

## 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

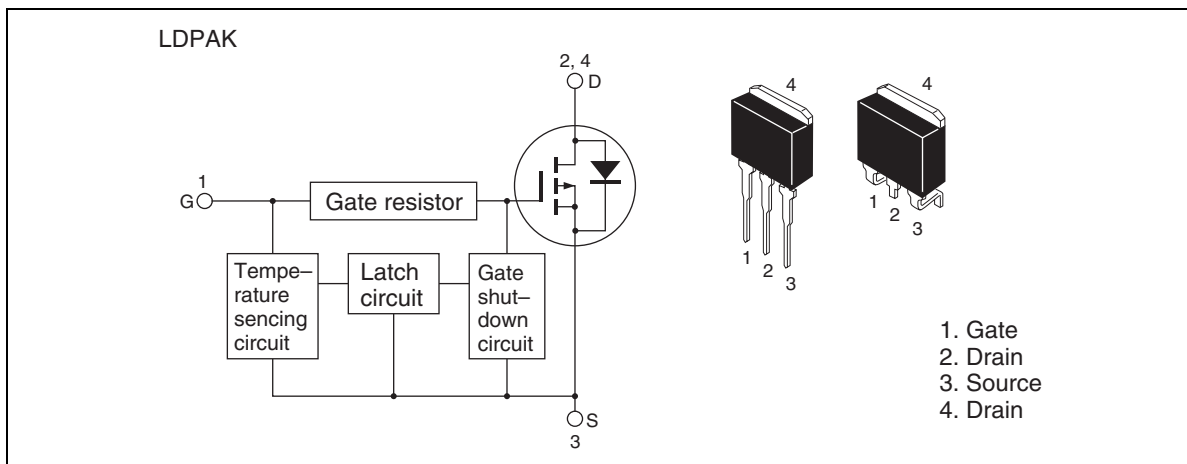
#### Description

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)

### Absolute Maximum Ratings

( $T_a = 25^\circ\text{C}$ )

Item	Symbol	Ratings	Unit
Drain to source voltage	$V_{DSS}$	-60	V
Gate to source voltage	$V_{GSS}$	-16	V
Gate to source voltage	$V_{GSS}$	2.5	V
Drain current	$I_D$	-40	A
Drain peak current	$I_D$ (pulse) <sup>Note1</sup>	-80	A
Body-drain diode reverse drain current	$I_{DR}$	-40	A
Channel dissipation	$P_{ch}$ <sup>Note2</sup>	50	W
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$

Notes: 1.  $PW \leq 10\mu\text{s}$ , duty cycle  $\leq 1\%$

2. Value at  $T_c = 25^\circ\text{C}$

### Typical Operation Characteristics

( $T_a = 25^\circ\text{C}$ )

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	$\mu\text{A}$	$V_i = -8\text{ V}, V_{DS} = 0$
	$I_{IH2}$	—	—	-50	$\mu\text{A}$	$V_i = -3.5\text{ V}, V_{DS} = 0$
	$I_{IL}$	—	—	-1	$\mu\text{A}$	$V_i = -1.2\text{ V}, V_{DS} = 0$
Input current (Gate shut down)	$I_{IH(sd)1}$	—	-0.8	—	$\text{mA}$	$V_i = -8\text{ V}, V_{DS} = 0$
	$I_{IH(sd)2}$	—	-0.35	—	$\text{mA}$	$V_i = -3.5\text{ V}, V_{DS} = 0$
Shut down temperature	$T_{sd}$	—	175	—	$^\circ\text{C}$	Channel temperature
Gate operation voltage	$V_{op}$	-3.5	—	-12	V	

