# MiniBoone Target BPM Installation Notes.

November 19, 2002

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## I. Introduction

This document describes the installation details of the BPM readouts for the MiniBoone Target BPM's. These BPM's slide as one assembly into the Target Horn Assembly. There are two Horizontal BPM's, HPTG1 and HPTG2, and two Vertical BPM's, VPTG1 and VPTG2. Half inch Heliax cables bring signals from these detectors up into service building MI-12 directly above.

Note that one horizontal / vertical pair of BPM's are readout using Log Amp style demodulators. These are the type of BPM readout electronics that are used for most of the BPM in the beam transport. The other horizontal / vertical pair are readout using the Synchronous Demodulator electronics. This style provides a bit more resolution, but only operates for a limited range of beam intensities. A spare set of Synchronous Demodulator electronics for both the horizontal and vertical is completely installed, cabled and has its own set of ACNET variable names. All that needs to be done to use the spare electronics is to move the Heliax cables at the top of the rack over to the spare connections.

The documentation for the Synchronous Demodulator readout electronics can be found at the following www page.

http://www-ppd.fnal.gov/EEDOffice-w/projects/MiniBooNE/MiniBooneDocs-www/MiniBooneTgtBpmDocs.htm

Section II. of this document describes the interconnections between the BPM detectors and the different pieces of the readout electronics used to convert the detector signals into beam positions.

Section III. documents the current values of the calibration coefficients for the readout electronics.

Section IV. provides some essential details on how the calibration coefficients were derived. Details on how the regression is performed is described into a separate document (see www page listed above).

## II. The Interconnections

Signals from channel A and channel B of each target BPM are brought up on half inch Heliax cables which connect to N-type bulkhead connectors at the top of the electronics rack. Figure II.1 illustrates and labels these connections.

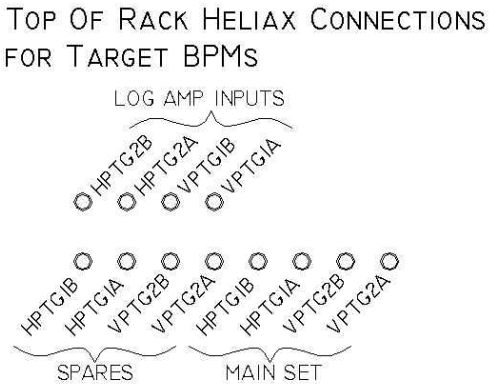


**Figure II.1 Heliax connections at the top of the rack (View from above).**

For the Sync. Demod. readouts the signals are brought from the bulkhead connectors at the top of the rack down into the rear of a Signal Select NIM module. The Signal Select module can be used to switch calibration signals into the electronics downstream of this point. The BPM signals pass through the Signal Select module and are jumpered at the front of the NIM crate to the inputs of the Synchronous Demodulator NIM modules. The demodulated signals are output at the rear of this module and are connected to the digitizer inputs of an IRM chassis. The IRM (Internet Rack Monitor) computes the beam position values and updates these values over the network to the ACNET DAQ system.

Table II.1 and Table II.2 list the interconnections made for the Sync. Demod. readouts. Table II.3 lists the connection of the Log Amp readouts.

### Table II.1 Connection Table for Target BPM's at MI-12

| Heliax Label | Signal Select Module Connection | Synch. Demod. Connection | IRM Digitizer Channel | ACNET Position Name |
|---|---|---|---|---|
| VPTG2A | SS1-A1 | SDM-3 A IN | CH 0 | BPM1P |
| VPTG2B | SS1-B1 | SDM-3 B IN | CH 1 | |
| HPTG1A | SS1-A2 | SDM-1 A IN | CH 2 | BPM2P |
| HPTG1B | SS1-B2 | SDM-1 B IN | CH 3 | |

**Table II.2 Spare Electronics Connection Table for Target BPM's at MI-12**

| Heliax Label | Signal Select Module Connection | Synch. Demod. Connection | IRM Digitizer Channel | ACNET Position Name |
|---|---|---|---|---|
| VPTG2A | SS2-A1 | SDM-2 A IN | CH 4 | BPM3P |
| VPTG2B | SS2-B1 | SDM-2 B IN | CH 5 | |
| HPTG1A | SS2-A2 | SDM-4 A IN | CH 6 | BPM4P |
| HPTG1B | SS2-B2 | SDM-4 B IN | CH 7 | |

**Table II.3 Log Amp Readout of Target BPM's**

| Heliax Label | ACNET Position Name |
|---|---|
| VPTG1A | VPTGTL |
| VPTG1B | |
| HPTG2A | HPTGTL |
| HPTG2B | |

## III. Calibration Coefficients

Tables III.1 and III.2 list the calibration coefficients computed that provide the best fit of the measured BPM signals to positions computed using wire chamber measurements on either side of the target BPM's. Section IV. describes the conversion between the wire chamber values and the expected beam position at the BPM of interest.

