

To our customers,

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## Old Company Name in Catalogs and Other Documents

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Renesas Electronics website: <http://www.renesas.com>

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

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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Not recommended  
for new design

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MOS FIELD EFFECT TRANSISTOR  
**2SK4078**

SWITCHING  
 N-CHANNEL POWER MOS FET

**DESCRIPTION**

The 2SK4078 is N-channel MOS Field Effect Transistor designed for high current switching applications.

**ORDERING INFORMATION**

PART NUMBER	LEAD PLATING	PACKING	PACKAGE
2SK4078-ZK-E1-AY <sup>Note</sup>	Pure Sn (Tin)	Tape 2500 p/reel	TO-252 (MP-3ZK) typ. 0.27 g
2SK4078-ZK-E2-AY <sup>Note</sup>			

**Note** Pb-free (This product does not contain Pb in external electrode.)

**FEATURES**

- Low on-state resistance  
 $R_{DS(on)1} = 8.5 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 25 \text{ A)}$   
 $R_{DS(on)2} = 14.0 \text{ m}\Omega \text{ MAX. (} V_{GS} = 4.5 \text{ V, } I_D = 13 \text{ A)}$
- Low input capacitance  
 $C_{iss} = 2300 \text{ pF TYP.}$
- Logic level drive type

**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C)**

Drain to Source Voltage (V <sub>GS</sub> = 0 V)	V <sub>DSS</sub>	40	V
Gate to Source Voltage (V <sub>DS</sub> = 0 V)	V <sub>GSS</sub>	±20	V
Drain Current (DC) (T <sub>C</sub> = 25°C)	I <sub>D(DC)</sub>	±50	A
Drain Current (pulse) <sup>Note1</sup>	I <sub>D(pulse)</sub>	±150	A
Total Power Dissipation (T <sub>C</sub> = 25°C)	P <sub>T1</sub>	45	W
Total Power Dissipation (T <sub>A</sub> = 25°C)	P <sub>T2</sub>	1.0	W
Channel Temperature	T <sub>ch</sub>	150	°C
Storage Temperature	T <sub>stg</sub>	-55 to +150	°C
Single Avalanche Current <sup>Note2</sup>	I <sub>AS</sub>	23	A
Single Avalanche Energy <sup>Note2</sup>	E <sub>AS</sub>	52	mJ

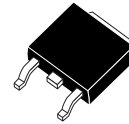
**Notes 1.** PW ≤ 10 μs, Duty Cycle ≤ 1%

**2.** Starting T<sub>ch</sub> = 25°C, V<sub>DD</sub> = 20 V, R<sub>G</sub> = 25 Ω, V<sub>GS</sub> = 20 → 0 V, L = 100 μH

**THERMAL RESISTANCE**

Channel to Case Thermal Resistance	R <sub>th(ch-C)</sub>	2.77	°C/W
Channel to Ambient Thermal Resistance	R <sub>th(ch-A)</sub>	125	°C/W

(TO-252)



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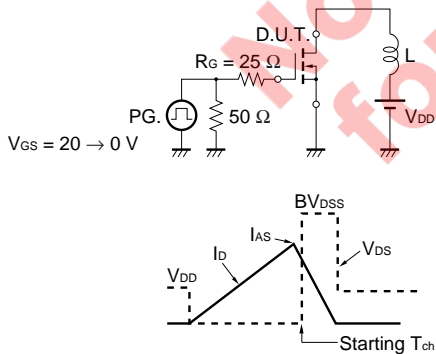
Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.

