TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT   SILICON MONOLITHIC

# TA8001S

# 5V VOLTAGE REGULATOR WITH RESET TIMER

The TA8001S is an IC specially designed for automotive microcomputer systems. It produces an output voltage of 5±0.5V without need for adjustment from its accurate reference voltage and amplifier circuit.
At power-on, it outputs a reset signal to reset the system. It will also output a reset signal when the 5V output voltage drops below 92% because of external disturbance or other problem. Since it is also designed to have a small bias current, power consumption on the system can be reduced.
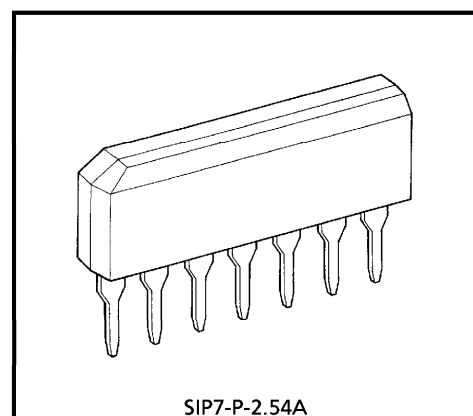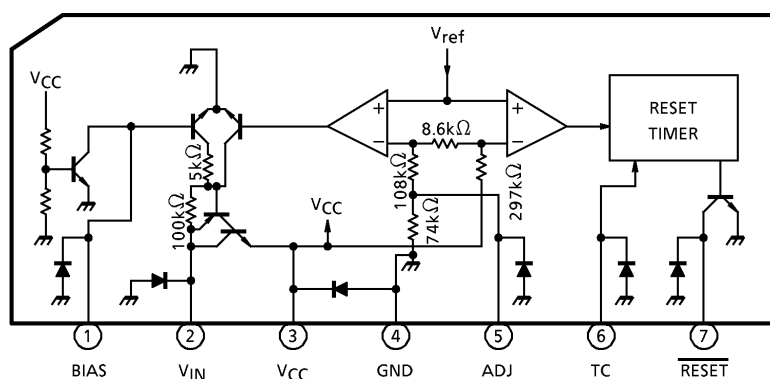
SIP7-P-2.54A

Weight : 0.7g (Typ.)

## FEATURES

- Accurate output                      : 5±0.5V
- Standby output                       : 3.5V
- Low bias current                     : 150$\mu$A (Typ.)
- Power-on reset timer
- Operating temperature range          : from −40 to 85°C
- Wide operating voltage range         : 30V (max.)
- Small SIP-7 pin

## BLOCK DIAGRAM AND PIN LAYOUT



| Pin | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-----|---|---|---|---|---|---|---|
|     | BIAS | $V_{IN}$ | $V_{CC}$ | GND | ADJ | TC | $\overline{RESET}$ |

980910EBA1

## PIN DESCRIPTION

| PIN No. | SYMBOL | DESCRIPTION |
|---|---|---|
| 1 | BIAS | Power supply starting pin. The starting current is supplied through a resistor to which the input voltage is applied. The output current from this starting current is as follows :<br>$I_{OUT}$ (Bias Pin) $\geq 3000 \times (V_{IN} - 0.6) / (200 + R_1)$ (mA)<br>where $R_1$ is the external resistance attached to Bias Pin (k$\Omega$).<br>When the output voltage rises above 2.7V, its control is transferred from the starting circuit to the internal control circuit. |
| 2 | $V_{IN}$ | Power supply input pin. |
| 3 | $V_{CC}$ | Power supply pin for internal circuit. The output voltage can also be detected at this pin. |
| 4 | GND | Grounded |
| 5 | ADJ | The output voltage can be adjusted by inserting a resistor between ADJ and GND or between ADJ and $V_{CC}$.<br><br>| Mode | ADJ Pin | Output Voltage $V_{REG}$ |<br>|---|---|---|<br>| Standby | OPEN | 3.5V |<br>| Normal | GND | 5.0V | |
| 6 | TC | Time setting pin for reset timer. Use external $R_T$ and $C_T$ to set the time. |
| 7 | $\overline{RESET}$ | NPN transistor open-collector output. This pin supplies a reset signal when the output drops below 92% of the specified level. After the output voltage increases above 92% of the specified level, the reset signal will be output for a period of time set at the TC pin. |

## FUNCTIONAL DESCRIPTION

The TA8001S incorporates a constant-voltage 5V power supply function to feed the 5V logic circuits and a reset function to ensure stable operation of the system. These functions are explained below.

