

## P-Channel Enhancement Mode Power MOSFET

### Description

The HM70P04 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This device is well suited for high current load applications.

### General Features

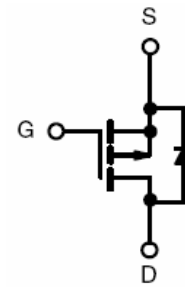
- $V_{DS} = -40V, I_D = -70A$   
 $R_{DS(ON)} < 10m\Omega @ V_{GS} = -10V$
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

### Application

- Power switch
- Load switch in high current applications
- DC/DC converters

**100% UIS TESTED!**

**100%  $\Delta V_{ds}$  TESTED!**



Schematic diagram



Marking and pin assignment



TO-220-3L top view

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
HM70P04	HM70P04	TO-220-3L	-	-	-

### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	-40	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	-70	A
Drain Current-Continuous( $T_C = 100^\circ C$ )	$I_D(100^\circ C)$	-35	A
Pulsed Drain Current	$I_{DM}$	-210	A
Maximum Power Dissipation	$P_D$	65	W
Derating factor		0.52	W/ $^\circ C$
Single pulse avalanche energy <sup>(Note 5)</sup>	$E_{AS}$	1020	mJ
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	$^\circ C$

### Thermal Characteristic

Thermal Resistance, Junction-to-Case(Note 2)	$R_{\theta JC}$	1.92	$^{\circ}\text{C/W}$
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### Electrical Characteristics ( $T_C=25^{\circ}\text{C}$ unless otherwise noted)

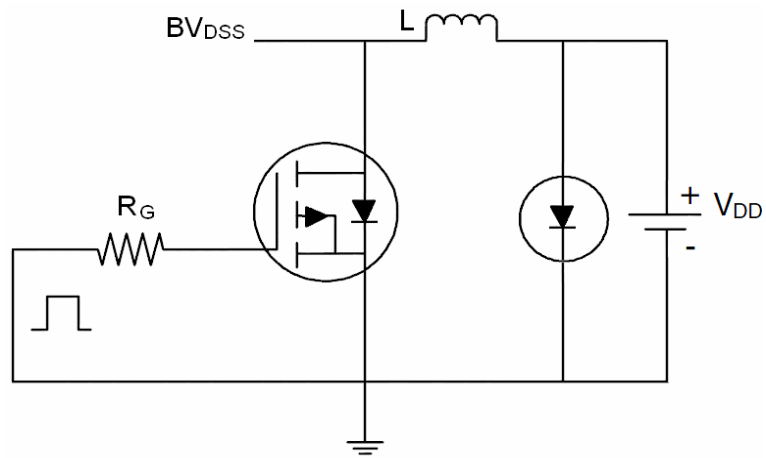
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=-250\mu A$	-40	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=-40V, V_{GS}=0V$	-	-	-1	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 100$	nA
<b>On Characteristics (Note 3)</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu A$	-1.2	-1.9	-2.5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=-10V, I_D=-20A$	-	7.5	10	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=-10V, I_D=-20A$	-	50	-	S
<b>Dynamic Characteristics (Note4)</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=-20V, V_{GS}=0V,$ $F=1.0\text{MHz}$	-	6460	-	PF
Output Capacitance	$C_{oss}$		-	684	-	PF
Reverse Transfer Capacitance	$C_{rss}$		-	600	-	PF
<b>Switching Characteristics (Note 4)</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-20V, R_L=2\Omega,$ $V_{GS}=-10V, R_G=1\Omega$	-	15	-	nS
Turn-on Rise Time	$t_r$		-	12	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	70	-	nS
Turn-Off Fall Time	$t_f$		-	18	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=-20, I_D=-20A,$ $V_{GS}=-10V$	-	106	-	nC
Gate-Source Charge	$Q_{gs}$		-	22	-	nC
Gate-Drain Charge	$Q_{gd}$		-	27	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	$V_{SD}$	$V_{GS}=0V, I_S=-10A$	-	-	-1.2	V
Diode Forward Current (Note 2)	$I_S$		-	-	-70	A
Reverse Recovery Time	$t_{rr}$	$T_J = 25^{\circ}\text{C}, I_F = -10A$ $di/dt = -100A/\mu s(\text{Note}3)$	-	53	-	nS
Reverse Recovery Charge	$Q_{rr}$		-	50	-	nC
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

