DATA SHEET

MOS FIELD EFFECT TRANSISTOR

NP88N04CHE, NP88N04DHE, NP88N04EHE

SWITCHING
N-CHANNEL POWER MOS FET
INDUSTRIAL USE

DESCRIPTION

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

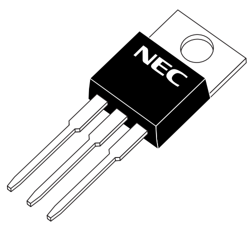
ORDERING INFORMATION

PART NUMBER	PACKAGE
NP88N04CHE	TO-220AB
NP88N04DHE	TO-262
NP88N04EHE	TO-263

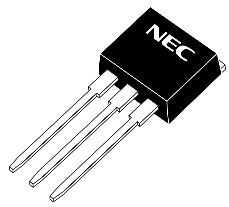
FEATURES

- Channel temperature 175 degree rated
- Super low on-state resistance
  $R_{DS(on)}$ = 4.3 mΩ MAX. (V_{GS} = 10 V, I_D = 44 A)
- Low C_{iss} : C_{iss} = 7300 pF TYP.
- Built-in gate protection diode

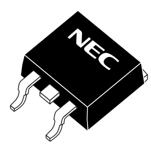
(TO-220AB)



(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	$I_{D(DC)}$	±88	A
Drain Current (Pulse) Note2	$I_{D(pulse)}$	±352	A
Total Power Dissipation (T_A = 25°C)	P_T	1.8	W
Total Power Dissipation (T_C = 25°C)	P_T	288	W
Single Avalanche Current Note3	I_{AS}	75 / 88	A
Single Avalanche Energy Note3	E_{AS}	562 / 232	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 μs, 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	$R_{th(ch-C)}$	0.52	°C/W
Channel to Ambient	$R_{th(ch-A)}$	83.3	°C/W

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

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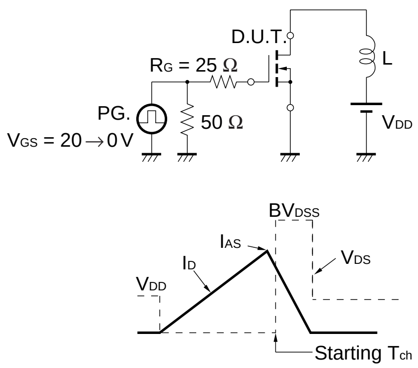
The mark ★ shows major revised points.

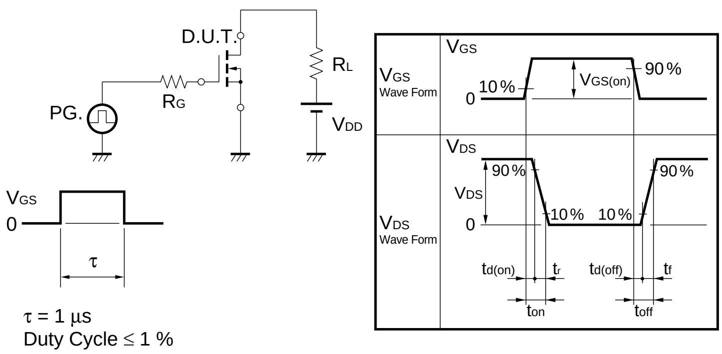
ELECTRICAL CHARACTERISTICS (T_A = 25 °C)

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Drain to Source On-state Resistance	$R_{DS(on)}$	V_{GS} = 10 V, I_D = 44 A		3.4	4.3	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 = 44 A	30	60		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, V_{GS} = 0 V, f = 1 MHz		7300	11000	pF
Output Capacitance	C_{oss}			1400	2100	pF
Reverse Transfer Capacitance	C_{rss}			620	1120	pF
★ Turn-on Delay Time	$t_{d(on)}$	I_D = 44 A, $V_{GS(on)}$ = 10 V, V_{DD} = 20 V, R_G = 1 Ω		38	84	ns
★ Rise Time	t_r			27	68	ns
★ Turn-off Delay Time	$t_{d(off)}$			110	220	ns
★ Fall Time	t_f			32	80	ns
Total Gate Charge	Q_G	I_D = 88 A, V_{DD} = 32 V, V_{GS} = 10 V		120	180	nC
Gate to Source Charge	Q_{GS}			30		nC
Gate to Drain Charge	Q_{GD}			43		nC
Body Diode Forward Voltage	$V_{F(S-D)}$	I_F = 88 A, V_{GS} = 0 V		0.95		V
Reverse Recovery Time	t_{rr}	I_F = 88 A, V_{GS} = 0 V, di/dt = 100 A/μs		64		ns
Reverse Recovery Charge	Q_{rr}			99		nC

