TELEFUNKEN ELECTRONIC

U 6046 B · U 6047 B
U 6048 B · U 6049 B

T-51-19

LONG-TIME TIMER CIRCUIT

Technology: Bipolar

Features:

- Low supply current
- Integrated relay driver with protection diode
- All time periods determined by RC oscillator
- Delay time: 3.7 s...20 h
- RF interference protected
- Protection according to VDE 0839
- Load dump protection

U 6046 B, U 6047 B

- Main application: Rear window heating
- Debounced input for toggle switch
- 2 debounced inputs for on/off switches
- U 6046 B: Input switched to V_{Batt}
- U 6047 B: Inputs switched to ground

U 6048 B, U 6049 B

- Main application: Radiator fan controlling
- Debounced input for coolant temperature switch
- Undebounced input for ignition key (Kl. 15)
- U 6048 B: Cool off time starts when ignition key is switched off
- U 6049 B: Cool off time starts when thermals switch is closed

Cases:

8 pin dual inline plastic (U 6046 B, U 6047 B, U 6048 B, U 6049 B)

8 pin SO plastic (U 6046 B-FP, U 6047 B-FP, U 6048 B-FP, U 6049 B-FP)

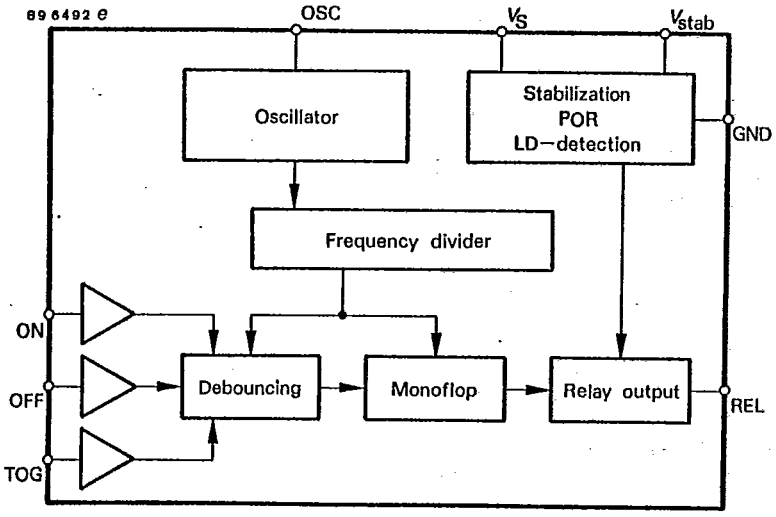

Fig. 1 Block diagram U 6046 B/U 6047 B

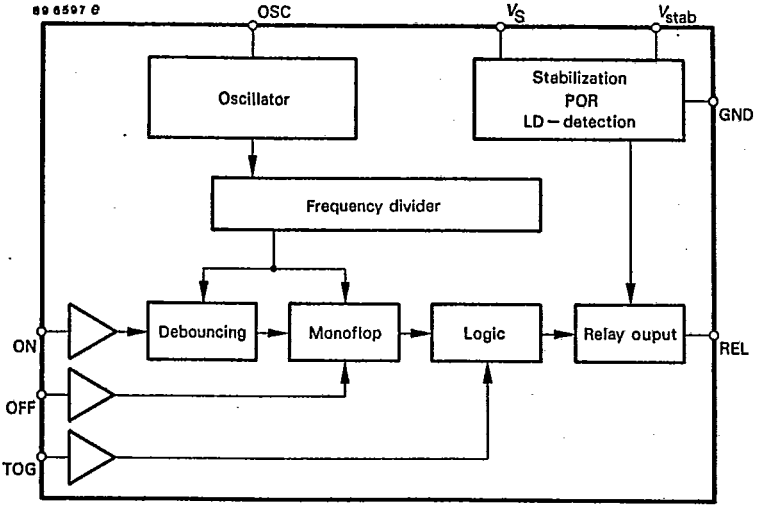

Fig. 2 Block diagram U 6048 B/U 6049 B

U 6046 B · U 6047 B
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Pin configuration (U 6046 B, U 6047 B)

