

# MOS FIELD EFFECT TRANSISTOR NP60N03SUG

## SWITCHING N-CHANNEL POWER MOS FET

### DESCRIPTION

The NP60N03SUG is N-channel MOS Field Effect Transistor designed for high current switching applications.

### ORDERING INFORMATION

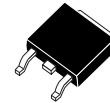
PART NUMBER	LEAD PLATING	PACKING	PACKAGE
NP60N03SUG-E1-AY <sup>Note</sup>	Pure Sn (Tin)	Tape 2500 p/reel	TO-252 (MP-3ZK) typ. 0.27 g
NP60N03SUG-E2-AY <sup>Note</sup>			

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

### FEATURES

- Channel temperature 175 degree rated
- Super low on-state resistance  
 $R_{DS(on)} = 3.8 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 30 \text{ A)}$
- High current rating  
 $I_{D(DC)} = \pm 60 \text{ A}$
- Low input capacitance  
 $C_{iss} = 5000 \text{ pF TYP.}$
- Designed for automotive application and AEC-Q101 qualified

(TO-252)



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

Drain to Source Voltage (V <sub>GS</sub> = 0 V)	V <sub>DSS</sub>	30	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>	±60	A
Drain Current (pulse) <sup>Note1</sup>	I <sub>D(pulse)</sub>	±240	A
Total Power Dissipation (T <sub>c</sub> = 25°C)	P <sub>T1</sub>	105	W
Total Power Dissipation (T <sub>A</sub> = 25°C)	P <sub>T2</sub>	1.2	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>	41	A
Repetitive Avalanche Energy <sup>Note2</sup>	E <sub>AR</sub>	168	mJ

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

**2.** T<sub>ch</sub> ≤ 150°C, R<sub>G</sub> = 25 Ω

### THERMAL RESISTANCE

Channel to Case Thermal Resistance	R <sub>th(ch-C)</sub>	1.43	°C/W
Channel to Ambient Thermal Resistance	R <sub>th(ch-A)</sub>	125	°C/W

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

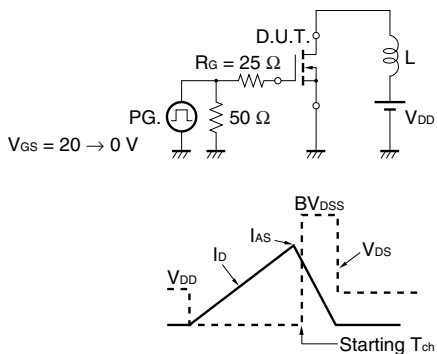
Not all products and/or types are available in every country. Please check with an NEC Electronics sales representative for availability and additional information.

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

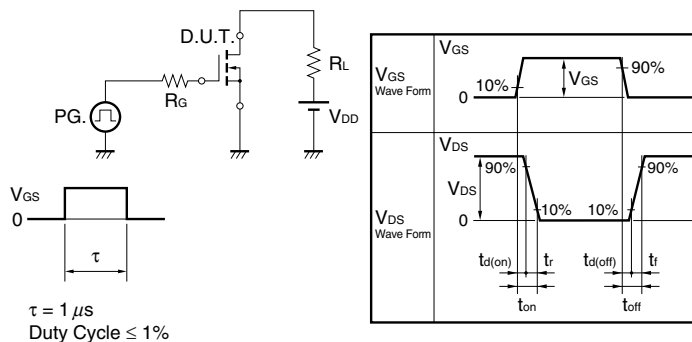
CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V			1	μA
Gate Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0 V			±100	nA
Gate to Source Threshold Voltage	V <sub>GS(th)</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 <sup>Note</sup>	y <sub>fs</sub>	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 30 A	25	41		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> = 30 A		3.0	3.8	mΩ
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V,		5000	7500	pF
Output Capacitance	C <sub>oss</sub>	f = 1 MHz		600	900	pF
Reverse Transfer Capacitance	C <sub>rss</sub>			420	760	pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 15 V, I <sub>D</sub> = 30 A,		32	64	ns
Rise Time	t <sub>r</sub>	V <sub>GS</sub> = 10 V,		20	49	ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		64	128	ns
Fall Time	t <sub>f</sub>			13	30	ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 24 V,		90	135	nC
Gate to Source Charge	Q <sub>GS</sub>	V <sub>GS</sub> = 10 V,		24		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 60 A		31		nC
Body Diode Forward Voltage <sup>Note</sup>	V <sub>F(S-D)</sub>	I <sub>F</sub> = 60 A, V <sub>GS</sub> = 0 V		0.9	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 60 A, V <sub>GS</sub> = 0 V,		42		ns
Reverse Recovery Charge	Q <sub>rr</sub>	di/dt = 100 A/μs		43		nC

