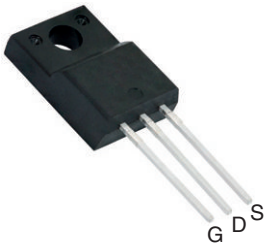
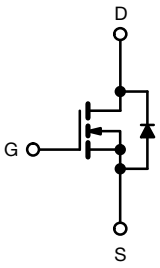
E Series Power MOSFET

Thin-Lead TO-220 FULLPAK





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

APPLICATIONS

- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Consumer
  - Adaptors
  - Televisions
  - Game console
- Computing
  - Adaptors
  - ATX power supply

PRODUCT SUMMARY		
V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ max. (Ω) at 25 °C	V_{GS} = 10 V	0.38
Q_g max. (nC)	58	
Q_{gs} (nC)	6	
Q_{gd} (nC)	13	
Configuration	Single	

ORDERING INFORMATION	
Package	Thin-Lead TO-220 FULLPAK
Lead (Pb)-free	SiHA12N60E-E3

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	I_D	12	A
		T_C = 100 °C		7.8	
Pulsed Drain Current [a]			I_{DM}	27	
Linear Derating Factor				0.26	W/°C
Single Pulse Avalanche Energy [b]			E_{AS}	117	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		dV/dt	70	V/ns
Reverse Diode dV/dt [d]				5	
Soldering Recommendations (Peak temperature) [c]	for 10 s			300	°C
Mounting Torque	M3 screw			0.6	Nm

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature.
b. V_{DD} = 50 V, starting T_J = 25 °C, L = 11.6 mH, R_g = 25 Ω, I_{AS} = 4.5 A.
c. 1.6 mm from case.
d. $I_{SD} \leq I_D$, dI/dt = 100 A/µs, starting T_J = 25 °C.
e. 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}	-	3.8	

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	-	0.71	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250 µA	2	-	4	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} = 600 V, V_{GS} = 0 V	-	-	1	µA
		V_{DS} = 480 V, V_{GS} = 0 V, T_J = 125 °C	-	-	10	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 10 V; I_D = 6 A	-	0.32	0.38	Ω
Forward Transconductance	g_{fs}	V_{DS} = 40 V, I_D = 8 A	-	3.8	-	S
Dynamic						
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz	-	937	-	pF
Output Capacitance	C_{oss}		-	53	-	
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	-	41	-	
Effective Output Capacitance, Time Related [b]	$C_{o(tr)}$		-	136	-	
Total Gate Charge	Q_g	V_{GS} = 10 V; I_D = 6 A, V_{DS} = 480 V	-	29	58	nC
Gate-Source Charge	Q_{gs}		-	6	-	
Gate-Drain Charge	Q_{gd}		-	13	-	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 480 V, I_D = 6 A, V_{GS} = 10 V, R_g = 9.1 Ω	-	14	28	ns
Rise Time	t_r		-	19	38	
Turn-Off Delay Time	$t_{d(off)}$		-	35	70	
Fall Time	t_f		-	19	38	
Gate Input Resistance	R_g	f = 1 MHz, open drain	-	1.1	-	Ω
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	12	A
Pulsed Diode Forward Current	I_{SM}		-	-	48	
Diode Forward Voltage	V_{SD}	T_J = 25 °C, I_S = 6 A, V_{GS} = 0 V	-	-	1.2	V
Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = I_S = 6 A, dI/dt = 100 A/µs, V_R = 25 V	-	350	-	ns
Reverse Recovery Charge	Q_{rr}		-	4	-	µC
Reverse Recovery Current	I_{RRM}		-	19	-	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)

