

TP-191

Bipolar Time of Flight Detector

Start Up Procedure

Unpacking Your Bipolar Time Of Flight Detector

The Bipolar Time of Flight detector contains contamination sensitive components and therefore must be handled with care. The following procedure should be followed in order to preserve the high performance properties of the Bipolar Time Of Flight Detector. Additional information on handling and storage is available from the BURLE ELECTRO-OPTICS INC. (www.burle.com) website.

The detector (both flanged and non-flanged models) will arrive in a vacuum-formed plastic case in a vacuum-sealed bag. To remove the detector from the package, carefully cut open the vacuum-sealed bag with a razor blade or pair of scissors.

For Flanged Detectors: Loosen the hose clamp from the outside diameter of the flange and slide off both top hats, using care not to touch the vacuum side of the detector with ungloved hands. Gently blow off the detector with clean dry nitrogen or dry air. The detector is now ready to mount to the vacuum system and pump down.

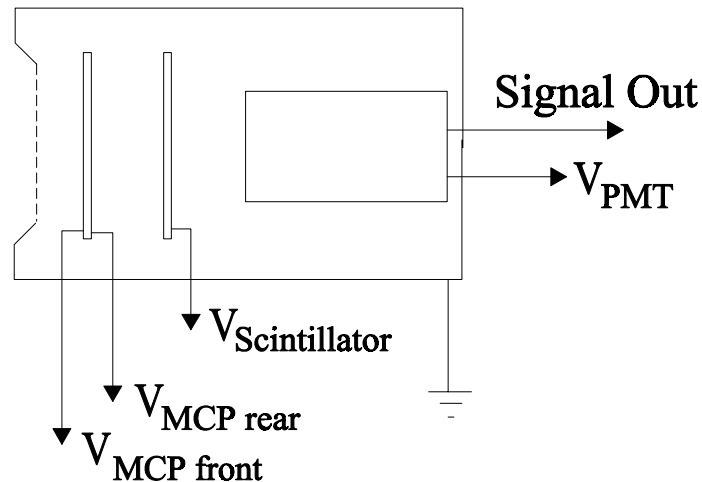
For Stand Alone (Flangeless) Detectors: The detector will arrive in a vacuum-formed case inside the vacuum-sealed bag. After removal from the bag, remove the detector from the case by first removing the case cover. Remove the detector from the case by grasping the outside of the cylindrical body or the mounting plate. **Do not grasp the detector from the topside, as damage to the grid may occur.** The detector is now ready for installation into the instrument.

Operating Instructions for Burle Electro-Optics Bipolar Detector

The BURLE ELECTRO-OPTICS INC. Bipolar detector is a high performance detector designed specifically for use in time-of-flight mass spectrometer systems. It is a hybrid device, containing a microchannel plate (MCP), ion-to-electron conversion and amplification, a scintillator electron-to-photon conversion surface, and a photomultiplier tube (PMT) detector. In this configuration both positive and negative ions may be post-accelerated with up to 10 KV of kinetic energy while the overall detector output remains fixed at ground potential. The principle of operation and detailed operating instructions for both positive and negative ion detection are described below. Typical operating voltages are given for applying 5 KV post-acceleration to the ions. **To avoid damage to the detector you must read and follow the operating instructions given below.**

Principle of Operation

A schematic drawing of the Bipolar detector is shown below, with the various detector leads identified:



Ions enter the detector from the left through a grounded wire-mesh grid where they are generally post-accelerated into the face of a 5 μm pore diameter MCP. The surface of the MCP serves as an ion/electron conversion surface; the primary electrons are multiplied as they move down the pores of the MCP where the gain is controlled by the voltage difference applied across the MCP (the difference between $V_{MCP\ front}$ and $V_{MCP\ rear}$). The electrons exit the MCP and are further accelerated by an electric field into the scintillator plate where they are converted into photons. The gain of the electron/photon conversion process is controlled by the voltage difference between $V_{scintillator}$ and $V_{MCP\ rear}$. Finally, the photons are detected by the high-speed PMT; the gain on the PMT being controlled by the voltage applied to the PMT dynode chain via V_{PMT} . Note that there are three ways that the overall gain on the Bipolar detector can be affected, and that changes in one may compensate for changes in another. The operating voltages given below should provide ample signal for analysis.

