SPECIFICATION

Device Name	:	Power MOSFET
Type Name	:	2SK3772-01
Spec. No.	:	MS5F5581
Date	:	*Oct.-02-2003*

Fuji Electric Co.,Ltd.
Matsumoto Factory

	DATE	NAME	APPROVED
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CHECKED	Oct.-02-'03	K. Yamada	

Fuji Electric Co.,Ltd.

DWG.NO. MS5F5581 1 / 18

Revised Records

Date	Classification	Index	Content	Drawn	Checked	Checked	Approved
Oct.-02 2003	enactment	—	———	Y. Hato	T. Hosen	K. Yamada	y. Sato

1.Scope This specifies Fuji Power MOSFET 2SK3772-01

2.Construction N-Channel enhancement mode power MOSFET

3.Applications for Switching

4.Outview TO-220 Outview See to 8/18 page

5.Absolute Maximum Ratings at Tc=25°C (unless otherwise specified)

Description	Symbol	Characteristics	Unit	Remarks
Drain-Source Voltage	V_{DS}	300	V	
	V_{DSX}	300	V	VGS=-30V
Continuous Drain Current	I_D	32	A	
Pulsed Drain Current	I_{DP}	± 128	A	
Gate-Source Voltage	V_{GS}	± 30	V	
Repetitive and Non-repetitive Maximum Avalanche Current	I_{AR}	32	A	Note *1
Non-Repetitive Maximum Avalanche Energy	E_{AS}	597.4	mJ	Note *2
Repetitive Maximum Avalanche Energy	E_{AR}	27	mJ	Note *3
Maximum Drain-Source dV/dt	dV_{DS}/dt	20	kV/μs	VDS≤300V
Peak Diode Recovery dV/dt	dV/dt	5	kV/μs	Note *4
Maximum Power Dissipation	P_D	270	W	Tc=25°C
		2.02		Ta=25°C
Operating and Storage Temperature range	T_{ch}	150	°C	
	T_{stg}	-55 to +150	°C	

6.Electrical Characteristics at Tc=25°C (unless otherwise specified)

Static Ratings

Description	Symbol	Conditions		min.	typ.	max.	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=250μA V_{GS}=0V		300	-	-	V
Gate Threshold Voltage	V_{GS}(th)	I_D=250μA V_{DS}=V_{GS}		3.0	-	5.0	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=300V V_{GS}=0V	T_{ch}=25°C	-	-	25	μA
		V_{DS}=240V V_{GS}=0V	T_{ch}=125°C	-	-	250	
Gate-Source Leakage Current	I_{GSS}	V_{GS}= ± 30V V_{DS}=0V		-	-	100	nA
Drain-Source On-State Resistance	R_{DS}(on)	I_D=16A V_{GS}=10V		-	0.10	0.13	Ω

Dynamic Ratings

Description	Symbol	Conditions	min.	typ.	max.	Unit
Forward Transconductance	g_{fs}	I_D=16A V_{DS}=25V	12	24	-	S
Input Capacitance	Ciss	V_{DS}=25V	-	1970	2955	pF
Output Capacitance	Coss	V_{GS}=0V	-	335	502	
Reverse Transfer Capacitance	Crss	f=1MHz	-	20	30	
Turn-On Time	td(on)	V_{cc}=180V	-	29	44	ns
	tr	V_{GS}=10V	-	7.5	11	
Turn-Off Time	td(off)	I_D=16A	-	57	86	
	tf	R_{GS}=10Ω	-	7	10.5	
Total Gate Charge	Q_G	V_{cc}=150V	-	44.5	67.0	nC
Gate-Source Charge	Q_{GS}	I_D=32A	-	18.0	27.0	
Gate-Drain Charge	Q_{GD}	V_{GS}=10V	-	13.5	20.5	

Reverse Diode

Description	Symbol	Conditions	min.	typ.	max.	Unit
Diode Forward On-Voltage	V_{SD}	I_F=32A V_{GS}=0V T_{ch}=25°C	-	0.90	1.50	V
Reverse Recovery Time	trr	I_F=32A V_{GS}=0V	-	270	-	ns
Reverse Recovery Charge	Qrr	-di/dt=100A/μs T_{ch}=25°C	-	3.0	-	μC

7.Thermal Resistance

Description	Symbol	min.	typ.	max.	Unit
Channel to Case	Rth(ch-c)			0.463	°C/W
Channel to Ambient	Rth(ch-a)			62	°C/W

Note *1 : Tch≤150°C, See Fig.1 and Fig.2

Note *2 : Starting Tch=25°C,I_{AS}=13A,L=6.13mH,Vcc=48V,R_G=50Ω,See Fig.1 and Fig.2
E_{AS} limited by maximum channel temperature and avalanche current.
See to the 'Avalanche Energy' graph of page 17/18.

Note *3 : Repetitive rating : Pulse width limited by maximum channel temperature.
See to the 'Transient Thermal impedance' graph of page 18/18.

Note *4 : I_F≤-I_D,-di/dt=50A/μs,Vcc≤BV_{DSS},Tch≤150°C

Fig.1 Test circuit

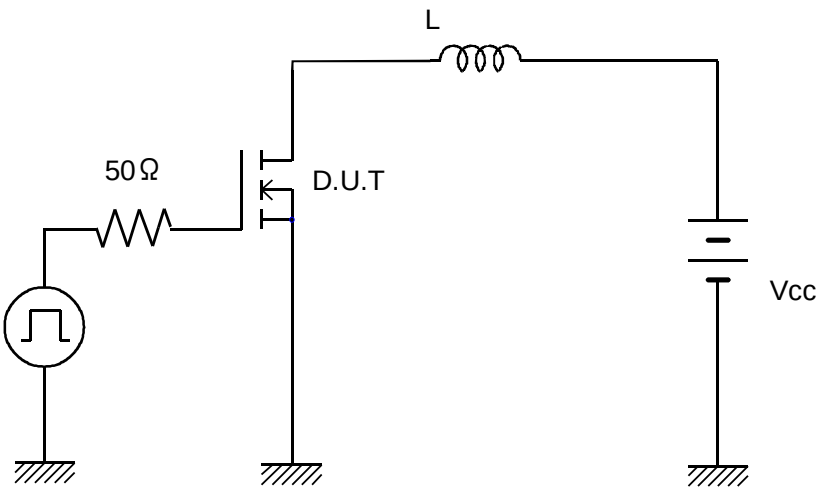
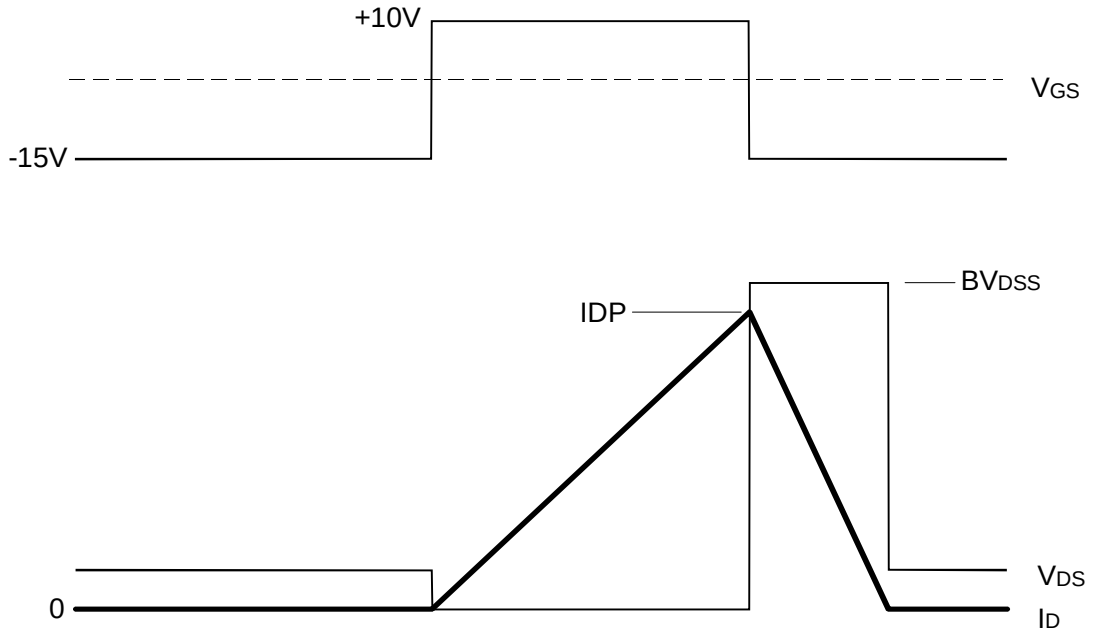


Fig.2 Operating waveforms



8.Reliability test items

All guaranteed values are under the categories of reliability per non-assembled(only MOSFETs).
Each categories under the guaranteed reliability conform to EIAJ ED4701 B101A standards.