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

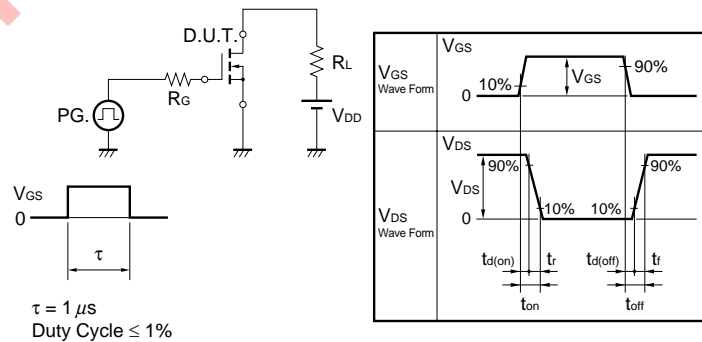
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 40 V, V <sub>GS</sub> = 0 V			1	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±100	nA
Gate to Source Cut-off Voltage	V <sub>GS(off)</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 1 mA	1.5	2.0	2.5	V
Forward Transfer Admittance <sup>Note</sup>	y <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 25 A	7.0			S
Drain to Source On-state Resistance <sup>Note</sup>	R <sub>DS(on)1</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 25 A		6.3	8.5	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 13 A		9.5	14.0	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 10 V,		2300		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V,		360		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		220		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 20 V, I <sub>D</sub> = 25 A,		12		ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = 10 V,		15		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		51		ns
Fall Time	t <sub>f</sub>			9		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 32 V,		45		nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 10 V,		7		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 50 A		13		nC
Body Diode Forward Voltage <sup>Note</sup>	V <sub>F(S-D)</sub>	I <sub>F</sub> = 50 A, V <sub>GS</sub> = 0 V			1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 50 A, V <sub>GS</sub> = 0 V,		30		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		26		nC

**Note** Pulsed

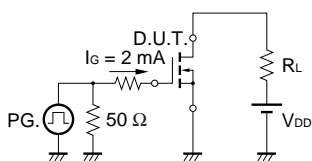
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



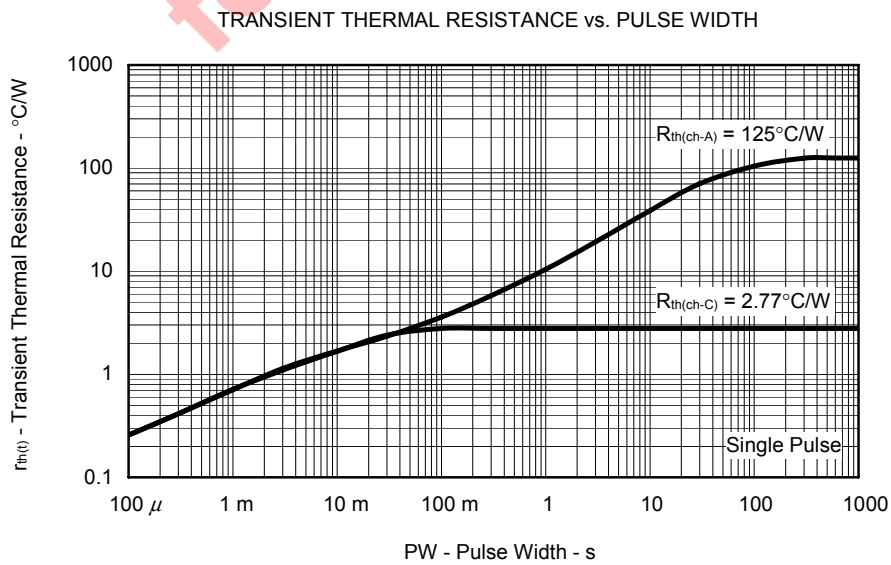
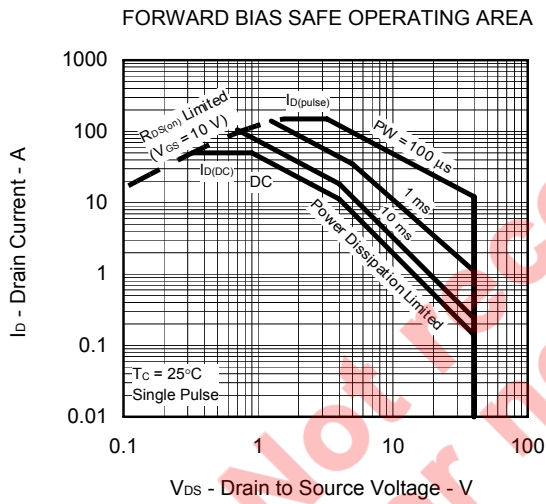
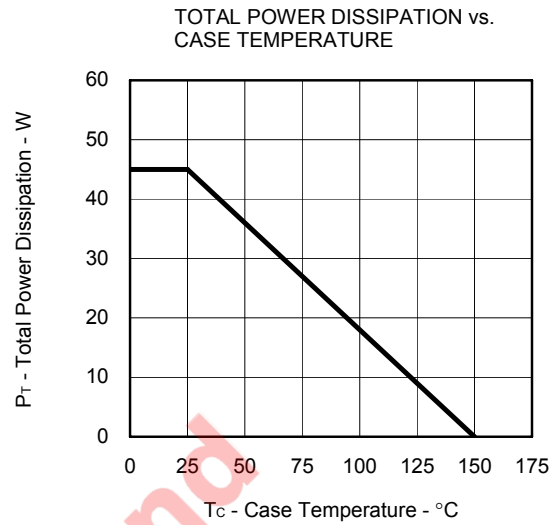
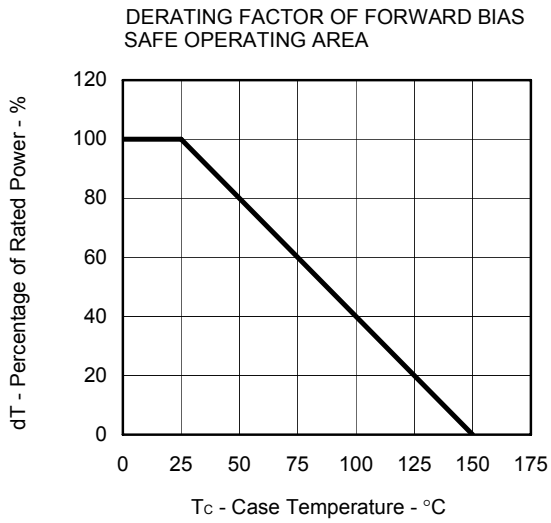
**TEST CIRCUIT 2 SWITCHING TIME**



