NUTAN MAHARASHTRA VIDYA PRASARAK MANDAL'S

Under administrative support of Pimpri Chinchwad Education Trust

# Nutan Maharashtra Institute of Engineering and Technology

## Talegaon Dabhade, Pune

**PBL REPORT ON**

**ELECTRICAL WIRE FAULT DETECTION**

**BY**


## Project Group Members

| Name of Student | Roll. No. |
|---|---|
| i. Gaurav Patil | SE 40 |
| ii. Shubham Patange | SE 39 |
| iii. Kalpesh Narkhede | SE 36 |
| iv. Prajwal Nakure | SE 32 |
| v. Vedang Modi | SE 25 |

**Under the Guidance**

**Of**

**Prof. Sarika N.Patil**

**DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING**


**2022-23**

**PCET's**

**NMVPM's**

**Nutan Maharashtra Institute of Engineering and Technology**

**Talegaon Dabhade, Pune**

# *CERTIFICATE*

This is to certify that, this PBL report entitled

**"ELECTRICAL WIRE FAULT DETECTION"**

is a record of Project based Learning work carried out in this college

**BY**

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**PBL Guide**

**(Dr. Nitin Dhawas)**
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**DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING**

**2022-23**

# ACKNOWLEDGEMENT

We would like to take this opportunity to express our hearty gratitude and sincere thanks towards our guide Prof.Sarika N.Patil for her invaluable assistance and support for our project. We express our sincere thanks to Dr.Nitin Dhawas sir, HOD of E&TC Dept. and our respected Principal Dr.V.V.Deotare sir for making full time availability of all the laboratories and necessary equipment. We would like to thank all the staff members of E&TC Department for their encouragement, suggestions during the partial fulfillment of the project of Project based Learning.

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# CHAPTER 1

INTRODUCTION

## 1.1 Aim of project

The aim of a wire fault detection project is to identify and locate faults or abnormalities in electrical or communication wires. The project typically involves developing a system or algorithm that can analyze the characteristics of the wires and detect any faults, such as breaks, short circuits, or insulation degradation.

## 1.2 Problem Statement

Here are some of the key needs or motivations for such a project:

1. Safety: Wire faults, such as short circuits or damaged insulation, can pose serious safety risks, including electric shocks and fire hazards.

2. Reliability and Performance: Faulty wires can lead to interruptions or fluctuations in electrical power supply or communication signals.

3. Cost Reduction: Identifying wire faults early on can help reduce maintenance and repair costs. By detecting faults before they escalate into more significant issues, expensive equipment damage or system failures can be avoided.

## 1.3 Literature review

- In this literature review, we will explore some of the research that has been conducted in this field, including the various types of concealed electrical wire detectors and their applications.
- Types of Concealed Electrical Wire Detectors : There are several types of concealed electrical wire detectors that have been developed for different applications. Some of the most common types include:

1. Magnetic Field Detectors: These detectors work by detecting the magnetic field produced by an electrical current passing through a wire. They are typically handheld devices that can be used to scan walls, floors, and ceilings for hidden wires.
2. Radio Frequency (RF) Detectors: RF detectors use radio waves to detect the presence of electrical wires. They can be used to locate wires behind walls, as well as underground cables.
3. Infrared (IR) Detectors: IR detectors use thermal imaging technology to detect the heat signature of electrical wires. They can be used to locate wires that are hidden behind walls, ceilings, or floors.

- Here are some patents and there number which are filed by the scientists

1) Electrical wiring safety device for use with electrical wire US7482535B2 Robert Jay Sexton.

The invention describes an electrical wire design with improved safety and convenience. It features electrifiable conductors surrounded by return conductors, preventing contact with the electrifiable conductors without touching the return conductors. The wire is surface-mountable and suitable for various voltage applications. Insulating layers separate the conductors, and protective treatment is applied to edges to prevent foreign object penetration. The wire may also include grounding conductors for inhibiting power transmission signals and dissipating heat more effectively than traditional round conductors. Multiple electrifiable conductors allow for communication and power transmission segments.

2) System for inductive power provision in wet environments US8536737B2 Yossi Azancot.

