

# HAF2001

## Silicon N Channel MOS FET Series Power Switching

# HITACHI

ADE-208-353 D (Z)  
5th. Edition  
October 1997

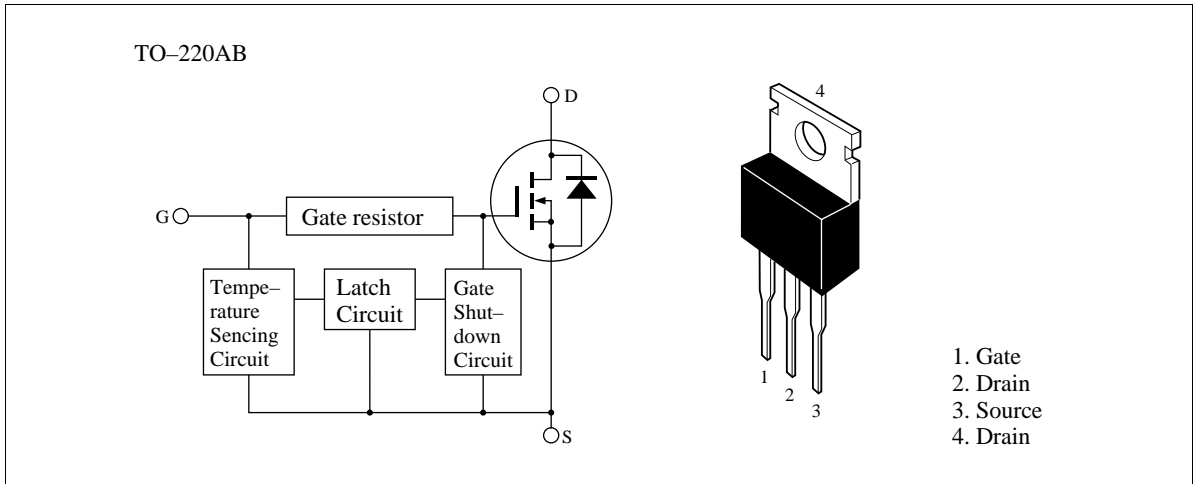
### Features

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.

- 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



**Absolute Maximum Ratings** ( $T_a = 25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Drain to source voltage	$V_{\text{DSS}}$	60	V
Gate to source voltage	$V_{\text{GSS}}$	16	V
Gate to source voltage	$V_{\text{GSS}}$	-2.8	V
Drain current	$I_{\text{D}}$	20	A
Drain peak current	$I_{\text{D(pulse)}}$ <sup>Note1</sup>	40	A
Body-drain diode reverse drain current	$I_{\text{DR}}$	20	A
Channel dissipation	$P_{\text{ch}}$ <sup>Note2</sup>	50	W
Channel temperature	$T_{\text{ch}}$	150	$^\circ\text{C}$
Storage temperature	$T_{\text{stg}}$	-55 to +150	$^\circ\text{C}$

Note: 1.  $PW \leq 10\mu\text{s}$ , duty cycle  $\leq 1\%$   
 2. Value at  $T_a = 25^\circ\text{C}$

**Typical Operation Characteristics**

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input voltage	$V_{\text{IH}}$	3.5	—	—	V	
	$V_{\text{IL}}$	—	—	1.2	V	
Input current (Gate non shut down)	$I_{\text{IH1}}$	—	—	100	$\mu\text{A}$	$V_i = 8\text{V}$ , $V_{\text{DS}} = 0$
	$I_{\text{IH2}}$	—	—	50	$\mu\text{A}$	$V_i = 3.5\text{V}$ , $V_{\text{DS}} = 0$
	$I_{\text{IL}}$	—	—	1	$\mu\text{A}$	$V_i = 1.2\text{V}$ , $V_{\text{DS}} = 0$
Input current (Gate shut down)	$I_{\text{IH(sd)1}}$	—	0.8	—	$\text{mA}$	$V_i = 8\text{V}$ , $V_{\text{DS}} = 0$
	$I_{\text{IH(sd)2}}$	—	0.35	—	$\text{mA}$	$V_i = 3.5\text{V}$ , $V_{\text{DS}} = 0$
Shut down temperature	$T_{\text{sd}}$	—	175	—	$^\circ\text{C}$	Channel temperature
Gate operation voltage	$V_{\text{OP}}$	3.5	—	13	V	

