## Features

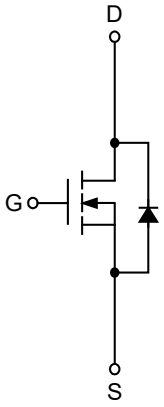
- 40V/195A(package limited)/350A(silicon limited)
  $R_{DS(ON)}$=1.4mΩ(typ.)@$V_{GS}$=10V
- 100% UIS + $R_g$ Tested
- Reliable and Rugged
- Lead Free and Green Devices Available
  (RoHS Compliant)

## Applications

- SMPS Synchronous Rectification.
- BLDC Motor drive applications.
- Load Switch.
- DC-DC Conversion.
- Or-ing.

## Pin Description


Top View of TO-220




N-Channel MOSFET

## Absolute Maximum Ratings ($T_A$=25°C Unless Otherwise Noted)

| Symbol | Parameter | | Rating | Unit |
|---|---|---|---|---|
| **Common Ratings** | | | | |
| $V_{DSS}$ | Drain-Source Voltage | | 40 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±20 | |
| $T_J$ | Maximum Junction Temperature | | 175 | °C |
| $T_{STG}$ | Storage Temperature Range | | -55 to 175 | |
| $I_S$ | Diode Continuous Forward Current | $T_C$=25°C | 195 | A |
| $I_D$ | Continuous Drain Current | $T_C$=25°C | 195 | |
| | Continuous Drain Current | $T_C$=100°C | 117 | |
| $I_{DM}$ [b] | Pulsed Drain Current | $T_C$=25°C | 585 | |
| $P_D$ | Maximum Power Dissipation | $T_C$=25°C | 136 | W |
| | | $T_C$=100°C | 68 | |
| $R_{\theta JC}$ | Thermal Resistance-Junction to Case | Steady State | 0.4 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance-Junction to Ambient | Steady State | 62.5 | °C/W |
| $I_{AS}$ [c] | Avalanche Current, Single pulse | L=0.1mH | 72 | A |
| $E_{AS}$ [c] | Avalanche Energy, Single pulse | L=0.1mH | 259 | mJ |

Note a : Maximum continuous current is limited by bonding wire.
Note b : Pulse width limited by maximum junction temperature.
Note c : UIS tested and pulse width limited by maximum junction temperature (initial temperature $T_j$=25°C).

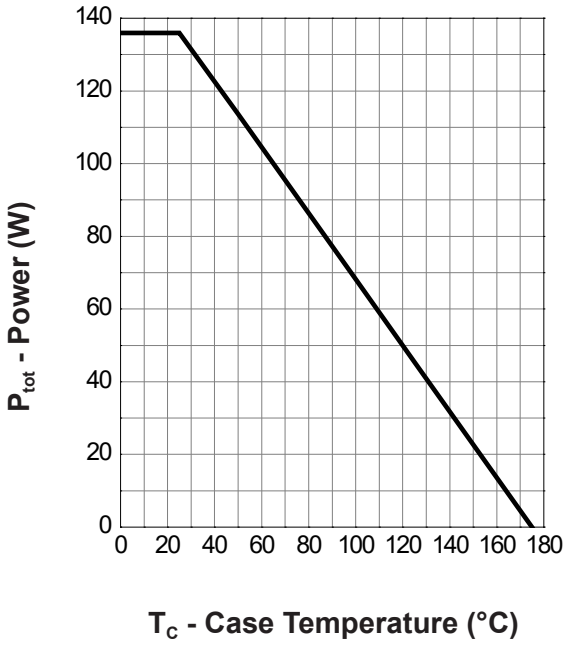
## Electrical Characteristics ($T_A$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V, $I_{DS}$=250μA | 40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=24V, $V_{GS}$=0V | - | - | 1 | μA |
| | | $T_J$=85°C | - | - | 30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_{DS}$=250μA | 2 | 3 | 4 | V |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$=±20V, $V_{DS}$=0V | - | - | ±100 | nA |
| $R_{DS(ON)}$ [d] | Drain-Source On-state Resistance | $V_{GS}$=10V, $I_{DS}$=20A | - | 1.4 | 1.7 | mΩ |
| Gfs | Forward Transconductance | $V_{DS}$=5V, $I_{DS}$=15A | - | 41.5 | - | S |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ [d] | Diode Forward Voltage | $I_{SD}$=20A, $V_{GS}$=0V | - | 0.8 | 1.1 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$=20A, $dI_{SD}/dt$=100A/μs | - | 44.2 | - | ns |
| $t_a$ | Charge Time | | - | 22.6 | - | |
| $t_b$ | Discharge Time | | - | 21.6 | - | |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 42.7 | - | nC |
| **Dynamic Characteristics** [e] | | | | | | |
| $R_G$ | Gate Resistance | $V_{GS}$=0V,$V_{DS}$=0V,F=1MHz | - | 2 | 4 | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=20V, Frequency=1.0MHz | - | 10347 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 1155 | - | |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 1058 | - | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$=20V, $R_L$=20Ω, $I_{DS}$=1A, $V_{GEN}$=10V, $R_G$=6Ω | - | 58.4 | - | ns |
| $t_r$ | Turn-on Rise Time | | - | 820 | - | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | - | 90.9 | - | |
| $t_f$ | Turn-off Fall Time | | - | 347.6 | - | |
| **Gate Charge Characteristics** [e] | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$=20V, $V_{GS}$=10V, $I_{DS}$=20A | - | 106 | - | nC |
| $Q_{gth}$ | Threshold Gate Charge | | - | 53.3 | - | |
| $Q_{gs}$ | Gate-Source Charge | | - | 28.4 | - | |
| $Q_{gd}$ | Gate-Drain Charge | | - | 49 | - | |

