

## N-Channel Trench Power MOSFET

### General Description

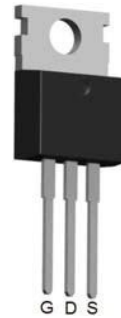
The HP50N10S is N-channel MOS Field Effect Transistor designed for high current switching applications. Rugged  $E_{AS}$  capability and ultra low  $R_{DS(ON)}$  is suitable for PWM, load switching applications.

### Features

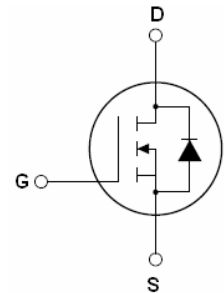
- $V_{DS}=100V$ ;  $I_D=50A @ V_{GS}=10V$ ;  
 $R_{DS(ON)} < 13m\Omega @ V_{GS}=10V$   
 $R_{DS(ON)} < 16m\Omega @ V_{GS}=4.5V$
- Ultra Low On-Resistance
- High UIS and UIS 100% Test

### Application

- Hard Switched and High Frequency Circuits
- Uninterruptible Power Supply



To-220 Top View



Schematic Diagram

$$V_{DS} = 100V$$

$$I_D = 50A$$

$$R_{DS(ON)} = 10m\Omega$$

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
HP50N10S	HP50N10S	TO-220	-	-	-

Table 1. Absolute Maximum Ratings (TA=25°C)

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-Source Voltage ( $V_{GS}=0V$ )	100	V
$V_{GS}$	Gate-Source Voltage ( $V_{DS}=0V$ )	±20	V
$I_{D(DC)}$	Drain Current (DC) at $T_c=25^\circ C$	50	A
$I_{D(DC)}$	Drain Current (DC) at $T_c=100^\circ C$	35	A
$I_{DM (pluse)}$	Drain Current-Continuous@ Current-Pulsed (Note 1)	200	A
dv/dt	Peak Diode Recovery Voltage	4.1	V/ns
$P_D$	Maximum Power Dissipation( $T_c=25^\circ C$ )	125	W
	Derating Factor	1.03	W/°C
$E_{AS}$	Single Pulse Avalanche Energy (Note 2)	529	mJ
$T_J, T_{STG}$	Operating Junction and Storage Temperature Range	-55 To 175	°C

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2. $E_{AS}$  condition:  $T_J=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

**Table 2. Thermal Characteristic**

Symbol	Parameter	Value	Max	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	---	0.97	$^{\circ}C/W$

