# DATA ACQUISITION SYSTEM FOR GENERATOR TEST RIG

**By**

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**Submitted in partial fulfillment of the Degree of Bachelor of Technology**

**DEPARTMENT OF ELECTRONICS & COMMUNICATION**
**JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY – WAKNAGHAT**

NEOMETRIX

*The Complete Engineering Solutions Company*

NATIONAL INSTRUMENTS Alliance MEMBER

20/5/2006

## Training Certificate

This is to certify that Mr. Aman Bhatia final year B. Tech. student from Jaypee University of Information Technology worked with Neometrix on "Data Acquisition Systems for Generator Test Rig" project from 1st March 2006 to 20th May 2006.

During this period he worked on development of Electronic/Instrumentation part of this project using:

1. NI DAQ Card and connector.
2. Various Electrical Transducers like power, voltage, current, frequency, pressure, torque etc.
3. Signal Conditioning device for interface between PC and Data Acquisition Hardware.

During the training period he was regular and serious towards this project. We wish him all the best for his future.

Shailendra Pratap Singh
CEO
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# CERTIFICATE

This is to certify that the work entitled, " **Data Acquisition System For Generator Test Rig**" Submitted by Aman Bhatia (021028), in partial fulfillment for the award of degree of Bachelor of Technology in May 2006 of Jaypee University of Information Technology has been carried out under my supervision in Neometrix Technology Pvt.Ltd. This work has not been submitted partially or wholly to any other University or Institute for the award of this or any other degree or diploma.

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# ACKNOWLEDGEMENT

The industrial project "**Data Acquisition System For Generator Test Rig**" started successfully with the help of many individuals who provided their full support and helped as and when needed at each and every steps. Without the help of Mr. G.N.Srivastava and Mr. Vivek Sehgal, this project was no where to stand.

# TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF ABBREVIATIONS

| | |
|---|---|
| DAQ | Data Acquisition System |
| DC | Direct Current |
| AC | Alternative Current |
| NI | National Instruments |
| VI | Virtual Instrumentation |
| TTL | Transistor Transistor Logic |
| PCI | Peripheral Computer Interface |
| PC | Personal Computer |

# ABSTRACT

Data Acquisition Systems are intended to provide flexible, user-defined measurement system by using combination of PC-based measurement hardware and software. NI data acquisition hardware and software can be used for very simple or highly sophisticated applications. In this project the data acquisition system is designed for monitoring various parameters of Generator through PC based Automation.

# CHAPTER 1

## INTRODUCTION

Data acquisition is the process of gathering information in an automated fashion from analog and digital measurement sources such as sensors and devices under test. Data acquisition uses a combination of PC-based measurement hardware and software to provide a flexible, user-defined Measurement system as shown in **Fig 1.**

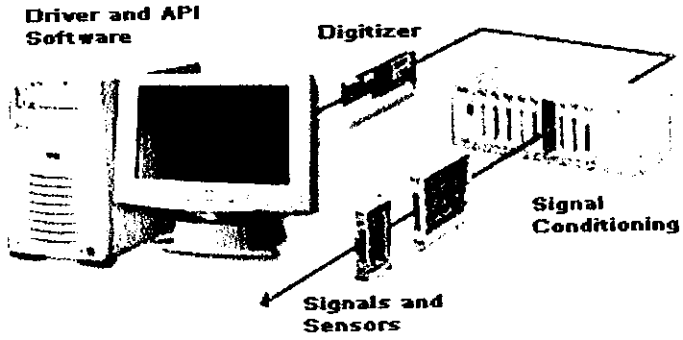



**Figure 1. Data Acquisition System**

## 1.1 Overview of Data Acquisition System

Data acquisition involves gathering signals from measurement sources and digitizing the signal for storage, analysis, and presentation on a personal computer. Data acquisition systems come in many different PC technology forms for great flexibility when choosing your system. Scientists and engineers can choose from PCI, PXI, CompactPCI, PCMCIA, USB, Firewire, parallel, or serial ports for data acquisition in test, measurement, and automation applications. There are five components to be considered when building a basic DAQ system:

- Transducers and sensors
- Signals
- Signal conditioning
- DAQ hardware
- Driver and application software

## 1.2 Transducers and Sensors

Data acquisition begins with the physical phenomenon to be measured. This physical phenomenon could be the temperature of a room, the intensity of a light source, the pressure inside a chamber, the force applied to an object, or many other things. An effective DAQ system can measure all of these different phenomena.

A transducer is a device that converts a physical phenomenon into a measurable electrical signal, such as voltage or current. The ability of a DAQ system to measure different phenomena depends on the transducers to convert the physical phenomena into signals measurable by the DAQ hardware. Transducers are synonymous with sensors in DAQ systems. There are specific transducers for many different applications, such as measuring temperature, pressure, or fluid flow. The following table shows a short list of some common transducers and the phenomena they can measure.

| Phenomena | Transducer |
|---|---|
| Temperature | Thermocouples<br>Resistive Temperature Devices (RTDs)<br>Thermistors |
| Light | Vacuum Tube<br>Photo Sensors |
| Sound | Microphone |
| Force and Pressure | Strain Gauges<br>Piezoelectric Transducers |
| Position and Displacement | Potentiometers<br>Linear Voltage Differential Transformer<br>Optical Encoder |
| Fluid | Head Meters<br>Rotational Flowmeters |
| pH | pH Electrodes |

## 1.3 Signals

The appropriate transducer converts the physical phenomena into measurable signals. However, different signals need to be measured in different ways. For this reason, it is important to understand the different types of signals and their corresponding attributes. Signals can be categorized into two groups:

· Analog
· Digital

### Analog Signals

An analog signal can be at any value with respect to time. A few examples of analog signals include voltage, temperature, pressure, sound, and load. The three primary characteristics of an analog signal include level, shape, and frequency.

### Digital Signals

A digital signal cannot take on any value with respect to time. Instead, a digital signal has two possible levels: high and low. Digital signals generally conform to certain specifications that define characteristics of the signal. Digital signals are commonly referred to as Transistor-to-Transistor Logic (TTL). TTL specifications indicate a digital signal to be low when the level falls within 0 to 0.8 Volts, and the signal is high between 2 to 5 Volts. The useful information that can be measured from a digital signal includes the state and the rate .

## 1.4 Signal Conditioning

Sometimes transducers generate signals too difficult or too dangerous to measure directly with a DAQ device. For instance, when dealing with high voltages, noisy environments, extreme high and low signals, or simultaneous signal measurement, signal conditioning is essential for an effective DAQ system. Signal conditioning maximizes the accuracy of a system, allow sensors to operate properly, and guarantees safety. It is important to select the right hardware for signal conditioning.

## 1.5 DAQ Hardware

The DAQ hardware acts as the interface between the computer and the outside world. It primarily functions as a device that digitizes incoming analog signals so that the computer can interpret them. Other data acquisition functionality includes:

· Analog Input/Output
· Digital Input/Output
· Counter/Timers
· Multifunction – a combination of analog, digital, and counter operations on a single device

National Instruments offers several hardware platforms for data acquisition. The most readily available platform is the desktop computer. National Instruments offers PCI DAQ devices that plug into any desktop computer. In addition, NI makes DAQ devices for PXI/CompactPCI, a more rugged modular computer platform specifically for measurement and automation applications. For distributed measurements, National Instruments Compact FieldPoint platform delivers modular I/O, embedded operation, and Ethernet communication. For portable or handheld measurements, National Instruments DAQ devices for USB and PCMCIA work with laptops or PocketPC PDAs .

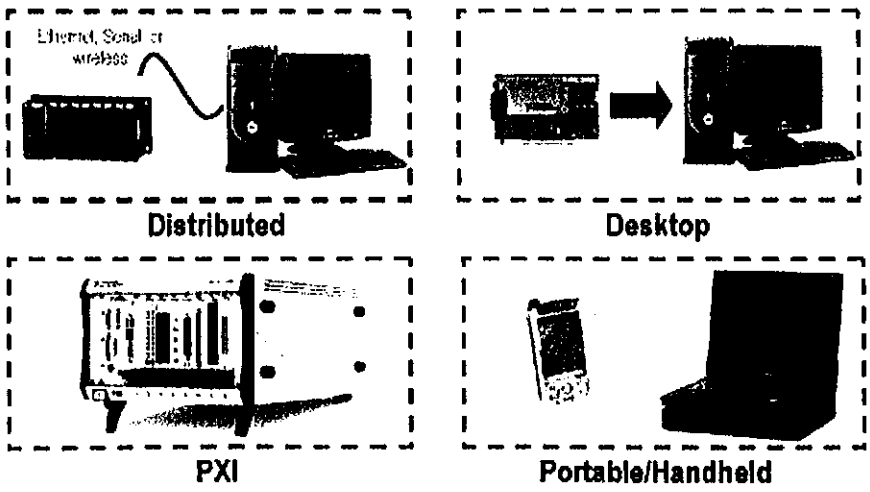



**Figure 2. DAQ Hardware Options**

## 1.6 Driver and Application Software

### Driver Software

Software transforms the PC and the DAQ hardware into a complete data acquisition, analysis, and presentation tool. Without software to control or drive the hardware, the DAQ device will not work properly. Driver software is the layer of software that allows easy communication to the hardware. It forms the middle layer between the application software and the hardware. Driver software also prevents a programmer from having to do register-level programming or complicated commands in order to access the hardware functions. National Instruments offers two different software options:

- NI-DAQmx driver and additional measurement services software
- NI-DAQmx Base driver software

With the introduction of NI-DAQmx, National Instruments revolutionized DAQ application development by greatly increasing the speed at which you can move from building a program to deploying a high-performance measurement application. The DAQ Assistant, which is included with NI-DAQmx, is a graphical, interactive guide for configuring, testing, and acquiring measurement data. With a single click, you can even generate code based on your configuration, making it easier and faster to develop complex operations. Because the DAQ Assistant is completely menu-driven, you will make fewer programming errors and drastically decrease the time from setting up your DAQ system to taking your first measurement.

