

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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Not recommended  
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# MOS FIELD EFFECT TRANSISTOR

# NP70N04MUG

## SWITCHING

### N-CHANNEL POWER MOS FET

**DESCRIPTION**

The NP70N04MUG is N-channel MOS Field Effect Transistor designed for high current switching applications.

**ORDERING INFORMATION**

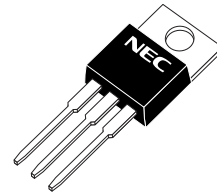
PART NUMBER	LEAD PLATING	PACKING	PACKAGE
NP70N04MUG-S18-AY <sup>Note</sup>	Pure Sn (Tin)	Tube 50 p/tube	TO-220 (MP-25K) typ. 1.9 g

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

**FEATURES**

- Super low on-state resistance  
 $R_{DS(on)} = 5.0 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 35 \text{ A)}$
- Channel temperature 175 degree rated

(TO-220)


**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>	±70	A
Drain Current (pulse) <sup>Note1</sup>	I <sub>D(pulse)</sub>	±280	A
Total Power Dissipation (T <sub>C</sub> = 25°C)	P <sub>T1</sub>	115	W
Total Power Dissipation (T <sub>A</sub> = 25°C)	P <sub>T2</sub>	1.8	W
Channel Temperature	T <sub>ch</sub>	175	°C
Storage Temperature	T <sub>stg</sub>	-55 to +175	°C
Repetitive Avalanche Current <sup>Note2</sup>	I <sub>AR</sub>	37	A
Repetitive Avalanche Energy <sup>Note2</sup>	E <sub>AR</sub>	137	mJ

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

**2.** T<sub>ch</sub> ≤ 150°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>	1.30	°C/W
Channel to Ambient Thermal Resistance	R <sub>th(ch-A)</sub>	83.3	°C/W

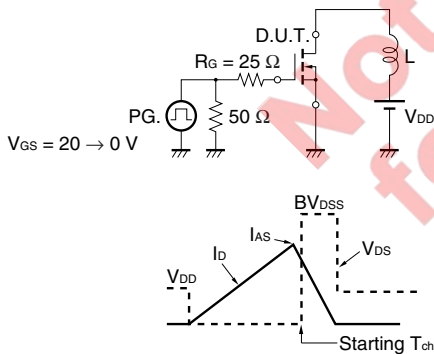
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**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)**

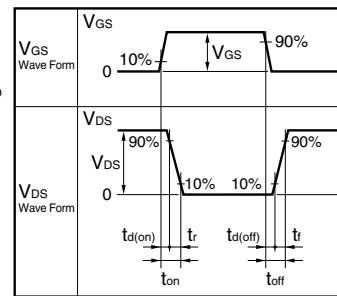
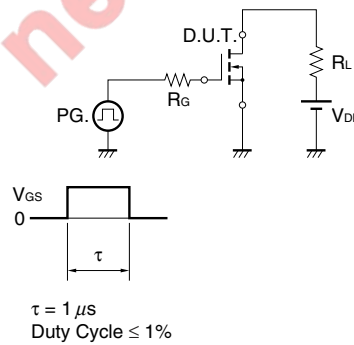
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 40 V, V <sub>GS</sub> = 0 V			1	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±100	nA
Gate to Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	2.0		4.0	V
Forward Transfer Admittance <sup>Note</sup>	y <sub>fs</sub>	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 35 A	25	49		S
Drain to Source On-state Resistance <sup>Note</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 35 A		4.0	5.0	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25 V,		4900		pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> = 0 V,		480		pF
Reverse Transfer Capacitance	C <sub>rss</sub>	f = 1 MHz		310		pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 20 V, I <sub>D</sub> = 35 A,		25		ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = 10 V,		18		ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		63		ns
Fall Time	t <sub>f</sub>			12		ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 32 V,		90		nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 10 V,		21		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 70 A		31		nC
Body Diode Forward Voltage <sup>Note</sup>	V <sub>F(S-D)</sub>	I <sub>F</sub> = 70 A, V <sub>GS</sub> = 0 V		0.96	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 70 A, V <sub>GS</sub> = 0 V,		37		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		42		nC

Note Pulsed

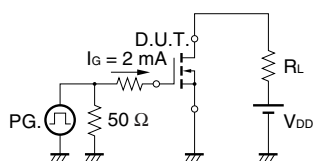
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



