



SUPER-SEMI



## SUPER-MOSFET

Super Junction Metal Oxide Semiconductor Field Effect Transistor

500V Super Junction Power MOSFET With Fast-Recovery  
SS\*50R100SFD

Rev.1.1  
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# SSW50R100SFD/SSA50R100SFD

## 500V N-Channel MOSFET With Fast-Recovery

### Description

SJ-FET is new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy.

SJ-FET is suitable for various AC/DC power conversion in switching mode operation for higher efficiency.

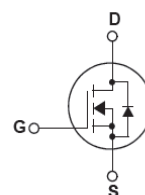
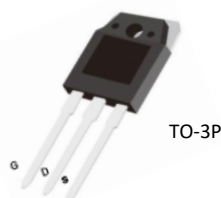
### Features

- Multi-Epi process SJ-FET
- Fast-Recovery body diode
- Extremely Low Reverse Recovery Charge
- 550V @T<sub>J</sub> = 150 °C
- Typ. RDS(on) = 90mΩ
- Ultra Low Gate Charge (typ. Qg = 45nC)
- 100% avalanche tested

SSW50R100SFD



SSA50R100SFD



### Absolute Maximum Ratings

| Symbol                            | Parameter                                                                       | SSW_A50R100SFD | Unit |
|-----------------------------------|---------------------------------------------------------------------------------|----------------|------|
| V <sub>DSS</sub>                  | Drain-Source Voltage                                                            | 500            | V    |
| I <sub>D</sub>                    | Drain Current    -Continuous (TC = 25°C)<br>-Continuous (TC = 100°C)            | 33*<br>20*     | A    |
| I <sub>DM</sub>                   | Drain Current - Pulsed                      (Note 1)                            | 100            | A    |
| V <sub>GSS</sub>                  | Gate-Source voltage                                                             | ±30            | V    |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                                         | 780            | mJ   |
| I <sub>AR</sub>                   | Repetitive Avalanche Current    (Note 1)                                        | 9              | A    |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy    (Note 1)                                         | 1              | mJ   |
| dv/dt                             | Peak Diode Recovery dv/dt    (Note 3)                                           | 15             | V/ns |
| dVds/dt                           | Drain Source voltage slope (Vds=400V)                                           | 50             | V/ns |
| P <sub>D</sub>                    | Power Dissipation (TC = 25°C)                                                   | 284            | W    |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range                                         | -55 to +150    | °C   |
| T <sub>L</sub>                    | Maximum Lead Temperature for Soldering Purpose,<br>1/8" from Case for 5 Seconds | 300            | °C   |

\* Drain current limited by maximum junction temperature. Maximum duty cycle D=0.75.

### Thermal Characteristics

| Symbol           | Parameter                               | SSW_A50R100SFD | Unit |
|------------------|-----------------------------------------|----------------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction-to-Case    | 0.44           | °C/W |
| R <sub>θCS</sub> | Thermal Resistance, Case-to-Sink Typ.   | 0.5            | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction-to-Ambient | 62             | °C/W |

