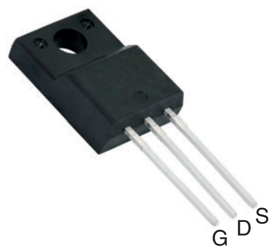
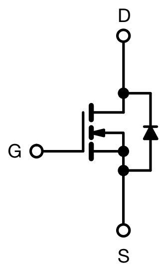
E Series Power MOSFET

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
HALOGEN FREE Available

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	0.156
Q_g max. (nC)	96	
Q_{gs} (nC)	12	
Q_{gd} (nC)	25	
Configuration	Single	

ORDERING INFORMATION	
Package	Thin-Lead TO-220 FULLPAK
Lead (Pb)-free	SiHA22N60AE-E3
Lead (Pb)-free and halogen-free	SiHA22N60AE-GE3

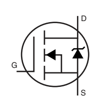
ABSOLUTE MAXIMUM RATINGS (T_C = 25 °C, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-source voltage			V_{DS}	600	V
Gate-source voltage			V_{GS}	± 30	V
Continuous drain current (T_J = 150 °C) [e]	V_{GS} at 10 V	T_C = 25 °C	I_D	8	A
		T_C = 100 °C		5	
Pulsed drain current [a]			I_{DM}	49	A
Linear derating factor				0.26	W/°C
Single pulse avalanche energy [b]			E_{AS}	204	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]				31	
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} = 140 V, starting T_J = 25 °C, L = 28.2 mH, R_g = 25 Ω, I_{AS} = 3.8 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 = 250 μA	-	0.72	-	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 = 11 A	-	0.156	0.180	Ω
Forward transconductance	g_{fs}	V_{DS} = 30 V, I_D = 11 A	-	4.8	-	S
Dynamic						
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz	-	1451	-	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	-	50	-	
Effective output capacitance, time related [b]	$C_{o(tr)}$		-	258	-	
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}		-	12	-	
Gate-drain charge	Q_{gd}		-	25	-	
Turn-on delay time	$t_{d(on)}$	V_{DD} = 480 V, I_D = 11 A, V_{GS} = 10 V, R_g = 9.1 Ω	-	19	38	ns
Rise time	t_r		-	33	66	
Turn-off delay time	$t_{d(off)}$		-	45	90	
Fall time	t_f		-	21	42	
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 	-	-	20	A
Pulsed diode forward current	I_{SM}		-	-	49	
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 = 25 V	-	319	638	ns
Reverse recovery charge	Q_{rr}		-	4.9	9.8	μC
Reverse recovery current	I_{RRM}		-	28	-	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)

