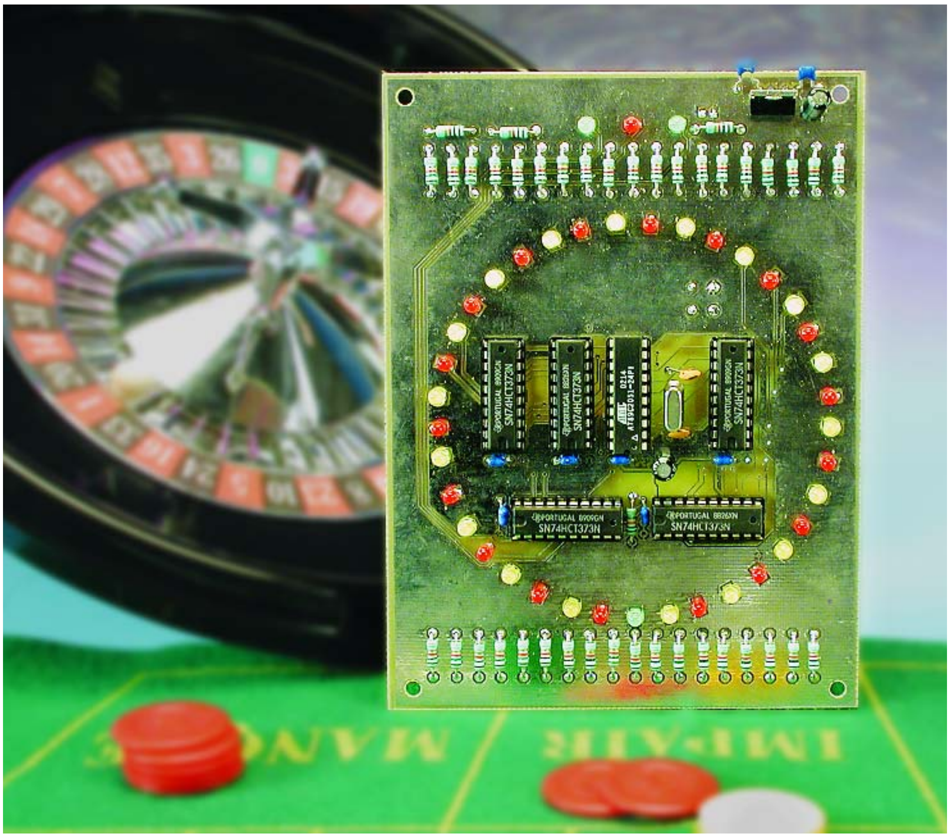
LED Roulette

using LEDs instead of a ball

Design by P. Goossens

Everybody gambles sometimes, perhaps in a lottery or even in a casino. After all, who doesn't dream of becoming rich without having to work hard? Although you can't win much with the LED roulette wheel described here, it does provide an excellent opportunity to practice the game of roulette at home in an honest manner. That's because you can't cheat with this version — the microcontroller that controls the LEDs doesn't take bribes!



The game of roulette has been known for centuries, and it is played all over the world. In order to make it easier to play this game at home, here we a present an electronic roulette game. This electronic version only replaces the turntable, which is the dished wheel used with a small ball to select a random number for each round of the game. You will have to make the playing field and the counters yourself.

Roulette

In the game of roulette, a random number is chosen for each round using a dished, spinning wheel within which a small ball circulates in the opposite direction. The ball ultimately lands in one of 37 compartments (numbered 1–36 and 0), with each compartment having a colour (black, red or green). The players can bet on the number, colour, etc, of the compartment where the ball ends up.

Roulette is not played very often at home, since it requires a proper roulette wheel. Any irregularity in the construction of the wheel will distort the probabilities and thus make the game unfair. A good roulette wheel is not cheap, and it also takes up a lot of space. An electronic version provides a solution to these problems: it doesn't cost a lot and it doesn't take up much space.

