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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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Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

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HAF2005

Silicon N Channel MOS FET Series Power Switching

RENESAS

ADE-208-688B (Z)

3rd. Edition
Apr. 2002

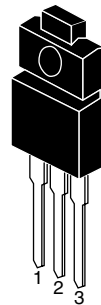
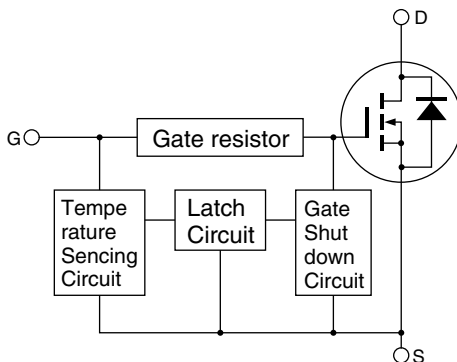
This FET has the over temperature shut-down capability sensing to the junction temperature. This FET has the built-in over temperature shut-down circuit in the gate area. And this circuit operation to shut-down the gate voltage in case of high junction temperature like applying over power consumption,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

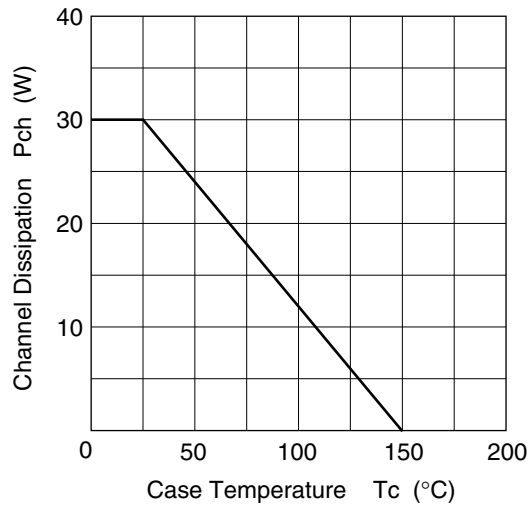
(Ta = 25°C)

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	$I_F = 40 \text{ A}$, $V_{GS} = 0$ $diF/dt = 50 \text{ A}/\mu\text{s}$
Over load shut down operation time ^{Note4}	t_{os1}	—	1	—	ms	$V_{GS} = 5 \text{ V}$, $V_{DD} = 16 \text{ V}$

