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April 1<sup>st</sup>, 2010 Renesas Electronics Corporation

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# MOS FIELD EFFECT TRANSISTOR NP90N055VDG

# SWITCHING N-CHANNEL POWER MOS FET

#### **DESCRIPTION**

The NP90N055VDG is N-channel MOS Field Effect Transistor designed for high current switching applications.

#### ORDERING INFORMATION

PART NUMBER	LEAD PLATING	PACKING	PACKAGE
NP90N055VDG-E1-AY Note		T 0500 / 1	TO 050 (MD 07D) / 0.07
NP90N055VDG-E2-AY Note	Pure Sn (Tin)	Tape 2500 p/reel	TO-252 (MP-3ZP) typ. 0.27 g

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

#### **FEATURES**

- Logic level
- Super low on-state resistance

 $R_{DS(on)1} = 6.0 \text{ m}\Omega$  MAX. (Vgs = 10 V, ID = 45 A)

 $R_{DS(on)2} = 10.5 \text{ m}\Omega$  MAX. (Vgs = 4.5 V, ID = 35 A)

High current rating

 $I_{D(DC)} = \pm 90 A$ 

Low input capacitance

Ciss = 4600 pF TYP.

• Designed for automotive application and AEC-Q101 qualified

#### ABSOLUTE MAXIMUM RATINGS (TA = 25°C)

Drain to Source Voltage (Vgs = 0 V)	VDSS	55	V
Gate to Source Voltage (V <sub>DS</sub> = 0 V)	Vgss	±20	V
Drain Current (DC) (Tc = 25°C)	ID(DC)	±90	Α
Drain Current (pulse) Note1	I <sub>D(pulse)</sub>	±200	Α
Total Power Dissipation (Tc = 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	Tch	175	°C
Storage Temperature	T <sub>stg</sub>	-55 to +175	°C
Repetitive Avalanche Current Note2	IAR	33	Α
Repetitive Avalanche Energy Note2	Ear	111	mJ

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

**2.** Tch  $\leq 150^{\circ}$ C, Rg = 25  $\Omega$ 

#### 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

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(TO-252)



#### **ELECTRICAL CHARACTERISTICS (TA = 25°C)**

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zero Gate Voltage Drain Current	IDSS	V <sub>DS</sub> = 55 V, V <sub>GS</sub> = 0 V			1	μΑ
Gate Leakage Current	Igss	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	1.4		2.5	V
Forward Transfer Admittance Note	y <sub>fs</sub>	V <sub>DS</sub> = 5 V, I <sub>D</sub> = 45 A	30	66		S
Drain to Source On-state Resistance Note	R <sub>DS(on)1</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 45 A		4.8	6.0	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 35 A		6.0	10.5	mΩ
Input Capacitance	Ciss	V <sub>DS</sub> = 25 V,		4600	6900	pF
Output Capacitance	Coss	V <sub>GS</sub> = 0 V,		390	590	pF
Reverse Transfer Capacitance	Crss	f = 1 MHz		240	440	pF
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = 28 V, I <sub>D</sub> = 45 A,		17	34	ns
Rise Time	tr	V <sub>GS</sub> = 10 V,		13	33	ns
Turn-off Delay Time	t <sub>d(off)</sub>	R <sub>G</sub> = 0 Ω		76	152	ns
Fall Time	tr			7	18	ns
Total Gate Charge	Q <sub>G</sub>	V <sub>DD</sub> = 44 V,		90	135	nC
Gate to Source Charge	Qgs	V <sub>GS</sub> = 10 V,		13		nC
Gate to Drain Charge	Q <sub>GD</sub>	I <sub>D</sub> = 90 A		26		nC
Body Diode Forward Voltage Note	V <sub>F(S-D)</sub>	I <sub>F</sub> = 90 A, V <sub>GS</sub> = 0 V		0.9	1.5	V
Reverse Recovery Time	trr	IF = 90 A, VGS = 0 V,		38		ns
Reverse Recovery Charge	Qrr	di/dt = 100 A/μs		45		nC

