Design and Implementation of Portable IPS

A Project and Thesis submitted in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Electrical and Electronic Engineering

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Certification

This is to certify that this project and thesis entitled "**Design and Implementation of Portable IPS**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on 30 January 2022.

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Dedicated to

Our Parents

CONTENTS

LIST OF FIGURES

LIST OF TABLES

List of Abbreviations

LED	Light Emitting Diodes
BMS	Battery management system
IPS	Interrupted power supply
PVC	Polyvinyl chloride
AC	Alternating current
DC	Direct current
BBC	British Broadcasting Corporation

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ABSTRACT

An Interrupted power supply (IPS) provides backup power when our regular power source fails or voltage drops to an unacceptable level. We need an IPS & power bank in the absence of electricity. At present, it is difficult for us to run without the benefit of electricity because everywhere, every moment we need electricity. Therefore, if there is a sudden interruption in the supply of electricity at the time of our need or if there is no electricity nearby in case of emergency, we run into various problems. It is not possible to carry a conventional power bank or IPS with us, no matter where we are or travelling anywhere. This portable IPS will work alone to solve these problems.

The battery size is quite large in a conventional IPS. But there is a major change in today's technology and we have also revolutionized this type of IPS by making it small and compact size to carry it anywhere as required.

This Portable IPS is user-friendly, mini size to carry & safe to use in our daily requires. Suppose we need to charge our mobile also laptop, Wi-Fi router, or any electronic devices when there are no electricity facilities available. This portable IPS can meet our needs. We can use this to power up 100watt bulbs easily. This is a reliable device for our daily requires.

CHAPTER 1

INTRODUCTION

1.1 Introduction

There was a time when generators were an alternative to electricity in the absence of line current or for frequent load shedding. Some people had their own generators, and many took the line of the far-flung generator. However, with the change of age and development of science, IPS came in the market, which is coming with uninterrupted power facility in every house, shop, office, institution etc. However, it only needs to be kept in the specified place. Outside or somewhere on the way to travel, we suddenly end up with a mobile task for which we need to carry a power bank. However, it is also limited in its use, because it can't use electric devices instead of mobile device. For this small portable IPS have been made to solve both these problems.

Fig 1.1 Portable IPS

Electricity is one of the most important necessities in our lives. But in our busy lives, electricity is always needed everywhere. So based on that, portable IPS works in two ways. For example, it can be used anywhere like normal IPS and can be carried anywhere. Also, it can be use as AC power bank.

1.2 Problem Statement

The proposed Portable Mini IPS is cheap, fast response, reliable, smaller in size, standard in look, touch system & secure for any user in daily requires. We use in-build battery system for transport friendly. We can charge our mobile also use as power supply for laptop or electronic devices when there are no electricity facilities nearby. Also, it can be use as like IPS. At the back side it has 2 plus minus knob for connect external 12v battery if necessary. The proposed system uses indicator LED's, touch sensor, digital & analog volt meter, inverter, 18650 li-on batterie's, USB, relay & step-down module, PVC sheet, power socket. It has proposed its advantages in the declaration.

1.3 Objectives

The main objective of this project is to make a user-friendly electric device which will lower in cost, smaller in size to carry it anywhere any time we need.

The objectives of this project and thesis are

i. To create easier device for people.
ii. To breakout the limitation in electricity facilities
iii. To help in emergency at any place or in loadshedding.

1.4 Scopes

i. Using as like portable power supply also as interrupted power supply.
ii. It can use for charging mobile phone, laptop etc.
iii. Also use to conduct a table fan, LED tv, sound box, 20-to-60-watt light etc.
iv. Because of its low weight & small size, it can be carried at any place like in journey time, picnic or tour, rural area where load shedding is common fact.

1.5 Research Methodology

In this project, we have built a 200 VA IPS which is portable & work like power bank. Here we used digital dc & analog ac volt meter to show the battery voltage & output voltage. With USB port user can charge mobile directly. User can operate this device easily by its TTP223 touch system & 4channel relay module. User can use this device as a power bank & also as an IPS because of its two functions. It has inbuild 14.8v

18650 li-on battery pack. It is more useful in loadshedding or rural area, also in any emergency time when electricity facilities is not close to us.

Still now electricity scarcity and poor electricity facilities in rural areas is present in Bangladesh. Though Bangladesh Power Development Board claims that total electricity generation capacity 21484 MW and total demand 13200 MW but load shedding occurs throughout the country. According to a report by Prothom Alo on power outages, although the ability generation within the country is over the demand, we tend to don't seem to be having the ability to completely use this capability throughout the fuel crisis. Because of lack of gas offer, power plants that are pass by expensive fuel are operative currently to tackle the case. It is ensured uninterrupted electricity offer for town dwellers, however the individuals in rural areas are enduring 4 hours of power failure on the average per day. Within the areas close to capital of Bangladesh, power goes out four to 5 times every day. The consumers of Bangladesh Rural Electrification Board are suffering the most. This is due to inadequate power supply as compared to the demand. As a result, they need to hold out power outages for 3 to 5 hours each day.

According to a report by BBC on power outages although Bangladesh Power Development Board claiming there are sufficient power generation capacity is available, but there is presence of load shedding due to system loss. Another cause is not to increase per unit cost if more generation take in place, then per unit cost will increase that’s why load shedding also occur.

Natural disasters like flood, cyclone also cause power outages damaging electricity line and equipment’s. Misuse of electricity is also responsible for load shedding.

This portable IPS will be helpful in those emergency situation of load shedding or power outages.

1.6 Project/Thesis Outline

This Project/thesis is organized as follows:

Chapter 1 Introduction.

Chapter 2 Literature reviews

Chapter 3 Analysis of the component systems

Chapter 4 Hardware development & system design.

Chapter 5 Result and Discussions.

Chapter 6 Conclusions

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction

In the beginning, we need to have sufficient knowledge of how Portable IPS work and how they can be built efficiently. This chapter focuses on similar efforts in other papers.

2.2 Related Works

Portable IPS is one of those widely used as IPS or power bank at home appliance or daily use devices. The portable IPS is very effective if we want people to use this when the absence of line power or any backup or recharge also can carry this with small bag or holding by its handle. This device can be used not only at house or travel time, but also at anywhere like marketplace, office or other institutions, village area. To move away from a large part of these flaws from this general strategy, a lot of ways to deal with digitization techniques have just been suggested and work like IPS or power supply bank. Some pre-existing technologies include the use of inverter in IPS, for example Owen, Edward L, Origins of the Inverter & A. Kumar and R. Gupta, single–phase DC/AC converter using inverter. The structure of Inverter IPS trace engineering, a review of inverter design and topologies.

