

# HA17L431/HA17L431A Series

## High-Precision Variable Shunt Regulators

# HITACHI

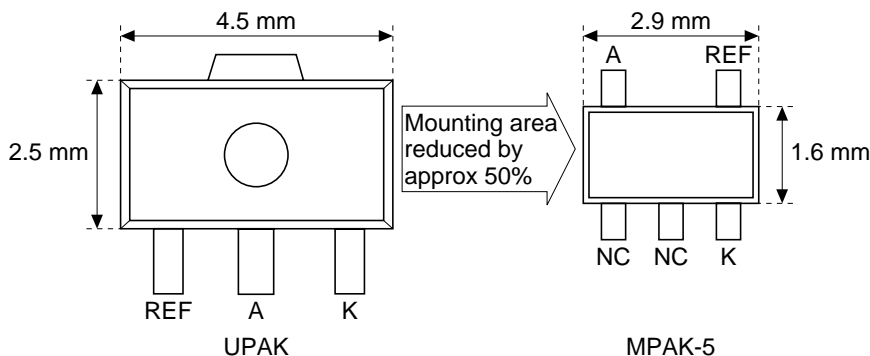
ADE-204-029D (Z)

Rev.4

Dec. 2000

### Description

The HA17L431LP(MPAK-5) / P(TO-92) / UP(UPAK) and the HA17L431ALP(MPAK-5) / AP(TO-92) are temperature-compensated variable shunt regulators. These ICs can operate at about half voltage in comparison with HA17431V series. They can be replaced for simple Zener diode and they can also be used for switching power supply secondary-side error amplification circuit. MPAK-5, TO-92 and UPAK packages are available. The MPAK-5 package, in particular, is suitable for high-density mounting, with a mounting area approximately half that of Hitachi's UPAK products.



### Features

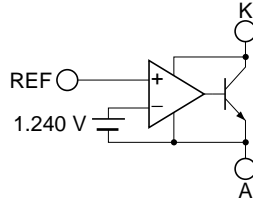
- On-chip high-precision reference voltage source :  $1.240\text{ V} \pm 1.0\%$  ( $T_a = 25^\circ\text{C}$ ) [HA17L431A]  
:  $1.240\text{ V} \pm 1.5\%$  ( $T_a = 25^\circ\text{C}$ ) [HA17L431]
- Small reference voltage temperature coefficient:  $30\text{ ppm}/^\circ\text{C}$  Typ
- Maximum cathode voltage: 16 V
- Maximum cathode current: 50 mA
- Minimum cathode current:  $200\text{ }\mu\text{A}$  Typ
- Operating temperature range:  $-20$  to  $+85^\circ\text{C}$

### Application Example

- Reference voltage generation circuits, etc.