(Test items required without fail : Test Method B-121,B-122,B-123,B-131,B-141
Humidification treatment (85±2°C,65±5%RH,168±24hr)
Heat treatment of soldering (Solder Dipping,260±5°C(265°Cmax.),10±1sec,2 times))

	Test No.	Test Items	Testing methods and Conditions	Reference Standard EIAJ ED4701	Sampling number	Acceptance number
Mechanical test methods	1	Terminal Strength (Tensile)	Pull force TO-220,TO-220F : 10N TO-3P,TO-3PF,TO-247 : 25N TO-3PL : 45N T-Pack,K-Pack : 10N Force maintaining duration :30±5sec	A-111A method 1	15	(0:1)
	2	Terminal Strength (Bending)	Load force TO-220,TO-220F : 5N TO-3P,TO-3PF,TO-247 : 10N TO-3PL : 15N T-Pack,K-Pack : 5N Number of times :2times(90deg./time)	A-111A method 3	15	
	3	Mounting Strength	Screwing torque value: (M3) TO-220,TO-220F : 40±10Ncm TO-3P,TO-3PF,TO-247 : 50±10Ncm TO-3PL : 70±10Ncm	A-112 method 2	15	
	4	Vibration	frequency : 100Hz to 2kHz Acceleration : 100m/s^2 Sweeping time : 20min./1 cycle 6times for each X,Y&Z directions.	A-121 test code C	15	
	5	Shock	Peak amplitude: 15km/s^2 Duration time : 0.5ms 3times for each X,Y&Z directions.	A-122 test code D	15	
	6	Solderability	Solder temp. : 235±5°C Immersion time : 5±0.5sec Each terminal shall be immersed in the solder bath within 1 to 1.5mm from the body.	A-131A test code A	15	
	7	Resistance to Soldering Heat	Solder temp. : 260±5°C Immersion time : 10±1sec Number of times : 2times	A-132	15	

	Test No.	Test Items	Testing methods and Conditions	Reference Standard EIAJ ED4701	Sampling number	Acceptance number
Climatic test methods	1	High Temp. Storage	Temperature : 150+0/-5°C Test duration : 1000hr	B-111A	22	(0:1)
	2	Low Temp. Storage	Temperature : -55+5/-0°C Test duration : 1000hr	B-112A	22	
	3	Temperature Humidity Storage	Temperature : 85±2°C Relative humidity : 85±5% Test duration : 1000hr	B-121A test code C	22	
	4	Temperature Humidity BIAS	Temperature : 85±2°C Relative humidity : 85±5% Bias Voltage : V_{DS}(max) * 0.8 Test duration : 1000hr	B-122A test code C	22	
	5	Unsaturated Pressurized Vapor	Temperature : 130±2°C Relative humidity : 85±5% Vapor pressure : 230kPa Test duration : 48hr	B-123A test code C	22	
	6	Temperature Cycle	High temp.side : 150±5°C Low temp.side : -55±5°C Duration time : HT 30min,LT 30min Number of cycles : 100cycles	B-131A test code A	22	
	7	Thermal Shock	Fluid : pure water(running water) High temp.side : 100+0/-5°C Low temp.side : 0+5/-0°C Duration time : HT 5min,LT 5min Number of cycles : 100cycles	B-141A test code A	22	
Test for FET	1	Intermittent Operating Life	Ta=25±5°C ΔTc=90degree Tch≤Tch(max.) Test duration : 3000 cycle	D-322	22	(0:1)
	2	HTRB (Gate-source)	Temperature : 150+0/-5°C Bias Voltage : V_{GS}(max) Test duration : 1000hr	D-323	22	
	3	HTRB (Drain-Source)	Temperature : 150+0/-5°C Bias Voltage : V_{DS}(max)*0.8 Test duration : 1000hr	D-323	22	

