Guide to replace NIKA2 electronic boxes for thermometer readout ('iMacrt')

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1 Electronics for NIKA2 thermometers readout

The NIKA2 thermometers are read out using dedicated elctronic boxes developed at Neel institut. Each box is composed of two parts:

- A small box, called **iMacrt**, which is located inside the CRYOcontroller electronics box, the one in the cabin just above the cryostat. This box contains the card with the firmware to readout the thermometers, control the amplifier used in the process, and communicate with the NIKA2 network.

- A second box, this time directly mounted on the NIKA2 cryostat (difficult to see, as it is hidden on the side towards the vertex). In this second box there are a series of amplifiers and signal generators that are the ones reading the temperature of the thermometers. They are mounted directly on the cryostat to minimize the noise pickup. Note that this second box comes in two versions: **MMR3** that is used to readout the temperature of up to 3 thermometers (3x in NIKA2), and **MGC3** that can send a current to up to 3 heaters to regulate the temperature of a particular stage (1x on NIKA2).

The MMR3 and MGC3 components are relatively solid ones, and in principle they will note pose problems. One spare of each is in any case available at the telescope.
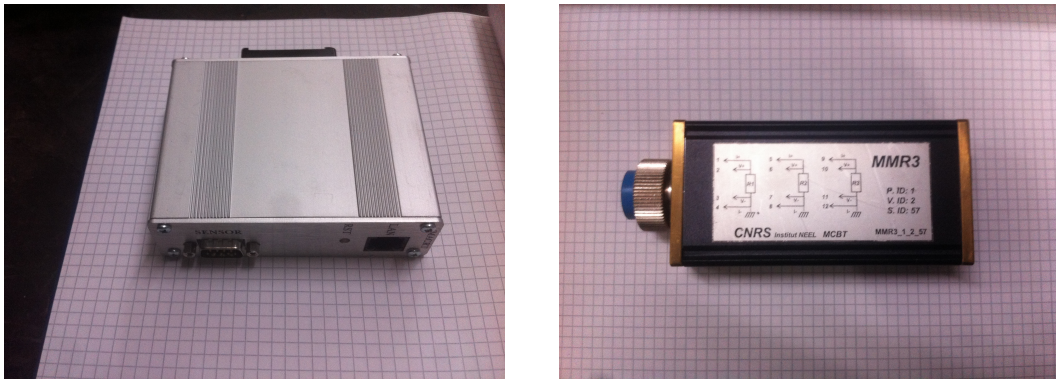

Figure 1: Examples of an iMacrt (left) and an MMR3 (right). The MGC3 for the heater control has exactly the same shape of an MM3R but its colour is red.

The iMacrt on the other hand have apparently some issues do to components ageing, so if some problems are observed on the readout of theromemeters or temperature regulations, they are the likely culprits.

2 Replacing a faulty iMacrt

First of all, keep in mind that sometimes an unresponsive box can be easily recovered via software, in which case no replacement is needed. If the problems keep reappearing regularly, on the other hand, it might be a good idea to replace the faulty box. Contact the NIKA2 team before proceeding, in order to get a confirmation that this is the right thing to do!

To identify the faulty box, check which one of the iMacrt is not responding. The configuration on the network is the following:

- 192.168.1.81 → readout of thermometers on 4K stage.

- 192.168.1.82 → readout of thermometers on Still and on the PT 'warm stages' (30K and 70K approximately).

- 192.168.1.83 → readout of thermometers on Mixing Chamber.

- 192.168.1.84 → control of heater on the Mixing Chamber.

To check if everything is fine, from a PC in the NIKA2 subnetwork open the corresponding adress in a browser. You should see something similar to what is shown in figure 2. The values should refresh once every 5 10 seconds. If there are a lot of red lines, or if value don't refresh after a long wait, then something is probably wrong. Note: the third channel on box 192.168.1.83 is always red, as there is no thermometer connected. So don't worry about it.

If you realize that a box is not working, and you consider that it is important to have this it available, you should first try to reboot the thermometer (ask the IRAM-NIKA cryo staff). Remember that sometimes it is better not to touch. For example, if observations

Figure 2: Example of the web page of a fully working iMacrt+MMR3 system.

are ongoing and a thermometer for a PT temperature is giving problems, then it might be better to wait the end of the run, or at least a moment when the observations are stopped, before intervening.

