

N-Channel Trench Power MOSFET

General Description

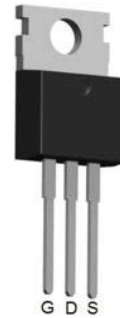
The HP120N04 is N-channel MOS Field Effect Transistor designed for high current switching applications. Rugged EAS capability and ultra low $R_{DS(ON)}$ is suitable for PWM, load switching .

Features

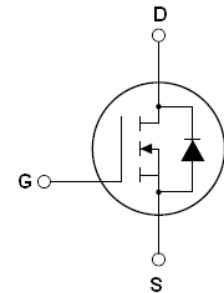
- $V_{DS}=40V$; $I_D=120A@ V_{GS}=10V$;
 $R_{DS(ON)}<4.0m\Omega @ V_{GS}=10V$
- Ultra Low On-Resistance
- High UIS and UIS 100% Test

Application

- Hard Switched and High Frequency Circuits
- Uninterruptible Power Supply



To-220 Top View



Schematic Diagram

$$V_{DS} = 40 V$$

$$I_D = 120 A$$

$$R_{DS(ON)} = 3.5 m\Omega$$

Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|----------------|----------|----------------|-----------|------------|----------|
| HP120N04 | HP120N04 | TO-220 | - | - | - |

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

| Symbol | Parameter | Value | Unit |
|-----------------|---|------------|------|
| V_{DS} | Drain-Source Voltage ($V_{GS}=0V$) | 40 | V |
| V_{GS} | Gate-Source Voltage ($V_{DS}=0V$) | ± 25 | V |
| $I_{D(DC)}$ | Drain Current (DC) at $T_c=25^\circ C$ | 120 | A |
| $I_{D(DC)}$ | Drain Current (DC) at $T_c=100^\circ C$ | 74 | A |
| $I_{DM(pulse)}$ | Drain Current-Continuous@ Current-Pulsed (Note 1) | 420 | A |
| dv/dt | Peak Diode Recovery Voltage | 6.9 | V/ns |
| P_D | Maximum Power Dissipation($T_c=25^\circ C$) | 147 | W |
| | Derating Factor | 0.98 | W/°C |
| E_{AS} | Single Pulse Avalanche Energy (Note 2) | 625 | 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: $T_J=25^\circ C, V_{DD}=40V, V_G=10V, R_G=25\Omega$

Table 2. Thermal Characteristic

| Symbol | Parameter | Value | Max | Unit |
|-----------------|--------------------------------------|-------|------|---------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | --- | 1.02 | $^{\circ}C/W$ |

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|----------------------|---|-------------------------------|-----|-----|-----------|------------|
| On/Off States | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS}=0V, I_D=250\mu A$ | 40 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current($T_C=25^{\circ}C$) | $V_{DS}=60V, V_{GS}=0V$ | | | 1 | μA |
| I_{DSS} | Zero Gate Voltage Drain Current($T_C=125^{\circ}C$) | $V_{DS}=60V, V_{GS}=0V$ | | | 1 | μA |
| I_{GSS} | Gate-Body Leakage Current | $V_{GS}=\pm 20V, V_{DS}=0V$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}=V_{GS}, I_D=250\mu A$ | 1 | 1.7 | 2.5 | V |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance | $V_{GS}=10V, I_D=60A$ | | 3.5 | 4.0 | m Ω |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance | $V_{GS}=4.5V, I_D=40A$ | | 5.0 | 7.0 | m Ω |

Dynamic Characteristics

| | | | | | | |
|-----------|------------------------------|--|----|------|--|----|
| g_{FS} | Forward Transconductance | $V_{DS}=25V, I_D=40A$ | 18 | | | S |
| C_{iss} | Input Capacitance | $V_{DS}=25V, V_{GS}=0V,$ $f=1.0MHz$ | | 4061 | | PF |
| C_{oss} | Output Capacitance | | | 485 | | PF |
| C_{rss} | Reverse Transfer Capacitance | | | 227 | | PF |
| Q_g | Total Gate Charge | $V_{DS}=30V, I_D=30A,$ $V_{GS}=10V$ | | 91 | | nC |
| Q_{gs} | Gate-Source Charge | | | 17 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 40 | | nC |

Switching Times

| | | | | | | |
|--------------|---------------------|---|--|----|--|----|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD}=30V, I_D=2A, R_L=15\Omega$ $V_{GS}=10V, R_G=2.5\Omega$ | | 27 | | nS |
| t_r | Turn-on Rise Time | | | 33 | | nS |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 67 | | nS |
| t_f | Turn-Off Fall Time | | | 34 | | nS |

