

# A5G35S004N

## Airfast RF Power GaN Transistor

Rev. 4 — November 2022

Data Sheet: Technical Data

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

### 3500 MHz

- Typical Single-Carrier W-CDMA Reference Circuit Performance:  
 $V_{DD} = 48 \text{ Vdc}$ ,  $I_{DQ} = 12 \text{ mA}$ ,  $P_{out} = 24.5 \text{ dBm Avg.}$ , Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.<sup>(1)</sup>

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

### 3700–4000 MHz

- Typical Single-Carrier W-CDMA Reference Circuit Performance:  
 $V_{DD} = 48 \text{ Vdc}$ ,  $I_{DQ} = 10 \text{ mA}$ ,  $P_{out} = 28 \text{ dBm Avg.}$ , Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.<sup>(1)</sup>

Frequency	$G_{ps}$ (dB)	$\eta_D$ (%)	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.

### 4100–4300 MHz

- Typical Single-Carrier W-CDMA Reference Circuit Performance:  
 $V_{DD} = 48 \text{ Vdc}$ ,  $I_{DQ} = 10 \text{ mA}$ ,  $P_{out} = 28 \text{ dBm Avg.}$ , Input Signal PAR = 9.9 dB @ 0.01% Probability on CCDF.<sup>(1)</sup>

Frequency	$G_{ps}$ (dB)	$\eta_D$ (%)	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.

### Features

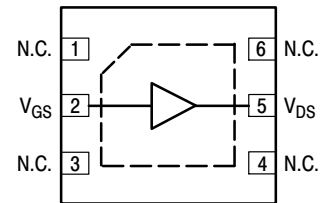
- High terminal impedances for optimal broadband performance
- Designed for low complexity linearization systems
- Universal broadband driver
- Optimized for massive MIMO active antenna systems for 5G base stations

## A5G35S004N

3300–4300 MHz, 24.5 dBm Avg., 48 V  
AIRFAST RF POWER GaN  
TRANSISTOR



DFN 4.5 × 4  
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 @ $T_C = 25^\circ\text{C}$	$I_{GMAX}$	0.74	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 $113^\circ\text{C}$ , $P_D = 1.3\text{ W}$	$R_{\theta JC}$ (IR)	8.9 (1)	$^\circ\text{C/W}$
Thermal Resistance by Finite Element Analysis, Channel–to–Case Case Temperature $113^\circ\text{C}$ , $P_D = 1.3\text{ W}$	$R_{\theta CHC}$ (FEA)	32 (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)	C2A

**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**

Off–State Drain Leakage ( $V_{DS} = 150\text{ Vdc}$ , $V_{GS} = -8\text{ Vdc}$ )	$I_{D(BR)}$	—	—	0.74	mAdc
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**On Characteristics**

Gate Threshold Voltage ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 0.74\text{ mAdc}$ )	$V_{GS(th)}$	–4.9	–2.5	–1.9	Vdc
Gate Quiescent Voltage ( $V_{DD} = 48\text{ Vdc}$ , $I_D = 12\text{ mAdc}$ , Measured in Functional Test)	$V_{GS(Q)}$	–2.78	–2.53	–2.30	Vdc
Gate–Source Leakage Current ( $V_{DS} = 150\text{ Vdc}$ , $V_{GS} = -12\text{ Vdc}$ )	$I_{GSS}$	–0.74	—	—	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,  $A = -11.1$  and  $B = 8366$ .

