

TP65H030G4PWS

650V SuperGaN® GaN FET in TO-247 (source tab)

Description

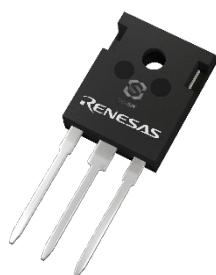
The TP65H030G4PWS 650V, 30mΩ Gallium Nitride (GaN) FET is a normally-off device using Renesas' Gen IV plus platform. It combines a state-of-the-art high voltage GaN HEMT with a low voltage silicon MOSFET to offer superior performance, standard drive, ease of adoption and reliability.

The Gen IV plus SuperGaN® platform uses advanced epi and patented design technologies to simplify manufacturability while improving efficiency over silicon via lower gate charge, output capacitance, crossover loss, and reverse recovery charge.

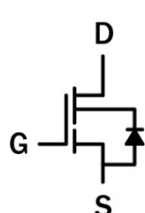
Benefits

- Superior normally off architecture with D-mode GaN HEMT
- Compatible with standard silicon drivers
- Enhanced noise immunity with a 4V threshold voltage with no negative gate drive required
- Enables high-efficiency, high power density, and reliable power conversion
- Facilitates cost-effective GaN adoption reducing system size, weight, and costs

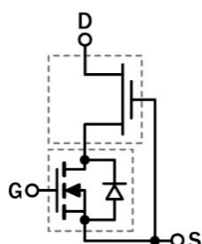
Product/Schematic Diagrams



TP65H030G4PWS TO-247 3L



Cascode Schematic Symbol



Cascode Device Structure

Features

- Ultra-fast switching Gen IV plus GaN
- JEDEC-qualified GaN technology
- Dynamic $R_{DS(on)eff}$ production tested
- Zero reverse recovery charge
- Reduced crossover loss
- RoHS compliant and Halogen-free packaging

Applications

- AI datacenter and telecom power supplies
- E-mobility charging
- PV inverter
- UPS
- BESS



Specifications

V_{DS} (V)	650
$V_{DSS(TR)}$ (V) maximum	800
$R_{DS(on)}$ (mΩ) maximum ^[1]	41
Q_{OSS} (nC) typical	135
Q_G (nC) typical	24.5

1. Dynamic $R_{DS(on)}$ (see Figure 21 and Figure 22)

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1. Pin Information

1.1 Pin Assignments

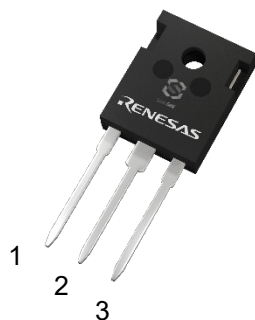


Figure 1. Pin Assignments – Bottom View

1.2 Pin Descriptions

Pin Number	Pin Name	Description
1	G	Gate.
2	S	Source.
3	D	Drain.

2. Specifications

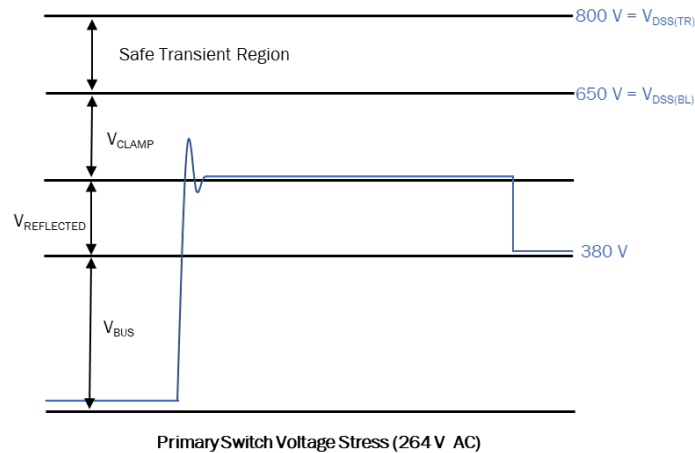
2.1 Absolute Maximum Ratings

$T_c = 25^\circ\text{C}$ unless otherwise stated.

Caution: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions can adversely impact product reliability and result in failures not covered by warranty.