**Note** Pulsed test

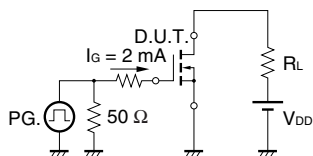
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



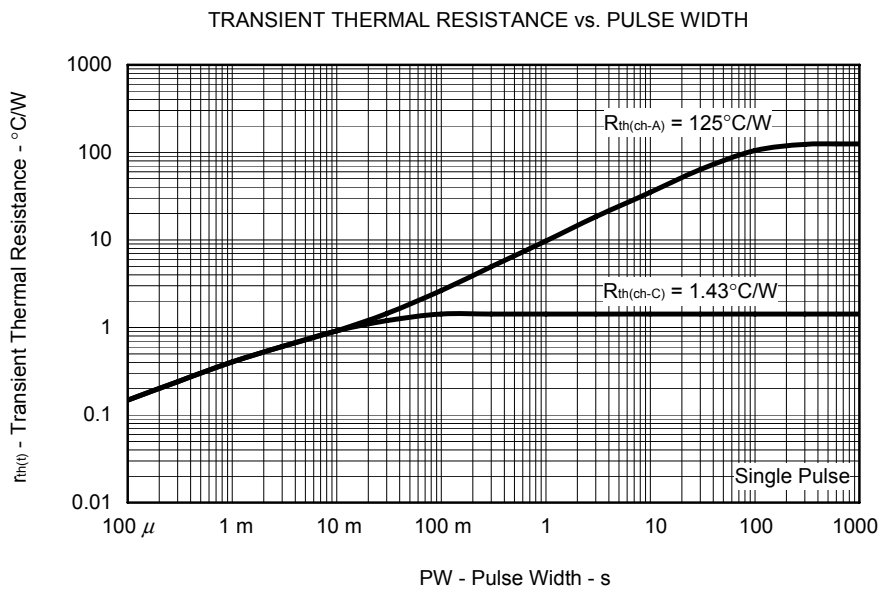
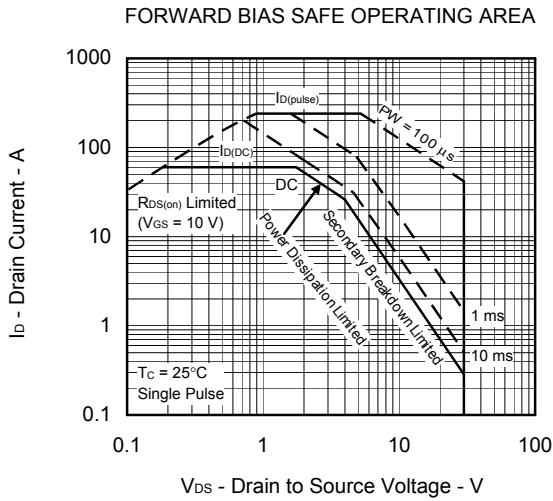
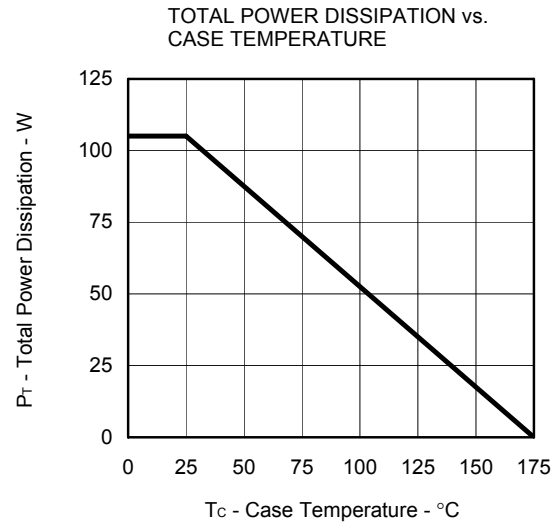
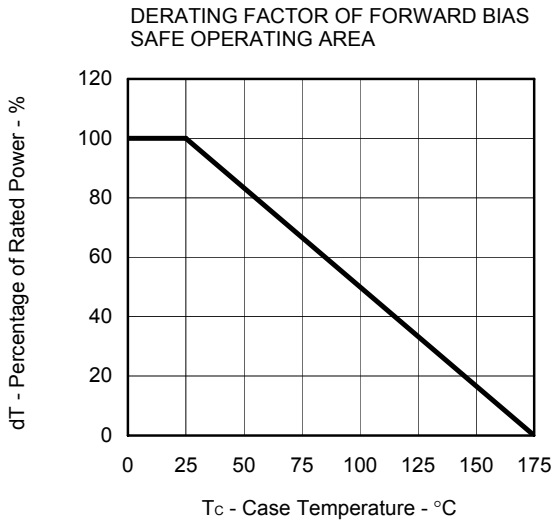
**TEST CIRCUIT 2 SWITCHING TIME**



