A New Type of High-Efficiency and Portable Digital Electric Experiment Board

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Abstract: With the continuous advancement of digital electronic technology, the domestic emphasis on cultivating talents in the field of digital technology has been increasing. Our team designed an efficient and high-precision digital circuit experiment board that is small in size, easy to carry and store, and is not limited by the site. It can be used for experiments in dormitories, classrooms or training rooms. The designed digital signal generation board is easy to operate, low in error rate, flexible in structural design, and improves the stability, safety and reliability of the circuit.

Keywords: Digital Signal; Portable; Various Structures

1. Introduction

The traditional digital circuit experiment box is bulky, heavy, inconvenient to carry, limited by the site, and cannot carry out experiments anytime and anywhere. It is difficult for schools to effectively carry out teaching. As a result, students are slack in learning digital electronics courses, and students cannot achieve the learning effect predicted by the school. At the same time, the simulation software on the computer cannot achieve the purpose of training students' hands-on ability and improving learning interest, which greatly reduces the learning effect of the course.

In view of the above shortcomings of the traditional digital experiment box, our team designed a portable and efficient digital experiment board. The main implementation contents include: digital display semi-free building module: can display two digits; level display module: digital signal input The part is composed of eight groups of toggle switches, which can output "0" and "1" levels; signal generator module: can provide 1HZ clock pulse and square wave signal; breadboard module: adopts movable 20pin socket, which is convenient for chip removal and insertion , to avoid damage. The digital experiment board is small in size and easy to carry and store. It can be used alone, or it can be connected to the test box in the laboratory with a data connection line. It is not limited by the site and can be used in dormitories, classrooms or training. High-efficiency and high-precision digital circuit experiment board for laboratory experiments.

Our portable and efficient experiment board can better transfer the boring classroom theoretical knowledge to practical application, and train students' digital logical thinking ability and practical ability to use digital integrated chips and their peripheral circuits to solve practical problems. In order to improve students' hardware circuit foundation and comprehensive circuit application ability.

2. Design Of The Digital Electric Experiment Board

Firstly, the functions to be realized by the circuit are systematically constructed, and the feasibility analysis of the circuit diagram is completed. Use the simulation software Multisim to build a circuit model to eliminate possible problems, and then use circuit diagram design software such as Ultiboard or AD to design and package the circuit board. Make the circuit copper board according to the circuit diagram of the package, and complete the welding of the parts. Experimental debugging is carried out on the circuit board with welded parts to test the degree of function realization.

2.1 The function and composition of each module of the experiment board

2.1.1 The Digital display semi-free construction circuit

It is composed of 7-segment digital tubes, two-decimal BCD code decoder CD4511, decimal synchronous addition counter CD4518, four 2-input AND gate CD4081, 14-level binary serial counter CD4060 and double D flip-flop CD4013, which can display two digits number.

2.1.2 Level display module

The digital signal input part is composed of eight groups of toggle switches, which can output "0" and "1" levels. The digital signal output part consists of a triode switching circuit to drive the LED. When the logic "1" level is input, the LED is on, otherwise it is not on.

2.1.3 Signal generator module

Composed of CD4060 and CD4013, it divides 32768HZ by 15 levels by two, and can provide 1HZ clock pulse, and square wave signals of 2048HZ, 1024HZ, 512HZ, 256HZ, 128HZ, 64HZ, 32HZ, 16HZ, 8HZ, 4HZ, 2HZ.

2.1.4 Breadboard Module

It is a free circuit construction area. It is composed of pin headers similar to the breadboard plug-in circuit mode, which makes the circuit construction flexible and changeable. The movable 20pin socket is used to facilitate chip insertion and avoid damage.

2.2 Experimental board hardware circuit design

In the design of the hardware circuit, we adopt high integration of the fixed part of the circuit, which reduces the size of the circuit board and improves the portability. The interface expansion circuit is composed of Dupont wire and banana port, which realizes the efficient transmission of data. On the circuit board The exposed part of the circuit is reduced in the design, and the stability, safety and reliability of the circuit are improved.

2.2.1 Chip connection circuit

A 20pin chip locking seat is used, and the side is a test connection pin header. Each pin header is connected to an LED, which can visually observe the high and low levels of each pin of the chip, which is convenient for checking whether the chip is faulty, and can prevent During the experiment, the pins of the chip were fixed unstable, which led to the failure of the experiment. When the chip fails, you only need to open the lock button to replace the chip, and the later maintenance cost is low.