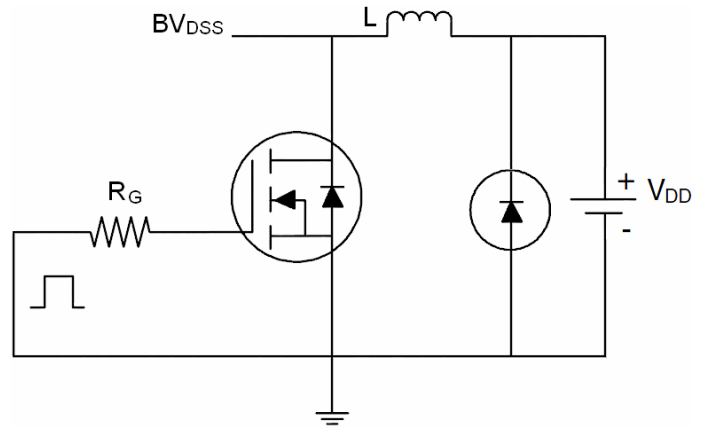
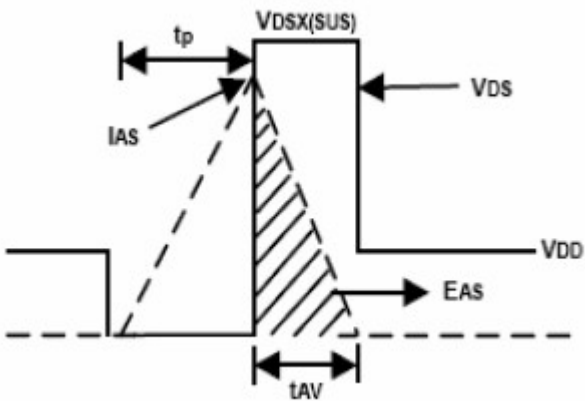
Source-Drain Diode Characteristics

| | | | | | | |
|-----------|---|--|--|------|------|----|
| I_{SD} | Source-drain Current(Body Diode) | | | 120 | | A |
| I_{SDM} | Pulsed Source-Drain Current(Body Diode) | | | 420 | | A |
| V_{SD} | Forward On Voltage ^(Note 1) | $T_J=25^{\circ}C, I_{SD}=40A, V_{GS}=0V$ | | 0.87 | 0.99 | V |
| t_{rr} | Reverse Recovery Time ^(Note 1) | $T_J=25^{\circ}C, I_F=75A$ $di/dt=100A/\mu s$ | | 32 | | nS |
| Q_{rr} | Reverse Recovery Charge ^(Note 1) | | | 49 | | nC |
| t_{on} | Forward Turn-on Time | Intrinsic turn-on time is negligible(turn-on is dominated by L_S+L_D) | | | | |

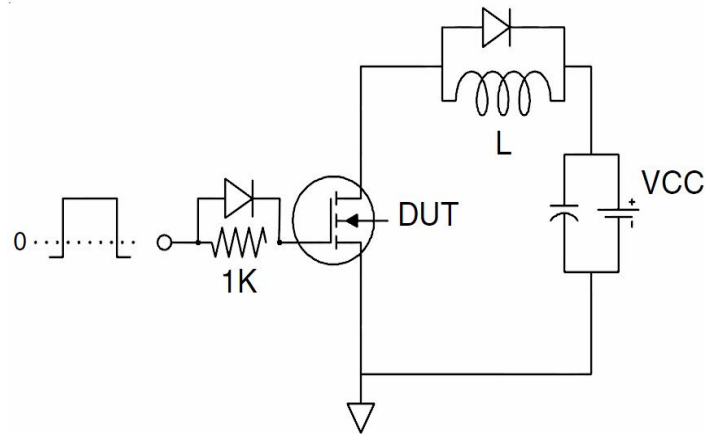
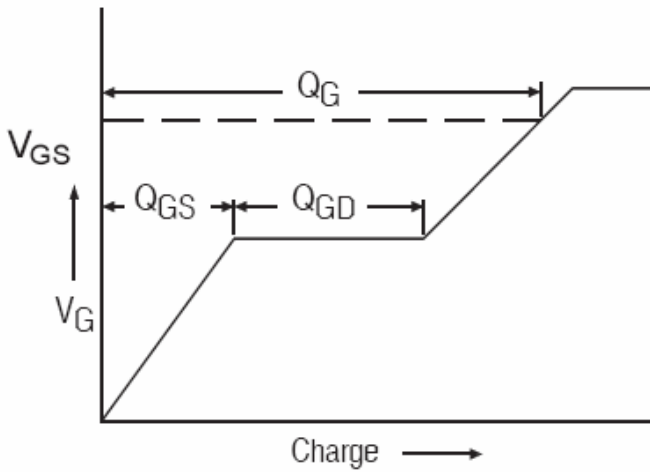
Notes 1. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 1.5\%$, $R_{\theta}=25\Omega$, Starting $T_J=25^{\circ}C$

