



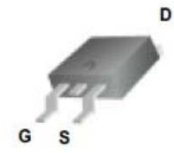
**PIN Connection TO-251/252**

**General Description :**

FIR5N50BPG,LG the silicon N-channel Enhanced VDMOSFETs, is obtained by the self-aligned planar Technology which reduce the conduction loss, improve switching performance and enhance the avalanche energy. The transistor can be used in various power switching circuit for system miniaturization and higher efficiency. The package form is TO-251 TO-252, which accords with the RoHS standard.

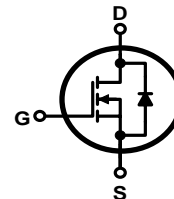


TO-251



TO-252

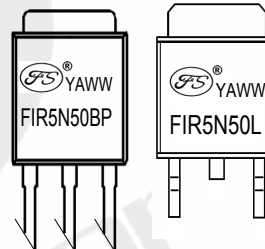
**Schematic diagram**



**Features :**

- l **Fast Switching**
- l **Low ON Resistance**( $R_{ds(on)} \leq 1.5\Omega$ )
- l **Low Gate Charge** (Typical Data: 12.6nC)
- l **Low Reverse transfer capacitances**(Typical:4pF)
- l **100% Single Pulse avalanche energy Test**

**Marking Diagram**



- Y = Year
- A = Assembly Location
- WW = Work Week
- FIR5N50BP/L = Specific Device Code

**Applications:**

Power switch circuit of adaptor and charger.

**Absolute** (Tc= 25°C unless otherwise specified):

| Symbol                            | Parameter  | Rating          | Units |
|-----------------------------------|--|-----------------|-------|
| V <sub>DSS</sub>                  | Drain-to-Source Voltage                          | 500             | V     |
| I <sub>D</sub>                    | Continuous Drain Current                         | 5               | A     |
|                                   | Continuous Drain Current T <sub>C</sub> = 100 °C | 3.1             | A     |
| I <sub>DM</sub> <sup>a1</sup>     | Pulsed Drain Current                             | 20              | A     |
| V <sub>GS</sub>                   | Gate-to-Source Voltage                           | ± 30            | V     |
| E <sub>AS</sub> <sup>a2</sup>     | Single Pulse Avalanche Energy                    | 250             | mJ    |
| dv/dt <sup>a3</sup>               | Peak Diode Recovery dv/dt                        | 5.0             | V/ns  |
| P <sub>D</sub>                    | Power Dissipation                                | 75              | W     |
|                                   | Derating Factor above 25°C                       | 0.60            | W/°C  |
| T <sub>J</sub> , T <sub>stg</sub> | Operating Junction and Storage Temperature Range | 150, -55 to 150 | °C    |
| T <sub>L</sub>                    | Maximum Temperature for Soldering                | 300             | °C    |



**Electrical Characteristics** (Tc= 25°C unless otherwise specified):

| <b>OFF Characteristics</b>          |                                   |  |        |      |      |       |
|-------------------------------------|-----------------------------------|--|--------|------|------|-------|
| Symbol                              | Parameter                         | Test Conditions  | Rating |      |      | Units |
|                                     |                                   |  | Min.   | Typ. | Max. |       |
| V <sub>DSS</sub>                    | Drain to Source Breakdown Voltage | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                           | 500    | --   | --   | V     |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | Bvdss Temperature Coefficient     | I <sub>D</sub> =250uA, Reference 25°C                                | --     | 0.6  | --   | V/°C  |
| I <sub>DSS</sub>                    | Drain to Source Leakage Current   | V <sub>DS</sub> = 500V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 25°C  | --     | --   | 1    | μA    |
|                                     |                                   | V <sub>DS</sub> = 400V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 125°C | --     | --   | 100  | μA    |
| I <sub>GSS(F)</sub>                 | Gate to Source Forward Leakage    | V <sub>GS</sub> = +30V   | --     | --   | 100  | nA    |
| I <sub>GSS(R)</sub>                 | Gate to Source Reverse Leakage    | V <sub>GS</sub> = -30V   | --     | --   | -100 | nA    |

| <b>ON Characteristics</b>      |                               |  |        |      |      |       |
|--------------------------------|-------------------------------|--|--------|------|------|-------|
| Symbol                         | Parameter                     | Test Conditions  | Rating |      |      | Units |
|                                |                               |  | Min.   | Typ. | Max. |       |
| R <sub>DS(ON)</sub>            | Drain-to-Source On-Resistance | V <sub>GS</sub> =10V, I <sub>D</sub> =2.5A                 | --     | 1.3  | 1.5  | Ω     |
| V <sub>GS(TH)</sub>            | Gate Threshold Voltage        | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA | 2.0    | --   | 4.0  | V     |
| Pulse width tp ≤ 300μs, δ ≤ 2% |                               |  |        |      |      |       |

| <b>Dynamic Characteristics</b> |                              |  |        |      |      |       |
|--------------------------------|------------------------------|--|--------|------|------|-------|
| Symbol                         | Parameter                    | Test Conditions  | Rating |      |      | Units |
|                                |                              |  | Min.   | Typ. | Max. |       |
| g <sub>fs</sub>                | Forward Trans conductance    | V <sub>DS</sub> =15V, I <sub>D</sub> =2.5A               | --     | 4    | --   | S     |
| C <sub>iss</sub>               | Input Capacitance            | V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V<br>f = 1.0MHz | --     | 584  | --   | pF    |
| C <sub>oss</sub>               | Output Capacitance           |  | --     | 61   | --   |       |
| C <sub>rss</sub>               | Reverse Transfer Capacitance |  | --     | 4    | --   |       |

