C4H2327N55P

Power GaN transistor

Rev. 1 — 8 July 2021

AMPLEON

Product data sheet

1. Product profile

1.1 General description

50 W GaN packaged Doherty power transistor for base station applications at frequencies from 2300 MHz to 2690 MHz.

Table 1. Typical performance

Typical RF performance at T_{case} = 25 °C in a Doherty application demo circuit. V_{DS} = 46 V; I_{Dq} = 20 mA (main), $V_{GS(amp)peak}$ = −5.1 V, unless otherwise specified.

Test signal	f	I_{Dq}	V_{DS}	$P_{L(AV)}$	G_p	η_D	ACPR	$P_{L(5dB)}$
	(MHz)	(mA)	(V)	(W)	(dB)	(%)	(dBc)	(dBm)
1-carrier W-CDMA [1]	2300 to 2400	20	46	6.8	16.7	54.1	−24	-
pulsed CW [2]	2300 to 2400	20	46	-	-	-	-	46.9

[1] Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 9.7 dB at 0.01 % probability on CCDF.

[2] Test signal: pulsed CW; t_p = 12 μs; δ = 10 %.

Table 2. Typical performance

Typical RF performance at T_{case} = 25 °C in a Doherty application demo circuit. V_{DS} = 50 V; I_{Dq} = 30 mA (main), $V_{GS(amp)peak}$ = −5.1 V, unless otherwise specified.

Test signal	f	I_{Dq}	V_{DS}	$P_{L(AV)}$	G_p	η_D	ACPR	$P_{L(3dB)}$
	(MHz)	(mA)	(V)	(W)	(dB)	(%)	(dBc)	(dBm)
1-carrier W-CDMA [1]	2496 to 2690	30	50	7.8	16.7	55	−26	-
pulsed CW [2]	2496 to 2690	30	50	-	-	-	-	46.5

[1] Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 9.7 dB at 0.01 % probability on CCDF.

[2] Test signal: pulsed CW; t_p = 12 μs; δ = 10 %.

1.2 Features and benefits

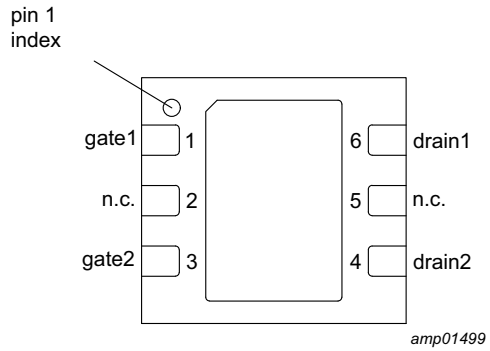
- Excellent digital pre-distortion capability
- High efficiency
- Designed for broadband operation
- Lower output capacitance for improved performance in Doherty applications
- Internally matched for ease of use
- For RoHS compliance see the product details on the Ampleon website

1.3 Applications

- RF power amplifier for base stations and multi carrier applications in the 2300 MHz to 2690 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 3. 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 4. Ordering information

Package name	Orderable part number	12NC	Packing description	Min. orderable quantity (pieces)
DFN-7x6.5-6-1	C4H2327N55PZ	9349 603 97515	TR7; 1000-fold; 16 mm; dry pack	1000
	C4H2327N55PX	9349 603 97525	TR13; 3000-fold; 16 mm; dry pack	3000

4. Limiting values

Table 5. 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		-	3.2	mA
$I_{GF(amp)peak}$	peak amplifier forward gate current		-	3.2	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 6. 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} = 125 °C; P_{dis} = 6.4 W	4.3	K/W
$R_{th(ch-c)(FEA)}$ [2]	thermal resistance from active die channel to case by Finite Element Analysis	T_{case} = 125 °C; P_{dis} = 6.4 W	5.8	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 7. DC characteristics

