

## Features

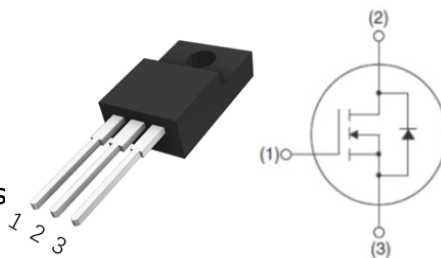
- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Avalanche Ruggednes

## Product Summary

|                    |       |
|--------------------|-------|
| $V_{DS}$           | 1200V |
| $R_{DS(on)_{typ}}$ | 160mΩ |
| $I_D$              | 16A   |

## Applications

- Solar Inverters
- Switch Mode Power Supplies
- High Voltage DC-DC Converters
- Battery Chargers



## Package Marking and Ordering Information

| Part #     | Marking   | Package |
|------------|-----------|---------|
| T1M160120F | 1M160120F | TO-220F |

## Absolute Maximum Ratings

| Parameter                                                                                                                         | Symbol                | Value      | Unit             |
|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|------------------|
| Drain-source voltage                                                                                                              | $V_{DS}$              | 1200       | V                |
| Continuous drain current<br>$T_C = 25^\circ\text{C}$ , $V_{GS} = 18\text{V}$<br>$T_C = 100^\circ\text{C}$ , $V_{GS} = 18\text{V}$ | $I_D$                 | 16<br>11   | A                |
| Pulsed drain current ( $T_C = 25^\circ\text{C}$ , $t_p$ limited by $T_{jmax}$ )                                                   | $I_{D \text{ pulse}}$ | 30         | A                |
| Gate-Source voltage                                                                                                               | $V_{GS}$              | -4/+18     | V                |
| Gate-Source voltage (Absolute maximum values)                                                                                     | $V_{GSmax}$           | -8/+22     | V                |
| Power dissipation ( $T_C = 25^\circ\text{C}$ )                                                                                    | $P_{tot}$             | 75         | W                |
| Operating junction and storage temperature                                                                                        | $T_j, T_{stg}$        | -55...+175 | $^\circ\text{C}$ |

- Example of acceptable  $V_{GS}$  waveform



**Thermal Resistance**

| Parameter                                   | Symbol     | Value | Unit |
|---------------------------------------------|------------|-------|------|
| Thermal resistance, junction – case. Max    | $R_{thJC}$ | 2.1   | °C/W |
| Thermal resistance, junction – ambient. Max | $R_{thJA}$ | 40    |      |

**Electrical Characteristic (at  $T_j = 25\text{ °C}$ , unless otherwise specified)**

| Parameter | Symbol | Value |      |      | Unit | Test Condition |
|-----------|--------|-------|------|------|------|----------------|
|           |        | min.  | typ. | max. |      |                |

**Static Characteristic**

|                                  |              |      |     |     |         |                                                 |
|----------------------------------|--------------|------|-----|-----|---------|-------------------------------------------------|
| Drain-source breakdown voltage   | $V_{DSS}$    | 1200 | -   | -   | V       | $V_{GS}=0V, I_D=100\mu A$                       |
| Gate threshold voltage           | $V_{GS(th)}$ | 2    | 3.1 | 4   | V       | $V_{DS}=V_{GS}, I_D=2.3mA$                      |
| Zero gate voltage drain current  | $I_{DSS}$    | -    | 1   | 20  | $\mu A$ | $V_{DS}=1200V, V_{GS}=0V$<br>$T_C=25\text{ °C}$ |
|                                  |              | -    | 5   | -   |         | $T_C=175\text{ °C}$                             |
| Gate-source leakage current      | $I_{GSS}$    | -    |     | 100 | nA      | $V_{GS}=18V, V_{DS}=0V$                         |
| Drain-source on-state resistance | $R_{DS(on)}$ | -    | 160 | 208 | mΩ      | $V_{GS}=18V, I_D=8A,$<br>$T_j=25\text{ °C}$     |
|                                  |              | -    | 250 | -   |         | $T_j=175\text{ °C}$                             |
| Drain-source on-state resistance | $R_{DS(on)}$ | -    | 220 | 320 | mΩ      | $V_{GS}=15V, I_D=8A,$<br>$T_j=25\text{ °C}$     |
|                                  |              | -    | 300 | -   |         | $T_j=175\text{ °C}$                             |

