

## Features

- Uses CRM advanced Trench technology
- Extremely low on-resistance  $R_{DS(on)}$
- Excellent  $Q_g \times R_{DS(on)}$  product(FOM)
- Qualified according to JEDEC criteria

## Applications

- Motor control and drive
- Electrical tools
- Lithium battery protection

## Product Summary

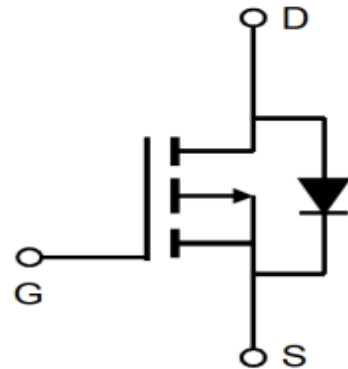
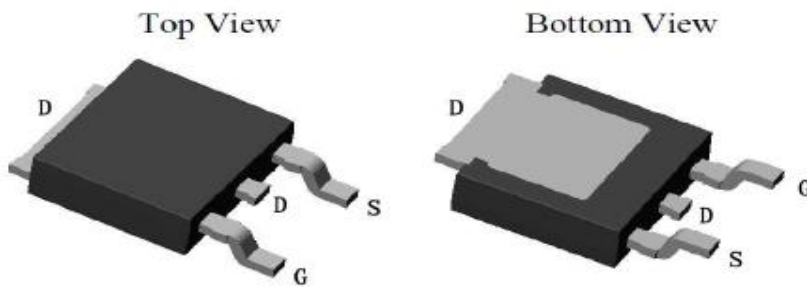
|                   |      |
|-------------------|------|
| $V_{DS}$          | -40V |
| $R_{DS(on)}$ typ. | 11mΩ |
| $I_D$             | -60A |

**100% DVDS Tested**

**100% Avalanche Tested**



## TO-252



## Package Marking and Ordering Information

| Part #         | Marking   | Package | Packing | Reel Size | Tape Width | Qty     |
|----------------|-----------|---------|---------|-----------|------------|---------|
| CRTD140P04L2-G | T140P04L2 | TO-252  | Reel    | N/A       | N/A        | 2500pcs |

## Absolute Maximum Ratings

| Parameter                                                                                | Symbol                | Value        | Unit             |
|------------------------------------------------------------------------------------------|-----------------------|--------------|------------------|
| Drain-source voltage                                                                     | $V_{DS}$              | -40          | V                |
| Continuous drain current<br>$T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$        | $I_D$                 | -60<br>-38.5 | A                |
| Pulsed drain current ( $T_C = 25^\circ\text{C}$ , $t_p$ limited by $T_{jmax}$ )          | $I_{D \text{ pulse}}$ | -200         | A                |
| Avalanche energy, single pulse ( $L=0.5\text{mH}$ )                                      | $E_{AS}$              | 190          | mJ               |
| Gate-Source voltage                                                                      | $V_{GS}$              | $\pm 18$     | V                |
| Power dissipation ( $T_C = 25^\circ\text{C}$ )                                           | $P_{tot}$             | 73.5         | W                |
| Operating junction and storage temperature                                               | $T_j, T_{stg}$        | -55...+150   | $^\circ\text{C}$ |
| Soldering temperature, wave soldering only allowed at leads<br>(1.6mm from case for 10s) | $T_{sold}$            | 260          | $^\circ\text{C}$ |

**Thermal Resistance**

| Parameter                                              | Symbol     | Typ | Max | Unit |
|--------------------------------------------------------|------------|-----|-----|------|
| Thermal resistance, junction – ambient(min. footprint) | $R_{thJC}$ | -   | 1.7 | °C/W |

