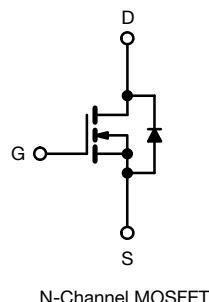
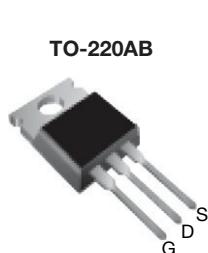


## E Series Power MOSFET



N-Channel MOSFET

### FEATURES

- 4<sup>th</sup> generation E series technology
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low effective capacitance ( $C_{o(er)}$ )
- Reduced switching and conduction losses
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS  
COMPLIANT  
HALOGEN  
FREE  
Available

### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Motor drives
  - Battery chargers
  - Solar (PV inverters)

PRODUCT SUMMARY	
$V_{DS}$ (V) at $T_J$ max.	650
$R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C	$V_{GS} = 10$ V 0.057
$Q_g$ max. (nC)	74
$Q_{gs}$ (nC)	19
$Q_{gd}$ (nC)	15
Configuration	Single

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free and halogen-free	SiHP065N60E-BE3
	SiHP065N60E-GE3

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)			
PARAMETER		SYMBOL	LIMIT
Drain-source voltage		$V_{DS}$	600
Gate-source voltage		$V_{GS}$	$\pm 30$
Continuous drain current ( $T_J = 150$ °C)	$V_{GS}$ at 10 V	$I_D$	40
			25
	$T_C = 100$ °C		A
Pulsed drain current <sup>a</sup>		$I_{DM}$	116
Linear derating factor			2.0
Single pulse avalanche energy <sup>b</sup>		$E_{AS}$	226
Maximum power dissipation		$P_D$	250
Operating junction and storage temperature range		$T_J, T_{stg}$	-55 to +150
Drain-source voltage slope	$T_J = 125$ °C	$dV/dt$	100
Reverse diode $dV/dt$ <sup>d</sup>			50
Soldering recommendations (peak temperature) <sup>c</sup>	For 10 s		300
			°C

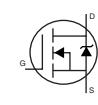
#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 120$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$  Ω,  $I_{AS} = 4.0$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $dI/dt = 400$  A/μs, starting  $T_J = 25$  °C