**Dynamic Characteristic**

|                              |                     |   |       |   |    |                                                                                                                                           |
|------------------------------|---------------------|---|-------|---|----|-------------------------------------------------------------------------------------------------------------------------------------------|
| Input Capacitance            | C <sub>iss</sub>    | - | 624   | - | pF | V <sub>DS</sub> = 1000V<br>V <sub>GS</sub> = 0V<br>T <sub>J</sub> = 25°C<br>V <sub>AC</sub> = 25mV<br>f = 1MHz                            |
| Output Capacitance           | C <sub>oss</sub>    | - | 42    | - |    |                                                                                                                                           |
| Reverse Transfer Capacitance | C <sub>rss</sub>    | - | 6     | - |    |                                                                                                                                           |
| Gate Total Charge            | Q <sub>G</sub>      | - | 37.4  | - | nC | V <sub>DS</sub> = 800V<br>V <sub>GS</sub> = 0/18V<br>I <sub>D</sub> = 8A<br>I <sub>G</sub> = 10mA                                         |
| Gate-Source charge           | Q <sub>gs</sub>     | - | 5.3   | - |    |                                                                                                                                           |
| Gate-Drain charge            | Q <sub>gd</sub>     | - | 20.6  | - |    |                                                                                                                                           |
| Turn-On Switching Energy     | E <sub>ON</sub>     | - | 11    | - | μJ | V <sub>DD</sub> =800V,<br>V <sub>GS</sub> =-4/18V<br>R <sub>G</sub> =5Ω,<br>I <sub>D</sub> =8A<br>Inductive Load,<br>T <sub>J</sub> =25°C |
| Turn-Off Switching Energy    | E <sub>OFF</sub>    | - | 230   | - |    |                                                                                                                                           |
| Turn-on delay time           | t <sub>d(on)</sub>  | - | 12.25 | - | ns |                                                                                                                                           |
| Rise time                    | t <sub>r</sub>      | - | 18.68 | - |    |                                                                                                                                           |
| Turn-off delay time          | t <sub>d(off)</sub> | - | 17.37 | - |    |                                                                                                                                           |
| Fall time                    | t <sub>f</sub>      | - | 11.82 | - |    |                                                                                                                                           |
| Gate resistance              | R <sub>G</sub>      | - | 3.3   | - | Ω  | V <sub>AC</sub> = 25mV, f=1MHz                                                                                                            |

**Body Diode Characteristic**

| Parameter                          | Symbol   | Value |      |      | Unit | Test Condition                                                                         |
|------------------------------------|----------|-------|------|------|------|----------------------------------------------------------------------------------------|
|                                    |          | min.  | typ. | max. |      |                                                                                        |
| Body Diode Forward Voltage         | $V_{SD}$ |       | 3.6  |      | V    | $V_{GS} = 0V, I_{SD}=4A,$<br>$T_J=25^{\circ}C$                                         |
|                                    |          |       | 3.2  |      |      | $V_{GS} = 0V, I_{SD}=4A,$<br>$T_J=175^{\circ}C$                                        |
| Body Diode Reverse Recovery Time   | $t_{rr}$ | -     | 13.5 | -    | ns   | $V_R = 800V, V_{GS} = 0V$<br>$I_D = 8A$<br>$di/dt = 800A/\mu S$<br>$T_J = 25^{\circ}C$ |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | -     | 36.8 | -    | nC   |                                                                                        |

Typical Performance Characteristics

Fig 1. Output Characteristic ( $T_J = -55^{\circ}\text{C}$ )

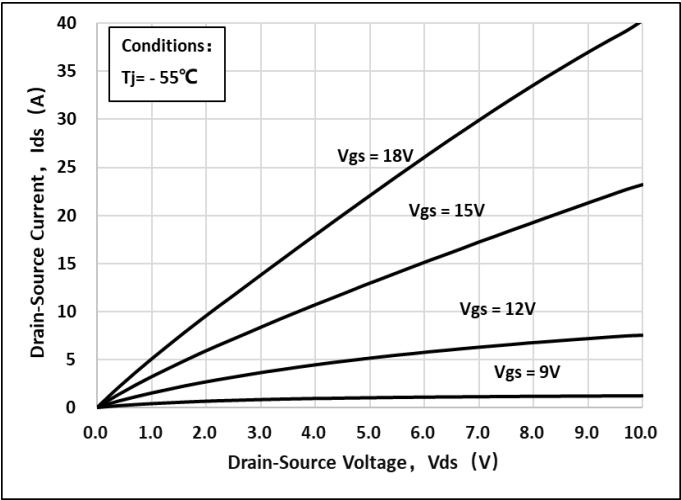


Fig 2. Output Characteristic ( $T_J = 25^{\circ}\text{C}$ )