**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   | $BV_{DSS}$   | -40 | -     | -         | V       | $V_{GS}=0V, I_D=-250\mu A$                     |
| Gate threshold voltage           | $V_{GS(th)}$ | -1  | -2    | -3        | V       | $V_{DS}=V_{GS}, I_D=-250\mu A$                 |
| Zero gate voltage drain current  | $I_{DSS}$    | -   | -     | -1        | $\mu A$ | $V_{DS}=-40V, V_{GS}=0V$<br>$T_j=25\text{ °C}$ |
|                                  |              | -   | -     | -100      |         | $T_j=150\text{ °C}$                            |
| Gate-source leakage current      | $I_{GSS}$    | -   | -     | $\pm 100$ | nA      | $V_{GS}=\pm 18V, V_{DS}=0V$                    |
| Drain-source on-state resistance | $R_{DS(on)}$ | -   | 11    | 14.0      | mΩ      | $T_j=25\text{ °C}$                             |
|                                  |              | -   | 15    | 20.0      |         | $V_{GS}=-10V, I_D=-19A$                        |
|                                  |              | -   | 15    | 20.0      |         | $V_{GS}=-4.5V, I_D=-19A$                       |
| Transconductance                 | $g_{fs}$     |     | 59.29 |           | S       | $V_{DS}=-5V, I_D=-19A$                         |

**Dynamic Characteristic**

|                              |              |   |      |   |    |                                                                   |
|------------------------------|--------------|---|------|---|----|-------------------------------------------------------------------|
| Input Capacitance            | $C_{iss}$    | - | 3768 | - | pF | $V_{GS}=0V, V_{DS}=-20V$<br>$f=1MHz$                              |
| Output Capacitance           | $C_{oss}$    | - | 249  | - |    |                                                                   |
| Reverse Transfer Capacitance | $C_{rss}$    | - | 188  | - |    |                                                                   |
| Gate Total Charge            | $Q_g$        | - | 62.9 | - | nC | $V_{GS}=-10V, V_{DS}=-20V$<br>$I_D=-19A$                          |
| Gate-Source charge           | $Q_{gs}$     | - | 8.6  | - |    |                                                                   |
| Gate-Drain charge            | $Q_{gd}$     | - | 10.4 | - |    |                                                                   |
| Turn-on delay time           | $t_{d(on)}$  | - | 19   | - | ns | $V_{GS}=-10V,$<br>$V_{DS}=-20V$<br>$R_G=3.0\Omega,$<br>$I_D=-19A$ |
| Rise time                    | $t_r$        | - | 6    | - |    |                                                                   |
| Turn-off delay time          | $t_{d(off)}$ | - | 100  | - |    |                                                                   |
| Fall time                    | $t_f$        | - | 32   | - |    |                                                                   |
| Gate resistance              | $R_G$        | - | 8.5  | - | Ω  | $V_{GS}=0V, V_{DS}=0V f=1MHz$                                     |

## Body Diode Characteristic

| Parameter                             | Symbol   | Value |       |      | Unit | Test Condition               |
|---------------------------------------|----------|-------|-------|------|------|------------------------------|
|                                       |          | min.  | typ.  | max. |      |                              |
| Body Diode Forward Voltage            | $V_{SD}$ | -     | -     | -1.2 | V    | $V_{GS}=0V, I_{SD}=-19A$     |
| Body Diode Continuous Forward Current | $I_S$    | -     | -     | -60  | A    | $T_C = 25^{\circ}C$          |
| Body Diode Reverse Recovery Time      | $t_{rr}$ | -     | 25.12 | -    | ns   | $I_F=-19A, dI/dt=100A/\mu s$ |
| Body Diode Reverse Recovery Charge    | $Q_{rr}$ | -     | 19.26 | -    | nC   |                              |

