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Wireless voltage and resistance meter based on STC89S52 and bluetooth module HC-05

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Abstract. A wireless voltage and resistance meter based on STC89C52 and Bluetooth module HC-05 is introduced. The principle of voltage measurement and Bluetooth communication is introduced.The hardware circuit and the software program is analyzed. Measured data can be displayed on the LCD1602 or sent to the phone and computer through Bluetooth module HC-05. The measurement range of voltage is 0-5V and the maximum voltage error is 0.09V. The measuring resistance range is 20 ~ 50K Ω and the maximum error is 395 Ω .

1. Introduction

The voltage and resistance meter is widely used in in the field of electronic measurement.The requirements for high-accuracy and versatility become higher. However, the traditional measurement equivalents all adopt wires or cables for connection , which make them inconvenient in specific environment. With the development of short-range wireless communication (SrWC)technologies，large amount of wireless measure instruments had emerged.The SrWC technologies include Zigbee, WiFi and Bluetooth.Bluetooth technology are used widely for its low-cost, interoperable robust and extremely low power consumption.

2. Measuring principle for voltage and resistance
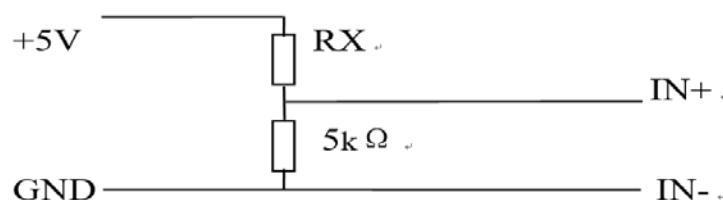
2.1 Voltage and Resistance measurement

Figure 1. Resistance measurement

Voltage measurements can be done by analog-digital converter (ADC0804) whose resolution is 0.0192V. Therefore,voltage data can be obtained by 8bits ADC digital signal(AD).Resistance

measurement circuit is shown in the Figure1.The input DC voltage is 5V and a series circuit contains an unknown resistor and a 5KΩ resistor . In the equation(1) ,the voltage-division principle is used[1] .

$$Rx = \frac{5000*(256-AD)}{AD} \tag{1}$$

3. System hardware and software design

The hardware of voltage and resistance measurement system is composed by the processor STC89C52[2],LCD display(1602), AD conversion chip(ADC0804) [3], Bluetooth serial port module(HC-05) and other components. System hardware block is shown in Figure 2.
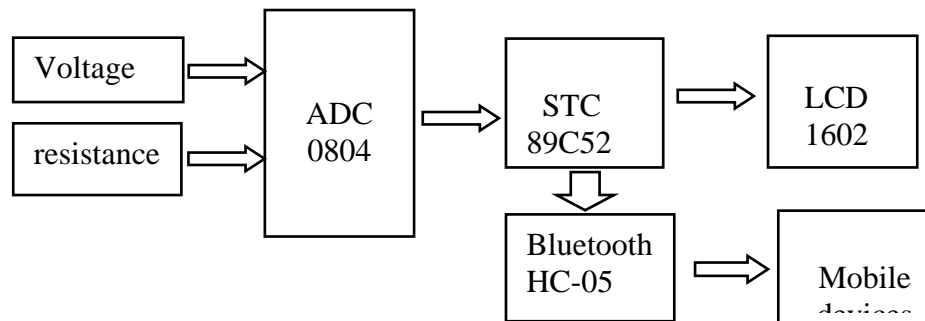

Figure 2. System hardware block

The STC89C52RC is a new generation MCU produced by of Hongjing Technology corporation.It has fast speed,low power,better anti-jamming capability. The instruction sets are completely compatible with the traditional 8051 MCU. STC MCU has two modes of operation:one is the single-speed, which is 12 clock mode; the other is double speed, also known as 6 clock mode.In double speed mode, STC MCU is twice as fast then the other 51 series MCU. The STC MCU has a strong processing capabilities.With on chip flash memory ,it can be simulated and programmed conveniently.

