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Old Company Name in Catalogs and Other Documents

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April 1st, 2010
Renesas Electronics Corporation

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

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MOS FIELD EFFECT TRANSISTOR

NP60N04HLF, NP60N04ILF

SWITCHING

N-CHANNEL POWER MOS FET

DESCRIPTION

The NP60N04HLF and NP60N04ILF are N-channel MOS Field Effect Transistors designed for high current switching applications.

FEATURES

- Super low on-state resistance
 $R_{DS(on)1} = 6.5 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 30 \text{ A)}$
 $R_{DS(on)2} = 9.1 \text{ m}\Omega \text{ MAX. (} V_{GS} = 4.5 \text{ V, } I_D = 30 \text{ A)}$
- Low C_{iss} : $C_{iss} = 2600 \text{ pF TYP. (} V_{DS} = 25 \text{ V, } V_{GS} = 0 \text{ V)}$
- Built-in gate protection diode

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

Drain to Source Voltage ($V_{GS} = 0 \text{ V}$)	V_{DSS}	40	V
Gate to Source Voltage ($V_{DS} = 0 \text{ V}$)	V_{GSS}	± 20	V
Drain Current (DC) ($T_C = 25^\circ\text{C}$) ^{Note1}	$I_{D(DC)}$	± 60	A
Drain Current (pulse) ^{Note2}	$I_{D(pulse)}$	± 240	A
Total Power Dissipation ($T_C = 25^\circ\text{C}$)	P_{T1}	100	W
Total Power Dissipation ($T_A = 25^\circ\text{C}$)	P_{T2}	1.2	W
Channel Temperature	T_{ch}	175	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to +175	$^\circ\text{C}$
Repetitive Avalanche Current ^{Note3}	I_{AR}	32	A
Repetitive Avalanche Energy ^{Note3}	E_{AR}	100	mJ

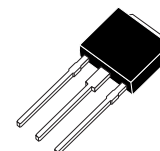
Notes 1. Calculated contact current according to MAX. allowable channel temperature.

- $PW \leq 10 \mu\text{s}$, Duty Cycle $\leq 1\%$
- $V_{DD} = 20 \text{ V}$, $R_G = 25 \Omega$, $V_{GS} = 20 \rightarrow 0 \text{ V}$, $T_{ch(peak)} \leq 150^\circ\text{C}$

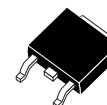
ORDERING INFORMATION

PART NUMBER	PACKAGE
NP60N04HLF	TO-251 (MP-3)
NP60N04ILF	TO-252 (MP-3Z)

(TO-251)



(TO-252)



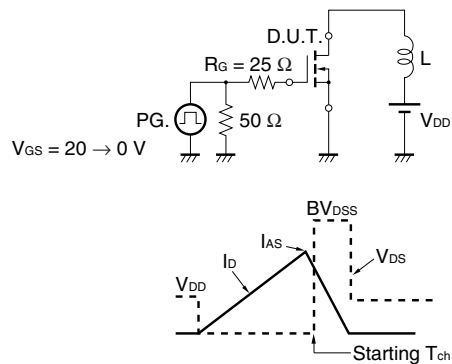
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ELECTRICAL CHARACTERISTICS (T_A = 25°C)

