

## 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

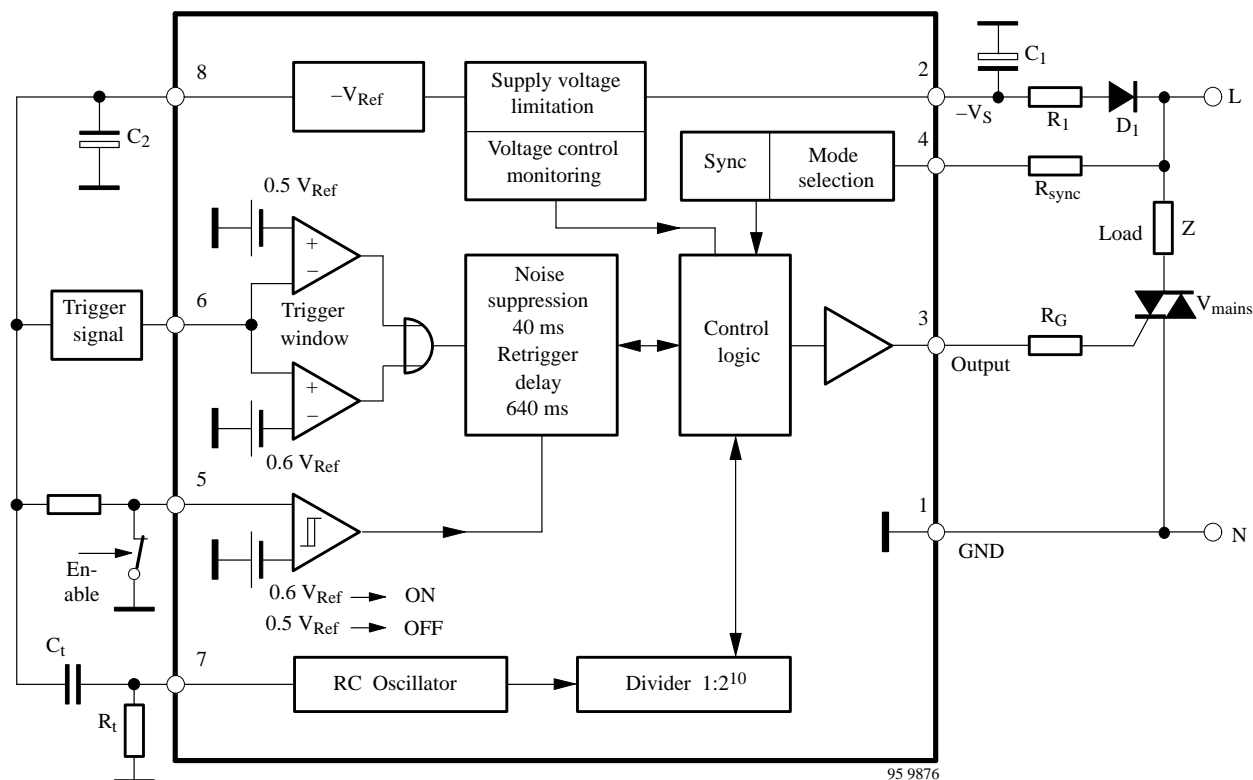
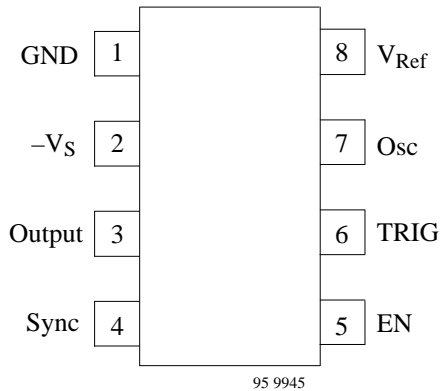


Figure 1. Block diagram with external circuit

## Pin Description



Pin	Symbol	Function
1	GND	Reference point
2	$-V_S$	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	$V_{Ref}$	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).