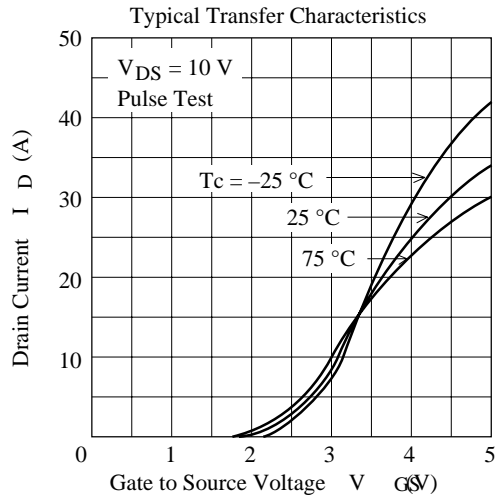
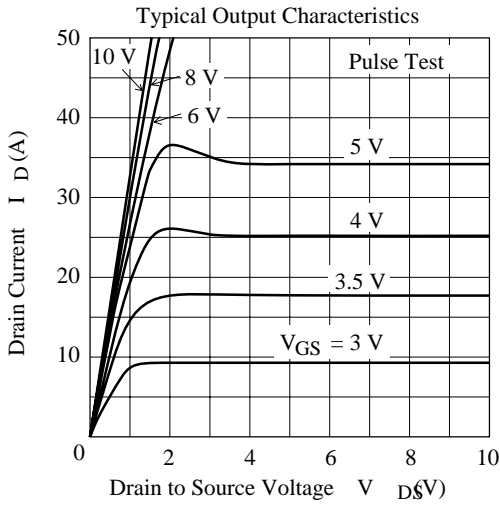
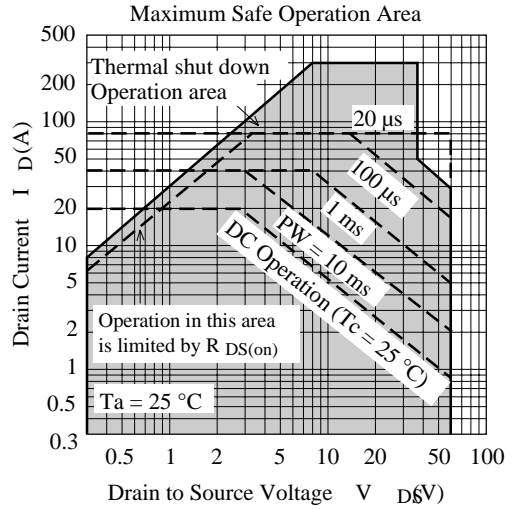
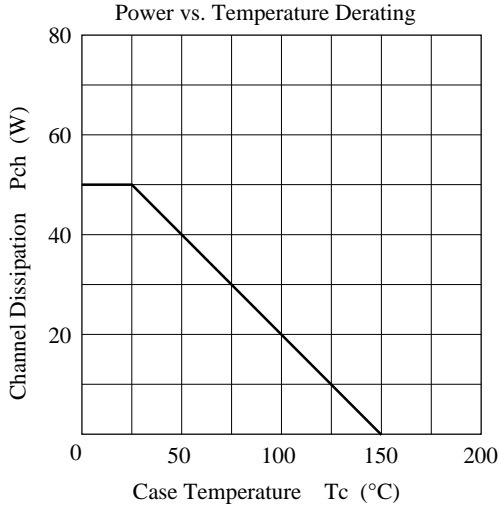
## Electrical Characteristics (Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain current	$I_{D1}$	10	—	—	A	$V_{GS} = 3.5V, V_{DS} = 2V$
Drain current	$I_{D2}$	—	—	10	mA	$V_{GS} = 1.2V, V_{DS} = 2V$
Drain to source breakdown voltage	$V_{(BR)DSS}$	60	—	—	V	$I_D = 10mA, V_{GS} = 0$
Gate to source breakdown voltage	$V_{(BR)GSS}$	16	—	—	V	$I_G = 100\mu A, V_{DS} = 0$
Gate to source breakdown voltage	$V_{(BR)GSS}$	-2.8	—	—	V	$I_G = -100\mu A, V_{DS} = 0$
Gate to source leak current	$I_{GSS1}$	—	—	100	$\mu A$	$V_{GS} = 8V, V_{DS} = 0$
	$I_{GSS2}$	—	—	50	$\mu A$	$V_{GS} = 3.5V, V_{DS} = 0$
	$I_{GSS3}$	—	—	1	$\mu A$	$V_{GS} = 1.2V, V_{DS} = 0$
	$I_{GSS4}$	—	—	-100	$\mu A$	$V_{GS} = -2.4V, V_{DS} = 0$
Input current (shut down)	$I_{GS(op)1}$	—	0.8	—	mA	$V_{GS} = 8V, V_{DS} = 0$
	$I_{GS(op)2}$	—	0.35	—	mA	$V_{GS} = 3.5V, V_{DS} = 0$
Zero gate voltage drain current	$I_{DSS}$	—	—	250	$\mu A$	$V_{DS} = 50V, V_{GS} = 0$
