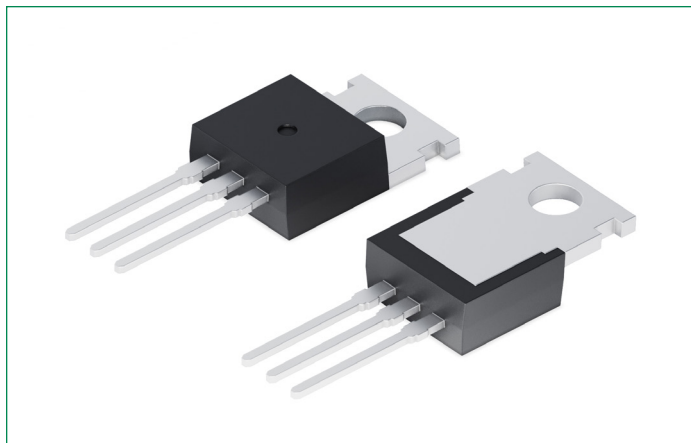


IOTP86N20X4

200 V, 13 mΩ X4-Class Power MOSFET™



Features:

- International Standard Package
- Low $R_{DS(on)}$ and Q_G
- Avalanche Rated
- Low Package Inductance

Advantages:

- High Power Density
- Easy to Mount
- Space Savings

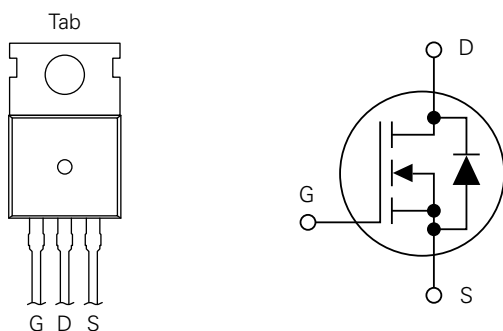
Applications:

- Switch-Mode and Resonant-Mode Power Supplies
- DC-DC Converters
- PFC Circuits
- AC and DC Motor Drives
- Robotics and Servo Controls

Product Summary

Characteristic	Value	Unit
V_{DSS}	200	V
I_{D25}	86	A
$R_{DS(on)}$	13	mΩ

Pinout Diagram (TO-220-3L)



G: Gate; **D:** Drain; **S:** Source; **Tab:** Drain

Maximum Ratings

Symbol	Characteristics	Conditions	Value	Units
V_{DSS}	Drain-Source Voltage	$T_J = 25^{\circ}\text{C}$ to 175°C	200	V
V_{DGR}	Drain-Gate Voltage	$T_J = 25^{\circ}\text{C}$ to 175°C , $R_{GS} = 1\text{ M}\Omega$	200	V
V_{GS}	Gate-Source Voltage	Continuous	± 20	V
V_{GSM}		Transient	± 30	
I_{D25}	Drain Current	$T_C = 25^{\circ}\text{C}$	86	A
I_{DM}		$T_C = 25^{\circ}\text{C}$, Pulse width limited by T_{JM}	160	
I_A	Avalanche Current	$T_C = 25^{\circ}\text{C}$	43	A
E_{AS}	Avalanche Energy	$T_C = 25^{\circ}\text{C}$	500	mJ
dV/dt	Reverse Diode dV/dt	$I_S \leq I_{DM}$, $V_{DD} \leq V_{DSS}$, $T_J \leq 150^{\circ}\text{C}$	50	V/ns
P_D	Power Dissipation	$T_C = 25^{\circ}\text{C}$	300	W
T_J	Operating Junction Temperature	–	-55 to +175	$^{\circ}\text{C}$
T_{JM}	Maximum Junction Temperature	–	175	
T_{stg}	Storage Temperature	–	-55 to +175	
T_L	Lead Temperature for Soldering	1.6 mm (0.062 in.) from case for 10 s	300	$^{\circ}\text{C}$
M_D	Mounting Torque	–	1.13 / 10	Nm/lb.in
W	Weight	–	3	g

Thermal Characteristics

Symbol	Characteristic	Value			Unit
		Min.	Typ.	Max.	
$R_{th, JC}$	Thermal Resistance, junction-to-case	–	–	0.50	$^{\circ}\text{C}/\text{W}$
$R_{th, CS}$	Thermal Resistance, case-to-sink	–	0.50	–	$^{\circ}\text{C}/\text{W}$

