

# HA178L02/56/06/09/10 Series

## 3-terminal Fixed Voltage Regulators

REJ03D0918-0100

Rev.1.00

Jan 16, 2009

### Description

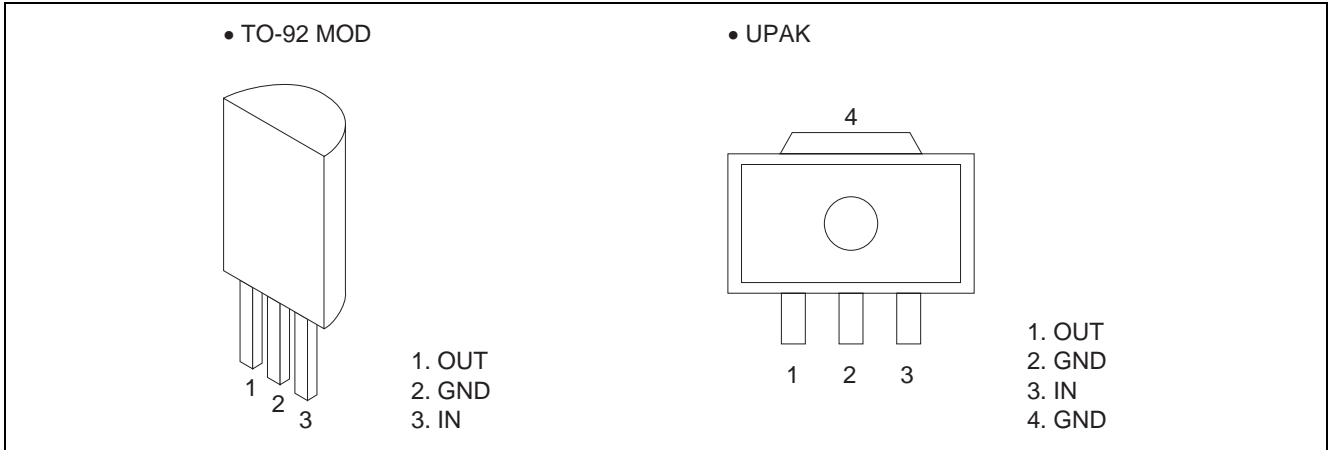
The HA178L02/56/06/09/10 series three-terminal fixed output voltage regulators. Can be used not only as stabilized power sources, but also as Zener diodes because of their small outline package.

### Features

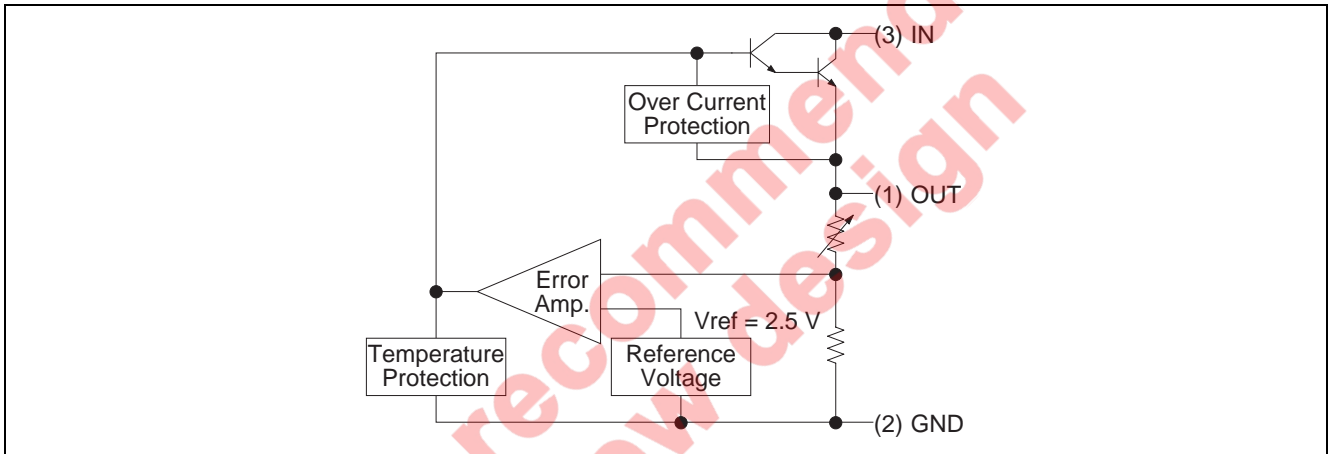
- Maximum output current: 150 mA ( $T_j = 25^\circ\text{C}$ )
- Large maximum power dissipation: 800 mW
- Over current protection
- Temperature protection circuit
- Ordering Information

