LED monitoring system in P2 (how to run)

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September 6, 2009

1 Introduction

In standard application LED MS system forms on the PHOS dynamical images (moving from event to event) consisting of four lines with width 2 crystals and length 64 crystals for each line. Operator can adjust brightness of the picture and set a mode of variation of amplitude: one-peak mode (amplitude is fixed) or grid mode when amplitude is changed from event to event that gives multi peak structure of the amplitude histograms.

In extended application operator can additionally control number of lines in the image, length of lines and can make both dynamical and static images. Chess-like and point-like structures are also possible. Point-like object is currently represented by switching on one LED-diode group with dimension 4*2 crystals. For static and dynamical objects (including point like object) one has ability to define the X-Z-coordinate on the PHOS which he want to illuminate ($0 \leq X \leq 63,\ 0 \leq Z \leq 55$) . This possibility can be used to check the map of channel connections in the critical situations.

For using in the PHOS-lab LED MS can serve currently one tested PHOS module (limitation is explained by limited number of produced master modules MMV). For the application in the pit LED MS can serve all three installed PHOS modules. There are three option of the LED MS triggering.

1) triggering by PP. Some features of this mode has been tested in the PHOS-lab but not opened for common use yet. The limitations are:

a) An extra soft should be installed on the DCS-board to select PP from the standard ALICE optical trigger sequence.

b) Time interval between pulses PP and L0 should be greater than 84.5+1.2=85.7 μs.

2) triggering by L0 through measuring of time interval t(L0-L0) in the master modules MMV's. This mode is opened for common use in PHOS-lab and in the pit. The limitations are:

a) Time t(L0-L0) between two consecutive pulses L0 should be greater than 84.5+1.2=85.7 μs.

b) Fixed value of t(L0-L0) between any of neighbor L0 pulses should be kept through all current LED run.

3) Auto-triggering mode when LED MS generates flashes on some frequency with synchronized sending signal "Fire" (ECL standard) to LTU, where this signal is transformed to pulse L0 with following distribution it to all consumers. This mode is opened for common use in PHOS-lab and in the pit. The limitation is:

a) PHOS is working autonomously without general triggering together with others detectors of the ALICE setup.

2 LED hardware

The hardware of LED MS consists of LED controller DCSV, LED master modules MMV (one for each PHOS module plus one additional module MMVsuper) installed in the VME crate (Rack C05) and command modules CM224 with light diodes covering the front panel of the PHOS. DCSV is designed as motherboard housing computer DCS board 331 `alidcsdcb1573` with ability of decoding of standard optical ALICE trigger sequence and selection signals PP (PrePulse), L0, L1, L2(a/r). MMV's are control blocks for CM224. MMVsuper is used to synchronize all MMV's in auto-triggering mode. Additional function of MMV's (including MMVsuper) is to measure the time interval L0-L0 in mode of triggering LED MS by L0-pulse.

General scheme of the LED MS electronics presented in Fig. 1 and correspondent view in point P2 of the LED VME crate with installed DCSV and MMV's is shown in Fig. 2.

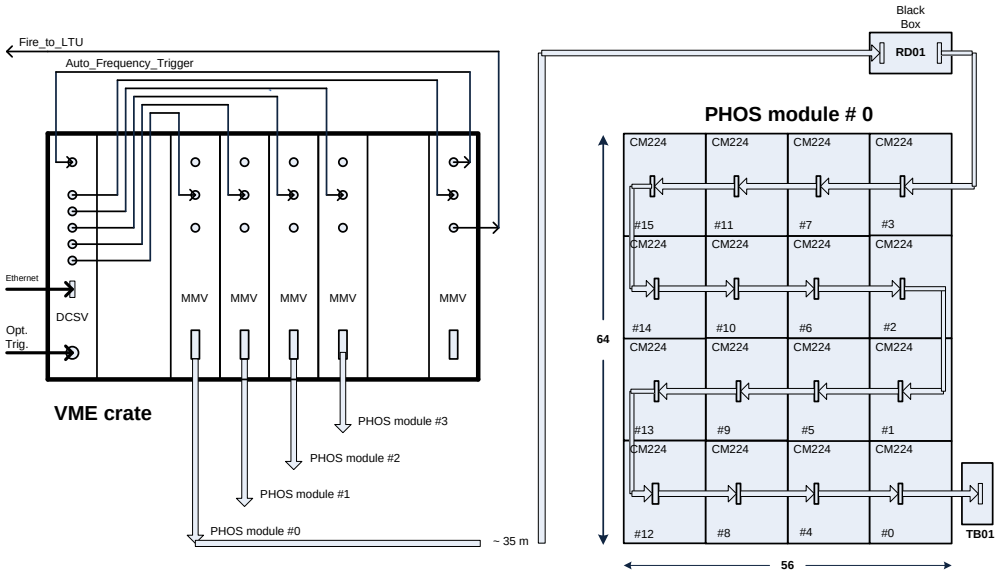

Figure 1: General scheme of the LED MS electronics.

