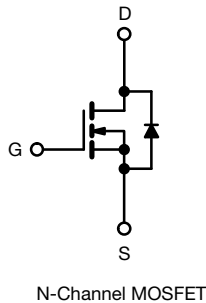


E Series Power MOSFET

Thin-Lead TO-220 FULLPAK


FEATURES

- 4th 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


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.	650	
$R_{DS(on)}$ typ. (Ω) at 25 °C	$V_{GS} = 10$ V	0.60
Q_g max. (nC)	12	
Q_{gs} (nC)	3	
Q_{gd} (nC)	3	
Configuration	Single	

ORDERING INFORMATION

Package	Thin-Lead TO-220 FULLPAK
Lead (Pb)-free and halogen-free	SiHA690N60E-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) ^e	V_{GS} at 10 V	$T_C = 25$ °C	4.3	A
		$T_C = 100$ °C	2.7	
Pulsed drain current ^a	I_{DM}	11		
Linear derating factor		0.23	W/°C	
Single pulse avalanche energy ^b	E_{AS}	9	mJ	
Maximum power dissipation	P_D	29	W	
Operating junction and storage temperature range	T_J, T_{stg}	-55 to +150	°C	
Drain-source voltage slope	dv/dt	70	V/ns	
Reverse diode dv/dt ^d				17
Soldering recommendations (peak temperature) ^c	For 10 s	260	°C	
Mounting torque, M3 screw		0.6	Nm	


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 , $I_{AS} = 0.8$ A
- 1.6 mm from case
- $I_{SD} \leq I_D$, $di/dt = 100$ A/ μ s, 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	°C/W
Maximum junction-to-case (drain)	R_{thJC}	-	4.3	

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 $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$	-	0.73	-	V/°C
Gate-source threshold voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3.0	-	5.0	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	μA
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	10	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 2.0\text{ A}$	-	0.60	0.70	Ω
Forward transconductance ^a	g_{fs}	$V_{DS} = 20\text{ V}, I_D = 2.0\text{ A}$	-	1.2	-	S
Dynamic						
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$	-	347	-	pF
Output capacitance	C_{oss}		-	24	-	
Reverse transfer capacitance	C_{rss}		-	4	-	
Effective output capacitance, energy related ^a	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	-	17	-	pF
Effective output capacitance, time related ^b	$C_{o(tr)}$		-	86	-	
Total gate charge	Q_g	$V_{GS} = 10\text{ V}, I_D = 2.0\text{ A}, V_{DS} = 480\text{ V}$	-	8	12	nC
Gate-source charge	Q_{gs}		-	3	-	
Gate-drain charge	Q_{gd}		-	3	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 480\text{ V}, I_D = 2.0\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$	-	12	24	ns
Rise time	t_r		-	9	18	
Turn-off delay time	$t_{d(off)}$		-	19	38	
Fall time	t_f		-	22	44	
Gate input resistance	R_g	$f = 1\text{ MHz}, \text{open drain}$	1.1	2.3	4.6	Ω
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	6.4	A
Pulsed diode forward current	I_{SM}		-	-	11	
Diode forward voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 2.0\text{ A}, V_{GS} = 0\text{ V}$	-	-	1.2	V
Reverse recovery time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 2.0\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 25\text{ V}$	-	146	292	ns
Reverse recovery charge	Q_{rr}		-	1.0	2.0	μC
Reverse recovery current	I_{RRM}		-	13	-	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)

