Rear Window Heating Long-term Timer IC

Description

The bipolar long-term timer LD6046 (analog 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.

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
- LD6046: Inputs Switched to VBatt

Ordering Information

Package	Remarks
SOP8	Tubed, Reeled, Pb-free
DIP8	Tubed, Pb-free

Block Diagram

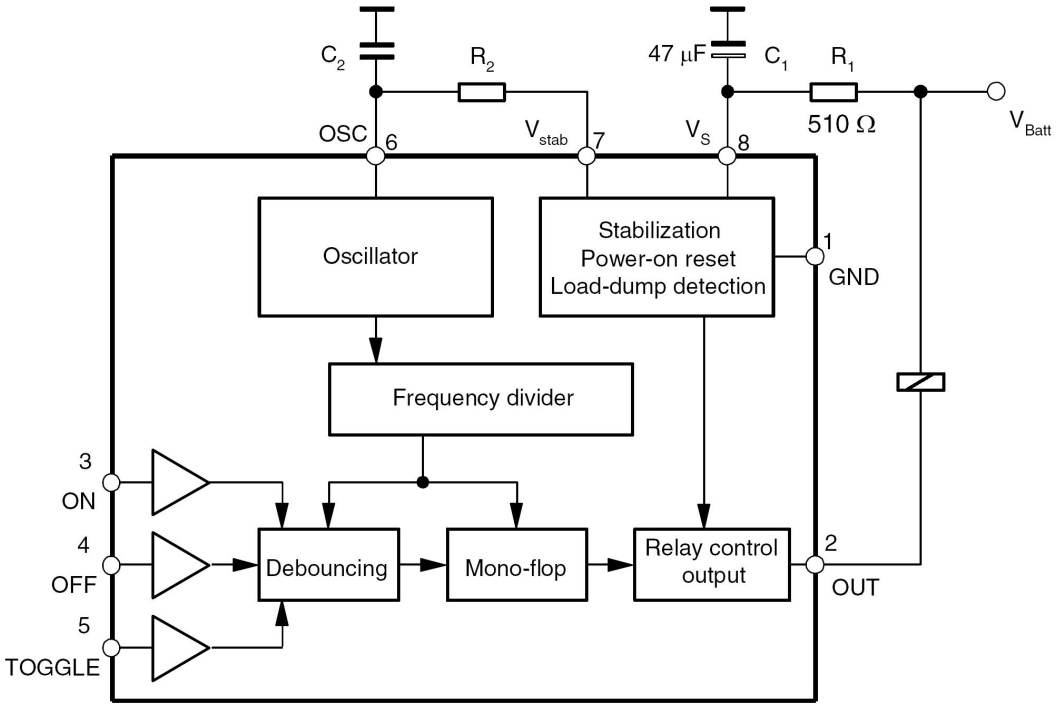


Figure 1. Block Diagram with External Circuit

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	V_{stab}	Stabilized voltage
8	V_S	Supply voltage

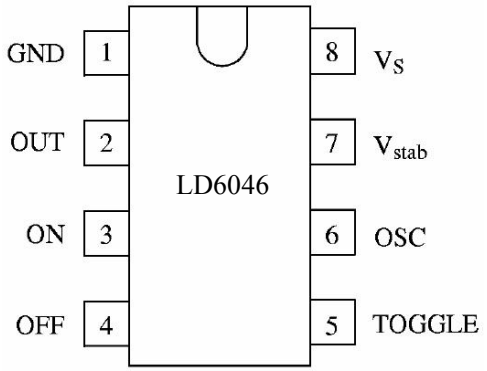


Figure2. Pinning

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, R1, limits the current in case of overvoltage, whereas C1 smooths the supply voltage at pin 8.

Recommended values are: R1 = 510Ω, C1 = 47 µF.
The integrated Z-diode (14V) protects the supply voltage, Vs. Therefore, the operation of the IC is possible between 7V and 16V, supplied by VBatt

.

