A5G35S004N

Airfast RF Power GaN Transistor

Rev. 5 — 18 October 2023 Product data sheet

1 General description

This RF power GaN transistor is designed for cellular base station applications covering the frequency range of 3300 to 4300 MHz.

2 Features and benefits

- High terminal impedances for optimal broadband performance
- Designed for low complexity linearization systems
- Universal broadband driver
- Optimized for massive MIMO active antenna systems for 5G base stations

3 Typical performance

Table 1. 3500 MHz — Typical single-carrier W-CDMA reference circuit performance

V_{DD} = 48 Vdc, I_{DQ} = 12 mA, P_{out} = 24.5 dBm Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.[1]

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
3400 MHz	19.3	19.5	9.9	–38.7
3500 MHz	19.4	20.0	9.7	–40.3
3600 MHz	18.8	20.4	9.4	–42.1

[1] All data measured with device soldered to NXP reference circuit.

Table 2. 3700–4000 MHz — Typical single-carrier W-CDMA reference circuit performance

V_{DD} = 48 Vdc, I_{DQ} = 10 mA, P_{out} = 28 dBm Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.[1]

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
3700 MHz	18.3	22.5	8.4	–35.2
3800 MHz	18.8	25.2	8.5	–38.6
3900 MHz	18.1	23.8	8.5	–41.2
4000 MHz	17.2	21.6	8.6	–42.4

[1] All data measured in reference circuit with device soldered to printed circuit board.

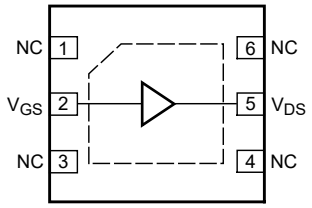
Table 3. 4100–4300 MHz — Typical single-carrier W-CDMA reference circuit performance

V_{DD} = 48 Vdc, I_{DQ} = 10 mA, P_{out} = 28 dBm Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.[1]

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
4100 MHz	17.6	26.5	7.6	–33.2
4200 MHz	17.2	26.5	7.8	–36.2
4300 MHz	16.5	26.5	7.9	–38.3

[1] All data measured in reference circuit with device soldered to printed circuit board.

4 Pinning information



(Top view)

Note: Exposed backside of the package is the source terminal for the transistor.

aaa-042956

Figure 1. Pin configuration

5 Ordering information

Table 4. Ordering information

Device	Tape and Reel Information	Package
A5G35S004NT6	T6 Suffix = 5,000 Units, 12 mm Tape Width, 13-inch Reel	DFN 4.5 × 4

6 Product marking

Figure 2. Product marking

Table 5. Product marking trace code

Identifier	Description
A	Assembly location
L	Wafer lot indicator
YW	Date code
Z	Assembly lot

7 Limiting values

Table 6. Limiting values

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	125	Vdc
Gate-Source Voltage	V_{GS}	–16, 0	Vdc
Operating Voltage	V_{DD}	55	Vdc
Maximum Forward Gate Current @ T_C = 25°C	I_{GMAX}	0.74	mA
Storage Temperature Range	T_{stg}	–65 to +150	°C
Case Operating Temperature Range	T_C	–55 to +150	°C
Maximum Channel Temperature	T_{CH}	225	°C

8 Recommended operating conditions

Table 7. Recommended operating conditions

Characteristic	Symbol	Value	Unit
Operating Voltage	V_{DD}	48	Vdc

9 Thermal characteristics

Table 8. Thermal characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case Case Temperature 113°C, P_D = 1.3 W	$R_{\theta JC}$ (IR)	8.9[1]	°C/W
Thermal Resistance by Finite Element Analysis, Channel-to-Case Case Temperature 113°C, P_D = 1.3 W	$R_{\theta CHC}$ (FEA)	32[2]	°C/W

[1] Refer to AN1955, *Thermal Measurement Methodology of RF Power Amplifiers*. Go to http://www.nxp.com/RF and search for AN1955.

[2] $R_{\theta CHC}$ (FEA) must be used for purposes related to reliability and limitations on maximum channel temperature. MTTF may be estimated by the expression MTTF (hours) = $10^{[A + B/(T + 273)]}$, where T is the channel temperature in degrees Celsius, A = –11.1 and B = 8366.

