

OSP5N60S/OSF5N60S /OSD5N60S 600V N-Channel MOSFET

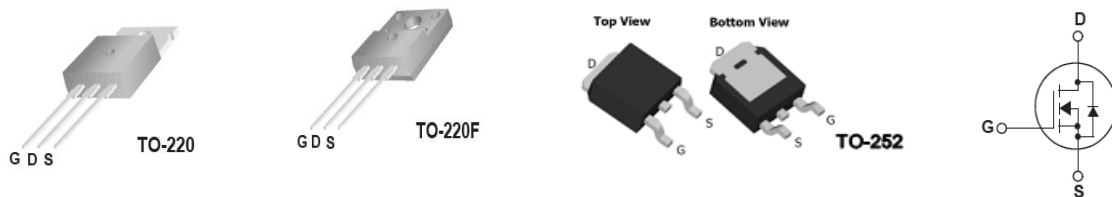
Description

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 inswitching mode operation for higher efficiency.

Features

- 600V @TJ = 150 °C
- Typ. RDS(on) = 0.77 Ω
- Ultra Low Gate Charge (typ. Qg = 15nC)
- 100% avalanche tested
- Rohs Compliant



Absolute Maximum Ratings

| Symbol | Parameter | OSD5N60S | OSP5N60S | OSF5N60S | Unit |
|-----------------------------------|---|-------------|-------------|------------|-----------|
| V _{DSS} | Drain-Source Voltage | 600 | | | V |
| I _D | Drain Current -Continuous (TC = 25°C) -Continuous (TC = 100°C) | 5* 4.5* | 5 4.5 | 5* 4.5* | A |
| I _{DM} | Drain Current - Pulsed (Note 1) | 20* | 20 | 20* | A |
| V _{GSS} | Gate-Source voltage | ±30 | | | V |
| E _{AS} | Single Pulsed Avalanche Energy (Note 2) | 120 | | | mJ |
| I _{AR} | Avalanche Current (Note 1) | 34 | | | A |
| E _{AR} | Repetitive Avalanche Energy (Note 1) | 17 | | | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 4.5 | | | V/ns |
| P _D | Power Dissipation (TC = 25°C) -Derate above 25°C | 30 0.8 | 205 1.67 | 35 0.3 | W W/°C |
| 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 | OSD5N60S | OSP5N60S | OSF5N60S | Unit |
|------------------|---|----------|----------|----------|------|
| R _{θJC} | Thermal Resistance, Junction-to-Case | 1.2 | 0.6 | 3.6 | °C/W |
| R _{θCS} | Thermal Resistance, Case-to-Sink Typ. | 0.5 | 0.5 | -- | °C/W |
| R _{θJA} | Thermal Resistance, Junction-to-Ambient | 62 | 62 | 62 | °C/W |

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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 |
| Δ BV _{DSS} / Δ T _J | Breakdown Voltage Temperature Coefficient | I _D = 250μA, Referenced to 25 °C | -- | 0.6 | -- | V/°C |
| ID _{SS} | Zero Gate Voltage Drain Current | V _{DS} = 600V, V _{GS} = 0V V _{DS} = 480V, TC = 125 °C | -- | -- | 1 10 | μA μA |
| IG _{TSF} | Gate-Body Leakage Current, Forward | V _{GS} = 30V, V _{DS} = 0V | -- | -- | 100 | nA |
| IG _{SSR} | 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 = 2.5A | -- | 0.77 | 0.85 | Ω |
| g _{FS} | Forward Transconductance | V _{DS} = 40V, I _D = 2.5A (Note 4) | -- | 8 | -- | 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 | -- | 320 | -- | pF |
| C _{oss} | Output Capacitance | | -- | 75 | -- | pF |
| C _{rss} | Reverse Transfer Capacitance | | -- | 4 | -- | pF |
| Switching Characteristics | | | | | | |
| t _{d(on)} | Turn-On Delay Time | V _{DD} = 400V, I _D = 2.5A R _G = 20 Ω (Note 4, 5) | -- | 18 | -- | ns |
| t _r | Turn-On Rise Time | | -- | 40 | -- | ns |
| t _{d(off)} | Turn-Off Delay Time | | -- | 50 | -- | ns |
| t _f | Turn-Off Fall Time | | -- | 30 | -- | ns |
| Q _g | Total Gate Charge | V _{DS} = 480V, I _D = 5A V _{GS} = 10V (Note 4, 5) | -- | 15 | -- | nC |
| Q _{gs} | Gate-Source Charge | | -- | 3 | -- | nC |
| Q _{gd} | Gate-Drain Charge | | -- | 6 | -- | nC |
| Drain-Source Diode Characteristics and Maximum Ratings | | | | | | |
| I _S | Maximum Continuous Drain-Source Diode Forward Current | | -- | -- | 5 | A |
| I _{SM} | Maximum Pulsed Drain-Source Diode Forward Current | | -- | -- | 20 | A |
| V _{SD} | Drain-Source Diode Forward Voltage | V _{GS} = 0V, I _S = 5A | -- | -- | 1.5 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0V, I _S = 5A dI _F /dt = 100A/μs (Note 4) | -- | 180 | -- | ns |
| Q _{rr} | Reverse Recovery Charge | | -- | 2.5 | -- | μC |