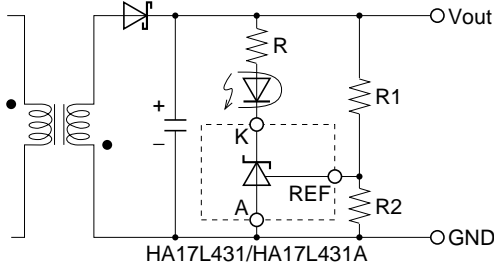
# HA17L431/HA17L431A Series

## Block Diagram



## Application Circuit Example

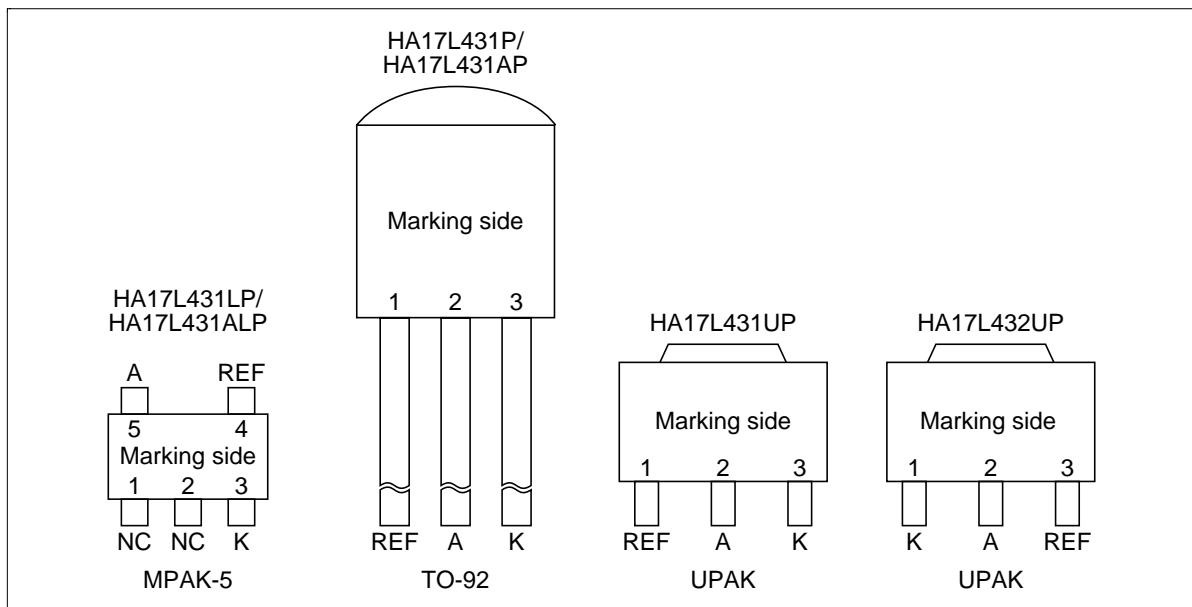
Switching Power Supply Secondary-Side Error Amplification Circuit



## Product Lineup

Item	Reference Voltage		Package	Operating Temperature Range
	Normal Version	A Version		
	±1.5%	±1.0%		
	1.222 to 1.258 V	1.227 to 1.253 V		
	1.240V	1.240V		
Industrial use	HA17L431LP	O	MPAK-5	-20 to +85°C
	HA17L431ALP		O	
	HA17L431P	O	TO-92	
	HA17L431AP		O	
	HA17L431UP	O	UPAK	
	HA17L432UP	O		

Pin Arrangement

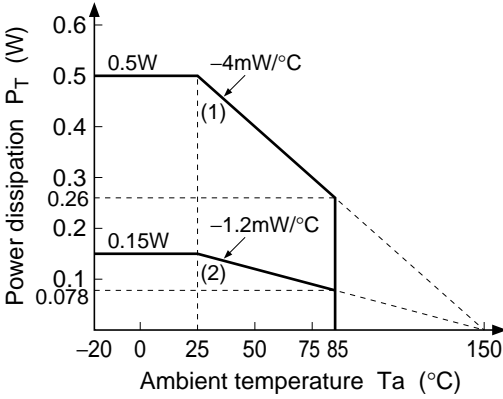


# HA17L431/HA17L431A Series

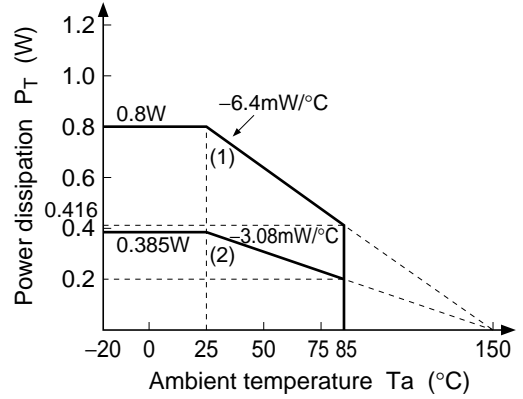
## Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Item	Symbol	Rated Value			Unit	Note
		HA17L431LP/ HA17L431ALP	HA17L431P/ HA17L431AP	HA17L431UP/ HA17L432UP		
Cathode voltage	$V_{KA}$	16	16	16	V	1
Continuous cathode current	$I_K$	-30 to +50	-30 to +50	-30 to +50	mA	
Reference input current	$I_{ref}$	-0.05 to +5	-0.05 to +5	-0.05 to +5	mA	
Power dissipation	$P_T$	150	500	800	mW	2
Operating temperature	$T_{opr}$	-20 to +85	-20 to +85	-20 to +85	$^\circ\text{C}$	
Storage temperature	$T_{stg}$	-55 to +150	-55 to +150	-55 to +150	$^\circ\text{C}$	

Notes: 1. The anode pin is used as the reference for voltage values.  
 2. These values apply when  $T_a \leq 25^\circ\text{C}$ . If  $T_a \geq 25^\circ\text{C}$ , derate by below figure.



