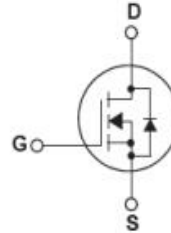
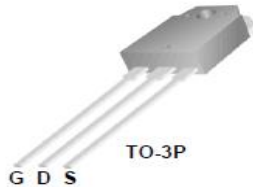


TSA60R070S1

600V 47A 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

- 650V @T_J = 150 °C
- Typ. R_{DS(on)} = 60mΩ
- Ultra Low gate charge (typ. Q_g = 170nC)
- 100% avalanche tested

Absolute Maximum Ratings

| Symbol | Parameter | Value | Unit |
|-----------------------------------|--|-------------|------|
| V _{DSS} | Drain-Source Voltage | 600 | V |
| I _D | Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C) | 47* 29* | A |
| I _{DM} | Drain Current – Pulsed (Note 1) | 140 | A |
| V _{GSS} | Gate-Source voltage | ±30 | V |
| E _{AS} | Single Pulsed Avalanche Energy (Note 2) | 1135 | mJ |
| I _{AR} | Avalanche Current (Note 1) | 9.3 | A |
| E _{AR} | Repetitive Avalanche Energy (Note 1) | 1.72 | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 15 | V/ns |
| dvds/dt | Drain Source voltage slope (V _{ds} =480V) | 50 | V/ns |
| P _D | Power Dissipation (TC = 25°C) | 391 | 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 | 0.32 | °C/W |
| R _{θCS} | Thermal Resistance, Case-to-Sink Typ. | 0.5 | °C/W |
| R _{θJA} | Thermal Resistance, Junction-to-Ambient | 62 | °C/W |

Electrical Characteristics TC = 25°C unless otherwise noted

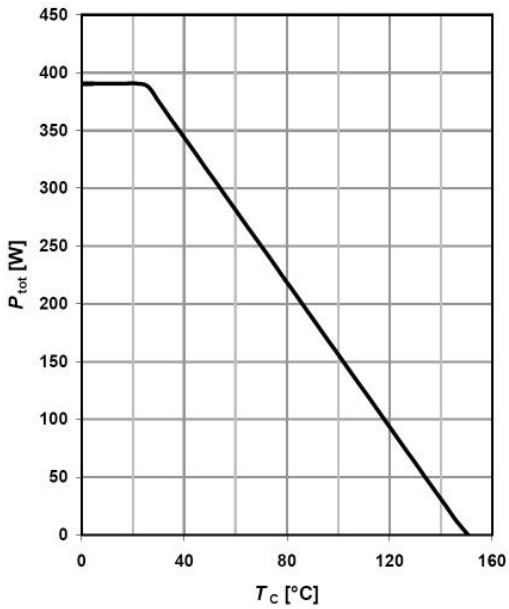
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--|---|--|-----|----------|---------|----------|
| Off Characteristics | | | | | | |
| BV _{DSS} | Drain-Source Breakdown Voltage | V _{GS} = 0V, I _D = 250μA, T _J = 25°C | 600 | -- | -- | V |
| | | V _{GS} = 0V, I _D = 250μA, T _J = 150°C | -- | 650 | -- | 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} = 600V, 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 = 23A | -- | 60 | 70 | mΩ |
| g _{FS} | Forward Trans conductance | V _{DS} = 40V, I _D = 25A | -- | 30 | -- | S |
| Dynamic Characteristics | | | | | | |
| C _{ISS} | Input Capacitance | V _{DS} = 25V, V _{GS} = 0V, f = 1.0MHz | -- | 3100 | -- | pF |
| C _{OSS} | Output Capacitance | | -- | 610 | -- | pF |
| C _{RSS} | Reverse Transfer Capacitance | | -- | 15 | -- | pF |
| t _{d(on)} | Turn-On Delay Time | V _{DD} = 480V, I _D = 23A R _G = 20Ω(Note 4) | -- | 16 | -- | ns |
| t _r | Turn-On Rise Time | | -- | 12 | -- | ns |
| t _{d(off)} | Turn-Off Delay Time | | -- | 83 | -- | ns |
| t _f | Turn-Off Fall Time | | -- | 5 | -- | ns |
| Q _g | Total Gate Charge | V _{DS} = 480V, I _D = 23A V _{GS} = 10V (Note 4) | -- | 170 | -- | nC |
| Q _{gs} | Gate-Source Charge | | -- | 21 | -- | nC |
| Q _{gd} | Gate-Drain Charge | | -- | 87 | -- | nC |
| Drain-Source Diode Characteristics and Maximum Ratings | | | | | | |
| I _S | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 47 | A |
| I _{SM} | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 140 | A |
| V _{SD} | Drain-Source Diode Forward Voltage | V _{GS} = 0V, I _F = 23A | -- | 0.9 | 1.5 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0V, V _R = 300V, I _F = 23A, di _F /dt = 40A/μs | -- | 900 | -- | ns |
| Q _{rr} | Reverse Recovery Charge | | -- | 7 | -- | μC |
| I _{rrm} | Peak Reverse Recovery Current | | -- | 14 | -- | A |

