Fuji Electric

*Innovating Energy Technology*

# FMV60N190S2HF

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FUJI POWER MOSFET

## Super J MOS® S2 series

**N-Channel enhancement mode power MOSFET**

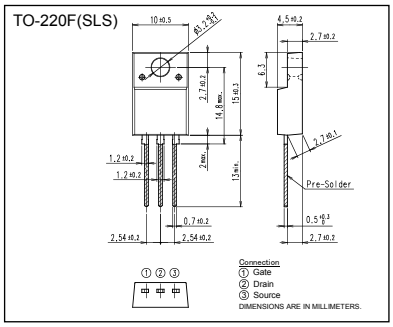
### Features

Pb-free lead terminal
RoHS compliant
uses Halogen-free molding compound

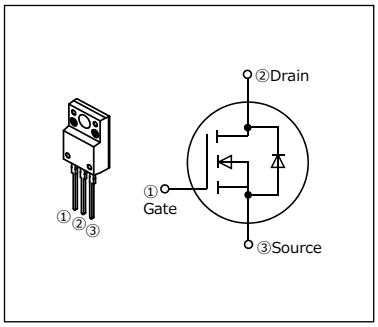
### Applications

For switching

### Outline Drawings [mm]




### Equivalent circuit schematic




### Absolute Maximum Ratings at $T_{vj}$=25°C (unless otherwise specified)

| Parameter | Symbol | Characteristics | Unit | Remarks |
|---|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 600 | V | |
| | $V_{DSX}$ | 600 | V | $V_{GS}$=-30V |
| Continuous Drain Current | $I_D$ | 20 | A | $T_{vj}$=25°C Note*1,2 |
| | | 12.6 | A | $T_{vj}$=100°C Note*1,2 |
| Pulsed Drain Current | $I_{DP}$ | 62 | A | Note *2 |
| Gate-Source Voltage | $V_{GS}$ | ±30 | V | |
| Non-Repetitive Maximum Avalanche Current | $I_{AS}$ | 2.3 | A | Note *3 |
| Non-Repetitive Maximum Avalanche Energy | $E_{AS}$ | 559 | mJ | Note *4 |
| Maximum Drain-Source dV/dt | $dV_{DS}/dt$ | 50 | V/ns | $V_{DS}$≤ 600V |
| Continuous Diode Forward Current | $I_{SD}$ | 20 | A | $T_{vj}$=25°C Note*1,2 |
| | | 12.6 | A | $T_{vj}$=100°C Note*1,2 |
| Pulsed Diode Forward Current | $I_{SDP}$ | 62 | A | Note *2 |
| Peak Diode Recovery dV/dt | dV/dt | 15 | V/ns | Note *5 |
| Peak Diode Recovery -di/dt | -di/dt | 100 | A/µs | Note *6 |
| Maximum Power Dissipation | $P_D$ | 2.16 | W | $T_a$=25°C |
| | | 38 | | $T_{vj}$=25°C |
| Operating and Storage Temperature range | $T_{ch}$ | 150 | °C | |
| | $T_{stg}$ | -55 to +150 | °C | |
| Isolation Voltage (TO-220F) | $V_{iso}$ | 2 | kVrms | t=60sec, f=60Hz |

Note *1 : Maximum duty cycle D=0.6
Note *2 : Limited by maximum channel temperature.
Note *3 : $T_{ch}$≤150°C, See Fig.1 and Fig.2
Note *4 : Starting $T_{ch}$=25°C, $I_{AS}$=1.4A, L=559mH, $V_{DD}$=60V, $R_G$=50Ω, See Fig.1 and Fig.2
$E_{AS}$ limited by maximum channel temperature and avalanche current.
Note *5 : $I_{SD}$≤15.5A, -di/dt≤100A/µs, $V_{DS}$ peak≤ 600V, $T_{ch}$≤150°C.
Note *6 : $I_{SD}$≤15.5A, dV/dt≤15V/ns, $V_{DS}$ peak≤ 600V, $T_{ch}$≤150°C.



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MARCH 2017

## Electrical Characteristics at $T_{vj}$=25°C (unless otherwise specified)

### • Static Ratings

| Parameter | Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V<br>$I_D$=250μA | | 600 | - | - | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$<br>$I_D$=250μA | | 2.5 | 3.0 | 3.5 | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=600V<br>$V_{GS}$=0V | $T_{ch}$=25°C | - | - | 25 | μA |
| | | $V_{DS}$=480V<br>$V_{GS}$=0V | $T_{ch}$=125°C | - | - | 250 | |
| Gate-Source Leakage Current | $I_{GSS}$ | $V_{DS}$=0V<br>$V_{GS}$= ± 30V | | - | 10 | 100 | nA |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}$=10V<br>$I_D$=7.8A | | - | 0.169 | 0.190 | Ω |
| Gate resistance | $R_G$ | f=1MHz, open drain | | - | 10.9 | - | Ω |