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=60mH, I_{AS}=1.5A, V_{DD}=150V, Starting T_J=25 °C
3. I_{SD} ≤ 4.5A, 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

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Typical Performance Characteristics

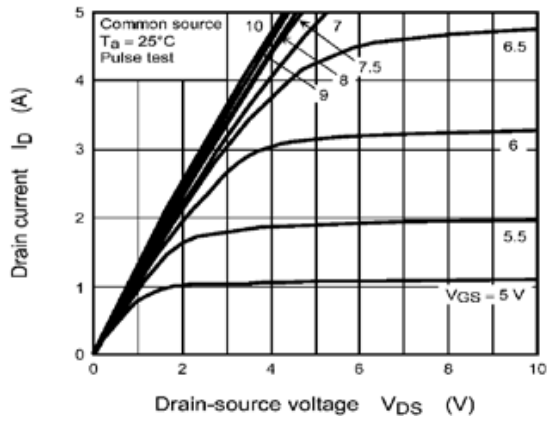


Figure 1: On-Region Characteristics @ 25°C

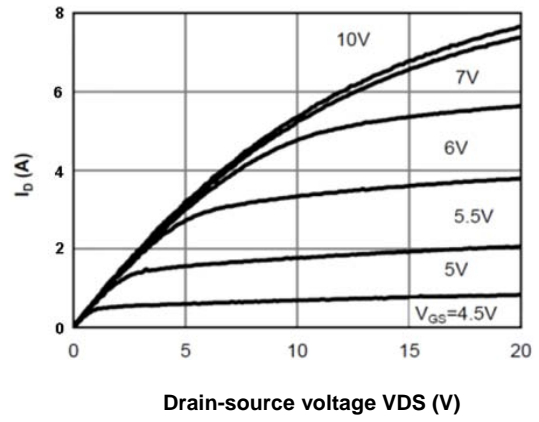


Figure 2: On-Region Characteristics @ 25°C

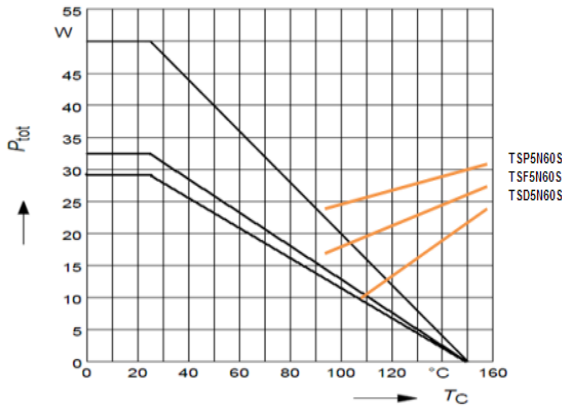


Figure 3: Power Dissipation

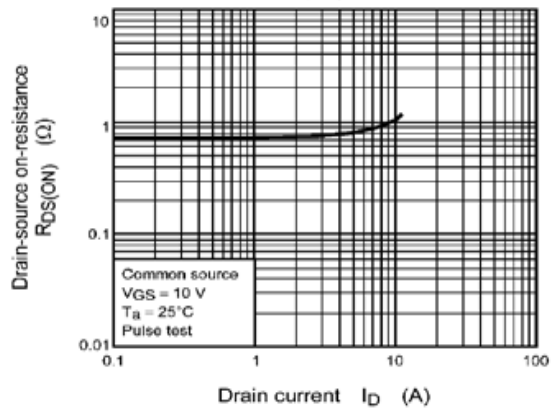


Figure 4: On-Resistance vs. Drain Current and Gate Voltage

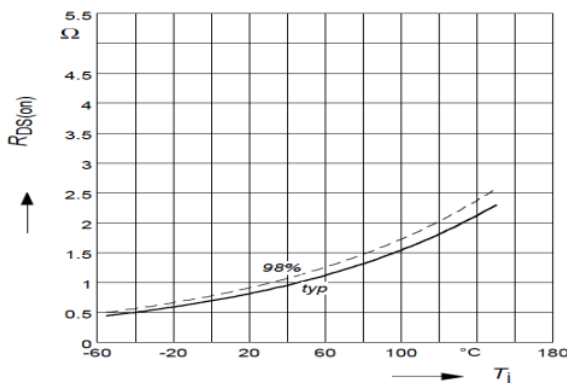


Figure 5: On-Resistance vs. Junction Temperature

