

# HAF1009(L), HAF1009(S)

## Silicon P Channel MOS FET Series Power Switching

REJ03G0029-0100Z  
(Previous ADE-208-1525 (Z))  
Rev.1.00  
May.13.2003

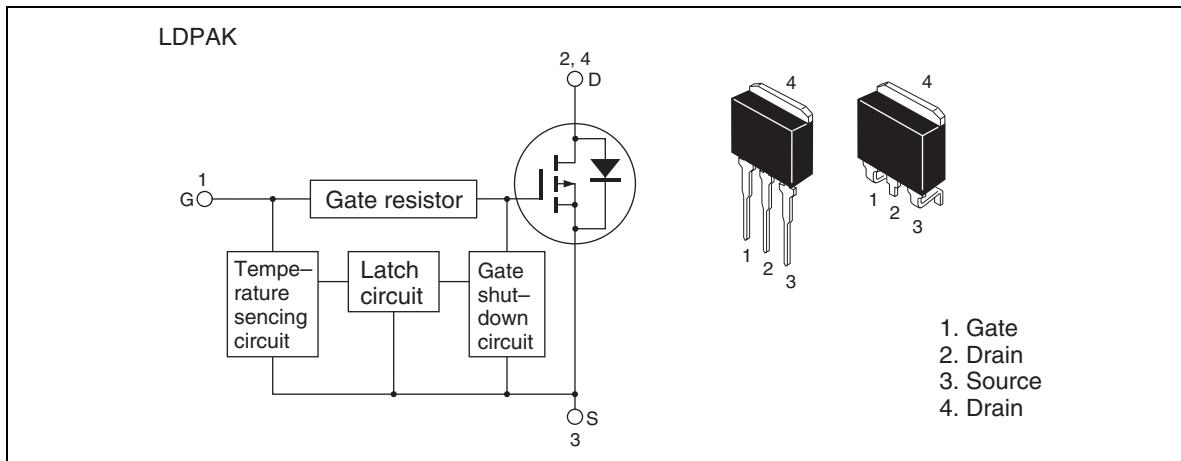
### Description

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



## **HAF1009(L), HAF1009(S)**

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### **Absolute Maximum Ratings**

(Ta = 25°C)

Item	Symbol	Ratings	Unit
Drain to source voltage	V <sub>DSS</sub>	-60	V
Gate to source voltage	V <sub>GSS</sub>	-16	V
Gate to source voltage	V <sub>GSS</sub>	2.5	V
Drain current	I <sub>D</sub>	-40	A
Drain peak current	I <sub>D</sub> (pulse) <sup>Note1</sup>	-80	A
Body-drain diode reverse drain current	I <sub>DR</sub>	-40	A
Channel dissipation	P <sub>ch</sub> <sup>Note2</sup>	50	W
Channel temperature	T <sub>ch</sub>	150	°C
Storage temperature	T <sub>stg</sub>	-55 to +150	°C

Notes: 1. PW ≤ 10μs, duty cycle ≤ 1 %

2. Value at T<sub>c</sub> = 25°C

### **Typical Operation Characteristics**

(Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input voltage	V <sub>IH</sub>	-3.5	—	—	V	Vi = -8 V, V <sub>DS</sub> = 0
	V <sub>IL</sub>	—	—	-1.2	V	
Input current (Gate non shut down)	I <sub>IH1</sub>	—	—	-100	μA	Vi = -8 V, V <sub>DS</sub> = 0
	I <sub>IH2</sub>	—	—	-50	μA	
	I <sub>IL</sub>	—	—	-1	μA	
Input current (Gate shut down)	I <sub>IH(sd)1</sub>	—	-0.8	—	mA	Vi = -8 V, V <sub>DS</sub> = 0
	I <sub>IH(sd)2</sub>	—	-0.35	—	mA	
Shut down temperature	T <sub>sd</sub>	—	175	—	°C	Channel temperature
Gate operation voltage	V <sub>op</sub>	-3.5	—	-12	V	

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### Electrical Characteristics