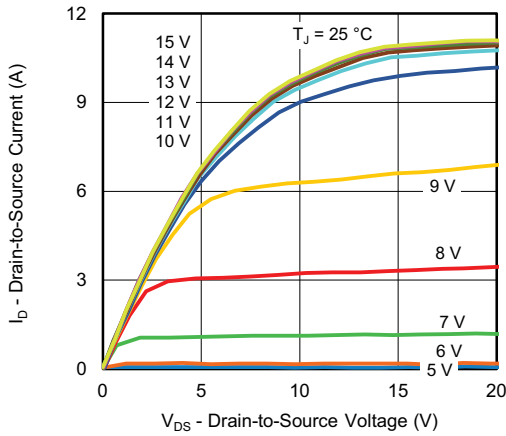


Fig. 1 - Typical Output Characteristics

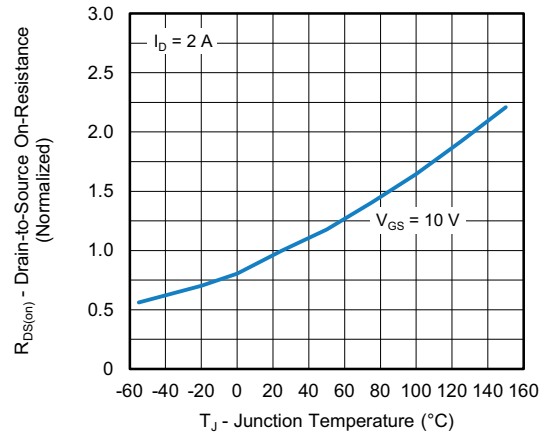


Fig. 4 - Normalized On-Resistance vs. Temperature

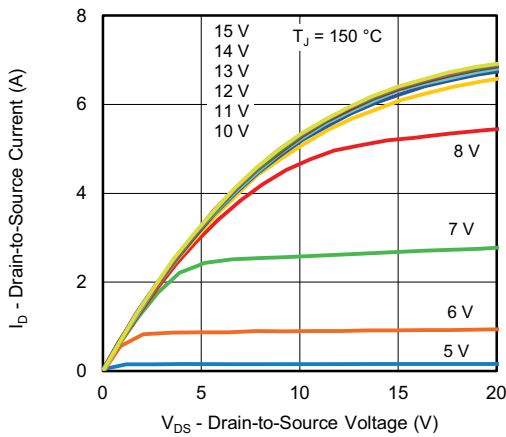


Fig. 2 - Typical Output Characteristics

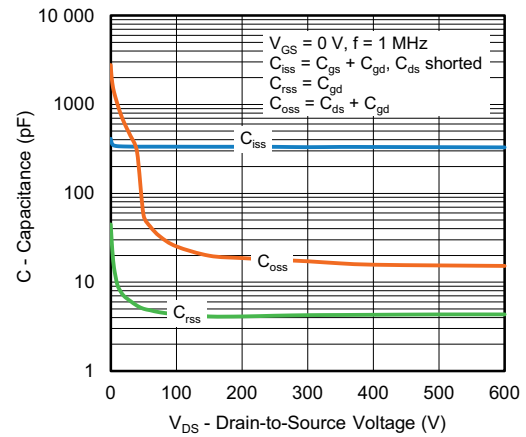


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

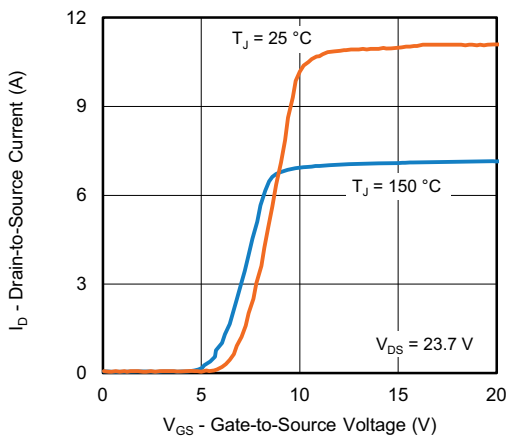


Fig. 3 - Typical Transfer Characteristics

