

# NP89N04MUK, NP89N04NUK

R07DS0599EJ0200

Rev.2.00

May 24, 2018

## MOS FIELD EFFECT TRANSISTOR

### Description

These products are N-channel MOS Field Effect Transistors designed for high current switching applications.

### Features

- Super low on-state resistance  
 $R_{DS(on)} = 3.3 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 45 \text{ A)}$
- Low  $C_{iss}$ :  $C_{iss} = 3900 \text{ pF TYP. (} V_{DS} = 25 \text{ V)}$
- Designed for automotive application and AEC-Q101 qualified

### Ordering Information

Part No.	Lead Plating	Packing	Package
NP89N04MUK-S18-AY *1	Pure Sn (Tin)	Tube 50 p/tube	TO-220 (MP-25K)
NP89N04NUK-S18-AY *1			TO-262 (MP-25SK)

Note: \*1 Pb-free (This product does not contain Pb in the external electrode)

### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )	$V_{DSS}$	40	V
Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )	$V_{GSS}$	$\pm 20$	V
Drain Current (DC) ( $T_C = 25^\circ\text{C}$ )	$I_{D(DC)}$	$\pm 90$	A
Drain Current (pulse) *1, 3	$I_{D(pulse)}$	$\pm 360$	A
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{T1}$	147	W
Total Power Dissipation ( $T_A = 25^\circ\text{C}$ )	$P_{T2}$	1.8	W
Channel Temperature	$T_{ch}$	175	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	-55 to 175	$^\circ\text{C}$
Repetitive Avalanche Current *2, 3	$I_{AR}$	37	A
Repetitive Avalanche Energy *2, 3	$E_{AR}$	136	mJ

### Thermal Resistance

Channel to Case Thermal Resistance	$R_{th(ch-C)}$ *3	1.02	$^\circ\text{C/W}$
Channel to Ambient Thermal Resistance	$R_{th(ch-A)}$ *3	83.3	$^\circ\text{C/W}$

Notes: \*1  $T_C = 25^\circ\text{C}$ ,  $P_w \leq 10 \mu\text{s}$ , Duty Cycle  $\leq 1\%$

\*2  $R_G = 25 \Omega$ ,  $V_{GS} = 20 \rightarrow 0 \text{ V}$

\*3 Not subject of production test. Verified by design/characterization.

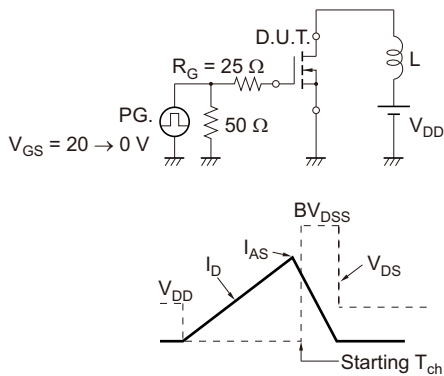
**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$ )

Item	Symbol	MIN.	TYP.	MAX.	Unit	Test Conditions
Zero Gate Voltage Drain Current	$I_{DSS}$	—	—	1	$\mu\text{A}$	$V_{DS} = 40\text{ V}, V_{GS} = 0\text{ V}$
Gate Leakage Current	$I_{GSS}$	—	—	$\pm 100$	nA	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$
Gate to Source Threshold Voltage	$V_{GS(th)}$	2.0	3.0	4.0	V	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$
Forward Transfer Admittance *1	$ y_{fs} $	30	60	—	S	$V_{DS} = 5\text{ V}, I_D = 45\text{ A}$
Drain to Source On-state Resistance *1	$R_{DS(on)}$	—	2.75	3.30	$\text{m}\Omega$	$V_{GS} = 10\text{ V}, I_D = 45\text{ A}$
Input Capacitance *2	$C_{iss}$	—	3900	5850	pF	$V_{DS} = 25\text{ V}$ $V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$
Output Capacitance *2	$C_{oss}$	—	530	800	pF	
Reverse Transfer Capacitance *2	$C_{rss}$	—	200	360	pF	
Turn-on Delay Time *2	$t_{d(on)}$	—	25	60	ns	$V_{DD} = 20\text{ V}, I_D = 45\text{ A}$ $V_{GS} = 10\text{ V}$ $R_G = 0\ \Omega$
Rise Time *2	$t_r$	—	12	30	ns	
Turn-off Delay Time *2	$t_{d(off)}$	—	65	130	ns	
Fall Time *2	$t_f$	—	8	20	ns	
Total Gate Charge *2	$Q_G$	—	68	102	nC	$V_{DD} = 32\text{ V}$
Gate to Source Charge	$Q_{GS}$	—	18	—	nC	$V_{GS} = 10\text{ V}$
Gate to Drain Charge	$Q_{GD}$	—	18	—	nC	$I_D = 90\text{ A}$
Body Diode Forward Voltage *1	$V_{F(S-D)}$	—	0.95	1.5	V	$I_F = 90\text{ A}, V_{GS} = 0\text{ V}$
Reverse Recovery Time	$t_{rr}$	—	47	—	ns	$I_F = 90\text{ A}, V_{GS} = 0\text{ V}$
Reverse Recovery Charge	$Q_{rr}$	—	68	—	nC	$di/dt = 100\text{ A}/\mu\text{s}$

