

Features

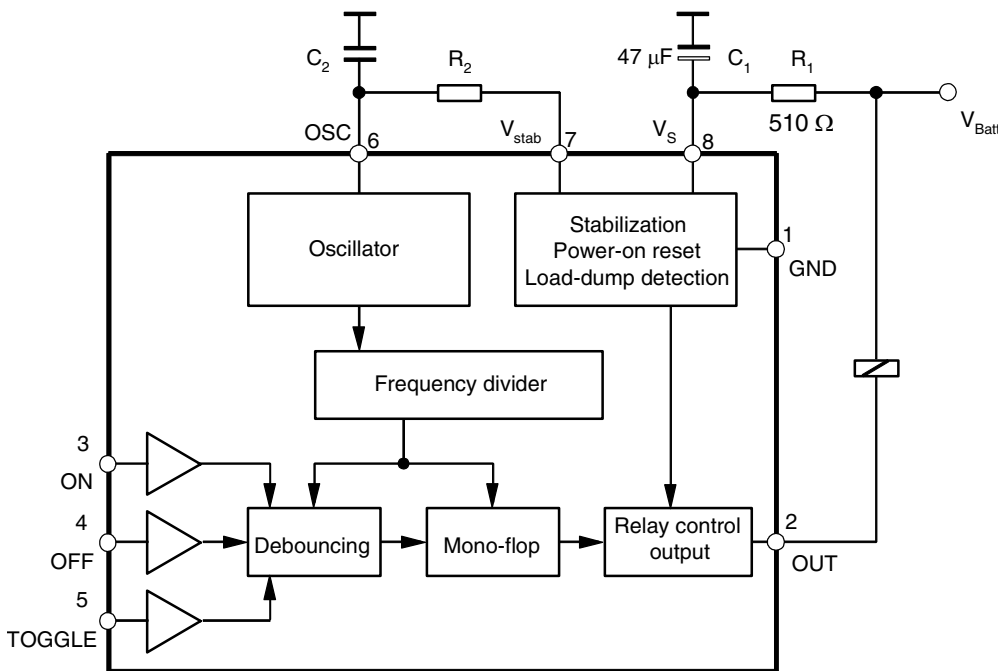
- Delay Time Range: 3.7 s to 20 h
- RC Oscillator Determines Timing Characteristics
- Relay Driver with Z-diode
- Debounced Input for Toggle Switch
- Two Debounced Inputs: ON and OFF
- Load-dump Protection
- RF Interference Protected
- Protection According to ISO/TR7637-1 (VDE 0839)
- Inputs Switched to V_{Batt}

Description

The bi-polar long-term timer U6046B is designed to automatically limit the operation time of high loads in the harsh automotive environment with a preset delay time. With the power-on-reset function the timers guarantee that current consuming devices are not operated unintentionally.

The delay time can be interrupted manually, but a retrigger function is not provided.

Figure 1. Block Diagram with External Circuit

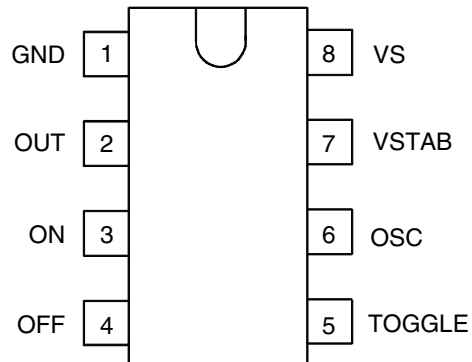


Rear Window Heating Timer/ Long-term Timer

U6046B

Pin Configuration

Figure 2. Pinning



Pin Description

Pin	Symbol	Function
1	GND	Reference point, ground
2	OUT	Relay control output
3	ON	Switch-on input
4	OFF	Switch-off input
5	TOGGLE	Toggle input
6	OSC	RC-oscillator input
7	VSTAB	Stabilized voltage
8	VS	Supply voltage

Functional Description

Power Supply (Pin 8)

For reasons of interference protection and surge immunity, the supply voltage (pin 8) must be provided with an RC circuit as shown in Figure 3. Dropper resistor, R_1 , limits the current in case of overvoltage, whereas C_1 smoothes the supply voltage at pin 8.

