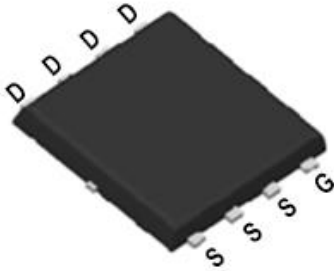
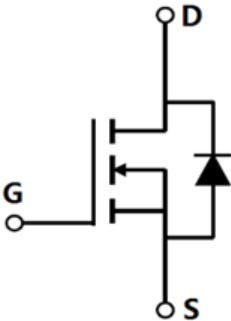


N-channel 40V, 1.0mΩ max., 250A  
 SGT MOSFET S2 in PDFN5\*6

Datasheet - production data

## 1. Descriptions

| PDFN5*6                                                                             |
|-------------------------------------------------------------------------------------|
|    |
| Schematic Diagram                                                                   |
|  |

### Key Performance Parameters

| Parameters       | Value | Unit |
|------------------|-------|------|
| $BV_{DSS}$       | 40    | V    |
| $R_{DS(on),max}$ | 1.0   | mΩ   |
| $Q_{g,type}$     | 41.7  | nC   |
| $I_{D,pulse}$    | 1000  | A    |
| $E_{AS}$         | 1225  | mJ   |

### Features

- Extremely Low Losses Due to Very Low FOM  $R_{dson} \cdot Q_g$ .
- High-Speed Switching.
- Qualified for Industrial Grade Applications According to JEDEC.
- 100% UIS Tested.

### Applications

High-Efficiency DC-DC Converters, High-Frequency Switching and Synchronous Rectification, Motor Drivers.

| Type/Ordering Code | Package | Marking  | Related Links  |
|--------------------|---------|----------|----------------|
| CSLS010N04S2       | PDFN5*6 | 010N04S2 | see Appendix A |

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## 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>            | -      | -    | 40   | V                | $V_{GS}=0\text{V}$ , $I_D=250\mu\text{A}$ |
| $I_D$          | Continuous Drain Current<br>(Silicon Limited) | -      | -    | 250  | A                | $T_C=25^\circ\text{C}$                    |
| $I_{D,pulse}$  | Pulsed Drain Current                          | -      | -    | 1000 | A                | $T_C=25^\circ\text{C}$                    |
| $E_{AS}$       | Avalanche Energy, Single Pulse <sup>2)</sup>  | -      | -    | 1225 | mJ               | $I_D=70\text{A}$ ; $V_{DD}=50\text{V}$    |
| $I_{AS}$       | Avalanche Current                             | -      | -    | 70   | A                | -                                         |
| $V_{GS}$       | Gate Source Voltage                           | -20    | -    | 20   | V                | Static; AC ( $f > 1\text{ Hz}$ )          |
| $P_{tot}$      | Power Dissipation                             | -      | -    | 375  | 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              | -      | -    | 250  | A                | $T_C=25^\circ\text{C}$                    |
| $I_{S,pulse}$  | Diode Pulse Current <sup>2)</sup>             | -      | -    | 1000 | A                | $T_C=25^\circ\text{C}$                    |

1) Limited by  $T_j$  max. Maximum Duty Cycle  $D=0.75$ .

2)  $V_{DD}=50\text{V}$ ,  $L=0.5\text{mH}$ ,  $R_G=25\Omega$ , 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                           | -      | -    | 0.4  | °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   | 40     | -    | -         | V          | $V_{GS}=0V, I_D=250\mu A$               |
| $V_{(GS)th}$  | Gate Threshold Voltage           | 1.0    | 1.7  | 2.5       | V          | $V_{DS}=V_{GS}, I_D=250\mu A$           |
| $I_{DSS}$     | Zero Gate Voltage Drain Current  | -      | -    | 1         | $\mu A$    | $V_{DS}=40V, V_{GS}=0V, T_J=25^\circ C$ |
| $I_{GSS}$     | Gate-Source Leakage Current      | -      | -    | $\pm 100$ | nA         | $V_{GS}=\pm 20V, V_{DS}=0V$             |
| $R_{DS(on)}$  | Drain-Source On-State Resistance | -      | 0.8  | 1.0       | m $\Omega$ | $V_{GS}=10V, I_D=20A, T_J=25^\circ C$   |
| $R_G$         | Gate resistance                  | -      | 3.5  | -         | $\Omega$   | $V_{DD}=0V, V_{GS}=0V, f=1MHz$          |
| $g_{fs}$      | Transconductance                 |        | 120  |           | S          | $V_{DS}=5V, I_D=20A$                    |

