N-Channel 60 V (D-S) MOSFET

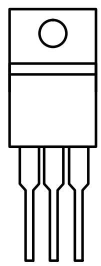
PRODUCT SUMMARY		
V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)[a]
60	0.024 at V_{GS} = 10 V	50
	0.028 at V_{GS} = 4.5 V	40

FEATURES

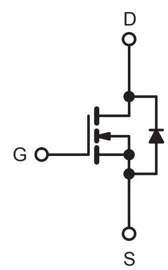
- **Halogen-free According to IEC 61249-2-21 Definition**
- Surface Mount
- Available in Tape and Reel
- Dynamic dV/dt Rating
- Logic-Level Gate Drive
- Fast Switching
- Compliant to RoHS Directive 2002/95/EC

RoHS*
COMPLIANT

TO-220AB



Top View



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T_C = 25 °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 °C	I_D	50	A
Continuous Drain Current		T_C = 100 °C		36	
Pulsed Drain Current[a]			I_{DM}	200	
Linear Derating Factor				1.0	W/°C
Linear Derating Factor (PCB Mount)[e]				0.025	
Single Pulse Avalanche Energy[b]			E_{AS}	400	mJ
Maximum Power Dissipation	T_C = 25 °C		P_D	150	W
Maximum Power Dissipation (PCB Mount)[e]	T_A = 25 °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	°C
Soldering Recommendations (Peak Temperature)[d]	for 10 s			300[d]	

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
b. V_{DD} = 25 V, starting T_J = 25 °C, L = 179 µH, R_g = 25 Ω, I_{AS} = 51 A (see fig. 12).
c. I_{SD} ≤ 51 A, dI/dt ≤ 250 A/µs, V_{DD} ≤ V_{DS}, T_J ≤ 175 °C.
d. 1.6 mm from case.
e. When mounted on 1" square PCB (FR-4 or G-10 material).
f. 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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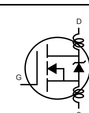
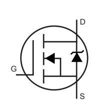
SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0, I_D = 250 μA	60	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA	-	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[c]	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 ≤ 300 μs; duty cycle ≤ 2 %.
c. Current limited by the package, (Die Current = 51 A).

