Timing System Delay Measurement for the SNS BPM System

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Abstract: Automating the timing measurements of the BPMs in the Linac, Ring, and RTBT requires that an absolute delay measurement of the SNS timing system be performed. Since the timing master is in the Ring Service Building, delays along the linac and RTBT were performed at various racks to measure the delays for fixed offsets to timing.

I. Introduction

Timing the BPM systems has historically been a task that requires monitoring the delays along the accelerator for various beam lengths and various beam energies. To aid in the automation, an absolute measurement of timing system delays from the timing master were performed. Coupling this fixed delay with knowledge of the cable lengths, it is possible to set the timing from a single measurement for all of the BPMs along the linac and RTBT.

II. Measurement Setup

A schematic of the measurement setup is depicted in Fig. 1. The timing NADs are set to an identical delay from an identical event. It was chosen to use the 2 Hz trigger, and a delay of 500 μsecs from the event, and a pulse length of 20 μsecs. One observes the two triggers on the oscilloscope and measures the time difference between the two systems. The trigger in the Ring Service Building always occurs first in time, as the timing master is kept in this building. After measuring the time difference between the two systems with the oscilloscope, the delay from the cables (L1, L2, L3, L4, BPM Cable #1, and BPM Cable #2) are then subtracted from the measurement.

The resulting time difference represents the time delay for the timing signal to be propagated from the timing master to the timing communications rooms to the individual racks. It is assumed that the cables that go from the Controls fanouts are identical in length. All of the

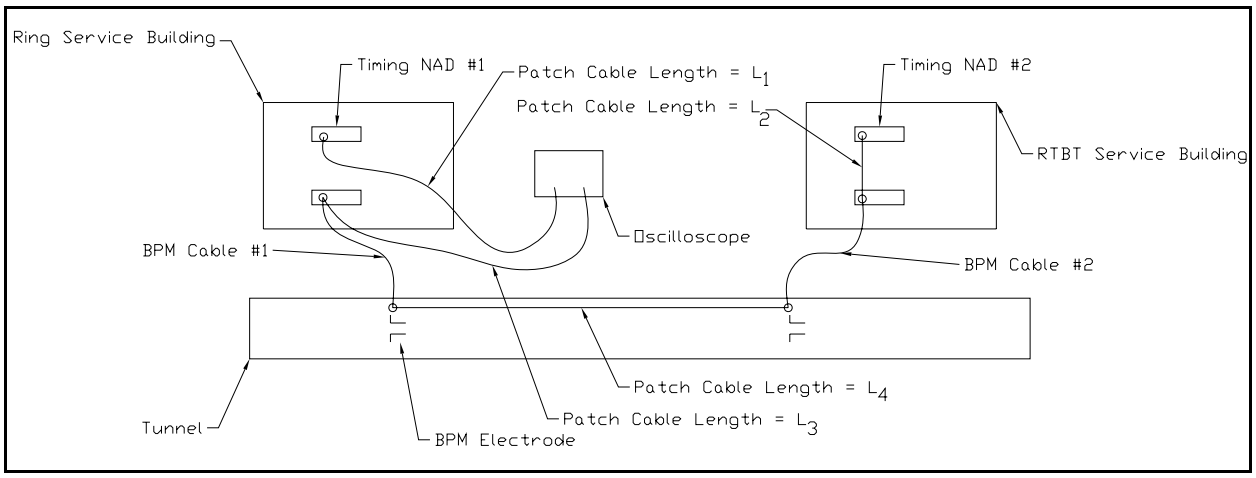

Figure 1. Schematic of the measurement setup. Timing NADs in different buildings are set to the identical event and identical delay. A cable of a known delay connects the two systems. Since cables exist already in the tunnel, it is possible to use the BPM cables to interconnect the different systems. An oscilloscope measures the delay between the two buildings.

measured system delays are accurate to about 5 nsecs.

Table 1. Measured Delays

From RSB to Rack Name	L1 (nsec)	L2 (nsec)	L3 (nsec)	L4 (nsec)	BPM Cable #1 (nsec)	BPM Cable #2 (nsec)	Measured Delay (nsec)	**Calculated Rack Delay (nsec)**
RTBT Row 6 Rack 2	18.45	20	41.23	596.5	540.45	152.88	8348	**7015**
HEBT Row 3 Rack 6	18.45	20	41.23	596.5	499.505	523.5	7973	**6311**
HEBT Row 3 Rack 5	18.45	20	41.23	596.5	499.505	360.98	7786	**6286**
HEBT Row 3 Rack 4	18.45	20	41.23	596.5	499.505	447.41	7866	**6280**
HEBT Row 3 Rack 3	18.45	20	41.23	596.5	499.505	304	7676	**6233**
SCL Row 41 Rack 1	18.45	20	41.23	3891	499.505	384.465	10750	**5932**
SCL Row 40 Rack 1	18.45	20	41.23	3891	499.505	241.985	10590	**5915**
SCL Row 35 Rack 2	18.45	20	41.23	3891	499.505	241.68	10430	**5755**
SCL Row 25 Rack 1	18.45	20	41.23	3891	499.505	256.485	10230	**5540**
SCL Row 15 Rack 1	18.45	20	41.23	3891	499.505	276.485	10160	**5450**
SCL Row 6 Rack 1	18.45	20	41.23	3891	499.505	202.49	9772	**5136**
CCL Row 4 Rack 7	18.45	20	41.23	3891	499.505	182.995	9585	**4969**
DTL Row 3 Rack 9	18.45	20	41.23	3891	499.505	210.54	9235	**4591**
MEBT FER 11	18.45	20	41.23	3891	499.505	0	8728	**4295**

These measurements, when implemented, would have identical (to within 5 nsecs) identical triggers.