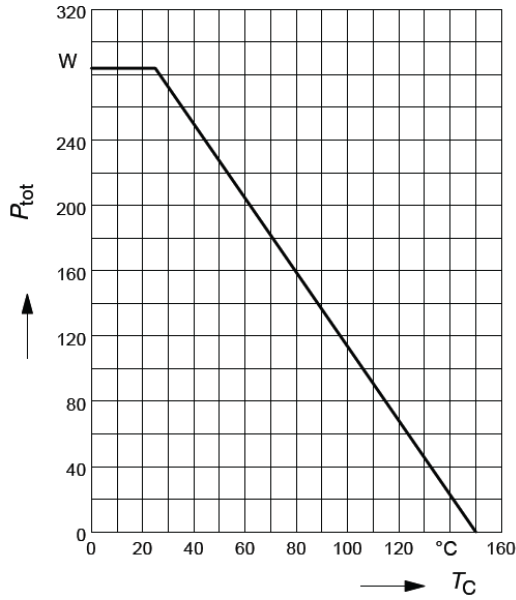
| Symbol                                                 | Parameter                                             | Conditions                                                                                         | Min | Typ      | Max    | Unit     |
|--------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----|----------|--------|----------|
| Off Characteristics                                    |                                                       |                                                                                                    |     |          |        |          |
| BV <sub>DSS</sub>                                      | Drain-Source Breakdown Voltage                        | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA, T <sub>J</sub> = 25°C                                | 500 | -        | -      | V        |
|                                                        |                                                       | V <sub>GS</sub> = 0V, I <sub>D</sub> = 10mA, T <sub>J</sub> = 150°C                                | 550 | -        | -      | V        |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>                    | Breakdown Voltage Temperature Coefficient             | I <sub>D</sub> = 10mA, Referenced to 25°C                                                          | -   | 0.6      | -      | V/°C     |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                       | V <sub>DS</sub> = 500V, V <sub>GS</sub> = 0V<br>-T <sub>J</sub> = 150°C                            | -   | 1<br>300 | 5<br>- | μA<br>μA |
| I <sub>GSS</sub> F                                     | Gate-Body Leakage Current, Forward                    | V <sub>GS</sub> = 30V, V <sub>DS</sub> = 0V                                                        | -   | -        | 100    | nA       |
| I <sub>GSS</sub> R                                     | Gate-Body Leakage Current, Reverse                    | V <sub>GS</sub> = -30V, V <sub>DS</sub> = 0V                                                       | -   | -        | -100   | nA       |
| On Characteristics                                     |                                                       |                                                                                                    |     |          |        |          |
| V <sub>GS</sub> (th)                                   | Gate Threshold Voltage                                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                         | 3.0 | -        | 5.0    | V        |
| R <sub>DS</sub> (on)                                   | Static Drain-Source On-Resistance                     | V <sub>GS</sub> = 10V, I <sub>D</sub> = 17A                                                        | -   | 90       | 105    | mΩ       |
| g <sub>FS</sub>                                        | Forward Transconductance                              | V <sub>DS</sub> = 40V, I <sub>D</sub> = 17A                                                        | -   | 25       | -      | S        |
| Dynamic Characteristics                                |                                                       |                                                                                                    |     |          |        |          |
| C <sub>iss</sub>                                       | Input Capacitance                                     | V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V,<br>f = 1.0MHz                                         | -   | 2100     | -      | pF       |
| C <sub>oss</sub>                                       | Output Capacitance                                    |                                                                                                    | -   | 850      | -      | pF       |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                          |                                                                                                    | -   | 13       | -      | pF       |
| Switching Characteristics                              |                                                       |                                                                                                    |     |          |        |          |
| t <sub>d</sub> (on)                                    | Turn-On Delay Time                                    | V <sub>DD</sub> = 400V, I <sub>D</sub> = 17A<br>R <sub>G</sub> = 20Ω (Note 4)                      | -   | 42       | -      | ns       |
| t <sub>r</sub>                                         | Turn-On Rise Time                                     |                                                                                                    | -   | 9        | -      | ns       |
| t <sub>d</sub> (off)                                   | Turn-Off Delay Time                                   |                                                                                                    | -   | 150      | -      | ns       |
| t <sub>f</sub>                                         | Turn-Off Fall Time                                    |                                                                                                    | -   | 9        | -      | ns       |
| Q <sub>g</sub>                                         | Total Gate Charge                                     | V <sub>DS</sub> = 400V, I <sub>D</sub> = 17A<br>V <sub>GS</sub> = 10V (Note 4)                     | -   | 45       | -      | nC       |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                    |                                                                                                    | -   | 10.5     | -      | nC       |
| Q <sub>gd</sub>                                        | Gate-Drain Charge                                     |                                                                                                    | -   | 16.5     | -      | nC       |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                       |                                                                                                    |     |          |        |          |
| I <sub>S</sub>                                         | Maximum Continuous Drain-Source Diode Forward Current |                                                                                                    | -   | -        | 33     | A        |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain-Source Diode Forward Current     |                                                                                                    | -   | -        | 100    | A        |
| V <sub>SD</sub>                                        | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0V, I <sub>S</sub> = 17A                                                         | -   | 0.9      | 1.5    | V        |
| t <sub>rr</sub>                                        | Reverse Recovery Time                                 | V <sub>GS</sub> = 0V, V <sub>R</sub> = 400V,<br>I <sub>S</sub> = 15A, dI <sub>F</sub> /dt =100A/μs | -   | 220      | -      | ns       |
| Q <sub>rr</sub>                                        | Reverse Recovery Charge                               |                                                                                                    | -   | 1.6      | -      | μC       |
| I <sub>rrm</sub>                                       | Peak Reverse Recovery Current                         |                                                                                                    | -   | 14       | -      | A        |

## NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I<sub>AS</sub> = 9A, V<sub>DD</sub> = 50V, Starting T<sub>J</sub> = 25 °C
3. I<sub>GS</sub> ≤ I<sub>D</sub>, di/dt ≤ 200A/μs, V<sub>DS</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25 °C
4. Essentially Independent of Operating Temperature Typical Characteristics