Important Notes:

- 1) $V_{MCP\ rear}$ must be more positive than $V_{MCP\ front}$ for the electrons to be drawn across the plate. **The maximum allowable voltage difference between $V_{MCP\ front}$ and $V_{MCP\ rear}$ is 1200V.** A new detector typically requires only 800V.
- 2) $V_{scintillator}$ must be more positive than $V_{MCP\ rear}$ for the electrons to be accelerated into the scintillator. **The maximum allowable voltage difference between $V_{scintillator}$ and $V_{MCP\ rear}$ is 4000V.** A new detector typically requires only 200-3000 V
- 3) For best results, the coaxial PMT signal line should be kept as short as possible. To maintain the high-speed nature of the signal a proper 50-ohm vacuum feed-through should be used. Units provided on a vacuum flange contain such a feed-through.

- 4) To preserve the high speed nature of the signal, cabling from the vacuum interface to the digitizer or high speed oscilloscope must be 50 ohms, and the length should be as short as possible.

Operating Limits

The maximum allowable voltages (versus ground, unless otherwise noted) for the various detector HV leads are given below:

Lead	+ Ion detection	- Ion detection
MCP Front	-10 KV	+10 KV
MCP Rear	-10 KV	+11 KV
Scintillator	-10 KV	+14 KV
PMT	-800 V	-800 V

However, *the maximum allowable difference* between the MCP Front and MCP Rear is 1200V, and *the maximum allowable difference* between the MCP Rear and the Scintillator is 4000V.

The background pressure of the instrument should be as low as possible to obtain the best results. ***To prevent damage to the MCP do not operate the detector when the background pressure is greater than 1×10^{-5} torr.***

Positive Ion Detection

This description will assume that the operator desires to impart 5 KV of post-acceleration to positive ions entering the Bipolar detector. The desired operating voltages will be –5000V on MCP front, –4200V on MCP rear, –2200V on the scintillator, and –500V on the PMT. *With separate power supplies attached to each of the voltage inputs, the following startup procedure **must** be followed:*

- Increase the voltage on MCP front to –1000V
- Increase the voltage on MCP rear to –1000V
- Increase the voltage on the Scintillator to –1000V
- Increase the voltage on MCP front to –1500V
- Increase the voltage on MCP rear to –1500V
- Increase the voltage on the Scintillator to –1500V

Continue to increase the three voltages in steps of approximately 500V in the order specified (MCP front, MCP rear, scintillator) until the desired set points are attained.

Finally, increase the voltage on the PMT to –500V

The rate of change of the voltage **should not exceed** approximately 200V/second.

If the overall gain of the detector needs to be changed, first adjust the voltage applied to the PMT. If these changes are not sufficient, adjust the voltage applied to the scintillator. Higher voltages applied to the PMT yield larger signals; the greater the voltage difference between MCP rear and Scintillator the greater the overall detector signal.

To turn off the detector, first set the PMT voltage to 0V. The voltages applied to MCP front, MCP rear, and the scintillator should be decreased in a similar manner to their startup, being careful never to allow the voltage difference across the MCP to exceed 1200V.

Negative Ion Detection

This description will assume that the operator desires to impart 5 KV of post-acceleration to negative ions entering the Bipolar detector. The desired operating voltages will be +5000V on MCP front, +5800V on MCP rear, +7800V on the scintillator, and -500V on the PMT. With separate power supplies attached to each of the voltage inputs, the following startup procedure **must** be followed:

- Increase the voltage on MCP front to +1000V
- Increase the voltage on MCP rear to +1000V
- Increase the voltage on the Scintillator to +1000V
- Increase the voltage on MCP front to +1500V
- Increase the voltage on MCP rear to +1500V
- Increase the voltage on the Scintillator to +1500V

Continue to increase the three voltages in steps of approximately 500V in the order specified (MCP front, MCP rear, scintillator) until the desired set points are attained.

Finally, increase the voltage on the PMT to -500V

The rate of change of the voltage ***should not exceed*** 200V/second.

If the overall gain of the detector needs to be changed, first adjust the voltage applied to the PMT. If these changes are not sufficient, next adjust the voltage applied to the scintillator. Higher voltages applied to the PMT yield larger signals; the greater the voltage difference between MCP rear and Scintillator the greater the overall detector signal.

To turn off the detector, first set the PMT voltage to 0V. The voltages applied to MCP front, MCP rear, and the scintillator should be decreased in a similar manner to their startup, being careful never to allow the voltage difference across the MCP to exceed 1200V.

Power Supplies

BURLE ELECTRO-OPTICS INC. recommends the use of well-filtered high voltage power supplies with the Bipolar detector. If separate HV supplies are used for each of the detector HV leads, *it is imperative that the voltage difference across the MCP never exceeds the specified 1200V*. The power supplies connected to the MCP front and MCP rear leads must be changed in unison as described above to avoid damaging the MCP.

This concern can be avoided by the use of floating supplies to control the MCP gain and Scintillator voltages; such a power supply is available from BURLE ELECTRO-OPTICS INC. Contact your local representative for further information.

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