Implementation

In this circuit, the circulation of the ball is simulated by a number of LEDs arranged in a circle.

Our electronic wheel has more to offer than just a simulation of a circulating ball. As anyone who has ever visited a casino knows, at first the ball rolls quite smoothly over the surface of the wheel when it is spun. But after the ball has lost speed and hits one of the compartment walls, it starts jumping all over the place. Our wheel shows the same characteristics, but if you would rather have the ball exhibit a 'wheel of fortune' type of behaviour, you can configure the circuit for this using a switch.

Another nice feature of our 'wheel' is that as soon as the ball has stopped, the circuit automatically indicates whether the present number is higher or lower than the previous number. This means that in addition to the usual manners of playing roulette, you can also bet on whether the next number will be higher or lower than the current number.

Schematic diagram

Figure 1 shows the schematic diagram of the roulette wheel. As is common nowadays with relatively complex digital circuits, it is based on a microcontroller.

In this case the microcontroller is an AT89C2051 (IC1), which requires only a small number of external components. C12 and R41 generate a reset signal when the supply voltage is switched on. X1, C1 and C2 ensure that the internal oscillator of IC1 generates a 12-MHz clock signal. The user controls are provided by a regular switch and a push-button switch (S2 and S1), each of which is directly connected to an I/O pin of the microcontroller.

The visual representation of the simulated ball is provided by 40 LEDs (D1–D40), with each LED having its own series resistor (R1–R40). The LEDs are driven by 8-bit latches (IC2–IC6).
LEDs D1–D37 are arranged in a circle, and they represent the various compartments of the wheel. LED D38 indicates that the value of the most recent spin is higher than that of the previous spin. By contrast, LED D40 indicates that the value of the most recent spin is lower than that of the previous spin. LED D39 lights up as soon as the 'ball' stops moving.