### • Dynamic Ratings

| Parameter | Symbol | Conditions | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| Forward Transconductance | $g_{fs}$ | $V_{DS}$=25V<br>$I_D$=7.8A | 7.2 | 14.5 | - | S |
| Input Capacitance | $C_{iss}$ | $V_{DS}$=400V<br>$V_{GS}$=0V<br>f=250kHz | - | 1130 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 30 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 4.4 | - | |
| Effective output capacitance, energy related (Note *7) | $C_{o(er)}$ | $V_{DS}$=0…400V<br>$V_{GS}$=0V | - | 69 | - | |
| Effective output capacitance, time related (Note *8) | $C_{o(tr)}$ | $V_{DS}$=0…400V<br>$V_{GS}$=0V<br>$I_D$=constant | - | 251 | - | |
| Turn-On Time | $t_{d(on)}$ | $V_{DD}$=400V, $V_{GS}$=10V<br>$I_D$=7.8A,<br>$R_G$=18Ω<br>See Fig.3 and Fig.4 | - | 18 | - | ns |
| | $t_r$ | | - | 30 | - | |
| Turn-Off Time | $t_{d(off)}$ | | - | 143 | - | |
| | $t_f$ | | - | 22 | - | |
| Total Gate Charge | $Q_G$ | $V_{DD}$=400V, $V_{GS}$=10V<br>$I_D$=15.5A<br>See Fig.5 | - | 46 | - | nC |
| Gate-Source Charge | $Q_{GS}$ | | - | 12 | - | |
| Gate-Drain Charge | $Q_{GD}$ | | - | 14 | - | |
| Drain-Source crossover Charge | $Q_{SW}$ | | - | 7 | - | |

Note *7 : $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V.
Note *8 : $C_{o(tr)}$ is a fixed capacitance that gives the same charging times as $C_{oss}$ while $V_{DS}$ is rising from 0 to 400V.

### • Reverse Diode

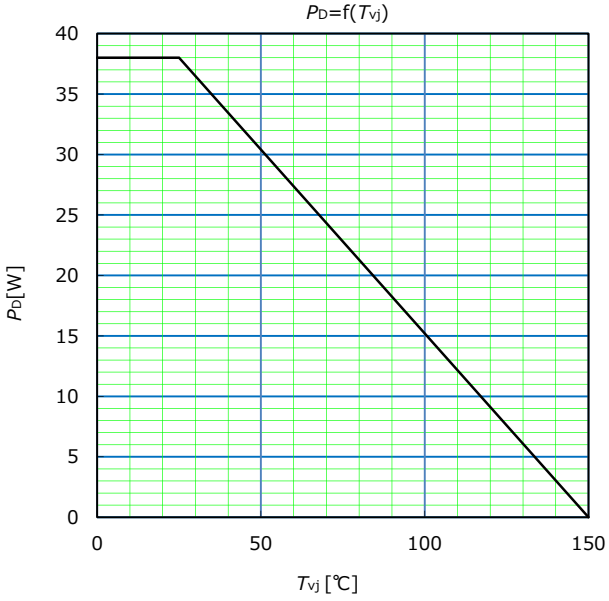
| Parameter | Symbol | Conditions | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| Diode Forward On-Voltage | $V_{SD}$ | $I_{SD}$=15.5A, $V_{GS}$=0V<br>$T_{ch}$=25°C | - | 0.90 | 1.35 | V |
| Reverse Recovery Time | $t_{rr}$ | $V_{DD}$=400V, $I_{SD}$=15.5A<br>-di/dt=100A/μs<br>$T_{ch}$=25°C<br>See Fig.6 and Fig.7 | - | 328 | - | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | - | 4.2 | - | μC |
| Peak Reverse Recovery Current | $I_{rp}$ | | - | 25 | - | A |

## Thermal Resistance

| Parameter | Symbol | min. | typ. | max. | Unit |
|---|---|---|---|---|---|
| Channel to Case | $R_{th(ch-c)}$ | - | - | 3.29 | °C/W |
| Channel to Ambient | $R_{th(ch-a)}$ | - | - | 58 | °C/W |

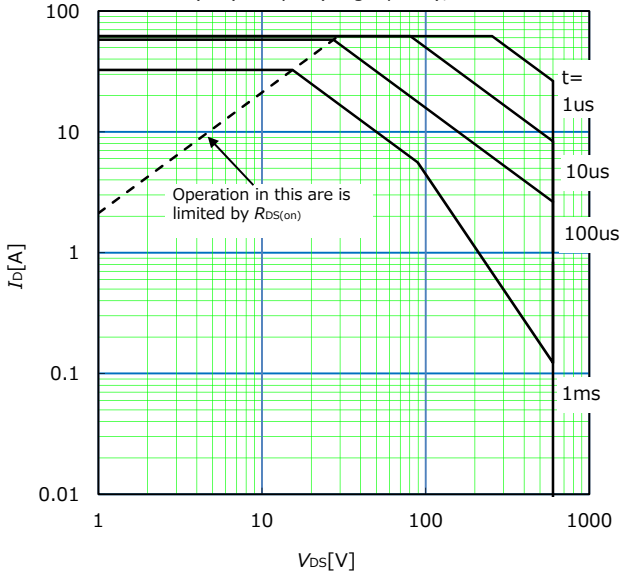
Allowable Power Dissipation

$P_D$=f($T_{vj}$)



