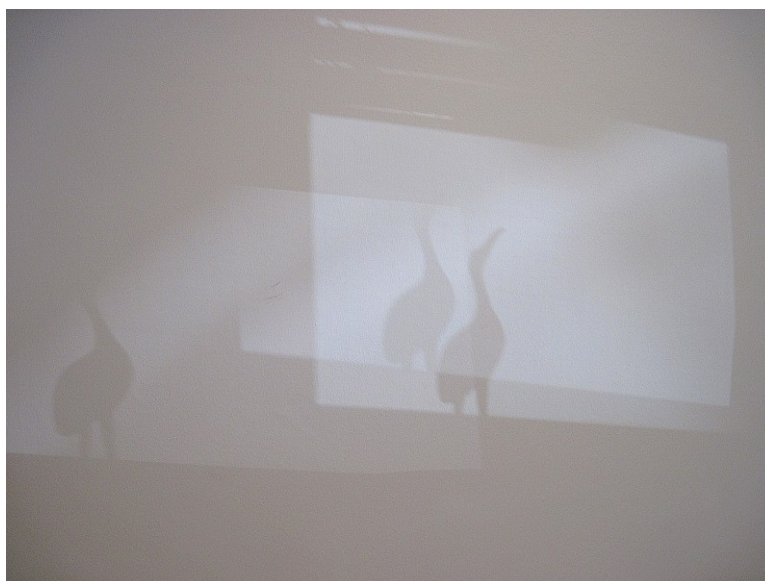


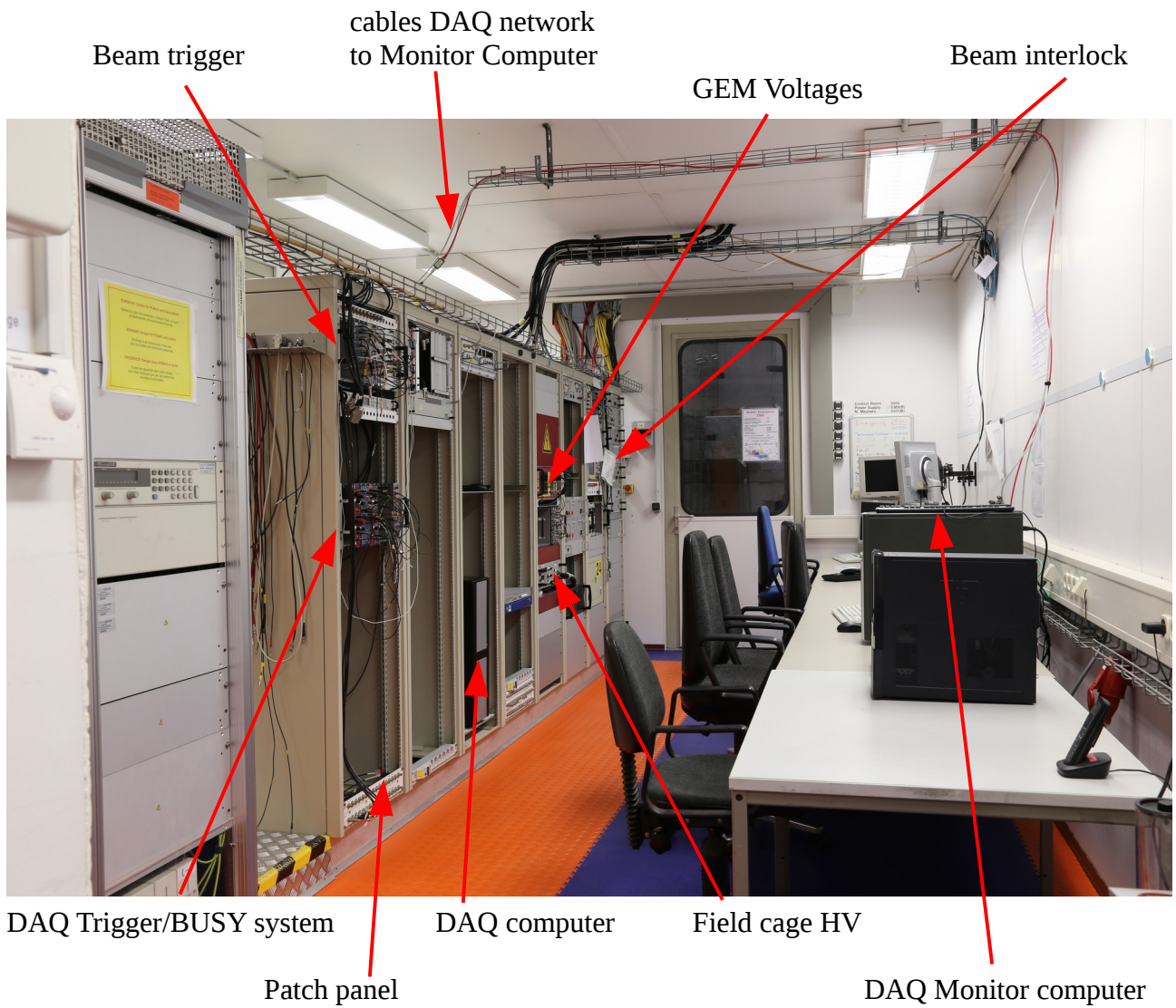
Preparation and setup of the readout electronics for the large prototype TPC
In Pictures
Beam test November 2016
Version 201611



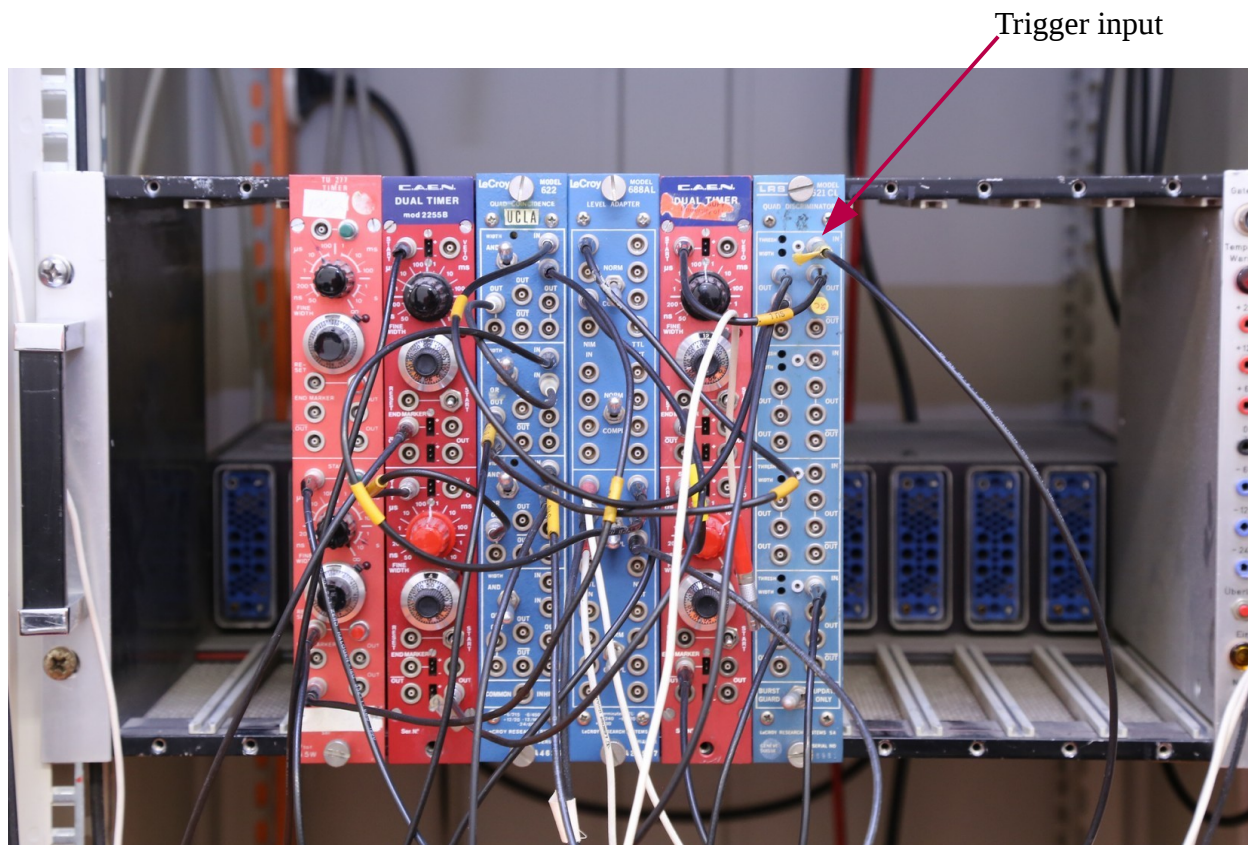
This document can be found in:
[http://www.hep.lu.se/eudet/daq/doc/
beam201611.pdf](http://www.hep.lu.se/eudet/daq/doc/beam201611.pdf)
or in editable form
beam201611.odt

In case you have proposals for changes or improvements please communicate these to Ulf Mjörnmark (ulf.mjornmark@hep.lu.se) or Leif Jönsson (leif.jonsson@hep.lu.se) and they will be implemented if considered relevant.