**TEST CIRCUIT 2 SWITCHING TIME**

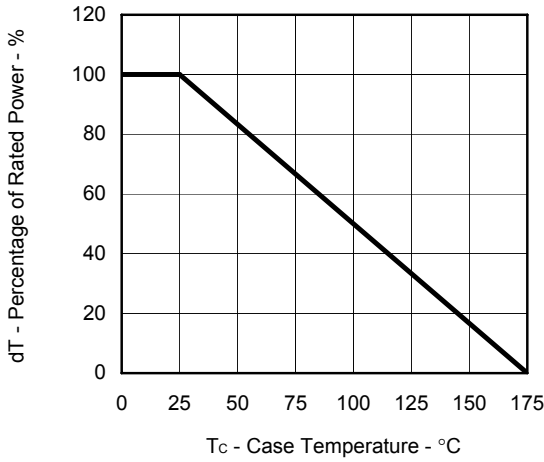


**TEST CIRCUIT 3 GATE CHARGE**

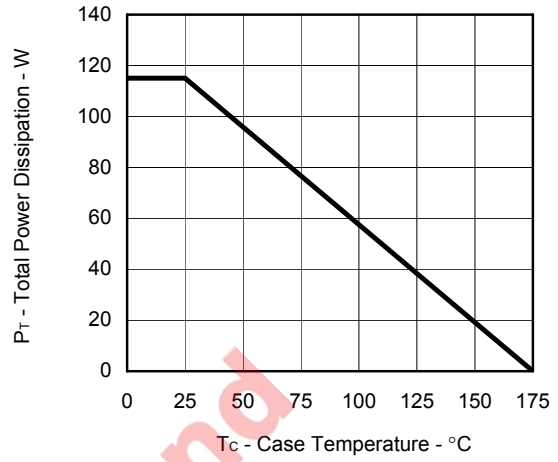


TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

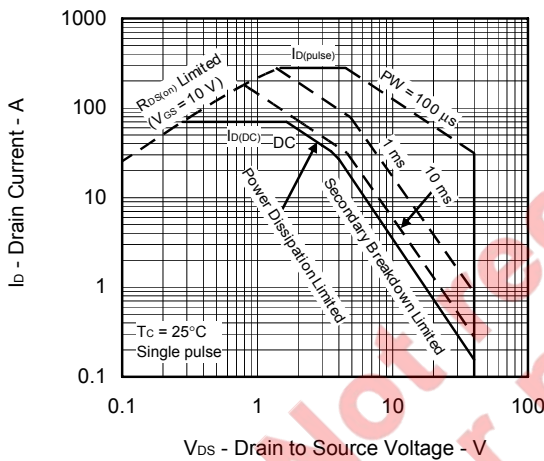
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



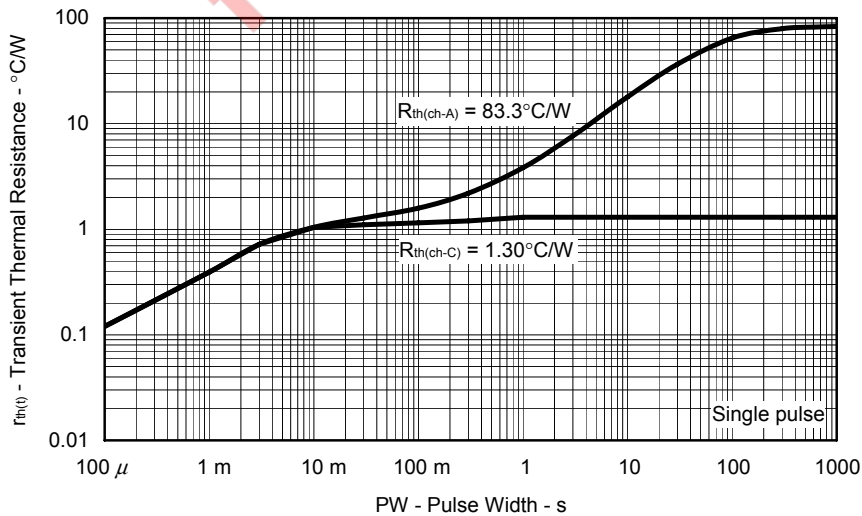
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