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS} = 9.3A, V_{DD} = 50V, Starting T_J = 25°C
3. I_{SD} ≤ 23A, di/dt ≤ 200A/μs, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Essentially Independent of Operating Temperature Typical Characteristics

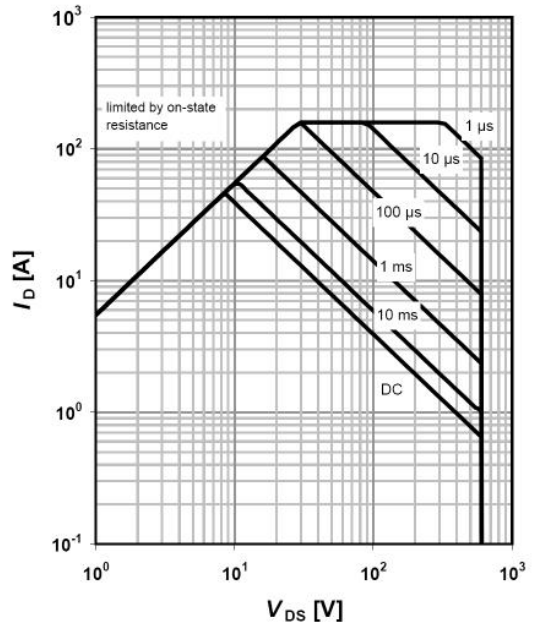
Typical Performance Characteristics

Power dissipation



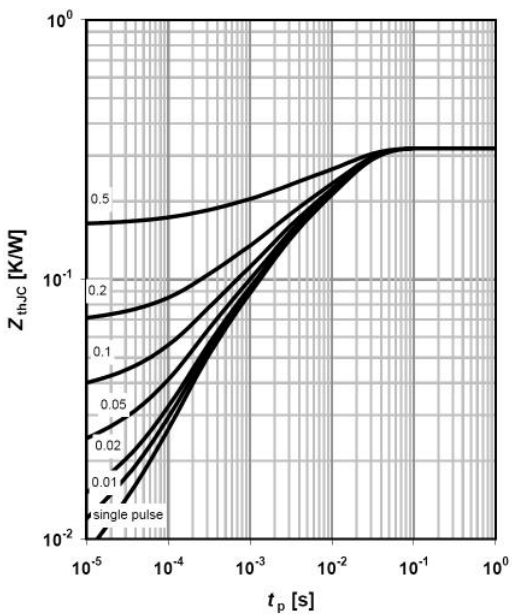
$$P_{tot} = f(T_C)$$

Safe operating area TC=25 °C



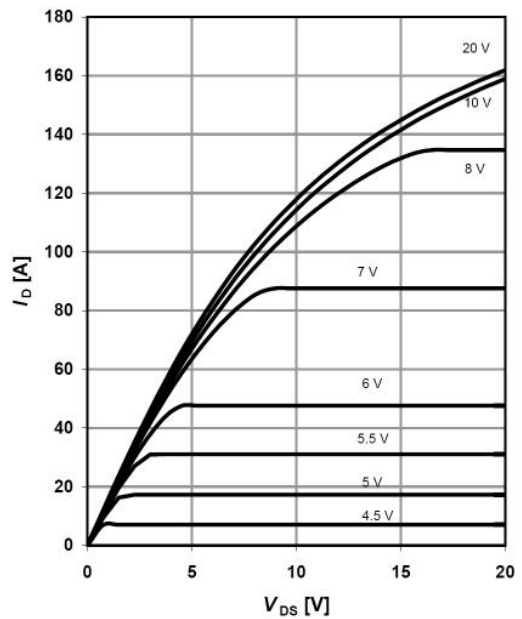
$$I_D = f(V_{DS}); T_C = 25 \text{ °C}; D = 0; \text{ parameter } t_p$$

