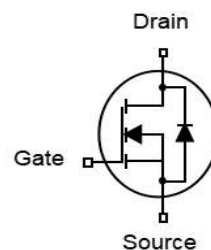


## Features

- N-Channel
- Excellent gate charge x  $R_{DS(on)}$  product(FOM)
- Very low on-resistance  $R_{DS(on)}$
- 150 °C operating temperature
- 100% EAS Tested

|                               |     |            |
|-------------------------------|-----|------------|
| $V_{DS}$                      | 60  | V          |
| $R_{DS(on),TYP@ V_{GS}=10V}$  | 1.3 | m $\Omega$ |
| $R_{DS(on),TYP@ V_{GS}=4.5V}$ | 1.9 | m $\Omega$ |
| $I_D$                         | 220 | A          |

TO-220



| Part ID   | Package Type | Marking   | Packing      |
|-----------|--------------|-----------|--------------|
| ZTG013N06 | TO-220       | ZTG013N06 | 1000pcs/Reel |

## Absolute Maximum Ratings $T_A = 25^\circ\text{C}$ , unless otherwise specified

| Symbol   | Parameter                                | Rating                          | Unit               |   |
|--|--|---------------------------------|--------------------|---|
| <b>Common Ratings (<math>T_c=25^\circ\text{C}</math> Unless Otherwise Noted)</b> |  |                                 |                    |   |
| $V_{GS}$   | Gate-Source Voltage                      | $\pm 20$                        | V                  |   |
| $V_{(BR)DSS}$  | Drain-Source Breakdown Voltage           | 60                              | V                  |   |
| $T_J$  | Maximum Junction Temperature             | 150                             | $^\circ\text{C}$   |   |
| $T_{STG}$  | Storage Temperature Range                | -55 to 150                      | $^\circ\text{C}$   |   |
| $I_{DM}$   | Drain Current-Continuous@ Current-Pulsed | $T_c = 25^\circ\text{C}$<br>760 | A                  |   |
| <b>Mounted on Large Heat Sink</b>  |  |                                 |                    |   |
| $I_D$  | Drain Current-Continuous                 | $T_c = 25^\circ\text{C}$        | 220                | A |
|  |  | $T_c = 100^\circ\text{C}$       | 126                | A |
| $P_D$  | Maximum Power Dissipation                | 150                             | W                  |   |
| $R_{\theta JC}$  | Thermal Resistance-Junction to Case      | 0.85                            | $^\circ\text{C/W}$ |   |
| <b>Drain-Source Avalanche Ratings</b>  |  |                                 |                    |   |
| EAS  | Avalanche Energy, Single Pulsed (Note 1) | 520                             | mJ                 |   |