| <b>Resistive Switching Characteristics</b> |                                |   |        |      |      |       |
|--|--------------------------------|---|--------|------|------|-------|
| Symbol                                     | Parameter                      | Test Conditions   | Rating |      |      | Units |
|  |                                |   | Min.   | Typ. | Max. |       |
| t <sub>d(ON)</sub>                         | Turn-on Delay Time             | I <sub>D</sub> =5A V <sub>DD</sub> = 250V<br>R <sub>G</sub> =10   | --     | 14   | --   | ns    |
| t <sub>r</sub>                             | Rise Time                      |   | --     | 18   | --   |       |
| t <sub>d(OFF)</sub>                        | Turn-Off Delay Time            |   | --     | 32   | --   |       |
| t <sub>f</sub>                             | Fall Time                      |   | --     | 11   | --   |       |
| Q <sub>g</sub>                             | Total Gate Charge              | I <sub>D</sub> =5A V <sub>DD</sub> =400V<br>V <sub>GS</sub> = 10V | --     | 12.6 | --   | nC    |
| Q <sub>gs</sub>                            | Gate to Source Charge          |   | --     | 3.1  | --   |       |
| Q <sub>gd</sub>                            | Gate to Drain ("Miller")Charge |   | --     | 4.9  | --   |       |



| Source-Drain Diode Characteristics               |  |   |        |      |      |       |
|--|--|---|--------|------|------|-------|
| Symbol   | Parameter                              | Test Conditions   | Rating |      |      | Units |
|  |  |   | Min.   | Typ. | Max. |       |
| $I_S$  | Continuous Source Current (Body Diode) |   | --     | --   | 5    | A     |
| $I_{SM}$   | Maximum Pulsed Current (Body Diode)    |   | --     | --   | 20   | A     |
| $V_{SD}$   | Diode Forward Voltage                  | $I_S=5.0A, V_{GS}=0V$   | --     | --   | 1.5  | V     |
| $t_{rr}$   | Reverse Recovery Time                  | $I_S=5.0A, T_j = 25^\circ C$<br>$dI_F/dt=100A/us,$<br>$V_{GS}=0V$ | --     | 328  | --   | ns    |
| $Q_{rr}$   | Reverse Recovery Charge                |   | --     | 1555 | --   | nC    |
| $I_{RRM}$  | Reverse Recovery Current               |   | --     | 9.5  | --   | A     |
| Pulse width $t_p \leq 300\mu s, \delta \leq 2\%$ |  |   |        |      |      |       |

| Symbol          | Parameter           | Typ. | Units        |
|-----------------|---------------------|------|--------------|
| $R_{\theta JC}$ | Junction-to-Case    | 1.67 | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction-to-Ambient | 100  | $^\circ C/W$ |

<sup>a1</sup>: Repetitive rating; pulse width limited by maximum junction temperature

<sup>a2</sup>:  $L=10mH, I_D=7.1A, \text{Start } T_j=25^\circ C$

<sup>a3</sup>:  $I_{SD}=5A, di/dt \leq 100A/us, V_{DD} \leq BV_{DS}, \text{Start } T_j=25^\circ C$



Characteristics Curve:

