CAEN
Tools for Discovery

A1421
Preamplifier and discriminator for He3 Tubes
Data Sheet

The **A1421** is a charge-sensitive preamplifier, shaper, and discriminator that provides both analog and logic outputs. It is designed for use with neutron detector tubes in various applications. The preamplifier is optimized for position-sensitive thermal neutron detectors, where high counting rates and good spatial resolution (low noise) are required. It is also suitable for counting applications when used with monitor counters like the **R7771B** and **R7780**, such as in the non-destructive analysis of nuclear materials by passive or active neutron methods for containment monitoring and waste control.

The device is equipped with a detector input on an **SHV** or **HN** connector and an external HV input on an SHV connector (which powers the internal decoupling circuits). Additionally, it features two rear 3-pin male connectors (ref.: RT3MP REAN) to power the preamplifier, also allowing for daisy-chain operation. It includes two trimmers to adjust the discriminator threshold and the discriminator output width. A digital input is available on a LEMO connector for cascading the summing of the discriminator signals.

The preamplifier can be powered directly by the **R7771B** or by the **A325** DC/DC power supply unit. Compatible power cables, models **A324** (1 meter) and **A323** (20 centimeters), are available as accessories. The A1421 is supplied with the A324 cable.

Two versions of this preamplifier have been designed: a standard version (**Version A**), suitable for most applications, and a version for active measurements (**Version B**), where the sample is activated using a neutron generator. **Version A** includes a pole-zero compensation circuit and is suitable for applications requiring Pulse Height Analysis (PHA), where neutron spectroscopy or position sensitivity may be needed alongside neutron counting. In contrast, **Version B** provides bipolar output pulses that are not pole-zero compensated and includes dedicated optimizations required for active interrogation measurements, ensuring a fast recovery from saturation conditions once the neutron generation burst is complete.

- **Specifically designed for neutron detectors as 3He or BF3 tubes in counting applications**
- **Gain: 30 mV/fC on HiZ (15 mV/fC on 50 Ω)**
- **Discriminator with adjustable threshold**
- **Analog and Logic dicriminator output**
- **Detector IN on SHV or HN connector**
- **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 in combination with R7771B Neutron Pulse Train Recorder or R7780 Shift register**

Specification

Mechanical

Form Factor
Alloy Box

Dimensions (connector included)
94 W x 157.5 L x 38 H mm³ (SHV connectors)
94 W x 155.5 L x 38 H mm³ (HN connectors)
Dimensions (connector excluded)
94 W x 119,5 L x 38 H mm³

Preamplifier and Shaper

Non inverting Charge Sensitive preamplifier

Output Impedance
50 Ω

Gain
30 mV/fC on HiZ
15 mV/fC on 50 Ω

Rise Time
120 ns

Fall Time
460 ns

FWHM
350 ns

Time to baseline
(5% of the maximum amplitude)
A1421A 750 ns
A1421B 2000 ns

Output Voltage
± 2.6 Vpp on HiZ
± 1.3Vpp on 50 Ω

Recovery time after saturation
A1421A 2 ms
A1421B 60 µs

Noise
2 mV RMS on 50 Ω (on the baseline, with open input)

Resolution
0.32 fC @ Qin = 80 fC (=0.4%)

Detector Bias Voltage

± 4000 V max

Detector input

Positive or negative input polarity accepted
Input charge range: ± 90 fC
ESD protected input

Discriminator

Output Characteristics
TTL on LEMO Connector, capable of driving a 50 Ω load

Threshold
Adjustable via front panel 12 turn trimmer
Range: −1 V ÷ +1V
Minimum threshold: 20 mV (min. threshold above the noise)
Minimum detectable signal (min 99% signal detected): 13 mV (0.86 fC)
Threshold voltage monitor output on testpoint

Output width
Adjustable via front panel 12 turn trimmer
Range: 35 ns ÷ 600 ns

Pulse pair resolution
800 ns (minimum separation between pulses)

Other features
TTL In on LEMO connector (Zin = 1 kΩ) for cascade summing
LED for signal activity