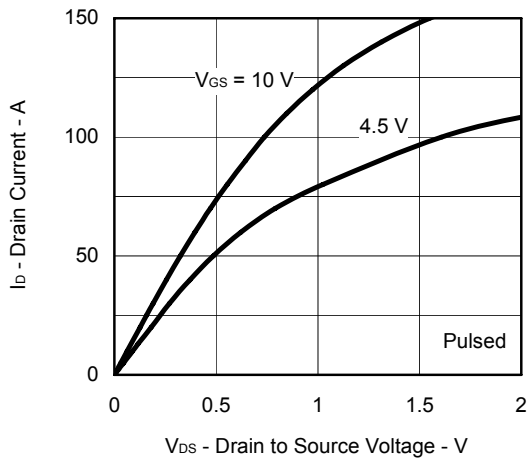
**TEST CIRCUIT 3 GATE CHARGE**



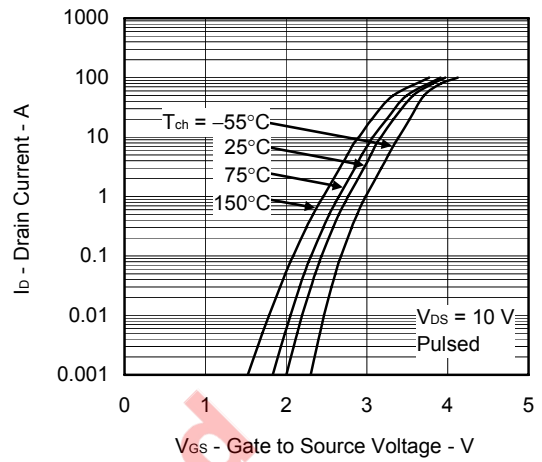
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



