

## MOSFET

52A,60V,15mΩ,N-CHANNEL MOSFET

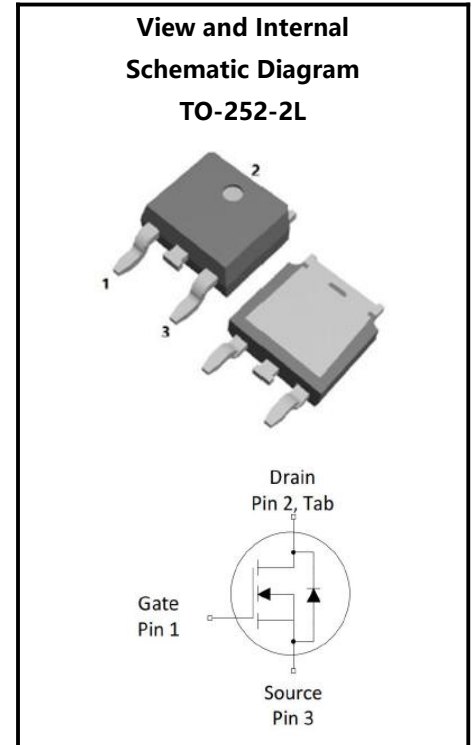
### Features

- ◆ Low gate charge
- ◆ Low Ciss
- ◆ Fast switching

### Applications

- ◆ High Efficiency Synchronous Rectification in SMPS
- ◆ Uninterruptible Power Supply
- ◆ High Speed Power Switching
- ◆ Hard Switched and High Frequency Circuits

| Parameter         | Values | Unit |
|-------------------|--------|------|
| $BV_{DSS}$        | 60     | V    |
| $I_D$             | 52     | A    |
| $R_{Dson(max)}$   | 15     | mΩ   |
| $V_{GS(th)}(Typ)$ | 1.54   | V    |



| Ordering Code | Marking     | Package   | Packaging     |
|---------------|-------------|-----------|---------------|
| X15N060TLE2   | X15N060TLE2 | TO-252-2L | Tape and Reel |

### Absolute Maximum Ratings( $T_C=25^{\circ}\text{C}$ , unless otherwise noted)

| Parameter                                        | Symbol         | Values |     |     | Unit               | Note/Test Conditions                                     |
|--------------------------------------------------|----------------|--------|-----|-----|--------------------|----------------------------------------------------------|
|                                                  |                | Min    | Typ | Max |                    |                                                          |
| Drain-Source Voltage                             | $V_{DS}$       | -      | -   | 60  | V                  | -                                                        |
| Gate-Source Voltage                              | $V_{GS}$       | -20    | -   | 20  | V                  | -                                                        |
| Continuous Drain Current(Note 1)                 | $I_D$          | -      | -   | 52  | A                  | $T_C=25^{\circ}\text{C}$                                 |
|                                                  |                | -      | -   | 33  | A                  | $T_C=100^{\circ}\text{C}$                                |
| Pulsed Drain Current(Note 2)                     | $I_{DM}$       | -      | -   | 208 | A                  | -                                                        |
| Single Pulse Avalanche Energy                    | $E_{AS}$       | -      | -   | 81  | mJ                 | $L=0.5\text{mH}, V_D=48\text{V}, T_C=25^{\circ}\text{C}$ |
| Maximum Power Dissipation                        | $P_D$          | -      | -   | 86  | W                  | $T_C=25^{\circ}\text{C}$                                 |
|                                                  |                | -      | -   | 3.4 | W                  | $T_A=25^{\circ}\text{C}$                                 |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -50    | -   | 150 | $^{\circ}\text{C}$ | -                                                        |

### Thermal Characteristics

| Parameter                                | Symbol        | Values |      |     | Unit                        | Note/Test Conditions |
|------------------------------------------|---------------|--------|------|-----|-----------------------------|----------------------|
|                                          |               | Min    | Typ  | Max |                             |                      |
| Thermal resistance , Junction to Case    | $R_{th(J-c)}$ | -      | 1.45 | -   | $^{\circ}\text{C}/\text{W}$ | -                    |
| Thermal resistance , Junction to Ambient | $R_{th(J-a)}$ | -      | 36   | -   |                             | -                    |

