

### N-Channel Trench Power MOSFET

#### General Description

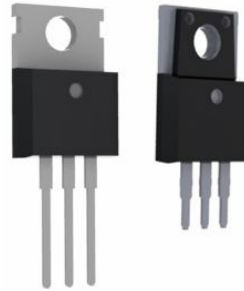
The 48N78 is N-channel MOS Field Effect Transistor designed for high current switching applications. Rugged EAS capability and ultra low  $R_{DS(ON)}$  is suitable for PWM, load switching especially for E-Bike controller applications.

#### Features

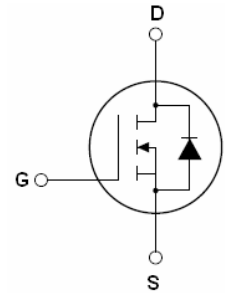
- $V_{DS}=70V$ ;  $I_D=80A@V_{GS}=10V$ ;  
 $R_{DS(ON)}<7.2m\Omega @ V_{GS}=10V$
- Special Designed for E-Bike Controller Application
- Ultra Low On-Resistance
- High UIS and UIS 100% Test

#### Application

- 48V E-Bike Controller Applications
- Hard Switched and High Frequency Circuits
- Uninterruptible Power Supply



To-220 TO-220N  
Top View



Schematic Diagram

$$V_{DS} = 70 V$$

$$I_D = 80 A$$

$$R_{DS(ON)} = 6.2 m\Omega$$

#### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
CS48N78	CS48N78	TO-220	-	-	-
CSN48N78	CSN48N78	TO-220N	-	-	-

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

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-Source Voltage ( $V_{GS}=0V$ )	70	V
$V_{GS}$	Gate-Source Voltage ( $V_{DS}=0V$ )	$\pm 25$	V
$I_{D(DC)}$	Drain Current (DC) at $T_c=25^\circ C$	80	A
$I_{D(DC)}$	Drain Current (DC) at $T_c=100^\circ C$	56	A
$I_{DM(pluse)}$	Drain Current-Continuous@ Current-Pulsed (Note 1)	320	A
dv/dt	Peak Diode Recovery Voltage	9.5	V/ns
$P_D$	Maximum Power Dissipation( $T_c=25^\circ C$ )	100	W
	Derating Factor	0.66	W/°C
$E_{AS}$	Single Pulse Avalanche Energy (Note 2)	410	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.EAS condition:  $T_J=25^\circ C, V_{DD}=33V, V_G=10V$

**Table 2. Thermal Characteristic**

Symbol	Parameter	Value	Max	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	---	1.5	°C/W

