

13NM60N-VB TO251 Datasheet

N-Channel 600V (D-S) Super Junction Power MOSFET

PRODUCT SUMMARY

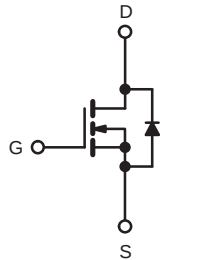
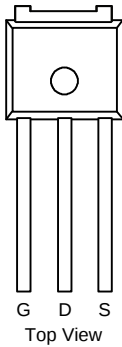
V_{DS} (V) at T_J max.	600	
$R_{DS(on)}$ at 25 °C (Ω)	$V_{GS} = 10$ V	0.38
Q_g max. (nC)	38	
Q_{gs} (nC)	4	
Q_{gd} (nC)	4.2	
Configuration	Single	

FEATURES

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

**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-251

N-Channel MOSFET

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

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V _{DS}	600	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	11	A
		T _C = 100 °C		6.7	
Pulsed Drain Current ^a			I _{DM}	30	
Linear Derating Factor				1.67/1.5/0.3	W/°C
Single Pulse Avalanche Energy ^b			E _{AS}	132	mJ
Maximum Power Dissipation			P _D	83/83/31	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		3.1			
Soldering Recommendations (Peak Temperature) ^c	for 10 s			300	°C

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature.
 b. $V_{DS} = 50$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 4.5$ A.
 c. 1.6 mm from case.
 d. $I_{SD} \leq I_D$, $dI/dt = 100$ A/ μ s, starting $T_J = 25$ °C.

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	80	°C/W
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.6	

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 = 250 μA		600	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA		-	0.65	-	V/°C
Gate-Source Threshold Voltage (N)	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		2	-	4	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} = 600 V, V _{GS} = 0 V		-	-	1	μA
		V _{DS} = 520 V, V _{GS} = 0 V, T _J = 125 °C		-	-	10	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = 10 V	I _D = 5 A	-	0.38	-	Ω
Forward Transconductance	g _{fs}	V _{DS} = 30 V, I _D = 5 A		-	16	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz		-	680	-	pF
Output Capacitance	C _{oss}			-	140	-	
Reverse Transfer Capacitance	C _{rss}			-	5	-	
Effective Output Capacitance, Energy Related ^a	C _{o(er)}	V _{DS} = 0 V to 520 V, V _{GS} = 0 V		-	63	-	
Effective Output Capacitance, Time Related ^b	C _{o(tr)}			-	113	-	
Total Gate Charge	Q _g	V _{GS} = 10 V	I _D = 5 A, V _{DS} = 520 V	-	38	56	nC
Gate-Source Charge	Q _{gs}			-	4	-	
Gate-Drain Charge	Q _{gd}			-	4.5	-	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 520 V, I _D = 5 A, V _{GS} = 10 V, R _g = 9.1 Ω		-	13	25	ns
Rise Time	t _r			-	11	35	
Turn-Off Delay Time	t _{d(off)}			-	81	90	
Fall Time	t _f			-	25	40	
Gate Input Resistance	R _g	f = 1 MHz, open drain		-	3.5	-	Ω
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	11	A
Pulsed Diode Forward Current	I _{SM}			-	-	30	
Diode Forward Voltage	V _{SD}	T _J = 25 °C, I _S = 5 A, V _{GS} = 0 V		-	-	1.5	V
Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = I _S = 5 A, dI/dt = 100 A/μs, V _R = 400 V		-	270	-	ns
Reverse Recovery Charge	Q _{rr}			-	3.3	-	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)