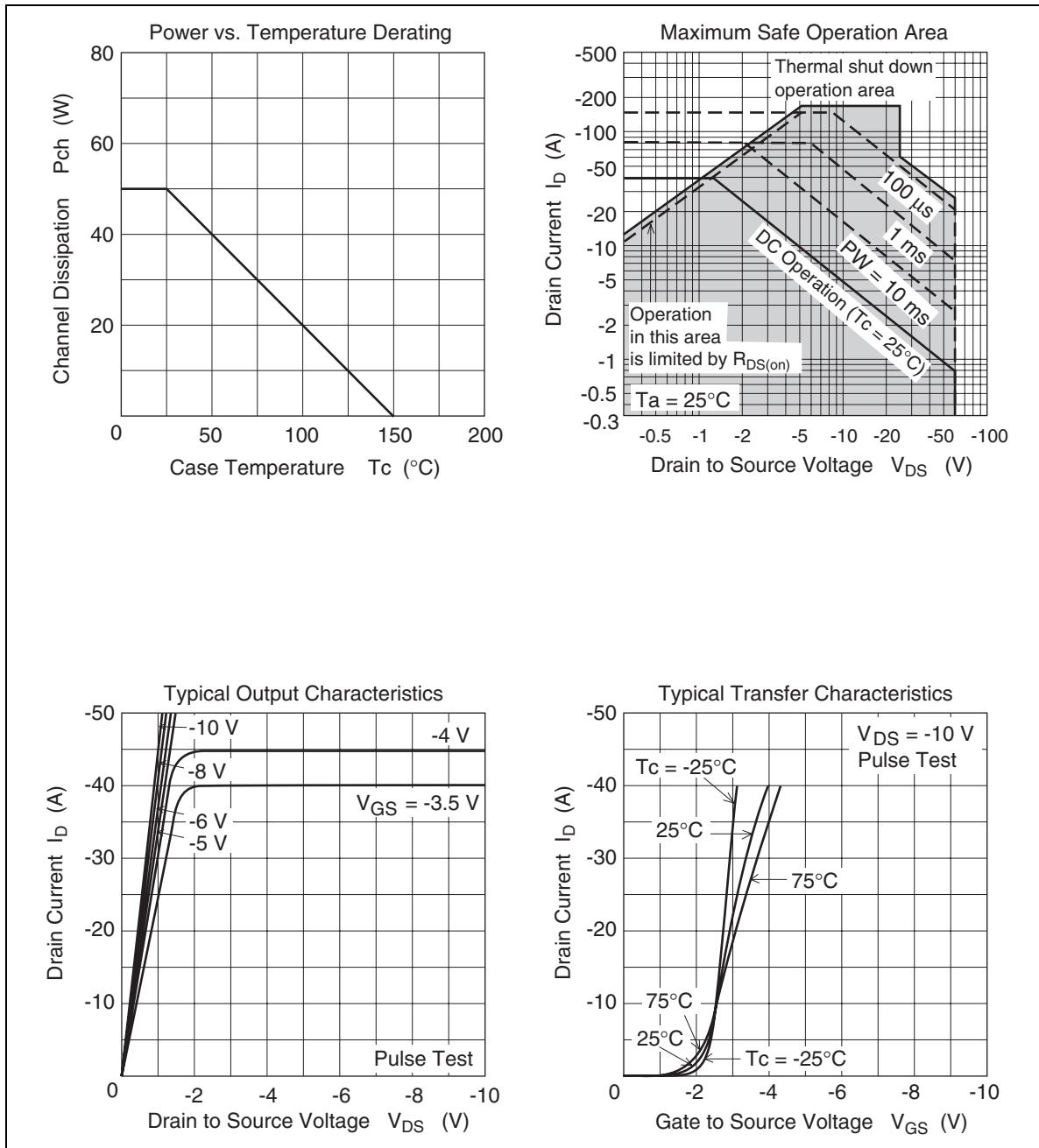
(Ta = 25°C)

Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain current	I <sub>D1</sub>	-10	—	—	A	V <sub>GS</sub> = -3.5, V <sub>DS</sub> = -2 V
Drain current	I <sub>D2</sub>	—	—	-10	mA	V <sub>GS</sub> = -1.2V, V <sub>DS</sub> = -2 V
Drain to source breakdown voltage	V <sub>(BR)DSS</sub>	-60	—	—	V	I <sub>D</sub> = -10 mA, V <sub>GS</sub> = 0
Gate to source breakdown voltage	V <sub>(BR)GSS</sub>	-16	—	—	V	I <sub>G</sub> = -800 μA, V <sub>DS</sub> = 0
Gate to source breakdown voltage	V <sub>(BR)GSS</sub>	2.5	—	—	V	I <sub>G</sub> = 100 μA, V <sub>DS</sub> = 0
Gate to source leak current	I <sub>GSS1</sub>	—	—	-100	μA	V <sub>GS</sub> = -8 V, V <sub>DS</sub> = 0
	I <sub>GSS2</sub>	—	—	-50	μA	V <sub>GS</sub> = -3.5 V, V <sub>DS</sub> = 0
	I <sub>GSS3</sub>	—	—	-1	μA	V <sub>GS</sub> = -1.2 V, V <sub>DS</sub> = 0
	I <sub>GSS4</sub>	—	—	100	μA	V <sub>GS</sub> = 2.4 V, V <sub>DS</sub> = 0
Input current (shut down)	I <sub>GS(OP)1</sub>	—	-0.8	—	mA	V <sub>GS</sub> = -8 V, V <sub>DS</sub> = 0
	I <sub>GS(OP)2</sub>	—	-0.35	—	mA	V <sub>GS</sub> = -3.5 V, V <sub>DS</sub> = 0
Zero gate voltage drain current	I <sub>DSS</sub>	—	—	-10	μA	V <sub>DS</sub> = -60 V, V <sub>GS</sub> = 0
Gate to source cutoff voltage	V <sub>GS(off)</sub>	-1.1	—	-2.15	V	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1 mA
Forward transfer admittance	y <sub>fs</sub>	8.4	14.8	—	S	I <sub>D</sub> = -20 A, V <sub>DS</sub> = -10 V <sup>Note3</sup>
Static drain to source on state resistance	R <sub>DS(on)</sub>	—	33	50	mΩ	I <sub>D</sub> = -20 A, V <sub>GS</sub> = -4 V <sup>Note3</sup>
Output capacitance	C <sub>oss</sub>	—	1500	—	pF	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0, f = 1 MHz
Turn-on delay time	t <sub>d(on)</sub>	—	10.6	—	μs	V <sub>GS</sub> = -10 V, I <sub>D</sub> = -20 A,
Rise time	t <sub>r</sub>	—	45	—	μs	R <sub>L</sub> = 1.5 Ω
Turn-off delay time	t <sub>d(off)</sub>	—	12	—	μs	
Fall time	t <sub>f</sub>	—	13	—	μs	
Body-drain diode forward voltage	V <sub>DF</sub>	—	-0.95	—	V	I <sub>F</sub> = -40 A, V <sub>GS</sub> = 0
Body-drain diode reverse recovery time	t <sub>rr</sub>	—	100	—	ns	I <sub>F</sub> = -40 A, V <sub>GS</sub> = 0 dI <sub>F</sub> /dt = 50 A/μs
Over load shut down operation time	t <sub>os1</sub>	—	4.1	—	ms	V <sub>GS</sub> = -5 V, V <sub>DD</sub> = -16 V
<sup>Note4</sup>	t <sub>os2</sub>	—	1.5	—	ms	V <sub>GS</sub> = -5 V, V <sub>DD</sub> = -24 V

