

To our customers,

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## Old Company Name in Catalogs and Other Documents

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

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# MOS FIELD EFFECT TRANSISTOR

# 2SK3404

## SWITCHING

### N-CHANNEL POWER MOS FET

### INDUSTRIAL USE

#### DESCRIPTION

The 2SK3404 is N-Channel MOS FET device that features a low on-state resistance and excellent switching characteristics, designed for low voltage high current applications such as DC/DC converter with synchronous rectifier.

#### FEATURES

- 4.5-V drive available
- Low on-state resistance  
 $R_{DS(on)1} = 14 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 20 \text{ A)}$
- Low gate charge  
 $Q_G = 25 \text{ nC TYP. (} I_D = 40 \text{ A, } V_{DD} = 24 \text{ V, } V_{GS} = 10 \text{ V)}$
- Built-in gate protection diode
- Surface mount device available

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

Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )	$V_{bss}$	30	V
Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )	$V_{GSS}$	$\pm 20$	V
Drain Current (DC) ( $T_C = 25^\circ\text{C}$ )	$I_{D(DC)}$	$\pm 40$	A
Drain Current (Pulse) <sup>Note</sup>	$I_{D(pulse)}$	$\pm 160$	A
Total Power Dissipation ( $T_A = 25^\circ\text{C}$ )	$P_{T1}$	1.5	W
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{T2}$	40	W
Channel Temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$

**Note**  $PW \leq 10 \mu\text{s}$ , Duty Cycle  $\leq 1\%$

#### ORDERING INFORMATION

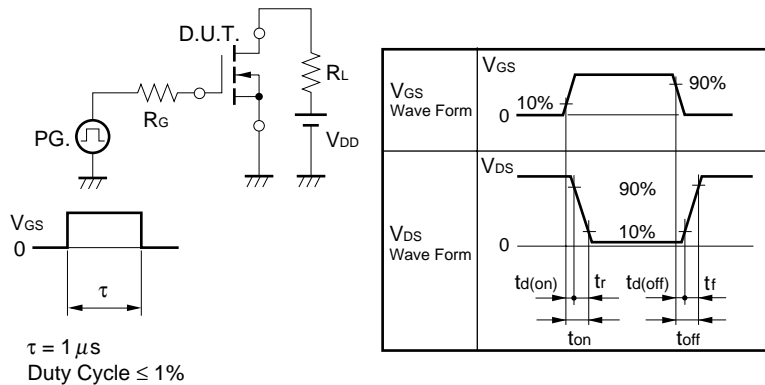
PART NUMBER	PACKAGE
2SK3404	TO-220AB
2SK3404-ZK	TO-263(MP-25ZK)
2SK3404-ZJ	TO-263(MP-25ZJ)

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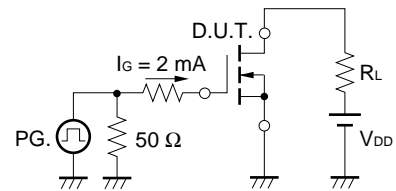
**ELECTRICAL CHARACTERISTICS(T<sub>A</sub> = 25°C)**

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Drain Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 30 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 to Source Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	1.5		2.5	V
Forward Transfer Admittance	y <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 20 A	8.0			S
Drain to Source On-state Resistance	R <sub>DS(on)1</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A		11	14	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 20 A		15	21	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 10 V		1400		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V		410		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		180		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 15 V, I <sub>D</sub> = 20 A		20		ns
Rise Time	t <sub>r</sub>	V <sub>GS(on)</sub> = 10 V		9		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 10 Ω		50		ns
Fall Time	t <sub>f</sub>			14		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 24 V		25		nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 10 V		5.0		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 40 A		7.0		nC
Diode Forward Voltage	V <sub>F(S-D)</sub>	I <sub>F</sub> = 40 A, V <sub>GS</sub> = 0 V		1.0		V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 40 A, V <sub>GS</sub> = 0 V		31		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		28		nC

