

**650V GaN FET PQFN**

**Preliminary Datasheet**

**Description**

The TP65H300G4LSG 650V, 300mΩ Gallium Nitride (GaN) FET is a normally-off device. It combines state-of-the-art high voltage GaN HEMT and low voltage silicon MOSFET technologies—offering superior reliability and performance.

Transphorm GaN offers improved efficiency over silicon, through lower gate charge, lower crossover loss, and smaller reverse recovery charge.

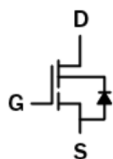
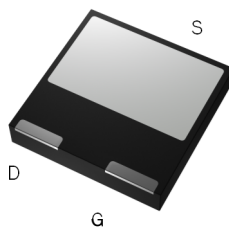
**Related Literature**

- [AN0009](#): Recommended External Circuitry for GaN FETs
- [AN0003](#): Printed Circuit Board Layout and Probing
- [AN0010](#): Paralleling GaN FETs

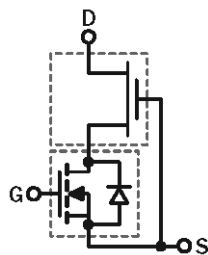
**Product Series and Ordering Information**

Part Number	Package	Package Configuration
TP65H300G4LSG	8x8mm PQFN	Source

**TP65H300G4LSG  
PQFN  
(top view)**



**Cascode Schematic Symbol**



**Cascode Device Structure**

**Features**

- Gen IV technology
- JEDEC-qualified GaN technology
- Dynamic  $R_{DS(on)}$  production tested
- Robust design, defined by
  - Intrinsic lifetime tests
  - Wide gate safety margin
  - Transient over-voltage capability
- Very low  $Q_{RR}$
- Reduced crossover loss
- RoHS compliant and Halogen-free packaging

**Benefits**

- Enables AC-DC bridgeless totem-pole PFC designs
  - Increased power density
  - Reduced system size and weight
  - Overall lower system cost
- Achieves increased efficiency in both hard- and soft-switched circuits
- Easy to drive with commonly-used gate drivers
- GSD pin layout improves high speed design

**Applications**

- Datacom
- Broad industrial
- PV inverter

<b>Key Specifications</b>	
$V_{DS}$ (V) min	650
$V_{(TR)DSS}$ (V) max	720
$R_{DS(on)}$ (mΩ) max*	290
$Q_{RR}$ (nC) typ	23
$Q_G$ (nC) typ	9

\* Dynamic  $R_{DS(on)}$ ; see Figures 19 and 20

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## Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ unless otherwise stated.)

Symbol	Parameter	Limit Value	Unit	
$V_{DSS}$	Drain to source voltage ( $T_J = -55^\circ\text{C}$ to $150^\circ\text{C}$ )	650	V	
$V_{(TR)DSS}$	Transient drain to source voltage <sup>a</sup>	720		
$V_{GSS}$	Gate to source voltage	$\pm 18$		
$P_D$	Maximum power dissipation @ $T_c=25^\circ\text{C}$	25	W	
$I_D$	Continuous drain current @ $T_c=25^\circ\text{C}$ <sup>b</sup>	8	A	
	Continuous drain current @ $T_c=100^\circ\text{C}$ <sup>b</sup>	5	A	
$I_{DM}$	Pulsed drain current (pulse width: 10 $\mu\text{s}$ )	30	A	
$T_c$	Operating temperature	Case	-55 to +150	$^\circ\text{C}$
$T_J$		Junction	-55 to +150	$^\circ\text{C}$
$T_s$	Storage temperature	-55 to +150	$^\circ\text{C}$	
$T_{SOLD}$	Soldering peak temperature <sup>c</sup>	260	$^\circ\text{C}$	

Notes:

- a. In off-state, spike duty cycle  $D < 0.01$ , spike duration  $< 1\mu\text{s}$
- b. For increased stability at high current operation, see Circuit Implementation on page 3
- c. For 10 sec., 1.6mm from the case

## Thermal Resistance

Symbol	Parameter	Maximum	Unit
$R_{\theta JC}$	Junction-to-case	3	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-ambient <sup>e</sup>	50	$^\circ\text{C}/\text{W}$

Notes:  
e. Device on one layer epoxy PCB for drain connection (vertical and without air stream cooling, with 6cm<sup>2</sup> copper area and 70 $\mu\text{m}$  thickness)

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## Electrical Parameters (T<sub>J</sub>=25 °C unless otherwise stated)

