UNIVERSAL INPUT UNIVERSAL OUTPUT POWER CONVERTER

Submitted in partial fulfillment of the requirements
of the degree of

Bachelor's in Electrical Engineering

by

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Mumbai University

(2015-2016)

Certificate

This is to certify that the project entitled **"Universal Input Universal Output Power Converter"** is a bonafide work of **"Abrar Shaikh"** (13EE66), **"Asim Shaikh"** (13EE75), **"Bilal Memon"** (12EE29), and **"Salahuddin Khan"** (12EE24), submitted to the University of Mumbai in partial fulfillment of the requirement for the award of **"Bachelor's Degree"** in **"Electrical Engineering"**.

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Project Report Approval

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Examiners

1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Date:

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Acknowledgement

We, the students of Final Year Electrical Engineering are proud to present our project on "**Universal Input Universal Output Power Converter**". The completion of this project is a matter of great pleasure for us as in this project we try to accomplish our vision of building an innovative project which is one of its kind on this planet.

The completion of this project work is milestone in our life and its execution is inevitable in the hand of guide. We take this opportunity to express our deep sense of gratitude to our guide **PROF. KALEEM SYED** for his valuable guidance and inspiration in spite of his busy schedule. He devoted himself in completing our task with the admirable excellence. He has taken keen and personal interest in giving us constant encouragement and timely suggestion.

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Abstract

We aimed at integrating nearly all power converters to obtain any kind of output for any given input (provided input has sufficient power) by smart switching of relays with the help of microcontroller. To economize the project, components are shared between modules and smart-switching enables the same components to act as different modules at different times.

We envisioned about this new type of converter because the power converters available in market provides single conversion process. This makes us purchase different power converters to perform different conversion operations. There are few converters which provide multiple outputs but they too support only single input. We were surprised to find that there is not a single converter in this market which can meet all conversion needs and this motivated us to make this project.

The aim of this project is not to build a new type of power supply. Rather it is to integrate all the available converters in an efficient manner while keeping the cost low. This project is not about just connecting various power converter modules with wires. But it is about smart switching between various modules to give desired output for any available input using microcontroller.

UiUo Power Converter brings all the available converters in a single modular setup in an efficient manner. No such power converter is available in the market and by making this project we are opening a whole new world of possibilities of conversion with just single module. Our project will provide compact & all-in-one power converter to field research teams or to anyone in need of multiple power conversions.

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Abbreviations and Notations

AC	Alternating current
DC	Direct current
VFD	Variable Frequency Drive
LED	Light Emitting Diode
PDF	Portable Document Format
PC	Personal Computer
PLC	Programmable Logic Controller
RLY	Relay
IC	Integrated Circuit
HMI	Human Machine Interface
CPU	Central Processing Unit
RAM	Random Access Memory
ROM	Read Only Memory
PS	Power Supply
NO	Normally Open
NC	Normally Closed
HMI	Human Machine Interfaced
GUI	Graphical User Interfaces
PCB	Printed Circuit Board

1 Introduction

1.1 Present Scenario

We have available devices in the market for electrical power conversion as individual and separate modules (e.g. only 1 phase to DC, 3 phase to DC, DC to 1 phase, etc.). If two or more modules are required, it would entail buying each module separately which increases the cost and decreases the handling efficiency. Therefore, we came up with the idea of Universal Input Universal Output Power Converter (UiUo PC), which would take in any kind of supply and convert it to any desired output (provided the input has sufficient power). For this purpose, we have identified various power sources used in electrical industry and research: Constant/Variable Voltage/Current Low Voltage DC, Dual DC, Power DC, 1 phase AC (nominal and regulated), 3 phase AC (nominal and regulated), Variable frequency AC (1 phase and 3 phase) and test signals from signal generators. UiUo PC will be able to take any one input from above mentioned sources and convert it into any other form. For e.g. if the input given is 1 phase then it can be converted into any of the other power sources mentioned above. The complete process will be automatic and microcontroller based.

The aim of this project is not to build a power supply. Rather, it is to:

- Integrate various power supplies
- Build efficient and compact circuits
- Keep the cost low

Project is not about just connecting various power converter modules with wires. But it is about smart switching between various modules to give desired output for any available input using microcontroller. In doing so, to economize the project, components are shared between modules and smart-switching enables the same components to act as different modules at different times.

For example, same set of bridge of diodes will be used in different connection format to achieve 1 phase inverter, 3 phase inverter, 1 phase rectifier, 3 phase rectifier, etc. And to change connections automatically, we will introduce relays which will use our smart switching microcontroller program to form the desired connections. So the most important part in our project is to implement the logic in microcontroller which operates only required components at any given time to provide desired output. Thus, the overall cost will be reduced as compared to individual modules.

1.2 History of Power Converters

Earlier, electro-mechanical devices were used for power conversion. If we had to convert AC to DC, then AC supply was given to Induction Motor which in turn was coupled to DC generator. Thus, we obtained the output in the form of DC. Similarly, if DC was available, then it was converted to AC with the combination of DC motor and AC generator. However, these conventional methods were very inefficient and involved a lot of losses.

In 1902, Peter Cooper Hewitt invented world’s first AC to DC converter involving solid state devices. This was the beginning of the family of rectifiers to follow. In 1957, William McMurray invented the inverter for DC to AC conversion. This was followed by Variable Frequency Drives in 1961. Modifications in AC supply was easy but it was required to have same control of ease in modifying DC which was made possible with the help of Chopper circuits developed by Kenneth Phillips in 1976. Cycloconverters filled the remaining piece of converter thus enabling almost any type of conversion to be made possible.

However, these converters were one to one converters. In some cases, it was possible to have one to many conversions which involved the use of selector switch for selecting the type of conversion. This process was manual in nature and was of use to limited applications. Any application requiring some different type of conversion involved purchasing that module. We extended the idea of selector switch to a whole new level by incorporating all the different types of converters in one module and connecting them smartly with relays controlled with microcontroller for automatic operation. And this is a beginning of a new history in this field.

1.3 Features of UiUo Power Converter

The three important features of UiUo Power Converter are:

- Innovative
- Simple
- Compact

This features makes this converter one of its kind, that is, a power converter which is very richly featured and can operate to satisfy any conversion needs. The heart of this project is **smart switching logic**. It is the logic developed by us in order to achieve this multiple conversion processes with the help of same set of conventional converters module. This enables us to have full control over the selection of modules to have the required results.

1.4 Benefits of Universal Power Converter

Universal Power converter not only eliminates the use of many converter modules for different conversion processes but at the same time reduces the cost, space required, etc. Our project will provide compact & all-in-one power converter to field research teams and educational facilities. With the help of this converter, a whole new benchmark will be set in the field of power electronics where competitors will try to incorporate as many converters in their system as possible once this UiUo Converter hits the market.

Achieving, the same conversion results in a more advanced, sophisticated yet simple way is possible with this converter and will be a massive success owing to its potential to be a real challenger to all the available converters in the market. Because, not all the converters can perform such heavy task with such simple logic.

1.5 Power Converters Basics

Various power converters are available in the market which makes conversion from one form of electricity to another to serve a given purpose. All these converters are based on certain topologies and are intended to produce a certain waveform. This has been explained below.

1.5.1 Waveforms

To categorize various topologies of converter circuits a common differentiation between AC and DC voltages must be made. The difference is AC voltages reverse their polarity over time while DC voltages don't. That however doesn't mean that DC voltages are always constant. Therefore, there are unlimited number of waveforms for AC as well as DC in our complex world. However, for practical use, most generally a couple of idealized waveforms are used in switch mode power conversion circuits.

