Fuji Electric

Innovating Energy Technology

FMH40N60S1FD

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FUJI POWER MOSFET

Super J-MOS series

N-Channel enhancement mode power MOSFET

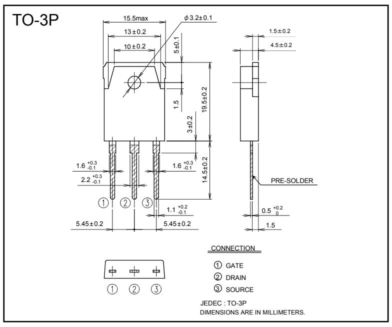
Features

Pb-free lead terminal
RoHS compliant

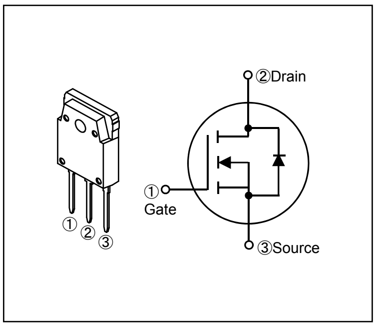
Applications

For switching

Outline Drawings [mm]



Equivalent circuit schematic



Absolute Maximum Ratings at T_c=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	±40	A	Tc=25°C Note*1
		±25	A	Tc=100°C Note*1
Pulsed Drain Current	I_{DP}	±120	A	Note*1
Gate-Source Voltage	V_{GS}	±30	V	
Repetitive and Non-Repetitive Maximum Avalanche Current	I_{AR}	7.6	A	Note *2
Non-Repetitive Maximum Avalanche Energy	E_{AS}	1390	mJ	Note *3
Maximum Drain-Source dV/dt	dV_{DS}/dt	50	kV/µs	V_{DS}≤ 600V
Peak Diode Recovery dV/dt	dV/dt	30	kV/µs	Note *4
Peak Diode Recovery -di/dt	-di/dt	100	A/µs	Note *5
Maximum Power Dissipation	P_D	2.5	W	T_a=25°C
		315		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}=4.6A, L=120mH, 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_{DS} peak ≤ 600V, T_{ch} ≤ 150°C.
Note *5 : I_F ≤ -I_D, dV/dt=30kV/µs, V_{DS} peak ≤ 600V, T_{ch} ≤ 150°C.

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

• Static Ratings

Parameter	Symbol	Conditions		min.	typ.	max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=250µA, V_{GS}=0V		600	-	-	V
Gate Threshold Voltage	$V_{GS(th)}$	I_D=1.5mA, V_{DS}=V_{GS}		3	4	5	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=600V, V_{GS}=0V	T_{ch}=25°C	-	-	25	µA
		V_{DS}=480V, V_{GS}=0V	T_{ch}=125°C	-	300	-	
Gate-Source Leakage Current	I_{GSS}	V_{GS}= ± 30V, V_{DS}=0V		-	10	100	nA
Drain-Source On-State Resistance	$R_{DS(on)}$	I_D=20A, V_{GS}=10V		-	0.079	0.093	Ω
Gate resistance	R_G	f=1MHz, open drain		-	1.1	-	Ω

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OCTOBER 2015

• Dynamic Ratings

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Forward Transconductance	g_{fs}	I_D=20A V_{DS}=25V	14.5	29	-	S
Input Capacitance	C_{iss}	V_{DS}=400V V_{GS}=0V f=250kHz	-	2865	-	pF
Output Capacitance	C_{oss}		-	83	-	
Reverse Transfer Capacitance	C_{rss}		-	6.5	-	
Effective output capacitance, energy related (Note *6)	$C_{o(er)}$	V_{GS}=0V V_{DS}=0…400V	-	216	-	
Effective output capacitance, time related (Note *7)	$C_{o(tr)}$	V_{GS}=0V V_{DS}=0…400V ID=constant	-	758	-	
Turn-On Time	$t_{d(on)}$	V_{DD}=400V, V_{GS}=10V I_D=20A, R_G=13Ω See Fig.3 and Fig.4	-	124	-	ns
	t_r		-	29	-	
Turn-Off Time	$t_{d(off)}$		-	139	-	
	t_f		-	19	-	
Total Gate Charge	Q_G	V_{DD}=400V, I_D=40A V_{GS}=10V See Fig.5	-	104	-	nC
Gate-Source Charge	Q_{GS}		-	27	-	
Gate-Drain Charge	Q_{GD}		-	46	-	
Drain-Source crossover Charge	Q_{SW}		-	14	-	

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 400V.
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 400V.