(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 Production Test Fixture, 50 ohm system) $V_{DD} = 48\text{ Vdc}$ , $I_{DQ} = 12\text{ mA}$ , $P_{out} = 24.5\text{ dBm Avg.}$ , $f = 3500\text{ MHz}$ , 1-tone CW.					
Power Gain	$G_{ps}$	15.5	16.9	19.5	dB
Drain Efficiency	$\eta_D$	16.0	19.0	—	%
$P_{out}$ @ 6 dB Compression Point	P6dB	35.0	37.0	—	dBm
<b>Wideband Ruggedness</b> <sup>(2)</sup> (In NXP Reference Circuit, 50 ohm system) $I_{DQ} = 12\text{ mA}$ , $f = 3500\text{ MHz}$ , Additive White Gaussian Noise (AWGN) with 10 dB PAR					
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				
<b>Typical Performance</b> <sup>(2)</sup> (In NXP Reference Circuit, 50 ohm system) $V_{DD} = 48\text{ Vdc}$ , $I_{DQ} = 12\text{ mA}$ , 3400–3600 MHz Bandwidth					
VBW Resonance Point (IMD Third Order Intermodulation Inflection Point)	$VBW_{res}$	—	300	—	MHz
Gain Flatness in 200 MHz Bandwidth @ $P_{out} = 24.5\text{ dBm Avg.}$	$G_F$	—	0.74	—	dB
<b>Fast CW, 27 ms Sweep</b>					
$P_{out}$ @ 6 dB Compression Point	P6dB	—	4.6	—	W
AM/PM (Maximum value measured at the P6dB compression point across the 3400–3600 MHz bandwidth)	$\Phi$	—	-16	—	$^\circ$
Gain Variation over Temperature ( $-40^\circ\text{C}$ to $+85^\circ\text{C}$ )	$\Delta G$	—	0.032	—	dB/ $^\circ\text{C}$
Output Power Variation over Temperature ( $-40^\circ\text{C}$ to $+85^\circ\text{C}$ )	$\Delta P_{6dB}$	—	0.007	—	dB/ $^\circ\text{C}$

**Table 7. 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

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

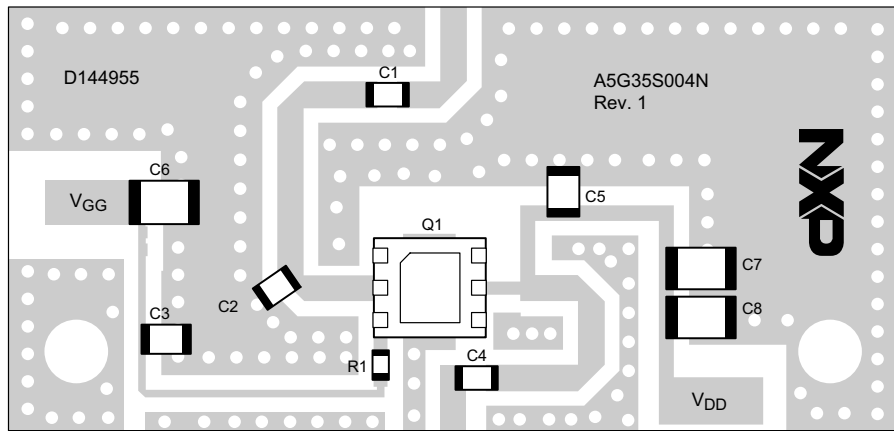
## Correct Biasing Sequence for GaN Depletion Mode Transistors

### Turning the device ON

1. Set  $V_{GS}$  to the pinch-off voltage, typically  $-5\text{ V}$ .
2. Turn on  $V_{DS}$  to nominal supply voltage ( $+48\text{ V}$ ).
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  $-5\text{ V}$ .
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  $V_{GS}$ .



Note: All data measured in reference circuit with device soldered to printed circuit board. *aaa-039743*

**Figure 2. A5G35S004N Reference Circuit Component Layout**

**Table 8. 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 $\mu$ F Chip Capacitor	GRM55ER72A475KA01B	Murata
Q1	RF Power GaN Transistor	A5G35S004N	NXP
R1	10 $\Omega$ , 1/10 W Chip Resistor	CRCW060310R0FKEA	Vishay
PCB	Rogers RO4350B, 0.020", $\epsilon_r = 3.66$	D144955	MTL

