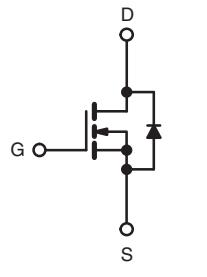
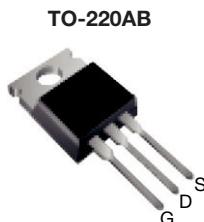


## D Series Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V) at $T_J$ max.	450
$R_{DS(on)}$ max. at 25 °C (Ω)	$V_{GS} = 10$ V 1.0
$Q_g$ max. (nC)	18
$Q_{gs}$ (nC)	3
$Q_{gd}$ (nC)	4
Configuration	Single



N-Channel MOSFET

### FEATURES

- Optimal Design
  - Low Area Specific On-Resistance
  - Low Input Capacitance ( $C_{iss}$ )
  - Reduced Capacitive Switching Losses
  - High Body Diode Ruggedness
  - Avalanche Energy Rated (UIS)
- Optimal Efficiency and Operation
  - Low Cost
  - Simple Gate Drive Circuitry
  - Low Figure-of-Merit (FOM):  $R_{on} \times Q_g$
  - Fast Switching
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)

#### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.



RoHS\*  
COMPLIANT  
HALOGEN  
FREE  
Available

### APPLICATIONS

- Consumer Electronics
  - Displays (LCD or Plasma TV)
- Server and Telecom Power Supplies
  - SMPS
- Industrial
  - Welding
  - Induction Heating
  - Motor Drives
- Battery Chargers

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free	SiHP6N40D-E3
Lead (Pb)-free and Halogen-free	SiHP6N40D-GE3

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-Source Voltage		$V_{DS}$	400	
Gate-Source Voltage		$V_{GS}$	$\pm 30$	V
Gate-Source Voltage AC (f > 1 Hz)			30	
Continuous Drain Current ( $T_J = 150$ °C)	$V_{GS}$ at 10 V	$I_D$	6	A
			4	
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	13	
Linear Derating Factor			0.8	W/°C
Single Pulse Avalanche Energy <sup>b</sup>		$E_{AS}$	104	mJ
Maximum Power Dissipation		$P_D$	104	W
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	- 55 to + 150	°C
Drain-Source Voltage Slope	$T_J = 125$ °C	$dV/dt$	24	V/ns
Reverse Diode $dV/dt^d$			0.48	
Soldering Recommendations (Peak Temperature)	for 10 s		300 <sup>c</sup>	°C

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 2.3$  mH,  $R_G = 25$  Ω,  $I_{AS} = 9.5$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ , starting  $T_J = 25$  °C.