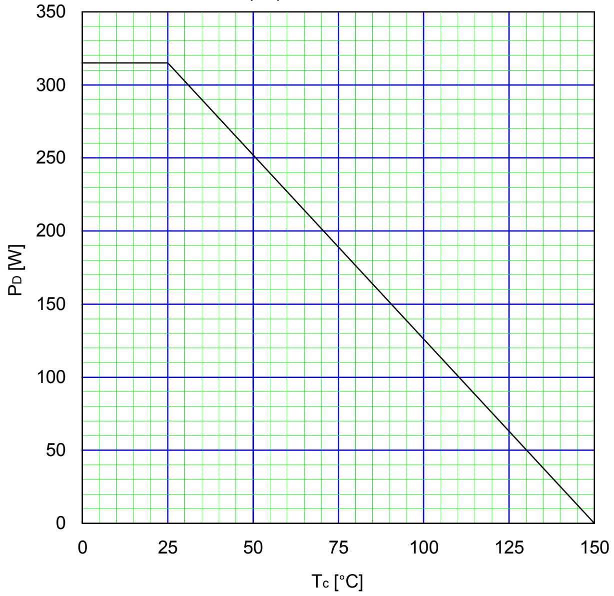
• Reverse Diode

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Avalanche Capability	I_{AV}	L=26.7mH,T_{ch}=25°C See Fig.1 and Fig.2	7.6	-	-	A
Diode Forward On-Voltage	V_{SD}	I_F=40A,V_{GS}=0V T_{ch}=25°C	-	1.1	1.35	V
Reverse Recovery Time	t_{rr}	I_F=40A, V_{DD}=400V -di/dt=100A/μs T_{ch}=25°C See Fig.6 and Fig.7	-	200	-	ns
Reverse Recovery Charge	Q_{rr}		-	1.35	-	μC
Peak Reverse Recovery Current	I_{rp}		-	13.5	-	A

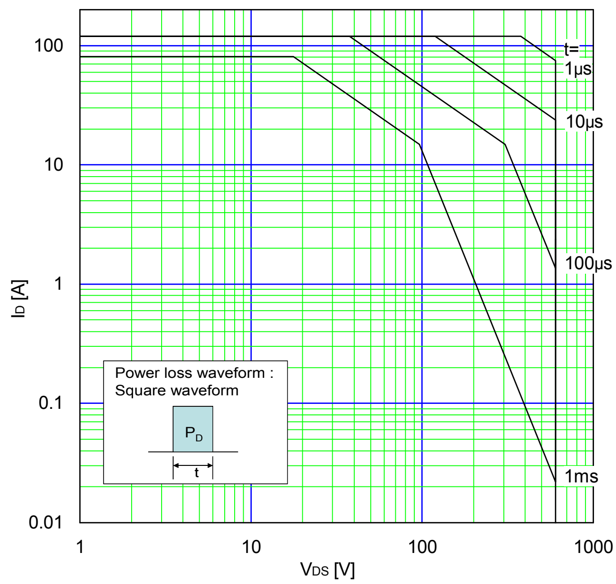
Thermal Resistance

Parameter	Symbol	min.	typ.	max.	Unit
Channel to Case	$R_{th(ch-c)}$	-	-	0.40	°C/W
Channel to Ambient	$R_{th(ch-a)}$	-	-	50	°C/W

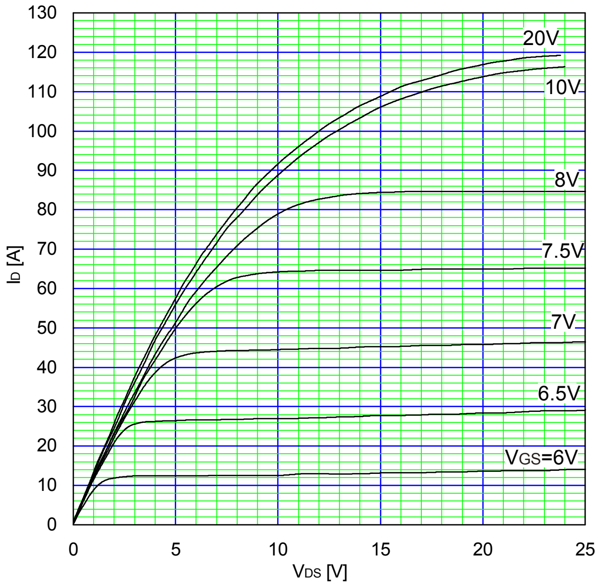
Allowable Power Dissipation
$P_D=f(T_c)$