**Electrical Characteristics (T<sub>J</sub>=25°C unless otherwise noted)**

| Symbol  | Parameter                        | Condition   | Min | Typ  | Max  | Unit |
|---|----------------------------------|---|-----|------|------|------|
| <b>Static Electrical Characteristics @ T<sub>J</sub>=25°C (unless otherwise stated)</b>     |                                  |   |     |      |      |      |
| V(BR)DSS  | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA  | 60  | --   | --   | V    |
| I <sub>DSS</sub>  | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =60V, V <sub>GS</sub> =0V   | --  | --   | 1    | μA   |
| I <sub>GSS</sub>  | Gate-Body Leakage Current        | V <sub>GS</sub> =±20V, 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  | 1.2 | 1.6  | 2.0  | V    |
| R <sub>DS(on)</sub>   | Drain-Source On-State Resistance | V <sub>GS</sub> =10V, I <sub>D</sub> =50A   | --  | 1.3  | 1.9  | mΩ   |
| R <sub>DS(on)</sub>   | Drain-Source On-State Resistance | V <sub>GS</sub> =4.5V, I <sub>D</sub> =45A  | --  | 1.9  | 2.4  | mΩ   |
| <b>Dynamic Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise stated)</b>  |                                  |   |     |      |      |      |
| C <sub>iss</sub>  | Input Capacitance                | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V,<br>f=1MHz  | --  | 7200 | --   | pF   |
| C <sub>oss</sub>  | Output Capacitance               |   | --  | 1470 | --   | pF   |
| C <sub>rss</sub>  | Reverse Transfer Capacitance     |   | --  | 30   | --   | pF   |
| R <sub>g</sub>  | Gate Resistance                  | f=1MHz  | --  | 1.5  | --   | Ω    |
| Q <sub>g</sub>  | Total Gate Charge                | V <sub>DS</sub> =30V, I <sub>D</sub> =50A,<br>V <sub>GS</sub> =4.5V                             | --  | 49   | --   | nC   |
| Q <sub>gs</sub>   | Gate-Source Charge               |   | --  | 23   | --   | nC   |
| Q <sub>gd</sub>   | Gate-Drain Charge                |   | --  | 15   | --   | nC   |
| <b>Switching Characteristics (Note 2)</b>   |                                  |   |     |      |      |      |
| T <sub>d(on)</sub>  | Turn-on Delay Time               | V <sub>DD</sub> =30V,<br>I <sub>D</sub> =50A,<br>R <sub>G</sub> =2.5Ω,<br>V <sub>GS</sub> =4.5V | --  | 38   | --   | ns   |
| T <sub>r</sub>  | Turn-on Rise Time                |   | --  | 34   | --   | ns   |
| T <sub>d(off)</sub>   | Turn-Off Delay Time              |   | --  | 52   | --   | ns   |
| T <sub>f</sub>  | Turn-Off Fall Time               |   | --  | 26   | --   | ns   |
| <b>Source- Drain Diode Characteristics @ T<sub>J</sub> = 25°C (unless otherwise stated)</b> |                                  |   |     |      |      |      |
| I <sub>S</sub>  | Diode Forward Current            |   | --  | --   | 220  | A    |
| V <sub>SD</sub>   | Forward on voltage               | I <sub>S</sub> =50A, V <sub>GS</sub> =0V  | --  | --   | 1.4  | V    |
| T <sub>rr</sub>   | Reverse Recovery Time            | T <sub>J</sub> =25°C, I <sub>S</sub> =50A,<br>V <sub>R</sub> =50V<br>di/dt=100A/μs              | --  | 68   | --   | ns   |
| Q <sub>rr</sub>   | Reverse Recovery Charge          |   | --  | 122  | --   | nC   |

**Notes:**

1. EAS condition : T<sub>J</sub>=25°C, V<sub>DD</sub>=50V, V<sub>G</sub>=10V, L=0.5mH, R<sub>G</sub>=25Ω
2. Guaranteed by design, not subject to production
3. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of T<sub>J</sub>(MAX)=150°C. The SOA curve provides a single pulse rating.

