

To our customers,

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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# MOS FIELD EFFECT TRANSISTOR

## 2SJ604

### SWITCHING

### P-CHANNEL POWER MOS FET

#### DESCRIPTION

The 2SJ604 is P-channel MOS Field Effect Transistor designed for solenoid, motor and lamp driver.

#### FEATURES

- Super low on-state resistance:
  - $R_{DS(on)1} = 30 \text{ m}\Omega \text{ MAX. (} V_{GS} = -10 \text{ V, } I_D = -23 \text{ A)}$
  - $R_{DS(on)2} = 43 \text{ m}\Omega \text{ MAX. (} V_{GS} = -4.0 \text{ V, } I_D = -23 \text{ A)}$
- Low input capacitance:
  - $C_{iss} = 3300 \text{ pF TYP. (} V_{DS} = -10 \text{ V, } V_{GS} = 0 \text{ V)}$
- Built-in gate protection diode

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ )

Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )	$V_{DS}$	-60	V
Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )	$V_{GS}$	$\mp 20$	V
Drain Current (DC) ( $T_C = 25^\circ\text{C}$ )	$I_{D(DC)}$	$\mp 45$	A
Drain Current (pulse) <sup>Note1</sup>	$I_{D(pulse)}$	$\mp 120$	A
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_T$	70	W
Total Power Dissipation ( $T_A = 25^\circ\text{C}$ )	$P_T$	1.5	W
Channel Temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$
Single Avalanche Current <sup>Note2</sup>	$I_{AS}$	-35	A
Single Avalanche Energy <sup>Note2</sup>	$E_{AS}$	123	mJ

**Notes 1.**  $PW \leq 10 \mu\text{s}$ , Duty cycle  $\leq 1\%$

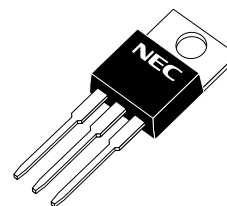
**2.** Starting  $T_{ch} = 25^\circ\text{C}$ ,  $V_{DD} = -30 \text{ V}$ ,  $R_G = 25 \Omega$ ,  $V_{GS} = -20 \rightarrow 0 \text{ V}$

#### ORDERING INFORMATION

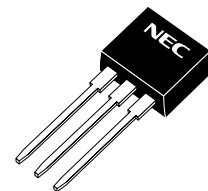
PART NUMBER	PACKAGE
2SJ604	TO-220AB
2SJ604-S	TO-262
2SJ604-ZJ	TO-263
2SJ604-Z	TO-220SMD <sup>Note</sup>

**Note** TO-220SMD package is produced only in Japan

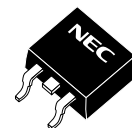
(TO-220AB)



(TO-262)



(TO-263, TO-220SMD)

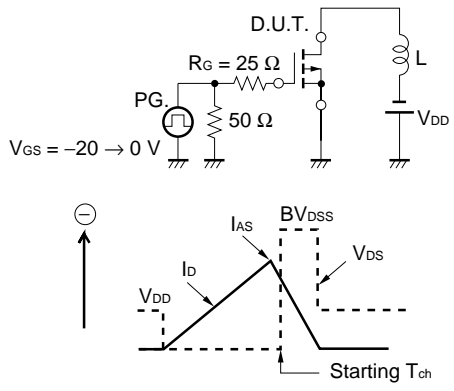


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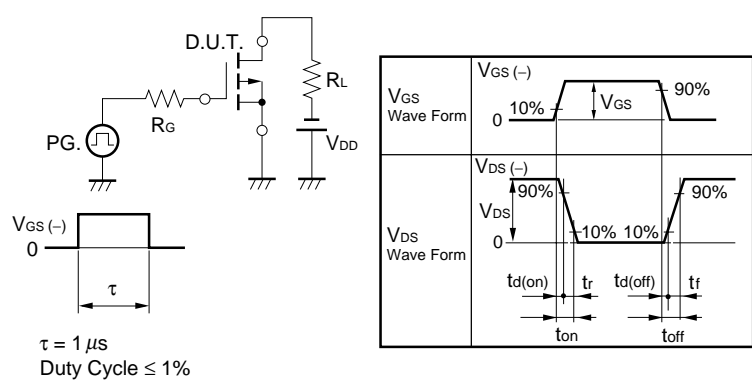
**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)**