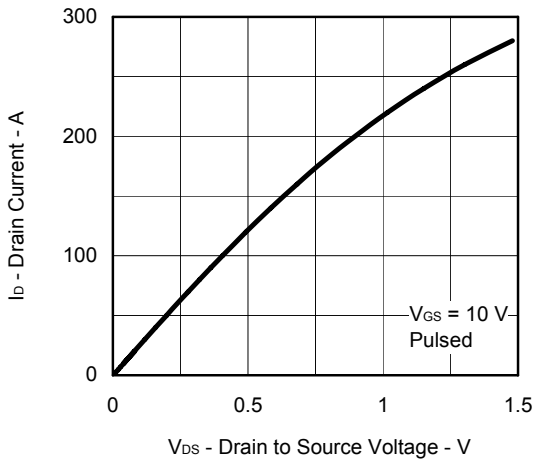
FORWARD BIAS SAFE OPERATING AREA



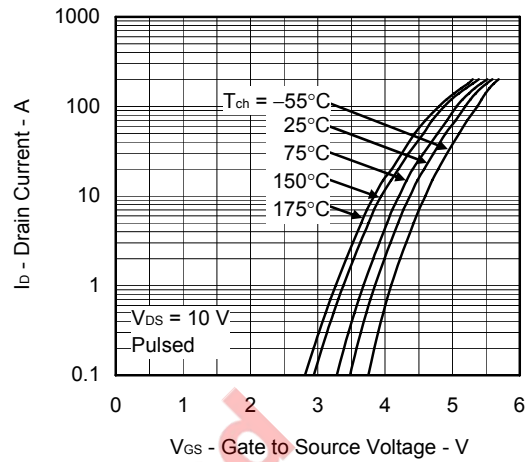
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



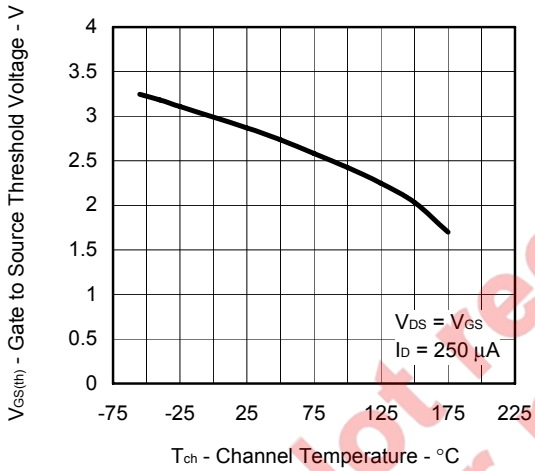
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



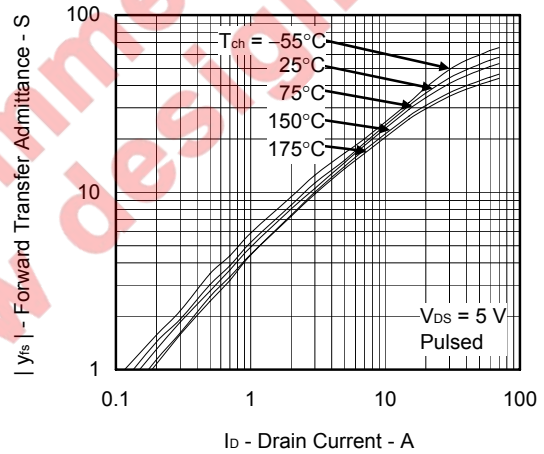
FORWARD TRANSFER CHARACTERISTICS



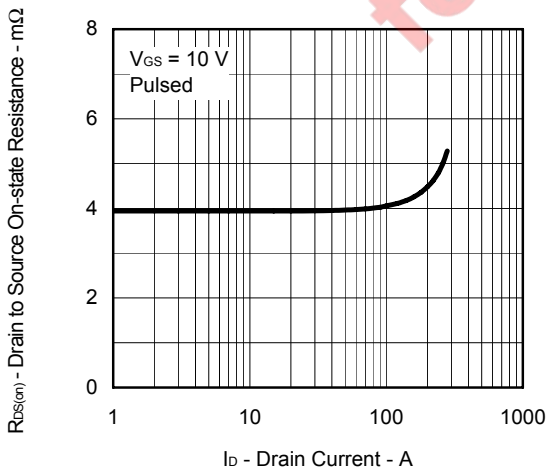
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



