MI ABORT BPM

SPLITTER COMBINER:

The Main Injector abort line contains three wide aperture bpm's, as seen in pict1. From each of these bpm's it is possible to get a horizontal and vertical position. So this would give 3 horizontal positions and three vertical positions.

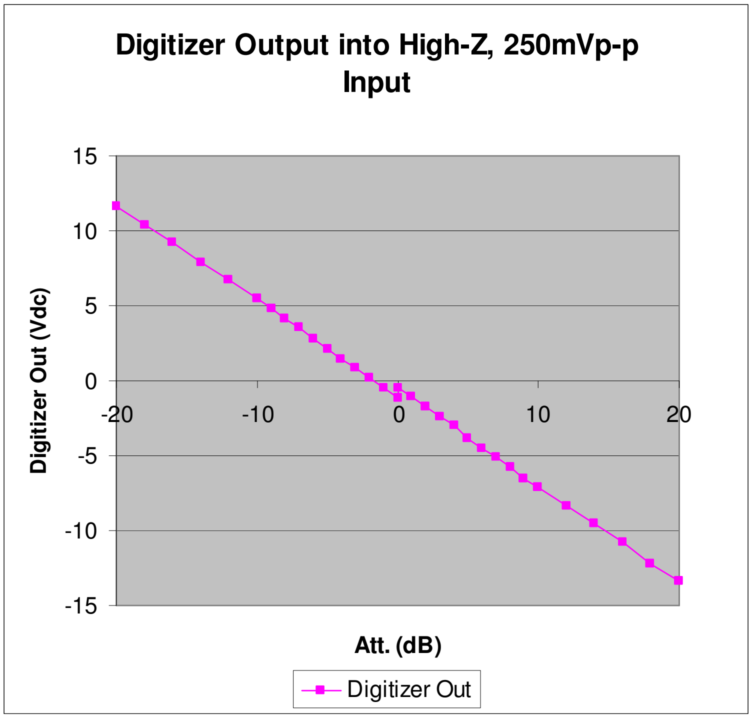
Pict 1

The electronics that was being used was an Ed Barsotti logamp module, labeled **BD/RFI FMI A1/P1 BPM LOGAMP MODULE 9520-ED-309864**. This module's only other use is in the P1 line. Very little documentation exists for this, such as a schematic, the drawing number leads to an empty file. What is known about this module comes from a rough schematic and Ed's notes. The module is setup to use 20db attenuators that the logamp (AD640JP) has jumpers for this built in attenuation. That there are two channels per module and each channel has an A and B input. Each A and B signal goes through a matched for loss daughter card that is a 53 MHz narrow band pass filter. Losses from this daughter card are in the neighborhood of 16db. For each channel there is an offset adjust, which enables the position to be zeroed for an equal A and B signal. There are no other adjustments. This logamp module interfaces to Craig McClure's transition box. From this box the logamp gets its trigger delayed from the main timing event, scale factor for each channel, offset, and transfers the output to acnet.

The timing event that is used is $27 which fires the Main Injector abort kicker. The timing event is available through a module which fans out this event to trigger the abort toroid (I:TOR003) electronics and to the transition module which then is sent to the logamp modules.

To set the delays or change the scaling, telnet to ibpmal (l is el not 1 one, there is an ibpma1). Here there are parameter pages that can be modified. The scale factor is a straight number change and was adjusted from 5.48 to 3.7 after using data from the files at Y:\Public\Crisp\bpm_test_data\MI_WideAper_BPMs.

The sensitivity of the BPMs is 2.3mm/dB as found in the files. Plot 1 below shows that the sensitivity of the electronics is 0.628V/dB. This is calculated by averaging the voltages at +10dB (5.48V) and -10dB (-7.08V) which gives 6.28V/10dB, dividing by 10dB yields 0.628V/dB. Dividing 2.3mm/dB by 0.628V/dB gives 3.7mm/V which is the value that the scale factor was changed to.



