# Manual for the MCA and Configurator Utility

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## I. Program function and manual organization

The MCA/Configurator utility has two main functions which are tied together, so they're presented in a single program. The first function is as an MCA, enabling one to look at the detector output and decide on ROIs (Regions of Interest). This is the function whose controls are on the top half of the screen, as shown in Figure 1. The second function is as an editor of configuration files. In this capacity, the program can add or delete logical scalers of any of the supported types (currently: Ge detector output (XIA), analog and pulse counter (NI)). It also lets you manage the 'file-of-config-files', allowing one to switch in different scaler map and XIA config files. Since XIA-type scalers are defined in part by ROI settings, the second function depends on the first and so it made sense to merge them. The front panel has a black line (not shown in figures), above which are the MCA controls and indicators, and below which live those relating to scalers and files.

First, I shall discuss the use of the MCA part to be found above the line. Next, I'll review the config-file structure and what the user needs to have access to. Then, I'll go over each of the below-the-line functions, wrapping up with a short 'cheat-sheet' of procedure summaries.

## II. MCA functions

Figure 1 shows a typical screen from the MCA part of the utility. The white Configuration control on the left shows which XIA configuration file is being used. This is a file which tells the XIA detector-control system about how to run the detector

and includes such information as how many detector elements there are. This indicator is automatically preloaded from the meta-configuration file used by the EXAFS program. If none of this makes sense, just note for now that the detector setup is copied from what is used by the EXAFS program and that all this 'file' structure will be discussed below. You can choose among several detector configurations which have been pre-set by choosing a different one from the Configuration control and hitting the green Set button. The big red light at the upper left goes on while the setup is being loaded.

The hexagonal array of radio buttons selects which detector's output spectrum is being plotted. If the configuration is one appropriate for a 7-element detector, any of the buttons will work. If it's only a 1-element detector, you won't be able to select any but element 0. There's also a Σ button which plots the sum of all elements. To the right of the detector selection buttons is a control for the count time. The detector will count for that amount of time, then either clear itself or keep accumulating counts. Most commands only take effect after the current count period has elapsed.

The big red STOP button does the obvious – ends the program. Next to it is an indicator showing how many detectors there are.

Below all these controls is the graph. It has a pair of cursors you can use to define ROIs. The Add to ROIs button below the graph causes a filled area to appear as defined by the cursors. Note that if two ROIs overlap, the ones set earlier will cover later entries. The Remove ROI button removes the last ROI from the list and its plotted manifestation from the graph. The legend to the right of the graph shows which color goes with which ROI. The three lists to the right of the graph show the ROI upper and lower channels and the number of counts in each ROI. The X mode switch toggles the abscissa between

channel number and energy. The energy calibration is done using one of the pages in the tabbed control below the black line. On startup, it's set to 10eV/channel, no offset. When the Clear Spectrum switch (below the graph) is up (`ON`), the spectrum is cleared before each collection. Otherwise, it's added to. To clear the spectrum, flip this switch `ON` and wait for the next update.

The Gate mode switch determines whether gate pulses should be generated on each count. Leave that on for normal operation.

To calibrate the energy scale, start by putting the cursors on two peaks of known energy. The two peaks from $^{55}$Fe (shown) are too close together to be useful. One way to get a good calibration is to interpose a Ti foil between the $^{55}$Fe source and the detector and use the Ti fluorescence as your low-energy point. Next, click on the Two-point energy calibration tab (Figure 2). Enter the energies of the peaks in the white spaces and hit the Calibrate to these values button. You can use the energy syntax of the EXAFS program, except for the keywords `start, end, mid` which refer to scans. This, in the $^{55}$Fe/Ti example, you could enter `tikf` and `mnkf` and use the highest peak from the $^{55}$Fe and that from the Ti fluorescence as calibration points. Thus, `8048, cukf` and `cuk-930` are all valid ways of specifying an energy, and all specify nearly the same energy.