Test Circuit

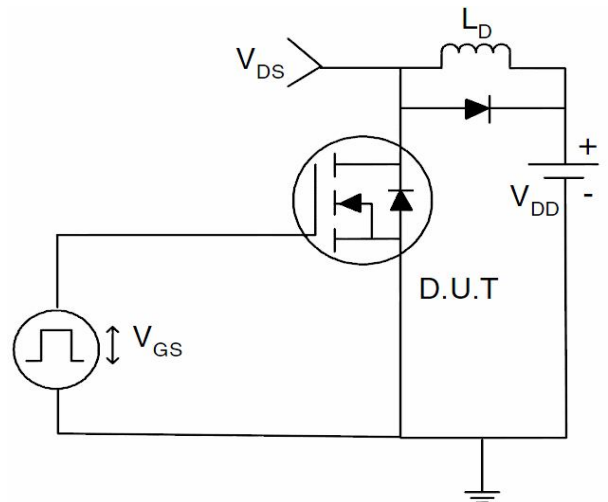
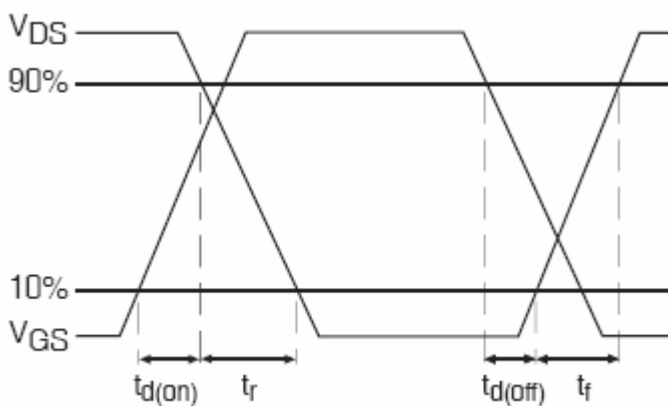
1) E_{AS} Test Circuits



2) Gate Charge Test Circuit:



3) Switch Time Test Circuit:



TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (Curves)

