

N-Channel 60 V (D-S) MOSFET

PRODUCT SUMMARY

V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A) ^a
60	0.024 at $V_{GS} = 10$ V	50
	0.028 at $V_{GS} = 4.5$ V	40

FEATURES

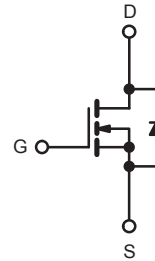
- Halogen-free According to IEC 61249-2-21 Definition
- Surface Mount
- Available in Tape and Reel
- Dynamic dV/dt Rating
- Logic-Level Gate Drive
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC


RoHS*
 COMPLIANT

TO-220AB



Top View



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, unless otherwise noted)

PARAMETER				SYMBOL	LIMIT	UNIT
Drain-Source Voltage				V_{DS}	60	V
Gate-Source Voltage				V_{GS}	± 20	
Continuous Drain Current ^f	V_{GS} at 10 V	$T_C = 25\text{ }^{\circ}\text{C}$	I_D	50	A	
Continuous Drain Current		$T_C = 100\text{ }^{\circ}\text{C}$		36		
Pulsed Drain Current ^a			I_{DM}	200		
Linear Derating Factor				1.0	W/ $^{\circ}\text{C}$	
Linear Derating Factor (PCB Mount) ^e				0.025		
Single Pulse Avalanche Energy ^b			E_{AS}	400	mJ	
Maximum Power Dissipation	$T_C = 25\text{ }^{\circ}\text{C}$		P_D	150	W	
Maximum Power Dissipation (PCB Mount) ^e	$T_A = 25\text{ }^{\circ}\text{C}$			3.7		
Peak Diode Recovery dV/dt^c			dV/dt	4.5	V/ns	
Operating Junction and Storage Temperature Range			T_J, T_{stg}	- 55 to + 175	$^{\circ}\text{C}$	
Soldering Recommendations (Peak Temperature) ^d	for 10 s			300 ^d		

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25$ V, starting $T_J = 25^\circ\text{C}$, $L = 179$ μH , $R_g = 25$ Ω , $I_{AS} = 51$ A (see fig. 12).
- $I_{SD} \leq 51$ A, $di/dt \leq 250$ A/ μs , $V_{DD} \leq V_{DS}$, $T_J \leq 175^\circ\text{C}$.
- 1.6 mm from case.
- When mounted on 1" square PCB (FR-4 or G-10 material).
- Current limited by the package, (die current = 51 A).

THERMAL RESISTANCE RATINGS

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	62	°C/W
Maximum Junction-to-Ambient (PCB Mount) ^a	R_{thJA}	-	40	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	1.0	

Note

a. When mounted on 1" square PCB (FR-4 or G-10 material).

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

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0, I _D = 250 μA		60	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA		-	0.070	-	V/°C
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		1.0	-	2.5	
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 10 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 60 V, V _{GS} = 0 V		-	-	25	μA
		V _{DS} = 48 V, V _{GS} = 0 V, T _J = 150 °C		-	-	250	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = 10 V	I _D = 21 A ^b	-	0.024	-	Ω
		V _{GS} = 4.5 V	I _D = 15 A ^b	-	0.028	-	
Forward Transconductance	g _{fs}	V _{DS} = 25 V, I _D = 21A ^b		23	-	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	190		pF
Output Capacitance	C _{oss}			-	920	-	
Reverse Transfer Capacitance	C _{rss}			-	170	-	
Total Gate Charge	Q _g	V _{GS} = 5.0 V	I _D = 51 A, V _{DS} = 48 V, see fig. 6 and 13 ^b	-	-	66	nC
Gate-Source Charge	Q _{gs}			-	-	12	
Gate-Drain Charge	Q _{gd}			-	-	43	
Turn-On Delay Time	t _{d(on)}	V _{DD} = 30 V, I _D = 51 A, R _g = 4.6 Ω, R _D = 0.56 Ω, see fig. 10 ^b		-	17	-	ns
Rise Time	t _r			-	230	-	
Turn-Off Delay Time	t _{d(off)}			-	2	-	
Fall Time	t _f			-	110	-	
Internal Drain Inductance	L _D	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal Source Inductance	L _S			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	50°	A
Pulsed Diode Forward Current ^a	I _{SM}			-	-	200	
Body Diode Voltage	V _{SD}	T _J = 25 °C, I _S = 51 A, V _{GS} = 0 V ^b		-	-	2.5	V
Body Diode Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = 51 A, dI/dt = 100 A/μs ^b		-	130	180	ns
Body Diode Reverse Recovery Charge	Q _{rr}			-	0.84	1.3	μC
Forward Turn-On Time	t _{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L _S and L _D)					

Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
 b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.
 c. Current limited by the package, (Die Current = 51 A).

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$



Fig. 3 - Typical Transfer Characteristics



Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$



Fig. 4 - Normalized On-Resistance vs. Temperature



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

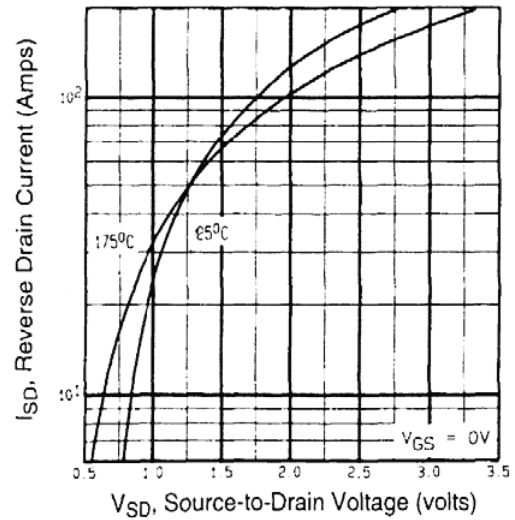


Fig. 7 - Typical Source-Drain Diode Forward Voltage



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

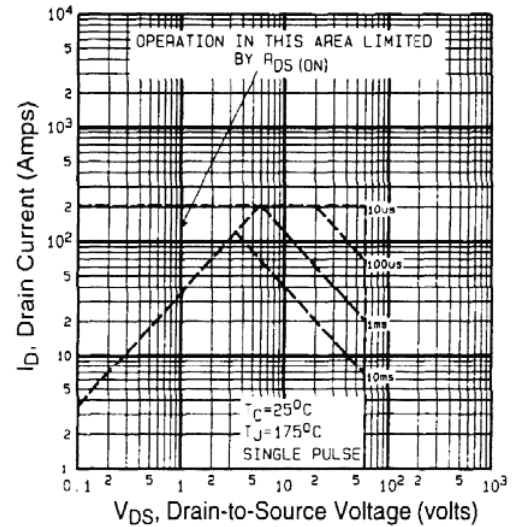


Fig. 8 - Maximum Safe Operating Area



Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 10a - Switching Time Test Circuit

