U 640 B · U 6040 B

T-51-19

TIMER CIRCUIT FOR RELAY CONTROL

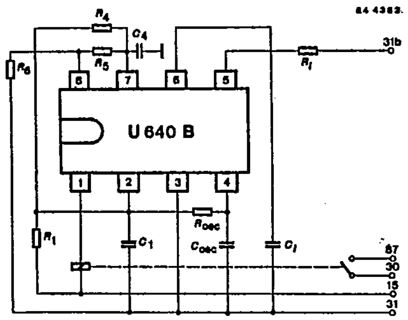
Technology: Bipolar

Features:

- Voltage stabilization
- Relay output with integrated Z-diode limitation
- Digital time sequence across one pin-RC-oscillator
- Low voltage effects a reset pulse
- Relay is switched ON by trigger pulses
- Relay is switched OFF with an external adjustable delay after the last trigger pulse
- Interference protected according to VDE 0839 and load dump protection
- U 640 B: Two adjustable comparator thresholds for hysteresis of motor speed limitation
- U 6040 B: One adjustable comparator threshold and internal hysteresis time for motor speed limitation

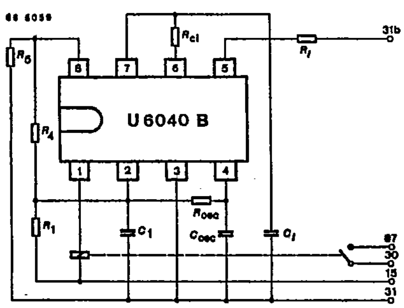
Case:

8 pin dual inline plastic



Pin	Function
1	Relay output
2	$V_S = 7.35$ V
3	Ground
4	RC-oscillator
5	Input
6	Integration capacitor
7	Reference voltage - High
8	Reference voltage - Low

a) U 640 B



Pin	Function
1	Relay output
2	$V_S = 7.35$ V
3	Ground
4	RC-oscillator
5	Input
6	Charge resistor
7	Integration capacitor
8	Reference voltage

b) U 6040 B

Fig. 1 Block diagramms and pin connections

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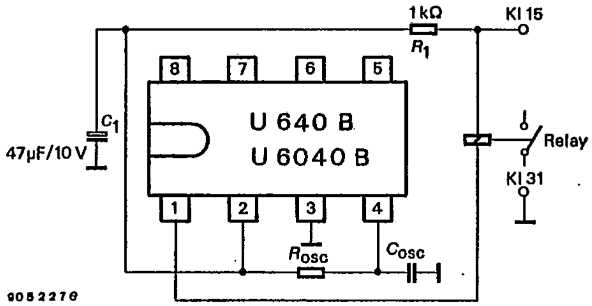


Fig. 2 Basic circuitry

The IC must be supplied through a series resistor R_1 for the following reasons:

- To protect against destruction in the event of over-voltages
- To limit the current for the parallel regulator

At a battery voltage of 12 V, a stabilized voltage of approximately 7.35 V is established at pin 2.
C_1 is an electrolytic capacitor with a value of 47 µF/10 V which supports the stabilized voltage in the event of voltage drops. The IC's current consumption is based on the following formula

$$I_S = \frac{V_{Batt} - V_{stab}}{R_1} \qquad (1)$$

$= 4.7$ mA when $V_{Batt} = 12$ V and $R_1 = 1$ kΩ

If V_{Batt} is less than 5.5 V, a reset signal is generated which sets the circuit to its basic state (POWER ON RESET). The current through R_1 rises in the event of overvoltages (load dump) and exceeds a specific value of $I_S = I_{ld}$, the relay output is activated to prevent the destruction of the output transistor.

The parallel regulator is designed for a pulse current of 200 mA. Any change in the series resistor R_1 influences three variables:

a. Power consumption

b. POWER ON RESET threshold

c. Response threshold for overvoltages

Calculation of the response threshold for over-voltages V_{ld}:

$$V_{ld} = R_1 \times I_{ld} + V_{stab} \qquad (2)$$

The current I_{ld} is approximately 45 mA, resulting in a response threshold of V_{ld} approx. 52 V (with $R_1 = 1$ kΩ)

RELAY OUTPUT

The relay output consists of a Darlington output stage with an integrated Z-diode (Fig. 3) and is designed for a pulse current of approximately 1.5 A. The Z-diode limits the relay winding's inductive switch-off voltage (Fig. 4).
The relay winding has a typical resistance of 80 Ω. With the circuitry of Fig. 1, the IC can be supplied with 24 V for two minutes without damage.

