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# M59350FP

## Watchdog Timer IC with Built-in 5 V Constant-Voltage Power Supply

REJ03F0016-0100Z

Rev.1.00

Aug.25.2003

### Description

The M59350FP is an IC developed for use as a watchdog timer with a built-in 5 V constant-voltage power supply. It is provided with functions for power-on reset, constant voltage monitoring, and watchdog timer operation, and can be used as a power supply circuit for various systems. Because it employs a 15-pin flat package, it is ideal for compact system designs.

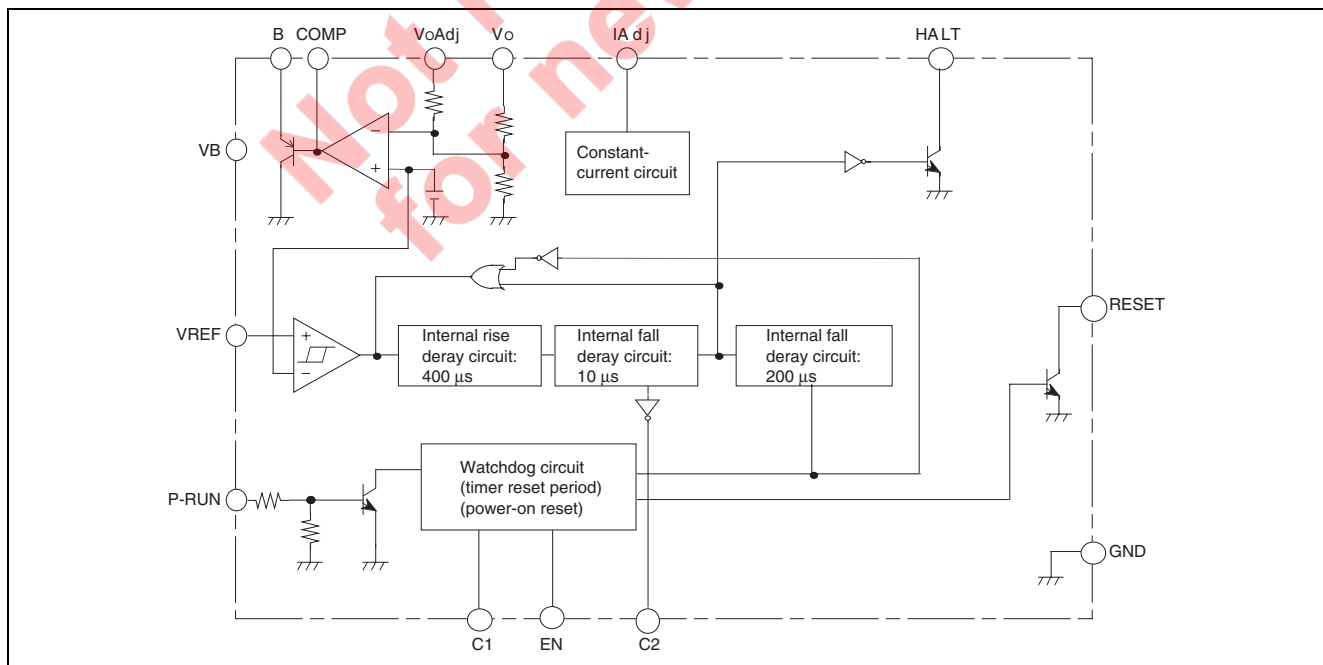
### Features

- Built-in power-on reset circuit
- Built-in 5 V constant-voltage power supply
- Built-in 5 V constant-voltage power supply monitoring circuit
- Built-in watchdog timer circuit
- Compact flat package (SOP, 14P2N, 1.27 mm pitch)

