Burglar Alarm

With individual sensor signalling

Design by E. Martens

This is a circuit of a simple but effective burglar alarm, which shows the status of each sensor with a separate LED. This allows you to see at a glance whether any doors or windows aren't closed properly before switching the alarm on.

Main Specifications

- Maximum number of sensors that can be connected: 8
- Monitoring and signalling of each sensor for activation and cable continuity
- Tamper input
- Panic pushbutton
- Exit delay: 60 seconds
- Entry delay: 60 seconds
- Power supply: 230 V_{AC} or backup battery
- LEDs indicate:
  - alarm armed
  - alarm activated
  - tampering
  - backup battery active
- Outputs: 2 (12 V_{DC}, 500 mA)
- Alarm duration: 60 seconds

Please note: *Readers Circuits have not been tested or post-engineered by the Elektor Electronics design laboratory.*

This article describes a design of a burglar alarm that can monitor up to eight sensors. The status of each individual sensor is indicated with an LED. This LED shows whether the sensor has been activated and whether the wiring to the sensor is in order.

Obviously, this burglar alarm also has an input to 'arm' the alarm, a tamper input and a couple of outputs to control a siren and/or a strobe light. The alarm is also fitted with a so-called 'panic button'.

Circuit description

The burglar alarm is built around the AT89C51 microcontroller from Atmel. This microcontroller provides all the functionality of the burglar alarm. It also takes care of (software) filtering of the signals at the inputs. Only after an input has remained unchanged for 30 milliseconds, is this new signal level passed on for processing by the microcontroller program.

The schematic for the burglar alarm (**Figure 1**) is simplicity itself and only a small number of components are required.

Sensors

A maximum of 8 sensors can be connected to the burglar alarm. These can be found along the left side of **Figure 1**. These sensors need to have their contacts closed when in the inactive state (i.e. Normally Closed). In addition, each sensor needs to have its tamper connection wired as well. A power supply voltage of +12 V_{DC} is available for each sensor at the corresponding wiring terminals (K3 through K10).

Operation

The alarm is switched on by opening key switch S1, at which point the so-called 'exit-delay' begins. This time delay (60 seconds) allows you to leave the protected area without triggering the alarm. The alarm is deactivated when key switch S1 is closed.

If a sensor contact is opened when the alarm is armed and after the exit-delay has expired, the entry-delay (60 seconds) will begin. Under normal circumstances, the alarm will be deactivated with key switch S1 during the entry-delay. In the event of a burglary, the alarm will trigger after the entry-delay has expired. The entry-delay can only be interrupted by switching the alarm off with key switch S1.

The special 'panic button' S2, can be used for those situations — whatever the reason may be — that require the alarm signal to be activated. The alarm signal will be activated immediately, independent of the armed or disarmed status of the burglar alarm. The alarm will be silenced after 60 seconds or after pressing the panic button again.

Sabotage

The purpose of tamper input K11 is to detect tampering attempts when the alarm is armed. Possible scenarios are opening of the burglar alarm enclosure, the cutting of cables, etc. The tamper input needs to be normally closed (NC). A number of NC-contacts and wires can be connected in series (the cables to the alarm sensors, for example).