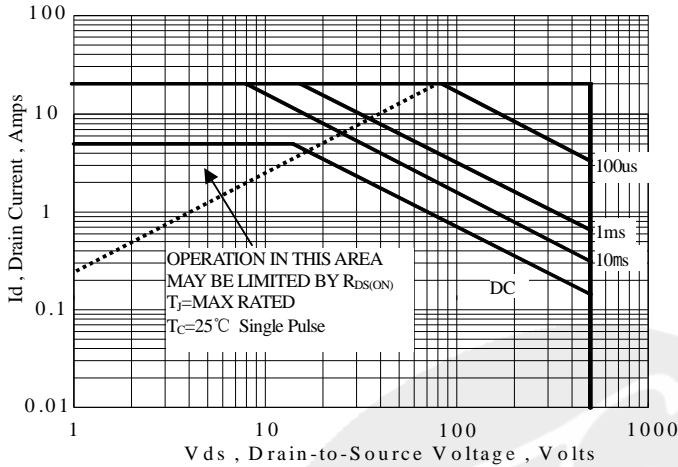


Figure 1 Maximum Forward Bias Safe Operating Area

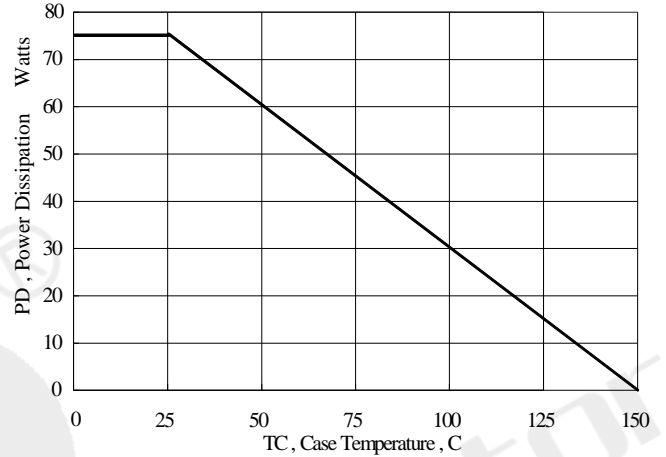


Figure 2 Maximum Power Dissipation vs Case Temperature

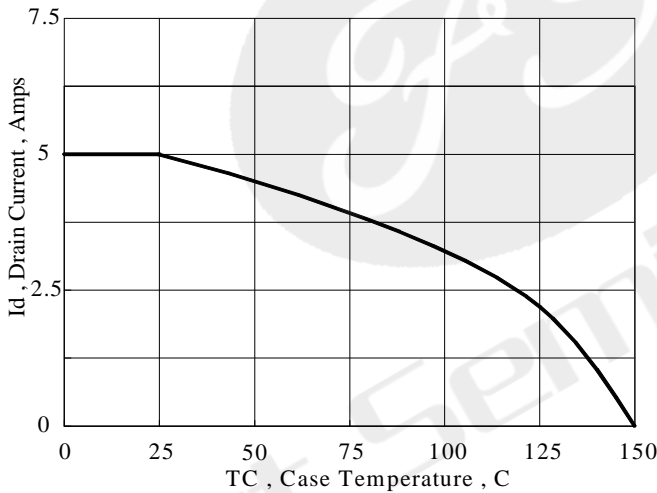


Figure 3 Maximum Continuous Drain Current vs Case Temperature

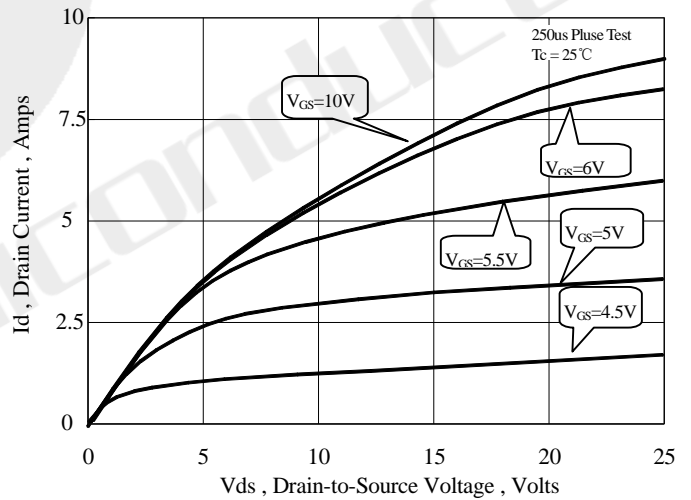


Figure 4 Typical Output Characteristics