Pin	Symbol	Function
1	GND	Reference point, ground
2	REL	Relay output
3	ON	Switch-on input
4	OFF	Switch-off input
5	TOG	Toggle input
6	OSC	RC oscillator input
7	V_{stab}	Stabilized voltage
8	V_S	Supply voltage

Pin configuration (U 6048 B, U 6049 B)

Pin	Symbol	Function
1	GND	Reference point, ground
2	REL	Relay output
3	IGN	Signal input, ignition
4	TS	Thermostatic switch input
5	PP	Programming input
6	OSC	RC oscillator input
7	V_{stab}	Stabilized voltage
8	V_S	Supply voltage

Functional description

1. Basic circuit

1.1. Power supply

For reasons of interference protection and surge immunity, all circuits must be provided with an RC circuit for current limitation in the event of overvoltages and for buffering in the event of voltage dips at V_S.

Suggested dimensioning:
$R_V = 510\ \Omega$; $C_V = 47\ \mu F$, refer to Fig. 3a.

There is a 14 V Z-diode between V_S and GND in each case. The operation voltage is between V_{Batt} = 6 V...16 V. All circuits can also be supplied by a stabilized 5 V voltage source which is free of interference voltages. In this case, the series resistor R_V and filter capacitor C_V are not required and pin V_{stab} is connected with pin V_S, refer to Fig. 3b.

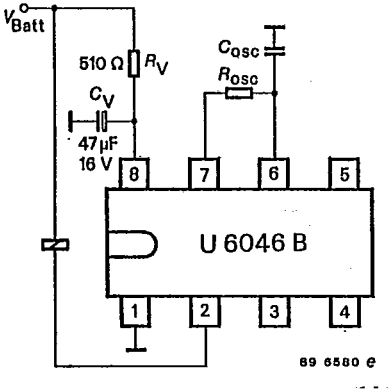

Fig 3a Basic circuit for 12 V voltage supply and oscillator

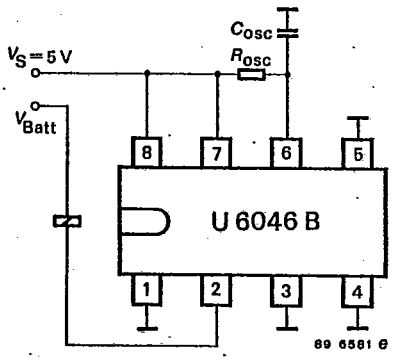

Fig. 3b Basic circuit for $V_S = 5$ V

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1.2 Oscillator

In the circuits, all timing sequences are derived from an RC oscillator whose charge time t_1 is determined by an external resistor R_{OSC} and whose discharge time t_2 is determined by an integrated 500 Ω resistor, refer to Figs. 3a and 3b. Since the temperature response and current of the integrated resistor are considerably greater than those of the external resistor, t_1 must be considerably larger than t_2 so that the influence of the integrated resistor on the stability of the oscillator frequency can be disregarded. The debounce time t_E and the delay time t_V depend on the oscillator frequency f_O as follows:

Debounce time: $t_E = 6 \cdot 1/f_O$

Delay time: $t_V = 73728 \cdot 1/f_O$

The oscillator frequency is calculated approx. in accordance with the following formula:

$f_O = 1/(t_1 + t_2)$

$t_1 = R_{OSC} \cdot C_{OSC} \cdot F1$

$t_2 = 500\ \Omega \cdot C_{OSC} \cdot F2$

With F1 = 0.833 and F2 = 1.551 for
C_{OSC} = 470 pF...10 nF

and F1 = 0.746 and F2 = 1.284 for
C_{OSC} = 10 nF...4700 nF

Table 1 shows the debounce time t_E, the delay time t_V and the corresponding dimensioning of C_{OSC} and R_{OSC} for frequencies from 1 Hz to 20 kHz.

