A1421

Preamplifier and discriminator for He3 Tubes

Data Sheet

The **A1421** is a charge-sensitive preamplifier with integrated shaping amplifier and discriminator stages, providing both analog and logic outputs. It is specifically designed to operate with neutron detector tubes (such as 3He and BF3 tubes) across a wide range of applications. The unit is optimized for position-sensitive thermal neutron detectors, where high counting rates and excellent spatial resolution (low-noise performance) are required. It is equally suitable for counting applications when used in combination with monitor counters such as the **R7771B** Neutron Pulse Train Recorder and the **R7780** Shift Register – for example, in the non-destructive analysis of nuclear materials by passive or active neutron methods, for containment monitoring and nuclear waste control.

The detector signal is acquired through an **SHV** or **HN** front connector, while the bias voltage is supplied via a dedicated external HV input on an SHV connector that feeds the internal decoupling circuits. Two rear 3-pin male connectors (REAN RT3MP) deliver the low-voltage supply to the preamplifier and also enable daisy-chain operation across multiple units. Two front-panel trimmers allow independent adjustment of the discriminator threshold and of the discriminator output pulse width.

The discriminator features an internal VETO circuit, factory-set by CAEN, that prevents early retriggering, for example due to pulse reflections. The VETO introduces a superimposed paralyzable dead-time. The veto duration can be adjusted by the user by means of an internal trimmer and a dedicated test point. A digital input on a LEMO connector is also provided to cascade the summing of discriminator signals between multiple A1421 units.

The preamplifier can be powered directly by the **R7771B**, by the R7780, or by the **A325** DC/DC power supply unit, by means of dedicated power cables: model **A324** (1 m) and model **A323** (20 cm), available as accessories. **The A1421 is shipped as standard equipped with the A324 cable.**

Three versions of the preamplifier are available.

- ⇒ **Version A** is the standard version, suitable for the majority of applications: it includes a pole-zero compensation circuit and is therefore ideal for applications requiring Pulse Height Analysis (PHA), where neutron spectroscopy or position sensitivity may be needed alongside neutron counting.
- ⇒ **Version B** is intended for active measurements, where the sample is activated by means of a neutron generator: it provides bipolar output pulses without pole-zero compensation and incorporates dedicated optimizations that ensure fast recovery from saturation conditions once the neutron generation burst is complete.
- ⇒ **Version C** is a modified version intended for high counting rate applications: it enables neutron counting at rates up to about 1 Mcps.

- **Specifically designed for neutron detectors such as ^{3}He or BF_3 tubes in counting applications**
- **Charge-sensitive preamplifier, shaping amplifier and discriminator integrated in a single unit**
- **Gain:**
  - ⇒ **30 mV/fC on HiZ (15 mV/fC on 50 Ω)**
  - ⇒ **8.2 mV/fC on HiZ (4.1 mV/fC on 50 Ω)**
- **Discriminator with adjustable threshold and width**
- **Internally generated discriminator VETO**
- **External HV input on SHV connector (feeding the internal decoupling circuits)**
- **Detector inputs on SHV or HN connectors**
- **Test input on LEMO (1 pF charge injection capacitors)**
- **Full counting acquisition system when combined with R7771B Neutron Pulse Train Recorder or R7780 Shift Register**
- **Three versions:**
  - ⇒ **A with pole-zero compensation for PHA and neutron spectroscopy**
  - ⇒ **B with bipolar output and fast saturation recovery for active interrogation**
  - ⇒ **C for high counting rate neutron counting (up to 1 Mcps)**

Developed in collaboration with Institut Laue-Langevin in Grenoble



A324 cable is included in the KIT

Inputs

DET IN

Accepts positive and negative input charge pulses from detectors and supplies the HV bias to the detector itself. ESD protected input. **SHV** or **HN** connector.

HV IN (Detector Bias)

Up to 4000 V (positive or negative) for the detector bias. **SHV** connector.

TEST

Positive or negative input for the energy calibration via Ctest = 1 pF; 10:1 Attenuation; 50 Ω Impedance; **LEMO-00** connector.

D IN

digital input **TTL** (Zin = 1 kΩ) for cascading the summing of the discriminator signals; **LEMO-00** connector.

Power

Input Power (± 12 V) through two rear 3-pin male connectors also allowing for daisy-chain operation. **3 pole male tiny XLR** connector.

