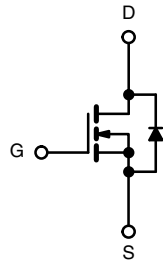
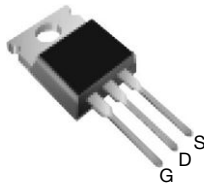


## Power MOSFET

### PRODUCT SUMMARY

$V_{DS}$ (V)	500	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.85
$Q_g$ (Max.) (nC)	63	
$Q_{gs}$ (nC)	9.3	
$Q_{gd}$ (nC)	32	
Configuration	Single	

**TO-220AB**


N-Channel MOSFET

### FEATURES

- Dynamic  $dV/dt$  Rating
- Repetitive Avalanche Rated
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC



Available

**RoHS\***  
COMPLIANT

### DESCRIPTION

Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220AB package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220AB contribute to its wide acceptance throughout the industry.

### ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free	IRF840PbF SiHF840-E3
SnPb	IRF840 SiHF840

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

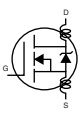

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	500	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Continuous Drain Current	$I_D$	$T_C = 25\text{ }^\circ\text{C}$	A
		$T_C = 100\text{ }^\circ\text{C}$	
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	32	
Linear Derating Factor		1.0	W/ $^\circ\text{C}$
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	510	mJ
Repetitive Avalanche Current <sup>a</sup>	$I_{AR}$	8.0	A
Repetitive Avalanche Energy <sup>a</sup>	$E_{AR}$	13	mJ
Maximum Power Dissipation	$P_D$	125	W
Peak Diode Recovery $dV/dt^c$	$dV/dt$	3.5	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to + 150	$^\circ\text{C}$
Soldering Recommendations (Peak Temperature)	for 10 s	300 <sup>d</sup>	
Mounting Torque	6-32 or M3 screw	10	lbf · in
		1.1	N · m

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$ , starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $L = 14\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 8.0\text{ A}$  (see fig. 12).
- $I_{SD} \leq 8.0\text{ A}$ ,  $dI/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^\circ\text{C}$ .
- 1.6 mm from case.

\* Pb containing terminations are not RoHS compliant, exemptions may apply

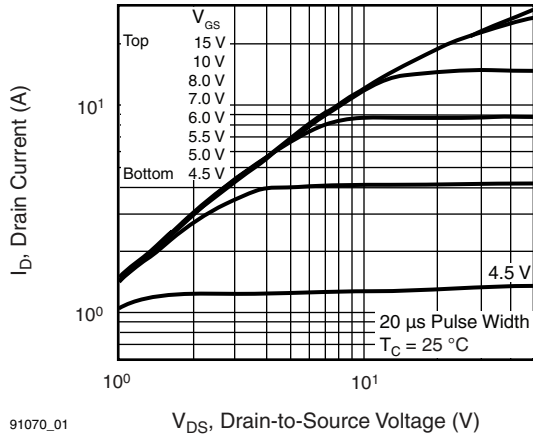
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.50	-	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.0	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	500	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$	-	0.78	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 4.8\text{ A}^b$	-	-	0.85	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 4.8\text{ A}^b$	4.9	-	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V},$ $V_{DS} = 25\text{ V},$ $f = 1.0\text{ MHz}$ , see fig. 5	-	1300	-	pF
Output Capacitance	$C_{oss}$		-	310	-	
Reverse Transfer Capacitance	$C_{rss}$		-	120	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V},$ $I_D = 8\text{ A}, V_{DS} = 400\text{ V},$ see fig. 6 and 13 <sup>b</sup>	-	-	63	nC
Gate-Source Charge	$Q_{gs}$		-	-	9.3	
Gate-Drain Charge	$Q_{gd}$		-	-	32	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250\text{ V}, I_D = 8\text{ A}$ $R_g = 9.1\text{ }\Omega, R_D = 31\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	14	-	ns
Rise Time	$t_r$		-	23	-	
Turn-Off Delay Time	$t_{d(off)}$		-	49	-	
Fall Time	$t_f$		-	20	-	
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	-	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	8.0	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	32	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 8\text{ A}, V_{GS} = 0\text{ V}^b$	-	-	2.0	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 8\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$	-	460	970	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	4.2	8.9	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

