

# SC020N65TK-R

Silicon Carbide MOSFET 650V, 20mΩ, 91A



重庆平伟半导体股份有限公司

## Features

- Low switching losses
- Extremely low on-resistance  $R_{DS(on)}$
- Robust body diode operation under hard commutation events
- Easy to Parallel and Simple to Drive
- Qualified according to JEDEC criteria

## Applications

- On-board charger
- DC/DC converter
- Auxiliary inverters

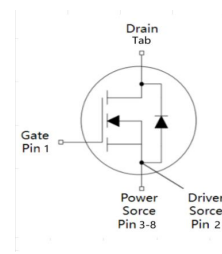
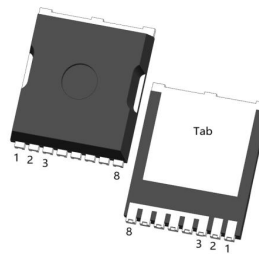


**100% DVDS Tested**  
**100% Avalanche Tested**

## Product Summary

|                   |      |
|-------------------|------|
| $V_{DS}$          | 650V |
| $R_{DS(on)}$ typ. | 20mΩ |
| $I_D$             | 91A  |

TOLL-2L



## Package Marking and Ordering Information

| Part #       | Marking    | Package | Packing   | Reel Size | Tape Width | Qty     |
|--------------|------------|---------|-----------|-----------|------------|---------|
| SC020N65TK-R | SC020N65TK | TOLL-2L | Tape&Reel | 13 inches | 24mm       | 1500pcs |

## Absolute Maximum Ratings

| Parameter                                                                         | Symbol                | Value      | Unit             |
|-----------------------------------------------------------------------------------|-----------------------|------------|------------------|
| Drain-source voltage                                                              | $V_{DS}$              | 650        | V                |
| Continuous drain current<br>$T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$ | $I_D$                 | 91<br>64   | A                |
| Pulsed drain current ( $T_C = 25^\circ\text{C}$ )                                 | $I_{D \text{ pulse}}$ | 272        | A                |
| Avalanche energy, single pulse ( $L=5\text{mH}$ )                                 | $E_{AS}$              | 423        | mJ               |
| Gate-Source voltage,max.transient voltage                                         | $V_{GSmax}$           | -10/+22    | V                |
| Gate-Source voltage,Recommended operating values                                  | $V_{GSsop}$           | -5/+18     | V                |
| Power dissipation<br>$T_C = 25^\circ\text{C}$                                     | $P_{tot}$             | 213        | W                |
| Operating junction and storage temperature                                        | $T_j, T_{stg}$        | -55...+175 | $^\circ\text{C}$ |

**Thermal Resistance**

| Parameter                                              | Symbol     | Value |      |      | Unit | Test Condition |
|--------------------------------------------------------|------------|-------|------|------|------|----------------|
|                                                        |            | min.  | typ. | max. |      |                |
| Thermal resistance, junction – case.                   | $R_{thJC}$ | -     | 0.47 | 0.71 | °C/W | -              |
| Thermal resistance, junction - ambient(min. footprint) | $R_{thJA}$ | -     | -    | 40.0 | °C/W | -              |

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

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

**Static Characteristic**

|                                  |              |     |     |      |         |                                                                     |
|----------------------------------|--------------|-----|-----|------|---------|---------------------------------------------------------------------|
| Drain-source breakdown voltage   | $BV_{DSS}$   | 650 | -   | -    | V       | $V_{GS}=0V, I_D=100\mu A$                                           |
| Gate threshold voltage           | $V_{GS(th)}$ | 2.2 | 3.0 | 4.2  | V       | $V_{DS}=V_{GS}, I_D=10mA$                                           |
| Zero gate voltage drain current  | $I_{DSS}$    | -   | 1   | 10   | $\mu A$ | $V_{DS}=650V, V_{GS}=0V$<br>$T_j=25^{\circ}C$<br>$T_j=175^{\circ}C$ |
| Gate-source leakage current      | $I_{GSS}$    | -   | -   | 100  | nA      | $V_{GS}=22V, V_{DS}=0V$                                             |
|                                  |              | -   | -   | -100 | nA      | $V_{GS}=-13V, V_{DS}=0V$                                            |
| Drain-source on-state resistance | $R_{DS(on)}$ | -   | 20  | 28   | mΩ      | $V_{GS}=18V, I_D=40A$                                               |
| Transconductance                 | $g_{fs}$     | -   | 10  | -    | S       | $V_{DS}=18V, I_D=10A$                                               |

