Simply Talking about Analog or Digital Signal Measurement

Living in a flourishing era of science and technology, you can often find the electronic signal. For example, telephone, computer, TV and so on. As technology is growing, the features of such products are more and more diverse and the operating speed becomes faster. This trend is testing the ability of R&D Staff. They need more powerful instruments to design the circuit or analyze the more complex electronic signal.

In general, the electronic signal will display in the form of waveform or pulse. The basic features of waveform include:

Amplitude

The amplitude used on the project is mainly defined as two types. The first is commonly called peak amplitude which expresses the maximum offset of interference signal. The second is the root mean square (RMS) amplitude. If the waveform of RMS is needed to calculate, the voltage waveform must be squared and calculate the average voltage, then calculate the square root.

Phase Shift

Phase shift refers to the horizontal shift between the two waveforms which have the same two other conditions (such as voltage and frequency). And it use the degree or radian as measurement unit. For sine wave, a period is expressed by 360 degrees. If the difference between two sine waves is half period, the corresponding phase shift is 180 degrees.

Period

The period of waveform refers to the time when the waveform appears once repetitively. It uses the second as measurement unit.

Frequency

Every periodic waveform has frequency. The frequency refers to the number of repeating waveform in a second. The relation between the frequency and the period is $F=1/T$.

Waveform

The waveform refers to the shape of the signal or graphic representation. Waveform can provide some information about signal. For example, waveform can represent whether the size of voltage changes linearly or remains unchanged. There are many kinds of standard waveform and several common kinds are as following.

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Sine wave

Sine wave usually is associated with the alternating current source, such as indoor electronic outlet. The peak amplitude of sine wave is not always fixed. If the peak amplitude continues to decrease with time, the waveform is called the damped sine wave.

Square/ Rectangular wave

Square wave will periodically beat between two different values, so the length at the high point and the length at the low point are the same. If they are not the same, the waveform is called rectangular wave.

Triangular / Sawtooth wave

In the triangular wave, the voltage will linearly change with time. The signal edge is called ramp, because the waveform won't ramp up or ramp down to a voltage. Sawtooth wave looks like the triangular wave, because the front or the back signal edge will produce linear voltage response with time, but the opposite signal edge will almost directly down out.

Pulse

The pulse refers to a sudden interference in the fixed voltage. A series of pulse is called pulse train. The pulse is the common glitch wave or error wave in the signal.

Complex wave

Waveform can be a mixture of the above waveforms. It does not need to have periodicity and can be very complex waveform.

Analog and Digital signal

Analog signal is a kind of continuous signal, such as temperature, humidity, light and so on. In order to observe the voltage, current and other information in the analog signal, it usually uses oscilloscope to measure.

Digital signal is a kind of non-continuous signal which uses 0 or 1 to represent. Because the signal state is relatively simple, using logic analyzer to record the measurements is more appropriate when observing the digital signal.

With the trends of the present electronic circuit design, more and more electronic devices convert the Analog Mode into Digital Mode for dealing with data transmission gradually, which is mainly due to the following points.

High stability: Digital circuit is not like analog circuit affected by noise interference.

High reliability: Digital signal state is relatively simple, which only needs to identify the positive or negative logic state of signal. So the design of circuit element allows a greater range of variation.

Easy storage: Digital signal can be stored through memory, disk magnetic sheet and other storage devices for a long time.

In the design of electronic circuit, it converts the signal into digital signal after receiving analog signal trough sensor and can do the processing, storage and transmission with higher efficiency. Then it converts the digital signal into the analog signal to drive control devices after completing the processing. (Such as electric heater, solenoid value or motor…etc.). For example, the Indoor Temperature Control System can convert the analog signal of temperature into digital signal through the temperature sensor and transmit it to the control device. At this time, the control device can judge the temperature according to the indoor temperature value and then convert it into analog signal to drive the operation of air conditioning compressor, so as to achieve the temperature control.

In the process of circuit design, It is bound to meet the situation of circuit measurement. When encountering the analog signal, you can use the oscilloscope to measure. When encountering the digital signal, you can use the logic analyzer to measure. But for comparing the measured results of the two instruments, it will be a little inconvenient. Therefore, National Instruments developed the Virtual Instrument Software Architecture (Be short for NI-VISA). It can integrate the different instruments to meet the more complex measurement needs. It can do the synchronization control between instruments through GPIB, VXI, PXI, Serial, Ethernet or USB interface.

ZEROPLUS Technology Logic Analyzer supports Tektronix oscilloscope according to the NI-VISA.

