AUTOMATIC BREAK FAILURE INDICATOR AND ENGINE OVER HEATING ALARM

Technical Project Report

Submitted in partial fulfillment of the requirement

for the B.Tech in Mechanical Engineering (8th Semester)

under Biju Patnaik University of Technology, Rourkela

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CERTIFICATE

This is to certify that the project work entitled **'Automatic Break Failure Indicator And Engine Over Heating Alarm'** is a bonafide work being done **Sonali Mishra, Vikash Chowdhary, Kishore Kumar Das and Satyabrata Nanda** bearing Registration No. **1601106601, 1601106619, 1721106159 and 1601106587** respectively of MECHANICAL ENGG branch.

This seminar report is submitted in partial fulfillment for the requirement of the B. Tech degree under Biju Patnaik University of Technology, Rourkela Odisha.

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ABSTRACT

The braking system of a car is undoubtedly one of its more important features. The aim of this work is to create a better braking system with indicator. Brake failure occurs only because cut in liner. It consists of an inductive sensor. The sensor is detecting the brake liner. The signal from the sensor is given to a microcontroller. When the brake liner is cut, the sensor sends signal to the microcontroller. The microcontroller analyses the signal and operates the corresponding indicator. It nothing wrong, the vehicle will move and if any one critical, the vehicle will stops and the screen show the indication of brake failure. Since this indicates the status of the brake, the user can identify the condition of the brake and thus limiting the chances of accident.

This project also has another feature. If the temperature of the engine goes beyond the predefined level the engine will shut down automatically. Here the drive motor will stop.

Keywords: in-situ examination; data acquisition; signal processing; friction; wear

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DECLARATION

We certify that

a. The work contained in the thesis is original and has been done by ourselves under the general supervision of my supervisor.
b. The work has not been submitted to any other Institute for any degree or diploma.
c. We have followed the guidelines provide by the Institute in writing the thesis.
d. We confirmed to the norms and guidelines given in Ethical Code of Conduct of the Institute.
e. Whenever we have used materials (data, theoretical analysis and text from other sources, I have given due credit to them citing in the text of the thesis and giving their details in the references.
f. Whenever we quoted written materials from other sources we have out them under the quotation marks and given due credit to the sources by citing in them and giving required details in the references.

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INTRODUCTION

The braking system of a car is undoubtedly one of its more important features. The aim of this work is to create a better braking system with indicator. Brake failure occurs only because cut in liner. It consists of an inductive sensor. The sensor is detecting the brake liner. The signal from the sensor is given to a microcontroller. When the brake liner is cut, the sensor sends signal to the microcontroller. The microcontroller analyses the signal and operates the corresponding indicator. It nothing wrong, the vehicle will move and if any one critical, the vehicle will stops and the screen show the indication of brake failure. Since this indicates the status of the brake, the user can identify the condition of the brake and thus limiting the chances of accident.

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THEORY

TYPES OF BRAKING

The brakes for automotive use may be classified according the following considerations.

1. PURPOSE
2. LOCATION
3. CONSTRUCTION
4. METHOD OF ACTUATION

5. EXTRA BRAKING EFFORT

Based on the above considerations, brakes are classified with respect to following factors.

1. With respect to application,
    a. Foot brake
    b. Hand brake

2. With respect to the number of wheels,
    a. Two wheel brakes
    b. Four wheel brakes

3. With respect to the method of braking contact
    a. Internal expanding brakes
    b. External contracting brakes

4. With respect to the method of applying the braking force.
    a. Single acting brake
    b. Double acting brakes.

5. With respect to the brake gear,
    a. Mechanical brake
    b. Power brakes

6. With respect to the nature of power employed

a. Vacuum brake

b. Air brake

c. Hydraulic brake

d. Hydrostatic brake

e. Electric brake

7. With respect to power transmission,

   a. Direct acting brakes

   b. Geared brakes

8. With respect to power unit,

   a. Cylinder brakes

   b. Diaphragm brake

The foot brake or service brake is always applied by a pedal, while the parking brake is applied by a hand lever. The parking brake is intended chiefly to hold the car in position. The parking brake can be set in the "ON" position by means of a latch while the service brake remains on only as long as the driver presses down on the pedal.

The hand brake is normally used only after the driver has stopped the car by using the foot brake. Its other use is as an emergency brake to stop the car if the foot braked system should fail. The hand or parking brakes operates on a pair of wheels, frequently the rear wheels. When drum type rear brakes are used, the same shoes can be used for both hand and foot control.

The drum type of brake may either be a band brake or a shoe brake. Both band brakes and shoe brakes may be either external or internal. The band brakes generally are external and shoe brakes internal. In drum brakes the drum is attached to the wheel and revolves with it. Friction to slow the drum is applied from inside by the shoes which do not rotate but are mounted on a stationary metal back plate. There are different types of drum brakes such as a two leading shoe arrangement – which gives an augmented response to pedal effort because of its self-applying arrangement. A leading-trailing shoe is a cheaper and better alternative as it is equally effective whether the car is going forward or backwards.

Manufacturers design drum brakes so that rain, snow or ice or grit cannot get inside and decrease braking efficiency for moisture greatly reduces the friction between the linings and the drum.

The dissipate quickly the considerable amount of heat generated when braking a fast moving heavy car large brake drums would be required. Disc brakes do the job more efficiently, for the cooling air can get to the rubbing between each piston and the disc, there is a friction pad held in position by retaining pins, spring plates etc. Passages are drilled in the caliper for the fluid to enter or leave the each housing. These passages are also connected to another one for bleeding. Each cylinder contains a rubber selling ring between the cylinder and the piston.

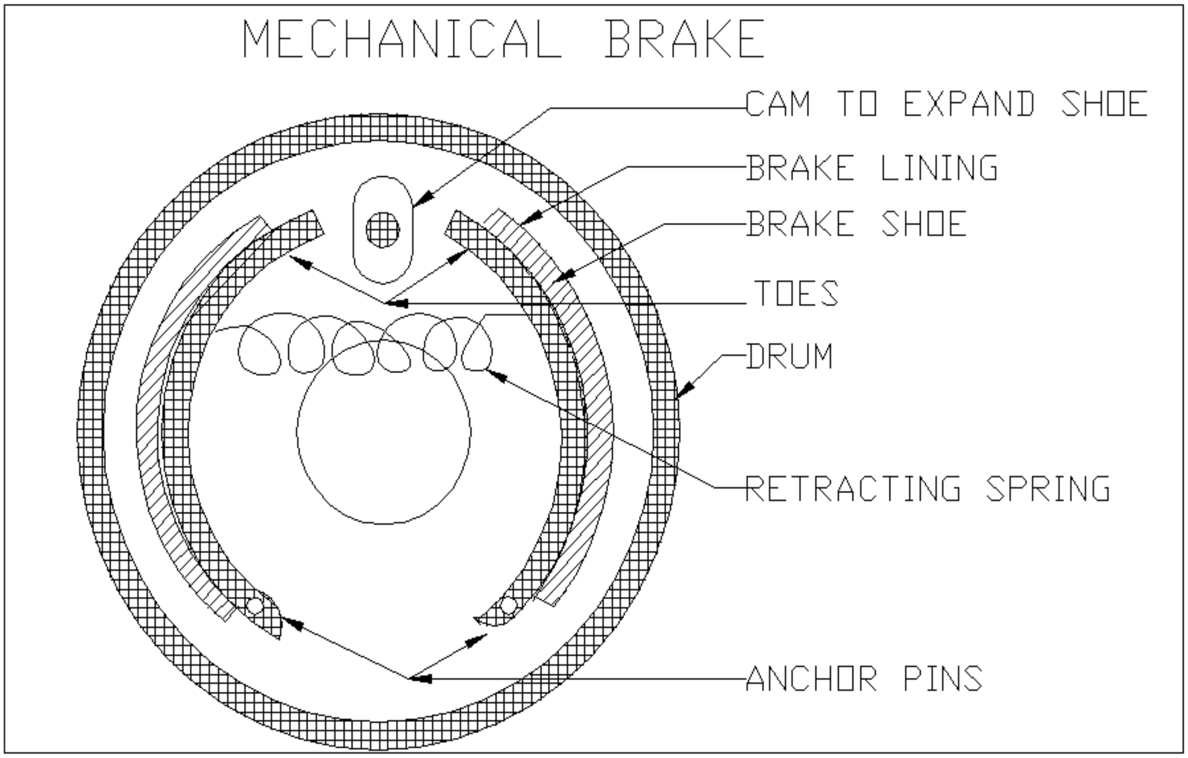
The brakes are applied, hydraulically actuated piston move the friction pads into contact with the disc, applying equal and opposite forces on the later. On releasing the brakes, the rubber sealing rings act as return springs and retract the pistons and the friction pads away from the disc.

