

## Ultra short Wave Set Tester Improvement Design

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**Abstract.** According to the problem that the original tester is big, heavy and expensive, using a virtual operation interface instead of actual operation panel and substituting a simple RS232 to USB converter for a big circuit box, make the tester be more portable and convenient operation. After practical application, the improved tester shows more stable and it also doesn't exist reliability degradation due to the aging of the circuit line and eliminate the need for daily maintenance.

Following the replacement of equipments, electric equipments become more and more advanced and their requirements are higher and higher. To guarantee the convenient operation, high efficiency and stability, the design becomes more and more humanization.

There are several defects in the original radio set tester. From the exterior, this tester is big in scale and heavy in weight. From the interior, there are some electric circuit boards and one programmable chip, which waste most space. From the cost, the shell is made of consumptive material, and is produced by professional manufacture. The production process is complicate and long and the cost is high. So, the original tester is no longer satisfied the requirements of users and shall be improved.

### Design Thoughts

The function of set tester is to substitute control box to control the transceiver, simulate operation and dispose cables necessarily. Nowadays, many functions are inclined to realize in software. In this project, the tester is converted from material object to software by designing a 3D module and functional software in computer.

### System Configuration

Many radio sets have serial ports to communicate with control boxes. Normally, this serial port is RS-232. But, with the development of computer, RS-232 port has been disappeared and USB is the most popular serial port instead[2]. Because USB could not be connected to RS-232 directly, a USB to RS-232 commutator shall be used to realize signal control to improve the original tester.

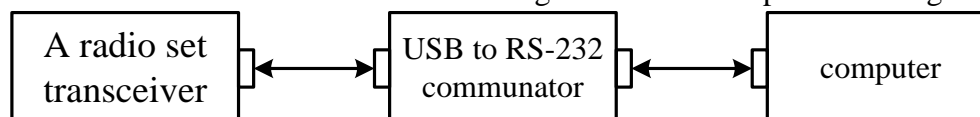


Fig.1. System Block Diagram

Fig 1 is the system block diagram of the tester. Any function is realized by the simulated tester in the computer. The disposed information is transferred to the commutator through USB. Then, the information is converted into RS-232 bus format to control the transceiver. In all, in this improved system, a tester is replaced by a simulated one and all functions are realized by software.

## System Realization

This system is divided into hardware and software. The hardware is to implement port conversion and information transmission. The software is to simulate control box and control the transceiver.

### 1. USB to RS-232 Converter

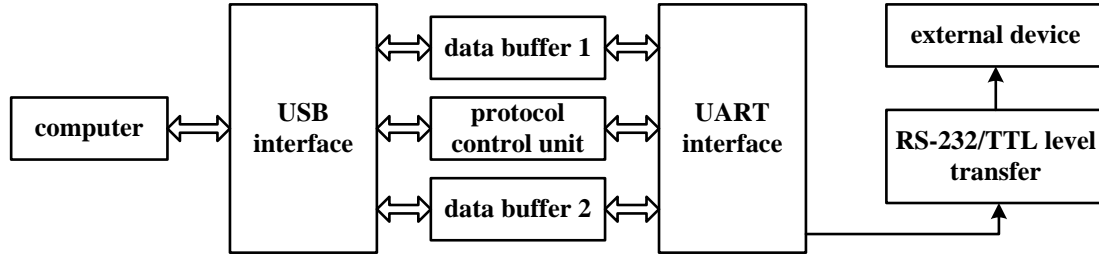


Fig. 2. block diagram of USB/RS-232 convertor

The block diagram of USB/RS-232 convertor is shown on fig 2. It is composed of USB interface, UART (Universal Asynchronous Receiver Transmitter) interface, data buffer and protocol control unit. The USB interface unit is to provide the connection to USB interface, which is designed to realize all functions of USB interface to transfer data with the host. The UART interface unit is to realize standard RS-232 interface function and connection. The protocol control unit is to configure UART interface according to USB commands, such as communication data rate, data bit, parity bit, stop bit and data capacity control and so on. The data buffer is to storage the temporary processing data for both sides.

Based on the block diagram, the key of the board is to choose a proper protocol convertor module. There are several ways to design this kind of board. The first one is to apply common USB controller with in-build convertor to transfer USB format to RS-232 format, such as EZ-USB series, PIC series and CY7C series. If there is no in-build convertor, an ordinary IO port simulating a data dispatching process is also can be used. In addition, a solo USB interface chip is another option, such as ISP series, PDI series and so on. This chip is required an additional controller to operate. The third method is to utilize a special convertor chip, such as CH341. This chip can realize protocol conversion process alone without any interface and hardware program.