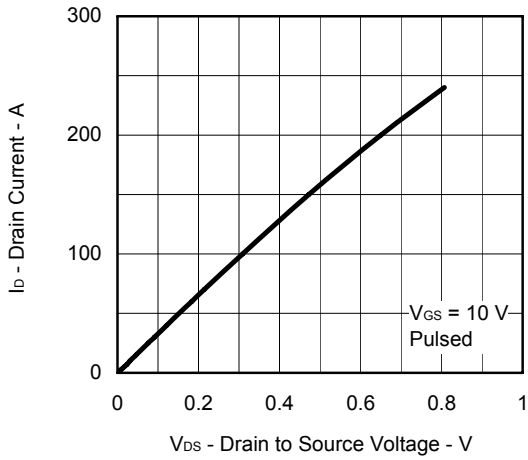
**TEST CIRCUIT 3 GATE CHARGE**



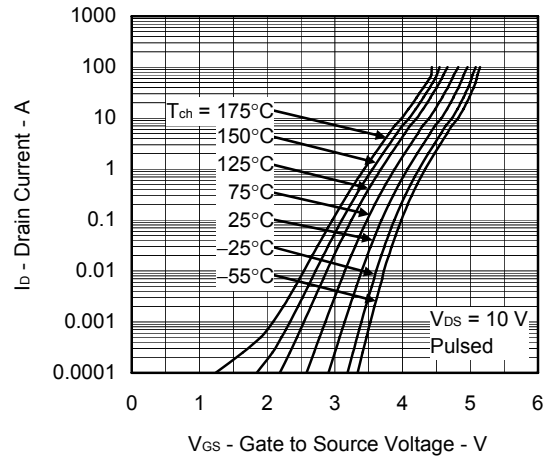
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)