Recommended values are: $R_1 = 510 \Omega$, $C_1 = 47 \mu\text{F}$.

The integrated Z-diode (14 V) protects the supply voltage, V_S . Therefore, the operation of the IC is possible between 6 V and 16 V, supplied by V_{Batt} .

However, it is possible to operate the integrated circuit with a 5 V supply, but it should be free of interference voltages. In this case, pin 7 is connected to pin 8 as shown in Figure 4, and the R_1C_1 circuit is omitted.

Figure 3. Basic Circuit for 12 V Supply and Oscillator

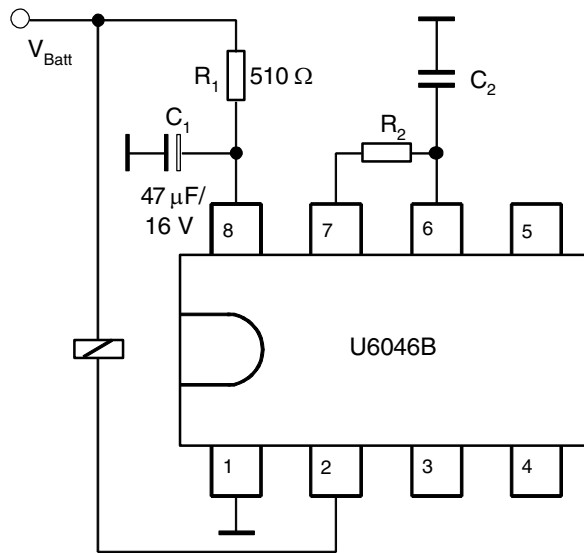
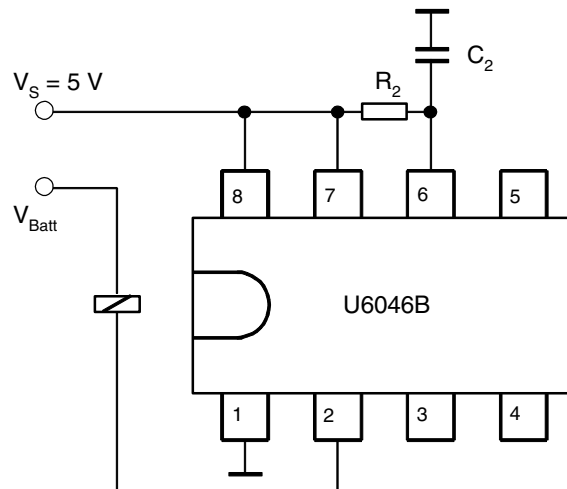


Figure 4. Basic Circuit for $V_S = 5 \text{ V}$



Oscillator (Pin 6)

The external components R_2 and C_2 determine the oscillator frequency. The capacitor C_2 is charged by R_2 and discharged by an integrated 2-k Ω resistor.

A stable oscillator frequency with minimal influence of the temperature coefficient of the integrated resistor is achieved with $R_2 \gg 2$ k Ω .

Oscillator frequency, f , is calculated as follows:

$$f = \frac{1}{t_1 + t_2}$$

where

$$t_1 = \text{charge time} = \alpha_1 \times R_2 \times C_2$$

$$t_2 = \text{discharge time} = \alpha_2 \times 2 \text{ k}\Omega \times C_2$$

α_1 and α_2 are constants as such

$$\alpha_1 = 0.833 \text{ and } \alpha_2 = 1.551 \text{ when } C_2 = 470 \text{ pF to } 10 \text{ nF}$$

$$\alpha_1 = 0.746 \text{ and } \alpha_2 = 1.284 \text{ when } C_2 = 10 \text{ nF to } 4700 \text{ nF}$$

The debounce time, t_3 , and the delay time, t_d , depend on the oscillator frequency, f , as follows:

$$t_3 = 6 \times \frac{1}{f}$$

$$t_d = 73728 \times \frac{1}{f}$$

Table 1 shows relationships between t_3 , t_d , C_2 , R_2 and frequencies from 1 Hz to 20 kHz.

Relay Control Output (OUT)

The relay control output is an open-collector Darlington circuit with an integrated 23-V Z-diode to limit the inductive cut-off pulse of the relay coil. The maximum static collector current must not exceed 300 mA and saturation voltage is typically 1.1 V at 200 mA.

