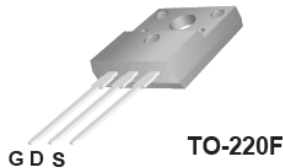


TSF65R300S1

650V 15A N-Channel SJ-MOSFET

General Description

Truesemi 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

- 700V @T_J = 150 °C
- Typ. R_{DS(on)} = 0.26Ω
- Ultra Low gate charge (typ. Q_g = 43nC)
- 100% avalanche tested



Absolute Maximum Ratings

| Symbol | Parameter | Value | Unit |
|-----------------------------------|--|-------------|------|
| V _{DSS} | Drain-Source Voltage | 650 | V |
| I _D | Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C) | 15* 9.4* | A |
| I _{DM} | Drain Current – Pulsed (Note 1) | 45* | A |
| V _{GSS} | Gate-Source voltage | ±30 | V |
| E _{AS} | Single Pulsed Avalanche Energy (Note 2) | 284 | mJ |
| I _{AR} | Avalanche Current (Note 1) | 2.4 | A |
| E _{AR} | Repetitive Avalanche Energy (Note 1) | 0.43 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 15 | V/ns |
| P _D | Power Dissipation (TC = 25°C) | 32 | W |
| T _J , T _{STG} | Operating and Storage Temperature Range | -55 to +150 | °C |
| T _L | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | 300 | °C |

* Drain current limited by maximum junction temperature.

Thermal Characteristics

| Symbol | Parameter | Value | Unit |
|------------------|---|-------|------|
| R _{θJC} | Thermal Resistance, Junction-to-Case | 3.9 | °C/W |
| R _{θCS} | Thermal Resistance, Case-to-Sink Typ. | -- | °C/W |
| R _{θJA} | Thermal Resistance, Junction-to-Ambient | 80 | °C/W |

Electrical Characteristics TC = 25 °C unless otherwise noted

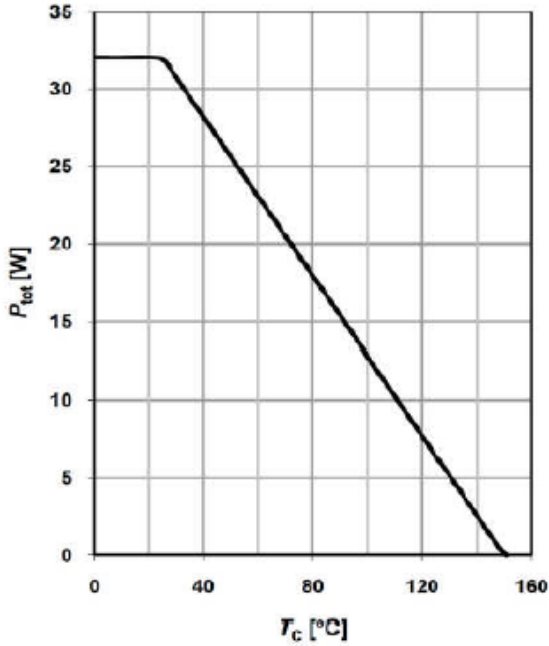
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--|---|---|-----|----------|---------|----------|
| Off Characteristics | | | | | | |
| BV _{DSS} | Drain-Source Breakdown Voltage | V _{GS} = 0V, I _D = 250μA, T _J = 25 °C | 650 | -- | -- | V |
| | | V _{GS} = 0V, I _D = 250μA, T _J = 150 °C | -- | 700 | -- | V |
| ΔBV _{DSS} / ΔT _J | Breakdown Voltage Temperature Coefficient | I _D = 250μA, Referenced to 25 °C | -- | 0.6 | -- | V/°C |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} = 650V, V _{GS} = 0V - T _J = 150 °C | -- | -- 10 | 1 -- | μA μA |
| I _{GSSF} | Gate-Body Leakage Current, Forward | V _{GS} = 30V, V _{DS} = 0V | -- | -- | 100 | nA |
| I _{GSSR} | Gate-Body Leakage Current, Reverse | V _{GS} = -30V, V _{DS} = 0V | -- | -- | -100 | nA |
| On Characteristics | | | | | | |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} = V _{GS} , I _D = 250μA | 2.5 | -- | 4.5 | V |
| R _{DS(on)} | Static Drain-Source On-Resistance | V _{GS} = 10V, I _D = 7.5A | -- | 0.26 | 0.3 | Ω |
| g _{FS} | Forward Trans conductance | V _{DS} = 40V, I _D = 7.5A (Note 4) | -- | 16 | -- | S |
| R _g | Gate resistance | f=1MHz, open drain | -- | 3.5 | -- | Ω |
| Dynamic Characteristics | | | | | | |
| C _{iss} | Input Capacitance | V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz | -- | 1200 | -- | pF |
| C _{oss} | Output Capacitance | | -- | 340 | -- | pF |
| C _{rss} | Reverse Transfer Capacitance | | -- | 10 | -- | pF |
| Switching Characteristics | | | | | | |
| t _{d(on)} | Turn-On Delay Time | V _{DD} = 400V, I _D = 7.5A R _G = 20Ω (Note 4, 5) | -- | 13 | -- | ns |
| t _r | Turn-On Rise Time | | -- | 11 | -- | ns |
| t _{d(off)} | Turn-Off Delay Time | | -- | 100 | -- | ns |
| t _f | Turn-Off Fall Time | | -- | 12 | -- | ns |
| Q _g | Total Gate Charge | V _{DS} = 480V, I _D = 7.5A V _{GS} = 10V (Note 4, 5) | -- | 43 | -- | nC |
| Q _{gs} | Gate-Source Charge | | -- | 5 | -- | nC |
| Q _{gd} | Gate-Drain Charge | | -- | 22 | -- | nC |
| Drain-Source Diode Characteristics and Maximum Ratings | | | | | | |
| I _S | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 15 | A |
| I _{SM} | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 40 | A |
| V _{SD} | Drain-Source Diode Forward Voltage | V _{GS} = 0V, I _F = 7.5A | -- | 0.9 | 1.5 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0V, I _F = 7.5A di _F /dt = 100A/μs (Note 4) | -- | 345 | -- | ns |
| Q _{rr} | Reverse Recovery Charge | | -- | 4.5 | -- | μC |