The Logic Analyzer Software Beta_V3.10.01 above version of ZEROPLUS Technology can simultaneously display with Tektronix oscilloscope through NI-VISA, which can meet the needs of users for analog or digital signal measurement during the period of circuit design. Before using the DSO stacking, the NI-VISA software needs to be installed in computer system. (Be available for download from http://www.ni.com/visa/)

After completing the environment installation, you need to open ZEROPLUS Technology Logic Analyzer Software and click on "Tools->DSO-stacked Settings", then you can begin to connect the oscilloscope.

Figure1 shows the DSO-stacked Settings dialog box in ZEROPLUS Technology Logic Analyzer Software.

Figure1: DSO-stacked Settings Dialog Box

Then according to the 8Bit DAC AD558 of ANALOG DEVICE, do the measurement instructions.

AD558 Digital input interface is the 8 Bit parallel bus, and use Up Counter to input from 0x00 to 0x3F, then you can get the voltage waveform changes from 0V to 4V at Analog output end.

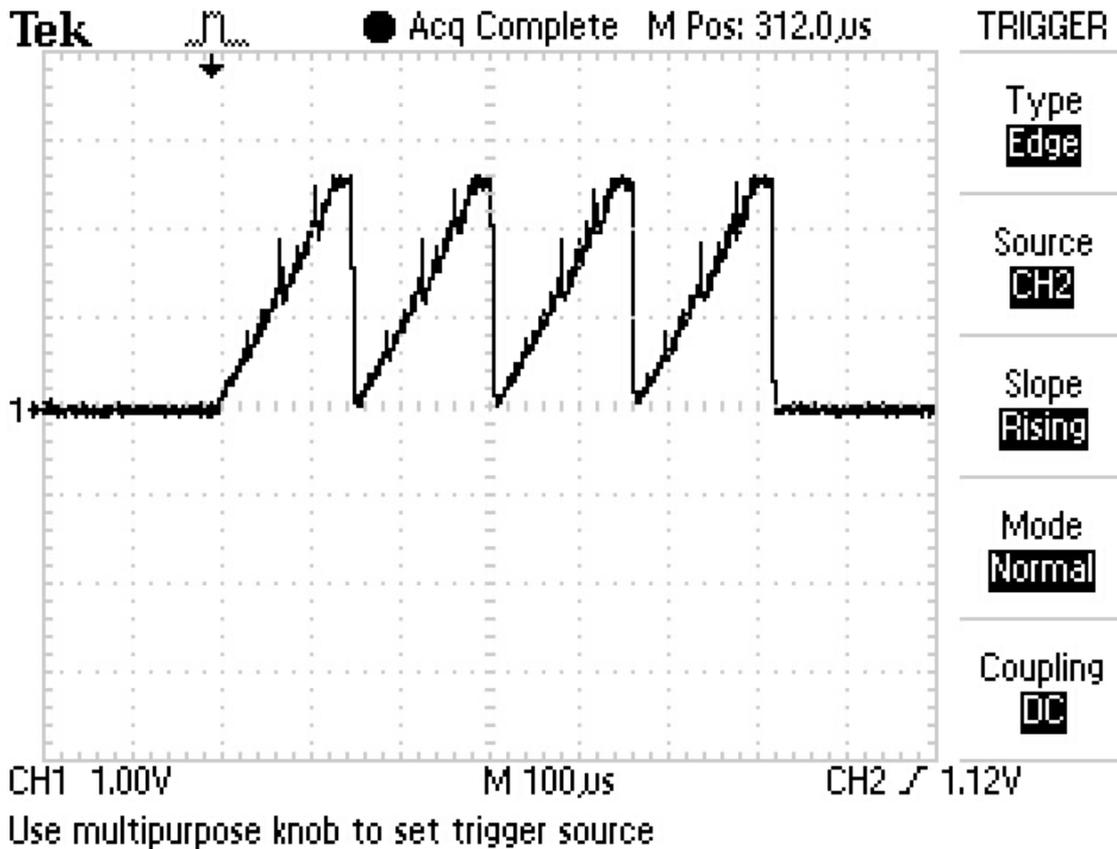Firstly, measure the output waveform of Analog End by the oscilloscope.