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

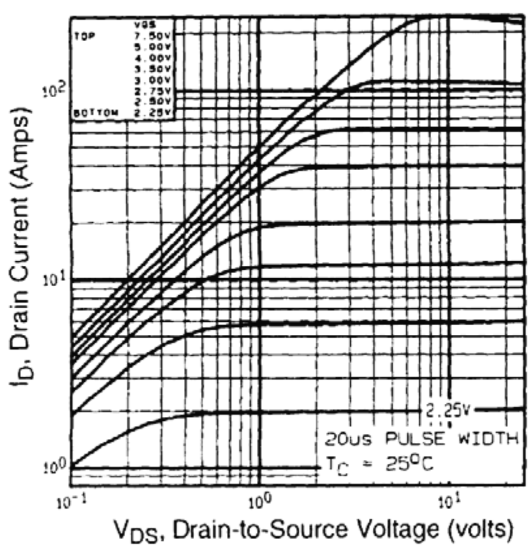


Fig. 1 - Typical Output Characteristics, T_C = 25 °C

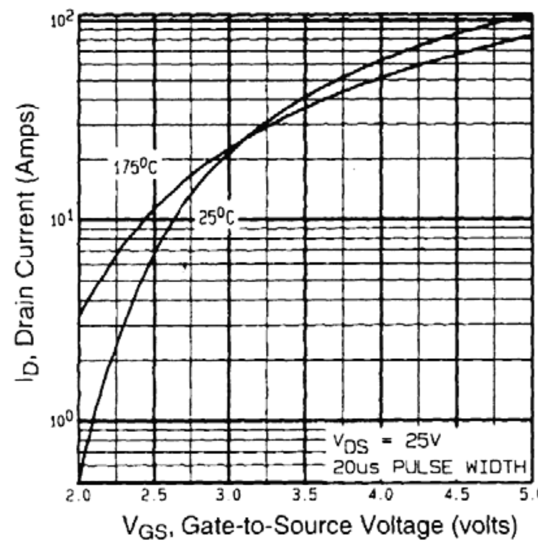


Fig. 3 - Typical Transfer Characteristics

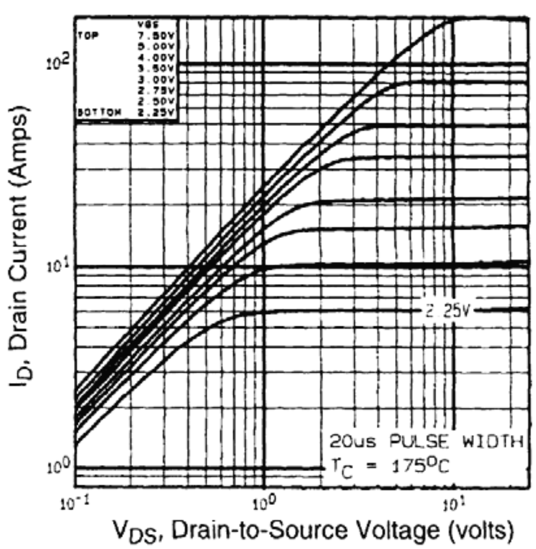


Fig. 2 - Typical Output Characteristics, T_C = 150 °C

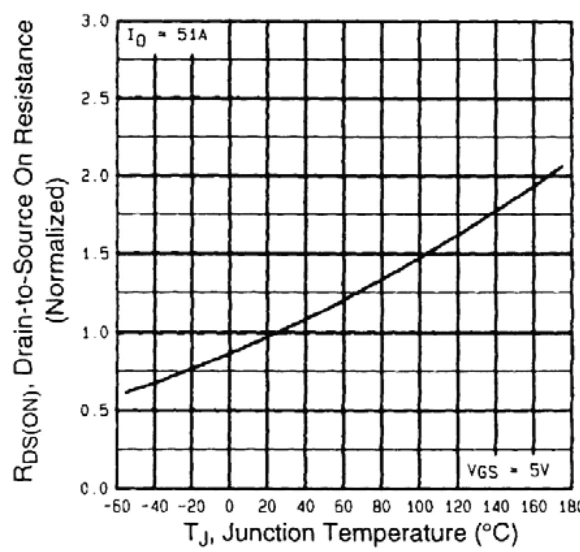


Fig. 4 - Normalized On-Resistance vs. Temperature

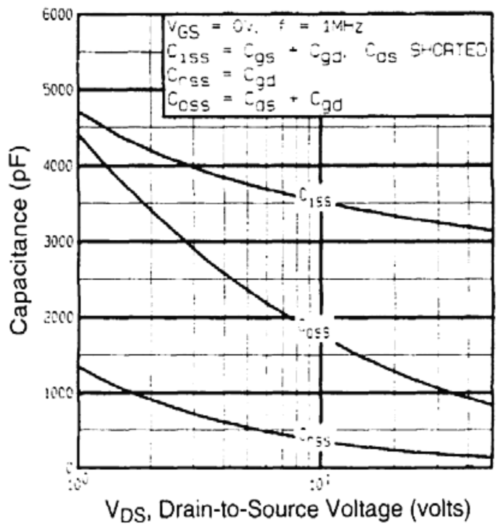