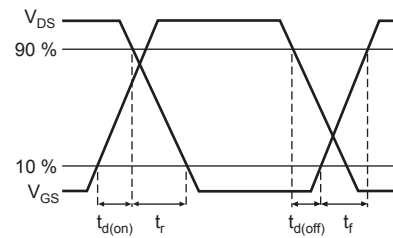


Fig. 10b - Switching Time Waveforms



Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

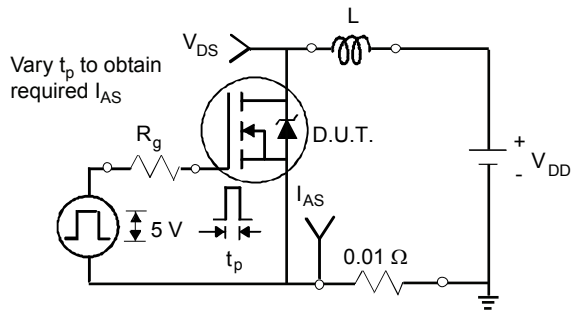


Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms

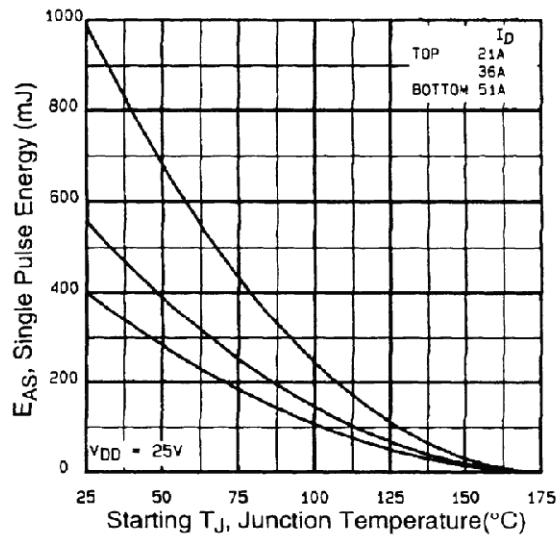


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

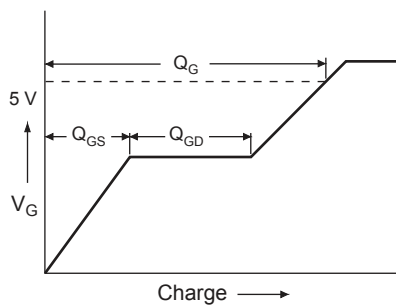


Fig. 13a - Basic Gate Charge Waveform

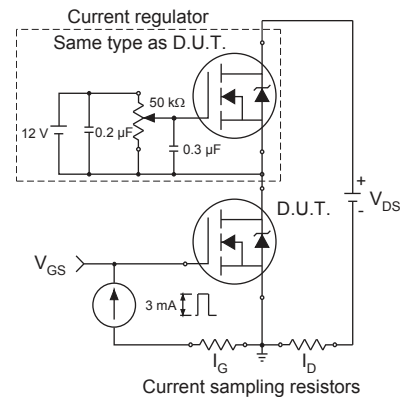
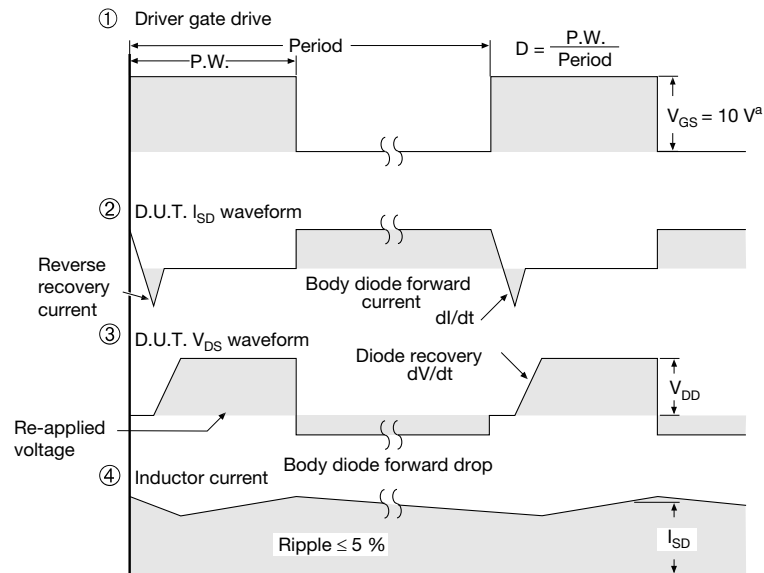
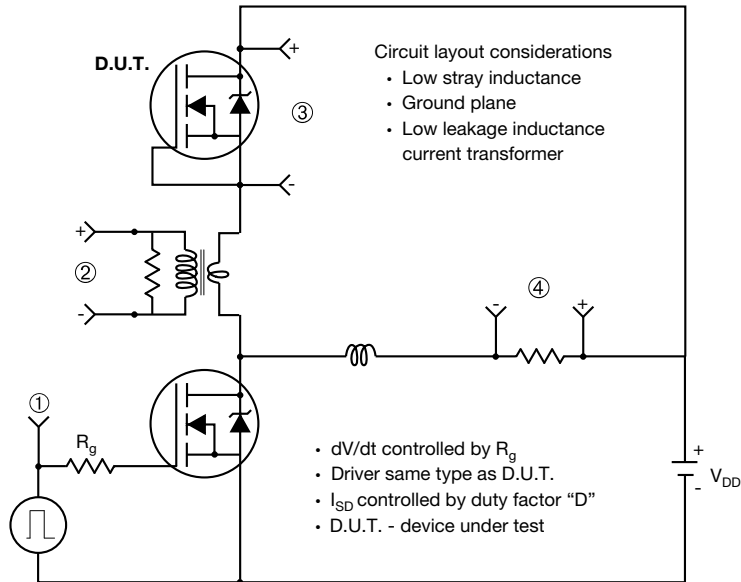


