To our customers,

# Old Company Name in Catalogs and Other Documents

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

April 1st, 2010
Renesas Electronics Corporation

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RENESAS

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# MOS FIELD EFFECT TRANSISTOR
# NP80N04MDG, NP80N04NDG, NP80N04PDG

## SWITCHING
## N-CHANNEL POWER MOS FET



### DESCRIPTION

The NP80N04MDG, NP80N04NDG, and NP80N04PDG are N-channel MOS Field Effect Transistors designed for high current switching applications.

### ORDERING INFORMATION

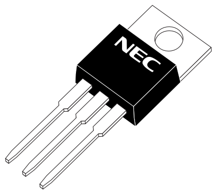
| PART NUMBER | LEAD PLATING | PACKING | PACKAGE |
|---|---|---|---|
| NP80N04MDG-S18-AY Note | Pure Sn (Tin) | Tube 50 p/tube | TO-220 (MP-25K) typ. 1.9 g |
| NP80N04NDG-S18-AY Note | | | TO-262 (MP-25SK) typ. 1.8 g |
| NP80N04PDG-E1B-AY Note | | Tape 1000 p/reel | TO-263 (MP-25ZP) typ. 1.5 g |
| NP80N04PDG-E2B-AY Note | | | |

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

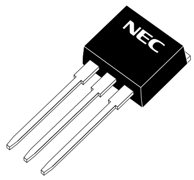
### FEATURES

- Logic level
- Super low on-state resistance
  - NP80N04MDG, NP80N04NDG
    $R_{DS(on)1}$ = 4.8 mΩ MAX. ($V_{GS}$ = 10 V, $I_D$ = 40 A)
    $R_{DS(on)2}$ = 9.0 mΩ MAX. ($V_{GS}$ = 4.5 V, $I_D$ = 35 A)
  - NP80N04PDG
    $R_{DS(on)1}$ = 4.5 mΩ MAX. ($V_{GS}$ = 10 V, $I_D$ = 40 A)
    $R_{DS(on)2}$ = 8.7 mΩ MAX. ($V_{GS}$ = 4.5 V, $I_D$ = 35 A)
- High current rating
  $I_{D(DC)}$ = ±80 A
- Low input capacitance
  $C_{iss}$ = 4600 pF TYP.
- Designed for automotive application and AEC-Q101 qualified

(TO-220)




(TO-262)

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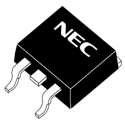


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Document No. D19795EJ1V0DS00 (1st edition)
Date Published May 2009 NS
Printed in Japan

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C)

| | | | |
|---|---|---|---|
| Drain to Source Voltage ($V_{GS}$ = 0 V) | $V_{DSS}$ | 40 | V |
| Gate to Source Voltage ($V_{DS}$ = 0 V) | $V_{GSS}$ | ±20 | V |
| Drain Current (DC) ($T_C$ = 25°C) | $I_{D(DC)}$ | ±80 | A |
| Drain Current (pulse) [Note1] | $I_{D(pulse)}$ | ±300 | A |
| Total Power Dissipation ($T_C$ = 25°C) | $P_{T1}$ | 115 | W |
| Total Power Dissipation ($T_A$ = 25°C) | $P_{T2}$ | 1.8 | W |
| Channel Temperature | $T_{ch}$ | 175 | °C |
| Storage Temperature | $T_{stg}$ | –55 to +175 | °C |
| Repetitive Avalanche Current [Note2] | $I_{AR}$ | 37 | A |
| Repetitive Avalanche Energy [Note2] | $E_{AR}$ | 137 | mJ |

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

**2.** $T_{ch}$ ≤ 150°C, $R_G$ = 25 Ω

## THERMAL RESISTANCE

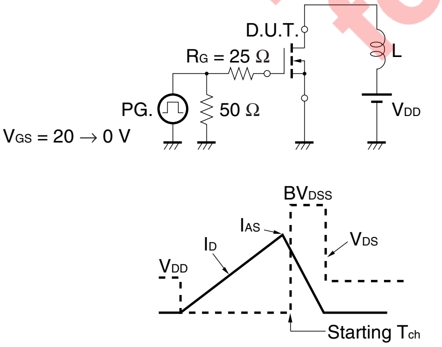
| | | | |
|---|---|---|---|
| Channel to Case Thermal Resistance | $R_{th(ch-C)}$ | 1.30 | °C/W |
| Channel to Ambient Thermal Resistance | $R_{th(ch-A)}$ | 83.3 | °C/W |