## Electrical Characteristics ( $T_j=25^{\circ}\text{C}$ , unless otherwise noted)

### Static characteristics

| Parameter                          | Symbol       | Values |      |      | Unit       | Note/Test Conditions                  |
|------------------------------------|--------------|--------|------|------|------------|---------------------------------------|
|                                    |              | Min    | Typ  | Max  |            |                                       |
| Drain-Source Breakdown Voltage     | $BV_{DSS}$   | 60     | -    | -    | V          | $V_{GS}=0V, I_D=250\mu A$             |
| Zero Gate Voltage Drain Current    | $I_{DSS}$    | -      | -    | 1    | $\mu A$    | $V_{DS}=60V, V_{GS}=0V$               |
| Gate-Body Leakage Current, Forward | $I_{GSSF}$   | -      | -    | 100  | nA         | $V_{GS}=20V, V_{DS}=0V$               |
| Gate-Body Leakage Current, Reverse | $I_{GSSR}$   | -      | -    | -100 | nA         | $V_{GS}=-20V, V_{DS}=0V$              |
| Gate-Source Threshold Voltage      | $V_{GS(th)}$ | 1.2    | -    | 2.4  | V          | $V_{DS}=V_{GS}, I_D=250\mu A$         |
| Drain-Source On-State Resistance   | $R_{DS(on)}$ | -      | 12.4 | 15   | m $\Omega$ | $V_{GS}=10V, I_D=15A$                 |
|                                    |              | -      | 15.4 | 21   | m $\Omega$ | $V_{GS}=4.5V, I_D=10A$                |
| Gate Resistance                    | $R_g$        | -      | 2    | -    | $\Omega$   | $V_{GS}=0V, V_{DS}=0V, f=1\text{MHz}$ |

### Dynamic characteristics

| Parameter                    | Symbol       | Values |      |     | Unit | Note/Test Conditions                            |
|------------------------------|--------------|--------|------|-----|------|-------------------------------------------------|
|                              |              | Min    | Typ  | Max |      |                                                 |
| Input Capacitance            | $C_{iss}$    | -      | 2228 | -   | pF   | $V_{DS}=30V, V_{GS}=0V, f=1.0\text{MHz}$        |
| Output Capacitance           | $C_{oss}$    | -      | 104  | -   | pF   |                                                 |
| Reverse Transfer Capacitance | $C_{rss}$    | -      | 92   | -   | pF   |                                                 |
| Turn-On Delay Time           | $t_{d(on)}$  | -      | 16   | -   | ns   | $V_{DD}=39V, V_{GS}=10V, R_G=20\Omega, I_D=25A$ |
| Turn-On Rise Time            | $t_r$        | -      | 48   | -   | ns   |                                                 |
| Turn-Off Delay Time          | $t_{d(off)}$ | -      | 166  | -   | ns   |                                                 |
| Turn-Off Fall Time           | $t_f$        | -      | 83   | -   | ns   |                                                 |

### Gate charge characteristics

| Parameter          | Symbol   | Values |     |     | Unit | Note/Test Conditions              |
|--------------------|----------|--------|-----|-----|------|-----------------------------------|
|                    |          | Min    | Typ | Max |      |                                   |
| Total Gate Charge  | $Q_g$    | -      | 43  | -   | nC   | $V_{DS}=30V, I_D=25A, V_{GS}=10V$ |
| Gate-Source Charge | $Q_{gs}$ | -      | 9   | -   | nC   |                                   |
| Gate-Drain Charge  | $Q_{gd}$ | -      | 9   | -   | nC   |                                   |

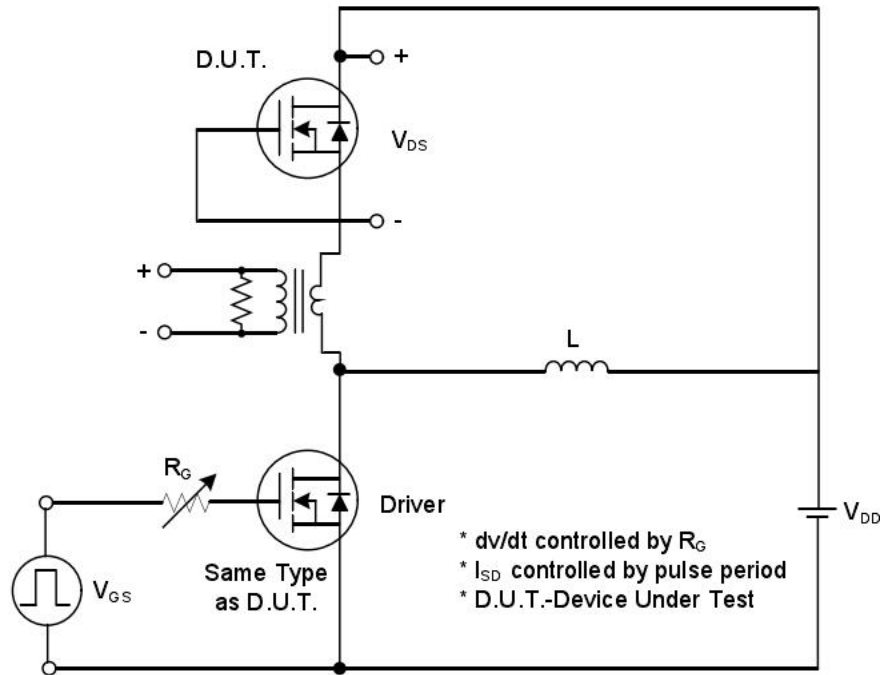
### Reverse diode

| Parameter                        | Symbol   | Values |     |     | Unit | Note/Test Conditions             |
|----------------------------------|----------|--------|-----|-----|------|----------------------------------|
|                                  |          | Min    | Typ | Max |      |                                  |
| Continuous Diode Forward Current | $I_S$    | -      | -   | 52  | A    | -                                |
| Pulsed Diode Forward Current     | $I_{SM}$ | -      | -   | 208 | A    | -                                |
| Diode Forward Voltage            | $V_{SD}$ | -      | -   | 1.2 | V    | $I_S=15A, V_{GS}=0V$             |
| Reverse Recovery Time            | $t_{rr}$ | -      | 26  | -   | ns   | $V_{DS}=51V, V_{GS}=0V, I_S=25A$ |
| Reverse Recovery Charge          | $Q_{rr}$ | -      | 21  | -   | nC   | $di/dt=100A/\mu s$               |

