DATA SHEET

NEC

# MOS FIELD EFFECT TRANSISTOR

## NP88N075EUE, NP88N075KUE
## NP88N075CUE, NP88N075DUE, NP88N075MUE, NP88N075NUE

## SWITCHING
## N-CHANNEL POWER MOS FET

### DESCRIPTION

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

<R> **ORDERING INFORMATION**

| PART NUMBER | LEAD PLATING | PACKING | PACKAGE |
|---|---|---|---|
| NP88N075EUE-E1-AY Note1, 2 | Pure Sn (Tin) | Tape 800 p/reel | TO-263 (MP-25ZJ) typ. 1.4 g |
| NP88N075EUE-E2-AY Note1, 2 | | | |
| NP88N075KUE-E1-AY Note1 | | | TO-263 (MP-25ZK) typ. 1.5 g |
| NP88N075KUE-E2-AY Note1 | | | |
| NP88N075CUE-S12-AZ Note1, 2 | Sn-Ag-Cu | Tube 50 p/tube | TO-220 (MP-25) typ. 1.9 g |
| NP88N075DUE-S12-AY Note1, 2 | Pure Sn (Tin) | | TO-262 (MP-25 Fin Cut) typ. 1.8 g |
| NP88N075MUE-S18-AY Note1 | | | TO-220 (MP-25K) typ. 1.9 g |
| NP88N075NUE-S18-AY Note1 | | | TO-262 (MP-25SK) typ. 1.8 g |

**Notes 1.** Pb-free (This product does not contain Pb in the external electrode.)

**2.** Not for new design

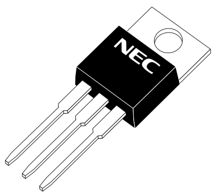
### FEATURES

- Channel temperature 175 degree rated
- Super low on-state resistance

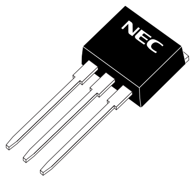
  $R_{DS(on)}$ = 8.5 mΩ MAX. ($V_{GS}$ = 10 V, $I_D$ = 44 A)
- Low input capacitance

  $C_{iss}$ = 8200 pF TYP.

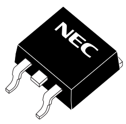
(TO-220)




(TO-262)




(TO-263)

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**The mark <R> shows major revised points.**
**The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.**

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C)

| | | | |
|---|---|---|---|
| Drain to Source Voltage ($V_{GS}$ = 0 V) | $V_{DSS}$ | 75 | V |
| Gate to Source Voltage ($V_{DS}$ = 0 V) | $V_{GSS}$ | ±20 | V |
| Drain Current (DC) ($T_C$ = 25°C) Note1 | $I_{D(DC)}$ | ±88 | A |
| Drain Current (Pulse) Note2 | $I_{D(pulse)}$ | ±352 | A |
| Total Power Dissipation ($T_C$ = 25°C) | $P_{T1}$ | 288 | W |
| Total Power Dissipation ($T_A$ = 25°C) | $P_{T2}$ | 1.8 | W |
| Channel Temperature | $T_{ch}$ | 175 | °C |
| Storage Temperature | $T_{stg}$ | −55 to +175 | °C |
| Single Avalanche Current Note3 | $I_{AS}$ | 69/88 | A |
| Single Avalanche Energy Note3 | $E_{AS}$ | 450/14 | mJ |

**Notes 1.** Calculated constant current according to MAX. allowable channel temperature.

**2.** PW ≤ 10 μs, Duty cycle ≤ 1%

**3.** Starting $T_{ch}$ = 25°C, $V_{DD}$ = 35 V, $R_G$ = 25 Ω, $V_{GS}$ = 20 → 0 V (See **Figure 4.**)

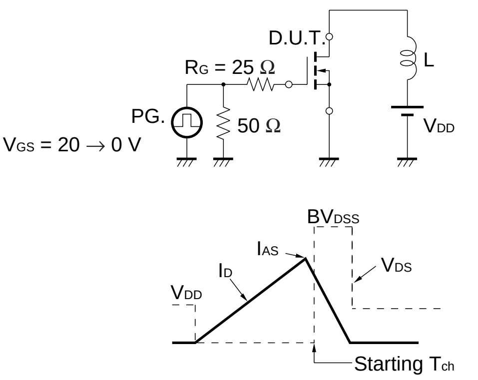
## THERMAL RESISTANCE

| | | | |
|---|---|---|---|
| Channel to Case Thermal Resistance | $R_{th(ch-C)}$ | 0.52 | °C/W |
| Channel to Ambient Thermal Resistance | $R_{th(ch-A)}$ | 83.3 | °C/W |