**THERMAL RESISTANCE RATINGS**

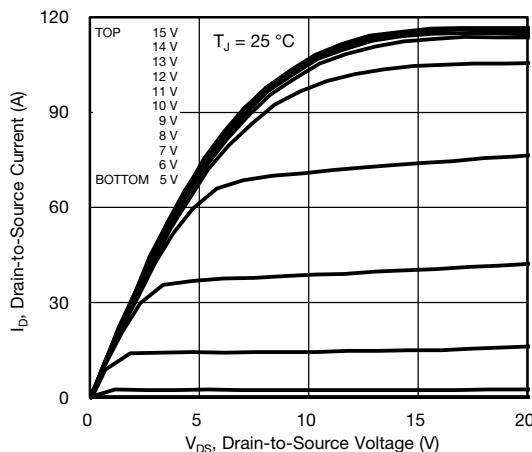
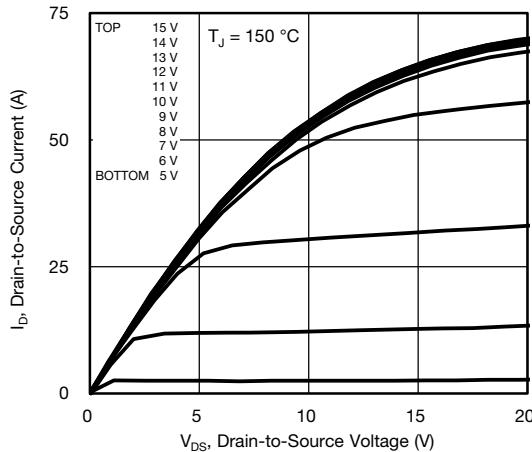
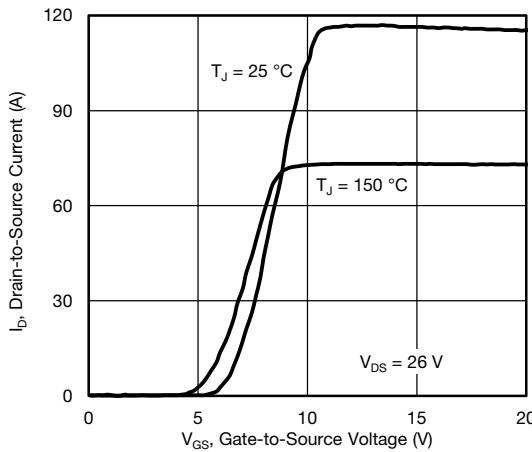
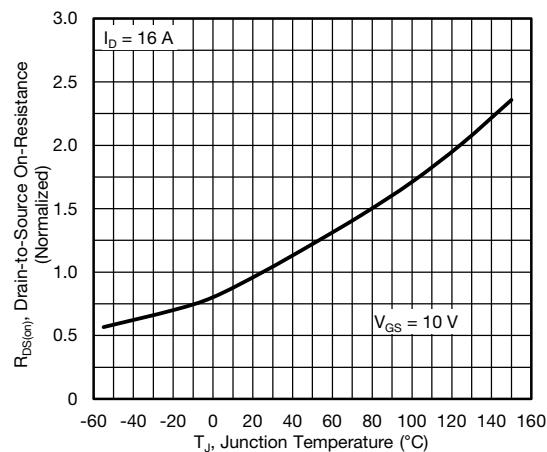
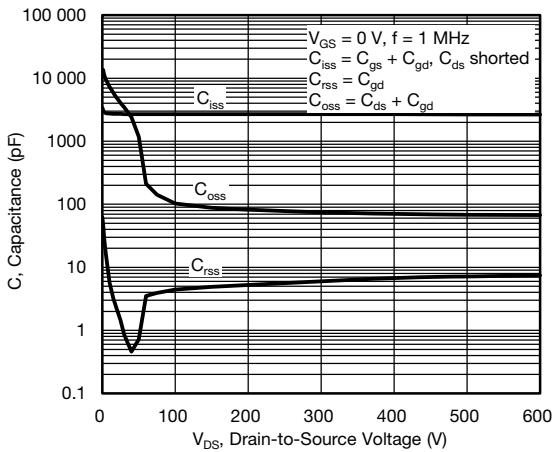
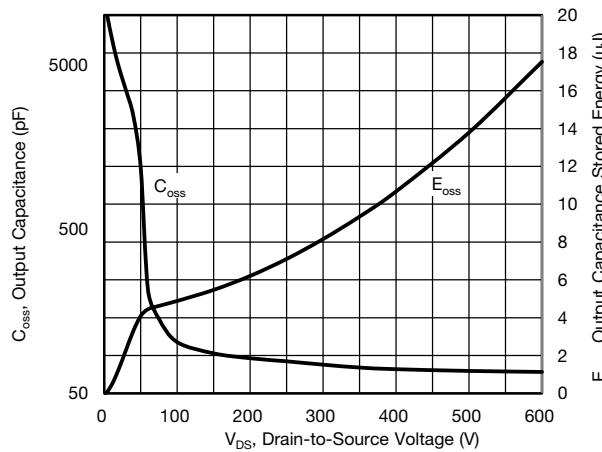
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	62	
Maximum junction-to-case (drain)	$R_{thJC}$	-	0.5	°C/W