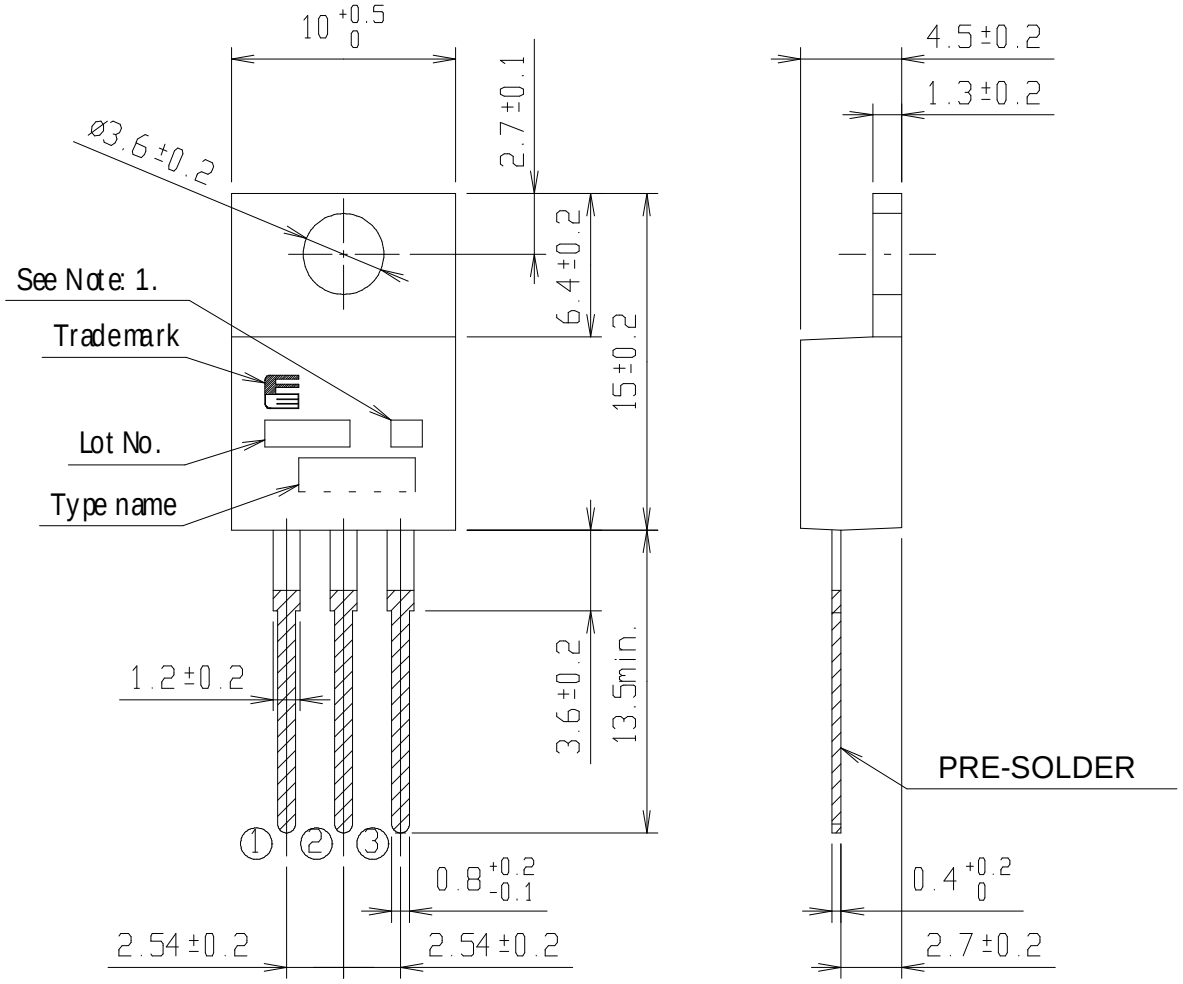
Failure Criteria

Item		Symbols	Failure Criteria		Unit
			Lower Limit	Upper Limit	
Electrical Characteristics	Breakdown Voltage	BVDSS	LSL * 1.0	-----	V
	Zero gate Voltage Drain-Source Current	IDSS	-----	USL * 2	A
	Gate-Source Leakage Current	IGSS	-----	USL * 2	A
	Gate Threshold Voltage	VGS(th)	LSL * 0.8	USL * 1.2	V
	Drain-Source on-state Resistance	RDS(on)	-----	USL * 1.2	Ω
	Forward Transconductance	gfs	LSL * 0.8	-----	S
	Diode forward on-Voltage	VSD	-----	USL * 1.2	V
Outview	Marking Soldering and other damages	-----	With eyes or Microscope		-----

* LSL : Lower Specification Limit * USL : Upper Specification Limit

* Before any of electrical characteristics measure, all testing related to the humidity have conducted after drying the package surface for more than an hour at 150°C.

FUJI POWER MOS FET



CONNECTION

① GATE
② DRAIN
③ SOURCE

JEDEC : TO-220AB

Note: 1. Guaranteed mark of avalanche ruggedness.

DIMENSIONS ARE IN MILLIMETERS.

9. Cautions

・Although Fuji Electric is continually improving 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 physical injury, fire, or other problem in case any of the products fail. It is recommended to make your design fail-safe, flame retardant, and free of malfunction.

・The products described in this Specification are intended for use in the following electronic and electrical equipment which has normal reliability requirements.

・Computers	・OA equipment	・Communications equipment(Terminal devices)
・Machine tools	・AV equipment	・Measurement equipment
・Personal equipment	・Industrial robots	・Electrical home appliances etc.

・The products described in this Specification are not designed or manufactured to be used in equipment or systems used under life-threatening situations. If you are considering using these products in the equipment listed below, first check the system construction and required reliability, and take adequate safety measures such as a backup system to prevent the equipment from malfunctioning.

・Backbone network equipment	・Transportation equipment (automobiles, trains, ships, etc.)
・Traffic-signal control equipment	・Gas alarms, leakage gas auto breakers
・Submarine repeater equipment	・Burglar alarms, fire alarms, emergency equipment
・Medical equipment	・Nuclear control equipment etc.

・Do not use the products in this Specification for equipment requiring strict reliability such as(but not limited to):

・Aerospace equipment ・Aeronautical equipment

10. Warnings

・The MOSFETs should be used in products within their absolute maximum rating(voltage, current, temperature, etc.).

・The MOSFETs may be destroyed if used beyond the rating.

・We only guarantee the non-repetitive and repetitive Avalanche capability and not for the continuous Avalanche capability which can be assumed as abnormal condition .Please note the device may be destructed from the Avalanche over the specified maximum rating.

・The equipment containing MOSFETs should have adequate fuses or circuit breakers to prevent the equipment from causing secondary destruction (ex. fire, explosion etc...).

・Use the MOSFETs within their reliability and lifetime under certain environments or conditions. The MOSFETs may fail before the target lifetime of your products if used under certain reliability conditions.

・Be careful when handling MOSFETs for ESD damage. (It is an important consideration.)

・When handling MOSFETs, hold them by the case (package) and don't touch the leads and terminals.

・ It is recommended that any handling of MOSFETs is done on grounded electrically conductive floor and tablemats.

・Before touching a MOSFET terminal, Discharge any static electricity from your body and clothes by grounding out through a high impedance resistor (about 1MΩ)
・ When soldering, in order to protect the MOSFETs from static electricity, ground the soldering iron or soldering bath through a low impedance resistor.

・You must design the MOSFETs to be operated within the specified maximum ratings(voltage, current, temperature, etc.) to prevent possible failure or destruction of devices.
・Consider the possible temperature rise not only for the channel and case, but also for the outer leads.
・Do not directly touch the leads or package of the MOSFETs while power is supplied or during operation in order to avoid electric shock and burns.
・The MOSFETs are made of incombustible material. However, if a MOSFET fails, it may emit smoke or flame. Also, operating the MOSFETs near any flammable place or material may cause the MOSFETs to emit smoke or flame in case the MOSFETs become even hotter during operation. Design the arrangement to prevent the spread of fire.
・The MOSFETs should not used in an environment in the presence of acid, organic matter, or corrosive gas(hydrogen sulfide, sulfurous acid gas etc.)
・The MOSFETs should not used in an irradiated environment since they are not radiation-proof.

Installation

・Soldering involves temperatures which exceed the device storage temperature rating. To avoid device damage and to ensure reliability, observe the following guidelines from the quality assurance standard.

Solder temperature and duration (through-hole package)

Solder temperature	Duration
260±5 °C	10±1 seconds
350±10 °C	3.5±0.5 seconds

・The immersion depth of the lead should basically be up to the lead stopper and the distance should be a maximum of 1.5mm from the device.
・When flow-soldering, be careful to avoid immersing the package in the solder bath.
・Refer to the following torque reference when mounting the device on a heat sink. Excess torque applied to the mounting screw causes damage to the device and weak torque will increase the thermal resistance, both of which conditions may destroy the device.

Table 1: Recommended tightening torques.

Package style	Screw	Tightening torques	Note
TO-220 TO-220F	M3	30 – 50 Ncm	flatness : < ±30μm roughness : <10μm Plane off the edges : C<1.0mm
TO-3P TO-3PF TO-247	M3	40 – 60 Ncm	
TO-3PL	M3	60 –80 Ncm	

・The heat sink should have a flatness within730 μm and roughness within 10 μm. Also, keep the tightening torque within the limits of this specification.
・Improper handling may cause isolation breakdown leading to a critical accident.
ex.) Over plane off the edges of screw hole. (Recommended plane off the edge is C<1.0mm)
・We recommend the use of thermal compound to optimize the efficiency of heat radiation. It is important to evenly apply the compound and to eliminate any air voids.

Storage

・The MOSFETs must be stored at a standard temperature of 5 to 35°C and relative humidity of 45 to 75%.
・If the storage area is very dry, a humidifier may be required. In such a case, use only deionized water or boiled water, since the chlorine in tap water may corrode the leads.
・The MOSFETs should not be subjected to rapid changes in temperature to avoid condensation on the surface of the MOSFETs. Therefore store the MOSFETs in a place where the temperature is steady.
・The MOSFETs should not be stored on top of each other, since this may cause excessive external force on the case.
・The MOSFETs should be stored with the lead terminals remaining unprocessed. Rust may cause presoldered connections to fail during later processing.
・The MOSFETs should be stored in antistatic containers or shipping bags.