Electrical Characteristics – Static ($T_J = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
BV_{DSS}	Drain-Source Breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0\text{ V}$	200	–	–	V
$V_{GS(th)}$	Gate Threshold Voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{DS} = V_{GS}$	2.5	–	4.5	V
I_{GSS}	Gate-Source Leakage Current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$	–	–	± 100	nA
I_{DSS}	Drain-Source Current	$V_{DS} = V_{DSS}$, $V_{GS} = 0\text{ V}$	–	–	5	μA
		$V_{DS} = V_{DSS}$, $V_{GS} = 0\text{ V}$, $T_J = 150^{\circ}\text{C}$	–	–	300	μA
$R_{DS(on)}$	Drain-Source On-Resistance ¹	$V_{GS} = 10\text{ V}$, $I_D = 0.5 \times I_{D25}$	–	11	13	m Ω

Note 1: Pulse test, $t \leq 300\text{ }\mu\text{s}$, duty cycle, $d \leq 2\%$

Electrical Characteristics – Dynamic ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
g_{fs}	Transconductance ¹	$V_{DS} = 10\text{ V}, I_D = 0.5 \times I_{D25}$	50	82	–	S
R_{Gi}	Gate Input Resistance	–	–	4.75	–	Ω
C_{iss}	Input Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$	–	2250	–	pF
C_{oss}	Output Capacitance		–	660	–	pF
C_{rss}	Reverse Transfer Capacitance		–	185	–	pF
$Q_{g(on)}$	Total Gate Charge	$V_{GS} = 10\text{ V}, V_{DS} = 0.5 \times V_{DSS},$ $I_D = 0.5 \times I_{D25}$	–	70	–	nC
Q_{gs}	Gate-Source Charge		–	20	–	
Q_{gd}	Gate-Drain Charge		–	38	–	
$t_{d(on)}$	Turn-on Delay Time	Resistive Switching $V_{GS} = 10\text{ V}, V_{DS} = 0.5 \times V_{DSS},$ $I_D = 0.5 \times I_{D25}, R_{G(ext)} = 10\ \Omega$	–	27	–	ns
t_r	Rise Time		–	38	–	
$t_{d(off)}$	Turn-off Delay Time		–	76	–	
t_f	Fall Time		–	35	–	

Source-Drain Diode Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
I_S	Continuous Diode Forward Current	$V_{GS} = 0\text{ V}$	–	–	86	A
I_{SM}	Diode Pulse Current	Repetitive, Pulse width limited by T_{JM}	–	–	344	A
V_{SD}	Diode Forward Voltage ¹	$I_F = I_S, V_{GS} = 0\text{ V}$	–	–	1.4	V
t_{rr}	Reverse Recovery Time	$I_F = 43\text{ A}, -di/dt = 200\text{ A}/\mu\text{s},$ $V_r = 100\text{ V}$	–	96	–	ns
I_{rm}	Reverse Recovery Charge		–	16.7	–	A
Q_{rm}	Reverse Recovery Current		–	0.8	–	μC