Max. transient thermal impedance



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

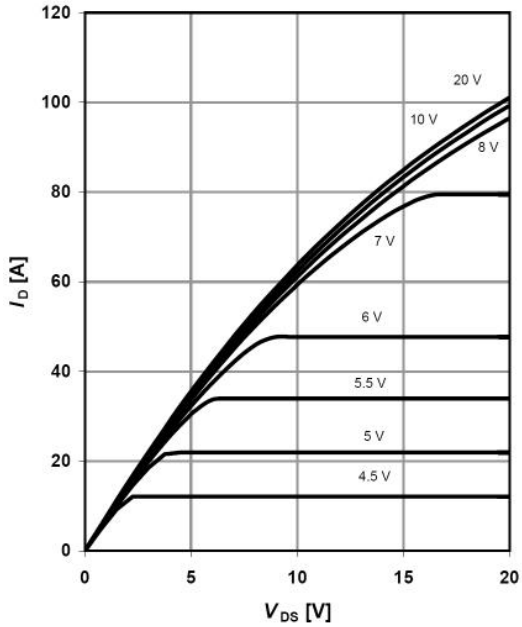
Typ. output characteristics $T_j = 25 \text{ °C}$



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

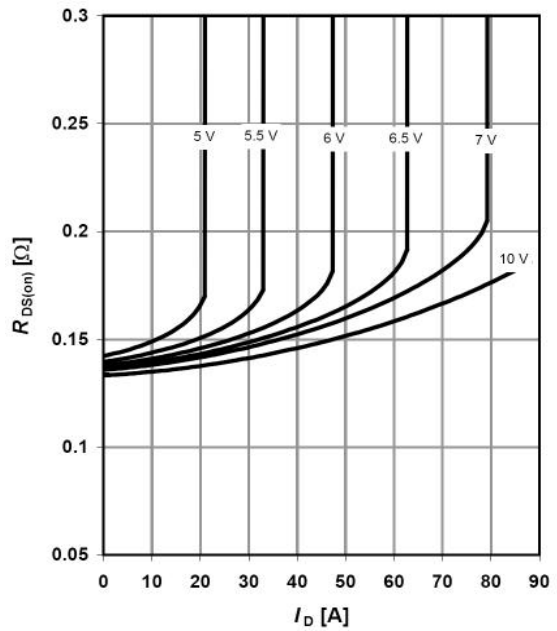
Typical Performance Characteristics

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



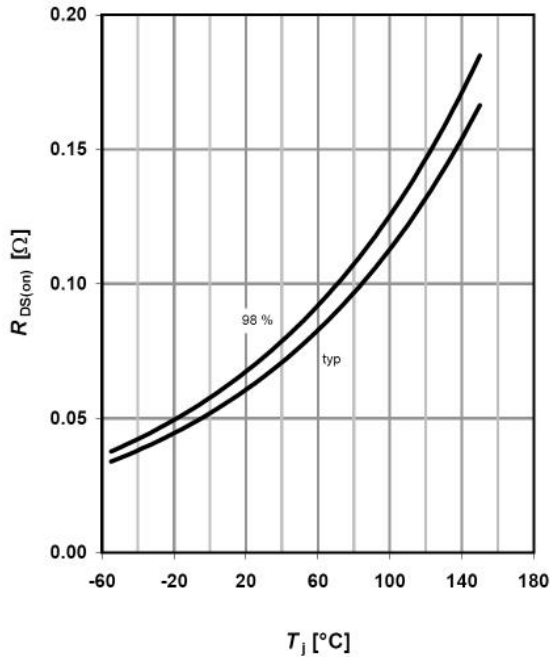
$I_D=f(V_{DS}); T_j=125\text{ }^\circ\text{C}$; parameter: V_{GS}

