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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<sub>DS(on)1</sub> = 14 mΩ MAX. (V<sub>GS</sub> = 10 V, I<sub>D</sub> = 20 A)
- Low gate charge
   Qg = 25 nC TYP. (ID = 40 A, VDD = 24 V, VGS = 10 V)
- · Built-in gate protection diode
- Surface mount device available

#### ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

VDSS	30	V
Vgss	±20	V
ID(DC)	±40	Α
D(pulse)	±160	Α
P <sub>T1</sub>	1.5	W
P <sub>T2</sub>	40	W
Tch	150	°C
T <sub>stg</sub>	-55 to +150	°C
	VGSS ID(DC) ID(pulse) PT1 PT2 Tch	VGSS ±20 ID(DC) ±40 ID(pulse) ±160 PT1 1.5 PT2 40 Tch 150

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

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

ORDERING INFORMATION

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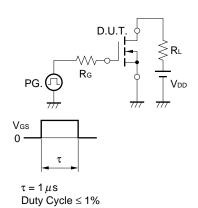
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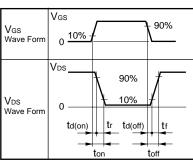


ELECTRICAL CHARACTERISTICS(TA = 25°C)

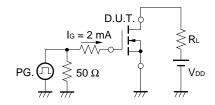
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Drain Leakage Current	Ioss	Vps = 30 V, Vgs = 0 V			10	μΑ
Gate Leakage Current	Igss	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±10	μΑ
Gate to Source Cut-off Voltage	V <sub>G</sub> S(off)	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	1.5		2.5	V
Forward Transfer Admittance	yfs	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 20 A	8.0			S
Drain to Source On-state Resistance	RDS(on)1	Vgs = 10 V, ID = 20 A		11	14	mΩ
	RDS(on)2	Vgs = 4.5 V, ID = 20 A		15	21	mΩ
Input Capacitance	Ciss	Vps = 10 V		1400		pF
Output Capacitance	Coss	V <sub>G</sub> S = 0 V		410		pF
Reverse Transfer Capacitance	Crss	f = 1 MHz		180		pF
Turn-on Delay Time	td(on)	VDD = 15 V , ID = 20 A		20		ns
Rise Time	tr	V <sub>GS(on)</sub> = 10 V		9		ns
Turn-off Delay Time	td(off)	R <sub>G</sub> = 10 Ω		50		ns
Fall Time	tr			14		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 24 V		25		nC
Gate to Source Charge	Qgs	Vgs = 10 V		5.0		nC
Gate to Drain Charge	Q <sub>GD</sub>	ID = 40 A		7.0		nC
Diode Forward Voltage	V <sub>F(S-D)</sub>	IF = 40 A, VGS = 0 V		1.0		V
Reverse Recovery Time	trr	IF = 40 A, VGS = 0 V		31		ns
Reverse Recovery Charge	Qrr	di/dt = 100 A/μs		28		nC

#### **TEST CIRCUIT 1 SWITCHING TIME**



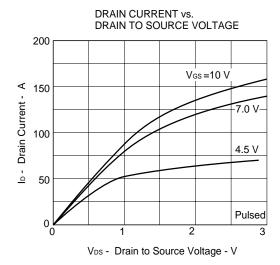


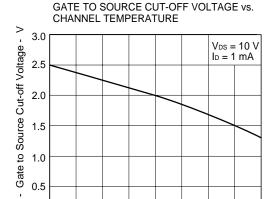
#### **TEST CIRCUIT 2 GATE CHARGE**

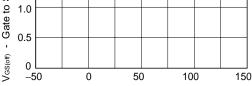




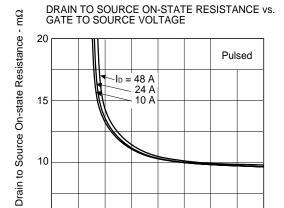
#### TYPICAL CHARACTERISTICS (TA = 25°C)







