

NP89N04MUK, NP89N04NUK

R07DS0599EJ0100

Rev.1.00

Jan 11, 2012

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} | ± 20 | V |
| Drain Current (DC) ($T_C = 25^\circ\text{C}$) | $I_{D(DC)}$ | ± 90 | A |
| Drain Current (pulse) *1 | $I_{D(pulse)}$ | ± 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 | I_{AR} | 37 | A |
| Repetitive Avalanche Energy *2 | E_{AR} | 136 | mJ |

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

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

Thermal Resistance

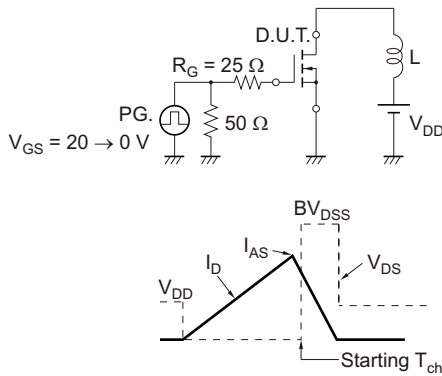
| | | | |
|---------------------------------------|----------------|------|--------------------|
| Channel to Case Thermal Resistance | $R_{th(ch-C)}$ | 1.02 | $^\circ\text{C/W}$ |
| Channel to Ambient Thermal Resistance | $R_{th(ch-A)}$ | 83.3 | $^\circ\text{C/W}$ |

Electrical Characteristics (T_A = 25°C)

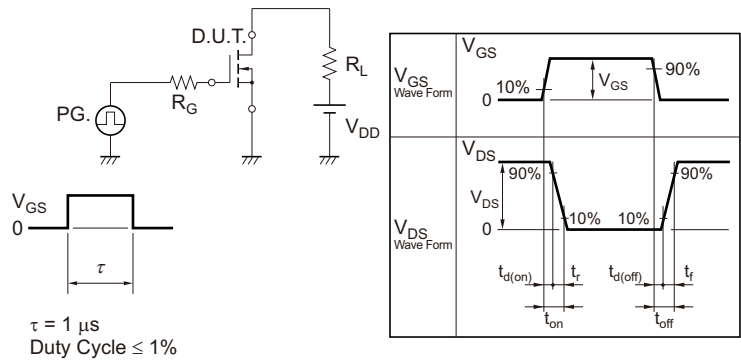
| Item | Symbol | MIN. | TYP. | MAX. | Unit | Test Conditions |
|--|---------------------|------|------|------|------|---|
| Zero Gate Voltage Drain Current | I _{DSS} | — | — | 1 | μA | V _{DS} = 40 V, V _{GS} = 0 V |
| Gate Leakage Current | I _{GSS} | — | — | ±100 | nA | V _{GS} = ±20 V, V _{DS} = 0 V |
| Gate to Source Threshold Voltage | V _{GS(th)} | 2.0 | 3.0 | 4.0 | V | V _{DS} = V _{GS} , I _D = 250 μA |
| Forward Transfer Admittance *1 | y _{fs} | 30 | 60 | — | S | V _{DS} = 5 V, I _D = 45 A |
| Drain to Source On-state Resistance *1 | R _{DS(on)} | — | 2.75 | 3.30 | mΩ | V _{GS} = 10 V, I _D = 45 A |
| Input Capacitance | C _{iss} | — | 3900 | 5850 | pF | V _{DS} = 25 V V _{GS} = 0 V f = 1 MHz |
| Output Capacitance | C _{oss} | — | 530 | 800 | pF | |
| Reverse Transfer Capacitance | C _{rss} | — | 200 | 360 | pF | |
| Turn-on Delay Time | t _{d(on)} | — | 25 | 60 | ns | V _{DD} = 20 V, I _D = 45 A V _{GS} = 10 V R _G = 0 Ω |
| Rise Time | t _r | — | 12 | 30 | ns | |
| Turn-off Delay Time | t _{d(off)} | — | 65 | 130 | ns | |
| Fall Time | t _f | — | 8 | 20 | ns | |
| Total Gate Charge | Q _G | — | 68 | 102 | nC | V _{DD} = 32 V |
| Gate to Source Charge | Q _{GS} | — | 18 | — | nC | V _{GS} = 10 V |
| Gate to Drain Charge | Q _{GD} | — | 18 | — | nC | I _D = 90 A |
| Body Diode Forward Voltage *1 | V _{F(S-D)} | — | 0.95 | 1.5 | V | I _F = 90 A, V _{GS} = 0 V |
| Reverse Recovery Time | t _{rr} | — | 47 | — | ns | I _F = 90 A, V _{GS} = 0 V |
| Reverse Recovery Charge | Q _{rr} | — | 68 | — | nC | di/dt = 100 A/μs |

