EDUCATIONAL ELECTRONIC KITS

Soft start for automotive light bulbs

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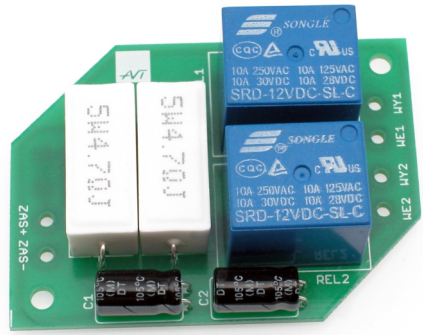

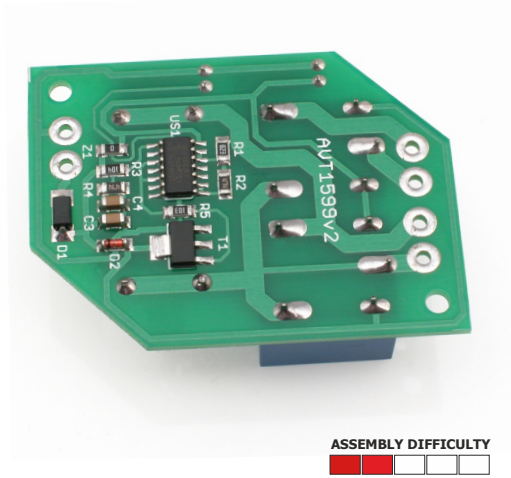

ASSEMBLY DIFFICULTY

We have been driving on Polish roads with our headlights on for several years now. As is well known, bulbs burn out primarily when they are switched on. In the car, the problem is mainly related to the dipped headlights. A few tens of dollars per year for a set of bulbs may not be much, but by using the device described below we can easily get rid of this "subscription".

Characteristics

- delayed, full power supply of automotive bulbs
- designed for passenger cars
- filament preheating current limited to 5 A
- warm-up time (full power delay) approx... 5 sec
- option to use one or two soft starters in the car
- 12 V DC power supply (car installation)
- PCB dimensions – 58 × 43 mm

Circuit description

The cold filament of an incandescent bulb has a resistance many times lower than that of a hot one, which results in the flow of considerable current when switched on. The proposed device introduces an intermediate step in the process of turning on the power to the bulb. First, the bulb is powered by an additional series resistance, which causes the current of the fiber to be limited to a safe value. This continues for a period of time, during which the filament is preheated. Only after this time the limiting resistor is disconnected and the bulb is connected directly to the power supply. Turning the lights back on or, very importantly, switching between high beam and low beam will not trigger the warm-up stage.
A diagram of the device is shown in Figure 1. It can switch on two bulbs. They were made using the 4093 integrated circuit. Gates A and B form an RS flip-flop. The R3 and C4 elements provide a pulse of about 0.1 s that sets the flip-flop when power is applied in the active state. Relays are then switched on, the bulbs are connected in parallel, and the R6 and R7 resistors are included in their power supply circuit. Their resistance was chosen to limit the current to about 5 A when two 55 W incandescent bulbs are connected in parallel, so 2.5 A per branch. When there is voltage at WE1, a current will flow through the bulbs to preheat the filaments and cause the C1 capacitor to be charged by the R1 resistor. These elements determine the warm-up time, which should be about 5 s. Charging the C1 capacitance will reset the flip-flop and disconnect the relays. The power supply circuits of the bulbs will return to their normal state,

and the circuit will go into a blocked state and draw only a small resting current. Re-starting the warm-up will be possible only after disconnecting the power supply to the system, waiting several seconds and turning it back on.