Part No.	Output Voltage (V)	Output Voltage Tolerance (%)	Package Name	Package Code	Taping Abbreviation (Quantity)	Application
HA178L02-TZ	2.5	±8	TO-92MOD	PRSS0003DC-A	TZ (2,500pcs/box)	Commercial use
HA178L02P-TZ						Industrial use
HA178L02A-TZ		±5	UPAK	PLZZ0004CA-A	TL (1,000pcs/reel)	Commercial use
HA178L02PA-TZ						Industrial use
HA178L02UA-TL						Commercial use
HA178L56-TZ	5.6	±8	TO-92MOD	PRSS0003DC-A	TZ (2,500pcs/box)	Commercial use
HA178L56P-TZ						Industrial use
HA178L56A-TZ		±5	UPAK	PLZZ0004CA-A	TL (1,000pcs/reel)	Commercial use
HA178L56PA-TZ						Industrial use
HA178L56UA-TL						Commercial use
HA178L06-TZ	6	±8	TO-92MOD	PRSS0003DC-A	TZ (2,500pcs/box)	Commercial use
HA178L06P-TZ						Industrial use
HA178L06A-TZ		±5	UPAK	PLZZ0004CA-A	TL (1,000pcs/reel)	Commercial use
HA178L06PA-TZ						Industrial use
HA178L06UA-TL						Commercial use
HA178L09-TZ	9	±8	TO-92MOD	PRSS0003DC-A	TZ (2,500pcs/box)	Commercial use
HA178L09P-TZ						Industrial use
HA178L09A-TZ		±5	UPAK	PLZZ0004CA-A	TL (1,000pcs/reel)	Commercial use
HA178L09PA-TZ						Industrial use
HA178L09UA-TL						Commercial use
HA178L10TZ	10	±8	TO-92MOD	PRSS0003DC-A	TZ (2,500pcs/box)	Commercial use
HA178L10P-TZ						Industrial use
HA178L10A-TZ		±5	UPAK	PLZZ0004CA-A	TL (1,000pcs/reel)	Commercial use
HA178L10PA-TZ						Industrial use
HA178L10UA-TL						Commercial use