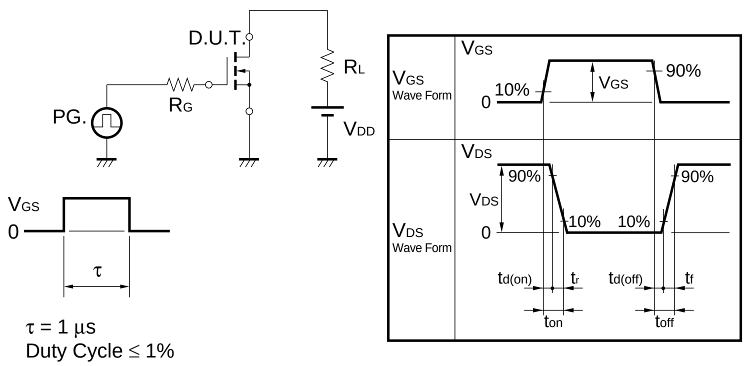
## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 75 V, $V_{GS}$ = 0 V | | | 10 | μA |
| Gate Leakage Current | $I_{GSS}$ | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | | | ±100 | nA |
| Gate to Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 μA | 2.0 | 3.0 | 4.0 | V |
| Forward Transfer Admittance | $\|y_{fs}\|$ | $V_{DS}$ = 10 V, $I_D$ = 44 A | 30 | 60 | | S |
| Drain to Source On-state Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 44 A | | 6.2 | 8.5 | mΩ |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25 V, $V_{GS}$ = 0 V, f = 1 MHz | | 8200 | 12300 | pF |
| Output Capacitance | $C_{oss}$ | | | 800 | 1200 | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 440 | 800 | pF |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$ = 38 V, $I_D$ = 44 A, $V_{GS}$ = 10 V, $R_G$ = 0 Ω | | 35 | 77 | ns |
| Rise Time | $t_r$ | | | 28 | 70 | ns |
| Turn-off Delay Time | $t_{d(off)}$ | | | 105 | 210 | ns |
| Fall Time | $t_f$ | | | 16 | 40 | ns |
| Total Gate Charge | $Q_G$ | $V_{DD}$ = 60 V, $V_{GS}$ = 10 V, $I_D$ = 88 A | | 150 | 230 | nC |
| Gate to Source Charge | $Q_{GS}$ | | | 30 | | nC |
| Gate to Drain Charge | $Q_{GD}$ | | | 52 | | nC |
| Body Diode Forward Voltage | $V_{F(S-D)}$ | $I_F$ = 88 A, $V_{GS}$ = 0 V | | 1.0 | | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 88 A, $V_{GS}$ = 0 V, di/dt = 100 A/μs | | 80 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | | | 240 | | nC |