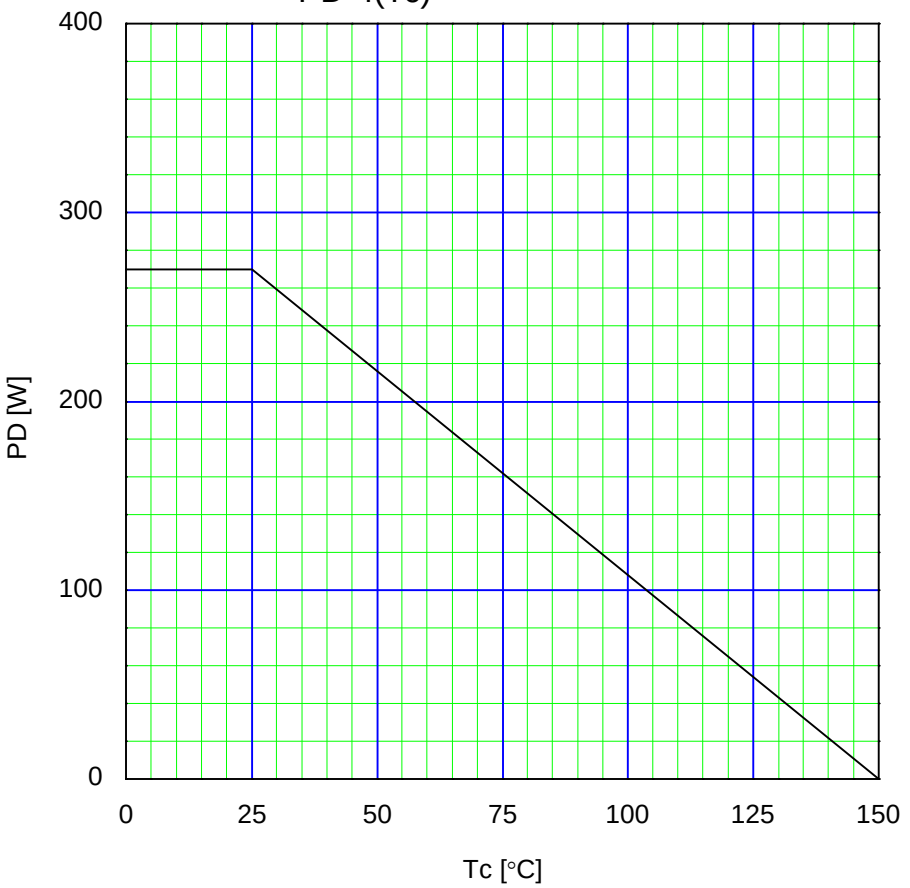
11.Appendix

・These products do not contain PBBs (Polybrominated Biphenyl) or PBDEs (Polybrominated Diphenyl Ether).
・These products do not contain Class-I ODS and Class-II ODS of 'Clean Air Act of US'.

・ If you have any questions about any part of this Specification, please contact Fuji Electric or its sales agent before using the product.
・ Neither Fuji nor its agents shall be held liable for any injury caused by using the products not in accordance with the instructions.
・ The application examples described in this specification are merely typical uses of Fuji Electric products.
・ This specification does not confer any industrial property rights or other rights, nor constitute a license for such rights.

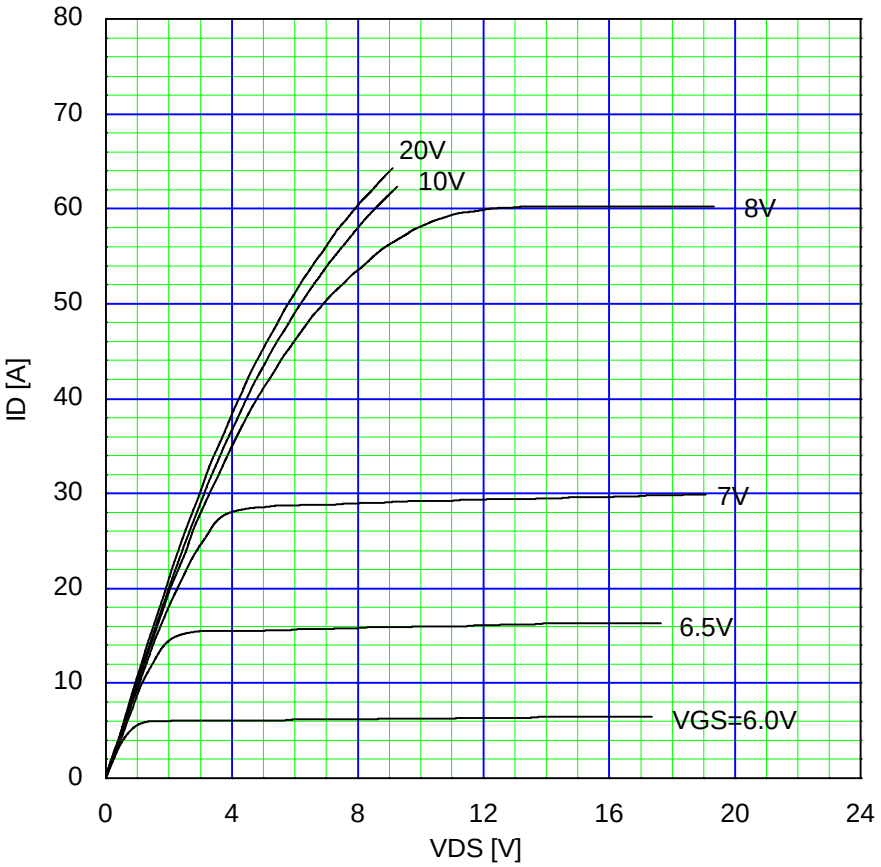
Allowable Power Dissipation

PD=f(Tc)