### Application Software

The application layer can be either a development environment in which you build a custom application that meets specific criteria, or it can be a configuration-based program with preset functionality. Application software adds analysis and presentation capabilities to the driver software. To choose the right application software, evaluate the complexity of the application, the availability of configuration-based software that fits the application, and the amount of time available to develop the application. If the application is complex or there is no existing program, use a development environment.

NI offers three development environment software products for developing complete instrumentation, acquisition, and control applications:

- LabVIEW with graphical programming methodology
- LabWindows/CVI for traditional C programmers
- Measurement Studio for Visual Basic, C++, and .NET

# CHAPTER 2

## GENERATOR SPECIFICATIONS

Generator is a 3 –Phase generator supplying 118V AC, 400Hz to various equipment of MIG-29 Bis Aircraft.

The already existing system using chart recorders for data recording is obsolete and therefore needs to be replaced by a New PC Based Data Acquisition System.

The various Parameters to be monitored are

| Parameter | Qty | Range |
|---|---|---|
| Pressure | 4 | 0-25 Kg/cm2 |
| Pressure | 2 | -1kg/cm2 to 1.5 kg/cm2 |
| Frequency of O/P voltage of Generator | 1 | 118V, 400Hz, 3Phase |
| Voltage for 3 phases | 3 | 118 V AC (400Hz) |
| Current for 3 phases | 3 | 70Amp AC (400Hz) |
| 3 phase Power | 1 | 48 KW AC |
| Output Voltage DC Drive | 1 | 0-500V DC |
| Output Current DC Drive | 1 | 0-800Amps DC |
| Drive RPM (Frequency to Voltage convertor) | 1 | Output Available in Frequency 83 Hz at 100% RPM |
| Torque | 1 | 0-100Kg.cm |
| Temperature indicators and controllers | 2 | 0-150 Deg C |
| DC Voltage Uncoupler | 1 | 19-30V DC |
| DC Current Uncoupler | 1 | 0-3 A DC |

# CHAPTER 3

## HARDWARE COMPONENTS USED

The following is the list of hardware components that are used for the development of Generator Test Rig:

| Product Description | Engg. Range | Quantity | Make/Model |
|---|---|---|---|
| **Industrial PC Related Hardware** | | | |
| Industrial PC<br>Single Board Computer, 5 PCI Slots | | 1 | ADVANTECH |
| 1 KVA OnLine UPS | | 1 | APC / SURT 1000 Uxi |
| Inkjet Printer | | 1 | HP / Inkjet |
| Industrial Cabinet for Mounting of Sensors, Computer and meters<br>19" , 30U | | 2 | President / Cyberack |
| PCI CARD with connector and cable.<br>1 Mega Samples/Sec, resolution >12 bits<br>22 analog inputs | | 1 | National Instruments / NI PCI 6254 |
| TFT Monitor | 17" | 1 | Samsung |
| **SENSORS** | | | |
| Pressure Transducer (Hydraulics)<br>Oil Type: Aerosole 390<br>O/p: 4-20 mA | 0-25 Kg/cm2, 0.15% BSL FS | 4 | DRUCK / PTX 7511 |
| Pressure Transducer (Hydraulics)<br>Oil Type: Aerosole 390<br>O/p: 4-20 mA | -1-1.5 Kg/cm2, 0.15% BSL FS | 2 | DRUCK / PTX 7511 |
| Frequency Transducer<br>O/p: 4-20 mA | 0-500Hz / 200V | 1 | CR Magnetics / CR6620-500 |
| AC Voltage Transducer<br>O/p: 4-20 mA | 0-118V AC, 400Hz | 3 | CR Magnetics / CR4520-250 |
| AC Current Transducer<br>O/p: 4-20 mA | 0-70Amp | 3 | CR Magnetics / CR4220-70 |
| AC Power Transducer<br>4 wire,active<br>O/p: 4-20 mA | 48KW | 1 | CR Magnetics / CR6260-150-5 |

| | | | |
|---|---|---|---|
| Current Transformers | 75:5 | 3 | CR Magnetics / CR2RL-750 |
| DC Voltage Transducer<br>O/p: 4-20 mA | 0-500V | 1 | CR Magnetics / 5320-500 |
| DC Current Transducer<br>a. Shunt<br>b. V to I converter | 0-800A<br>75 mV<br>I/P: 0-75 mV,<br>O/p: 4-20 mA | <br>1<br>1 | AE / RS Component<br>Siemens / 7NG3120-0JN00 |
| DC Voltage Transducer<br>O/p: 4-20 mA | 0-50V | 1 | CR Magnetics / 5320-50 |
| DC Current Transducer<br>O/p: 4-20 mA | 0-3A | 1 | CR Magnetics / 5220-5 |
| Frequency Transducer<br>O/p: 4-20 mA | 0-83Hz / 200V | 1 | CR Magnetics / CR6621-100 |
| Temperature Sensors (RTD) & Controllers<br>O/p: 4-20 mA | 0-200 Deg C | 2 | Radix / Tunix 96A |
| Torque Sensor<br>O/p: 5 V DC | 0-100 Kg.cm | 1 | Futek / TRS605 |
| Panel Meters<br>I/P: 4-20 mA<br><br>a. Pressure Display<br>b. AC Voltage Display<br>c. AC Current Display<br>d. DC Voltage Display<br>e. DC Current Display<br>f. Frequency Display<br>g. AC Power Display<br>h. Torque Display | <br><br>0-25 Kg/cm2<br>0-118V AC<br>0-70 Amp AC<br>0-500 V DC<br>0-800 A DC<br>0-500 Hz<br>0-50 KW<br>0-100 Kg.cm | <br><br>6<br>3<br>3<br>2<br>2<br>2<br>1<br>1 | RADIX |
| Power Supply | 24 V | 1 | Meanwell |
| MCB | 220 V | 1 | Meanwell |
| Signal Conditioning Plate | | 2 | Neometrix |
| Stainless Steel Pipes<br>OD 6 mm, ID 5 mm | | 1 | Parker/Swagelok |
| Lapp Cables | .75mm | 500m | Garg Associates |
| Contacts | | 30 | Phoenix Contact |

