

## 3-Phase Ac Motor Monitoring and Parameter Calculation Using Labview and Daq

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### ABSTRACT

3-phase AC motor monitoring and parameter calculation using lab VIEW is the project which makes use of lab VIEW to monitor and control operation of the electrical machine. The real time variables of electrical machine are measured and given to lab VIEW through DAQ. Lab VIEW allows us to program as per our requirements. We continuously observe the operating voltage and current of the motor and trip the circuit if the motor exceeds a safe value. A comparison has been made such that the voltage or current above safe value would turn on an LED emitting red light. When the light glows, a digital signal of 5V is generated at the selected line on DAQ. This 5V is drawn into the relay arrangement, which is used to energized itself and trip the contact, hence isolating the machine from the main supply.s A Data Acquisition Card (DAQ) is used to perform the core of the control action by switching on the relay. The DAQ, USB 6009 is selected for this project. In order to provide precise input voltages to the DAQ, such that change in each volt of voltage or amp of current is observable; the current is read to the DAQ through current sensor. A suitable logic using is written into the DAQ in the Lab VIEW. Observing the voltages that are obtained from the step down transformer the relay is operated. When the voltage or current exceeds its operating range the relay is operated

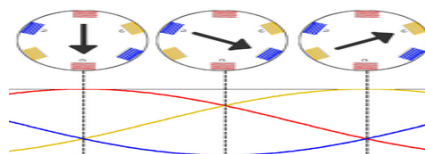
**KEYWORDS:** 3-Ph Motor, LabView, DAQ, Voltage, Current

## I. INTRODUCTION

### 1.1: INTRODUCTION TO 3-PHASE MOTOR

An electric motor is a device which converts an electric energy into a mechanical energy. This mechanical energy then can be supplied to various types of load the motors can operate on dc as well as single and 3 phase ac supply. The motors operating on dc supply are called dc motors while motors operating on ac supply are called ac motors. As ac supply is commonly available, the ac motors are popularly used in practice. The ac motors are classified as single and 3 phase induction motors, synchronous motor and some special purpose motors. Out of all these types 3 phase induction motors are widely used various industrial applications. The important advantages of 3 phase induction motors over other types are self starting property, no need of starting device, high power factor, good speed regulation and robotics construction. The working principle of 3 phase induction is based on the production of rotating magnetic field.

### 1.3. PRINCIPLE OF OPERATION



**Fig: 1.1.Rotating Magnetic Field**

A three-phase power supply provides a rotating magnetic field in an induction motor. In both induction and synchronous motors, the AC power supplied to the motor's stator creates a magnetic field that rotates in time with the AC oscillations. Whereas a synchronous motor's rotor turns at the same rate as the stator field, an induction motor's rotor rotates at a slower speed than the stator field. The induction motor stator's magnetic field is therefore changing or rotating relative to the rotor. This induces an opposing current in the induction motor's rotor, in effect the motor's secondary winding, when the latter is short-circuited or closed through an external impedance. The rotating magnetic flux induces currents in the windings of the rotor; in a manner similar to currents induced in transformer's secondary windings. These currents in turn create magnetic fields in the rotor that react against the stator field. Due to Lenz's Law, the direction of the magnetic field created will be such as to oppose the change in current through the windings. The cause of induced current in the rotor is the rotating stator magnetic field, so to oppose this the rotor will start to rotate in the direction of the rotating stator magnetic field. The rotor accelerates until the magnitude of induced rotor current and torque balances the applied load. Since rotation at synchronous speed would result in no induced rotor current, an induction motor always operates slower than synchronous speed. The difference between actual and synchronous speed or slip varies from about 0.5 to 5% for standard Design B torque curve induction motors. The induction machine's essential character is that it is created solely by induction instead of being separately excited as in synchronous or DC machines or being self-magnetized as in permanent magnet motors.

For these currents to be induced, the speed of the physical rotor must be lower than that of the stator's rotating magnetic field ( $n_s$ ), or the magnetic field would not be moving relative to the rotor conductors and no currents would be induced. As the speed of the rotor drops below synchronous speed, the rotation rate of the magnetic field in the rotor increases, inducing more current in the windings and creating more torque. The ratio between the rotation rate of the magnetic field as seen by the rotor (slip speed) and the rotation rate of the stator's rotating field is called slip. Under load, the speed drops and the slip increases enough to create sufficient torque to turn the load. For this reason, induction motors are sometimes referred to as asynchronous motors. An induction motor can be used as an induction generator, or it can be unrolled to form the linear induction motor which can directly generate linear motion.

#### 1.4. NEED FOR MONITORING

Monitoring of ac motor is necessary for operating efficiently. There are many undesirable things that happen to electric motors and other electrical equipment as a result of operating a power system in an over voltage manner. Operating a motor beyond its nominal range of its voltage requirements will reduce its efficiency and cause premature failure. The economic loss from premature motor failure can be devastating. In most cases, the price of the motor itself is trivial compared to the cost of unscheduled shutdowns of the process. Both high and low voltages can cause premature motor failure, as well as voltage imbalance.