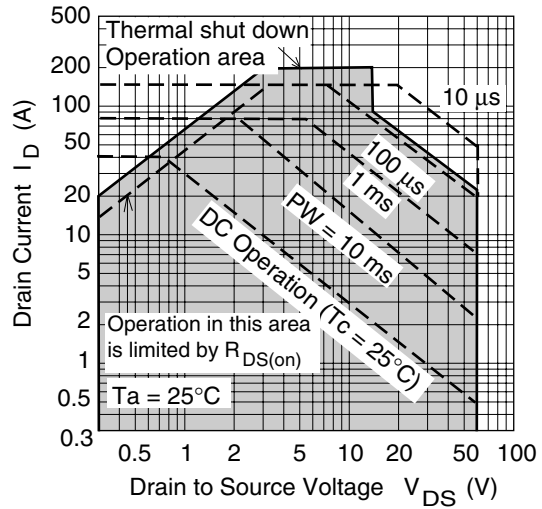
Notes: 3. Pulse test

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

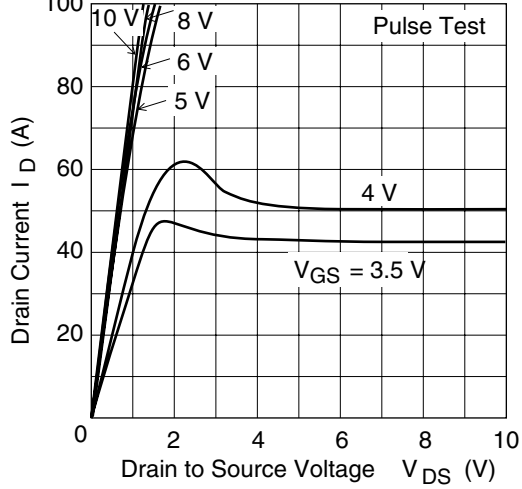
Power vs. Temperature derating



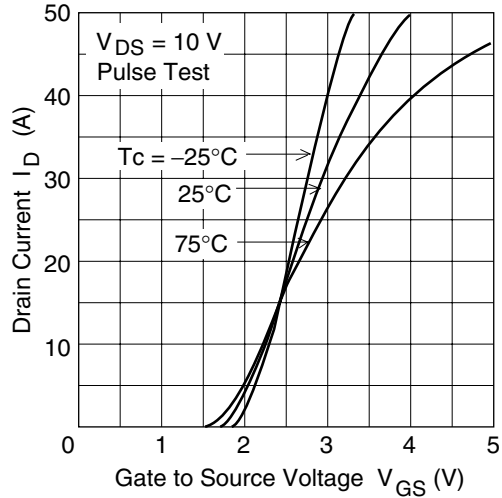
Maximum Safe Operation Area



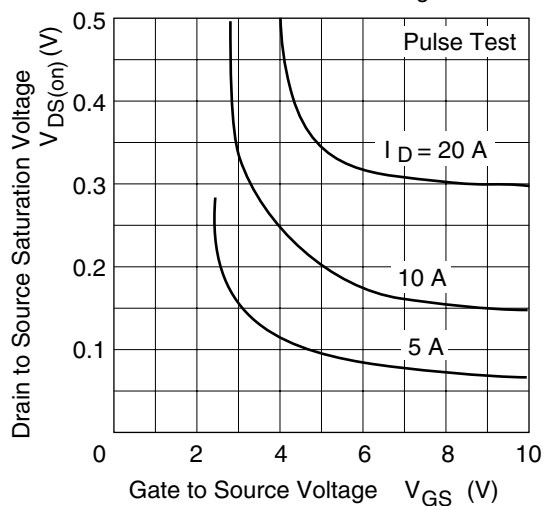
Typical Output Characteristics



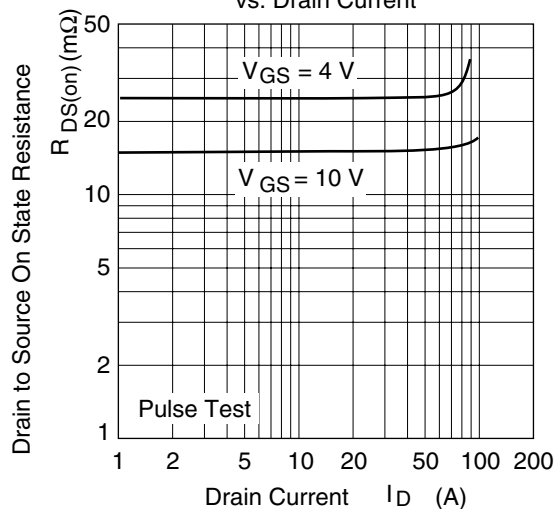
Typical Transfer Characteristics



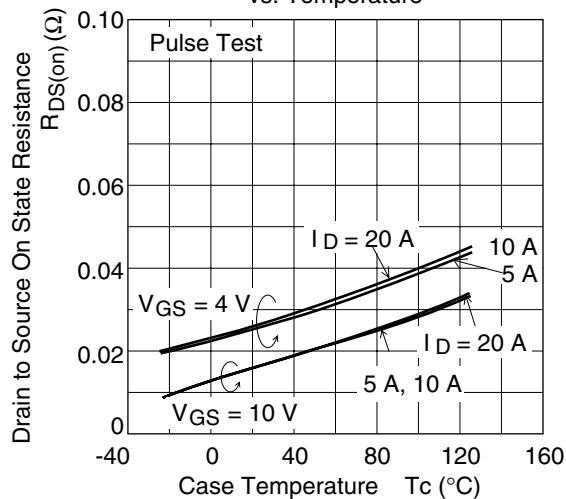
Drain to Source Saturation Voltage vs.
Gate to Source Voltage



