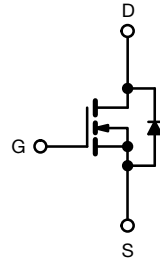
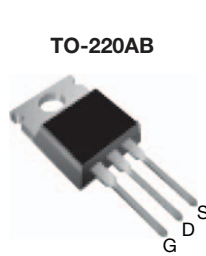


## D Series Power MOSFET

PRODUCT SUMMARY	
$V_{DS}$ (V) at $T_J$ max.	450
$R_{DS(on)}$ max. ( $\Omega$ ) at 25 °C	$V_{GS} = 10$ V   0.6
$Q_g$ max. (nC)	30
$Q_{gs}$ (nC)	4
$Q_{gd}$ (nC)	7
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

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.



**RoHS\***  
Available  
**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	SiHP10N40D-E3
Lead (Pb)-free and Halogen-free	SiHP10N40D-GE3


ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	$V_{DS}$	400	V
Gate-Source Voltage	$V_{GS}$	$\pm 30$	
Gate-Source Voltage AC ( $f > 1$ Hz)		30	
Continuous Drain Current ( $T_J = 150$ °C)	$V_{GS}$ at 10 V	$T_C = 25$ °C	10
		$T_C = 100$ °C	6
Pulsed Drain Current <sup>a</sup>	$I_{DM}$	23	A
Linear Derating Factor		1.2	
Single Pulse Avalanche Energy <sup>b</sup>	$E_{AS}$	194	mJ
Maximum Power Dissipation	$P_D$	147	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	°C
Drain-Source Voltage Slope	$dV/dt$	$T_J = 125$ °C	24
Reverse Diode $dV/dt$ <sup>d</sup>		0.6	
Soldering Recommendations (Peak temperature) <sup>c</sup>	for 10 s	300	°C

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 2.3$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 13$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ , starting  $T_J = 25$  °C.



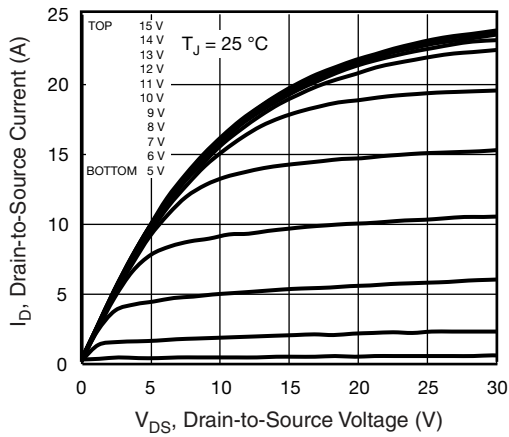
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.85	

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	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		400	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 250\text{ }\mu\text{A}$		-	0.53	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		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	$\mu\text{A}$
		$V_{DS} = 320\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	10	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 5\text{ A}$	-	0.5	0.6	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}, I_D = 5\text{ A}$		-	2.7	-	S
<b>Dynamic</b>							
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$		-	526	-	pF
Output Capacitance	$C_{oss}$			-	59	-	
Reverse Transfer Capacitance	$C_{rss}$			-	9	-	
Effective Output Capacitance, Energy Related <sup>a</sup>	$C_{o(er)}$	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ V to } 320\text{ V}$		-	66	-	
Effective Output Capacitance, Time Related <sup>b</sup>	$C_{o(tr)}$			-	84	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 5\text{ A}, V_{DS} = 320\text{ V}$	-	15	30	nC
Gate-Source Charge	$Q_{gs}$			-	4	-	
Gate-Drain Charge	$Q_{gd}$			-	7	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 400\text{ V}, I_D = 10\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$		-	12	24	ns
Rise Time	$t_r$			-	18	36	
Turn-Off Delay Time	$t_{d(off)}$			-	18	36	
Fall Time	$t_f$			-	14	28	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}, \text{open drain}$		0.9	1.8	3.6	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>							
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	10	A
Pulsed Diode Forward Current	$I_{SM}$			-	-	40	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 5\text{ A}, V_{GS} = 0\text{ V}$		-	-	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 25\text{ V}$		-	230	-	ns
Reverse Recovery Charge	$Q_{rr}$			-	1.6	-	$\mu\text{C}$
Reverse Recovery Current	$I_{RRM}$			-	14	-	A

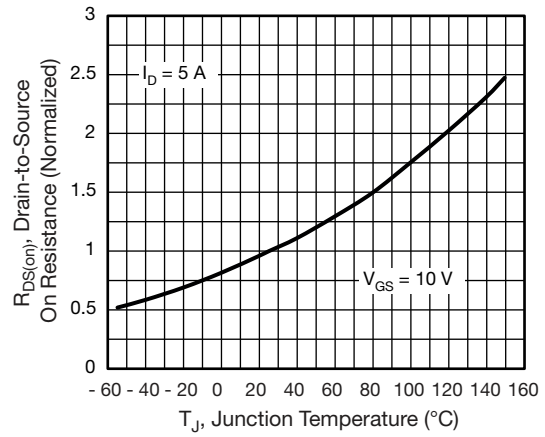
**Notes**

- 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 %  $V_{DS}$ .

