

Recycler BPM Sign Convention And Signal Path

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This note describes the sign convention used in the Recycler BPM system effective after the Fall 2003 shutdown.

System Convention:

The fundamental sign convention for the Recycler BPM System is that measured positions delivered from the VME front-end data acquisition system to ACNET shall be signed positively for beam positions radially outside at horizontal locations and above center at vertical locations. POSITIVE measurement values correspond to beam UP or OUT and NEGATIVE measurement values correspond to beam DOWN or IN. This convention applies to the two Recycler transfer lines as well as to the Recycler Ring itself.

NOTE: the personnel aisle is on the radial INSIDE of the machine in the Recycler tunnel.

BPM:

The Recycler BPM pickups are two-electrode devices made with diagonally split elliptical pipes. Vertical pickups have output connectors on the top and the bottom of the pickup body attached to the top and bottom electrodes respectively. Similarly, horizontal pickups have output connectors on the radial inside and the radial outside of the pickup body attached to the inside and outside electrodes respectively.

There are some MI-8 style or 8-GeV style pickups in the Recycler system. These pickups are of the two-electrode, diagonally split cylinder design, may be used in either horizontal or vertical applications, and have both connectors on one side of the pickup body. In vertical installations the upper and lower connectors attach to the top and bottom electrodes respectively. Similarly, in horizontal installations, the radial inside and outside connectors attach to the inside and outside electrodes respectively.

Pre-Amplifier and Input Cabling:

Each Recycler BPM pre-amplifier (dwg. 8130-ED-356081) has two signal channels, one for each of two BPM electrode signals. The pre-amp circuit board and schematic documentation identifies one channel by 100-series component numbers and the other by 200-series component numbers. SMA connectors located on one side of the pre-amp module serve the inputs. The SMA (nearest the Burndy connector end of the pre-amp) labeled "B"/TOP/OUTSIDE is the 100-series channel input and the SMA (nearer the BNC connector end of the pre-amp) labeled "A"/BOTTOM/INSIDE is the 200-series channel input.

RG-58 type cables carry the electrode signals from the BPM pickup to the pre-amp inputs. At each location these cables are labeled "A" and "B". The "A" cable connects the Bottom or Inside electrode signal to the "A"/BOTTOM/INSIDE input and the "B" cable connects the Top or Outside electrode signal to the "B"/TOP/OUTSIDE input.

Pre-amplifier to Service Building Cabling:

A Belden YR-43786 cable, comprised of several twisted-pair wires, connects to the pre-amp through a Burndy connector and carries the pre-amp output signals from the tunnel to a rack top-entry panel in the service building. The same cable delivers power to the pre-amp from a supply in the service building. The Burndy pin and twisted pair wire assignments are specified on the Recycler pre-amp dwg. 8130-ED-356081.

Relay Rack Top Entry Panel:

The top-entry panel wiring details, including signal and power pin assignments, are defined on dwg. 8130-ED-356146.

Top Entry Panel to Transition Module Cable:

The cabling that conducts the signals from the top-entry panel to the transition module is shown in dwg. 8130-EB-356139 (Rev A or later).

Transition Module:

The Transition Module (dwg. 8130-EC-356147) is an eight-channel board capable of handling pairs of signals from four BPMs. Inputs are applied through four rear panel 9-pin D connectors, one per BPM. Outputs are on the front panel; the top two outputs are associated with the top D connector input, the second two outputs with the second D connector input, etc. The eight outputs are labeled, top to bottom, on the front panel as A1, B1, A2, B2, A3, B3, A4, and B4.

The cabling between pre-amp and transition module connects the bottom or inside electrode signals (pre-amp 200-series channel outputs) to transition module “A” channels and the top or outside electrode signals (100-series pre-amp channel outputs) to corresponding transition module “B” channels. The A and B convention and labeling is consistent between pre-amp input cable and transition module output.

