CHAPTER -4

Development of Welding Signature Analyzer

Introduction

Welding Signature Analyzer (WSA) is developed with voltage transducer, current transducer, signal Conditioner, Data Acquisition card, and Industrial computer. The software used are Window XP, Office 2003, Visual Basics Version-6, DAQ Bench Run time software and software package is developed for analyzing the weld voltage and weld current signatures.

4.1 Operation of WSA

Online, analog, weld voltage and current signals of the Semi-Mechanized welding system are captured by the transducers. Then the analog signals are conditioned, amplified in AP4300, then it are digitalized, sampled in the DAQ card and the online samples are stored in the buffer memory of the Industrial PC in the First Input to First output basis. The block diagram and process diagrams are shown in fig.4.1.1 and fig.4.1.2

![Fig.4.1.1 Block diagram of WSA](image-url)
Using Active X control method in the DAQ bench software, the digitized sampled data is processed directly for online monitoring of arc voltage and current signature. A software Package is developed for obtaining desired sampling rate per second, data acquisition period, viewing any desired range of recorded voltage and current samples at any desired time period, computing statistical parameters for micro and macro range of sample and calculation of Short Circuited Time (SCT), Net Burning Time (NBT) and Cycle Time (CT).

### 4.2 Major Components used for Developing WSA

The major components of Welding Signature Analyzer are voltage transducer, current transducer, Data acquisition card, Dual OP AMP, Voltage Reference AP4300 and Industrial computer [18].

#### 4.2.1 Voltage and Current Transducer

In this research work the instantaneous Hall Effect voltage transducer LEM Module LV 100-1000 shown in fig.4.2.1 and current Transducer LEM module LT 505-S shown in fig.4.2.2 are used and their technical specifications are given in table 4.2.1
Table-4.2.1 Specifications of LEM LV 100-1000 & LEM LT 505-S

<table>
<thead>
<tr>
<th>Details</th>
<th>Technical Data of LEM LV 100-1000</th>
<th>Technical Data of LEM LT 505-S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Type : Instantaneous</td>
<td>Accuracy : 0.7 %</td>
<td>Accuracy : 0.6 %</td>
</tr>
<tr>
<td>Measurement : Voltage</td>
<td>Measuring Range : 1500 V</td>
<td>Measuring Range : 1200 A</td>
</tr>
<tr>
<td>Primary Nominal Value : 1000 V</td>
<td>Supply voltage type Bipolar</td>
<td>Supply voltage type Bipolar</td>
</tr>
<tr>
<td>Mounting: -</td>
<td>Secondary Signal : 50 mA</td>
<td>Secondary Signal : 100 mA</td>
</tr>
<tr>
<td>Details of Secondary Terminals:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


4.2.2 Data Acquisition Card

ADLINK- DAQ model 2010 card is used in the Welding Signature Analyzer to process the online welding voltage and current samples. The DAQ-2010 is an advanced data acquisition card based on the 32-bit PCI architecture. High performance designs and the state-of-the-art technology make this card ideal for data logging and signal analysis. DAQ-2010 has 2MHz 4 channels simultaneous A/D and 2 channels D/A output device with bus mastering DMA transfer capability. Its full technical specifications are given in reference [52].

Features of DAQ-2010 Data Acquisition Card

- 32-bit PCI-Bus, plug and play
- 4-channel simultaneous differential analog inputs
- DAQ/PXI-2010: 14-bit Analog input resolution with sampling rate up to 2MS/sec.
- Programmable bipolar / unipolar analog input
- DAQ/PXI-2010: Total 8K samples A/D FIFO
- A/D Data transfer: software polling & bus-mastering DMA with Scatter/Gather functionality
- Four A/D trigger modes: post-trigger, delay-trigger, pre-trigger and middle-trigger
- 2 channel DA outputs with waveform generation capability
- 2K samples output data FIFO for DA channels
- DA Data transfer: software update and bus-mastering DMA with Scatter/Gather functionality
- System Synchronization Interface (SSI)
- A/D/DA fully auto-calibration
General Specifications

- Connector: VHDCI 68-pin connector X1
- Operating temperature: 0°C ~ 65°C
- Storage temperature: -20°C ~ 80°C
- Humidity: 5 ~ 95%, non-condensing,
- Dimension: Standard Half Size PCI form,
- Termination Boards: DIN-68S

DAQ-2010 is a high performance data acquisition driver for developing custom applications under Windows NT, Windows 98 and Windows 2000 environments.

D2K-DASK is constructed to provide a simple programming interface for communication with the DAQ-2000 data acquisition cards.