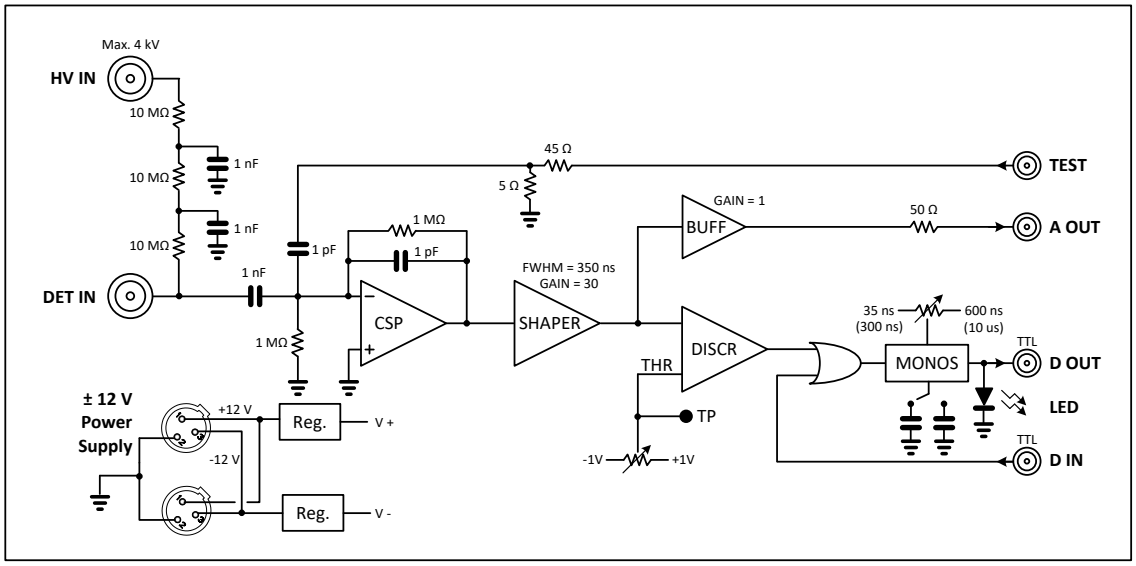


Fig. 1: A1421 Block diagram

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)

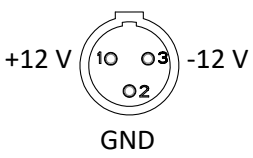


Fig. 2: Power Supply Connector pin out

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 (35 ns ÷ 600 ns)

LEMO-00 connector.

Environmental

- Indoor use
- Operating Humidity: 10% ± 90% RH non
- condensing
- Storage Humidity: 5% ± 90% RH non condensing
- Pollution Degree: 2
- Altitude: <2000 m
- 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.

Pease 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 hearth.

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

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

A1421 analog and logic output signal

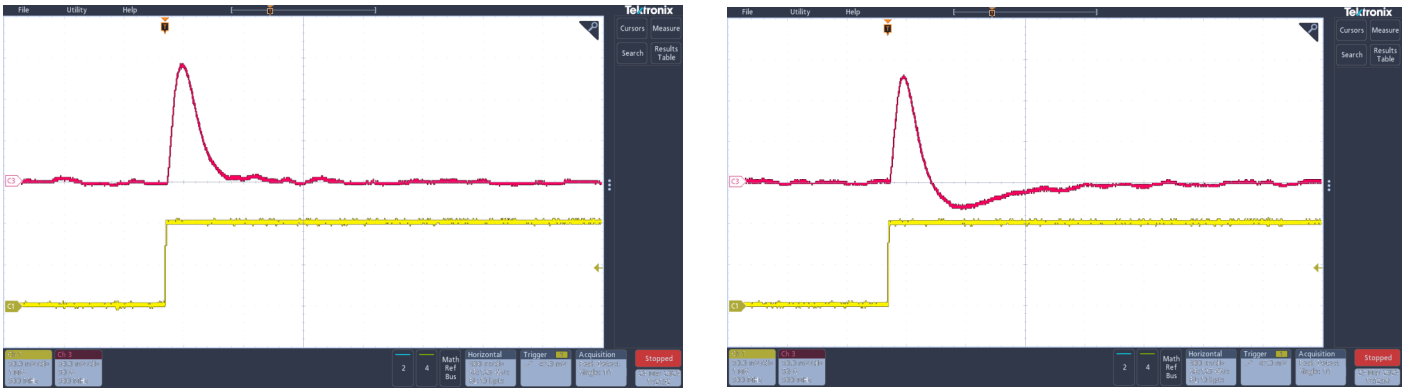


Fig. 3: Semigaussian analog out AOUT (red) and Test Input (yellow - 100 mV step) for the A1421A (left) and A1421B (right).

