

650V Super-GaN FET in TO-247

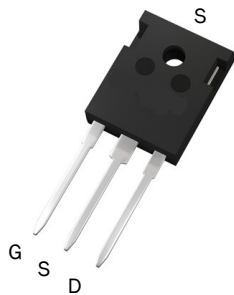
Datasheet

Key Specifications

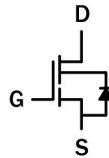
V_{DS} (V) min	650
V_{TDS} (V) max	800
$R_{DS(on)}$ (m Ω) max	41
Q_{rr} (nC) typ	175
Q_g (nC) typ	28

Applications

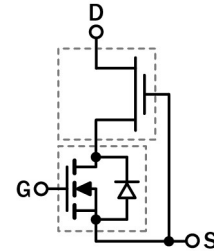
- Renewable energy
- Industrial
- Automotive
- Telecom and datacom
- Servo motors



TO-247
(top view)



Cascode Schematic Symbol



Cascode Device Structure

Features

- Easy to drive—compatible with standard gate drivers
- Low conduction and switching losses
- Low Q_{rr} of 175nC—no free-wheeling diode required
- GSD pin layout improves high speed design
- JEDEC-qualified GaN technology
- RoHS compliant and Halogen-free

Benefits

- Increased efficiency through fast switching
- Increased power density
- Reduced system size and weight
- Enables more efficient topologies—easy to implement bridgeless totem-pole designs
- Lower BOM cost

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

Symbol	Parameter	Limit Value	Unit
$I_{D25^\circ\text{C}}$	Continuous drain current @ $T_c=25^\circ\text{C}$ ^a	50	A
$I_{D100^\circ\text{C}}$	Continuous drain current @ $T_c=100^\circ\text{C}$ ^a	31.5	A
I_{DM}	Pulsed drain current (pulse width: 10 μs)	240	A
V_{DSS}	Drain to source voltage	650	V
V_{TDS}	Transient drain to source voltage ^b	800	V
V_{GSS}	Gate to source voltage	± 18	V
$P_{D25^\circ\text{C}}$	Maximum power dissipation	178	W
T_J	Operating junction temperature	-55 to +150	$^\circ\text{C}$
T_S	Storage temperature	-55 to +150	$^\circ\text{C}$
T_{CSOLD}	Soldering peak temperature ^c	260	$^\circ\text{C}$

Thermal Resistance

Symbol	Parameter	Typical	Unit
$R_{\theta JC}$	Junction-to-case	0.7	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-ambient	40	$^\circ\text{C/W}$

Electrical Characteristics (T_C=25 °C unless otherwise stated)

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
Static						
V _{DSS-MAX}	Maximum drain-source voltage	650	—	—	V	V _{GS} =0V
V _{GS(th)}	Gate threshold voltage	1.65	2.1	2.65	V	V _{DS} =V _{GS} , I _D =0.7mA
R _{DS(on)}	Drain-source on-resistance (T _J =25 °C)	—	35	41	mΩ	V _{GS} =8V, I _D =32A, T _J =25 °C
	Drain-source on-resistance (T _J =150 °C)	—	72	—		V _{GS} =8V, I _D =32A, T _J =150 °C
I _{DSS}	Drain-to-source leakage current (T _J =25 °C)	—	5	50	μA	V _{DS} =650V, V _{GS} =0V, T _J =25 °C
	Drain-to-source leakage current (T _J =150 °C)	—	10	—		V _{DS} =650V, V _{GS} =0V, T _J =150 °C
I _{GSS}	Drain-to-source forward leakage current	—	—	100	nA	V _{GS} =18V
	Drain-to-source reverse leakage current	—	—	-100		V _{GS} =-18V
Dynamic						
C _{ISS}	Input capacitance	—	2197	—	pF	V _{GS} =0V, V _{DS} =400V, f=1MHz
C _{OSS}	Output capacitance	—	202	—		
C _{RSS}	Reverse transfer capacitance	—	27	—		
C _{O(er)}	Output capacitance, energy related ^a	—	280	—	pF	V _{GS} =0V, V _{DS} =0V to 400V
C _{O(tr)}	Output capacitance, time related ^b	—	404	—		
Q _g	Total gate charge	—	28	42	nC	V _{DS} =400V, V _{GS} =0V to 8V, I _D =32A
Q _{gs}	Gate-source charge	—	10	—		
Q _{gd}	Gate-drain charge	—	6	—		
t _{d(on)}	Turn-on delay	—	56	—	ns	V _{DS} =400V, V _{GS} =0V to 10V, I _D =32A, 0.5A gate drive, test circuit as in Figure 13
t _r	Rise time	—	12	—		
T _{d(off)}	Turn-off delay	—	79	—		
t _f	Fall time	—	9	—		
Reverse Operation						
I _S	Reverse current	—	—	31	A	V _{GS} =0V, T _C =100 °C
V _{SD}	Reverse voltage	—	1.73	—	V	V _{GS} =0V, I _S =32A, T _J =25 °C
		—	1.24	—		V _{GS} =0V, I _S =16A, T _J =25 °C
t _{rr}	Reverse recovery time	—	42	—	ns	I _S =32A, V _{DD} =400V, di/dt=1000A/μs, T _J =25 °C
Q _{rr}	Reverse recovery charge	—	175	—	nC	

