

A5G23H065N

Airfast RF Power GaN Amplifier

Rev. 2 — 18 October 2023

Product data sheet



1 General description

This 8.8 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

$V_{DD} = 48 \text{ Vdc}$, $I_{DQA} = 30 \text{ mA}$, $V_{GSB} = -4.3 \text{ Vdc}$, $P_{out} = 8.8 \text{ W Avg.}$, 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 | 17.3 | 61.7 | 8.3 | -27.3 |
| 2350 MHz | 17.3 | 60.2 | 8.4 | -28.4 |
| 2400 MHz | 17.1 | 58.2 | 8.4 | -29.4 |

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



4 Pinning information

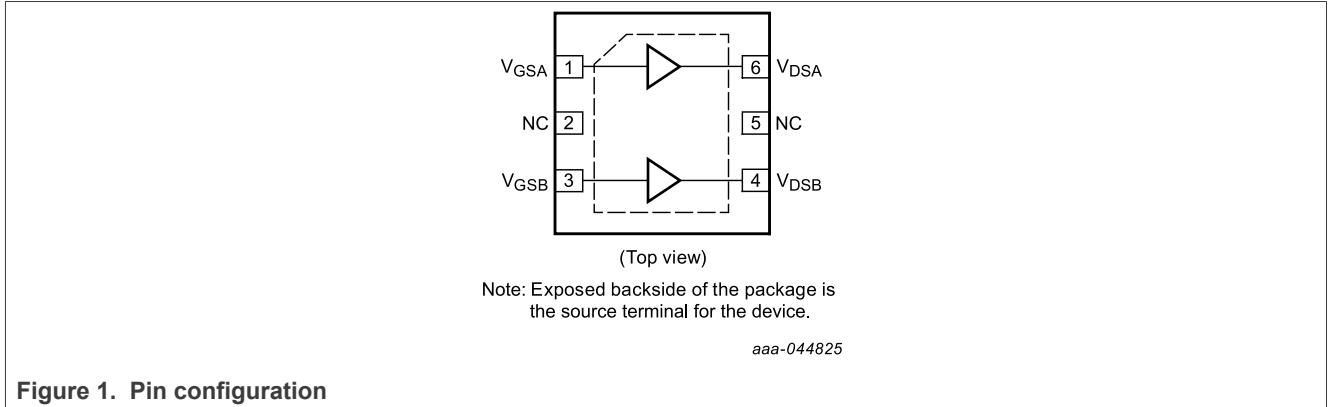


Figure 1. Pin configuration

5 Ordering information

Table 2. Ordering information

| Device | Tape and Reel Information | Package |
|--------------|---|-------------|
| A5G23H065NT4 | 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, $I_{G(A+B)}$, @ $T_C = 25^\circ\text{C}$ | I_{GMAX} | 7.5 | mA |
| Storage Temperature Range | T_{stg} | -65 to +150 | $^\circ\text{C}$ |
| Case Operating Temperature Range | T_C | -55 to +150 | $^\circ\text{C}$ |
| Maximum Channel Temperature | T_{CH} | 225 | $^\circ\text{C}$ |

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 119°C , $P_D = 8.1\text{ W}$ | $R_{\theta JC}$ (IR) | 3.9 ^[1] | $^\circ\text{C/W}$ |
| Thermal Resistance by Finite Element Analysis, Channel-to-Case Case Temperature 119°C , $P_D = 8.1\text{ W}$ | $R_{\theta CHC}$ (FEA) | 11.5 ^[2] | $^\circ\text{C/W}$ |

[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 $MTTF (\text{hours}) = 10^{[A + B/(T + 273)]}$, 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 | $^\circ\text{C}$ |

12 Electrical characteristics

12.1 DC characteristics

12.1.1 DC characteristics — off characteristics

Table 9. DC characteristics — off characteristics

($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|-------------|--------------|--------|------------|------|
| Off characteristics^[1] | | | | | |
| Off-State Drain Leakage ($V_{DS} = 150\text{ Vdc}$, $V_{GS} = -8\text{ Vdc}$) Carrier ($V_{DS} = 150\text{ Vdc}$, $V_{GS} = -8\text{ Vdc}$) Peaking | $I_{D(BR)}$ | — | — | 1.1 2.4 | mAdc |
| Off-State Gate Leakage ($V_{DS} = 48\text{ Vdc}$, $V_{GS} = -8\text{ Vdc}$) Carrier ($V_{DS} = 48\text{ Vdc}$, $V_{GS} = -8\text{ Vdc}$) 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

