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

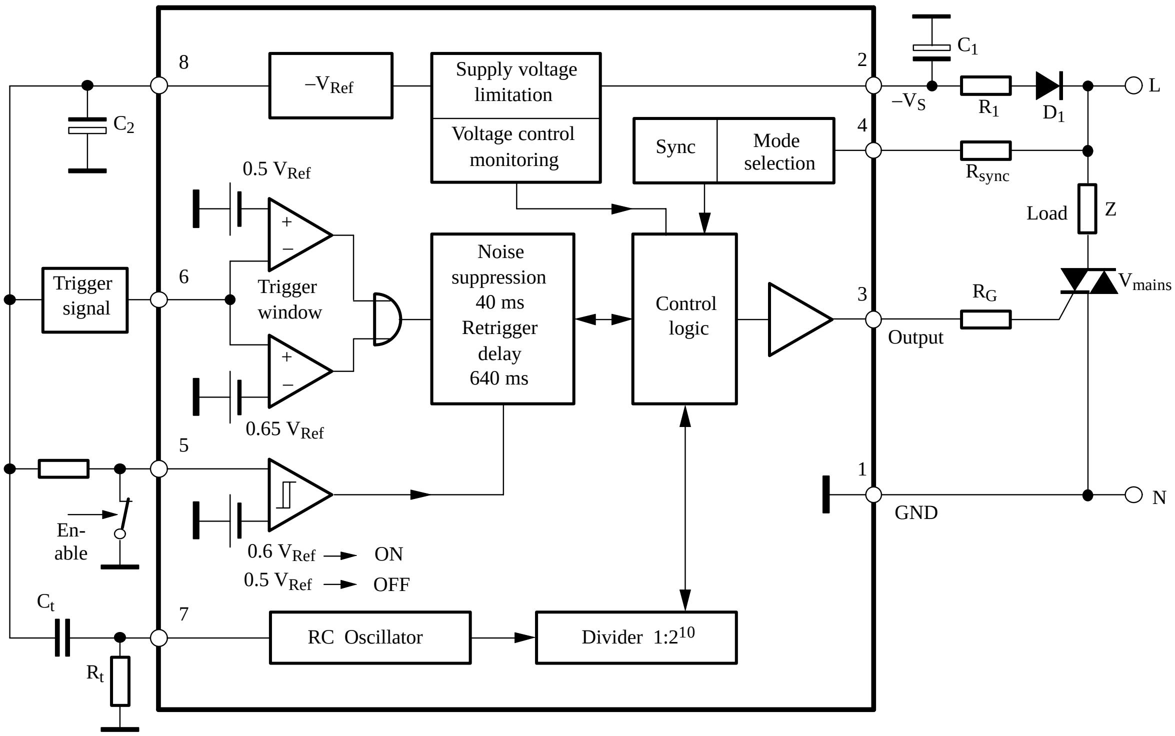


Figure 1. Block diagram with external circuit

Ordering Information

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

Pin Description

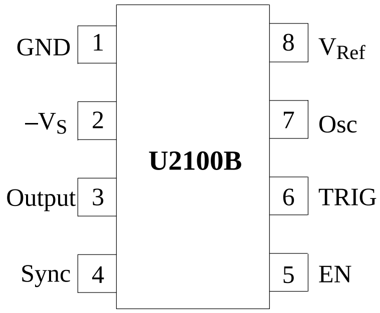


Figure 2. Pinning

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 (α_{min}-operation).