Symbol	Parameter	Minimum	Maximum	Unit
V_{DSS}	Drain to source voltage ($T_J = -55^\circ\text{C}$ to 150°C)	-	650	V
$V_{DSS(TR)}, \text{non-repetitive}$	Transient drain to source voltage, non-repetitive ^[1]	-	800	
$V_{DSS(TR)}, \text{repetitive}$	Transient drain to source voltage, repetitive ^[2]	-	750	
V_{GSS}	Gate to source voltage	-20	+20	
P_D	Maximum power dissipation at $T_c = 25^\circ\text{C}$	-	192	W
I_D	Continuous drain current at $T_c = 25^\circ\text{C}$ ^[3]	-	55.7	A
	Continuous drain current at $T_c = 100^\circ\text{C}$ ^[3]	-	35	A
I_{DM}	Pulsed drain current (pulse width: 10 μs)	-	230	A
T_J	Operating temperature junction	-55	+150	$^\circ\text{C}$
T_S	Storage temperature	-55	+150	$^\circ\text{C}$
T_{SOLD}	Soldering peak temperature ^[4]	-	260	$^\circ\text{C}$

1. In off-state, spike duration < 30 μs , non-repetitive.
2. Off-state, spike duration < 5 μs .
3. For increased stability at high current operation, see [Circuit Implementation](#).
4. For 10 sec., 1.6mm from the case



2.2 Thermal Specifications

Symbol	Condition	Typical Value	Unit
$R_{\theta JC}$	Junction-to-case	0.65	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-ambient	40	

2.3 Circuit Implementation

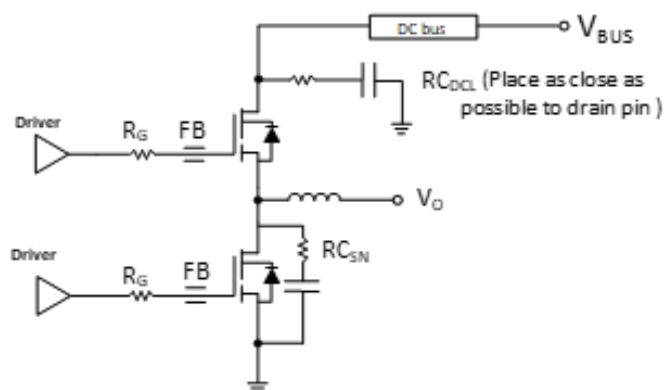


Figure 2. Simplified Half-Bridge Schematic

Recommended gate drive: (0V, 12V) with $R_{G(\text{tot})} = 30\Omega$ ^[1]

Gate Ferrite Bead (FB1)	Recommended DC Link RC Snubber (RC_{DCL}) ^[2]
120 Ω at 100MHz	10nF + 2.3 Ω

1. For bridge topologies only.
2. Place RC_{DCL} as close as possible to the drain pin.

For additional driver configurations/options, see application note [Recommended External Circuitry for Renesas GaN FETs](#).

2.4 Electrical Specifications – Forward Device

$T_J = 25^\circ\text{C}$ unless otherwise stated.

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
$V_{DS(BL)}$	Maximum drain-source voltage	$V_{GS} = 0\text{V}$	650	-	-	V
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 1\text{mA}$	3.3	4	4.8	V
$\Delta V_{GS(th)}/T_J$	Gate threshold voltage temperature coefficient		-	-6.5	-	mV/ $^\circ\text{C}$
$R_{DS(on)eff}$	Drain-source on-resistance ^[1]	$V_{GS} = 12\text{V}, I_D = 30\text{A}, T_J = 25^\circ\text{C}$	-	30	41	m Ω
		$V_{GS} = 12\text{V}, I_D = 30\text{A}, T_J = 150^\circ\text{C}$	-	62	-	
I_{DSS}	Drain-to-source leakage current	$V_{DS} = 650\text{V}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	-	3	30	μA
		$V_{DS} = 650\text{V}, V_{GS} = 0\text{V}, T_J = 150^\circ\text{C}$	-	20	-	
I_{GSS}	Gate-to-source forward leakage current	$V_{GS} = 20\text{V}$	-	-	400	μA
	Gate-to-source reverse leakage current	$V_{GS} = -20\text{V}$	-	-	-400	
C_{iss}	Input capacitance	$V_{GS} = 0\text{V}, V_{DS} = 400\text{V}, f = 1\text{MHz}$	-	1500	-	pF
C_{oss}	Output capacitance		-	127	-	
C_{rss}	Reverse transfer capacitance		-	4.6	-	
$C_{O(er)}$	Output capacitance, energy related ^[2]	$V_{GS} = 0\text{V}, V_{DS} = 0\text{V to } 400\text{V}$	-	183	-	pF
$C_{O(tr)}$	Output capacitance, time related ^[3]		-	339	-	
Q_G	Total gate charge	$V_{DS} = 400\text{V}, V_{GS} = 0\text{V to } 12\text{V}, I_D = 30\text{A}$	-	24.5	-	nC
Q_{GS}	Gate-source charge		-	8.4	-	
Q_{GD}	Gate-drain charge		-	6.6	-	
Q_{oss}	Output charge	$V_{GS} = 0\text{V}, V_{DS} = 0\text{V to } 400\text{V}$	-	135	-	nC
$t_{D(on)}$	Turn-on delay	$V_{DS} = 400\text{V}, V_{GS} = 0\text{V to } 12\text{V}, R_{G(on)} = 10\Omega, R_{G(off)} = 30\Omega, I_D = 30\text{A}, Z_{FB} = 180\Omega \text{ at } 100\text{MHz}$ (see Figure 17)	-	40.8	-	ns
t_R	Rise time		-	6.8	-	
$t_{D(off)}$	Turn-off delay		-	89.2	-	
t_F	Fall time		-	8	-	