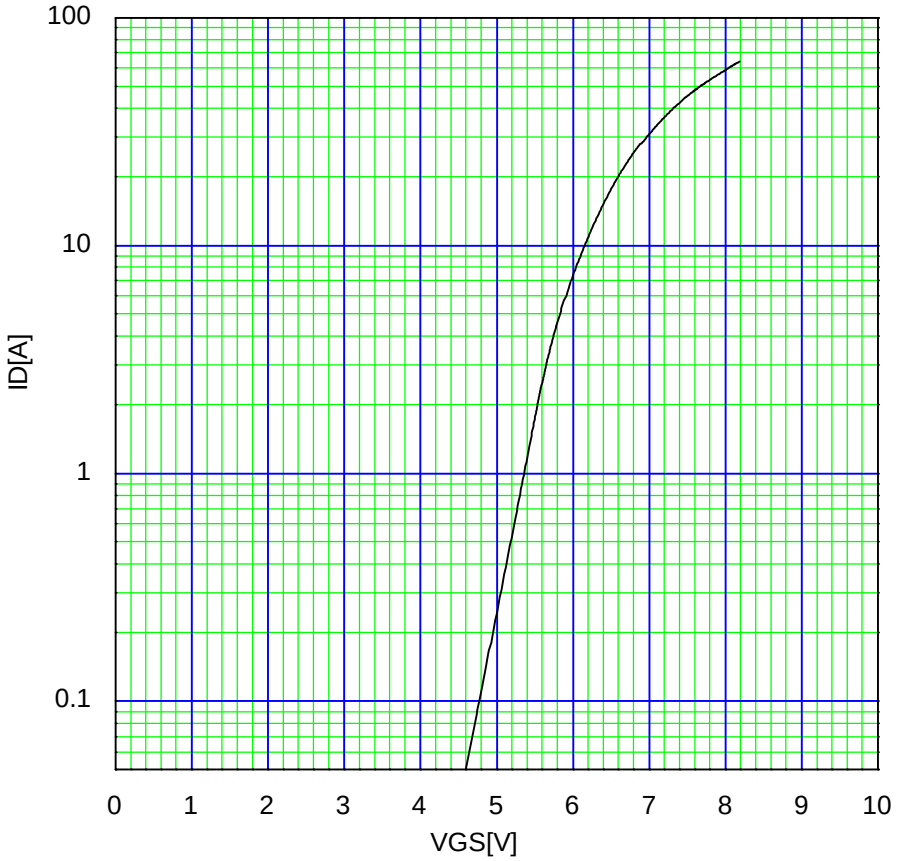


Typical Output Characteristics

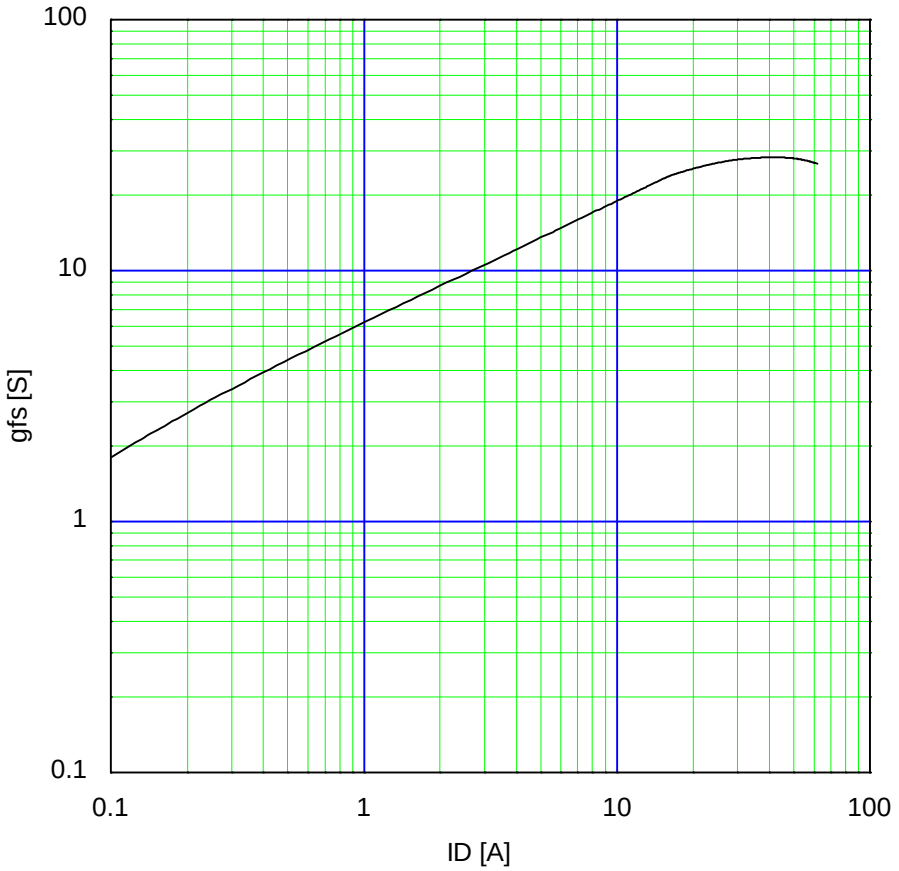
ID=f(VDS):80 μs pulse test,Tch=25 °C



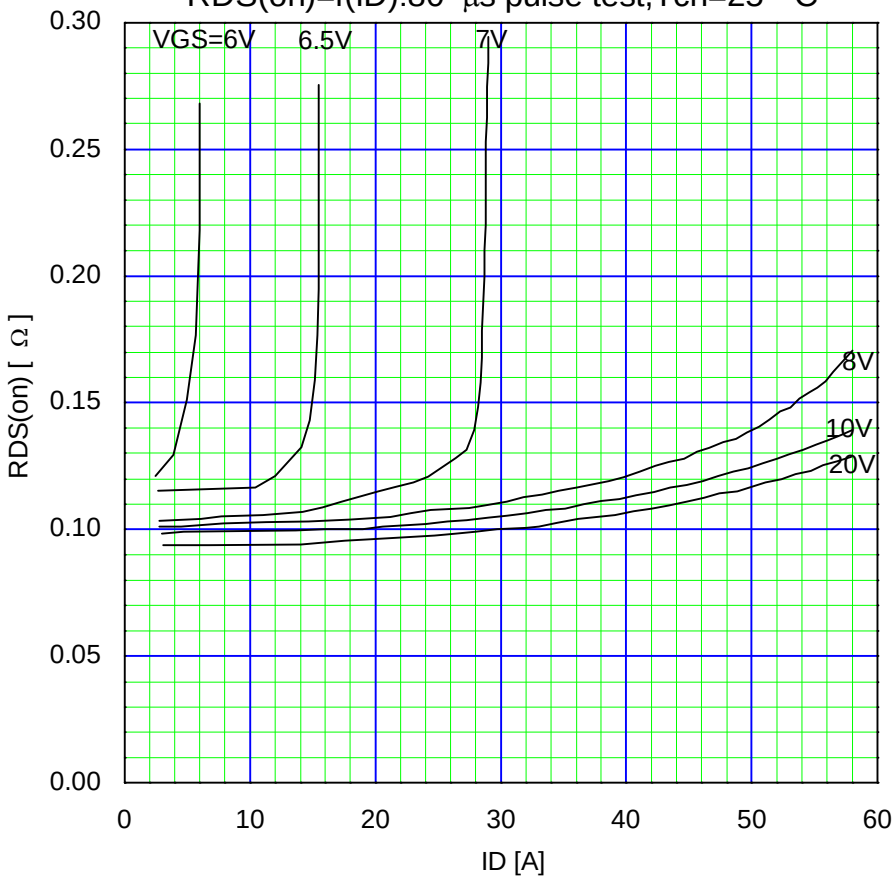
Typical Transfer Characteristic
ID=f(VGS):80 μs pulse test,VDS=25V,Tch=25 °C



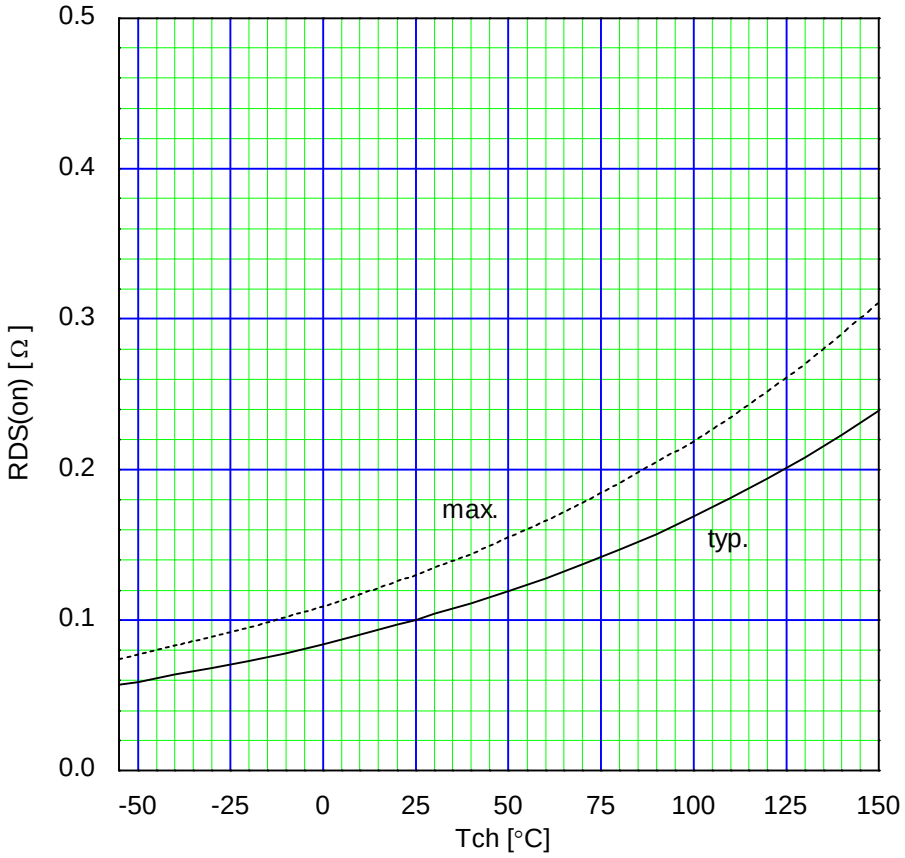
Typical Transconductance
gfs=f(ID):80 μs pulse test,VDS=25V,Tch=25 °C