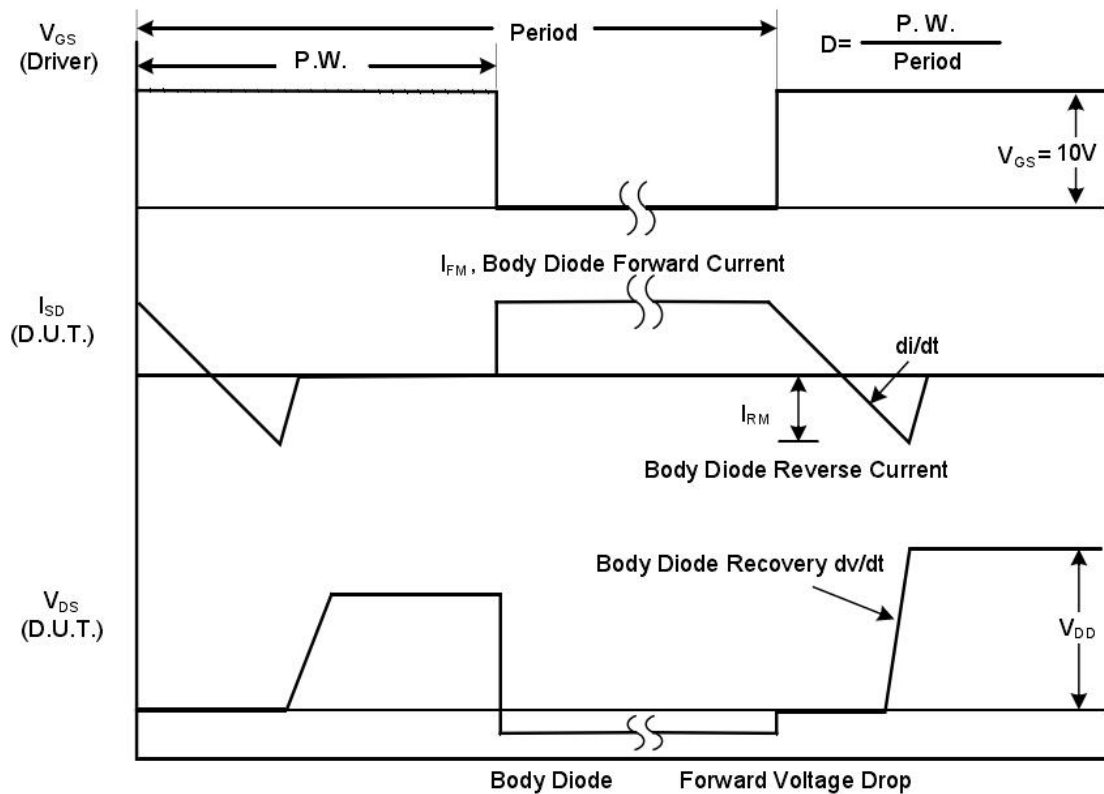
### Notes

1. Computed continuous current assumes the condition of  $T_{j\_Max}$  while the actual continuous current depends on the thermal & electro-mechanical application board design.
2. This single-pulse measurement was taken under  $T_{j\_Max} = 150^{\circ}\text{C}$ .

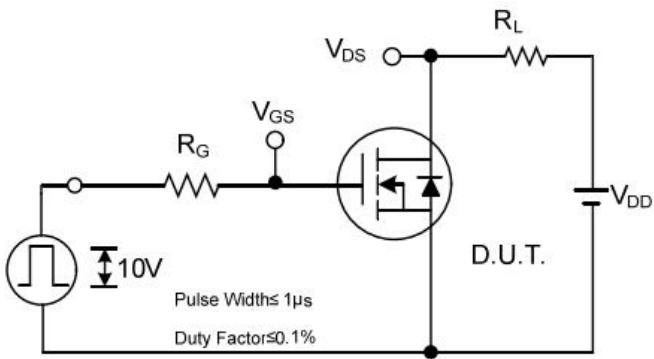
## RATING AND CHARACTERISTIC CURVES



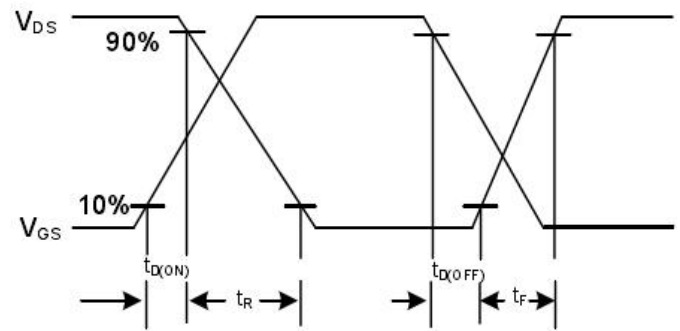
Peak Diode Recovery  $dv/dt$  Test Circuit



