

Channeltron® Installation and First-Time Use Guide

Handling, mounting, electrical connection, and initial verification

A quick-start guide preserving the original technical instructions while improving readability, structure, and usability.

WARNING

This guide includes information on high-voltage and high-vacuum operation. Installation and first-time use should be performed only by qualified personnel following applicable safety procedures.

1. Overview

Channeltron® detectors amplify incoming particle or photon events through secondary electron emission. When an incoming electron, ion, XUV, X-ray, or gamma photon strikes the input with sufficient energy, one or more secondary electrons are generated. These electrons multiply through an avalanche process, reaching up to 10^8 electrons at the output. The output electrons are collected by the anode, typically a simple metal plate, and create a pulse that is visible on an oscilloscope through the connecting wire. For a $50\ \Omega$ input, the pulse is typically around 1–5 mV.

QUICK NOTE

The input particle should strike the cone to initiate the avalanche of electrons at the output.

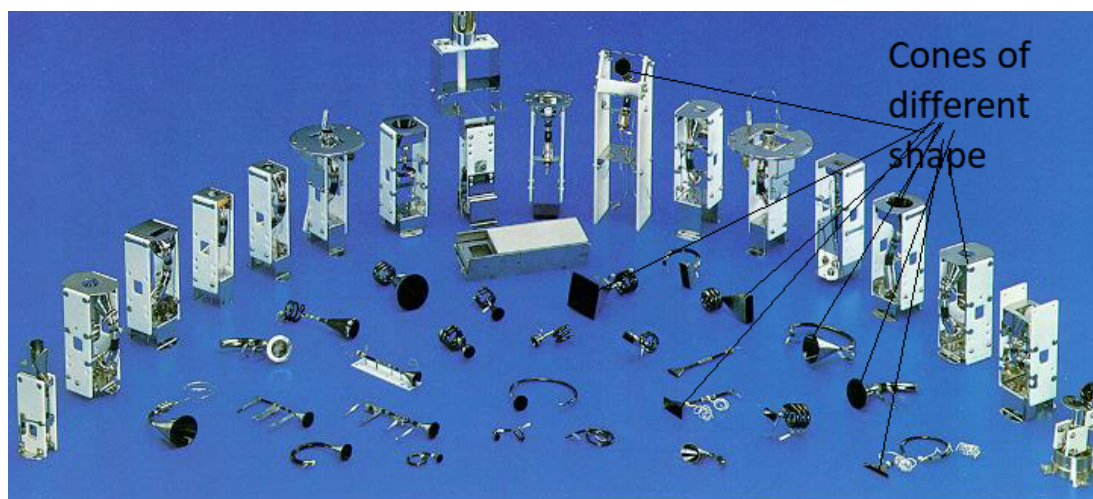


Figure 1. Channeltron® detector formats and cone variations.

2. Storage, Handling, and Operating Requirements

Channeltron® is made from lead glass reduced by hydrogen at elevated temperature at the surface. If left in air for a very long time, such as months, re-oxidation can occur and the tube surface can become non-conducting again. The guidance below consolidates the original storage, vacuum, and voltage requirements into a quick reference table.

Requirement	Guidance from original document
Storage after opening	Keep Channeltron® in dry nitrogen or rough vacuum (10^{-2} Torr or lower). In these conditions, it may be kept indefinitely.
Coated Channeltron® handling	For CsI, MgF_2 , or KBr coatings, place under dry nitrogen or rough vacuum immediately upon arrival and keep there until installation. Moisture can recrystallize coatings rapidly; CsI is noted as around 1 hour in humid air.
One-channel operation	10^{-5} Torr or better.

Spiraltron™ / Magnum™ operation	Below 7×10^{-4} Torr.
MegaSpiraltron™ operation	Designed to work up to 10^{-3} Torr or below.
High-voltage supply	Required for operation; maximum voltage for Channeltron® types is stated as up to 3 kV.
Recommended initial startup	Start at -2000 to -2200 V and observe the anode pulse on an oscilloscope.