Figure1. Output Characteristics

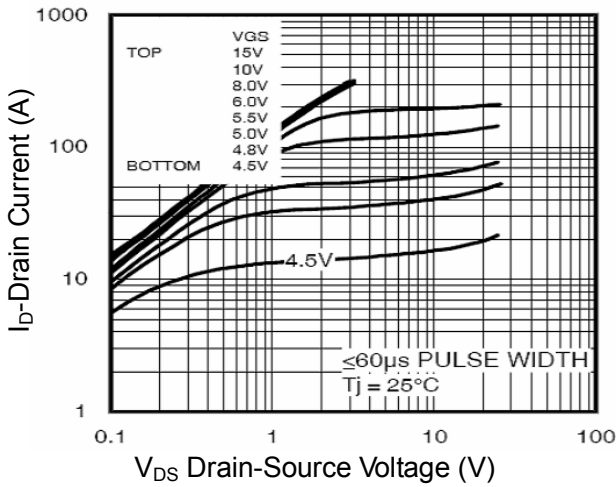


Figure2. Transfer Characteristics

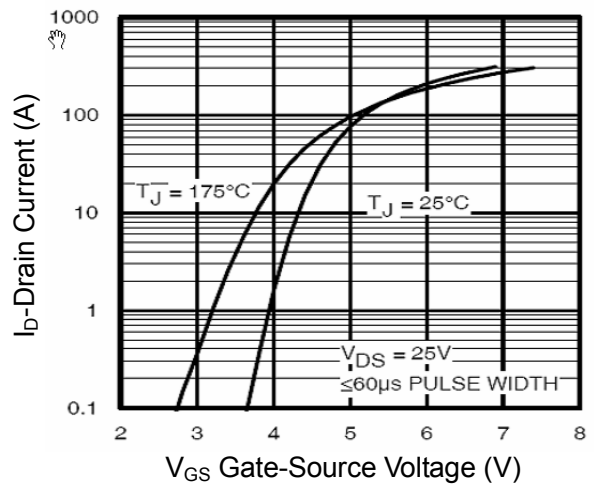


Figure3. ID vs Junction Temperature

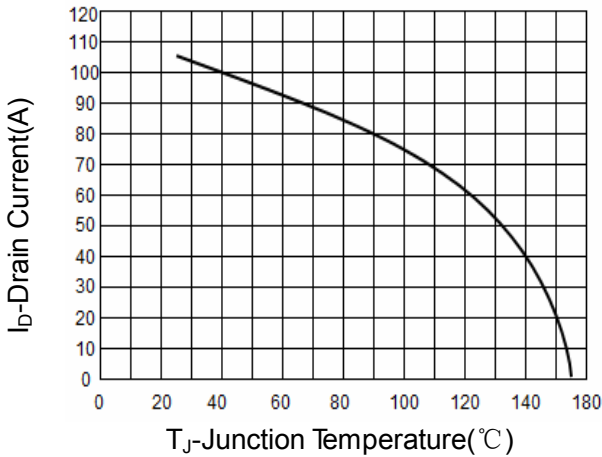


Figure4. Rds(on) Vs Junction Temperature

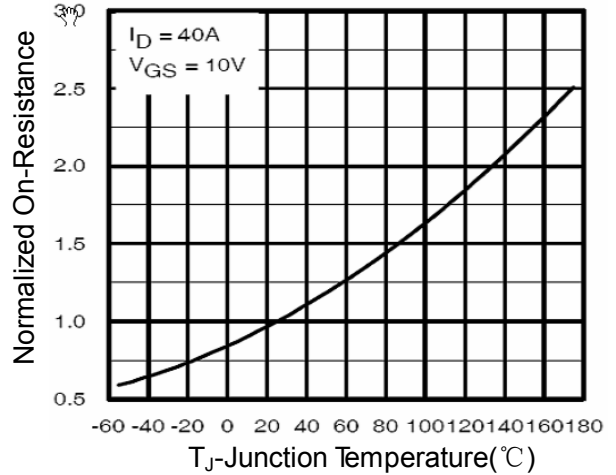