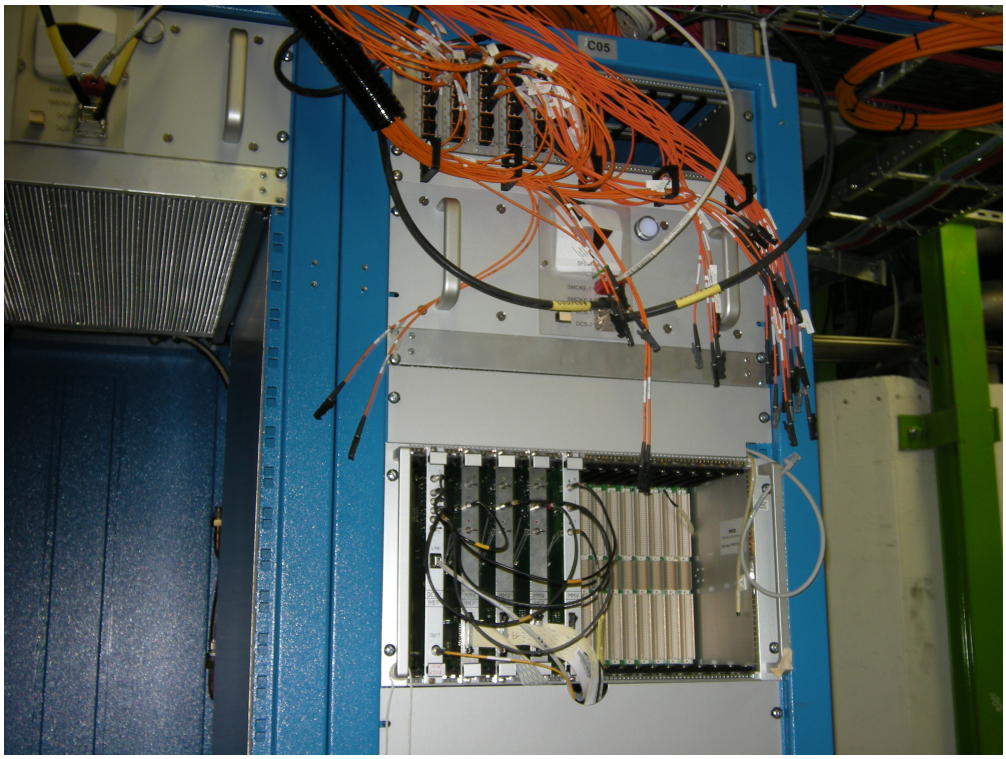

Figure 2: General view of the LED VME crate in Rack C05 (Point P2).

2.1 Cabling

Communication of the LED DCS computer with external word is done via standard Ethernet inserted in proper connector on the front panel of the DCSV with connection from other end to switch Rack A17, port 23.

For triggering of the LED MS by PP (PrePulse) two cables are used: a) coax cable (length=16 m) sending PP signal in standard NIM from LTU (LTC) partition 22 PHOS to trigger input of the DCSV and/or b) optical cable (length=16 m) where PP is propagated as coded broadcast from LTU (LTC) partition 22 PHOS to input optical connector on the DCSV front. This optical cable transmits also signals L0, which can be additionally used as LED trigger (be sure using the optical fiber, that the laser is switch on). For completeness we add that length of cables from the LTU (LTC) to the trigger Fan-Out panel near PHOS is 20 m.

Then DCSV distributes the trigger signal in NIM format through embedded Fan-Out to five modules MMV through five short coax cables.

In auto-triggering mode master modules MMVsuper generate signal "Fire" in ECL standard which can be used to form trigger L0 for the PHOS FEE by sending this signal through coax cable (length=16 m) from MMV module (output connector "Fire") to input Pulser connector on the LTU (LTC), partition 22 PHOS.

Simultaneously command "Fire" goes from MMV to CM224 through flat cable (Length=30 m). The flat cable from LED MS (length=2 m) is connected with flat cable from MMV master module through "black box" $8.2 \times 5.6 \times 1.8$ cm with buffer amplifiers.