10 ESD protection characteristics

Table 9. ESD protection characteristics

Test Methodology	Class
Human Body Model (per JS-001-2017)	1A
Charge Device Model (per JS-002-2014)	C2A

11 Moisture sensitivity level

Table 10. Moisture sensitivity level

Test Methodology	Rating	Package Peak Temperature	Unit
Per JESD22-A113, IPC/JEDEC J-STD-020	3	260	°C

12 Electrical characteristics

12.1 DC characteristics

12.1.1 DC characteristics — off characteristics

Table 11. DC characteristics — off characteristics

(T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off characteristics					
Off-State Drain Leakage (V_{DS} = 150 Vdc, V_{GS} = –8 Vdc)	$I_{D(BR)}$	—	—	0.74	mAdc

12.1.2 DC characteristics — on characteristics

Table 12. DC characteristics — on characteristics

(T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
On characteristics					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 0.74 mAdc)	$V_{GS(th)}$	–4.9	–2.5	–1.9	Vdc
Gate Quiescent Voltage (V_{DD} = 48 Vdc, I_D = 12 mAdc, Measured in Functional Test)	$V_{GS(Q)}$	–2.78	–2.53	–2.30	Vdc
Gate-Source Leakage Current (V_{DS} = 150 Vdc, V_{GS} = –12 Vdc)	I_{GSS}	–0.74	—	—	mAdc

12.2 Functional tests

Table 13. Functional tests

(In NXP Doherty Production ATE[1] Test Fixture, T_A = 25°C unless otherwise noted, 50 ohm system)[2] V_{DD} = 48 Vdc, I_{DQ} = 12 mA, P_{out} = 24.5 dBm Avg., f = 3500 MHz, 1-tone CW.

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	15.5	16.9	19.5	dB
Drain Efficiency	η_D	16.0	19.0	—	%
Saturated Power (Pulsed CW, 5% Duty Cycle)	P_{sat}	35.0	37.0	—	dBm

[1] ATE is a socketed test environment.
[2] Internally unmatched part.

12.3 Wideband ruggedness

Table 14. Wideband ruggedness

(In NXP Doherty Reference Circuit, T_A = 25°C unless otherwise noted, 50 ohm system)[1] I_{DQ} = 12 mA, f = 3500 MHz, Additive White Gaussian Noise (AWGN) with 10 dB PAR.

Characteristic	Symbol	Min	Typ	Max	Unit
ISBW of 400 MHz at 55 Vdc, 0.58 W Avg. Modulated Output Power (3 dB Input Overdrive from 0.28 W Avg. Modulated Output Power)	No Device Degradation				

[1] All data measured with device soldered to NXP reference circuit.

12.4 Typical performance

Table 15. Typical performance

(In NXP Doherty Reference Circuit, T_A = 25°C unless otherwise noted, 50 ohm system)[1] V_{DD} = 48 Vdc, I_{DQ} = 12 mA, 3400–3600 MHz Bandwidth.

Characteristic	Symbol	Min	Typ	Max	Unit
Fast CW, 27 ms sweep					
Saturated Power	P_{sat}	—	4.6	—	W
AM/PM (Maximum value measured at saturated power across the 3400–3600 MHz bandwidth)	Φ	—	–16	—	°
Gain Variation @ Avg. Power over Temperature (–40°C to +85°C)	ΔG	—	0.032	—	dB/°C
Output Power Variation @ Saturated Power over Temperature (–40°C to +85°C)	ΔP_{sat}	—	0.007	—	dB/°C
Single-carrier W-CDMA, unclipped					
Gain Flatness in 200 MHz Bandwidth @ P_{out} = 24.5 dBm Avg.	G_F	—	0.74	—	dB
2-tone CW					
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	300	—	MHz

[1] All data measured with device soldered to NXP reference circuit.

