

# Motorised Volume Pot



## High-end with remote control

design: Frank Link (Germany)

**Many audio enthusiasts still prefer a good potentiometer for adjusting the audio volume. It would be even nicer if this potentiometer could also be controlled remotely. This is possible with a high-quality motorised potentiometer from Alps and a handful of electronics, as is described here.**

Controlling the volume in high-quality audio equipment is always a critical part of the audio path. The potentiometer that is to be used for this has to be first-rate to give excellent matching between the two channels and at the same time it needs to function for a long time without generating any crackling or other noise. These days it is more common that electronic potentiometer-ICs and resistor networks with relays are used, but these solutions are rather involved. Many audio enthusiasts still swear by a good 'old-fashioned' potentiometer. Whenever you start looking for a good specimen you will quickly arrive at the

Alps brand. Alps truly make excellent potentiometers, both without and with motor control. The latter is very nice to enable you to conveniently control the volume remotely from your listening position. In this article we present a small circuit that can control such an Alps motorised potentiometer using a standard RC-5 remote control. In addition to turn the volume up or down the circuit also has 5 outputs for switching between different input channels.

### One IC

Not counting the voltage regulator IC, the entire circuit contains only one IC

that takes care of all the operations: an ATmega from Atmel, which is responsible for decoding the RC-5 signals and driving the potentiometer (and the optional input relays). Apart from that, there isn't much to the schematic, shown in **Figure 1**, but we will nevertheless walk through it.

IC1 is the brains in this circuit, an ATmega8L, which is running here at a clock frequency of 4 MHz, thanks to crystal X1. An IR receiver module, type SFH5110-36, is connected to port PD7. This receives the signals from the RC-5 remote control, polishes them into 'clean' digital pulses and then passes

To indicate that the motor is turning, a dual-colour LED (D1) is connected in parallel with the motor. Depending on the direction of rotation the LED will illuminate red or green. The current through the LED is about 10 mA, this is therefore not a problem for the driver stage in the microcontroller.

You can make an RS232 connection via K2 (which is connected to PD0 and PD1) for debugging or other purposes (however, you will have to write the software routine to do this yourself!).

The power supply consists of a bridge rectifier, a 5-V regulator (IC3) and a few capacitors. For the power supply you can use a transformer, a suitable DC voltage already present in the amplifier or a mains adapter.

For the motorised potentiometer we assumed the version with the connec-

**Figure 1. The schematic for the remote volume control. An ATmega8 does all the work here.**

On the controller PCB, K5 is the connection for the power supply voltage. The regulated 5 V is also made avail-

The connections for the IR receiver (IC2) that is used here, is via a 3-way row of connections. So you can either

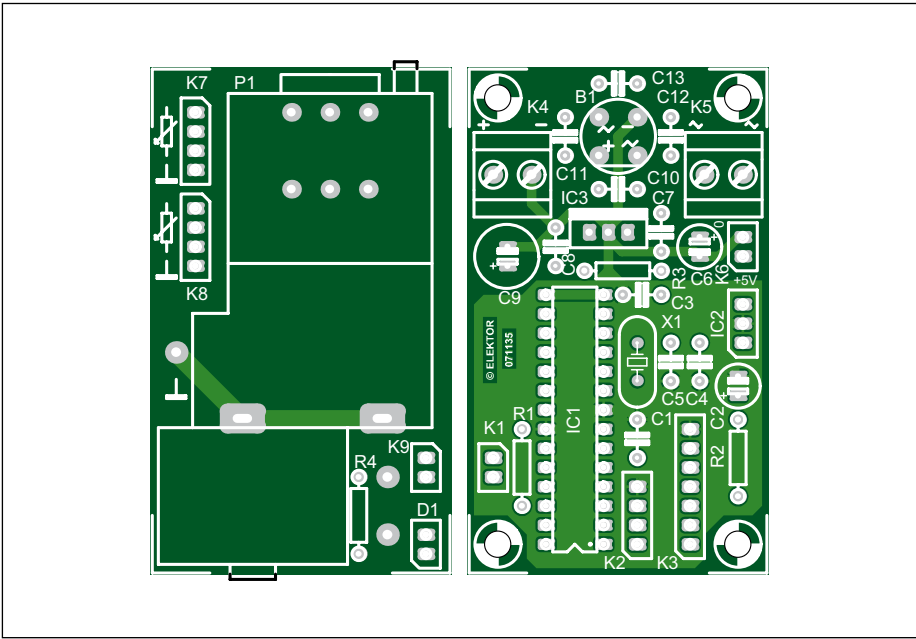


Figure 2. The circuit is built on two printed circuit boards, one for the electronics and one for the potentiometer.

elect to fit IC2 directly on the PCB or connect it with a short length of cable to a connector (but make sure you get the polarity correct!).

