RESEARCH ARTICLE   OPEN ACCESS

A Novel Design and Application of Binary Resistance Box Using DIP Switches

[1]A.Anvesh, [2]T.Charan Singh, [3]M.Maheswara Rao

[1 2,3]Swarna Bharathi Institute of Science & Technology, Khammam – 507002 ,T.S, India.
anvesh.anche@gmail.com,charanphd734@gmail.com, mahi214@gmail.com

Abstract:
This paper presents a model is to design a resistance box which has both step tuning and fine tuning of resistances, which is not facilitated with normal decade boxes and also provides the information regarding the selection of appropriate resistors to make the device capable of withstanding high power loss and all measures are also taken to keep the tolerance below 1%. The idea of designing this box is purely taken from working of normal decade resistances boxes and a slight change is done in alignment of resistors is made i.e. the resistances are in increasing powers of two, hence the box is named as binary resistance box. The rotary switches in decade boxes are replaced by DIP switches (ON/OFF) that facilitate the resistances to be dialed in and to build a binary (base=2) box. Each switch represents a power of two and the resulting resistance equals the combined value of the "ON" switches.

Index Term— Binary resistance box, DIP switches, decade resistances box, rotary switches

I. INTRODUCTION

A resistance decade box is a unit containing resistors of various values, with one or more mechanical switches which allow any one of various discrete resistances offered by the box to be dialed in. Usually the resistance is accurate to high precision, ranging from laboratory/calibration grade accuracy of 20 parts per million, to field grade at 1%. Inexpensive boxes with lesser accuracy are also available. All types offer a convenient way of selecting and quickly changing a resistance in laboratory, experimental and development work without needing to attach resistors one by one or even stock each value. The range of resistance provided, the maximum resolution, and the accuracy characterize the box. For example, one box offers resistances from 0 to 24 mega ohms, maximum resolution 0.1 ohm, accuracy 0.1%

Fig 1: Decade Resistance Box

• Decade resistance box takes only the discrete values (1,2,3,……..,10,20,30….,100,200,……) of resistances.
• Fine tuning of resistance is not possible in decade boxes.
•

II. CONSTRUCTION AND COMPONENTS

Since binary DIP switches are more difficult to read on site than rotary switches, here we used two sets of binding posts; one set to attach to an ohmmeter (to verify the selected resistance value) and one set to put the resistance in-circuit. A DPDT switch lets you toggle between them. Also, since the combined analog resistor values tend to vary from the perfect digital values you want, we added a 25 ohm POT for fine tuning and two 8-channel DIP switches, which provide the following binary values: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1,024, 2,048, 4,096, 8,192, 16,384, and 32,768. With it, you can combine switches to create any value between 0 and 65,535 ohms. As is customary with binary numbers, I started with the least significant digit (lowest ohm value) on the rightmost switch and increased in power-of-two increments to the maximum value on the left.

A.**Resistor:** Resistance is the property of component which resists the flow of electric current. The higher the value of resistance (measured in ohms) the lower will be the current. The voltage across the component drives the current through it and this energy appears as

International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
NATIONAL CONFERENCE on Developments, Advances & Trends in Engineering Sciences
(NCDATES- 09th & 10th January 2015)

heat in the component.   Each switch in the DIP corresponds to a power of 2, we intended the closest combination of available resistors to total these values. R1+R2 = Resistors in Series   R1//R2 = Resistors in Parallel. The resistors are so selected such that the tolerances are kept less than 1%. When the switch is closed, the resistance is bypassed. When the switch is open, its resistors are added to the total resistance value. The 25 ohm rheostat is connected in series with the switches to allow fine tuning of the resistance value. The DPDT switch allows you to toggle between the two sets of binding posts.
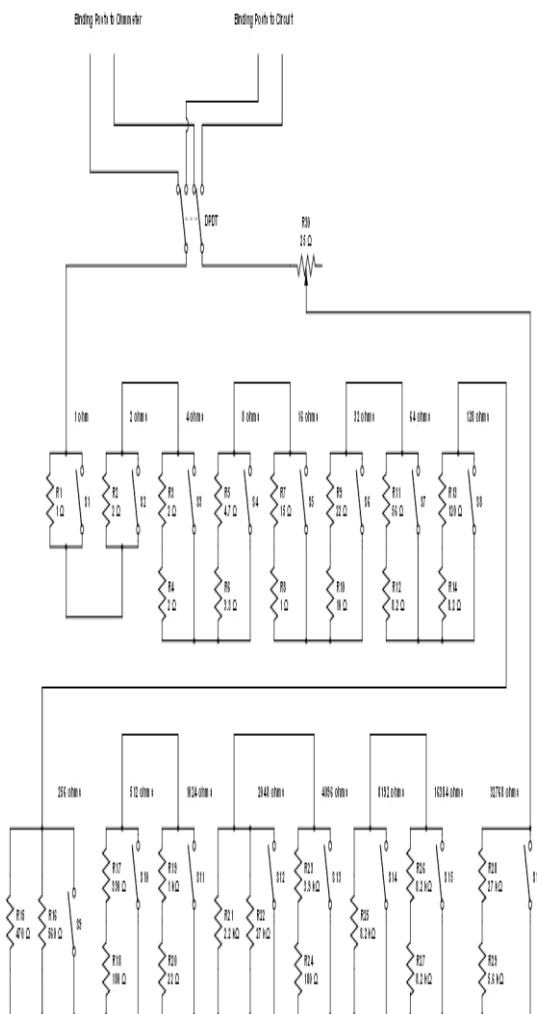