Interference Voltages and Load-dump

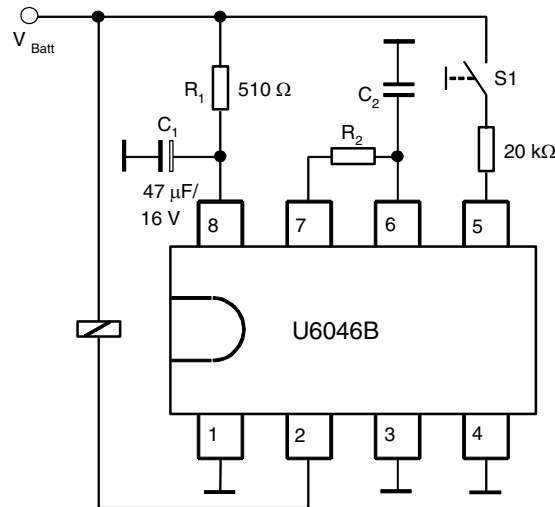
The IC supply is protected by R_1 , C_1 , and an integrated Z-diode, while the inputs are protected by a series resistor, integrated Z-diode and RF capacitor (see Figure 8).

The relay control output is protected via the integrated 23-V Z-diode in the case of short interference peaks. It is switched to a conductive condition for a battery voltage of greater than approximate 40 V in the case of a load-dump. The output transistor is dimensioned so that it can withstand the current produced.

Power-on Reset

When the operating voltage is switched on, an internal power-on reset pulse (POR) is generated which sets the logic of the circuits to a defined initial condition. The relay output is disabled.

Figure 5. TOGGLE Function



Relay Control Output Behavior (Pin 2)

Time functions (relay output) can be started or interrupted by the three inputs i.e., ON, OFF or TOGGLE (pins 3, 4 and 5).

The relay becomes active if the time function is triggered, and the relay contact is interrupted after the elapse of delay time, t_d . There are two input possibilities:

Toggle Input

When the push-button (TOGGLE) switch, S_1 , is pressed for the first time, the relay becomes active after the debounce time, t_3 , i.e., the relay output, pin 2, is active (see Figure 5).

Renewed operation of S_1 causes the interruption of the relay contact and the relay is disabled. Each operation of the toggle switch, S_1 , changes (alters) the condition of the relay output when the debounce time, t_3 , is exceeded i.e., the TOGGLE function.

If the relay output is not disabled by pressing the switch S_1 , the output is active until the delay time, t_d , is over.

ON, OFF Inputs (Pins 3 and 4)

To avoid simultaneous operation of both inputs, pin 3 (ON) and pin 4 (OFF), use of two-way contacts with a centre-off position with spring returns (also known as rocker-actuated switch) is recommended (see Figure 6).

Pressing the push-button switch (pin 3-ON) leads to the activation of the relay after the debounce time, t_3 , whereas the switching of the Pin 4 switch correspondingly leads to the relay being de-energized. If the relay is not de-energized by the push-button switch, it becomes disabled after the delay time, t_d , is over.

Combined operation, TOGGLE and ON/OFF is not possible because both inputs are connected to the same debounce stage. Debouncing functions on both edges i.e., whenever S_1 is ON or OFF.

If pin 3 (input ON) is continuously closed, the delay time, t_d , still elapses and the relay is interrupted. This can be used to generate a defined power-on-reset pulse to trigger, for example, a delay time, t_d , when the battery voltage, V_{Batt} , is applied.

Figure 8 shows the input circuit of U6046B. It has an integrated pull-down resistance (20 kΩ), RF capacitor (15 pF) and Z-diode (7 V). It reacts to voltages greater than 2 V. The external protective resistor has a value of 20 kΩ and the push-button switch, S, is connected to the battery as shown in the diagram.

