

TOSHIBA BIPOLAR LINEAR INTEGRATED CIRCUIT SILICON MONOLITHIC

TA8008F

VOLTAGE REGULATOR WITH WAKE UP TIMER

The TA8008F is designed for microcomputer systems.

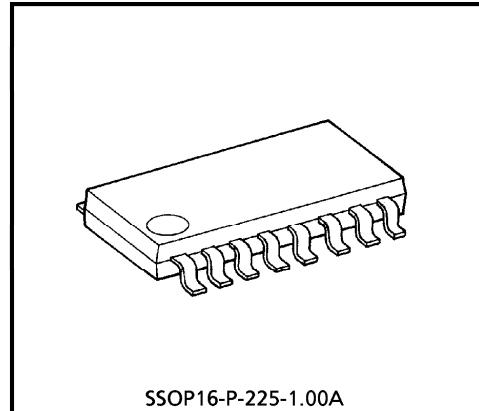
It incorporates a highly accurate constant-voltage power supply ($5 \pm 0.15V$), wake up timer which can make low current consumption of the system and various system reset function in a chip.

The wake up timer starts CPU system and etc. in periodically and decrease average current consumption.

Starting period can be set with external capacitor.

The watchdog timer works while the system is working.

The TA8008F incorporates current limiter of 600mA (Typ.), so it is possible to build the system easily without external protection circuits and detection resistors.



Weight : 0.14g (Typ.)

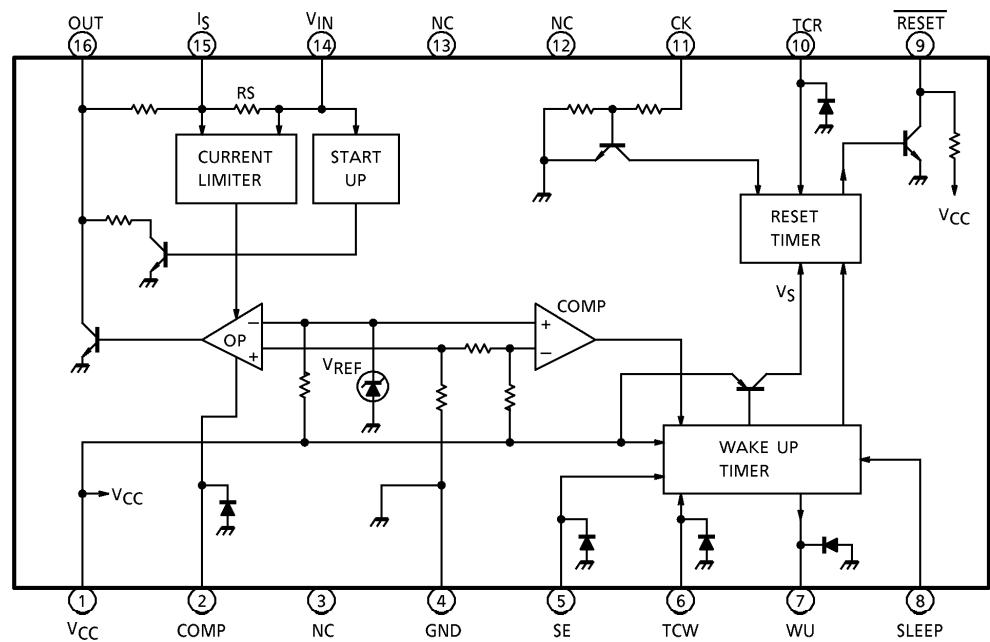
FEATURES

- Accurate output : $5 \pm 0.15V$ ($T_a = -40 \sim 105^\circ C$)
- Low standby current : 0.95mA (Max.)
- Wake up timer incorporated : It is possible to set the periodical time with external capacitor.
- Reset function : Power on reset (The power on reset function can be selected for its function through the SE pin.)
Watchdog reset
- Current limiter incorporated : 600mA (Typ.)
- External parts are a few.
- Plastic SSOP 16 Pin Package.