Main and peak side DC characteristics; T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{GS(th)}$	gate-source threshold voltage	V_{DS} = 10 V; I_D = 3.2 mA	–3.45	–2.96	–2.15	V
V_{GSq}	gate-source quiescent voltage	V_{DS} = 50 V; I_D = 64 mA	–3.25	–2.65	–1.95	V
$I_{D(leak)}$	drain leakage current	V_{GS} = –10 V; V_{DS} = 50 V	-	-	0.774	mA
I_{GSS}	gate leakage current	V_{GS} = –8 V; V_{DS} = 0 V	-	-	0.155	mA

Table 8. RF characteristics

Test signal: pulsed CW; t_p = 50 μs; δ = 1.38 %; f_1 = 2496 MHz; f_2 = 2690 MHz; main and peak one side; RF performance at V_{DS} = 48 V; I_{Dq} = 35 mA; T_{case} = 25 °C; unless otherwise specified; in a class-AB production RF test circuit.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_p	power gain	$P_{L(AV)}$ = 7.6 W	17.8	19.6	-	dB
η_D	drain efficiency	$P_{L(AV)}$ = 7.6 W	34	38	-	%
$P_{L(3dB)}$	output power at 3 dB gain compression		20.0	23.4	-	W

7. Test information

7.1 Ruggedness in Doherty operation

The C4H2327N55P is capable of withstanding a load mismatch corresponding to VSWR = 10 : 1 through all phases under the following conditions:

- V_{DS} = 46 V; I_{Dq} = 20 mA; $V_{GS(amp)peak}$ = −5.1 V; P_L = 45 W (pulsed CW; t_p = 100 μs; δ = 10 %); f = 2300 MHz; tested on the Doherty demo board.
- V_{DS} = 48 V; I_{Dq} = 18 mA; $V_{GS(amp)peak}$ = −5.0 V; P_L = 45 W (pulsed CW; t_p = 100 μs; δ = 10 %); f = 2500 MHz; tested on the Doherty development RF test circuit.

7.2 Impedance information

Table 9. Typical impedance of maximum power and drain efficiency

Measured load-pull data; all data measured on a harmonic impedance load-pull fixture; I_{Dq} = 36 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)	(W)	(%)	(dB)
Maximum power load					
2300	7.2 – j13.7	18.1 + j14.4	35.1	64.6	18.2
2350	8.8 – j16.1	20.5 + j14.3	34.5	64.0	18.2
2400	11.1 – j19.2	20.0 + j13.9	33.3	62.9	18.3
2500	64.3 – j13.0	16.2 + j5.3	32.2	67.2	18.2
2600	66.2 + j2.5	13.5 + j5.0	32.8	70.1	18.7
2700	57.8 – j13.5	15.1 + j2.2	33.4	66.4	17.8
Maximum drain efficiency load					
2300	8.4 – j18.0	14.1 + j26.8	23.8	75.8	20.4
2350	9.7 – j19.4	17.1 + j23.8	29.9	74.5	19.4
2400	13.8 – j28.1	19.0 + j26.0	25.1	73.9	19.4
2500	64.3 – j13.0	12.0 + j12.3	24.3	74.5	19.7
2600	66.2 + j2.5	10.5 + j14.4	18.8	76.8	19.8
2700	57.8 – j13.5	9.2 + j12.4	19.3	77.2	19.8

[1] Z_S and Z_L defined in Figure 2.

[2] At 3 dB gain compression.

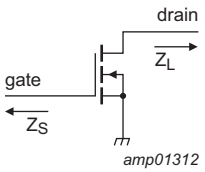
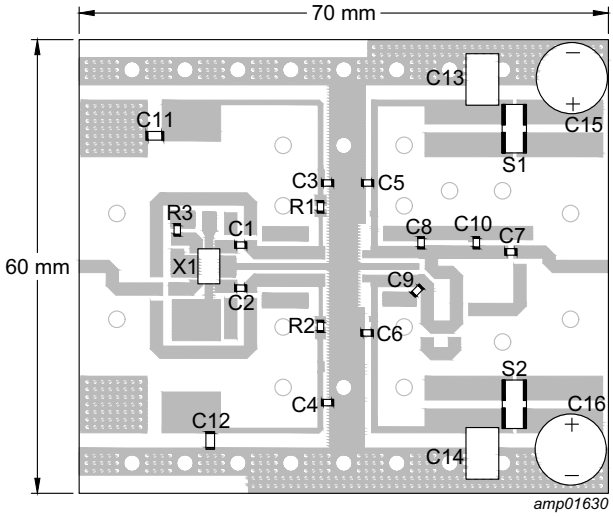


Fig 2. Definition of transistor impedance

7.3 Test circuit

The RF test circuit is used in the 2496 MHz to 2690 MHz frequency range.