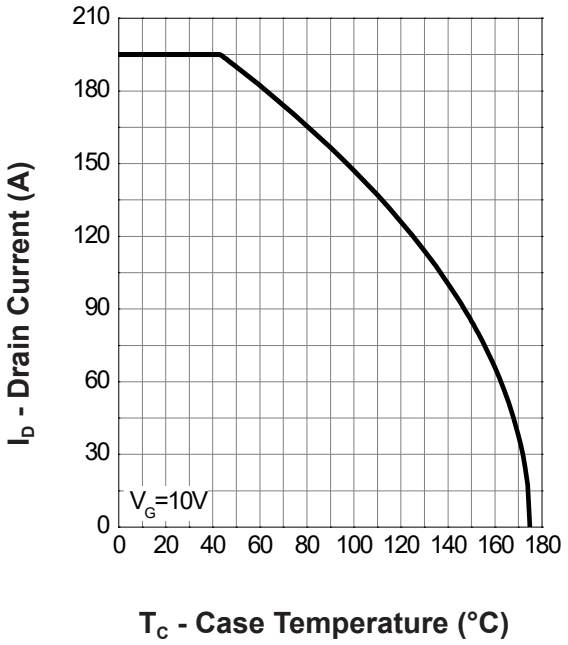
Note d：Pulse test ; pulse width≤300μs, duty cycle≤2%.
Note e：Guaranteed by design, not subject to production testing.

