# A5G23H065N

## Airfast RF Power GaN Transistor

Rev. 0 — November 2021

Data Sheet: Technical Data

This 8.8 W asymmetrical Doherty RF power GaN transistor 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.

**2300 MHz**

- Typical Doherty Single-Carrier W-CDMA Reference Circuit Performance: $V_{DD}$ = 48 Vdc, $I_{DQA}$ = 30 mA, $V_{GSB}$ = –4.3 Vdc, $P_{out}$ = 8.8 W Avg., Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF. (1)

| Frequency | $G_{ps}$ (dB) | $\eta_D$ (%) | 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 in reference circuit with device soldered to printed circuit board.

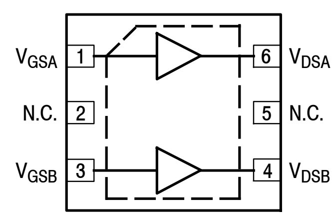
**Features**

- 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 analog or digital linearization systems
- Optimized for massive MIMO active antenna systems for 5G base stations

**A5G23H065N**

**2300–2400 MHz, 8.8 W Avg., 48 V AIRFAST RF POWER GaN TRANSISTOR**

**DFN 7 × 6.5 PLASTIC**




(Top View)

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

**Figure 1. Pin Connections**

**Table 1. Maximum Ratings**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DSS}$ | 125 | Vdc |
| Gate-Source Voltage | $V_{GS}$ | –8, 0 | Vdc |
| Operating Voltage | $V_{DD}$ | 55 | Vdc |
| Maximum Forward Gate Current, $I_{G\ (A+B)}$, @ $T_C$ = 25°C | $I_{GMAX}$ | 7.5 | 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 |

**Table 2. Recommended Operating Conditions**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Operating Voltage | $V_{DD}$ | 48 | Vdc |

**Table 3. Thermal Characteristics**

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance by Infrared Measurement, Active Die Surface-to-Case<br>Case Temperature 119°C, $P_D$ = 8.1 W | $R_{\theta JC}$ (IR) | 3.9 (1) | °C/W |
| Thermal Resistance by Finite Element Analysis, Channel-to-Case<br>Case Temperature 119°C, $P_D$ = 8.1 W | $R_{\theta CHC}$ (FEA) | 11.5 (2) | °C/W |

**Table 4. ESD Protection Characteristics**

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

**Table 5. Moisture Sensitivity Level**

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

**Table 6. Electrical Characteristics** ($T_A$ = 25°C unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Off Characteristics (3)** | | | | | |
| Off-State Drain Leakage<br>($V_{DS}$ = 150 Vdc, $V_{GS}$ = –8 Vdc) Carrier<br>($V_{DS}$ = 150 Vdc, $V_{GS}$ = –8 Vdc) Peaking | $I_{D(BR)}$ | —<br>— | —<br>— | 1.1<br>2.4 | mAdc |
| Off-State Gate Leakage<br>($V_{DS}$ = 48 Vdc, $V_{GS}$ = –8 Vdc) Carrier<br>($V_{DS}$ = 48 Vdc, $V_{GS}$ = –8 Vdc) Peaking | $I_{GLK}$ | –1.0<br>–1.0 | —<br>— | —<br>— | mAdc |
| **On Characteristics — Side A, Carrier** | | | | | |
| Gate Threshold Voltage<br>($V_{DS}$ = 10 Vdc, $I_D$ = 2.3 mAdc) | $V_{GS(th)}$ | –4.6 | –2.5 | –1.9 | Vdc |
| Gate Quiescent Voltage<br>($V_{DD}$ = 48 Vdc, $I_{DA}$ = 30 mAdc, Measured in Functional Test) | $V_{GSA(Q)}$ | –2.9 | –2.5 | –1.9 | Vdc |
| Gate-Source Leakage Current<br>($V_{DS}$ = 150 Vdc, $V_{GS}$ = –8 Vdc) | $I_{GSS}$ | –1.1 | — | — | mAdc |
| **On Characteristics — Side B, Peaking** | | | | | |
| Gate Threshold Voltage<br>($V_{DS}$ = 10 Vdc, $I_D$ = 5.2 mAdc) | $V_{GS(th)}$ | –4.6 | –2.5 | –1.9 | Vdc |
| Gate-Source Leakage Current<br>($V_{DS}$ = 150 Vdc, $V_{GS}$ = –8 Vdc) | $I_{GSS}$ | –2.4 | — | — | mAdc |

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.
3. Each side of device measured separately.