1. Dynamic $R_{DS(on)}$, 100% tested; see Figure 21 and Figure 22 for conditions.
2. Equivalent capacitance to give same stored energy from 0V to 400V.
3. Equivalent capacitance to give same charging time from 0V to 400V.

2.5 Electrical Specifications – Reverse Device

$T_J = 25^\circ\text{C}$ unless otherwise stated.

Symbol	Parameter	Test Conditions	Minimum	Typical	Maximum	Unit
I_S	Reverse current	$V_{GS} = 0V$, $T_C = 100^\circ\text{C}$, $\leq 25\%$ duty cycle	-	-	32	A
V_{SD}	Reverse voltage ^[1]	$V_{GS} = 0V$, $I_S = 32A$	-	1.8	-	V
		$V_{GS} = 0V$, $I_S = 16A$	-	1.3	-	
t_{RR}	Reverse recovery time	$I_S = 10A$, $V_{DD} = 400V$, $di/dt = 1000A/\mu s$	-	36	-	ns
Q_{RR}	Reverse recovery charge ^[2]		-	0	-	nC

1. Includes dynamic $R_{DS(on)}$ effect.
2. Excludes Q_{oss} .

3. Typical Performance Graphs

$T_c = 25^{\circ}\text{C}$ unless otherwise stated.

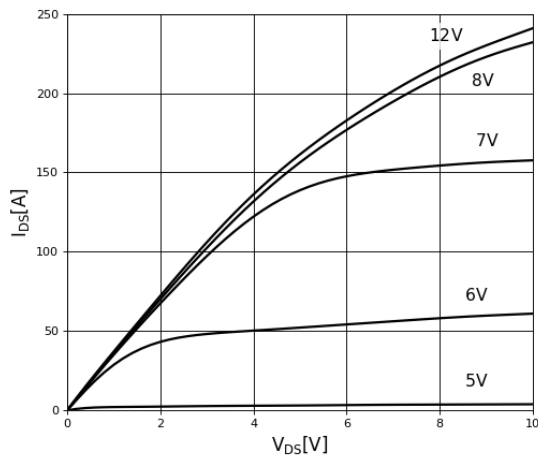


Figure 3. Typical Output Characteristics, $T_J = 25^{\circ}\text{C}$
Parameter: V_{GS}

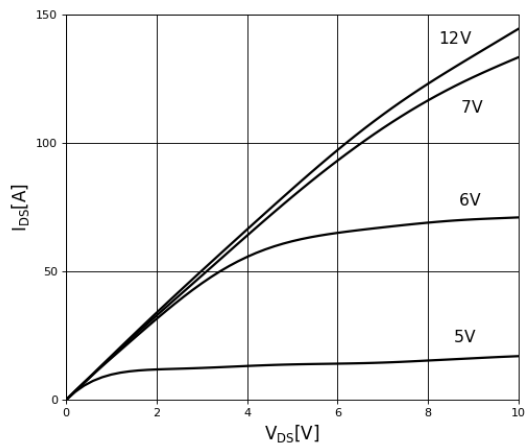


Figure 4. Typical Output Characteristics, $T_J = 150^{\circ}\text{C}$
Parameter: V_{GS}

