An automated scheme for continuity checks of the 50Ω terminated end of RPC Pickup Panels

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An automatic procedure of continuity checks of the low resistance connecting point of pickup strips has been developed. A prototype of this design has been developed and tested.

Introduction

In the INO experiment a large number of resistive plate chambers that are read out through pickup strip panels made up of polycarbonate, a dielectric material. In a pickup strip panel pickup strips are on one side of the panel and is made of copper and the other side is covered with an aluminum sheet. Both ends are terminated by a 50Ω resistance. In this paper we are focusing the study about continuity check of connection between pickup strip and ground (GND) by an automatic method. If the soldering is not up to the mark and hence there is no proper connection between the strips and the GND, either the signals will be absent or distorted. At the time of manufacture, the bad solder joint is not so apparent. It may look fine to a casual inspection and still can be a bad connection. In this situation the only way to check the continuity is with a continuity tester. To check the continuity of each pickup strip one-by-one will consume a lot of man hours, and therefore a suitable continuity tester circuit and also suitable automated methods have been studied. In this method one can measure continuity of each pickup strip of a panel at the same time, store data and also display pickup strip panel's status.

Simple continuity circuit

Designing a relatively less resistive continuity tester circuit is very important because pickup strips are terminated with 50Ω resistance. One of the easiest ways to measure continuity is with a multimeter that will give an audible alarm. If the multimeter and the resistance between the probes are less than 100Ω then the multimeter will not be suitable for the continuity check of such pickup strips. To check the continuity precisely and easily, the multimeter resistance between probes must have less than the termination value i.e. 50Ω of the strips. But the problem in this approach is that usually a continuity test multimeter is little bit costly and bulky too and at the same time one multimeter should be used for each pickup strips of the panel. To solve this problem a multimeter continuity circuit is designed and made in our laboratory and continuity between the pickup strips have been checked. The basic principle of continuity tester circuit is to measure resistance between two ends as shown in Figure 1. In this circuit, the value of R2 is kept at 50Ω and continuously optimizes the value of R1 resistance and at less resistance for this circuit to fulfil the requirements. If the continuity is good in pickup strip panel the LED is glowing otherwise LED is in the switch off mode, which means the resistance between two ends is very high i.e. no connection between the ends. LED light provides the double check of the test results.

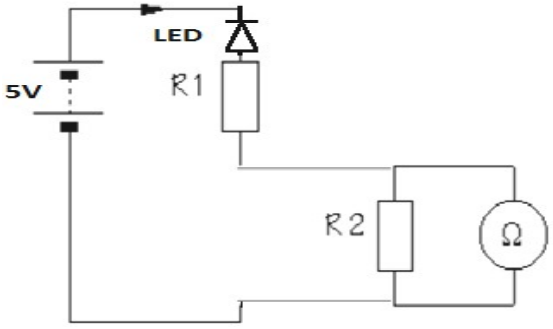

Fig. 1: A simple continuity circuit.

Op-Amp continuity tester

The op-amp circuit was developed to produce a continuity tester with a low resistance mainly for checking the connections between soldered joints**.** This simple circuit **[1]** uses a 741 op-amp in differential mode as a continuity tester. This circuit is built around a common IC-741 in differential mode and it provides high input impedance and low noise amplification in the input stage. The continuity test circuit can precisely judge continuity as well as soldering point also at the low resistance (0.25Ω to 4Ω). IC-741 Op-Amp is the most common and cheapest op-amp used in several circuits because of 1 MHz gain bandwidth. In this circuit, as shown in Figure 2, the two resistances are connected to the inverting and non-inverting terminals. If these two resistors maintained the op-amp inputs are ideally equal then the circuit would be balanced, therefore the output from the probes would be zero and hence producing zero potential difference. When circuit is checking the continuity of pick up strip panel 470kΩ and 10kΩ resistance create minimal voltage

difference that could be applied to the inputs of the op-amp. This potential difference is amplified and there will be a swing to full supply by the op-amp output which will cause the LEDs to glow.