## Typical Operating Characteristics

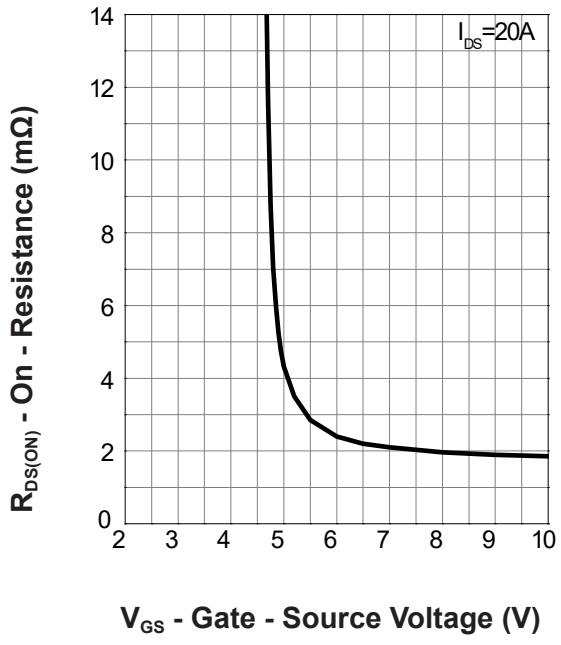
### Power Dissipation



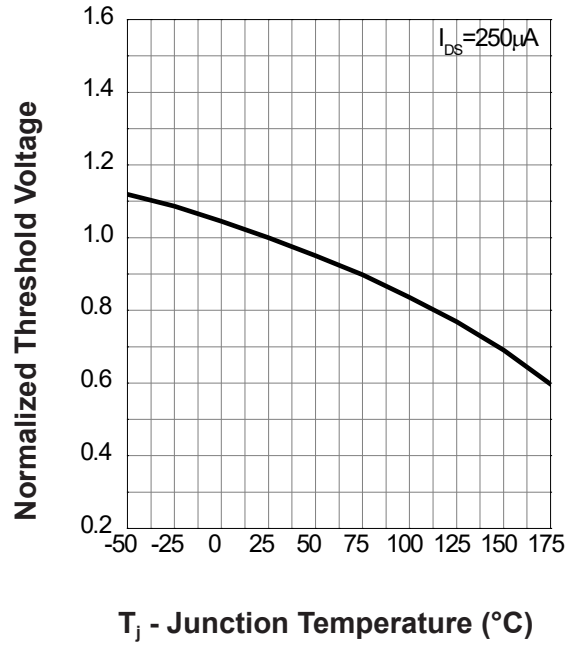

### Drain Current




### Gate-Source On Resistance

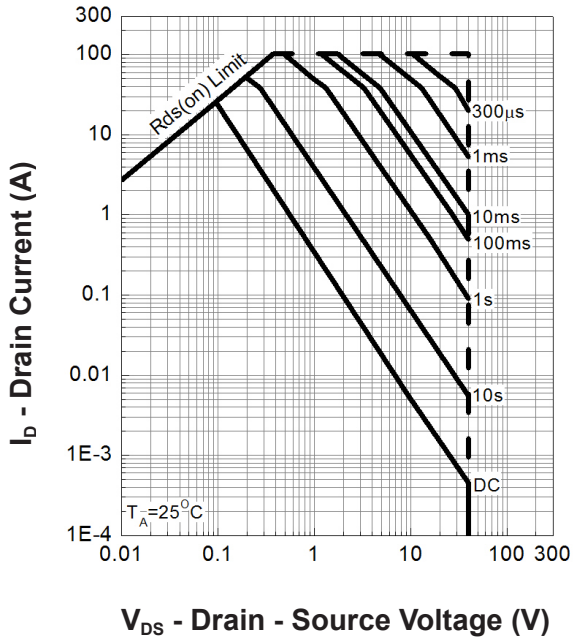



### Gate Threshold Voltage

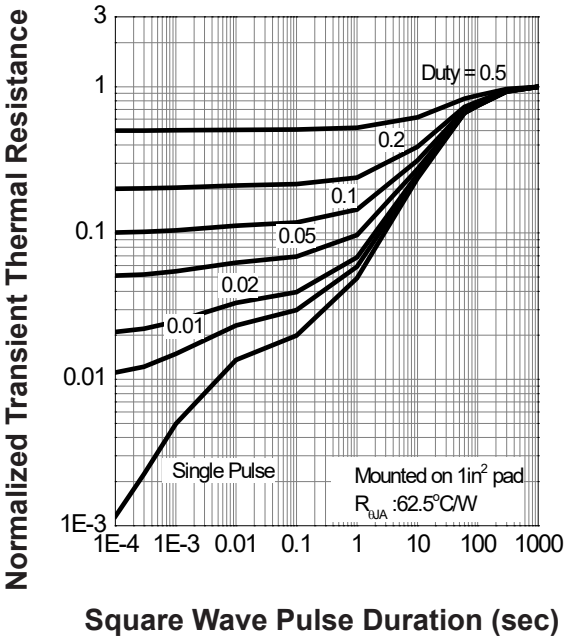


## Typical Operating Characteristics(Cont.)

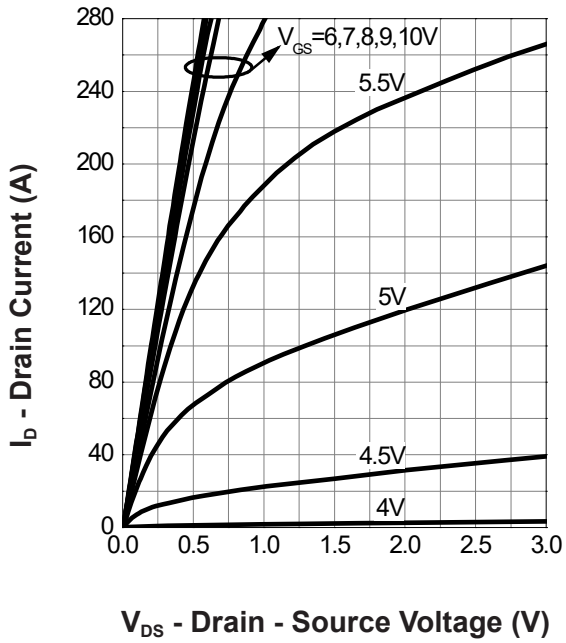
### Safe Operation Area



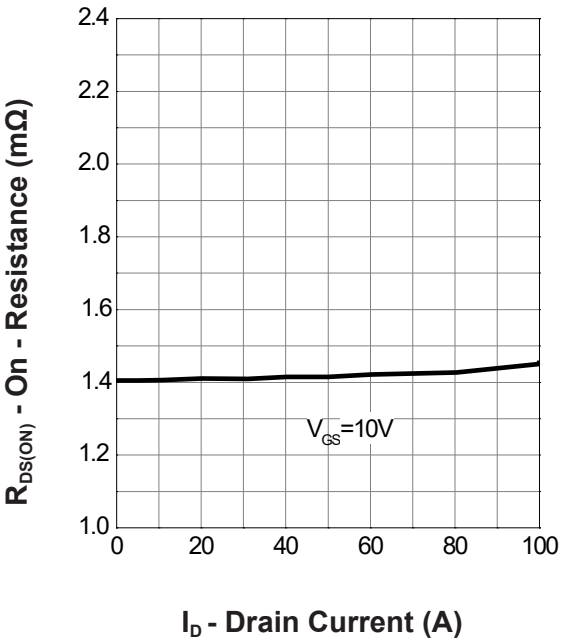

