# DATA SHEET

# MOS FIELD EFFECT TRANSISTOR

# NP84N04CHE, NP84N04DHE, NP84N04EHE

## SWITCHING
## N-CHANNEL POWER MOS FET
## INDUSTRIAL USE

### DESCRIPTION

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

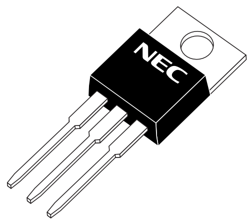
### ORDERING INFORMATION

| PART NUMBER | PACKAGE |
|---|---|
| NP84N04CHE | TO-220AB |
| NP84N04DHE | TO-262 |
| NP84N04EHE | TO-263 |

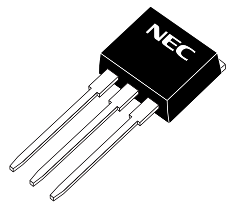
### FEATURES

- Channel temperature 175 degree rated
- Super low on-state resistance
  $R_{DS(on)}$ = 5.2 mΩ MAX. ($V_{GS}$ = 10 V, $I_D$ = 42 A)
- Low $C_{iss}$ : $C_{iss}$ = 4410 pF TYP.
- Built-in gate protection diode

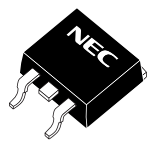
(TO-220AB)



(TO-262)



(TO-263)



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

| | | | |
|---|---|---|---|
| Drain to Source Voltage | $V_{DSS}$ | 40 | V |
| Gate to Source Voltage | $V_{GSS}$ | ±20 | V |
| Drain Current (DC) Note1 | $I_{D(DC)}$ | ±84 | A |
| Drain Current (Pulse) Note2 | $I_{D(pulse)}$ | ±336 | A |
| Total Power Dissipation ($T_A$ = 25°C) | $P_T$ | 1.8 | W |
| Total Power Dissipation ($T_C$ = 25°C) | $P_T$ | 200 | W |
| Single Avalanche Current Note3 | $I_{AS}$ | 84 / 61 / 22 | A |
| Single Avalanche Energy Note3 | $E_{AS}$ | 70 / 372 / 484 | mJ |
| Channel Temperature | $T_{ch}$ | 175 | °C |
| Storage Temperature | $T_{stg}$ | –55 to +175 | °C |

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

**2.** PW ≤ 10 $\mu$s, Duty cycle ≤ 1 %

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

### THERMAL RESISTANCE

| | | | |
|---|---|---|---|
| Channel to Case | $R_{th(ch-C)}$ | 0.75 | °C/W |
| Channel to Ambient | $R_{th(ch-A)}$ | 83.3 | °C/W |

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The mark ★ shows major revised points.