Fig 2: Circuital Approach

Table1: binary Resistance box resistors values

Ohms	Resistors Used	Actual Resistance in Ohms	Tolerance
1	1	1	0.00 %
2	2	2	0.00 %
4	2 + 2	4	0.00 %
8	4.7 + 3.3	8	0.00 %
16	15 + 1	16	0.00 %
32	22 + 10	32	0.00 %
64	56 + 8.2	64.2	0.31 %
128	120 + 8.2	128.2	0.16 %
256	470 // 560	255.53	-0.18 %
512	330 + 180	510	-0.39 %
1024	1K + 22	1022	-0.20 %
2048	1.5K + 560	2060	0.59 %
4096	3.9K + 180	4080	-0.39 %
8192	8.2K	8200	0.10 %
16384	8.2K + 8.2K	16400	0.10 %
32768	27K + 5.6K	32600	-0.51 %

Standard EIA Color Code Table 4 Band: ±2%, ±5%, and ±10%
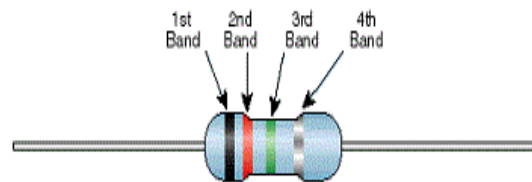
Color	1st Band (1st figure)	-2nd Band (2nd figure)	3rd Band (multiplier)	4th Band (tolerance)
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	±2%
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Gray	8	8	10^8	
White	9	9	10^9	
Gold			10^{-1}	±5%
Silver			10^{-2}	±10%

Fig 3 : resistor color codes

B. DIP switches

A dip switch is a manual electric switch that is packaged with others in a group in a standard dual in-line package (DIP). The term may refer to each individual switch, or to the unit as a whole. This type of switch is designed to be used on a printed circuit board along with other electronic components and is commonly used to customize the behavior of an electronic device for specific situations.DIP switches are an alternative to jumper blocks. Their main advantages are that they are quicker to change and there are no parts to lose. This binary resistance box

International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
NATIONAL CONFERENCE on Developments, Advances & Trends in Engineering Sciences
(NCDATES- 09th & 10th January 2015)

needs two DIP switches and by increasing the number of DIP switches we can increase the range of the resistance binary box.

C. Ohm rheostat

This rheostat is accountable for achieving fine tuning of resistances. The most common way to vary the resistance in a circuit is to use a rheostat, which is a two-terminal variable resistor. For low-power applications (less than about 1 watt) a three-terminal potentiometer is often used, with one terminal unconnected or connected to the wiper. Where the rheostat must be rated for higher power (more than about 1 watt), it may be built with a resistance wire wound around a semicircular insulator, with the wiper sliding from one turn of the wire to the next. Sometimes a rheostat is made from resistance wire wound on a heat-resisting cylinder, with the slider made from a number of metal fingers that grip lightly on to a small portion of the turns of resistance wire. The "fingers" can be moved along the coil of resistance wire by a sliding knob thus changing the "tapping" point. Wire-wound rheostats made with ratings up to several thousand watts are used in applications such as DC motor drives, electric welding controls, or in the controls for generators. The rating of the rheostat is given with the full resistance value and the allowable power dissipation is proportional to the fraction of the total device resistance in circuit.

