

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

## TA78DL05AF, TA78DL06AF, TA78DL08AF, TA78DL09AF, TA78DL10AF, TA78DL12AF, TA78DL15AF

5 V, 6 V, 8 V, 9 V, 10 V, 12 V, 15 V

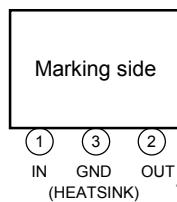
Three-Terminal Low Dropout Voltage Regulator

The TA78DL××AF series consists of fixed-positive-output voltage regulator ICs capable of sourcing current of up to 250 mA. Due to the features of low dropout voltage and low standby current, these devices are useful for battery-powered equipment. This series includes built-in current limiting, thermal shutdown, overvoltage protection, input fault protection and excessive transient protection circuits.

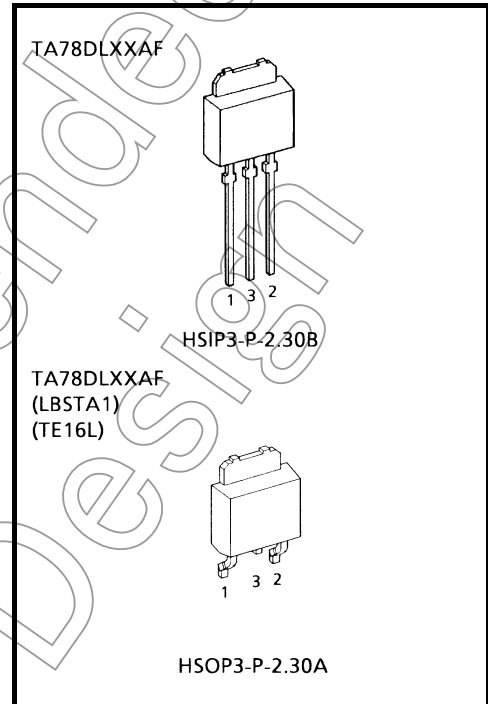
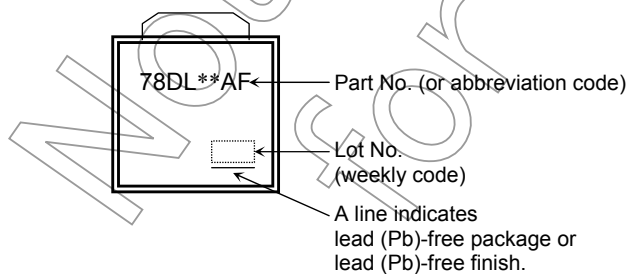
### Features

- Low standby current of 500  $\mu$ A typical.
- Maximum output current of 250 mA.
- Low dropout voltage of less than 0.6 V (@  $I_{OUT} = 0.2$  A).
- Multi-protection:  
Reverse connection of power supply, 60 V load dump, thermal shut down and current limiting.
- Packaged in POWER MOLD.

### Pin Assignment

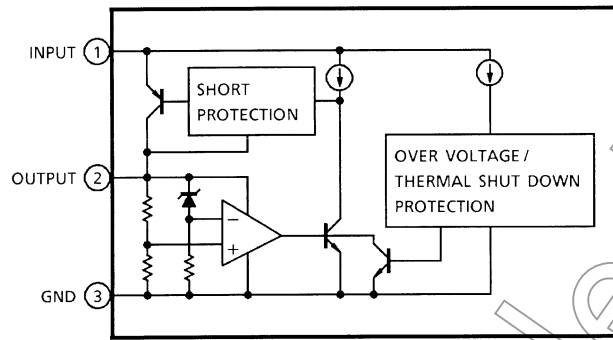


### Marking



Weight  
 HSIP3-P-2.30B: 0.36 g (Typ.)  
 HSOP3-P-2.30A: 0.36 g (Typ.)