Gate to source cutoff voltage	$V_{GS(off)}$	1.0	—	2.25	V	$I_D = 1mA, V_{DS} = 10V$
Static drain to source on state resistance	$R_{DS(on)}$	—	50	65	m $\Omega$	$I_D = 10A, V_{GS} = 4V$ <sup>Note3</sup>
Static drain to source on state resistance	$R_{DS(on)}$	—	30	43	m $\Omega$	$I_D = 10A, V_{GS} = 10V$ <sup>Note3</sup>
Forward transfer admittance	$ y_{fs} $	6	12	—	S	$I_D = 10A, V_{DS} = 10V$ <sup>Note3</sup>
Output capacitance	$C_{oss}$	—	630	—	pF	$V_{DS} = 10V, V_{GS} = 0$ $f = 1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	—	7.5	—	$\mu s$	$I_D = 5A, V_{GS} = 5V$
Rise time	$t_r$	—	29	—	$\mu s$	$R_L = 6\Omega$
Turn-off delay time	$t_{d(off)}$	—	34	—	$\mu s$	
Fall time	$t_f$	—	26	—	$\mu s$	
Body-drain diode forward voltage	$V_{DF}$	—	1.0	—	V	$I_F = 20A, V_{GS} = 0$
Body-drain diode reverse recovery time	$t_{rr}$	—	110	—	ns	$I_F = 20A, V_{GS} = 0$ $di_F/dt = 50A/\mu s$
Over load shut down operation time	$t_{os1}$	—	1.8	—	ms	$V_{GS} = 5V, V_{DD} = 12V$
operation time <sup>Note4</sup>	$t_{os2}$	—	0.7	—	ms	$V_{GS} = 5V, V_{DD} = 24V$