**Table 4. Dynamic Characteristics**

| Symbol       | Parameter                    | Values |      |      | Unit | Test Condition                                   |
|--------------|------------------------------|--------|------|------|------|--------------------------------------------------|
|              |                              | Min.   | Typ. | Max. |      |                                                  |
| $C_{iss}$    | Input Capacitance            | -      | 7070 | -    | pF   | $V_{GS}=0V, V_{DS}=20V, f=250kHz$                |
| $C_{oss}$    | Output Capacitance           | -      | 1800 | -    | pF   | $V_{GS}=0V, V_{DS}=20V, f=250kHz$                |
| $C_{rss}$    | Reverse Transfer Capacitance | -      | 128  | -    | pF   | $V_{GS}=0V, V_{DS}=20V, f=250kHz$                |
| $t_{d(on)}$  | Turn-On Delay Time           | -      | 18   | -    | ns   | $V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$ |
| $t_r$        | Rise Time                    | -      | 40   | -    | ns   | $V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$ |
| $t_{d(off)}$ | Turn-Off Delay Time          | -      | 180  | -    | ns   | $V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$ |
| $t_f$        | Fall Time                    | -      | 60   | -    | ns   | $V_{DD}=20V, V_{GS}=10V, I_D=20A, R_G=1.8\Omega$ |

**Table 5. Gate Charge Characteristics**

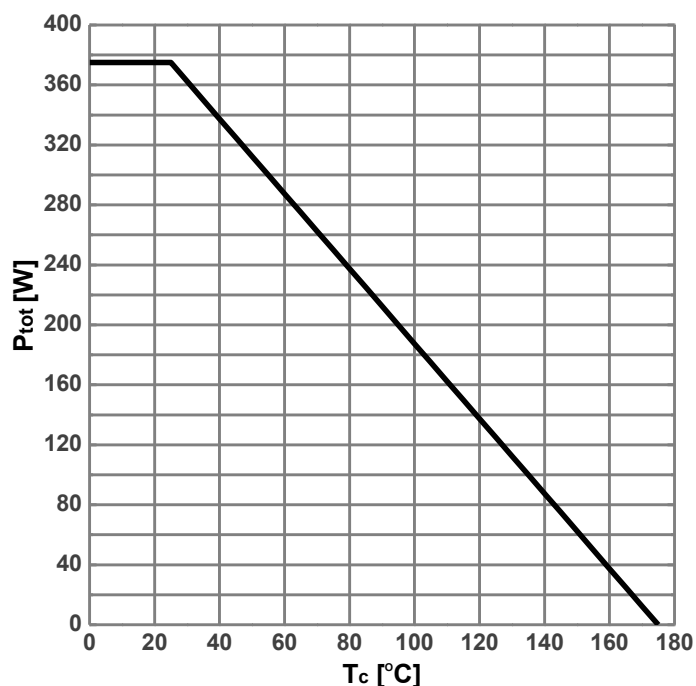
| Symbol        | Parameter             | Values |      |      | Unit | Test Condition                                  |
|---------------|-----------------------|--------|------|------|------|-------------------------------------------------|
|               |                       | Min.   | Typ. | Max. |      |                                                 |
| $Q_{gs}$      | Gate to Source Charge | -      | 5.4  | -    | nC   | $V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $Q_{gd}$      | Gate to Drain Charge  | -      | 4.3  | -    | nC   | $V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $Q_g$         | Gate Charge Total     | -      | 41.7 | -    | nC   | $V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $V_{plateau}$ | Gate Plateau Voltage  | -      | 2    | -    | V    | $V_{DD}=20V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |

**Table 6. Reverse Diode Characteristics**

| Symbol   | Parameter               | Values |      |      | Unit | Test Condition                         |
|----------|-------------------------|--------|------|------|------|----------------------------------------|
|          |                         | Min.   | Typ. | Max. |      |                                        |
| $V_{SD}$ | Diode Forward Voltage   | -      | 0.8  | -    | V    | $V_{GS}=0V, I_F=20A, T_J=25^\circ C$   |
| $t_{rr}$ | Reverse Recovery Time   | -      | 57   | -    | ns   | $V_R=20V, I_F=20A, dI_F/dt=100A/\mu s$ |
| $Q_{rr}$ | Reverse Recovery Charge | -      | 60   | -    | nC   | $V_R=20V, I_F=20A, dI_F/dt=100A/\mu s$ |