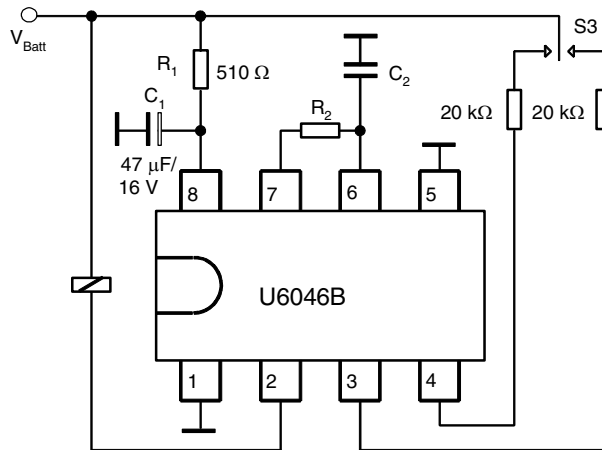
Contact current, I, is calculated as follows:

$$I = \frac{V_{\text{Batt}} - V_Z}{R(= 20 \text{ k}\Omega)} \text{ where } V_{\text{Batt}} = 12 \text{ V}, V_Z = 7 \text{ V}$$

$$I = \frac{(12 - 7)\text{V}}{20 \text{ k}\Omega} \approx 0.25 \text{ mA}$$

It can be increased by connecting a 5.6 kΩ resistor from the push-button switch to ground as shown in Figure 12.

Figure 6. ON/OFF Function



Timing Waveform

Figure 7. Behavior of the Relay Control Output as a Function of Input Condition

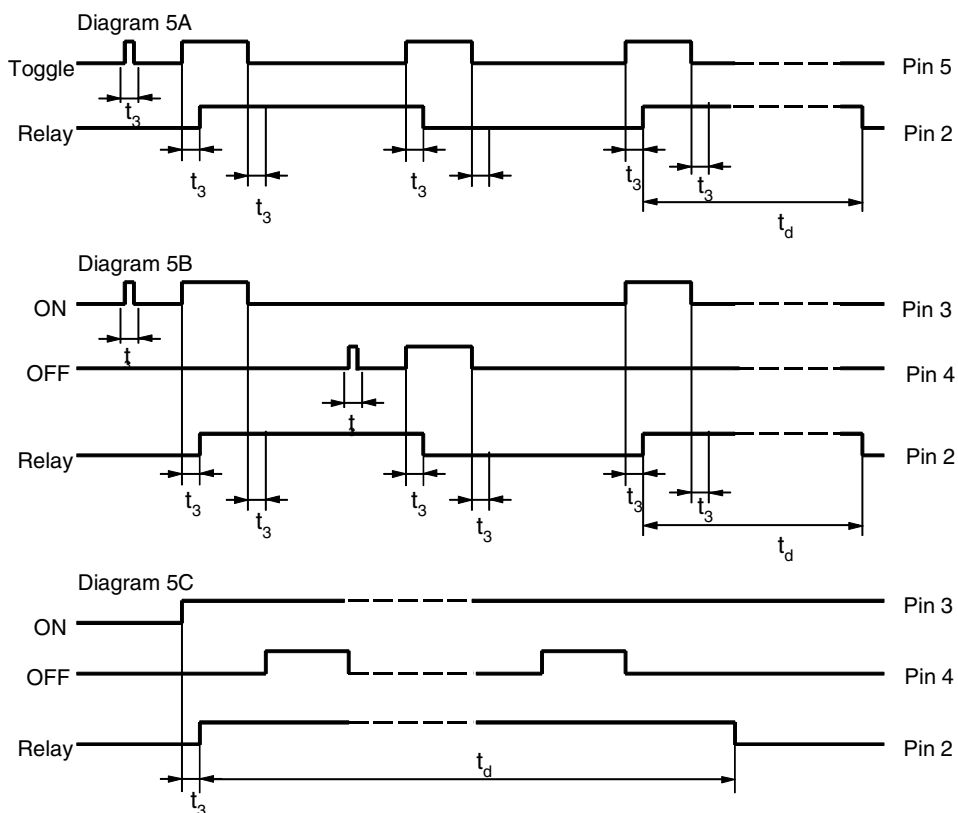
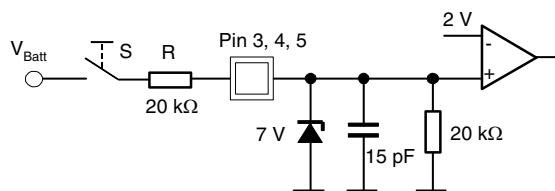