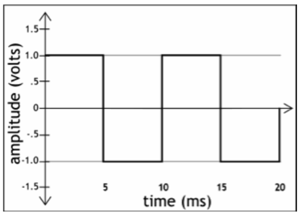


FIGURE 1-1 TRAPEZOIDS WITH STEEP SLOPE

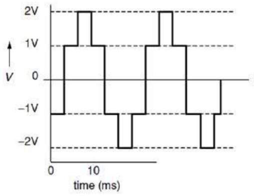


FIGURE 1-2 MODIFIED SQUARE WAVE AC

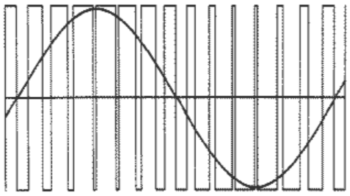


FIGURE 1-3 PWM APPROXIMATED TO SINE WAVE

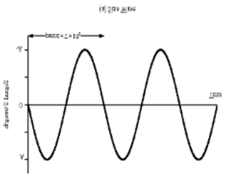


FIGURE 1-4 SINUSOID

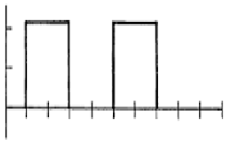


FIGURE 1-5 SQUARE DC WAVE

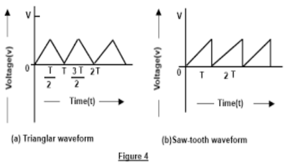


FIGURE 1-6 SAW TOOTH DC

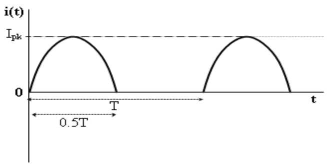


FIGURE 1-7 SINUOSID POSITIVE DC

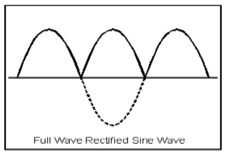


FIGURE 1-8 RECTIFED WAVEFORM

Like for example we have square wave AC which are not actually square waves but trapezoids with very steep slope as seen in figure 1. Next we have modified square wave AC which have number of steps in a particular square as seen in figure 2. Next we have a PWM waveform approximated to Sine wave and then we have actual sinusoid as seen in figure 3 and figure 4. As for DC voltages we will find constant values of course but also pulse DC voltages in different shapes. Most commonly, the square wave which again actually has a form of trapezoid as seen in figure 5. There is also available, pulse DC in the form of a saw tooth which is often times just a simplification of an exponential function with the charging curve of a capacitor as seen in figure 6. Also often found, are DC voltages in the shape of positive and negative half of the sinusoid as seen in figure 7 and figure 8.

2 Review of Literature

Universal Input Universal Output Power Converter is one of its kind at is not available in the market yet. The idea though is very simple and therefore we referred to the various bits and pieces of information available in the literature by the scholars of Power Converters. We collected this information to aid us in our innovative idea to create something new and make our contribution in the field of Electrical Engineering These scholars, are not only knowledgeable in their field but they have an art of how to depict their knowledge on paper and it was truly exciting journey while referring to their work.

Initially, we developed our own block diagram and **smart switching logic** and then to continue with the prototype we referred to Power Electronics by Khanchandani to get the basic idea behind the circuit designing stage and then we referred Encyclopedia of Electronic Components Volume 2 by Platt Charles and Jansson Fredrik for selecting appropriate components.

Next we referred to two IEEE papers in this multiple power conversion field to understand the basic approach of the scholars towards an innovative design. To have a real practical aid we referred to various sites such as homemadecircuits.com, circuitvalley.com, etc. which helped us a lot in building and troubleshooting our prototype until final model was complete. All the references have been made at the end of this report and it was a matter of happiness in referring the works of genius to aid us in our project.

3 Designing of Circuit

3.1 Selection of Microcontroller

Selecting the microcontroller was a very important step in giving this project a particular direction towards successful build. Selecting the right microcontroller for a product can be a daunting task. Not only are there a number of technical features to consider, there are also business case issues such as cost and lead-times that can cripple a project. At the start of a project there is a great temptation to jump in and start selecting a microcontroller before the details of the system has been hashed out. This is of course a bad idea. Before any thought is given to the microcontroller, the hardware and software engineers should work out the high levels of the system, block diagram and flowchart them and only then is there enough information to start making a rational decision on microcontroller selection. When that point is reached, there are 10 easy steps that can be followed to ensure that the right choice is made.

Step 1: Making a list of required hardware interface: Using the general hardware block diagram, make a list of all the external interfaces that the microcontroller will need to support. There are two general types of interfaces that need to be listed. The first are communication interfaces. These are peripherals such as USB, I2C, SPI, UART, and so on. Make a special note if the application requires USB or some form of Ethernet. These interfaces greatly affect how much program space the microcontroller will need to support. The second type of interface is digital inputs and outputs, analog to digital inputs, PWM's, etc. These two interface types will dictate the number of pins that will be required by the microcontroller. Figure 1 shows a generic example of a block diagram with the i/o requirements listed.

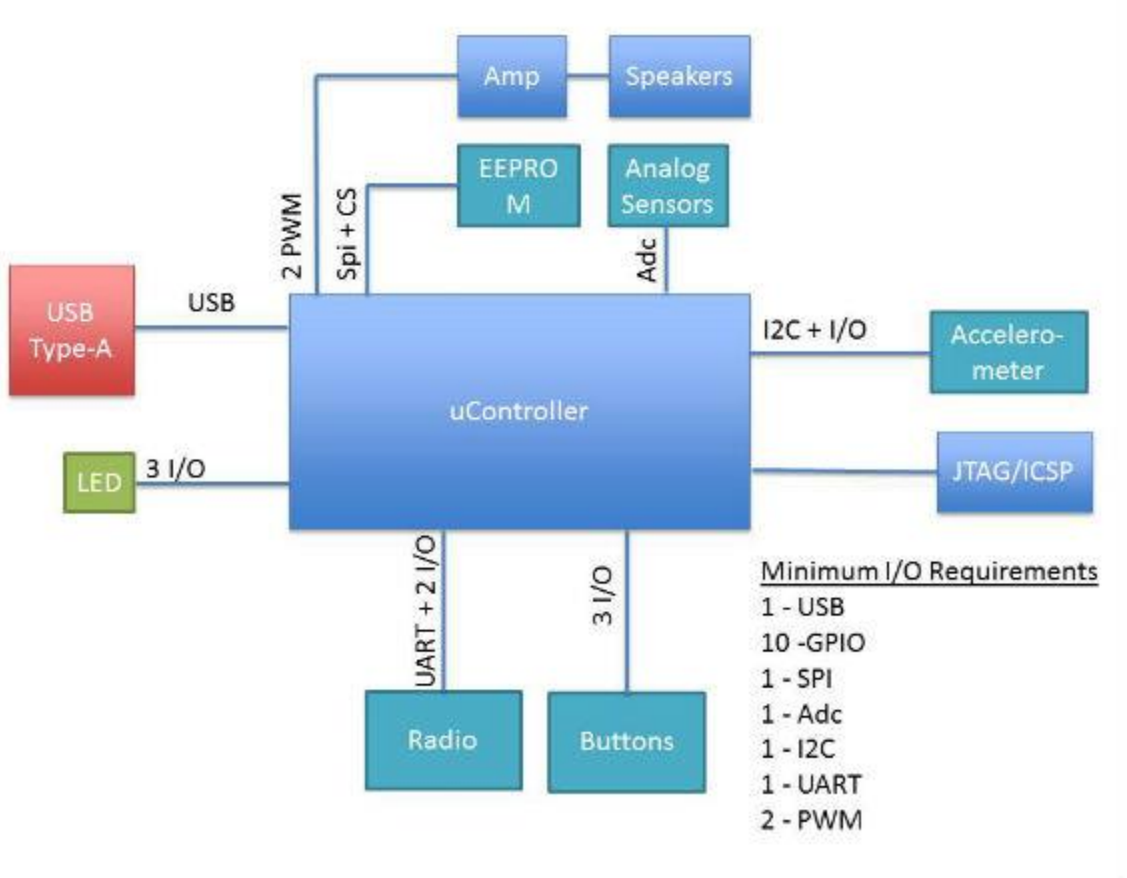


FIGURE 3-1 LIST OF HARDWARE FEATURES OF MICROCONTROLLER

Step 2: Examine the software architecture: The software architecture and requirements can greatly affect the selection of a microcontroller. How heavy or how light the processing requirements will determine whether you go with an 80 MHz DSP or an 8 MHz 8051.For example, do any of the algorithms require floating point mathematics? Are there any high frequency control loops or sensors? Estimate how long and how often each task will need to run. Get an order of magnitude feel for how much processing power will be needed. The amount of computing power required will be one of the biggest requirements for the architecture and frequency of the microcontroller.

