

## Features

- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Easy to Parallel and Simple to Drive
- Avalanche Ruggedness
- Fast Reverse Recovery
- Halogen Free, RoHS Compliant

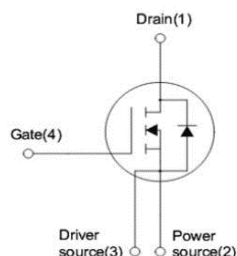
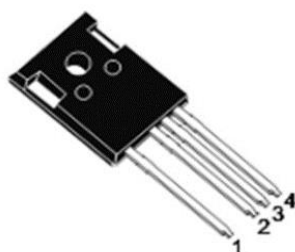
## Applications

- Solar Inverters
- Switch Mode Power Supplies
- High Voltage DC/DC Converters
- On Board Charger

## Product Summary

|                         |      |
|-------------------------|------|
| VDS                     | 650V |
| R <sub>DS(on)_typ</sub> | 60mΩ |
| I <sub>D</sub>          | 37A  |

**100% Avalanche Tested**



## Package Marking and Ordering Information

| Part #        | Marking | Package   | Packing | Reel Size | Tape Width | Qty   |
|---------------|---------|-----------|---------|-----------|------------|-------|
| CRXQF60M065G1 | -       | TO-247-4L | Tube    | N/A       | N/A        | 25pcs |

## Absolute Maximum Ratings

| Parameter                                                                                                               | Symbol                | Value     | Unit |
|-------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|------|
| Drain-source voltage                                                                                                    | V <sub>DSmax</sub>    | 650       | V    |
| Continuous drain current<br>V <sub>GS</sub> =20V, T <sub>C</sub> = 25°C<br>V <sub>GS</sub> =20V, T <sub>C</sub> = 100°C | I <sub>D</sub>        | 37<br>26  | A    |
| Pulsed drain current (T <sub>C</sub> = 25°C, t <sub>p</sub> limited by T <sub>jmax</sub> )                              | I <sub>D(pulse)</sub> | 93        | A    |
| Avalanche energy, single pulse (L=10mH, R <sub>g</sub> =25Ω)                                                            | E <sub>AS</sub>       | 590       | mJ   |
| Gate-Source voltage (dynamic)                                                                                           | V <sub>GSmax</sub>    | -10/+25   | V    |
| Gate-Source voltage (static)                                                                                            | V <sub>GSop</sub>     | -5/+20    | V    |
| Power dissipation (T <sub>C</sub> =25°C, T <sub>J</sub> =175°C)                                                         | P <sub>D</sub>        | 183       | W    |
| Operating junction temperature                                                                                          | T <sub>J</sub>        | -55...175 | °C   |
| Storage temperature                                                                                                     | T <sub>stg</sub>      | -55...150 | °C   |

## Thermal Resistance

| Parameter                                   | Symbol     | Value | Unit |
|---------------------------------------------|------------|-------|------|
| Thermal resistance, junction – case. Max    | $R_{thJC}$ | 0.82  | °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   | $V_{(BR)DSS}$ | 650 | -   | -   | V       | $V_{GS}=0V, I_D=250\mu A$                      |
| Gate threshold voltage           | $V_{GS(th)}$  | 2   | -   | 4   | V       | $V_{DS}=V_{GS}, I_D=5mA$                       |
| Zero gate voltage drain current  | $I_{DSS}$     | -   | 1   | 100 | $\mu A$ | $V_{DS}=650V, V_{GS}=0V$                       |
|                                  |               | -   | 10  | -   |         | $T_j=25\text{ °C}$<br>$T_j=175\text{ °C}$      |
| Gate-source leakage current      | $I_{GSS}$     | -   | -   | 250 | nA      | $V_{GS}=20V, V_{DS}=0V$                        |
| Drain-source on-state resistance | $R_{DS(on)}$  | -   | 60  | -   | mΩ      | $V_{GS}=18V, I_D=13.2A$                        |
|                                  |               | -   | 52  | 70  | mΩ      | $V_{GS}=20V, I_D=13.2A,$<br>$T_j=25\text{ °C}$ |
|                                  |               | -   | 77  | -   |         | $T_j=175\text{ °C}$                            |
| Transconductance                 | $g_{fs}$      | -   | 7.4 | -   | S       | $V_{DS}=20V, I_{DS}=13.2A$                     |

