

# NP60N04MUK, NP60N04NUK

## MOS FIELD EFFECT TRANSISTOR

R07DS0597EJ0100

Rev.1.00

Jan 11, 2012

### Description

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

### Features

- Super low on-state resistance  
 $R_{DS(on)} = 4.3 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 30 \text{ A)}$
- Low  $C_{iss}$ :  $C_{iss} = 2450 \text{ pF TYP. (} V_{DS} = 25 \text{ V)}$
- Designed for automotive application and AEC-Q101 qualified

### Ordering Information

Part No.	Lead Plating	Packing	Package
NP60N04MUK-S18-AY *1	Pure Sn (Tin)	Tube 50 p/tube	TO-220 (MP-25K)
NP60N04NUK-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) ( $T_C = 25^\circ\text{C}$ )	$I_{D(DC)}$	$\pm 60$	A
Drain Current (pulse) *1	$I_{D(pulse)}$	$\pm 240$	A
Total Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_{T1}$	105	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	$I_{AR}$	28	A
Repetitive Avalanche Energy *2	$E_{AR}$	78	mJ

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

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

### Thermal Resistance

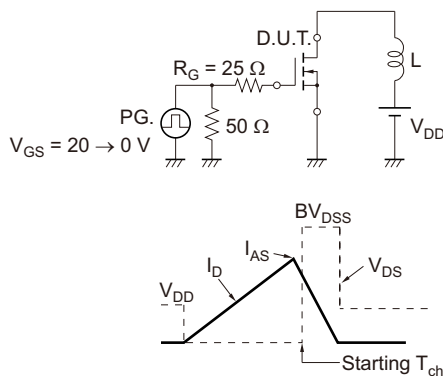
Channel to Case Thermal Resistance	$R_{th(ch-C)}$	1.43	$^\circ\text{C/W}$
Channel to Ambient Thermal Resistance	$R_{th(ch-A)}$	83.3	$^\circ\text{C/W}$

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

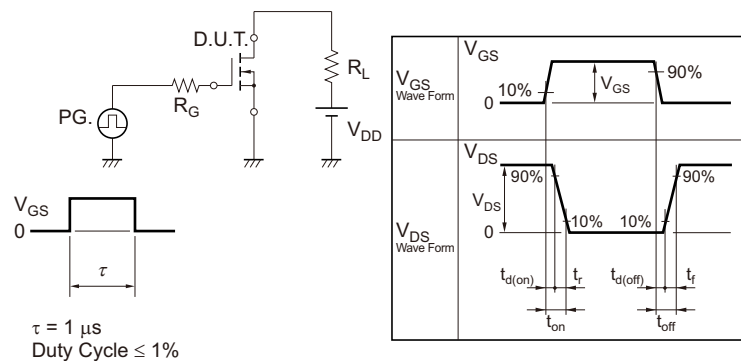
Item	Symbol	MIN.	TYP.	MAX.	Unit	Test Conditions
Zero Gate Voltage Drain Current	$I_{DSS}$	—	—	1	$\mu\text{A}$	$V_{DS} = 40\text{ V}$ , $V_{GS} = 0\text{ V}$
Gate Leakage Current	$I_{GSS}$	—	—	$\pm 100$	nA	$V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$
Gate to Source Threshold Voltage	$V_{GS(th)}$	2.0	3.0	4.0	V	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$
Forward Transfer Admittance <sup>*1</sup>	$ y_{fs} $	22	44	—	S	$V_{DS} = 5\text{ V}$ , $I_D = 30\text{ A}$
Drain to Source On-state Resistance <sup>*1</sup>	$R_{DS(on)}$	—	3.6	4.3	m $\Omega$	$V_{GS} = 10\text{ V}$ , $I_D = 30\text{ A}$
Input Capacitance	$C_{iss}$	—	2450	3680	pF	$V_{DS} = 25\text{ V}$ $V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$
Output Capacitance	$C_{oss}$	—	340	510	pF	
Reverse Transfer Capacitance	$C_{rss}$	—	140	260	pF	
Turn-on Delay Time	$t_{d(on)}$	—	19	50	ns	$V_{DD} = 20\text{ V}$ , $I_D = 30\text{ A}$ $V_{GS} = 10\text{ V}$ $R_G = 0\text{ }\Omega$
Rise Time	$t_r$	—	9	30	ns	
Turn-off Delay Time	$t_{d(off)}$	—	45	90	ns	
Fall Time	$t_f$	—	7	20	ns	
Total Gate Charge	$Q_G$	—	42	63	nC	$V_{DD} = 32\text{ V}$
Gate to Source Charge	$Q_{GS}$	—	11	—	nC	$V_{GS} = 10\text{ V}$
Gate to Drain Charge	$Q_{GD}$	—	11	—	nC	$I_D = 60\text{ A}$
Body Diode Forward Voltage <sup>*1</sup>	$V_{F(S-D)}$	—	0.9	1.5	V	$I_F = 60\text{ A}$ , $V_{GS} = 0\text{ V}$
Reverse Recovery Time	$t_{rr}$	—	44	—	ns	$I_F = 60\text{ A}$ , $V_{GS} = 0\text{ V}$
Reverse Recovery Charge	$Q_{rr}$	—	40	—	nC	$di/dt = 100\text{ A}/\mu\text{s}$