The invention involves a power providing system that incorporates inductive power outlets into various surfaces such as walls, floors, ceilings, sinks, and doors. The power outlets consist of primary inductors connected to a power supply, which generate an oscillating voltage supply. These primary inductors inductively couple with secondary inductors connected to electric loads. The invention includes different embodiments using prefabricated materials like plasterboard, paper

sheets, and wallpaper for incorporating the power outlets. It also mentions various features like ferromagnetic cores, water resistance, heating elements, and high-resistance primary inductors. Additionally, the passage discusses the adaptation of electrical appliances to draw power from the inductive power outlets and the incorporation of power outlets into furniture items. The invention further introduces a positioning mechanism for moving the primary inductors behind the bounding surfaces and indicators to determine their location. The passage also addresses a protection system comprising circuit-breakers, primary detectors, secondary detectors, and controllers to prevent power transmission in the absence of electric loads.

3) Device for analysis of synthetic rope or cable, and method of use CA2942917C Sylvain Ouellette. The invention described is an apparatus for measuring the lay length of a synthetic rope using magnetic detection elements. The apparatus includes a sensor device with a passageway for the rope, sensors to detect changes in magnetic flux caused by the magnetic detection elements, and a calculation or display unit to determine the distance along the rope corresponding to the number of helical or circumferential paths of the magnetic detection elements. The magnetic detection elements are made of metallic or synthetic fibers coated with a detectable material. Additionally, the invention can be used for testing the integrity, strength, safety, lifespan, load capacity, wear, or analyzing the lay length and detecting damage or breakage in synthetic ropes.

## 1.4 **Proposed Work**

Conduct a comprehensive literature review on wire fault detection techniques, algorithms, and existing systems.

Determine the appropriate sensors or measurement techniques for detecting wire faults.

Evaluate various sensors or measurement devices suitable for detecting wire faults (e.g., voltage sensors, current sensors, thermographic cameras).

## 1.5 Introduction

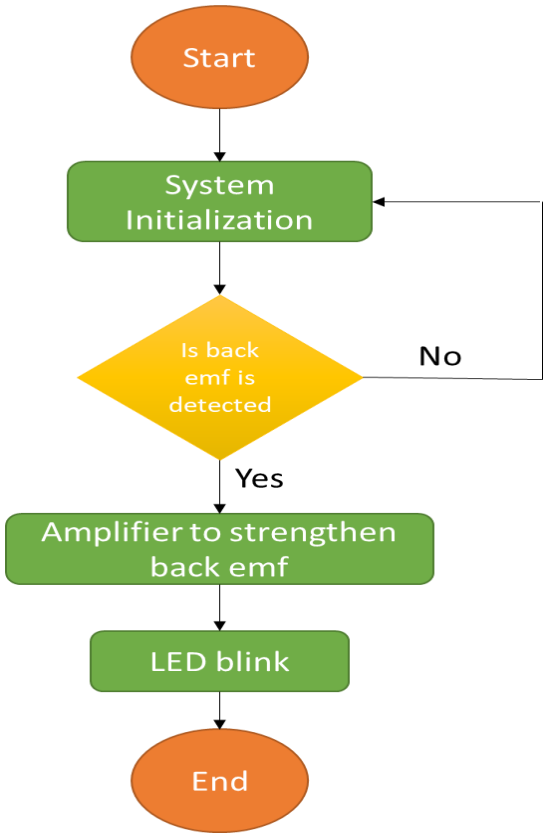
Wire fault detection is a critical aspect of electrical system maintenance and safety. It involves identifying and locating faults in wires, such as breaks, shorts, or abnormal behavior, to ensure the proper functioning of electrical circuits and prevent potential hazards. Wire faults can occur due to various reasons, including physical damage, insulation degradation, environmental factors, or manufacturing defects.

The purpose of wire fault detection is to quickly and accurately identify the presence and location of faults in electrical wiring systems. Detecting and resolving wire faults promptly is crucial to maintain operational efficiency, minimize downtime, and prevent accidents, fires, or equipment damage. Wire fault detection is particularly essential in industries such as power distribution, manufacturing, automotive, aerospace, telecommunications, and building infrastructure.