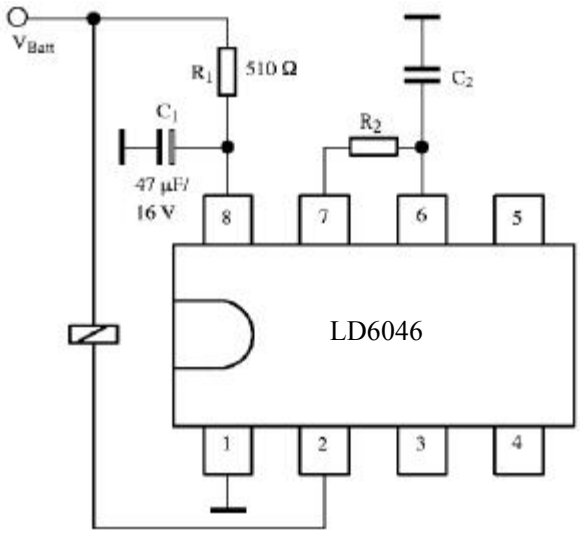


Figure 3. Basic Circuit for 12 V Supply and Oscillator

Oscillator (Pin 6)

The external components R2 and C2 determine the oscillator frequency. The capacitor C2 is charged by R2 and discharged by an integrated 2kΩ resistor.

A stable oscillator frequency with minimal influence of the temperature coefficient of the integrated resistor is achieved with R2 >> 2 kΩ.

Oscillator frequency (f) is calculated as follows: $f = 1 / (t1 + t2)$

where: $t1$ = charge time = $\alpha1 \times R2 \times C2$

$t2$ = discharge time = $\alpha2 \times 2\ k\Omega \times C2$

$\alpha1$ and $\alpha2$ are constants as such: $\alpha1 = 0.833$ and $\alpha2 = 1.551$ when C2 = 470 pF to 10 nF

$\alpha1 = 0.746$ and $\alpha2 = 1.284$ when C2 = 10 nF to 4700 nF

The debounce time, t3, and the delay time, td, depend on the oscillator frequency, f, as follows:

$t3 = 6 / f$

$td = 73728 / f$

Table 1 shows relationships between t3, td, C2, R2 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 23V 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 lC supply is protected by R1, C1, and an integrated Z-diode, while the inputs are protected by a series resistor, integrated Z-diode and RF capacitor (see Figure 7).

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

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, td. There are two input possibilities:

Toggle Input (Pin 5)

When the push-button (TOGGLE) switch, S1, is pressed for the first time, the relay becomes active after the debounce time, t3, i.e., the relay output, pin 2, is active (see Figure 4).

Renewed operation of S1 causes the interruption of the relay contact and the relay is disabled. Each operation of the toggle switch, S1, changes (alters) the condition of the relay output when the debounce time, t3, is exceeded i.e., the TOGGLE function.

If the relay output is not disabled by pressing the switch S1, the output is active until the delay time, td, is

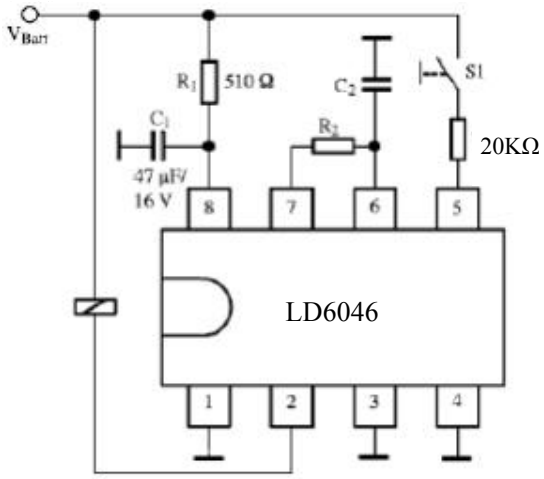


Figure 4. TOGGLE Function LD6046

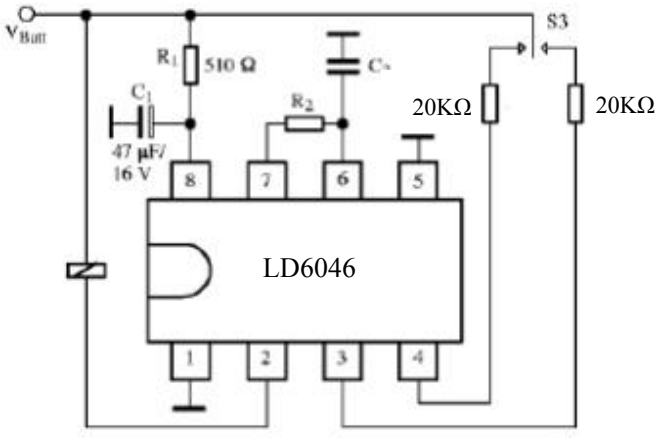


Figure 5. ON/OFF Function LD6046

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 5).