a1: Repetitive rating; pulse width limited by maximum junction temperature

## Typical Performance Characteristics

Fig 1: Output Characteristics

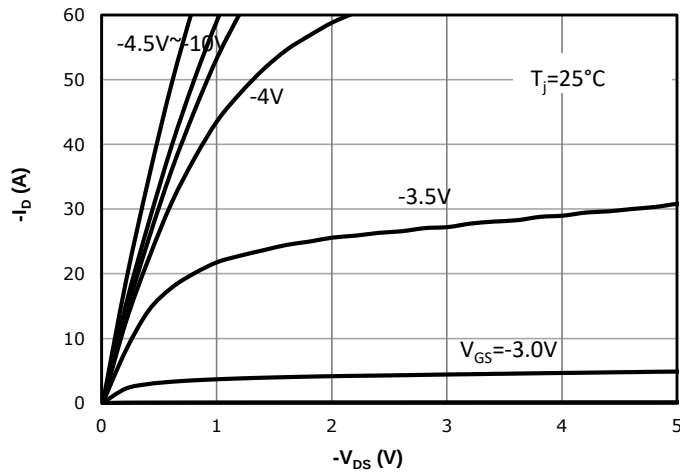


Fig 2: Transfer Characteristics

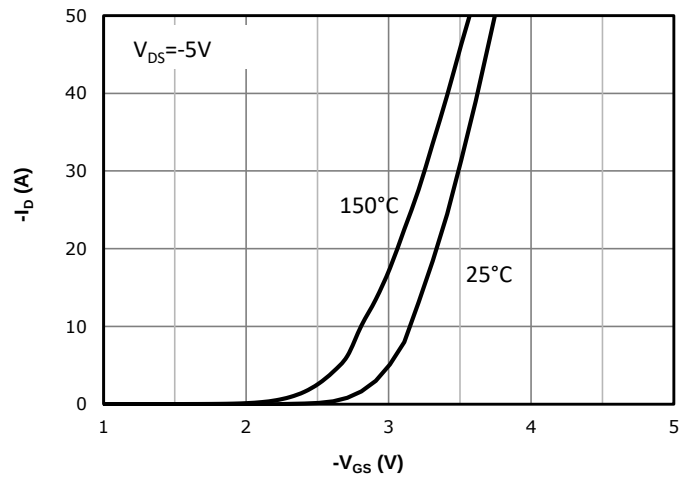


Fig 3: R<sub>DS(on)</sub> vs Drain Current and Gate Voltage