The power supply can be provided by CAEN **A325** DC/DC converter. It can supply power to up to 8 A1421 units in a daisy chain configuration.

CAEN also provides the **A323** and **A324** cables, which enable the connection between the A325 and the A1421 units, as well as facilitating daisy chain connections.

Power Requirements

+12 V	65 mA (Typ)
–12 V	45 mA (Typ)

Outputs

A OUT

± 2.6 Vpp max. (open circuit), 50 Ω back termination. The output voltage is proportional to the amount of input charge. **LEMO-00** connector.

D OUT

Discriminator digital output **TTL**

threshold, adjustable from –1V to +1 V via front panel 12 turn trimmer,

Output width Adjustable via front panel 12 turn trimmer

LEMO-00 connector.

Environmental

- Indoor use
- Operating Humidity: 10% to 90% RH non
- condensing
- Storage Humidity: 5% to 90% RH non condensing
- Pollution Degree: 2
- Overvoltage Category: II
- EMC Environmental Commercial
- Operating Temperature range: 0°C +50°C
- Storage Temperature range: -10°C +80°C

WARNING During normal operation, a potentially hazardous high voltage bias is applied to a detector via the preamplifier.

Only qualified personnel should carry out installation, operation and maintenance procedures of this unit.

Furthermore, the preamplifier bias circuit has a very long time constant and therefore this circuitry can remain at high voltage for a very long time. If the user does not exercise adequate caution, this voltage can cause personal injury due to electrical shock.

Please observe the following precautions:

- Completely discharge the detector bias circuit by switching off the bias supply before connecting a cable, to the Input/Detector connector.
- If you are using a variable power supply, bring the voltage value to zero and wait for at least 30-60 seconds. The bias circuitry will discharge itself through the output of the bias supply.

WARNING Do not connect the **DET IN** to exposed circuitry. Connect the preamplifier to a Detector/ Power Supply properly grounded to safety earth.

Operation

Care must be taken in the use of A1421 with high voltage detectors.

Please remember to:

- Turn down gradually bias voltage prior to connect or disconnect preamp input
- Avoid fast changes in bias voltage
- Avoid Detector breakdown or discharge

LED

D OUT-LED

Bi-color LED: Green when D OUT is inactive, Red when D OUT is active

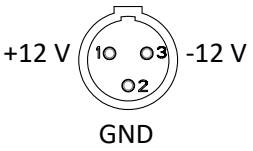


Fig. 2: Power Supply Connector pin out.

VETO Trimmer

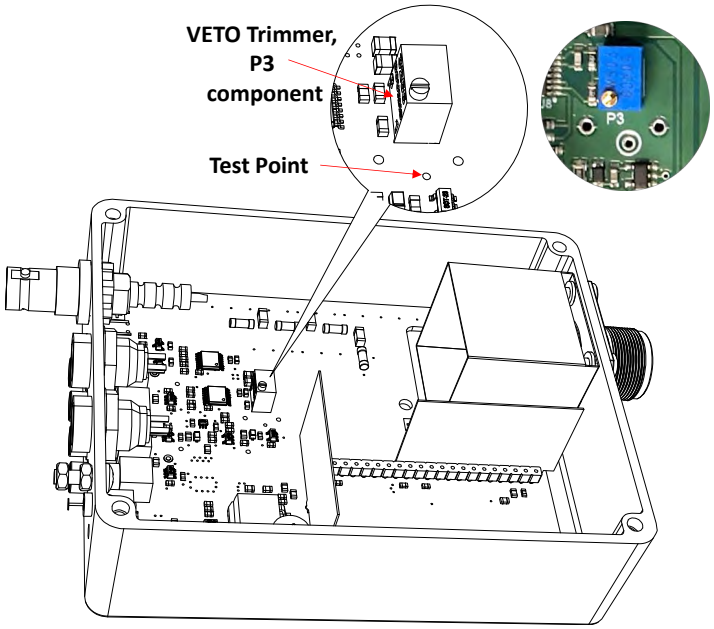


Fig. 2: Internal Trimmer for VETO width setting and Test point location.

The test point provides a monitor output for the VETO signal, allowing the user to verify and adjust the VETO duration set by trimmer P3.

To observe the VETO waveform, apply a test signal to the front-panel TEST input and monitor the resulting VETO pulse at the test point with an oscilloscope. Adjust trimmer P3 until the desired VETO width is achieved.