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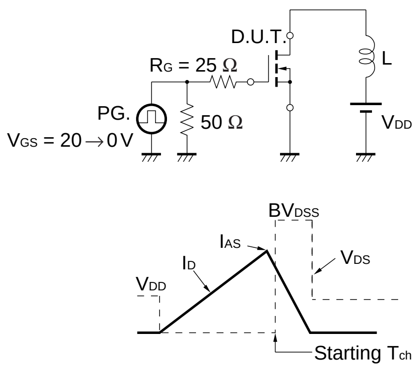
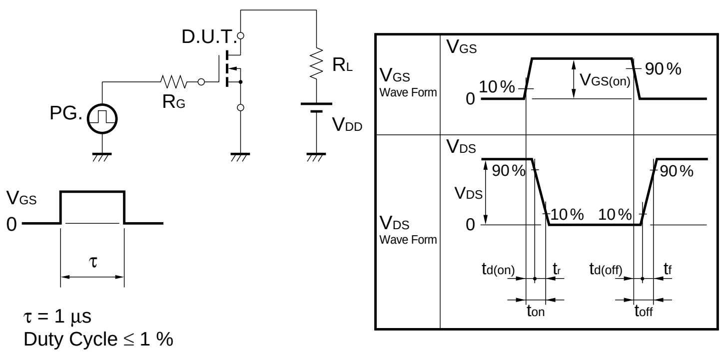
## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Drain to Source On-state Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 42 A | | 4.6 | 5.2 | mΩ |
| 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, $I_D$ = 42 A | 23 | 47 | | S |
| Drain Leakage Current | $I_{DSS}$ | $V_{DS}$ = 40 V, $V_{GS}$ = 0 V | | | 10 | μA |
| Gate to Source Leakage Current | $I_{GSS}$ | $V_{GS}$ = ±20 V, $V_{DS}$ = 0 V | | | ±10 | μA |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 25 V | | 4410 | 6620 | pF |
| Output Capacitance | $C_{oss}$ | $V_{GS}$ = 0 V | | 950 | 1430 | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | f = 1 MHz | | 490 | 890 | pF |
| Turn-on Delay Time | $t_{d(on)}$ | $I_D$ = 42 A | | 36 | 79 | ns |
| Rise Time | $t_r$ | $V_{GS(on)}$ = 10 V | | 25 | 62 | ns |
| Turn-off Delay Time | $t_{d(off)}$ | $V_{DD}$ = 20 V | | 77 | 150 | ns |
| Fall Time | $t_f$ | $R_G$ = 1 Ω | | 28 | 69 | ns |
| Total Gate Charge | $Q_G$ | $I_D$ = 84 A | | 87 | 130 | nC |
| Gate to Source Charge | $Q_{GS}$ | $V_{DD}$ = 32 V | | 20 | | nC |
| Gate to Drain Charge | $Q_{GD}$ | $V_{GS}$ = 10 V | | 32 | | nC |
| Body Diode Forward Voltage | $V_{F(S-D)}$ | $I_F$ = 84 A, $V_{GS}$ = 0 V | | 1.0 | | V |
| Reverse Recovery Time | $t_{rr}$ | $I_F$ = 84 A, $V_{GS}$ = 0 V | | 49 | | ns |
| Reverse Recovery Charge | $Q_{rr}$ | di/dt = 100 A/μs | | 60 | | nC |