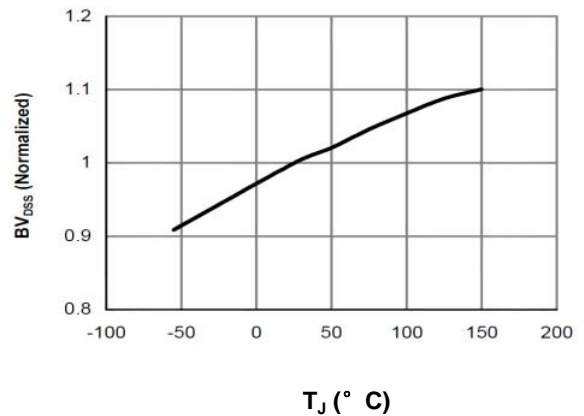


Figure 6: Break Down vs. Junction Temperature

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Typical Performance Characteristics

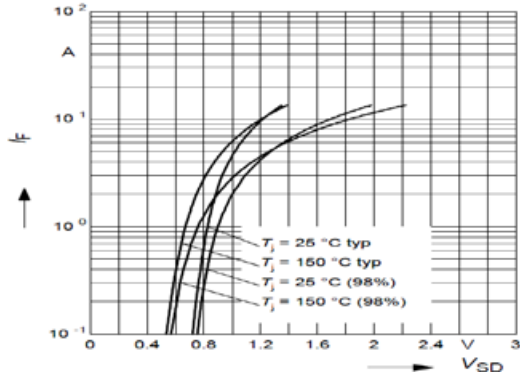


Figure 7: Body-Diode Characteristics

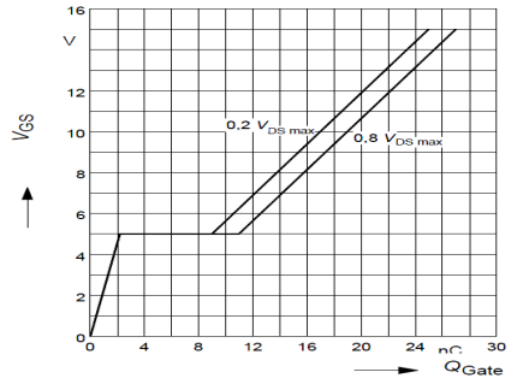


Figure 8: Gate-Charge Characteristics

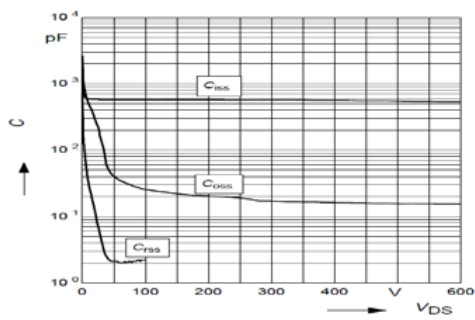


Figure 9: Capacitance Characteristics

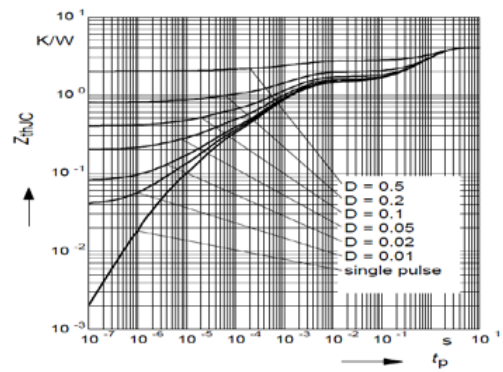


Figure 10: C_{oss} stored Energy

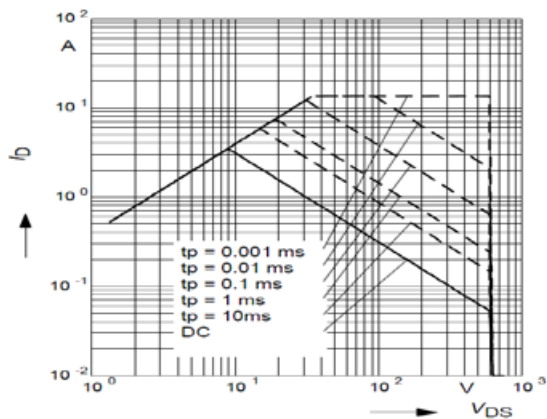


Figure 11: Maximum Forward Biased Safe Operating Area (Full PAK)

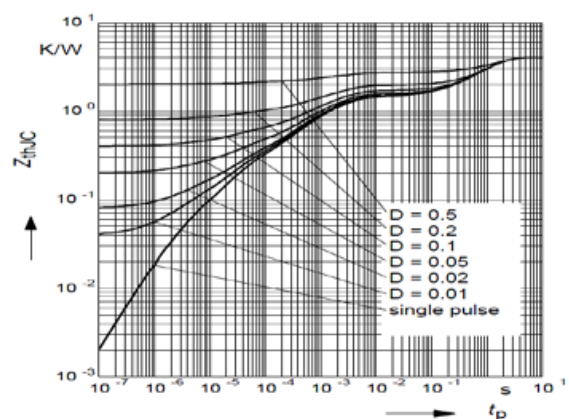


Figure 12: Single Pulse Power Rating Junction to Case (Full PAK)

