# FMP20N60S1

FUJI POWER MOSFET

## Super J-MOS series

N-Channel enhancement mode power MOSFET

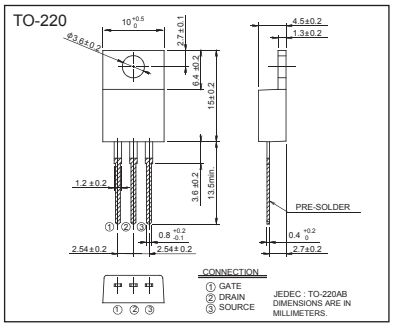
### Features

Low on-state resistance
Low switching loss
easy to use (more controllabe switching dV/dt by $R_g$)

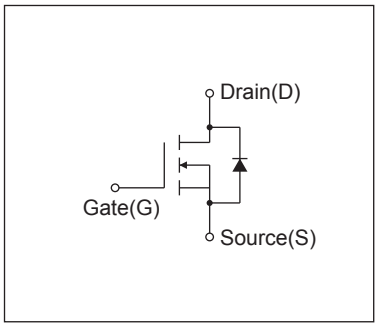
### Applications

UPS
Server
Telecom
Power conditioner system
Power supply

### Outline Drawings [mm]




### Equivalent circuit schematic




### Maximum Ratings and Characteristics

● **Absolute Maximum Ratings at $T_c$=25°C (unless otherwise specified)**

| Description | 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 | Tc=25°C Note*1 |
| | | ±12.6 | A | Tc=100°C Note*1 |
| Pulsed Drain Current | $I_{DP}$ | ±60 | A | |
| Gate-Source Voltage | $V_{GS}$ | ±30 | V | |
| Repetitive and Non-Repetitive Maximum Avalanche Current | $I_{AR}$ | 6.6 | A | Note *2 |
| Non-Repetitive Maximum Avalanche Energy | $E_{AS}$ | 472.2 | mJ | Note *3 |
| Maximum Drain-Source dV/dt | $dV_{DS}/dt$ | 50 | kV/μs | $V_{DS}$≤ 600V |
| Peak Diode Recovery dV/dt | dV/dt | 15 | kV/μs | Note *4 |
| Peak Diode Recovery -di/dt | -di/dt | 100 | A/μs | Note *5 |
| Maximum Power Dissipation | $P_D$ | 2.02 | W | $T_a$=25°C |
| | | 150 | | $T_C$=25°C |
| Operating and Storage Temperature range | $T_{ch}$ | 150 | °C | |
| | $T_{stg}$ | -55 to +150 | °C | |

Note *1 : Limited by maximum channel temperature.
Note *2 : $T_{ch}$≤150°C, See Fig.1 and Fig.2
Note *3 : Starting $T_{ch}$=25°C, $I_{AS}$=2A, L=216mH, $V_{DD}$=60V, $R_G$=50Ω, See Fig.1 and Fig.2
$E_{AS}$ limited by maximum channel temperature and avalanche current.
Note *4 : $I_F$≤-$I_D$, -di/dt=100A/μs, $V_{DD}$≤400V, $T_{ch}$≤150°C.
Note *5 : $I_F$≤-$I_D$, dV/dt=15kV/μs, $V_{DD}$≤400V, $T_{ch}$≤150°C.