Note: *1 Pulsed test

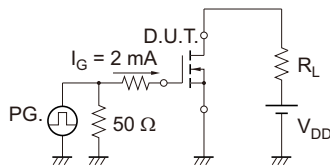
TEST CIRCUIT 1 AVALANCHE CAPABILITY



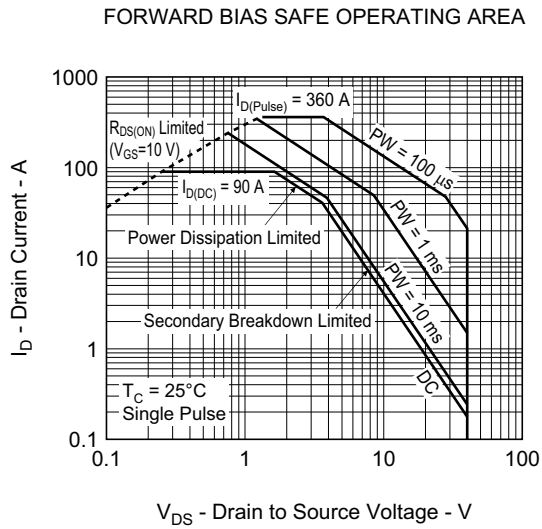
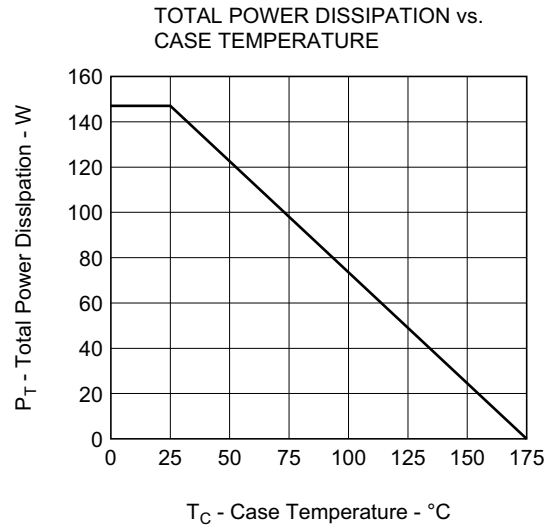
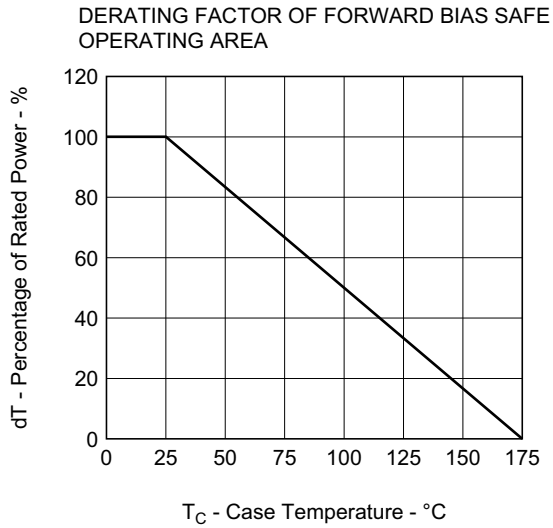
TEST CIRCUIT 2 SWITCHING TIME