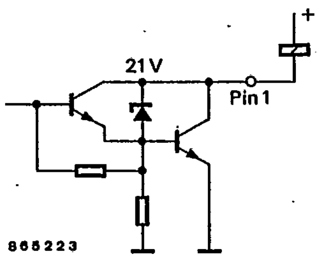


Fig. 3 Relay output

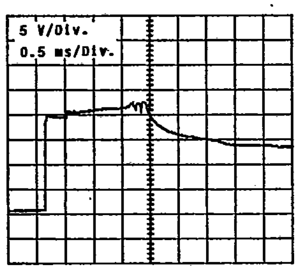


Fig. 4 Inductive switch-off pulse

Oscillator

The one pin-RC oscillator with its long charging time t_1 and short discharging time t_2 determines all of the IC's time sequences. Fig. 5 shows the voltage progression at pin 4.

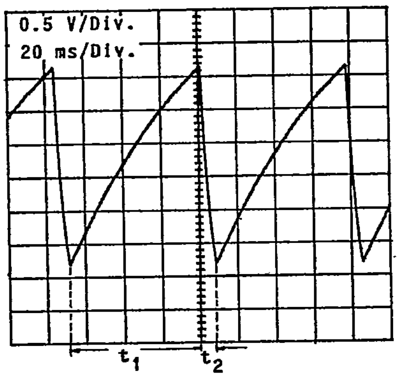


Fig. 5 Voltage sequence at Pin 4

The frequency is calculated according to

$$f = \frac{1}{t_1 + t_2} = \frac{1}{C_{osc}\,(R_{osc} \times 0.8 + 10200)} \qquad (3)$$

The charging time is determined by the resistance R_{osc} and the discharging time by an integrated 10 kΩ resistance (temperature coefficient TC = 0.46%/°).

In order to minimize the influence on the frequency's stability, the chosen discharging time t_2 must be much less than t_1 because the tolerance and temperature response of the integrated resistance are considerably higher than the ones of the external charging resistance R_{osc}.

Attempts are made to achieve a ratio of $t_1/t_2 \geq 10$, corresponding to a minimum resistance of $R_{osc} = 130$ kΩ. The oscillator's guaranteed maximum frequency is 20 kHz.

The oscillator's upper switching point is approx. 4.9 V, and its lower switching point approx. 1.8 V.

The following dimensioning is recommended for a 1 s switch-off delay:

$R_{osc} = 200$ kΩ, $C_{osc} = 470$ pF.

C_{osc} should have a negative temperature coefficient in order to compensate for the temperature coefficient of the integrated discharging resistor. Temperature coefficient TC = 0.46%/°.

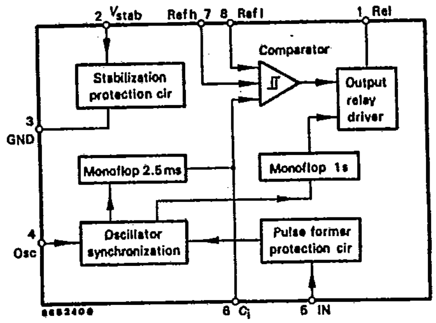


Fig. 6a Block diagram – U 640 B

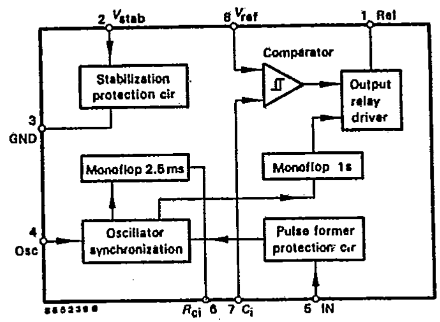


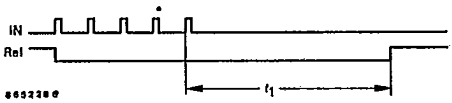
Fig. 6b Block diagram – U 6040 B

1s SWITCH–OFF DELAY

The principle of operation is identical for both types. When the first ignition pulse appears at pin 5, the relay output becomes conductive and the petrol pump is fed with current. The internal monoflop is retriggered by each further ignition pulse (refer to the pulse diagram).

