

## 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 applications

### Applications

- Motion detectors
- Touch sensors
- Timer

### Block Diagram

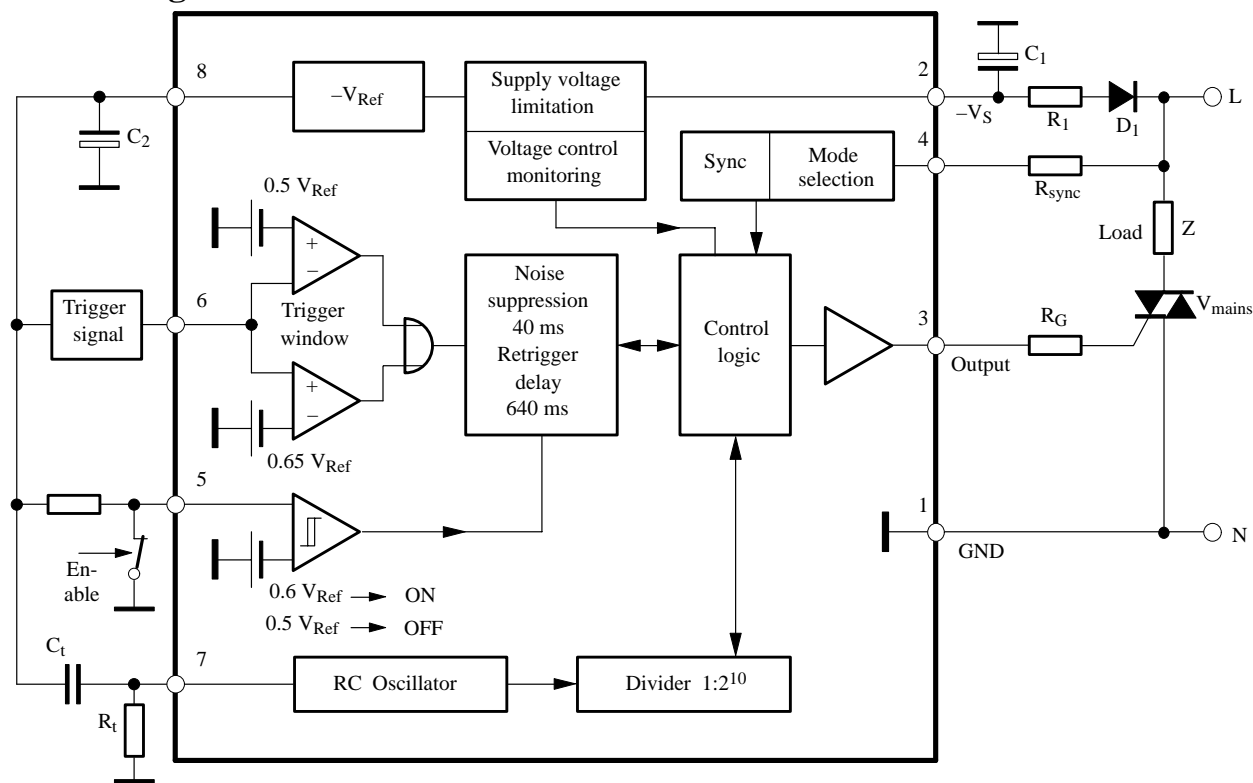


Figure 1. Block diagram with external circuit

### Ordering Information

Extended Type Number	Package	Remarks
U2100B-x	DIP8	Tube
U2100B-xFP	SO8	Tube
U2100B-xFPG3	SO8	Taped and reeled