Figure 8. Input Circuit U6046B



Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Operating voltage, static, 5 min	V_{Batt}	24	V
Ambient temperature range	T_{amb}	-40 to +125	°C
Storage temperature range	T_{stg}	-55 to +125	°C
Junction temperature	T_j	150	°C

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction ambient DIP8	R_{thJA}	120	K/W
SO8	R_{thJA}	160	K/W

Electrical Characteristics

$V_{Batt} = 13.5\text{ V}$, $T_{amb} = 25^\circ\text{C}$, reference point ground, Figure 2, unless otherwise specified

No.	Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
1.1	Operating voltage	$R_1 \geq 510\ \Omega$ $t < 5\text{ min}$ $t < 60\text{ min}$		V_{Batt}	6		16 24 18	V
1.2	5 V supply	Without R_1 , C_1 , Figure 4	7, 8	V_8 , V_7	4.3		6.0	V
1.3	Stabilized voltage	$V_{Batt} = 12\text{ V}$	7	V_7	5.0	5.2	5.4	V
1.4	Undervoltage threshold	Power on reset		V_8	3.0		4.2	V
1.5	Supply current	All push buttons open	8	I_8		1.3	2.0	mA
1.6	Internal Z-diode	$I_8 = 10\text{ mA}$	8	V_8	13.5	14	16	V
2	Relay Control Output		2					
2.1	Saturation voltage	$I_2 = 200\text{ mA}$ $I_2 = 300\text{ mA}$		V_2		1.2	1.5	V
2.2	Leakage current	$V_2 = 14\text{ V}$		I_2		2	100	μA
2.3	Output current			I_2			300	mA
3	Output Pulse Current							
3.1	Load dump pulse	$t \leq 300\text{ ms}$		I_2			1.5	A
3.2	Internal Z-diode	$I_2 = 10\text{ mA}$		V_2	20	22	24	V
4	Oscillator Input $f = 0.001$ to 40 kHz, See Table 1		6					
4.1	Internal discharge resistance	$V_6 = 5\text{ V}$		R_6	1.6	2.0	2.4	$\text{k}\Omega$
4.2	Switching voltage	Lower Upper		V_{6L} V_{6H}	0.9 2.8	1.1 3.1	1.4 3.5	V
4.3	Input current	$V_6 = 0\text{ V}$		$-I_6$			1	μA
5	Switching Time							
5.1	Debounce time			t_3	5		7	cycles
5.2	Delay time			t_d	72704		74752	cycles
6	Inputs ON, OFF, TOGGLE		3, 4, 5					
6.1	Switching threshold voltage			$V_{3,4,5}$	1.6	2.0	2.4	V
6.2	Internal Z-diode	$I_{3,4,5} = 10\text{ mA}$		$V_{3,4,5}$	6.5	7.1	8.0	V
6.3	Pull-down resistance	$V_{3,4,5} = 5\text{ V}$		$R_{3,4,5}$	13	20	50	$\text{k}\Omega$

Table 1. Dimensioning for Oscillator Frequency, Debounce Time and Delay Time

Frequency f	Debounce Time t_3	Delay Time t_d		C_2	R_2
		Hz	ms		
1	6000	1229		4700	280
2	3000	614		1000	650
3	2000	410		1000	440
4	1500	307		1000	330
5	1200	246		1000	260
6	1000	205		1000	220
7	857	176		1000	190
8	750	154		1000	160
9	667	137		1000	140
10	600	123		1000	130
20	300	61		100	650
30	200	41		100	440
40	150	31		100	330
50	120	25		100	260
60	100	20		100	220
70	86	18		100	190
80	75	15		100	160
90	67	14		100	140
100	60	12		100	130
200	30		369	10	600
300	20		246	10	400
400	15		184	10	300
500	12		147	10	240
600	10		123	10	200
700	9.00		105	10	170
800	8.00		92	10	150
900	7.00		82	10	130
1000	6.00		74	10	120
2000	3.00		37	1	600
3000	2.00		25	1	400
4000	1.50		18	1	300
5000	1.20		15	1	240
6000	1.00		12	1	200
7000	0.86		11	1	170
8000	0.75		9	1	150
9000	0.67		8	1	130
10000	0.60		7	1	120
11000	0.55		6.7	1	110
12000	0.50		6.1	1	99
13000	0.46		5.7	1	91
14000	0.43		5.3	1	85
15000	0.40		4.9	1	79
16000	0.38		4.6	1	74
17000	0.35		4.3	1	70
18000	0.33		4.1	1	66
19000	0.32		3.9	1	62
20000	0.30		3.7	1	59