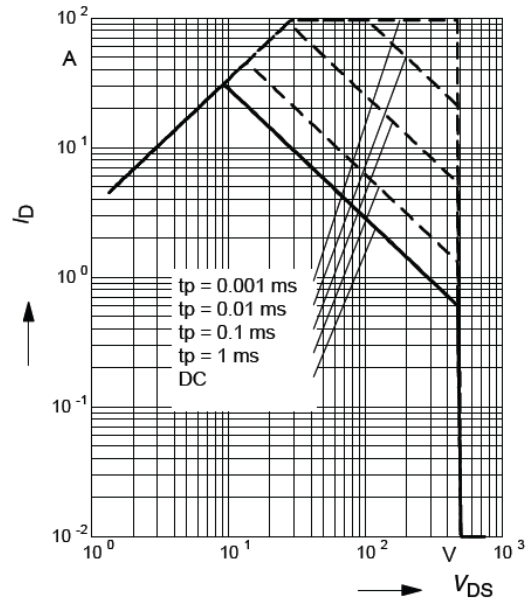
# Typical Performance Characteristics

Power dissipation



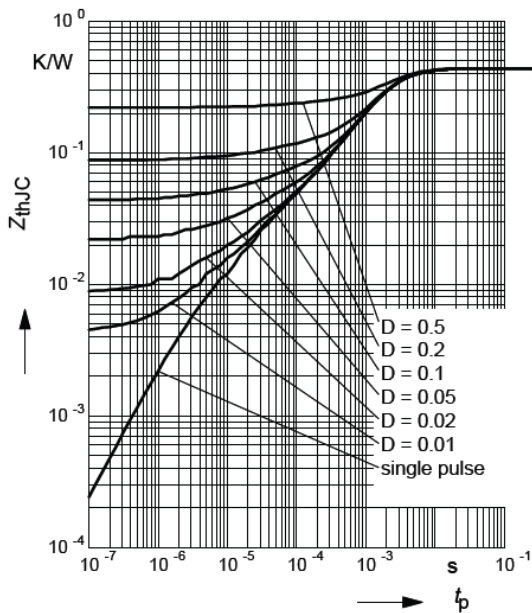
$$P_{tot}=f(T_C)$$

Safe operating area TC=25 °C



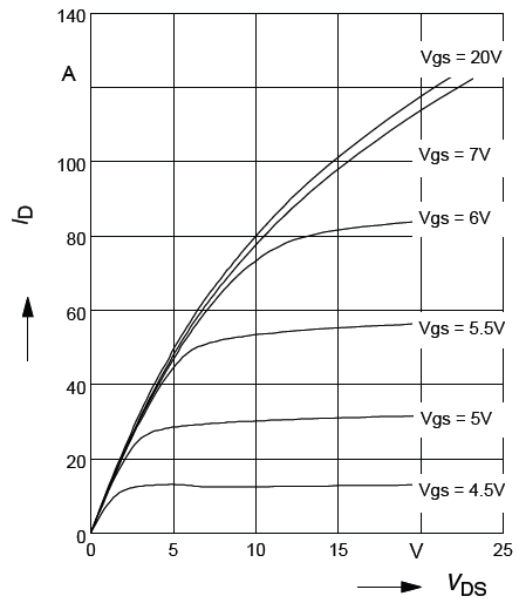
$$I_D=f(V_{DS}); T_C=25\text{ }^{\circ}\text{C}; D=0; \text{ parameter } t_p$$

Max. transient thermal impedance



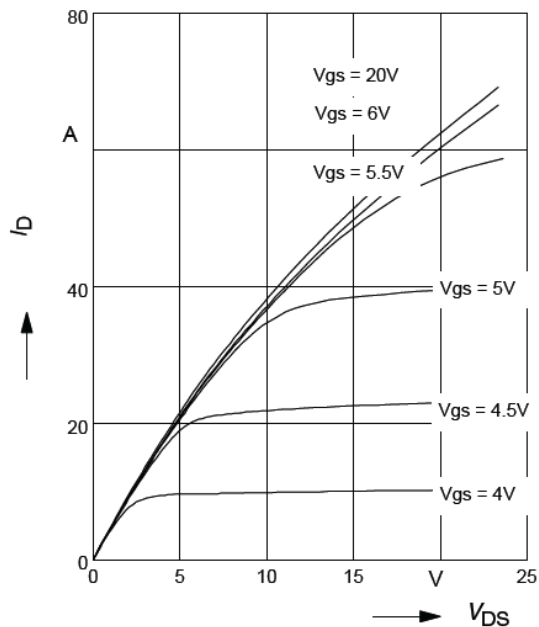
$$Z_{(th)JC}=f(t_p); \text{ parameter } D=t_p/T$$

Typ. output characteristics  $T_j=25\text{ }^{\circ}\text{C}$



$$I_D=f(V_{DS}); T_j=25\text{ }^{\circ}\text{C}; t_p=10\mu\text{s parameter: } V_{GS}$$