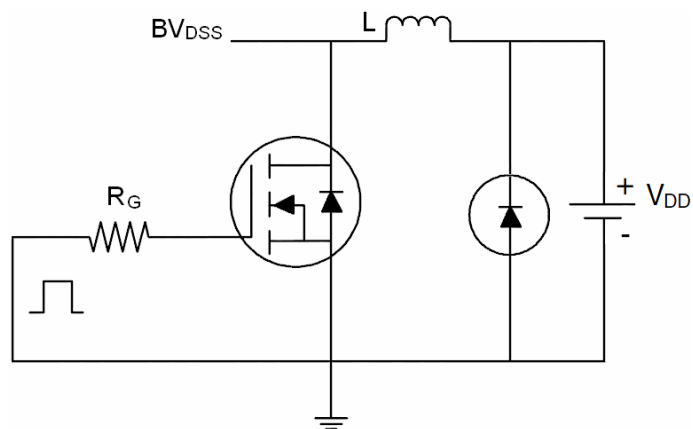
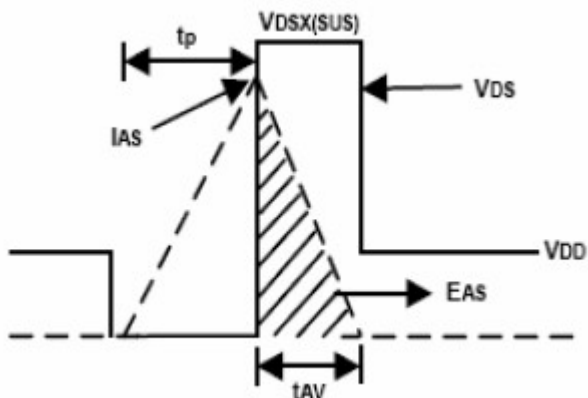
**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>On/Off States</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	70			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current(Tc=25°C)	V <sub>DS</sub> =68V, V <sub>GS</sub> =0V			1	μA
I <sub>DSS</sub>	Zero Gate Voltage Drain Current(Tc=125°C)	V <sub>DS</sub> =68V, V <sub>GS</sub> =0V			10	μA
I <sub>GSS</sub>	Gate-Body Leakage Current	V <sub>GS</sub> =±25V, V <sub>DS</sub> =0V			±100	nA
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	2		4	V
R <sub>DS(ON)</sub>	Drain-Source On-State Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =40A		6.2	7.2	mΩ
<b>Dynamic Characteristics</b>						
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> =10V, I <sub>D</sub> =15A	20			S
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0MHz		3290		pF
C <sub>oss</sub>	Output Capacitance			335		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			245		pF
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =50V, I <sub>D</sub> =40A, V <sub>GS</sub> =10V		90		nC
Q <sub>gs</sub>	Gate-Source Charge			18		nC
Q <sub>gd</sub>	Gate-Drain Charge			42		nC
<b>Switching Times</b>						
t <sub>d(on)</sub>	Turn-on Delay Time	V <sub>DD</sub> =30V, I <sub>D</sub> =2A, R <sub>L</sub> =15Ω V <sub>GS</sub> =10V, R <sub>G</sub> =2.5Ω		21		nS
t <sub>r</sub>	Turn-on Rise Time			31		nS
t <sub>d(off)</sub>	Turn-Off Delay Time			63		nS
t <sub>f</sub>	Turn-Off Fall Time			29		nS
<b>Source-Drain Diode Characteristics</b>						
I <sub>SD</sub>	Source-Drain Current(Body Diode)			80		A
I <sub>SDM</sub>	Pulsed Source-Drain Current(Body Diode)			320		A
V <sub>SD</sub>	Forward On Voltage <sup>(Note 1)</sup>	T <sub>J</sub> =25°C, I <sub>SD</sub> =40A, V <sub>GS</sub> =0V		0.89	0.99	V
t <sub>rr</sub>	Reverse Recovery Time <sup>(Note 1)</sup>	T <sub>J</sub> =25°C, I <sub>F</sub> =75A di/dt=100A/μs		26		nS
Q <sub>rr</sub>	Reverse Recovery Charge <sup>(Note 1)</sup>			35		nC
t <sub>on</sub>	Forward Turn-on Time	Intrinsic turn-on time is negligible(turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )				

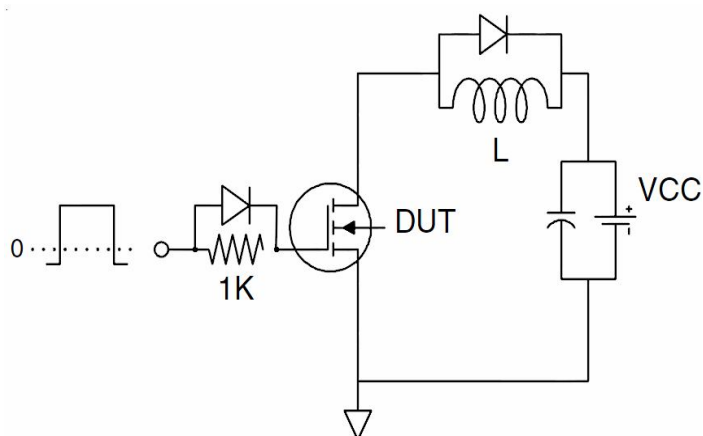
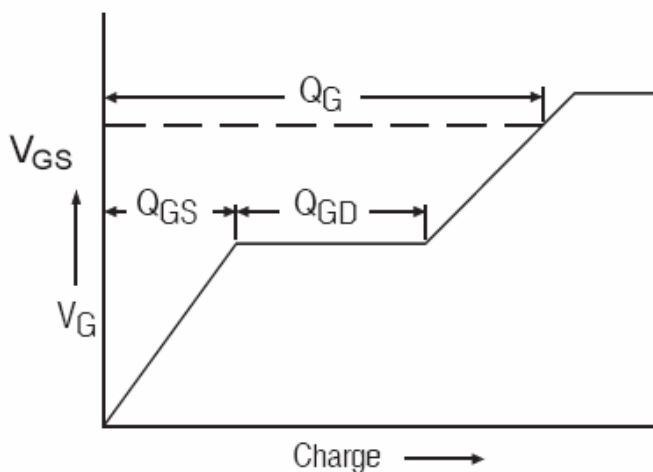
Notes 1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 1.5%, R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C