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BLOCK DIAGRAM AND PIN LAYOUT



PIN DESCRIPTION

| PIN No. | SYMBOL | DESCRIPTION |
|-----------|-----------------|---|
| 1 | V _{CC} | 5V constant-voltage pin. Power supply pin for inside circuits. The output voltage 5V is also detected. |
| 2 | COMP | Phase compensation pin for output stabilization. |
| 4 | GND | Grounded. |
| 5 | SE | The power on reset function is controlled by this pin when the mode is changed active from standby. SE = L : The reset signal is output on every mode's change (standby→active). SE = H : The reset signal is output only when the power supply starts. |
| 6 | TCW | Pin for setting a time for the wake up timer. A capacitor is connected to this pin. It incorporates a 10 μ A (Typ.) constant-current, so external resistor is not needed. The wake up time is approximately calculated by the following formula : $TWU = 400 \times CW \text{ (ms)}$ TWU : wake up time, CW : capacitor connected to 6 pin (μ F) |
| 7 | WU | This pin outputs the wake up signal which starts the CPU. When 8 pin receives the sleep signal, this pin outputs wake up signal after TWU time which is set by TCW. |
| 8 | SLEEP | When the CPU goes into sleep mode, this pin receives the signal which comes from the CPU. If wake up function is not necessary : • Connected to "L" 5V power supply and all reset timers work. • Connected to "H" Become to be standby mode. |
| 9 | RESET | Power-on / watchdog timer reset pin. • Generates a reset signal which is determined by the C of the TCR pin. • Intermittently generates reset pulses if no clock is supplied to the CK pin. The RESET signal is the output from the collector of an NPN transistor with a pull-up resistor. |
| 10 | TCR | Pin for setting a time for the reset timer and watchdog timer. It connects to a resistor and capacitor. The charging and discharging are done with internal 100 μ A (Typ.) constant-current and 1k Ω resistor, so external pull-up resistor and etc. are not needed. |
| 11 | CK | Clock input pin for the watchdog timer. If it is used for a power-on reset timer only, it is connected to the 9 pin (RESET). |
| 14 | V _{IN} | Power supply pin for the current limiter and the startup circuit which turns on 5V power. |
| 15 | I _S | Detection pin for the current limiter. It incorporates current detection resistor (30m Ω) between V _{IN} and I _S . The load current exceeding 600mA activates the current limiter. |
| 16 | OUT | Connected to the base of an external PNP transistor so that the output voltage is stabilized. Power supply design suitable for particular load capacities is thus possible. Since recommended maximum I _{OUT} is 8mA, an output current of 320mA is assured if the external transistor has an h _{FE} of 40 or more. |
| 3, 12, 13 | NC | Non-connected pin. (Electrically, this pin is completely open.) |

FUNCTIONAL DESCRIPTION

The TA8008F incorporates a constant-voltage 5V power supply function to feed stable power to the CPU, a system reset function to ensure stable operation of the CPU, and a wakeup timer function to materialize low-current operation of the application system by operating it intermittently. These functions are explained below.

(1) Constant-voltage 5V power supply function

This constant-voltage function has the reference voltage V_{ref} 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.

If you are using only the reset timer and not this power supply function, connect the BIAS, OUT, and COMP pins to GND.

A current detecting resistor is inserted between the VIN and the IS pins. The voltage generated in this resistor and the internal comparator together detect the load current 600mA (Typ). Because the detecting resistor is a small $30m\Omega$, the voltage drop is only 18mV at 600mA, making it possible to minimize the drop between input and output.

(2) Wakeup timer (See the timing chart)

A wakeup signal (WAKE-UP) is output from the IC to the application system, upon which the application system starts operating. Then when the application system enters a sleep state, it asserts a sleep signal (SLEEP) to the IC. The IC receives this signal and after an elapse of the set time (TWU) it outputs a wakeup signal again. By repeating this, the application system is operated intermittently, so that its average operating current can be reduced to a minimum. The TWU time is set using the capacitor connected to the TCW pin. Any desired value can be chosen for this capacitor according to the application equipment.

Suitable applications include monitoring various vehicle-mounted systems and a keyless entry system input signal wait function.

(3) 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.

This function works regardless of whether the application system is active while operating or during standby while in sleep state.