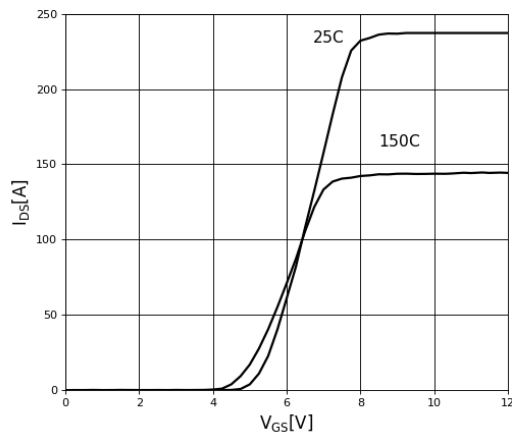


Figure 5. Typical Transfer Characteristics
 $V_{DS} = 10\text{V}$, parameter: T_J

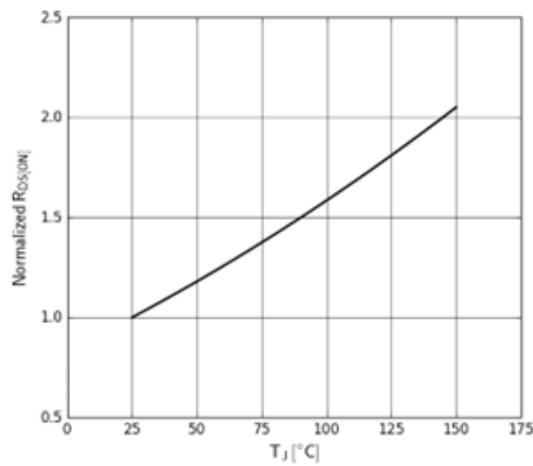


Figure 6. Normalized On-Resistance
 $I_D = 30\text{A}$, $V_{GS} = 12\text{V}$

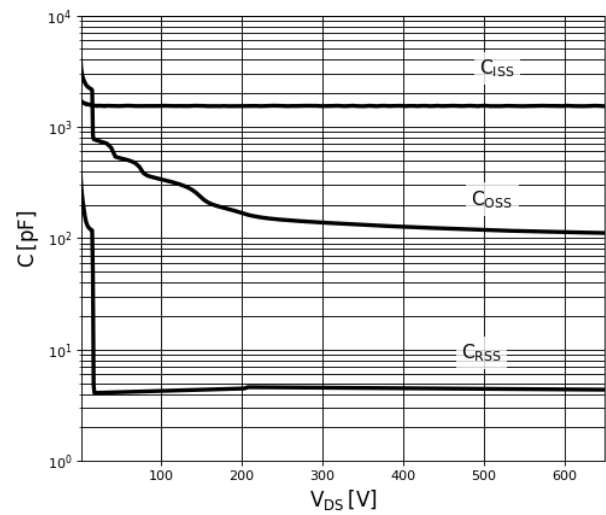


Figure 7. Typical Capacitance
V_{GS} = 0V, f = 1MHz

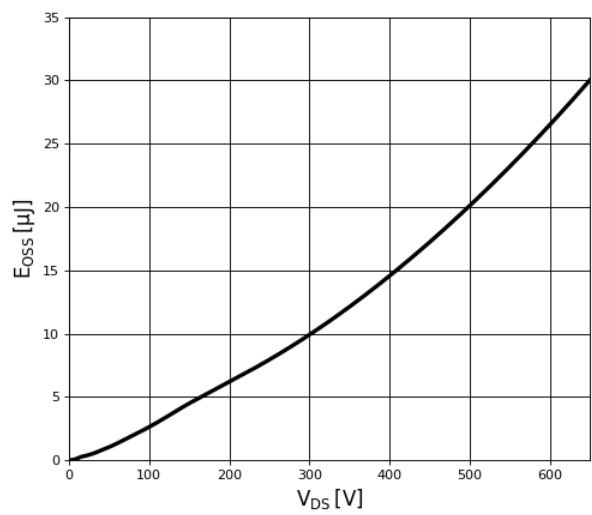


Figure 8. Typical Coss Stored Energy

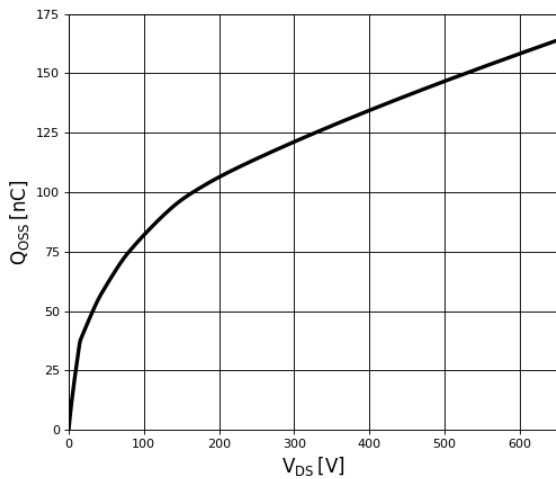


Figure 9. Typical QOSS