So the best life and most efficient operation occur when motors are operated at voltages close to the nameplate ratings. Monitoring of ac motor provides not only reducing the cost of the electricity bill, but also extending the life of the electrical motors while Preventing unexpected failures.

## II. EFFECTS OF HIGH VOLTAGE

For example, many motors are rated at 220/230 volts and had a tolerance band of plus/minus 10%. Thus, the actual voltage range that they can tolerate on the high voltage connections would be at least 207 volts to 253 volts. Even though this is the so-called tolerance band, the best performance of larger motors would occur at or near the rated voltage. The extreme ends, either high or low, would be putting unnecessary stress on the motor. Generally speaking, these voltage tolerance ranges are in existence, not to set a standard that can be used all the time, but rather to set a range that can be used to accommodate the normal hour-to-hour swings in received voltage. An operation of a motor on a continuous basis at either the high extreme or the low extreme will shorten the life of the motor. Although this paper covers the effects of high and low voltage on motors, the operation of other magnetic devices is often affected in similar ways. Solenoids and coils used in relays and starters are punished by high voltage more than they are by low voltage. This is also true of ballasts in fluorescent, mercury, and high pressure sodium light fixtures. Transformers of all types, including welding transformers, are damaged in the same way. Incandescent lights are especially susceptible to high voltage conditions. A 5% increase in voltage results in a 50% reduction in bulb life. A 10% increase in voltage above the rating reduces incandescent bulb life by 70%. Overall, it is definitely in the equipment's best interest to have incoming voltage close to the equipment ratings. High voltage will always tend to reduce power factor and increase the losses in the system which results in higher operating costs for the equipment and the system.

### III. LOW VOLTAGE

When electric motors are subjected to voltages below the nameplate rating, some of the characteristics will change slightly and others will change more dramatically. A basic point to note is that to drive a fixed mechanical load connected to the shaft, a motor must draw a fixed amount of power from the power line. The amount of power the motor draws is roughly related to the voltage x current (amps). Thus, when Voltage gets low, the current must get higher to provide the same amount of power. The fact that current gets higher is not alarming unless it exceeds the nameplate current rating of the motor. When amps go above the nameplate rating, it is safe to assume that the buildup of heat within the motor will become damaging if it is left unchecked. If a motor is lightly loaded and the voltage drops, the current will increase in roughly the same proportion that the voltage decreases. For example, say a 10% voltage decrease would cause a 10% amperage increase. This would not be damaging if the motor current stays below the nameplate value. However, if a motor is heavily loaded and a voltage reduction occurs, the current would go up from an already fairly high value to a new value which might be in excess of the full load rated amps. This could be damaging. It can thus be safely said that low voltage in itself is not a problem unless the motor amperage is pushed beyond the nameplate rating. That is it must be controlled in a safe range. Aside from the possibility of over-temperature and shortened lifespan created by low voltage, some other important items need to be understood. The first is that the starting torque, pull-up torque, and pull-out torque of induction motors, all change based on the applied voltage squared. Thus, a 10% reduction from nameplate voltage (100% to 90%, 230 volts to 207 volts) would reduce the starting torque, pull-up torque, and pull-out torque by a factor of  $.9 \times .9$ . The resulting values would be 81% of the full voltage values. At 80% voltage, the result would be  $.8 \times .8$ , or a value of 64% of the full voltage value. In this case, it is easy to see why it would be difficult to start "hard-to-start" loads if the voltage happens to be low. Similarly the motor's pull-out torque would be much lower than it would be under normal voltage conditions. **To summarise:** low voltage can cause high currents and overheating which will subsequently shorten motor life. Too low voltage can also reduce the motor's ability to get started and its values of pull-up and pull-out torque. On lightly loaded motors with easy-to-start loads, reducing the voltage will not have any appreciable effect except that it might help reduce the light load losses and improve the efficiency under this condition.

### IV. OVER CURRENT IN AC MOTOR

Over current is a condition in electronics when too much current is running through an electrical circuit. This problem is relatively common in the electrical engineering field. Over current protection is one of the essential elements of a proper electrical installation. The problem has many symptoms and can eventually lead to permanent damage to the motor or electrical device. A few of the symptoms of over current in a motor are shorts, blown fuses and unintended switching on and off of the motor. An over current exists when the normal load current for a circuit is exceeded. It can be in the form of an overload or short circuit. When applied to motor circuits an overload is any current, flowing within the normal circuit path that is higher than the motor's normal Full Load Amps (FLA). A short-circuit is an Over current which greatly exceeds the normal full load current of the circuit. Also, as its name infers, a short-circuit leaves the normal current carrying path of the circuit and takes a "short cut" around the load and back to the power source. Motors can be damaged by both types of currents. Single-phasing, overworking and locked rotor conditions are just a few of the situations that can be protected against with the careful choice of protective devices. If left unprotected, motors will continue to operate even under abnormal conditions. The excessive current causes the motor to overheat, which in turn causes the motor winding insulation to deteriorate and ultimately fail. Good motor overload protection can greatly extend the useful life of a motor. Because of a motor's characteristics, many common over current devices actually offer limited or no protection.