- A1421A / A1421B: 1.3 µs to 10 µs Factory set to 4 µs
- A1421C: 55 ns to 1.1 µs Factory set to 70 ns

A1421 analog and logic output signal

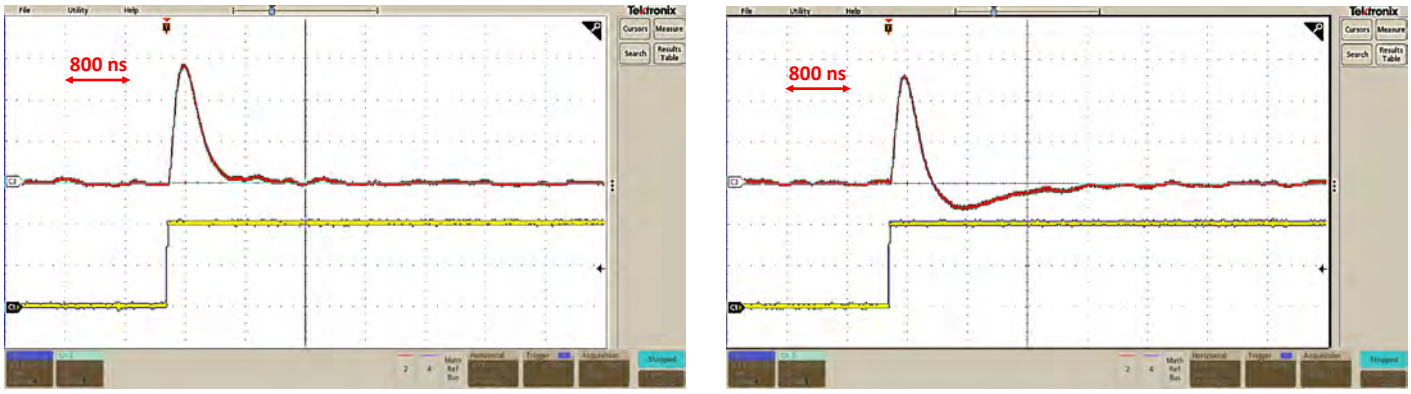


Fig. 3: Semi gaussian analog out AOUT (red) and Test Input (yellow - 100 mV step) for the A1421A (left) and A1421B (right) - 800 ns/div.

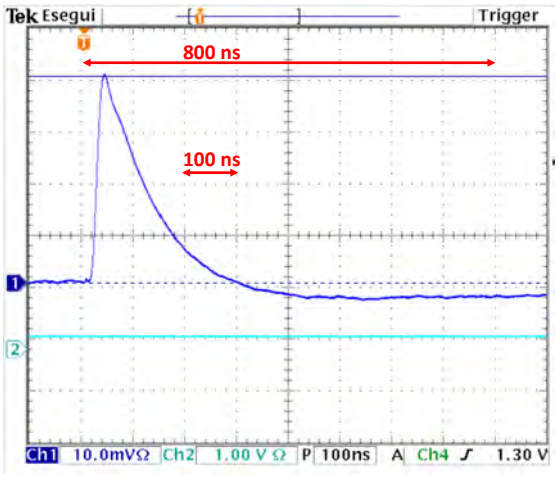


Fig. 4: Semi gaussian analog out AOUT (10 mV step) for the A1421C - 100 ns/div.



Fig. 5: Minimum distance for two pulses to be discriminated for the A1421A (left) and A1421B (right).

