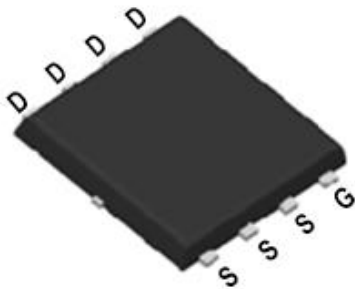


N-channel 60V, 1.6mΩ max.,225A  
 SGT MOSFET S2 in PDFN5\*6

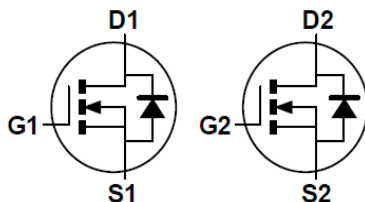
Datasheet - production data

## 1. Descriptions

PDFN5\*6



Schematic Diagram



## Key Performance Parameters

| Parameters       | Value | Unit |
|------------------|-------|------|
| $BV_{DSS}$       | 60    | V    |
| $R_{DS(on),max}$ | 1.6   | mΩ   |
| $Q_{g,typ}$      | 118   | nC   |
| $I_{D,pulse}$    | 787   | A    |
| $E_{AS}$         | 1024  | 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  |
|--------------------|---------|----------|----------------|
| CSLS016N06S2       | PDFN5*6 | 016N06S2 | 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>           | -      | -    | 60   | V                | $V_{GS}=0V$ , $I_D=250\mu A$   |
| $I_D$          | Continuous drain current                     | -      | -    | 225  | A                | $T_C=25^\circ\text{C}$         |
| $I_{D,pulse}$  | Pulsed drain current                         | -      | -    | 787  | A                | $T_C=25^\circ\text{C}$         |
| $E_{AS}$       | Avalanche energy, single pulse <sup>2)</sup> | -      | -    | 1024 | mJ               | $I_D=64A$ ; $V_{DD}=50V$       |
| $I_{AS}$       | Avalanche current                            | -      | -    | 64   | A                | -                              |
| $V_{GS}$       | Gate source voltage                          | -20    | -    | 20   | V                | static; AC ( $f>1\text{ Hz}$ ) |
| $P_{tot}$      | Power dissipation                            | -      | -    | 167  | 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             | -      | -    | 225  | A                | $T_C=25^\circ\text{C}$         |
| $I_{S,pulse}$  | Diode pulse current <sup>2)</sup>            | -      | -    | 787  | 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                           | -      | -    | 0.9  | °C/W | $T_C = 25^{\circ}\text{C}$              |
| $R_{thJA}$ | Thermal resistance, junction - ambient                        | -      | -    | 60   | °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   | 60     | -    | -         | 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         | $\mu A$    | $V_{DS}=120V, V_{GS}=0V, T_j=25^\circ C$ |
| $I_{GSS}$     | Gate-source leakage current      | -      | -    | $\pm 100$ | nA         | $V_{GS}=\pm 20V, V_{DS}=0V$              |
| $R_{DS(on)}$  | Drain-source on-state resistance | -      | 1.3  | 1.6       | m $\Omega$ | $V_{GS}=10V, I_D=20A, T_j=25^\circ C$    |
| $R_G$         | Gate resistance                  | -      | 0.97 | -         | $\Omega$   | $V_{DD}=0V, V_{GS}=0V, F=1MHz$           |
| $g_{fs}$      | Transconductance                 |        | 161  |           | S          | $V_{DS}=5V, I_D=20A$                     |

**Table 4. Dynamic Characteristics**

| Symbol       | Parameter                    | Values |      |      | Unit | Test Condition                                 |
|--------------|------------------------------|--------|------|------|------|------------------------------------------------|
|              |                              | Min.   | Typ. | Max. |      |                                                |
| $C_{iss}$    | Input capacitance            | -      | 6220 | -    | pF   | $V_{GS}=0V, V_{DS}=25V, f=250kHz$              |
| $C_{oss}$    | Output capacitance           | -      | 1460 | -    | pF   | $V_{GS}=0V, V_{DS}=25V, f=250kHz$              |
| $C_{rss}$    | Reverse transfer capacitance | -      | 54.5 | -    | pF   | $V_{GS}=0V, V_{DS}=25V, f=250kHz$              |
| $t_{d(on)}$  | Turn-on delay time           | -      | 18.5 | -    | ns   | $V_{DD}=30V, V_{GS}=10V, I_D=20A, R_G=1\Omega$ |
| $t_r$        | Rise time                    | -      | 7    | -    | ns   | $V_{DD}=30V, V_{GS}=10V, I_D=20A, R_G=1\Omega$ |
| $t_{d(off)}$ | Turn-off delay time          | -      | 69.4 | -    | ns   | $V_{DD}=30V, V_{GS}=10V, I_D=20A, R_G=1\Omega$ |
| $t_f$        | Fall time                    | -      | 2    | -    | ns   | $V_{DD}=30V, V_{GS}=10V, I_D=20A, R_G=1\Omega$ |