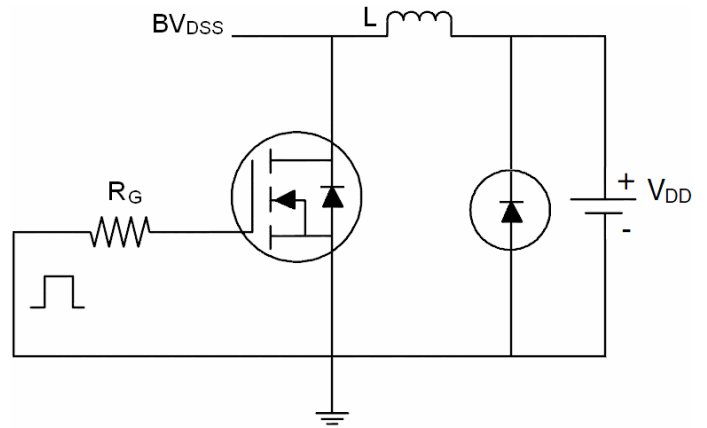
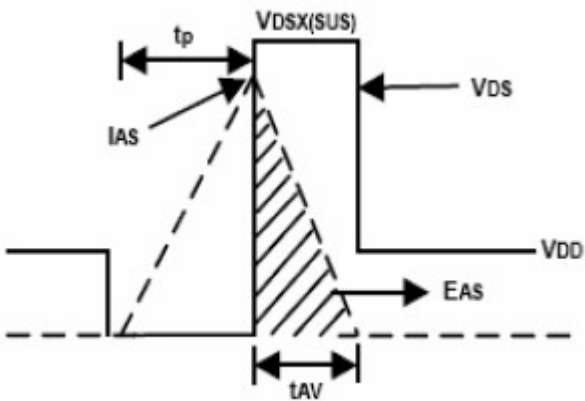
**Table 3. Electrical Characteristics (TA=25 $^{\circ}C$  unless otherwise noted)**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>On/Off States</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	100			V
$I_{DSS}$	Zero Gate Voltage Drain Current(Tc=25 $^{\circ}C$ )	$V_{DS}=100V, V_{GS}=0V$			1	$\mu A$
$I_{DSS}$	Zero Gate Voltage Drain Current(Tc=125 $^{\circ}C$ )	$V_{DS}=100V, V_{GS}=0V$			10	$\mu A$
$I_{GSS}$	Gate-Body Leakage Current	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 100$	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	1	1.6	2.5	V
$R_{DS(ON)}$	Drain-Source On-State Resistance	$V_{GS}=10V, I_D=40A$		10	13	m $\Omega$
		$V_{GS}=4.5,  I_D =40A$		13	16	m $\Omega$
<b>Dynamic Characteristics</b>						
$g_{FS}$	Forward Transconductance	$V_{DS}=10V, I_D=15A$	20			S
$C_{iss}$	Input Capacitance	$V_{DS}=25V, V_{GS}=0V$ $f=1.0MHz$		4435		PF
$C_{oss}$	Output Capacitance			336		PF
$C_{rss}$	Reverse Transfer Capacitance			248		PF
$Q_g$	Total Gate Charge	$V_{DS}=50V, I_D=40A$ $V_{GS}=10V$		94		nC
$Q_{gs}$	Gate-Source Charge			19		nC
$Q_{gd}$	Gate-Drain Charge			31		nC
<b>Switching Times</b>						
$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=65V, I_D=40A, R_L=15\Omega$ $V_{GS}=10V, R_G=2.5\Omega$		33		nS
$t_r$	Turn-on Rise Time			59		nS
$t_{d(off)}$	Turn-Off Delay Time			86		nS
$t_f$	Turn-Off Fall Time			29		nS
<b>Source-Drain Diode Characteristics</b>						
$I_{SD}$	Source-Drain Current(Body Diode)			60		A
$I_{SDM}$	Pulsed Source-Drain Current(Body Diode)			240		A
$V_{SD}$	Forward On Voltage <sup>(Note 1)</sup>	$T_J=25^{\circ}C, I_{SD}=40A, V_{GS}=0V$		0.86	0.99	V
$t_{rr}$	Reverse Recovery Time <sup>(Note 1)</sup>	$T_J=25^{\circ}C, I_F=40A$ $di/dt=100A/\mu s$		31		nS
$Q_{rr}$	Reverse Recovery Charge <sup>(Note 1)</sup>			78		nC
$t_{on}$	Forward Turn-on Time	Intrinsic turn-on time is negligible(turn-on is dominated by $L_S+L_D$ )				