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
<b>Forward Device Characteristics</b>						
V <sub>(BL)DSS</sub>	Maximum drain-source voltage	650	—	—	V	V <sub>GS</sub> =0V
V <sub>GS(th)</sub>	Gate threshold voltage	1.6	2.1	2.6	V	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =0.5mA
R <sub>DS(on)eff</sub>	Drain-source on-resistance <sup>a</sup>	—	240	290	mΩ	V <sub>GS</sub> =8V, I <sub>D</sub> =5A
		—	492	—		V <sub>GS</sub> =8V, I <sub>D</sub> =5A, T <sub>J</sub> =150 °C
I <sub>DSS</sub>	Drain-to-source leakage current	—	1.2	10	μA	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V
		—	5	—		V <sub>DS</sub> =650V, V <sub>GS</sub> =0V, T <sub>J</sub> =150 °C
I <sub>GSS</sub>	Gate-to-source forward leakage current	—	—	100	nA	V <sub>GS</sub> =20V
	Gate-to-source reverse leakage current	—	—	-100		V <sub>GS</sub> =-20V
C <sub>ISS</sub>	Input capacitance	—	760	—	pF	V <sub>GS</sub> =0V, V <sub>DS</sub> =400V, f=1MHz
C <sub>OSS</sub>	Output capacitance	—	17	—		
C <sub>RSS</sub>	Reverse transfer capacitance	—	TBD	—		
C <sub>O(er)</sub>	Output capacitance, energy related <sup>b</sup>	—	25	—	pF	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V to 400V
C <sub>O(tr)</sub>	Output capacitance, time related <sup>c</sup>	—	48	—		
Q <sub>G</sub>	Total gate charge	—	9	—	nC	V <sub>DS</sub> =400V, V <sub>GS</sub> =0V to 8V, I <sub>D</sub> =5A
Q <sub>GS</sub>	Gate-source charge	—	TBD	—		
Q <sub>GD</sub>	Gate-drain charge	—	TBD	—		
Q <sub>OSS</sub>	Output charge	—	19	—	nC	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V to 400V
t <sub>D(on)</sub>	Turn-on delay	—	TBD	—	ns	V <sub>DS</sub> =400V, V <sub>GS</sub> =0V to 12V, I <sub>D</sub> =5
t <sub>R</sub>	Rise time	—	TBD	—		
t <sub>D(off)</sub>	Turn-off delay	—	TBD	—		
t <sub>F</sub>	Fall time	—	TBD	—		

Notes:

- Dynamic R<sub>DS(on)</sub> value; see Figures 19 and 20 for conditions
- Equivalent capacitance to give same stored energy from 0V to 400V
- Equivalent capacitance to give same charging time from 0V to 400V

# TP65H300G4LSG—Preliminary

## Electrical Parameters (T<sub>J</sub>=25 °C unless otherwise stated)

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
<b>Reverse Device Characteristics</b>						
I <sub>S</sub>	Reverse current	—	—	5	A	V <sub>GS</sub> =0V, T <sub>C</sub> =100 °C, ≤25% duty cycle
V <sub>SD</sub>	Reverse voltage <sup>a</sup>	—	2.4	—	V	V <sub>GS</sub> =0V, I <sub>S</sub> =5A
		—	3.7	—		V <sub>GS</sub> =0V, I <sub>S</sub> =5A
t <sub>RR</sub>	Reverse recovery time	—	TBD	—	ns	I <sub>S</sub> =5A, V <sub>DD</sub> =400V, di/dt=1000A/us
Q <sub>RR</sub>	Reverse recovery charge	—	23	—	nC	

Notes:

- a. Includes dynamic R<sub>DS(on)</sub> effect

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## Design Considerations

The fast switching of GaN devices reduces current-voltage crossover losses and enables high frequency operation while simultaneously achieving high efficiency. However, taking full advantage of the fast switching characteristics of GaN switches requires adherence to specific PCB layout guidelines and probing techniques.

Before evaluating Transphorm GaN devices, see application note [Printed Circuit Board Layout and Probing for GaN Power Switches](#). The table below provides some practical rules that should be followed during the evaluation.