**Table 5. Gate Charge Characteristics**

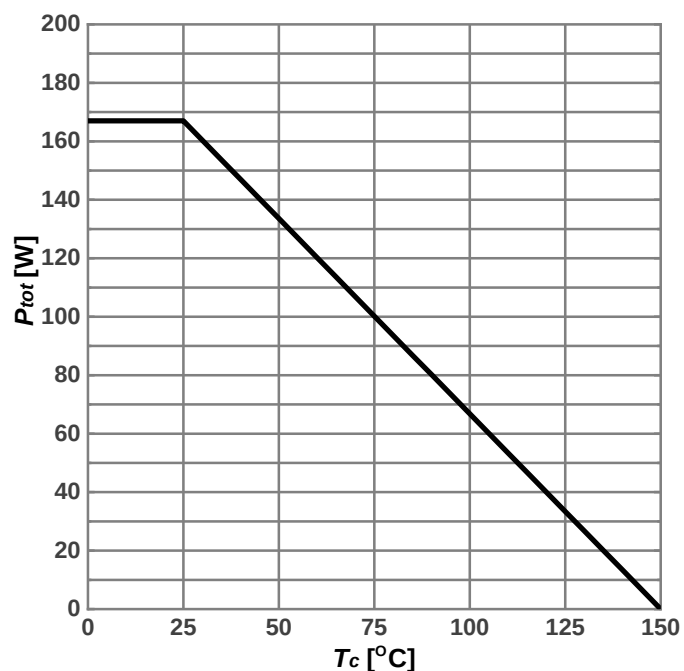
| Symbol        | Parameter             | Values |      |      | Unit | Test Condition                                  |
|---------------|-----------------------|--------|------|------|------|-------------------------------------------------|
|               |                       | Min.   | Typ. | Max. |      |                                                 |
| $Q_{gs}$      | Gate to source charge | -      | 10.7 | -    | nC   | $V_{DD}=30V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $Q_{gd}$      | Gate to drain charge  | -      | 21.4 | -    | nC   | $V_{DD}=30V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $Q_g$         | Gate charge total     | -      | 118  | -    | nC   | $V_{DD}=30V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| $V_{plateau}$ | Gate plateau voltage  | -      | 2.1  | -    | V    | $V_{DD}=30V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |

**Table 6. Reverse Diode Characteristics**

| Symbol    | Parameter                     | Values |       |      | Unit | Test Condition                         |
|-----------|-------------------------------|--------|-------|------|------|----------------------------------------|
|           |                               | Min.   | Typ.  | Max. |      |                                        |
| $V_{SD}$  | Diode forward voltage         | -      | 0.75  | 1.2  | V    | $V_{GS}=0V, I_F=20A, T_j=25^\circ C$   |
| $t_{rr}$  | Reverse recovery time         | -      | 46.5  | -    | ns   | $V_R=30V, I_F=20A, di_F/dt=100A/\mu s$ |
| $Q_{rr}$  | Reverse recovery charge       | -      | 61.92 | -    | nC   | $V_R=30V, I_F=20A, di_F/dt=100A/\mu s$ |
| $I_{rrm}$ | Peak reverse recovery current | -      | 0.2   | -    | A    | $V_R=30V, I_F=20A, di_F/dt=100A/\mu s$ |

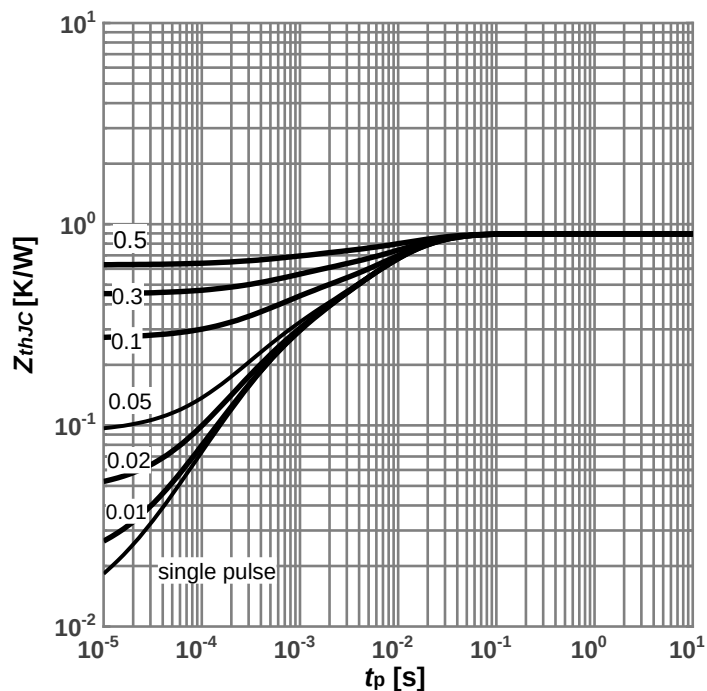
## 5. Electrical Characteristics Diagrams