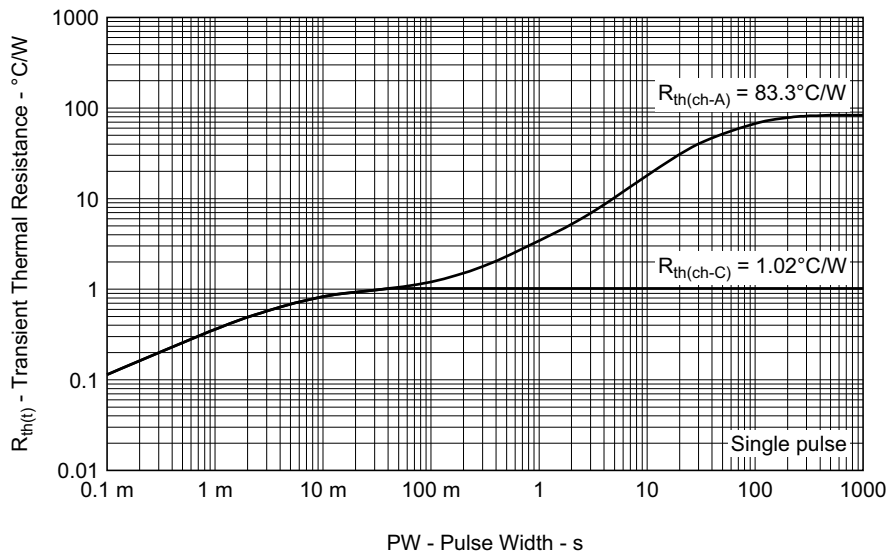
TEST CIRCUIT 3 GATE CHARGE



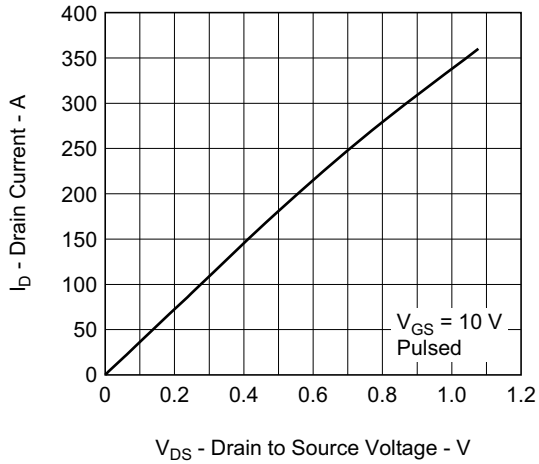
Typical Characteristics ($T_A = 25^\circ\text{C}$)



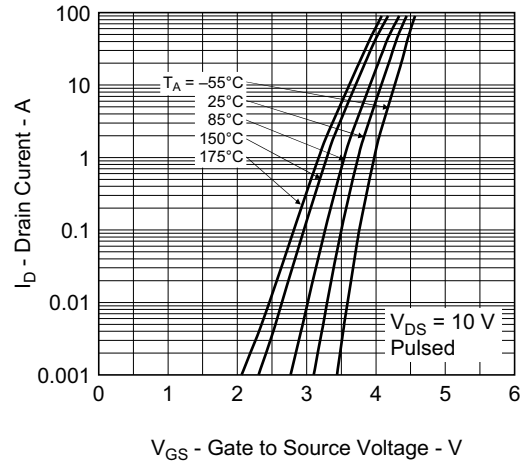
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



