

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

## TA78DS05BP, TA78DS06BP, TA78DS08BP, TA78DS09BP, TA78DS10BP, TA78DS12BP, TA78DS15BP, TA78DS05CP

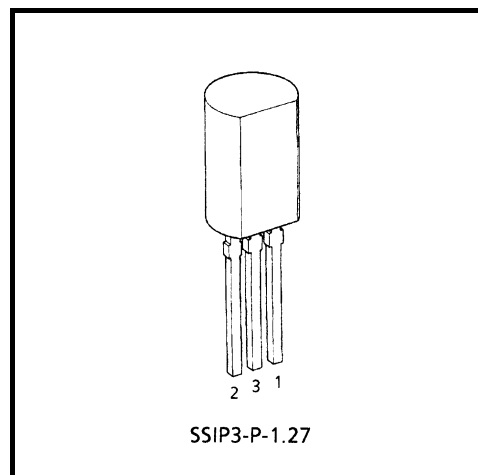
5 V, 6 V, 8 V, 9 V, 10 V, 12 V, 15 V

Low Dropout Voltage Regulator

The TA78DS××BP series consists fixed-positive-output voltage regulator ICs capable of sourcing current up to 30 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, over voltage protection, input fault protection and excessive transient protection circuits.

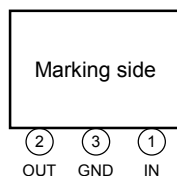
### Features

- Low standby current of 600  $\mu$ A typical.
- Maximum output current of 30 mA.
- Low dropout voltage of less than 0.3 V.
- Multi-protection:  
Reverse connection of power supply, 60V load dump, thermal shut down and current limiting.
- Available in the plastic TO-92 MOD package.

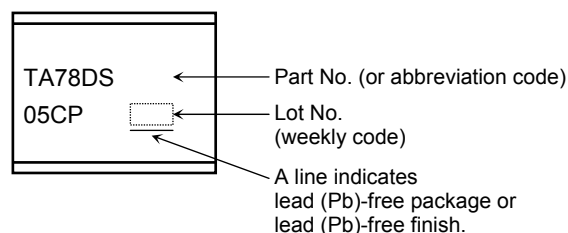
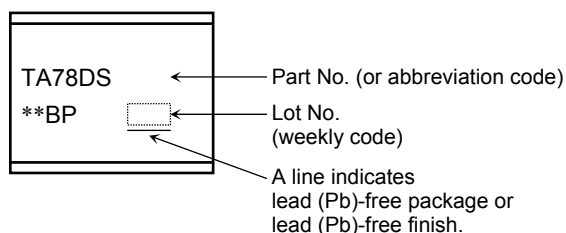


Weight: 0.36 g (Typ.)

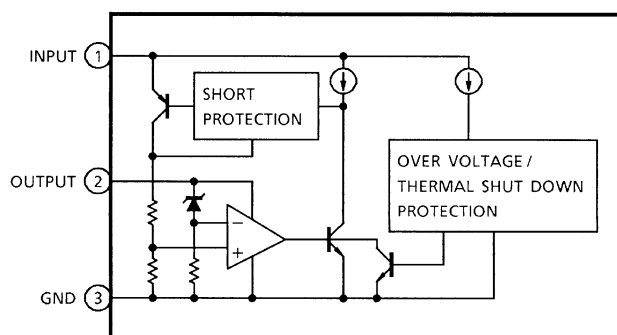
### Pin Assignment



### Marking



## 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 (Ta = 25°C) | $P_D$         | 800        | mW   |
| Operating temperature         | $T_{opr}$     | -40~85     | °C   |
| Storage temperature           | $T_{stg}$     | -55~150    | °C   |
| Junction temperature          | $T_j$         | 150        | °C   |
| Thermal resistance            | $R_{th(j-a)}$ | 156        | °C/W |
| Soldering temperature time    | $T_{sol}$     | 260 (10 s) | °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).