($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|--------------|------|------|------|------|
| On characteristics — Side A, carrier | | | | | |
| Gate Threshold Voltage ($V_{DS} = 10\text{ Vdc}$, $I_D = 2.3\text{ mAdc}$) | $V_{GS(th)}$ | -4.6 | -2.5 | -1.9 | Vdc |
| Gate Quiescent Voltage ($V_{DD} = 48\text{ Vdc}$, $I_{DA} = 30\text{ mAdc}$, Measured in Functional Test) | $V_{GSA(Q)}$ | -2.9 | -2.5 | -1.9 | Vdc |
| Gate-Source Leakage Current ($V_{DS} = 150\text{ Vdc}$, $V_{GS} = -8\text{ Vdc}$) | I_{GSS} | -1.1 | — | — | mAdc |
| On characteristics — Side B, peaking | | | | | |
| Gate Threshold Voltage ($V_{DS} = 10\text{ Vdc}$, $I_D = 5.2\text{ mAdc}$) | $V_{GS(th)}$ | -4.6 | -2.5 | -1.9 | Vdc |
| Gate-Source Leakage Current ($V_{DS} = 150\text{ Vdc}$, $V_{GS} = -8\text{ Vdc}$) | I_{GSS} | -2.4 | — | — | mAdc |

12.2 Functional tests

Table 11. Functional tests

(In NXP Doherty Production ATE^[1] Test Fixture, $T_A = 25^\circ\text{C}$ unless otherwise noted, 50 ohm system)^[2] $V_{DD} = 48\text{ Vdc}$, $I_{DQA} = 30\text{ mA}$, $V_{GSB} = (V_t - 1.22)\text{ Vdc}$, $P_{out} = 8.8\text{ W Avg.}$, $f = 2300\text{ MHz}$, 1-tone CW.

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|-----------|------|------|------|------|
| Power Gain | G_{ps} | 14.0 | 15.5 | 18.5 | dB |
| Drain Efficiency | η_D | 48.0 | 53.3 | — | % |
| Saturated Power (Pulsed CW, 5% Duty Cycle) | P_{sat} | 45.2 | 46.1 | — | 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, $T_A = 25^\circ\text{C}$ unless otherwise noted, 50 ohm system)^[1] $I_{DQA} = 30\text{ mA}$, $V_{GSB} = -4.3\text{ Vdc}$, $f = 2350\text{ MHz}$, Additive White Gaussian Noise (AWGN) with 10 dB PAR.

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|--------|-----------------------|-----|-----|------|
| ISBW of 400 MHz at 55 Vdc, 17.6 W Avg. Modulated Output Power (3 dB Input Overdrive from 8.8 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, $T_A = 25^\circ\text{C}$ unless otherwise noted, 50 ohm system)^[1] $V_{DD} = 48\text{ Vdc}$, $I_{DQA} = 30\text{ mA}$, $V_{GSB} = -4.3\text{ Vdc}$, 2300–2400 MHz Bandwidth.

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|------------------|-----|-------|-----|-------|
| Fast CW, 27 ms sweep | | | | | |
| Saturated Power | P_{sat} | — | 63.1 | — | W |
| AM/PM (Maximum value measured at saturated power across the 2300–2400 MHz bandwidth) | Φ | — | -18 | — | ° |
| Gain Variation @ Avg. Power over Temperature (-40°C to +85°C) | ΔG | — | 0.016 | — | 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 @ $P_{out} = 8.8\text{ W Avg.}$ | G_F | — | 0.2 | — | dB |
| 2-tone CW | | | | | |
| VBW Resonance Point (IMD Third Order Intermodulation Inflection Point) | VBW_{res} | — | 310 | — | MHz |