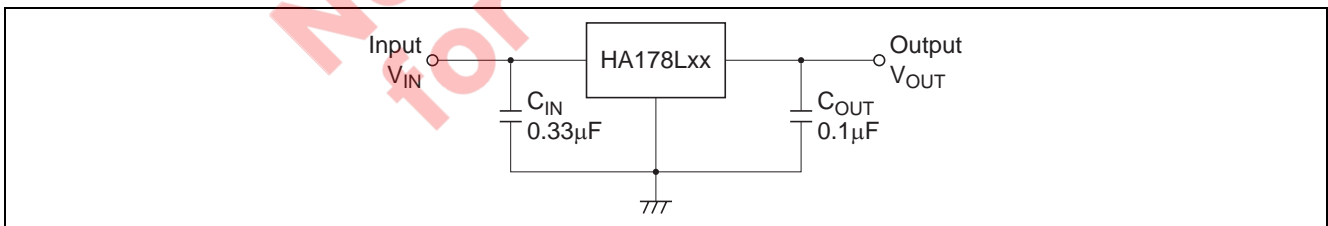
### Pin Arrangement



### Block Diagram



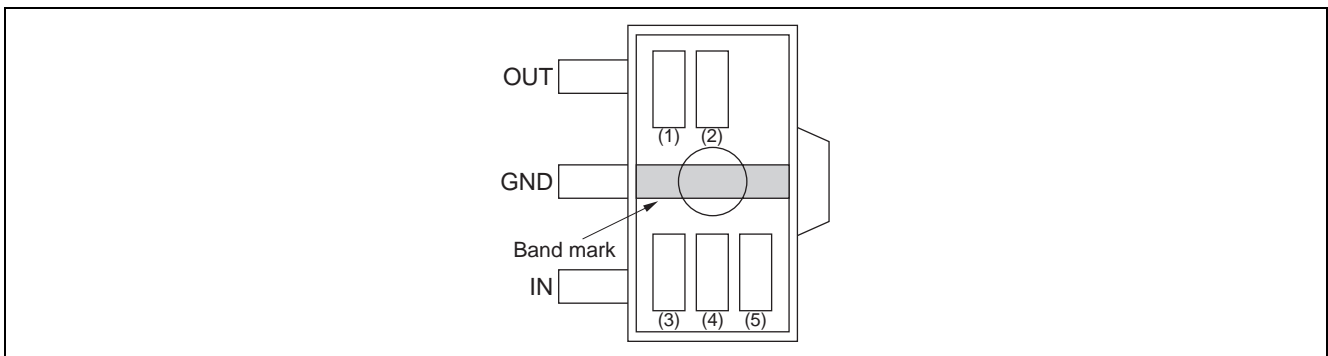
### Standard Circuit



## UPAK Product (HA178LxxUA) Mark Patterns

The mark patterns shown below are used on UPAK products, as the package is small. Note that the product code and mark pattern are different.

The pattern is laser-printed.



Notes: 1. Boxes (1) to (5) in the figures show the position of the letters or numerals, and are not actually marked on the package.

2. (1) and (2) show the product-specific mark pattern.

Output Voltage (V)	Part No.	Mark Pattern (2 digit)
2.5	HA178L02UA	8A
5.6	HA178L56UA	8C
6	HA178L06UA	8D
9	HA178L09UA	8F
10	HA178L10UA	8G

3. (3) shows the production year code (the last digit of the year).

4. (4) shows the production month code.

Production Month	1	2	3	4	5	6	7	8	9	10	11	12
Marked Code	A	B	C	D	E	F	G	H	J	K	L	M

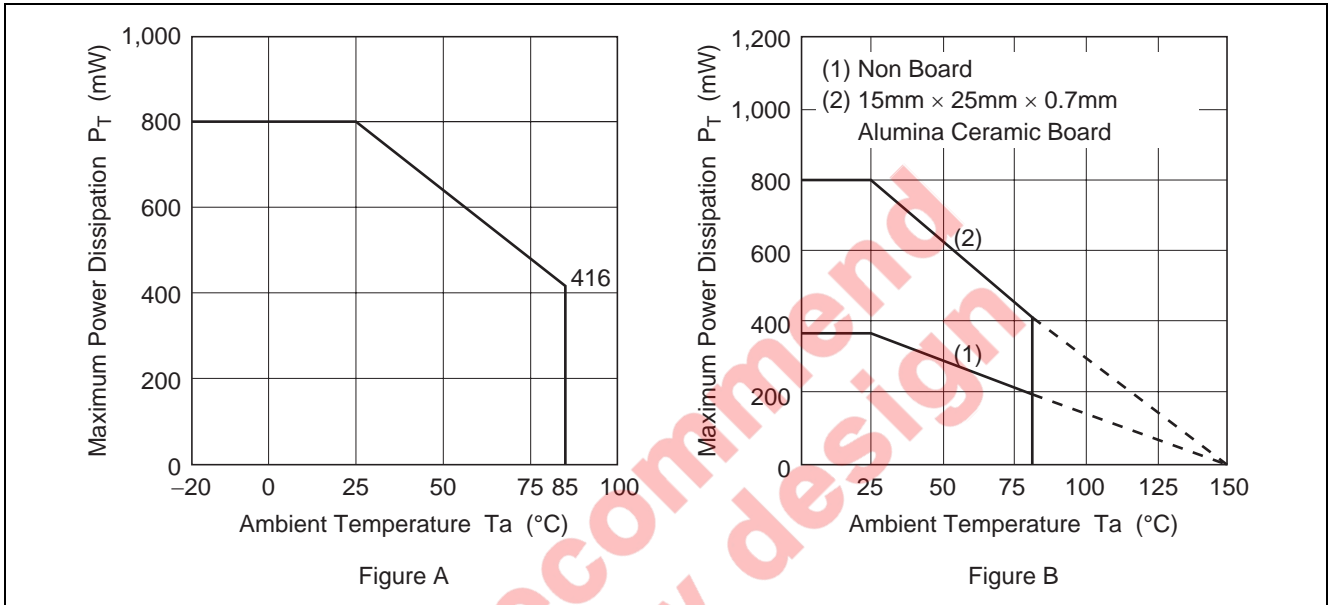
5. (5) shows the production week code.

