

# A5G37H110N

## Airfast RF Power GaN Transistor

Rev. 1 — November 2022

Data Sheet: Technical Data

This 13.5 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 3600 to 3800 MHz.

This part is characterized and performance is guaranteed for applications operating in the 3600 to 3800 MHz band. There is no guarantee of performance when this part is used in applications designed outside of these frequencies.

### 3700 MHz

- Typical Doherty Single-Carrier W-CDMA Reference Circuit Performance:  $V_{DD} = 48$  Vdc,  $I_{DQA} = 70$  mA,  $V_{GSB} = -4.0$  Vdc,  $P_{out} = 13.5$  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)
3600 MHz	15.1	54.1	8.1	-29.5
3700 MHz	15.4	53.5	8.4	-31.8
3800 MHz	15.3	54.3	8.3	-32.0

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

### Features

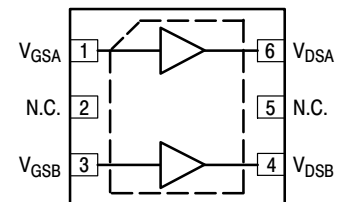
- High terminal impedances for optimal broadband performance
- Improved linearized error vector magnitude with next generation signal
- Able to withstand extremely high output VSWR and broadband operating conditions
- Designed for low complexity linearization systems
- Optimized for massive MIMO active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

## A5G37H110N

3600–3800 MHz, 13.5 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	$V_{GS}$	–16, 0	Vdc
Operating Voltage	$V_{DD}$	55	Vdc
Maximum Forward Gate Current, $I_{G(A+B)}$ @ $T_C = 25^\circ\text{C}$	$I_{GMAX}$	13.3	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	$^\circ\text{C}$

**Table 2. Recommended Operating Conditions**

Characteristic	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 Case Temperature $133^\circ\text{C}$ , $P_D = 14.7\text{ W}$	$R_{\theta JC}$ (IR)	2.7 (1)	$^\circ\text{C/W}$
Thermal Resistance by Finite Element Analysis, Channel–to–Case Case Temperature $133^\circ\text{C}$ , $P_D = 14.7\text{ W}$	$R_{\theta CHC}$ (FEA)	6.1 (2)	$^\circ\text{C/W}$

**Table 4. ESD Protection Characteristics**

Test Methodology	Class
Human Body Model (per JS–001–2017)	1A
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	$^\circ\text{C}$

**Table 6. Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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**Off Characteristics (3)**

Off–State Drain Leakage ( $V_{DS} = 150\text{ Vdc}$ , $V_{GS} = -8\text{ Vdc}$ ) ( $V_{DS} = 150\text{ Vdc}$ , $V_{GS} = -8\text{ Vdc}$ )	Carrier Peaking	$I_{D(BR)}$	— —	— —	2.1 3.9	mAdc
Off–State Gate Leakage ( $V_{DS} = 48\text{ Vdc}$ , $V_{GS} = -8\text{ Vdc}$ ) ( $V_{DS} = 48\text{ Vdc}$ , $V_{GS} = -8\text{ Vdc}$ )	Carrier Peaking	$I_{GLK}$	–1.0 –1.0	— —	— —	mAdc

**On Characteristics — Side A, Carrier**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 4.6\text{ mAdc}$ )	$V_{GS(th)}$	–4.6	–3.0	–1.9	Vdc
Gate Quiescent Voltage ( $V_{DD} = 48\text{ Vdc}$ , $I_{DA} = 70\text{ mAdc}$ , Measured in Functional Test)	$V_{GSA(Q)}$	–3.0	–2.5	–2.0	Vdc
Gate–Source Leakage Current ( $V_{DS} = 150\text{ Vdc}$ , $V_{GS} = -8\text{ Vdc}$ )	$I_{GSS}$	–2.1	—	—	mAdc