Correct biasing sequence for GaN depletion mode transistors

Turning the device ON

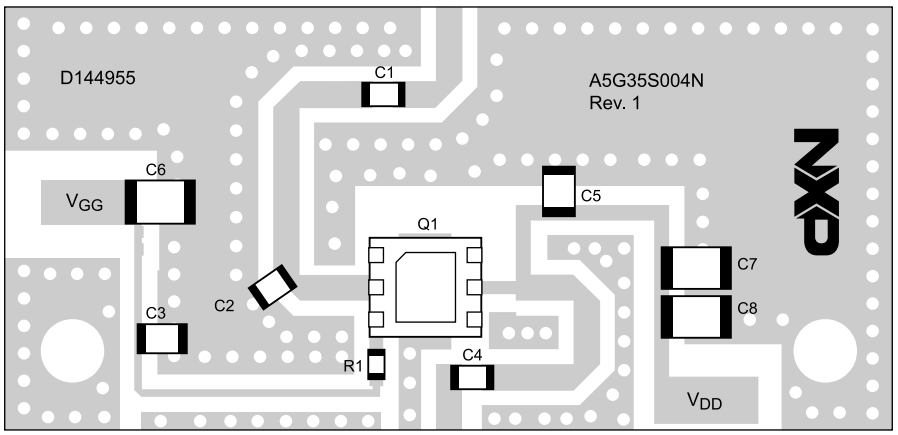
1. Set V_{GS} to the pinch-off voltage, typically –5 V.
2. Turn on V_{DS} to nominal supply voltage (+48 V).
3. Increase V_{GS} until I_{DS} current is attained.
4. Apply RF input power to desired level.

Turning the device OFF

1. Turn RF power off.
2. Reduce V_{GS} down to the pinch-off voltage, typically –5 V.
3. Adjust drain voltage V_{DS} to 0 V. Allow adequate time for drain voltage to reduce to 0 V from external drain capacitors.
4. Turn off V_{GS}.

13 Component layout and parts list

13.1 Component layout



Note: All data measured with device soldered to NXP reference circuit.

aaa-039743

Figure 3. A5G35S004N reference circuit component layout

13.2 Component designations and values

Table 16. A5G35S004N reference circuit component designations and values

Part	Description	Part Number	Manufacturer
C1, C3, C4, C5	10 pF Chip Capacitor	600S100JT250XT	ATC
C2	1.6 pF Chip Capacitor	600S1R6BT250XT	ATC
C6, C7, C8	4.7 µF Chip Capacitor	GRM55ER72A475KA01B	Murata
Q1	RF Power GaN Transistor	A5G35S004N	NXP
R1	10 Ω, 1/10 W Chip Resistor	CRCW060310R0FKEA	Vishay
PCB	Rogers RO4350B, 0.020″, ε_r = 3.66	D144955	MTL