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = -60 V, V <sub>GS</sub> = 0 V			-10	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±10	μA
Gate Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1 mA	-1.5	-2.0	-2.5	V
Forward Transfer Admittance	y <sub>fs</sub>	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -23 A	20	41		S
Drain to Source On-state Resistance	R <sub>DS(on)1</sub>	V <sub>GS</sub> = -10 V, I <sub>D</sub> = -23 A		23	30	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = -4.0 V, I <sub>D</sub> = -23 A		30	43	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = -10 V		3300		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V		580		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		230		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = -30 V, I <sub>D</sub> = -23 A		12		ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = -10 V		11		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		77		ns
Fall Time	t <sub>f</sub>			52		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = -48 V		63		nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = -10 V		11		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = -45 A		16		nC
Body Diode Forward Voltage	V <sub>F(S-D)</sub>	I <sub>F</sub> = 45 A, V <sub>GS</sub> = 0 V		1.0		V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 45 A, V <sub>GS</sub> = 0 V		51		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		105		nC

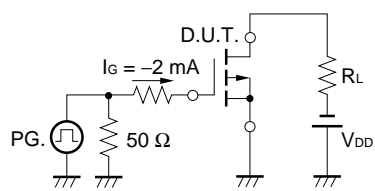
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



**TEST CIRCUIT 2 SWITCHING TIME**

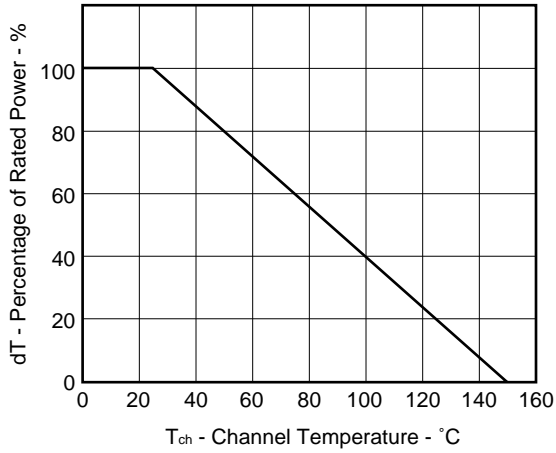


**TEST CIRCUIT 3 GATE CHARGE**

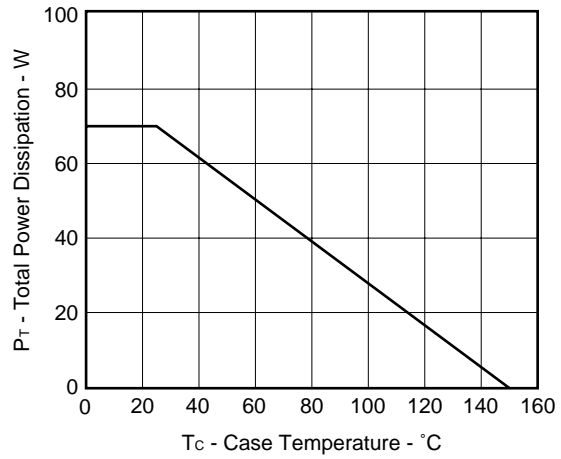


TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

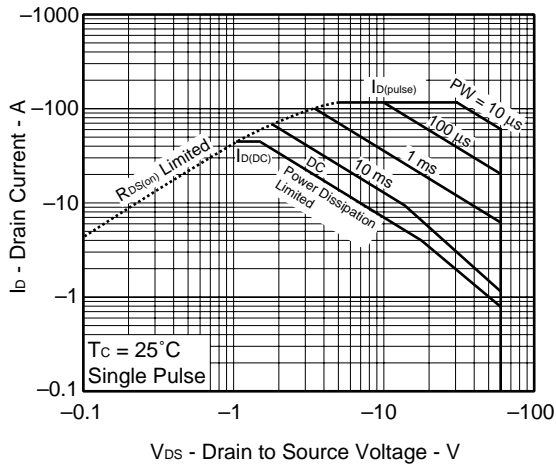
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



