Basic instructions for SVX4_MS_2.4.dma.xls (revised 01/31/2003)

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1.Introduction

SVX4_MS_2.4.dma.xls is a MS Excel Spreadsheet to be used for testing of Run IIa / IIb hybrids and detectors. The main idea is to read out hybrids or detectors and get:

1. Mean, total noise and differential noise of a series of events
2. Pedestal distributions
3. Correlation between chips,
4. Response of a chip as a function of the pipeline cell,
5. Gain of a chip,
6. Response of a detector to a laser signal,
7. Depletion voltage and leakage current of a detector
8. Simultaneous readout of up to 6 chains.

The necessary run2b hardware consist of a VME crate controlled by a Bit 3 PCI bus, a Stand Alone Sequencer, a 50-conductor 3M cable, a Purple card, a jumper cable, Low voltage power supplies and the hybrid to be read out (look in http://d0server1.fnal.gov/projects/run2b/silicon/www/smt2b/readout/readout.html for details).

There are different Bit3 versions and this spreadsheet works with a 616, 617, 618 or 620 SBS model PCI bus to VME bus on a Windows NT4, 2000 or XP machine. The board comes with its own drivers but I suggest installing the drivers designed by Robert Angstadt (angstadt@fnal.gov).

There is a great documentation on how to install these drivers (giveio.sys, mapmem.sys and bntdv617.dll) in http://d0server1.fnal.gov/users/angstadt/www/b3/b3_61x.htm. To convert the spreadsheet to a different Bit3 model and/or Operative systems go to http://d0server1.fnal.gov/users/angstadt/www/d0notes/2589/convertb3.htm.

This spreadsheet uses Visual Basic macros. In order to enable them the security level of MS Excel should be set to medium (go to Tools ->Macros -> Security and choose

"Medium") and some add-ins should be enabled (Tools -> Add-Ins and select "Analysis ToolPak" and "Analysis ToolPak-VBA"). Also some source files for the unpacking of the data and some dlls (Xutil.dll, MCMutil2.c, MCMutil2.def, MCMutil2.h, MCMutil2s.h, mcmutil2.dll) should be copied in C:\Winnt\System32 (these files are available at http://d0server1.fnal.gov/projects/run2b/Silicon/www/smt2b/Testing/DLLfiles.html).

2.Features

2.1 M_S_ave sheet

This is the main sheet from where most of the things can be done. The basic steps to use it are steps 1 to 5 below.

1. **Hit the "Init Bit 3" button**. The value of cell (C5) shows the result and if this is "ok!" the Bit 3 was successfully initialized (*1).
2. **Enter the desired parameters** (see section 2.1.2).
3. **Hit "Init Sequencers"**. This will download the SASeqs with the parameters set in the corresponding "Saseq_Master/Slave" sheet. There user must specify the type of SASeq to be used in Cells(E15-E17) ("1" for V1 SASeqs and "-1" for V2 ones). There is also the chance to choose whether DMA is going be used or not (Cells(F15-F17)) and/or a reset on the SASeq before triggering (Cells(G15-G17)).
4. **Hit "Download SVX chips"**. This downloads the type of chips specified in Cell(G9) for the active chains with the corresponding parameters in the "Init_SVX4(2)_Master(Slave)" sheet. Cell (E11) will show the result of the download ("Init OK" in a green background or "n errors" in red background). The type of mask used in Cal_Inject mode is specified in cell(P2).
5. **Hit "Get Data".** The program will begin reading incrementing a counter in Cell(B9) till it gets the predetermined number of events. The user can choose how many events can be taken before counting the events that are going to be used for calculations in cell(D6). If for some reason there were readout errors, those particular events are tagged as bad and not taken into account, and a counter of bad events in Cell (E9) gets incremented. If the counter of bad events is the only one that gets incremented the user might want to stop the program, to

do so just press the "End" key of the keyboard. Once the desired number of events is collected, the program will print channel numbers in a column that begins in Cell (B32), the average of the readout for each channel in the column beginning in Cell (D32), ten times the Total noise in the next column and ten times the Differential noise in the last column (*2). Plots for all these values are shown in the sheet if desired.