#### 4.1. PROBLEM DEFINITION

The aim of the paper is to monitor the 3 phase ac motor so that when over voltages or under voltage and over current or under current occur in motor, the motor can disconnects from the supply. The problem is that there are many undesirable things that happen to electric motors and other electrical equipment as a result of operating a power system in an over voltage manner. Operating a motor beyond its nominal range of its voltage requirements will reduce its efficiency and cause premature failure. The problem with low voltage in motor can cause high currents and overheating which will subsequently shorten motor life. Too low voltage can also reduce the motor's ability to get started and its values of pull-up and pull-out torque. The problem with over current in motor has many symptoms and can eventually lead to permanent damage to the motor or electrical device. A few of the symptoms of overcurrent in a motor are shorts, blown fuses and unintended switching on and off of the motor. The problems with over voltage, under voltage and over current can overcome by monitoring ac motor using NI-LabVIEW and DAQ.

**4.2.HOW 3-PHASE AC MOTOR IS MONITORING**

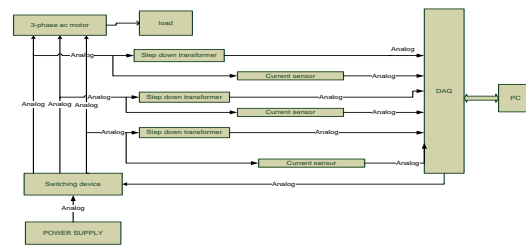
The monitoring is done by monitoring the parameters of the motor. These parameters include voltage, current, speed. The motor is disconnected if the voltage exceeds its operating range. Each phase of the ac motor is connected to the step-down transformer in order to step-down the voltage. The output of the step-down transformer from each phase is connected to the voltage and current transducer (sensor). These voltage and current transducer senses the voltage and currents which are act as input to the DAQ and it is connected to a PC. By programming in PC using GUI, a relay is operated to disconnect the motor if the output voltage is out of range.

**V. SYSTEM SPECIFICATIONS**

**5.1.BLOCK DIAGRAM**



**Fig 1.2: Monitoring of motor using DAQ Motor Monitoring**

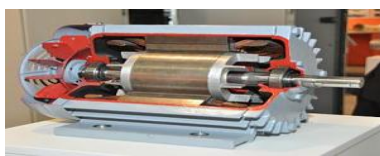


**Fig 2.1: Block Diagram of 3 Phase Ac**

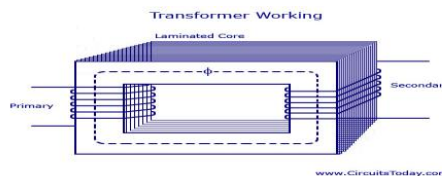
**5.2. DESCRIPTION**

**5.3.PHASE AC MOTOR**

An **induction** or **asynchronous motor** is an AC motor in which all electromagnetic energy is transferred by inductive coupling from a primary winding to a secondary winding, the two windings being separated by an air gap. In three-phase induction motors, that are inherently self-starting, energy transfer is usually from the stator to either a wound rotor or a short-circuited squirrel cage rotor. Three-phase cage rotor induction motors are widely used in industrial drives because they are rugged, reliable and economical. Single-phase induction motors are also used extensively for smaller loads. Although most AC motors have long been used in fixed-speed load drive service, they are increasingly being used in variable-frequency drive (VFD) service, variable-torque centrifugal fan, pump and compressor loads being by far the most important energy saving applications for VFD service. Squirrel cage induction motors are most commonly used in both fixed-speed and VFD applications.



**Fig 2.2:3-Phase Ac Motor**



**Fig 2.3: Stepdown Transformer**

**5.4.CURRENT SENSOR**

**Components used in designing the circuit**  
**Hall Effect Base Linear Current Sensor**

**5.5.Functional Description**

The Winsor WCS2720 provides economical and precise solution for both DC and AC current sensing in industrial, commercial and communications systems. The unique package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, over-current fault detection and any intelligent power management system etc...

The WCS2720 consists of a precise, low-temperature drift linear hall sensor IC with temperature compensation circuit and a current path with 0.4 mΩ typical internal conductor resistance. This extremely low resistance can effectively reduce power loss, operating temperature and increase the reliability greatly. Applied current flowing through this conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. The terminals of the conductive path are electrically isolated from the sensor leads. This allows the WCS2720 current sensor to be used in applications requiring electrical isolation without the use of opto-isolators or other costly isolation techniques and make system more competitive in cost.