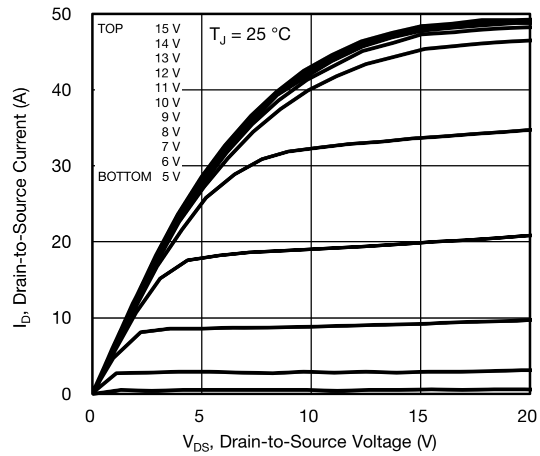


Fig. 1 - Typical Output Characteristics

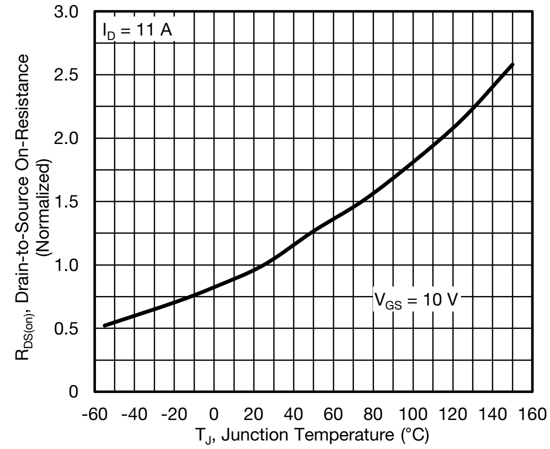


Fig. 4 - Normalized On-Resistance vs. Temperature

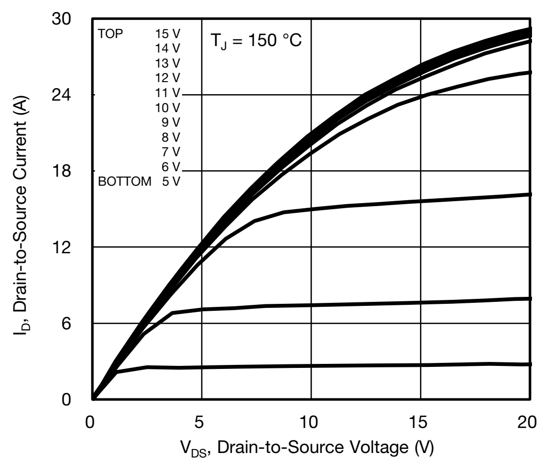


Fig. 2 - Typical Output Characteristics

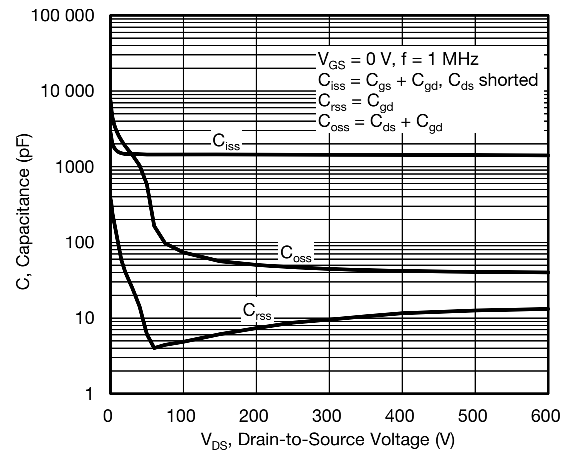


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

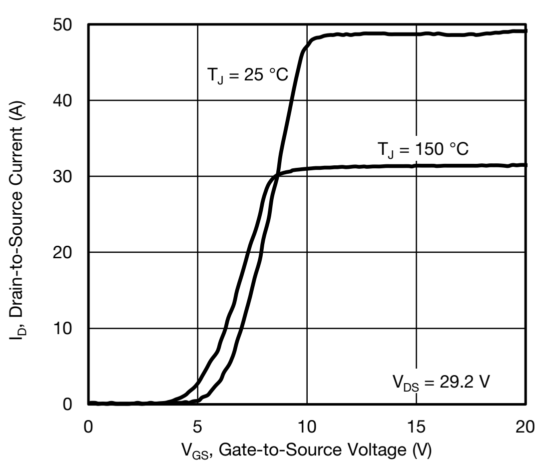


Fig. 3 - Typical Transfer Characteristics

