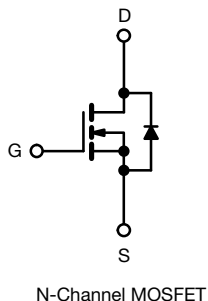
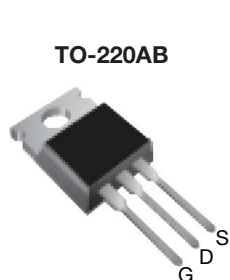


EF Series Power MOSFET With Fast Body Diode



FEATURES

- 4th generation E series technology
- Low figure-of-merit (FOM) $R_{DS(on)} \times Q_g$
- 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



RoHS
COMPLIANT
HALOGEN
FREE

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. (Ω) at 25 °C	$V_{GS} = 10$ V 0.059
Q_g max. (nC)	77
Q_{gs} (nC)	19
Q_{gd} (nC)	16
Configuration	Single

ORDERING INFORMATION

Package	TO-220AB
Lead (Pb)-free and halogen-free	SiHP068N60EF-GE3

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	V_{DS}	600	V
Gate-source voltage	V_{GS}	± 30	
Continuous drain current ($T_J = 150$ °C)	V_{GS} at 10 V	$T_C = 25$ °C	A
		$T_C = 100$ °C	
Pulsed drain current ^a	I_{DM}	115	
Linear derating factor		2	W/°C
Single pulse avalanche energy ^b	E_{AS}	226	mJ
Maximum power dissipation	P_D	250	W
Operating junction and storage temperature range	T_J, T_{stg}	-55 to +150	°C
Drain-source voltage slope	dV/dt	100	V/ns
Reverse diode dV/dt ^d		50	
Soldering recommendations (peak temperature) ^c	For 10 s	260	°C

Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DS} = 120$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 4$ A
- 1.6 mm from case
- $I_{SD} \leq I_D$, $di/dt = 210$ A/ μ s, starting $T_J = 25$ °C

**THERMAL RESISTANCE RATINGS**

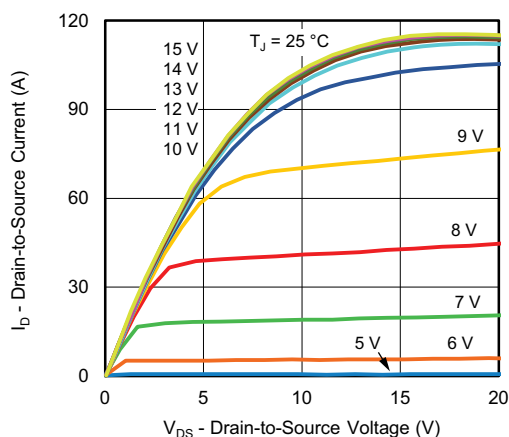
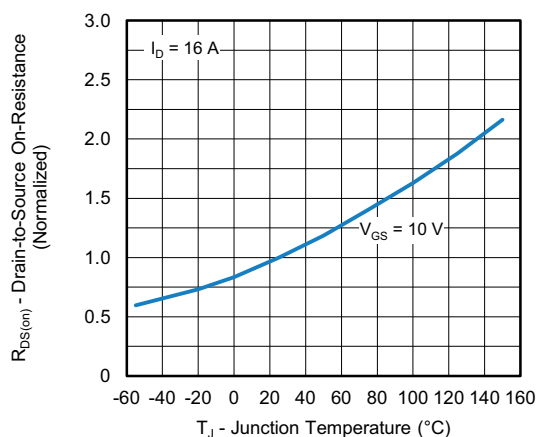
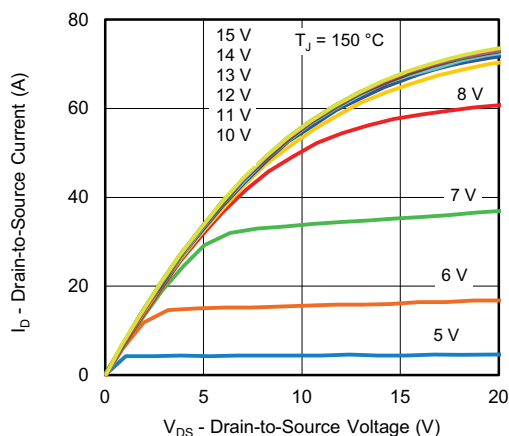
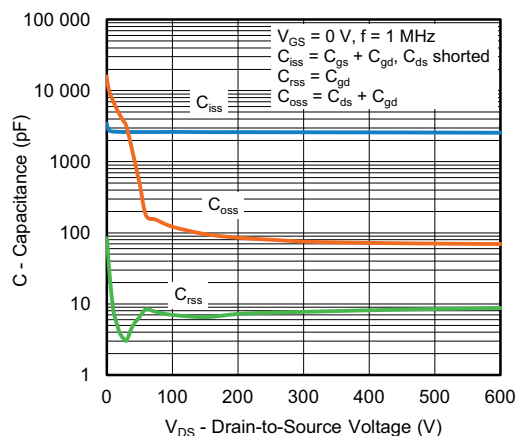
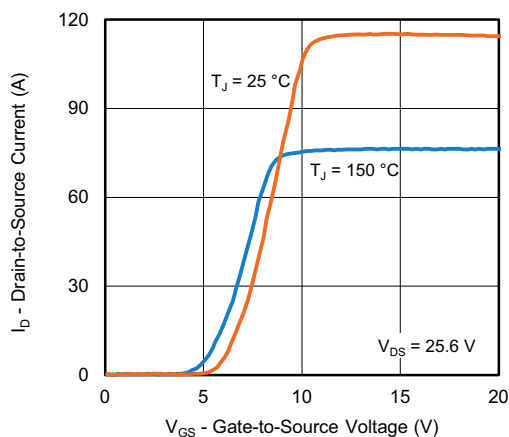
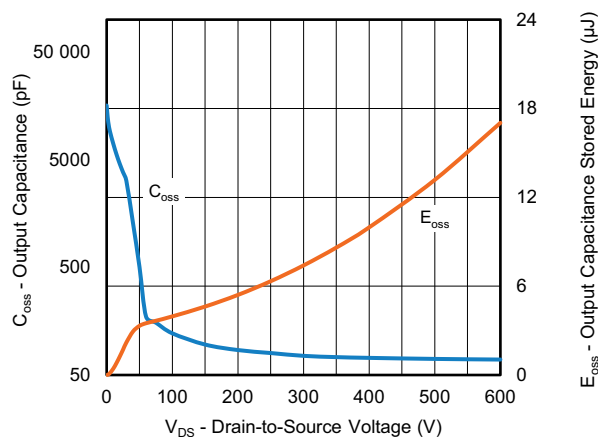
PARAMETER	SYMBOL	LIMIT	UNIT
Maximum junction-to-ambient	R_{thJA}	62	°C/W
Maximum junction-to-case (drain)	R_{thJC}	0.5	