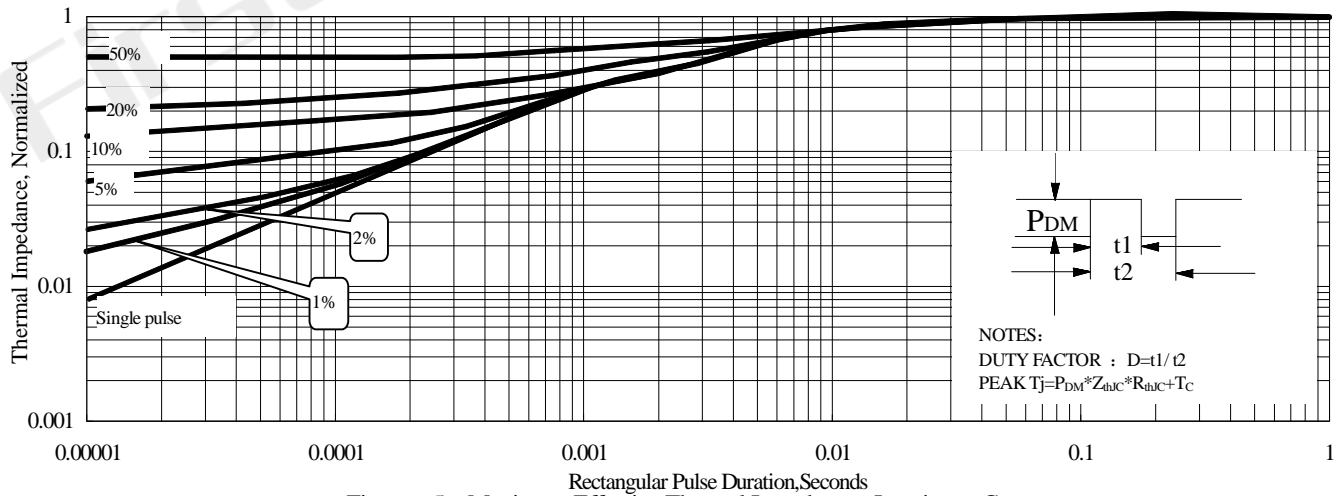


Figure 5 Maximum Effective Thermal Impedance , Junction to Case

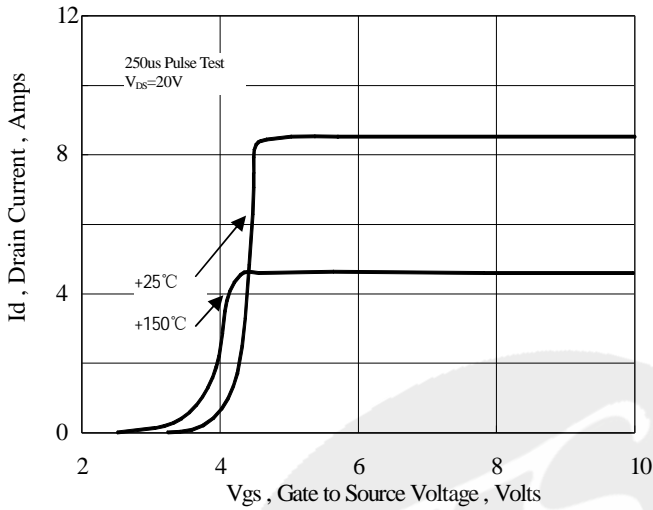


Figure 6 Typical Transfer Characteristics

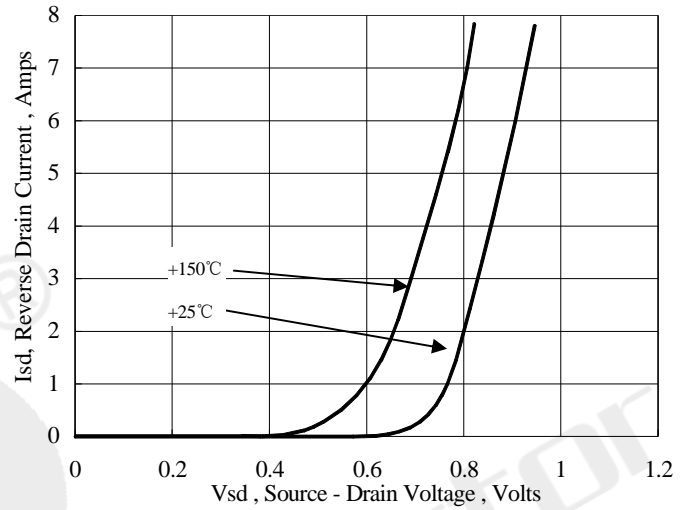


Figure 7 Typical Body Diode Transfer Characteristics

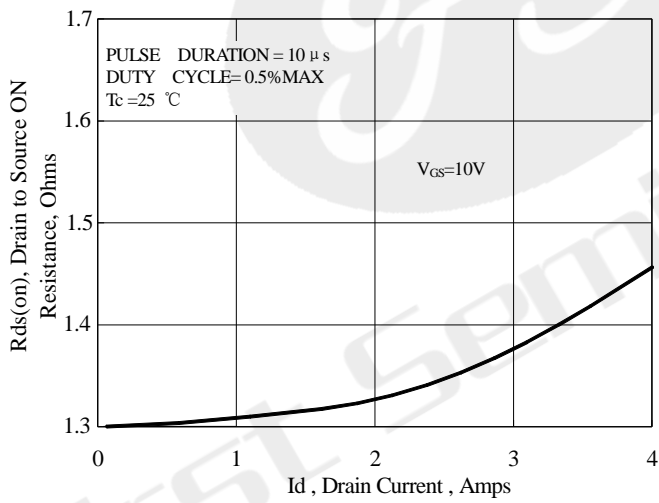


Figure 8 Typical Drain to Source ON Resistance vs Drain Current

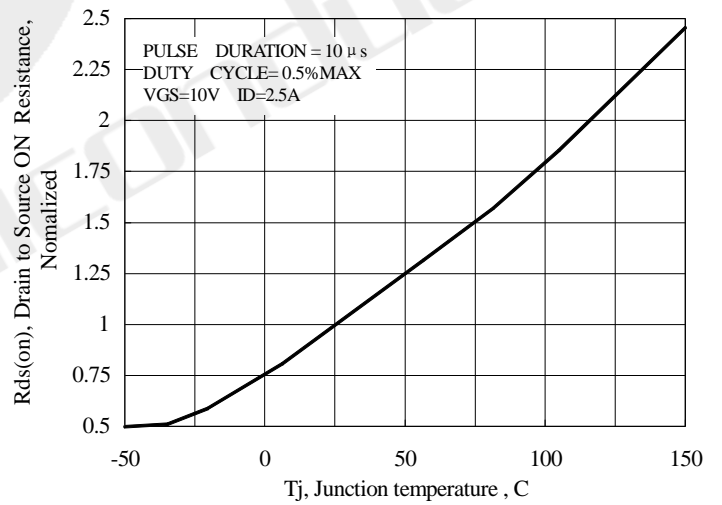