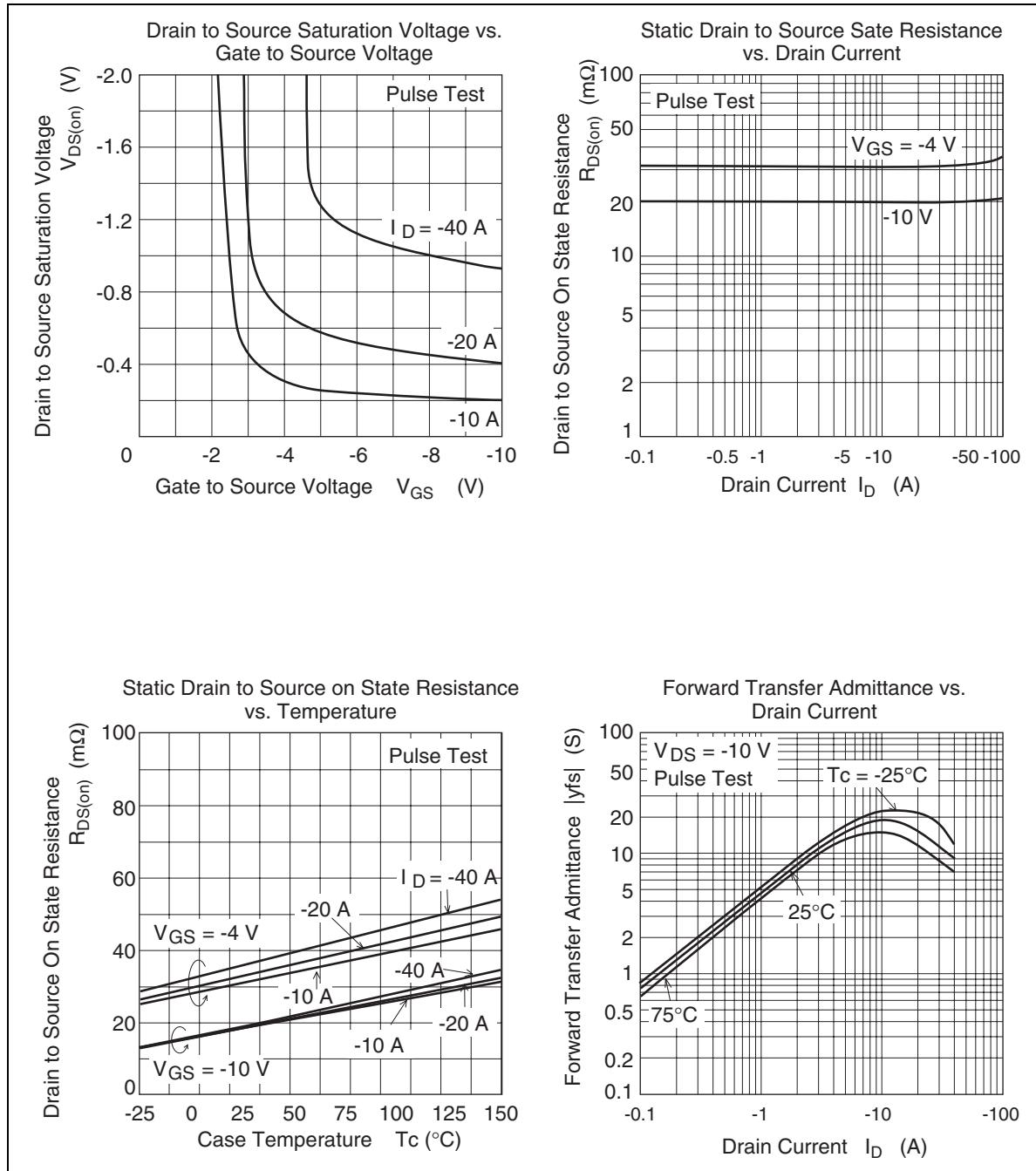
Notes: 3. Pulse test

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