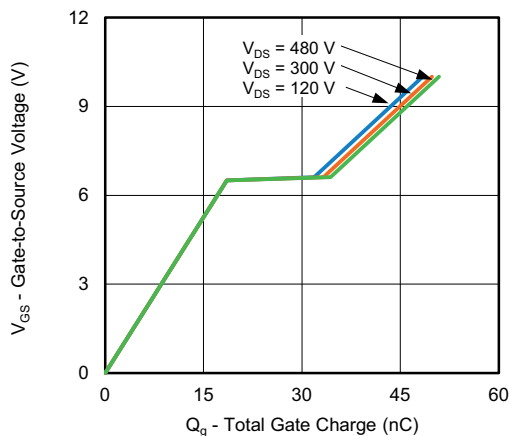
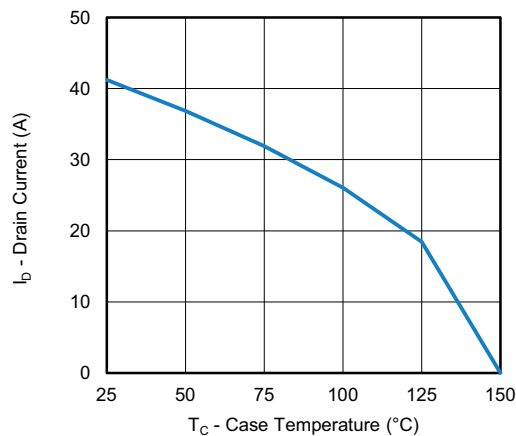
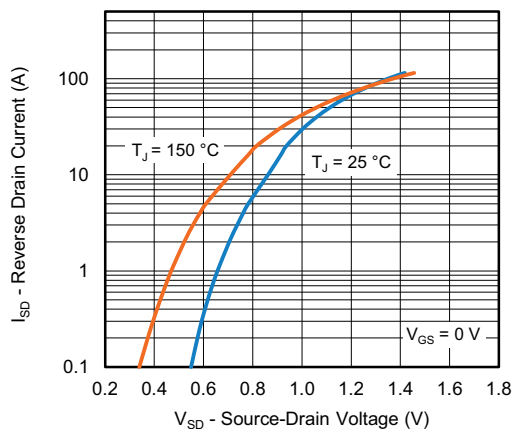
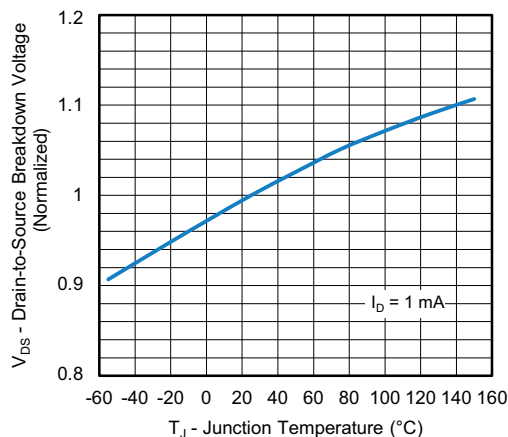
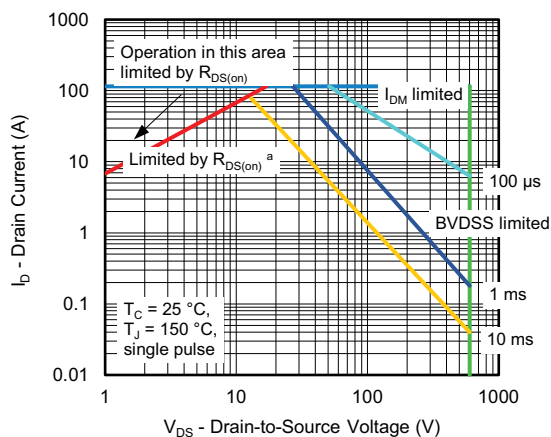
SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-source breakdown voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$	600	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^{\circ}\text{C}$, $I_D = 1\text{ mA}$	-	0.63	-	V/ $^{\circ}\text{C}$
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}	$V_{GS} = \pm 20\text{ V}$	-	-	± 100	nA
		$V_{GS} = \pm 30\text{ V}$	-	-	± 1	μA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$	-	-	1	μA
		$V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	-	2	mA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$, $I_D = 16\text{ A}$	-	0.059	0.068	Ω
Forward transconductance	g_{fs}	$V_{DS} = 30\text{ V}$, $I_D = 16\text{ A}$	-	9	-	S
Dynamic						
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$	-	2628	-	pF
Output capacitance	C_{oss}		-	122	-	
Reverse transfer capacitance	C_{rss}		-	7	-	
Effective output capacitance, energy related ^a	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 480\text{ V}$, $V_{GS} = 0\text{ V}$	-	87	-	
Effective output capacitance, time related ^b	$C_{o(tr)}$		-	543	-	
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$, $I_D = 16\text{ A}$, $V_{DS} = 480\text{ V}$	-	51	77	nC
Gate-source charge	Q_{gs}		-	19	-	
Gate-drain charge	Q_{gd}		-	16	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 480\text{ V}$, $I_D = 16\text{ A}$, $V_{GS} = 10\text{ V}$, $R_g = 9.1\text{ }\Omega$	-	27	54	ns
Rise time	t_r		-	55	83	
Turn-off delay time	$t_{d(off)}$		-	53	80	
Fall time	t_f		-	35	70	
Gate input resistance	R_g	$f = 1\text{ MHz}$, open drain	0.3	0.7	1.4	Ω
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	41	A
Pulsed diode forward current	I_{SM}		-	-	115	
Diode forward voltage	V_{SD}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_S = 16\text{ A}$, $V_{GS} = 0\text{ V}$	-	-	1.2	V
Reverse recovery time	t_{rr}	$T_J = 25\text{ }^{\circ}\text{C}$, $I_F = I_S = 16\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_R = 400\text{ V}$	-	152	304	ns
Reverse recovery charge	Q_{rr}		-	1	2	μC
Reverse recovery current	I_{RRM}		-	14	-	A