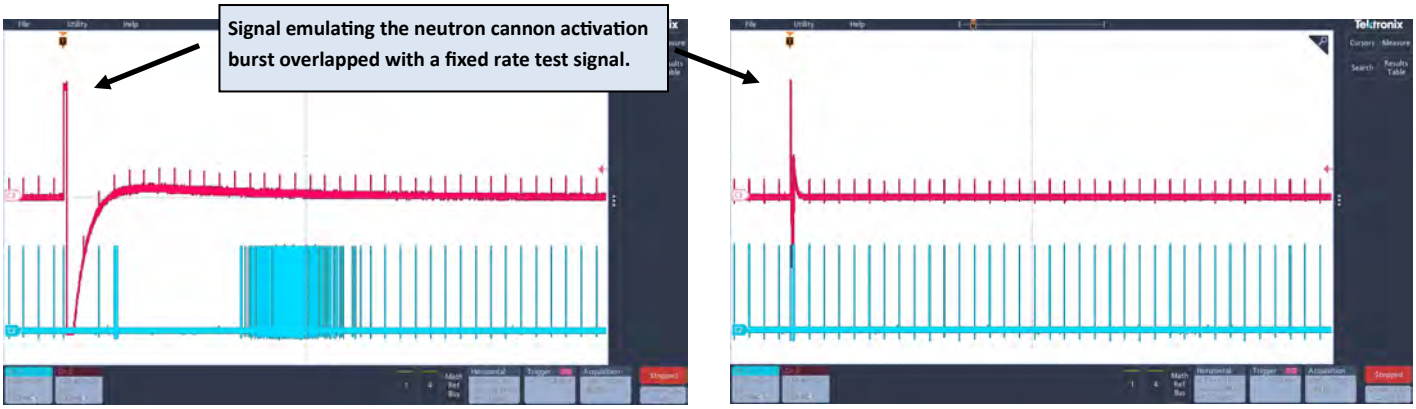


Fig. 6: After saturation recovery for the A1421A (left) and A1421B (right).

A1421 rate characterization

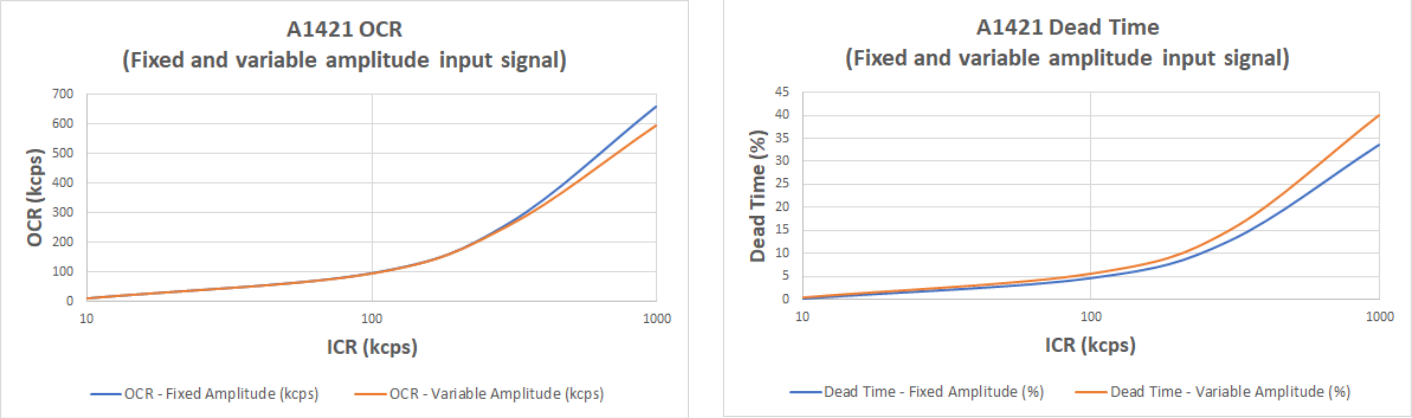


Fig. 7: OCR (left) and Dead Time (right) characterization using fixed and variable amplitude input signal. A1421A and B model have the same behavior.