Note: <sup>\*1</sup> Pulsed test

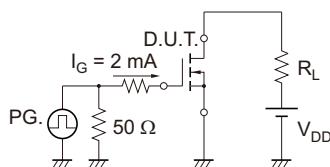
## TEST CIRCUIT 1 AVALANCHE CAPABILITY

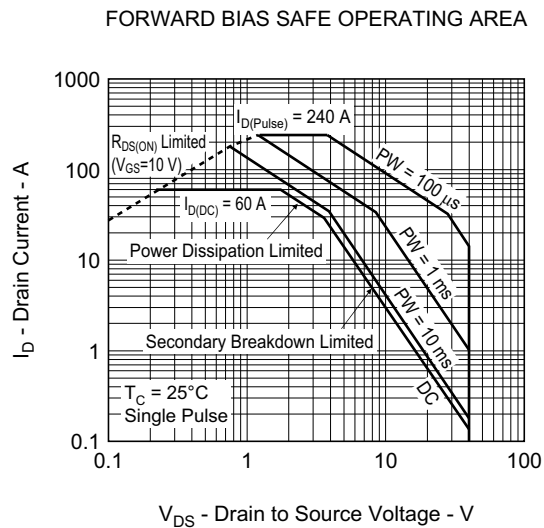
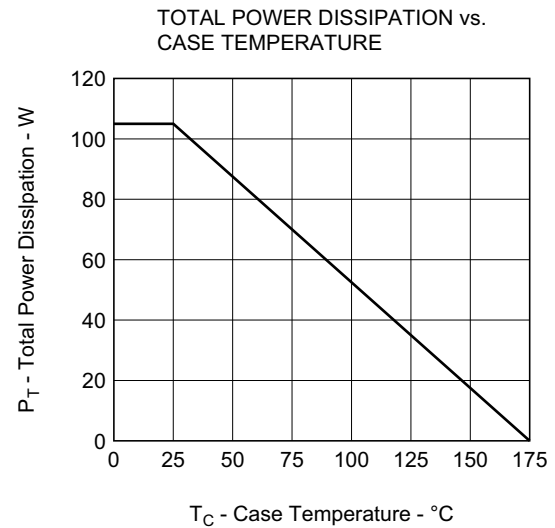
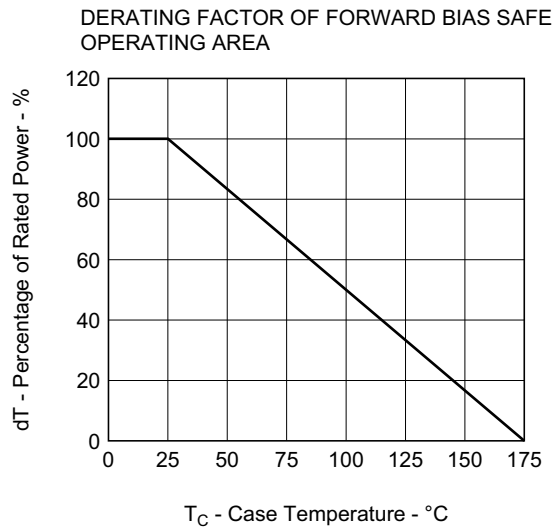