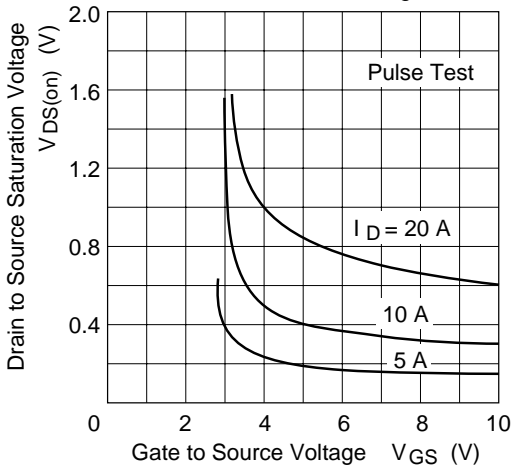
Note: 3. Pulse test

4. Include the time shift based on increasing of channel temperature when operate under over load condition.

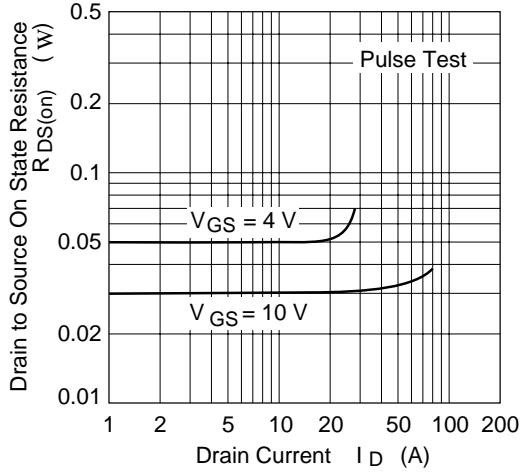
Main Characteristics



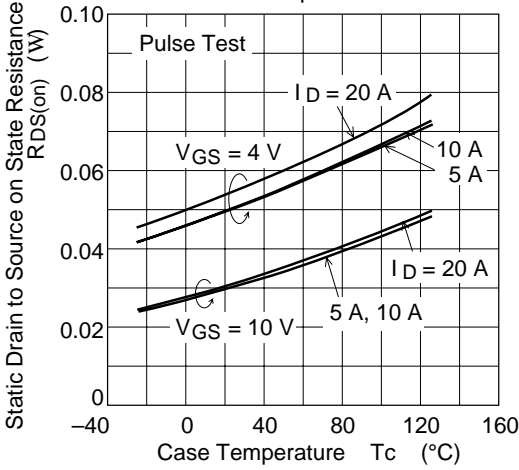
Drain to Source Saturation Voltage vs. Gate to Source Voltage



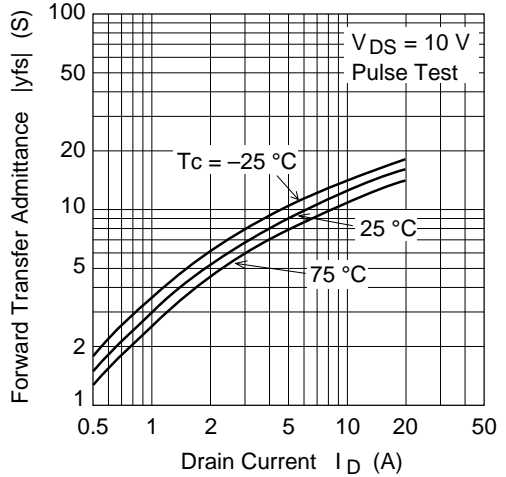
Static Drain to Source State Resistance vs. Drain Current