Step 3: Selecting the architecture: Using the information from steps 1 and 2 an engineer should be able to start getting an idea of the architecture that will be needed. Can the application get by with eight bit architectures? How about 16 bits? Does it require a 32-bit ARM core? Between the application and the required software algorithms these questions will start to converge on a solution. Don’t forget to keep in mind possible future requirements and feature creep. Just because you could currently get by with an 8-bit microcontroller doesn’t mean you shouldn’t consider a 16-bit microcontroller for future features or even for ease of use. Don’t forget that microcontroller selection can be an iterative process. You may select a

16-bit part in this step but then in a later step find that a 32-bit ARM part works better. This step is simply to start getting an engineer to look in the right direction.

Step 4: Identify Memory Needs: Flash and RAM are two very critical components of any microcontrollers. Making sure that you don't run out of program space or variable space is undoubtedly of highest priority. It is far easier to select a part with too much of these features than not enough. Getting to the end of a design and discovering that you need 110% or that features need to be cut just isn't going to fly. After all, you can always start with more and then later move to a more constrained part within the same chip family. Using the software architecture and the communication peripherals included in the application, an engineer can estimate how much flash and RAM will be required for the application. Don't forget to leave room for feature creep and the next versions! It will save many headaches in the future.

Step 5: Start searching for microcontrollers: Now that there is a better idea of what the required features of the microcontroller will be the search can begin! One place that can be a good place to start is with a microcontroller supplier such as Arrow, Avnet, Future Electronics or similar. Talk with an FAE about your application and requirements and often times they can direct you to a new part that is cutting edge and meets the requirements. Just keep in mind that they might have pressure on them at that time to push a certain family of microcontrollers!

The next best place to start is with a silicon provider that you are already familiar with. For example, if you have used Microchip parts in the past and had a good experience with them, then start at their website. Most silicon providers have a search engine that allows you to enter your peripheral sets, I/O and power requirements and it will narrow down the list of parts that match the criteria. From that list the engineer can then move forward towards selecting a microcontroller.

Step 6: Examine Costs and Power Constraints: At this point the selection process has revealed a number of potential candidates. This is a great time to examine the power requirements and cost of the part. If the device will be powered from a battery and mobile, then making sure the parts are low-power is absolutely precarious. If it doesn't meet power requirements, then keep weeding the list down until you have a select few. Don't forget to examine the piece price of the processor either. While prices have steadily been approaching $1 in volume for many parts, if it is highly specialized or a high-end processing machine then price might be critical. Don't forget about this key element.

Step 7: Check part availability: With the list of potential parts in hand, now is a good time to start checking on how available the part is. Some of the things to keep in mind are what the lead times for the part? Are they kept in stock at multiple distributors or is there 6 – 12 week lead time? What are your requirements for availability? You don't want to get stuck with a large order and have to wait three months to be able to fill it. Then there is a question of how new the part is and whether it will be around for the duration of your product life cycle. If your product will be around for 10 years, then you need to find a part that the manufacturer guarantees will still be built in 10 years.

Step 8: Select a development kit: One of the best parts of selecting a new microcontroller is finding a development kit to play with and learn the inner working of the controller. Once an engineer has settled their heart on the part they want to use they should research what development kits are available. If a development kit isn't available, then the selected part is most likely not a good choice and they should go back a few steps and find a better part. Most development kits today cost under $100. Paying any more than that (unless it is designed to work with multiple processor modules) is just too much. Another part may be a better choice.

Step 9: Investigate compilers and tools: The selection of the development kit nearly solidifies the choice of microcontroller. The last consideration is to examine the compiler and tools that are available. Most microcontrollers have a number of choices for compilers, example code and debugging tools. It is important to make sure that all the necessary tools are available for the part. Without the right tools the development process could become tedious and expensive.

Step 10: Start Experimenting: Even with the selection a microcontroller nothing is set in stone. Usually the development kit arrives long before the first prototyped hardware. Take advantage by building up test circuits and interfacing them to the microcontroller. Choose high risk parts and get them working on the development kit. It may be that you discover the part you thought would work great has some unforeseen issue that would force a different microcontroller to be selected. In any event, early experimentation will ensure that you made the right choice and that if a change is necessary, the impact will be minimal!

After evaluating all these steps we arrived at a conclusion of using ATMEL 89S52 microcontroller for the required purpose in a 40 pin PDIP package.

3.1.1 ATMEL 89S52 Microcontroller

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the indus-try-standard 80C51 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory pro-grammer. By combining a versatile 8-bit CPU with in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications. In addition, the AT89S52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port, and interrupt system to continue functioning. The Power-down mode saves the RAM con-tents but freezes the oscillator, disabling all other chip functions until the next interrupt or hardware reset.

3.1.2 Features of 89S52

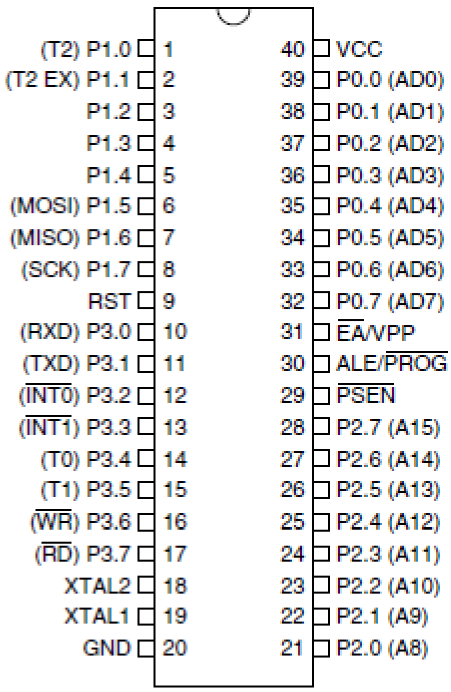


FIGURE 3-2 89S52 PIN CONFIGURATION

8K bytes of Flash,

256 bytes of RAM,

32 I/O lines

Watchdog timer

Two data pointers

Three 16-bit timer/counters

Six-vector two-level interrupt architecture

3.1.3 Memory Organization

MCS-51 devices have a separate address space for Program and Data Memory. Up to 64K bytes each of external Program and Data Memory can be addressed. If the EA pin is connected to GND, all program fetches are directed to external memory. On the AT89S52, if EA is connected to VCC, program fetches to addresses 0000H through 1FFFH are directed to internal memory and fetches to addresses 2000H through FFFFH are to external memory. The AT89S52 implements 256 bytes of on-chip RAM. The upper 128 bytes occupy a parallel address space to the Special Function Registers. This means that the upper 128 bytes have the same addresses as the SFR space but are physically separate from SFR space. When an instruction accesses an internal location above address 7FH, the address mode used in the instruction specifies whether the CPU accesses the upper 128 bytes of RAM or the SFR space. Instructions which use direct addressing access the SFR space. For example, the following direct addressing instruction accesses the SFR at location 0A0H (which is P2). MOV 0A0H, #data Instructions that use indirect addressing access the upper 128 bytes of RAM. For example, the following indirect addressing instruction, where R0 contains 0A0H, accesses the data byte at address 0A0H, rather than P2 (whose address is 0A0H). MOV @R0, #data Note that stack operations are examples of indirect addressing, so the upper 128 bytes of data RAM are available as stack space

3.2 Selection of Relays

A **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary **to control a circuit by a low-power signal** (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled **by one signal**.

FIGURE 3-3
RELAY

Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults.

3.2.1 Working

Basically a Relay consists of an electromagnet, an armature, a spring and a series of electrical contacts. The electromagnet coil gets power through a switch or a relay driver and causes the armature to get connected such that the load gets the power supply. The armature movement is done using a spring. Thus the relay consists of two separate electrical circuits which are connected to each other only through magnetic connection and the relay is controlled by controlling the switching of the electromagnet.