General view of the LTU (LTC) is presented in Fig. 3. Disposition of trigger Fan-Out

panel direct before the PHOS modules installed in the pit 2 and detailed view of this panel are presented in Fig. 3 and Fig. 5 respectively (photo in Fig. 5 was taken from Hans Muller's collection).

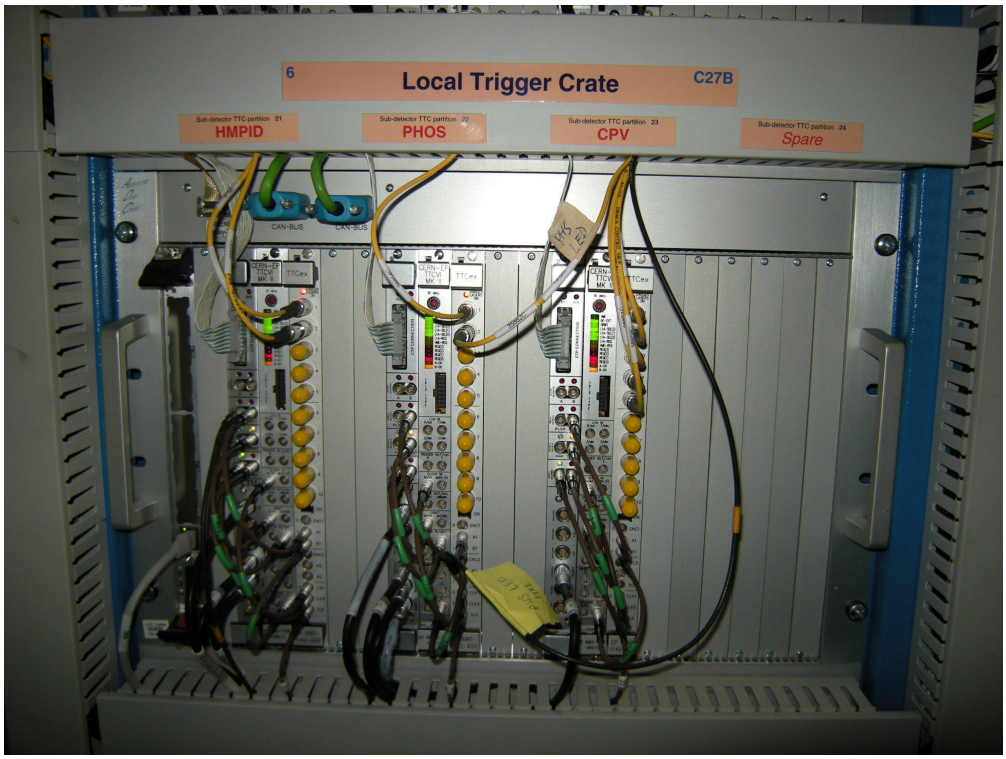

Figure 3: General view of the LTU (LTC) in Rack C27B.

3 Control of the LED MS

One can control the LED MS by two possibilities a) through DCS/PVSS and b) manually. In the case of the DCS/PVSS its DIM client on computer `alidcscom074` (this is the same computer which is used for cooling system) interacts with LED DIM server on computer `alidcsdcb1573`. DIM client sends to DIM sever operator command "Start" after which DIM server starts the LED-supervisor process `ledEngine` intended for settings, initiation, launching and general control of the LED MS.

4 Running LED MS in the DCS/PVSS

How to switch power ON/OFF on LED VME crate one can read in details in Mamonov's manuals "PHOS Detector Control System", "Power System Instruction for 3 PHOS modules (22.01.2008)" (see: http://aliceinfo.cern.ch). Correspondent virual panels which the DCS/PVSS presents to operator are shown in Fig. 6 and Fig. 7.

Figure 4: PHOS modules in the pit P2. Disposition of the trigger Fan-Out panel is just before PHOS.

After powering the VME crate an operator can launch the DCS MS through virtual panel by setting parameter `<m>` which indicates for supervisor *ledEngine* the PHOS working modules. One of following values of parameter `<m>` is valid:

`<m>=0,1,2,3,4, -1` .

Last value `-1` means that all PHOS modules are working . Setting of this parameter `<m>` provided for by pressing on bottons on the virtual panel corresponding to to the PHOS-modules which should be illuminated by the LED MS.

The following parameter which operator should select is configuring number formed for standard application as follows (extended application will be done in Addendum 1):

`<c><t>` ,

where valid values are `<t>=0,1,2,3,4,5` and `<c>=0,1,2 ... 254, 255,256` . The meaning `<c>` and `<t>` is explained below in section dedicated to manual launching of the LED MS.