The circuit is powered by a 9-V

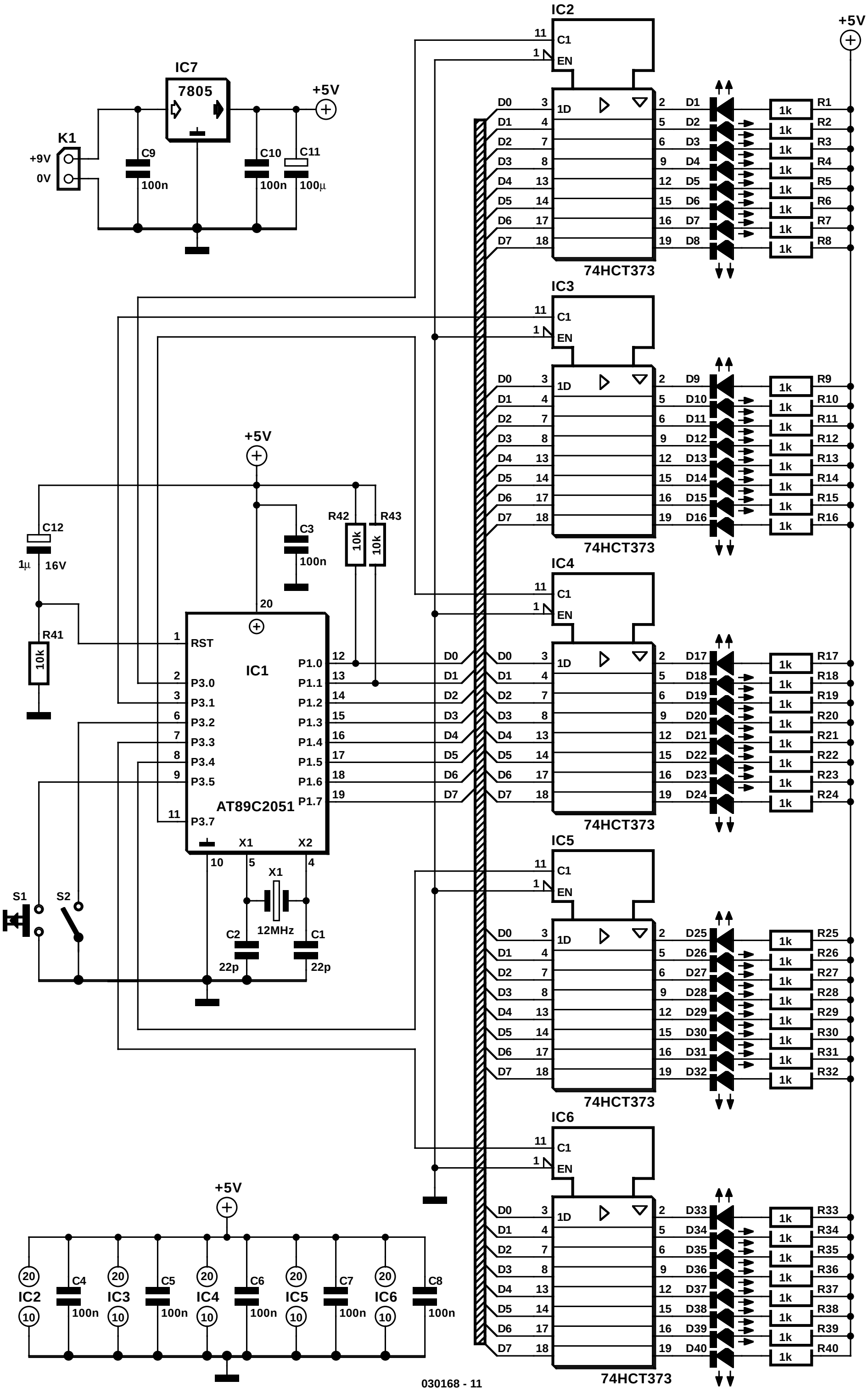


Figure 1. The schematic diagram of the roulette circuit: 40 LEDs controlled by a microcontroller.

battery, whose voltage is reduced to 5 V by IC7 to meet the demands of the digital components. Naturally, the necessary buffer capacitors and decoupling capacitors are also present in the circuit.

Resistors R42 and R43 are present because P1.0 and P1.1 are the only I/O pins of the AT89C2051 that do not have internal pull-up resistors. This allows these two ports to double as analogue inputs. However, in this circuit pull-up resistors are needed for all