All the systems proposed and activated above have some conclusive flaws or cannot be fully achieved in the application with respect to actual implementation. In this case, the implementation of this project could dramatically alter environmental issues as well as improve the use of technology. This will require inverter which connect with batteries & convert the low battery power to high AC power. Here are more benefits of using LED indicators display or indicate information about IPS like low voltage, charging, power or load on. By this indicator we can easily know that working properly which controlled with touch panel.

2.3 Summary

To overcome the limitations on the position of modern models, the project is used to have lithium-ion battery that is powerful than lead-acid battery, as well as it saves us from any interruption our emergency time & its act like line current, so that with it we don’t have any worry about using electronic devices.

CHAPTER 3

ANALYSIS OF SYSTEM COMPONENT

3.1 Introduction

In this chapter, we have discussed various components that will be needed to make this design and hardware development of Potable IPS.

3.2 Required Component

The project proposed is composed of the following components:

1. Led (Indicator)
2. TTP 223 Touch Sensor
3. Lm2596 DC to DC Step Down Module
4. 4 Channel 5v Relay Module
5. AC 220v to DC 5v Dc Step Down Converter
6. Digital DC Volt Meter
7. DC 6-32v to 5v Step-down USB Module
8. Analog AC Volt Meter
9. DC To AC Inverter 250watt
10. 18650 Rechargeable Batterie’s
11. 4S BMS Battery Protection Board
12. 19v Adapter
13. AC Power Cable Connector
14. Battery Low Voltage Indicator
15. Small On/Off Rocker Switch
16. Banana Jack (Female)
17. Fuse
18. Power Socket
19. PVC Sheet
20. Connecting Wire

3.2.1 Led (Indicator)

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light is determined by the energy required for electrons to cross the band gap of the semiconductor.

Fig. 3.2.1 LED

Here we have used multicolor LED as an indicator.

An LED has a positive (Anode) lead and a negative (Cathode) lead. The longer lead of an LED is generally the positive (Anode), while the shorter lead is the negative (cathode).

Mostly single-die LEDs used as indicators, and their sizes 2 mm, through-hole and surface mount packages. Typical current ratings range from around 1 mA to above 20 mA & voltage limit 1.9 to 2.2v dc.

3.2.2 TTP 223 Touch Sensor

Touch sensors are now standard in most wearables and IoT products. They are used in a wide range of display applications, from smart homes and appliances to security and industrial solutions.

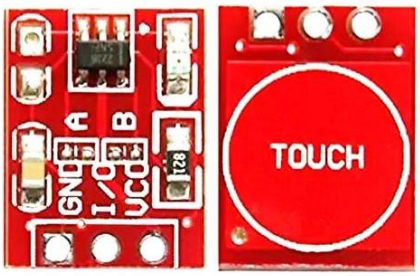

Fig. 3.2.2 TTP 223 Touch Sensor

It’s called capacitive because the technology is based on capacitive coupling that detects anything that is conductive or has a dielectric different from air. In this case, the

human body (fingers) is being used as an electrical charge conductor. The way it locates where finger is on the screen is the change of local electrostatic field when finger touches the glass of the capacitive surface. An image processing controller continuously monitors the electrostatic field to find where exactly the finger touched the screen.

Features:

- Supply Voltage: 2.5 to 5.5V
- Supply current: (Vcc = 5V): 6uA (Idle) 16mA (Active)
- Sensor area: 11 x 10.5mm
- Max sensor range: ~5mm
- Module dimensions: 14.5mm x 11mm

3.2.3 Lm2596 DC To DC Step Down Module

DC-DC Buck Converter Step Down Module LM2596 Power Supply is a step-down(buck) switching regulator, with excellent line and load regulation. This is an LM2596 DC-DC buck converter step-down power module with high-precision potentiometer, capable of driving a load up to 3A with high efficiency. When the output current keeps greater than 2.5A (or output power greater than 10W), need to add a heat sink on it.

Fig. 3.2.3 Lm2596 DC To DC Step Down Module

The module IC is basically a buck converter that operates on 150KHz switching frequency, it takes in an input voltage and uses the internal switching circuit to regulated a desired output voltage. It has high efficiency and in-built Thermal shutdown and current limit functionalities

Features:

- Short Circuit Protection: Current limiting, since the recovery
- Input Voltage: DC 4V-35V
- Output Voltage: DC 1.23V-30V
- Output Current:3A (Maximum)
- Conversion Efficiency:92%(Highest)
- Output Ripple:30mv (Maximum)
- Switching Frequency:150KHz
- Load regulation:0.5%
- Voltage regulation:2.5%
- Work temperature: -40 to +85 degree
- Dimension: 43x20x14mm

3.2.4 4 Channel 5v Relay Module

The 4 Channel Relay Module is a convenient board which can be used to control high voltage, high current load such as motor, solenoid valves, lamps and AC load. The relay module is an electrically operated switch that can be turned on or off deciding to let current flow through or not.