14 Package information

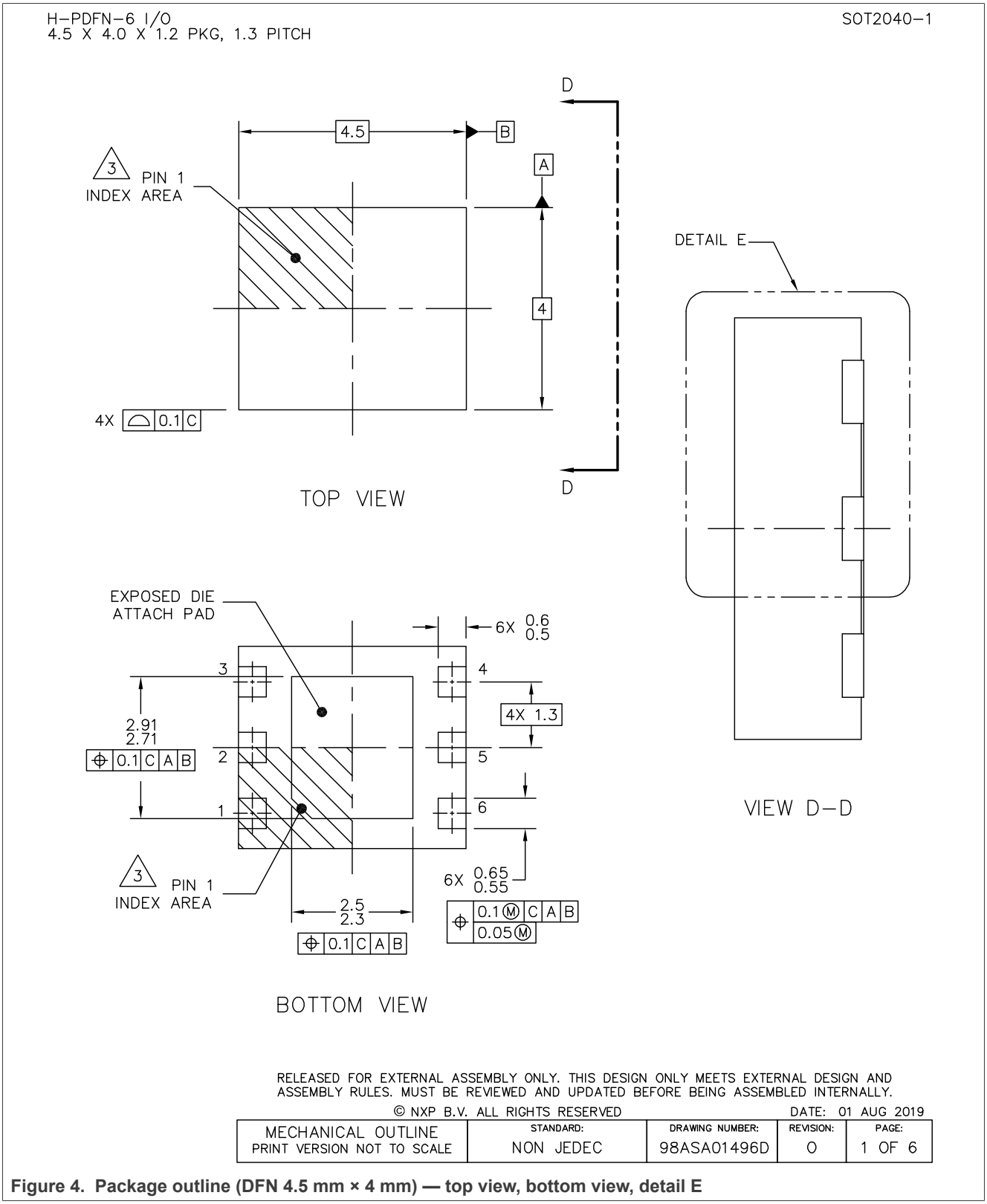


Figure 4. Package outline (DFN 4.5 mm × 4 mm) — top view, bottom view, detail E

H–PDFN–6 I/O
4.5 X 4.0 X 1.2 PKG, 1.3 PITCH

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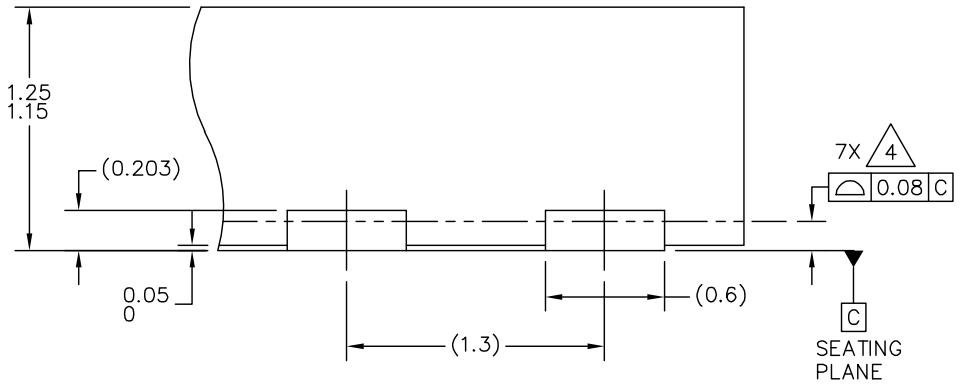

DETAIL E
VIEW ROTATED 90°CW

RELEASED FOR EXTERNAL ASSEMBLY ONLY. THIS DESIGN ONLY MEETS EXTERNAL DESIGN AND ASSEMBLY RULES. MUST BE REVIEWED AND UPDATED BEFORE BEING ASSEMBLED INTERNALLY.

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Figure 5. Package outline (DFN 4.5 mm × 4 mm) — detail E, rotated