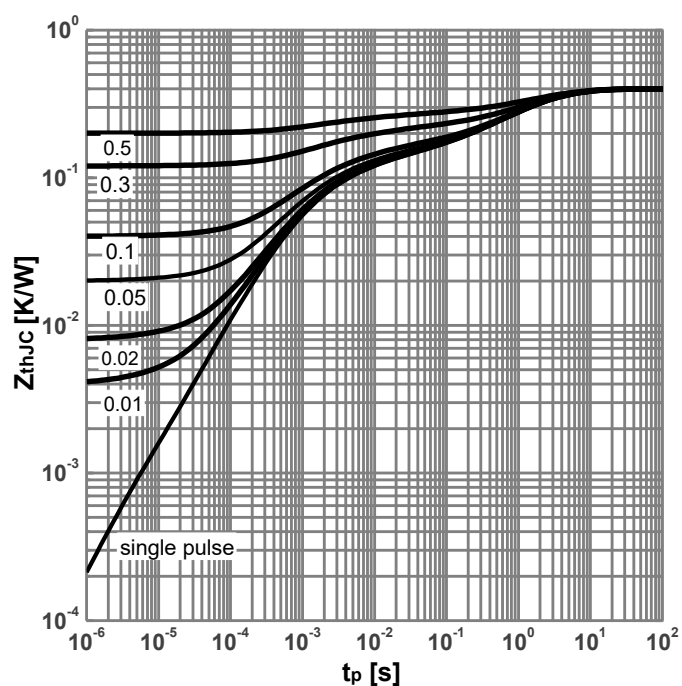
## 5. Electrical Characteristics Diagrams

Diagram 1: Power Dissipation



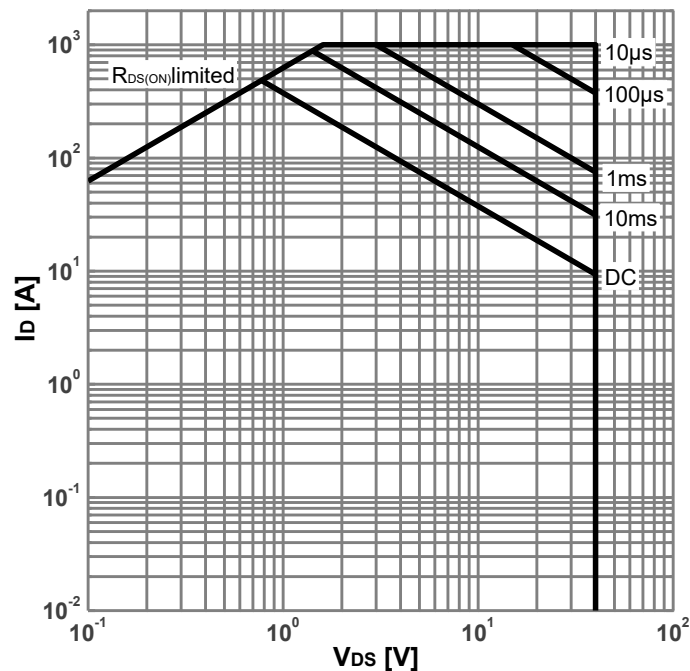
$$P_{tot}=f(T_c)$$

Diagram 2: Max. Transient Thermal Impedance



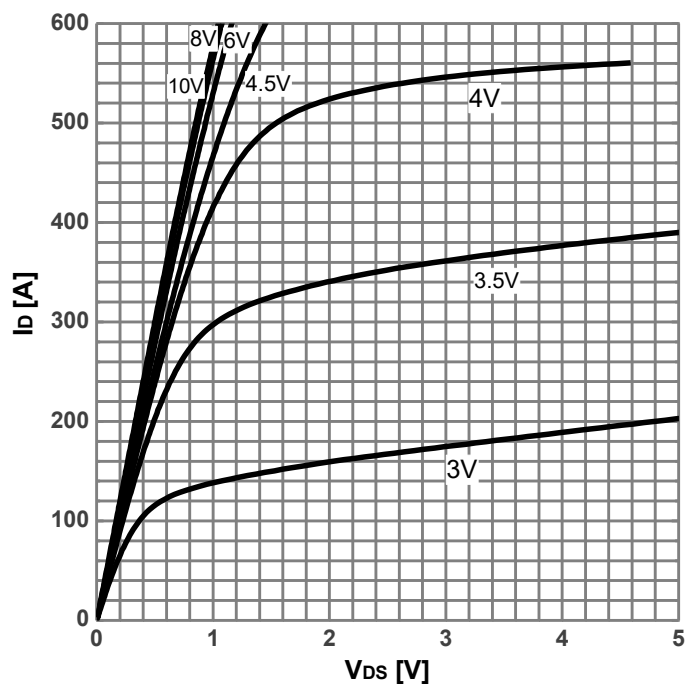
$$Z_{thJC}=f(t_p); \text{ parameter: } D=t_p/T$$