Typical Electrical and Thermal Characteristics

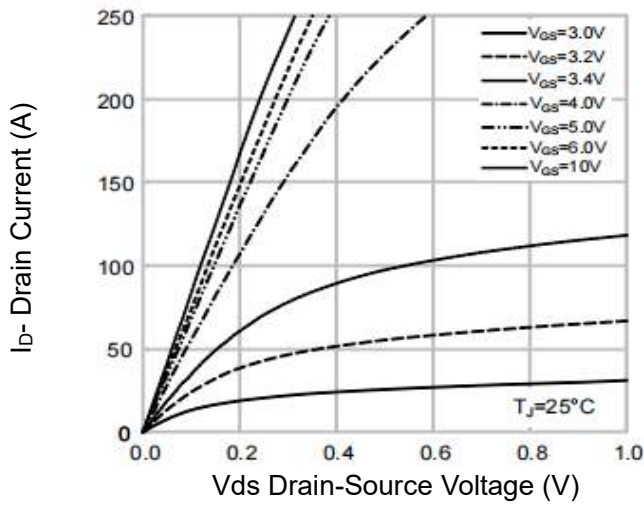


Figure 1 Output Characteristics

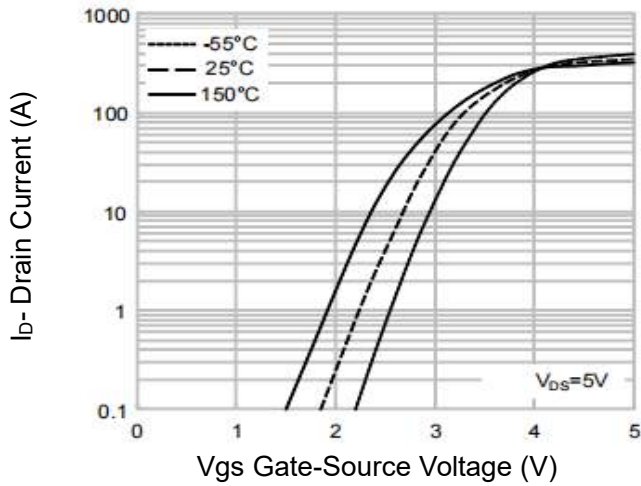


Figure 2 Transfer Characteristics