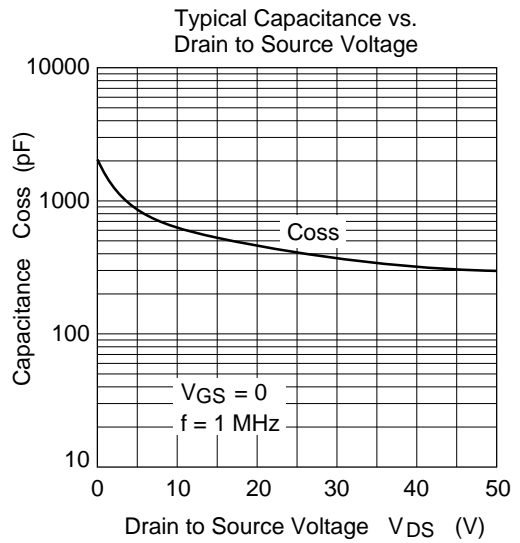
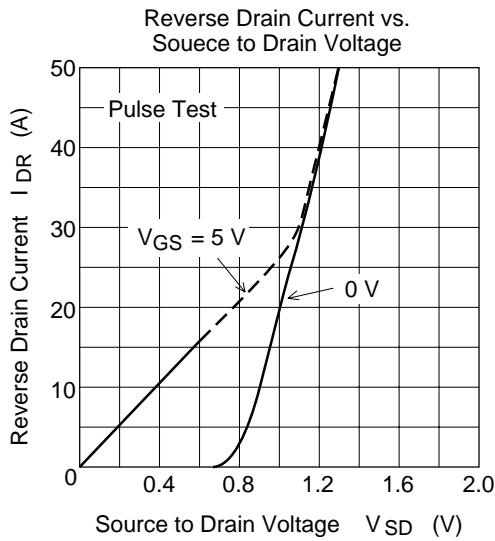
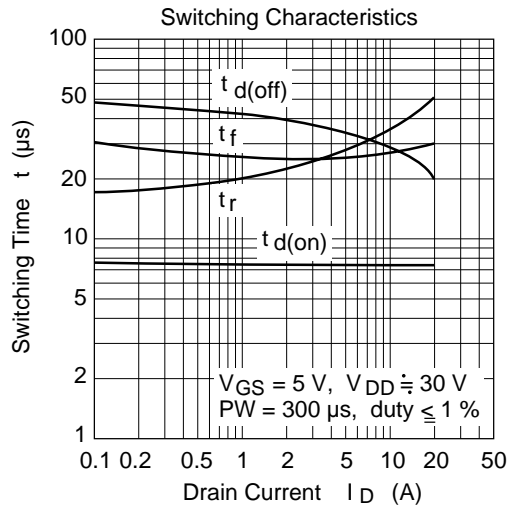
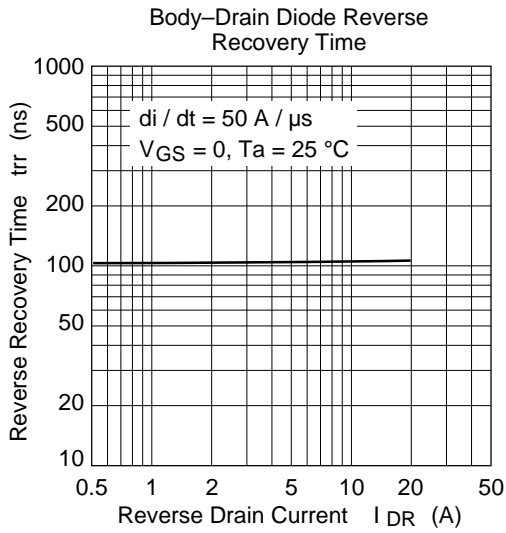