**Dynamic Characteristic**

|                              |              |   |      |   |    |                                                              |
|------------------------------|--------------|---|------|---|----|--------------------------------------------------------------|
| Input Capacitance            | $C_{iss}$    | - | 2977 | - | pF | $V_{GS}=0V, V_{DS}=400V,$<br>$f=1MHz$                        |
| Output Capacitance           | $C_{oss}$    | - | 186  | - |    |                                                              |
| Reverse Transfer Capacitance | $C_{rss}$    | - | 9    | - |    |                                                              |
| Gate Total Charge            | $Q_G$        | - | 131  | - | nC | $V_{DS}=400V, I_D=20A$<br>$V_{GS}=-5V/18V$                   |
| Gate-Source charge           | $Q_{gs}$     | - | 49   | - |    |                                                              |
| Gate-Drain charge            | $Q_{gd}$     | - | 28   | - |    |                                                              |
| Turn-on delay time           | $t_{d(on)}$  | - | 15   | - | ns | $V_{GS}=-5/18V,$<br>$V_{DD}=400V,$<br>$R_G=5\Omega, I_D=20A$ |
| Rise time                    | $t_r$        | - | 45   | - |    |                                                              |
| Turn-off delay time          | $t_{d(off)}$ | - | 13   | - |    |                                                              |
| Fall time                    | $t_f$        | - | 10   | - |    |                                                              |
| Gate resistance              | $R_G$        | - | 1.5  | - | Ω  | $V_{GS}=0V, f=1MHz$                                          |

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## Body Diode Characteristic

| Parameter                             | Symbol    | Value |      |      | Unit | Test Condition                                                      |
|---------------------------------------|-----------|-------|------|------|------|---------------------------------------------------------------------|
|                                       |           | min.  | typ. | max. |      |                                                                     |
| Body Diode Forward Voltage            | $V_{SD}$  | -     | 3.4  | -    | V    | $V_{GS} = -5V, I_{SD} = 20A$<br>$T_j = 25^{\circ}C$                 |
|                                       |           | -     | 3.1  | -    |      | $T_j = 175^{\circ}C$                                                |
| Body Diode Continuous Forward Current | $I_S$     | -     | -    | 86   | A    | $T_C = 25^{\circ}C$                                                 |
|                                       |           | -     | -    | 48   | A    | $T_C = 100^{\circ}C$                                                |
| Body Diode Reverse Recovery Time      | $t_{rr}$  | -     | 17   | -    | ns   | $V_{GS} = -5V, I_{SD} = 20A,$<br>$V_R = 400V$<br>$di/dt = 1200A/us$ |
| Body Diode Reverse Recovery Charge    | $Q_{rr}$  | -     | 112  | -    | nC   |                                                                     |
| Peak Reverse Recovery Current         | $I_{RRM}$ | -     | 11   | -    | A    |                                                                     |

