HIGH-VOLTAGE POWER SUPPLY DISTRIBUTION SYSTEM

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Abstract

High-volage splitters enable connecting a larger number of ion-pumps to a single ion-pump controller. In particle accelerator facilities where relatively small pumps are used, high-voltage splitters can significantly reduce costs and rack space. By using simple high-voltage splitters some functionality of the conrollers can be lost.

The presented high-volage splitter is one of the most advanced devices on the market. It measures current going to every pump in the range 100 pA to 100 mA with an accuracy of 5%. Fully configurable tables are used to convert the measured current to the pressure at the pump. Current measurements are also used to monitor cable and ion-pump aging which results in linear increase of current with time. Hardware interlocks are used to disconnect individual pumps in case of poor vacuum to avoid pump damage. The limits can be set by the user, who can also set the number of active pumps. EPICS support was developed for the device with graphical user interfaces writen in EDM, java and WebCA. Since the presented device covers or exceeds a lot of the ion-pump controller functionality, simpler controlers can be used.

INTRODUCTION

Vacuum in storage rings is achieved with several hundred ion pumps with a total pumping power of tens of thousand liters per second. Ion pumps are connected to high-voltage (HV) controllers, which not only provide power, but also measure current running through the pump. From the current, pressure inside the pumps can be determined [1]. In addition to having extra pressure readings around the ring, the pumps can be switched off if the pressure is too high to avoid pump damage.

Ion pump sizes in storage rings range form 20 l/s to 500 l/s with the larger number of smaller pumps. Since high-voltage (HV) controllers can handle pumps with the total size of 500 l/s to 1500 l/s, a number of facilities use HV splitters to reduce the number of HV controllers and consequently costs and rack space.

By using simple splitters the current going through individual pump can no longer be determined and the pressure measurements and machine protection capability of the controller is lost. First version of LOCO [2] was developed for facilities where losing current measurements is not an option,

Logarithmic Converter (LOCO) is a HV splitter that can be connected between any commercial ion pump controller and up to 16 ion pumps. It measures current going to every pump and also provides cable interlock capability, by disabling the HV channel.

After the original LOCO was on the market for a couple of years, it was decided to upgrade it with suggestions received by our clients. Switches were added to enable control over the number of active channels, cable aging can be monitored by analysis of the archived data. Varian Dual controller, IOC and an LCD can be already integrated in the LOCO unit.
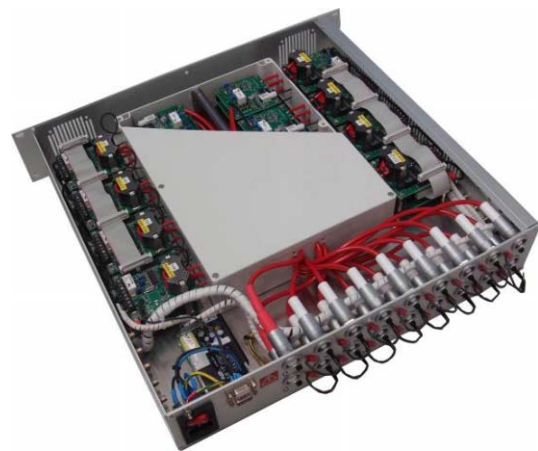

Figure 1: A view inside LOCO.

DESIGN

LOCO is a 19" rackmount HV distribution case with up to 16 modules (Figure 1) [2]. Modules comprise high voltage part, where the voltage is supplied to the pump and the current is measured, and a low-voltage part where the data is processed and transmitted to the control system. HV parts of all modules are enclosed in the isolation box positioned in the casing centre, while low voltage parts are turned towards the casing sides. The isolation box is split into two parts, allowing half of the modules to be at one HV level and the others at another.

HV is supplied to the unit over two FISCHER D105Z049 connectors, while it is distributed to the ion pumps via FISCHER D 105A049 connectors. All connectors are mounted on a back-panel with cable interlock connections. The device is controlled using a RS485 serial communication. EPICS [3] support is provided to

allow direct integration into control system. User interfaces written in EDM [4], WebCA [5] and java (Figure 2) using the Caj library [6] exist to allow remote monitoring of the LOCO devices.

In the original LOCO, interlocks of all channels were connected in a serial fashion and the triggering of a single interlock resulted in powering down of the HV power supply. In the new version, relays were added to every module (Figure 3) to allow disconnection of a single ion-pump.