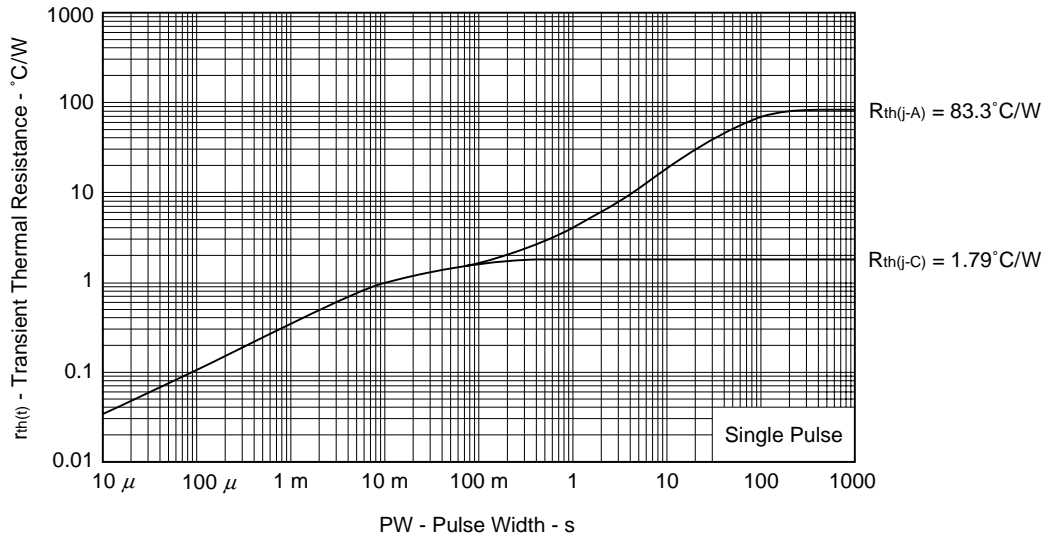
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



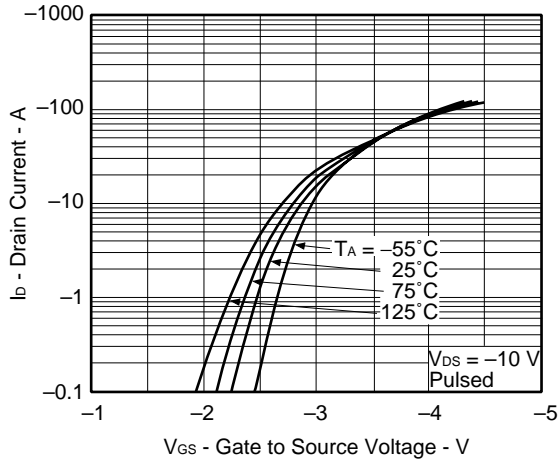
FORWARD BIAS SAFE OPERATING AREA



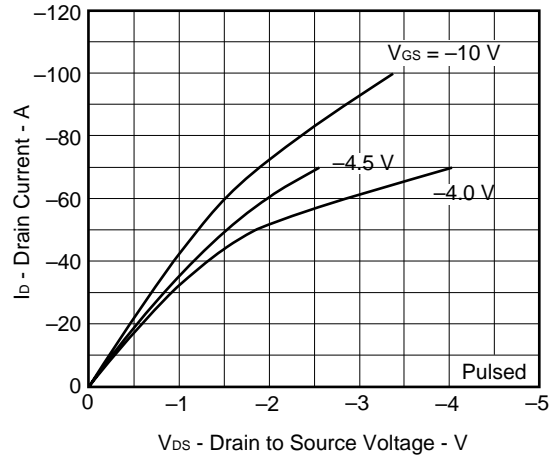
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