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Typical Performance Characteristics

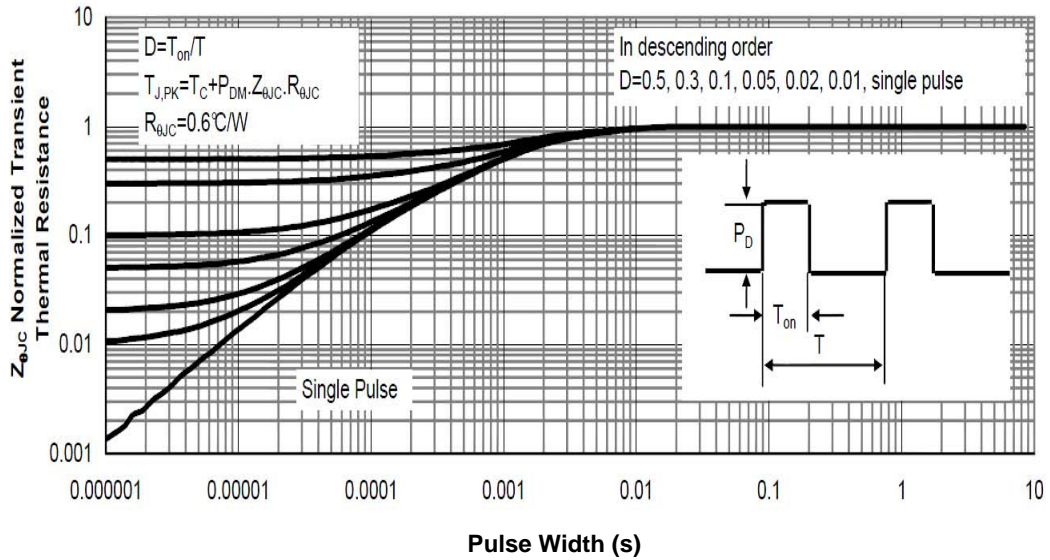


Figure 12: Normalized Maximum Transient Thermal Impedance

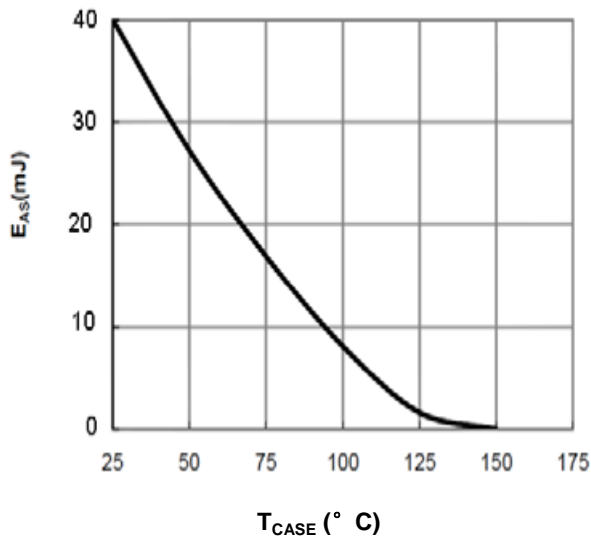


Figure 13: Avalanche energy

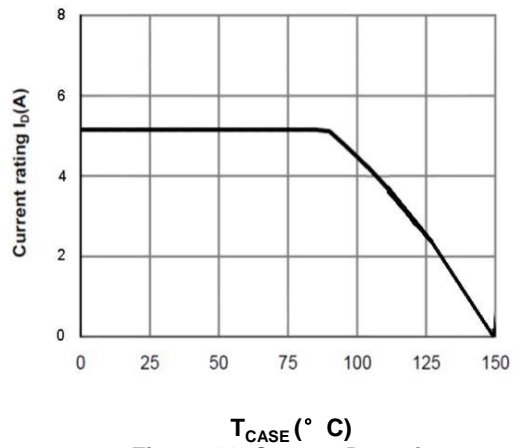


Figure 14: Current De-rating

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Typical Performance Characteristics