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

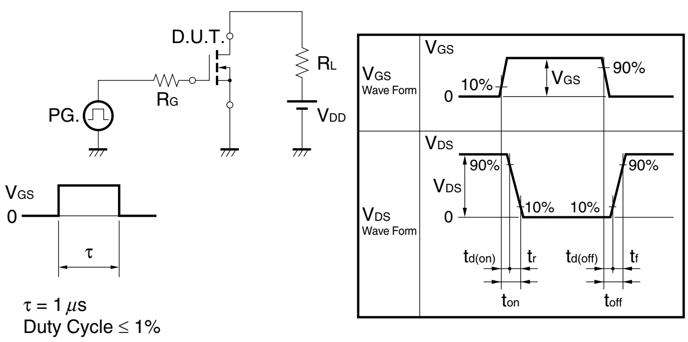
| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V | | | 1 | μA |
| Gate Leakage Current | $I_{GSS}$ | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | | | ±100 | nA |
| Gate to Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 1.4 | | 2.5 | V |
| Forward Transfer Admittance Note | \| $y_{fs}$ \| | $V_{DS}$ = 5 V, $I_D$ = 35 A | 25 | 63 | | S |
| Drain to Source On-state Resistance Note | $R_{DS(on)1}$ | $V_{GS}$ = 10 V, $I_D$ = 40 A NP80N04MDG, NP80N04NDG | | 3.7 | 4.8 | mΩ |
| | | $V_{GS}$ = 10 V, $I_D$ = 40 A NP80N04PDG | | 3.2 | 4.5 | mΩ |
| | $R_{DS(on)2}$ | $V_{GS}$ = 4.5 V, $I_D$ = 35 A NP80N04MDG, NP80N04NDG | | 4.8 | 9.0 | mΩ |
| | | $V_{GS}$ = 4.5 V, $I_D$ = 35 A NP80N04PDG | | 4.3 | 8.7 | mΩ |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25 V, | | 4600 | 6900 | pF |
| Output Capacitance | $C_{oss}$ | $V_{GS}$ = 0 V, | | 480 | 720 | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | f = 1 MHz | | 310 | 560 | pF |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$ = 20 V, $I_D$ = 40 A, | | 17 | 37 | ns |
| Rise Time | $t_r$ | $V_{GS}$ = 10 V, | | 18 | 45 | ns |
| Turn-off Delay Time | $t_{d(off)}$ | $R_G$ = 0 Ω | | 74 | 148 | ns |
| Fall Time | $t_f$ | | | 8 | 20 | ns |
| Total Gate Charge | $Q_G$ | $V_{DD}$ = 32 V, | | 90 | 135 | nC |
| Gate to Source Charge | $Q_{GS}$ | $V_{GS}$ = 10 V, | | 13 | | nC |
| Gate to Drain Charge | $Q_{GD}$ | $I_D$ = 80 A | | 26 | | nC |
| Body Diode Forward Voltage Note | $V_{F(S-D)}$ | $I_F$ = 80 A, $V_{GS}$ = 0 V | | 0.94 | 1.5 | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 80 A, $V_{GS}$ = 0 V, | | 39 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | di/dt = 100 A/μs | | 39 | | nC |

