



BEAM DIAGNOSTIC COMPONENTS

National Electrostatics Corp.

Beam Profile Monitors

The unique design of the NEC beam profile monitors (BPM) have made them among the most popular and reliable beam diagnostic instruments available. The NEC BPM reliably gives accurate information concerning the ion beam cross-section for ion beams with currents as low as 1 nA.

Applications

The NEC BPM system is ideally suited for applications that require instantaneous scope display of beam cross-sectional shape and position without significantly interrupting beam transmissions. Particle beams of electrons, ions, or energetic neutrals are monitored.

Over 1,000 BPMs are in use worldwide on ion implanters, cyclotrons, linacs, and electronic ion beam systems with terminal potentials from below 100 kV to above 25 MV.

Design

The unique patented design of the NEC BPM relies on the collection of secondary electrons from a grounded scanning wire. This arrangement eliminates contact noise at the rotating scanning wire.

The BPM is ultra high vacuum compatible. A magnetic coupling is used to transfer motion into the vacuum system for the rotating scanning wire. There are no sliding seals. The only (UHV compatible) organic material is in the lubricant in the stainless steel bearings. Under typical vacuum conditions, no pressure rise is seen when turning the scanning wire on in the 10^{-9} Torr range.

The wire sweeps across the beam twice during each revolution to give a Y profile in a half revolution and an X profile during the next half revolution. This scanning wire is surrounded by a collector cylinder that picks up secondary electrons from the scanning wire. The signal from the collector cylinder is transported to a preamplifier. This signal is then sent to the NEC controller and to an oscilloscope for direct viewing of the beam profile. The signal resulting from the interaction of the ion beam and the scanning wire is dependent on the beam current density, which also affects the maximum beam power that can be accepted and the ultimate sensitivity of the BPM.



The original NEC beam profile monitor, Model BPM80, which monitors beams up to 25mm diameter.

Beam power- The standard 0.5mm diameter scanning wire will accept a maximum beam power density of 140 W/mm² of continuous beam with no deformation. This means that the beam power can be a maximum of 1 kW for a 3 mm diameter beam or 2 kW of beam power for a beam diameter no less than 4.3 mm.

Scanning wires of larger diameter are available for applications involving higher beam power densities.

Sensitivity- The standard BPM system will routinely monitor beams with current densities to 10 nA/cm². Therefore, a 1 nA beam with a diameter of 1 mm is readily monitored. However, a 1 nA beam with a diameter of 10 mm is less readily observed. NEC has recently developed a low current BPM with a minimum detectable beam current in the FemptoAmp range. Please contact NEC for further information.

Beam size- The original NEC beam profile monitor, Model BPM80, is apertured to allow monitoring of beams up to 2.5 cm in diameter. The Model BPM83 is available to monitor beams of diameters up to 7 cm. These two models come complete with housing with NEC or CF flanges. Model BPM81 and BPM82 are also available for insertion into existing vacuum housings, and can monitor beams up to 2.5 cm and 5.0 cm respectively.

Accessories

For a complete beam profile monitor system, the BPM is connected to an NEC controller and a display oscilloscope.

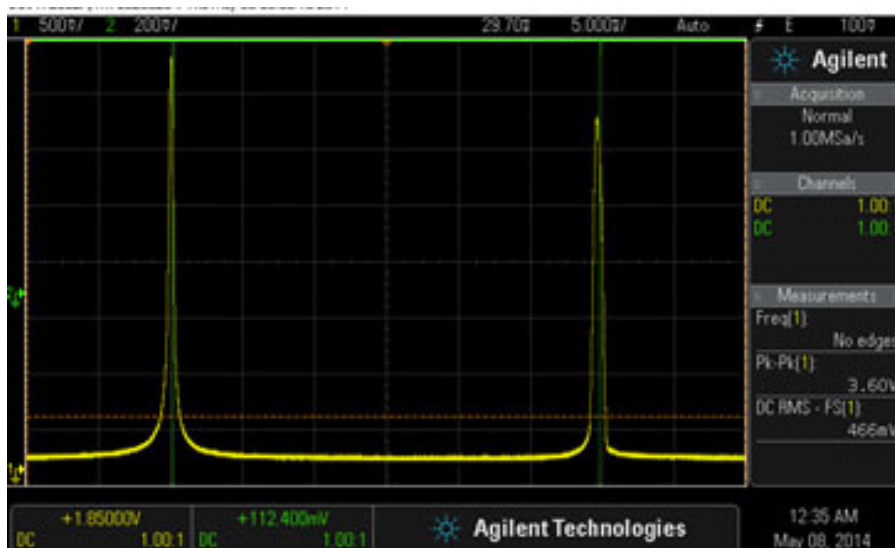
BPM Controllers- Three BPM controllers are available. The Model FP3A and SS5A include on/off control, fiducial pulse shaping circuit and a front panel switch which allows increasing the amplifier gain by a factor of ten. This is frequently useful when tuning ion beams. The FP3A controller is designed for use with a single beam profile monitor. The SS5A has switches and connectors to select for display one of up to 12 BPM units. The Model SS6 is similar to the SS5A with the addition of external interfacing and no gain adjust. The SS6 accepts 24 VDC to any one of several control ports to select the BPM associated with that port. This is done by using a computer controlled data acquisition system. The SS6 output is not digitized and must be connected to a BPM display oscilloscope.

Display oscilloscope- The digital display oscilloscope to be used with the BPM must have the following specifications:

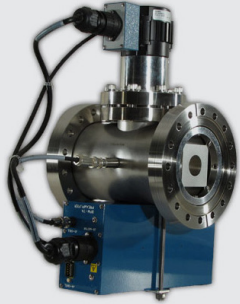
- Time base: 5 ms/div.
- Band Pass: 10 kHz
- Vertical sensitivity: 50 mV to 5 V/div.