Typ. drain-source on-state resistance



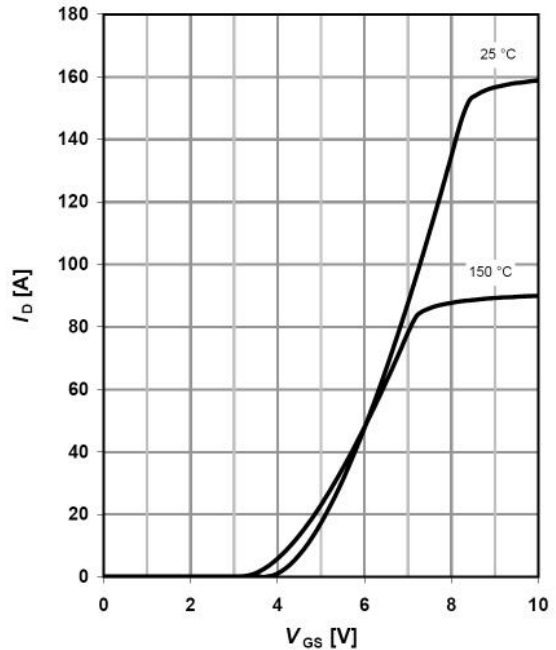
$R_{DS(on)}=f(I_D); T_j=125\text{ }^\circ\text{C}$; parameter: V_{GS}

Typ. drain-source on-state resistance



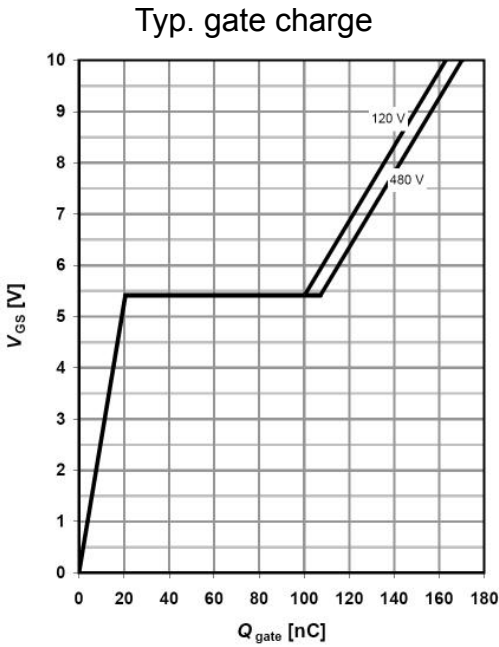
$R_{DS(on)}=f(T_j); I_D=23\text{ A}; V_{GS}=10\text{ V}$