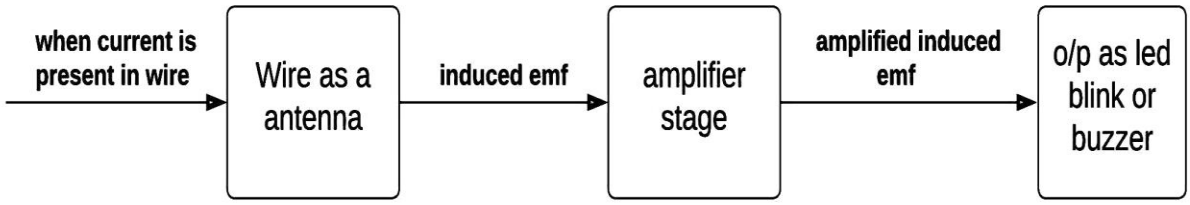
# CHAPTER 2

## SYSTEM IMPLEMENTATION

## 2.1 System Flowchart




## 2.2 Block diagram



# CHAPTER 3

HARDWARE DESIGN

## 3.1 Specifications

1. Wire diameter :

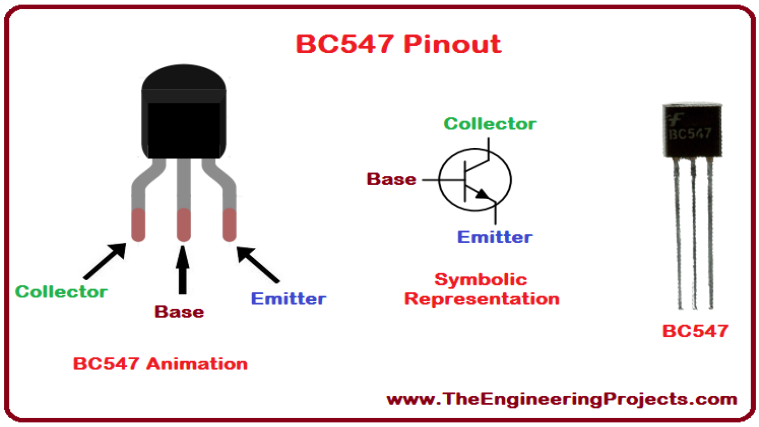
   Copper wire 1.628mm AWG:12.

2. Detection range:

   0.5 cm-2cm

## 3.2 COMPONENTS

### 1. **Transistor BC547** :

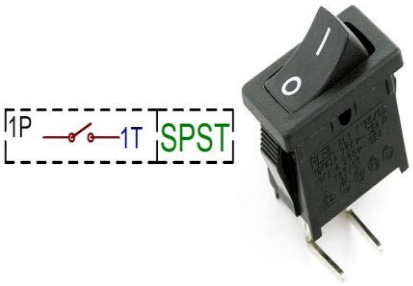



The MOSFET BC547 is a popular small-signal NPN transistor that finds extensive use in electronic circuits. This transistor is specifically designed for low-power applications, making it suitable for amplification and switching purposes in a wide range of electronic devices.The BC547 MOSFET offers several advantages, including low power consumption, high gain, and excellent linearity. It can handle moderate current and voltage levels, making it suitable for small-scale applications. Additionally, it has a low noise figure, allowing for clear and accurate signal amplification.Due to its compact size and versatile performance, the BC547 is widely utilized in various electronic projects, including audio amplifiers, signal processing circuits, and voltage regulators. It is also commonly employed in sensor interfaces, oscillators, and switching circuits.When using the BC547 MOSFET, it is important to ensure proper biasing and operating conditions to achieve optimal performance. The datasheet for this transistor provides essential information regarding its electrical characteristics, pin configuration, and recommended operating conditions.

## 2. BUZZER:

A buzzer is an electronic component used to generate audible sound signals. It consists of a vibrating element, usually a diaphragm or a piezoelectric crystal, that produces sound when an electrical current passes through it. Buzzer components are commonly used in a variety of applications, including alarms, timers, electronic games, and notification systems. They are compact, easy to integrate into circuits, and come in different sizes and types, such as electromagnetic and piezoelectric buzzers. By controlling the frequency and duration of the electrical signal, buzzers can produce different sounds, ranging from simple beeps to more complex melodies, making them invaluable for auditory communication and signaling purposes.

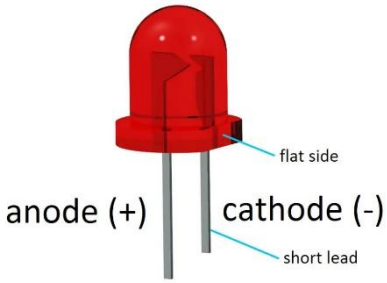
## 3. SPST(Single pole single throw) :




SPST, which stands for Single Pole Single Throw, is a fundamental type of switch commonly found in electronic circuits. It consists of a single input terminal, known as the pole, that can be connected to one of two output terminals, referred to as the throws. In its default state, the switch is open, meaning there is no electrical connection between the pole and either throw terminal.

