Regeneration Of Power By Using Thermoelectric Generator In Boiler

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Abstract- In recent days, the power consumption of the world is increases and also non-renewable energy sources like coal is drastically reduced so we have to use this source in efficient manner. Steam power plant plays a first place in the production of power in the world but the efficiency is around 36-40% only, the remaining 60% is wasted in the form of waste flue gases and low pressure steam.In our project waste heat emitted from the boiler into useful electrical energy with the help of Thermoelectric Generator. In TNPL, they use five boilers for the production of power by using Steam power plant so this project is used here to increase efficiency of the power system and reduced the fuel cost.

I. INTRODUCTION

In recent years, an increasing concern of environmental issues of emissions, in particular global warming and the limitations of energy resources has resulted in extensive research into novel technologies of generating electrical power. Electrical energy has become more important for modern day living. However, due to the insufficient production of electricity leads to the frequent power cut offs at many areas. Nowadays, due to the frequent power cut offs the electrical power in remote areas is generated primarily by gasoline motor- generators. But, most people believe these generators are too noisy, require too much maintenance, and have high fuel costs. Currently, the electrical-power demand is increasing which prompts the need to build new Power Plants.

Thermoelectric power generators have emerged as a promising alternative green technology due to their distinct advantages. Thermoelectric power generation offer a potential application in the direct conversion of waste-heat energy into electrical power where it is unnecessary to consider the cost of the thermal energy input. The application of this alternative green technology in converting waste-heat energy directly into electrical power can be improved the overall efficiencies of energy conversionsystems.

Renewable energy, such as solar energy, wind energy or hydropower is preferred, but it has limited use and is dependent on weather and topography. As an alternate resource of energy, ThermoElectric Generators can be used for waste heat conversion applications. TEGs are solid-state devices that directly convert heat energy into Electrical energy. The ability to create electrical power from any type of heat source enables a wide application space of a TEG. Additionally, TEG has the output of relatively large and stable dc voltage, which can simplify the design of Power ManagementElectronics.

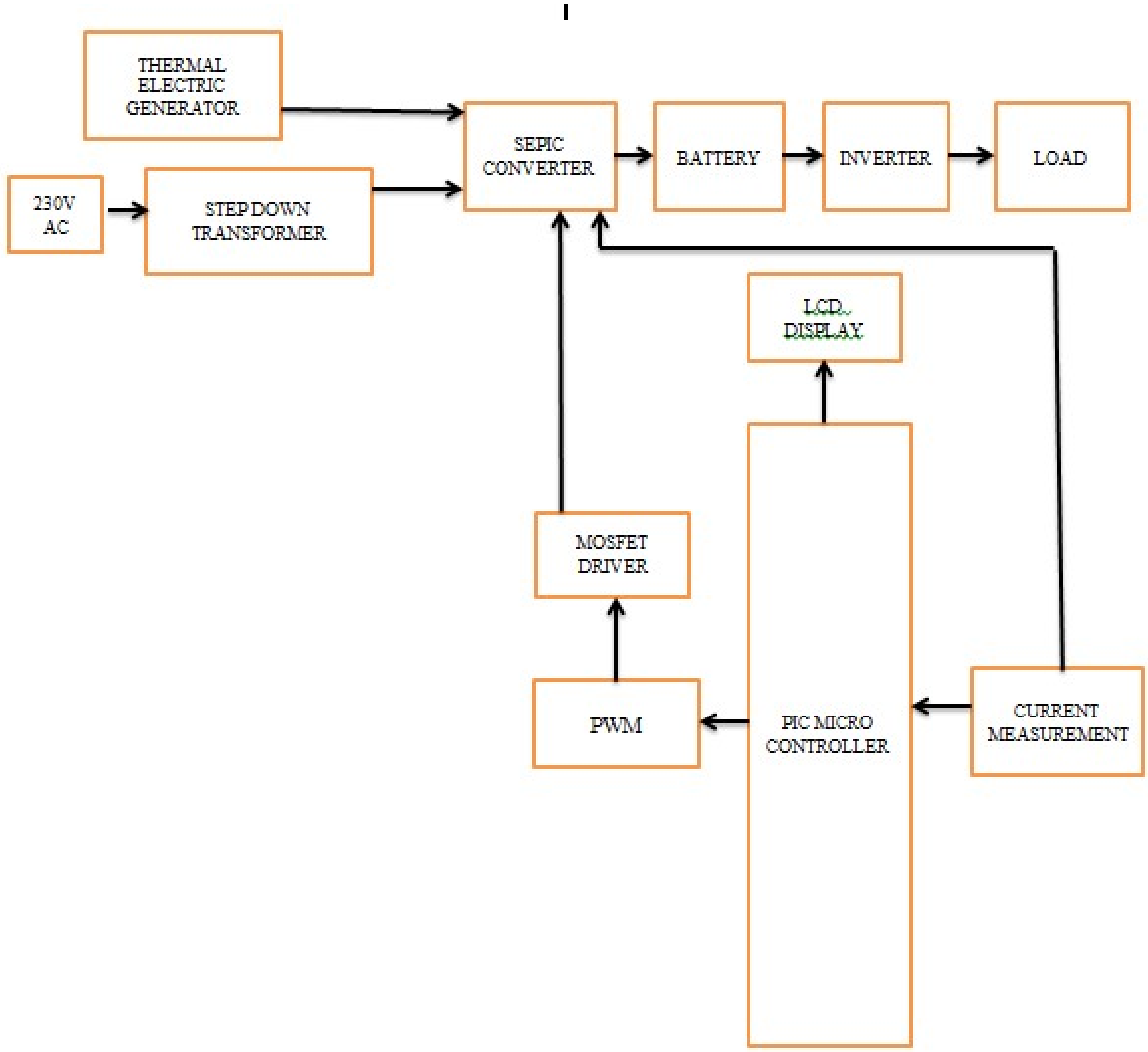

Fig 1 Block diagram of TEG with PIC16f877

CHAPTER 3
THERMOELECTRICGENERATOR

3.1 INTRODUCTION

A Thermoelectric power generator is a solid state device that provides direct energy conversion from thermal energy (heat) due to a temperature gradient into electrical energy based on “Seebeck effect”. In fact, this phenomenon is applied to thermocouples that are extensively used for temperature measurements. Based on this Seebeck effect, thermoelectric devices can act as electrical power generators.

A. 3.2 Schematic of a single thermoelectric-couple

A typical thermoelectric power module is shown schematically. In the following figure 3.1: n-type and p-type semiconductor thermo elements are connected in series by highly- conducting metal strips to form a thermocouple. The two sides of the thermocouple are maintained at two different temperatures. Due to this temperature difference, flow of the charge carriers’ takes place in both n-type and p-type pellets constituting to the voltage difference across the load resistance.

