



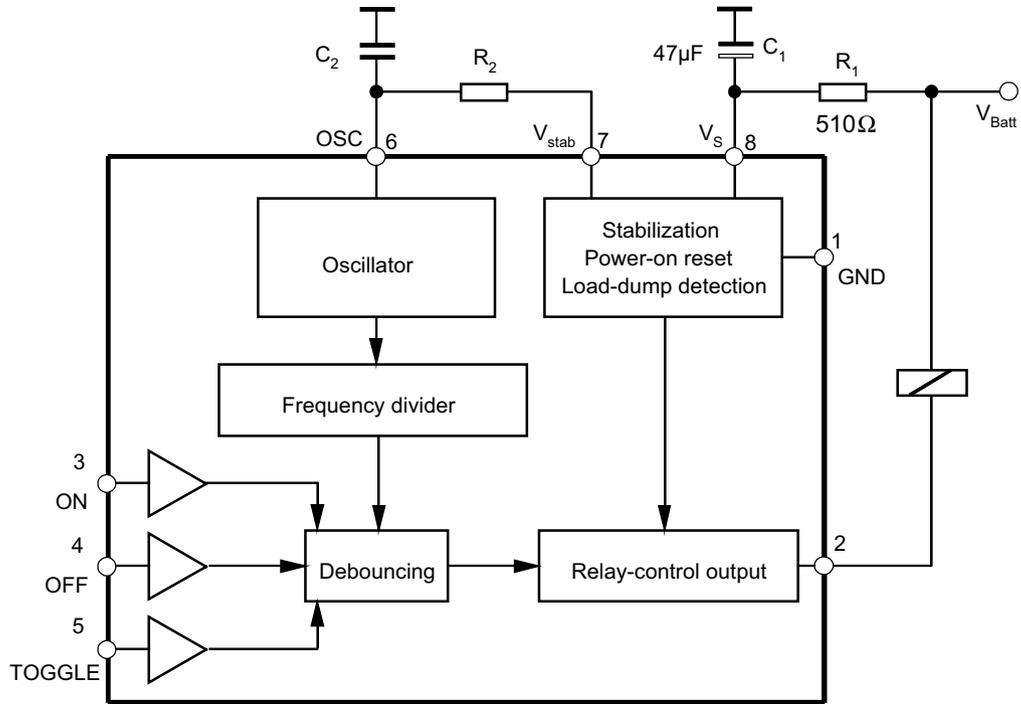
Features

- Debounce time: 0.3ms to 6s
- RC oscillator determines switching characteristics
- Relay driver with Z-diode
- Debounced input for toggle switch
- Three debounced inputs: ON, OFF and TOGGLE
- Load-dump protection
- RF interference protection
- Protection according to ISO/TR7637-1 (VDE 0839)

Description

The bipolar integrated circuit Atmel® U6032B is designed as a toggle switch. The device, which has a defined power-on status, can be used to control electrical loads, for example, fog lamps, high/low beam or heated windows for automotive applications.

Figure 1. Block Diagram with External Circuit



1. Pin Configuration

Figure 1-1. Pinning DIP8

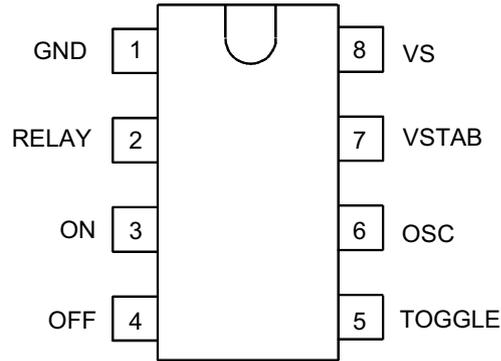


Table 1-1. Pin Description

| Pin | Symbol | Function |
|-----|--------|-------------------------|
| 1 | GND | Reference point, ground |
| 2 | RELAY | 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 |

2. Functional Description

2.1 Power Supply, Pin 8

To achieve interference protection and surge immunity, the supply voltage (pin 8) must be provided with an RC circuit as shown in [Figure 2-1](#). The dropping resistor, R_1 , limits the current in case of overvoltage, whereas C_1 smooths the supply voltage at pin 8.

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

An integrated Z-diode (14V) protects the supply voltage, V_S , thus enabling stable operation in a supply-voltage range of 6V to 16V, supplied by V_{Batt} .