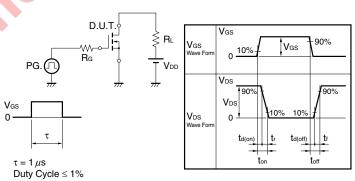
Note Pulsed test

#### TEST CIRCUIT 1 AVALANCHE CAPABILITY

# $V_{GS} = 20 \rightarrow 0 \text{ V}$ $V_{DD}$ $V_{DD}$ $V_{DD}$ $V_{DD}$ $V_{DD}$ $V_{DD}$ $V_{DD}$ $V_{DD}$

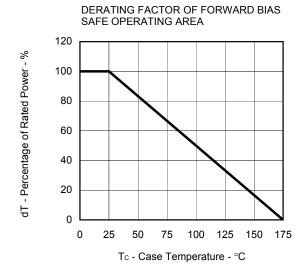
-Starting Tch

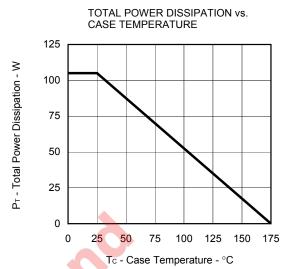
#### TEST CIRCUIT 2 SWITCHING TIME

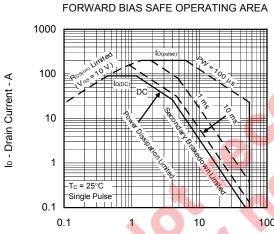


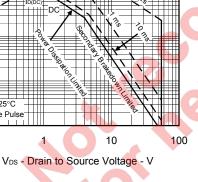
#### **TEST CIRCUIT 3 GATE CHARGE**

#### TYPICAL CHARACTERISTICS (TA = 25°C)

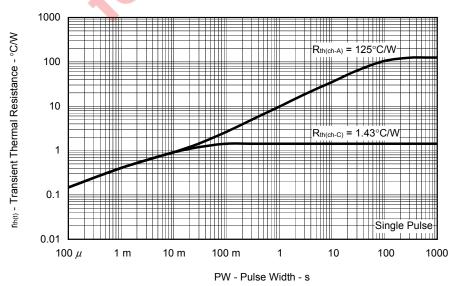








TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

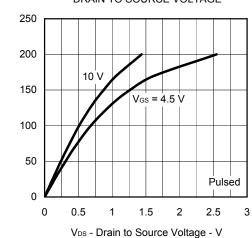


3

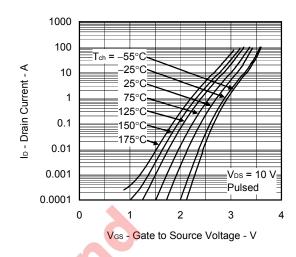
Ip - Drain Current - A

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

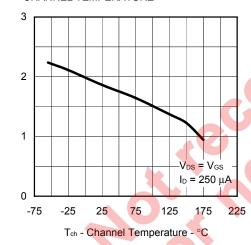




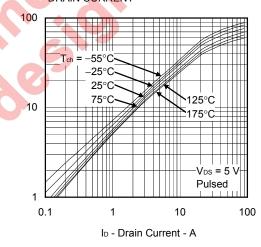
#### FORWARD TRANSFER CHARACTERISTICS



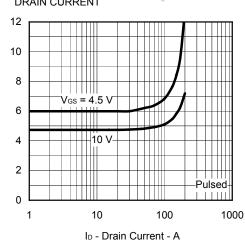
## GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



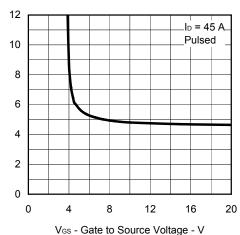
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



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

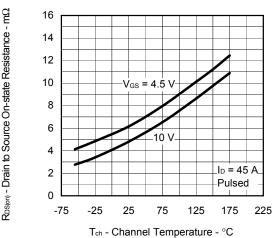


 $\mathsf{R}_{\mathsf{DS}(m)}$  - Drain to Source On-state Resistance -  $m\Omega$ 

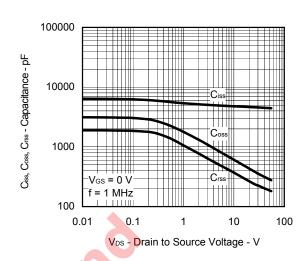
ys | - Forward Transfer Admittance - S

 $\mathsf{R}_{\mathsf{DS}(m)}$  - Drain to Source On-state Resistance -  $m\Omega$ 

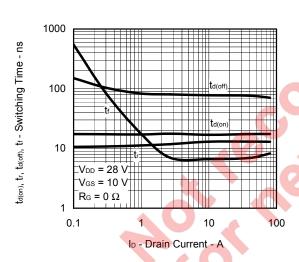
# DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



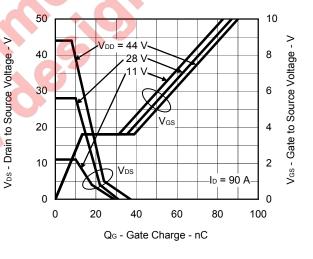
#### CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



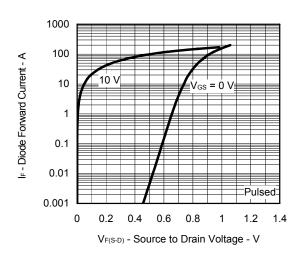
#### SWITCHING CHARACTERISTICS



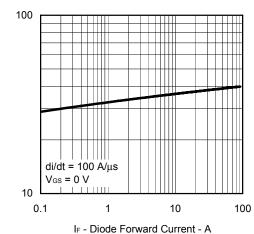
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



#### SOURCE TO DRAIN DIODE FORWARD VOLTAGE



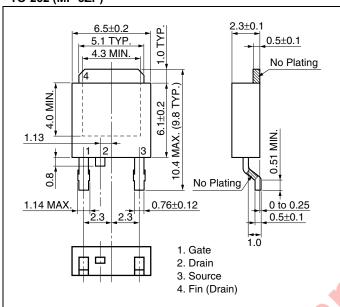
REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT



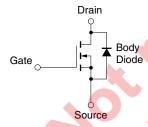
tr - Reverse Recovery Time - ns

#### PACKAGE DRAWING (Unit: mm)

#### TO-252 (MP-3ZP)



#### **EQUIVALENT CIRCUIT**

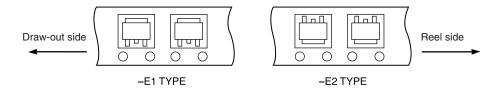


**Remark** Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

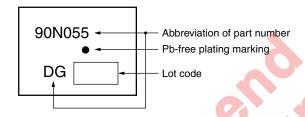
6

#### TAPE INFORMATION

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



#### MARKING INFORMATION



#### RECOMMENDED SOLDERING CONDITIONS

The NP90N055VDG 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	IR60-00-3
	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	
Partial heating	Maximum temperature (Pin temperature): 350°C or below	P350
	Time (per side of the device): 3 seconds or less	
	Maximum chlorine content of rosin flux: 0.2% (wt.) or less	

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

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