## FUNCTIONAL BLOCK

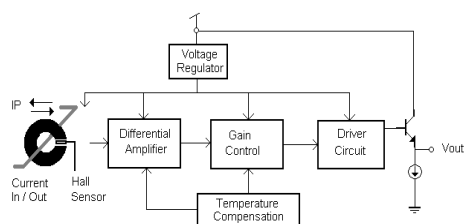


Fig: 2.4. Functional Block Of Current Sensor

## PIN CONFIGURATION AND RATINGS

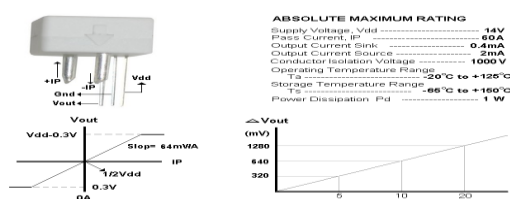


Fig: 2.5. V-I Characteristics Of Current Sensor

## 5.6.DAQ (NI USB – 6009)

DAQ is data acquisition. It is device which contains both ADC & DAC in it. It is interface between analog output of sensor and the PC. The data traditional experiments in it signal from sensors are sent to analog or digital domain, read by experimenter, and recorded by hand. In automated data acquisition systems the sensors transmit a voltage or current signal directly to a computer via data acquisition board. Software such as Lab VIEW controls the acquisition and processing of such data. Here we have to consider the following properties of the input signal.

1. Sampling rate
2. Resolution
3. Range
4. Amplification

Here the DAQ being used is NI USB – 6009.

### NI USB – 6009

#### Features

- 8 analog inputs (14-bit, 48 kS/s)
- 2 analog outputs (12-bit, 150 S/s); 12 digital I/O; 32-bit counter
- Bus-powered for high mobility; built-in signal connectivity
- Compatible with LabVIEW, LabWindows/CVI, and Measurement Studio for Visual Studio .NET

#### Description

The NI USB – 6009 provides connection to eight single-ended analog input (AI) channels, two analog output (AO) channels, 12 digital input/output (DIO) channels, and a 32-bit counter with a full-speed USB interface. The National Instruments USB-6009 provides basic data acquisition functionality for applications such as simple data logging, portable measurements, and academic lab experiments. It is affordable for student use and powerful enough for more sophisticated measurement applications.

Block Diagram

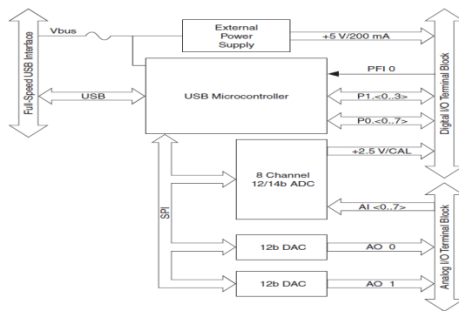


Fig: 2.6. Block Diagram of DAQ

PIN Diagram

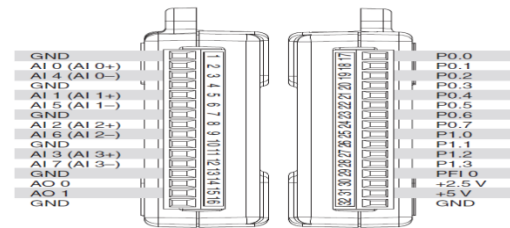


Fig: 2.7. Pin Diagram

## Of DAQ

### COMPUTER (Lab VIEW)

NI Lab VIEW is software where all the code is implemented and interfacing of DAQ is done.

Lab VIEW is a graphical programming environment used by millions of engineers and scientists to develop sophisticated measurement, test, and control systems using intuitive graphical icons and wires that resemble a flowchart. It offers unrivaled integration with thousands of hardware devices and provides hundreds of built-in libraries for advanced analysis and data visualization – all for creating virtual instrumentation. The Lab VIEW platform is scalable across multiple targets and OSs, and, since its introduction in 1986, it has become an industry leader. The programming that is done in this Lab VIEW software is mainly **Graphical Programming** that is Program with drag-and-drop, graphical function blocks instead of writing lines of text. The representation is mainly **Dataflow Representation** which is easily developed, maintain, and understand code with an intuitive flowchart representation.

Lab VIEW is the center piece of graphical system design and provides engineers and scientists with the tools you need to create and deploy measurement and control systems. You can get more done in less time with Lab VIEW through its unique graphical programming environment; built-in engineering-specific libraries of software functions and hardware interfaces; and data analysis, visualization, and sharing features. You can bring your vision to life with Lab VIEW. Through a world-class ecosystem of partners and technology alliances, a global and active user community, and consistent annual releases, you can have the confidence to continually innovate. Lab VIEW makes complex control simple and accessible.

Lab VIEW makes us better because code reuse saves time and effort because one of the most efficient ways to shorten development time is through code reuse. By taking advantage of existing code, whether it has already been written or is part of a resource library, developers and domain experts can focus on their applications rather than committing valuable time and resources to programming. Lab VIEW is an ideal platform for prototyping, designing, and deploying high-quality products to market fast. You can use one development environment to quickly iterate on your embedded hardware and software designs and then reuse the best parts in a final product.