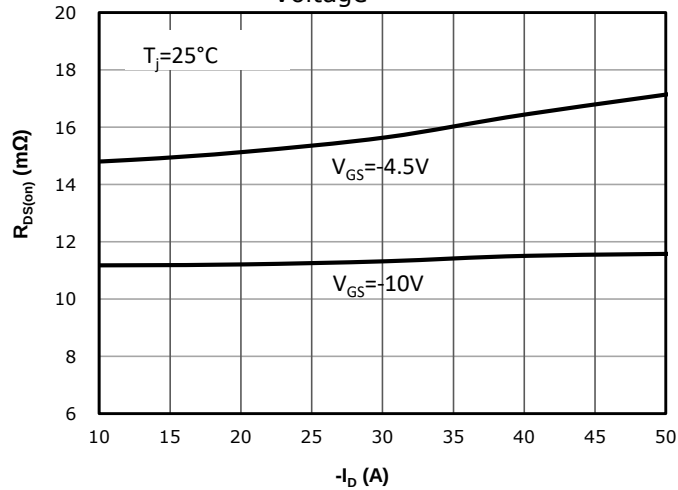


Fig 4: R<sub>DS(on)</sub> vs Gate Voltage

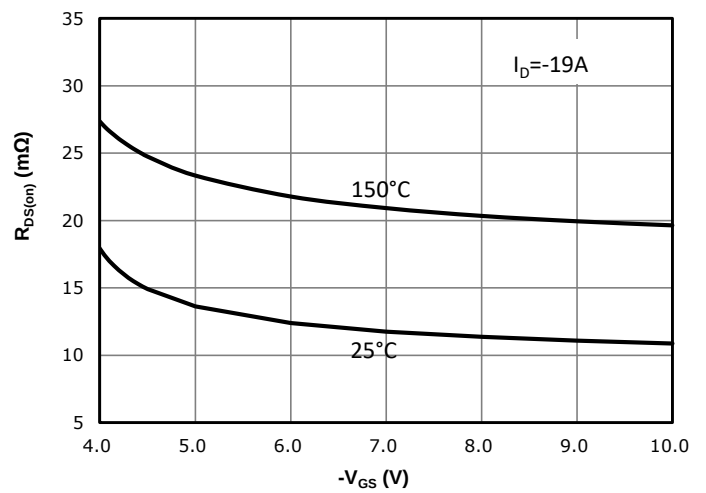


Fig 5: R<sub>DS(on)</sub> vs. Temperature

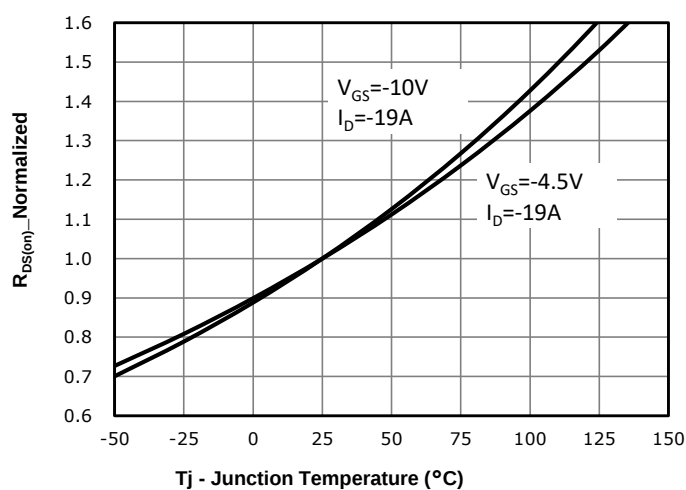


Fig 6: V<sub>GS(th)</sub> vs. Temperature

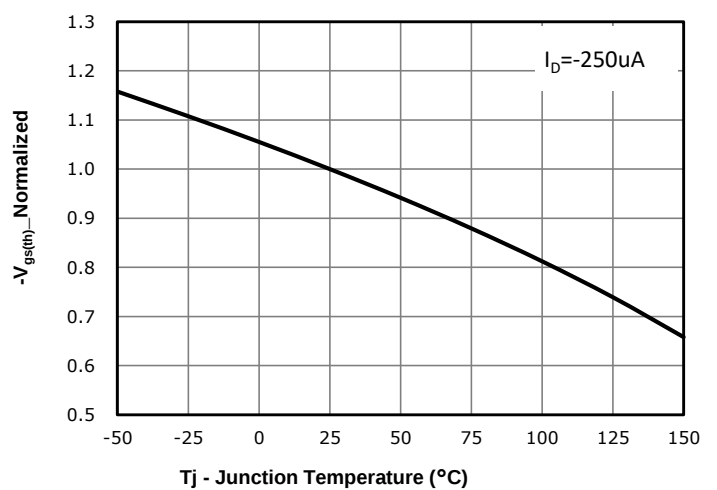