# CHAPTER 4

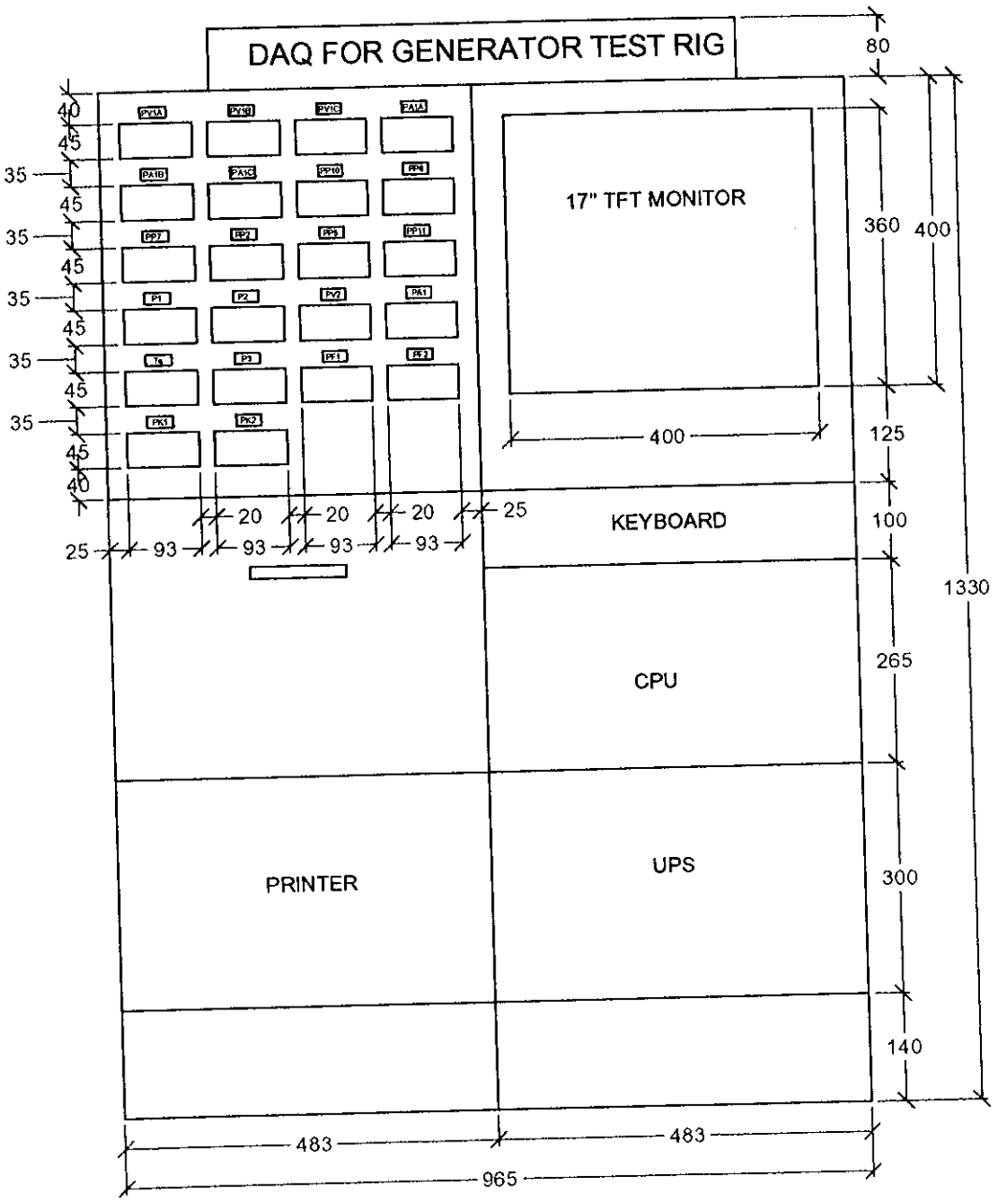
## GENERAL APPEARANCE OF TEST RIG

The general appearance drawings of the test rig are developed in AutoCAD using exact

Dimensions for mounting purpose. The drawings are in three parts:

a. Front Panel Drawing
b. Front Panel View 3 D
c. Display Of Panel Indicators

These are shown in **Fig. 3, 4 and 5**.


DAQ FOR GENERATOR TEST RIG
17" TFT MONITOR
KEYBOARD
CPU
PRINTER
UPS
80
360
400
125
100
1330
265
300
140
400
483
483
965
20
20
20
25
25
93
93
93
93
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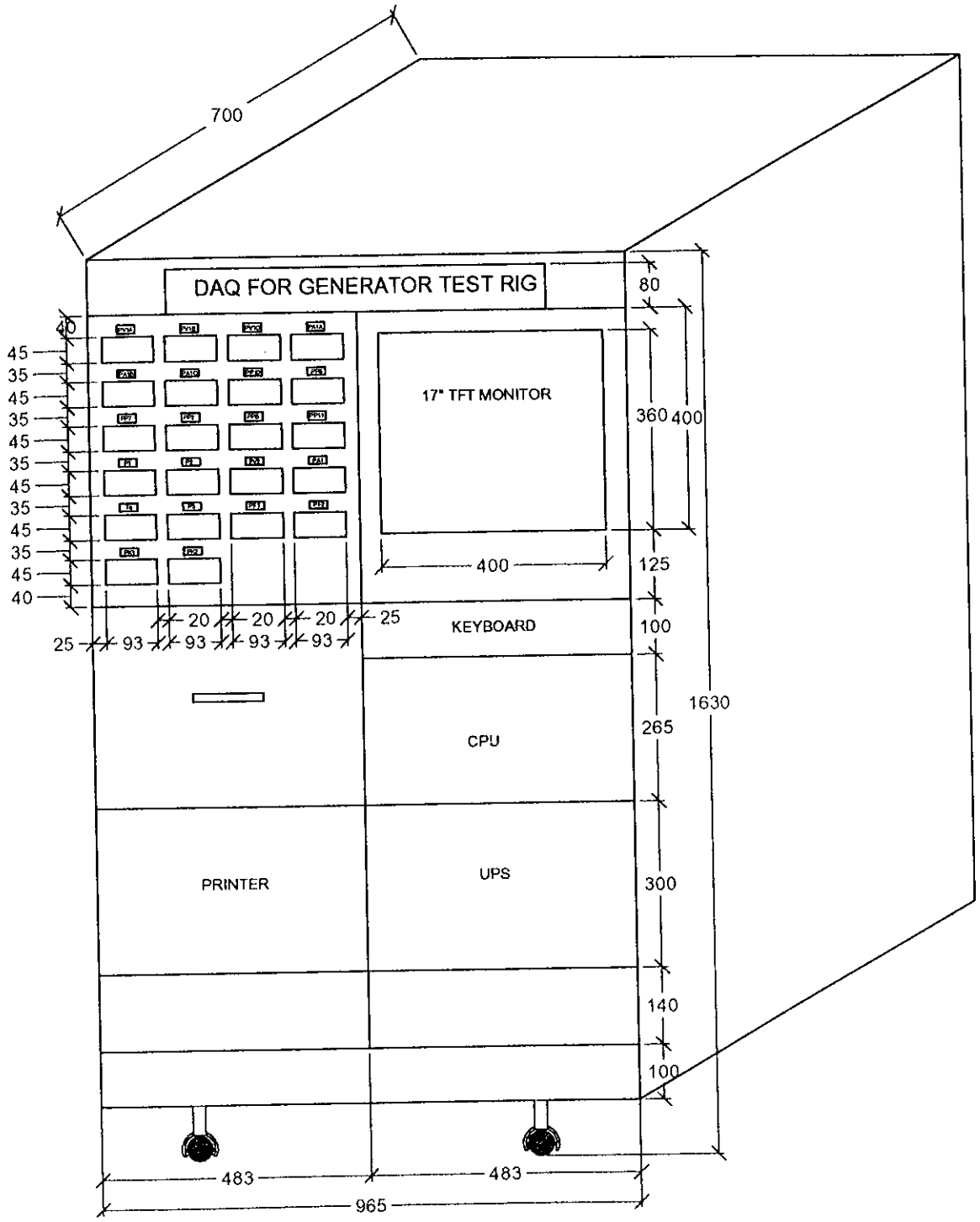
35
45
40

**Fig. 3**


700
DAQ FOR GENERATOR TEST RIG
80
17" TFT MONITOR
360
400
400
125
KEYBOARD
100
CPU
265
1630
PRINTER
UPS
300
140
100
483
483
965
45
35
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25
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93
93
93
93