Static Drain to Source on State Resistance vs. Temperature

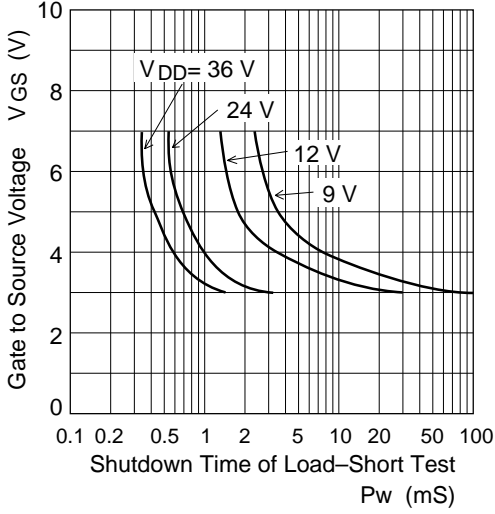


Forward Transfer Admittance vs. Drain Current

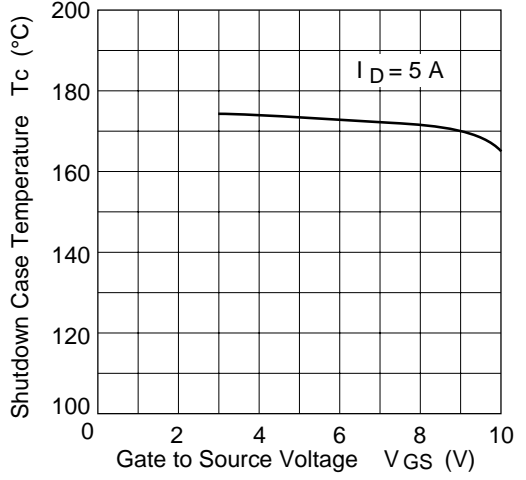




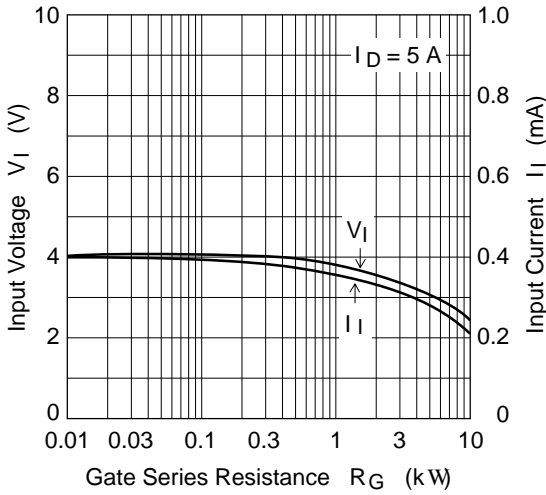
Gate to Source Voltage vs. Shutdown Time of Load-Short Test



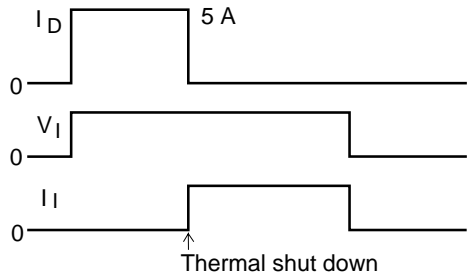
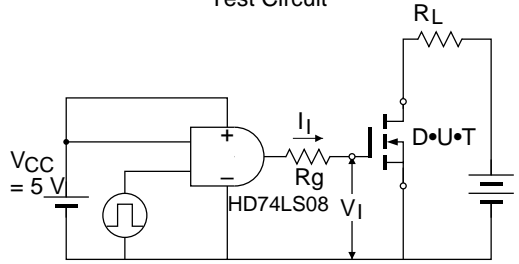
Shutdown Case Temperature vs. Gate to Source Voltage