## Typical Performance Characteristics

Fig 1: Output Characteristics  $T_j=25^\circ\text{C}$

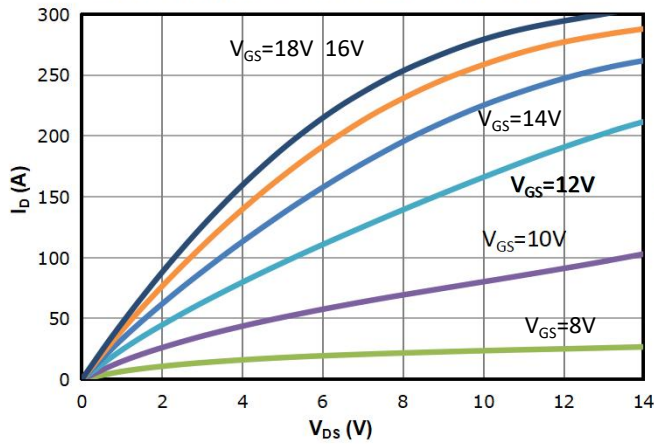


Fig 2: Output Characteristics  $T_j=175^\circ\text{C}$

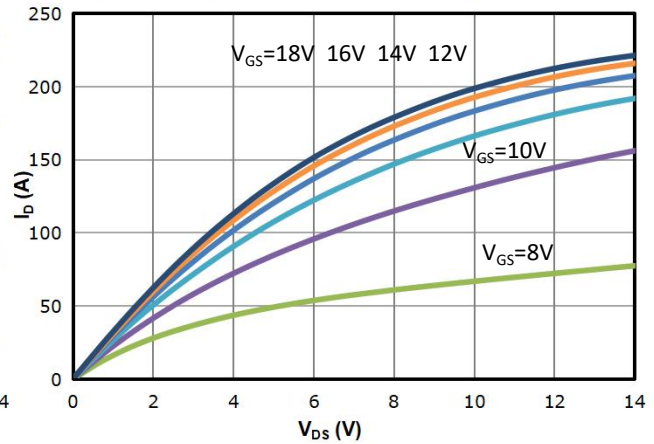


Fig 3: Transfer Characteristics

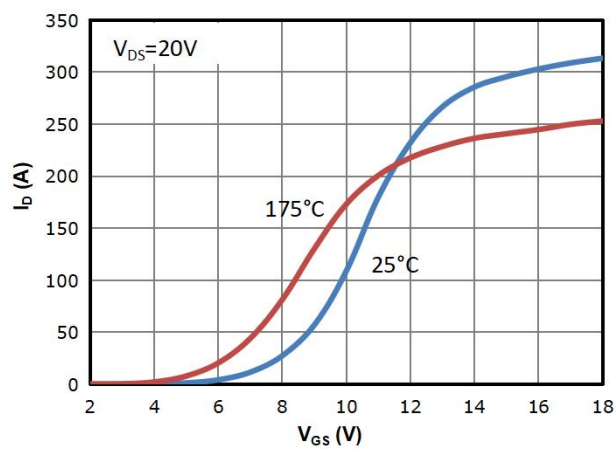