## VI. SYSTEM DESIGN

### 6.1.HARDWARE

Designing of this system is possible when you select the specific device and software to suite. For this we selected NI USB – 6009, DAQ device and NI LabVIEW software. With the help of these, 3-phase ac motor monitoring can be implemented successfully with the help of sensor technology. To the DAQ we connected sensor circuit. Whenever the motor getting started, sensors detect the voltage and current of the ac motor and sends the signal to computer (LabVIEW) through DAQ device. Based on the voltage and current(Low, Medium and High), the motor operated through relay circuit.



key in keyboard shortcuts corresponds to the (**Mac OS X**) <Option> or <Command> key or (**Linux**) <Alt> key.

6. Select **Window»Show Block Diagram** and examine the block diagram of the VI. The block diagram appears with a white background and includes VIs and structures that control the front panel objects. The title bar of the block diagram indicates that this window is the block diagram for the Generate and Display VI.
7. On the front panel toolbar, click the **Run** button, shown at left. We also can press the <Ctrl-R> keys to run a VI. A sine wave appears on the graph in the front panel window.



8. Stop the VI by clicking the front panel **STOP** button, shown at left.

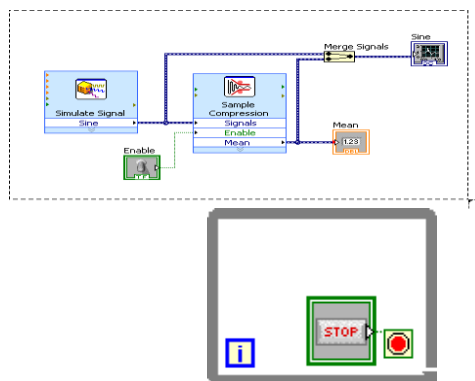


### Configuring a VI to Run Continuously until the User Stops It

In the current state, the VI runs once, generates one signal, and then stops running. To run the VI until a condition occurs, We can use a While Loop.

Complete the following steps to add a While Loop to the block diagram.

- [1] Display the front panel and run the VI. The VI runs once and then stops. The front panel does not have a stop button.
- [2] Display the block diagram.
- [3] Click the **Search** button, shown at left, on the **Functions** palette, and enter while in the text box. LabVIEW searches as we type the first few letters and display any matches in the search results text box. If there are objects with the same name, use the information in the brackets to the right of each object name to decide which object to select. Some objects are located on multiple palettes because we can use them for multiple applications.
- [4] Double-click **While Loop** <<Execution Control>> to display the **Execution Control** subpalette and temporarily highlight the While Loop on the subpalette.
- [5] Select the While Loop on the **Execution Control** palette.
- [6] Move the cursor to the upper left corner of the block diagram. Click and drag the cursor diagonally to enclose all the Express VIs and wires, as shown in Figure.
- [7] Release the mouse to place the While Loop around the Express VIs and wires.
- [8] The While Loop, shown at left, appears with a **STOP** button wired to the conditional terminal. This While Loop is configured to stop when the user clicks the **STOP** button.
- [9] Display the front panel and run the VI. The VI now runs until you click the **STOP** button. A While Loop executes the VIs and functions inside the loop until the user clicks the **STOP** button.
- [10] Click the **STOP** button and save the VI.



**Fig 3.3: Working Of Stop Button**

### Controlling the Speed of Execution of a VI loop

To plot the points on the waveform graph more slowly, we can add a time delay to the block diagram.

Complete the following steps to control the speed at which the VI runs.



- [1] On the block diagram, search for the Time Delay Express VI, shown at left, on the **Functions** palette and place it inside the While Loop. We can use the Time Delay Express VI to control the execution rate of the VI.
- [2] Enter 0.25 in the **Time delay (seconds)** text box. This time delay specifies how fast the loop runs. With a 0.25 second time delay, the loop iterates once every quarter of a second.
- [3] Click the **OK** button to save the current configuration and close the **Configure Time Delay** dialog box.
- [4] Display the front panel and run the VI.
- [5] Click the **Enable** switch and examine the change on the graph. If the **Enable** switch is on, the graph displays the reduced signal. If the **Enable** switch is off, the graph does not display the reduced signal.
- [6] Click the **STOP** button to stop the VI.

### Acquiring a Signal in NI-DAQmx

We will use the DAQ Assistant Express VI to create a task in NI-DAQmx. NI-DAQmx is a programming interface we can use to communicate with data acquisition devices. Refer to the **Getting Started with LabVIEW» Getting Started with DAQ» Taking an NI-DAQmx Measurement in LabVIEW** book on the **Contents** tab in the *LabVIEW Help* for information about additional ways to create NI-DAQmx tasks. In the following exercises, we will create an NI-DAQmx task that continuously takes a voltage reading and plots the data on a waveform graph.

### Creating an NI-DAQmx Task

In NI-DAQmx, a task is a collection of one or more channels, which contains timing, triggering, and other properties. Conceptually, a task represents a measurement or generation you want to perform. For example, we can create a task to measure temperature from one or more channels on a DAQ device.

Complete the following steps to create and configure a task that reads a voltage level from a DAQ device.