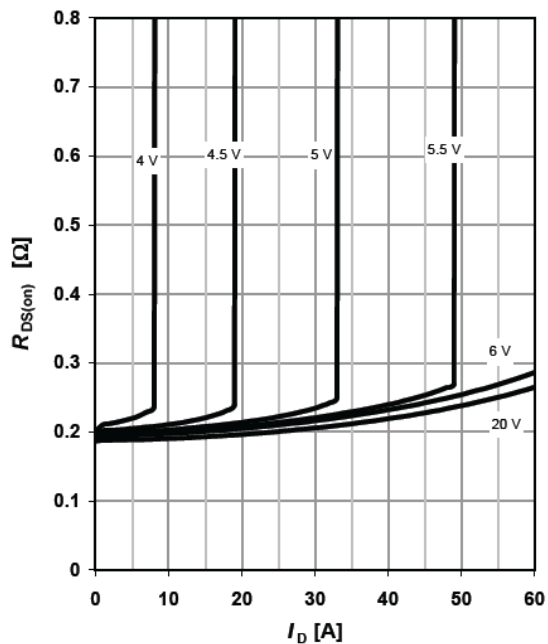
Typ. output characteristics  $T_j=125^\circ\text{C}$



$$I_D = f(V_{DS}); T_j = 125^\circ\text{C}; t_p = 10\mu\text{s}$$

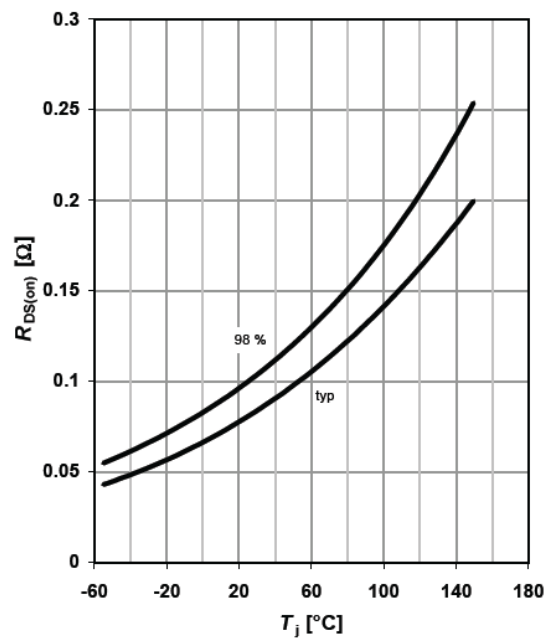
parameter:  $V_{GS}$

Typ. drain-source on-state resistance



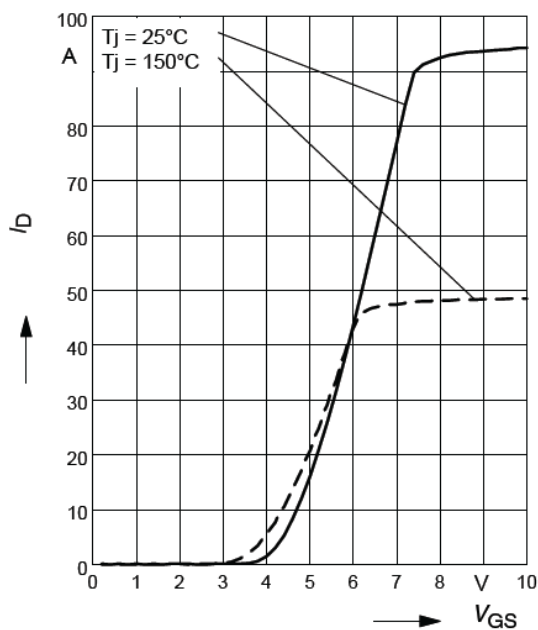
$$R_{DS(on)} = f(I_D); T_j = 125^\circ\text{C}; \text{parameter: } V_{GS}$$