Figure 2: Oscilloscope Waveform

In Figure 2, you can see that the different parallel value is input to DAC and converted to different voltage waveform. At this time, you can observe the inputting state of parallel value to match with ZEROPLUS Technology Logic Analyzer.
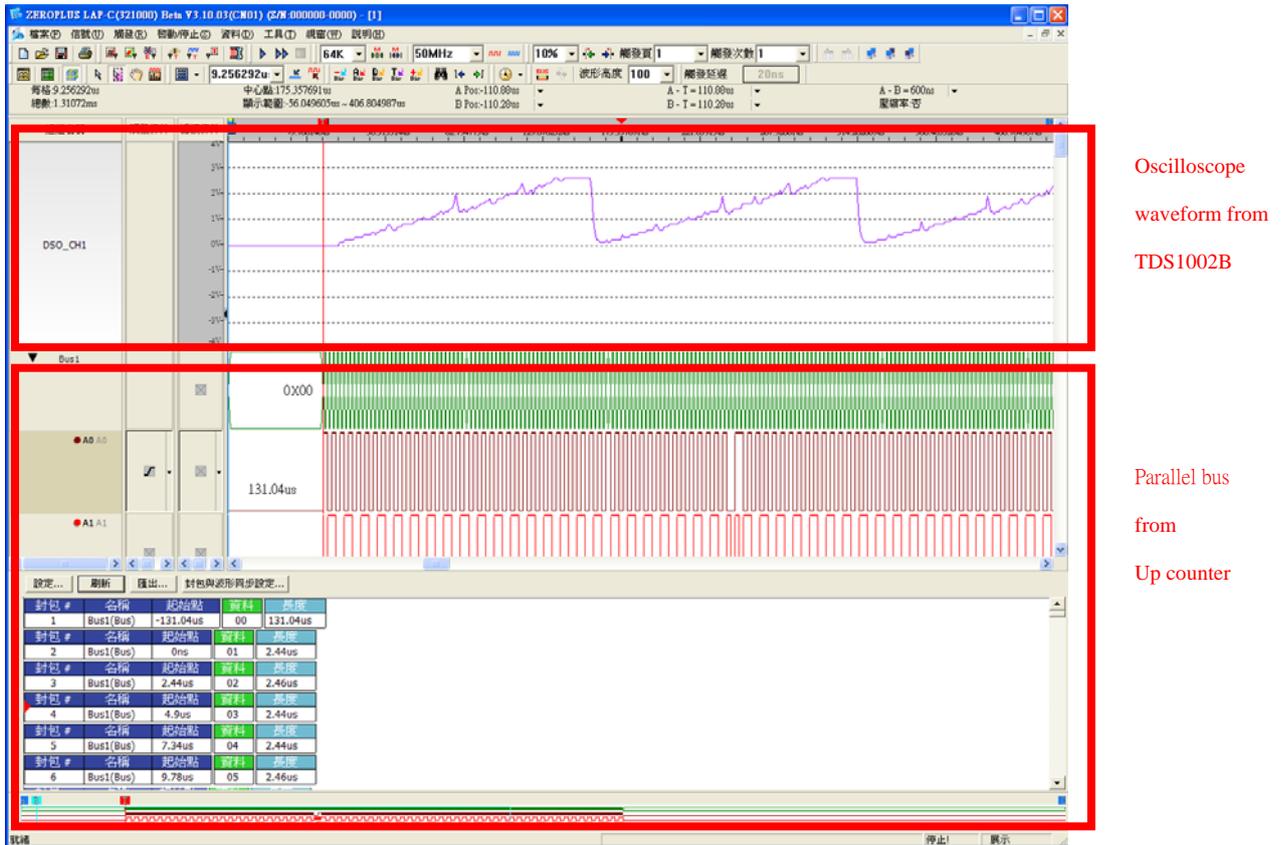
Oscilloscope waveform from TDS1002B

Parallel bus from Up counter

Figure 3: Waveform Display of Using logic analyzer and oscilloscope stacking

After the logic analyzer stacks with oscilloscope, it can do the signal analysis of analog and digital signals in the same software window. When doing the DAC or ADC observation, it can improve the analysis efficiency.

Conclusion

In response to a variety of measurement needs, there are more and more types of instruments. NI-VISA launched by the National Instruments is used to integrate the different types of measuring instruments. It uses the software development way to synchronously control through the common control interface, so as to integrate a variety of instruments.

We often encounter the analog and digital signals in electronic circuit design. According to the devices like sensors, the common application is that you can obtain the analog signal and convert it into digital signal to deal with or convert the digital signal into the analog signal to drive control devices. However, when encountering this measuring environment, if we can do analysis of analog or digital signal in the same UI, it is bound to improve the work efficiency.

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About

ZEROPLUS Technology Co., Ltd was established in 1997. It focuses on the design of the peripheral products of computer games. In 2004, the business scope was extended to the electronic measurement instruments. Applying the advanced MCU programming technology, the company successfully developed the latest patented measurement instrument, PC-Based Logic Analyzer. The unique and innovative technology was accredited by a number of patents granted, and the regions or countries where the company applied for patents have covered the whole world and the number of the patent and the country continues to grow. Since the release in 2005, the Logic Analyzer has been widely adopted by tens of dozens of public-listed technological manufacturers in the IC industry and the tertiary educational institutions. The excellent sale has made the Logic Analyzer the most popular in the market.