

HA178L00 Series

3-terminal Fixed Voltage Regulators

HITACHI

ADE-204-051 (Z)

Rev. 0

Dec. 2000

Description

The HA178L00 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
- Overcurrent protection
- Temperature protection circuit

Ordering Information

| Application | Standard Output Voltage Tolerance $\pm 8\%$ | A Version Output Voltage Tolerance $\pm 5\%$ |
|----------------|--|---|
| Industrial use | HA178L00P | HA178L00PA |
| Commercial use | HA178L00 | HA178L00A |
| | | HA178L00UA |

HA178L00 Series

Output Voltage and Type

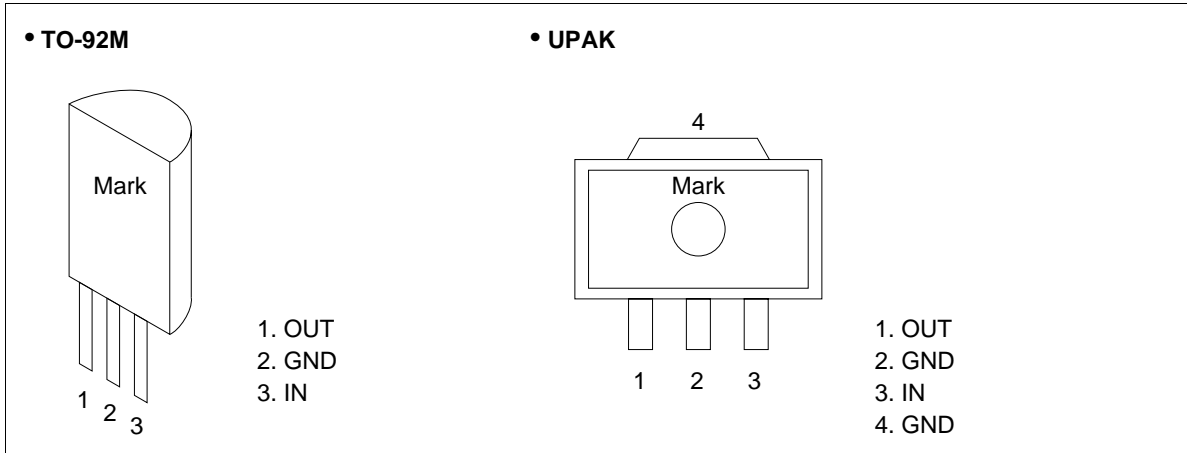
HA178L00PA • HA178L00P • HA178L00A • HA178L00

| Output Voltage (V) | Type | Package |
|--------------------|----------|---------|
| 2.5 | HA178L02 | TO-92M |
| 5 | HA178L05 | |
| 5.6 | HA178L56 | |
| 6 | HA178L06 | |
| 8 | HA178L08 | |
| 9 | HA178L09 | |
| 10 | HA178L10 | |
| 12 | HA178L12 | |
| 15 | HA178L15 | |

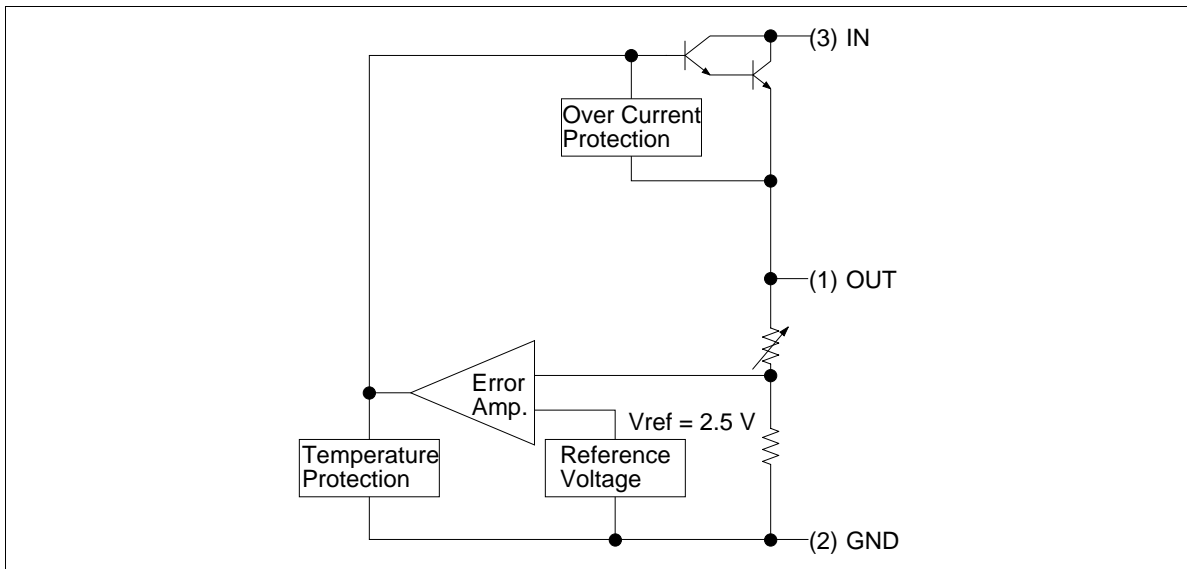
HA178L00UA

| Output Voltage (V) | Type | Marking | Package |
|--------------------|------------|---------|---------|
| 2.5 | HA178L02UA | 8A | UPAK |
| 5 | HA178L05UA | 8B | |
| 5.6 | HA178L56UA | 8C | |
| 6 | HA178L06UA | 8D | |
| 8 | HA178L08UA | 8E | |
| 9 | HA178L09UA | 8F | |
| 10 | HA178L10UA | 8G | |
| 12 | HA178L12UA | 8H | |
| 15 | HA178L15UA | 8J | |