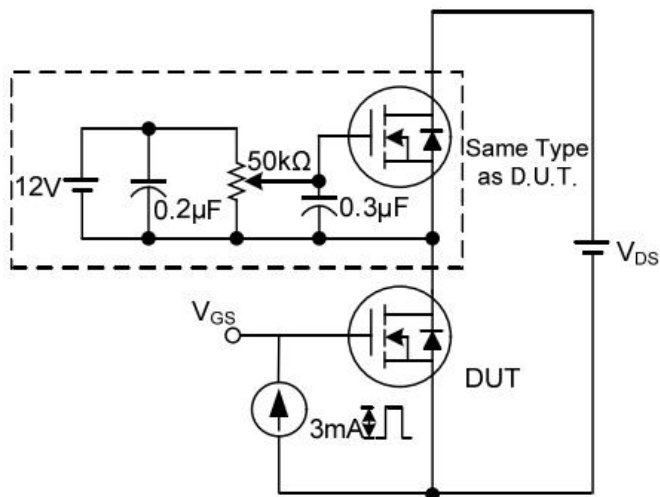
Peak Diode Recovery  $dv/dt$  Waveforms



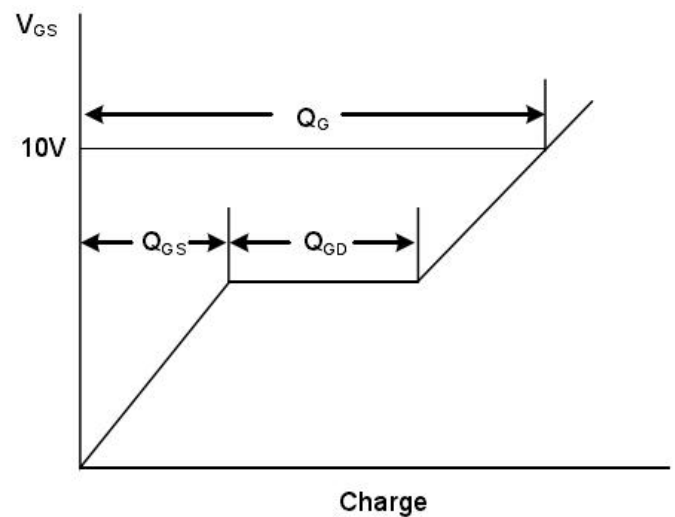
Switching Test Circuit



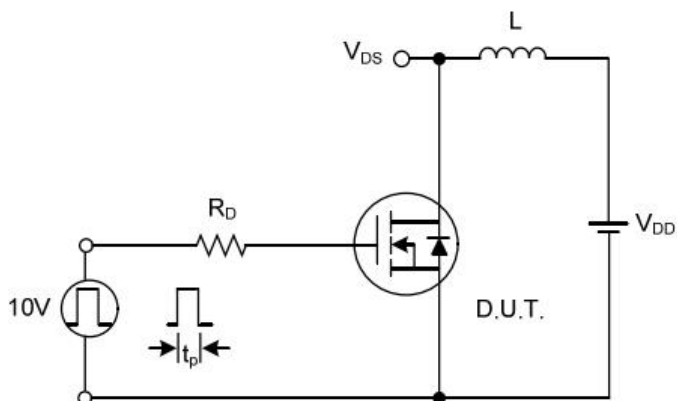
Switching Waveforms



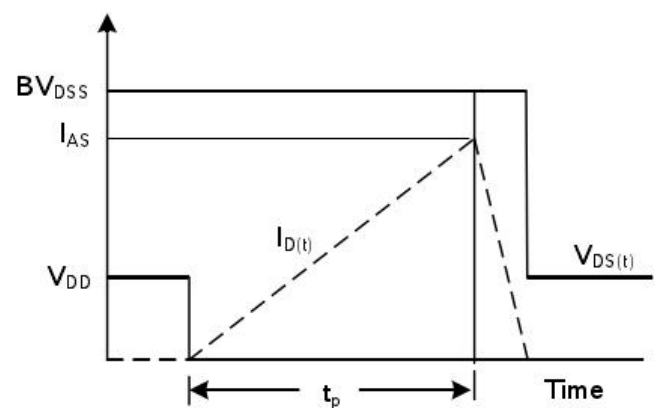
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

