

N-Channel 650V (D-S) Super Junction Power MOSFET With Fast Diode

PRODUCT SUMMARY

V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ at 25 °C (Ω)	$V_{GS} = 10$ V	0.036

FEATURES

- Low figure-of-merit (FOM) $R_{on} \times Q_g$
- Ultra-fast body diode
- Reduced switching and conduction losses
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)

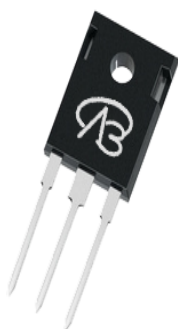


RoHS

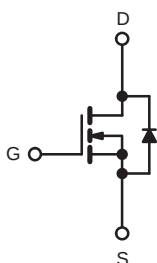
APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
 - High-intensity discharge (HID)
 - Fluorescent ballast lighting
- Industrial

TO-247



Top View



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V _{DS}	650	V
Gate-Source Voltage			V _{GS}	± 30	
Continuous Drain Current (T _J = 150 °C)	V _{GS} at 10 V	T _C = 25 °C	I _D	64	A
		T _C = 100 °C		38	
Pulsed Drain Current ^a			I _{DM}	190	
Linear Derating Factor				1.67	W/°C
Single Pulse Avalanche Energy ^b			E _{AS}	1700	mJ
Maximum Power Dissipation			P _D	500	W
Operating Junction and Storage Temperature Range			T _J , T _{stg}	-55 to +150	°C
Drain-Source Voltage Slope	T _J = 125 °C		dV/dt	50	V/ns
Reverse Diode dV/dt ^d		15			
Soldering Recommendations (Peak Temperature) ^c	for 10 s			260	°C

Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 100$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 8$ A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$, $dI/dt = 100$ A/ μ s, starting $T_J = 25$ °C.

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	62	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.57	

SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 1 mA		650	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA		-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		2.5	-	4.5	V
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 20 V		-	-	± 100	nA
		V _{GS} = ± 30 V		-	-	± 1	μA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 650V, V _{GS} = 0 V		-	-	1	μA
		V _{DS} = 520 V, V _{GS} = 0 V, T _J = 125 °C		-	-	100	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = 10 V	I _D = 22A	-	0.036	-	Ω
Forward Transconductance	g _{fs}	V _{DS} = 30 V, I _D =22A		-	5.6	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz		-	6800	-	pF
Output Capacitance	C _{oss}			-	80	-	
Reverse Transfer Capacitance	C _{rss}			-	4	-	
Effective Output Capacitance, Energy Related ^a	C _{o(er)}	V _{DS} = 0 V to 520 V, V _{GS} = 0 V		-	63	-	pF
Effective Output Capacitance, Time Related ^b	C _{o(tr)}			-	213	-	
Total Gate Charge	Q _g	V _{GS} = 10 V	I _D = 8 A, V _{DS} = 520 V	-	110	-	nC
Gate-Source Charge	Q _{gs}			-	15	-	
Gate-Drain Charge	Q _{gd}			-	1.9	-	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 520 V, I _D = 8 A, V _{GS} = 10 V, R _g = 9.1 Ω		-	18	25	ns
Rise Time	t _r			-	24	55	
Turn-Off Delay Time	t _{d(off)}			-	8.0	-	
Fall Time	t _f			-	1.2	-	
Gate Input Resistance	R _g	f = 1 MHz, open drain		-	0.8	-	Ω
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	64	A
Pulsed Diode Forward Current	I _{SM}			-	-	190	
Diode Forward Voltage	V _{SD}	T _J = 25 °C, I _S = 8 A, V _{GS} = 0 V		-	-	1.5	V
Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = I _S = 8 A, di/dt = 100 A/μs, V _R = 400 V		-	475	-	ns
Reverse Recovery Charge	Q _{rr}			-	5.8	-	μC
Reverse Recovery Current	I _{RRM}			-	30	-	A

Notes

- a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .
 b. $C_{oss(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