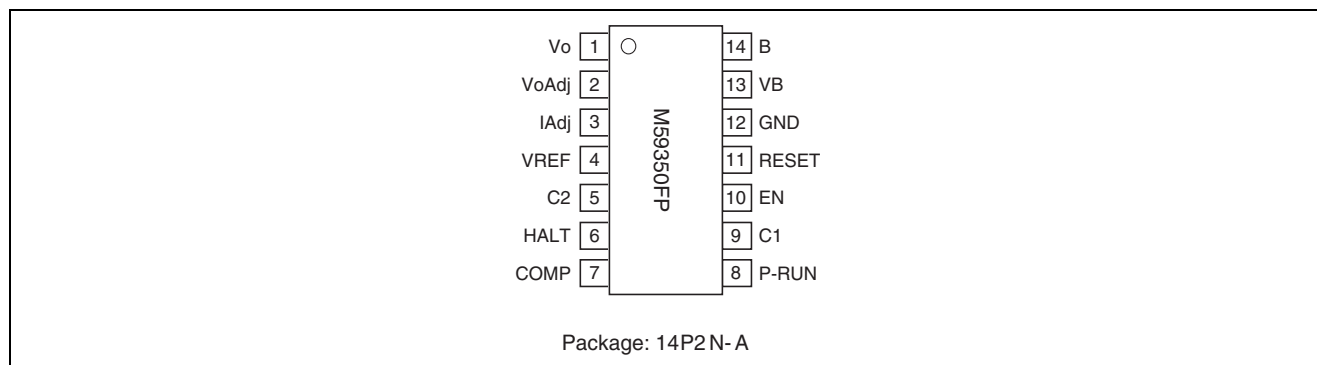
### Application

- ECU power supply circuit for automotive use
- Other automotive applications

### System Block Diagram



## Pin Arrangement (top view)



## Pin Description

| Pin no. | Pin symbol | Function  |
|---------|------------|---|
| [1]     | Vo         | By connecting an external PNP transistor,<br>pin [1] (VO): 5 V constant voltage output<br>pin [1] (VO): PNP transistor collector connection<br>pin [13] (VB): PNP transistor emitter + power supply connection<br>pin [14] (B): PNP transistor base connection<br>(pin [1]: grounded via capacitor (100 $\mu$ F)) |
| [13]    | VB         |   |
| [14]    | B          |   |
| [2]     | VoAdj      |   |
| [3]     | IAdj       | Sets charge/discharge current of capacitors to set time (C1, C2 within IC)  |
| [4]     | VREF       | Monitors voltage, compares with set voltage to control pin [6] (HALT), pin [11] (RESET) output  |
| [5]     | C2         | Delay time from decision that pin [4] (VREF) is "L" until pin [6] (HALT) outputs "L" is set through the grounding capacitance (when open, the IC Built-in capacitance results in a delay time of 10 $\mu$ s)  |
| [6]     | HALT       | Outputs pin [4] (VREF) voltage monitoring result  |
| [7]     | COMP       | Pin for connection of constant-voltage power supply (Vo) phase compensation capacitance   |
| [8]     | P-RUN      | Detects voltage and period of input clock signal, controls pin [11] (RESET) output  |
| [9]     | C1         | Sets the power-on reset time (T3), watchdog time (T2), watchdog reset pulse width (T1) time through the grounding capacitance   |
| [10]    | EN         | Halts the watchdog function on input of "L" level (open: H input fixed)   |
| [11]    | RESET      | Outputs judgment result of pin [4] (VREF) voltage monitoring, pin [8] (P-RUN) input clock signal  |
| [12]    | GND        | GND   |

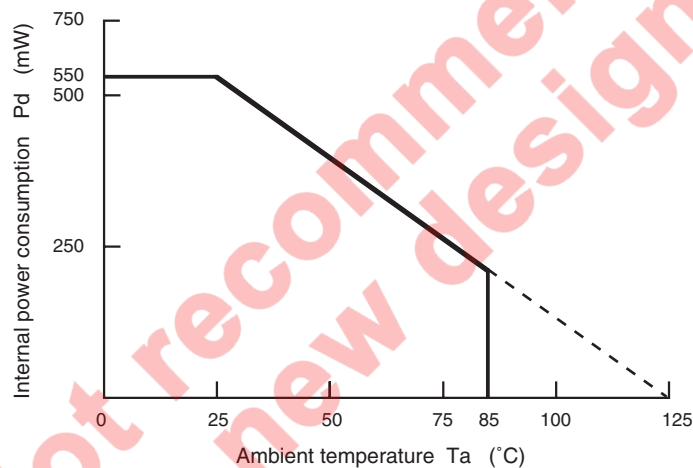
## Absolute Maximum Ratings

(Unless otherwise specified,  $T_a = 25^\circ\text{C}$ )