Current moving through the coil of the relay makes a magnetic field which attracts a lever and changes the switch contacts. The loop or coil current can be on or off so relays have two switch positions and generally have double throw (changeover) switch contacts. Relays can have numerous sets of switch contacts. The following designations are commonly encountered:

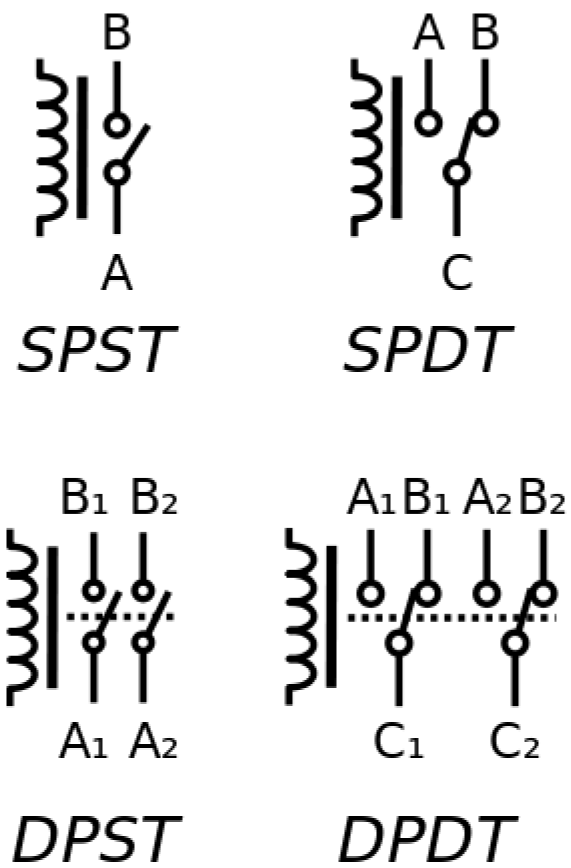


FIGURE 3-4 TYPES OF RELAYS

The "S" or "D" may be replaced with a number, indicating multiple switches connected to a single actuator. For example, 4PDT indicates a four pole double throw relay that has 12 switch terminals.

However, relays, which are normally used, are usually SPDT or DPDT. The contacts are usually common (COM), normally open (NO) and normally closed (NC). The normally closed contact will be connected to the common contact when no power is applied to the coil. The normally open contact will be open when the no power is applied to the coil. When the coil is energized the common is connected to the normally open contact and the normally closed contact is left floating. The double pole versions are the same as the single pole version except there are two switches that open and close together.

3.2.2 Relay Cards

FIGURE 3-5 RELAY CARD

Relay cards are specially designed industrial grade relays set mounted on a single PCB with the required drivers. SPDT Relay card is used with 8 relays on board and therefore two such cards are required. Each relay can be controlled separately and has its own indicator LED.

4 Implementation of Project

4.1 Block Diagram

4.1.1 Input &Outputs use in Block Diagram

Inputs	Outputs
Single Phase AC	Single Phase AC
Small Signal DC	Single Phase AC Regulated
Three Phase AC	Variable DC
	Constant Voltage DC
	Constant Current DC
	Power DC
	Three Phase
	Three Phase VFD

TABLE 4-1 INPUTS-OUTPUTS

4.1.2 Color Coding Used in Block Diagram

Yellow: Input Terminals

Blue: Output Terminals

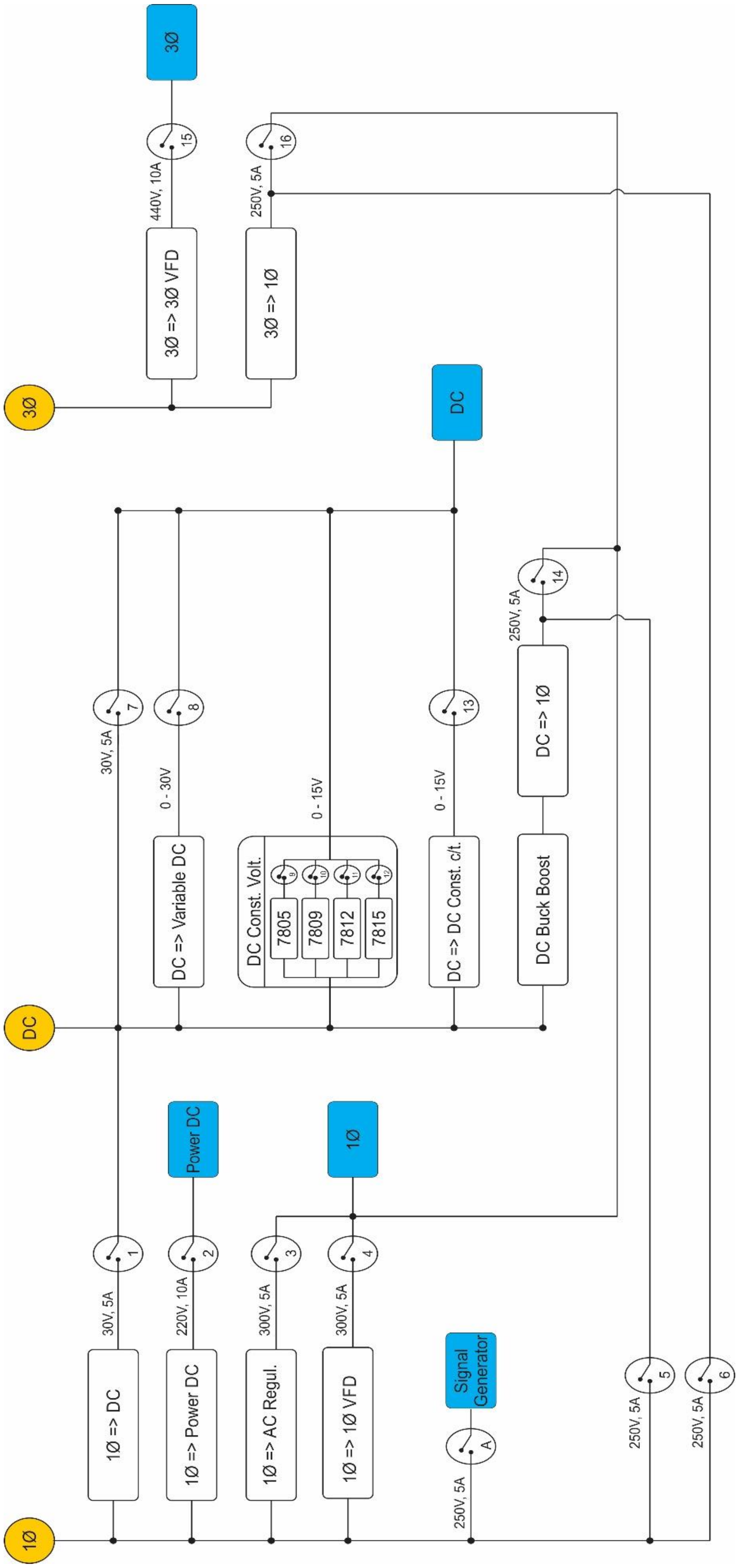


FIGURE 4-1 BLOCK DIAGRAM

4.2 Tools and Components Required

FIGURE 4-2 POT

4.2.1 Potentiometer

In electrical engineering parlance, the term "potentiometer" is used in either one of two ways. It may refer to an instrument that measures an unknown emf or voltage by comparing it to a standard emf. In this capacity, it is functioning as a null instrument; it permits precision measurement by adjusting a value of a circuit element until a meter reads zero. Alternatively, "potentiometer" may refer to an electronic component that is used to vary resistance in a circuit. A potentiometer is also referred to as a variable resistor or pot. They have three terminals, where the one in the middle is known as the wiper, and the other two are known as ends. The wiper is a movable contact where resistance is measured with respect to it and either one of the end terminals.

They are useful for circuits where the resistance needs to be dynamically changed to control the current. They are also popular as voltage dividers,

If only two terminals of a potentiometer are used, one end and the wiper, it acts as a variable resistor or rheostat.

4.2.1.1 Working

Potentiometers work by having a resistive element inside. Both end terminals are attached to it, and do not move. The wiper travels along the strip when the knob is turned. The closer the wiper is to the end terminal it is wired in conjunction with, the less the resistance, because the path of the current will be shorter. The further away it moves from the terminal, the greater the resistance will be.

The symbol for a potentiometer is the same one as a resistor, save for an arrow in the middle. In a circuit where they are used strictly as variable resistors or rheostats, only two terminals are wired to the other components. All three terminals are wired separately when they function as voltage dividers.

Light dimmers in houses and volume controls on electronics are two common applications. Others include switches and position sensors.

4.2.2 Toggle Switch

FIGURE 4-3 TOGGLE SWITCH

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 numerous applications. Many are designed to provide the simultaneous actuation of multiple sets of electrical contacts, or the control of large amounts of electric current or main voltages.

