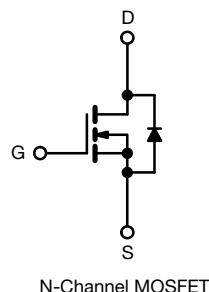


## EF Series Power MOSFET With Fast Body Diode

**Thin-Lead TO-220 FULLPAK**

**FEATURES**

- 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**

**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
  - Solar (PV inverters)

**PRODUCT SUMMARY**

$V_{DS}$ (V) at $T_J$ max.	850	
$R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C	$V_{GS} = 10$ V	0.220
$Q_g$ max. (nC)	71	
$Q_{gs}$ (nC)	10	
$Q_{gd}$ (nC)	21	
Configuration	Single	

**ORDERING INFORMATION**

Package	Thin-Lead TO-220 Fullpack
Lead (Pb)-free and halogen-free	SIHA21N80AEF-GE3

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

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-source voltage	$V_{DS}$	800	V
Gate-source voltage	$V_{GS}$	$\pm 30$	
Continuous drain current ( $T_J = 150$ °C) <sup>e</sup>	$V_{GS}$ at 10 V	7.0	A
		4.4	
Pulsed drain current <sup>a</sup>	$I_{DM}$	37	
Linear derating factor		0.26	W/°C
Single pulse avalanche energy <sup>b</sup>	$E_{AS}$	127	mJ
Maximum power dissipation	$P_D$	33	W
Operating junction and storage temperature range	$T_J, T_{stg}$	-55 to +150	°C
Drain-source voltage slope	$T_J = 125$ °C	100	V/ns
Reverse diode dv/dt <sup>d</sup>		50	
Soldering recommendations (peak temperature) <sup>c</sup>	For 10 s	260	°C
Mounting torque	M3 screw	-	Nm

**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 140$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$  Ω,  $I_{AS} = 3.0$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $di/dt = 170$  A/μs, starting  $T_J = 25$  °C
- Limited by maximum junction temperature