It is possible to operate the integrated circuit with a 5V supply, but it should be assured that there are no interference voltages. In this case, pin 7 is connected to pin 8 as shown in [Figure 2-2](#) on page 4, and the R_1C_1 circuit is omitted.

Figure 2-1. Basic Circuit for 12-V Supply and Oscillator

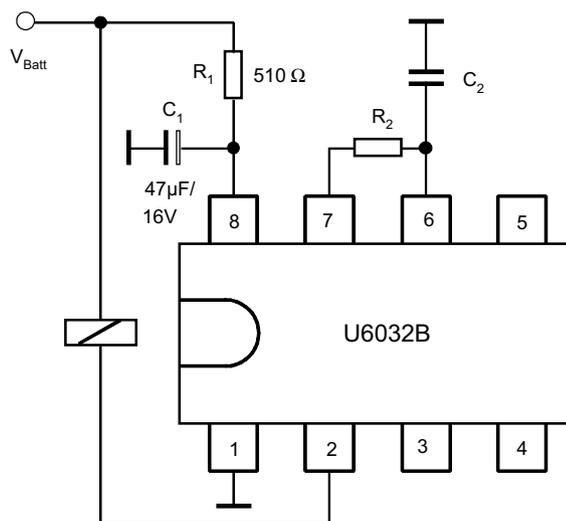
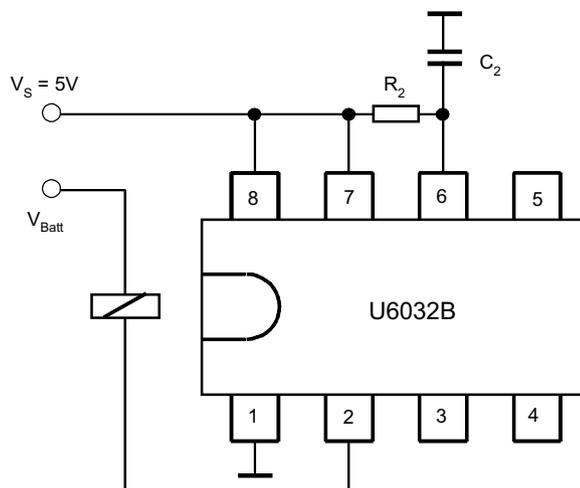


Figure 2-2. Basic Circuit for $V_S = 5\text{V}$



2.2 Oscillator, Pin 6

The oscillator frequency, f , is determined mainly by the R_2C_2 circuit. The resistance, R_2 , determines the charge time, and the integrated resistance ($2k\Omega$) is responsible for the discharge time. To ensure the stability of the oscillator frequency, it is recommended that the selected R_2 value is remarkably greater than the internal resistance ($2k\Omega$), as the temperature response and the tolerances of the integrated resistance are considerably greater than the external resistance value.

The oscillator frequency, f , is calculated as follows:

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

where

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

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

α_1 and α_2 are constants, e.g.:

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

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

The debounce time, t_3 , depends on the oscillator frequency, f , as follows:

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

Table 5-1 on page 8 shows the relationship between t_3 , C_2 , R_2 and frequencies from 1Hz to 20kHz.

2.3 Relay-control Output

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

2.4 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 (refer to [Figure 2-4 on page 6](#)).

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

2.5 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.

2.6 Relay-control Output Behavior, Pin 2

The time functions (relay output) can be started or interrupted by the three inputs ON, OFF or TOGGLE (pins 3, 4 and 5, input circuit of these pins see [Figure 2-4 on page 6](#)).

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

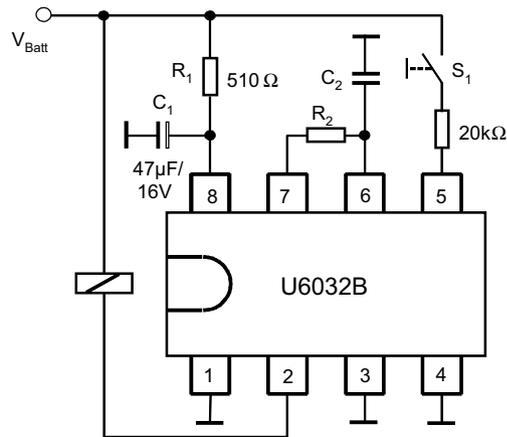
2.7 Toggle Input, Pin 5

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.

Repeated operation of S_1 causes the interruption of the relay contact, thus disabling the relay. 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 stays active.