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

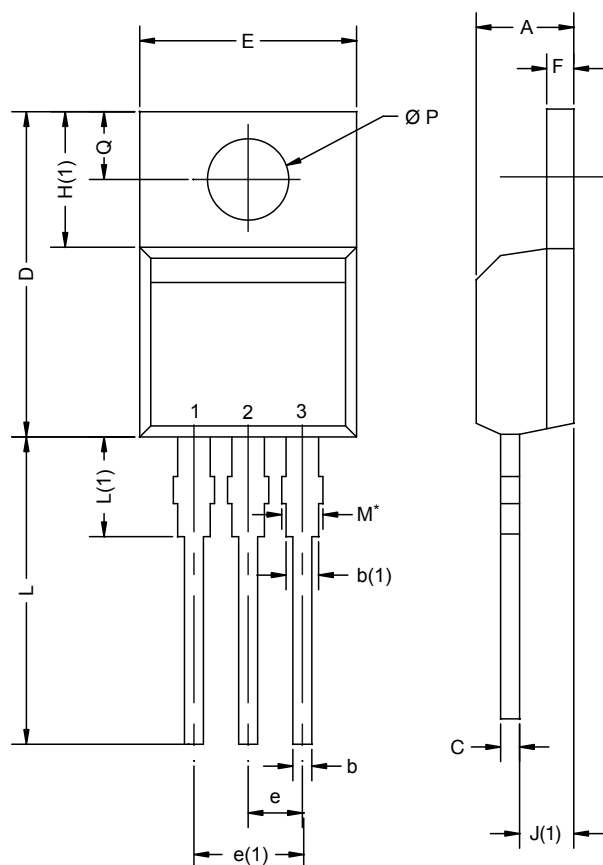


Note

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

Fig. 14 - For N-Channel

TO-220AB



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.25	4.65	0.167	0.183
b	0.69	1.01	0.027	0.040
b(1)	1.20	1.73	0.047	0.068
c	0.36	0.61	0.014	0.024
D	14.85	15.49	0.585	0.610
E	10.04	10.51	0.395	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.09	6.48	0.240	0.255
J(1)	2.41	2.92	0.095	0.115
L	13.35	14.02	0.526	0.552
L(1)	3.32	3.82	0.131	0.150
Ø P	3.54	3.94	0.139	0.155
Q	2.60	3.00	0.102	0.118
ECN: X12-0208-Rev. N, 08-Oct-12 DWG: 5471				

Notes

* M = 1.32 mm to 1.62 mm (dimension including protrusion)
Heatsink hole for HVM

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