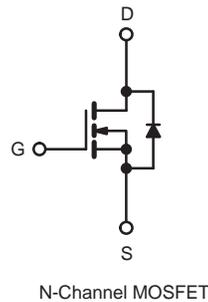
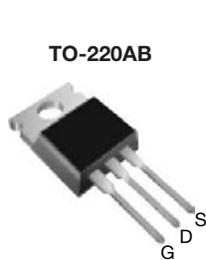


## Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V)	500	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10$ V	0.85
$Q_g$ (Max.) (nC)	39	
$Q_{gs}$ (nC)	10	
$Q_{gd}$ (nC)	19	
Configuration	Single	



### FEATURES

- Ultra Low Gate Charge
- Reduced Gate Drive Requirement
- Enhanced 30 V  $V_{GS}$  Rating
- Reduced  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$
- Extremely High Frequency Operation
- Repetitive Avalanche Rated
- Compliant to RoHS Directive 2002/95/EC



**RoHS\***  
COMPLIANT

### DESCRIPTION

This new series of low charge Power MOSFETs achieve significantly lower gate charge over conventional MOSFETs. Utilizing the new LCDMOS technology, the device improvements are achieved without added product cost, allowing for reduced gate drive requirements and total system savings. In addition, reduced switching losses and improved efficiency are achievable in a variety of high frequency applications. Frequencies of a few MHz at high current are possible using the new low charge MOSFETs.

These device improvements combined with the proven ruggedness and reliability that are characteristic of Power MOSFETs offer the designer a new standard in power transistors for switching applications.

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	IRF840LCPbF
	SiHF840LC-E3
SnPb	IRF840LC
	SiHF840LC

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$ , unless otherwise noted)					
PARAMETER		SYMBOL	LIMIT	UNIT	
Drain-Source Voltage		$V_{DS}$	500	V	
Gate-Source Voltage		$V_{GS}$	$\pm 30$		
Continuous Drain Current	$V_{GS}$ at 10 V	$I_D$	$T_C = 25^\circ\text{C}$	8.0	A
			$T_C = 100^\circ\text{C}$	5.1	
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	28		
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	$T_C = 25^\circ\text{C}$	$P_D$	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).
- $V_{DD} = 50$  V, starting  $T_J = 25^\circ\text{C}$ ,  $L = 14$  mH,  $R_g = 25 \Omega$ ,  $I_{AS} = 8.0$  A (see fig. 12).
- $I_{SD} \leq 8.0$  A,  $dI/dt \leq 100$  A/ $\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150^\circ\text{C}$ .
- 1.6 mm from case.

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

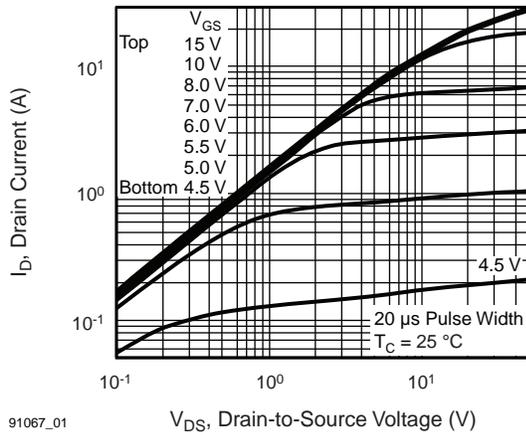
THERMAL RESISTANCE				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.50	-	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.0	

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	$V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	0.63	-	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	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 4.8\text{ A}^b$		4.0	-	-	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		-	1100	-	pF
Output Capacitance	$C_{oss}$			-	170	-	
Reverse Transfer Capacitance	$C_{riss}$			-	18	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 8.0\text{ A}, V_{DS} = 400\text{ V}$ see fig. 6 and 13 <sup>b</sup>	-	-	39	nC
Gate-Source Charge	$Q_{gs}$			-	-	10	
Gate-Drain Charge	$Q_{gd}$			-	-	19	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 250\text{ V}, I_D = 8.0\text{ A}, R_g = 9.1\text{ }\Omega, R_D = 30\text{ }\Omega$ see fig. 10 <sup>b</sup>		-	12	-	ns
Rise Time	$t_r$			-	25	-	
Turn-Off Delay Time	$t_{d(off)}$			-	27	-	
Fall Time	$t_f$			-	19	-	
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>	$I_{SM}$			-	-	28	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 8.0\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	2.0	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = 8.0\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	490	740	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$			-	3.0	4.5	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )					