The control room

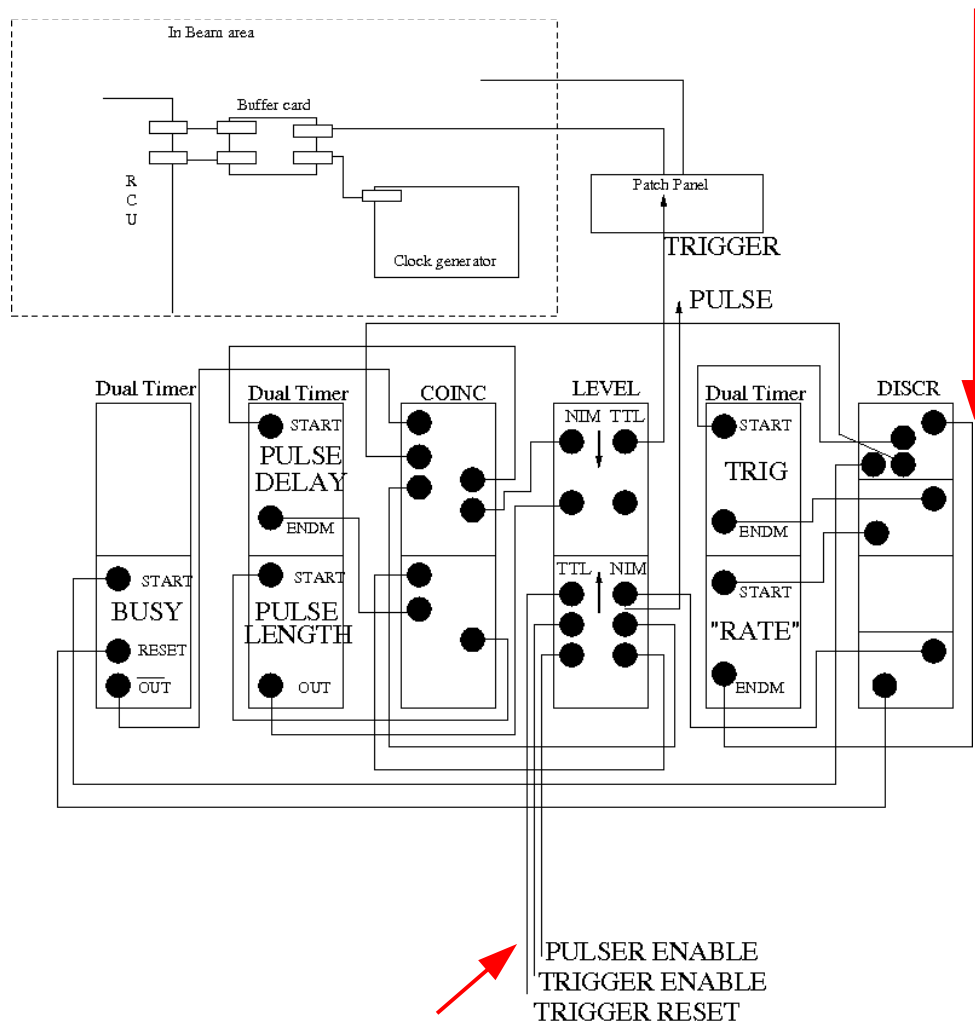


DAQ trigger/busy crate

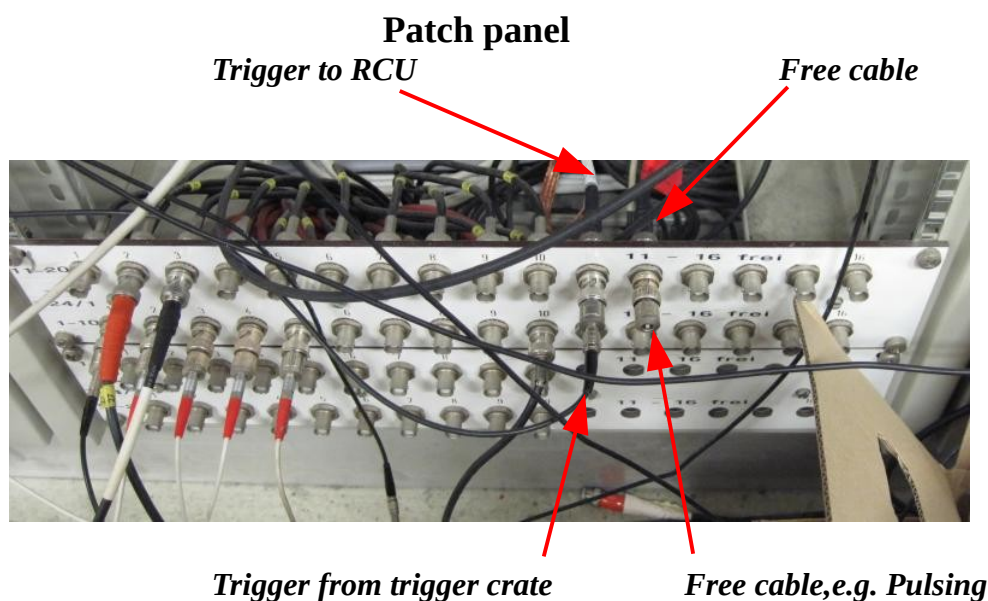


The trigger input can either be a “pulser”, from a dual timer, or the beam trigger. The trigger input is to be changed accordingly. The pulser is used for tests and pedestal runs.

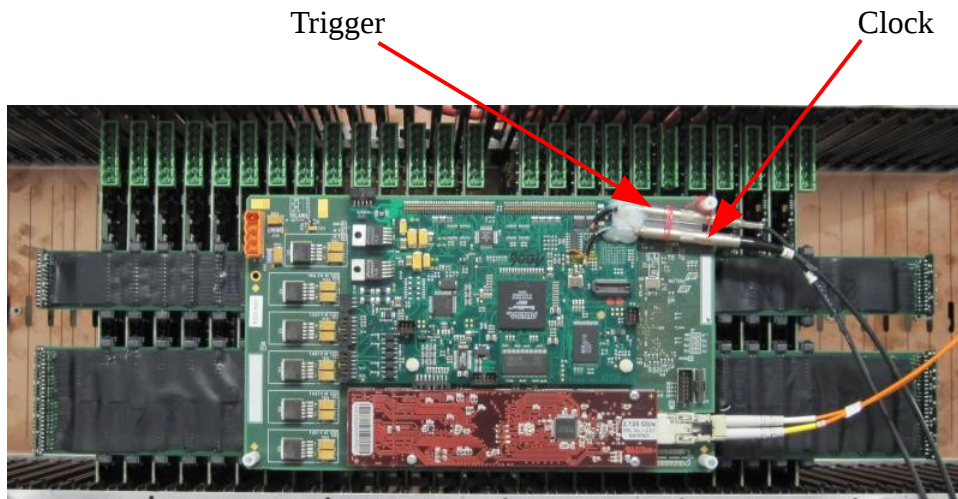
Trigger input(here pulser)



From parallel port on DAQ computer (cable 0 = trigger reset, 1 = trigger enable, 2 = pulser enable)



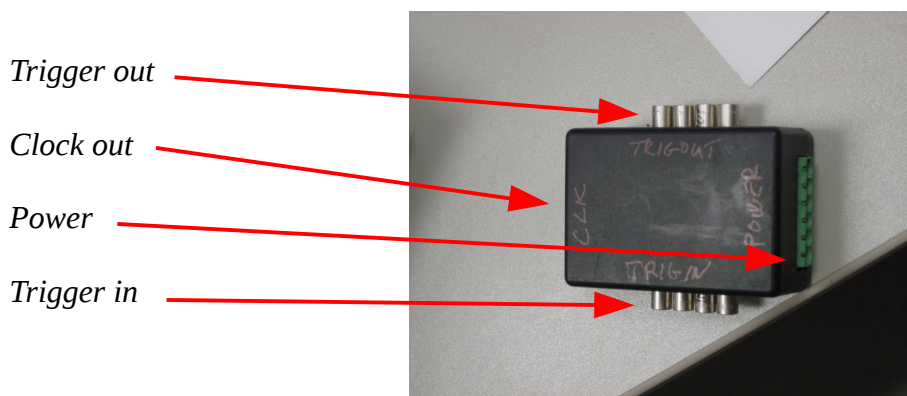
Trigger and clock distribution to the RCU



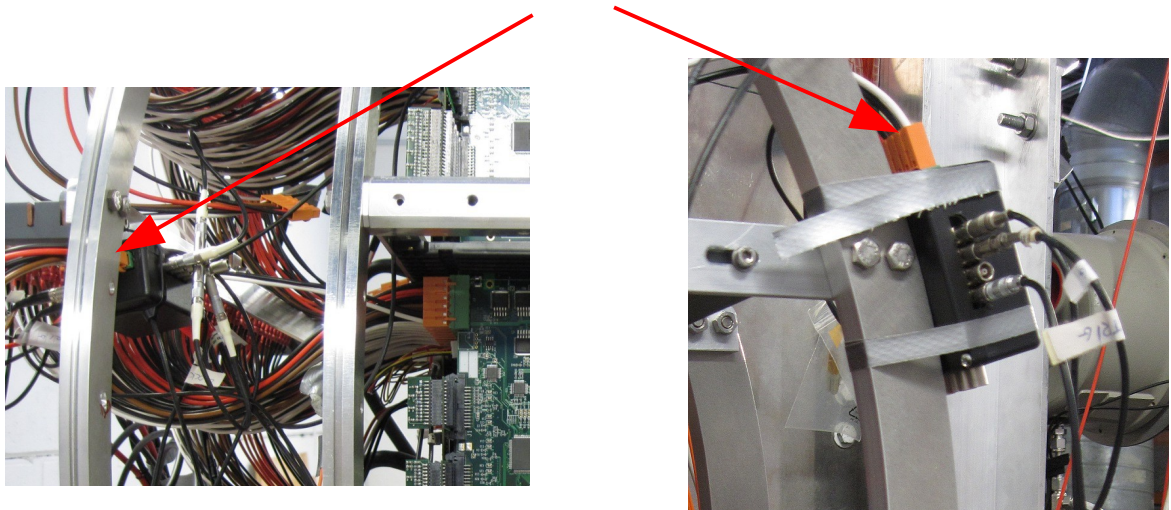
Trigger buffer and clock distribution box at the electronics rings

The box generates the 40 MHz clock for the RCU.