Now let us see in detail about different braking systems in automobiles.

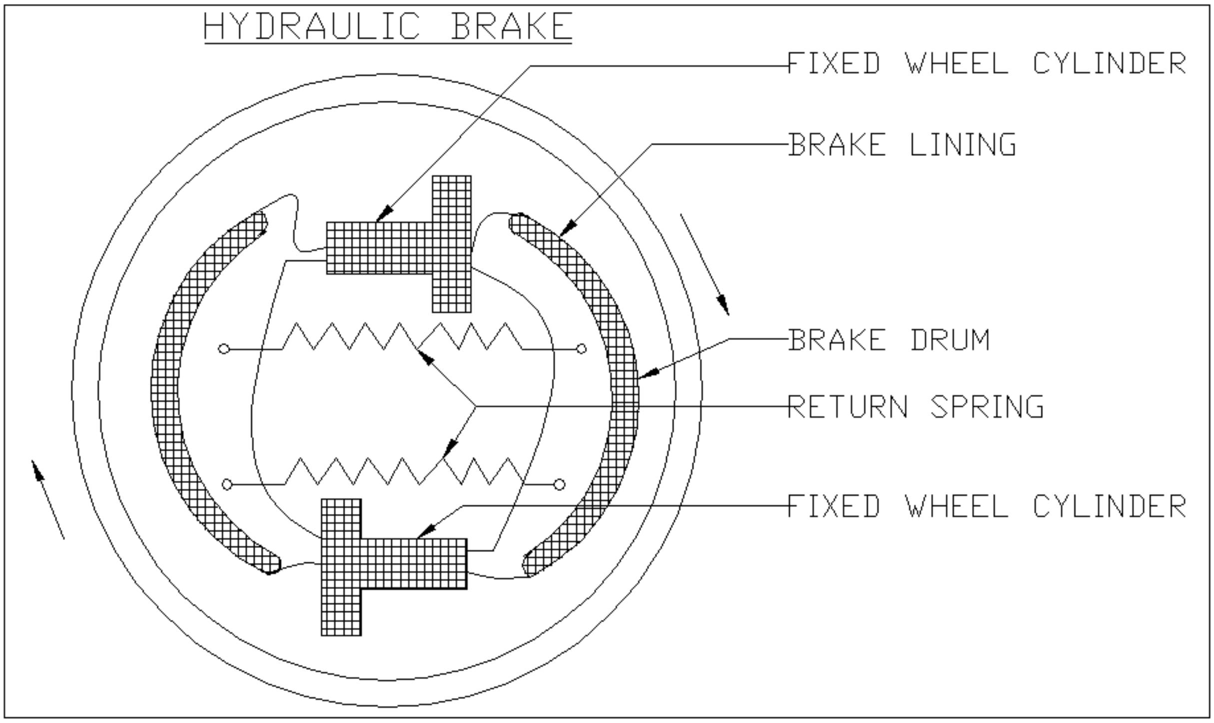
CLASSIFICATION

MECHANICAL BRAKE:

In a motor vehicle, the wheel is attached to an auxiliary wheel called drum. The brake shoes are made to contact this drum. In most designs, two shoes are used with each drum to form a complete brake mechanism at each wheel. The brake shoes have brake linings on their outer surfaces. Each brake shoe is hinged at one end by on anchor pin; the other end is operated by some means so that the brake shoe expands outwards. The brake linings come into contact with the drum. Retracting spring keeps the brake shoe into position when the brakes are not applied. The drum encloses the entire mechanism to keep out dust and moisture. The wheel attaching bolts on the drum are used to contact wheel and drum. The braking plate completes the brake enclosure, holds the assembly to car axle, and acts the base for fastening the brake shoes and operating mechanism. The shoes are generally mounted to rub against the inside surface of the drum to form as internal expanding brake as shown in the figure.



LAYOUT OF MECHANICAL BRAKE



LAYOUT OF HYDRAULIC BRAKE

HYDRAULICBRAKES:

The hydraulic brakes are applied by the liquid pressure. The pedal force is transmitted to the brake shoe by means of a confined liquid through a system of force transmission.

The force applied to the pedal is multiplied and transmitted to brake shoes by a force transmission system. This system is based upon Pascal's principle, which states that "The confined liquids transmit pressure without loss equally in all directions".

It essentially consists of two main components – master cylinder and wheel cylinder the master cylinder is connected by the wheel cylinders at each of the four wheels. The system is filled with the liquid under light pressure when the brakes are not in operation. The liquid is known as brake fluid, and is usually a mixture of glycerin and alcohol or caster-oil, denatured alcohol and some additives Spring pressure, and thus the fluid pressure in the entire system drops to its original low valve, which allows retracting spring on wheel brakes to pull the brake shoes out of contact with the brake drums into their original positions. This causes the wheel cylinder piston also to come back to its original inward position. Thus, the brakes are released.

AIR BRAKE:

Air brakes are widely used in heavy vehicle like buses and trucks which require a heavier braking effort that can be applied by the driver's foot. Air brakes are applied by the pressure of compressed air, instead of foot pressure, acting against flexible diaphragms in brake chamber. The diaphragms are connected to the wheel brakes. These diaphragms are controlled through a hand or foot operated valve. The brake valve controls brake operation by directing the flow of air from a reservoir against diaphragms in the brake chamber when the brakes are applied and from brake chambers to tube atmosphere when the brakes are released. The air compressor, driven by the engine furnishes compressed air to the reservoir fall below a set valve.

ELECTRIC BRAKE:

Electric Brakes are also used in some motor vehicles, although these are not very popular. Warner electric brake is one of the examples of such brakes. An electric brake essentially consists of an electromagnet within the brake drum. The current from the battery is utilized to energize the electromagnet, which actuates the mechanism to expand the brake shoe against the brake drum, thus applying the brakes. The severity of braking is controlled by means of a rheostat, which is operated by the driver through the foot pedal.

Electric brakes are simpler. These brakes do not require complicated operating linkage. Only cable is required to take current from the battery to the electromagnet. Also, these are very quick in action as compared to other types of brakes.

VACUUM BRAKES / SERVO BRAKES:

A serve mechanism fitted to the braking system reduces the physical effort the driver has to use on the brake pedal most servo mechanisms are of the vacuum assistance type. A pressure differential can be established by subjecting one side of the piston to atmospheric pressure and the other side to a pressure below atmospheric pressure by exhausting air from the corresponding end of the servo cylinder.

REGENERATIVE BRAKING:

Electricity powered vehicles use regenerative braking for stopping the vehicle. With regenerative braking pressing the brake pedal does not necessarily activate a conventional friction brake. The motor controller controlling the vehicle is treated as a generator which slows the vehicle and simultaneously provides an output for charging the battery. The effectiveness of regenerative braking falls off with vehicle speed. Electric vehicles will have to be fitted with conventional hydraulic friction brakes as well as with regenerative systems.

- **COMPONENT USED IN ELECTROMAGNETIC BREAKING**

1. Electromagnetic solenoid Actuator
2. Single phase Electric motor
3. Pillow block bearing
4. MS shaft
5. Wheel with drum breaking system

SINGLE PHASE INDUCTION MOTOR:-

SINGLE PHASE INDUCTION MOTOR

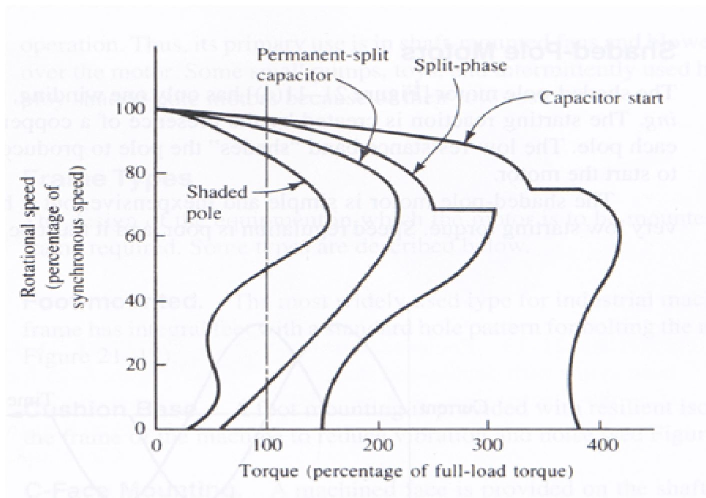
It is found to drive the roller shaft which fixed on the end of the frame structure. The free end of the shaft in the motor a large pulley is found around which the belt runs. The other specification about the motor is discussed in design part of the machine.