- [1] Open a new, blank VI.
- [2] On the block diagram, display the **Functions** palette and select **Express»Input** to display the **Input** palette.
- [3] Select the DAQ Assistant Express VI, shown at left, on the **Input** palette and place it on the block diagram. The DAQ Assistant launches and the **Create New Express Task** dialog box appears.
- [4] Click **Acquire Signals»Analog Input** to display the **Analog Input** options.
- [5] Select **Voltage** to create a new voltage analog input task. The dialog box displays a list of channels on each installed DAQ device. The number of channels listed depends on the number of channels you have on the DAQ device.
- [6] In the **Supported Physical Channels** list, select the physical channel to which the device connects the signal, such as **ai0**, and then click the **Finish** button. The DAQ Assistant opens a new dialog box, shown in Figure 4-1 that displays options for configuring the channel you selected to complete a task.
- [7]



Fig 3.4: DAQ Assistant

### Graphing Data from a DAQ Device

We can use the task you created in the previous exercise to graph the data acquired from a DAQ device. Complete the following steps to plot the data from the channel on a waveform graph and change the name of the signal.

- [1] On the block diagram, right-click the **data** output and select **Create» Graph Indicator** from the shortcut menu.
- [2] Display the front panel and run the VI three or four times. Observe the waveform graph. **Voltage** appears in the plot legend at the top of the waveform graph.
- [3] On the block diagram, right-click the DAQ Assistant Express VI and select **Properties** from the shortcut menu to open the DAQ Assistant.
- [4] Right-click **Voltage** in the list of channels and select **Rename** from the shortcut menu to display the **Rename a channel or channels** dialog box. You also can select the name of the channel and press the <F2> key to display the **Rename a channel or channels** dialog box.
- [5] In the **New Name** text box, enter First Voltage Reading, and click the **OK** button.

- [6] In the **DAQ Assistant** dialog box, click the **OK** button to save the current configuration and close the DAQ Assistant.
- [7] Display the front panel and run the VI. **First Voltage Reading** appears in the waveform graph plot legend.
- [8] Save the VI.
- [9] Editing an NI-DAQmx Task**
- i. You can add a channel to the task so you can compare two separate voltage readings.
- [10] You also can customize the task to acquire the voltage readings continuously.
- [11] Complete the following steps to add a new channel to the task and acquire data continuously.
1. In the block diagram window, double-click the DAQ Assistant Express VI to open the DAQ Assistant.
  2. Click the **Add Channels** button, shown at left, and select **Voltage** to display the **Add Channels To Task** dialog box.
  3. Select any unused physical channel in the **Supported Physical Channels** list, and click the **OK** button to return to the DAQ Assistant.
  4. Rename the channel Second Voltage Reading.
  5. In the **Timing Settings** section of the **Configuration** page, select **Continuous Samples** from the **Acquisition Mode** pull-down menu. When you set timing and triggering options in the DAQ Assistant, these options apply to all the channels in the list of channels.
  6. Click the **OK** button to save the current configuration and close the DAQ Assistant. The **Confirm Auto Loop Creation** dialog box appears.
  7. Click the **Yes** button. LabVIEW places a While Loop around the DAQ Assistant Express VI and the graph indicator on the block diagram. A stop button appears wired to the **stop** input of the DAQ Assistant Express VI. The **stopped** output of the Express VI is wired to the conditional terminal of the While Loop. The block diagram should appear similar to Figure.

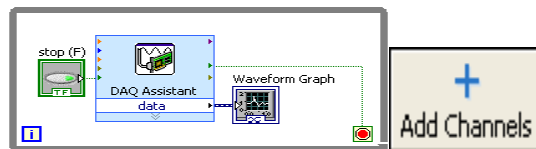
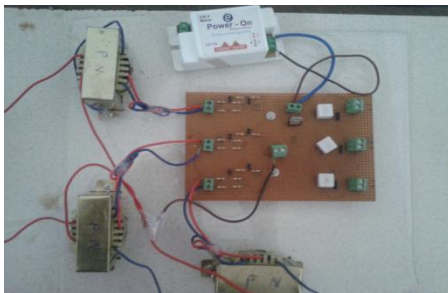


Fig 3.5: Block Diagram Of The Read Voltage VI

8. If an error occurs or you click the **stop** button while the VI is running, the DAQ Assistant Express VI stops reading data and the **stopped** output returns a TRUE value and stops the While Loop.

### IMPLEMENTATION, TESTING & RESULTS

- Connect the step down transformers for each phase of the 3-phase ac motor. For the convenient daq ratings with maximum 10v, the suitable step down transformer or the step down transformer with voltage divider can be used.



