



Research Article

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## Fault detection technology of electronic circuit

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### ABSTRACT

*Faults are inevitable in electronic circuits. Timely and rapid solutions to these faults are the key technologies that make electronic circuit reached the target performance. This thesis explores several causes of electronic circuit faults and the performance of circuits when faults occur. It also conducts a multi-perspective analysis, and proposes several fault detection technologies that are effective. The author points out that several things should be paid attention to when using the proposed detection technologies and a systematic analysis of the fault detection technologies of electronic circuit is carried out. A thorough analysis of fault detection technologies of electronic circuit will help technical staff to respond to faults of electronic circuit in a timely manner.*

**Key words:** Electronic circuit; fault detection technologies; trail-run

### INTRODUCTION

Nowadays, electronic technologies are applied in various areas and people have higher expectations for the installation and trail-run of electronic equipment as well as the technical expertise of technical staff. During the operation of some electronic equipment, some unexpected technical faults are inevitable, thus, to better solve these faults, technical staff must understand how to use scientific fault detection methods and technologies of electronic circuit. When electronic circuit faults occur, technical staff should use their technical expertise to make timely analysis of faulted parts, and then conduct detection of faulted components. For more complicated devices, detection of faulted components is relatively difficult. So far, there are many fault detection methods of electronic circuit, for instance, direct observational method, parameter test method, signal tracing method, method of comparison, method of substitution and segmentation method. When applying such methods, many factors need to be considered, such as configuration device, instruments and equipment.

### COMMON FAULTS OF ELECTRONIC CIRCUIT AND THEIR CAUSES

Lots of faults can occur in the electronic circuit and its manifestation is various. Common faults are as follows: inability to adjust the output voltage; output voltage damage; considerable fluctuation on output voltage; circuit with waveform but no signal; circuit with signal but no waveform; unsteady signal; amplitude anomaly; no-oscillation in the oscillating circuit; abnormal counting and so on. The causes of faults are complex and multi-faced. In most cases, one single factor leads to faults, and then other factors together cause more damage.

#### 1. Faults caused by wrong design

Such fault can be avoided through a thorough and careful analysis in the circuit design. Take the design of topology structure of quantum neural network, which occurs very often, as an example. If the learning rate is too high, the weight of the network will change. The weight is much likely to be overcorrected and faults may occur under such condition. Figure 1 is the topology structure of quantum neural network.

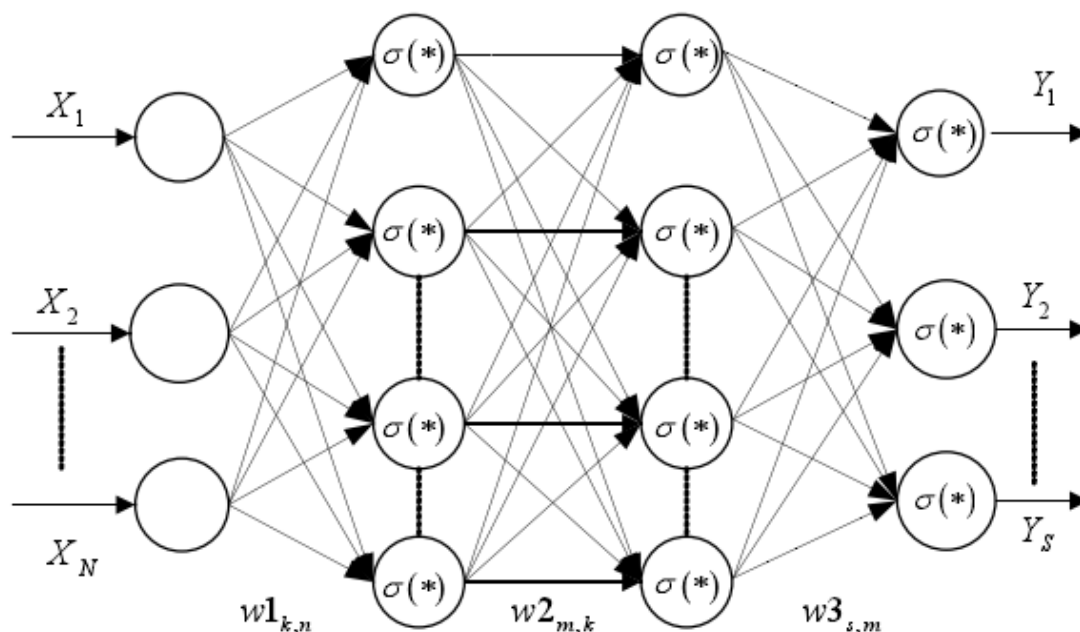


Fig.1

## 2. Faults of the prototype sample circuit

The causes are as follows: the actual printed circuit board of the circuit doesn't conform to the design schematic; damage to the device; abnormality of 12-phase modulation pulse rectifier in the way of double bridge cascade connection (refer to Figure2:); wrong connection of plus and minus pole of the diode, triode and electrolytic capacitor, etc.