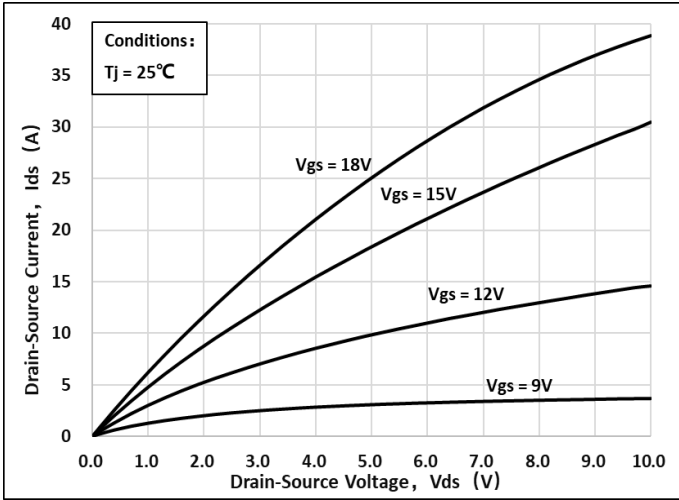


Fig 3. Output Characteristic ( $T_J = 175^{\circ}\text{C}$ )

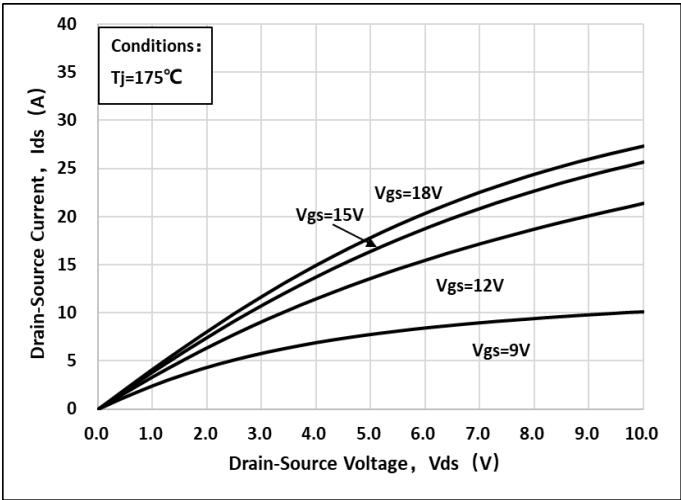


Fig 4:  $R_{ds(on)}$  Vs  $I_{ds}$  Characteristic

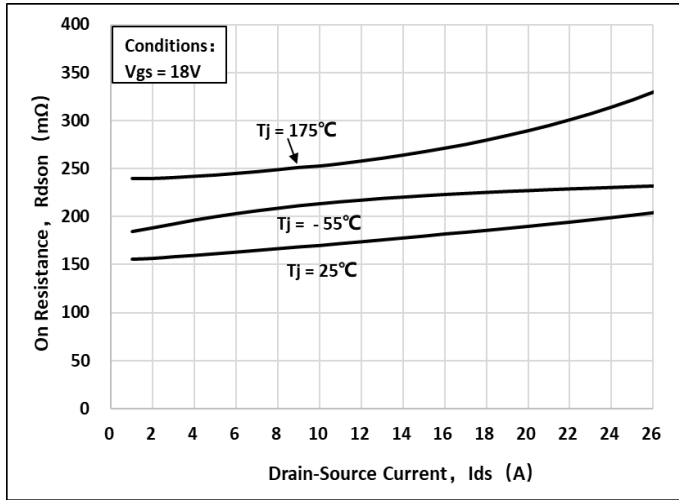


Fig 5:  $R_{ds(on)}$  vs. Temperature

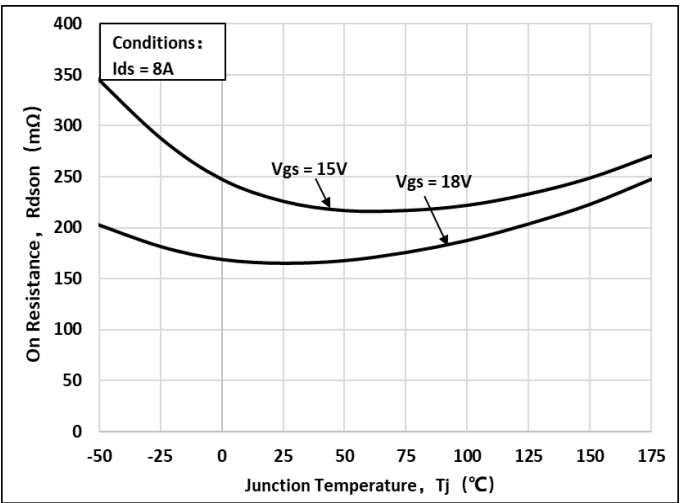