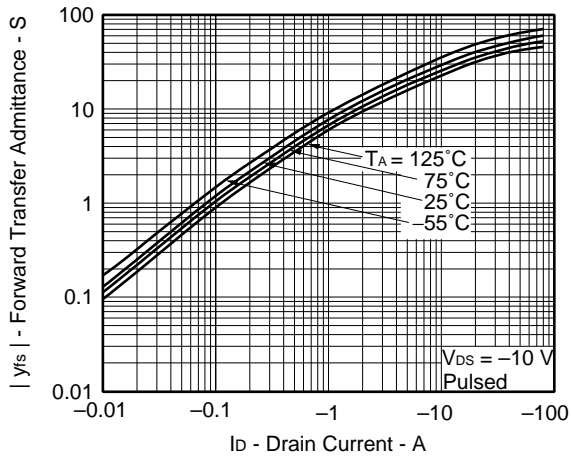
FORWARD TRANSFER CHARACTERISTICS



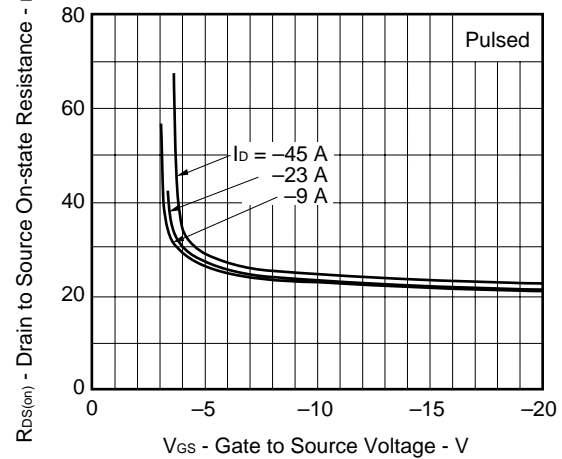
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



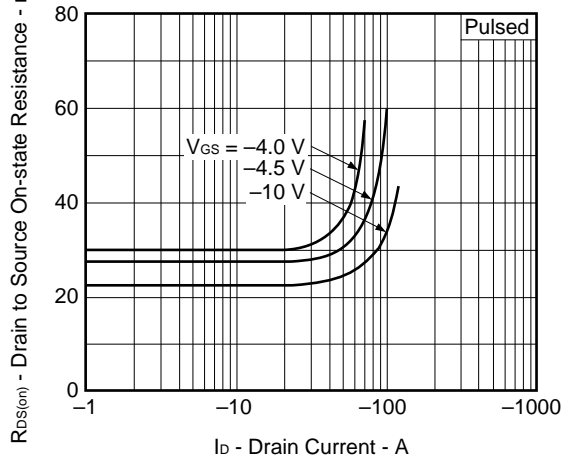
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



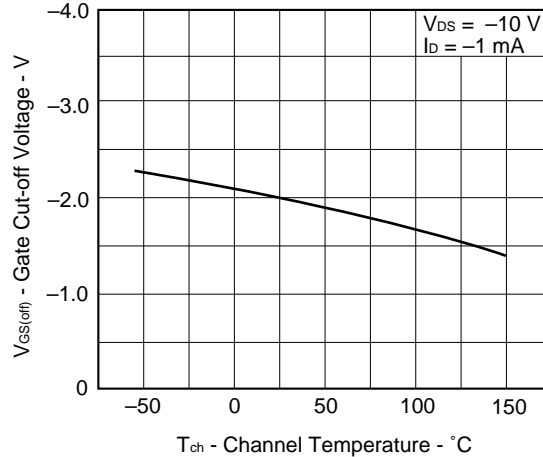
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE

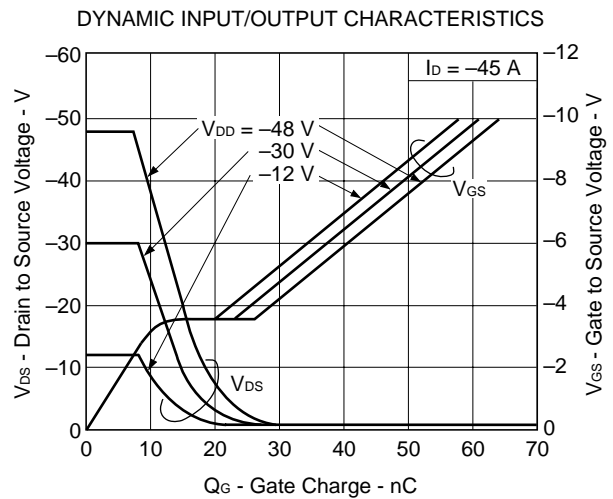
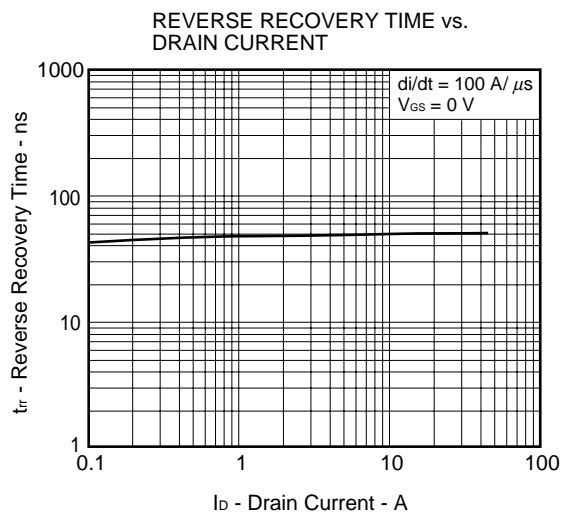
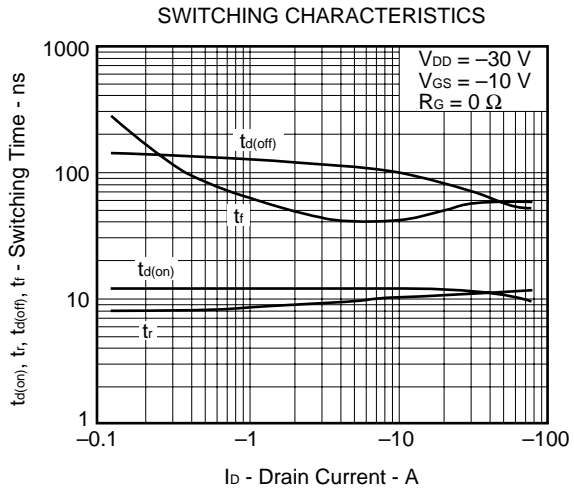
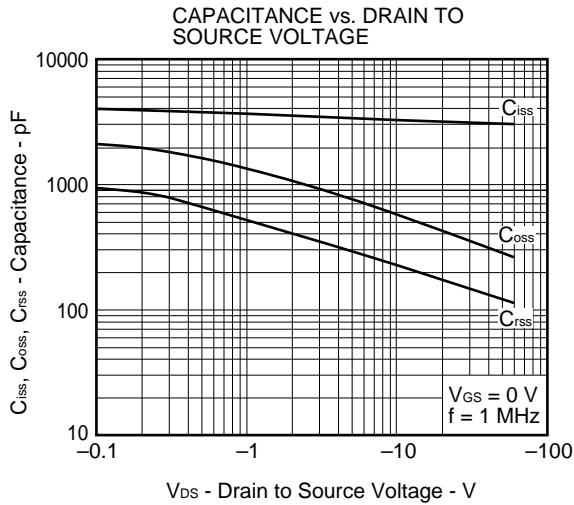
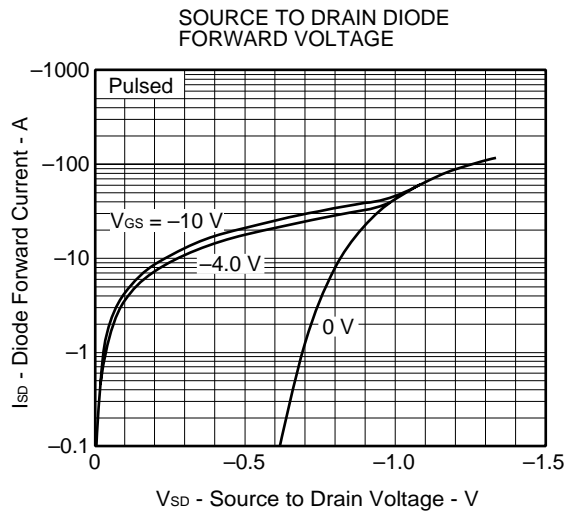
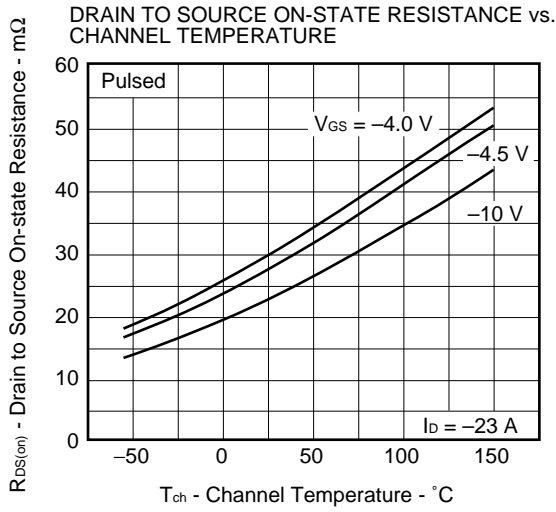


