

# NP89N04PUK

R07DS0562EJ0200

Rev.2.00

May 24, 2018

## MOS FIELD EFFECT TRANSISTOR

### Description

The NP89N04PUK is N-channel MOS Field Effect Transistor designed for high current switching applications.

### Features

- Super low on-state resistance  
 $R_{DS(on)} = 2.95 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 45 \text{ A)}$
- 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
NP89N04PUK-E1-AY *1	Pure Sn (Tin)	Tape 800 p/reel	Taping (E1 type)	TO-263 (MP-25ZP)
NP89N04PUK-E2-AY *1			Taping (E2 type)	

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.

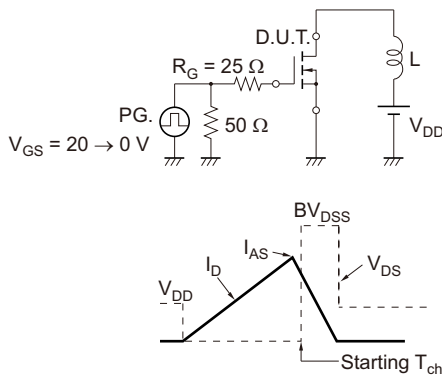
**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$ )

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	$R_{DS(on)}$	—	2.45	2.95	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	$V_{F(S-D)}$	—	0.9	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	$di/dt = 100\text{ A}/\mu\text{s}$

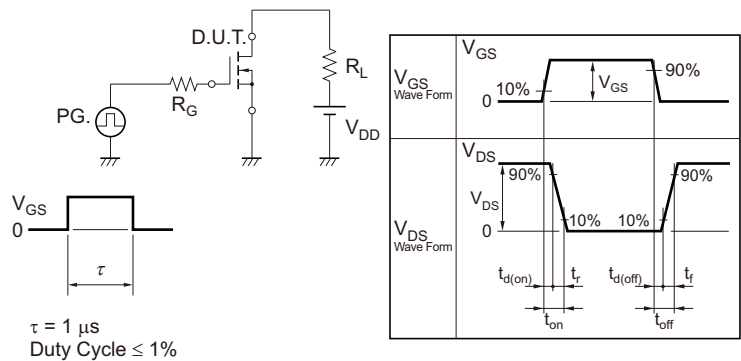
Note: \*1 Pulsed test

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

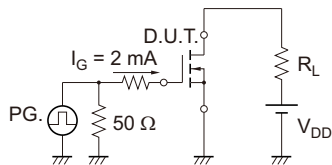
**TEST CIRCUIT 1 AVALANCHE CAPABILITY**



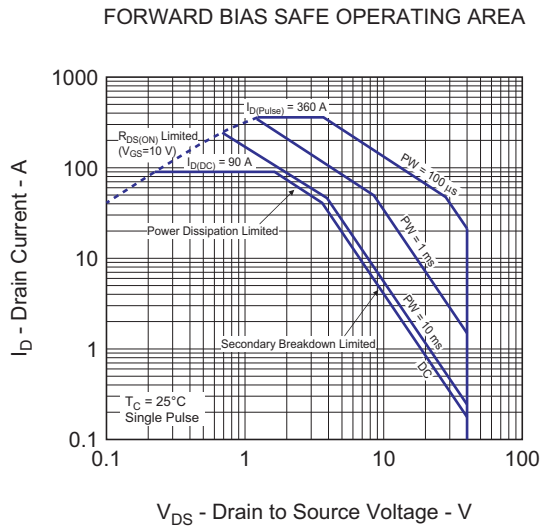
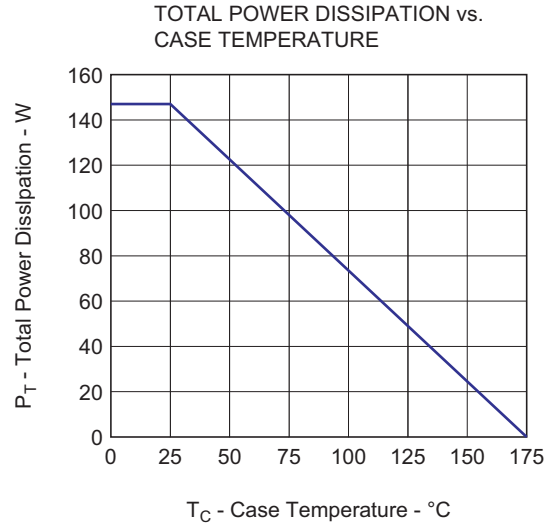
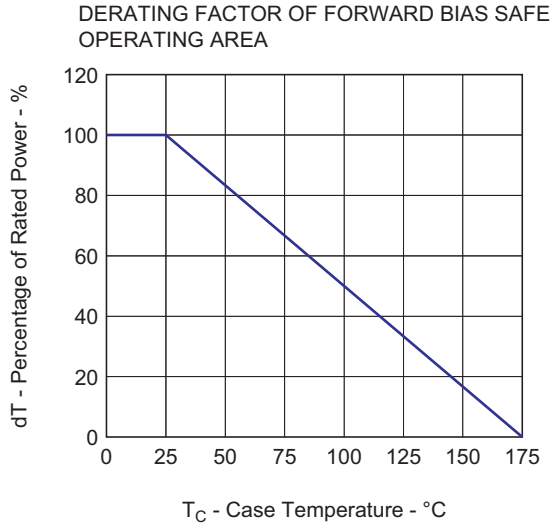
**TEST CIRCUIT 2 SWITCHING TIME**