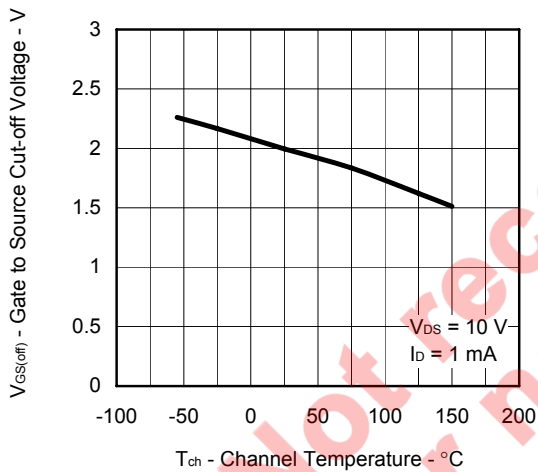
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



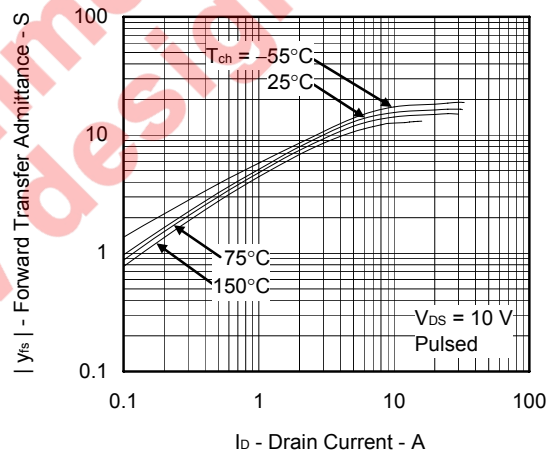
FORWARD TRANSFER CHARACTERISTICS



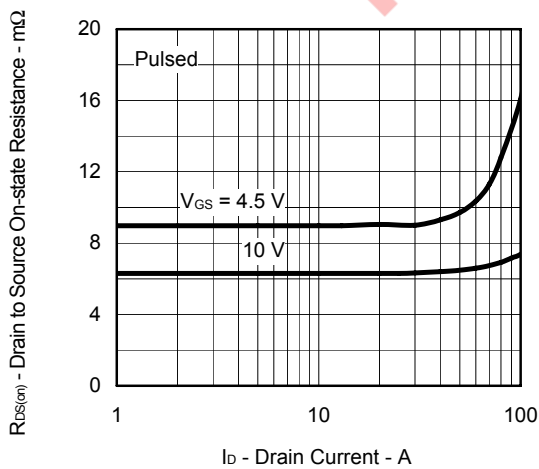
GATE TO SOURCE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



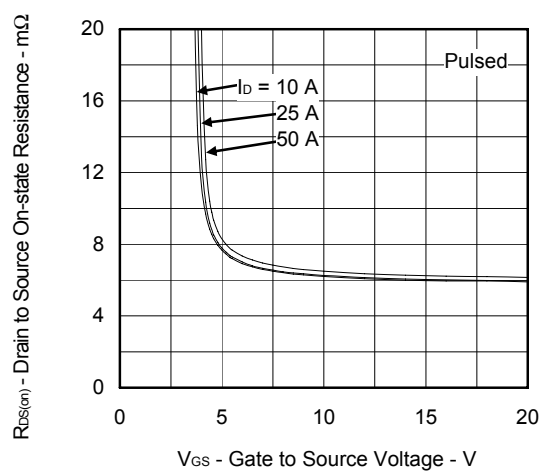
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



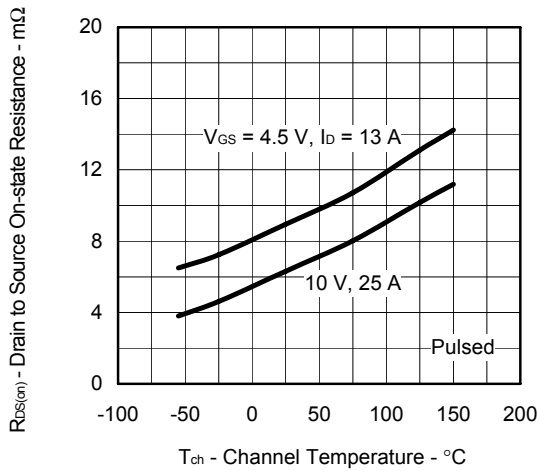
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



