LR-BPM

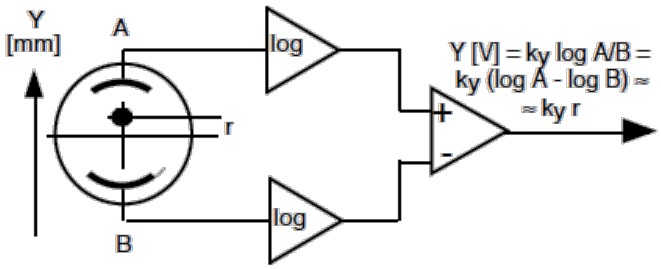
- Non-interceptive beam position measurement
- Bunches at any repetition rate up to 500 MHz
- Optimal for single-pass short bunches
- Linacs, transfer lines, first turns fast-cycling synchrotrons, boosters
- Dynamic range >50 dB

The Log-ratio BPM was developed by Alexander Kalinin, with contributions from Jim Hinkson and Klaus Unser. Based on Robert E. Shafer original concept.

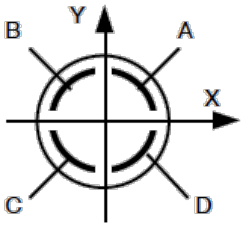
Operating principle

Based on the pioneering work of Robert E. Shafer at Los Alamos Laboratory, the S-BPM derives beam position from logarithm of the ratio of opposite pickup signals: 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.



Signal processing

Signals from the pickups are stretched to produce bursts. This is essential to measure the single pass of a bunch. Four parallel logarithmic amplifiers detect the burst envelopes.

Amplifiers' response is log of amplitude. Logs of opposite pickups are subtracted. If pickups are rotated, axes are translated to obtain X and Y positions. The process is all-analog, wideband.

The Log-Ratio Beam Position Monitor (LR-BPM) is an electronics module for fast analog processing of beam pickup signals.

Input signals parallel processing allows single-pass position measurement.

Individual bunches can be distinguished from one another up to 5 MHz repetition.

±2V X and Y outputs are held until the next bunch when Sample & Hold mode (optional) is activated.

On option, provides log signal from each pickup electrode for additional analysis, with 5MHz bandwidth.

MANUFACTURER

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LR-BPM

Specifications

Bunch rep. rate	From 25 MHz to 500 MHz
Inputs	One per pickup, SMA 50 Ω Possibility to configure for orthogonal or rotated pickups
Outputs	X and Y: -2 V...0...+2 V 40 mA max Sum of logs: 0...+2 V 40 mA max
X and Y gain	1.5 V corresponds 1/2 of aperture radius for orthogonal pickups 1.0 V corresponds to 1/2 of aperture radius for rotated pickups
Beam intensity position dependence	
On center	Near zero.
Off-center	Worst case when beam is 6 dB off center (e.g. ±7 mm in a 20 mm radius aperture): ±3 %
Temperature drift	0.6 x 10^{-3} of aperture per degree, e.g. 25 µm/K in 20 mm radius aperture
Trigger output	> 10 ns trigger after single bunch
Power supply	+15 V, < 300 mA; −15 V < 300 mA

Order codes

LR-BPM-xxxMHz	Log-ratio BPM plug-in module

On-board factory-installed options:

LR-BPM-SH	Sample and Hold on X and Y outputs
LR-BPM-TRG	Beam Trigger, built-in
LR-BPM-SUM	Sum of log (A,B,C,D)

Accessories:

BPM-RFC/xx	RF-chassis, ≤16 stations 19” rack-mountable 3U-high EMIRFI-shielded chassis for 100~240 V 50~60 Hz mains power, features up to 16 stations for any mix of Log-ratio BPM or Multiplexed BPM
BPM-KIT	Table-top test kit 100~245V 50~60Hz powered kit Pickup inputs on SMAs Outputs on BNCs and DB15
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

Modes of operation

Track-Continuous

Advised for CW beams or macropulses longer than 1 µs
No trigger needed

Output bandwidth	5 MHz
Resolution in function of input power (per intput):	
-5 dBm to -30 dBm	1/10’000 of aperture radius
-30 dBm to -50 dBm	1/2’000 of aperture radius
-50 dBm to -60 dBm	1/660 of aperture radius

Sample & Hold

Advised for single pulse or macropulses shorter than 1 µs
Requires LR-BPM-SH option
Requires trigger (built-in or external)

Processing time	~450 ns
Hold time	≤ 100 ms
Pulses rep. rate	Up to 2 MHz
Resolution in function of input power (per input):	
-5 dBm to -20 dBm	1/200 of aperture radius
-20 dBm to -40 dBm	1/100 of aperture radius

Track & Hold

Advised for single pulse or macropulses shorter than 50 ns
Requires LR-BPM-SH option
Requires trigger (built-in or external)

Processing time	~110 ns
Hold time	~70 ns
Pulses rep. rate	Up to 5 MHz
Resolution in function of input power (per input):	
-5 dBm to -20 dBm	1/200 of aperture radius
-20 dBm to -40 dBm	1/100 of aperture radius

Packaging

LR-BPM module is 3U-high x 160mm shielded Euromodule; 20-mm wide.

Interchangeable / plug-compatible with other Bergoz Instrumentation’s BPM modules.

LR-BPM can be installed in same chassis as S-BPM, BB-BPM and MX-BPM for mixed application.

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