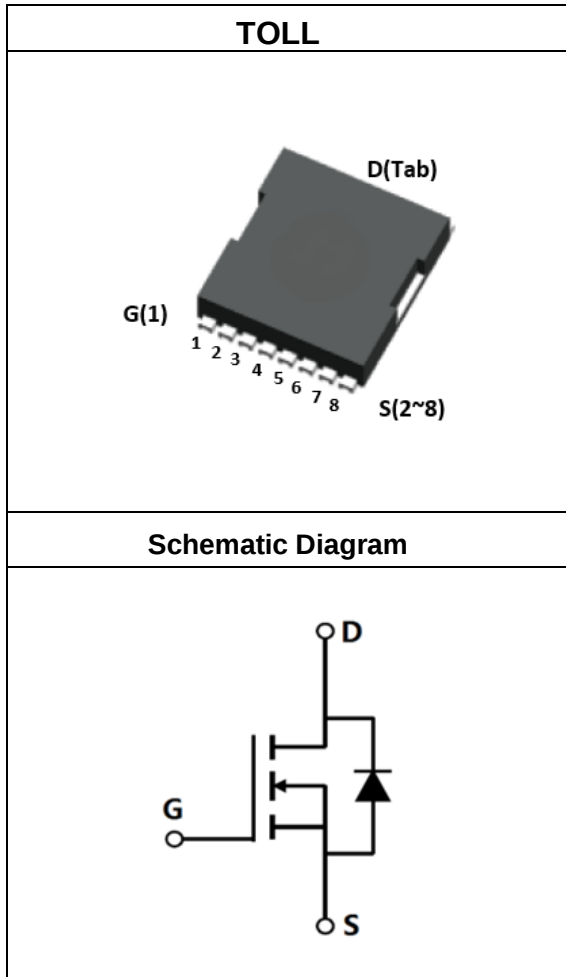


N-channel 250V, 22mΩ max.,100A  
SGT MOSFET S2 in TOLL

Datasheet - production data

## 1. Descriptions



## Key Performance Parameters

| Parameters       | Value | Unit |
|------------------|-------|------|
| $BV_{DSS}$       | 250   | V    |
| $R_{DS(on),max}$ | 22    | mΩ   |
| $Q_{g,typ}$      | 71    | nC   |
| $I_{D,pulse}$    | 350   | A    |
| $E_{AS}$         | 400   | mJ   |

## Features

- Extremely low losses due to very low FOM  $R_{ds(on)} \cdot Q_g$ .
- High-speed switching.
- Qualified for industrial grade applications according to JEDEC.
- 100% UIS Tested.

## Applications

High-Efficiency DC-DC Converters, Switching Voltage Regulators and Motor Drivers.

| Type/Ordering Code | Package | Marking  | Related Links  |
|--------------------|---------|----------|----------------|
| CST220N25S2        | TOLL    | 220N25S2 | See Appendix A |

## Contents

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## 2. Maximum Ratings

at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

**Table 1. Absolute Maximum Ratings**

| Symbol         | Parameter                                    | Values |      |           | Unit             | Test Condition                                    |
|----------------|----------------------------------------------|--------|------|-----------|------------------|---------------------------------------------------|
|                |                                              | Min.   | Typ. | Max.      |                  |                                                   |
| $V_{DS}$       | Drain-source voltage <sup>1)</sup>           | -      | -    | 250       | V                | $V_{GS}=0V$ , $I_D=250\mu A$                      |
| $I_D$          | Continuous drain current                     | -      | -    | 100<br>70 | A                | $T_C=25^\circ\text{C}$<br>$T_C=100^\circ\text{C}$ |
| $I_{D,pulse}$  | Pulsed drain current                         | -      | -    | 350       | A                | $T_C=25^\circ\text{C}$                            |
| $E_{AS}$       | Avalanche energy, single pulse <sup>2)</sup> | -      | -    | 400       | mJ               | $I_D=40A$ ; $V_{DD}=50V$                          |
| $I_{AS}$       | Avalanche current                            | -      | -    | 40        | A                | -                                                 |
| $V_{GS}$       | Gate source voltage                          | -20    | -    | 20        | V                | static; AC ( $f>1\text{ Hz}$ )                    |
| $P_{tot}$      | Power dissipation                            | -      | -    | 500       | W                | $T_C=25^\circ\text{C}$                            |
| $T_j, T_{stg}$ | Operating and storage temperature            | -55    | -    | 175       | $^\circ\text{C}$ | -                                                 |
| $I_S$          | Continuous diode forward current             | -      | -    | 100       | A                | $T_C=25^\circ\text{C}$                            |
| $I_{S,pulse}$  | Diode pulse current <sup>2)</sup>            | -      | -    | 350       | A                | $T_C=25^\circ\text{C}$                            |

1) Limited by  $T_j$  max. Maximum duty cycle  $D=0.75$ .

2)  $V_{DD}=50V$ ,  $L=0.5mH$ ,  $R_G=25\Omega$ , Starting  $T_j=25^\circ\text{C}$ .