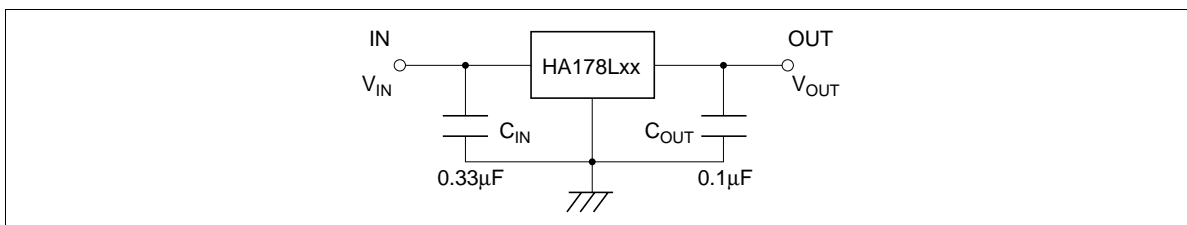
Pin Arrangement



Block Diagram



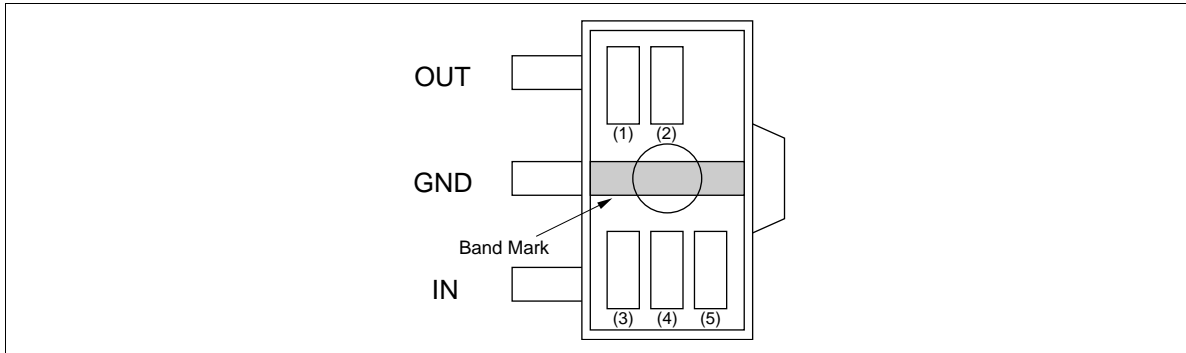
Standard Circuit



HA178L00 Series

UPAK Product (HA178L00UA) 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. (see table 1)

Table 1

| Output Voltage (V) | Product No. | Mark Pattern (2 digit) |
|--------------------|-------------|------------------------|
| 2.5 | HA178L02UA | 8A |
| 5 | HA178L05UA | 8B |
| 5.6 | HA178L56UA | 8C |
| 6 | HA178L06UA | 8D |
| 8 | HA178L08UA | 8E |
| 9 | HA178L09UA | 8F |
| 10 | HA178L10UA | 8G |
| 12 | HA178L12UA | 8H |
| 15 | HA178L15UA | 8J |

3. (3) shows the production year code (the last digit of the year).
 4. (4) shows the production month code (see table 2).

Table 2

| 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.

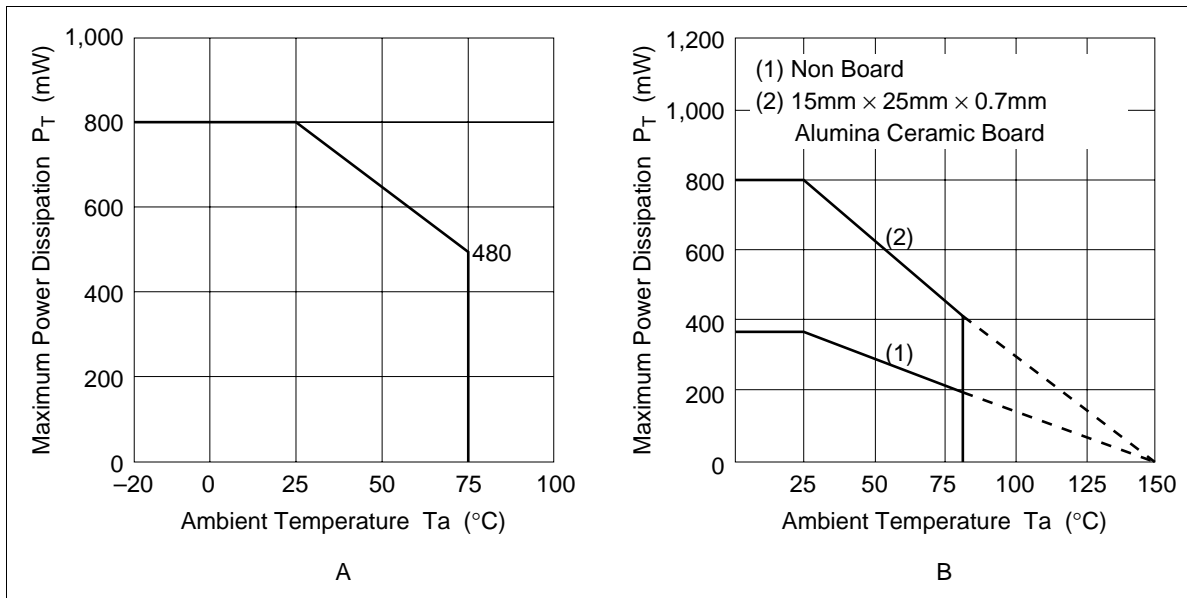
HITACHI

HA178L00 Series

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

| Item | Symbol | Rating | Unit | Note |
|-------------------------------|-----------|-------------|------------------|----------------------|
| Input voltage | V_{IN} | 35 | V | |
| Power dissipation | P_T | 800 | mW | TO-92M ^{*1} |
| | | 800 | mW | UPAK ^{*2} |
| Operating ambient temperature | T_{opr} | -20 to +75 | $^\circ\text{C}$ | TO-92M |
| | | -20 to +85 | $^\circ\text{C}$ | UPAK |
| Storage temperature | T_{stg} | -55 to +150 | $^\circ\text{C}$ | |

Note: 1. $T_a \leq 25^\circ\text{C}$, If $T_a > 25^\circ\text{C}$, derate by $6.4 \text{ mW}/^\circ\text{C}$ (See figure A)
 2. $15\text{mm} \times 25\text{mm} \times 0.7 \text{ mm}$ alumina ceramic board, $T_a \leq 25^\circ\text{C}$ (See figure B)