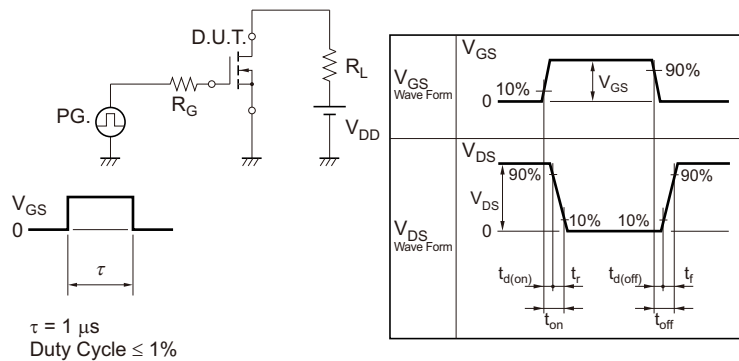
Note: \*1 Pulsed test

Note: \*2 Not subject of production test. Verified by design/characterization.

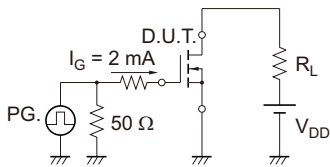
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



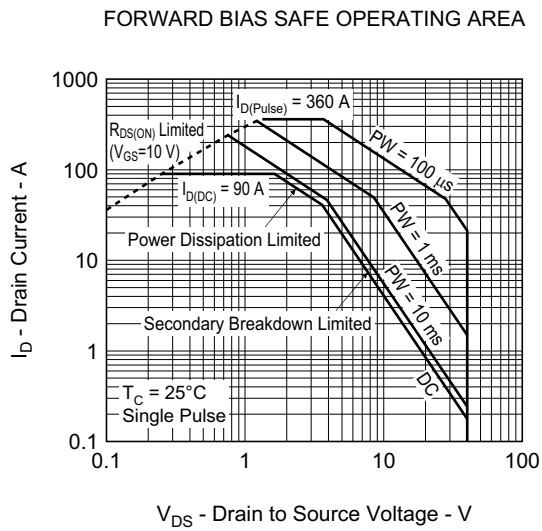
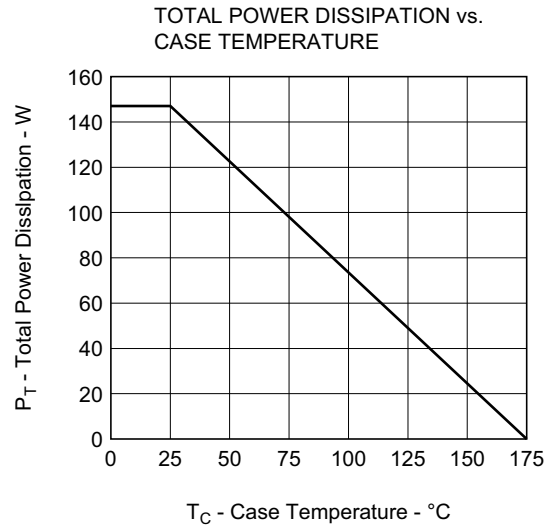
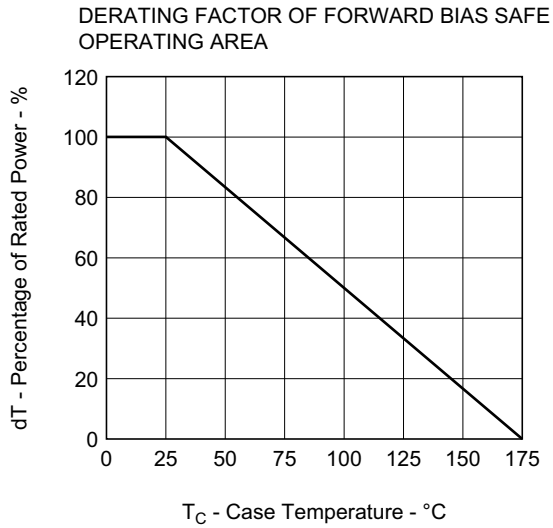
**TEST CIRCUIT 2 SWITCHING TIME**



