

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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# MOS FIELD EFFECT TRANSISTOR

# NP109N04PUG

## SWITCHING

### N-CHANNEL POWER MOS FET

**DESCRIPTION**

The NP109N04PUG is N-channel MOS Field Effect Transistor designed for high current switching applications.

**ORDERING INFORMATION**

PART NUMBER	LEAD PLATING	PACKING	PACKAGE
NP109N04PUG-E1-AY <sup>Note</sup>	Pure Sn (Tin)	Tape 800 p/reel	TO-263 (MP-25ZP) typ. 1.5 g
NP109N04PUG-E2-AY <sup>Note</sup>			

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

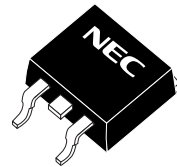
**FEATURES**

- Super low on-state resistance  
 $R_{DS(on)} = 2.3 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 55 \text{ A)}$
- High current rating  $I_{D(DC)} = \pm 110 \text{ A}$

(TO-263)

**ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°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) ( $T_C = 25^\circ\text{C}$ )	$I_{D(DC)}$	±110	A
Drain Current (pulse) <sup>Note1</sup>	$I_{D(pulse)}$	±440	A
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{T1}$	220	W
Total Power Dissipation ( $T_A = 25^\circ\text{C}$ )	$P_{T2}$	1.8	W
Channel Temperature	$T_{ch}$	175	°C
Storage Temperature	$T_{stg}$	-55 to +175	°C
Repetitive Avalanche Current <sup>Note2</sup>	$I_{AR}$	60	A
Repetitive Avalanche Energy <sup>Note2</sup>	$E_{AR}$	360	mJ



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

**2.**  $T_{ch} \leq 150^\circ\text{C}$ ,  $V_{DD} = 20 \text{ V}$ ,  $R_G = 25 \Omega$ ,  $V_{GS} = 20 \rightarrow 0 \text{ V}$

**THERMAL RESISTANCE**

Channel to Case Thermal Resistance	$R_{th(ch-C)}$	0.68	°C/W
Channel to Ambient Thermal Resistance	$R_{th(ch-A)}$	83.3	°C/W

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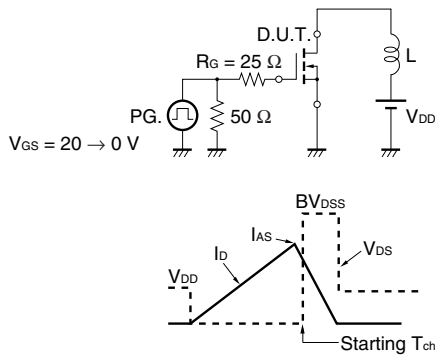
Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.

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

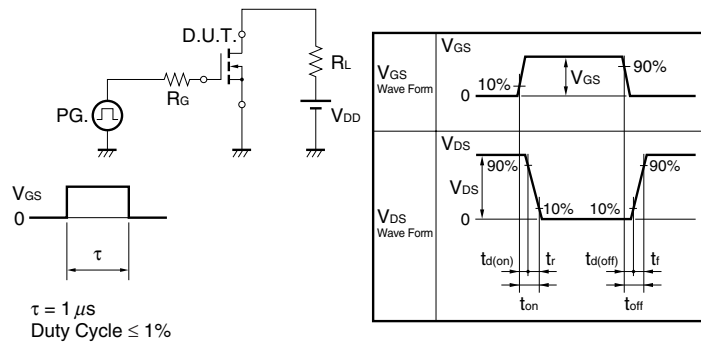
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 40 V, V <sub>GS</sub> = 0 V			1	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±100	nA
Gate to Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.0	3.0	4.0	V
Forward Transfer Admittance	y <sub>fs</sub>	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 55 A	31	63		S
Drain to Source On-state Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 55 A		1.7	2.3	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25 V,		10500	15750	pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V,		980	1470	pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		630	1140	pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 20 V, I <sub>D</sub> = 55 A,		47	103	ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = 10 V,		35	70	ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		90	180	ns
Fall Time	t <sub>f</sub>			35	70	ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 32 V,		180	270	nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 10 V,		44		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 110 A		64		nC
Body Diode Forward Voltage	V <sub>F(S-D)</sub>	I <sub>F</sub> = 110 A, V <sub>GS</sub> = 0 V		0.9	1.4	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 110 A, V <sub>GS</sub> = 0 V,		56		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		80		nC

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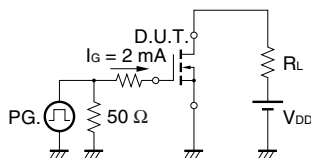
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