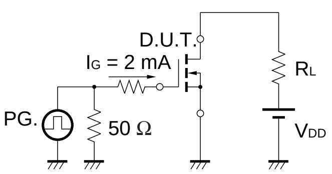
### TEST CIRCUIT 1 AVALANCHE CAPABILITY




### TEST CIRCUIT 2 SWITCHING TIME




### TEST CIRCUIT 3 GATE CHARGE



## TYPICAL CHARACTERISTICS ($T_A$ = 25°C)

Figure1. DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA

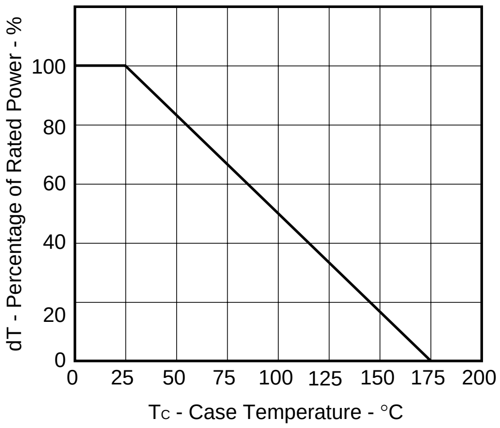



Figure2. TOTAL POWER DISSIPATION vs. CASE TEMPERATURE

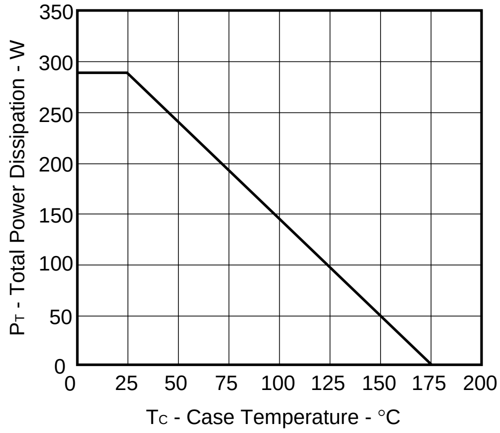



Figure3. FORWARD BIAS SAFE OPERATING AREA

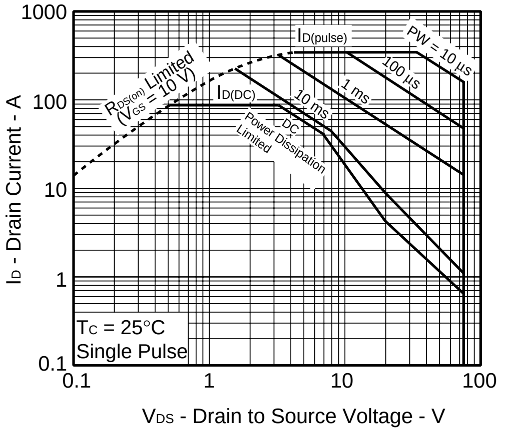