HA178L00 Series

HA178L02 Electrical Characteristics

($V_{IN} = 10\text{ V}$, $I_{OUT} = 40\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\ \mu\text{F}$, $C_{OUT} = 0.1\ \mu\text{F}$)

| Item | Symbol | HA178L02P HA178L02 | | | HA178L02PA HA178L02A HA178L02UA | | | Unit | Test Conditions |
|---|-----------------------------|-----------------------|------|------|---------------------------------------|------|------|-------|--|
| | | Min | Typ | Max | Min | Typ | Max | | |
| Output voltage | V_{OUT} | 2.32 | 2.48 | 2.64 | 2.38 | 2.48 | 2.58 | V | $T_j = 25^\circ\text{C}$ |
| Line regulation | δV_{OLINE} | — | 35 | 125 | — | 35 | 95 | mV | $T_j = 25^\circ\text{C}$ $7\text{ V} \leq V_{IN} \leq 20\text{ V}$ $8\text{ V} \leq V_{IN} \leq 20\text{ V}$ |
| | | — | 30 | 100 | — | 30 | 75 | | |
| Load regulation | δV_{LOAD} | — | 14 | — | — | 14 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | 9.5 | 50 | — | 9.5 | 50 | | |
| | | — | 4.5 | 25 | — | 4.5 | 25 | | |
| Output voltage | V_{OUT} | 2.28 | — | 2.68 | 2.35 | — | 2.61 | V | $7\text{ V} \leq V_{IN} \leq 20\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ $V_{IN} = 9\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| | | 2.28 | — | 2.68 | 2.35 | — | 2.61 | | |
| Quiescent current | I_Q | — | 3.0 | 6.0 | — | 3.0 | 6.0 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $8\text{ V} \leq V_{IN} \leq 20\text{ V}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | — | 0.2 | — | — | 0.1 | | |
| Ripple rejection ratio | R_{REJ} | — | 60 | — | — | 60 | — | dB | $f = 120\text{ Hz}$, $8.0\text{ V} \leq V_{IN} < 18\text{ V}$, $T_j = 25^\circ\text{C}$ |
| Temperature coefficient of output voltage | $\delta V_{OUT}/\delta T_j$ | — | +0.2 | — | — | +0.2 | — | mV/°C | $I_{OUT} = 5\text{ mA}$ |

HA178L00 Series

HA178L05 Electrical Characteristics

($V_{IN} = 10\text{ V}$, $I_{OUT} = 40\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\ \mu\text{F}$, $C_{OUT} = 0.1\ \mu\text{F}$)

| Item | Symbol | HA178L05P HA178L05 | | | HA178L05PA HA178L05A HA178L05UA | | | Unit | Test Conditions |
|---|-----------------------------|-----------------------|------|------|---------------------------------------|------|------|-------|--|
| | | Min | Typ | Max | Min | Typ | Max | | |
| Output voltage | V_{OUT} | 4.68 | 5.0 | 5.32 | 4.8 | 5.0 | 5.2 | V | $T_j = 25^\circ\text{C}$ |
| Line regulation | δV_{OLINE} | — | 55 | 200 | — | 55 | 150 | mV | $T_j = 25^\circ\text{C}$ $7\text{ V} \leq V_{IN} \leq 20\text{ V}$ $8\text{ V} \leq V_{IN} \leq 20\text{ V}$ |
| | | — | 45 | 150 | — | 45 | 100 | | |
| Load regulation | δV_{LOAD} | — | 16 | — | — | 16 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | 11 | 60 | — | 11 | 60 | | |
| | | — | 5.0 | 30 | — | 5.0 | 30 | | |
| Output voltage | V_{OUT} | 4.6 | — | 5.4 | 4.75 | — | 5.25 | V | $7\text{ V} \leq V_{IN} \leq 20\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ $V_{IN} = 10\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| | | 4.6 | — | 5.4 | 4.75 | — | 5.25 | | |
| Quiescent current | I_Q | — | 3.0 | 6.0 | — | 3.0 | 6.0 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $8.0\text{ V} \leq V_{IN} \leq 20\text{ V}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | — | 0.2 | — | — | 0.1 | | |
| Ripple rejection ratio | R_{REJ} | — | 58 | — | — | 58 | — | dB | $f = 120\text{ Hz}$, $8.0\text{ V} \leq V_{IN} < 18\text{ V}$, $T_j = 25^\circ\text{C}$ |
| 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 | $T_j = 25^\circ\text{C}$ |

HA178L00 Series

HA178L56 Electrical Characteristics

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

| Item | Symbol | HA178L56P HA178L56 | | | HA178L56PA HA178L56A HA178L56UA | | | Unit | Test Conditions |
|---|-----------------------------|-----------------------|------|------|---------------------------------------|------|------|-------|--|
| | | Min | Typ | Max | Min | Typ | Max | | |
| Output voltage | V_{OUT} | 5.24 | 5.6 | 5.96 | 5.38 | 5.6 | 5.82 | V | $T_j = 25^\circ\text{C}$ |
| Line regulation | δV_{OLINE} | — | 50 | 200 | — | 50 | 150 | mV | $T_j = 25^\circ\text{C}$ $7.6\text{ V} \leq V_{IN} \leq 21\text{ V}$ $8.5\text{ V} \leq V_{IN} \leq 21\text{ V}$ |
| | | — | 45 | 150 | — | 45 | 100 | | |
| Load regulation | δV_{OLOAD} | — | 17 | — | — | 17 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | 11 | 60 | — | 11 | 60 | | |
| | | — | 5.0 | 30 | — | 5.0 | 30 | | |
| Output voltage | V_{OUT} | 5.16 | — | 6.04 | 5.32 | — | 5.88 | V | $7.6\text{ V} \leq V_{IN} \leq 21\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | 5.16 | — | 6.04 | 5.32 | — | 5.88 | | $V_{IN} = 11\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| Quiescent current | I_Q | — | 3.0 | 6.0 | — | 3.0 | 6.0 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $8.5\text{ V} \leq V_{IN} \leq 2.0\text{ V}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | — | 0.2 | — | — | 0.1 | | |
| Ripple rejection ratio | R_{REJ} | — | 58 | — | — | 58 | — | dB | $f = 120\text{ Hz}$, $8.5\text{ V} \leq V_{IN} < 18.5\text{ V}$, $T_j = 25^\circ\text{C}$ |
| 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 | $T_j = 25^\circ\text{C}$ |

HA178L00 Series

HA178L06 Electrical Characteristics

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

| 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 | δV_{OLINE} | — | 50 | 200 | — | 50 | 150 | mV | $T_j = 25^\circ\text{C}$ $8.1\text{ V} \leq V_{IN} \leq 21\text{ V}$ |
| | | — | 45 | 150 | — | 45 | 110 | | $9.0\text{ V} \leq V_{IN} \leq 21\text{ V}$ |
| Load regulation | δV_{LOAD} | — | 17.5 | — | — | 17.5 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ |
| | | — | 12 | 70 | — | 12 | 70 | | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ |
| | | — | 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 | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $9.0\text{ V} \leq V_{IN} \leq 20\text{ V}$ |
| | | — | — | 0.2 | — | — | 0.1 | | $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| 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/ $^\circ\text{C}$ | $I_{OUT} = 5\text{ mA}$ |
| Dropout voltage | V_{DROP} | — | 1.7 | — | — | 1.7 | — | V | $T_j = 25^\circ\text{C}$ |