When the switch is actuated, it closes the circuit, creating a direct electrical path between the pole and the selected throw terminal. This allows current to flow through the switch and complete the desired circuit. Once released, the switch returns to its open state, interrupting the current flow.

## 4. LED (Light Emiting Diode) :-




LED stands for Light-Emitting Diode. It is an electronic component that emits light when an electric current passes through it. LEDs are compact, energy-efficient, and have a long lifespan compared to traditional light sources. They are commonly used in various applications, including lighting, displays, indicators, and electronic signage. LEDs come in different colors, including red, green, blue, and white, and their intensity can be controlled by adjusting the current passing through them. Due to their versatility and efficiency, LEDs have become widely popular in many industries and everyday consumer products.

## 5. Battery :-

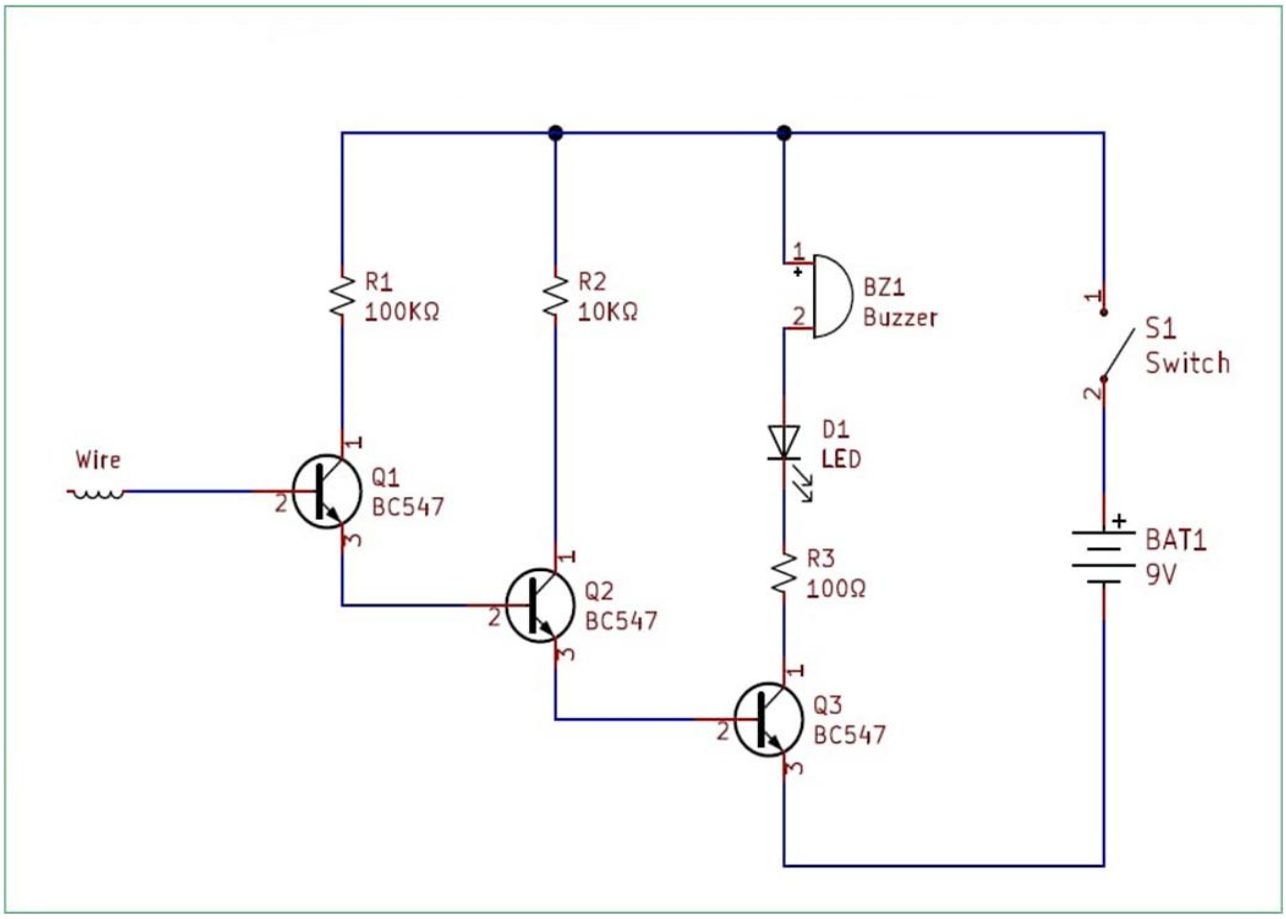

A 9V battery is a small, portable power source commonly used in electronic devices. It is a rectangular-shaped battery that provides a stable and reliable source of direct current (DC) voltage. It typically consists of six individual cells connected in series, each providing approximately 1.5 volts. The battery is often characterized by its nominal voltage of 9 volts, which remains relatively constant throughout its discharge cycle until it reaches the end of its usable life. It is widely used in various applications, such as smoke detectors, portable radios, electronic toys, and other low-power electronic devices

## 6. Breadboard

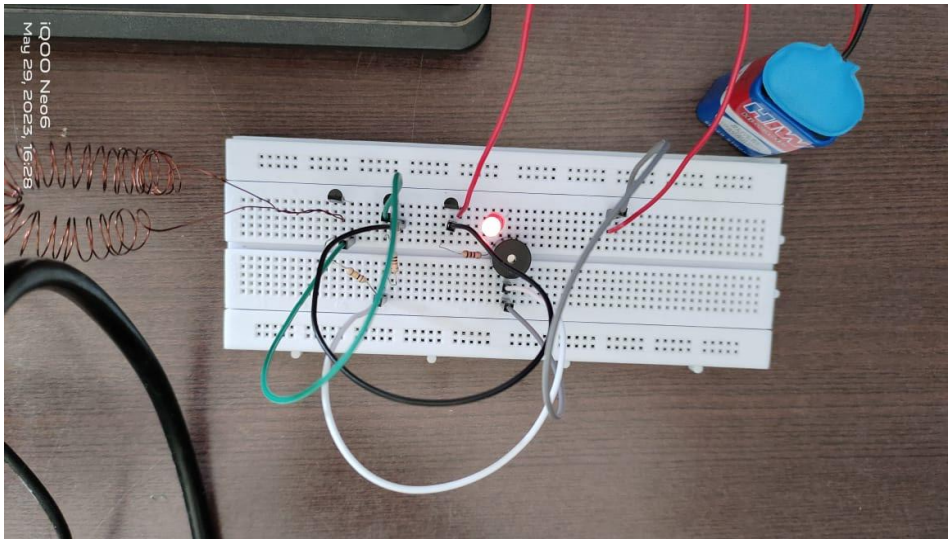