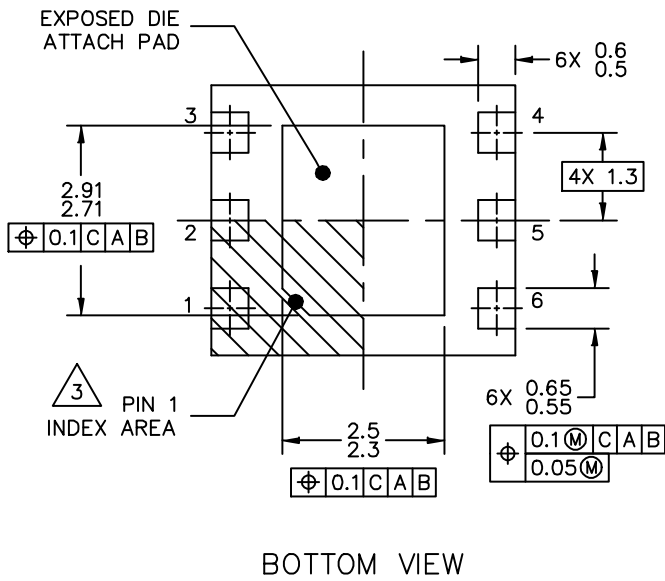
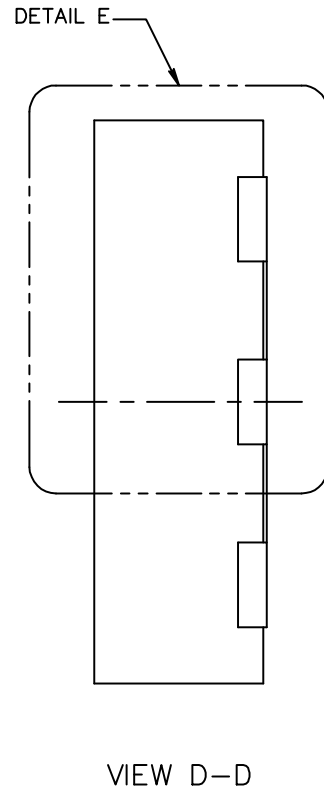
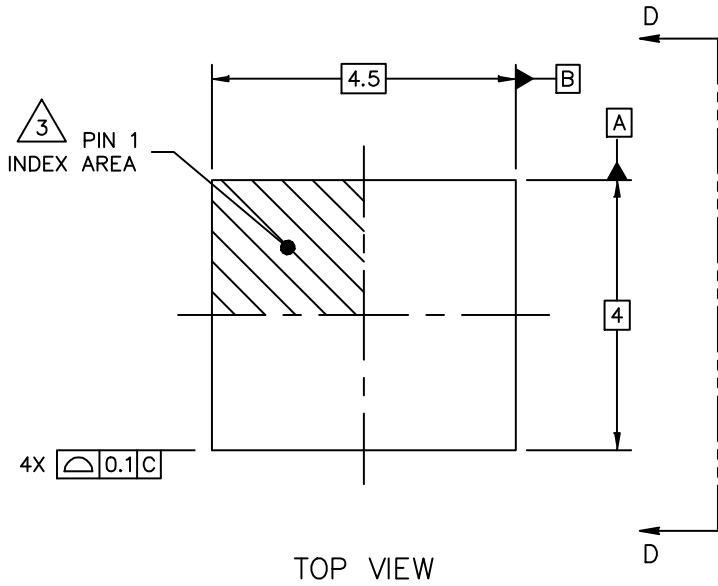