**On Characteristics — Side B, Peaking**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 8.7\text{ mAdc}$ )	$V_{GS(th)}$	–4.6	–3.0	–1.9	Vdc
Gate–Source Leakage Current ( $V_{DS} = 150\text{ Vdc}$ , $V_{GS} = -8\text{ Vdc}$ )	$I_{GSS}$	–3.9	—	—	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** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (continued)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>Functional Tests</b> <sup>(1)</sup> (In NXP Doherty Production Test Fixture, 50 ohm system) $V_{DD} = 48\text{ Vdc}$ , $I_{DQA} = 70\text{ mA}$ , $V_{GSB} = (V_t - 1.55)\text{ Vdc}$ , $P_{out} = 12.6\text{ W Avg.}$ , $f = 3700\text{ MHz}$ , 1-tone CW.					
Power Gain	$G_{ps}$	12.0	15.1	18.0	dB
Drain Efficiency	$\eta_D$	38.0	42.9	—	%
$P_{out}$ @ 6 dB Compression Point	P6dB	46.0	47.8	—	dBm
<b>Wideband Ruggedness</b> <sup>(2)</sup> (In NXP Doherty Reference Circuit, 50 ohm system) $I_{DQA} = 70\text{ mA}$ , $V_{GSB} = -4.0\text{ Vdc}$ , $f = 3700\text{ MHz}$ , Additive White Gaussian Noise (AWGN) with 10 dB PAR					
ISBW of 400 MHz at 55 Vdc, 25 W Avg. Modulated Output Power (3 dB Input Overdrive from 0.4 W Avg. Modulated Output Power)	No Device Degradation				
<b>Typical Performance</b> <sup>(2)</sup> (In NXP Doherty Reference Circuit, 50 ohm system) $V_{DD} = 48\text{ Vdc}$ , $I_{DQA} = 70\text{ mA}$ , $V_{GSB} = -4.0\text{ Vdc}$ , 3600–3800 MHz Bandwidth					
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	$VBW_{res}$	—	250	—	MHz
Gain Flatness in 200 MHz Bandwidth @ $P_{out} = 13.5\text{ W Avg.}$	$G_F$	—	0.26	—	dB
<b>Fast CW, 27 ms Sweep</b>					
$P_{out}$ @ 6 dB Compression Point	P6dB	—	89.1	—	W
AM/PM (Maximum value measured at the P6dB compression point across the 3600–3800 MHz bandwidth)	$\Phi$	—	-5	—	°
Gain Variation over Temperature (-40°C to +85°C)	$\Delta G$	—	0.030	—	dB/°C
Output Power Variation over Temperature (-40°C to +85°C)	$\Delta P_{6dB}$	—	0.001	—	dB/°C

**Table 7. Ordering Information**

Device	Tape and Reel Information	Package
A5G37H110NT4	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.

## 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.

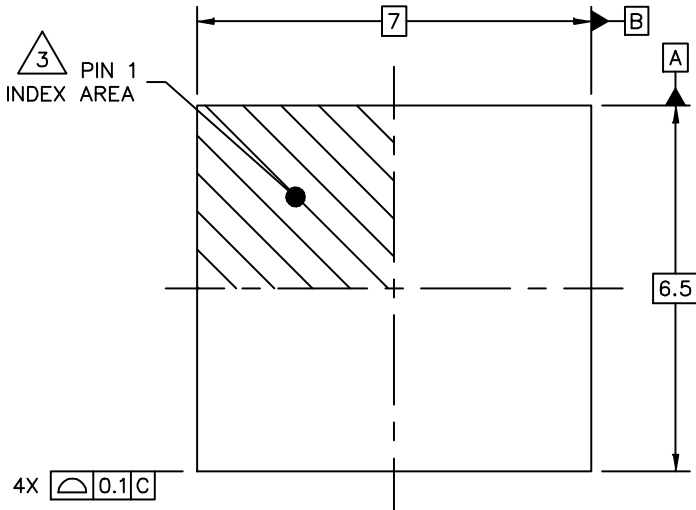
### Bias OFF the device

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  $V_{GSB}$ .