## ● Electrical Characteristics at $T_c$=25°C (unless otherwise specified)

### Static Ratings

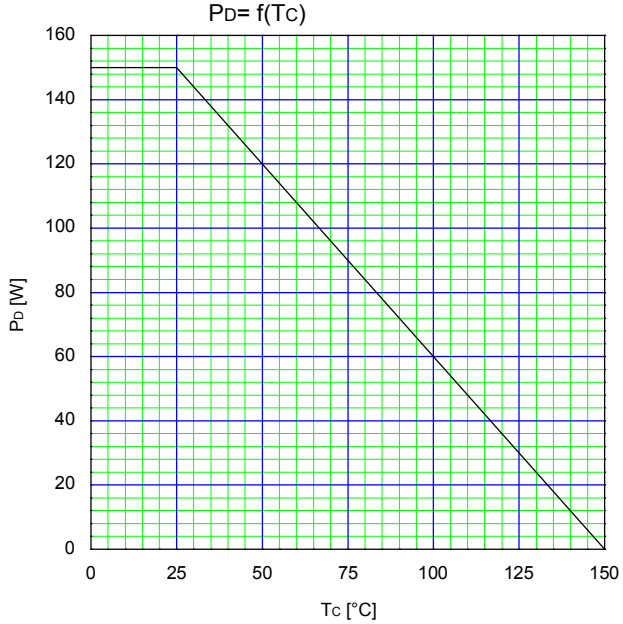
| Description | Symbol | Conditions | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $I_D$=250μA<br>$V_{GS}$=0V | | 600 | - | - | V |
| Gate Threshold Voltage | $V_{GS(th)}$ | $I_D$=250μA<br>$V_{DS}$=$V_{GS}$ | | 2.5 | 3 | 3.5 | V |
| Zero 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 | $I_{GSS}$ | $V_{GS}$= ± 30V<br>$V_{DS}$=0V | | - | 10 | 100 | nA |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $I_D$=10A<br>$V_{GS}$=10V | | - | 0.161 | 0.19 | Ω |
| Gate resistance | $R_G$ | f=1MHz, open drain | | - | 3.7 | - | Ω |
| Forward Transconductance | $g_{fs}$ | $I_D$=10A<br>$V_{DS}$=25V | | 8.5 | 17.5 | - | S |
| Input Capacitance | $C_{iss}$ | $V_{DS}$=10V<br>$V_{GS}$=0V<br>f=1MHz | | - | 1470 | - | pF |
| Output Capacitance | $C_{oss}$ | | | - | 3120 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 280 | - | |
| Effective output capacitance, energy related (Note *6) | $C_{o(er)}$ | $V_{GS}$=0V<br>$V_{DS}$=0…480V | | - | 90 | - | |
| Effective output capacitance, time related (Note *7) | $C_{o(tr)}$ | $V_{GS}$=0V<br>$V_{DS}$=0…480V<br>ID=constant | | - | 305 | - | |
| Turn-On Time | $t_{d(on)}$ | $V_{DD}$=400V, $V_{GS}$=10V<br>$I_D$=10A, $R_G$=27Ω<br>See Fig.3 and Fig.4 | | - | 22 | - | ns |
| | $t_r$ | | | - | 40 | - | |
| Turn-Off Time | $t_{d(off)}$ | | | - | 162 | - | |
| | $t_f$ | | | - | 22 | - | |
| Total Gate Charge | $Q_G$ | $V_{DD}$=480V, $I_D$=20A<br>$V_{GS}$=10V<br>See Fig.5 | | - | 48 | - | nC |
| Gate-Source Charge | $Q_{GS}$ | | | - | 12.5 | - | |
| Gate-Drain Charge | $Q_{GD}$ | | | - | 15 | - | |
| Drain-Source crossover Charge | $Q_{SW}$ | | | - | 8 | - | |
| Avalanche Capability | $I_{AV}$ | L=6.02mH, $T_{ch}$=25°C<br>See Fig.1 and Fig.2 | | 6.6 | - | - | A |
| Diode Forward On-Voltage | $V_{SD}$ | $I_F$=20A, $V_{GS}$=0V<br>$T_{ch}$=25°C | | - | 0.9 | 1.35 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$=20A, $V_{GS}$=0V<br>$V_{DD}$=400V<br>-di/dt=100A/μs<br>$T_{ch}$=25°C<br>See Fig.6 | | | 370 | - | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | - | 6.2 | - | μC |
| Peak Reverse Recovery Current | $I_{rp}$ | | | - | 32 | - | A |

Note *6 : $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $BV_{DSS}$.
Note *7 : $C_{o(tr)}$ is a fixed capacitance that gives the same charging times as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $BV_{DSS}$.

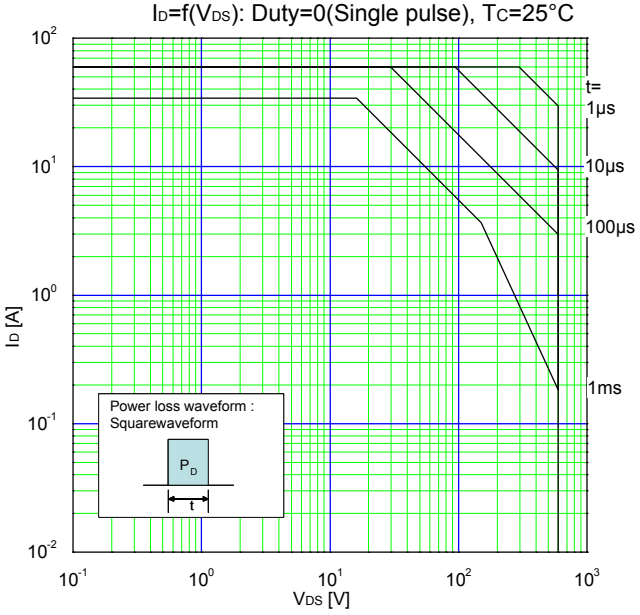
## ● Thermal Characteristics

| Description | Symbol | min. | typ. | max. | Unit |
|---|---|---|---|---|---|
| Channel to Case | $R_{th(ch-c)}$ | | | 0.83 | °C/W |
| Channel to Ambient | $R_{th(ch-a)}$ | | | 62 | °C/W |