Typ. transfer characteristics

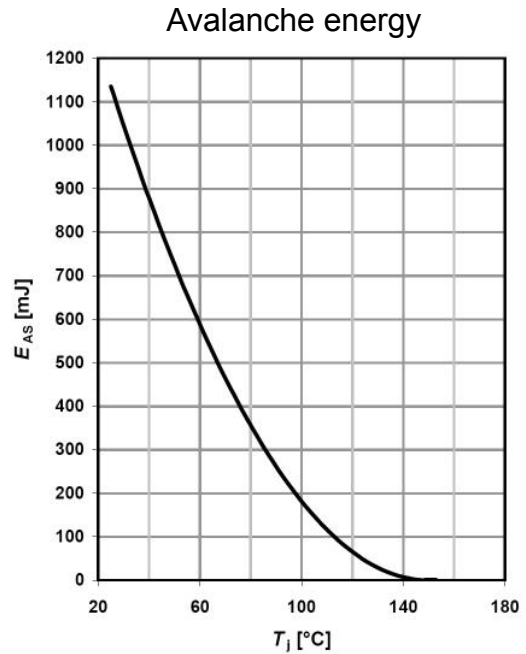


$I_D=f(V_{GS}); V_{DS}=40\text{ V}$

Typical Performance Characteristics

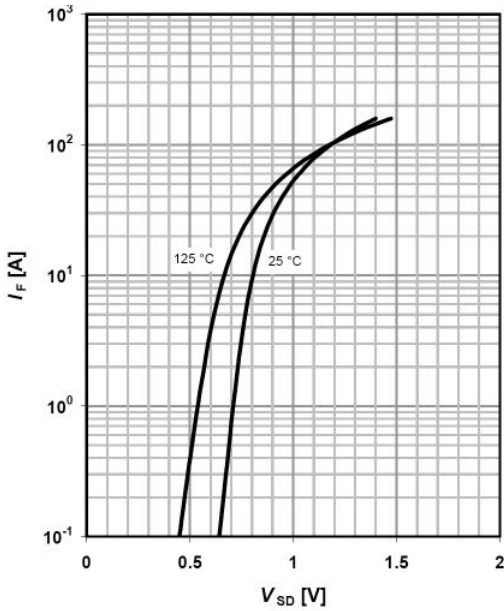


$V_{GS}=f(Q_g), I_D=23A$ pulsed



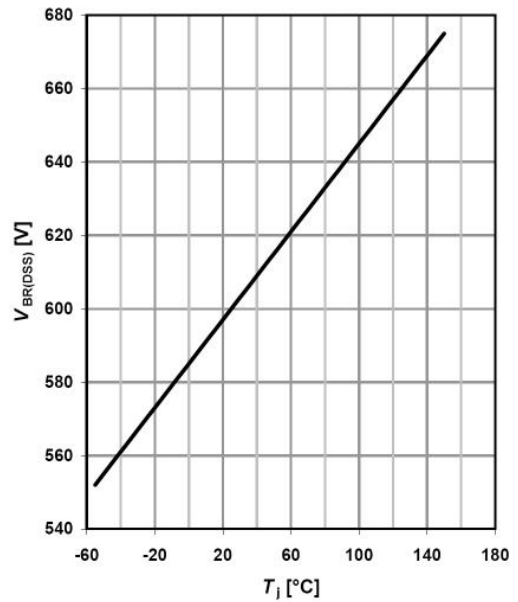
$E_{AS}=f(T_j); I_D=9.3A; V_{DD}=50V$

Forward characteristics of reverse diode



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

Drain-source breakdown voltage

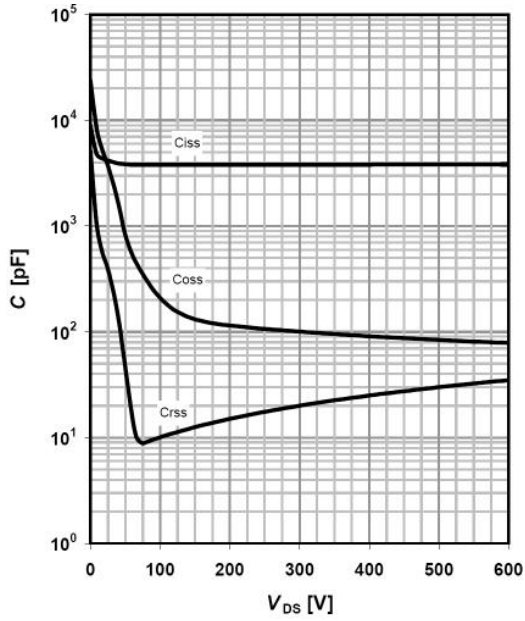


$V_{BR(DSS)}=f(T_j); I_D=0.25mA$

Typical Performance Characteristics

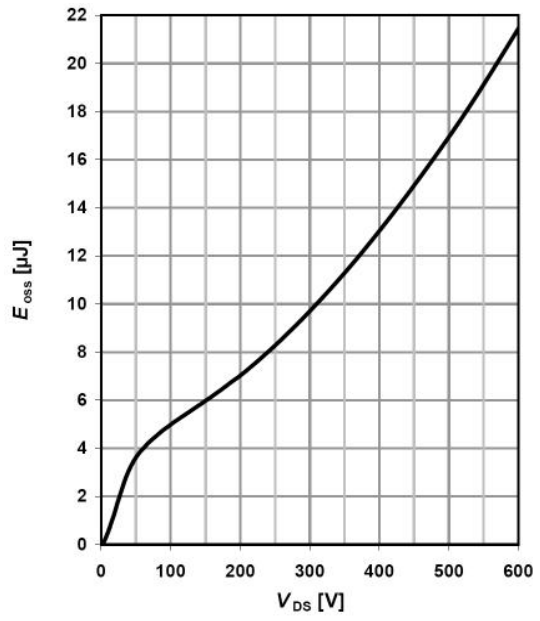
TSA60R070S1 600V 47A N-Channel SJ-MOSFET

