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Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

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Keep safety first in your circuit designs!

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HAF2005

Silicon N Channel MOS FET Series Power Switching

RENESAS

ADE-208-688B (Z)

3rd. Edition
Apr. 2002

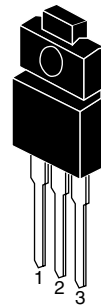
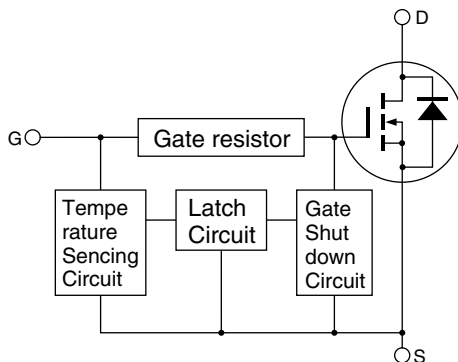
This FET has the over temperature shut-down capability sensing to the junction temperature. This FET has the built-in over temperature shut-down circuit in the gate area. And this circuit operation to shut-down the gate voltage in case of high junction temperature like applying over power consumption, over current etc.

Features

- Logic level operation (4 to 6 V Gate drive)
- High endurance capability against to the short circuit
- Built-in the over temperature shut-down circuit
- Latch type shut-down operation (Need 0 voltage recovery)

Outline

TO-220FM



1. Gate
2. Drain
3. Source

Absolute Maximum Ratings

(Ta = 25°C)

| Item | Symbol | Ratings | Unit |
|--|---------------------------------|-------------|------|
| Drain to source voltage | V_{DS} | 60 | V |
| Gate to source voltage | V_{GS} | 16 | V |
| Gate to source voltage | V_{GS} | -2.5 | V |
| Drain current | I_D | 40 | A |
| Drain peak current | $I_{D(pulse)}$ ^{Note1} | 80 | A |
| Body-drain diode reverse drain current | I_{DR} | 40 | A |
| Channel dissipation | Pch ^{Note2} | 30 | W |
| Channel temperature | Tch | 150 | °C |
| Storage temperature | Tstg | -55 to +150 | °C |

Notes: 1. $PW \leq 10ms$, duty cycle $\leq 1\%$

2. Value at Ta = 25°C

Typical Operation Characteristics

| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---------------------------------------|---------------|-----|------|-----|------|--------------------------|
| Input voltage | V_{IH} | 3.5 | — | — | V | |
| | V_{IL} | — | — | 1.2 | V | |
| Input current (Gate non shut down) | I_{IH1} | — | — | 100 | μA | $V_i = 8V, V_{DS} = 0$ |
| | I_{IH2} | — | — | 50 | μA | $V_i = 3.5V, V_{DS} = 0$ |
| | I_{IL} | — | — | 1 | μA | $V_i = 1.2V, V_{DS} = 0$ |
| Input current (Gate shut down) | $I_{IH(sd)1}$ | — | 0.8 | — | mA | $V_i = 8V, V_{DS} = 0$ |
| | $I_{IH(sd)2}$ | — | 0.35 | — | mA | $V_i = 3.5V, V_{DS} = 0$ |
| Shut down temperature | T_{sd} | — | 175 | — | °C | Channel temperature |
| Gate operation voltage | V_{op} | 3.5 | — | 12 | V | |

Electrical Characteristics

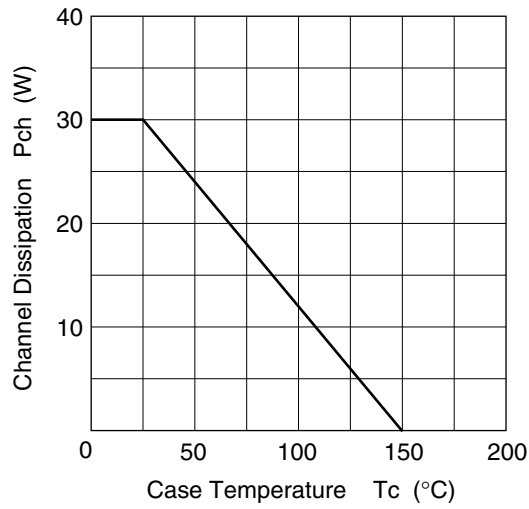
(Ta = 25°C)

| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---------------|------|------|------|---------------|---|
| Drain current | I_{D1} | 15 | — | — | A | $V_{GS} = 3.5 \text{ V}$, $V_{DS} = 2 \text{ V}$ |
| Drain current | I_{D2} | — | — | 10 | mA | $V_{GS} = 1.2 \text{ V}$, $V_{DS} = 2 \text{ V}$ |
| Drain to source breakdown voltage | $V_{(BR)DSS}$ | 60 | — | — | V | $I_D = 10 \text{ mA}$, $V_{GS} = 0$ |
| Gate to source breakdown voltage | $V_{(BR)GSS}$ | 16 | — | — | V | $I_G = 300 \mu\text{A}$, $V_{DS} = 0$ |
| Gate to source breakdown voltage | $V_{(BR)GSS}$ | -2.5 | — | — | V | $I_G = -100 \mu\text{A}$, $V_{DS} = 0$ |
| Gate to source leak current | I_{GSS1} | — | — | 100 | μA | $V_{GS} = 8 \text{ V}$, $V_{DS} = 0$ |
| | I_{GSS2} | — | — | 50 | μA | $V_{GS} = 3.5 \text{ V}$, $V_{DS} = 0$ |
| | I_{GSS3} | — | — | 1 | μA | $V_{GS} = 1.2 \text{ V}$, $V_{DS} = 0$ |
| | I_{GSS4} | — | — | -100 | μA | $V_{GS} = -2.4 \text{ V}$, $V_{DS} = 0$ |
| Input current (shut down) | $I_{GS(op)1}$ | — | 0.8 | — | mA | $V_{GS} = 8 \text{ V}$, $V_{DS} = 0$ |
| | $I_{GS(op)2}$ | — | 0.35 | — | mA | $V_{GS} = 3.5 \text{ V}$, $V_{DS} = 0$ |
| Zero gate voltage drain current | I_{DSS} | — | — | 10 | μA | $V_{DS} = 60 \text{ V}$, $V_{GS} = 0$ |
| Gate to source cutoff voltage | $V_{GS(off)}$ | 1.0 | — | 2.25 | V | $I_D = 1 \text{ mA}$, $V_{DS} = 10 \text{ V}$ |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 25 | 33 | m Ω | $I_D = 20 \text{ A}$, $V_{GS} = 4 \text{ V}$ ^{Note3} |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 15 | 20 | m Ω | $I_D = 20 \text{ A}$, $V_{GS} = 10 \text{ V}$ ^{Note3} |
| Forward transfer admittance | $ y_{fs} $ | 8 | 16 | — | S | $I_D = 20 \text{ A}$, $V_{DS} = 10 \text{ V}$ ^{Note3} |
| Output capacitance | C_{oss} | — | 940 | — | pF | $V_{DS} = 10 \text{ V}$, $V_{GS} = 0$ $f = 1 \text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | — | 10.7 | — | μs | $I_D = 20 \text{ A}$, $V_{GS} = 5 \text{ V}$ |
| Rise time | t_r | — | 66 | — | μs | $R_L = 1.5 \Omega$ |
| Turn-off delay time | $t_{d(off)}$ | — | 15.5 | — | μs | |
| Fall time | t_f | — | 19 | — | μs | |
| Body-drain diode forward voltage | V_{DF} | — | 1 | — | V | $I_F = 40 \text{ A}$, $V_{GS} = 0$ |
| Body-drain diode reverse recovery time | t_{rr} | — | 200 | — | ns | $I_F = 40 \text{ A}$, $V_{GS} = 0$ $di_F/dt = 50 \text{ A}/\mu\text{s}$ |
| Over load shut down operation time ^{Note4} | t_{os1} | — | 1 | — | ms | $V_{GS} = 5 \text{ V}$, $V_{DD} = 16 \text{ V}$ |