Fig. 4: Minimum distance for two pulses to be discriminated for the A1421A (left) and A1421B (right).

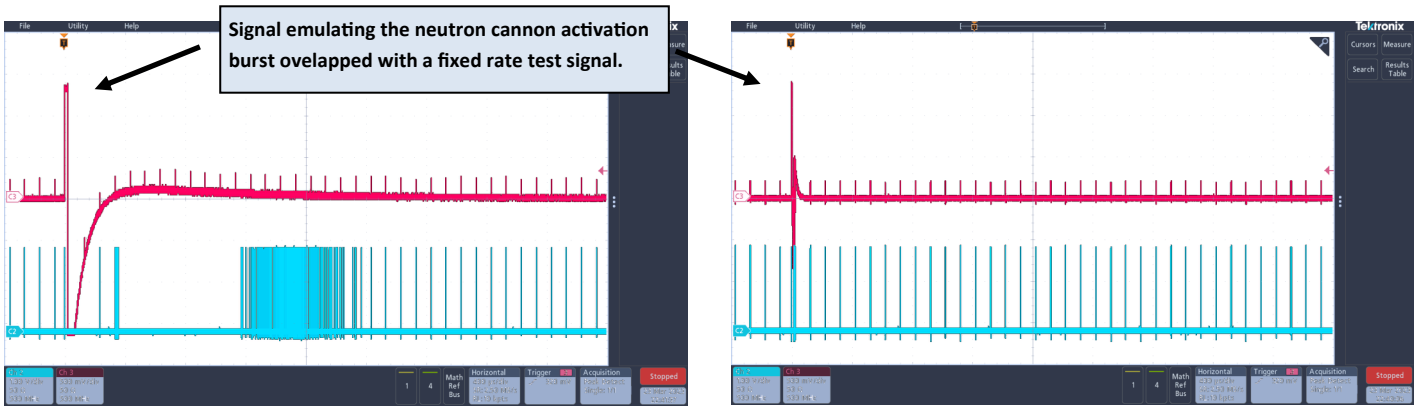


Fig. 5: After saturation recovery for the A1421A (left) and A1421B (right).