### Test Circuit

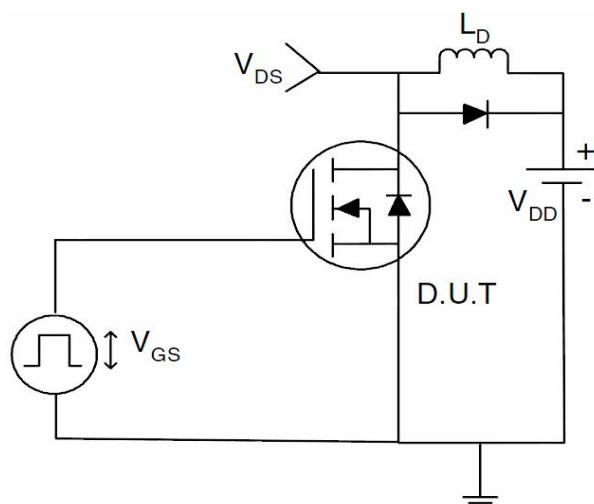
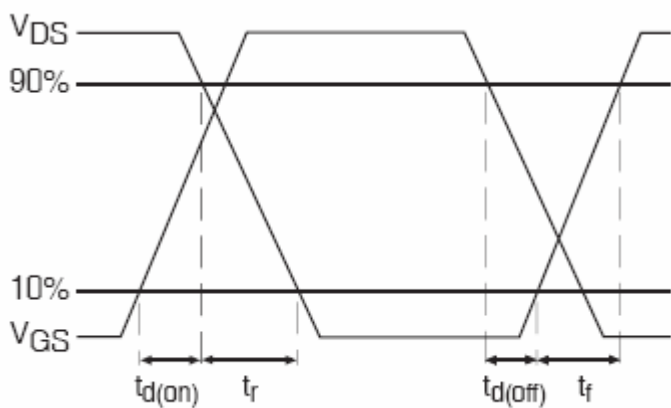
#### 1) E<sub>AS</sub> Test Circuits



#### 2) Gate Charge Test Circuit:

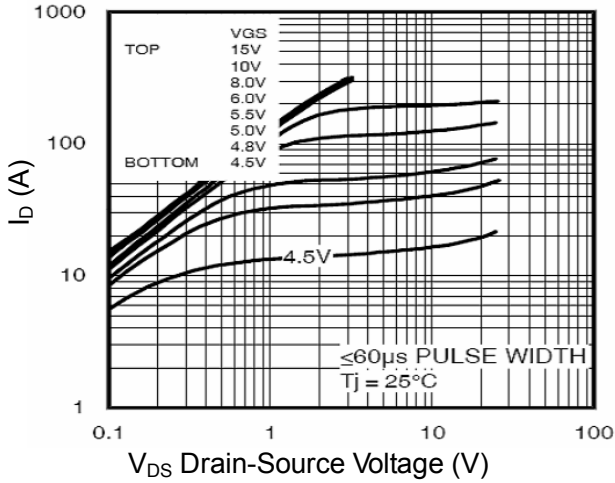


#### 3) Switch Time Test Circuit:

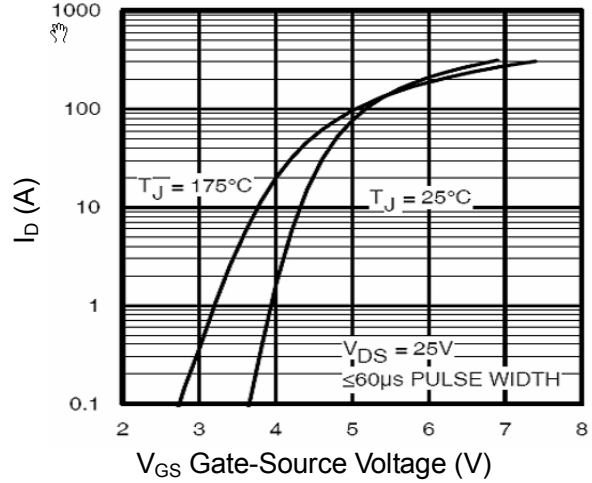


## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (Curves)