(continued)

**Table 6. Electrical Characteristics** ($T_A$ = 25°C unless otherwise noted) **(continued)**

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **Functional Tests** (1) (In NXP Doherty Production Test Fixture, 50 ohm system) $V_{DD}$ = 48 Vdc, $I_{DQA}$ = 30 mA, $V_{GSB}$ = ($V_t$ – 1.22) Vdc, $P_{out}$ = 8.8 W Avg., f = 2300 MHz, 1-tone CW. **[See note on correct biasing sequence.]** | | | | | |
| Power Gain | $G_{ps}$ | 14.0 | 15.5 | 18.5 | dB |
| Drain Efficiency | $\eta_D$ | 48.0 | 53.3 | — | % |
| $P_{out}$ @ 6 dB Compression Point | P6dB | 45.2 | 46.1 | — | dBm |
| **Wideband Ruggedness** (2) (In NXP Doherty Reference Circuit, 50 ohm system) $I_{DQA}$ = 30 mA, $V_{GSB}$ = –4.3 Vdc, f = 2350 MHz, Additive White Gaussian Noise (AWGN) with 10 dB PAR | | | | | |
| 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 | | | | |
| **Typical Performance** (2) (In NXP Doherty Reference Circuit, 50 ohm system) $V_{DD}$ = 48 Vdc, $I_{DQA}$ = 30 mA, $V_{GSB}$ = –4.3 Vdc, 2300–2400 MHz Bandwidth | | | | | |
| VBW Resonance Point (IMD Third Order Intermodulation Inflection Point) | $VBW_{res}$ | — | 310 | — | MHz |
| Gain Flatness in 100 MHz Bandwidth @ $P_{out}$ = 8.8 W Avg. | $G_F$ | — | 0.2 | — | dB |
| **Fast CW, 27 ms Sweep** | | | | | |
| $P_{out}$ @ 6 dB Compression Point | P6dB | — | 63.1 | — | W |
| AM/PM (Maximum value measured at the P6dB compression point across the 2300–2400 MHz bandwidth) | Φ | — | –18 | — | ° |
| Gain Variation over Temperature (–40°C to +85°C) | ΔG | — | 0.016 | — | dB/°C |
| Output Power Variation over Temperature (–40°C to +85°C) | ΔP6dB | — | 0.002 | — | dB/°C |

**Table 7. 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 |

1. Part internally input matched.
2. All data measured in reference circuit with device soldered to printed circuit board.

## NOTE: Correct Biasing Sequence for GaN Depletion Mode Transistors 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.