1.3 Relay output

The relay output is an open collector Darlington transistor with integrated 23 V Z-diode for limitation of the inductive cut-out pulse of the relay winding. The maximum static collector current must not exceed 300 mA and saturation voltage is typically 1.1 V for a current of 200 mA.

1.4 Interference voltages and load dump

The IC supply is protected by R_V, C_V, and an integrated Z-diode, while the inputs are protected by a series resistor, integrated Z-diode and RF capacitor, refer to Fig. 7.
The relay output is protected via the integrated 23 V Z-diode in the case of short interference peaks and the relay output 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 absorb the current produced.

1.5 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.

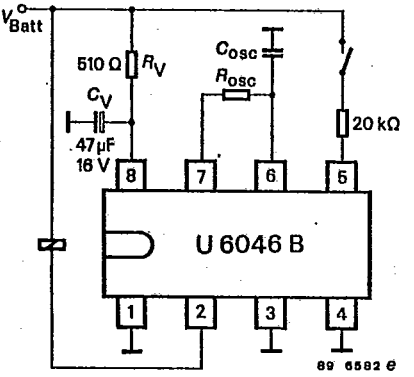

Fig. 4a Toggle function U 6046 B

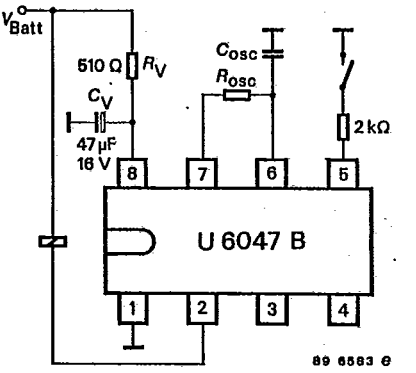

Fig. 4b Toggle function U 6047 B

2. U 6046 B/U 6047 B

A time function can be started or interrupted by the three inputs TOG, ON and OFF. If the time function is triggered, the relay is active; the relay contact drops out after expiry of the delay time. There are two application possibilities:

a) Use of the toggle input
When the button TOG is pressed for the first time, the relay is picked up after the debounce time t_E, i.e.: the output REL conducts. Renewed operation of the TOG pushbutton causes the relay contact to drop out and the output REL is disabled again. Each actuation of the TOG pushbutton changes the condition of the relay output when the debounce time has been exceeded, i.e. "Toggle function". If the relay output is not disabled by pressing the pushbutton, the output conducts until the delay time has elapsed, refer to Fig. 4 and time diagram 1a.

b) Use of the ON and OFF inputs
The ON and OFF pushbuttons should be realized as rocker switches, since both inputs must not be operated simultaneously. Pressing the ON button leads to activation of the relay after the debounce time t_E, while pressing the OFF button correspondingly leads to the relay being de-energized. If the relay is not de-energized by the button, the delay time t_V runs down, after which the relay output is disabled, refer to Fig. 5 and time diagram 1b.

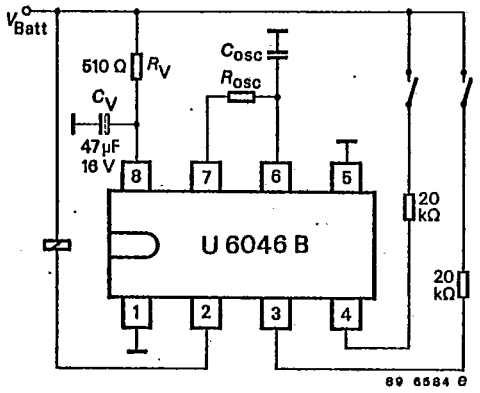

Fig. 5a ON/OFF function U 6046 B

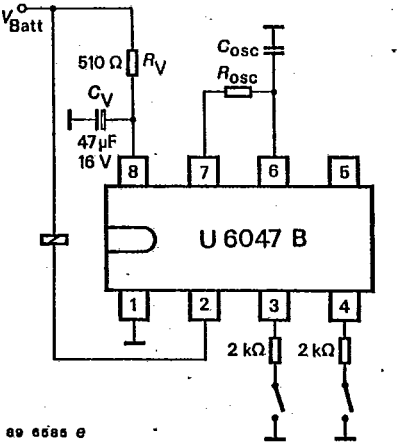

Fig. 5b ON/OFF function U 6047 B

Since only one debouncing circuit is present, mixed operation with TOG and ON/OFF is not possible. Debouncing acts in both directions, that is to say both for closing and opening of the pushbuttons. If the input ON is continuously closed, the delay time still elapses and the relay contact drops out. This may be exploited to generate a defined power-on reset pulse, for example, or to trigger a delay time when the battery voltage is applied, refer to Fig. 8, for example.