Pressing the push-button switch (pin 3-ON) leads to the activation of the relay after the debounce time, t3, 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, td, 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 S1 is ON or OFF.

If pin 3 (input ON) is continuously closed, the delay time, td, 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, td, when the battery voltage, VBatt, is applied.

Figure 7 shows the input circuit of LD6046. It has an integrated pull-down resistance (20 kΩ), RF capacitor (15 pF) and Z-diode (7 V). It reacts to voltages greater than 2V. The external protective resistor

has a value of 7.5 k Ω and the push-button switch is connected to the Battery as shown in the diagram.

Contact current, I, is calculated as follows:

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

$$I = (12 - 7)V / 20k\Omega \approx 0.25mA$$

Timing Waveform

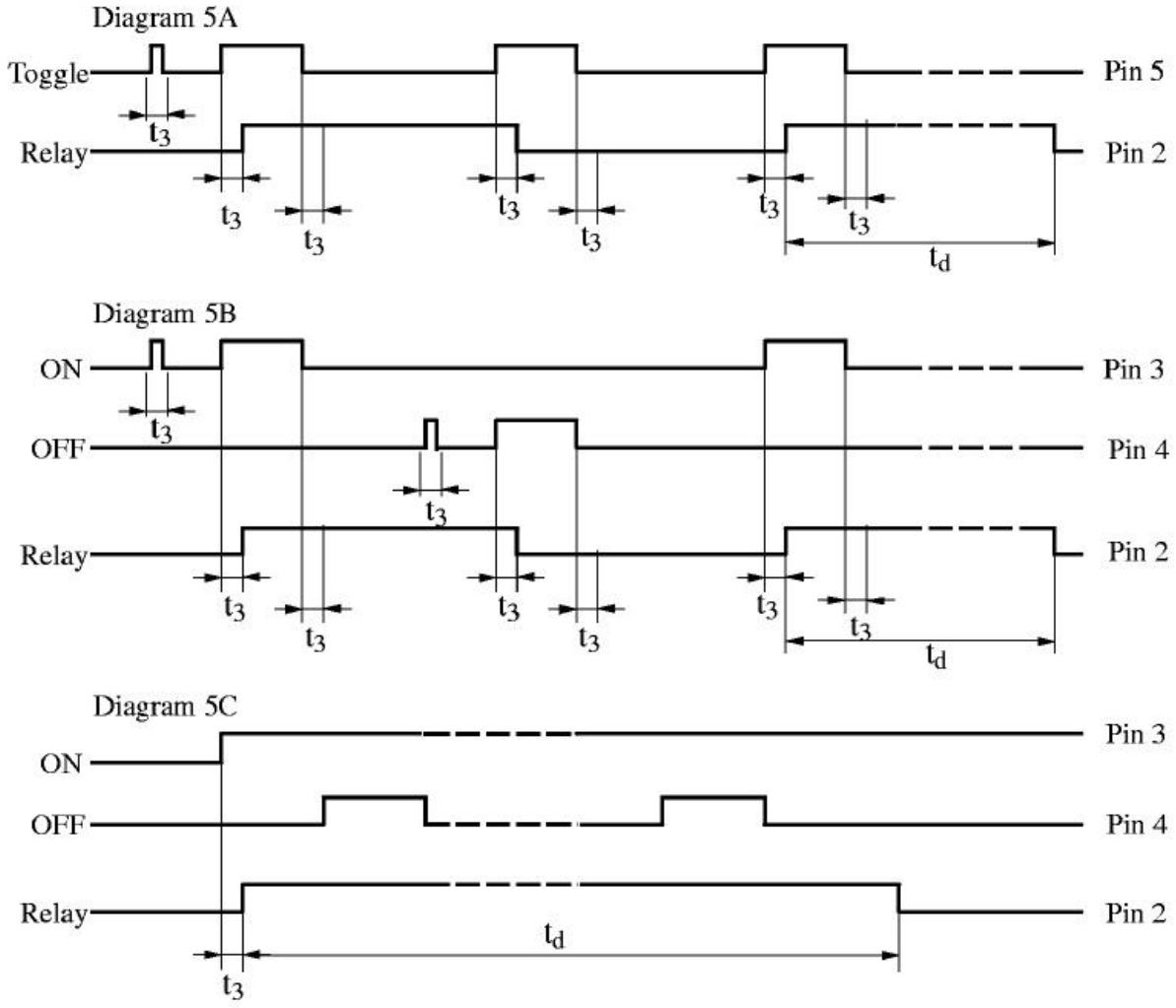


Figure 6. Behavior of the Relay Control Output as a Function of Input Condition

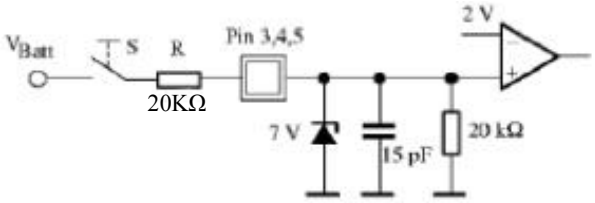


Figure 7. Input Circuit LD6046

Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Operating voltage, static, 5 min	VBatt	24	V
Ambient temperature range	Tamb	-40 to +125	℃
Storage temperature range	Tstg	-55 to +125	℃
Junction temperature	Tj	150	℃

Thermal Resistance

Parameters		Symbol	Value	Unit
Junction ambient	DIP8	RthJA	120	K/W
	SOP8	RthJA	160	K/W

Electrical Characteristics

VBatt =13.5 V, Tamb = 25℃, reference point ground, Figure 2, unless otherwise specified

Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