## III. Configuration file structure

The EXAFS program has several layers to it which make for a complex structure of configurations, most of which the user doesn't need to deal with. This structure is shown in brief in the EXAFS program cheat sheet. The top-level file is one which

specifies other configuration files. For that reason, it's the 'file-of-config-files' or the 'meta-config' file. This file refers to other files specifying the EXAFS scan, the XIA configuration, the scaler map and the monochromator configuration. The "scaler map" file deserves some special attention. The EXAFS program records the counts in logical scalers which may physically be ADC (analog) channels, pulse counters, or ROIs in one or all elements of the Ge detector. These types of scalers are referred to as analog, NI (for National Instruments – the manufacturer of the counting board), and XIA, the latter referring to the manufacturer of the device which runs the detector. An example of such a file, with comments added to each line, is:

```
[Gate]                      Defines the gate-pulse generator
board=1                     Which NI6602 board
counter=0                   Which channel is used for gate
[Scaler 0]                  The first scaler - numbering is 0-base
type=660x                   A channel of the 6602 counter
board=1                     Same board as  the gate
counter=1                   This counter is used as a counter
[Scaler 1]
type=XIA                    Ge detector
detector=0                  The first element.
roilow=400                  Low end of region-of-interest
roihigh=600                 High end of region-of-interest
[Scaler 2]
type=XIA
detector=-1                 Add up all 7 elements
roilow=500
roihigh=600
[Scaler 3]
type=Analog                 An A/D channel
counter=3                   The 4th channel
[Scaler 4]
type=end                    That's all - there's no scaler 4.
```

As you can see, this file can be read and edited by a human, but it's tedious. The purpose of the whole below-the-line section (except for energy calibration) is to make this automatic. Each kind of scaler has one or more properties such as which ADC channel to use. Thus, scaler 3 is defined as a readout of Channel 3 on the ADCs.

The overall structure looks like this:

```
Meta-config → scan definition
              mono config file
              scaler map file
              XIA config file → detector config → detector spec
                                                  DXP values
                                                  DXP firmware
                                                  Fippi firmware
```

The detector spec file specifies how many detector elements they are and what slots the processor modules occupy in the CAMAC crate. The DXP and Fippi stuff refer to data and code loaded into the XIA modules to make them work with the specific detector.

Confusing? Yes, but you don't actually need to know how to set any of the XIA config file stuff. Files have been set up and linked to descriptive names. Thus, if you need to change shaping times or detectors, you can choose the appropriate config file from the list in the Configuration control, then hit Set, do your other editing, then use the Modify Files tab to write new config files or modify old ones. Similarly, to set up a scaler map, you can use the controls in the Add XIA scaler(s), Delete scalers, Add NI scaler, or Add analog scalers to set up your scalers the way you want, then again use the Modify Files controls to write the new files. All config files are ASCII so you can check your work.

## IV. Scaler map editing

The scaler map, as the program presently understands it, is displayed in the cluster indicator to the right of the tab control. This indicator has two functions – it lets you check your work, but its most important function is that it specifies where added scalers should go in the list or which scaler to delete. The index display (the little box with a number and an up-down arrow) controls the current position in the list. Thus, if that display reads 0, you will add a scaler to the front of the list or delete the first one. If it reads 2, then you will add one before #2 or delete #2. If it reads a number greater than

the last index, then the display will be grayed out and a new one will be added to the end of the list.

Now let's look at the Add XIA scaler(s) tab (Figure 3). The left half specifies which ROI in which detector or set of detectors to add. Note that if you follow one of the three branching paths, it reads almost like a sentence. This sentence tells you what the Add button in the middle will do. Thus, the top Add button will make a scaler consisting (in this example) of the counts in ROI 0 in detector 0. The line of text after the Add button tells you where the new scaler will go. In this case, it will become scaler 0, and the analog channel now displayed will become scaler 1. Similarly, the middle Add button causes 7 new scalers to be added if the detector has 7 elements. These go in order before the first existing scaler. The bottom Add button adds a new scaler which represents the sum of all scalers, in ROI 0. Note that the color of the Add ROI # button changes to match the color of the ROI plotted on the graph.

Next comes the Add NI scaler tab (Figure 4). These scalers are defined by a channel and a board number. As of this writing, there's only one board (1) and only channels 1,3,5 work. This screen also reads like a sentence. A small complication is that the gate pulse which enables counting for the NI and XIA scalers is generated by one channel on an NI board (as of this writing, channel 0, board 1). The scaler map file tells which channel and board that is. The program won't allow you to set a scaler to be on the same channel and board as the gate generator. If you try, the Add button is grayed out. This button is also grayed out if you try to make a duplicate scaler, that is one with the same channel and board number as an existing scaler.

The Add analog scaler button (Figure 5) is simpler than the Add NI scaler button because there's only a channel number and no need to check for the gate channel.

The Delete button is the simplest of all. It does just what it says on the button. Again, change which one gets deleted by clicking on the up or down arrows in the index display of the Scaler properties indicator.

There are Undo and Redo buttons below the tab control. These allow arbitrarily-deep undo and redo of the commands which add and delete scalers. They don't let you undo the energy calibration, ROI or file modification functions.