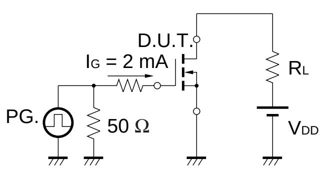
TEST CIRCUIT 1 AVALANCHE CAPABILITY



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

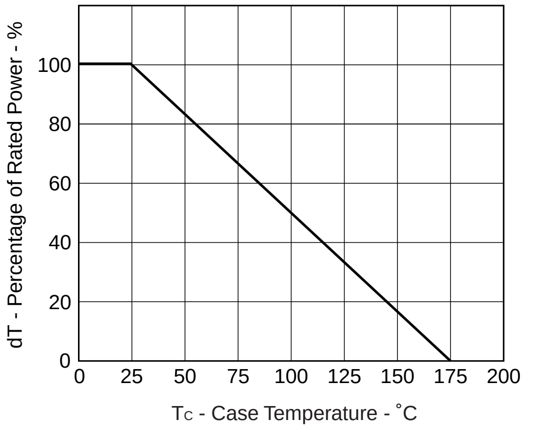


Figure2. TOTAL POWER DISSIPATION vs. CASE TEMPERATURE

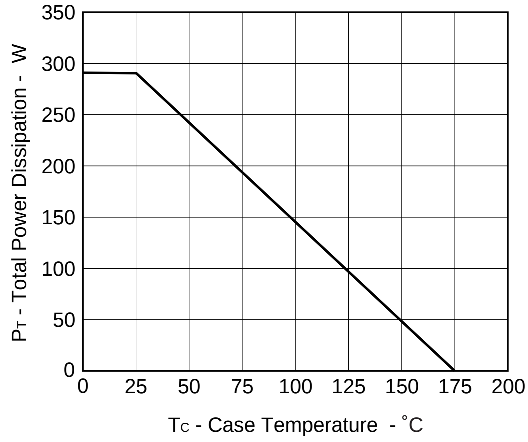


Figure3. FORWARD BIAS SAFE OPERATING AREA

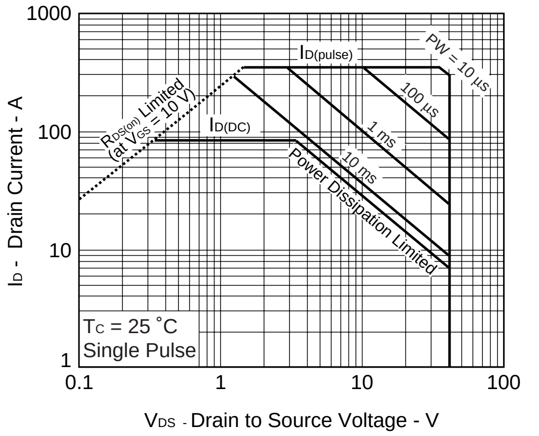


Figure4. SINGLE AVALANCHE ENERGY DERATING FACTOR

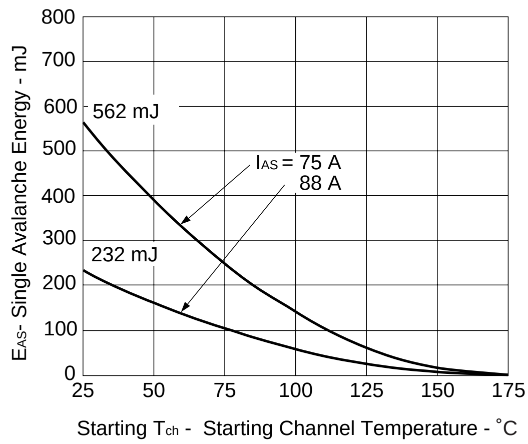


Figure5. TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