A1421 rate characterization

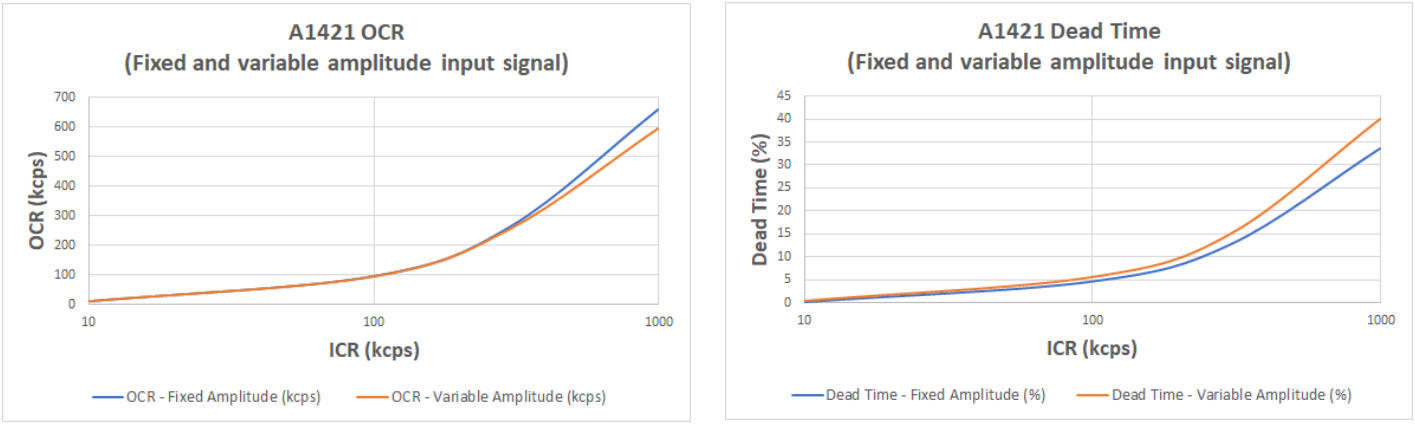


Fig. 6: OCR (left) and Dead Time (right) characterization using fixed and variable amplitude input signal. A1421A and B model have the same behaviour.

Panel Layout

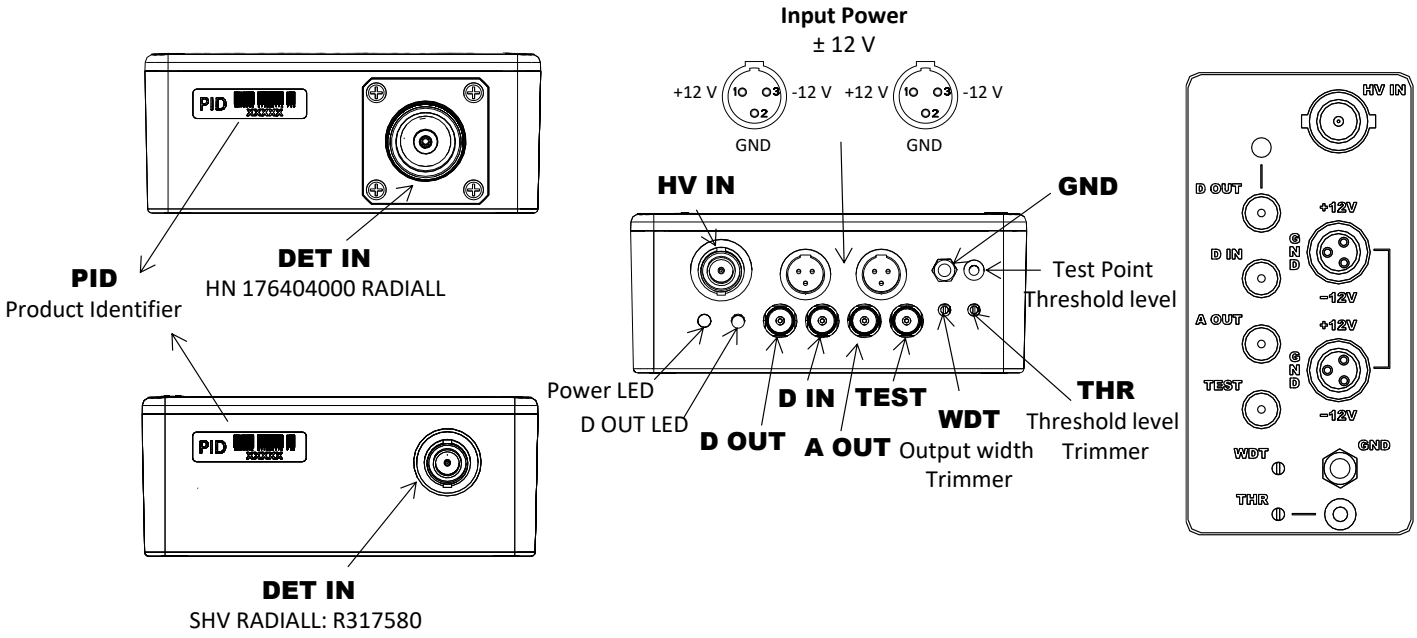


Fig. 6: A1421A(B)H(S) front and rear panel.