HA178L00 Series

HA178L08 Electrical Characteristics

($V_{IN} = 14\text{ V}$, $I_{OUT} = 40\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\ \mu\text{F}$, $C_{OUT} = 0.1\ \mu\text{F}$)

| Item | Symbol | HA178L08P HA178L08 | | | HA178L08PA HA178L08A HA178L08UA | | | Unit | Test Conditions |
|---|-----------------------------|-----------------------|------|------|---------------------------------------|------|-----|-------|--|
| | | Min | Typ | Max | Min | Typ | Max | | |
| Output voltage | V_{OUT} | 7.48 | 8.0 | 8.52 | 7.7 | 8.0 | 8.3 | V | $T_j = 25^\circ\text{C}$ |
| Line regulation | δV_{OLINE} | — | 20 | 200 | — | 20 | 175 | mV | $T_j = 25^\circ\text{C}$ $10.5\text{ V} \leq V_{IN} \leq 23\text{ V}$ $11\text{ V} \leq V_{IN} \leq 23\text{ V}$ |
| | | — | 12 | 150 | — | 12 | 125 | | |
| Load regulation | δV_{OLOAD} | — | 22 | — | — | 22 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | 15 | 80 | — | 15 | 80 | | |
| | | — | 7.0 | 40 | — | 7.0 | 40 | | |
| Output voltage | V_{OUT} | 7.36 | — | 8.64 | 7.6 | — | 8.4 | V | $10.5\text{ V} \leq V_{IN} \leq 23\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ $V_{IN} = 14\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| | | 7.36 | — | 8.64 | 7.6 | — | 8.4 | | |
| Quiescent current | I_Q | — | 3.0 | 6.5 | — | 3.0 | 6.5 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $11\text{ V} \leq V_{IN} \leq 23\text{ V}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | — | 0.2 | — | — | 0.1 | | |
| Ripple rejection ratio | R_{REJ} | — | 55 | — | — | 55 | — | dB | $f = 120\text{ Hz}$, $12\text{ V} \leq V_{IN} < 23\text{ V}$, $T_j = 25^\circ\text{C}$ |
| 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 | $T_j = 25^\circ\text{C}$ |

HA178L00 Series

HA178L09 Electrical Characteristics

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

| 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 | δV_{OLINE} | — | 80 | 230 | — | 80 | 200 | mV | $T_j = 25^\circ\text{C}$ $11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$ $12\text{ V} \leq V_{IN} \leq 24\text{ V}$ |
| | | — | 20 | 160 | — | 20 | 160 | | |
| Load regulation | δV_{OLOAD} | — | 24.5 | — | — | 24.5 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | 17 | 90 | — | 17 | 90 | | |
| | | — | 8.0 | 45 | — | 8.0 | 45 | | |
| Output voltage | V_{OUT} | 8.28 | — | 9.72 | 8.55 | — | 9.45 | V | $11.4\text{ V} \leq V_{IN} \leq 24\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ $V_{IN} = 15\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| | | 8.28 | — | 9.72 | 8.55 | — | 9.45 | | |
| Quiescent current | I_Q | — | 3.1 | 6.5 | — | 3.1 | 6.5 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $12\text{ V} \leq V_{IN} \leq 24\text{ V}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | — | 0.2 | — | — | 0.1 | | |
| 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/ $^\circ\text{C}$ | $I_{OUT} = 5\text{ mA}$ |
| Dropout voltage | V_{DROP} | — | 1.7 | — | — | 1.7 | — | V | $T_j = 25^\circ\text{C}$ |

HA178L00 Series

HA178L10 Electrical Characteristics

($V_{IN} = 16\text{ V}$, $I_{OUT} = 40\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\ \mu\text{F}$, $C_{OUT} = 0.1\ \mu\text{F}$)

| Item | Symbol | HA178L10P HA178L10 | | | HA178L10PA HA178L10A HA178L10UA | | | Unit | Test Conditions |
|---|-----------------------------|-----------------------|------|-------|---------------------------------------|------|------|-------|--|
| | | Min | Typ | Max | Min | Typ | Max | | |
| Output voltage | V_{OUT} | 9.35 | 10 | 10.65 | 9.6 | 10 | 10.4 | V | $T_j = 25^\circ\text{C}$ |
| Line regulation | δV_{OLINE} | — | 80 | 230 | — | 80 | 230 | mV | $T_j = 25^\circ\text{C}$ $12.5\text{ V} \leq V_{IN} \leq 25\text{ V}$ |
| | | — | 30 | 170 | — | 30 | 170 | | $13\text{ V} \leq V_{IN} \leq 25\text{ V}$ |
| Load regulation | δV_{OLOAD} | — | 26 | — | — | 26 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ |
| | | — | 18 | 90 | — | 18 | 90 | | $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ |
| | | — | 8.5 | 45 | — | 8.5 | 45 | | $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| Output voltage | V_{OUT} | 9.2 | — | 10.8 | 9.5 | — | 10.5 | V | $12.5\text{ V} \leq V_{IN} \leq 25\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | 9.2 | — | 10.8 | 9.5 | — | 10.5 | | $V_{IN} = 16\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| Quiescent current | I_Q | — | 3.1 | 6.5 | — | 3.1 | 6.5 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $13\text{ V} \leq V_{IN} \leq 25\text{ V}$ |
| | | — | — | 0.2 | — | — | 0.1 | | $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| Ripple rejection ratio | R_{REJ} | — | 54 | — | — | 54 | — | dB | $f = 120\text{ Hz}$, $13\text{ V} \leq V_{IN} < 24\text{ V}$, $T_j = 25^\circ\text{C}$ |
| Temperature coefficient of output voltage | $\delta V_{OUT}/\delta T_j$ | — | -0.2 | — | — | -0.2 | — | mV/°C | $I_{OUT} = 5\text{ mA}$ |
| Dropout voltage | V_{DROP} | — | 1.7 | — | — | 1.7 | — | V | $T_j = 25^\circ\text{C}$ |