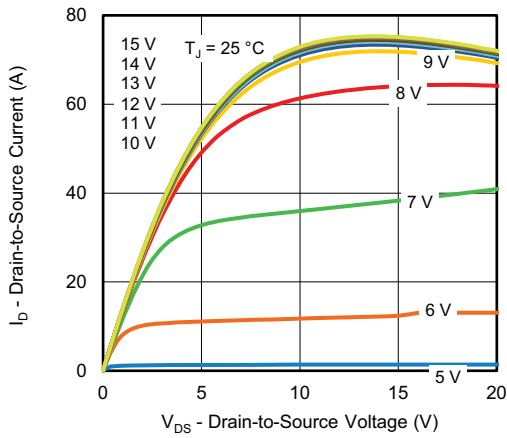


Fig. 1 - Typical Output Characteristics

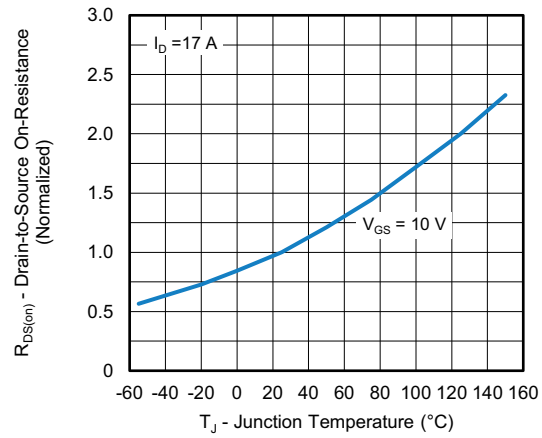


Fig. 4 - Normalized On-Resistance vs. Temperature

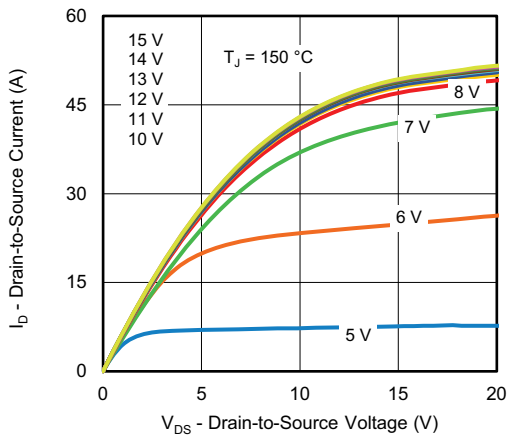


Fig. 2 - Typical Output Characteristics

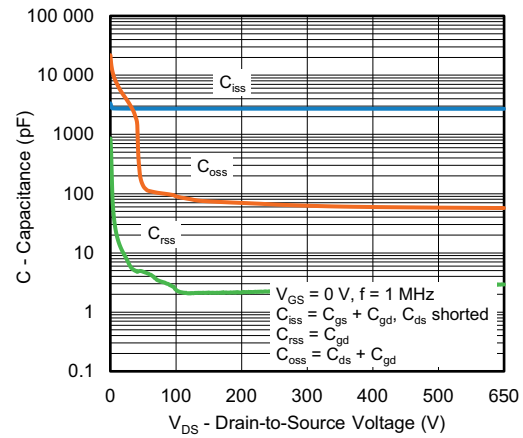


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

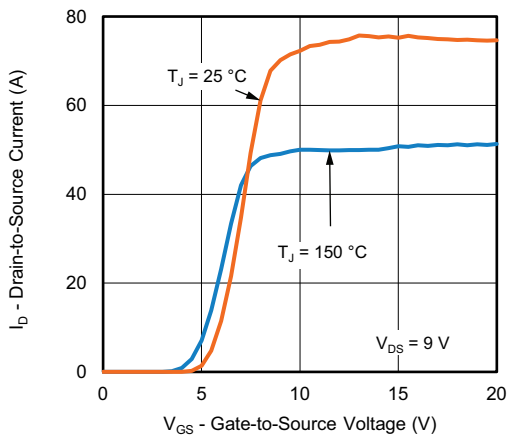


Fig. 3 - Typical Transfer Characteristics

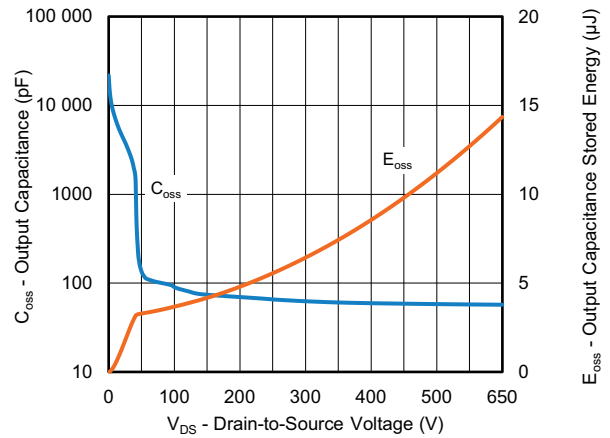


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}



Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage



Fig. 10 - Maximum Drain Current vs. Case Temperature