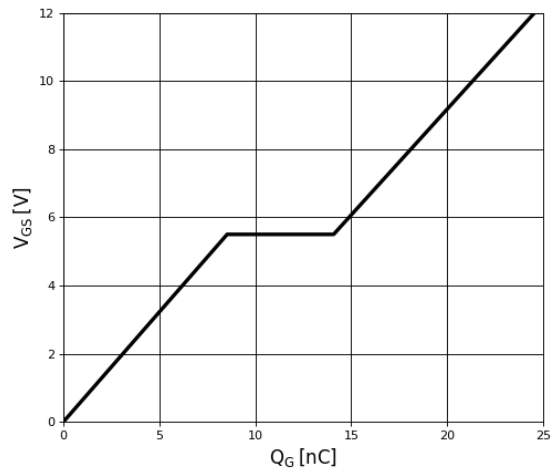


Figure 10. Typical Gate Charge
I_{DS} = 30A, V_{DS} = 400V

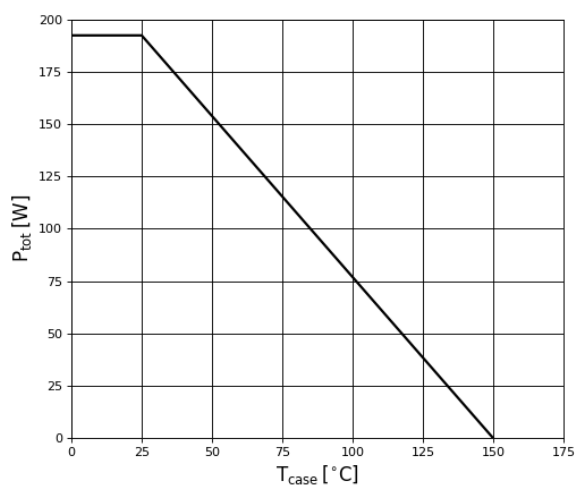


Figure 11. Power Dissipation

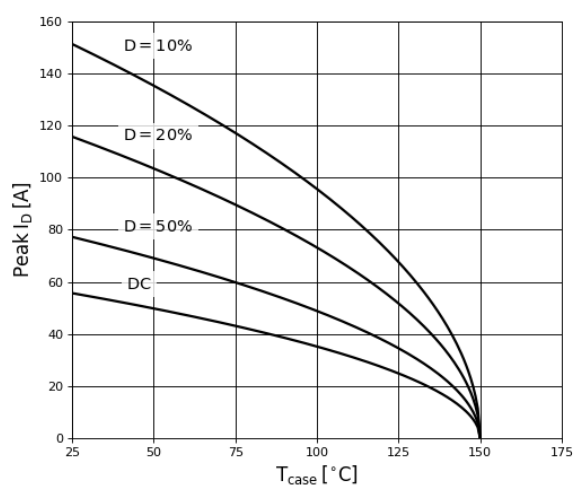


Figure 12. Current Derating

Pulse width $\leq 10\mu s$, $V_{GS} \geq 12V$

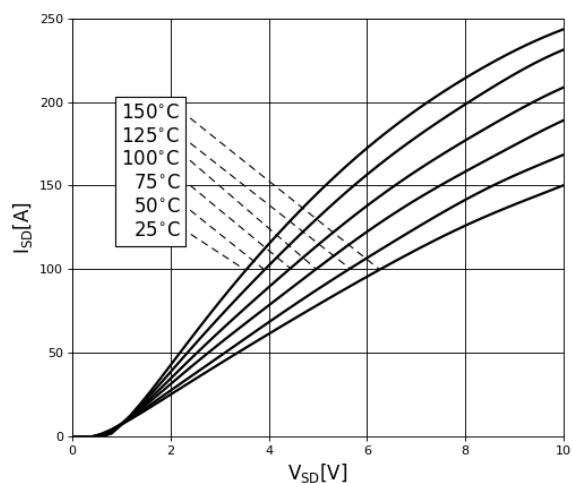


Figure 13. Forward Characteristics of Rev. Diode

$I_S = f(V_{SD})$, parameter: T_J

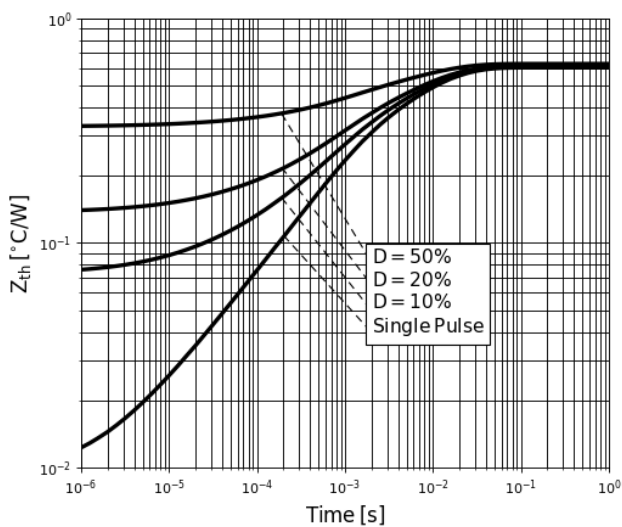