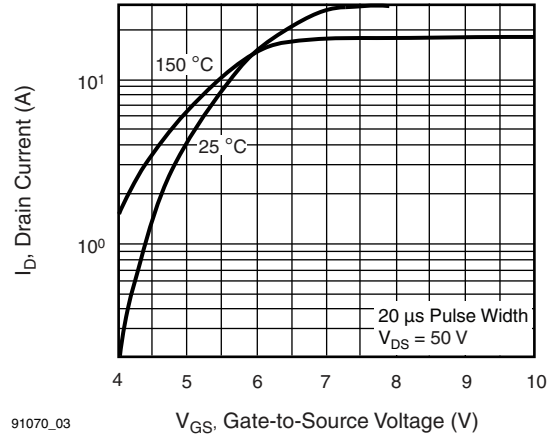
**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

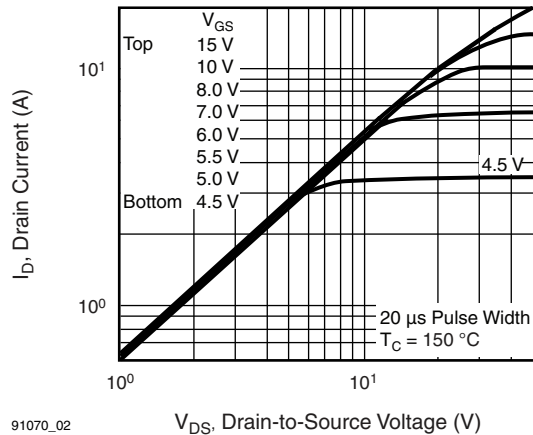
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



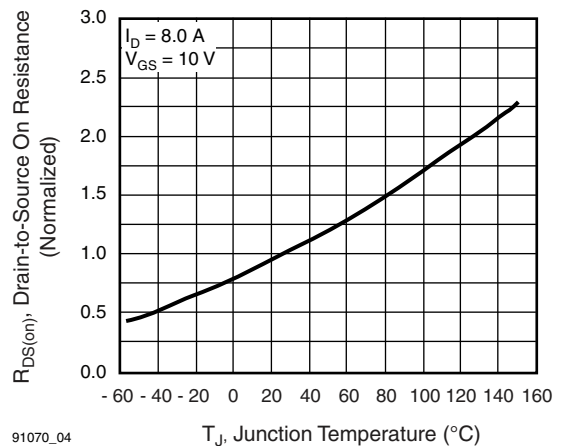
**Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$**



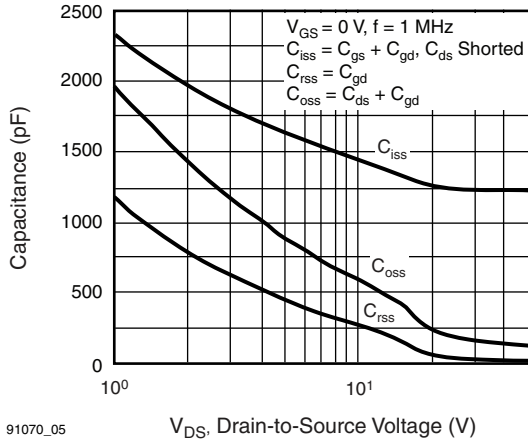
**Fig. 3 - Typical Transfer Characteristics**



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

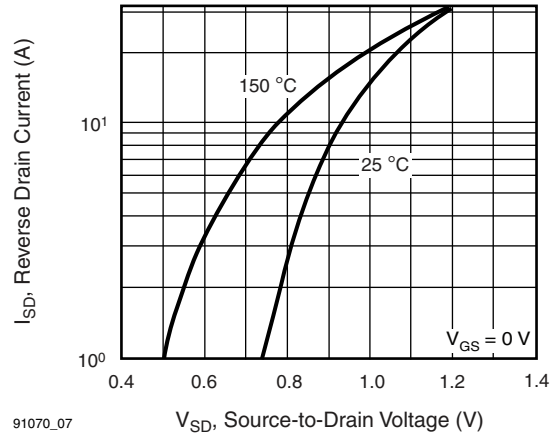


**Fig. 4 - Normalized On-Resistance vs. Temperature**



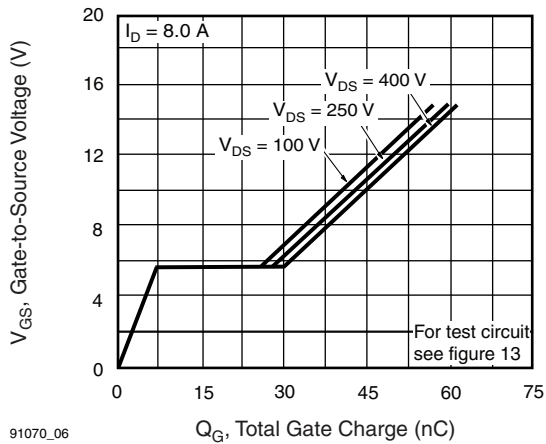
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Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage



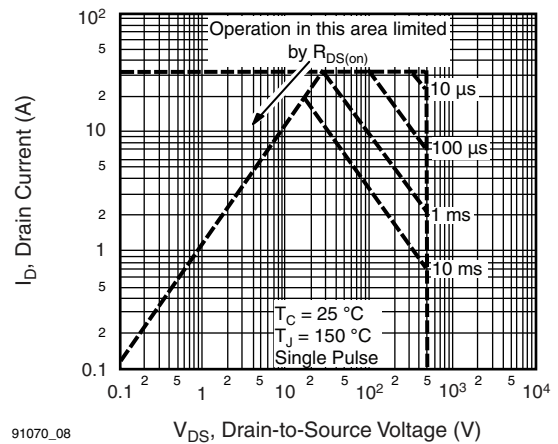
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Fig. 7 - Typical Source-Drain Diode Forward Voltage



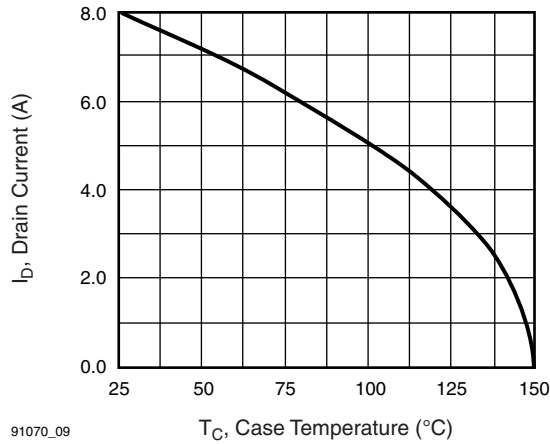
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Fig. 6 - Typical Gate Charge vs. Drain-to-Source Voltage



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Fig. 8 - Maximum Safe Operating Area



91070\_09

Fig. 9 - Maximum Drain Current vs. Case Temperature

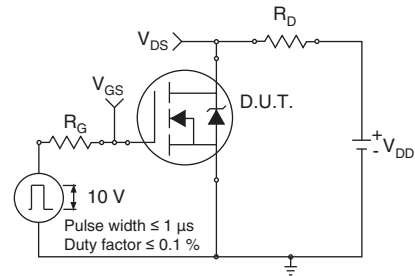


Fig. 10a - Switching Time Test Circuit

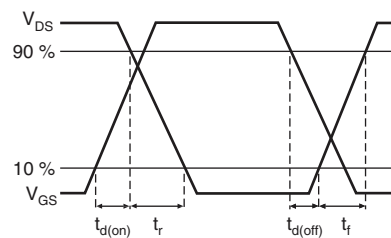
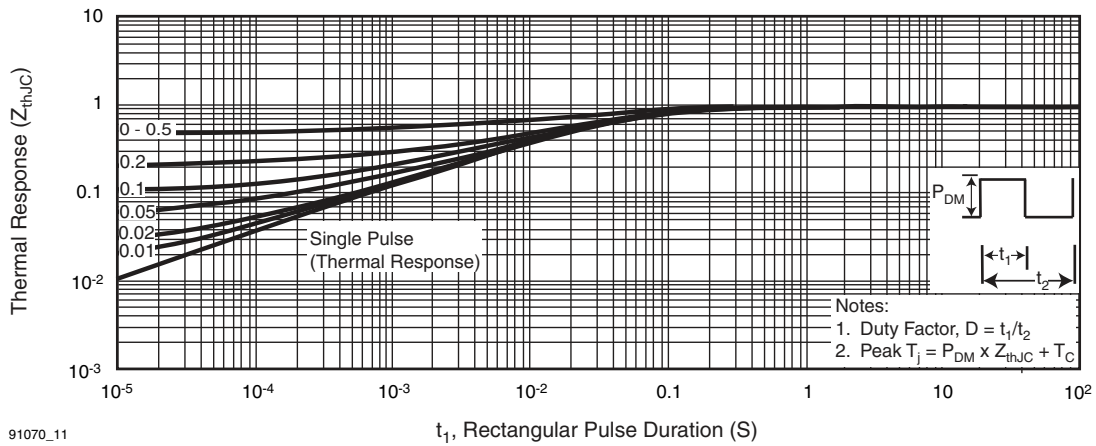