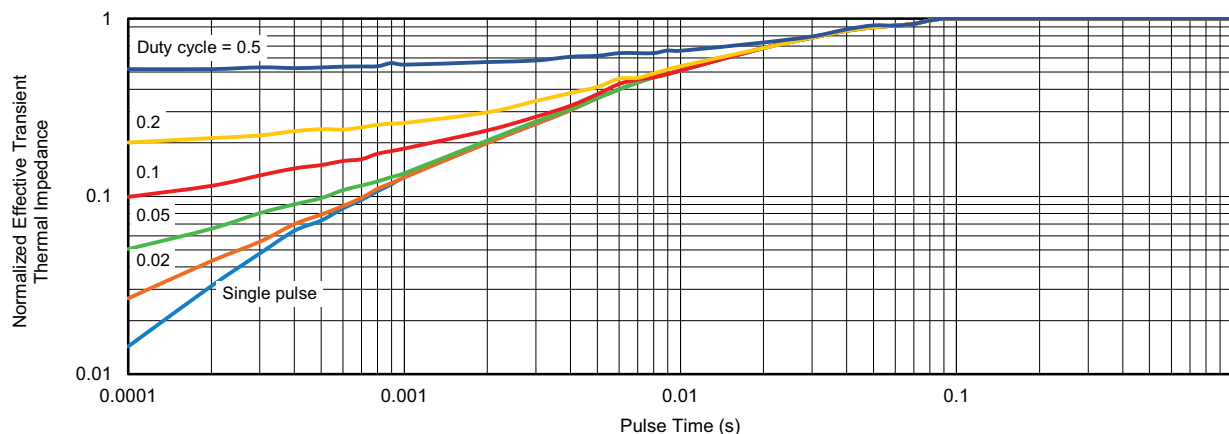
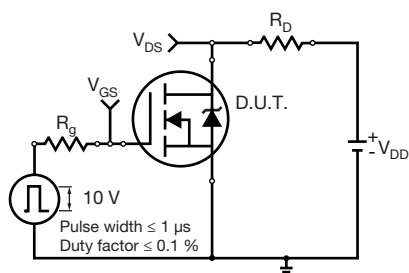
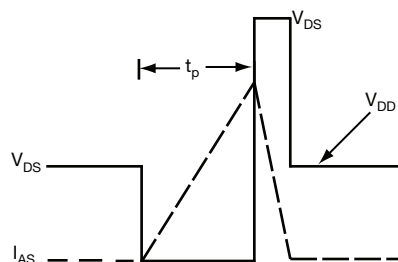
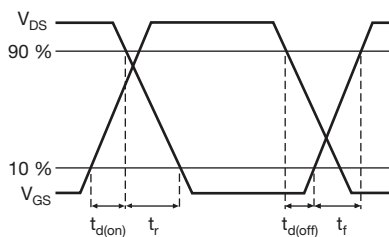
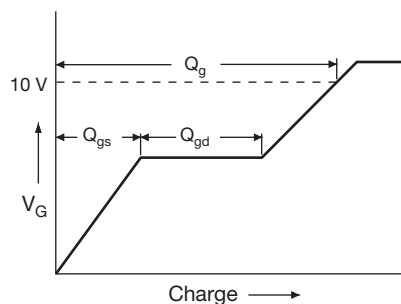
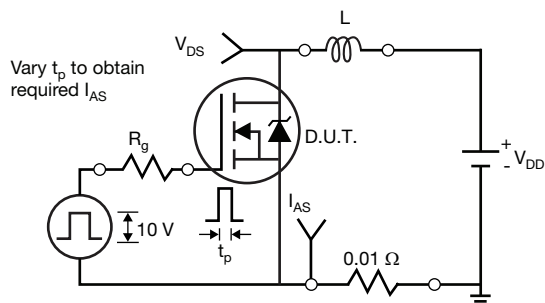
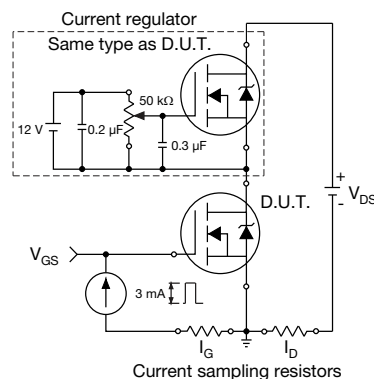