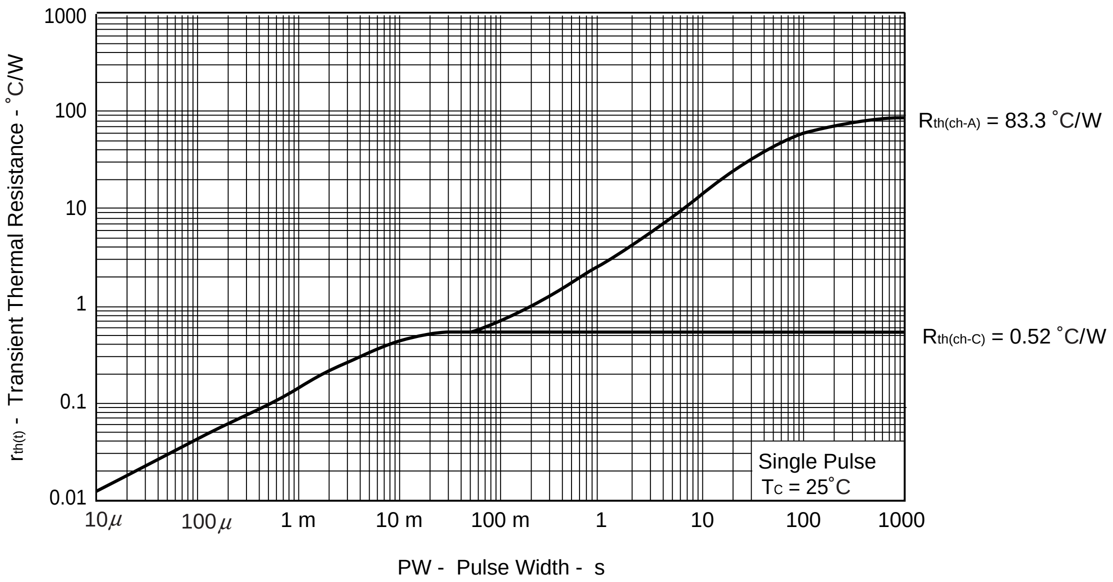


Figure6. FORWARD TRANSFER CHARACTERISTICS

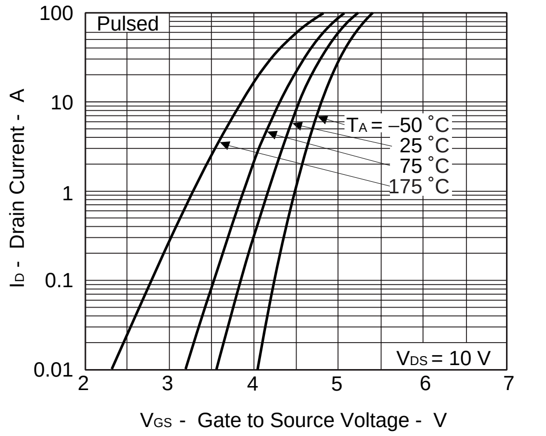


Figure7. DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE

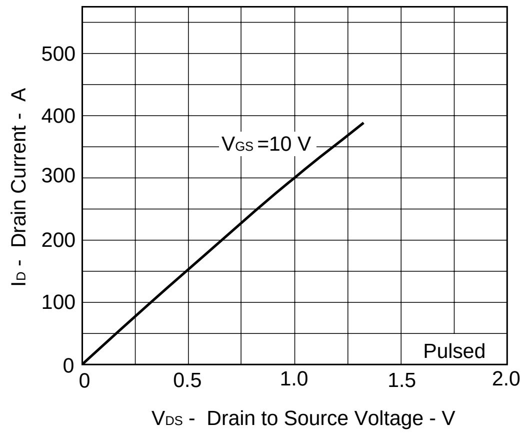


Figure8. FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT

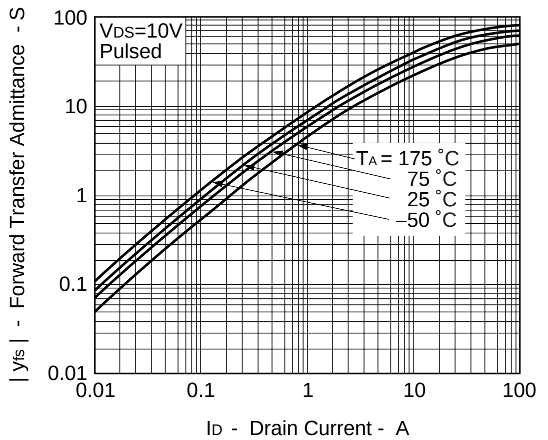


Figure9. DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE

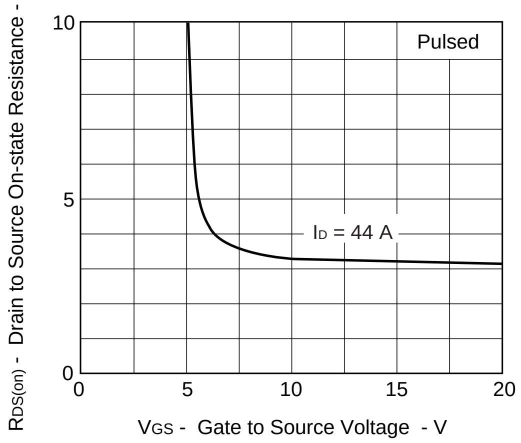


Figure10. DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT

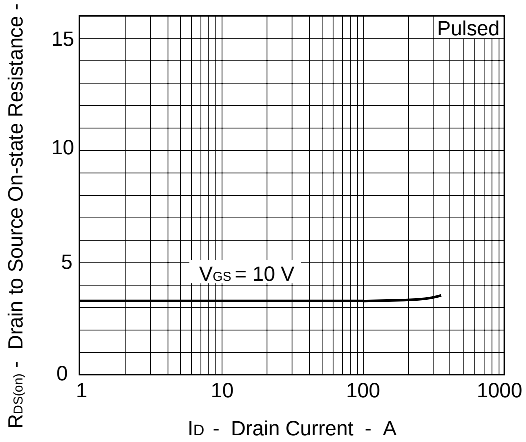
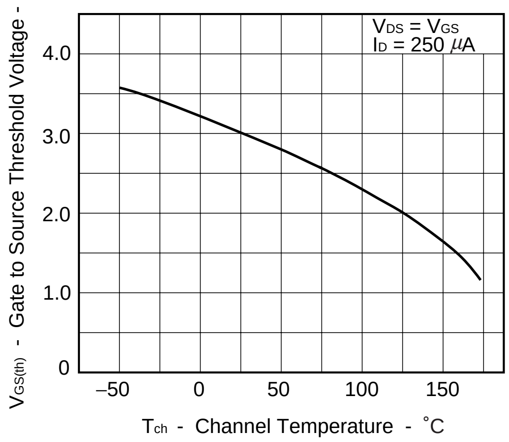


Figure11. GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



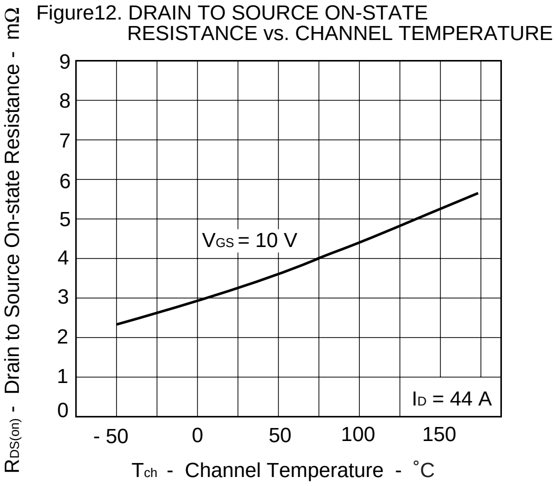


Figure12. DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE
RDS(on) - Drain to Source On-state Resistance - mΩ
VGS = 10 V
ID = 44 A
Tch - Channel Temperature - ˚C

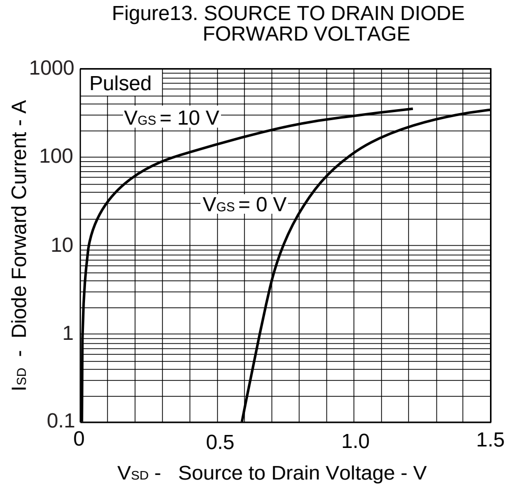


Figure13. SOURCE TO DRAIN DIODE FORWARD VOLTAGE
Pulsed
VGS = 10 V
VGS = 0 V
ISD - Diode Forward Current - A
VSD - Source to Drain Voltage - V