H–PDFN–6 I/O
4.5 X 4.0 X 1.2 PKG, 1.3 PITCH

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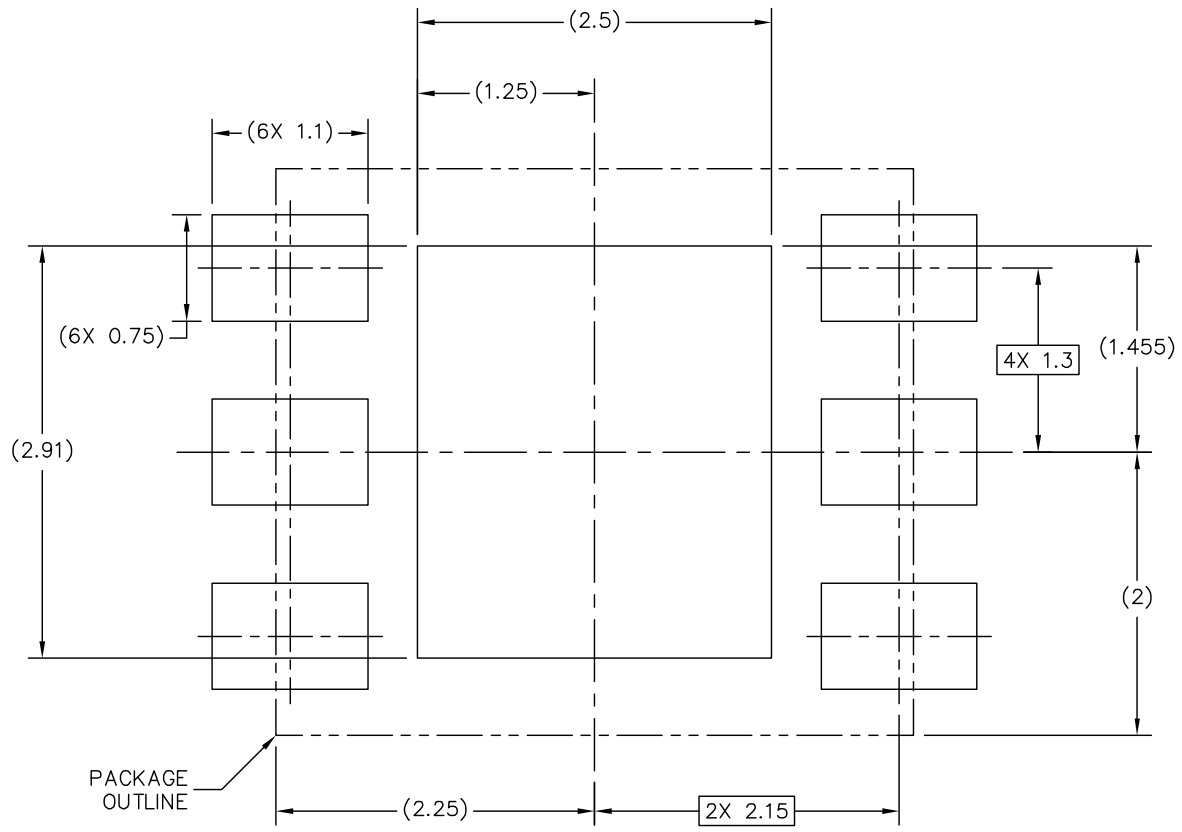

PCB DESIGN GUIDELINES – SOLDER MASK OPENING PATTERN

THIS SHEET SERVES ONLY AS A GUIDELINE TO HELP DEVELOP A USER SPECIFIC SOLUTION. DEVELOPMENT EFFORT WILL STILL BE REQUIRED BY END USERS TO OPTIMIZE PCB MOUNTING PROCESSES AND BOARD DESIGN IN ORDER TO MEET INDIVIDUAL/SPECIFIC REQUIREMENTS.

DATE: 01 AUG 2019

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Figure 6. Package outline (DFN 4.5 mm × 4 mm) — PCB design guidelines: solder mask opening pattern