Figure 9 Typical Drain to Source on Resistance vs Junction Temperature

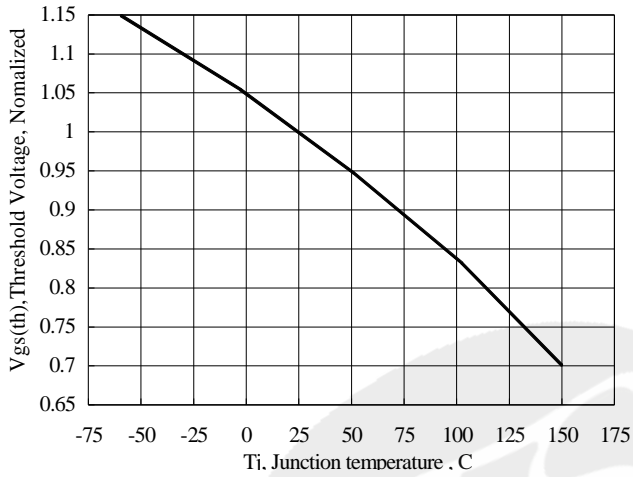


Figure 10 Typical Theshold Voltage vs Junction Temperature

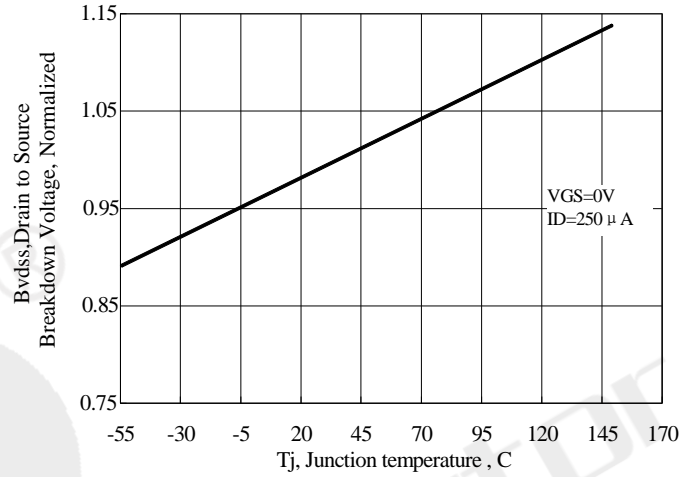


Figure 11 Typical Breakdown Voltage vs Junction Temperature

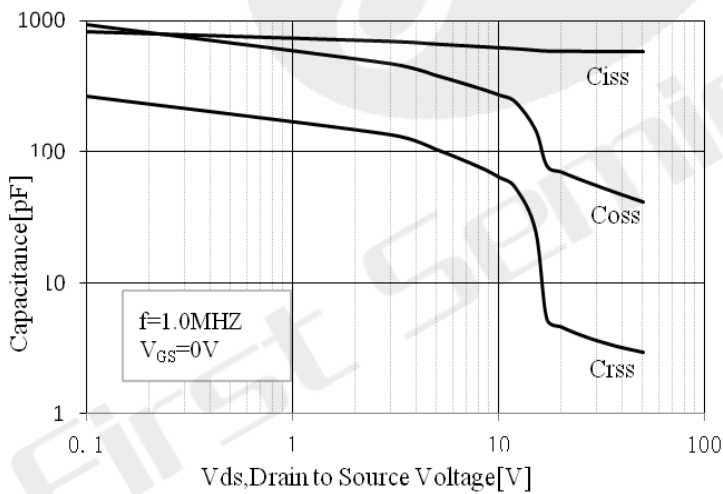


Figure 12 Typical Capacitance vs Drain to Source Voltage

