

## Timer Control for Triac and Relay

### Description

The timer control circuit, U2100B, uses bipolar technology. It has different mode selections (Zero voltage switch, Phase control, Relay control). The output stage is

triggered according to input conditions. It can be used in triac application for two or three wire system as a power switch.

### Features

- Adjustable and retriggerable tracking time
- Window monitoring for sensor input
- Enable input for triggering
- Internal noise suppression (40 ms) and retrigger blocking (640 ms)
- Two or three wire application

### Applications

- Motion detectors
- Touch sensors
- Timer

**Package:** DIP8, SO8

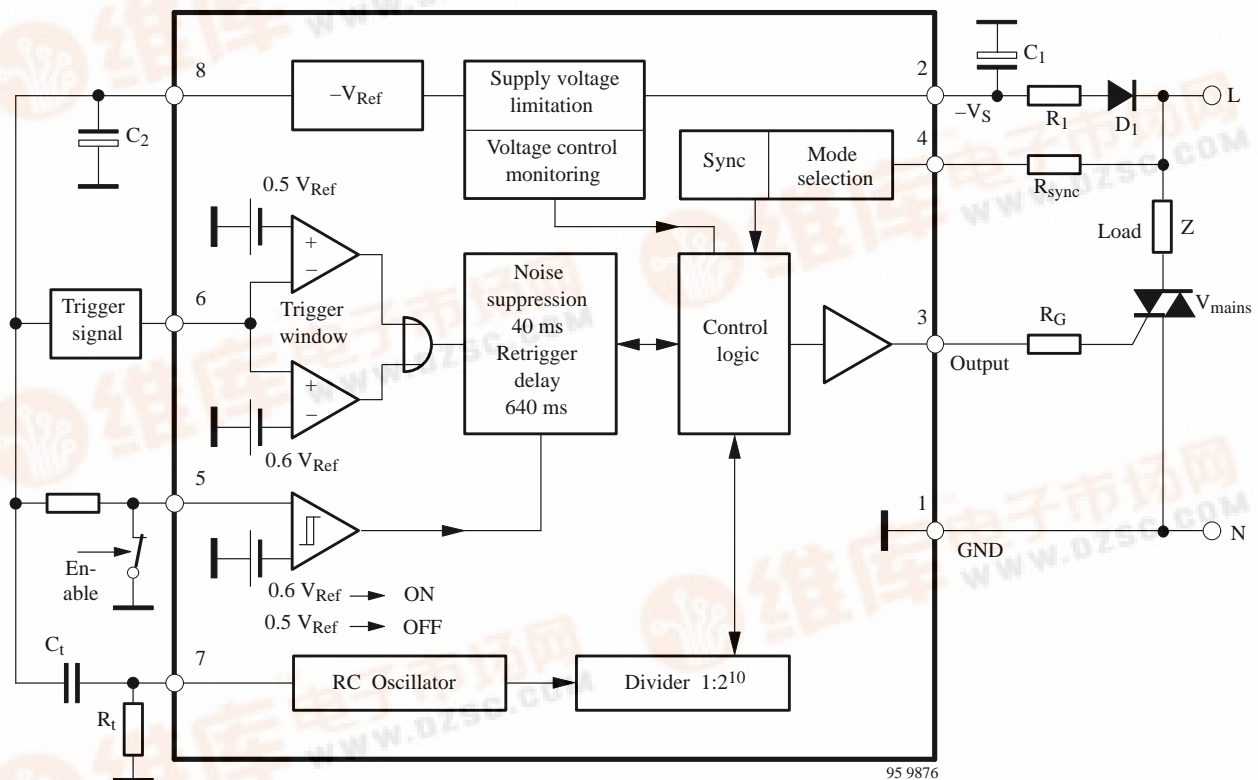
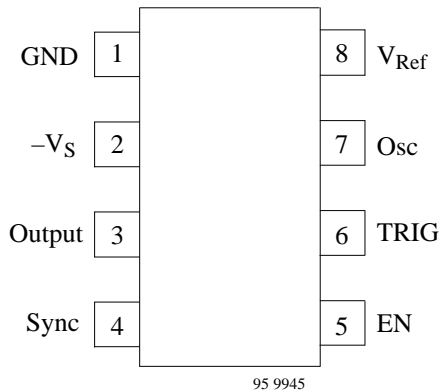