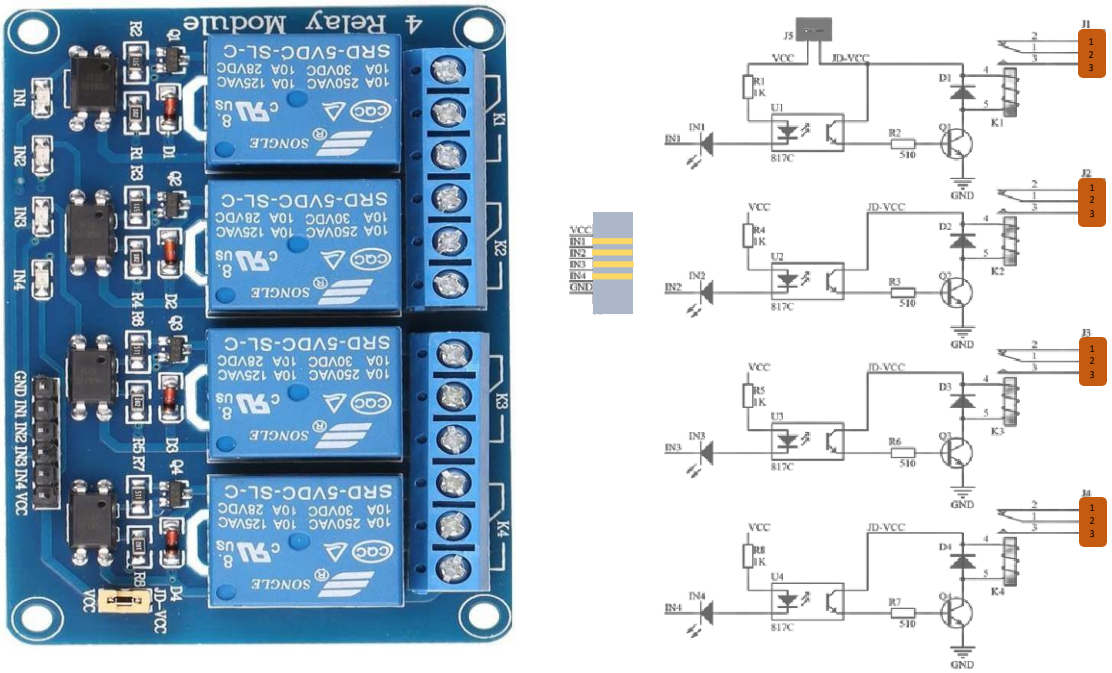

Fig. 3.2.4 4 Channel 5v Relay Module

The relay is an electrically operated switch where the relay opens when the two contacts are disconnected, while the relay is closed when the two contacts touch. When set to high, the relay will close allowing current to flow. The 4 Channel Relay Breakout is an easy way to use our Arduino, Raspberry Pi, or other microcontroller to switch high voltages and high current loads & uses 4 digital outputs to control 4 individual relays.

Features:

- No. of relay channel: 4
- Rated through-current: 10A (NO) 5A (NC)
- Control signal: TTL level
- Max. switching voltage 250VAC/30VDC
- Max. switching current 10A
- Size: 75mm (Length) * 55mm (Width) * 19.3mm (Height)
- Trigger Voltage (VDC): 5V
- Trigger Current (mA): 20mA

3.2.5 AC 220v To DC 5v Dc Step Down Converter

Step Down converters are electrical circuits that transform alternating current (AC) input into direct current (DC) output.

Fig. 3.2.5 AC220v to DC5v Step Down Module

Features:

- Input voltage: AC220V
- Input Current: 0.014A
- Output voltage: DC 5V (+ / - 0.2 V)
- Output current 700 mA
- Power 3.5 W
- Output range: 4.8~5.2v
- Output power:0-4W (DC current)
- Output efficiency: 80%

3.2.6 Digital DC Volt Meter

DC voltmeter is a measuring instrument, which is used to measure the DC voltage across any two points of electric circuit. A digital voltmeter is converting an analogue signal into a train of pulses. The number of pulses is proportional to the input signal.

Fig. 3.2.6 Digital DC Volt Meter

Features:

- Material: PP, electronic components
- Measuring range: Three-wire, DC 0〜100V
- Working voltage: 4~40V
- Accuracy: ±1%, >10V> ±0.2V, <10V: ±0.03V
- Input impedance: >50KΩ
- Working current: <30mA
- Update rate: approx.100mS/time
- Display: three 0.36" digital LED tube
- Hole distance: 28mm, hole diameter:2.8mm
- Working temperature: -10 〜 +65°
- Working humidity: 10 〜 80%
- Working pressure: 80 〜 106k

3.2.7 DC 6-32v to 5v Step-down USB Module

This step-down (buck) power supply module converts its input voltage of 6V to 24V to a fixed 5V USB output at up to 3A output current. It is suitable for providing a regulated 5V USB output to charge our mobile phone, tablet or any other USB-powered device.

Fig. 3.2.7 DC 6-32 To 5v step-down USB Module

Features:

- Input voltage range: 6V to 32V
- Output voltage: The default is 5V.
- Output Power. 10W
- Output voltage wired compensation
- Conversion efficiency: 90% to 97%

3.2.8 Analog AC Volt Meter

AC Analog voltmeters are one of the most popular electronic measuring in- students in use today. This instrument, used to measure the AC voltage across any two points of electric circuit.

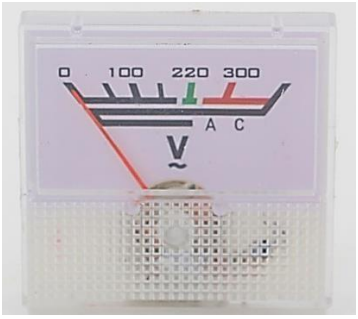

Fig. 3.2.8 Analog AC Volt Meter

Features:

- Measurement Range: 0 to 300 Volts (AC)
- Full scale: 300V
- Connector: Half rice field attaching terminal width 1.9mm
- External dimensions: 4cm x 3.8cm x 2.7cm (W x H x D)
- Weight: 9g

3.2.9 DC To AC Inverter 250watt

An inverter is an electronic device or circuitry that changes direct current to alternating current. As we know due to the mutual inductance high switching frequency pulse reaches the step-up transformer then the output voltage will reach a high value. With the help of variable resistor RV1 and capacitor C1, we configured IC CD 4047 in a stable multivibrator mode. We can get a different range of output pulse at Q and Q' pins by varying the value of the variable resistor and it results in a variation of the output

voltage at the transformer. Now N channel power MOSFETs IRFZ44 Drain pins are connected with the transformer low voltage side pins and the common pin in the low voltage winding is connected with battery positive bias, both MOSFET source pins are connected to the negative bias of the battery, and these MOSFETs are driven by Q and Q' output from IC CD4047. The low voltage side winding is forced to induce an alternating magnetic field When the alternating square pulse drives the MOSFET switches then it produces high alternating voltage with this large induced magnetic field at high voltage side of the transformer.