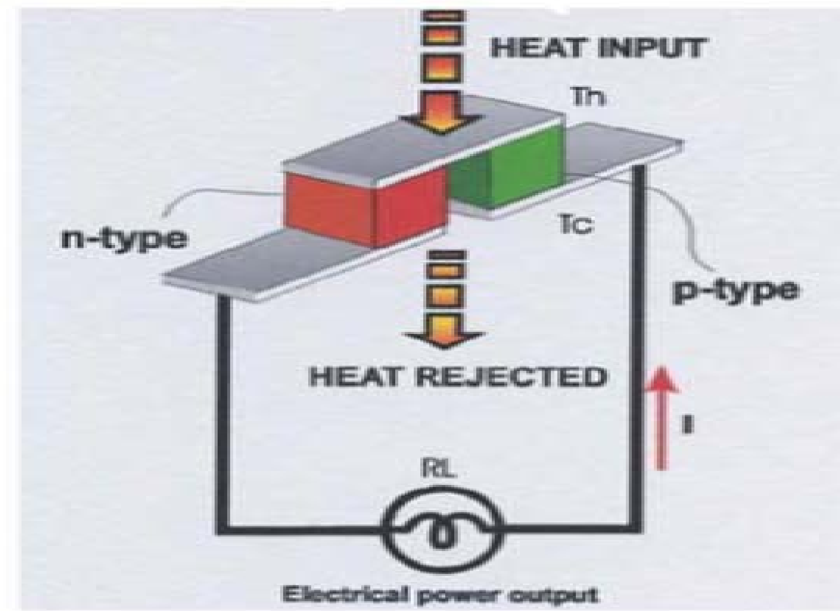

Figure 3.1 A typical ThermoElectric Power Module

A thermoelectric module is made up of a number of thermocouples connected together electrically in series and thermally in parallel. The diagram below shows the three dimensional view of the typical Thermo Electric Generator. When heat is absorbed on one side of a TEG (red arrow) the movable charge carriers begin to diffuse, resulting in a uniform concentration distribution in the TEG along the temperature gradient, and producing the difference in the electrical potential on both sides of the TEG. To maximize the power generation output, p-bars and n-bars (see circles) are connected together in a cell electrically in series and thermally parallel. Due to the thermoelectric effect, electrons flow through the n-type element to the colder side while in the p-type elements, the positive charge carriers flow to the cold side. This illustrates how connecting the p-bar and the n-bar augments the voltage of each bar and the voltage of each unit cell. These unit cells are assembled in long sequences to eventually build aTEG.

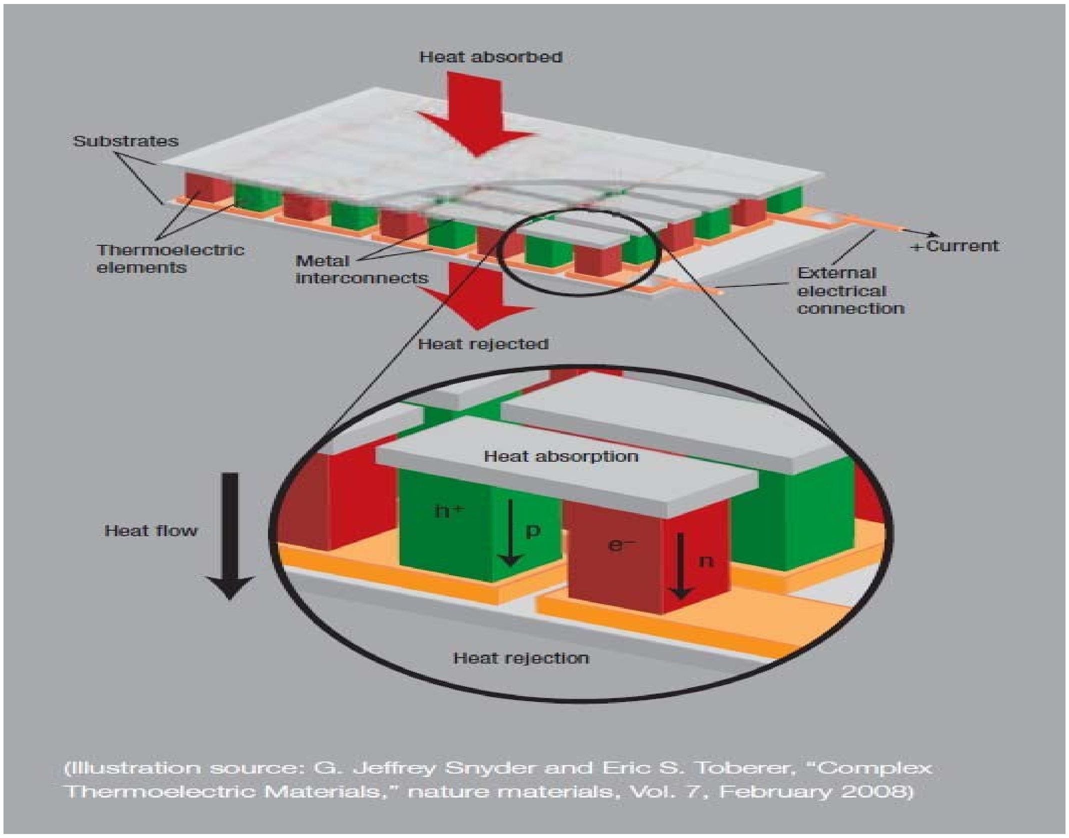

Figure 3.2 A typical ThermoElectric Power Generator

Thermoelectric power generators offer several distinct advantages over other technologies:

- They are extremely reliable (typically exceed 100,000 hours of steady-state operation) and silent in operation since they have no mechanical moving parts andrequire considerably lessmaintenance.
- They are simple, compact andsafe.
- They have very small size and virtuallyweightless.
- They are capable of operating at elevatedtemperatures.
- They are suited for small-scale and remote applications typical of rural power supply, where there is limited or noelectricity.
- They are environmentfriendly.
- They are not positiondependent.
- They are flexible powersources.

B. 3.3 Working Principle ofTEG

Thermoelectric power generation is based on a phenomenon called "Seebeck effect" discovered by Thomas Seebeck in 1821. The Seebeck effect was first discovered in 1822 by Seebeck, who observed an electric flow when one junction of two dissimilar metals, jointed at two places, was heated while the other junction was kept at a lowertemperature.

The semiconductor thermo elements that are sandwiched between the ceramic plates are connected thermally in parallel and electrically in series to form a thermoelectric device (module). More than one pair of semiconductors are normally assembled together to form a thermoelectric module and within the module a pair of thermo elements is called a thermocouple. The junctions connecting the thermo elements between the hot and cold plates are interconnected using highly conducting metal (e.g. copper) strips.

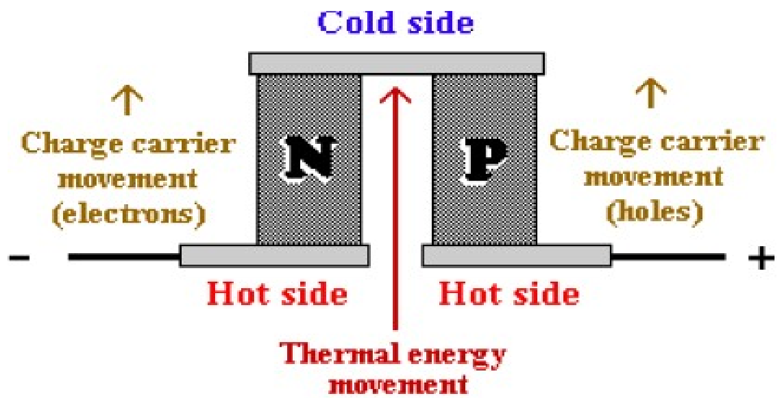

Figure 3.3 Thermo Elements Sandwiched between Ceramic Plates

Electrons on the hot side of a material are more energized than on the cold side. These electrons will flow from the hot side to the cold side. If a complete circuit can be made, electricity will flow continuously. Semiconductor materials are the most efficient, and are combined in pairs of "p type" and "n type". The electrons flow from hot to cold in the "n type", while the holes flow from hot to cold in the "p type." This allows them to be combined electrically in series.