Fig 6: Transfer Characteristic

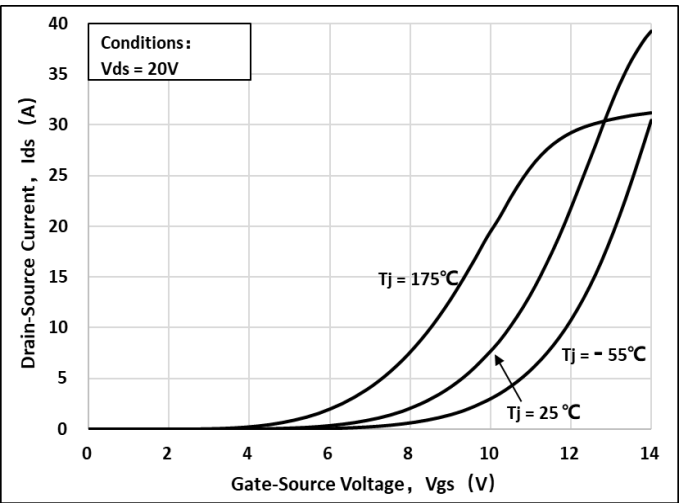


Fig 7: Body-diode Characteristic ( $T_J=-55^{\circ}\text{C}$ )

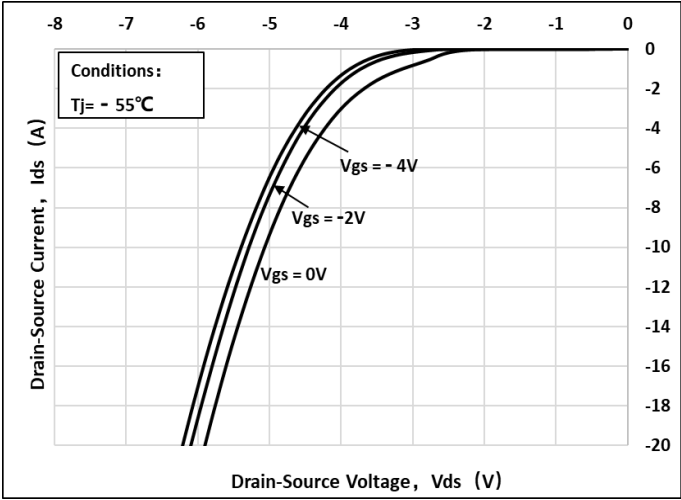


Fig 8: Body-diode Characteristic ( $T_J=25^{\circ}\text{C}$ )

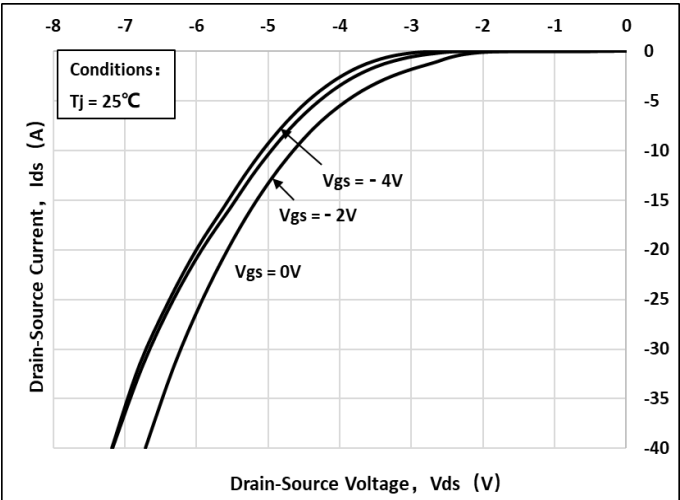


Fig 9: Body-diode Characteristic ( $T_J=175^{\circ}\text{C}$ )