(1) Constant-voltage 5V power supply function

This constant-voltage function has the reference voltage Vref in the IC that is insusceptible to temperature changes and input voltage fluctuations. The power supply circuit is designed in such a way that this voltage is stepped up to 5V by using an OP amp and a voltage-dividing resistor. These OP amp and dividing resistor and an output transistor connected to the OP amp output together configure a closed loop.

The output voltage of 5V is obtained by shorting the ADJ pin to GND. The output voltage is reduced to 3.5V by leaving this pin open, allowing for a further reduction in the amount of current consumed by the entire system during standby.

(2) System reset function (See Timing Chart)

- Voltage monitoring function

  When powered on, the power-on reset timer starts counting the moment the voltage $V_{CC}$ applied to the CPU exceeds 4.6V. When powered off, this voltage monitoring function outputs a reset signal immediately when $V_{CC}$ drops below 4.6V. A reset signal also is output immediately when $V_{CC}$ drops for some reason during normal operation. Then, when $V_{CC}$ is restored to the normal voltage and exceeds 4.6V, the power-on reset timer starts counting.

- Power-on reset timer function

  To allow the 5V constant voltage to stabilize at power-on, as well as prevent the circuit system from operating erratically at power-on, the device remains reset for a predetermined time before being released from the reset state. The duration of this time can be set as desired by choosing appropriate values for the external resistor and capacitor connected to the TC pin.
  The system starts charging the capacitor when the VCC voltage exceeds 4.6V. When this charging voltage exceeds 1.7V, the reset signal is inverted to deactivate the reset.

## TIMING CHART
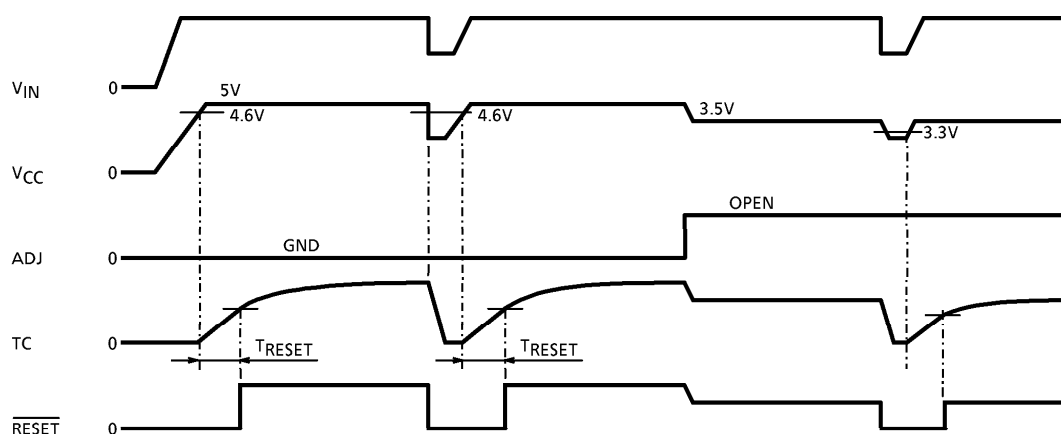


(Note) $T_{RESET}$ : Reset timer time

## MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 30 | V |
| Output Current | $I_{OUT1}$ | 20 | mA |
|  | $I_{OUT2}$ | 1 | mA |
| Output Voltage | $V_{OUT2}$ | 16 | V |
| Power Dissipation | $P_D$ | 500 | mW |
| Operating Temperature | $T_{opr}$ | $-40\sim85$ | °C |
| Storage Temperature | $T_{stg}$ | $-55\sim150$ | °C |
| Lead Temperature-time | $T_{sol}$ | 260 (10s) | °C |