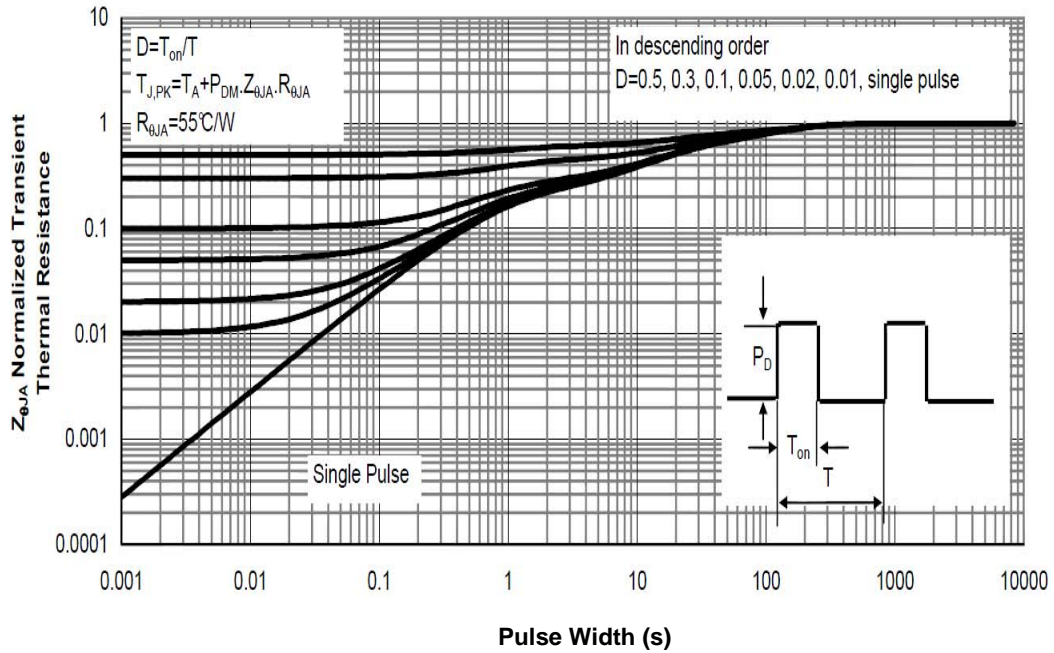
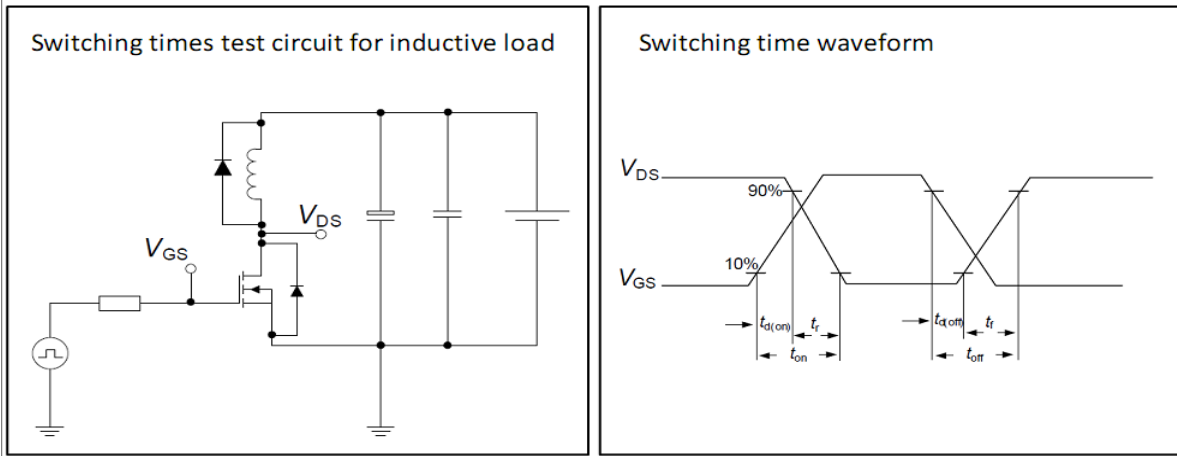


Figure 15: Normalized Maximum Transient Thermal Impedance

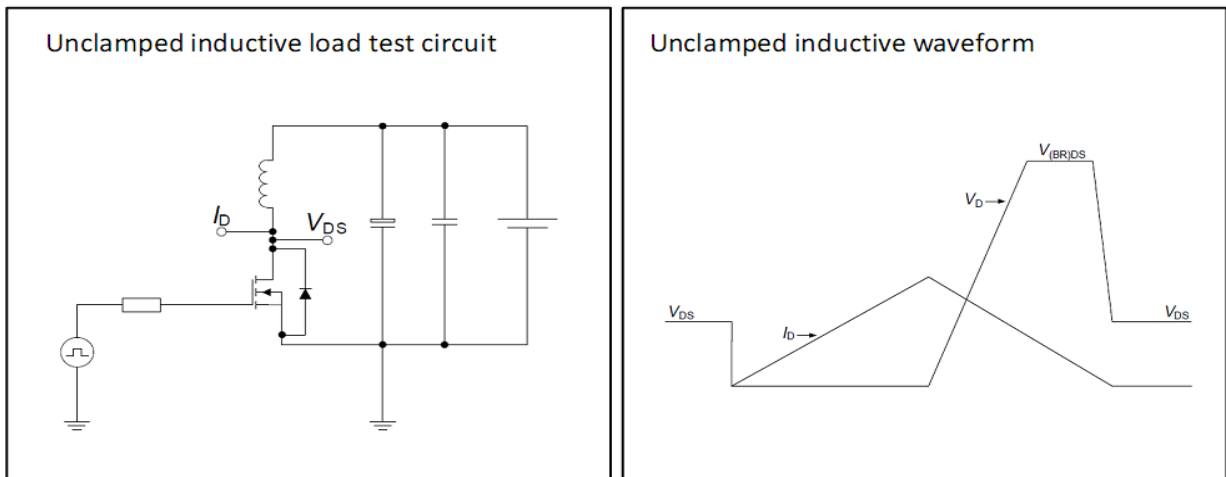
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Test circuits