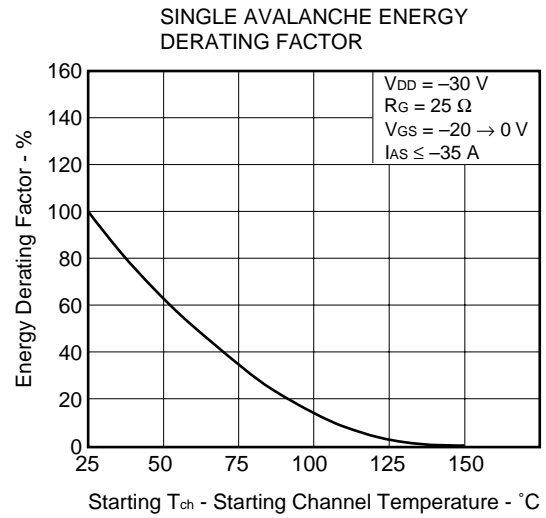
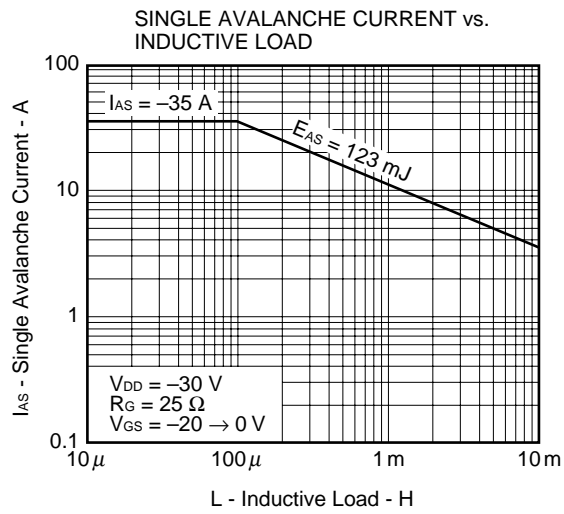
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