Applications

Figure 9. Generation of a Monostable Delay Time, t_d , Caused by Applying the Operating Voltage V_{Batt} , not Externally Deactivatable

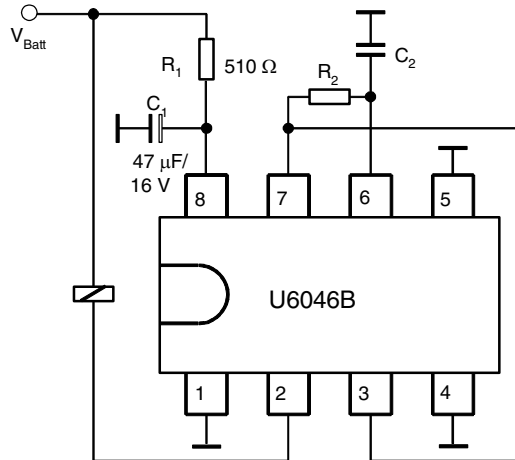


Figure 10. Generation of a Monostable Delay Time, t_d , by Applying the Operating Voltage V_{Batt} , Deactivatable by the OFF Push-button

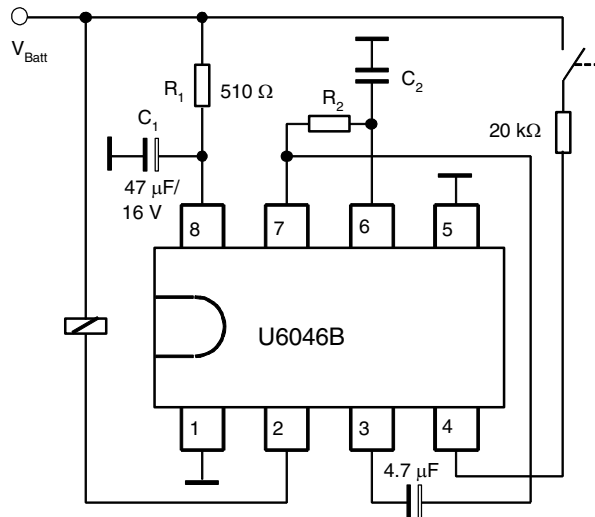


Figure 11. Monostable Delay Time, t_{d1} , can be Activated by the ON Push-button, not Externally Deactivatable

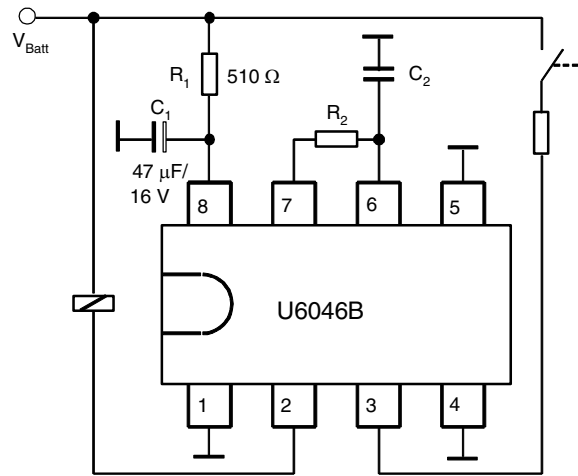
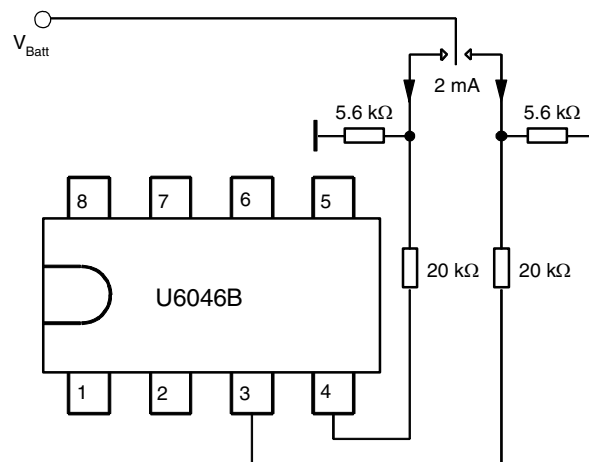


