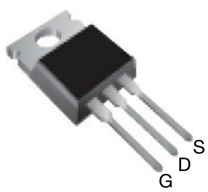
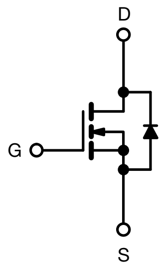
EF Series Power MOSFET With Fast Body Diode

TO-220AB





N-Channel MOSFET

FEATURES

- Low figure-of-merit (FOM) R_{on} x Q_g
- Low input capacitance (C_{iss})
- Reduced switching and conduction losses
- Ultra low gate charge (Q_g)
- 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
  - Induction heating
  - Motor drives
  - Battery chargers
  - Renewable energy
  - 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	0.158
Q_g max. (nC)	96	
Q_{gs} (nC)	9	
Q_{gd} (nC)	21	
Configuration	Single	

ORDERING INFORMATION	
Package	TO-220AB
Lead (Pb)-free and halogen-free	SiHP22N60EF-GE3

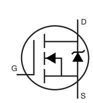
ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

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	I_D	19	A
		T_C = 100 °C		12	
Pulsed drain current [a]			I_{DM}	46	
Linear derating factor				1.4	W/°C
Single pulse avalanche energy [b]			E_{AS}	144	mJ
Maximum power dissipation			P_D	179	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	70	V/ns
Reverse diode dv/dt [d]				50	
Soldering recommendations (peak temperature) [c]	For 10 s			260	°C

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature
b. V_{DD} = 140 V, starting T_J = 25 °C, L = 28.2 mH, R_g = 25 Ω, I_{AS} = 3.2 A
c. 1.6 mm from case
d. $I_{SD} \leq I_D$, 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	°C/W
Maximum junction-to-case (drain)	R_{thJC}	-	0.7	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static						
Drain-source breakdown voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 μA	600	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA	-	0.68	-	V/°C
Gate-source threshold voltage (N)	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 μA	2.0	-	4.0	V
Gate-source leakage	I_{GSS}	V_{GS} = ± 20 V	-	-	± 100	nA
		V_{GS} = ± 30 V	-	-	± 1	μA
Zero gate voltage drain current	I_{DSS}	V_{DS} = 480 V, V_{GS} = 0 V	-	-	1	μA
		V_{DS} = 480 V, V_{GS} = 0 V, T_J = 125 °C	-	-	500	
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 11 A	-	0.158	0.182	Ω
Forward transconductance [a]	g_{fs}	V_{DS} = 30 V, I_D = 11 A	-	5.8	-	S
Dynamic						
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz	-	1423	-	pF
Output capacitance	C_{oss}		-	73	-	
Reverse transfer capacitance	C_{rss}		-	5	-	
Effective output capacitance, energy related [a]	$C_{o(er)}$	V_{DS} = 0 V to 480 V, V_{GS} = 0 V	-	48	-	
Effective output capacitance, time related [b]	$C_{o(tr)}$		-	240	-	
Total gate charge	Q_g	V_{GS} = 10 V, I_D = 11 A, V_{DS} = 480 V	-	48	96	nC
Gate-source charge	Q_{gs}		-	9	-	
Gate-drain charge	Q_{gd}		-	21	-	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 480 V, I_D = 11 A, V_{GS} = 10 V, R_g = 9.1 Ω	-	15	30	ns
Rise time	t_r		-	21	42	
Turn-off delay time	$t_{d(off)}$		-	58	87	
Fall time	t_f		-	25	50	
Gate input resistance	R_g	f = 1 MHz, open drain	0.3	0.6	1.2	Ω
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	19	A
Pulsed diode forward current	I_{SM}		-	-	46	
Diode forward voltage	V_{SD}	T_J = 25 °C, I_S = 11 A, V_{GS} = 0 V	-	-	1.2	V
Reverse recovery time	t_{rr}	T_J = 25 °C, I_F = I_S = 11 A, di/dt = 100 A/μs, V_R = 400 V	-	113	226	ns
Reverse recovery charge	Q_{rr}		-	0.7	1.4	μC
Reverse recovery current	I_{RRM}		-	11	-	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)