Figure 1. Block diagram with external circuit

## Pin Description



| Pin | Symbol           | Function                           |
|-----|------------------|------------------------------------|
| 1   | GND              | Reference point                    |
| 2   | -V <sub>S</sub>  | Supply voltage                     |
| 3   | Output           | Driver output                      |
| 4   | Sync             | Synchronisation and mode selection |
| 5   | EN               | Enable                             |
| 6   | TRIG             | Input trigger signal               |
| 7   | Osc              | RC Oscillator                      |
| 8   | V <sub>Ref</sub> | Reference voltage                  |

## General Description

Monostable integrated power control circuit, U2100B, can be used according to mode selection in relay's or triac's applications. Beyond that, it can be used in triac-application for two wire system as power switch, (being the load in series to the switch) whereas the supply voltage for the control unit is gained from phase rest angle ( $\alpha_{\min}$ -operation).

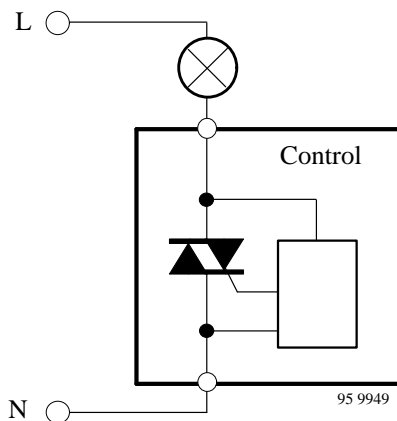


Figure 2. Two wire circuit

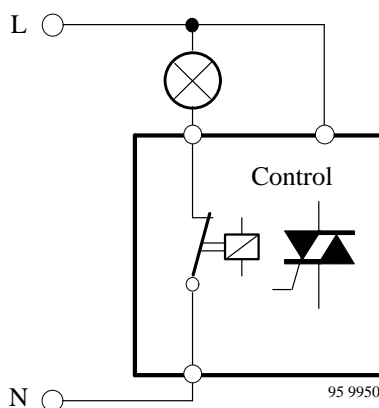


Figure 3. Three wire circuit

For three wire switch, two modes of operations are possible:

- Zero voltage switch operation for triac control
- Static operation for relay control

### Mode Selection Pin 4 and Supply Voltage Pin 2

Operation modes can be selected by external voltage at the sync. input Pin 4 (clamping). Mode selection determines the current requirement of driver stage for relay's or triac's and hence the selection of supply voltage.

### Zero Voltage Switch Operation, Figure 4

Selection condition:

$V_4$  = internal sync limitation, without external clamping

$$R_1 \approx 0.85 \frac{V_M - V_S}{2 I_{\text{tot}}}$$

$$I_{\text{tot}} = I_S + I_p + I_X$$

whereas:

$I_S$  = Supply current of IC without load

$I_p$  = Average trigger current  $I_G$

$I_X$  = External circuit current requirement

$V_M$  = Mains voltage

Required firing pulse width  $t_p$

$$t_p = \frac{2}{\omega} \arcsin \left( \frac{I_L \times V_M}{P \times \sqrt{2}} \right)$$

whereas:

$I_L$  = Triac latching current

$P$  = Power at load Z

$$R_{\text{sync}}[\text{k}\Omega] \approx \frac{V_M[\text{V}] \times \sqrt{2} \sin(\omega \times t_p[\text{s}]) - 0.7}{1.8 \times 10^{-2}} - 176$$

