A5G23H110N

Airfast RF Power GaN Amplifier

Rev. 2 — 18 October 2023 Product data sheet

1 General description

This 13.8 W asymmetrical Doherty RF power GaN amplifier is designed for cellular base station applications requiring very wide instantaneous bandwidth capability covering the frequency range of 2300 to 2400 MHz.

This part is characterized and performance is guaranteed for applications operating in the 2300 to 2400 MHz band. There is no guarantee of performance when this part is used in applications designed outside of these frequencies.

2 Features and benefits

- High terminal impedances for optimal broadband performance
- Improved linearized error vector magnitude with next generation signal
- Able to withstand extremely high output VSWR and broadband operating conditions
- Designed for low complexity linearization systems
- Optimized for massive MIMO active antenna systems for 5G base stations

3 Typical performance

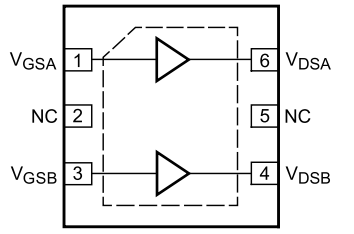
Table 1. 2300 MHz — Typical Doherty single-carrier W-CDMA reference circuit performance

V_{DD} = 48 Vdc, I_{DQA} = 50 mA, V_{GSB} = –4.7 Vdc, P_{out} = 13.8 W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.[1]

Frequency	G_{ps} (dB)	η_D (%)	Output PAR (dB)	ACPR (dBc)
2300 MHz	16.3	56.6	8.5	–29.1
2350 MHz	16.1	56.5	8.6	–30.8
2400 MHz	16.2	56.3	8.8	–32.4

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

4 Pinning information



(Top view)

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

aaa-044825

Figure 1. Pin configuration

5 Ordering information

Table 2. Ordering information

Device	Tape and Reel Information	Package
A5G23H110NT4	T4 Suffix = 2,500 Units, 16 mm Tape Width, 13-inch Reel	DFN 7 × 6.5

6 Product marking

Figure 2. Product marking

Table 3. Product marking trace code

Identifier	Description
A	Assembly location
WL	Wafer lot indicator
YYWW	Date code
Z	Assembly lot

7 Limiting values

Table 4. 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, $I_{G\ (A+B)}$, @ T_C = 25°C	I_{GMAX}	13.3	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 5. Recommended operating conditions

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

9 Thermal characteristics

Table 6. Thermal characteristics

Characteristic	Symbol	Value	Unit
Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case Case Temperature 117°C, P_D = 15.1 W	$R_{\theta JC}$ (IR)	2.7[1]	°C/W
Thermal Resistance by Finite Element Analysis, Channel-to-Case Case Temperature 117°C, P_D = 15.1 W	$R_{\theta CHC}$ (FEA)	5.9[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 = –11.6 and B = 9129.

10 ESD protection characteristics

Table 7. ESD protection characteristics

Test Methodology	Class
Human Body Model (per JS-001-2017)	1A
Charge Device Model (per JS-002-2014)	C3

11 Moisture sensitivity level

Table 8. 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 9. DC characteristics — off characteristics
(T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Off characteristics[1]					
Off-State Drain Leakage (V_{DS} = 150 Vdc, V_{GS} = –8 Vdc) Carrier (V_{DS} = 150 Vdc, V_{GS} = –8 Vdc) Peaking	$I_{D(BR)}$	 — —	 — —	 2.1 3.9	mAdc
Off-State Gate Leakage (V_{DS} = 48 Vdc, V_{GS} = –8 Vdc) Carrier (V_{DS} = 48 Vdc, V_{GS} = –8 Vdc) Peaking	I_{GLK}	 –1.0 –1.0	 — —	 — —	mAdc

[1] Each side of device measured separately.