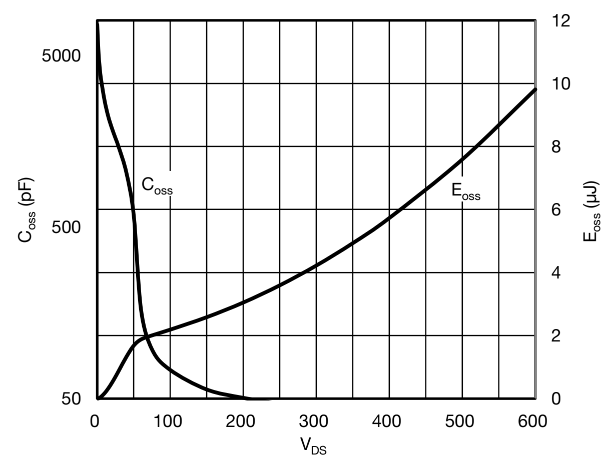


Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

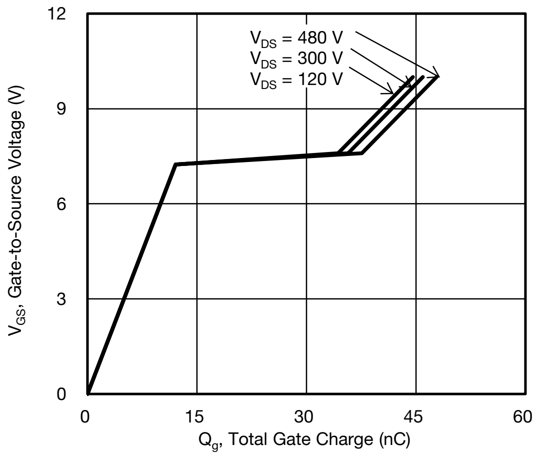


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

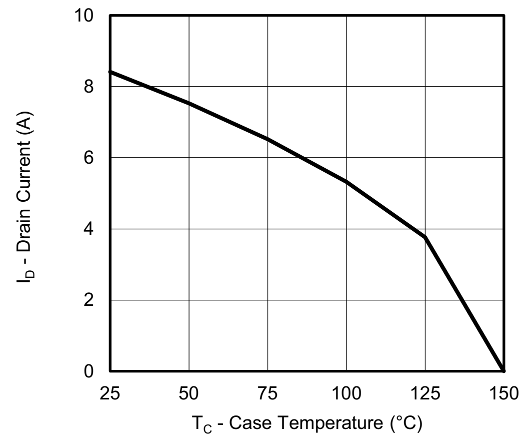


Fig. 10 - Maximum Drain Current vs. Case Temperature

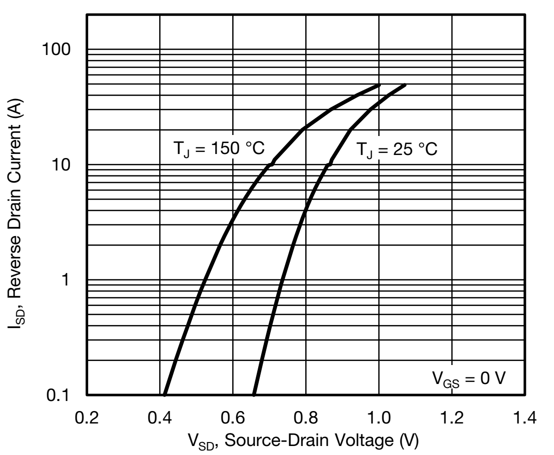


Fig. 8 - Typical Source-Drain Diode Forward Voltage

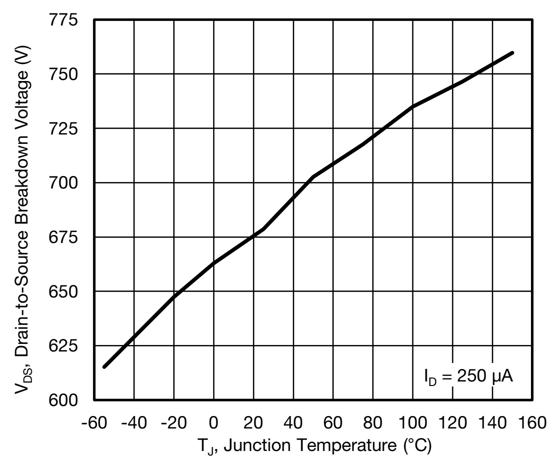
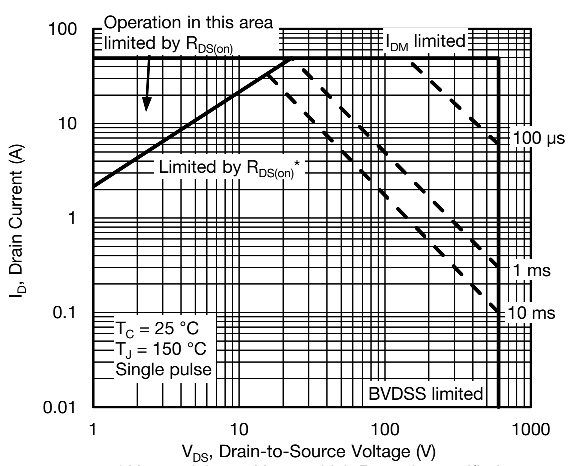