### 3. Thermal Characteristics

**Table 2. Thermal Characteristics**

| Symbol     | Parameter                                                     | Values |      |      | Unit | Test Condition                          |
|------------|---------------------------------------------------------------|--------|------|------|------|-----------------------------------------|
|            |                                                               | Min.   | Typ. | Max. |      |                                         |
| $R_{thJC}$ | Thermal resistance, junction - case                           | -      | -    | 0.3  | °C/W | $T_C = 25^{\circ}\text{C}$              |
| $R_{thJA}$ | Thermal resistance, junction - ambient                        | -      | -    | 50   | °C/W | $T_C = 25^{\circ}\text{C}$              |
| $T_{sold}$ | Soldering temperature,<br>wavesoldering only allowed at leads | -      | -    | 260  | °C   | Lead Temperature<br>(Soldering, 10 sec) |

## 4. Electrical Characteristics

at  $T_j = 25^{\circ}\text{C}$ , unless otherwise specified

**Table 3. Static Characteristics**

| Symbol        | Parameter                        | Values |      |           | Unit       | Test Condition                                   |
|---------------|----------------------------------|--------|------|-----------|------------|--------------------------------------------------|
|               |                                  | Min.   | Typ. | Max.      |            |                                                  |
| $V_{(BR)DSS}$ | Drain-source breakdown voltage   | 250    | -    | -         | V          | $V_{GS}=0V, I_D=250\mu A$                        |
| $V_{(GS)th}$  | Gate threshold voltage           | 2      | 3.0  | 4         | V          | $V_{DS}=V_{GS}, I_D=250\mu A$                    |
| $I_{DSS}$     | Zero gate voltage drain current  | -      | -    | 1         | $\mu A$    | $V_{DS}=250V, V_{GS}=0V, T_j=25^{\circ}\text{C}$ |
| $I_{GSS}$     | Gate-source leakage current      | -      | -    | $\pm 100$ | nA         | $V_{GS}=\pm 20V, V_{DS}=0V$                      |
| $R_{DS(on)}$  | Drain-source on-state resistance | -      | 15.5 | 22        | m $\Omega$ | $V_{GS}=10V, I_D=20A, T_j=25^{\circ}\text{C}$    |
| $R_G$         | Gate resistance                  | -      | 3.7  | -         | $\Omega$   | $V_{DD}=0V, V_{GS}=0V, F=1\text{MHz}$            |
| $g_{fs}$      | Transconductance                 |        | 44   |           | S          | $V_{DS}=5V, I_D=20A$                             |

**Table 4. Dynamic Characteristics**

| Symbol       | Parameter                    | Values |      |      | Unit | Test Condition                                   |
|--------------|------------------------------|--------|------|------|------|--------------------------------------------------|
|              |                              | Min.   | Typ. | Max. |      |                                                  |
| $C_{iss}$    | Input capacitance            | -      | 5660 | -    | pF   | $V_{GS}=0V, V_{DS}=100V, f=250\text{kHz}$        |
| $C_{oss}$    | Output capacitance           | -      | 358  | -    | pF   | $V_{GS}=0V, V_{DS}=100V, f=250\text{kHz}$        |
| $C_{rss}$    | Reverse transfer capacitance | -      | 6.8  | -    | pF   | $V_{GS}=0V, V_{DS}=100V, f=250\text{kHz}$        |
| $t_{d(on)}$  | Turn-on delay time           | -      | 18   | -    | ns   | $V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$ |
| $t_r$        | Rise time                    | -      | 23   | -    | ns   | $V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$ |
| $t_{d(off)}$ | Turn-off delay time          | -      | 36   | -    | ns   | $V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$ |
| $t_f$        | Fall time                    | -      | 13   | -    | ns   | $V_{DD}=125V, V_{GS}=10V, I_D=20A, R_G=10\Omega$ |

**Table 5. Gate Charge Characteristics**

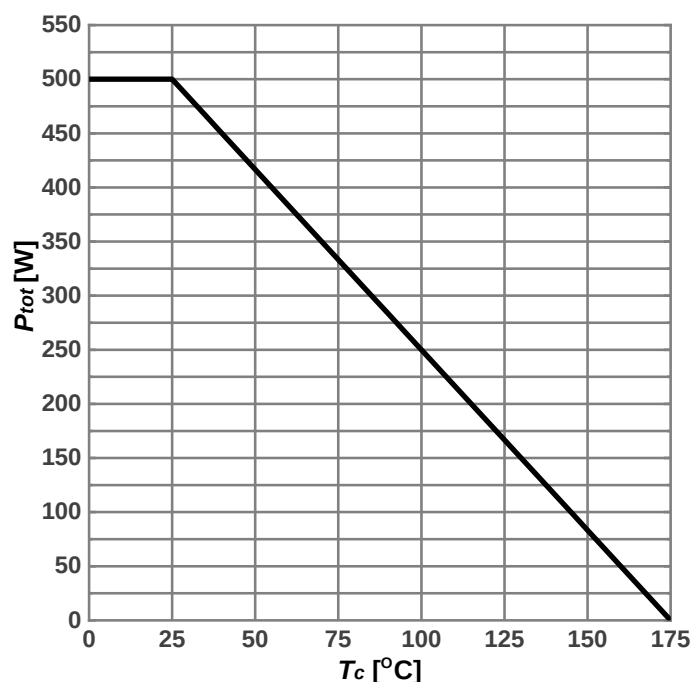
| Symbol        | Parameter             | Values |      |      | Unit | Test Condition                                   |
|---------------|-----------------------|--------|------|------|------|--------------------------------------------------|
|               |                       | Min.   | Typ. | Max. |      |                                                  |
| $Q_{gs}$      | Gate to source charge | -      | 23   | -    | nC   | $V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $Q_{gd}$      | Gate to drain charge  | -      | 9.5  | -    | nC   | $V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $Q_g$         | Gate charge total     | -      | 71   | -    | nC   | $V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $V_{plateau}$ | Gate plateau voltage  | -      | 4.45 | -    | V    | $V_{DD}=125V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |

**Table 6. Reverse Diode Characteristics**

| Symbol   | Parameter               | Values |      |      | Unit | Test Condition                               |
|----------|-------------------------|--------|------|------|------|----------------------------------------------|
|          |                         | Min.   | Typ. | Max. |      |                                              |
| $V_{SD}$ | Diode forward voltage   | -      | -    | 1.2  | V    | $V_{GS}=0V, I_F=20A, T_j=25^{\circ}\text{C}$ |
| $t_{rr}$ | Reverse recovery time   | -      | 152  | -    | ns   | $V_R=125V, I_F=20A, di_F/dt=100A/\mu s$      |
| $Q_{rr}$ | Reverse recovery charge | -      | 850  | -    | nC   | $V_R=125V, I_F=20A, di_F/dt=100A/\mu s$      |

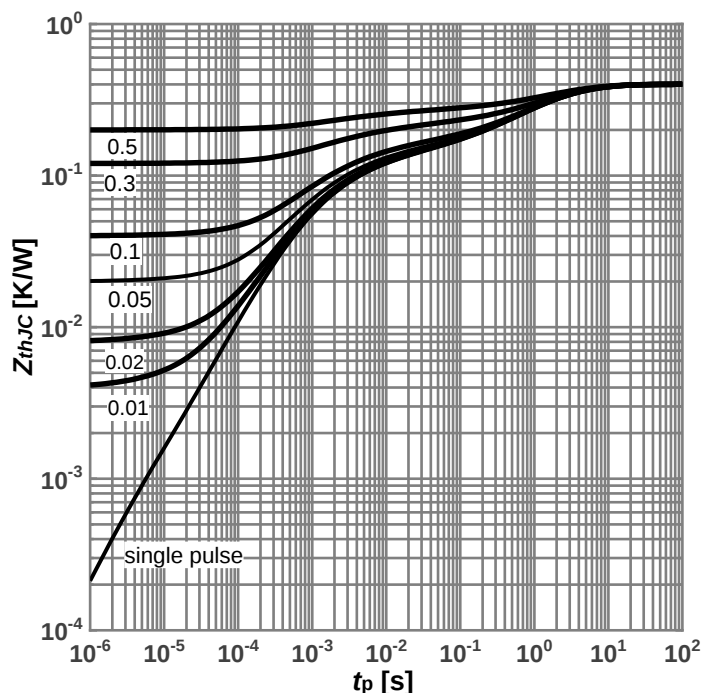
## 5. Electrical Characteristics Diagrams

Diagram 1: Power dissipation



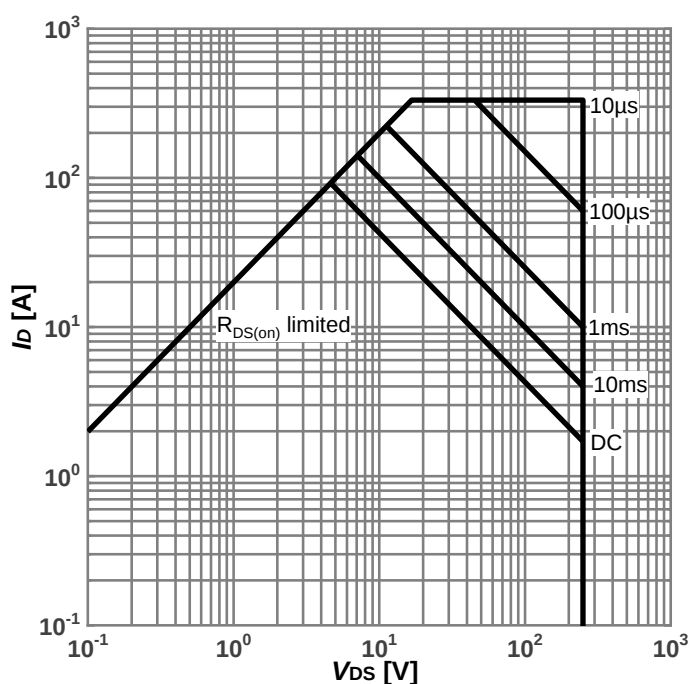
$$P_{tot}=f(T_c)$$

Diagram 2: Max. transient thermal impedance



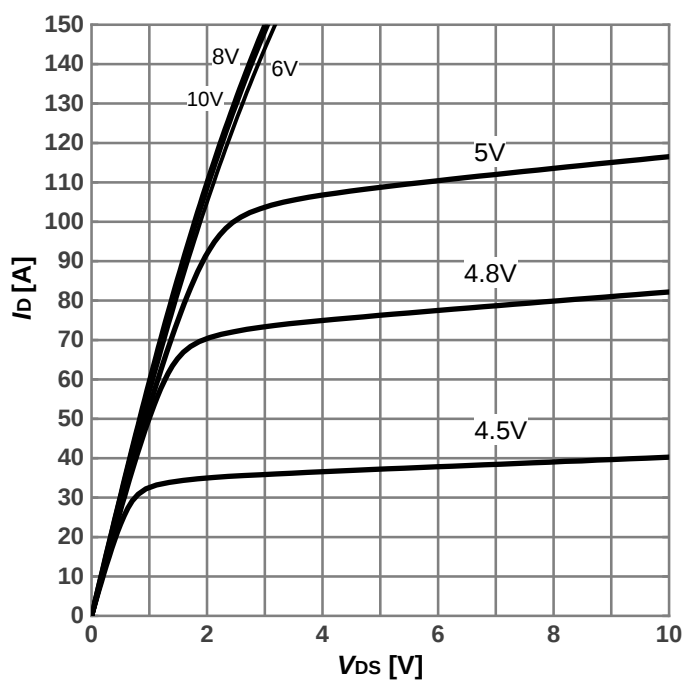
$$Z_{thJC}=f(t_p); \text{ parameter: } D = t_p/T$$

