Research and design of a simple test instrument for electronic components

TANG Ya-ping

Hunan Railway Professional Technology College, Zhuzhou, 412001

Keywords: PLC component; three terminal voltage regulator; component tester

Abstract. RLC components or transistor is identified first. Then through the oscillation circuit turn resistance's, inductance's, capacitance's value into a frequency value by the microprocessor LM3S811 accurately. The transistor is measured by the A/D that can get its parameters.

Introduction

In electronic design, often encounter the following problems[1-2] :

The first point: there are always a few scattered resistance, throw a pity, using a meter to test or stop to change the range, it is not convenient. Secondly, to get a capacitor, is not sure is good, the general million with the table and no capacitor file. Again, do DC/DC and other needs of the design of the inductor, get an inductance, but do not know its parameters. Finally, get a transistor, but forgot to be NPN, or PNP. So, decided to design a simple operation of the electronic test instrument, the use of the measuring range without conversion resistance, inductance, capacitance and identification of transistors and they all use the same interface[3-5].

System design scheme

Design scheme of RLC:

Through the LM3S811 TI chip to achieve a precise measurement of the frequency, the measurement range of 1Hz to 12. 5MHz, less than 1Hz of the frequency theory can be achieved, but the low frequency tend to measure pulse width, so here to achieve; LM3S811 for the limit of 12.5MHz, can no longer high (50% duty cycle).1HZ to 10kHz, the accuracy is less than 1Hz. 10kHz the accuracy is less than 1/10000. The actual is a 16 bit timer, so the accuracy is 1 / 65535 * 100%.Then, the electric resistance, inductance and capacitance are converted into frequency signals by the oscillation circuit, which can realize the accurate measurement.When measuring frequency, use the chip two timer. A set of 32 bit cycle mode (Periodic Timer Mode 32-Bit), used to set the sampling period. A set of 16 bit 16-Bit input edge sampling technology model (Input Edge Count Mode), for the frequency of the signal sampling.

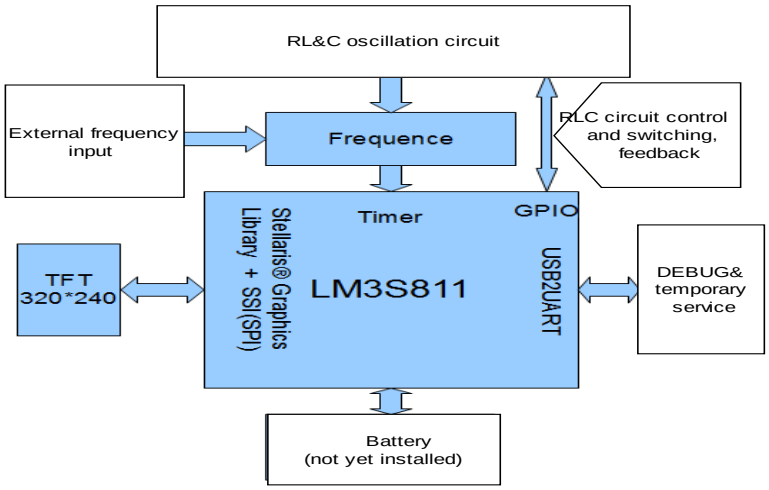

Fig. 1 Hardware system block diagram

The key of hardware design is to use resistance, inductance, capacitance design oscillation circuit. LC, RC oscillation circuit of a lot of programs, so when selecting the design is simple, easy to calculate the circuit, the circuit oscillation effect.There are 555 RC oscillation oscillation timer, gate oscillation, oscillation amplifier. After comparing the gate vibration test (optional TI:74LVC2G132 - 3.3V).

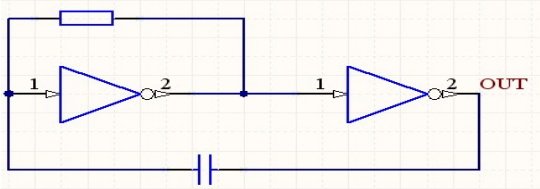

Fig. 2 Oscillating circuit

In Fig2,

$$Frequence = \ln 4 * R * C$$

Note: LC oscillation due to the lack of testing accuracy at the present stage, the circuit design is still under improvement, so in this space.