**Notes**

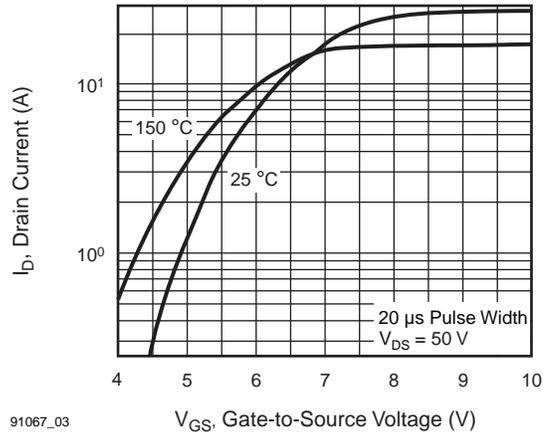
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

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



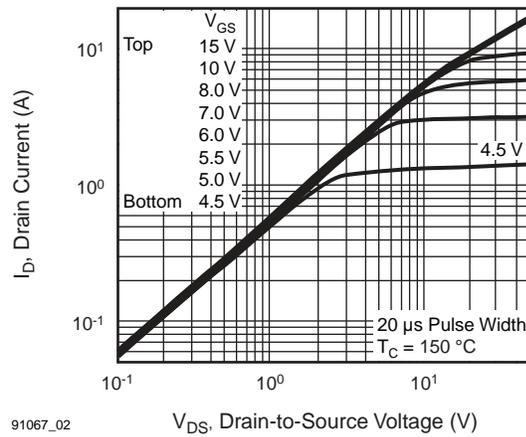
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Fig. 1 - Typical Output Characteristics,  $T_C = 25\text{ }^\circ\text{C}$



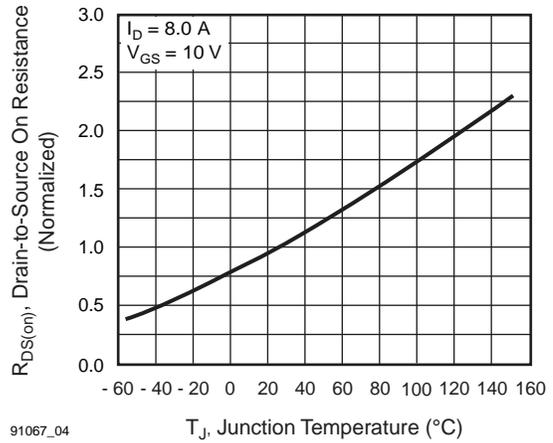
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Fig. 3 - Typical Transfer Characteristics



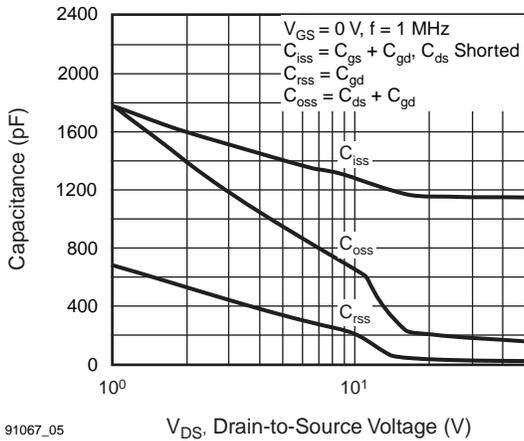
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Fig. 2 - Typical Output Characteristics,  $T_C = 150\text{ }^\circ\text{C}$



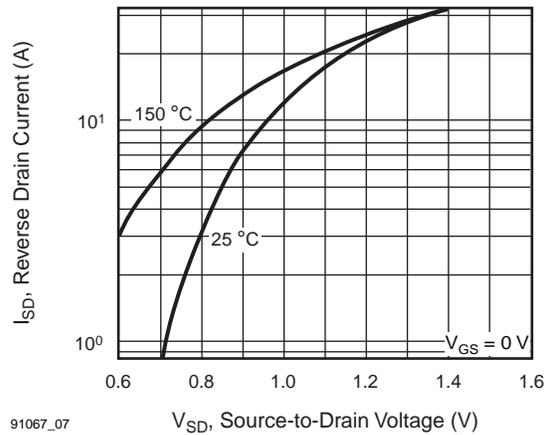
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Fig. 4 - Normalized On-Resistance vs. Temperature