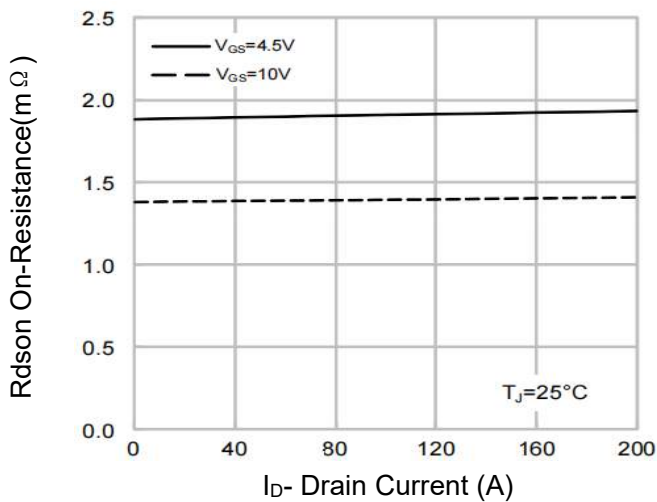


Figure 3 Rdson- Drain Current

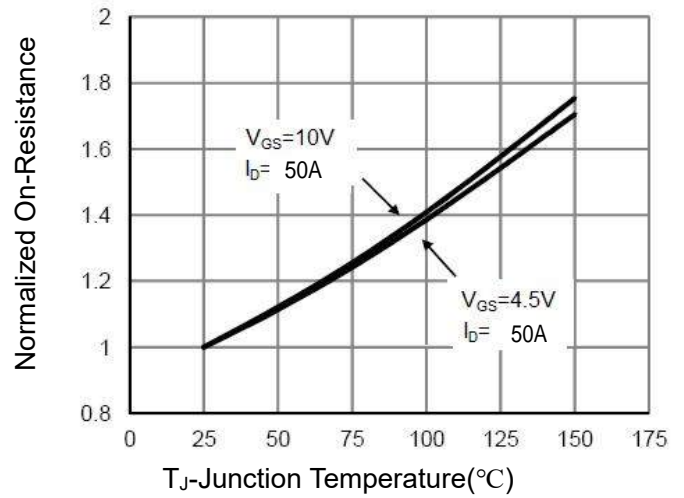


Figure 4 Rdson-Junction Temperature

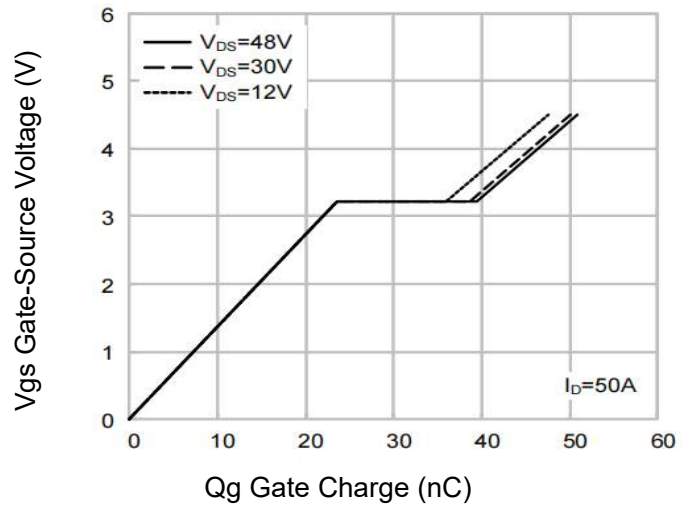


Figure 5 Gate Charge

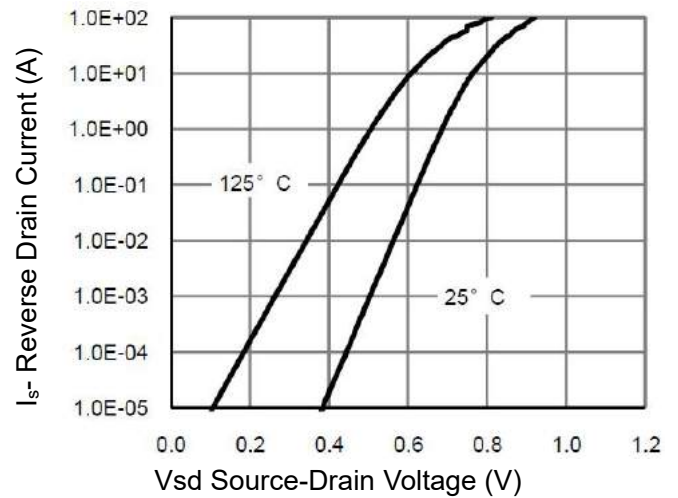