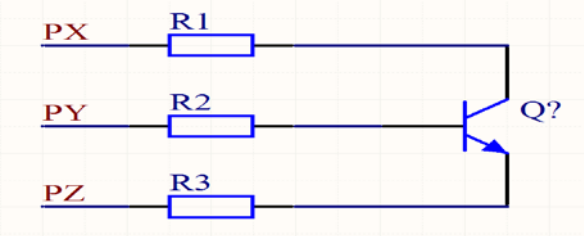

Fig3 .transistor three terminal device

Conduction as the chart shows, for example, to detect the NPN tube in the PX and py and PZ ends are respectively applying different voltage, if R1, R2, R3 as long as there is one end of a voltage, then the pipe. At the same time, the state is 1, otherwise it is zero when the PX, py and PZ three terminal position is changed, the corresponding state word will change, but the status word 1 and 0 the number of unchanged, can according to different pin voltage is different, drawing status word of truth value table, the program can write algorithm to get the status word look-up table device and pin information, and then sent to the display circuit, judge device type, the corresponding parameters can also be measured, so the work of the key is to determine the device types.

The status word truth table of the NPN transistor is shown below:

Tab.1The true value of the NPN transistor

set up	X	1	0	Z	Z	1	0	Status word
	Y	0	1	1	0	Z	Z	
	Z	Z	Z	0	1	0	1	
NPN	X/Z	X	√	√	X	X	X	0x18
	Z/Y	√	X	X	X	√	X	0x22
	X/Y	X	X	X	√	X	√	0x05

System software design

As the frequency measurement range is very wide (1Hz~12.5MHz), it is necessary to change the sampling period in real time according to the measured frequency.

The software flow chart of the system is shown in Fig. 4.

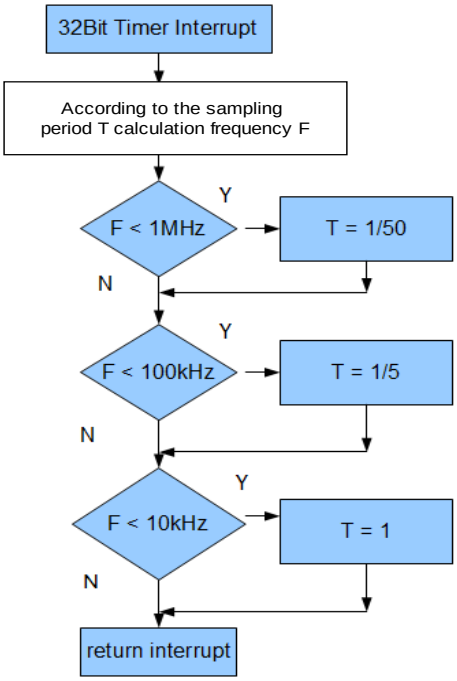

Fig. 4 flow chart of system software

Test

The measurement of the universal meter is simplified by the processor. No longer need to switch gears, no longer need to place the component properly. Which will get the components of the R, L, C value (if it is RLC components). To a certain extent, to determine the R, L, C. And the circuit is simple, easy to use, with the low power consumption of M3 on the development of a simple and convenient test equipment.

Tab.2 resistance test parameters

parameter / group	frequency	original value	Test value
Resistance 1	124HZ	12k	12k
Resistance 2	18HZ	82k	82.7k
Resistance 3	2HZ	300k	298k

Tab.3 Capacitance test parameter

parameter / group	frequency	original value	Test value
Capacitance 1	18HZ	0.47u	0.4744u
Capacitance 2	688HZ	0.01u	0.012033u
Capacitance 3	70HZ	0.1u	0.11455u

Tab.4 Frequency test parameter

parameter / group	Generator frequency	Oscilloscope test	M3 display test values
Frequency	1HZ	<10HZ	1HZ
Frequency	10HZ	10HZ	10HZ
Frequency	100HZ	100HZ	100HZ
Frequency	1KHZ	1KHZ	1KHZ
Frequency	10KHZ	10KHZ	10KHZ
Frequency	100KHZ	100KHZ	100KHZ
Frequency	1MHZ	1MHZ	1MHZ
Frequency	10MHZ	10.02MHZ	9.9994MHZ
Frequency	12.5MHZ	12.69MHZ	12.499MHZ

Conclusion

It can be found that the frequency measurement is very accurate, and the error of the frequency is mainly in the oscillation circuit. In part, it depends on the accuracy of the shock element, so if it can be integrated with high precision components, it can improve its accuracy.

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