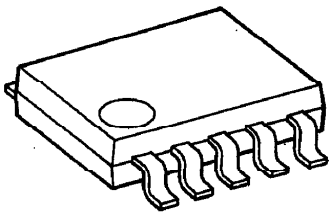
TOSHIBA Bi-CMOS INTEGRATED CIRCUIT SILICON MONOLITHIC

# TB1022F

## CR TIMER

### FEATURES

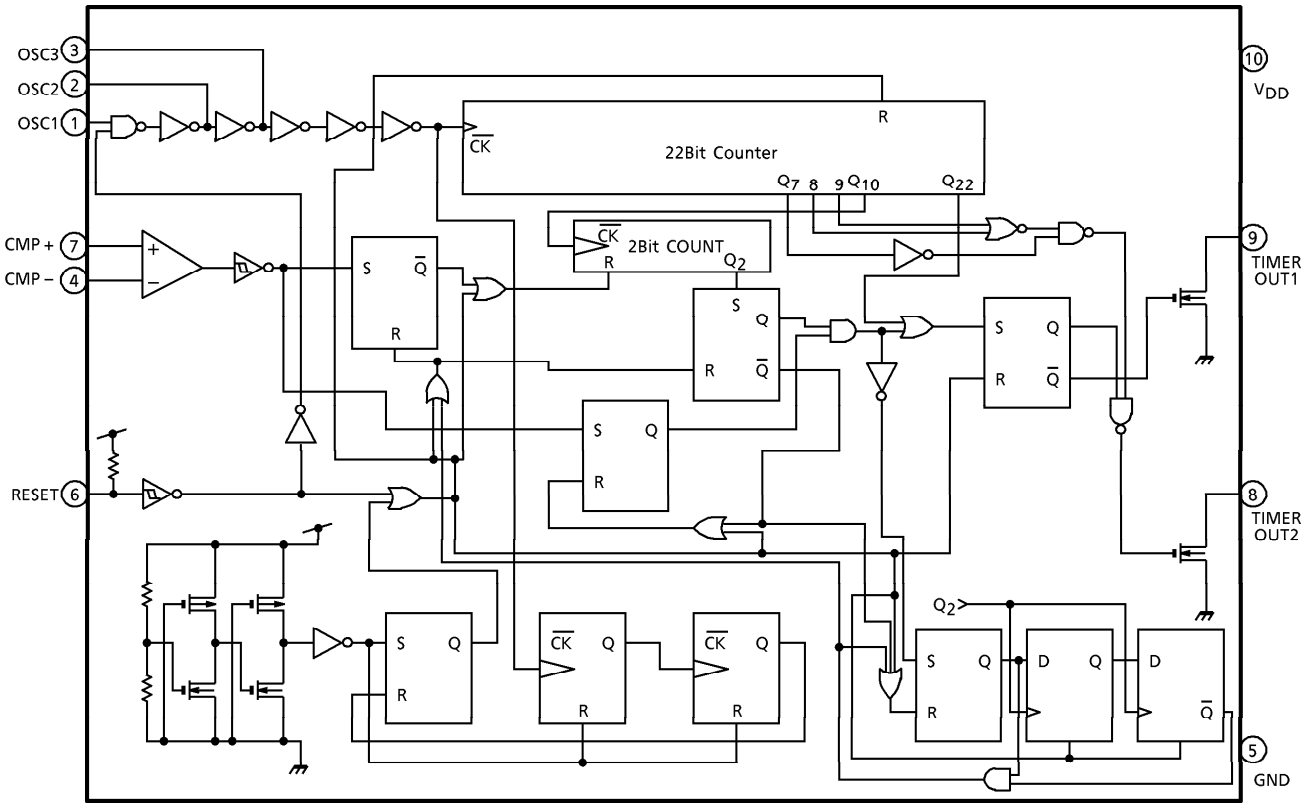
- MOS IC with 22-stage binary counter.
- Built-in initialize circuit.
- Built-in voltage detection comparator.
- Wide range timer setting.
- Low power dissipation current.
- Suitable for Ni-cd battery charger.



SSOP10-P-225-1.00

Weight : 0.1g (Typ.)

