

# A NEW REMOTE CONTROL AND MONITORING SYSTEM FOR THE ISIS ION SOURCE ON THE 665 KV DC ACCELERATING PLATFORM

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## ABSTRACT

The control system is based on commercially available equipment and provides a high integrity datalink to the ISIS ion source. The system communicates with the H source situated at the 665 kV high voltage potential of the DC accelerating column and replaces a 50 Hz 160 bit serial link with a high speed, adaptable, microprocessor based and PC controlled system. The prototype installation highlighted the problems associated with such equipment when used in electrically hostile environments. These have been surmounted with careful consideration to noise immunity and power supply integrity. Software has been written that allows communication between the commercial software and the ISIS (VAX based) control system software. This provides full monitoring and control of the ion source from the ISIS main control room.

## 1 INTRODUCTION

The performance of the ISIS ion source has improved to an extent where the reliability of the equipment controlling the source is a significant factor.

The ion source is situated on a -665 kV high voltage platform with all its associated power supplies contained within the same Faraday cage. The power supplies both remotely operated and monitored, from the injector control room. Electric mains power at 230 V is supplied by a 6 kVA motor driven alternator.

Electrical breakdowns of the accelerating column make the working environment of any electronics, extremely hostile. The incidence of mains failures is also sufficient to require consideration.

Equipment had previously been controlled using an ISIS designed serial data-link, that presented a 160 bit word, 50 times a second to a decoder to display and control the ion-source parameters. This was linked to the main ISIS control computer by several interface modules. This system was, from experience, overcomplicated and unreliable.

Ion source hardware was undergoing a modernisation so it was decided to up-date the method of control and monitoring of the ion source at the same time.

## 2 HARDWARE

### 2.1 Serial link

The heart of the new system is a commercially available, high speed data-link made by Group 3 Technology Limited [1]. This CONTROLNET (tm) consists of a fibre-optic linked 'Device Interface (DI)' that contains a main microprocessor control board and up to three interface boards. These DI's can be daisy chained together for communication to a remotely situated control personal computer (PC). The fibre optic drivers are capable of driving up to 40 metres of plastic fibre. This enabled almost perfect positioning of the control PC in the injector control room.

The installation called for two DI's to be mounted on the EHT platform, Figure 1, with six internal interface boards being selected. These were ;

- 2 off, 8 channel, configurable analogue input boards,
- 1 off, 8 channel, configurable analogue output board,
- 2 off, 24 channel logic input / output boards,
- 1 off fibre optic RS 232 interface board.

### 2.2 Digital / analogue interfacing

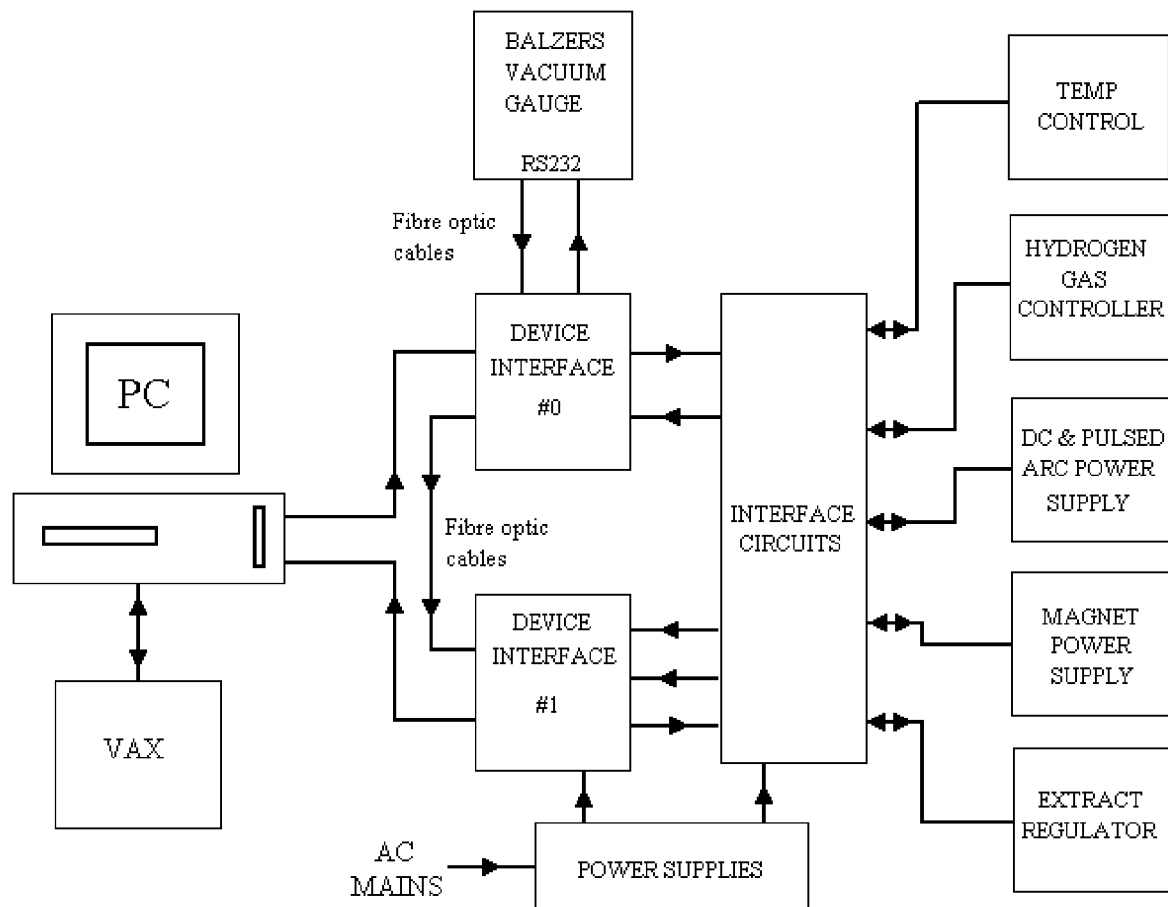
The RS232 interface was required to connect to a Balzer TPG300 vacuum controller unit. All other equipment was connected via multicore cables. Status and control line were fed on a 19 pole cable to the 5 ion source power supply systems. All analogue set and read signals being made using 2 pole, screened connections.