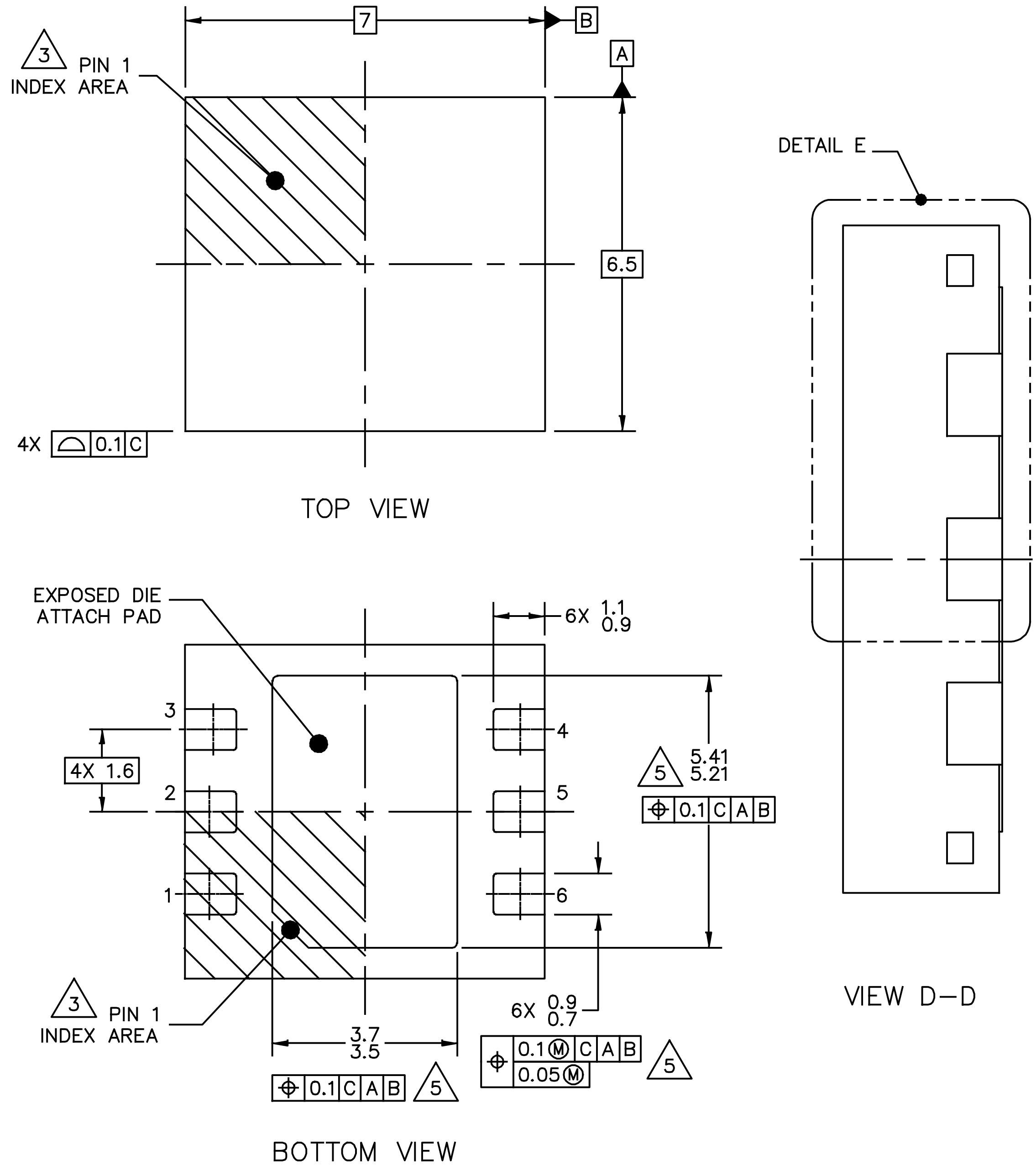
### Bias OFF the device

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 $V_{GSB}$.