| Pin no.   | Symbol    | Item                       | Test conditions          | Ratings      | Unit             |
|-----------|-----------|----------------------------|--------------------------|--------------|------------------|
| [13]      | $V_B$     | Power supply voltage       |                          | -0.3 to 36   | V                |
| [13]      | $V_B$     | Power supply surge voltage | $t \leq 200 \text{ ms}$  | -0.3 to 36.5 | V                |
| [14]      | $I_B$     | Bias current               |                          | 30           | mA               |
| [6], [11] | $V_{OUT}$ | Output voltage             |                          | -0.3 to 36   | V                |
| [6], [11] | $I_{OUT}$ | Output current             |                          | 10           | mA               |
| [8], [10] | $V_{IN}$  | Input voltage              |                          | -0.3 to 16   | V                |
| [8], [10] | $I_{IN}$  | Input current              |                          | -2.0 to 2.0  | mA               |
|           | $P_d$     | Power dissipation          | $T_a = 25^\circ\text{C}$ | 550          | mW               |
|           | $T_{opr}$ | Operating temperature      |                          | -40 to +85   | $^\circ\text{C}$ |
|           | $T_{stg}$ | Storage temperature        |                          | -55 to +125  | $^\circ\text{C}$ |

Note: All voltages are relative to the IC GND pin voltage (0 V). All current directions are positive when flowing into the IC (unmarked, or marked with a +), and are negative when flowing out (marked -).

## Thermal Reduction Rate Curve (Maximum Rating)



## Recommended Operating Conditions

(Unless otherwise specified,  $T_a = -40$  to  $+85^\circ\text{C}$ )

| Pin No.   | Symbol    | Item                        | Conditions | Ratings    | Unit |
|-----------|-----------|-----------------------------|------------|------------|------|
| [13]      | $V_B$     | Power supply voltage        |            | 6 to 16    | V    |
| [1]       | $V_O$     | Output power supply voltage |            | 4.5 to 5.5 | V    |
| [8], [10] | $V_{IN}$  | Input voltage               |            | 0 to $V_O$ | V    |
| [8], [10] | $V_{OUT}$ | Output voltage              |            | 0 to $V_O$ | V    |

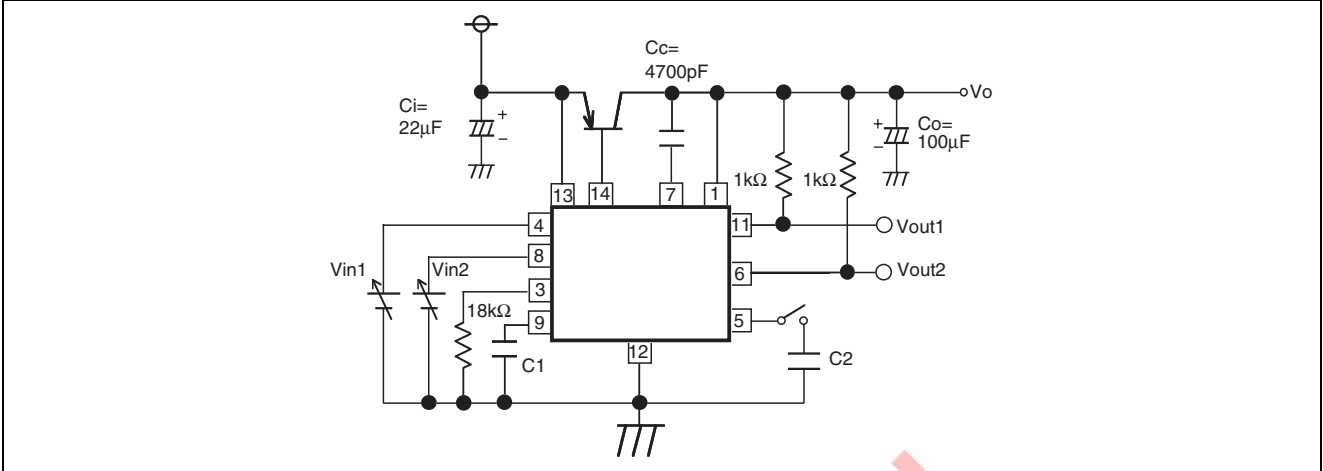
## Electrical Characteristics

(Unless otherwise specified, Ta = -40 to +85°C, Io = 50 mA, Ci = 22 μF, Co = 100 μF, C1 = 0.47 μF, Cc = 4700 pF, RIAdj = 18 kΩ)

