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April 1st, 2010 Renesas Electronics Corporation

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

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DATA SHEET



MOS FIELD EFFECT TRANSISTOR NP160N04TUG

SWITCHING N-CHANNEL POWER MOS FET

DESCRIPTION

The NP160N04TUG is N-channel MOS Field Effect Transistor designed for high current switching applications.

ORDERING INFORMATION

| PART NUMBER | LEAD PLATING | PACKING | PACKAGE | | |
|------------------------|---------------|-----------------|----------------------------------|--|--|
| NP160N04TUG-E1-AY Note | | | | | |
| NP160N04TUG-E2-AY Note | Pure Sn (Tin) | Tape 800 p/reel | TO-263-7pin (MP-25ZT) typ. 1.5 g | | |

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

FEATURES

• Super low on-state resistance

 $R_{DS(on)}$ = 1.6 m Ω TYP. / 2.0 m Ω MAX. (Vgs = 10 V, ID = 80 A)

High Current Rating

 $I_{D(DC)} = \pm 160 A$

ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

| Drain to Source Voltage (V _{GS} = 0 V) | VDSS | 40 | V |
|---|-----------------------|-------------|----|
| Gate to Source Voltage (V _{DS} = 0 V) | Vgss | ±20 | V |
| Drain Current (DC) (Tc = 25°C) | I _{D(DC)} | ±160 | Α |
| Drain Current (pulse) Note1 | I _{D(pulse)} | ±640 | Α |
| Total Power Dissipation (Tc = 25°C) | P _{T1} | 220 | W |
| Total Power Dissipation (T _A = 25°C) | P _{T2} | 1.8 | W |
| Channel Temperature | Tch | 175 | °C |
| Storage Temperature | Tstg | -55 to +175 | °C |
| Single Avalanche Energy Note2 | Eas | 372 | mJ |
| Repetitive Avalanche Current Note3 | IAR | 61 | Α |
| Repetitive Avalanche Energy Note3 | Ear | 372 | mJ |

Notes 1. PW \leq 10 μ s, Duty Cycle \leq 1%

2. Starting T_{ch} = 25°C, V_{DD} = 20 V, R_G = 25 Ω , V_{GS} = 20 \rightarrow 0 V, L = 100 μ H

3. Rg = 25 Ω , Tch(peak) $\leq 150^{\circ}$ C

THERMAL RESISTANCE

| Channel to Case Thermal Resistance | Rth(ch-C) | 0.68 | °C/W |
|---------------------------------------|-----------|------|------|
| Channel to Ambient Thermal Resistance | Rth(ch-A) | 83.3 | °C/W |

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(TO-263-7pin)



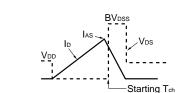
ELECTRICAL CHARACTERISTICS (TA = 25°C)

| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|--|---------------------|--|------|-------|-------|------|
| Zero Gate Voltage Drain Current | IDSS | V _{DS} = 40 V, V _{GS} = 0 V | | | 1 | μΑ |
| Gate Leakage Current | Igss | V _{GS} = ±20 V, V _{DS} = 0 V | | | ±100 | nA |
| Gate to Source Threshold Voltage | V _{GS(th)} | $V_{DS} = V_{GS}, I_{D} = 250 \ \mu A$ | 2.0 | 3.0 | 4.0 | ٧ |
| Forward Transfer Admittance Note | y _{fs} | V _{DS} = 5 V, I _D = 40 A | 28 | 76 | | S |
| Drain to Source On-state Resistance Note | R _{DS(on)} | V _{GS} = 10 V, I _D = 80 A | | 1.6 | 2.0 | mΩ |
| Input Capacitance | Ciss | V _{DS} = 25 V, | | 10500 | 15750 | pF |
| Output Capacitance | Coss | V _{GS} = 0 V, | | 980 | 1470 | pF |
| Reverse Transfer Capacitance | Crss | f = 1 MHz | | 630 | 1140 | pF |
| Turn-on Delay Time | t _{d(on)} | V _{DD} = 20 V, I _D = 80 A, | | 47 | 110 | ns |
| Rise Time | tr | V _{GS} = 10 V, | | 67 | 170 | ns |
| Turn-off Delay Time | t _{d(off)} | R _G = 0 Ω | | 94 | 190 | ns |
| Fall Time | tr | | | 19 | 50 | ns |
| Total Gate Charge Note | Q _G | V _{DD} = 32 V, | | 178 | 270 | nC |
| Gate to Source Charge | Q _{GS} | V _{GS} = 10 V, | | 44 | | nC |
| Gate to Drain Charge | Q _{GD} | I _D = 160 A | | 61 | | nC |
| Body Diode Forward Voltage Note | V _{F(S-D)} | I _F = 160 A, V _{GS} = 0 V | | 0.92 | 1.5 | V |
| Reverse Recovery Time | trr | IF = 160 A, VGS = 0 V, | | 50 | | ns |
| Reverse Recovery Charge | Qrr | di/dt = 100 A/ <i>μ</i> s | | 75 | | nC |