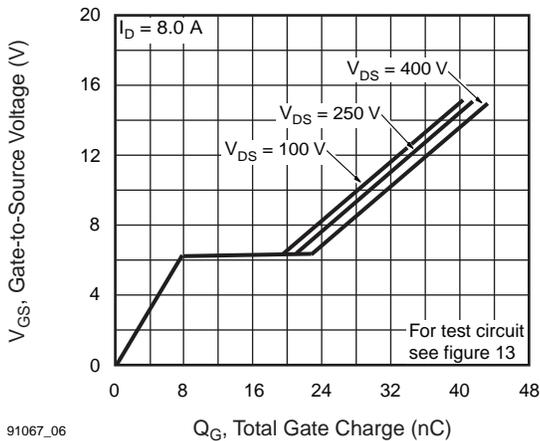
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**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



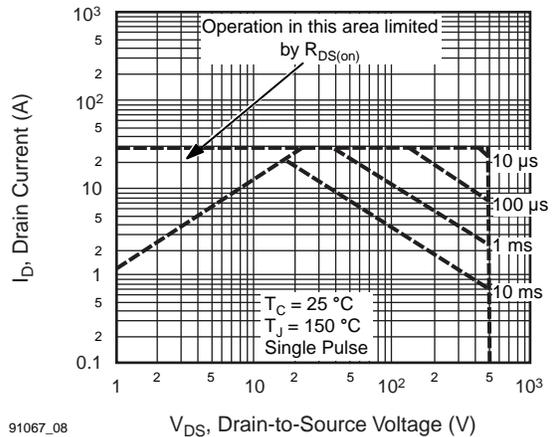
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**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



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



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**Fig. 8 - Maximum Safe Operating Area**