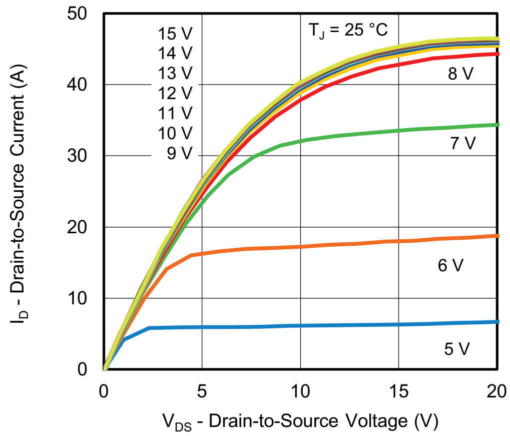


Fig. 1 - Typical Output Characteristics

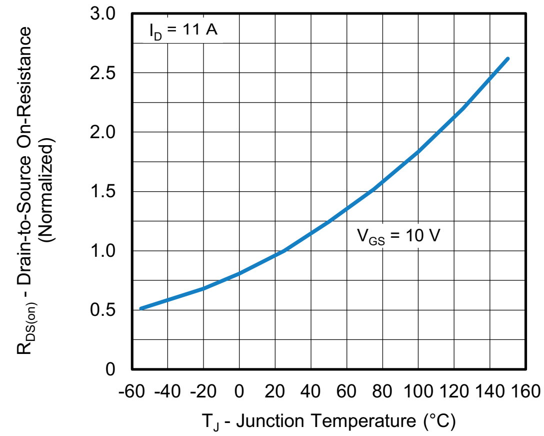


Fig. 4 - Normalized On-Resistance vs. Temperature

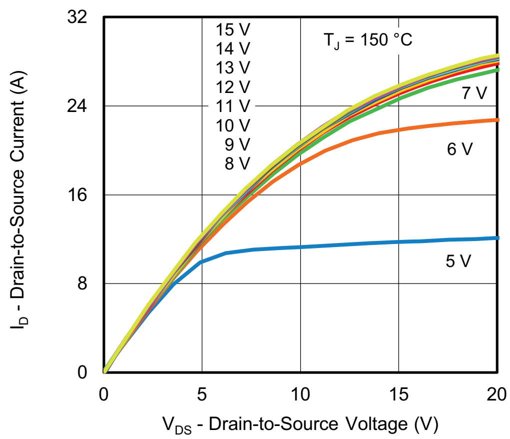


Fig. 2 - Typical Output Characteristics

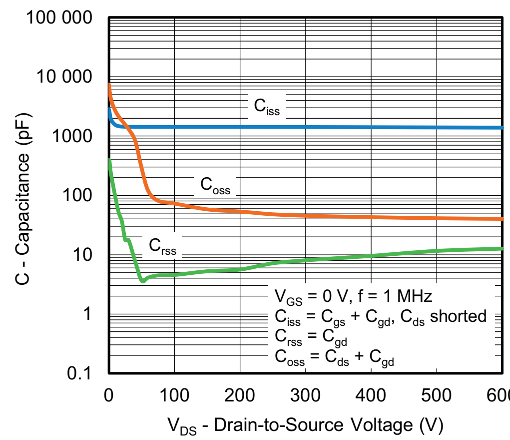


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

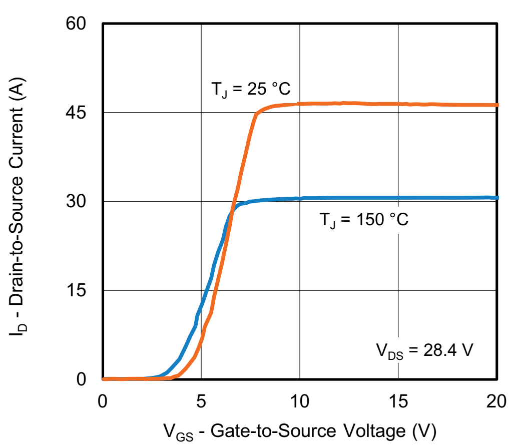


Fig. 3 - Typical Transfer Characteristics

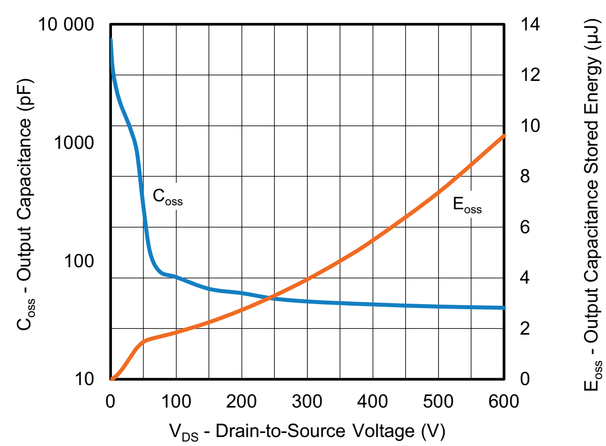


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