12.1.2 DC characteristics — on characteristics

Table 10. DC characteristics — on characteristics
(T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
On characteristics — Side A, carrier					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 4.6 mAdc)	$V_{GS(th)}$	–4.6	–3.0	–1.9	Vdc
Gate Quiescent Voltage (V_{DD} = 48 Vdc, I_{DA} = 60 mAdc, Measured in Functional Test)	$V_{GSA(Q)}$	–3.0	–2.4	–2.0	Vdc
Gate-Source Leakage Current (V_{DS} = 150 Vdc, V_{GS} = –8 Vdc)	I_{GSS}	–2.1	—	—	mAdc
On characteristics — Side B, peaking					
Gate Threshold Voltage (V_{DS} = 10 Vdc, I_D = 8.7 mAdc)	$V_{GS(th)}$	–4.6	–3.0	–1.9	Vdc
Gate-Source Leakage Current (V_{DS} = 150 Vdc, V_{GS} = –8 Vdc)	I_{GSS}	–3.9	—	—	mAdc

12.2 Functional tests

Table 11. 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_{DQA} = 60 mA, V_{GSB} = (V_t – 1.25) Vdc, P_{out} = 14 W Avg., f = 2400 MHz, 1-tone CW.

Characteristic	Symbol	Min	Typ	Max	Unit
Power Gain	G_{ps}	15.5	17.9	20.5	dB
Drain Efficiency	η_D	47.0	57.0	—	%
Saturated Power (Pulsed CW, 5% Duty Cycle)	P_{sat}	46.8	48.7	—	dBm

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

12.3 Wideband ruggedness

Table 12. Wideband ruggedness

(In NXP Doherty Reference Circuit, T_A = 25°C unless otherwise noted, 50 ohm system)[1] I_{DQA} = 50 mA, V_{GSB} = –4.7 Vdc, f = 2350 MHz, Additive White Gaussian Noise (AWGN) with 10 dB PAR.

Characteristic	Symbol	Min	Typ	Max	Unit
ISBW of 400 MHz at 55 Vdc, 27.5 W Avg. Modulated Output Power (3 dB Input Overdrive from 13.8 W Avg. Modulated Output Power)	No Device Degradation				

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

12.4 Typical performance

Table 13. Typical performance

(In NXP Doherty Reference Circuit, T_A = 25°C unless otherwise noted, 50 ohm system)[1] V_{DD} = 48 Vdc, I_{DQA} = 50 mA, V_{GSB} = –4.7 Vdc, 2300–2400 MHz Bandwidth.

Characteristic	Symbol	Min	Typ	Max	Unit
Fast CW, 27 ms sweep					
Saturated Power	P_{sat}	—	92	—	W
AM/PM (Maximum value measured at saturated power across the 2300–2400 MHz bandwidth)	Φ	—	–10	—	°
Gain Variation @ Avg. Power over Temperature (–40°C to +85°C)	ΔG	—	0.028	—	dB/°C
Output Power Variation @ Saturated Power over Temperature (–40°C to +85°C)	ΔP_{sat}	—	0.002	—	dB/°C
Single-carrier W-CDMA, unclipped					
Gain Flatness in 100 MHz Bandwidth @ P_{out} = 13.8 W Avg.	G_F	—	0.2	—	dB
2-tone CW					
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	VBW_{res}	—	180	—	MHz

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

Correct biasing sequence for GaN depletion mode amplifiers in a Doherty configuration

Bias ON the device

1. Set gate voltage V_{GSA} and V_{GSB} to –5 V.
2. Set drain voltage V_{DSA} and V_{DSB} to nominal supply voltage (+48 V).
3. Increase V_{GSA} (carrier side) until I_{DQA} current is attained.
4. Increase V_{GSB} (peaking side) to target bias voltage.
5. Apply RF input power to desired level.

Bias OFF the device

1. Disable RF input power.
2. Adjust gate voltage V_{GSA} and V_{GSB} to –5 V.
3. Adjust drain voltage V_{DSA} and V_{DSB} to 0 V. Allow adequate time for drain voltage to reduce to 0 V from external drain capacitors.
4. Disable V_{GSA} and V_{GSB}.