(1): HA17L431P/AP  
 (2): HA17L431LP/ALP

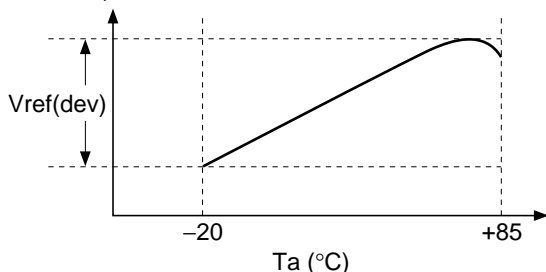


HA17L431UP/432UP  
 (1): With 15mm × 25mm × 0.7mm alumina ceramic board  
 (2): Without printed circuit board

## Electrical Characteristics (Ta = 25°C, I<sub>K</sub> = 10 mA)

Item	Symbol	Min	Typ	Max	Unit	Test Condition	Remark
Reference voltage	V <sub>ref</sub>	1.222	1.240	1.258	V	V <sub>KA</sub> = V <sub>ref</sub>	HA17L431 HA17L431A
Reference voltage deviation	V <sub>ref(dev)</sub>	—	5	—	mV	V <sub>KA</sub> = V <sub>ref</sub> , Ta = -20°C to +85°C	*1
Reference voltage temperature coefficient	ΔV <sub>ref</sub> /ΔTa	—	±30	—	ppm/°C	V <sub>KA</sub> = V <sub>ref</sub> , 0°C to 50°C gradient	
Reference voltage regulation	ΔV <sub>ref</sub> /ΔV <sub>KA</sub>	—	1.0	2.0	mV/V	V <sub>KA</sub> = V <sub>ref</sub> to 16V	
Reference input current	I <sub>ref</sub>	—	2	6	μA	R1 = 10 kΩ, R2 = ∞	
Reference current temperature deviation	I <sub>ref(dev)</sub>	—	0.5	—	μA	R1 = 10 kΩ, R2 = ∞, Ta = -20°C to +85°C	
Minimum cathode current	I <sub>min</sub>	—	0.2	1.0	mA	V <sub>KA</sub> = V <sub>ref</sub>	*2
Off cathode current	I <sub>off</sub>	—	0.001	1.0	μA	V <sub>KA</sub> = 16 V, V <sub>ref</sub> = 0 V	
Dynamic impedance	Z <sub>KA</sub>	—	0.2	0.5	Ω	V <sub>KA</sub> = V <sub>ref</sub> , I <sub>K</sub> = 1 mA to 50 mA	

Notes: 1.  $V_{ref(dev)} = (V_{ref \text{ maximum value at } Ta = -20^{\circ}C \text{ to } +85^{\circ}C) - (V_{ref \text{ minimum value at } Ta = -20^{\circ}C \text{ to } +85^{\circ}C)$