After selecting of these two control parameters *ledDIMServer* generates the daughter process with launching of the supervisor *ledEngine* which initiates the firing of the light emitted diodes and, by this, the LED RUN is started.

Operator has of course possibility to stop LED run by intervention from DCS/PVSS virtual panel.

5 Manual Running LED MS

We begin a description in this section from powering of the LED VME crate.

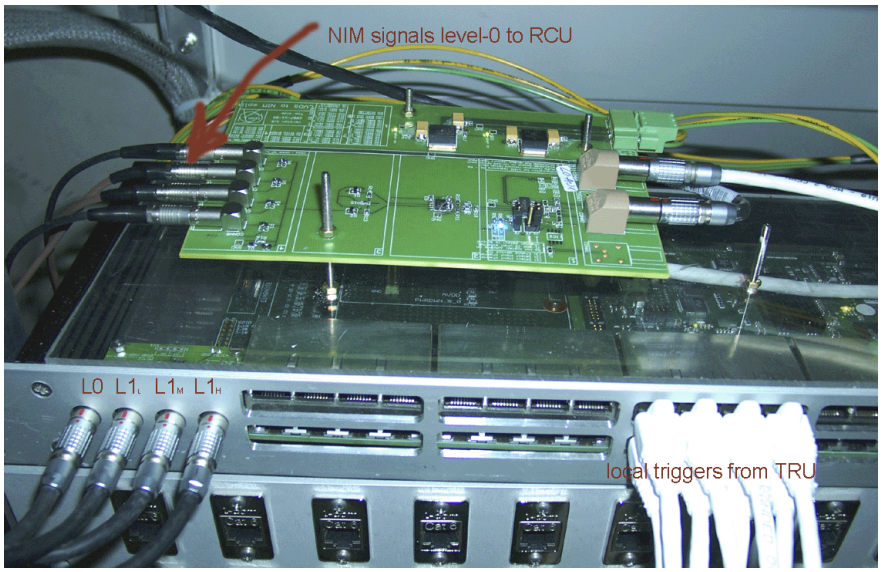

Figure 5: Detailed view of the trigger Fan-Out panel near the PHOS (this photo was taken from Hans Muller's collection).

5.1 Powering of the LED VME crate

The LED VME crate is located in the Rack C05 and connected via the CAN bus to the computer `alidcscom074` running Windows-XP. Login to `alidcscom074` is available from the DCS gateway `alidcscom001` (Windows Server 2003) with the remote desktop. Remember that only one remote session to `alidcscom074`, one opened session prevents other users to login to `alidcscom074`. Please logoff from `alidcscom074` when you do not need it.

The power button on the rare panel of the VME crate switches on the power supply only, but not the whole crate. The VME crate can be switched on and off only via software, OPC server. There are 2 means of the software control for LED VME crate: PVSS and a Matrikon OPC explorer.

Open a remote desktop on the computer `alidcscom074`. Start a Matrikon OPC explorer in the directory `D:\Software\Matrikon\OPCExplorer.exe` and open a configuration file `C:\WienerOPC\Wiener-LED_VME.xml`, see fig.8 When the configuration is loaded to the OPC browser, the control of the LED VME crate is accessed via several tags shown in fig.9. Among them, two tags concern the power state of the VME crate:

- `WIENER.CAN8.Crate1.GetPowerOn` is a boolean variable equal to `True` is the crate is on, and `False` in the crate is off.
- `WIENER.CAN8.Crate1.OnOffCrate` allows to switch on and off the crate.

If the VME crate is switched off (the `WIENER.CAN8.Crate1.GetPowerOn` tag is `False`), one can switch on the crate by right-button click on the tag `WIENER.CAN8.Crate1.OnOffCrate`, than the pop-up menu appears, and select "Write Value"; type in "1" in the field "New Value" (fig.10). If the VME crate is switched on (the `WIENER.CAN8.Crate1.GetPowerOn` tag is `True`), one can switch off by writing the value 0 to the tag `WIENER.CAN8.Crate1.OnOffCrate`. When the power is on in the LED VME crate, the DCSV and MMV modules are blinking