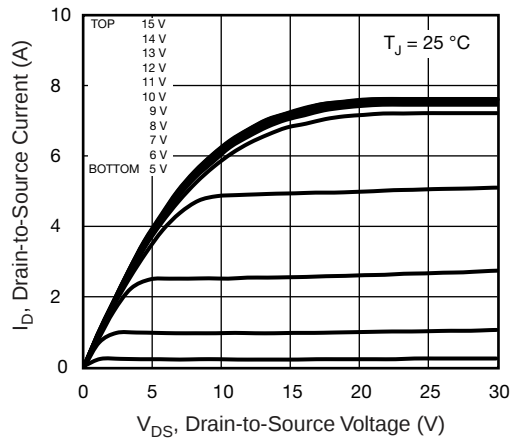


Fig. 1 - Typical Output Characteristics

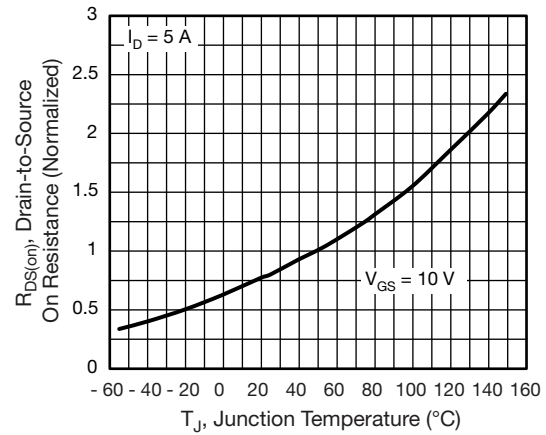


Fig. 4 - Normalized On-Resistance vs. Temperature

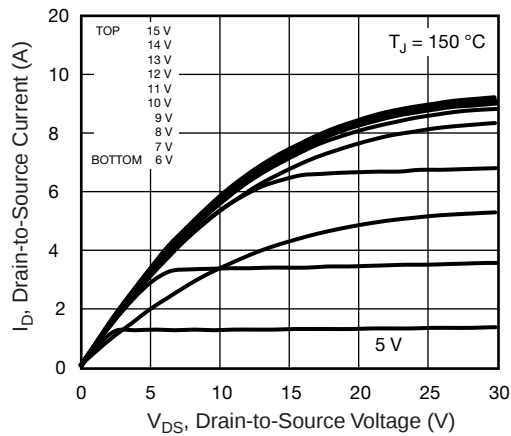


Fig. 2 - Typical Output Characteristics

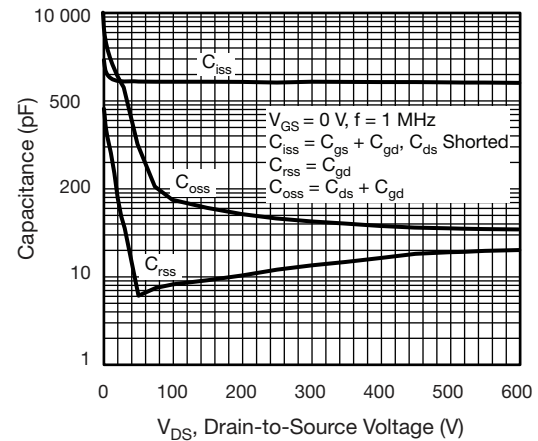


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

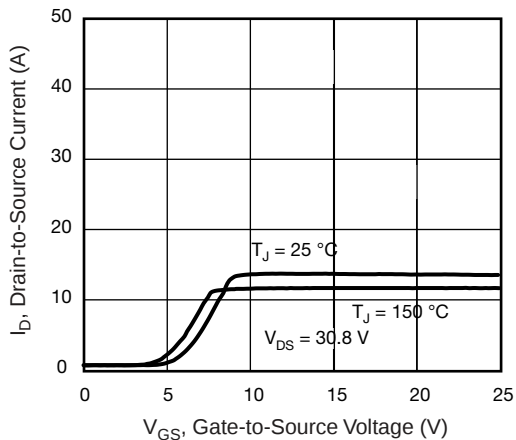


Fig. 3 - Typical Transfer Characteristics



Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

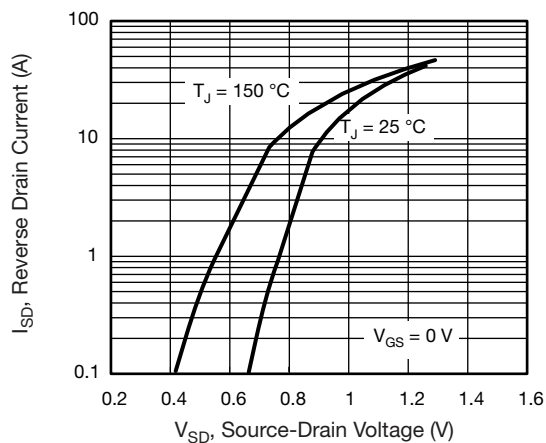