**TA78DS05BP**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 14\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 3.3\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                       | Min  | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|------------------------------------------------------------------------------------------------------|------|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $5.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 4.75 | 5.0  | 5.25 | V    |
|                       |           |              | $5.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 4.5  | 5.0  | 5.5  |      |
| Line regulation       | Reg-line  | —            | $9.0\text{ V} \leq V_{IN} \leq 16\text{ V}$                                                          | —    | 1    | 10   | mV   |
|                       |           |              | $6.0\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                          | —    | 4    | 30   |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                       | —    | 1    | 50   | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                              | —    | 0.6  | 1    | mA   |
|                       |           |              | $6\text{ V} \leq V_{IN} \leq 26\text{ V}$ , $I_{OUT} = 5\text{ mA}$                                  | —    | 0.7  | 1    |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                              | —    | 0.1  | 0.2  | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                             | —    | 0.2  | 0.3  |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                    | 29   | 33   | —    | V    |

**TA78DS05CP**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 14\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 3.3\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                       | Min  | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|------------------------------------------------------------------------------------------------------|------|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $5.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 4.8  | 5.0  | 5.2  | V    |
|                       |           |              | $5.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 4.75 | 5.0  | 5.25 |      |
| Line regulation       | Reg-line  | —            | $9.0\text{ V} \leq V_{IN} \leq 16\text{ V}$                                                          | —    | 1    | 10   | mV   |
|                       |           |              | $6.0\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                          | —    | 4    | 30   |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                       | —    | 1    | 50   | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                              | —    | 0.6  | 1    | mA   |
|                       |           |              | $6\text{ V} \leq V_{IN} \leq 26\text{ V}$ , $I_{OUT} = 5\text{ mA}$                                  | —    | 0.7  | 1    |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                              | —    | 0.1  | 0.2  | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                             | —    | 0.2  | 0.3  |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                    | 29   | 33   | —    | V    |

**TA78DS06BP**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 14\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 3.3\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                       | Min | Typ. | Max | Unit |
|-----------------------|-----------|--------------|------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| Output voltage        | $V_{OUT}$ | —            | $6.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 5.7 | 6.0  | 6.3 | V    |
|                       |           |              | $6.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 5.4 | 6.0  | 6.6 |      |
| Line regulation       | Reg-line  | —            | $10\text{ V} \leq V_{IN} \leq 17\text{ V}$                                                           | —   | 1    | 20  | mV   |
|                       |           |              | $7.0\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                          | —   | 4    | 40  |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                       | —   | 1    | 60  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                              | —   | 0.6  | 1.1 | mA   |
|                       |           |              | $7\text{ V} \leq V_{IN} \leq 26\text{ V}$ , $I_{OUT} = 5\text{ mA}$                                  | —   | 0.7  | 1.1 |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                              | —   | 0.1  | 0.2 | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                             | —   | 0.2  | 0.3 |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                    | 29  | 33   | —   | V    |

**TA78DS08BP**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 14\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 3.3\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                       | Min | Typ. | Max | Unit |
|-----------------------|-----------|--------------|------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| Output voltage        | $V_{OUT}$ | —            | $8.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 7.6 | 8.0  | 8.4 | V    |
|                       |           |              | $8.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 7.2 | 8.0  | 8.8 |      |
| Line regulation       | Reg-line  | —            | $12\text{ V} \leq V_{IN} \leq 19\text{ V}$                                                           | —   | 2    | 30  | mV   |
|                       |           |              | $9.0\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                          | —   | 5    | 60  |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                       | —   | 4    | 80  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                              | —   | 0.7  | 1.2 | mA   |
|                       |           |              | $9\text{ V} \leq V_{IN} \leq 26\text{ V}$ , $I_{OUT} = 5\text{ mA}$                                  | —   | 0.8  | 1.2 |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                              | —   | 0.1  | 0.2 | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                             | —   | 0.2  | 0.3 |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                    | 29  | 33   | —   | V    |