Diagram 3: Safe Operating Area



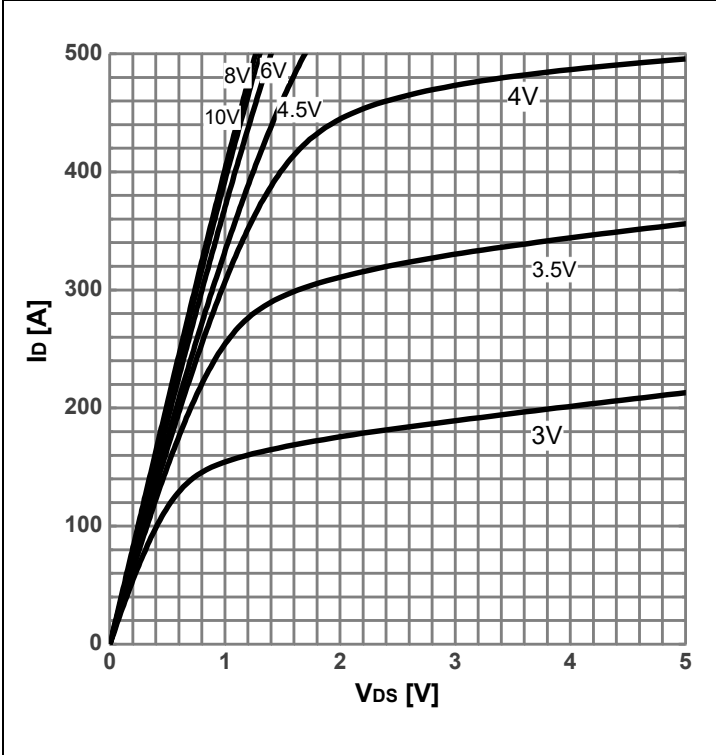
$$I_D=f(V_{DS}); T_J=25^\circ\text{C}; D=0; \text{ parameter: } t_p$$

Diagram 4: Typ. Output Characteristics



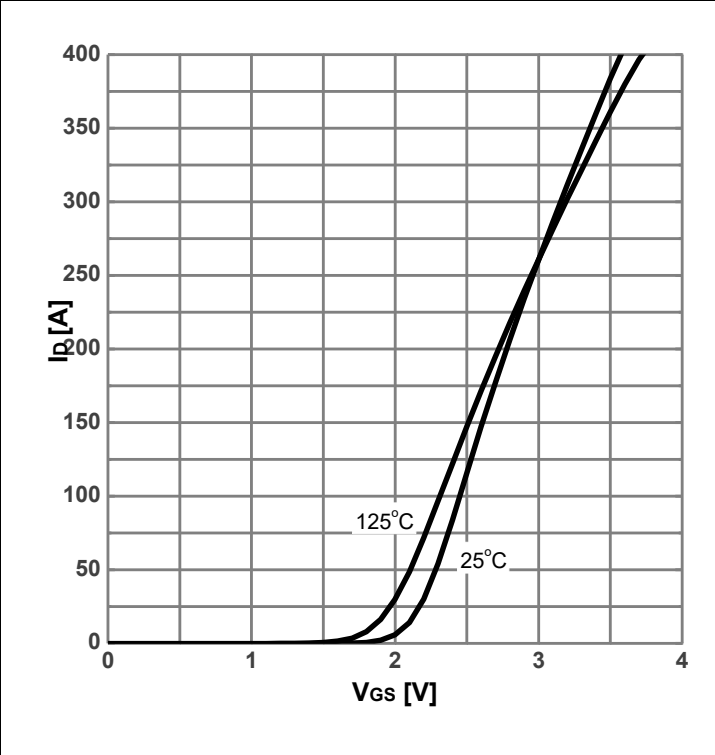
$$I_D=f(V_{DS}); T_J=25^\circ\text{C}; \text{ parameter: } V_{GS}$$

Diagram 5: Typ. Output Characteristics



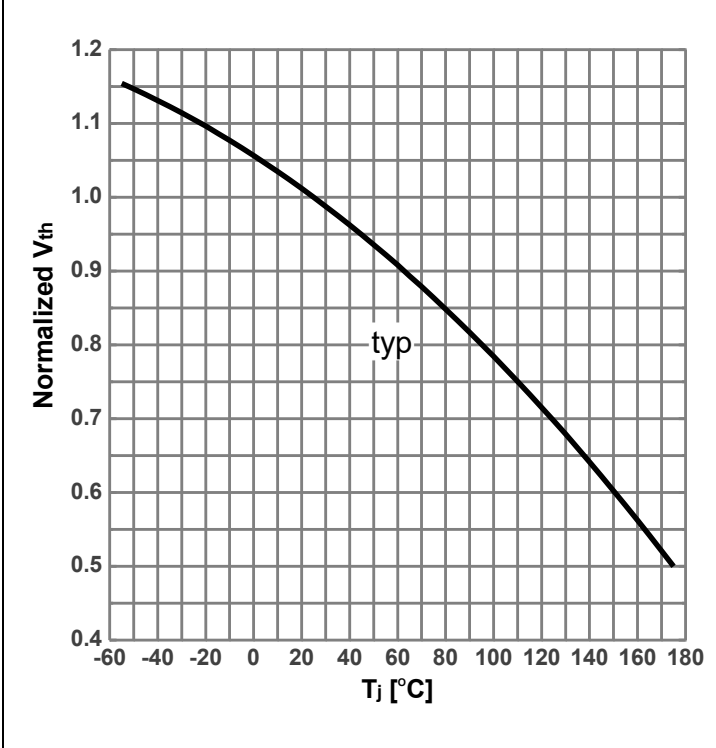
$I_D=f(V_{DS})$ ;  $T_J=125^{\circ}\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. Transfer Characteristics