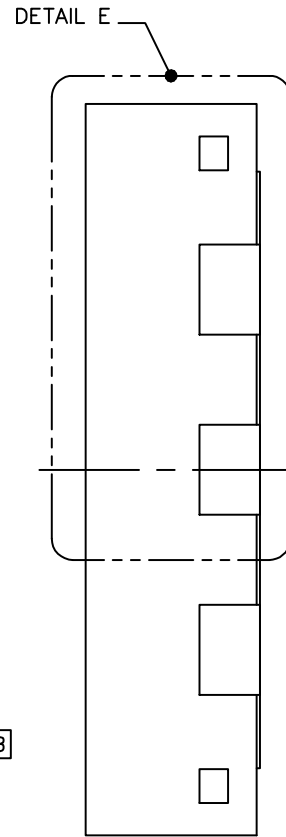
# Package Information

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

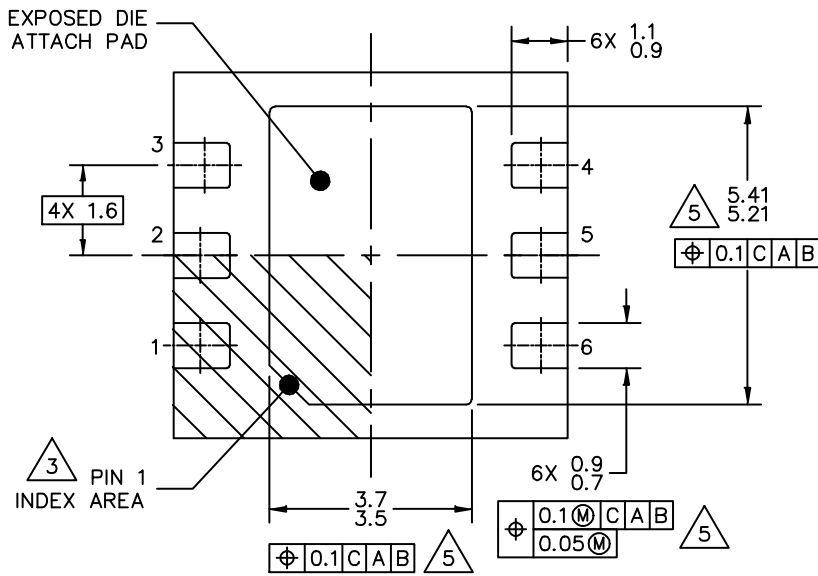
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TOP VIEW



VIEW D-D



BOTTOM VIEW

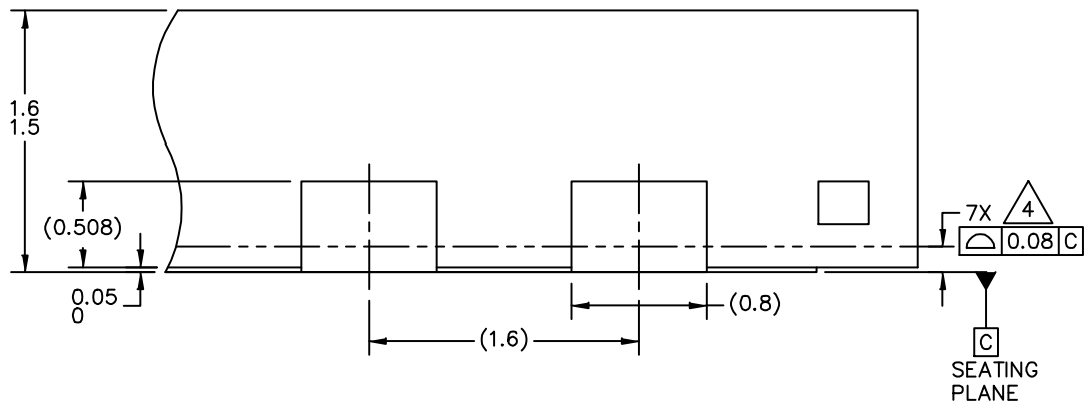
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H-PDFN-6 I/O  
7 X 6.5 X 1.55 PKG, 1.6 PITCH