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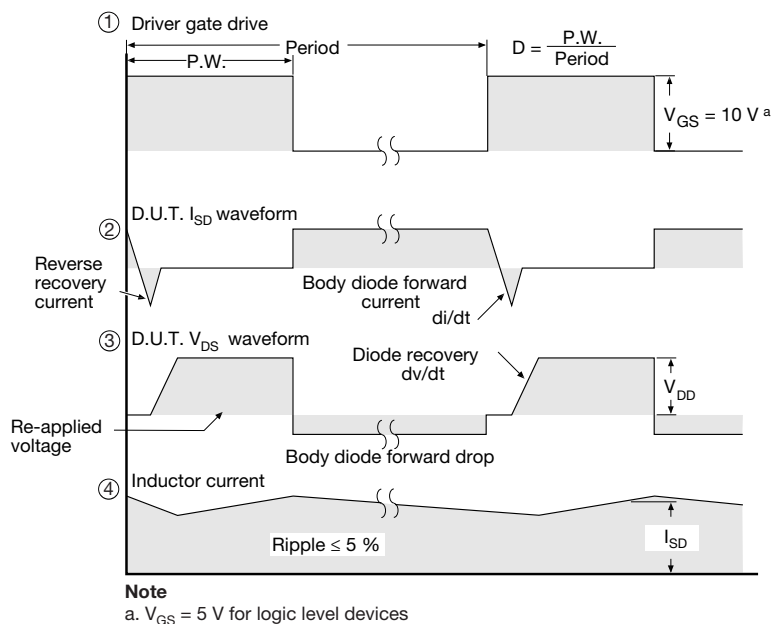
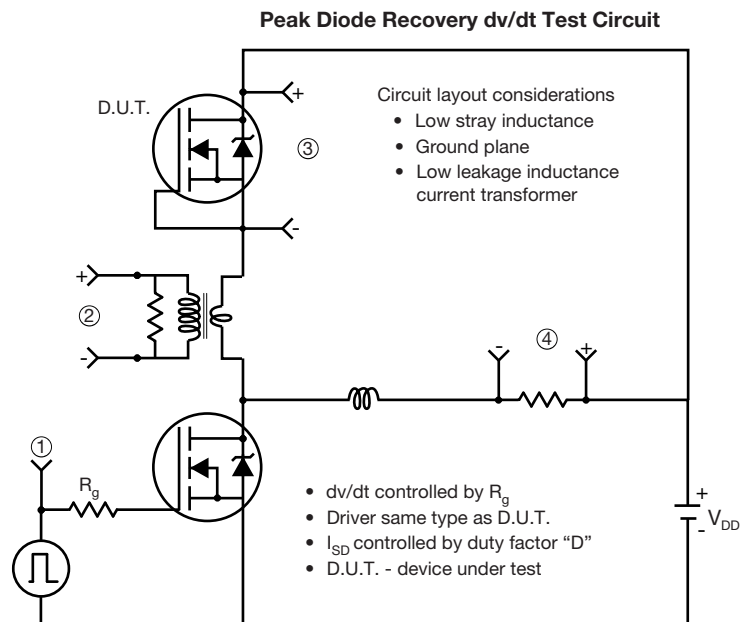
- a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS}
b. $C_{oss(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS}