Note 1: Pulse test, $t \leq 300\ \mu\text{s}$, duty cycle, $d \leq 2\%$

Characteristic Curves

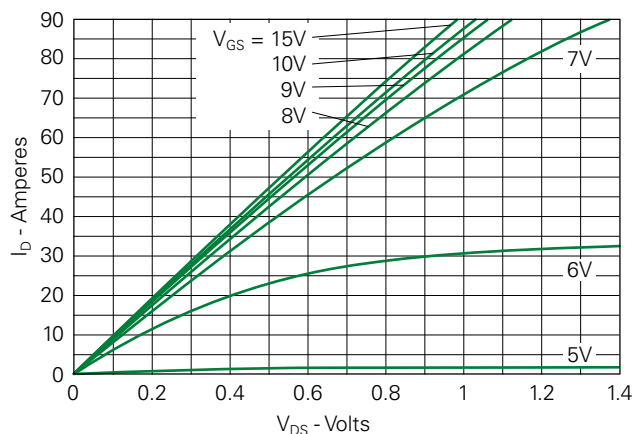
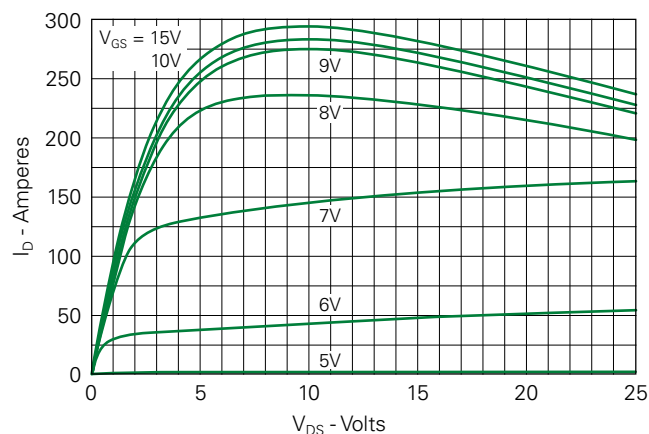
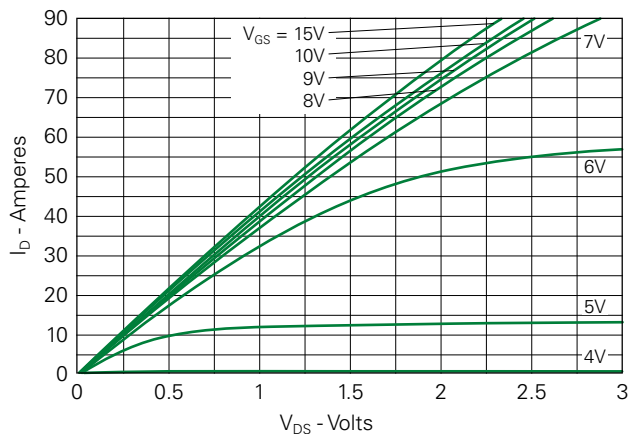
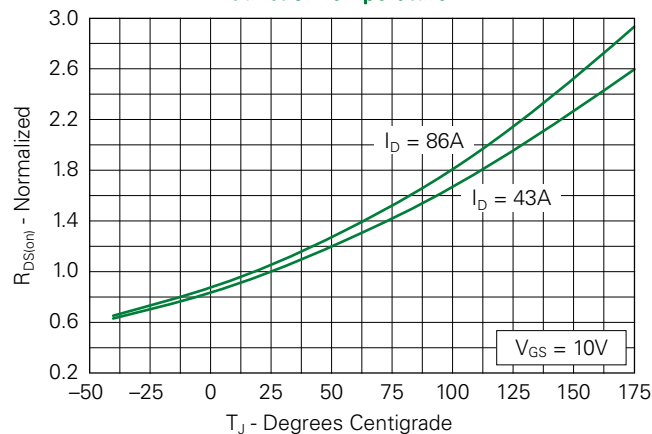
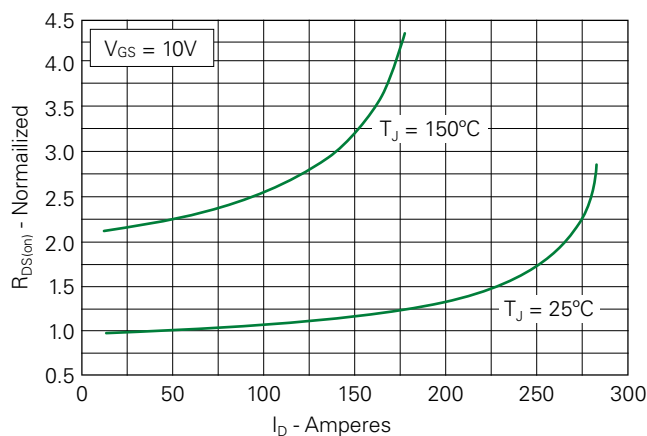
Fig. 1. Output Characteristics @ $T_J = 25^\circ\text{C}$ Fig. 2. Extended Output Characteristics @ $T_J = 25^\circ\text{C}$ Fig. 3. Output Characteristics @ $T_J = 150^\circ\text{C}$ Fig. 4. $R_{DS(on)}$ Normalized to $I_D = 43\text{A}$ Value vs. Junction TemperatureFig. 5. $R_{DS(on)}$ Normalized to $I_D = 43\text{A}$ Value vs. Drain Current