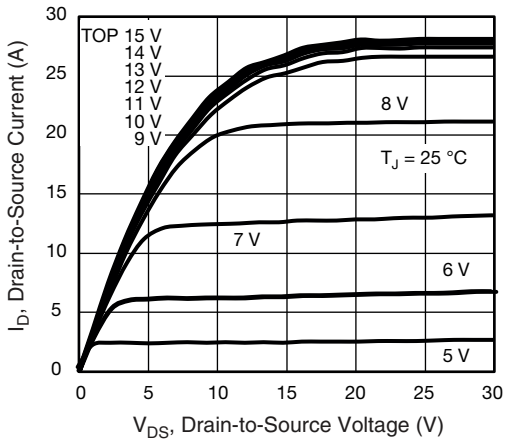


Fig. 1 - Typical Output Characteristics

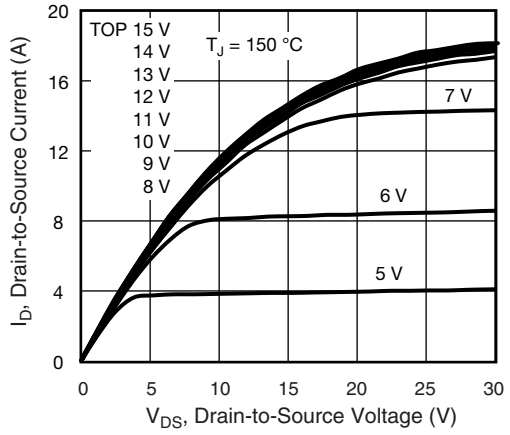


Fig. 2 - Typical Output Characteristics

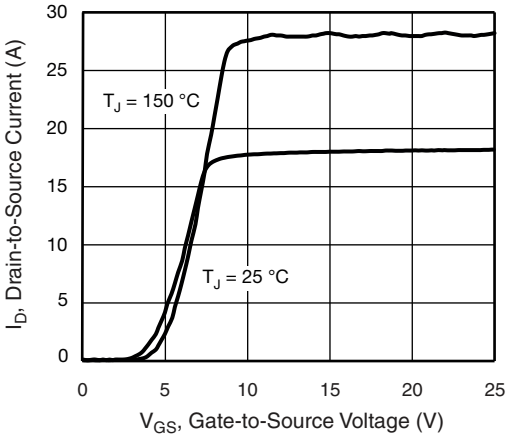


Fig. 3 - Typical Transfer Characteristics

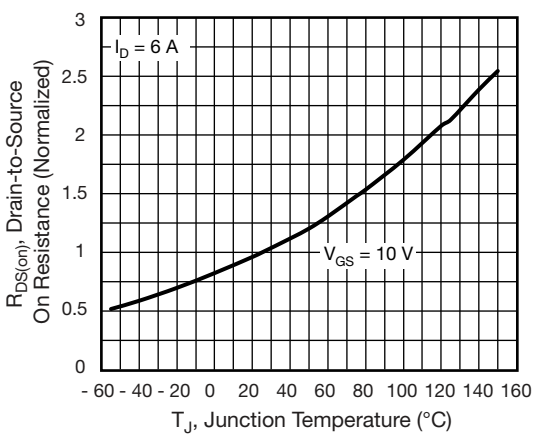


Fig. 4 - Normalized On-Resistance vs. Temperature

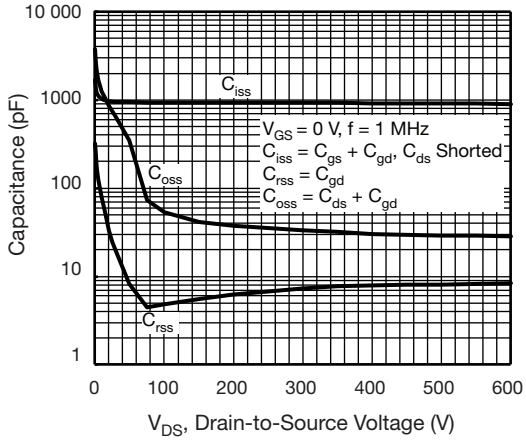


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

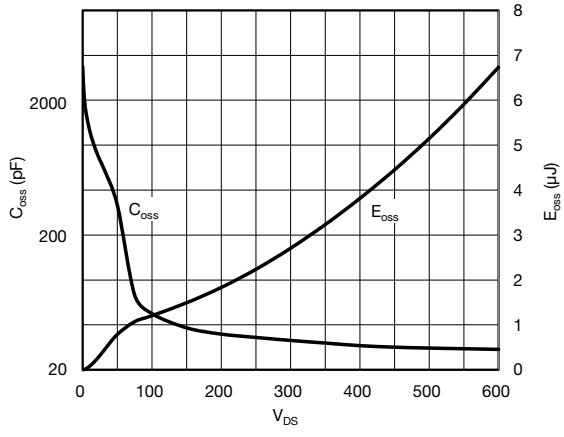