## RATING AND CHARACTERISTIC CURVES

Figure.1 Output Characteristics  $T_J=25^{\circ}\text{C}$

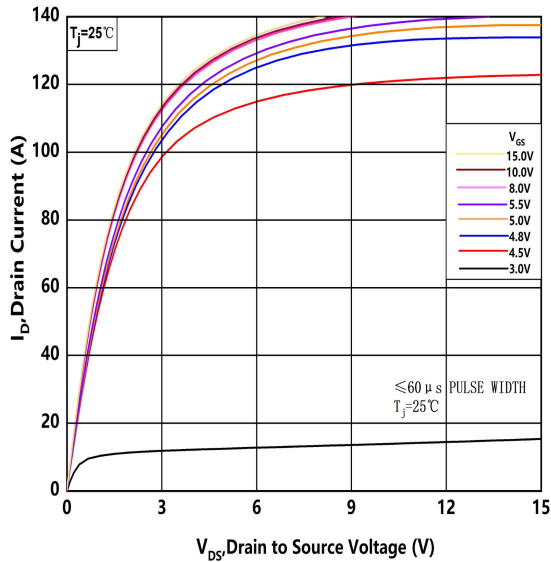


Figure.2 Transfer Characteristic for Various Junction Temperatures

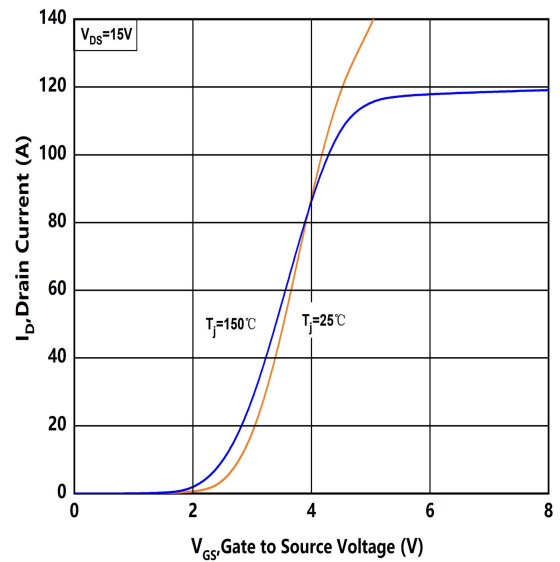


Figure.3 On-Resistance vs Drain Current For Various Gate Voltage

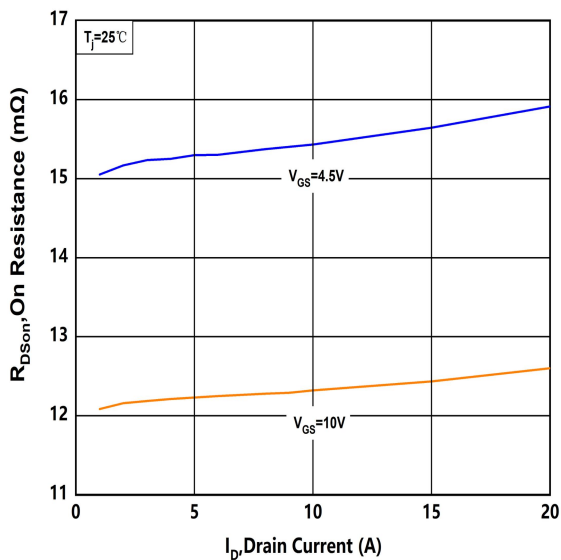


Figure.4 Typical On-Resistance vs Junction Temperature

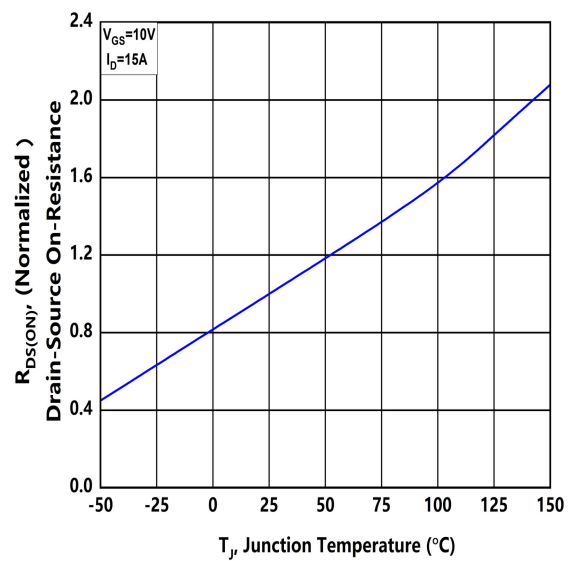


Figure.5 Typical Threshold Voltage vs Junction Temperature

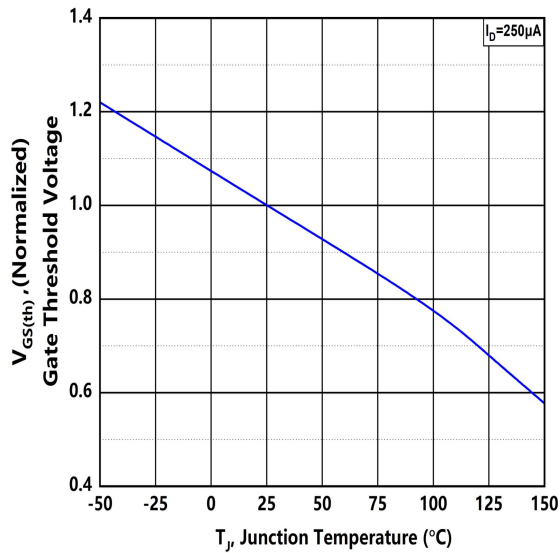


Figure.6 Typical Breakdown Voltage vs Junction Temperature