**Absolute Maximum Ratings**

(Ta = 25°C)

Item	Symbol	Rating	Unit	Note
Input voltage	V <sub>IN</sub>	35	V	
Power dissipation	P <sub>T</sub>	800	mW	TO-92 MOD * <sup>1</sup>
		800		UPAK * <sup>2</sup>
Operating ambient temperature	T <sub>opr</sub>	-40 to +85	°C	
Storage temperature	T <sub>stg</sub>	-55 to +150	°C	

- Note: 1. Ta ≤ 25°C, If Ta > 25°C, derate by 6.4 mW/°C (See figure A)  
 2. 15mm × 25mm × 0.7 mm alumina ceramic board, Ta ≤ 25°C (See figure B)



Not recommended for new designs

## Electrical Characteristics

## HA178L02

(V<sub>IN</sub> = 10 V, I<sub>OUT</sub> = 40 mA, 0°C ≤ T<sub>j</sub> ≤ 125°C, C<sub>IN</sub> = 0.33 μF, C<sub>OUT</sub> = 0.1 μF)

Item	Symbol	HA178L02P HA178L02			HA178L02PA HA178L02A HA178L02UA			Unit	Test Conditions	
		Min	Typ	Max	Min	Typ	Max			
Output voltage	V <sub>OUT</sub>	2.32	2.48	2.64	2.38	2.48	2.58	V	T <sub>j</sub> = 25°C	
Line regulation	ΔV <sub>OLINE</sub>	—	35	125	—	35	95	mV	T <sub>j</sub> = 25°C	7 V ≤ V <sub>IN</sub> ≤ 20 V
		—	30	100	—	30	75		8 V ≤ V <sub>IN</sub> ≤ 20 V	
Load regulation	ΔV <sub>OLOAD</sub>	—	14	—	—	14	—	mV	T <sub>j</sub> = 25°C	1.0 mA ≤ I <sub>OUT</sub> ≤ 150 mA
		—	9.5	50	—	9.5	50			1.0 mA ≤ I <sub>OUT</sub> ≤ 100 mA
		—	4.5	25	—	4.5	25			1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA
Output voltage	V <sub>OUT</sub>	2.28	—	2.68	2.35	—	2.61	V	7 V ≤ V <sub>IN</sub> ≤ 20 V, 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA	V <sub>IN</sub> = 9 V, 1.0 mA ≤ I <sub>OUT</sub> ≤ 70 mA
		2.28	—	2.68	2.35	—	2.61			
Quiescent current	I <sub>Q</sub>	—	3.0	6.0	—	3.0	6.0	mA	T <sub>j</sub> = 25°C	
Quiescent current change	ΔI <sub>Q</sub>	—	—	1.5	—	—	1.5	mA	8.0 V ≤ V <sub>IN</sub> ≤ 20 V, T <sub>j</sub> = 25°C	1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA, T <sub>j</sub> = 25°C
		—	—	0.2	—	—	0.1			
Ripple rejection ratio	R <sub>REJ</sub>	—	60	—	—	60	—	dB	f = 120 Hz, 8.0 V ≤ V <sub>IN</sub> < 18 V, T <sub>j</sub> = 25°C	
Temperature coefficient of output voltage	ΔV <sub>OUT</sub> /ΔT <sub>j</sub>	—	+0.2	—	—	+0.2	—	mV/°C	I <sub>OUT</sub> = 5 mA	

## HA178L56

(V<sub>IN</sub> = 11 V, I<sub>OUT</sub> = 40 mA, 0°C ≤ T<sub>j</sub> ≤ 125°C, C<sub>IN</sub> = 0.33 μF, C<sub>OUT</sub> = 0.1 μF)

