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Designing of Universal Serial Bus port Device Protection Circuit

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ABSTRACT

Now a days the PCs and laptop computers has become an integral part of our professional as well as personal life. Due to rapid advancement of Hardware as well as Software technology most of the electronic Gadgets and Gizmos are coming as USB port compatible plug and Play. As it is inconvenient to carry a computer for all the business meetings or other visits hence the USB compatable devices such as Flash Drive etc are used widely. But this USB plugable devices are susceptible to get damaged by a faulty USB port in a Laptop or a PC. In this paper a ciruit which will detect a faulty USB port is proposed which will save the USB playable devices from getting damaged.

Keywords: Universal Serial Bus Port, Pen Drive, Fault Detection, Circuit.

1. INTRODUCTION

The attraction of USB technology is the "Plug and Play" functionality that has turned out to be an industry benchmark Information Communication Technology (ICT) peripherals and digital devices. USB ports are nowadays used for charging of devices as well as for data storage and data transfer. The USB interface standard has been updated several times to keep pace with the growing demand for speed as well as the increasing storage capacity requirement of the users at a faster data transfer speed[1].
\Starting from 48 Mbps in version 1.1 to 480 Mbps in version 2.0 there was a jump in speed when version 3.0 is likely to provide a 4.8 Gbps. USB 3.0 will present a noteworthy increase in storage capacity in addition to the higher data transfer rate USB port.

In spite of the ease and speed accessible by the USB edge standard, there are basic design-level considerations that need to be guarantee functionality and dependability of the hardware. As built-in circuits reduce in size and as data transmission rates increase, it is notable that each time the edge is connected or disconnected; the port is subject to both overvoltage and over current transients. Additional threats take account of hot plugging, short circuiting, ESD events, damaged equipment, and user error. Mix this variety of potential threats with the increased breakable nature of small integrated circuits, it becomes very important than ever to provide strong protection for USB ports [2][4].

Rest of the paper is divided into 6 Sections. Section 2 is about the USB flash drive. In Section 3 we have proposed a circuit to detect the short-Circuit fault in a USB port. In Section 4 we have described the functions of the components of our proposed device. In Section 5 we have mentioned about the test result of the USB port test device.

2. USB INTERFACE

USB is a 4-wire interface having the following lines:

- A pair of data lines
- 1 power line
- A ground which operates at 4.4 V–5.25 Volt DC required by USB interface standard that a resettable fuse is used for over-current protection, which is only essential on the power line. The power line and both data lines utilize overvoltage protection with reference to ground.

The following table gives the details of the lines in USB and the Figure 1shows the Flash drive architecture.

Pin	Wire Color	Signal Name	Description
1	Red	VCC	+5VDC
2	White	D-	Data -
3	Green	D+	Data +
4	Black	GND	Ground

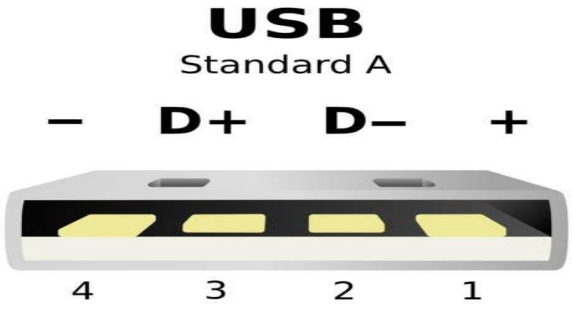


Figure 1: Flash drive architecture

Prevent such problem, here, we use a simple circuit to detect short circuit indication . In Figure 2 Transistors SK100 and BC547 are used to obtain the secondary output of approximately 5V (O/P2) from the main 5V supply.

Working of the Short-circuit Protection circuit is simple. With 5V DC output from USB port, transistor BC547 conducts through resistors R1 and R3 and LED1. As a result, transistor SK100 conducts and short-circuits protected 5V DC output show across O/P2 terminals. The green LED (LED2) glows to specify the same, while the red LED (LED1) rest off due to occurrence of the same voltage at both of its edge. When O/P2 edge short, BC547 cuts off due to grounding of its base. As a result, SK100 is also cut-off. Thus during short-circuit, the green LED (LED2) goes off and the red LED (LED1).