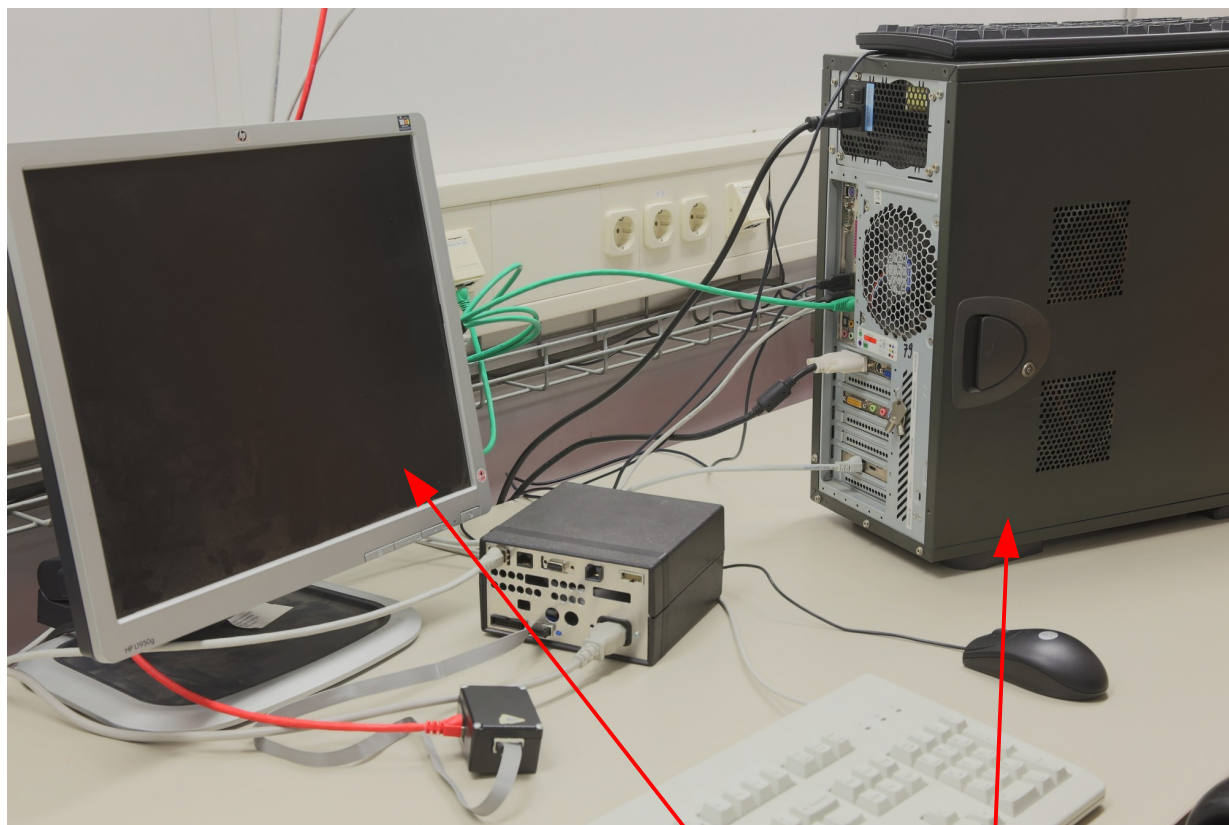
The box acts as buffer for the trigger, for each output must there be one corresponding input.



Power is taken from a power connector for the FECs



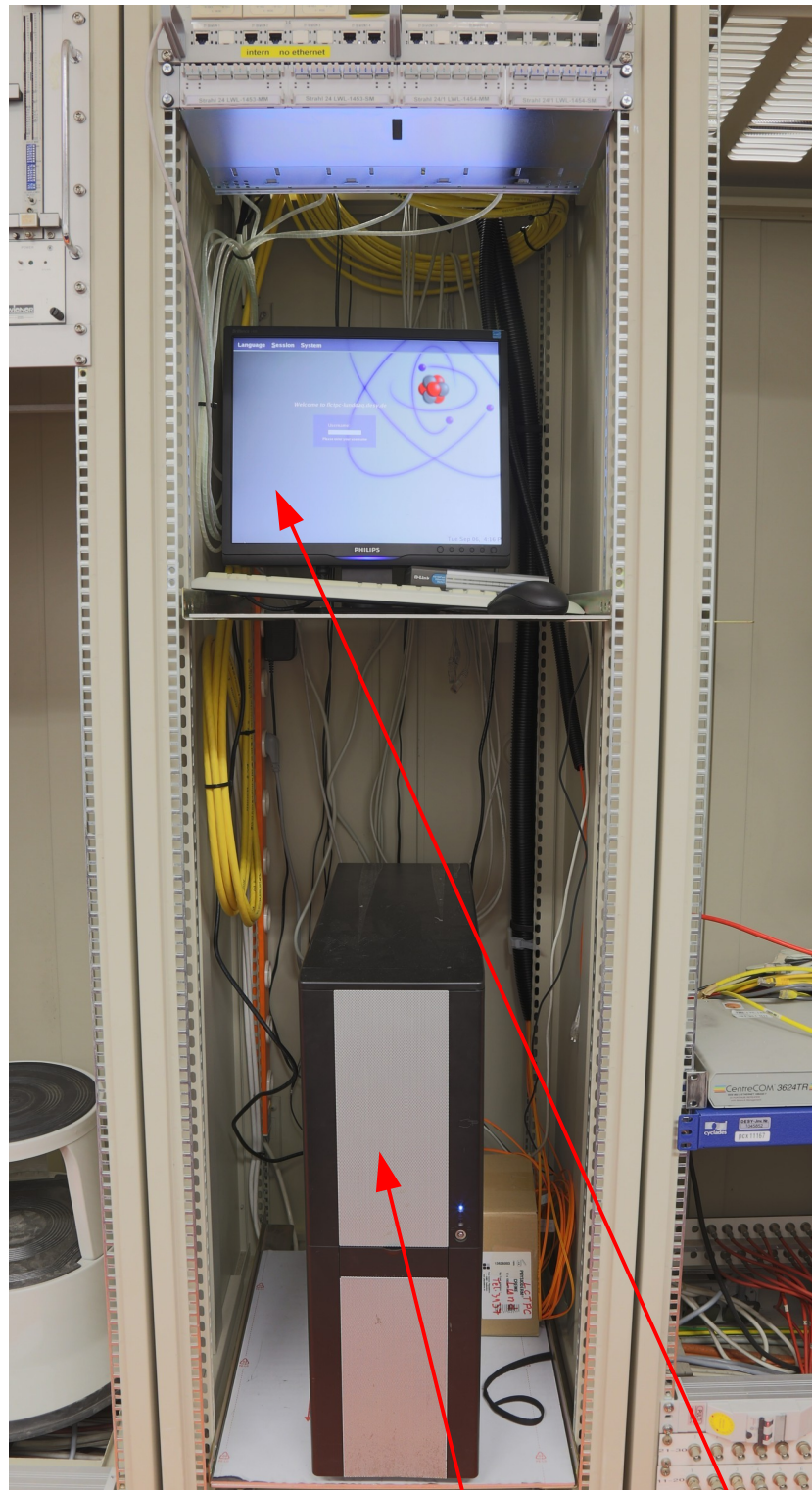
The monitor computer



Monitor screen

Monitor computer
(flctpc-lundmon)