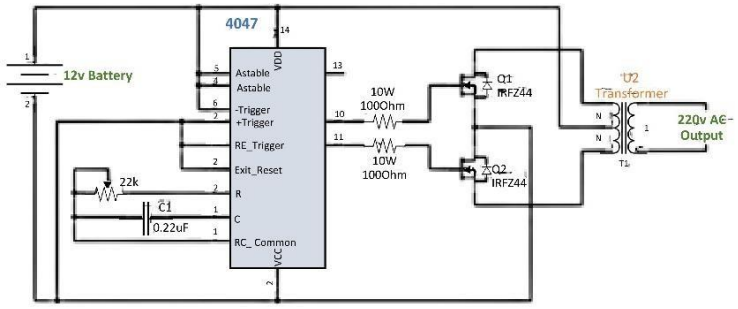

Fig. 3.2.9 DC To AC Inverter 250watt

Features:

- Shell material: Aluminum alloy
- Peak-power: 250W
- Continuous output power: 200W
- Input voltage: DC 12V
- Output voltage: AC 220V
- Conversion efficiency: Greater than 90%
- Wave form: Modified Sine Wave

3.2.10 18650 Rechargeable Batterie's

An 18650 is a lithium-ion rechargeable battery. Their proper name is "18650 cell". The 18650 cell has standard voltage 3.7v and has between 1800mAh and 3500mAh (milli-amp-hours). Compatible with: Fan, flash light, power bank, portable, speaker, power tool battery. Advanced integrated overcharge and discharge protection circuits.

Fig. 3.2.10 18650 Rechargeable Battery

Features:

- Type of lithium ion
- Voltage Battery 3.7 V
- Rated voltage: 3.6V
- Internal resistance: ≤ 26mΩ
- Discharge cut-off voltage: 2.5V
- Max. continuous discharge: 20A
- Charging mode: CC-CV, 4.20 ± 0.05 V, 100mA cut-off
- Charging time: standard charge: 180 min / 1500mA; rapid charge: 60 min / 4A
- Battery capacity 2000mAh
- Rechargeable battery
- 1000 times rechargeable battery
- PCB board protected no
- Ideal application for laptop / flashlight, etc.
- Dimensions: 2.56 in x 0.71 in x 0.71 in (6.5 cm x 1.8 cm x 1.8 cm)
- Weight: ~ 44g

3.2.11 4S BMS Battery Protection Board

A Battery Management System, or BMS for short, is used to protect your battery during charging and discharging. During charging, the BMS will monitor the voltage of all of the cells and balance the cell groups to ensure they are charged equally.

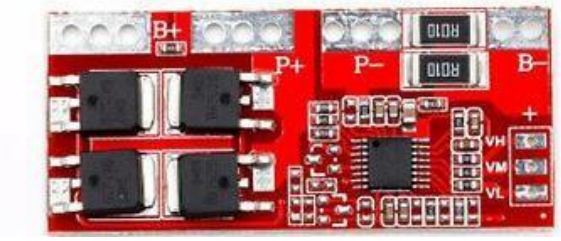

Fig. 3.2.11 4S BMS Battery Protection Board

Features:

- Voltage range 4.25~4.35V ± 0.05V
- Overvoltage range 2.3~3.0V±0.05V
- Upper working current 10A
- Working temperature -40 to +50 Celsius
- Maximum instantaneous current 20A
- Static current Less than 30uA
- Effective life More than 50000 hours
- Internal resistance Less than 100m ohm
- Short circuit protection Yes,
- Charging voltage 16.8V-17V

3.2.12 19v Adapter

It is a very good power supply. When AC supply is given to the input of battery charger the voltage level is step down by step down transformer. This voltage is rectified by bridge rectifier circuit. But the rectified output is not purely DC. So rectified output is given to filter circuit which removes ripples from the rectified output. This output voltage is higher than battery voltage and battery is connected with the output of filter circuit. So, battery will be charged with the help of this filtered output voltage.

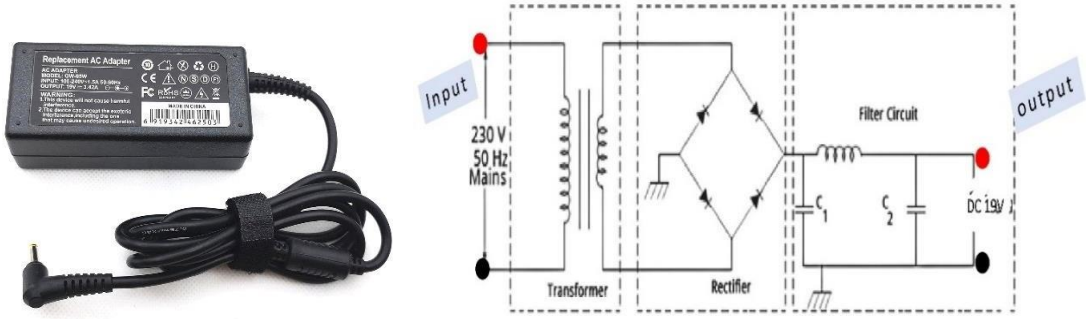

Fig. 3.2.12 19v Adapter

Features:

- Input Voltage: AC100-240V / 50 ~ 60Hz
- Output Voltage: 19V DC
- Output current: 1.5A
- Total output power: 29W

3.2.13 AC Power Cable Connector

An AC power plug is a portable electrical connector which consists at the minimum of two/three metal contact prongs designed to make contact with matching points connected to a power supply, usually contained in a protected electrical outlet.

An alternating current (AC) power cable connector, or simply AC cord, is a medium that used to connect a device to a power supply.

Fig. 3.2.13 AC Power Cable Connector.

Features:

- Type: AC Power Cord EU
- AC Voltage: 110V / 220V / 240V
- Current: 10A Maximum Wire

3.2.14 Battery Low Voltage Indicator

Battery low voltage indicator circuit use to indicate or alert for battery voltages goes into low voltage of its standard voltage value. It's an adjustable indicator circuit which can be control with potentiometer around DC 3 to 20v & up to 4amp. Here (TL 431) transistor is the main sensor of this circuit which can sense the voltages of battery going down in its fixed value. For indicating it connect with a 2-3v LED indicator which indicate at low voltage. Its directly connected with battery knob.