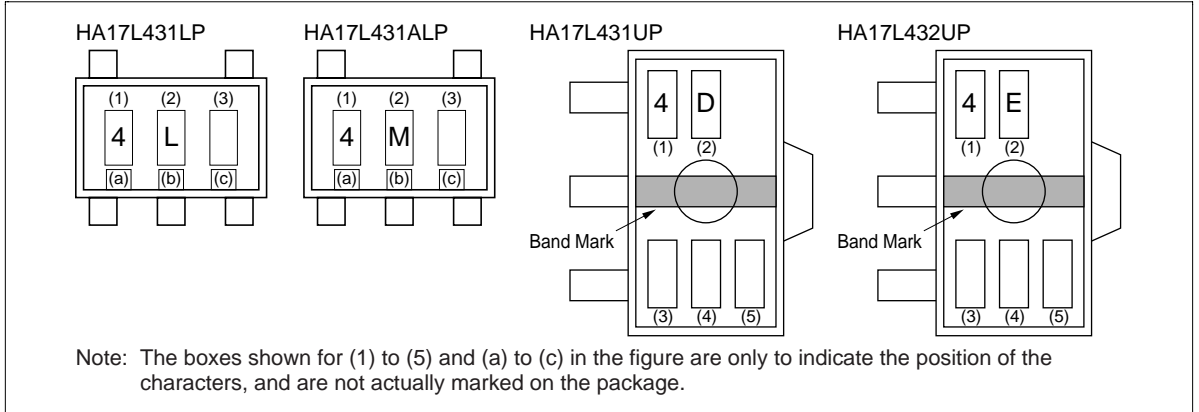
2. Definition of minimum cathode current.

I<sub>min</sub> is the cathode current value at which  $V_{ref} = V_{ref(I_K = 10 \text{ mA})} - 15 \text{ mV}$ .

# HA17L431/HA17L431A Series

## Marking Pattern on MPAK-5 Models (HA17L431LP/HA17L431ALP) and UPAK Models (HA17L431UP/HA17L432UP)

Because of the small package size, the following marking patterns are used on MPAK-5 and UPAK models. Note that the product code and marking pattern are different. The patterns are laser-marked.



### Markings

#### • HA17L431LP, HA17L431ALP

	Type of Marking	Meaning																																				
(1), (2)	Characters	Model code: 4L (HA17L431LP), 4M (HA17L431ALP)																																				
(3)		Production month code: <table border="1"> <thead> <tr> <th>Production month</th> <th>JAN</th> <th>FEB</th> <th>MAR</th> <th>APR</th> <th>MAY</th> <th>JUN</th> <th>JUL</th> <th>AUG</th> <th>SEP</th> <th>OCT</th> <th>NOV</th> <th>DEC</th> </tr> </thead> <tbody> <tr> <td>Code</td> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>F</td> <td>G</td> <td>H</td> <td>J</td> <td>K</td> <td>L</td> <td>M</td> </tr> </tbody> </table>	Production month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Code	A	B	C	D	E	F	G	H	J	K	L	M										
Production month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC																										
Code	A	B	C	D	E	F	G	H	J	K	L	M																										
(a), (b), (c)	Bar mark	Production year code: <table border="1"> <thead> <tr> <th>Production year</th> <th>'98</th> <th>'99</th> <th>2000</th> <th>2001</th> <th>2002</th> <th>2003</th> <th>2004</th> <th>2005</th> </tr> </thead> <tbody> <tr> <td>(a)</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>(b)</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>(c)</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> </tr> </tbody> </table> Notes: 1. 1 indicates a bar, and 0 indicates no bar. 2. Repeated every 8 years from 2006 on.	Production year	'98	'99	2000	2001	2002	2003	2004	2005	(a)	1	1	1	0	0	0	0	1	(b)	0	1	1	0	0	1	1	0	(c)	1	0	1	0	1	0	1	0
Production year	'98	'99	2000	2001	2002	2003	2004	2005																														
(a)	1	1	1	0	0	0	0	1																														
(b)	0	1	1	0	0	1	1	0																														
(c)	1	0	1	0	1	0	1	0																														

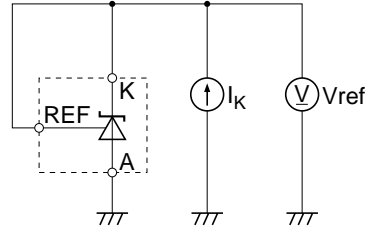
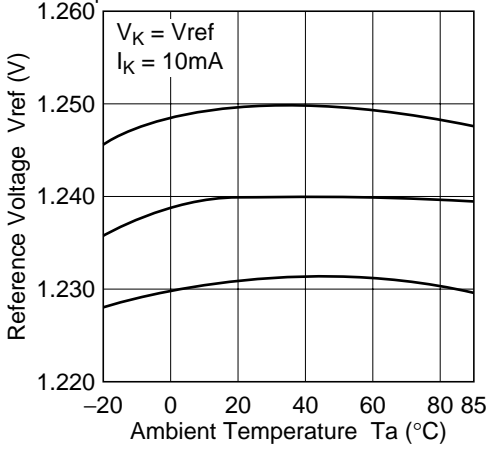
#### • HA17L431UP, HA17L432UP