The DAQ computer



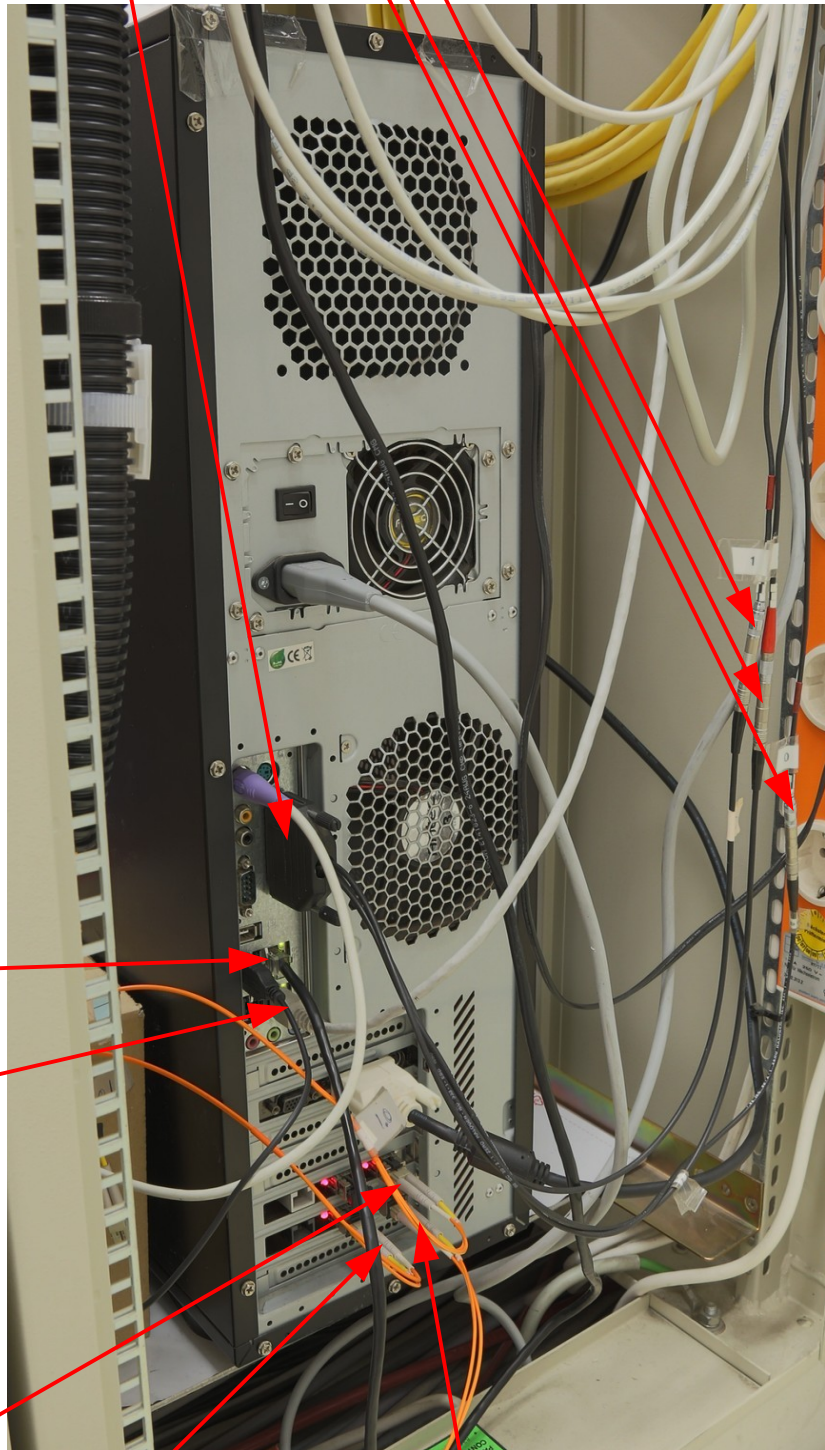
DAQ computer

DAQ monitor

Back side of DAQ computer

Parallel port

Cables to parallel port (cables computer <-> Trigger)



DAQ network

DESY network

Optical fiber 1.0

Optical fiber 0.1

Optical fiber 0.0

DRORC.SERIAL

9034

10081

10081

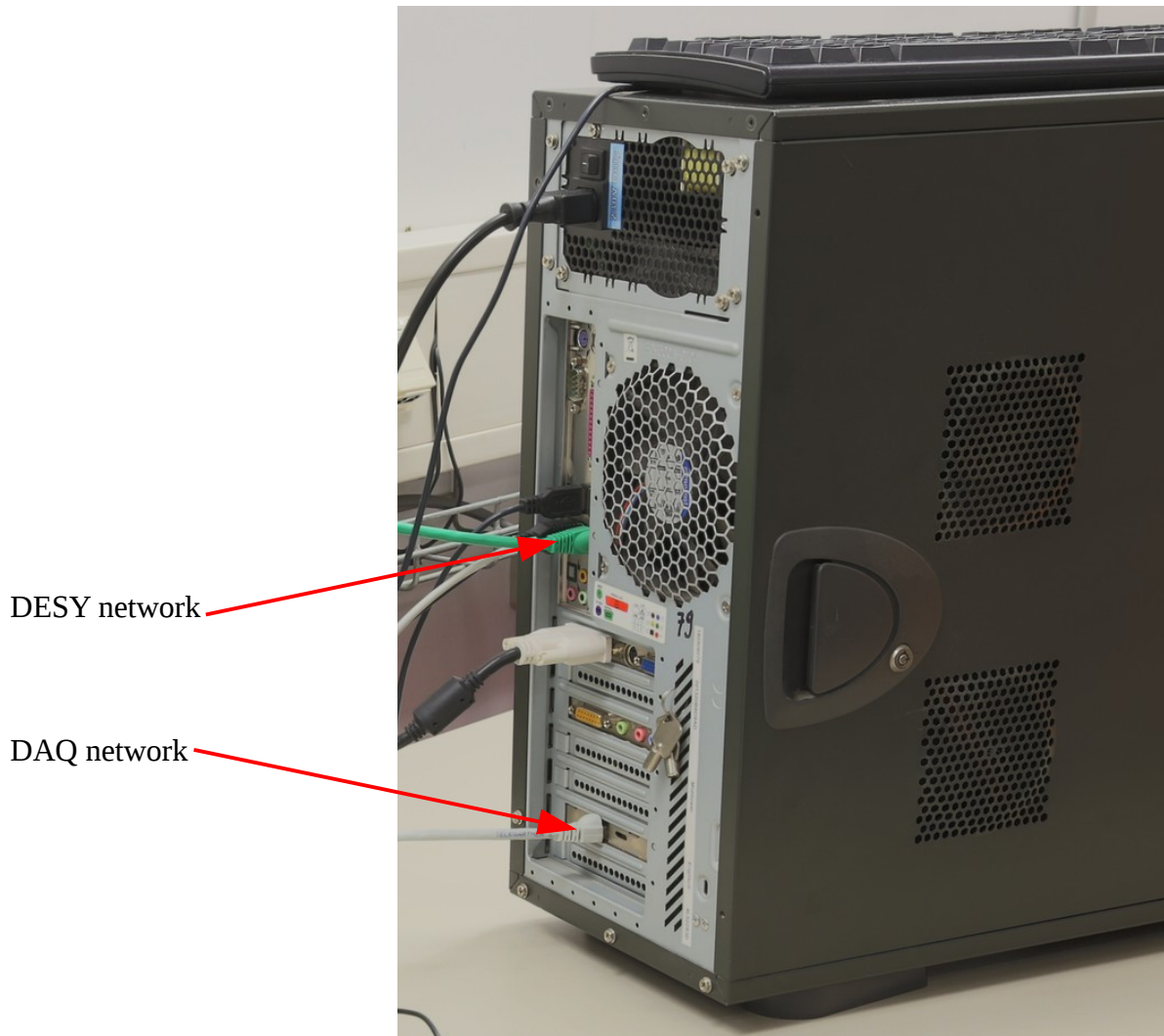
DRORC.CHANNEL

0

1

0

Back side of the monitor computer



Compressed air Cooling system

The compressor is outside the hut



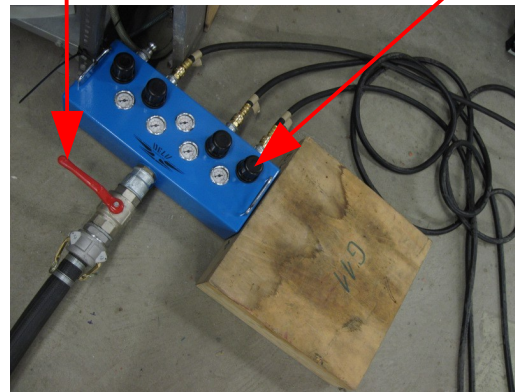
Main ON/OFF switch



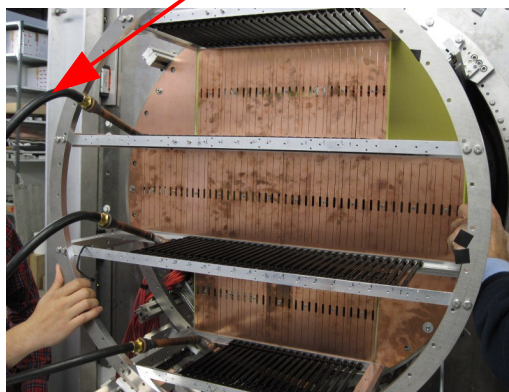
Switch on/off compressor



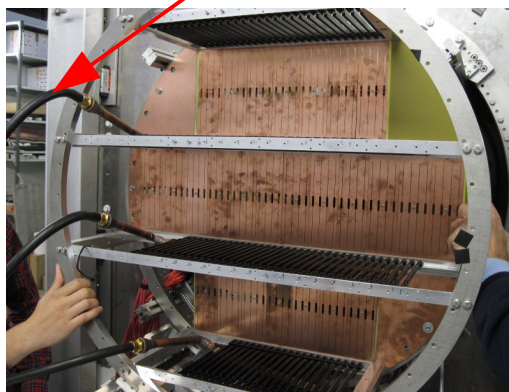
Close/open valve in the beam area
The valve is here in closed position. The pressure should be between 2-2.5.
This can be regulated with the knobs.