Typ. capacitances



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

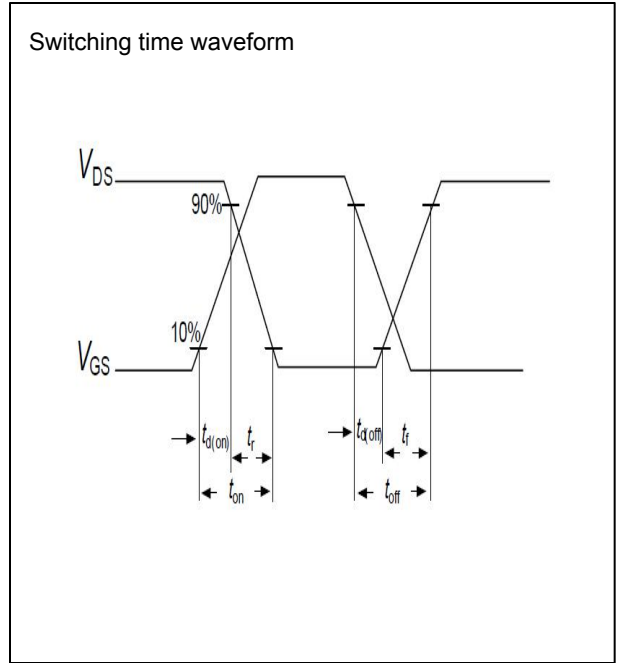
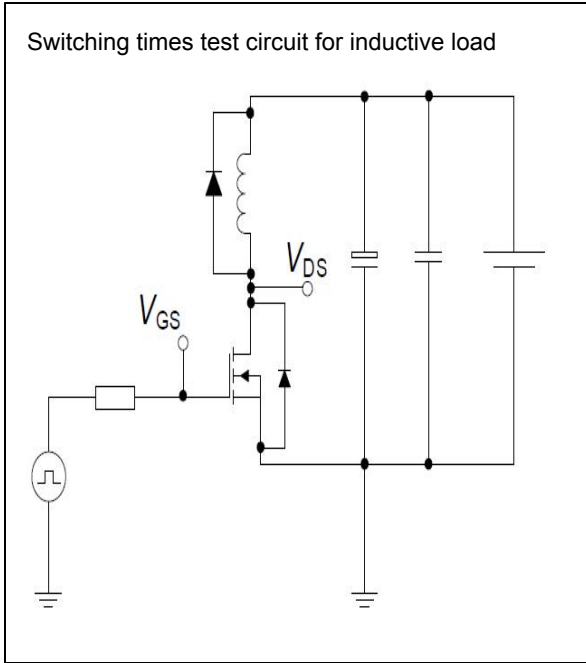
Typ. Coss stored energy