## Dynamic Characteristic

|                              |              |   |      |   |    |                                                                             |
|------------------------------|--------------|---|------|---|----|-----------------------------------------------------------------------------|
| Internal Gate resistance     | $R_{G(int)}$ | - | 3.4  | - | Ω  | $f=1MHz$                                                                    |
| Input Capacitance            | $C_{iss}$    | - | 1190 | - | pF | $V_{GS}=0V, V_{DS}=650V,$<br>$f=1MHz$                                       |
| Output Capacitance           | $C_{oss}$    | - | 129  | - |    |                                                                             |
| Reverse Transfer Capacitance | $C_{rss}$    | - | 13   | - |    |                                                                             |
| Coss Stored Energy           | $E_{oss}$    | - | 29   | - | uJ | $V_{DS}=650V$                                                               |
| Gate Total Charge            | $Q_g$        | - | 68   | - | nC | $V_{GS}=-5/20V$<br>$V_{DS}=400V$<br>$I_D=13.2A$                             |
| Gate-Source charge           | $Q_{gs}$     | - | 16   | - |    |                                                                             |
| Gate-Drain charge            | $Q_{gd}$     | - | 17   | - |    |                                                                             |
| Turn-on delay time           | $t_{d(on)}$  | - | 16   | - | ns | $V_{DD}=400V, I_D=13.2A$<br>$V_{GS}=-5V/20V,$<br>$R_G=10\Omega, L=100\mu H$ |
| Rise time                    | $t_r$        | - | 21   | - |    |                                                                             |
| Turn-off delay time          | $t_{d(off)}$ | - | 38   | - |    |                                                                             |
| Fall time                    | $t_f$        | - | 13   | - |    |                                                                             |
| Turn-On Switching Energy     | $E_{(on)}$   | - | 134  | - | uJ |                                                                             |
| Turn Off Switching Energy    | $E_{(off)}$  | - | 8.7  | - |    |                                                                             |

## Body Diode Characteristic

| Parameter                                | Symbol    | Value |      |      | Unit | Test Condition                                   |
|------------------------------------------|-----------|-------|------|------|------|--------------------------------------------------|
|                                          |           | min.  | typ. | max. |      |                                                  |
| Body Diode Forward Voltage               | $V_{SD}$  | -     | 3.3  | -    | V    | $V_{GS}=0V, I_F=6.6A$                            |
|                                          |           | -     | 2.6  | -    | V    | $V_{GS}=0V, I_F=6.6A, T_j=175^{\circ}C$          |
| Body Diode Reverse Recovery Time         | $t_{rr}$  | -     | 14   | -    | ns   | $di/dt=1860A/us$<br>$I_F=13.2A$<br>$V_{dd}=400V$ |
| Body Diode Reverse Recovery Charge       | $Q_{rr}$  | -     | 72   | -    | nC   |                                                  |
| Body Diode Peak Reverse Recovery Current | $I_{rrm}$ | -     | 8.7  | -    | A    |                                                  |

## Typical Performance Characteristics

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

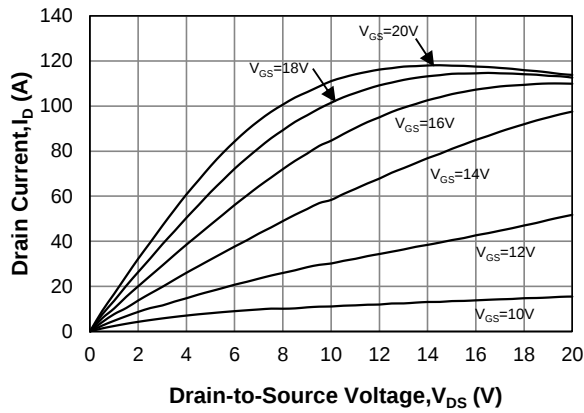


Fig 2. Output Characteristics ( $T_j = 25^\circ\text{C}$ )