## Block Diagram



## Absolute Maximum Ratings (Ta = 25°C)

| Characteristics          | Symbol        | Rating      | Unit |
|--------------------------|---------------|-------------|------|
| Operating input voltage  | $V_{IN}$      | 29          | V    |
| Input voltage of surge   | $V_{IN}$      | 60          | V    |
| Power dissipation        | $P_D$         | (Ta = 25°C) | 1    |
|                          |               | (Tc = 25°C) | 10   |
| Operating temperature    | $T_{opr}$     | -40~85      | °C   |
| Storage temperature      | $T_{stg}$     | -55~150     | °C   |
| Junction temperature     | $T_j$         | 150         | °C   |
| Thermal resistance       | $R_{th(j-c)}$ | 12.5        | °C/W |
|                          | $R_{th(j-a)}$ | 125         |      |
| Storage temperature time | $T_{sol}$     | 260 (10s)   | °C   |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

## TA78DL05AF

### Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 14$  V,  $I_{OUT} = 10$  mA,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition   | Min  | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|--|------|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $5.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 4.75 | 5    | 5.25 | V    |
| Line regulation       | Reg-line  | —            | $9\text{ V} \leq V_{IN} \leq 16\text{ V}$  | —    | 2    | 10   | mV   |
|                       |           |              | $6\text{ V} \leq V_{IN} \leq 26\text{ V}$  | —    | 4    | 30   |      |
| Load regulation       | Reg-load  | —            | $10\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$   | —    | 14   | 50   | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} \leq 10\text{ mA}$ ,<br>$6\text{ V} \leq V_{IN} \leq 26\text{ V}$                           | —    | 0.5  | 1    | mA   |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 50\text{ mA}$   | —    | 0.15 | 0.3  | V    |
|                       |           |              | $I_{OUT} = 200\text{ mA}$  | —    | 0.4  | 0.6  |      |
| Max operating voltage | $V_{IN}$  | —            | —  | 29   | 33   | —    | V    |

## TA78DL06AF

### Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 14\text{ V}$ ,  $I_{OUT} = 10\text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition   | Min | Typ. | Max | Unit |
|-----------------------|-----------|--------------|--|-----|------|-----|------|
| Output voltage        | $V_{OUT}$ | —            | $6.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 5.7 | 6    | 6.3 | V    |
| Line regulation       | Reg-line  | —            | $10\text{ V} \leq V_{IN} \leq 17\text{ V}$   | —   | 2    | 12  | mV   |
|                       |           |              | $7\text{ V} \leq V_{IN} \leq 26\text{ V}$  | —   | 5    | 36  |      |
| Load regulation       | Reg-load  | —            | $10\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$   | —   | 17   | 60  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} \leq 10\text{ mA}$ ,<br>$7\text{ V} \leq V_{IN} \leq 26\text{ V}$                           | —   | 0.55 | —   | mA   |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 50\text{ mA}$   | —   | 0.15 | 0.3 | V    |
|                       |           |              | $I_{OUT} = 200\text{ mA}$  | —   | 0.4  | 0.6 |      |
| Max operating voltage | $V_{IN}$  | —            | —  | 29  | 33   | —   | V    |

## TA78DL08AF

### Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 16\text{ V}$ ,  $I_{OUT} = 10\text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition   | Min | Typ. | Max | Unit |
|-----------------------|-----------|--------------|--|-----|------|-----|------|
| Output voltage        | $V_{OUT}$ | —            | $8.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 7.6 | 8    | 8.4 | V    |
| Line regulation       | Reg-line  | —            | $12\text{ V} \leq V_{IN} \leq 19\text{ V}$   | —   | 3    | 16  | mV   |
|                       |           |              | $9\text{ V} \leq V_{IN} \leq 26\text{ V}$  | —   | 6    | 45  |      |
| Load regulation       | Reg-load  | —            | $10\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$   | —   | 22   | 80  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} \leq 10\text{ mA}$ ,<br>$9\text{ V} \leq V_{IN} \leq 26\text{ V}$                           | —   | 0.6  | —   | mA   |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 50\text{ mA}$   | —   | 0.15 | 0.3 | V    |
|                       |           |              | $I_{OUT} = 200\text{ mA}$  | —   | 0.4  | 0.6 |      |
| Max operating voltage | $V_{IN}$  | —            | —  | 29  | 33   | —   | V    |