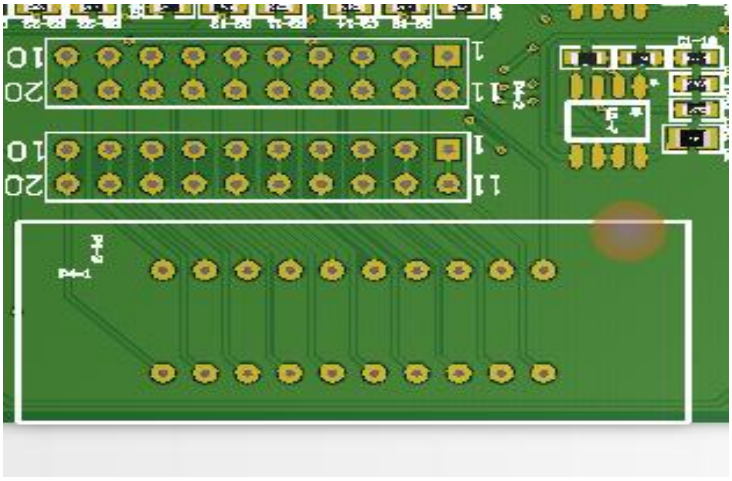

Fig.1 Chip connection module circuit and locking socket

2.2.2 Interface expansion circuit (banana head and DuPont line conversion circuit):

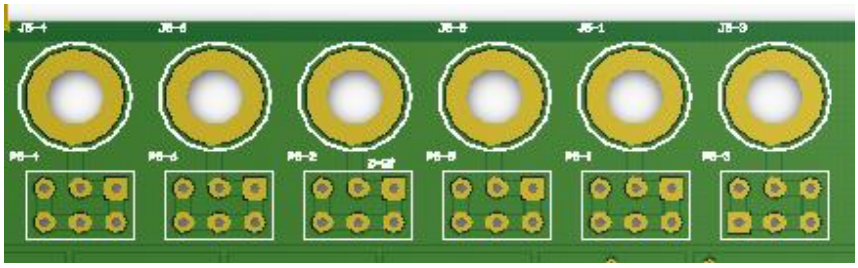

Fig.2 Banana head and DuPont line conversion circuit

It has eight banana heads and DuPont line conversion ports. When in use, connect the signal output on the board to the pin header side of the conversion port with DuPont lines so that the signal can be connected to the banana port of the test box. The interconnection between different circuit boards can be realized, and the combined use of different circuit boards can be realized.

2.2.3 Power circuit

Connect four micro USBs in parallel, add independent VCC and GND, and VCC and GND each lead to a 10PIN pin header, which can supply power to the breadboard. Add the banana port of VCC and GND, which is convenient to use when the test box is powered. Add diodes and self-recovery fuses for overload and reverse connection protection. The power supply can come from 5V power sources such as special power modules, mobile phone chargers, mobile power supplies, etc. The low power supply voltage level is safe, convenient and reliable to operate, so that the use of digital experiment circuit boards is not limited by the site. During the epidemic, it can be used in dormitories, ordinary classrooms or study rooms The construction and debugging of the experimental circuit can be completed.

Since the main circuit board does not integrate an AC/DC power conversion module, the volume of the circuit board will be greatly reduced, and the manufacturing cost will be greatly reduced.

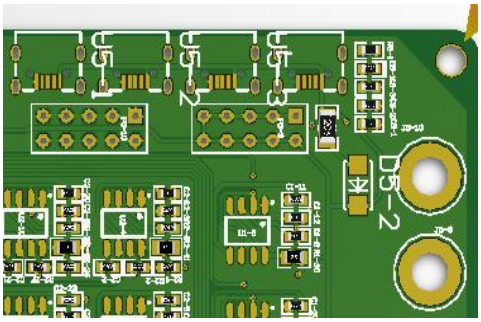

Fig.3 Power circuit

2.2.4 Manual pulse edge generation circuit:

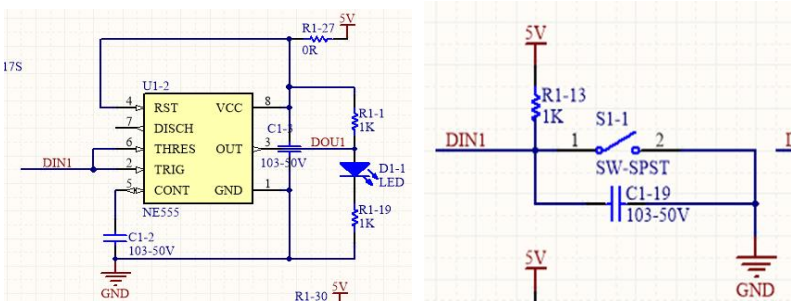

Fig.4 Manual pulse edge generation circuit 1

The 555 is used as a Schmitt trigger to filter the upper and lower edge signals, and the buttons are also filtered with

capacitors. The 0R resistor is used as a fuse for protection, and when the chip burns out, the 0R resistor is disconnected to completely disconnect this part of the circuit without affecting the use of other parts of the circuit.