Finally, we come to the Modify files tab (Figure 7). This is the one which lets you write into config files. This tab lets you write a new meta-config file based on different mono and XIA configurations. Thus, if you've been using a shaping time of 0.5μs and want to change to 1μs, you can load in the appropriate XIA config using the Configuration control at the top of the screen, then use the Write file of config files button to write the new choice into the meta-config file. Now, when you run EXAFS, the detector will be used with a 1μs shaping time.

Another important use is in rewriting the scaler map file. After having edited the scaler map using the other tabs, you can hit the Write scaler map file button, which will prompt you with a file dialog. The name of the scaler map file currently specified will be the default choice. You can either overwrite the current file or write a new one. After that, if you have written a new file, you can do Write file of config files to make that choice known to the EXAFS program.

## V. Procedure summaries

1. To calibrate energy scale:

   Expose the detector to a source which yields widely-separated peaks of known energy.

   Position cursors to these peaks.

   Click on Two-point energy calibration tab, enter the energies, then hit the button.

2. To set up ROIs:

   Flip the Clear spectrum? switch to No and let a spectrum accumulate.
   Use the detector radio buttons to view the different detector elements.

   Use the cursors to bracket an appropriate energy range.

   Push the Add to ROIs button. A filled region will appear on the spectrum.

   Push the Remove ROIs button to remove the last one if you need to. Repeat as needed to get the set you want. Indicators on the right side of the graph show the ROI boundaries and counts.

3. To add an XIA (detector) scaler:

   After ROIs are set as you like, click on the Add XIA scaler(s) tab.

   Choose the position in the list of scalers at which you want to add the new one by selecting the appropriate index on the Scaler properties indicator.

   Choose the ROI you want to add, then choose either a single detector (using the top branch), all detectors (middle) or the sum (bottom) and click on the appropriate Add button. This adds the requested ROI/detector combination(s) to the list.

4. To add an analog or NI (pulses) scaler:

   Click the appropriate tab and select the desired position as with the XIA scalers.

   Select the channel and board (for NI) numbers.

Push the Add button. If this button is grayed out, you either have a duplicate scaler already set or are trying to use the gate counter as a counter.

5. To delete a scaler:

   Select the scaler you want to delete in the Scaler properties indicator.

   Click the Delete tab and push the button.

6. To write the new scaler map into a file:

   Click the Modify files tab.

   Push the Write scaler map file button. The file dialog that comes up will be preloaded with the name of the current scaler map file.

   If you wrote a new scaler map file and want the EXAFS program to know about it, push the Write file of config files button.

7. To change detector configurations:

   Choose the new configuration with the Configuration control at the top left of the screen.

   Click the Modify files tab.

   Push the Write file of config files button.