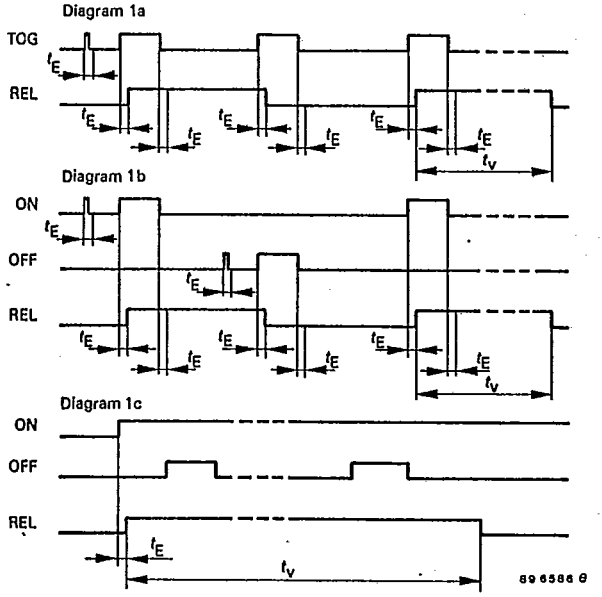

Fig. 6 Behaviour of the relay output as a function of input condition

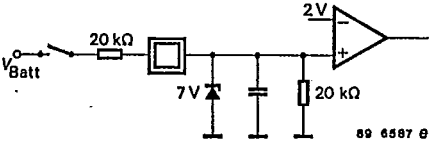

Fig. 7a Input circuit U 6046 B

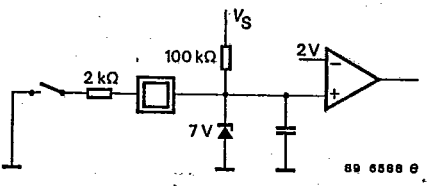

Fig. 7b Input circuit U 6047 B

The input circuit of the U 6046 B is shown in Fig. 7a. A 20 kΩ pull-down resistor is integrated as well as an RF capacitor and 7 V Z-diode. The circuit reacts to voltages greater than 2 V. The external protective resistor has a value of 20 kΩ and the pushbutton is connected to the battery voltage.
The contact current is $I \approx (V_{Batt} - V_Z)/20\ k\Omega$ at $V_{Batt} = 12$ V, this corresponding to approx. 0.25 mA. The contact current can be increased by connecting a resistor from the pushbutton to ground, refer to Fig. 11a.

The input circuit of the U 6047 B is shown in Fig. 7b. A 100 kΩ pull-up resistor is integrated in addition to an RF capacitor and 7 V Z-diode. The circuit reacts to voltages of less than 2 V. The external protective resistor has a value of 2 kΩ and the pushbutton is connected to GND.
The contact current is $I \approx V_S/102\ k\Omega$ at $V_{Batt} = 12$ V, this corresponding to approx. 0.1 mA. The contact current can be increased here as well by connecting a resistor from the pushbutton to V_{Batt}, refer to Fig. 11b.