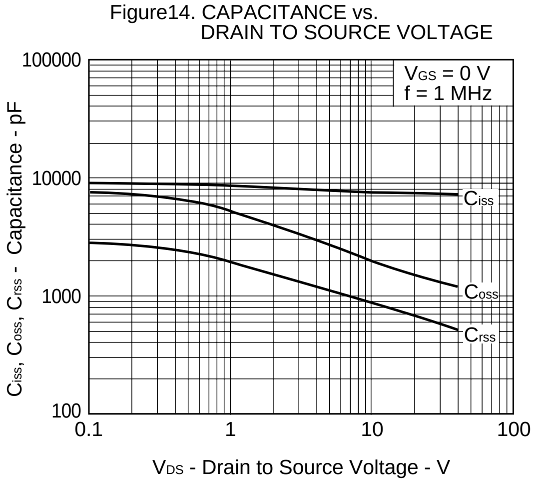


Figure14. CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE
VGS = 0 V
f = 1 MHz
Ciss
Coss
Crss
Ciss, Coss, Crss - Capacitance - pF
VDS - Drain to Source Voltage - V

★

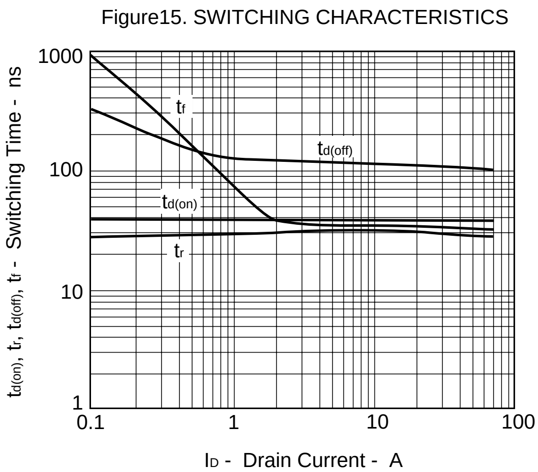


Figure15. SWITCHING CHARACTERISTICS
tf
td(off)
td(on)
tr
td(on), tr, td(off), tf - Switching Time - ns
ID - Drain Current - A

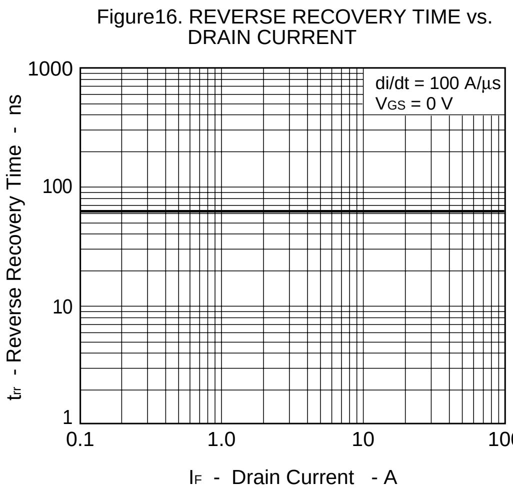


Figure16. REVERSE RECOVERY TIME vs. DRAIN CURRENT
di/dt = 100 A/μs
VGS = 0 V
trr - Reverse Recovery Time - ns
IF - Drain Current - A

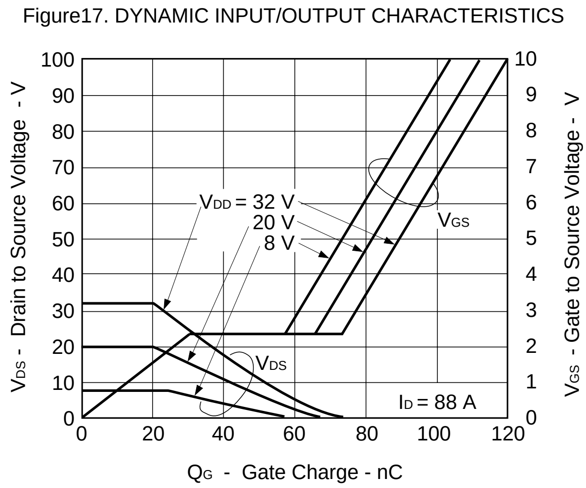
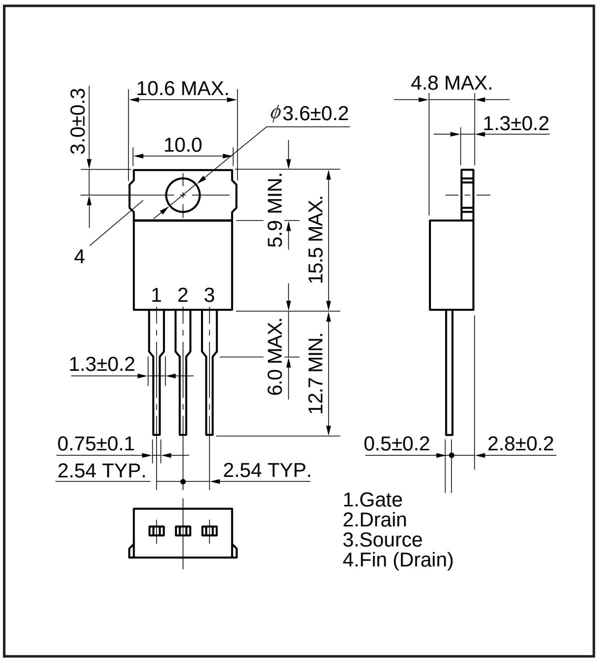