While the ignition is switched on, the relay output is disabled 1s after the last ignition pulse and the relay contact is deenergized. Any other monostable time can also be set with these ICs. The internal frequency divider's division factor is 12 276. If the oscillator is set to 12.276 kHz, the monostable time is $t_1 = 1$ s or, at a frequency of 1.23 kHz, it is $t_1 = 10$ s. The monostable time t_1 thus depends only on the frequency of the oscillator and is calculated in accordance with (4):

$t_1 = 12276/f_{osc}$ (4)



Pulse diagram

The series resistor at pin 5 (signal input) is selected as follows:
$R_i = 270$ kΩ when the ignition pulse is taken from the breaker contact. The response threshold is then approximately 55 V. $R_i = 10$ kΩ when the ignition pulse is provided by an electronic ignition system. The response threshold is then approximately 4 V. There is a NPN comparator with 10 kΩ leak resistance and 7.5 V Z-diode as a protection device for the pin 5.

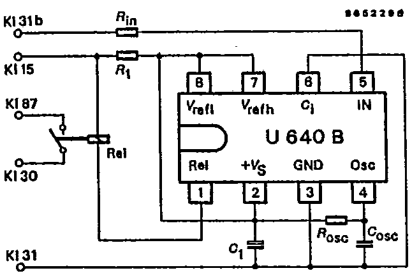


Fig. 7a Monostable time function 1s with U 640B

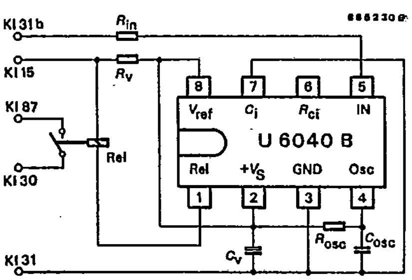


Fig. 7b Monostable time function 1s with U 6040B

1s SWITCH-OFF DELAY AND SPEED LIMITING WITH U 640B

Each ignition pulse at pin 5 triggers a monoflop with $t_6 = 2.5$ ms. The monoflop pulses can be observed at pin 6 when this pin is not connected. The ignition pulses are synchronized by the internal clock pulse, visible on an oscilloscope as jitter of the monoflop pulses.
The integration capacitor is connected between pin 6 and ground and charged via an integrated 210 kΩ resistor during the active monoflop time t_6, and is discharged during the pulse pauses. A DC voltage proportional to the ignition pulses frequency with superimposed residual ripple is produced at the capacitor.

If at a specific speed this voltage at C_i should ever exceed an upper reference voltage which is adjustable by means of a voltage divider at pin 7, the relay output is disabled, i.e. the electric petrol pump is switched OFF and thus limits the speed. As the result of this, the speed and the voltage at C_i also drops accordingly until it falls below a lower reference voltage which can be adjusted by means of a voltage divider at pin 8. The relay is activated again and the control pump then delivers fuel again.
The residual ripple of the integration voltage must also be taken into account as regards the switching threshold hysteresis.
Fig. 8a shows a typical wiring configuration with the U 640B. The capacitor at pin 7 suppresses interference in the reference voltage. Note that the adjusted switch OFF speed and hysteresis are influenced by the tolerance and temperature coefficient of the integrated charging and discharging resistor.

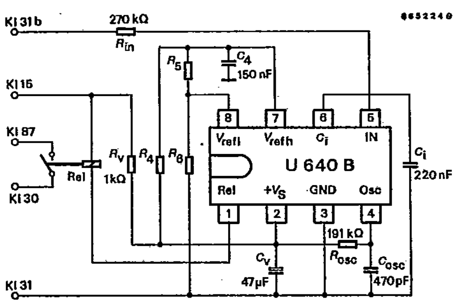


Fig. 8a Typical wiring configuration with U 640B

1s DELAY AND SPEED LIMITING WITH U6040B

The principle of operation is identical to that of the U 640 B, but with the following exceptions:
The charging and discharging resistor is designed as an external resistor R_{ci} = 200 kΩ, which necessitates a pinning alteration. Pin 7 and pin 8 are the inputs for the integrated comparator. For speed limitation, pin 8 is wired to the reference voltage (voltage divider), and the integration voltage proportional to the ignition pulses frequency is applied to pin 7.
At the switch-off speed, e.g. 6600 rpm, the integration voltage exceeds the reference voltage and the relay is deactivated.
Since no second threshold is available for the switching hysteresis, renewed activation of the relay is prevented for approximately 20 ms when $V_7 = V_{ref}$. This prevents uncontrolled oscillation of the relay output. Fig. 8b shows the complete circuit with the U 6040B.