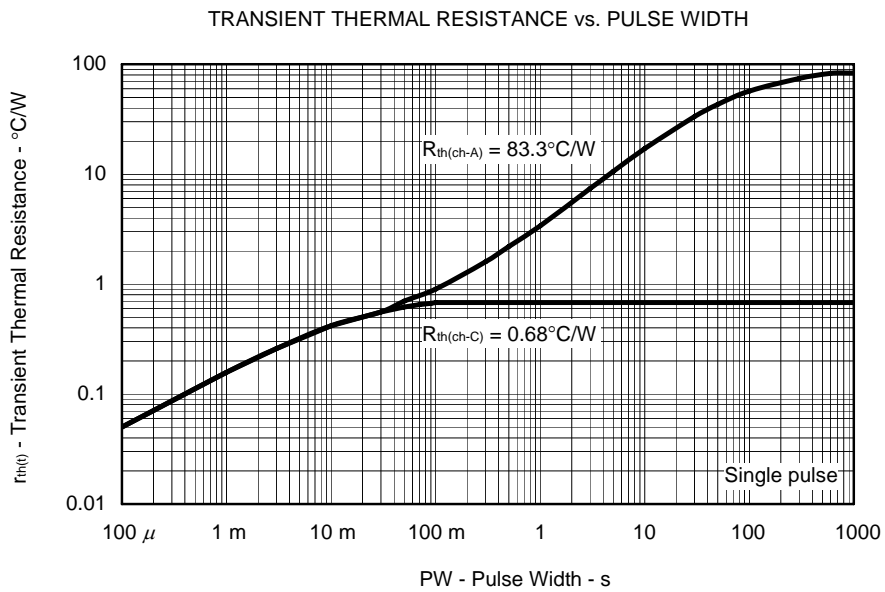
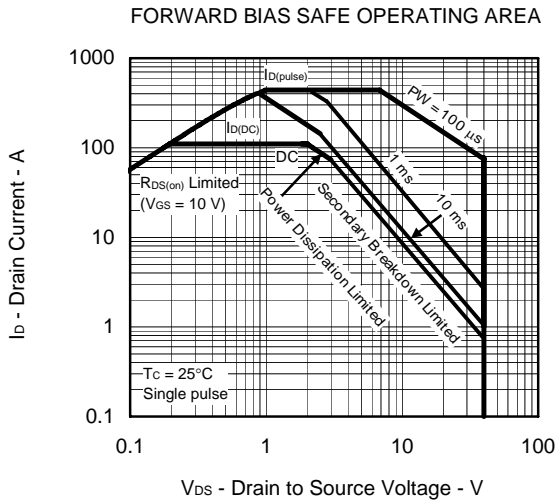
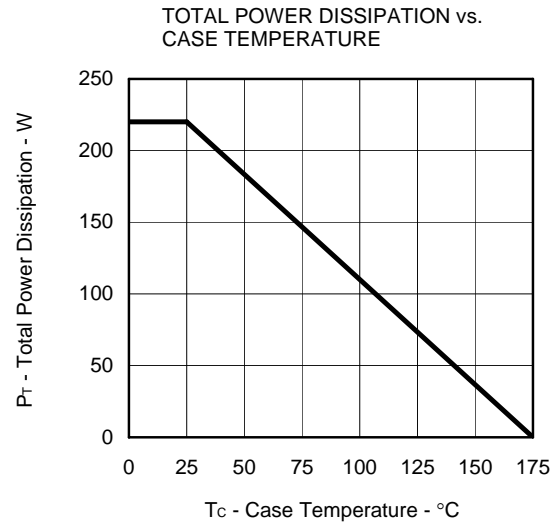
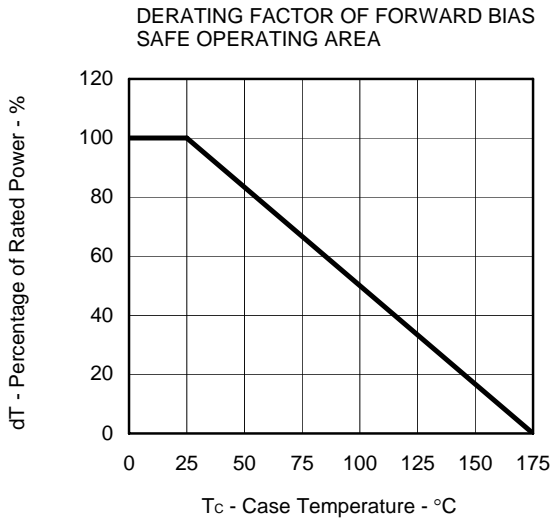
**TEST CIRCUIT 2 SWITCHING TIME**