Diagram 3: Safe operating area



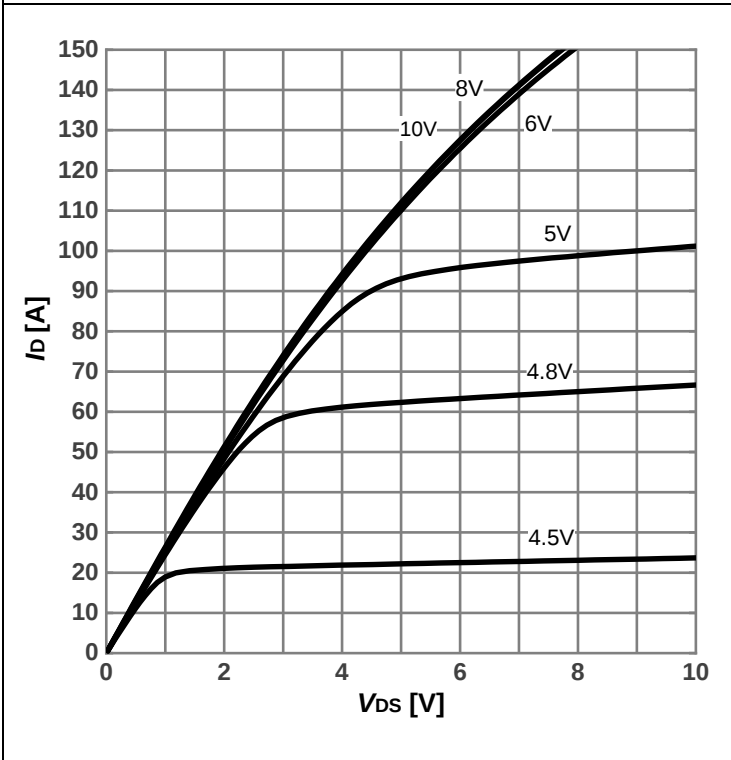
$$I_D=f(V_{DS}); T_J=25^\circ\text{C}; D=0; \text{ parameter: } t_p$$

Diagram 4: Typ. output characteristics



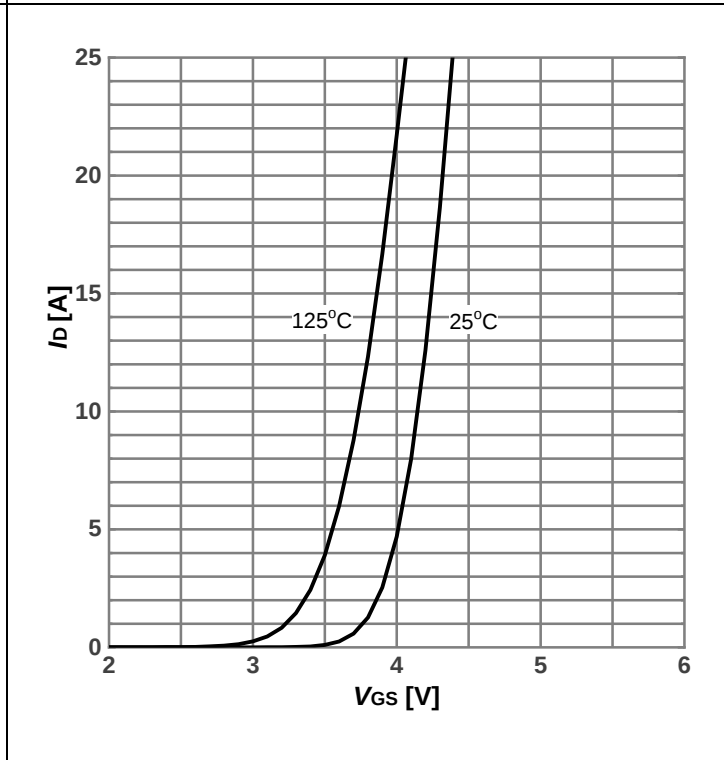
$$I_D=f(V_{DS}); T_J=25^\circ\text{C}; \text{ parameter: } V_{GS}$$

Diagram 5: Typ. output characteristics



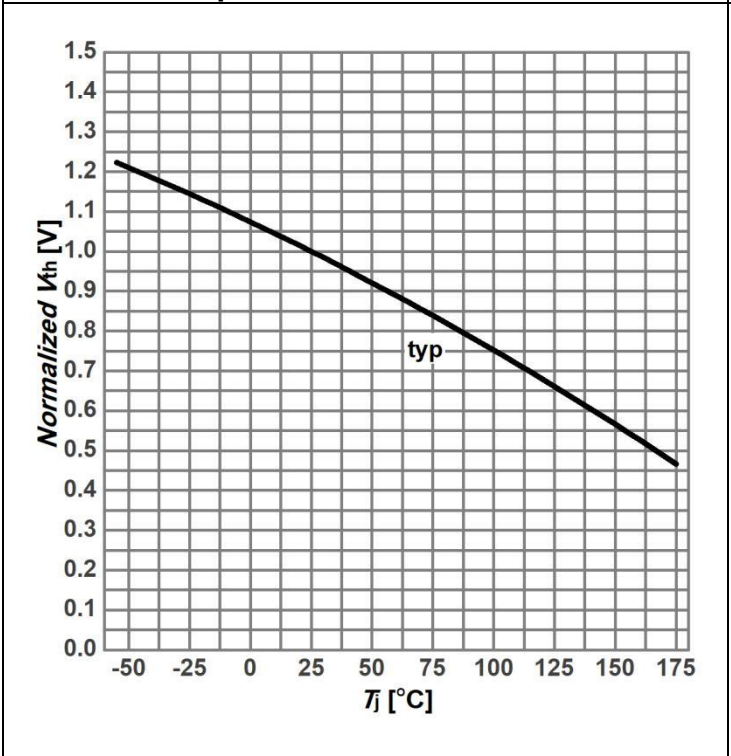
$I_D=f(V_{DS})$ ;  $T_J=125^{\circ}\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. transfer characteristics