Fig. 11 - Temperature vs. Drain-to-Source Voltage



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

Fig. 9 - Maximum Safe Operating Area

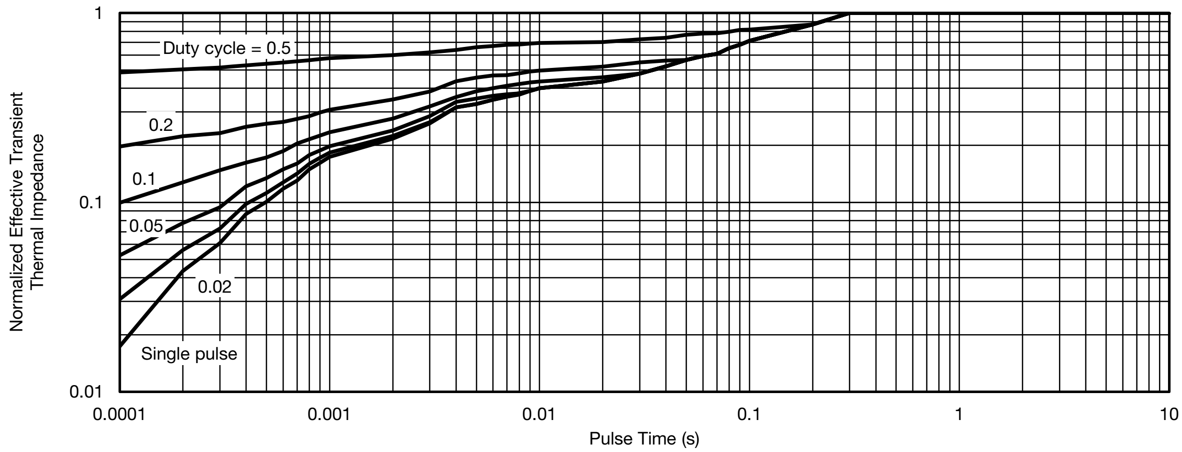


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

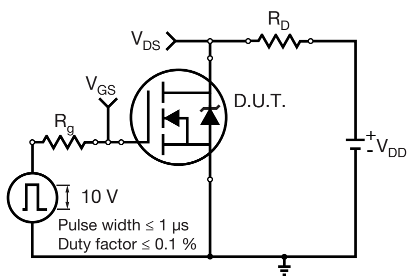


Fig. 13 - Switching Time Test Circuit

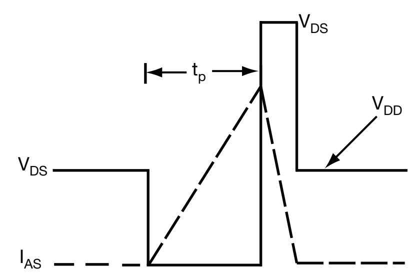


Fig. 16 - Unclamped Inductive Waveforms

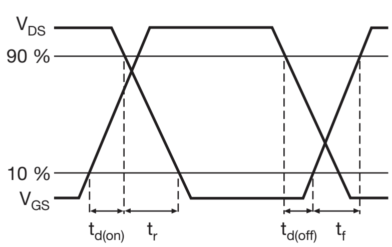


Fig. 14 - Switching Time Waveforms

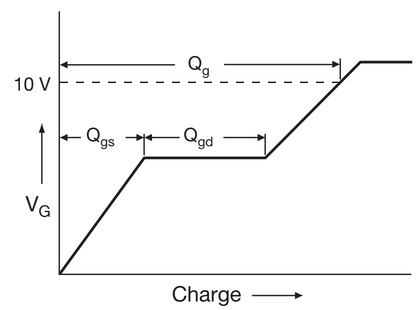


Fig. 17 - Basic Gate Charge Waveform

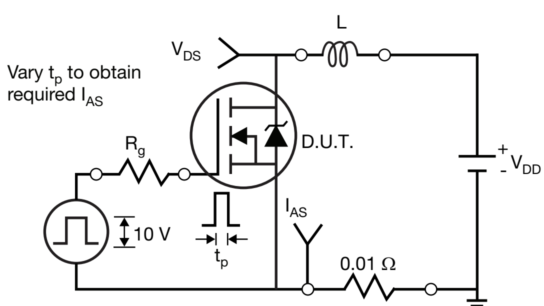