The word toggle is reference to a kind of mechanism or joint consisting of two arms, which are almost in line with each other, connected with an allow 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. Similarly, a switch where a definitive click is heard is called a positive on- off switch multiple toggle switches may be mechanically interlocked to prevent forbidden combinations

Switches are devices that create a short circuit or an open circuit depending on the position of the switch for a light switch ON means short circuit. when the switch OFF that means there is an open circuit. When the switch is ON it look and act like a wire. When the switch is OFF there being no connection.

4.2.3 MCB

FIGURE 4-4 MCB

A **circuit breaker** is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overcurrent/overload or short circuit. Its basic function is to interrupt current flow after protective relays detect a fault. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation.

Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city. The generic function of a circuit breaker as an automatic means of removing power from a faulty system is often abbreviated to ADS (Automatic Disconnection of Supply).

Miniature circuit breaker (short as MCB) can be also called as mini circuit breaker, micro circuit breaker, etc. It is a widely used appliance for terminal protection, working as protection from short circuit, overload, overvoltage and etc. in both single phase and three phase system with rated current up to 125A. It normally includes four types of 1P, 2P, 3P, 4P.

4.2.3.1 Working

1. Overload protection

Overload protection function is realized based on principle that bimetallic strips bend with temperature rises. When miniature circuit breaker is working under normal working condition, inner bimetallic strips heat as electric current flows, also different thermal expansion coefficients of two metal strips lead to bending. The bending angle is so small under normal current (1.13In), therefore the thrust generated is not big enough to make release trip; but bending angle gets larger when overload happens in the circuit (current up to 1.45In), so that bended metal strips touch lever in tripping mechanism, and then make release trip, thus realizing overload protection function.

For miniature circuit breaker, different current flowing through causes different bending degree for bimetallic strips. When normal overload happens in the circuit, the tripping time is a bit longer because of not so large overload current.

2. Short circuit protection

Short circuit protection is realized through instantaneous release. According to analysis of equation of F=IN (suction is directly proportional to product of current and number of windings), and few windings of instantaneous release coil (normally less than 10 turns), the suction generated under normal working current is not big enough to overcome spring's reactive force, thus the circuit still works. But when short circuit or severe overload happens, large current will flow through induction coil, and a strong magnetic field is generated. Although coil's windings number is same, the current produced increases by several times and even more than normal working current, thus suction will also increase by same times, so that lever is pushed to make release trip, the tripping time is normally within 0.1s because of large current.

4.2.4 RCD

A **residual-current device** (**RCD**), or **residual-current circuit breaker** (**RCCB**), is a device to quickly disconnect current to prevent serious harm from an ongoing electric shock.

These electrical wiring devices disconnect a circuit when it detects that the electric current is not balanced between the energized (line) conductor(s) and the return (neutral) conductor. Under normal circumstances, these two wires are expected to carry matching currents, and any difference usually indicates that a short circuit or other electrical anomaly is present. Even a small leakage current can mean a risk of harm or death due to electric shock if the leaking electric current passes through a human; a current of around 30 mA (0.030 amperes) is potentially sufficient to cause cardiac arrest or serious harm if it persists for more than a small fraction of a second. RCDs/RCCBs are designed to disconnect the conducting wires quickly enough to prevent serious injury from such shocks. (This is commonly described as the RCD/RCCB being "tripped".)

FIGURE 4-5 RCD

A RCD does not provide protection against unexpected or dangerously high current when current is flowing in the usual wires in the circuit, therefore it cannot replace a fuse or protect against overheating or fire risk due to overcurrent (overload) or short circuits if the fault does not lead to current leakage. Therefore, RCDs are often used or integrated as a single product along with some kind of circuit breaker, such as a fuse or miniature circuit breaker (MCB), which adds protection in the event of excessive current in the circuit. RCDs also cannot detect the situation where a human accidentally touches both conductors at the same time, since the flow of current through an expected device, an unexpected route, or a human, are indistinguishable if the current returns through the expected conductor.

4.2.5 Buck Boost Converter

The **buck–boost converter** is a type of DC-to-DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. It is equivalent to a flyback converter using a single inductor instead of a transformer.

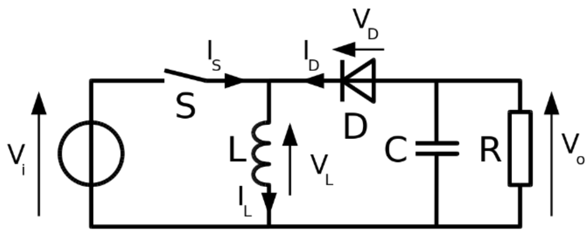
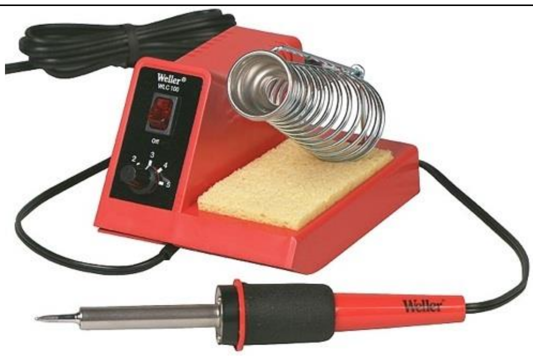


FIGURE 4-6 BUCK BOOST CONVERTER

It is a buck (step-down) converter combined with a boost (step-up) converter. The output voltage is typically of the same polarity of the input, and can be lower or higher than the input. Such a non-inverting buck-boost converter may use a single inductor which is used for both the buck inductor and the boost inductor, sometimes called a **"four-switch buck-boost converter"**, it may use multiple inductors but only a single switch.

4.2.6 Tools

Solder Gun	
Long Nose Pliers	

Screw Driver Set	
Glue Gun	
Wire Stripper	

4.3 Circuit Working

All the different modules are so connected as to provide any kind of output for any given input. This is based on the operation of relays in a logical manner. This logic is controlled by microcontroller which is the brain and heart of our project. Say for example user wants constant current output from single phase input. Then the relays would be so switched that first the single phase output would be converted to DC voltage and this DC voltage would pass through constant current module to give desired output. Such logic would be set for all types of input to give any desired output.

To economize the project, components are shared between modules and smart-switching enables the same components to act as different modules at different times. Same set of bridge of thyristors will be used in different connection format to achieve 1 phase inverter, 3 phase inverter, 1 phase rectifier, 3 phase rectifier, etc. And to change connections automatically, we will introduce relays which will use our smart switching microcontroller program to form the desired connections. So the most important part in our project is to implement the logic in microcontroller which operates only required components at any given time to provide desired output. Thus, the overall cost will be reduced as compared to individual modules.

At the same time the circuit monitoring, control and protection will be in action to give reliable and safe operating conditions. Monitoring circuit will indicate if the given input has enough power to provide desired output. Also, measuring devices will provide real time information of voltages, current, etc. UiUo Power Converter brings all the available converters in a single modular setup in an efficient manner and no such power converter is available in the electrical market. Our project will provide compact & all-in-one power converter to field research teams. Also, it will be useful in educational institutions and industrial testing.

Output Terminal Name	**Types of output we get on this terminal**
Single Phase AC	1ϕ AC, 1ϕ AC Regulated, 1ϕ AC VFD
Three phase AC	3ϕ AC VFD
Small Signal DC	30V DC, Variable DC, Constant v/g DC, Constant c/n DC
Power DC	Power DC
Signal Generator	Various Signals as per selection

TABLE 4-2 OUTPUT TERMINALS

4.3.1 Working Steps

Step 1: Switch ON battery supply to power the microcontroller and auxiliary circuits

Step 2: Selecting input from input pushbutton panel

Step 3: Selecting output from output pushbutton panel

Step 4: Microcontroller will do the rest.

4.3.2 Circuit Operation

User has to select the type of input given with the help of Input Pushbutton on the keypad matrix. Once microcontroller detects the type of input it enables the selection of outputs for that particular input. User then selects the output desired. Microcontroller then selects the sequence of relays which needs to be switched on to get desired output from the given input accordingly. Relays which needs to be switched on in all the three cases are illustrated in tables below.

