Design and Construction of an Intelligent Transistor Analyzer

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A bipolar transistor analyzer was designed, constructed and experimented. It has three probes with crocodile dips connected at the ends for connection to the transistor. It can easily identify which pin or terminal is connected to any of its probes irrespective of the order in which it is connected. It can also identify if the transistor is NPN or PNP. This device is microprocessor controlled and takes few seconds to identify leads of a transistor and the type of a transistor.

1. Introduction

Transistor is an essential component of every electronic circuit from the simplest amplifier to the most elaborate computer. There is hardly any electronic circuit without one or more transistor existing in it either as discrete components or embedded in an integrated circuit. In as much as the transistor is a vital element in the electronic world, it has a setback, which lies in the difficulty in identifying the leads or pins of a transistor by mere looking at it.

There is no known common standard adopted by the manufactures for arranging the pins. The only known method for identifying the pins is the resistance test using a multi-meter. This is done by series of elimination tests guided by easily forgotten rules. This process is usually time consuming and is unreliable because of errors and faults that may come from the test equipment.

For this reason, it is necessary to design a device that will be used in identifying the pins of the bipolar (BJT) without having to go through the pains of trial and error associated with the resistance method.

2. Results

The intelligent transistor analyzer (ITA) uses the phase shift characteristics of the common emitter configuration of the NPN transistors and the non-phase reversal characteristics of the common collector configuration of the PNP to determine the leads of a transistor connected to it. The circuit diagram for the intelligent transistor analyzer (ITA) is shown in Fig.1.

The switch array matrix was designed to swap the leads of a transistor when a signal is applied to the appropriate control input used to close the electronic switches. The solid-state matrix was used to provide an automatic way of swapping the leads of the transistor in all the six possible permutations i.e., cbe, ceb, bec, bce, ecb, and ebc. It is made up of 18 bilateral switches that were gotten from IC 4066 chips. The programme was written in assembly language and stored in the microprocessor (IC8951).

Once the circuit is powered and the terminal of the transistor connected to the probes, the test key (S1) pressed, the microprocessor sends a signal to three of eight decoders (74138) to close the first possible combination out of the six possibilities. The output from the decoder is inverted using the Hex Schmitt inverter (40106). This is because the control terminals of the analogue bilateral switches (4066) used requires a HIGH to be able to close, but the output of the decoder is active low.

After this is done and the first possible combinations closed, the microprocessor sends a pulse to point X of the switch array matrix and then checks the effect of the pulse on the matrix at point Y. If there is a 180^{o} phase reversal between the signal applied to point X and the result gotten from Y, this tells the microprocessor that it is an NPN transistor. It then goes further to deduce the terminals of the transistor. The microprocessor then generates the codes for the results and sends it to the display section. If, on the other hand, there is no phase reversal and it is not PNP, the microprocessor closes another set of combinations and tests the transistor all over again. This cycle continues until the right configuration is arrived at and the leads of the transistor were swapped in all the six possible permutations until the bias circuit responds to the permutation that gives the required condition.

In a situation where after the sixth possible combination, the results do not correspond to the requirement for common emitter (NPN) or common collector (PNP), it then means that the transistor connected to the probes is either bad or not a bipolar transistor. When a bad transistor was

used, the ITA displayed 'BAD' and this means that the transistor is bad.

3. Conclusion

If there is 180^{O} phase reversal between the signal applied to point X and the result from point Y, then this tells the Microprocessor that it is an NPN transistor and it then goes further to deduce the leads of the transistor, but if there is no phase reversal it then means it is a PNP transistor. The intelligent transistor analyzer makes use of these distinctions to distinguish between an NPN and a PNP transistor.

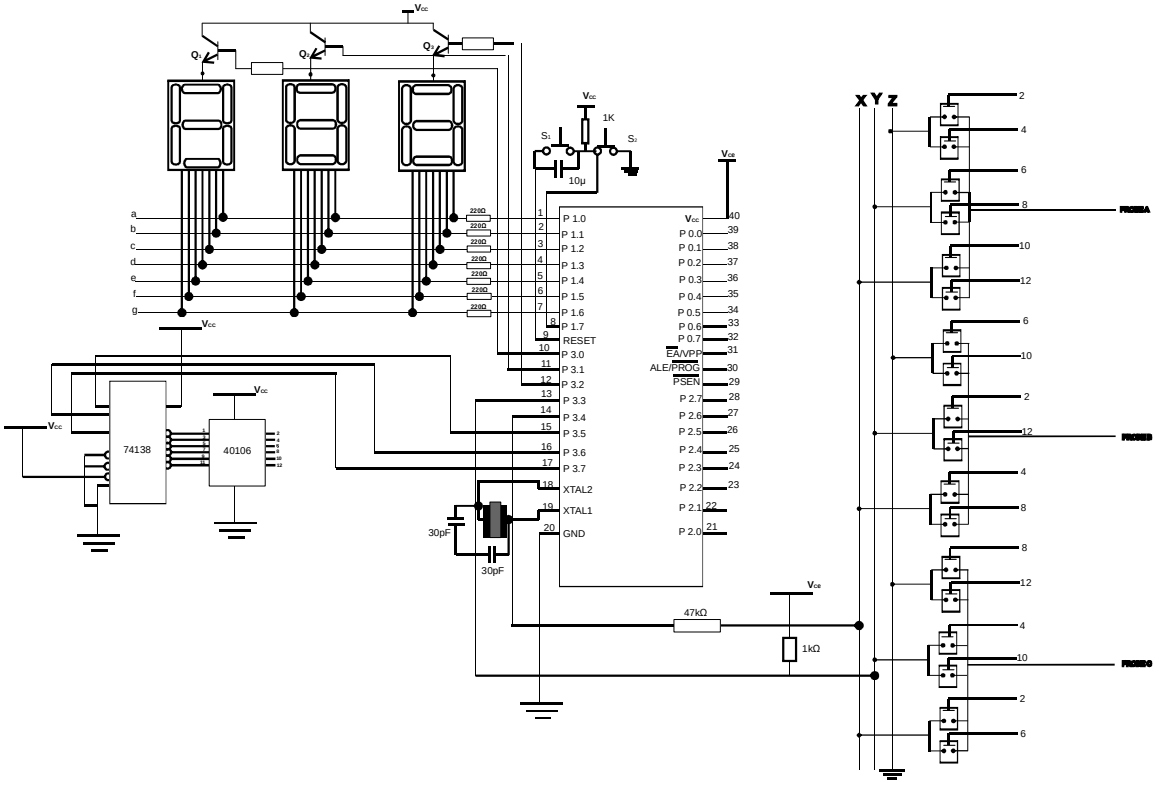

Fig 1: THE CIRCUIT DIAGRAM OF AN INTELLIGENT TRANSISTOR ANALYZER