CHAPTER V
DEVELOPMENT OF HARDWARE

5.1 INTRODUCTION

There are various factors to be considered for selecting the most appropriate hardware scheme for motor current signature analysis. These are

- Sensor must be non invasive
- Online recording of 3 voltages and 3 currents
- Variable Sampling frequency to achieve the resolution of 0.01Hz
- Good memory for storage of instantaneous samples at particular sampling frequency

5.2 Hardware Scheme

The following Hardware Schematic was developed in order to satisfy the above factors.

Hardware Schematic

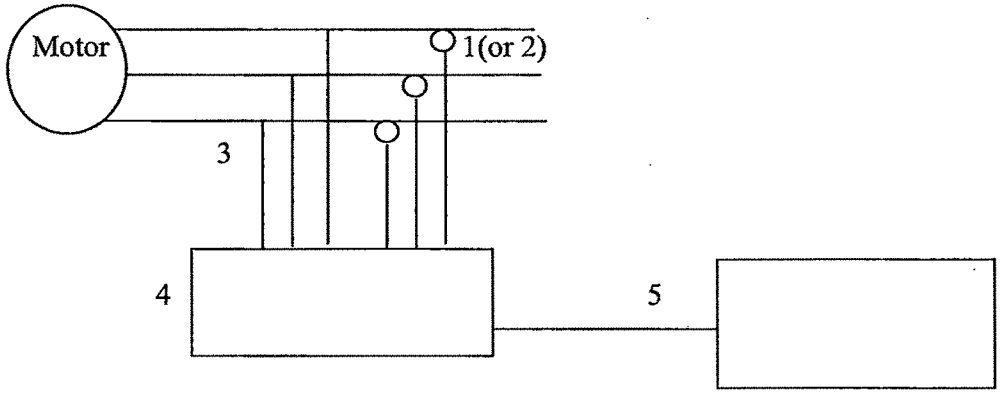

Figure 5.1 : Hardware scheme

5.3 Description & Specifications

1. Current Transformer (For LT motors) – 3nos.

Make: YEW; Model: 96001; Range: 0 to 400A AC rms (600A peak); Dia; 33 mm Output: 0 to 4 V Ac rms (10mV/A); Accuracy: ±1.5% rdg Max. ; 20Hz to 20 KHz wide frequency Characteristics

These CTs are having the wide frequency response from 20HZ to 20 kHz; hence they can easily capture the various harmonic frequencies in the current signature. Typically the frequency range to harmonic in current signature ranges upto 5kHz. Hence these CTs are very well suited to capture the harmonic in the stator current

2. Current Transformers (from CT Secondary for HT motors) – 3nos.

Make: YEW; Model: 96033; Range: 0.1A to 50A; Dia; 11.8mm
Output; 10mV/A; Accuracy: 3% Max; 20Hz to 20 KHz wide frequency Characteristics

3. Voltage probes

Make: YEW; Isolated Voltage probes; Max: 1000V;
100:1 ratio; Model: 700929

4. ADC Card

Make: National Instruments: 8 channel NI DAQ card –6123 & NI-DAQ Software
SCB-68 Noise Rejecting, Shielding I/O Connector Block I/O Signal termination accessory for 68-pin MIO Board
SHC 68-68 EP shielded cable, 68 D-type to 68 VHDCI offset, 2m

Part no 778561-01; 776844-01; 186838-02

5. Desktop Computer

Make : HP; Pentium IV; 256 MB DDR Ram

Photograph 5.1 Hardware for Motor Current Signature Analysis

5.3.1 Description of Hardware

The Clamp CT's are used for capturing of Current signal directly from LT motor cable or from CT secondary of HT Motors. The current signal is converted to equivalent low voltage signal through the inbuilt shunt of the CT. The current equivalent low voltage signal is fed the signal conditioner unit of DAQ card.

Voltages probes are used to capture the voltage signal from LT motor control panel or from PT secondary of HT motors. The voltage probes step down the voltage to level of 0-5V. This signal is then fed to the signal conditioning unit of DAQ card.

The current and voltage signals are fed to the Data acquisition card of National instruments NI 6123 through Signal Condition unit. This signal condition unit conditions the current and voltage signal by eliminating any spurious signals. The filtering also removes the undesirable high frequency components that produce aliasing of the sampled signal. The sampling frequency and time of data collection of DAQ card can be controlled from Computer according to the maximum frequency required and frequency resolution. The maximum sampling frequency can be upto 500 kHz/ channel. The DAQ card can capture the simultaneous sampling of 8 different signals. The maximum onboard memory of DAQ card is 32 MS.

The condition signal from signal conditioner is fed to the DAQ card. The DAQ card captures the instantaneous samples of voltage and current signal depending upon the sampling frequency set on the card by the data logging software. These instantaneous samples of voltage and current are converted into the ASCII format for use by computer for the analysis purpose.

The instantaneous samples of voltage and current signal are then fed to FFT software where the signature of voltage and current is computed through FAST FOURIER TRANSFORM. Signal noise that is present in the calculated spectrum is reduced by averaging a predetermined number of generated spectrum. This can be accomplished by using either spectra calculated from multiple sample sets or spectra computed from multiple predetermined sections (or windows) of single large sample set. Because of the frequency range of interest and the desired frequency resolution, several thousand frequency components are generated.

The output of FFT software gives the values voltage and current at different frequencies and this values are transferred to EXCEL sheet for analysis purpose. In order to reduce the large amount of spectral information to usable level an algorithm in fact a frequency filter, eliminates those components that provide no useful information. The algorithm keeps only those components that are of particular interest because they specify characteristic frequencies in the current spectrum that are know to be coupled to particular motor faults. The brief description of Software is given in the next chapter.

5.4 Conclusion

The hardware scheme mentioned above satisfies the all the requirements such non invasive sensor using clamp CTs, Online recording of three phase voltages and currents, variable sampling frequency and record length to suit the requirement of high spectral resolution of 0.01Hz and huge memory storage of recorded samples and analyzed data.