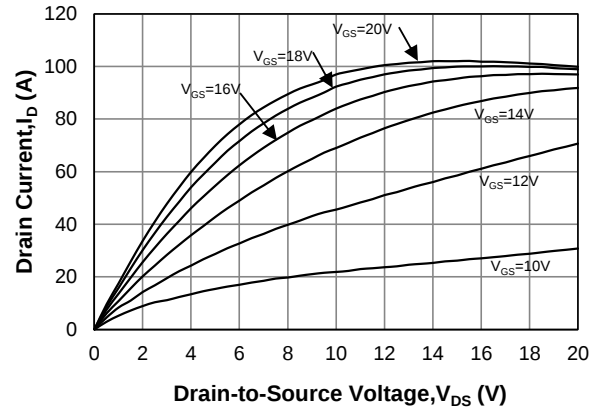


Fig 3. Output Characteristics ( $T_j = 175^\circ\text{C}$ )

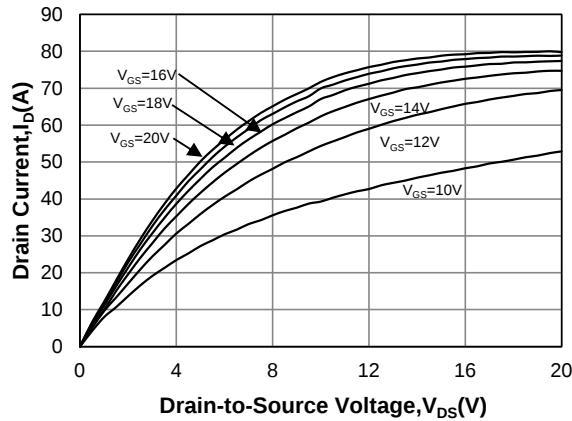


Fig 4:  $R_{ds(on)}$  vs. Temperature

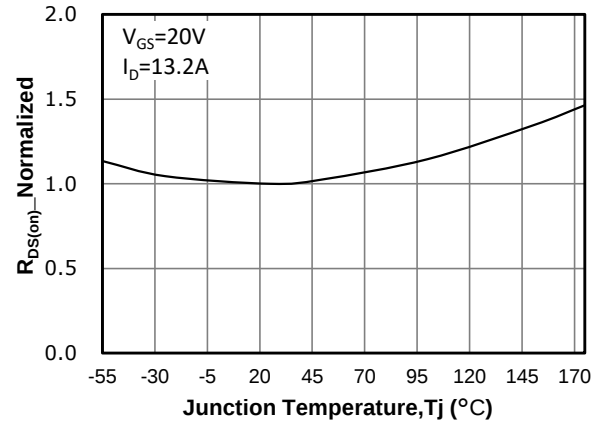


Fig 5: On-Resistance vs. Drain Current For Various Temperatures

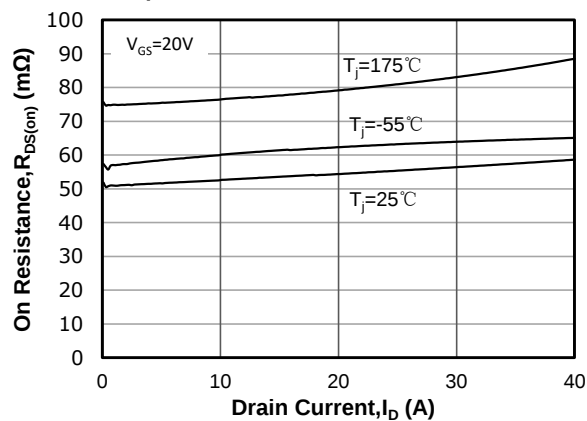