13 Package information

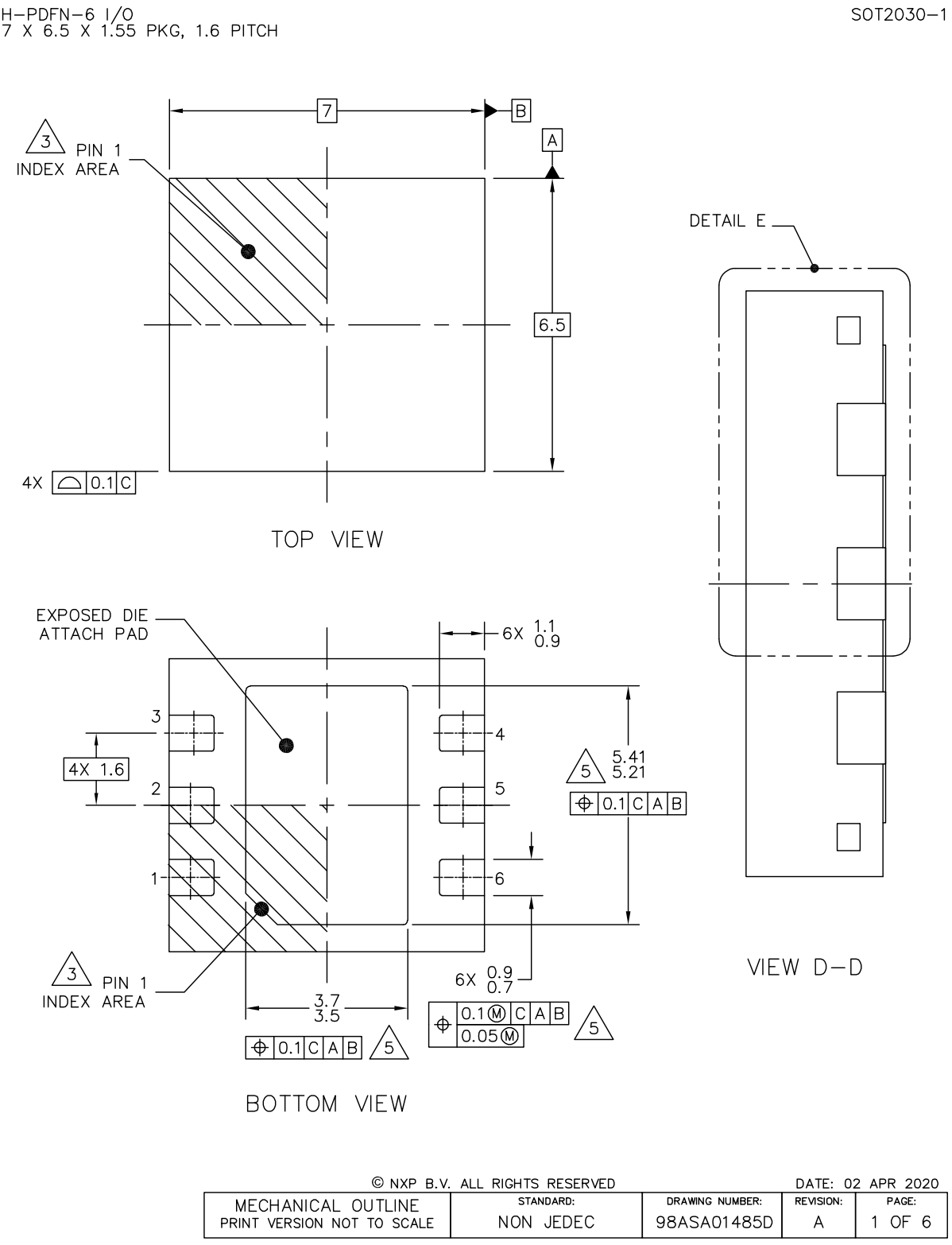
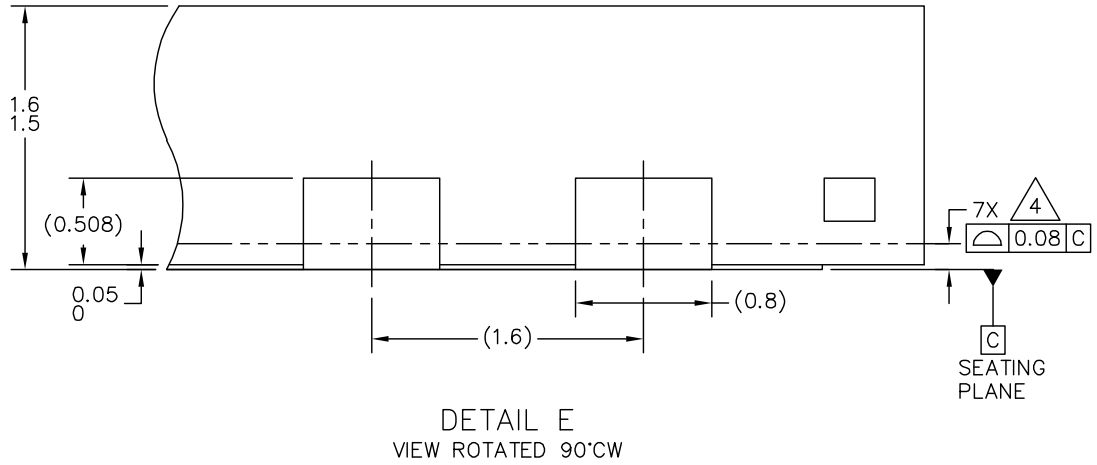