Figure 2-3. TOGGLE Function



2.8 ON, OFF Inputs, Pins 3 and 4

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

Pressing the push-button switch (pin 3 ON) leads to an activation of the relay after the debounce time, t_3 , has elapsed whereas the switching of pin 4 switch correspondingly leads to the de-energization of the relay. If the relay is not de-energized by the push-button switch, the output remains active.

Combined operation “TOGGLE” and “ON/OFF” is not possible due to the fact that there is only one debouncing circuit. Debouncing is possible in both modes, i.e., whenever S_1 is ON or OFF.

Figure 2-4 shows the input circuit of Atmel® U6032B. It has an integrated pull-down resistor (20kΩ), RF capacitor (15pF) and Z-diode (7V). It reacts to voltages greater than 2V. The external protective resistor has a value of 20kΩ and the push-button switch, S , is connected to the battery as shown in the diagram.

The 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 5.6kΩ resistor from the push-button switch to ground as shown in Figure 2-6 on page 7.

Figure 2-4. Input Circuit

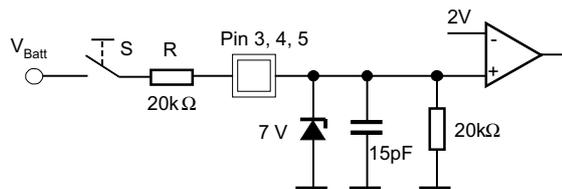


Figure 2-5. ON/OFF Function

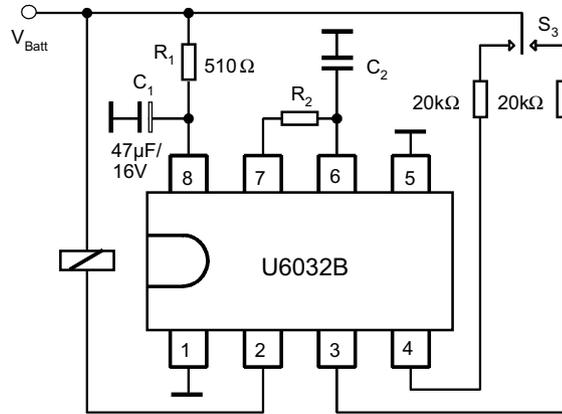
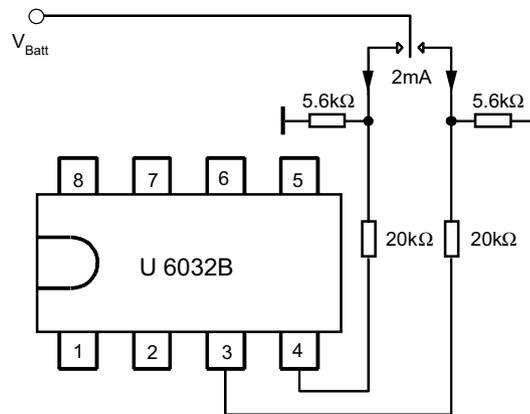


Figure 2-6. Increasing the Contact Current by Parallel Resistors



3. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

| Parameters | Symbol | Value | Unit |
|--------------------------------------|------------|-------------|------|
| Operating voltage, static, 5 minutes | 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 |

4. Thermal Resistance

| Parameters | Symbol | Value | Unit |
|--------------------------|------------|-------|------|
| Junction ambient DIP8 | T_{thJA} | 110 | K/W |

5. Electrical Characteristics

$V_{Batt} = 13.5\text{ V}$, $T_{amb} = 25^\circ\text{C}$, reference point ground, [Figure 1 on page 2](#), unless otherwise specified

| Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit |
|-------------------------------|---|----------------|----------------------|------------|------------|----------------|------------------|
| Operating voltage | $R_1 \geq 510\Omega$ $t < 5\text{min}$ $t < 60\text{min}$ | | V_{Batt} | 6 | | 16 24 18 | V |
| 5 V supply | Without R_1 , C_1 | 7, 8 | V_8 , V_7 | 4.3 | | 6.0 | V |
| Stabilized voltage | $V_{Batt} = 12\text{V}$ | 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 push buttons open | 8 | I_S | | 1.3 | 2.0 | mA |
| Internal Z-diode | $I_8 = 10\text{mA}$ | 8 | V_Z | 13.5 | 14 | 16 | V |
| Relay Control Output | | 2 | | | | | |
| Saturation voltage | $I_2 = 200\text{mA}$ $I_2 = 300\text{mA}$ | | V_2 | | 1.2 | 1.5 | V |
| Leakage current | $V_2 = 14\text{V}$ | | I_{lkg} | | 2 | 100 | μA |
| Output current | | | I_2 | | | 300 | mA |
| Output Pulse Current | | | | | | | |
| Load-dump pulse | $t \leq 300\text{ms}$ | | I_2 | | | 1.5 | A |
| Internal Z-diode | $I_2 = 10\text{mA}$ | | V_Z | 20 | 22 | 24 | V |
| Oscillator Input | $f = 0.001$ to 40kHz, see Table 5-1 | 6 | | | | | |
| Internal discharge resistance | $V_6 = 5\text{V}$ | | R_6 | 1.6 | 2.0 | 2.4 | $\text{k}\Omega$ |
| Switching thresholds | Lower Upper | | V_{6L} V_{6H} | 0.9 2.8 | 1.1 3.1 | 1.4 3.5 | V |
| Input current | $V_6 = 0\text{V}$ | | $-I_6$ | | | 1 | μA |
| Switching Times | | | | | | | |
| Debounce time | | | t_3 | 5 | | 7 | Cycles |
| Inputs ON, OFF, TOGGLE | | 3, 4, 5 | | | | | |
| Switching threshold voltage | | | $V_{3,4,5}$ | 1.6 | 2.0 | 2.4 | V |
| Internal Z-diode | $I_{3,4,5} = 10\text{mA}$ | | $V_{3,4,5}$ | 6.5 | 7.1 | 8.0 | V |
| Pull-down resistance | $V_{3,4,5} = 5\text{V}$ | | $R_{3,4,5}$ | 13 | 20 | 50 | $\text{k}\Omega$ |

Table 5-1. Values for C_2 and R_2 for a Given Oscillator Frequency and Debounce Time

| Frequency f (Hz) | Debounce Time t_3 (ms) | C_2 (nF) | R_2 ($\text{k}\Omega$) |
|--------------------|--------------------------|------------|----------------------------|
| 1 | 6000 | 4700 | 280 |
| 2 | 3000 | 1000 | 650 |
| 3 | 2000 | 1000 | 440 |
| 4 | 1500 | 1000 | 330 |
| 5 | 1200 | 1000 | 260 |
| 6 | 1000 | 1000 | 220 |
| 7 | 857 | 1000 | 190 |
| 8 | 750 | 1000 | 160 |
| 9 | 667 | 1000 | 140 |
| 10 | 600 | 1000 | 130 |

Table 5-1. Values for C₂ and R₂ for a Given Oscillator Frequency and Debounce Time (Continued)

| Frequency f (Hz) | Debounce Time t ₃ (ms) | C ₂ (nF) | R ₂ (kΩ) |
|------------------|-----------------------------------|---------------------|---------------------|
| 20 | 300 | 100 | 650 |
| 30 | 200 | 100 | 440 |
| 40 | 150 | 100 | 330 |
| 50 | 120 | 100 | 260 |
| 60 | 100 | 100 | 220 |
| 70 | 86 | 100 | 190 |
| 80 | 75 | 100 | 160 |
| 90 | 67 | 100 | 140 |
| 100 | 60 | 100 | 130 |
| 200 | 30 | 10 | 600 |
| 300 | 20 | 10 | 400 |
| 400 | 15 | 10 | 300 |
| 500 | 12 | 10 | 240 |
| 600 | 10 | 10 | 200 |
| 700 | 9.00 | 10 | 170 |
| 800 | 8.00 | 10 | 150 |
| 900 | 7.00 | 10 | 130 |
| 1000 | 6.00 | 10 | 120 |
| 2000 | 3.00 | 1 | 600 |
| 3000 | 2.00 | 1 | 400 |
| 4000 | 1.50 | 1 | 300 |
| 5000 | 1.20 | 1 | 240 |
| 6000 | 1.00 | 1 | 200 |
| 7000 | 0.86 | 1 | 170 |
| 8000 | 0.75 | 1 | 150 |
| 9000 | 0.67 | 1 | 130 |
| 10000 | 0.60 | 1 | 120 |
| 11000 | 0.55 | 1 | 110 |
| 12000 | 0.50 | 1 | 99 |
| 13000 | 0.46 | 1 | 91 |
| 14000 | 0.43 | 1 | 85 |
| 15000 | 0.40 | 1 | 79 |
| 16000 | 0.38 | 1 | 74 |
| 17000 | 0.35 | 1 | 70 |
| 18000 | 0.33 | 1 | 66 |
| 19000 | 0.32 | 1 | 62 |
| 20000 | 0.30 | 1 | 59 |