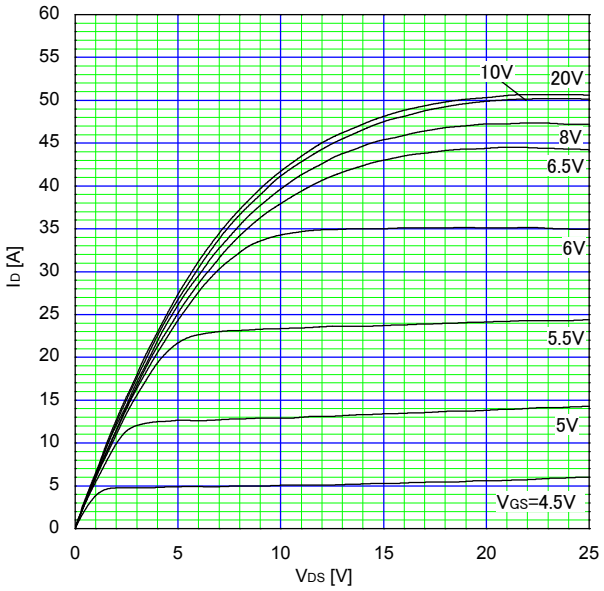
Allowable Power Dissipation
$P_D$= f($T_C$)