Single-Phase Theory

Because it has but a single alternating current source, a single-phase motor can only produce an alternating field: one that pulls first in one direction, then in the opposite as the polarity of the field switches. A squirrel-cage rotor placed in this field would merely twitch, since there would be no moment upon it. If pushed in one direction, however, it would spin.

The major distinction between the different types of single-phase AC motors is how they go about starting the rotor in a particular direction such that the alternating field will produce rotary motion in the desired direction. This is usually done by some device that introduces a phase-shifted magnetic field on one side of the rotor.

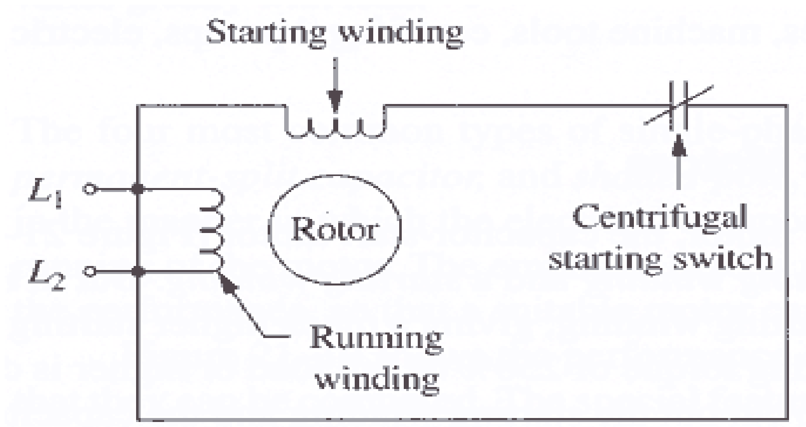
The figure the performance curves of the four major types of single-phase AC motors. They are described below.



1. Split-Phase Motors:

The split phase motor achieves its starting capability by having two separate windings wound in the stator. The two windings are separated from each other. One winding is used only for starting and it is wound with a smaller wire size having higher electrical resistance than the main windings. From the rotor's point of view, this time delay coupled with the physical location of the starting winding produces a field that appears to rotate. The apparent rotation causes the motor to start.

A centrifugal switch is used to disconnect the starting winding when the motor reaches approximately 75% of rated speed. The motor then continues to run on the basis of normal induction motor principles.



Split-phase motor

2. Capacitor-Start Motors

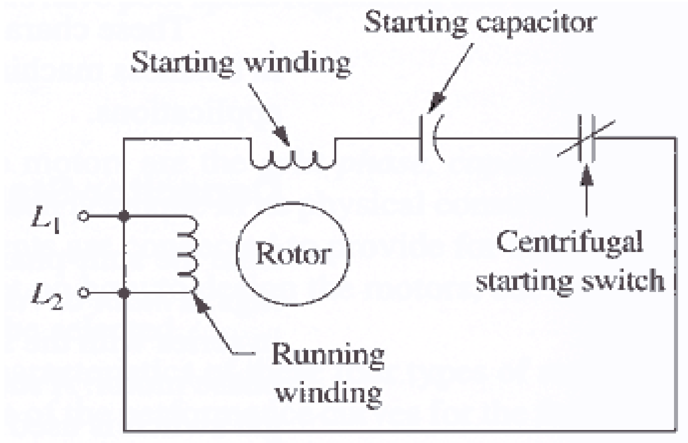
Capacitor start motors form the largest single grouping of general purpose single phase motors. These motors are available in a range of sizes from fractional through 3HP.

The winding and centrifugal switch arrangement is very similar to that used in a split phase motor. The main difference being that the starting winding does not have to have high resistance. In the case of a capacitor start motor, a specialized capacitor is utilized in a series with the starting winding.

The addition of this capacitor produces a slight time delay between the magnetization of starting poles and the running poles. Thus the appearance of a rotating field exists. When the motor approaches running speed, the starting switch opens and the motor continues to run in the normal induction motor mode.

This moderately priced motor produces relatively high starting torque, 225 to 400% of full load torque. The capacitor start motor is ideally suited for hard to start loads such as conveyors, air compressors and refrigeration compressors. Due to its general overall desirable characteristics, it also is used for many applications where high starting torque may not be required.

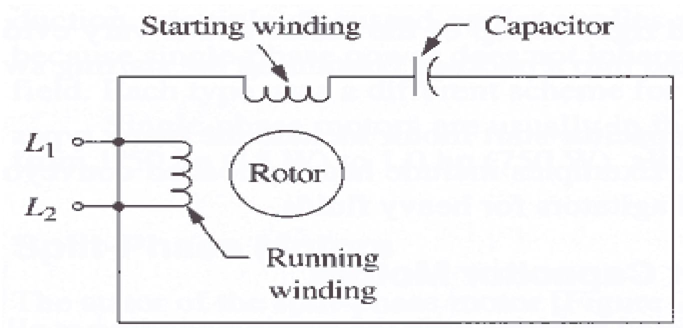
The capacitor start motor can usually be recognized by the bulbous protrusion on the frame where the starting capacitor is located.



Capacitor-start motor

Permanent-Split Capacitor Motors

The capacitor of this motor is left in series with the starting winding during normal operation. The starting torque is quite low, roughly 40% of full-load, so low-inertia loads such as fans and blowers make common applications.



Permanent-split capacitor motor

Running performance and speed regulation can be tailored by selecting an appropriate capacitor value. No centrifugal switch is required.

- **PULLY**

DIAGRAM OF PULLEY

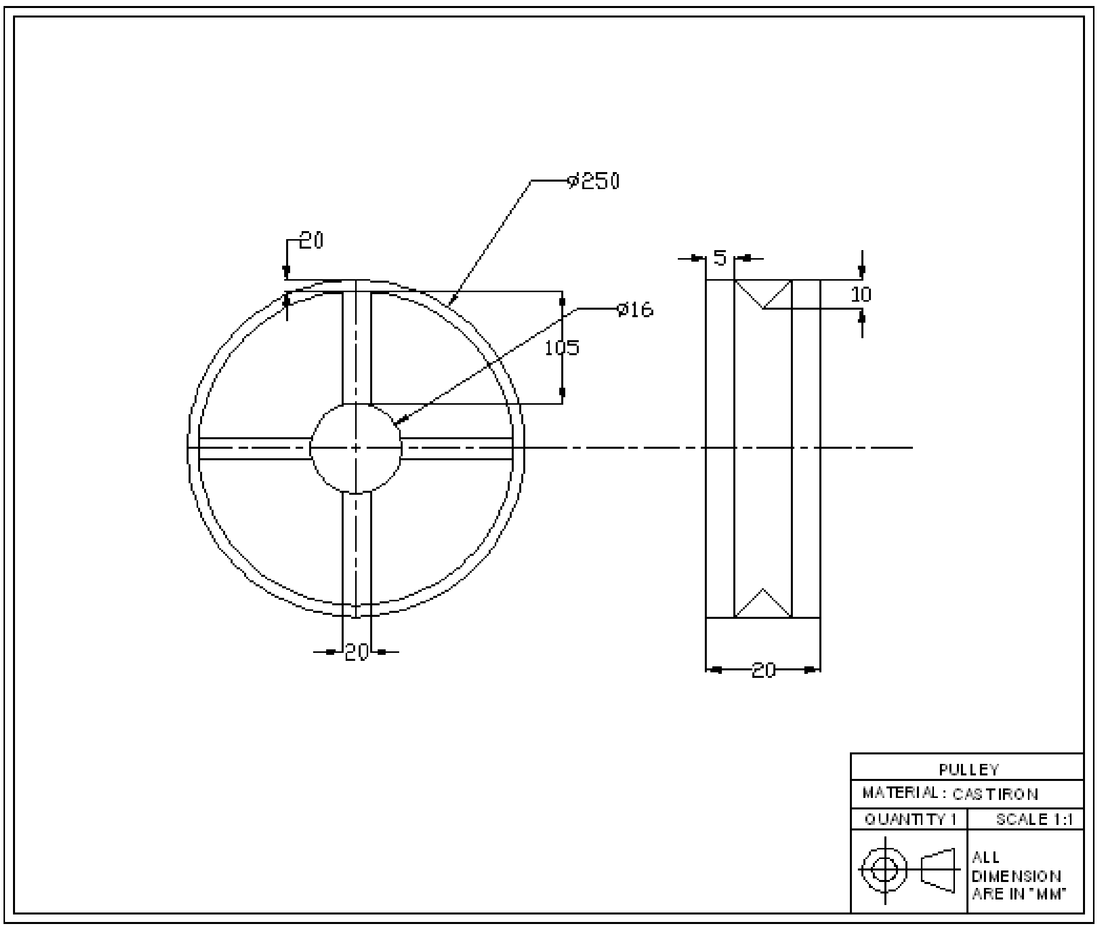
A **pulley** is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave.