NOTES:

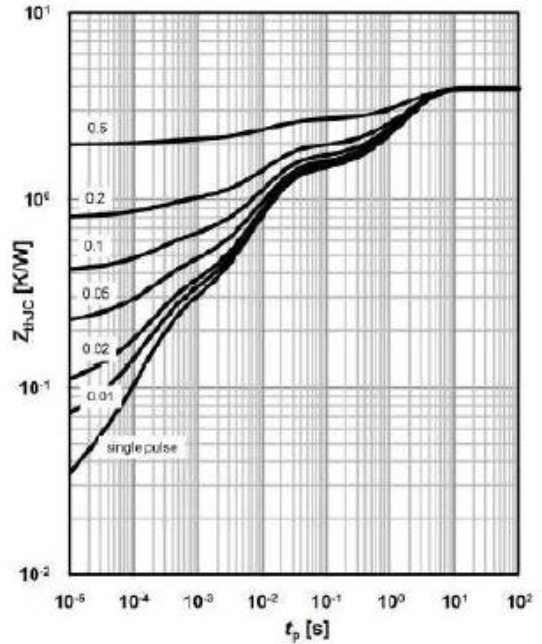
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS}=2.4A, V_{DD}=50V, Starting T_J=25 °C
3. I_{SD}≤15A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25 °C
4. Pulse Test: Pulse width ≤ 300μs, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