### When Evaluating Transphorm GaN Devices:

DO	DO NOT
Minimize circuit inductance by keeping traces short, both in the drive and power loop	Twist the pins of TO-220 or TO-247 to accommodate GDS board layout
Minimize lead length of TO-220 and TO-247 package when mounting to the PCB	Use long traces in drive circuit, long lead length of the devices
Use shortest sense loop for probing; attach the probe and its ground connection directly to the test points	Use differential mode probe or probe ground clip with long wire
See <a href="#">AN0003</a> : Printed Circuit Board Layout and Probing	

## GaN Design Resources

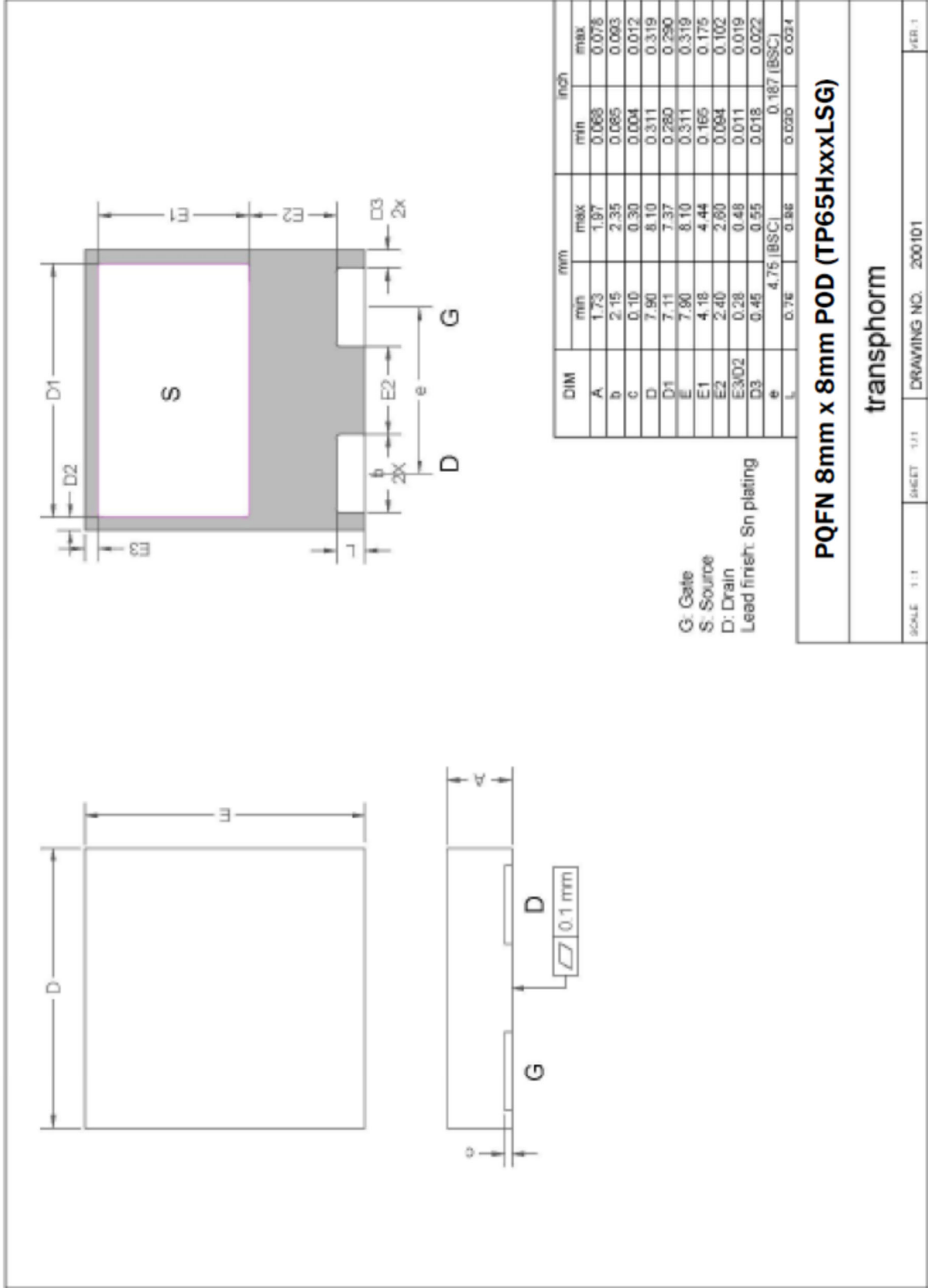
The complete technical library of GaN design tools can be found at [transphormusa.com/design](https://transphormusa.com/design):

- Evaluation kits
- Application notes
- Design guides
- Simulation models
- Technical papers and presentations

# TP65H300G4LSG—Preliminary

8x8 PQFN (LSG) Package

Mechanical



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## Revision History

Version	Date	Change(s)
0	06/24/2019	Preliminary Datasheet

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