A belt and pulley system is characterized by two or more pulleys in common to a belt. This allows for mechanical power, torque, and speed to be transmitted across axles. If the pulleys are of differing diameters, a mechanical advantage is realized.

A belt drive is analogous to that of a chain drive; however, a belt sheave may be smooth (devoid of discrete interlocking members as would be found on a chain sprocket, spur gear, or timing belt) so that the mechanical advantage is approximately given by the ratio of the pitch diameter of the sheaves only, not fixed exactly by the ratio of teeth as with gears and sprockets.

In the case of a drum-style pulley, without a groove or flanges, the pulley often is slightly convex to keep the flat belt centered. It is sometimes referred to as a crowned pulley. Though once widely used on factory line shafts, this type of pulley is still found driving the rotating brush in upright vacuum cleaners, in belt sanders and band saws. Agricultural tractors built up to the early 1950s generally had a belt pulley for a flat belt (which is what *Belt Pulley* magazine was named after). It has been replaced by other mechanisms with more flexibility in methods of use, such as power take-off and hydraulics.

Just as the diameters of gears (and, correspondingly, their number of teeth) determine a gear ratio and thus the speed increases or reductions and the mechanical advantage that they can deliver, the diameters of pulleys determine those same factors. Cone pulleys and step pulleys (which operate on the same principle, although the names tend to be applied to flat belt versions and V-belt versions, respectively) are a way to provide multiple drive ratios in a belt-and-pulley system that can be shifted as needed, just as a transmission provides this function with a gear train that can be shifted. V-belt step pulleys are the most common way that drill presses deliver a range of spindle speeds.



Driven pulley Dia (D) =304mm

Arm length =105mm

Driving pulley dia (d) =152mm

Rim thickness =5mm

Material - CI

- **V BELT**

A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel.

In a two pulley system, the belt can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyor belt is one application where the belt is adapted to carry a load continuously between two points. The belt drive can also be used to change the speed of rotation, either up or down, by using different sized pulleys.

V belts (also style V-belts, vee belts, or, less commonly, wedge rope) solved the slippage and alignment problem. It is now the basic belt for power transmission. They provide the best combination of traction, speed of movement, load of the bearings, and long service life. They are generally endless, and their general cross-section shape is roughly trapezoidal (hence the name "V"). The "V" shape of the belt tracks in a mating groove in the pulley (or sheave), with the result that the belt cannot slip off. The belt also tends to wedge into the groove as the load increases—the greater the load, the greater the wedging action—improving torque transmission and making the V-belt an effective solution, needing less width and tension than flat belts. V-belts trump flat belts with their small center distances and high reduction ratios. The preferred center distance is larger than the largest pulley diameter, but less than three times the sum of both pulleys. Optimal speed range is 1,000–7,000 ft. /min (300–2,130 m/min). V-belts need larger pulleys for their thicker cross-section than flat belts.

For high-power requirements, two or more V-belts can be joined side-by-side in an arrangement called a multi-V, running on matching multi-groove sheaves. This is known as a multiple-V-belt drive (or sometimes a "classical V-belt drive").

V-belts may be homogeneously rubber or polymer throughout, or there may be fibers embedded in the rubber or polymer for strength and reinforcement. The fibers may be of textile materials such as cotton, polyamide (such as Nylon) or polyester or, for greatest strength, of steel or aramid (such as Technora, Twaron or Kevlar).

When an endless belt does not fit the need, jointed and link V-belts may be employed. Most models offer the same power and speed ratings as equivalently-sized endless belts and do not require special pulleys to operate. A link v-belt is a number of polyurethane/polyester composite links held together, either by themselves, such as Fenner Drives' Power Twist, or Nu-T-Link (with metal studs). These provide easy installation and superior environmental resistances compared to rubber belts and are length-adjustable by disassembling and removing links when needed.

DESIGN CALCULATION:

Cross section thickness of belt =7mm

Width (b) =11mm

Angle of 'v' belt =50°

We know;

n =100 rpm (assume)

Weight =70kg   70X10 =70N

Power =force X velocity

$P = 700X3.14X16X10^{-3}/60X100$

P =58.6W

P =60 watts power is to be transmitted

LENGTH OF THE BELT

$L = 2c + 3.14/2\ (D+d) + (D+d)^2 /4c$

C center of distance=225 mm

Speed radio I =D/d

=250/50

I =5

The recommended C/D radio is 0.9

Therefore,

c/D =0.9

C /250 =0.9

c=250X0.9

c = 225mm

$L = 2c + 3.14/2\ (D+d) + (D+d)^2\ /4c$

$= 2X225 + 3.14/2\ (250+50) + (250-50)^2/4X225$

=965.67mm

L =96 cm (length of the belt)

Angle of contact, θ =180 – (D-d)/c X60°

, θ =180 – (250-50)/225 X60°

θ =126.6°

Initial belt tension to be provided for firm grip of the v- belt on pulleys, is 0.5% of L

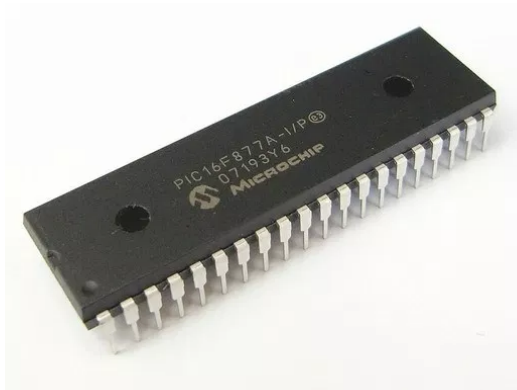
New length = L+0.5 % x L

=965+0.5X 1/100X965

=970mm.

FEATURES AND SPECIFICATIONS

MICROCONTROLLER 16F877A



The microcontroller that has been used for this project is from PIC series. PIC microcontroller is the first RISC based microcontroller fabricated in CMOS (complementary metal oxide semiconductor) that uses separate bus for instruction and data allowing simultaneous access of program and data memory.

The main advantage of CMOS and RISC combination is low power consumption resulting in a very small chip size with a small pin count. The main advantage of CMOS is that it has immunity to noise than other fabrication techniques.

Various microcontrollers offer different kinds of memories. EEPROM, EPROM, FLASH etc. are some of the memories of which FLASH is the most recently developed. Technology that is used in pic16F877 is flash technology, so that data is retained even when the power is switched off. Easy Programming and Erasing are other features of PIC 16F877.

<u>CORE FEATURES:</u>

- High-performance RISC CPU
- Only 35 single word instructions to learn
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input

DC - 200 ns instruction cycle

- Up to 8K x 14 words of Flash Program Memory,

  Up to 368 x 8 bytes of Data Memory (RAM)

  Up to 256 x 8 bytes of EEPROM data memory

- Pin out compatible to the PIC16C73/74/76/77
- Interrupt capability (up to 14 internal/external
- Eight level deep hardware stack
- Direct, indirect, and relative addressing modes
- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC Oscillator for reliable operation
- Programmable code-protection
- Power saving SLEEP mode
- Selectable oscillator options
- Low-power, high-speed CMOS EPROM/EEPROM technology
- Fully static design
- In-Circuit Serial Programming (ICSP) via two pins
- Only single 5V source needed for programming capability
- In-Circuit Debugging via two pins
- Processor read/write access to program memory
- Wide operating voltage range: 2.5V to 5.5V

• High Sink/Source Current: 25 mA

• Commercial and Industrial temperature ranges

• Low-power consumption:

< 2mA typical @ 5V, 4 MHz

20mA typical @ 3V, 32 kHz

< 1mA typical standby current

PERIPHERAL FEATURES:

• Timer0: 8-bit timer/counter with 8-bit prescaler

• Timer1: 16-bit timer/counter with prescaler, can be incremented during sleep via external crystal/clock

• Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler

• Two Capture, Compare, PWM modules

Capture is 16-bit, max resolution is 12.5 ns,

Compare is 16-bit, max resolution is 200 ns,

PWM max. Resolution is 10-bit

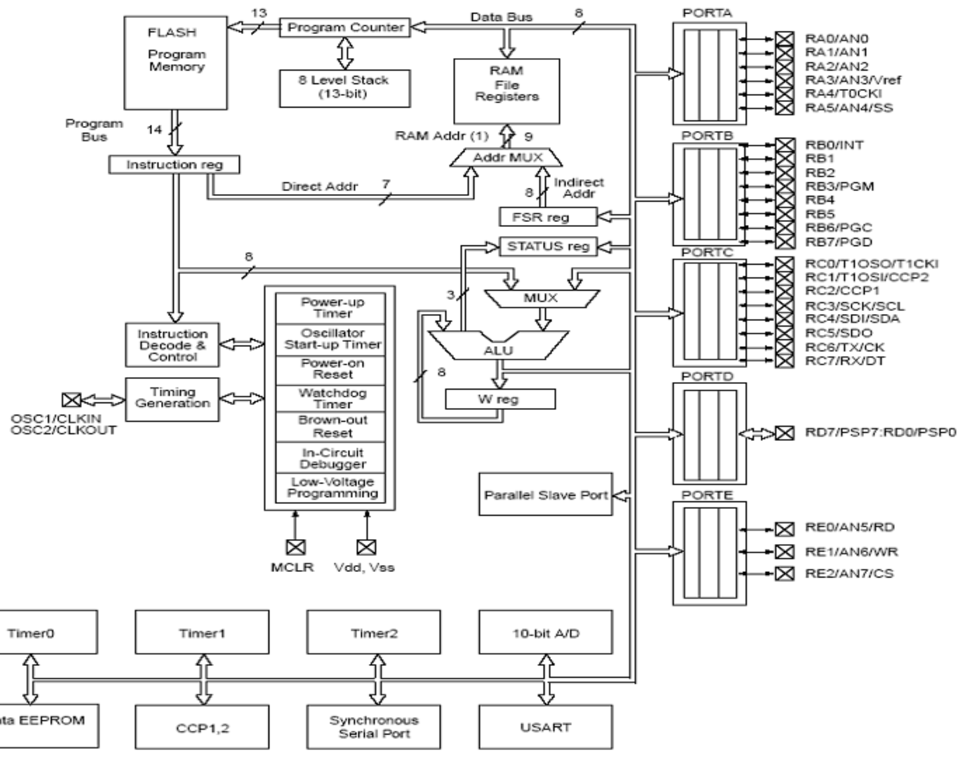
• 10-bit multi-channel Analog-to-Digital converter

• Synchronous Serial Port (SSP) with SPI. (Master Mode) and I2C. (Master/Slave)

• Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9- Bit addresses detection.

• Brown-out detection circuitry for Brown-out Reset (BOR)

ARCHITECTURE OF PIC 16F877:

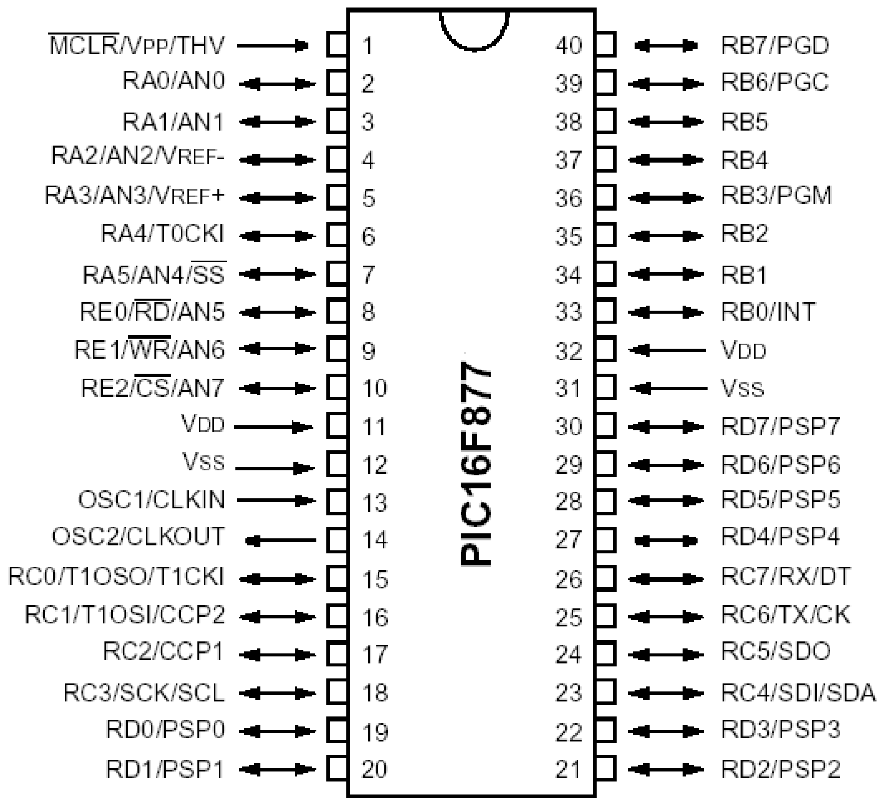


Note 1: Higher order bits are from the STATUS register.

TABLE SPECIFICATIONS

DEVICE	PROGRAM FLASH	DATA MEMORY	DATA EEPROM
PIC 16F877	8K	368 Bytes	256 Bytes

PIN DIAGRAM OF PIC 16F877



PIN OUT DESCRIPTION

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	13	14	30	I	ST/CMOS(4)	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	14	15	31	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
$\overline{MCLR}$/VPP/THV	1	2	18	I/P	ST	Master clear (reset) input or programming voltage input or high voltage test mode control. This pin is an active low reset to the device.
						PORTA is a bi-directional I/O port.
RA0/AN0	2	3	19	I/O	TTL	RA0 can also be analog input0
RA1/AN1	3	4	20	I/O	TTL	RA1 can also be analog input1
RA2/AN2/VREF-	4	5	21	I/O	TTL	RA2 can also be analog input2 or negative analog reference voltage
RA3/AN3/VREF+	5	6	22	I/O	TTL	RA3 can also be analog input3 or positive analog reference voltage
RA4/T0CKI	6	7	23	I/O	ST	RA4 can also be the clock input to the Timer0 timer/counter. Output is open drain type.
RA5/$\overline{SS}$/AN4	7	8	24	I/O	TTL	RA5 can also be analog input4 or the slave select for the synchronous serial port.
						PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT	33	36	8	I/O	TTL/ST(1)	RB0 can also be the external interrupt pin.
RB1	34	37	9	I/O	TTL	
RB2	35	38	10	I/O	TTL	
RB3/PGM	36	39	11	I/O	TTL	RB3 can also be the low voltage programming input
RB4	37	41	14	I/O	TTL	Interrupt on change pin.
RB5	38	42	15	I/O	TTL	Interrupt on change pin.
RB6/PGC	39	43	16	I/O	TTL/ST(2)	Interrupt on change pin or In-Circuit Debugger pin. Serial programming clock.
RB7/PGD	40	44	17	I/O	TTL/ST(2)	Interrupt on change pin or In-Circuit Debugger pin. Serial programming data.

Pin Name	DIP Pin#	PLCC Pin#	QFP Pin#	I/O/P Type	Buffer Type	Description
						PORTC is a bi-directional I/O port.
RC0/T1OSO/T1CKI	15	16	32	I/O	ST	RC0 can also be the Timer1 oscillator output or a Timer1 clock input.
RC1/T1OSI/CCP2	16	18	35	I/O	ST	RC1 can also be the Timer1 oscillator input or Capture2 input/Compare2 output/PWM2 output.
RC2/CCP1	17	19	36	I/O	ST	RC2 can also be the Capture1 input/Compare1 output/ PWM1 output.
RC3/SCK/SCL	18	20	37	I/O	ST	RC3 can also be the synchronous serial clock input/ output for both SPI and I^2C modes.
RC4/SDI/SDA	23	25	42	I/O	ST	RC4 can also be the SPI Data In (SPI mode) or data I/O (I^2C mode).
RC5/SDO	24	26	43	I/O	ST	RC5 can also be the SPI Data Out (SPI mode).
RC6/TX/CK	25	27	44	I/O	ST	RC6 can also be the USART Asynchronous Transmit or Synchronous Clock.
RC7/RX/DT	26	29	1	I/O	ST	RC7 can also be the USART Asynchronous Receive or Synchronous Data.
						PORTD is a bi-directional I/O port or parallel slave port when interfacing to a microprocessor bus.
RD0/PSP0	19	21	38	I/O	ST/TTL(3)	
RD1/PSP1	20	22	39	I/O	ST/TTL(3)	
RD2/PSP2	21	23	40	I/O	ST/TTL(3)	
RD3/PSP3	22	24	41	I/O	ST/TTL(3)	
RD4/PSP4	27	30	2	I/O	ST/TTL(3)	
RD5/PSP5	28	31	3	I/O	ST/TTL(3)	
RD6/PSP6	29	32	4	I/O	ST/TTL(3)	
RD7/PSP7	30	33	5	I/O	ST/TTL(3)	
						PORTE is a bi-directional I/O port.
RE0/$\overline{RD}$/AN5	8	9	25	I/O	ST/TTL(3)	RE0 can also be read control for the parallel slave port, or analog input5.
RE1/$\overline{WR}$/AN6	9	10	26	I/O	ST/TTL(3)	RE1 can also be write control for the parallel slave port, or analog input6.
RE2/$\overline{CS}$/AN7	10	11	27	I/O	ST/TTL(3)	RE2 can also be select control for the parallel slave port, or analog input7.
Vss	12,31	13,34	6,29	P	—	Ground reference for logic and I/O pins.
VDD	11,32	12,35	7,28	P	—	Positive supply for logic and I/O pins.
NC	—	1,17,28, 40	12,13, 33,34		—	These pins are not internally connected. These pins should be left unconnected.