**Note** Pulsed test

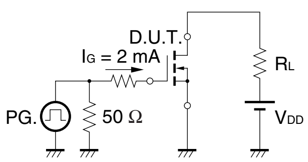
### TEST CIRCUIT 1 AVALANCHE CAPABILITY




### TEST CIRCUIT 2 SWITCHING TIME

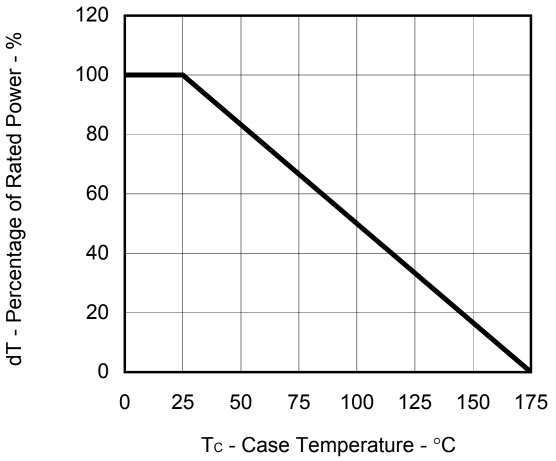



### TEST CIRCUIT 3 GATE CHARGE

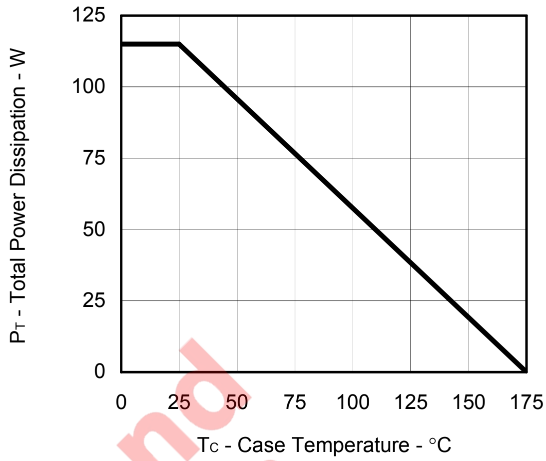


## TYPICAL CHARACTERISTICS ($T_A$ = 25°C)

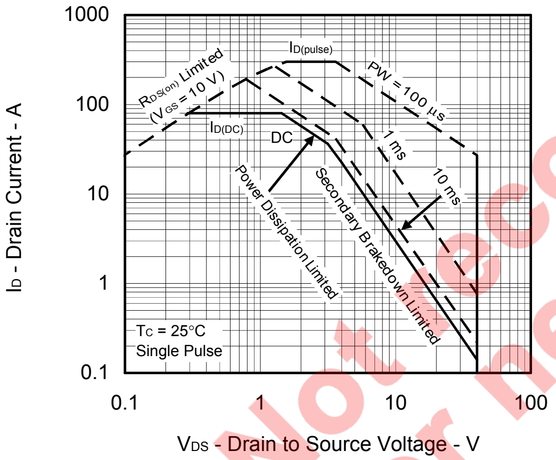
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