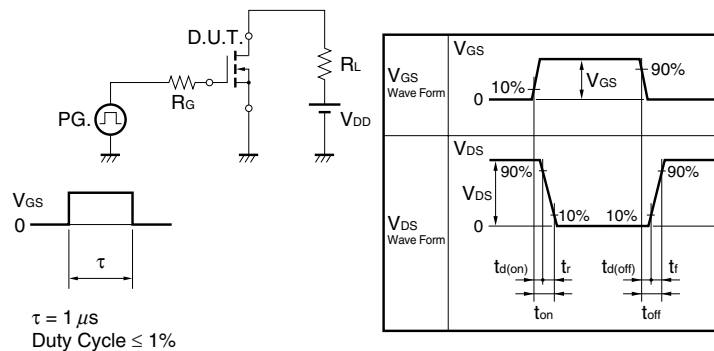
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 40 V, V _{GS} = 0 V			10	μA
Gate Leakage Current	I _{GSS}	V _{GS} = ±20 V, V _{DS} = 0 V			±10	μA
Gate to Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA	1.5	2.0	2.5	V
Forward Transfer Admittance ^{Note}	y _{fs}	V _{DS} = 10 V, I _D = 30 A	22	43		S
Drain to Source On-state Resistance ^{Note}	R _{DS(on)1}	V _{GS} = 10 V, I _D = 30 A		5.2	6.5	mΩ
	R _{DS(on)2}	V _{GS} = 4.5 V, I _D = 30 A		6.6	9.1	mΩ
Input Capacitance	C _{iss}	V _{DS} = 25 V		2600	3900	pF
Output Capacitance	C _{oss}	V _{GS} = 0 V		480	720	pF
Reverse Transfer Capacitance	C _{rss}	f = 1 MHz		180	330	pF
Turn-on Delay Time	t _{d(on)}	V _{DD} = 20 V, I _D = 30 A		11	23	ns
Rise Time	t _r	V _{GS} = 10 V		13	32	ns
Turn-off Delay Time	t _{d(off)}	R _G = 0 Ω		69	138	ns
Fall Time	t _f			14	34	ns
Total Gate Charge	Q _G	V _{DD} = 32 V		50	75	nC
Gate to Source Charge	Q _{GS}	V _{GS} = 10 V		9		nC
Gate to Drain Charge	Q _{GD}	I _D = 60 A		13		nC
Body Diode Forward Voltage ^{Note}	V _{F(S-D)}	I _F = 60 A, V _{GS} = 0 V		0.94	1.5	V
Reverse Recovery Time	t _{rr}	I _F = 60 A, V _{GS} = 0 V		40		ns
Reverse Recovery Charge	Q _{rr}	di/dt = 100 A/μs		42		nC