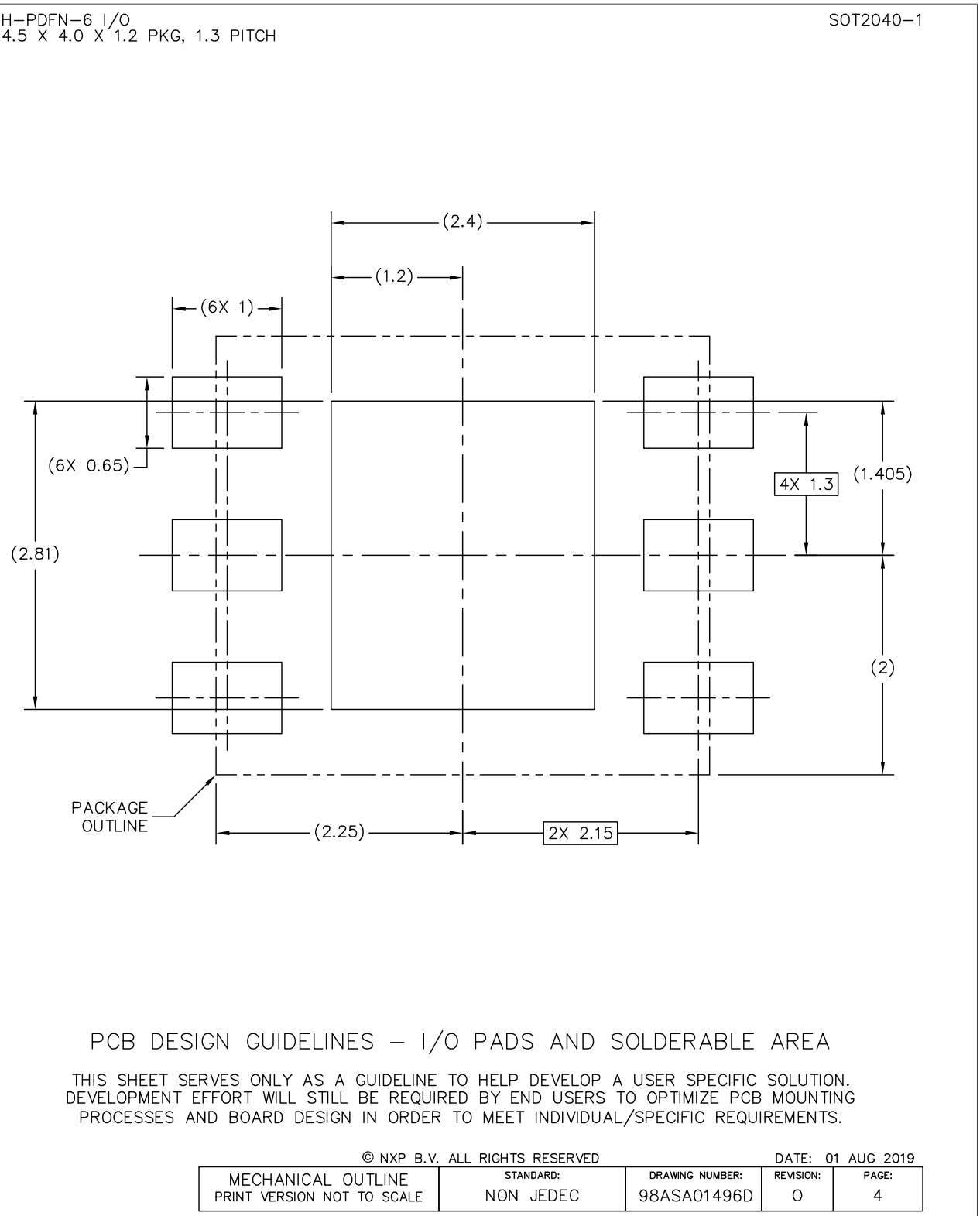

Figure 7. Package outline (DFN 4.5 mm × 4 mm) — PCB design guidelines: I/O pads and solderable area