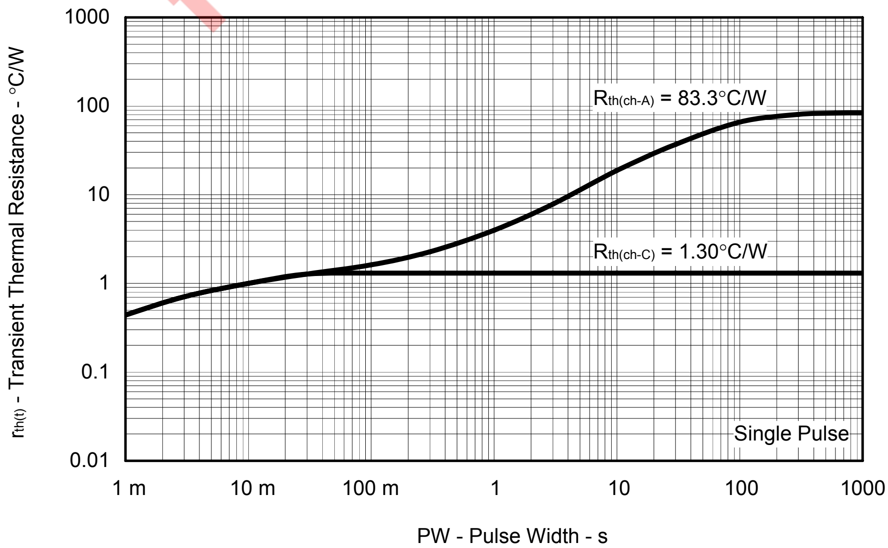

TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



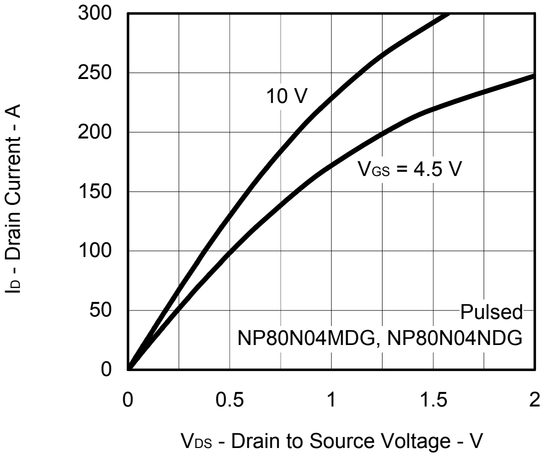

FORWARD BIAS SAFE OPERATING AREA



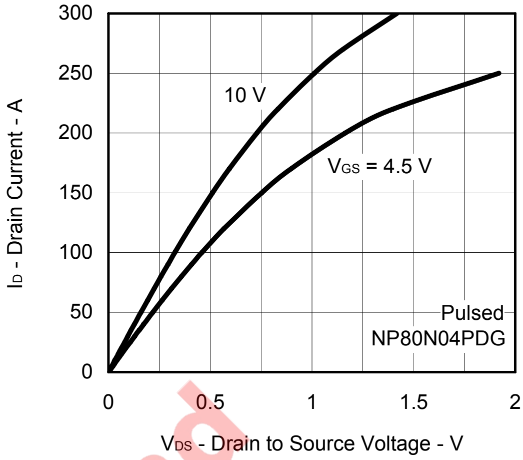

TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



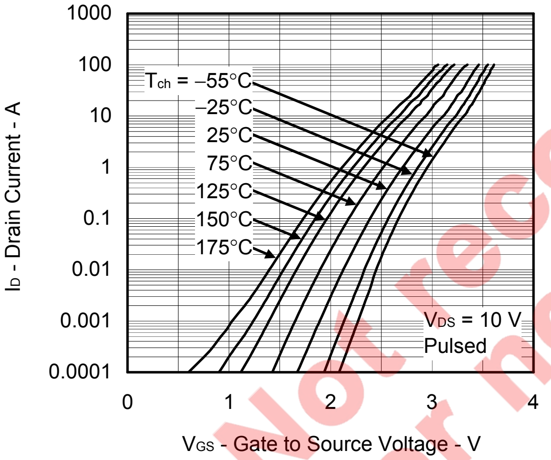
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