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

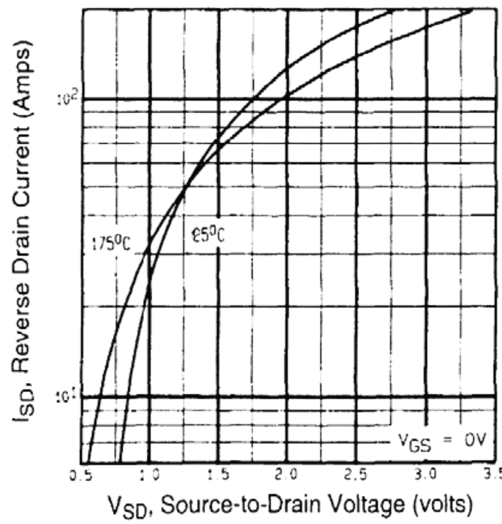


Fig. 7 - Typical Source-Drain Diode Forward Voltage

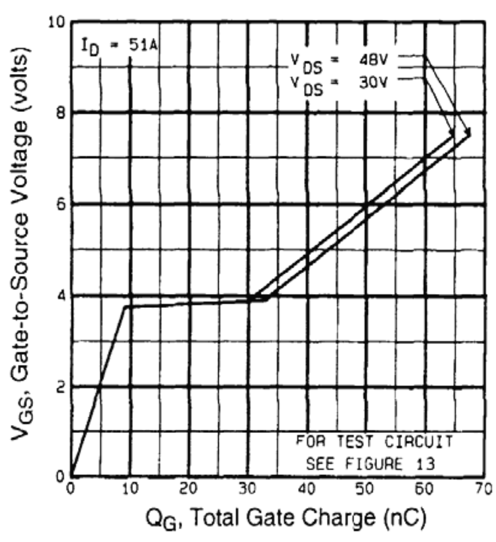


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

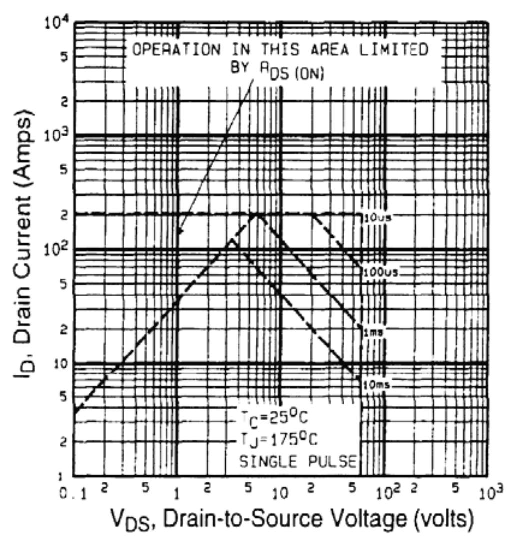


Fig. 8 - Maximum Safe Operating Area

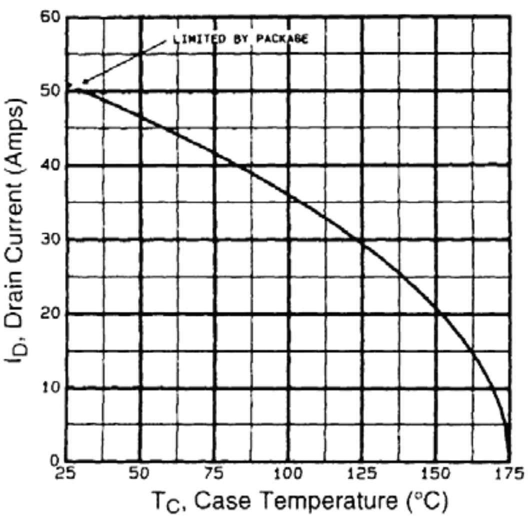


Fig. 9 - Maximum Drain Current vs. Case Temperature

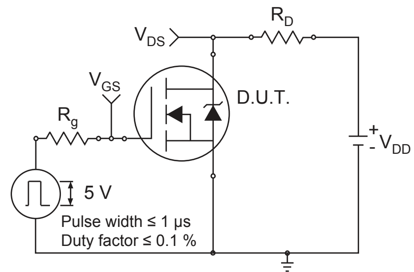