## Pin Description

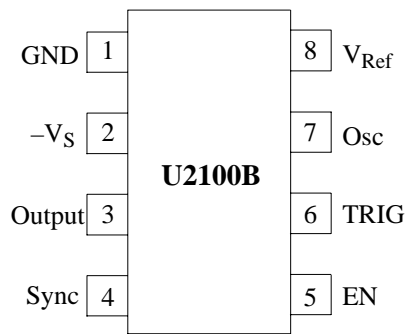


Figure 2. Pinning

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

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

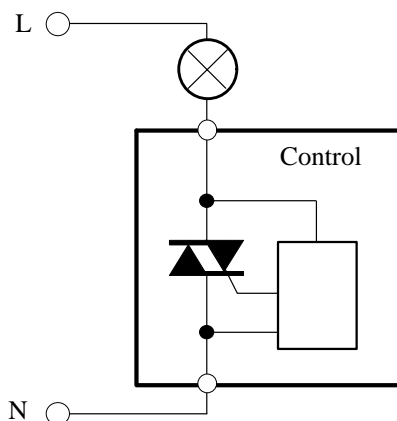


Figure 3. Two-wire circuit

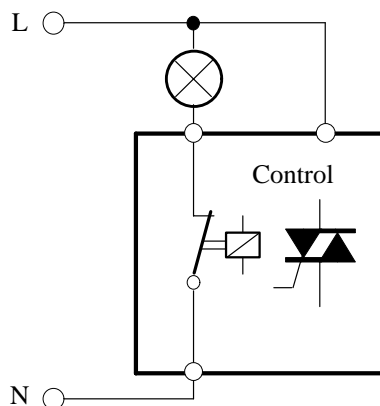


Figure 4. Three-wire circuit

For three-wire switch systems, two operation modes 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 the external voltage at the sync. input Pin 4 (clamping). Mode selection determines the current requirement of the relay's or triac's driver stage and hence the selection of supply voltage.

### Zero Voltage Switch Operation (Figure 5)

Selection condition:

$V_4$  = internal sync. limitation, without external clamping

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

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

where:

$I_S$  = 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  $t_p$

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

where:

$I_L$  = Triac latching current

$P$  = Power at load  $Z$

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

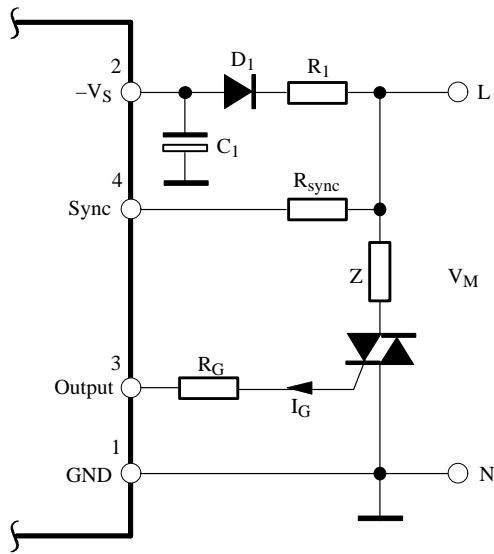


Figure 5. Zero voltage switch operation

**DC Operation (Figure 6)**

Selection condition:

+V<sub>4</sub> = 6.1 V -V<sub>4</sub> = int. limitation

whereas:

$$R_0 \approx 1/10 X_c$$

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

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

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

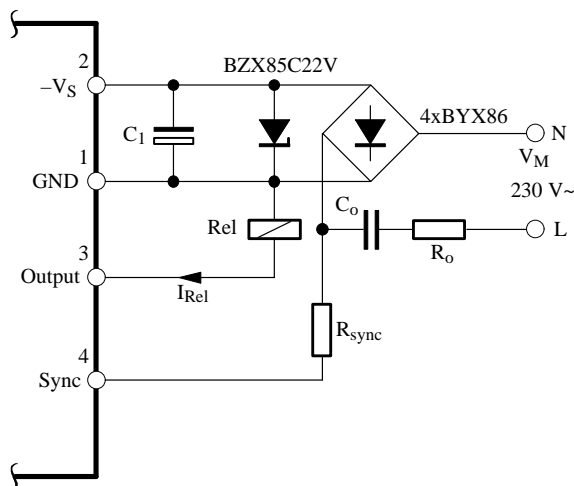


Figure 6. DC operation

**α<sub>min</sub>-Operation (Figure 7)**

Selection condition:

-V<sub>4</sub> = 6.5 to 7.8 V +V<sub>4</sub> = int. limitation

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

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

V<sub>R(peak)</sub> is the peak voltage of the rest phase angle, which should be high enough to generate the supply voltage, V<sub>S</sub>.