**Fig. 4**

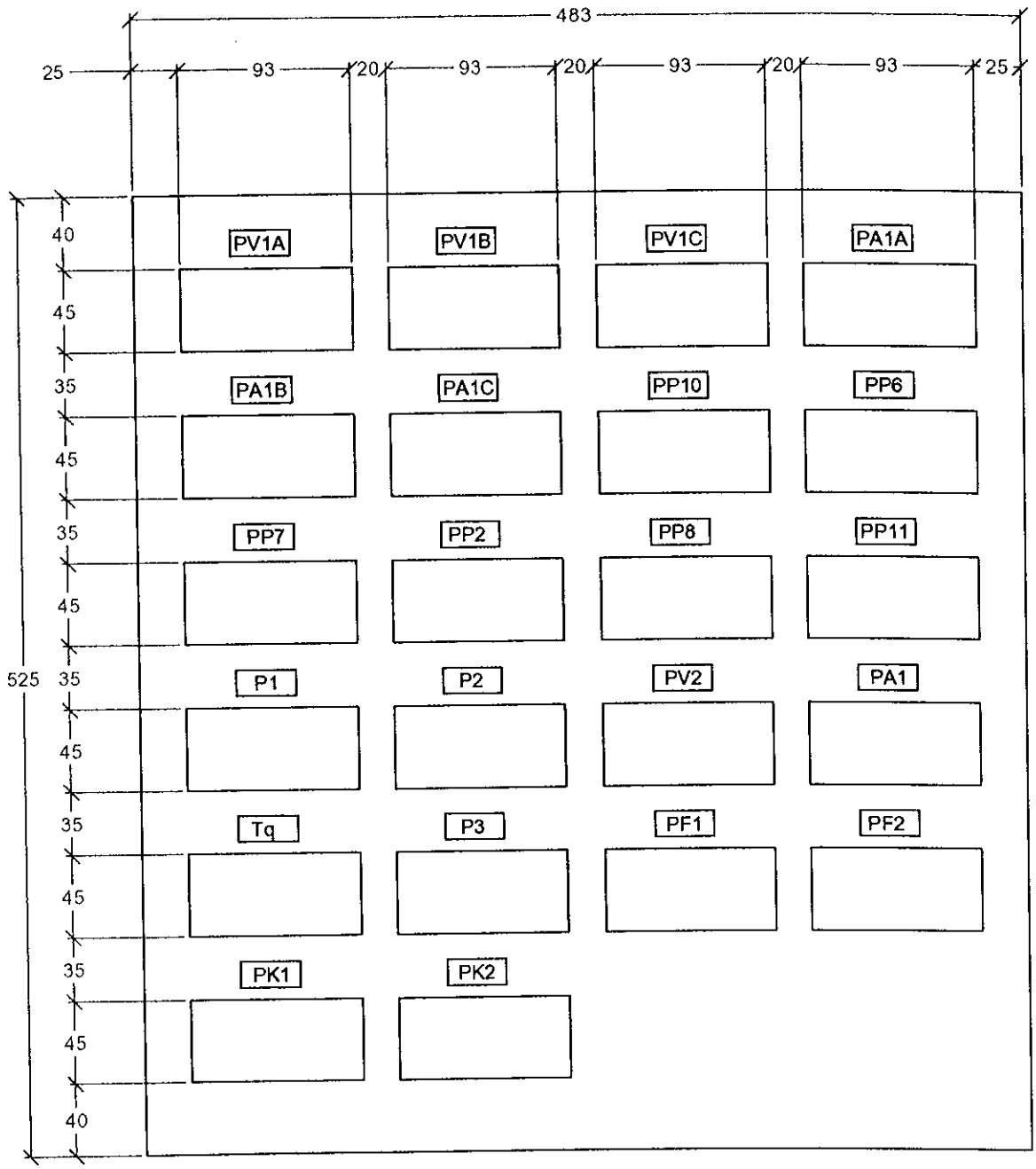

483
25
93
20
93
20
93
20
93
25
525
40
45
35
45
35
45
35
45
35
45
35
45
40
PV1A
PV1B
PV1C
PA1A
PA1B
PA1C
PP10
PP6
PP7
PP2
PP8
PP11
P1
P2
PV2
PA1
Tq
P3
PF1
PF2
PK1
PK2

**Fig. 5**

# CHAPTER 5

# CONNECTION DIAGRAM OF TRANSDUCERS

In this project the various transducers are used for monitoring different parameters of the GENERATOR. The main principle for using these transducers is that the output of these transducers is in range 4 –20 mA. This output is directly used by Panel Indicators for display and also this output is passed through Signal Conditioning Device to the Data Acquisition Hardware. The DAQ needs 1-5V DC as its input for PC Based Automation.

The Connection Diagrams of These Transducers are represented in the following Figures.