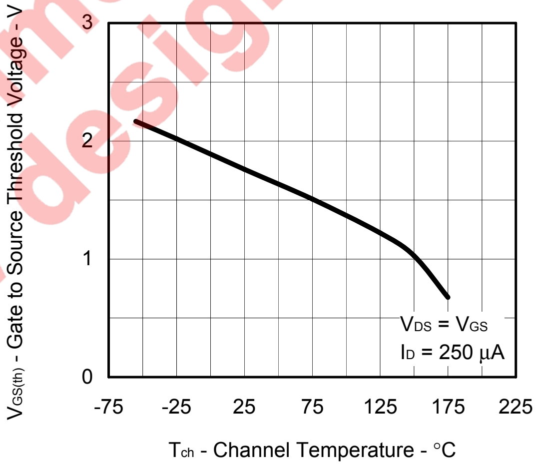

DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



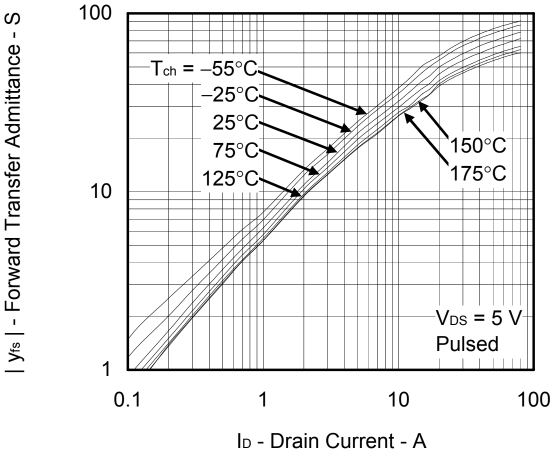

FORWARD TRANSFER CHARACTERISTICS



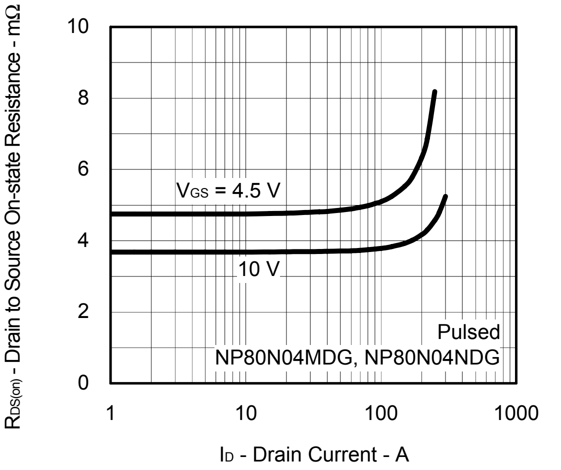

GATE TO SOURCE THRESHOLD VOLTAGE vs.
CHANNEL TEMPERATURE



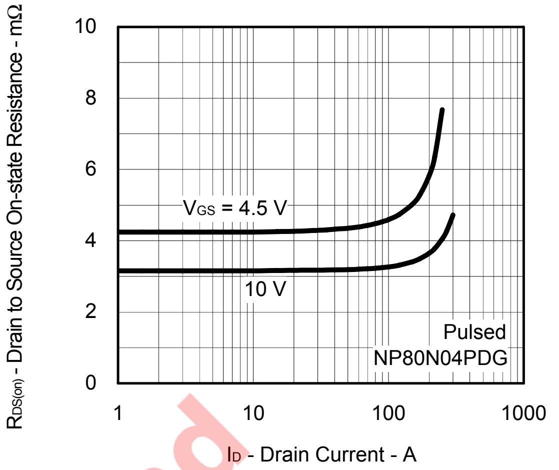

FORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENT



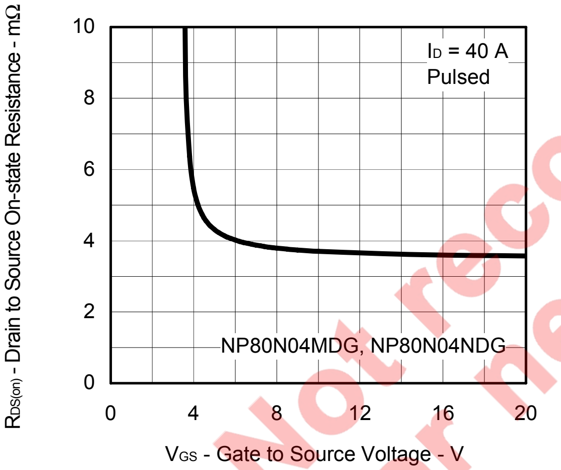
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