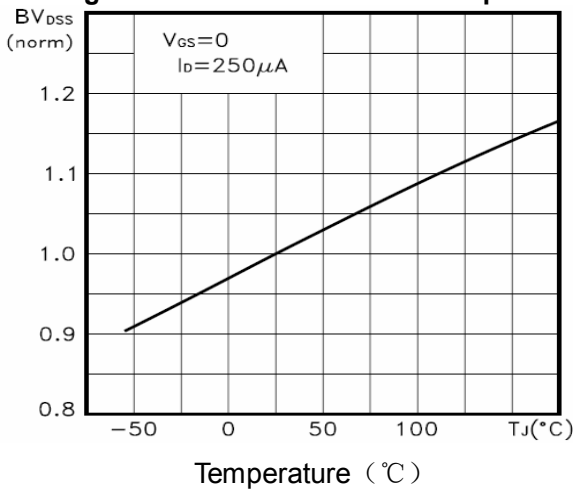
**Figure1. Output Characteristics**



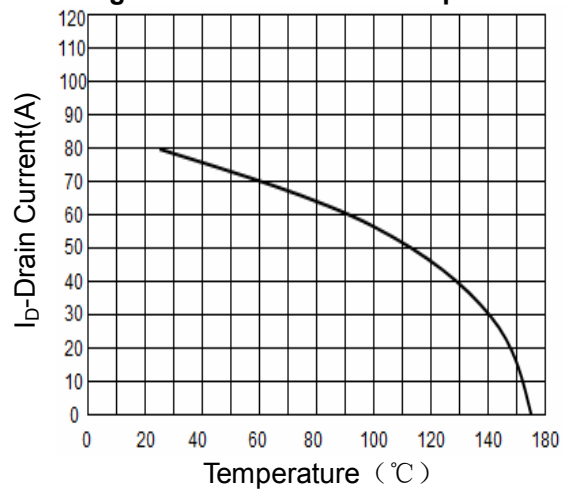
**Figure2. Transfer Characteristics**



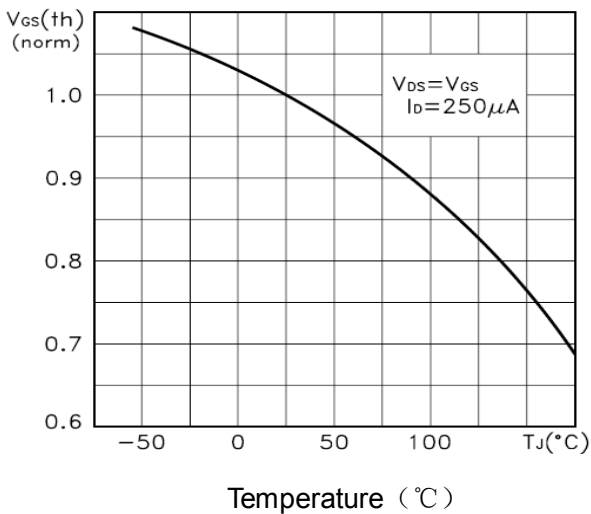
**Figure3. BVDSS vs Junction Temperature**



