



BB-BPM module was originally developed by A. Kalinin and redesigned by S. Artinian. It is based on Robert E. Shafer's original concept.

The BaseBand BPM is a log amplifier-based beam position monitor. It operates up to 25MHz.

Output signals are analog voltages:
 X&Y narrowband outputs for close orbit measurement
 X&Y wideband outputs for machine study, to see orbit changes or instabilities during the ramp

Cable length matching not required: pickup signals don't need to be in phase

To prevent noise pickup by way of ground loops:

- The front-end amplifiers and filters are powered via their RF output coaxial cables
- The front-end amplifiers gain is controlled by fiber optic signals

Front-end Filter and Amplifier BB-BPM-FEFA

Four BB-BPM-FEFA are required for each BB-BPM plug-in module, one per pickup.

BB-BPM-FEFA has been specifically developed to measure low intensity ion beams. It is best to install it very close to the stripline or shoebox pickups to minimize capacitive loading.

Control of BB-BPM-FEFA gain is done by FO fiber optics, one per front-end amplifier.

A single control FO can be daisy-chained to all front-end amplifiers. The FO signal is under user's control. The user must provide FO with a high level to switch the gain from 0dB to nominal value.

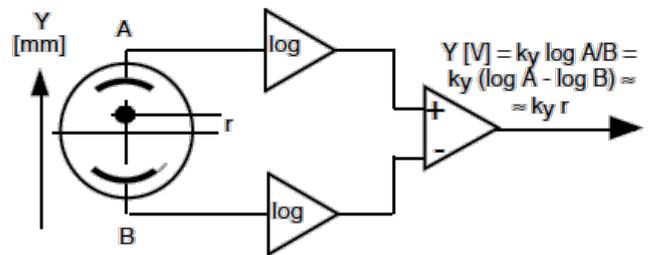
For cancer therapy synchrotrons
 Tracks the beam during energy ramp

Optimized for proton/carbon beams
 Handles >70dB beam intensity range
 Up to 40dB additional gain preamplifier

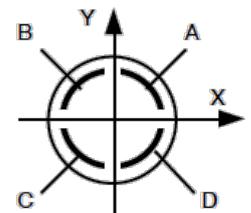
Operating principle

Based on the pioneering work of Robert E. Shafer at Los Alamos Laboratory, the Log-Ratio BPM derives beam position from logarithm of the ratio of opposite pickup signals: $\text{Log}(A/B)$.

Position measured by this method is more linear, over a wider range, than difference-over-sum.



The position of the beam from rotated pickups is obtained by axes translation to the vertical resp. horizontal plane by wideband analog circuits.



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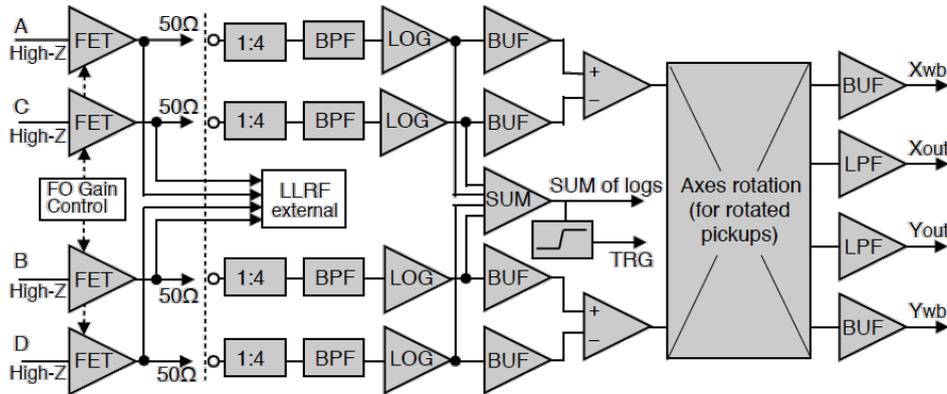
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Block diagram



Specifications

	BB-BPM-FEFA Amplifier and filter	BB-BPM Log-Ratio processor
Input intensity range	0dB or +40dB switchable gain	>70dB continuous gain
Frequency range	200kHz - ≤25MHz	200kHz - ≤25MHz
Input signal	High impedance 2.5Vmax	-70dBm - +5dBm
Input noise floor	25nV/√Hz	<-70dBm
Controls	Gain control by FO Daisy chain	N/A
Power supply max	+15V, 1.5W supplied by BB-BPM	±15V, 9W includes supply to BB-BPM-FEFA
Output to external LLRF	50Ω unity gain pickup image	None
Outputs	When measured in 50Ω load or 100Ω differential load	When measured in high-impedance load
X & Y Narrowband for close orbit on front panel DB9	-2V...0...+2V 0V on center 25MHz bandwidth	-5V...0...+5V 0V on center 25MHz bandwidth
X & Y Wideband for machine study on front panel DB9	-2V...0...+2V 0V on center 25MHz bandwidth	-5V...0...+5V 0V on center 25MHz bandwidth
X&Y gains Orthogonal PU	0.75V for ½ radius	1.5V for ½ radius
X&Y gains Rotated PU	0.5V for ½ radius	1.0V for ½ radius
Output noise rms for input >1mV	<0.1% of pickup radius, e.g. 100µm in 100mm radius	<1% of pickup radius, e.g. 100µm in 100mm radius
Linearity error As % of pickup radius	On-center <0.1% e.g. 100µm in 100mm radius	Off-center <1% e.g. 100µm in 100mm radius
Temperature drift as % of pickup radius	300 ppm/K e.g. 30µm/K in 100mm radius	

Order codes

BB-BPM-E	Eurocard format 100 x 160mm, 20mm wide to be plugged into one BPM-RFC chassis station. May be mixed with LR-BPM-E and MX-BPM-E in same chassis
BB-BPM-FEFA/xxdB	W40mm, L80mm, H22mm front-end Filter and amplifier with F.O. selectable gain 0dB or xxdB. Features four 3-mm mounting holes.
BPM-RFC/xx	19"x3U RF-shielded chassis with xx wired stations (power-limited to up to 8 stations) AC mains 90-245Vac, 50/60Hz
Accessories:	
BPM-Cxx	SMA-SMA coaxial cable with PTFE connector dielectric, xx meters
BPM-RHCxx	Radiation-tolerant SMA-SMA coaxial Radox cable with PEEK connector dielectric, xx meters
BPM-KIT	Table-top test kit for one XX-BPM-E, with SMA inputs and BNC output
BPM-XTD	Module extender card
BPM-SERV/RF	RF service module
	Passive module. Brings the pickup signals from the back connectors to front panel BNCs

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