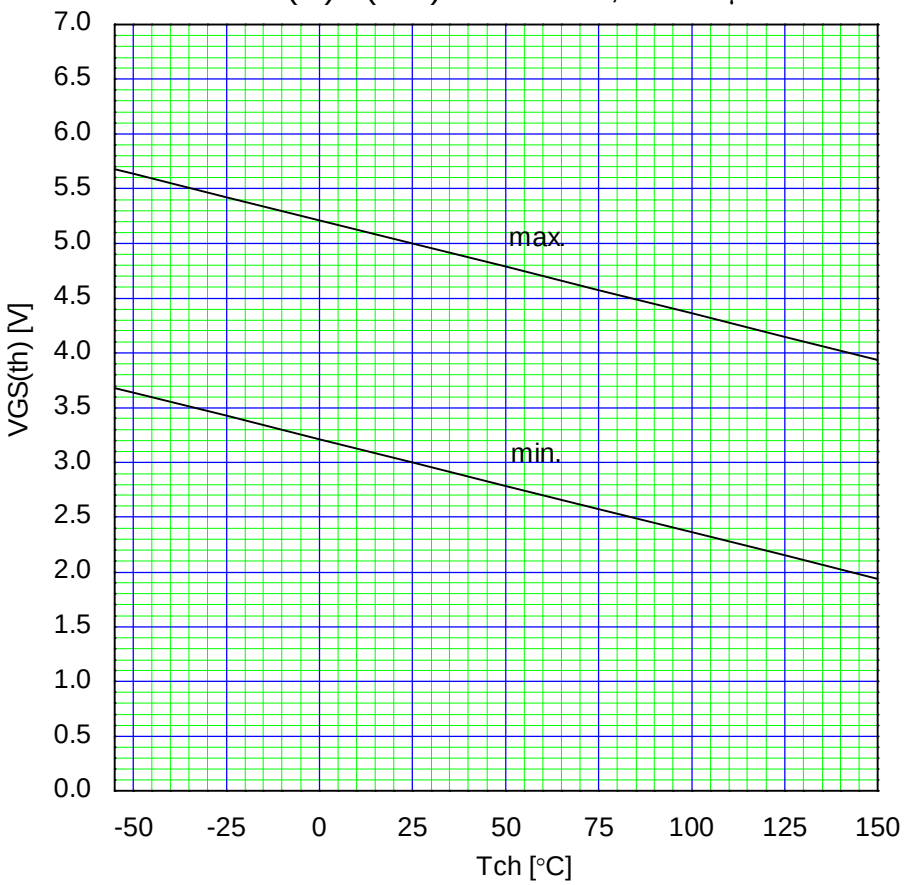
Typical Drain-Source on-state Resistance
RDS(on)=f(ID):80 μs pulse test,Tch=25 °C



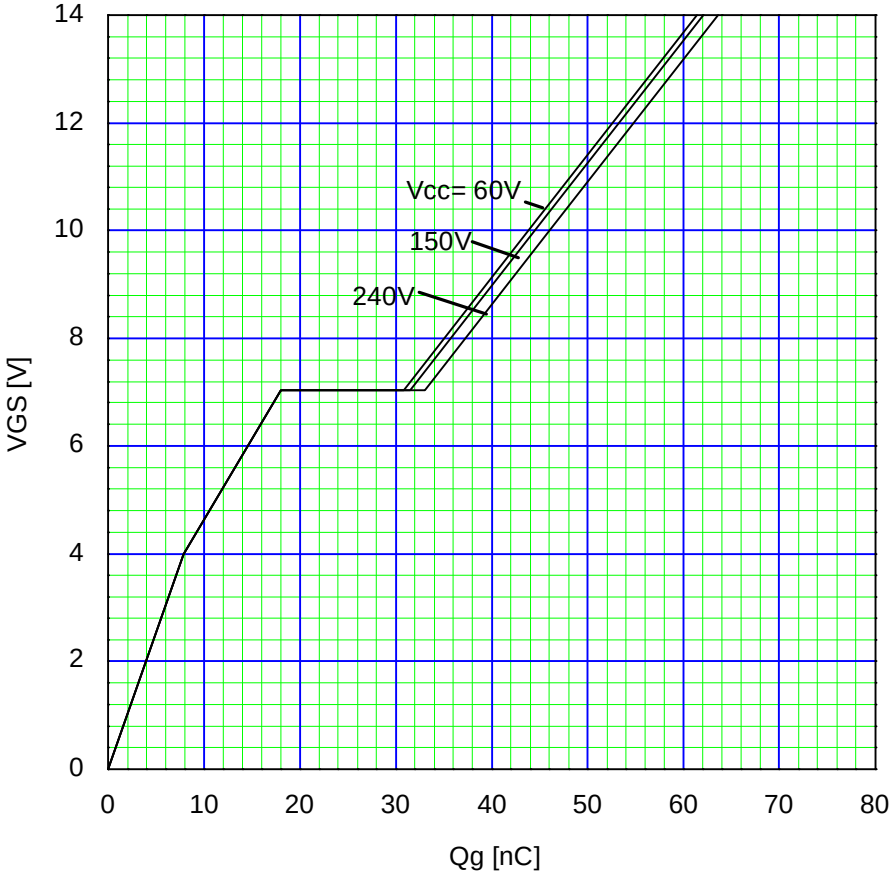
Drain-Source On-state Resistance
RDS(on)=f(Tch):ID=16A,VGS=10V



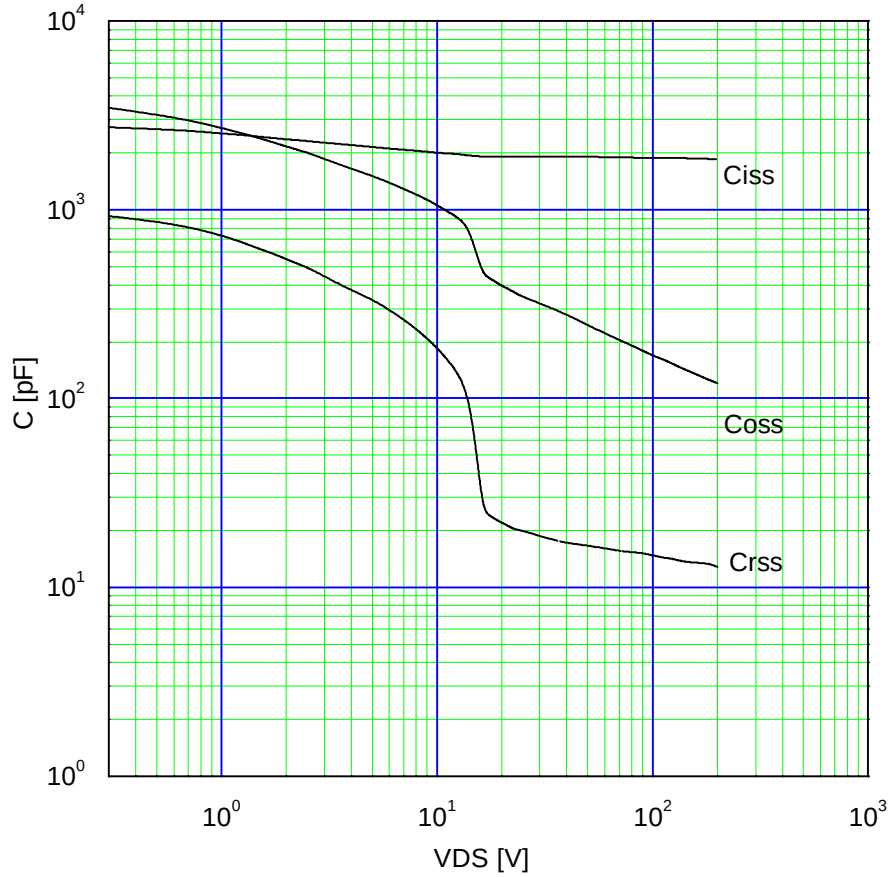
Gate Threshold Voltage vs. Tch
VGS(th)=f(Tch):VDS=VGS,ID=250μA