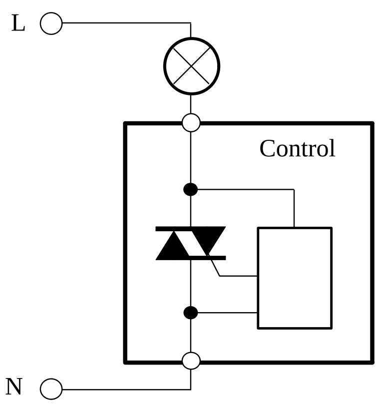


Figure 3. Two-wire circuit

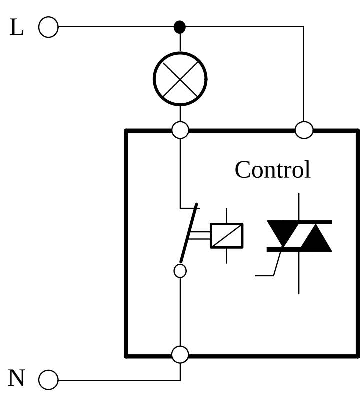


Figure 4. Three-wire circuit

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

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

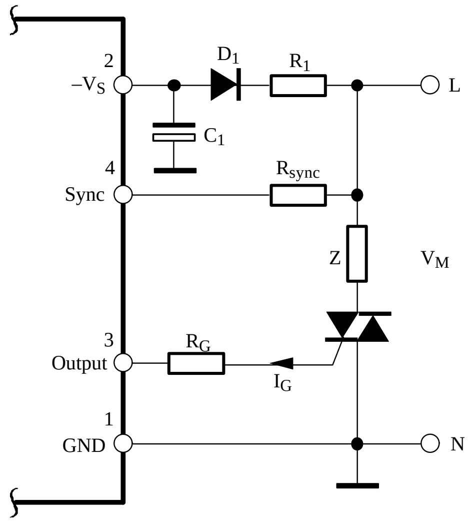


Figure 5. Zero voltage switch operation

DC Operation (Figure 6)

Selection condition:

$+V_4 = 6.1$ V $-V_4 =$ int. limitation

whereas:

$$R_0 \approx 1/10\ X_c$$

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

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

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

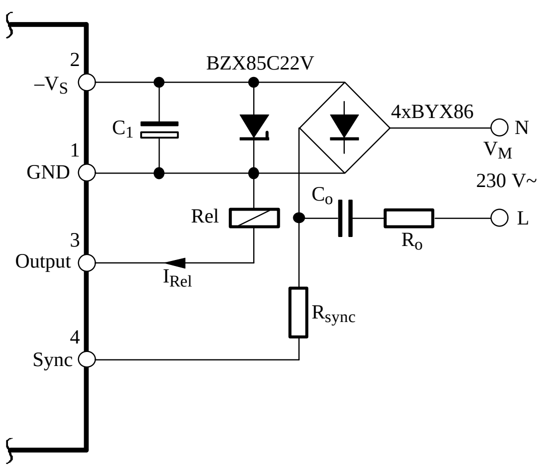


Figure 6. DC operation

α_{min}-Operation (Figure 7)

Selection condition:

$-V_4 = 6.5$ to 7.8 V $+V_4 =$ int. limitation

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

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

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

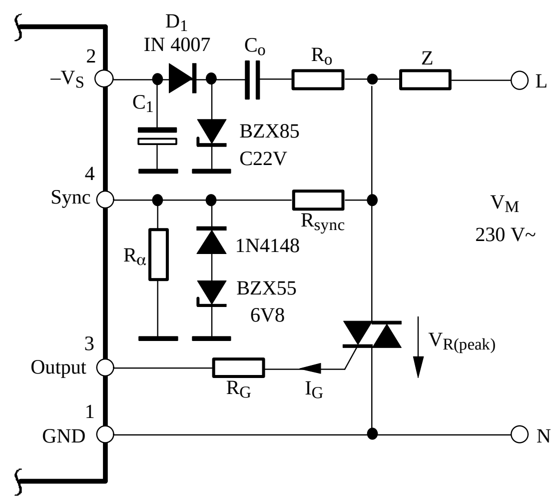


Figure 7. α_{min} operation (two wire operation)

C_1	=	100 µF/35 V
C_o	=	0.33 µF/250 V~
R_o	=	390 Ω
R_{sync}	=	220 kΩ
R_α	=	10 kΩ
R_G	=	390 Ω
D_1	=	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:

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

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

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

Trigger Inputs Pins 5 and 6 (Figures 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_{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_{OFF}), to avoid noise signal to trigger the relay.