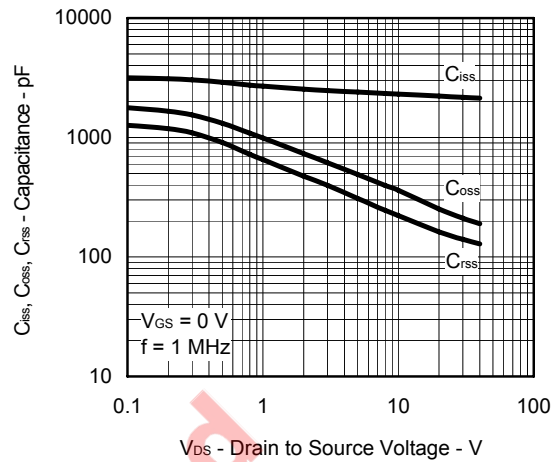
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



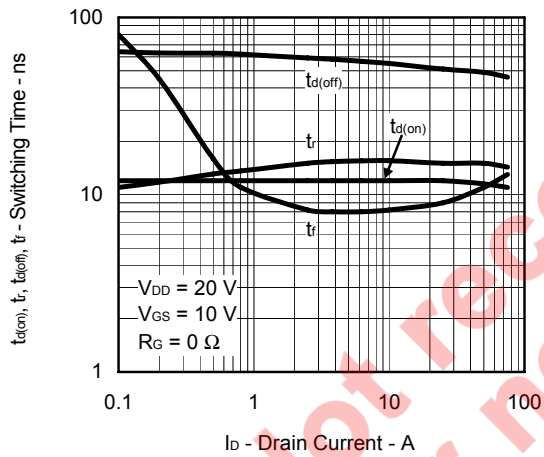
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



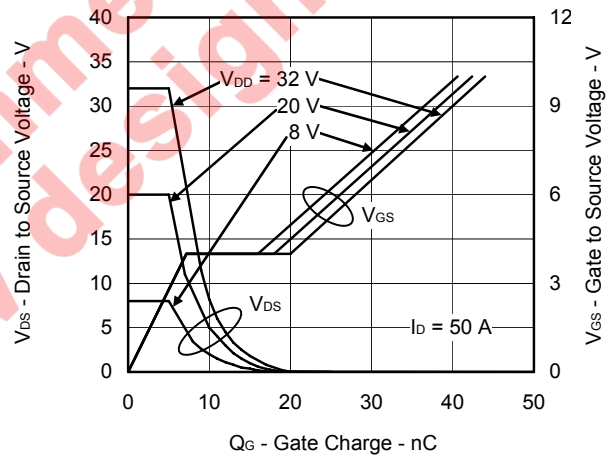
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



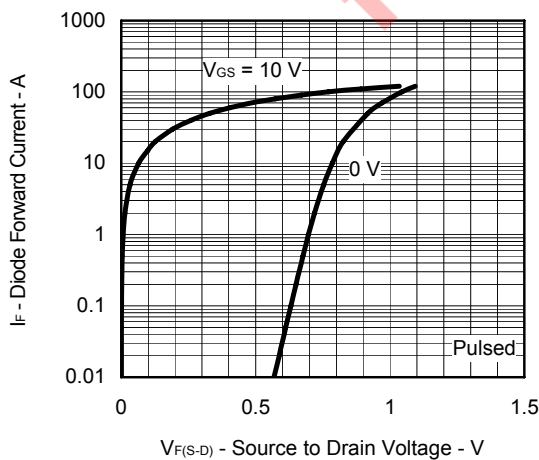
SWITCHING CHARACTERISTICS



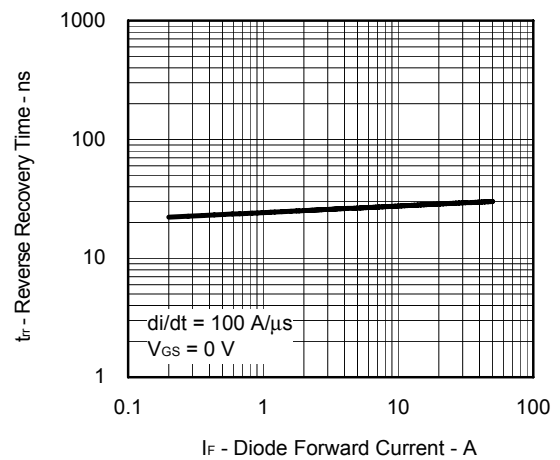
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