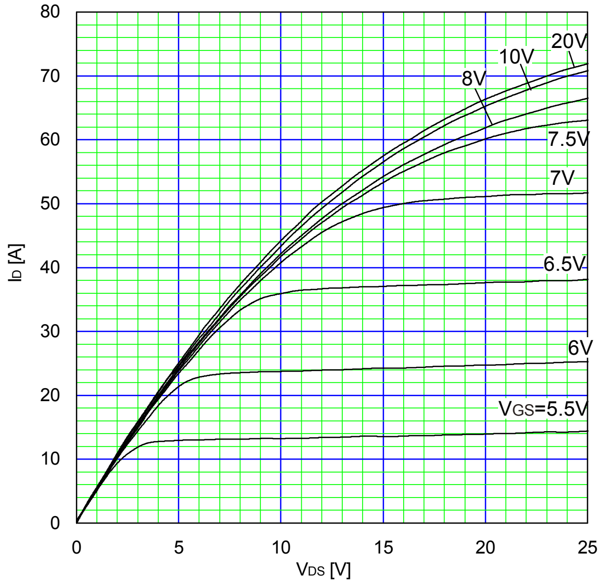
Safe Operating Area
$I_D=f(V_{DS})$:Duty=0(Single pulse), T_c=25°C



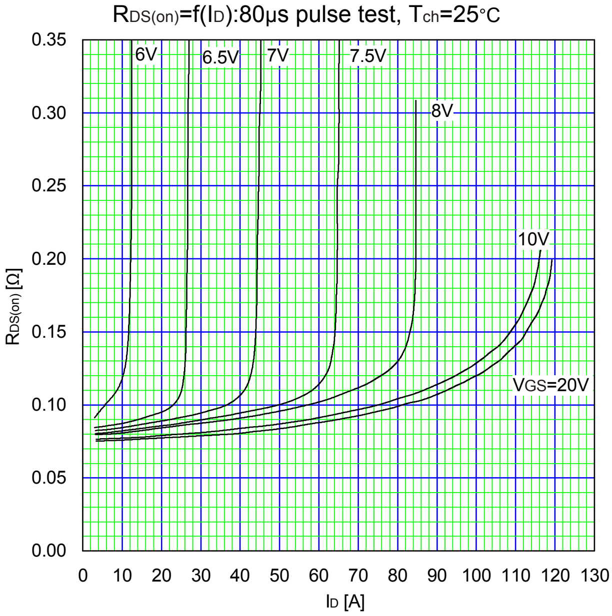
Typical Output Characteristics
$I_D=f(V_{DS})$:80μs pulse test, T_{ch}=25°C



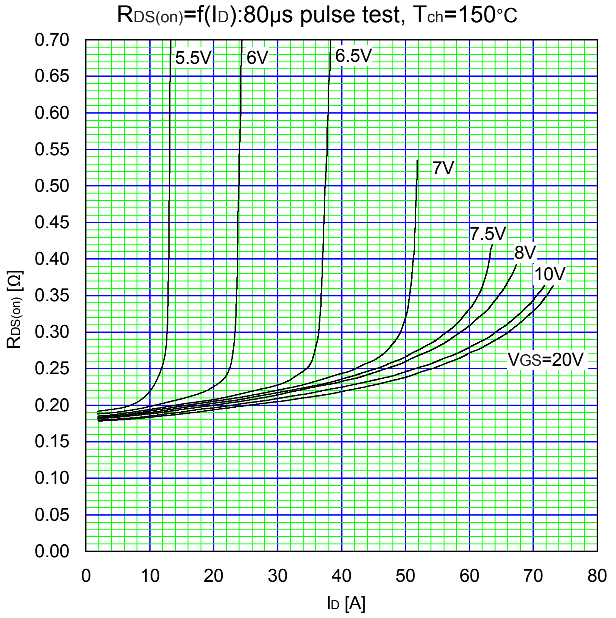
Typical Output Characteristics
$I_D=f(V_{DS})$:80μs pulse test, T_{ch}=150°C