## TA78DL09AF

### Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 16\text{ V}$ ,  $I_{OUT} = 10\text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition   | Min  | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|--|------|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $9.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 8.55 | 9    | 9.45 | V    |
| Line regulation       | Reg-line  | —            | $13\text{ V} \leq V_{IN} \leq 20\text{ V}$   | —    | 3    | 18   | mV   |
|                       |           |              | $10\text{ V} \leq V_{IN} \leq 26\text{ V}$   | —    | 7    | 50   |      |
| Load regulation       | Reg-load  | —            | $10\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$   | —    | 25   | 90   | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} \leq 10\text{ mA}$ ,<br>$10\text{ V} \leq V_{IN} \leq 26\text{ V}$                          | —    | 0.65 | —    | mA   |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 50\text{ mA}$   | —    | 0.15 | 0.3  | V    |
|                       |           |              | $I_{OUT} = 200\text{ mA}$  | —    | 0.4  | 0.6  |      |
| Max operating voltage | $V_{IN}$  | —            | —  | 29   | 33   | —    | V    |

## TA78DL10AF

### Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 16\text{ V}$ ,  $I_{OUT} = 10\text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition  | Min | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|---|-----|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $10.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 9.5 | 10   | 10.5 | V    |
| Line regulation       | Reg.line  | —            | $14\text{ V} \leq V_{IN} \leq 21\text{ V}$  | —   | 4    | 20   | mV   |
|                       |           |              | $11\text{ V} \leq V_{IN} \leq 26\text{ V}$  | —   | 8    | 60   |      |
| Load regulation       | Reg.load  | —            | $10\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$  | —   | 28   | 100  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} \leq 10\text{ mA}$ ,<br>$11\text{ V} \leq V_{IN} \leq 26\text{ V}$                           | —   | 0.7  | —    | mA   |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 50\text{ mA}$  | —   | 0.15 | 0.3  | V    |
|                       |           |              | $I_{OUT} = 200\text{ mA}$   | —   | 0.4  | 0.6  |      |
| Max operating voltage | $V_{IN}$  | —            | —   | 29  | 33   | —    | V    |

## TA78DL12AF

### Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 18\text{ V}$ ,  $I_{OUT} = 10\text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition  | Min  | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|---|------|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $12.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 11.4 | 12   | 12.6 | V    |
| Line regulation       | Reg.line  | —            | $16\text{ V} \leq V_{IN} \leq 23\text{ V}$  | —    | 5    | 24   | mV   |
|                       |           |              | $13\text{ V} \leq V_{IN} \leq 26\text{ V}$  | —    | 10   | 70   |      |
| Load regulation       | Reg.load  | —            | $10\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$  | —    | 33   | 120  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} \leq 10\text{ mA}$ ,<br>$13\text{ V} \leq V_{IN} \leq 26\text{ V}$                           | —    | 0.8  | —    | mA   |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 50\text{ mA}$  | —    | 0.15 | 0.3  | V    |
|                       |           |              | $I_{OUT} = 200\text{ mA}$   | —    | 0.4  | 0.6  |      |
| Max operating voltage | $V_{IN}$  | —            | —   | 29   | 33   | —    | V    |

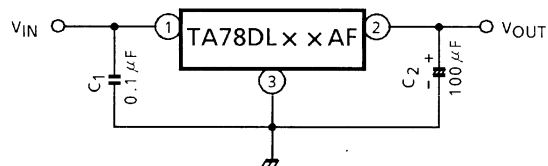
## TA78DL15AF

### Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 20\text{ V}$ ,  $I_{OUT} = 10\text{ mA}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition  | Min   | Typ. | Max   | Unit |
|-----------------------|-----------|--------------|---|-------|------|-------|------|
| Output voltage        | $V_{OUT}$ | —            | $15.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 14.25 | 15   | 15.75 | V    |
| Line regulation       | Reg.line  | —            | $19\text{ V} \leq V_{IN} \leq 26\text{ V}$  | —     | 6    | 30    | mV   |
|                       |           |              | $16\text{ V} \leq V_{IN} \leq 26\text{ V}$  | —     | 12   | 80    |      |
| Load regulation       | Reg.load  | —            | $10\text{ mA} \leq I_{OUT} \leq 200\text{ mA}$  | —     | 40   | 150   | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} \leq 10\text{ mA}$ ,<br>$16\text{ V} \leq V_{IN} \leq 26\text{ V}$                           | —     | 0.9  | —     | mA   |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 50\text{ mA}$  | —     | 0.15 | 0.3   | V    |
|                       |           |              | $I_{OUT} = 200\text{ mA}$   | —     | 0.4  | 0.6   |      |
| Max operating voltage | $V_{IN}$  | —            | —   | 29    | 33   | —     | V    |