Emergency switch off



The cooling pipes at electronics ring



Order of switch on operation

Main ON

Switch on compressor

Open valve

Check that the compressed air flow at the electronics rings

Order of switch off operation

BEFORE SWITCHING OFF, THE FRONT END CARDS MUST BE POWERED OFF!

Close valve

Switch off compressor

Main OFF

Backplanes

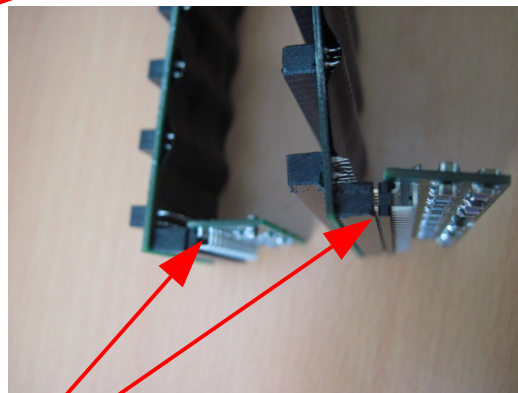
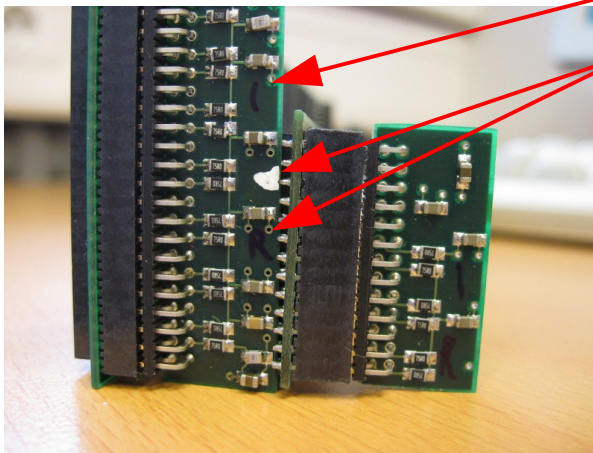
*Orientation of backplanes.
Note that Left and Right refer to as seen from FEC side*



Right seen from FEC side BACKPLANES Left seen from FEC side
BE SURE NOT TO SWAP LEFT AND RIGHT OR PUT THE BACKPLANES IN WRONG RCU CONNECTOR

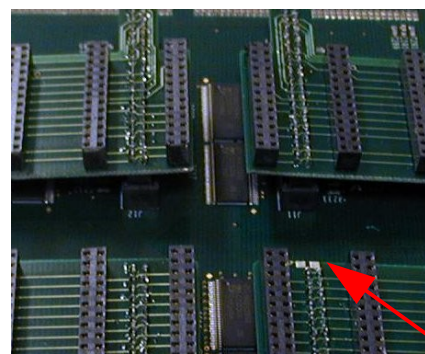
Terminators

They are not identical for Left and Right. They are labeled nL and nR where 'n' is a number.
In addition do the Right side terminators have a white dot on them.



Insert terminator in this orientation, i.e. connector outwards.

The backplanes are labeled nL and nR where 'n' is a number, written on a yellow tape.



On the wide Right backplane are two small 'dots'

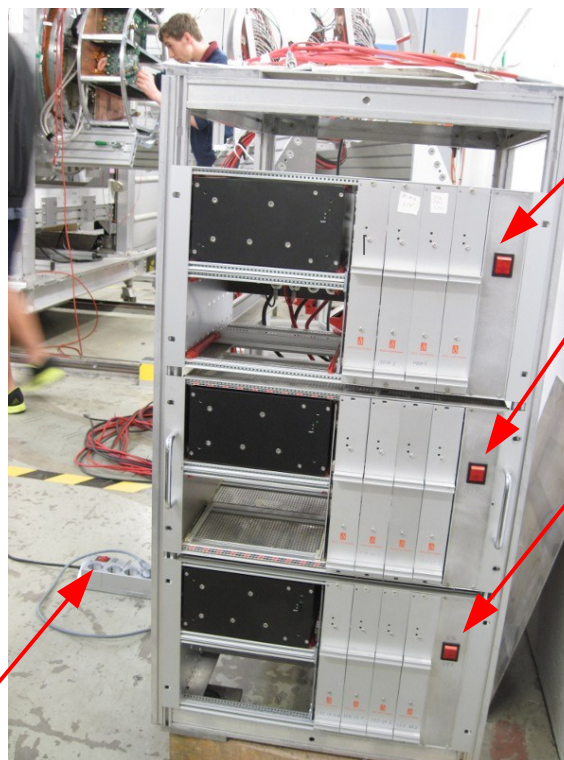
Backplane and terminator combinations

Some terminators and backplanes do not work together with a large number of FECs inserted. The following combinations have been tried with the given number of FECs inserted in the backplane. (N= Narrow backplane, B=Broad backplane).

RCU	Backplane	Terminator	FECs
1005	N2R/B2R	N2R/B2R	10 OK
1006	N1R/B1R	N1R/B1R	16 OK
1006	N2L/B2L	N2L/B2L	15 OK
1006	N2L/B2L	N1L/B1L	15 Not working
1006	N2L/B2L	N1L/B2L	15 Not working

Power system to the electronics

The power supplies



Top level

Middle level

Lower level

Main power distributor

Adjustment of the power levels:

1. Switch on the three crates (red switch which lightens up when the crate is on)
2. Increase the voltages until it reach the desired value (is measured over the copper bars at the power distribution wheel)
3. For the 3.3 V supplies (they are three per crate) check that the currents drawn are about the same for each of the three, using a current meter enclosing the outgoing red cables at the crate. If the currents are very different, adjust them with a screwdriver at the small screws on the front surface (see picture). NOTE: this adjustment requires great feeling.

Order of operation to switch on

Main power distributor must be on

Switch on the levels that are used

Wait until the red light on the RCU become green

(SEE NEXT PAGE).