### BLOCK DIAGRAM

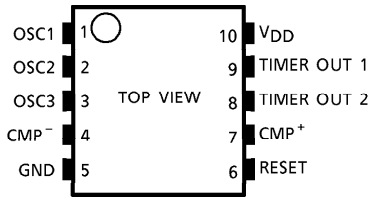



961001EBA2

## FUNCTION DESCRIPTION ON EACH TERMINAL

| PIN No. | SYMBOL | FUNCTION |
|---|---|---|
| 1 | OSC1 | Oscillation input terminal 1 |
| 2 | OSC2 | Oscillation input terminal 2 |
| 3 | OSC3 | Oscillation input terminal 3 |
| 4 | $CMP^-$ | Comparator minus (−) side input terminal<br>"L" : Timer mode, "H" : Timer over voltage detection mode |
| 5 | GND | GND |
| 6 | RESET | Reset terminal (H→L : inside reset) |
| 7 | $CMP^+$ | Comparator plus (+) side input terminal<br>"H" : Timer mode, "L" : Timer over voltage detection mode |
| 8 | TIMER OUT2 | Timer output terminal 2 (N-ch open drain, sink max. 5mA) |
| 9 | TIMER OUT1 | Timer output terminal 1 (N-ch open drain, sink max. 5mA) |
| 10 | $V_{DD}$ | System power supply |

## PIN CONNECTION



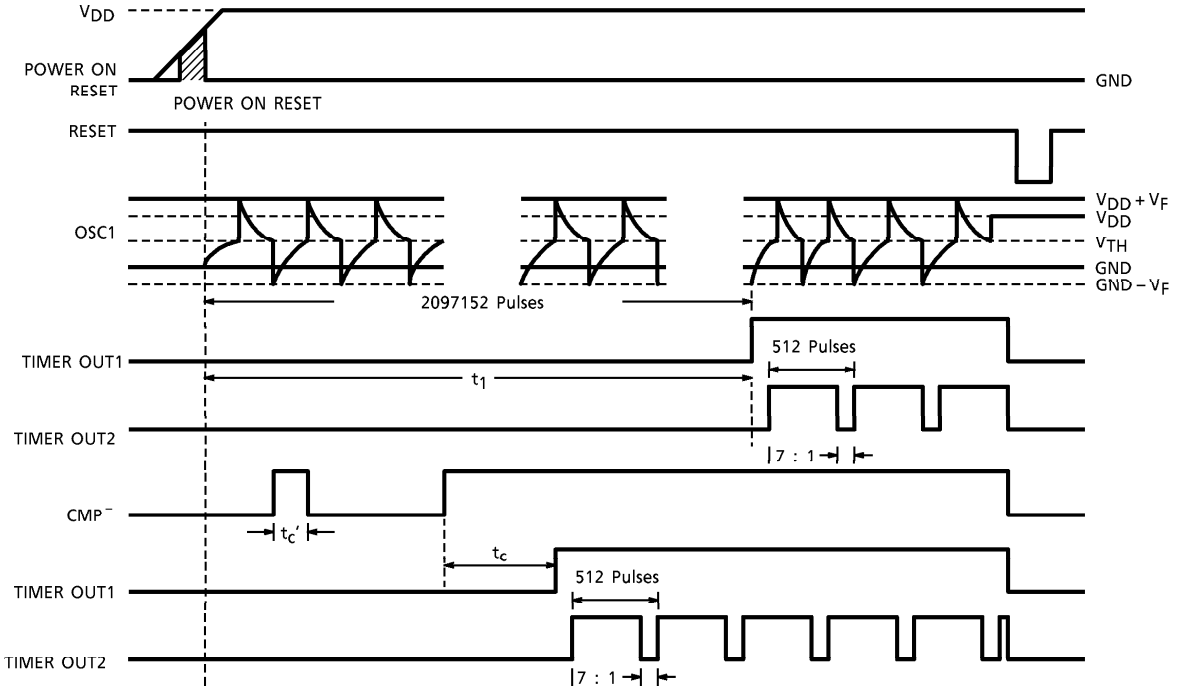

## TRUTH TABLE

| MODE | INPUT | | | OUTPUT |
|---|---|---|---|---|
| | RESET | $CMP^+$ | $CMP^-$ | |
| 1 | L | (*) | (*) | L |
| 2 | H | H | L | Timer Mode |
| 3 | H | L | H | Timer over voltage detecting Mode |

(*) : H or L

Turning the power supply on, "Power on Reset" is operated and output level is "L".

**TIMING CHART**




(*) : $t_c' < t_c$ at $CMP^-$ input "H" Level cancelled

**MAXIMUM RATINGS** (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Power Supply Voltage | $V_{DD}$ | −0.3~7.0 | V |
| Power Dissipation | $P_D$ | 250~300 | mW |
| Operating Temperature | $T_{opr}$ | −20~75 | °C |
| Storage Temperature | $T_{stg}$ | −55~125 | °C |
| Electrostatic Discharge | ESD (*) | ±200 | V |
| Latch Up Current | — | ±10 | mA |