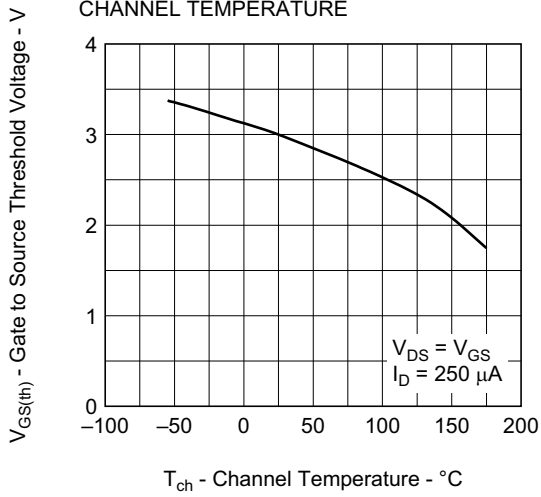
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



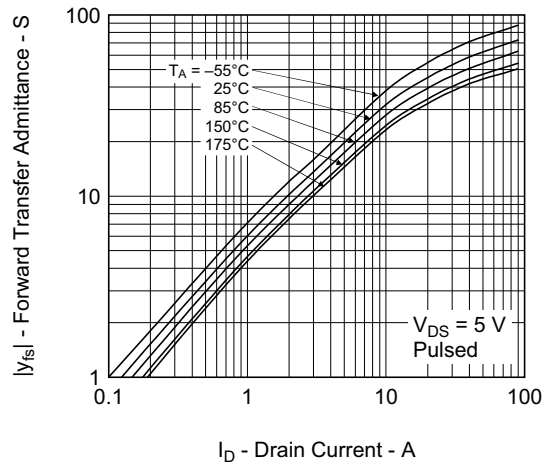
FORWARD TRANSFER CHARACTERISTICS



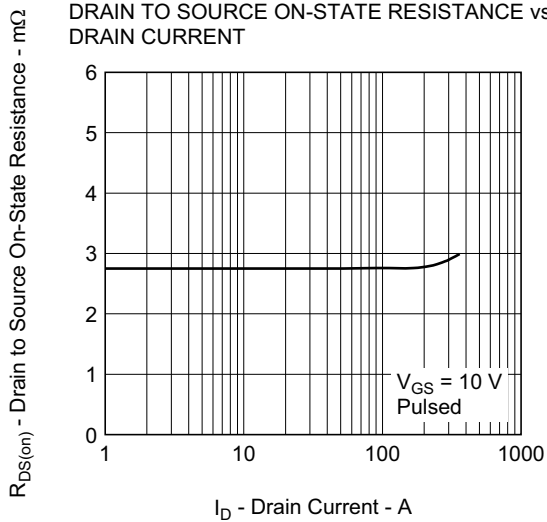
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



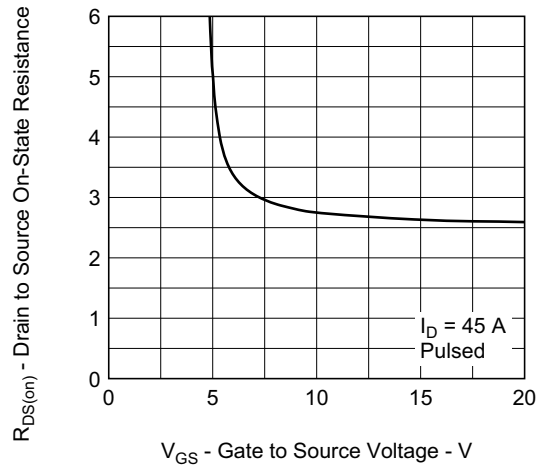
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



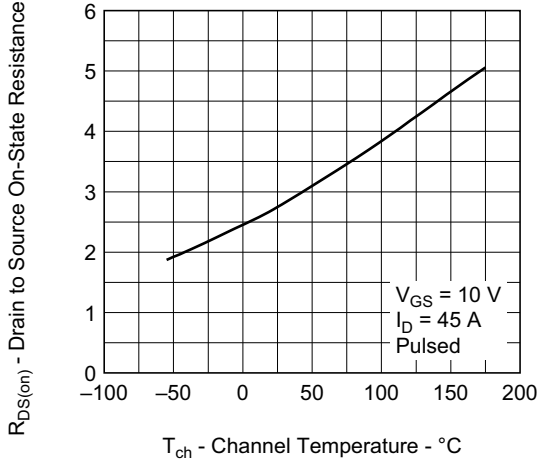
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