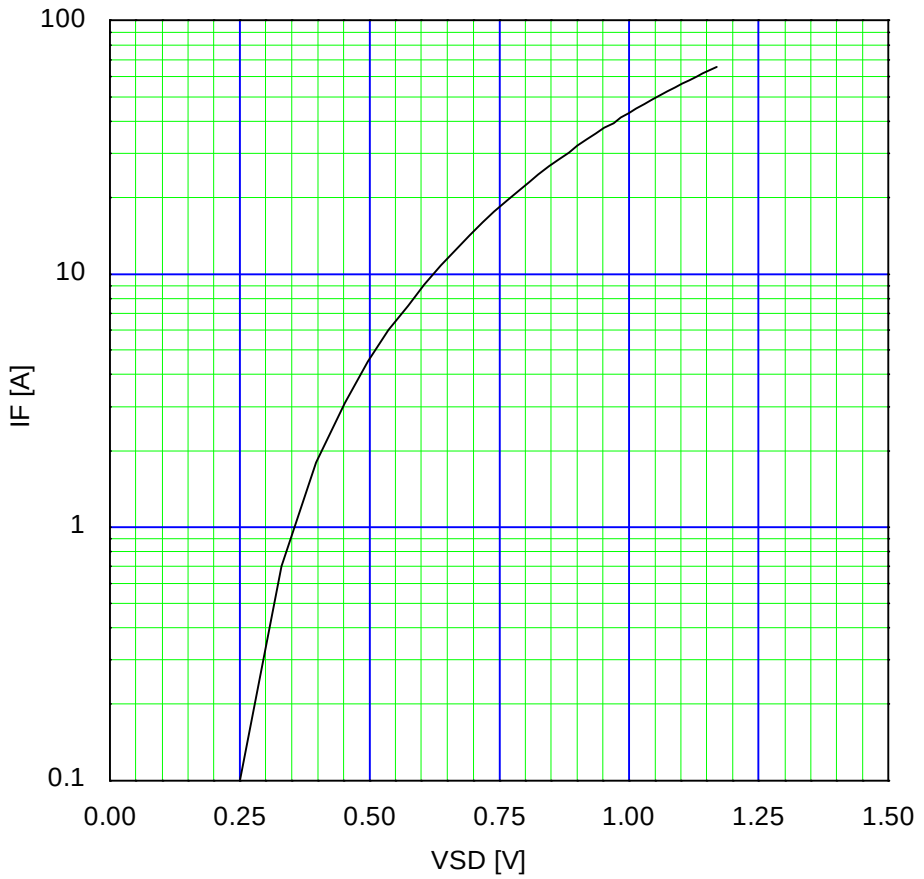
Typical Gate Charge Characteristics
VGS=f(Qg):ID=32A,Tch=25 °C



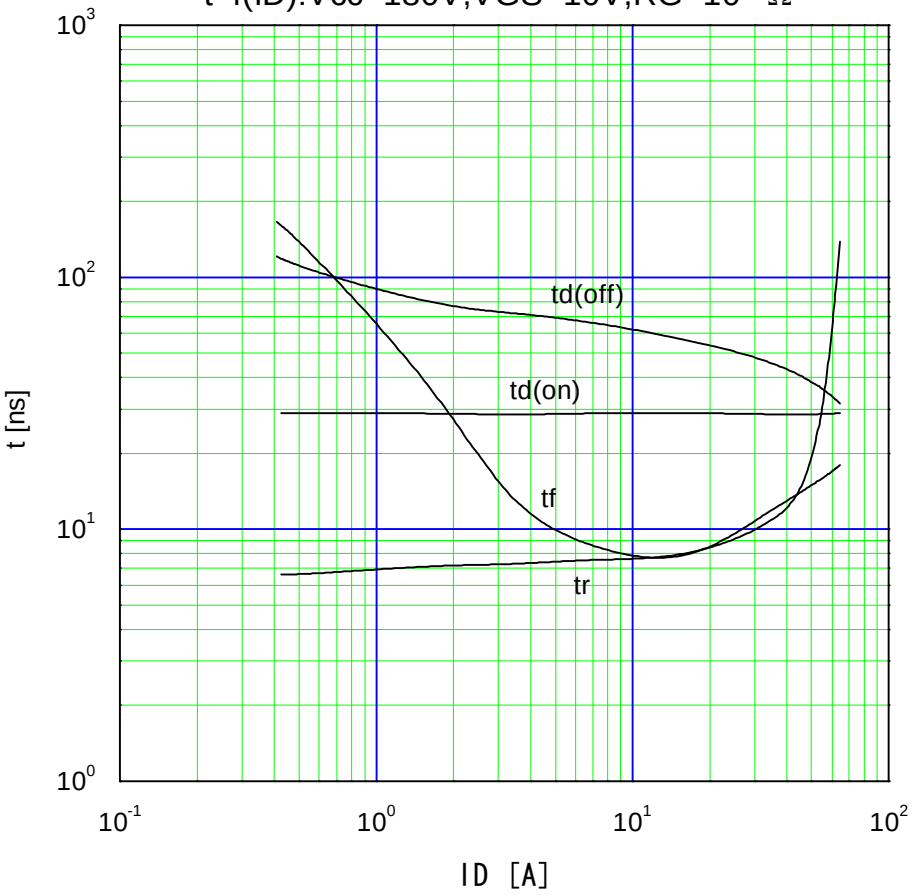
Typical Capacitance
C=f(VDS):VGS=0V,f=1MHz