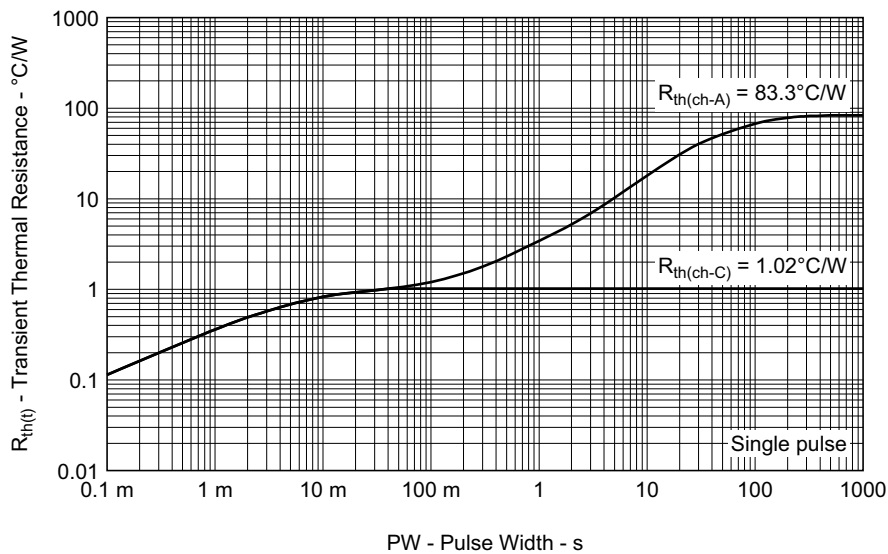
**TEST CIRCUIT 3 GATE CHARGE**



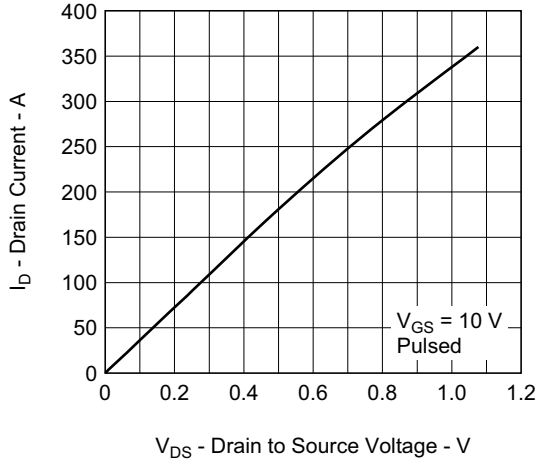
Typical Characteristics (T<sub>A</sub> = 25°C)



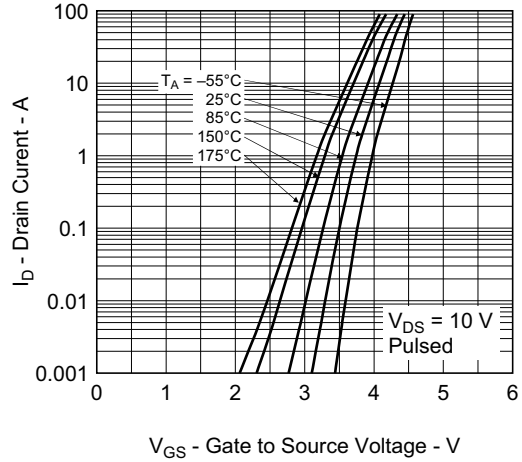
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