6. Hitting "Plot Favorite Chip" will show a separate plot for the chip specified in Cell (Y4) in the chain that corresponds to the value of Cell (Y3).
7. By clicking on the "Delete Plots" button the user will get exactly that.

2.1.1 "M_S_ave" other features

1. **Pedestal distributions**. If the user would choose to get a pedestal distribution for a single channel or all the channels in a chip, entering the necessary parameters in cells(X9, X10, X11, Y10, Y11), (see section 2.1.2 to figure out how to do that) the corresponding histogram will be done in the "Histo" sheet and Cell (X12) will show the number of entries for that histogram. By default the flag in cell(X9) is in FALSE so that the readout is the fastest.
2. **Scanning pipeline-cells**. Pressing the "Peds (Pipeline)" button will cause a not so fancy process that will scan the pedestal values for all channels and chips as a function of the Pipeline cell value (Cell (B21) and Cell (B44) of "Init_SVX4 (2)_Master (Slave)"). The value of Cell (V22) tells the number of pipeline cells to be scanned. If the flag in Cell(V24) is TRUE (FALSE) the scan is going to begin in pipeline cell 0 (42). Basically a loop will begin and in each step the chips will be downloaded for a different value of the pipeline cells and then a readout loop will take place. After the scan is done the results (values and plots for pedestals, Total noise and Differential noise) will be shown in the "Pipeline_Ped" sheet.
3. **Scanning the gain as a function of pipeline-cells**. Hitting the "Gain of Pipeline" button will do a similar process as in step 9 but instead of scanning the pedestals as a function of the pipeline cells, what is scanned here is the difference between

the cal-injected and not cal-injected values for each channel. The results will be shown in the “Pipeline_Gain” sheet.

4. **Correlation between chips**. Cell(X13) has a flag that by default is FALSE. If this flag is TRUE, setting the desired parameters in cells(X14, X16, AA14, AA15, AA16, AA17) (see section 2.1.2 for details on these cells) will show a scatter plot (in the “Correlation” sheet) of the readout of the desired channels of a chip versus other group of channels of other chip.
5. **Exporting plots**. The “Export Active Plot” button allows to save the active plot (left click on the plot to activate it) as a .GIF, .JPEG or .HTML file in the desired folder.

(*1) If there is more than one spreadsheet open (with Bit 3 related macros) or a macro was compiled it might be the case that the message “Connection lost, no buffer from mapmem.sys” appears. This is related to the fact that the mentioned .sys file has single threading protection and Visual Basic somehow causes bntdv617.dll and its mapmem.sys connection to be broken. In that case Excel should be restarted.

(*2) Total noise is defined as the standard deviation of the readout values for each channel, while the differential noise is the standard deviation of the difference between the readouts of one channel an its following neighbor.

2.1.2 Parameters

This sheet has blue-ish fields that can be adjusted to the user’s preferences.

- Cells(C2-C3) are related to the Bit3 base address and should be “39” and “D0000” respectively.
- Cell (C6) sets the desired number of events to be taken.
- Cell (C14) indicates the number of SASeqs-Slaves to be downloaded.
- Cells (C15-C16-C17) are the base addresses of the Master and Slaves SASeqs respectively. For “old” SASeqs (serial number 1 to 60) the value of this address is 50dxxx (usually 50d000). The address of the SASeqs can be physically determined setting some switches on the board. For more information go to

http://d0server1.fnal.gov/users/utes/WEBPAGE/saseq2.htm. For new SASeqs some adjustments in the downloading sheet (Saseq_Master) need to be made and possibly the address may look different (more information on this for the next version of the spreadsheet…).