## HAF1009(L), HAF1009(S)

### Electrical Characteristics

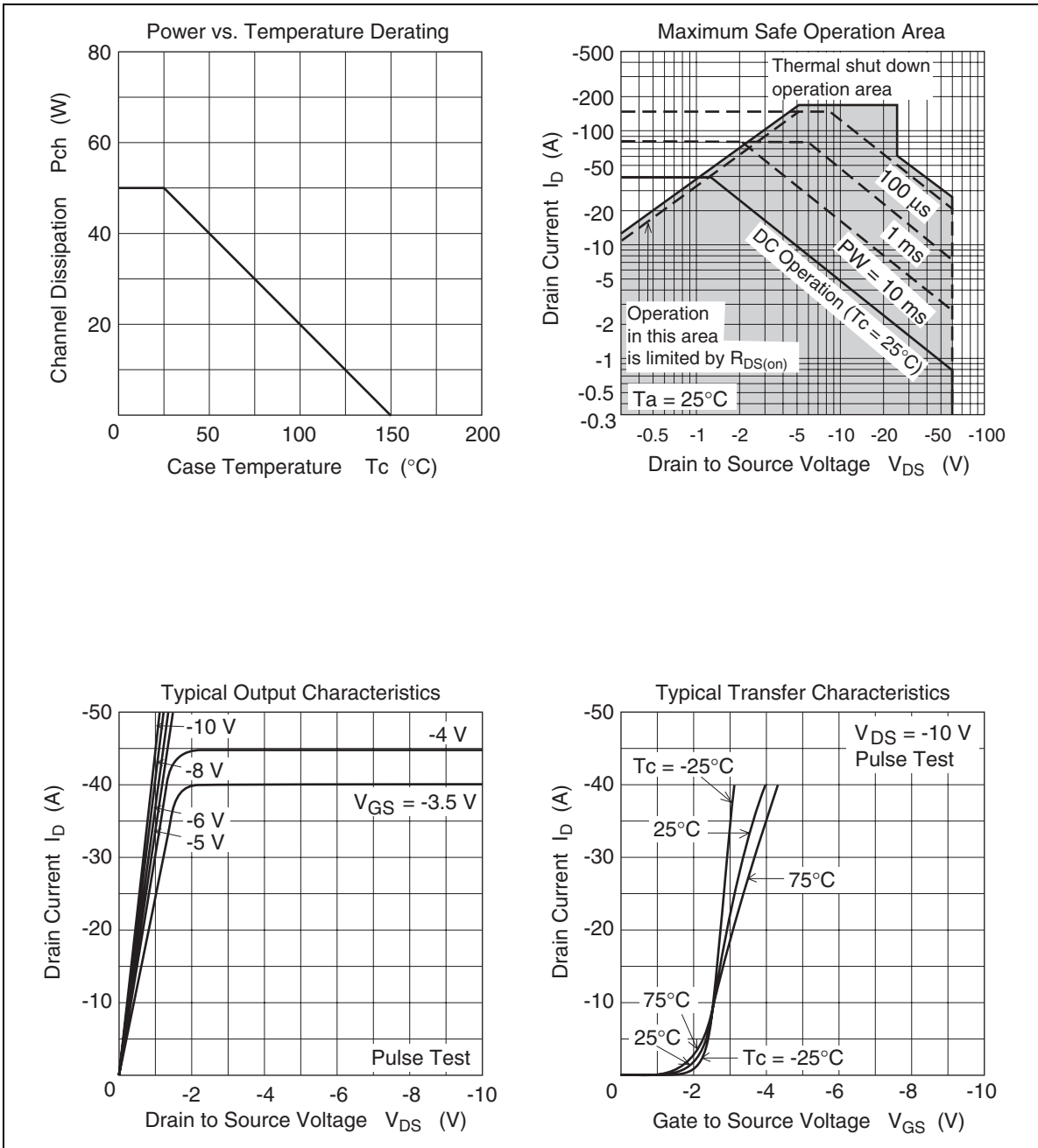
(T<sub>a</sub> = 25°C)