Typ. drain-source on-state resistance



$$R_{DS(on)} = f(T_j); I_D = 17\text{A}; V_{GS} = 10\text{V}$$

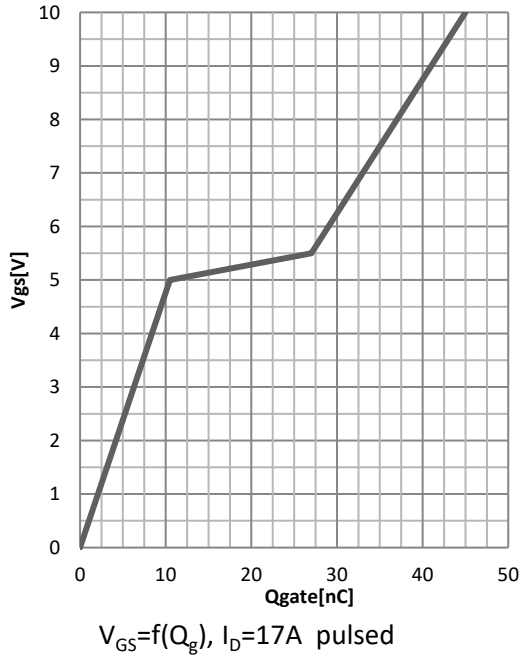
Typ. transfer characteristics



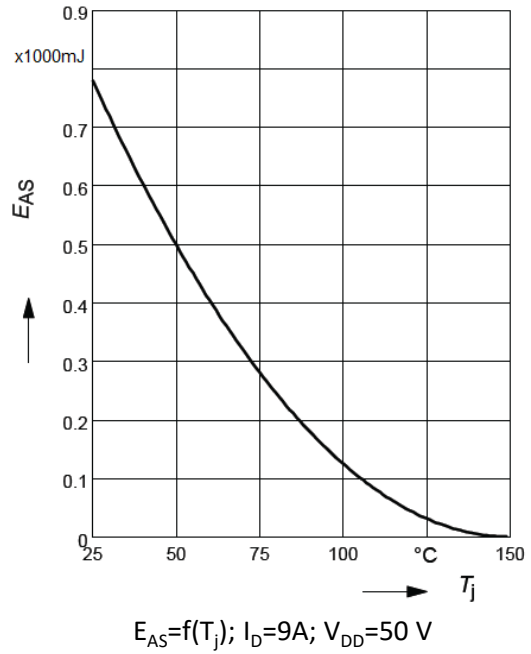
$$I_D = f(V_{GS}); V_{DS} = 40\text{V}; t_p = 10\mu\text{s}$$