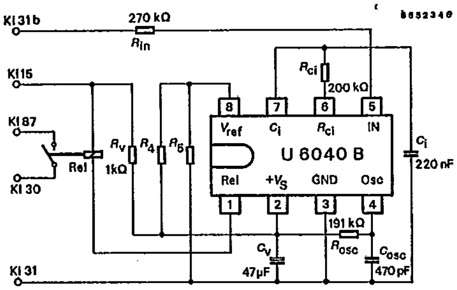


Fig. 8b Typical wiring configuration with U 6040B

INVERTED RELAY CONTROL

Operation of the relay output can be inverted for other applications such as a switching display or optical emphasis of rpm or speed ranges.
If the two comparator inputs are interchanged, i.e. the reference voltage connected to pin 7 and the integration voltage to pin 8, functioning of the relay is inverted: i.e. the relay output is disabled when the integration voltage is less than the reference voltage and is enabled when $V_7 = V_{ref}$.
The 1s function is inactive in this case.

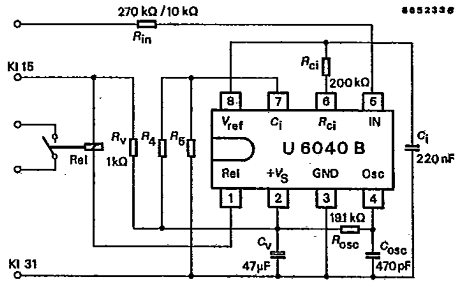


Fig. 9 Inverted relay control

DIGITAL CONTROL OF PINS 7/8

If approximately 2.5 V are applied to a reference voltage input with a voltage divider, the other comparator input can be controlled with a TTL or CMOS signal in order to enforce specific relay switching states. Refer to figures 10 and 11 with the corresponding truth table.

$V_{ref} = 2.5$ V

V_{ci}	t_1	Relay
O	O	OFF
O	H	ON
H	O	OFF
H	H	OFF

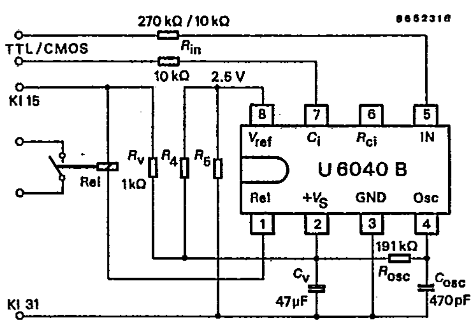
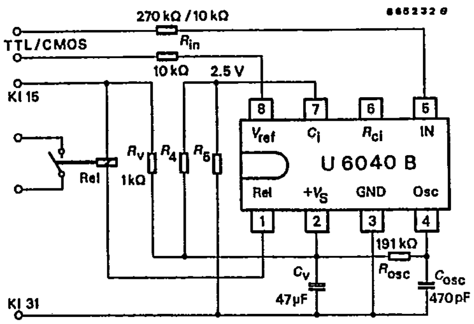


Fig. 10 Digital control at Pin 7

U 640 B · U 6040 B

T-51-19



$V_{cl} = 2.5$ V

V_{ref}	t_1	Relay
O	O	OFF
O	H	OFF
H	O	OFF
H	H	ON

Fig. 11 Digital control at Pin 8

Absolute maximum ratings
Reference point Pin 3 (Ground), see Fig. 2

Supply voltage Kl (terminal) 15	V_{Batt}	24	V
Power dissipation $T_{amb} = 95$ °C	P_{tot}	420	mW
Ambient temperature range	T_{amb}	−40...+95	°C
Storage temperature range	T_{stg}	−55...+125	°C

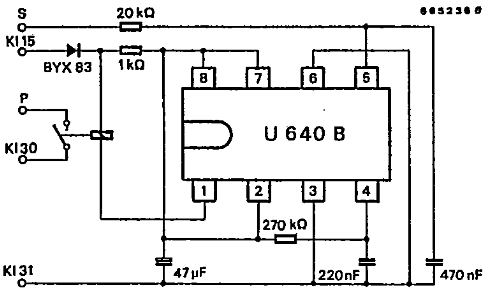
Electrical characteristics
Reference point Pin 3 (Ground), $T_{amb} = 25$ °C, see Fig. 2, V_{Batt} (Kl 15) = 12 V, unless otherwise specified