Note : $V_{IN}$ : BIAS input
$I_{OUT1}$, $V_{OUT1}$ : $\overline{OUT}$ output
$I_{OUT2}$, $V_{OUT2}$ : $\overline{RESET}$ output

## ELECTRICAL CHARACTERISTICS ($V_{IN}$ = 7 to 17V, Ta = −40 to 85°C, $I_{LOAD}$ = 5mA)

| CHARACTERISTIC | SYMBOL | PIN | TEST CIRCUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|
| Output Voltage | $V_{REG}$ | $V_{CC}$ | 1 | — | 4.5 | 5.0 | 5.5 | V |
| Line Regulation | — | $V_{CC}$ | — | $V_{IN}=7\sim30V$ | — | 0.2 | 1.0 | % |
| Load Regulation | — | $V_{CC}$ | — | $I_{LOAD}=2\sim10mA$ | — | 0.5 | 2.0 | % |
| Temperature Coefficient | — | $V_{CC}$ | — | — | — | 0.01 | — | % / °C |
| Output Voltage | $V_{OL}$ | $\overline{RESET}$ | 2 | $I_{OL}=300\mu A$ | — | — | 0.4 | V |
| Output Leakage Current | $I_{LEAK}$ | $\overline{RESET}$ | 3 | $V_{OUT}=10V$ | — | — | 5 | $\mu A$ |
| Input Current | $I_{IN}$ | TC | 4 | $V_{IN}=0\sim V_{REG}$ | −2 | — | 2 | $\mu A$ |
| Threshold Voltage | $V_{TH}$ | TC | 5 | TC : Low to High | — | 1.7 | — | V |
| Reset Detect Voltage | — | $V_{CC}$ | — | $V_{REG}=5V$ | — | 4.6 | — | V |
| Standby Voltage | $V_S$ | $V_{CC}$ | 6 | — | 3.1 | 3.5 | 3.9 | V |
| Standby Current | $I_S$ | $V_{CC}$ | 7 | $V_{IN}=14V$ | — | 150 | 300 | $\mu A$ |
| Reset Timer | $T_{RESET}$ | $\overline{RESET}$ | 5 | — | — | $0.4\times C_T R_T$ | — | ms |

Note : The unit for $C_T$ is $\mu F$, the unit for $R_T$ is $k\Omega$.