(*) : C = 200pF, R = 0Ω, one time discharge

**ELECTRICAL CHARACTERISTICS** (Unless otherwise specified, Ta = 25 ± 1.5°C, $V_{DD}$ = 5.0V)

| CHARACTERISTIC | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|
| Operating Voltage | $V_{opr}$ | — | — | 4.0 | 5.0 | 6.0 | V |
| Oscillation Frequency Characteristic | $\Delta f_{osc1}$ | — | 1H C = 4700pF, R = 254.9kΩ, $V_{DD}$ = 5V (f = 582.5Hz) | — | — | 10 | % |
| | $\Delta f_{osc2}$ | — | 60s C = 1000pF, R = 17.2kΩ, $V_{DD}$ = 5V (f = 34.9kHz) | — | — | 15 | |
| | | | 8H C = 0.01μF, R = 996.7kΩ, $V_{DD}$ = 5V (f = 72.8Hz) | | — | | |

| CHARACTERISTIC | | SYMBOL | TEST CIR-CUIT | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|
| Power Dissipation Current | 1 | $I_{QD}$ | — | CR OSC. stopping (at reset) $V_{DD}$ = 6V | — | — | 130 | μA |
| | 2 | $I_{DD}$ | — | CR OSC. operating (at 60s setting) | — | — | 700 | |
| Power on Reset Release Voltage | | $V_{thH}$ | — | $V_{DD}$ rise time 40μs / V | 1.4 | 2.5 | 3.5 | V |
| | | $V_{thL}$ | — | | 1.4 | 2.5 | 3.5 | |

DC CHARACTERISTICS

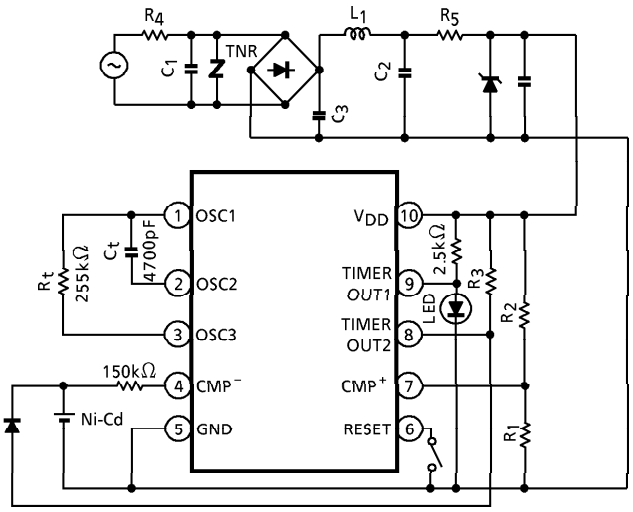
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. Oscillation Input | | | | | | | |
| OSC1 Leak Current | $I_{IH\ OSC}$ | — | $V_{IN}$ = 5.0V | – 1.0 | — | 1.0 | μA |
| OSC1 Leak Current | $I_{IL\ OSC}$ | — | $V_{IN}$ = 0V | – 1.0 | — | 1.0 | μA |
| 2. CMP Terminal | | | | | | | |
| CMP Offset Voltage | $V_{off}$ | — | $V_{DD}$ = 5V | – 30 | — | 30 | mV |
| Offset Supply Voltage Change | $\Delta V_{off}$ | — | $V_{DD}$ = 4~6V | – 10 | — | 10 | mV |
| $CMP^+$, $CMP^-$ Leak Current | $I_{IH\ CMP^+,\ ^-}$ $I_{IL\ CMP^+,\ ^-}$ | — | $V_{IN}$ = 5.0V | – 1.0 | — | 1.0 | μA |
| | | | $V_{IN}$ = 0V | – 1.0 | — | 1.0 | |
| Input Dynamic Range | — | — | — | 0 | — | $V_{DD}$ – 2.5 | V |
| 3. Reset Terminal | | | | | | | |
| Leak Current | $I_{IHR}$ | — | $V_{IN}$ = 5.0V | – 1.0 | — | 1.0 | μA |
| Input Pull Up Resistance | $R_3$ | — | — | 490 | 700 | 910 | kΩ |
| 4. Timer OUT1, 2 Terminal | | | | | | | |
| Timer Out1, 2 Sink Current | $I_{TS}$ | — | $V_{OL}$ = 0.3V | — | — | 5 | mA |
| Timer Out Offleak Current | $I_{TLH1,\ 2}$ | — | $V_{IN}$ = 0~5.0V | – 1.0 | — | 1.0 | μA |

FUNCTION CHARACTERISTICS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Timer 1 Precision (TIMER OUT1) | $\Delta T_1$ | — | C = 4700pF, R = 254.9kΩ, $V_{DD}$ = 5V (1H) | — | — | 10 | % |
| | $\Delta T_2$ | — | C = 1000pF, R = 17.2kΩ, $V_{DD}$ = 5V (60s) | — | — | 15 | |
| | | | C = 0.01μF, R = 966.7kΩ, $V_{DD}$ = 5V (8H) | | — | | |
| CMP Detecting Timer Precision | $t_c$ | — | C = 4700pF, R = 254.9kΩ, $V_{DD}$ = 5V (1H) Typ. = 3.5s | – 50 | — | 50 | % |
| Timer 2 Precision (TIMER OUT2) | Duty | — | C = 4700pF, R = 254.9kΩ, $V_{DD}$ = 5V (1H) | 0.85 : 7.15 | 1 : 7 | 1.15 : 6.85 | — |
| | Frequency | | | 0.967 | 1.137 | 1.308 | Hz |

