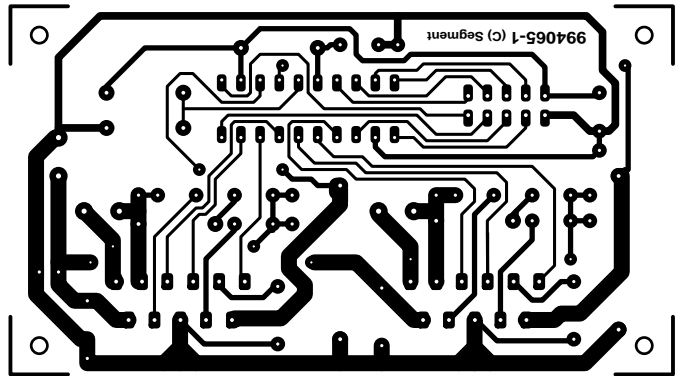
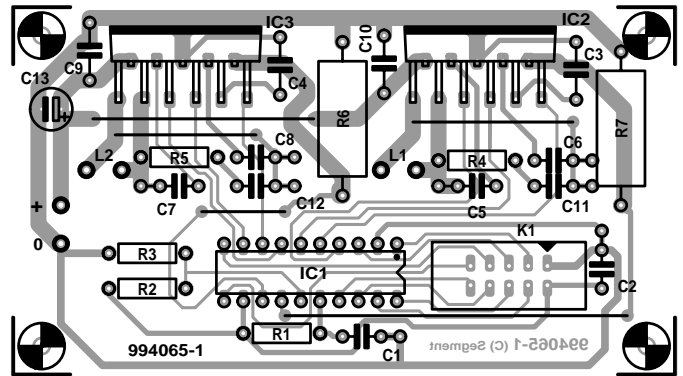
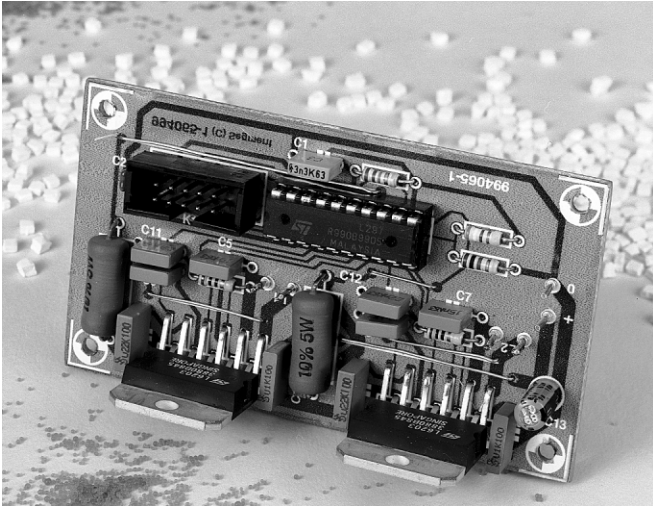