## TEST CIRCUIT

### 1. $V_{REG}$
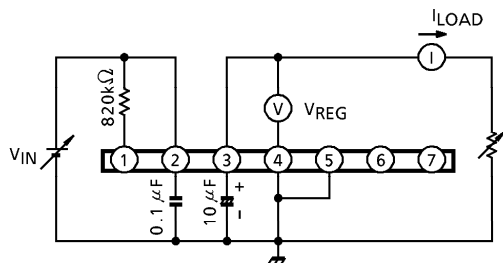


### 5. $V_{RESET}$, $V_{TH}$, $T_{RESET}$



### 2. $V_{OL}$ ($\overline{RESET}$)





### 3. $I_{LEAK}$ ($\overline{RESET}$)



### 6. $V_S$
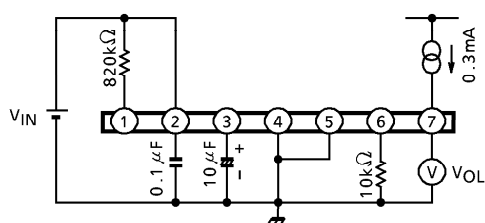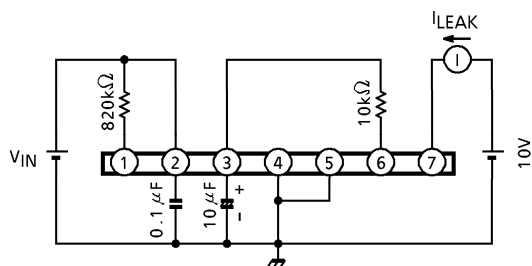


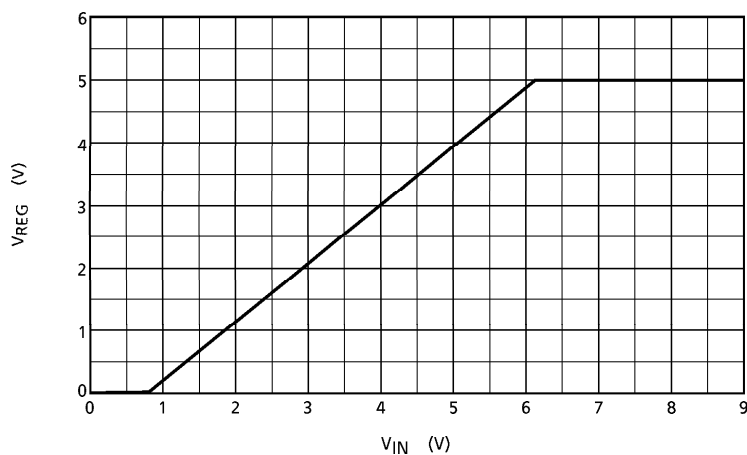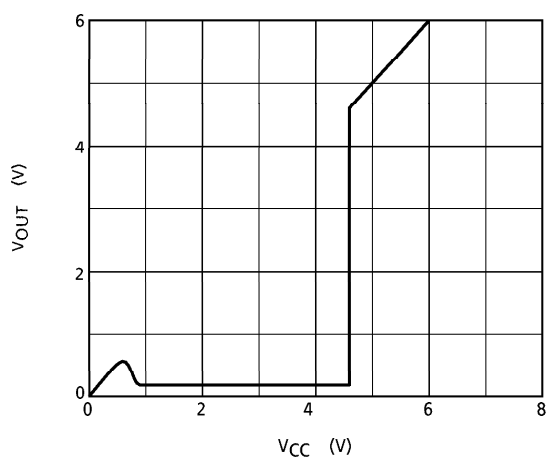### 4. $I_{IN}$ (TC)
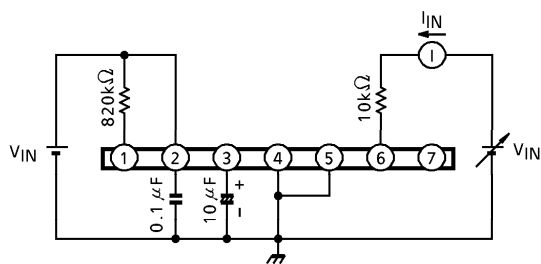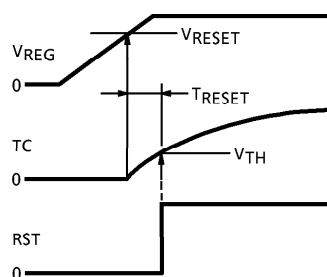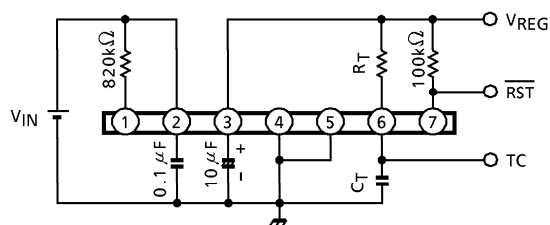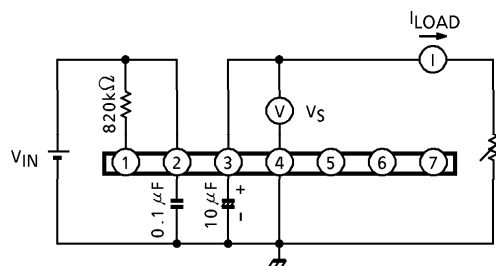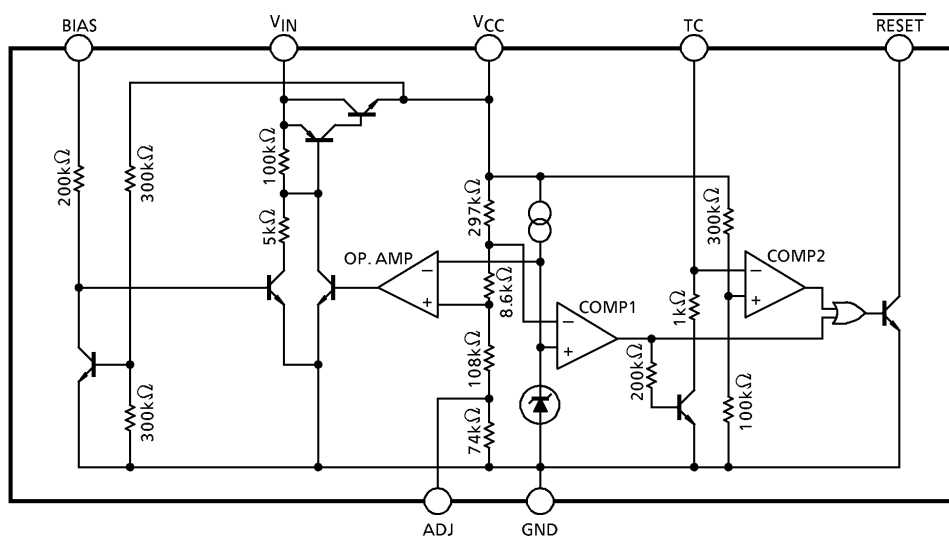