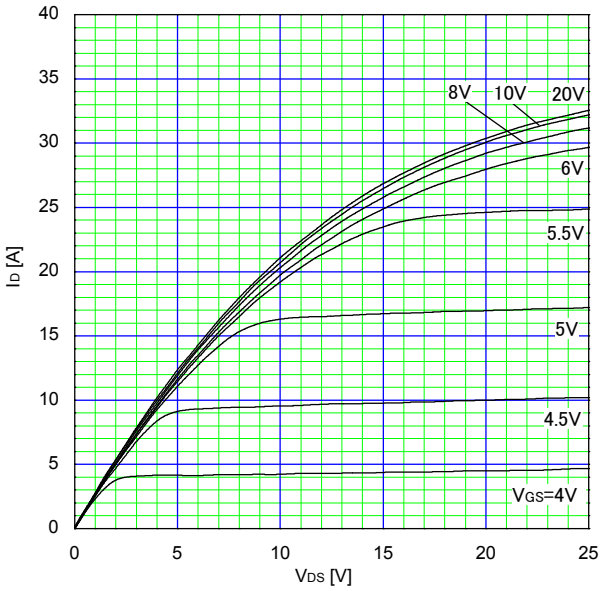

Safe Operating Area
$I_D$=f($V_{DS}$): Duty=0(Single pulse), $T_C$=25°C



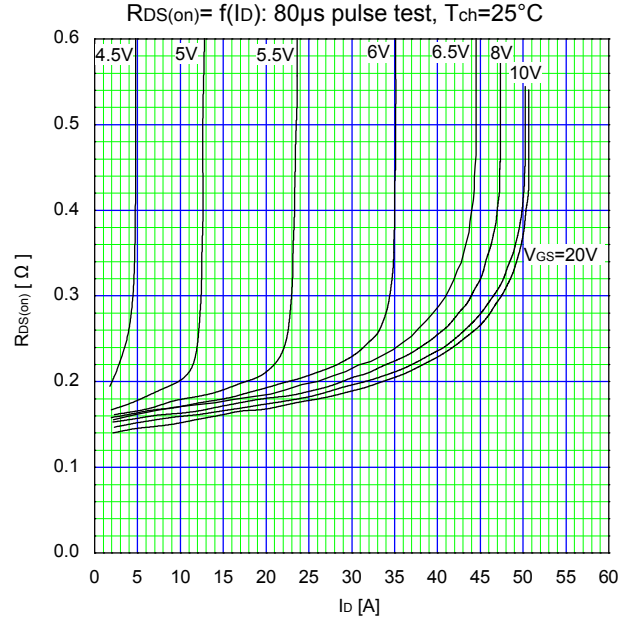

Typical Output Characteristics
$I_D$=f($V_{DS}$): 80µs pulse test, $T_{ch}$=25°C



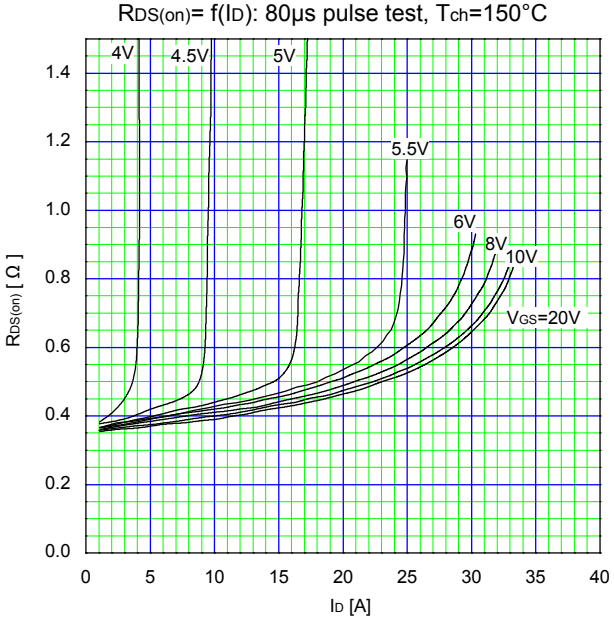

Typical Output Characteristics
$I_D$=f($V_{DS}$): 80µs pulse test, $T_{ch}$=150°C



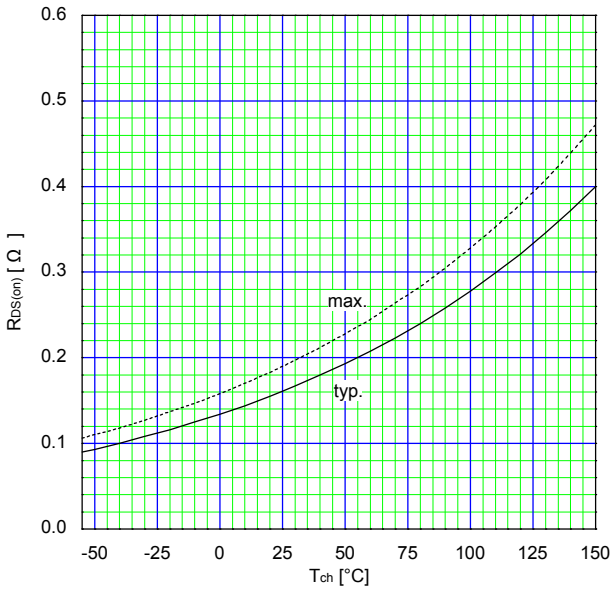

Typical Drain-Source on-state Resistance
$R_{DS(on)}$= f($I_D$): 80µs pulse test, $T_{ch}$=25°C



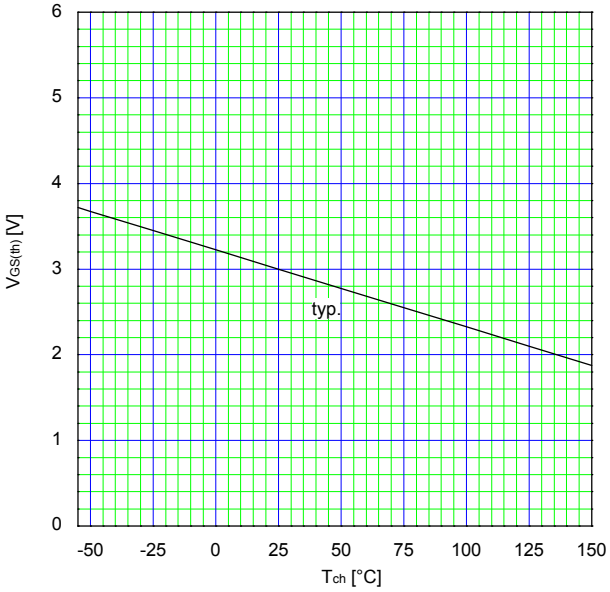

Typical Drain-Source on-state Resistance
$R_{DS(on)}$= f($I_D$): 80µs pulse test, $T_{ch}$=150°C