HA178L00 Series

HA178L12 Electrical Characteristics

($V_{IN} = 19\text{ V}$, $I_{OUT} = 40\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\ \mu\text{F}$, $C_{OUT} = 0.1\ \mu\text{F}$)

| Item | Symbol | HA178L12P HA178L12 | | | HA178L12PA HA178L12A HA178L12UA | | | Unit | Test Conditions |
|---|-----------------------------|-----------------------|------|-------|---------------------------------------|------|------|-------|--|
| | | Min | Typ | Max | Min | Typ | Max | | |
| Output voltage | V_{OUT} | 11.22 | 12 | 12.78 | 11.5 | 12 | 12.5 | V | $T_j = 25^\circ\text{C}$ |
| Line regulation | δV_{OLINE} | — | 120 | 250 | — | 120 | 250 | mV | $T_j = 25^\circ\text{C}$ $14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$ $16\text{ V} \leq V_{IN} \leq 27\text{ V}$ |
| | | — | 100 | 200 | — | 100 | 200 | | |
| Load regulation | δV_{OLOAD} | — | 28.5 | — | — | 28.5 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | 20 | 100 | — | 20 | 100 | | |
| | | — | 10 | 50 | — | 10 | 50 | | |
| Output voltage | V_{OUT} | 11.04 | — | 12.96 | 11.4 | — | 12.6 | V | $14.5\text{ V} \leq V_{IN} \leq 27\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ $V_{IN} = 19\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| | | 11.04 | — | 12.96 | 11.4 | — | 12.6 | | |
| Quiescent current | I_Q | — | 3.1 | 6.5 | — | 3.1 | 6.5 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $16\text{ V} \leq V_{IN} \leq 27\text{ V}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | — | 0.2 | — | — | 0.1 | | |
| Ripple rejection ratio | R_{REJ} | — | 52 | — | — | 52 | — | dB | $f = 120\text{ Hz}$, $15\text{ V} \leq V_{IN} < 25\text{ V}$, $T_j = 25^\circ\text{C}$ |
| Temperature coefficient of output voltage | $\delta V_{OUT}/\delta T_j$ | — | -0.3 | — | — | -0.3 | — | mV/°C | $I_{OUT} = 5\text{ mA}$ |
| Dropout voltage | V_{DROP} | — | 1.7 | — | — | 1.7 | — | V | $T_j = 25^\circ\text{C}$ |