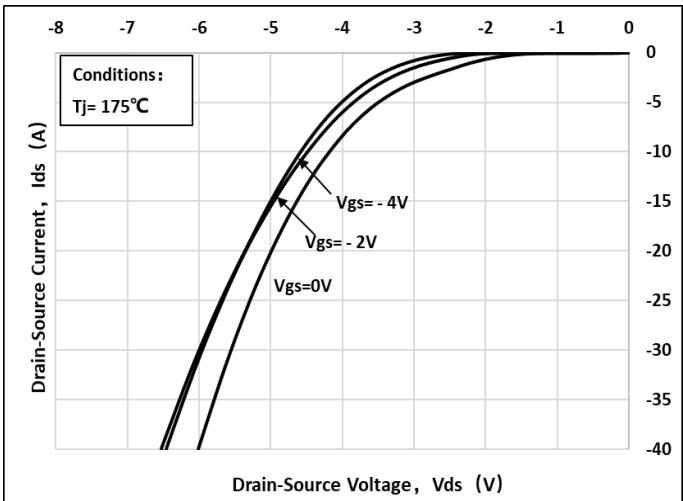


Fig 10:  $V_{TH}$  Vs  $T_J$  Temperature Characteristic

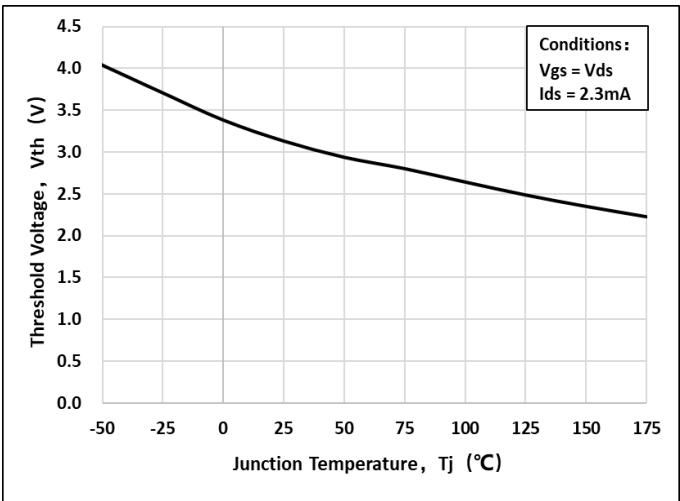


Fig 11: Gate Charge Characteristics

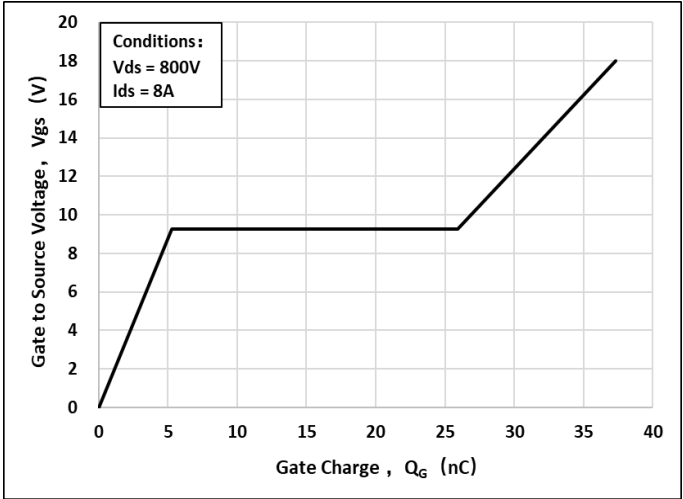


Fig 12: 3rd Quadrant Characteristic( $T_J=-55^{\circ}\text{C}$ )