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DETAIL E  
VIEW ROTATED 90°CW

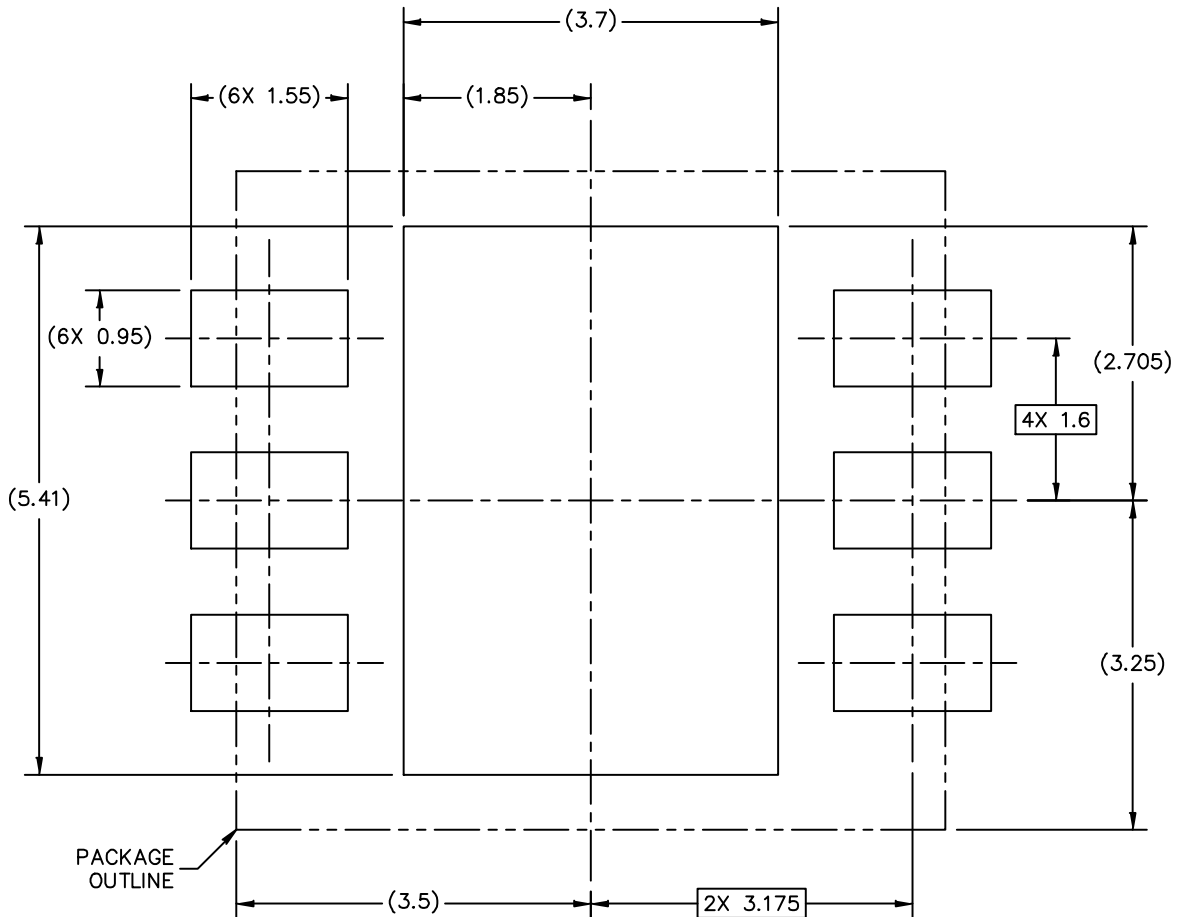
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H-PDFN-6 I/O  
7 X 6.5 X 1.55 PKG, 1.6 PITCH