Signalling

Eight LEDs (D10 through D17) indicate the status of the corresponding

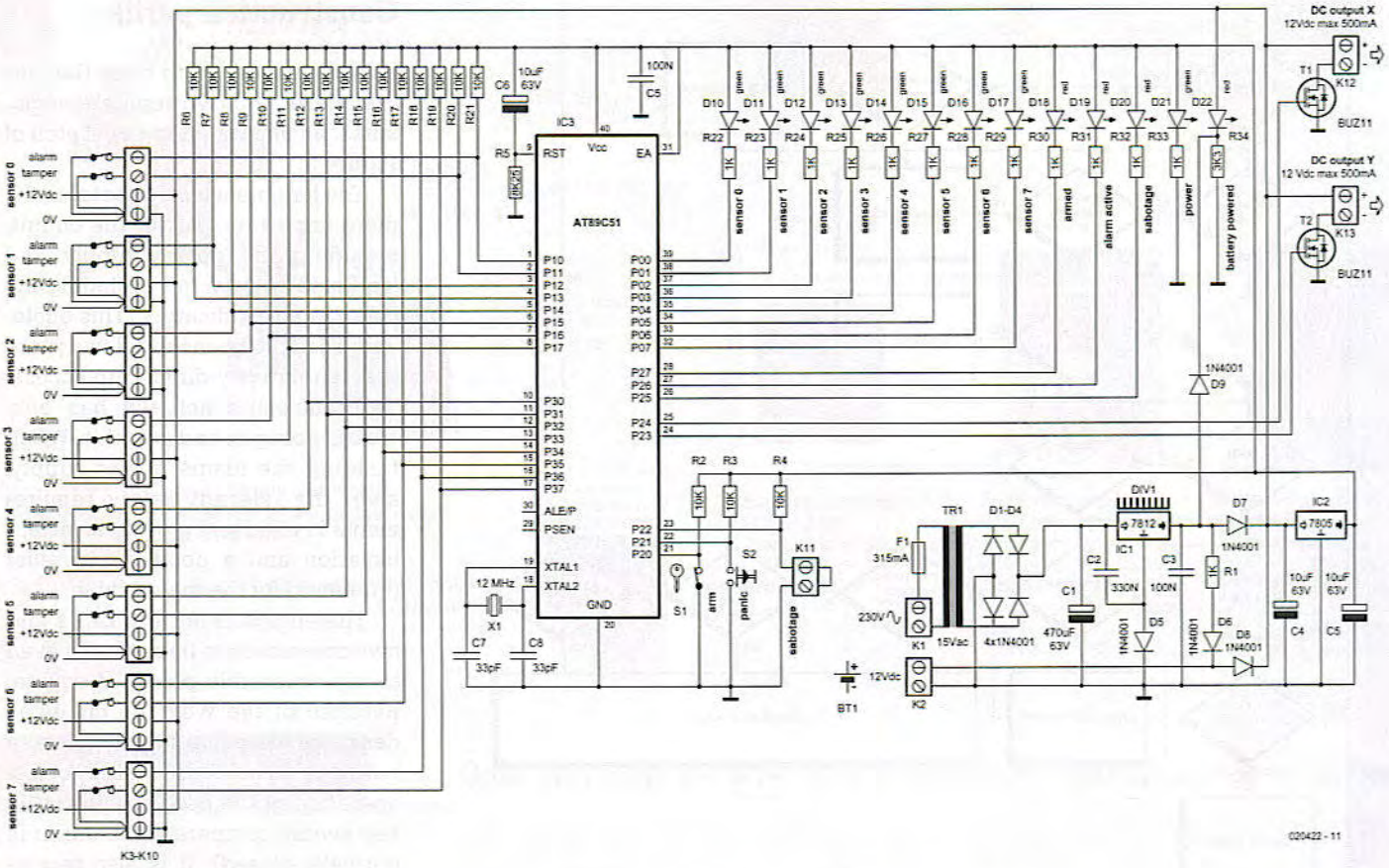

Figure 1. The alarm consists mainly of a microcontroller, a number of sensor inputs and a set of indicator LEDs.

sensors. When the alarm has been activated, the LED of the sensor that caused the alarm will light up, or flash in the event of a cable failure.

When the alarm is armed, the LED *'alarm armed'* (D18) will flash during the exit-delay. After the exit-delay, the LED will light continuously. D18 turns off, of course, when the alarm is disarmed.

The LED *'alarm triggered'* (D19) flashes during the entry-delay and will turn on continuously once an actual alarm has been generated. D19 turns off only when the alarm is switched off with key switch S1. When an alarm has taken place, it can be determined afterwards which sensor (or tamper input) caused the alarm to trigger.