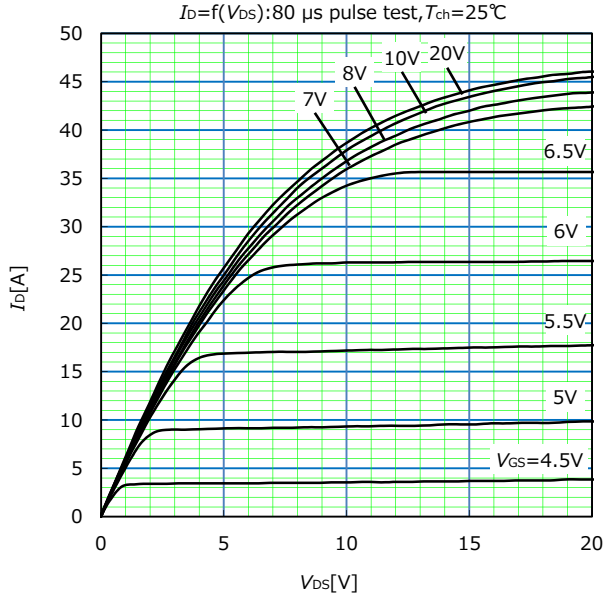

Safe Operating Area

$I_D$=f($V_{DS}$):Duty=0(Single pulse),$T_{vj}$=25℃



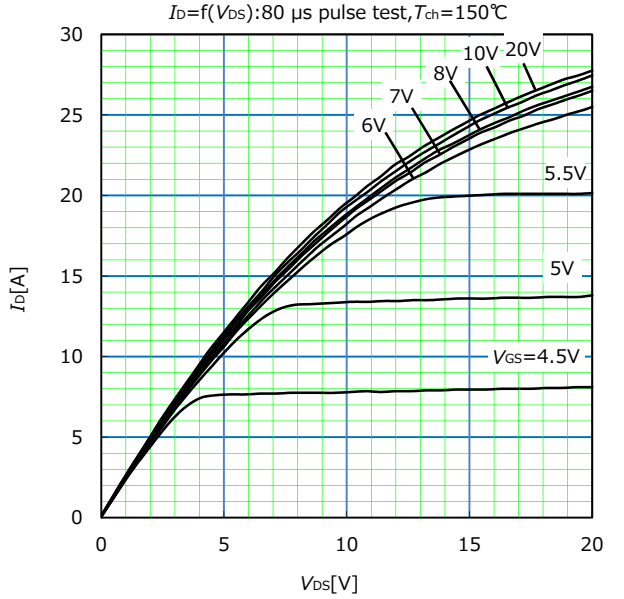

Typical Output Characteristics

$I_D$=f($V_{DS}$):80 μs pulse test,$T_{ch}$=25℃



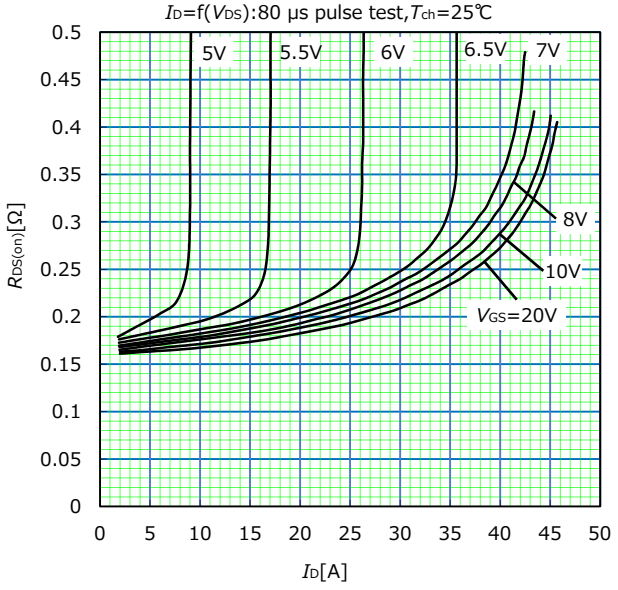

Typical Output Characteristics

$I_D$=f($V_{DS}$):80 μs pulse test,$T_{ch}$=150℃



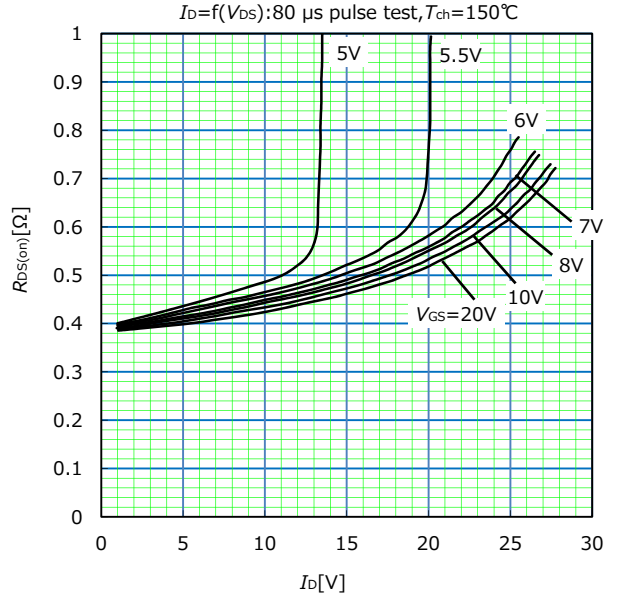

Typical Output Characteristics