## TEST CIRCUIT 2 SWITCHING TIME

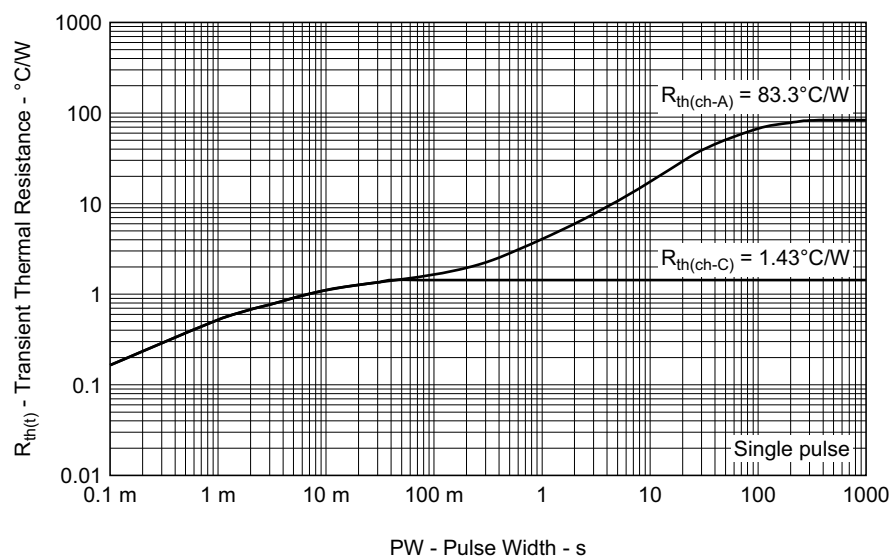


## TEST CIRCUIT 3 GATE CHARGE

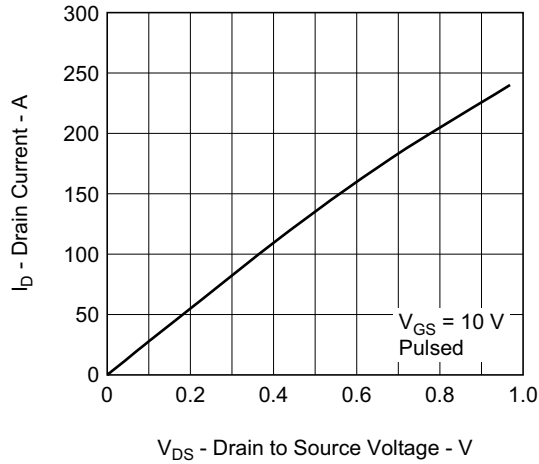


Typical Characteristics ( $T_A = 25^\circ\text{C}$ )

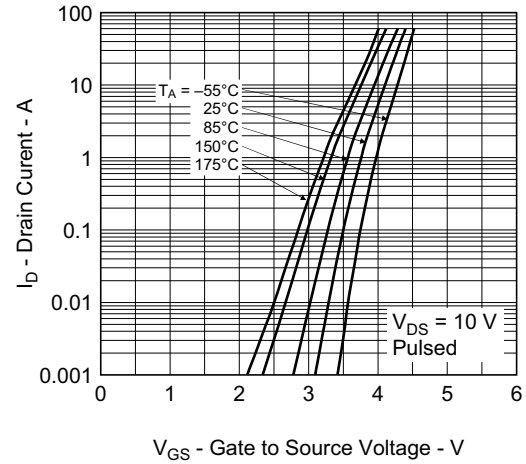
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