**Figure 3. Product Marking**

# Package Information

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

SOT2040-1



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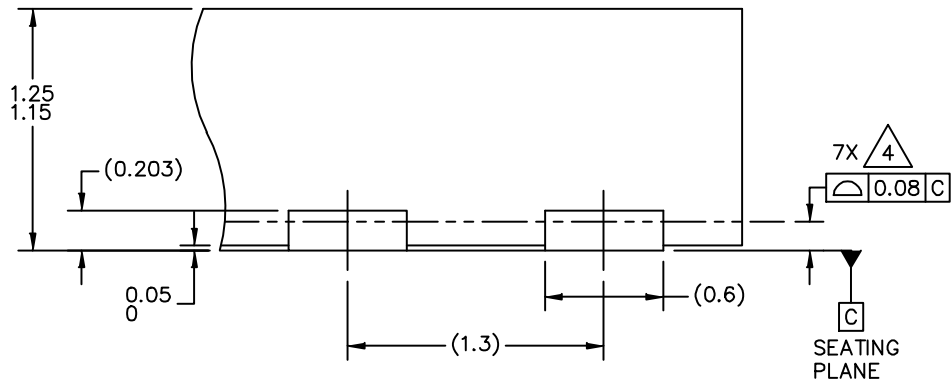
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H-PDFN-6 I/O  
4.5 X 4.0 X 1.2 PKG, 1.3 PITCH

SOT2040-1



DETAIL E  
VIEW ROTATED 90°CW

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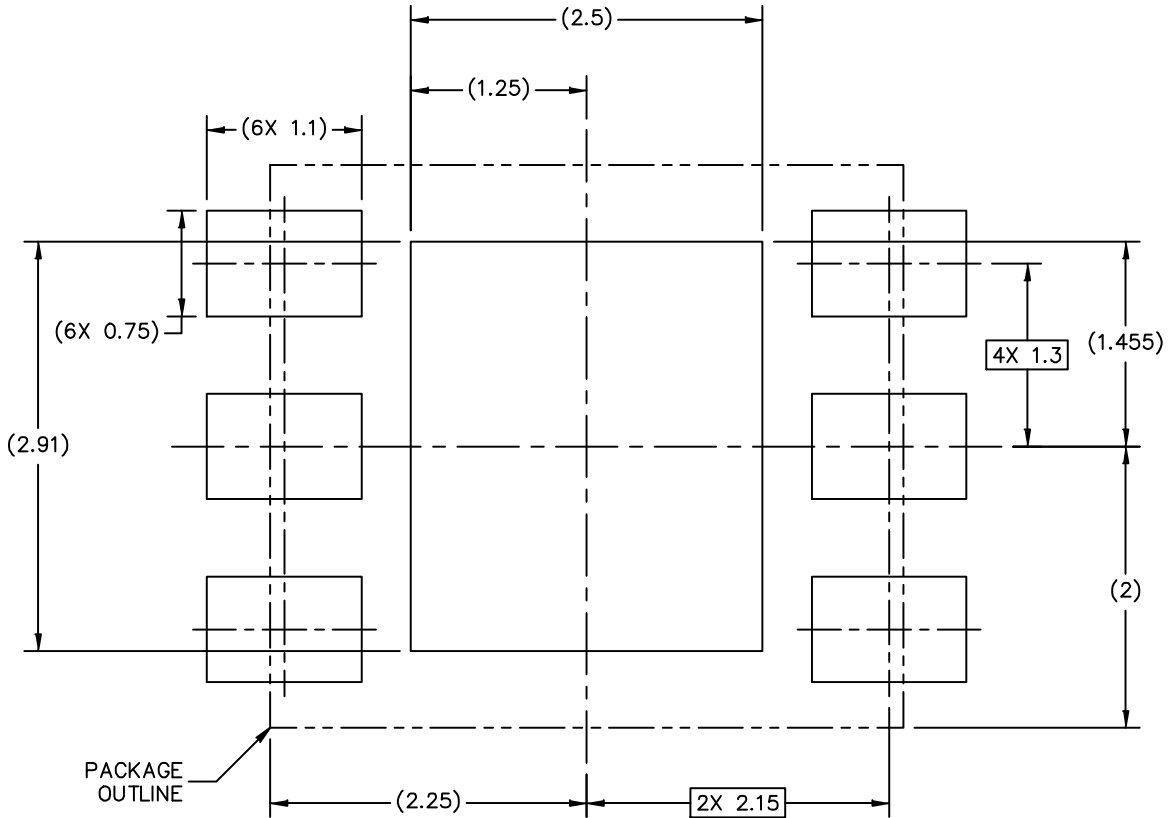
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H-PDFN-6 I/O  
4.5 X 4.0 X 1.2 PKG, 1.3 PITCH