Operating voltage	R1≥510Ω t < 60min t< 5 min		VBatt	7		16 18 24	V
Stabilized voltage	VBatt = 12 V	7	V7	5.0	5.2	5.4	V
Undervoltage threshold	Power on reset		V8	3.0		4.2	V
Supply current	All push buttons open	8	I8		1.3	2.0	mA
Internal Z-diode	I8 = 10 mA	8	V8	13.5	14	16	V
Relay Control Output		2					
Saturation voltage	I2 = 200 mA I2 = 300 mA		V2		1.2	 1.5	V
Leakage current	V2 = 14 V		I2		2	100	μA
Output current			I2			300	mA
Output Pulse Current							
Load dump pulse	t ≤ 300 ms		I2			1.5	A
Internal Z-diode	I2 = 10 mA		V2	20	22	24	V
Oscillator Input f = 0.001 to 40 kHz, See Table 1		6					
Internal discharge resistance	V6 = 5 V		R6	1.6	2.0	2.4	kΩ
Switching voltage	Lower Upper		V6L V6H	0.9 2.8	1.1 3.1	1.4 3.5	V
Input current	V6 = 0 V		-I6			1	μA

Electrical Characteristics (continued)

VBatt =13.5 V, Tamb = 25℃, reference point ground, Figure 2, unless otherwise specified

Parameters	Test Conditions	Pin	Symbol	Min.	Typ.	Max.	Unit
Switching Time							
Debounce time			t3	5		7	cycles
Delay time			td	72704		74752	cycles
Inputs ON, OFF, TOGGLE		3, 4, 5					
Switching threshold voltage			V3,4,5	1.6	2.0	2.4	V
Internal Z-diode	I3, 4, 5 = 10 mA		V3,4,5	6.5	7.1	8.0	V
Pull-down resistance	V3,4,5 = 5 V		R3,4,5	13	20	50	kΩ

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

Frequency f	Debounce Time t3	Delay Time td		C_2	R_2
Hz	ms	min	s	nF	kΩ
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

Frequency f	Debounce Time t3	Delay Time td		C_2	R_2
Hz	ms	min	s	nF	kΩ
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

