# Darkroom Timer

## simple… with a PIC!

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A darkroom timer is not such a complicated device: you can easily build one yourself using a microcontroller.

Although previous darkroom timer designs have contained vast expanses of TTL or CMOS devices, that has all radically changed now, as can be seen in **Figure 1**. The circuit is controlled by a microcontroller from the PIC range. This drives an opto-triac (IC3) which switches the mains voltage from the input connector K1 to the output connector K2, and thereby turns on the enlarger lamp. The desired exposure time can be set to a resolution of 0.1 s using three thumbwheel switches. The setting is read directly from the switches in BCD format: their four outputs A-D represent the four bits of the BCD digit.

Since the PIC16F84 device chosen is only equipped with 13 I/O pins, the corresponding bits of the three switches are connected together in the so-called wired-OR configuration (D5/D9/D13, D6/D10/D14 and so on) and then connected to the controller. The four resistors pull the port inputs low when not pulled high through a switch. This ensures that clean logic levels are present at the inputs to the PIC.

The three thumbwheel switches are driven in sequence via ports RB0, RB1 and RB2, and the switch positions are read consecutively by the control software. A further port pin (RB4) is used for the ‘Start’ switch. On pressing switch S4 the darkroom timer starts, and after the preset time the software switches the output RB3 low again. During this period, LED D17 lights. The enlarger lamp can also be turned on using switch S5, overriding the timer.

A standard power supply, consisting of a small 1.5 VA mains transformer, a full-wave bridge rectifier and a 7805 fixed voltage regulator, provides the supply for the PIC. The microcontroller is clocked at 4 MHz.

## Software in JAL

The software was developed using *Just Another Language (JAL)*, which is freeware. DOS/Windows and Linux versions can be downloaded from the site http://come.to/jal. JAL is very easy to use and especially suited for those new to programming PIC16C/F84 and certain SX microcontrollers. It is handy for small projects where optimal use of program memory is less of a concern.

The structure of the software is very simple. As soon as power is applied to the darkroom timer, the

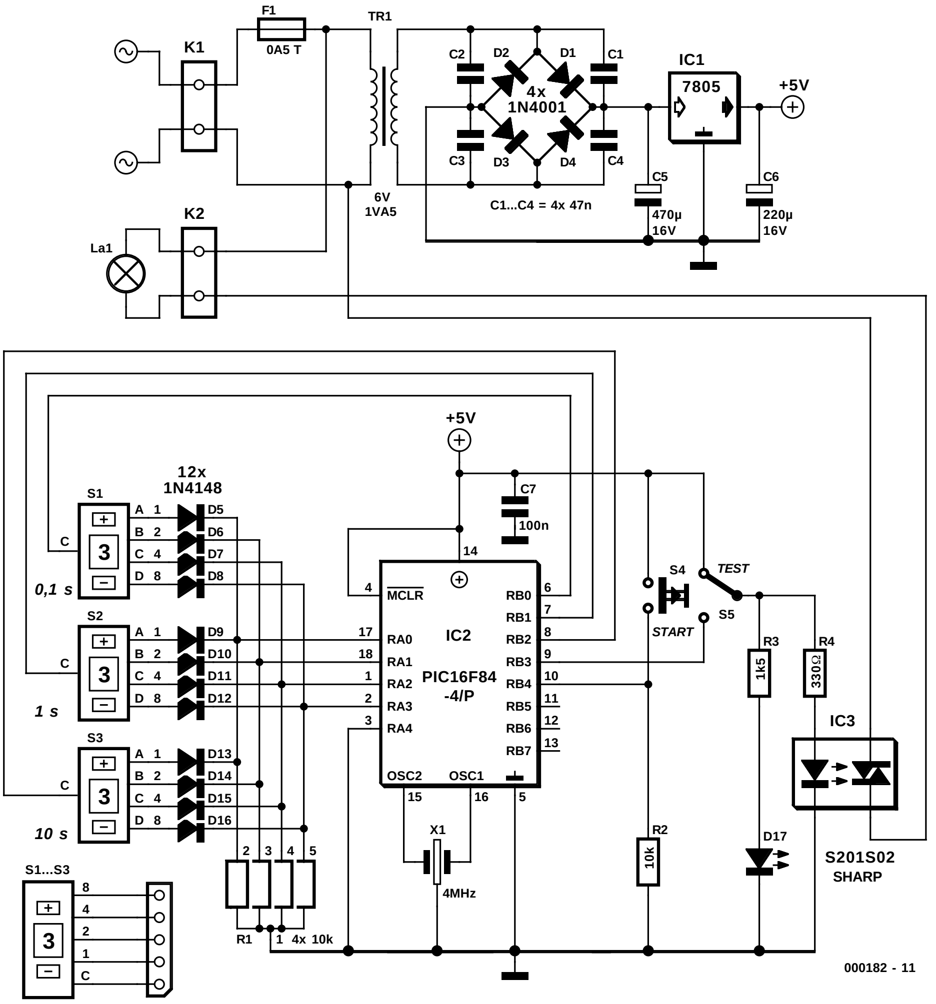



Figure 1. The darkroom timer is controlled by a PIC microcontroller.