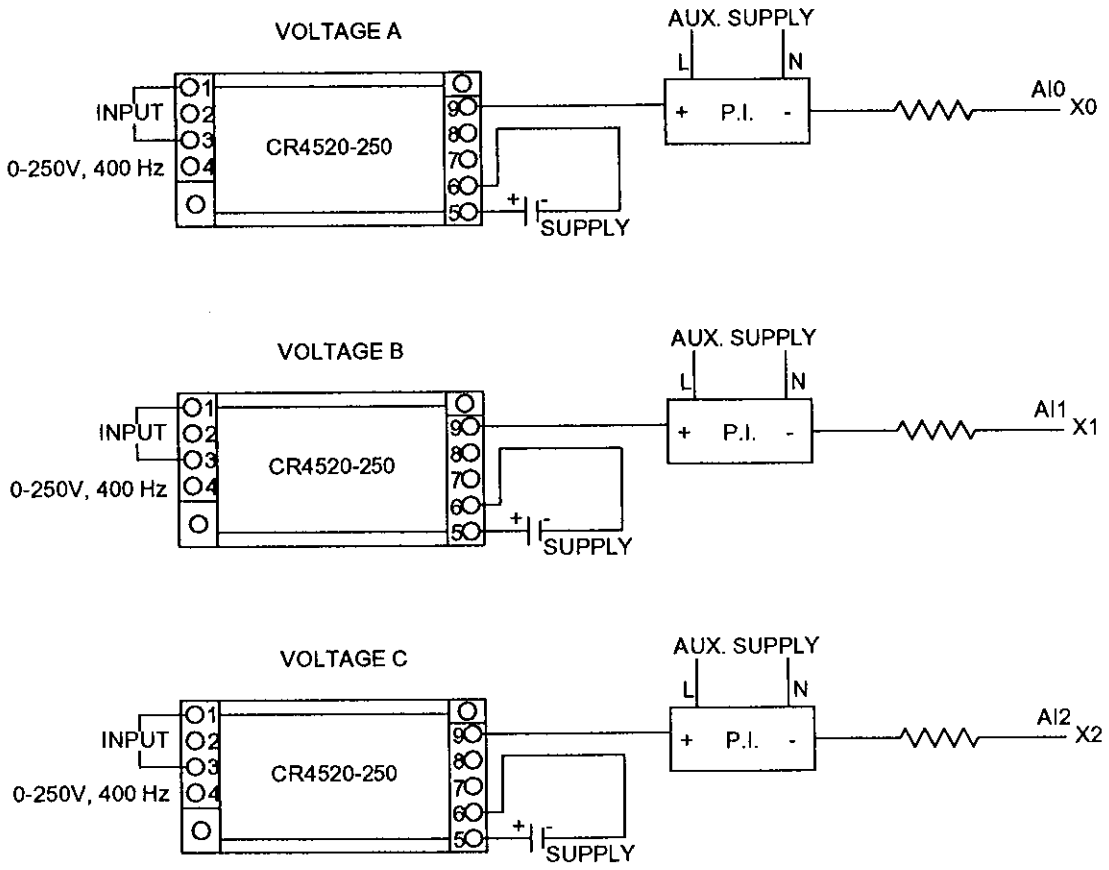



**Fig. 6 AC VOLTAGE TRANSDUCER**

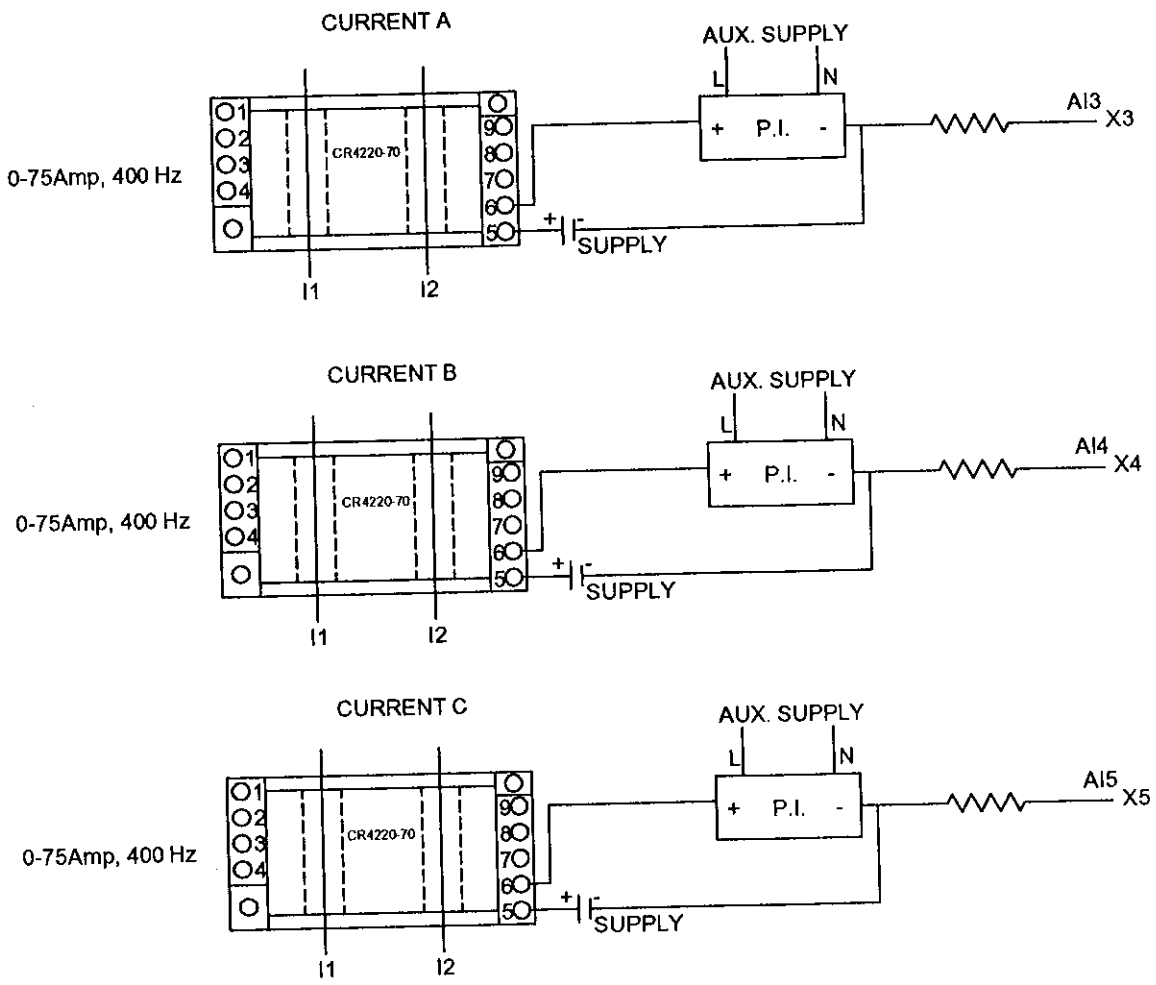



**Fig. 7 AC CURRENT TRANSDUCER**

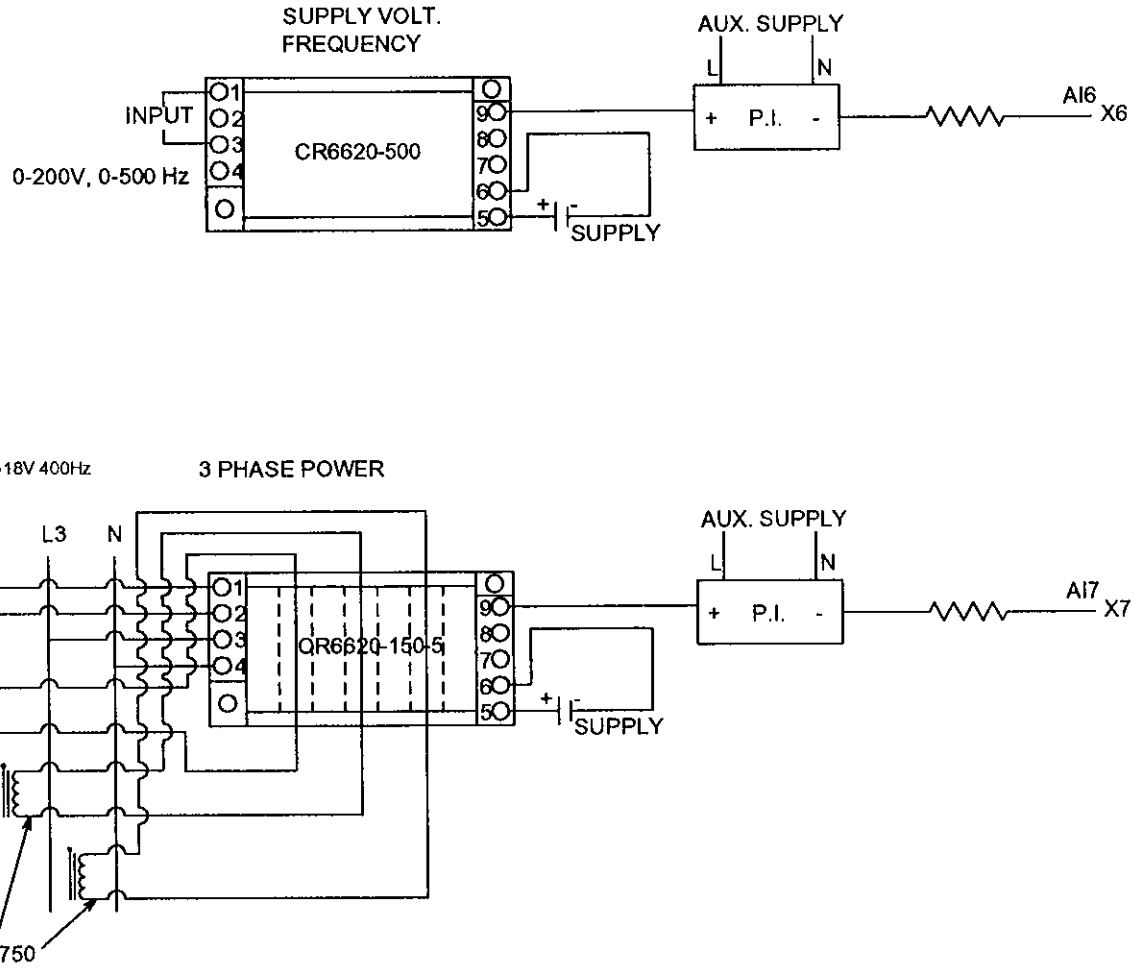



**Fig. 8 AC POWER TRANSDUCER & FREQUENCY TRANSDUCER**

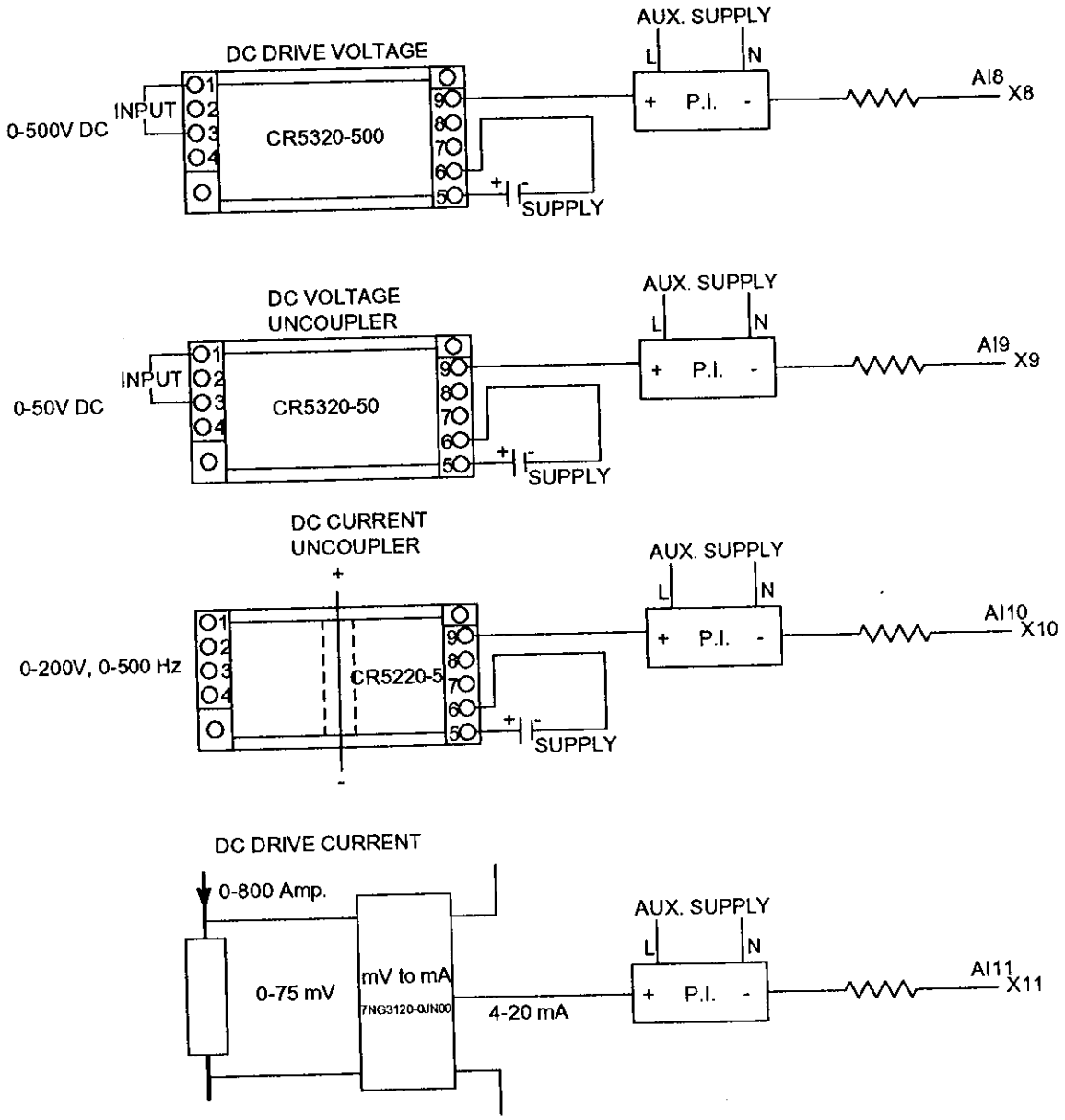



**Fig. 9 DC VOLTAGE &CURRENT TRANSDUCERS**

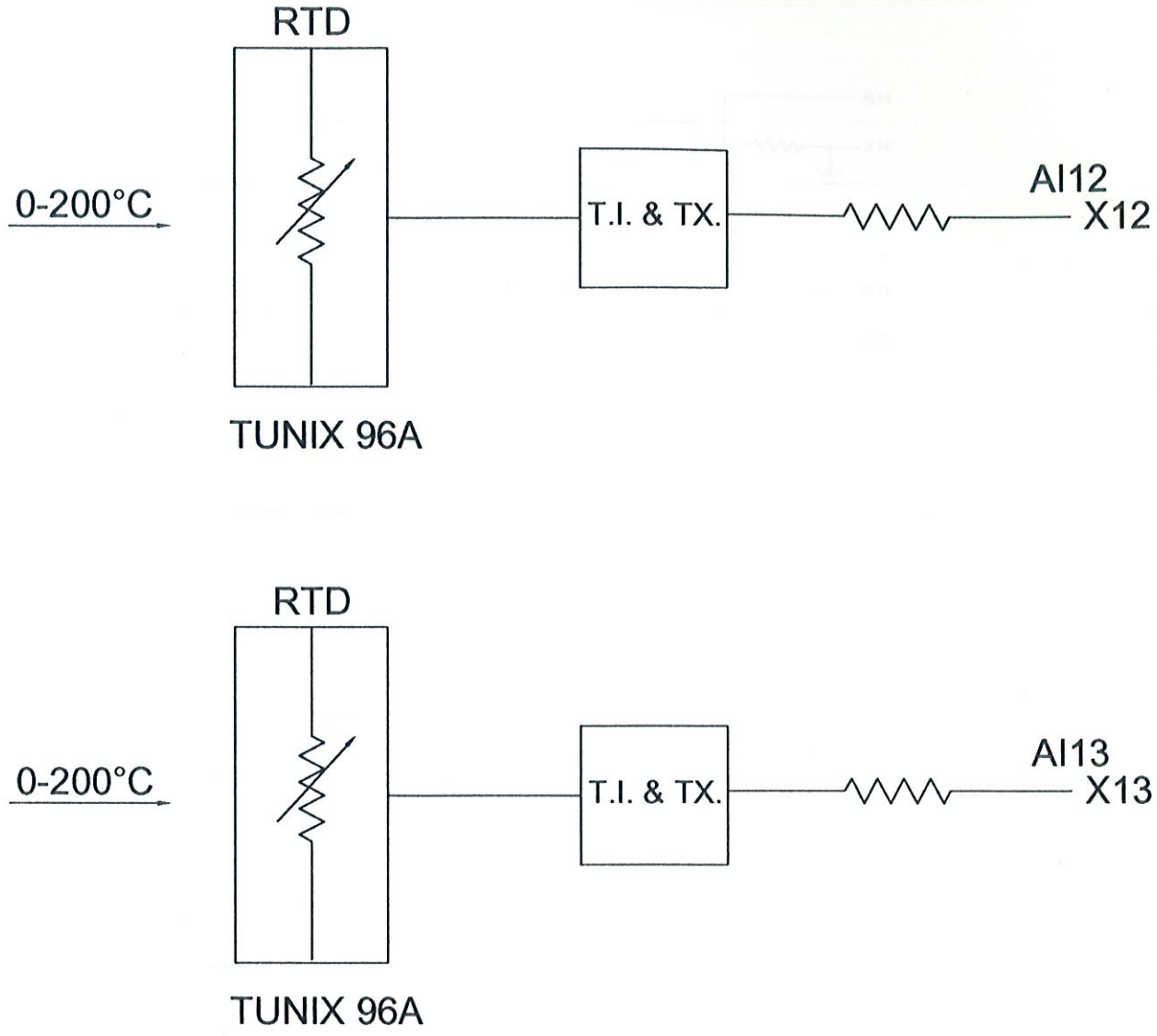



**Fig. 10 TEMPERATURE TRANSDUCER**

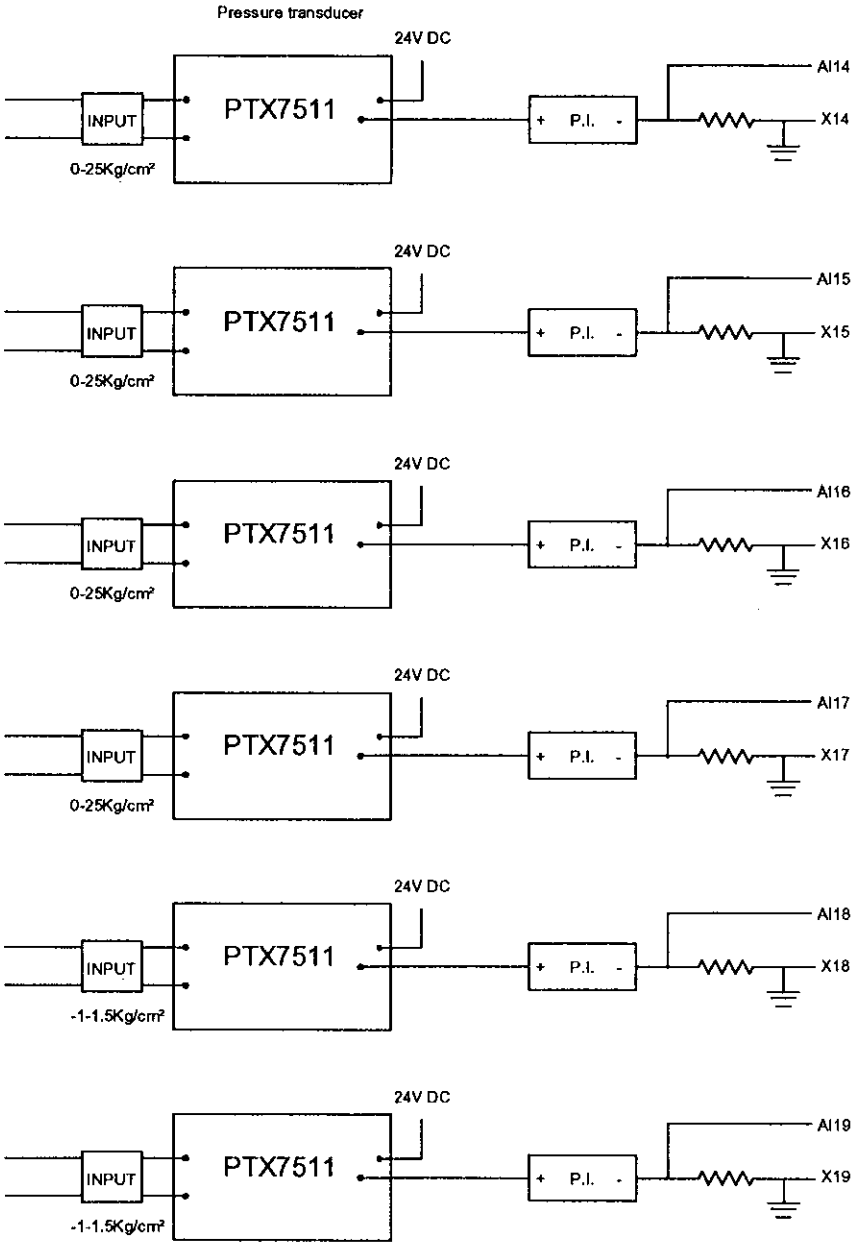
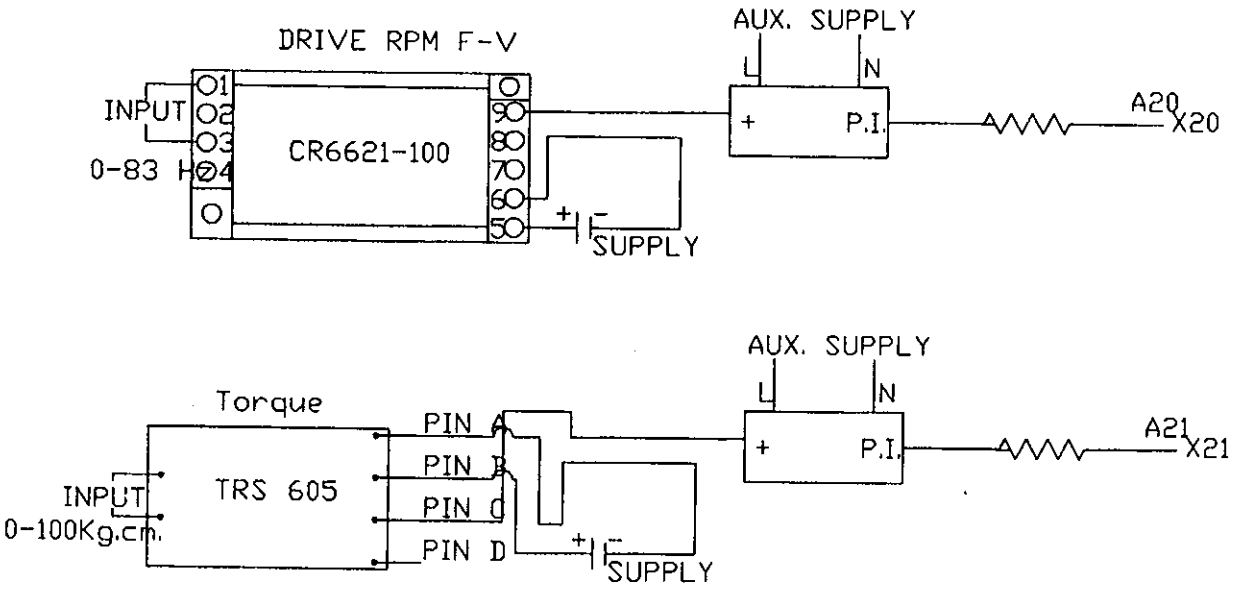



**Fig. 11 PRESSURE TRANSDUCER**




A POWER
B GROUND
C SIGNAL
D AUTO ID

FIG. 12 FREQUENCY TRANSDUCER AND TORQUE SENSOR

# CHAPTER 6

# DATA ACQUISITION AND SIGNAL CONDITIONING

## 5.1 DAQ Card Specifications

NI DAQ Card with following specifications is there:

| | |
|---|---|
| Model | : NI PCI-6254 |
| Sampling Rate | : 1.25 Mega Samples/sec |
| Resolution | : 16 bit |
| Filter | : 1 Hz to 10 KHz (pre – selectable) |
| Amplifier | : Programmable channel universal amplifier |
| Input Impedance | : up to 1 M ohm |
| Analog Inputs | : 32 |
| Digital Input/Output | : 48 |
| Connector/Cable | : 68-68 Pin Connector/Cable |

