Fermilab

Recycler bpm Proposal
Cost and Schedule

Jim Crisp

crisp@fnal.gov

Cost

Qty	part	each k$	total k$	notes
60	GC814 digital receiver	7.5	450	8 spares
8	VME64x crates	3.5	32	2 spares
8	2401 PowerPC	2.5	20	2 spares
8	PMC UCD clock decoder	2.5	20	2 spares
8	IPTSG	2	16	2 spares
8	Digital I/O board	1	8	2 spares
8	rack top fan out/cables	1.5	12	2 spares
	total		$558	(includes $86k for spares)

- It may be necessary to use two smaller VME64x crates per building. The additional cost would be $51k.

Schedule

Fermilab

task	resource	weeks	July	Aug	Sep	Oct	Nov
October shutdown (6 weeks)		6				x x x x	x x
GC814 delivery	Echotek	14	x x	x x x x	x x x x	x x x x	
Modify/tune/calibrate preamps	Prieto	4				x x x x	
Modify RR front end software for 2401	Voy	4		x x x x			
Support 9 cards in 1 crate	Voy	4			x x x x		
Modify software from 2 to 8 channel board	Meyer	6	x x	x x x x			
Support 9 cards in 1 crate	Meyer	6			x x x x x x		
Design/assemble new rack tops	Seraphin	4	x x	x x			
Oder intra rack cables	Seraphin	8		x x x x	x x x x		
Design optimum grey chip filters	Schepart	0	x				
Develop optimum calibration	Schepart	4	x x x x				
Build PMC UCD and IPTSG cards	McClure	8		x x x x	x x x x		
Modify acnet routines to support 2401 cards	Hendricks	1			x		
Modify application program (R39)	Winterowd	1			x		
Program new bpm diagnostics page	Marsh	?		x x x x	x x x x x		
Vacations	all	2					
Commission/startup		2					x x

Improvements

Fermilab

- 2.5MHz bpm system to detect 2.5MHz beam
  - Required to measure first turn accurately
- Digital receiver is software reconfigurable to optimize for different beam current structures such as .089 or 7.5MHz
- Preamp is modified for optimum performance
- Measure beam intensity at each bpm
  - Good check for proper operation
- Cabling scheme allows for easier diagnosis of problems
- Built in diagnostics to facilitate identification and repair of bad channels

Future

Fermilab

- Turn by turn for all bpm's

- Diagnostic application page

- Test system with arbitrary waveform generator

- Excellent approach for Main Injector and Tev bpm systems

Conclusion

- A bpm receiver measures the relative amplitude of two signals to an accuracy of about .05db.

- A $35K HP network analyzer has a relative accuracy of .1db when measuring CW signals after it has been calibrated. This is in a controlled atmosphere and requires short, high quality cables and connectors.

- The bpm receiver measures a complex signal that lasts for 1.6usec at the end of a 1000+ foot cable across substantial potential differences in ground.

- The digital receiver has demonstrated the ability to meet specifications throughout an impressive dynamic range
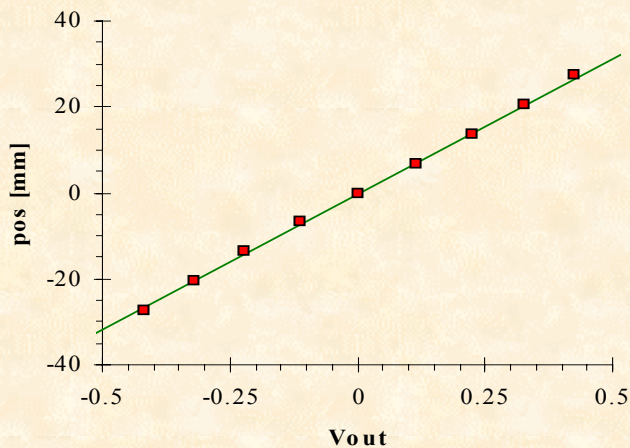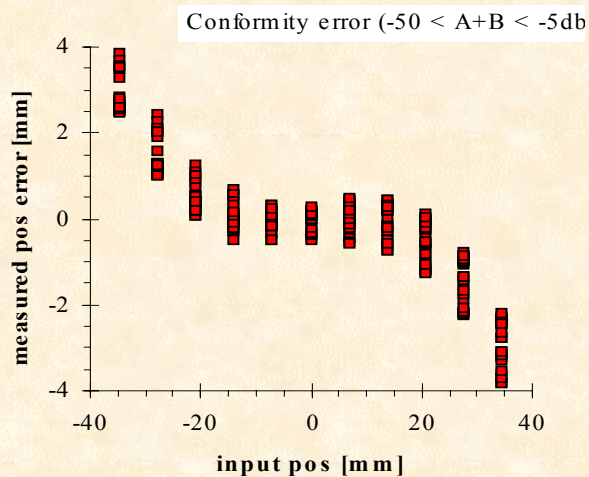
- It will work!

Digital Receiver Performance

Fermilab

30db preamp 15.6db cable

.3 to 100e10
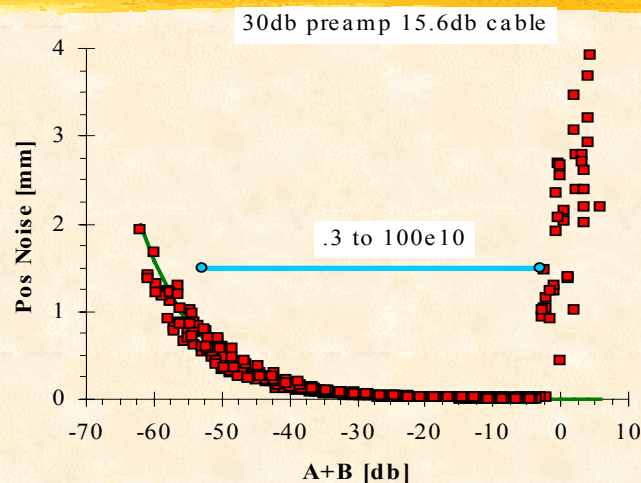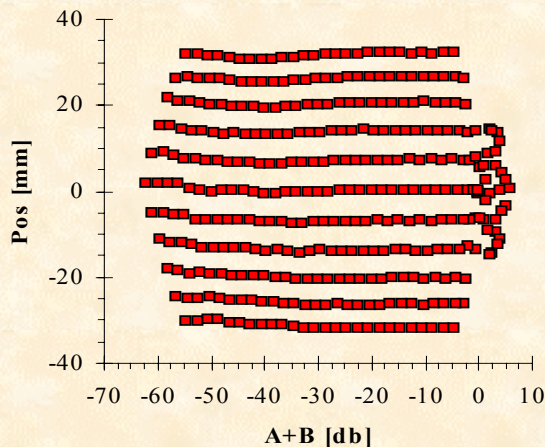
-90.4 dbm equiv noise   15.0 bits   4-2.5MHz gaussian bunches   62.85 mm/Volt   0.29 bpm db/mm

Conformity error (-50 < A+B < -5db

Summary

- **Digital receiver works!**
  - SINAD 74.5db at 2.2MHz (from Analog Devices)
  - Allow 10db for A/B and get 64.5 db dynamic range
  - After filter, SINAD = 92db or ENOB = 15
  - Pos noise = (20/.29) –92db   (for Hor, Ver about ½ this)
    - 1.7um at max intensity   1.7mm at –60db
- Emphasis on well supported standard lab tools
- Use commercial hardware
- Exploit current software to the extent possible
  - Front end, ACNET, Application
- Initial implementation supports current bpm features
  - Allow for future improvements