### 7. $I_S$
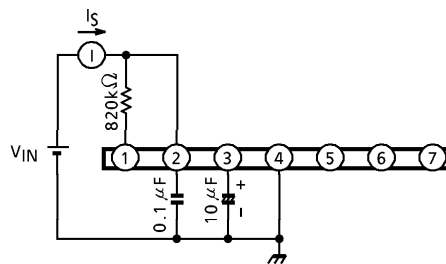
## TYPICAL CHARACTERISTICS

### 1. Input-Output Characteristic ($R_L = 500\Omega$)
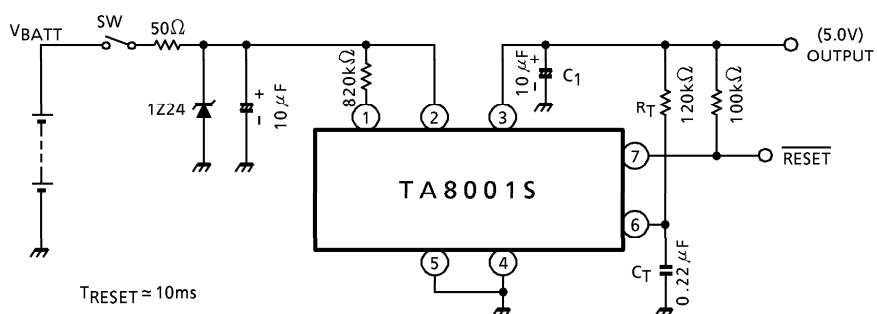


### 2. Reset Characteristic



## EQUIVALENT CIRCUIT

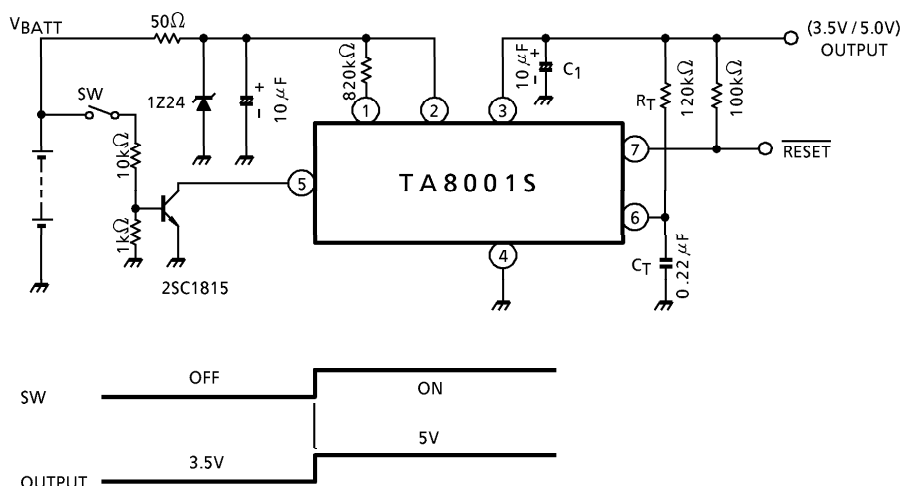## EXAMPLE OF APPLICATION CIRCUIT

$I_{LOAD} = 10mA$ Max. $V_{BATT} = 7 \sim 17V$ (LOAD DUMP 120Vpeak, 200ms)