Figure 3. Package outline (DFN 7 mm × 6.5 mm) — top view, bottom view, detail E

H–PDFN–6 I/O
7 X 6.5 X 1.55 PKG, 1.6 PITCH

SOT2030–1



DETAIL E
VIEW ROTATED 90°CW

DATE: 02 APR 2020

MECHANICAL OUTLINE PRINT VERSION NOT TO SCALE	STANDARD: NON JEDEC	DRAWING NUMBER: 98ASA01485D	REVISION: A	PAGE: 2

Figure 4. Package outline (DFN 7 mm × 6.5 mm) — detail E, rotated

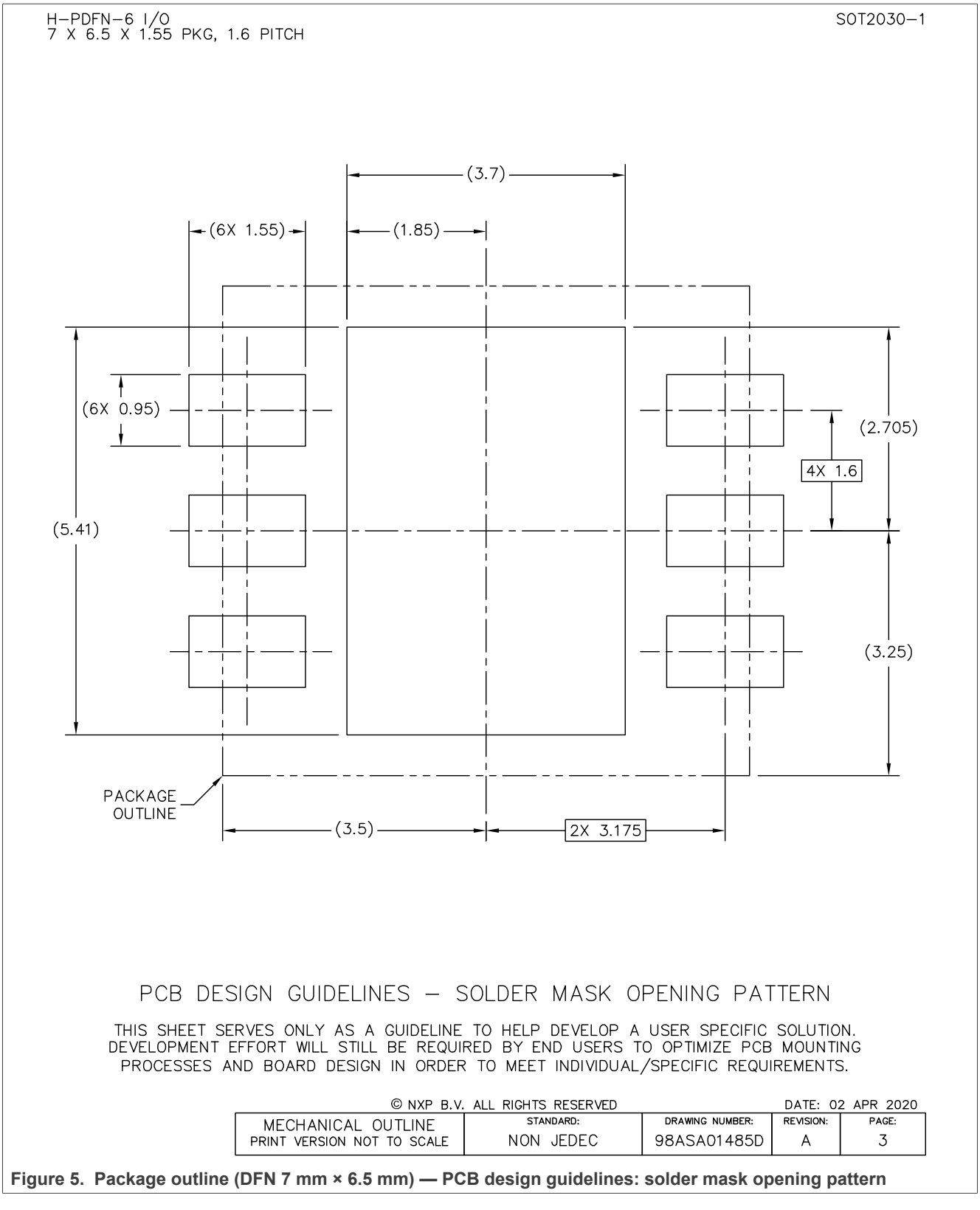
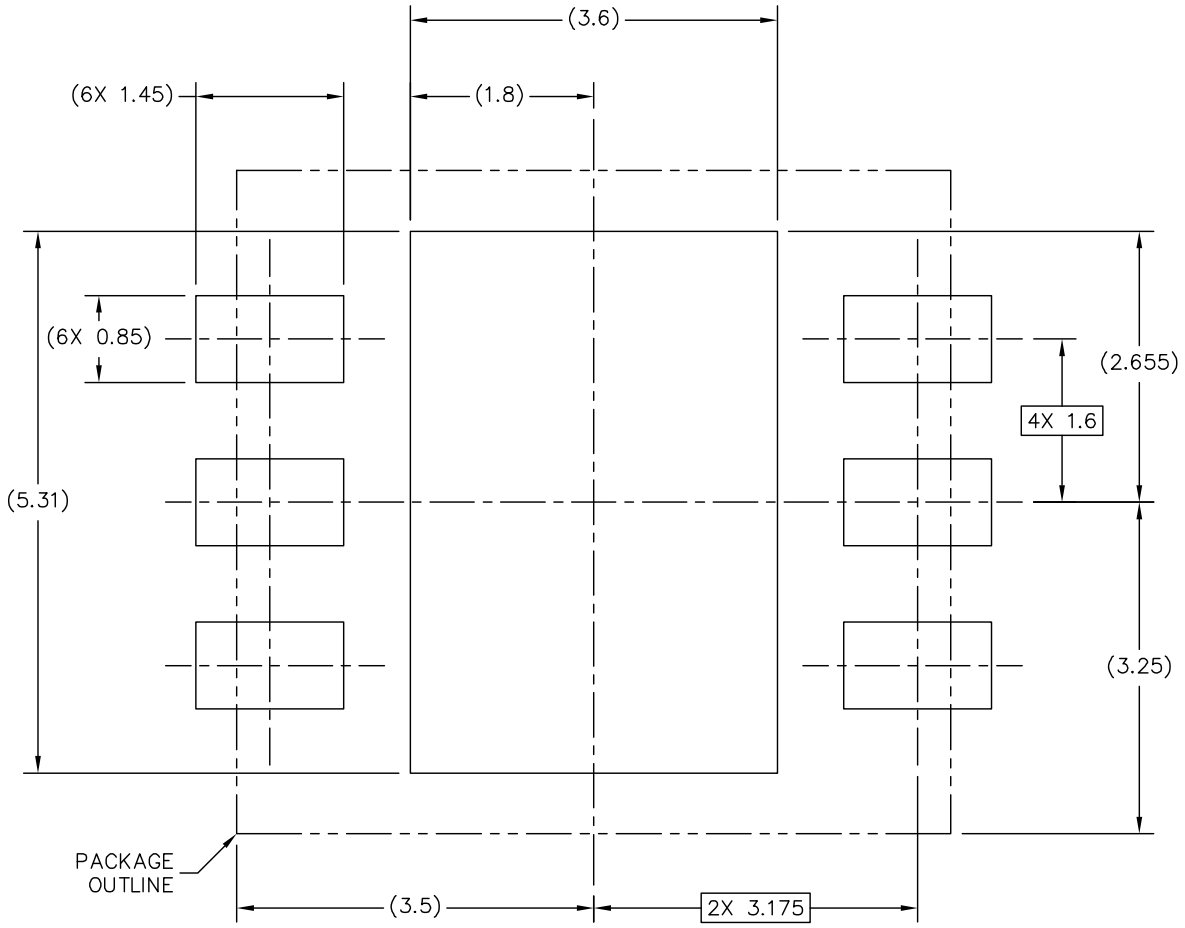