**TA78DS09BP**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 14\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 3.3\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                       | Min  | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|------------------------------------------------------------------------------------------------------|------|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $9.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 8.55 | 9.0  | 9.45 | V    |
|                       |           |              | $9.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 8.1  | 9.0  | 9.9  |      |
| Line regulation       | Reg-line  | —            | $13\text{ V} \leq V_{IN} \leq 20\text{ V}$                                                           | —    | 2    | 35   | mV   |
|                       |           |              | $10\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                           | —    | 5    | 70   |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                       | —    | 4    | 90   | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                              | —    | 0.7  | 1.3  | mA   |
|                       |           |              | $10\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$I_{OUT} = 5\text{ mA}$                              | —    | 0.8  | 1.3  |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                              | —    | 0.1  | 0.2  | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                             | —    | 0.2  | 0.3  |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                    | 29   | 33   | —    | V    |

**TA78DS10BP**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 14\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 3.3\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                        | Min | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|-------------------------------------------------------------------------------------------------------|-----|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $10.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 9.5 | 10.0 | 10.5 | V    |
|                       |           |              | $10.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 9.0 | 10.0 | 11.0 |      |
| Line regulation       | Reg-line  | —            | $14\text{ V} \leq V_{IN} \leq 21\text{ V}$                                                            | —   | 3    | 40   | mV   |
|                       |           |              | $11\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                            | —   | 7    | 80   |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                        | —   | 6    | 100  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                               | —   | 0.7  | 1.4  | mA   |
|                       |           |              | $11\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$I_{OUT} = 5\text{ mA}$                               | —   | 0.8  | 1.4  |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                               | —   | 0.1  | 0.2  | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                              | —   | 0.2  | 0.3  |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                     | 29  | 33   | —    | V    |

