U 6030 B / U 6031 B

Switch ON/OFF delay circuit for timing relays

Description

The bipolar integrated circuits, U 6030 B and U 6031 B, are designed as switch ON/ OFF delay circuits for timing relays. They have a defined switch ON/ OFF delay time.

Features

- Delay time range: 3.7 s to 20 h
- RC oscillator determines switching characteristics
- Relay driver with Z-diode
- Low supply current
- Load dump protection
- RF interference protected
- Protection according to ISO/TR7637-1 (VDE 0839)
- U 6030 B: Switch ON delay
- U 6031 B: Switch OFF delay

Cases:

DIP 8	U 6030 B, U 6031 B
SO 8	U 6030 B-FP, U 6031 B-FP

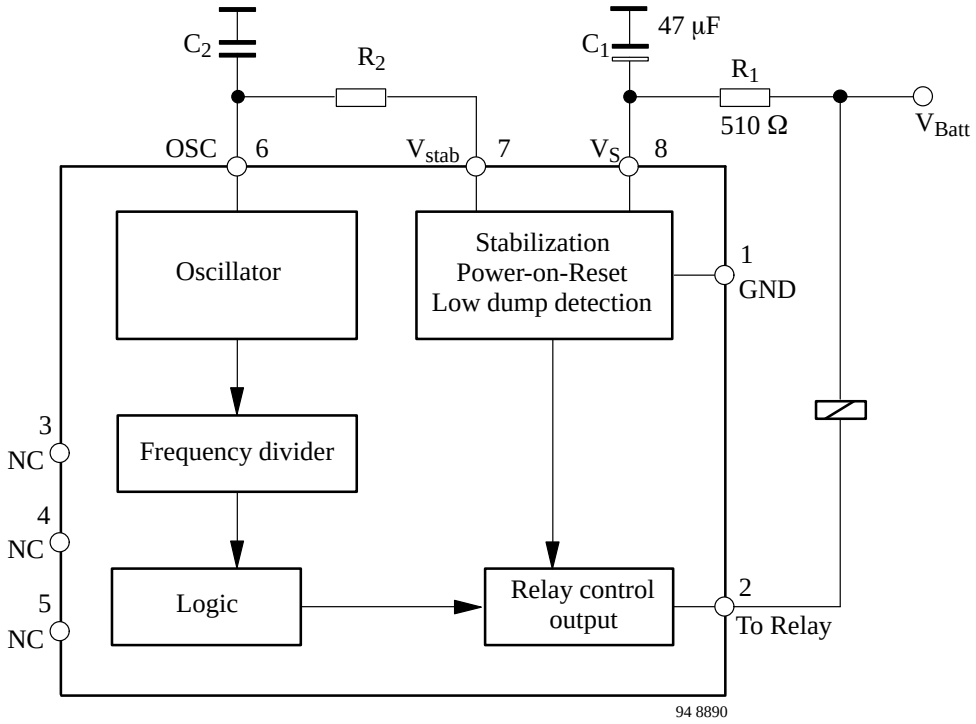
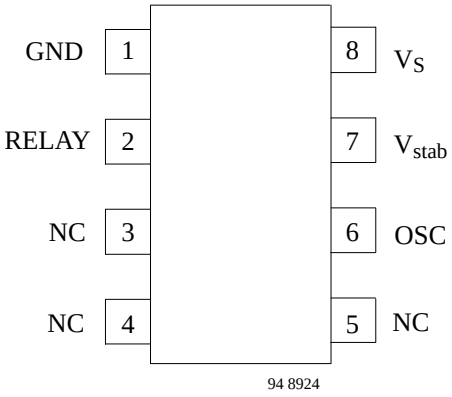


Figure 1 Block diagram with external circuit

Pin Configuration

Pin	Symbol	Function
1	GND	Reference point, ground
2	RELAY	Relay control output
3	NC	Not connected
4	NC	Not connected
5	NC	Not connected
6	OSC	RC oscillator input
7	V_{stab}	Stabilized voltage
8	V_S	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 2a. 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 Ω, C_1 = 47 µF.

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 2b, and the R_1C_1 circuit is omitted.