C. 3.4 Performance ofTEG

The better performance of TEG is based upon the Thermal Conductivity of the materials used, Thermal Expansion Coefficient of the materials used, Specific Heat of the materials used, Resistivity of the materials used and Seebeck coefficients of the materials used. Figure of merit and its efficiency is also taken into consideration.

Thermal conductivity is the ability of a material to conduct heat. The thermo materials selected for the TEG Module must have high thermal conductivity.

S.I unit = W/ (m-K)

Thermal Expansion Coefficient is the change in the size of material with change in temperature.

S.I unit = /•C (or) / •K

Specific Heat is the heat capacity per unit mass of the substance where heat capacity is the amount of heat supply to increase the change in the temperature.

S.I unit =J/ kg/ K

Resistivity tells how strongly a material opposes the flow of electric current.

S.I unit = Ω-m

Seebeck coefficient or the thermo power, represented by 'S', of a material measures the magnitude of an induced thermoelectric voltage in response to a temperature difference across that material. If the temperature difference ΔT between the two ends of a material is small, then the thermopower of a material is defined approximatelyas,

$$S = -\frac{\Delta V}{\Delta T}$$

A thermoelectric voltage of ΔV is seen at the terminals. The negative sign indicates the flow of electrons and positive sign means flow of holes.

S.I unit = V/ •C

The figure of merit *Z* for thermoelectric devices is defined as,

$$Z = \frac{\sigma S^2}{\kappa}$$

Where σ is the electrical conductivity, κ is the thermal conductivity, and S is the Seebeck coefficient. The dimensionless figure of merit ZT is formed by multiplying Z with the averagetemperature.

$$\bar{T} = \frac{(T_2 + T_1)}{2}$$

A greater ZT indicates a greater efficiency, subject to certain provisions, particularly that the two materials in the couple have similar Z. ZT is therefore a method for comparing the potential efficiency of devices using different materials. Values of 1 are considered good; values in the 3–4 range are essential for thermoelectric to compete with mechanical devices in efficiency. To date, the best reported ZT values are in the 2–3range.

Efficiency of a thermoelectric device for electricity generation is given by η, defined as,

$$\eta = \frac{\text{energy provided to the load}}{\text{heat energy absorbed at hot junction}}.$$

CHAPTER 4
PIC16F877A MICROCONTROLLER

4.1 Introduction

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This microcontroller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many pic microcontroller projects. PIC16F877A also have much application in digital electronics circuits.

PIC16f877a finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and many industrial instruments. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. It is flexible and can be used in areas where microcontrollers have never been used before as in microprocessor applications and timer functions etc.

- It has a smaller 35instructions set.
- It can operate up to 20MHz frequency.
- The operating voltage is between 4.2 volts to 5.5 volts. If you provide it voltage more than 5.5 volts, it may get damaged permanently.
- It does not have an internal oscillator like other PIC18F46K22, PIC18F4550.
- The maximum current each PORT can sink or source is around 100mA. Therefore, the current limit for each GPIO pin of PIC16F877A is 10 miliampere.
- It is available in four IC packaging such as 40-pin PDIP 44-pin PLCC, 44-pin TQFP, 44-pin QFN

D. 4.2 Pin configuration and description of PIC16f877a microcontroller

E. As it has been mentioned before, there are 40 pins of this microcontroller IC. It consists of two 8 bit and one 16 bit timer. Capture and compare modules, serial ports, parallel ports and five input/output ports are also present in it. This picture shows the pinout diagram of PIC16F877A.

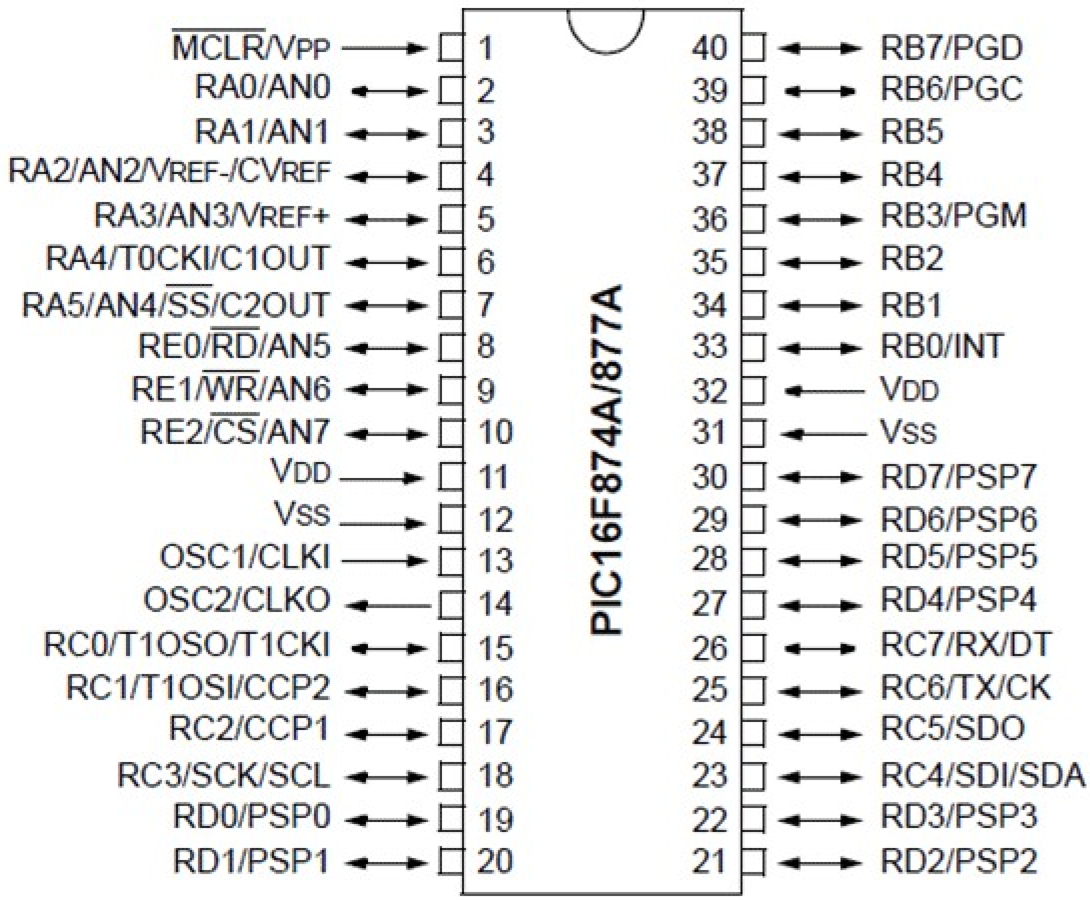

Figure 4.1 PIN DIAGRAM OF PIC16F877

PIN 1:MCLR: The first pin is the master clear pin of this IC. It resets the microcontroller and is active low, meaning that it should constantly be given a voltage of 5V and if 0 V are given then the controller is reset. Resetting the controller will bring it back to the first line of the program that has been burned into the IC.