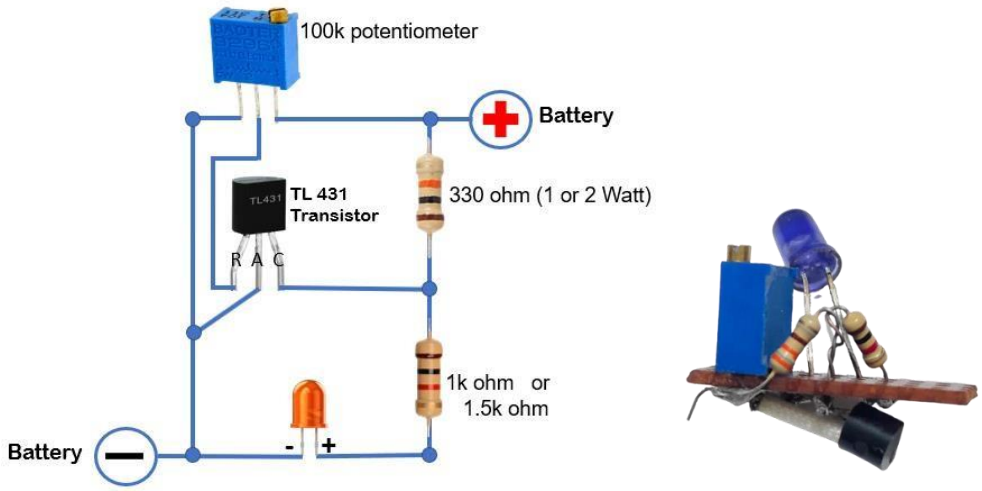

Fig. 3.2.14 Battery Low Voltage Indicator

Features:

- Input Voltage: DC 3V to 20V
- Input ampere: 0.5A to 4A
- Potentiometer: 103 (100k)
- Sensor Transistor: TL 431
- Resistor: 330ohm & 1k ohm
- Indicator: 3v LED

3.2.15 Small On/Off Rocker Switch

Small mini boat on/off rocker switch red plastic button one-way electrical switch, made of high-quality polyamide eP (Nylon PA66), anti-corrosion, acid, alkali and heat resistant, Terminals are silver. This incredibly small rocker switch measures just 14.9 x 10.5mm and 19.75mm deep. The switch is rated to 3A at 250VAC and 6A at 125VAC. Wiring these switches is easy; there are two contacts in this Single Pole, Single Throw (SPST) switch, meaning it works as a simple On / Off.

Widely used for various kinds of electrical products, instrument, car, boat, household appliances.

Fig. 3.2.15 Small On/Off Rocker Switch

Features:

- Switch Function: On / Off
- Switch Type: Single Pole Single Throw (SPST)
- Termination: Solder Lug
- Maximum Voltage: 250VAC
- Depth (behind panel): 16.5mm
- Cutout Size: 13.6 x 8.7
- Dimensions: 14.9 x 10.5 x 19.75mm
- Maximum Current: 3A/6A (250VAC/125VAC)

3.2.16 Banana Jack (Female)

A banana connector/jack is a single-wire (one conductor) electrical connector used for joining wires to equipment. This Female Banana (Colors Red & Black) is ideal for building your own charging station or as a 12-24volt power access point for DC power supply applications.

They are designed to pass through wooden or metal facias up to 5mm thick (they are insulated and required a 6mm mounting hole). These have 4mm holes to suit 4mm male banana plugs.

Fig. 3.2.16 Female Banana Jack

Features:

- Rated to around 30amps
- Total length: 15mm
- Depth: 10mm
- Mounting hole: 6mm

3.2.17 Fuse

A fuse is a safety device in an electric plug or circuit. It contains a piece of wire which melts when there is a fault so that the flow of electricity stops. Here it's a Fast Blow Type AC 250V 2A Glass Fuse.

Designed with 5 x 20mm ceramic tube, 2A breaking current. Widely used in power supply, switching power supplies, computers, chargers, telephones, household appliances, communication products, all kinds of instruments and electronic components, electrical products, is indispensable in electrical products safety accessories.

Fig. 3.2.17 Fuse

Features:

- Current:2A
- Voltage:250V
- Material: GLASS
- Dimension: 5 mm (3/16 in) x 20 mm (3/4 in)
- Fast-Blow: (Fast Acting Fuses)
- Material: Glass, Metal
- Color: Silver Tone, Clear
- Weight: 13 g

3.2.18 Power Socket

AC power socket connect electric equipment to the alternating current (AC) mains electricity power supply in buildings and at other sites.

Here it's an AC 250v panel mount snap in universal power socket outlet receptacle.

Fig. 3.2.18 Power Socket

Features:

- 3 Pin
- AC 220v
- 6Amp
- Materials: Plastic & Metal
- Mount system

3.2.19 PVC Sheet

PVC sheet, known as Chevron Board or Andy Board, is widely used for both internal and external applications. It contains chemical installation, PVC, which is used in industries, furniture, construction and advertising.

Made of lightweight PVC and foam, this PVC foam sheet is moisture resistant and corrosion. It is completely lighter. They are also resistant to chemicals. The total thickness of the material will be from 6mm to 45mm. It is possible to carve, engrave, paint, print, laminate and grind the surface of the foam plate according to your needs. One of the most highlighting characteristics of this foam board is that it will not decay over time and the color is still in the same new form for long without fading.

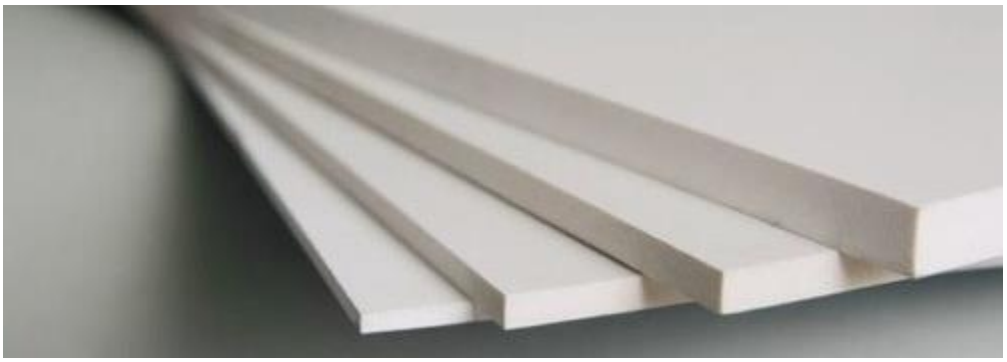

Fig. 3.2.19 PVC Sheet

Features:

- Material: PVC
- Kind: PVC Plastic Sheet
- Water Absorption: ＜0.01%
- Contraction Percentage: ＜0.4%
- Tensile Strength: （81~130）MPa
- Flame Retardancies: Self-Extinguishing Less Than 5 Seconds
- Size: 3mm
- Color: White

3.2.20 Connecting Wire

An electrical connecting wire is a type of conductor, which is a material that conducts electricity. Typically made of aluminum or copper. They are either bare or insulated and typically covered in a thin layer of PVC.