**SPECIFICATIONS (T<sub>J</sub> = 25 °C, unless otherwise noted)**

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
<b>Static</b>							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0 \text{ V}$ , $I_D = 250 \mu\text{A}$		600	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, $I_D = 1 \text{ mA}$		-	0.72	-	V/°C
Gate-source threshold voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250 \mu\text{A}$		3	-	5	V
Gate-source leakage	$I_{GSS}$	$V_{GS} = \pm 20 \text{ V}$		-	-	± 100	nA
		$V_{GS} = \pm 30 \text{ V}$		-	-	± 1	μA
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 600 \text{ V}$ , $V_{GS} = 0 \text{ V}$		-	-	1	
		$V_{DS} = 480 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_J = 125 \text{ °C}$		-	-	10	μA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10 \text{ V}$	$I_D = 16 \text{ A}$	-	0.057	0.065	Ω
Forward transconductance	$g_{fs}$	$V_{DS} = 20 \text{ V}$ , $I_D = 16 \text{ A}$		-	12	-	S
<b>Dynamic</b>							
Input capacitance	$C_{iss}$	$V_{GS} = 0 \text{ V}$ , $V_{DS} = 100 \text{ V}$ , $f = 1 \text{ MHz}$		-	2700	-	pF
Output capacitance	$C_{oss}$			-	102	-	
Reverse transfer capacitance	$C_{rss}$			-	5	-	
Effective output capacitance, energy related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0 \text{ V}$ to 480 V, $V_{GS} = 0 \text{ V}$		-	93	-	pF
Effective output capacitance, time related <sup>b</sup>	$C_{o(tr)}$			-	593	-	
Total gate charge	$Q_g$			-	49	74	nC
Gate-source charge	$Q_{gs}$	$V_{GS} = 10 \text{ V}$	$I_D = 16 \text{ A}$ , $V_{DS} = 480 \text{ V}$	-	19	-	
Gate-drain charge	$Q_{gd}$			-	15	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 480 \text{ V}$ , $I_D = 16 \text{ A}$ , $V_{GS} = 10 \text{ V}$ , $R_g = 9.1 \Omega$		-	28	56	ns
Rise time	$t_r$			-	46	92	
Turn-off delay time	$t_{d(off)}$			-	54	108	
Fall time	$t_f$			-	13	26	
Gate input resistance	$R_g$	$f = 1 \text{ MHz}$ , open drain		0.3	0.7	1.4	Ω
<b>Drain-Source Body Diode Characteristics</b>							
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p-n junction diode		-	-	40	A
Pulsed diode forward current	$I_{SM}$			-	-	116	
Diode forward voltage	$V_{SD}$	$T_J = 25 \text{ °C}$ , $I_S = 16 \text{ A}$ , $V_{GS} = 0 \text{ V}$		-	-	1.2	V
Reverse recovery time	$t_{rr}$	$T_J = 25 \text{ °C}$ , $I_F = I_S = 16 \text{ A}$ , $dI/dt = 100 \text{ A}/\mu\text{s}$ , $V_R = 400 \text{ V}$		-	382	764	ns
Reverse recovery charge	$Q_{rr}$			-	7.1	14.2	μC
Reverse recovery current	$I_{RRM}$			-	34	-	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 %  $V_{DSS}$   
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 %  $V_{DSS}$