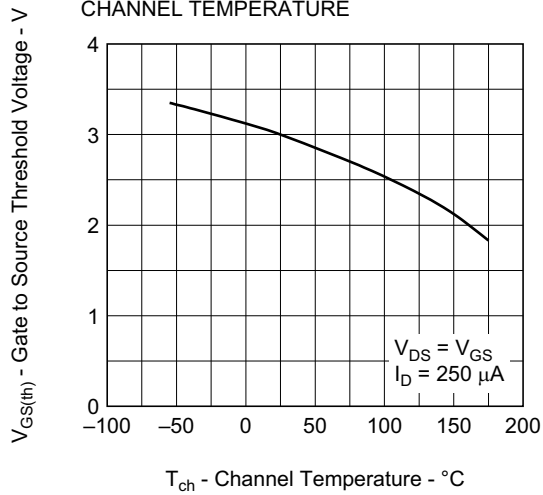
DRAIN CURRENT vs.  
DRAIN TO SOURCE VOLTAGE



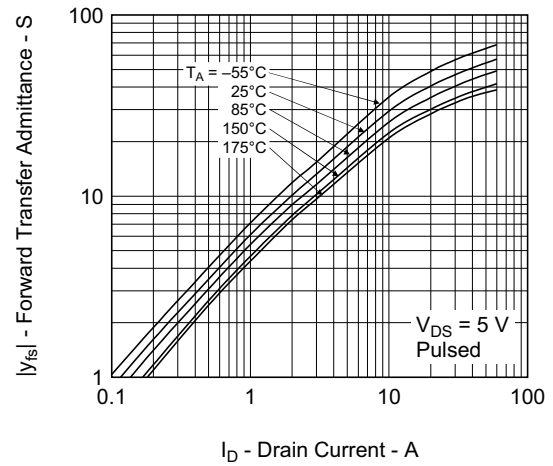
FORWARD TRANSFER CHARACTERISTICS



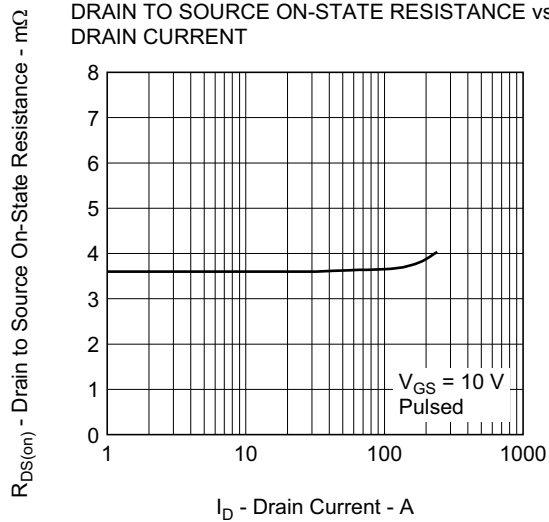
GATE TO SOURCE THRESHOLD VOLTAGE vs.  
CHANNEL TEMPERATURE