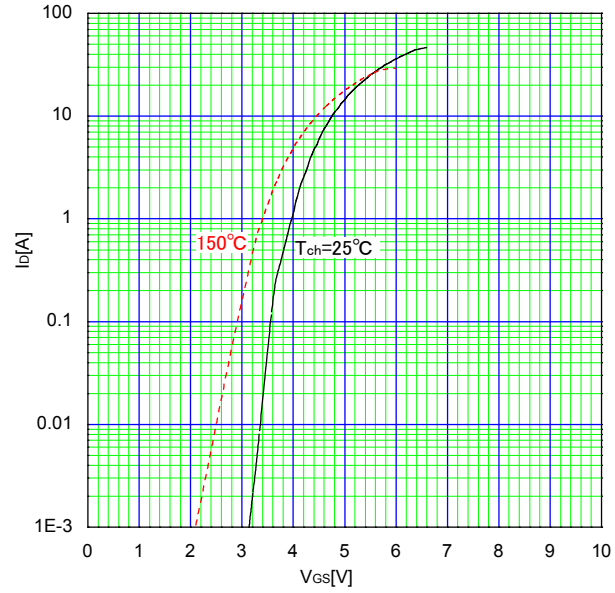
Drain-Source On-state Resistance
$R_{DS(on)}$= f($T_{ch}$): $I_D$=10A, $V_{GS}$=10V



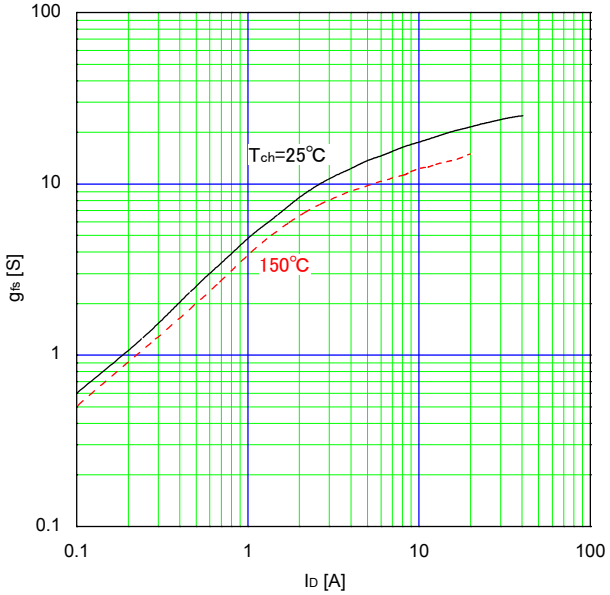

Gate Threshold Voltage vs. Tch
$V_{GS(th)}$= f($T_{ch}$): $V_{DS}$= $V_{GS}$, $I_D$= 250μA



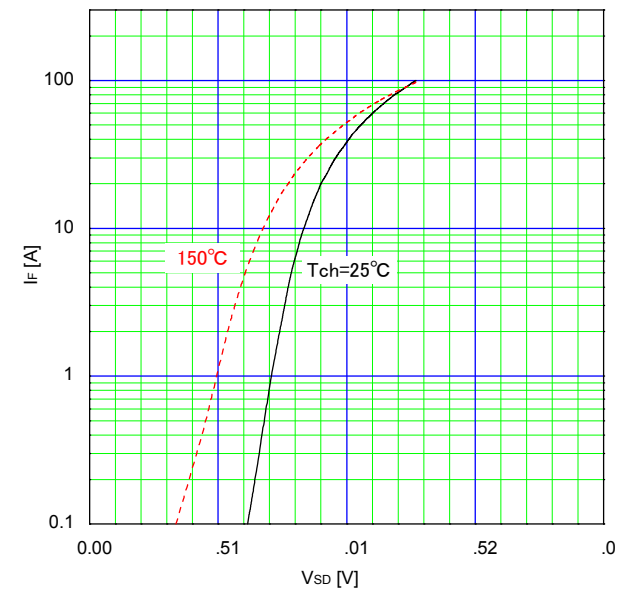

Typical Transfer Characteristic
$I_D$= f($V_{GS}$): 80μs pulse test, $V_{DS}$=25V