| Symbol | Item  | Measurement conditions    | Units |       |       | Unit |
|--------|---|---------------------------|-------|-------|-------|------|
|        |   |                           | min.  | typ.  | max.  |      |
| IB     | Bias current                                  | Note1                     | —     | 9     | 20    | mA   |
| VO     | Output voltage                                | Steady-state              | 4.75  | 5.0   | 5.25  | V    |
| VON    |   | VoAdj pin grounded        | 5.2   | 5.5   | 6.0   | V    |
| Reg-IN | Input stability                               | Vcc = 7 to 36 V           | —     | 0.1   | 0.2   | %/V  |
| Reg-L  | Load stability                                | Io = 1 to 500 mA          | —     | 40    | 200   | mV   |
| VREF   | Reference voltage                             |                           | 1.200 | 1.265 | 1.330 | V    |
| ΔVTH1  | Threshold voltage hysteresis                  | Note2: VTH1 set to 4.35 V | 20    | 50    | 100   | mV   |
| IVREF  | VREF input current                            |                           | —     | —     | 10    | μA   |
| VsatH  | HALT output saturation voltage                | IHALT = 5 mA              | —     | 0.2   | 0.6   | V    |
| VsatR  | RESET output saturation voltage               | IRESET = 5 mA             | —     | 0.2   | 0.6   | V    |
| ILHAL  | HALT output leakage current                   | VHALT = 5 V               | —     | —     | 10    | μA   |
| ILR    | RESET output leakage current                  | VRESET = 5 V              | —     | —     | 10    | μA   |
| VL-EN  | ENL input voltage                             |                           | —     | —     | 0.6   | V    |
| IL-EN  | ENL input current                             | VIN – EN = 0 V            | —     | -250  | -500  | μA   |
| IIN-P  | P-RUN input current                           | VIN – P = 5 V             | 100   | 200   | 400   | μA   |
| VIN-PH | P-RUN H input voltage                         |                           | 2.5   | —     | —     | V    |
| VIN-PL | P-RUN L input voltage                         |                           | —     | —     | 0.3   | V    |
| T1(RW) | Watchdog reset pulse width                    | C1 = 0.22 μF              | 0.23  | 0.46  | 0.69  | ms   |
|        |   | C1 = 0.47 μF              | 0.5   | 1     | 1.5   | ms   |
| T2(RW) | Watchdog time (reset pulse interval)          | C1 = 0.22 μF              | 7.3   | 14.6  | 21.9  | ms   |
|        |   | C1 = 0.47 μF              | 15    | 30    | 45    | ms   |
| T3(R)  | RESET output delay time (power-on reset time) | C1 = 0.22 μF              | 14.6  | 29.2  | 44.0  | ms   |
|        |   | C1 = 0.47 μF              | 30    | 60    | 90    | ms   |
| T4(R)  | RESET output delay time                       |                           | 75    | 200   | 450   | μA   |
| T5(H)  | HALT output delay time                        |                           | 150   | 400   | 900   | μA   |
| T6(H)  | HALT output delay time                        | C2: open                  | 3     | 10    | 25    | μA   |
|        |   | C2 = 4700 pF ± 10%        | 1     | 2     | 3     | ms   |
| VB-MIN | VB minimum operating voltage                  | Note3, Ta = 25°C          | —     | —     | 2.0   | V    |
| VO-MIN | Vo minimum operating voltage                  | Note4, Ta = 25°C          | —     | 0.8   | 1.0   | V    |
| ID     | Driving current                               | Note5, Ta = 40 to 85°C    | 8     | —     | —     | mA   |