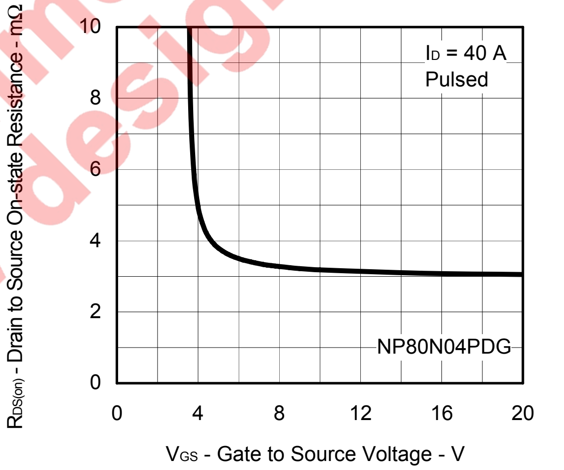

DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



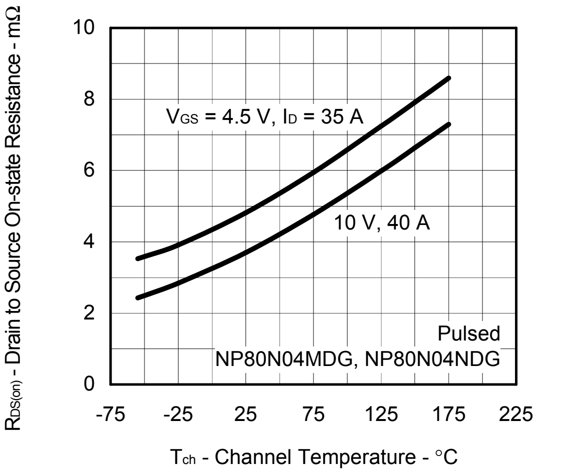

DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



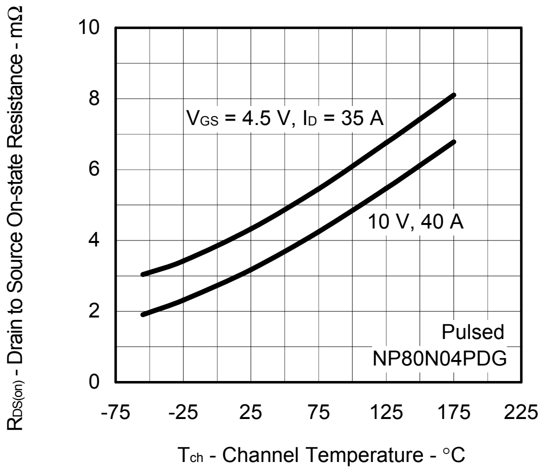

DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



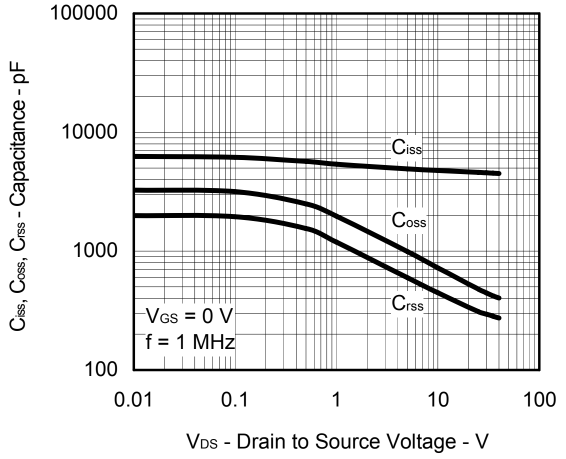

DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



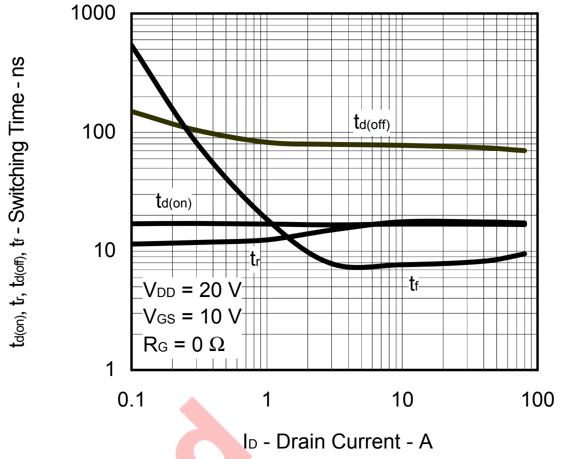

DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



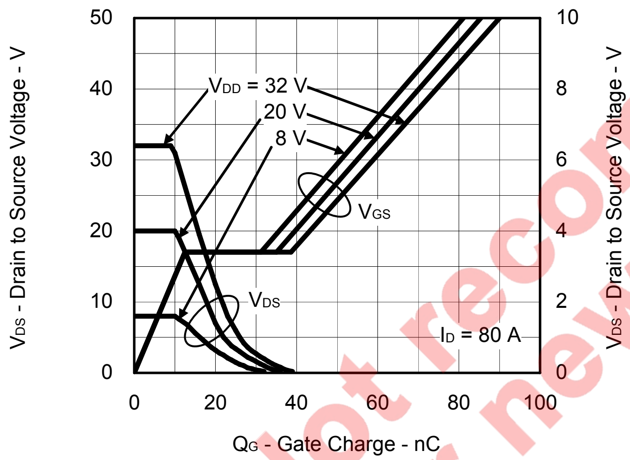
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