IMPORTANT	The factory package is not completely impermeable to water vapor. For moisture-sensitive coatings, move the Channeltron® to dry nitrogen or rough vacuum immediately upon arrival.
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3. Identifying Connections

Each Channeltron® has a recognizable shape with a cone. In many cases, connections are attached to the tube as strap lines. The most common configuration has three connectors: the connector nearest the cone is the input, the middle connector is the output, and the connector at the second end of the tube is the anode.

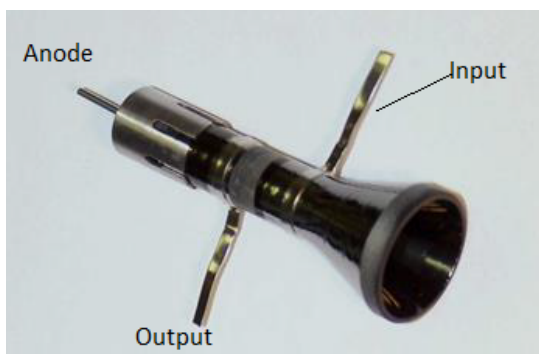


Figure 2. Input, output, and anode identification.

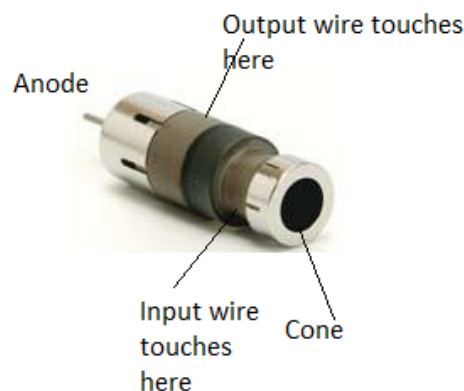


Figure 3. Magnum™-style body with wire contact points.

Some Channeltron® types, such as Magnum™, may have no connectors or only one connector. These are designed for installation into commercial mass spectrometers, where connection is made by wires touching the body of the Channeltron®.

4. Mounting Options

Channeltron® may be mounted on a vacuum flange, with the electrical connections on the air side. Other mounting approaches include attaching the detector to a high-vacuum-compatible PC board or mounting the

Channeltron® by hanging it on wires. Channeltron® detectors are light enough that wire mounting should not break the straps.

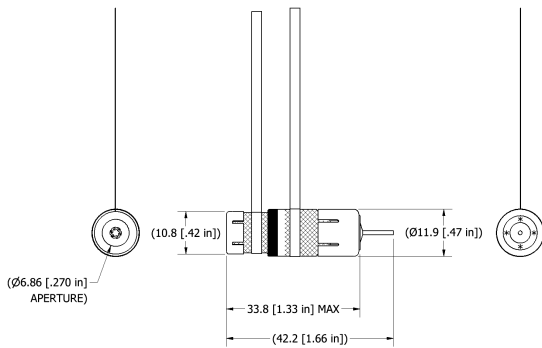


Figure 4. Vacuum flange mounting dimensions.

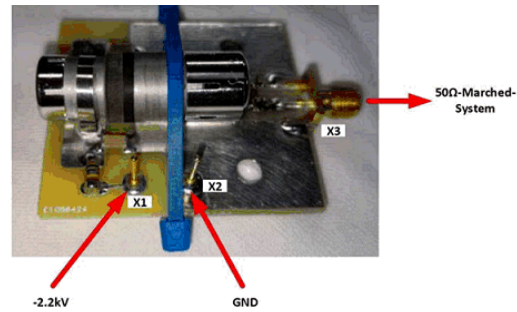


Figure 5. PC-board mounting with short SMA transition.

DESIGN NOTE

The PC-board mounting shown includes a very short transition to an SMA connector and allows a 5 ns pulse out from CEM 5901.