PIN 2: RA0/AN0:PORTA consists of 6 pins, from pin 2 to pin 7, all of these are bidirectional input/output pins. Pin 2 is the first pin of this port. This pin can also be used as an analog pin AN0. It is built in analog to digital converter.

PIN 3: RA1/AN1:This can be the analog input 1.

PIN 4: RA2/AN2/Vref:It can also act as the analog input2.

PIN 5: RA3/AN3/Vref+:It can act as the analog input 3.

PIN 6: RA0/TOCK1:To timer0 this pin can act as the clock input pin, the type of output is open drain.

PIN 7: RA5/SS/AN4:This can be the analog input 4. There is synchronous serial port in the controller also and this pin can be used as the slave select for that port.

PIN 8: RE0/RD/AN5: PORTE starts from pin 8 to pin 10 and this is also a bidirectional input output port. It can be the analog input 5 or for parallel slave port it can act as a ‘read control’ pin which will be active low.

PIN 9: RE1/WR/AN6: It can be the analog input 6. And for the parallel slave port it can act as the ‘write control’ which will be active low.

PIN 10: RE2/CS/A7: It can be the analog input 7, or for the parallel slave port it can act as the ‘control select’ which will also be active low just like read and write control pins.

PIN 11 and 32: VDD: These two pins are the positive supply for the input/output and logic pins. Both of them should be connected to 5V.

PIN 12 and 31: VSS: These pins are the ground reference for input/output and logic pins. They should be connected to 0 potential.

PIN 13: OSC1/CLKIN: This is the oscillator input or the external clock input pin.

PIN 14: OSC2/CLKOUT: This is the oscillator output pin. A crystal resonator is connected between pin 13 and 14 to provide external clock to the microcontroller. ¼ of the frequency of OSC1 is outputted by OSC2 in case of RC mode. This indicates the instruction cycle rate.

PIN 15: RC0/T1OCO/T1CKI: PORTC consists of 8 pins. It is also a bidirectional input output port. Of them, pin 15 is the first. It can be the clock input of timer 1 or the oscillator output of timer 2.

PIN 16: RC1/T1OSI/CCP2: It can be the oscillator input of timer 1 or the capture 2 input/compare 2 output/ PWM 2 output.

PIN 17: RC2/CCP1: It can be the capture 1 input/ compare 1 output/ PWM 1 output.

PIN 18: RC3/SCK/SCL: It can be the output for SPI or I2C modes and can be the input/output for synchronous serial clock.

PIN 23: RC4/SDI/SDA: It can be the SPI data in pin. Or in I2C mode it can be data input/output pin.

PIN 24: RC5/SDO: It can be the data out of SPI in the SPI mode.

PIN 25: RC6/TX/CK: It can be the synchronous clock or USART Asynchronous transmit pin.

PIN 26: RC7/RX/DT: It can be the synchronous data pin or the USART receive pin.

PIN 19,20,21,22,27,28,29,30: All of these pins belong to PORTD which is again a bidirectional input and output port. When the microprocessor bus is to be interfaced, it can act as the parallel slave port.

PIN 33-40: PORT B: All these pins belong to PORTB. Out of which RB0 can be used as the external interrupt pin and RB6 and RB7 can be used as in-circuit debugger pins.

4.3 MEMORY ORGANISATION

There are three memory blocks in each of the PIC16F877 MUC’S . The program memory and Data Memory have separate buses so that concurrent access can occur.

The PIC 16F877 devices have a 13-bit program counter capable of addressing 8k 14 words of FLASH program memory. Accessing a location above the physically implemented address will cause a wraparound. The RESET vector is at 0000 and the interrupt vector is at 0004h.

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the special functions Registers Bits RPI (STATUN) and RPO (STATUS<5>) are the bank selected bits.

RP1:RP2	Banks
00	0
01	1
10	2
11	3

Table 4.1 Register bank selection

Each bank extends upto 7Fh (1238 bytes). The lower locations of each bank are reserved for the Special Function Registers. Above the Special Function Registers are General Purpose Registers, implemented as static RAM. All implemented banks contain special function register. Some frequently used special function registers from one bank may be mirrored in another bank for code reduction and quicker access.

General purpose register file

The register file can be accessed either directly or indirectly through the File Selected Register (ESR). There are some Special Function Registers used by the CPU and peripheral modules for controlling the desired operation of the device . These registers are implemented as Static RAM. The Special Function Registers can be classified into two sets. core (CPU) and peripheral. Those registers associated with the core functions.

Instruction set summary

Each PIC 16F877 instruction is a 14-bit word, divided into an opcode which specifies the instruction type and one or more operand which further specify the operation of the instruction. The PIC16F877 instructions set summary in Table 3.2 lists byte-oriented, bit-oriented and literal and control operations. It shows the opcode Field descriptions.

Field	Description

F	Register file address (0x00 to 0x7F)
W	Working register (accumulator)
B	Bit address, within an 8-bit file register
K	Literal field, constant data or label
X	Don’t care location (=0 to 1) The assembler will generate code with x=0. It is the recommended form of use for compatibility with all Microchip software tools.
D	Destination select; d=0, store result in W, d=1; store result in file register f. Defaults is d=1
PC	Program Counter
TO	Time out bit
PD	Power-down bit

Table 4.2 Opcode field descriptions

For byte-oriented instructions, 'f’ represents a file register designator and ‘d’ represents a destination designator. The file register designator specifies which file register is to be used by the instruction. The destination designator specified where the result of the operation is to be placed. If 'd' is zero, the result is placed in the w register. If 'd' is one, the result is placed in the file register specified in the instruction.

For bit-oriented instructions, 'b' represents a bit field designator which selects the number of the affected by the operation, which represents the address of the file in which the bits is located. For literal and control operations, 'k' represents an eight or eleven bit constant or literal value.

The instruction set is highly orthogonal and is grouped into three basic categories:

- Bit-oriented operations
- Byte-oriented operations
- Literal and control operations

All instructions are executed within one single instruction cycle, unless a conditional test is true or the program counter is changed as a result of an instruction. In this case, the execution takes two instruction cycles with the second cycle executed as a NOP. One instruction cycle consist of four oscillator period. Thus, for an oscillator frequency of 4 MHz, the normal instruction execution time is 1ms. If a conditional test is true or the program counter is changed as a result of an instruction, then the instruction execution time is 2ms.

CHAPTER 5

LCD DISPLAY

5.1 Introduction

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

A LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

One each polarizers are pasted outside the two glass panels. These polarizers would rotate the light rays passing through them to a definite angle, in a particular direction.