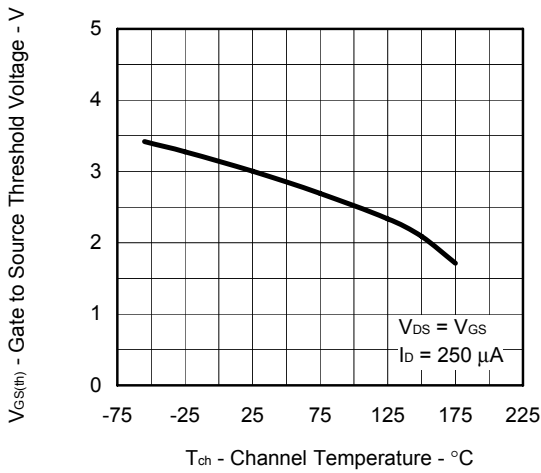
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



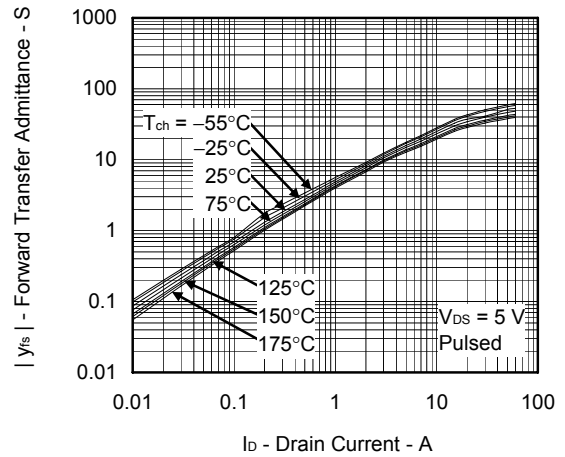
FORWARD TRANSFER CHARACTERISTICS



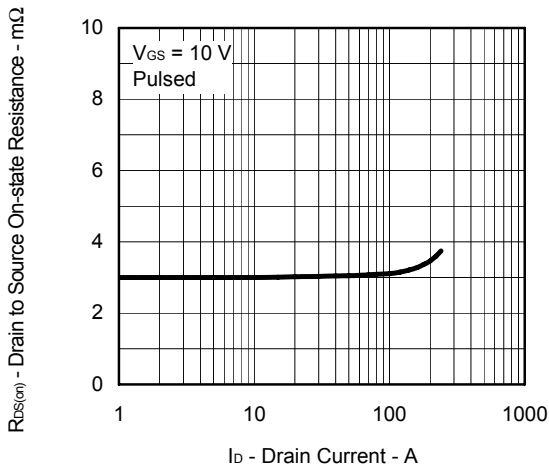
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



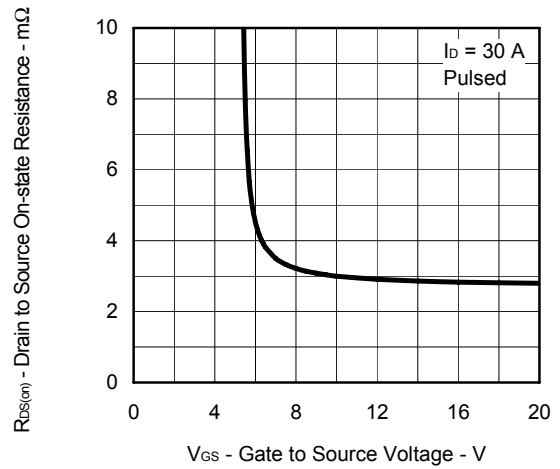
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



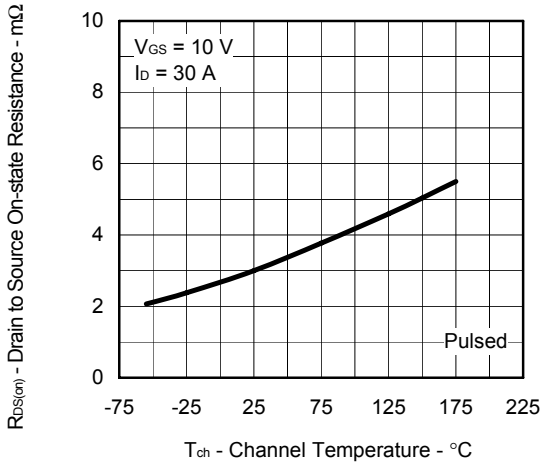
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