Figure5. BVDS vs Junction Temperature

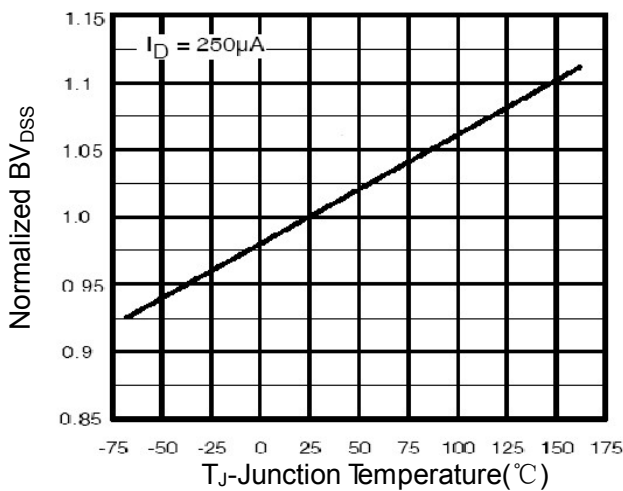


Figure6. VGS(th) vs Junction Temperature

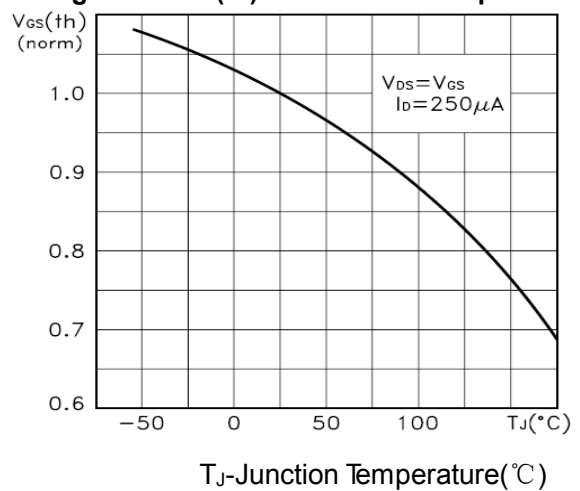


Figure7. Gate Charge

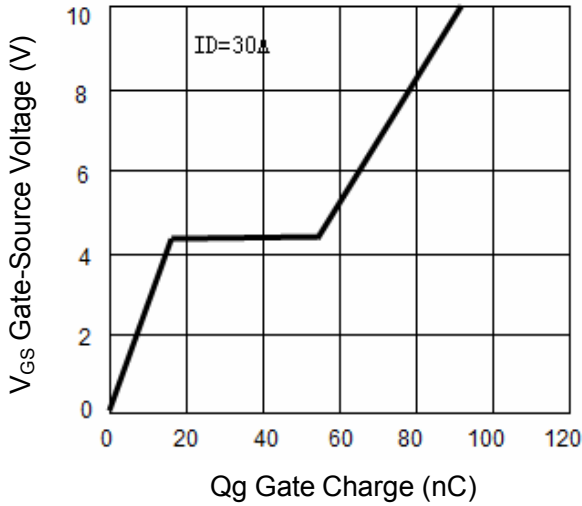


Figure8. Capacitance vs Vds

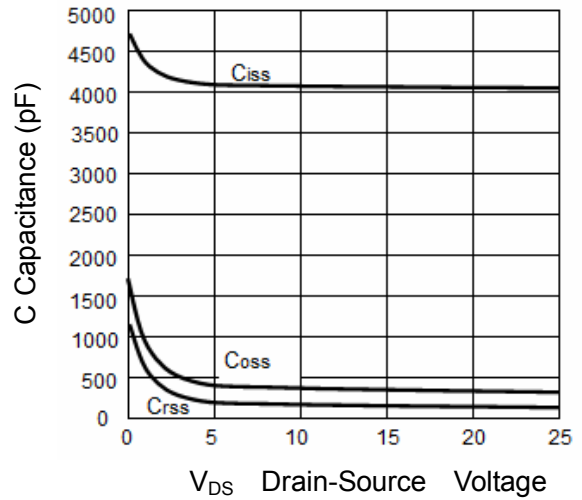


Figure9. Source- Drain Diode Forward