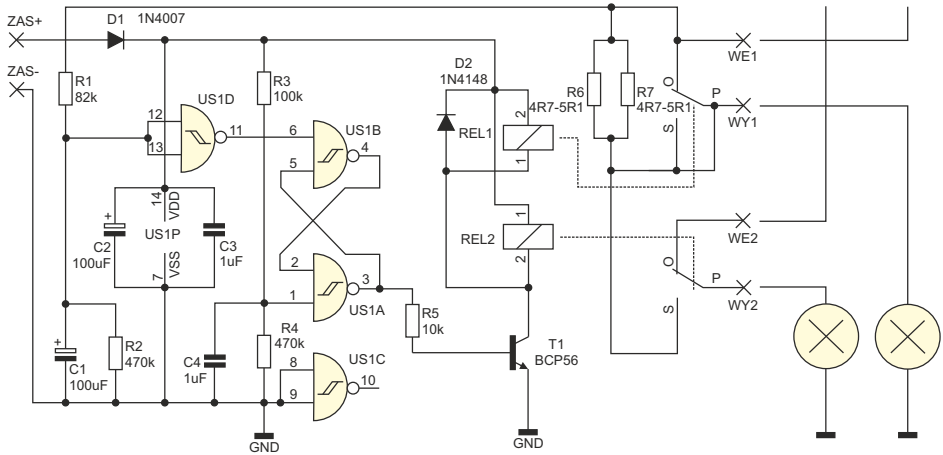

Fig. 1 Schematic diagram of the soft starter

Assembly and start-up

The installation diagram of the device is shown in **Figure 2**. It requires no startup and, assembled properly from working parts, works as soon as the power is turned on. They can be attached to the car's installation in one of two ways.

The **first** way is shown in **Figure 3**. A single device was used that turns on the dipped beam bulbs of both headlights. ATTENTION! You can't put the device on the high beam circuit in this way, because it can cause dangerous situations (high beam is usually first turned on at a certain speed, and then you will be surprised by 5 s of darkness).

The **second** way is shown in **Figure 4**. It uses two devices, each of which turns on the low-beam and high-beam bulbs of one headlight. It is important that the dipped beam circuit is connected to WE1 and WY1, and the high beam to WE2 and WY2. If we do not have an automatic light switching system, the power supply of the device can be connected to the circuit of the position lights, which will simplify the installation. Otherwise, we connect the power supply of the circuit to any circuit switched by the ignition switch.

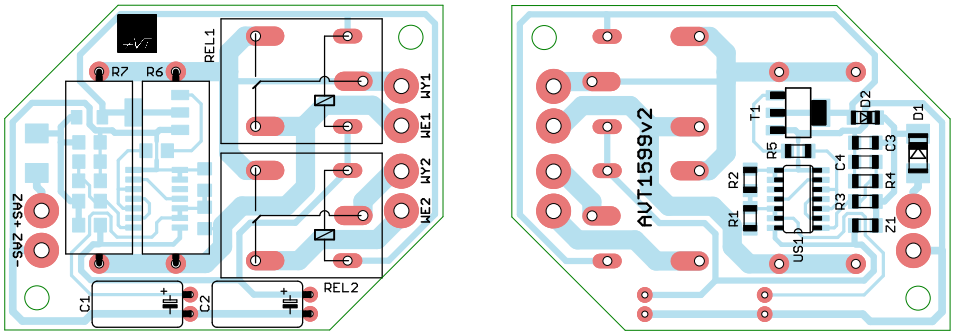

Fig. 2. Assembly diagram of the soft starter

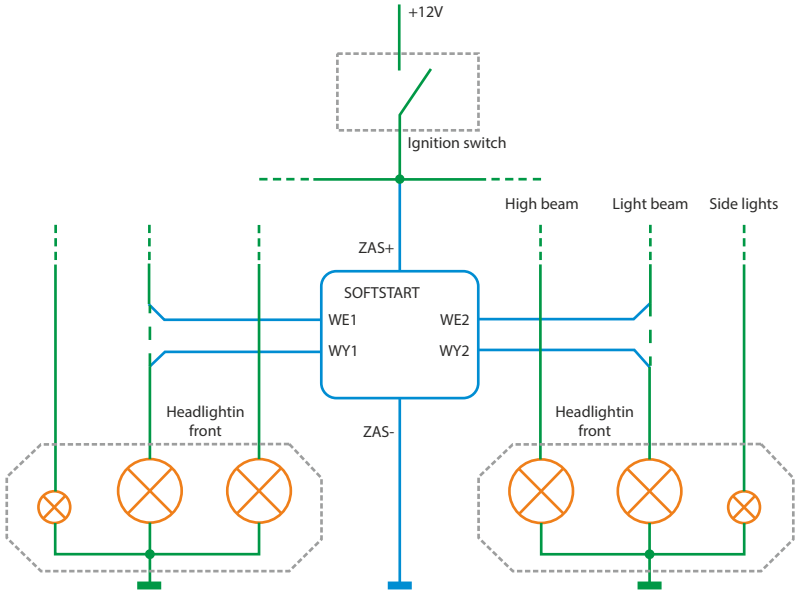

Figure 3. Connection diagram for in-car installation – single soft starter device variant