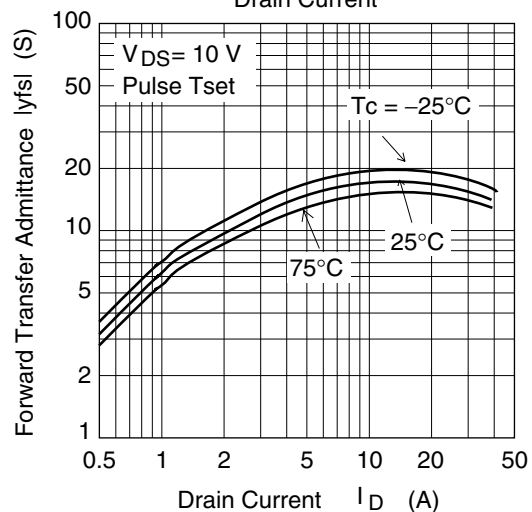
Static Drain to Source State Resistance
vs. Drain Current



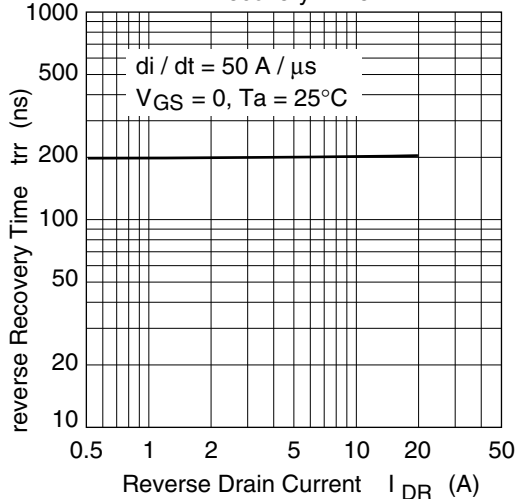
Static Drain to Source on State Resistance
vs. Temperature



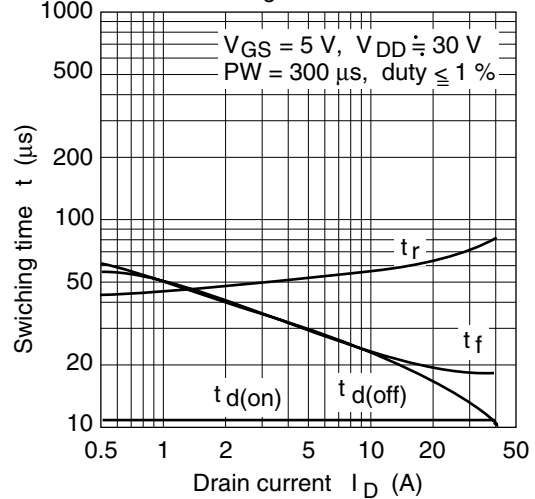
Forward transfer Admittance vs.
Drain Current



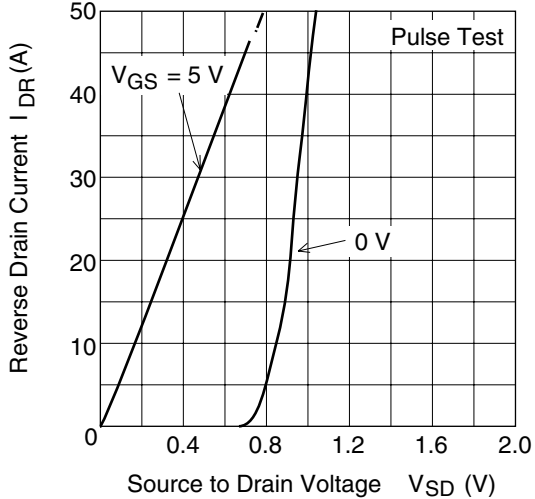
Body to Drain Diode Reverse Recovery Time