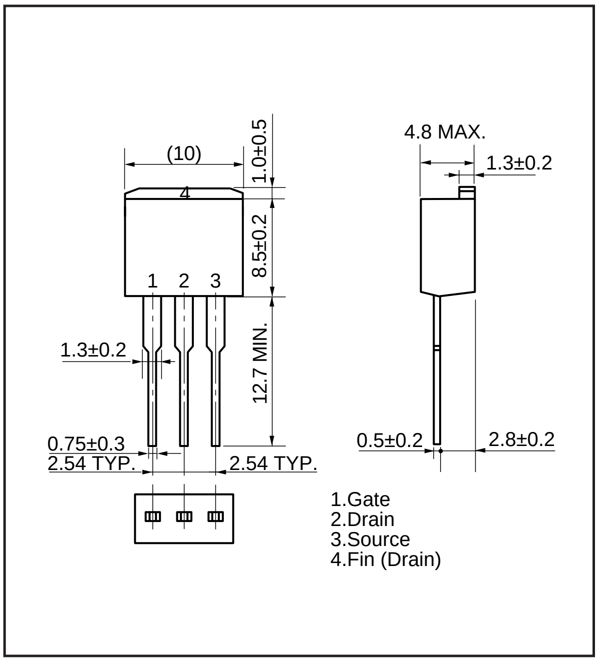
Figure17. DYNAMIC INPUT/OUTPUT CHARACTERISTICS
VDD = 32 V
20 V
8 V
VGS
VDS
ID = 88 A
VDS - Drain to Source Voltage - V
VGS - Gate to Source Voltage - V
QG - Gate Charge - nC

PACKAGE DRAWINGS (Unit: mm)

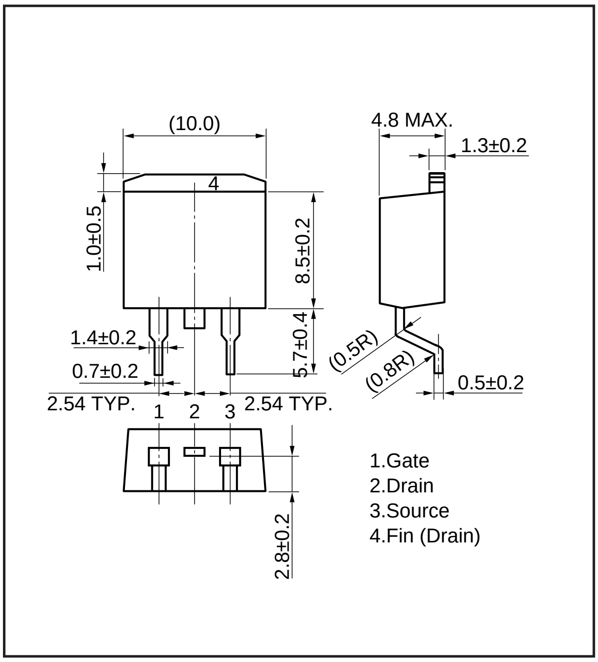
1) TO-220AB (MP-25)



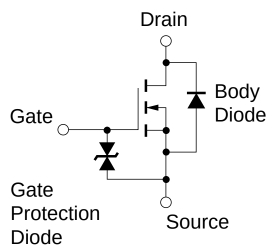
2) TO-262 (MP-25 Fin Cut)



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]