The LED *'tamper'* (D20) lights up when the tamper input (K11) is opened. This LED will also continue to be on until the alarm is switched off.

Finally, the LED *'battery operation'* (D22) indicates that lead-acid battery BT1 has taken over the power supply for the burglar alarm.

Outputs

The burglar alarm is provided, from the viewpoint of reliability, with two separate outputs (K12 and K13). Both outputs are controlled by a BUZ11 (T1 and T2) and can switch up to 500 mA at 12 V. This is more than enough for all common signal sources such as strobe lights and sirens. If more power is required or a signal source with a different voltage needs to be controlled, then a 12-V relay can be connected directly to the alarm output and it in turn can then switch the signal source on and off.

Power supply

The circuit is provided with its own mains power supply. It follows the usual design of transformer, bridge rectifier (D1 through D4) and filter capacitor (C1) and generates an input voltage of about 18 V for voltage regulator IC1. With the addition of diode D5 in the ground connection, the output voltage if IC1 amounts to about 12.65 V. This voltage is subsequently reduced to about 12 V by diode D7. Voltage regulator IC2 in turn changes this 12 V into a stabilised 5 V power supply voltage.

In the event that the mains voltage at K1 disappears, the 12-V lead-acid battery connected to K2 will immediately take over the power supply for the circuit. The battery is continually being charged via resistor R1 and diode D6, when the mains voltage is present. D7 and D8 prevent the charging current from flowing in the wrong direction.

Software

The software that is required for the alarm is of a relatively simple design. The flow chart shown in **Figure 2** illustrates this. This really shows a kind of logical summary of all the things that have been described above.

After the reset-phase of the microcontroller, all the LEDs are switched on for a period of two seconds. This allows for a quick lamp test to check if all the LEDs are functional and are connected correctly.

In the source code for the software, the values for the various timers can easily be adjusted to suit your own requirements. It concerns the following timers:

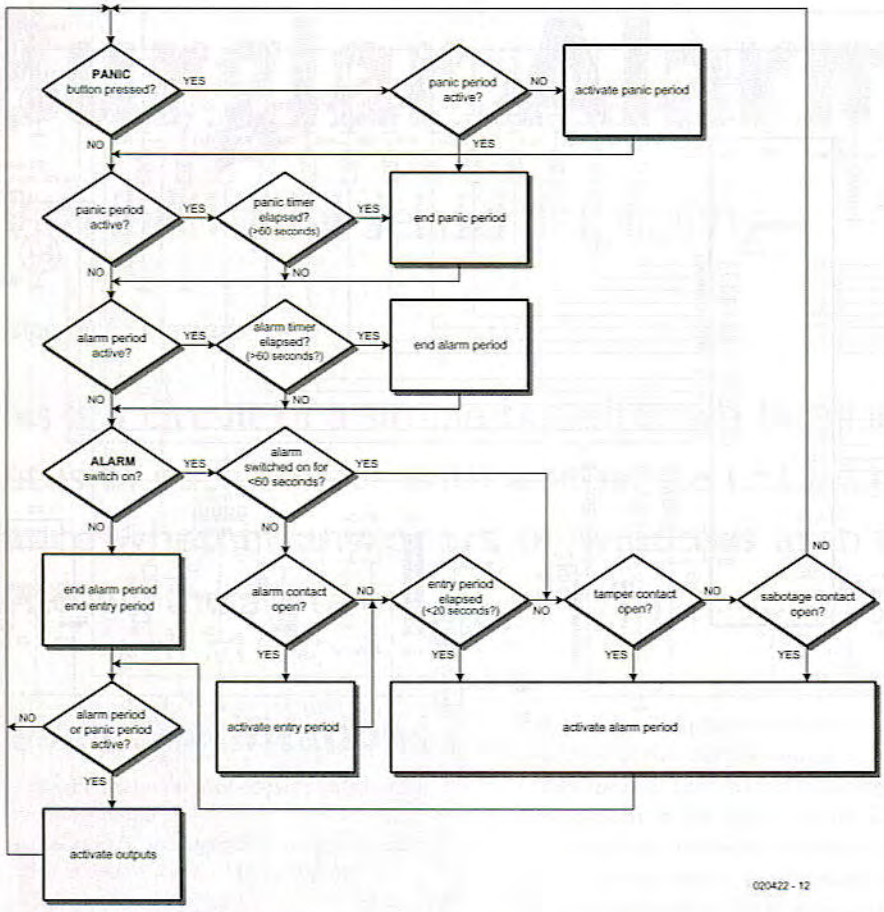

Figure 2. This flowchart makes it obvious how the software has been designed.

timer	variable	default (s)
panic timer	PANVAL	60
exit-delay timer	UITVAL	60
entry-delay timer	INLVAL	60
output X active	ALXVAL	60
output Y active	ALYVAL	60

Incidentally, the software for the burglar alarm (ref. no. **020422-11**) can be downloaded free of charge from the www.elektor-electronics.co.uk website.

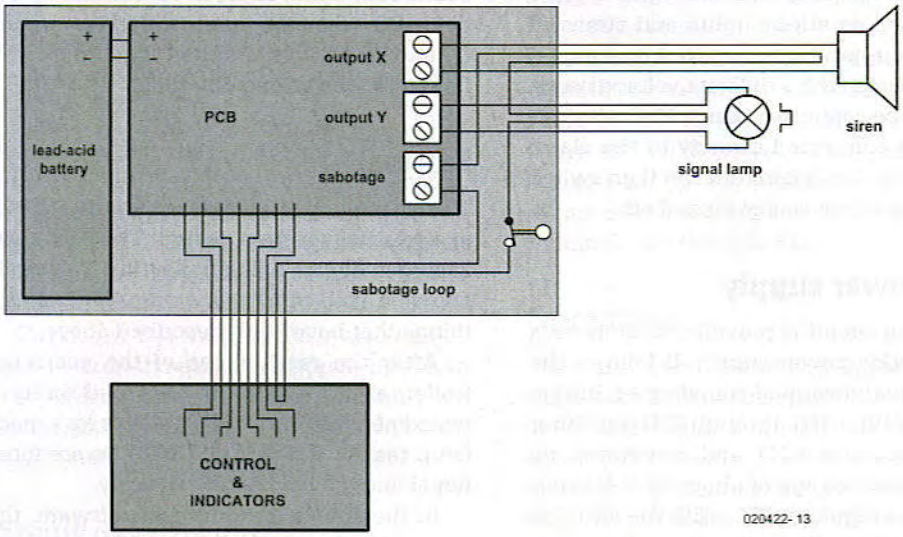

Figure 3. A practical implementation of the burglar alarm separates the control and indication from the other parts.

Construction perils

It is recommended to build the burglar alarm into two separate enclosures, as illustrated in the sketch of **Figure 3**.

The larger enclosure contains the more important part of the circuit, including the power supply and lead-acid battery, but excluding the controls and indicators. This enclosure needs to be mounted in a place that is relatively difficult to access. This enclosure actually has only cables going in and out of it. When building the mains power supply, keep the relevant safety requirements in mind and provide sufficient isolation and a good strain relief (grommet) for the mains cable.

The enclosure for the LEDs and switches needs to be mounted in an easily accessible place, of course. Because of the way the circuit is designed, damaging this enclosure will have no influence on the correct operation of the burglar alarm (the key switch to operate the alarm is normally closed). It is also recommended to include this enclosure in the tamper circuit.

To prevent the burglar alarm from being easily circumvented without this being detected, it is necessary that the cables to the sensors are located in such a way that they are difficult to access. These cables can also be included in the tamper circuit.

A practical application of the tamper circuit is shown in **Figure 3**. A switch (normally closed) is also included in the tamper loop. This switch needs to open in the event that the enclosure is opened or vandalised.

If not all sensor inputs are being used, the alarm contact and tamper contact of each unused sensor needs to be shorted out.

(020422-1)