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Fig. 1 - Typical Output Characteristics

Fig. 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 - 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 Voltage

Fig. 9 - Maximum Safe Operating Area
Note

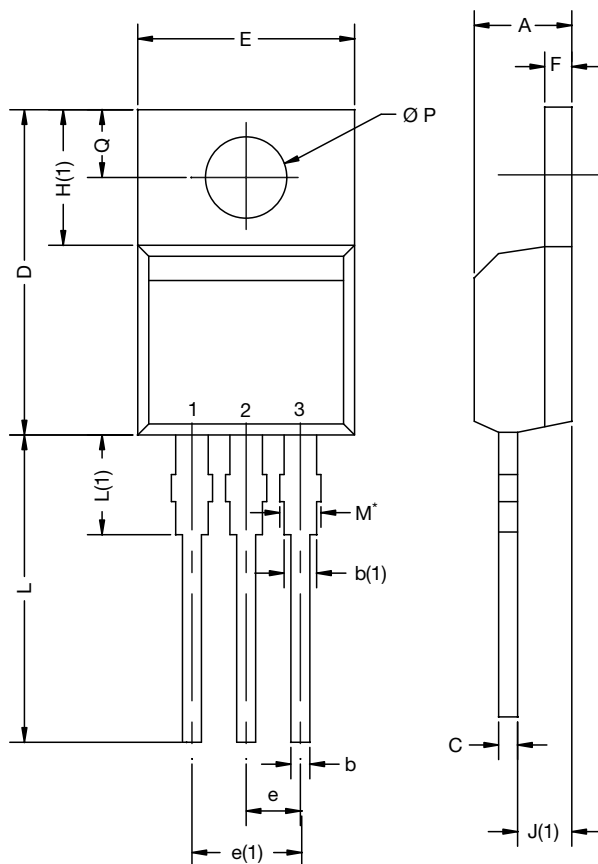
a. $V_{GS} >$ minimum V_{GS} at which $R_{DS(on)}$ is specified


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
$\varnothing P$	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

ECN: E21-0621-Rev. D, 04-Nov-2021
DWG: 6031

Note

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



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