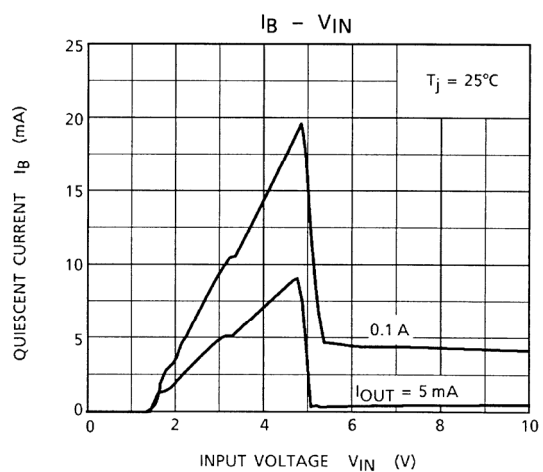
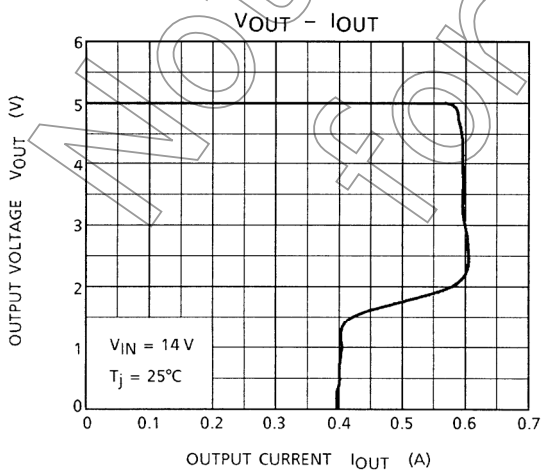
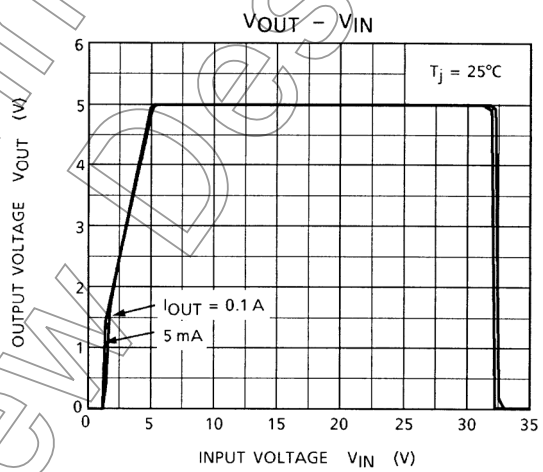
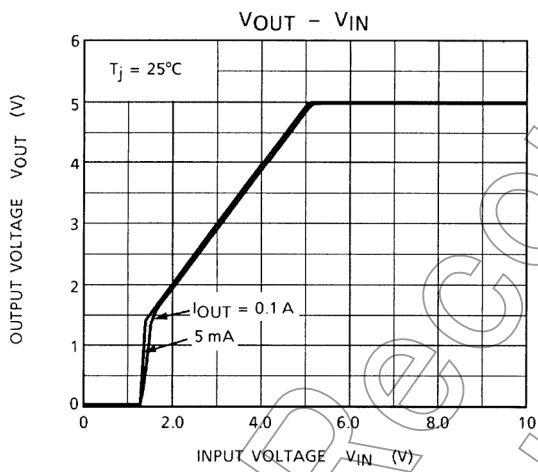
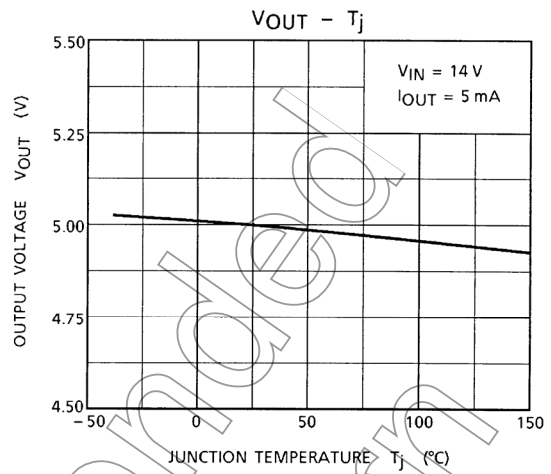
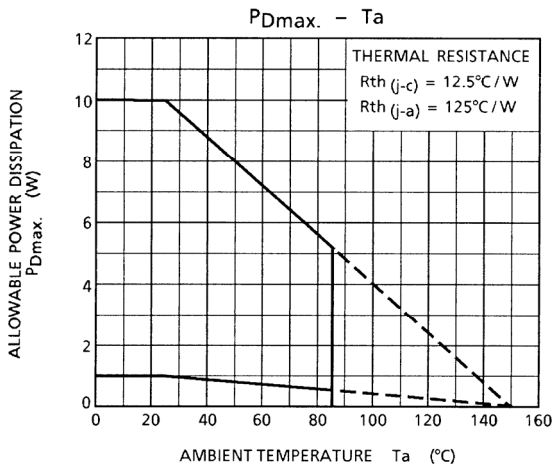
## Application Circuit