Fig. 6. Normalized Breakdown & Threshold Voltages vs. Junction Temperature

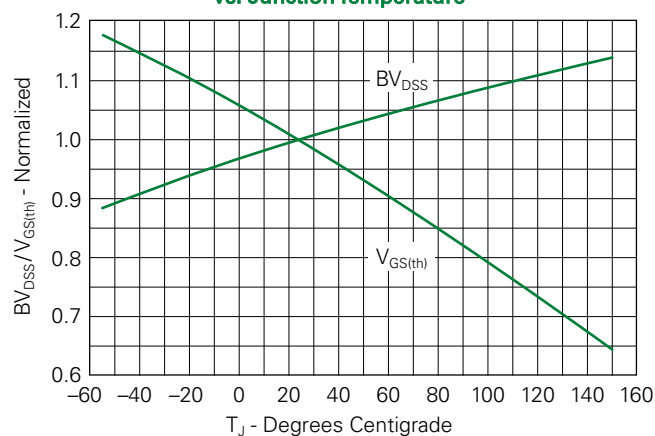


Fig. 7. Maxium Drain Current vs. CaseTemperature

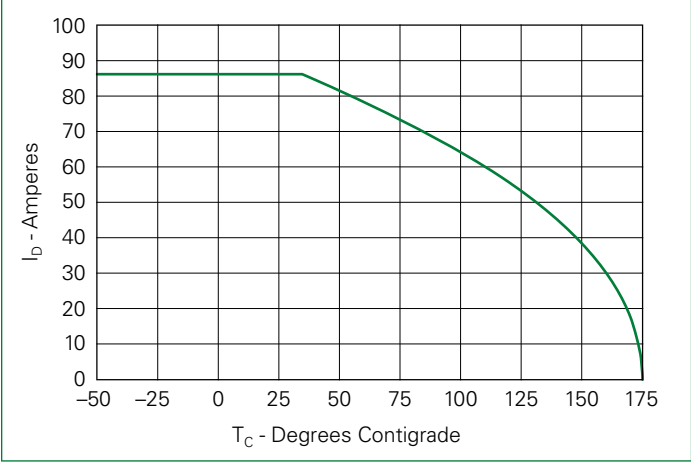


Fig. 8. Input Admittance

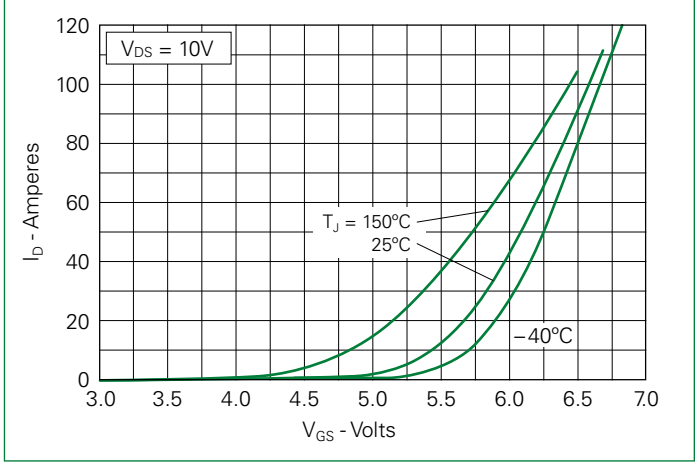


Fig. 9. Transconductance

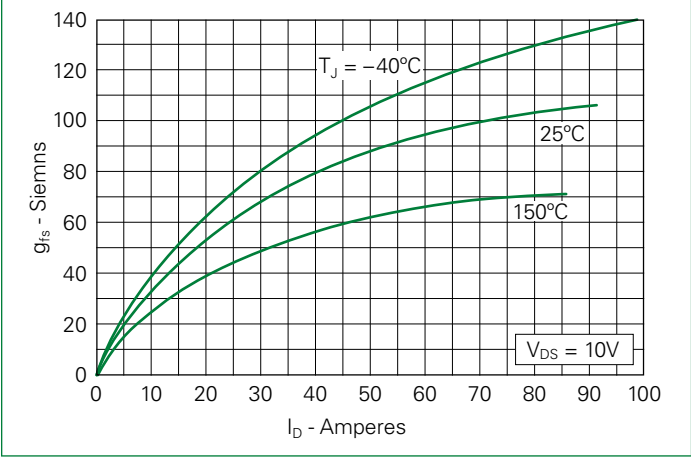


Fig. 10. Forward Voltage Drop of Intrinsic Diode

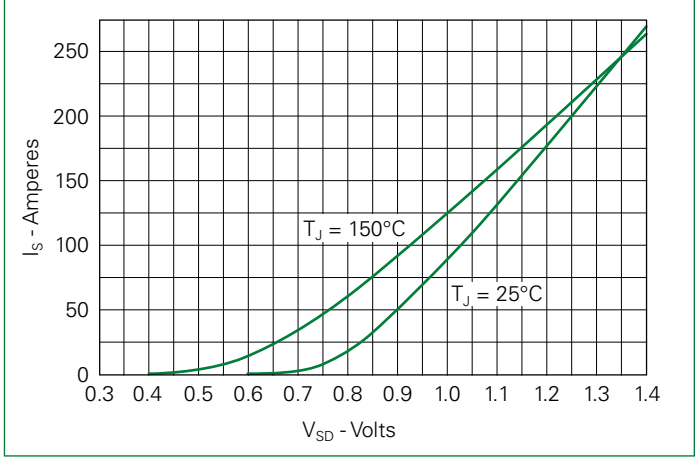


Fig. 11. Gate Charge

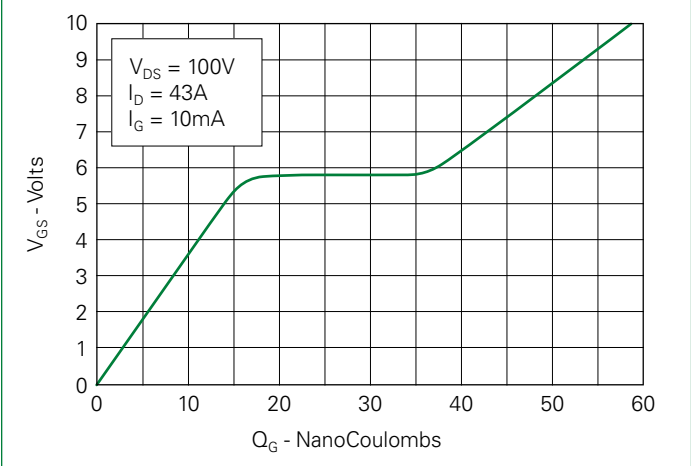