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

**Fig. 1 - Typical Output Characteristics**

**Fig. 2 - Typical Output Characteristics**

**Fig. 3 - Typical Transfer Characteristics**

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

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

**Fig. 6 -  $C_{oss}$  and  $E_{oss}$  vs.  $V_{DS}$**

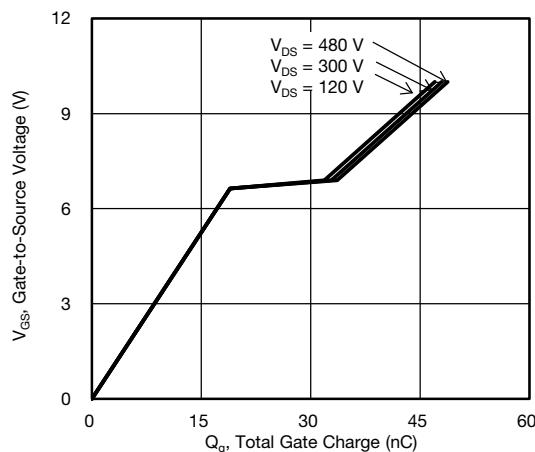


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

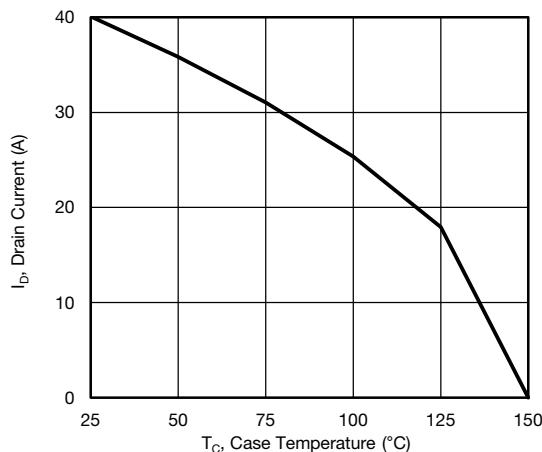


Fig. 10 - Maximum Drain Current vs. Case Temperature

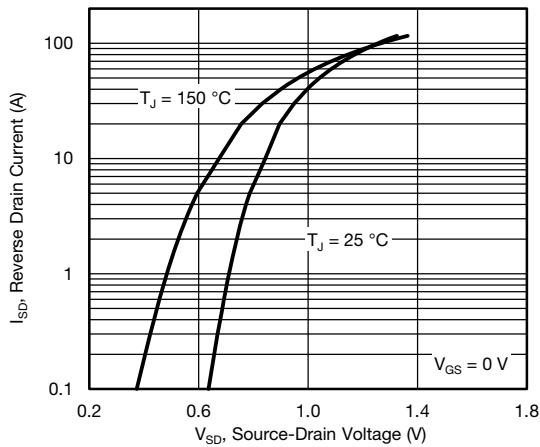


Fig. 8 - Typical Source-Drain Diode Forward Voltage

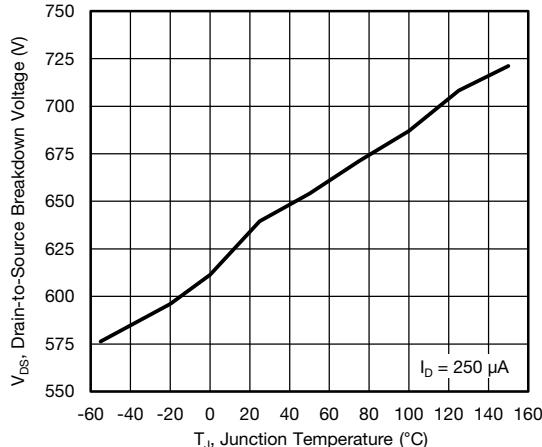


Fig. 11 - Temperature vs. Drain-to-Source Breakdown Voltage