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

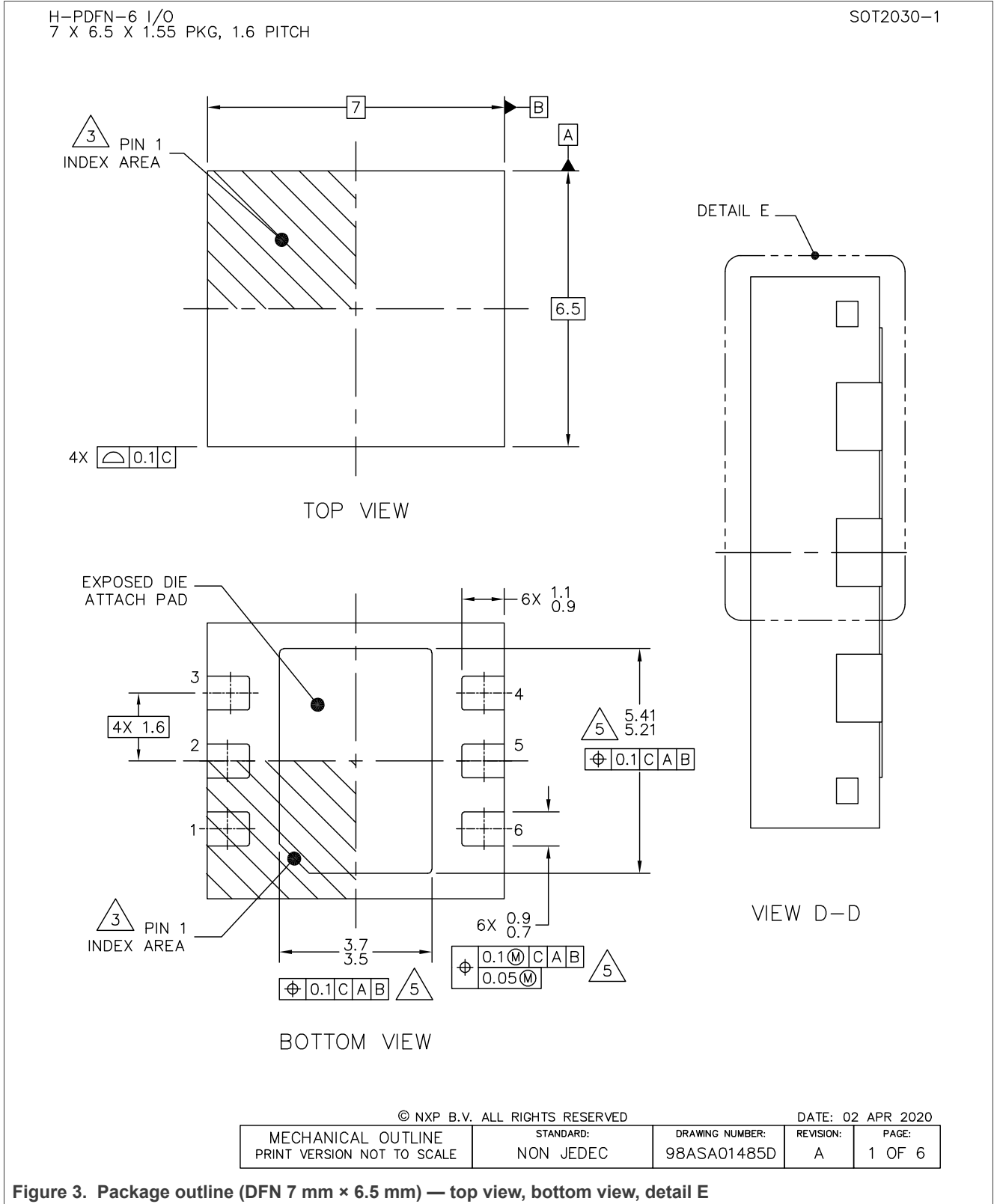
Correct biasing sequence for GaN depletion mode amplifiers in a Doherty configuration**Bias ON the device**