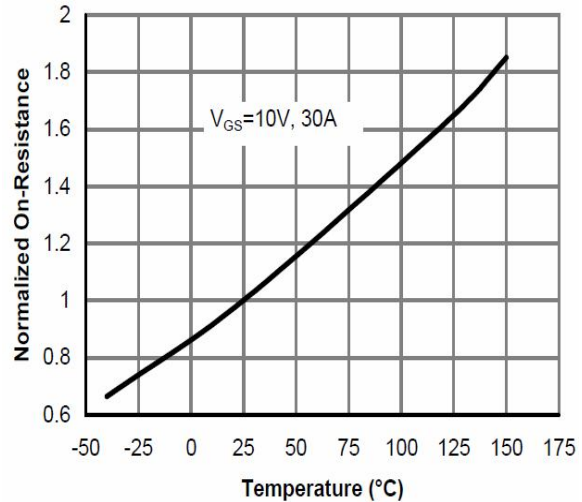
**Figure4. ID vs Junction Temperature**

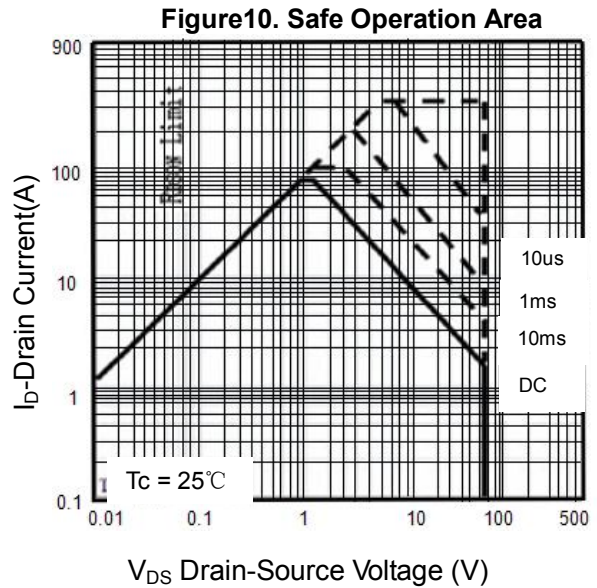
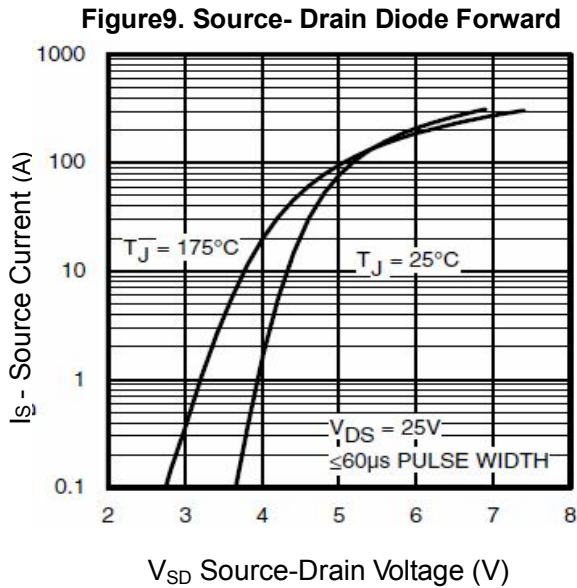
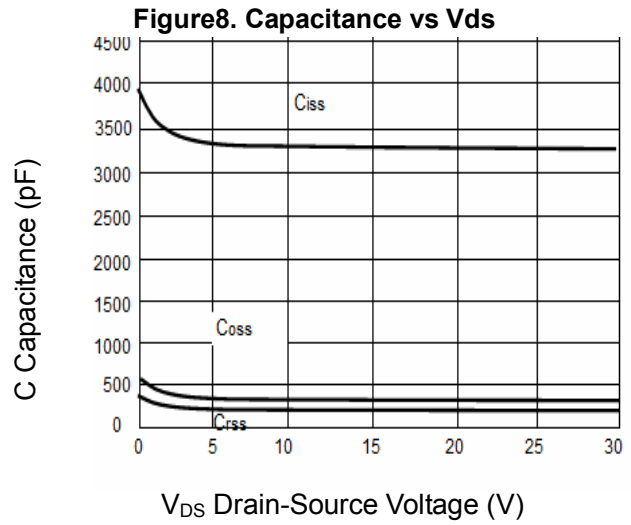
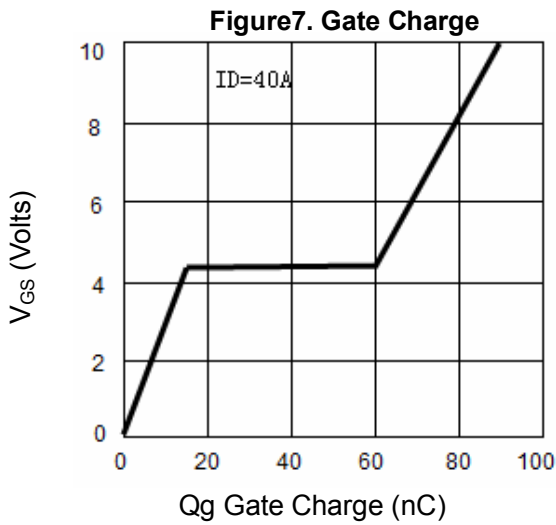