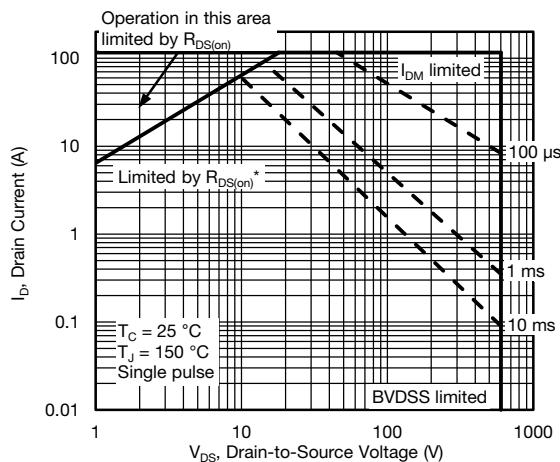


Fig. 9 - Maximum Safe Operating Area

#### Note

a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified

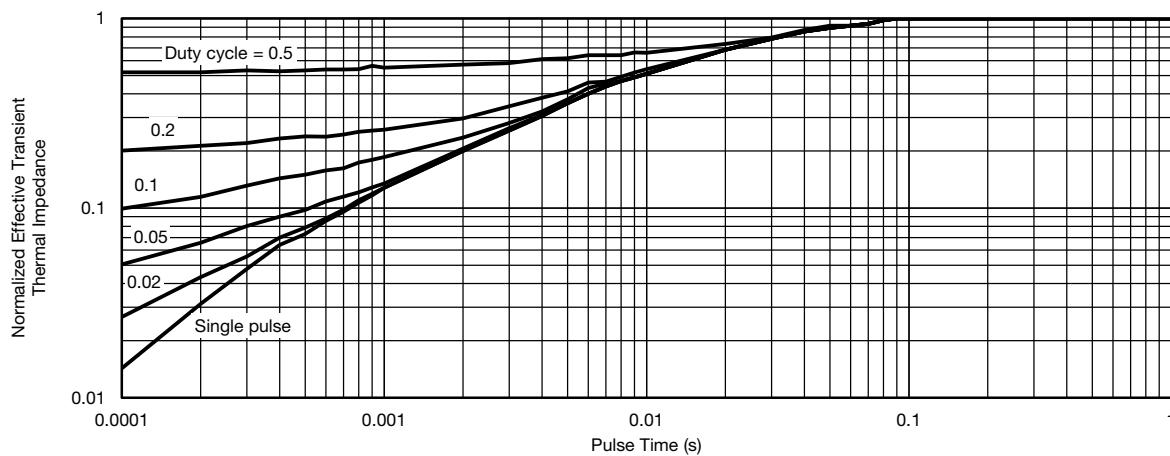


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

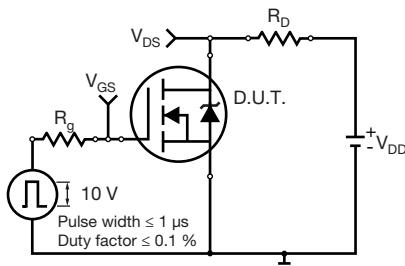


Fig. 13 - Switching Time Test Circuit

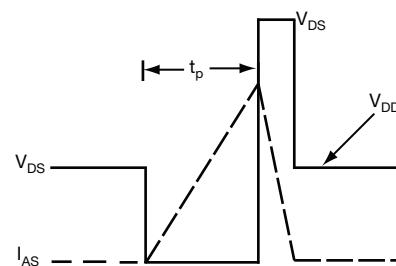


Fig. 16 - Unclamped Inductive Waveforms

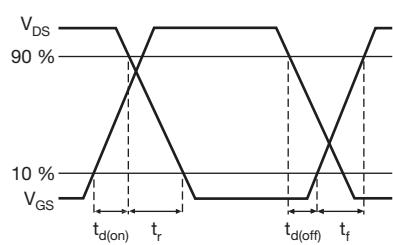


Fig. 14 - Switching Time Waveforms

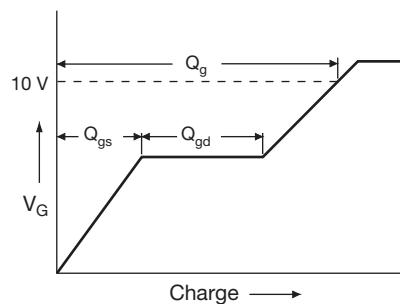


Fig. 17 - Basic Gate Charge Waveform

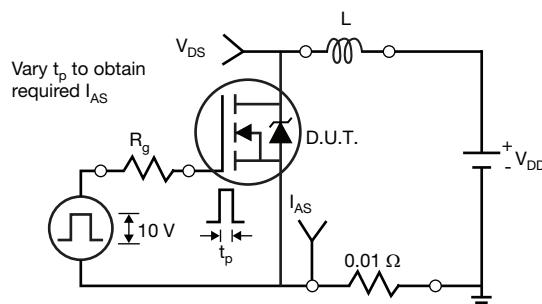


Fig. 15 - Unclamped Inductive Test Circuit

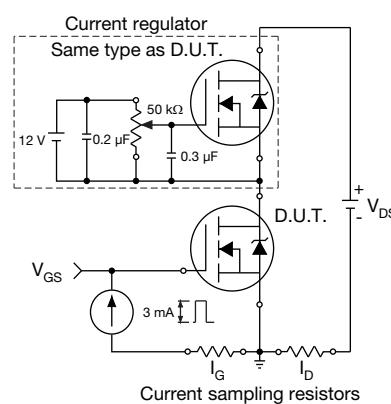