Fig. 15 - Unclamped Inductive Test Circuit

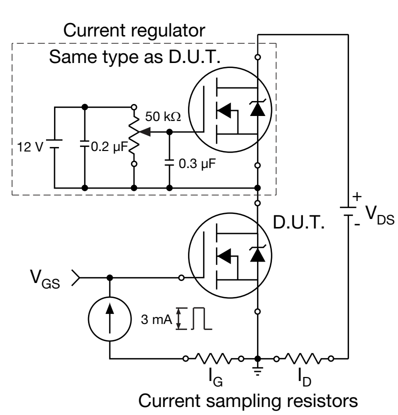
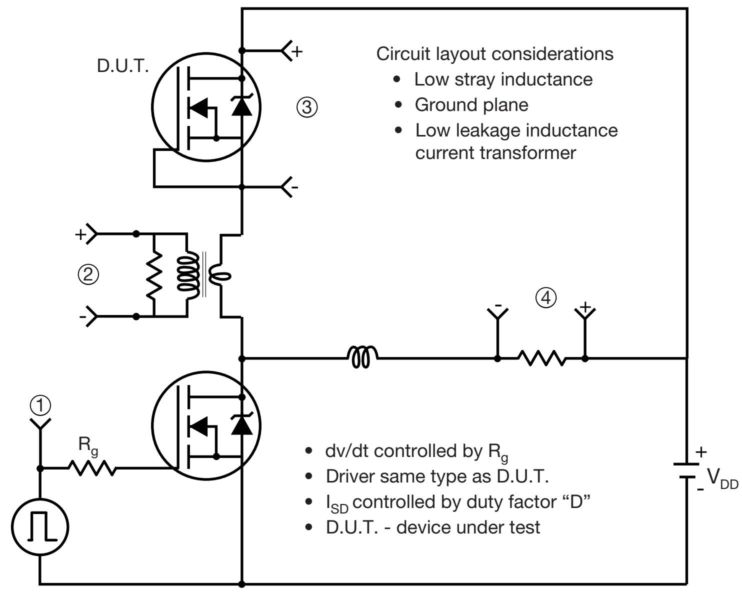
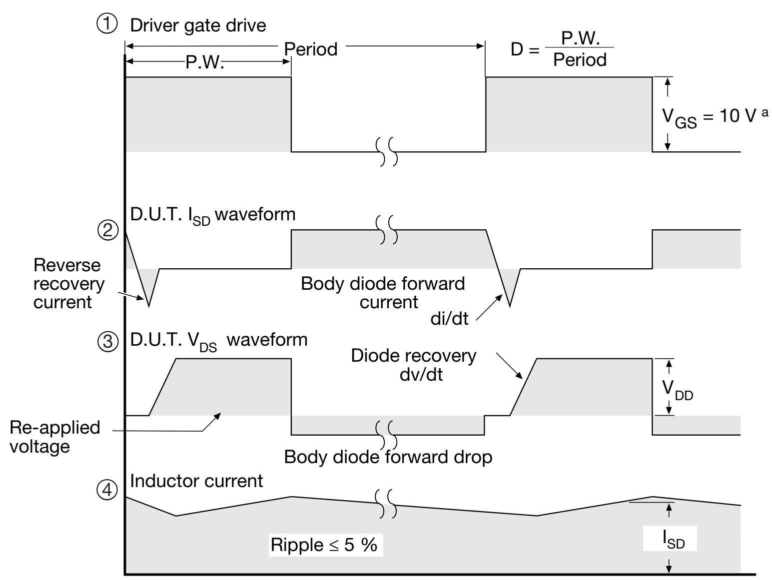


Fig. 18 - Gate Charge Test Circuit

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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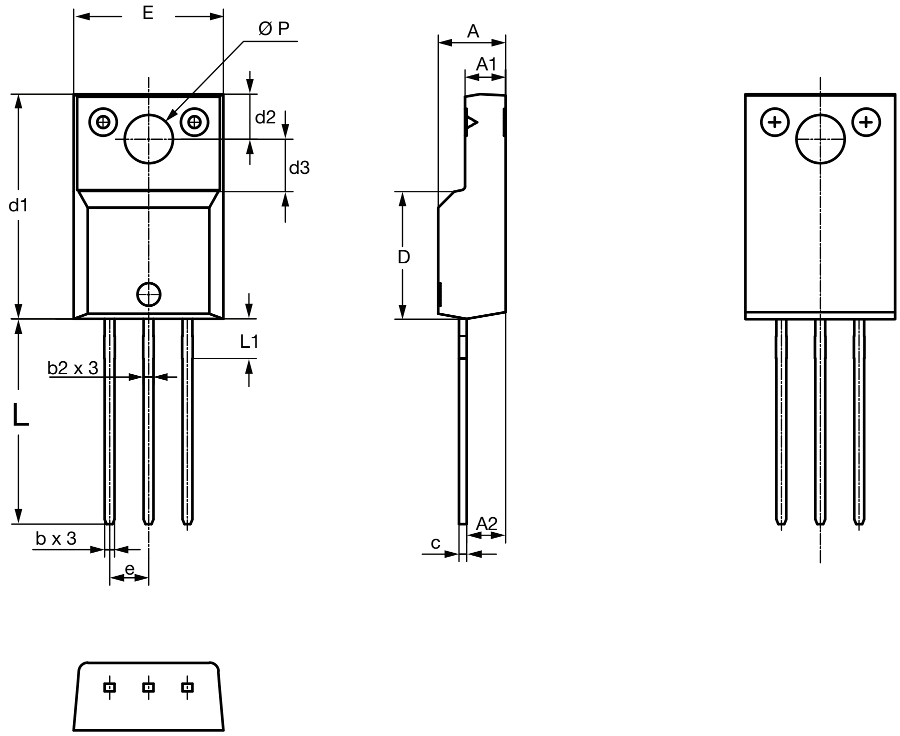
TO-220 FULLPAK Thin Lead



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	2.40	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

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DWG: 6021

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