Figure 6 Source- Drain Diode Forward

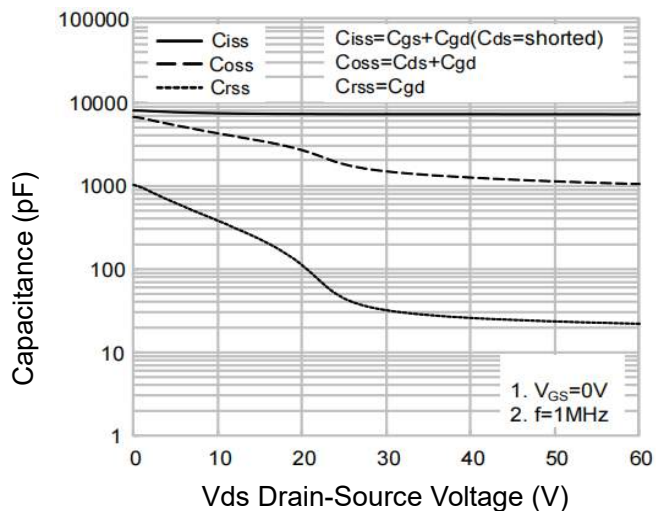


Figure 7 Capacitance vs Vds

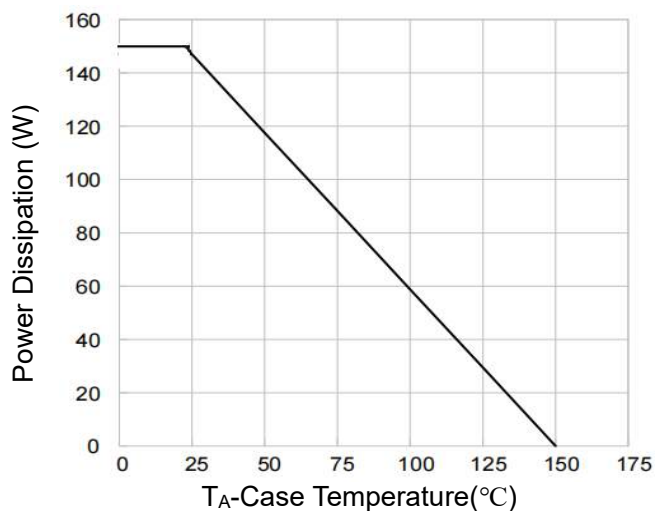


Figure 9 Power De-rating

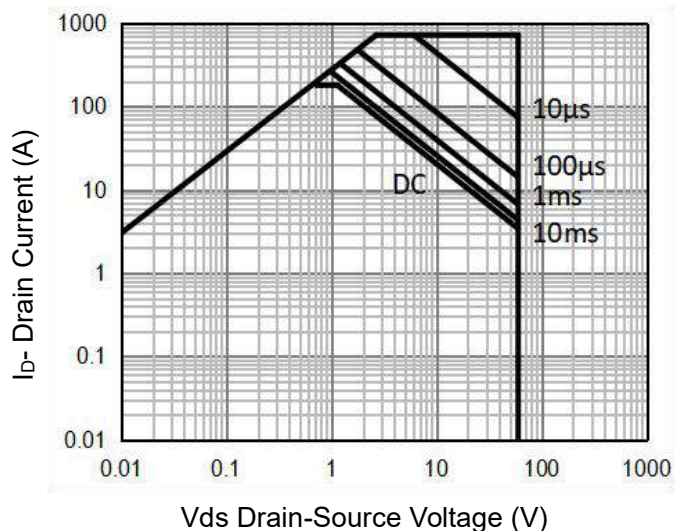