In this article, a CH342 chip is used as the core of the convertor board. The fig 3 is a hardware block diagram of USB interface design figure with CH341T and MAX232. As shown on the figure, there are four components including USB interface, CH341T, MAX232 and RS-232 interface. The USB interface is connected to the host with A type connector. The CH341T is to fulfill all hardware functions converting USB interface to RS-232 interface. The MAX232 is to convert RS-232 interface level to TTL level. The RS-232 interface is to connect with a RS-232 device with usual DB9 connector.

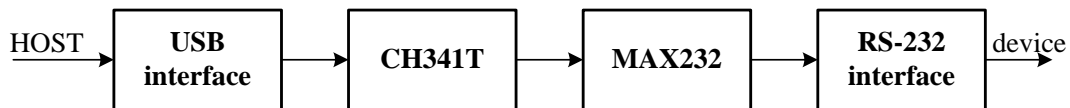


Fig. 3. the hardware structure of RS-232 device and USB interface

The hardware structure of RS-232 device and USB interface is shown on figure 4. The USB interface includes a pair of power lines and data lines. Normally, positive power line is red, the ground line is dark, positive data line is green and negative data line is white. The maximum current provided by USB interface is 500mA, and the USB interface can provide positive 5 volt voltage to CH341T chip. The C3 and C4 are radioceramic capacitance. The value of C3 is in the range from 4700pF to 0.02μF to decouple the internal power node of CH341T. The value of C4 is around 0.1μF to decouple external power. The crystal X1 and the capacitances C1 and C2 are for clock oscillation circuit. The frequency of X1 is 12M Hz. The capacitances are also radioceramic. MAX232 is to provide level transfer.

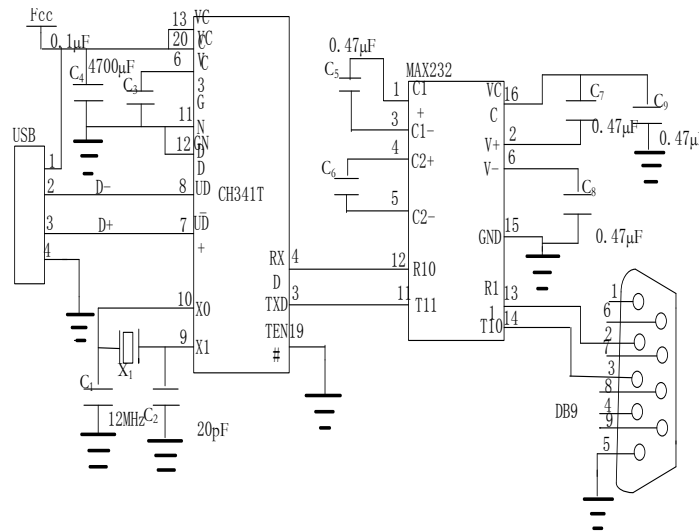


Fig 4. circuit of USB/RS-232 convertor

Take a data transferring from the host to the device for example, introduce the operating principle.

When the convertor is connected to a USB, a device shall be detected by the host, and a configuration shall be initialized. Then, customer driver software is started. The configuration commands will be transferred to the device to setup RS-232 data transmission peculiarity. At last, the data package is transferred to USB interface firstly. The practical data shall be read from the interface and store in data buffer. Then, the data will be read by UART interface and transferred to devices.

## 2. Software Design

The program is installed on the computer. It is the control interface of this tester. It can be programmed by high-level programming language. VC++ is a popular tool to develop application software with its object-oriented peculiarity and powerful MFC[4]. MFC is a patulous C++ class hierarchy to make a develop progress be easy, and it is compatible with the whole windows family. The project is developed by Visual C++, and its function includes opening/closing USB device, detecting USB device and transferring certain quantity data to USB device.

The following is some code and description.

```
Void CSINGALSDlg : : FindLoopDevice( )
```

```
{
```

```
 :
```

```
USBDevice -> Open (d) ;
```

```
 :
```

```
}
```

```
While( ( d < devices ) && ( USBDevice ->VendorID! =0x04b4)
```

```
&& (USBDevice ->ProductID ! = 0x8613 ) ) ; //Detect Vendor ID and Product ID to locate a device
```

```
 :
```

```
}
```

This program is to read/write data by a thread. The thread is the solo ordinal flow control. This procedure design uses the working thread to perform the data read and write operation mainly. The thread is the flow control alone in the procedure.. A thread is an entity in the process, a process can have a plurality of threads, a thread must have a parent process. The thread does not have system resources, and only some data structures that must be run. It is shared with other threads of the parent process to share all the resources in the process. Threads are divided into two types: support for the interface thread and the working thread (also known as the background thread). It is different from the user interface thread that it is not derived from the CWinThread class. It is the most important for it to realize the running control function of the job thread tasks.

## Conclusion

In actual application, after development, the manufacturing cost is saved, the problem of portability and convenient operation are solved, the stability is improved by circuit board substitution. At the same time, it also doesn't exist reliability degradation due to the aging of the circuit line and eliminate the need for daily maintenance.

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