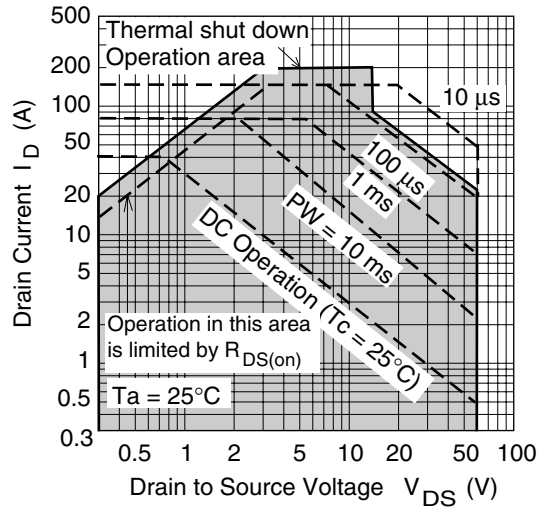
Notes: 3. Pulse test

4. Including the junction temperature rise of the over loaded condition.

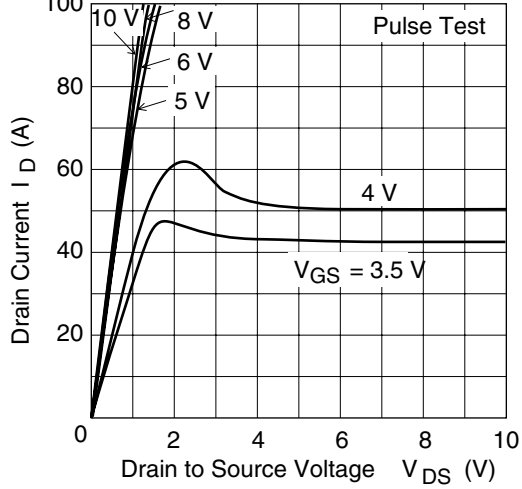
Power vs. Temperature derating



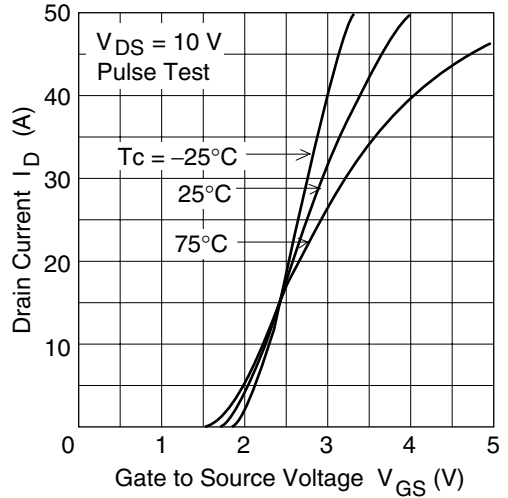
Maximum Safe Operation Area



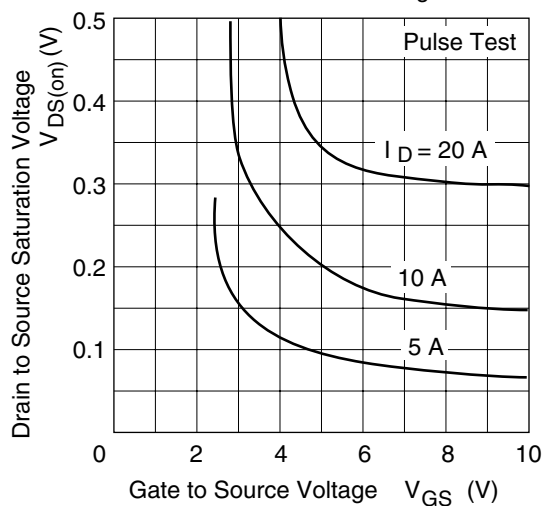
Typical Output Characteristics



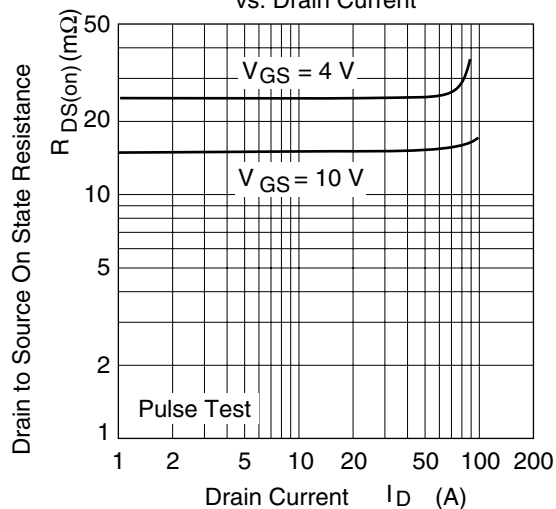
Typical Transfer Characteristics



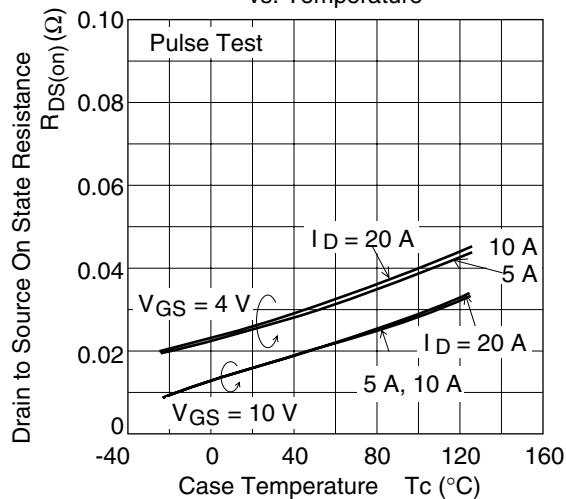
Drain to Source Saturation Voltage vs.
Gate to Source Voltage