Plot 1

Timing was set using beam to the abort line. The timing delays are calculated by dividing the time change (in ns) by 19ns and then adding or subtracting that value from the value in the file. Larger the number the wider the gate will be. The minimum delay is 250ns/19ns= 13.157…
The method being used to give position used the four outputs from the bpm into one logamp. So that horizontal was (1+3)/(2+4), vertical (1+2)/(3+4) this is from Ed Barsotti's document Wide Aperture bpm.xls. Then using software provided the final horizontal and vertical position. This was of questionable accuracy and future plans for a new electronics package would require a different way of getting the horizontal and vertical information. From this it was decided to use a splitter combiner setup to get the needed information. (As seeing in fig1)

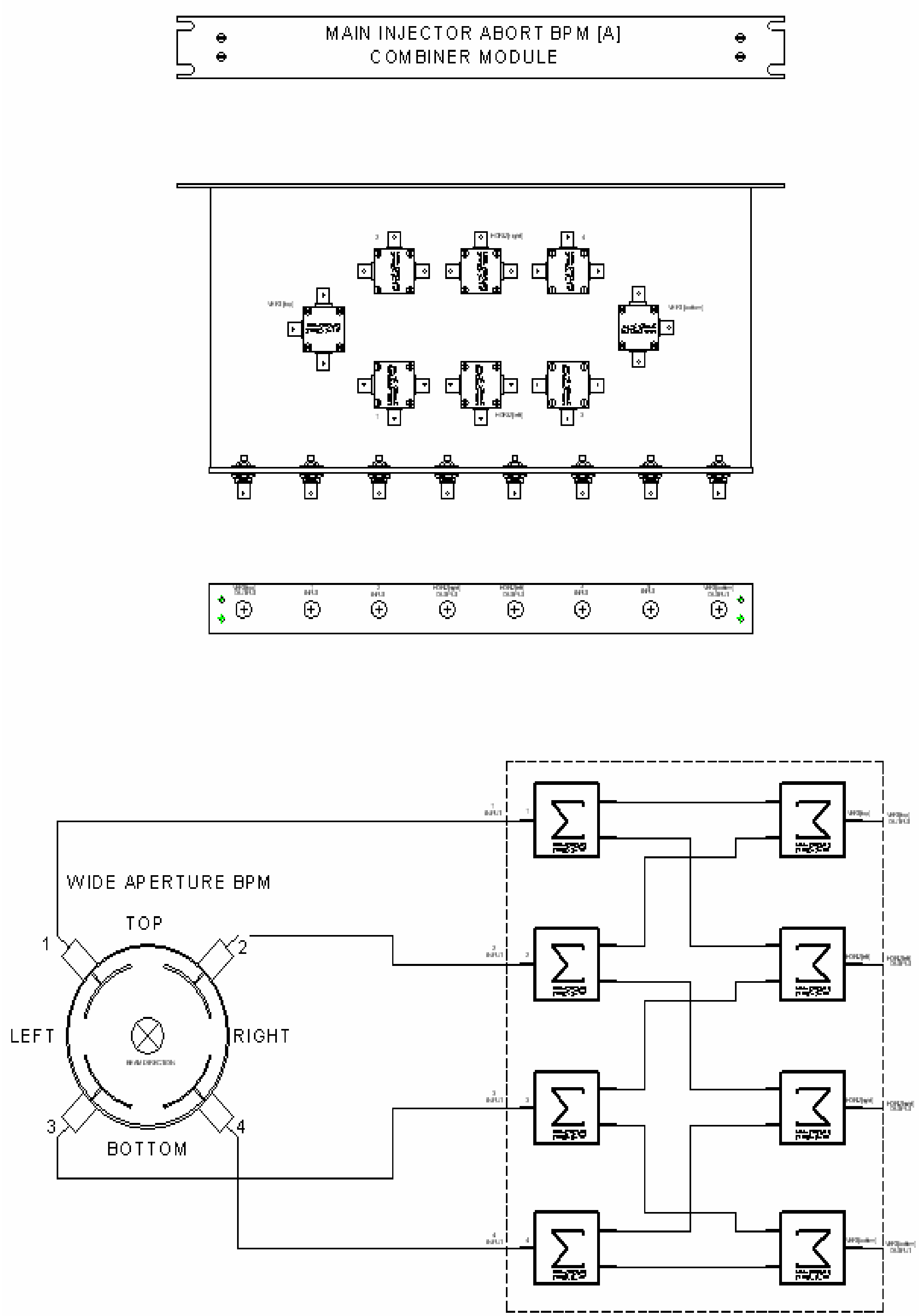

MAIN INJECTOR ABORT BPM [A]
COMBINER MODULE
WIDE APERTURE BPM
TOP
LEFT
RIGHT
BOTTOM
1
2
3
4

Fig 1

ATTENUATION SELECTION:

Using Bob Dysert's excel file *01-03-05 MI Abort BPM Intensity Measurents.xls* (this file can be found in this database) and using the graph in that file, *Abs. Value Intensity 84 Bunches* following was determined. In the first graph you can see that there is a linear range of operation for the electronics. If a large signal is put into the electronics the results can be in the nonlinear range and not what expected. Bob's graph does not show the effects of a small signal, but for this application the amplitude of the beam is expected to be large, 1e13 per batch being common. To limit the input signal so that it is in the linear range the use of an attenuator on the input lines to the electronics is a logical solution.