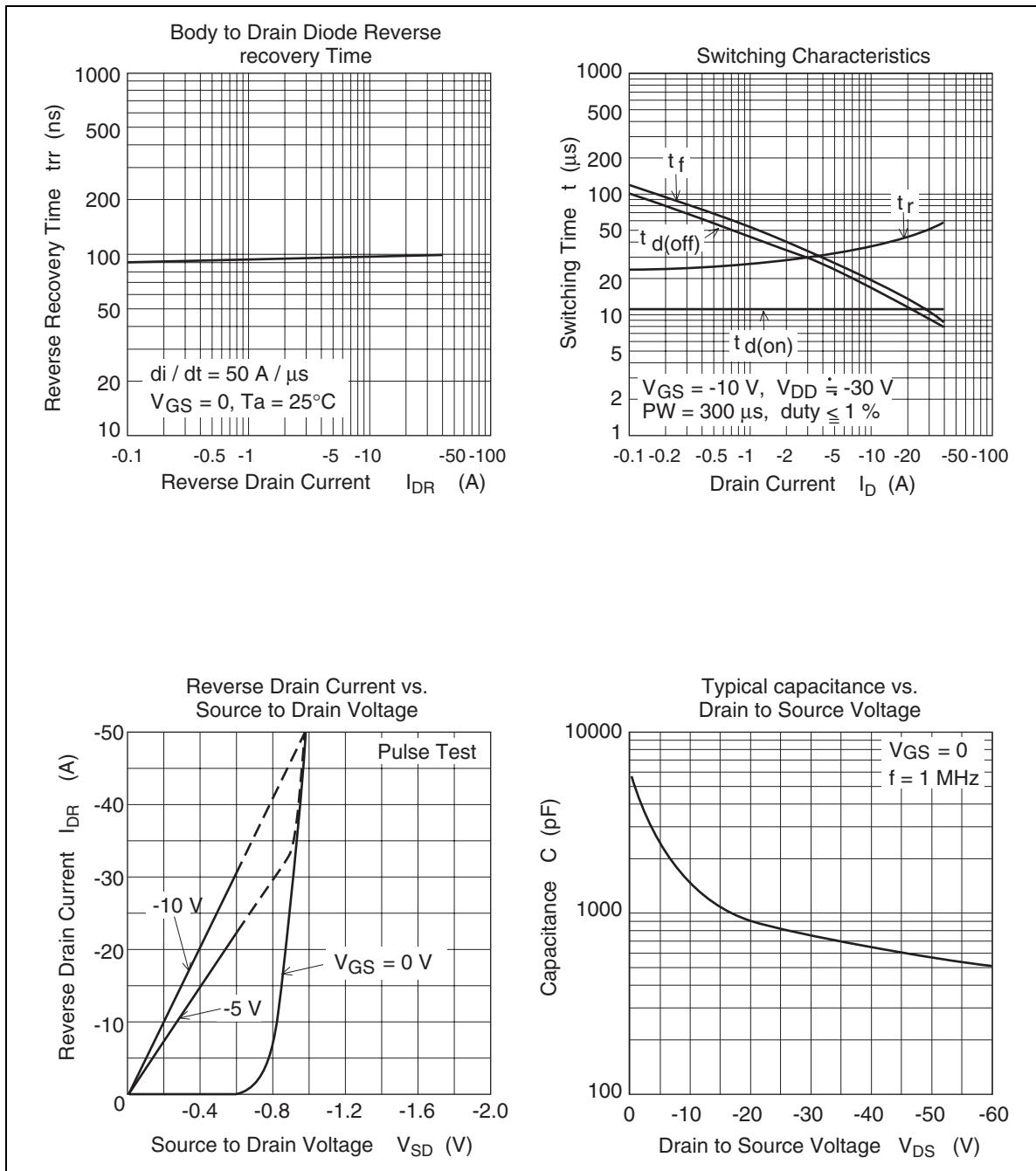
## Main Characteristics