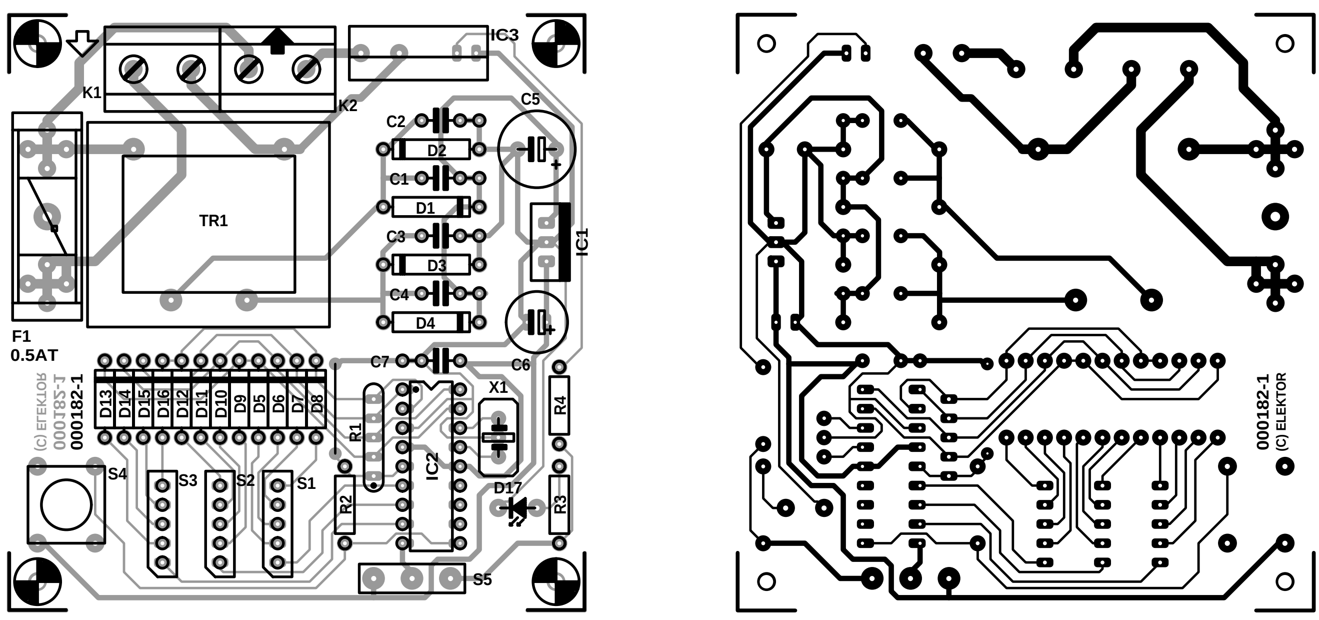



Figure 2. The circuit board carries all the components.

software starts running in a loop, continuously reading the switch settings. As soon as a falling edge is detected on RB4 (i.e., when the switch is released), the loop is exited, and the lamp is turned on. A delay is executed, and then the lamp is turned off again. Then the software returns to the beginning. You may encounter one peculiarity if you study the source code: the value read from the switch in the 10 s decade (S3) is doubled, and then the delay executed in the 5 s loop. This is because the JAL *delay* command only allows a maximum time period of 5 s.

You can obtain the JAL source code, as well as the object code, from the *Elektor Electronics* download site via
http://www.elektor-electronics.co.uk.

For non-Internet users, it is also available on diskette, order number **000182-11**. It is easy to modify the code or to add extra functions.