### 2.3 Sample and hold

Pulsed signals from the ion source supplies such as, arc current required a sample and hold circuit. This was provided as an 8 channel differential input, and independently timed circuit. All channels are fed to the DI but it also has a multiplexed output to a locally mounted voltmeter, for monitoring purposes.

## 3 SCREENING

Experience gained from the installation of a prototype system showed that considerable attention had to be paid



**FIGURE 1- BLOCK DIAGRAM OF ION SOURCE CONTROLS**

to electro-magnetic noise suppression. Electrical breakdowns had caused both latch-ups of the communication systems and corruption's of the analogue control signals.

### **3.1 Rf screened enclosure**

The most significant step was to mount the entire platform end control system in an earthed, rf screened enclosure. This aluminium box, is mounted on the side of a rack on the EHT platform and has a removable panel with finger strip contacts fitted. No apertures whatever compromise this rf integrity.

All connectors are screened with filtered bulkhead 'D' connectors for status/control signals. The mains input is screened and filtered.

The box contains the power supplies, both DI's, all ferrites, and all interface circuits.

### **3.2 Ferrite absorbers**

At the recommendation of Group 3, ferrite absorbers were fitted to the ribbon cables connecting the DI's to the interface circuits. The fitting of ferrite absorbers to all incoming and outgoing analogue signals was also found to be very successful improvement in immunity against electrical breakdown.

### **3.3 Printed circuit board**

All interface circuits are mounted on one large 350 x 300mm, double layer, ground plane, printed circuit board (pcb). The connections to both analogue and digital grounds are kept separate, following the Group 3 practice. Connections to the pcb are by either ribbon cable or pcb mounting plugs and sockets. A single grounding point is provided for connection to the enclosures' earthing point.

### ***3.4 Power supply integrity***

To protect against short-term power supply failures the system is powered from the 230 V ac mains using very basic power supplies with large reservoir capacitance's. This degrades slightly the DI integral power supply versatility but allows the controls to function whilst all around is collapsing. The interface circuits are powered from simple linear power supply modules.

### ***3.5 Firmware***

The Group 3 manufacturers were regularly updated the firm-ware with some of the modifications helping the microprocessors to recover from latch-ups. The latest version now allows processor resets and system configuration from the PC and has proved to be successful.

## **4 PROTECTION**

The system is protected from voltage spikes and over-range signals by the use of several different techniques. Most analogue inputs and outputs employ transient absorption diodes and differential  $\pi$  filters. The widespread use of metal oxide varistors has been useful on this and other ISIS pre-injector equipment.

The clamping of set value signals by zener diodes has overcome the upward drift of the set level during a latch-up in communication.

## **5 SOFTWARE**

### ***5.1 Communication***

The Group 3 Controlnet contains a dynamic data exchange (DDE) that communicates between DI's and the PC

### ***5.2 Control screen***

The control screen and software interface is by a product call INTOUCH by Pantek Ltd. [2]. This is marketed as a man-machine interface and allows generation of the screens for operator control and interfaces the equipment values to the communication software.

### ***5.3 Connection to ISIS controls***

The ISIS control system is VAX based and communication is by an ethernet, Local Area Network. The ethernet protocol is **P**acket **H**andler for **ISIS** **D**ata

**O**perations. It was necessary to write software to convert the DDE server protocol to this PHIDO protocol. This is the WinPHIDO packet handler software.

This allows full communication with the ion source from any terminal on the ISIS control network.

## **6 CONCLUSIONS**

The installation of the new ion source datalink and control system has been a major contributor to the reliability of the ion source and hence ISIS. The stability of control and status signals has meant that premature failures of the ion source are rare. The fully installed system has operated for over a year without a single corruption or failure and is being fitted to an ion source test rig for a source development program.

## **7 REFERENCES**

- [1] Group 3 Technology Ltd. 2 Charann Place, Avondale, Auckland, New Zealand.
- [2] Pantek Ltd, 44 Europa Business park, Bird hall lane, Stockport, UK.