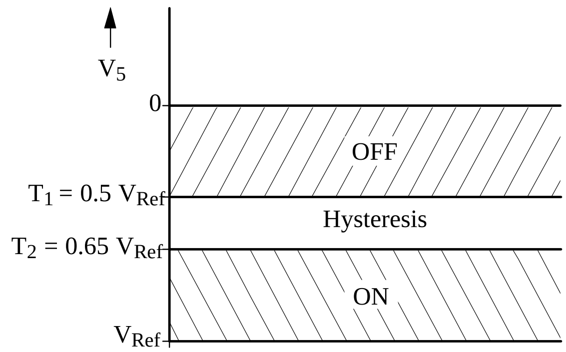


Figure 8. Trigger condition, Pin 5

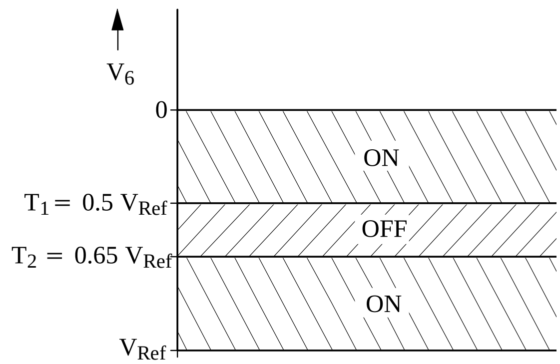


Figure 9. Trigger condition, Pin 6

Absolute Maximum Ratings

Reference point Pin 1, unless otherwise specified

Parameters		Symbol	Value	Unit
Supply	Pin 2			
Supply current Peak current t ≤ 10 µs		$-I_S$ $-i_s$	10 60	mA mA
Supply voltage		$-V_S$	32	V
Reference voltage source Output current	Pin 8	I_O	3	mA
Synchronization Input current t ≤ 10 µs	Pin 4	$\pm I_{Sync.}$ $i_{Sync.}$	5 20	mA mA
Window monitoring				
Input voltage	Pin 6	$-V_1$	V_{Ref} to 0	V
Enable Schmitt trigger	Pin 5			
Input voltage		$-V_1$	V_{Ref} to 0	V
Driver output	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	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 V, T_{amb} = 25°C, reference point Pin 1, unless otherwise specified

Parameters	Test Conditions / Pins	Symbol	Min	Typ	Max	Unit
Supply-voltage limitation	I_S = 800 µA Pin 2 I_S = 2 mA	$-V_S$ $-V_S$	21 21.3		23 24	V V
Current consumption	I_3 = 0	$-I_S$			750	µA
Supply-voltage monitoring	Pin 2					
ON-Threshold		$-V_S$		15		V
OFF-Threshold		$-V_S$		6.5		V
Reference voltage	I_8 = 0.1 mA Pin 8 I_8 = 1.5 mA	$-V_{Ref}$ $-V_{Ref}$	4.75 4.55		5.25 5.25	V V
Synchronization	Pin 4					
Input current		$\pm i_{sync}$	0.1		1.1	mA
Voltage limitation	I_4 = ± 1 mA	$\pm V_{sync}$	8.8	9.4	10	V
Rest phase angle α_{min}-threshold	ON Off	$\pm V_T$ $\pm V_T$	3.6 1.8	4 2	4.4 2.2	V V
Zero-identification	Pin 4					
Zero-identification	ON OFF	$\pm V_T$ $\pm I_T$ $\pm V_T$ $\pm I_T$		1.5 8.5 4 20		V µA V µA
Operation selection	Pin 4					
Zero voltage switch		$\pm V_{sync}$		V_4 limit		
α_{min}-operation		$+V_{sync}$ $-V_{sync}$		V_4 limit 6.5 to 7.8		V V
DC mode		$-V_{sync}$ $+V_{sync}$		V_4 limit 6.5 to 7.8		V V
Window monitoring 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	
Enable Schmitt trigger, 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	
Oscillator	$f = \frac{1}{1.6 \times R_t \times C_t}$					
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
Output stage limiter diode	Pin 3					
Saturation voltage	I_3 = 100 mA	V_{3-2}			2	V
Output current		I_3	100			mA