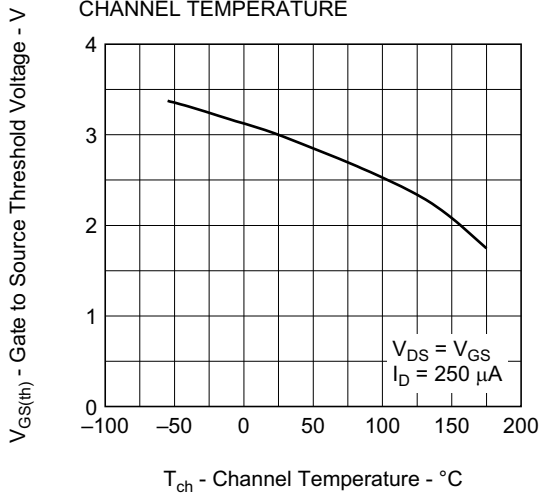
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



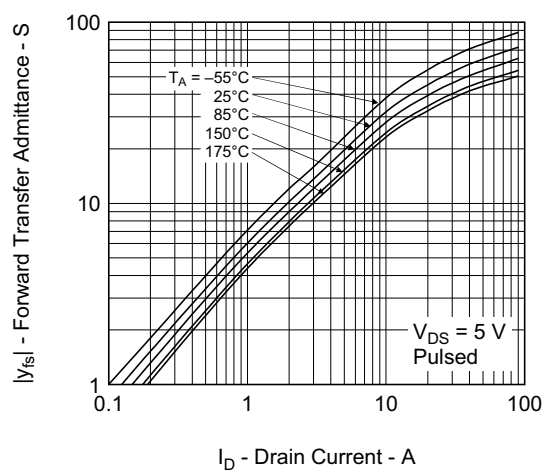
FORWARD TRANSFER CHARACTERISTICS



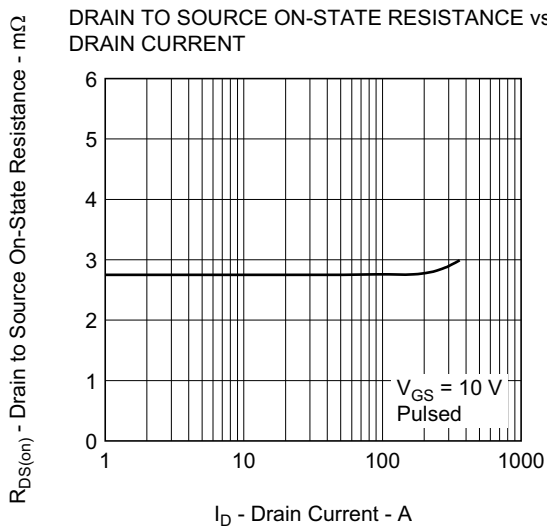
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



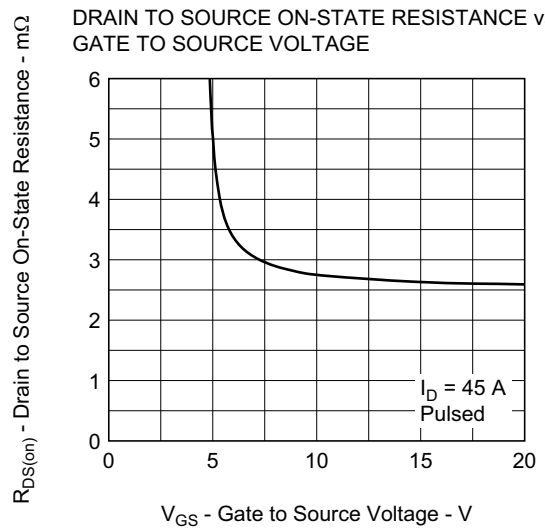
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



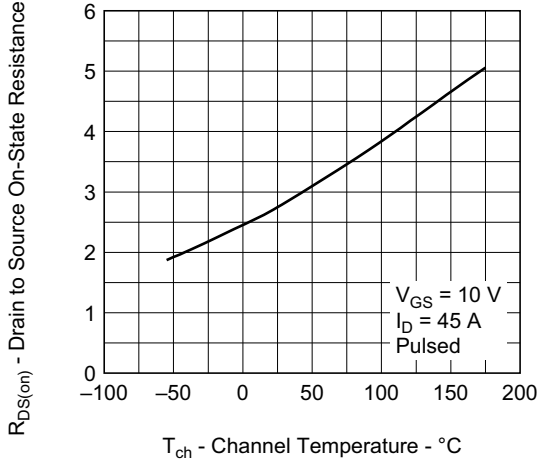
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