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

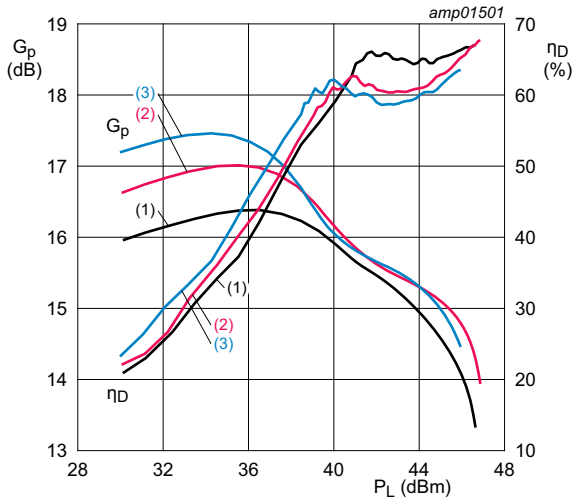
Table 10. List of components
See Figure 3 for component layout.

Component	Description	Value	Remarks
C1, C2, C3, C4, C5, C6, C7	multilayer ceramic chip capacitor	9.1 pF	ATC 600F
C8, C9	multilayer ceramic chip capacitor	1.0 pF	ATC 600F
C10	multilayer ceramic chip capacitor	1.1 pF	ATC 600F
C11, C12	multilayer ceramic chip capacitor	0.1 μF, 50 V	Murata
C13, C14	multilayer ceramic chip capacitor	10 μF, 100 V	Murata
C15, C16	electrolytic capacitor	1000 μF, 100 V	
R1, R2	resistor	5.1 Ω	SMD 0603
R3	resistor	50 Ω	SMD 0805
S1, S2	four terminal high precision current sense resistor	0.01 Ω	Ohmite: LVK25 (1224) or of same quality
X1	hybrid coupler	3 dB, 90°	Anaren: X3C25F1-03S

7.4 Graphical data

All data are measured on the Doherty development RF test circuit in the 2496 MHz to 2690 MHz frequency range.

7.4.1 Pulsed CW



V_{DS} = 50 V; I_{Dq} = 18 mA; $V_{GS(amp)peak}$ = −5 V; t_p = 100 µs; δ = 10 %.

(1) f = 2500 MHz

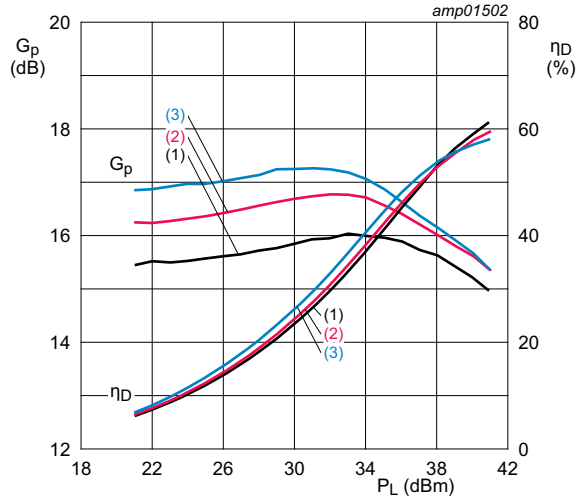
(2) f = 2600 MHz

(3) f = 2700 MHz

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

7.4.2 1-Carrier W-CDMA

Test signal: 1-carrier W-CDMA; 3GPP test model 1; 64 DPCH; PAR = 7.2 dB at 0.01 % probability on the CCDF.