5. Resistance Check Before Electrical Connection

Once the Channeltron® is mounted inside the high vacuum, check the resistances before completing electrical connection.

- Between input and output, resistance should be 60–100 MΩ for a non-extended dynamic range Channeltron®.
- For extended dynamic range Channeltron®, resistance may be up to 5 MΩ.
- Resistance below approximately 5 MΩ is not possible under normal conditions; if measured, something is wrong.
- Before any connection, the anode should be completely isolated.

6. Electrical Connection Examples

Photons and positive ions

The easiest connection is for photons and positive ions. The first resistor of 1 MΩ is used for safety to help prevent damage to the high-voltage power supply in the case of a short circuit. The first capacitor supports faster recharging of the surface after each pulse. The resistor at the anode is 50 Ω for an undistorted pulse. A larger resistor, such as 1 kΩ, may provide a stronger pulse, but ringing is inevitable.

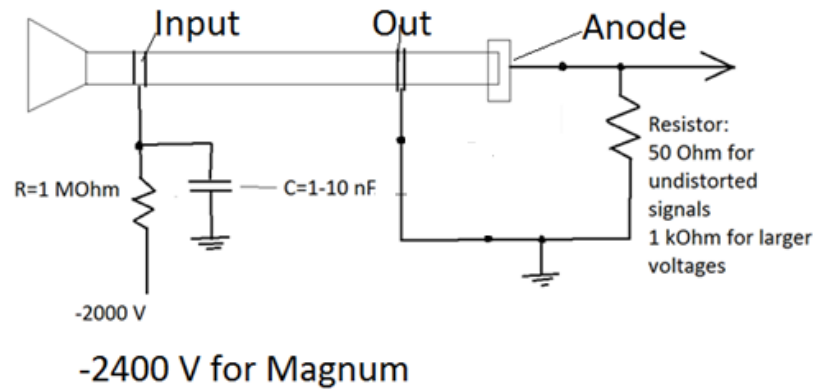


Figure 6. Typical connection schematic for photons and positive ions.

Negative ions and electrons

For negative ions and electrons, capacitive coupling is necessary. The schematic below shows the configuration for negative particles.

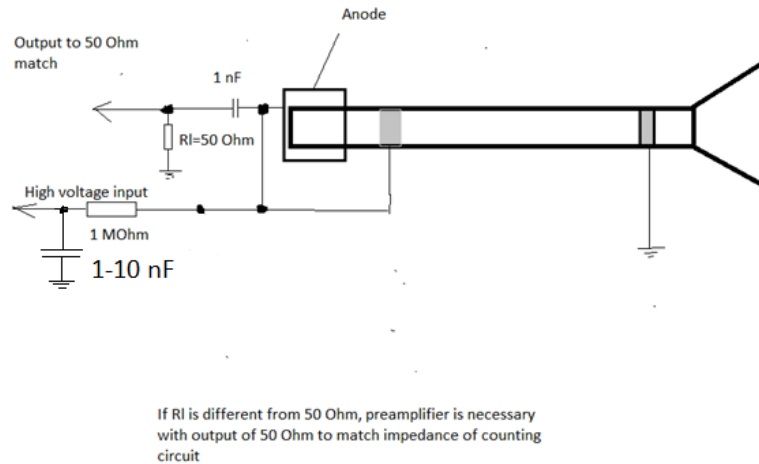


Figure 7. Capacitive coupling schematic for negative particles.

One capacitive coupler example includes two high-voltage-rated capacitors: one for the signal and a second between the SMA connector bodies. One capacitor alone creates ringing.