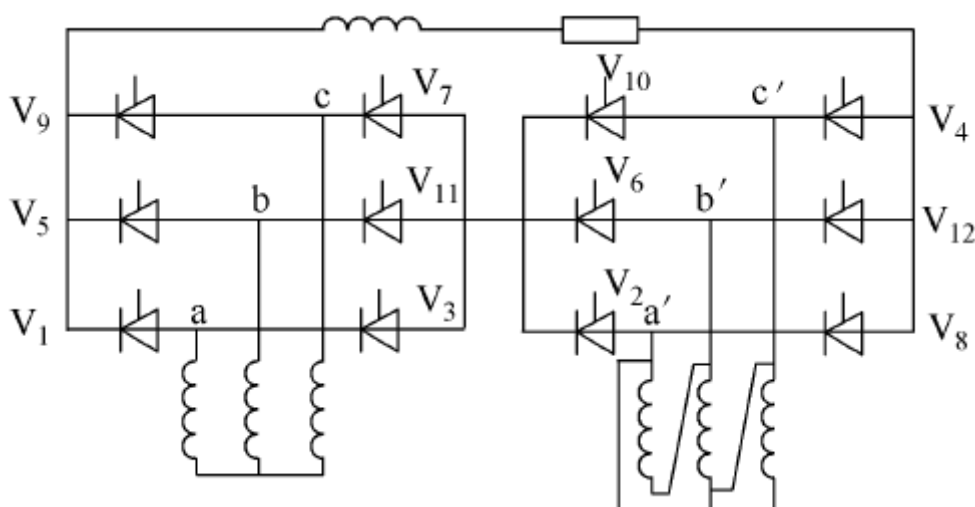


Fig.2

## 3. Faults of finished product

Some common causes of finished product can be listed as follows: damage to the device; wrong connection or disconnection, such as poor contact of the connecting line. Sometimes the change of using condition can affect the function of electronic devices, for example, the fluctuations of the temperature and radio wave.

## 4. Misuse of the instrument

The misuse of the instrument can also cause faults in the electronic circuit. For example, misusing oscilloscope may lead to abnormal waveform or no display of waveform. Inappropriate connection to the ground also results in negative influence.

## FAULT DETECTION METHODS OF ELECTRONIC CIRCUIT

When electronic circuit fault occurs, timely repair is necessary. The first step is fault detection, including analyzing faults manifestation, locating faults and finding out faults components. According to different settings of the

electronic circuit and installation of the circuits, there are various faults detection methods. Common detection methods of electronic circuit faults are listed below.

### 1. Direct observational method

Direct observational method solely relies on the observation of the technical staff to discover problems and find out the causes of faults without detecting instrument or changing the connection of the wires. Direct observational method works in the following way: cutting off the electricity, then testing whether the device and the power are proper; whether the diode and the triode are well-connected; the polarity of the electrolytic capacitor; whether the integrated circuit has disconnection or collision; the value of the resistance; whether the components has burning or smoke problems; whether the transformer has burning smell; whether the LED functions normally; Direct observational method is simple, which can preliminarily analyze some obvious faults.

### 2. Parameter test method

Parameter test method mainly uses instruments to detect the circuits, discover problems and find out faults. Working with or without power, it composes power-off test and power-on test. When the power is off, the ohmmeter can be used to measure the circuit flow and the multimeter can be used to measure the resistance. The connectivity of the circuit, the stability of the junction points, the current of power supply system and integrated circuit system can be detected this way. If the result doesn't conform to the set value, then the instrument can help to find out the faults. When power is on, we can measure and compare the voltage and current in the circuit, finding out the differences and faults. For example, while measuring if the current can flow normally at static state, we can also measure whether the parameter of the components function well. The measurement at static state is often displayed by oscilloscope. The advantages of using oscilloscope lies in its large resistance, which enables it to observe the waveform, possible influence signal and voltage at the same time under DC condition. These data are of great help to find out faults. Figure 3 shows the parametric variation of the backward current and resistance degradation.