When the LCD is in the off state, light rays are rotated by the two polarizers and the liquid crystal, such that the light rays come out of the LCD without any orientation. and hence the LCD appears transparent.

When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizers, which would result in activating / highlighting the desired characters.

The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

The LCD's don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range.

Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly.

The LCDs used exclusively in watches, calculators and measuring instruments are the simple seven-segment displays, having a limited amount of numeric data. The recent advances in technology have resulted in better legibility. more information displaying capability and a wider temperature range These have resulted in the

LCD being extensively used in telecommunications and entertainment electronics The ID have even started replacing the cathode ray tubes (CRT) used for the display of text and graphics, and also in small TV applications

5.2 POWER SUPPLY

The power supply should be +5V, with maximum allowable transients of 0mv. To achieve a better suitable contrast for the display, the voltage (VL) at pin 3 should be adjusted properly.

A module should not be inserted or removed from a live circuit. The ground terminal of the power supply must be isolated properly so that no voltage is induced in it. The module should be isolated from the other circuits, so that stray voltages are not induced, which cause a flickering could display.

5.3 HARDWARE

Develop a uniquely decoded 'E' strobe pulse, active high, to accompany each module transaction. Address or control lines can be assigned to drive the RS and R/W inputs.

Utilize the Host's extended timing mode, if available, when transacting with the module. Use instructions, which prolong the Read and Write or other appropriate data strobes, so as to realize the interface timing requirements.

If a parallel port is used to drive the RS. R/W and 'E' control lines, setting the 'E' bit simultaneously with RS and R/W would violate the module's set up time. A separate instruction should be used to achieve proper interfacing timing requirements.

5.4 MOUNTING

Cover the display surface with a transparent protective plate, to protect the polarizer

Don't touch the display surface with bare hands or any hard materials. This will stain the display area and degrade the insulation between terminals.

Do not use organic solvents to clean the display panel as these may adversely affect tape or with absorbent cotton and petroleum benzene.

The processing or even a slight deformation of the claws of the metal frame will have effect on the connection of the output signal and cause an abnormal display.

Do not damage or modify the pattern wiring, or drill attachment holes in the PCB. When assembling the module into equipment, the space between the fitting plate should have enough height, to avoid causing stress to the module surface.

Make sure that there is enough space behind the module. to dissipate the heat generated by the ICs while functioning for longer durations.

When an electrically powered screw driver is used to install the module, ground it properly.

While cleaning by a vacuum cleaner, do not bring the sucking mouth near the module. Static electricity of the electrically powered driver or the vacuum cleaner may destroy the module.

CHAPTER 6

SINGLE-ENDED PRIMARY –INDUCTOR CONVERTER (SEPIC)

6.1 Introduction

Single-ended primary –inductor converter (SEPIC) is a type of DC-DC converter allowing the electrical potential (voltage) at its output to be greater than, less then, or equal to that at its input: the output of the SEPIC is controlled by the duty cycle of the control transistor.

A SEPIC IS Similar to a traditional buck-boost converter. but has advantages of having non-inverted output (the output has the same voltage polarity as the input), using a series capacitor to couple energy from the input to the output (and thus can respond more gracefully to a short-circuit output), and being capable of true shutdown. When the switch is turn off. It's output drops to 0 V. following a fairly hefty transient dump of charge.

SEPICs are useful in applications in which a battery voltage can be above and below that of the regulator's intended output: for example, a single lithium ion battery typically discharges from 3.4 volts to 3 volts: if other components require 3.3 volts, then the DEPIC would be effective

6.2 Circuit diagram

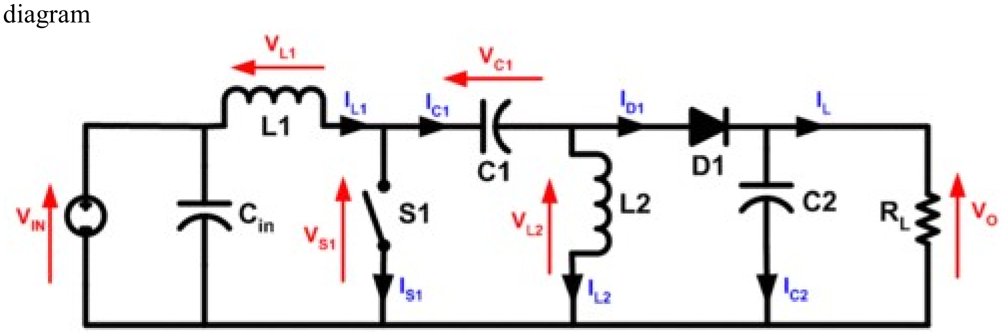

Figure 6.1 Sepic converter

The schematic diagram for a basic SEPIC is shown in Figure 6.1. As with other switched mode power supplies (specifically DC-to-DC converters) the SEPIC exchanges energy between the capacitors and inductors in order to convert from one voltage to another. The amount of energy exchanged is controlled by switch S1, which is typically a transistor such as a MOSFET. MOSFETs offer much higher input impedance and lower voltage drop than bipolar junction transistors (BJTs) and do not require biasing resistors (as MOSFET switching is controlled by differences in voltage rather than a current, as with BJTs).

Continuous mode

A SEPIC is said to be in continuous-conduction, mode ("continuous mode") if the current through the Livener falls to zero. During a SEPIC's steady-state operation, the average voltage across capacitor C1(VI) is equal to the input voltage (Vin). Because capacitor C1 blocks direct current (DC) the average current across it(ie2) is zero, making inductor 1.2 the only source of load current.

Therefore the average current through inductor L2(l1.2) is the same as the average load current and hence independent of the input voltage.

Looking at average voltages, the following can be written :

$$VIN=V_{L1}+V_{C1}+V_{12}$$

Because the average voltage of V_{C1} is equal to $V_{11}=V_{12}$ For the reason. the two inductors can be wound on the same core. Since the voltages are the same in magnitude, their effects of the mutual inductance will be zero, assuming the polarity of the windings is correct. Also since the Voltages are the same in magnitude, the ripple currents from the two inductors will the equal in magnitude.

The average currents can be summed as follows:

$l_{D1}=I_{L1}- I_{L2}$

When switch S1 is turned on, Current I_{L1} increases and the current I_{L2} increases in the negative direction. (Mathematically, it decreases due to arrow direction) The energy to increase the current I_{L1} comes from the input source. Since SI is a short while closed, and the instantaneous voltage V_{c1} is approximately I_{L1} .Therefore the capacitor C1 supplies the energy to increase the magnitude of the current in I_{L2} and thus increase the energy stored in L2. The easiest way to visualize this is to consider the bias voltages of the circuit in a D.C state, then close S.I.

When switch S1 is turned off, the current I_{C1} becomes the same as the current I_{L1} since inductors do not allow instantaneous changes in current. The current $I_{L1.2}$ will continue in the negative direction. in fact it never reverses direction. It can be seen from the diagram that a negative I_{L2} will add to the current I_{L1} to increase the current delivered to the load. Using Kirchhoff's Current Law, it can be shown that $I_{L1} = I_{C1} - I_{C2}$. It can then be concluded that while S1 is off, power is delivered to the load from both 1,2 and 1.1 C1, however is being charged by L1 during this off cycle, and will in turn recharge 1.2 during the on cycle.