Fig. 3.2.20 Connecting Wire

Features:

- Product Type: Copper Cable
- RM: 1x0.65 rm
- Core: Single Core
- Día: 23/0.19 mm
- Cable Type: Flexible Cable
- Voltage Rating: 300/500 V
- PVC Insulated & PVC Sheathed Flexible Cable

3.3 Summary

This chapter covers the tools used in design and hardware development of Portable IPS. All the equipment used in this project is in good condition and they are working properly. In this chapter, we try to discuss the details about the individual devices and the user for each description of their steps.

CHAPPTER 4

HARDWARE DEVELOPMENT & SYSTEM DESIGN

4.1 Introduction

In this venture, the entire model depends on 250watt inverter & its battery pack.

1. 250watt inverter chosen because of small size, small load & lite weight. That's why the all equipment's can fit easily in handy cover. Its input DC voltage 12 to 24v & gives output 210 to 220v AC.
2. This 250watt inverter operate by TTP223 touch & 4channel relay module. Also, it operates as load switch, inverter on off (when in IPS mode), checking battery voltage level at digital dc volt meter.
3. The whole touch & relay system operating dc 5v comes through the lm2596 dc to dc buck converter which input is connected with 14.8v 18650 li-on battery pack BMS.
4. Using these 18650 li-on batteries instead of lead acid battery because of its higher ampere, small size, take short time to recharge & give long time performance. Also, it has longer worked life. Generally, it can be charged and discharged more than 500 times in normal use. For charging & battery safety it connects with BMS (battery management system) & 19v charging adapter.
5. The low battery voltage indicator circuit directly connected with battery BMS positive & negative knob to detect when battery voltages cross the minimum voltage of 18650 li-on battery.
6. 2 plus minus banana jack (female knob) connect to inverter for external 12v battery, if necessary, at the back side.

7. For showing output AC voltage we use analogue volt meter & for indicating it has 4 indicator LED also output load safety these load line connected with 2amp 220-240v fast melting glass fuse.

The Portable IPS block diagram is shown in Figure 4.1

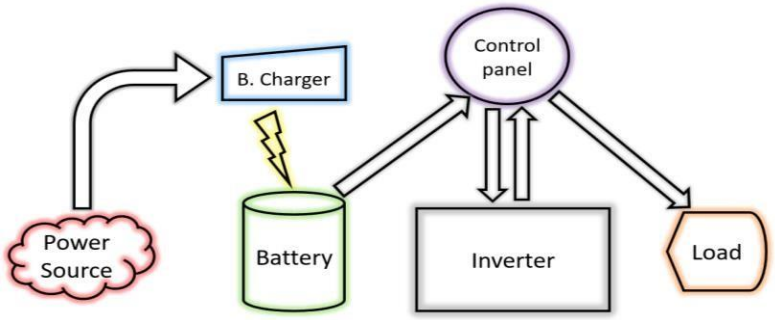

Figure 4.1 Portable IPS Block Diagram

4.2 Circuit Details

A straightforward square model was utilized in the undertaking. In this model, we need to associate the inverter to battery source. In the wake of associating the inverter to the battery supply by control panel, the inverter will turn on & give DC to AC at the load side. But when the AC power cable connect with the AC supply line, then its relay disconnects the inverter load line & connect the AC supply line directly to the load line. Figure 4.2 shows the circuit diagram for this model.

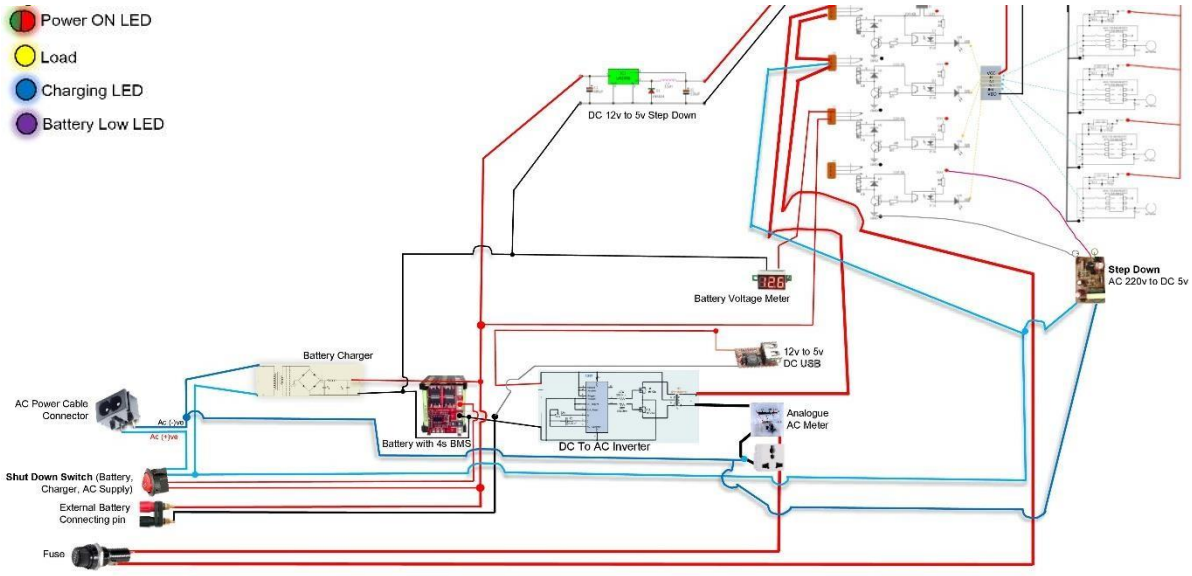

Fig. 4.2 Portable IPS Connection Diagram

After connecting AC power cable shut down switch needs to be turned on. So that battery charger circuit can charge the battery with 4s BMS circuit. This battery is connected with DC to AC inverter which will convert 14.8v DC to 220v AC. This will happen when the power on touch switch will be on. These TTP 223 touch switches are controlled with 4 channel 5v relay module, which is supplied by battery through DC-to-DC step down module.