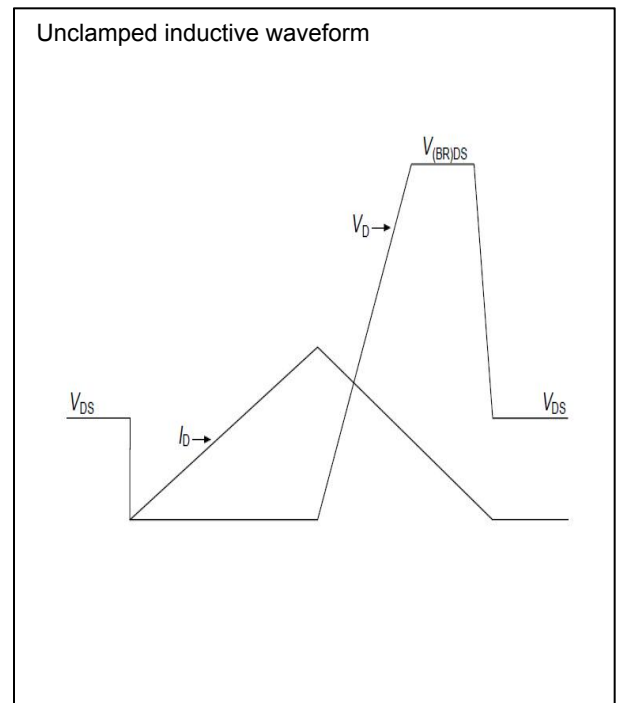
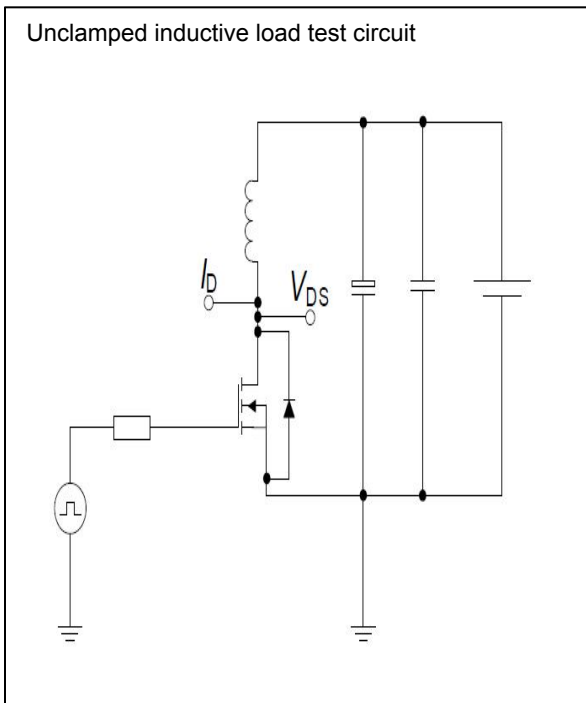
$E_{OSS}=f(V_{DS})$

Test circuits

Switching times test circuit and waveform for inductive load

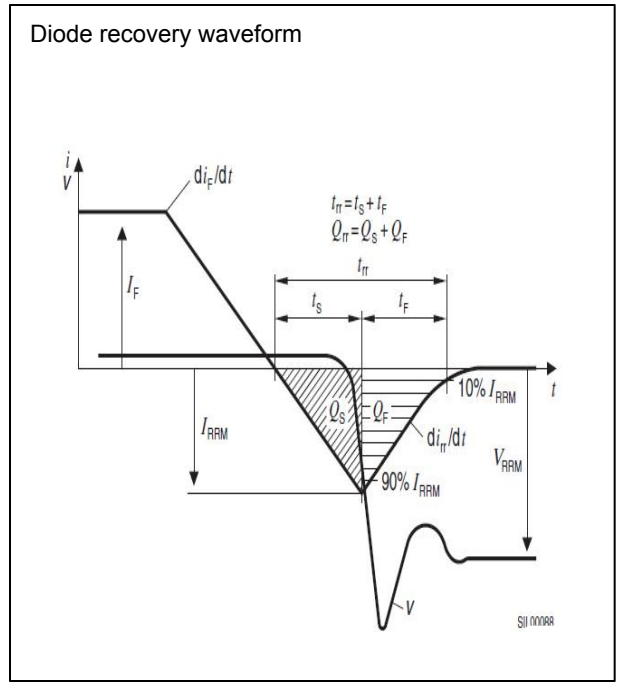
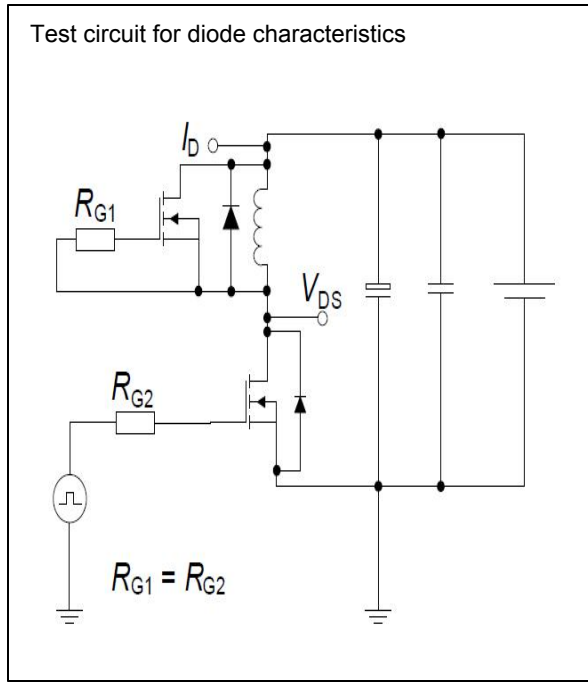