Because the potential (voltage) across capacitor C1 may reverse direction every cycle, a non-polarized capacitor should be used. However a polarized tantalum or electrolytic capacitor may be used in some cases, because the potential (voltage) across capacitor C1 will discharge unless the switch is closed ling enough for a half cycle of resonance with inductor L2. and by this time the current in inductor L1 could be quite large.

The capacitor C_{in} is required to reduce the effects of the parasitic inductance and internal resistance of the power supply. The boost/buck capabilities of the ASEPIC are possible because of capacitor C1 and inductor L2. Inductor L1 and switch S1 create a standard boost converter, which generates a voltage (V_{s1}) that is higher than V_{IN}, whose magnitude is determined by the duty cycle of the switch S1. Since the average voltage across C1 is V_{IN}, then the output voltage will be less than the input voltage. If V_{S1} is greater than double V_{S1} then the output voltage will be greater than the input voltage.

The evolution of switched – power can be seen by coupling the two inductors in a SEPIC converter together, which begins to resemble a FLYBACK converter, the most basic of the transformer – isolated SMPS topologies.

Discontinuous mode

A SEPIC is said to be in discontinuous conduction ode (or discontinuous mode) if the current through the inductor L1 is allowed to fall to zero.

6.3 Reliability and efficiency

The voltage drop and switching time of diode D1 is critical to a SEPIC reliability and efficiency. The diode's switching time needs to be extremely fast in order to not generate high voltage spikes across the inductors, which could cause damage to components. Fast conventional diodes or Schottky diodes may be used.

The resistance in the inductors and the capacitors can also have large effects on the converter efficiency and ripple. Inductors with lower series resistance allow less energy to be dissipated as heat, resulting in greater efficiency (a larger portion of the input power being transferred to the load) Capacitors with low equivalent series resistance (ESR) should also be used for C1 and C2 to minimize ripple and prevent heat built-Up. Especially in C1 where the current is changing direction frequently.

6.4 Disadvantages

- Like buck- boost converters, SEPICs have a pulsating output current, the similar buck converter does not have this disadvantage, but it can only have negative output polarity. Unless the isolated buck converter is used.
- Since the SEPIC converter transfers all its energy via the series capacitor, a capacitor with high capacitance and current handling capability is required.
- The fourth- order nature of the converter also makes the SEPIC converter difficult to control, making them only suitable for very slow varying applications.

CHAPTER 7

POWER SUPPLY

7.1 Block diagram

The ac voltage typically, 220 V_{rms}, is connected to a transformer, which steps that ac voltage down to the level of thee desired de output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter in produce a dc voltage. This resulting de voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

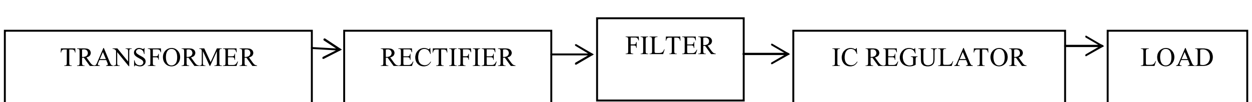

Figure 7.1 Block Diagram (Power supply)

7.2 Working principle

Transformer:

The potential transformer will step down the power supply voltage (0-230V to (0-6v) Level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op-amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

Bridge rectifier

When four diodes are connected as shown in figure 7.1, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformers is working properly and there is a positive potential. At point A and a negative potential at point B, the positive potential at point a will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them. D4 and D2 are reversed biased and will block current flow.

The path for current flow is from point B through D1, up through R1, Through R3, Through the secondary of the transformers back to point B, this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half Cycle late the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3, Current flow will now be from point A through D4, up through R1, through D2, through the secondary of T1, and be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing Through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage. This bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier is a full-wave rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown b assigning values to some of the components shown in views A and B, assume that the same transformer is used in both circuits. The peak Voltage developed between points X and Y is 1000 volts in both circuits , In the conventional full-wave circuit shown-in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds 500 volts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full -wave rectifier circuit.

IC Voltage regulators

Voltage regulators comprise a class of widely used ICs Regulator IC units contain the circuitry for reference source, comparator amplifier, control device. and overload protection all in a single IC, IC units provide regulation of either a fixed positive voltage. a fixed negative voltage, or an adjustable set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

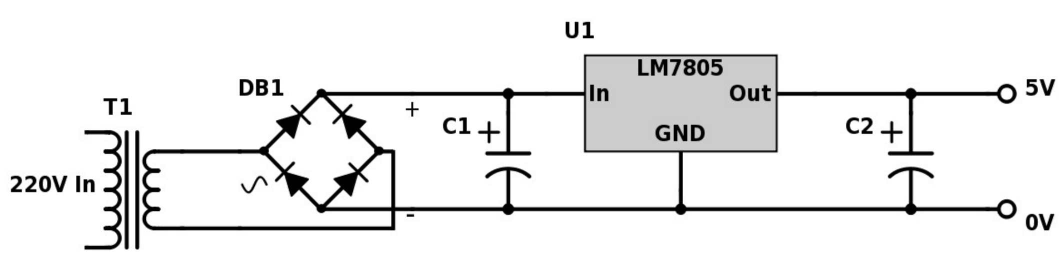

Figure 7.1 5V Voltage regulator

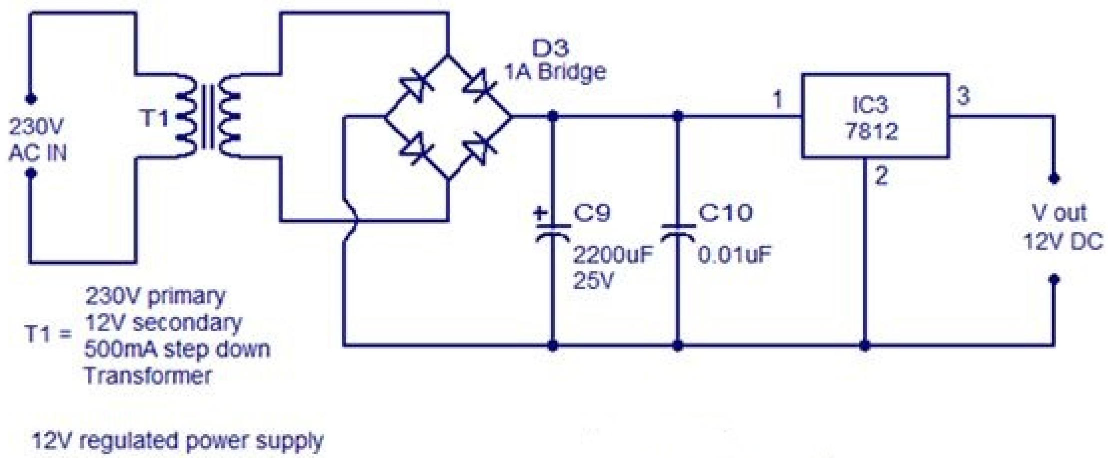

Figure 7.2 12V Voltage Regulator

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi applied to one input terminal, a regulated dc output voltage, Vo , from a second terminal with the third terminal connected to ground.