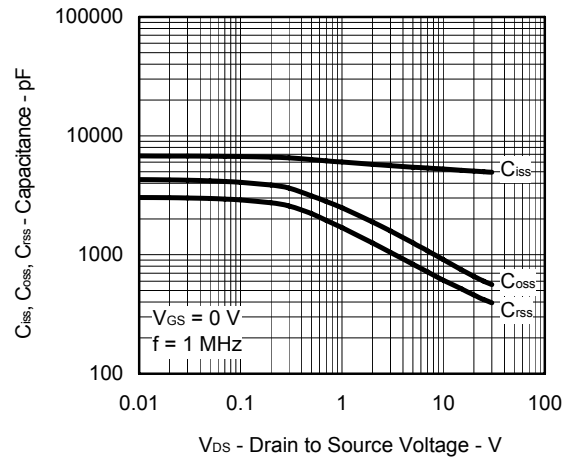
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



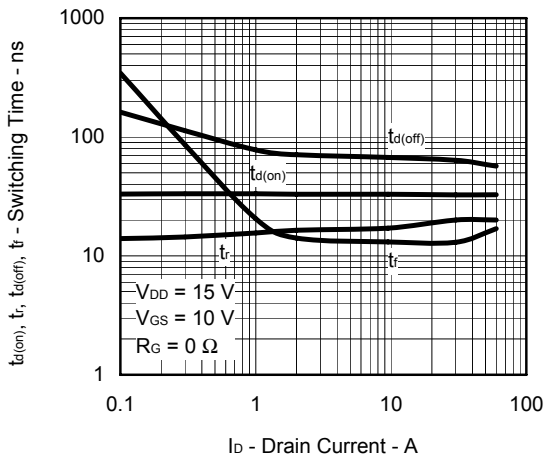
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



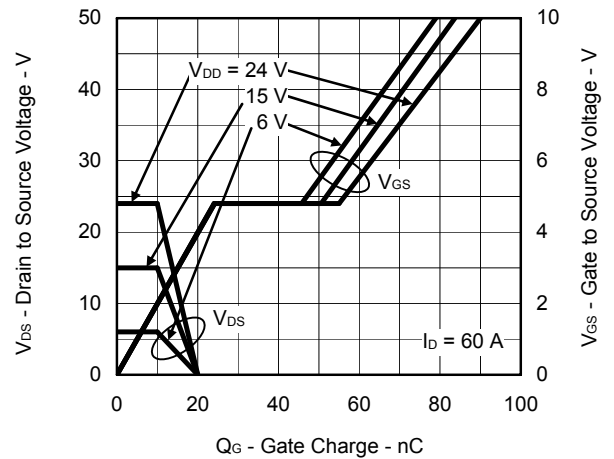
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