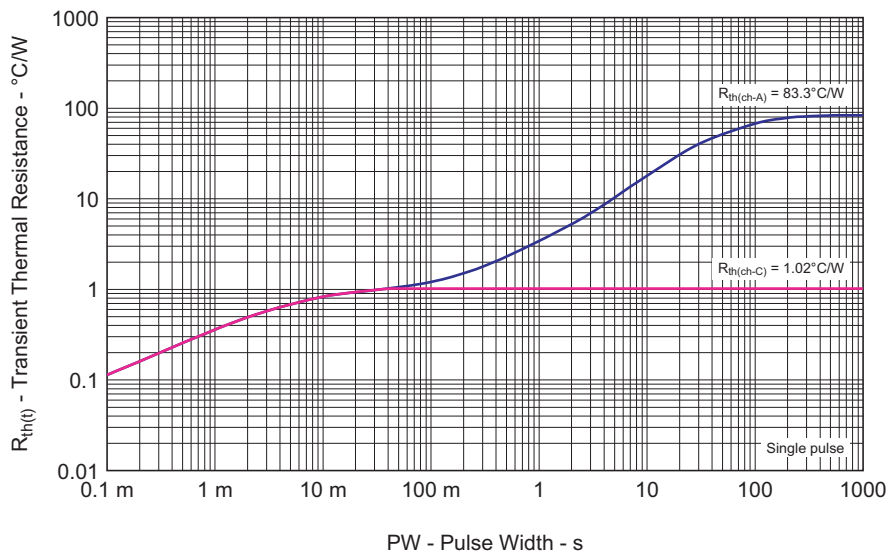
**TEST CIRCUIT 3 GATE CHARGE**



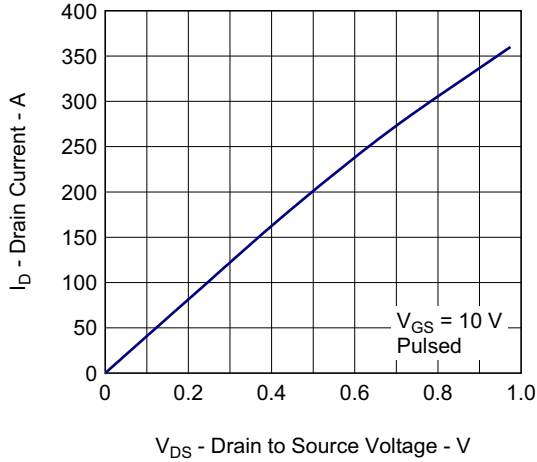
Typical Characteristics (T<sub>A</sub> = 25°C)



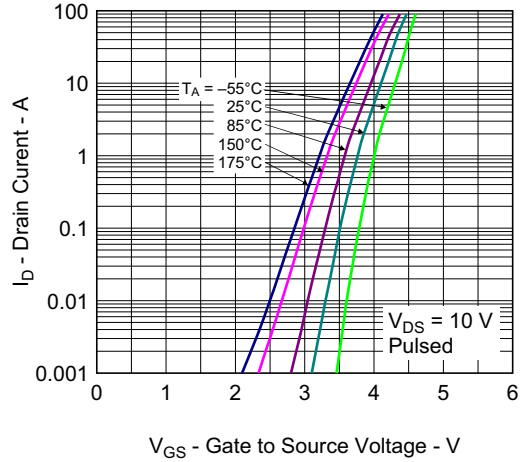
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