Figure 2: Java LOCO operator interface.

SINGLE CHANNEL DISCONNECT

In the original LOCO all ion-pumps connected to a single HV channel were disconnected in case of pressure increase, pump fault or cable disconnect on any ion-pump. If the problem was due to a faulty pump, the system could be restarted after the pump was replaced or disconnected. In such cases the single channel disconnect option is not really needed, but it is convenient to restart the system without having to do hardware changes.

The single disconnect option is more required if power is distributed to ion-pumps over different vacuum section. If vacuum in one sector drops, pumping in other section is also stopped. Pumps in the faulty sector must be disconnected to resume pumping and reconnected again when also the vacuum in their section is improved.

Although it is usually possible in boosters and storage rings to use one distribution system per vacuum section, the single channel disconnect feature is very interesting for beamlines, where only a small number of ion-pumps are present in one section.

CABLE AGING MONITORING

Due to cable and pump aging the current going through the pump increases with time even if vacuum level remains the same. This increase can easily be distinguished from other disturbances, since it is linear and on a relatively long time scale. In most cases there are also other vacuum gauges measuring the pressure levels and the aging can be unambiguously determined.

Age monitoring can help schedule maintenance tasks and indicate where cable shielding is required.

A COMPLETE SOLUTION

To make the vacuum system more compact, a unit with Varian Dual controller [7] and LOCO was developed. microIOC [8], an LCD and external interlocks can be added optionally. With this solution the customer gets an ion-pump power supply for up to 16 ion-pumps, with a total pumping power and the functionality of Varian Controller, but at a significantly smaller cost and size. In addition the device can have a powerful IOC which can be configured to provide the user any desired information about the system and can be directly integrated into the control system.
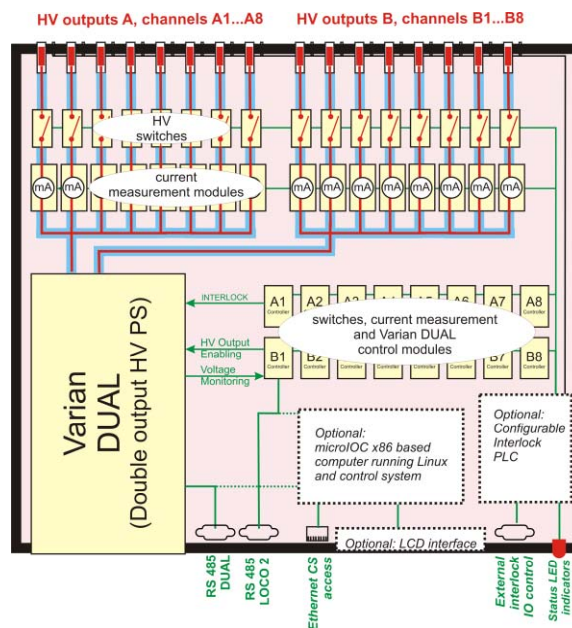

Figure 3: A HV distribution unit comprised of LOCO and Varian Dual Controller. microIOC, LCD and external interlocks can be optionally added. HV switches are added to original LOCO modules to enable single channel disconnect.

CONCLUSIONS

LOCO is an ideal device for vacuum systems where a large number of relatively small ion pumps are used. Its use enables connecting a larger number of ion pumps to a single HV controller channel, thus reducing costs and rack space without losing any functionality of the controller.

Unlike simple HV splitters, LOCO measures pressure at every pump and provides interlocks to protect pumps from being damaged by poor vacuum. Any individual pump can be activated or deactivated and cables and pumps are monitored for aging. A compact solution with Varial Dual Controller, IOC and LCD integrated with LOCO exists.

REFERENCES

[1] Giacuzzo, F.; Miertusova, J.," Total pressure measurements in the Elettra storage ring according to the performance of the sputter-ion pumps", PAC 95, p.2042.

[2] Kobal, M. et. al.,"Extended microIOC family (LOCO)", ICALEPCS 07.

[3] http://www.aps.anl.gov/epics/.

[4] http://ics-web1.sns.ornl.gov/edm/.

[5] http://webca.cosylab.com/.

[6] http://caj.cosylab.com/.

[7] Varian Dual controller:

[8] microIOC: http://www.microioc.com.