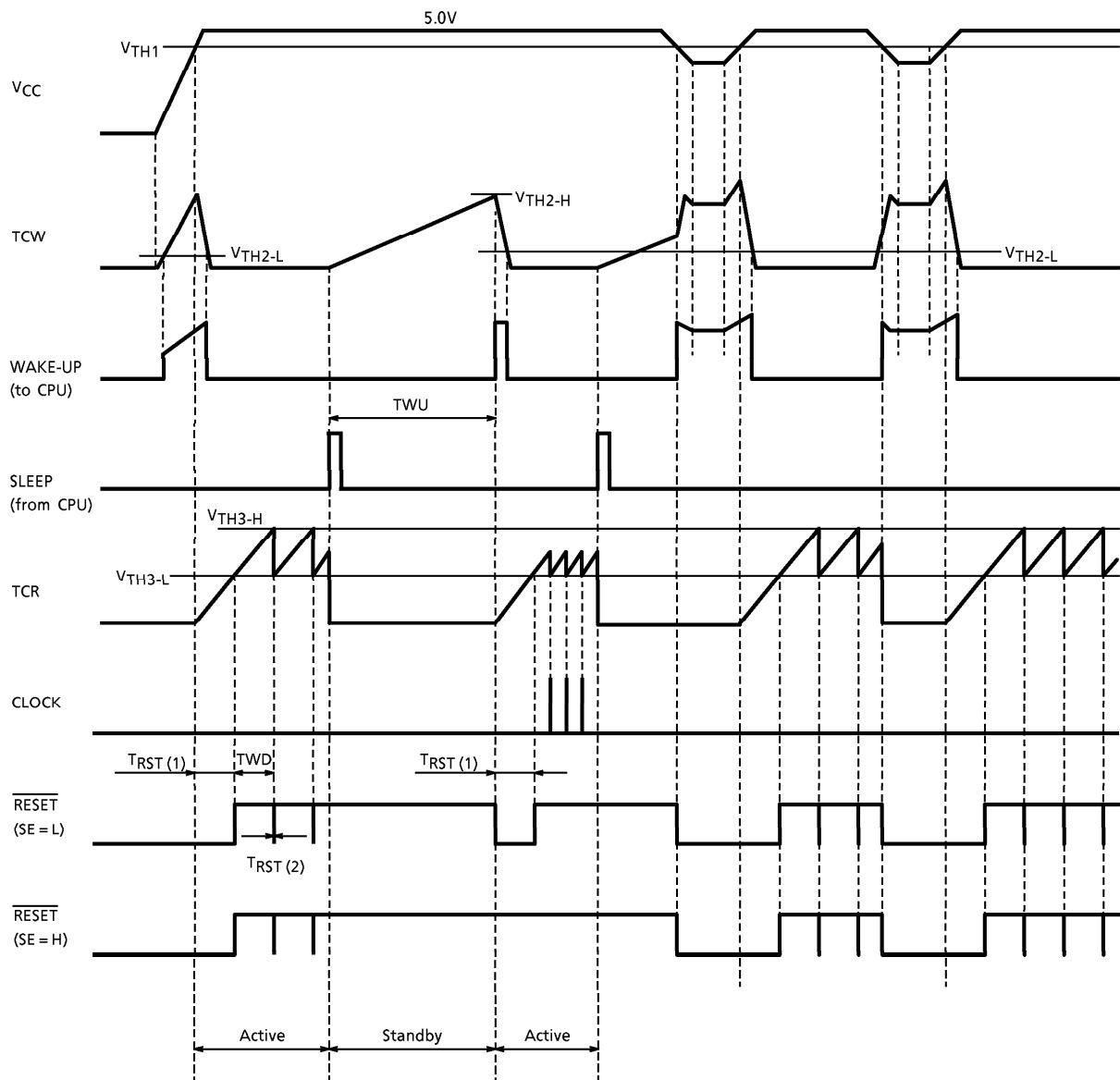
- Power-on reset timer function

To allow the 5V constant voltage to stabilize at power-on, as well as provide a sufficient time for the clock oscillation in the CPU to stabilize, 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 V_{CC} voltage exceeds 4.6V. When this charge voltage exceeds 4V, the capacitor is discharged by the IC's internal transistor. When the capacitor is discharged down to 2V, the reset signal is inverted to deactivate the reset. Also, when the wakeup timer is operating, the select pin SE can be chosen to know whether a power-on reset is generated at switchover from standby to active modes.