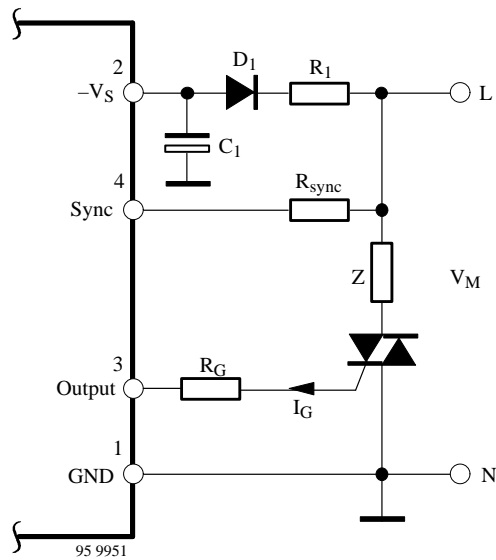


Figure 4.

**$\alpha_{min}$ -operation, Figure 6**

Selection condition:

$$-V_4 = 6.5 \text{ to } 7.8 \text{ V} \quad +V_4 = \text{int. limitation}$$

$$R_{\alpha_{max}} = R_{sync} \frac{3.6 \text{ V}}{V_{R(\text{peak})} - 3.6 \text{ V}}$$

$$R_{\alpha_{min}} = R_{sync} \frac{10 \text{ V}}{V_M \times \sqrt{2} - 10 \text{ V}}$$

$V_{R(\text{peak})}$  is the peak voltage of the rest phase angle, which should be high enough to generate the supply voltage,  $V_S$ .

**DC Operation, Figure 5**

Selection condition:

$$+V_4 = 6.1 \text{ V} \quad -V_4 = \text{int. limitation}$$

whereas:

$$R_0 \approx 1/10 X_c$$

$$X_c = 0.85 \frac{V_M - V_S}{I_{tot}}$$

$$I_{tot} = I_S + I_{Rel} + I_X$$

$$C_0 = \frac{1}{\omega \times X_c}$$

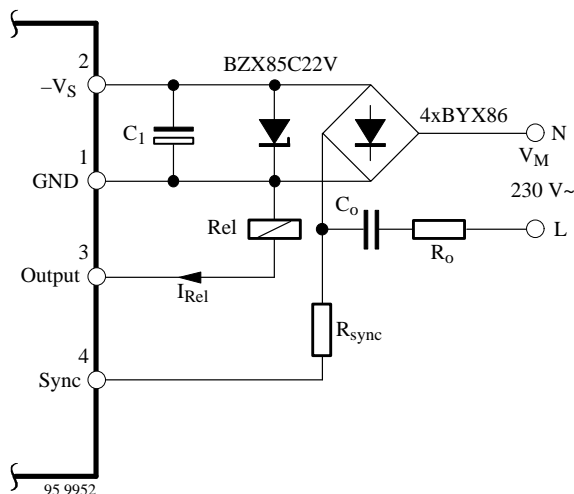


Figure 5.

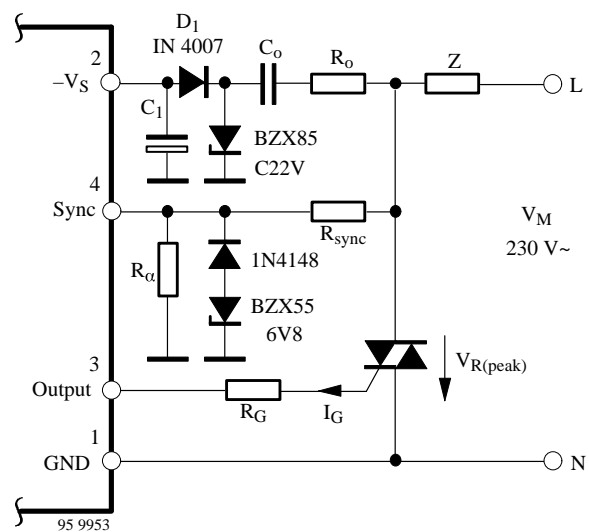


Figure 6.