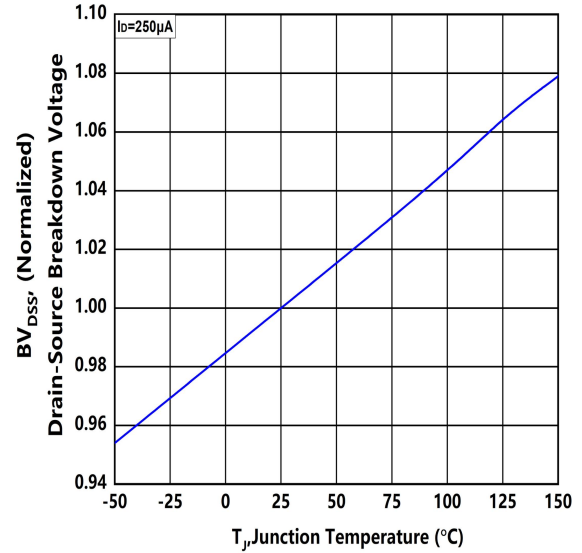


Figure.7 Typical Capacitance vs Drain to Source Voltage

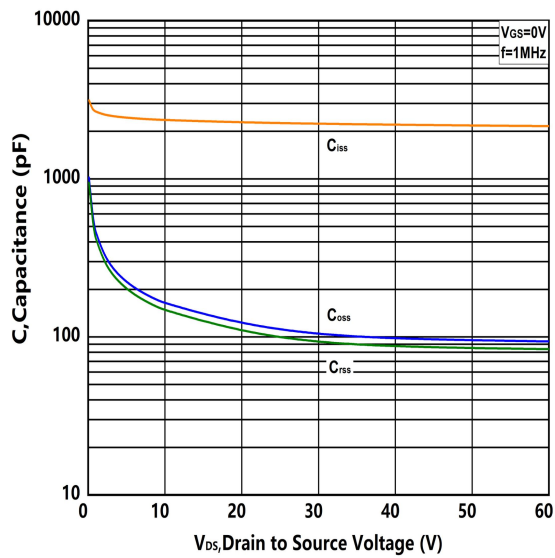


Figure.8 Typical Gate Charge vs Gate to Source Voltage

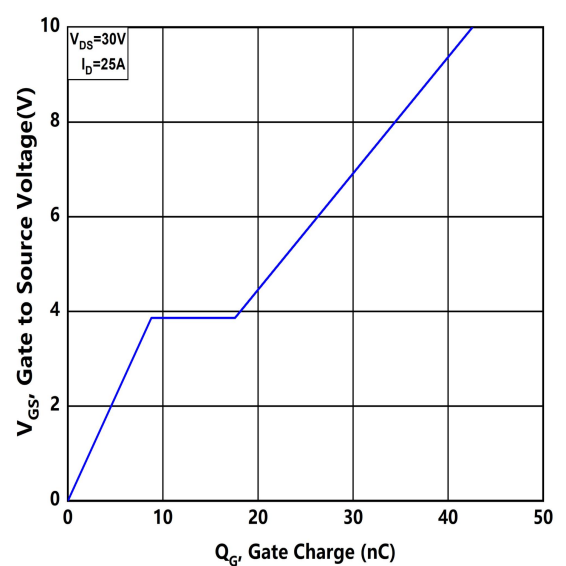


Figure.9 Typical Body Diode Characteristics

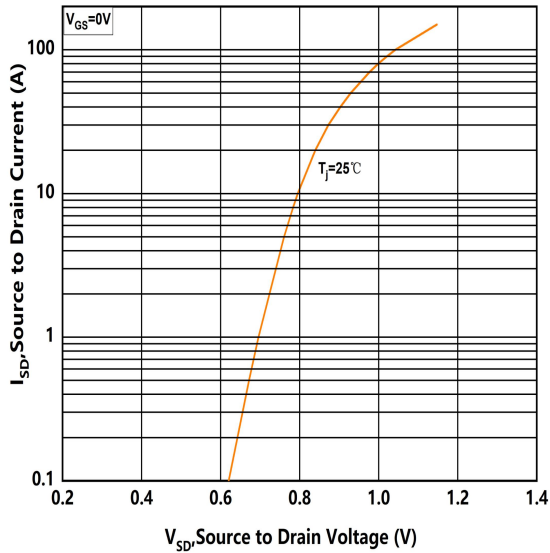


Figure.10 Maximum power Dissipation Derating vs Case Temperature

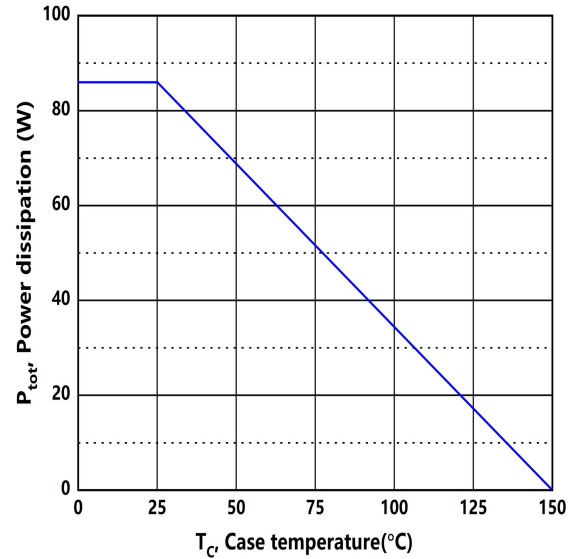


Figure.11 Continuous Drain Current Derating vs Case Temperature

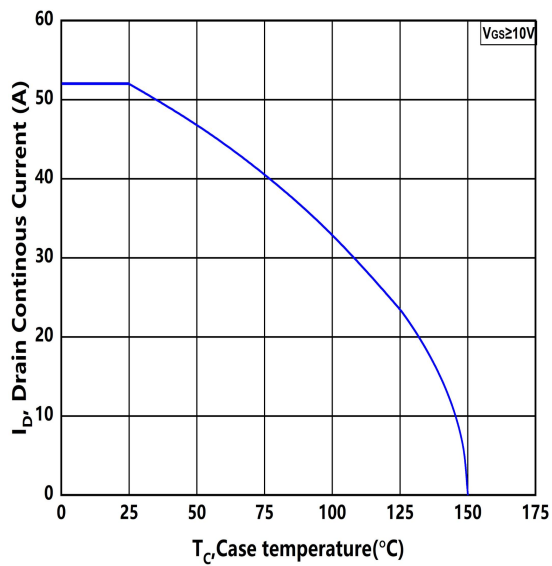


Figure.12 Safe Operating Area