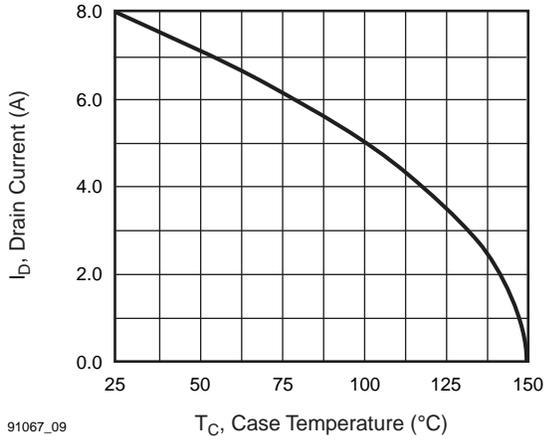


Fig. 9 - Maximum Drain Current vs. Case Temperature

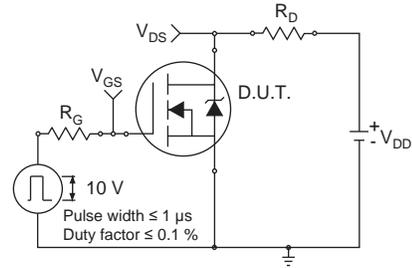


Fig. 10a - Switching Time Test Circuit

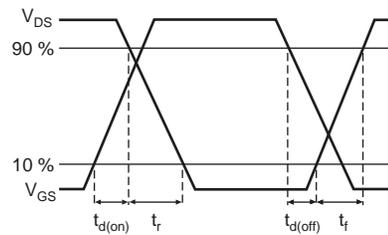


Fig. 10b - Switching Time Waveforms

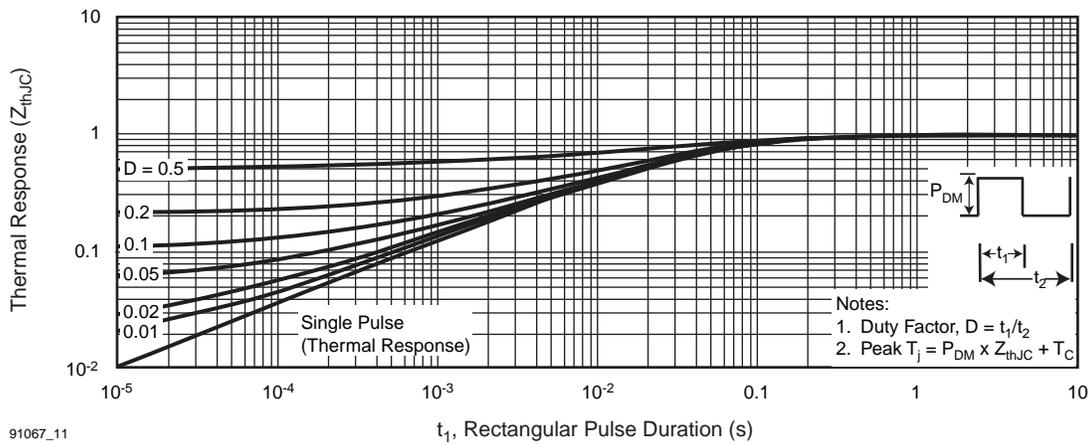


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

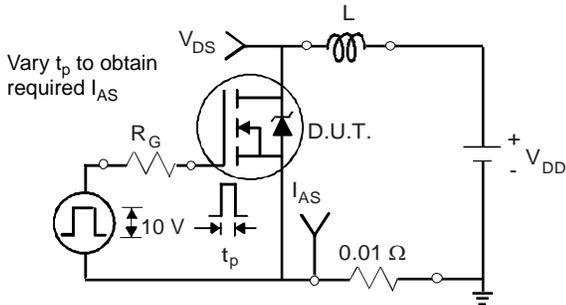


Fig. 12a - Unclamped Inductive Test Circuit

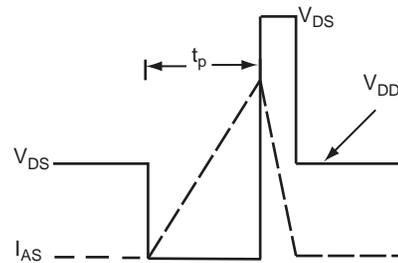


Fig. 12b - Unclamped Inductive Waveforms

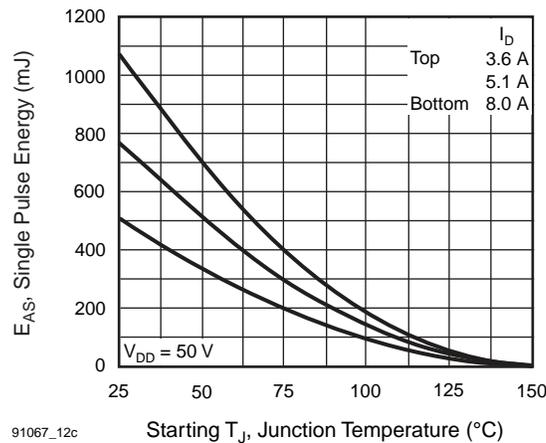


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

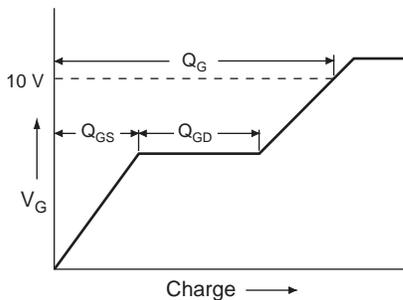


Fig. 13a - Basic Gate Charge Waveform