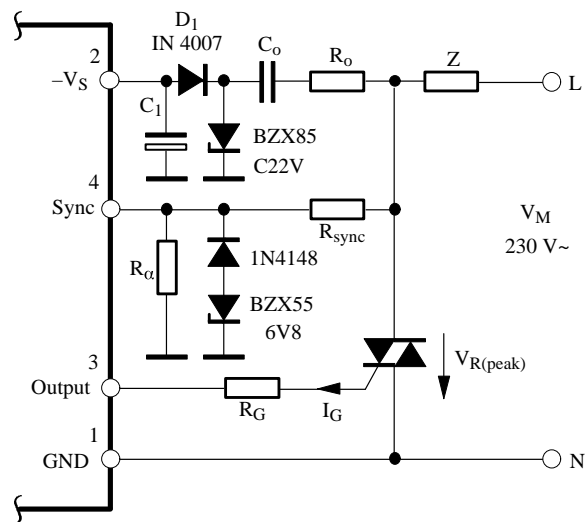


Figure 7. α<sub>min</sub> operation (two wire operation)

- C<sub>1</sub> = 100 μF/35 V
- C<sub>0</sub> = 0.33 μF/250 V~
- R<sub>0</sub> = 390 Ω
- R<sub>sync</sub> = 220 kΩ
- R<sub>α</sub> = 10 kΩ
- R<sub>G</sub> = 390 Ω
- D<sub>1</sub> = 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:

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

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

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

## Trigger Inputs Pins 5 and 6 (Figures 8, 9)

Two AND-connected, identical inputs determine the trigger conditions of the 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.

The noise suppression for  $t_{\text{ON}} = 40$  ms guarantees that there are 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 ( $t_{\text{OFF}}$ ), to avoid noise signal to trigger the relay.

## 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	mA
Supply voltage	$-V_S$	32	V
Reference voltage source	Pin 8		
Output current	$I_O$	3	mA
Synchronization	Pin 4		
Input current $t \leq 10 \mu\text{s}$	$\pm I_{\text{Sync.}}$	5	mA
	$i_{\text{Sync.}}$	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

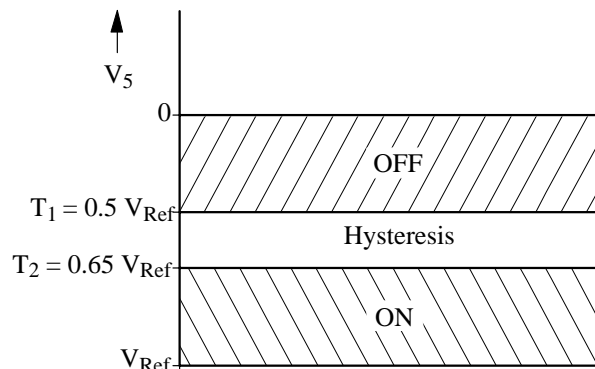


Figure 8. Trigger condition, Pin 5

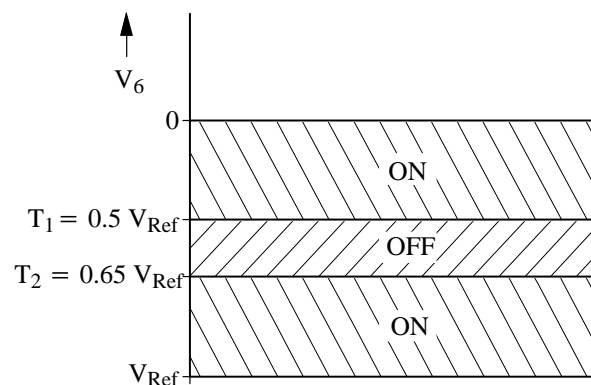


Figure 9. Trigger condition, Pin 6

## Thermal Resistance

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

## Electrical Characteristics

$V_S = -18\text{ V}$ ,  $T_{amb} = 25^\circ\text{C}$ , 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	$-V_S$	21		23	V
	$I_S = 2\ \text{mA}$	$-V_S$	21.3		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	$-V_{Ref}$	4.75		5.25	V
	$I_8 = 1.5\ \text{mA}$	$-V_{Ref}$	4.55		5.25	V
<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		$+V_{sync}$		$V_4$ limit		V
		$-V_{sync}$		6.5 to 7.8		V
DC mode		$-V_{sync}$		$V_4$ limit		V
		$+V_{sync}$		6.5 to 7.8		V
<b>Window monitoring</b> figure 9 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> , figure 8 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 Pin 3						
Saturation voltage	$I_3 = 100\ \text{mA}$	$V_{3-2}$			2	V
Output current		$I_3$	100			mA