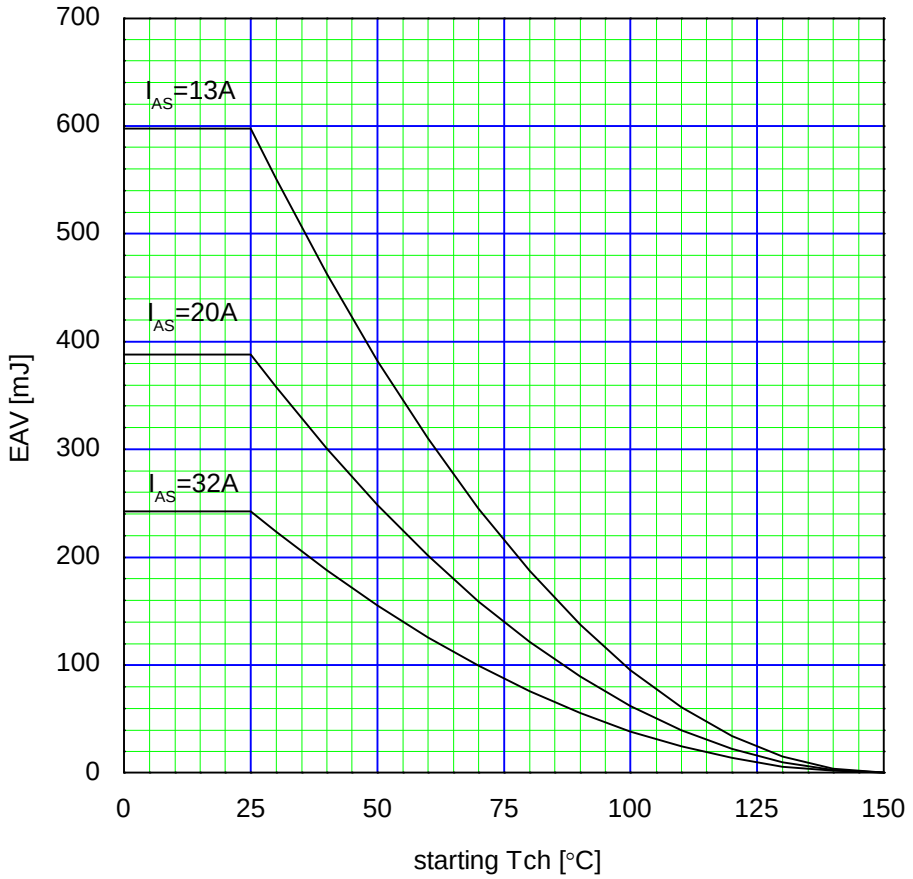
Typical Forward Characteristics of Reverse Diode
IF=f(VSD):80 μs pulse test,Tch=25 °C



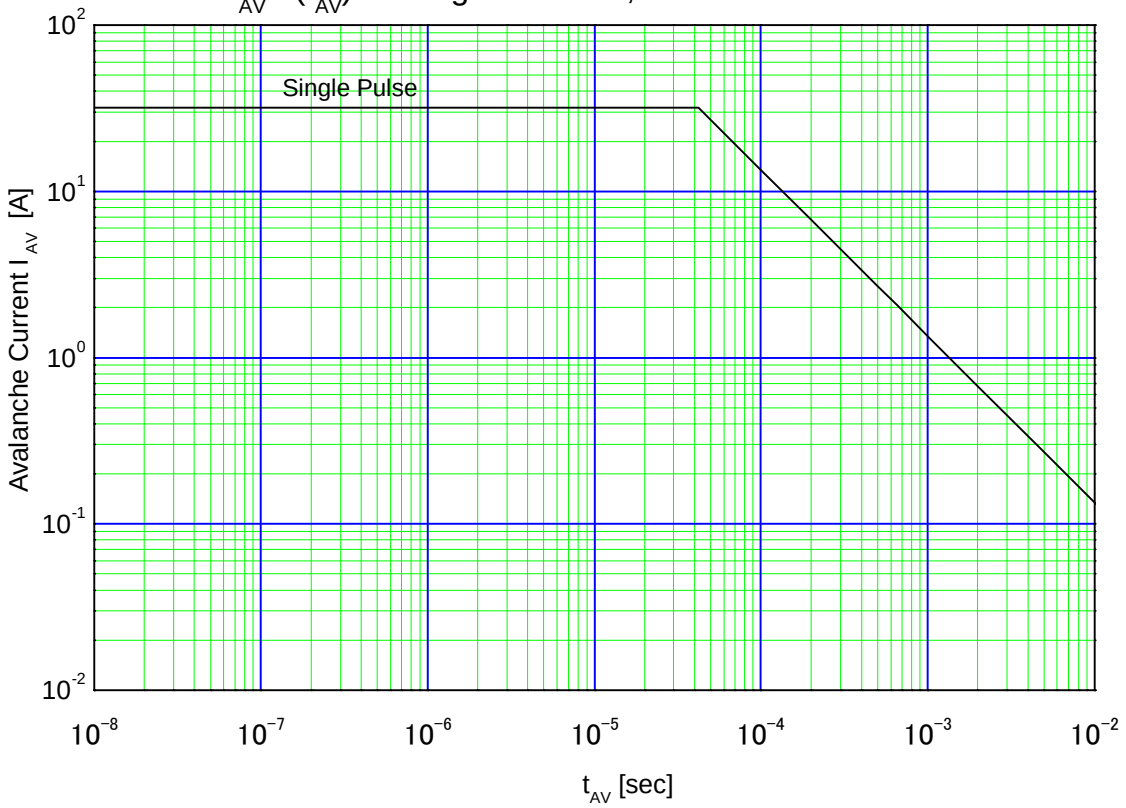
Typical Switching Characteristics vs. ID
t=f(ID):Vcc=180V,VGS=10V,RG=10 Ω



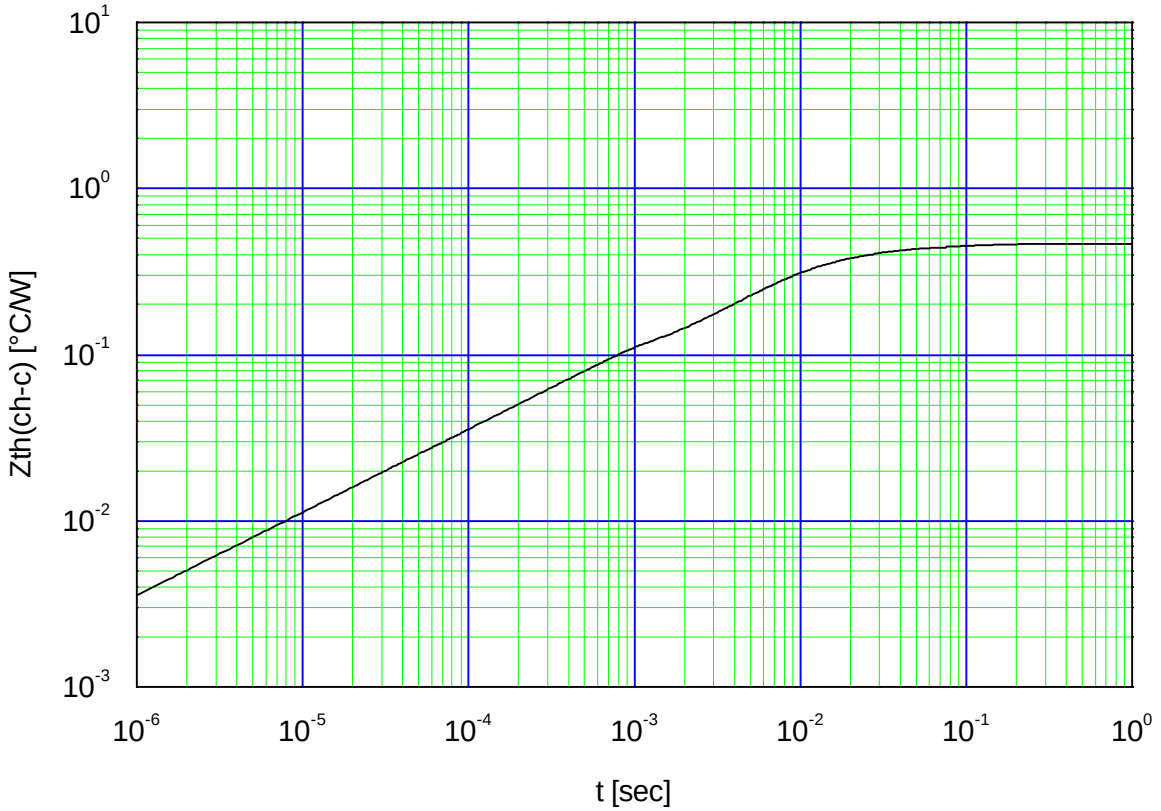
Maximum Avalanche Energy vs. starting Tch
E(AV)=f(starting Tch):Vcc=48V,I(AV)<=32A



Maximum Avalanche Current Pulsewidth
$I_{AV}=f(t_{AV})$:starting Tch=25°C,Vcc=48V



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



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