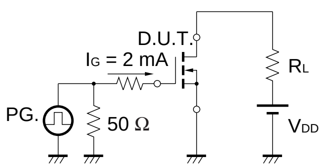
### TEST CIRCUIT 1 AVALANCHE CAPABILITY




### 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

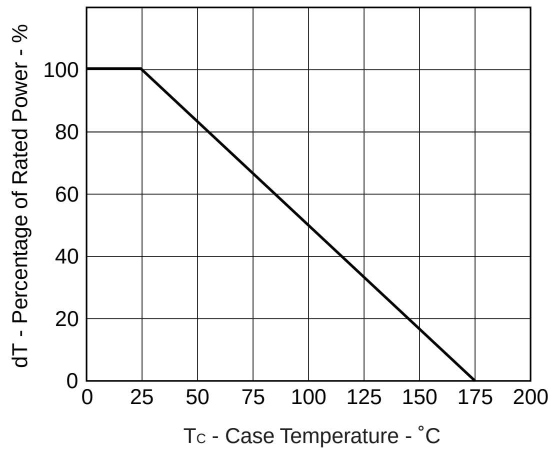



Figure2. TOTAL POWER DISSIPATION vs. CASE TEMPERATURE

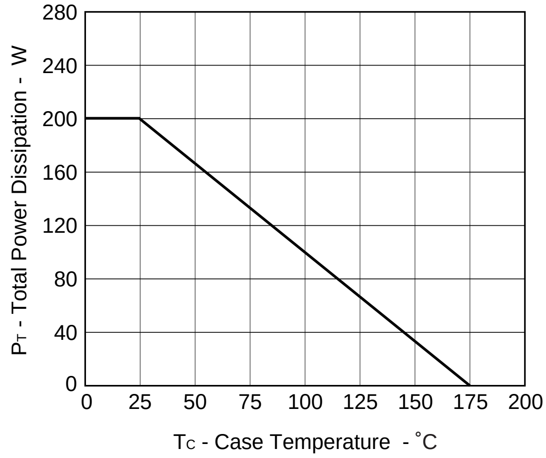



Figure3. FORWARD BIAS SAFE OPERATING AREA

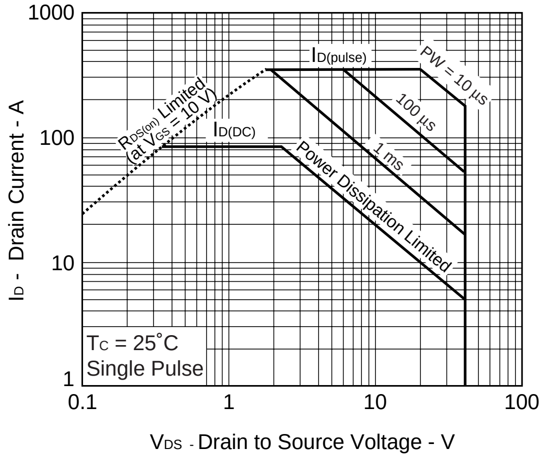



Figure4. SINGLE AVALANCHE ENERGY DERATING FACTOR

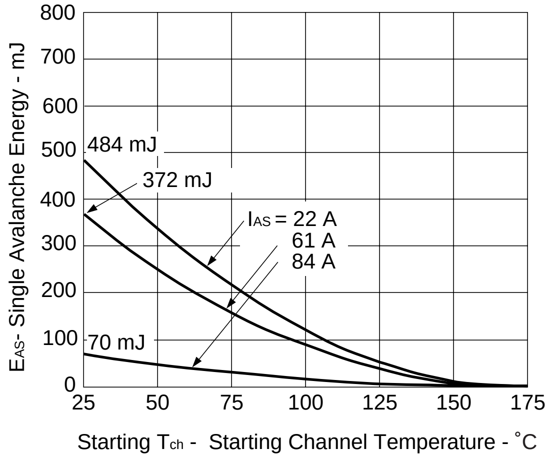