Figure 12. Increasing the Contact Current by Parallel Resistors



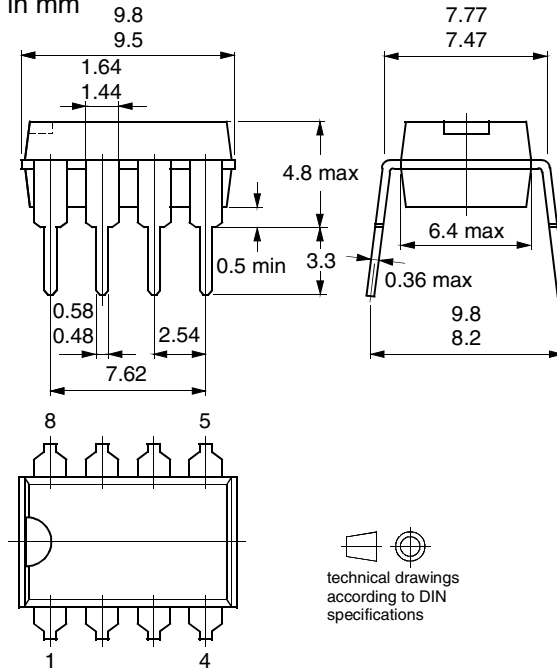
Ordering Information

Extended Type Number	Package	Remarks
U6046B	DIP8	
U6046B-FP	SO8	

Package Information

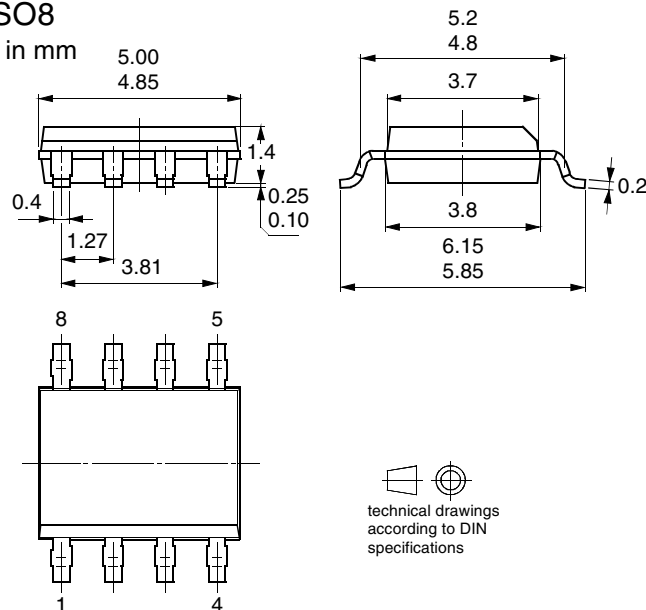
Package DIP8

Dimensions in mm



Package SO8

Dimensions in mm





Atmel Headquarters

Corporate Headquarters

2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 487-2600

Europe

Atmel Sarl
Route des Arsenaux 41
Case Postale 80
CH-1705 Fribourg
Switzerland
TEL (41) 26-426-5555
FAX (41) 26-426-5500

Asia

Room 1219
Chinachem Golden Plaza
77 Mody Road Tsimhatsui
East Kowloon
Hong Kong
TEL (852) 2721-9778
FAX (852) 2722-1369

Japan

9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
Japan
TEL (81) 3-3523-3551
FAX (81) 3-3523-7581

Atmel Operations

Memory

2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
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FAX 1(719) 540-1759

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FAX (44) 1355-242-743

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74025 Heilbronn, Germany
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FAX (49) 71-31-67-2340

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e-mail

literature@atmel.com

Web Site

<http://www.atmel.com>

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