Diagram 1: Power dissipation



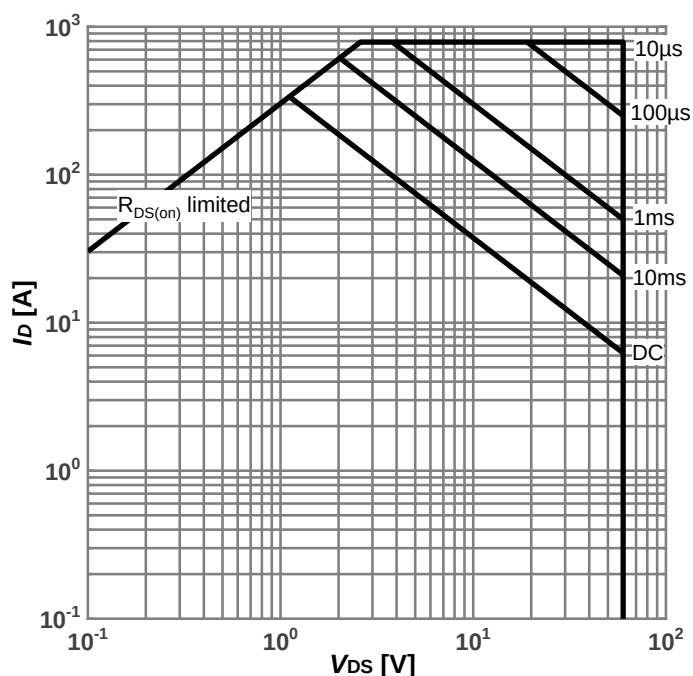
$$P_{tot}=f(T_c)$$

Diagram 2: Max. transient thermal impedance



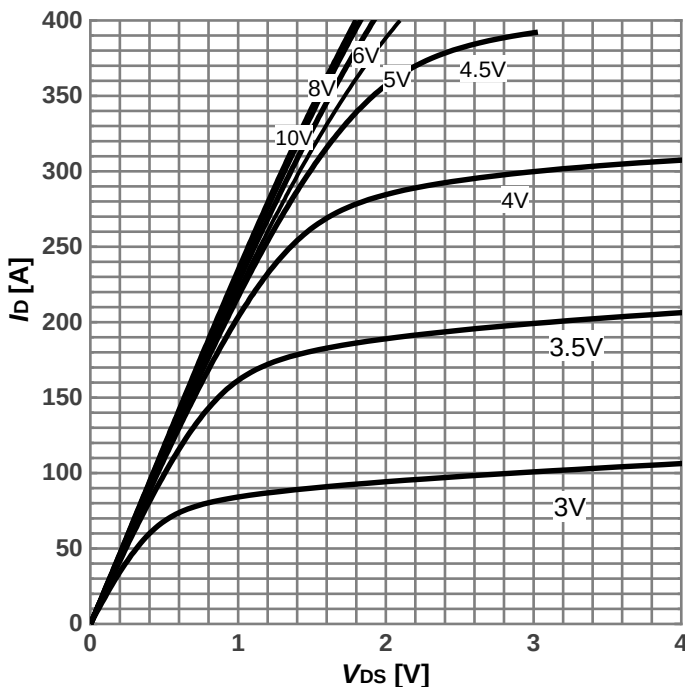
$$Z_{thJC}=f(t_p); \text{ parameter: } D = t_p/T$$

Diagram 3: Safe operating area



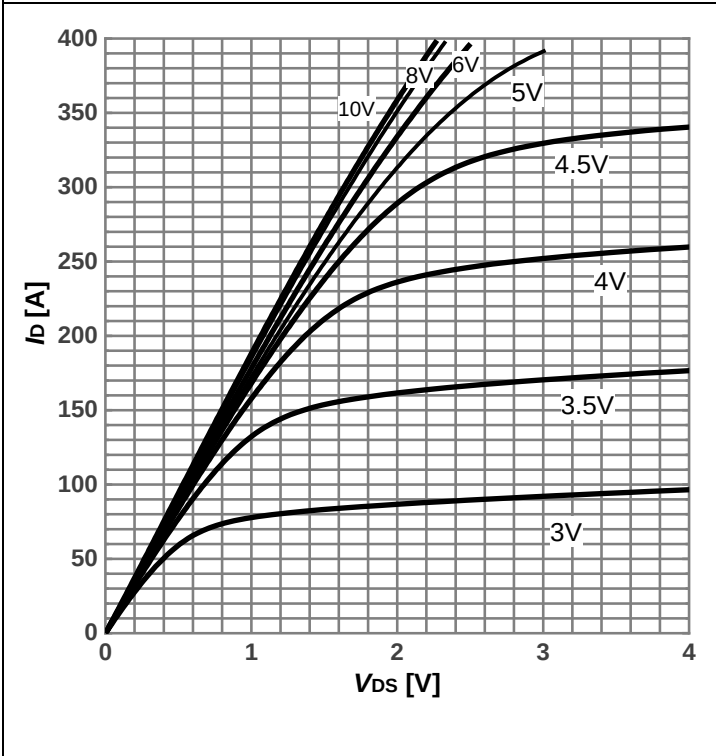
$$I_D=f(V_{DS}); T_j=25^\circ\text{C}; D=0; \text{ parameter: } t_p$$