- Watchdog timer function

Program your system to output a clock each time one program routine is finished in the CPU system software, and input this clock to the CK pin of the IC. The IC's TC pin is repeatedly charged and discharged between 2V and 4V. However, when a clock is input, it switches over and starts discharging in the middle of charging and then starts charging from 2V again. Since the clock is generated at predetermined intervals when the CPU system is operating normally, the TC pin switches over and starts discharging before the charge voltage reaches 4V. However, if no clock is input while being charged from 2V to 4V, the clock is assumed to have stopped, i.e., the CPU system has gone wild, so that a reset signal is output to reset the CPU system. The IC's CK pin is connected to the CPU system with a differential circuit. This is to ensure that when an erratic condition occurs in the CPU system, a low signal is always input to the CK pin regardless of whether the clock output from the CPU has stopped in the high or low state. When the CK pin is fixed high, no reset signal is output, in which case only the power-on reset timer is useful.

TIMING CHART



Note : See Electrical Characteristics for symbols in the timing chart.

MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | PIN | RATING | UNIT |
|-----------------------|-------------------|----------------------------------|----------------------|------|
| Input Voltage | V _{IN1} | V _{IN} , I _S | 60 (1s) | V |
| | V _{IN2} | CK, SLEEP | −5~V _{CC} | |
| | V _{IN3} | SE | −0.5~V _{CC} | |
| Output Current | I _{OUT1} | OUT | 10 | mA |
| | I _{OUT2} | WU | −1 | |
| | I _{OUT2} | RESET | 2 | |
| Output Voltage | V _{OUT1} | OUT | 60 (1s) | V |
| | V _{OUT2} | RESET | V _{CC} | |
| Power Dissipation | P _D | — | 500 | mW |
| Operating Temperature | T _{opr} | — | −40~105 | °C |
| Storage Temperature | T _{stg} | — | −55~150 | °C |
| Lead Temperature Time | T _{sol} | — | 260 (10s) | °C |

ELECTRICAL CHARACTERISTICS (V_{IN} = 6~18V, I_{LOAD} = 10mA, Ta = -40~105°C)
 (1) DC CHARACTERISTICS

| CHARACTERISTICS | SYMBOL | PIN | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------------|--------------------|-----------------|----------------------------|------------------------|------------------------|------------------------|--------|
| Output Voltage | V _{REG} | V _{CC} | | 4.85 | 5.0 | 5.15 | V |
| Line Regulation | | V _{CC} | V _{IN} = 5.5~40V | — | 0.1 | 0.5 | % |
| Load Regulation | | V _{CC} | I _{LOAD} = 1~50mA | — | 0.1 | 0.5 | % |
| Temperature Coefficient | | V _{CC} | | — | 0.01 | — | % / °C |
| Input Current | I _{IN} | SE | V _{IN} = 0~5V | — | — | 5 | μA |
| Input Voltage | V _{IH} | SE | | 2 | — | — | V |
| | V _{IL} | | | — | — | 0.5 | |
| Input Current | I _{IN} | SLEEP | V _{IN} = 5V | — | 17 | 35 | μA |
| Input Voltage | V _{IH} | SLEEP | | 2.5 | — | — | V |
| | V _{IL} | | | — | — | 0.5 | |
| Output Leakage Current | I _{LEAK} | RESET | V _{OUT} = 5V | — | — | 5 | μA |
| | | WU | V _{OUT} = 0V | -5 | — | — | |
| Output Voltage | V _{OL} | RESET | I _{OL} = 1mA | — | — | 0.5 | V |
| | V _{OH} | WU | I _{OH} = 1mA | V _{CC} - 0.5 | — | — | |
| Input Current | I _{IN} | TCW | | — | -10 | — | μA |
| | | TCR | | — | -100 | — | |
| Threshold Voltage | V _{TH2-H} | TCW | | — | V _{REG} × 80% | — | V |
| | V _{TH2-L} | | | — | V _{REG} × 20% | — | |
| | V _{TH3-H} | TCR | | — | V _{REG} × 80% | — | |
| | V _{TH3-L} | | | — | V _{REG} × 40% | — | |
| Input Current | I _{IN} | CK | V _{IN} = 5V | — | 0.17 | 0.35 | mA |
| Input Voltage | V _{IH} | CK | | 2 | — | — | V |
| | V _{IL} | | | — | — | 0.5 | |
| Reset Detect Voltage | V _{TH1} | | | V _{REG} × 89% | V _{REG} × 92% | V _{REG} × 95% | |
| Standby Current | I _{ST} | V _{CC} | | — | 0.5 | 0.95 | mA |
| Power Supply Current | I _{CC} | V _{CC} | | — | 2.8 | 5.0 | mA |
| Current Limiter Detection | I _{LMT} | I _S | | — | 600 | — | mA |