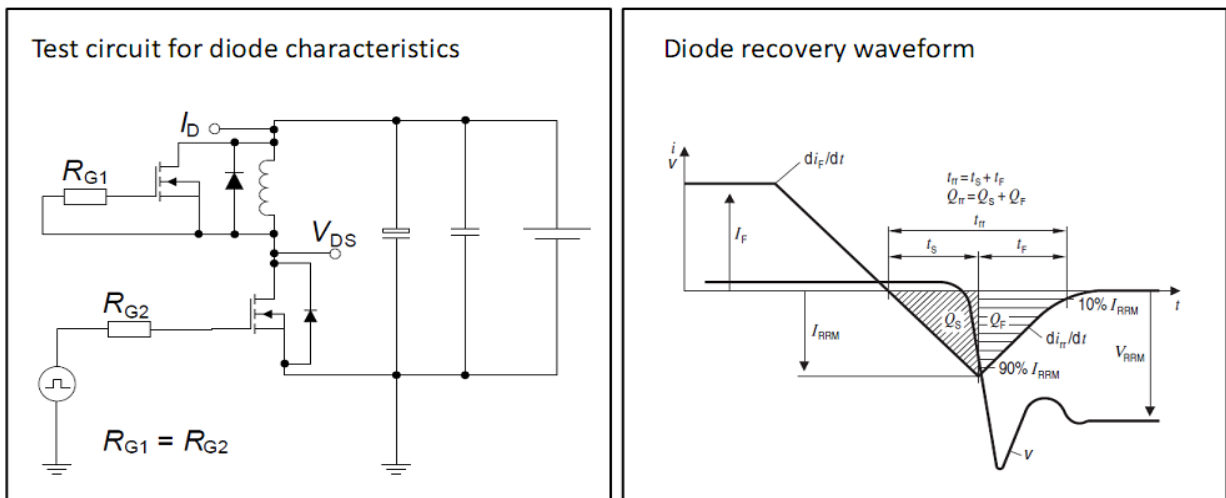
Switching times test circuit and waveform for inductive load



Unclamped inductive load test circuit and waveform

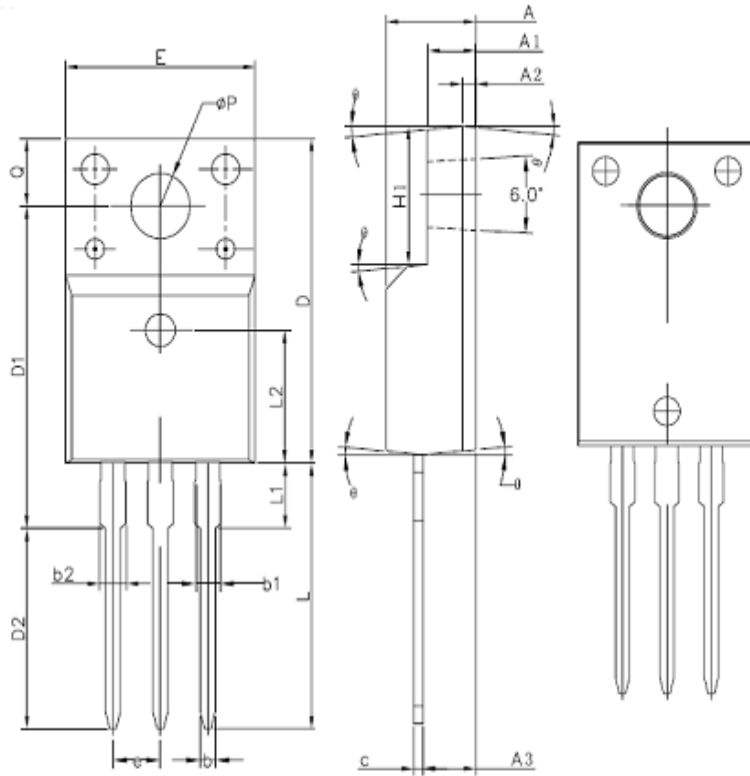


Test circuit and waveform for diode characteristics



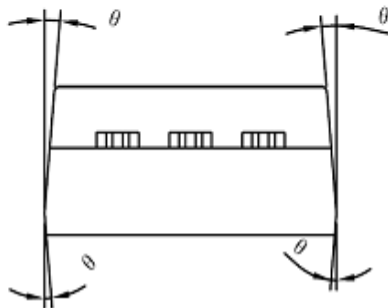
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PKG TO-220F