A breadboard, also known as a prototyping board or solderless breadboard, is a common tool used in electronics prototyping and experimentation. It is a rectangular board with a grid of holes and metal clips that allow for the temporary connection of electronic components without the need for soldering. These holes are interconnected in groups of five, forming a continuous electrical connection along the row or column. The clips inside the board can be used to insert and hold electronic components, such as resistors, capacitors, integrated circuits (ICs), and wires.

The main advantage of a breadboard is its ability to quickly and easily build and test circuits without the need for permanent connections. Components can be inserted into the board and connected using jumper wires, allowing for rapid experimentation and modification. This makes breadboards an essential tool for prototyping circuits, testing ideas, and learning electronics.

## 3.3 Circuit diagram



## OBSERVATION AND RESULT




The project successfully developed a wire fault detection device using magnetic fields. It accurately detects and locates faults in electrical wires, such as breaks, short circuits, and insulation defects. The device includes a magnetic field generator, sensors, signal processing, and a user interface for efficient fault detection and localization.

## APPLICATIONS

- Automotive Industry: In the automotive industry, wire fault detection is used to identify faults in the wiring harnesses of vehicles. This helps prevent electrical failures and ensures the safety of passengers.
- Aerospace Industry: In the aerospace industry, wire fault detection is used to identify faults in the wiring systems of aircraft. This helps ensure the safety and reliability of the aircraft.
- Telecommunications Industry: In the telecommunications industry, wire fault detection is used to identify faults in the cables and wiring used for communication networks. This helps prevent downtime and improves the overall performance of the network.
- Power Distribution Industry: In the power distribution industry, wire fault detection is used to identify faults in power transmission lines. This helps prevent power outages.