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

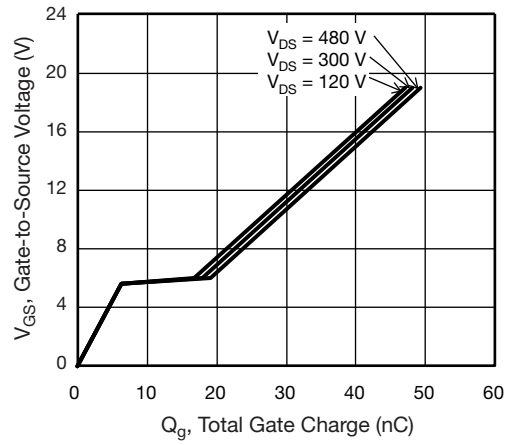


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

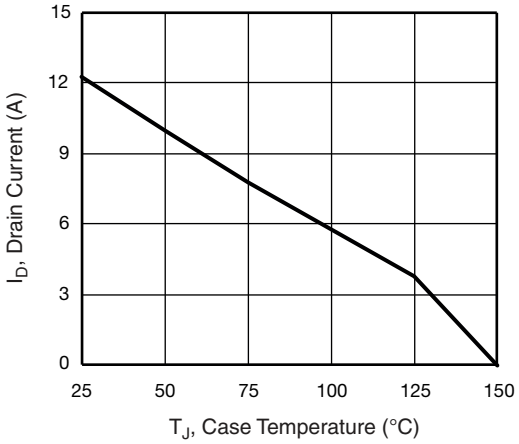


Fig. 10 - Maximum Drain Current vs. Case Temperature

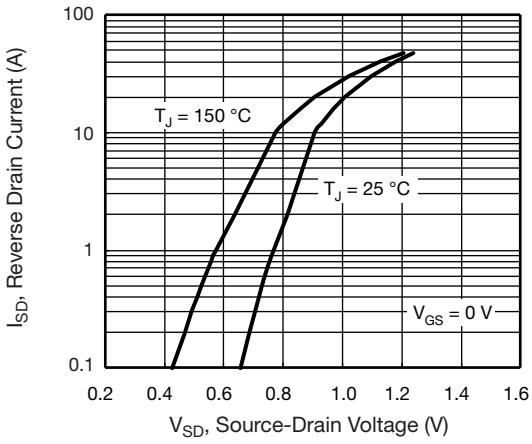


Fig. 8 - Typical Source-Drain Diode Forward Voltage

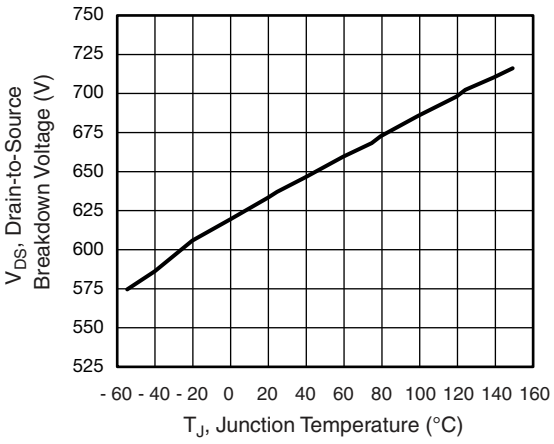


Fig. 11 - Temperature vs. Drain-to-Source Voltage

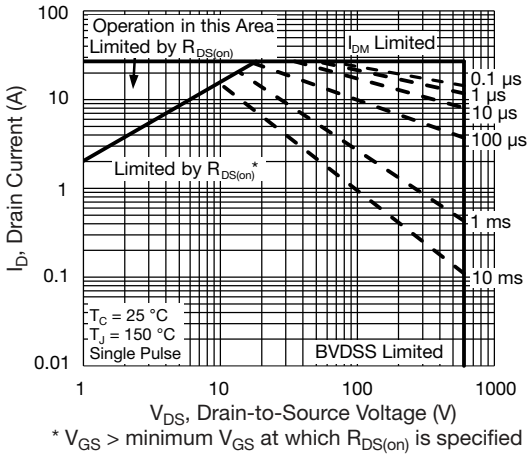