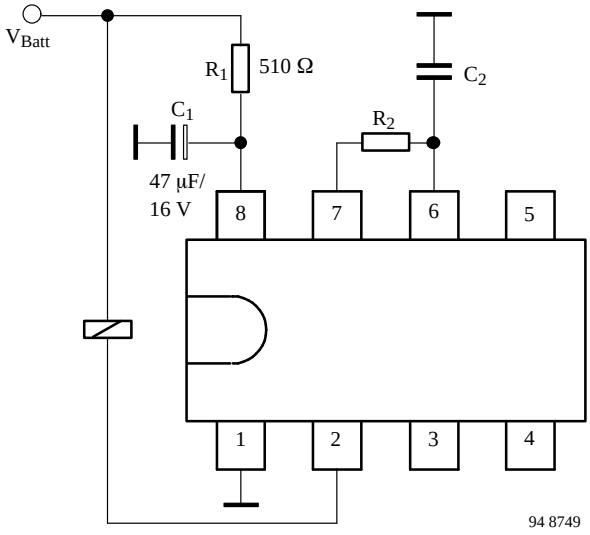


Figure 2a Basic circuit for 12 V supply and oscillator

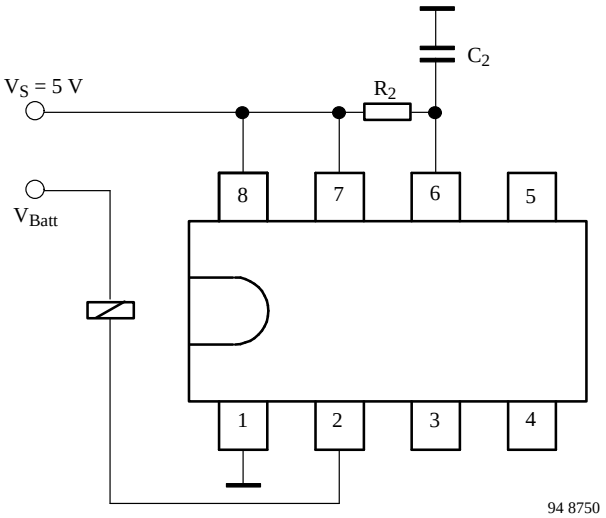


Figure 2b Basic circuit for V_S = 5 V

Oscillator, Pin 6

Oscillator frequency, f, is determined mainly by the R_2C_2 circuit. Resistance, R_2, determines the charge time, and the integrated resistance (2 kΩ) is responsible for discharge time. For the stability of the oscillator frequency, it is recommended that the selected R_2 value be much greater than the internal resistance (2 kΩ), because the temperature response and the tolerances of the integrated resistance are considerably greater than the external resistance value.

Oscillator frequency, f, is calculated as follows:

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

where
t_1 = charge time = $\alpha_1 . R_2 . C_2$
t_2 = discharge time = $\alpha_2 \cdot 2\ k\Omega \cdot C_2$

α_1 and α_2 are constants as such
$\alpha_1 = 0.833$ and $\alpha_2 = 1.551$ when C_2 = 470 pF to 10 nF
$\alpha_1 = 0.746$ and $\alpha_2 = 1.284$ when C_2 = 10 nF to 4700 nF

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

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

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

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

Relay control output

The relay control output is an open collector Darlington circuit with an integrated 23-V Z-diode for limitation of 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 @ 200 mA.

Interference voltages and load dump

The lC 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 (refer to Figure 6).

The relay control output is protected via the integrated 23-V Z-diode in the case of short interference peaks. It is switched to conductive condition for a battery voltage of greater than approx. 40 V in the case of 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.

Timing waveform

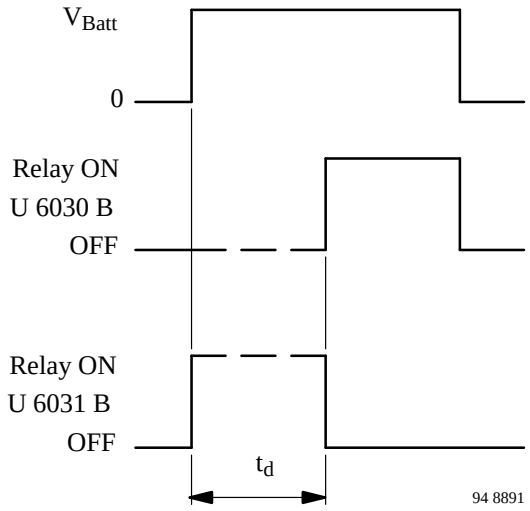


Figure 3 Behaviour of the control output as a function of supply voltage

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	Maximum	Unit
Junction ambient	DIP 8	T_{thJA}	110	K/W
	SO 8	T_{thJA}	160	K/W

Electrical Characteristics

V_{Batt} =13.5 V, T_{amb} = 25°C, reference point ground, figure 2, unless otherwise specified