Note Pulsed

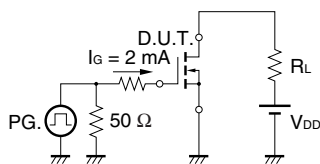
TEST CIRCUIT 1 AVALANCHE CAPABILITY



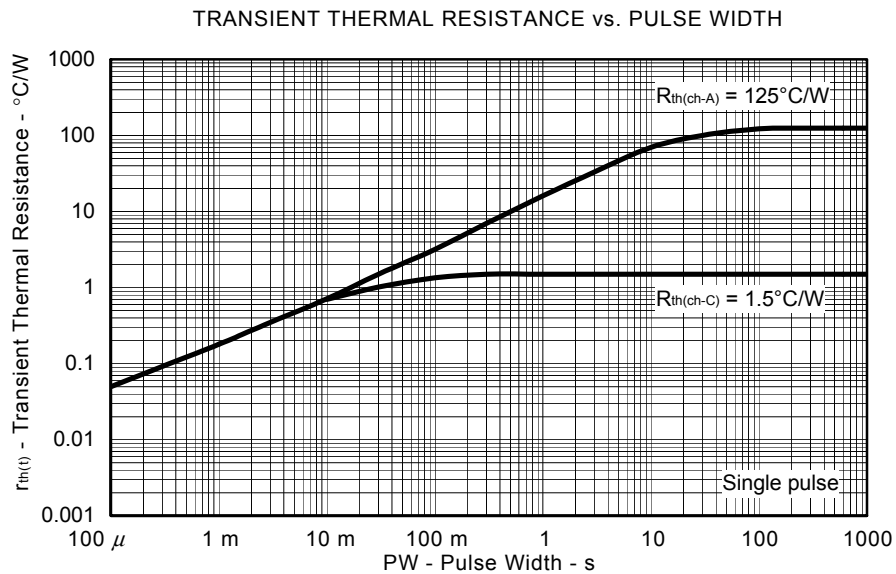
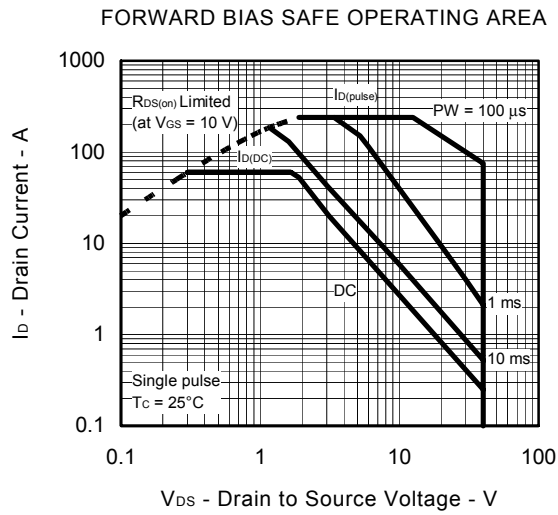
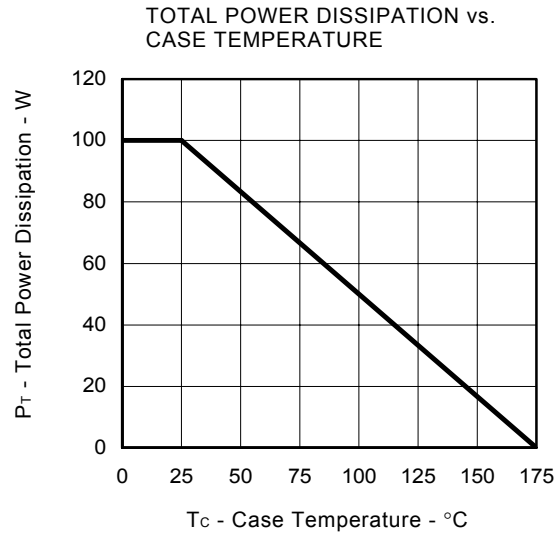
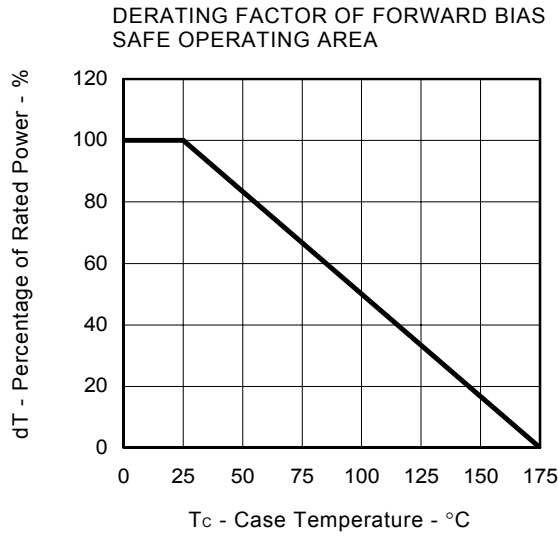
TEST CIRCUIT 2 SWITCHING TIME



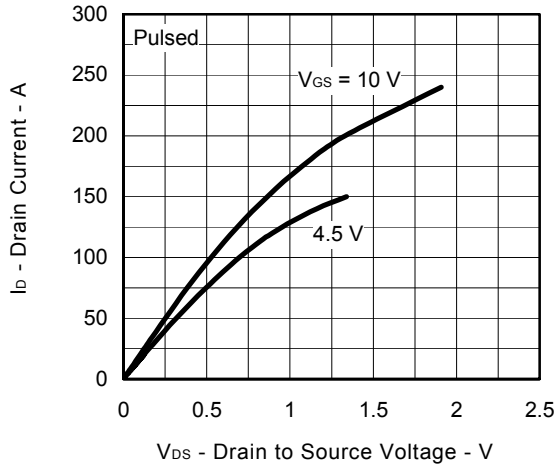
TEST CIRCUIT 3 GATE CHARGE



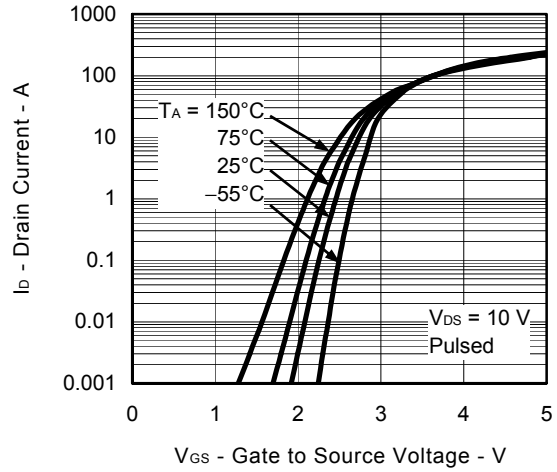
TYPICAL CHARACTERISTICS (T_A = 25°C)