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PCB DESIGN GUIDELINES – SOLDER MASK OPENING PATTERN

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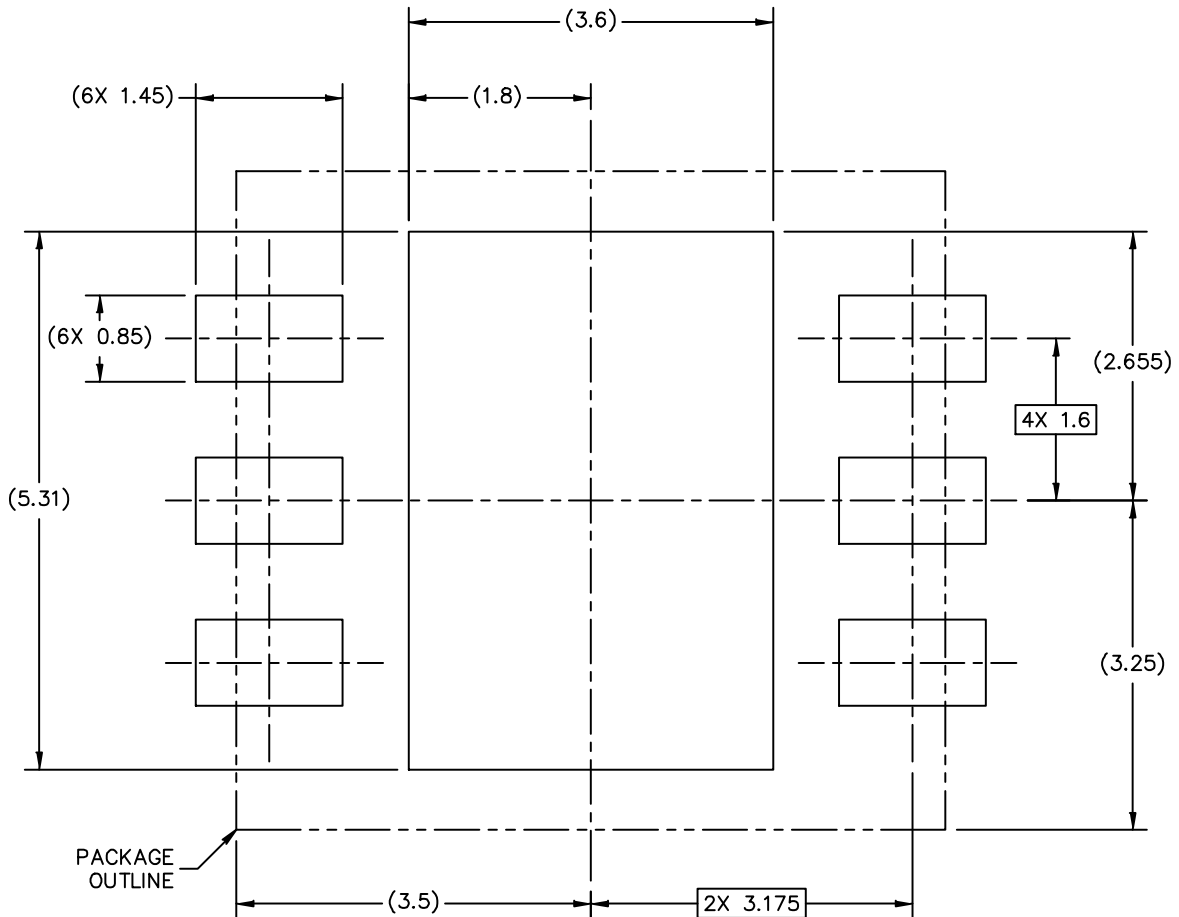
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H-PDFN-6 I/O  
7 X 6.5 X 1.55 PKG, 1.6 PITCH