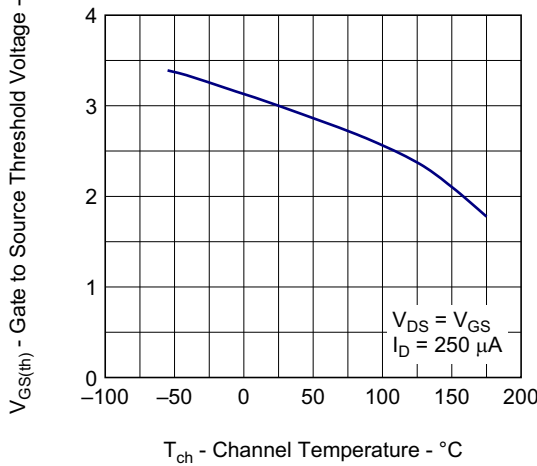
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



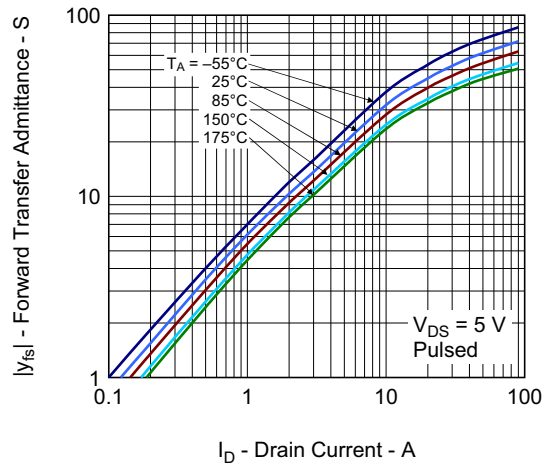
FORWARD TRANSFER CHARACTERISTICS



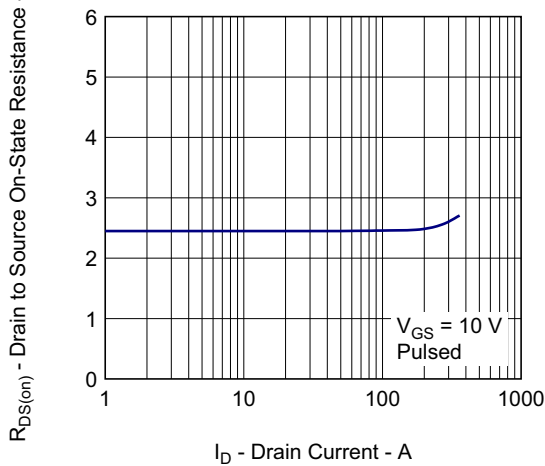
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



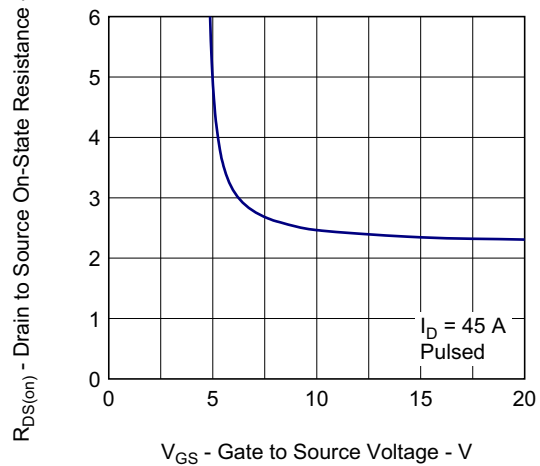
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



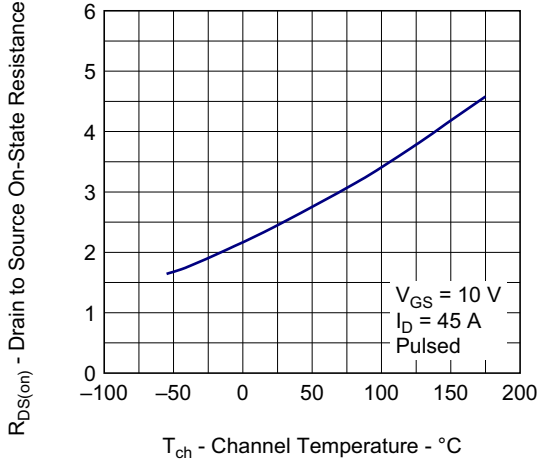
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