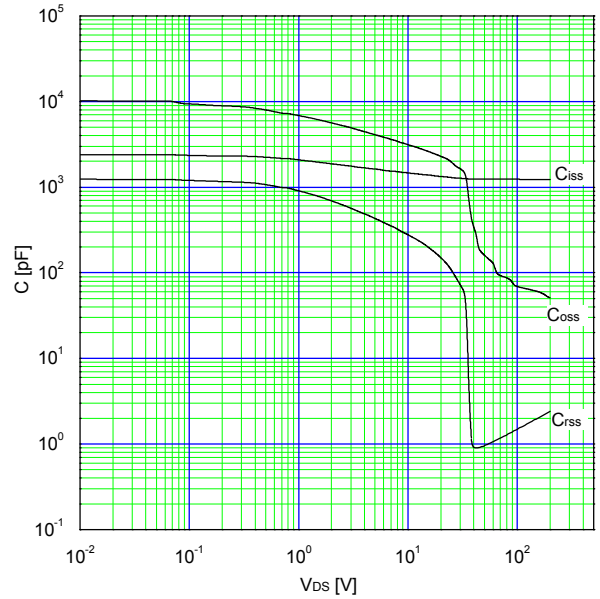

Typical Transconductance
$g_{fs}$= f($I_D$):80μs pulse test, $V_{DS}$=25V



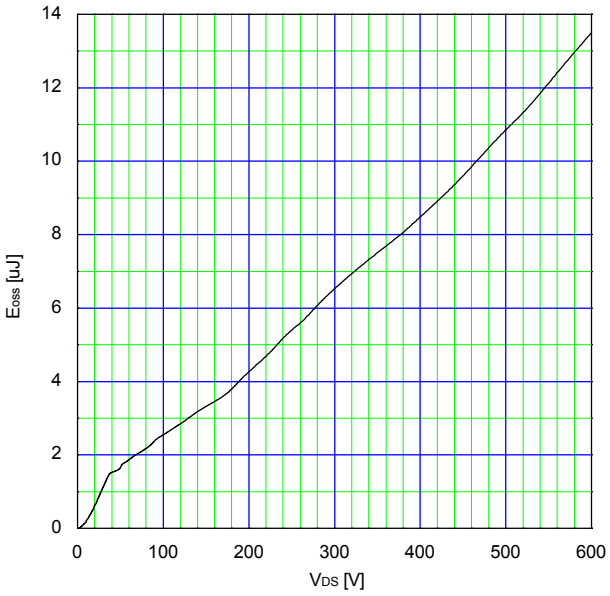

Typical Forward Characteristics of Reverse Diode
$I_F$= f($V_{SD}$): 80μs pulse test