Tch - Channel Temperature - °C



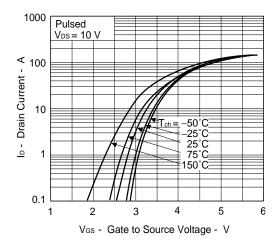
10

5

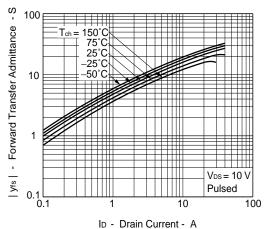
RDS(on) -



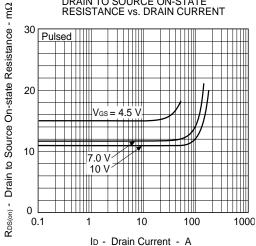
#### FORWARD TRANSFER CHARACTERISTICS



## FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT

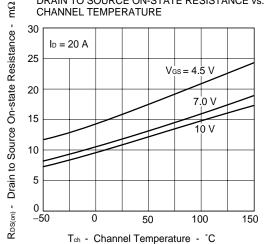




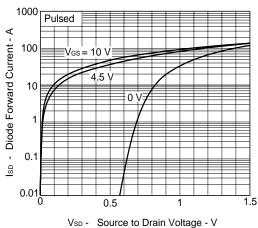


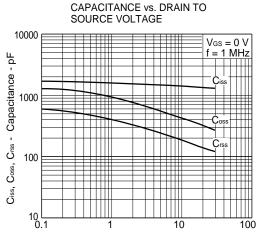
20

#### DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



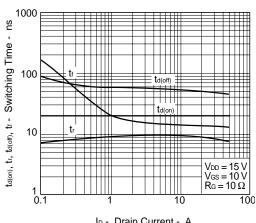
#### SOURCE TO DRAIN DIODE FORWARD VOLTAGE





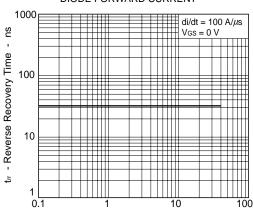
VDS - Drain to Source Voltage - V

### SWITCHING CHARACTERISTICS



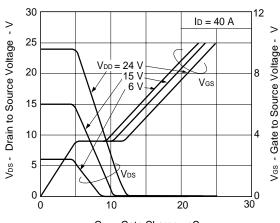
ID - Drain Current - A

#### REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

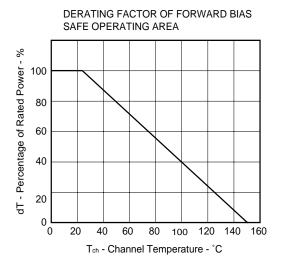


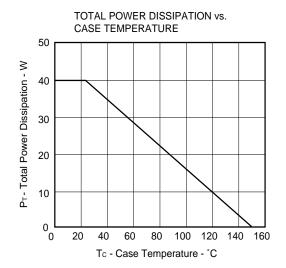
Isp - Diode Forward Current - A

#### DYNAMIC INPUT/OUTPUT CHARACTERISTICS

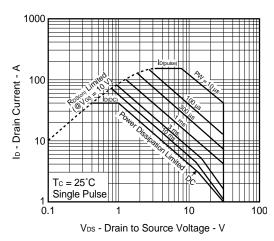


Q<sub>G</sub> - Gate Charge - nC

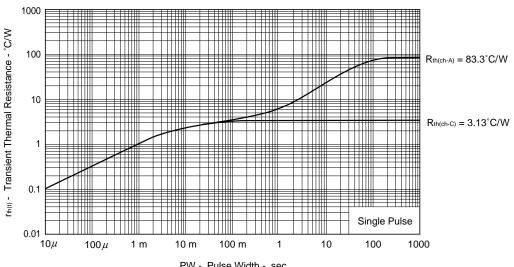




#### FORWARD BIAS SAFE OPERATING AREA



#### TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

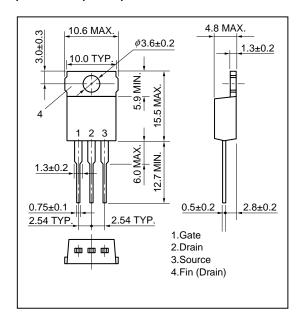


PW - Pulse Width - sec

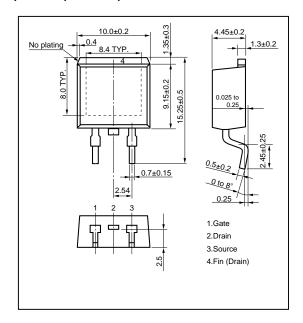


#### **PACKAGE DRAWINGS (Unit: mm)**

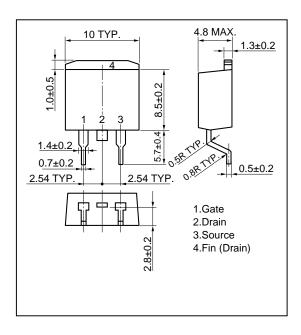
#### ★ 1)TO-220AB (MP-25)



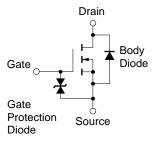
#### 2)TO-263 (MP-25ZK)



#### ★ 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.

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