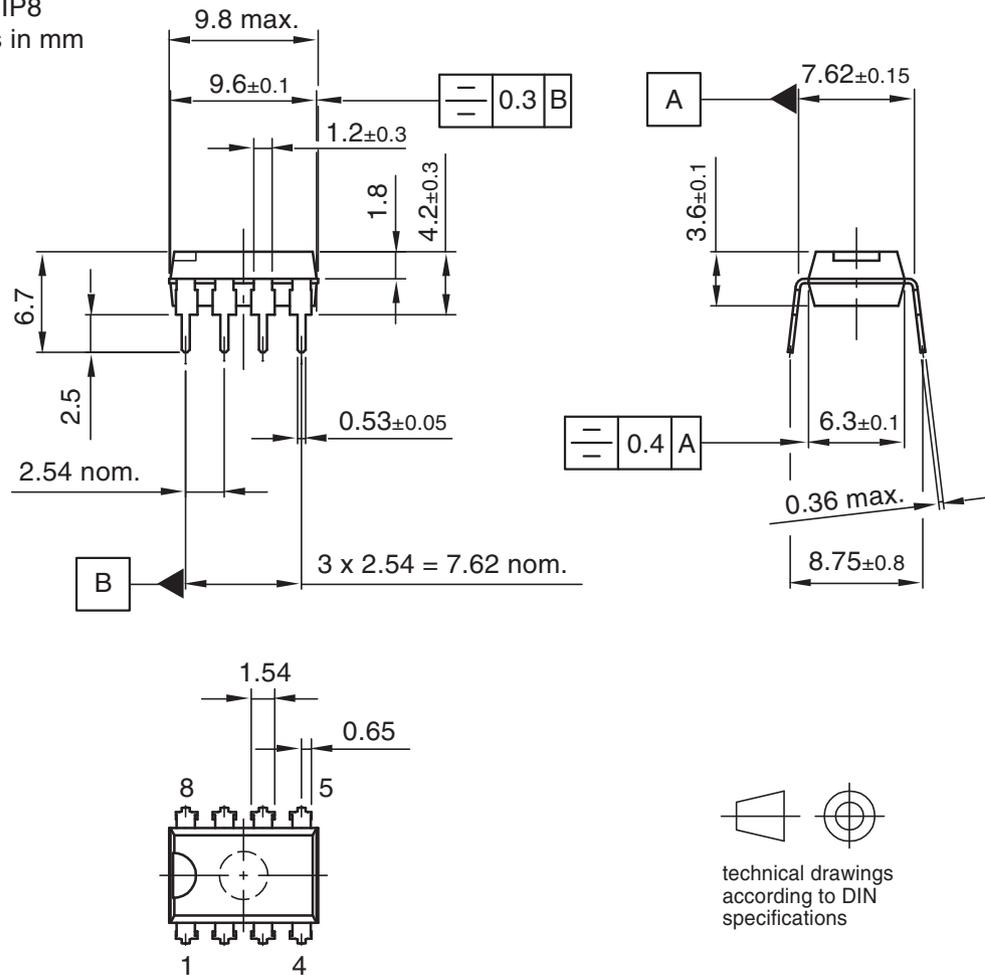
6. Ordering Information

| Extended Type Number | Package | Remarks |
|----------------------|---------|---------|
| U6032B-MY | DIP8 | Pb-free |

7. Package Information

Figure 7-1. DIP8

Package: DIP8
Dimensions in mm



Drawing-No.: 6.543-5040.01-4

Issue: 1; 16.01.02

8. Revision History

Please note that the following page numbers referred to in this section refer to the specific revision mentioned, not to this document.

| Revision No. | History |
|------------------|---|
| 4771C-AUTO-06/12 | <ul style="list-style-type: none">• Section 4 “Thermal Resistance” on page 7 changed• Section 7 “Ordering Information” on page 10 changed• Section 8 “Package Information” on page 10 changed |
| 4771B-AUTO-11/05 | <ul style="list-style-type: none">• First page: Pb-free logo added• Page 10: Ordering Information changed |



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