4.3.2.1 Input: Single Phase

Desired Output for Single Phase Input	Relay to be switched ON
DC	R1, R7
Variable DC	R1, R8
Power DC	R2
5V Constant Voltage DC	R1, R9
9V Constant Voltage DC	R1, R10
12V Constant Voltage DC	R1, R11
15V Constant Voltage DC	R1, R12

Constant Current DC	R1, R13
1ϕ AC Regulated	R3
1ϕ AC VFD	R4
Signal Generator	R17

TABLE 4-3 RELAY SEQUENCE FOR SINGLE PHASE INPUT

4.3.2.2 Input: Three Phase

Desired Output for Three Phase Input	Relay to be switched ON
DC	R6, R1, R7
Variable DC	R6, R1, R8
Power DC	R6, R2
5V Constant Voltage DC	R6, R1, R9
9V Constant Voltage DC	R6, R1, R10
12V Constant Voltage DC	R6, R1, R11
15V Constant Voltage DC	R6, R1, R12
Constant Current DC	R6, R1, R13
1ϕ AC	R16
1ϕ AC Regulated	R6, R3
1ϕ AC VFD	R6, R4
Signal Generator	R6, R17
3ϕ VFD	R15

TABLE 4-4 RELAY SEQUENCE FOR THREE PHASE INPUT

4.3.2.3 Input: Small Signal DC

Desired Output for DC Input	Relay to be switched ON
Variable DC	R8
Power DC	R5, R2
5V Constant Voltage DC	R9
9V Constant Voltage DC	R10
12V Constant Voltage DC	R11
15V Constant Voltage DC	R12
Constant Current DC	R13
1ϕ AC	R14
1ϕ AC Regulated	R5, R3
1ϕ AC VFD	R5, R4
Signal Generator	R5, R17

TABLE 4-5 RELAY SEQUENCE FOR DC INPUT

4.3.3 Sample Syntax in easy If else language

We have done our programming of 89S52 in Assembly language but assembly language is not easy to understand by people who don’t know it. So just to make our understanding of code simpler we have written a few lines of code in simple C language.

Program Syntax

While input button pressed = IN PB 1

{

```
    If desired output = OUT PB 6                  //DC
    {
            Relay R1, R7
}
Else if desired output = OUT PB 7                 //Variable DC
{
            Relay R1, R8
}
Else if desired output = OUT PB 8                 //Power DC
{
            Relay R2
}
Else if desired output = OUT PB 9                 //5V DC
{
            Relay R1, R9
}
```

.... and so on.

4.4 Component List

Sr. No.	Component	Rating/Size	No. of Units	Price (Rupees)
01	Microcontroller	89S52	1	40
02	Transformer	15-0-15	1	450
03	Relay Card	12V	2	700
04	Matrix Button	5V	1	120
05	Lead Acid Battery	12V	3	250
06	AC to DC	230 VAC to 28VDC	1	435
07	Single Phase Regulator	230V	1	70
08	Inverter	12VDC to 300VAC	1	800
09	Regulator IC		5	30
10	Constant Current	30V	1	500
11	Buck Boost	3-30V	1	450
12	Connecting wires		As Required	200
13	Fabrication		1	3000
14	Misc.		1	2000
	Total			8555

TABLE 4-6 COMPONENT LIST

5 Implementation of Program

5.1 Software and Programmer

To program 89S52, we made the use of Flash Programmer and Keil uVision software to do the same. Steps in programming involved writing the program in Assembly language in Keil uVision and then converting it to HEX file. Then uploading the HEX file to the microcontroller with the help of programmer.