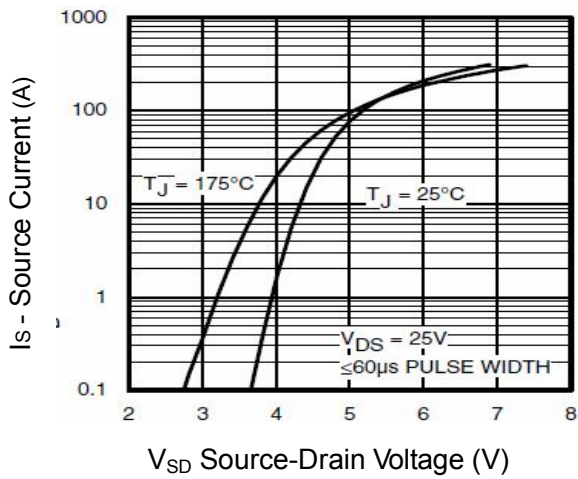


Figure10. Safe Operation Area

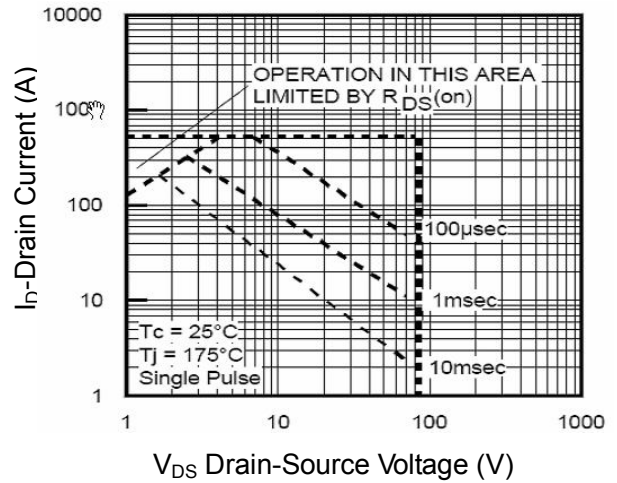
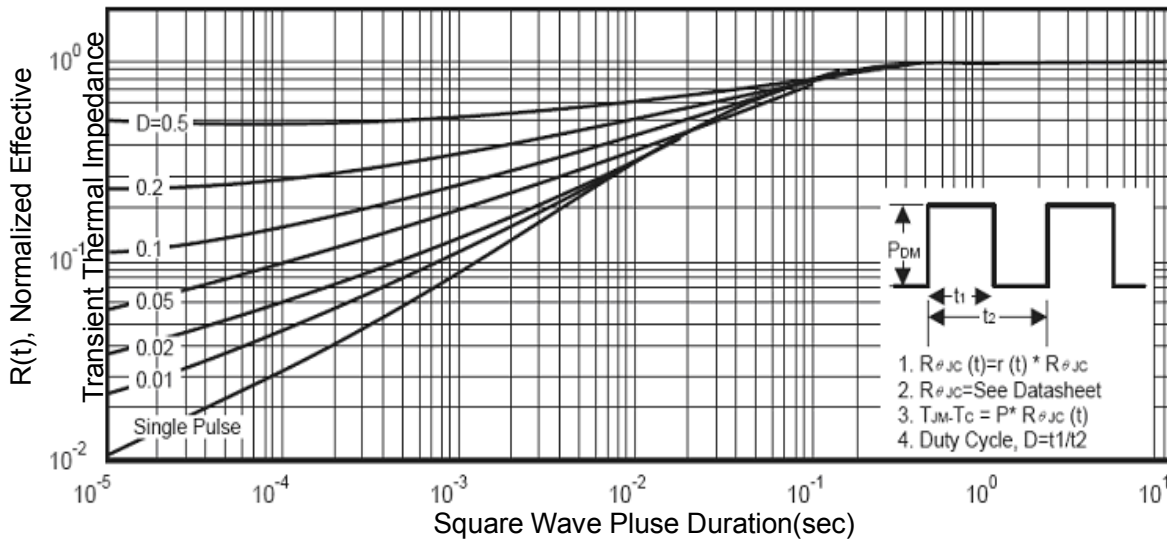
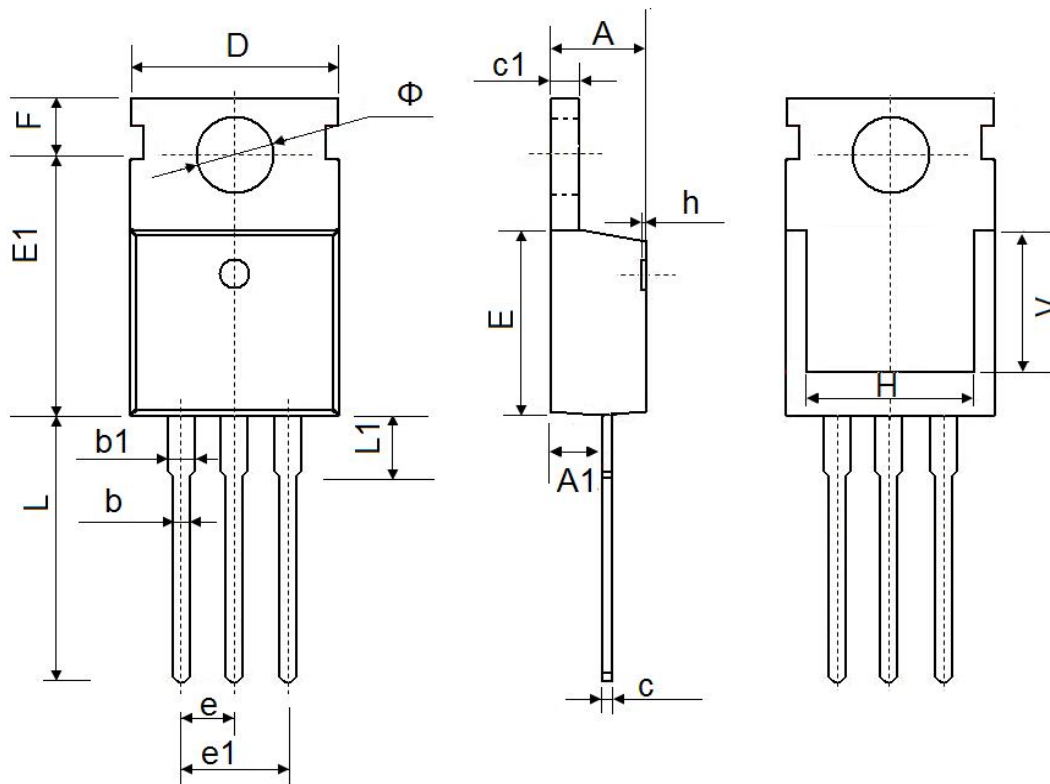


Figure11. Normalized Maximum Transient Thermal Impedance



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 |