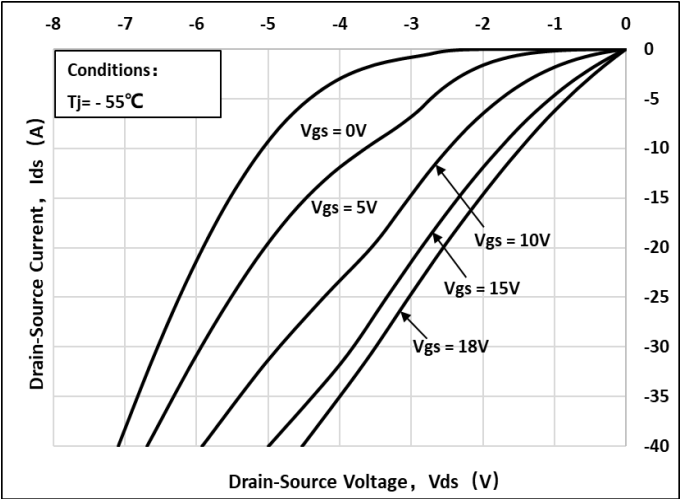


Fig 13: 3rd Quadrant Characteristic( $T_J=25^{\circ}\text{C}$ )

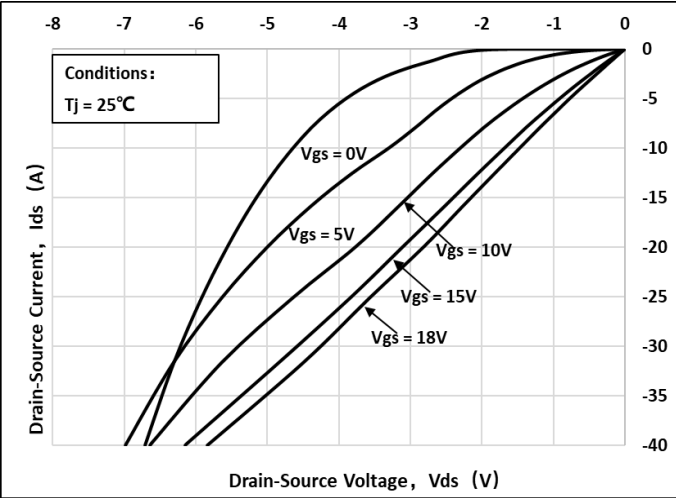


Fig 14: 3rd Quadrant Characteristic( $T_J=175^{\circ}\text{C}$ )