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PCB DESIGN GUIDELINES – SOLDER MASK OPENING PATTERN

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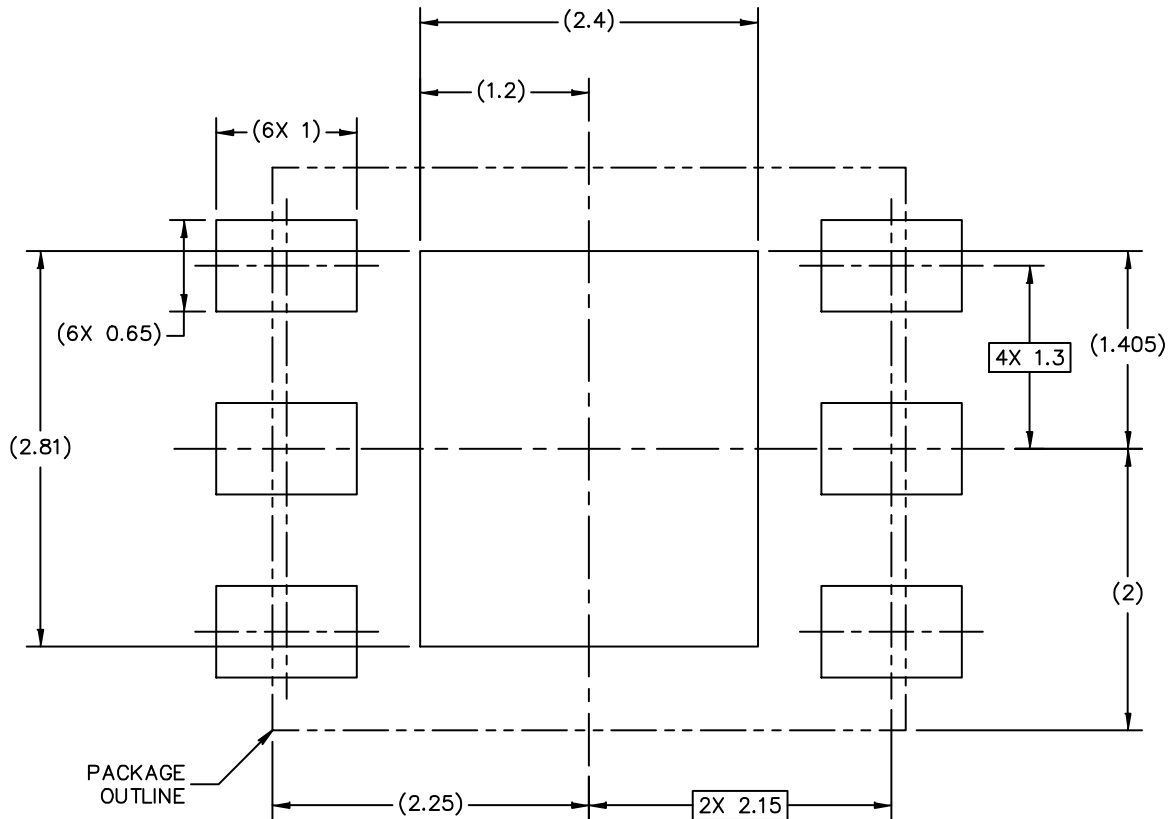
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H-PDFN-6 I/O  
4.5 X 4.0 X 1.2 PKG, 1.3 PITCH