Fig 6:  $R_{ds(on)}$  vs. Temperature For Various Gate Voltage

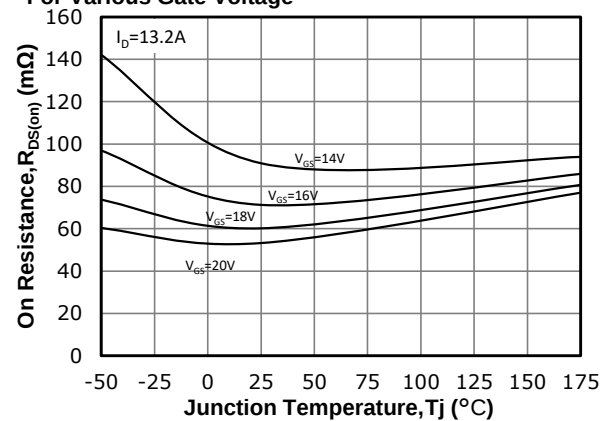


Fig 7: Transfer Characteristics

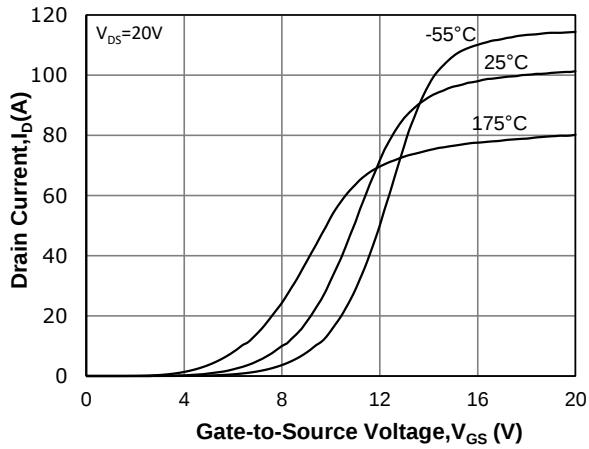


Fig 8: Body-diode Forward Characteristics For Various Temperatures

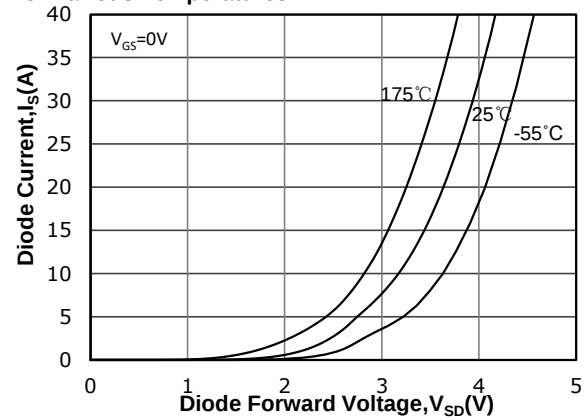