Mechanical Dimension

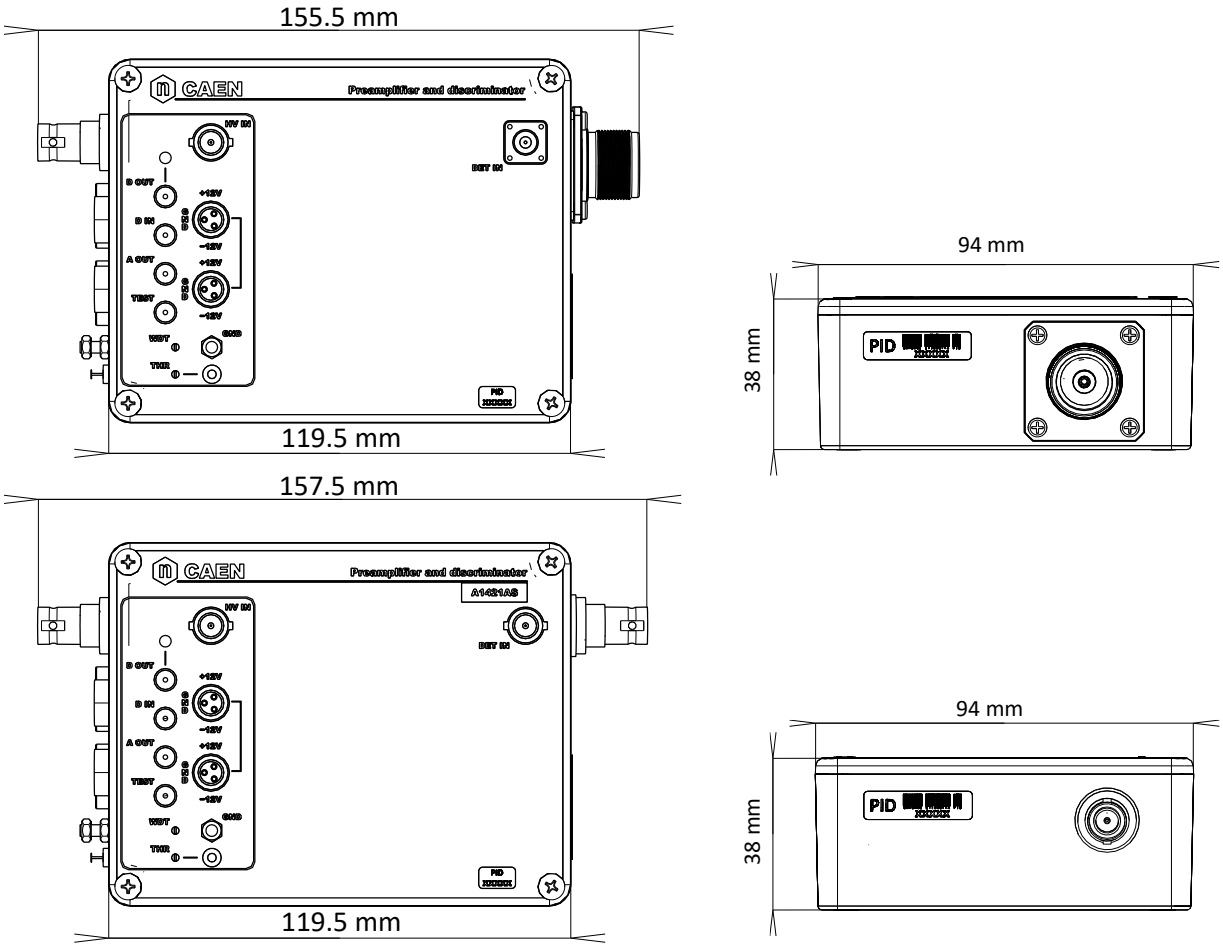


Fig. 7: A1421A(B)H(S) dimension.

A325

DC/DC Converter for A1421

Mechanical Packaging
Desktop module (112 x 60 x 31 mm3)