Panel Layout

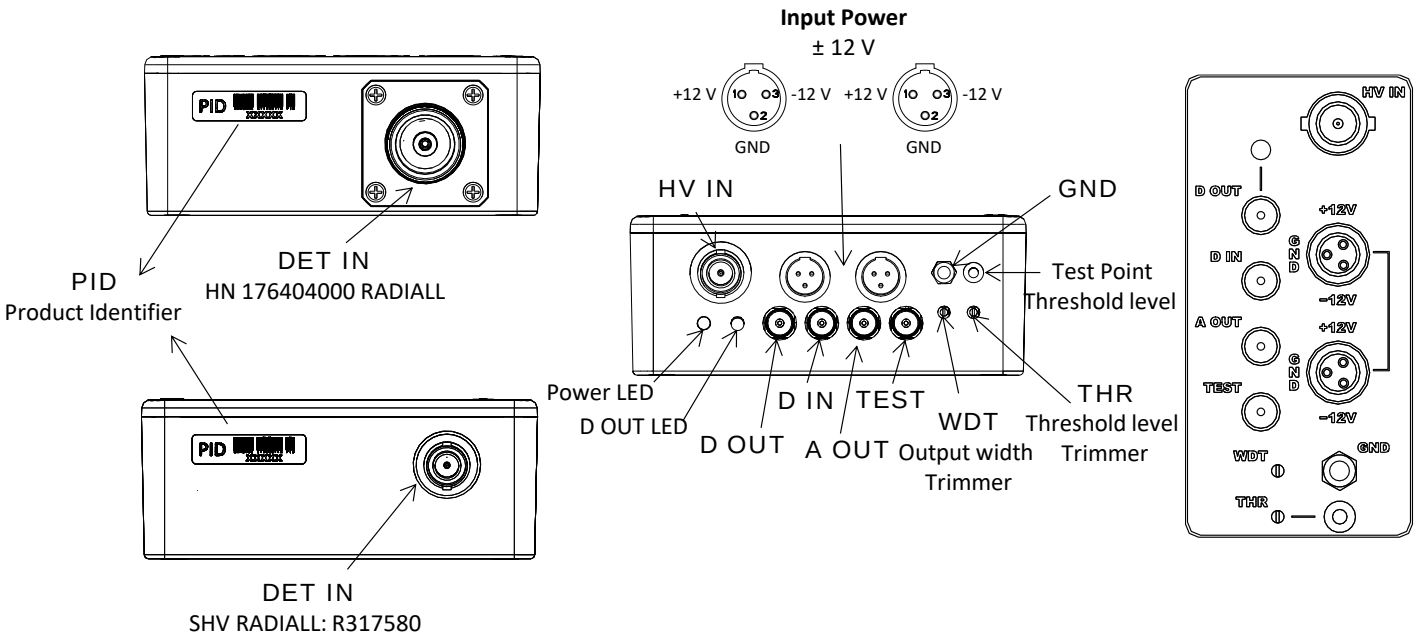


Fig. 8: A1421A(B)H(S) front and rear panel.