**THERMAL RESISTANCE RATINGS**

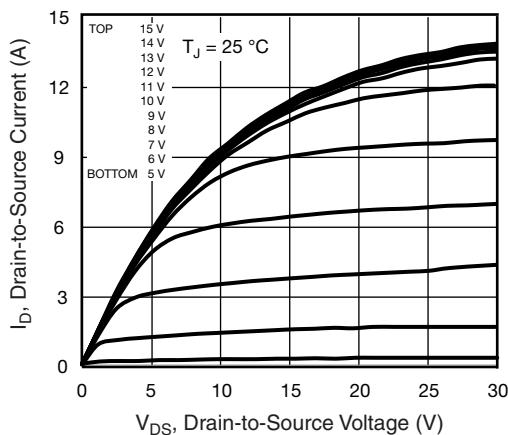
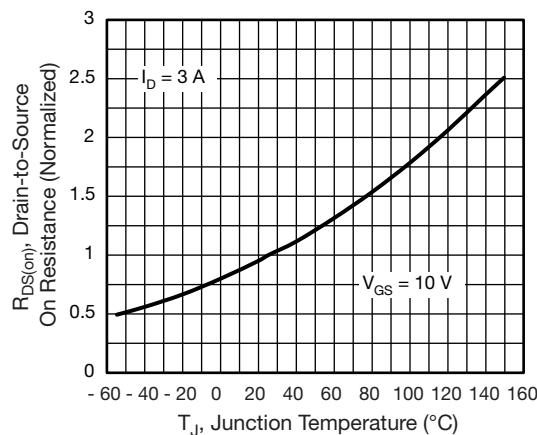
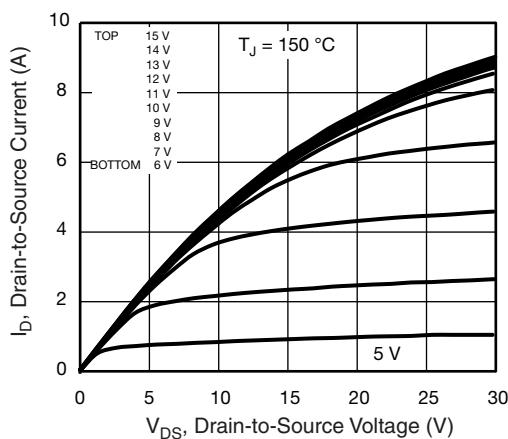
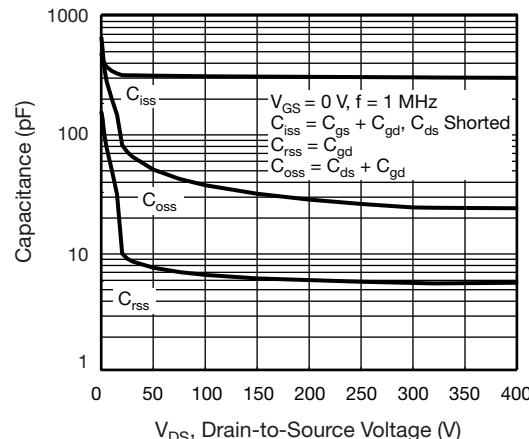
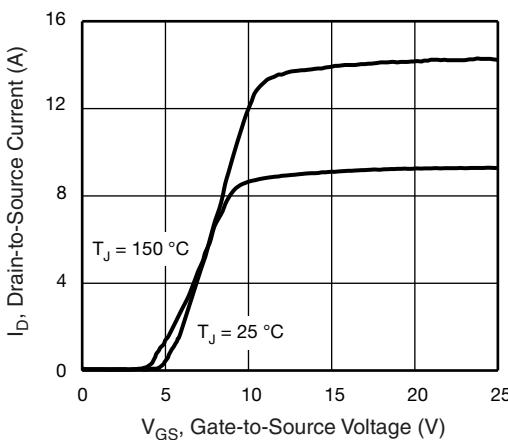
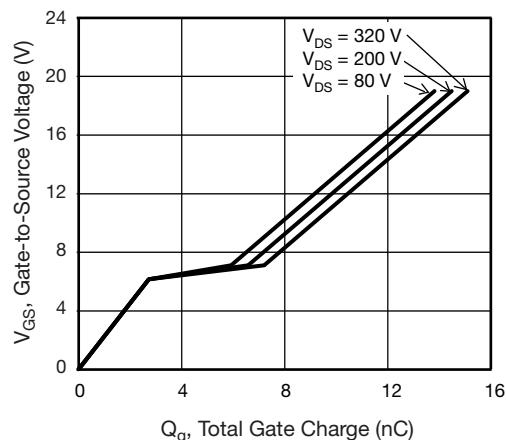
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	$^{\circ}\text{C}/\text{W}$
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.2	