Fig. 8 - Typical Source-Drain Diode Forward Voltage

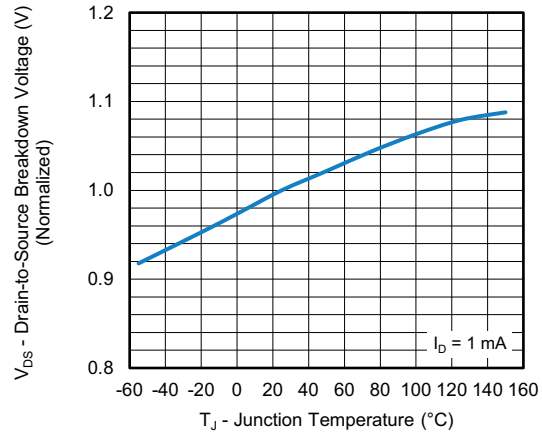


Fig. 11 - Temperature vs. Drain-to-Source Voltage



Fig. 9 - Maximum Safe Operating Area

Note

a. $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified

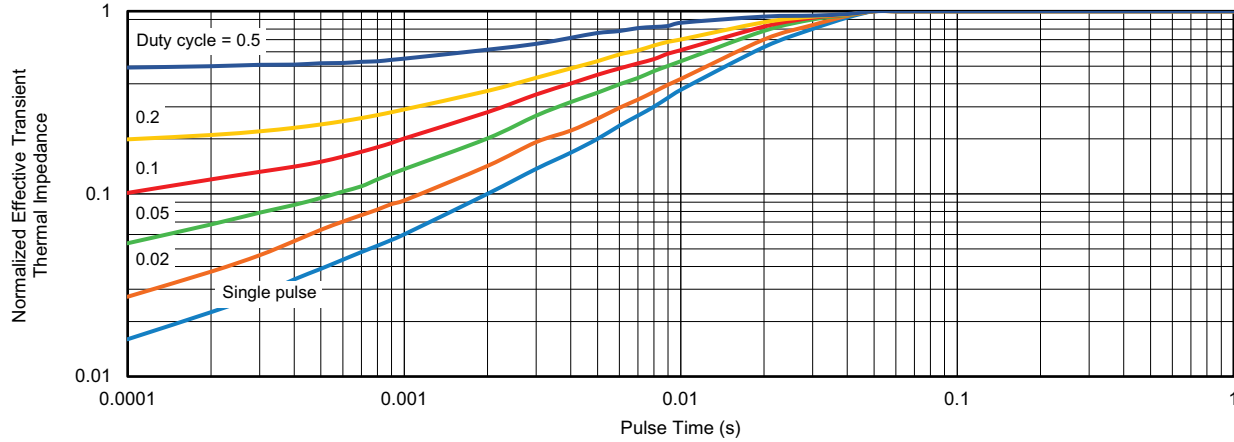


Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case

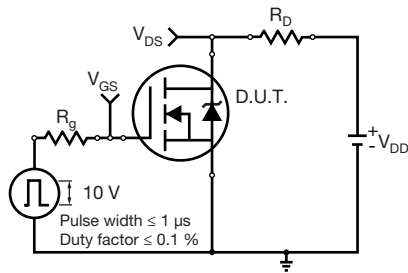


Fig. 13 - Switching Time Test Circuit

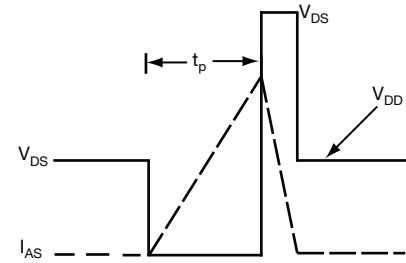


Fig. 16 - Unclamped Inductive Waveforms



Fig. 14 - Switching Time Waveforms



Fig. 17 - Basic Gate Charge Waveform

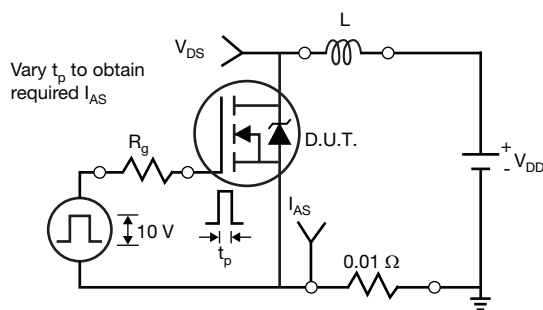