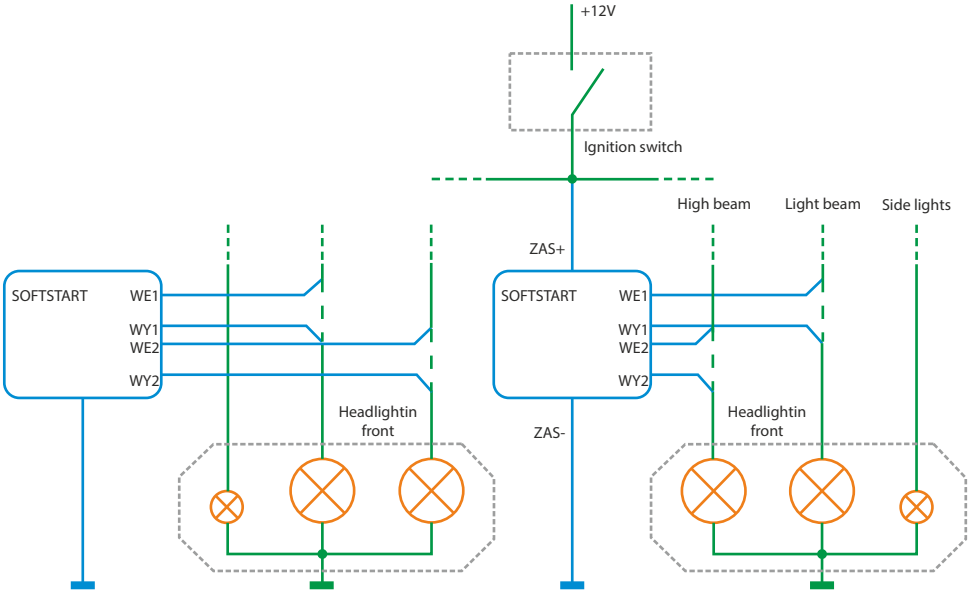

Figure 4. Connection diagram for in-car installation – two soft starter device variant

List of elements

Resistors:
R1: .....82 kΩ (1206)
R2, R4: .....470 kΩ (1206)
R3: .....100 kΩ (1206)
R5: .....10 kΩ (1206)
R6, R7: .....4,7 Ω - 5,1Ω / 5 W
Z1: .....0 Ω (1206)

Capacitors:
C1, C2: .....100 uF
C3, C4: .....1 uF (1206)

Semiconductors:
D1: 1N4007 (M7)
D2: .....1N4148 (MINI MELF)
T1: BCP56 (SOT223)
US1: 4093 (SO14)

Other:
REL1, REL2: .....JQC3FF 1HS/12 V
Case: Z-68U
IDC quick connector – 6pcs
Insulated wire of section 1-2 mm^2

A quick-release coupling, crimped with ordinary pliers, can be used for installation in an automobile system (**Figure 5**). It allows us to connect a second wire without having to isolate it.

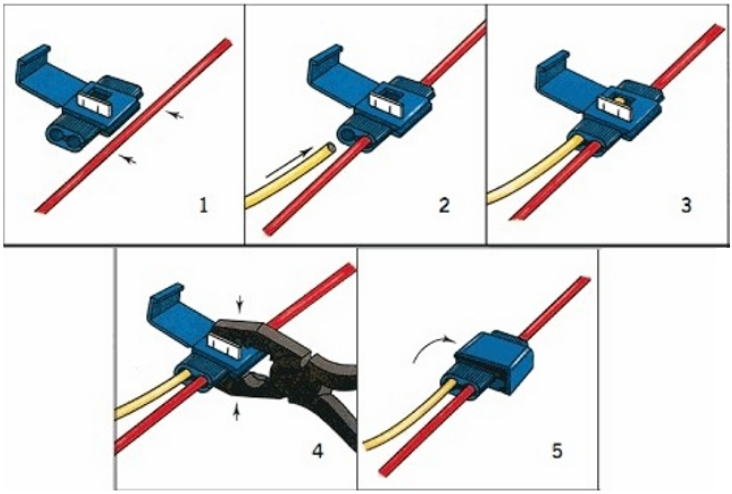

Fig. 5 Quick-connector wire connecting method

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