Fig 9:  $V_{th}(th)$  Vs  $T_j$  Characteristics

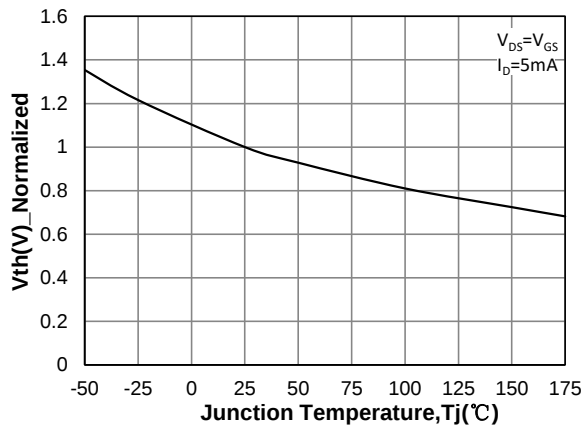


Fig 10: 3rd Quadrant Characteristic at  $25^\circ C$

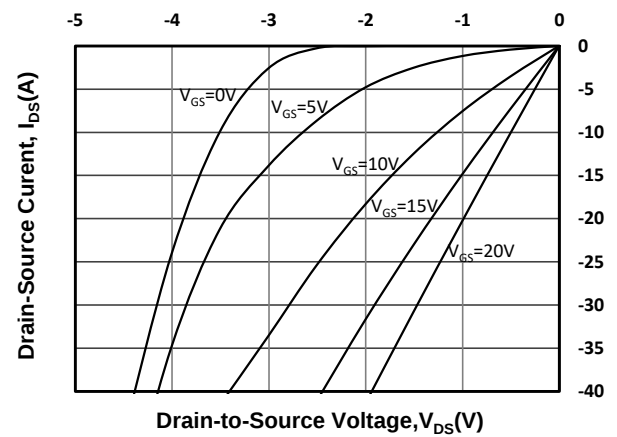


Fig 11: Gate Charge Characteristics

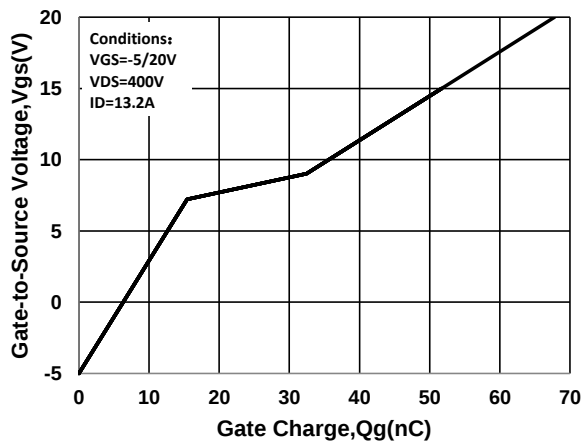
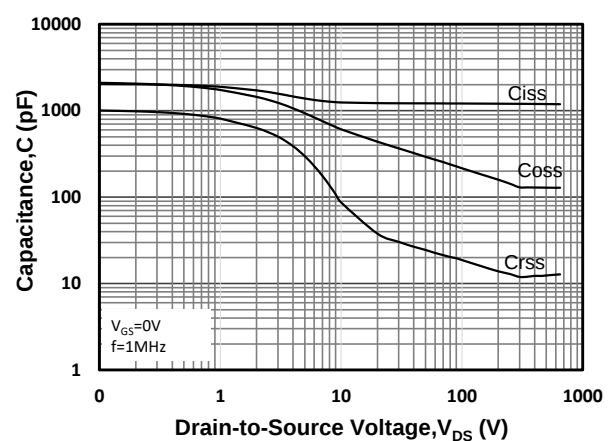
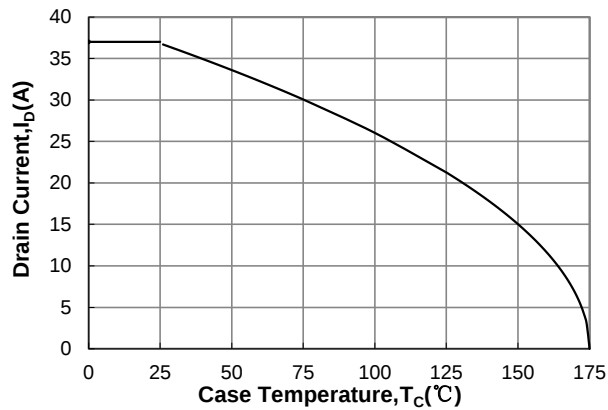