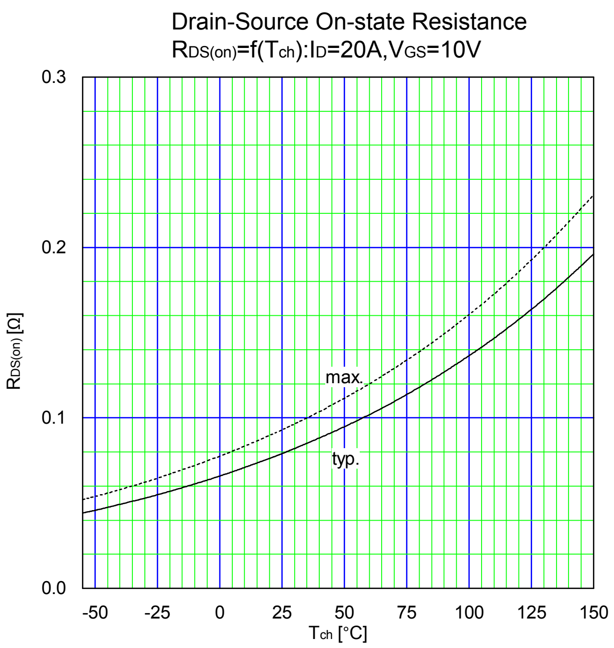


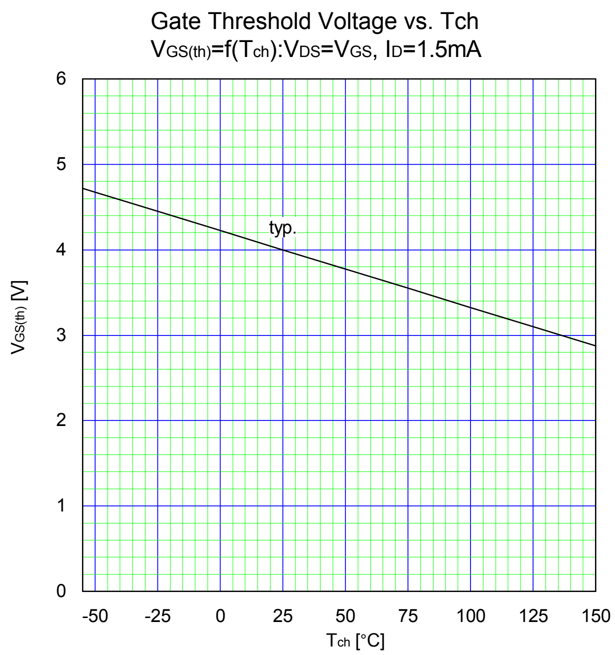
Typical Drain-Source on-state Resistance
$R_{DS(on)}=f(I_D)$:80μs pulse test, T_{ch}=25°C

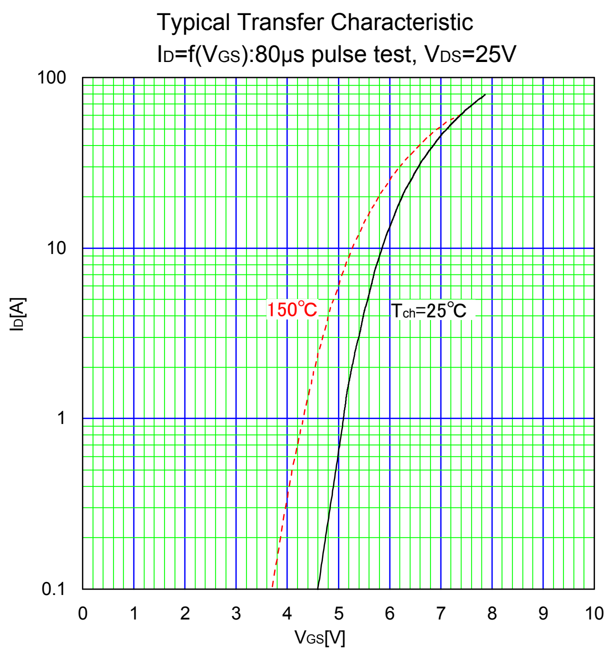


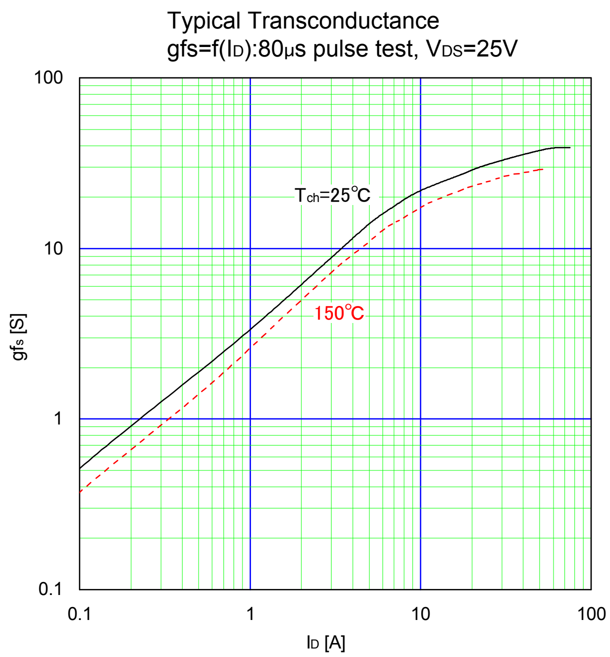
Typical Drain-Source on-state Resistance
$R_{DS(on)}=f(I_D)$:80μs pulse test, T_{ch}=150°C