3. Applications

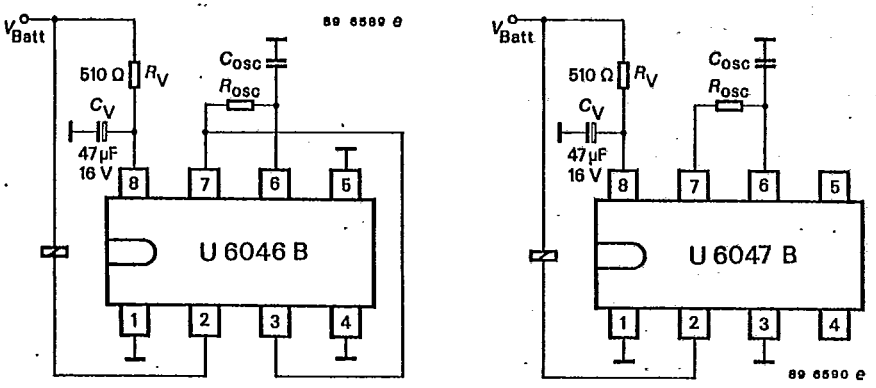

Fig. 8 Generation of a monostable delay time t_V, caused by applying the operating voltage V_{Batt}, not externally deactivatable.

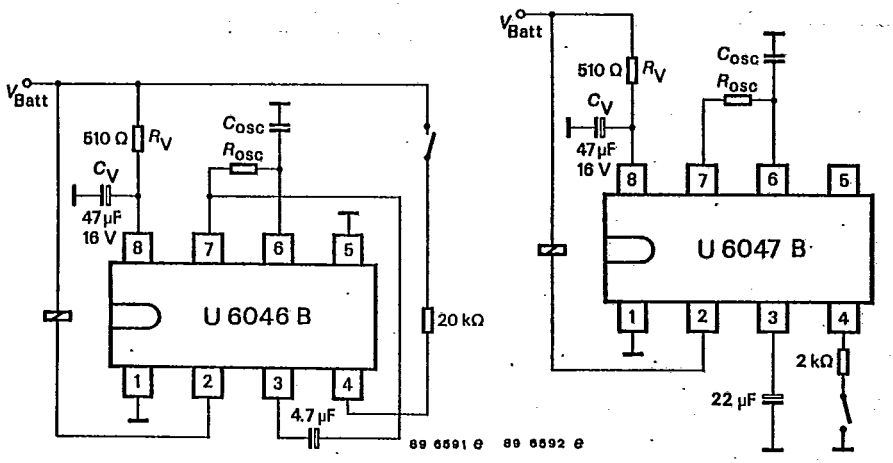

Fig. 9 Generation of a monostable, delay time t_V by applying the operating voltage V_{Batt}, deactivatable by OFF pushbutton

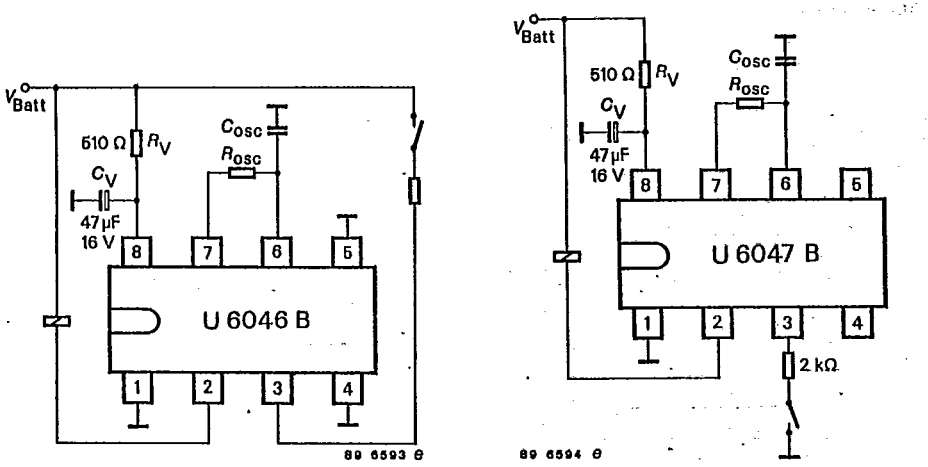

Fig. 10 Monostable delay time t_V, can be activated by ON pushbutton, not externally deactivatable