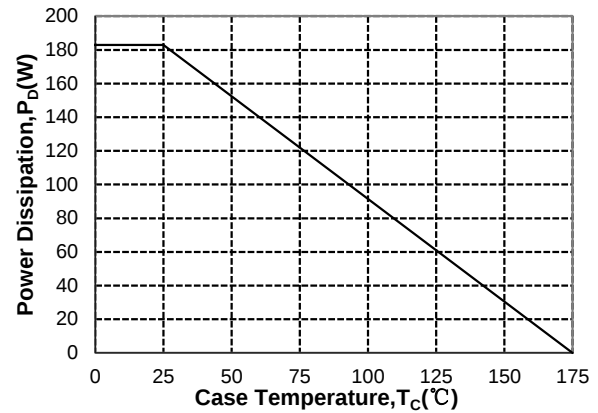
Fig 12: Capacitance Characteristics



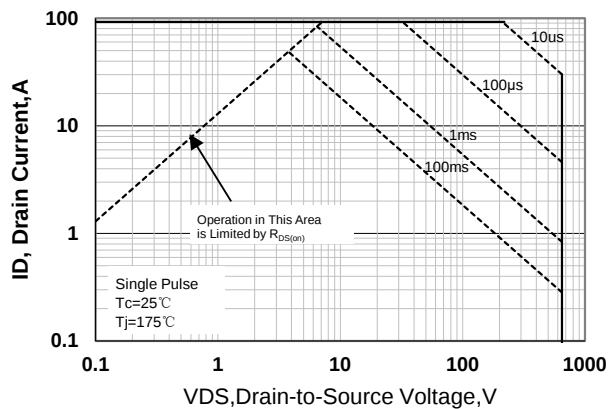
**Fig 13: Continuous Drain Current vs. Case Temperature**



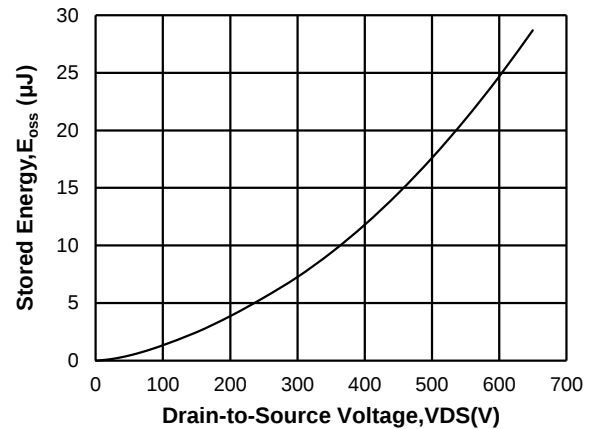
**Fig 14: Maximum Power Dissipation vs. Case Temperature**