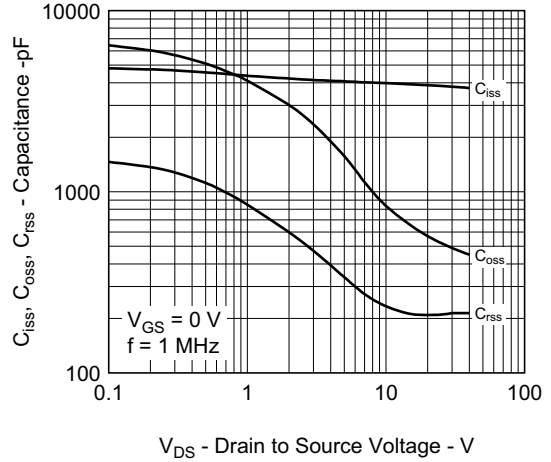
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



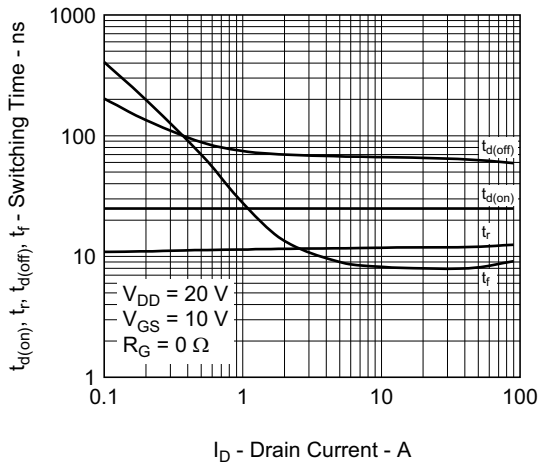
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



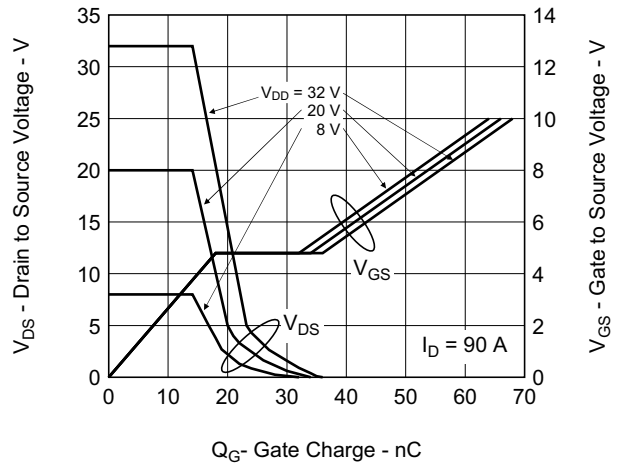
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