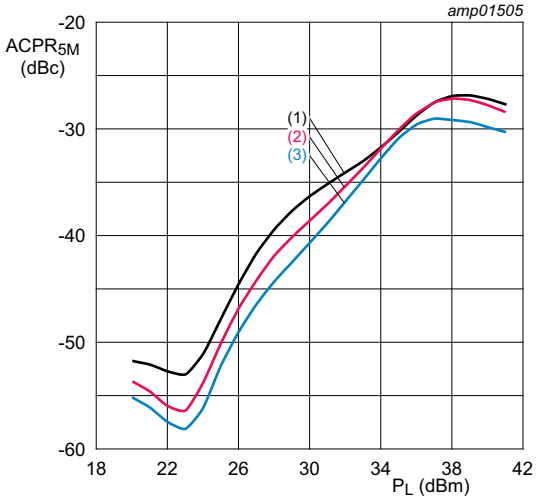
V_{DS} = 50 V; I_{Dq} = 18 mA; $V_{GS(amp)peak}$ = −5 V.

(1) f = 2500 MHz

(2) f = 2600 MHz

(3) f = 2700 MHz

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



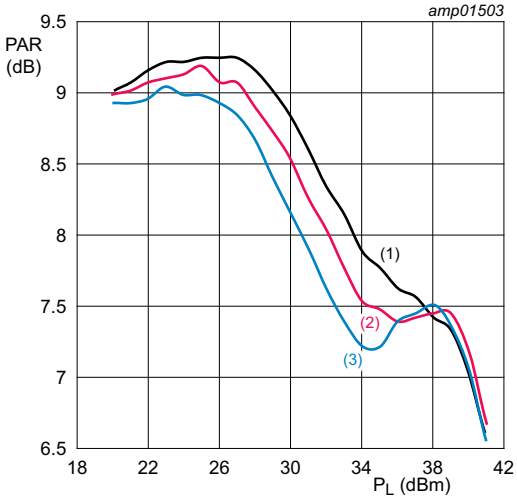
V_{DS} = 50 V; I_{Dq} = 18 mA; $V_{GS(amp)peak}$ = −5 V.

(1) f = 2500 MHz

(2) f = 2600 MHz

(3) f = 2700 MHz

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



V_{DS} = 50 V; I_{Dq} = 18 mA; $V_{GS(amp)peak}$ = −5 V.

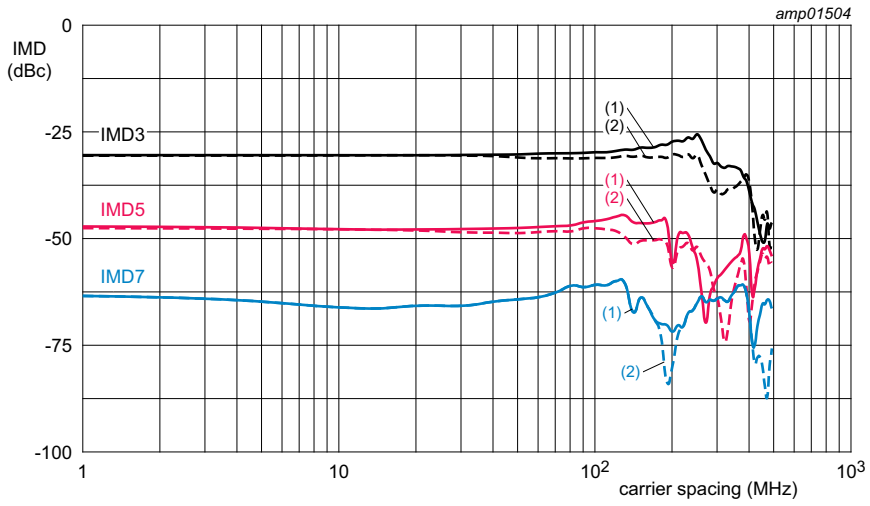
(1) f = 2500 MHz

(2) f = 2600 MHz

(3) f = 2700 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} = 18 mA; $V_{GS(amp)peak}$ = −5 V; P_L = 25.5 dBm; f = 2600 MHz.