Fig 4:  $R_{DS(on)}$  vs Drain Current and Gate Voltage

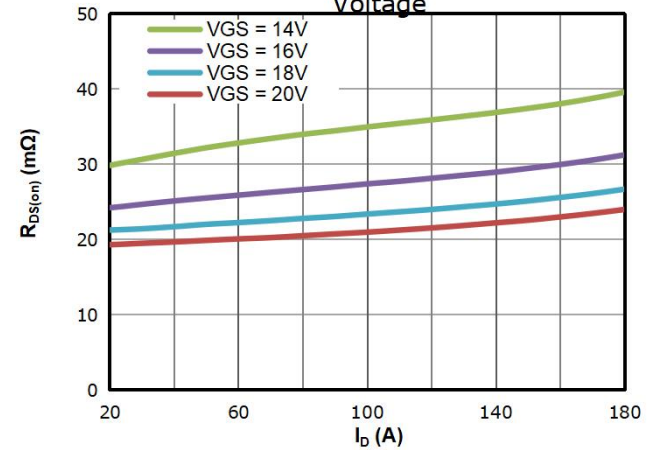


Fig 5:  $R_{DS(on)}$  vs. Temperature

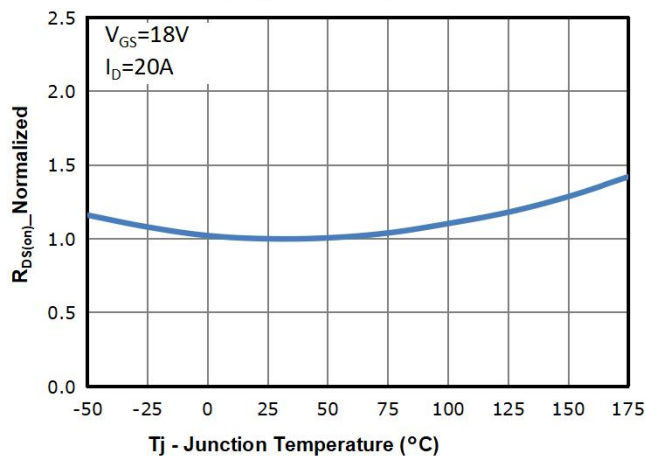


Fig 6:  $V_{GS(th)}$  vs. Temperature

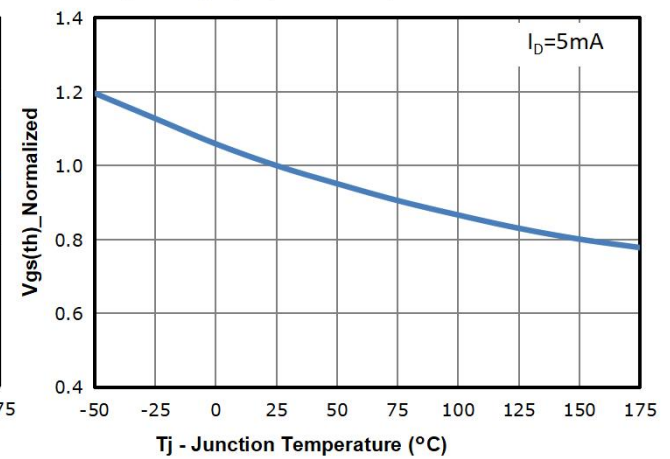


Fig 7: BVdss vs. Temperature