Unclamped inductive load test circuit and waveform



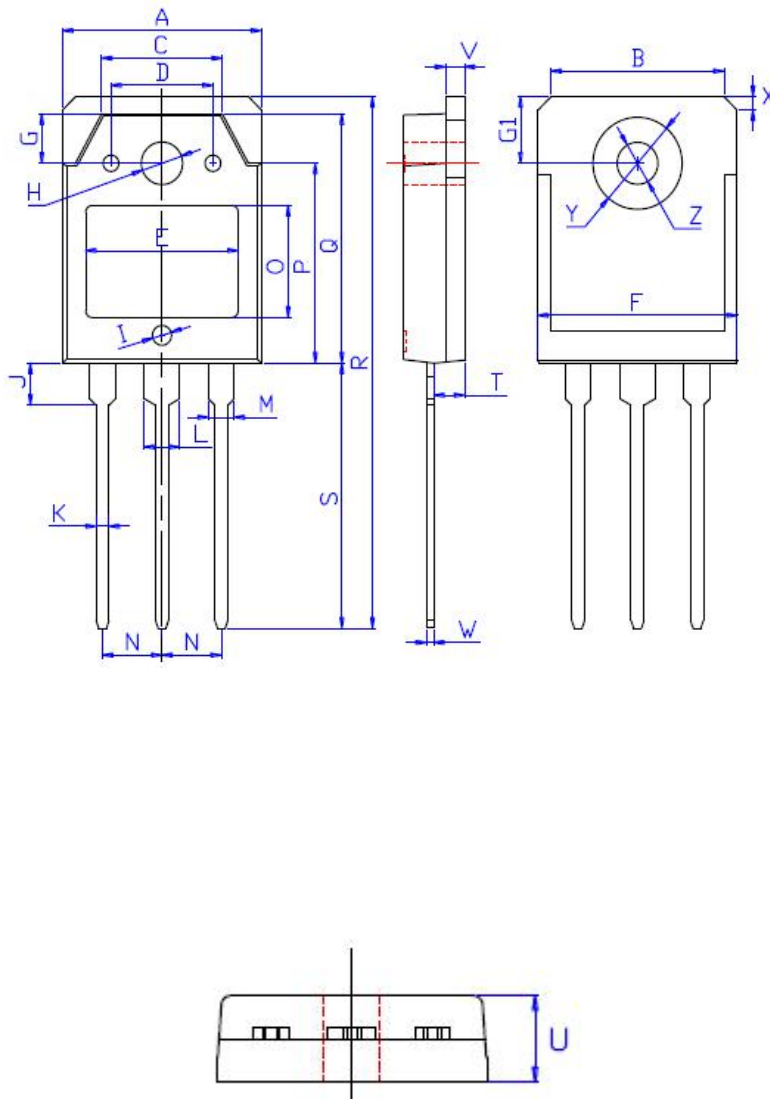
Test circuits

Test circuit and waveform for diode characteristics



Package Outline TO-3P

TSA60R070S1 600V 47A N-Channel SJ-MOSFET



| DIM | MILLIMETERS |
|-----|----------------------------|
| A | 15.60±0.30 |
| B | 13.60±0.30 |
| C | 9.50±0.30 |
| D | 8.00±0.30 |
| E | 11.85±0.30 |
| F | 15.65±0.30 |
| G | 3.80±0.30 |
| G1 | 5.00±0.30 |
| H | φ 3.50±0.30 |
| I | φ 1.50±0.30 深 0.15±0.15 |
| J | 3.20±0.30 |
| K | 1.00±0.15 |
| L | 3.10±0.15 |
| M | 2.10±0.15 |
| N | 5.45±0.30 |
| O | 8.40±0.30 |
| P | 13.90±0.30 |
| Q | 18.70±0.30 |
| R | 40.00±0.60 |
| S | 20.00±0.40 |
| T | 2.40±0.30 |
| U | 4.80±0.30 |
| V | 1.50±0.15 |
| W | 0.60±0.15 |
| X | 1.80±0.40 |
| Y | 7.00±0.30 |
| Z | 3.20±0.30 |