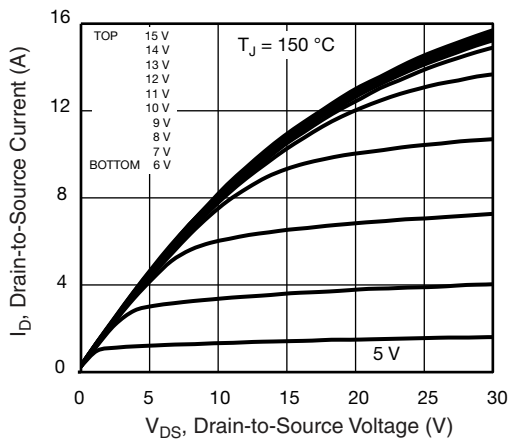
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



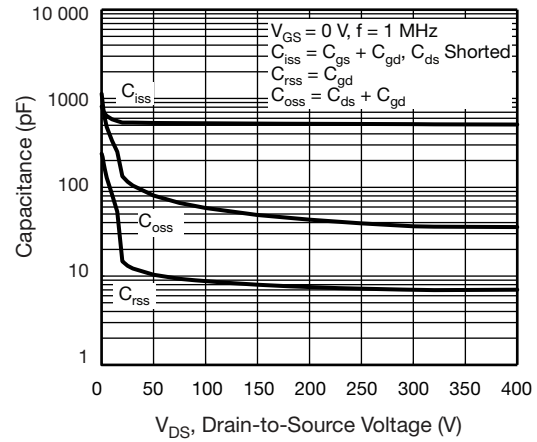
**Fig. 1 - Typical Output Characteristics**



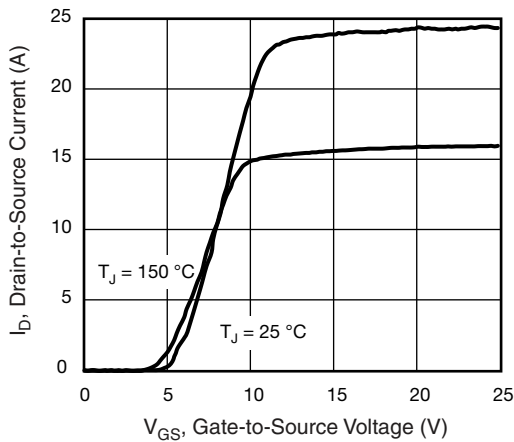
**Fig. 4 - Normalized On-Resistance vs. Temperature**



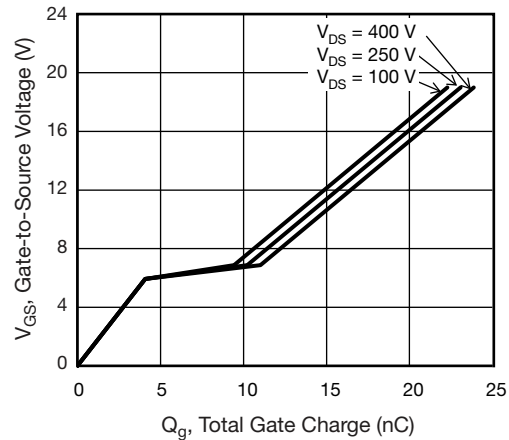
**Fig. 2 - Typical Output Characteristics**



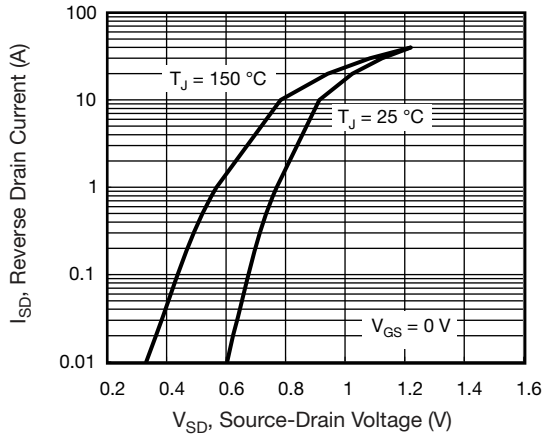
**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**