**THERMAL RESISTANCE RATINGS**

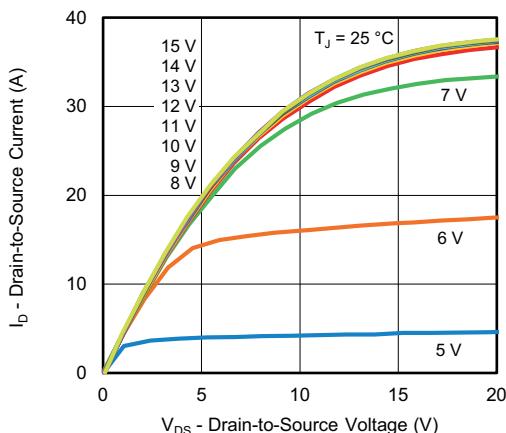
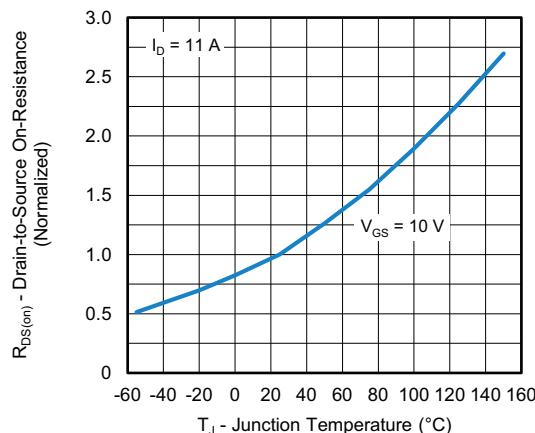
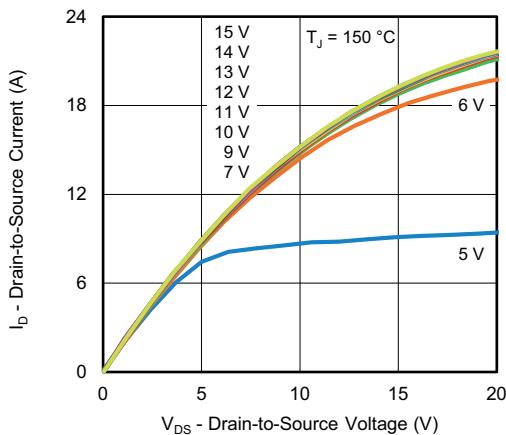
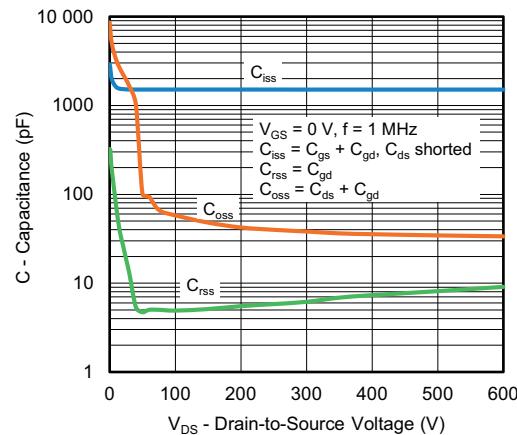
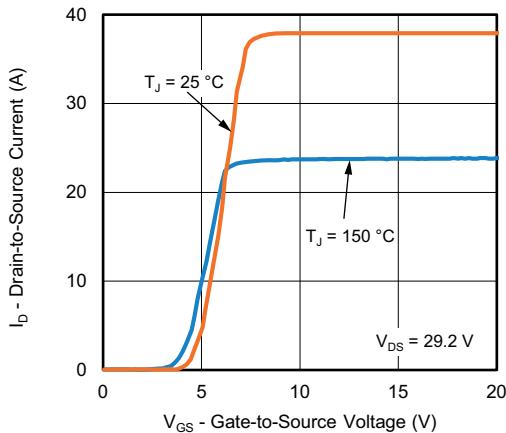
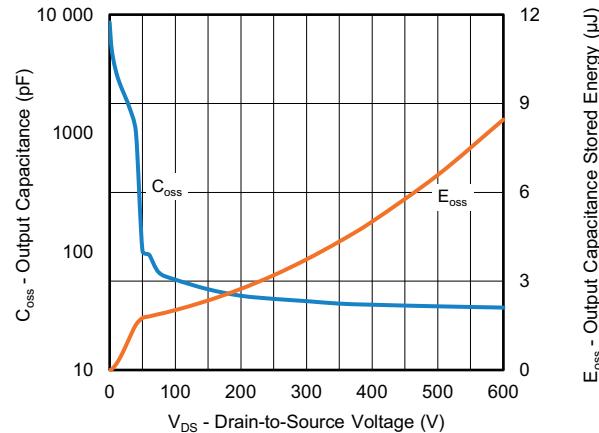
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	65	
Maximum junction-to-case (drain)	$R_{thJC}$	-	3.8	°C/W

**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	$V_{DS}$	$V_{GS} = 0$ V, $I_D = 250$ μA		800	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, $I_D = 1$ mA		-	0.8	-	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	$I_{GSS}$	$V_{GS} = \pm 20$ V		-	-	± 100	nA
		$V_{GS} = \pm 30$ V		-	-	± 1	μA
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 640$ V, $V_{GS} = 0$ V		-	-	1	μA
		$V_{DS} = 640$ V, $V_{GS} = 0$ V, $T_J = 125$ °C		-	-	2	mA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10$ V	$I_D = 8.5$ A	-	0.220	0.250	Ω
Forward transconductance <sup>a</sup>	$g_{fs}$	$V_{DS} = 30$ V, $I_D = 11$ A		-	8.7	-	S
<b>Dynamic</b>							
Input capacitance	$C_{iss}$	$V_{GS} = 0$ V, $V_{DS} = 100$ V, $f = 1$ MHz		-	1511	-	pF
Output capacitance	$C_{oss}$			-	58	-	
Reverse transfer capacitance	$C_{rss}$			-	5	-	
Effective output capacitance, energy related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0$ V to 480 V, $V_{GS} = 0$ V		-	44	-	
Effective output capacitance, time related <sup>b</sup>	$C_{o(tr)}$			-	271	-	
Total gate charge	$Q_g$		$V_{GS} = 10$ V	$I_D = 11$ A, $V_{DS} = 640$ V	-	47	71
Gate-source charge	$Q_{gs}$				-	10	-
Gate-drain charge	$Q_{gd}$				-	21	-
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 640$ V, $I_D = 11$ A, $V_{GS} = 10$ V, $R_g = 9.1$ Ω		-	18	36	ns
Rise time	$t_r$			-	28	56	
Turn-off delay time	$t_{d(off)}$			-	44	88	
Fall time	$t_f$			-	43	86	
Gate input resistance	$R_g$	$f = 1$ MHz, open drain		0.2	0.5	1.0	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		-	-	7.0	A
Pulsed diode forward current	$I_{SM}$			-	-	37	
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		-	128	256	ns
Reverse recovery charge	$Q_{rr}$			-	0.8	1.6	μC
Reverse recovery current	$I_{RRM}$			-	12	-	A