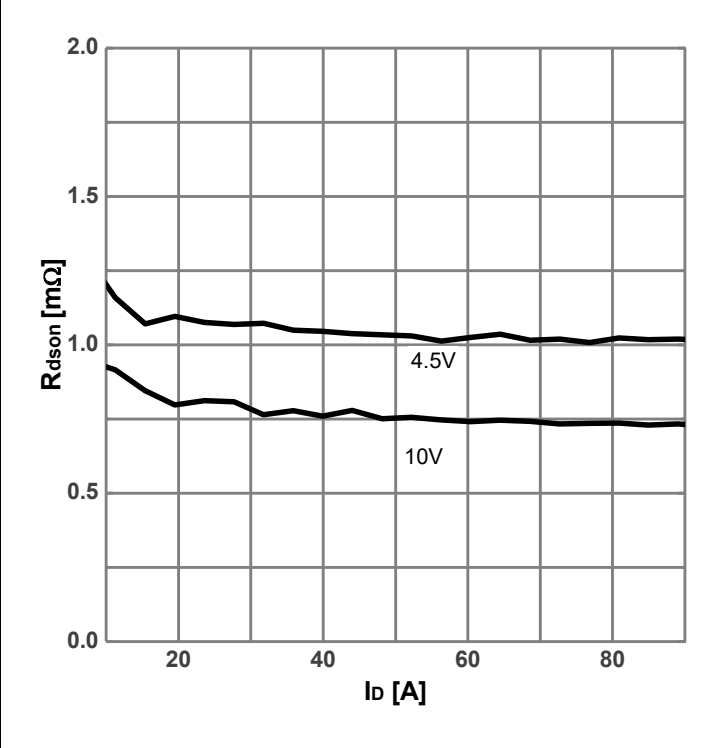
$I_D=f(V_{GS})$ ;  $V_{DS}=20\text{V}$ ; parameter:  $T_J$

Diagram 7: Gate Threshold Voltage vs. Junction Temperature



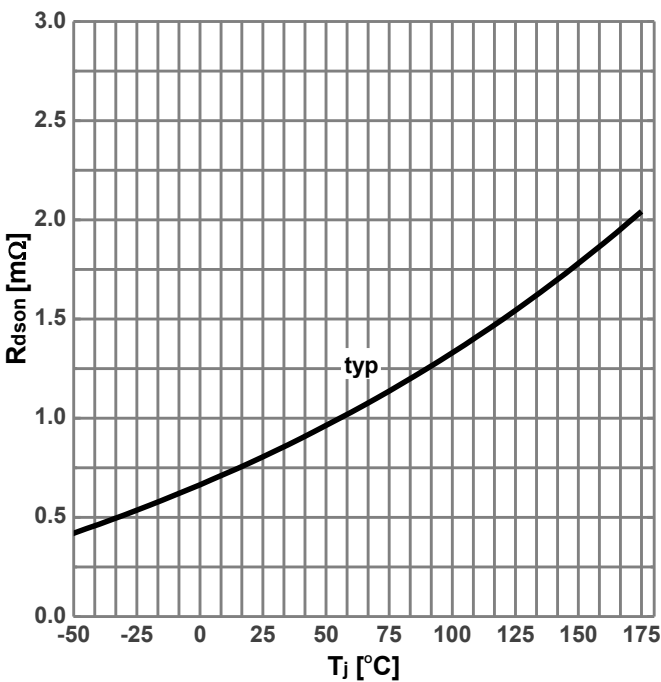
$V_{th}=f(T_J)$ ;  $I_D=250\mu\text{A}$

Diagram 8: On-State Resistance vs. Drain Current



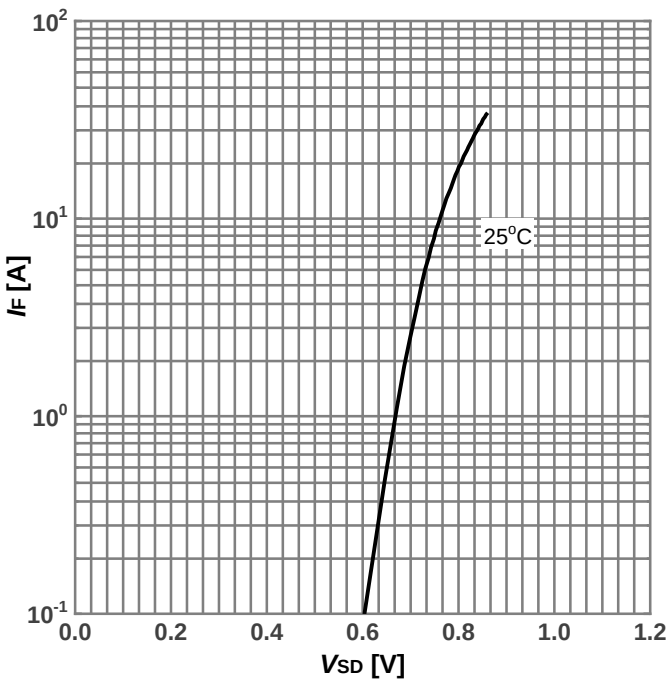
$R_{DS(on)}=f(I_D)$ ;  $T_J=25^{\circ}\text{C}$ ; parameter:  $V_{GS}$