# Package Information

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

SOT2030–1



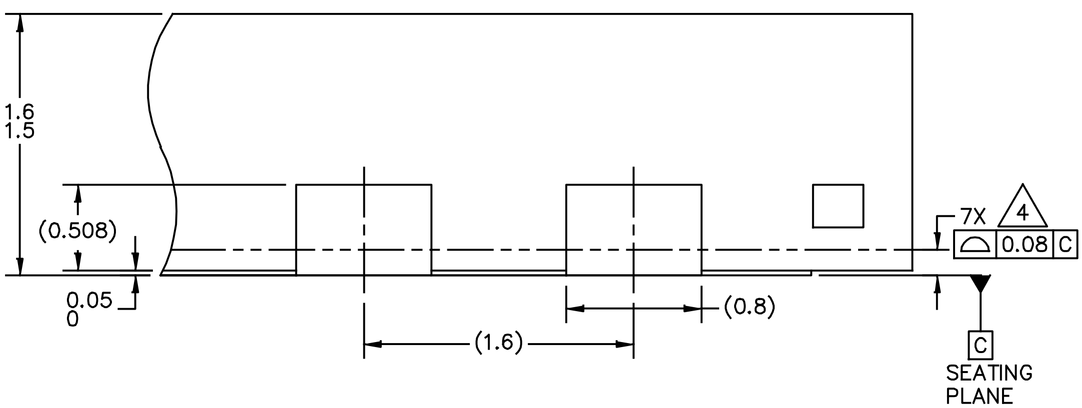



DATE: 02 APR 2020

| MECHANICAL OUTLINE<br>PRINT VERSION NOT TO SCALE | STANDARD: | DRAWING NUMBER: | REVISION: | PAGE: |
|---|---|---|---|---|
| | NON JEDEC | 98ASA01485D | A | 1 OF 6 |

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

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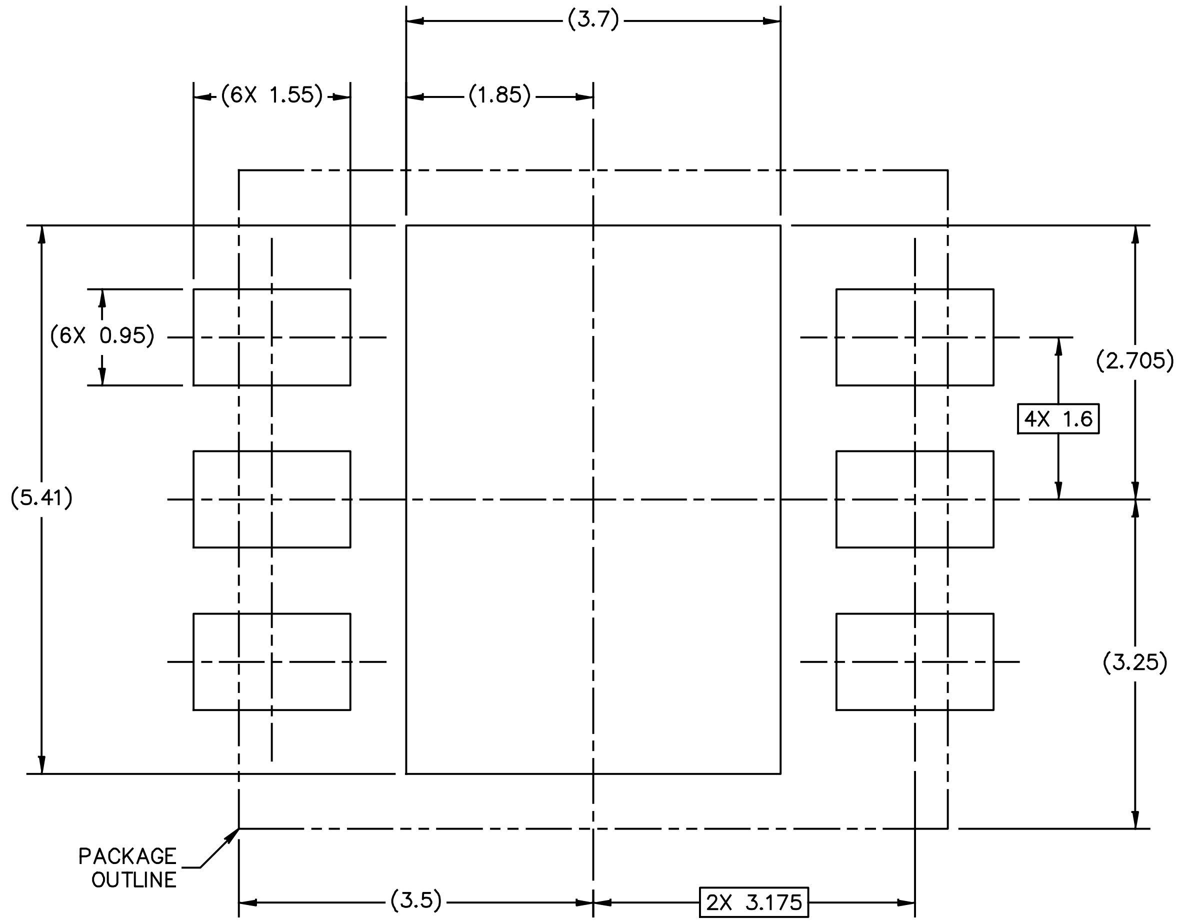
H–PDFN–6 I/O
7 X 6.5 X 1.55 PKG, 1.6 PITCH