Diagram 4: Typ. output characteristics



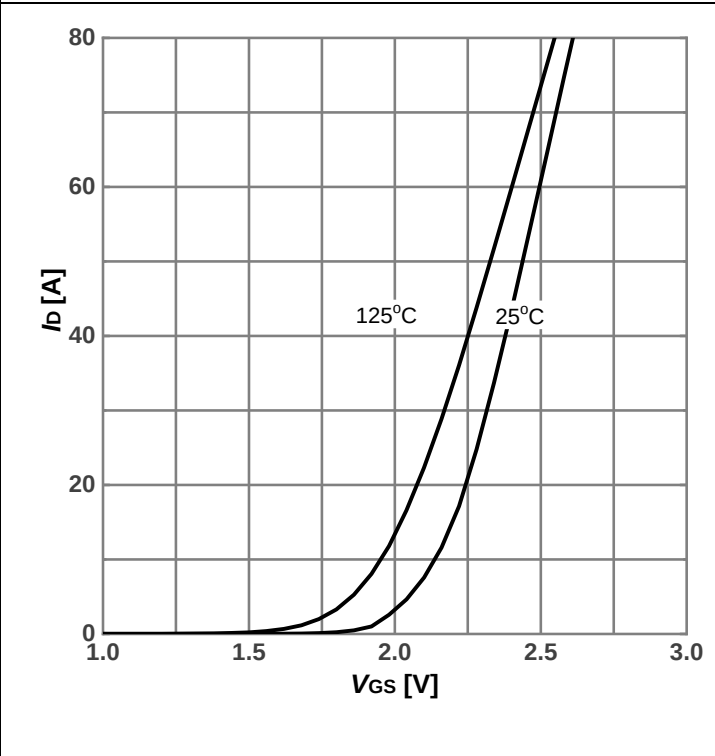
$$I_D=f(V_{DS}); T_j=25^\circ\text{C}; \text{ parameter: } V_{GS}$$

Diagram 5: Typ. output characteristics



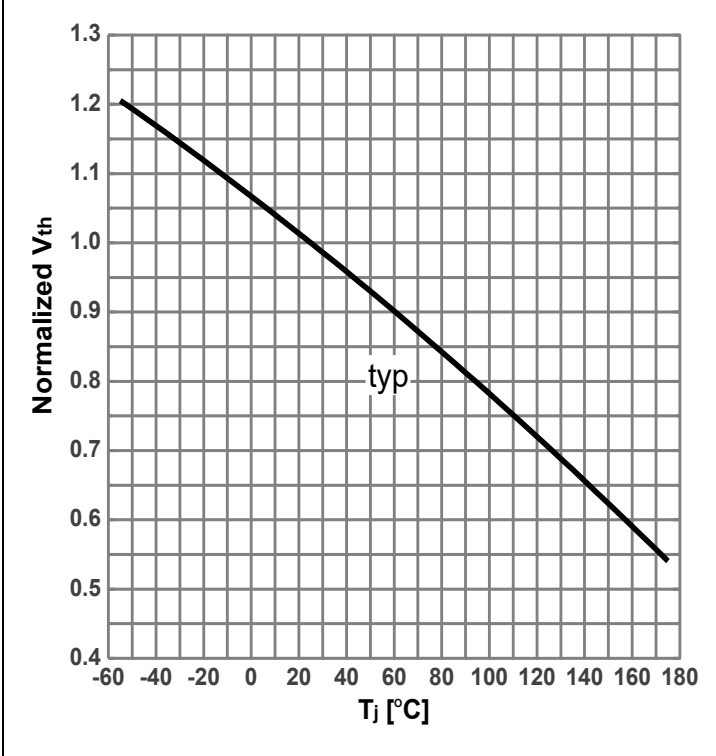
$I_D=f(V_{DS})$ ;  $T_j=125^{\circ}\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. transfer characteristics