Figure4. SINGLE AVALANCHE ENERGY DERATING FACTOR

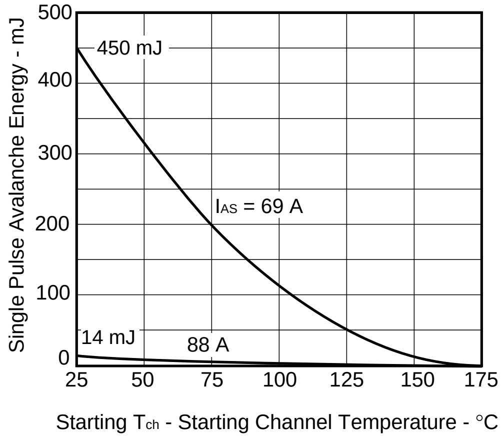



Figure5. TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

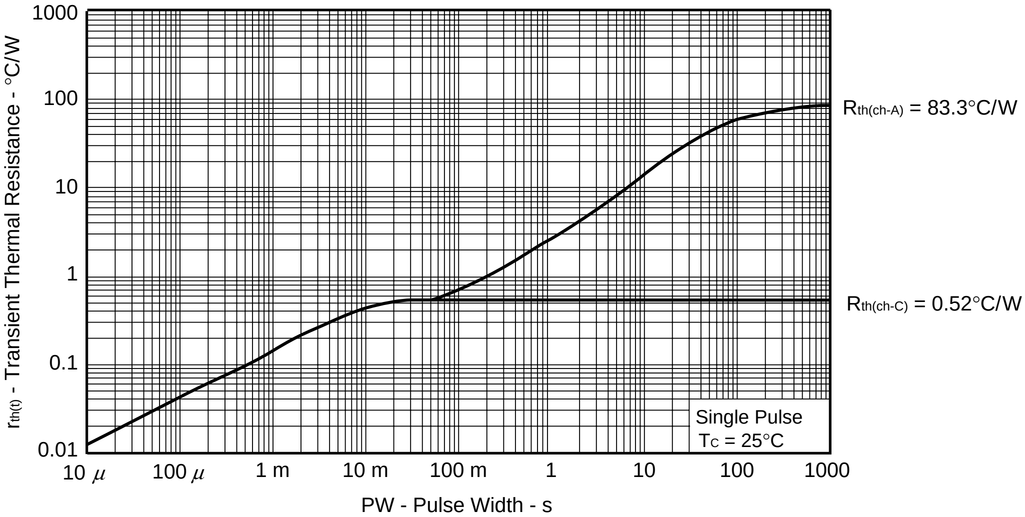


Figure6. FORWARD TRANSFER CHARACTERISTICS

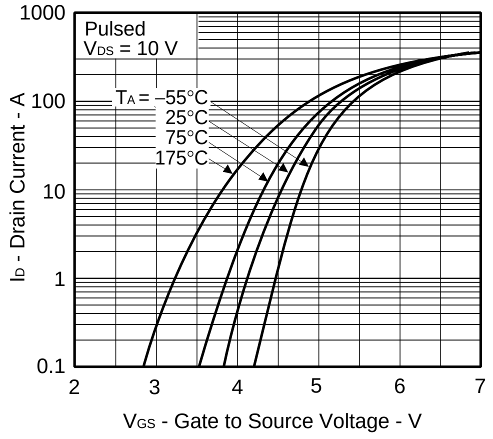



Figure7. DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE

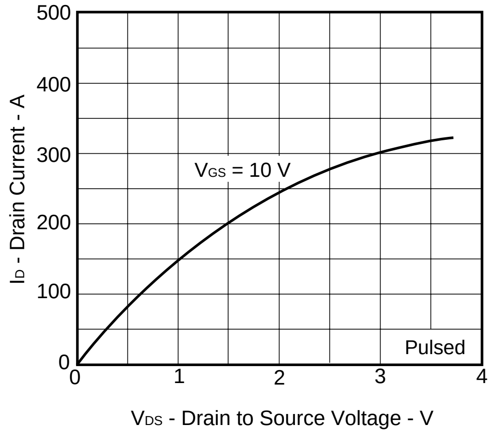



Figure8. FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT

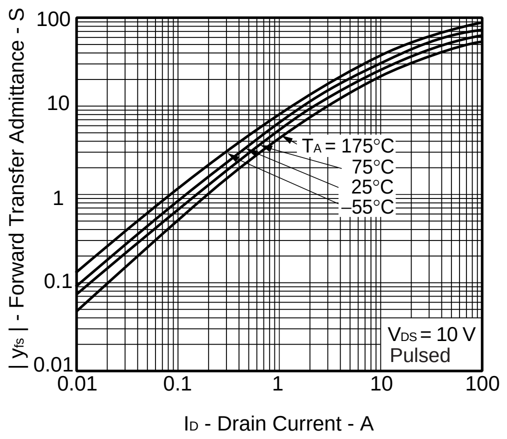



Figure9. DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE

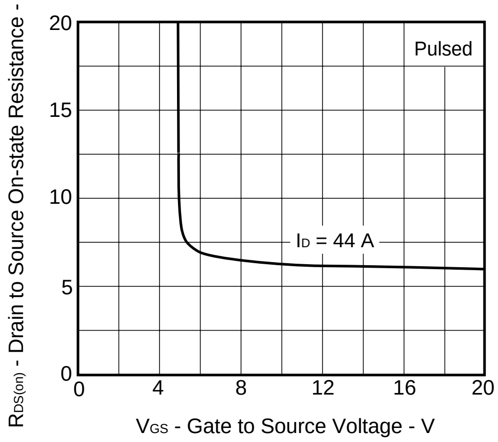



Figure10. DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

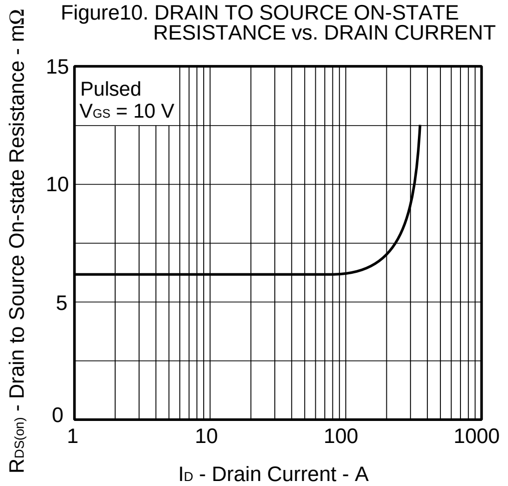



Figure11. GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE

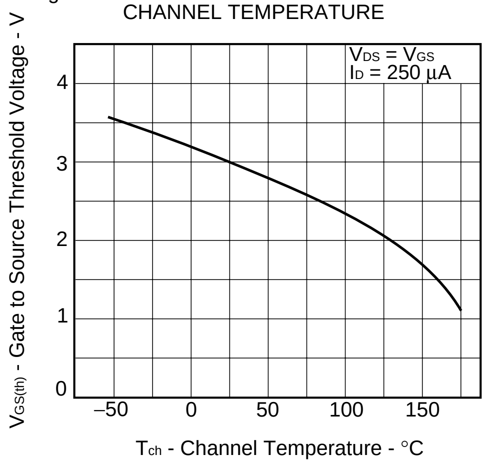


Figure12. DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE

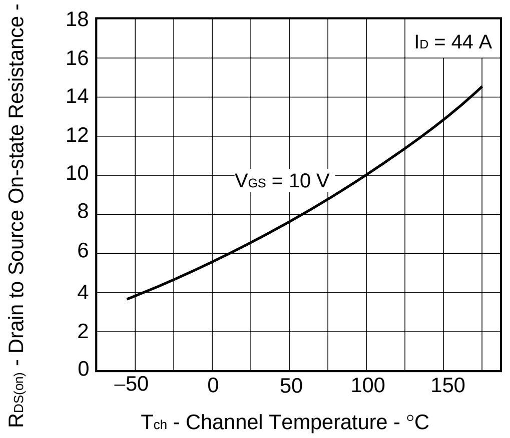