- $C_1 = 100 \mu\text{F}/35 \text{ V}$
- $C_0 = 0.33 \mu\text{F}/250 \text{ V} \sim$
- $R_0 = 390 \Omega$
- $R_{sync} = 220 \text{ k}\Omega$
- $R_\alpha = 10 \text{ k}\Omega$
- $R_G = 390 \Omega$
- $D_1 = \text{IN } 4007$

## Tracking Time Pin 7

An internal RC oscillator with following divider stage  $1:2^{10}$  allows a very long and reproducible tracking time.

RC-values for required final time,  $t_t$ , can be calculated as follows:

$$R_t[\Omega] = \frac{t_t[s] \cdot 10^6}{1.6 \cdot 1024 \cdot C_t[\mu F]}$$

$$C_t[\mu F] = \frac{t_t[s] \cdot 10^6}{1.6 \cdot 1024 \cdot R_t[\Omega]}$$

$$t_t[s] = \frac{C_t[\mu F] \times R_t[\Omega] \times 1.6 \times 1024}{10^6}$$

## Trigger Inputs Pins 5 and 6, Figures 7 and 8

Two AND-connected, identical inputs determine the trigger conditions of monostable time stages, i.e., both inputs must be in position "ON" so that the output is switched ON. The tracking time starts after the trigger conditions has elapsed. The output ON state is given until the tracking time is over.

Input Pin 5 is a simple comparator whereas input Pin 6 is built up as a window discriminator.

Noise suppression for  $t_{ON} = 40$  ms guarantee, that there is no peak noise signals at the inputs which could trigger the circuit.

At the same time, the retrigger is delayed for a duration of 640 ms ( $t_{OFF}$ ), to avoid noise signal to trigger the relay.