Typical Characteristics (25 °C unless otherwise stated)

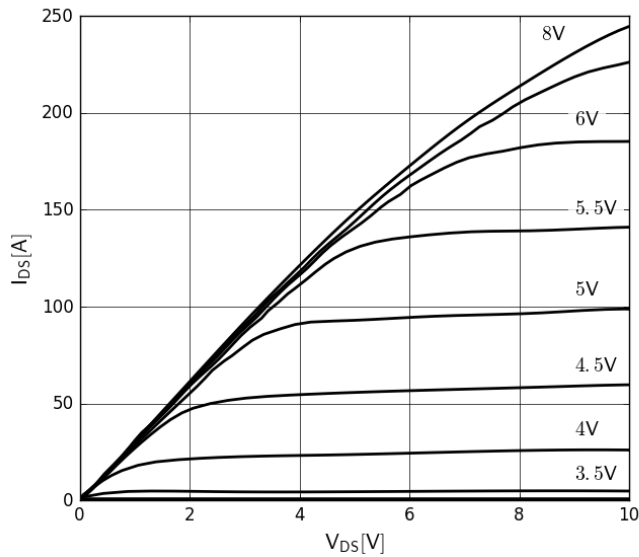


Figure 1. Typical Output Characteristics $T_J=25^{\circ}\text{C}$
Parameter: V_{GS}

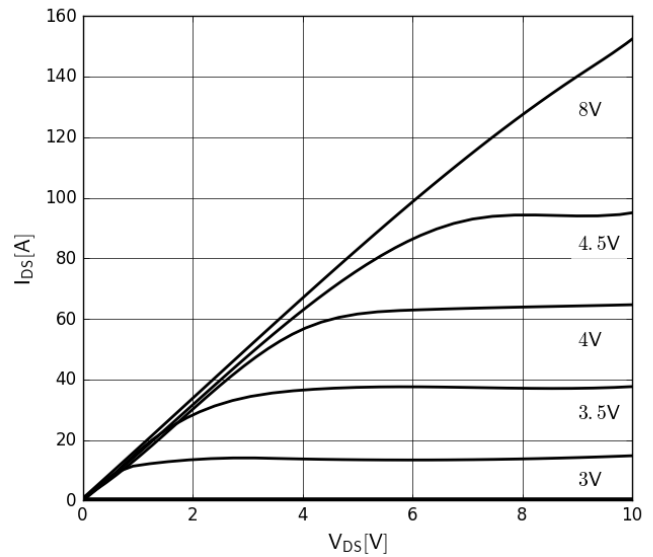


Figure 2. Typical Output Characteristics $T_J=150^{\circ}\text{C}$
Parameter: V_{GS}