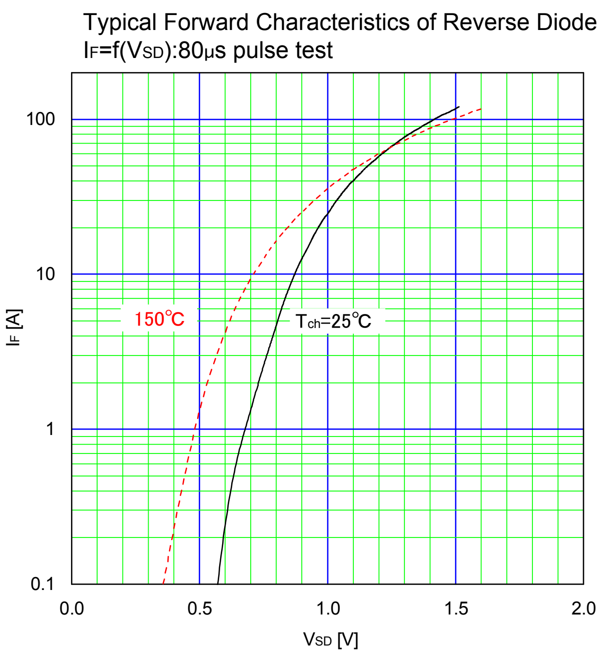


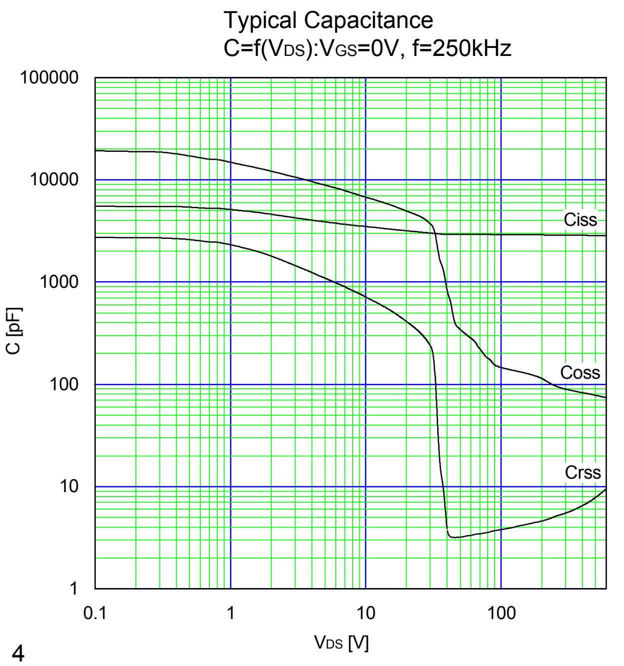

Drain-Source On-state Resistance
RDS(on)=f(Tch):ID=20A,VGS=10V
RDS(on) [Ω]
Tch [°C]
max.
typ.


Gate Threshold Voltage vs. Tch
VGS(th)=f(Tch):VDS=VGS, ID=1.5mA
VGS(th) [V]
Tch [°C]
typ.

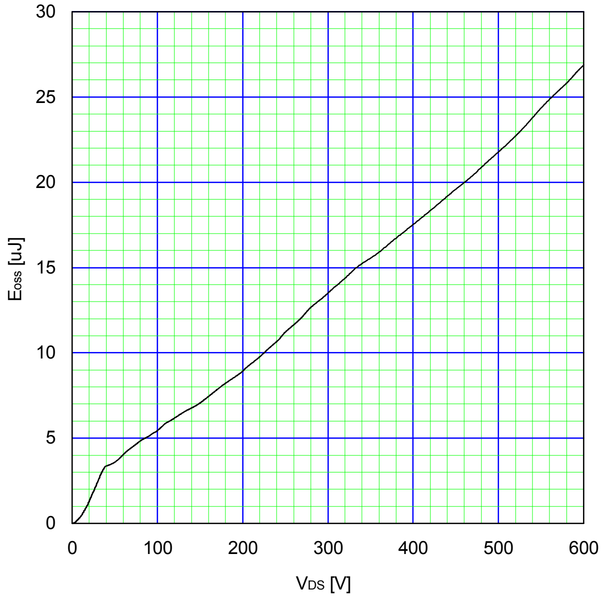

Typical Transfer Characteristic
ID=f(VGS):80μs pulse test, VDS=25V
ID[A]
VGS[V]
150℃
Tch=25℃


Typical Transconductance
gfs=f(ID):80μs pulse test, VDS=25V
gfs [S]
ID [A]
Tch=25℃
150℃

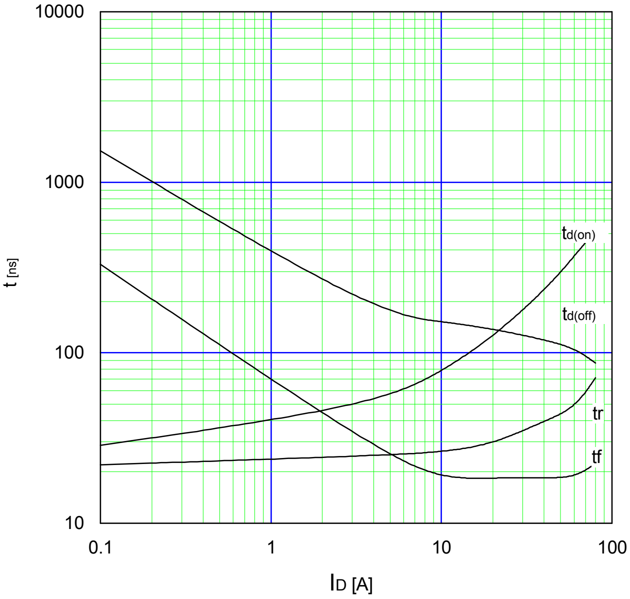

Typical Forward Characteristics of Reverse Diode
IF=f(VSD):80μs pulse test
IF [A]
VSD [V]
150℃
Tch=25℃