Figure 14. Transient Thermal Resistance

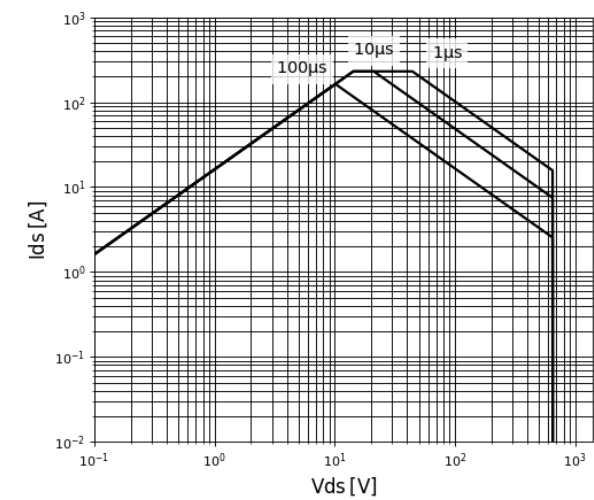


Figure 15. Safe Operating Area $T_c = 25^\circ\text{C}$

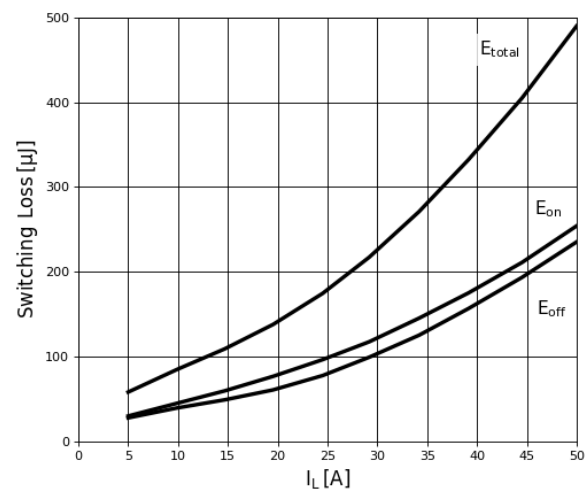


Figure 16. Inductive Switching Loss $T_c = 25^\circ\text{C}$

$R_{g(on)} = 10\Omega$, $R_{g(off)} = 30\Omega$, $V_{DS} = 400\text{V}$

4. Test Circuits and Waveforms

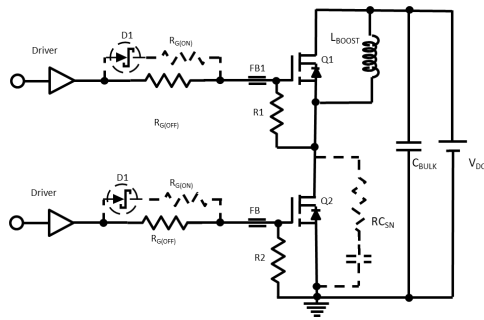


Figure 17. Switching Time Test Circuit

(For methods to ensure clean switching, see [Circuit Implementation](#))