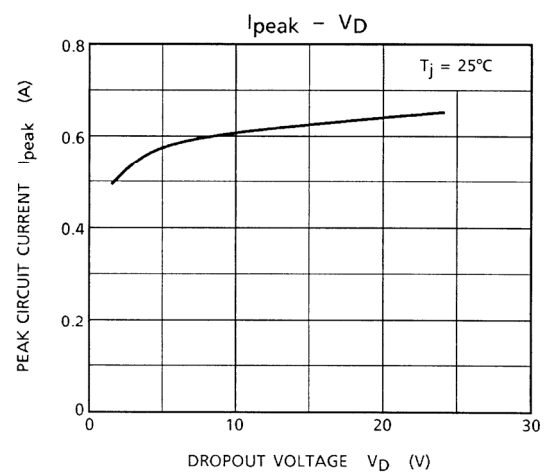
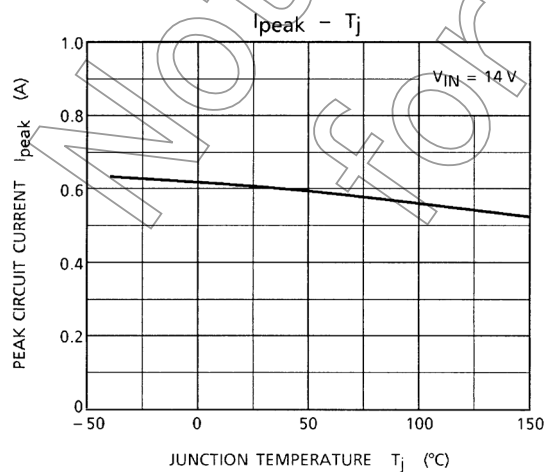
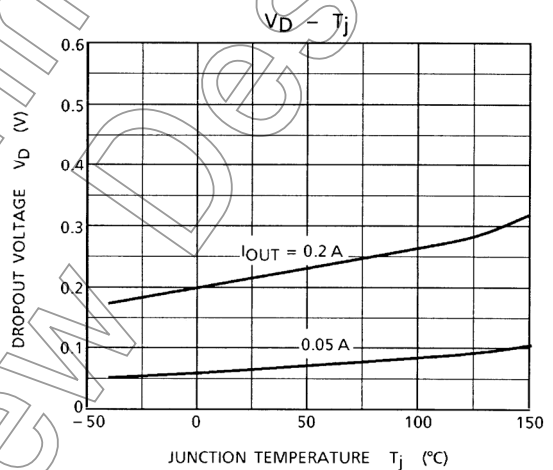
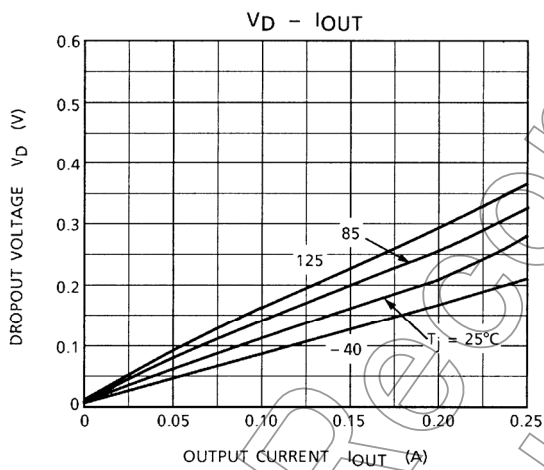
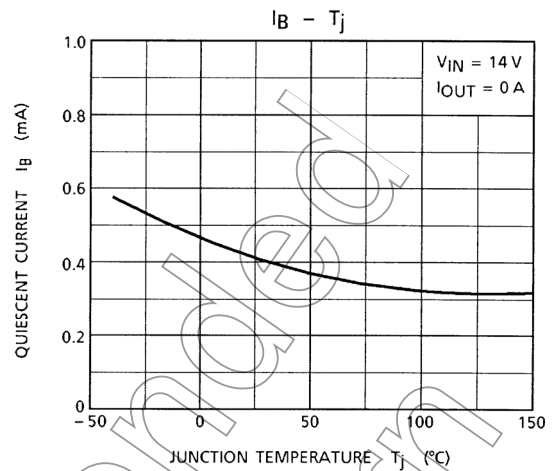
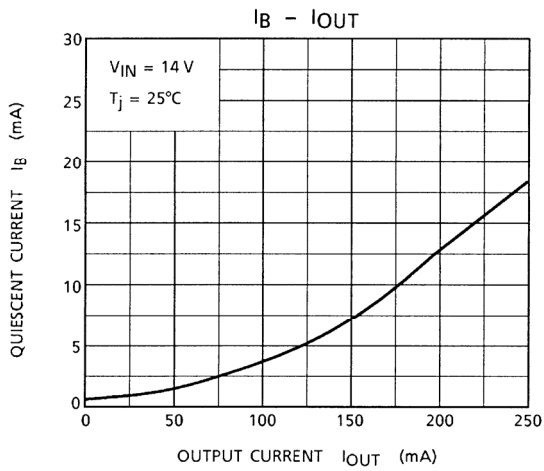