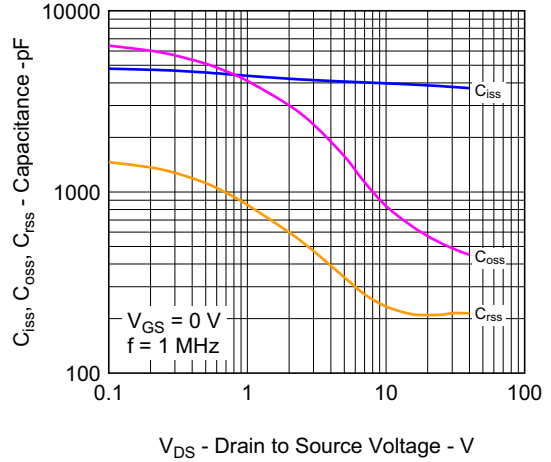
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



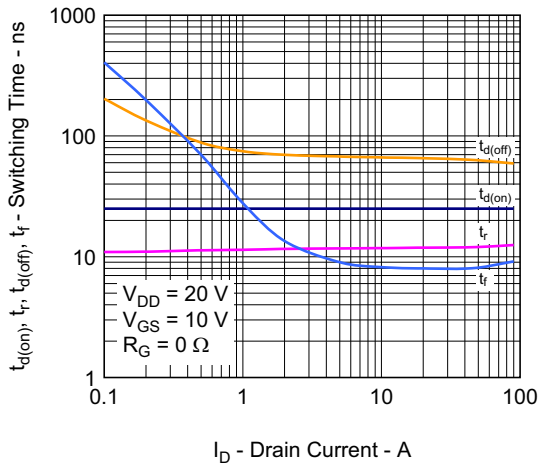
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



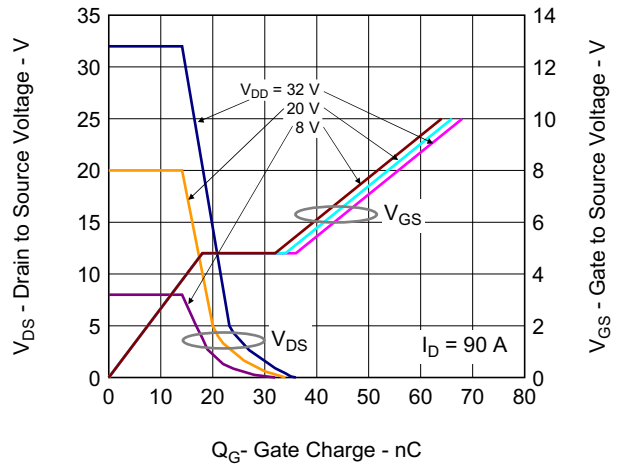
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



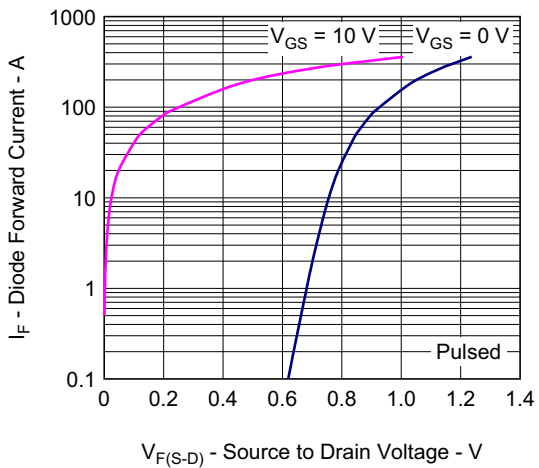
SWITCHING CHARACTERISTICS



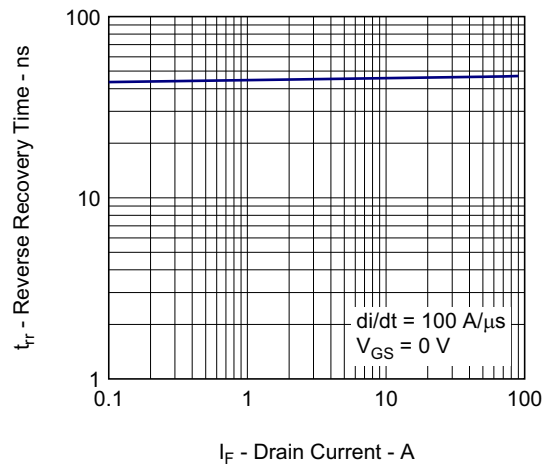
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