Diagram 9: On-State Resistance vs. Junction Temperature



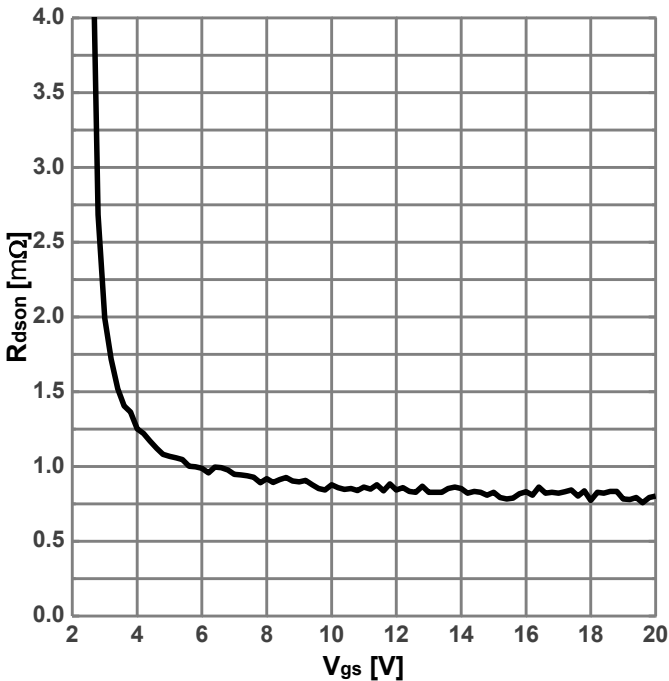
$R_{DS(on)}=f(T_J); I_D=20A; V_{GS}=10V$

Diagram 10: Forward Characteristics of Reverse Diode



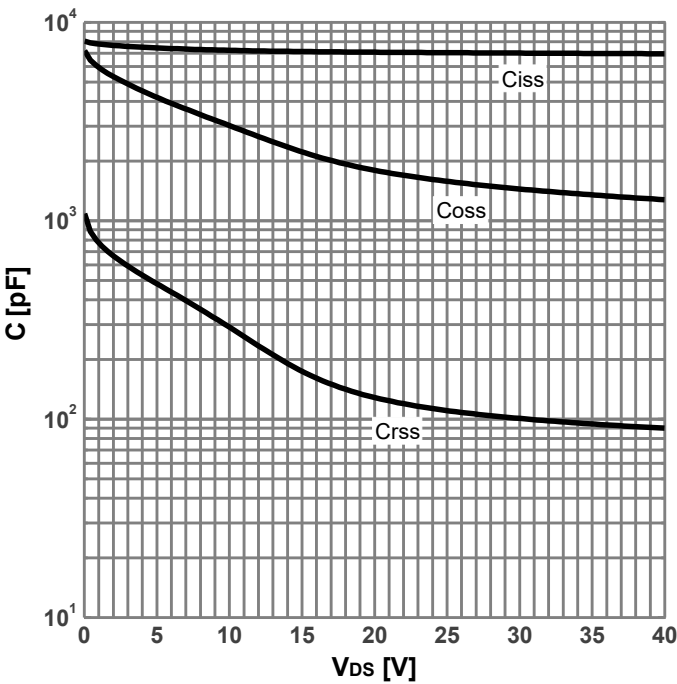
$I_F=f(V_{SD}); \text{parameter: } T_J$

Diagram 11: On-State Resistance vs.  $V_{GS}$  Characteristics



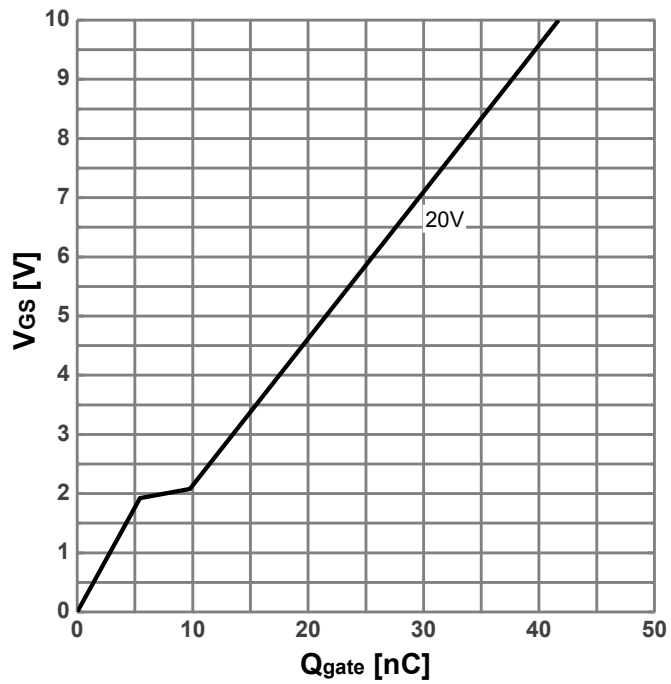
$R_{DS(on)}=f(V_{GS}); T_J=25^{\circ}C; I_D=20A$