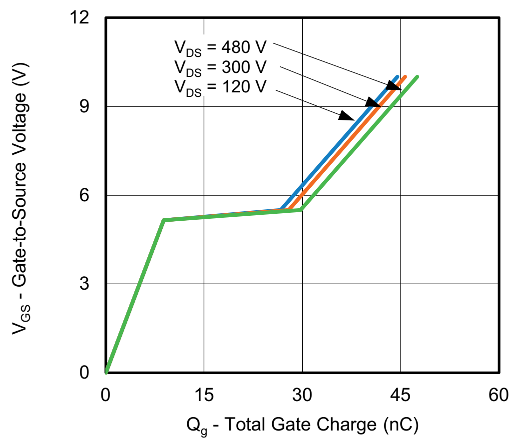


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

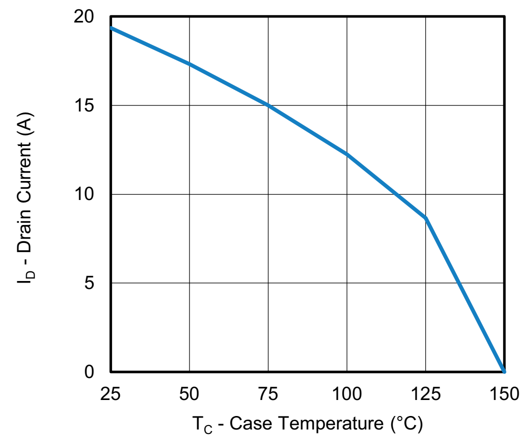


Fig. 10 - Maximum Drain Current vs. Case Temperature

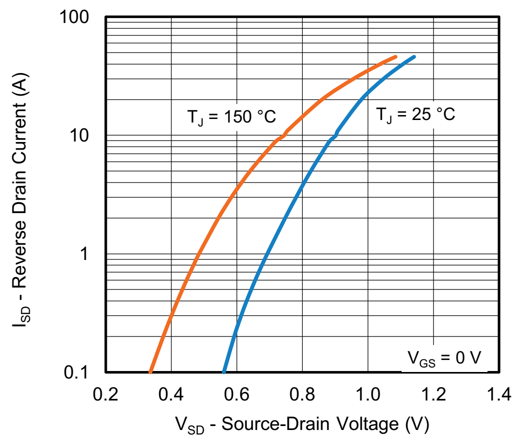


Fig. 8 - Typical Source-Drain Diode Forward Voltage

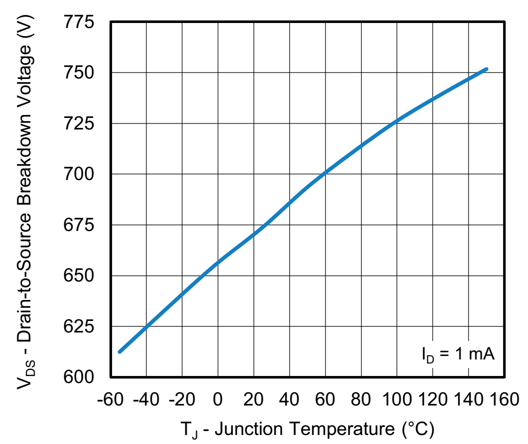


Fig. 11 - Temperature vs. Drain-to-Source Voltage

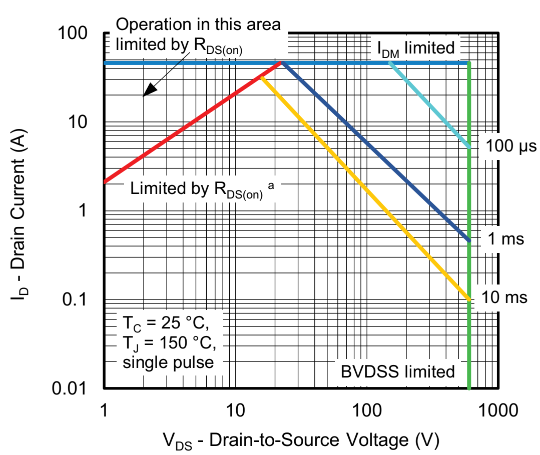


Fig. 9 - Maximum Safe Operating Area

Note

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