The series 78 regulators provided fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

- For ICs, Microcontroller, LCD……………. 5 volts
- For alarm circuit, op-amp , relay circuits………….. 12 volts.

CHAPTER 8
BATTERY
8.1 Introduction

A battery is a device in which chemical energy is directly converted to electrical energy. It consists of one or more voltaic cells, each of which is composed of two half cells connected in series by the conductive electrolyte consists of one or more voltaic cells in series.

Each cell has a positive terminal, shown by a long horizontal line, and a negative terminal, shown by the shorter horizontal line. These do not touch each other but are immersed in a solid or liquid electrolyte. The electrolyte is a conductor which connects the half-cells together. it also contains ions which can react with chemicals of the electrodes, Chemical energy is converted into electrical energy by chemical reactions that transfer charge between the electrode and the electrolyte at their interface. Such reactions are called faradaic, and are responsible for current flow through the cell. Ordinary, non-charge - transferring 9non-faradaic) reactions also occur that voltaic cells (particularly the lead-acid cell of ordinary car batteries) “ run down” when sitting unused.

Various cells and batteries (top-left to bottom -right) two AA, one D, one handheld ham radio battery, two 9-volt PP3, two AAA, one C, one camcorder battery, one cordless phone battery.

An electrical battery is one or more electrochemical cells that convert stored chemical energy intro electrical energy. Since the invention of the first battery for “voltaic pile”) in 1800 y Alesandro Volta batteries have become a cannon power source for many household and industrial applications according to a 2005 estimate, worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth

There are two types of batteries : primary batteries (disposable batteries), which are to be used once and discarded when they are exhausted and secondary batteries(rechargeable batteries), which are designed to be recharged and used multiple times. Miniature cells are used to power devices such as hearing aids and wristwatches: larger batteries provide standby power for telephone exchanges or computer data centers.

8.2 INVERTER

A power inverter, or inverter, is an electrical power converter that changes direct current (DC) to alternating current (AC); the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits.

Solid-state inverters have no moving parts and are used in wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries.

The inverter performs the opposite function of a rectifier. The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical AC to DC converters was made to work in reverse, and thus were "inverted", to convert DC to AC.

CCFL INVERTER

CCFL inverter is an electrical inverter that supplies alternating current power to a cold cathode fluorescent lamp (CCFL). CCFLs are often used as inexpensive light units in electrical devices that are powered by direct current sources such as batteries. CCFL inverters are small, have switchover efficiency over 80%, and offer adjustable output of light. They are widely used for backlights for LCDs, or for rear lighting in advertising signs.

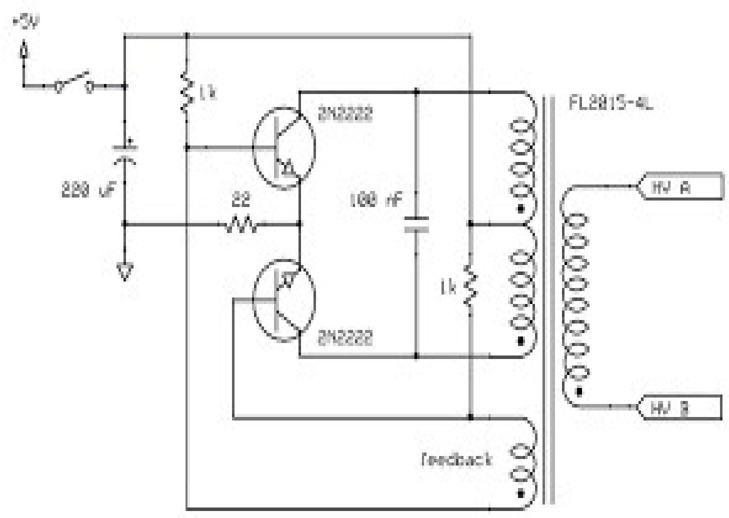

Figure 8.1 CCFL Inverter

Schematic Description

An AC load can be powered from a DC source by using a converter to charge DC to AC. This circuit is designed for taking 230V AC From the 12V DC input. An AC load can be powered from a DC source by using a converter to charge DC to AC. This is efficiently done through above circuit with the use of two transistors Q1 & Q2 and one Transformer(T). The wattage of output depends on these three equipment.

A DC-AC inverter energized from a 12 volt DC input signal uses a single stage inverter circuit to produce a quasi-sin wave output signal. When we are giving 12V DC input to the circuit, initially it goes to diode Di which is used to product reverse voltage. Then Q1 will conduct first, at that time we can get the positive cycle of 230V output in the output transformer side. It will prolong some seconds and gets saturated then Q2 will conduct this time. This switching makes the reverse polarity in the output side with constant 230v output. Then Q2 will conduct some seconds and gets saturated and Q1 will conduct. Likewise this switching makes alternating 230v output in the transformer output side. This will continue up to the input given to the circuit, which makes constant 230V AC output in the transformer side. The output voltage of the inverter is decided only in the transformer.

While saying in briefly, DC to AC converters a direct current voltage is applied to a so-called half bridge with two power transistors connected in series. The power transistors are gated alternatively conducting and generate at their connection point an alternating voltage for the load. DC-to-AC voltage converters have many uses, such as the supply of power to gas discharge lamps or, after rectifying and smoothing the AC voltage, supplying power to electronic circuits, motors, relays, magnetic valves, magnetic clutches, etc. DC-to-AC power converters are often used in uninterruptible power supplies.