Software

The firmware for this circuit is built up in modules. The source code for the various hardware parts can be found in separate files. So, for example, motor.c contains the various functions for switching the motor on and off. In buttons.c are all the definitions and functions for the RC-5 codes from the remote control.

The design of the program is quite simple. An interrupt routine takes care of receiving the RC-5 bits. This routine also checks whether the received code conforms to the RC-5 standard. If this is the case, then the received code is stored so that it can be used for fur-

Code-tangle

Not everyone will have a remote control from a Philips receiver or tuner (or another brand that uses RC-5) handy available to use for this application. Fortunately there are cheap alternatives in the form of a pre-programmed universal remote control. The author had a closer look at a type ‘EuroSky 8’ which is sold by Conrad, among others, for

about 14 Euro (they call it a ‘Universal Remote Control MF-8 Black’). This seems to work well with most devices, although the range could have been a little greater. However, it turned out that the RC-5 system address 17 (dec.), which can be programmed for device AMP (enter code 1112 on the remote control) did not work entirely according to the standard. The volume buttons, channel buttons and stand-by button proved to work correctly. These are very important for us, but the operation of the other functions of an audio device requires the number buttons. Unfortunately the code that is transmitted for these buttons is a complete surprise. While we expected code 1 for button 1, code 2 for button 2, etc. something completely different was transmitted instead (see the following table).

Button	EuroSky 8 (AMP code 1112)		RC5 (Tuner)	
	Address (hex.)	Command	Address (hex.)	Command
1	11	3F	11	01
2	0C	3F	11	02
3	17	3F	11	03
4	12	3F	11	04
5	05	3F	11	05

The author noticed this too and he adapted the software in the controller accordingly. However, this results in problems when we use a remote control which does transmit the correct codes. This is why the Elektor lab has modified the controller software in such a way that it only reacts to the correct commands of system address 17. For the tests we used a universal remote control from Philips (type SBC RU 865, code 0001 for TUNER). Using this, the circuit works as expected; other universal remote controls should also work well with this circuit. To check whether a remote control transmits the correct codes, you can use the circuit from the Elektor October 2001 issue (IR Code Analyser, article number 010029). If you would like to make your own simple remote control (without microcontroller) you can have a look whether an SAA3010, PT2211 or HT6230 can be obtained from somewhere. One example for such a circuit is in the December 2003 issue (Small RC5 Transmitter, article number 024034).



ther processing by the main program. If the code is incorrect the value '0' is stored. This causes the main program to ignore this code.

After the initialisation of the various peripherals comes the main program loop of the firmware. This loop is repeated indefinitely. Once a valid RC-5 code has been received it is split into device code, key code and the toggle bit. The software subsequently checks, based on a table stored in EEPROM, whether an RC-5 code has been received that is relevant to this circuit.

By the way, these codes can be freely selected. For this you need to change the table in buttons.c and recompile the firmware and program the controller again. For the latter you will need AVR-Studio or WinAVR.

When the received code matches one of the codes in the EEPROM, the microcontroller will execute the corresponding command.

The software contains also a second

## COMPONENTS LIST

### Resistors

R1,R3 = 10k $\Omega$

R2 = 82 $\Omega$

R4 = 390 $\Omega$

P1 = Alps 10k $\Omega$  logarithmic stereo motor potentiometer (e.g. RK27112MC)

### Capacitors

C1,C7,C8 = 100nF ceramic, lead pitch 5mm

C2,C6 = 10 $\mu$ F 63V, radial, lead pitch 2.5mm

C3 = 100pF, lead pitch 5mm

C4,C5 = 22pF, lead pitch 5mm

C9 = 220 $\mu$ F 25 V radial, lead pitch 2.5mm

C10-C13 = 22nF ceramic, lead pitch 5mm

### Semiconductors

D1 = 2-pin dual-LED

IC1 = ATMEGA8-16PU, programmed, Elektor SHOP # 071135-41

IC2 = SFH5110-36 (possibly via 3-way SIL pinheader)

IC3 = 7805

### Miscellaneous

B1 = B80C1500 (80Vpiv, 1.5A) (round case)

K1,K6,K9 = 2-way SIL pinheader

K2,K7,K8 = 4-way SIL pinheader

K3 = 7-way SIL pinheader

K4,K5 = 2-way PCB screw terminal block, lead pitch 5mm

X1 = 4MHz quartz crystal

PCB, ref. 071135-1 from [www.thepcbshop.com](http://www.thepcbshop.com)

Controller software: free download 071135-11.zip from [www.elektor.com](http://www.elektor.com)

operating mode, where the fifth output is replaced with an on/off function (standby, command 12 decimal).

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