### Thermal Transient Impedance




### Output Characteristics

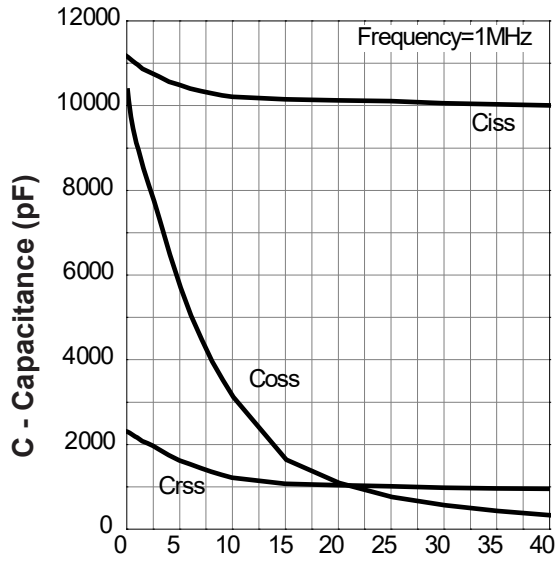



### Drain-Source On Resistance

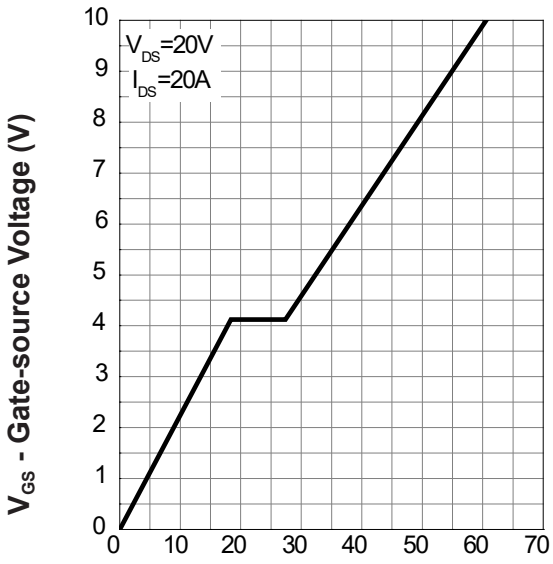


## Typical Operating Characteristics(Cont.)

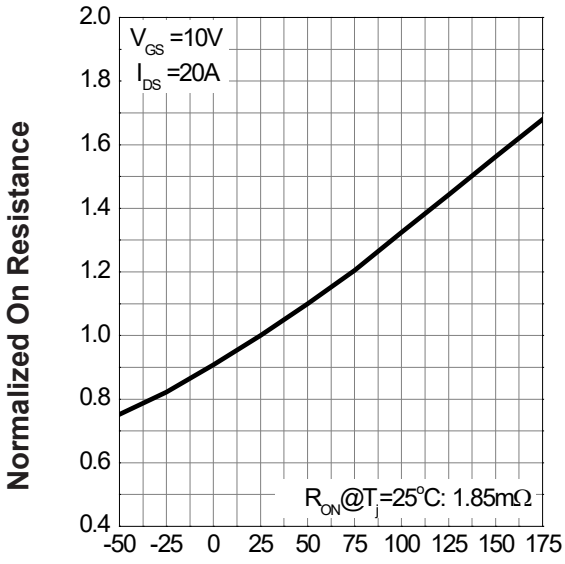
### Capacitance



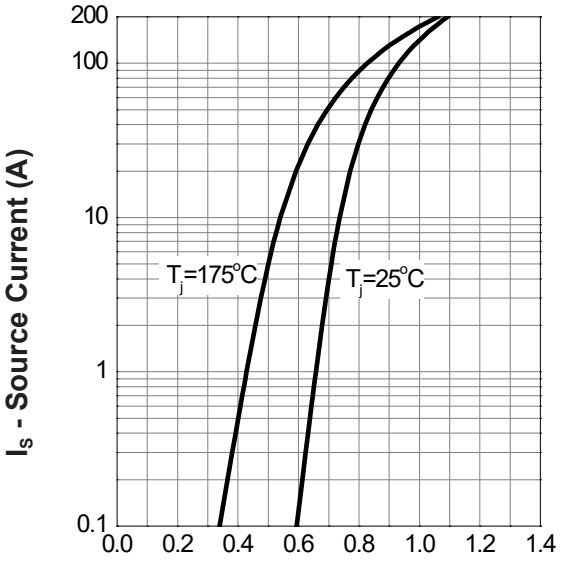

### Gate Charge



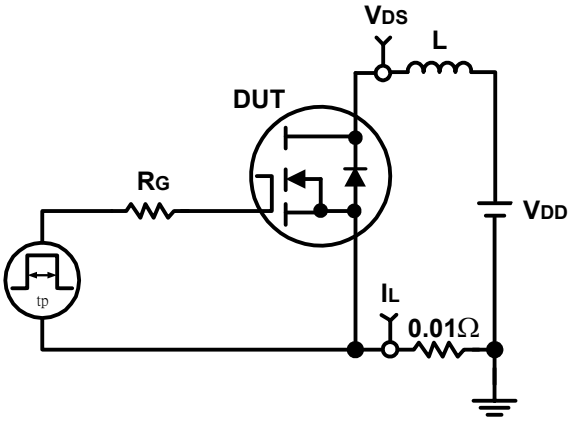

### Drain-Source On Resistance

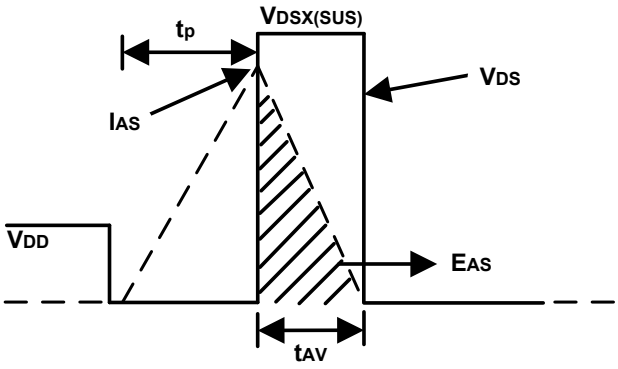



### Source-Drain Diode Forward

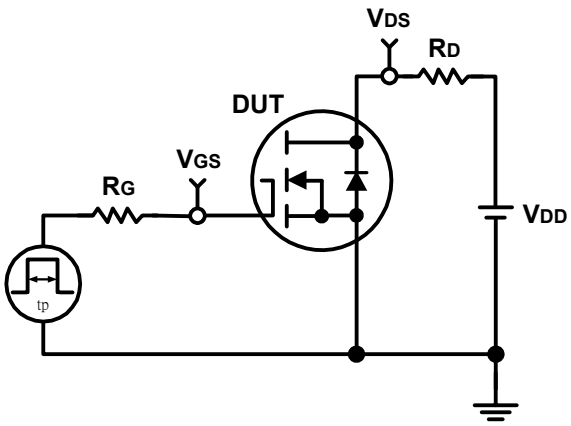