**Notes**

f.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 V to 480 V  
g.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 V to 480 V

**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.  $V_{DS}$**

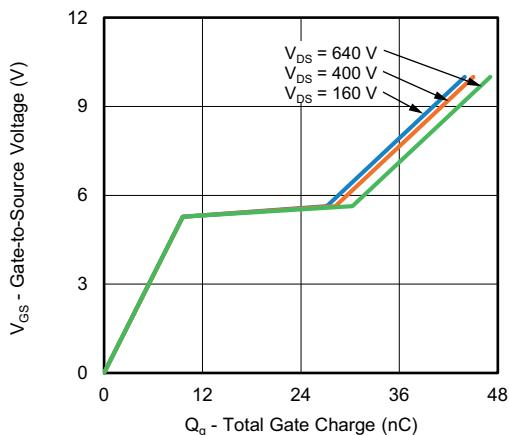


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

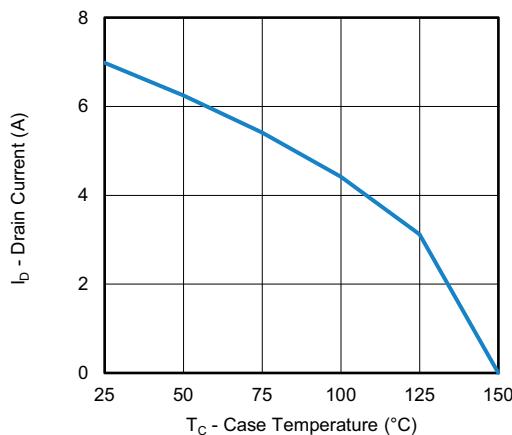


Fig. 10 - Maximum Drain Current vs. Case Temperature

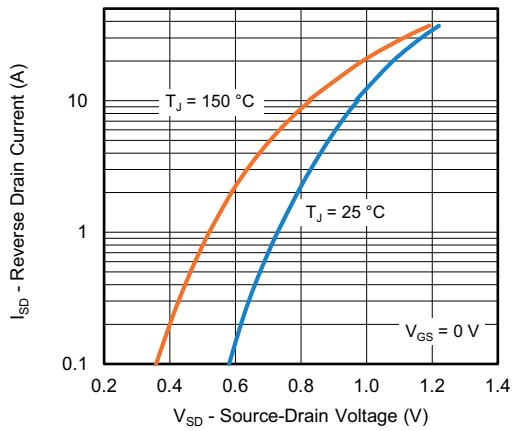


Fig. 8 - Typical Source-Drain Diode Forward Voltage