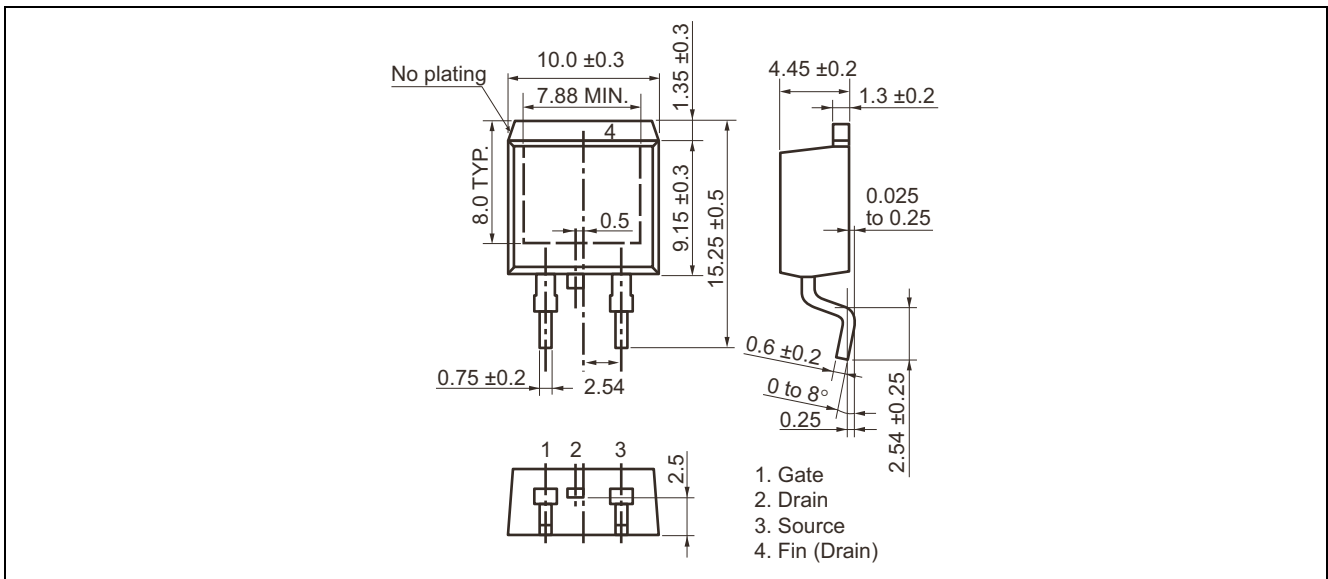


REVERSE RECOVERY TIME vs. DRAIN CURRENT

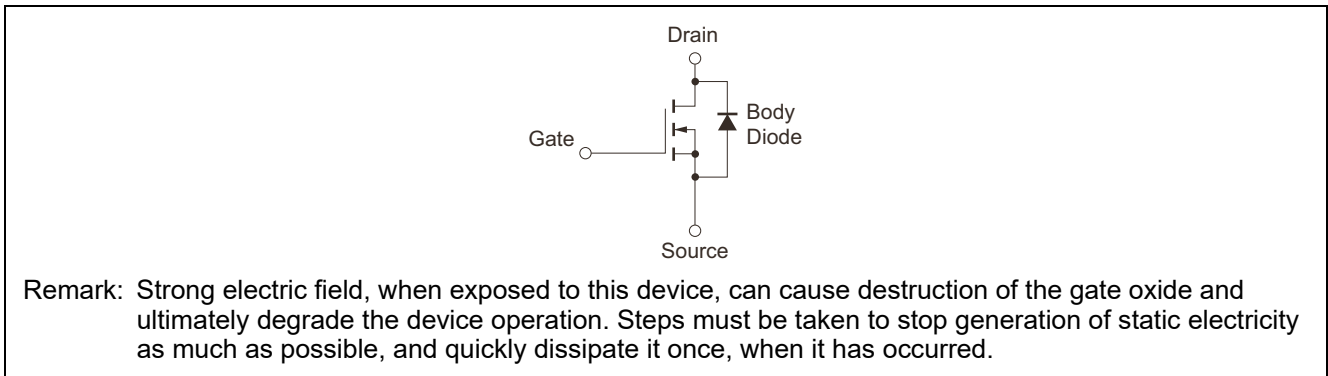


Package Drawing (Unit: mm)

TO-263 (MP-25ZP) (Mass: 1.5 g TYP.)



Equivalent Circuit



<b>Revision History</b>	<b>NP89N04PUK Data Sheet</b>
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Rev.	Date	Description	
		Page	Summary
1.00	Nov 07, 2011	—	First Edition Issued
2.00	May 24 ,2018	1	Note 3 was added
		2	Note 2 was added

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