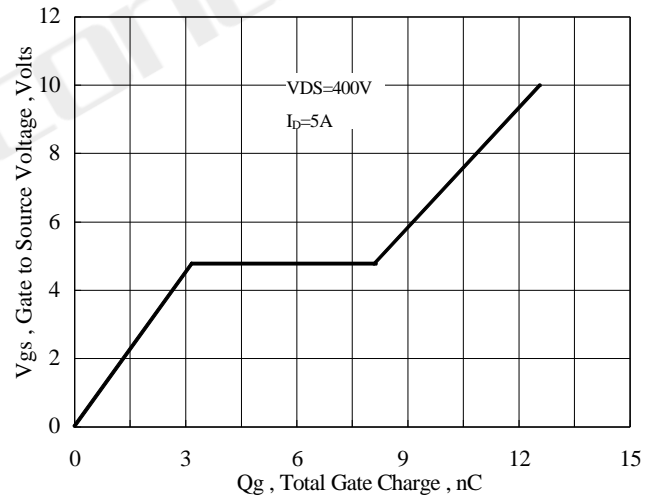


Figure 13 Typical Gate Charge vs Gate to Source Voltage

Test Circuit and Waveform

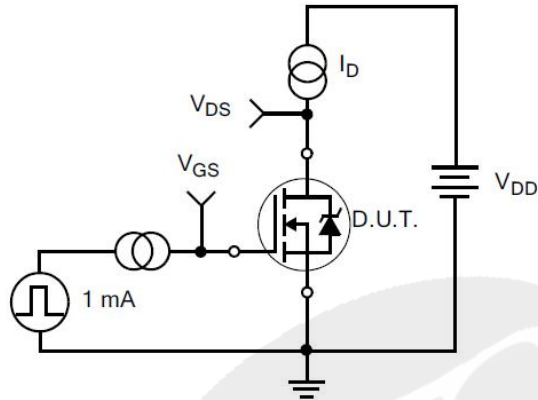


Figure 17. Gate Charge Test Circuit

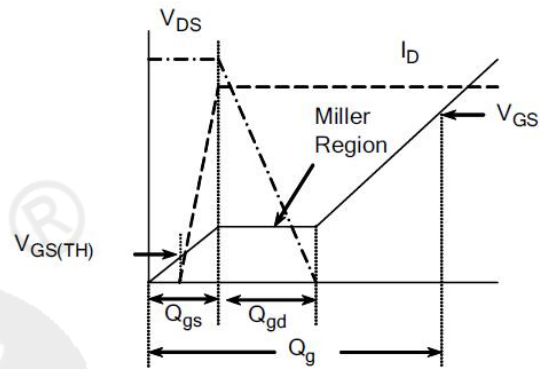


Figure 18. Gate Charge Waveform

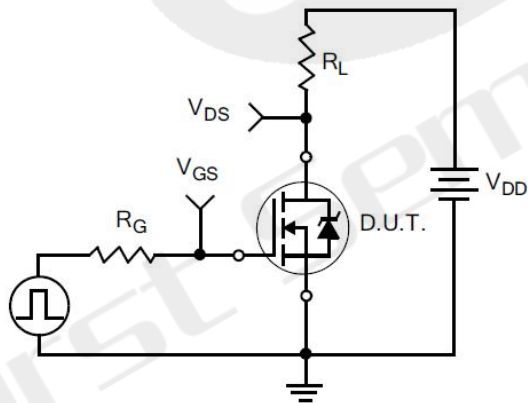


Figure 19. Resistive Switching Test Circuit

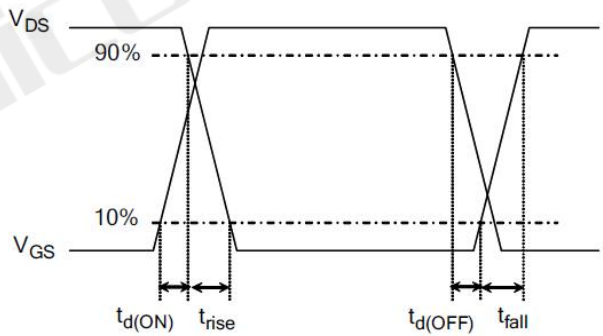