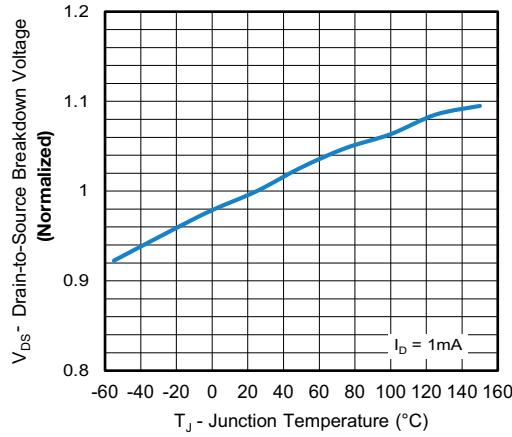


Fig. 11 - Temperature vs. Drain-to-Source Voltage

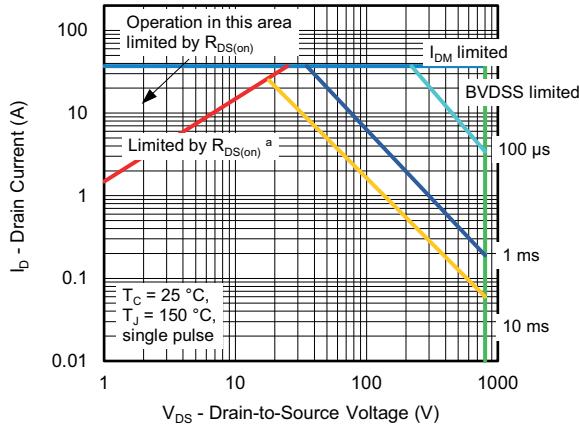
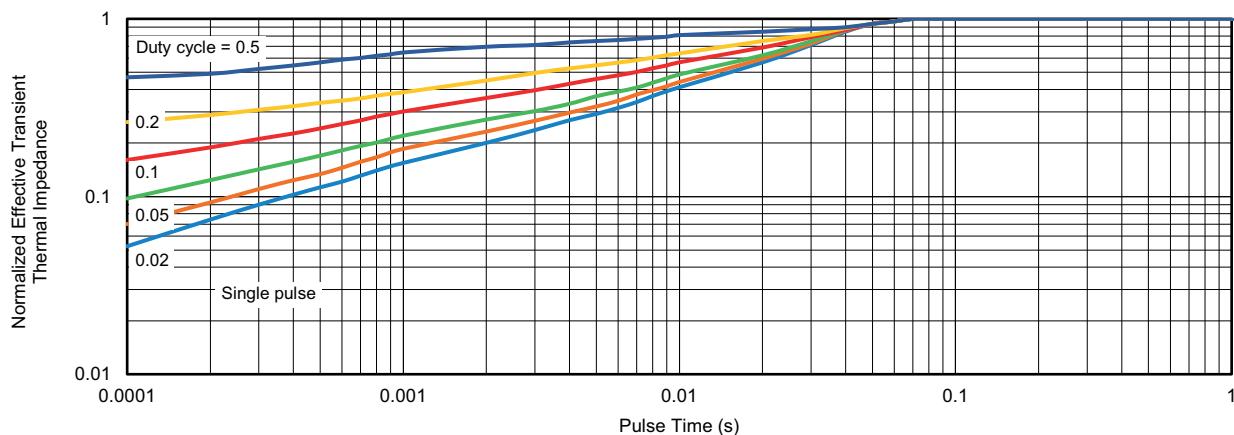


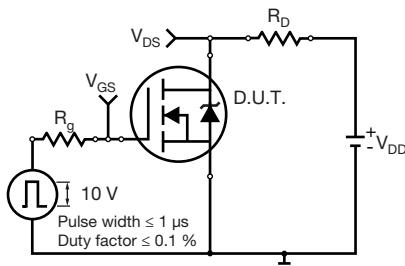
Fig. 9 - Maximum Safe Operating Area

#### Note

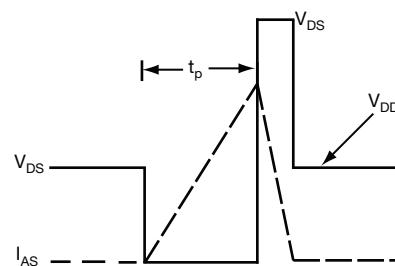
a.  $V_{GS} >$  minimum  $V_{GS}$  at which  $R_{DS(on)}$  is specified



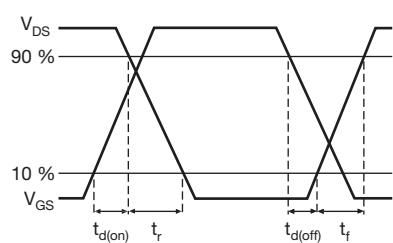
**Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case**



