PCA Training

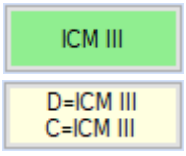
Getting started

1 What is PCA and what it is used for?

a. PCA is a SW internally developed by GSI used to configure power converters. The configuration consists in a set of parameters used to adjust all the possible power converter regulations (and as consequence the behavior).
b. It can be used to perform FW updates as well as semi-automatic power converter commissioning procedure.
c. It requires an USB connection between the power converter and a PC. In the PC the .NET driver has to be installed as well as the D2XX FTDI driver (https://ftdichip.com/drivers/).

2 How does PCA looks like?

a. The PCA outlook reflects the HW control unit's (ACU) modules. Each module has its own form where the user can tune the module settings and monitor live the measured quantities.
b. The typical ACU system is made of a MFU (the control system brain), one or more ADC modules (used to monitor the magnet current/voltage) and a module (usually ICM) that collects interlocks, activates the power converter and drives the semiconductor switches.
c. It is possible to connect up to 10 modules to the MFU. The communication protocol between the MFU and the other modules is performed with a custom internally developed protocol (USI). It is important to define in PCA the correct module both in terms of FW version and of USI connection in order to align the control system architecture with the PCA SW representation of it. When everything is aligned, the defined modules background color is green. If there is a mismatch, the color is yellow and it is possible (left clicking the module icon) to check the discrepancy in the "Description window" in the setup form.



d. In order to open the module form, a right click on the icon has to be performed.

3 What is a PCA configuration file?

a. A PCA configuration file is a file with .XPC7 extension that collects all the power converter settings mentioned above. When the save button in the "Main" form is pressed (alternatively `File`→ `Save` or `Save as`), a .XPC7 file is generated. With that it is possible to save the power converter tunings without doing that every time from scratch.

4 How are the settings saved in the power converter?

a. A copy of the configuration file mentioned above is saved by inside a MFU memory flash. Every time the ACU system is powered up, the configuration file is automatically loaded from the flash and used to setup all the modules. In order to reduce the number of flash writing actions (increasing the chip life time), all the ACU settings can be written to a MFU RAM and after the settings validation, they can be moved to the flash.

b. The MFU RAM and flash writing actions are performed with two buttons (green and yellow arrows respectively) placed in the “Main” form. When the “Write flash” button (yellow) is pressed, the configuration file is first saved locally on the PC and after that sent to the flash. This will ensure that the configuration file on the PC and the one used by the power converter are aligned each other. Please note that the configuration file is saved on the PC and permanently stored in the power converter only when the yellow button is pressed. When the settings are sent to the RAM  (green arrow), the configuration file is not locally saved and the settings inside the power converter are lost if an ACU power down is performed.

5 How does a form look like?

a. Each module form is made of more tabs. Each tab collects a set of parameters coherent to a thematic. Below there are the typical tabs of a module form:
   i. *Environment tab*: it collects the module status information (temperature, measured quantities, switching status, etc..)
   ii. *Interlock tab*: it displays the interlocks status and gives the possibility to properly name the interlocks as well as to mask them if they are not relevant for the power converter activity.
   iii. *Controller configuration tab*: It is usually made of those modules used to perform a controller action like PI controllers. It can also have the semiconductor switches driver module (PWM generator).
b. On each tab there is a button used to send the parameters related just on that tab to the RAM. Of course the button is not there if the tab has not parameter to send (like the *Environment tab*)
c. In case there is the possibility to monitor live internal quantities during the power converter setup, on the tab there is a button to refresh those quantities.

6 The MFU form has a little bit different structure compared with the other module forms. This because in the MFU form it is possible to setup more functionality:

a. Which data have to be exchanged (in both ways) between the ACU modules (*USI High Speed configuration tab*).
b. What the power converter information is (*PSU Data tab*)
c. How the main control loop looks like (*Controller configuration tab*)
d. How the internal function generators (used to emulate the accelerator control room) is setup (*Function generator tab*).
e. Which signals are connected to the internal oscilloscope (*Internal oscilloscope tab*).
f. How it is possible to turn the power converter on and off via PCA (*Remote Control tab*).
g. etc..

7 In order to be sure to work with the correct power converter configuration file, it is possible and recommended, via PCA, to read that file directly from the MFU flash. This action is possible in two ways:

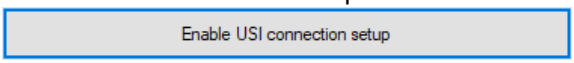
 a. By clicking the blue button on the setup form.
b. Performing an auto-configuration when PCA is started.

As soon as the configuration file is read and the forms loaded, please check if all the modules icons backgrounds are green and after that save the configuration file locally on the PC

before going forward with the setup. In case there is no configuration file stored in the flash, this is communicated via a popup window.

8 Configuration files generation (from scratch). There are two ways:

a. If PCA is connected to the power converter (on line mode), clicking the "New" button in the "Main" form (alternatively `File→ New`) it is possible to automatically define all the modules forms that PCA detects automatically. In this way the configuration file generation is easier and faster than doing it manually.
b. If PCA is not connected to the power converter (off line mode), then the manual module definition is the only way possible. To do that, the user should be aware of the ACU structure and FWs versions. Only after getting those info, clicking the "Enable USI Connection Setup" button



it is possible to select and allocate on the right USI the right module with the right FW version.

9 FW update via PCA: as mentioned on the point 1-b, PCA can perform a module FW update. This feature can be considered as a PCA spinoff because it has nothing to do with power converter configuration and it can run even if no configuration is loaded by PCA.

a. Start the program in the "Main" form: Tools→FW Update.
b. On the drop-down menu below the USI label, select which ACU module has to be updated
c. Click the "Browse" button and select the .rbf FW file (or the .s19 for the NIOS)
d. As soon as it is selected, check if the file is listed in the "File to upload list" expanding the tree nodes.
e. Repeat the steps b, c and d for all the ACU modules to update
f. In case of a mistake, select the file in the "File to upload list" and click the "Remove" button
g. Last step is clicking the "Update" button. Before the update starts, a summary of the incoming FWs updates is displayed in a popup window. Click "Ok" and wait till the end (also communicated via popup window).