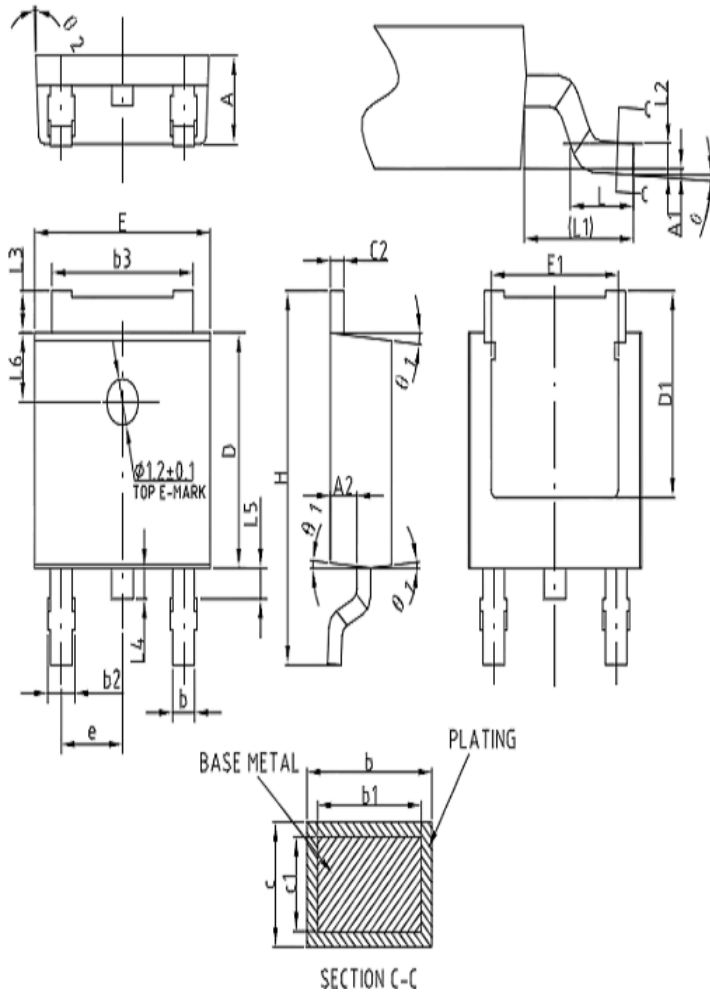
COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|--------|----------|-------|-------|
| A | 4.50 | 4.70 | 4.90 |
| A1 | 2.34 | 2.54 | 2.74 |
| A2 | 0.70 REF | | |
| A3 | 2.56 | 2.76 | 2.96 |
| b | 0.70 | - | 0.90 |
| b1 | 1.18 | - | 1.38 |
| b2 | - | - | 1.47 |
| c | 0.45 | 0.50 | 0.60 |
| D | 15.67 | 15.87 | 16.07 |
| D1 | 15.55 | 15.75 | 15.95 |
| D2 | 9.60 | 9.80 | 10.0 |
| E | 9.96 | 10.16 | 10.36 |
| e | 2.54BSC | | |
| H1 | 6.48 | 6.68 | 6.88 |
| L | 12.68 | 12.98 | - |
| L1 | - | - | 3.50 |
| L2 | 6.50REF | | |
| phi P | 3.08 | 3.18 | 3.28 |
| Q | 3.20 | - | 3.40 |
| theta | 3° | 5° | 7° |