$I_D$=f($V_{DS}$):80 μs pulse test,$T_{ch}$=25℃

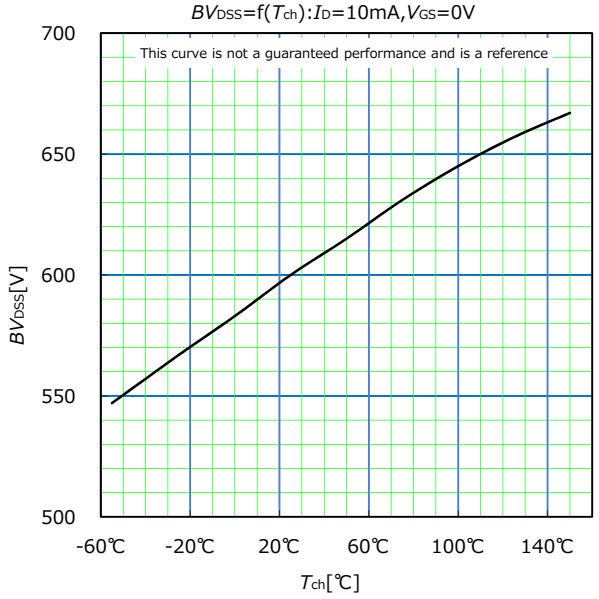



Typical Output Characteristics

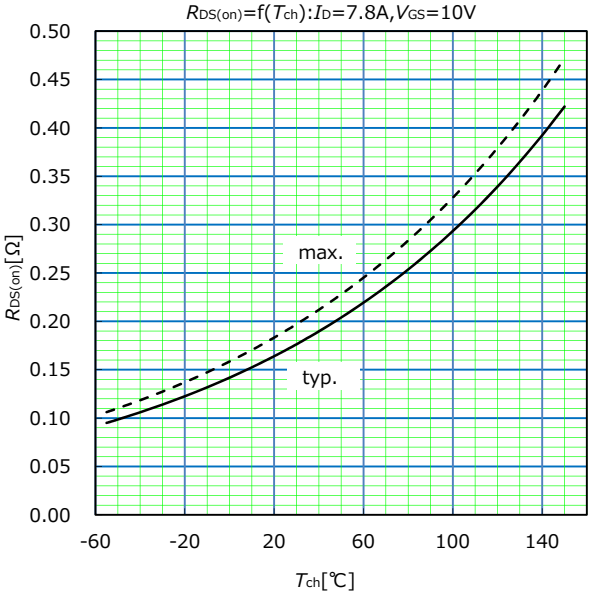
$I_D$=f($V_{DS}$):80 μs pulse test,$T_{ch}$=150℃



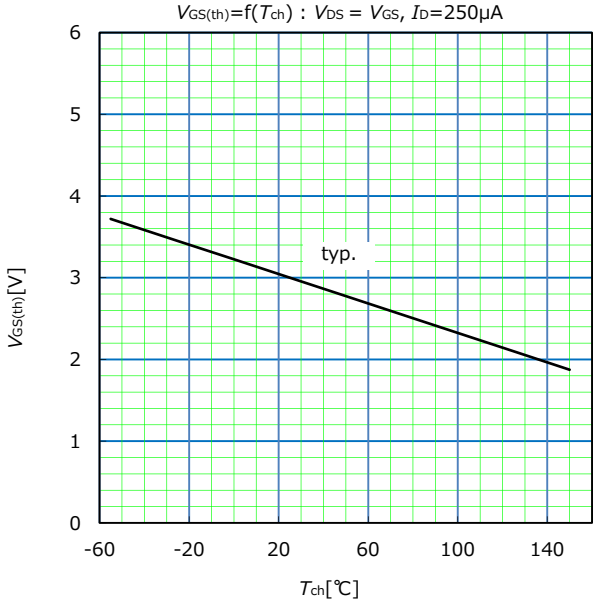
Drain-Source Breakdown Voltage
$BV_{DSS}$=f($T_{ch}$):$I_D$=10mA,$V_{GS}$=0V



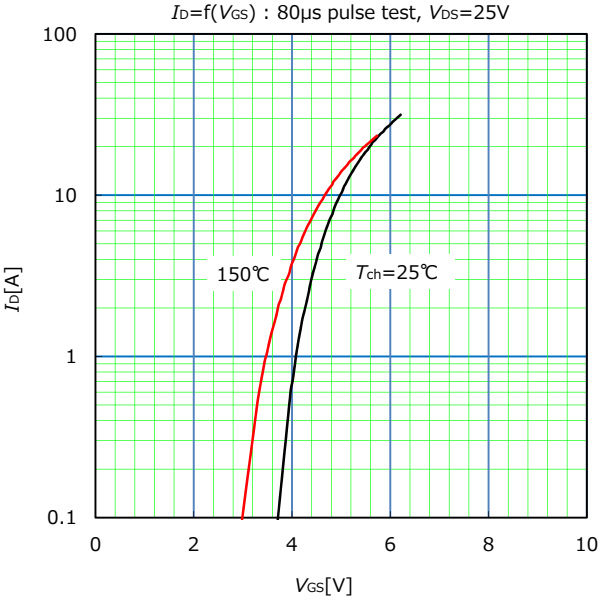

Drain-Source On-state Resistance
$R_{DS(on)}$=f($T_{ch}$):$I_D$=7.8A,$V_{GS}$=10V