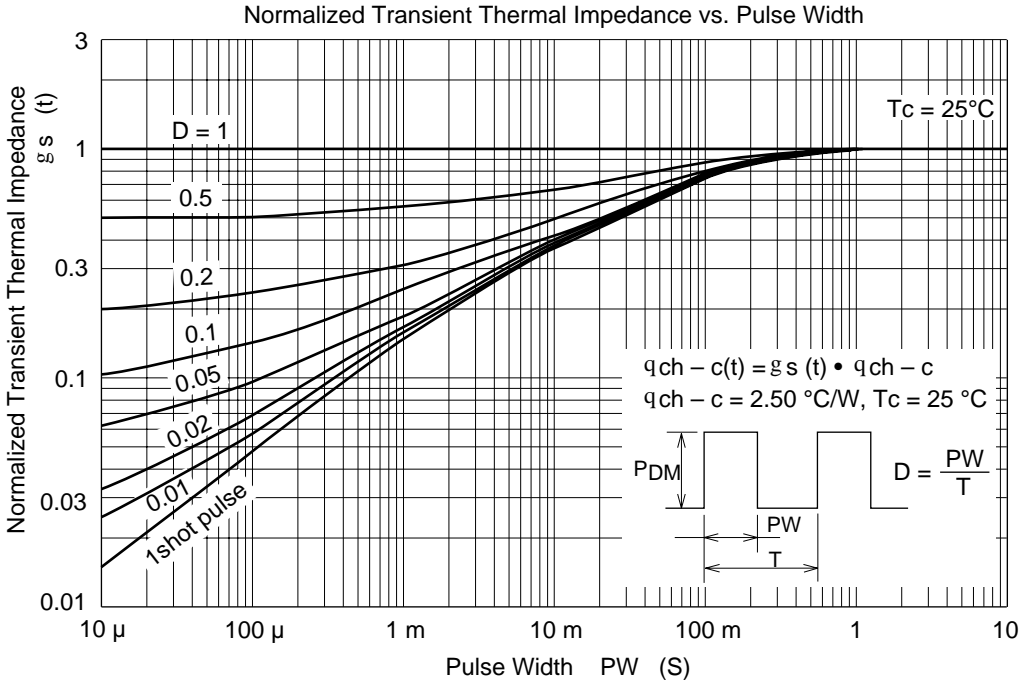


TTL Drive Characteristics

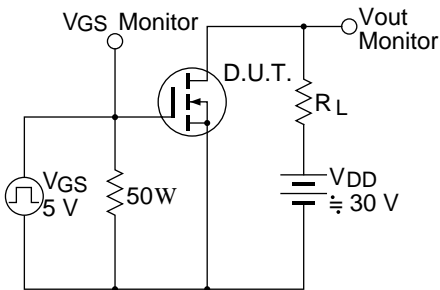


Test Circuit

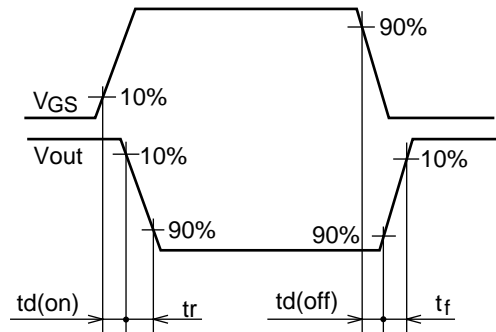




Switching Time Test Circuit



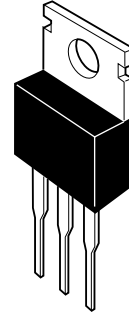
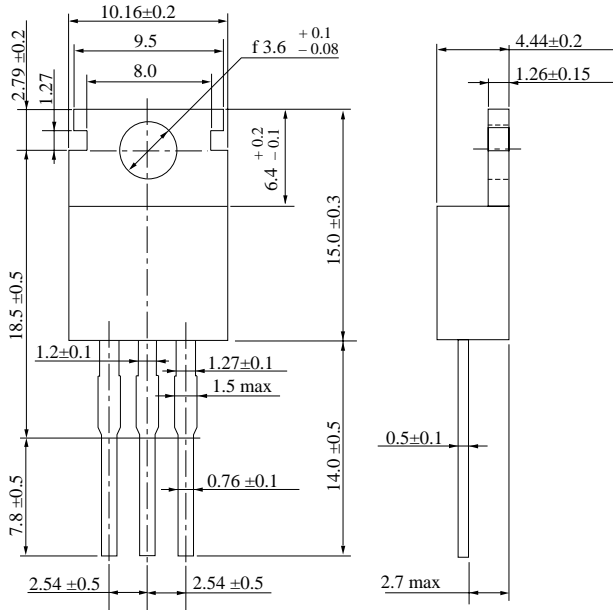
Waveform





Package Dimensions

Unit: mm



Hitachi Code	TO-220AB
EIAJ	SC-46
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