	Type of Marking	Meaning																										
(1), (2)	Characters	Model code: 4D (HA17L431UP), 4E (HA17L432UP)																										
(3)		Production year code: The last digit of the year.																										
(4)		Production month code: <table border="1"> <thead> <tr> <th>Production month</th> <th>JAN</th> <th>FEB</th> <th>MAR</th> <th>APR</th> <th>MAY</th> <th>JUN</th> <th>JUL</th> <th>AUG</th> <th>SEP</th> <th>OCT</th> <th>NOV</th> <th>DEC</th> </tr> </thead> <tbody> <tr> <td>Code</td> <td>A</td> <td>B</td> <td>C</td> <td>D</td> <td>E</td> <td>F</td> <td>G</td> <td>H</td> <td>J</td> <td>K</td> <td>L</td> <td>M</td> </tr> </tbody> </table>	Production month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Code	A	B	C	D	E	F	G	H	J	K	L	M
Production month		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC															
Code	A	B	C	D	E	F	G	H	J	K	L	M																
(5)	HITACHI management code																											

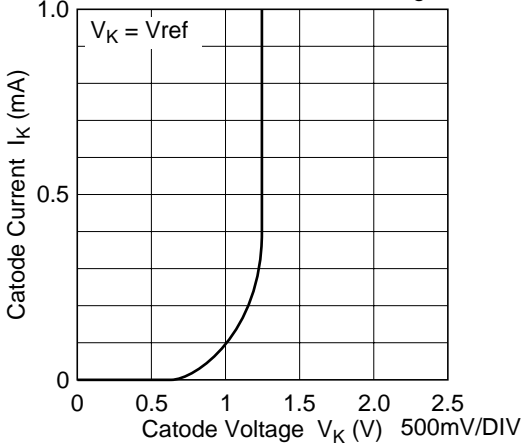
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Characteristic Curves

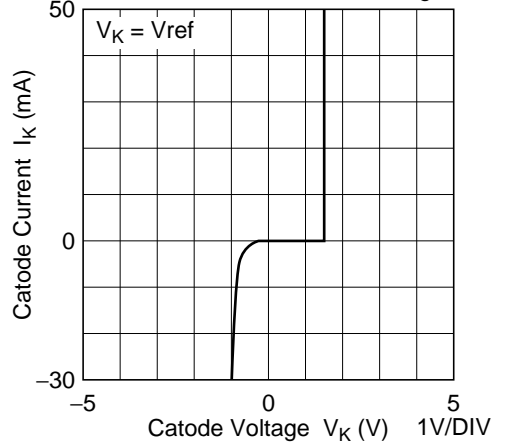
Temperature Characteristics of Reference Voltage



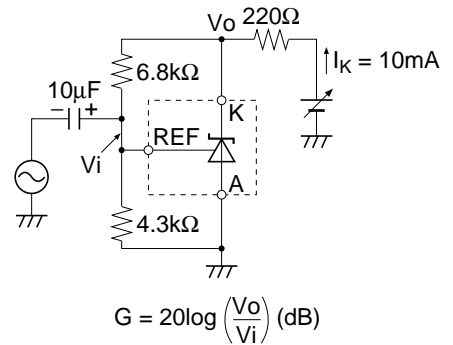
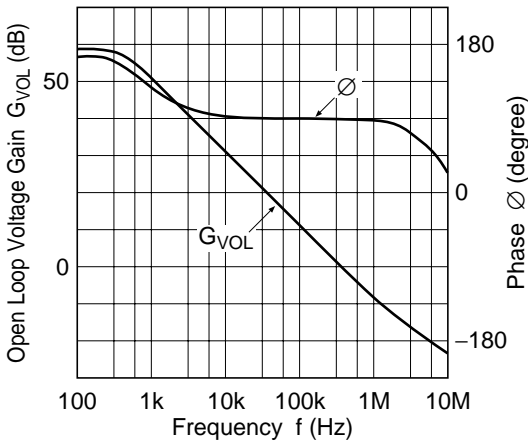
Catode Current vs. Catode Voltage1