### Notes:

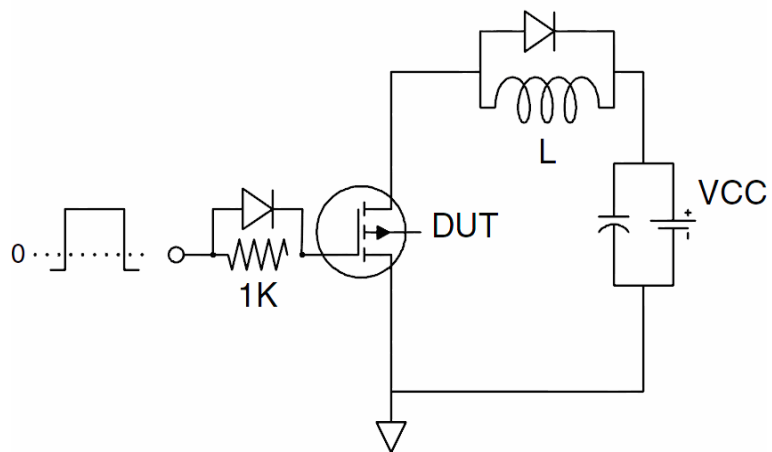
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5.  $E_{AS}$  condition:  $T_J=25^{\circ}\text{C}, V_{DD}=-20V, V_G=-10V, L=1\text{mH}, R_G=25\Omega, I_{AS}=45A$

Test Circuit

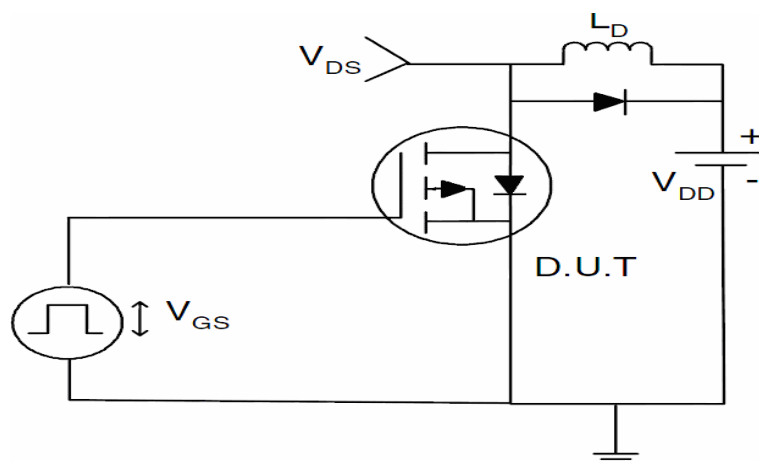
1)  $E_{AS}$  Test Circuit



2) Gate Charge Test Circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics (Curves)