The Pin Diagram of NI-6254 is shown in Fig.13

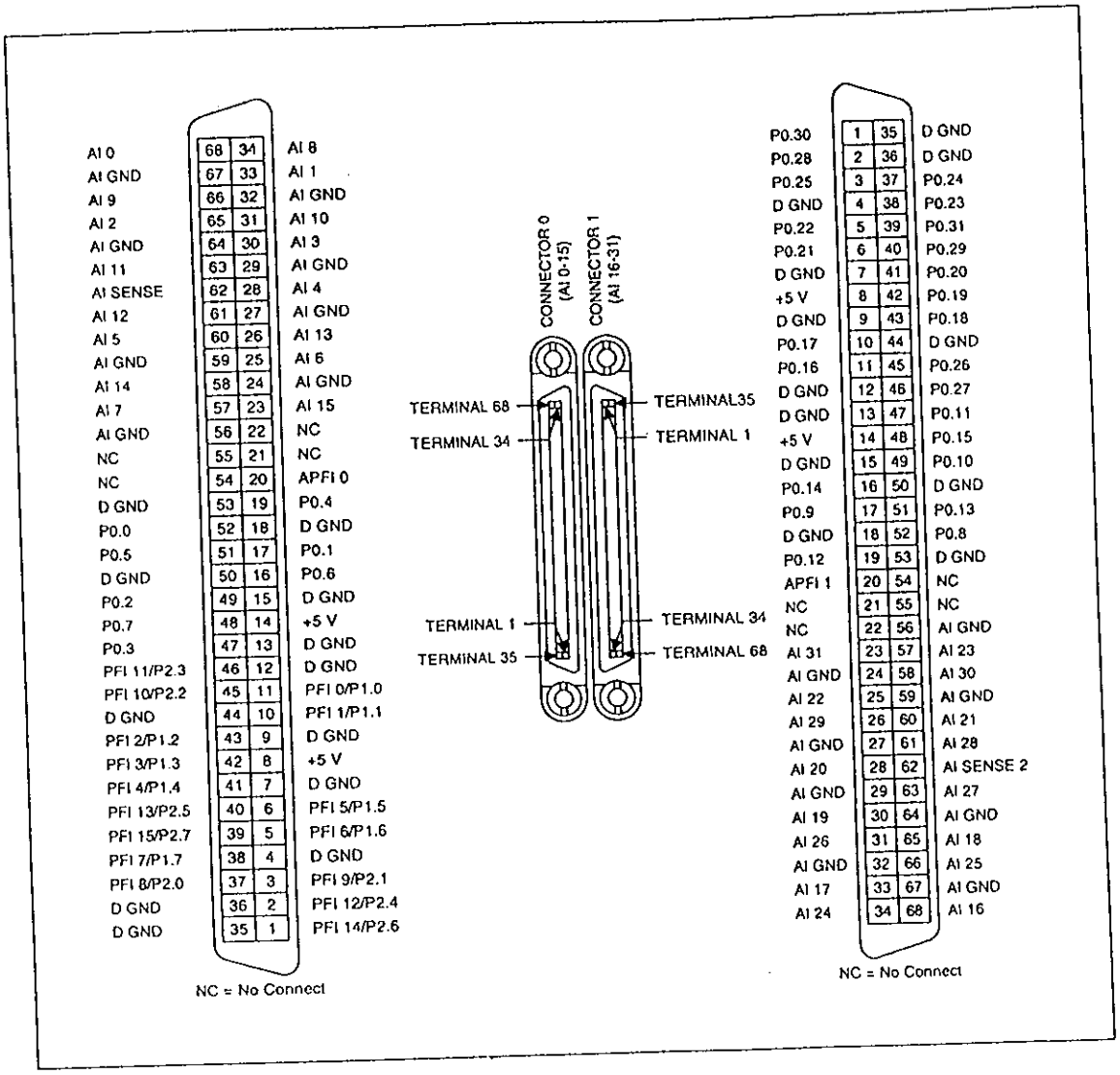

AI 0
AI GND
AI 9
AI 2
AI GND
AI 11
AI SENSE
AI 12
AI 5
AI GND
AI 14
AI 7
AI GND
NC
NC
D GND
P0.0
P0.5
D GND
P0.2
P0.7
P0.3
PFI 11/P2.3
PFI 10/P2.2
D GND
PFI 2/P1.2
PFI 3/P1.3
PFI 4/P1.4
PFI 13/P2.5
PFI 15/P2.7
PFI 7/P1.7
PFI 8/P2.0
D GND
D GND
68 34
67 33
66 32
65 31
64 30
63 29
62 28
61 27
60 26
59 25
58 24
57 23
56 22
55 21
54 20
53 19
52 18
51 17
50 16
49 15
48 14
47 13
46 12
45 11
44 10
43 9
42 8
41 7
40 6
39 5
38 4
37 3
36 2
35 1
AI 8
AI 1
AI GND
AI 10
AI 3
AI GND
AI 4
AI GND
AI 13
AI 6
AI GND
AI 15
NC
NC
APFI 0
P0.4
D GND
P0.1
P0.6
D GND
+5 V
D GND
D GND
PFI 0/P1.0
PFI 1/P1.1
D GND
+5 V
D GND
PFI 5/P1.5
PFI 6/P1.6
D GND
PFI 9/P2.1
PFI 12/P2.4
PFI 14/P2.6
NC = No Connect
CONNECTOR 0 (AI 0-15)
CONNECTOR 1 (AI 16-31)
TERMINAL 68
TERMINAL 34
TERMINAL 1
TERMINAL 35
TERMINAL35
TERMINAL 1
TERMINAL 34
TERMINAL 68
P0.30
P0.28
P0.25
D GND
P0.22
P0.21
D GND
+5 V
D GND
P0.17
P0.16
D GND
D GND
+5 V
D GND
P0.14
P0.9
D GND
P0.12
APFI 1
NC
NC
AI 31
AI GND
AI 22
AI 29
AI GND
AI 20
AI GND
AI 19
AI 26
AI GND
AI 17
AI 24
1 35
2 36
3 37
4 38
5 39
6 40
7 41
8 42
9 43
10 44
11 45
12 46
13 47
14 48
15 49
16 50
17 51
18 52
19 53
20 54
21 55
22 56
23 57
24 58
25 59
26 60
27 61
28 62
29 63
30 64
31 65
32 66
33 67
34 68
D GND
D GND
P0.24
P0.23
P0.31
P0.29
P0.20
P0.19
P0.18
D GND
P0.26
P0.27
P0.11
P0.15
P0.10
D GND
P0.13
P0.8
D GND
NC
NC
AI GND
AI 23
AI 30
AI GND
AI 21
AI 28
AI SENSE 2
AI 27
AI GND
AI 18
AI 25
AI GND
AI 16
NC = No Connect

FIG. 13

## 5.2 I/O Connector Signal Descriptions

The following table describes the signals found on the I/O connectors.

| Signal Name | Reference | Direction | Description |
|---|---|---|---|
| AI GND | — | — | **Analog Input Ground**—These terminals are the reference point for single-ended AI measurements in RSE mode and the bias current return point for DIFF measurements. All three ground references—AI GND, AO GND, and D GND—are connected on the device. |
| AI <0..31> | Varies | Input | **Analog Input Channels 0 to 31**—For single-ended measurements, each signal is an analog input voltage channel. In RSE mode, AI GND is the reference for these signals. In NRSE mode, the reference for each AI <0..15> and AI <64..79> signal is AI SENSE; the reference for each AI <16..63> signal is AI SENSE 2.<br><br>For differential measurements, AI 0 and AI 8 are the positive and negative inputs of differential analog input channel 0. Similarly, the following signal pairs also form differential input channels:<br><br><AI 1, AI 9>, <AI 2, AI 10>,<br><AI 3, AI 11>, <AI 4, AI 12>,<br><AI 5, AI 13>, <AI 6, AI 14>,<br><AI 7, AI 15>, <AI 16, AI 24>,<br><AI 17, AI 25>, <AI 18, AI 26>,<br><AI 19, AI 27>, <AI 20, AI 28>,<br><AI 21, AI 29>, <AI 22, AI 30>,<br><AI 23, AI 31>,. |
| AI SENSE<br>AI SENSE 2 | — | Input | **Analog Input Sense**—In NRSE mode, the reference for each AI <0..15> and AI <64..79> signal is AI SENSE; the reference for each AI <16..63> signal is AI SENSE 2. |

| | | | |
|---|---|---|---|
| D GND | — | — | **Digital Ground**—D GND supplies the reference for P0.<0..31>, PFI <0..15>/P1/P2, and +5 V. All three ground references—AI GND, AO GND, and D GND—are connected on the device. |
| P0.<0..31> | D GND | Input or Output | **Port 0 Digital I/O Channels 0 to 31**—You can individually configure each signal as an input or output. |
| APFI <0..1> | AO GND/ AI GND | Input | **Analog Programmable Function Interface Channels 0 to 1**—Each APFI signal can be used as AO External Reference inputs for AO <0..3>, AO External Offset input, or as an analog trigger input. APFI <0..1> are referenced to AI GND when they are used as analog trigger inputs. APFI <0..1> are referenced to AO GND when they are used as AO External Offset or Reference inputs. |
| +5 V | D GND | Input or Output | **+5 V Power Source**—These terminals provide a fused +5 V power source. |
| PFI <0..7>/P1.<0..7><br>PFI <8..15>/P2.<0..7> | D GND | Input or Output | **Programmable Function Interface or Digital I/O Channels 0 to 7 and Channels 8 to 15**—Each of these terminals can be individually configured as a PFI terminal or a digital I/O terminal.<br><br>As an input, each PFI terminal can be used to supply an external source for AI, AO, DI, and DO timing signals or counter/timer inputs.<br><br>As a PFI output, you can route many different internal AI, AO, DI, or DO timing signals to each PFI terminal. You also can route the counter/timer outputs to each PFI terminal. |
| NC | — | — | **No connect**—Do not connect signals to these terminals. |