Fig. 12. Capacitance

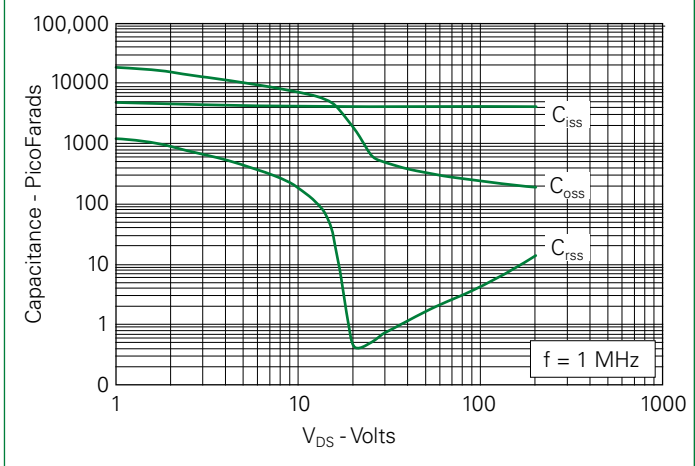


Fig. 13. Output Capacitance Stored Energy

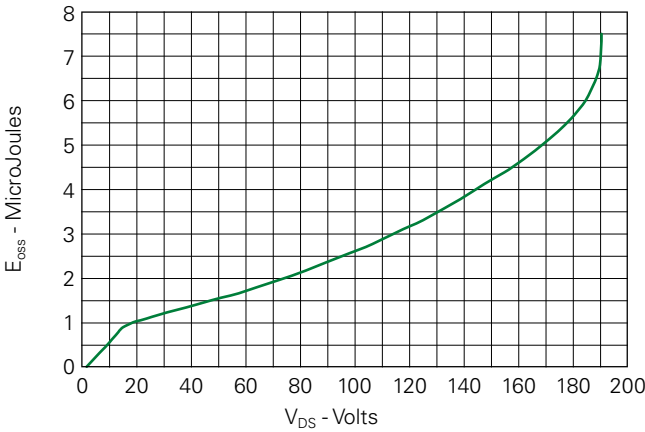


Fig. 14. Forward-Bias Safe Operating Area

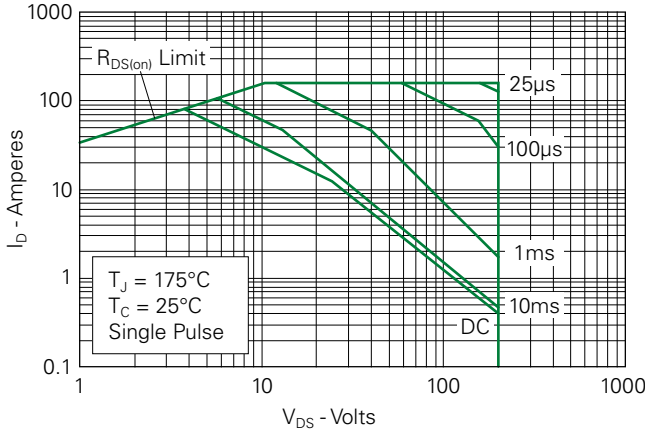
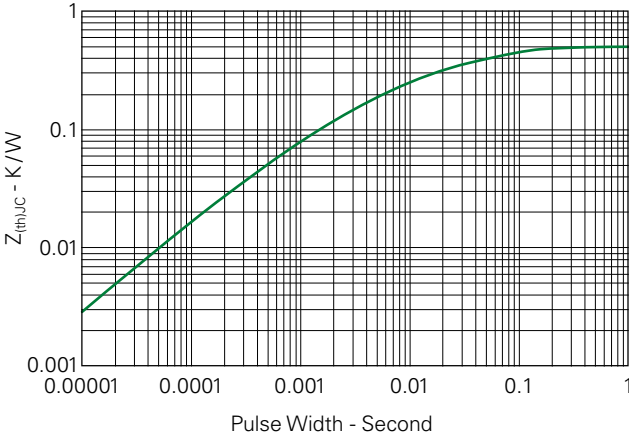
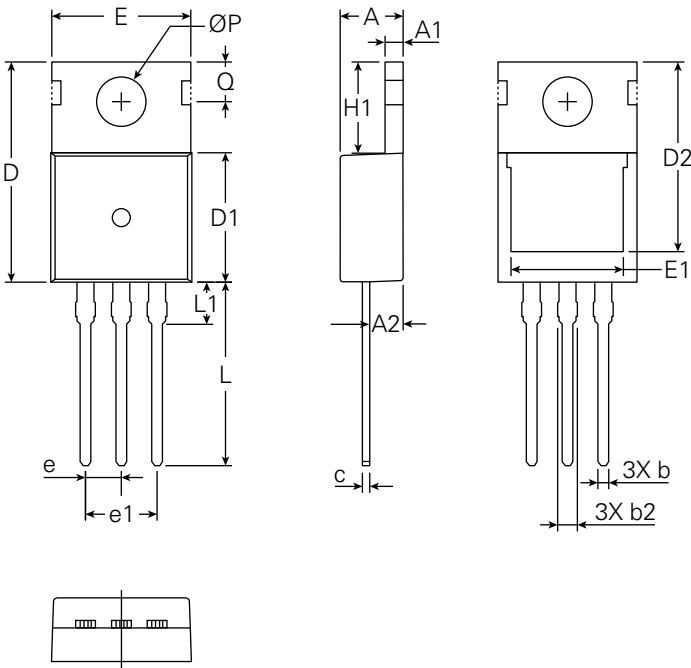


Fig. 15. Maximum Transient Thermal Impedance



Part Outline Drawing (TO-220-3L)



Symbol	Inches			Millimeters		
	Min.	Typical	Max.	Min.	Typical	Max
A	0.169	–	0.185	4.30	–	4.70
A1	0.047	–	0.055	1.20	–	1.40
A2	0.079	–	0.106	2.00	–	2.70
b	0.024	–	0.039	0.60	–	1.00
b2	0.045	–	0.057	1.15	–	1.45
c	0.014	–	0.026	0.35	–	0.65
D	0.587	–	0.626	14.90	–	15.90
D1	0.335	–	0.370	8.50	–	9.40
(D2)	0.500	–	0.531	12.70	–	13.50
E	0.382	–	0.406	9.70	–	10.30
(E1)	0.283	–	0.323	7.20	–	8.20
e	0.100 BSC			2.45 BSC		
e1	0.200 BSC			5.08 BSC		
H1	0.244	–	0.268	6.20	–	6.80
L	0.492	–	0.547	12.50	–	13.90
L1	0.110	–	0.154	2.80	–	3.90
ØP	0.134	–	0.150	3.40	–	3.80
Q	0.106	–	0.126	2.70	–	3.20

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