Applications

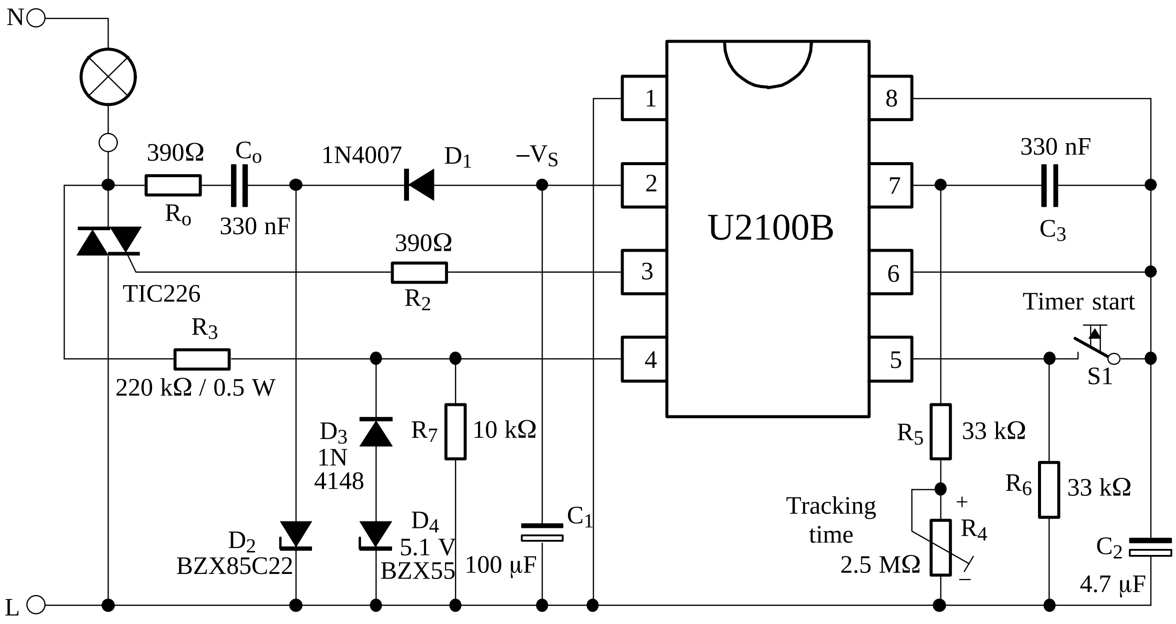


Figure 10. Lamp time control 18 sec. to 23 min. for two-wire systems

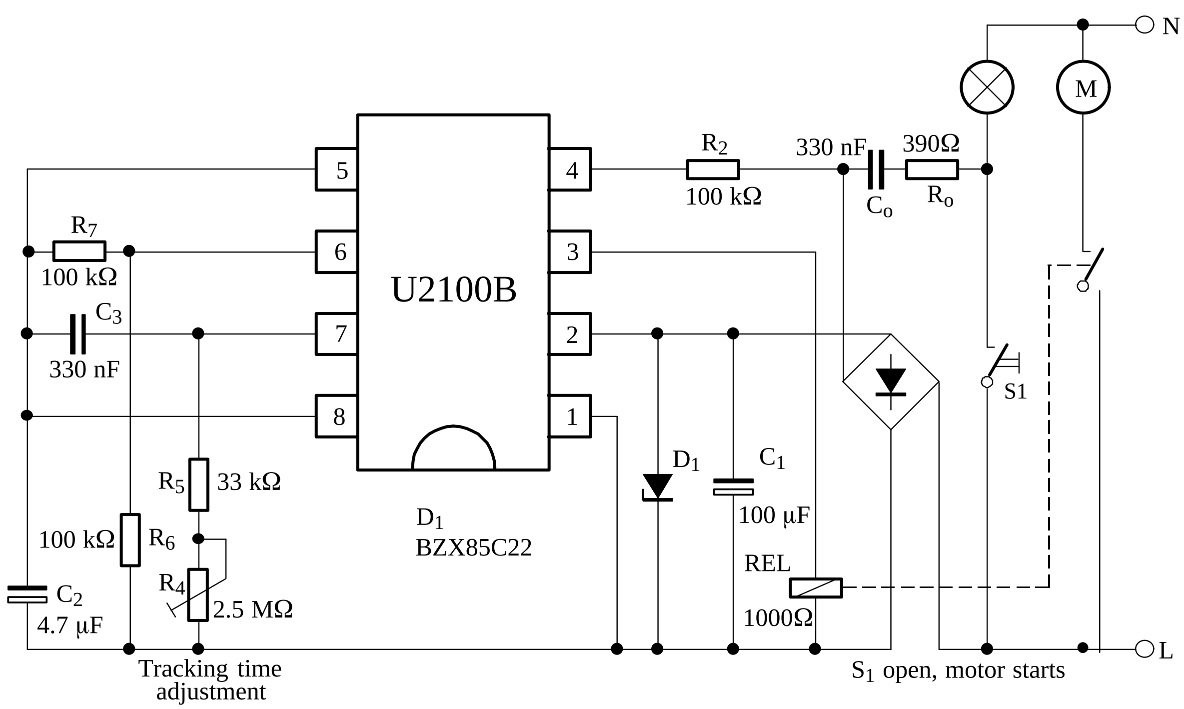
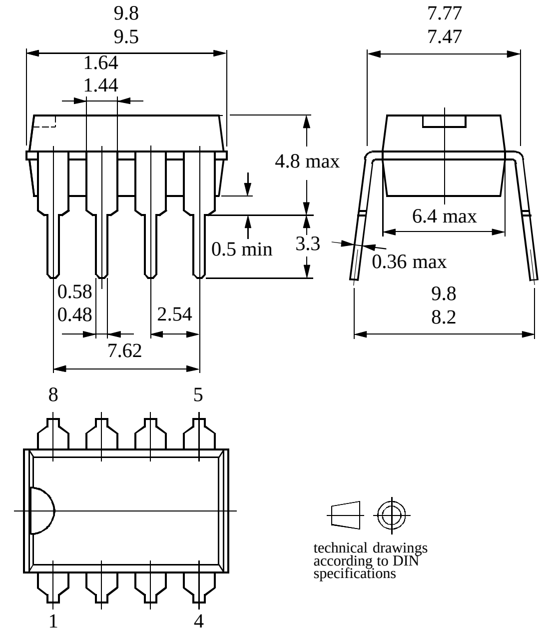


Figure 11. Fan tracking time control 18 sec. to 23 min.

Package Information

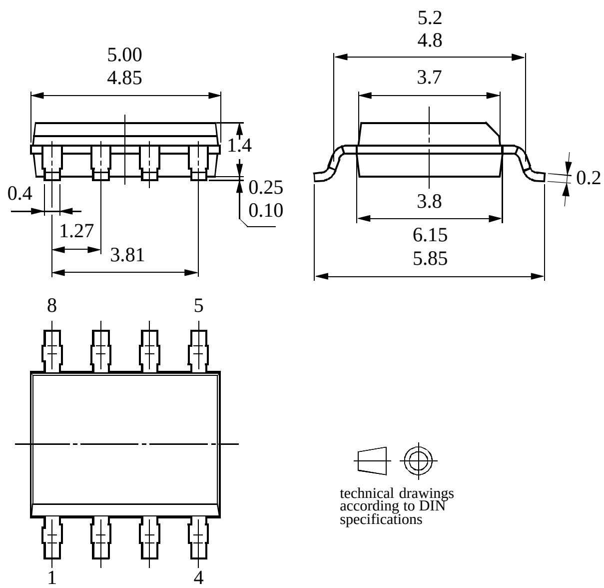
Package DIP8

Dimensions in mm



Package SO8

Dimensions in mm



Ozone Depleting Substances Policy Statement

It is the policy of **Atmel Germany GmbH** to

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.

Atmel Germany 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.

Atmel Germany GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

Data sheets can also be retrieved from the Internet: http://www.atmel–wm.com

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