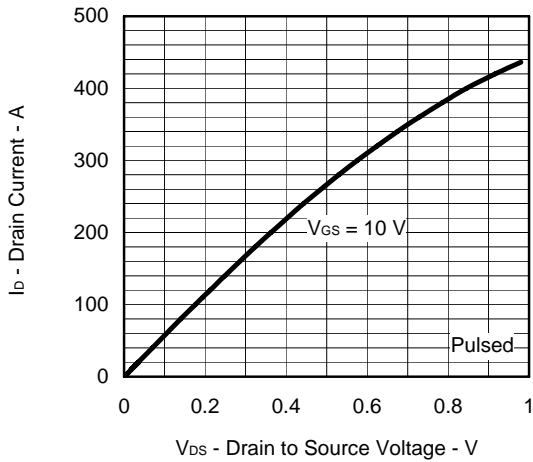
**TEST CIRCUIT 3 GATE CHARGE**



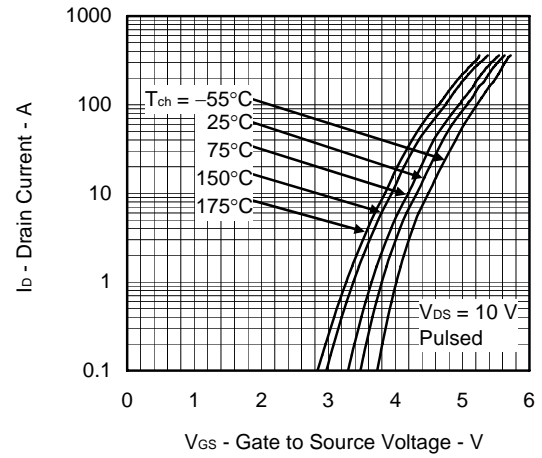
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



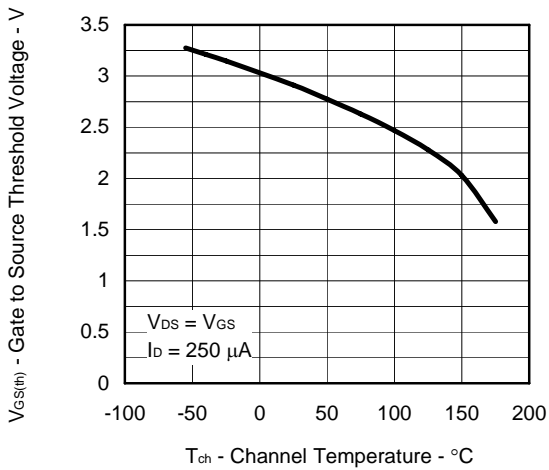
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



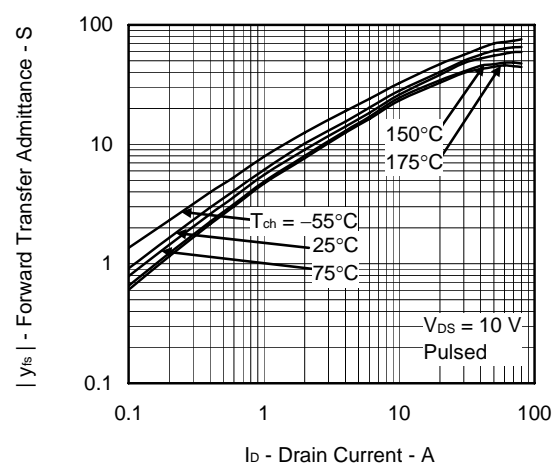
FORWARD TRANSFER CHARACTERISTICS



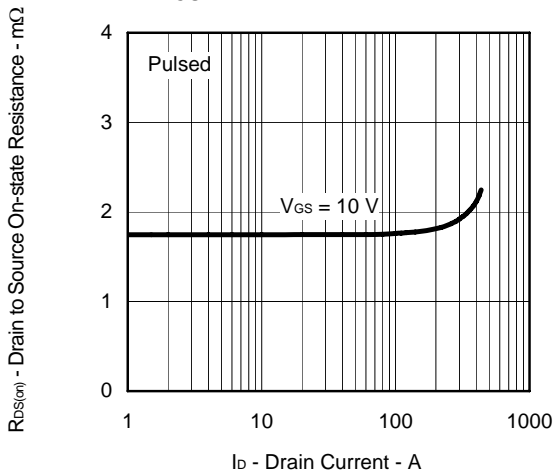
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