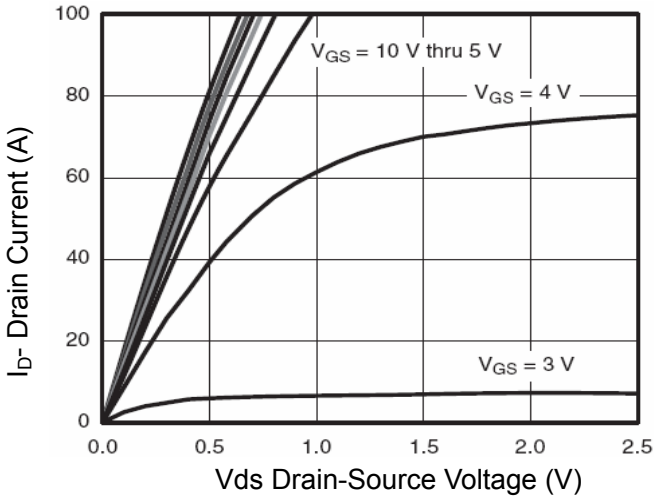


Figure 1 Output Characteristics

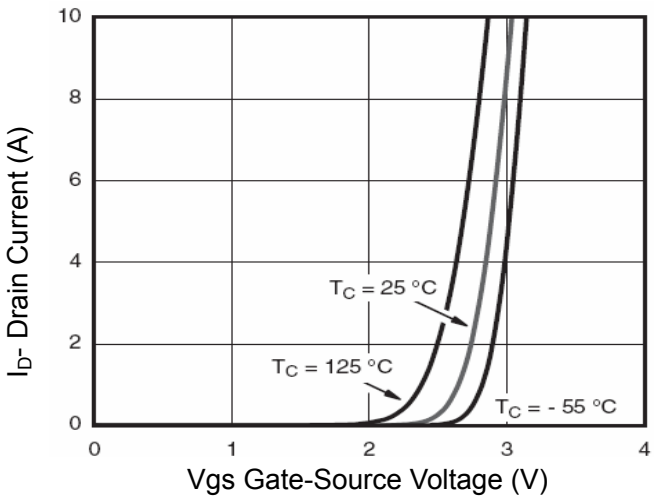


Figure 2 Transfer Characteristics

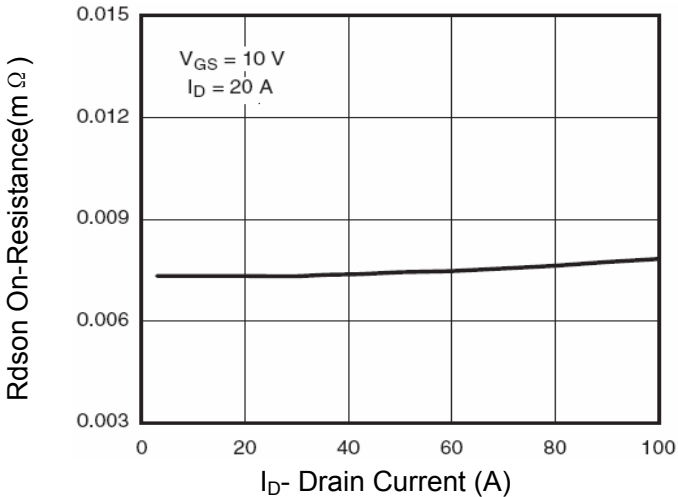


Figure 3 Rdson- Drain Current

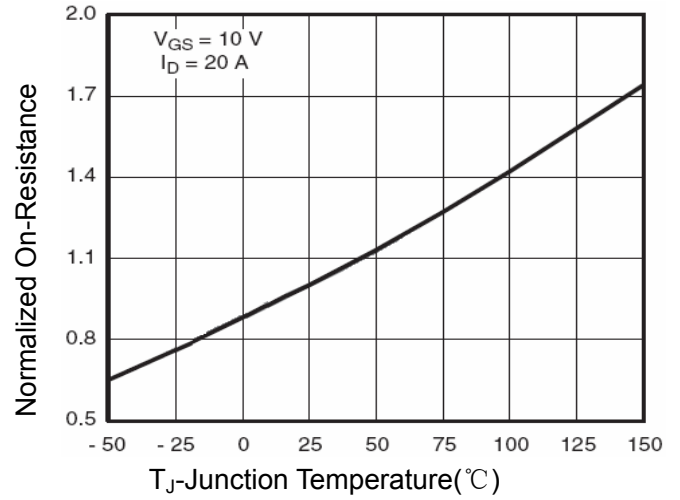