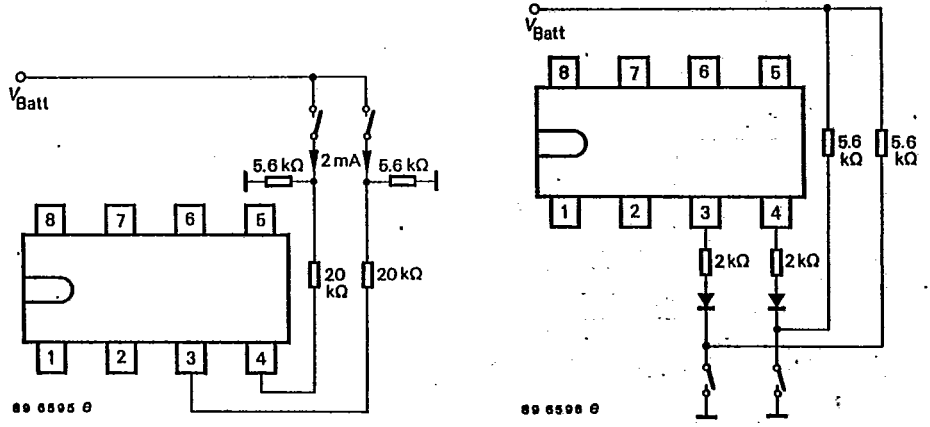

Fig. 11 Increasing the contact current by parallel resistors

4. U 6048 B/U 6049 B

The circuits U 6048 B and U 6049 B control the fan motor in the motor vehicle by means of a relay. The oscillator circuit and times t_E and t_V are identical with those of U 6046 B and are given in table 1. The input for the thermostatic switch TS is debounced. The thermostatic switch is connected to ground; the internal input circuit is shown in Fig. 7b.
The input IGN is the signal input for the ignition, terminal 15, and is not debounced. These two circuits are aluminium mask versions of the U 6046 B, and for this reason only one debounce circuit is integrated. Debouncing of input IGN must therefore be performed by an external RC element. The internal input circuit is shown in Fig. 7a. The programming input PP is a high-resistance input and must be connected either to V_{Stab} or GND.
The function of U 6048 B is shown in time diagram Fig. 12 and that of U 6049 B in time diagram Fig. 13.

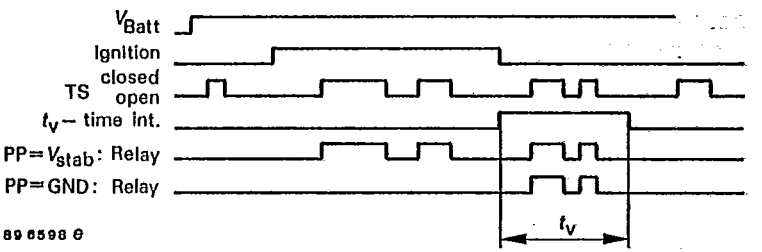

Fig. 12 Behaviour of the relay output of U 6048 B as a function of the inputs and programming pin. The debounce time t_E for TS is not shown

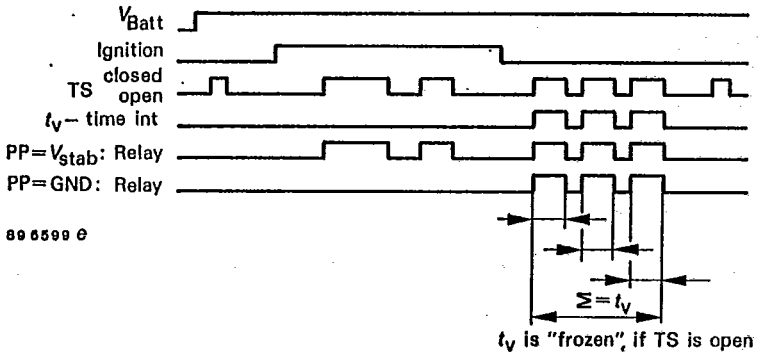

Fig. 13 Behaviour of the relay output of U 6049 B as a function of the inputs and programming pin