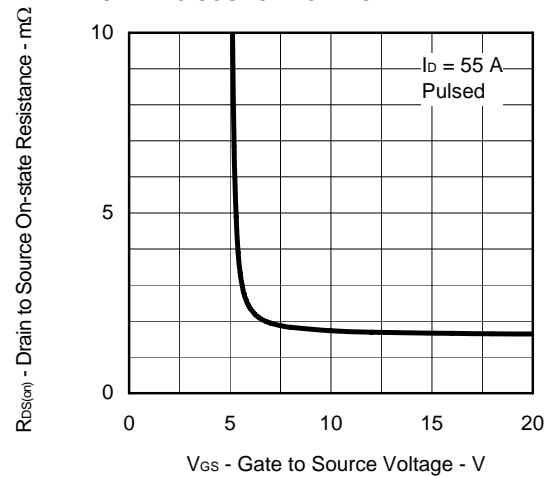
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



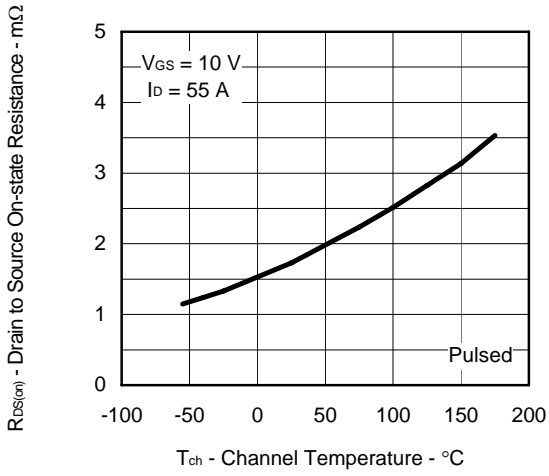
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



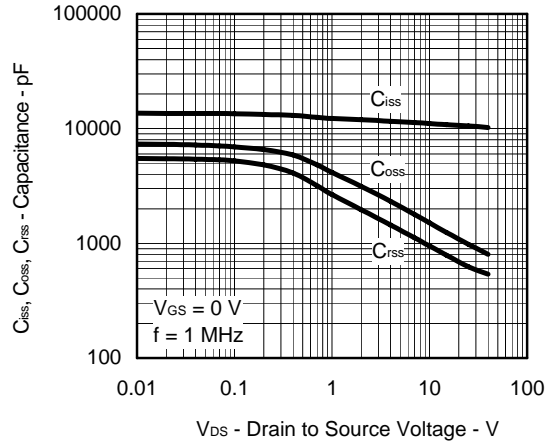
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



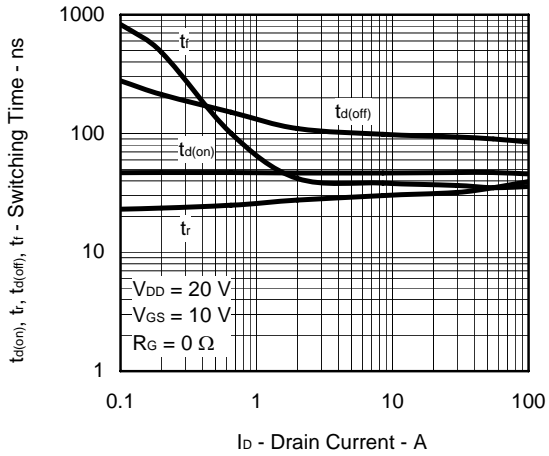
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



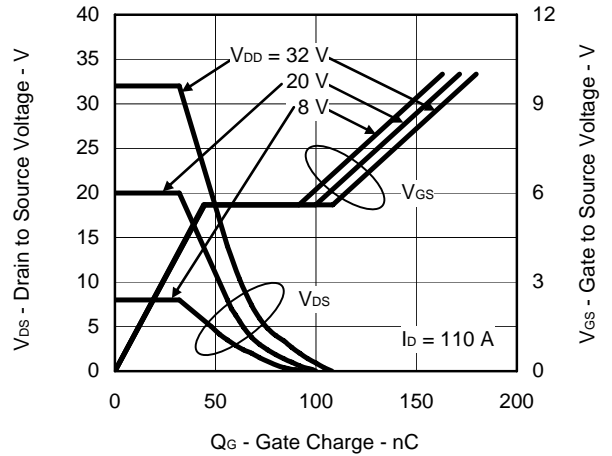
<R> CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