## FUTURE SCOPE

- Wire cut detection is a critical project, and there is always scope for improvement and expansion. Here are some potential future directions for wire cut detection projects:
- Improved Detection Accuracy: The primary goal of any wire cut detection project is to detect any cuts or tampering on wires accurately.
- Wireless Wire Cut Detection: One potential future direction for wire cut detection projects is to move away from wired connections altogether.
- Integration with Smart Home Systems: With the growing popularity of smart home technology, integrating wire cut detection with smart home systems could be another potential future direction.
- Expanding Application to Other Industries: Wire cut detection systems are not

- limited to just the home security industry. In the future, the technology could be applied to other industries that rely on wires and electrical conductivity, such as the automotive industry, aerospace, and even healthcare.
- Developing Cost-Effective Solutions: Another potential future direction for wire cut detection projects is to develop more cost-effective solutions. This would make the technology more accessible to a wider range of consumers and industries.

## ADVANTAGES

- Enhanced Safety
- Preventive Maintenance
- Increased System Reliability
- Time and Cost Savings

## DISADVANTAGES

- False Alarms
- Limited Detection Range

## CONCLUSION

- In conclusion, the wire cut detection project is a valuable initiative that can provide numerous benefits to various industries.
- The project aimed to detect wire cuts in a timely manner, prevent damage to equipment, ensure safety, and minimize downtime.
- The project's outcomes demonstrate the effectiveness of wire cut detection and highlight the importance of integrating it into a broader maintenance and repair strategy.
- The project's findings have significant implications for safety, reliability, and cost-effectiveness and can be applied in practice to enhance the performance of electrical systems.

## REFERENCES

1. https://www.mdpi.com/1424-8220/19/17/3763
2. https://circuitdigest.com/electronic-circuits/broken-wire-detector.
3. https://patents.google.com/patent/US7482535B2/en
4. https://patents.google.com/patent/US8049370B2/en
5. https://patents.google.com/patent/CA2942917C/en
6. https://www.alldatasheet.com/datasheet-pdf/pdf/586720/FAIRCHILD/BC547.html

# COST OF PROJECT

| SR.NO | COMPONENTS | COST (Rupees) |
|---|---|---|
| 1 | MOSFET BC547 x 3 | 96 |
| 2 | Resistor: 100Kohm,10Kohm,100ohm | 10 |
| 3 | LED | 10 |
| 4 | Buzzer | 34 |
| 5 | SPST (Single Pole Single Throw) | 30 |
| 6 | Battery: 9V | 20 |
| 7 | Wire used as antenna | 10 |
| 8 | Breadboard | 75 |
| | Total | 285 |

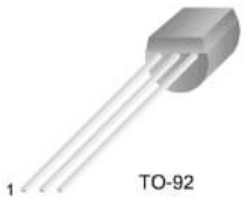
# DATASHEET

FAIRCHILD
SEMICONDUCTOR®

# BC546/547/548/549/550

## Switching and Applications

- High Voltage: BC546, $V_{CEO}$=65V
- Low Noise: BC549, BC550
- Complement to BC556 ... BC560



1 TO-92

1. Collector 2. Base 3. Emitter

## NPN Epitaxial Silicon Transistor

### Absolute Maximum Ratings $T_a$=25°C unless otherwise noted

| Symbol | Parameter | Value | Units |
|---|---|---|---|
| $V_{CBO}$ | Collector-Base Voltage : BC546 | 80 | V |
| | : BC547/550 | 50 | V |
| | : BC548/549 | 30 | V |
| $V_{CEO}$ | Collector-Emitter Voltage : BC546 | 65 | V |
| | : BC547/550 | 45 | V |
| | : BC548/549 | 30 | V |
| $V_{EBO}$ | Emitter-Base Voltage : BC546/547 | 6 | V |
| | : BC548/549/550 | 5 | V |
| $I_C$ | Collector Current (DC) | 100 | mA |
| $P_C$ | Collector Power Dissipation | 500 | mW |
| $T_J$ | Junction Temperature | 150 | °C |
| $T_{STG}$ | Storage Temperature | -65 ~ 150 | °C |