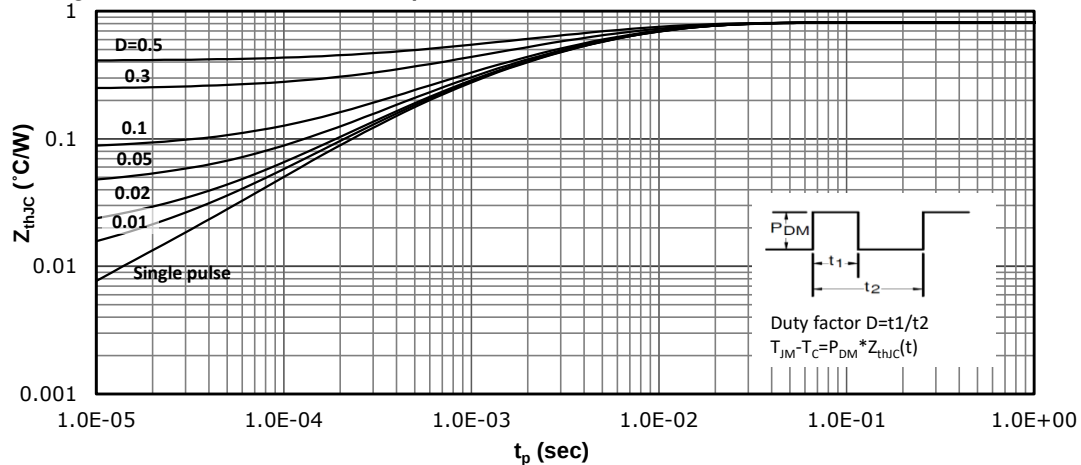
**Fig 15: Safe Operating Area**



**Fig 16: Output Capacitor Stored Energy**

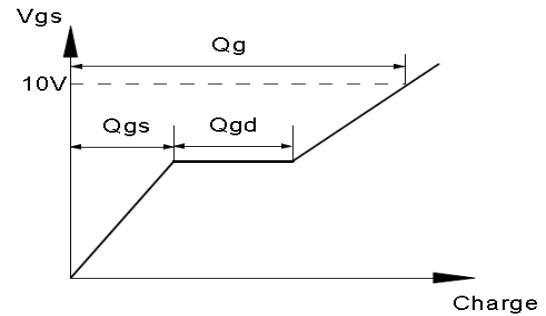
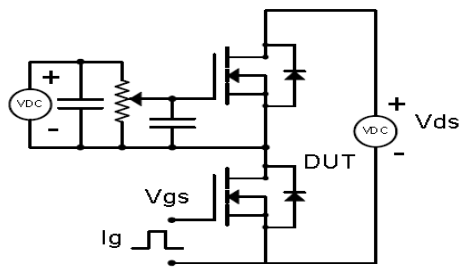


**Fig 17: Max. Transient Thermal Impedance**

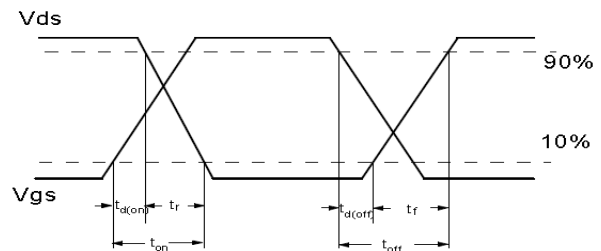
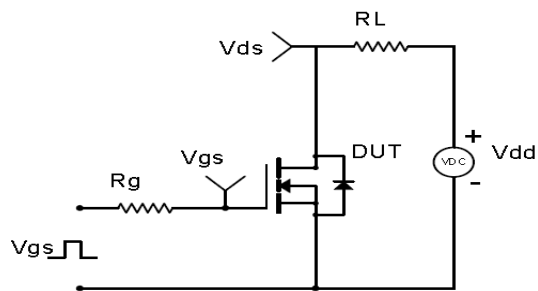


## Test Circuit & Waveform

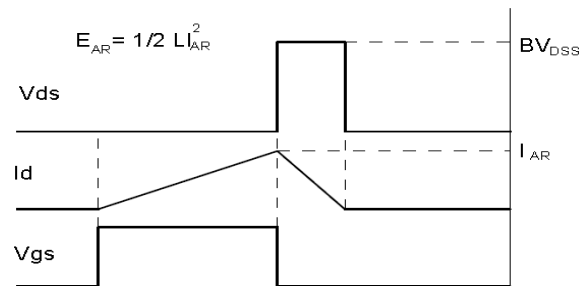
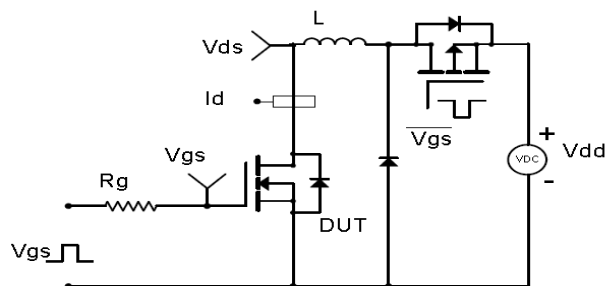
Gate Charge Test Circuit & Waveform



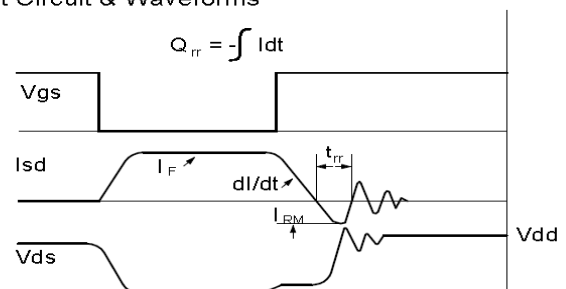
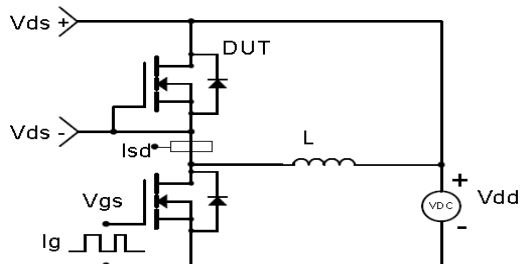
Resistive Switching Test Circuit & Waveforms