Fig. 9 - Maximum Safe Operating Area

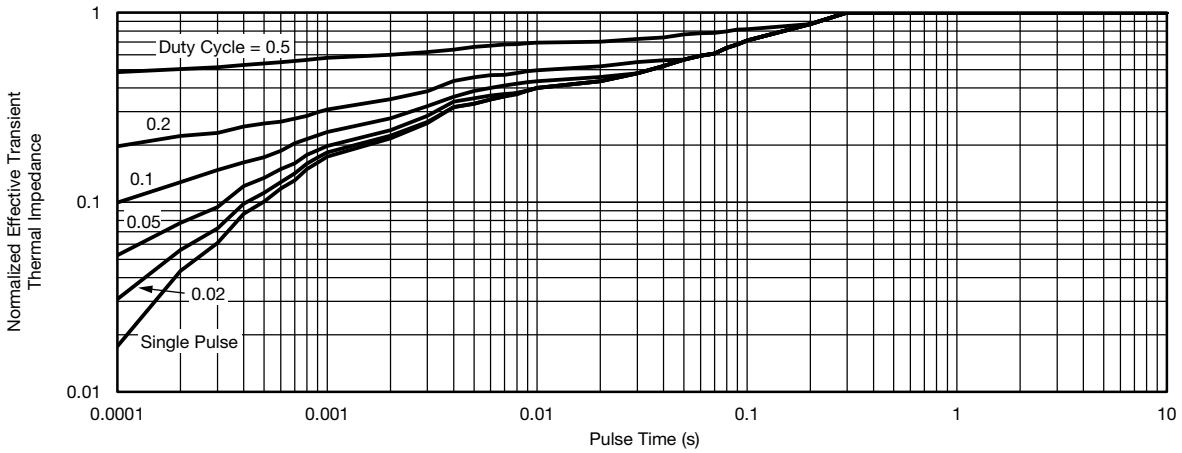


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

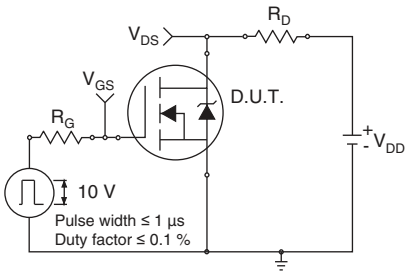


Fig. 13 - Switching Time Test Circuit

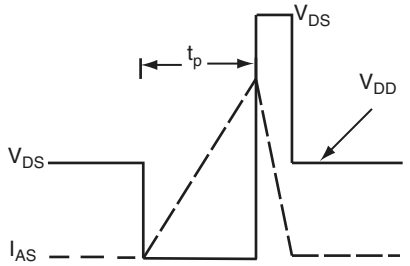


Fig. 16 - Unclamped Inductive Waveforms

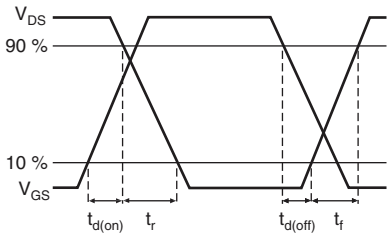


Fig. 14 - Switching Time Waveforms

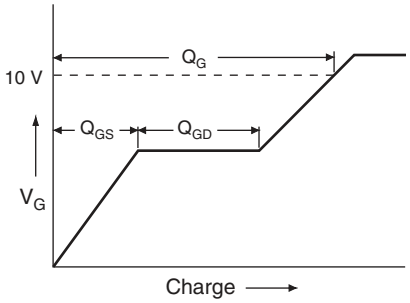


Fig. 17 - Basic Gate Charge Waveform

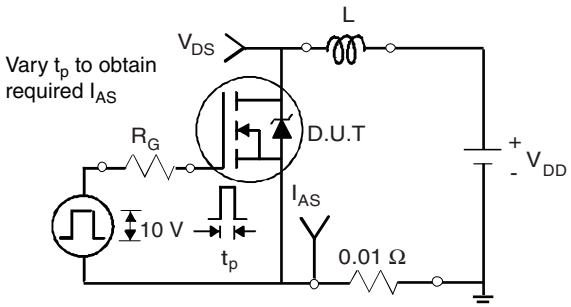