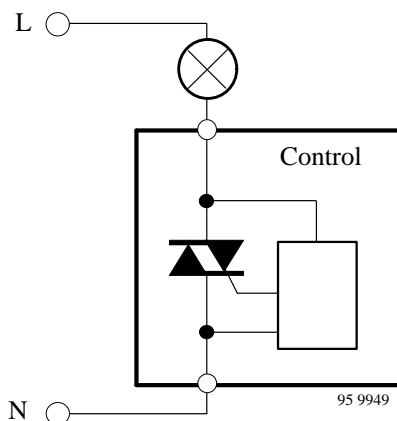


Figure 2. Two wire circuit

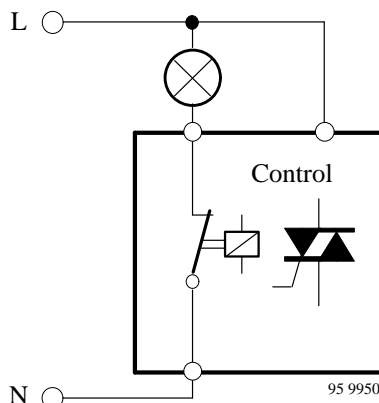


Figure 3. Three wire circuit

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

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

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

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

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

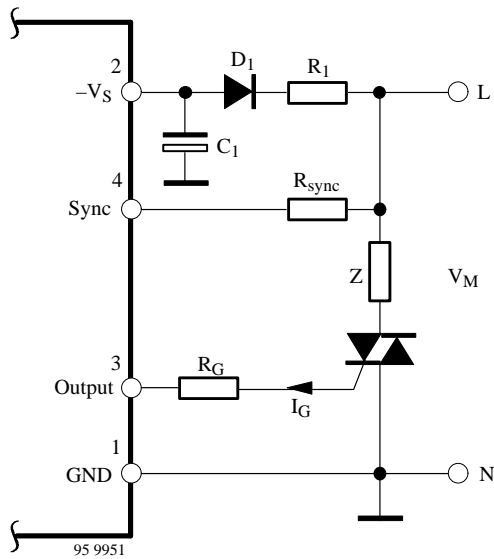


Figure 4.

**$\alpha_{min}$ -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:

$$R_0 \approx 1/10 X_c$$

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

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

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

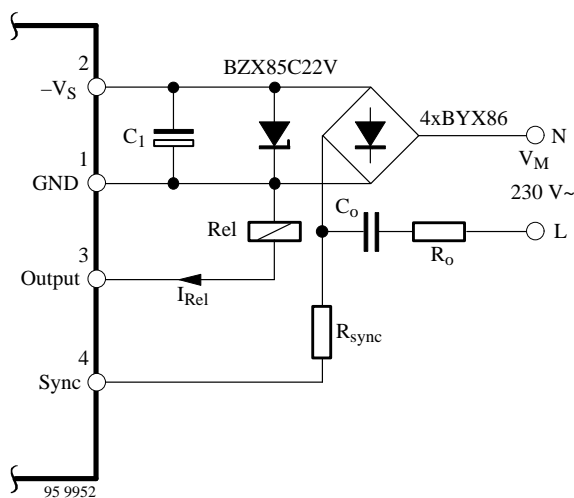


Figure 5.

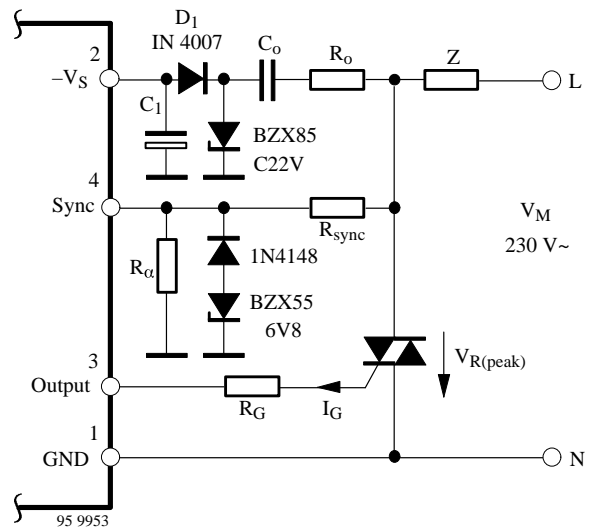


Figure 6.