Figure5. TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

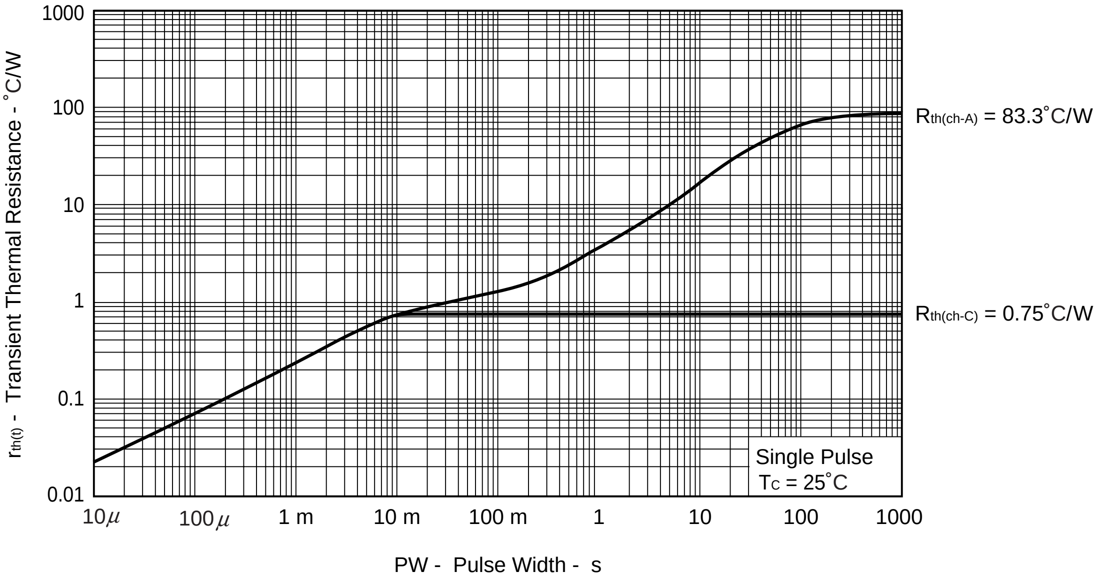


Figure6. FORWARD TRANSFER CHARACTERISTICS

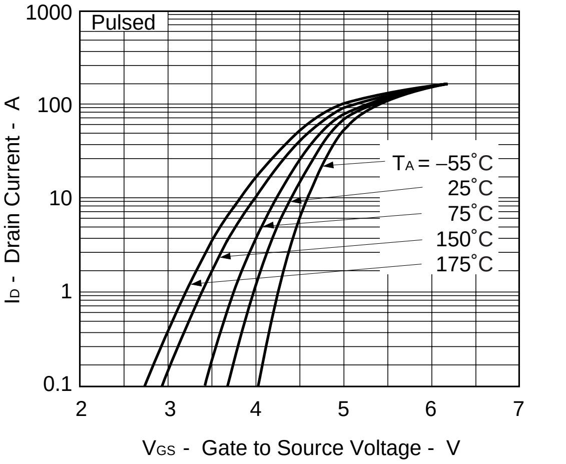



Figure7. DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE

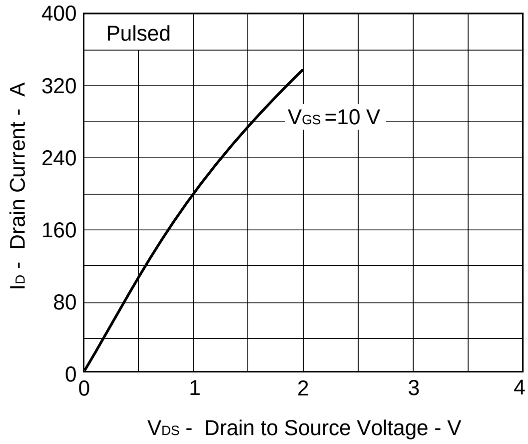



Figure8. FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT

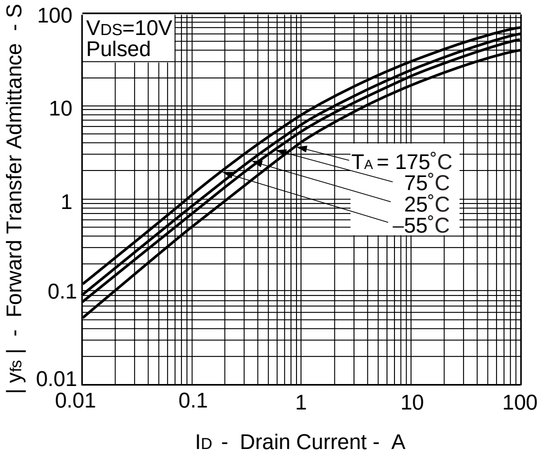