Fig. 10a - Switching Time Test Circuit

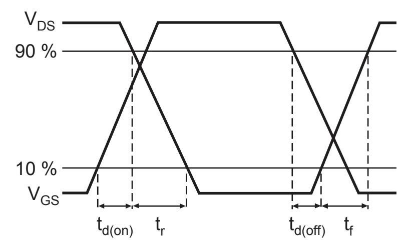


Fig. 10b - Switching Time Waveforms

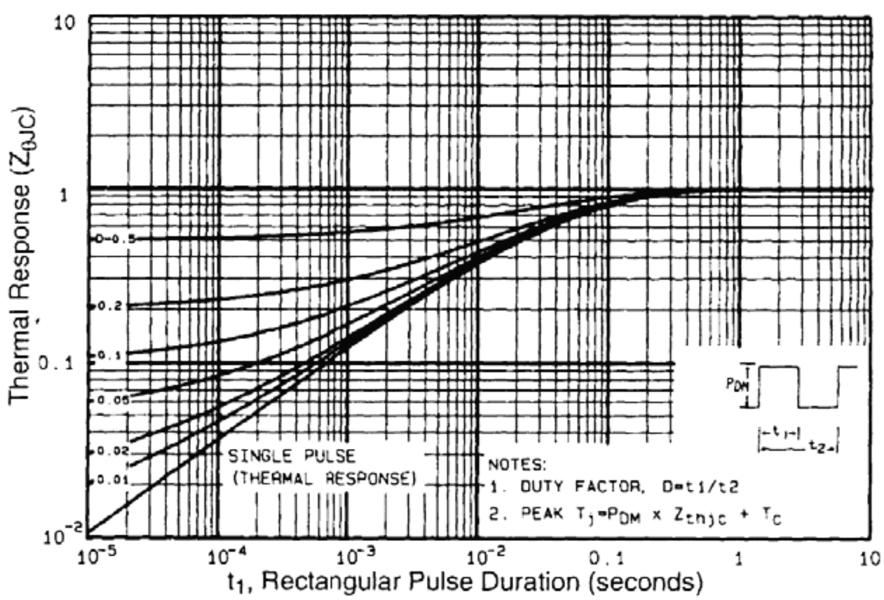


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

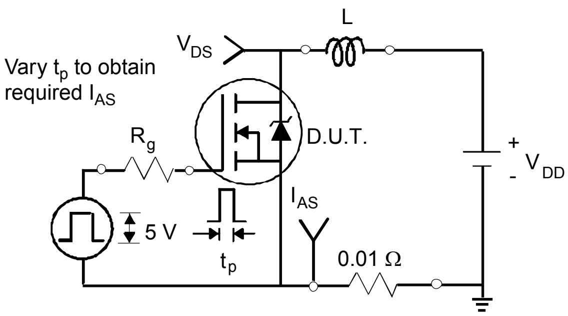


Fig. 12a - Unclamped Inductive Test Circuit

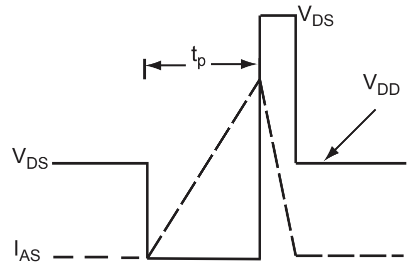


Fig. 12b - Unclamped Inductive Waveforms

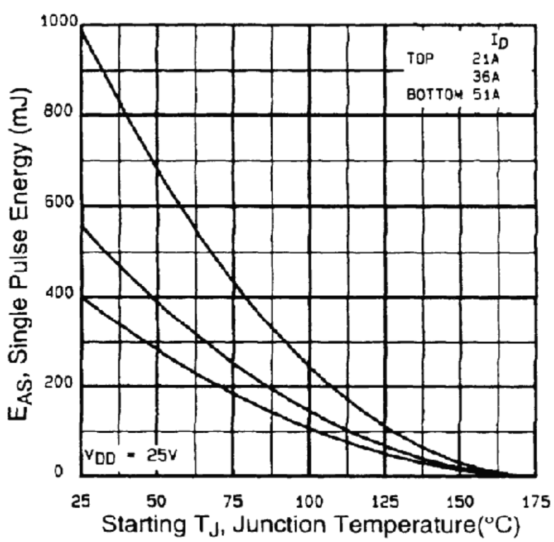