D. DPDT mini toggle switch:

A double pole double throw (**DPDT**) toggle switch is accountable for toggling the entire resistance between two binding posts that is between ohmmeter and test circuit. Toggle Switches have a to and fro switching movement but through an arc. They are easy to install and look good on a Switchboard. Power connected to the centre pair of terminals can be switched in turn to either of the two other pairs of terminals. Much more usefully, connect together the outer pairs of terminals but with the connecting wires crossing over. In other words connect the terminal in one corner to the corner terminal which is diagonally opposite and repeat on the other side. The wires from the middle pair of terminals are the output and the pair of terminals at the end of the switch - it doesn't matter which end are the input. When an A1 switch wired in this way the polarity of the output will be reversed. This offers a solution to the polarity conflict on return loops. The switch will also work two aspect color light signals fitted with light emitting diodes because these devices only light up when a DC current passes in the right direction through them. Reversing the polarity of the feed to the LED's will change the aspect from green to red or vice versa. A toggle switch is a class of electrical switches that are manually actuated by a

mechanical lever, handle, or rocking mechanism. Toggle switches are available in many different styles and sizes, and are used in countless applications. Many are designed to provide the simultaneous actuation of multiple sets of electrical contacts or the control of large amount of electric current or mains voltages. The word "toggle" is a reference to a kind of mechanism or joint consisting of two arms, which are almost in line with each other, connected with an elbow-like pivot. However, the phrase "toggle switch" is applied to a switch with a short handle and a positive snap-action, whether it actually contains a toggle mechanism or not

Fig: 4   DIP switch,   Rheostat,   Toggle Switch

III. CIRCUIT IMPLEMENTATION

The Radio Shack Dual-IC board is used because it included pads projecting out from both sides of the DIP. This seemed to be the perfect starting point for soldering resistors across each switch. Start by breaking the board in half along the perforated edge. Solder one DIP switch in the middle of each board segment, then add resistors across each switch and jumper wires to connect adjacent resistors. As you can see from the photos, the resistors get pretty crowded especially when you have to use series or parallel groups of resistors to get the desired value. Be very careful not to let adjacent leads touch each other. This could obviously cause problems with total resistance. Next, connect the two IC boards together by soldering a short length of wire between the tail end of the 128 ohm switch (on board 1) and the leading end of the 256 ohm switch (on board 2). Then wire in the rheostat, toggle switch, and binding post ends according to the schematic.

After the complete construction of the box, try it out using the following steps:-

- Make sure that the toggle switch is in Ohmmeter position.
- Connect your ohmmeter to the ohmmeter side binding posts.
- Connect your leads to test circuit.
- Flip on the appropriate switches to get the resistance wanted
- Verify with the ohmmeter.

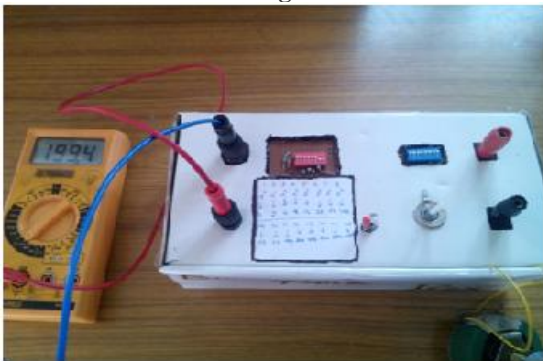*International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622*
NATIONAL CONFERENCE on Developments, Advances & Trends in Engineering Sciences
(NCDATES- 09th & 10th January 2015)

Fig:1

Fig: 2

Fig: 3

Fig: 4

Fig: 5

Fig: 6

Fig: 7

Fig: 8

International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
NATIONAL CONFERENCE on Developments, Advances & Trends in Engineering Sciences
(NCDATES- 09th & 10th January 2015)

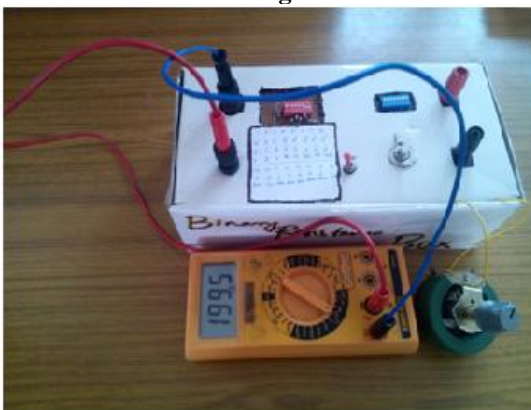**Fig: 9**

From the fig: 1 to fig: 9 are showing the working of binary resistance box for various resistance values