**TEST CIRCUIT 1 SWITCHING TIME**

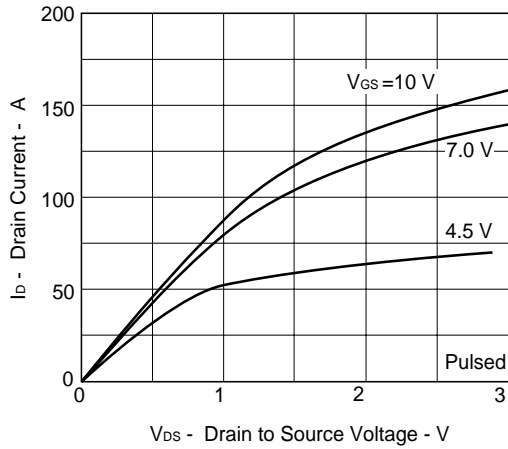


**TEST CIRCUIT 2 GATE CHARGE**

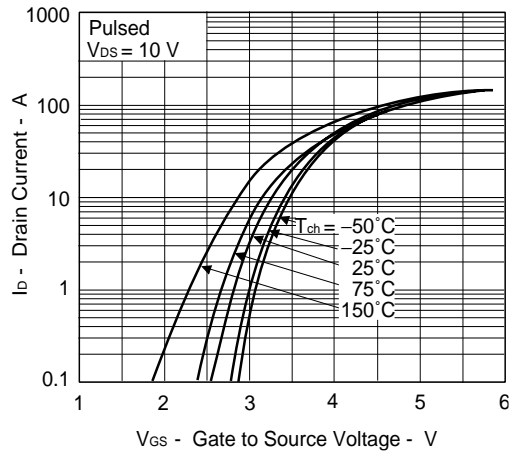


TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

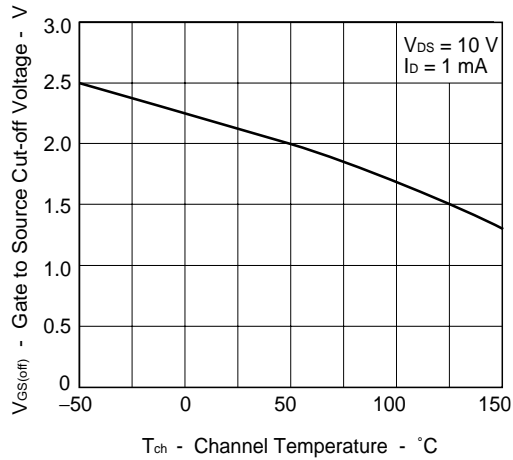
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



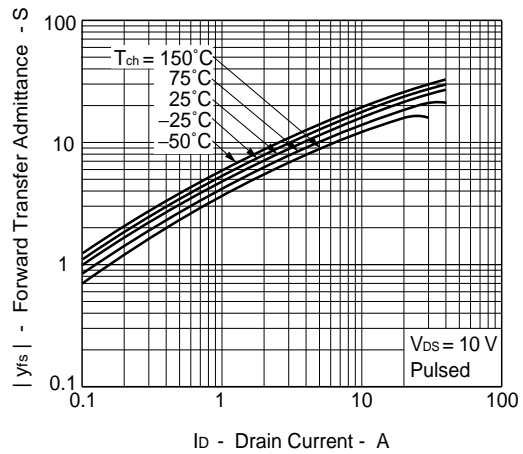
FORWARD TRANSFER CHARACTERISTICS



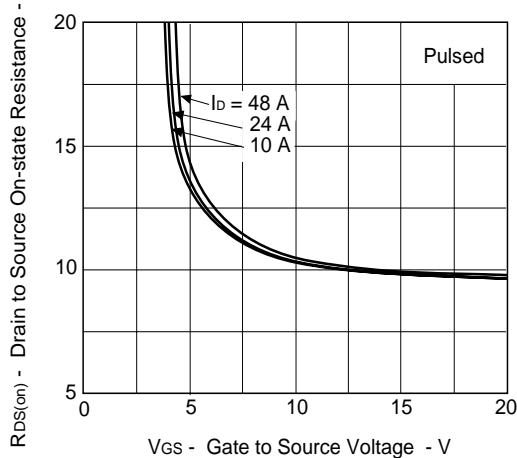
GATE TO SOURCE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



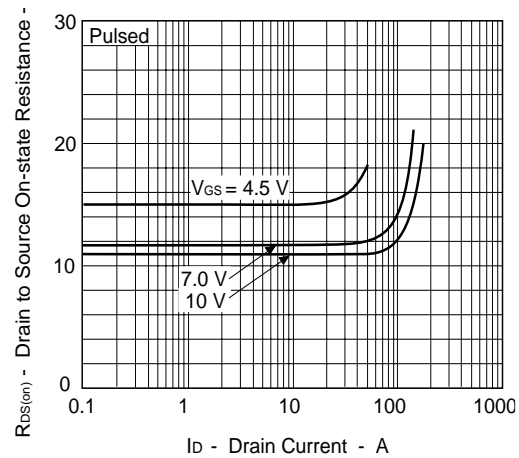
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