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PCB DESIGN GUIDELINES – I/O PADS AND SOLDERABLE AREA

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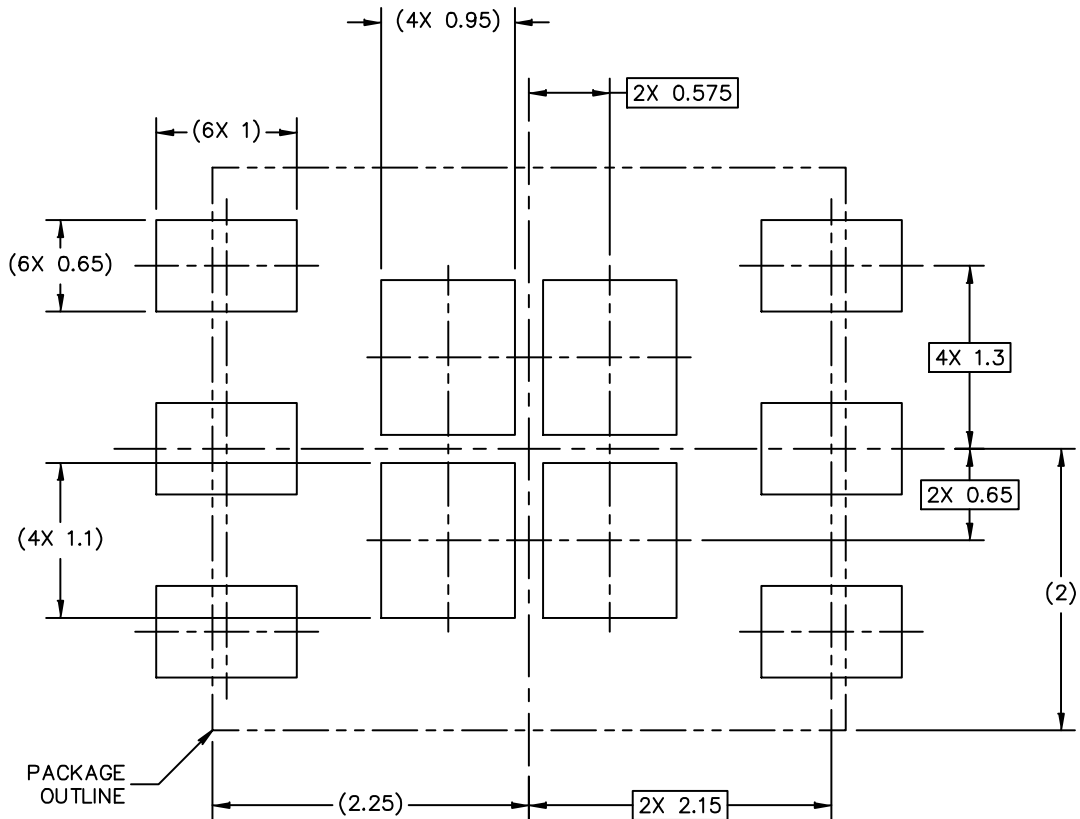
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H-PDFN-6 I/O  
4.5 X 4.0 X 1.2 PKG, 1.3 PITCH

SOT2040-1



RECOMMENDED STENCIL THICKNESS 0.125 OR 0.15

PCB DESIGN GUIDELINES – SOLDER PASTE STENCIL

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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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## 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

## Revision History

The following table summarizes revisions to this document.

Revision	Date	Description
0	Dec. 2020	<ul style="list-style-type: none"> <li>• Initial release of data sheet</li> </ul>
1	Jan. 2021	<ul style="list-style-type: none"> <li>• Table 1, Maximum Ratings: updated operating voltage for complete data sheet standardization, p. 2</li> <li>• Table 2, Recommended Operating Conditions: added to data sheet, p. 2</li> </ul>
2	Jan. 2022	<ul style="list-style-type: none"> <li>• Table 6, DC On Characteristics, <math>V_{GS(th)}</math>: Min, Typ and Max values updated to match production test values, p. 2</li> </ul>
3	July 2022	<ul style="list-style-type: none"> <li>• Table 6, DC On Characteristics, <math>V_{GS(Q)}</math>: Min, Typ and Max values updated to match production test values, p. 2</li> </ul>
4	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>• General updates made to align data sheet to current standard</li> </ul>

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