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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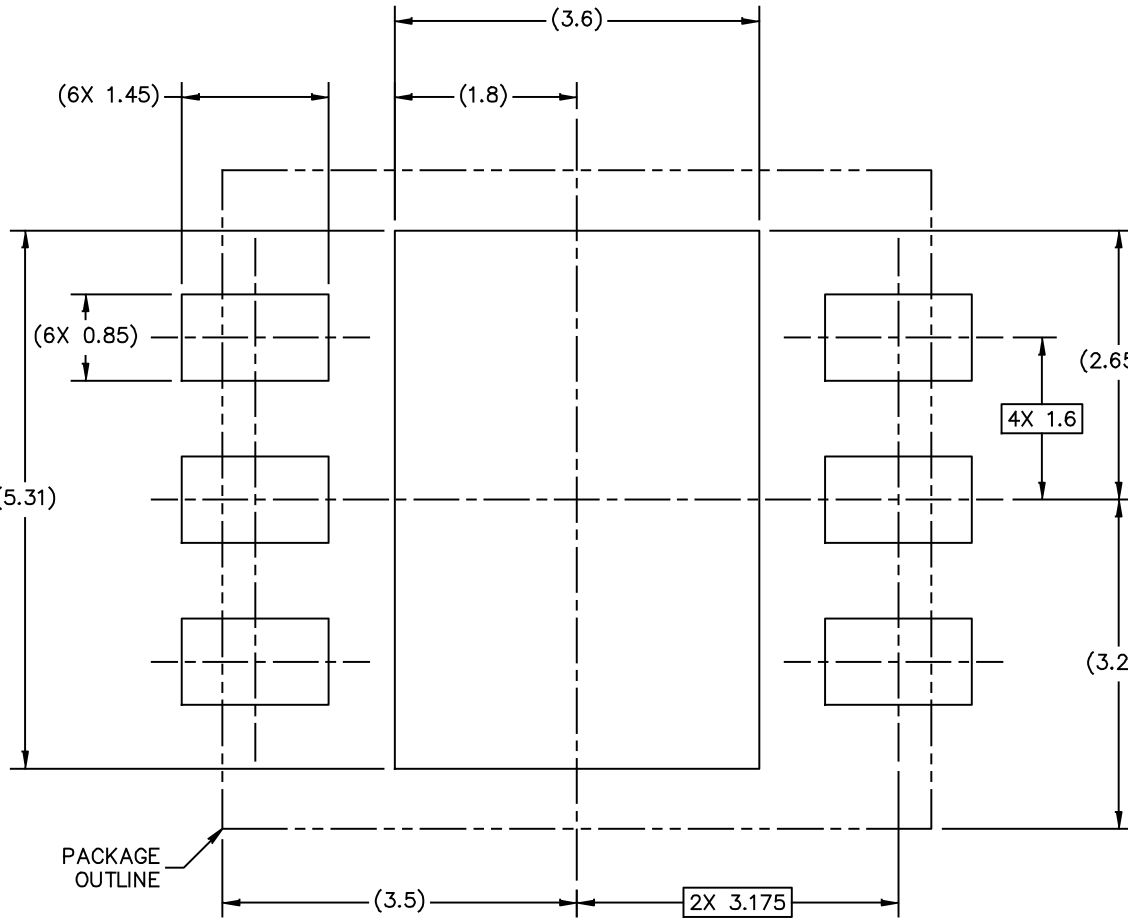
| | NON JEDEC | 98ASA01485D | A | 3 |

