.10 Angle: ± 1°	Revision: 0 Revision date: 05/29/2020
		Third angle projection	Sheet 2 of 2

Fig 10. Package outline DFN-7x6.5-6-1 (sheet 2 of 2)

9. 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	C2B [1]
Human Body Model (HBM); According to ANSI/ESDA/JEDEC standard JS-001	1A [2]

[1] CDM classification C2B is granted to any part that passes after exposure to an ESD pulse of 750 V.

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

10. Abbreviations

Table 12. Abbreviations

Acronym	Description
3GPP	3rd Generation Partnership Project
CCDF	Complementary Cumulative Distribution Function
CW	Continuous Wave
DPCH	Dedicated Physical CHannel
GaN	Gallium Nitride
MTF	Median Time to Failure
PAR	Peak-to-Average Ratio
RoHS	Restriction of Hazardous Substances
SMD	Surface Mounted Device
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband Code Division Multiple Access

11. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
C4H2327N110A v.1	20211223	Product data sheet	-	-

12. Legal information

12.1 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.

12.2 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. In no event however, shall an agreement be valid in which the Ampleon product is deemed to offer functions and qualities beyond those described in the Product data sheet.

12.3 Disclaimers

Maturity — The information in this document can only be regarded as final once the relevant product(s) has passed the Release Gate in Ampleon's release process. Prior to such release this document should be regarded as a draft version.

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, Ampleon does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. Ampleon takes no responsibility for the content in this document if provided by an information source outside of Ampleon.

In no event shall Ampleon be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory.

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.

Right to make changes — Ampleon reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information 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. Ampleon and its suppliers accept no liability for inclusion and/or use of Ampleon products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

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 accepts no liability 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 should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products.

Ampleon does not accept any liability 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 doing 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 does not accept any liability 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 warranted. 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 case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. Ampleon hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of Ampleon products by customer.

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 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 accepts no liability for inclusion and/or use of non-automotive qualified products in automotive equipment or applications.

In the event that customer uses the product for design-in and use in automotive applications to automotive specifications and standards, customer (a) shall use the product without Ampleon's warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond Ampleon's specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies Ampleon for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond Ampleon's standard warranty and Ampleon's product specifications.

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.

12.4 Trademarks

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

13. Contact information

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

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

14. Contents

Date of release: 23 December 2021
Document identifier: C4H2327N110A