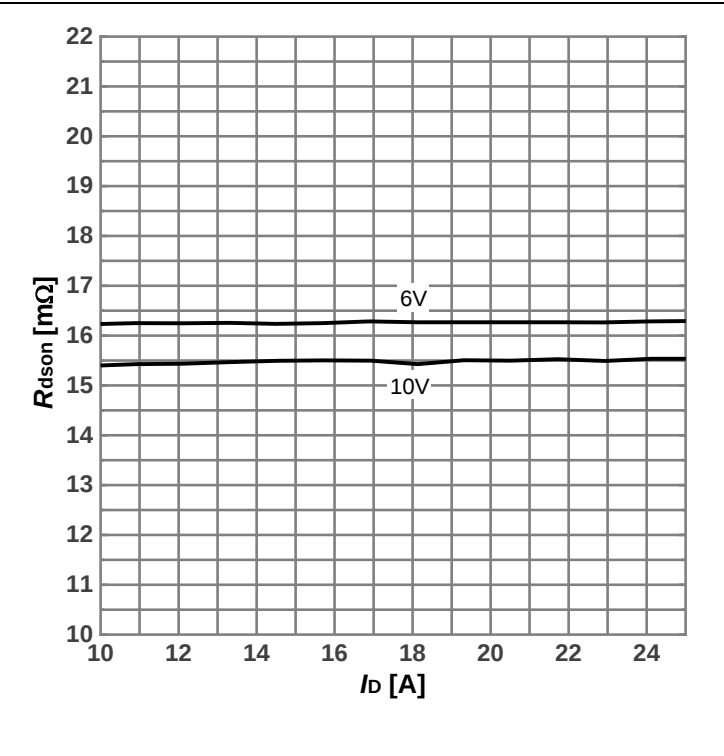
$I_D=f(V_{GS})$ ;  $V_{DS}=5\text{V}$ ; parameter:  $T_J$

Diagram 7: Gate threshold voltage vs. Junction temperature



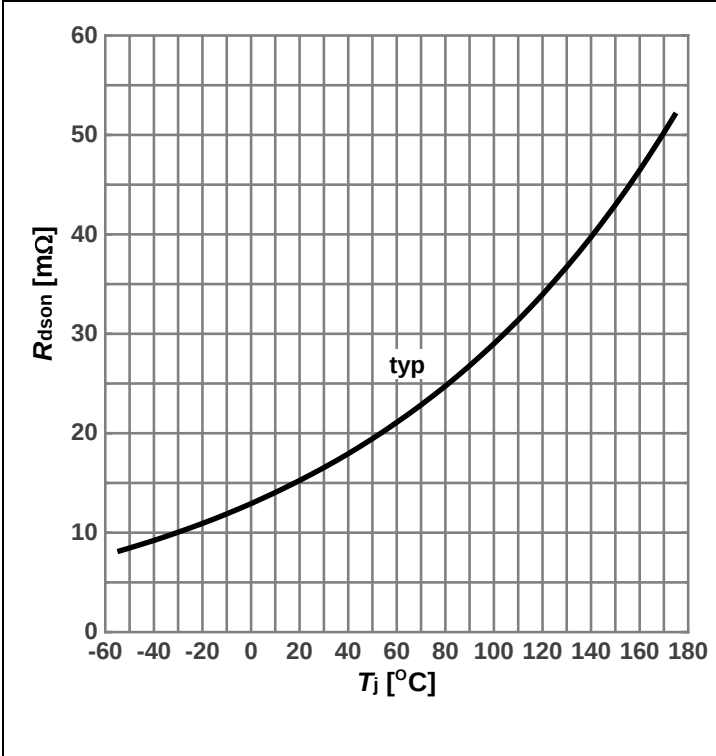
$V_{th}=f(T_J)$ ;  $I_D=250\mu\text{A}$

Diagram 8: On-state resistance vs. Drain current



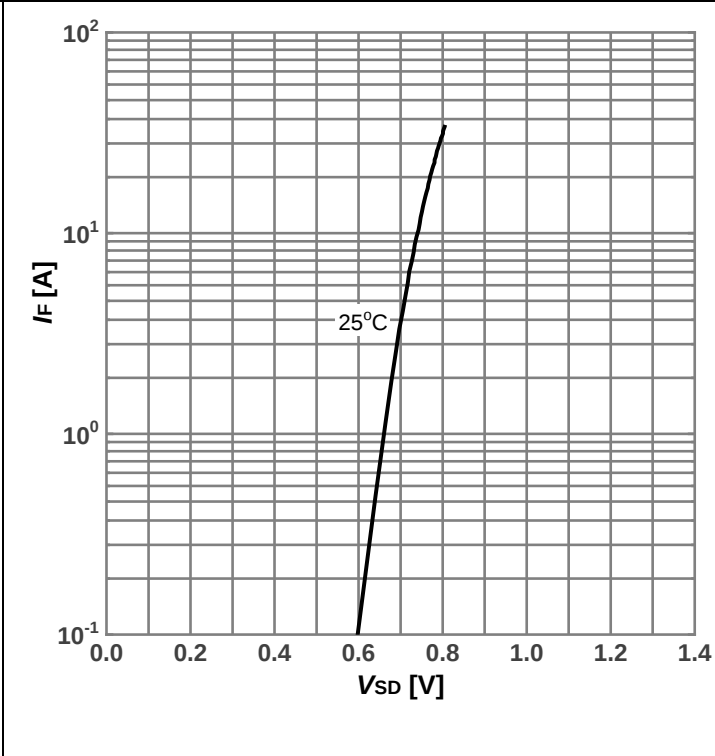
$R_{DS(on)}=f(I_D)$ ;  $T_J=25^{\circ}\text{C}$ ; parameter:  $V_{GS}$