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

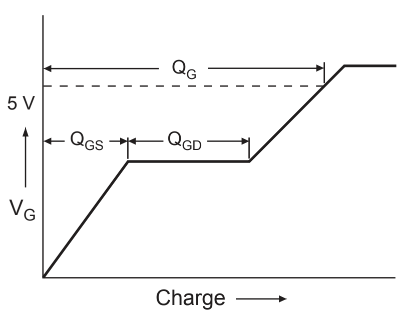


Fig. 13a - Basic Gate Charge Waveform

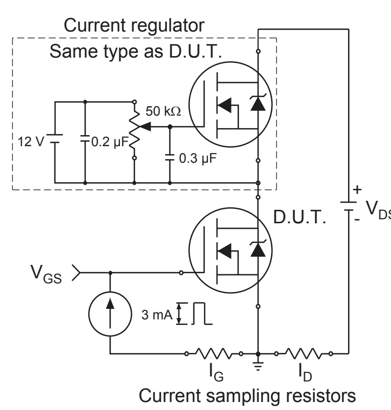
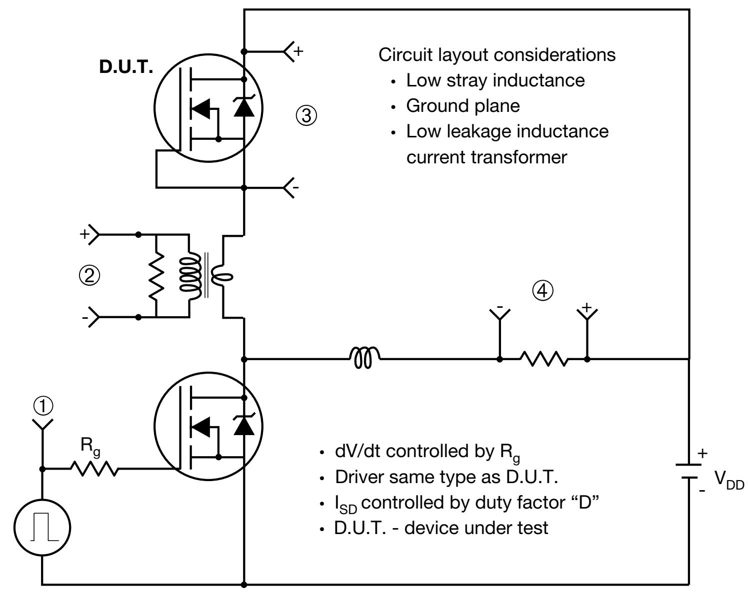
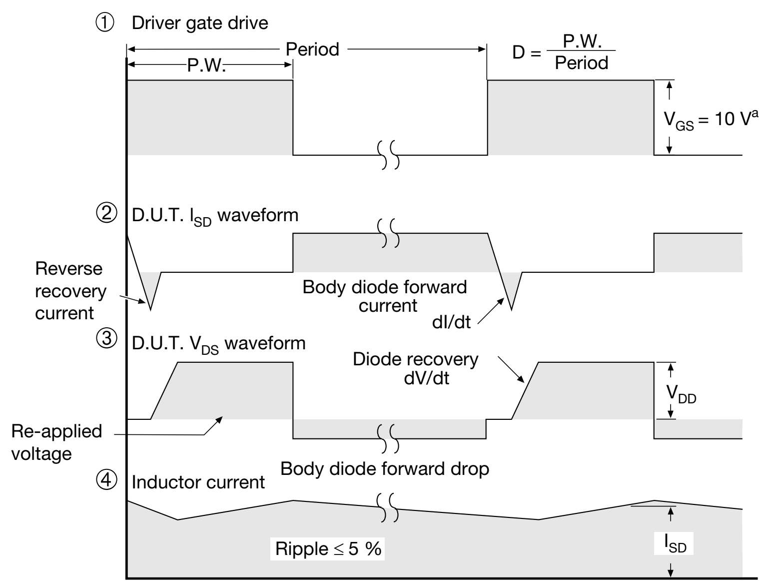


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



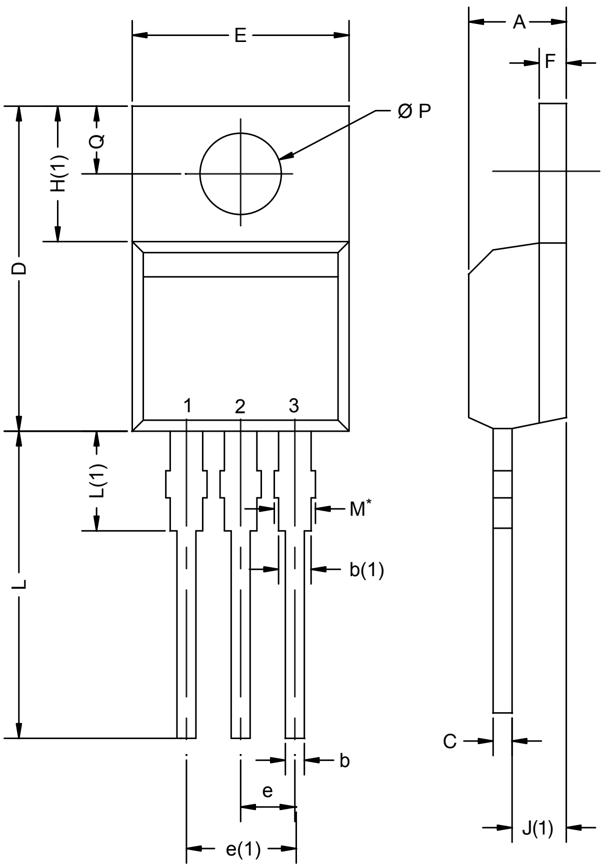


Note

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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