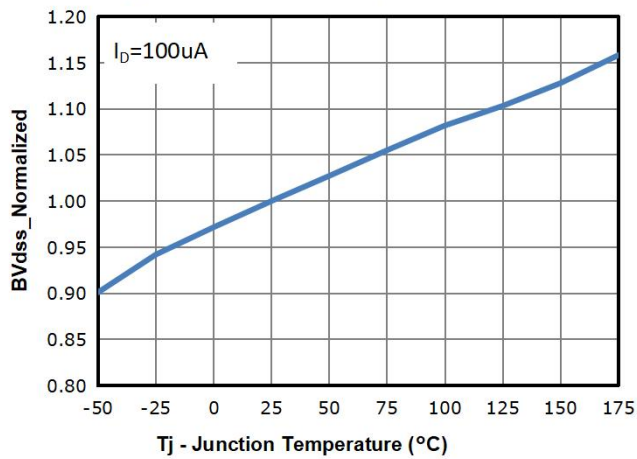


Fig 8: Capacitance Characteristics

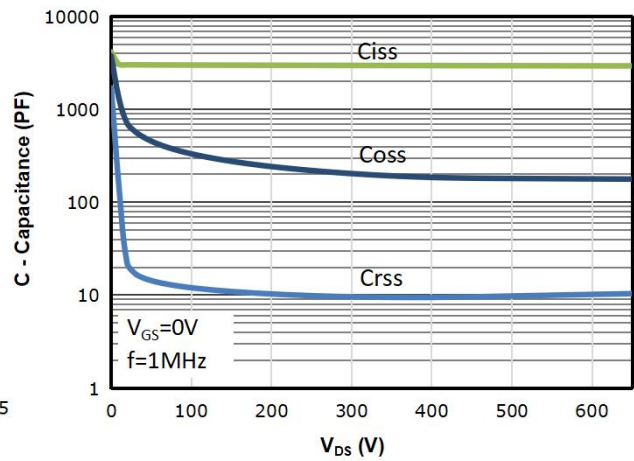


Fig 9: Gate Charge Characteristics

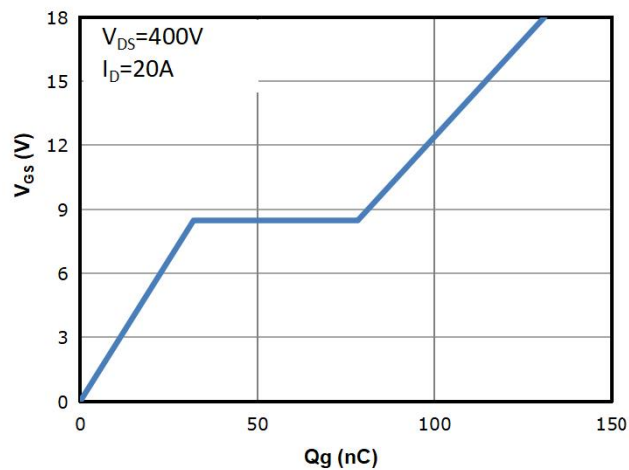


Fig 10: Body-diode Forward Characteristics

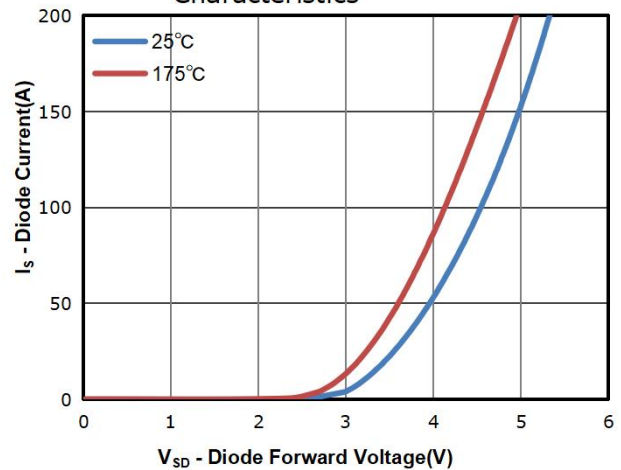


Fig 11: Power Dissipation