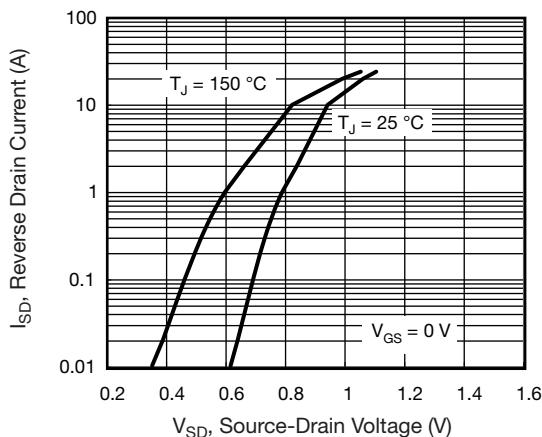
**SPECIFICATIONS** ( $T_J = 25^{\circ}\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$		400	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25^{\circ}\text{C}$ , $I_D = 250 \mu\text{A}$		-	0.53	-	$^{\circ}\text{C}/\text{V}$
Gate-Source Threshold Voltage (N)	$V_{GS(\text{th})}$	$V_{DS} = V_{GS}$ , $I_D = 250 \mu\text{A}$		3	-	5	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30 \text{ V}$		-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 400 \text{ V}$ , $V_{GS} = 0 \text{ V}$		-	-	1	$\mu\text{A}$
		$V_{DS} = 320 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_J = 125^{\circ}\text{C}$		-	-	10	
Drain-Source On-State Resistance	$R_{DS(\text{on})}$	$V_{GS} = 10 \text{ V}$	$I_D = 3 \text{ A}$	-	0.85	1.0	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50 \text{ V}$ , $I_D = 3 \text{ A}$		-	1.7	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0 \text{ V}$ , $V_{DS} = 100 \text{ V}$ , $f = 1 \text{ MHz}$		-	311	-	pF
Output Capacitance	$C_{oss}$			-	38	-	
Reverse Transfer Capacitance	$C_{rss}$			-	7	-	
Effective output capacitance, energy related <sup>a</sup>	$C_{o(er)}$	$V_{GS} = 0 \text{ V}$ , $V_{DS} = 0 \text{ V to } 320 \text{ V}$		-	44	-	
Effective output capacitance, time related <sup>b</sup>	$C_{o(tr)}$			-	54	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10 \text{ V}$	$I_D = 3 \text{ A}$ , $V_{DS} = 320 \text{ V}$	-	9	18	nC
Gate-Source Charge	$Q_{gs}$			-	3	-	
Gate-Drain Charge	$Q_{gd}$			-	4	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 400 \text{ V}$ , $I_D = 3 \text{ A}$ , $V_{GS} = 10 \text{ V}$ , $R_g = 9.1 \Omega$		-	12	24	ns
Rise Time	$t_r$			-	11	22	
Turn-Off Delay Time	$t_{d(off)}$			-	14	28	
Fall Time	$t_f$			-	8	16	
Gate Input Resistance	$R_g$	$f = 1 \text{ MHz}$ , open drain		-	1.9	-	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode		-	-	6	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	24	
Diode Forward Voltage	$V_{SD}$	$T_J = 25^{\circ}\text{C}$ , $I_S = 3 \text{ A}$ , $V_{GS} = 0 \text{ V}$		-	-	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25^{\circ}\text{C}$ , $I_F = I_S = 3 \text{ A}$ , $dl/dt = 100 \text{ A}/\mu\text{s}$ , $V_R = 20 \text{ V}$		-	236	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	1.1	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	9	-	A

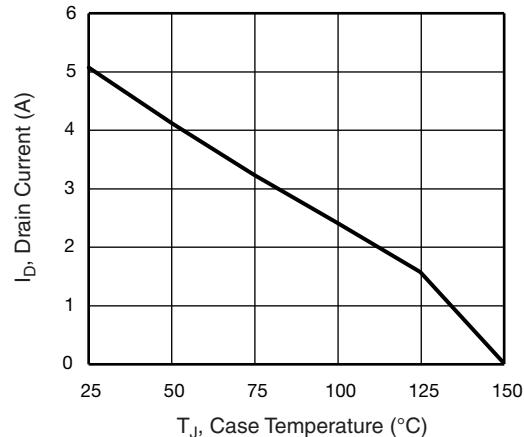
**Notes**

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 %  $V_{DS}$ .  
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 %  $V_{DS}$ .