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;  $V_{DS}=20V$

6. Test Circuits

Table 7. Diode Characteristics

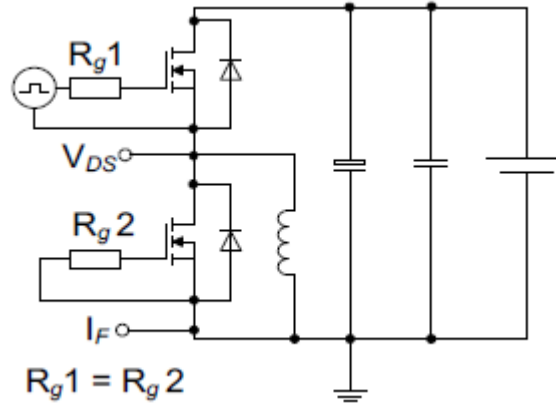
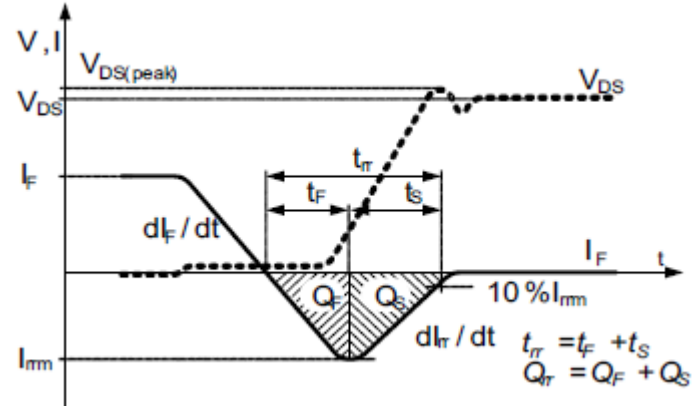
| Test Circuit for Diode Characteristics                                            | Diode Recovery Waveform                                                            |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|  |  |