Fig 7: BVdss vs. Temperature

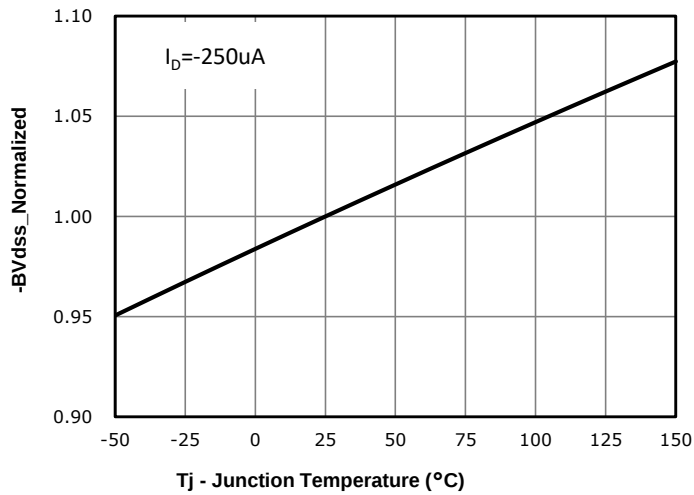


Fig 8: Body-diode Forward Characteristics

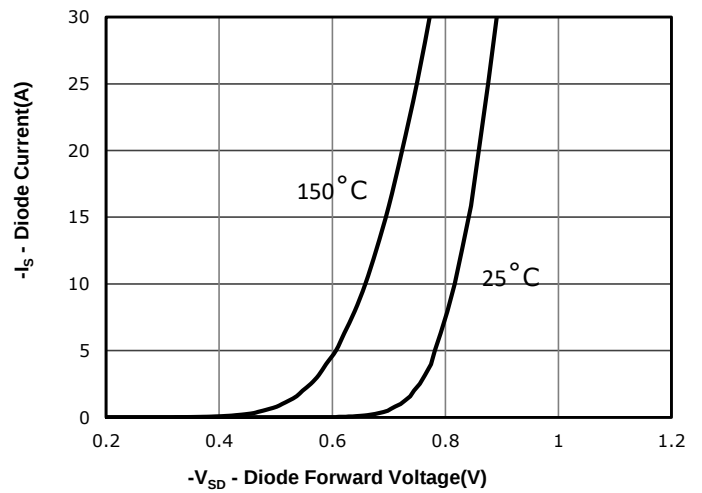


Fig 9: Gate Charge Characteristics

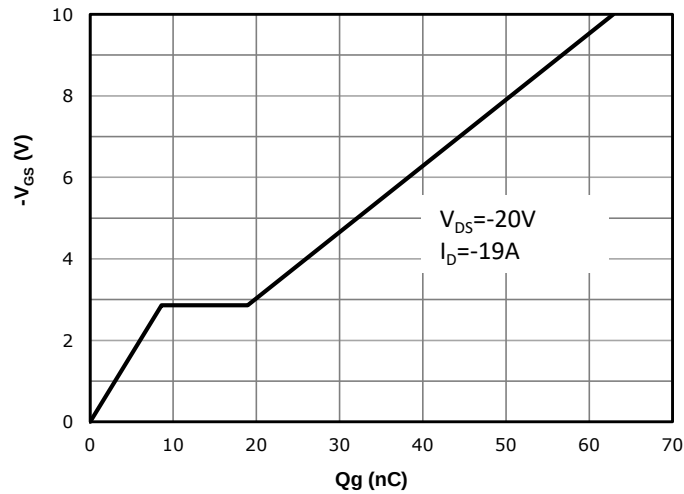


Fig 10: Capacitance Characteristics

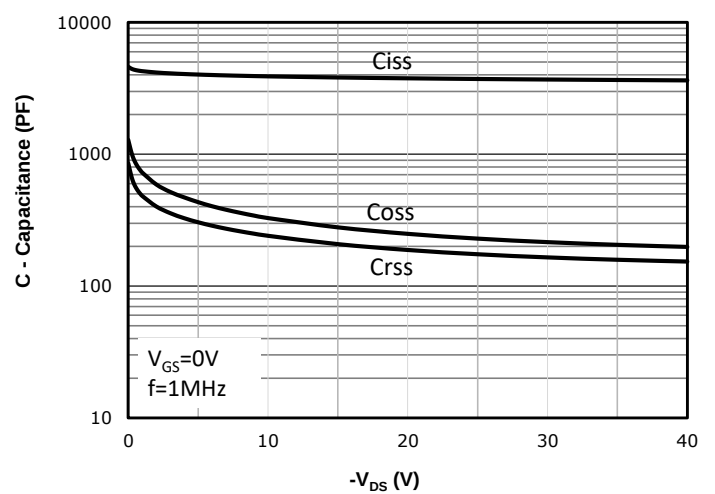


Fig 11: Drain Current Derating