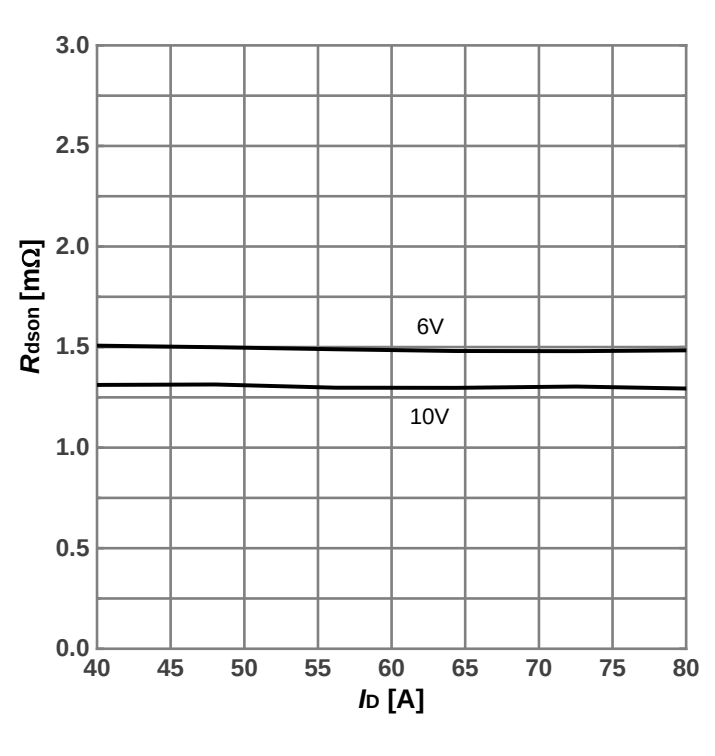
$I_D=f(V_{GS})$ ;  $V_{DS}=5\text{V}$ ; parameter:  $T_j$

Diagram 7: Gate threshold voltage vs. Junction temperature



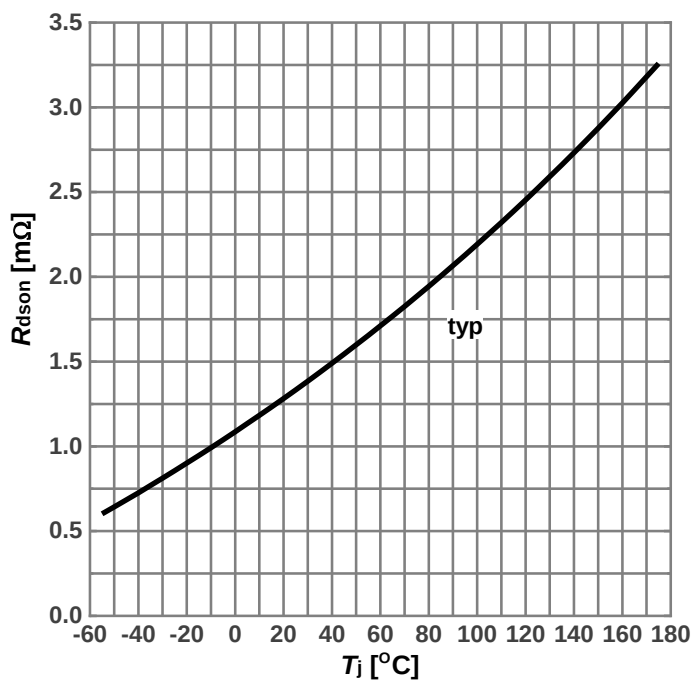
$V_{th}=f(T_j)$ ;  $I_D=250\mu\text{A}$

Diagram 8: On-state resistance vs. Drain current



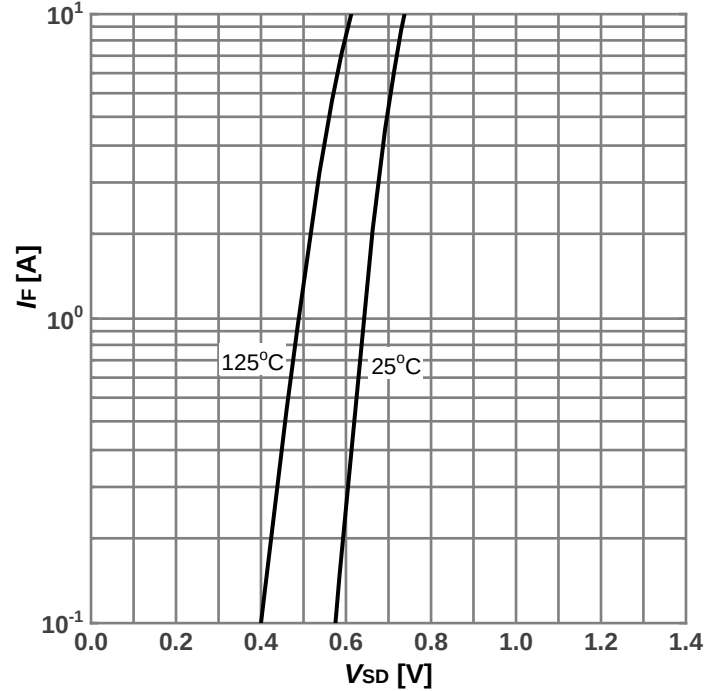
$R_{DS(on)}=f(I_D)$ ;  $T_j=25^{\circ}\text{C}$ ; parameter:  $V_{GS}$