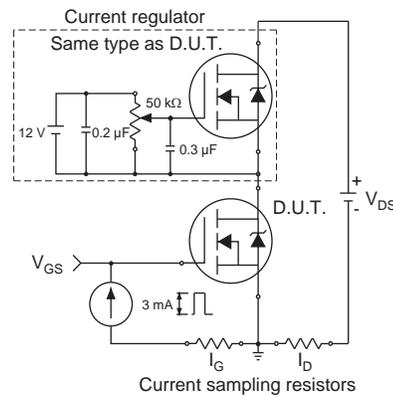
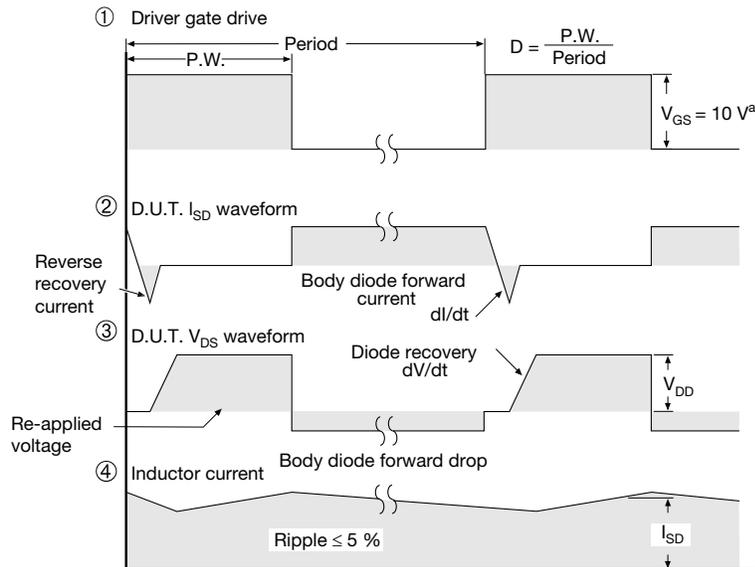
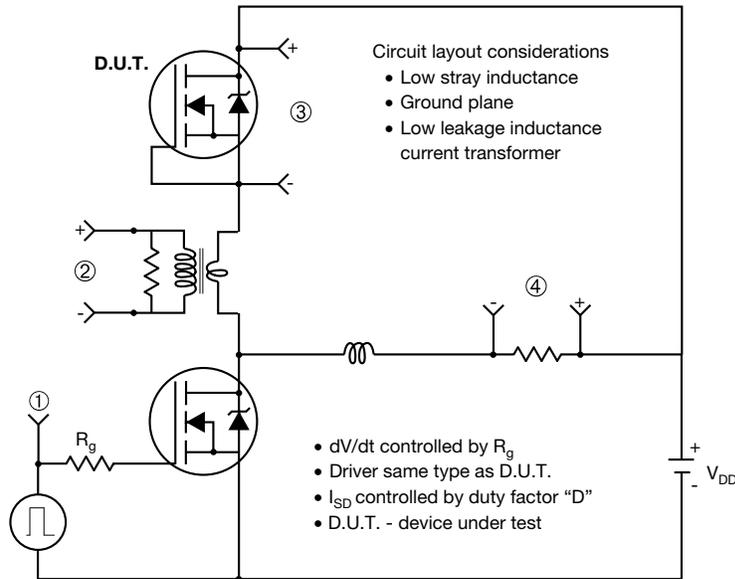


Fig. 13b - Gate Charge Test Circuit

### Peak Diode Recovery dV/dt Test Circuit

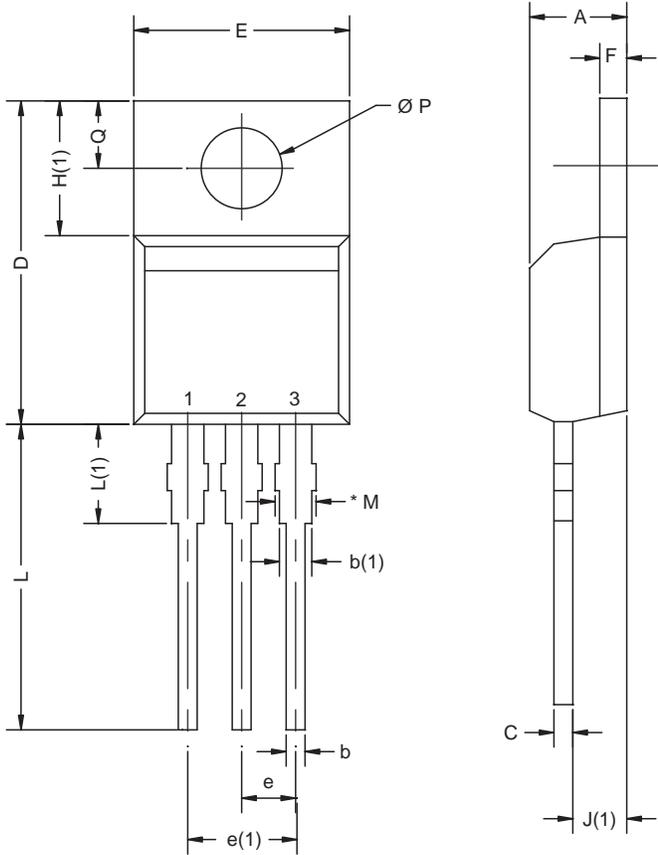


**Note**  
 a.  $V_{GS} = 5 V$  for logic level devices

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

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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
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: X10-0416-Rev. M, 01-Nov-10  
DWG: 5471

**Note**

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



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