5.2 Program of UiUo Power Converter

```
ORG 0
; BIT & BYTE DEFINITIONS OF PORT PINS AS PER HARDWARE CONNECTIONS
LCD EQU P0 ; LCD DATA BUS IS CONNECTED AT PORT 0
RS BIT P1.0 ; REGISTER SELECT
RW BIT P1.1 ; READ/WRITE CONTROL
EN BIT P1.2 ; ENABLE

; KEYPAD CONNECTIONS
; C1,C2,C3,C4
; R1 ->>> 1,2,3,A 1,2,3 ARE IN1, IN2 & IN3. A IS OUT1
; R2 ->>> 4,5,6,B 4,5,6,B ARE OUT2, OUT3, OUT4 & OUT5
; R3 ->>> 7,8,9,C 7,8,9,C ARE OUT6, OUT7, OUT8 & OUT9
; R4 ->>> *,0,#,D *,0,#,D ARE OUT10, OUT11, OUT12 & OUT13
ROW1 BIT P2.7
ROW2 BIT P2.6
ROW3 BIT P2.5
ROW4 BIT P2.4
COL1 BIT P2.3
COL2 BIT P2.2
COL3 BIT P2.1
COL4 BIT P2.0
KEYPAD EQU P2

RELAY1 BIT P1.3
RELAY2 BIT P1.4
```

```
RELAY3 BIT P1.5
RELAY5 BIT P1.6
RELAY6 BIT P1.7
RELAY8 BIT P3.0
RELAY9 BIT P3.1
RELAY13 BIT P3.2
RELAY14 BIT P3.3
RELAY15R BIT P3.4
RELAY15Y BIT P3.5
RELAY15B BIT P3.6
RELAY16 BIT P3.7
; I/O PORT INITIALIZATION

MOV P0,#0FFH
MOV P1,#0 ; TURN OFF RELAYS
MOV P2,#0FFH
MOV P3,#0 ; TURN OFF RELAYS

; LCD INITIALIZATION
ACALL LCD_INIT

; DISPLAY PROJECT TITLE ON LCD SCREEN
STARTING:
ACALL DISP_TITLE

ACALL DISP_MEMBERS

SW_RST:
ACALL DISP_SELECT_IN

SCAN_KEYPAD:
MOV KEYPAD,#0FFH
CLR ROW1
POLL_INPUTS:
JNB COL1,IN1_PRESSED_ ; POLL IN1
JNB COL2,IN2_PRESSED_ ; POLL IN2
JNB COL3,IN3_PRESSED_ ; POLL IN3
SJMP POLL_INPUTS
IN1_PRESSED_: AJMP IN1_PRESSED
IN2_PRESSED_: AJMP IN2_PRESSED
IN3_PRESSED_: AJMP IN3_PRESSED


IN1_PRESSED:
ACALL DISP_IN1_SELECTED
IN1_PRESSED__:
MOV KEYPAD,#0FFH
CLR ROW1
JNB COL4,OUT1_PRESSED

MOV KEYPAD,#0FFH
CLR ROW2
JNB COL1,OUT2_PRESSED
JNB COL2,OUT3_PRESSED
JNB COL3,OUT4_PRESSED
JNB COL4,OUT5_PRESSED

MOV KEYPAD,#0FFH
CLR ROW3
JNB COL1,OUT6_PRESSED
JNB COL2,OUT7_PRESSED
JNB COL3,OUT8_PRESSED
JNB COL4,OUT9_PRESSED

MOV KEYPAD,#0FFH
CLR ROW4
JNB COL1,OUT10_PRESSED
JNB COL2,OUT11_PRESSED
JNB COL3,OUT12_PRESSED
JNB COL4,OUT13_PRESSED
AJMP IN1_PRESSED__
```

```

OUT1_PRESSED:
ACALL DISP_IN1OUT1_AVAIL

SENSE_KEYPAD:
MOV KEYPAD,#0FFH
CLR ROW4
JB COL1,$
CLR P1.3
CLR P1.4
CLR P1.5
CLR P1.6
CLR P1.7
MOV P3,#0
AJMP SW_RST


OUT2_PRESSED:
SETB RELAY3
ACALL DISP_IN1OUT2
AJMP SENSE_KEYPAD


OUT3_PRESSED:
;SETB RELAY4
ACALL DISP_IN1OUT3
AJMP SENSE_KEYPAD


OUT4_PRESSED:
;SETB RELAY17
ACALL DISP_IN1OUT4
AJMP SENSE_KEYPAD


OUT5_PRESSED:
ACALL DISP_IN1OUT5_UNAVAIL
AJMP SENSE_KEYPAD


OUT6_PRESSED:
SETB RELAY1
;SETB RELAY7
ACALL DISP_IN1OUT6
AJMP SENSE_KEYPAD


OUT7_PRESSED:
SETB RELAY1
SETB RELAY8
ACALL DISP_IN1OUT7
AJMP SENSE_KEYPAD


OUT8_PRESSED:
SETB RELAY2
ACALL DISP_IN1OUT8
AJMP SENSE_KEYPAD


OUT9_PRESSED:
SETB RELAY1
SETB RELAY9
ACALL DISP_IN1OUT9
AJMP SENSE_KEYPAD


OUT10_PRESSED:
SETB RELAY1
;SETB RELAY10
ACALL DISP_IN1OUT10
```

```
AJMP SENSE_KEYPAD


OUT11_PRESSED:
SETB RELAY1
;SETB RELAY11
ACALL DISP_IN1OUT11
AJMP SENSE_KEYPAD


OUT12_PRESSED:
SETB RELAY1
;SETB RELAY12
ACALL DISP_IN1OUT12
AJMP SENSE_KEYPAD


OUT13_PRESSED:
SETB RELAY1
SETB RELAY13
ACALL DISP_IN1OUT13
AJMP SENSE_KEYPAD


IN2_PRESSED:
ACALL DISP_IN2_SELECTED
IN2_PRESSED__:
MOV KEYPAD,#0FFH
CLR ROW1
JNB COL4,OUT1_PRESSED2

MOV KEYPAD,#0FFH
CLR ROW2
JNB COL1,OUT2_PRESSED2
JNB COL2,OUT3_PRESSED2
JNB COL3,OUT4_PRESSED2
JNB COL4,OUT5_PRESSED2

MOV KEYPAD,#0FFH
CLR ROW3
JNB COL1,OUT6_PRESSED2
JNB COL2,OUT7_PRESSED2
JNB COL3,OUT8_PRESSED2
JNB COL4,OUT9_PRESSED2

MOV KEYPAD,#0FFH
CLR ROW4
JNB COL1,OUT10_PRESSED2
JNB COL2,OUT11_PRESSED2
JNB COL3,OUT12_PRESSED2
JNB COL4,OUT13_PRESSED2
AJMP IN2_PRESSED__

OUT1_PRESSED2:
SETB RELAY16
ACALL DISP_IN1OUT1
AJMP SENSE_KEYPAD


OUT2_PRESSED2:
SETB RELAY6
SETB RELAY3
ACALL DISP_IN1OUT2
AJMP SENSE_KEYPAD


OUT3_PRESSED2:
SETB RELAY6
;SETB RELAY4
ACALL DISP_IN1OUT3
AJMP SENSE_KEYPAD
```

```
OUT4_PRESSED2:
SETB RELAY6
;SETB RELAY17
ACALL DISP_IN1OUT4
AJMP SENSE_KEYPAD


OUT5_PRESSED2:
SETB RELAY15R
SETB RELAY15Y
SETB RELAY15B
ACALL DISP_IN1OUT5
AJMP SENSE_KEYPAD

OUT6_PRESSED2:
SETB RELAY6
SETB RELAY1
;SETB RELAY7
ACALL DISP_IN1OUT6
AJMP SENSE_KEYPAD


OUT7_PRESSED2:
SETB RELAY6
SETB RELAY1
SETB RELAY8
ACALL DISP_IN1OUT7
AJMP SENSE_KEYPAD


OUT8_PRESSED2:
SETB RELAY6
SETB RELAY2
ACALL DISP_IN1OUT8
AJMP SENSE_KEYPAD


OUT9_PRESSED2:
SETB RELAY6
SETB RELAY1
SETB RELAY9
ACALL DISP_IN1OUT9
AJMP SENSE_KEYPAD


OUT10_PRESSED2:
SETB RELAY6
SETB RELAY1
;SETB RELAY10
ACALL DISP_IN1OUT10
AJMP SENSE_KEYPAD


OUT11_PRESSED2:
SETB RELAY6
SETB RELAY1
;SETB RELAY11
ACALL DISP_IN1OUT11
AJMP SENSE_KEYPAD


OUT12_PRESSED2:
SETB RELAY6
SETB RELAY1
;SETB RELAY12
ACALL DISP_IN1OUT12
AJMP SENSE_KEYPAD
```

```
OUT13_PRESSED2:
SETB RELAY6
SETB RELAY1
SETB RELAY13
ACALL DISP_IN1OUT13
AJMP SENSE_KEYPAD


IN3_PRESSED:
ACALL DISP_IN3_SELECTED
IN3_PRESSED__:
MOV KEYPAD,#0FFH
CLR ROW1
JNB COL4,OUT1_PRESSED3

MOV KEYPAD,#0FFH
CLR ROW2
JNB COL1,OUT2_PRESSED3
JNB COL2,OUT3_PRESSED3
JNB COL3,OUT4_PRESSED3
JNB COL4,OUT5_PRESSED3

MOV KEYPAD,#0FFH
CLR ROW3
JNB COL1,OUT6_PRESSED3
JNB COL2,OUT7_PRESSED3
JNB COL3,OUT8_PRESSED3
JNB COL4,OUT9_PRESSED3

MOV KEYPAD,#0FFH
CLR ROW4
JNB COL1,OUT10_PRESSED3
JNB COL2,OUT11_PRESSED3
JNB COL3,OUT12_PRESSED3
JNB COL4,OUT13_PRESSED3
AJMP IN3_PRESSED__

OUT1_PRESSED3:
SETB RELAY14
ACALL DISP_IN1OUT1
AJMP SENSE_KEYPAD


OUT2_PRESSED3:
SETB RELAY5
SETB RELAY3
ACALL DISP_IN1OUT2
AJMP SENSE_KEYPAD


OUT3_PRESSED3:
SETB RELAY5
;SETB RELAY4
ACALL DISP_IN1OUT3
AJMP SENSE_KEYPAD


OUT4_PRESSED3:
SETB RELAY5
;SETB RELAY17
ACALL DISP_IN1OUT4
AJMP SENSE_KEYPAD


OUT5_PRESSED3:
ACALL DISP_IN1OUT5_UNAVAIL
AJMP SENSE_KEYPAD


OUT6_PRESSED3:
ACALL DISP_IN1OUT1_AVAIL
```

```
AJMP SENSE_KEYPAD


OUT7_PRESSED3:
SETB RELAY8
ACALL DISP_IN1OUT7
AJMP SENSE_KEYPAD


OUT8_PRESSED3:
SETB RELAY5
SETB RELAY2
ACALL DISP_IN1OUT8
AJMP SENSE_KEYPAD


OUT9_PRESSED3:
SETB RELAY9
ACALL DISP_IN1OUT9
AJMP SENSE_KEYPAD


OUT10_PRESSED3:
;SETB RELAY10
ACALL DISP_IN1OUT10
AJMP SENSE_KEYPAD


OUT11_PRESSED3:
;SETB RELAY11
ACALL DISP_IN1OUT11
AJMP SENSE_KEYPAD


OUT12_PRESSED3:
;SETB RELAY12
ACALL DISP_IN1OUT12
AJMP SENSE_KEYPAD


OUT13_PRESSED3:
SETB RELAY13
ACALL DISP_IN1OUT13
AJMP SENSE_KEYPAD


; LCD INITIALIZATION SUBROUTINE
LCD_INIT:
MOV A,#38H
ACALL COMMAND

MOV A,#0CH
ACALL COMMAND

MOV A,#01H
ACALL COMMAND

MOV A,#06H
ACALL COMMAND
RET

; DISPLAY PROJECT TITLE
DISP_TITLE:
ACALL LINE1

MOV R5,#16
MOV DPTR,#TITLE1
ACALL LOOKUP_TABLE

ACALL LINE2