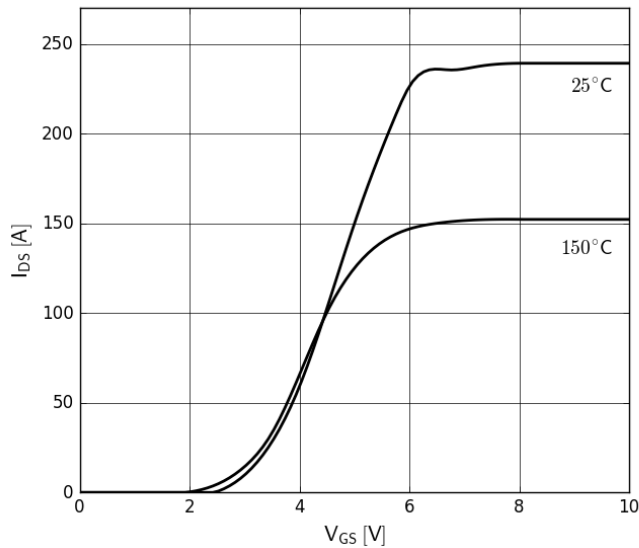


Figure 3. Typical Transfer Characteristics
 $V_{DS}=10\text{V}$, parameter: T_J

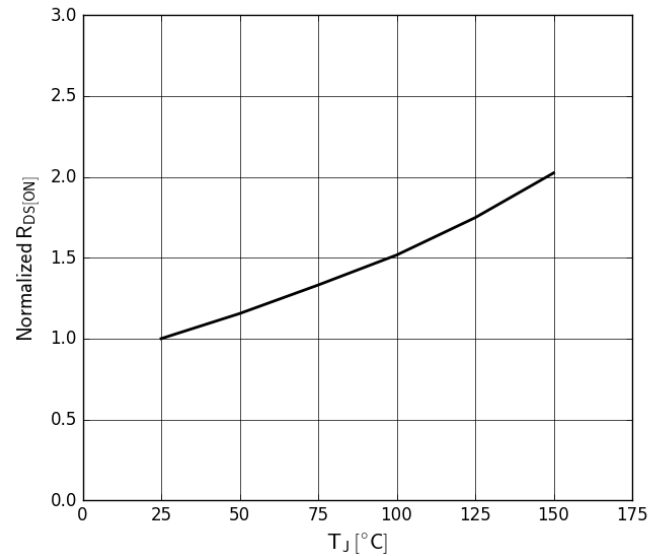


Figure 4. Normalized On-Resistance
 $I_D=32\text{A}$, $V_{GS}=8\text{V}$

Typical Characteristics (25 °C unless otherwise stated)