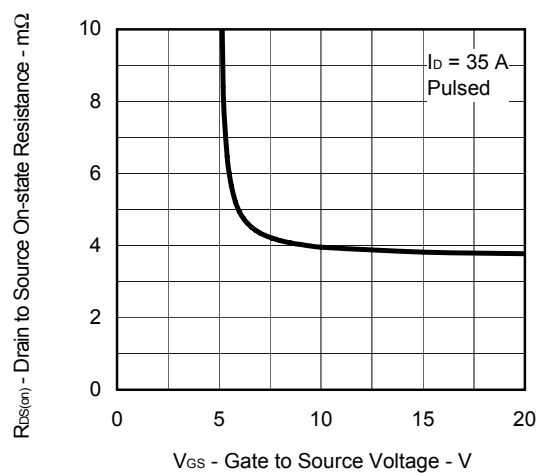
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



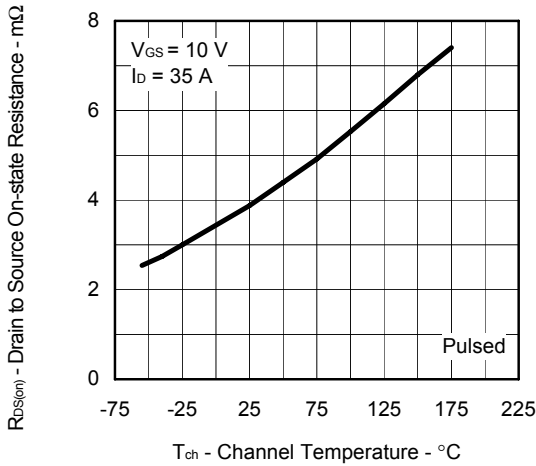
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



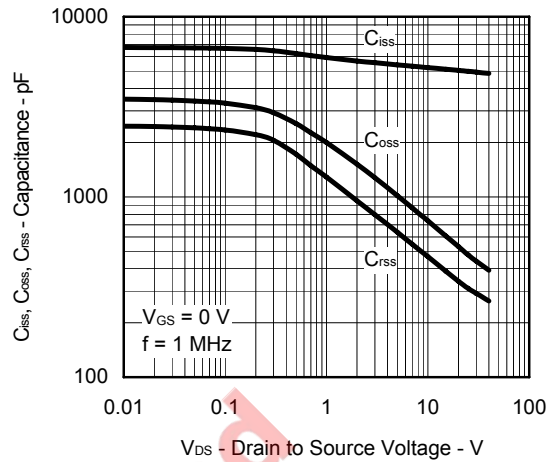
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



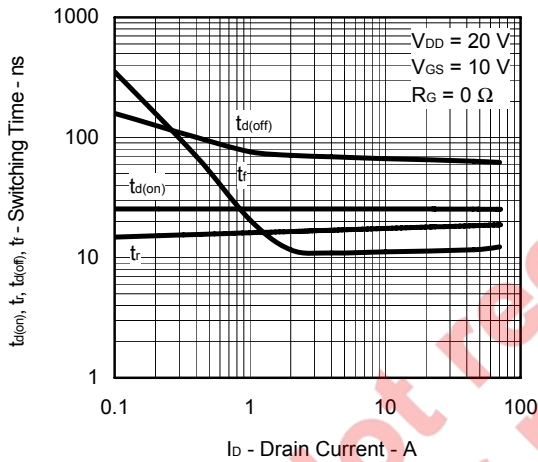
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



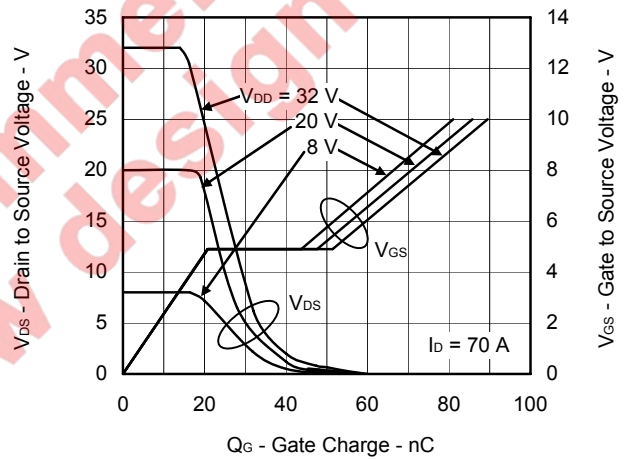
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