```

```
MOV R5,#16
MOV DPTR,#TITLE2
AJMP LOOKUP_N_DELAY
TITLE1: DB "~~ UiUo POWER =>"
TITLE2: DB "<= CONVERTER ~~"

; DISPLAY NAME OF GROUP MEMBERS
DISP_MEMBERS:
ACALL LINE1

MOV R5,#16
MOV DPTR,#MEMBER1
ACALL LOOKUP_TABLE

ACALL LINE2

MOV R5,#16
MOV DPTR,#MEMBER2
ACALL LOOKUP_N_DELAY

ACALL LINE1

MOV R5,#16
MOV DPTR,#MEMBER3
ACALL LOOKUP_TABLE

ACALL LINE2

MOV R5,#16
MOV DPTR,#MEMBER4
AJMP LOOKUP_N_DELAY

MEMBER1: DB "** Guided by: **"
MEMBER2: DB "Prof.SYED KALEEM"
MEMBER3: DB "Team: ABRAR,ASIM"
MEMBER4: DB "BILAL,SALAHUDDIN"


; DISPLAY TO SELECT THE INPUT
DISP_SELECT_IN:
ACALL LINE1

MOV R5,#16
MOV DPTR,#SELECT_IN1
ACALL LOOKUP_TABLE

ACALL LINE2

MOV R5,#16
MOV DPTR,#SELECT_IN2
AJMP LOOKUP_TABLE
SELECT_IN1: DB "Plug-in I/P Powr"
SELECT_IN2: DB "& press a button"


; DISPLAY THAT IN1 IS SELECTED SO NOW SELECT OUTPUT
DISP_IN1_SELECTED:
ACALL LINE1

MOV R5,#16
MOV DPTR,#SELECTED_IN11
ACALL LOOKUP_TABLE

ACALL LINE2

MOV R5,#16
MOV DPTR,#SELECTED_IN12
AJMP LOOKUP_TABLE
SELECTED_IN11: DB "I/P: 1 Ph 230VAC"
SELECTED_IN12: DB "Now Select O/P "
```

```

; DISPLAY THAT IN2 IS SELECTED SO NOW SELECT OUTPUT
DISP_IN2_SELECTED:
ACALL LINE1

MOV R5,#16
MOV DPTR,#SELECTED_IN21
ACALL LOOKUP_TABLE

ACALL LINE2

MOV R5,#16
MOV DPTR,#SELECTED_IN12
AJMP LOOKUP_TABLE
SELECTED_IN21: DB "I/P: 3 Ph 440VAC"


; DISPLAY THAT IN3 IS SELECTED SO NOW SELECT OUTPUT
DISP_IN3_SELECTED:
ACALL LINE1

MOV R5,#16
MOV DPTR,#SELECTED_IN31
ACALL LOOKUP_TABLE

ACALL LINE2

MOV R5,#16
MOV DPTR,#SELECTED_IN12
AJMP LOOKUP_TABLE
SELECTED_IN31: DB "I/P:Small DC 30V"


; DISPLAY THAT OUT1 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT1:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT1
AJMP LOOKUP_TABLE
IN1OUT1: DB "O/P:1Ph AC Unreg"


; DISPLAY THAT OUTPUT IS ALREADY AVAILABLE AS IT IS SAME AS INPUT
DISP_IN1OUT1_AVAIL:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT1_AVAIL
AJMP LOOKUP_TABLE
IN1OUT1_AVAIL: DB "O/P Alrdy Availb"


; DISPLAY THAT OUTPUT IS UNAVAILABLE DUE TO UNAVAILABILITY OF CONVERTER MODULE
DISP_IN1OUT5_UNAVAIL:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT5_UNAVAIL
AJMP LOOKUP_TABLE
IN1OUT5_UNAVAIL: DB "O/P Unavailable!"



; DISPLAY THAT OUT2 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT2:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT2
```

```
AJMP LOOKUP_TABLE
IN1OUT2: DB "O/P: 1 Ph AC Reg"
; DISPLAY THAT OUT3 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT3:
ACALL LINE2
MOV R5,#16
MOV DPTR,#IN1OUT3
AJMP LOOKUP_TABLE
IN1OUT3: DB "O/P: 1 Ph AC VFD"
; DISPLAY THAT OUT4 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT4:
ACALL LINE2
MOV R5,#16
MOV DPTR,#IN1OUT4
AJMP LOOKUP_TABLE
IN1OUT4: DB "O/P: Signal Gen."
; DISPLAY THAT OUT5 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT5:
ACALL LINE2
MOV R5,#16
MOV DPTR,#IN1OUT5
AJMP LOOKUP_TABLE
IN1OUT5: DB "O/P: 3 Ph AC VFD"
; DISPLAY THAT OUT6 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT6:
ACALL LINE2
MOV R5,#16
MOV DPTR,#IN1OUT6
AJMP LOOKUP_TABLE
IN1OUT6: DB "O/P: DC Voltage "
; DISPLAY THAT OUT7 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT7:
ACALL LINE2
MOV R5,#16
MOV DPTR,#IN1OUT7
AJMP LOOKUP_TABLE
IN1OUT7: DB "O/P: Variable DC"
; DISPLAY THAT OUT8 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT8:
ACALL LINE2
MOV R5,#16
MOV DPTR,#IN1OUT8
AJMP LOOKUP_TABLE
IN1OUT8: DB "O/P: Hi-Power DC"
; DISPLAY THAT OUT9 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT9:
ACALL LINE2
MOV R5,#16
MOV DPTR,#IN1OUT9
AJMP LOOKUP_TABLE
```

```
IN1OUT9: DB "O/P: Lo-Pwr 5VDC"


; DISPLAY THAT OUT10 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT10:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT10
AJMP LOOKUP_TABLE
IN1OUT10: DB "O/P: Lo-Pwr 9VDC"


; DISPLAY THAT OUT11 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT11:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT11
AJMP LOOKUP_TABLE
IN1OUT11: DB "O/P:Lo-Pwr 12VDC"


; DISPLAY THAT OUT12 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT12:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT12
AJMP LOOKUP_TABLE
IN1OUT12: DB "O/P:Lo-Pwr 15VDC"


; DISPLAY THAT OUT13 IS SELECTED WHEN IN1 IS ACTIVE
DISP_IN1OUT13:
ACALL LINE2

MOV R5,#16
MOV DPTR,#IN1OUT13
AJMP LOOKUP_TABLE
IN1OUT13: DB "O/P:Const c/n DC"



LOOKUP_N_DELAY: ; FOR CALLING LOOKUP_TABLE & DELAY_MORE FOR 2nd LINE ON LCD
ACALL LOOKUP_TABLE
AJMP DELAY_MORE

; DELAY MORE SUBROUTINE FOR DELAY OF 1.8 SEC AFTER DISPLAYING THE STRINGS
DELAY_MORE:
MOV R5,#100 ; DELAY OF APPROX. 2 SEC
DELAY_REPEAT: ACALL DELAY
DJNZ R5,DELAY_REPEAT
RET

DELAY_HALF_SEC: ; DELAY OF APPROX. 0.6 SEC FOR FLASHER
MOV R6,#20
DELAY_REPEAT1:
ACALL DELAY
DJNZ R6,DELAY_REPEAT1
RET

; LOOKUP_TABLE SUBROUTINE FOR DISPLAYING STRING
LOOKUP_TABLE:
CLR A
MOVC A,@A+DPTR
ACALL DELAY
ACALL DATA_WRITE
INC DPTR
DJNZ R5,LOOKUP_TABLE
RET
```

```
; ROUTINES TO SEND COMMANDS TO BRING CURSOR TO HOME SCREEN (LINE1 & LINE 2)
LINE1:
MOV A,#01H
ACALL COMMAND

MOV A,#80H
ACALL COMMAND
RET

LINE2:
MOV A,#0C0H
ACALL COMMAND
RET

; LCD SUBROUTINES FOR DELAY (Approx. 20 ms), DATA & COMMAND WRITE
DELAY: MOV 7CH,#50
BACK1: MOV 7DH,#255
DJNZ 7DH,$
DJNZ 7CH,BACK1
RET

DATA_WRITE: MOV LCD,A
SETB RS
CLR RW
SETB EN
ACALL DELAY
CLR EN
ACALL DELAY
RET

COMMAND: MOV LCD,A
CLR RS
CLR RW
SETB EN
ACALL DELAY
CLR EN
ACALL DELAY
RET

END
```

6 Conclusion

The aim of this project is not to build a power supply. Rather, it is to integrate various power supplies, build efficient and compact circuits and at the same time keep the cost low. Project is not about just connecting various power converter modules with wires. But it is about smart switching between various modules to give desired output for any available input using microcontroller. In doing so, to economize the project, components are shared between modules and smart-switching enables the same components to act as different modules at different times.

UiUo Power Converter brings all the available converters in a single modular setup in an efficient manner and no such power converter is available in the electrical market. Our project will provide compact & all-in-one power converter to field research teams. Also, it will be useful in educational institutions and industrial testing. It is not just a project. It is a product of the future electrical market.

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