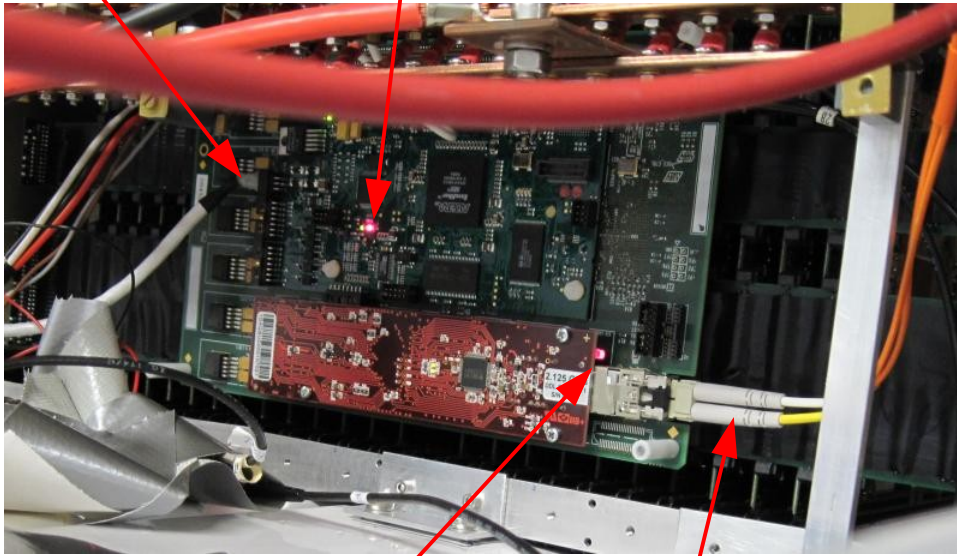
Order of operation to switch off

Switch off all FECs from the run control on the monitoring computer

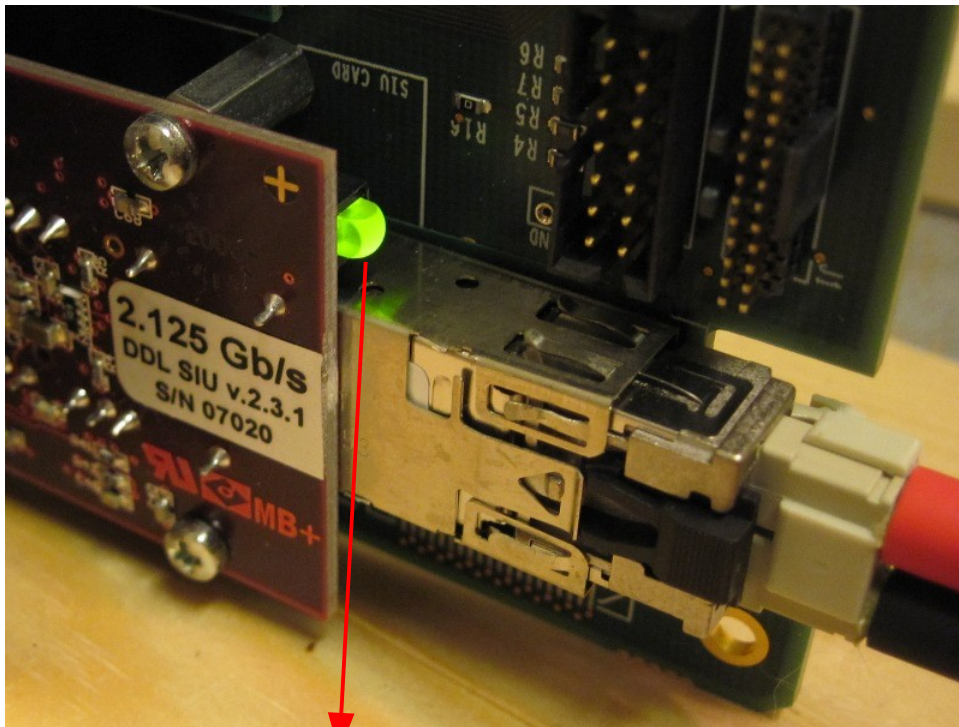
Switch off the levels that are used

Network cable

Red light = network connected

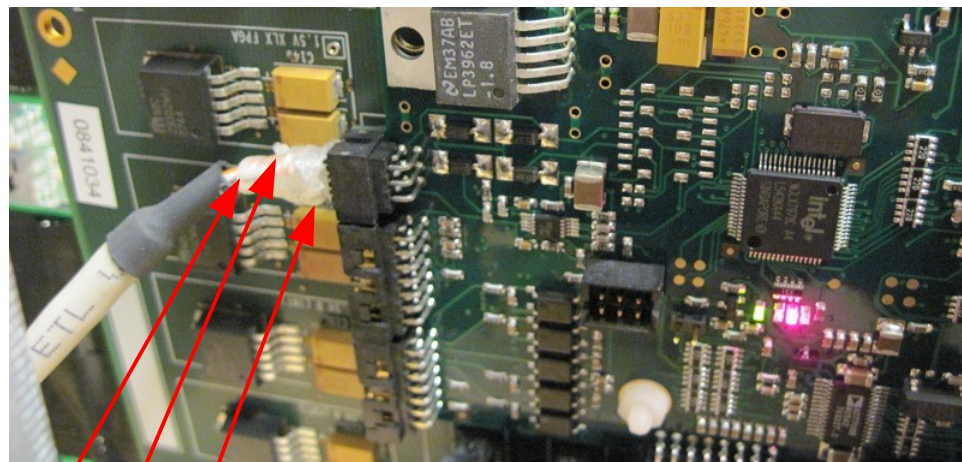
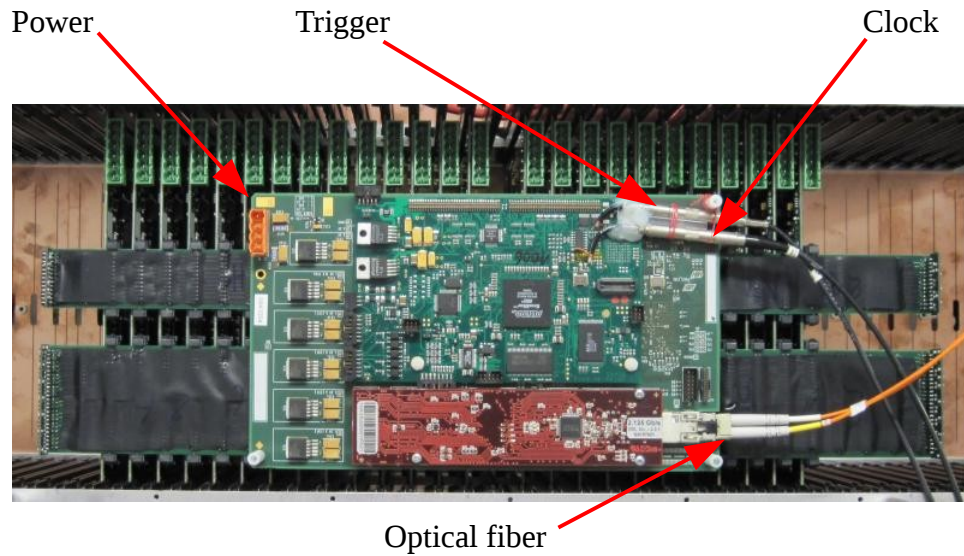


Link status red = link down Optical fiber 0.0 -> DAQ



Link status green = Link Up

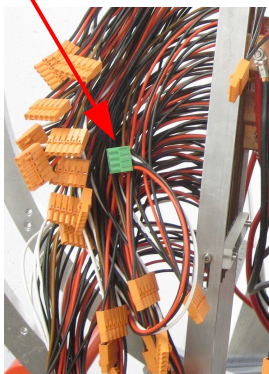
Cable connections on the RCU



Network cable – note the color of small cables:
Orange (upper left)
White/orange (upper right)

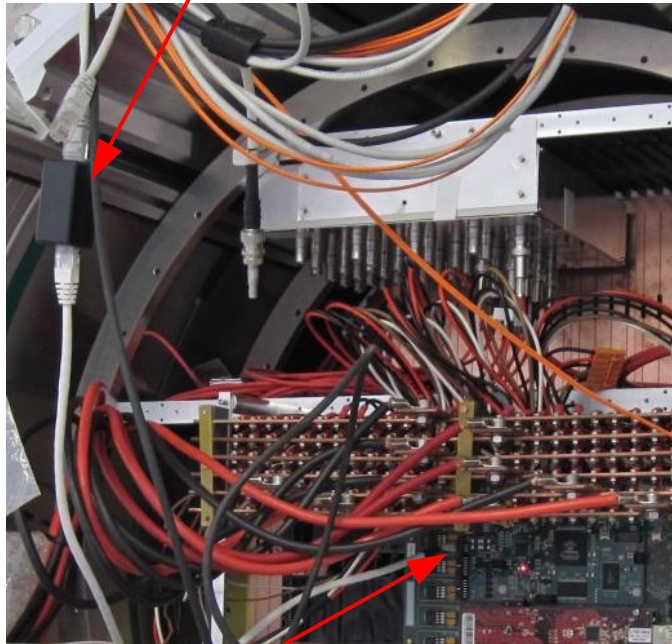
The network is normally not needed to be connected, it is used for debugging purpose in this setup.

Power to RCU is taken from the 5V power bars. These cables have diodes to drop the voltage to the proper values for the RCUs.



Network

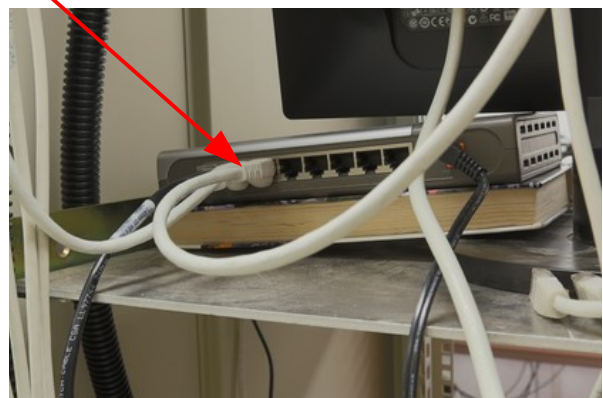
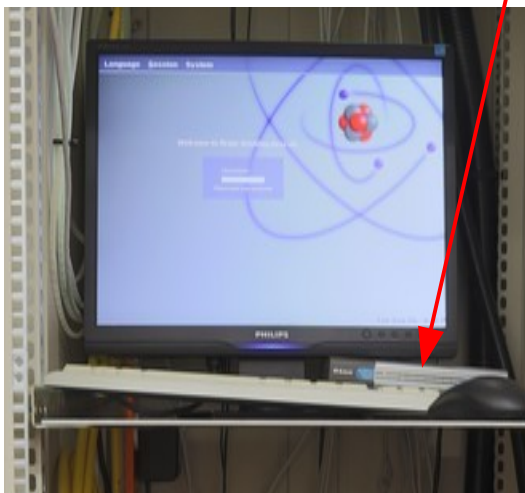
The special RCU network cable is connected to the control room through a network cable, at the RCU side is there a RJ45 adapter to which to connect the RCU cable.