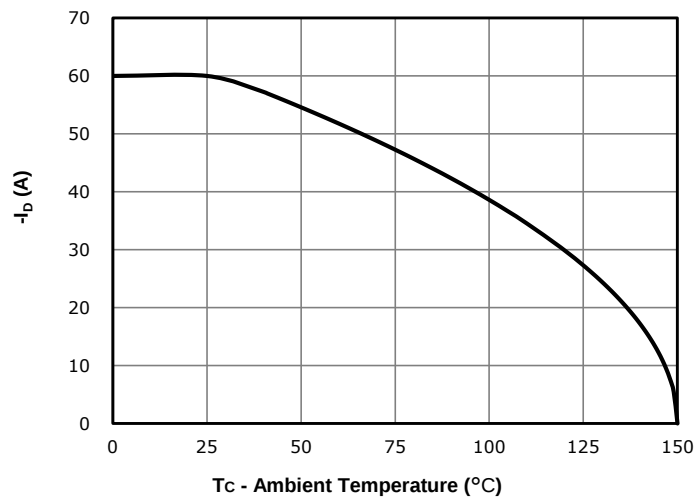


Fig 12: Power Dissipation

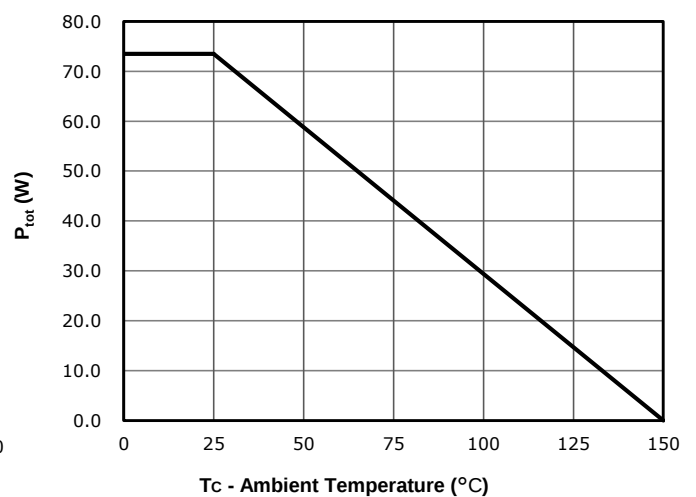


Fig 13: Safe Operating Area

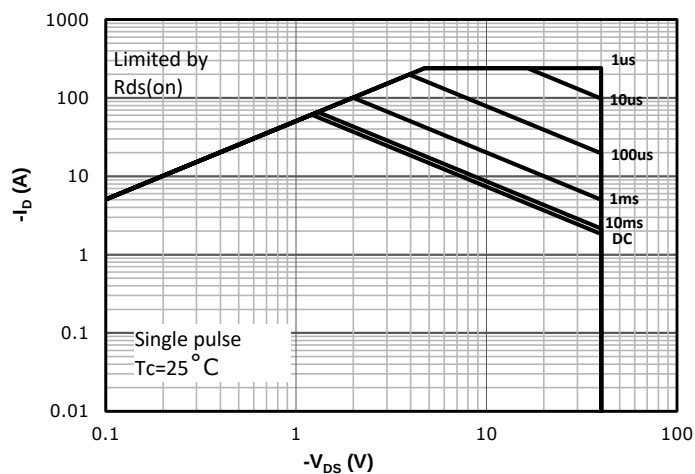
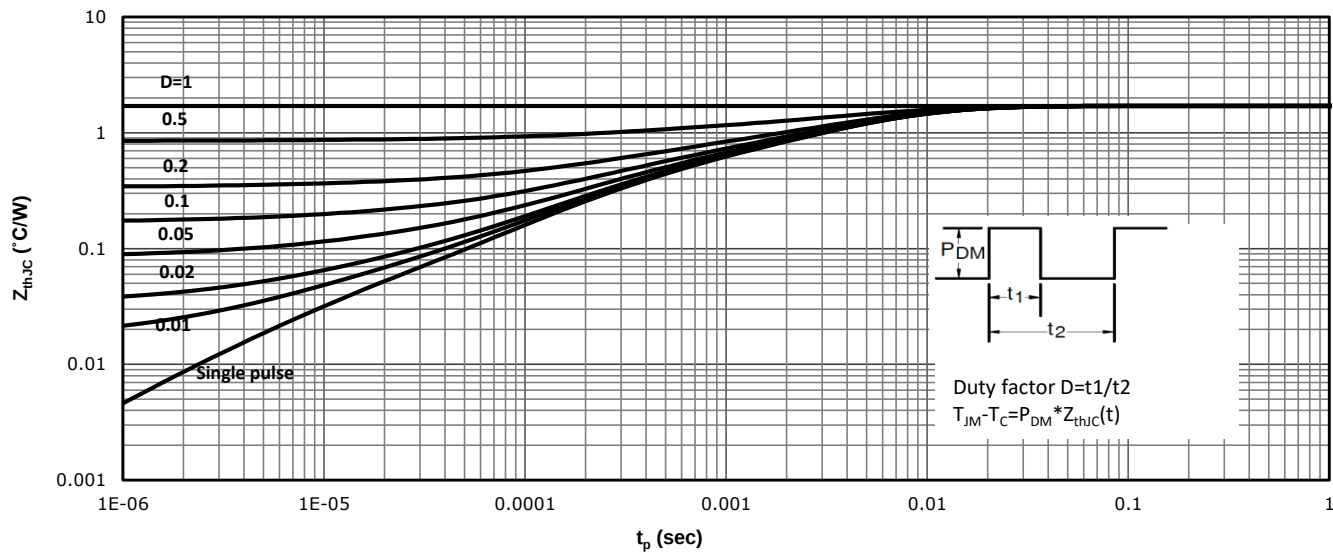
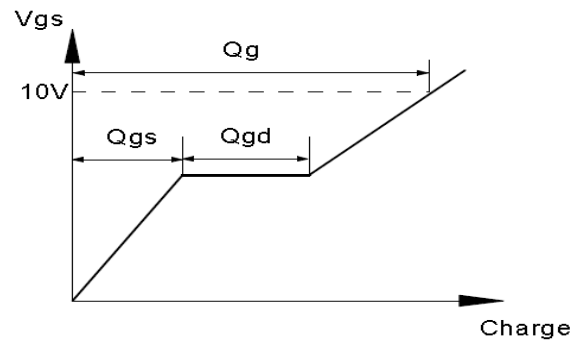
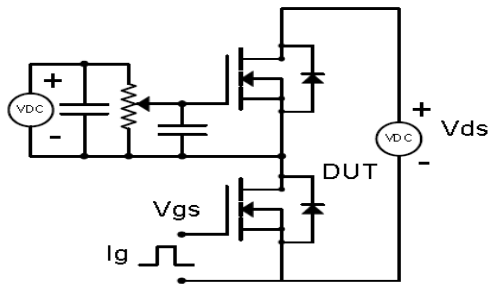