# Typical Performance Characteristics

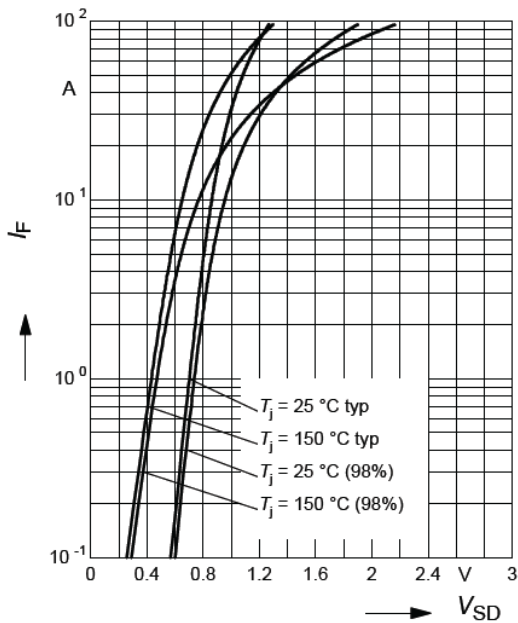
Typ. gate charge



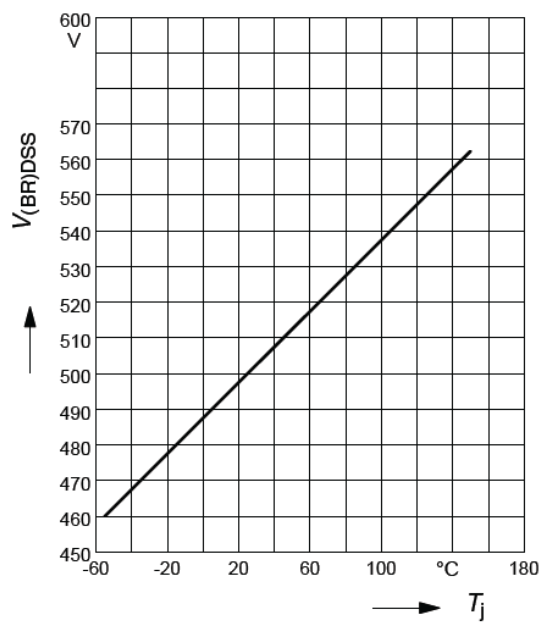
Avalanche energy



Forward characteristics of reverse diode

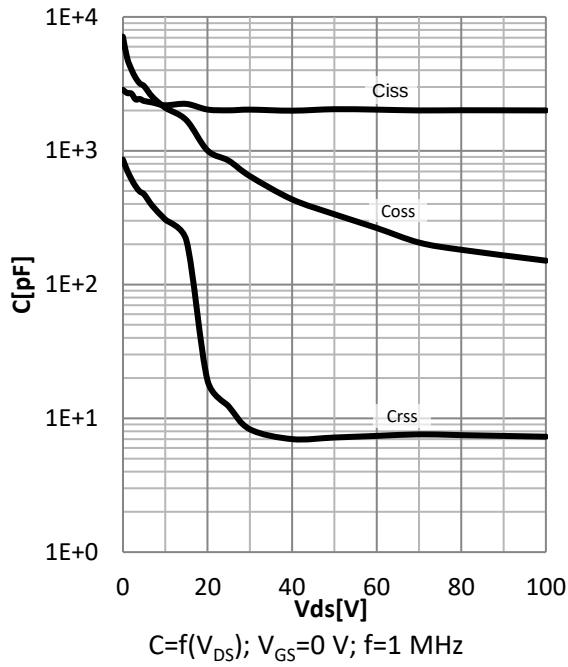


Drain-source breakdown voltage

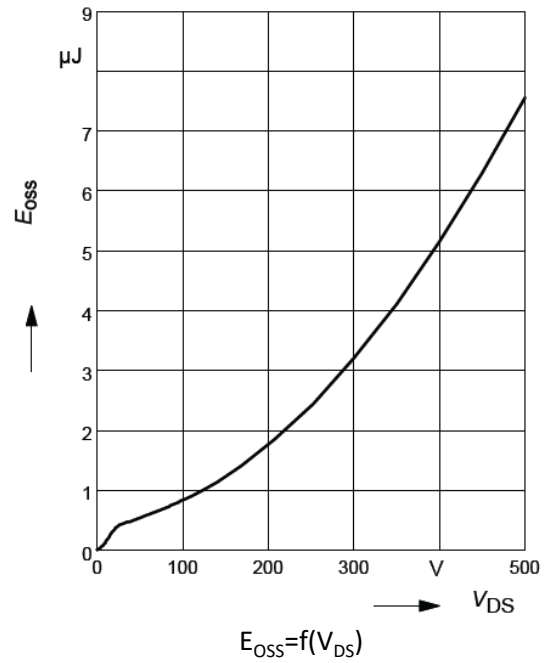


# Typical Performance Characteristics

Typ. capacitances

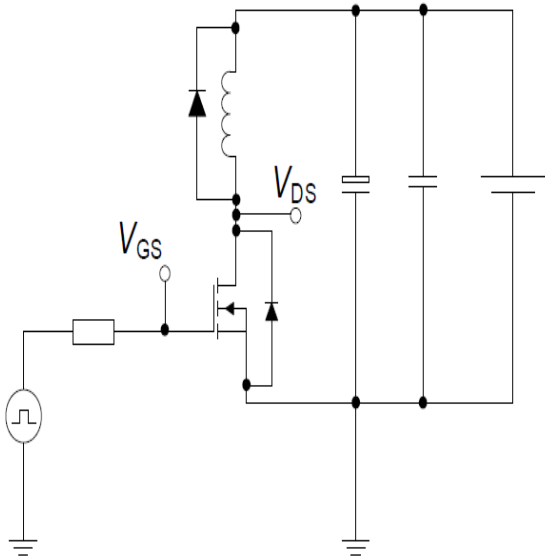