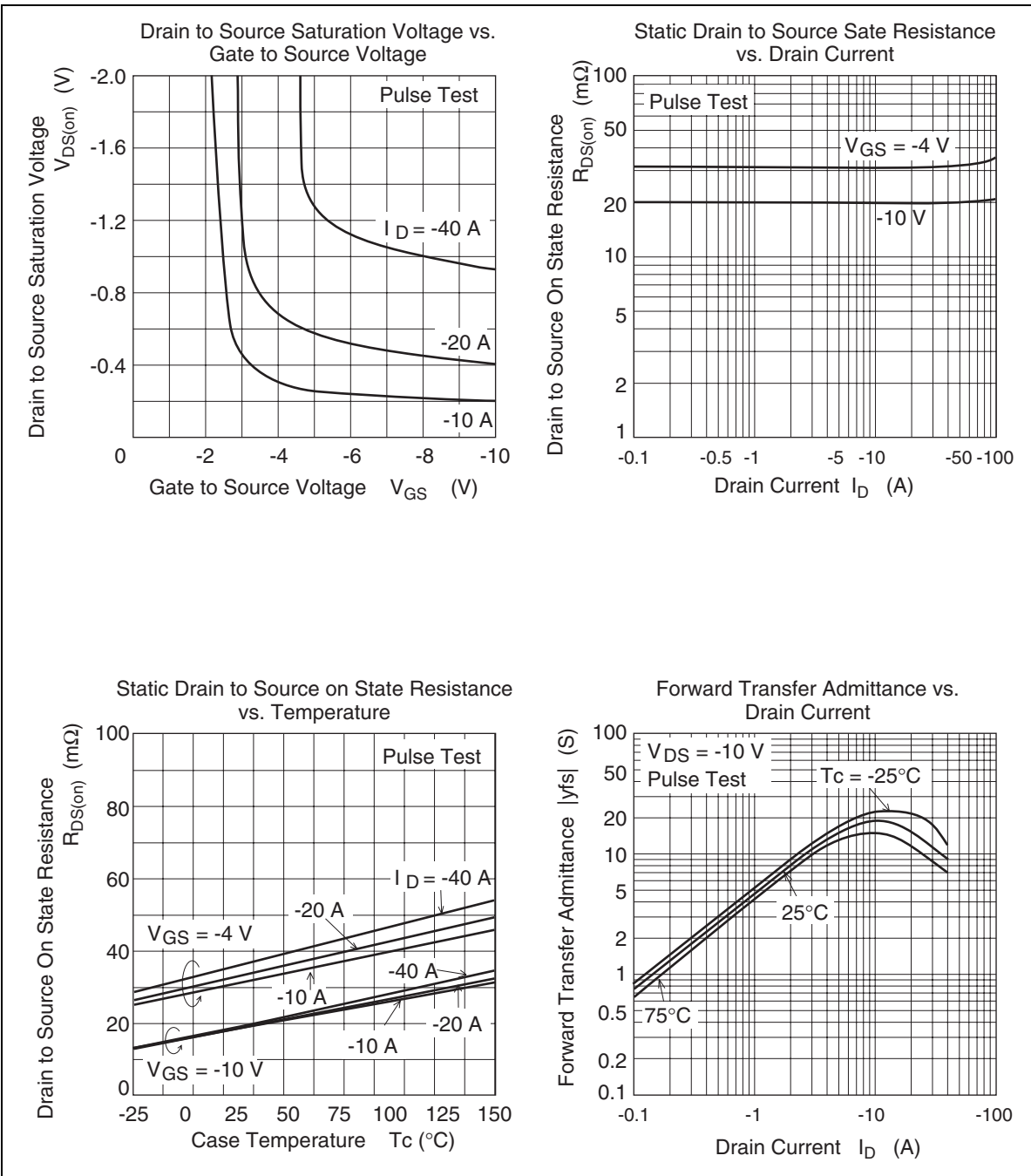
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain current	I <sub>D1</sub>	-10	—	—	A	V <sub>GS</sub> = -3.5, V <sub>DS</sub> = -2 V
Drain current	I <sub>D2</sub>	—	—	-10	mA	V <sub>GS</sub> = -1.2V, V <sub>DS</sub> = -2 V
Drain to source breakdown voltage	V <sub>(BR)DSS</sub>	-60	—	—	V	I <sub>D</sub> = -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>
	R <sub>DS(on)</sub>	—	20	27	mΩ	I <sub>D</sub> = -20 A, V <sub>GS</sub> = -10 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	td(on)	—	10.6	—	μs	V <sub>GS</sub> = -10 V, I <sub>D</sub> = -20 A, R <sub>L</sub> = 1.5 Ω
Rise time	tr	—	45	—	μs	
Turn-off delay time	td(off)	—	12	—	μs	
Fall time	tf	—	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	trr	—	100	—	ns	I <sub>F</sub> = -40 A, V <sub>GS</sub> = 0 diF/dt = 50 A/μs
Over load shut down operation time <sup>Note4</sup>	t <sub>os1</sub>	—	4.1	—	ms	V <sub>GS</sub> = -5 V, V <sub>DD</sub> = -16 V
	t <sub>os2</sub>	—	1.5	—	ms	V <sub>GS</sub> = -5 V, V <sub>DD</sub> = -24 V

