pplVacuumControl

Release 1.0

CAS

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CHAPTER 1

Introduction

The pplVacuumControl device is designed to provide an automatic control of the vacuum in the beam section of the pulse probe laser [1] (located where the beam is delivered to the instruments).

The configuration editor of the device is shown in Fig. 1.1.

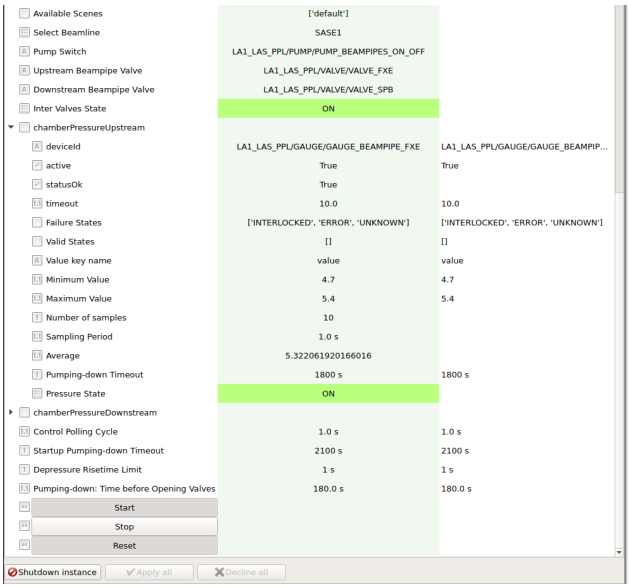

Fig. 1.1: Configuration editor of the pplVacuumControl device.

The operational principle is graphically displayed in Fig. 1.2, considering as an example the beamline in the laser hutch in SASE1. Identical considerations can be done for the laser beamline in SASE3; for SASE2 only one beamline exists, but similar working principles can be applied.

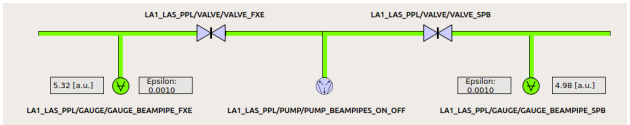

Fig. 1.2: The diagram describes the beamline and its components in the SASE1 laser hutch.

[1] M. Pergament et al., "Versatile optical laser system for experiments at the European X-ray free-electron laser facility," Opt. Express 24, 29349-29359 (2016)

From the hutch two individual beamlines provide the pulse probe laser separately to the two SASE instruments. In this example FXE and SPB, located on left and right side of the beamline sketch, respectively, are considered. In each instrument section a dedicated gauge (controlled by the Beckhoff PLC) continuously measures the pressure. The gauge readout is presented in arbitrary units as a running average of N continuous measurements. The parameter **Number of samples** defines how many continuous measurements are considered in the running average. The measurements are taken at **Sampling Period** intervals.

The minimum and maximum values (**Maximum Value** and **Maximum Value** in the device editor) are provided by the PPL group.

Note that the change of pressure value is acknowledged only if the difference with respect to the previously reported value is larger than the so called **Epsilon** parameter; this parameter can be configured in the configuration editor of the corresponding karabo gauge device.

The control of vacuum is activated (deactivated) by clicking the **Start** (**Stop**) button. If the control is activated, as soon as the pressure overshoots the maximum limit, the pump in the pre-chamber (located in-between the valves in the two sections) is started to create a pre-vacuum in front of the relevant valve. The state of the pipe in-between the two valves is ON in case both valves are closed; it is OFF otherwise.

After an user-configurable interval (**Pumping-down: Time**) the valve in the section is opened and the pressure decreases. In case both sections have the pressure above the limit, priority is given to the section which has the lowest **Pumping-down Timeout** value. This value is the maximum interval allowed to bring the pressure below the limit.

When the gauge readout in the section under pumping gets lower than the minimum limit, the valve is closed and the pumping stopped.

An example of the change of the section pressure when controlled by the karabo device is presented in Fig. 1.3.