Fig. 15 - Unclamped Inductive Test Circuit

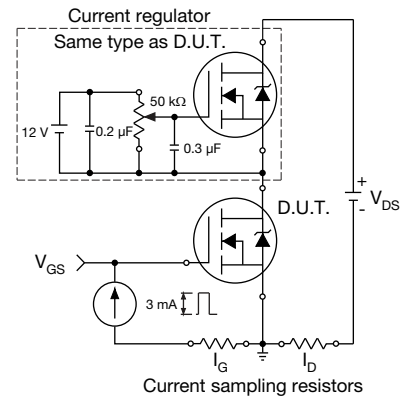
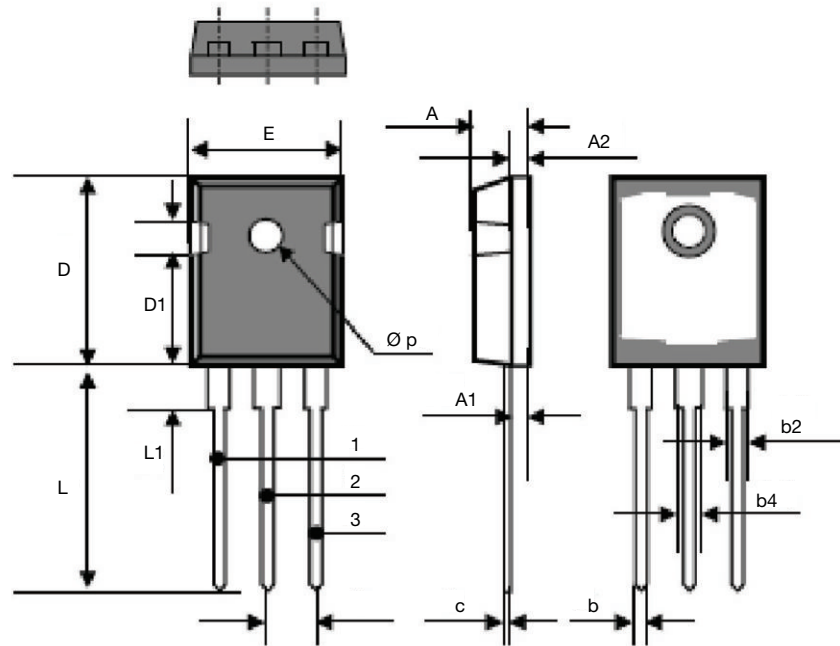


Fig. 18 - Gate Charge Test Circuit

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DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.70	5.31	0.185	0.209
A1	2.21	2.59	0.087	0.102
A2	1.50	2.49	0.059	0.098
b	0.99	1.40	0.039	0.055
b2	1.65	2.41	0.065	0.095
b4	2.59	3.43	0.102	0.135
c	0.61 BSC		0.024 BSC	
D	20.80	21.46	0.819	0.845
D1	3.68	5.49	0.145	0.216
(e)	5.46 BSC		0.215 BSC	
E	15.49	16.26	0.610	0.640
L	19.81	20.32	0.780	0.800
L1	4.06	4.50	0.160	0.177
$\varnothing p$	3.51	3.66	0.138	0.144

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