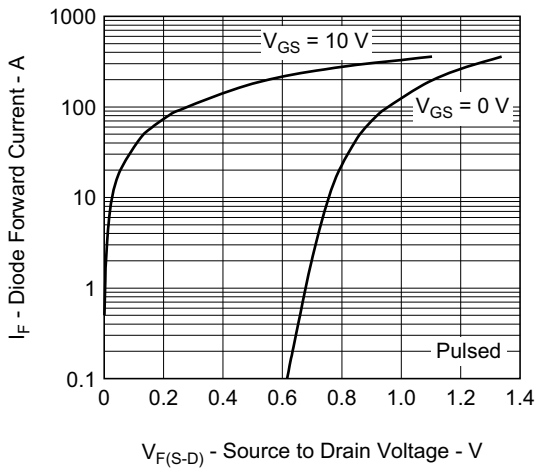
SWITCHING CHARACTERISTICS



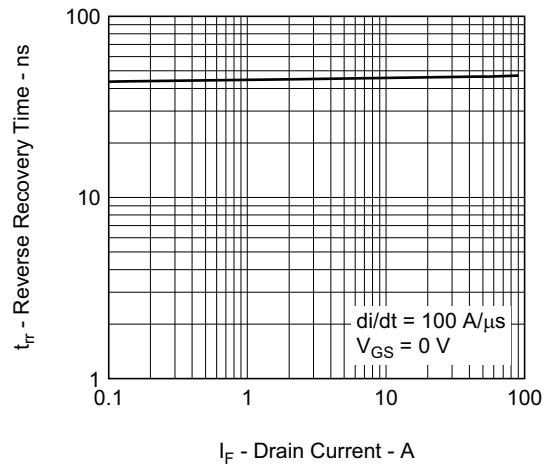
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