Diagram 9: On-state resistance vs. Junction temperature



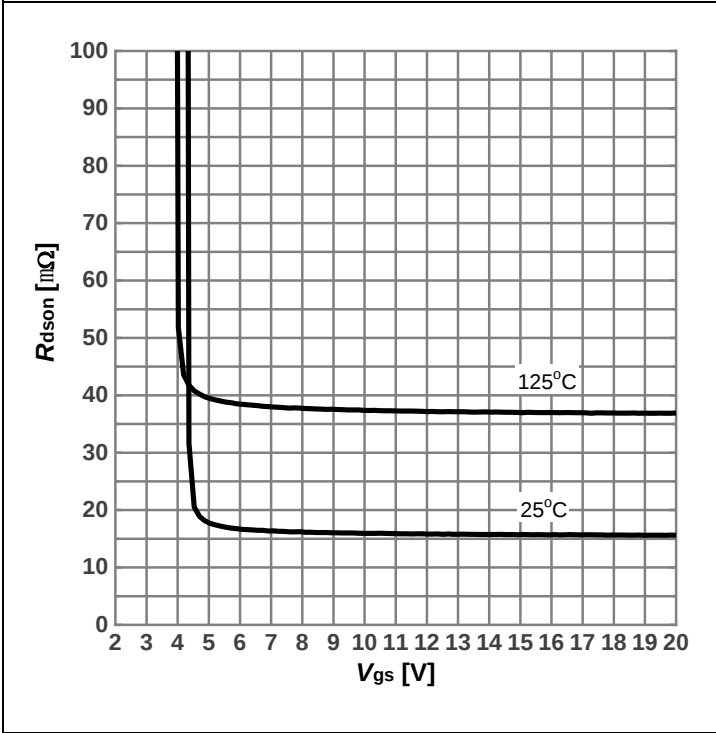
$R_{DS(on)}=f(T_j)$ ;  $I_D=20A$ ;  $V_{GS}=10V$