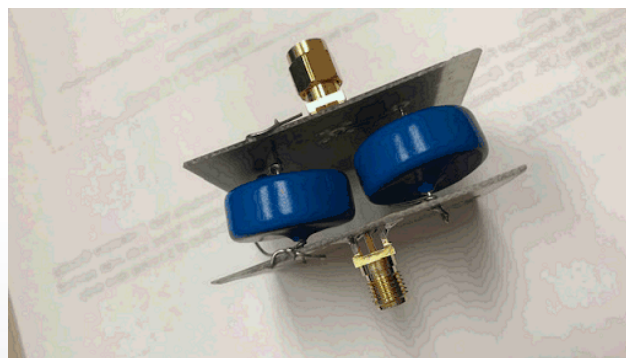


Figure 8. Example of a capacitive coupler with two high-voltage-rated capacitors.

7. First-Time Startup Checklist

Use the following checklist to support the first startup and verification sequence.

✓	Step	What to verify
☐	Storage condition	Confirm the Channeltron® has been stored in dry nitrogen or rough vacuum as applicable, especially for coated versions.
☐	Vacuum level	Confirm vacuum is appropriate for the Channeltron® type before applying high voltage.
☐	Resistance check	Verify input-to-output resistance and confirm the anode is isolated before connection.
☐	Connect instrumentation	Connect the high-voltage supply and oscilloscope according to the appropriate positive/negative particle configuration.
☐	Initial voltage	Begin at -2000 to -2200 V for initial start.
☐	Observe dark pulses	With the oscilloscope connected to the anode, expect dark pulses around 1–2 mV in amplitude without input signals.
☐	Check response	If the ionization gauge is on, the number of pulses may increase. Turning the ionization gauge on and off can help observe response to positive ions.
☐	Light response	If the chamber has a viewport, the Channeltron® may respond to light. A UVC hand-held lamp near the viewport may raise counts to hundreds per second.
☐	Voltage limit	Do not exceed the stated maximum voltage of 3000 V.

8. Expected Pulse and Gain Behavior

The example oscilloscope captures below show typical pulse observations. In a $50\ \Omega$ input, typical amplitude is around 100 mV. Pulse width is around 20 ns because of propagation along the wire in vacuum when wires are used up to the vacuum exit.

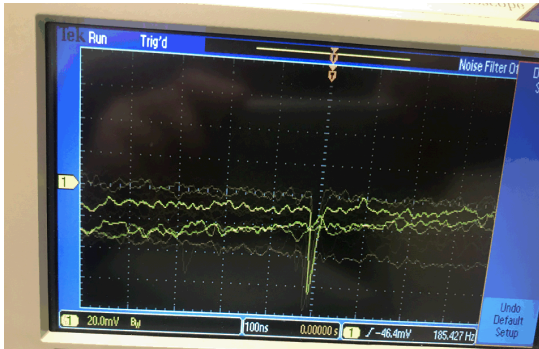


Figure 9. Oscilloscope pulse example.

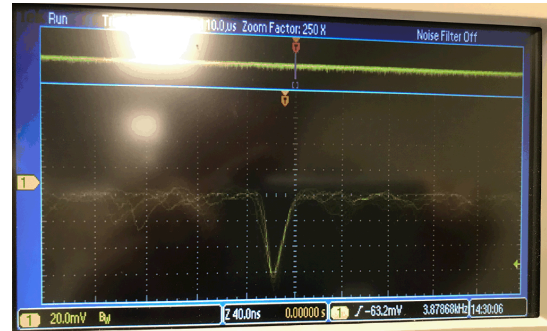


Figure 10. Oscilloscope pulse example with negative-going pulse.