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PCB DESIGN GUIDELINES – I/O PADS AND SOLDERABLE AREA

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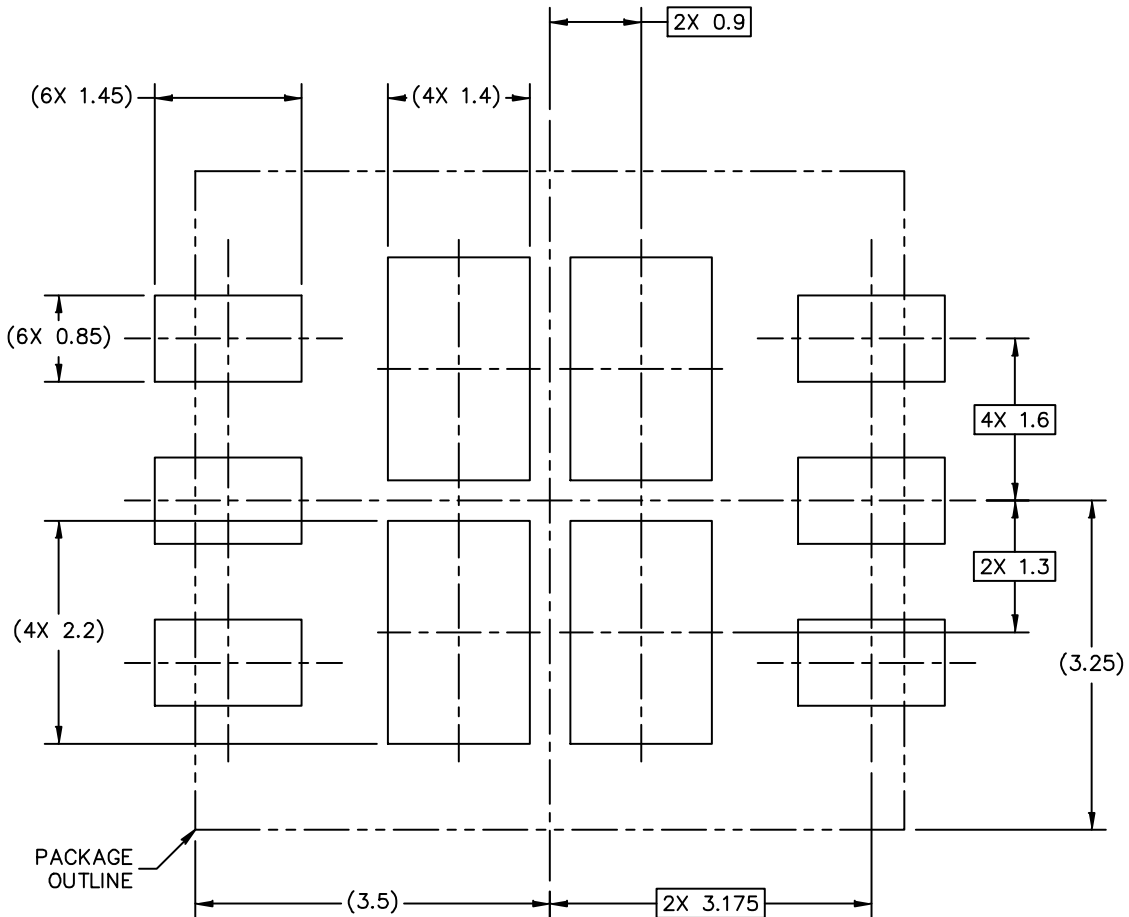
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H-PDFN-6 I/O  
7 X 6.5 X 1.55 PKG, 1.6 PITCH

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STENCIL THICKNESS 0.125 OR 0.15

PCB DESIGN GUIDELINES – SOLDER PASTE STENCIL

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

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## 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	Jan. 2022	<ul style="list-style-type: none"><li>• Initial release of data sheet</li></ul>
1	Nov. 2022	<ul style="list-style-type: none"><li>• Table 1, Maximum Ratings: Gate–Source Voltage: updated –8, 0 to –16, 0 Vdc, p. 2</li><li>• Table 4, ESD Protection Characteristics, Human Body Model: updated to reflect test data, p. 2</li><li>• Table 6, Electrical Characteristics, Off Characteristics: added Off–State Gate Leakage, p. 2</li><li>• General updates made to align data sheet to current standard</li></ul>

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