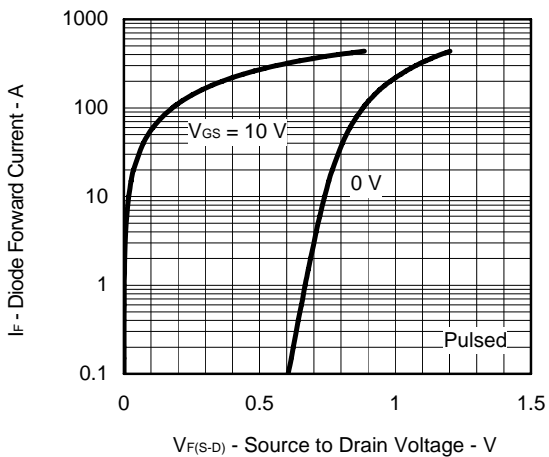
SWITCHING CHARACTERISTICS



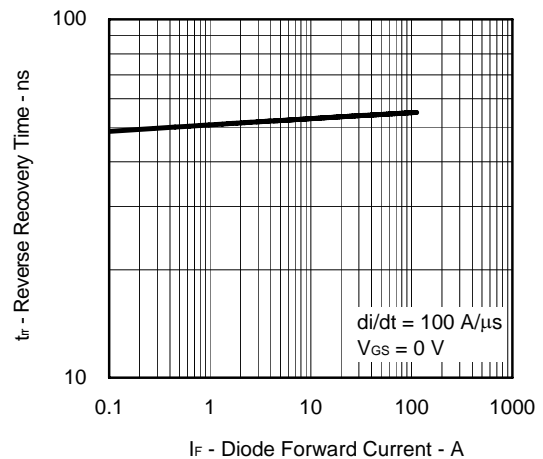
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

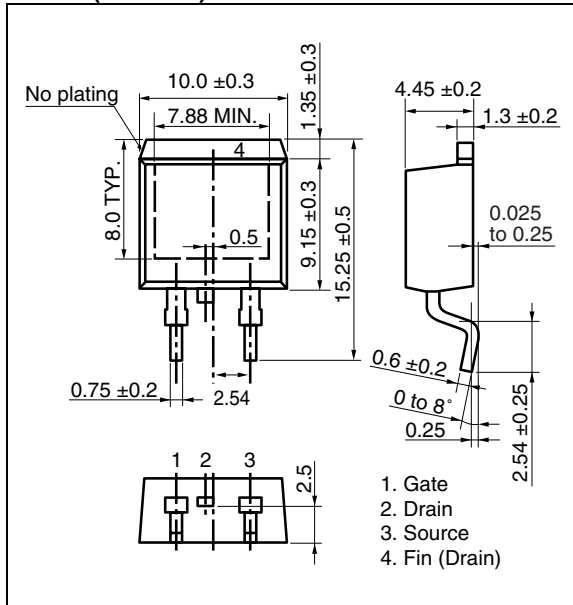


REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

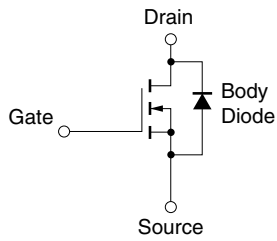


PACKAGE DRAWING (Unit: mm)

TO-263 (MP-25ZP)



EQUIVALENT CIRCUIT

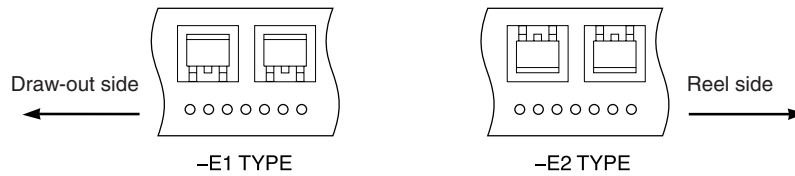


**Remark** Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

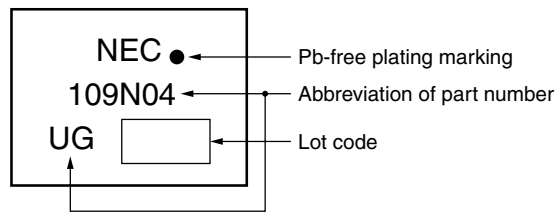


**TAPE INFORMATION**

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



**MARKING INFORMATION**



**RECOMMENDED SOLDERING CONDITIONS**

The NP109N04PUG 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

**Caution Do not use different soldering methods together (except for partial heating).**

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