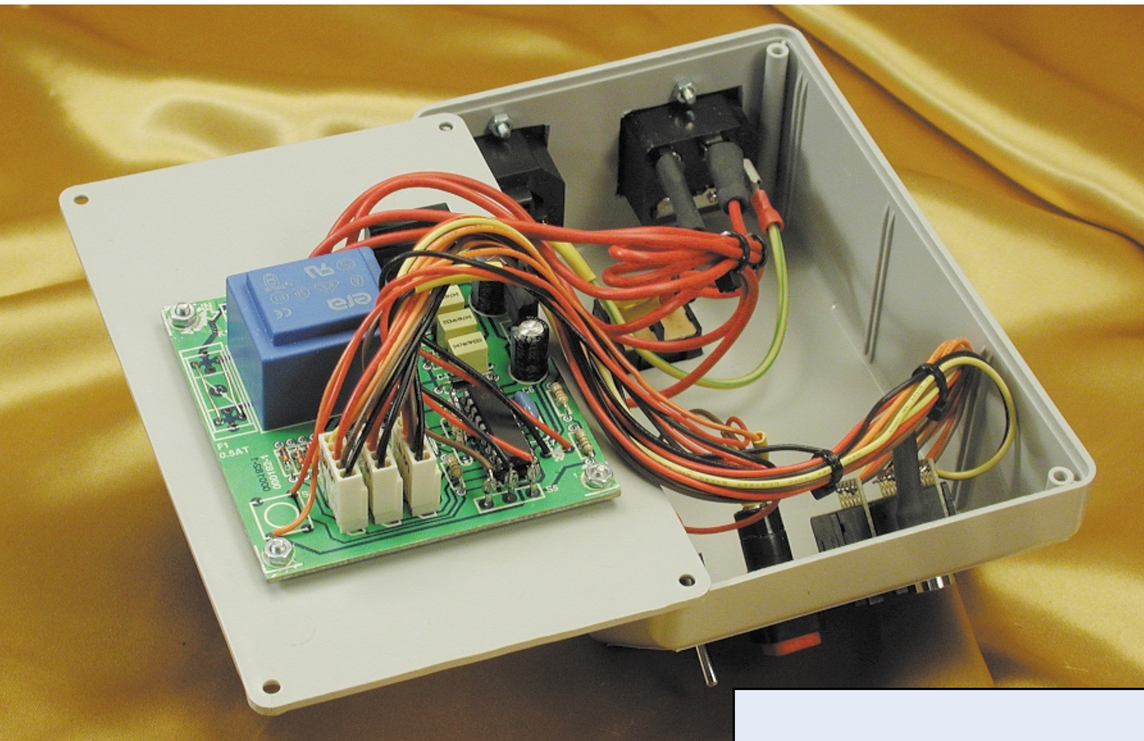
## COMPONENTS LIST

**Resistors:**
R1 = 4 x◊10kW SIL array
R2 = 10kW
R3 = 1kW5
R4 = 330W

**Capacitors:**
C1-C4 = 47nF
C5 = 470mF 16V radial
C6 = 220mF 16V radial
C7 = 100nF

**Semiconductors:**
D1-D4 = 1N4001
D5-D16 = 1N4148
D17 = LED, red, high efficiency
IC1 = 7805
IC2 = PIC16F84-04/P (order code 000182-41)
IC3 = S201S01 (Sharp) (Conrad # 16 81 65)

**Miscellaneous:**
K1,K2 = 2-way PCB terminal block, 7.5 mm lead pitch
F1 = fuse, 0.5 AT (time lag), with PCB-mount holder
TR1 = Mains transformer 6 V, 1.5 VA (Conrad Electronics # 50 60 44)
S1,S2,S3 = BCD-encoded thumbwheel switch type PICO (Conrad 70 10 84)
2 spacers (Conrad Electronics # 70 11 06)
1 pair end cheeks (Conrad Electronics #70 11 33)
X1 = 4 MHz resonator (Conrad Electronics # 50 31 69-55)
S4 = pushbutton, 1 make contact
S5 = SPDT changeover switch
Case: Teko 362 (Conrad Electronics # 52 39 68)
Disk, source and object code, order code **000182-11**



are used and correct polarities are observed. This goes not just for semiconductors and electrolytics: the resistor array and the thumbwheel switches must also be fitted with the correct orientation. Don't forget the single wire link, next to resistor array R1. The PIC microcontroller is worth a socket, as well as visual and supply voltage checks before fitting it and applying power.

(000182-1)

If you do not wish to be bothered with programming a PIC yourself, ready-programmed devices are also available under order code **000182-41**.

## The circuit board

Unfortunately, the printed circuit board for the darkroom timer, is not available ready-made. Populating the board should present no surprises as long as the specified components

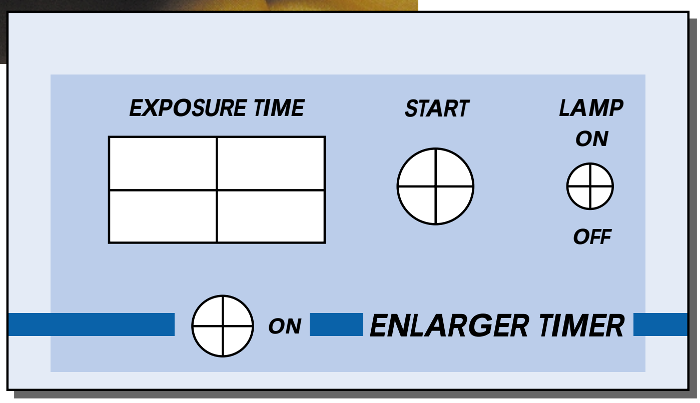



Figure 3. Suggested front panel layout for the darkroom timer.