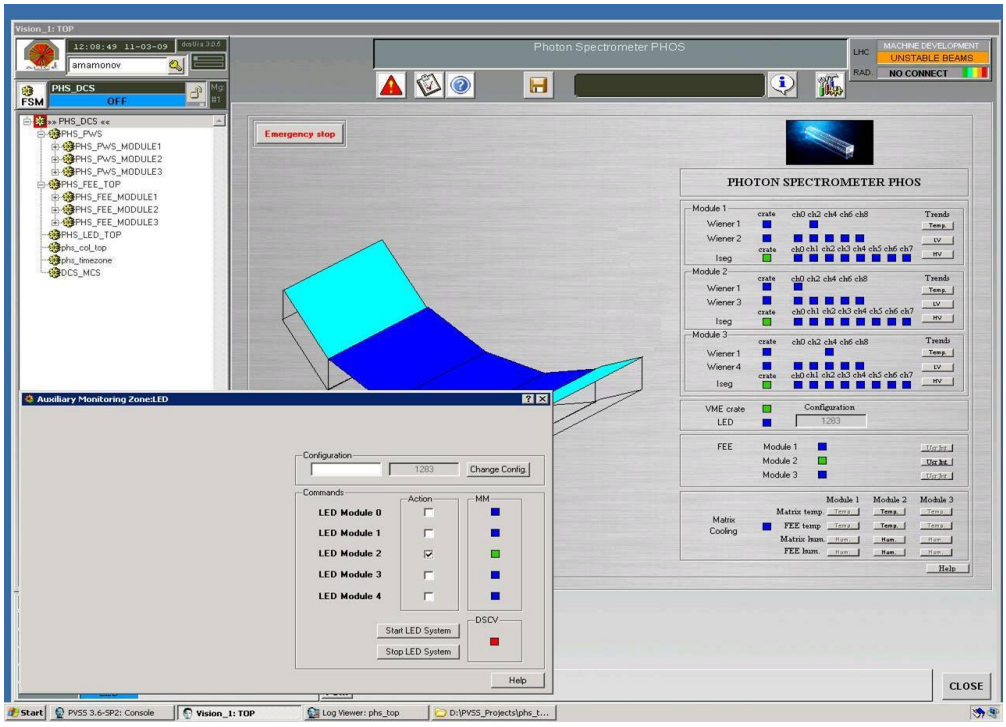

Figure 6: Main virtual DCS/PVSS-panel to control the LED MS.

by their LEDs.

5.2 Running the LED supervisor process ledEngine

The control of the LED monitoring system is provided by the the DCSV module designed as motherboard housing computer DCS board 331. DCSV is installed in the VME crate (Rack C05). The DCS board is registered in the DCS network under the name `alidcsdcb1573`. The LED software supervisor intended for settings, launching and general control of the LED MS is called ledEngine. To launch this process make the following steps. Connect to the gateway

rdesktop -f alidcscom001

Select PUTTY tool and login to the computer `alidcsdcb1573`, go to (command cd) the directory `/home/ledEngine` and run the command

`ledEngine -c <c> -m <m> -t <a> > /dev/null &` .

- Parameter `<c> = 0 -- 254` is code of fire amplitude in one peak mode (note, `<c>=143` — very small signal, `<c>=167` — average signal, `<c>=254` — maximal signal). Two values `<c> = 255, 256` are used for grid (multi-peak) mode of operation with step of amplitude 3 and 6 respectively (parameters of the grid mode like initial amplitude and step of amplitude can be change by editing files *led_255.conf* and *led_256.conf*).

- Parameter `<m>=0,1,2,3,4,5, -1` defines the working PHOS module/modules. Last value `-1` means that all PHOS modules are working (`<m>=-1, 012, 01234` are

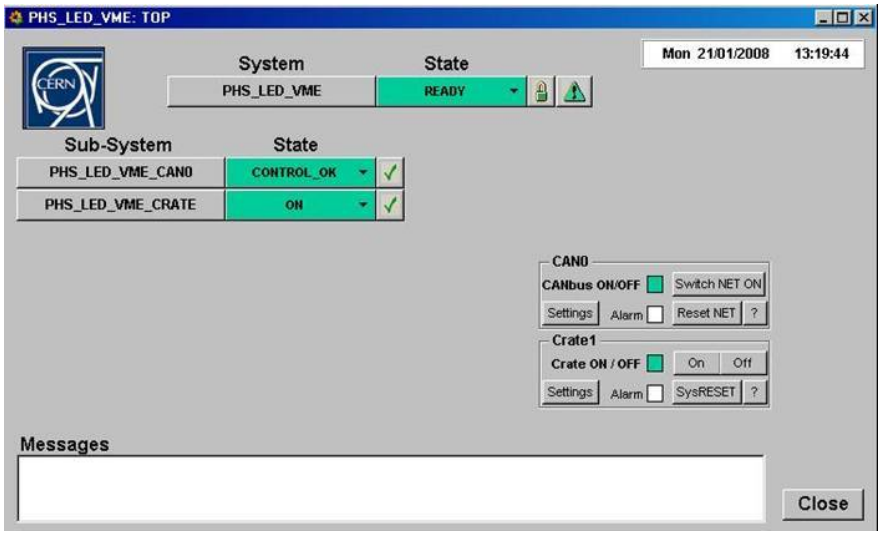

Figure 7: Virtual DCS/PVSS-panel to control VME-crate of the LED MS.