Figure 8 Safe Operation Area<sup>(Note 3)</sup>

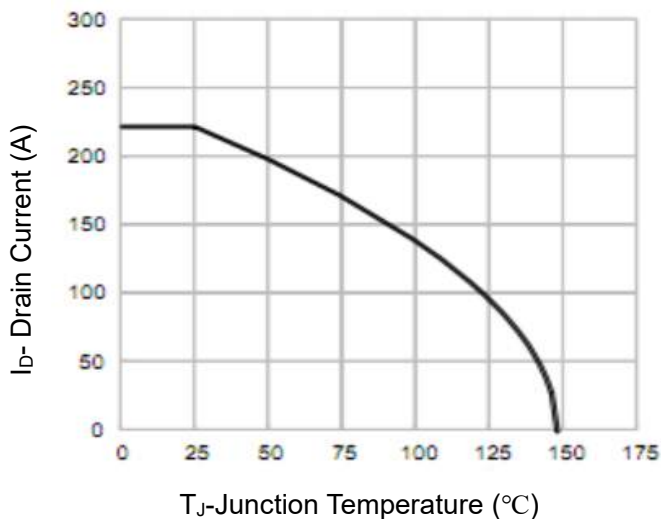


Figure 10 Current De-rating

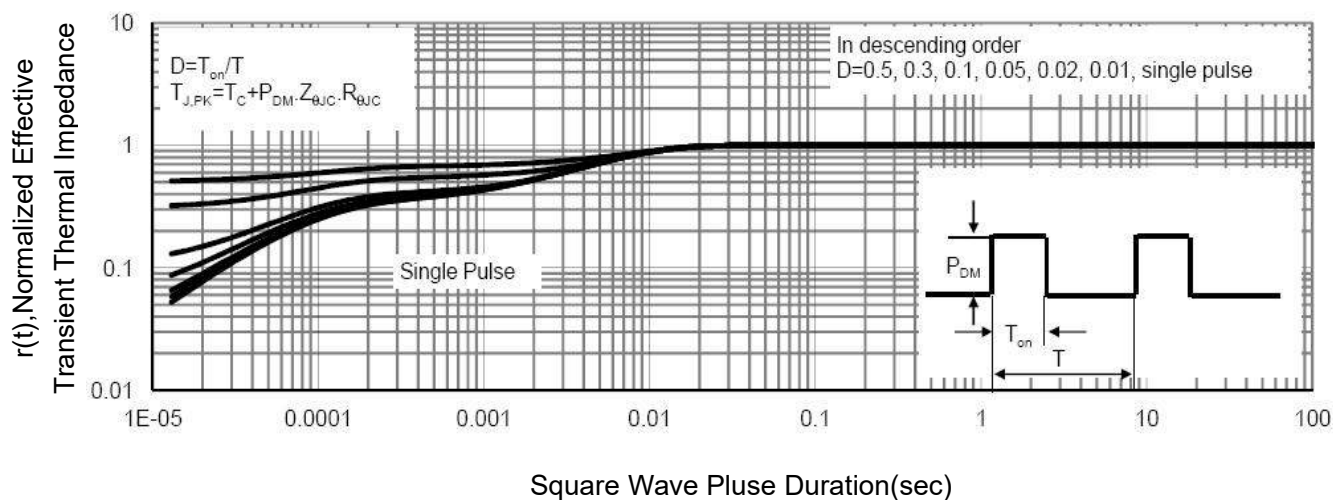
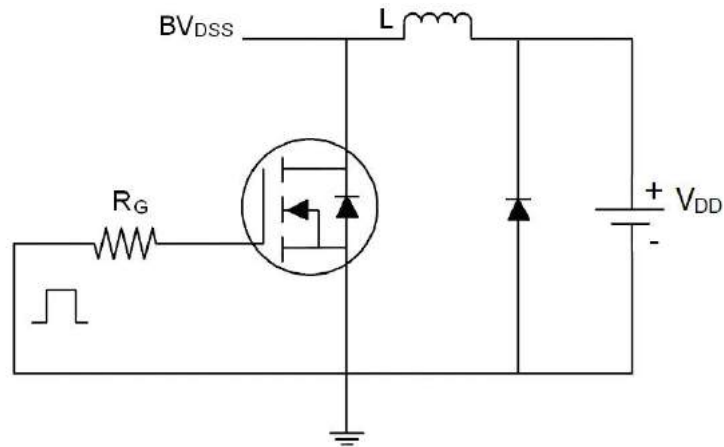