## Applications

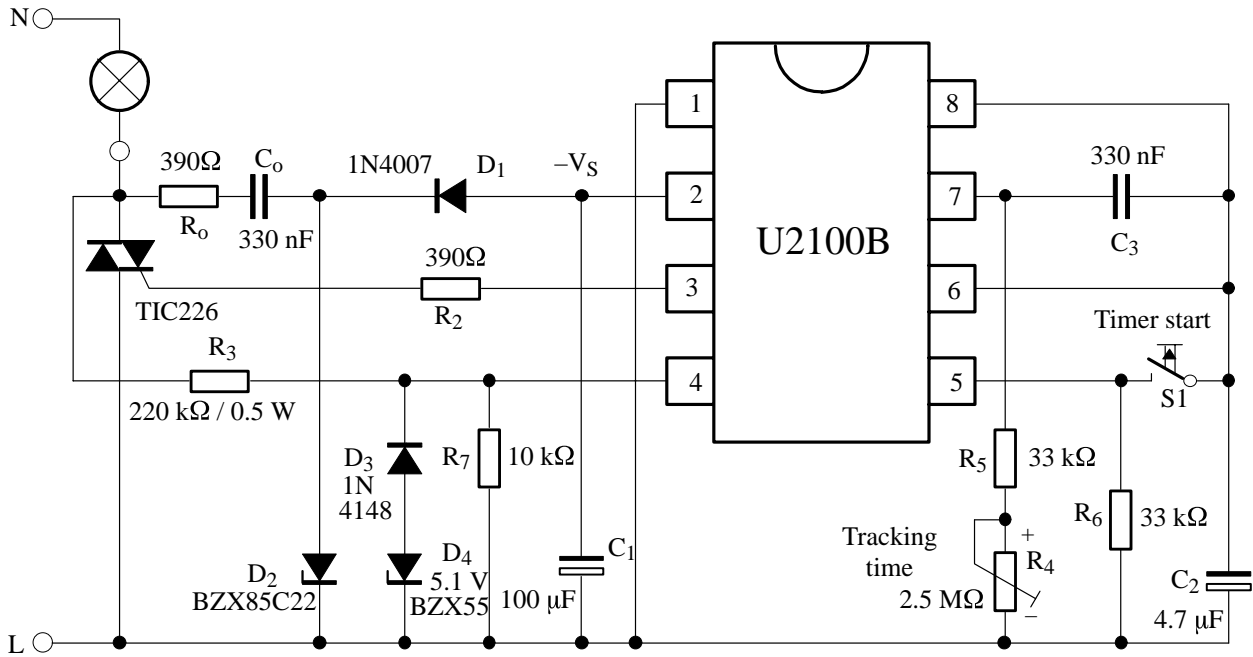


Figure 10. Lamp time control 18 sec. to 23 min. for two-wire systems

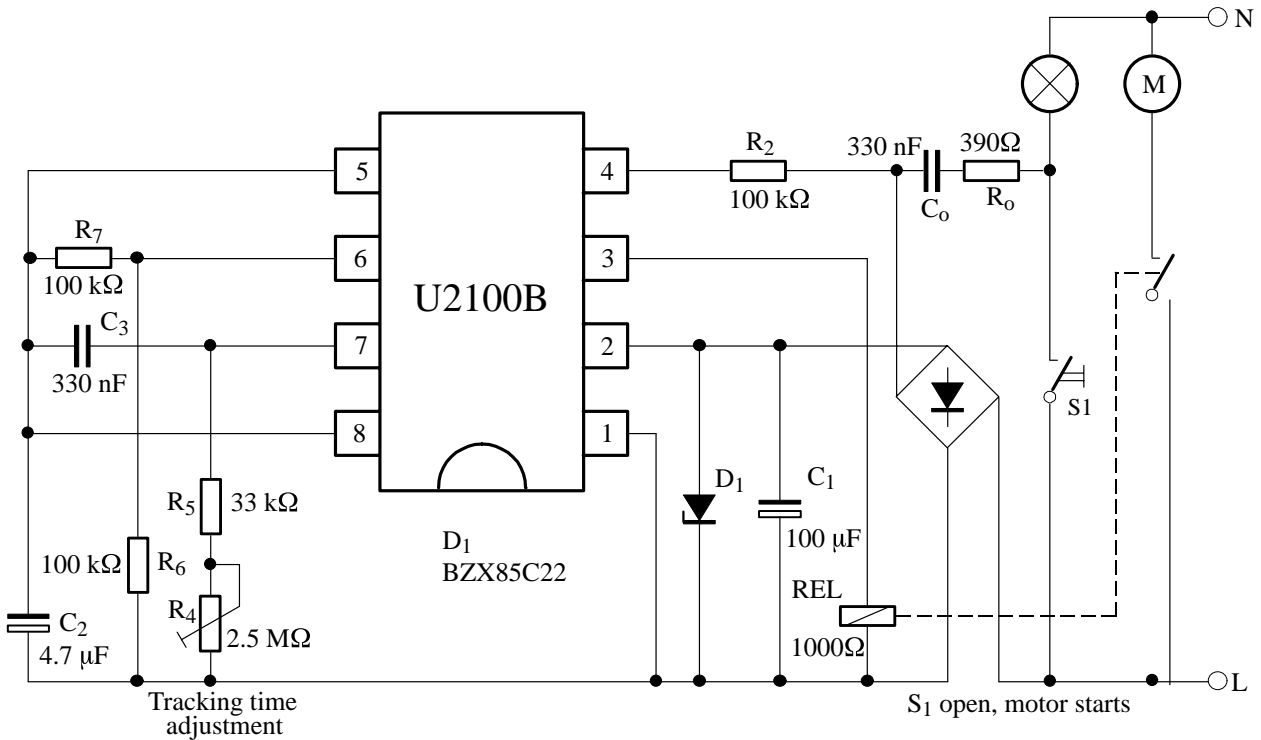
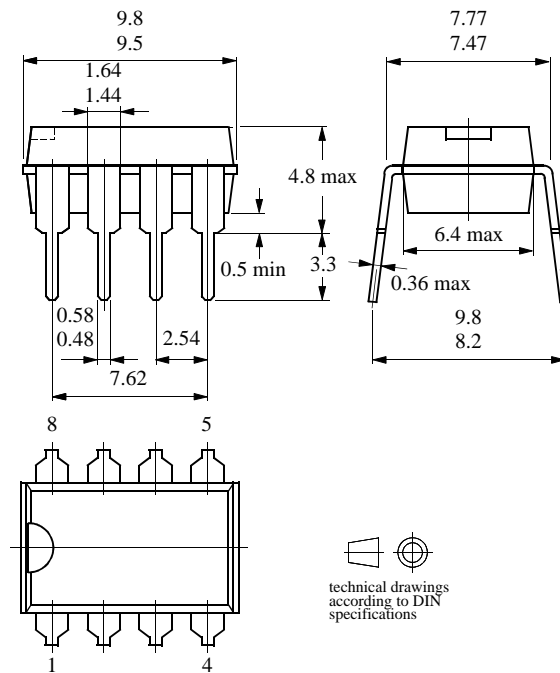


Figure 11. Fan tracking time control 18 sec. to 23 min.

## Package Information

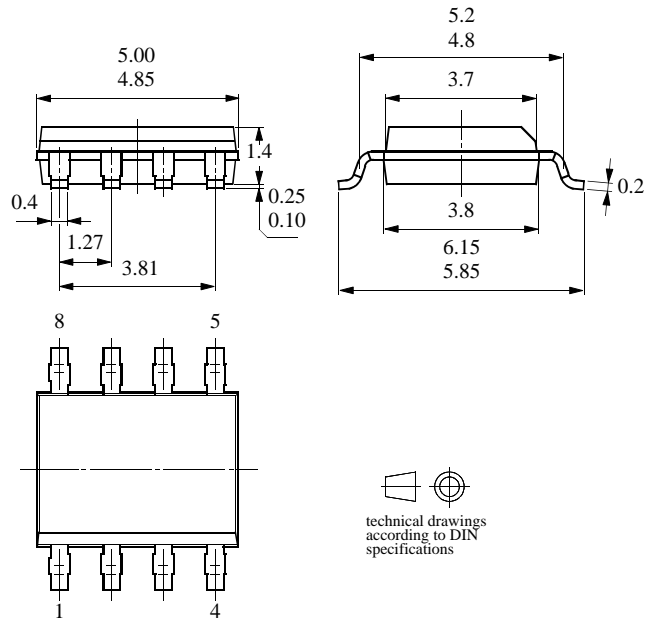
Package DIP8

Dimensions in mm



Package SO8

Dimensions in mm



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1. Meet all present and future national and international statutory requirements.
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).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

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

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.

**TEMIC Semiconductor GmbH** can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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