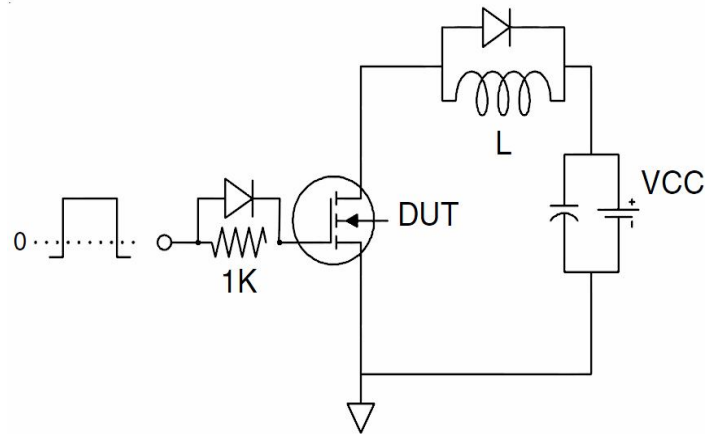
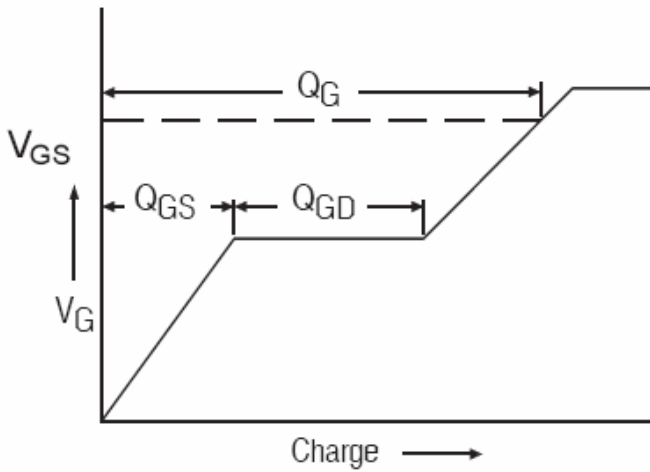
**Notes 1.** Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 1.5\%$ ,  $R_G=25\Omega$ , Starting  $T_J=25^{\circ}C$

## Test Circuit

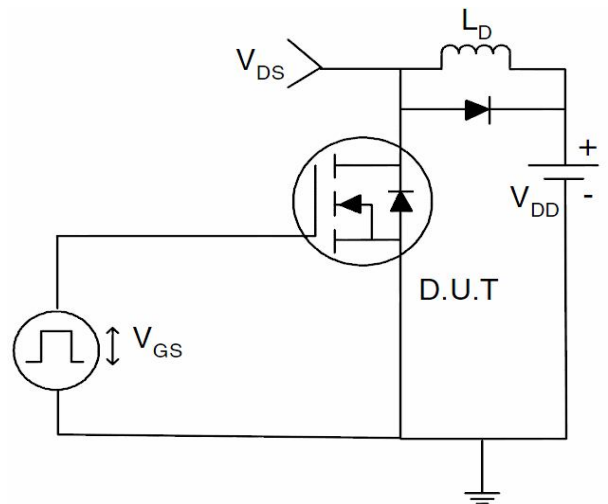
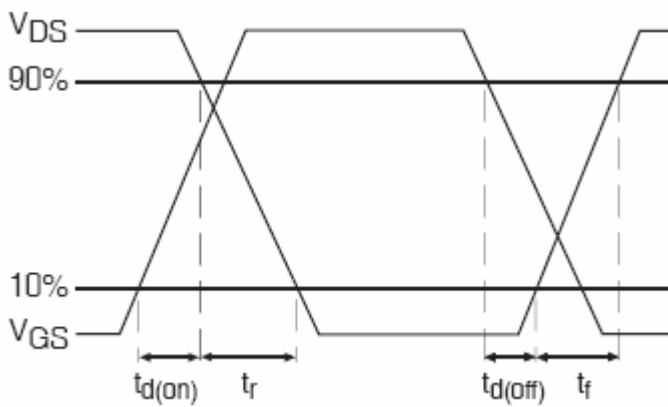
### 1) $E_{AS}$ Test Circuits