**Figure7. BV<sub>DSS</sub> vs Junction Temperature**

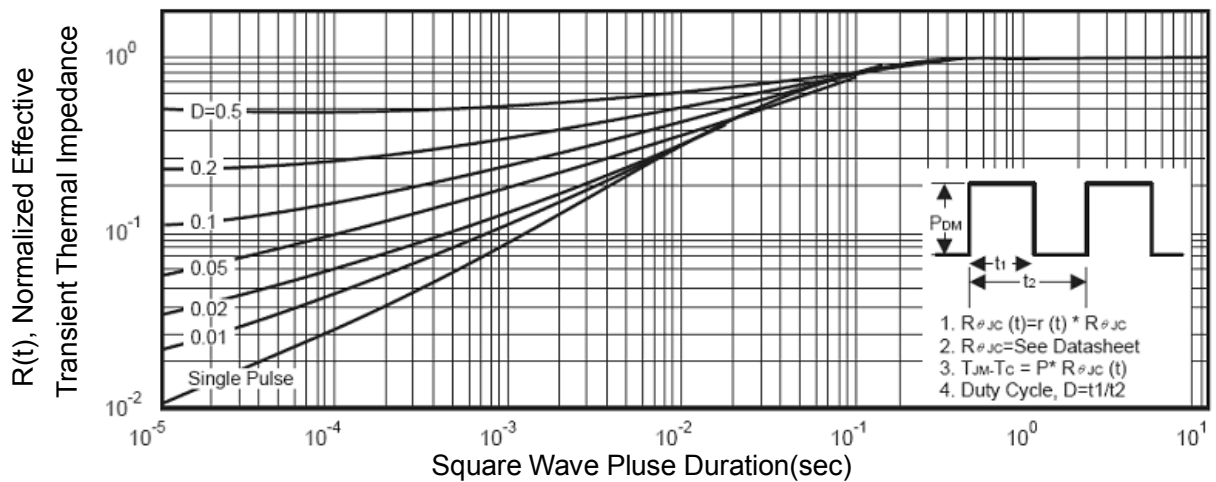


**Figure8. V<sub>GS(th)</sub> vs Junction Temperature**

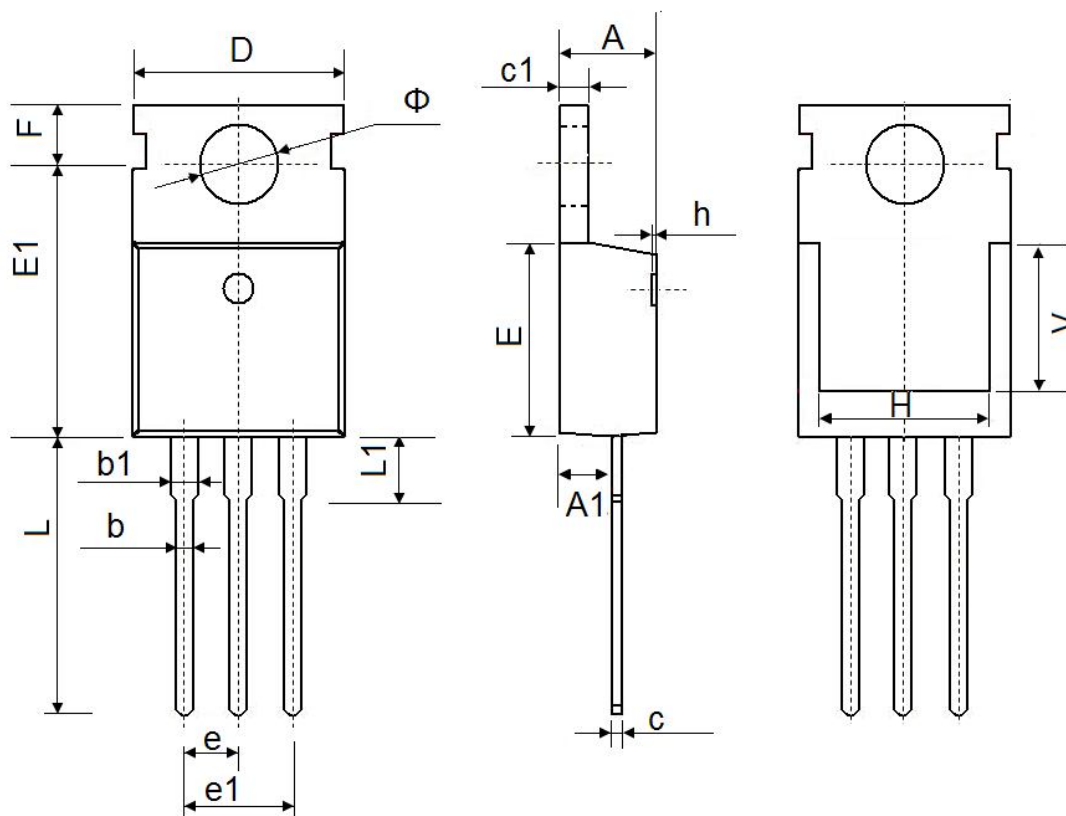




**Figure11. Normalized Maximum Transient Thermal Impedance**



### 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