### Electrical Characteristics $T_a$=25°C unless otherwise noted

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | Collector Cut-off Current | $V_{CB}$=30V, $I_E$=0 | | | 15 | nA |
| $h_{FE}$ | DC Current Gain | $V_{CE}$=5V, $I_C$=2mA | 110 | | 800 | |
| $V_{CE}$ (sat) | Collector-Emitter Saturation Voltage | $I_C$=10mA, $I_B$=0.5mA | | 90 | 250 | mV |
| | | $I_C$=100mA, $I_B$=5mA | | 200 | 600 | mV |
| $V_{BE}$ (sat) | Base-Emitter Saturation Voltage | $I_C$=10mA, $I_B$=0.5mA | | 700 | | mV |
| | | $I_C$=100mA, $I_B$=5mA | | 900 | | mV |
| $V_{BE}$ (on) | Base-Emitter On Voltage | $V_{CE}$=5V, $I_C$=2mA | 580 | 660 | 700 | mV |
| | | $V_{CE}$=5V, $I_C$=10mA | | | 720 | mV |
| $f_T$ | Current Gain Bandwidth Product | $V_{CE}$=5V, $I_C$=10mA, f=100MHz | | 300 | | MHz |
| $C_{ob}$ | Output Capacitance | $V_{CB}$=10V, $I_E$=0, f=1MHz | | 3.5 | 6 | pF |
| $C_{ib}$ | Input Capacitance | $V_{EB}$=0.5V, $I_C$=0, f=1MHz | | 9 | | pF |
| NF | Noise Figure : BC546/547/548 | $V_{CE}$=5V, $I_C$=200μA | | 2 | 10 | dB |
| | : BC549/550 | f=1KHz, $R_G$=2KΩ | | 1.2 | 4 | dB |
| | : BC549 | $V_{CE}$=5V, $I_C$=200μA | | 1.4 | 4 | dB |
| | : BC550 | $R_G$=2KΩ, f=30~15000MHz | | 1.4 | 3 | dB |

### $h_{FE}$ Classification

| Classification | A | B | C |
|---|---|---|---|
| $h_{FE}$ | 110 ~ 220 | 200 ~ 450 | 420 ~ 800 |