When the operating voltage is applied, the relay output is disabled and cannot be activated by switching TS. Only when the ignition is switched on does the relay output follow the condition of the thermostatic switch TS after the debounce time t_E if the programming pin PP is connected to V_{stab}.
When the ignition is switched off, the delay time t_V runs down internally in the U 6048 B. During this time, the relay output of the thermostatic switch can be activated. After expiry of t_V, the relay output is disabled again irrespective of the position of TS. After the ignition is switched off, the function of U 6049 B differs from that of U 6048 B. The sum of all ON-times caused by the thermostatic switch produces the delay time t_V. This can run down at once or in parts. If TS switches off, the oscillator is "frozen" internally: if TS switches on again, t_V starts to run again. In the event of renewed switching on of the ignition, the counter for the delay time is reset again.

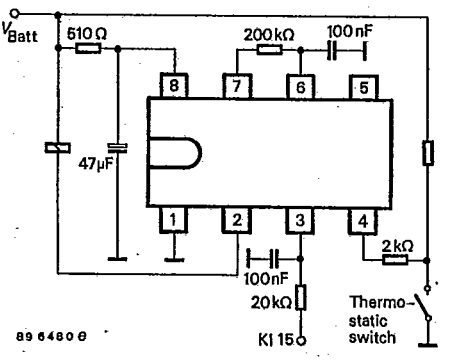

Fig. 14 Basic circuit U 6048 B/U 6049 B

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Absolute maximum ratings

(For all circuits with recommended circuitry)

Operating voltage, static, 5 min		V_{Batt}	24	V
Ambient temperature range		T_{amb}	−40...+ 95	°C
Storage temperature range		T_{stg}	−55...+125	°C
Junction temperature		T_j	150	°C

Maximum thermal resistance

Junction ambient	DIP 8	R_{thJA}	110	K/W
	SO 8	R_{thJA}	160	K/W

Electrical characteristics

$V_{Batt} = 13.5$ V, $T_{amb} = 25$ °C, reference point ground, circuits with recommended external circuitry

			Min.	Typ.	Max.	
Supply voltage range		V_{Batt}	6		16	V
5 V supply (without R_V, C_V)	Pin 7, 8	V_S, V_{stab}	4.3		6.0	V
Stabilized voltage	Pin 7	V_{stab}		5.2		V
Series resistance		R_V	270	510		Ω
Filter capacitance		C_V		47		µF
Undervoltage threshold (POR)		V_S	3.0		4.2	V
Supply current, all pushbuttons open	Pin 8	I_S			2.0	mA
Internal Z-diode	Pin 8	V_Z		14		V
Internal capacitance	Pin 7	C_7		15		pF
	Pin 8	C_8		15		pF

Relay output, without short-circuit limitation

Saturation voltage $I_2 = 200$ mA	Pin 2	V_2		1.1	1.5	V
Relay coil resistance		R_{REL}	60			Ω
Output current normal operation		I_2			300	mA
Output pulse current load dump		I_2			1.5	A
Internal Z-diode		V_Z		23		V

Oscillator input Pin 6

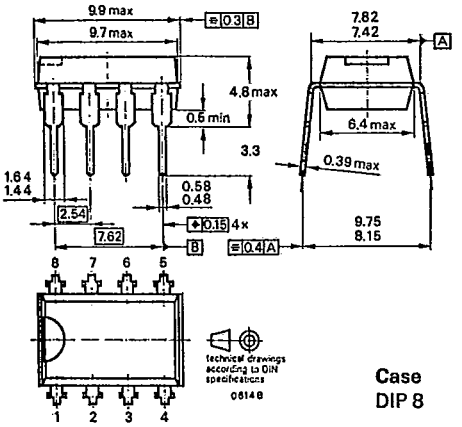
Oscillator capacitance $t_V = 20$ min		C_{OSC}		100		nF
Internal discharge resistance		R_6		0.5		kΩ