Legend: I = input O = output I/O = input/output P = power

= Not used TTL = TTL input ST = Schmitt Trigger input

I/O PORTS:

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin.

Additional Information on I/O ports may be found in the IC micro™ Mid-Range Reference Manual,

PORTA AND THE TRISA REGISTER:

PORTA is a 6-bit wide bi-directional port. The corresponding data direction register is TRISA. Setting a TRISA bit (=1) will make the corresponding PORTA pin an input, i.e., put the corresponding output driver in a Hi-impedance mode. Clearing a TRISA bit (=0) will make the corresponding PORTA pin an output, i.e., put the contents of the output latch on the selected pin.

PORTB AND TRISB REGISTER:

PORTB is an 8-bit wide bi-directional port. The corresponding data direction register is TRISB. Setting a TRISB bit (=1) will make the corresponding PORTB pin an input, i.e., put the corresponding output driver in a hi-impedance mode. Clearing a TRISB bit (=0) will make the corresponding PORTB pin an output, i.e., put the contents of the output latch on the selected pin. Three pins of PORTB are multiplexed with the Low Voltage Programming function; RB3/PGM, RB6/PGC and RB7/PGD. The alternate functions of these pins are described in the Special Features Section. Each of the PORTB pins has a weak internal pull-up. A single control bit can turn on all the pull-ups.

This is performed by clearing bit RBPU (OPTION_REG<7>). The weak pull-up is automatically turned off when the port pin is configured as an output. The pull-ups are disabled on a Power-on Reset.

PORTC AND THE TRISC REGISTER:

PORTC is an 8-bit wide bi-directional port. The corresponding data direction register is TRISC. Setting a TRISC bit (=1) will make the corresponding PORTC pin an input, i.e., put the corresponding output driver in a hi-impedance mode. Clearing a TRISC bit (=0) will make the corresponding PORTC pin an output, i.e., put the contents of the output latch on the selected pin. PORTC is multiplexed with several peripheral functions. PORTC pins have Schmitt Trigger input buffers.

PORTD AND TRISD REGISTERS:

This section is not applicable to the 28-pin devices. PORTD is an 8-bit port with Schmitt Trigger input buffers. Each pin is individually configurable as an input or output. PORTD can be configured as an 8-bit wide microprocessor Port (parallel slave port) by setting control bit PSPMODE (TRISE<4>). In this mode, the input buffers are TTL.

PORTE AND TRISE REGISTER:

PORTE has three pins RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7, which are individually configurable as inputs or outputs. These pins have Schmitt Trigger input buffers.

The PORTE pins become control inputs for the microprocessor port when bit PSPMODE (TRISE<4>) is set. In this mode, the user must make sure that the TRISE<2:0> bits are set (pins are configured as digital inputs). Ensure ADCON1 is configured for digital I/O. In this mode the input buffers are TTL.

PORTE pins are multiplexed with analog inputs. When selected as an analog input, these pins will read as '0's. TRISE controls the direction of the RE pins, even when they are being used as analog inputs. The user must make sure to keep the pins configured as inputs when using them as analog inputs.

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.

PROGRAM MEMORY ORGANISATION:

The PIC16f877 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 0000h and the interrupt vector is at 0004h.

DATA MEMORY ORGANISTION:

The data memory is partitioned into multiple banks which contain the General Purpose Registers and the special functions Registers. Bits RP1 (STATUS<6) and RP0 (STATUS<5>) are the bank selected bits.

RP1:RP0	Banks
00	0
01	1
10	2
11	3

Each bank extends up to 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 registers. Some frequently used special function registers from one bank may be mirrored in another bank for code reduction and quicker access.

EEPROM:

EEPROM (electrically erasable, programmable read only memory) technology supplies

Nonvolatile storage of variables to a PIC-controlled device or instrument. That is variables stored in an EEPROM will remain there even after power has been turned off and then on again. Some instruments use an EEPROM to store calibration data during manufacture. In this way, each instrument is actually custom built, with customization that can be easily automated. Other instruments use and EEPROM to allow a user to store several sets of setup information. For an instrument requiring a complicated setup procedure, this permits a user to retrieve the setup required for any one of several very different measurements. Still other devices use an EEPROM in a way that is transparent to a user, providing backup of setup parameters and thereby bridging over power outages

The data EEPROM and flash program memory are readable and writable during normal operation over the entire VDD range. A bulk erase operation may not be issued from user code (which includes removing code protection. The data memory is not directly mapped in the register file space. Instead it is indirectly addressed through the special function registers (SFR).

There are six SFRS used to read and write the program and data EEPROM memory.

These registers are:

EECON1

EECON2

EEDATA

EEDATH

EEADR

EEADRH

EEDATA holds the 8-bit data for read/write and EEADRR holds the address of the EEPROM location being accessed. The 8-bit EEADR register can access up to 256 locations of data EEPROM. The EEADR register can be thought of as the indirect addressing register of the data EEPROM. EEcon1 contains the control bits, while eecon2 is the register used to initiate the read/write. The EEPROM data memory allows bytes read and write. A byte write automatically erases the location and writes the new data. The write time is controlled by timer in-built.

TIMERS

There are three timers used Timer 0, Timer1 and Timer2

Timer 0

8-bit timer/counter

Software programmable prescaler

Internal or external clock select

Readable writable

Interrupt on overflow

Edge selects for external clock

Timer 1

Timer 1 can be used as timer or counter

It is 16-bit register

Software programmable prescaler

Interrupt on overflow

Readable and writable

The timer-1 module is a 16-bit timer/counter consisting two 8-bit register (TMR1H) and (TMR1L), which are readable and writable. The TMR1 register pair (TMR1H:TMR1L)

Increments from 0000h to FFFFH and rolls over to 0000h. The tmr1 interrupt, if enabled, is generated on overflow, which is latched in interrupt flag bit tmr1IF. This interrupt can be enabled/disabled by setting/clearing tmr1 interrupt enable bit tmr1IE.

Timer-2

Timer2 is an 8-bit timer with a prescaler and a postscaler. IT can be used as the PWM.

Time-base for the PWM mode of the CCP module(s). The TMR2 register is readable and writable, and is cleared on any device reset.

The input clock (Fosc/4) has a prescale option of 1:1, 1:4 OR 1:16, selected by control bits.

The timer2 module has an 8-bit period register PR2. Timer2 increments from 00h until it match PR2 and then resets to 00h on the next increment cycle. PR2 is a readable and writable register. The PR2 register is initialized to FFh upon reset.

The match output of TMR2 goes through a 4-bit postscaler (which gives a 1:1 to 1:16 scaling inclusive) to generate a tmr2 interrupt

Timer 2 can be shut off by clearing control bit tmr2on to minimize power consumption.

The prescaler and postscaler counters are cleared when any of the following occurs:

A write to the tmr2 register

A write to the t2con register

Any device reset Tmr2 is not cleared when t2con is written

ANALOG TO DIGITAL CONVERTER (ADC)

There are two types of analog to digital converter is present in this IC. We use 10-bit ADC. The ADC module can have up to eight analog inputs for a device. The analog input charges a sample and hold capacitor. The output of sample and hold capacitor is the input into the converter. The converter then generates a digital result of this analog level via successive approximation. The A/D conversion of the analog input signal results in a Corresponding10-bit digital number. The A/D module has high and low voltage reference input that is software selectable to some combination of VDD, VSS, and RA2 or RA3.

The A/D module has four registers. These registers are

A/D result high register (ADRESH)

A/D RESULT LOW REGISTER (ADRESL)

A/D CONTROL REGISTER 0 (ADCON0)

A/D CONTROL REGISTER 1 (ADCON1)

INTERRUPTS

The PIC16F87X FAMILY HAS UPTO 14 SOURCES OF INTERRUPT. The interrupt control register (INTCON) records individual interrupt requests in flag bits. IT also has individual interrupt requests in flag bits. IT also has individual and global interrupt enables bits.