Figure 5. Package outline (DFN 7 mm × 6.5 mm) — PCB design guidelines: solder mask opening pattern

H–PDFN–6 I/O
7 X 6.5 X 1.55 PKG, 1.6 PITCH

SOT2030–1



PCB DESIGN GUIDELINES – I/O PADS AND SOLDERABLE AREA

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.

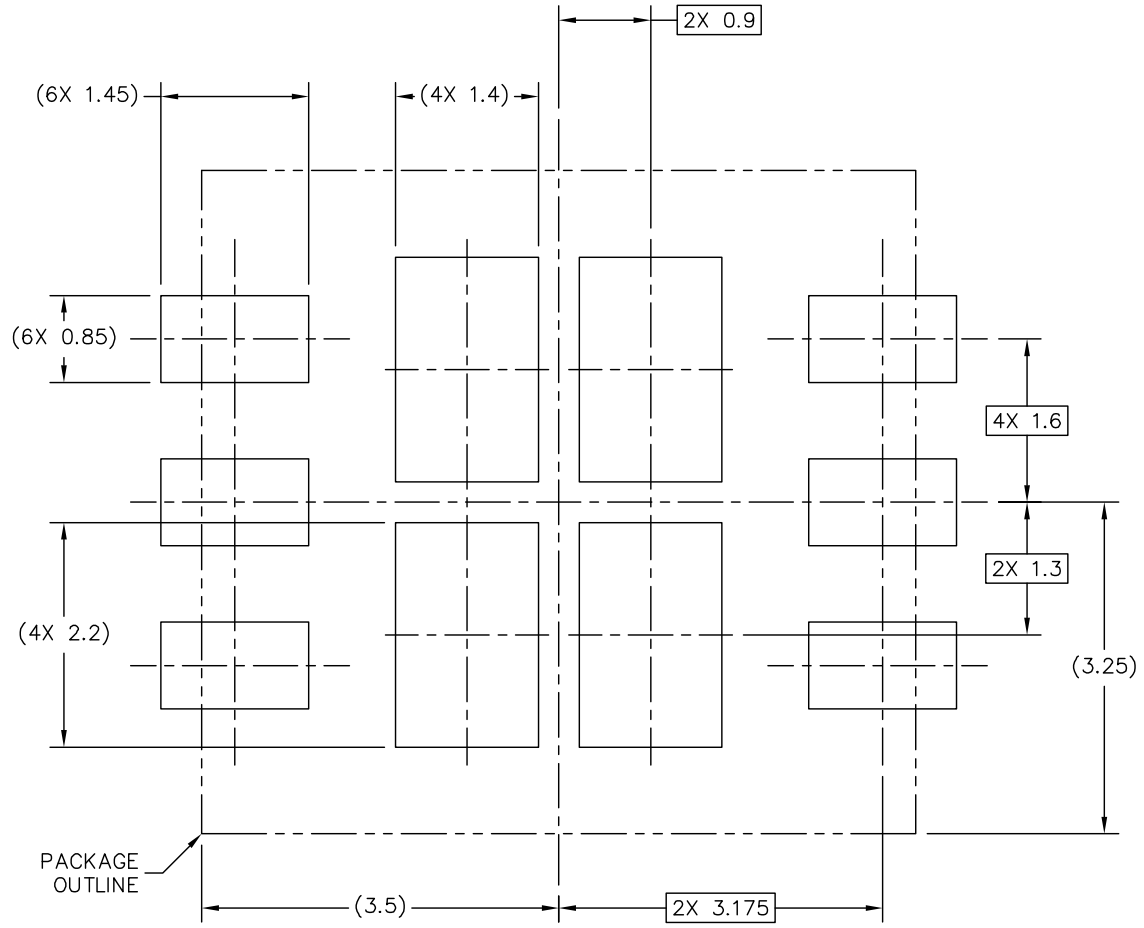
DATE: 02 APR 2020

MECHANICAL OUTLINE PRINT VERSION NOT TO SCALE	STANDARD: NON JEDEC	DRAWING NUMBER: 98ASA01485D	REVISION: A	PAGE: 4

Figure 6. Package outline (DFN 7 mm × 6.5 mm) — PCB design guidelines: I/O pads and solderable area