## 5.3 Analog Input Circuitry

### I/O Connector

You can connect analog input signals to the M Series device through the I/O connector. The proper way to connect analog input signals depends on the analog input ground-reference settings. Also refer to I/O Connector Pinouts.

### MUX

Each M Series device has one analog-to-digital converter (ADC). The multiplexers (MUX) route one AI channel at a time to the ADC through the NI-PGIA.

### Ground-Reference Settings

The analog input ground-reference settings circuitry selects between differential, referenced single-ended, and non-referenced single-ended input modes. Each AI channel can use a different mode.

### Instrumentation Amplifier (NI-PGIA)

The NI programmable gain instrumentation amplifier (PGIA) is a measurement and instrument class amplifier that minimizes settling times for all input ranges. The NI-PGIA can amplify or attenuate an AI signal to ensure that you use the maximum resolution of the ADC.

M Series devices use the NI-PGIA to deliver high accuracy even when sampling multiple channels with small input ranges at fast rates. M Series devices can sample channels in any order at the maximum conversion rate, and you can individually program each channel in a sample with a different input range.

### A/D Converter

The analog-to-digital converter (ADC) digitizes the AI signal by converting the analog voltage into a digital number.

### AI FIFO

M Series devices can perform both single and multiple A/D conversions of a fixed or infinite number of samples. A large first-in-first-out (FIFO) buffer holds data during AI acquisitions to ensure that no data is lost. M Series devices can handle multiple A/D conversion operations with DMA, interrupts, or programmed I/O.

## 5.4 Signal Conditioning

Many sensors and transducers require signal conditioning before a measurement system can effectively and accurately acquire the signal. The front-end signal conditioning system can include functions such as signal amplification, attenuation, filtering, electrical isolation, simultaneous sampling, and multiplexing. In addition, many transducers require excitation currents or voltages, bridge completion, linearization, or high amplification for proper and accurate operation. Therefore, most computer-based measurement systems include some form of signal conditioning in addition to plug-in data acquisition DAQ devices.

Sensors can generate electrical signals to measure physical phenomena, such as temperature, force, sound, or light. Some commonly used sensors are strain gauges, thermocouples, thermistors, angular encoders, linear encoders, and resistance temperature detectors (RTDs).

To measure signals from these various transducers, you must convert them into a form that a DAQ device can accept. For example, the output voltage of most thermocouples is very small and susceptible to noise. Therefore, you may need to amplify or filter the thermocouple output before digitizing it. The manipulation of signals to prepare them for digitizing is called signal conditioning.

The various transducers, which has been used in this project gives the DC current output in range 4-20mA.The requirement for DAQ Card is DC voltage in range 1-5V.

Thus, all the outputs have to be conditioned first. For this we have connected 249K Ohms across the output of various transducers.Hence, the signal conditioning is implemented.

# CHAPTER 7

## The Software Development Using Labview

**Software Features:**

- Display of Waveforms
- Approx. 15 no. of fast varying channels with respect to time are required to be plotted and recorded simultaneously in one graph.
- Internal and external triggering
- Programmable pre-trigger and post trigger record interval
- Time based, slope based, amplitude based decision making
- Waveform Zooming and Panning at any portion of waveform
- Off line viewing
- Curve fitting
- Help of various testing procedures for testing units
- Store and acquire waveform as numerical values in tabular format in ASCII text files which can be directly imported to Excel, Lotus or nay other program allowing to perform offline analysis
- Programmable calibration factor, unit text format( digit after decimal) individually after every channel
- Measurement of time ( milliseconds) b/w any two points with the help of 2 cursors
- Obtain Hard cope of Displayed Waveform in the form of a test report at click of a mouse button
- Measurement of slope b/w 2 points on displayed waveform
- Operator entry screen to enter part number and name, graph title, remarks etc for inclusion on test report
- Measured data is stored in user-defined format.

The user interface is shown in the following Fig.14.

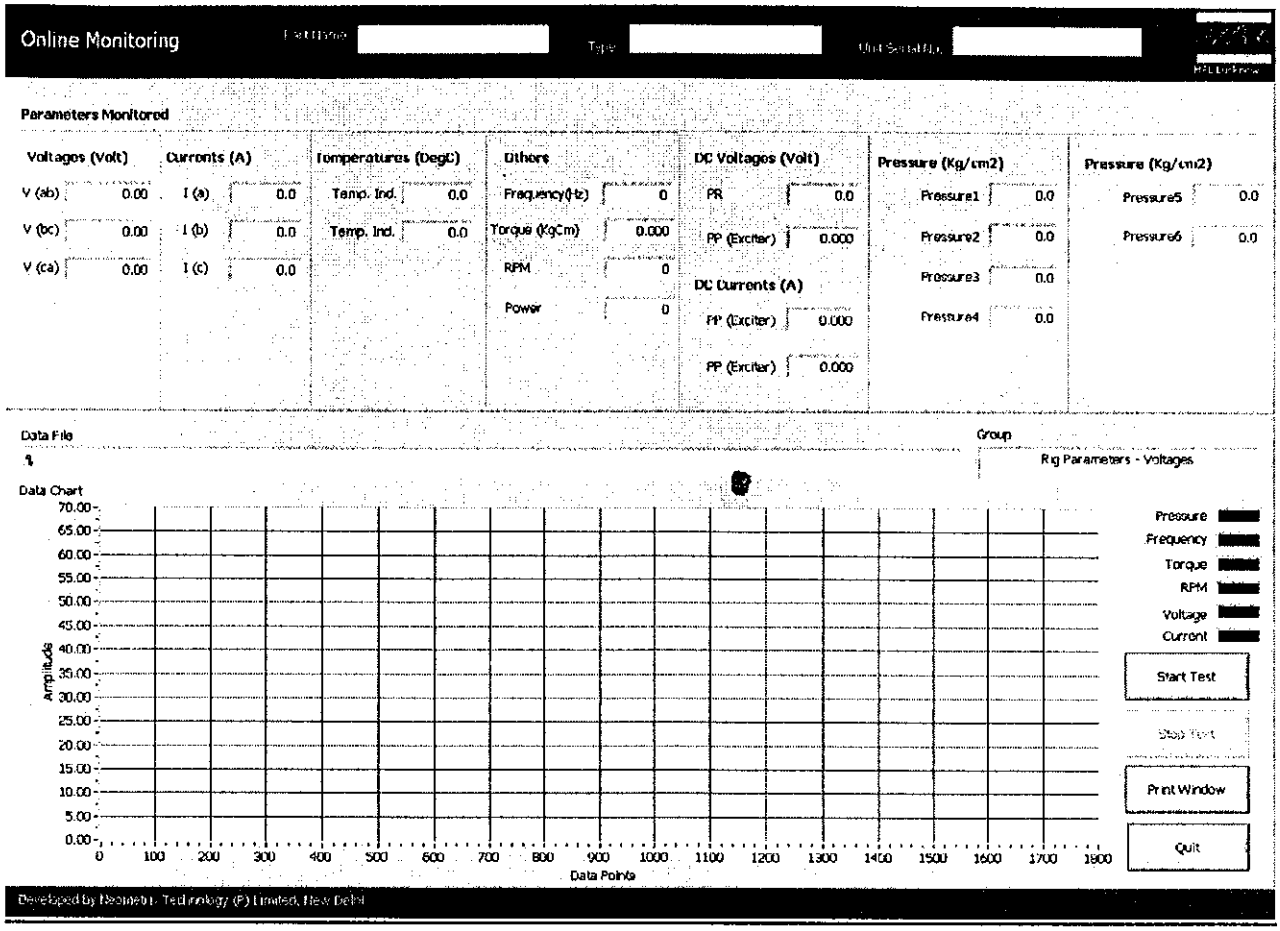



**Fig.14 User Interface**

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