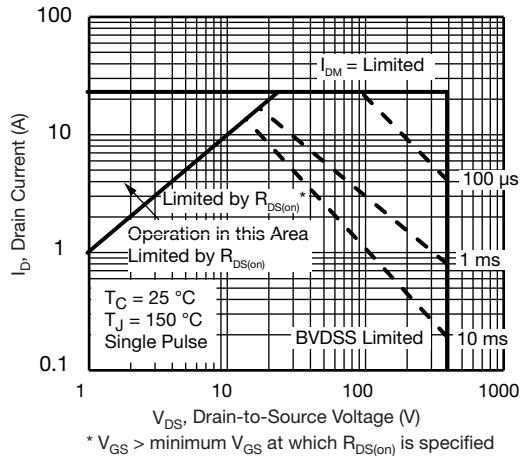
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**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**



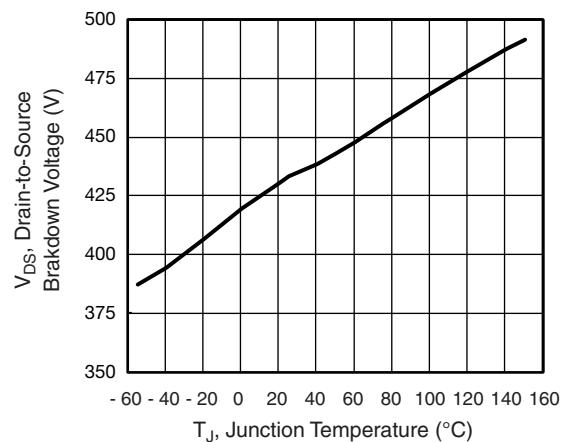
**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



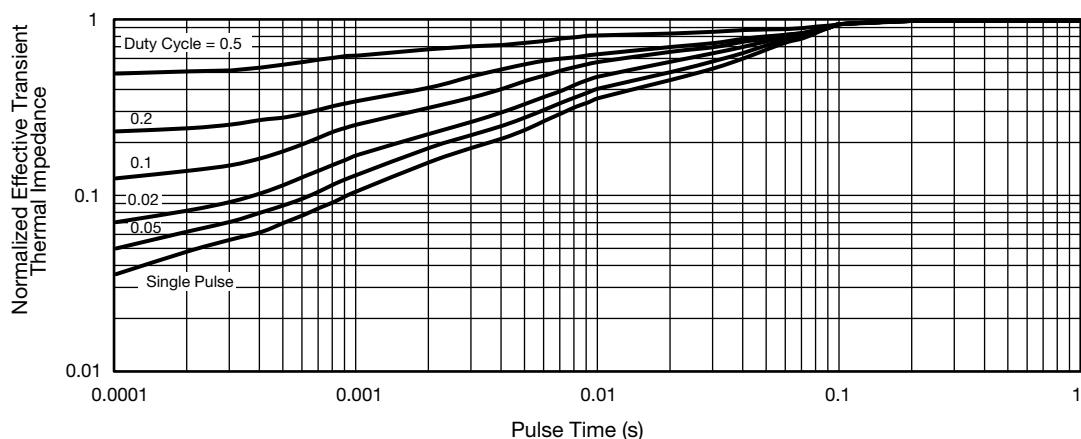
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