D2K-DASK also has the advantage of the power and features of Microsoft Win32 System for data acquisition applications. These include running multiple applications and using extended memory. Also, using D2K-DASK under Visual Basic environment makes it easy to create custom user interfaces and graphics.

4.2.3 Dual OP AMP and Voltage Reference AP4300

The AP4300 is a monolithic IC specifically designed to regulate the output current and voltage levels of switching battery chargers and power supplies. It contains two operational amplifiers and a precision shunt regulator. Op Amp 1 is designed for voltage control, whose non-inverting input internally connects to the output of the shunt regulator. Op Amp 2 is for current control with both inputs uncommitted.

The IC offers the power converter designer a control solution that features increased precision with a corresponding reduction in system complexity and cost.
Salient Features of AP 4300

Op Amp

- Input Offset Voltage: 0.5mV
- Supply Current: 250µA per Op Amp at 5.0V Supply Voltage
- Unity Gain Bandwidth: 1MHz
- Output Voltage Swing: 0 to (VCC-1.5) V
- Power Supply Range: 3 to 18V

Voltage Reference

Fixed Output Voltage Reference: 2.5V, 2.6V

Voltage Tolerance: 0.5%, 1%

Sink Current Capability from 0.1 to 80mA

4.2.4 Industrial Computer

Industrial computer withstands a variety of harsh environments such as battlefield, extreme temperature, polar region, high altitude, desert, as well as hostile environment exposed to water, dust, grit and extreme weather conditions [43], etc. Rugged Computer technology and its application have been highly regarded by the government and other industries, Rugged Computer suitable for the national defense, public security, petroleum, geophysical prospecting, traffic, medical care, etc.,

Features:

- Use ATX motherboard, support Intel® Core™2 Duo Processor,
- Al-alloy sheet and hard anodic oxidation and is anti-corrosion and anti-scratch
- Provides multi PCI and PCI-E expansion slot.
- Optimized design in anti-vibration, rugged installation and EMC.
Technical Specification of Industrial Computer

Processor Supports: Intel® Core™2 Duo processor of Socket P
Chipset: Intel® GME965 + ICH8M
Memory Supports: 1 x 200-pin 533/667MHz DDRII SO-DIMM,
Onboard 2GB memory, up to 4GB
Graphics controller: Intel® GME965 Express chipset integrates GMA X3100 Core
display supports VGA and LVDS display or video card expandable via PCIE x16

Mechanical and Environmental Features

Dimensions(W x D x H)  482.6mm x 480.0mm x 177.0mm
Reliability     MTBF ≥5000h; MTTR ≤0.5h
Safety       Meets MIL-STD-810F
Operating Temperature  -5°C ~55°C
Storage Temperature  -40°C ~60°C
Operating Humidity  5%-95%, 40°C non-condensing
Expansion Interface  1 x PCI-E x16, 2 x PCI-E x1, 4 x PCI

4.2.5 Computer Mother Board Specifications

Mother board used in the industrial computer is NuPRO-840. The NuPRO-840
Pentium 4 Full Size PICMG CPU Card incorporates the Intel advanced 845 Chipset
Memory Controller Hub and supports the 478-pin Intel Pentium 4 processors of 1.3GHz
and up to 2GHz. This CPU card has superior performance for rugged and demanding
applications in industrial automation, image processing, multimedia and
telecommunications. The NuPRO-840 CPU card is designed for the highest level of
computing performance yet available on SBC’s.
Its features are 400MHz front side bus,

Ultra DMA/100 IDE data transfers,

Up to 2GB of DDR SDRAM support that delivers 1GB/s of memory bandwidth.

The NuPRO-840 features a SIS305 3D graphics engine with 16MB Video Memory.

The Schematic and wiring diagram of WSA is shown in fig.4.2.3 & 4.2.4

Fig.4.2.3 Schematic Diagram of WSA
Wiring Diagrams of WSA is shown in fig 4.2.4

Fig. 4.2.4 Wiring Diagram of WSA
Welding Signature Analyzer’s Panel dimensions are shown in fig.4.2.5 [All units in mm]

Fig.4.2.5 Panel Dimension of WSA
Fig. 4.2.6 and Fig.4.2.7 shows the front and side view of the newly developed WSA

NEWLY DEVELOPED WELDING SIGNATURE ANALYZER

![Fig.4.2.6 Front view of WSA](image1)
![Fig. 4.2.7 Side View of WSA](image2)

**4.2.6 Conclusion**

In this chapter the major components used to develop Welding Signature and their salient technical specifications are discussed. The WSA’s wiring diagram, schematic diagram and its panel board dimensions are also presented.