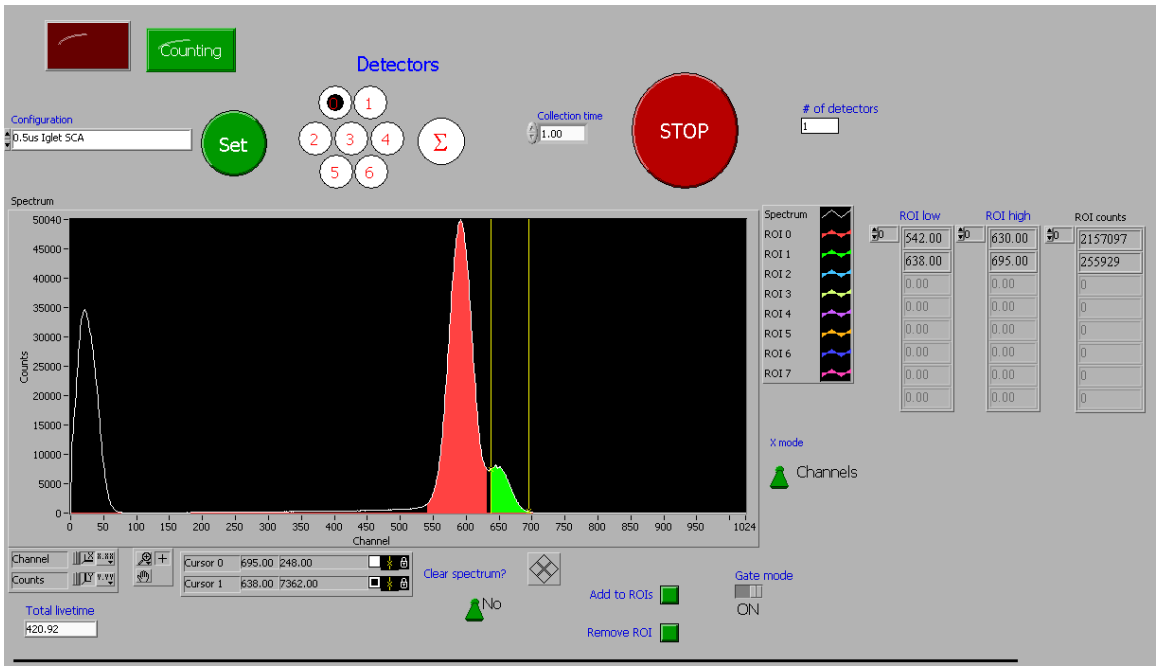


*Figure 1. The "above-the-line" MCA screen showing two SCA's and detector 0 counting.*


*Figure 2. The "below-the-line" screen for calibrating the energy scale. To use, fill in the white typing areas with the energies for the two cursors and hit the `Calibrate to these energies` button. You can use all of the syntax of the EXAFS code except for the `start`, `mid` and `end` keywords.*

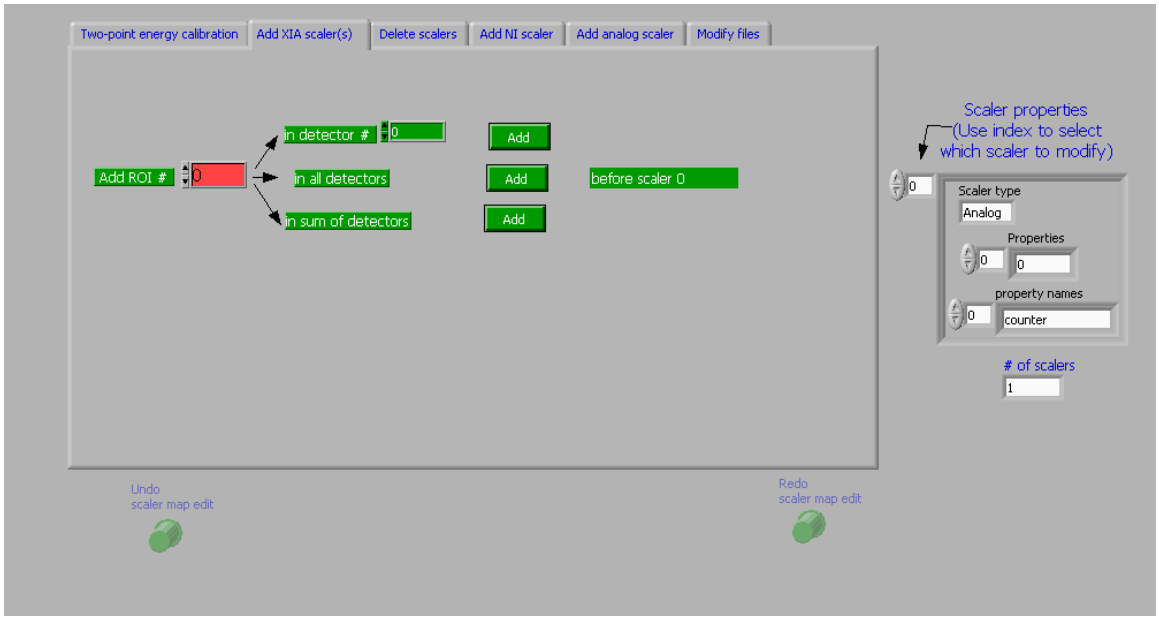


*Figure 3. Screen for adding Ge-detector (XIA) scalers to the list. Pushing any of the* `Add` *buttons now will add ROI 0 (the red area in Figure 1), either in detector 0 only, all detectors, or the sum of all detectors, all prepended to the list. Where the new scalers get added depends on the setting of the index in the* `Scaler properties` *display to the right of the tabbed control.*


*Figure 4. Controls for adding an NI (counter) scaler.*


*Figure 5. Screen for adding an analog scaler (using Channel 1), again before the first scaler on the list. The `Undo/Redo` buttons are grayed because no actions have yet been taken.*