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



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



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

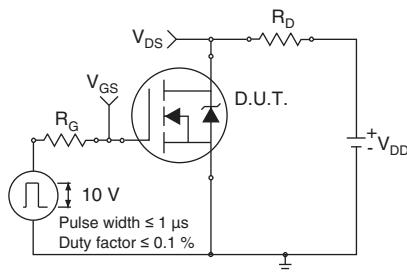


Fig. 12 - Switching Time Test Circuit

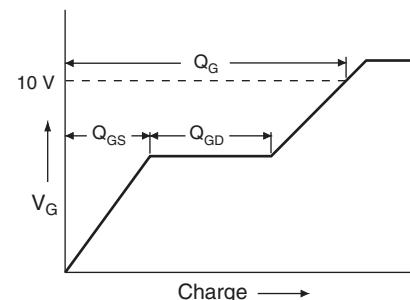


Fig. 16 - Basic Gate Charge Waveform

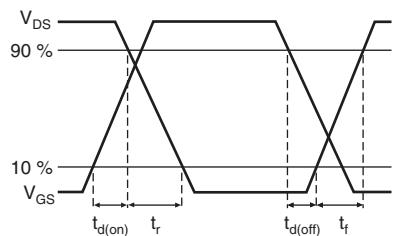


Fig. 13 - Switching Time Waveforms

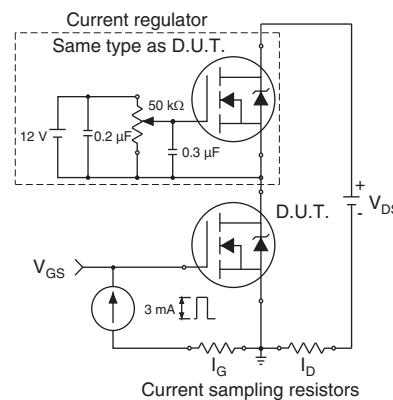


Fig. 17 - Gate Charge Test Circuit

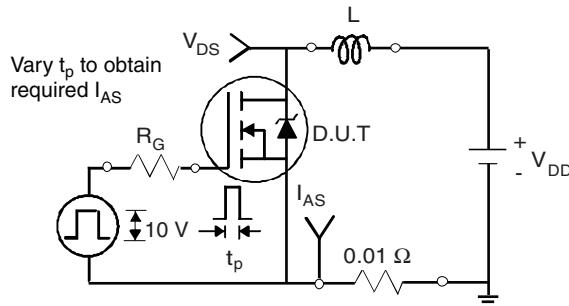


Fig. 14 - Unclamped Inductive Test Circuit

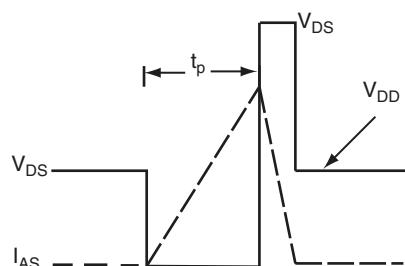
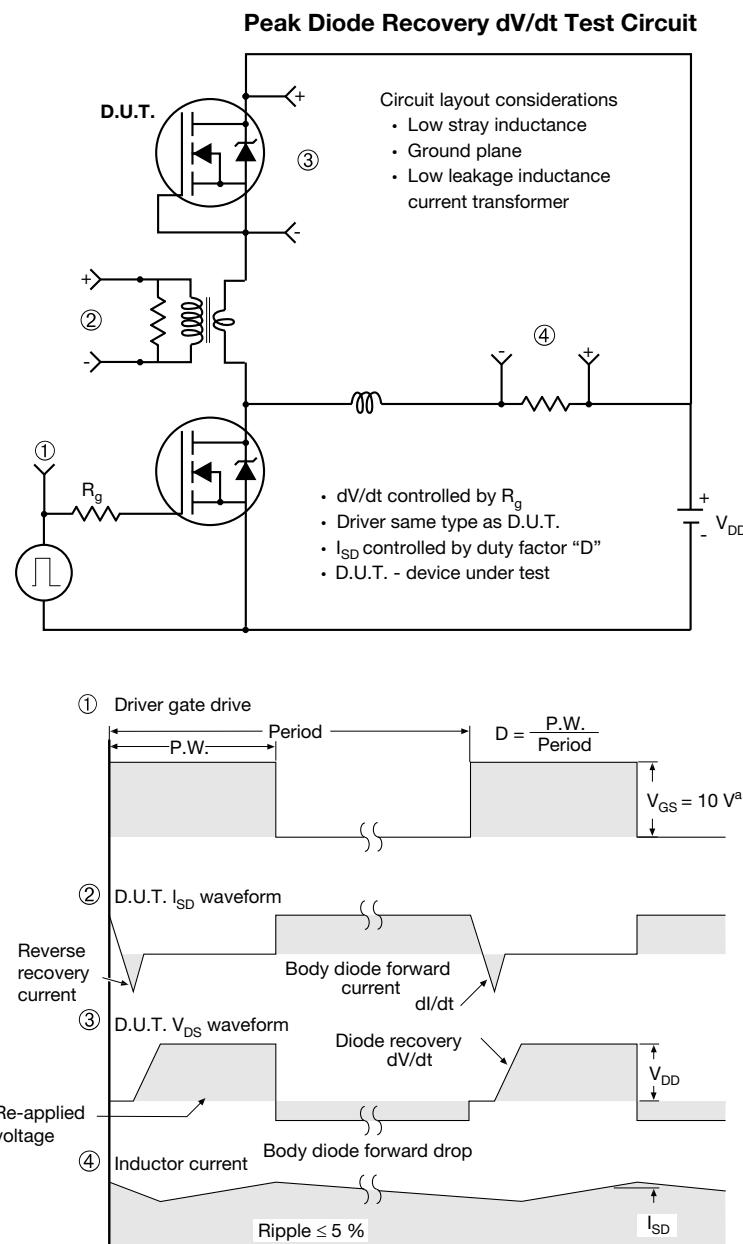