Connect to RCU as described above

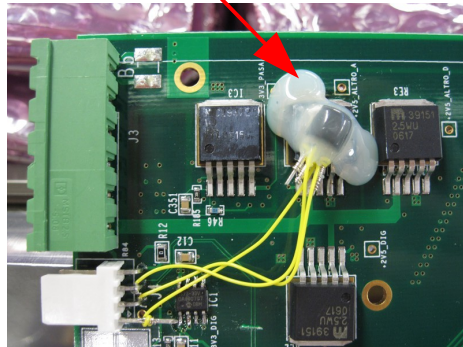
DAQ Network

DLINK switch with
RCUs, lundmon, lunddaq, and temperature monitor

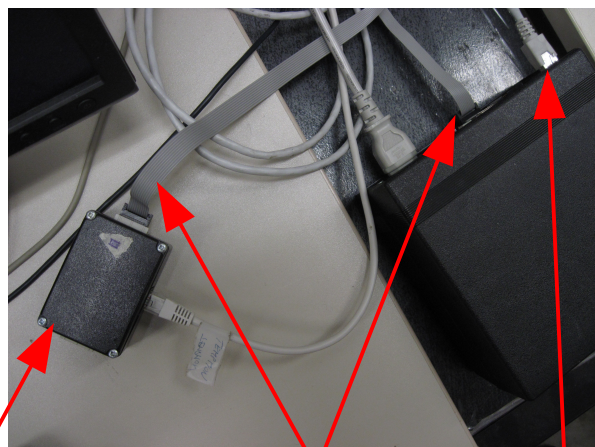
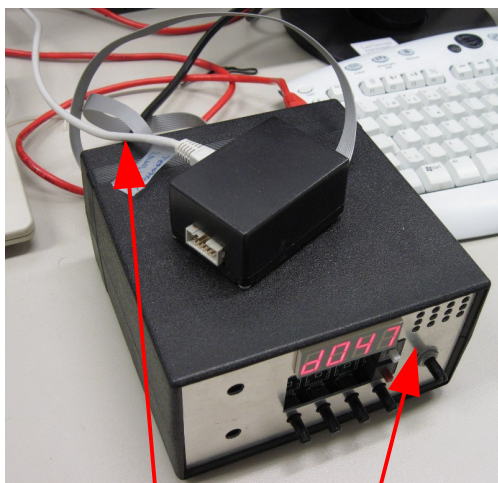
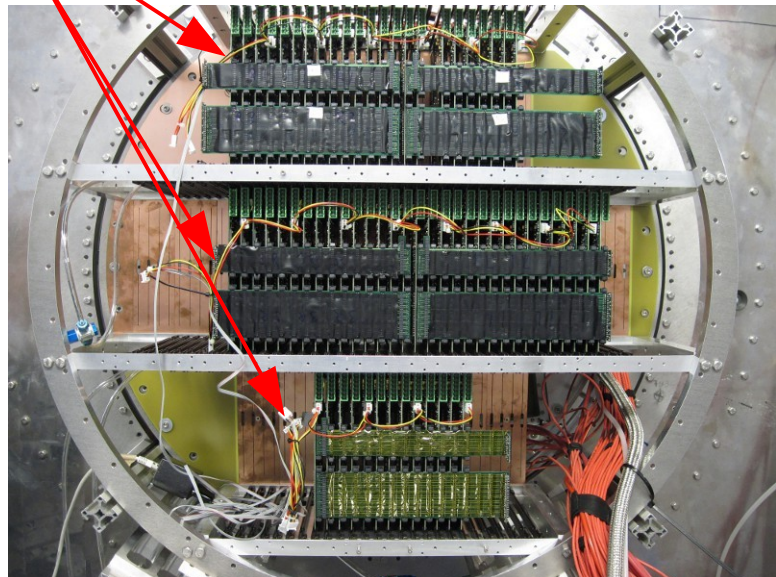
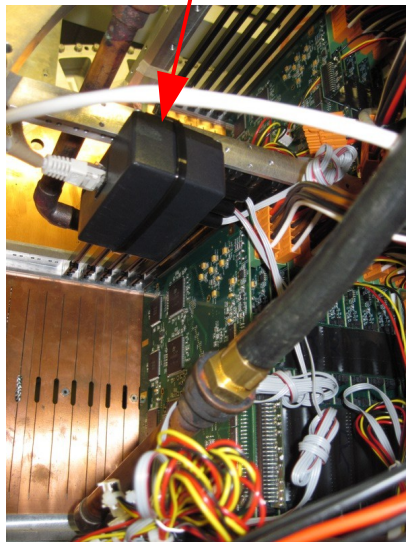


Temperature monitoring

On some FECs are temperature sensors placed (glued) on the 3.3V input voltage regulator for the ALTRO chip. These sensors are read through an I2C bus with a microprocessor box in the control room, which sends the values via ethernet to the run control computer.



At the FECs there is a box that takes 3 I2C bus lines with temperature sensors, into a 20 meter RJ45 cable to the counting room, where it is connected with the microprocessor box via a small interface unit. The microprocessor is connected with ethernet to the local switch.



RJ45 cable from electronics

Interface

Cable to microprocessor box

DAQ network

Microprocessor box with highest temperature value

In the run control computer the temperature values are logged. These can be analyzed for a given day with the command 'tempplot YYYYMMDD'. The result is plotted in a pdf file. The name of the file is output from the command. The sensor with the highest temperature is displayed on the microprocessor box, as well as in the run control.

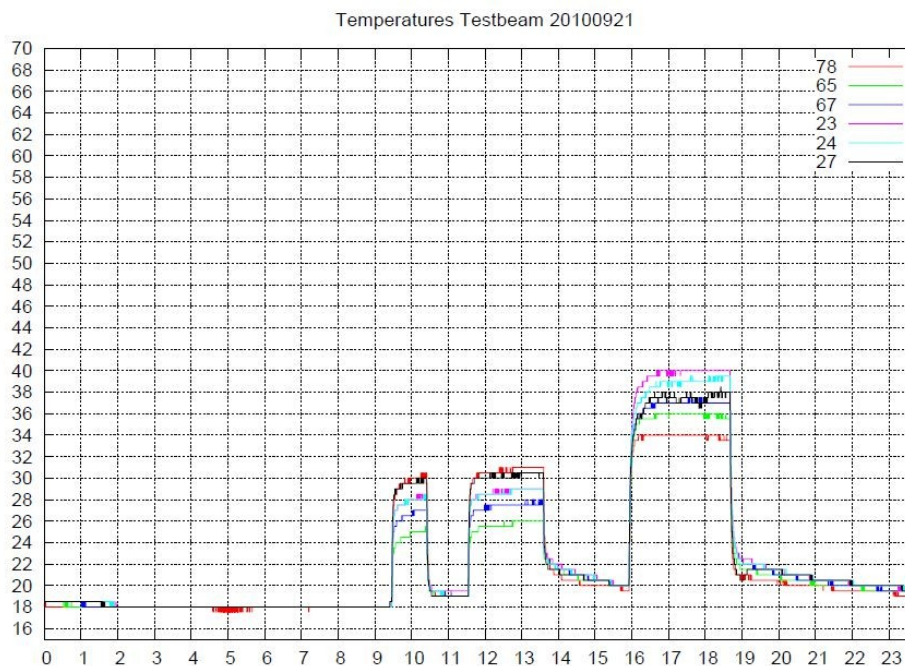
The screenshot shows the Run Control interface. On the left, there's a sidebar with 'SCRIPT' (highlighted in cyan), 'Events: 125', 'Run: 16752 [2010-03-04 14:26:19]', and an 'Exit' button. The main area displays 'Temperature alarms:' with a log entry: '[2010-03-04 14:25:45] ALARM level: 1 sensor: 1 value: 44'. Below this, a status bar shows '[2010-03-04 14:26:36] Sensor with highest value: 1 value= 44'. At the bottom, there are controls for 'Run type' (Physics selected), 'Run mode' (Pedestal subtraction and Zero suppression selected), and a 'Monitor' section showing '1 Read events'.

In case of too high temperature there is a software controlled automatic power off of the FECs. If there is a run going on will this first be stopped. In the case the software do not work is there NO automatic hardware switch off. For safety, the temperature should be manually monitored.

If there has been an automatic shutdown the 'Alarm' indicator in the run control becomes red and all actions in the run control are blocked until one has clicked on the red 'Alarm' indicator. This is to prevent accidentally switching on the power again without any cooling.

The screenshot shows the Run Control interface with a red 'Alarm' indicator. At the top, there are two rows of status indicators for RCU0, RCU1, RCU2, and RCU3. Below these, there are checkboxes for 'Load lookup tables at power on' and 'Load lookup tables at Start DAQ'. A red arrow points to a red 'Alarm' button. To the right of the 'Alarm' button are 'PowOn' and 'PowOff' buttons.

Example of a temperature plot. The legend is the FEC card number. The temperature should be below 45 degrees. If the temperature increases above that then one can try to increase the compress air pressure.

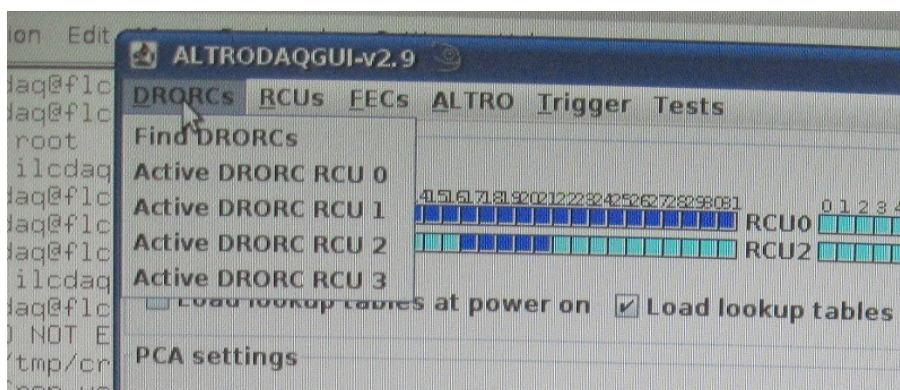


Mapping between DRORC channel and RCU number

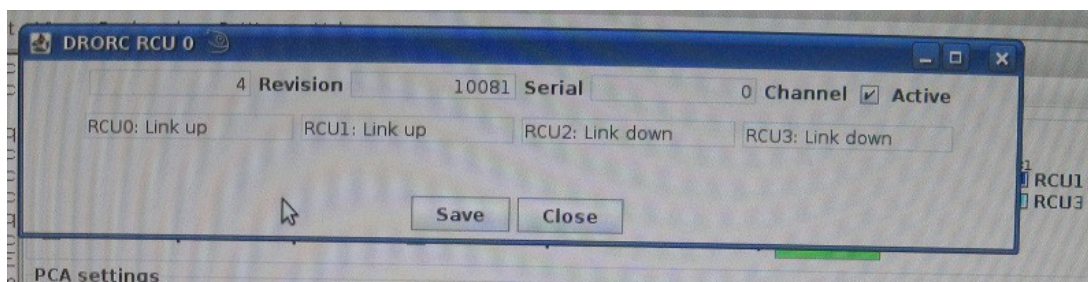
There are three optical fibers between the test area and the DAQ computer in the control room. The connection between cable label and the DRORC channel is shown on a picture further up in this document. For the mapping of the RCU number (0-3) connected to which DRORC one needs to know to which DRORC serial number and channel number the optical fiber is connected:

Optical fiber label	DRORC serial number	DRORC channel
0.0	10081	0
0.1	10081	1
1.0	9034	0
No cable	9034	1

The mapping can be done from the run control, from the menu DRORCs:



Select 'Active DRORC RCU n' where n is the RCU number you want to map to a DRORC channel.