Though some modules may generate multiple interrupts such as (USART) they have 14 sources. There is a minimum of one register used in the control and status of the interrupts.

INTCON

Additionally if the device has peripheral interrupts, then it will have registers to enable the peripheral interrupts and registers to hold the interrupt flag bits

PIE1

PIE2

PIR1

PIR2

The following table shows which devices have which interrupts.

Device	T0IF	INTF	RBIF	PSPIF	ADIF	RCIF	TXIF	SSPIF	CCP1IF	TMR2IF	TMR1IF	EEIF	BCLIF	CCP2IF
PIC16F876/873	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PIC16F877/874	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

DIRECT ADDRESSING:

In direct addressing, the operand specified by an 8-bit address field in the instruction. Only internal data RAM and SFR's can be directly addressed.

INDIRECT ADDRESSING:

In Indirect addressing, the instruction specifies a register that contains the address of the operand. Both internal and external RAM can indirectly address.

The address register for 8-bit addresses can be either the Stack Pointer or R0 or R1 of the selected register Bank. The address register for 16-bit addresses can be only the 16-bit data pointer register, DPTR.

INDEXED ADDRESSING:

Program memory can only be accessed via indexed addressing this addressing mode is intended for reading look-up tables in program memory. A 16 bit base register (Either DPTR or the Program Counter) points to the base of the table, and the accumulator is set up with the table entry number. Adding the Accumulator data to the base pointer forms the address of the table entry in program memory.

Another type of indexed addressing is used in the "case jump" instructions. In this case the destination address of a jump instruction is computed as the sum of the base pointer and the Accumulator data.

REGISTER INSTRUCTION:

The register banks, which contains registers R0 through R7, can be accessed by instructions whose opcodes carry a 3-bit register specification. Instructions that access the registers this way make efficient use of code, since this mode eliminates an address byte. When the instruction is executed, one of four banks is selected at execution time by the row bank select bits in PSW.

REGISTER - SPECIFIC INSTRUCTION:

Some Instructions are specific to a certain register. For example some instruction always operates on the Accumulator, so no address byte is needed to point OT. In these cases, the opcode itself points to the correct register. Instruction that register to Accumulator as A assemble as Accumulator - specific Opcodes.

IMMEDIATE CONSTANTS:

The value of a constant can follow the opcode in program memory For example. MOV A, #100 loads the Accumulator with the decimal number 100. The same number could be specified in hex digit as 64h.

OSCILLATOR AND CLOCK CIRCUIT:

XTAL1 and XTAL2 are the input and output respectively of an inverting amplifier which is intended for use as a crystal oscillator in the pierce configuration, in the frequency range of 1.2 MHz to 12 Mhz. XTAL2 also the input to the internal clock generator.

To drive the chip with an internal oscillator, one would ground XTAL1 and XTAL2. Since the input to the clock generator is divide by two flip flop there are no requirements on the duty cycle of the external oscillator signal. However, minimum high and low times must be observed.

The clock generator divides the oscillator frequency by 2 and provides a tow phase clock signal to the chip. The phase 1 signal is active during the first half to each clock period and the phase 2 signals are active during the second half of each clock period.

CPU TIMING:

A machine cycle consists of 6 states. Each stare is divided into a phase / half, during which the phase 1 clock is active and phase 2 half. Arithmetic and Logical operations take place during phase1 and internal register - to register transfer take place during phase 2

APPLICATIONS

TRENDS AND DEVELOPMENTS IN MICRO CONTROLLER

The manner in which the use of micro controllers is shaping our lives is breathtaking. Today, this versatile device can be found in a variety of control applications. **CVTs, VCRs**, **CD** players, microwave ovens, and automotive engine systems are some of these.

A micro controller unit (MCU) uses the microprocessor as its central processing unit (CPU) and incorporates memory, timing reference, **I/O** peripherals, etc. on the same chip. Limited computational capabilities and enhanced **I/O** are special features.

The micro controller is the most essential **IC** for continuous process- based applications in industries like chemical, refinery, pharmaceutical automobile, steel, and electrical, employing programmable logic systems (DCS). **PLC** and **DCS** thrive on the programmability of an **MCU.**

There are many **MCU** manufacturers. To understand and apply general concepts, it is necessary to study one type in detail. This specific knowledge can be used to understand similar features of other **MCU**s.

Micro controller devices have many similarities. When you look at the differences, they are not so great either. Most common and popular **MCU**s are considered to be mature and well-established products, which have their individual adherents and devotees. There are a number of variants within each family to satisfy most memory, **I/O**, data conversion, and timing needs of end-user applications.

The **MCU** is designed to operate on application-oriented sensor data-for example, temperature and pressure of a blast furnace in an industrial process that is fed through its serial or operated on under the control of software and stored in **ROM**. Appropriate signals are fed via output ports to control external devices and systems.

APPLICATIONS OF MICROCONTROLLERS

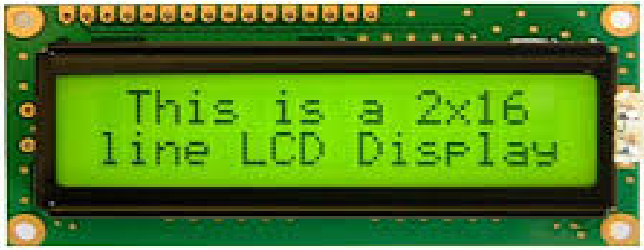
Microcontrollers are designed for use in sophisticated real time applications such as

1. Industrial Control
2. Instrumentation and
3. Intelligent computer peripherals

They are used in industrial applications to control

- Motor
- Robotics
- Discrete and continuous process control
- In missile guidance and control
- In medical instrumentation
- Oscilloscopes
- Telecommunication
- Automobiles
- For Scanning a keyboard
- Driving an LCD
- For Frequency measurements

LIQUID CRYSTAL DISPLAY (LCD)



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.

An 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 polarizes are pasted outside the two glass panels. These polarizes 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 polarizes 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 polarizes, 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 does not 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 customers 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 LCDs being extensively used in telecommunications and entertainment electronics. The LCDs have even started replacing the cathode ray tubes (CRTs) used for the display of text and graphics, and also in small TV applications.

Crystalonics dot–matrix (alphanumeric) liquid crystal displays are available in TN, STN types, with or without backlight. The use of C-MOS LCD controller and driver ICs result in low power consumption. These modules can be interfaced with a 4-bit or 8-bit microprocessor /Micro controller.

- The built-in controller IC has the following features:
- Correspond to high speed MPU interface (2MHz)
- 80 x 8 bit display RAM (80 Characters max)
- 9,920-bit character generator ROM for a total of 240 character fonts. 208 character fonts (5 x 8 dots) 32 character fonts (5 x 10 dots)
- 64 x 8 bit character generator RAM 8 character generator RAM 8 character fonts (5 x 8 dots) 4 characters fonts (5 x 10 dots)
- Programmable duty cycles
- 1/8 – for one line of 5 x 8 dots with cursor
- 1/11 – for one line of 5 x 10 dots with cursor
- 1/16 – for one line of 5 x 8 dots with cursor
- Wide range of instruction functions display clear, cursor home, display on/off, cursor on/off, display character blink, cursor shift, display shift.
- Automatic reset circuit, which initializes the controller / driver ICs after power on.

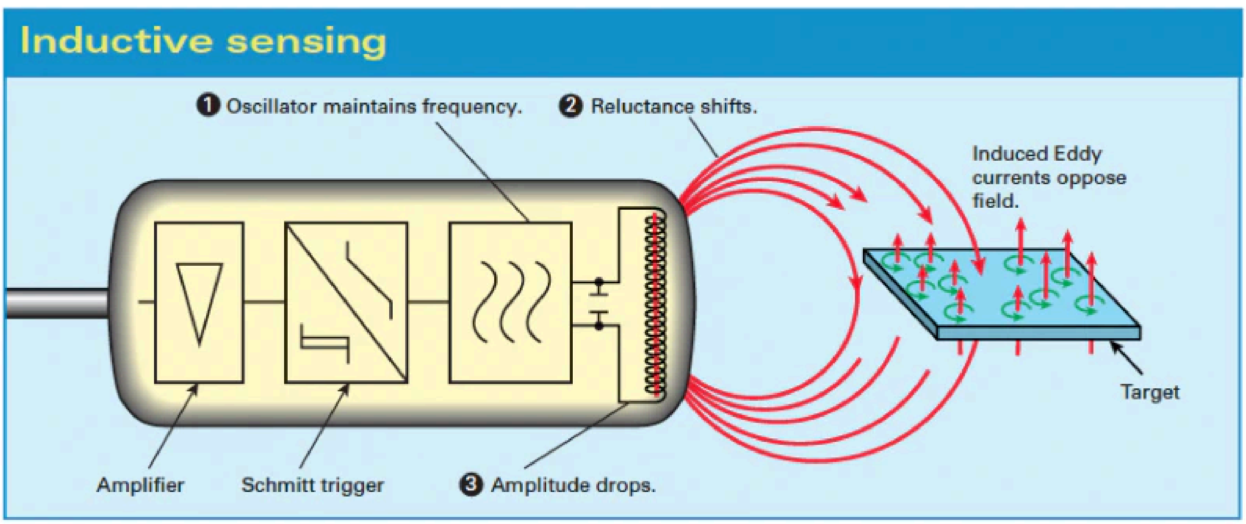
INDUCTIVE SENSOR

An inductive sensor is a device that uses the principle of electromagnetic induction to detect or measure objects. An inductor develops a magnetic field when a current flows through it; alternatively, a current will flow through a circuit containing an inductor when the magnetic field through it changes. This effect can be used to detect metallic objects that interact with a magnetic field. Non-metallic substances such as liquids or some kinds of dirt do not interact with the magnetic field, so an inductive sensor can operate in wet or dirty conditions.