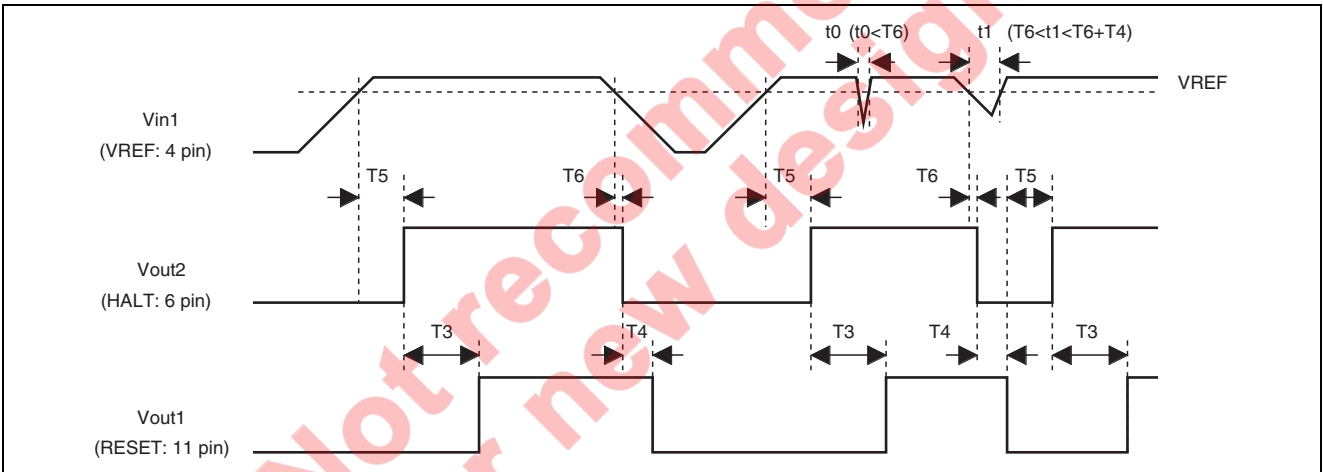
- Notes:
1. The bias current IB is the sum of all currents flowing into the pins [1], [7], [13], [14].
  2. VTH1 is the threshold voltage relative to VREF, and is set using an external resistance.
  3. The minimum operating voltage of VB for the operation of various functions
  4. The minimum operating voltage Vo at which the HALT output and RESET output can be held at L (when the HALT and RESET output pull-up resistance is 1 kΩ)
  5. B (pin [14]) driving current capacity

**Power Supply Monitoring/Watchdog Timer Timing Diagram**



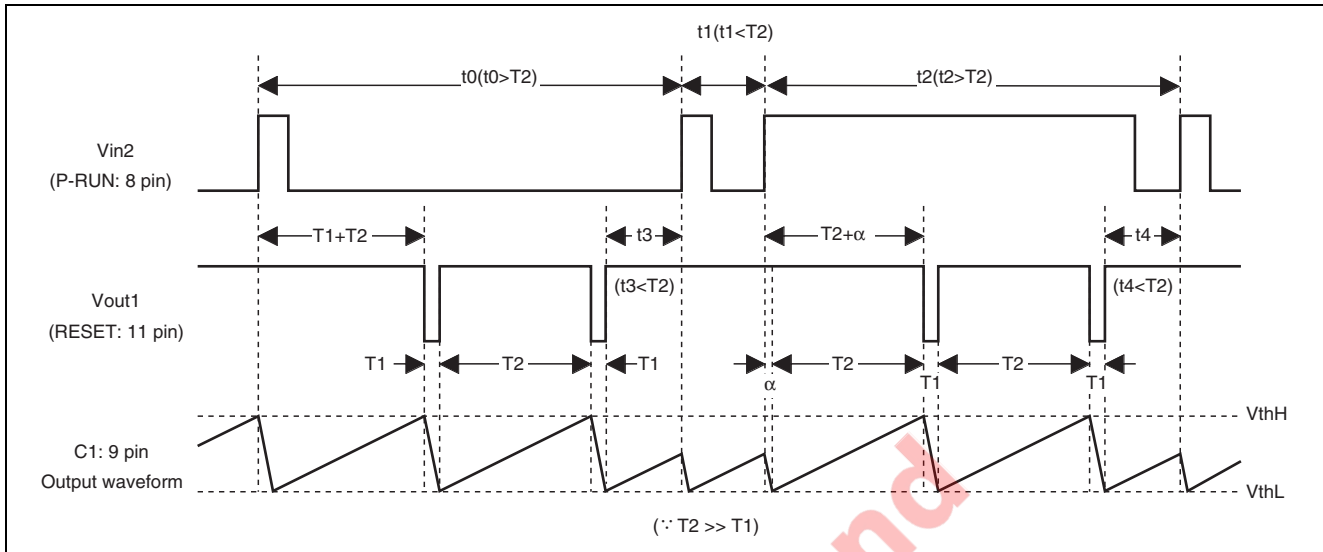
**Power Supply Monitor Timing Diagram**

(When a normal pulse is input to P-RUN (pin [8]))