Diagram 9: On-state resistance vs. Junction temperature



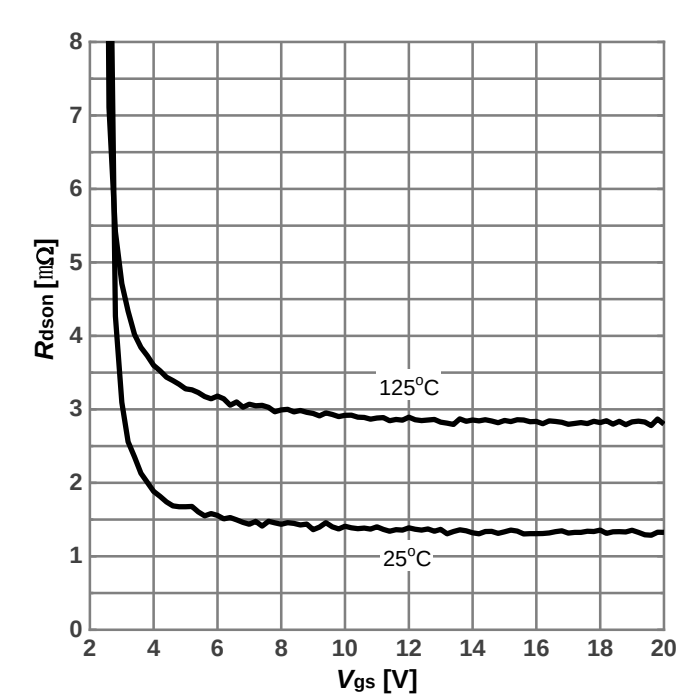
$R_{DS(on)}=f(T_j); I_D=20A; V_{GS}=10V$

Diagram 10: Forward characteristics of reverse diode



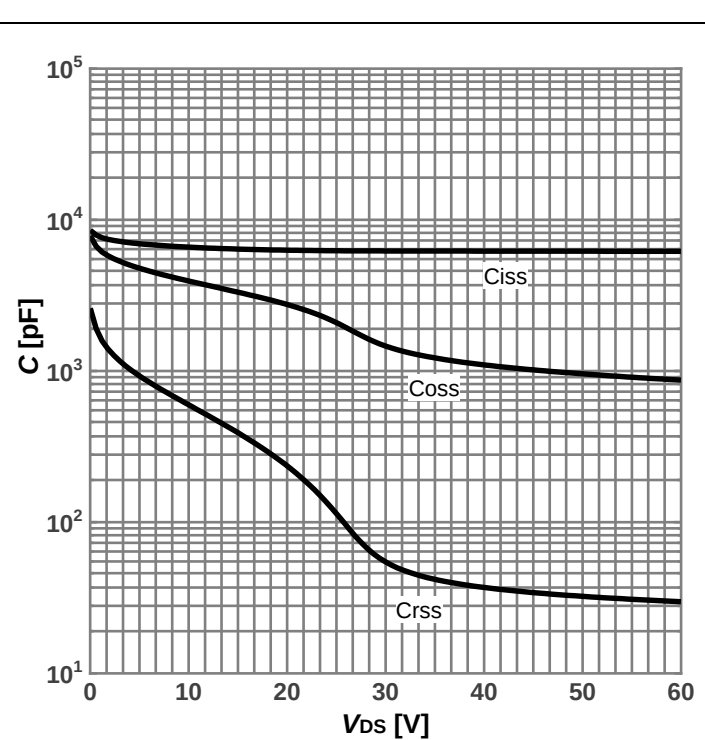
$I_F=f(V_{SD}); \text{parameter: } T_j$

Diagram 11: On-state resistance vs. Vgs characteristics



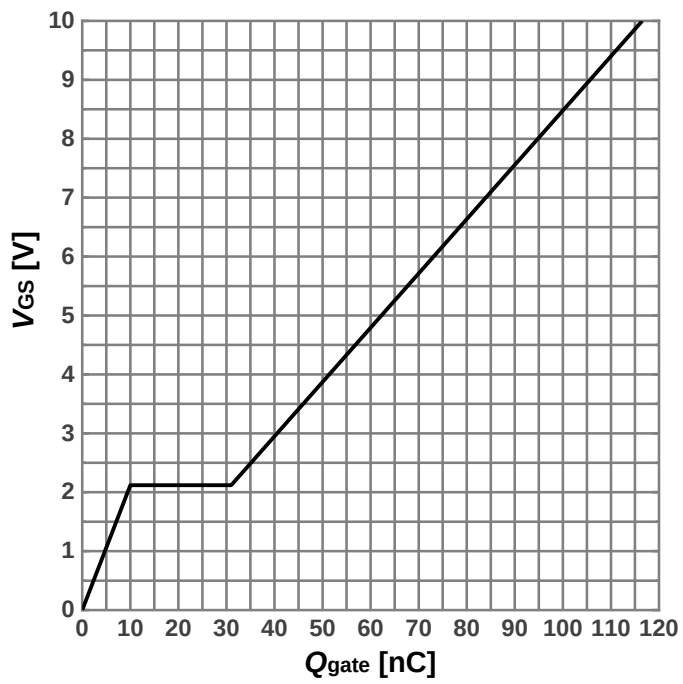
$R_{DS(on)}=f(V_{GS}); T_j=25^{\circ}C; I_D=20A$