An analog oscilloscope can be used if it has simultaneous Z axis intensification and remote trigger.

Upon request, NEC can recommend and/or supply an oscilloscope that meets the above requirements.



(To the left) a trace from a digital oscilloscope shows the Y scan (left peak) and the X scan (right peak) of the beam in real time. The FWHM relates directly to the beam size on the oscilloscope, 2mm per minor division. The area under the peaks represents the relative intensity of the two axes.



BPM80- 1.0" dia. aperture

Model BPM80

The NEC BPM80 is our original BPM and our most popular configuration. It is designed to monitor beams up to 1.0" (2.54 cm) diameter. The BPM80 is in use worldwide on electrostatic, cyclotron, and linear accelerator systems.

The BPM80 includes a housing and preamplifier. The housing has a nominal diameter of 4.0" (10 cm) with a 1.0" (2.54 cm) diameter molybdenum beam entrance aperture. Standard flanges include 6.0" O.D. CF and 6.0" O.D. NEC flanges.



BPM83- 2.75" dia. aperture

Model BPM83

The NEC BPM83 is specifically designed to handle large diameter ion beams up to 2.75" (6.98 cm) in diameter. The BPM83 is ideal for applications involving large diameter beams, such as those commonly found in production ion implanters.

The BPM83 includes a housing and preamplifier. The housing has a nominal diameter of 6.0" (15 cm) with a 2.75" (6.98 cm) diameter molybdenum beam entrance aperture. Standard flanges include 6.0" O.D. or 8.0" O.D. CF, 6.0" O.D. and 8.0" O.D. NEC flanges.



BPM81- 1.0" dia. aperture

Model BPM81

The NEC BPM81 is designed for insertion into a customer supplied housing. It is designed to monitor beams up to 1.0" (2.5 cm) diameter. The BPM81 is ideal for use when beamline length is at a premium.

The BPM81 includes a preamplifier and has a 1.0" (2.54 cm) diameter molybdenum beam entrance aperture. It requires a nominal port diameter of 2.50" (6.35 cm). The insertion distance from flange gasket surface to beamline center is 2.72" (6.9 cm). Custom insertion distances are available. Standard mounting flanges include 4.25" O.D. NEC or 4.50" O.D. CF flanges.



BPM82- 2.0" dia. aperture

Model BPM82

The NEC BPM82 is a large aperture unit designed for insertion into a customer-supplied housing. It is designed to monitor beams up to 2.0" (5 cm) diameter. The BPM82 is ideal for applications involving large diameter beams when beamline length is at a premium.

The BPM82 includes a preamplifier and has a 2.0" (5 cm) diameter molybdenum beam entrance aperture. It requires a nominal port diameter of 4.0" (10.16 cm). The insertion distance from flange gasket surface to beamline center is 4.5" (11.43 cm). Custom insertion distances are available upon request. Standard mounting flanges include 6.0" O.D. NEC or CF

flanges.

	BPM80	BPM83	BPM81	BPM82
Overall Length	6.7" (17.15 cm) - 7.38" (18.73 cm) dependent on flange type	8.0" (20.32 cm) for 8.0" O.D. NEC or CF flanges	N/A (mounts on a nominal 2.5" (6.35 cm) dia. port)	N/A (mounts on a nominal 4.0" (10.16 cm) dia. port)
Standard Flanges*	Housing Flanges: <ul style="list-style-type: none"> ■ 6.0" or 8.0" O.D. CF ■ 6.0" O.D. NEC ■ 4.0" O.D. Dependex 	Housing Flanges: <ul style="list-style-type: none"> ■ 6.0" or 8.0" O.D. CF ■ 6.0" or 8.0" O.D. NEC ■ 4.0" or 6.0" Dependex 	Mounting Flange: <ul style="list-style-type: none"> ■ 4.5" O.D. CF ■ 4.25" O.D. NEC 	Mounting Flange: <ul style="list-style-type: none"> ■ 6.0" O.D. CF ■ 6.0" O.D. NEC
Housing	4.0" (10.16 cm) dia. (nominal)	6.0" (15.24 cm) dia. (nominal)	N/A	N/A
Beam Aperture dia./ material	1.0" (2.54 cm) dia./ molybdenum	2.75" (6.98 cm) dia./ molybdenum	1.0" (2.54 cm) dia./ molybdenum	2.0" (5.08 cm) dia./ molybdenum
Maximum Beam Power Density	140 Watts/mm ² (1 kW for 3 mm dia. beam)	150 Watts/mm ²	140 Watts/mm ² (1 kW for 3 mm dia. beam)	140 Watts/mm ² (1 kW for 3 mm dia. beam)
Scanning Wire material/dia.	Molybdenum / 0.020" (0.5 mm) dia.**	Molybdenum / 0.060" (1.5 mm) dia.	Molybdenum / 0.020" (0.5 mm) dia.**	Molybdenum / 0.040" (1 mm) dia.
Catalog No.	2EA008245 (6.0" O.D. CF) 2EA008255 (6.0" O.D. NEC)	2EA008165 (8.0" O.D. CF) 2EA008155 (8.0" O.D. NEC)	2EA008195 (4.5" O.D. CF) 2EA008115 (4.25" O.D. NEC)	2EA008125 (6.0" O.D. CF) 2EA008205 (6.0" O.D. NEC)

* Other flange size and type available upon request


** 0.040" (1.0 mm) dia. optional

Preamplifier: Local manual gain switch sets input sensitivity at decades between 10-3 A/V and 10-7 A/V.

Minimum Detectable Beam Current/Density: 1 nA or 10 nA/cm²

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