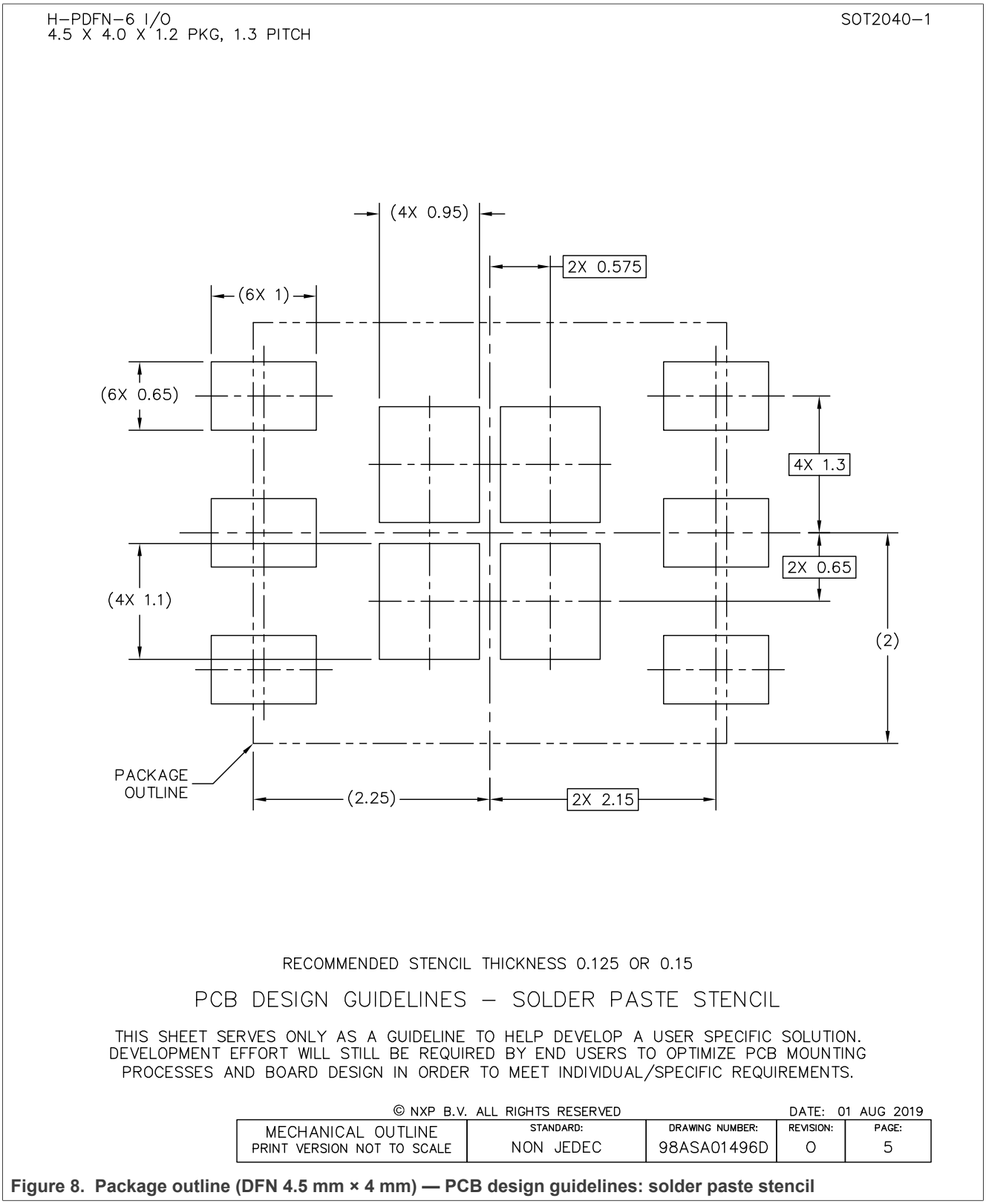

Figure 8. Package outline (DFN 4.5 mm × 4 mm) — PCB design guidelines: solder paste stencil

H–PDFN–6 I/O
4.5 X 4.0 X 1.2 PKG, 1.3 PITCH

SOT2040–1

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.
3. PIN 1 FEATURE SHAPE, SIZE AND LOCATION MAY VARY.
4. COPLANARITY APPLIES TO LEADS AND DIE ATTACH FLAG.

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Figure 9. Package outline (DFN 4.5 mm × 4 mm) — notes

15 Product documentation, software and tools

Refer to the following resources to aid your design process.

Application notes

- AN1907: Solder Reflow Attach Method for High Power RF Devices in Plastic Packages
- AN1955: Thermal Measurement Methodology of RF Power Amplifiers

Software

- .s2p File

Development tools

- Printed Circuit Boards

16 Revision history

The following table summarizes revisions to this document.

Table 17. Revision history

Revision	Date	Description
0	20 December 2020	• Initial release of data sheet
1	15 January 2021	• Table 1, Maximum Ratings: updated operating voltage for complete data sheet standardization, p. 2 • Table 2, Recommended Operating Conditions: added to data sheet, p. 2
2	21 January 2022	• Table 6, DC On Characteristics, $V_{GS(th)}$: Min, Typ and Max values updated to match production test values, p. 2
3	5 July 2022	• Table 6, DC On Characteristics, $V_{GS(Q)}$: Min, Typ and Max values updated to match production test values, p. 2
4	30 November 2022	• Table 1, Maximum Ratings: Gate−Source Voltage: updated –8, 0 to –16, 0 Vdc, p. 2 • Table 4, ESD Protection Characteristics, Human Body Model: updated to reflect test data, p. 2 • General updates made to align data sheet to current standard
5	18 October 2023	• Figure 2, Product Marking: added, p. 3 • Table 5, Product Marking Trace Code: added, p. 3 • Table 13, Functional Tests: updated output power test condition, p. 5 • General updates made to align data sheet to current standard

17 Legal information

17.1 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.

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Date of release: 18 October 2023
Document identifier: A5G35S004N