The ADC0804 is an 8-bit successive approximation A/D converter. This type of A/D converter has the fast conversion speed (a few hundreds microseconds),high resolution and the cheap price.It universally is applied to the MCU interface design.
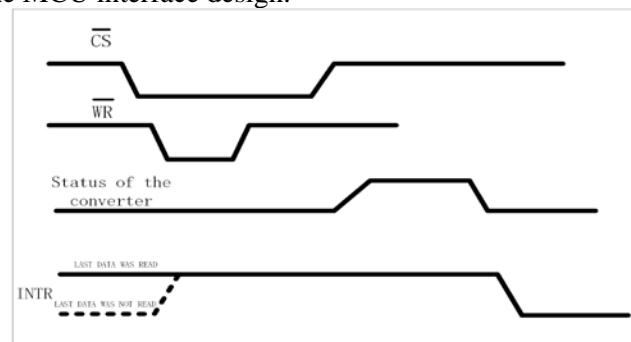

Figure 3. Chip operation timing diagram

The working progress of the ADC is shown in the Figure 3.As $\overline{CS}$ firstly get to low voltage, $\overline{WR}$ then fall to low voltage. When $\overline{WR}$ is set to high voltage , AD converter started to work. After several period , the analog-digital conversion completed and the conversion data will be put into the data latch. Then INTR will automatically notify the MCU.
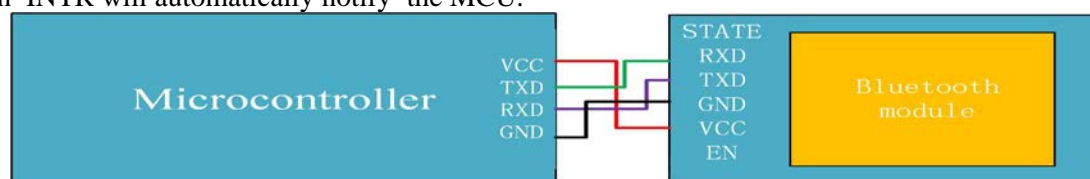

Figure 4. Micro-controller and Bluetooth hardware connection

Bluetooth is a radio technology which supports short-range communication(typically within 10m)[4]. By using Bluetooth technology, communication between mobile communication terminal can be simplified.Micro-controller can send the measured data to mobile phone with Bluetooth module(HC-05)[5]. The voltage and resistance data will be shown on the screen of phone.The detailed connection mode of Micro-controller and Bluetooth module is shown in Figure 4.A two-line serial port with TXD and RXD is adopted for data exchange between MCU and Bluetooth module.

System software diagram is shown in the Figure 5. The main program contain system settings, measurement function,display function and communication function.
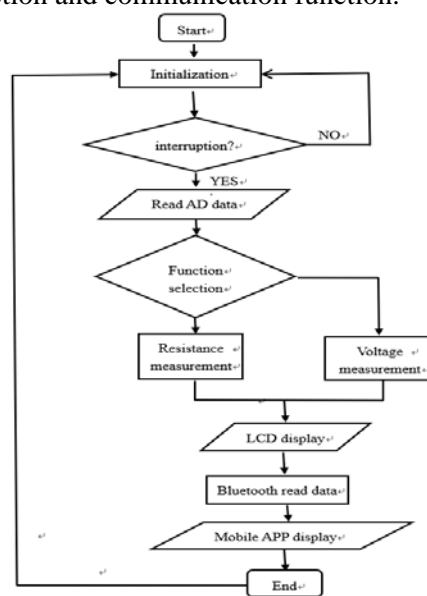

Figure 5. System software diagram

4. Test

The hardware circuit test is done and the obtained data are shown in the Table 1. The data obtained from the multimeter VC890D are also shown .The measurement range of voltage is 0-5V and the maximum voltage error is 0.09V. The measuring resistance range is 20 ~ 50KΩ and the maximum error is 395 Ω .

Table 1. Voltage and resistance measurement

	The setting voltage	VC890D	The measured voltage
Voltage (V)	0.4	0.36	0.372
	1.3	1.32	1.333
	2.4	2.43	2.470
	3.9	3.91	3.922
	4.4	4.42	4.490
Resistance (Ω)	resistance	VC890D	The measured resistance
	470	468	477
	5600	5590	5688
	10000	9790	10112
	20000	20400	20224
	43000	41700	42695

5. Conclusion

The wireless digital voltmeter is designed in this passage.The STC89C52 is used as micro-controller and the measuring data can be shown on the LCD display.The measured voltage and resistance data can be shown on the the mobile phone with the Bluetooth communication .

Acknowledgments

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