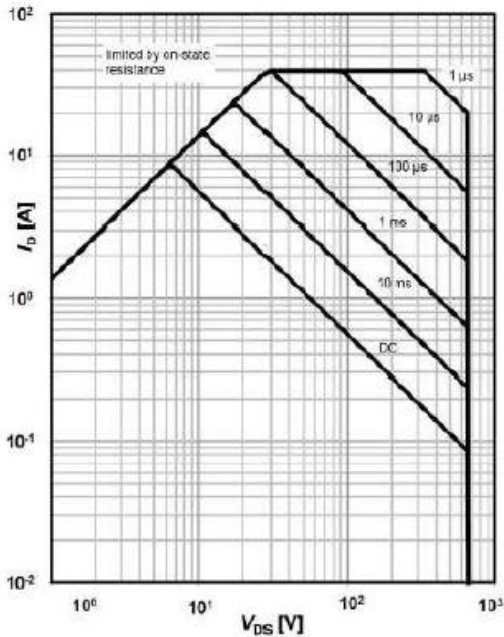
Power dissipation



Max. transient thermal impedance

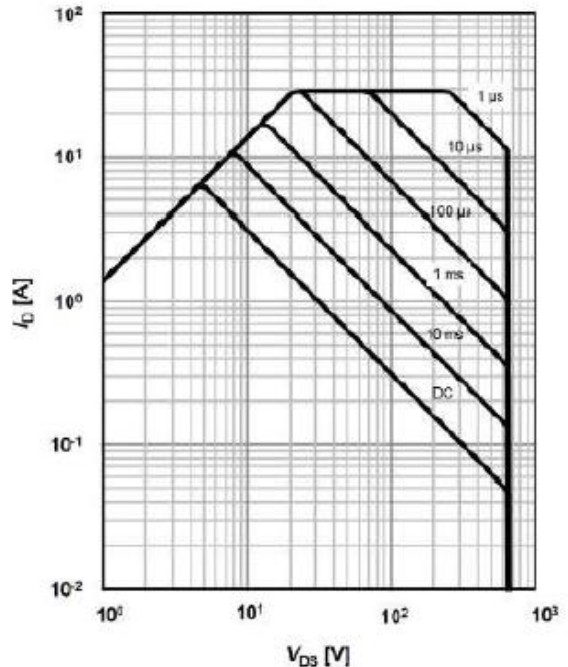


Safe operating area $T_c=25$ °C



$I_D=f(V_{DS}); T_c=25$ °C; $V_{GS} > 7V$;
 $D=0$; parameter t_p

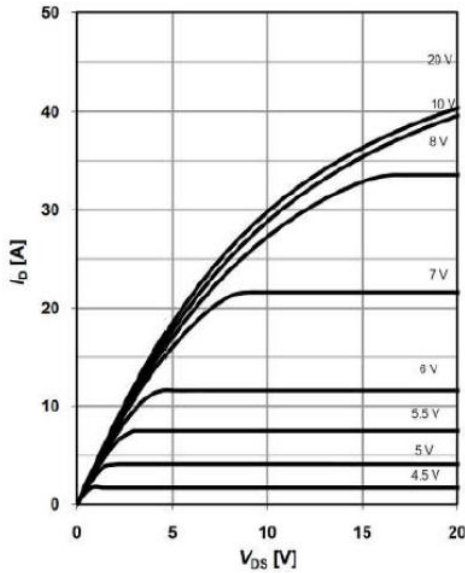
Safe operating area $T_c=80$ °C



$I_D=f(V_{DS}); T_c=80$ °C; $V_{GS} > 7V$;
 $D=0$; parameter t_p

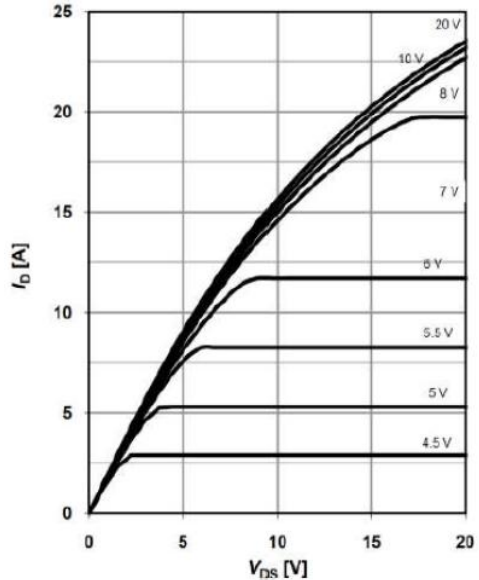
Typical Performance Characteristics

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



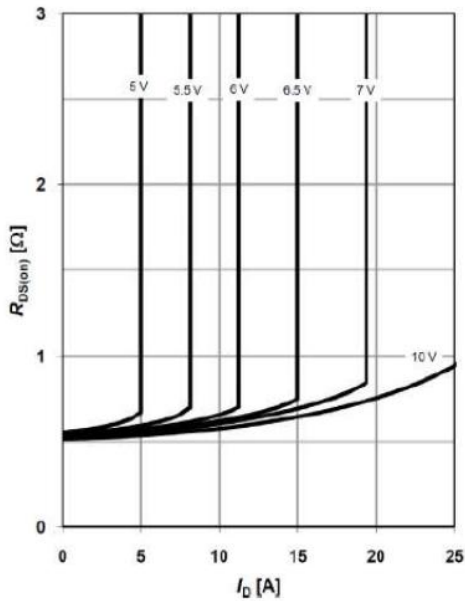
$I_D=f(V_{DS}); T_j=25\text{ }^\circ\text{C}$; parameter: V_{GS}