Fig. 15 - Unclamped Inductive Test Circuit

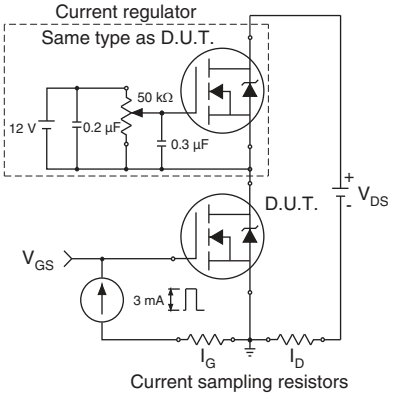
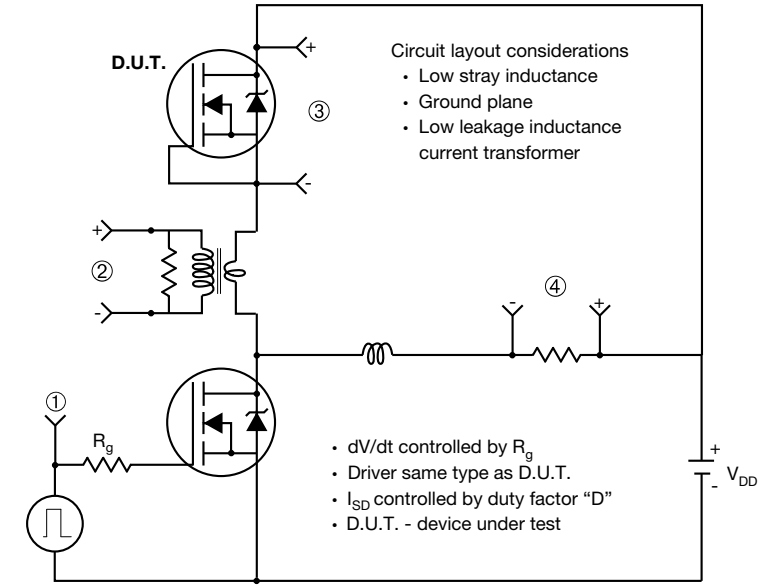
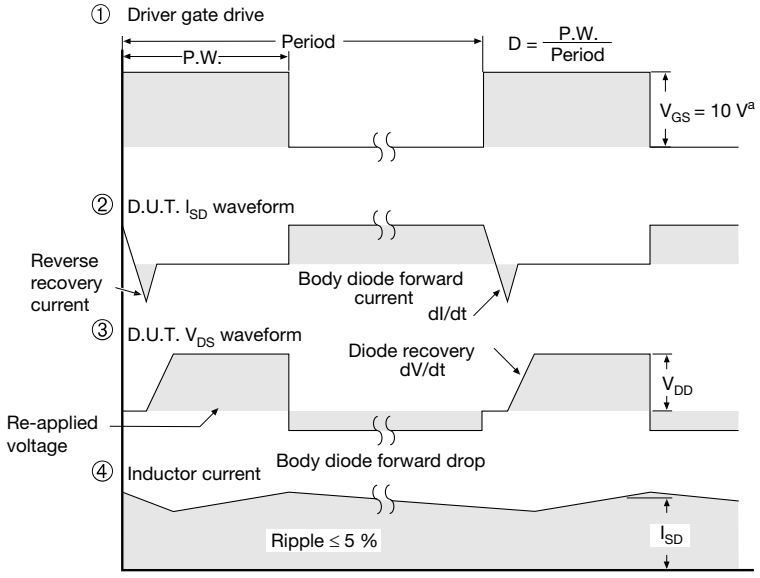


Fig. 18 - Gate Charge Test Circuit

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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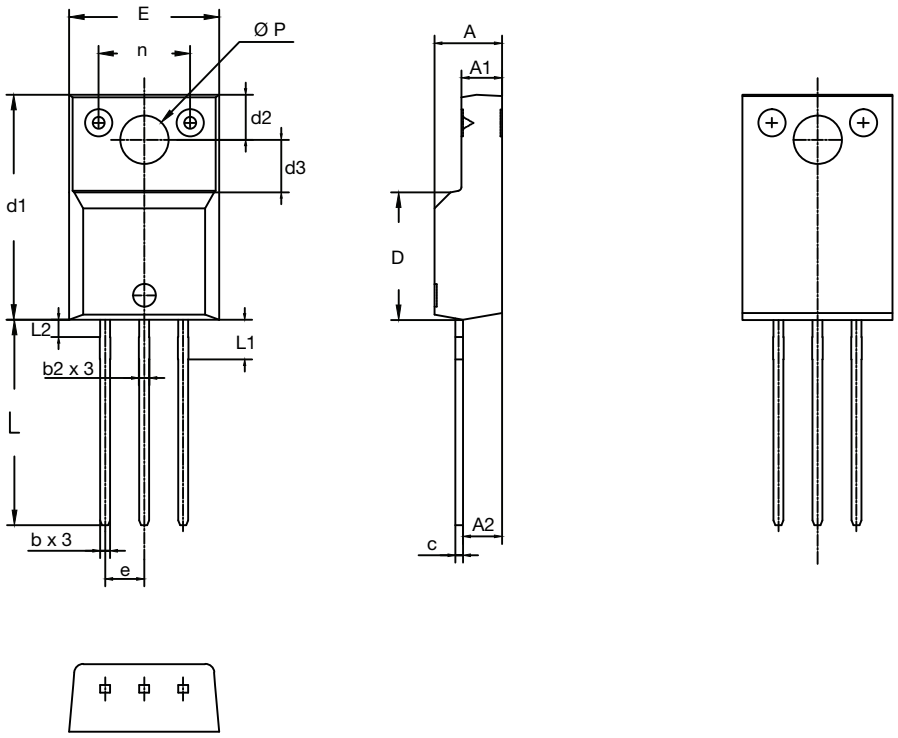
TO-220 FULLPAK Thin Lead



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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