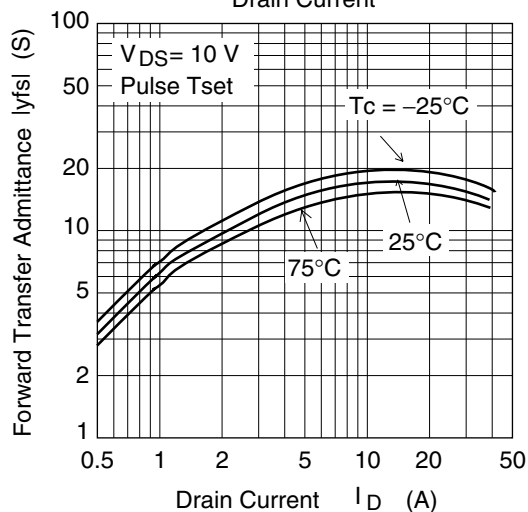
Static Drain to Source State Resistance
vs. Drain Current



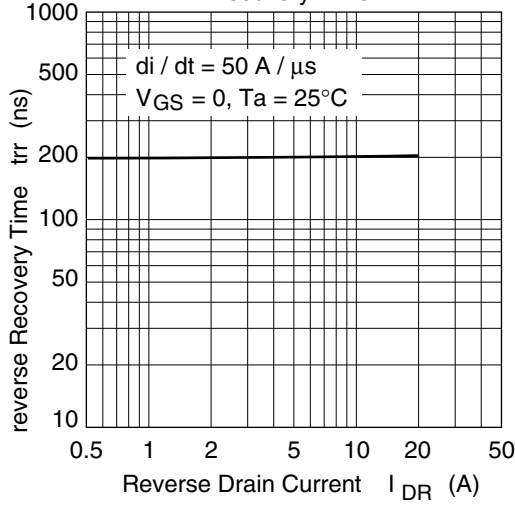
Static Drain to Source on State Resistance
vs. Temperature



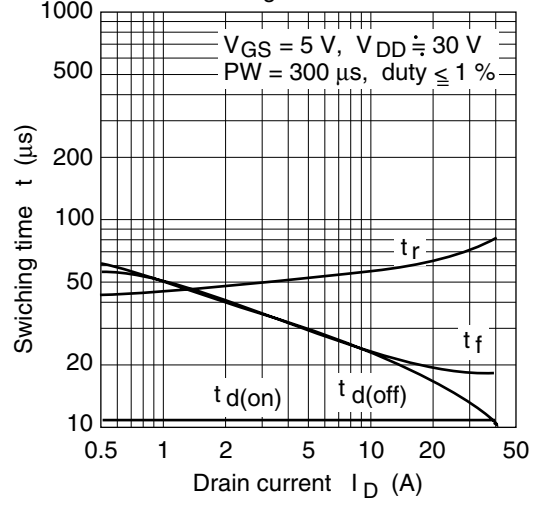
Forward transfer Admittance vs.
Drain Current



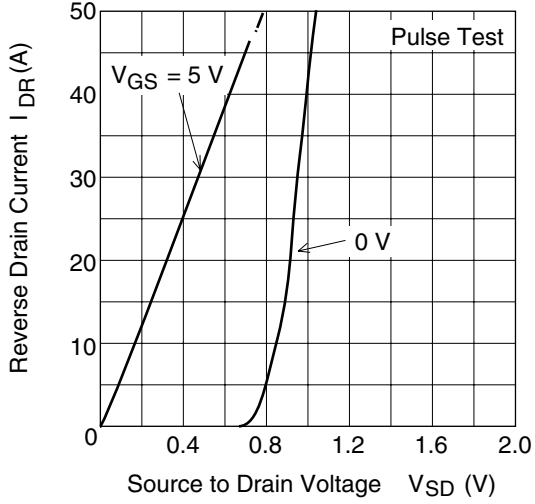
Body to Drain Diode Reverse Recovery Time