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



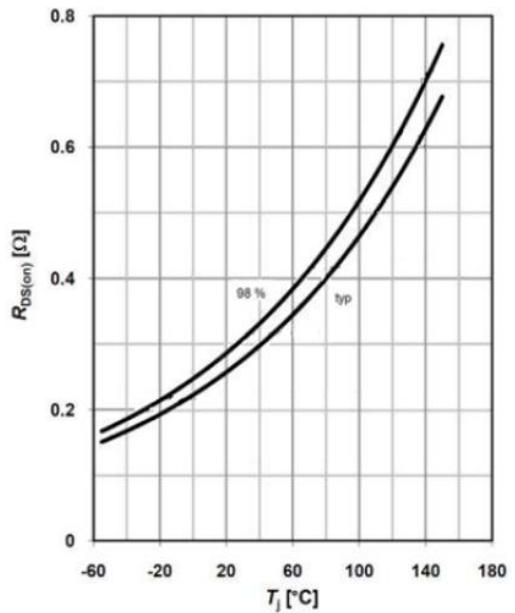
$I_D=f(V_{DS}); T_j=125\text{ }^\circ\text{C}$; parameter: V_{GS}

Typ. drain-source on-state resistance



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

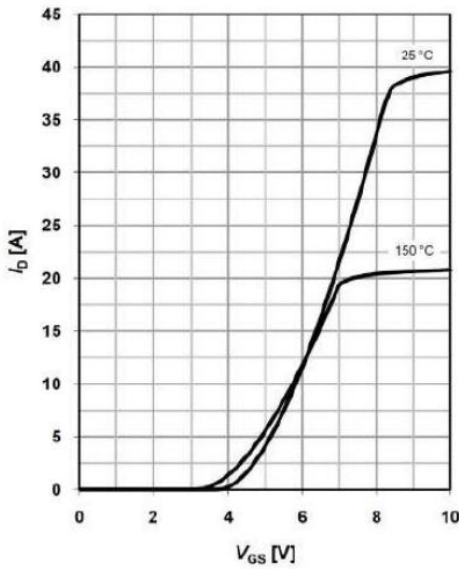
Typ. drain-source on-state resistance



$R_{DS(on)}=f(T_j); I_D=4.4\text{ A}; V_{GS}=10\text{ V}$

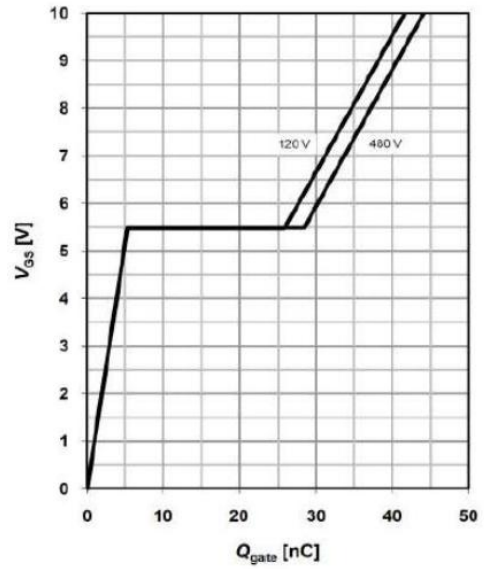