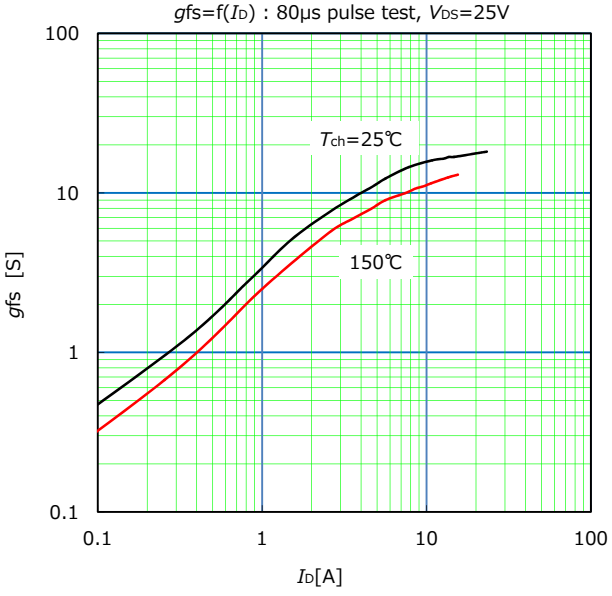

Gate Threshold Voltage vs. $T_{ch}$
$V_{GS(th)}$=f($T_{ch}$) : $V_{DS}$ = $V_{GS}$, $I_D$=250μA



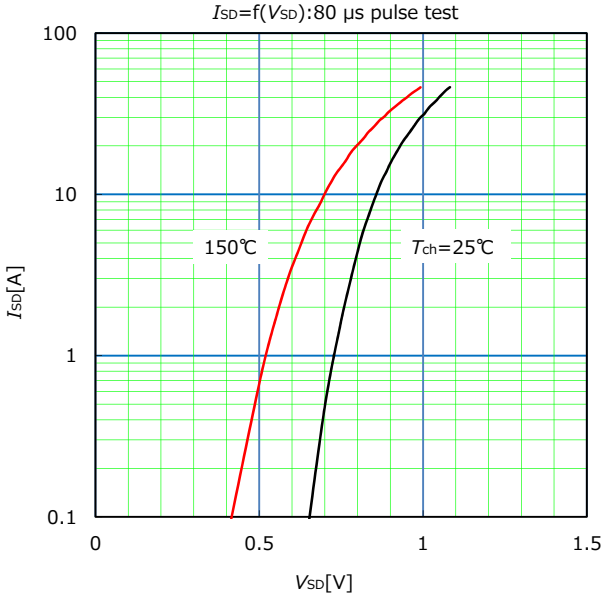

Typical Transfer Characteristic
$I_D$=f($V_{GS}$) : 80μs pulse test, $V_{DS}$=25V



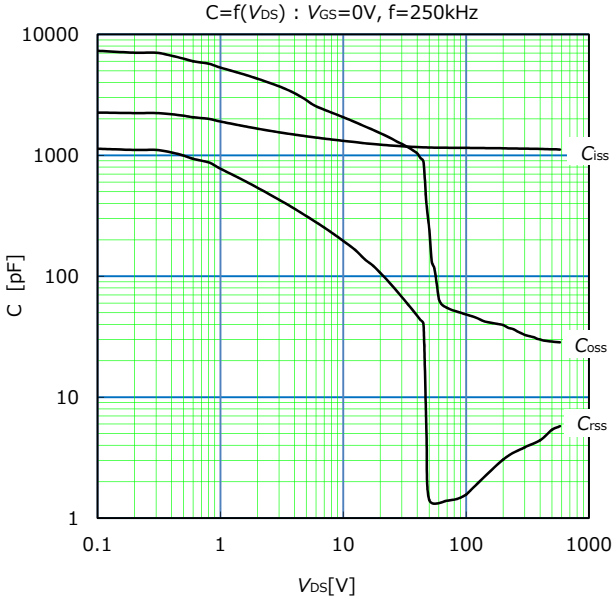

Typical Transconductance
$g_{fs}$=f($I_D$) : 80μs pulse test, $V_{DS}$=25V



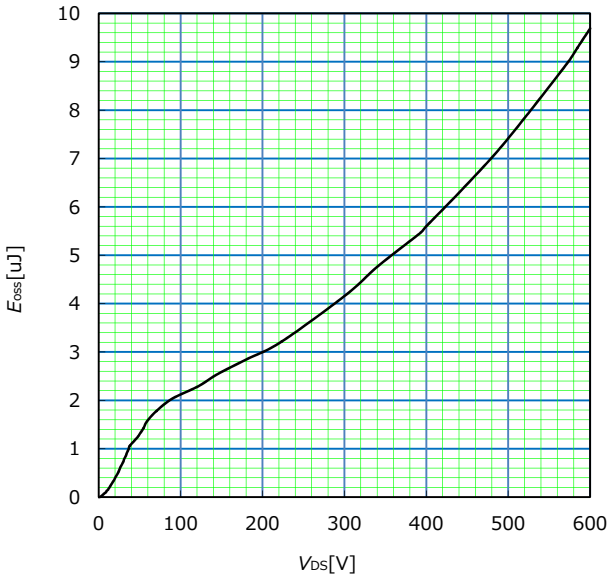

Typical Forward Characteristics of Reverse Diode
$I_{SD}$=f($V_{SD}$):80 μs pulse test