equivalent and mean also all modules);

- Parameter `<t>=0,1, 2,3,4,5` is responsible for mode of LED MS triggering.

  `<t>=0` — triggering by PP (PrePulse).

  `<t>=1` — triggering by L0 signal with measuring of the time interval between two consecutive pulses L0.

  `<t>=2,3,4,5` — auto-triggering of the LED MS at frequencies 2 Hz, 20 Hz, 200 Hz and 1000 Hz respectively. In this case the signal "Fire" from the LED master module MMVsuper is sending to the Pulser input of LTU (LTC) to form the trigger L0 for the PHOS FEE.

5.3 kill the ledEngine

Kill the launching process by command

```
killall ledEngine
```

If the process was launching from local console without putting into background the same result gives prompt from console:

```
<CTR/C>
```

5.4 example running and kill

Running with amplitude=167, PHOS module=2, auto-triggering mode at frequency 20 Hz:

```
./ledEngine -c 167 -m 2 -t 3  > /dev/null & .
```

Kill:

```
kilallledEngine
```

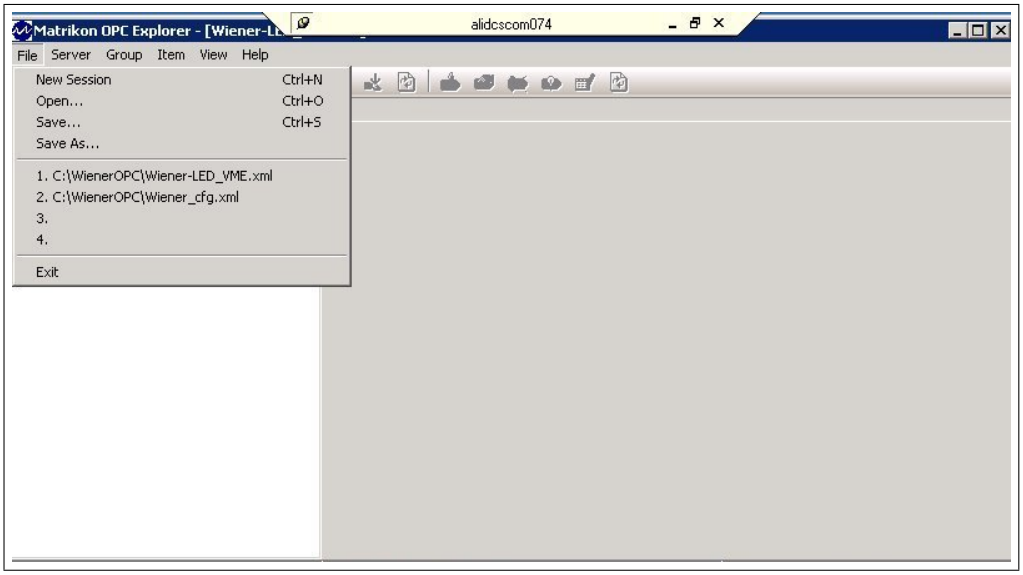

Figure 8: Start Matrikon OPC explorer and open a LED_VME configuration file.

6 Configuration files

There are three configuration files: led255.conf, led256.conf and led_timing.conf. The data from files led255.conf and led256.conf are taking into account by ledEngine only for settings of GRID mode `<c>=255,256` . Data consist of initial amplitude, step of amplitude and number of peaks in grid mode. Format is obvious (open files and look through).

File led_timing.conf is used for adjusting of delays by setting time-delay parameters and time of transferring data from MMV to CM224. This file also defines parameter `keep_amplitude`, that is time during which given amplitude is fixed in the grid mode. Recommended value of the parameter is 15 s at flashing frequency $f = 20$ Hz and can be lowered to 1.5 s with growth value of f to 200 Hz. This recommendation corresponds to 50 consecutive flashes of each diode with given fixed amplitude before transferring to new value of amplitude in grid-mode.