Catode Current vs. Catode Voltage2

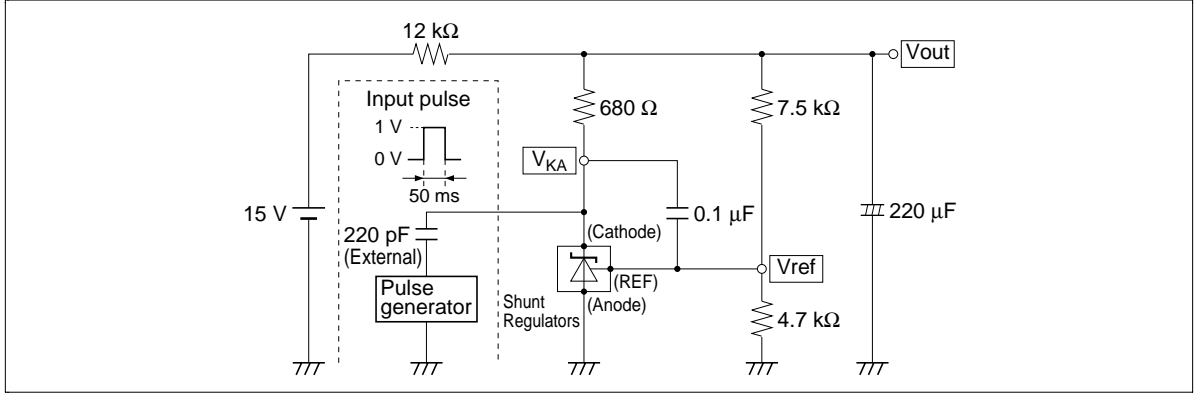


Open Loop Voltage Gain, Phase vs. Frequency Characteristics

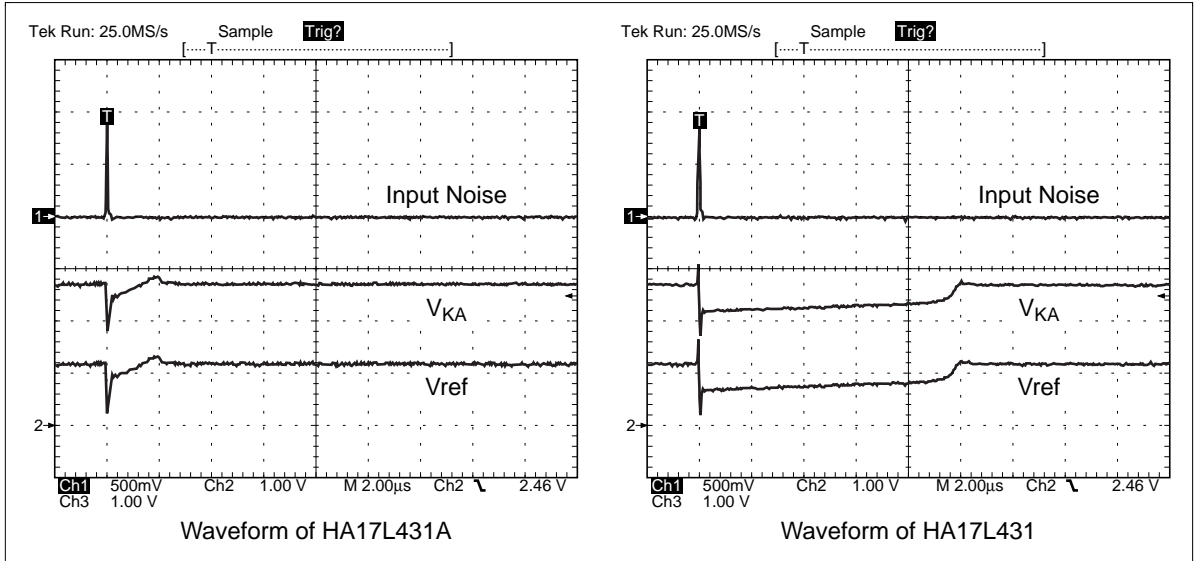


## Noise Recovery Characteristics of HA17L431A and HA17L431

The HA17L431A bettered  $V_{KA}$  and  $V_{ref}$  recovery time against the HA17L431 when it was inputted noise.



**Figure 1 Noise Response Characteristics Measurement Circuit**



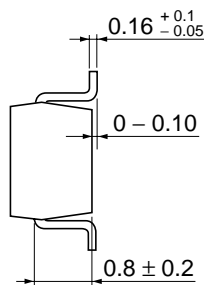