Item	Symbol	HA178L56P HA178L56			HA178L56PA HA178L56A HA178L56UA			Unit	Test Conditions	
		Min	Typ	Max	Min	Typ	Max			
Output voltage	V <sub>OUT</sub>	5.24	5.6	5.96	5.38	5.6	5.82	V	T <sub>j</sub> = 25°C	
Line regulation	ΔV <sub>OLINE</sub>	—	50	200	—	50	150	mV	T <sub>j</sub> = 25°C	7.6 V ≤ V <sub>IN</sub> ≤ 21 V
		—	45	150	—	45	100			8.5 V ≤ V <sub>IN</sub> ≤ 21 V
Load regulation	ΔV <sub>OLOAD</sub>	—	17	—	—	17	—	mV	T <sub>j</sub> = 25°C	1.0 mA ≤ I <sub>OUT</sub> ≤ 150 mA
		—	11	60	—	11	60			1.0 mA ≤ I <sub>OUT</sub> ≤ 100 mA
		—	5.0	30	—	5.0	30			1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA
Output voltage	V <sub>OUT</sub>	5.16	—	6.04	5.32	—	5.88	V	7.6 V ≤ V <sub>IN</sub> ≤ 21 V, 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA	V <sub>IN</sub> = 11 V, 1.0 mA ≤ I <sub>OUT</sub> ≤ 70 mA
		5.16	—	6.04	5.32	—	5.88			
Quiescent current	I <sub>Q</sub>	—	3.0	6.0	—	3.0	6.0	mA	T <sub>j</sub> = 25°C	
Quiescent current change	ΔI <sub>Q</sub>	—	—	1.5	—	—	1.5	mA	8.5 V ≤ V <sub>IN</sub> ≤ 2.0 V, T <sub>j</sub> = 25°C	1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA, T <sub>j</sub> = 25°C
		—	—	0.2	—	—	0.1			
Ripple rejection ratio	R <sub>REJ</sub>	—	58	—	—	58	—	dB	f = 120 Hz, 8.5 V ≤ V <sub>IN</sub> < 18.5 V, T <sub>j</sub> = 25°C	
Temperature coefficient of output voltage	ΔV <sub>OUT</sub> /ΔT <sub>j</sub>	—	+0.1	—	—	+0.1	—	mV/°C	I <sub>OUT</sub> = 5 mA	
Dropout voltage	V <sub>DROP</sub>	—	1.7	—	—	1.7	—	V	T <sub>j</sub> = 25°C	

HA178L06

( $V_{IN} = 11\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ ,  $C_{IN} = 0.33\ \mu\text{F}$ ,  $C_{OUT} = 0.1\ \mu\text{F}$ )

Item	Symbol	HA178L06P HA178L06			HA178L06PA HA178L06A HA178L06UA			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
Output voltage	$V_{OUT}$	5.61	6.0	6.39	5.76	6.0	6.24	V	$T_j = 25^\circ\text{C}$
Line regulation	$\Delta V_{OLINE}$	—	50	200	—	50	150	mV	$T_j = 25^\circ\text{C}$
		—	45	150	—	45	110		$8.1\text{ V} \leq V_{IN} \leq 21\text{ V}$ $9.0\text{ V} \leq V_{IN} \leq 21\text{ V}$
Load regulation	$\Delta V_{OLOAD}$	—	17.5	—	—	17.5	—	mV	$T_j = 25^\circ\text{C}$
		—	12	70	—	12	70		$1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$
		—	5.5	35	—	5.5	35		$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$
Output voltage	$V_{OUT}$	5.52	—	6.48	5.7	—	6.3	V	$8.1\text{ V} \leq V_{IN} \leq 21\text{ V}$ , $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$
		5.52	—	6.48	5.7	—	6.3		$V_{IN} = 11\text{ V}$ , $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$
Quiescent current	$I_Q$	—	3.0	6.0	—	3.0	6.0	mA	$T_j = 25^\circ\text{C}$
Quiescent current change	$\Delta I_Q$	—	—	1.5	—	—	1.5	mA	$9.0\text{ V} \leq V_{IN} \leq 20\text{ V}$ , $T_j = 25^\circ\text{C}$
		—	—	0.2	—	—	0.1		$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ , $T_j = 25^\circ\text{C}$
Ripple rejection ratio	$R_{REJ}$	—	57	—	—	57	—	dB	$f = 120\text{ Hz}$ , $9.0\text{ V} \leq V_{IN} < 19\text{ V}$ , $T_j = 25^\circ\text{C}$
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta T_j$	—	+0.1	—	—	+0.1	—	mV/°C	$I_{OUT} = 5\text{ mA}$
Dropout voltage	$V_{DROP}$	—	1.7	—	—	1.7	—	V	$T_j = 25^\circ\text{C}$