Watchdog Timer Timing Chart (H input to Vin1 (pin [4], VREF))

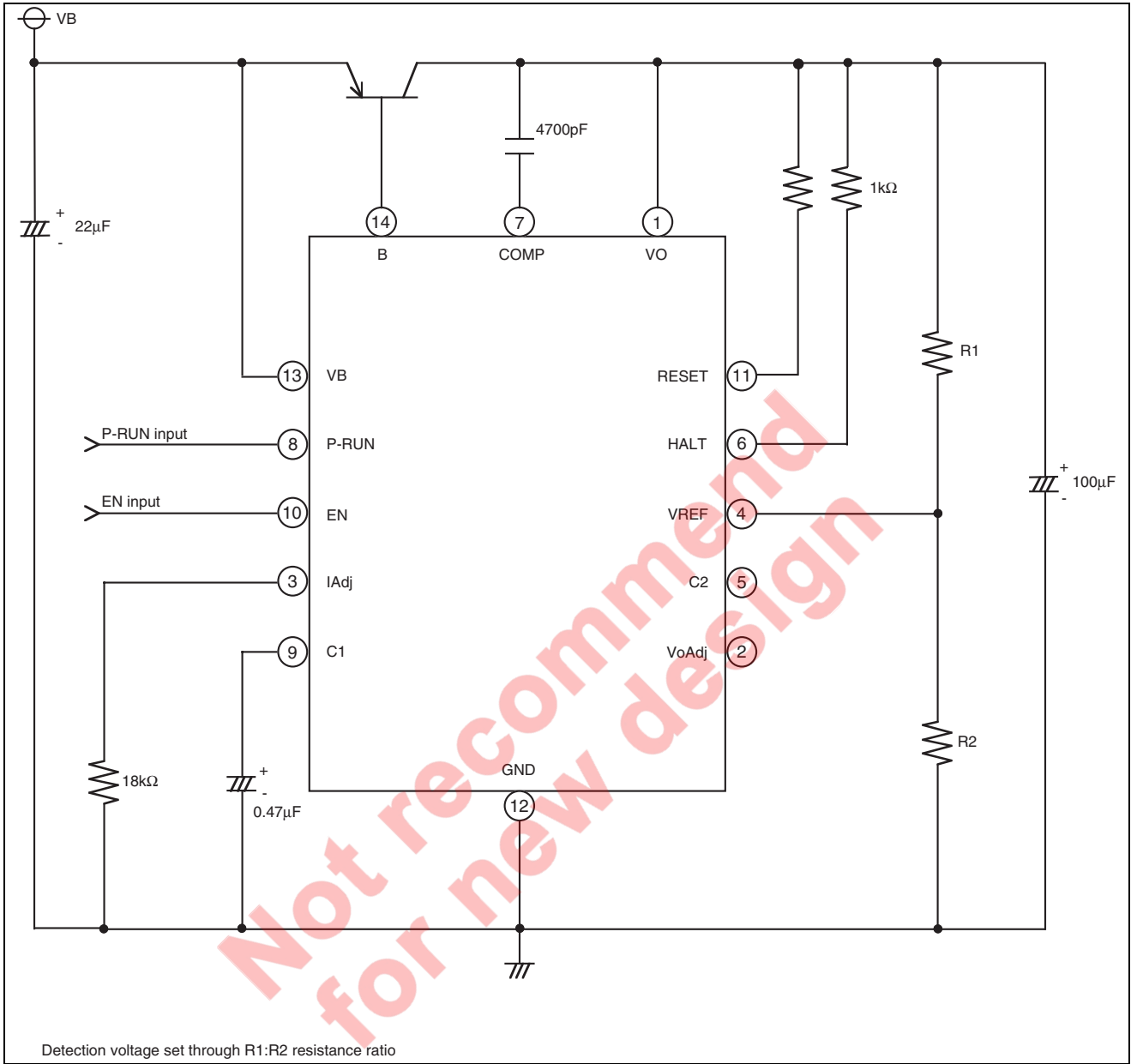
(When "L" is input to pin [10] (EN), watchdog function halted)