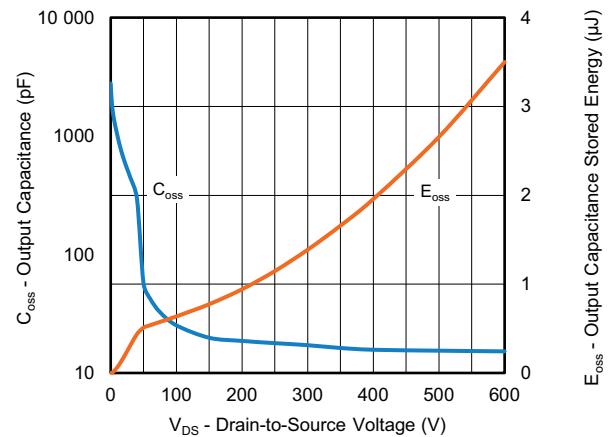


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

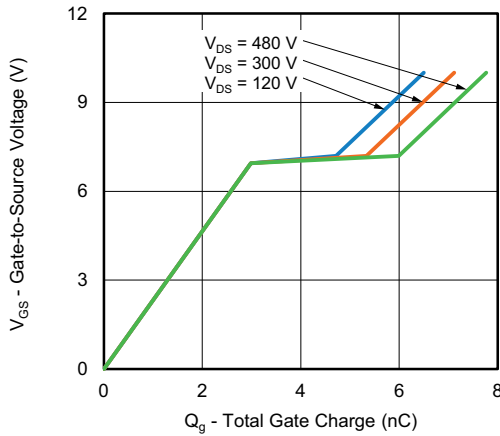


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

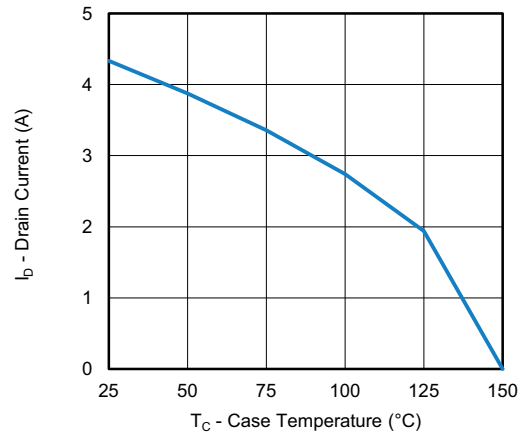


Fig. 10 - Maximum Drain Current vs. Case Temperature

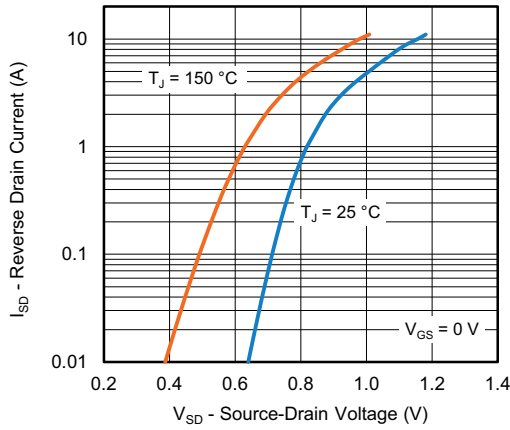


Fig. 8 - Typical Source-Drain Diode Forward Voltage

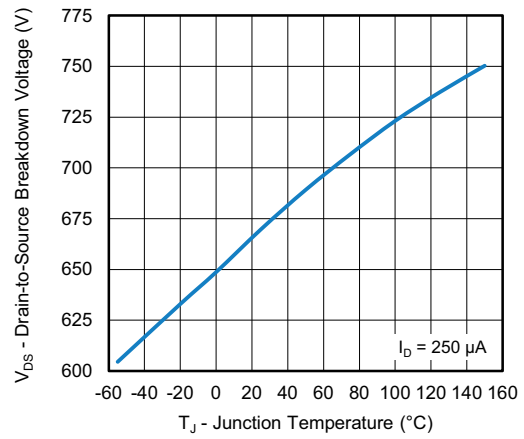


Fig. 11 - Temperature vs. Drain-to-Source Voltage