Figure9. DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE

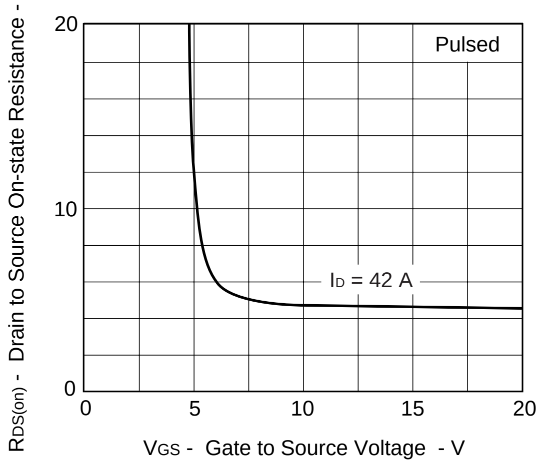



Figure10. DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

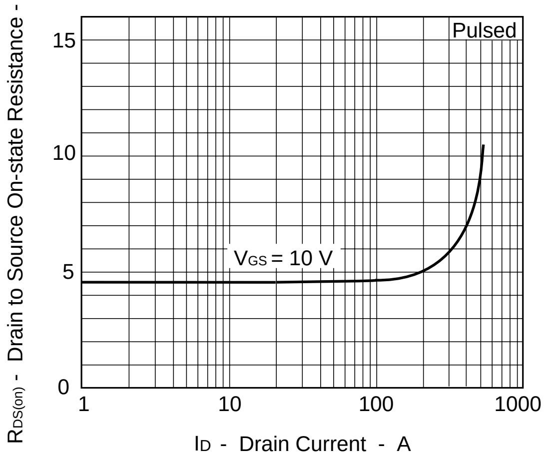



Figure11. GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE

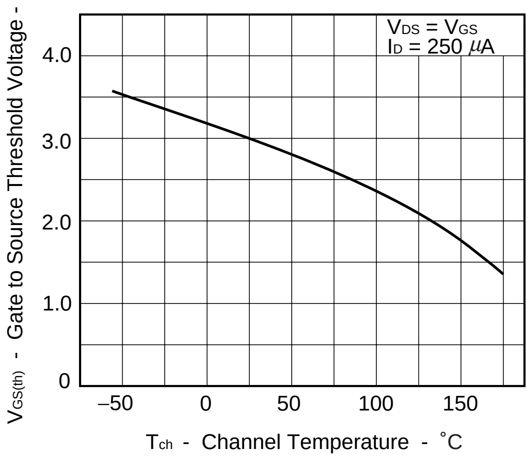


Figure12. DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE

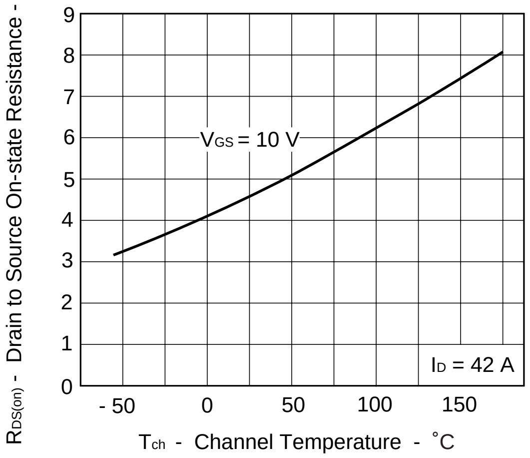