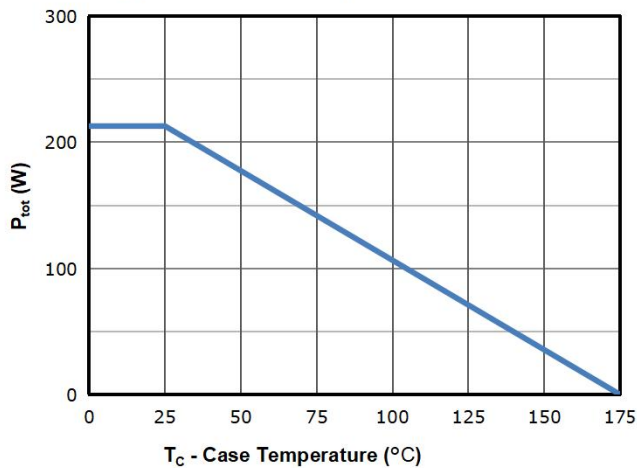


Fig 12: Drain Current Derating

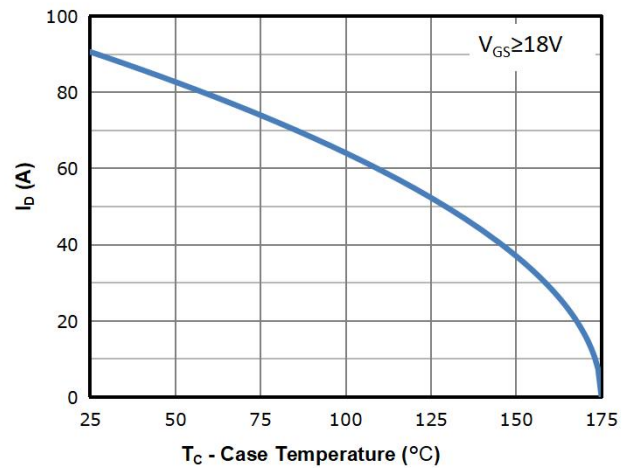




Fig 13: Safe Operating Area

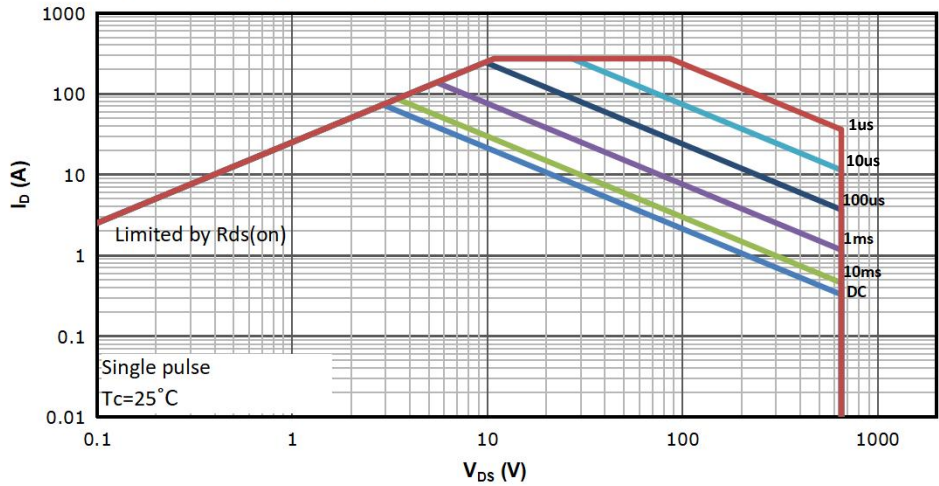
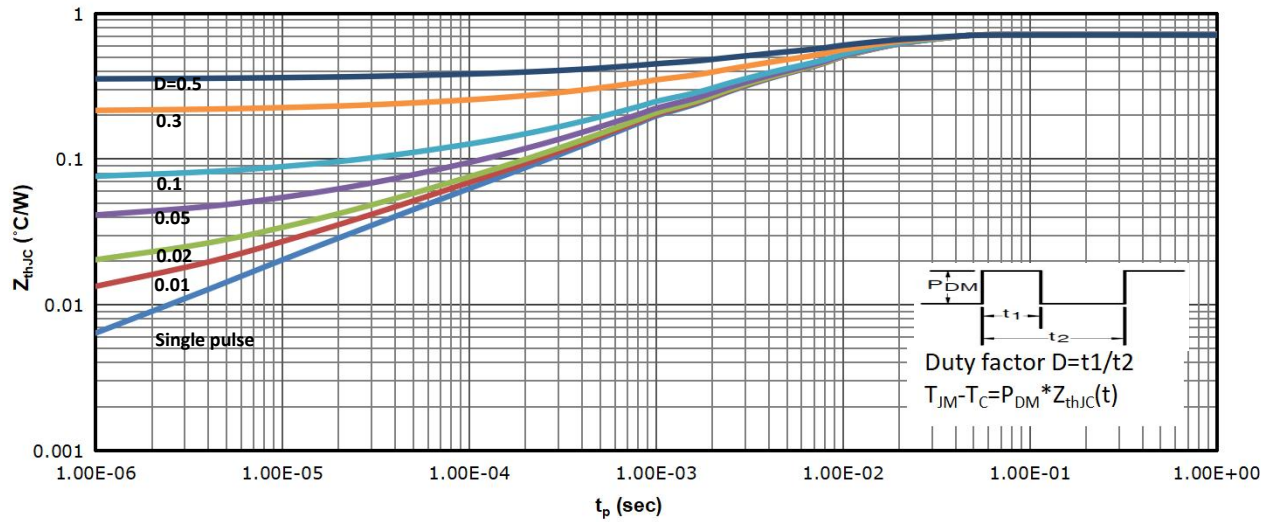
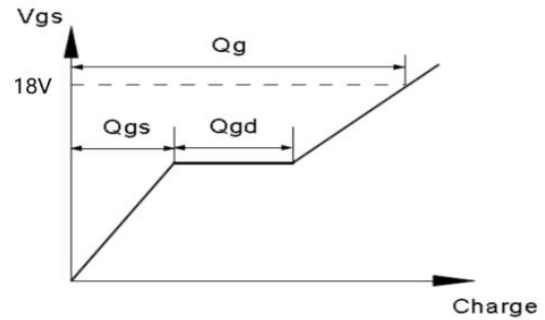
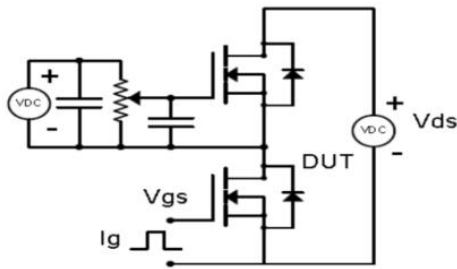