- Cells(E15-E17) allow to choose between version 1 ("old") or version 2("new") SASeqs.
- Cells (C21-26) set the number of chips to be readout in each chain. It is important to have the proper numbers in these fields.
- Cells (I2-4) enable/disable the SASeqs' chains (0=both chains off, 21=chain A on, 12=chain B on and 23=both chains on.
- Cell (G6) is a flag that, when set to TRUE, allows to display the raw data in a column that begins in Cell (U30) for the SASeq Master and in Cells (V30-W30) for the Slaves. The first to characters of each word correspond to chain B and the rest for chain A. For SVX4 chips the fourth word corresponds to chip ID, the sixth eight etc is channel 1, 2… to channel 128 (you will read 7F for this last channel). The same structure repeats for the following chips.
- Cell (G7) allows choosing between Cal Inject mode (TRUE) and Trigger mode (FALSE) that are two different readout modes for the SASeq.
- Cell (G8) is a flag that allows seeing some information about the readout errors if any. Errors are shown in rows 21-26 for each chain of the corresponding SASeq.
- Cell (G9) sets the type of chip to be read out (TRUE=SVX4 and FALSE=SVX2). Cell (P2) indicates the mask that is going to be cal-injected (in Cal-Inject mode, 0=none, 9=all, 1 to 8=mask 1 to 8 + n*8, for n=0…15 for each chip. So mask 3 means that the masks that will be cal-injected per chip are 3, 11, 19…123. Mask = 16 injects 8 channels (1, 17, 33...) per chip, mask = 32 injects 4 channels, mask = "user" injects the range of channels specified in the cells that are just to the right of this mask flag for all the chips, mask = "free" allows to choose whatever channel you want for EACH chip setting the bits manually in the Chip Download page ("Init_SVX4_Master"). In this page the column to the left is A and the other guess what, but the last chip of the detector/hybrid is the uppermost one in the sheet!

- Cell (Q4), if TRUE, indicates that a plot showing the readout of all chips is going to be done. FALSE will erase the previous plots and will not crate any other plot.
- Cell (Q5) sets a separate plot for each chain when this flag is set to TRUE.
- Cell (Q6) keeps the status quo of the actual plots when set to TRUE.
- Cells (Y3-4) sets the information about the Chain and Chip to be plotted when the “Plot Favorite Chip” button is hit.
- Cell (X9) determines if an update in the “Pedestal Distribution” plot in the Histo sheet is desired. If set to TRUE, Cell (X11) determines if the histogram is going to be done for all channels in a chip (TRUE) or for a single channel (FALSE). The chip and channel numbers are indicated in Cells (Y10-11) respectively.
- Cell (V22) determines the number of Pipeline Cells to be taken into account for the “Ped (pipeline) test”. Cell (V223) is a counter and Cell (V24) indicates if the starting cell is “0” (TRUE) or “42” (FALSE).
- Cells (Y22, Y23, Y24) follow the same attributes as Cells (V22, V23, V24) but for the Gain (Pipeline) test.
- Cell(X13) is a flag to turn on/off the correlation measurement between chips. Cells(X14, X16) determines de number of the chips to be compared and Cells(AA14, AA15, AA16, AA17) specify the number of channels to be compared for each chip (i.e. StartChannelX=1, EndChannelX=1, StartChannelY=1, EndChannelY=128 will compare de first channel of chipX versus the average of the 128 channels of chipY).

2.2. “Laser” sheet

This sheet has the controls to init the bit3, download the sequencer and the chips as explained in 2.1. It also has buttons to control the DMC-1300 laser table.

As with “M_S_ave” sheet, the first thing to do is to set the number of chips (cell(9,3) and cell(10,3)), set the proper value in the “IGNORE Master” flag (Cell(8,3)), the SASeq mode in cell(1,7) (false = data mode, true = cal_inject mode) and, if in cal_inject mode, the type of mask (cell(13,2)).

Once the laser table is powered (button inside the laser box at the lower left corner) hitting the **“Init DMC”** will initialize the controls for the table. If the motor of the table is making noises - which means that the wrong gains are set- these should go away after initialization. To move the table, set the desired number of counts to move in the blue cells bellow the **"GoToXY rel"** button (100000 counts = 1 inch). A positive value in 'Y' moves the platform, where detector sits, from left to right (if you are looking at the table through the window). A negative value in 'Y' will move the table in the other direction. The movement is relative to the current position. **"Set Vel XY"** sets the velocity of movement (in counts/sec) according to the red cells bellow the button. The **"Moving?"** button indicates if the table is moving or not.