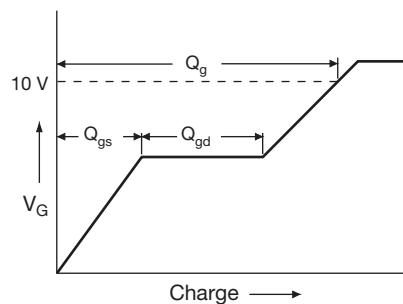
**Fig. 13 - Switching Time Test Circuit**



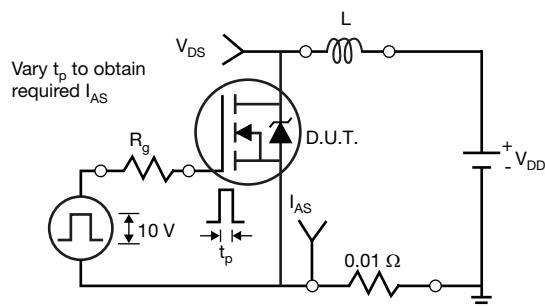
**Fig. 16 - Unclamped Inductive Waveforms**



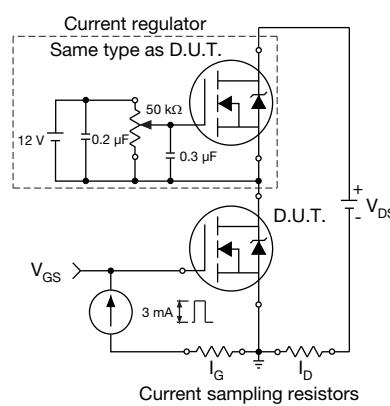
**Fig. 14 - Switching Time Waveforms**



**Fig. 17 - Basic Gate Charge Waveform**



**Fig. 15 - Unclamped Inductive Test Circuit**



**Fig. 18 - Gate Charge Test Circuit**

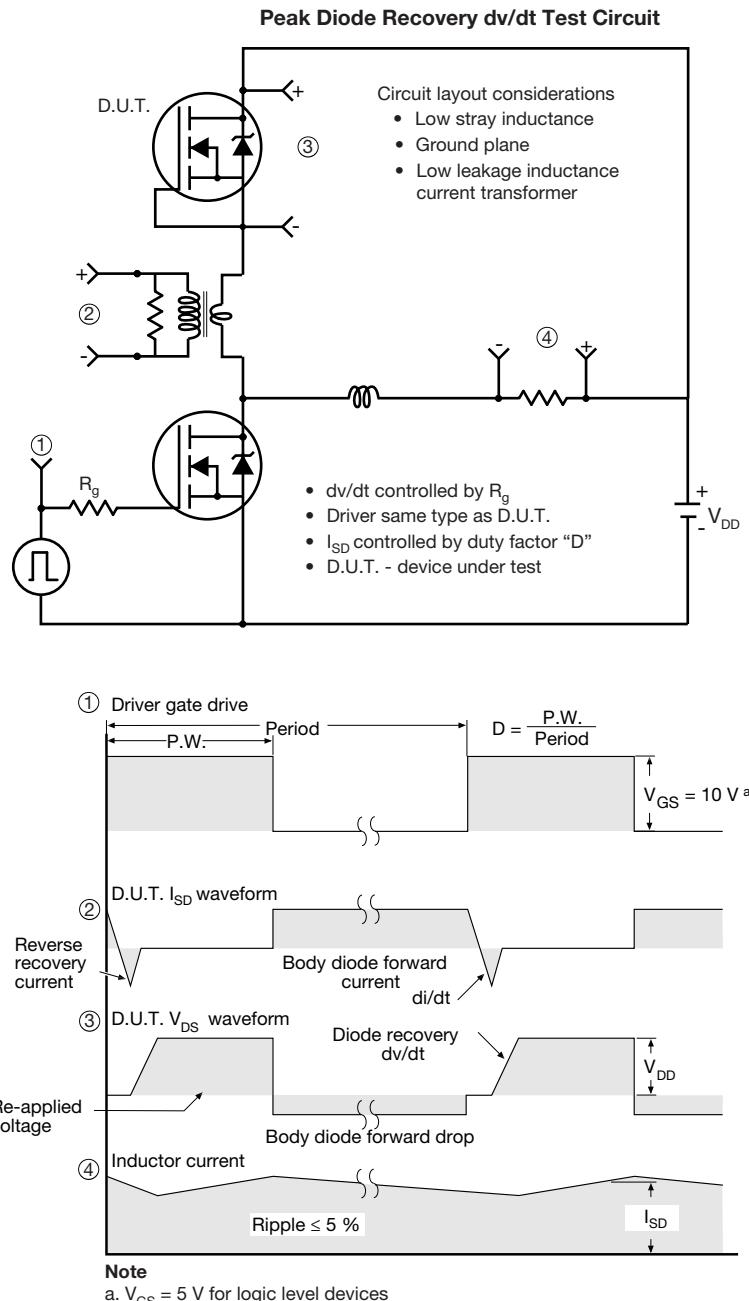
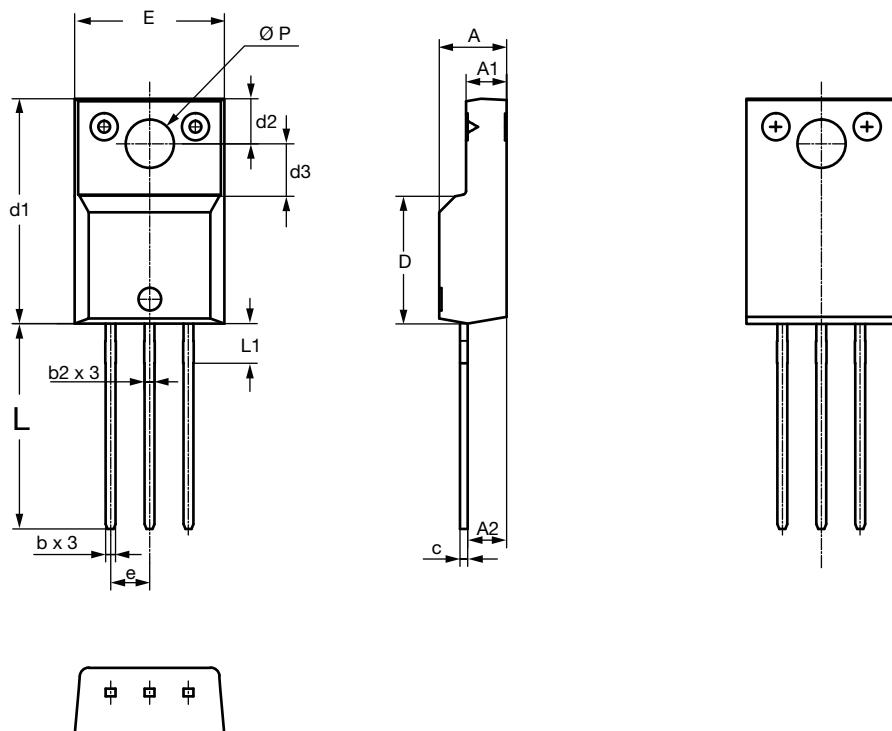


Fig. 19 - For N-Channel

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## TO-220 FULLPAK Thin Lead



SYMBOL	DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.30	4.70	0.169	0.185
A1	2.50	2.90	0.098	0.114
A2	2.40	2.80	0.094	0.110
b	0.60	0.80	0.024	0.031
b2	0.60	0.90	0.024	0.035
c	-	0.60	-	0.024
D	8.30	8.70	0.327	0.342
d1	14.70	15.30	0.579	0.602
d2	2.90	3.10	0.114	0.122
d3	3.30	3.70	0.130	0.146
E	9.70	10.30	0.382	0.406
e	2.50	2.70	0.098	0.106
L	13.40	13.80	0.528	0.543
L1	1.00	2.80	0.039	0.110
Ø P	3.00	3.40	0.118	0.134

ECN: E20-0684-Rev. D, 28-Dec-2020  
DWG: 6021

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