Fig 14: Max. Transient Thermal Impedance

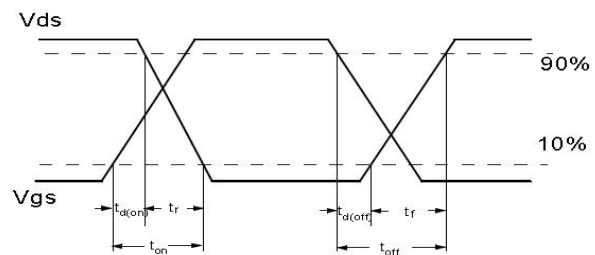
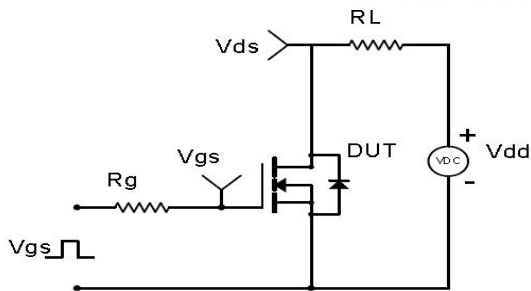


## Test Circuit & Waveform

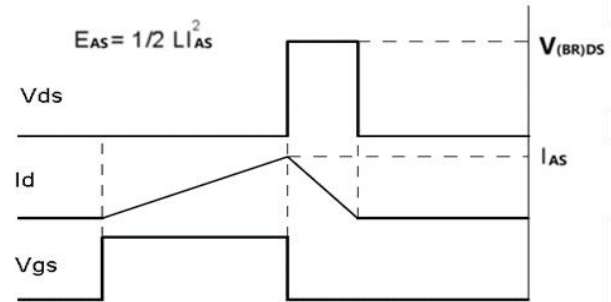
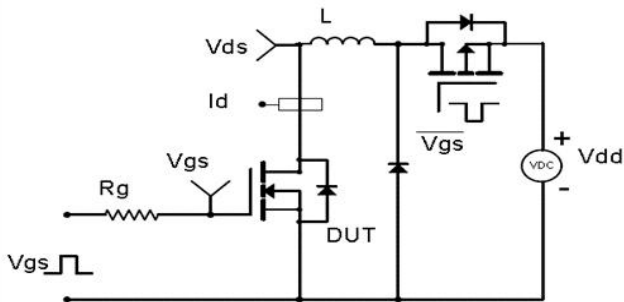
Gate Charge Test Circuit & Waveform



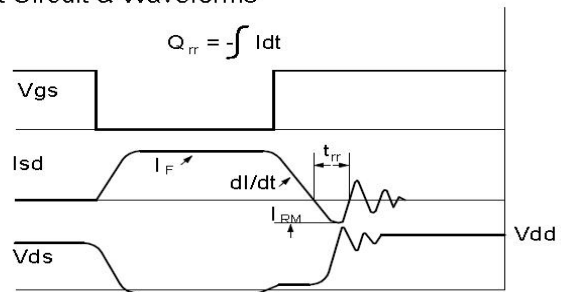
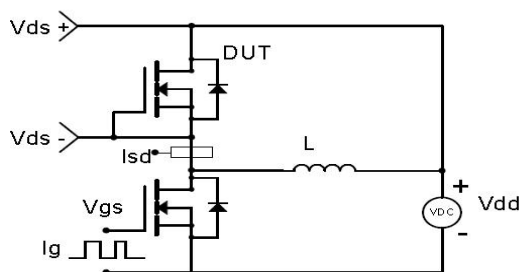
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms





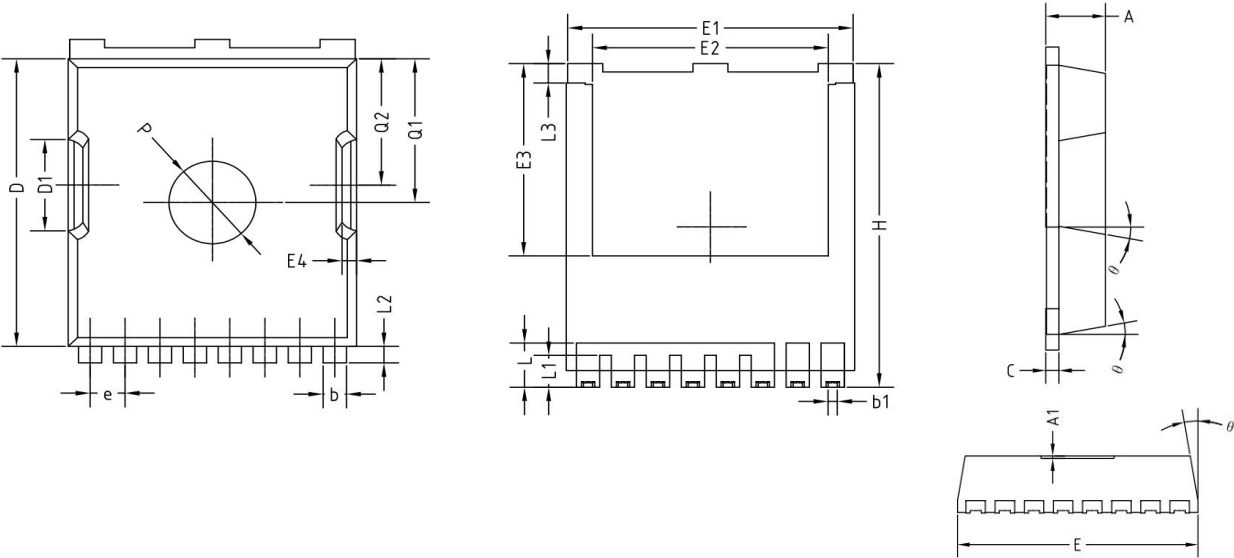
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## Package Outline: TOLL-2L



| SYMBOL | MILLIMETERS |       | INCHES |       |
|--------|-------------|-------|--------|-------|
|        | MIN         | MAX   | MIN    | MAX   |
| A      | 2.20        | 2.40  | 0.087  | 0.094 |
| A1     | 0.05        | 0.20  | 0.002  | 0.008 |
| b      | 0.65        | 0.85  | 0.026  | 0.033 |
| b1     | 0.30        | 0.50  | 0.012  | 0.020 |
| C      | 0.35        | 0.65  | 0.014  | 0.026 |
| D      | 10.35       | 10.70 | 0.407  | 0.421 |
| D1     | 3.15        | 3.45  | 0.124  | 0.136 |
| E      | 9.80        | 10.00 | 0.386  | 0.394 |
| E1     | 9.65        | 9.95  | 0.380  | 0.392 |
| E2     | 7.90        | 8.30  | 0.311  | 0.327 |
| E3     | 6.80        | 7.20  | 0.268  | 0.283 |
| E4     | 0.30        | 0.75  | 0.012  | 0.030 |
| e      | 1.15        | 1.25  | 0.045  | 0.049 |
| L      | 1.35        | 1.85  | 0.053  | 0.073 |
| L1     | 0.95        | 1.35  | 0.037  | 0.053 |
| L2     | 0.40        | 0.80  | 0.016  | 0.031 |
| L3     | 0.60        | 0.85  | 0.024  | 0.033 |
| θ      | 7°          | 12°   | 7°     | 12°   |
| P      | 2.90        | 3.10  | 0.114  | 0.122 |
| Q      | 4.50        | 4.70  | 0.177  | 0.185 |
| Q1     | 5.10        | 5.30  | 0.201  | 0.209 |
| H      | 11.55       | 11.95 | 0.455  | 0.470 |



## Disclaimer

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