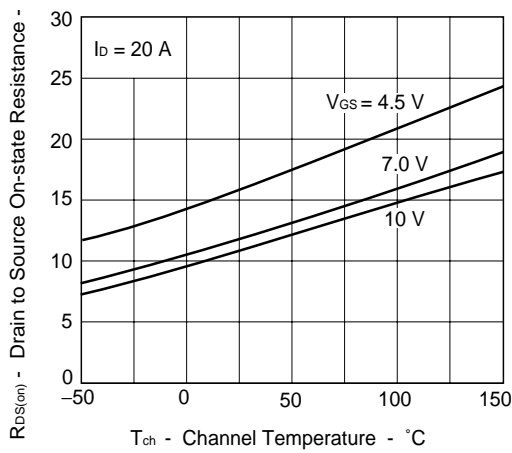
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



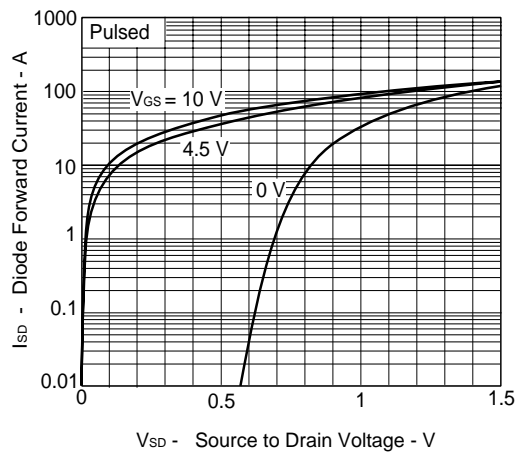
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



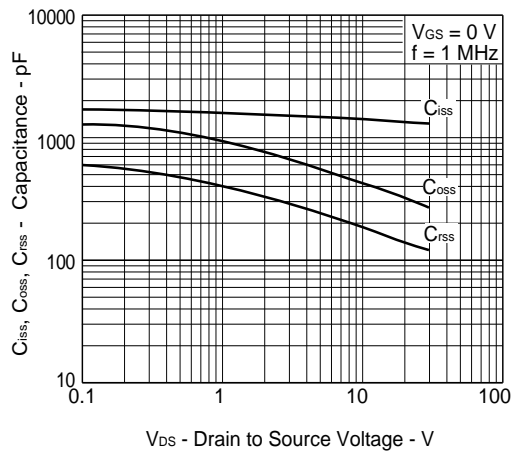
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



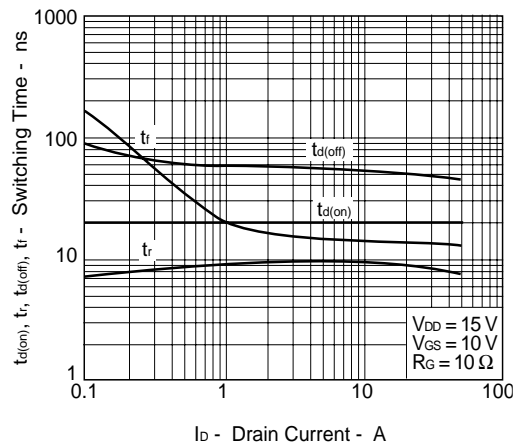
SOURCE TO DRAIN DIODE FORWARD VOLTAGE



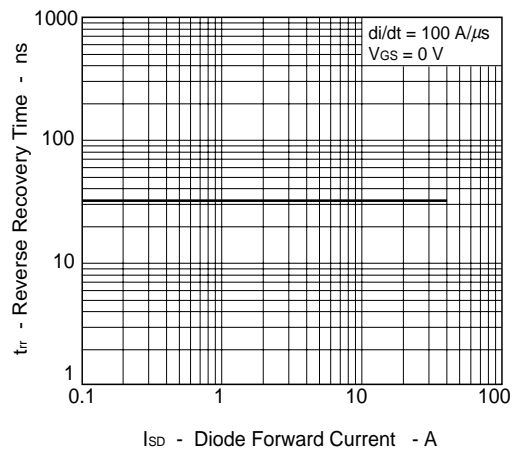
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