CHAPTER 9

CIRCUIT DIAGRAM

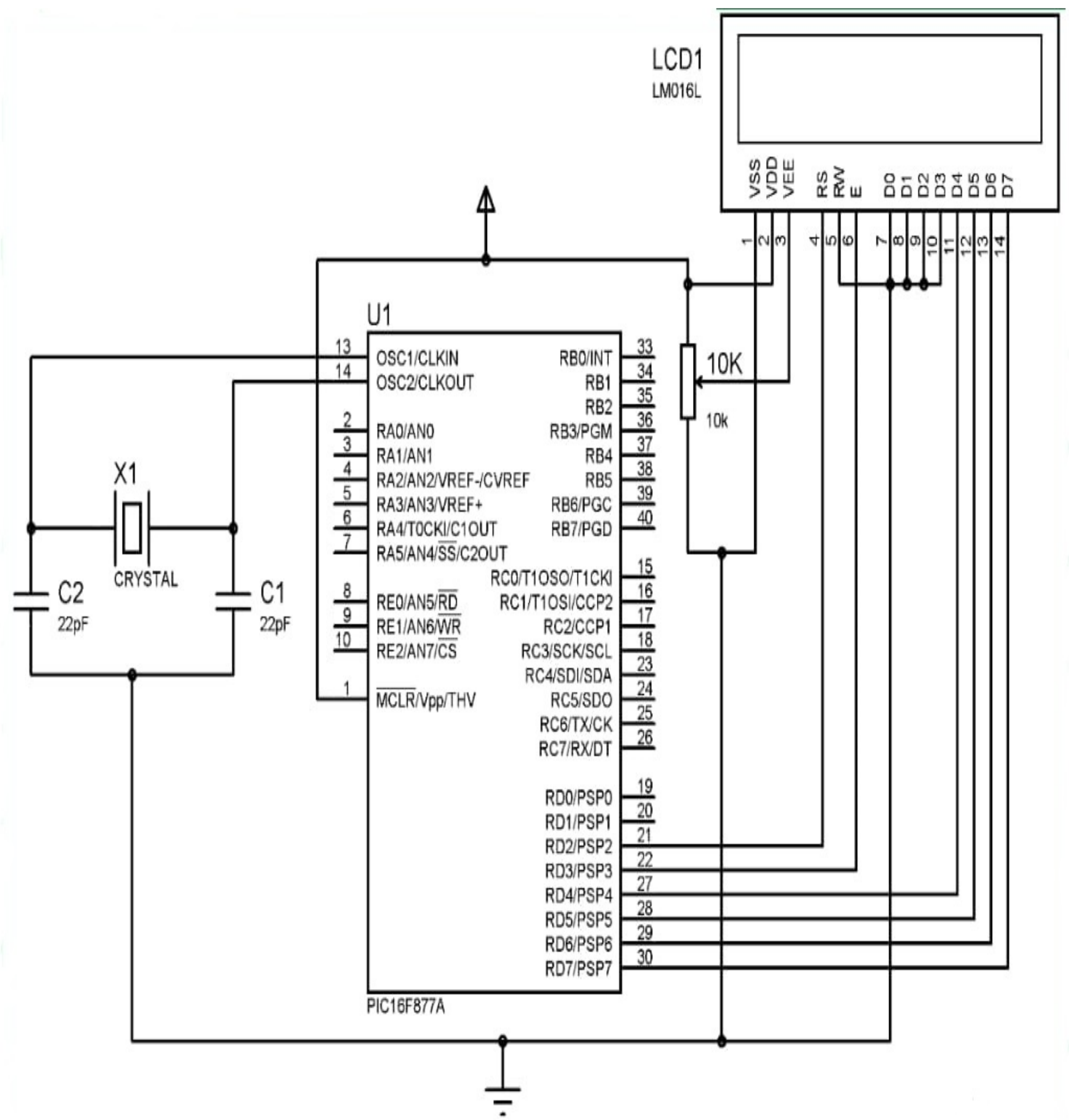

Figure 9.1 Circuit diagram of TEG with PIC16F877

II.

CHAPTER 10

WORKING OF TEG WITH PIC 16F877

TEG is a device which directly convert heat into electrical energy. We place a TEG in the exhaust of the boiler it produce maximum of 5v (for single TEG) depending upon the beat. Battery is used to store the output voltage from TEG but the 5v output is not enough to recharge the battery, SEPIC converter is used to boost the voltage in the ration of 1:2:5. So therefore 5V is converter to 12.5 V and the battery is begun to recharge. PIC microcontroller is used to produce PWM pulse with the help of that pulse we control the SEPIC converter and boost the voltage. The output current from the SEPIC converter is displayed in the LCD display which is also control by means of the PIC Microcontroller. Inverter is used to convert DC into AC for the AC load. We can directly taken the 12V output from the battery for DC loads.

CHAPTER 11

PROGRAM

```
#include<pic.h>
#include"pic_lcd8.h"
#include"pic_adc.h"
unsigned char count, sec:
unsigned char a, vin,, vout;
bit s:
void interrupt timer2()
{
                If(TMR21F==1)
                        {
                                TMR21F=0;
                        CCPR1L=a;
                        }
        }
        void main()
        {
                TRISD=OXOO;
                TRISC=OXc0;
                TRISB=0x00;
                TRISA =0x03;
                Led8 int();
                Led8 Display (0X80, REGENERATION OF POWER
Delay (65000) Delay (5000)
Led8 Display (0x80, "GENERATOR…." 16) Delay (65000) Delay (15000)
Led8 Command(0E)
GIE=1;
PEIE=E;
TR2HE1;
PR2-249;
CCPICON=0xOc;
Led8_Display(0x80,"IO:   "16);
Led8_Display(0c80,"II:   "16);
        While (i)
        {
                Vout=Adc8_Chat(0);
Vin=Adc8_Cha(1);
        if(vout<125){a++;if(a>199){a>199;}
        else if(vout>115){a--if(a<5){a=1;}}
        Led8 _ Decimal3c(0x83, vout);
        Led8_Decimal3e(0xc3, vin);
        }
}
```

CHAPTER 12

PCB DESIGN

Printed circuit boards, or PCBs fom the core of electronic equipment domestic and industrial. Some of the areas where PCB's are intensively used are computers, process control, telecommunications and instrumentation.

Manufacturing

The manufacturing process consists of two methods, print and etch, and print, plate and etech, The single sided PCBs are usually made using the print and etech method.

The double sided plates through whole(PTH) boards are made by the print plate and etch method.

The production of multi-layer boards uses both the methods. The inner layers are printed and etch while the outer layers are produced by print, plate and etch after pressing the inner layers.

Panelisation

Here the schematic transformed into the working positive/negative films. The is repeated conveniently to accommodate economically as many circuits as e in a panel, which can be operated in every sequence of subsequent steps in the B process. This is called penalization. For the PTH boards, the next operation is drilling.

Drilling

PCB drilling is state of the art operation. Very small holes are drilled with high speed CNC drilling machines, giving a wall finish with less or no smear or epoxy, required for void free through hole plating.

Plating

The heart of the PCB manufacturing process. The holes drilled in the board are treated both mechanically and chemically before depositing the copper by the electro less copper platting process.

Etching

Once a multiplayer board is drilled and electro less copper deposited the image available in the form of a film is transferred on to the outside by photo printing using a dry film printing process. The boards are them electrolytic plated on to the circuit pattern with copper and tin. The tin-plated deposit serves an etch resist when copper in the unwanted area is removed by the conveyor's spray etching machines with chemical etch chines are attached to automatic dosing equipment, which analyses and controls etch ants concentrations.

Solder mask

Since a PCB design may call for very close spacing between conductors, a solder mask has to be applied on the both sides of the circuitry to avoid the bridging of conductors. The solder mask ink is applied by screening. The ink is dried, exposed to UV, developed in a mild alkaline solution and finally cured by both UV and thermal energy.

Hot air leveling

After applying the solder mask, the circuit pads are soldered using the hot air leveling process. The bare bodies fluxed and dipped in to a molten solder bath. While removing the board from the solder bath, hot air is blown on both sides of the board through air knives in the machines, leaving the board soldered and leveled. This is one of the common finishes given to the boards. Thus the double sided plated through whole printed circuit board is manufactured and is now ready for the components to be soldered.

CHAPTER 13
CONCLUSION

Thermoelectric generators are an intriguing way to generate renewable energy directly from waste heat. However, their efficiencies are limited due to their thermal and electrical properties being dependent on each other. Nevertheless, their solid state scalable technology makes them appealing and even more efficient in selective applications. Implementing thermoelectric generators on vehicle exhaust manifolds would help to reduce fuel consumption, which in turn would help to preserve the world natural resources and reduce carbon emissions.

CHAPTER 14
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