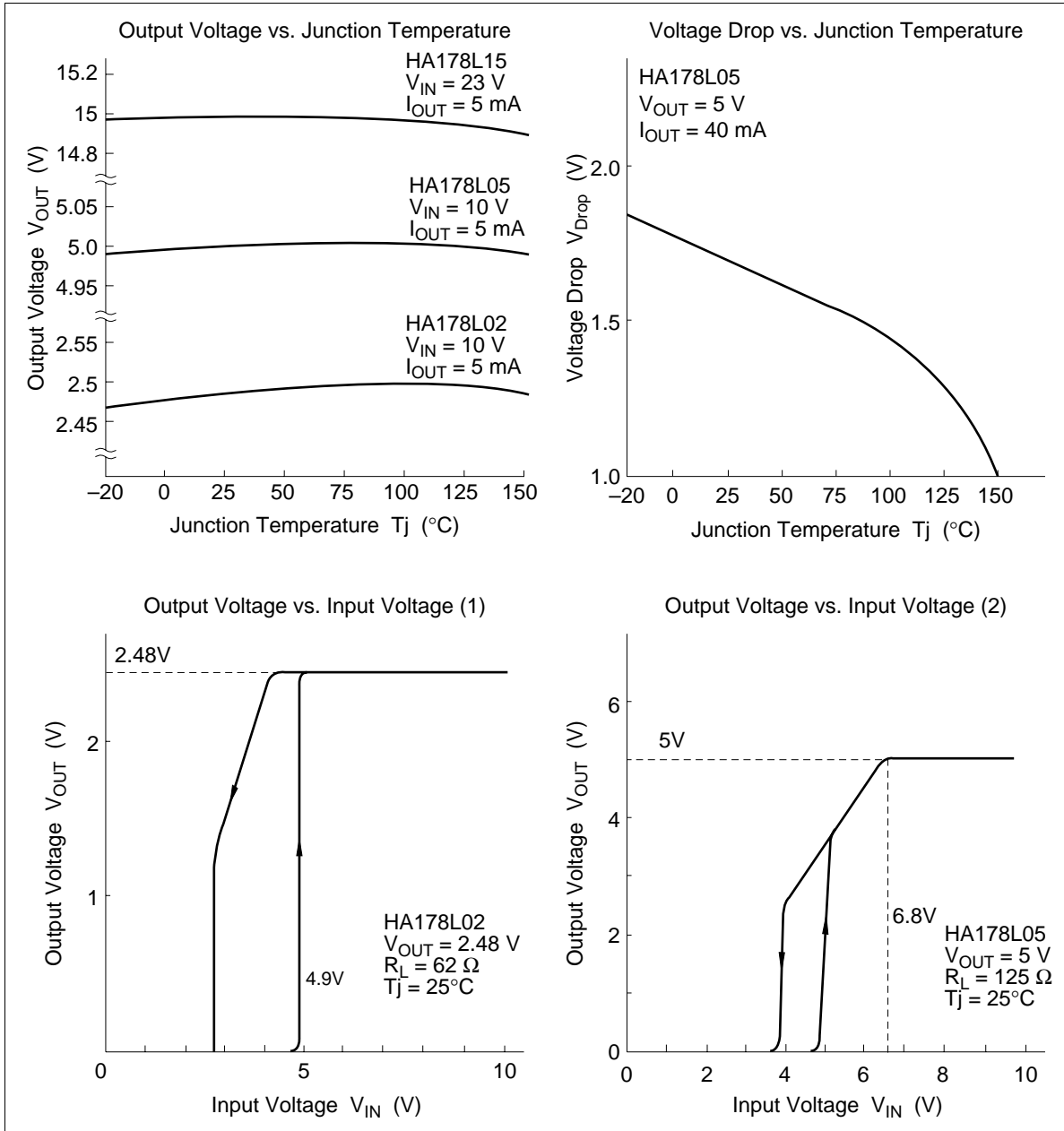
HA178L00 Series

HA178L15 Electrical Characteristics

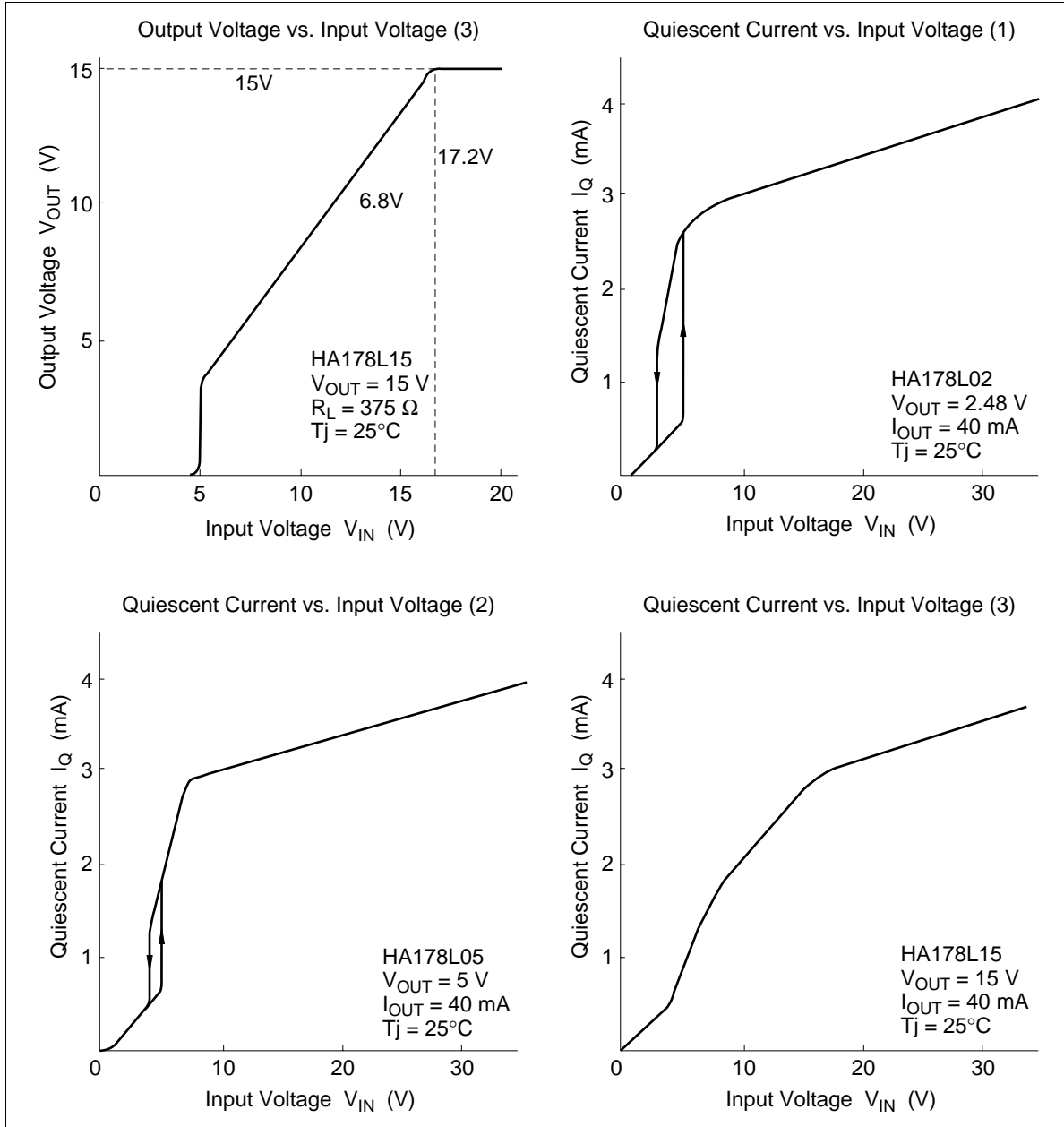
($V_{IN} = 23\text{ V}$, $I_{OUT} = 40\text{ mA}$, $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$, $C_{IN} = 0.33\ \mu\text{F}$, $C_{OUT} = 0.1\ \mu\text{F}$)

| Item | Symbol | HA178L15P HA178L15 | | | HA178L15PA HA178L15A HA178L15UA | | | Unit | Test Conditions |
|---|-----------------------------|-----------------------|------|-------|---------------------------------------|------|-------|-------|--|
| | | Min | Typ | Max | Min | Typ | Max | | |
| Output voltage | V_{OUT} | 14.03 | 15 | 15.97 | 14.4 | 15 | 15.6 | V | $T_j = 25^\circ\text{C}$ |
| Line regulation | δV_{OLINE} | — | 130 | 300 | — | 130 | 300 | mV | $T_j = 25^\circ\text{C}$ $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$ $20\text{ V} \leq V_{IN} \leq 30\text{ V}$ |
| | | — | 110 | 250 | — | 110 | 250 | | |
| Load regulation | δV_{OLOAD} | — | 36 | — | — | 36 | — | mV | $T_j = 25^\circ\text{C}$ $1.0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 100\text{ mA}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | 25 | 150 | — | 25 | 150 | | |
| | | — | 12 | 75 | — | 12 | 75 | | |
| Output voltage | V_{OUT} | 13.8 | — | 16.2 | 14.25 | — | 15.75 | V | $17.5\text{ V} \leq V_{IN} \leq 30\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ $V_{IN} = 23\text{ V}$, $1.0\text{ mA} \leq I_{OUT} \leq 70\text{ mA}$ |
| | | 13.8 | — | 16.2 | 14.25 | — | 15.75 | | |
| Quiescent current | I_Q | — | 3.2 | 6.5 | — | 3.2 | 6.5 | mA | $T_j = 25^\circ\text{C}$ |
| Quiescent current change | δI_Q | — | — | 1.5 | — | — | 1.5 | mA | $T_j = 25^\circ\text{C}$ $20\text{ V} \leq V_{IN} \leq 30\text{ V}$ $1.0\text{ mA} \leq I_{OUT} \leq 40\text{ mA}$ |
| | | — | — | 0.2 | — | — | 0.1 | | |
| Ripple rejection ratio | R_{REJ} | — | 49 | — | — | 49 | — | dB | $f = 120\text{ Hz}$, $18.5\text{ V} \leq V_{IN} < 28.5\text{ V}$, $T_j = 25^\circ\text{C}$ |
| Temperature coefficient of output voltage | $\delta V_{OUT}/\delta T_j$ | — | -0.5 | — | — | -0.5 | — | mV/°C | $I_{OUT} = 5\text{ mA}$ |
| Dropout voltage | V_{DROP} | — | 1.7 | — | — | 1.7 | — | V | $T_j = 25^\circ\text{C}$ |