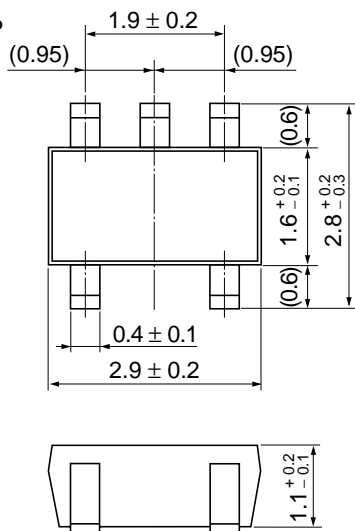
**Figure 2 Noise Recovery Characteristics**



## Package Dimension

- HA17L431LP
- HA17L431ALP

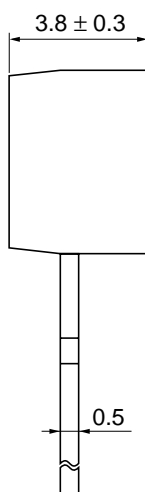
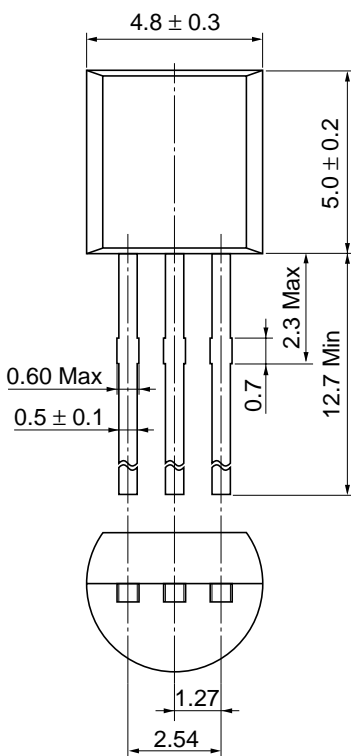
Unit: mm



Hitachi Code	MPAK-5
JEDEC	—
EIAJ	—
Mass (reference value)	0.013 g

- HA17L431P
- HA17L431AP

Unit: mm

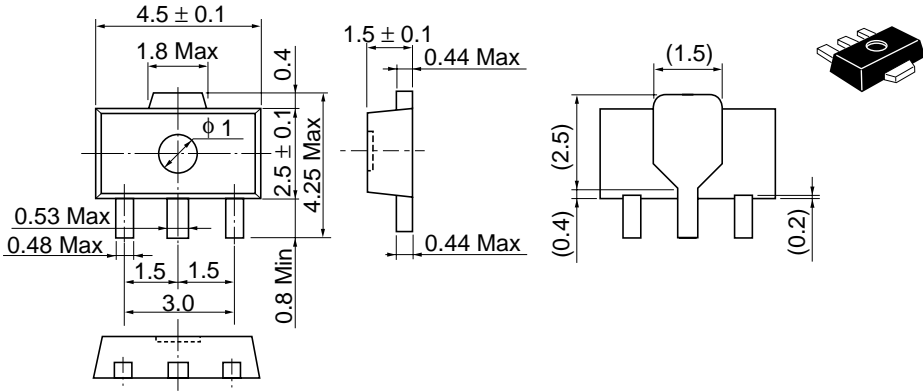


Hitachi Code	TO-92 (1)
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	0.25 g