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

## Tracking Time Pin 7

An internal RC oscillator with following divider stage 1:2<sup>10</sup> allows a very long and reproducible tracking time.

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

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

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

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

## 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.

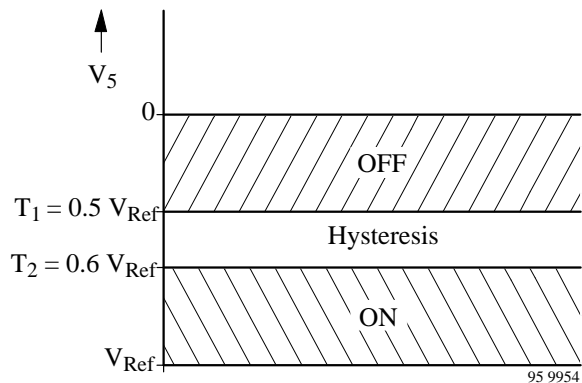


Figure 7. Trigger condition, Pin 5

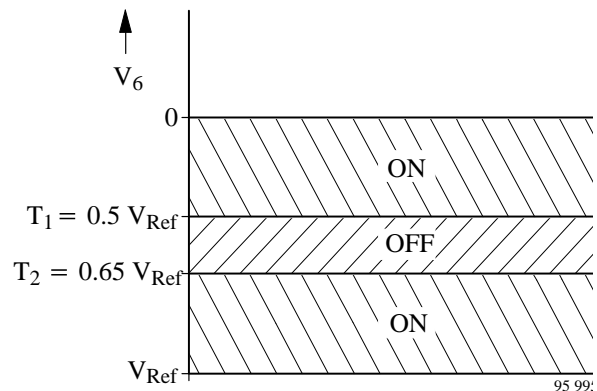


Figure 8. Trigger condition, Pin 6

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

## Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient			
DIP8	$R_{\text{thJA}}$	110	K/W
SO8 on PC board		220	
SO8 on ceramic		140	

## Electrical Characteristics

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

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

Parameters	Test Conditions / Pins	Symbol	Min	Typ	Max	Unit
<b>Synchronization</b> Pin 4						
Input current		$\pm i_{sync}$	0.1		1.1	mA
Voltage limitation	$I_4 = \pm 1 \text{ mA}$	$\pm V_{sync}$	8.8	9.4	10	V
Rest phase angle	ON	$\pm V_T$	3.6	4	4.4	V
$\alpha_{min}$ -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		$\pm V_{sync}$		$V_4$ limit		
$\alpha_{min}$ -operation		$+V_{sync}$ $-V_{sync}$		$V_4$ limit 6.5 to 7.8		V
DC mode		$-V_{sync}$ $+V_{sync}$		$V_4$ limit 6.5 to 7.8		V
<b>Window monitoring</b> figure 4 Pin 6						
Threshold 1		$-V_I/V_{Ref}$	0.52	0.49	0.46	
Threshold 2		$-V_I/V_{Ref}$	0.67	0.65	0.63	
<b>Enable-Schmitt trigger</b> Pin 5						
Threshold 1	OFF	$-V_I/V_{Ref}$	0.33	0.3	0.27	
Threshold 2	ON	$-V_I/V_{Ref}$	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	$V_I/V_{Ref}$	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**