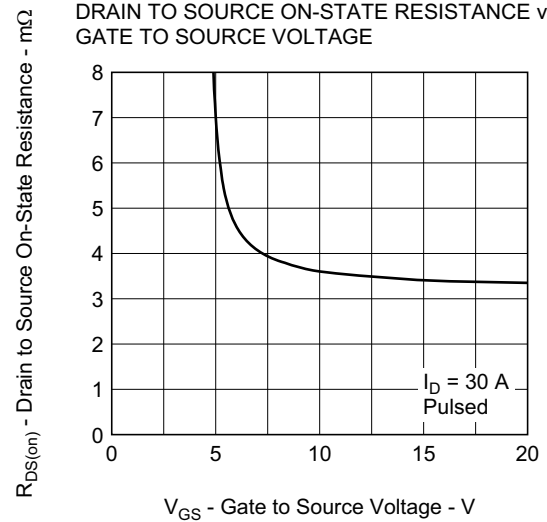
FORWARD TRANSFER ADMITTANCE vs.  
DRAIN CURRENT



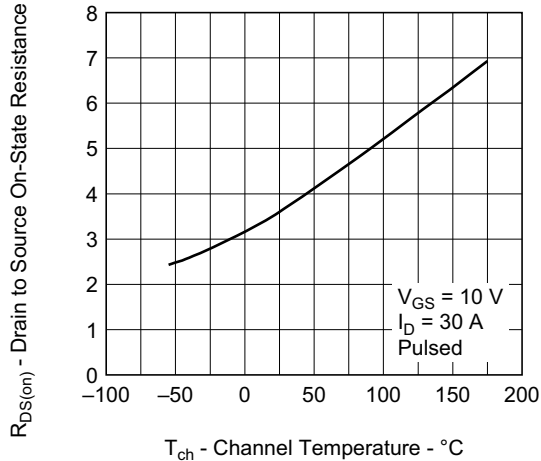
DRAIN TO SOURCE ON-STATE RESISTANCE vs.  
DRAIN CURRENT



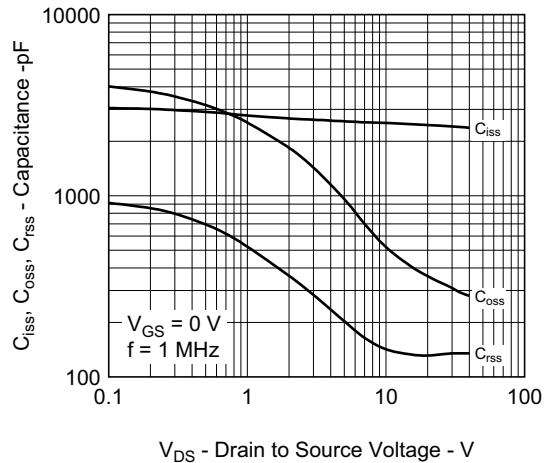
DRAIN TO SOURCE ON-STATE RESISTANCE vs.  
GATE TO SOURCE VOLTAGE



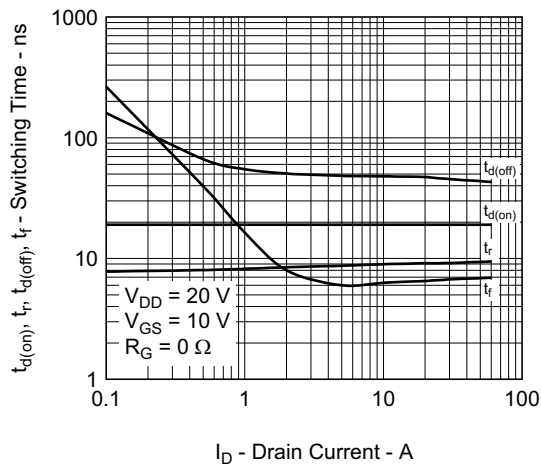
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



