TDS3034B Oscilloscope Fault Diagnosis and Repair Technology

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Abstract This article summarizes the common faults of the TDS3034B oscilloscope, and on the basis of studying the structural characteristics and circuit composition of the instrument, comprehensive

Using measurement analysis methods such as comparison measurement and circuit functional segmentation, the partial circuit schematic diagram of the instrument was drawn inversely based on the measurement data, and the research formed a

Targeted fault diagnosis methods and key maintenance technologies.

Keywords TDS3034B oscilloscope; fault diagnosis; maintenance

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0 Introduction

The TDS3034B oscilloscope is a universal/convenient product produced by Tektronix

Portable digital oscilloscope, its highest real-time sampling rate reaches 5 per second

×10 9　 sampling points, equipped with a variety of trigger kits to meet the needs of scientific research, production

The basic needs of production. Found that the oscilloscope exists in actual use

The following common faults: 1) Unable to turn on or display fault; 2) Signal test

The measurement is not accurate; 3) The small range in the vertical direction cannot be measured, and the baseline disappears.

DC bias is out of tolerance, etc. In the absence of a maintenance manual, analyze

Instrument structure and circuit principles, research targeted maintenance methods

The fundamental way to solve this kind of maintenance problem.

1 Formulation of maintenance plan for TDS3034B oscilloscope

The TDS3034B oscilloscope consists of the main board, switching power supply module, LCD

The display panel and other modules are composed as shown in Figure 1. The motherboard has finished losing

Input signal shaping, acquisition, processing and display functions are the instrument’s

The core part, other units have completed power supply, graphic display and other functions

can. The analysis found that the circuit structure of the instrument is concise and compact, with various functions

Units can be quickly located, which facilitates component-level maintenance. Therefore, the first

The first type of failure: the problem of unable to boot or no display or flickering after booting, but

Quickly locate the faulty unit or use the method of substitution and comparison measurement

Components, laying the foundation for further implementation of device-level maintenance. Directly

The second and third types of faults that affect the signal measurement results can be preliminary

Locate the fault in the motherboard unit, but it is expensive to replace the motherboard.

There is no manual to carry out device-level maintenance. Because the signal path is unknown, the test

The test node is not suitable for positioning and other issues. In addition, the shaping circuit at the signal input

The road is an overall structure integrated on a ceramic substrate, which satisfies the large

Signal measurement needs protection and heat dissipation, but it cannot be passed through conventional welding hands.

The segment is replaced by replacement. Therefore, when encountering the second and third types of failures

After comprehensive consideration, it was decided to adopt the core function of each unit of the motherboard

Based on software, diagnosis is carried out by analyzing signal flow and signal characteristics

Measured maintenance plan.

Figure 1 Block diagram of TDS3034B oscilloscope circuit structure

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| **Page 2** |

Use and maintenance

Metrology Technology 2014. No 九

・85・

2 Analysis of maintenance examples

1) Fault description: A TDS3034B starts up normally and runs automatically

There is no error prompt in the inspection program, input excitation signal test found channel 1

Signal measurement amplitude is abnormal, frequency accuracy is normal, switch range

The fault condition remains the same; the other three channels are measured, and it is normal.

Failure analysis and maintenance process: According to the preliminary test, the failure

Focus on channel 1. As the other three channels are normal, it can be compared

Pair and signal tracking methods to locate faults. Disassemble the machine first, and on the motherboard

Use ±5V, +3V and ±12V reference power to measure, all are normal;

In the case of no power, weld the input end of channel 1 firmly,

Measure the value of DC blocking capacitor and shield grounding, etc., and there is no difference

often. Because the signal shaping circuit structure is relatively independent, through continuous change

The method of changing the setting state of the instrument, measuring the state and change of the incoming and outgoing signal

Can locate signal path and control path.

Draw a partial circuit diagram of the input terminal according to the actual circuit, as shown in Figure 2

Shown: the input signal is connected from the BNC connector and enters through the DC blocking capacitor

Input relay 1, complete the AC/DC input coupling here, and then by the relay

Appliance 2 controls and switches the input impedance. Load channel 1 and channel 2

Same signal, and make the same settings, test each signal node

try. In the case of setting 50Ω impedance matching and DC coupling, points

Don't measure the signals coming in and out of the two relays, fault channel relay 2

The output signal amplitude is significantly higher than the normal value, switch to 1MΩ impedance

When matched, the signal amplitude is normal. Continuously switch 1MΩ/50Ω input

Impedance, signal amplitude changes. Therefore, it is suspected that the port impedance matching is not

Good, further measurement found that when the faulty channel is switched to 50Ω, the actual

The measured value is 70Ω, and the mismatch causes the measurement result to be too large. Shut down, plus continue

Electrical control signal, the measurement found that the relay 2 switching action is normal, but

The 50Ω impedance access terminal is not closed properly, and there is a resistance value of about 20Ω.