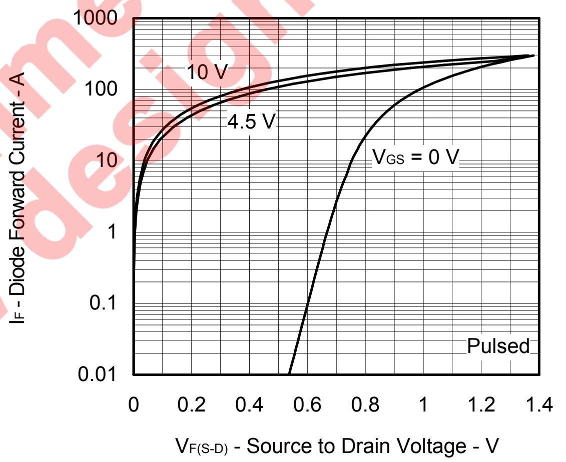

SWITCHING CHARACTERISTICS




DYNAMIC INPUT/OUTPUT CHARACTERISTICS

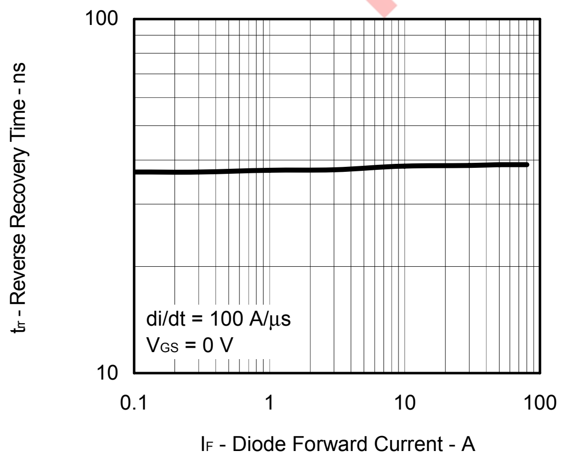



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



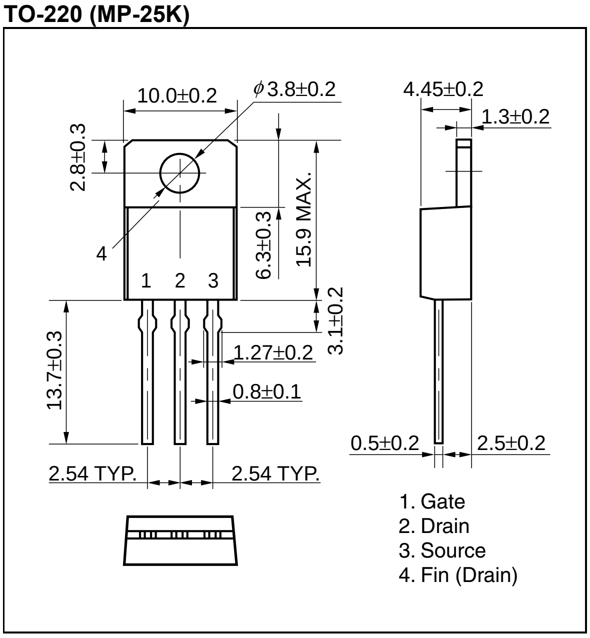



REVERSE RECOVERY TIME vs.
DIODE FORWARD CURRENT

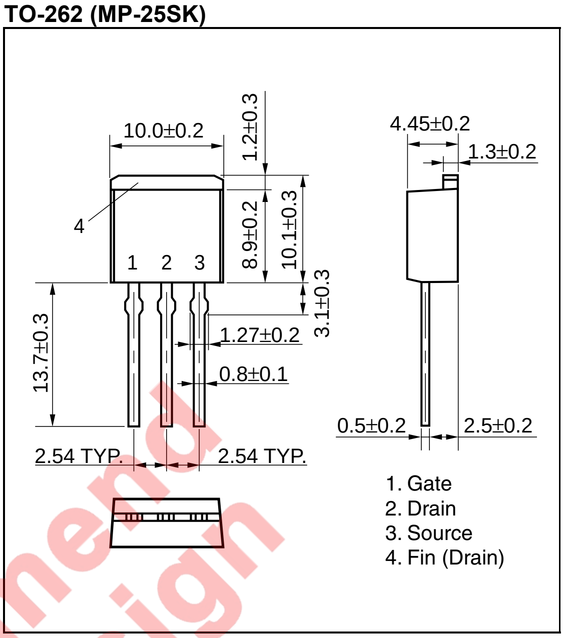


## PACKAGE DRAWINGS (Unit: mm)

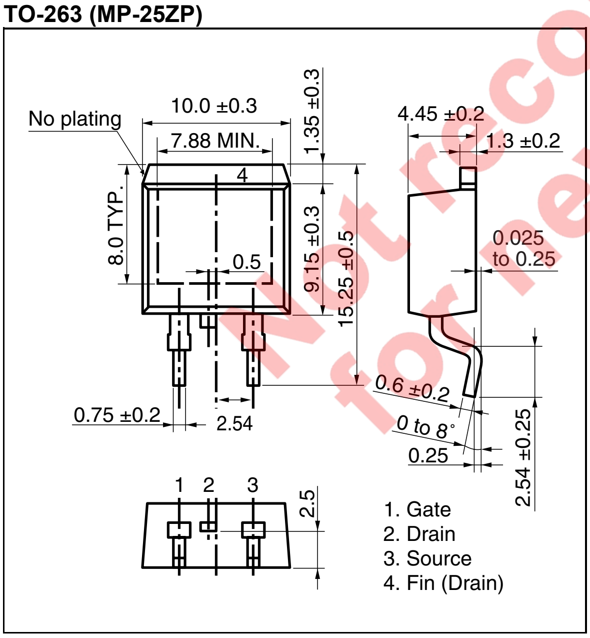
**TO-220 (MP-25K)**



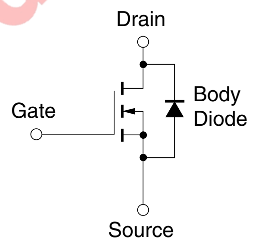

**TO-262 (MP-25SK)**




**TO-263 (MP-25ZP)**



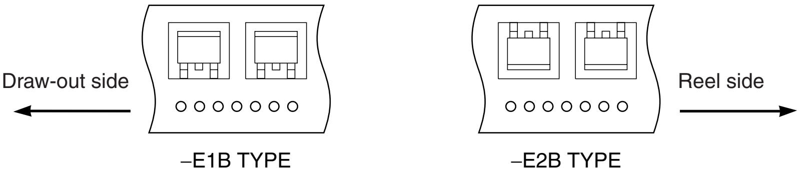

## EQUIVALENT CIRCUIT



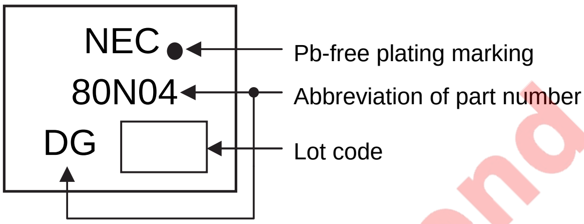

**Remark** Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

## TAPE INFORMATION (NP80N04PDG)

There are two types (-E1B, -E2B) of taping depending on the direction of the device.




## MARKING INFORMATION




## RECOMMENDED SOLDERING CONDITIONS

These products 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<br>NP80N04PDG | Maximum temperature (Package's surface temperature): 260°C or below<br>Time at maximum temperature: 10 seconds or less<br>Time of temperature higher than 220°C: 60 seconds or less<br>Preheating time at 160 to 180°C: 60 to 120 seconds<br>Maximum number of reflow processes: 3 times<br>Maximum chlorine content of rosin flux (percentage mass): 0.2% or less | IR60-00-3 |
| Wave soldering<br>NP80N04MDG,<br>NP80N04NDG | Maximum temperature (Solder temperature): 260°C or below<br>Time: 10 seconds or less<br>Maximum chlorine content of rosin flux: 0.2% (wt.) or less | THDWS |
| Partial heating<br>NP80N04MDG,<br>NP80N04NDG,<br>NP80N04PDG | Maximum temperature (Pin temperature): 350°C or below<br>Time (per side of the device): 3 seconds or less<br>Maximum chlorine content of rosin flux: 0.2% (wt.) or less | P350 |

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