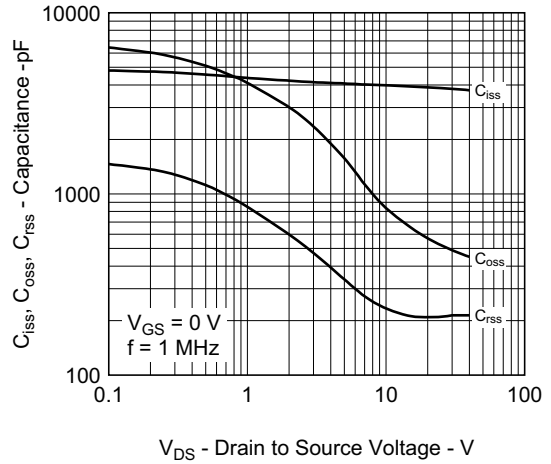
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



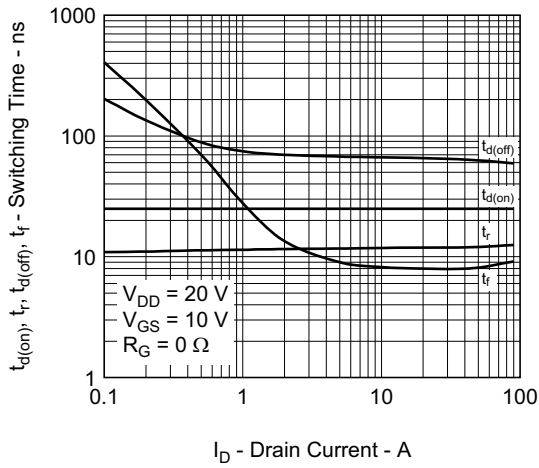
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



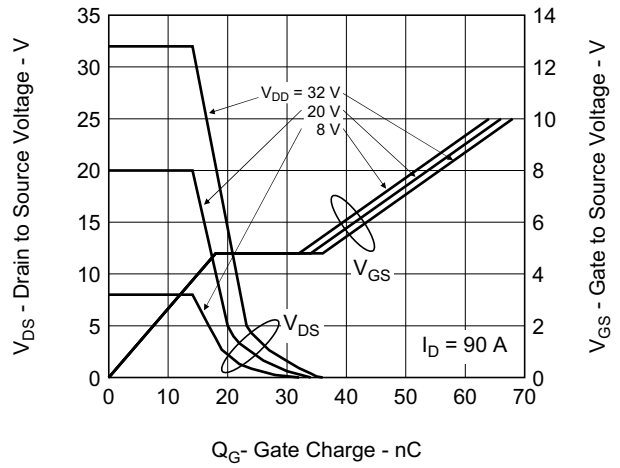
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



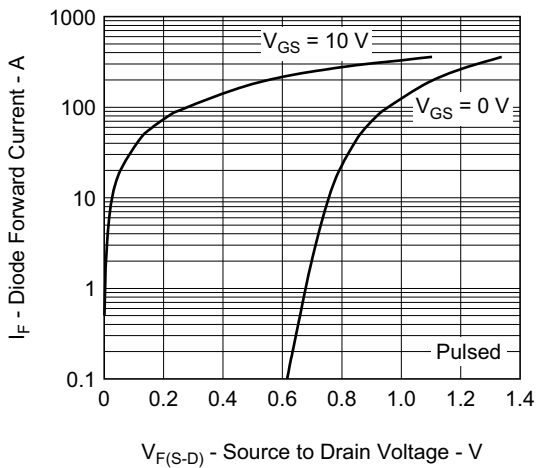
SWITCHING CHARACTERISTICS



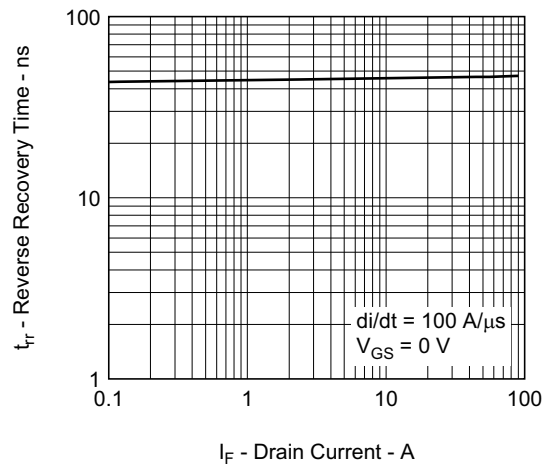
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