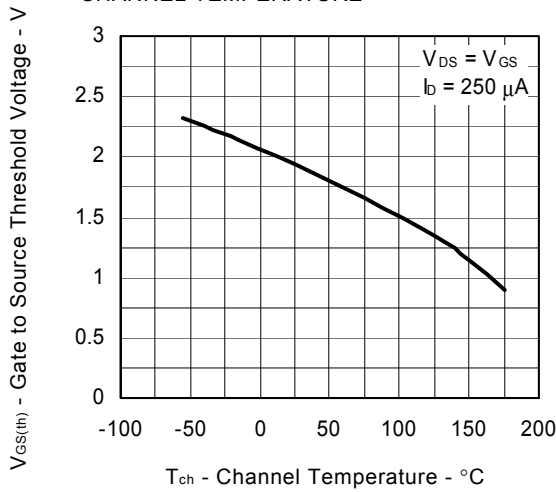
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



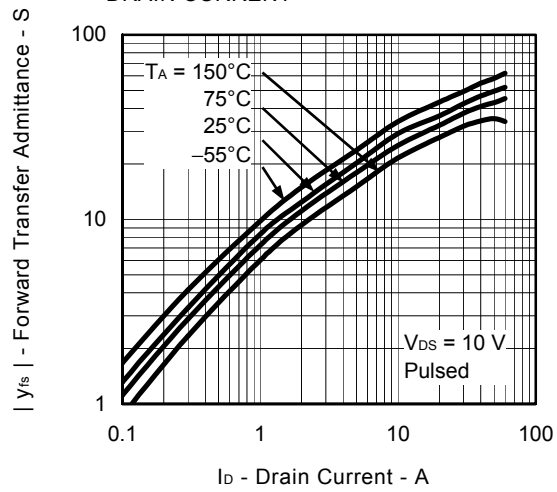
FORWARD TRANSFER CHARACTERISTICS



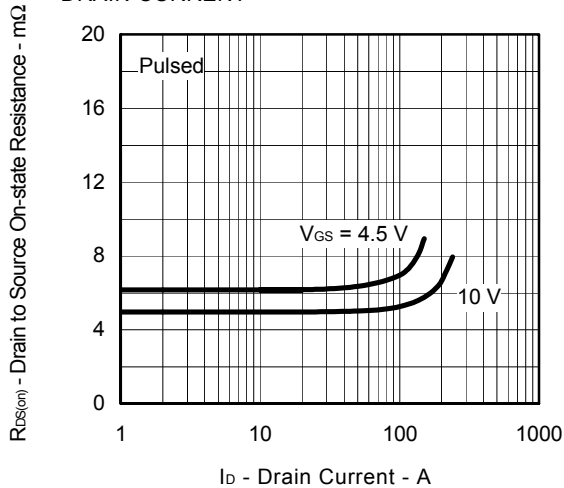
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



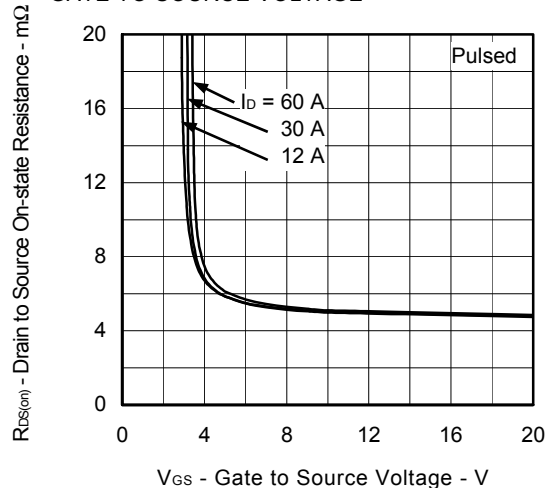
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