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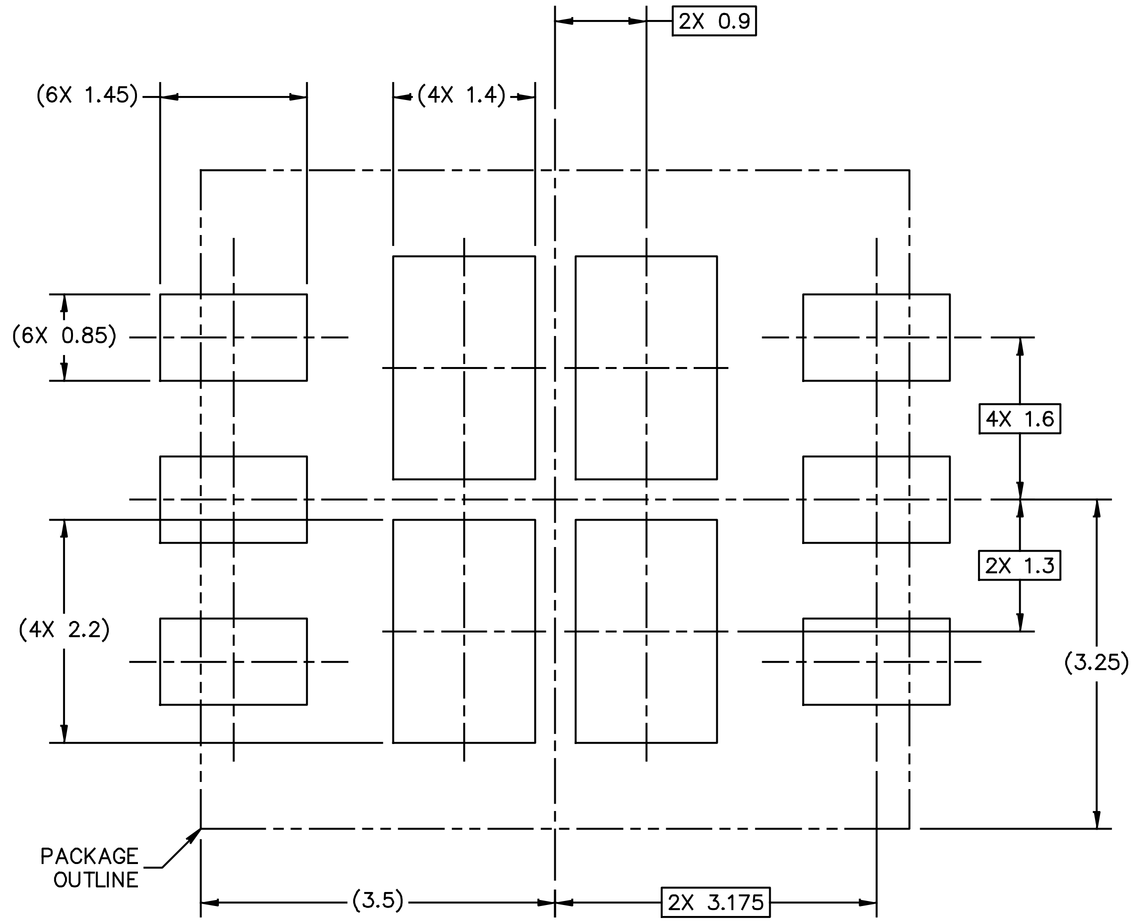
H–PDFN–6 I/O
7 X 6.5 X 1.55 PKG, 1.6 PITCH

SOT2030–1




STENCIL THICKNESS 0.125 OR 0.15

PCB DESIGN GUIDELINES – SOLDER PASTE STENCIL

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| PRINT VERSION NOT TO SCALE | NON JEDEC | 98ASA01485D | A | 5 |

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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# 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

# Revision History

The following table summarizes revisions to this document.

| Revision | Date | Description |
|---|---|---|
| 0 | Nov. 2021 | • Initial release of data sheet |

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Date of release: November 2021
Document identifier: A5G23H065N