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

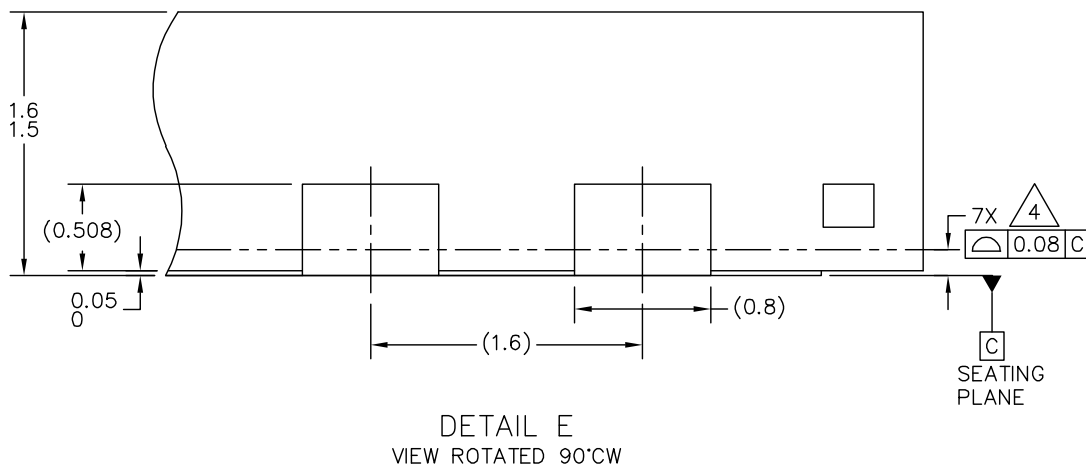
1. Disable RF input power.
2. Adjust gate voltage V_{GSA} and V_{GSB} to -5 V.
3. Adjust drain voltage V_{DSA} and V_{DSB} to 0 V. Allow adequate time for drain voltage to reduce to 0 V from external drain capacitors.
4. Disable V_{GSA} and V_{GSB} .

13 Package information



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

SOT2030-1



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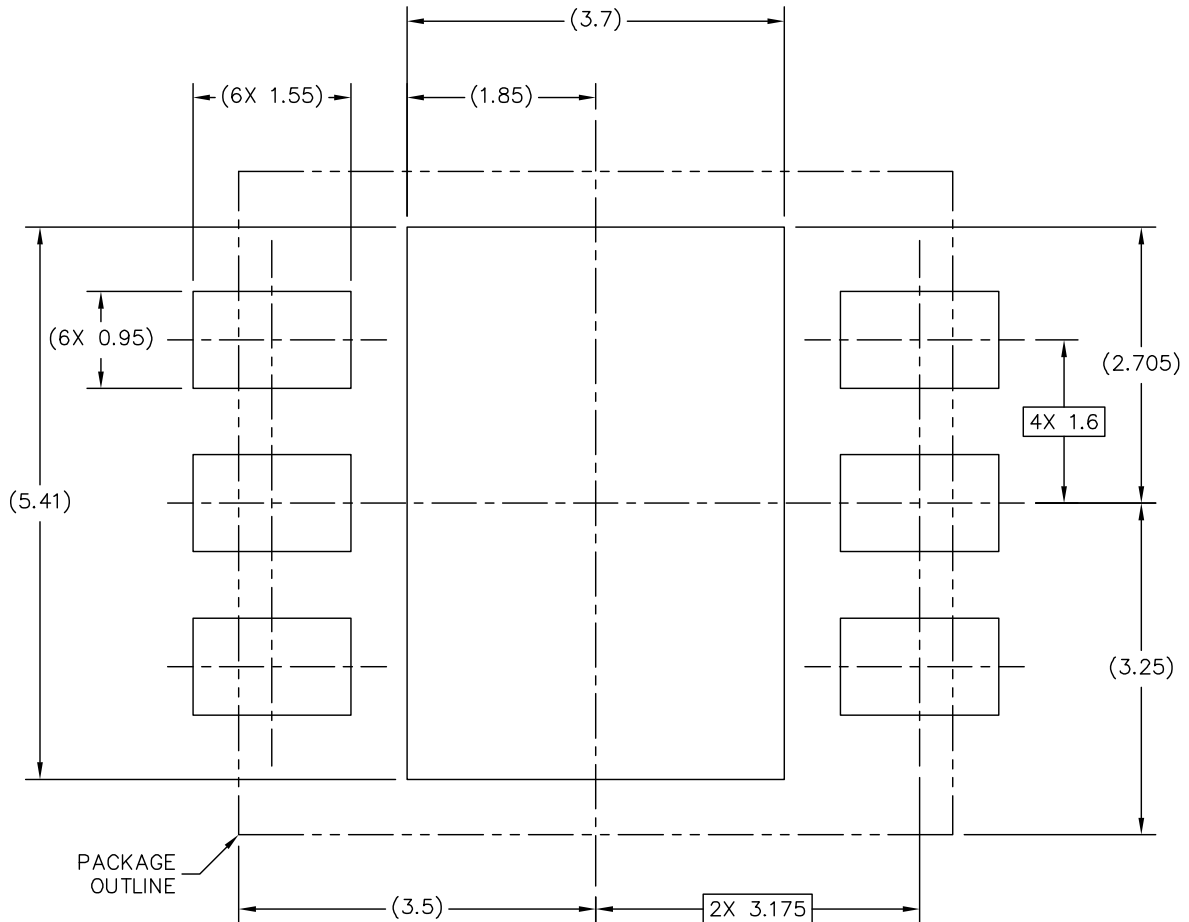
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|--|------------------------|--------------------------------|----------------|------------|