7 Adjusting of delays and timing

Adjusting of delays has goal to synchronize fire of light diodes with the PHOS FEE readout so that trigger L0 should be about 600 ns later of fire. We discuss separately the trigger modes `<t>=0,1, 2,3,4,5`

- `<t>=0`. In this case LED MS is triggering by PP and setting parameter from file led_timing.conf is `delay_fire_mks`. This integer value defines the delay [μs] of "fire" command after finish charging of capacitances. It is strongly recommended to do this value not too big due to parasitic leakage and discharge, from the point of view of brightness optimization the best value is zero. The interval of internal processes of LED MS and charging has summary duration 85.5 μs. It limits the maximal frequency of flashing $f_{max} = 11.4$ kHz.

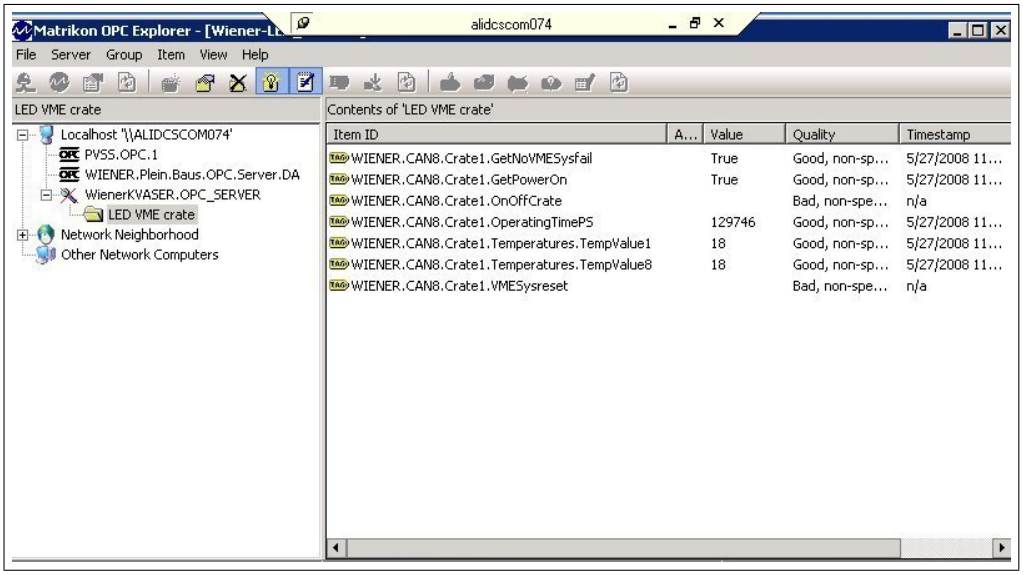

Figure 9: Tags for LED VME control.

Additional possibility of synchronization, that should be used as preferable, is to adjust the interval between PP and L0 by setting in the LTU (LTC) to value about 85.5+0.6 = 86.1μs (ask LTU's experts D.Rohrich, J.Alme for this).

- `<t>=1`. In this case the LED MS is triggering by L0 and setting parameter from file led_timing.conf is `tFireL0`. This float value [μs] defines the time interval between command "fire" and trigger L0. The best setting satisfying the PHOS FEE is about 0.6 μs (or 1.2μs). The value of transferring time from MMV's to CM224 setting from file *led_timing.conf* effects also on synchronization.

- `<t>=2,3,4,5`. In this case the LED MS is working in auto-triggering mode where needed timing is achieved only by external delay-lines.

8 Conclusion: Current status

— The LED DIM server and LED DIM clients are ready and working.

— Option of triggering LED MS by PP extracted in NIM format from LTU has been tested in the PHOS-lab but not opened for common use.

— Analogous option of triggering LED MS by PP in the form of coded broadcast from optical cable has been also prepared. But it is not activated yet. It can be really activated only after reprogramming of the computer DCS board to select PP.

— Option of triggering LED MS by L0 with measuring L0-L0 time interval is ready and opened for common use in PHOS-lab and in the pit.

— Auto-triggering mode of LED MS is ready and opened for common use in PHOS-lab and in the pit.