**Table III.1 Calibration Coefficients for the Sync. Demod. BPM Readouts.**

| | BPM1P | BPM2P | BPM3P | BPM4P |
|---|---|---|---|---|
| **M1** | 0.9923 | 0.9851 | 0.8905 | 0.8568 |
| **M2** | -0.2683 | -0.3633 | -0.3350 | -0.2839 |
| **M3** | -0.22451 | -0.51730 | -0.5754 | -0.6892 |
| **Sx** | 30.842 | 30.842 | 30.842 | 30.842 |

**Table III.1 Calibration Coefficients for the Log Amp BPM Readouts.**

| | VPTGTL | HPTGTL |
|---|---|---|
| **slope, m** | 1.3239 | 1.3858 |
| **intercept, b** | 1.3301 | -3.0356 |

## IV. Conversion of Wire Chamber Position Values to Expected BPM Positions

In calibrating the target BPM's, expected horizontal and vertical beam positions were computed from the beam position reported by a wire chamber upstream of the BPM's (M875) and a wire chamber downstream of the BPM's (MMBT). The distances between these wire chambers and the target BPM's are illustrated in Figure IV.1. The distances are given in inches.

Knowing the wire chamber mean position values and the distances between the instruments, the BPM positions were computed using the geometry shown in Figure IV.2 and Equation IV.1.

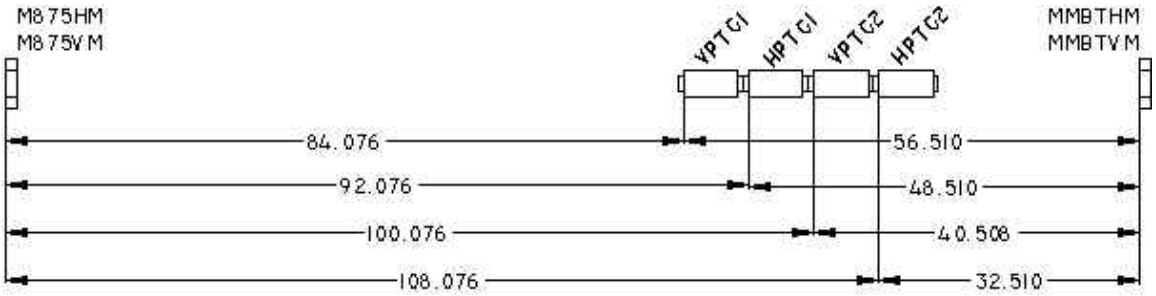


**Figure IV.1 Distances in inches between wire chambers and BPM's**

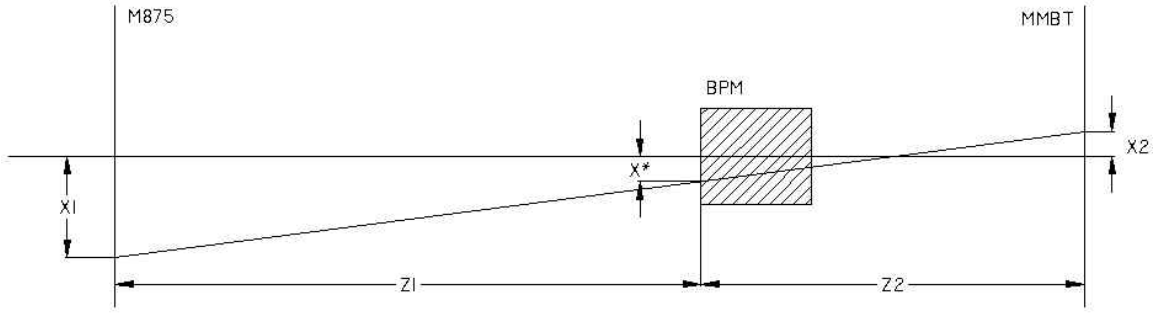


**Figure IV.2**

$$X^* = \left(\frac{X_2 - X_1}{Z_1 + Z_2}\right) \cdot Z_1 + X_1$$

$$X^* = \left(\frac{1}{1+\alpha}\right) \cdot \left(X_2 + X_1 \cdot \alpha\right) \quad Where \quad \alpha = \frac{Z_2}{Z_1}$$

**Equation IV.1**