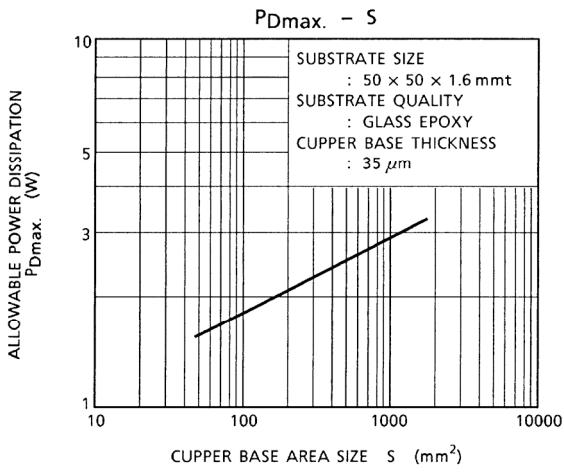
The capacitors  $C_{IN}/C_{OUT}$  must be guaranteed to operate within the temperature range in which the regulator operates correctly.

The equivalent series resistance (ESR) of  $C_{OUT}$  must be less than 1  $\Omega$  inside the operating temperature range.

Not Recommended  
for New Design







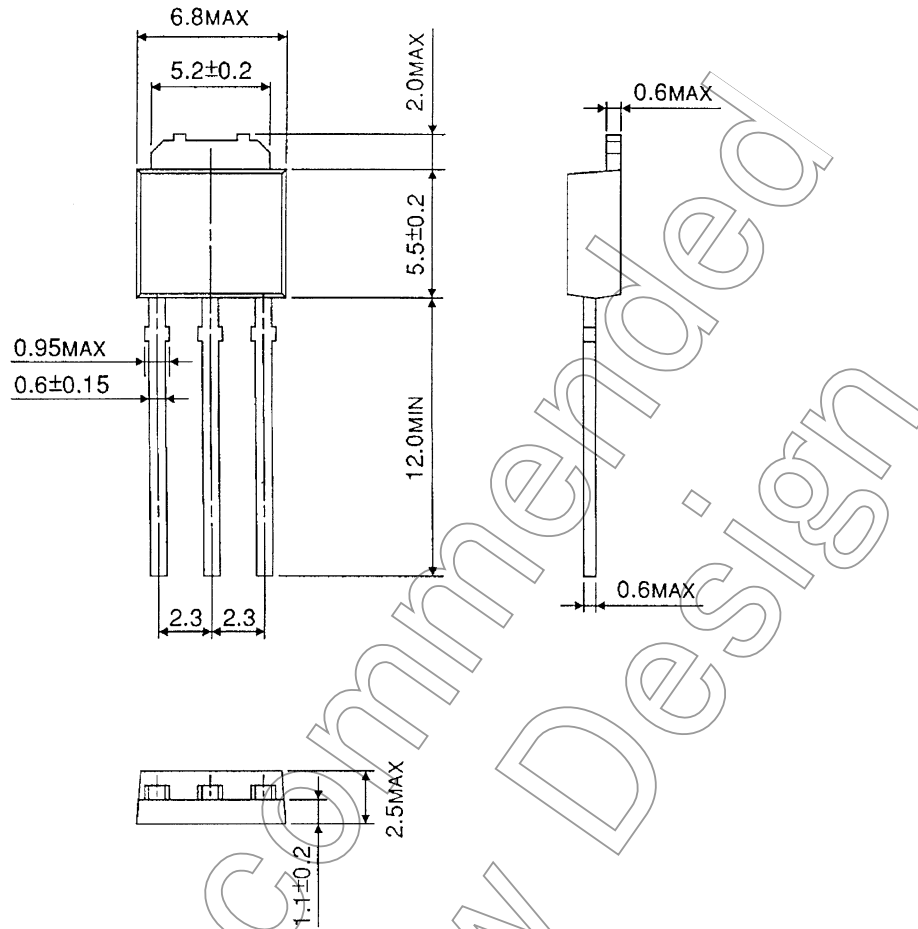
Not Recommended  
