The analyzer could be divided into four major parts: the experimental computer, high voltage rack (HV-rack), camera and spectrometer with detector. In this technical note we focus on the HV-rack and low/high pass mode in particular.

The HV-rack contains the high voltage cards and the DAC-cards. The rack is controlled by the SES-computer via a USB/serial connection. This connection is communicating with the rack which in turn set the right potentials of each HV/DAC-card via opto fibers (see Figure 1). These potentials are feed to the spectrometer via junction boxes.

The standard analyzer has two pass energy operational modes: low- and high pass mode. Low pass mode is designed to measure low kinetic energies and high pass settings are designed for high kinetic energies. With low pass mode it is possible to measure spectra using pass energies 1-20 eV and high pass energy it is recommended to use for pass energies 50-200 eV. It could be possible to use high pass settings when measuring with pass energies 5-20 eV but the resolution will be affected. It is not possible to measure pass energies 50-200 eV with low pass mode, since the HV-rack can not give out sufficient voltage.

The energy range in which each pass energy could operate depends on the specific lens tables and the individual HV-card setup of the HV-rack. From the 1.2.6.r3 version of the software it is possible to check the range of each lens table by entering the voltage calibration window (Calibration → Voltages...) and then go to View → Energy range. The window in Figure 2 shows this window as it looks in the SES software for a standard R3000 analyzer.

![Figure 2: Energy range window displaying the kinetic energy range of each lens table for high and low pass settings.](image-url)

![Figure 1: Bottom) R4000 standard HV-rack. Top) Zoom in on two of the HV-cards in the rack.](image-url)
To change between high and low pass mode:

1. Turn the high voltage off at the HV-rack.

2. Enter the setup and choose high or low pass mode. A dialog box, as in Figure 3, will appear. Proceed without pressing ok.

3. Change the junction box cable positions to the desired pass energy mode (the same mode as indicated in the dialog box in Figure 1). All HV-cards marked with L (low pass) and H (high pass) needs to be changed.

4. Press ok on the dialog box in the SES program.

As an example the junction box cable for the lens1 element is marked LV1. This element should go in one HV-card for low pass and another for high pass. In a standard R3000 analyzer this means that the LV1 junction box card should be switched between the LV1 L/AV-H and LV1 H cards. For low pass settings the LV1 junction box cable should go into the LV1 L/AV-H card, since the L after the LV1 text on the card LV1 L/AV-H indicates low pass settings. For high pass settings the LV1 junction box cable should be put in the HV-card marked LV1 H, since the H after LV1 on the card LV1 H indicates high pass settings. Further; in the HV-card marked LV1 L/AV-H the junction box cable marked AV- should be plugged in for high pass settings (see Fig. 4). Cards like SCREEN and MCP, that has no marking should not be changed.

For more information about high and low pass settings consult the User Manual section 3-10 C.

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**Figure 3:** High- and Low pass information dialog box.

**Figure 4:** Low (left) and high (right) pass settings for the LV1 L/AV- H and LV1 H cards. The circle in the upper right corner of each HV-card is symbolizing the junction box cables connectors. The blue text in these connectors is corresponding to the cable with the same labeling. The white and red circles are the HV card opto cable connector and LED indicator respectively.