

Measurement of inductors with resistance below  $2100\Omega$ .  
Measurement of ESR value of capacitors with value of above  $2\mu F$ .  
Using of pin PC4 as serial output.

**Missing precision voltage reference** Usually the software should detect the missing voltage reference with the unconnected pin PC4. In this case no  $VCC=x.xV$  message should appear in row 2 of the LCD on power on. If this message appear without the reference, you should connect a  $2.2k\Omega$  resistor to the PC4 input and VCC.

## 2.4 Chinese clones

As I know, the tester is rebuild in China in two versions. The first model is rebuild from the first design of Markus F. without the ISP port. The assembled ATmega8 is placed in a socket, so you can replace it with a ATmega168 or ATmega328. For this version you should consider all the hints of section 2.3. Additional  $100nF$  ceramic capacitors should be connected near by the VCC-GND and AVCC-GND pins of the ATmega for better stabilization of the power voltage. In addition you should notice, that if you expand the board with the additional 8 MHz crystal, your external ISP programmer must have a external clock for programming.

The second version of rebuildted tester is build with SMD components. Also the fix installed ATmega168 is a SMD type with 32TQFP body. Fortunately on the board is a 10-pole ISP connector provided for the programming. I have analysed the board version "2.1 2012/11/06". One error is the assembly of the part "D1", which should be a precision 2.5V voltage reference. Assembled is only a zener diode. This part should be removed. You can mount a LM4040AIZ2.5 or LT1004CZ-2.5 precision voltage reference at this place. A missing voltage reference is noticed by the software, so that you must not install the voltage reference. My exemplar was delivered with software version 1.02k. The 10-pole ISP plug was not assembled and I must install a jumper from ISP pin 6 to ISP pin 10. My programmer expect a GND connection at pin 10, but the board has GND level only on pin 4 and pin 6 of the ISP. The label of the ATmega168 was rub away and there was no documentation delivered with the part. The lock fuses of the ATmega were set, so no readout was possible. But I could install the software version 1.05k without any problems. Another user has problems with the same software version 1.05k. This user has the chinese board "2.2 2012/11/26". The software runs only without problems, if a additional  $100nF$  keramic capacitor was placed between the pin 18-AVCC and 21-GND near by the ATmega. The software 1.05k uses the sleep state of the ATmega for waiting time. For this reason the current alternates often and the voltage regulator is stressed more. Further I have noticed, that the VCC voltage is blocked with a  $100nF$  ceramic capacitor and with a  $220\mu F$  electrolytic capacitor nearby the 78L05 voltage regulator. The 9V supply voltage is blocked with the same capacitors, but not at the input of the regulator but at the emitter of the PNP transistor (parallel with the battery). The printed circuit board track from the ATmega168 to the test port is very thin, so that a resistance of  $100m\Omega$  could be measured for one path. This will be the reason for measuring a resistance of  $0.3\Omega$  for two direct connected pins. The ESR measuring can usually consider this by zero compensation. The current version of software does not respect this offset for measuring of resistors with low resistance.

## 2.5 Programming of the microcontroller

I release the software for the microcontroller with source code. The developement is done with Linux operating system (Ubuntu) and is controlled with a Makefile. The Makefile makes shure, that your