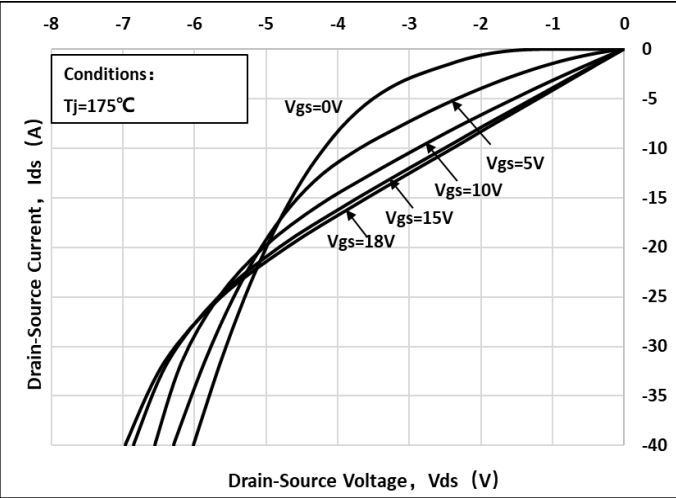


Fig 15: Capacitance Characteristic

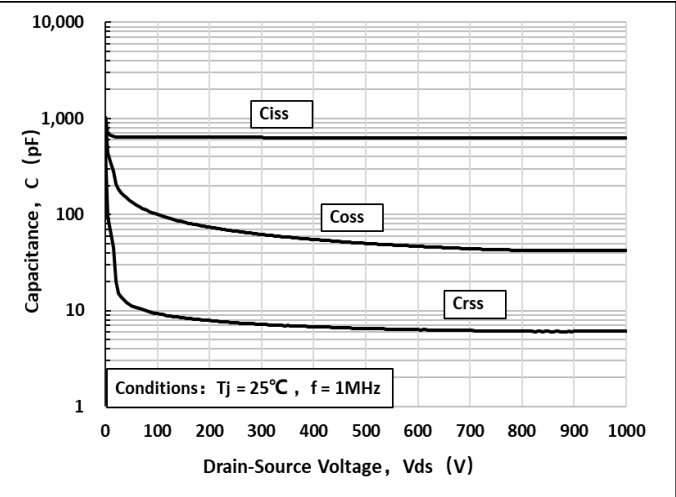


Fig 16: Safe Operating Area

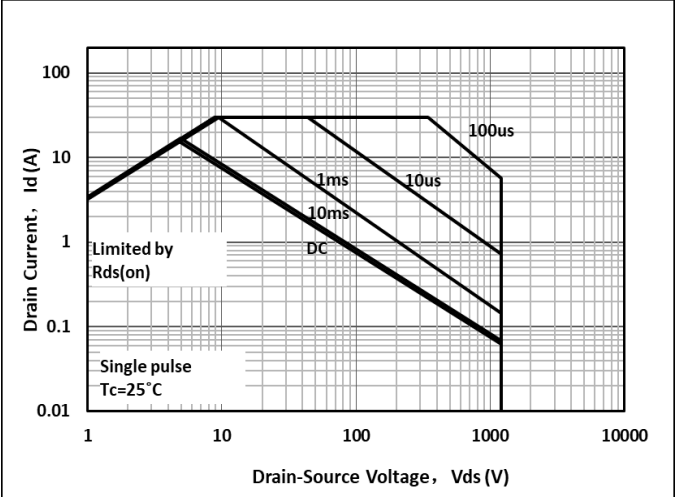
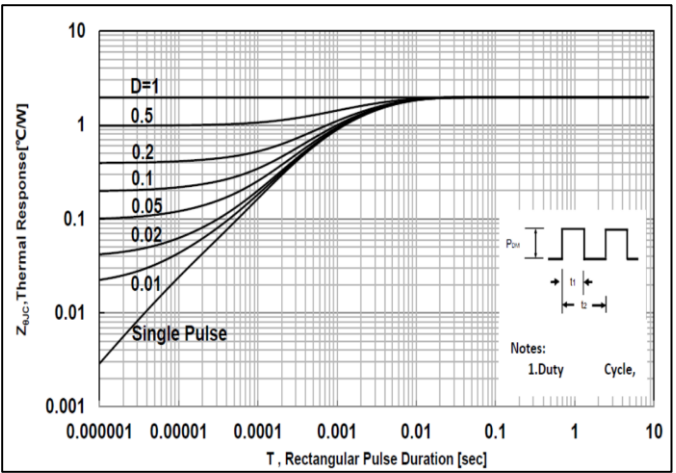