### 1. 5V Standard Circuit



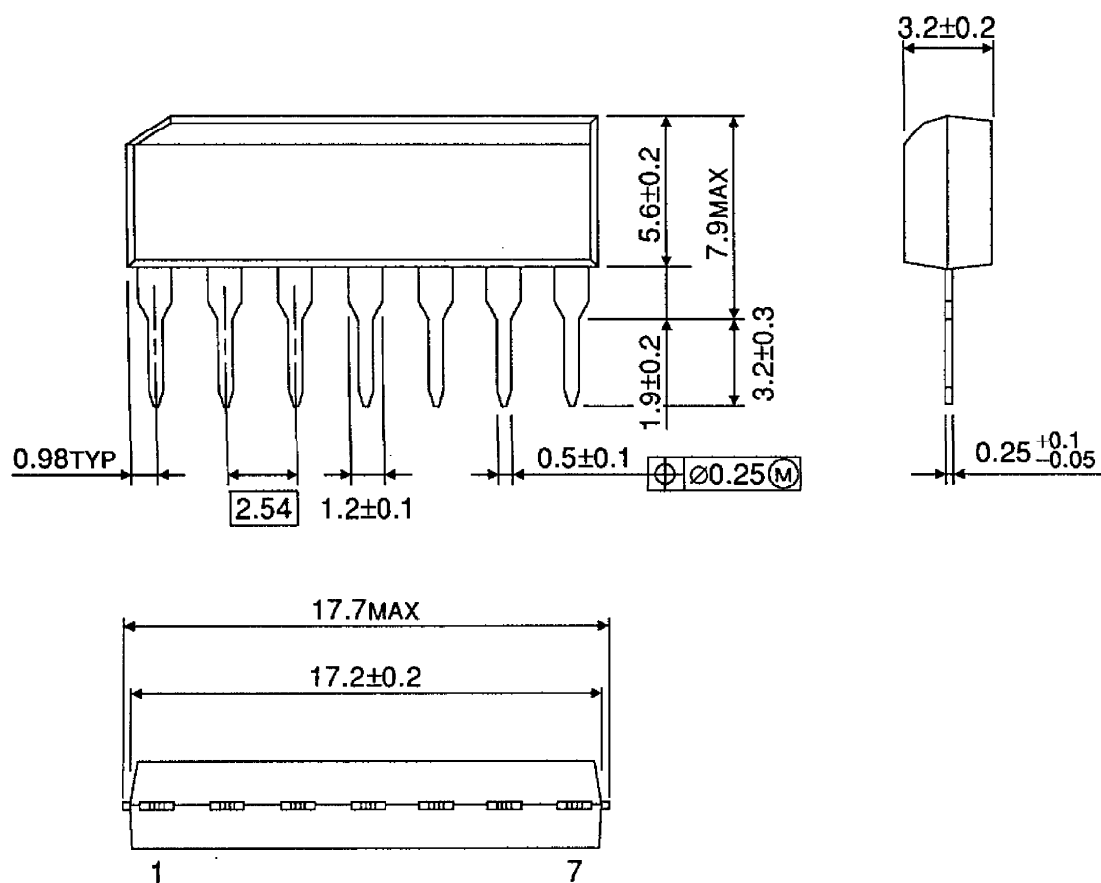$T_{RESET} \simeq 10ms$

### 2. Backup Circuit



*   Use an output capacitor $C_1$ which has a low temperature dependence (such as a tantalum capacitor). Connect it as close to the IC as possible.

**OUTLINE DRAWING**
SIP7-P-2.54A

Unit : mm



Weight : 0.7g (Typ.)