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;  $V_{DS}=30V$

6. Test Circuits

Table 7. Diode Characteristics

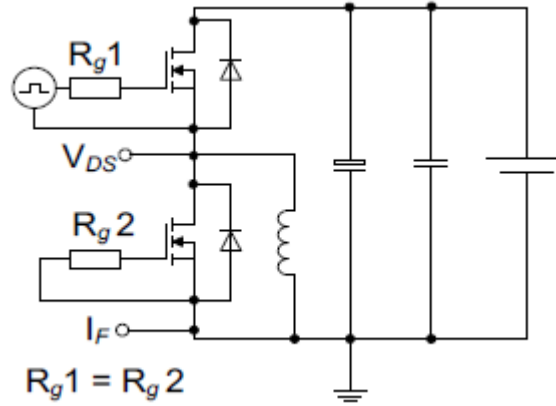
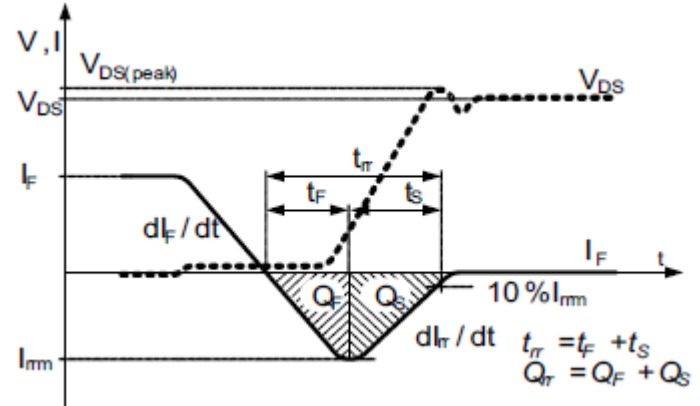
| Test circuit for diode characteristics                                            | Diode recovery waveform                                                            |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|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