Fig 17: Transient Thermal Impedance



Test Circuit & Waveform

Figure A. Definition of switching times

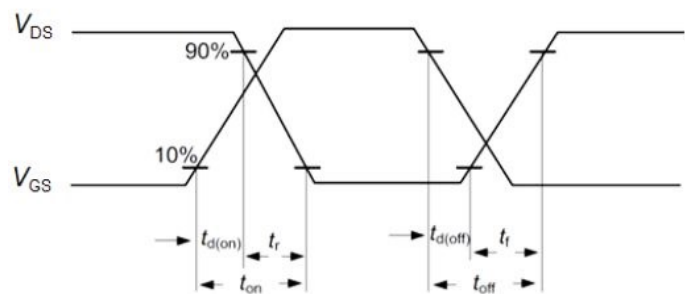


Figure B. Dynamic test circuit

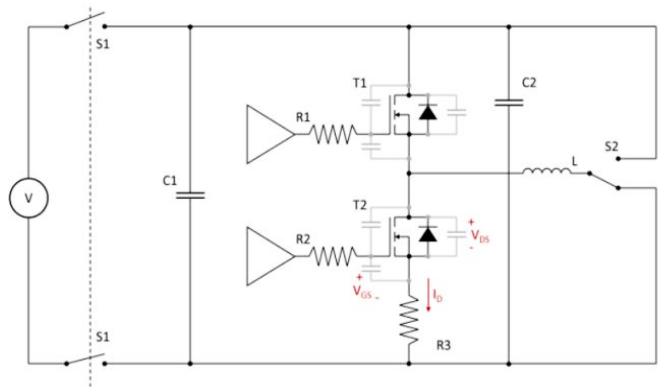


Figure C. Definition of body diodeswitching characteristics

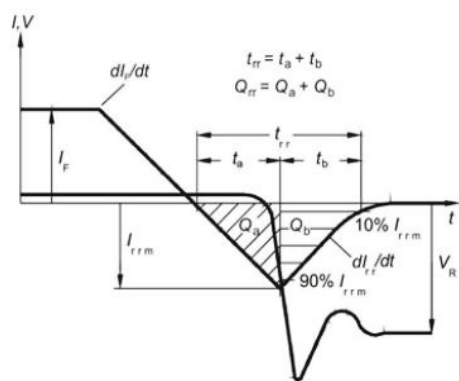


Figure C. Definition of diode switching characteristics

Technical drawing of a multi-pin connector showing three views: Front View, Side View, and Bottom View.

**Front View:** Shows a rectangular connector with width  $E$  and height  $D$ . It features a central circular feature with diameter  $\phi R$  and six smaller circular features arranged in a 2x3 grid. The distance from the top edge to the center of the top row of small circles is  $Q1$ . The total height of the connector is  $L$ . The bottom edge shows three pins with dimensions  $2Xe$  and  $3Xb$ . A detail callout 'Detail 'Y'' points to the bottom edge.

**Side View:** Shows the profile of the connector with height  $G$  and width  $A$ . The distance from the top edge to the bottom edge is  $F$ . The bottom edge shows a detail of the pins with dimensions  $A3$  and  $C$ . The distance from the top edge to the bottom edge of the pins is  $Q$ .

**Bottom View:** Shows the bottom of the connector with three pins. The pins are labeled  $3Xb2$  and  $3Xb1$ . The bottom edge shows a detail of the pins with dimensions  $3Xb$  and  $2Xe$ . The bottom edge is labeled **BOTTOM VIEW**.

**Labels and Dimensions:**

- $E$ : Width of the connector.
- $D$ : Height of the connector.
- $\phi R$ : Diameter of the central circular feature.
- $Q1$ : Distance from the top edge to the center of the top row of small circles.
- $L$ : Total height of the connector.
- $2Xe$ : Distance between the centers of the bottom pins.
- $3Xb$ : Distance from the bottom edge to the center of the bottom pins.
- $3Xb2$ : Distance from the bottom edge to the center of the bottom pins (left side).
- $3Xb1$ : Distance from the bottom edge to the center of the bottom pins (right side).
- $A$ : Width of the connector (Side View).
- $G$ : Height of the connector (Side View).
- $F$ : Distance from the top edge to the bottom edge (Side View).
- $A3$ : Distance from the top edge to the bottom edge of the pins (Side View).
- $C$ : Distance from the bottom edge to the center of the bottom pins (Side View).
- $Q$ : Distance from the top edge to the bottom edge of the pins (Side View).
- Detail 'Y'**: Detail of the bottom edge.
- Mold Flash Bleeding**: Label for the bottom edge of the pins.
- Exposed Cu**: Label for the bottom edge of the pins.
- BOTTOM VIEW**: Label for the bottom view.

| SYMBOL | DIMENSIONS |       |       |
|--------|------------|-------|-------|
|        | Min.       | Nom.  | Max.  |
| A      | 4.60       | 4.70  | 4.80  |
| b      | 0.70       | 0.80  | 0.91  |
| b1     | 1.20       | 1.30  | 1.47  |
| b2     | 1.10       | 1.20  | 1.30  |
| C      | 0.45       | 0.50  | 0.63  |
| D      | 15.80      | 15.87 | 15.97 |
| e      | 2.54       |       |       |
| E      | 10.00      | 10.10 | 10.30 |
| F      | 2.44       | 2.54  | 2.64  |
| G      | 6.50       | 6.70  | 6.90  |
| L      | 12.90      | 13.10 | 13.30 |
| L1     | 3.13       | 3.23  | 3.33  |
| Q      | 2.65       | 2.75  | 2.85  |
| Q1     | 3.20       | 3.30  | 3.40  |
| ΦR     | 3.08       | 3.18  | 3.28  |

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