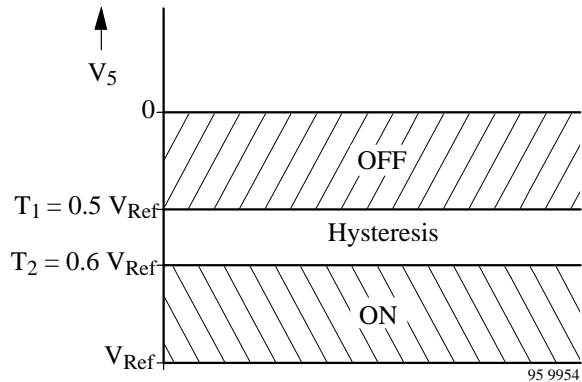


Figure 7. Trigger condition, Pin 5

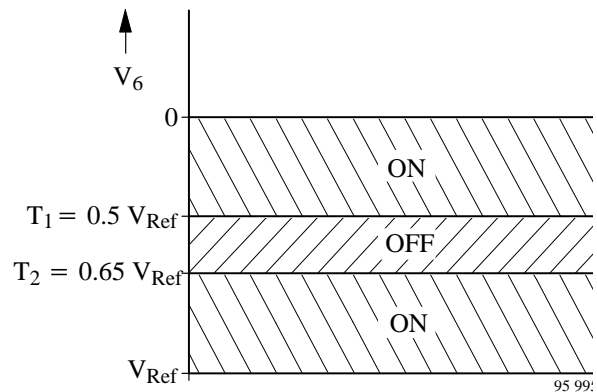


Figure 8. Trigger condition, Pin 6

## Absolute Maximum Ratings

Reference point Pin 1, unless otherwise specified

| Parameters                          | Symbol                         | Value       | Unit           |
|-------------------------------------|--------------------------------|-------------|----------------|
| <b>Supply</b> Pin 2                 |                                |             |                |
| Supply current                      | $-I_S$                         | 10          | mA             |
| Peak current $t \leq 10 \mu s$      | $-i_s$                         | 60          |                |
| Supply voltage                      | $-V_S$                         | 32          | V              |
| Reference voltage source            | Pin 8                          |             |                |
| Output current                      | $I_O$                          | 3           | mA             |
| Synchronization                     | Pin 4                          |             |                |
| Input current $t \leq 10 \mu s$     | $\pm I_{Sync.}$<br>$i_{Sync.}$ | 5<br>20     | mA             |
| <b>Window monitoring</b>            |                                |             |                |
| Input voltage                       | Pin 6                          | $-V_1$      | $V_{Ref}$ to 0 |
| <b>Enable-Schmitt trigger</b> Pin 5 |                                |             |                |
| Input voltage                       |                                | $-V_1$      | $V_{Ref}$ to 0 |
| <b>Driver output</b> Pin 3          |                                |             |                |
| Collector voltage                   | $-V_O$                         | $V_S$ to 2  | V              |
| Storage temperature range           | $T_{stg}$                      | -40 to +125 | °C             |
| Junction temperature                | $T_j$                          | 125         | °C             |
| Ambient temperature range           | $T_{amb}$                      | 0 to 100    | °C             |

## Thermal Resistance

| Parameters       | Symbol     | Value             | Unit |
|------------------|------------|-------------------|------|
| Junction ambient | $R_{thJA}$ | 110<br>220<br>140 | K/W  |
| DIP8             |            |                   |      |
| SO8 on PC board  |            |                   |      |
| SO8 on ceramic   |            |                   |      |

## Electrical Characteristics

$V_S = -18 V$ ,  $T_{amb} = 25^\circ C$ , reference point Pin 1, unless otherwise specified

| Parameters                             | Test Conditions / Pins                  | Symbol     | Min          | Typ | Max          | Unit    |
|----------------------------------------|-----------------------------------------|------------|--------------|-----|--------------|---------|
| <b>Supply voltage limitation</b>       | $I_S = 800 \mu A$ Pin 2<br>$I_S = 2 mA$ | $-V_S$     | 21<br>21.3   |     | 23<br>24     | V       |
| <b>Current consumption</b>             | $I_3 = 0$                               | $-I_S$     |              |     | 750          | $\mu A$ |
| <b>Supply voltage monitoring</b> Pin 2 |                                         |            |              |     |              |         |
| ON-Threshold                           |                                         | $-V_S$     |              | 15  |              | V       |
| OFF-Threshold                          |                                         | $-V_S$     |              | 6.5 |              | V       |
| Reference voltage                      | $I_8 = 0.1 mA$ Pin 8<br>$I_8 = 1.5 mA$  | $-V_{Ref}$ | 4.75<br>4.55 |     | 5.25<br>5.25 | V       |