Fig. 7 - Typical Source-Drain Diode Forward Voltage

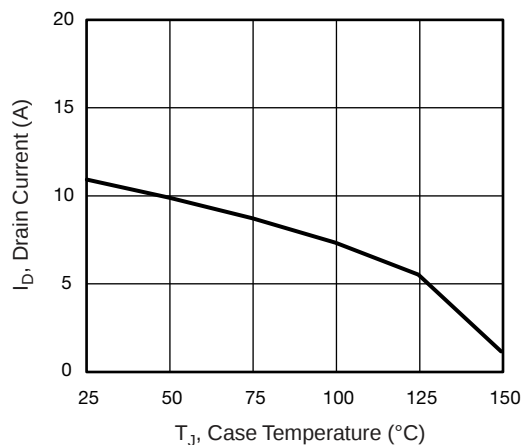


Fig. 9 - Maximum Drain Current vs. Case Temperature

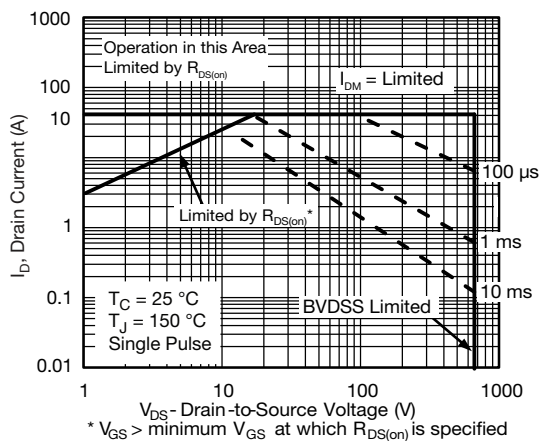


Fig. 8 - Maximum Safe Operating Area

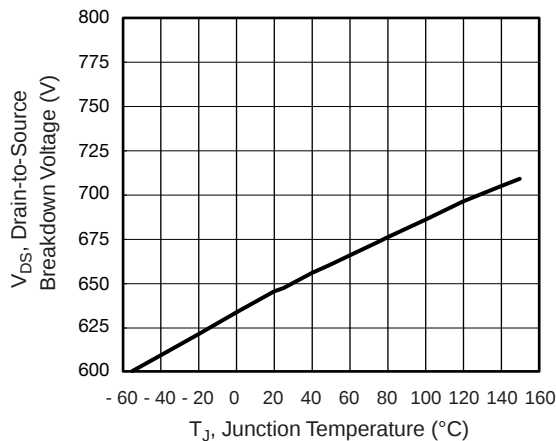


Fig. 10 - Temperature vs. Drain-to-Source Voltage

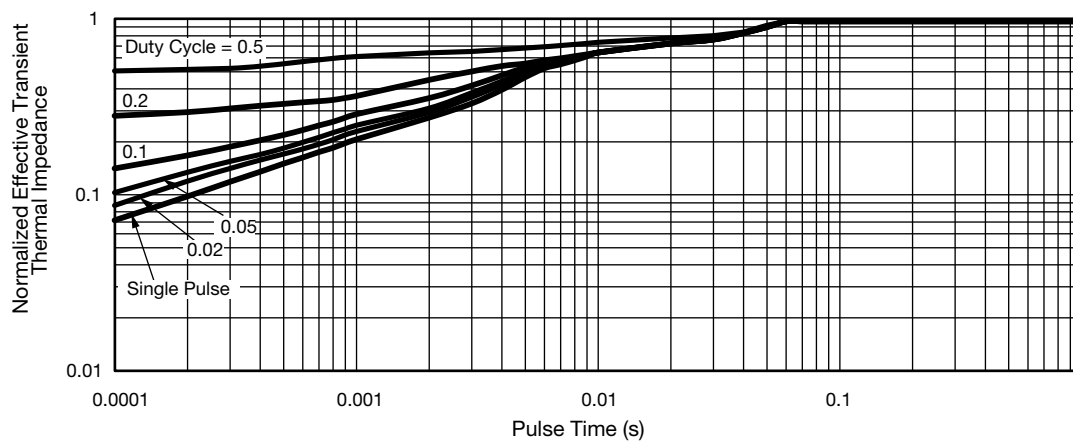


Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case

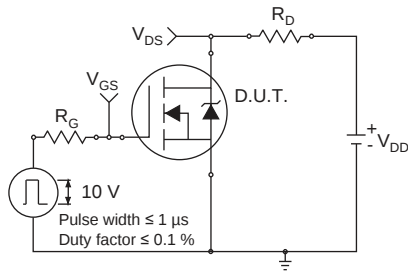


Fig. 12 - Switching Time Test Circuit

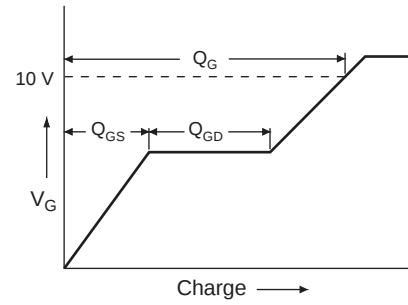