Internal components of a flash drive	
1	USB connector
2	USB mass storage controller device
3	Test points
4	Flash memory chip
5	Crystal oscillator
6	LED
7	Write-protect switch
8	Unpopulated space for second flash

3. SHORT CIRCUIT PROTECTION DIAGRAM

Here is a Short-Circuit Protection circuit to obtain the extra power supply from the USB port of computer. The USB device is protected from any destruction due to short-circuit in the power supply of PC (Personal Computer).An LED is used to specify whether short-circuit exists or not.

USB devices do not required any additional power source for working. When we connect any USB Device in computer Rear panel or front panel it automatically detect and got the power from mother board or main board and the supply gives to mother board from SMPS(switch mode power supply).If our USB port is shorted then device connected to that port goes off. The following circuit gave us the concept as well as the start point of our work [3].

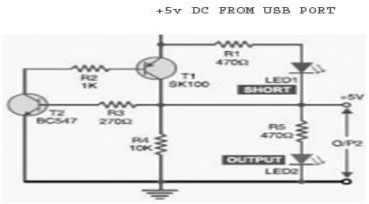
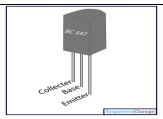
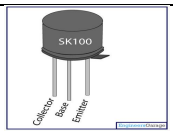


Figure 2 : Proposed circuit for short circuit detection in USB port

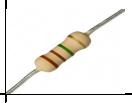
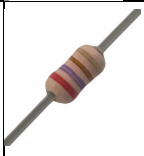
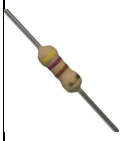
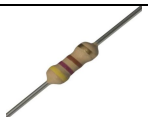
4. PROPOSED CIRCUIT

Our proposed circuit will be having the following components

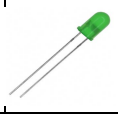
a. Transistors

Transistor–(T1)-SK100-1 no.	
Transistor–(T2)-BC547-1no.	

b. Resistors

R1- 470 Ω	
R2- 1Killo- Ω	
R3- 270 Ω	
R4- 10 Kilo- Ω	
R5- 470 Ω	

c.LEDs

LED1	
LED2	

Function of Transistor BC547

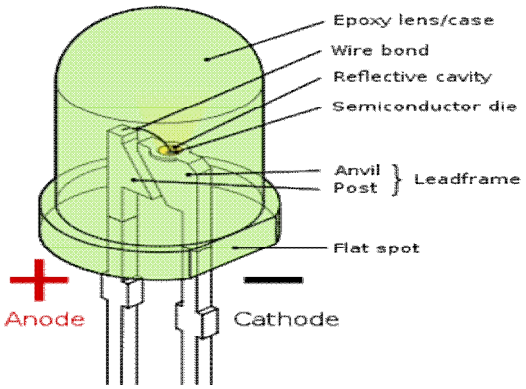
BC547 is an NPN bi-polar junction transistor. A transistor, stands for transfer of resistance, is commonly used to amplify current. A small current at its base controls a larger current in collector & emitter terminals. BC547 is mainly used for amplification and switching purposes. It has a maximum current gain of 800. Its equivalent transistors are BC548 and BC549. The transistor edge needs a permanent DC voltage to function in the preferred area of its characteristic curves. This is known as the biasing. For amplification applications, the transistor is biased such that it is to a certain extent on for all input circumstances. The input signal at base is amplified and taken at the emitter. BC547 is used in common emitter arrangement for amplifiers. The voltage divider is the generally used biasing mode. For switching applications, transistor is biased so that it rest completely on if there is a signal at its base.

Function of Transistor SK100

SK100 is a universal use, standard power PNP transistor. The basic applications of a transistor are switching, amplification and regulation. Its DC current gain ranges from 100 to a highest of 300. The transistor edge needs a permanent DC voltage to function in the preferred area of its characteristic curves. This is known as the biasing. For amplification applications, the transistor is biased such that it is to a certain extent for all input circumstances. The input signal at base is amplified and taken at the emitter. BC548 is used in common emitter arrangement for amplifiers. The voltage divider is normally used biasing mode. For switching applications, transistor is biased so that it remains fully on if there is a signal at its base. In the absence of base signal, it gets totally off.