| Parameters                                                  | Test Conditions / Pins   | Symbol                                   | Min  | Typ                       | Max  | Unit          |
|-------------------------------------------------------------|--------------------------|------------------------------------------|------|---------------------------|------|---------------|
| <b>Synchronization</b> Pin 4                                |                          |                                          |      |                           |      |               |
| Input current                                               |                          | $\pm i_{\text{sync}}$                    | 0.1  |                           | 1.1  | mA            |
| Voltage limitation                                          | $I_4 = \pm 1 \text{ mA}$ | $\pm V_{\text{sync}}$                    | 8.8  | 9.4                       | 10   | V             |
| Rest phase angle                                            | ON                       | $\pm V_T$                                | 3.6  | 4                         | 4.4  | V             |
| $\alpha_{\text{min}}$ -threshold                            | Off                      | $\pm V_T$                                | 1.8  | 2                         | 2.2  | V             |
| <b>Zero-identification</b> Pin 4                            |                          |                                          |      |                           |      |               |
| Zero-identification                                         | ON                       | $\pm V_T$                                |      | 1.5                       |      | V             |
|                                                             |                          | $\pm I_T$                                |      | 8.5                       |      | $\mu\text{A}$ |
|                                                             | OFF                      | $\pm V_T$                                |      | 4                         |      | V             |
|                                                             |                          | $\pm I_T$                                |      | 20                        |      | $\mu\text{A}$ |
| <b>Operation selection</b> Pin 4                            |                          |                                          |      |                           |      |               |
| Zero voltage switch                                         |                          | $\pm V_{\text{sync}}$                    |      | $V_4$ limit               |      |               |
| $\alpha_{\text{min}}$ -operation                            |                          | $+V_{\text{sync}}$<br>$-V_{\text{sync}}$ |      | $V_4$ limit<br>6.5 to 7.8 |      | V             |
| DC mode                                                     |                          | $-V_{\text{sync}}$<br>$+V_{\text{sync}}$ |      | $V_4$ limit<br>6.5 to 7.8 |      | V             |
| <b>Window monitoring</b> figure 4 Pin 6                     |                          |                                          |      |                           |      |               |
| Threshold 1                                                 |                          | $-V_I/V_{\text{Ref}}$                    | 0.52 | 0.49                      | 0.46 |               |
| Threshold 2                                                 |                          | $-V_I/V_{\text{Ref}}$                    | 0.67 | 0.65                      | 0.63 |               |
| <b>Enable-Schmitt trigger</b> Pin 5                         |                          |                                          |      |                           |      |               |
| Threshold 1                                                 | OFF                      | $-V_I/V_{\text{Ref}}$                    | 0.33 | 0.3                       | 0.27 |               |
| Threshold 2                                                 | ON                       | $-V_I/V_{\text{Ref}}$                    | 0.62 | 0.6                       | 0.58 |               |
| <b>Oscillator</b> $f = \frac{1}{1.6 \times R_t \times C_t}$ |                          |                                          |      |                           |      |               |
| Threshold 1                                                 | Pin 7 – 1                | $V_I/V_{\text{Ref}}$                     | 0.25 | 0.20                      | 0.15 |               |
| Threshold 2                                                 | Pin 7 – 8                | $V_I$                                    |      | 100                       | 200  | mV            |
| Input current                                               | Pin 7                    | $I_I$                                    |      | 100                       | 500  | nA            |
| <b>Output stage</b> limiter diode w.r.t. Pin 1 Pin 3        |                          |                                          |      |                           |      |               |
| Saturation voltage                                          | $I_3 = 100 \text{ mA}$   | $V_{3-2}$                                |      |                           | 2    | V             |
| Output current                                              |                          | $I_3$                                    | 100  |                           |      | mA            |