To get the laser signal, the sequencer should triggers the laser through the software trigger output, the SASeq should be in data mode ("FALSE" in cell(1,7)) and the pipeline cell should be set to 4 (cell(21,2) for chain A and cell(44,2) for chain B in "Init_SVX4_Master"). A cable has to connect the sequencer from the "Trigout" output of the SASeq to the laser external input. Set the bias voltage (using the "hvSlot7" sheet) With 10V, an attenuation of 2 in the laser beam, and a distance from the laser to the detector of around 3cm, one should be able to see the peak. To increase the resolution Real Time Pedestal Subtraction can be used (cell(30,2) for chain A and cell(50,2) for chain B in "Init_SVX4_Master").

Then hit **"Init Bit 3", "Init Sequencer"** and **"Init SVX chips"** until the chips are properly downloaded. Hitting the **"Get Data Laser"** will take the desired number of events, specified in cell(6,3), and do the same as in the "M_S_ave" sheet. The result is shown in the chart on the same sheet. If you can not see the peak check:

- Chips have been downloaded in pipeline 4?
- Is the bias voltage on?
- Check voltages (AVDD and DVDD).
- Is the laser above the detector?
- Do a Cal-Inject cycle to check that the chips are working.

2.3 "hvSlot7" sheet

This is the main sheet to control the high voltage (the HV address of the motherboard in the crate should be '8700).

First set the pod that will be used in cells(L32-33), press **"Init Bit 3"**, **"Set_I_trip_All_Channels"** and enter the current trip value (~2000 uA) , **"Reset"** and **"On"**. You may have to click again the last two buttons until you see the red led on in the board. If you want you can use the Keithley power source for biasing the detector but this means that you will have to set the different voltages by hand. The initialization of the table, SVX chips, and HV is independent. The voltage can be readout in cell(23,8) to cell(30,8) for each pod. To set a different voltage enter the desired value in cell(35,12) and press **"V_Ramp"**.

To measure the depletion voltage, once you know that the laser signal can be seen, the program will take n events with the laser off for each bias voltage within the desired range, then it will do the same but with the laser on, it will subtract the corresponding pedestal to the readout with the laser and calculate the area of the peak. This is the collected charge in arbitrary units for that specific voltage.

To do this measurement, enter the desired range to ramp the voltage and the value for the step in cells(S 32 to S 34). Also enter the desired number of events to be taken in each loop. The flag in cell(B31) when set to "1" will ramp the HV pod automatically, if you want to use other Power Supply (Keithley) set the flag to 0 and change the voltage manually. <u>The measurement is more precise if you select which channels are going to be taken in account to calculate the collected charge</u>. This channels should be determined prior to this measurement and entered in cells(B36 and B37). Then click **"BV_Deple_Test"**. The program will prompt the user to turn off the laser and then begin to take n measurements for each bias voltage (this takes time because there is a delay between measurements to allow the voltage to stabilize). There is a counter in cell(U34) that shows the value of the current bias voltage. Another prompt will ask the user to turn the laser on and a new cycle will take place. After the measurements are taken a plot with the Depletion Curve will be shown.

3. Multiple Readout

The spreadsheet is designed to readout up to six chains using one SASeq as a Master and 2 Slaves. In this configuration the base addresses of the SASeqs should be properly entered in the "M_S_ave" sheet as explained in 2.1.2. The Master triggers the two slaves and a lemo conector should go from the trigout output of the master to the trigin of the 1st slave and so on (see http://d0server1.fnal.gov/users/utes/WEBPAGE/saseq2.htm). If many chips are readout you might want to plot each chain separately using the ploting flags in "M_S_ave" cells(Q5-Q7) as described in 2.1.2. The desired SASeq and SVX4 parameters should be entered in the corresponding sheets ("Init_SVX4_Slave2, Saseq_Slave, etc.)

Apology

This write up was done in a hurry, especially the parts concerning the laser and the depletion voltage measurement. It will be done in a proper way soon. All comments are more than welcome.