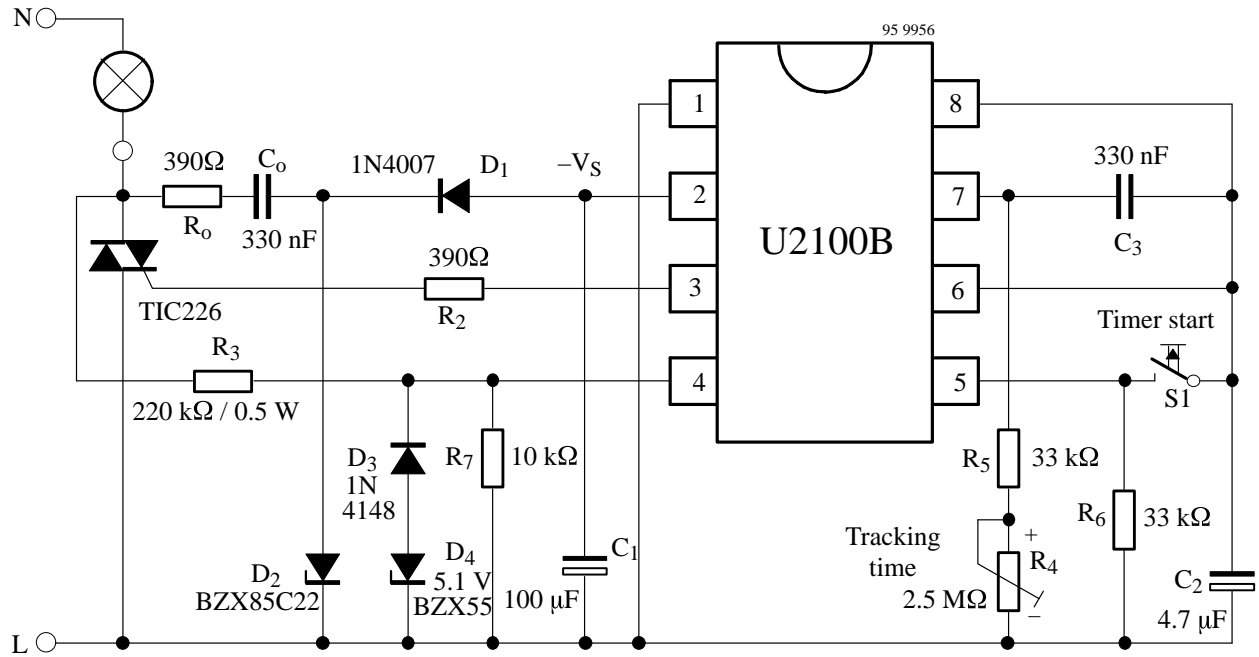


Figure 9. Lamp time control 18 sec. to 23 min. for two wire systems

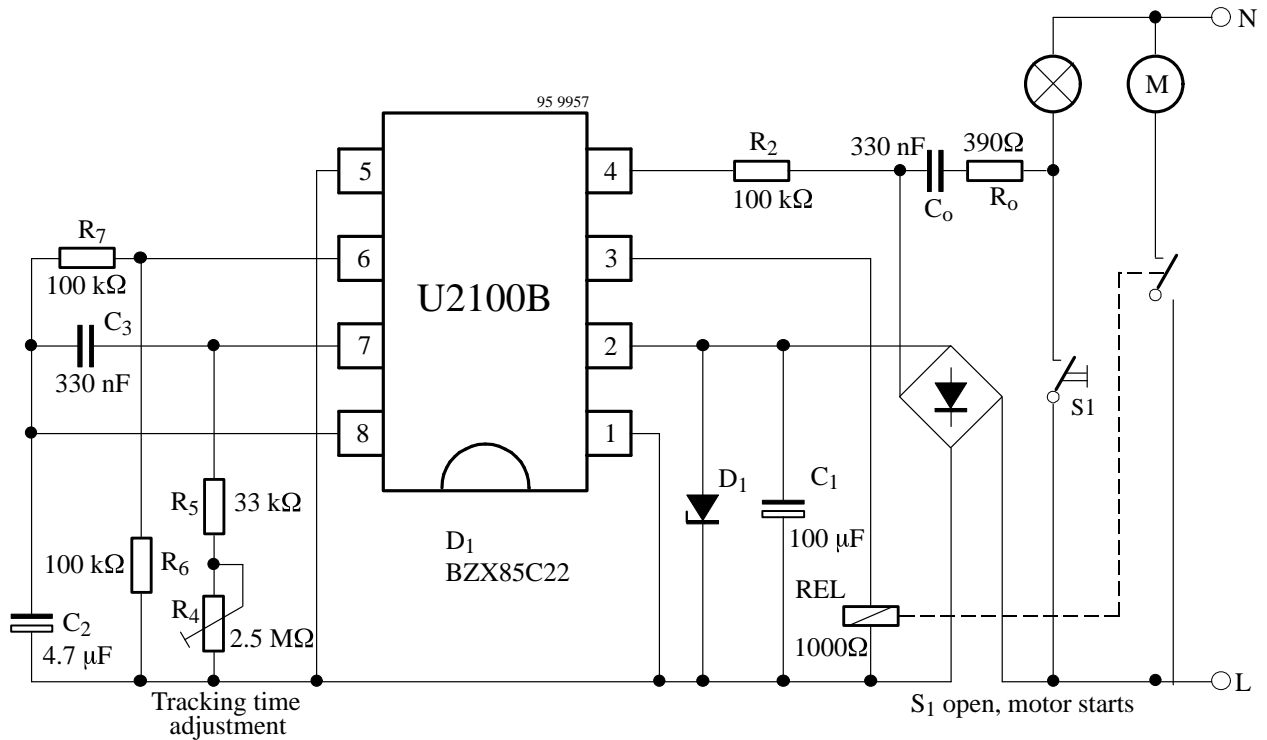
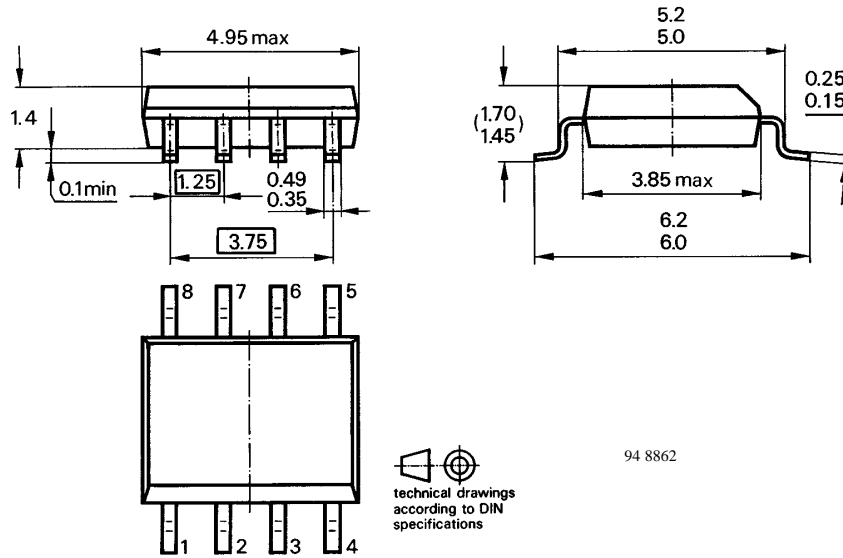


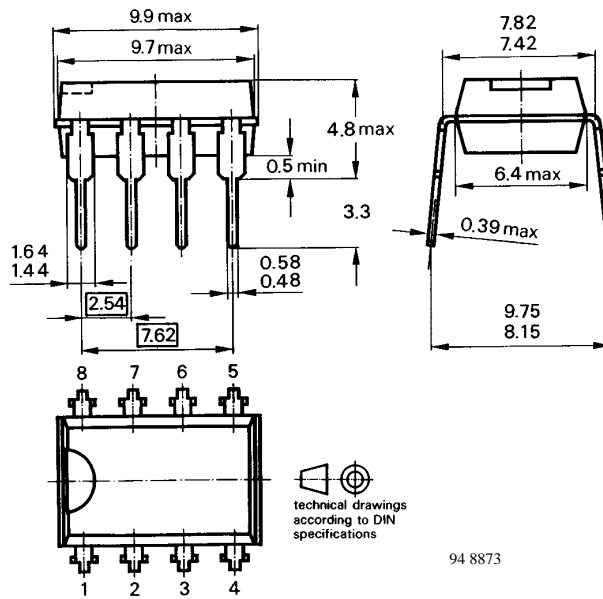
Figure 10. Fan tracking time control 18 sec. to 23 min.

## Dimensions in mm

Package: DIP8



Package: SO8





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## Ozone Depleting Substances Policy Statement

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2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

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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1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

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