			Min.	Typ.	Max.	
Supply voltage Kl 15		V_{Batt}	6		16	V
Stabilized voltage $R_1 = 500...1200$ Ω, $C_1 = 47$ µF	Pin 2	$V_S = V_2$		7.5		V
Low voltage identification	Pin 2	V_2		4.7		V
Supply current						
$V_B = 12$ V, $R_1 = 1$ kΩ	Pin 2	I_2		4.5		mA
$V_B = 6$ V, $R_1 = 1$ kΩ	Pin 2	I_2		1		mA
Load dump protection Operating threshold current	Pin 2	I_2		45		mA
Relay output	Pin 1					
Saturation voltage $I_1 = 100$ mA		V_1			1	V
$I_1 = 200$ mA		V_1			1.5	V
Z-Diode for inductive load		V_1		20		V
Monoflop time, $f_{osc} = 12.3$ kHz		t_1		1		s

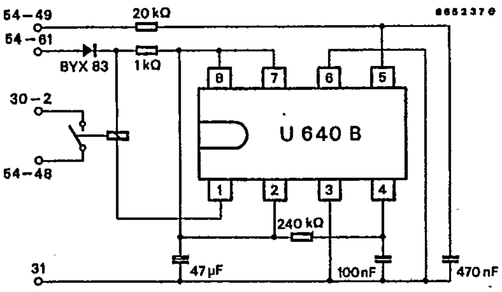
			Min.	Typ.	Max.	
Oscillator input	Pin 4					
Switching threshold	– High	V_H		4.9		V
	– Low	V_L		1.8		V
Discharge resistance (integrated)		R	8	10	12	kΩ
Discharge current	$V_4 = 6$ V	I_4		550		μA
Input current	$V_4 = 0$ V	$-I_4$			550	nA
RC oscillator		R_{osc}	130	220	1000	kΩ
		C_{osc}		470		pF
					100	μF
Ignition pulse input	Pin 5					
Operation threshold voltage		V_5		1.8		V
Protection diode, $I_5 = 10$ mA		V_5		7.8		V
$I_5 = 10$ mA		$-V_5$		0.75		V
Input resistance		R		10		kΩ
Series resistance, ignition pulse input		R_i	10			kΩ
Integration output		Pin 6				
Charge and discharge resistance	U 640 B	R_6		210		kΩ
	U 6040 B	R_6		5.6		kΩ
Charge current $V_6 = 0$ V	U 640 B	$-I_6$		35		μA
	U 6040 B	$-I_6$			100	μA
Discharge current $V_6 = V_2$	U 640 B	I_6		35		μA
	U 6040 B	I_6			100	μA
External charging resistor	U 6040 B	R_{ci}	100	200		kΩ
Monoflop time $f_{osc} = 12.3$ kHz		t_6		2.52		ms
Reference inputs	Pin 7+8					
Input voltage		V_7, V_8	0		$V_2 - 1.5$	V
Input current $V_7, V_8 = 0$		I_7, I_8			550	nA
Offset voltage: Relay = OFF	U 640 B	V_{7-6}		12		mV
	U 6040 B	V_{7-8}		12		mV
Relay = ON	U 640 B	V_{8-6}		12		mV

T-51-19

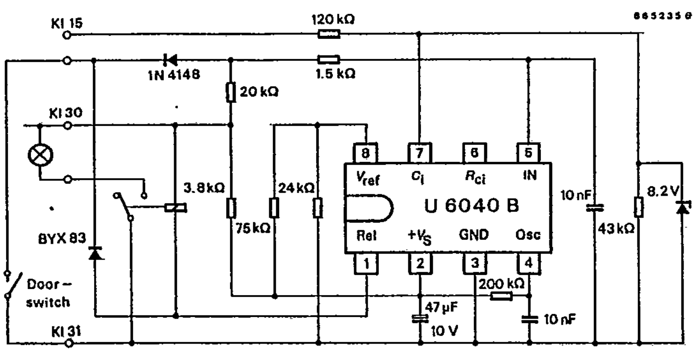
Application



Timer for rear pane heating

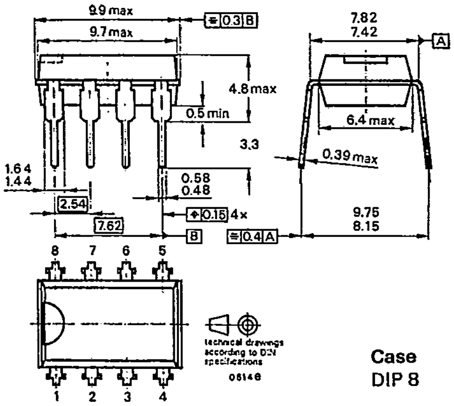


Timer for windscreen heating



Automotive interior light timer (Delay time $t_1 = 18$ s)

Dimensions in mm



Case
DIP 8