HA178L09

( $V_{IN} = 15\text{ V}$ ,  $I_{OUT} = 40\text{ mA}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ ,  $C_{IN} = 0.33\ \mu\text{F}$ ,  $C_{OUT} = 0.1\ \mu\text{F}$ )

Item	Symbol	HA178L09P HA178L09			HA178L09PA HA178L09A HA178L09UA			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
Output voltage	$V_{OUT}$	8.42	9.0	9.58	8.64	9.0	9.36	V	$T_j = 25^\circ\text{C}$
Line regulation	$\Delta V_{OLINE}$	—	80	230	—	80	200	mV	$T_j = 25^\circ\text{C}$
		—	20	160	—	20	160		$11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$ $12\text{ V} \leq V_{IN} \leq 24\text{ V}$
Load regulation	$\Delta V_{OLOAD}$	—	24.5	—	—	24.5	—	mV	$T_j = 25^\circ\text{C}$
		—	17	90	—	17	90		$1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$
		—	8.0	45	—	8.0	45		$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$
Output voltage	$V_{OUT}$	8.28	—	9.72	8.55	—	9.45	V	$11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$ , $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$
		8.28	—	9.72	8.55	—	9.45		$V_{IN} = 15\text{ V}$ , $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$
Quiescent current	$I_Q$	—	3.1	6.5	—	3.1	6.5	mA	$T_j = 25^\circ\text{C}$
Quiescent current change	$\Delta I_Q$	—	—	1.5	—	—	1.5	mA	$12\text{ V} \leq V_{IN} \leq 24\text{ V}$ , $T_j = 25^\circ\text{C}$
		—	—	0.2	—	—	0.1		$1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ , $T_j = 25^\circ\text{C}$
Ripple rejection ratio	$R_{REJ}$	—	55	—	—	55	—	dB	$f = 120\text{ Hz}$ , $12\text{ V} \leq V < 24\text{ V}$ , $T_j = 25^\circ\text{C}$
Temperature coefficient of output voltage	$\Delta V_{OUT}/\Delta T_j$	—	-0.15	—	—	-0.15	—	mV/°C	$I_{OUT} = 5\text{ mA}$
Dropout voltage	$V_{DROP}$	—	1.7	—	—	1.7	—	V	$T_j = 25^\circ\text{C}$