**TA78DS12BP**
**Electrical Characteristics**

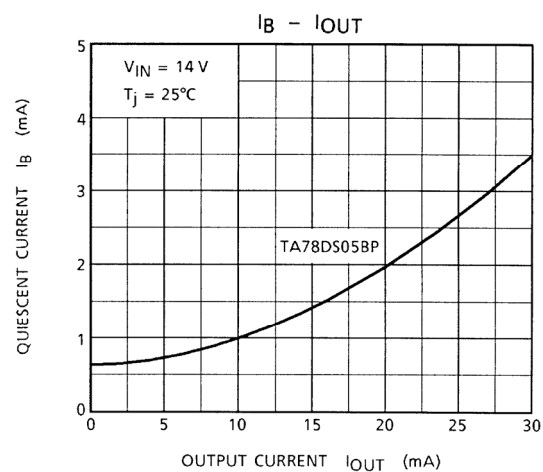
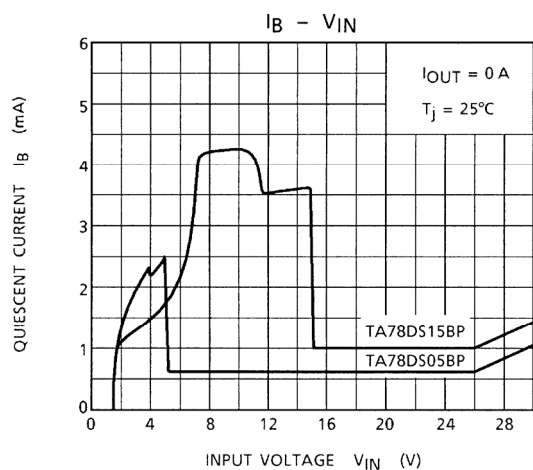
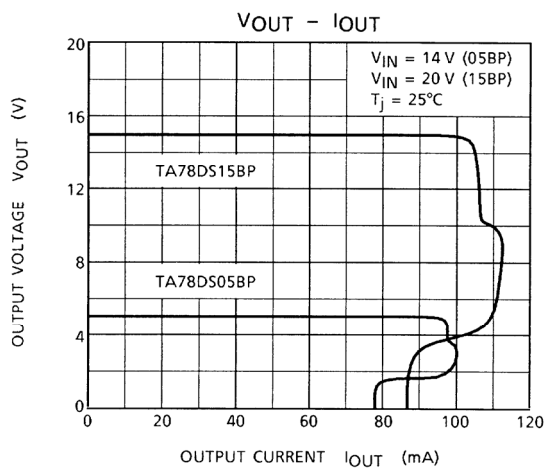
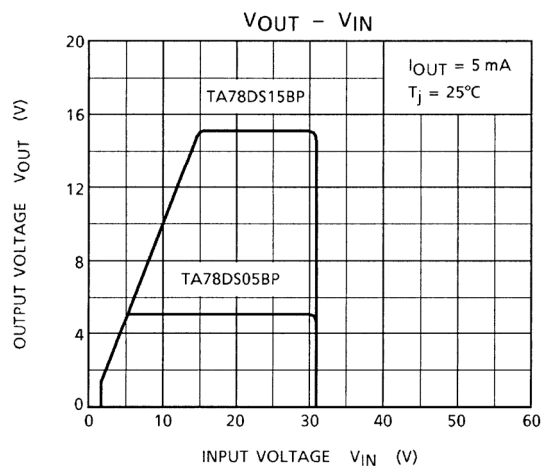
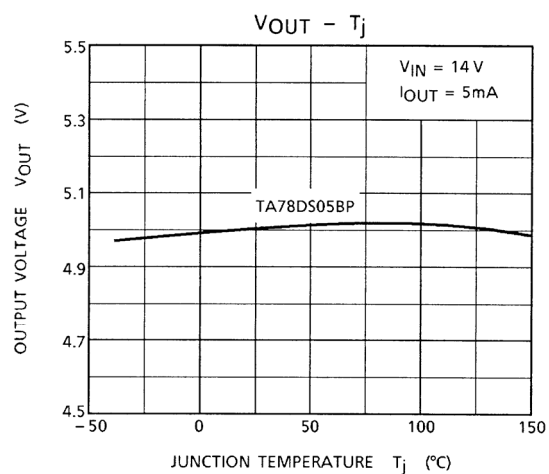
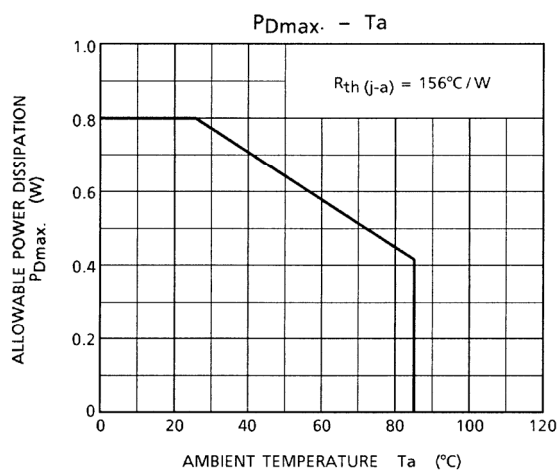
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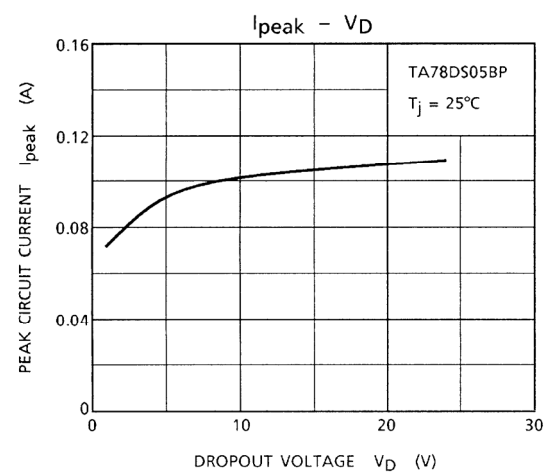
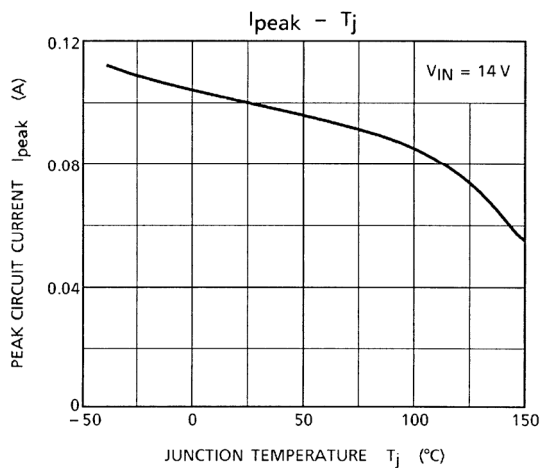
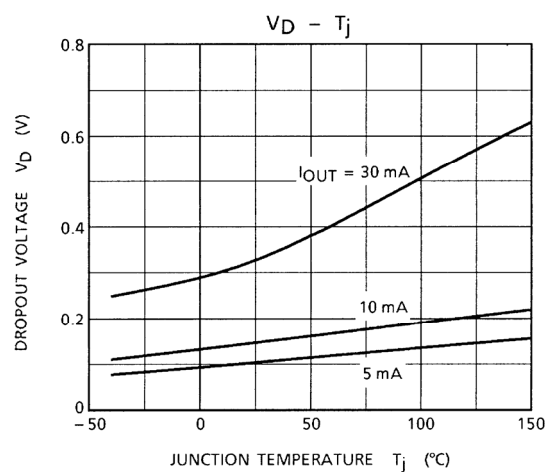
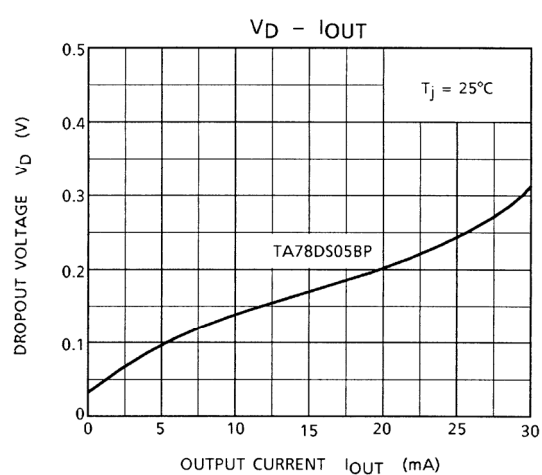
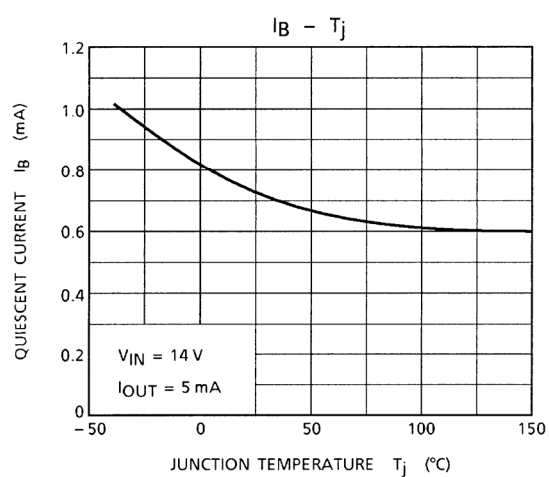
| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                        | Min  | Typ. | Max  | Unit |
|-----------------------|-----------|--------------|-------------------------------------------------------------------------------------------------------|------|------|------|------|
| Output voltage        | $V_{OUT}$ | —            | $12.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 11.4 | 12.0 | 12.6 | V    |
|                       |           |              | $12.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 10.8 | 12.0 | 13.2 |      |
| Line regulation       | Reg-line  | —            | $16\text{ V} \leq V_{IN} \leq 23\text{ V}$                                                            | —    | 4    | 50   | mV   |
|                       |           |              | $13\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                            | —    | 8    | 100  |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                        | —    | 2    | 120  | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                               | —    | 0.8  | 1.5  | mA   |
|                       |           |              | $13\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$I_{OUT} = 5\text{ mA}$                               | —    | 1.0  | 1.5  |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                               | —    | 0.1  | 0.2  | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                              | —    | 0.2  | 0.3  |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                     | 29   | 33   | —    | V    |