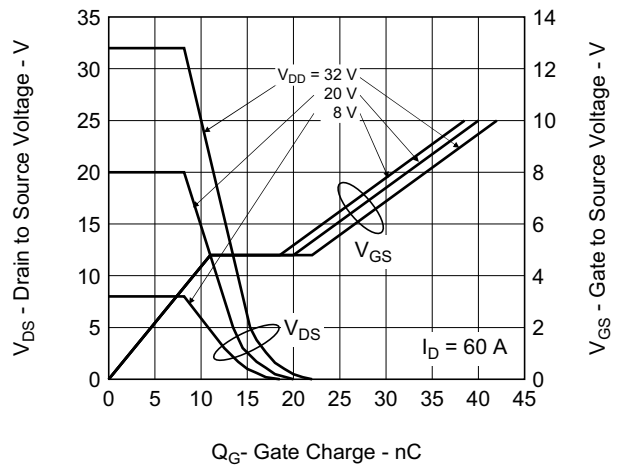
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



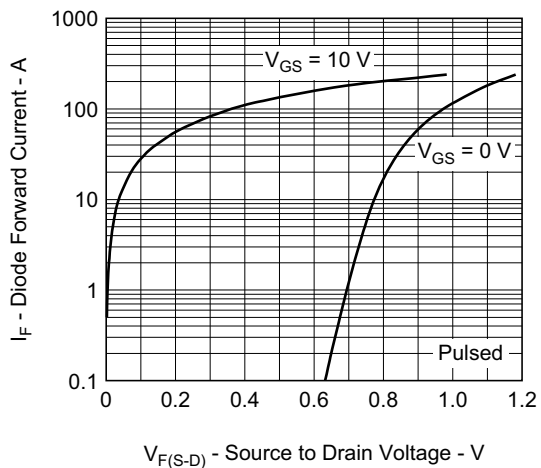
SWITCHING CHARACTERISTICS



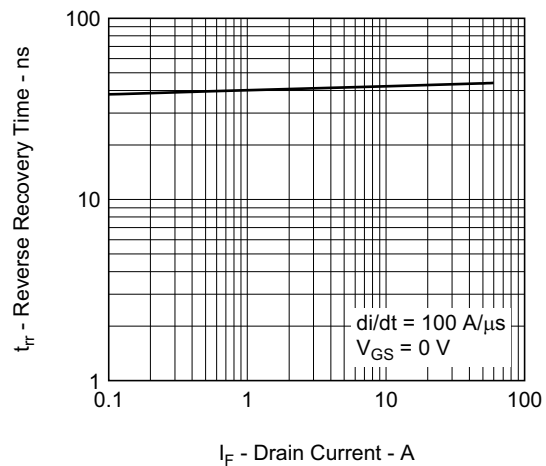
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