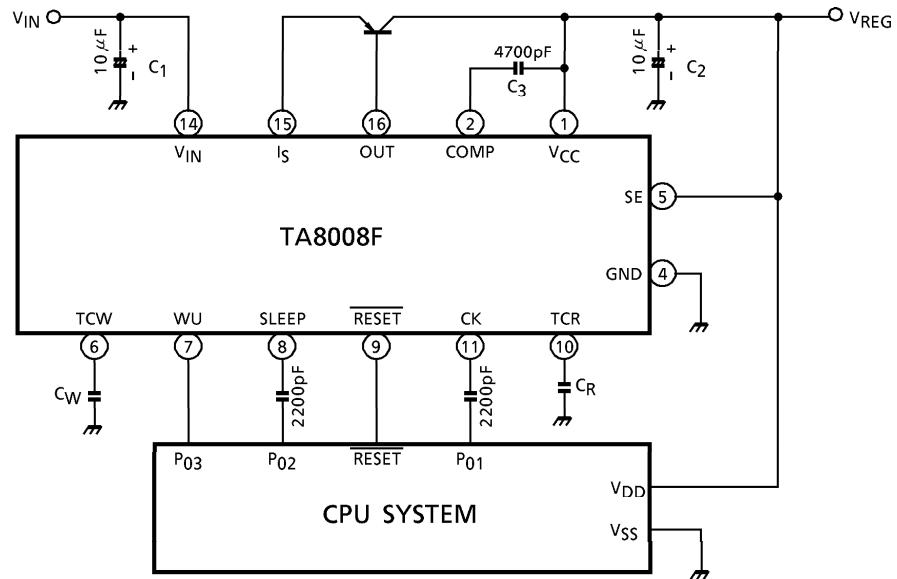
(2) AC CHARACTERISTICS

| CHARACTERISTICS | SYMBOL | PIN | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------|----------------------|-------|----------------|----------|----------|----------|------|
| Wake Up Timer | TWU | WU | | 275 × CW | 400 × CW | 580 × CW | ms |
| Watchdog Timer | TWD | | | 13 × CR | 20 × CR | 30 × CR | |
| Reset Timer (1) | T _{_RST(1)} | | | 10 × CR | 16 × CR | 24 × CR | |
| Reset Timer (2) | T _{_RST(2)} | | | 0.3 × CR | 0.7 × CR | 1.5 × CR | |
| Sleep Pulse Width | T _{SLEEP} | SLEEP | | 3 | — | — | |
| Clock Pulse Width | TW | CK | | 3 | — | — | μs |

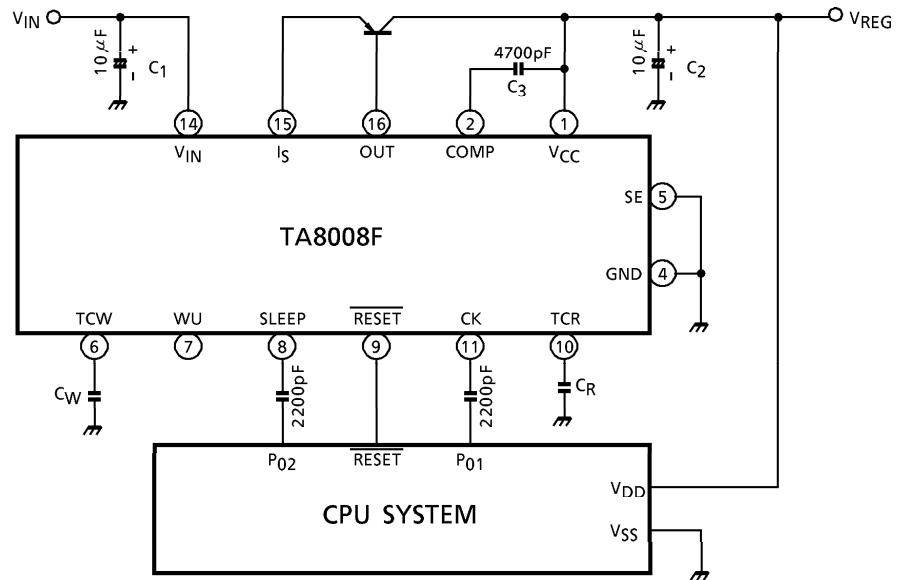
* UNIT ; CR, CW (μF)