OSP5N60S/OSF5N60S /OSD5N60S

PKG TO-252



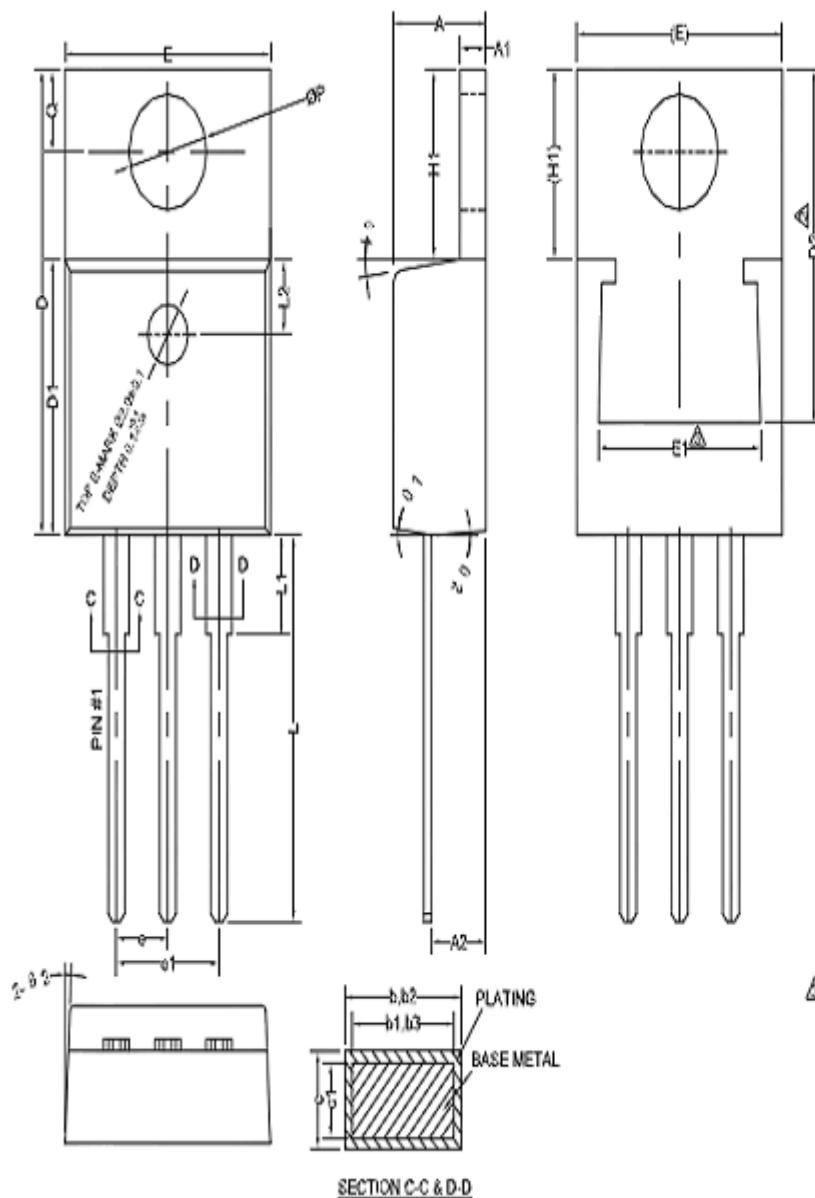
COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|------------|---------|-------|-------|
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0 | - | 0.10 |
| A2 | 0.90 | 1.00 | 1.10 |
| b | 0.77 | - | 0.89 |
| b1 | 0.76 | 0.81 | 0.86 |
| b2 | 0.77 | - | 1.10 |
| b3 | 5.23 | 5.33 | 5.43 |
| c | 0.47 | - | 0.60 |
| c1 | 0.46 | 0.51 | 0.56 |
| c2 | 0.47 | - | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.25 | - | - |
| E | 6.50 | 6.60 | 6.70 |
| E1 | 4.70 | - | - |
| e | 2.28BSC | | |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1 |
| L1 | 2.90REF | | |
| L2 | 0.51BSC | | |
| L3 | 0.90 | - | 1.25 |
| L4 | 0.60 | 0.80 | 1.00 |
| L5 | 0.90 | - | 1.50 |
| L6 | 1.80REF | | |
| θ | 0° | - | 8° |
| θ_1 | 3° | 5° | 7° |
| θ_2 | 1° | 3° | 5° |

NOTES:
ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 AA DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

OSP5N60S/OSF5N60S /OSD5N60S

PKG TO-220



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|--------|---------|-------|-------|
| A | 4.40 | 4.57 | 4.70 |
| A1 | 1.22 | - | 1.32 |
| A2 | 2.59 | 2.38 | 2.76 |
| b | 0.77 | - | 0.90 |
| b1 | 0.76 | 0.81 | 0.83 |
| b2 | 1.23 | - | 1.35 |
| b3 | 1.22 | 1.27 | 1.32 |
| c | 0.34 | - | 0.47 |
| c1 | 0.33 | 0.38 | 0.43 |
| D | 15.15 | 15.45 | 15.75 |
| D1 | 9.05 | 9.15 | 9.25 |
| D2 | 11.40 | - | 12.88 |
| E | 9.98 | 10.13 | 10.33 |
| E1 | 3.66 | - | 3.89 |
| a | 2.44 | 2.54 | 2.64 |
| ø1 | 4.96 | 5.06 | 5.1 |
| H1 | 3.10 | 3.30 | 3.50 |
| L | 12.70 | - | 13.12 |
| L1 | - | - | 3.90 |
| L2 | 2.50REF | | |
| ØP | 3.80 | 3.84 | 3.88 |
| Q | 2.30 | - | 2.90 |
| Ø 1 | 5' | 7' | 9' |
| Ø 2 | 1' | 3' | 5' |

NOTES:

1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-220 AB DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

2. D2 AND E1 ARE VARIABLES DEPENDING ON DIE PAD SIZES.