**APPLICATION CIRCUIT (example)**

1 hour setting




Timer setting time

$$T = 2^{21} \cdot C_t \cdot R_t \cdot \ell n \left\{ \frac{V_{DD}^2 - V_f^2}{V_{TH}\,(V_{DD} - V_{TH})} \right\}$$

T : Timer setting time (s)

$C_t$ (F)

$R_t$ (Ω)

$V_{TH} = 1.95$ (V) : Voltage of OSC. first stage circuit

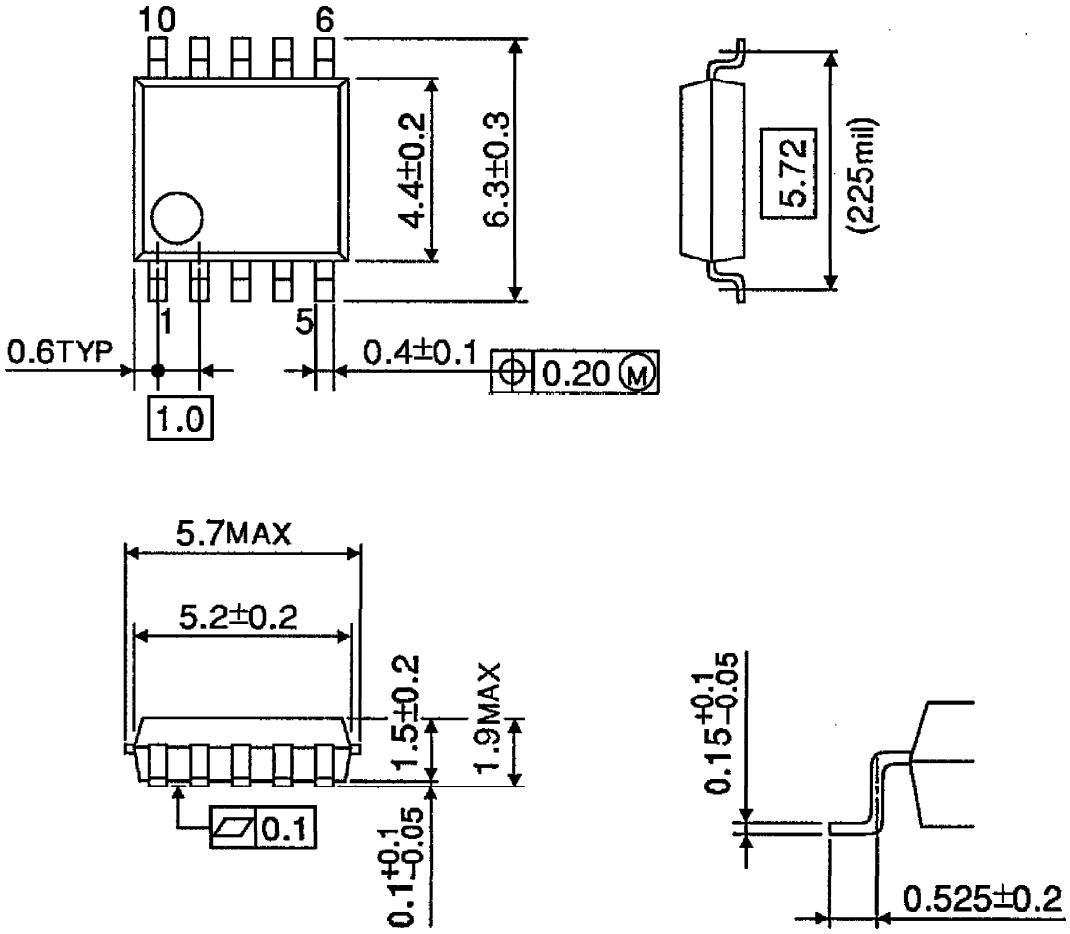
$V_f = 0.7$ (V) : Voltage of input protection diode (1Pin)

(*) Recommendation of timer setting

| TIMER SET UP | $R_t$ | $C_t$ |
|---|---|---|
| About 60s | 17.2kΩ | 1000pF |
| About 1Hour | 254.9kΩ | 4700pF |
| About 8Hour | 966.7kΩ | 0.01μF |

**OUTLINE DRAWING**

SSOP10-P-225-1.00 Unit : mm




Weight : 0.1g (Typ.)