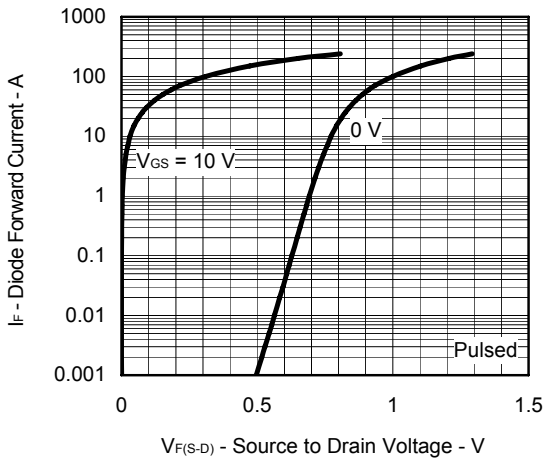
SWITCHING CHARACTERISTICS



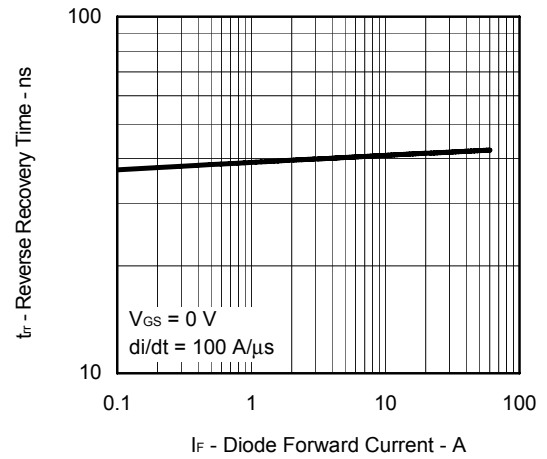
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

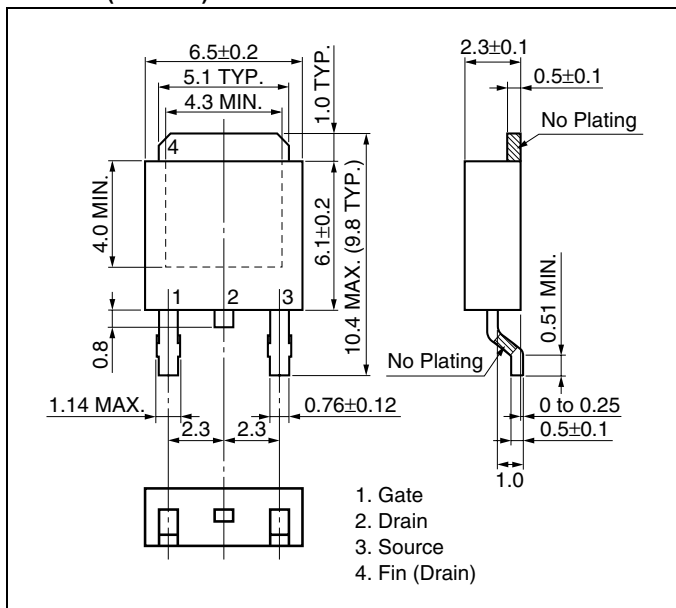


REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

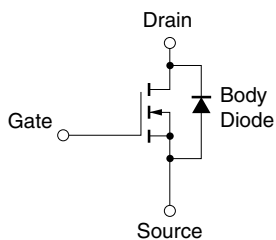


PACKAGE DRAWING (Unit: mm)

TO-252 (MP-3ZK)



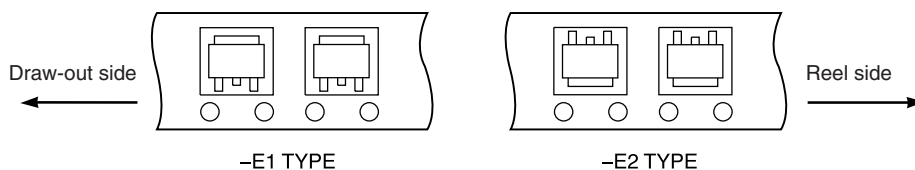
EQUIVALENT CIRCUIT



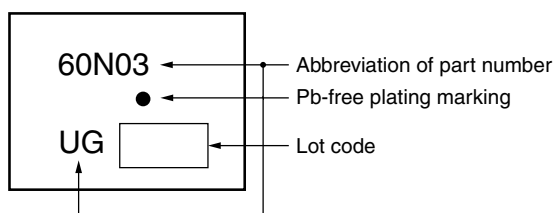
**Remark** Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

**TAPE INFORMATION**

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



**MARKING INFORMATION**



**RECOMMENDED SOLDERING CONDITIONS**

The NP60N03SUG 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).**