Figure13. SOURCE TO DRAIN DIODE FORWARD VOLTAGE

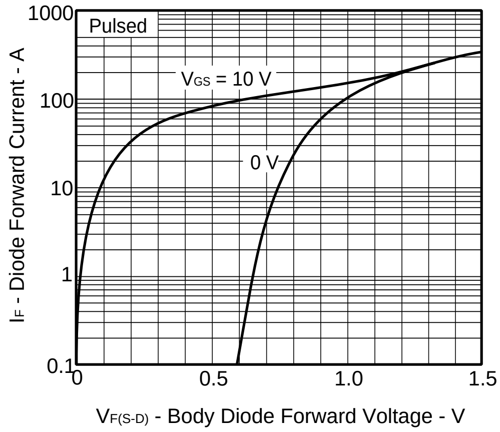



Figure14. CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE

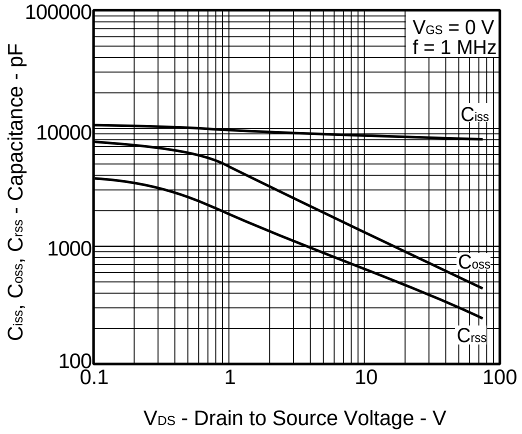



Figure15. SWITCHING CHARACTERISTICS

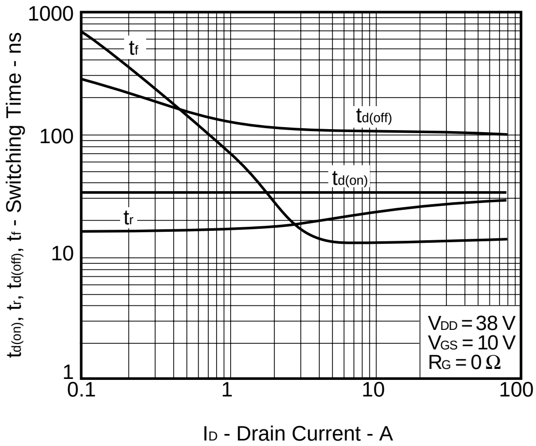



Figure16. REVERSE RECOVERY TIME vs. DIODE FORWARD CURRENT

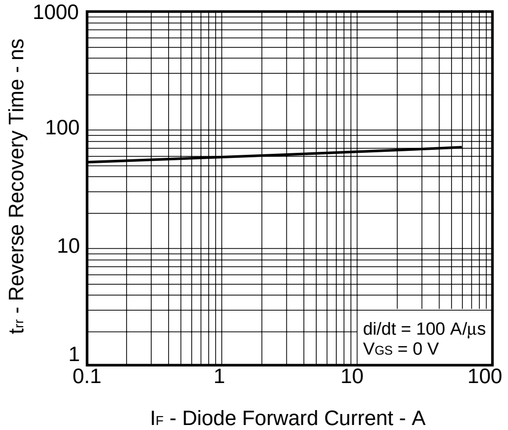
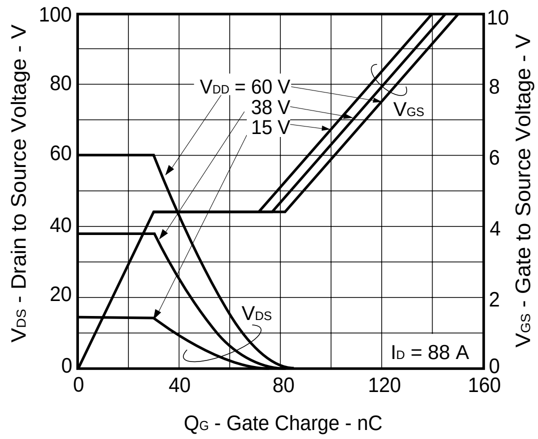
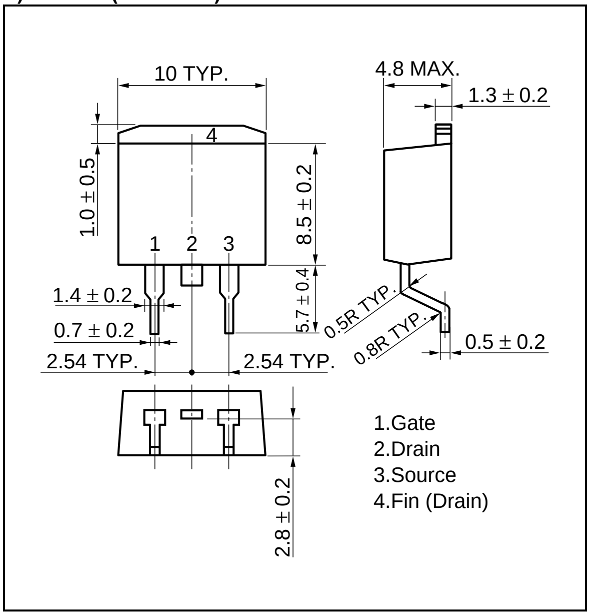