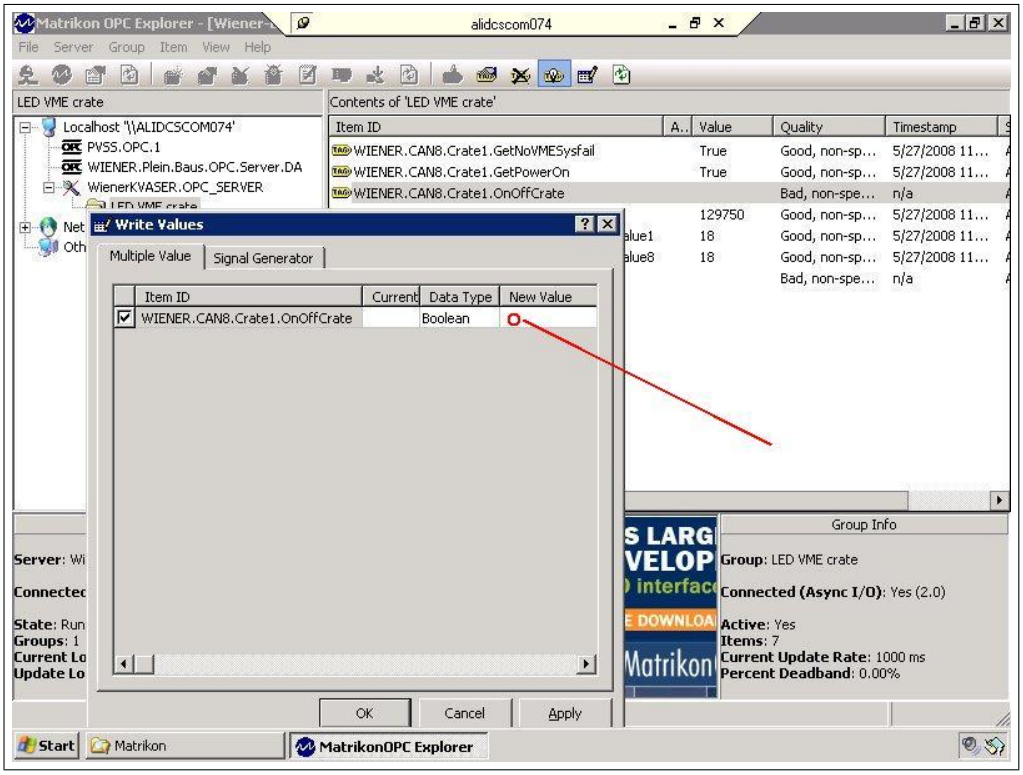

Figure 10: Switching on and off the VME crate.

9 Addendum 1: Extended usage of the LED MS

9.1 Launching of the ledEngine from command line

In extended usage the LED MS can be launched from command line with one of following two variants

```
ledEngine -c <c> -m <m> -t <t> -x <x> -z <z> -r <r> > /dev/null &
ledEngine -c <c> -m <m> -t <t> -g <g> -r <r>   > /dev/null &
```

where the meaning and usage of parameters `<c>` , `<m>` and `<t>` are the same as in standard application;

Keys `"-g", "-x", "-z"` are used to illuminate specified regions on the PHOS:
`<g>=0,1 ... 447` - diode group to fire,
`<x>=0,1 ... 63, <z>=0,1 ... 55` is coordinate on the PHOS panel to fire (mix of key `"-g"` with keys `"-x"` or `"-y"` is forbidden, usage of `"-x"` is valid only together with `"-z"` !);

Key `"-r"` with `<r>=0, 1, 2 ... 7` defines the regime of firing forming X-line images with width 2 cryst. and different length;

<r>=0: four long dynamical lines in event with length=64 cryst. (default),
1: 1 middle dynamical line with length=16,
2: 16 short dynamical lines (groups) with length=4 (chess),
3: 1 short dynamical line (group) with length=4 (point-like);

<r> = 4,5,6,7 - the same as <r>=0,1,2,3 but static images (for <r>=0 keys "-g", "-x", "-z" are not used and ignored, for <r>=4,5,6,7 keys "-g" or "-x" and "-z" are obligatory).

9.2 Forming of the extended config-number in the DCS PVSS

The extended config number for using in the DCS PVSS II is formed as follows:

<r><x><z><c><t> ,
where valid values are
<t>=0,1,2,3,4,5 ,
<c>=000,001,002 ... 254, 255,256 ,
<z>=00,01,02 ... 55 , <x>=00,01,02 ... 63 and
<r>=0,1,2,3,4,5,6,7 .

The meaning of <t> , <c> , <z> , <x> and <r> has been already explained in the previous part of this Addendum.

10 Addendum 2: Usage of the LED MS in the PHOS-lab

For current moment LED MS can serve in the PHOS-lab one tested PHOS module (limitation is explained by limited number of produced master modules MMV). All is the same as in the pit, excluding only one point: master module MMVsuper should be not installed in the VME crate with correspondent subscription of this absence in configuring file led_timing.conf.