Typical Performance Characteristics

Typ. transfer characteristics



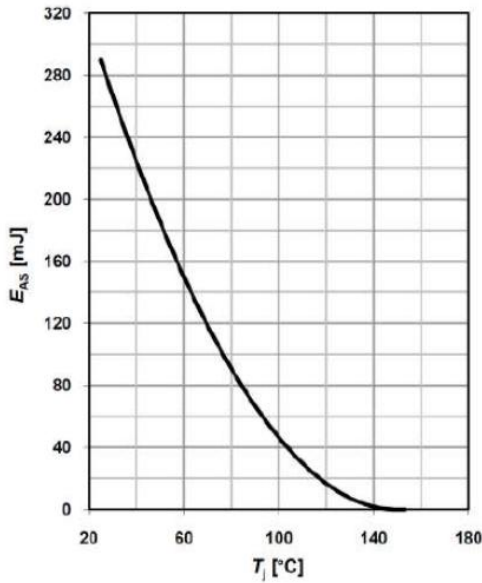
$I_D=f(V_{GS}); V_{DS}=20V$

Typ. gate charge



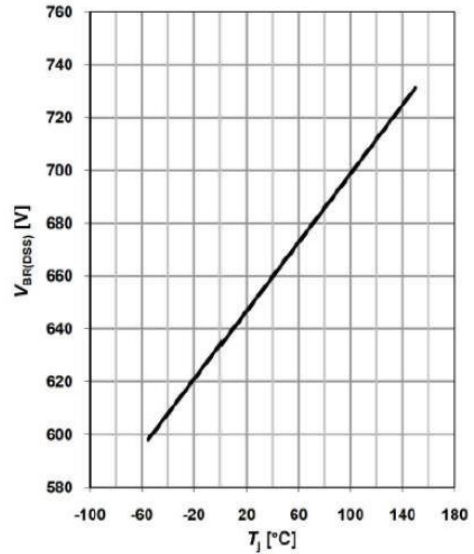
$V_{GS}=f(Q_g), I_D=4.4 A$ pulsed

Avalanche energy



$E_{AS}=f(T_j); I_D=2.4A; V_{DD}=50 V$

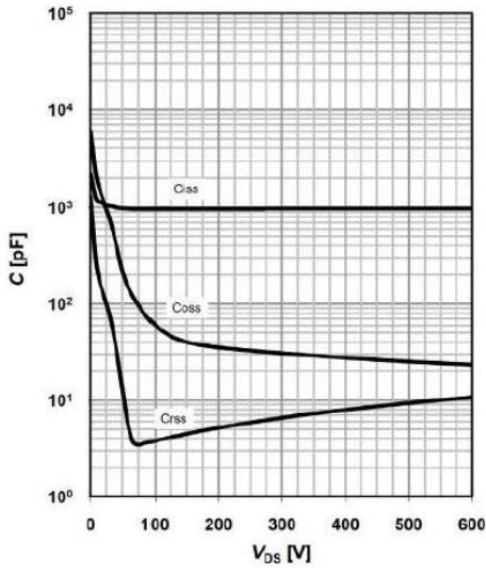
Drain-source breakdown voltage



$V_{BR(DSS)}=f(T_j); I_D=0.25mA$

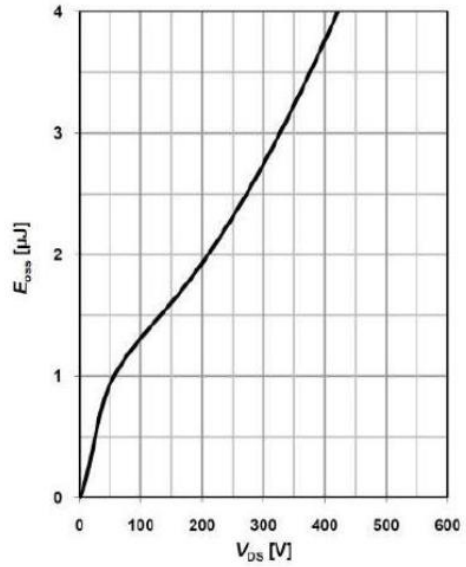
Typical Performance Characteristics