There are different switches to turn on the load and battery level. Battery level will be shown in the battery voltage meter. There are 4 different indicator LED used for showing power on/off, charging, load on/off and low battery. 12v to 5v DC USB is used for emergency mobile charging. External battery connecting pin is used to connect more batteries. It is designed as if there are power supply available then it will conduct the AC supply directly to the load and also charge the battery for later use when power supply is not available. When AC supply is available 4 channel relay module is supplied by step down 220v AC to 5v DC circuit. A fuse is used to protect circuit equipment being damage.

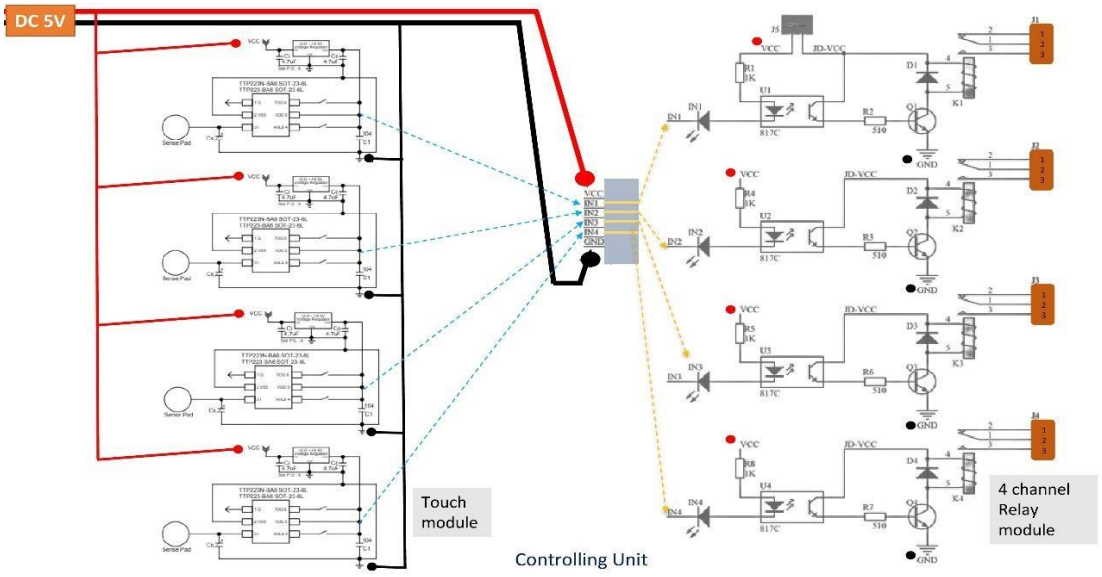

Fig. 4.2.1 Portable IPS Control Unit Diagram

Here controlling unit is combination of TTP223 touch sensor and 4 channel 5V relay module. At first DC 5V supply is given to VCC and GND of touch sensor & relay module both. At this time both circuits are active but won't work until command is given. When we give command by touching sense pad a signal current flow through VDD 5 pin of the TTP223N IC. This current signal works as input command of relay

as touch sensor I/O is connected with signal pin of the relay. Before getting any command, relay contact is connected with normally closed terminal. When it gets command relay coil get energized and relay contact connects with normally open terminal. However, the command signal current is low so a switching transistor Q1 is used to strengthen the current requirement of the minimum current level of the relay coil. A freewheeling diode D1 is connected across the coil to keep back emf effect away from coil. All the relay of control unit works as same way.

4.3 Summary

In this chapter covers the design and hardware development of Portable IPS. We try to discuss about the details of the components used in this project, their connection & working properly step by step.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Introduction

This chapter will present all the results and calculations and relevant discussions.

5.2 Final Result

Firstly, when the main/shutdown button will be turned on, the control panel get power from the battery. Its front panel fully touch system. After that touching the power on button, the inverter will on, also on load button, the load gets on. Here it has another touch button which will show the battery level. At the front, it has 4 indicator LED, to indicates the power on, load, charging & battery low voltage. Now it's in potable power system mode. When this device connects through the power connecting cable with AC line, it will act like IPS mode. That means the battery to inverter system will turned off & line power directly connect with its load side also the inbuild battery will be charged. But when the absence of line power the inverter mode will activated. So that then load power will come from inverter circuit. Fig.5.2 all highlights this model's functional theory-

Fig.5.2 Portable IPS main view

5.2.1 Portable IPS side view

From the side view of portable IPS we can see battery pack is connected to inverter and inverter is connected to 4 channel 5v relay module. Also, we can see connection of Lm2596 DC To DC Step Down Module and connection of AC 220v To DC 5v Dc Step Down Converter.

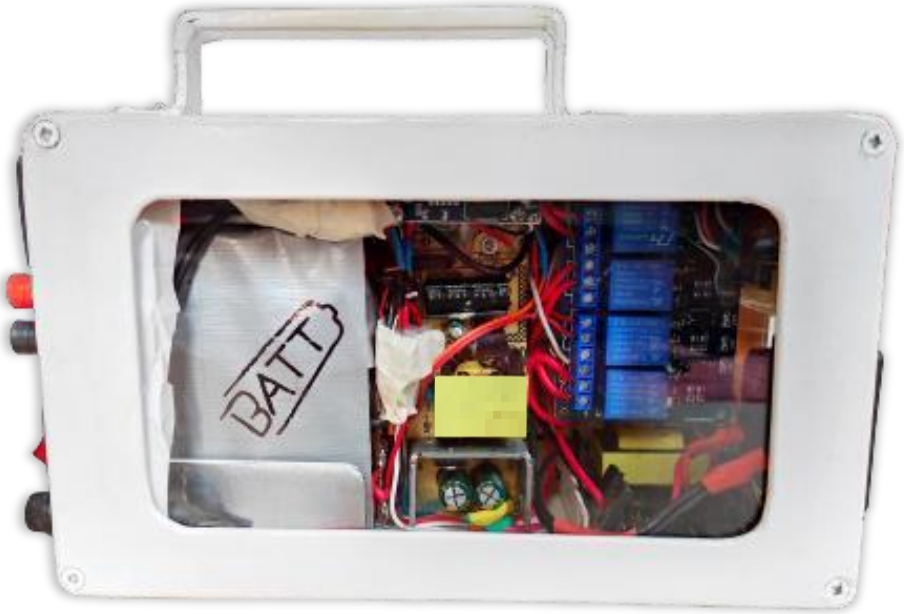

Fig.5.2.1 Portable IPS side view

5.2.2 Portable IPS back & front view

From the back view of portable IPS we can see the AC power cable connector.