Typical Capacitance
C=f(VDS):VGS=0V, f=250kHz
C [pF]
VDS [V]
Ciss
Coss
Crss

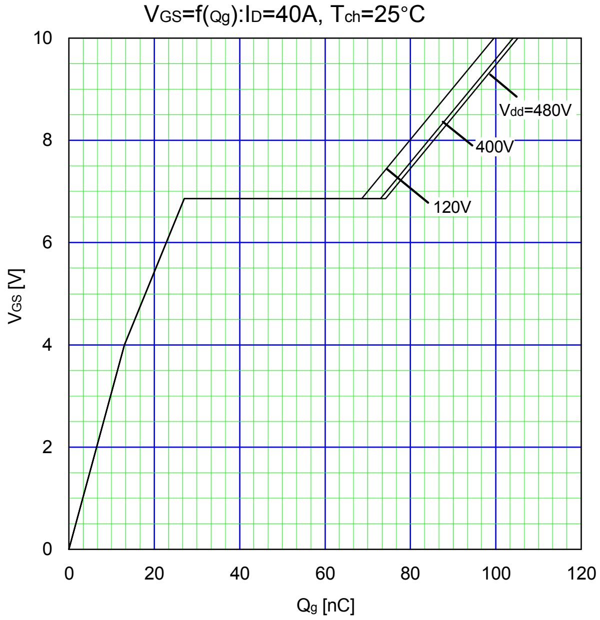
Typical Coss stored energy



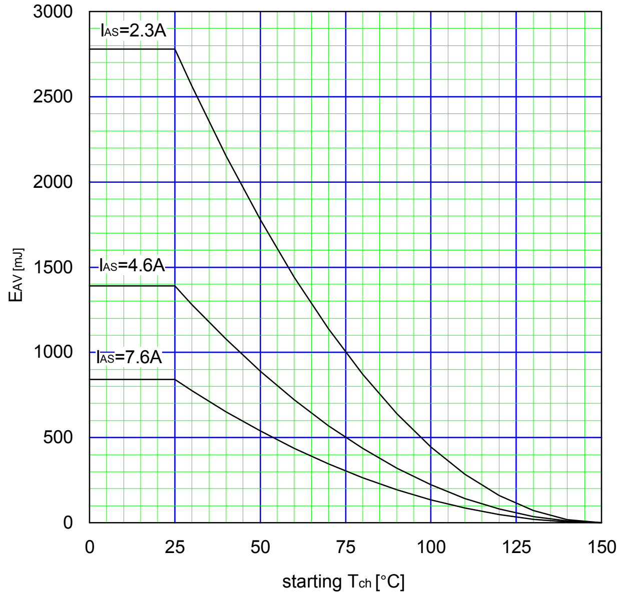
Typical Switching Characteristics vs. ID Tch=25°C
t=f(ID):Vdd=400V, VGS=10V/0V, RG=13Ω



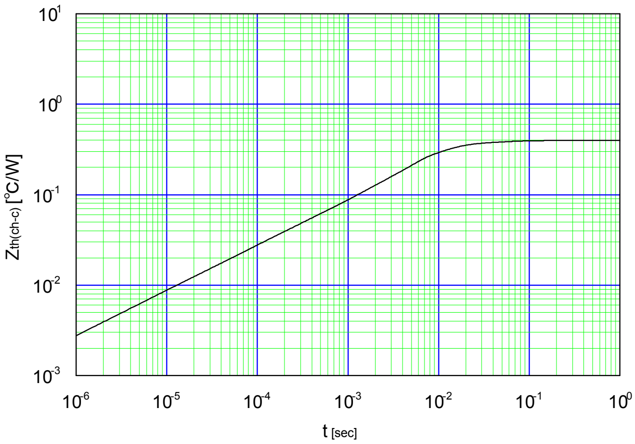
Typical Gate Charge Characteristics
VGS=f(Qg):ID=40A, Tch=25°C



Maximum Avalanche Energy vs. starting Tch
E(AV)=f(starting Tch):Vcc=60V, I(AV)<=7.6A