Mechanical Dimension

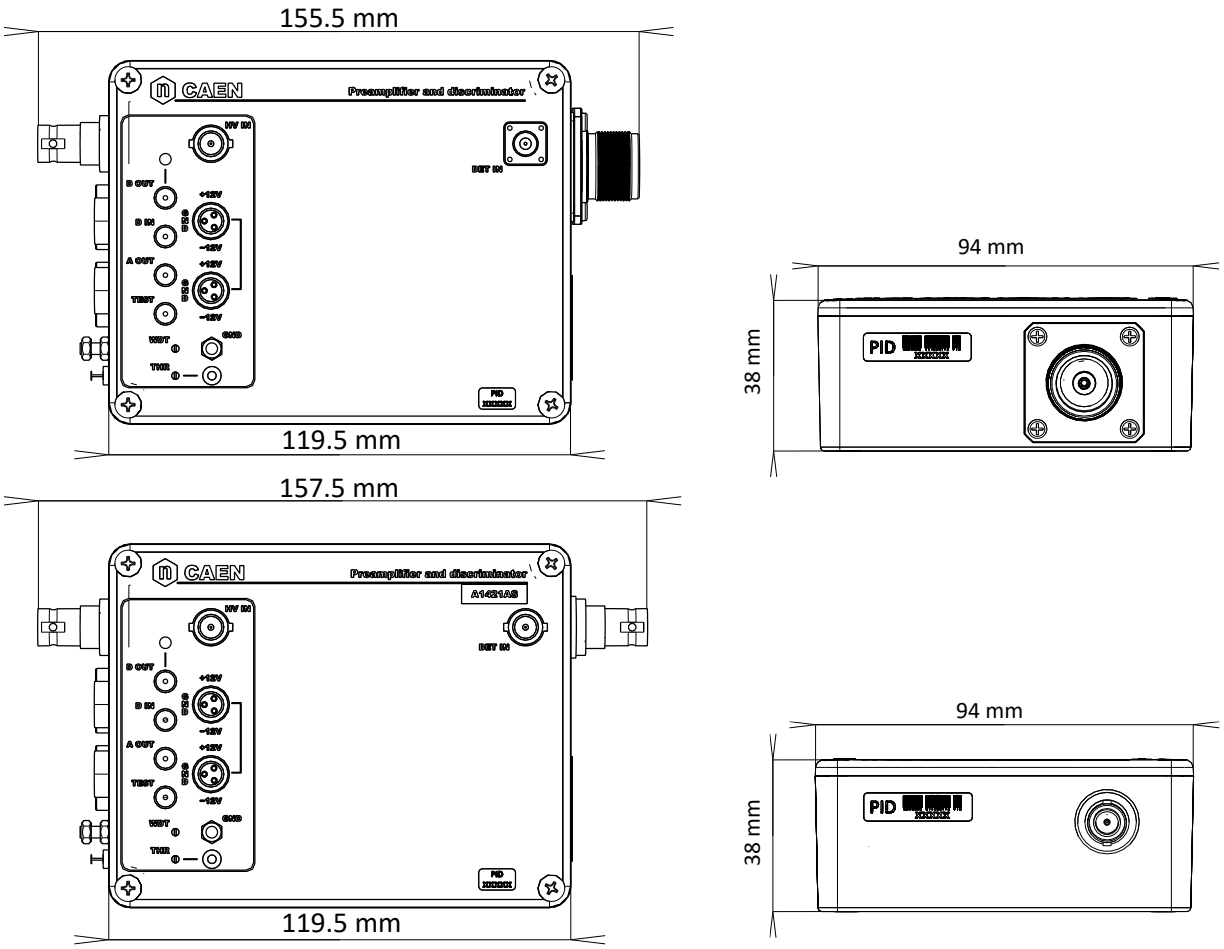


Fig. 9: A1421A(B)H(S) dimension.

Accessories

A325
DC/DC converter for A1421



A323 - A324
A1421 power cords



The A323 (20 cm) and A324 (1 m) are power cords used to supply the A1421.
A1421 is supplied with the A324 cable.



A325

DC/DC Converter for A1421

Mechanical Packaging
Desktop module
112 x 60 x 31 mm^3 (without connectors)
132 x 60 x 31 mm^3 (including connectors)

A1421 Supply
+/-12 V / 600 mA
Power supply for up to 8 A1421 units in a daisy chain configuration

Input
+12 V +/-5%

Connectors
- BNC (In)
- 3 pole male tiny XLR (Out)

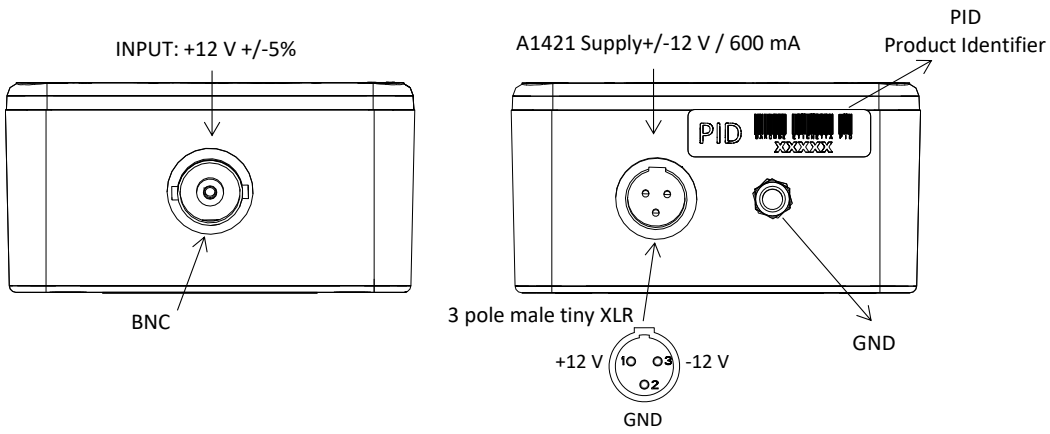


Fig. 10: A325 front (left) and rear (right) panel.

Mechanical Dimension

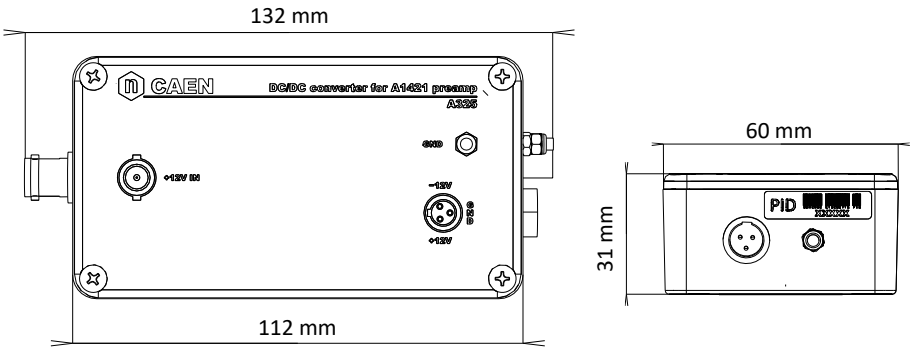


Fig. 11: A325 dimension.