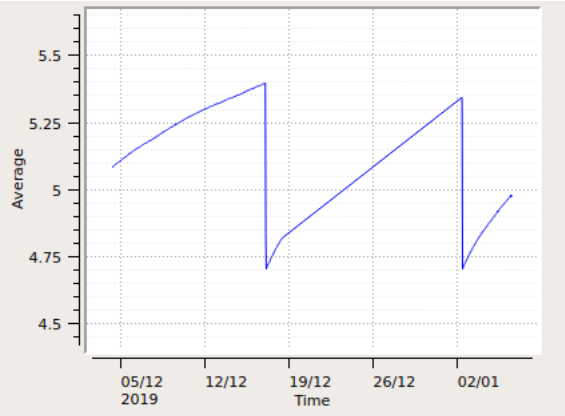

Fig. 1.3: The device allows to maintain the pressure in a beam section within desired limits.

In the configuration editor of the device, the settings of some parameters can be done with the device in control mode active, as for the lower/upper limits of the pressure. In contrast, some parameters should be configured before instantiating the device; this applies for example to the pump, valves and gauges to be used.

During pumping, in case the pressure remains above the maximum after the timeout **Pumping-down Timeout**, an error is issued, warning of a possible leak or of a possible malfunctioning of the pump. A leak may also be present, if pumping is needed more frequent than the **Depressure Risetime Limit**. Also in this case the device enters an error state. As typical to many karabo devices, the error state can be removed using the button **reset**. If the error situation persists, the alarm will be again issued. The parameters **Pumping-down Timeout** and **Depressure Risetime Limit** should be tuned by PPL operators according to the type of pumps and pipes used in the system.

CHAPTER 2

Device Scenes

At the moment, one scene is auto-generated by the device. The scene differs according to whether the device is monitoring the laser beamline in SASE1/SASE3 (two beam sections present), or SASE2 hutch (one single beam section present), and is automatically tailored to the beamline selected in the editor.

It can be opened either by right-clicking on the device name, and selecting from the drop up menu the item *Open device scene*, or double-clicking on the device name.

An example of scene to control a two-section and one-section beamline is presented in Fig. 2.1 and Fig. 2.2, respectively:

Fig. 2.1: The scene of the pplVacuumControl device for a two-section beamline.

All configuration parameters are available in the right-side sub-panel.

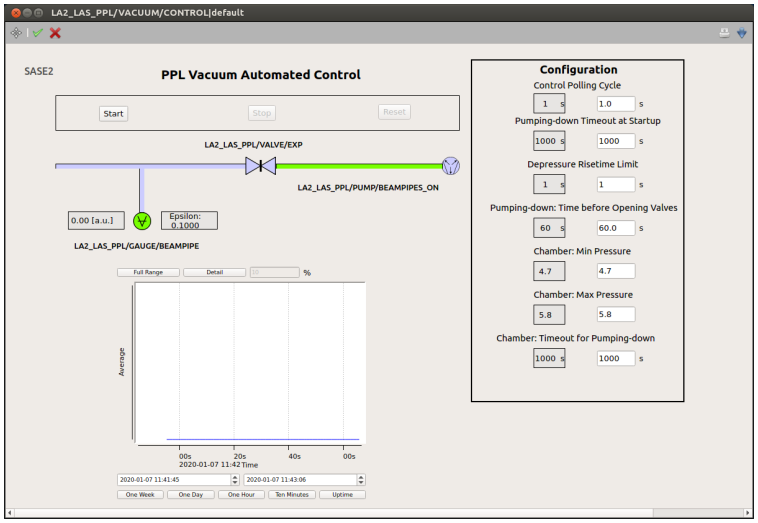

Fig. 2.2: The scene of the pplVacuumControl device for a one-section beamline.

CHAPTER 3

Troubleshooting

Some typical errors have been identified up to now:

- The device cannot instantiate, but remains in **INIT** state: in this case, likely the device cannot connect to one of the needed PLC devices (pump, valve or gauge). The state of those devices (from both karabo and PLC side) should be investigated. They may be in error state, or not instantiated, or the PLC is not connected (PLC troubleshooting);
- In case the gauge readout does not change, although the valve is opened and the pump appears to be pumping, control please that the pump connected to the PLC is fully functional;
- In case no history is present in the pressure graphs, although the gauges are active since some time, then possibly the property **Archive** is set to False. This parameter allows the properties of this device to be logged. In this case, the device should be shutdown, this property set to True, the project saved, and finally the device restarted;
- In case a component was replaced, the previously saved scene may still point to the previous device, thus showing a broken link although the situation in the configuration editor appears fine. This problem is fixed by deleting the old scene, and saving again the auto-generated one.

CHAPTER 4

Indices and tables

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