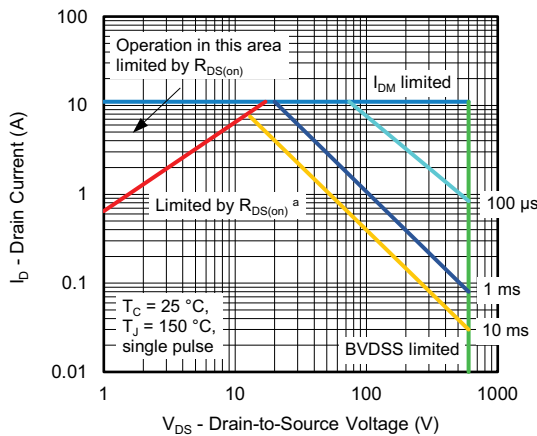


Fig. 9 - Maximum Safe Operating Area

Note

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

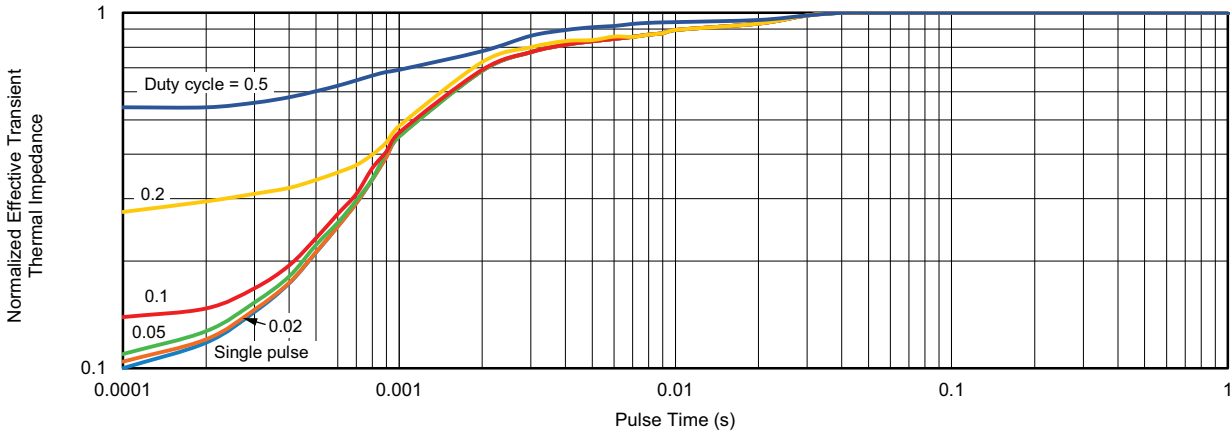


Fig. 12 - Normalized Transient Thermal Impedance, Junction-to-Case

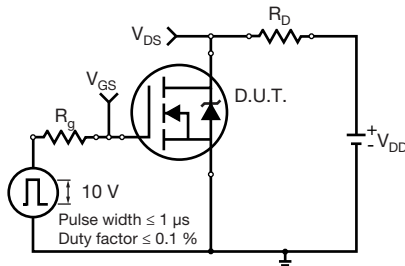


Fig. 13 - Switching Time Test Circuit

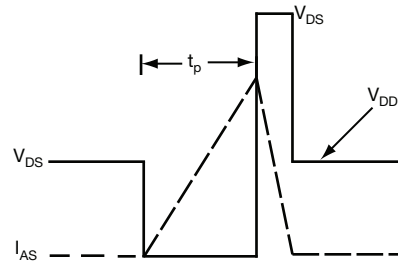


Fig. 16 - Unclamped Inductive Waveforms