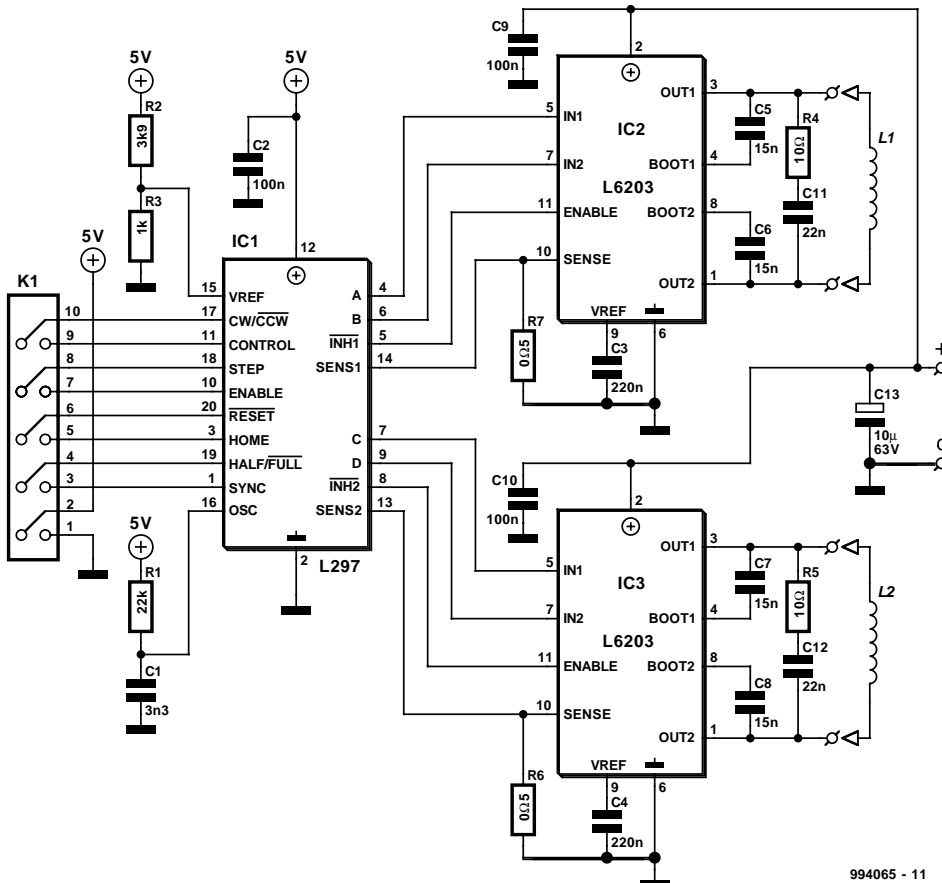
# stepper motor control 009



**K.S.M. Walraven**

The control is a compact design for driving bipolar stepper motors. Driver stages IC<sub>2</sub> and IC<sub>3</sub> are modern types from ST Microelectronics. Because of the combination of CMOS logic with D-MOS power transistors, these devices need few external components. Also, compared with the previous generation of bipolar devices such as the L298, the D-MOS transistors drop lower voltages so that the internal dissipation is smaller.

The input stage, IC<sub>1</sub>, enables the motor to proceed one step for each pulse at its input pin 18. The level at pin 17 (CW/CCW)



determines whether the motor rotates clockwise or anticlockwise. The level at pin 19 decides whether the motor moves whole or half steps for each pulse at pin 18. In normal operation, pin 20 (reset), pin 11 (control), and pin 10 (enable) should be linked to the +5 V supply. Pin 1 (sync) is an output used when several L297s are driven in tandem and should be left open in the present design. Pin 3 (home) is an output that indicates when outputs A, B, C, and D, assume the binary code 0101, and is not used in the present design. The other pins are of less importance and will in most cases not be used at all – further information may be obtained from Internet address <http://www.us.st.com>

Since the current through the motor coils must not only be switched on and off, but also be reversed, the driver ICs contain a complete bridge formed by four D-MOSFETs. The upper two need to be driven by a potential that is higher than the supply voltage, and this is obtained with the aid of a boot-

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#### Parts list

#### Resistors:

$$R_1 = 22 \text{ k}\Omega$$

$$R_2 = 3.9 \text{ k}\Omega$$

$$R_3 = 1 \text{ k}\Omega$$

$$R_4, R_5 = 10 \text{ }\Omega$$

$$R_6, R_7 = 0.5 \text{ }\Omega, 3 \text{ W (see text)}$$

#### Capacitors:

$$C_1 = 3.3 \text{ nF}$$

$$C_2, C_9, C_{10} = 100 \text{ nF}$$

$$C_3, C_4 = 220 \text{ nF}$$

$$C_5\text{--}C_8 = 15 \text{ nF}$$

$$C_{11}, C_{12} = 22 \text{ nF}$$

$$C_{13} = 10 \text{ }\mu\text{F}, 63 \text{ V, radial}$$

#### Semiconductors:

$$IC_1 = \text{L297}$$

(ST Microelectronics)

$$IC_2, IC_3 = \text{L6203}$$

(ST Microelectronics)

#### Miscellaneous:

$$K_1 = 10\text{-way header}$$

$$PC_1\text{--}PC_6 = \text{PCB pins}$$

$$L_1, L_2 = \text{bipolar stepper motor}$$

$$\text{PCB Order no. 994065-I}$$

strap circuit ( $C_5, C_6$ ). Network  $R_4\text{--}C_{11}$  suppress voltage peaks across the motor terminals. Most of the other capacitors in the dia-

gram are decoupling (bypass) elements.

The driver ICs can handle currents of up to 4 A at voltages up to 42 V. For safety's sake, it is better for the voltage to remain well below 42 V; the current is internally limited to 4 A. Any tendency of the current to rise above this level is sensed by resistors  $R_6$  and  $R_7$ , whereupon the IC is disabled. The value,  $R$ , of these resistors must, therefore, be in line with  $I_m$ , the motor current:  $R = 1/I_m$ .

The driver ICs are provided with internal thermal protection, but when the dissipation is large, it is advisable to mount them on a suitable heat sink. They do not get damaged by heat, but they do switch off the motor when the temperature rises above the maximum specified temperature.

Finally, it should be noted that  $IC_1$  operates from a +5 V supply (via  $K_1$ ) from which it draws a current of about 50 mA. The voltage at pins 0 and + is intended for the stepper motor and should be equal to, or a little higher than, the rated motor voltage.