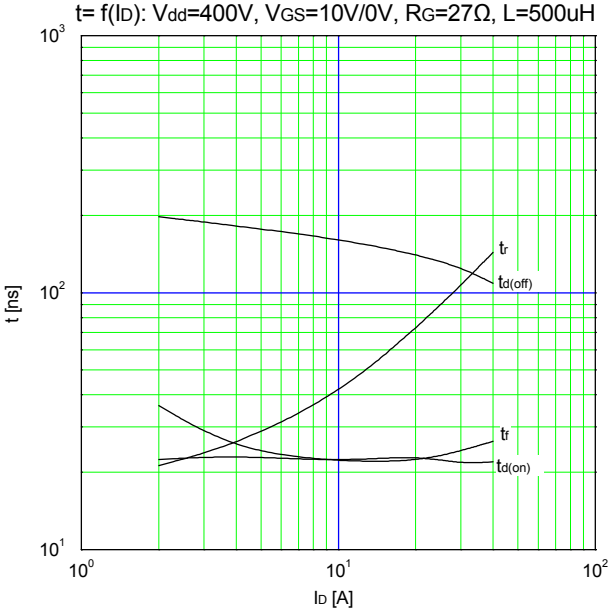

Typical Capacitance
C= f($V_{DS}$): $V_{GS}$=0V, f=1MHz



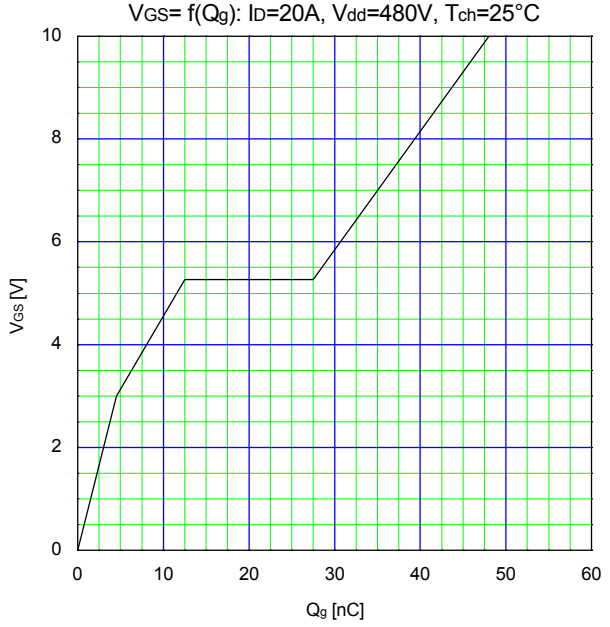
Typical Coss stored energy



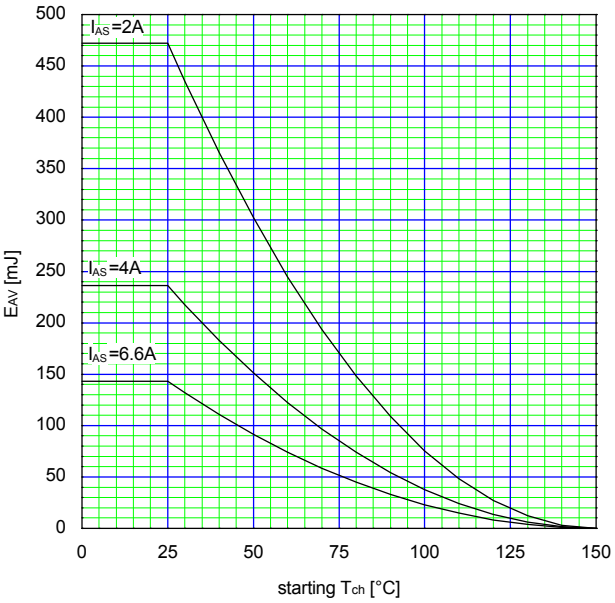

Typical Switching Characteristics vs. ID Tch=25
t= f(ID): Vdd=400V, VGS=10V/0V, RG=27Ω, L=500uH