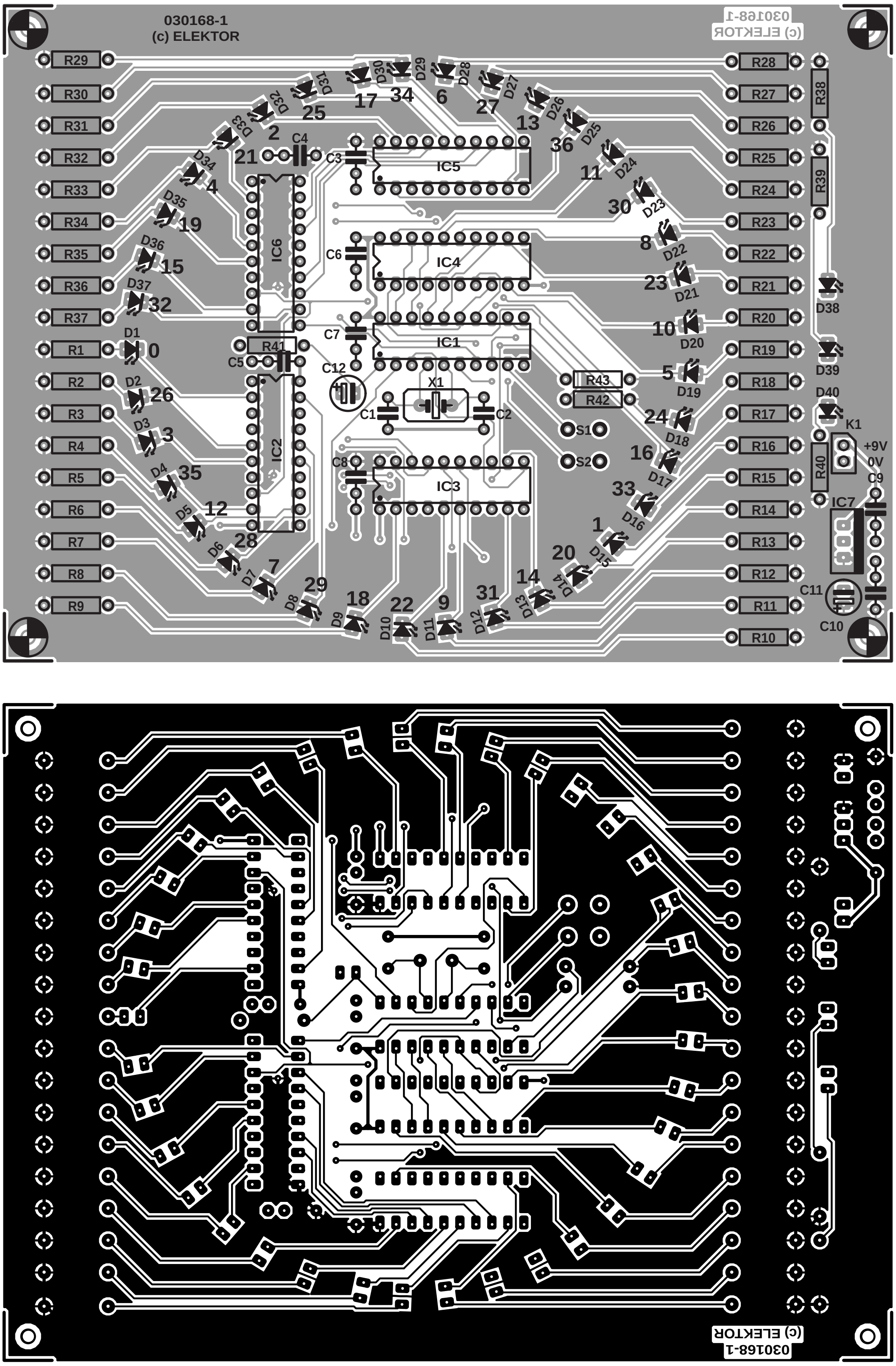
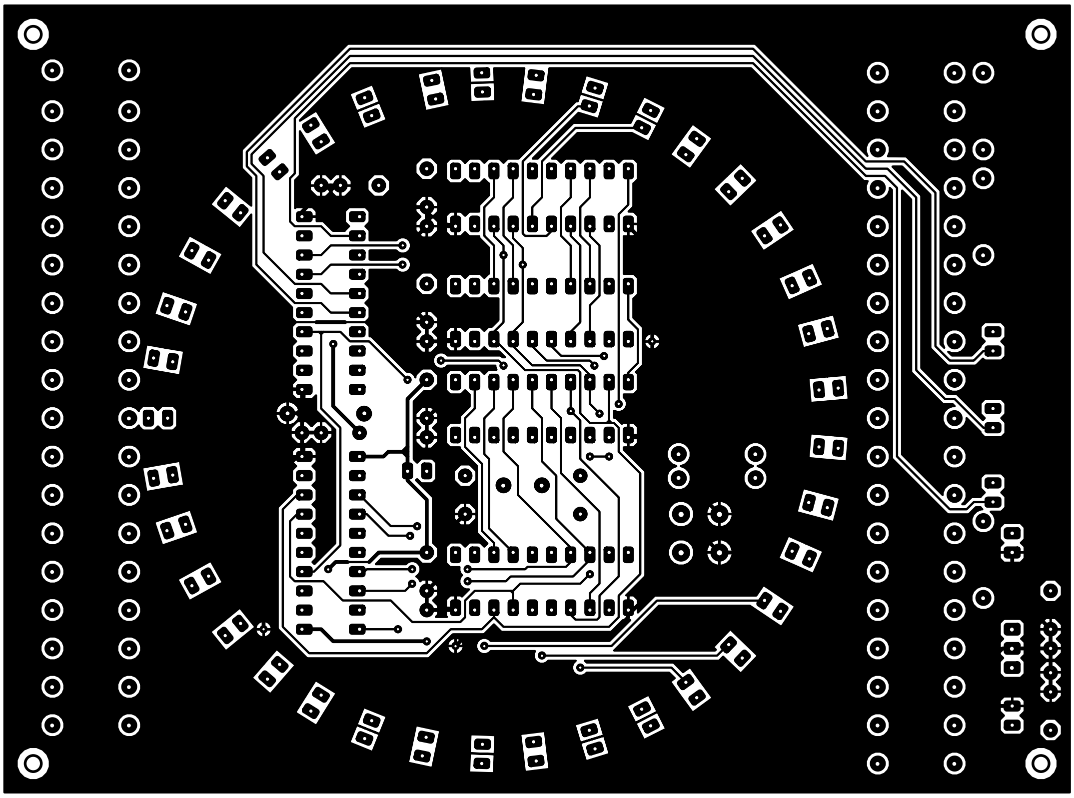