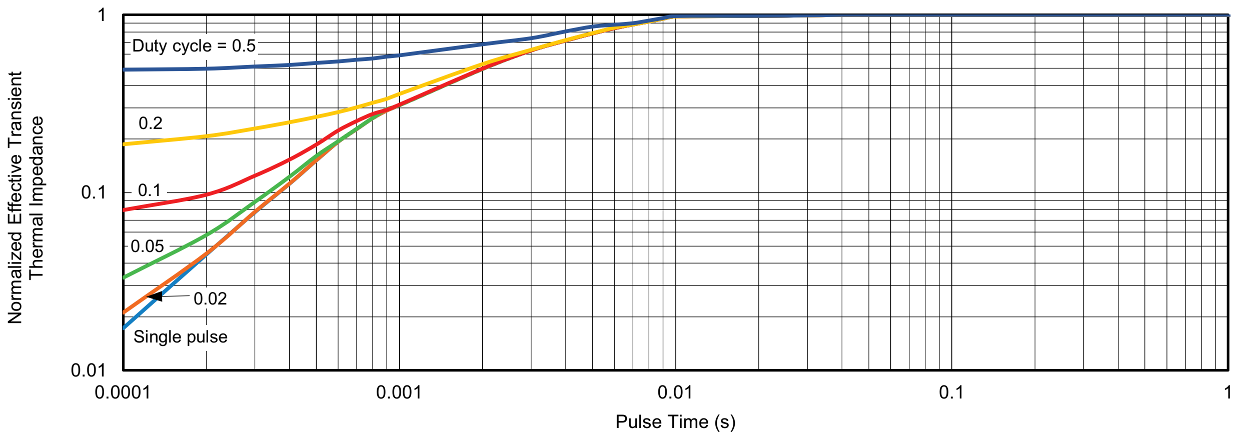


Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case

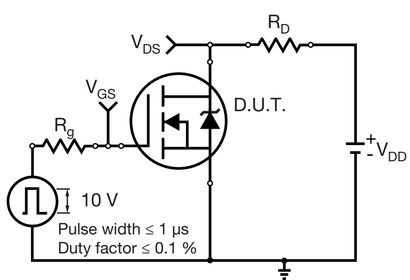


Fig. 13 - Switching Time Test Circuit

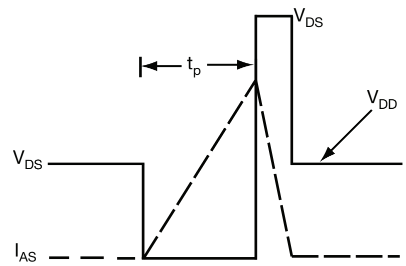


Fig. 16 - Unclamped Inductive Waveforms

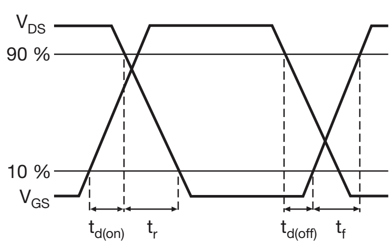


Fig. 14 - Switching Time Waveforms

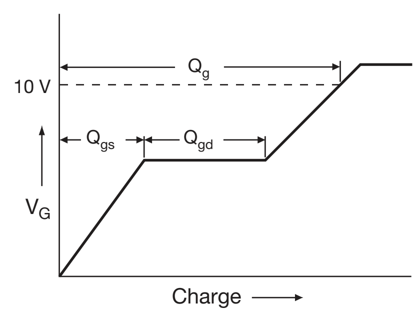


Fig. 17 - Basic Gate Charge Waveform

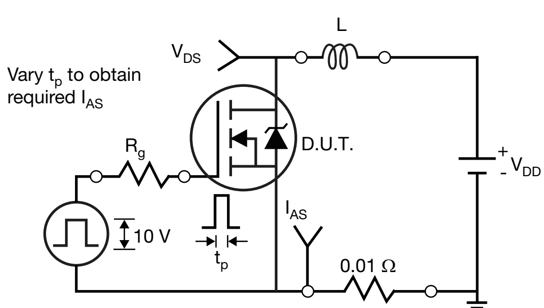


Fig. 15 - Unclamped Inductive Test Circuit