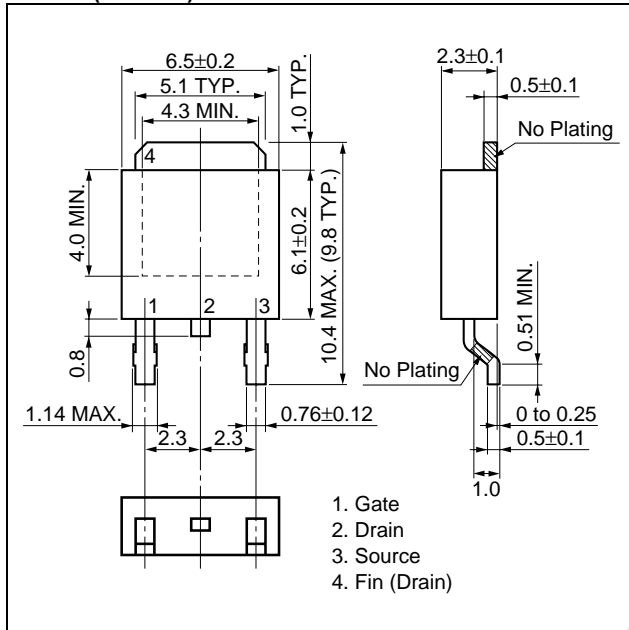


REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

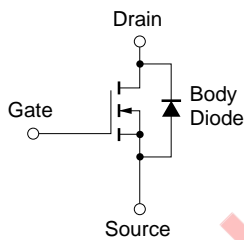


PACKAGE DRAWING (Unit: mm)

TO-252 (MP-3ZK)



EQUIVALENT CIRCUIT

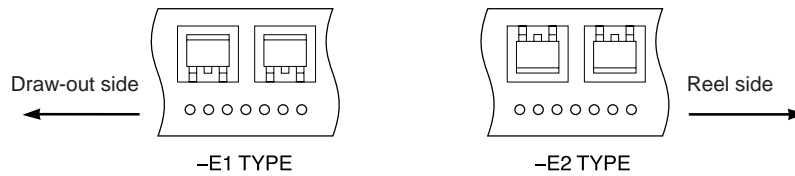


**Remark** Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

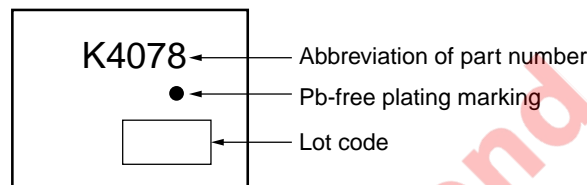


**TAPE INFORMATION**

There are two types (-E1, -E2) of taping depending on the direction of the device.



**MARKING INFORMATION**



**RECOMMENDED SOLDERING CONDITIONS**

The 2SK4078 should be soldered and mounted under the following recommended conditions.

For soldering methods and conditions other than those recommended below, please contact an NEC Electronics sales representative.

For technical information, see the following website.

Semiconductor Device Mount Manual (<http://www.necel.com/pkg/en/mount/index.html>)

Soldering Method	Soldering Conditions	Recommended Condition Symbol
Infrared reflow	Maximum temperature (Package's surface temperature): 260°C or below Time at maximum temperature: 10 seconds or less Time of temperature higher than 220°C: 60 seconds or less Preheating time at 160 to 180°C: 60 to 120 seconds Maximum number of reflow processes: 3 times Maximum chlorine content of rosin flux (percentage mass): 0.2% or less	IR60-00-3
Partial heating	Maximum temperature (Pin temperature): 350°C or below Time (per side of the device): 3 seconds or less Maximum chlorine content of rosin flux: 0.2% (wt.) or less	P350

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