### 2) Gate Charge Test Circuit:

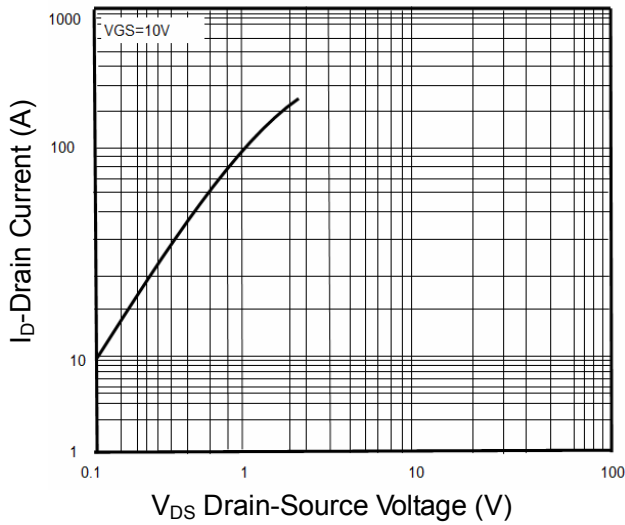


### 3) Switch Time Test Circuit:

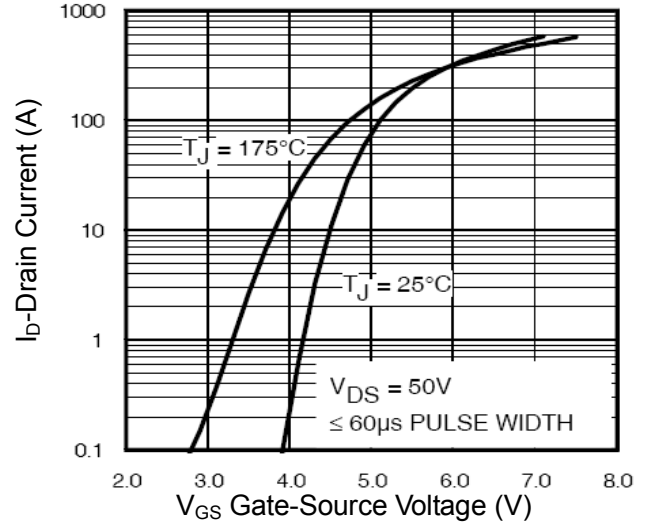


**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (Curves)**

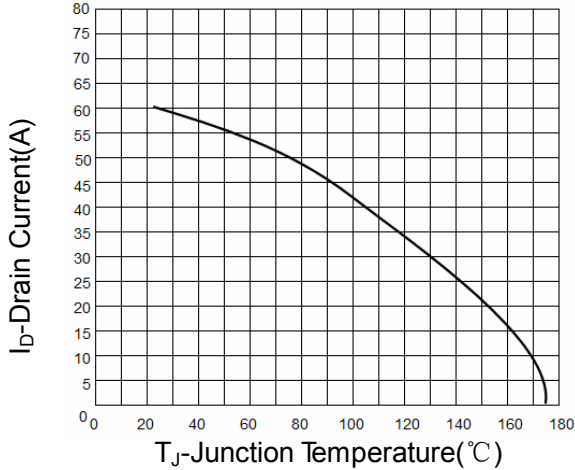
**Figure1. Output Characteristics**



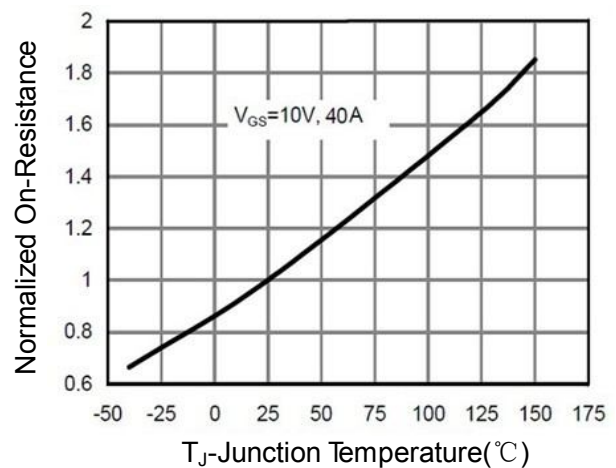
**Figure2. Transfer Characteristics**



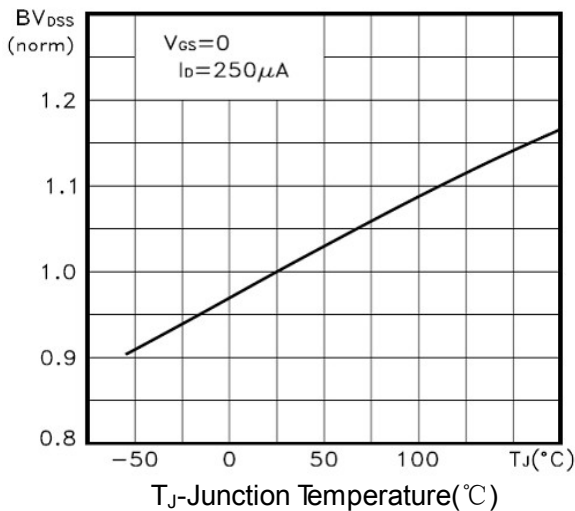