Fig. 10b - Switching Time Waveforms



91070\_11

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

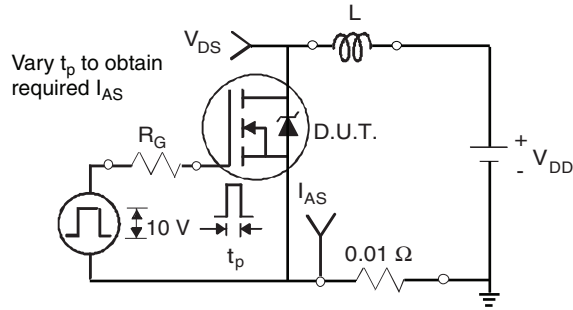


Fig. 12a - Unclamped Inductive Test Circuit

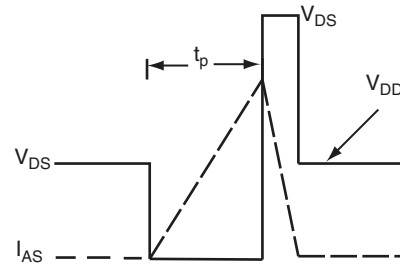


Fig. 12b - Unclamped Inductive Waveforms

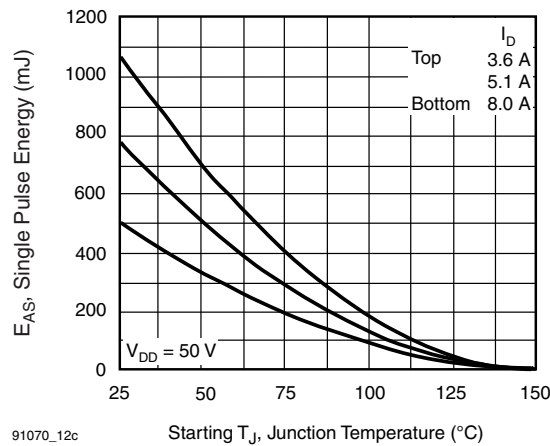


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

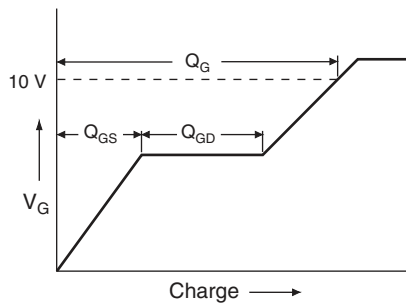


Fig. 13a - Basic Gate Charge Waveform

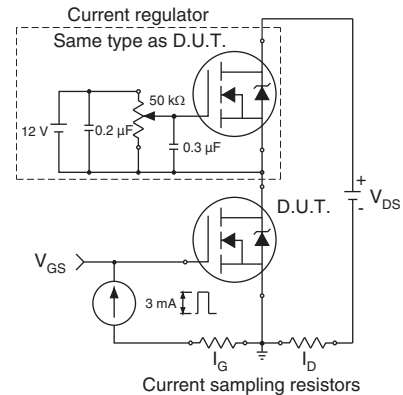
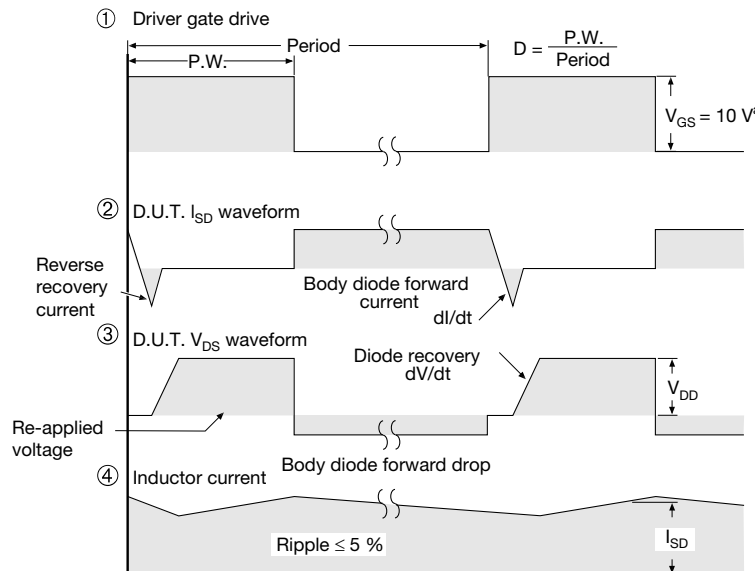
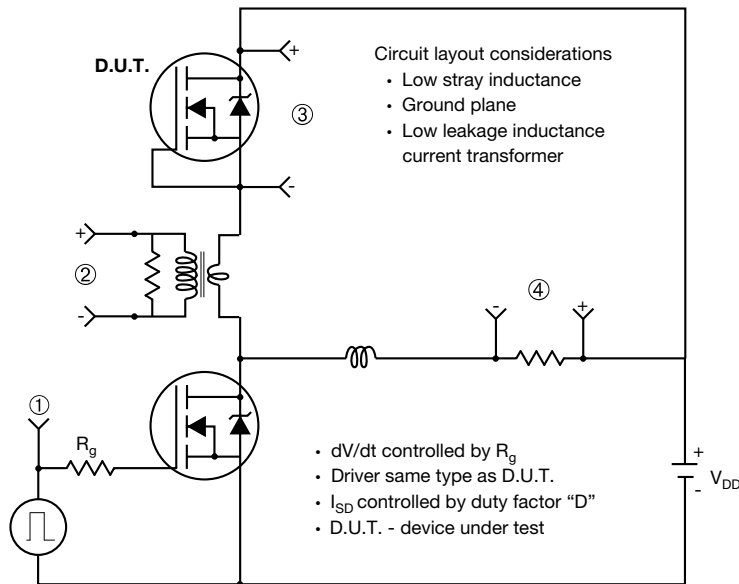