Replace the relay, the indicators of measurement channel 1 are normal; for the oscilloscope

Perform the necessary index calibration and the instrument returns to normal.

2) Fault description: A TDS3034B starts up normally and runs automatically

There is no error prompt in the inspection program, and the user's fault is described as channel 4

It is not possible to measure small ranges below 10mV/div. Check channel 4 accordingly,

There are 5mV/div, 2mV/div, 1mV/div without scanning baseline

Problem, switch the input port to the ground state, adjust the vertical position up and down

Set the potentiometer, can not make the scanning baseline return to the normal position; 10mV/

The range above div is normal. Measure the other three channels: the state is basically positive

Often, there is a problem that the small range DC offset is out of tolerance.

Failure analysis and repair process: due to the DC bias in channel 4

For the problem of setting and small signal measurement, first run the instrument SPC program

(Signal path compensation program: can be corrected due to temperature changes or long

DC error caused by period drift, when the ambient temperature change is greater than 10℃

Or start at 5mV/div or smaller range), error cannot be reported during the process

Compensation is completed, and the fault still exists. Since there is no maintenance manual, for

There are no ready-made parameters for the specific composition and control process of the signal shaping circuit.

Test basis, therefore, the next step needs to be combined with the circuit for specific faults

Test results, analyze circuit composition and control signal flow. Because of the letter

The number shaping circuit is an independent ceramic substrate structure, which can be used with this unit

The core device TEK1650004102423 chip is the center and extends outward

Find the signals and control logic that enter and exit the shaping circuit. As shown in Figure 2

As shown, the signal lines entering and exiting the ceramic substrate are divided into three groups, with 11 lines on the left

The line numbers are L1～L11; the 11 lines on the right are numbered R1～R11;

The upper 8 lines are numbered U1～U8. Continuous switching of range and baseline

Vertical position, actual measurement of the level of each signal line of the faulty channel in groups

And the changes, the following results are obtained: See Table 1 for details.

Figure 2 Schematic diagram of TDS3034B oscilloscope signal shaping circuit

Table 1

TDS3034B oscilloscope shaping circuit

Pin signal analysis result

U1 Vcc = +4.94V L8

+0.065V

U2

Signal output

L9

~1.25V

U3

Signal output

L10

Ground

U4

Ground

L11

Ground

U5

Signal output

R1

Ground

U6

Signal output

R2

Ground

U7

+2.57V

R3

+2.57V

U8

Ground

R4

+0.9965V

L1

+1.02V

R5

+2.57V

|  |
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| **Page 3** |

Use and maintenance

・ 86・

Metrology Technology 2014. No 九

Continued

L2

Ground

R6

＋2.57V ／0V

L3

Ground

R7

Ground

L4

Signal output

R8

＋2.57V ／0V

L5 V EE = -4.94V R9

+2.57V/0V

L6

1.818V

R10

Switch with vertical range, vertical

Position changes continuously

L7

Ground

R11

＋2.57V ／0V

Comparing the test results of the normal channel, the analysis data can be sent

Now: 1) The DC bias voltage of the output signal of the shaping circuit (U2 ~ U3

Is a group, U5～U6 are a group) After setting the up and down position of the baseline,

Does not change with the switching of the vertical range. Under normal circumstances, the DC bias

Set in the range of -0.5～0.6V in proportion to the corresponding vertical position of the baseline

For example; and the signal DC bias of the faulty channel is 5mV/div, 2mV/

The range of div, 1mV/div exceeds the normal range more. 2) At R10

The signal changes continuously with the vertical range switch, the vertical position changes, and the positive

Under normal circumstances, the measurement result of R10 pin and its range and baseline vertical position

Set proportional changes, see Table 2 for details.

Analyzing the data in Table 2 can be determined: the vertical position control signal is determined by

R10 is injected into the shaping circuit, and its value is proportional to its range.

According to the relationship, the different gray areas in Table 2 represent the range control signal

Number of sections, respectively corresponding to different sections of the control signal: one packet of area

The content range is 1mV/div, 2mV/div, 5mV/div; area 2 contains

Process (10mV/div, 100mV/div, 1V/div), (20mV/div,

200mV/div, 2V/div), (50mV/div, 500mV/div, 5V/

div); Area 3 includes the range 10V/div. Analyze the test data to get

The corresponding law of the baseline position and the vertical control signal

The measured value of the control signal of the channel is compared with the normal value.

1mV/div, 2mV/div, 5mV/div, the number of vertical control signals

Value has greatly exceeded the normal range, which directly caused the baseline to exceed

The screen is malfunctioning. Track the source of the control signal from R10 and combine

The actual circuit draws the circuit schematic diagram in reverse, as shown in Figure 3.