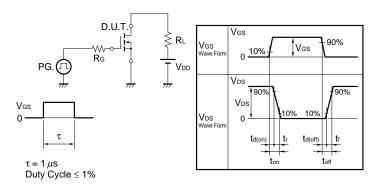
Note Pulsed test

TEST CIRCUIT 1 AVALANCHE CAPABILITY

$\begin{array}{c} \text{D.U.T.} \\ \text{Rg} = 25 \ \Omega \\ \text{Vgs} = 20 \rightarrow 0 \ \text{V} \end{array} \begin{array}{c} \text{PG.} \\ \text{M} \end{array} \begin{array}{c} \text{S} \\ \text{S} \\ \text{S} \end{array} \begin{array}{c} \text{D.U.T.} \\ \text{In } \\ \text{N} \end{array} \end{array}$



TEST CIRCUIT 2 SWITCHING TIME



TEST CIRCUIT 3 GATE CHARGE

$$\begin{array}{c|c}
D.U.T. & \\
I_G = 2 \text{ mA} & \\
\hline
PG. & \\
\end{array}$$

$$\begin{array}{c|c}
PG. & \\
\end{array}$$

$$\begin{array}{c|c}
\end{array}$$

$$\begin{array}{c|c}$$

$$\begin{array}{c|c}
\end{array}$$

$$\begin{array}{c|c}$$

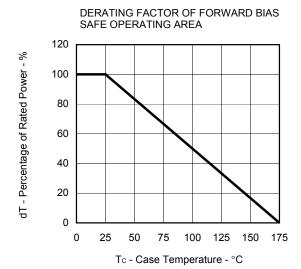
$$\begin{array}{c|c}$$

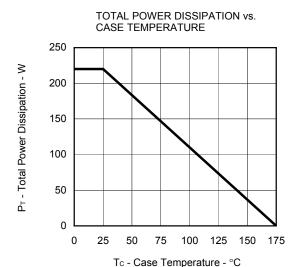
$$\begin{array}{c|c}
\end{array}$$

$$\begin{array}{c|c}$$

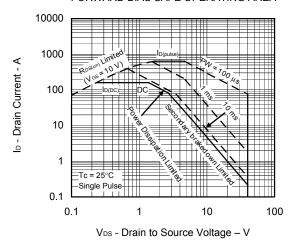
$$\end{array}$$

TYPICAL CHARACTERISTICS (TA = 25°C)