Typ. Coss stored energy

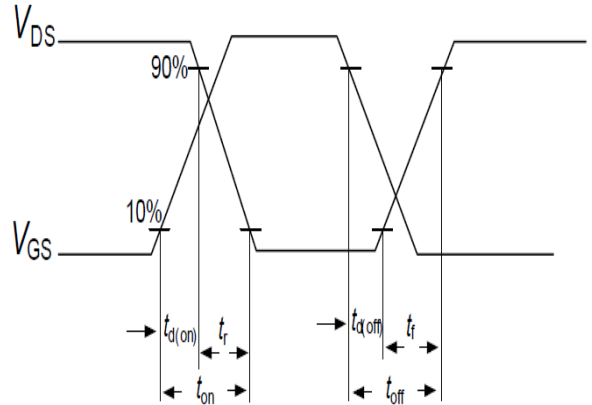


## Switching times test circuit and waveform for inductive load

### Switching times test circuit for inductive load

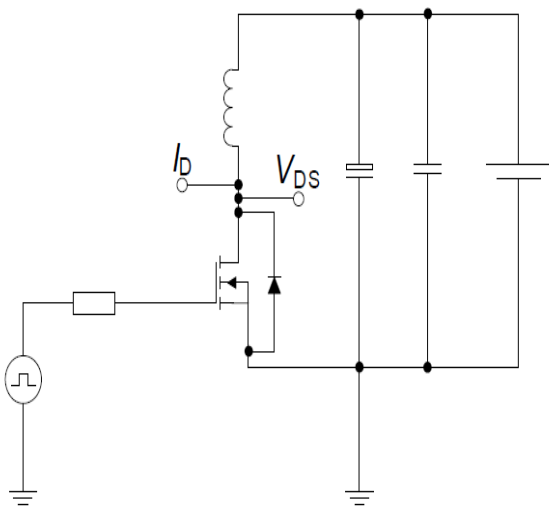


### Switching time waveform

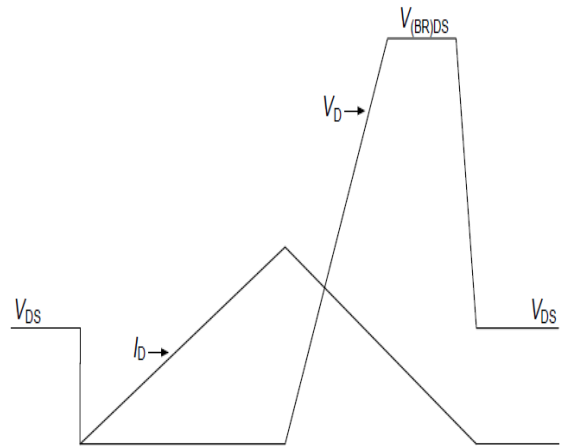


## Unclamped inductive load test circuit and waveform

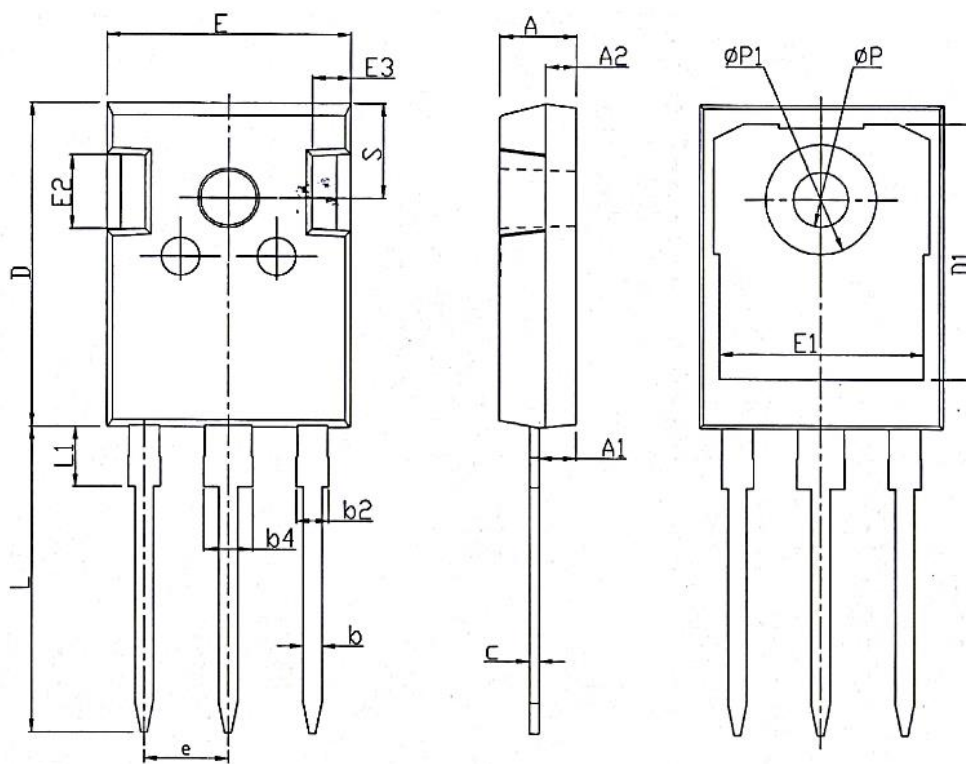
### Unclamped inductive load test circuit