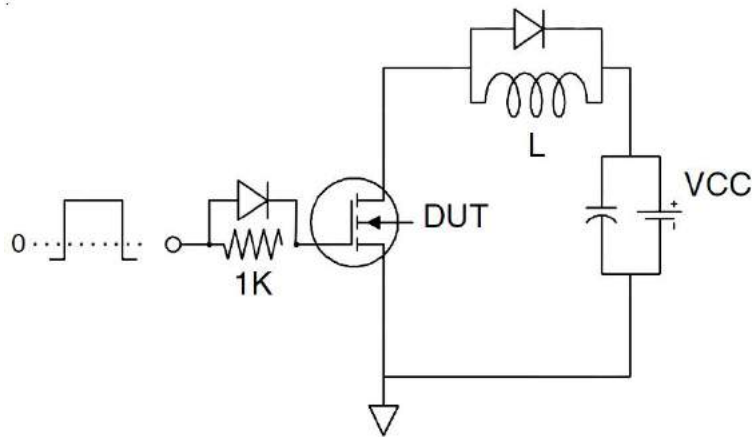
Figure 11 Normalized Maximum Transient Thermal Impedance

### Test Circuit

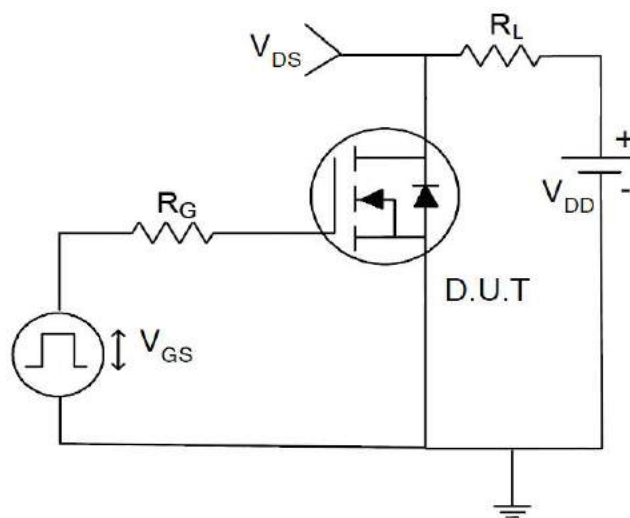
#### 1) $E_{AS}$ test Circuit



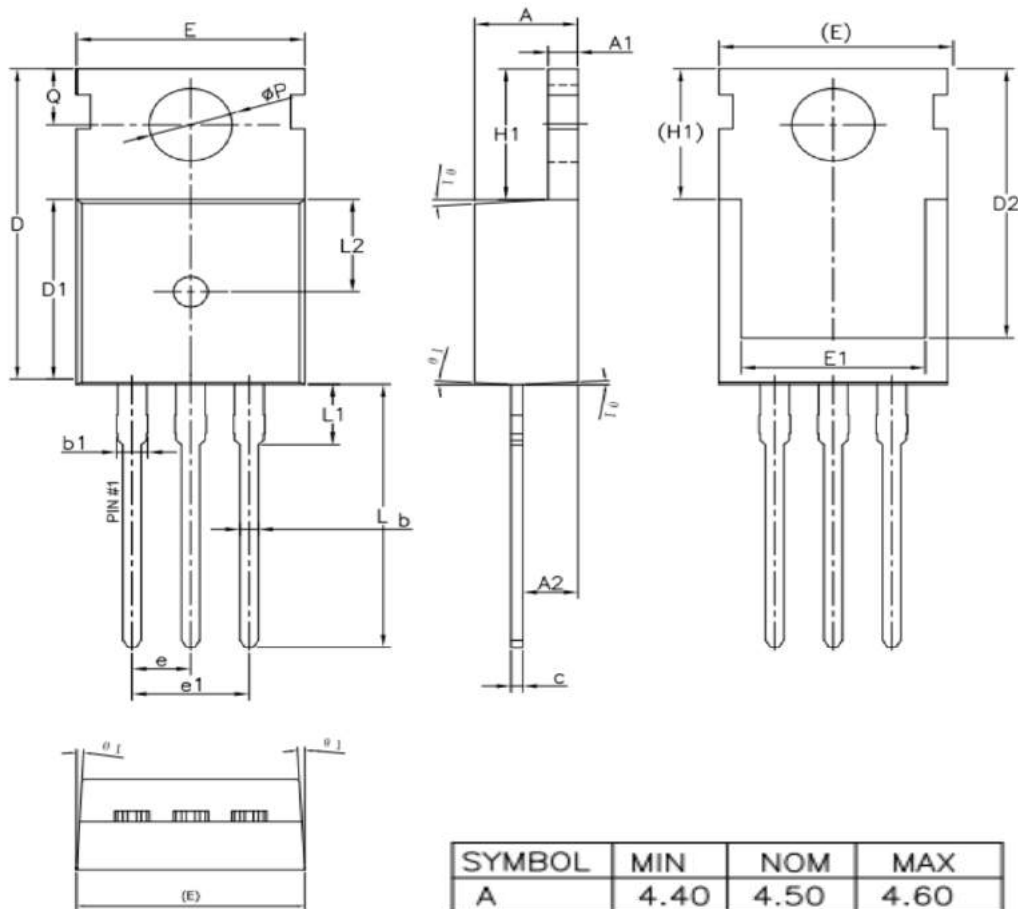
#### 2) Gate charge test Circuit



#### 3) Switch Time Test Circuit



## TO-220-3L Package Information



| SYMBOL     | MIN     | NOM   | MAX   |
|------------|---------|-------|-------|
| A          | 4.40    | 4.50  | 4.60  |
| A1         | 1.27    | 1.30  | 1.33  |
| A2         | 2.30    | 2.40  | 2.50  |
| b          | 0.70    | —     | 0.90  |
| b1         | 1.27    | —     | 1.40  |
| c          | 0.45    | 0.50  | 0.60  |
| D          | 15.30   | 15.70 | 16.10 |
| D1         | 9.10    | 9.20  | 9.30  |
| D2         | 13.10   | —     | 13.70 |
| E          | 9.70    | 9.90  | 10.20 |
| E1         | 7.80    | 8.00  | 8.20  |
| e          | 2.54BSC |       |       |
| e1         | 5.08BSC |       |       |
| H1         | 6.30    | 6.50  | 6.70  |
| L          | 12.78   | 13.08 | 13.38 |
| L1         | —       | —     | 3.50  |
| L2         | 4.60REF |       |       |
| $\phi P$   | 3.55    | 3.60  | 3.65  |
| Q          | 2.73    | —     | 2.87  |
| $\theta 1$ | 1°      | 3°    | 5°    |

## Customer Service

Sales and Service:

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