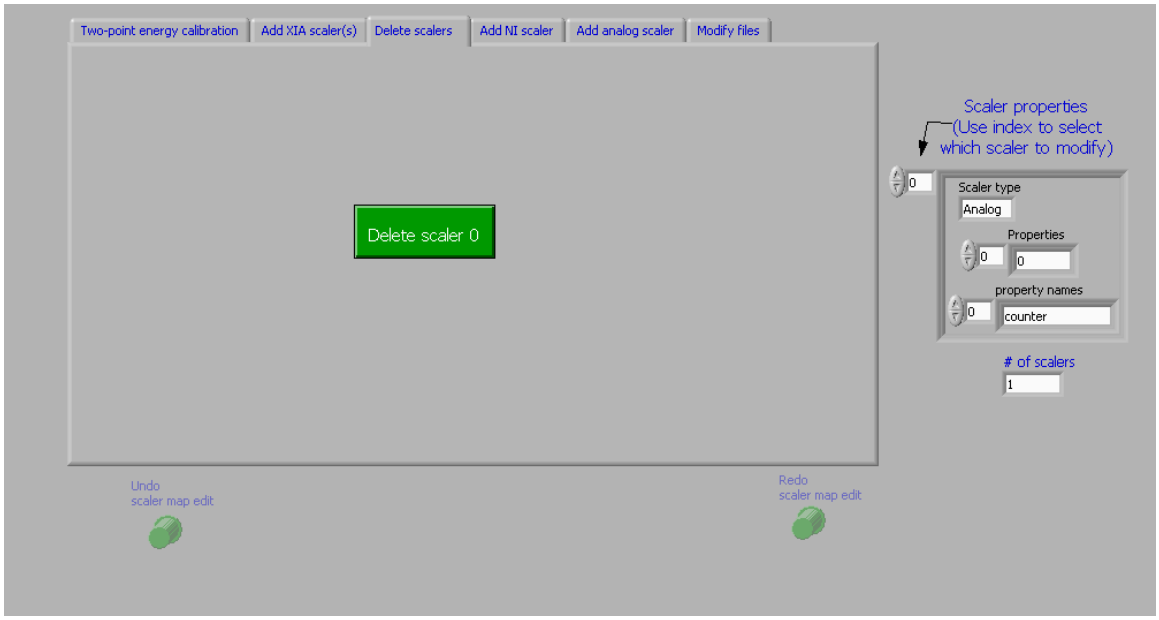


*Figure 6. Screen for deleting a scaler, here Scaler 0.*

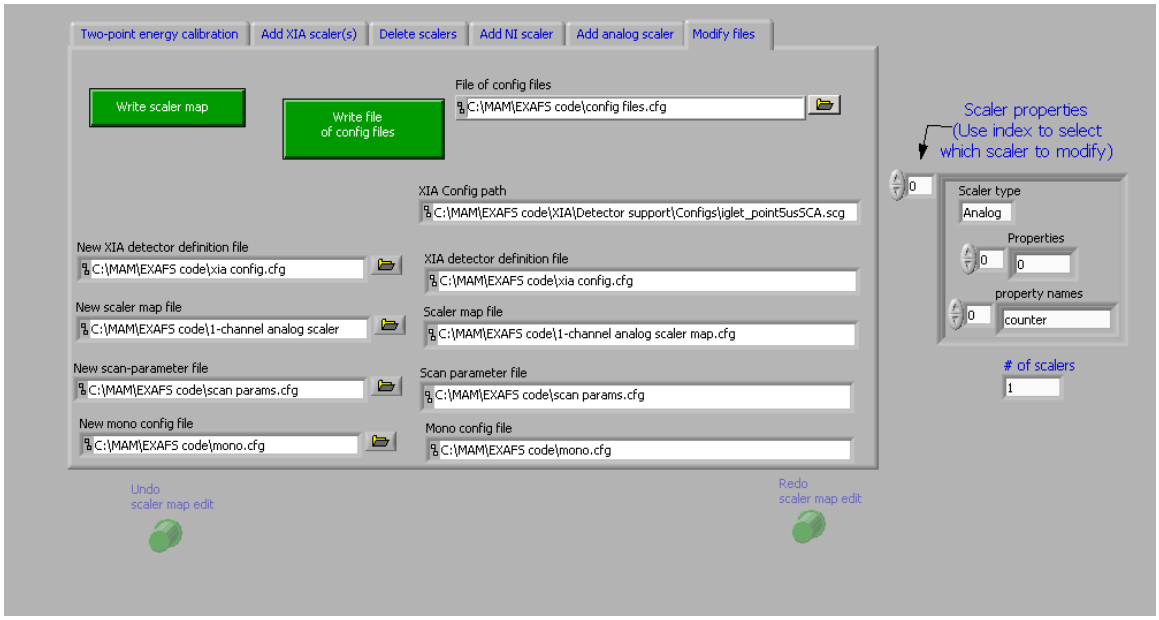


*Figure 7. Screen for modifying the main config and scaler map files. Note that Undo/Redo don't work on changes made here.*