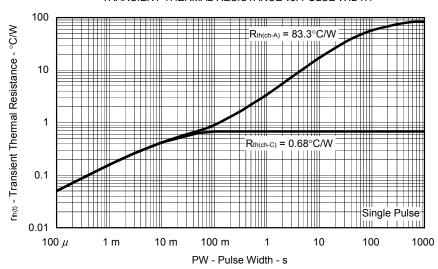




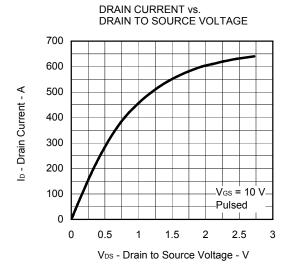
FORWARD BIAS SAFE OPERATING AREA

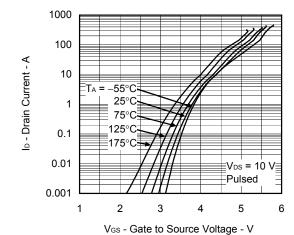


TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



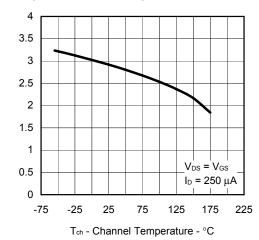
3



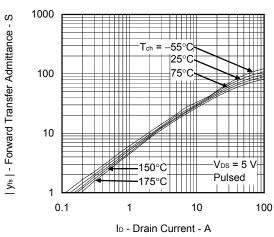


FORWARD TRANSFER CHARACTERISTICS

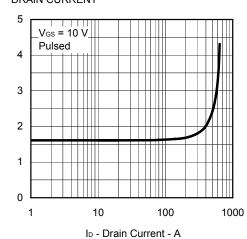
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



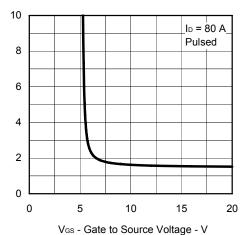
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



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



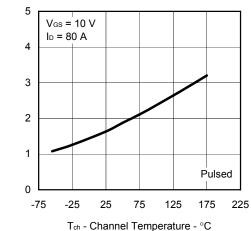
RDS(m) - Drain to Source On-state Resistance - m\Omega

Ves(th) - Gate to Source Threshold Voltage - V

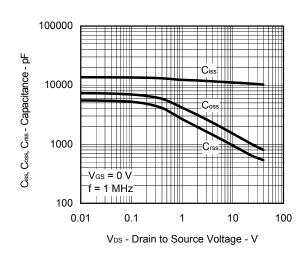
R_{DS(on)} - Drain to Source On-state Resistance - mΩ

R_{DS(on)} - Drain to Source On-state Resistance - mΩ

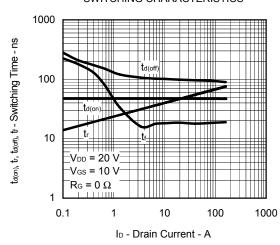




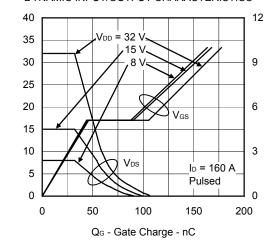
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



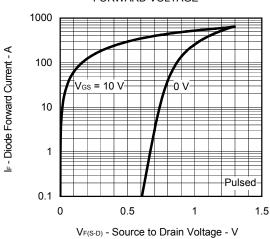
SWITCHING CHARACTERISTICS



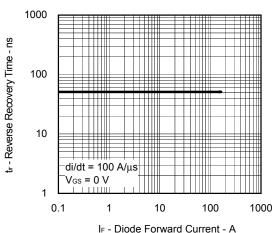
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



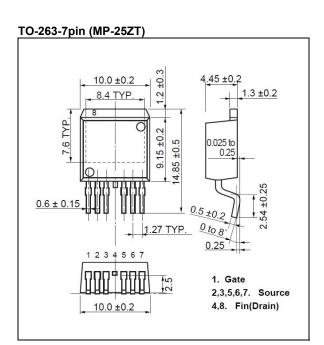
REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



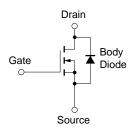
Vos - Gate to Source Voltage - V

Vps - Drain to Source Voltage - V

PACKAGE DRAWING (Unit: mm)



EQUIVALENT CIRCUIT

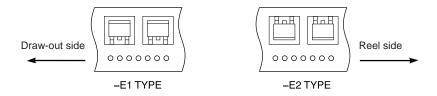


Remark Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

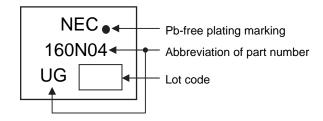
6

TAPE INFORMATION

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



MARKING INFORMATION



RECOMMENDED SOLDERING CONDITIONS

The NP160N04TUG 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 | IR60-00-3 | |
| Partial heating | Maximum chlorine content of rosin flux (percentage mass): 0.2% or less 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).

7

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