Fig. 16 - Basic Gate Charge Waveform

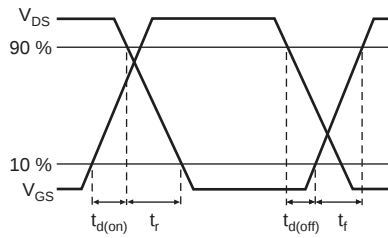


Fig. 13 - Switching Time Waveforms

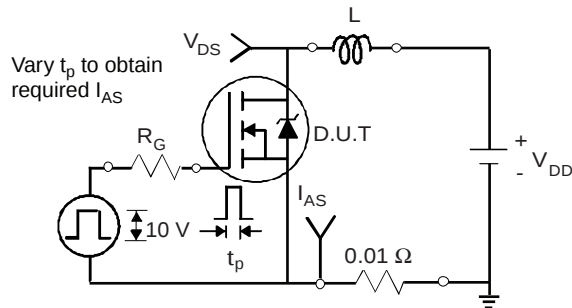


Fig. 14 - Unclamped Inductive Test Circuit



Fig. 15 - Unclamped Inductive Waveforms

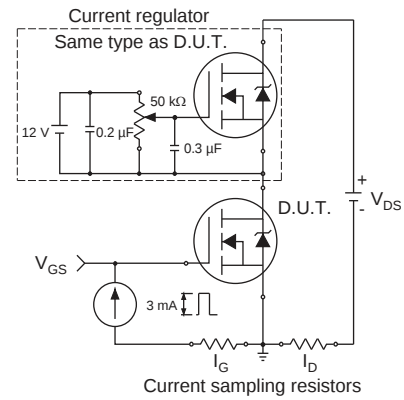
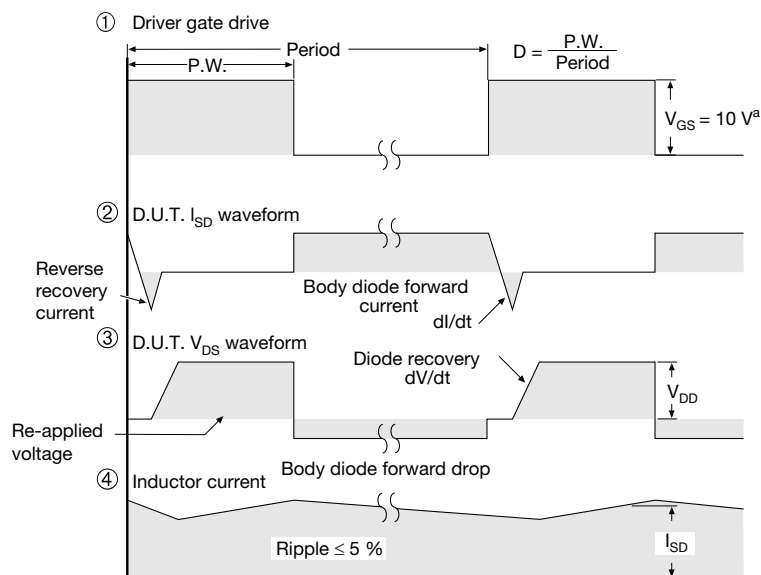
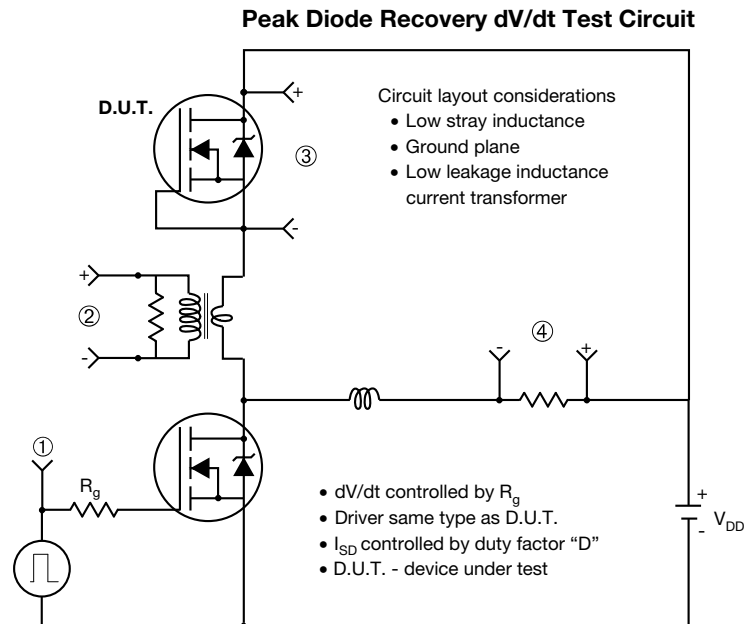


Fig. 17 - Gate Charge Test Circuit

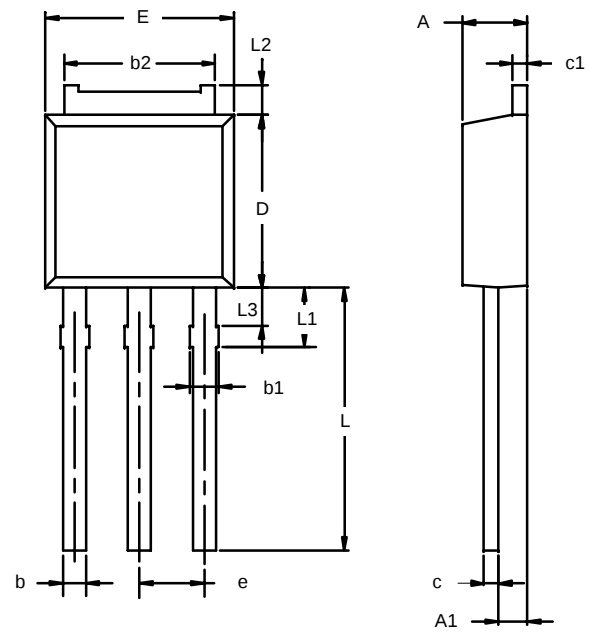


Note

a. $V_{GS} = 5 V$ for logic level devices

Fig. 18 - For N-Channel

TO-251AA (DPAK)



Note: Dimension L3 is for reference only.

Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	2.21	2.38	0.087	0.094
A1	0.89	1.14	0.035	0.045
b	0.71	0.89	0.028	0.035
b1	0.76	1.14	0.030	0.045
b2	5.23	5.43	0.206	0.214
c	0.46	0.58	0.018	0.023
c1	0.46	0.58	0.018	0.023
D	5.97	6.22	0.235	0.245
E	6.48	6.73	0.255	0.265
e	2.28 BSC		0.090 BSC	
L	8.89	9.53	0.350	0.375
L1	1.91	2.28	0.075	0.090
L2	0.89	1.27	0.035	0.050
L3	1.15	1.52	0.045	0.060
ECN: S-03946—Rev. E, 09-Jul-01 DWG: 5346				

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