Diagram 10: Forward characteristics of reverse diode



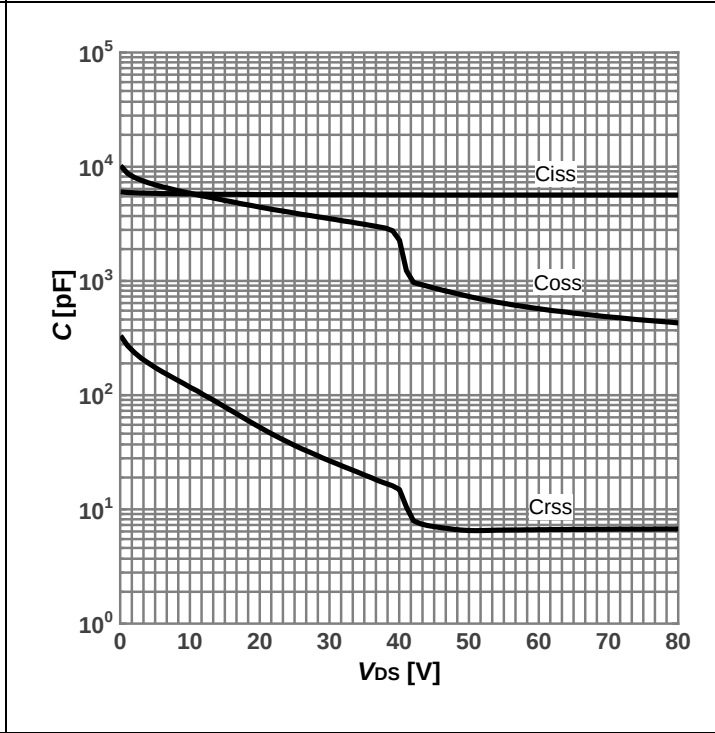
$I_F=f(V_{SD})$ ;  $T_J=25^{\circ}C$

Diagram 11: On-state resistance vs. Vgs characteristics

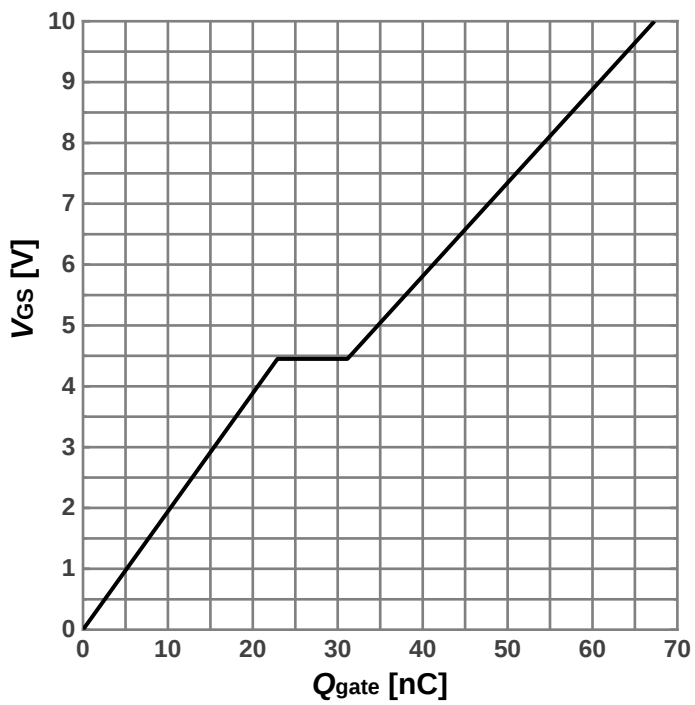


$R_{DS(on)}=f(V_{gs})$ ;  $I_D=20A$  ;parameter:  $T_j$

Diagram 12: Typ. capacitances



$C=f(V_{DS})$ ;  $V_{GS}=0V$ ;  $f=250KHz$

**Diagram 13: Typ. gate charge**

$V_{GS}=f(Q_{gate})$ ;  $I_D=20A$  pulsed;  $V_{DS}=125V$

6. Test Circuits

Table 7. Diode Characteristics

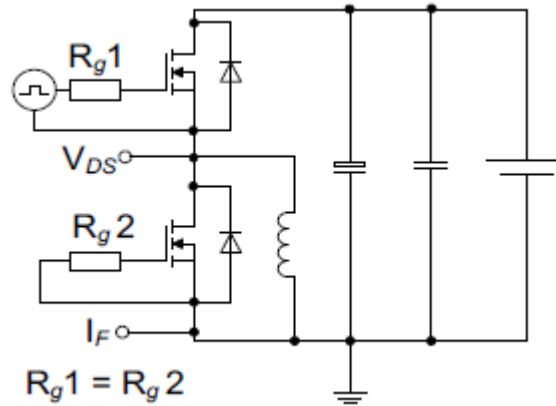
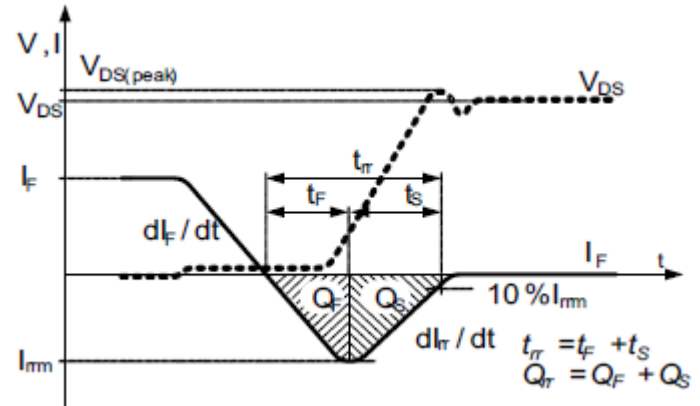
| Test circuit for diode characteristics                                            | Diode recovery waveform                                                            |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|  |  |