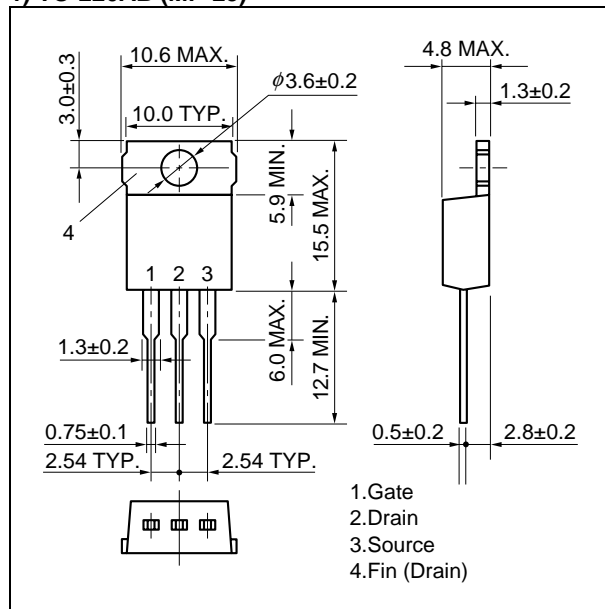




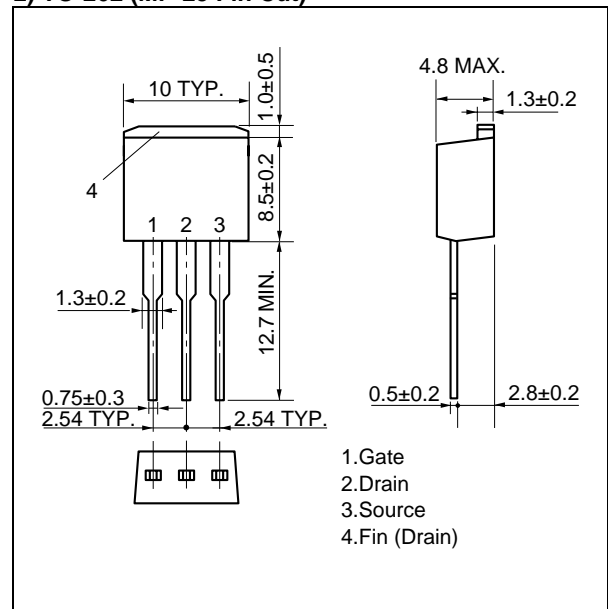


★ PACKAGE DRAWINGS (Unit: mm)

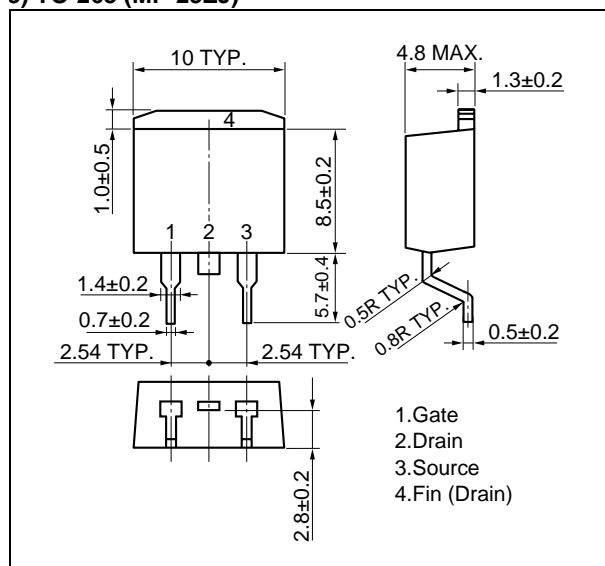
1) TO-220AB (MP-25)



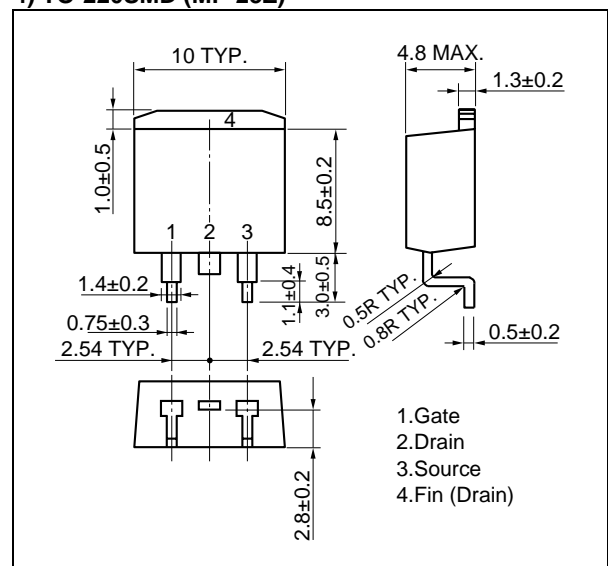
2) TO-262 (MP-25 Fin Cut)



3) TO-263 (MP-25ZJ)

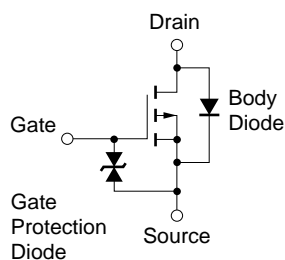


4) TO-220SMD (MP-25Z) <sup>Note</sup>



**Note** This package is produced only in Japan.

EQUIVALENT CIRCUIT



**Remark** The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.

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