Rev. A2, August 2002

BC546/547/548/549/550

## Typical Characteristics

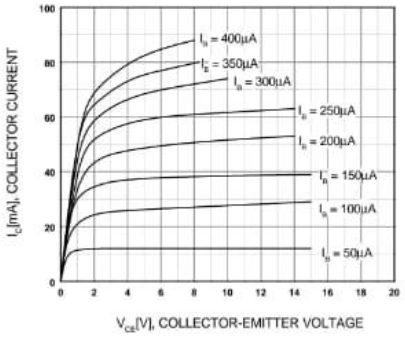



**Figure 1. Static Characteristic**

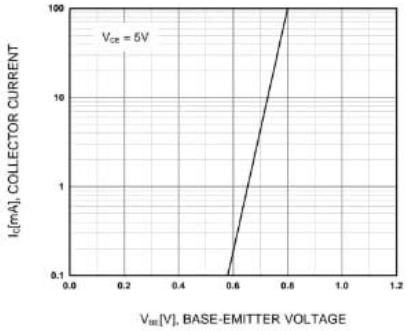



**Figure 2. Transfer Characteristic**

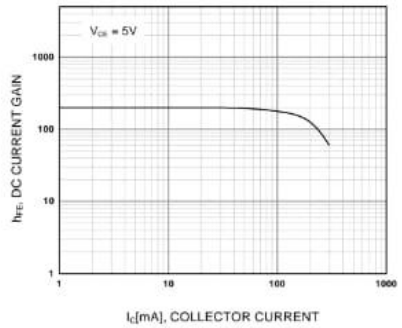



**Figure 3. DC current Gain**

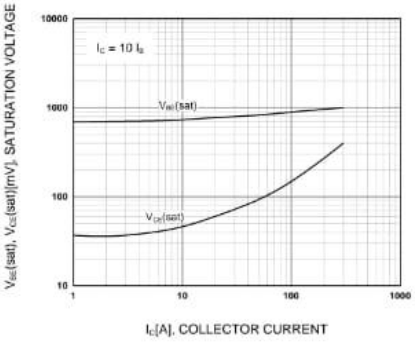



**Figure 4. Base-Emitter Saturation Voltage Collector-Emitter Saturation Voltage**

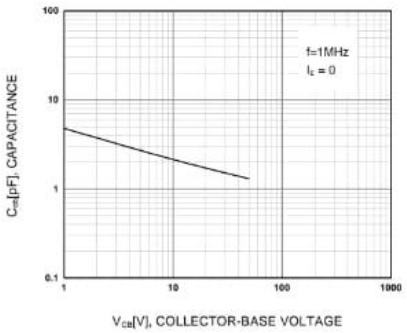



**Figure 5. Output Capacitance**

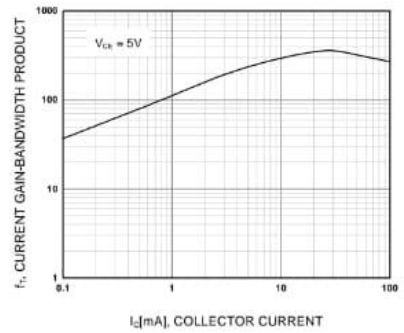



**Figure 6. Current Gain Bandwidth Product**

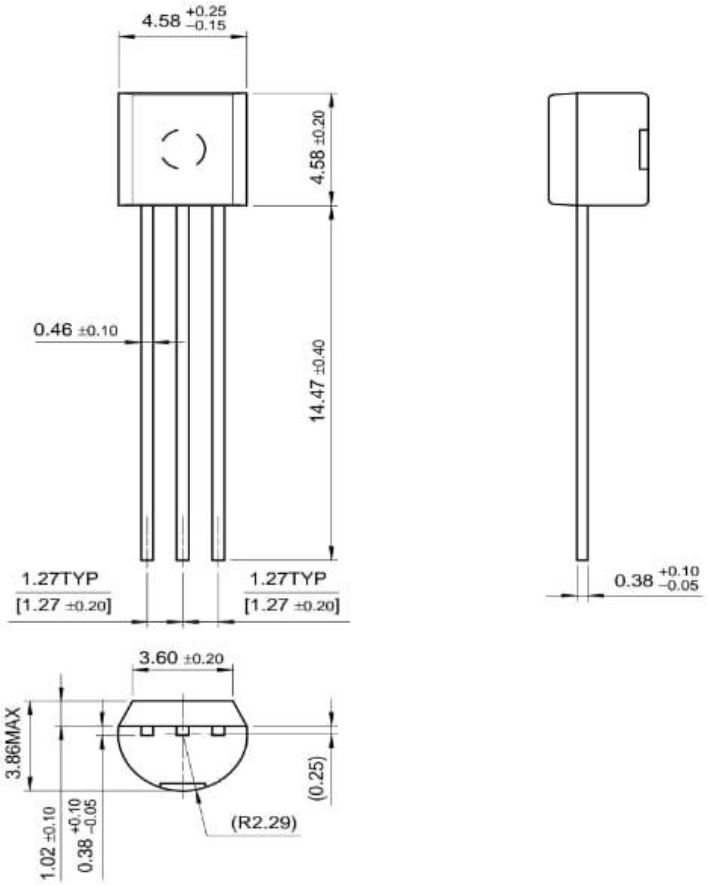


Rev. A2, August 2002

BC546/547/548/549/550

## Package Dimensions

TO-92




Dimensions in Millimeters



Rev. A2, August 2002

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| | | | | |
|---|---|---|---|---|
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| ActiveArray™ | FACT Quiet series™ | ISOPLANAR™ | POP™ | Stealth™ |
| Bottomless™ | FAST® | LittleFET™ | Power247™ | SuperSOT™-3 |
| CoolFET™ | FASTr™ | MicroFET™ | PowerTrench® | SuperSOT™-6 |
| *CROSSVOLT*™ | FRFET™ | MicroPak™ | QFET™ | SuperSOT™-8 |
| DOME™ | GlobalOptoisolator™ | MICROWIRE™ | QS™ | SyncFET™ |
| EcoSPARK™ | GTO™ | MSX™ | QT Optoelectronics™ | TinyLogic™ |
| $E^2$CMOS™ | HiSeC™ | MSXPro™ | Quiet Series™ | TruTranslation™ |
| EnSigna™ | $I^2C$™ | OCX™ | RapidConfigure™ | UHC™ |
| Across the board. Around the world.™ | | OCXPro™ | RapidConnect™ | UltraFET® |
| The Power Franchise™ | | OPTOLOGIC® | SILENT SWITCHER® | VCX™ |
| Programmable Active Droop™ | | OPTOPLANAR™ | SMART START™ | |

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design. |
| No Identification Needed | Full Production | This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design. |
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