Typ. capacitances



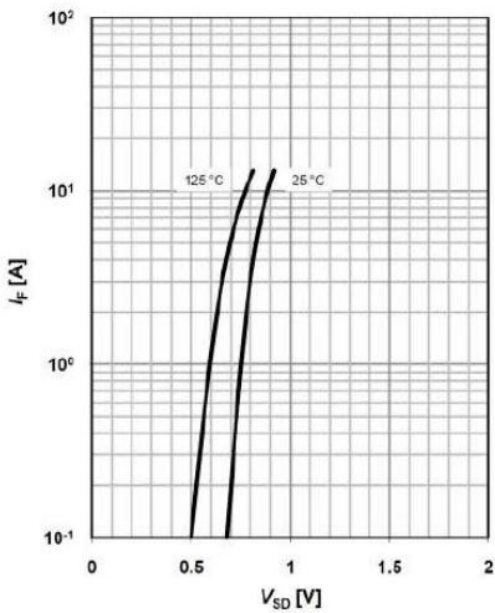
$$C=f(V_{DS}); V_{GS}=0 V; f=1 MHz$$

Typ. C_{oss} stored energy



$$E_{OSS}=f(V_{DS})$$

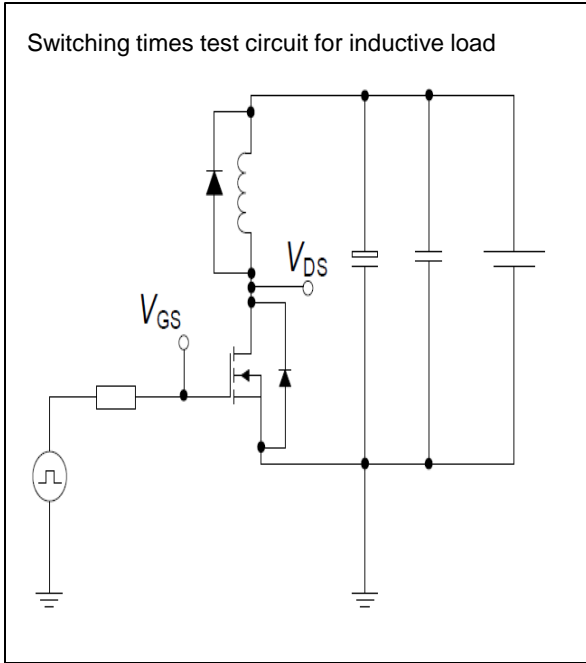
Forward characteristics of reverse diode



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

Test circuits

Switching times test circuit and waveform for inductive load

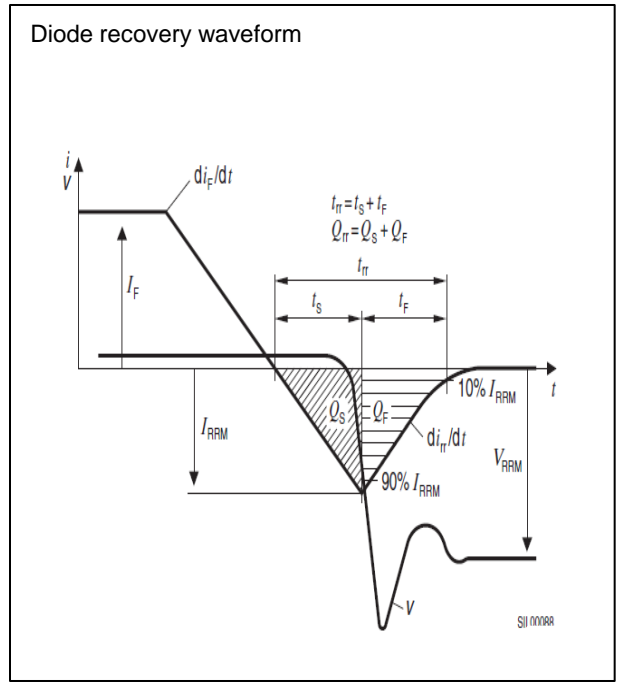
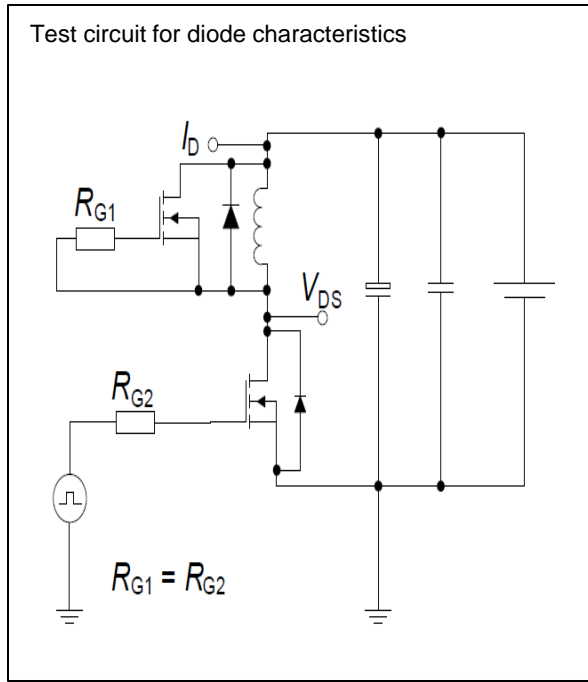