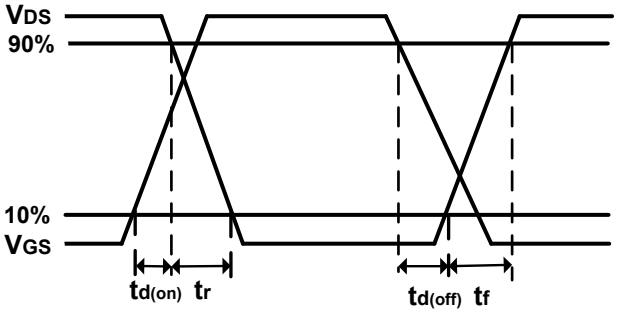
## Avalanche Test Circuit and Waveforms



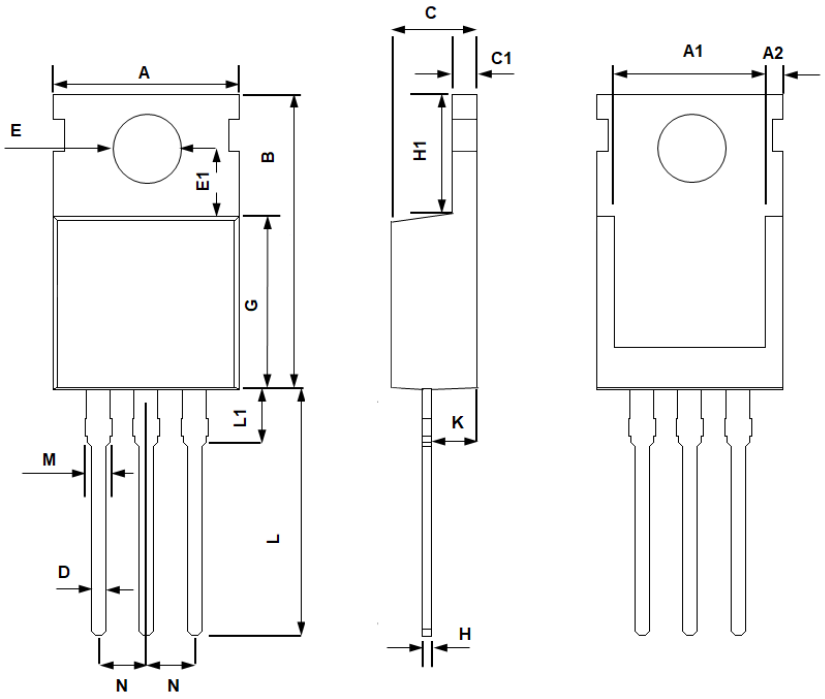

## Switching Time Test Circuit and Waveforms



## Package Information

**TO-220**




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MAX | MIN | MAX | MIN |
| A | 10.400 | 9.700 | 0.409 | 0.382 |
| A1 | 8.900 | 7.400 | 0.350 | 0.291 |
| A2 | 1.400 | 0.800 | 0.055 | 0.031 |
| B | 16.500 | 14.500 | 0.650 | 0.571 |
| C | 4.750 | 4.200 | 0.187 | 0.165 |
| C1 | 1.500 | 1.100 | 0.059 | 0.043 |
| D | 1.000 | 0.600 | 0.039 | 0.024 |
| E | 4.000 | 3.300 | 0.157 | 0.130 |
| E1 | 3.800 | 3.400 | 0.150 | 0.134 |
| G | 9.400 | 8.400 | 0.370 | 0.331 |
| H | 0.600 | 0.200 | 0.024 | 0.008 |
| H1 | 6.850 | 6.200 | 0.270 | 0.244 |
| K | 2.850 | 2.100 | 0.112 | 0.083 |
| L | 14.000 | 12.500 | 0.551 | 0.492 |
| L1 | 4.000 | 2.700 | 0.157 | 0.106 |
| M | 1.750 | 1.100 | 0.069 | 0.043 |
| N | 2.640 | 2.440 | 0.104 | 0.096 |