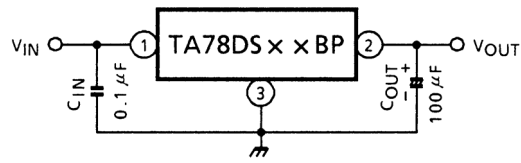
**TA78DS15BP**
**Electrical Characteristics**

 (Unless otherwise specified,  $V_{IN} = 20\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 3.3\text{ }\mu\text{F}$ ,  $T_j = 25^\circ\text{C}$ )

| Characteristics       | Symbol    | Test Circuit | Test Condition                                                                                        | Min   | Typ. | Max   | Unit |
|-----------------------|-----------|--------------|-------------------------------------------------------------------------------------------------------|-------|------|-------|------|
| Output voltage        | $V_{OUT}$ | —            | $15.35\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                         | 14.25 | 15.0 | 15.75 | V    |
|                       |           |              | $15.35\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$ | 13.5  | 15.0 | 16.5  |      |
| Line regulation       | Reg-line  | —            | $19\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                            | —     | 5    | 60    | mV   |
|                       |           |              | $16\text{ V} \leq V_{IN} \leq 26\text{ V}$                                                            | —     | 8    | 130   |      |
| Load regulation       | Reg-load  | —            | $5.0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$                                                        | —     | 1    | 150   | mV   |
| Quiescent current     | $I_B$     | —            | $I_{OUT} = 0\text{ mA}$                                                                               | —     | 1.0  | 1.6   | mA   |
|                       |           |              | $16\text{ V} \leq V_{IN} \leq 26\text{ V}$ ,<br>$I_{OUT} = 5\text{ mA}$                               | —     | 1.2  | 1.6   |      |
| Dropout voltage       | $V_D$     | —            | $I_{OUT} = 5\text{ mA}$                                                                               | —     | 0.1  | 0.2   | V    |
|                       |           |              | $I_{OUT} = 10\text{ mA}$                                                                              | —     | 0.2  | 0.3   |      |
| Max operating voltage | $V_{IN}$  | —            | —                                                                                                     | 29    | 33   | —     | V    |





**Application Circuit**

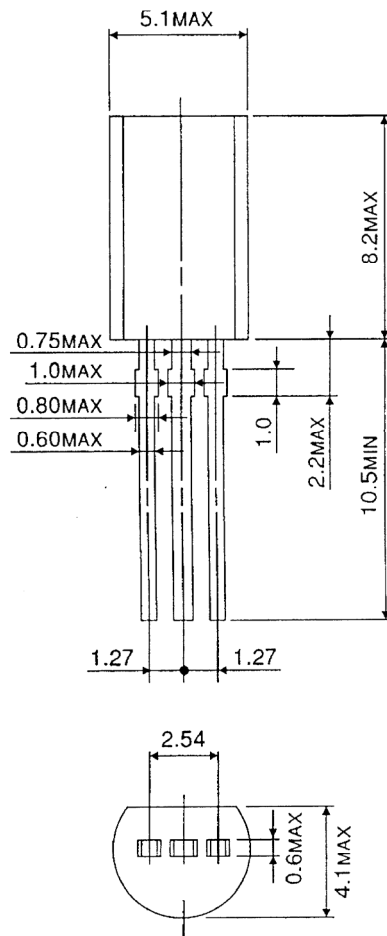
The capacitors  $C_{IN}/C_{OUT}$  must be guaranteed to operate within the temperature range in which the regulator operates correctly.

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

**Package Dimensions**

SSIP3-P-1.27

Unit : mm



Weight : 0.36 g (Typ.)

**RESTRICTIONS ON PRODUCT USE**

20070701-EN

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.  
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc.
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