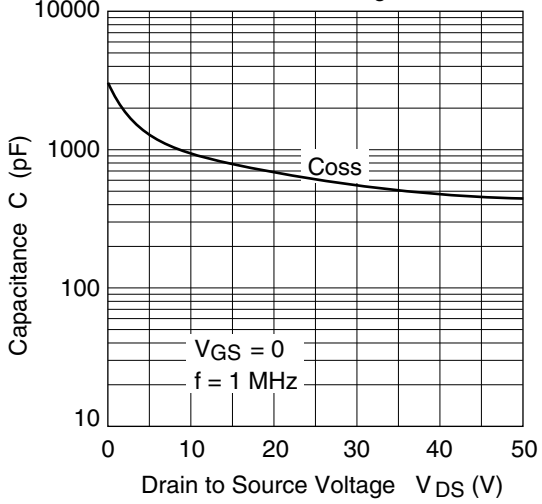
Switching Characteristics

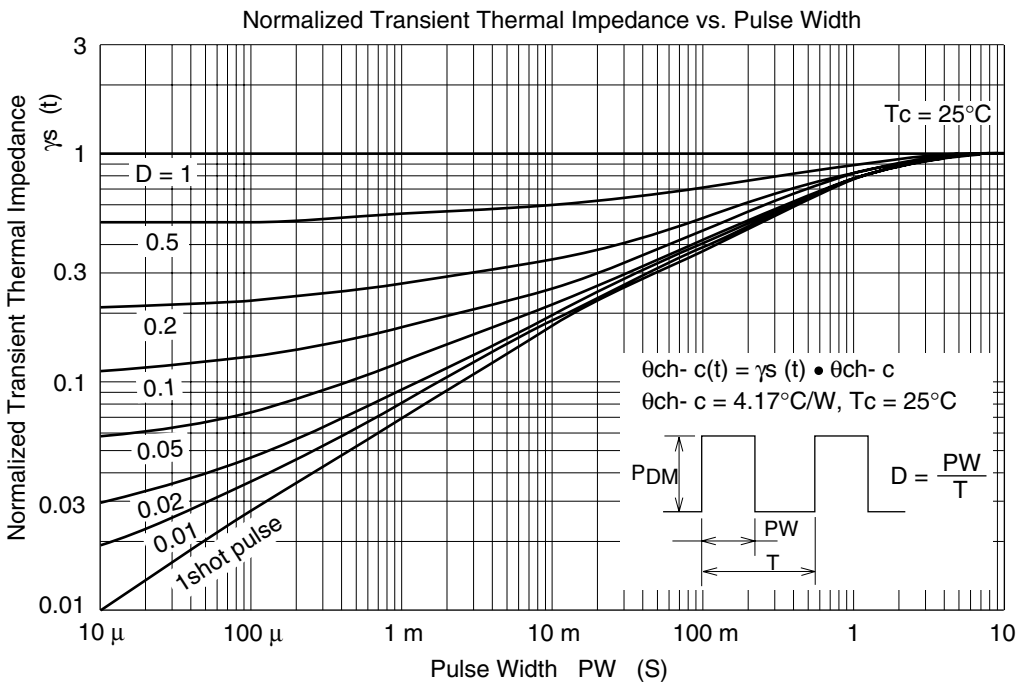
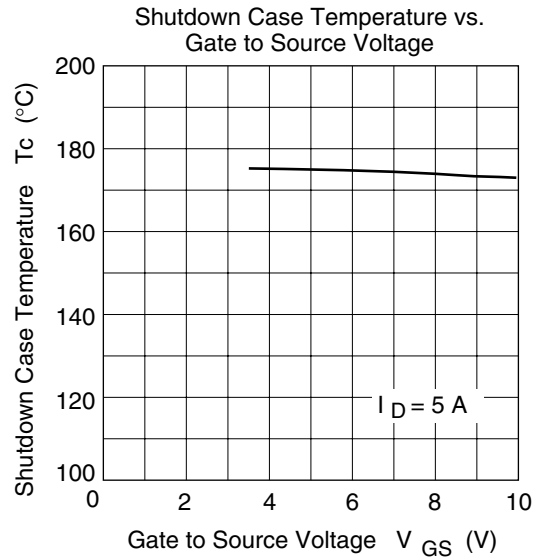
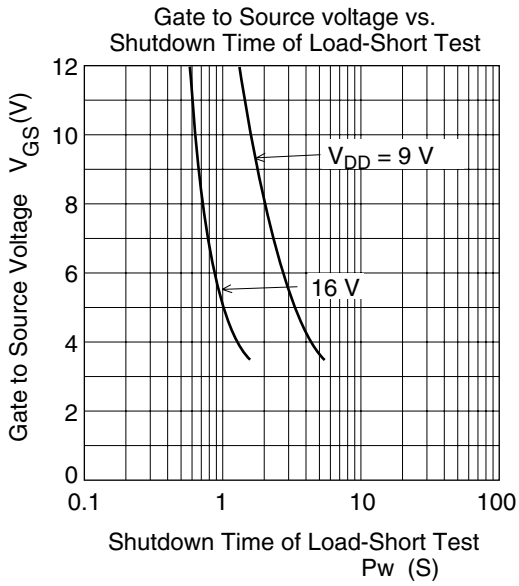