Table 8. Switching Times

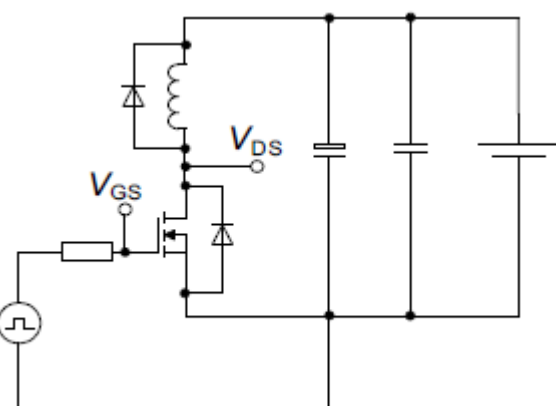
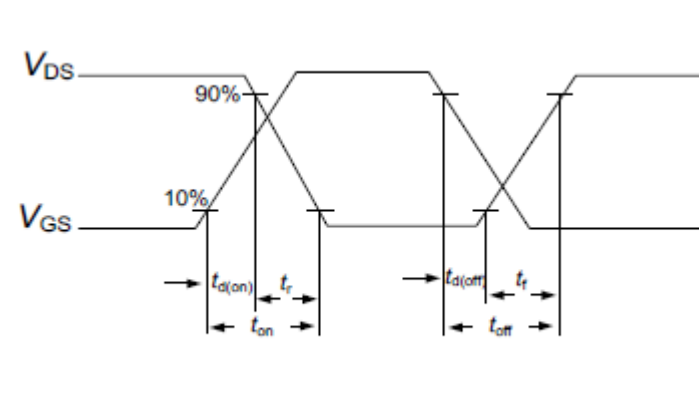
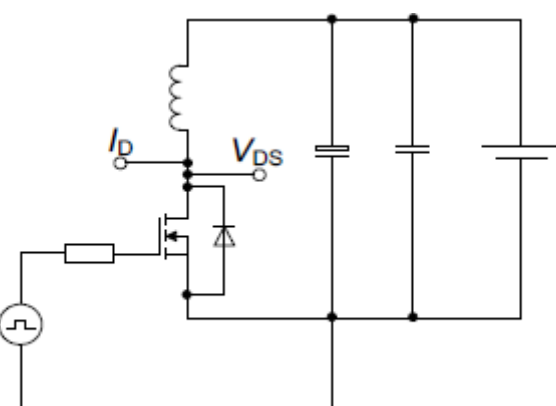
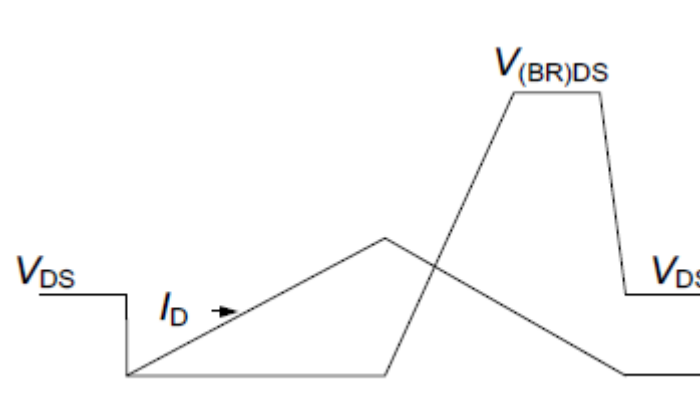
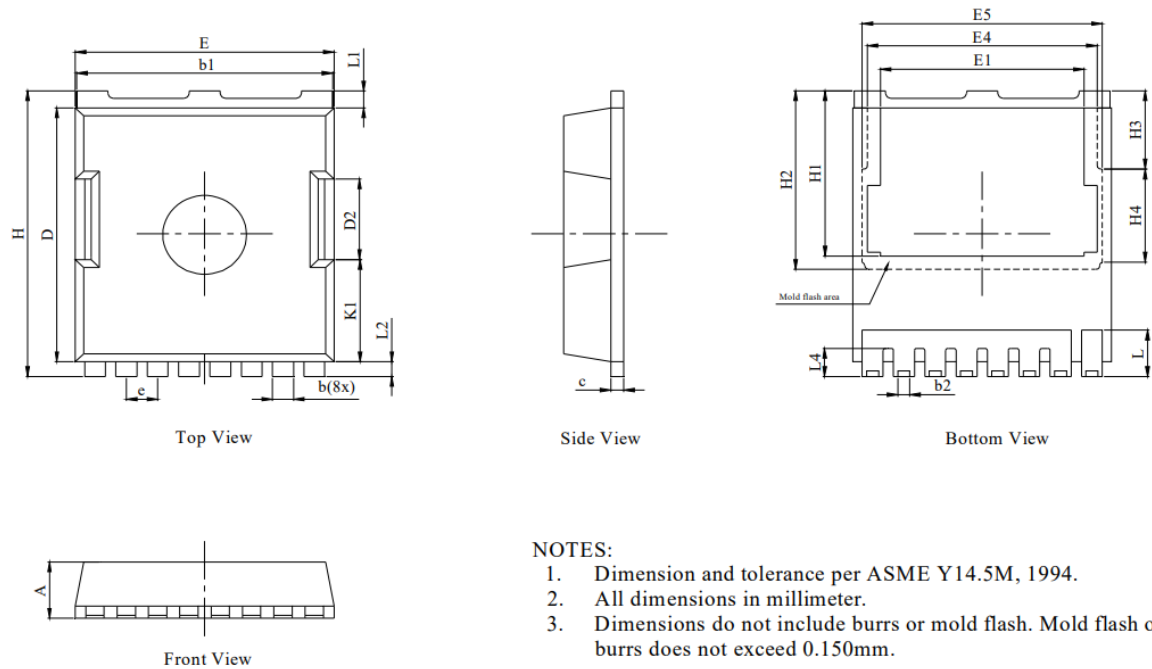
| Switching times test circuit for inductive load                                    | Switching times waveform                                                            |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |

Table 9. Unclamped Inductive Load

| Unclamped inductive load test circuit                                               | Unclamped inductive waveform                                                         |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

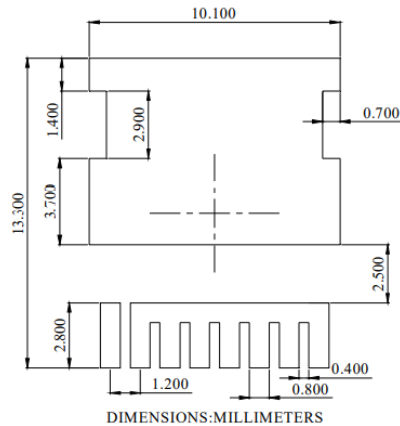
# 7. Package Outlines

Figure 1 Outline TOLL Dimensions in mm



| DIM. | MILLIMETER |       |       |
|------|------------|-------|-------|
|      | MIN.       | NOM.  | MAX.  |
| A    | 2.20       | 2.30  | 2.40  |
| b    | 0.70       | 0.80  | 0.90  |
| b1   | 9.70       | 9.80  | 9.90  |
| b2   | 0.42       | 0.46  | 0.50  |
| c    | 0.40       | 0.50  | 0.60  |
| D    | 10.28      | 10.38 | 10.58 |
| D2   |            | 3.30  |       |
| E    | 9.70       | 9.90  | 10.10 |
| E1   |            | 7.80  |       |
| E4   |            | 8.80  |       |
| E5   |            | 9.20  |       |
| e    | 1.20 (BSC) |       |       |
| H    | 11.48      | 11.68 | 11.88 |
| H1   | 6.55       | 6.75  | 6.85  |
| H2   |            | 7.30  |       |
| H3   |            | 3.20  |       |
| H4   |            | 3.80  |       |
| K1   |            | 4.18  |       |
| L    | 1.70       | 1.90  | 2.10  |
| L1   |            | 0.70  |       |
| L2   |            | 0.60  |       |
| L4   | 1.00       | 1.15  | 1.30  |

## Recommended Soldering Footprint



## 8. Appendix

CoolSemi Webpage: [www.coolsemi.com](http://www.coolsemi.com).