Fig. 13b - Gate Charge Test Circuit

### Peak Diode Recovery dV/dt Test Circuit



**Note**

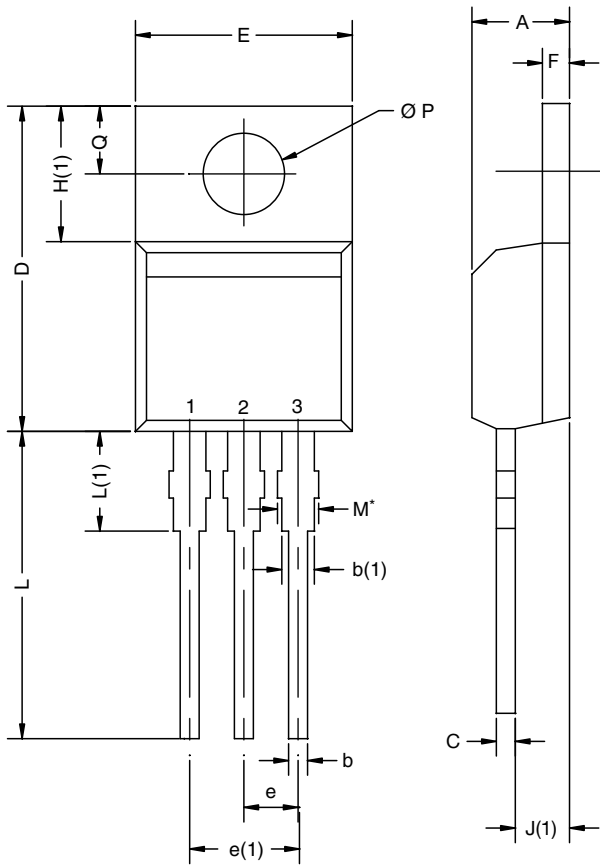
a.  $V_{GS} = 5\text{ V}$  for logic level devices

**Fig. 14 - For N-Channel**

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### TO-220AB

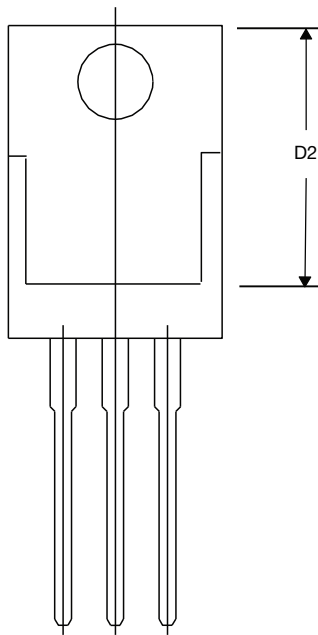


DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.25	4.65	0.167	0.183
b	0.69	1.01	0.027	0.040
b(1)	1.20	1.73	0.047	0.068
c	0.36	0.61	0.014	0.024
D	14.85	15.49	0.585	0.610
D2	12.19	12.70	0.480	0.500
E	10.04	10.51	0.395	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	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
$\varnothing P$	3.54	3.94	0.139	0.155
Q	2.60	3.00	0.102	0.118

ECN: T14-0413-Rev. P, 16-Jun-14  
DWG: 5471

**Note**

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







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