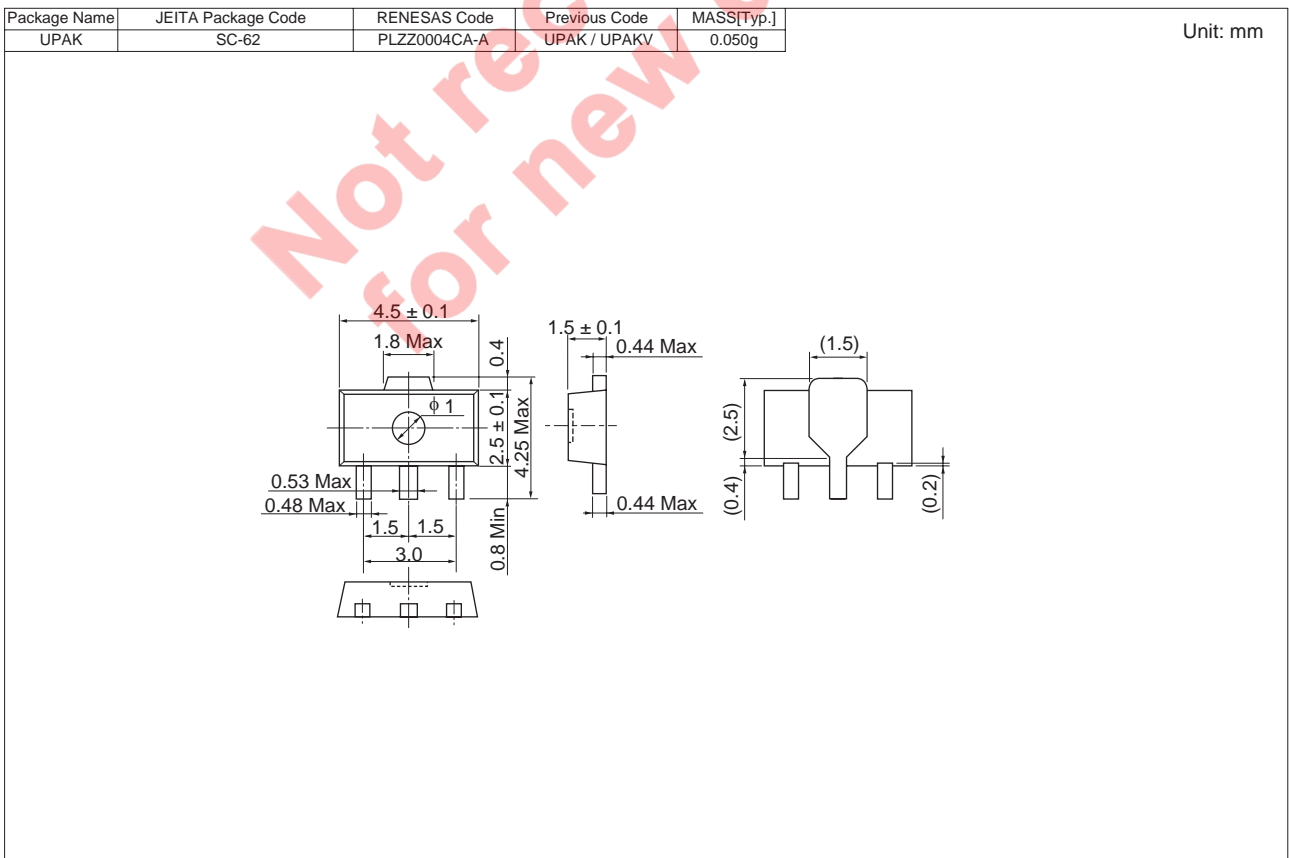
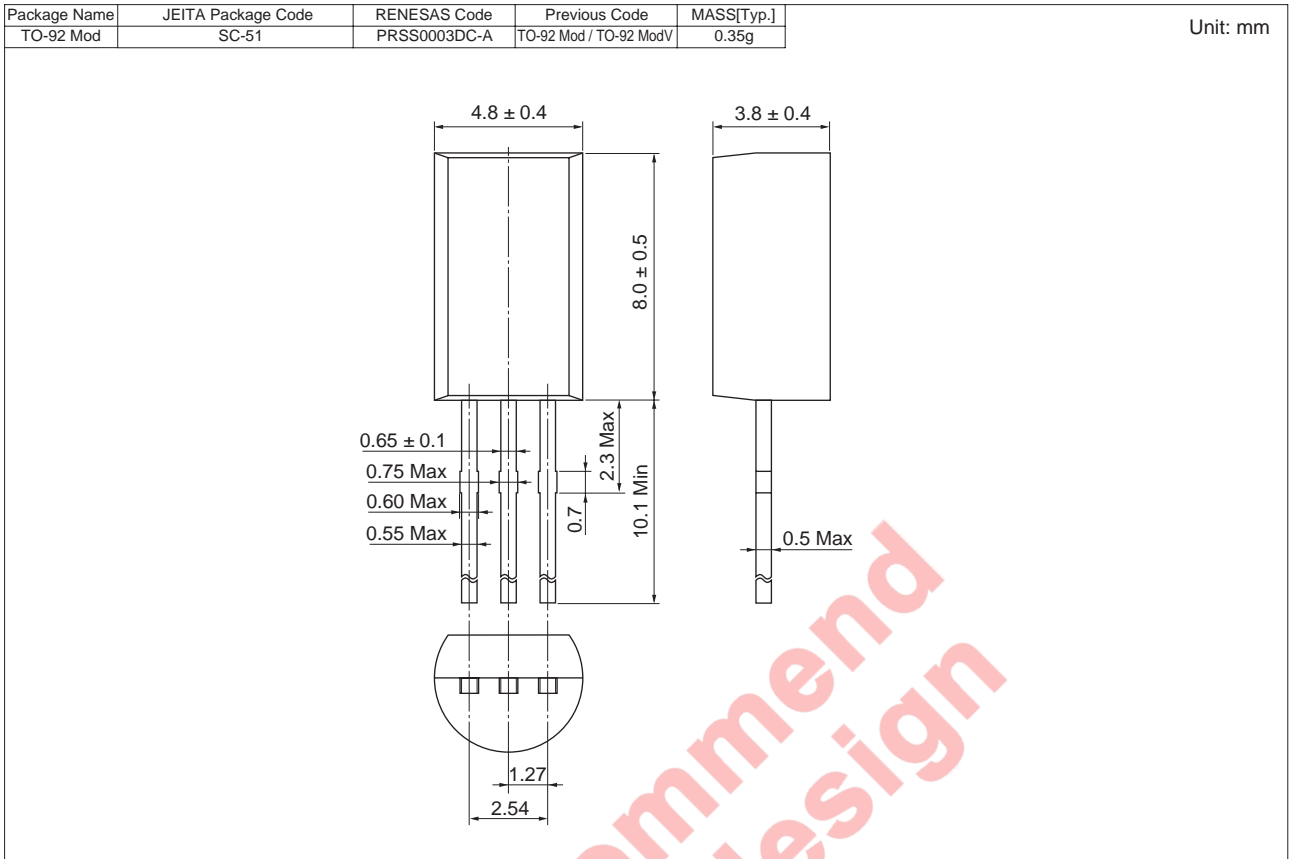
## HA178L10