Screen 1: Circuit Of The Project

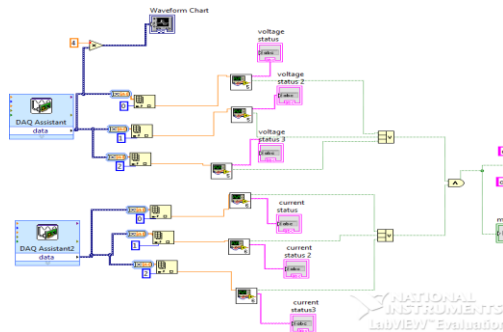


Screen 2: Pins Of DAQ

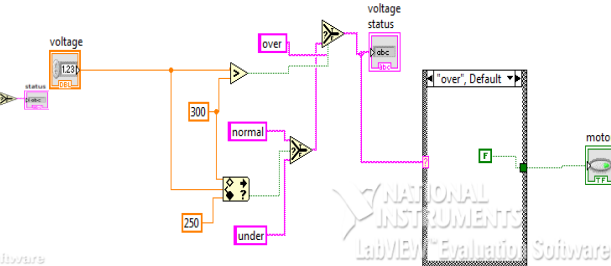
- Connect the current sensors in series with the each phase of the 3- phase ac motor.
- Place the IC for supplying constant 5v to energise the current sensor.
- All those arrangements placed on the pcb for convenient purpose.
- Connections are made to DAQ as shown in the hardware schematic. Use a common pin for ground and +5V supply.
- Connections should be made carefully such that there is no interference of connections in between.

**PROGRAMMING**

- LabVIEW is a graphical user interface language where we can drag and drop the code instead of writing
- The code design for this project is shown below.

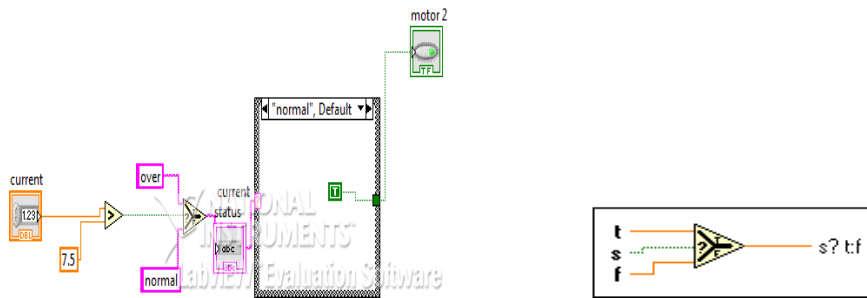


**Fig4.1: VI of 3-Phase Ac Motor**



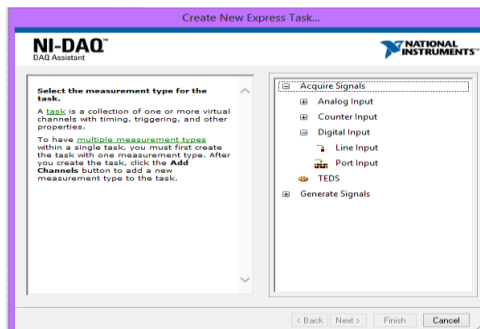
**Fig4.2: Sub VI for Voltage Monitoring Of Motor**

- Sub VI for calculate voltage used in the above code is shown below
- Sub VI for calculate current used in the above code is shown below

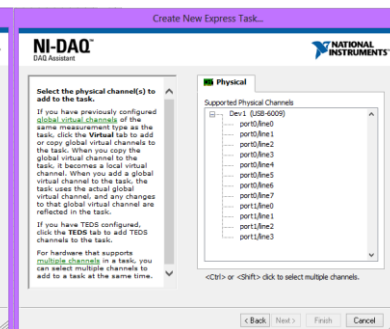


**Fig 4.3: Sub VI for Current Monitoring**

- Several functions used in the above code are
  - **Select function:** Returns the value wired to the **t** input or **f** input, depending on the value of **s**. If **s** is TRUE, this function returns the value wired to **t**. If **s** is FALSE, this function returns the value wired to **f**. The connector pane displays the default data types for this polymorphic function.



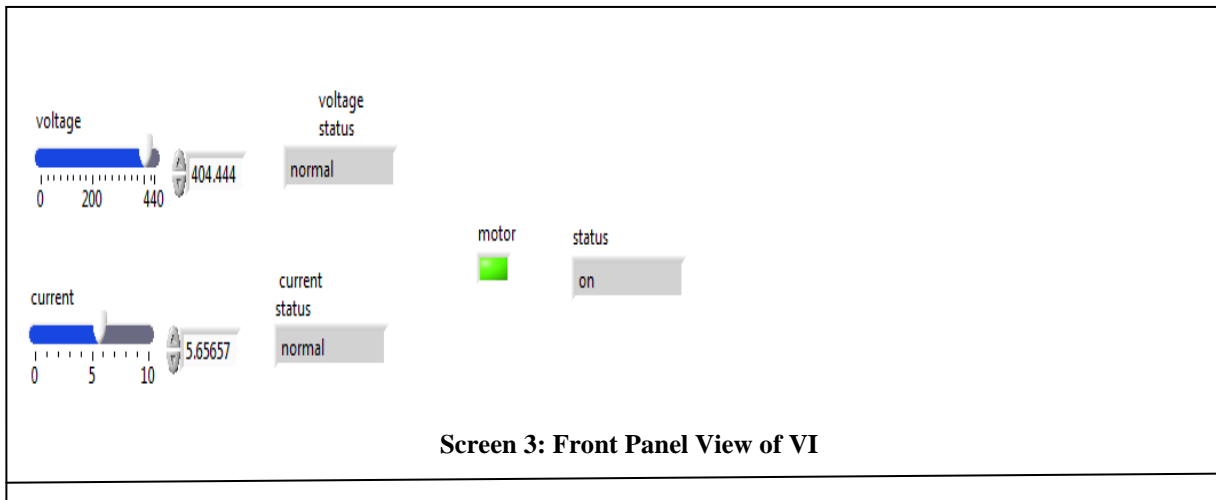
**Fig 4.7: Acquiring signals through DAQ**