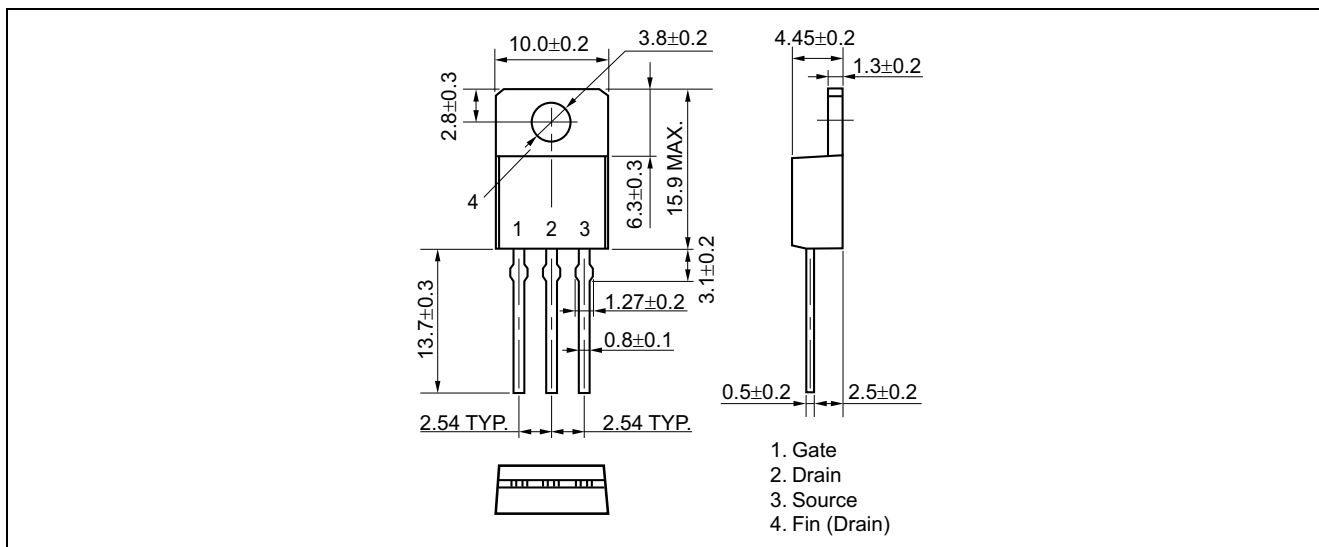


REVERSE RECOVERY TIME vs. DRAIN CURRENT

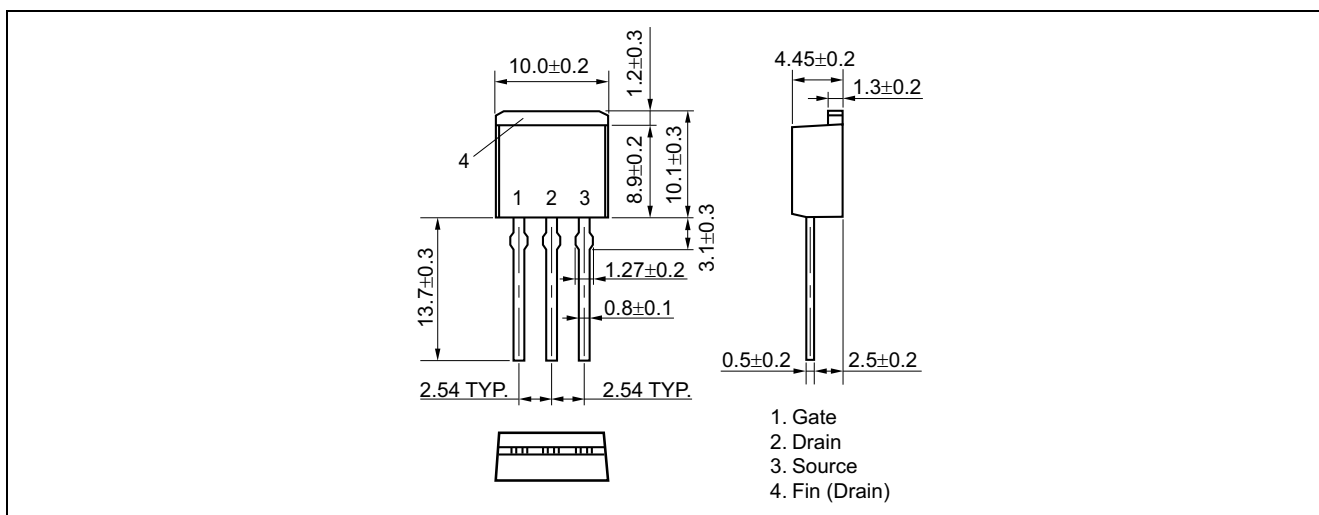


## Package Drawing (Unit: mm)

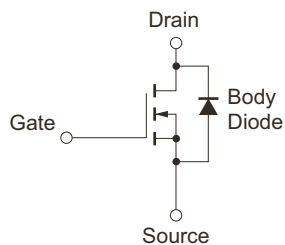
TO-220 (MP-25K) (Mass: 1.9 g TYP.)



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



## Equivalent Circuit



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.

<b>Revision History</b>	<b>NP60N04MUK, NP60N04NUK Data Sheet</b>
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Rev.	Date	Description	
		Page	Summary
1.00	Jan 11, 2012	—	First Edition Issued

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