Figure 2. The double-sided printed circuit board holds the entire circuit except for the 9-V battery.

bits of port 1, so R42 and R43 have been added to ensure that a well-defined 'high' signal is also present on bits 0 and 1 when their outputs are not low.

Construction

Figure 2 shows the printed circuit board that has been designed for the electronic roulette game. A double-sided printed circuit board is used here, because otherwise too many wire bridges would be needed to



COMPONENTS LIST

Resistors:
R1-R40 = 1kΩ
R41-R43 = 10kΩ

Capacitors:
C1,C2 = 22pF
C3-C10 = 100nF
C11 = 10µF 16V radial
C12 = 1µF 16V radial

Semiconductors:
D1,D38,D40 = LED, 3mm, green, low current
D2,D4,D6,D8,D10,D12,D14,D16, D18,D20,D22,D24,D26,D28,D30, D32,D34,D36,D39 = LED, 3mm, yellow, low current
D3,D5,D7,D9,D11,D13,D15,D17, D19,D21,D23,D25,D27,D29,D31, D33,D35,D37 = LED, 3mm, red, low current
IC1 = 89C2051-12PC, programmed, order code **030168-41**
IC2-IC6 = 74HCT373
IC7 = 7805CP (TO-220 case)

Miscellaneous:
K1 = 9V battery with clip and on/off switch (optional)
S1 = pushbutton with make contact
S2 = on/off switch
X1 = 12MHz quartz crystal
PCB, order code **030168-1**
Disk, contains source and hex code files, order code **030168-11** or Free Download

allow the LEDs to be arranged in a nice circle.

Little needs to be said about building the board. Just solder everything where it's supposed to be and you're all set. Of course, you must pay attention to the correct polarisation of the LEDs, ICs and electrolytic capacitors. Sockets can be used for the ICs, but they are not necessary if you have a certain amount experience with soldering.

If desired, all of the LEDs can be fitted on the solder side of the board, but that naturally depends on what sort of enclosure you plan to use.

The switches can also be connected to the board using lengths of wire, so they can be fitted at the side of the enclosure if so desired. You can also fit an on/off switch at the side of the enclosure and connect it in series with the battery connector (K1).

Conclusion

The software for the AT89C2051 was written in C and compiled using the Keil C51 compiler, for which (as you probably know) an evaluation version is available free of charge (http://www.keil.com/demo/eval/c51.htm). As the source and hex code are available from the *Elektor Electronics* website under number **030168-11** (and naturally on diskette as well), you can adapt the program to your own wishes if so desired. To do this, in addition to the compiler you will need to have a certain knowledge of the C programming language and a programmer for the AT89C2051.