Figure 4 Rdson-Junction Temperature

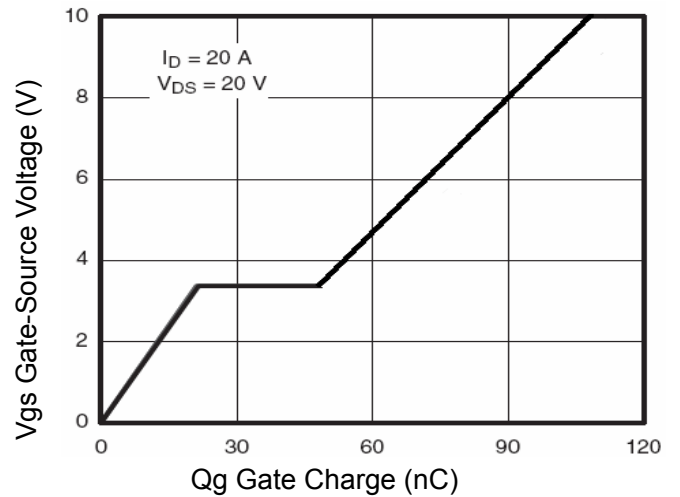


Figure 5 Gate Charge

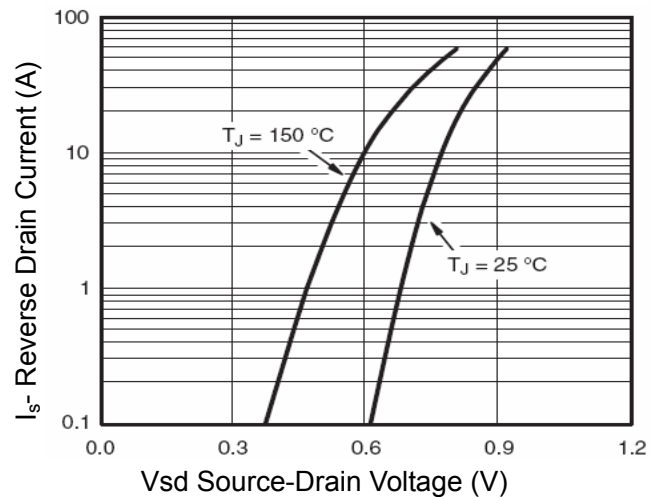


Figure 6 Source- Drain Diode Forward

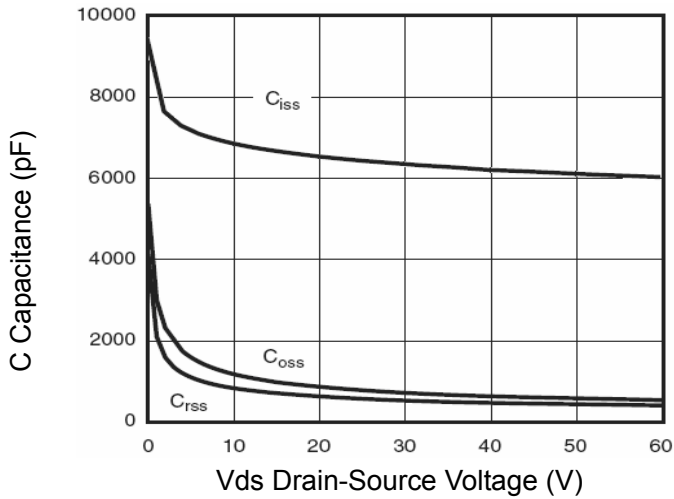


Figure 7 Capacitance vs Vds

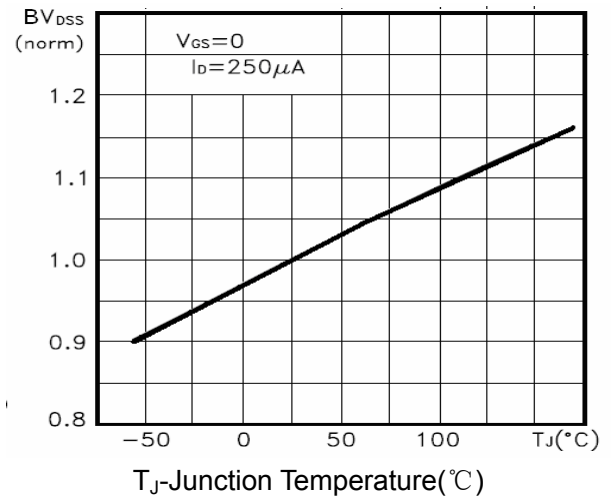