Not recommended for new design



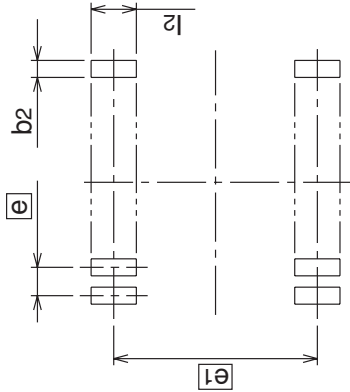
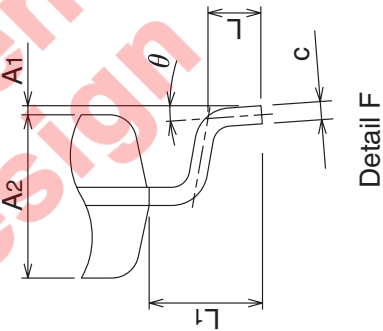
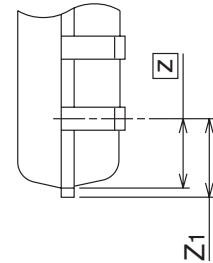
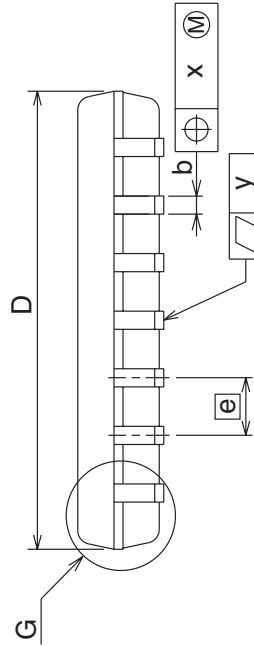
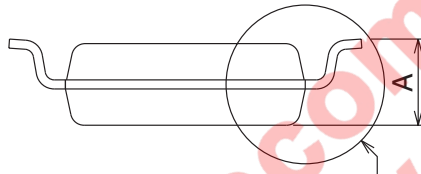
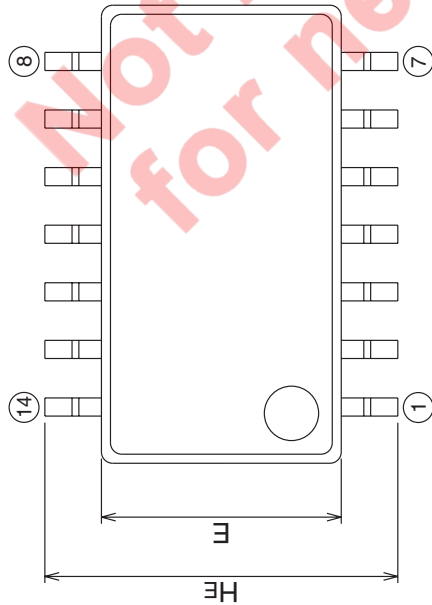
Application Example



Package Dimensions

14P2N-A (MMP) Plastic 14pin 300mil SOP

|                                       |                 |                  |                           |
|---------------------------------------|-----------------|------------------|---------------------------|
| EIAJ Package Code<br>SOP14-P-300-1.27 | JEDEC Code<br>— | Weight(g)<br>0.2 | Lead Material<br>Cu Alloy |
|---------------------------------------|-----------------|------------------|---------------------------|



Recommended Mount Pad

| Symbol   | Dimension in Millimeters |      |      |
|----------|--------------------------|------|------|
|          | Min                      | Nom  | Max  |
| A        | —                        | —    | 2.1  |
| A1       | 0                        | 0.1  | 0.2  |
| A2       | —                        | 1.8  | —    |
| b        | 0.35                     | 0.4  | 0.5  |
| c        | 0.18                     | 0.2  | 0.25 |
| D        | 10.0                     | 10.1 | 10.2 |
| E        | 5.2                      | 5.3  | 5.4  |
| e        | —                        | 1.27 | —    |
| HE       | 7.5                      | 7.8  | 8.1  |
| L        | 0.4                      | 0.6  | 0.8  |
| L1       | —                        | 1.25 | —    |
| Z        | —                        | 1.24 | —    |
| Z1       | —                        | —    | 1.39 |
| x        | —                        | —    | 0.25 |
| y        | —                        | —    | 0.1  |
| $\theta$ | 0°                       | —    | 8°   |
| b2       | —                        | 0.76 | —    |
| el       | —                        | 7.62 | —    |
| l2       | 1.27                     | —    | —    |

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