			Min.	Typ.	Max.	
Lower switching point		V_{6L}		1.1		V
Upper switching point		V_{6H}		3.3		V
Input current, $V_6 = 0$ V		$-I_6$			1	µA
Oscillator frequency		f_{OSC}	0.001		40	kHz
$t_V = 20$ min				61.4		Hz
$t_V = 2$ min				614		Hz
Times						
Debounce time		t_E	5		7	cycles
Delay time		t_V	72704		74752	cycles
U 6046 B, U 6047 B						
Inputs ON, OFF, TOG	Pin 3, 4, 5					
Switching threshold		$V_{3,4,5}$	1.6	2.0	2.4	V
Protective diode		V_Z		7		V
Internal capacitance		$C_{3,4,5}$		15		pF
Pull-down resistance, pushbutton to V_{Batt}	(U 6046 B)	R		20		kΩ
	(U 6047 B)	R		100		kΩ
protective resistance	(U 6046 B)	R_S		20		kΩ
	(U 6047 B)	R_S		2		kΩ
U 6048 B, U 6049 B						
Inputs IGN, TS, PP	Pin 3, 4, 5					
Switching threshold		$V_{3,4,5}$	1.6	2.0	2.4	V
Protective diode		V_Z		7		V
Internal capacitance		$C_{3,4,5}$		15		pF
Input IGN	Pin 3					
Pull-down resistance switch to V_{Batt}		R_3		20		kΩ
Protective resistance		R_{3S}		20		kΩ
Input TS	Pin 4					
Pull-up resistance switch ground		R_4		100		kΩ
Protective resistance		R_{4S}		2		kΩ
Input PP	Pin 5					
Input current		$-I_S$			1	µA

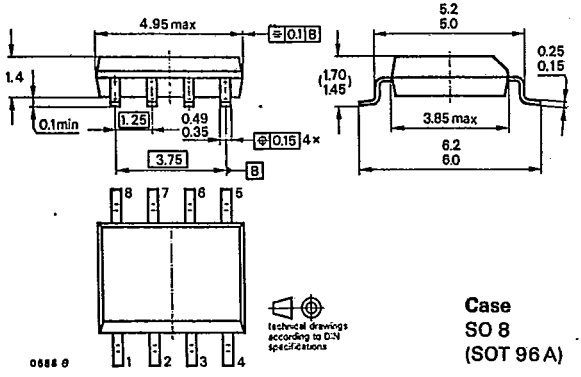
Frequency f_o Hz	Debounce time t_E ms	Delay time t_V min	s	C_{osc} nF	R_{osz} kΩ	Frequency f_o Hz	Debounce time t_E ms	Delay time t_V min	s	Cosc nF	Rosz kΩ
1	6000	1229		4700	280	600	10		123	10	200
2	3000	614		1000	650	700	9		105	10	170
3	2000	410		1000	440	800	8		92	10	150
4	1500	307		1000	330	900	7		82	10	130
5	1200	246		1000	260	1000	6		74	10	120
6	1000	205		1000	220	2000	3.00		37	1	600
7	857	176		1000	190	3000	2.00		25	1	400
8	750	154		1000	160	4000	1.50		18	1	300
9	667	137		1000	140	5000	1.20		15	1	240
10	600	123		1000	130	6000	1.00		12	1	200
20	300	61		100	650	7000	.86		11	1	170
30	200	41		100	440	8000	.75		9	1	150
40	150	31		100	330	9000	.67		8	1	130
50	120	25		100	260	10000	.60		7	1	120
60	100	20		100	220	11000	.55		6.7	1	110
70	86	18		100	190	12000	.50		6.1	1	99
80	75	15		100	160	13000	.46		5.7	1	91
90	67	14		100	140	14000	.43		5.3	1	85
100	60	12		100	130	15000	.40		4.9	1	79
200	30		369	10	600	16000	.38		4.6	1	74
300	20		246	10	400	17000	.35		4.3	1	70
400	15		184	10	300	18000	.33		4.1	1	66
500	12		147	10	240	19000	.32		3.9	1	62
						20000	.30		3.7	1	59

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

Dimensions in mm



Case
DIP 8



Case
SO 8
(SOT 96 A)