Figure 9  $BV_{DSS}$  vs Junction Temperature

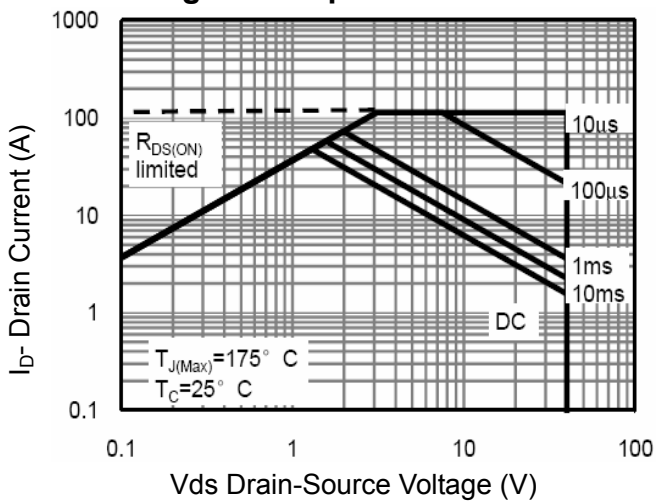


Figure 8 Safe Operation Area

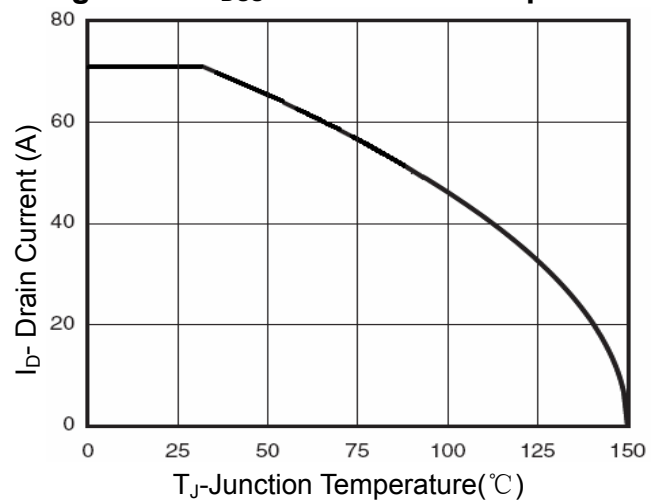


Figure 10  $I_D$  Current Derating vs Junction Temperature

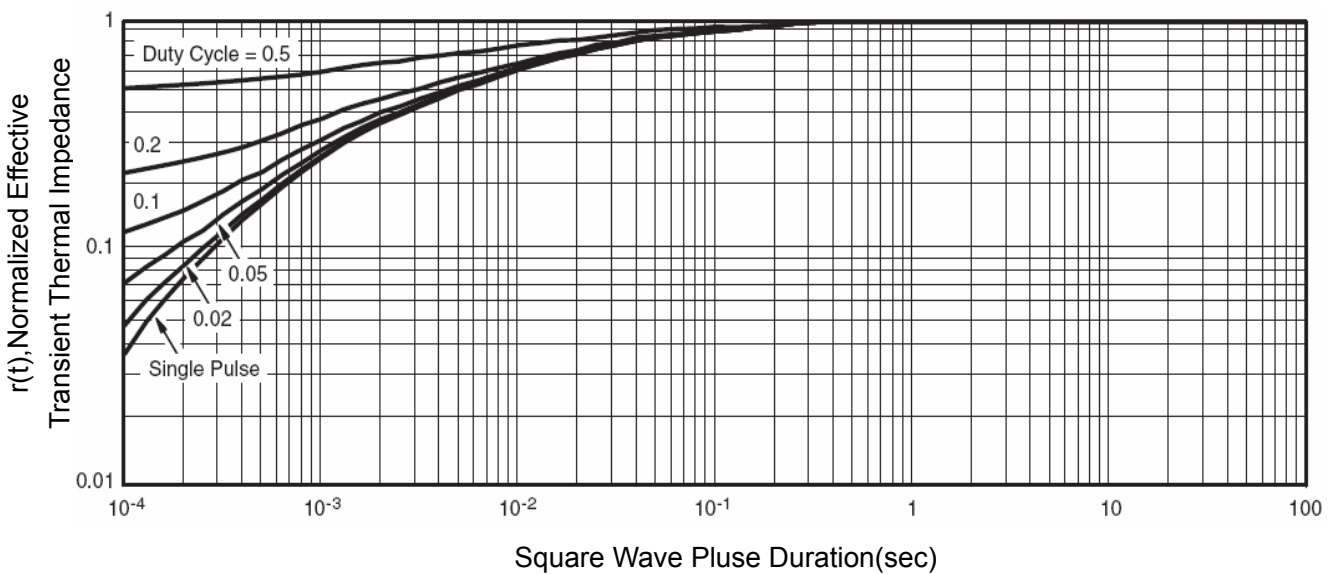