### Unclamped inductive waveform

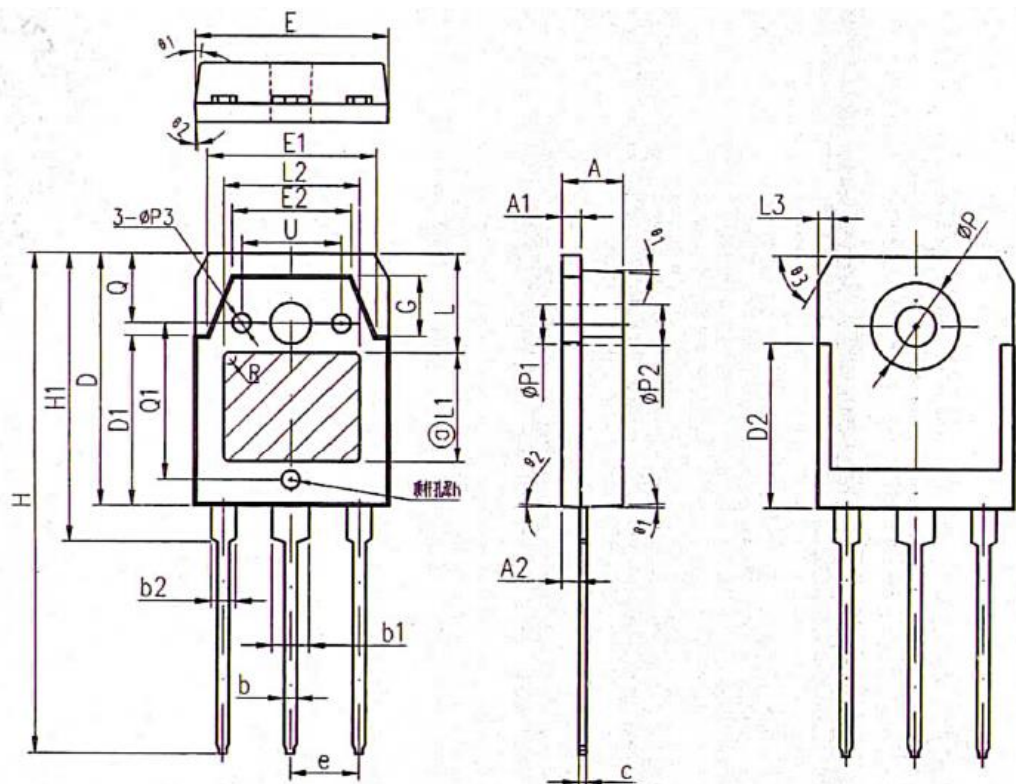






COMMON DIMENSIONS

| SYMBOL | MM       |       |       |
|--------|----------|-------|-------|
|        | MIN      | NOM   | MAX   |
| A      | 4.90     | 5.00  | 5.10  |
| A1     | 2.31     | 2.41  | 2.51  |
| A2     | 1.90     | 2.00  | 2.10  |
| b      | 1.16     | 1.21  | 1.26  |
| b2     | 1.96     | 2.01  | 2.06  |
| b4     | 2.96     | 3.01  | 3.06  |
| c      | 0.59     | 0.61  | 0.66  |
| D      | 20.90    | 21.00 | 21.10 |
| D1     | 16.25    | 16.55 | 16.85 |
| D2     | 1.05     | 1.20  | 1.35  |
| E      | 15.70    | 15.80 | 15.90 |
| E1     | 13.10    | 13.30 | 13.50 |
| E2     | 4.90     | 5.00  | 5.10  |
| E3     | 2.40     | 2.50  | 2.60  |
| e      | 5.44BSC  |       |       |
| h      | 0.05     | 0.10  | 0.15  |
| L      | 19.80    | 19.92 | 20.10 |
| L1     | -        | -     | 4.30  |
| ØP     | 3.50     | 3.60  | 3.70  |
| ØP1    | -        | -     | 7.30  |
| ØP2    | 2.40     | 2.50  | 2.60  |
| Q      | 5.60     | 5.80  | 6.00  |
| S      | 6.15BSC  |       |       |
| R      | 0.50REF  |       |       |
| T      | 9.80     | -     | 10.20 |
| T1     | 1.65REF  |       |       |
| T2     | 8.00REF  |       |       |
| T3     | 12.80REF |       |       |
| U      | 6.00     | -     | 6.40  |
| Ø1     | 6°       | 7°    | 8°    |
| Ø2     | 4°       | 5°    | 6°    |
| Ø3     | 1°       | -     | 1.5°  |
| Ø4     | 14°      | 15°   | 16°   |



COMMON DIMENSIONS

| SYMBOL | MM        |       |       |
|--------|-----------|-------|-------|
|        | MIN       | NOM   | MAX   |
| A      | 4.60      | 4.80  | 5.00  |
| A1     | 1.40      | 1.50  | 1.60  |
| A2     | 1.33      | 1.38  | 1.43  |
| b      | 0.80      | 1.00  | 1.20  |
| b1     | 2.80      | 3.00  | 3.20  |
| b2     | 1.80      | 2.00  | 2.20  |
| c      | 0.50      | 0.60  | 0.70  |
| D      | 19.75     | 19.90 | 20.05 |
| D1     | 13.70     | 13.90 | 14.10 |
| D2     | 12.90 REF |       |       |
| E      | 15.40     | 15.60 | 15.80 |
| E1     | 13.40     | 13.60 | 13.80 |
| E2     | 9.40      | 9.60  | 9.80  |
| e      | 5.45 TYP  |       |       |
| G      | 4.60      | 4.80  | 5.00  |
| H      | 40.30     | 40.50 | 40.70 |
| H1     | 23.20     | 23.40 | 23.60 |
| h      | 0.05      | 0.10  | 0.15  |
| L      | 7.40 TYP  |       |       |
| L1     | 9.00 TYP  |       |       |
| L2     | 11.00 TYP |       |       |
| L3     | 1.00 REF  |       |       |
| ØP     | 6.90      | 7.00  | 7.10  |
| ØP1    | 3.20 REF  |       |       |
| ØP2    | 3.50 REF  |       |       |
| ØP3    | 1.40      | 1.50  | 1.60  |
| R      | 0.50 REF  |       |       |
| Q      | 5.00 REF  |       |       |
| Q1     | 12.56     | 12.76 | 12.96 |
| U      | 7.8       | 8     | 8.2   |
| Ø1     | 5°        | 7°    | 9°    |
| Ø2     | 1°        | 3°    | 5°    |
| Ø3     | 60° REF   |       |       |



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