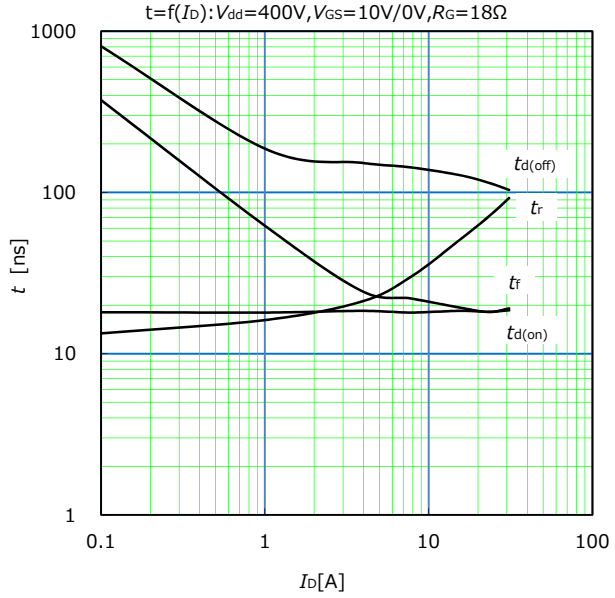
Typical Capacitance
C=f($V_{DS}$) : $V_{GS}$=0V, f=250kHz



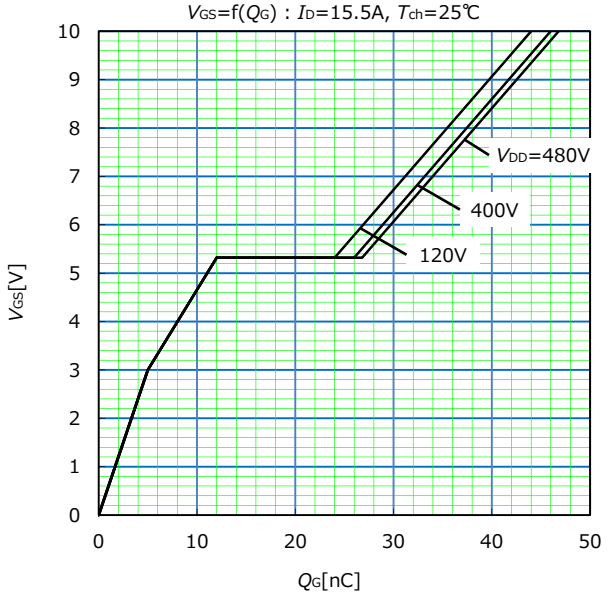

Typical $C_{oss}$ stored energy



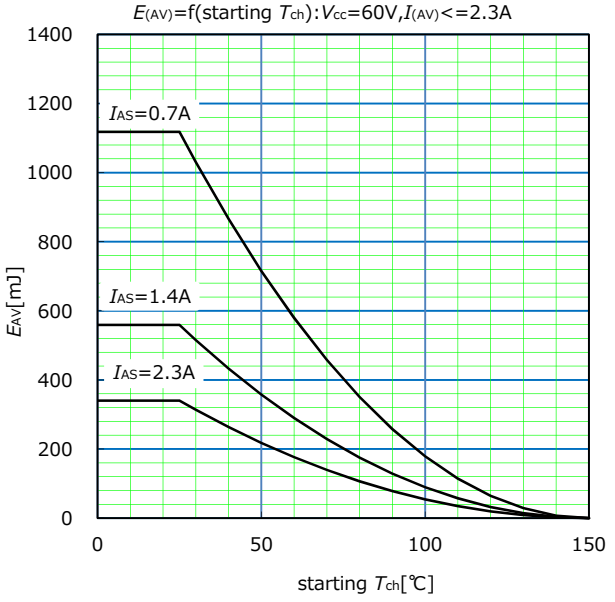

Typical Switching Characteristics vs. $I_D$ $T_{ch}$=25℃
t=f($I_D$):$V_{dd}$=400V,$V_{GS}$=10V/0V,$R_G$=18Ω



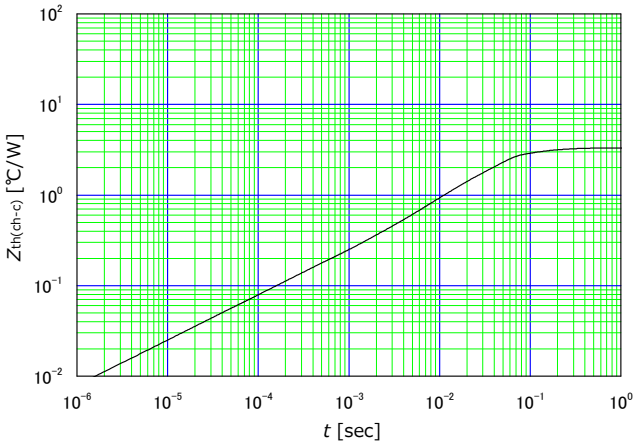

Typical Gate Charge Characteristics
$V_{GS}$=f($Q_G$) : $I_D$=15.5A, $T_{ch}$=25℃