IV. APPLICATIONS

A. Measurement of Resistances or Inductances Using Bridges: The bridge circuit is used to measure unknown inductances in terms of calibrated resistance and capacitance. Calibration-grade inductors are more difficult to manufacture than capacitors of similar precision, and so the use of a simple "symmetrical" inductance bridge is not always practical. Because the phase shifts of inductors and capacitors are exactly opposite each other, capacitive impedance can balance out inductive impedance if they are located in opposite legs of a bridge, as they are here. Unlike this straight Wien Bridge, the balance of the Maxwell-Wien Bridge is independent of the source frequency. In some cases, this bridge can be made to balance in the presence of mixed frequencies from the AC voltage source, the limiting factor being the inductor's stability over a wide frequency range. Hence in the presence of mixed frequencies the inductance value present on one of the arms of the bridge changes. In order to balance the bridge we need to adjust the resistance on one of the arms of the bridge, the resistance that needs to be changed may be in integers or in fractions, so to apply fractional value of integer's binary resistance box is helpful. Also during the designing stages of resistance box itself, we need to employ a particular value of resistance on one of the arms of the bridge, that resistance value is again can be measured from binary resistance box.

B. Setting Current in a Test Circuit: Electric current is measured in amperes, but actually in most electronics work, you'll measure current in milliamps, also you need to vary the current in milli amps or mA to study the variation of system parameters. To measure current, you must connect the two leads of the ammeter in the circuit so that the current flows through the ammeter. In other words, the ammeter must become a part of the circuit itself. More often while doing any experiment on a testing circuit; we need to employ small value of current in it. We know that higher value of resistance is responsible for small current; this smaller current can be attained from the box.

C. Calibration of Lab Equipment Such As Ammeter: Ammeter is the universal meter available and any meter can be easily designed using the construction principle of ammeter. In any Ammeter electro mechanical energy conversion takes place two times. The second phase of energy conversion results in pointer running over calibrated scale. The customer is very much concerned about reading given on scale by the pointer. Hence the meter has to be calibrated perfectly to get accurate and précised outputs. Calibration depends on the variation of value of current entering and hence depending on magnitude of current pointer deflects. The coli mechanism present inside the meter has some resistance to be offered and there should be some deviation in the measured value of the current. This error can be neglected by properly calibrating the scale. Hence for calibration we need to employ small resistances to mark divisions on the scale, in order to draw milli and micro divisions. This is possible with the help of this box.

V. CONCLUSION

The "Binary Resistance Box" has been successfully designed and tested. Integrated features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit.

REFERENCES

[1] S. Chen, B. Mulgrew, and P. M. Grant, "A clustering technique for digital communications channel equalization using radial basis function networks," IEEE Trans. on Neural Networks, vol. 4, pp. 570-578, July 1993.
[2] J. U. Duncombe, "Infrared navigation—Part I: An assessment of feasibility," IEEE Trans. Electron Devices, vol. ED-11, pp. 34-39, Jan. 1959.
[3] C. Y. Lin, M. Wu, J. A. Bloom, I. J. Cox, and M. Miller, "Rotation, scale, and translation resilient public watermarking for images," IEEE Trans. Image Process., vol. 10, no. 5, pp. 767-782, May 2001.

AUTHOR BIOGRAPHY

A.Anvesh, he obtained his B.Tech in Electrical and Electronics Engineering from Swarna Bharathi Institute of Science and Technology, JNTU, Hyderabad in 2014, Telangana, India.
T. Charan Singh he obtained his B.Tech in Electrical and Electronics Engineering from JNTU, Hyderabad in 2001. He obtained M.Tech in Energy Systems in 2006 from JNTU college engineering Hyderabad and pursuing Ph.D at JNTU, Hyderabad. He has teaching experience of 11 years and

International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
NATIONAL CONFERENCE on Developments, Advances & Trends in Engineering Sciences
(NCDATES- 09th & 10th January 2015)

guided more than 20 UG projects and 7 PG projects. He has five International Journal publications to his credit. Present he working as, Assoc. Professor & H.O.D of Dept of EEE SBIT, Khammam Telangana India. 507002And his areas of interest include 6-Phase system, Power Systems stability, FACTS and Smart Grid.

M.Maheswara Rao obtained his B.Tech in Electrical and Electronics Engineering from JNTU, Hyderabad in 2005. He obtained M.Tech in Electrical Power systems in 2010 from JNTU college engineering Hyderabad.. He has teaching experience of 8 years . presently working as, Asst. Professor Dept of EEE SBIT, Khammam Telangana India. 50