(1) IMD low

(2) IMD high

Fig 8. VBW capability

8. Package outline

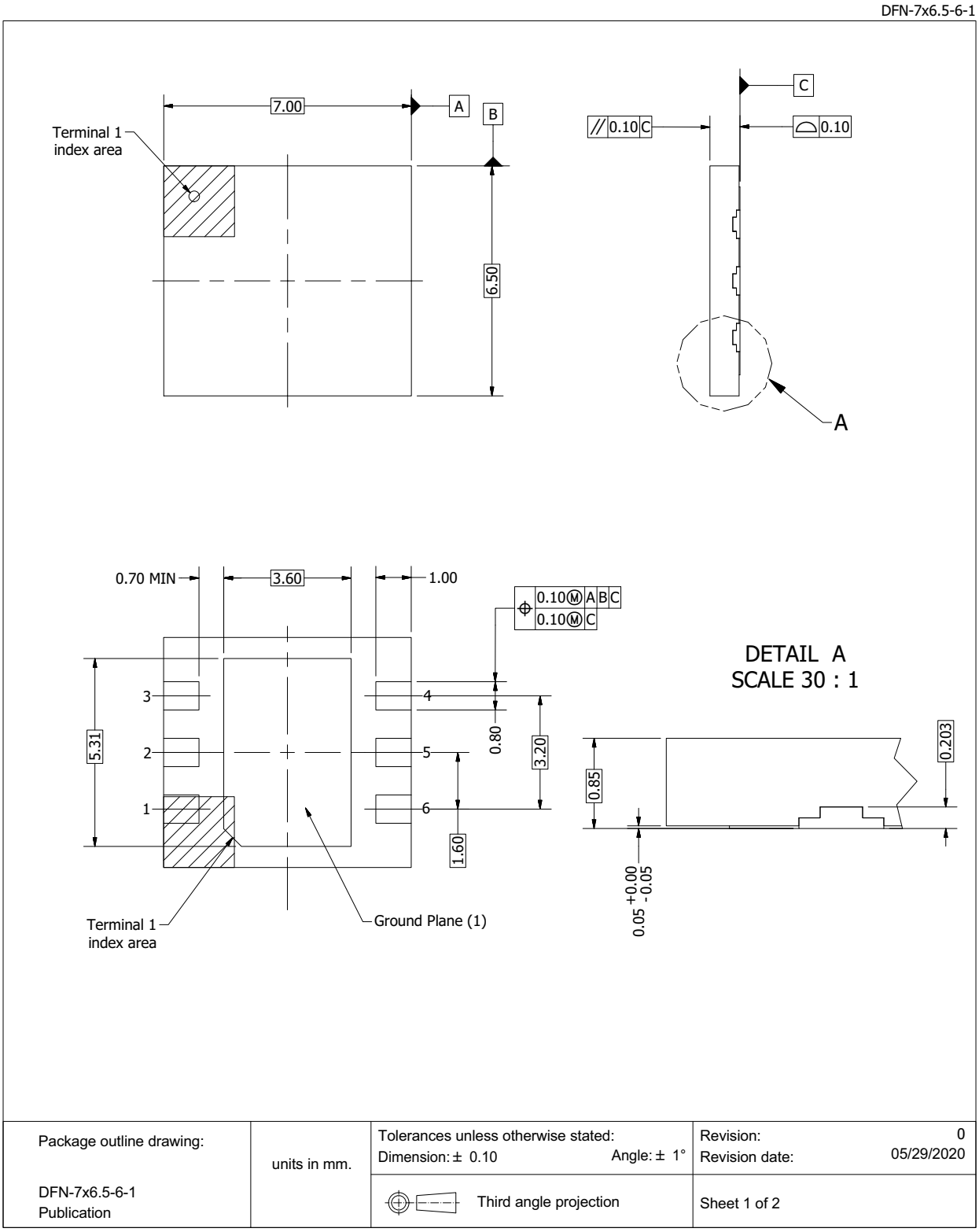


Fig 9. Package outline DFN-7x6.5-6-1 (sheet 1 of 2)

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° Third angle projection	Revision: 0 Revision date: 05/29/2020 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
C4H2327N55P v.1	20210708	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".

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14. Contents

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