**Applications**

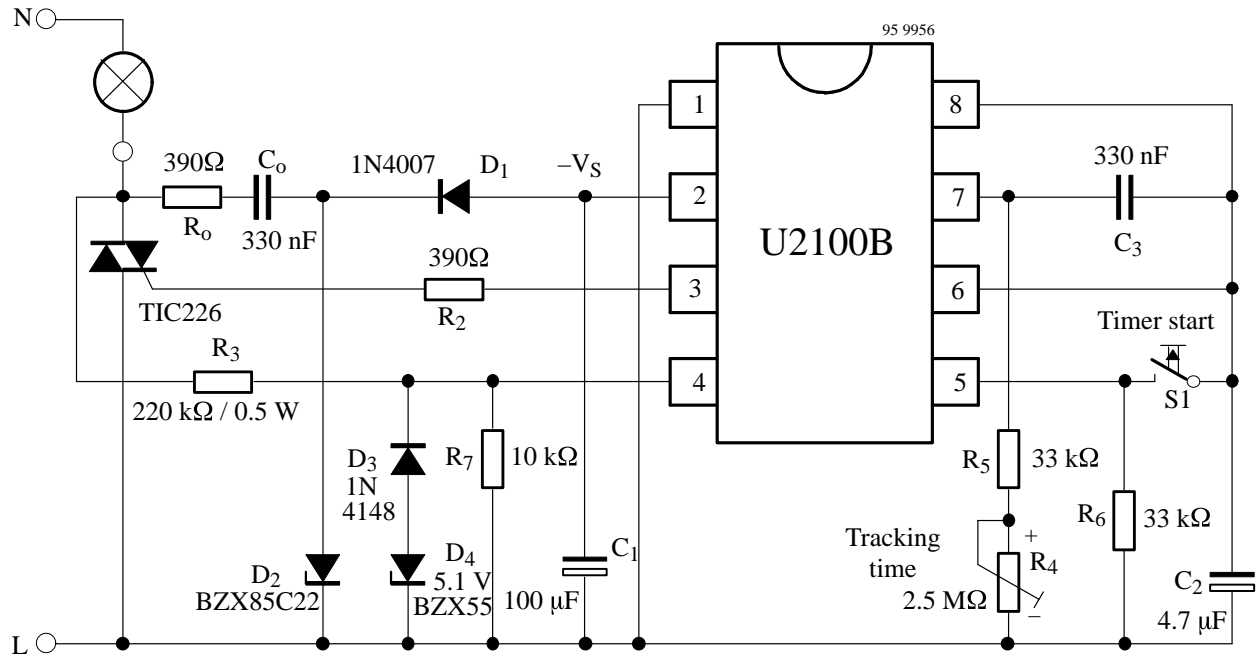


Figure 9. Lamp time control 18 sec. to 23 min. for two wire systems

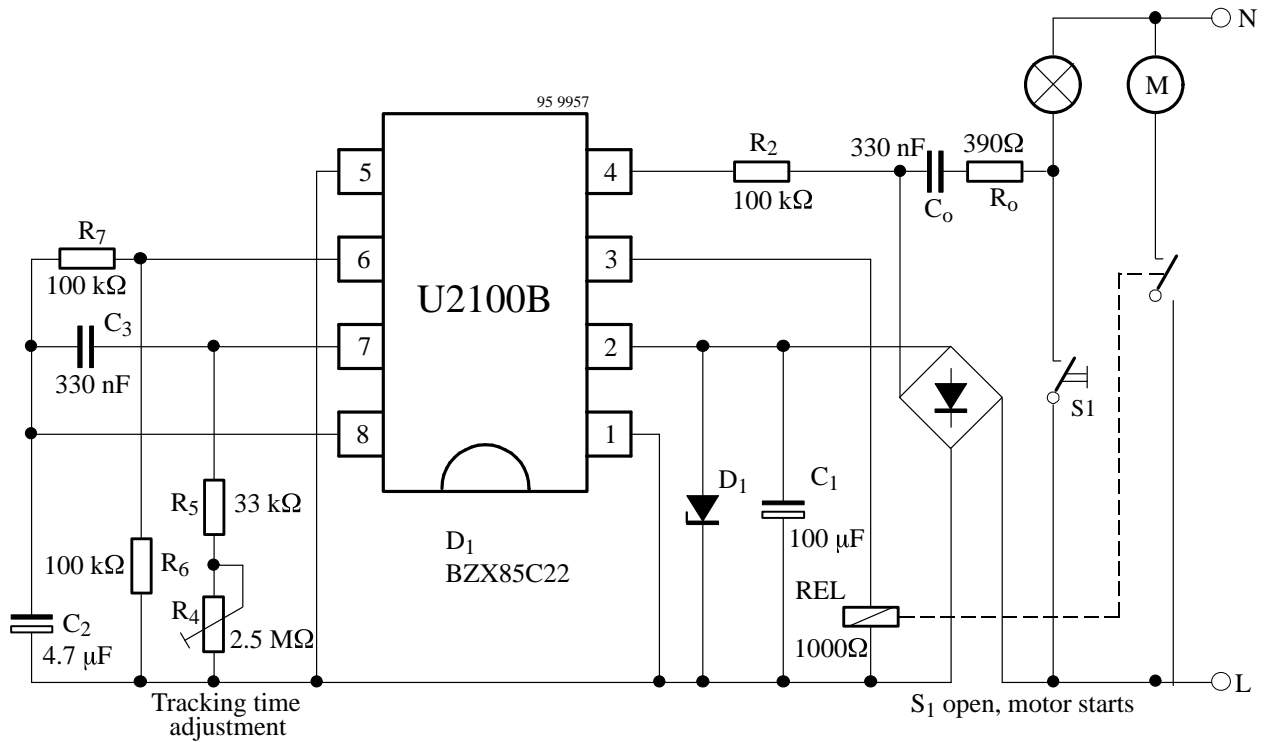
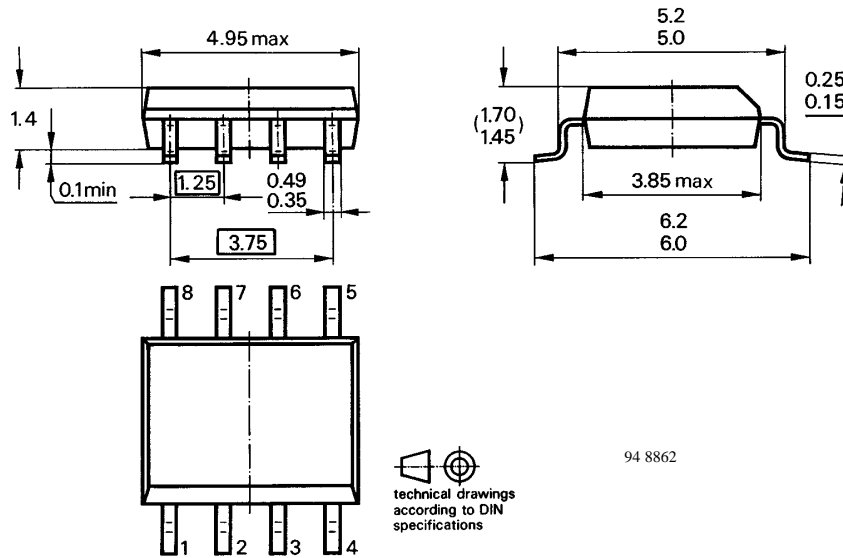


Figure 10. Fan tracking time control 18 sec. to 23 min.

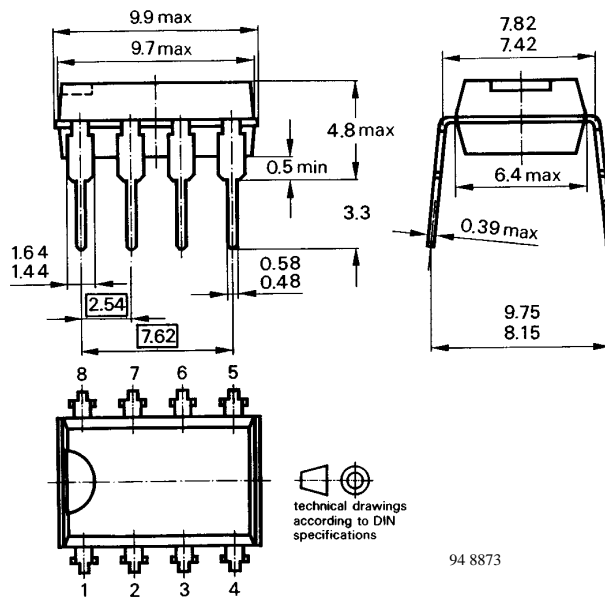
# U2100B

## Dimensions in mm

Package: DIP8



Package: SO8



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It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

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**TEMIC TELEFUNKEN microelectronic GmbH** semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

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