Ordering Option

Ordering code	Description
WA1421ASXAAA	A1421AS – Preamp. and discriminator for He3 Tubes for passive measurements (SHV Det. In Conn.)
WA1421BSXAAA	A1421BS – Preamp. and discriminator for He3 Tubes for active measurements (SHV Det. In Conn.)
WA1421CSXAAA	A1421CS – Preamp. and discriminator for He3 Tubes for high count rate (SHV Det. In Conn.)
WA1421AHXAAA	A1421AH – Preamp. and discriminator for He3 Tubes for passive measurements (HN Det. In Conn.)
WA1421BHXAAA	A1421BH – Preamp. and discriminator for He3 Tubes for active measurements (HN Det. In Conn.)
WA1421CHXAAA	A1421CH – Preamp. and discriminator for He3 Tubes for high count rate (HN Det. In Conn.)

Accessories

WA325XAAAAAA	A325 - DC/DC converter for A1421 preamp
WA323XAAAAAA	A323 - A1421 power cord, 20 cm
WA324BAAAAAA	A324 - A1421 power cord, 1 m

A1421 Power Supply Configurations and Setup Guide

This guide will help you set up the necessary power configurations with ease, ensuring optimal performance every time. The A1421 module requires a ±12V DC power supply, and we've outlined three straightforward setups to match your specific needs.

Option A: Simplify Your Setup with the CAEN R7771B

The A1421 is designed to work effortlessly with the CAEN Neutron Pulse Train Recording Device **R7771B**. The R7771B's rear panel, as shown in Figure 10, features a convenient 3-pin Tiny XLR connector that delivers the required ±12V DC power. For the smoothest and safest connection, we recommend the CAEN **A324** cables (provided with the A1421), which create a seamless link between the A1421 module and the R7771B.

Fig. 12: Option A

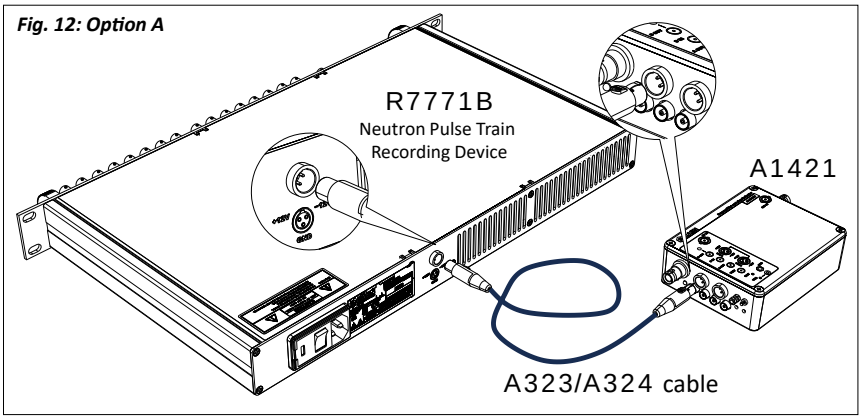
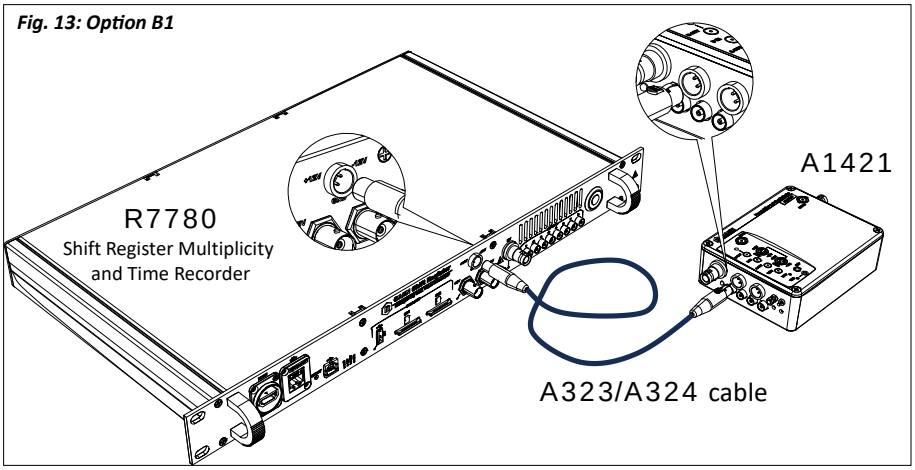