for New Design



## Package Dimensions

HSIP3-P-2.30B

Unit : mm



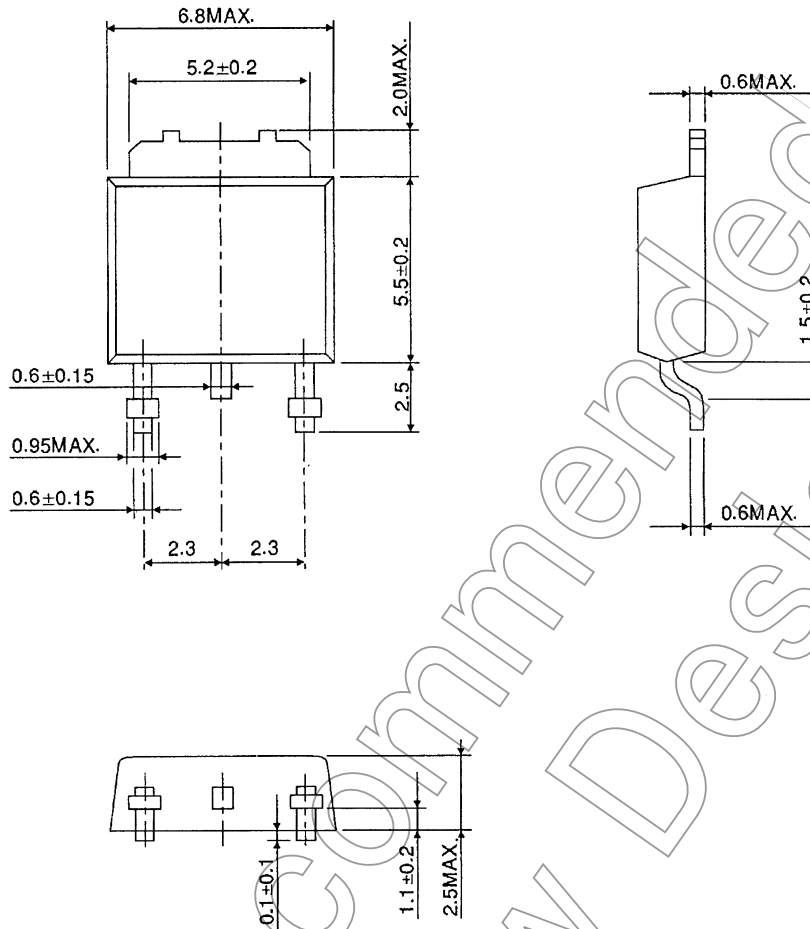
Weight : 0.36 g (Typ.)

Not Recommended for New Design

## Package Dimensions

HSOP3-P-2.30A

Unit : mm



Weight : 0.36 g (Typ.)

Not Recommended for New Design

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20070701-EN

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