Unclamped inductive load test circuit and waveform



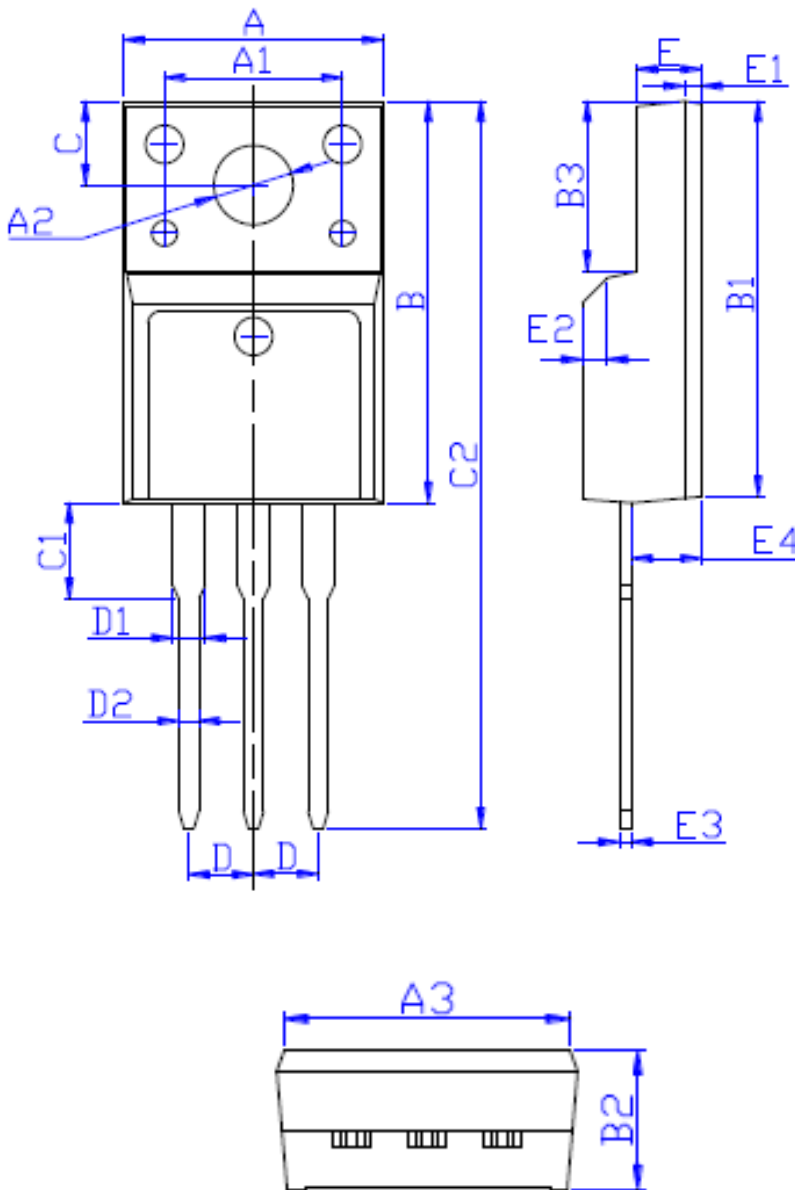
Test circuits

Test circuit and waveform for diode characteristics



Package Outline TO-220F

TSF65R300S1 650V 15A N-Channel SJ-MOSFET



| DIM | MILLIMETERS |
|-----|--------------|
| A | 10.16 ± 0.30 |
| A1 | 7.00 ± 0.20 |
| A2 | 3.12 ± 0.20 |
| A3 | 9.70 ± 0.30 |
| B | 15.90 ± 0.50 |
| B1 | 15.60 ± 0.50 |
| B2 | 4.70 ± 0.30 |
| B3 | 6.70 ± 0.30 |
| C | 3.30 ± 0.25 |
| C1 | 3.25 ± 0.30 |
| C2 | 28.70 ± 0.50 |
| D | Typical 2.54 |
| D1 | 1.47 (MAX) |
| D2 | 0.80 ± 0.20 |
| E | 2.55 ± 0.25 |
| E1 | 0.70 ± 0.25 |
| E2 | 1.0 × 45° |
| E3 | 0.50 ± 0.20 |
| E4 | 2.75 ± 0.30 |