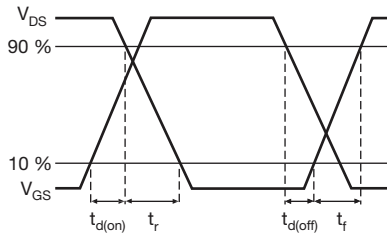


Fig. 14 - Switching Time Waveforms

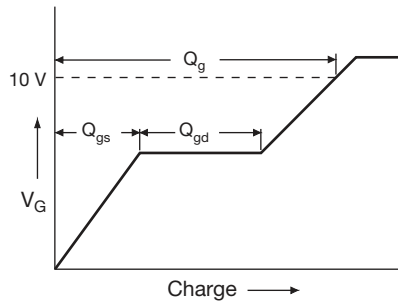


Fig. 17 - Basic Gate Charge Waveform

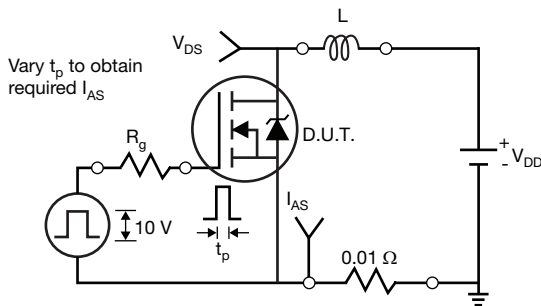


Fig. 15 - Unclamped Inductive Test Circuit

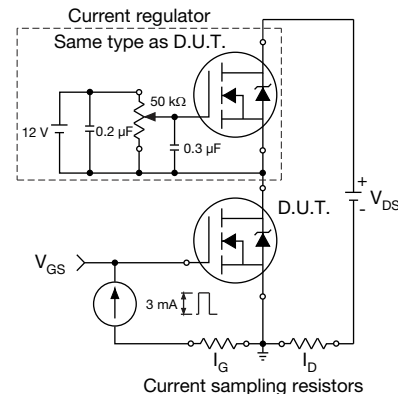


Fig. 18 - Gate Charge Test Circuit

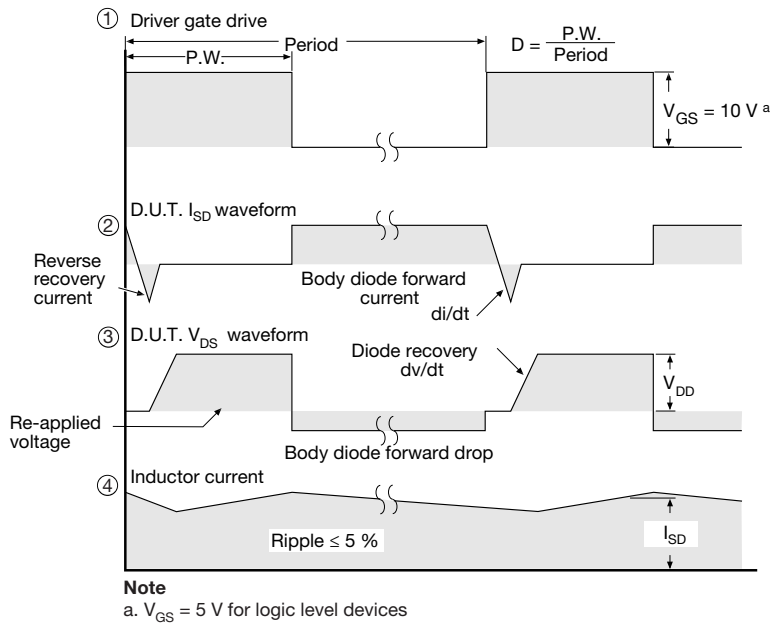
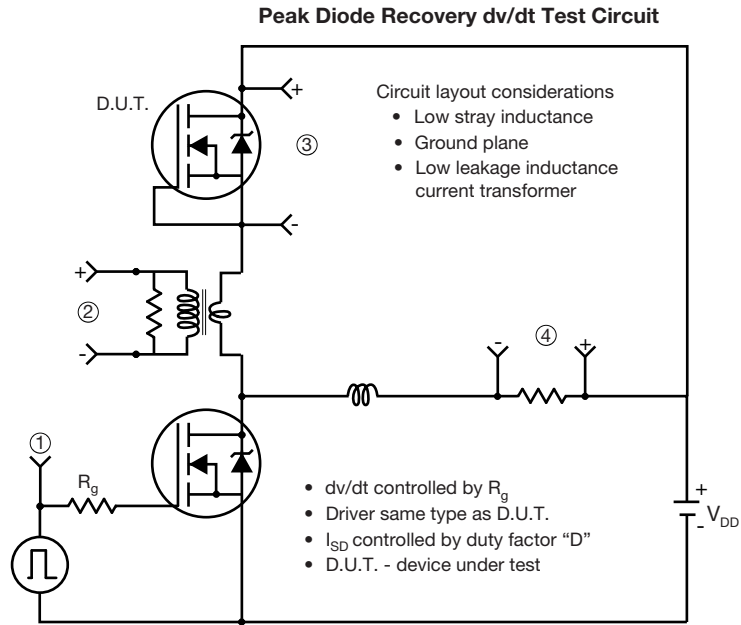
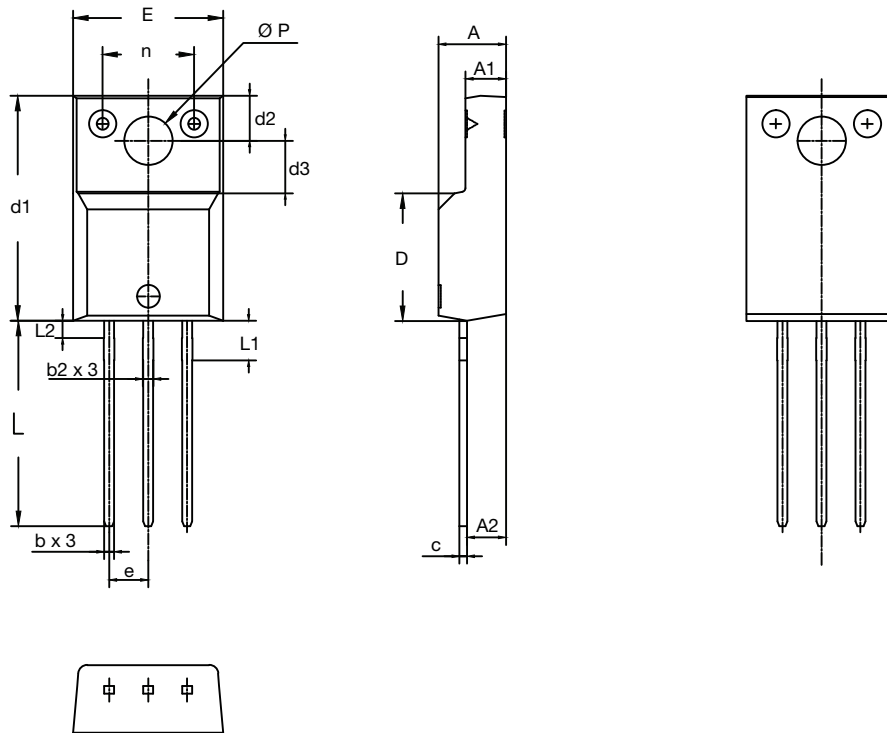


Fig. 19 - For N-Channel

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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	2.50	2.70	0.098	0.106
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	3.40	3.60	0.134	0.142
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	2.50	2.80	0.098	0.110
L2	-	1.20	-	0.047
n	6.05	6.15	0.238	0.242
Ø P	3.00	3.40	0.118	0.134

ECN: T16-0549-Rev. C, 12-Sep-16
DWG: 6021



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