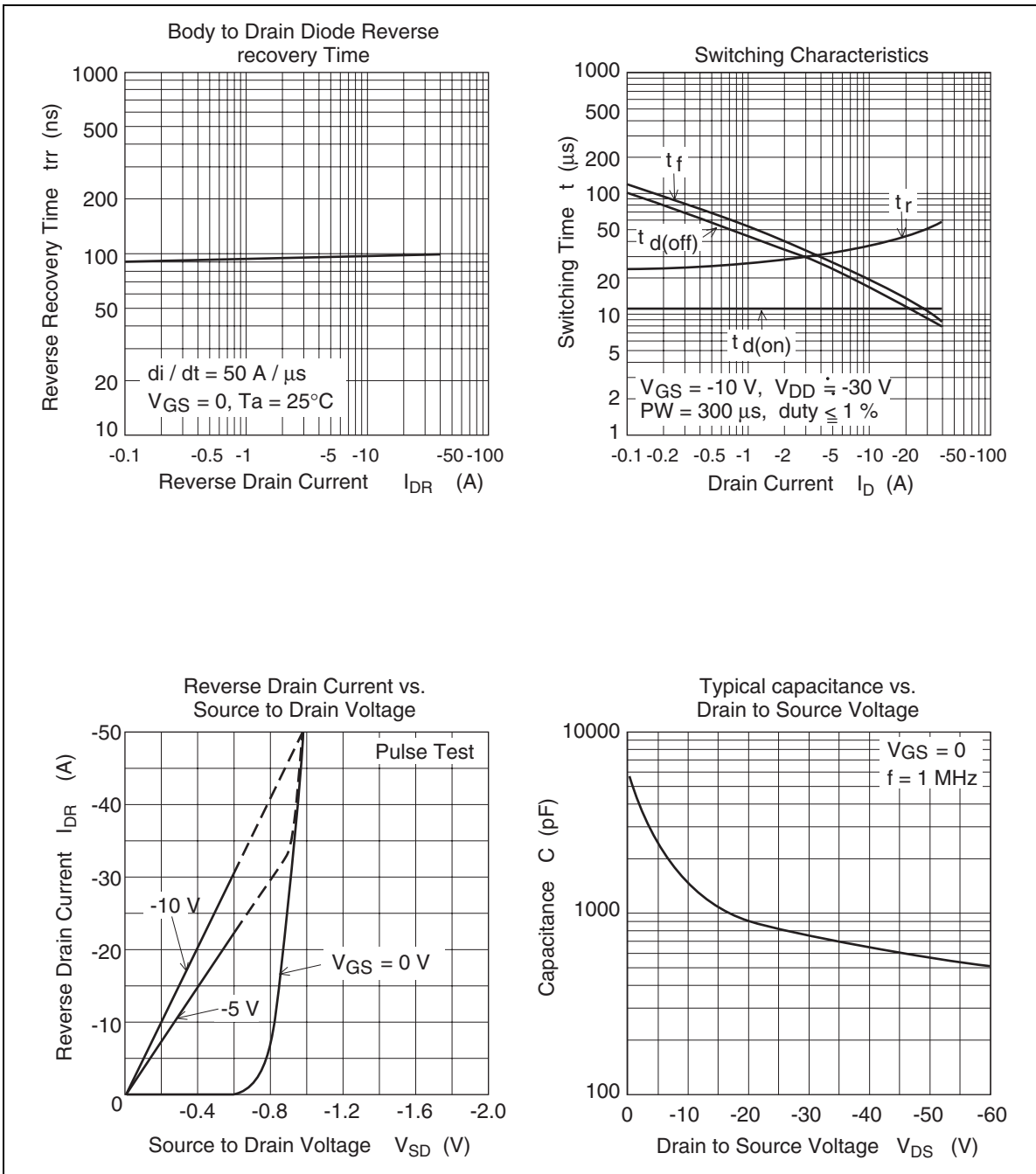
Notes: 3. Pulse test

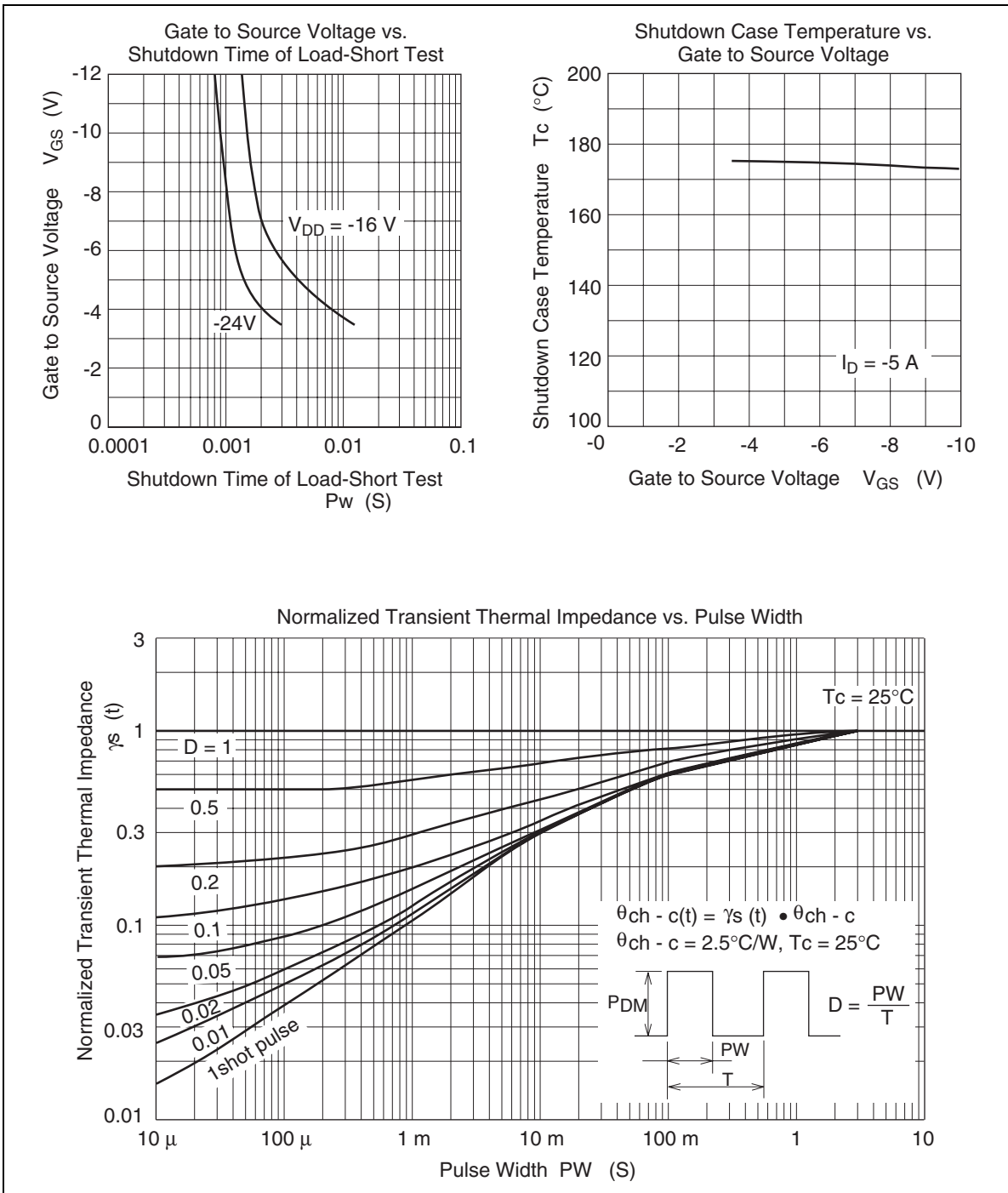
4. Including the junction temperature rise of the over loaded condition.