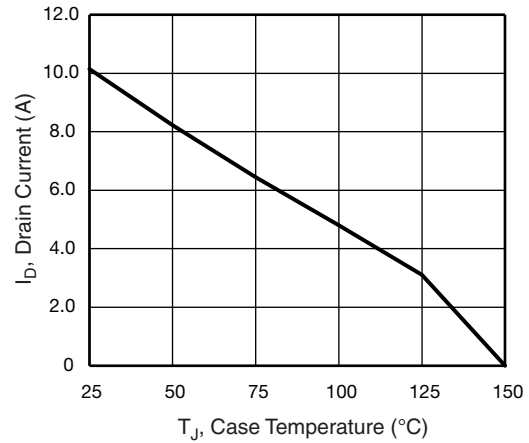
**Fig. 3 - Typical Transfer Characteristics**



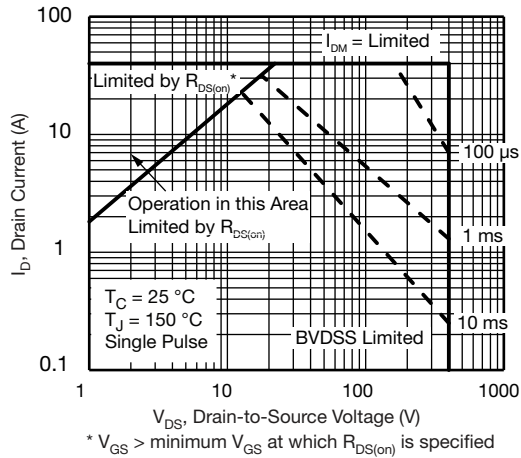
**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**



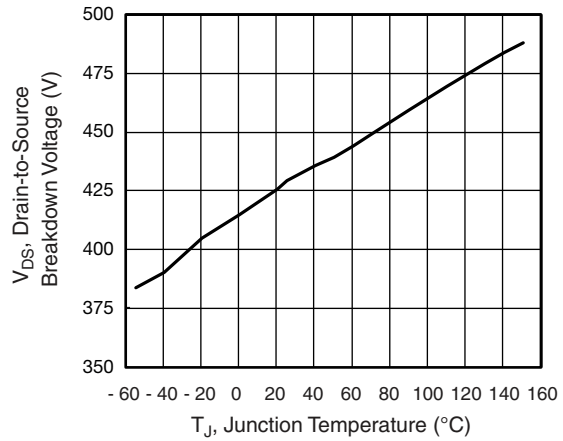
**Fig. 7 - Typical Source-Drain Diode Forward Voltage**



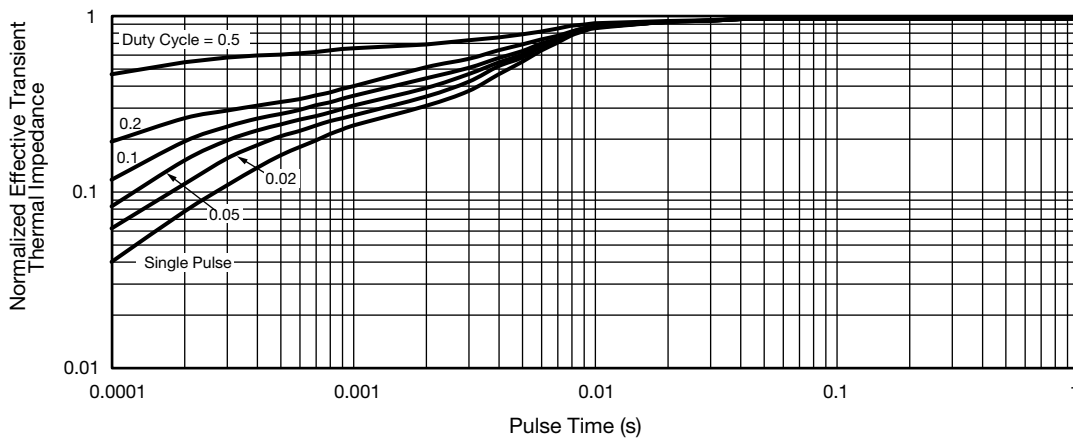
**Fig. 9 - Maximum Drain Current vs. Case Temperature**



**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**



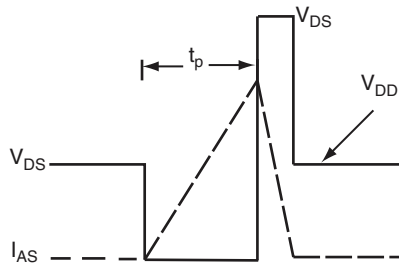
**Fig. 13 - Switching Time Waveforms**



**Fig. 17 - Gate Charge Test Circuit**



**Fig. 14 - Unclamped Inductive Test Circuit**



**Fig. 15 - Unclamped Inductive Waveforms**

### Peak Diode Recovery dV/dt Test Circuit



**Note**

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

**Fig. 18 - 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

ECN: X15-0364-Rev. C, 14-Dec-15  
DWG: 6031

Note

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





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