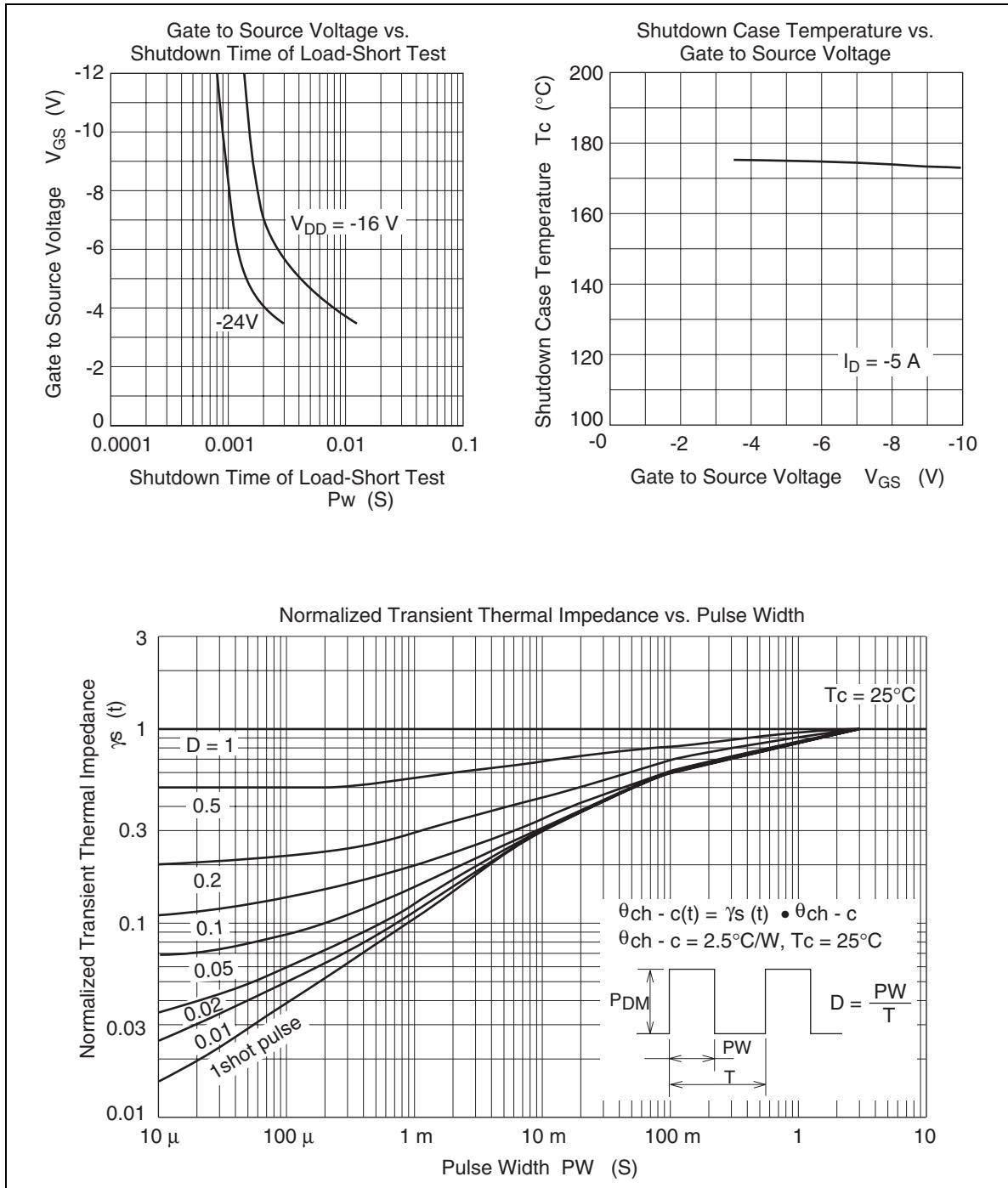
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## HAF1009(L), HAF1009(S)