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

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

SOT2030-1



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.

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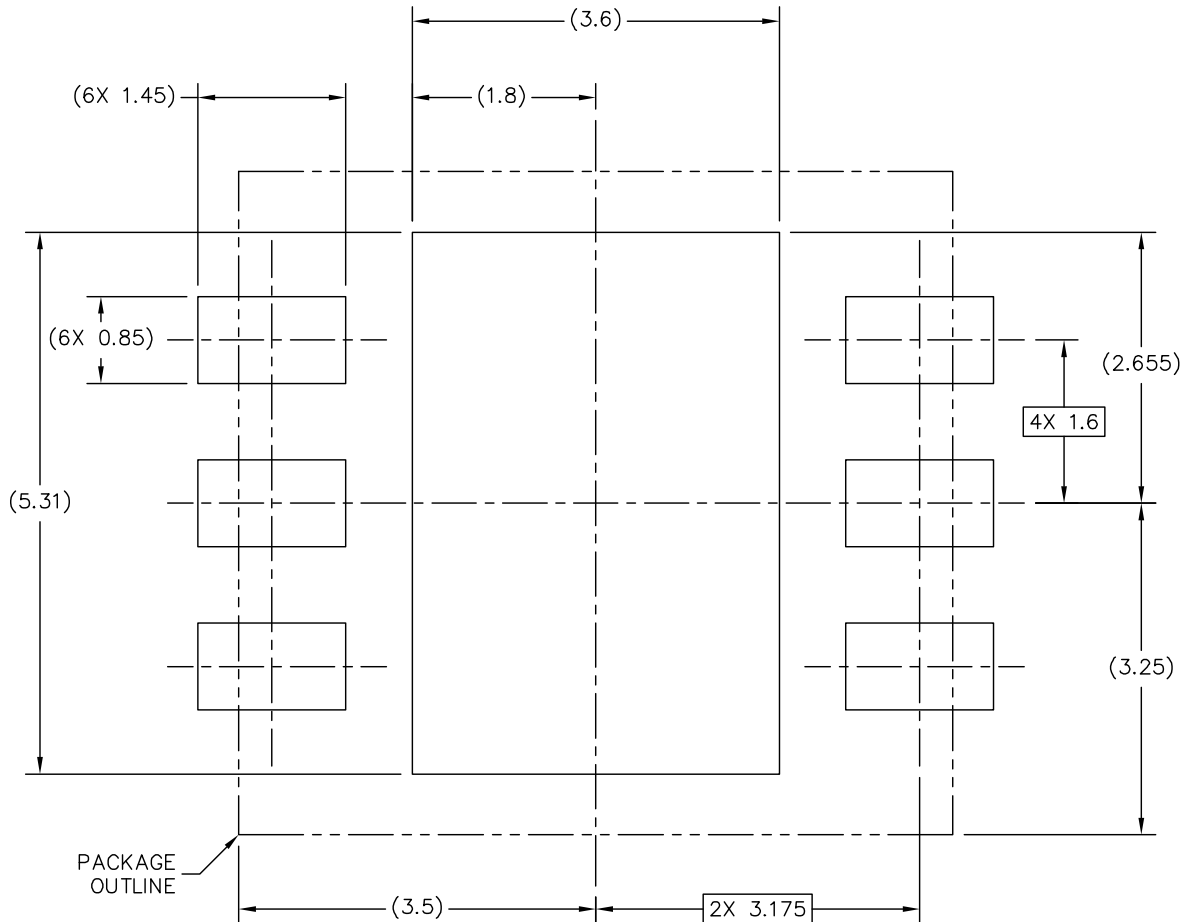
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Figure 5. Package outline (DFN 7 mm × 6.5 mm) — PCB design guidelines: solder mask opening pattern