**Fig 4.8: Selection of Ports in DAQ**

- [1] On the first screen, select **Acquire Signals** and then **Digital Input** for the Measurement Type.
- [2] Next, select **line input**.
- [3] The next screen lets the user to select the physical channel (or channels) for which the task is being created. All supported data acquisition hardware devices should appear in the tree control, and the user can expand them to view a list of the physical channels that can be selected for the task. To select more than one channel, hold down the Ctrl button while clicking on the channel names.

- [4] Click **Finish** to move on to the configuration stage.  
 After interfacing is done click run to run the program. The front panel of the LabVIEW will be used to display the status of the motor.

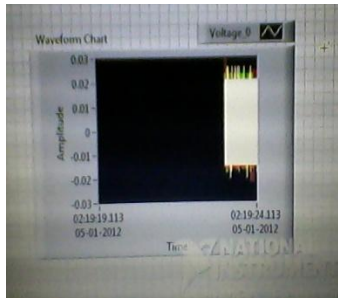


Screen 3: Front Panel View of VI

Screen 4.4: System Testing

**RESULTS**

Results include the successful operation of 3 phase Ac motor monitoring and parameter calculation. Whenever the motor exceeds its ratings the pc detects and the signal is acquired by the DAQ. Based on the voltage and current rating i.e., low, medium, and high, voltage and current rating is set.



Screen 4.5: Waveform of voltage of output VI of 3-phase ac motor

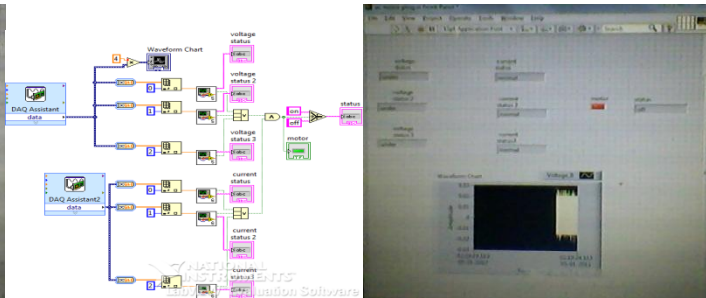
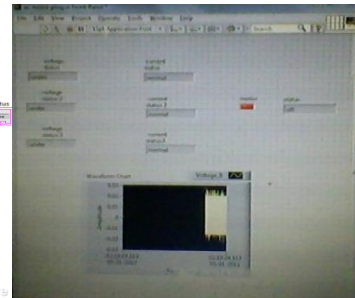


Fig 4.9: Motor VI with DAQ assistance



Screen 4.6: Front panel of output VI of 3-phase ac motor

**VII. CONCLUSION AND FUTURE SCOPE**

**7.1.CONCLUSION**

The protection of 3-phase ac motor is largely dependent on the modern ways of power supply and control. Advanced power technologies and control system contribute to the improvement of the motor efficiency. we designed a system by which the motor voltage and current controlled automatically based upon the supply. If motor exceeds its rating the motor will shut down automatically by switching the relay. So it protect the motor from the damage. So the motor gives good efficiency and efficient voltage and current waveforms. So it saves money and time.

By comparing with normal operation of motor it will measure all the parameters easily and efficiently. It will helpful to the industrial management.

**7.2.FUTURE SCOPE**

The 3 phase Ac motor monitoring system should be programmed and necessary circuitry added to operate the motor in normal condition. The monitoring of 3 phase ac motor can be used in industrial purpose. The control of ac motor is necessary for the continuous operation of motor. FEEDBACK CONTROL LOOPS are implemented to increase dynamical performance or precision of scientific and industrial equipment. The basic principle of such loops is to take into account actual measurements in order to compute appropriate actuations that adjust the operational conditions to meet given requirements. Motion control and process control

are two major application areas of this paradigm. Due to this broad application field and its interdisciplinary nature, Automatic Control is a fundamental subject usually taught in many engineering disciplines, such as electrical, mechanical and chemical engineering. Implementing a complete control solution from scratch requires knowledge not only of the matter studied but also of the different technologies needed to interface the real process such as sensors and actuators, to the computer used to conduct the experiment.

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