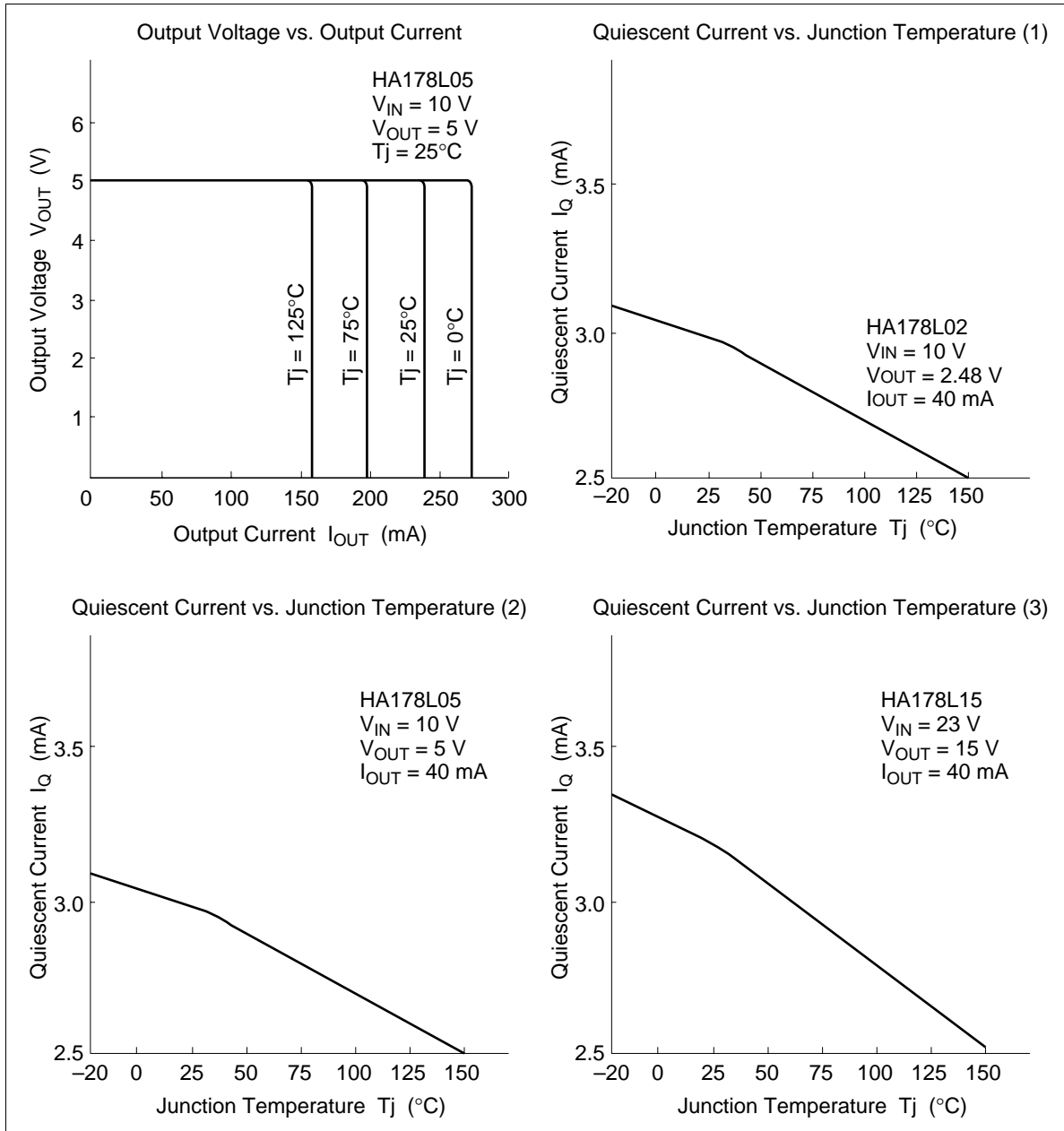
Characteristic Curves



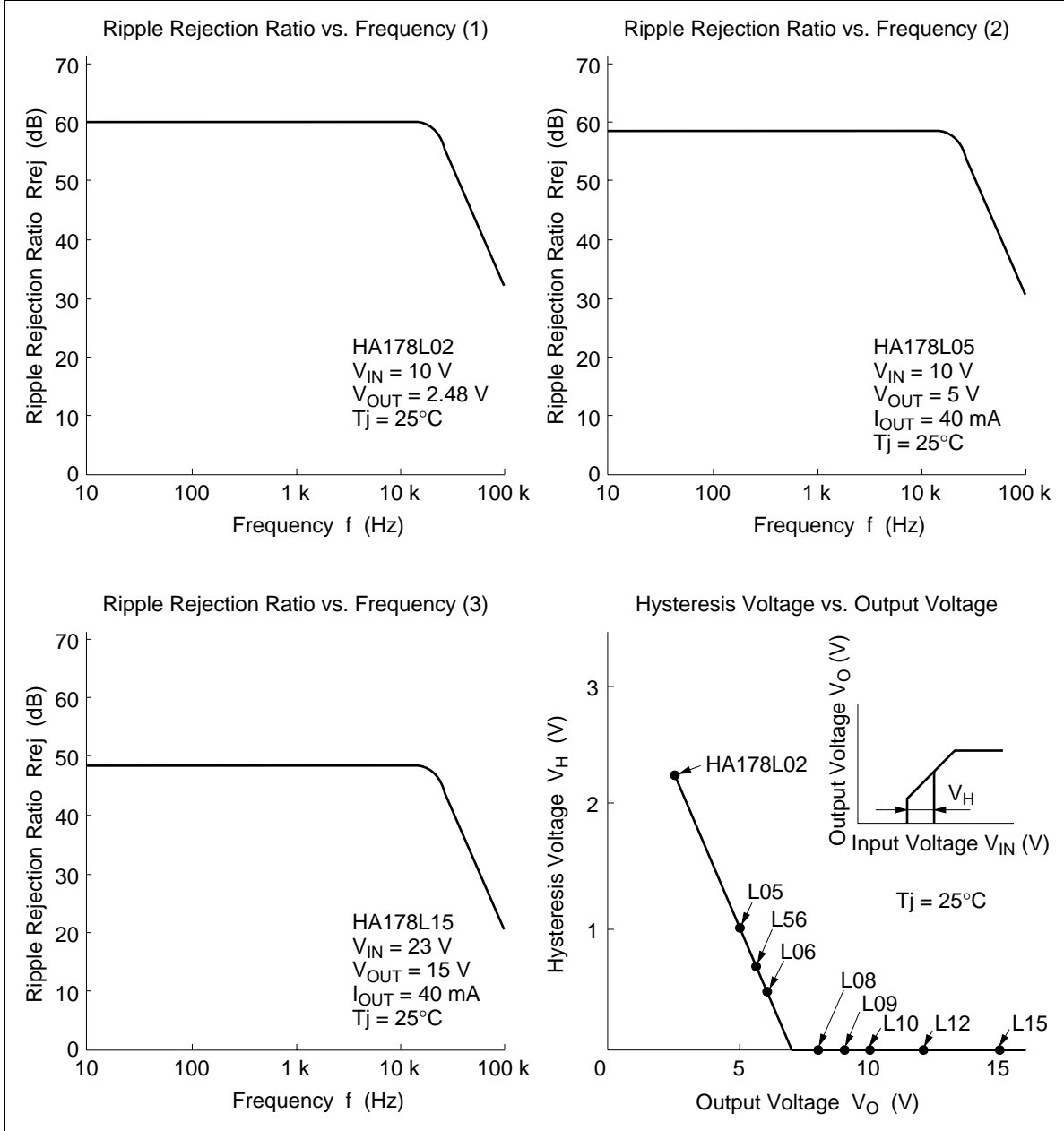
HA178L00 Series



HA178L00 Series

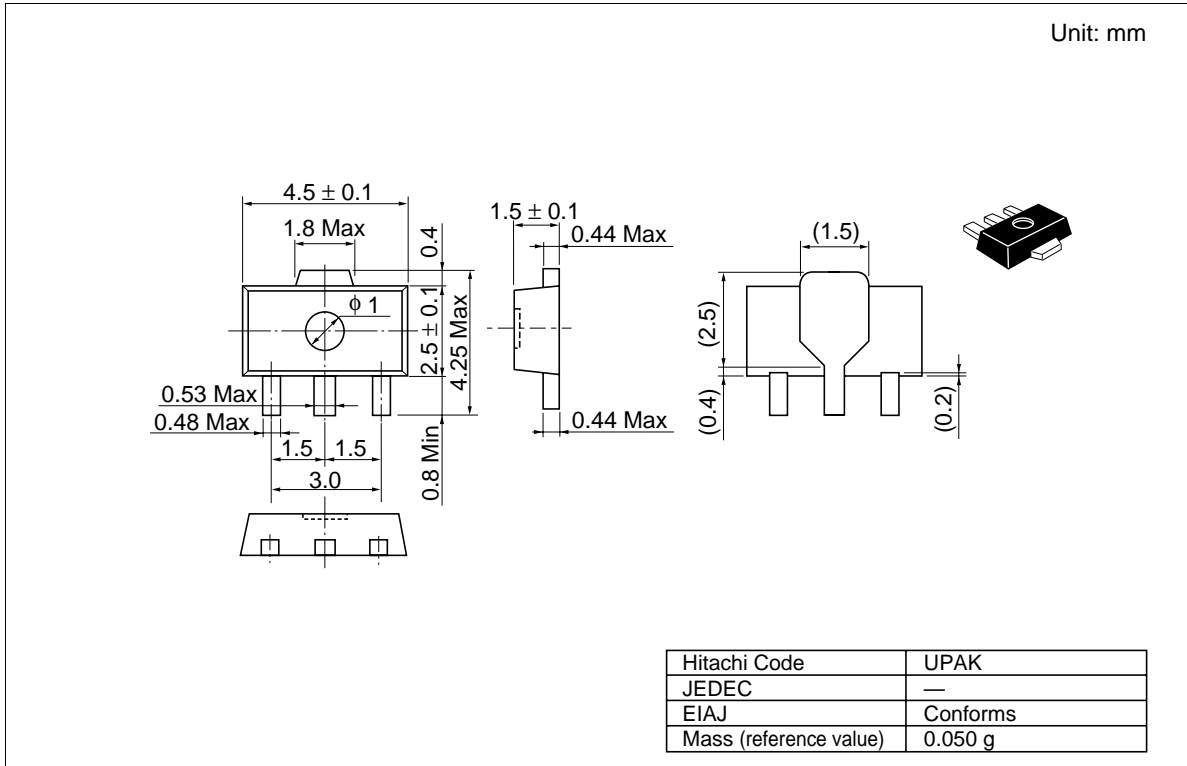


HA178L00 Series



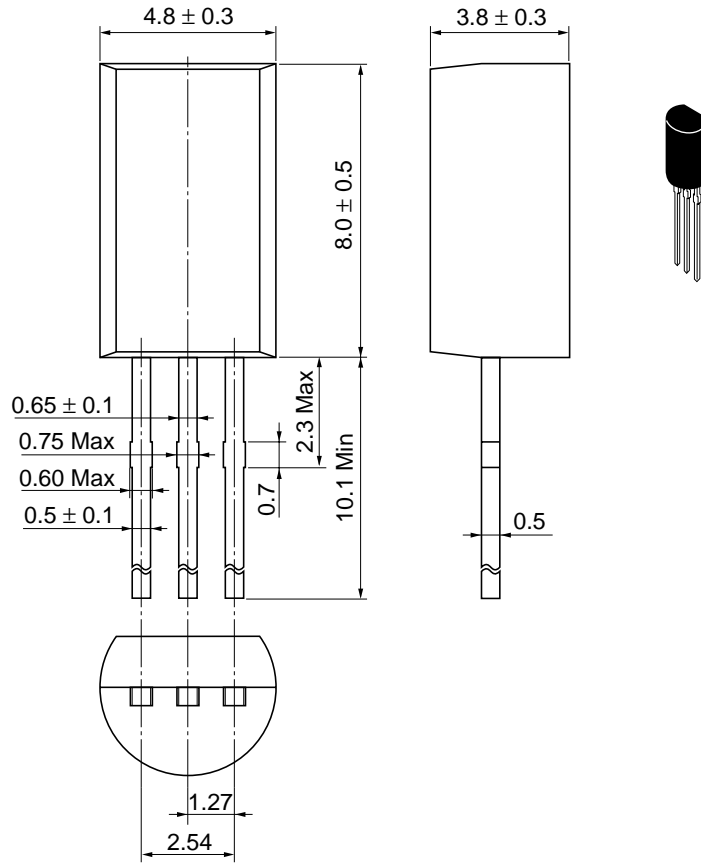
HA178L00 Series

Package Dimensions



HA178L00 Series

Unit: mm



| | |
|------------------------|-----------|
| Hitachi Code | TO-92 Mod |
| JEDEC | — |
| EIAJ | Conforms |
| Mass (reference value) | 0.35 g |

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Hitachi, Ltd.

Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL NorthAmerica : <http://semiconductor.hitachi.com/>
 Europe : <http://www.hitachi-eu.com/hel/ecg>
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For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose, CA 95134
Tel: <1>(408) 433-1990
Fax: <1>(408) 433-0223

Hitachi Europe GmbH
Electronic Components Group
Dornacher StraÙe 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 585160

Hitachi Asia Ltd.
Hitachi Tower
16 Collyer Quay #20-00,
Singapore 049318
Tel : <65>-538-6533/538-8577
Fax : <65>-538-6933/538-3877
URL : <http://www.hitachi.com.sg>

Hitachi Asia Ltd.
(Taipei Branch Office)
4/F, No. 167, Tun Hwa North Road,
Hung-Kuo Building,
Taipei (105), Taiwan
Tel : <886>-(2)-2718-3666
Fax : <886>-(2)-2718-8180
Telex : 23222 HAS-TP
URL : <http://www.hitachi.com.tw>

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon,
Hong Kong
Tel : <852>-(2)-735-9218
Fax : <852>-(2)-730-0281
URL : <http://www.hitachi.com.hk>

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