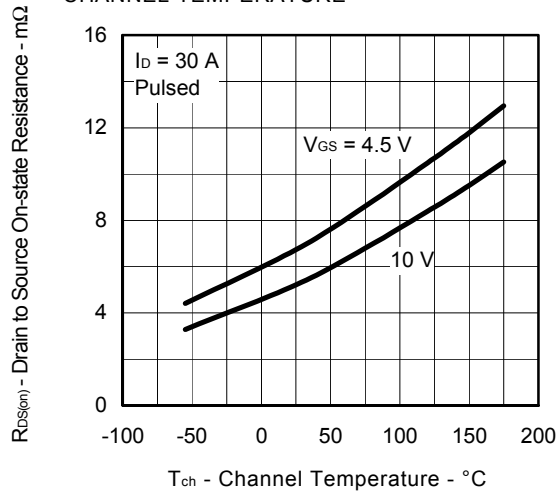
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



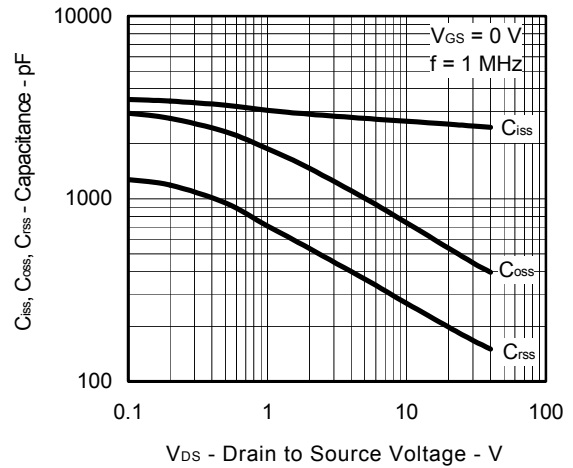
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



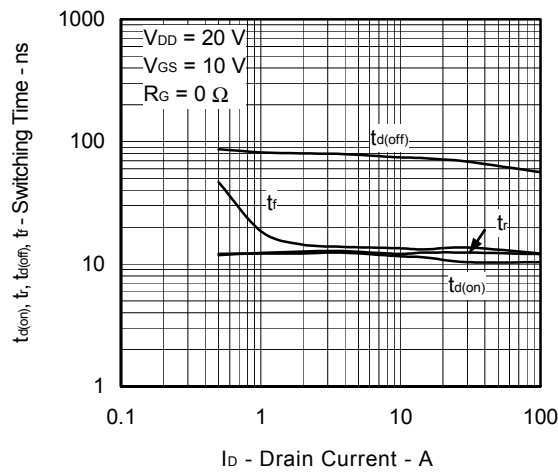
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



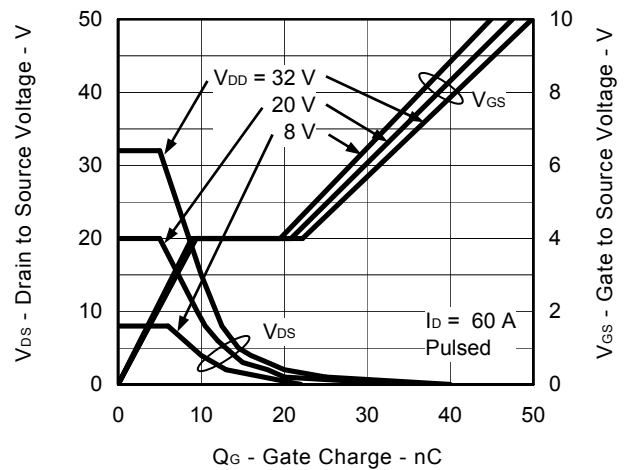
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