If the 'sofware' reboot does not suffice, or if the problems keep reappearing regularly, then the iMacrt should be replaced. There are 4 backup boxes, each already configured to replace one of the channel (the corresponding IP address is marked on the box itself). Therefore, the replcament is (almost) straightforward. It is in any case strongly recommended to do this with the assistance of one of the NIKA2 instrument experts (even from remote). The steps to do are the following:

- Go to the cabin and open the electronics box located above the NIKA2 cryostat (it can be opened only partially due to the 'arm' of M3). Note that this can be done even while observations are ongoing, but the risk is that, if the MC temperature is being regulated, the regulation might have to be turned off (or this might happen by mistake). This would translate in a drift in the temperature of the detectors which could affect observations. So be careful and inform the observers!

- Identify the iMacrt to change: once you know the IP of the faulty box, use the figure 3 to identify the corresponding iMacrt inside the electronics box.

- Unplug the ethernet and the black cable from the box to be replaced. **Be careful**
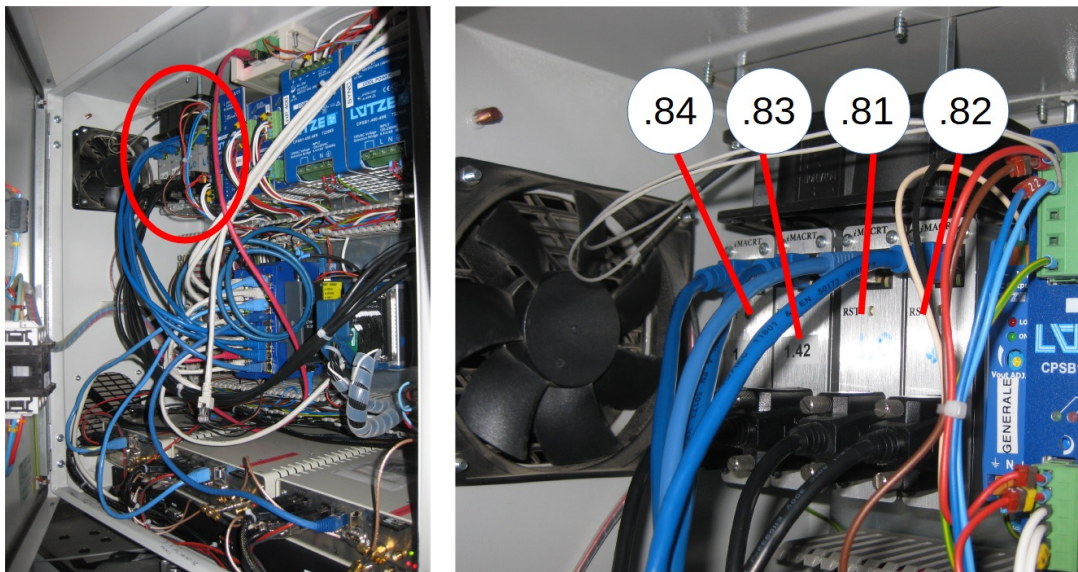

Figure 3: Positions of the iMacrt inside the NIKA2 cryostat electronics box (red circle on the left figure) and correspondance between the various iMacrts and their IP adress (right). Note that the numbers written on the iMacrt do not forcefully correspond to their IPs (that used to be in te .40-.43 range before switching to .81-.84).

when working with the iMacrt as they are very near to the fan for the electronics box ventilation. **Avoid touching the fan with your hands or you could get harmed!**

- **Carefully** pull the iMacrt outwards. This boxes are attached to the rail on the back. You have to find the best way to pull it out. Typically, a good technique is, from the bottom, reach to the back of the box and then pull it out. Keep the old iMacrt aside and send it back to Grenoble for repair (you can wait for someone travelling to Grenoble).

- Take the backup iMacrt configured with the IP of the one to be replaced. **Carefully** put it in place at the place of the faulty one. The process is a bit tricky, you have to find the correct move for it to 'click' to the rail. Last time I was lucky and after 5 minutes I got it in place. If you really can't, you can fix it temporarily with some tape then try again at the end of the run or when someone of the NIKA2 team is there.

- Plug back in the black cable, and then the ethernet cable.

- Try to leave a bit of space between the different iMacrt boxes so that the air flux will be able to cool them down efficiently.

Ok, it is done. Open a web page, try to access the thermometers page, and check that it's ok. Note that the readout takes a few minutes to stabilize, so it's normal if at first all the readings are in red. If after 5 minutes the readings are still all in red, on the web page change the 'MODE' and 'I MODE' to 'PRIORITY CURRENT' and 'AUTO RANGE' respectively (if they are not already so), then wait 5 extra minutes.

The readings should in the end become green. If this is not the case, or if the thermometer is not accessible on the expected IP address, or again if the mulfuctioning that convinced you to change the iMacrt is not solved, contact someone from the NIKA2 team and decide together how to proceed.

Note: after the replacement of a thermometer box, the corresponding reading might not be automatically updated in the cryostat control program. If this is the case, contact a NIKA2 team member.