Figure 20. Resistive Switching Waveforms

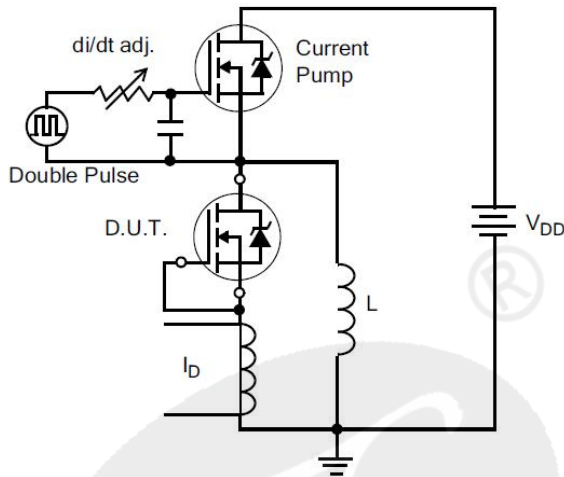


Figure 21. Diode Reverse Recovery Test Circuit

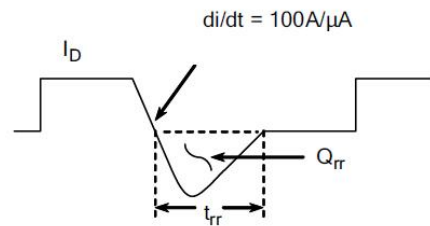


Figure 22. Diode Reverse Recovery Waveform

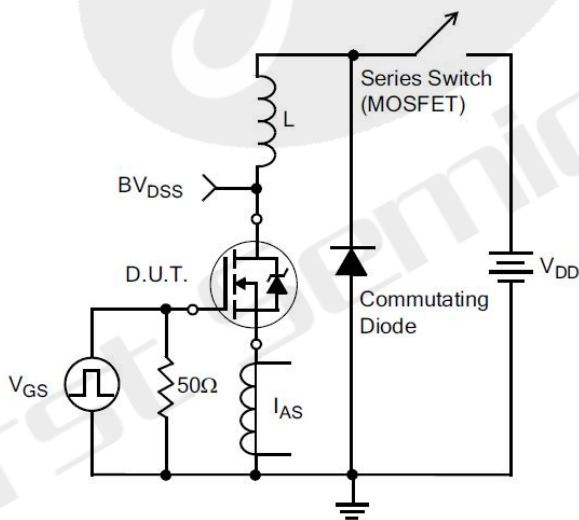


Figure 23. Unclamped Inductive Switching Test Circuit

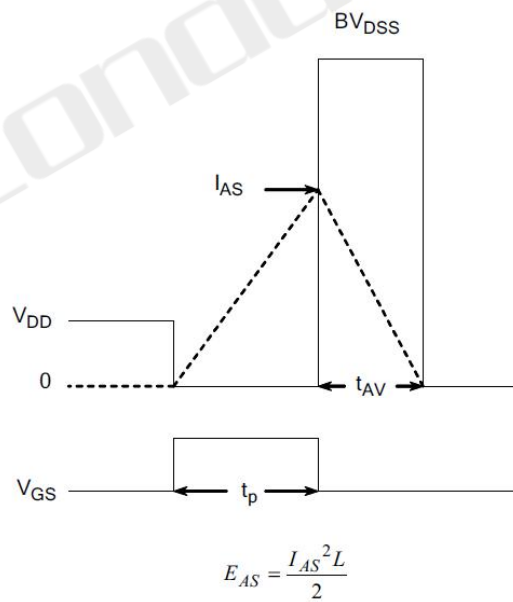
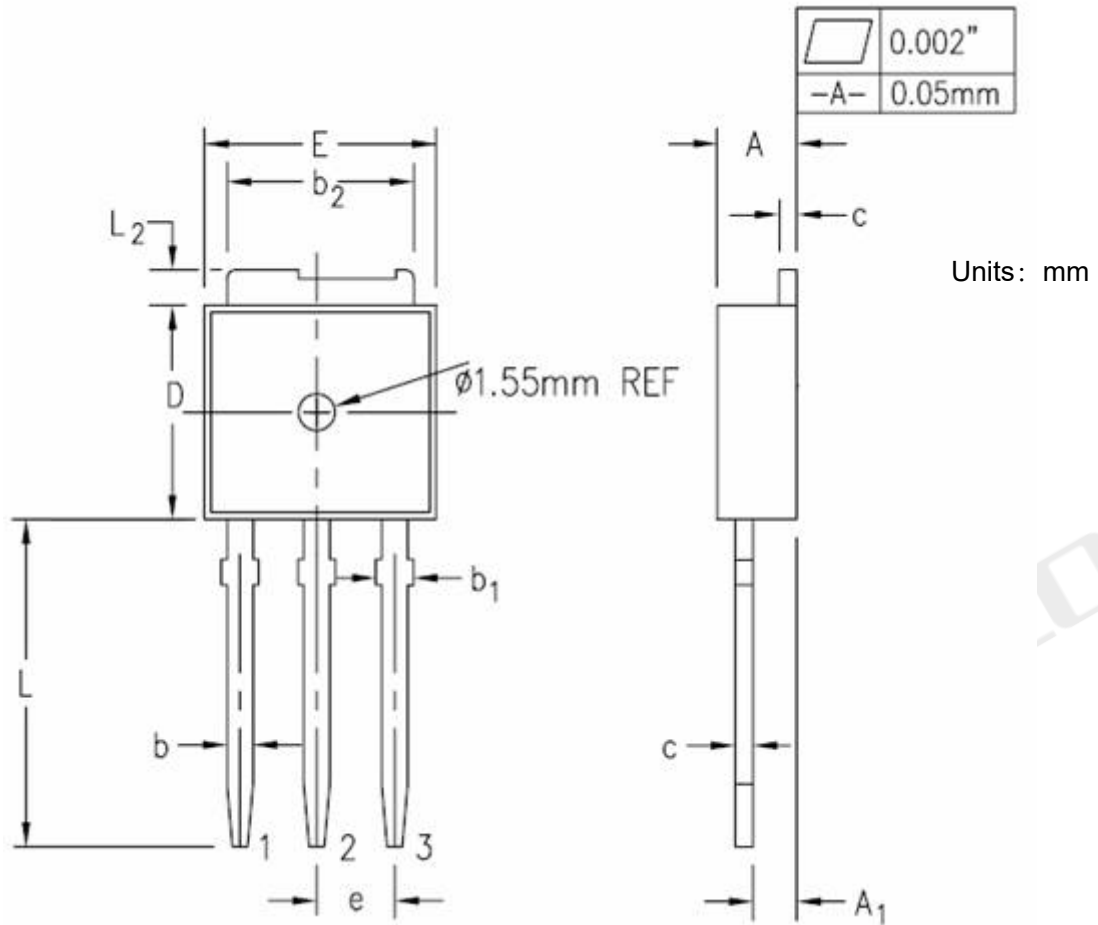