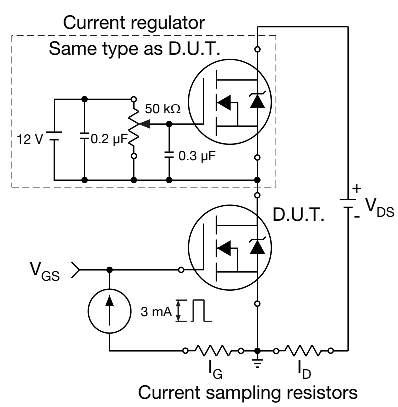
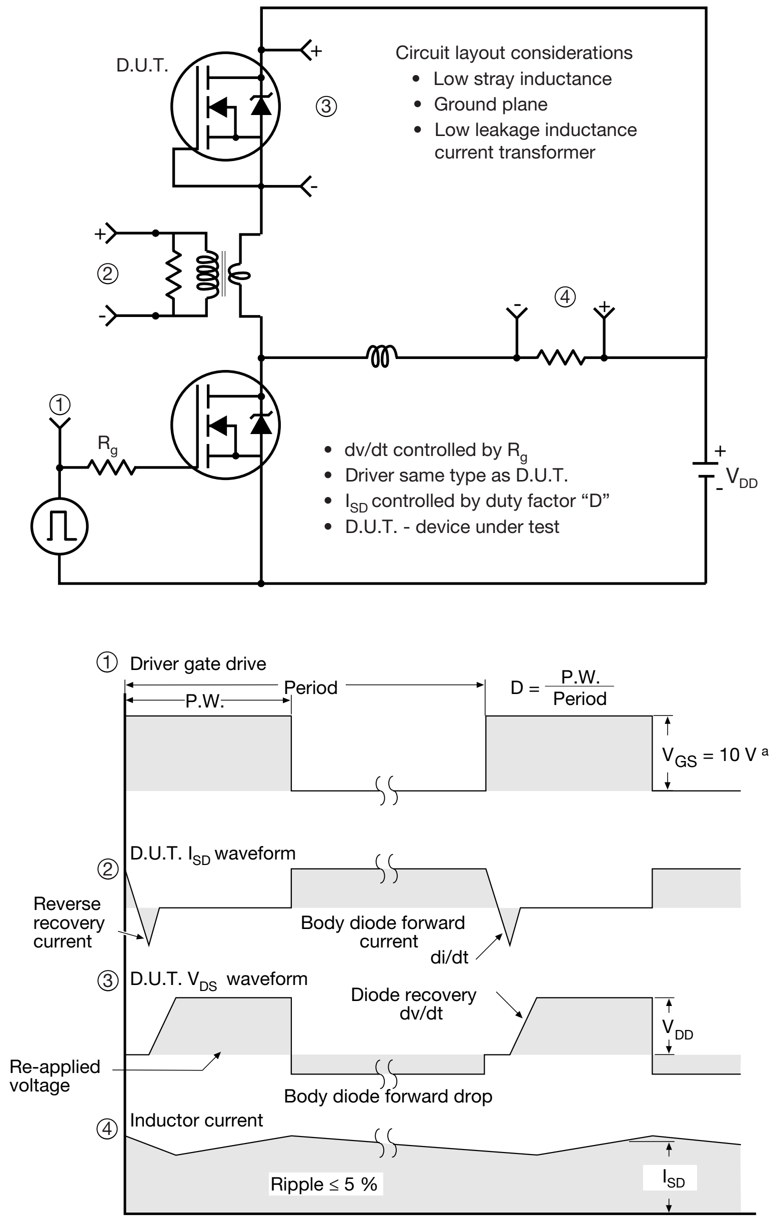


Fig. 18 - Gate Charge Test Circuit

Peak Diode Recovery dv/dt Test Circuit



Note

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

Fig. 19 - For N-Channel

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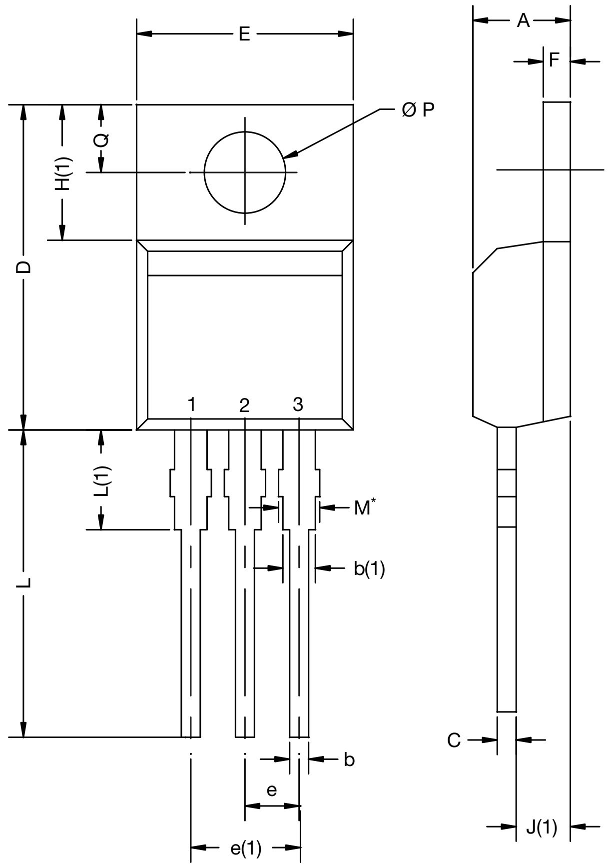
TO-220-1



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
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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