**Figure3. ID vs Junction Temperature**



**Figure4. RDS(ON)- Junction Temperature**



**Figure5. BVDS vs Junction Temperature**



**Figure6. VGS(th) vs Junction Temperature**

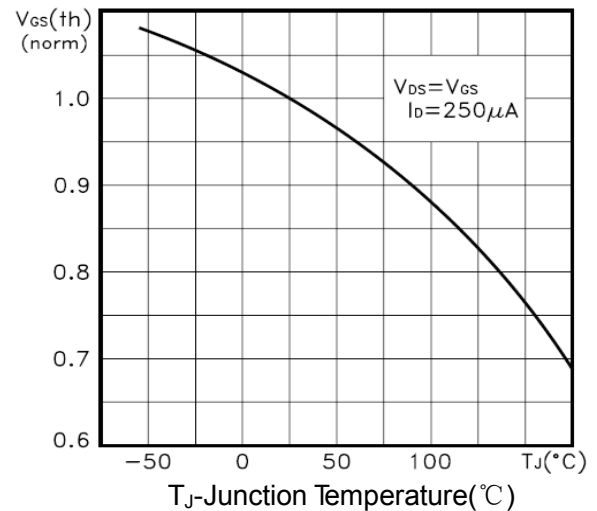


Figure7. Gate Charge

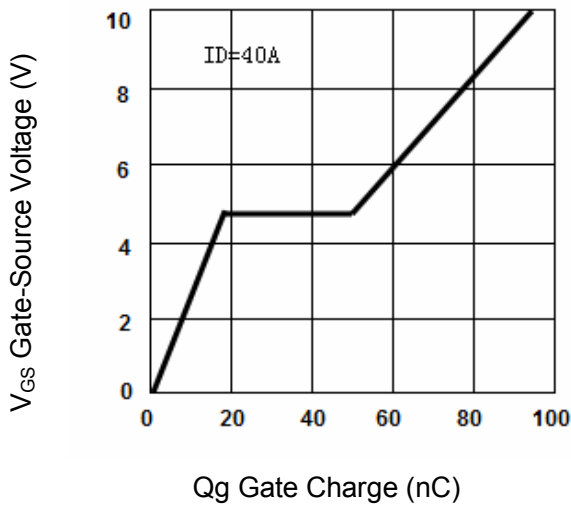


Figure8. Capacitance vs Vds

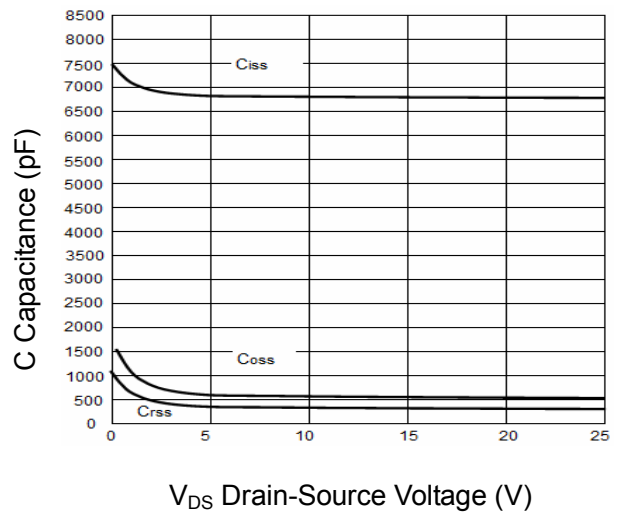