Table 2

TDS3034B oscilloscope vertical position signal measurement results

Range

Location

R10 (V)

Range

Location

R10 (V)

Range

Location

R10 (V)

1mV/div

10mV/div

100mV/div

１V／div

１０V／div

5div

-0.0101

0div

-0.0052

－5div

-0.0004

5div

-0.0622

0div

-0.0136

－5div

0.0352

5div

-0.0663

0div

-0.0176

－5div

0.0312

5div

-0.0637

0div

-0.015

－5div

0.0337

5div

-0.5818

0div

-0.0939

－5div

0.3934

2mV/div

20mV/div

200mV/div

2V/div

5div

-0.0155

0div

-0.0057

－5div

0.004

5div

-0.1212

0div

-0.0236

－5div

0.0737

5div

-0.1255

0div

-0.027

－5div

0.0697

5div

-0.1227

0div

-0.0251

－5div

0.0722

5mV/div

50mV/div

500mV/div

5V/div

5div

-0.034

0div

-0.0096

－5div

0.0149

5div

-0.2984

0div

-0.0547

－5div

0.1887

5div

-0.3028

0div

-0.059

－5div

0.1849

5div

-0.2997

0div

-0.0565

－5div

0.1873

It can be seen from the circuit drawn in reverse that the control signal is generated by the chip

The output of ADG361 is composed of operational amplifier and electronic switch

The circuit unit. The test found that: when switched to below 10mV/div

When measuring range, the 4th pin of the electronic switch is at high level, and control the closing switch to make

The signal is grounded. Measured fault channel, closed control signal is normal, but

The switch is not normally closed, which results in DC entering the amplifier

The control signal is disordered, which eventually causes the vertical offset control signal to exceed the limit

The interval baseline jumps out of the screen. Replace the suspicious electronic switch and start the test

|  |
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| **Page 4** |

Use and maintenance

Metrology Technology 2014. No 九

・ 87・

Figure 3 A partial block diagram of the vertical control circuit of the TDS3034B oscilloscope

Test the instrument back to normal, run the SPC adjustment program again to pass, the instrument

The indicator returns to normal and the maintenance is over.

3 Summary

In the maintenance practice, it is found that although the TDS3034B oscilloscope is in

The circuit structure is unique, but the overall design is representative.

Fault analysis and diagnosis for digital oscilloscope signal path and control path

The methods can learn from each other. The reference information in the maintenance manual is very

Under limited circumstances, study the fault diagnosis and maintenance of this model oscilloscope

Method, can provide a way of thinking and method for the maintenance of similar instruments

I also hope that this article will give some inspiration to the majority of instrument maintenance colleagues.

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Correct use of capacitor film vacuum gauge

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The use of capacitor film vacuum gauge is directly related to the reliability of the product. This article analyzes in detail the vacuum of the capacitor film from five aspects.

Precautions for the correct use of the regulation, thus ensuring its accuracy and stability, and improving its service life.

Keywords capacitor film vacuum gauge; over-range; preheating; zero point; temperature environment

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0 Introduction

In vacuum measurement, the capacitive thin film vacuum gauge is used as a high-precision

Pressure sensor with a measuring range of 10 -2　～10 5 Pa, mainly used

For accurate measurement of rough and low vacuum or as a reference standard. its work

The principle is that the elastic membrane produces displacement under the action of the pressure difference, leading to

The change in the distance between the electrode and the diaphragm causes the capacitance to change

The purpose of measuring the degree of vacuum is achieved by measuring the change of capacitance.

Capacitor film vacuum gauges are divided into two types: absolute pressure type and differential pressure type.

Pressure means that the pressure in the reference chamber is negligible relative to the pressure in the measurement chamber

Don’t count, think that the reference chamber pressure is zero, in fact, the reference chamber

High vacuum, use getter to maintain the vacuum of the measuring chamber in the capacitance gauge

Below the minimum resolution. Differential pressure refers to any pressure as the zero point,

Measure relative pressure. This article refers to the absolute pressure capacitance gauge.

The main feature of the capacitor film vacuum gauge is: measurement accuracy

High, good linearity, sensitivity has nothing to do with gas type, can detect vapor and corrosion

The pressure of corrosive gas, the structure is firm, and it is easy to use. Single gauge

The measurement range can cover 5 orders of magnitude of the vacuum area, but the measurement is accurate

The quantity is generally only 3 orders of magnitude.

In order to enable the vacuum operators to use the capacitor film correctly

Vacuum gauge, so as to ensure the accuracy and reliability of the measurement, while extending

The service life of the long gauge, now we discuss the precautions in use.

1 Prevent over-range

Over-range means that the vacuum exceeds 10% of the full range or

higher. Although the capacitance film vacuum gauge is fixed occasionally when the range is exceeded

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| **Page 5** |

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