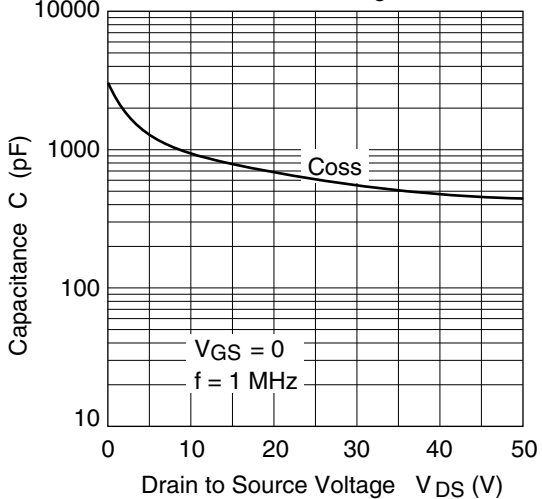
Switching Characteristics

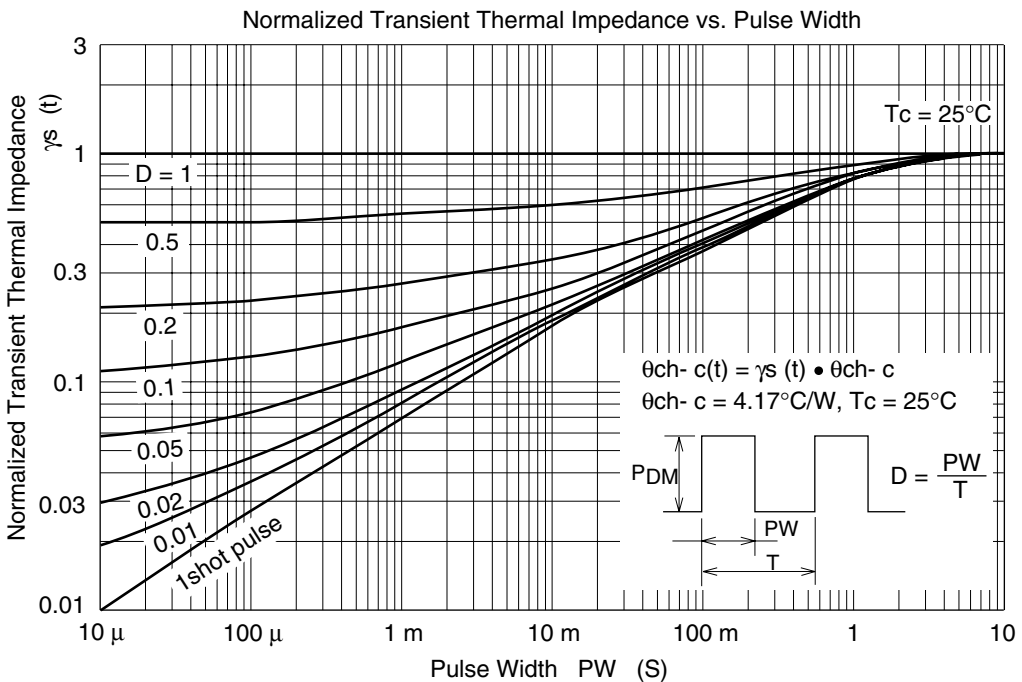
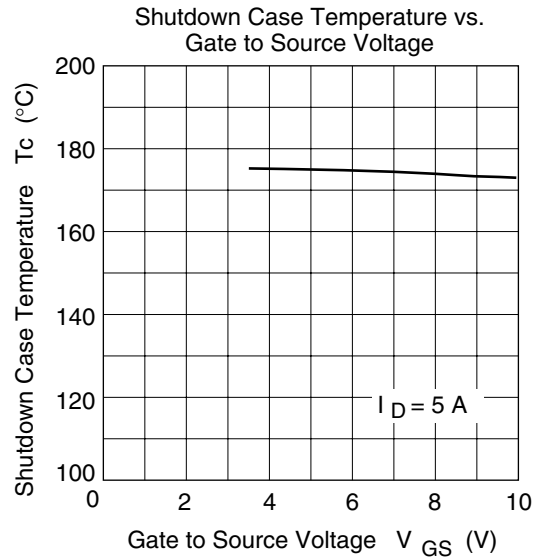
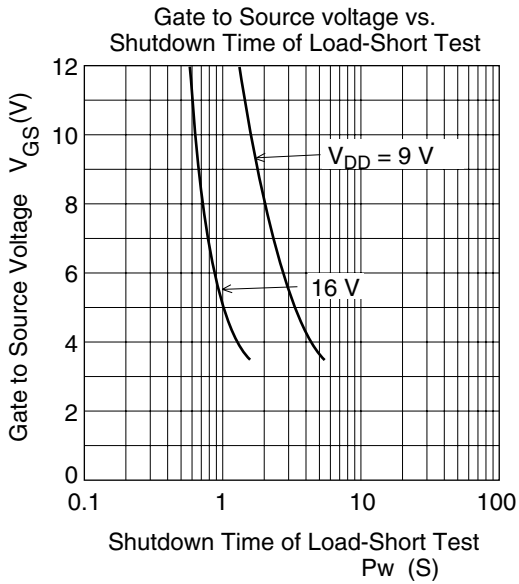