Figure13. SOURCE TO DRAIN DIODE FORWARD VOLTAGE

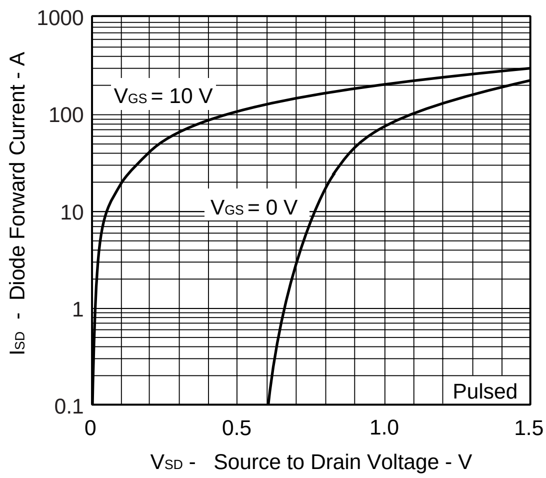



Figure14. CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE

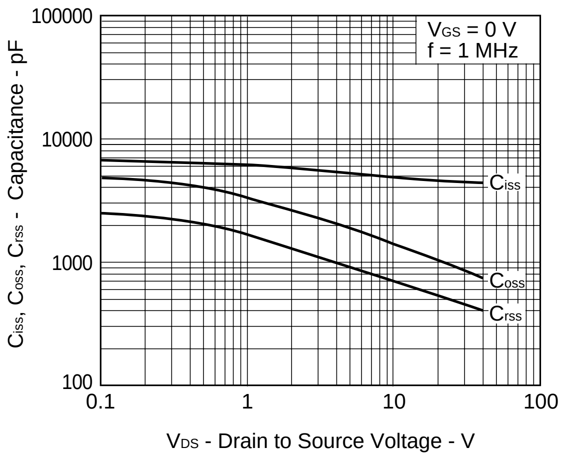



Figure15. SWITCHING CHARACTERISTICS

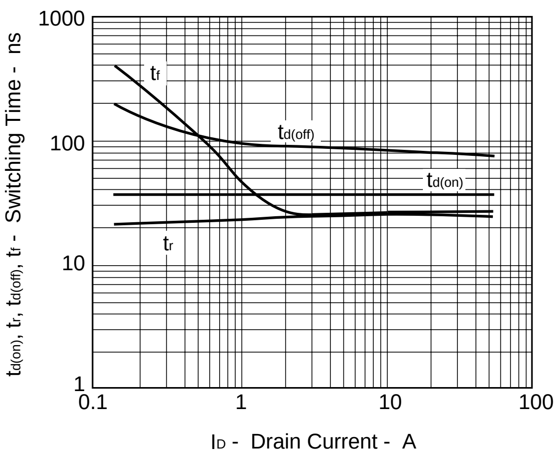



Figure16. REVERSE RECOVERY TIME vs. DRAIN CURRENT

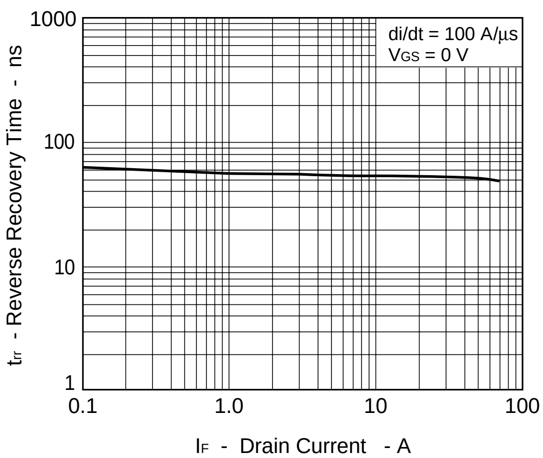
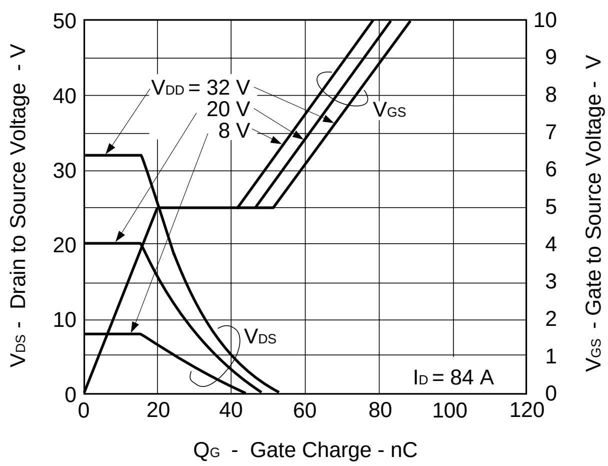
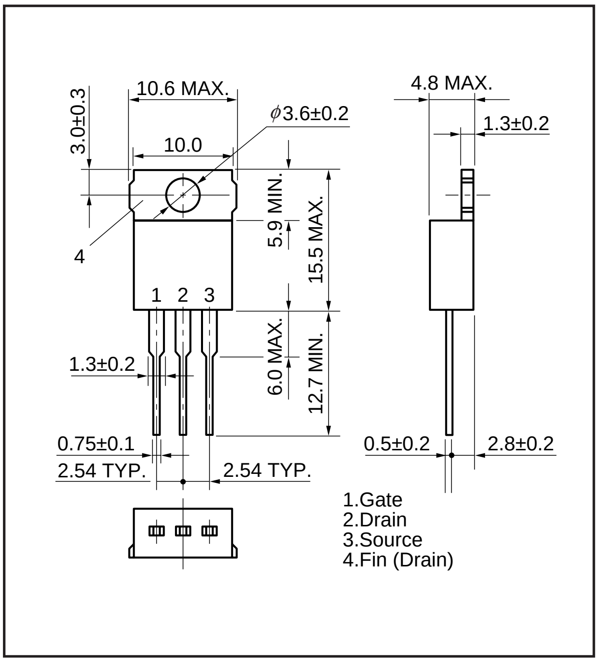