Main Characteristics

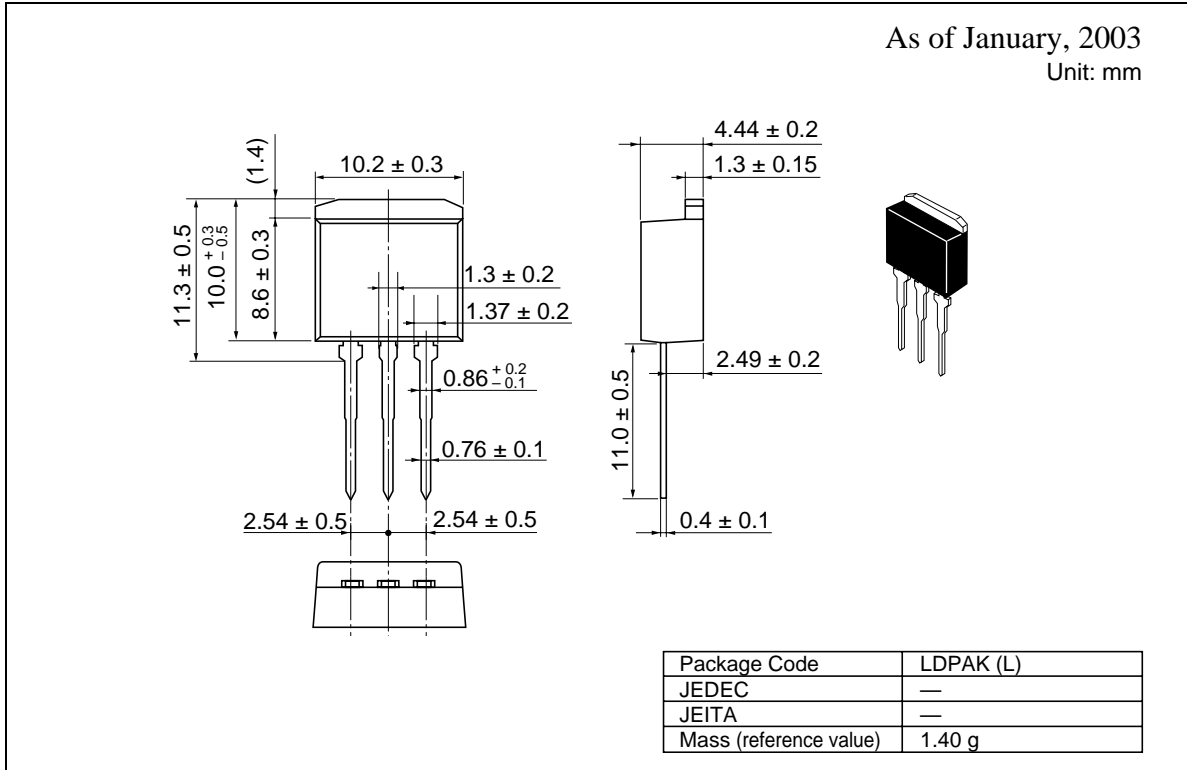








Package Dimensions

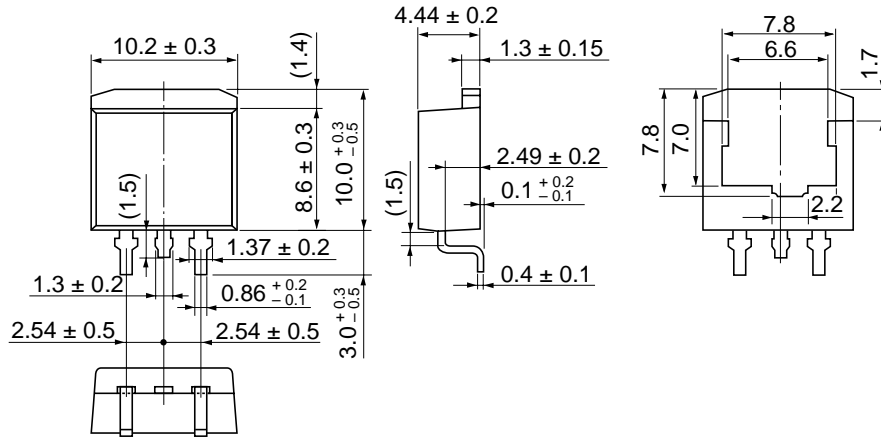




HAF1009(L), HAF1009(S)

As of January, 2003

Unit: mm



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

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**Keep safety first in your circuit designs!**

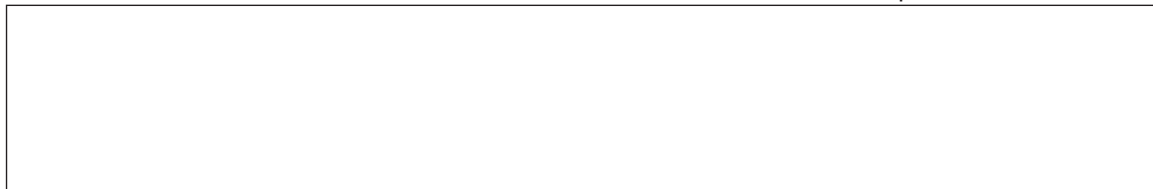
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