If you have no desire to modify the program or do your own device programming, you can simply purchase a pre-programmed version from Readers Services (order number **030168-41**).

(030168-1)

Free Downloads

Microcontroller software.
File number: 030168-11.zip
PCB layout in PDF format.
File number: 030168-1.zip
www.elektor-electronics.co.uk/dl/dl.htm, select month of publication.

1 and 4 MHz when the preset is turned three quarters cw. Do you recognise this effect or did I make a mistake somewhere?

Dick Flanderijn, Holland (by email)

Although the project is now almost seven years old, the Compact Amp has made it to Evergreen status, hence we include this letter in this month's MailBox. Looking at the impressive PCB sales volumes achieved by this project, the problem can only be said to have been reported sporadically. A suggested cure is to fit a 100-pF cap between the base of T16 and ground. This will however affect the amplifier's sonic response to some extent.

Tension rising! Dear Jan, can I ask two questions about the power supply with the Valve Final Amp from April 2003, please?

The required alternating voltage should be 340 V (I_{max} = 0.7 A). I have had a matching transformer made which supplies 365 Vac under no-load conditions and 340 Vac when loaded with 0.7 A. Is 365 Vac too much of a good thing?

Second, you state that the direct voltage after rectification is 440 Vdc. My calculations tell me that $340 \times \sqrt{2} \approx$ 480 Vdc.

The two above factors cause a high tension of about 510 V in my circuit. Is that a problem?

Patrick Görlach (by email)

The designer of the amplifier, Bob Stuurman, replies: Mr. Görlach's transformer is probably beyond reproach. As a safety precaution I would advise loading in the HT PSU with two parallel connected 230-V, 40-watt bulbs. This load will draw about 200 mA which is about the same as the amplifier under no signal conditions. Replacing the transformer should only be considered if the HT is far off the 440-V mark with the lamps connected.

Those Elektor drawings
Dear Editor, which drawing or CAD program do you use to make your schematics and PCBs? I'm curious because your drawing style appears to have been identical since the early 1990s when there were no drawing programs I know of.

Serdar Ulukonakci (by email)

Well Serdar this question is asked at least once a week hence we print a reply here. We started drawing schematics on PCs as far back as 1985 using OrCAD and PCB artwork using Ultiboard. Today we employ versions of McCad (www.mccad.com) and Ultiboard (www.ultiboard.com), both heavily customised and extended with our own libraries for circuit symbols and shapes.

Corrections & Updates

FMS Flight Simulator Encoder

January 2004, p. 22-26, 030066-1

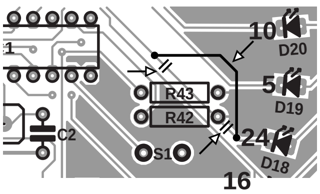
In the parts list, the CTS model number for mini joysticks P1 and P2 belongs to the 100-kΩ version. The circuit diagram however shows 10-kΩ joysticks (model no. CTS 25A103A60TB). The 10-kΩ and 100-kΩ versions function equally well in the circuit.

LED Roulette

January 2004, p. 52-55, 030168-1

The PCB has a short-circuit between the anode of D18 and the +5 V rail.

To lift the short-circuit, two tracks have to be cut and a wire link fitted, as shown in the illustration.



Seconds and Minutes Clocks from DCF77

July/August 2003, p. 40, 024005-1

The RC time defined for IC2 needs to be increased by a factor of 10. This requires changing P1 to 1 MΩ and R7 to 330 kΩ.

Stepper Motors Uncovered (2)

December 2003, p. 54-63, 020127-2

On the printed circuit board overlay, the symbols for FETs T1-T16 have been printed the wrong way around. The FETs devices should be mounted the other way around.

Lambda Probe Readout for Carburettor Tuning

July/August 2003, p. 36, 034052-1

In the circuit diagram, the anodes of D1-D10 should be shown as connected to +12 V.

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