EXAMPLE OF APPLICATION CIRCUIT

1. Example for using the wake up signal to start the CPU system.



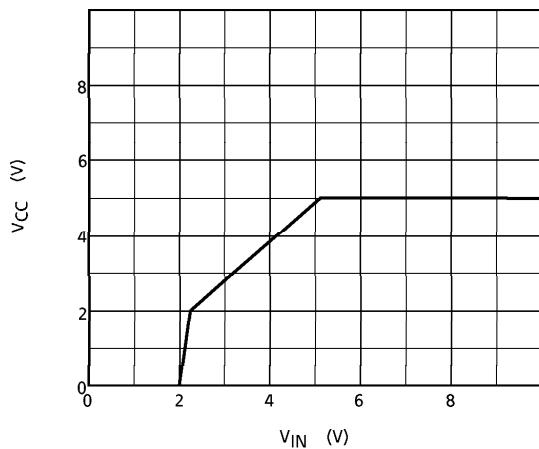
2. Example for using the reset signal to start the CPU system.



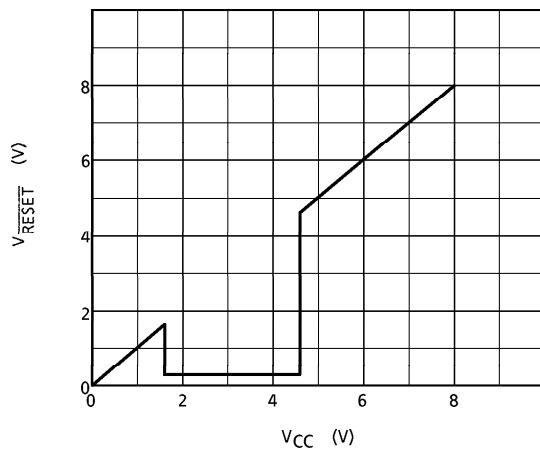
(*) Cautions for wiring

1. C₁ and C₂ are for absorbing disturbance, noise, etc. Connect them as close as the IC as possible.
2. C₃ is for phase compensation. Also, connect C₃ close to the IC.

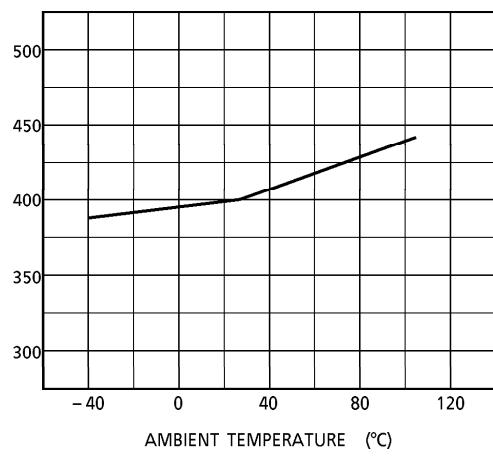
TYPICAL CHARACTERISTIC

INPUT – OUTPUT CHARACTERISTIC ($R_L = 500\Omega$)