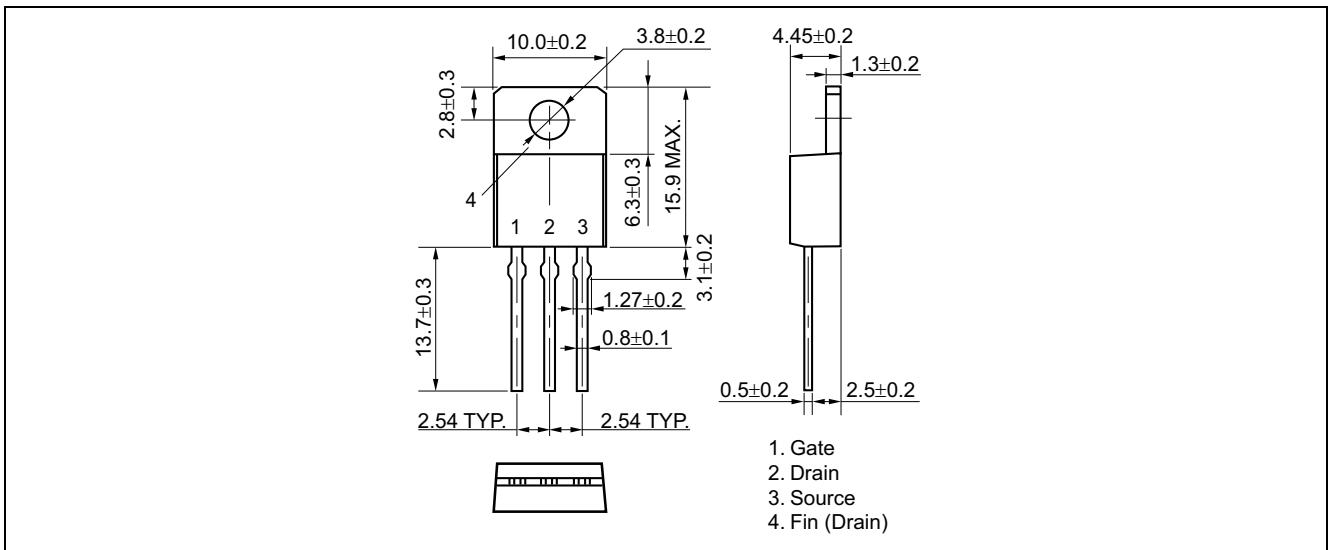


REVERSE RECOVERY TIME vs. DRAIN CURRENT

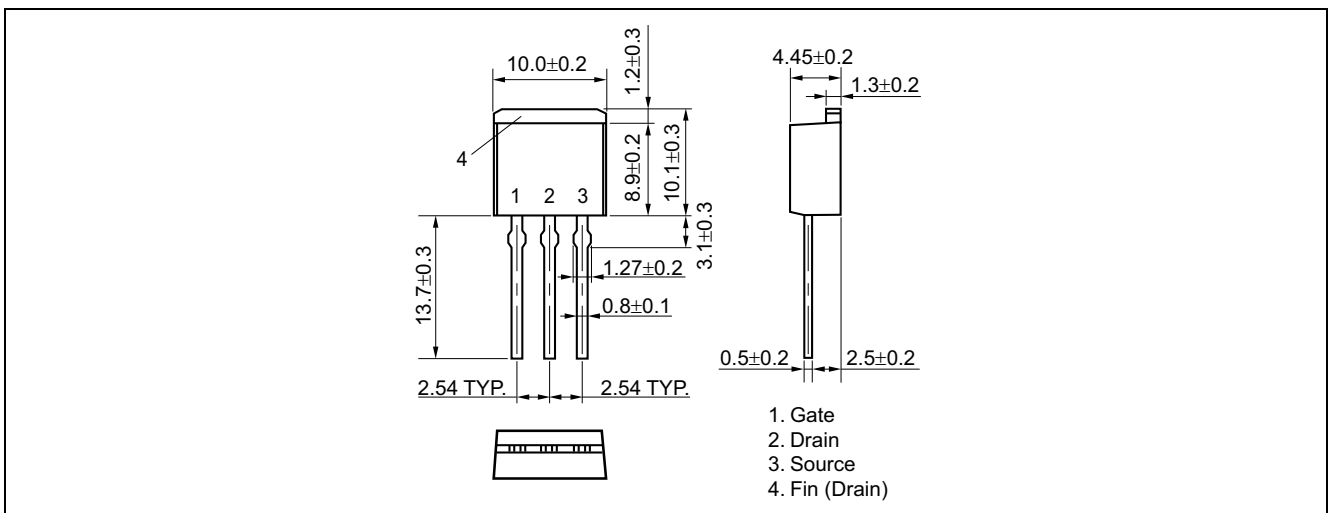


Package Drawing (Unit: mm)

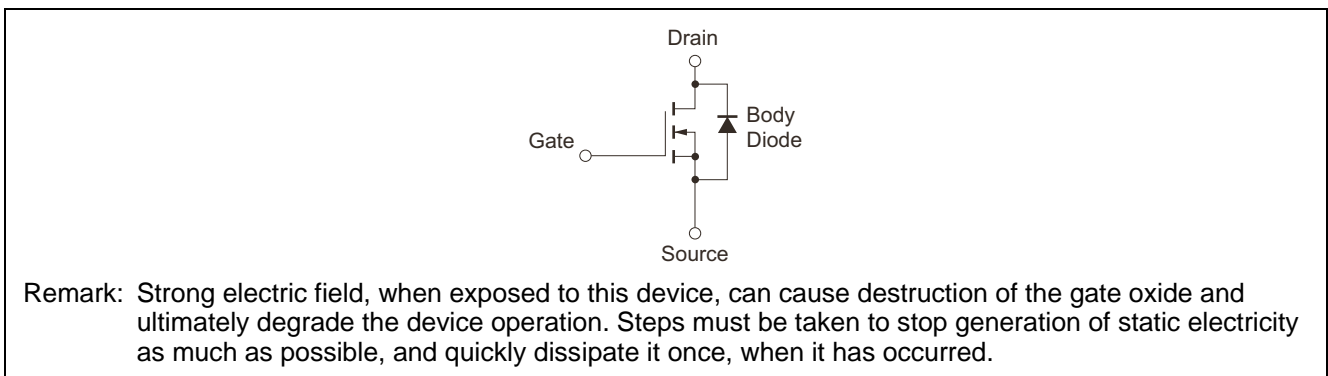
TO-220 (MP-25K) (Mass: 1.9 g TYP.)



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



Equivalent Circuit



| | |
|-------------------------|--|
| Revision History | NP89N04MUK, NP89N04NUK Data Sheet |
|-------------------------|--|

| Rev. | Date | Description | |
|------|--------------|-------------|----------------------|
| | | Page | Summary |
| 1.00 | Jan 11, 2012 | — | First Edition Issued |

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