Maximum Avalanche Energy vs. starting $T_{ch}$
$E_{(AV)}$=f(starting $T_{ch}$):$V_{cc}$=60V,$I_{(AV)}$<=2.3A




Transient Thermal Impedance
$Z_{th(ch-c)}$=f(t):D=0



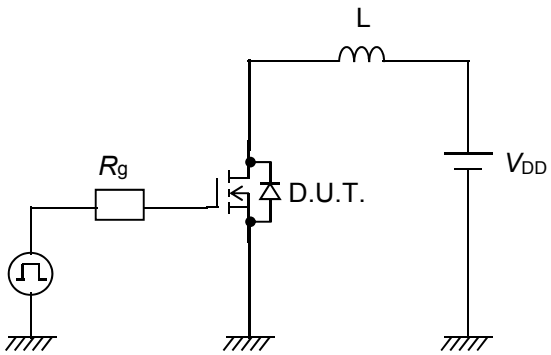



Fig.1 Avalanche Test circuit

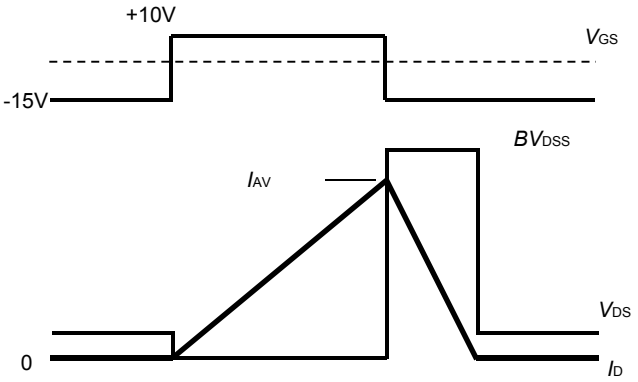



Fig.2 Operating waveforms of Avalanche Test

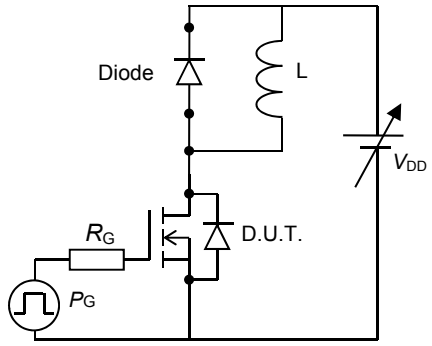



Fig.3 Switching Test circuit

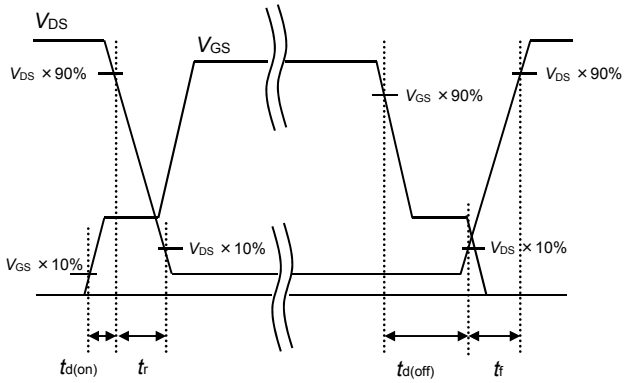



Fig.4 Operating waveform of Switching Test

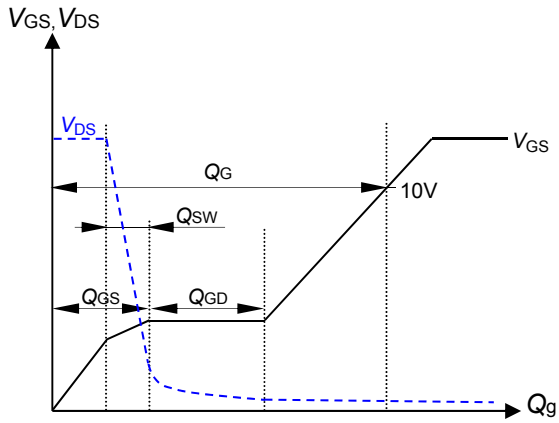



Fig.5 Operating waveform of Gate charge Test

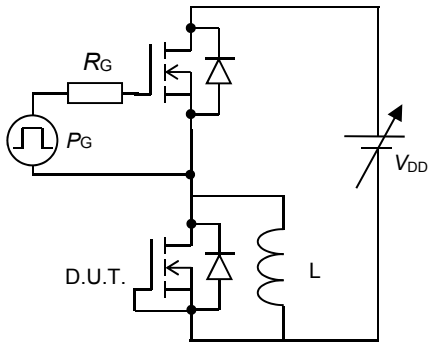



Fig.6 Reverse recovery Test circuit

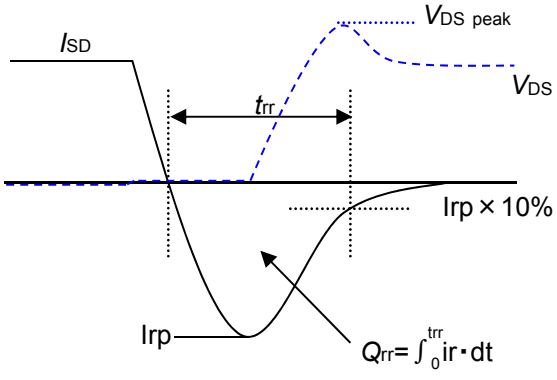
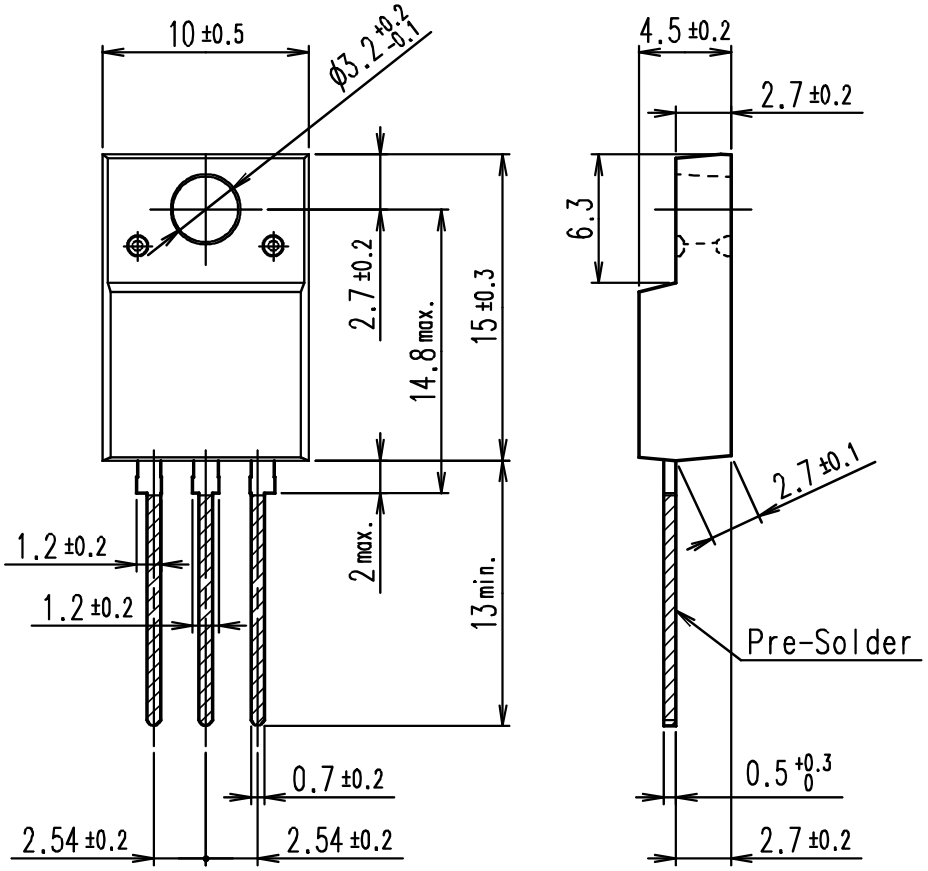
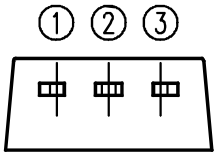



Fig.7 Operating waveform of Reverse recovery Test

## Outview: TO-220F(SLS) Package

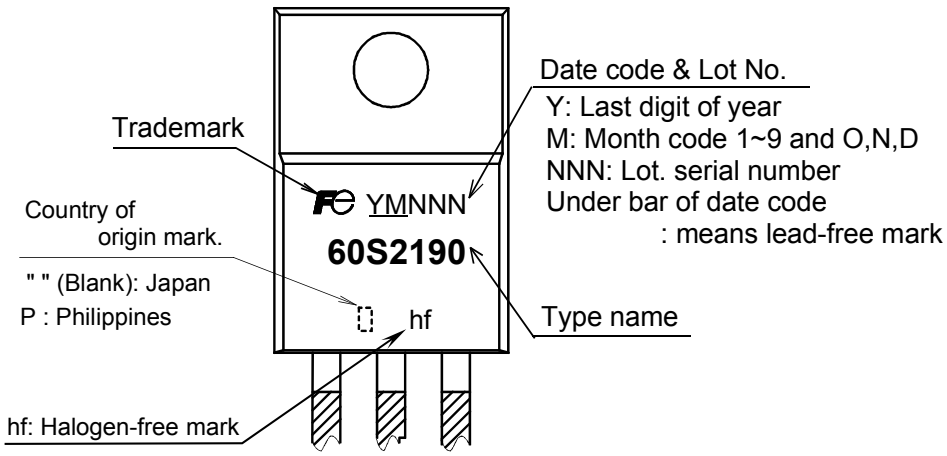



Connection
① Gate
② Drain
③ Source

DIMENSIONS ARE IN MILLIMETERS.

## Marking




* The font (font type,size) and the trademark-size might be actually different.

## WARNING

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The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sur to obtain the latest specifications.

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• Machine tools • Audiovisual equipment • Electrical home appliances • Personal equipment • Industrial robots etc.

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• Traffic-signal control equipment • Gas leakage detectors with an auto-shut-off feature
• Emergency equipment for responding to disasters and anti-burglary devices • Safety devices
• Medical equipment

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• Submarine repeater equipment



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