These non-contact proximity sensors detect ferrous targets, ideally mild steel thicker than one millimeter. They consist of four major components: a *ferrite core* with *coils*, an *oscillator*, a *Schmitt trigger*, and an *output amplifier*. The oscillator creates a symmetrical, oscillating magnetic field that radiates from the ferrite core and coil array at the sensing face. When a ferrous target enters this magnetic field, small independent electrical currents called eddy currents are **induced** on the metal's surface. This changes the reluctance (natural frequency) of the magnetic circuit, which in turn reduces the oscillation amplitude. As more metal enters the sensing field the oscillation amplitude shrinks, and eventually collapses. (This is the "Eddy Current Killed Oscillator" or ECKO principle.) The Schmitt trigger responds to these amplitude changes, and adjusts sensor output. When the target finally moves from the sensor's range, the circuit begins to oscillate again, and the Schmitt trigger returns the sensor to its previous output.

If the sensor has a **normally open** configuration, its output is an **on** signal when the target enters the sensing zone. With *normally closed*, its output is an *off* signal with the target present. Output is then read by an external control unit (e.g. PLC, motion controller, smart drive) that converts the sensor on and off states into useable information. Inductive sensors are typically rated by frequency, or on/off cycles per second. Their speeds range from 10 to 20 Hz in ac, or 500 Hz to 5 kHz in dc. Because of magnetic field limitations, inductive sensors have a relatively narrow sensing range — from fractions of millimeters to 60 mm on average — though longer-range specialty products are available.

To accommodate close ranges in the tight confines of industrial machinery, geometric and mounting styles available include shielded (flush), unshielded (non-flush), tubular, and rectangular "flat-pack". Tubular sensors, by far the most popular, are available with diameters from 3 to 40 mm.



THERMISTOR

A **thermistor** is a type of resistor whose resistance is dependent on temperature, more so than in standard resistors. The word is a combination of *thermal* and *resistor*. Thermistors are widely used as inrush current limiters, temperature sensors (negative temperature coefficient or **NTC** type typically), self-resetting over current protectors, and self-regulating heating elements (positive temperature coefficient or **PTC** type typically).

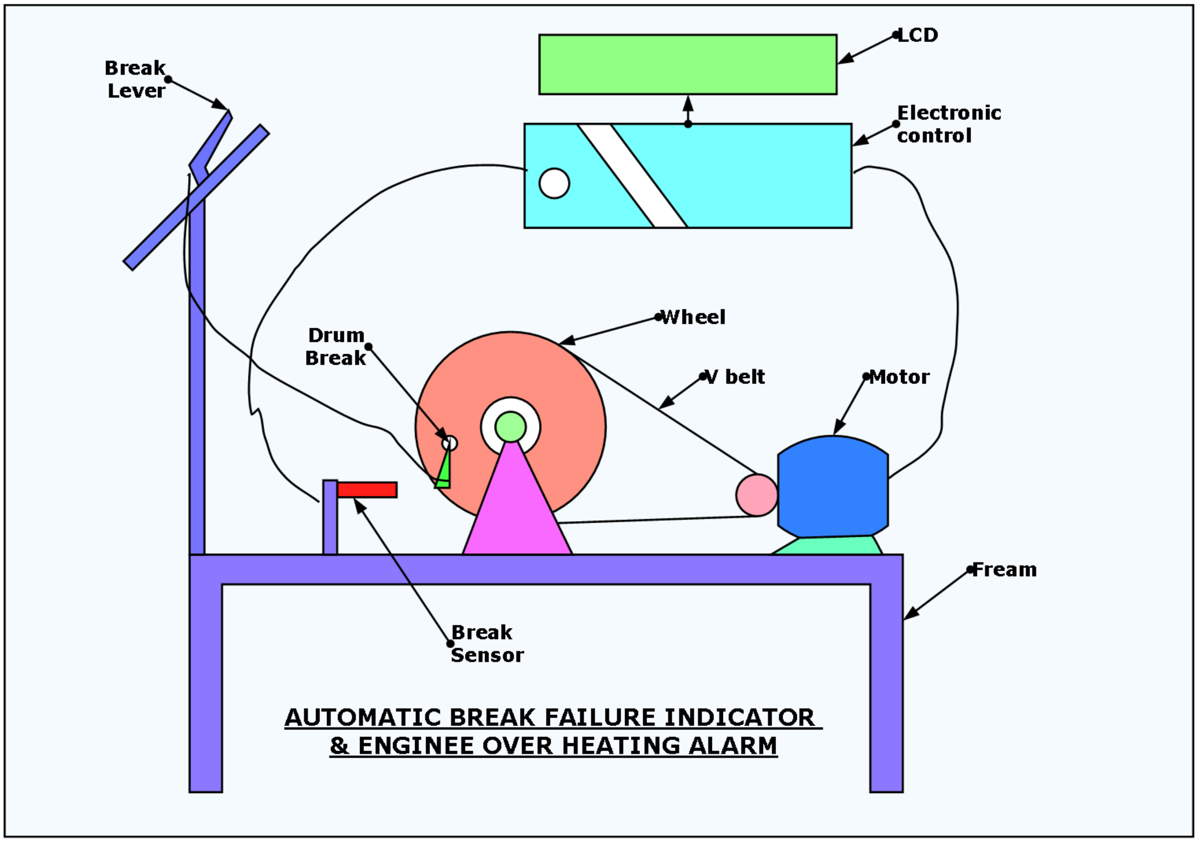
Thermistors are of two opposite fundamental types:

- With **NTC** thermistors, resistance ***decreases*** as temperature rises. An NTC is commonly used as a temperature sensor, or in series with a circuit as an inrush current limiter.
- With **PTC** thermistors, resistance ***increases*** as temperature rises. PTC thermistors are commonly installed in series with a circuit, and used to protect against *overcurrent* conditions, as resettable fuses.

Thermistors are generally produced using powdered metal oxides. [1] With vastly improved formulas and techniques over the past 20 years, NTC thermistors can now achieve accuracies over wide temperature ranges such as ±0.1 °C or ±0.2 °C from 0 °C to 70 °C with excellent long-term stability. NTC thermistor elements come in many styles such as axial-leaded glass-encapsulated (DO-35, DO-34 and DO-41 diodes), glass-coated chips, epoxy-coated with bare or insulated lead wire and surface-mount, as well as rods and discs. The typical operating temperature range of a thermistor is −55 °C to +150 °C, though some glass-body thermistors have a maximal operating temperature of +300 °C.

Thermistors differ from resistance temperature detectors (RTDs) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a greater precision within a limited temperature range, typically −90 °C to 130 °C.

BASIC DESIGN



FUTURE SCOPE

The brake failure indicator circuit is designed for avoiding accidents due to brake failure. If you can grasp the necessary force and the durability that brakes require to stop tones of moving metal, you can understand how brake malfunctions can occur. So many things can cause brake failure. There are something that we all take for granted, the brake on our vehicles. It is very unusual for a vehicle to suffer total failure of¬ the braking system. Though it has so many limitations, this equipment is very effective to detect brake failure and it will find great scope in future.

CONCLUSION

We are proud to express our delight as the project we embarked upon is successfully finished within the target date. The project gave us more confidence that we will be able to put in practice, whatever theoretical knowledge. We gained during our course of study till now. If really persuades us to do more and more, perhaps in better way in our future. Brake failure indicator is an early warning system. It constantly monitors the condition of the brake and gives audio visual indication.

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