Fig. 13: Option B1



Option B: Versatility with the CAEN A325 DC-DC Converter Module

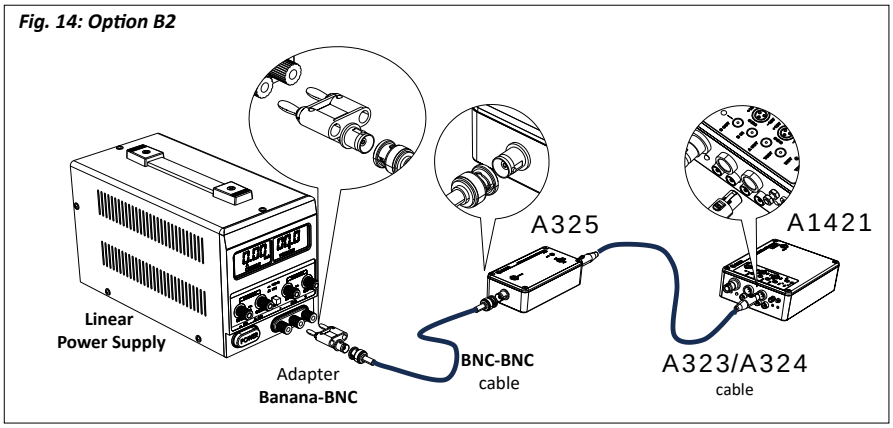
The A1421 can also be powered by providing a single power line of +12V. In this case you need a power adapter, the CAEN DC-DC converter module A325, which converts +12V input (via BNC connector) into ±12V output.

You have two main options to power the A325 module:

1. CAEN **R7780** Module: The A1421 can work with our Shift Register and Time Recorder R7780. In this case use the +12V DC output on the BNC connector of the R7780 with the A325 connected to the A1421.
2. **Linear Power Supply**: Opt for a standard linear benchtop power supply that delivers +12V DC.

As shown in Fig. 14, ensure you use an appropriate interface to connect your voltage source to the +12V DC BNC input of the A325 module. The Banana-BNC Adapter is not included.

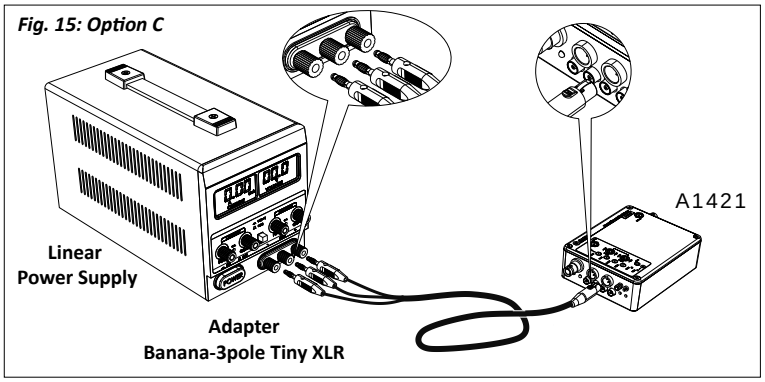
Fig. 14: Option B2



Option C: Dual-Line Power with a Linear Benchtop Supply

For users requiring a more customized configuration, a linear bench power supply capable of delivering +12V and -12V on two separate lines, referenced to the same ground (GND), is ideal. As illustrated in Figure 15, connect the +12V, -12V, and GND terminals to an adapter designed to interface correctly with the 3-pin Tiny XLR A1421 input power connector.

Fig. 15: Option C



WARNING Pay close attention to the polarity of your adapter to avoid potential damage. Fig. 15 details the voltage assignments for each pin of the 3-pin Tiny XLR connector to ensure flawless operation.

Key Takeaways for a Safe and Efficient Setup

- Use only compatible cables and adapters to ensure proper connectivity.
- Double-check all connections for correct polarity and voltage before powering up.

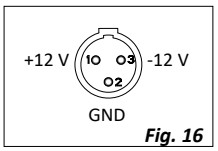


Fig. 16

CAEN SpA
Via Vetraia 11
55049 – Viareggio Italy
Tel +39.0584.388.398
Fax +39.0584.388.959
info@caen.it www.caen.it

2026 Copyright © CAEN SpA. All rights reserved. Information in this publication supersedes all earlier versions. Specifications subject to change without notice.