(V<sub>IN</sub> = 16 V, I<sub>OUT</sub> = 40 mA, 0°C ≤ T<sub>j</sub> ≤ 125°C, C<sub>IN</sub> = 0.33 μF, C<sub>OUT</sub> = 0.1 μF)

Item	Symbol	HA178L10P HA178L10			HA178L10PA HA178L10A HA178L10UA			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
Output voltage	V <sub>OUT</sub>	9.35	10	10.65	9.6	10	10.4	V	T <sub>j</sub> = 25°C
Line regulation	ΔV <sub>OLINE</sub>	—	80	230	—	80	230	mV	T <sub>j</sub> = 25°C
		—	30	170	—	30	170		12.5 V ≤ V <sub>IN</sub> ≤ 25 V 13 V ≤ V <sub>IN</sub> ≤ 25 V
Load regulation	ΔV <sub>OLOAD</sub>	—	26	—	—	26	—	mV	T <sub>j</sub> = 25°C
		—	18	90	—	18	90		1.0 mA ≤ I <sub>OUT</sub> ≤ 150 mA 1.0 mA ≤ I <sub>OUT</sub> ≤ 100 mA
		—	8.5	45	—	8.5	45		1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA
Output voltage	V <sub>OUT</sub>	9.2	—	10.8	9.5	—	10.5	V	12.5 V ≤ V <sub>IN</sub> ≤ 25 V, 1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA
		9.2	—	10.8	9.5	—	10.5		V <sub>IN</sub> = 16 V, 1.0 mA ≤ I <sub>OUT</sub> ≤ 70 mA
Quiescent current	I <sub>Q</sub>	—	3.1	6.5	—	3.1	6.5	mA	T <sub>j</sub> = 25°C
Quiescent current change	ΔI <sub>Q</sub>	—	—	1.5	—	—	1.5	mA	13 V ≤ V <sub>IN</sub> ≤ 25 V, T <sub>j</sub> = 25°C
		—	—	0.2	—	—	0.1		1.0 mA ≤ I <sub>OUT</sub> ≤ 40 mA, T <sub>j</sub> = 25°C
Ripple rejection ratio	R <sub>REJ</sub>	—	54	—	—	54	—	dB	f = 120 Hz, 13 V ≤ V <sub>IN</sub> < 24 V, T <sub>j</sub> = 25°C
Temperature coefficient of output voltage	ΔV <sub>OUT</sub> /ΔT <sub>j</sub>	—	-0.2	—	—	-0.2	—	mV/°C	I <sub>OUT</sub> = 5 mA
Dropout voltage	V <sub>DROP</sub>	—	1.7	—	—	1.7	—	V	T <sub>j</sub> = 25°C

Not recommended  
for new design

Package Dimensions





Notes:

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