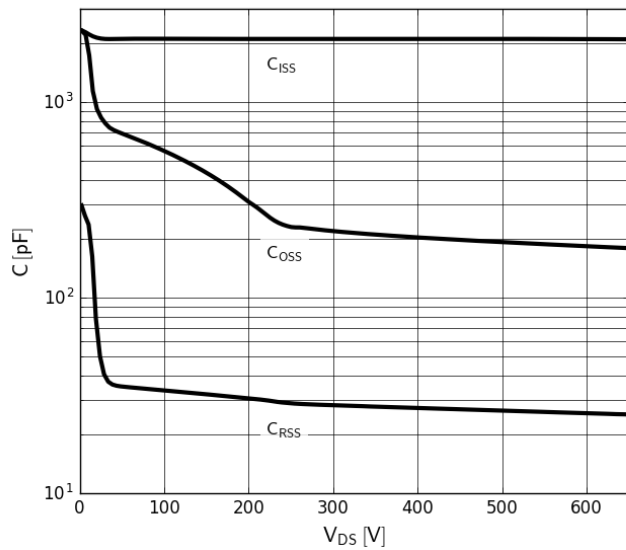


Figure 5. Typical Capacitance
 $V_{GS}=0V$, $f=1MHz$

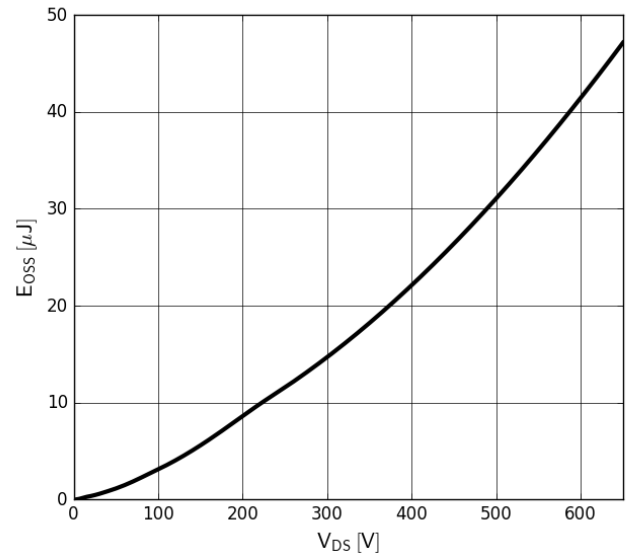


Figure 6. Typical C_{OSS} Stored Energy

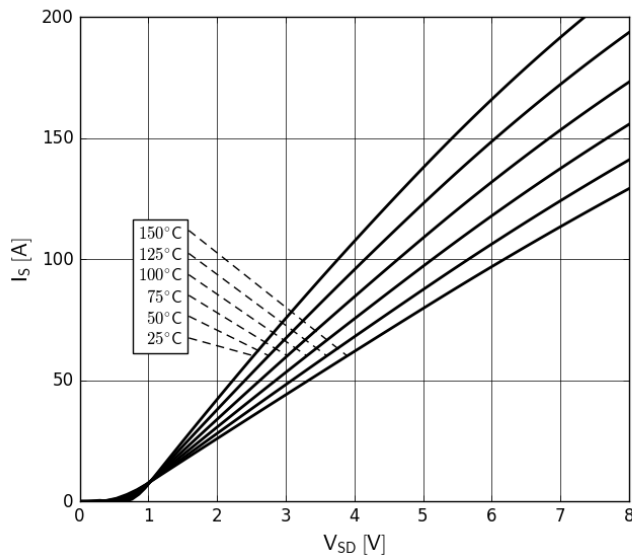


Figure 7. Forward Characteristics of Rev. Diode
 $I_S=f(V_{SD})$; parameter: T_J ; pulse width = 20μs

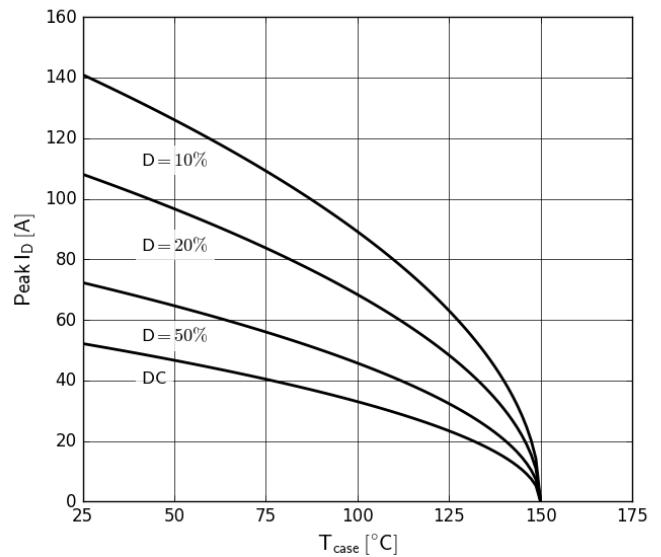


Figure 8. Current Derating
 Pulse width ≤ 10μs

Typical Characteristics (25 °C unless otherwise stated)