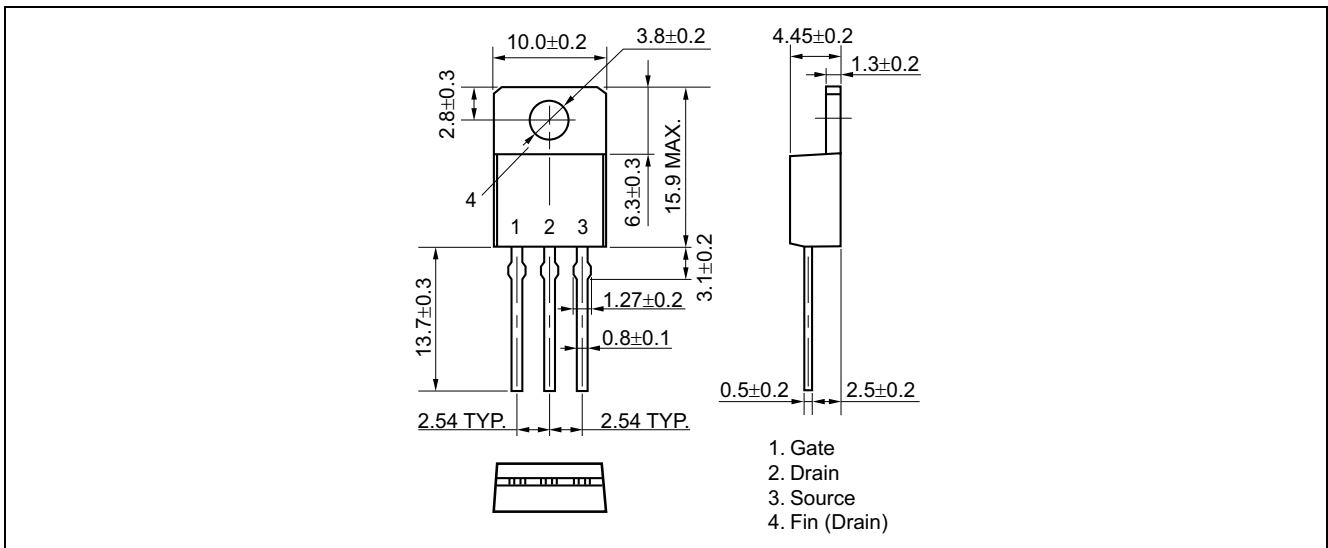


REVERSE RECOVERY TIME vs. DRAIN CURRENT

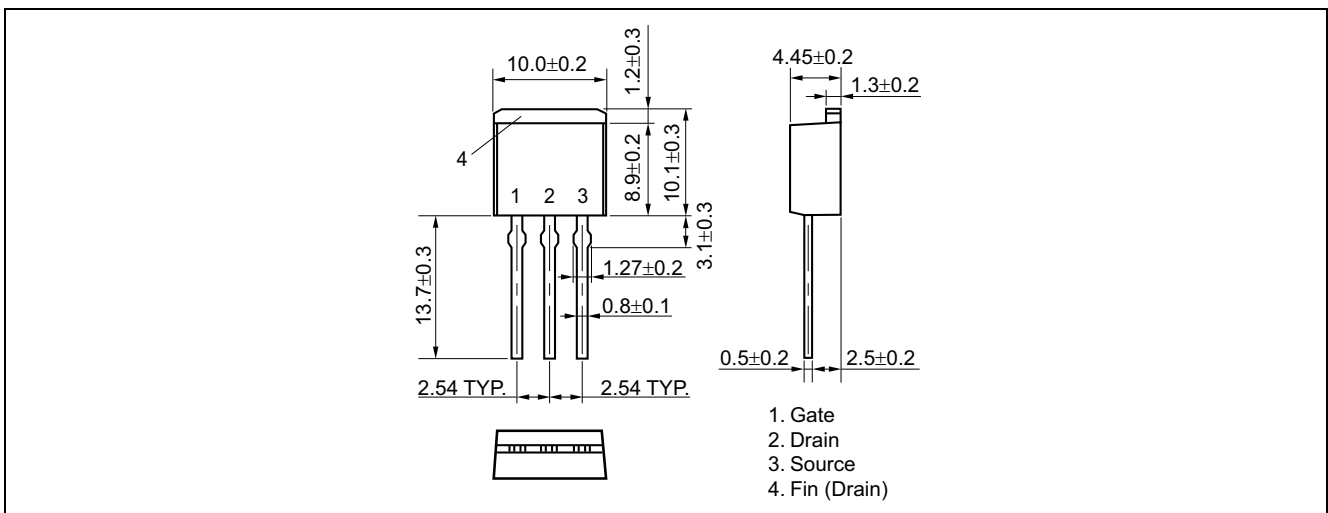


Package Drawing (Unit: mm)

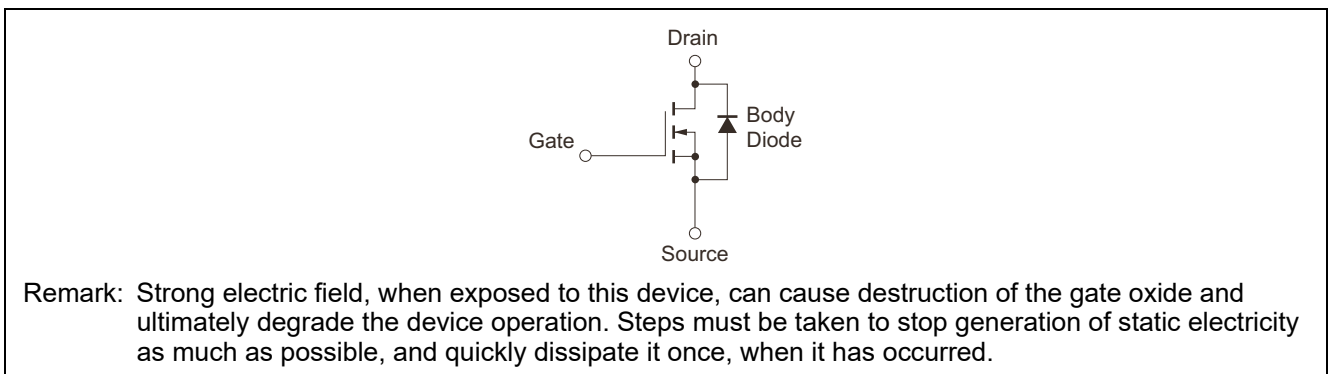
TO-220 (MP-25K) (Mass: 1.9 g TYP.)



TO-262 (MP-25SK) (Mass: 1.8 g TYP.)



Equivalent Circuit



<b>Revision History</b>	<b>NP89N04MUK, NP89N04NUK Data Sheet</b>
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Rev.	Date	Description	
		Page	Summary
1.00	Jan 11, 2012	—	First Edition Issued
2.00	May 24 ,2018	1	Note 3 was added
		2	Note 2 was added

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#### **Renesas Electronics America Inc.**

1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.  
Tel: +1-408-432-8888, Fax: +1-408-434-5351

#### **Renesas Electronics Canada Limited**

9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3  
Tel: +1-905-237-2004

#### **Renesas Electronics Europe Limited**

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K  
Tel: +44-1628-651-700, Fax: +44-1628-651-804

#### **Renesas Electronics Europe GmbH**

Arcadiastrasse 10, 40472 Düsseldorf, Germany  
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

#### **Renesas Electronics (China) Co., Ltd.**

Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China  
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

#### **Renesas Electronics (Shanghai) Co., Ltd.**

Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China  
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

#### **Renesas Electronics Hong Kong Limited**

Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong  
Tel: +852-2265-6688, Fax: +852 2886-9022

#### **Renesas Electronics Taiwan Co., Ltd.**

13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan  
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

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80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949  
Tel: +65-6213-0200, Fax: +65-6213-0300

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Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

#### **Renesas Electronics India Pvt. Ltd.**

No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India  
Tel: +91-80-67208700, Fax: +91-80-67208777

#### **Renesas Electronics Korea Co., Ltd.**

17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea  
Tel: +82-2-558-3737, Fax: +82-2-558-5338