Fig 14: Max. Transient Thermal Impedance

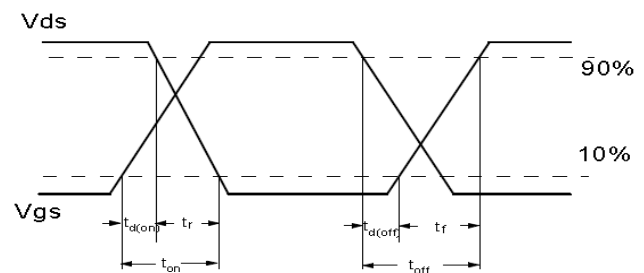
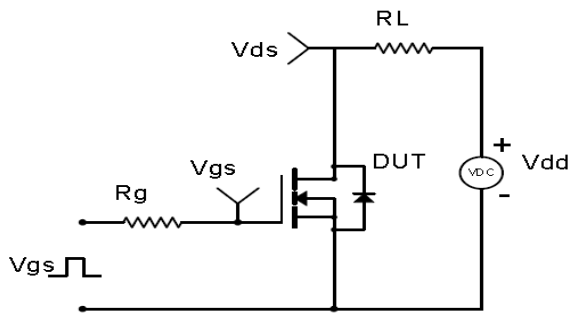


## Test Circuit & Waveform

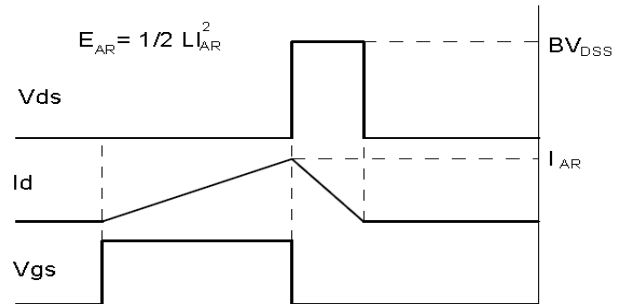
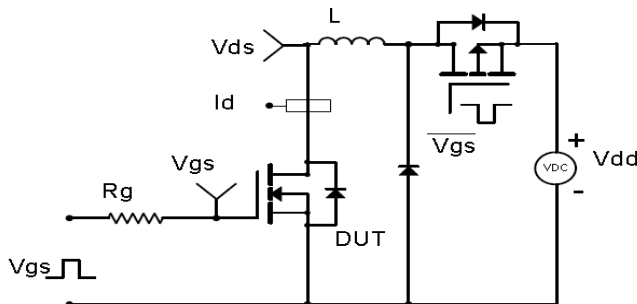
Gate Charge Test Circuit & Waveform



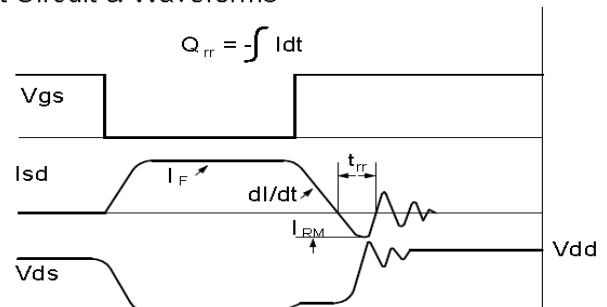
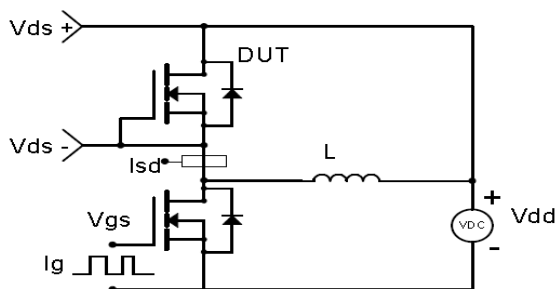
Resistive Switching Test Circuit & Waveforms