Parameters	Test Conditions / Pin	Symbol	Min	Typ	Max	Unit
Operating voltage	$R_1 \geq 510\ \Omega$ t < 5 min t < 60 min	V_{Batt}	6		16 24 18	V
5 V supply	Without R_1, C_1 figure 2b Pins 7 and 8	V_8, V_7	4.3		6.0	V
Stabilized voltage	V_{Batt} = 12 V Pin 7	V_7	5.0	5.2	5.4	V
Undervoltage threshold	Power on reset	V_S	3.0		4.2	V
Supply current	All pushbuttons open, Pin 8	I_S		1.3	2.0	mA
Internal Z-diode	I_8 = 10 mA Pin 8	V_Z	13.5	14	16	V
Relay control output	Pin 2					
Saturation voltage	I_2 = 200 mA I_2 = 300 mA	V_2		1.2	 1.5	V
Leakage current	V_2 = 14 V	I_{lkg}		2	100	µA
Output current		I_2			300	mA
Output pulse current						
Load dump pulse	t ≤ 300 ms	I_2			1.5	A
Internal Z-diode	I_2 = 10 mA	V_Z	20	22	24	V
Oscillator input	f = 0.001 to 40 kHz, see table 1 Pin 6					
Internal discharge resistance	V_6 = 5 V	R_6	1.6	2.0	2.4	kΩ
Switching voltage	Lower Upper	V_{6L} V_{6H}	0.9 2.8	1.1 3.1	1.4 3.5	V
Input current	V_6 = 0 V	$-I_6$			1	µA
Switching times						
Debounce time		t_3	5		7	cycles
Delay time		t_d	72704		74752	cycles

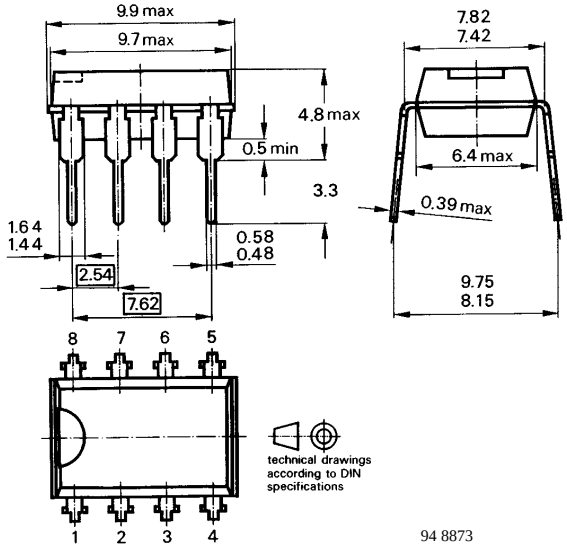
Table 1 Oscillator frequency, debounce time, delay time. dimensioning

Frequency f	Debounce time t_3	Delay time t_d		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

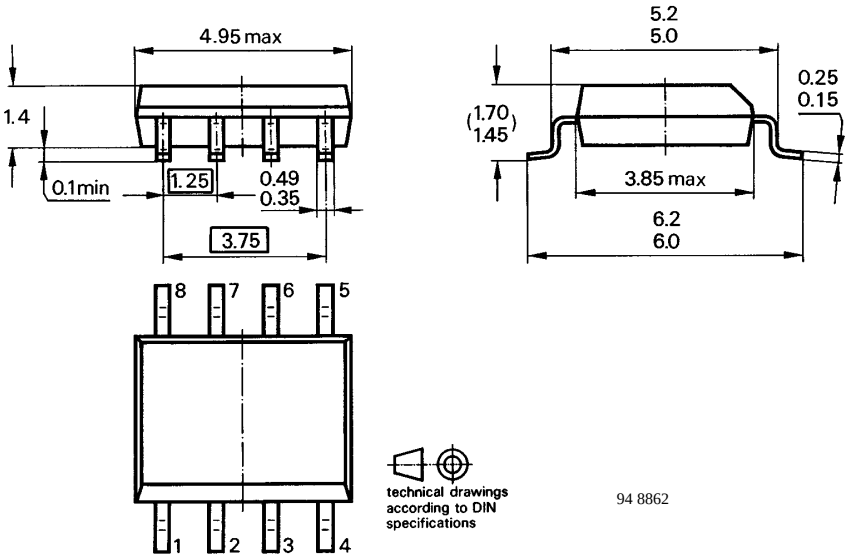
Frequency f_0	Debounce time t_3	Delay time t_d		C_2	R_2
Hz	ms	min	s	nF	kΩ
700	9		105	10	170
800	8		92	10	150
900	7		82	10	130
1000	6		74	10	120
2000	3.00		37	1	600
3000	2.00		25	1	400
4000	1.50		18	1	300
5000	1.20		15	1	240
6000	1.00		12	1	200
7000	.86		11	1	170
8000	.75		9	1	150
9000	.67		8	1	130
10000	.60		7	1	120
11000	.55		6.7	1	110
12000	.50		6.1	1	99
13000	.46		5.7	1	91
14000	.43		5.3	1	85
15000	.40		4.9	1	79
16000	.38		4.6	1	74
17000	.35		4.3	1	70
18000	.33		4.1	1	66
19000	.32		3.9	1	62
20000	.30		3.7	1	59

Dimensions in mm

Package: DIP 8



Package: SO 8



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