DDC:

The EchoTek GC814 digital receiver boards are eight channel circuits. The channels are numbered 1 through 8 on the front panel input connectors. Transition module “A” channel output signals connect to odd-numbered EchoTek inputs and transition module “B” channel outputs to the next respectively even-numbered channels. In most, but not all cases, this results in direct physical mapping from the top output of a transition module to the top input of the corresponding EchoTek, second transition module output to second EchoTek input, etc. through all eight channels of each. Specific channel assignments are identified in Beams Document “RR BPM Channel Assignments” (Beams-doc-560-v12(or later)) by Peter Prieto.

Signal cables between Transition Modules and EchoTek cards are labeled with the BPM and the A or B signal identification, e.g. VP521-A for signal A from vertical BPM at lattice location 521.

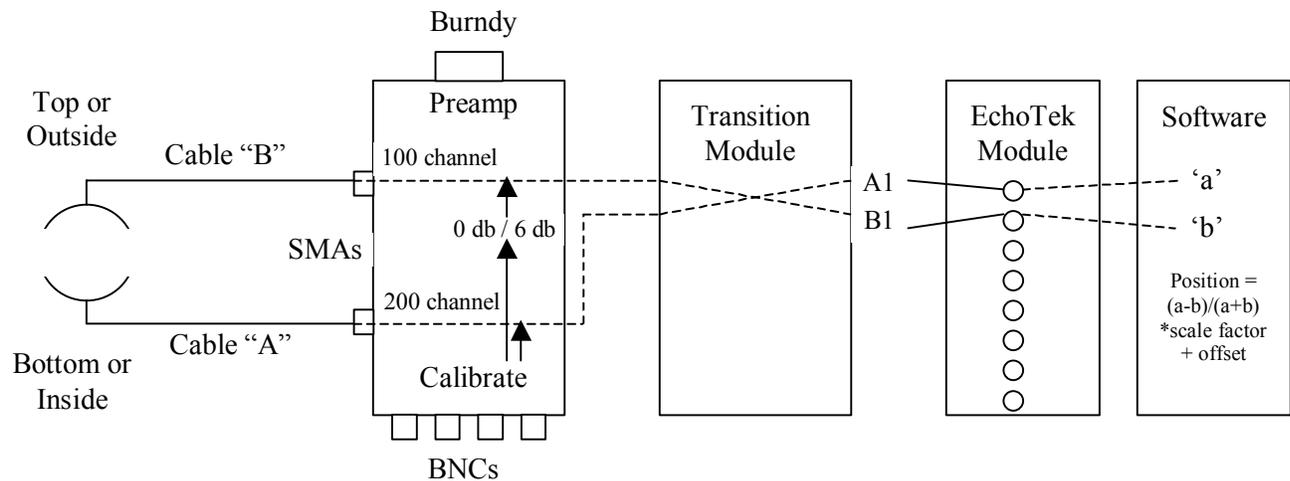
Software:

The software maps EchoTek channels to program variables, 'a' and 'b', to compute beam positions. Mapping is as follows:

```
static unsigned int kChanMap[2][(kMaxBrdNum*kMaxBrdChan)/2]=  
  
{ {0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52,  
54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92, 94},  
  
{1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53,  
55, 57, 59, 61, 63, 65, 67, 69, 71, 73, 75, 77, 79, 81, 83, 85, 87, 89, 91, 93, 95}};  
  
kChanMap[0][chan]==a  
kChanMap[1][chan]==b
```

Note that this definition of 'a' and 'b' is consistent with the labeling on the transition module front panel and with the pre-amp and its input cable labeling.

Given the described cabling, software channel mapping, and arithmetic algorithm, the sign of the scale factor used in position computation must be negative to maintain the desired convention.



Recycler BPM Connections: Top plate to cable "B" to Preamp SMA near Burndy to Transition Module "B" channel to EchoTek second channel to software variable 'b' into (a-b)/(a+b) times negative scale factor.