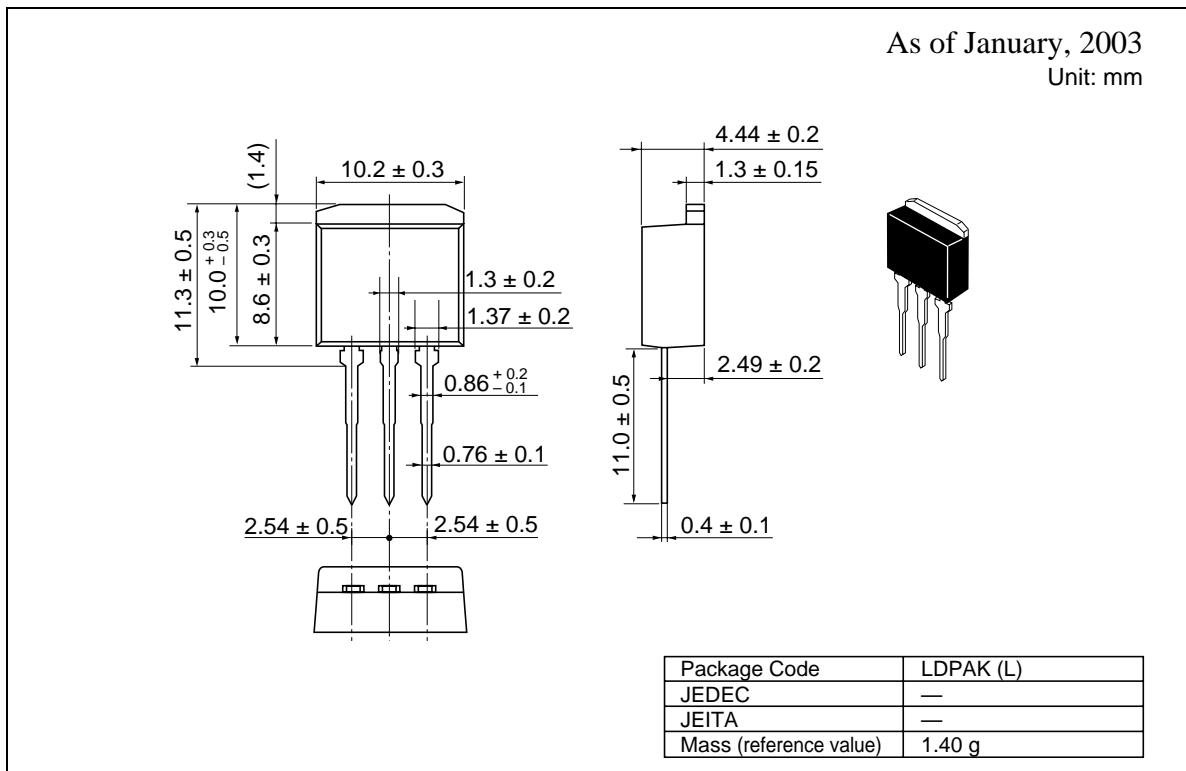


## HAF1009(L), HAF1009(S)



## **HAF1009(L), HAF1009(S)**

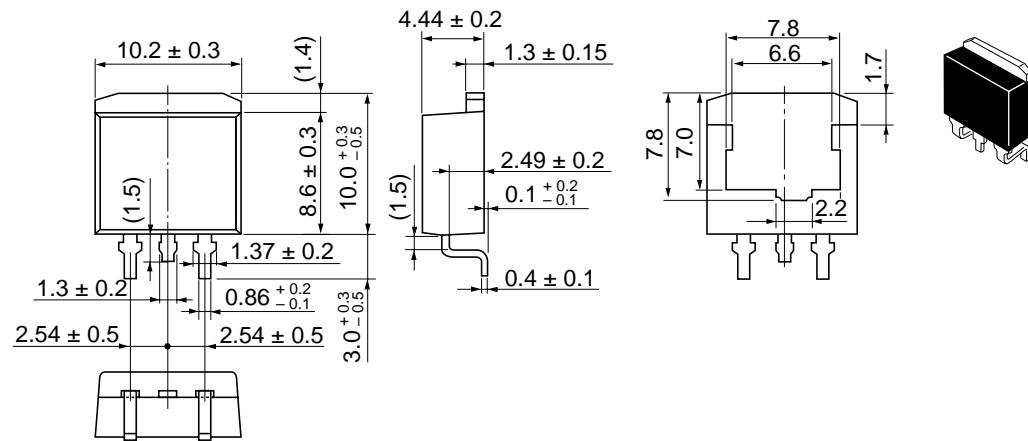
### **Package Dimensions**



## HAF1009(L), HAF1009(S)

As of January, 2003

Unit: mm



Package Code	LDPAK (S)-(1)
JEDEC	—
JEITA	—
Mass (reference value)	1.30 g

## **HAF1009(L), HAF1009(S)**

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