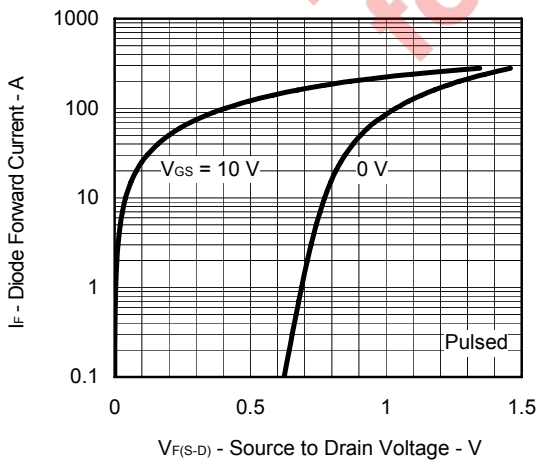
SWITCHING CHARACTERISTICS



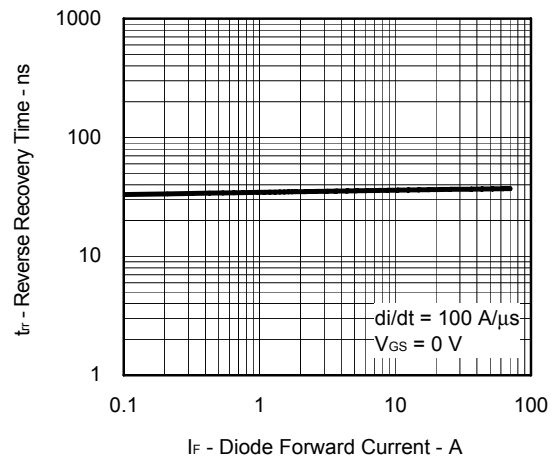
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

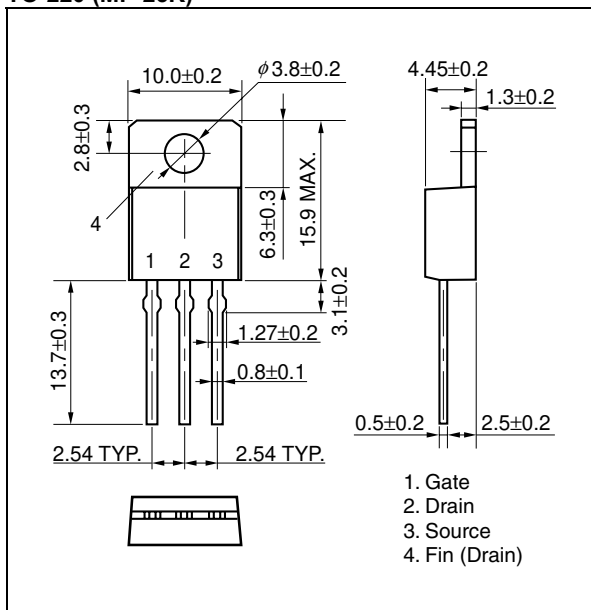


REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

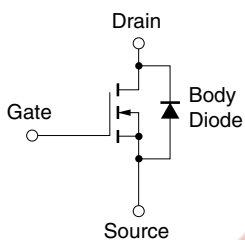


PACKAGE DRAWING (Unit: mm)

TO-220 (MP-25K)



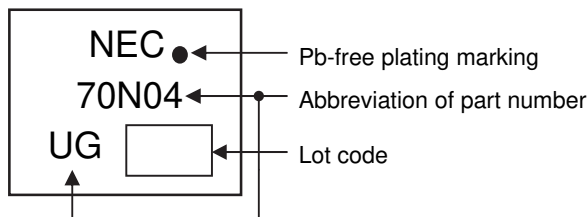
EQUIVALENT CIRCUIT



**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.



**MARKING INFORMATION**



**RECOMMENDED SOLDERING CONDITIONS**

The NP70N04MUG 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
Wave soldering MP-25K	Maximum temperature (Solder temperature): 260°C or below Time: 10 seconds or less Maximum chlorine content of rosin flux: 0.2% (wt.) or less	THDWS
Partial heating MP-25K	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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