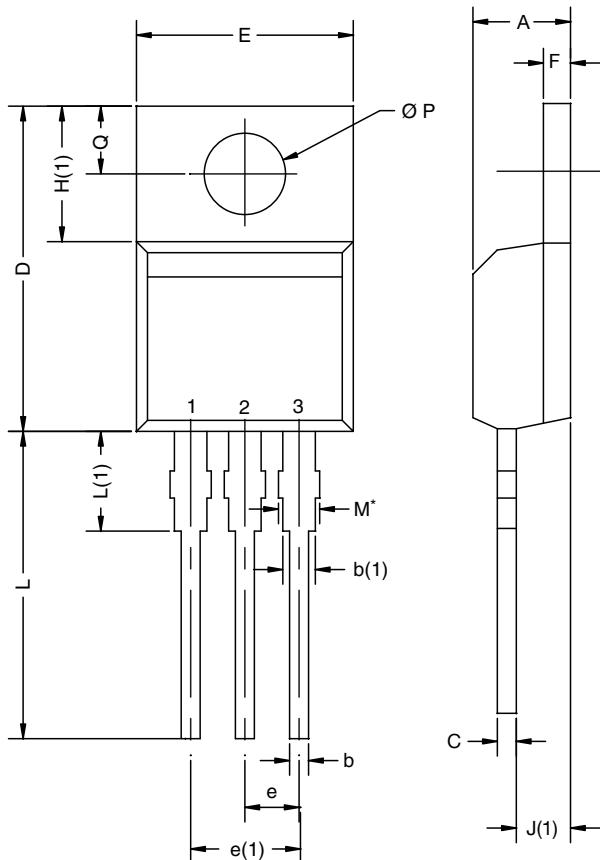
Fig. 15 - Unclamped Inductive Waveforms



**Fig. 18 - For N-Channel**

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### TO-220AB

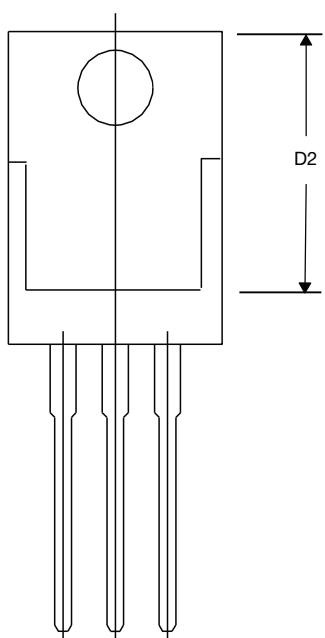


DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.25	4.65	0.167	0.183
b	0.69	1.01	0.027	0.040
b(1)	1.20	1.73	0.047	0.068
c	0.36	0.61	0.014	0.024
D	14.85	15.49	0.585	0.610
D2	12.19	12.70	0.480	0.500
E	10.04	10.51	0.395	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)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