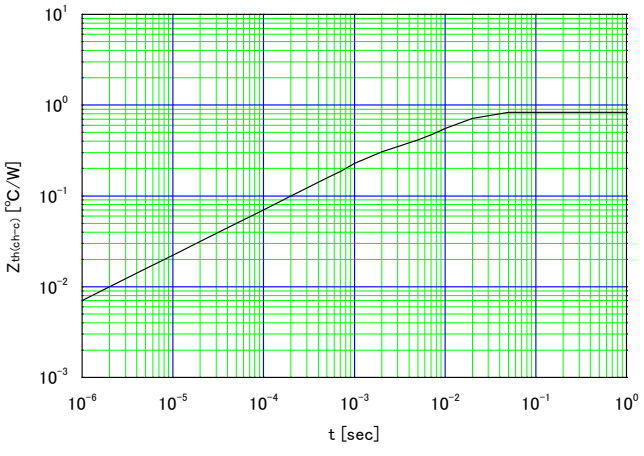

Typical Gate Charge Characteristics
VGS= f(Qg): ID=20A, Vdd=480V, Tch=25°C



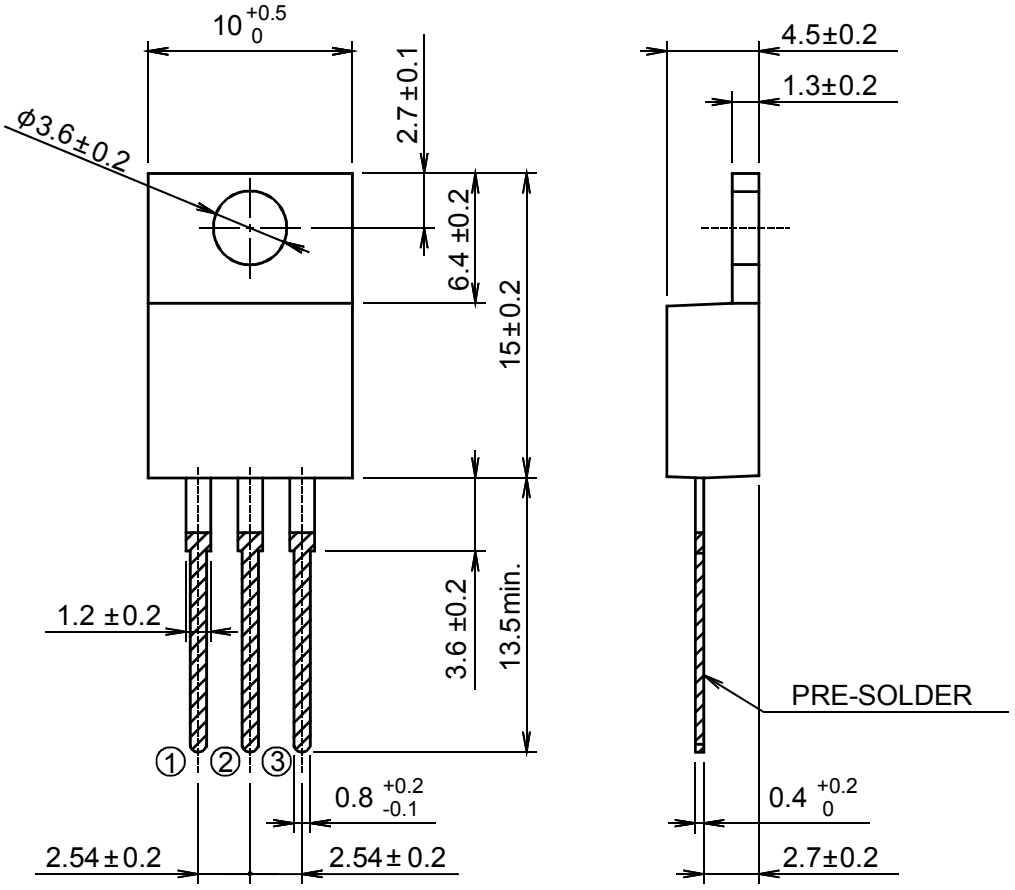

Maximum Avalanche Energy vs. startingTch
E(AV)= f(starting Tch): VCC=60V, I(AV)<=6.6A

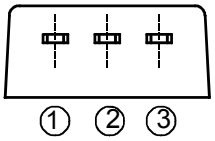



Transient Thermal Impedance
Zth(ch-c)= f(t): D=0



## ■ Outview: TO-220 Package



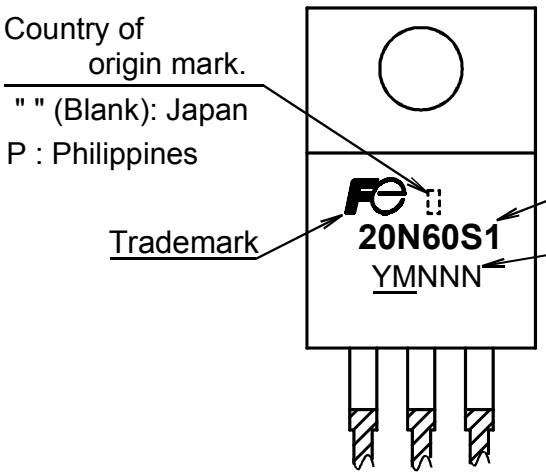




CONNECTION

① GATE
② DRAIN
③ SOURCE

JEDEC : TO-220AB
DIMENSIONS ARE IN MILLIMETERS.

## ■ Marking




Type name

Date code & Lot No.

Y: Last digit of year
M: Month code 1~9 and O,N,D
NNN: Lot. serial number
Under bar of date code
: means lead-free mark

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

## WARNING

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of February 2012.
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.

2. All applications described in this Catalog exemplify the use of Fuji's products for your reference only. No right or license, either express or implied, under any patent, copyright, trade secret or other intellectual property right owned by Fuji Electric Co., Ltd. is (or shall be deemed) granted. Fuji Electric Co., Ltd. makes no representation or warranty, whether express or implied, relating to the infringement or alleged infringement of other's intellectual property rights which may arise from the use of the applications described herein.

3. Although Fuji Electric Co., Ltd. is enhancing product quality and reliability, a small percentage of semiconductor products may become faulty. When using Fuji Electric semiconductor products in your equipment, you are requested to take adequate safety measures to prevent the equipment from causing a physical injury, fire, or other problem if any of the products become faulty. It is recommended to make your design failsafe, flame retardant, and free of malfunction.

4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
- Computers
- OA equipment
- Communications equipment (terminal devices)
- Measurement equipment
- Machine tools
- Audiovisual equipment
- Electrical home appliances
- Personal equipment
- Industrial robots etc.

5. If you need to use a product in this Catalog for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric Co., Ltd. to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji's product incorporated in the equipment becomes faulty.
- Transportation equipment (mounted on cars and ships)
- Trunk communications equipment
- 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

6. Do not use products in this Catalog for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
- Space equipment
- Aeronautic equipment
- Nuclear control equipment
- Submarine repeater equipment



8. If you have any question about any portion in this Catalog, ask Fuji Electric Co., Ltd. or its sales agents before using the product.
Neither Fuji Electric Co., Ltd. nor its agents shall be liable for any injury caused by any use of the products not in accordance with instructions set forth herein.