Figure17. DYNAMIC INPUT/OUTPUT CHARACTERISTICS

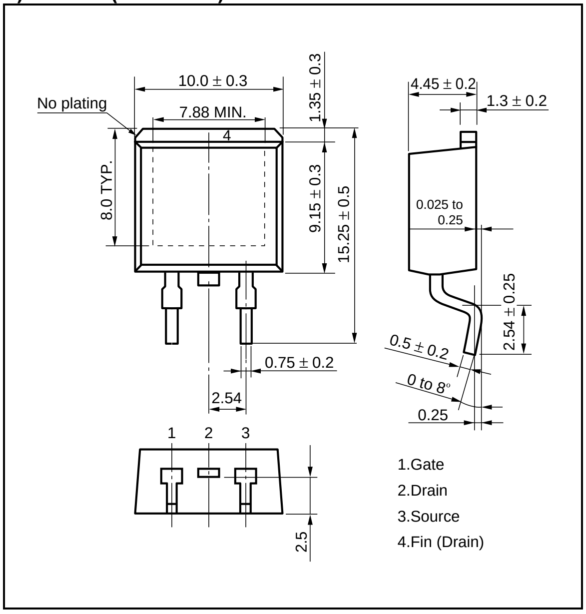


<R> **PACKAGE DRAWINGS (Unit: mm)**

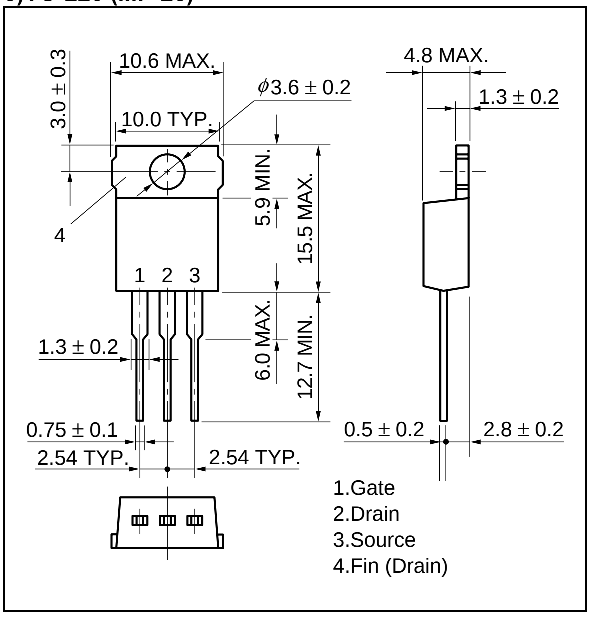
**1)TO-263 (MP-25ZJ)** Note



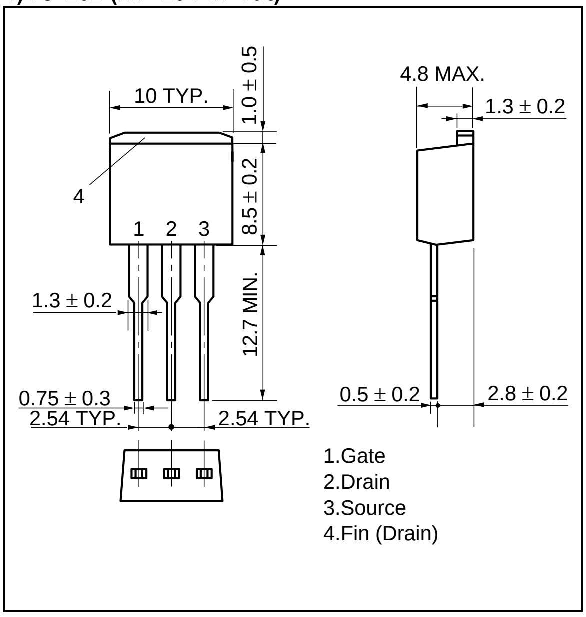

**2)TO-263 (MP-25ZK)**




**3)TO-220 (MP-25)** Note

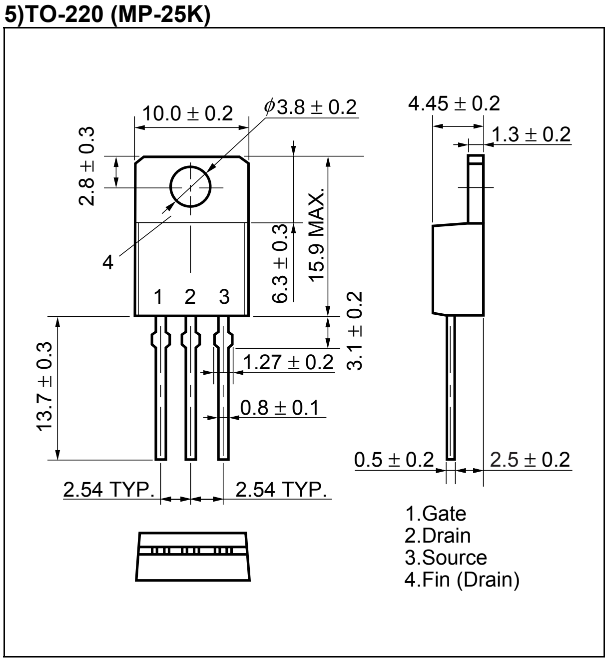



**4)TO-262 (MP-25 Fin Cut)** Note

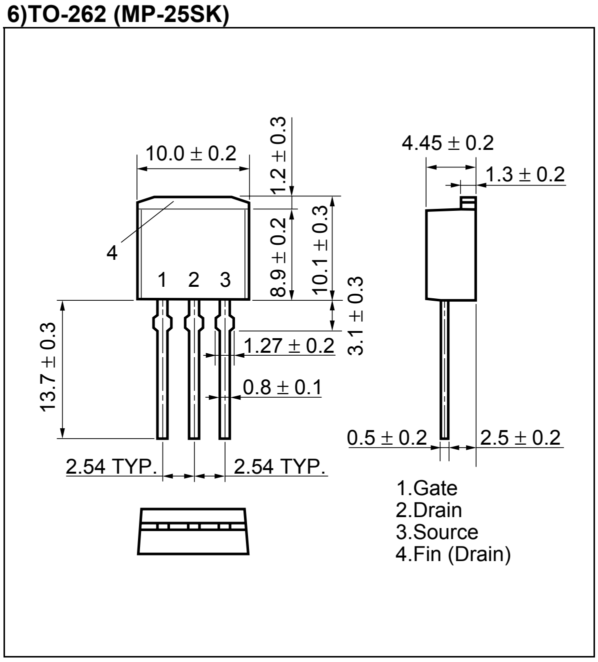



**Note** Not for new design

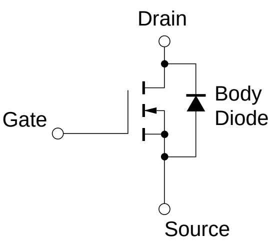
**5)TO-220 (MP-25K)**




**6)TO-262 (MP-25SK)**



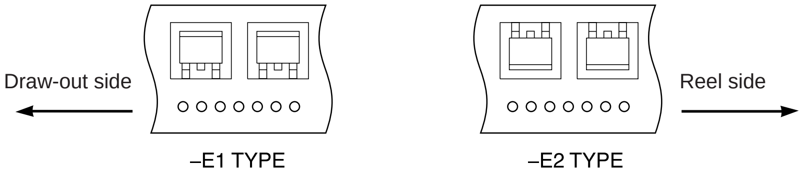

## EQUIVALENT CIRCUIT



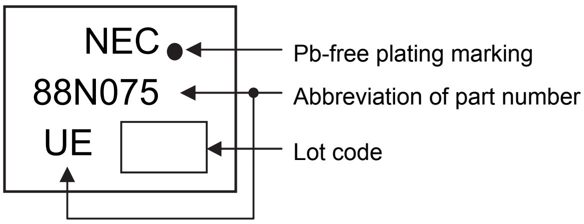

**Remark** Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

## <R> TAPE INFORMATION

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




## <R> MARKING INFORMATION




## <R> RECOMMENDED SOLDERING CONDITIONS

These products 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<br>MP-25ZJ, MP-25ZK | Maximum temperature (Package's surface temperature): 260°C or below<br>Time at maximum temperature: 10 seconds or less<br>Time of temperature higher than 220°C: 60 seconds or less<br>Preheating time at 160 to 180°C: 60 to 120 seconds<br>Maximum number of reflow processes: 3 times<br>Maximum chlorine content of rosin flux (percentage mass): 0.2% or less | IR60-00-3 |
| Wave soldering<br>MP-25, MP-25K, MP-25SK,<br>MP-25 Fin Cut | Maximum temperature (Solder temperature): 260°C or below<br>Time: 10 seconds or less<br>Maximum chlorine content of rosin flux: 0.2% (wt.) or less | THDWS |
| Partial heating<br>MP-25ZJ, MP-25ZK,<br>MP-25K, MP-25SK | Maximum temperature (Pin temperature): 350°C or below<br>Time (per side of the device): 3 seconds or less<br>Maximum chlorine content of rosin flux: 0.2% (wt.) or less | P350 |
| Partial heating<br>MP-25, MP-25 Fin Cut | Maximum temperature (Pin temperature): 300°C or below<br>Time (per side of the device): 3 seconds or less<br>Maximum chlorine content of rosin flux: 0.2% (wt.) or less | P300 |

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

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