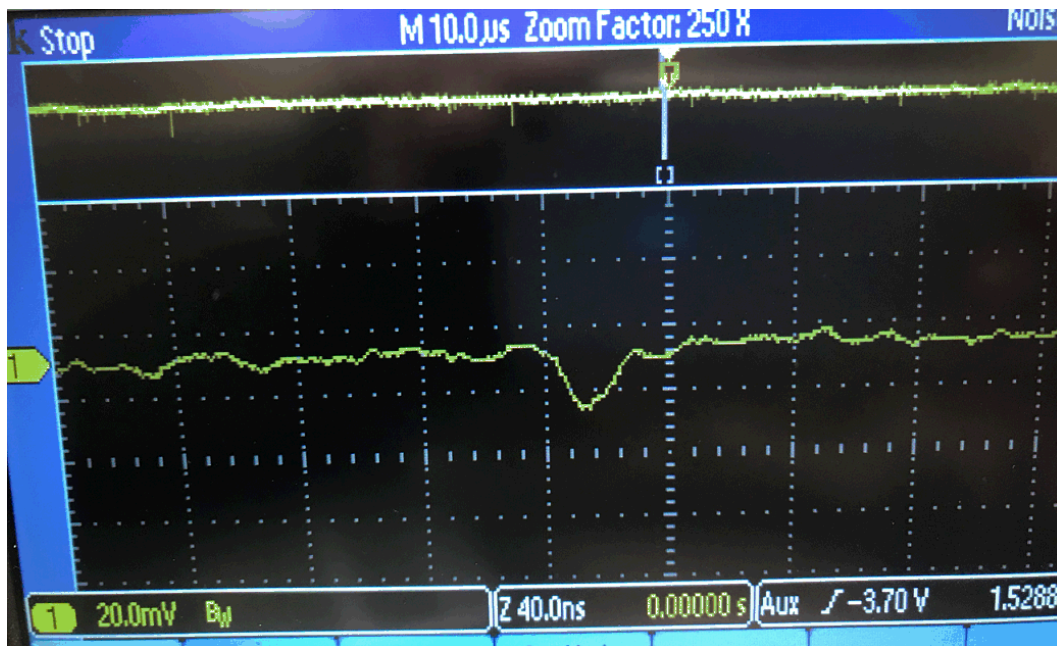


Figure 11. Additional oscilloscope pulse capture.

The figure below shows a typical gain curve for a pulse-counting Channeltron®.

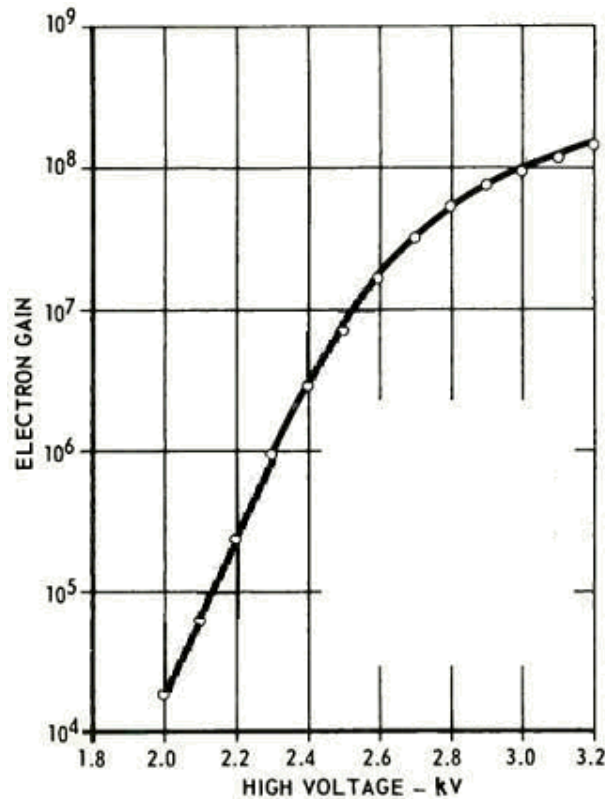


Figure 12. Typical gain curve for pulse-counting Channeltron®.

9. Reference

For more details about Channeltron® operation, avalanche development and propagation, experimental approaches to measure pulse width, ringing elimination, and detection efficiency estimates, see: [Photoionisation Detection or Single 87Rb-Atoms using Channel Electron Multipliers.](#)



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Nd:YAGレーザー、Ti:Sレーザー
OPOLレーザー

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