Table 8. Switching Times

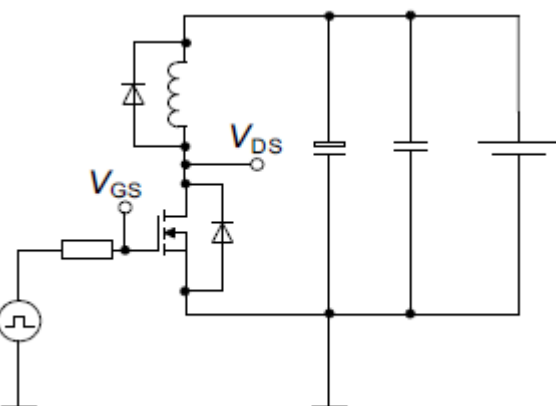
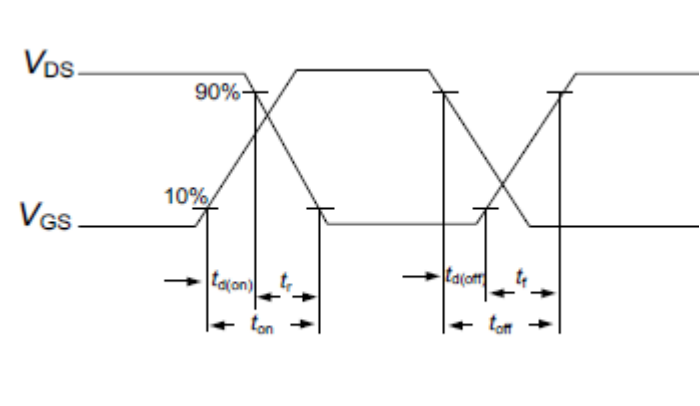
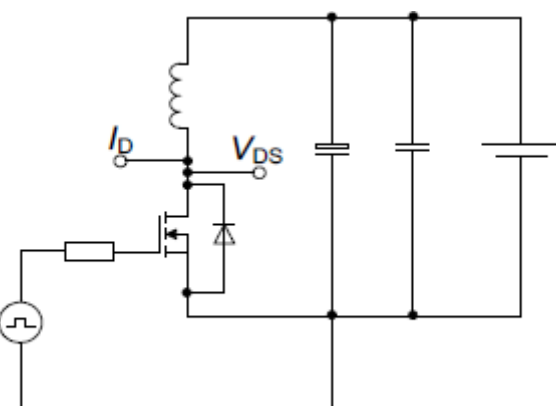
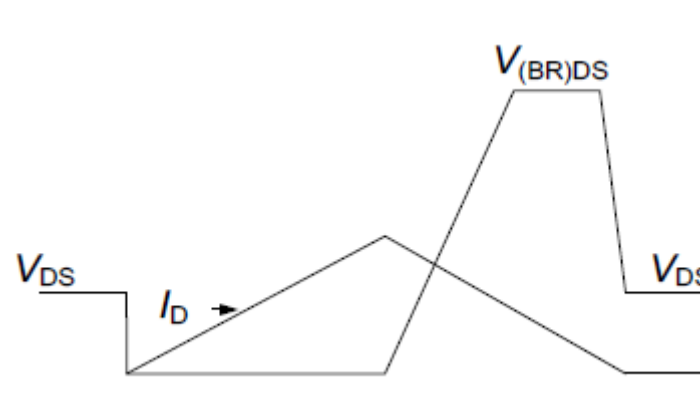
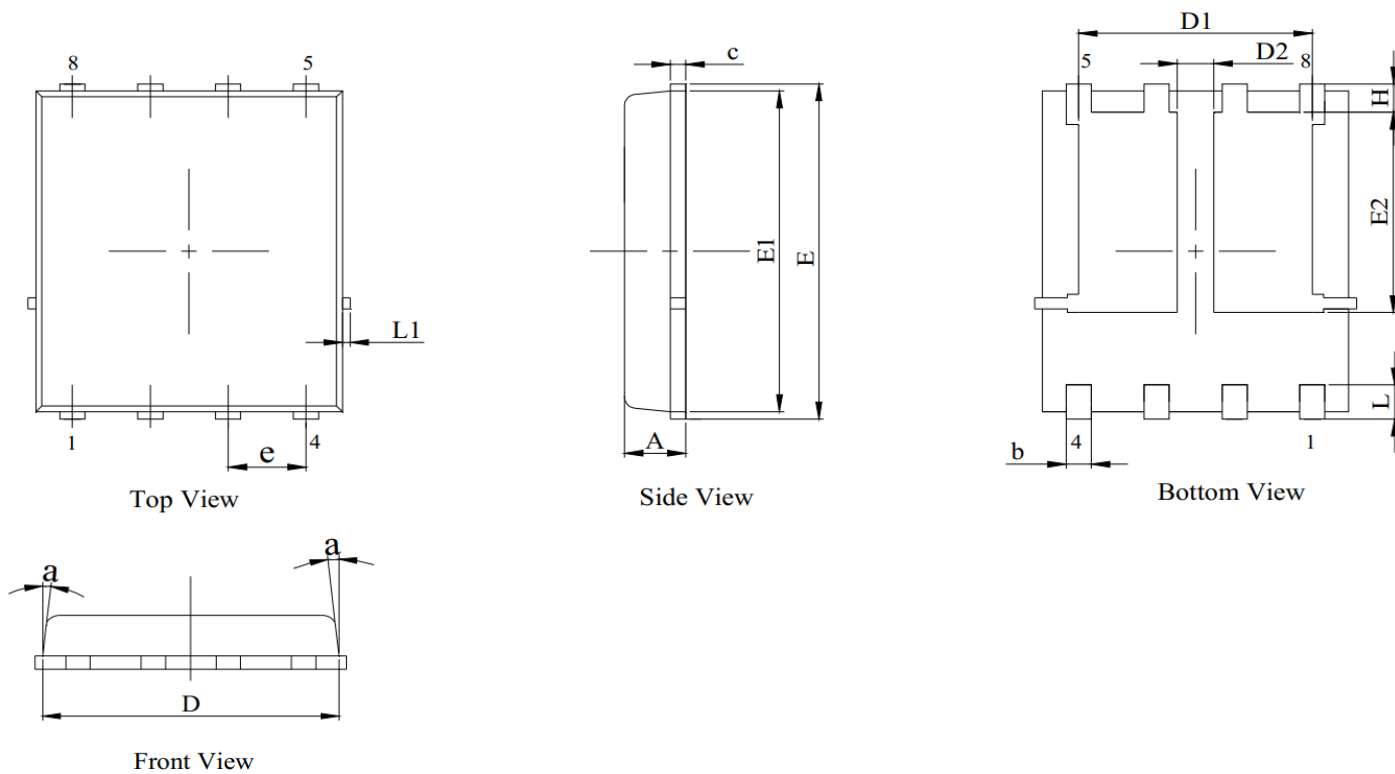
| Switching times test circuit for inductive load                                    | Switching times waveform                                                            |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|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

Table 9. Unclamped Inductive Load

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

7. Package Outlines

Figure 1 Outline PDFN5\*6 Dimensions in mm



| DIM. | MILLIMETER |      |
|------|------------|------|
|      | MIN.       | MAX. |
| A    | 0.90       | 1.10 |
| b    | 0.33       | 0.51 |
| c    | 0.23       | 0.33 |
| D    | 4.80       | 5.40 |
| D1   | 3.61       | 4.25 |
| D2   | 0.50       | 0.70 |
| E    | 5.90       | 6.25 |
| E1   | 5.55       | 5.80 |
| E2   | 3.35       | 3.78 |
| e    | 1.27 BSC   |      |
| H    | 0.41       | 0.80 |
| L    | 0.51       | 0.80 |
| L1   | -          | 0.15 |
| a    | 0°         | 12°  |

## 8. Appendix

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