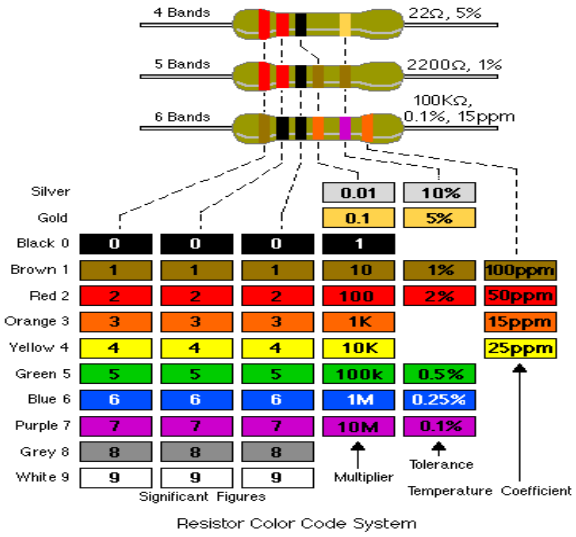
The emitter leg of SK100 is indicated by a protruding edge in the transistor case. The base is nearest to the emitter while collector lies at other radical of the casing [5].

a) Pin Diagram of SK 100 & BC 547



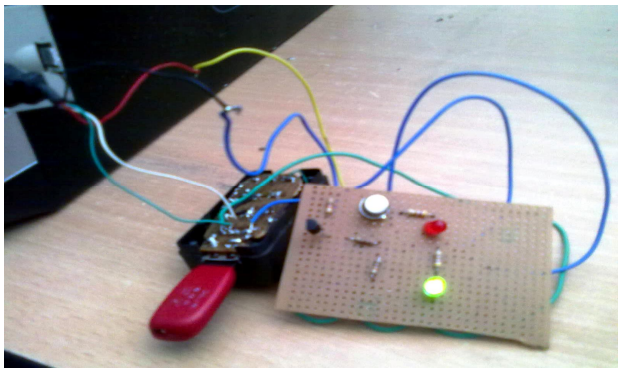
b) Connecting and soldering

LEDs must be fixed the right method, the diagram may be labeled positive (+) for anode (A) and negative (-) for cathode (K). The short lead is cathode and long lead is anode as shown in below. If you can see inside the LED the cathode is the larger electrode (but this is not an actual identification method).

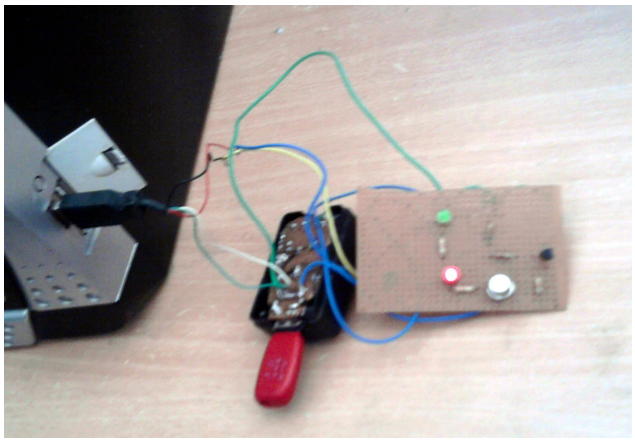


4. IMPLEMENTATION OF THE PROPOSED WORK

We arrange all the components as shown in parts list table and connect all these according to proposed circuit diagram in figure-2.After that we connect this device to Desktop USB port as shown above diagram. We observed that LED2 (Green led) glows and flash drive connect to the device. We explore my computer and see that flash drive detected. The green LED indicates that the USB port is OK.



Secondly, we reverse the USB port connection for short circuit means +5v (pin1) to Gnd. (pin4) and vice versa. Now, connect the device to USB port as above diagram and observed that Red led (LED1) glows. The current does not pass to the pen drive also pen drive is not detected. The Red led indicates that the USB port is shorted.



This small device is most essential for today because most of devices now comes with USB supported, if USB port is shorted then device connect to this port goes off. Prevent for this problem this circuit acts like a fire wall to protect the devices and cost will be approximately US $ 2.

5. CONCLUSION

The circuit designed by us worked during our trail in laboratory. If this circuit is added to the Flash Drive or any other USB compatible device this will perfectly detect a faulty USB port which will save the device specifically flash drive getting damaged.

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REFERENCES

1. http://www.arrownac.com/offers/bourns/Bourns_USB_Port_Protection_Final.pdf
2. http://www.bangkoksite.com/DigitalPhotography/Accessory/ExternalHDD1.htm
3. http://apowersupply.com/short-circuit-protection-in-dc-low-voltage-systems-380.html
4. www.bourns.com/pdfs/cgshortform.pdf
5. http://www.engineersgarage.com/electronic-components/sk100