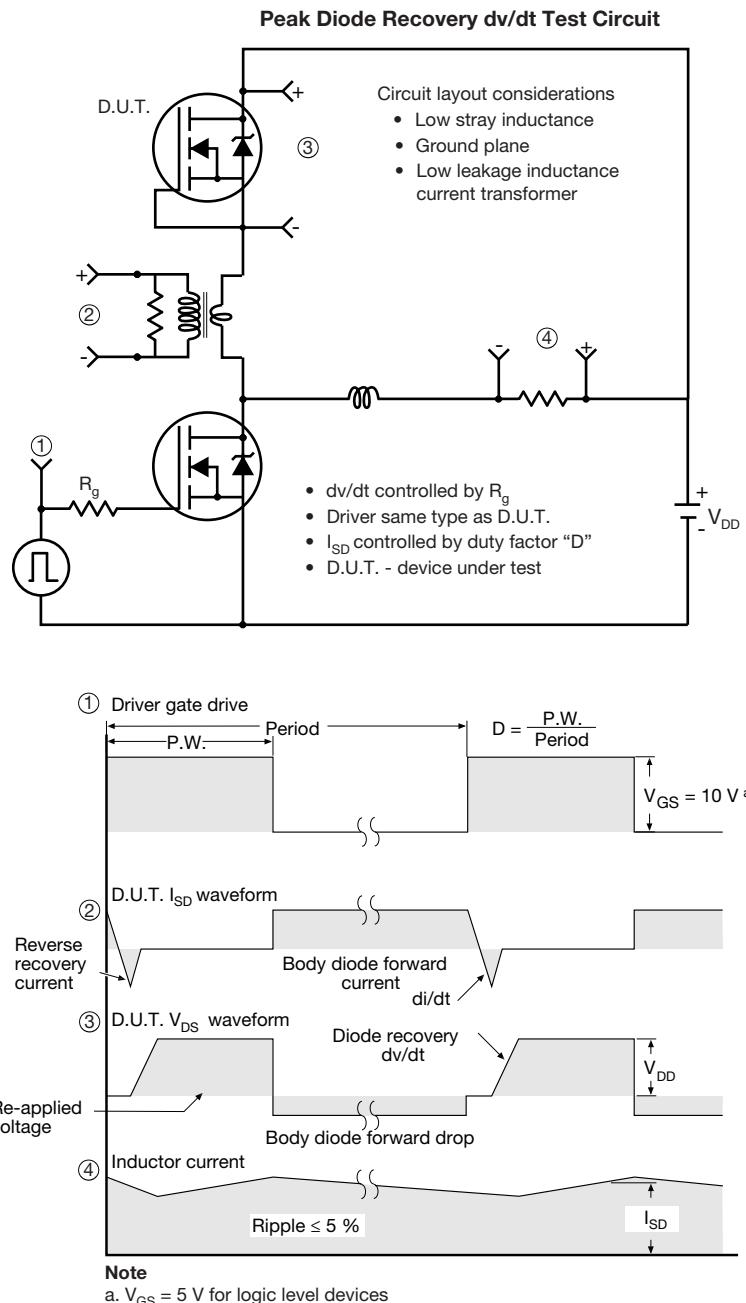


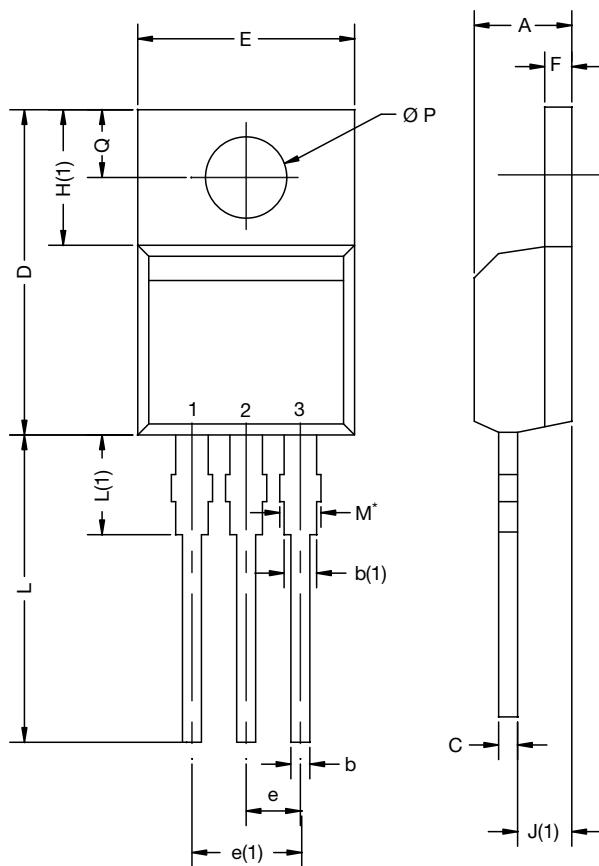
Fig. 18 - Gate Charge Test Circuit



**Fig. 19 - For N-Channel**

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## TO-220-1



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.24	4.65	0.167	0.183
b	0.69	1.02	0.027	0.040
b(1)	1.14	1.78	0.045	0.070
c	0.36	0.61	0.014	0.024
D	14.33	15.85	0.564	0.624
E	9.96	10.52	0.392	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)	6.10	6.71	0.240	0.264
J(1)	2.41	2.92	0.095	0.115
L	13.36	14.40	0.526	0.567
L(1)	3.33	4.04	0.131	0.159
Ø P	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

## Note

- $M^*$  = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM

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