To choose the right attenuator the following test with beam was done, the setup can be seen below. Alberto Marchionni was doing abort line studies. The abort beam was **1e13 in 6 batches;** this was with each batch of the same intensity, according to Alberto. Simple math shows that there is about **1.6e12 per batch** (1e13/6=1.66667e12). When using a **10dB** attenuator on the input to the electronics, and the above intensity per batch, the log amp module showed a position output of **580mV** was measured on the oscilloscope at MI40 (measured in the same way as Bob Dysert had done in his test).

The test setup:

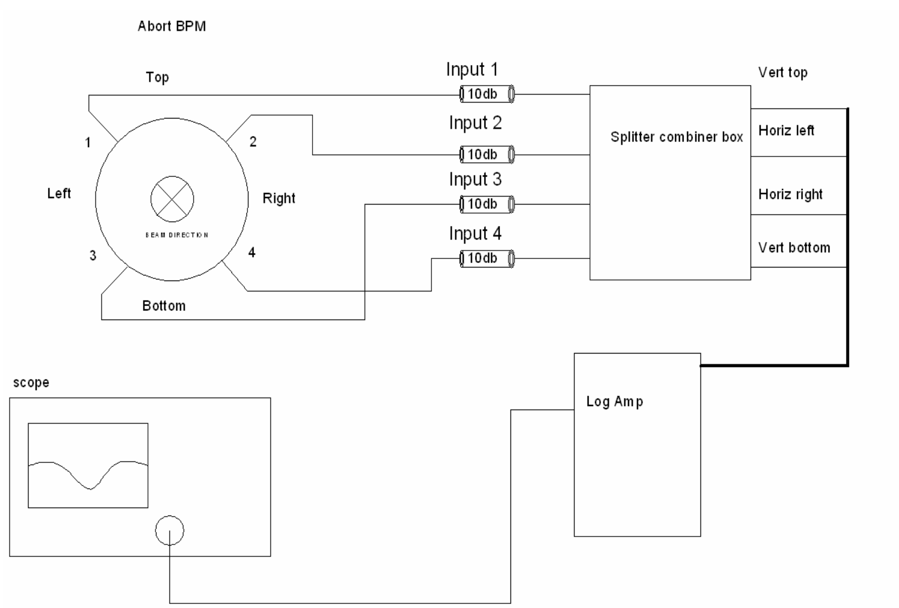


Fig.2

Using Bob Dysert's excel file and using the graph in that file, *Abs. Value Intensity 84 Bunches* following was determined. Given the information that the maximum intensity will be 1e13 per batch, and the resulting voltage output has to be in the linear range of the logamp BPM electronics, then picking 2.5Vp-p is good, a value near the top of the range, but before the roll off, for the maximum output. Looking at the graph *Abs. Value Intensity 84 Bunches* this will correspond to approximately 700mV on the graph. The maximum batch intensity that will be seen is 1e13 and this is 6 about times bigger than the batches observed 1.6e12 per batch, which is where the 580 mV was measured. This then would correspond to 400mVp-p input into the electronics. This 400mVp-p if multiplied by the 6 times bigger beam intensity comes close to 2.5Vp-p which is the maximum. Therefore the 10db attenuators are a good choice for these beam conditions.

Conclusions:

The use of logamps in BPM electronics means the timing becomes critical for accurate position readings. We took lots of data to determine the timing, but still small changes in the timing can cause large errors. As of February 2005 the timing was set using the Numi beam about 2.5nS after the abort kicker. This will be the most accurate for Numi beam aborts, but will also give readings for other types of beam aborts.

Also with logamps small signals can become large outputs. It was observed that when the abort kicker would fire the reflected signal would give an output signal almost as large as one caused by beam, in fact we miss timed the system on this signal at one point, where there was no beam but the kicker was firing. The area where we set the timing for the abort bpm's should not cause any problems from a reflected kicker signal, but other outside noise could cause a problem.