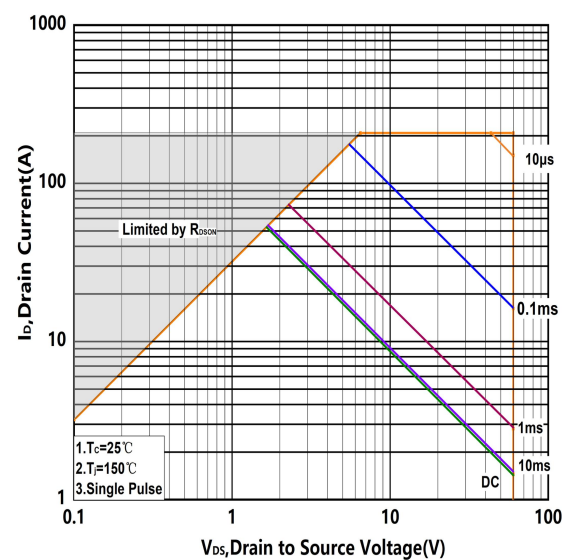
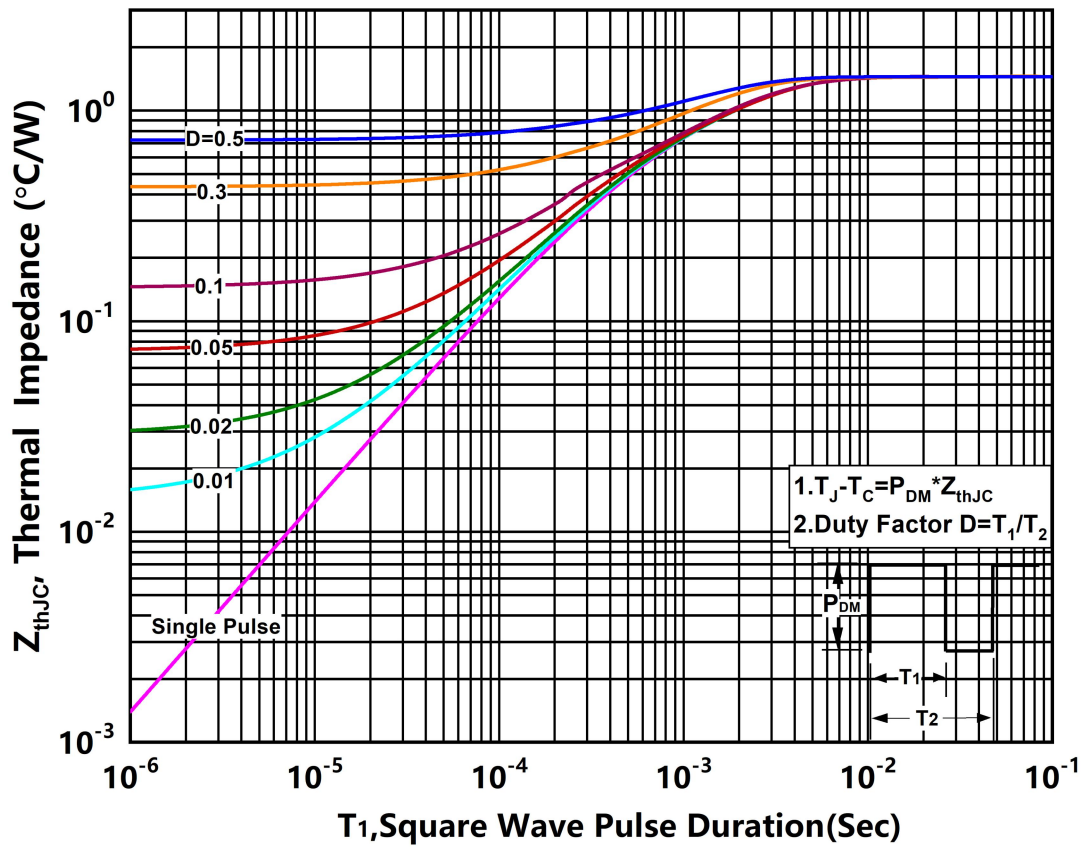
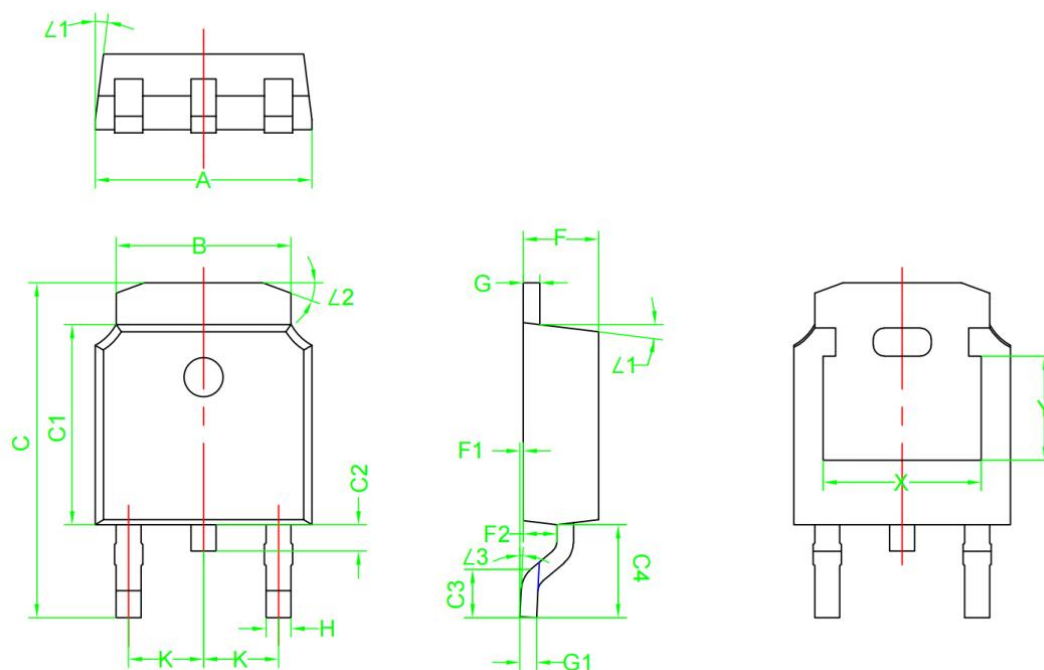


Figure.13 Transient Thermal Impedance (Junction - Case)





## Package Outline:TO-252-2L



| DIMENSIONS(unit:mm) |          |        |
|---------------------|----------|--------|
| Symbol              | MIN      | MAX    |
| A                   | 6.500    | 6.700  |
| B                   | 5.230    | 5.430  |
| C                   | 10.000   | 10.400 |
| C1                  | 6.000    | 6.200  |
| C2                  | 0.600    | 0.900  |
| F                   | 2.200    | 2.400  |
| F1                  | 0        | 0.100  |
| F2                  | 0.930    | 1.130  |
| G                   | 0.460    | 0.560  |
| ∠1                  | 6°       | 8°     |
| H                   | 0.710    | 0.810  |
| K                   | 2.250    | 2.350  |
| ∠2                  | 15°      | 20°    |
| C3                  | 1.350    | 1.650  |
| G1                  | 0.460    | 0.560  |
| ∠3                  | 0°       | 5°     |
| C4                  | 2.800REF |        |
| X                   | 4.650    | 4.850  |
| Y                   | 3.000    | 3.200  |