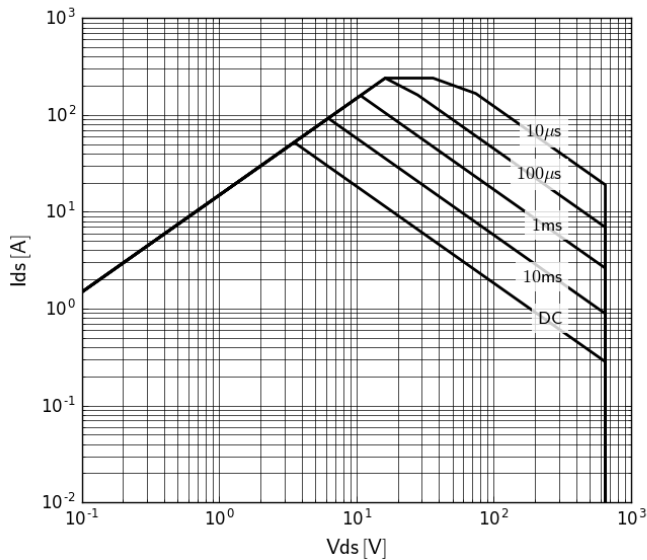


Figure 9. Safe Operating Area $T_c=25^\circ\text{C}$

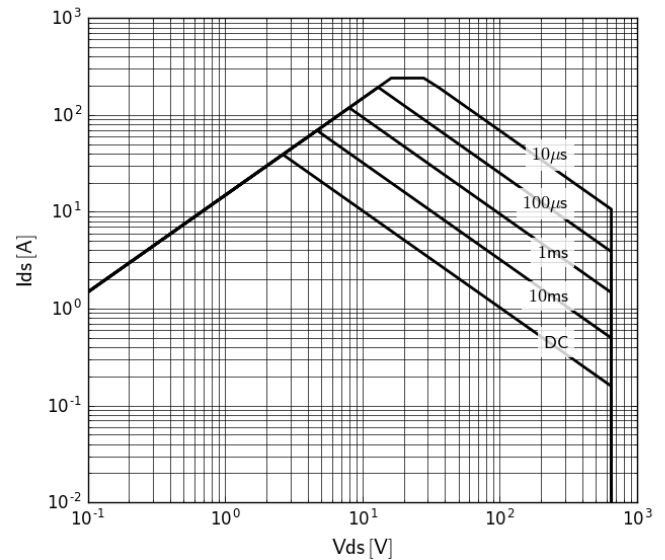


Figure 10. Safe Operating Area $T_c=80^\circ\text{C}$

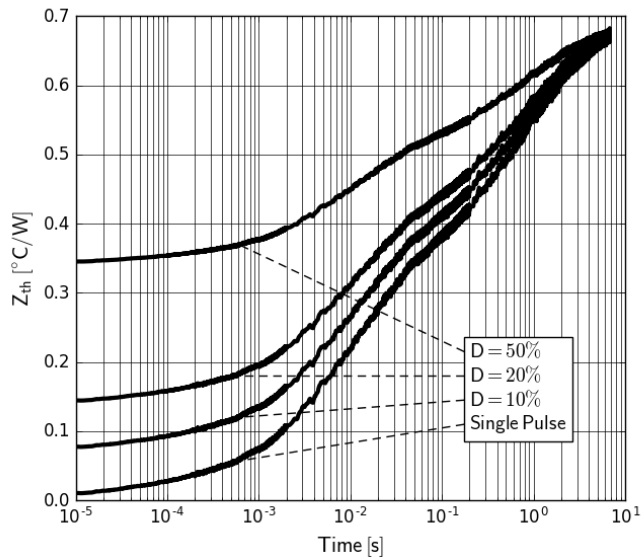


Figure 11. Transient Thermal Resistance

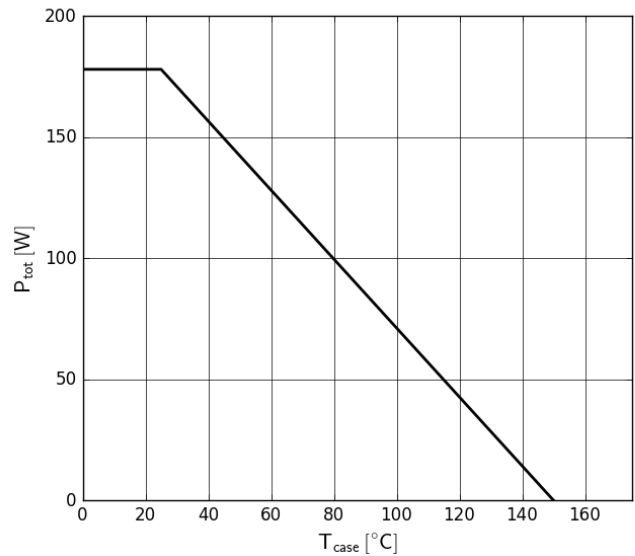


Figure 12. Power Dissipation