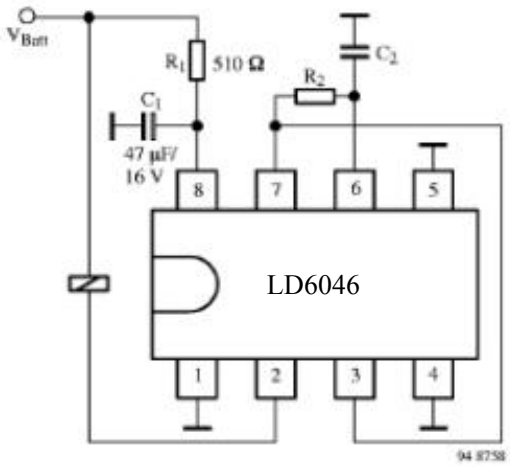


Figure 8. Generation of a monostable delay time, td, caused by applying the operating voltage VBatt, not

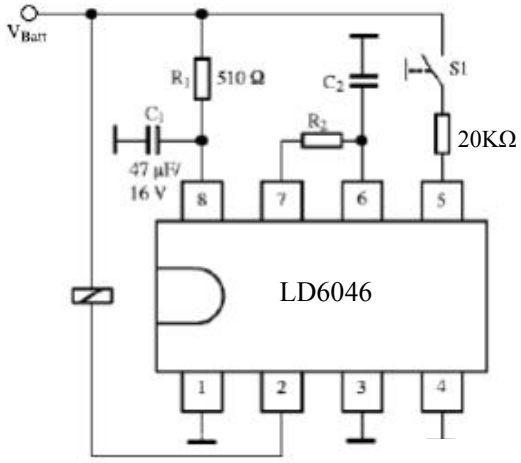


Figure 9. Generation of a monostable delay time, td, by applying the operating

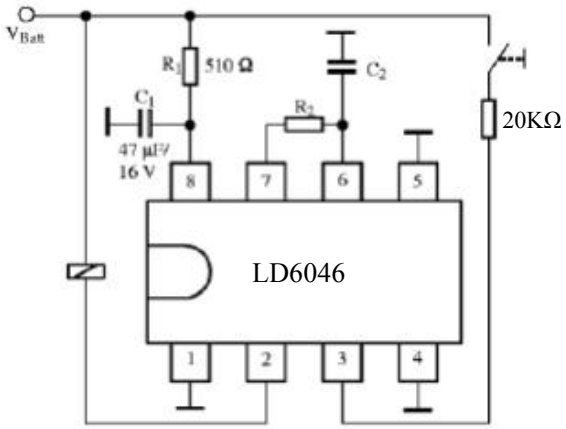
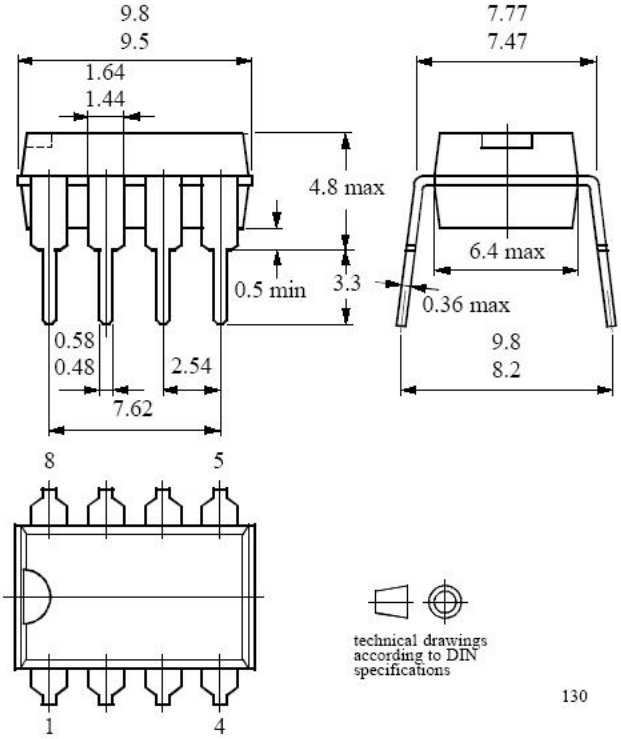


Figure 10. Monostable delay time, td, can be activated by the ON push-button, not externally deactivatable

Package Information

DIP8

Dimensions in mm



SOP8

Dimensions in mm