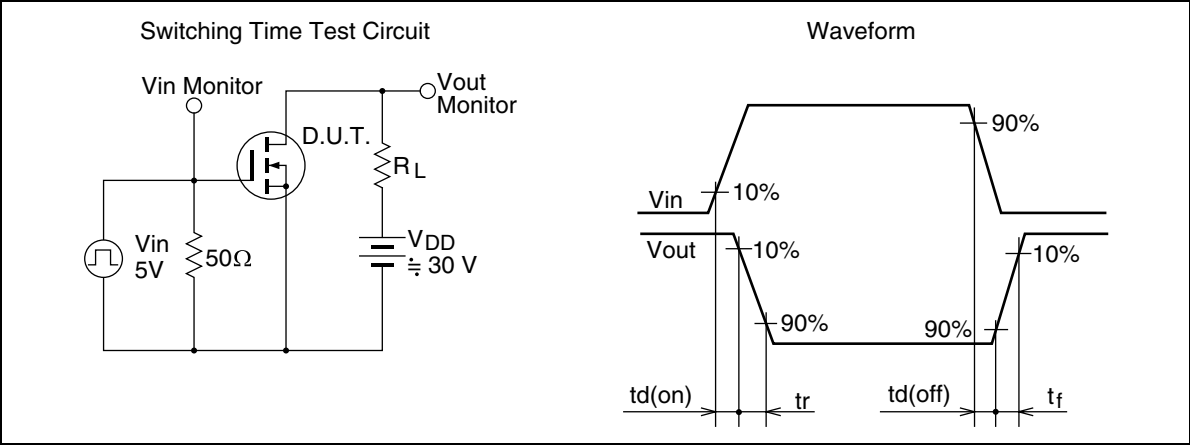
Reverse Drain Current vs. Source to Drain Voltage



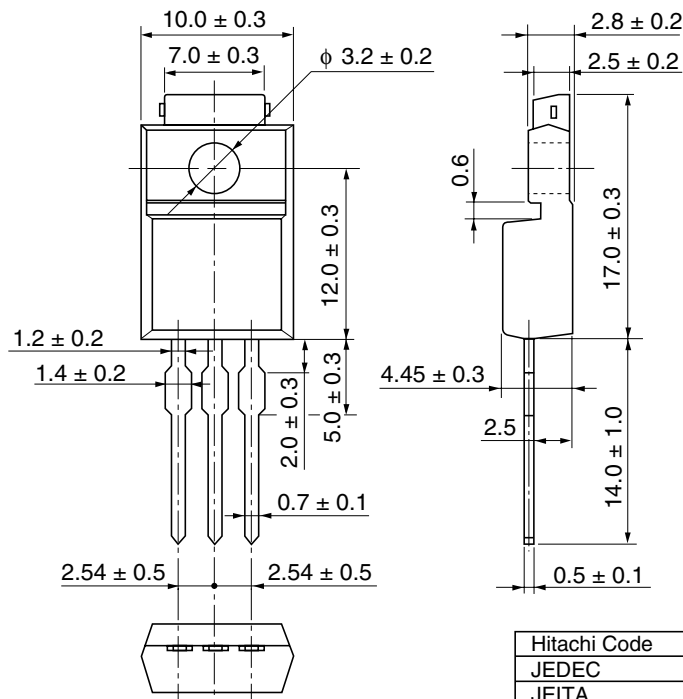
Typical Capacitance vs. Drain to Voltage



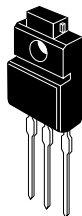




Package Dimensions



As of July, 2001
Unit: mm



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

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