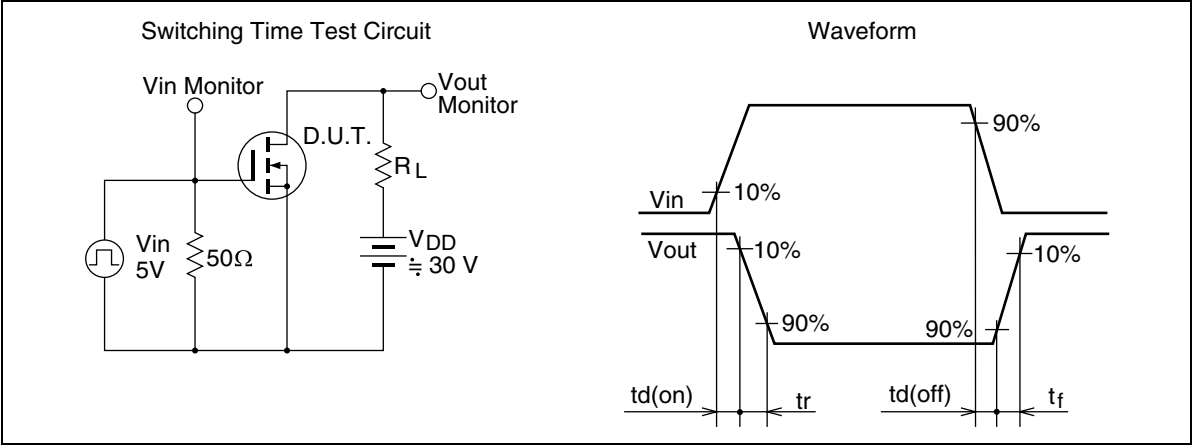
Reverse Drain Current vs. Source to Drain Voltage



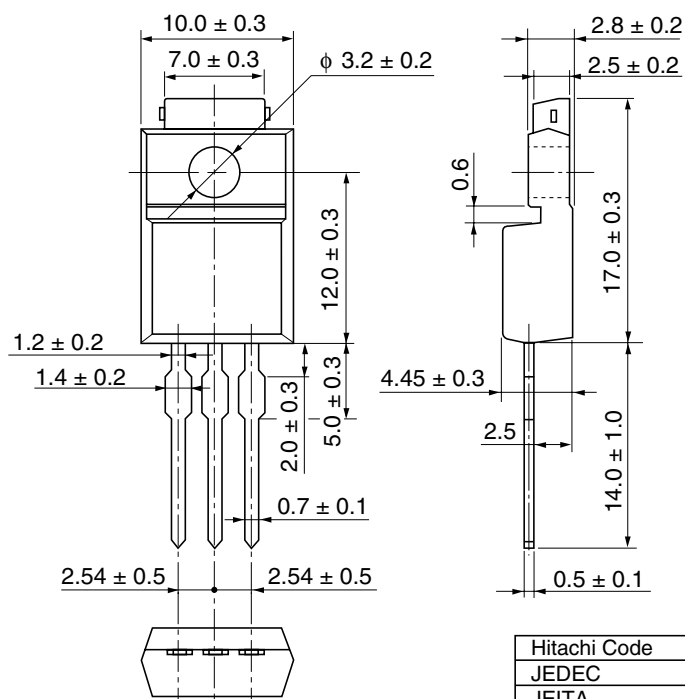
Typical Capacitance vs. Drain to Voltage



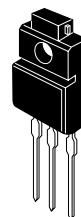




Package Dimensions



As of July, 2001
Unit: mm



| | |
|------------------------|----------|
| Hitachi Code | TO-220FM |
| JEDEC | — |
| JEITA | Conforms |
| Mass (reference value) | 1.8 g |

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