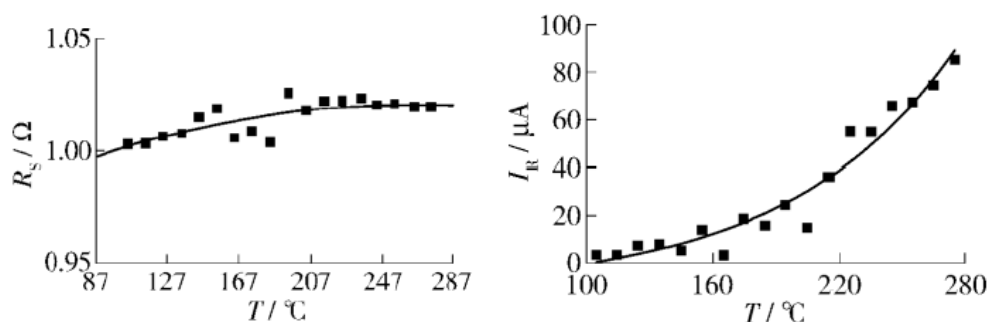


Fig.3

### 3. Signal tracing method

In signal tracing method, fluctuated but appropriate frequency signal is connected to the input end of the circuit, after which the changes of waveform and amplitude are analyzed through oscilloscope according to the input stage and the output stage of the signal fluctuation. Abnormal stage can be observed, where faults are likely to be found. The detection can also be done in the opposite sequence, that is to say, from the output stage to the input stage. It's noteworthy that once one component has problem, the whole loop will arise problems during the feedback. Thus, the feedback loop should be cut off instantly as soon as faults are detected, so that the whole loop can form an open cycle system. Then appropriate input signal is connected to the circuit. Finally faulted component can be found out according to output signals. Figure 4 shows the components damage rate.

Component	Component damage rate
Electrolytic capacitor	57%
MOSFET	32%
Inductance	7%
Diode	4%

Fig.4

### 4. Method of comparison

The method of comparison focuses on comparing the parameters under operation with normal ones. For example, if we assume some section of the circuit has faults, actual parameters as well as other theoretical values such as value,

voltage, current, amplitude and waveform should be measured and compared with normal ones in order to analyze where the faults are.

### 5. Method of substitution

There are also unsuspecting faults in the electronic circuit, as the faults of some components are subtle, such as leakage in the circuit line and decreased performance of integrated circuit. The best way to avoid such problems is to dismantle the faulted components and replace it with the same type. As a result, fewer places need fault detection.

### 6. Split test method

Split test method requires separating the whole circuit into many relatively independent circuits and test them respectively, which can reduce the difficulties of finding faults. The first step is to find out the faulted circuit, then find out the exact faulted component. As for the feedback circuit related to other circuits, we can use split loop circuit to remove the reflection process, and then detect them one by one, which will save lots of time. Split test method is very effective in narrowing down places that need fault detection.

## MATTERS NEED THAT WHILE DETECTING FAULTS

The accuracy of the electronic circuit faults testing results are greatly influenced by the precision. This is in particular true for some soft faults. In order to get more accurate results and minimize the errors, several aspects need to be noticed:

### 1. Use the measuring instruments' grounded junction correctly

While using the electronic instrument to detect faults, great attention needs to be paid to its' grounded junction. Make sure the grounded junction is connected with that of the amplifier. If they are not connected properly, the grounded junction of the instrument will hamper the amplifier's work and cause error in the measurement results.

### 2. Keep the measurement simple

Normally it is the voltage rather than current that needs to be measured, as measuring the current needs to change the circuits, which will bring troubles.

### 3 Record while measuring

Apart from careful measurement and observation, a good record is necessary while detecting electronic circuit faults. We can find the faults more quickly with lots of actual data record.

### 4 DO NOT dismantle and reassemble

Some staff may dismantle and reassemble the circuit when there are faults in trail-run. This can easily lead to some other problems in assembling. Some faults cannot be found out simply by dismantling the circuits, because they are root problems. Besides, other faults can arise while reassembling. So we should study the root of the faults and improve the ability to detect faults.

## CONCLUSION

This paper mainly introduces several effective fault detection methods of electronic circuit and matters need attention. To find out the causes of faults timely and accurately, we need not only rich theoretical knowledge, but also lots of practice as professional technical staff. In real practice, fault detection relies on our careful observation, skilled operation, frequent summary and extensive record. Only by doing so, can a technician master fault detection methods and technologies of electronic circuit and can be more competent in detecting and solving faults.

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