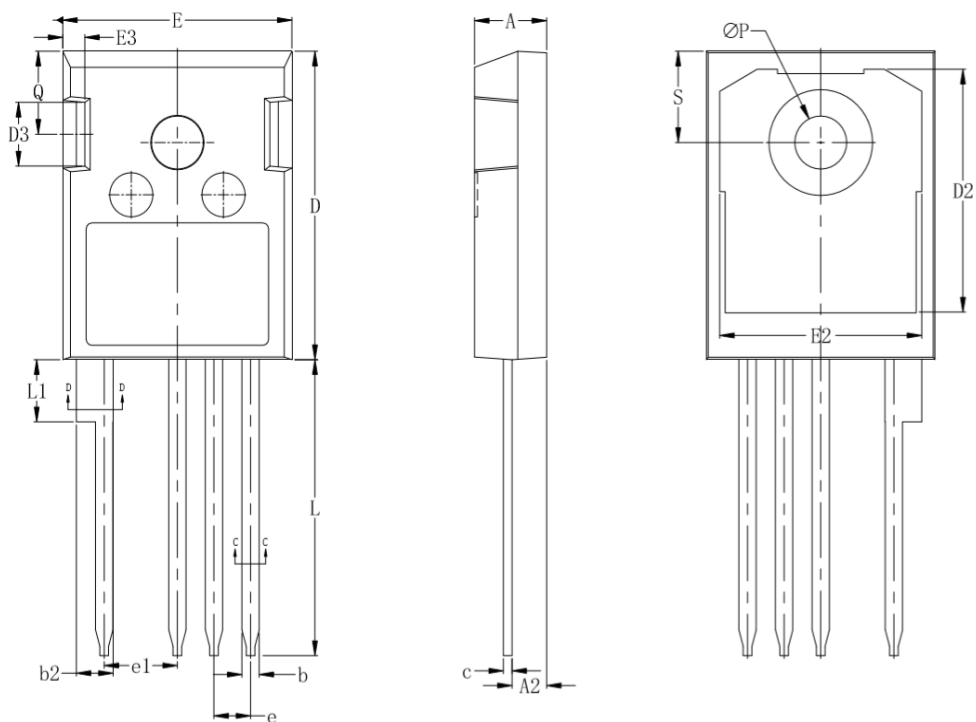
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



## Package Outline: TO-247-4L



| Items | Values(mm) |      |
|-------|------------|------|
|       | MIN        | MAX  |
| A     | 4.8        | 5.2  |
| A2    | 2.2        | 2.6  |
| b     | 1.05       | 1.4  |
| b2    | 2.4        | 2.75 |
| c     | 0.5        | 0.75 |
| D     | 20         | 21.5 |
| D2    | 15.5       | 17.2 |
| D3    | 4          | 5    |
| E     | 15.5       | 16.1 |
| E2    | 13         | 15   |
| E3    | 1          | 2    |
| e     | 2.54 BSC.  |      |
| e1    | 5.08 BSC.  |      |
| L     | 19         | 21   |
| L1    | 4          | 4.45 |
| ØP    | 3.5        | 3.7  |
| Q     | 5.4        | 5.9  |
| S     | 5.9        | 6.4  |

**Revision History**

| Revision | Date       | Major changes             |
|----------|------------|---------------------------|
| 1.0      | 2022/10/20 | Release of formal version |
| 2.0      | 2022/12/26 | Tighten Rdson Spec        |
| 3.0      | 2023/3/2   | Update VTH Spec           |

**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.