2.2.5 Manual pulse filter circuit

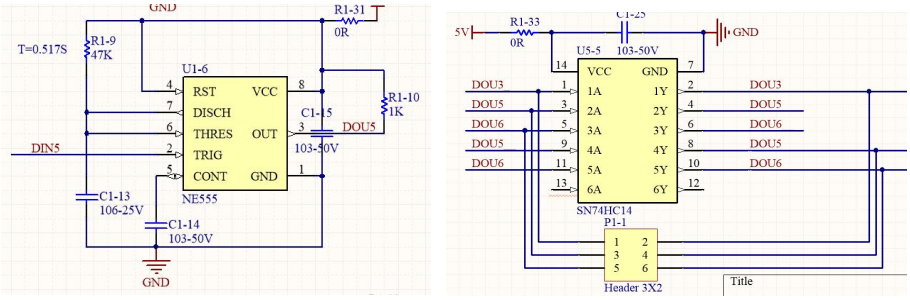

Fig.5 Manual pulse filter circuit

555 constitutes a monostable flip-flop, and the 7414 two-stage Schmitt trigger reverses as a filter device. The pin header and short-circuit cap can bypass the 7414 when it fails, and it can continue to be used. Also add a 0R resistor.

2.2.6 Adjustable PWM generating circuit:

Frequency adjustable PWM, range 1-1000Hz, add 0R resistor.

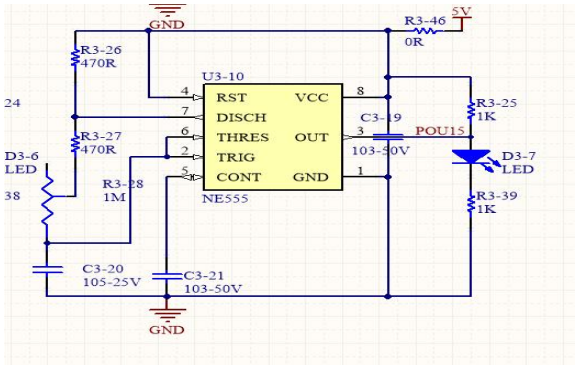

Fig.6 Adjustable PWM Generating Circuit

3. Results

By simplifying the original circuit layout and rationalizing the number of pulse input and output groups, a more stable and efficient pulse trigger circuit is obtained. Proven, the signal generator with the board.

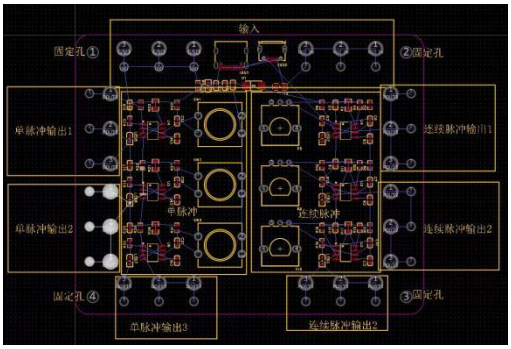

Fig.7 Pulse signal generator circuit diagram

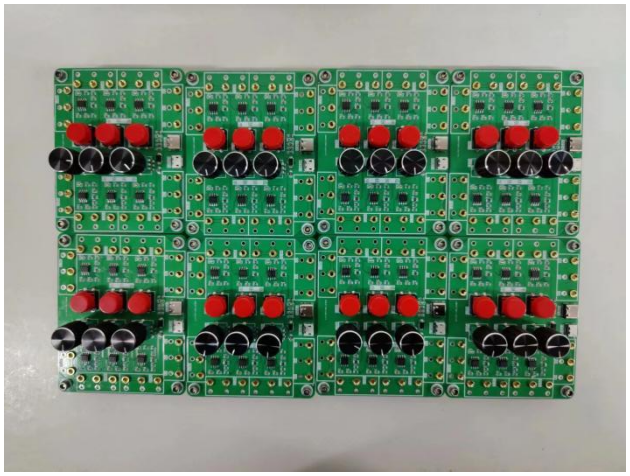

Fig.8 Physical picture of pulse signal generator

4. Conclusions

It can be seen that the new digital electrical experiment signal generator circuit board developed by our team has the advantages of small size, easy to carry, easy to replace the chip with the chip base, modular design, strong expansion and low cost, etc., which perfectly solves the problem of testing The box is not easy to carry, occupies a large volume, has unreasonable design and layout, and is not easy to maintain.

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