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



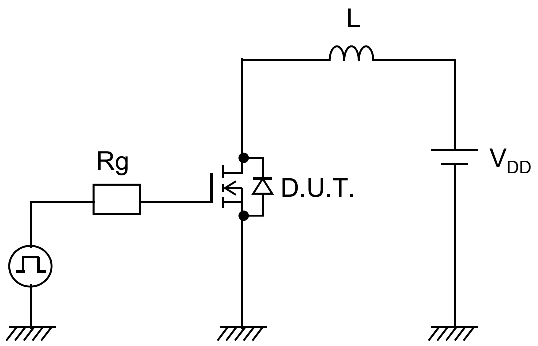


Fig.1 Avalanche Test circuit

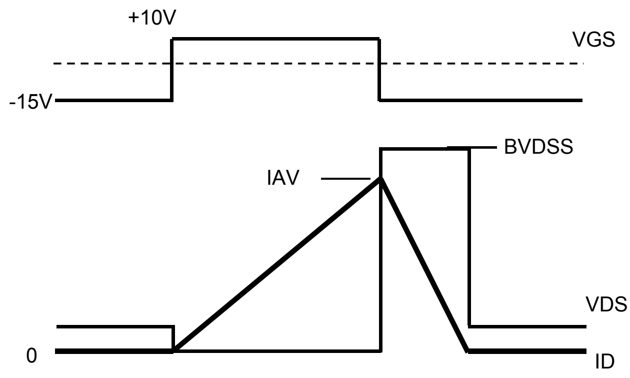


Fig.2 Operating waveforms of Avalanche Test

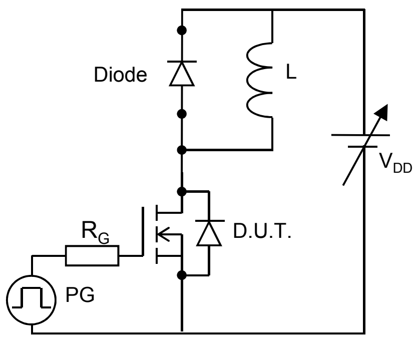


Fig.3 Switching Test circuit

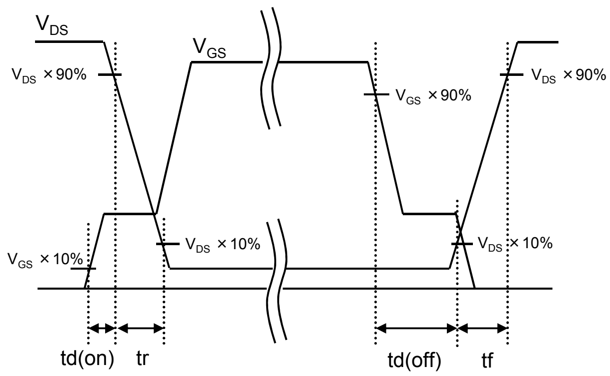


Fig.4 Operating waveform of Switching Test

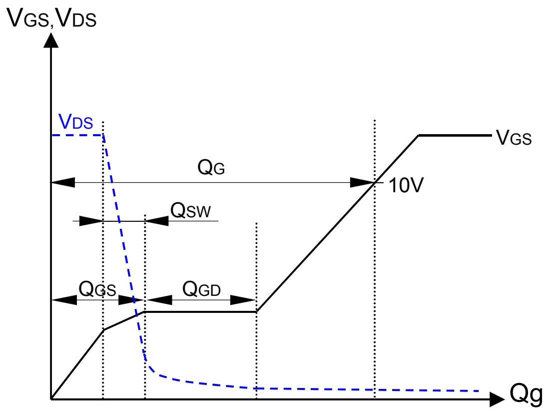


Fig.5 Operating waveform of Gate charge Test

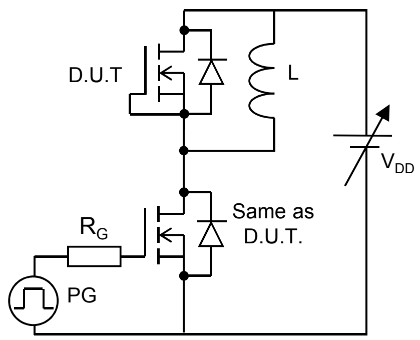


Fig.6 Reverse recovery Test circuit