Enter serial number and channel number to which you have connected the optical fiber for the 'RCU n' according to the table above, and set the DRORC channel to be active.

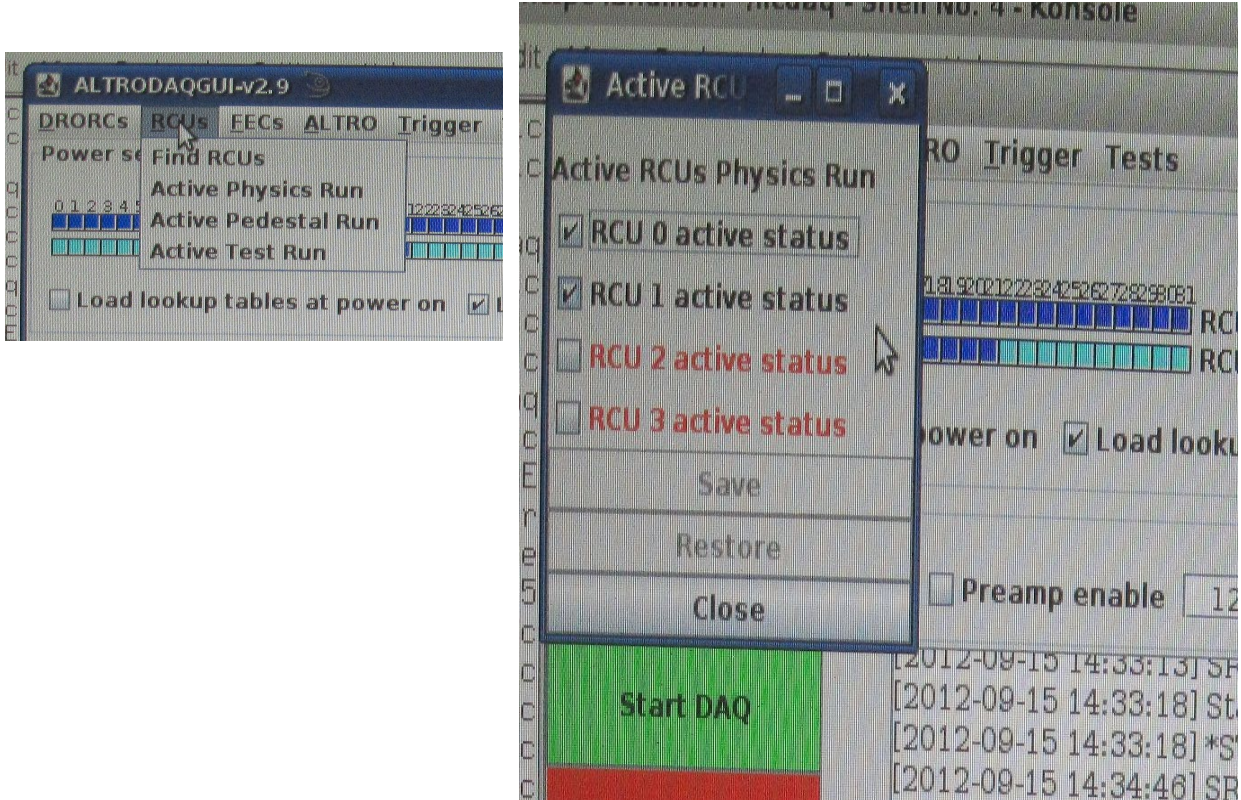
NOTE1: If you do not want to readout this DRORC channel, you should set it not active.

NOTE2: The program do not recognize if the optical link is up or down, one must do the 'Find DRORCs' to scan links for being up or down. Only links which are known to be 'up' will be readout.

NOTE3: Do not enter the same serial number and channel number for two RCUs. There is no check in the program for this.

Activating RCUs and FECs to be used in the readout.

For activating the readout of the RCUs, select in the menu 'RCUs' → 'Active Physics Run' and check the RCUs to be used. RCU indicated in red are connected to a nonactive DRORC channel. Activate the same RCUs for pedestal runs. Important to do both for physics and pedestal runs.

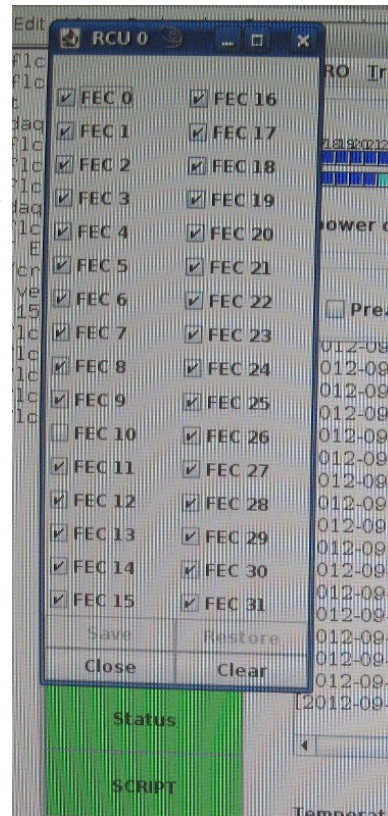


When this is done, and after powering up the electronics, do from the 'RCUs' menu 'Find RCUs'. *This should be done before powering on the FECs.* If all is well configured, the power status should be 'red' (= OFF) for all FECs for the activated RCUs. The other RCUs should be '(light)blue'.

The FECs to be powered on and to be read is set in the menu 'FECs' → 'RCU n', where n is the RCU number for which to activate the FECs.

NOTE1: After modifying the readout list one has to do a power on of the FECs again. Not used FECs are powered off by default. This will also make a reload of the lookup tables.

NOTE2: It is possible to set a FEC active and still not read any channels from it, but this require editing a configuration file on the DAQ computer.



APPENDIX

Power and currents for 201209 setup with RCU on the top and middle.

Upper 10 cards

V at supply	V at rail	Current	Current 1	Current 2	Current 3
-	3.59	15.5	5.7	3.4	6.2
-	5.05	3.2	-	-	-
-	2.60	8.8	-	-	-

Middle 31 cards

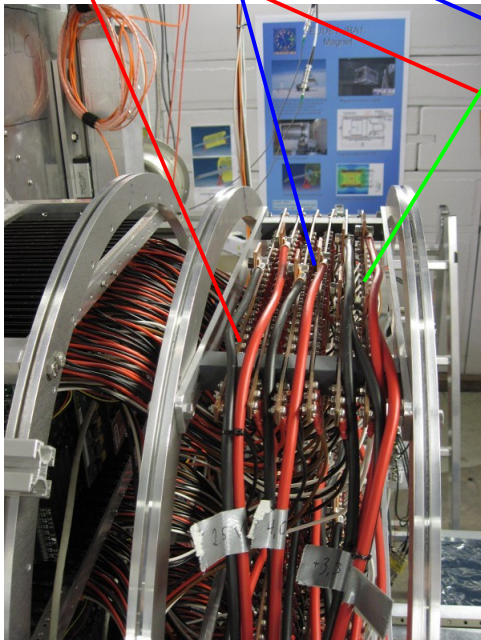
V at supply	V at rail	Current	Current 1	Current 2	Current 3
3.73	3.31	46	18	12	16
5.08	4.99	5	-	-	-
2.82	2.45	22	-	-	-

The three supplies for 3.3 V is setup to have roughly equal currents, and such that the V at the rail is 3.3 V. One has to adjust the voltage from one of the three supplies connected together one by one, until the currents are roughly equal and the voltage at the rail is 3.3V. Some iteration is needed.

V = 2.5

V = 5.0

V = 3.3 (three together)



Note that the 3.3V supplies are three connected together, with two power cables out. The supply for 5V has cabling labeled 4V. Why? Should the supply give out 4V?

What do write down when mounting the electronics

The backplanes and terminators labels. Each backplane and terminator is labeled as described above.

Which FEC is placed in which backplane slot. On each FEC is a number written. The slots on the backplanes are numbered as:

RIGHT backplane branch: 16-31 starting with 16 from the left.

LEFT backplane branch: 0-15 starting with 0 from the right.

Where right and left are as seen from the FEC side.

On the RCU is a number written. Write down the number and the corresponding location in the electronics ring (i.e. RCU # vs (lower,middle,upper), as well as the optical fiber connected.