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

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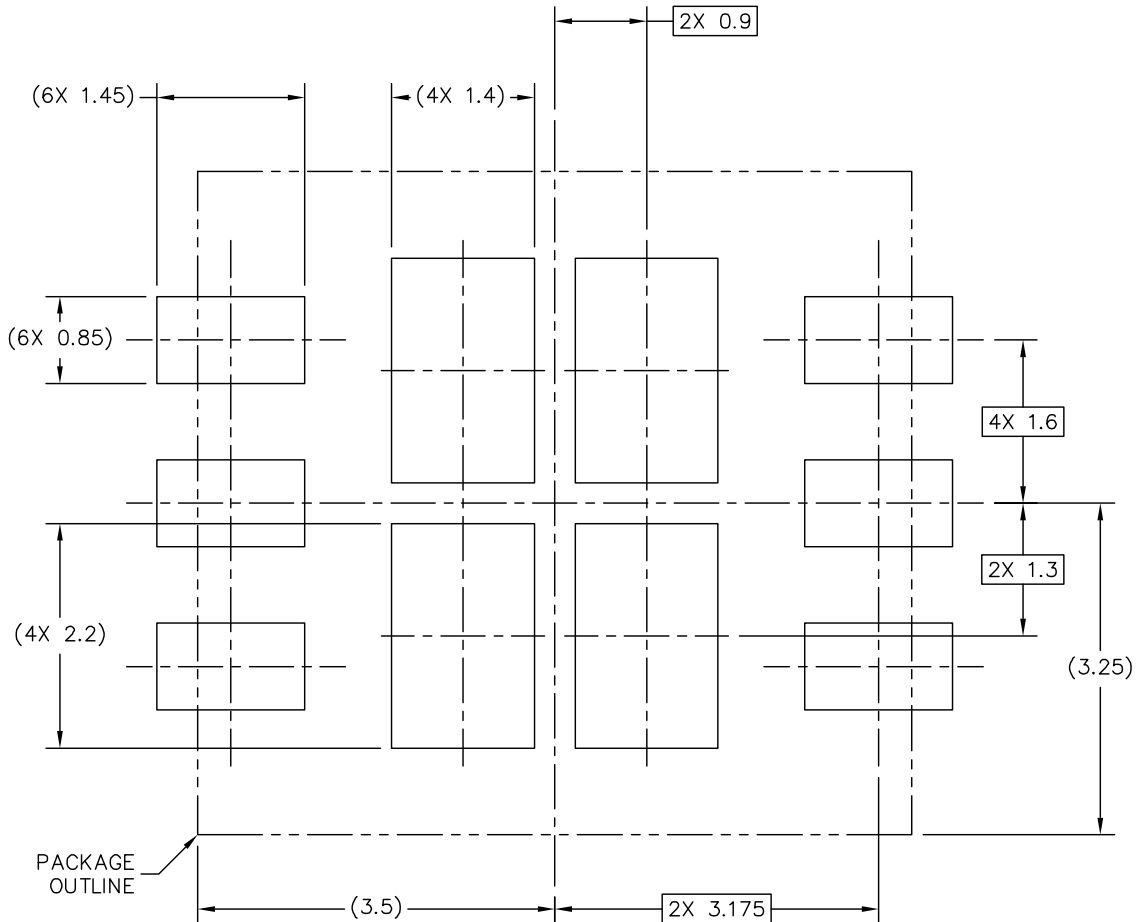
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Figure 6. Package outline (DFN 7 mm × 6.5 mm) — PCB design guidelines: I/O pads and solderable area

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

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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.

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|--|------------------------|--------------------------------|----------------|------------|

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 | 18 November 2021 | <ul style="list-style-type: none"> • Initial release of data sheet |
| 1 | 30 November 2022 | <ul style="list-style-type: none"> • 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 |
| 2 | 18 October 2023 | <ul style="list-style-type: none"> • 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".

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