# HA17L431/HA17L431A Series

- HA17L431UP
- HA17L432UP

Unit: mm



Hitachi Code	UPAK
JEDEC	—
EIAJ	Conforms
Weight (reference value)	0.050 g

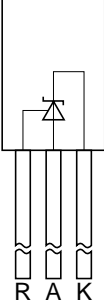
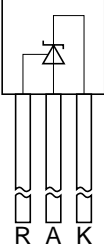
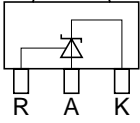
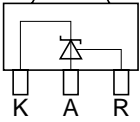
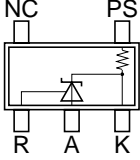
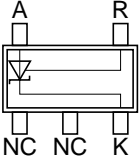
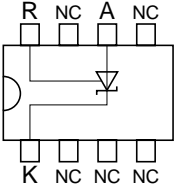
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**Shunt Regulator Selection Guide**

<b>Package</b>	<b>Vref/Tolerance</b>	<b>I<sub>k</sub> max (mA)</b>	<b>V<sub>k</sub> max (V)</b>	<b>Topr (°C)</b>	<b>Product Name</b>
TO-92	2.5 V ± 2.2%	-100 to +150	40	-20 to +85	HA17431PNA
	2.5 V ± 1.0%	-50 to +50	16	-20 to +85	HA17431VP
	1.24 V ± 1.5%	-30 to +50	16	-20 to +85	HA17L431P
	1.24 V ± 1.0%	-30 to +50	16	-20 to +85	HA17L431AP
TO-92MOD	2.5 V ± 2.2%	-100 to +150	40	-20 to +85	HA17431PA
UPAK	2.5 V ± 2.2%	-100 to +150	40	-20 to +85	HA17431UA
	2.5 V ± 2.2%	-100 to +150	40	-20 to +85	HA17431UPA
	1.24 V ± 1.5%	-30 to +50	16	-20 to +85	HA17L431UP
	2.5 V ± 2.2%	-100 to +150	40	-20 to +85	HA17432UA
	2.5 V ± 2.2%	-100 to +150	40	-20 to +85	HA17432UPA
	1.24 V ± 1.5%	-30 to +50	16	-20 to +85	HA17L432UP
MPAK-5	2.5 V ± 1.0%	-50 to +50	16	-20 to +85	HA17431VLP
	1.24 V ± 1.5%	-30 to +50	16	-20 to +85	HA17L431LP
	1.24 V ± 1.0%	-30 to +50	16	-20 to +85	HA17L431ALP
SOP-8	2.5 V ± 2.2%	-100 to +150	40	-20 to +85	HA17431FPA

# HA17L431/HA17L431A Series

## Pin Arrangement by Product

Product Name (Vref / Tolerance)	Package	Pin Arrangement
HA17431PA (2.5 V $\pm$ 2.2%)	TO-92MOD	
HA17431VP (2.5 V $\pm$ 1%) HA17431PNA (2.5 V $\pm$ 2.2%) HA17L431P (1.24 V $\pm$ 1.5%) HA17L431AP (1.24 V $\pm$ 1%)	TO-92	
HA17431UA (2.5 V $\pm$ 2.2%) HA17431UPA (2.5 V $\pm$ 2.2%) HA17L431UP (1.24 V $\pm$ 1.5%)	UPAK	
HA17432UA (2.5 V $\pm$ 2.2%) HA17432UPA (2.5 V $\pm$ 2.2%) HA17L432UP (1.24 V $\pm$ 1.5%)	UPAK	
HA17431VLP (2.5 V $\pm$ 1%)	MPAK-5	
HA17L431LP (1.24 V $\pm$ 1.5%) HA17L431ALP (1.24 V $\pm$ 1%)	MPAK-5	
HA17431FPA (2.5 V $\pm$ 2.2%)	SOP-8	

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