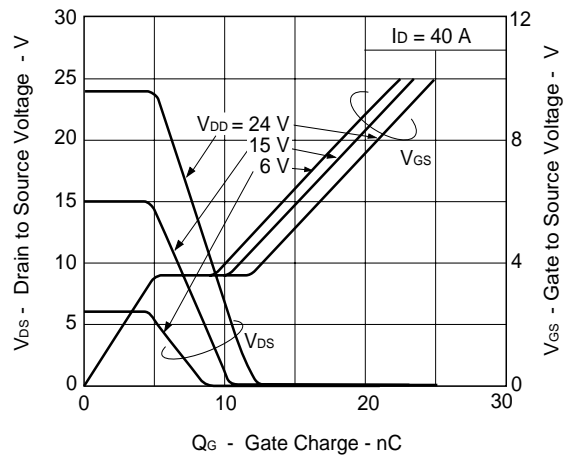
SWITCHING CHARACTERISTICS



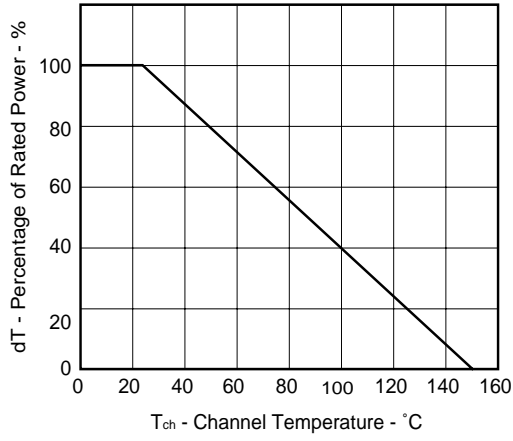
REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



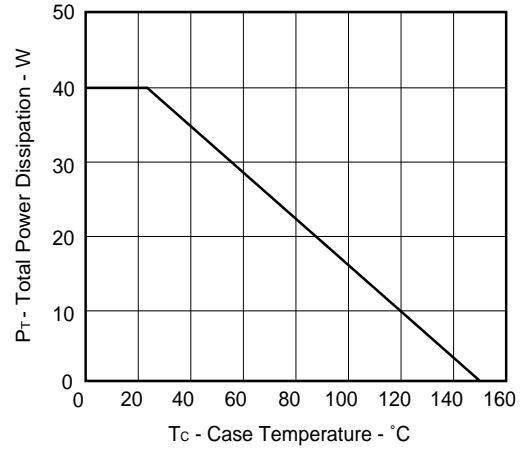
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA

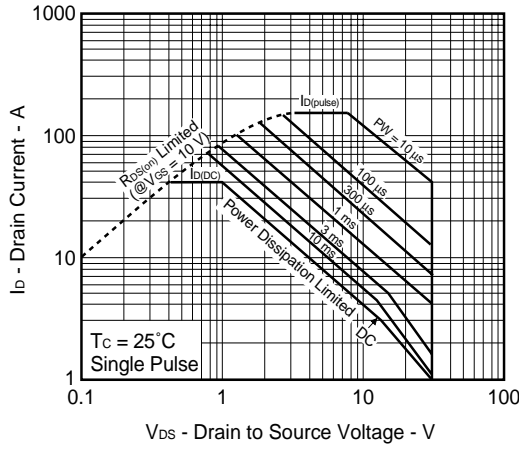


TOTAL POWER DISSIPATION vs. CASE TEMPERATURE

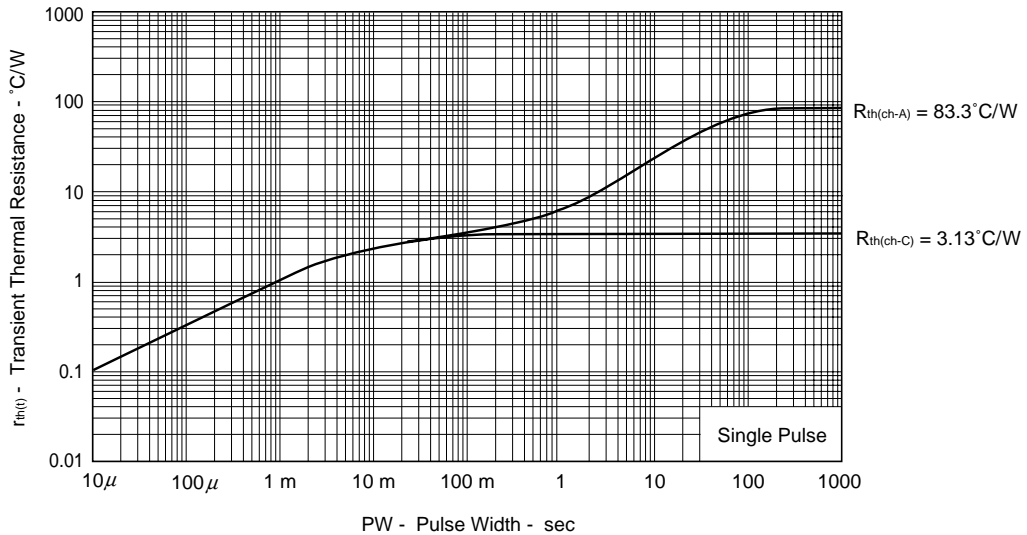


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FORWARD BIAS SAFE OPERATING AREA