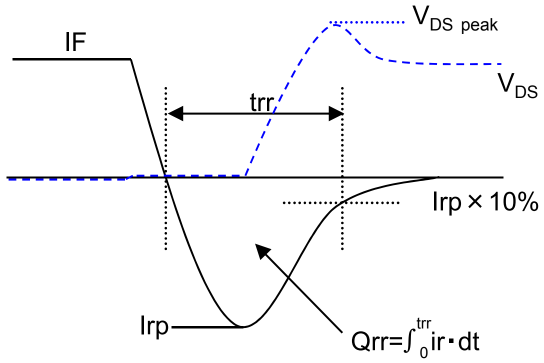
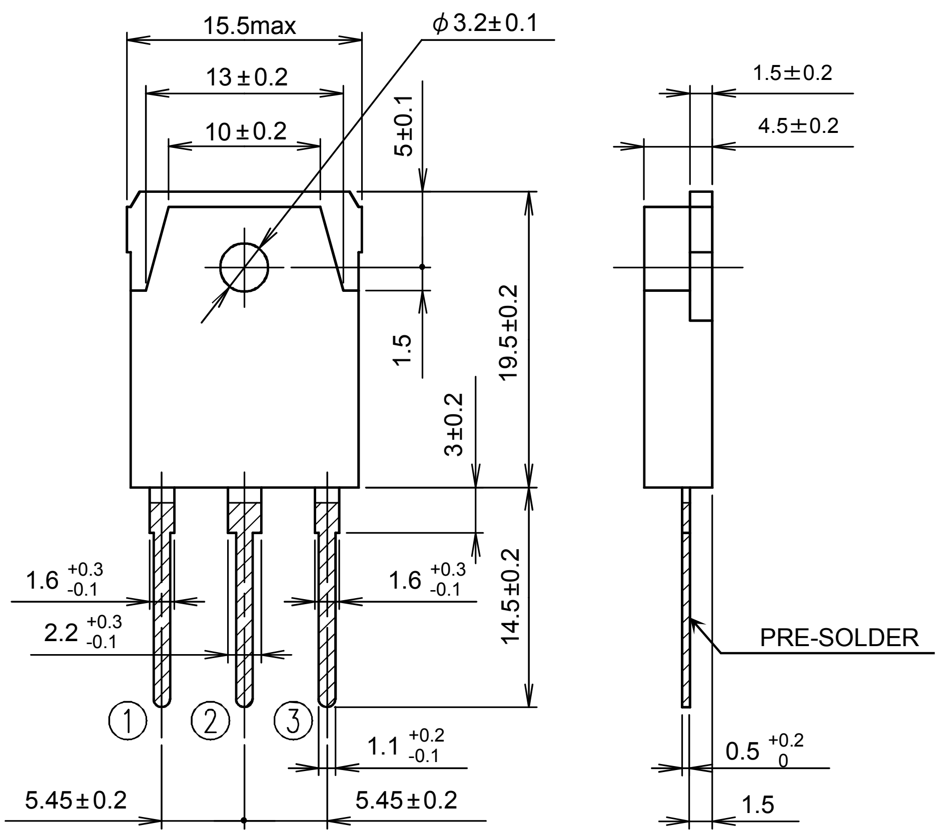
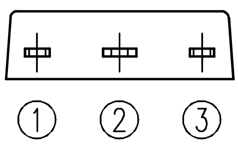


Fig.7 Operating waveform of Reverse recovery Test

Outview: TO-3P Package



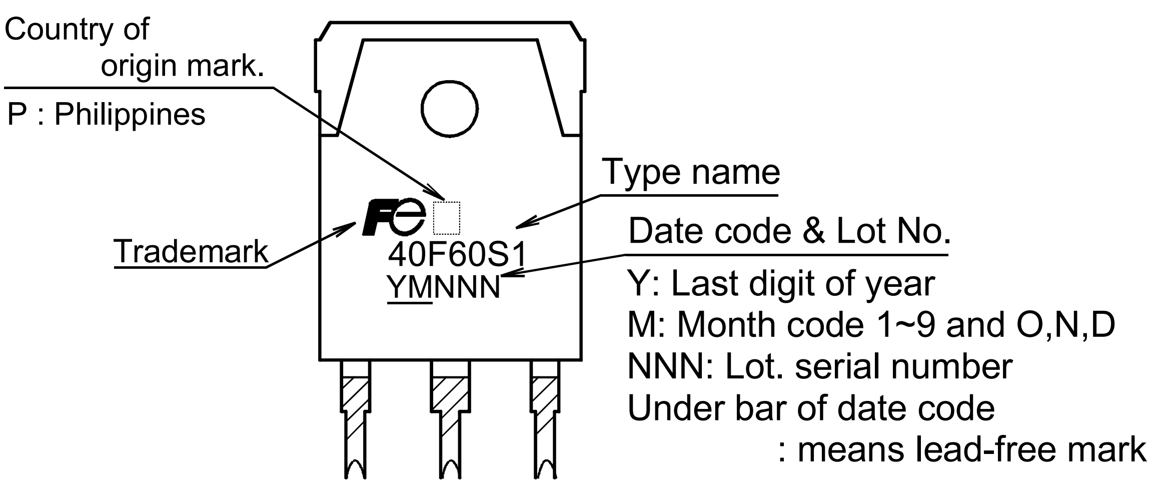


CONNECTION

① GATE
② DRAIN
③ SOURCE

JEDEC : TO-3P
DIMENSIONS ARE IN MILLIMETERS.

Marking



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

WARNING

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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

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