Test Circuits and Waveforms

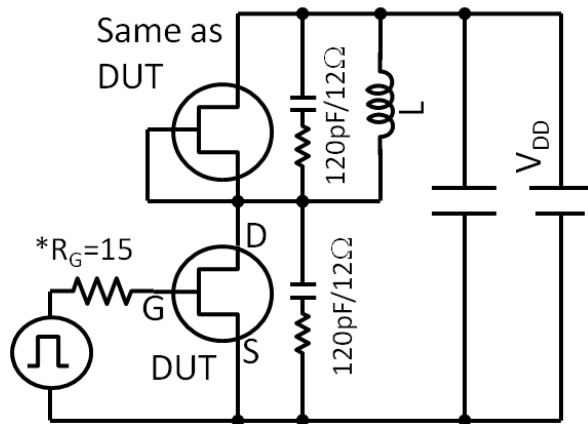


Figure 13. Switching Time Test Circuit

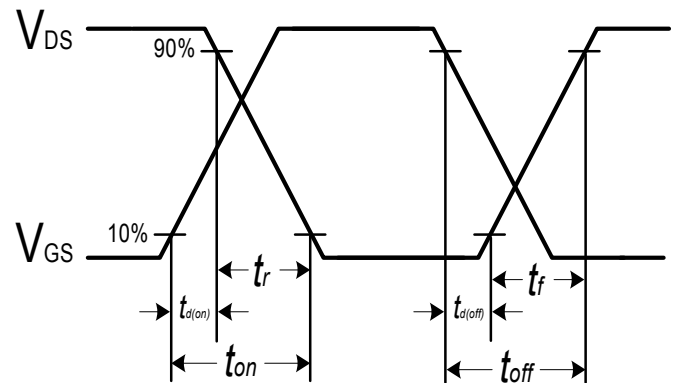


Figure 14. Switching Time Waveform

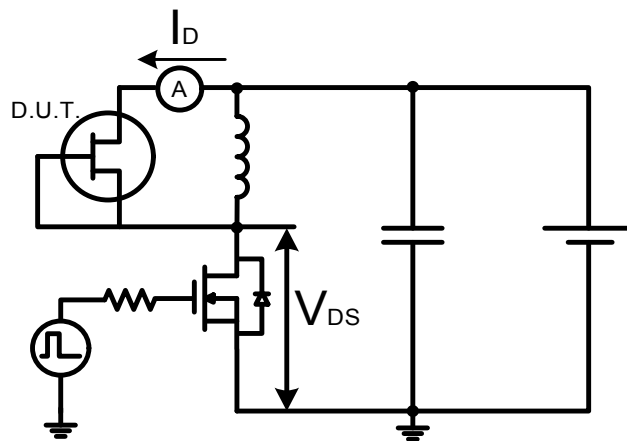


Figure 15. Test Circuit for Diode Characteristics

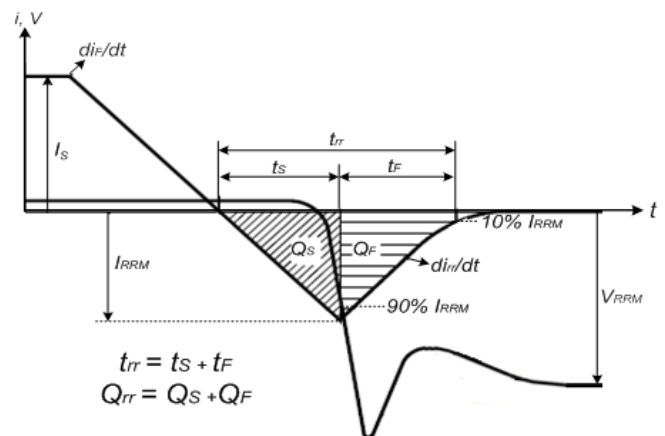


Figure 16. Diode Recovery Waveform

Mechanical