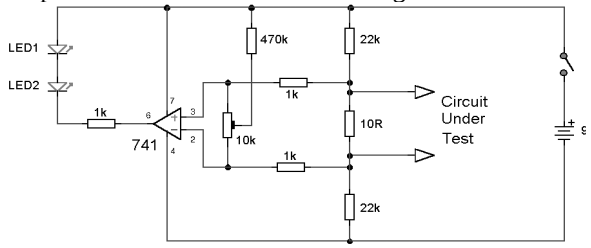

Fig. 2: An op-amp continuity tester circuit **[1]**.

Experimental details

In our method, we use a 2m×2m square aluminium frame and that square frame with a metal rod attached on the right side of the frame as shown in Figure 3. That rod contains separate (at 2mm gaps) metallic (aluminium) clips with pair tips coated with silver. These clips are Crocodile clips or ordinary type clips as well and also these clips are adjustable. The clips will be connected with the continuity circuit probes and also top side of each clips have LED to confirm the obtained value visually. If we want to check the continuity of the pickup strips, that pickup strip panel is placed between the adjustable clips and every pickup strip will be connected with separated clips. The continuity between copper and aluminium is very good the LED glows otherwise the circuit is not continuous. We take the output of pickup strip panel across the LED in terms of voltage and that voltage is connected to the TTL logic 7415. The TTL-7415 is 8 pin IC-TTL logic gives output only if input is more than 2V and if there is any short connection then TTL does not give any output. The TTL output is connected to the multiplexer SN74150. The multiplexer will work as switch. This multiplexer has 16 inputs and corresponding single outputs. The multiplexer's selected lines (S0,S1,S2,S3) determines which input is connected to the output and then output of the multiplexer is connected to the ADC-0801. The multiplexer gives output one by one to ADC converter with the help of the selected lines. The ADC will convert the every continuous signal in to the digital form and that digital form of signal is directly connected to the Arduino uno (microcontroller circuit). The Arduino uno has ATmega-328 microcontroller with 14 Digital input Pins, 32k Flash Memory, and 16MHz Clock Speed. It easily interfaced with computer. The Matlab software will show every pickup strip panel data and its status.

Conclusion

The above mentioned automatic continuity test method is one of the best methods and in this method we are avoiding unwanted fluctuations in the voltage across the LED with the help of TTL gate. This method can check continuity of pickup strips, store and also display the pickup strip status in the computer.

Acknowledgement

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Reference

[1] www.zen22142.zen.co.uk/Circuits/Testgear/connectiontester.htm

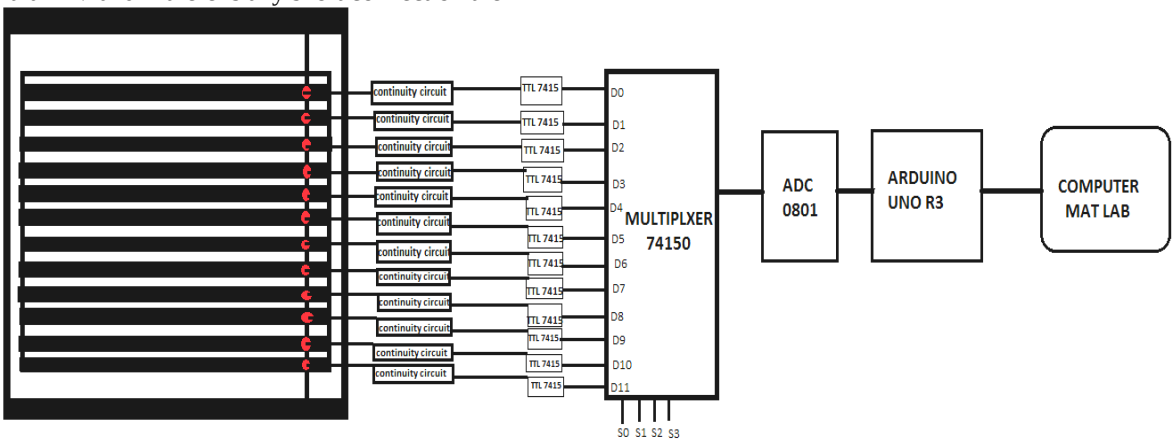

FIG. 3: Diagram shows automated continuity checking of pickup strip panel and data storage scheme.