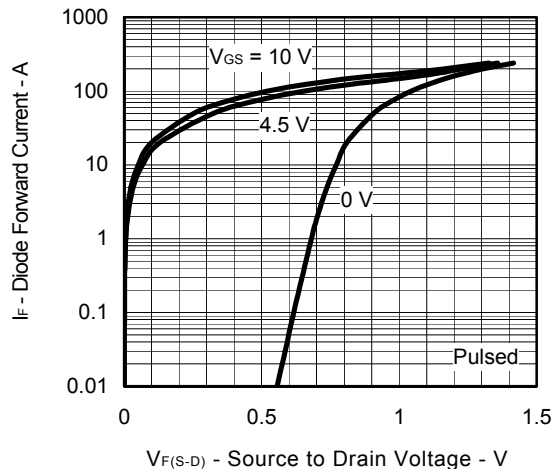
SWITCHING CHARACTERISTICS



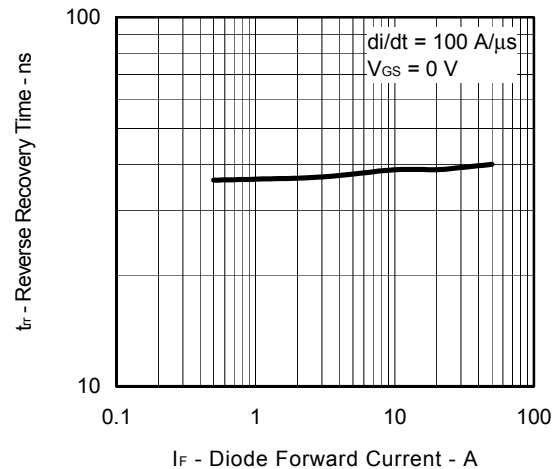
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

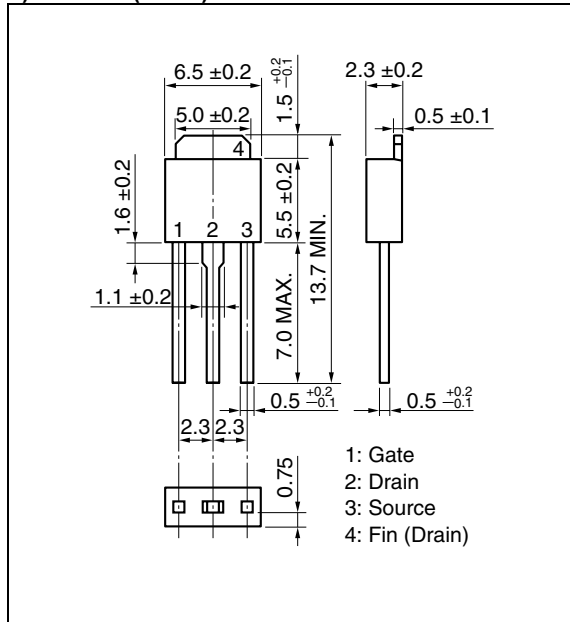


REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

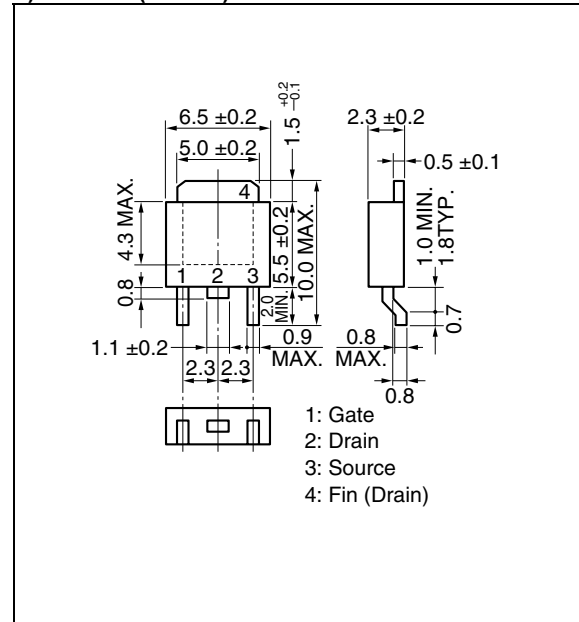


PACKAGE DRAWINGS (Unit: mm)

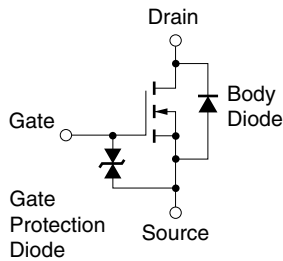
1) TO-251 (MP-3)



2) TO-252 (MP-3Z)



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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