Figure9. Safe Operation Area

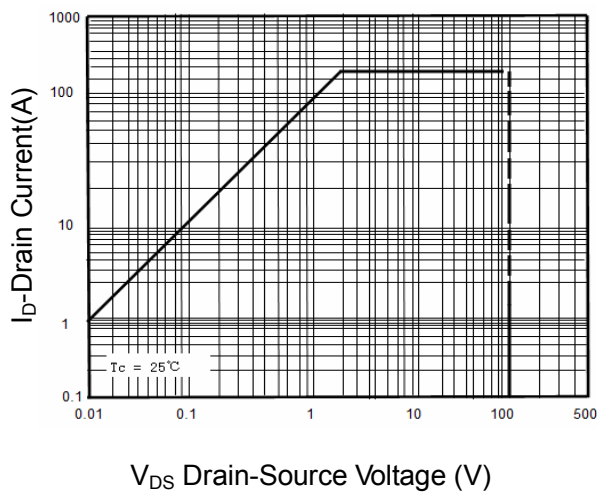


Figure10. Source- Drain Diode Forward

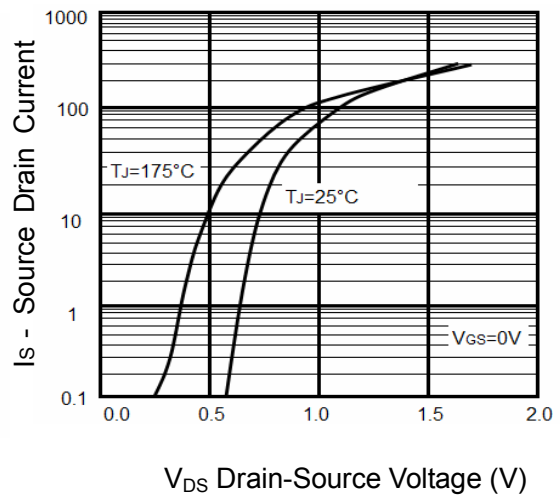
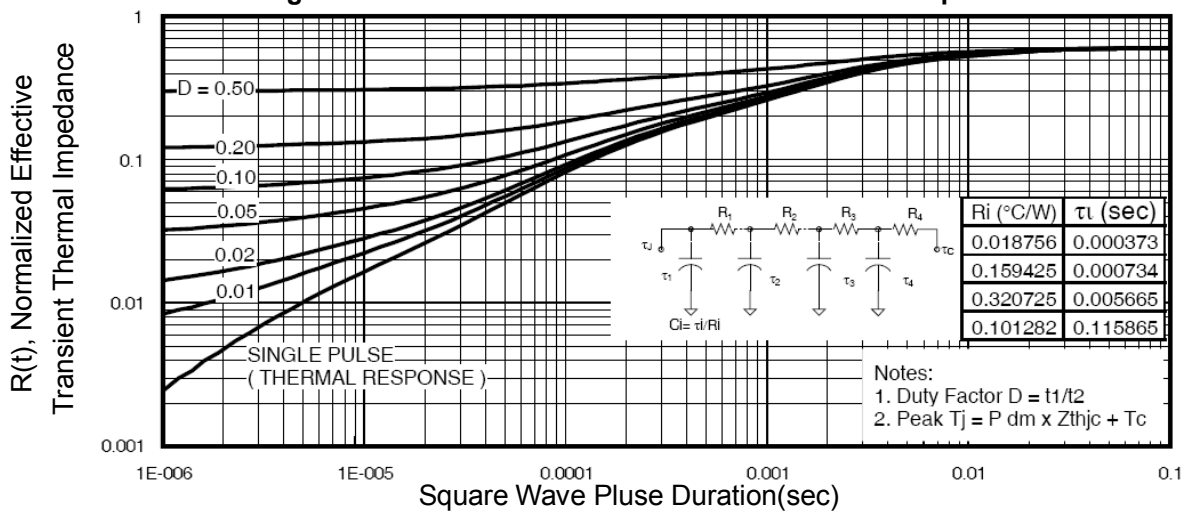
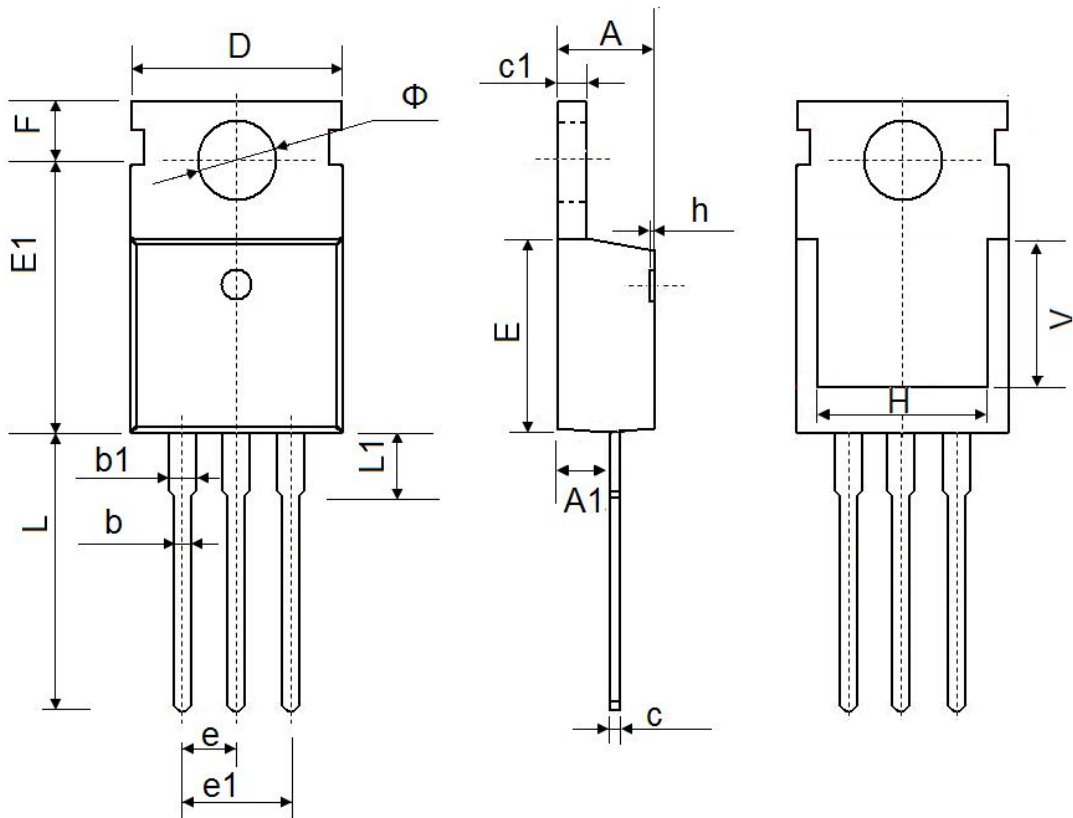


Figure11. Normalized Maximum Transient Thermal Impedance



## TO-220 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	2.200	2.600	0.087	0.102
b	0.700	0.950	0.028	0.037
b1	1.170	1.410	0.046	0.056
c	0.450	0.650	0.018	0.026
c1	1.200	1.400	0.047	0.055
D	9.600	10.400	0.378	0.409
E	8.8500	9.750	0.348	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100TYP.	
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	12.750	14.300	0.502	0.563
L1	2.850	3.950	0.112	0.156
V	7.500 REF.		0.295 REF.	
φ	3.400	4.000	0.134	0.157

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