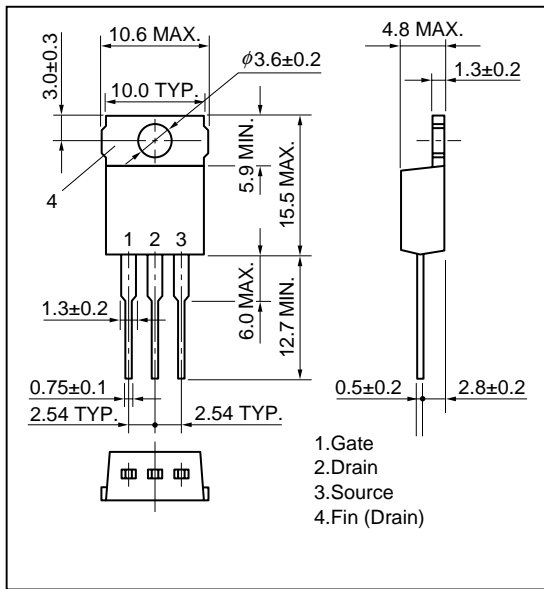


TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

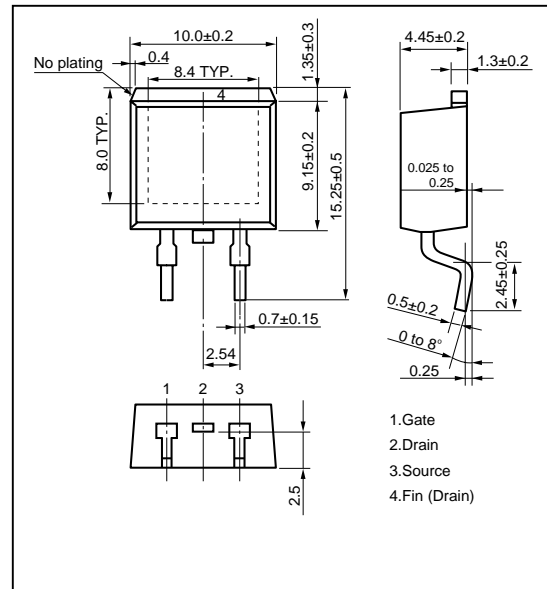


PACKAGE DRAWINGS (Unit : mm)

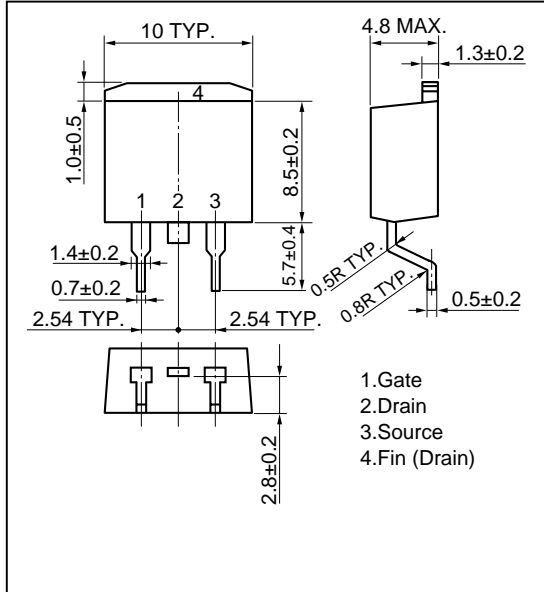
★ 1)TO-220AB (MP-25)



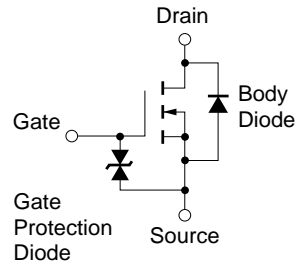
2)TO-263 (MP-25ZK)



★ 3)TO-263 (MP-25ZJ)



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.



[MEMO]

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