H–PDFN–6 I/O
7 X 6.5 X 1.55 PKG, 1.6 PITCH

SOT2030–1



STENCIL THICKNESS 0.125 OR 0.15

PCB DESIGN GUIDELINES – SOLDER PASTE STENCIL

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: 02 APR 2020

MECHANICAL OUTLINE PRINT VERSION NOT TO SCALE	STANDARD: NON JEDEC	DRAWING NUMBER: 98ASA01485D	REVISION: A	PAGE: 5

Figure 7. Package outline (DFN 7 mm × 6.5 mm) — PCB design guidelines: solder paste stencil

H–PDFN–6 I/O
7 X 6.5 X 1.55 PKG, 1.6 PITCH

SOT2030–1

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.
5. RADIUS ON LEAD AND DIE ATTACH FLAG IS OPTIONAL.

DATE: 02 APR 2020

MECHANICAL OUTLINE PRINT VERSION NOT TO SCALE	STANDARD: NON JEDEC	DRAWING NUMBER: 98ASA01485D	REVISION: A	PAGE: 6

Figure 8. Package outline (DFN 7 mm × 6.5 mm) — notes

14 Product documentation and software

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

15 Revision history

The following table summarizes revisions to this document.

Table 14. Revision history

Revision	Date	Description
0	13 September 2022	• Initial release of data sheet
1	30 November 2022	• Table 1, Maximum Ratings: Gate−Source Voltage: updated –8, 0 to –16, 0 Vdc, p. 2 • General updates made to align data sheet to current standard
2	18 October 2023	• Figure 2, Product Marking: added, p. 2 • Table 3, Product Marking Trace Code: added, p. 2 • Table 11, Functional Tests: updated output power test condition, p. 5 • General updates made to align data sheet to current standard

16 Legal information

16.1 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.nxp.com.

16.2 Definitions

Draft — A draft status on a document indicates that the content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included in a draft version of a document 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 NXP Semiconductors 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 NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

16.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors 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. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors.

In no event shall NXP Semiconductors 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, NXP Semiconductors' 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 NXP Semiconductors.

Right to make changes — NXP Semiconductors 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 — NXP Semiconductors 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 NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors 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. NXP Semiconductors 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 NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors 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.

NXP Semiconductors 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 NXP Semiconductors 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). NXP 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 — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/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. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors 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.

Suitability for use in non-automotive qualified products — Unless this document expressly states that this specific NXP Semiconductors 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. NXP Semiconductors 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 NXP Semiconductors' warranty of the product for such automotive applications, use and specifications, and (b) whenever customer uses the product for automotive applications beyond NXP Semiconductors' specifications such use shall be solely at customer's own risk, and (c) customer fully indemnifies NXP Semiconductors for any liability, damages or failed product claims resulting from customer design and use of the product for automotive applications beyond NXP Semiconductors' standard warranty and NXP Semiconductors' product specifications.

Translations — A non-English (translated) version of a document, including the legal information in that document, is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Security — Customer understands that all NXP products may be subject to unidentified vulnerabilities or may support established security standards or specifications with known limitations. Customer is responsible for the design and operation of its applications and products throughout their lifecycles to reduce the effect of these vulnerabilities on customer's applications and products. Customer's responsibility also extends to other open and/or proprietary technologies supported by NXP products for use in customer's applications. NXP accepts no liability for any vulnerability. Customer should regularly check security updates from NXP and follow up appropriately.

Customer shall select products with security features that best meet rules, regulations, and standards of the intended application and make the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP.

NXP has a Product Security Incident Response Team (PSIRT) (reachable at PSIRT@nxp.com) that manages the investigation, reporting, and solution release to security vulnerabilities of NXP products.

NXP B.V. - NXP B.V. is not an operating company and it does not distribute or sell products.

16.4 Trademarks

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

NXP — wordmark and logo are trademarks of NXP B.V.

Airfast — is a trademark of NXP B.V.

Contents

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

Date of release: 18 October 2023
Document identifier: A5G23H110N