Fig.5.2.2 Portable IPS back & front view

Where AC power cable connector will be connected for charging battery and using AC power supply directly to load. We can see female banana jack where external battery can be connected. Shut down switch to turn on/off portable IPS. Fuse is also located there which protects all circuits from being damage.

From front view of portable IPS we can see touch switches, 4 indicator light, battery level indicator display, power socket, volt meter and USB port.

5.2.3 Portable IPS top view

From top view of portable IPS we can see the holding handle, by holding the handle we can move portable IPS from one place to another place.

Fig.5.2.3 Portable IPS top view

This handle is used to make its portability easy and meet the main goal of portable IPS.

5.2.4 Portable IPS battery pack view

In this view we can see battery pack is connected with 4s BMS circuit. Which protects battery from getting overcharge or over discharge. If overcharge or over discharge happens batteries will be damaged.

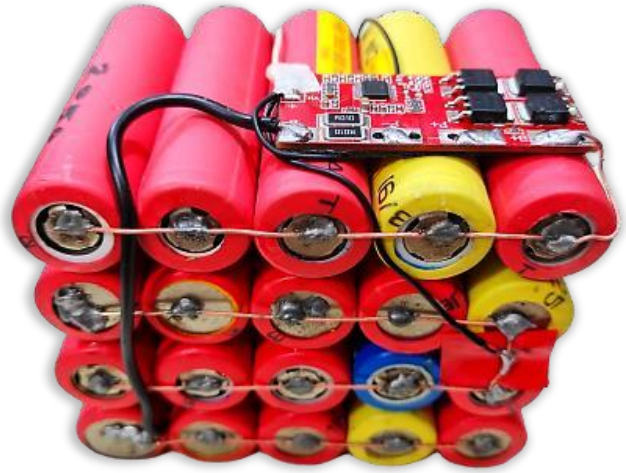

Fig.5.2.4 Portable IPS battery pack view

5.2.5 Portable IPS power off view

In the power off view of portable IPS we can see that inverter is off so no indicator is on. Analog volt meter is showing zero output voltage of inverter.

Fig.5.2.5 Portable IPS power off view

In this mode if AC power cable is connected then battery will be charged at the same time, we can be able to use AC power supply directly through power socket.

5.2.6 Portable IPS power on view

From the power on view of portable IPS we can see power on indicator light is on. With the touch button of power on we can turn on the power.

Fig.5.2.6 Portable IPS power on view

5.2.7 Portable IPS load on view

In the load on view of portable IPS we can see that load indicator light on. We can turn on or off the load by touching the load touch switch. Power on indicator is also on as inverter is on.

Fig.5.2.7 Portable IPS load on view

5.2.8 Portable IPS battery charging view

From the battery charging view of portable IPS we can see that charging indicator light is on. Battery will be charged when AC power cable is connected to AC power supply and shut down switch is on.

Fig.5.2.8 Portable IPS battery charging view

5.2.9 Portable IPS low battery indicate view

From the low battery indicate view we can see that low battery indicator light is on. This will happen when battery charge level goes to a certain voltage level.

Fig.5.2.9 Portable IPS low battery indicate view

5.3 Cost Analysis

Serial No	Name	Quantity (Pcs)	Price (BTD)
1.	Indicator LED	4	8
2.	TTP 223 Touch Sensor	4	160
3.	Lm2596 DC To DC Step Down Module	1	90
4.	4 Channel 5v Relay Module	1	180
5.	AC 220v To DC 5v Dc Step Down Converter	1	90
6.	Digital DC Volt Meter	1	80
7.	DC 6-32v to 5v step-down USB Module	1	140
8.	Analog AC Volt Meter	1	30
9.	DC To AC Inverter 250watt	1	450
10.	18650 Rechargeable Batterie's	20	2000
11.	4S BMS Battery Protection Board	1	220
12.	19v Adapter	1	410
13.	AC Power Cable Connector	1	30
14.	Battery Low Voltage Indicator	1	50
15.	Small On/Off Rocker Switch	1	15
16.	Banana Jack (Female)	2	20
17.	Fuse	1	25
18.	Power Socket	1	60
19.	PVC Sheet	5	500
20.	Connecting wire	2	50
	Total		***4,608***

Table 5.3 Cost analysis of the project

5.4 Summary

At last, completing this chapter and the project is ready to use. The main drawback of any project is the cost. This chapter discusses the results of the project, here is the real-life implementation of the project. Here each task is done step by step according to the block diagram. As a proof, some snap pictures have been added while running after finishing the project.

CHAPTER 6

CONCLUSIONS

6.1 Conclusion

A Portable IPS is a structured way of representing the modern world smart device. It's a 200VA IPS which easy to use & placing it anywhere any time. Because this Portable IPS is user friendly, mini size & safe to use in our daily requires. It can be used as power bank or power supply & also can use as like IPS. The main purpose of this project is to breakout the limitation in electricity facilities in daily use, create easier device for people to help in emergency at any place or in loadshedding. It provides more useful in loadshedding or rural area, also in our any emergency time when electricity facilities not close to us. At present we haven't much time to operate & carry something with us which is required. This Portable IPS has been made keeping in mind of all the opportunity of technology in regular life.

For decades to come, we definitely hope that these kinds of user-friendly project can more dominant and discover in modern technology.

6.2 Limitations of the Work

- This device can only be used in lower load up to 100watt.
- Battery charge goes down faster depending on load watt.

6.3 Future Scopes of the Work

Portable IPS is two in one system mode which main part is inverter which successfully run this device. Other control procedures should be designed and developed to compare between the control methods. Experimental setup to compare with the simulation results. Integration of communication interface with the system

It can be used as high-power power bank as well as power source. It can be used this anywhere like normal IPS and can be carried anywhere. Anyone can use for charging

mobile phone, laptop etc. Also, can be used to conduct a table fan, LED tv, sound box, light etc. Because of its low weight & small size, it can be carried to any place like in journey time, picnic or tour, rural area where load shedding is common fact. Where we are, or travelling anywhere this Portable IPS will work alone to save our emergency electric problem. Connect this device with an external higher amp size battery, this will run more well than its in-build battery system.

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