Figure17. DYNAMIC INPUT/OUTPUT CHARACTERISTICS

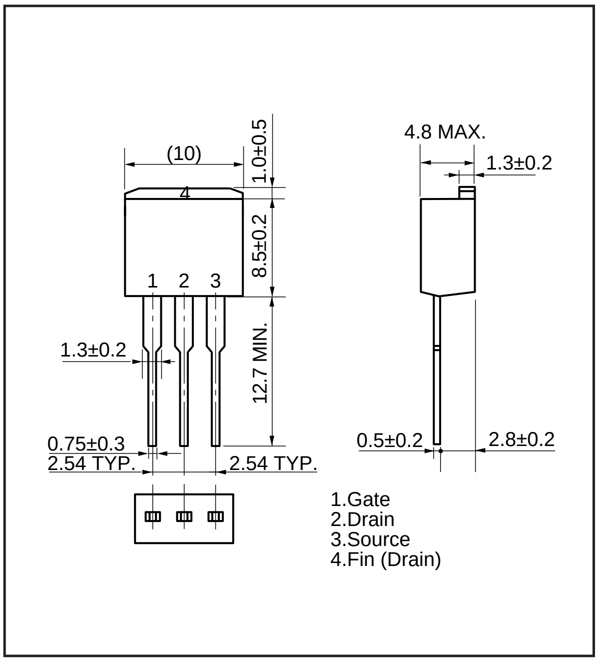


## PACKAGE DRAWINGS (Unit: mm)

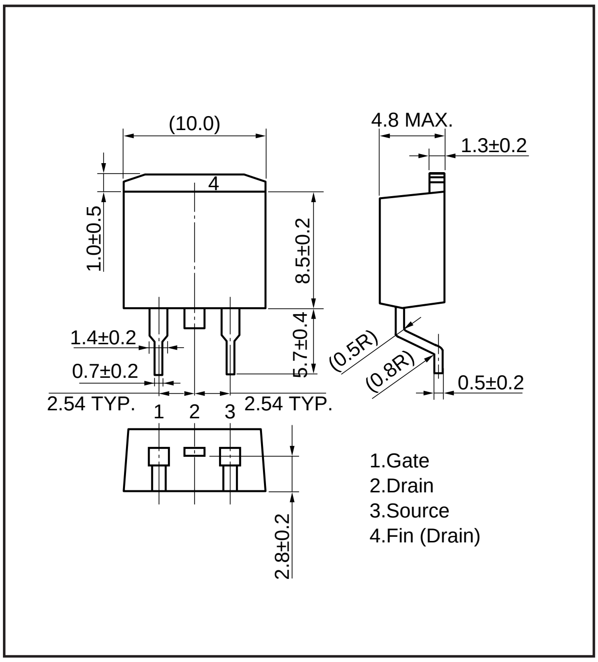
1) TO-220AB (MP-25)



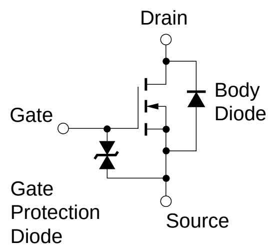

2) TO-262 (MP-25 Fin Cut)




3) TO-263 (MP-25ZJ)




## EQUIVALENT CIRCUIT




**Remark** The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.

**[MEMO]**

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