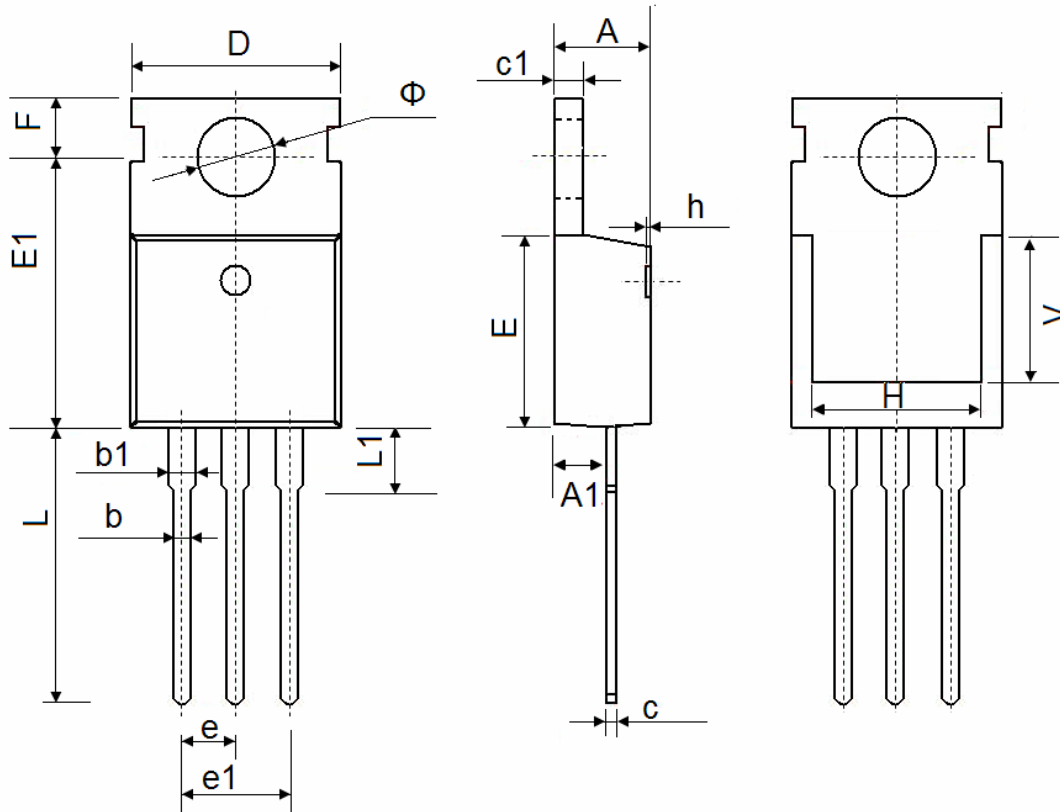


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-220-3L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	7.500 REF.		0.295 REF.	
$\Phi$	3.400	3.800	0.134	0.150

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