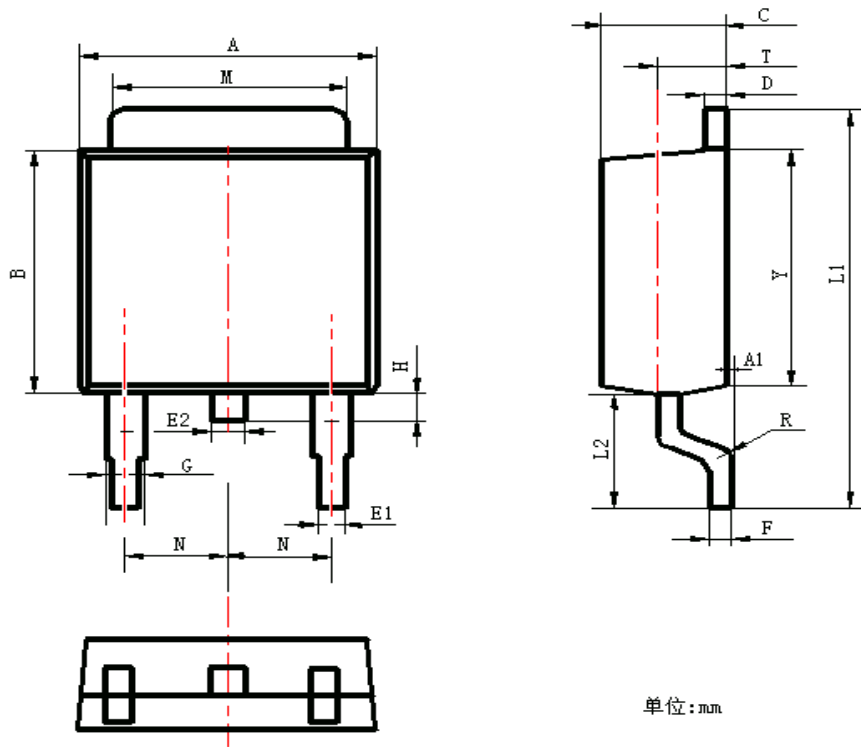
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



## Package Outline: TO-252



| Symbol | Values(mm) |       |
|--------|------------|-------|
|        | Min.       | Max.  |
| A      | 6.30       | 6.90  |
| A1     | 0.00       | 0.16  |
| B      | 5.70       | 6.30  |
| C      | 2.10       | 2.50  |
| D      | 0.30       | 0.70  |
| E1     | 0.60       | 0.90  |
| E2     | 0.70       | 1.00  |
| F      | 0.30       | 0.60  |
| G      | 0.70       | 1.20  |
| L1     | 9.60       | 10.50 |
| L2     | 2.70       | 3.10  |
| H      | 0.40       | 1.00  |
| M      | 5.10       | 5.50  |
| N      | 2.09       | 2.49  |
| R      | 0.30       |       |
| T      | 1.40       | 1.60  |
| Y      | 5.10       | 6.30  |

**Marking****NOTE:**

AABXXXG

AA —cycle code

B —Fab code

XXX —Assembly lot code

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**Revision History**

| Revision | Date      | Major changes             |
|----------|-----------|---------------------------|
| 1.0      | 2023/4/28 | Release of formal version |
| 2.0      |           |                           |
| 3.0      |           |                           |

**Disclaimer**

Unless otherwise specified in the datasheet, the product is designed and qualified as a standard commercial product and is not intended for use in applications that require extraordinary levels of quality and reliability, such as automotive, aviation/aerospace and life-support devices or systems.

Any and all semiconductor products have certain probability to fail or malfunction, which may result in personal injury, death or property damage. Customer are solely responsible for providing adequate safe measures when design their systems.

CRM reserves the right to improve product design, function and reliability without notice.