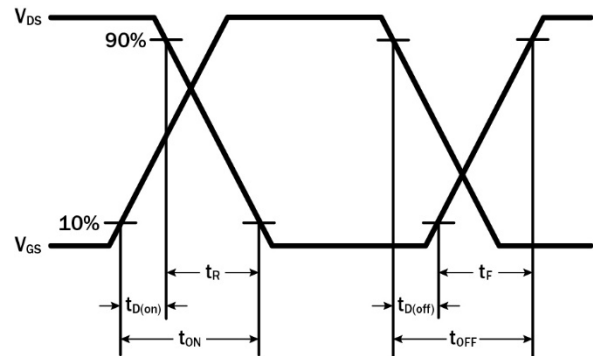


Figure 18. Switching Time Waveform

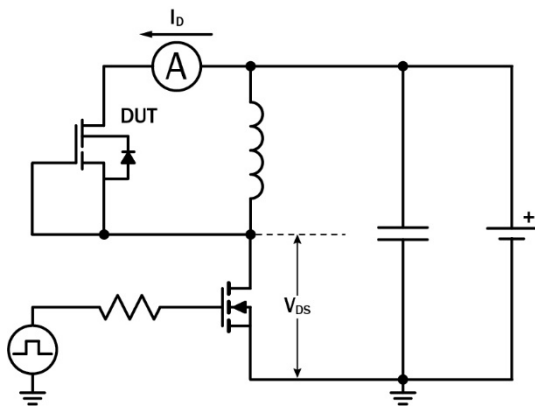


Figure 19. Diode Characteristics Test Circuit

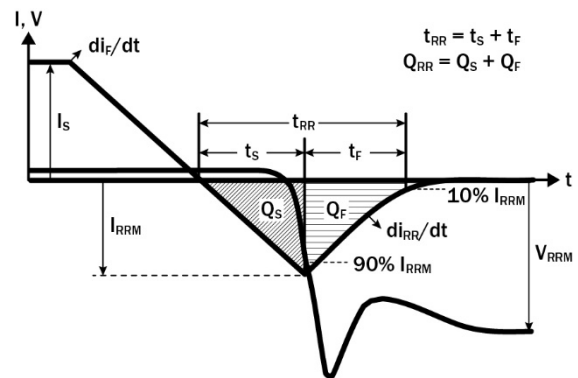


Figure 20. Diode Recovery Waveform

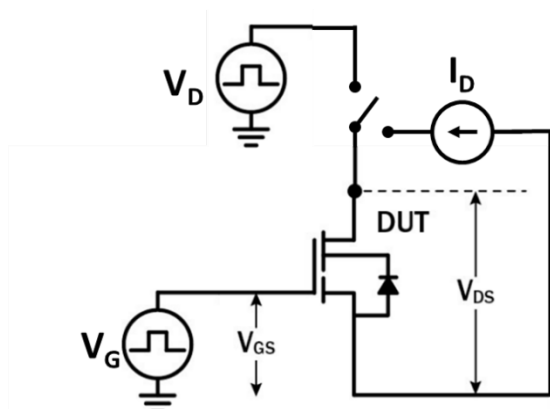


Figure 21. Dynamic $R_{DS(on)eff}$ Test Circuit

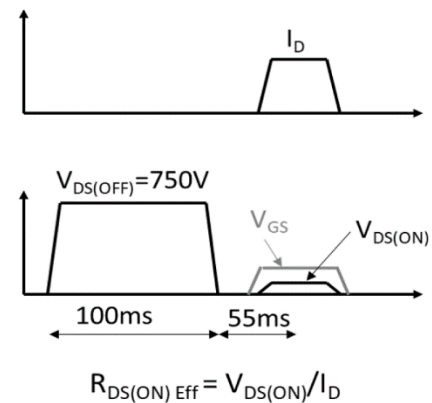
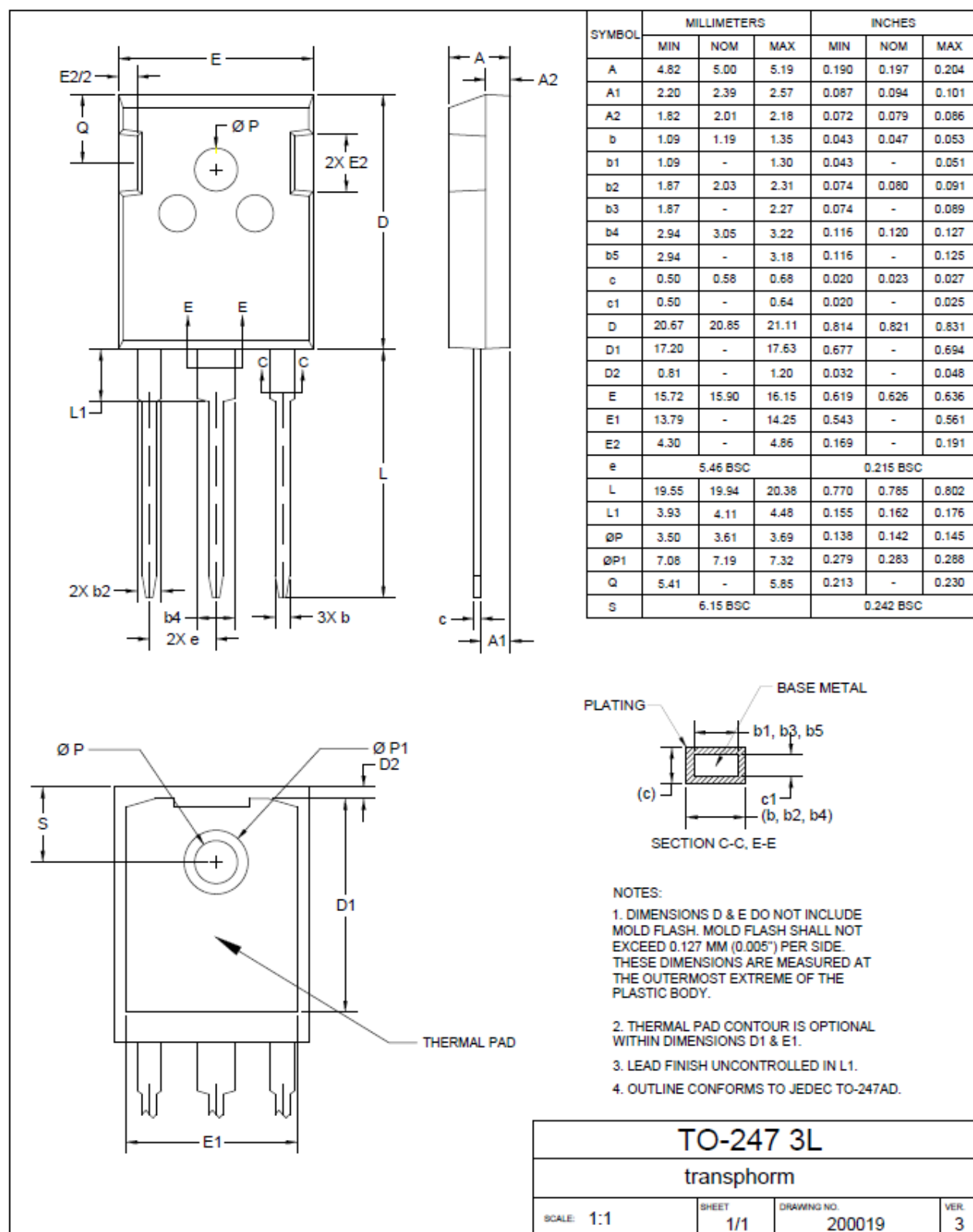


Figure 22. Dynamic $R_{DS(on)eff}$ Waveform

5. Package Outline Drawings



6. 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 Renesas GaN devices, see application note [Printed Circuit Board Layout and Probing for GaN Power Switches](#). The following table provides some practical rules to follow during the evaluation.

When Evaluating Renesas 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.

7. Related Information

The complete technical library of GaN design tools can be found at [Renesas](#):

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

Specific resources include:

- [Printed Circuit Board Layout and Probing for GaN Power Switches](#)
- [Recommendations for Vapor Phase Reflow](#)
- [Recommended External Circuitry for GaN FETs](#)

8. Ordering Information

Part Number	Package Description	Package Configuration
TP65H030G4PWS	TO-247 3L	Source

9. Revision History

Revision	Date	Description
1.00	May 13, 2025	Initial release.

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