Table 8. Switching Times

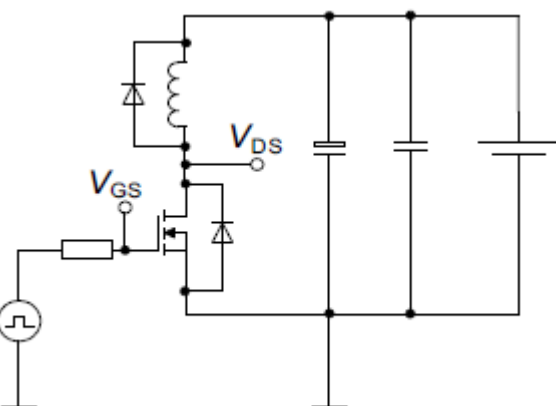
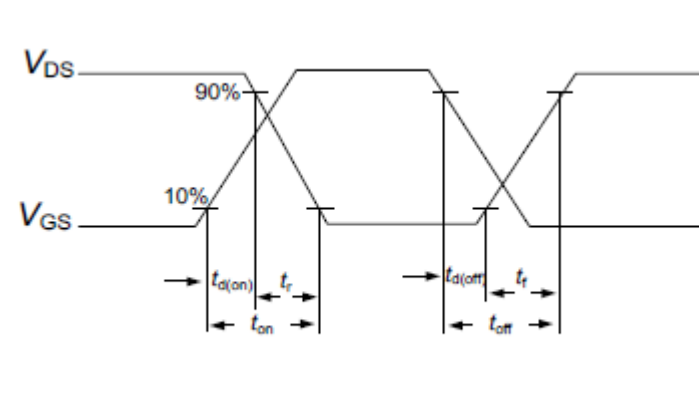
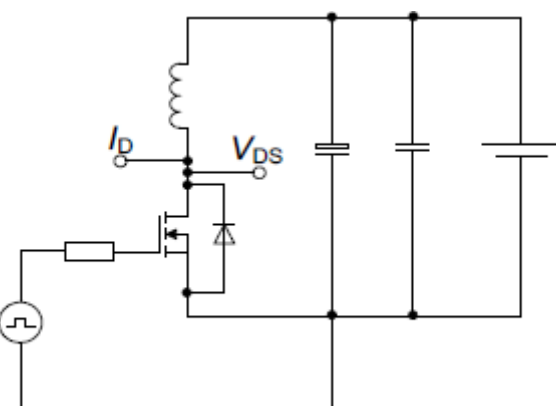
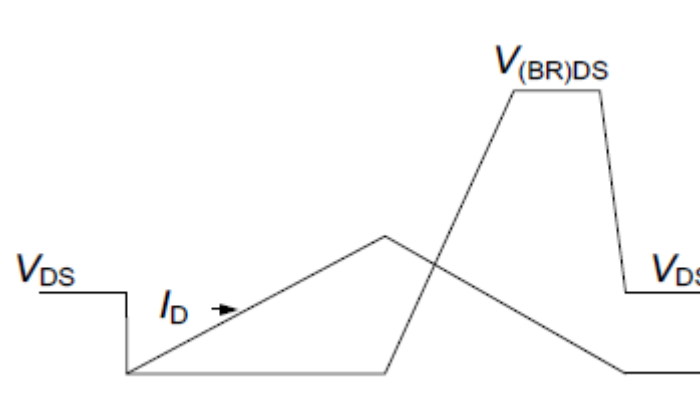
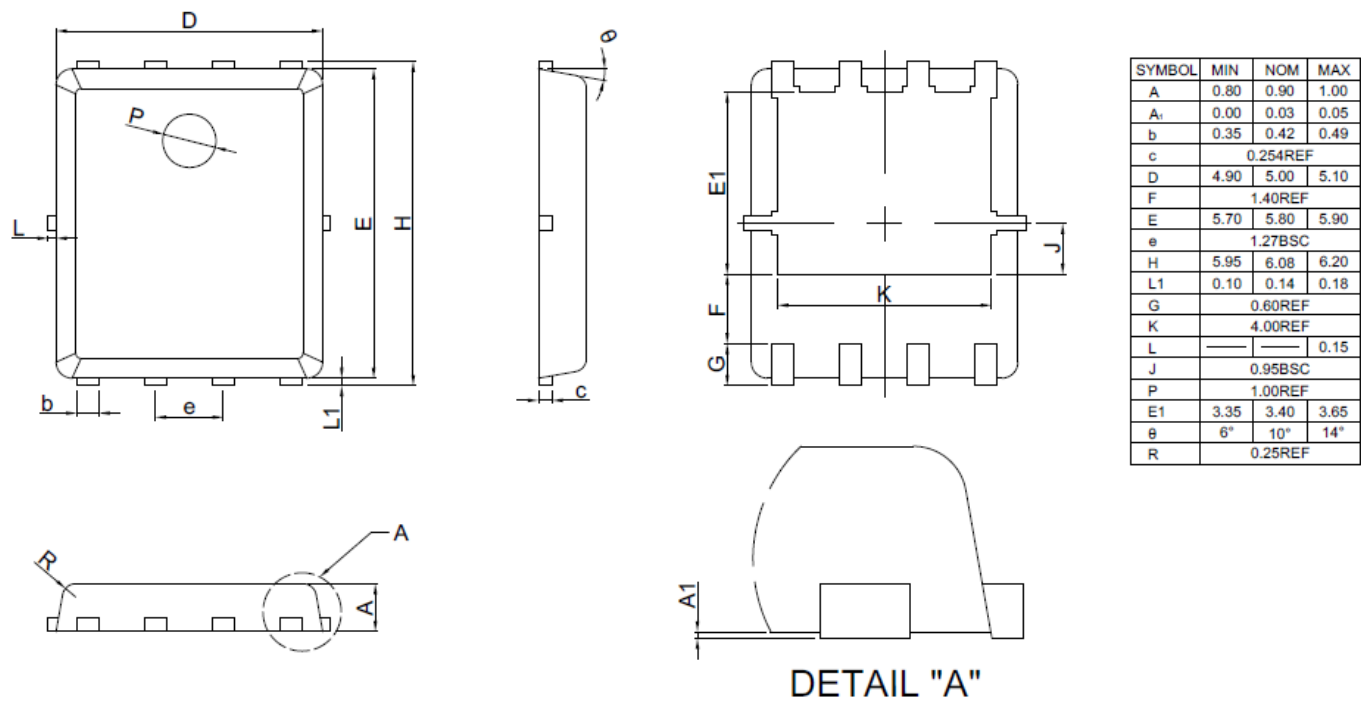
| Switching Times Test Circuit for Inductive Load                                    | Switching Times Waveform                                                            |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |

Table 9. Unclamped Inductive Load

| Unclamped Inductive Load Test Circuit                                               | Unclamped Inductive Waveform                                                         |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |

7. Package Outlines

Figure 1 Outline PDFN5\*6 Dimensions in mm



DETAIL "A"

## 8. Appendix

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