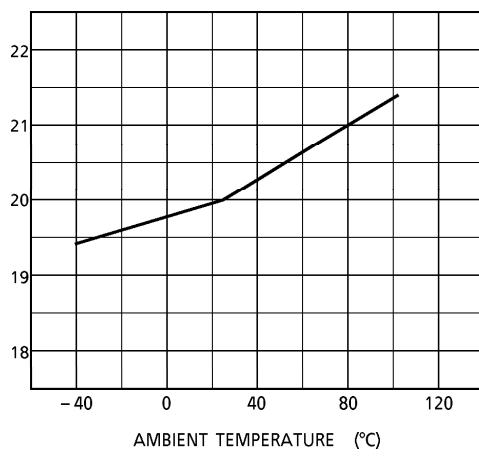
RESET OUTPUT CHARACTERISTIC



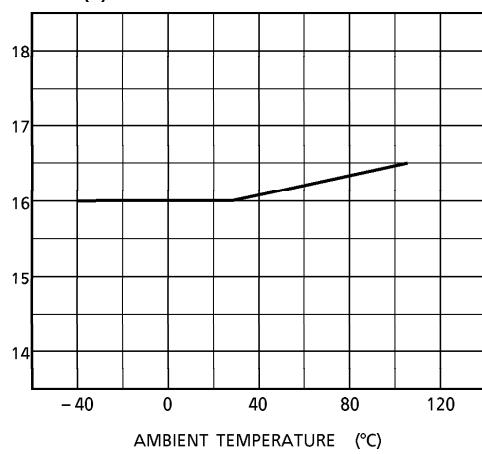
TWU TIME COEFFICIENT CHARACTERISTIC



TWD TIME COEFFICIENT CHARACTERISTIC

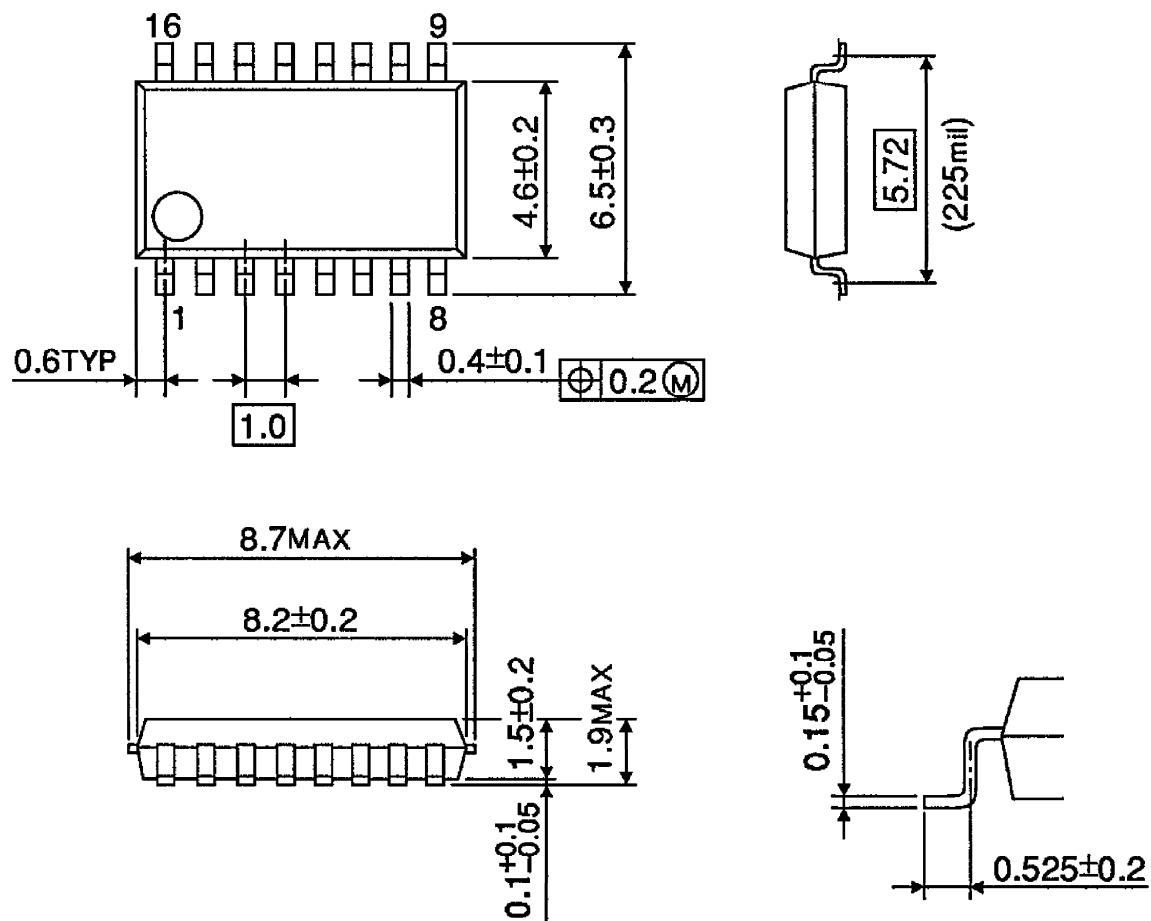


TRST (1) TIME COEFFICIENT CHARACTERISTIC



OUTLINE DRAWING
SSOP16-P-225-1.00A

Unit : mm



Weight : 0.14g (Typ.)