Figure 24. Unclamped Inductive Switching Waveforms



TO-251



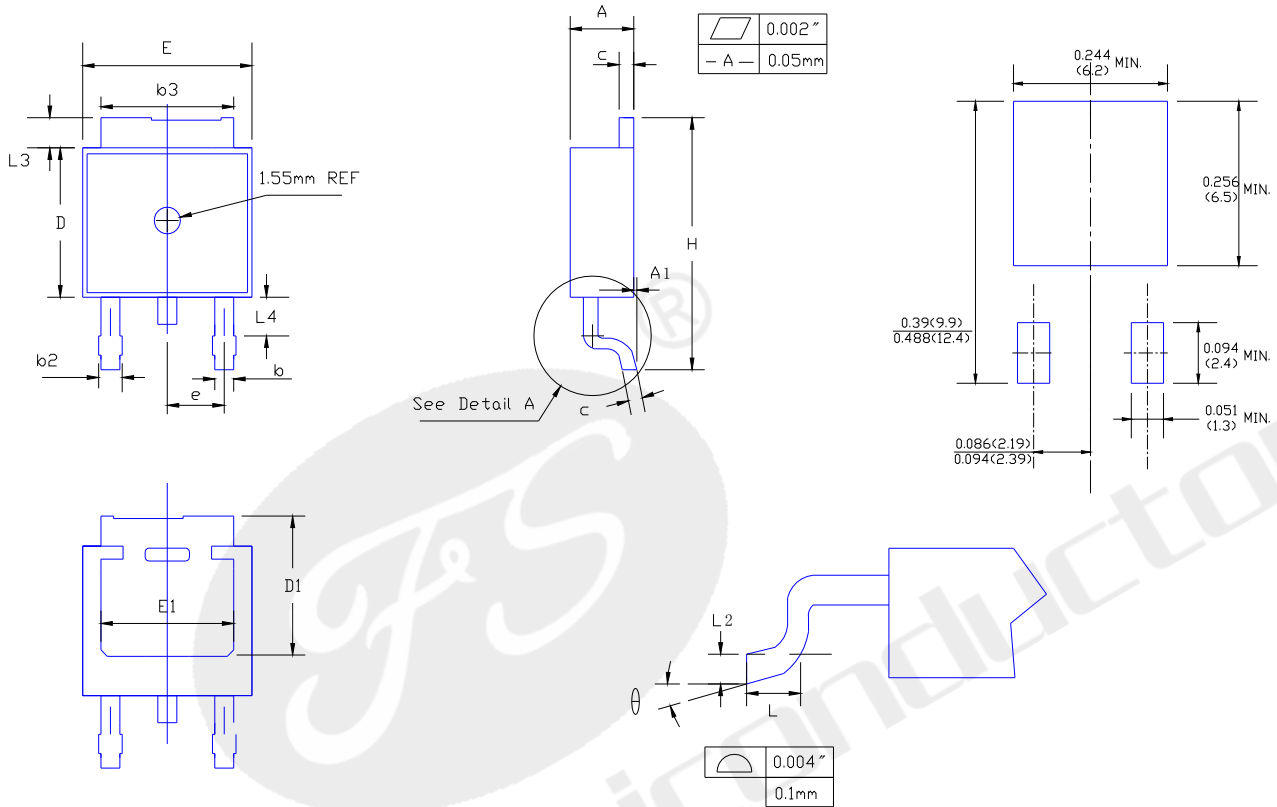
| SYMBOL | INCHES     |       | MILLIMETERS |      | NOTES |
|--------|------------|-------|-------------|------|-------|
|        | MIN        | MAX   | MIN         | MAX  |       |
| A      | 0.086      | 0.094 | 2.19        | 2.38 |       |
| A1     | 0.041      | 0.048 | 1.04        | 1.23 |       |
| b      | 0.025      | 0.035 | 0.64        | 0.89 |       |
| b1     | 0.027      | 0.039 | 0.69        | 0.92 |       |
| b2     | 0.206      | 0.216 | 5.23        | 5.48 |       |
| c      | 0.018      | 0.024 | 0.46        | 0.61 |       |
| D      | 0.241      | 0.249 | 6.12        | 6.32 |       |
| E      | 0.250      | 0.265 | 6.35        | 6.73 |       |
| e      | 0.090 TYP. |       | 2.28 TYP.   |      |       |
| L      | 0.350      | 0.380 | 8.89        | 9.65 |       |
| L2     | 0.035      | 0.050 | 0.89        | 1.27 |       |



Unit: mm

**Package Dimension**

**TO-252**



| SYMBOL   | INCHES     |       | MILLIMETERS |       | NOTES |
|----------|------------|-------|-------------|-------|-------|
|          | MIN        | MAX   | MIN         | MAX   |       |
| A        | 0.086      | 0.094 | 2.19        | 2.38  |       |
| A1       | -          | 0.005 | -           | 0.13  |       |
| b        | 0.025      | 0.035 | 0.64        | 0.89  |       |
| b2       | 0.033      | 0.045 | 0.84        | 1.14  |       |
| b3       | 0.205      | 0.215 | 5.21        | 5.46  |       |
| c        | 0.018      | 0.024 | 0.46        | 0.61  |       |
| D        | 0.241      | 0.249 | 6.12        | 6.32  |       |
| D1       | 0.205      | -     | 5.21        | -     |       |
| E        | 0.250      | 0.265 | 6.35        | 6.73  |       |
| E1       | 0.190      | -     | 4.83        | -     |       |
| e        | 0.090 BSC. |       | 2.29 BSC.   |       |       |
| H        | 0.380      | 0.410 | 9.65        | 10.41 |       |
| L        | 0.055      | 0.070 | 1.40        | 1.78  |       |
| L2       | 0.020 BSC. |       | 0.51 BSC.   |       |       |
| L3       | 0.035      | 0.050 | 0.89        | 1.27  |       |
| L4       | 0.025      | 0.040 | 0.64        | 1.01  |       |
| $\theta$ | 0°         | 8°    | 0°          | 8°    |       |



Declaration

- FIRST reserves the right to change the specifications, the same specifications of products due to different packaging line mold, the size of the appearance will be slightly different, shipped in kind, without notice! Customers should obtain the latest version information before ordering, and verify whether the relevant information is complete and up-to-date.
- Any semiconductor product under certain conditions has the possibility of failure or failure, The buyer has the responsibility to comply with safety standards and take safety measures when using FIRST products for system design and manufacturing, To avoid To avoid potential failure risks, which may cause personal injury or property damage!
- Product promotion endless, our company will wholeheartedly provide customers with better products!

**ATTACHMENT**

Revision History

| Date       | REV | Description     | Page |
|------------|-----|-----------------|------|
| 2018.01.01 | 1.0 | Initial release |      |