A1421 Supply
+/-12 V / 600 mA

Input
+12 V +/-5%

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

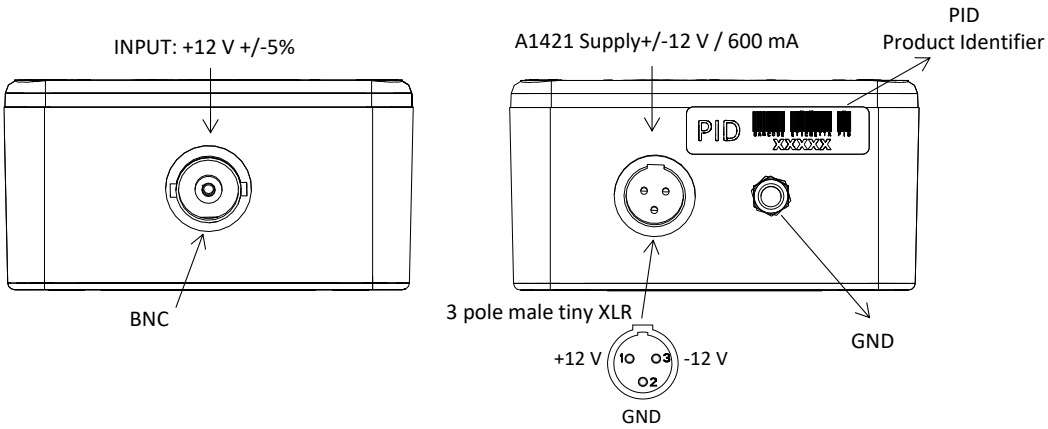


Fig. 8: A325 front (left) and rear (right) panel.

Mechanical Dimension

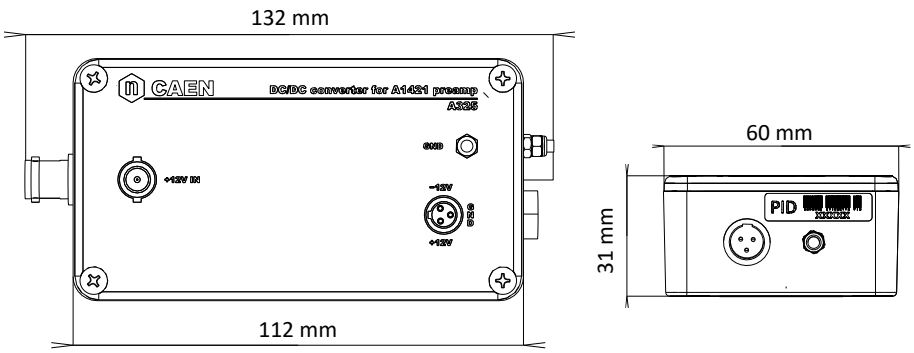


Fig. 9: A325 dimension

Ordering Option

Ordering code	Description
WA1421ASAAAA	A1421AS - Preamp. and discriminator for He3 Tubes for passive measurements (SHV Det. In Conn.)
WA1421BSAAAA	A1421BS - Preamp. and discriminator for He3 Tubes for active measurements (SHV Det. In Conn.)
WA1421AHAAAA	A1421AH - Preamp. and discriminator for He3 Tubes for passive measurements (HN Det. In Conn.)
WA1421BHAAAA	A1421BH - Preamp. and discriminator for He3 Tubes for active measurements (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 mt

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 creates a seamless link between the A1421 module and the R7771B.

Fig. 10: Option A

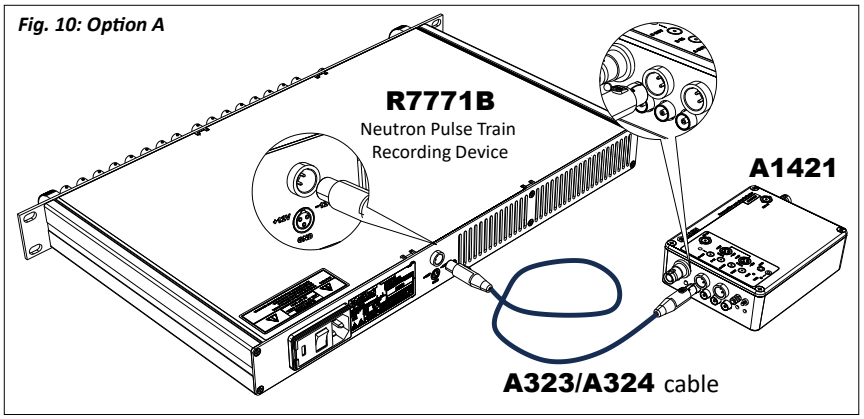
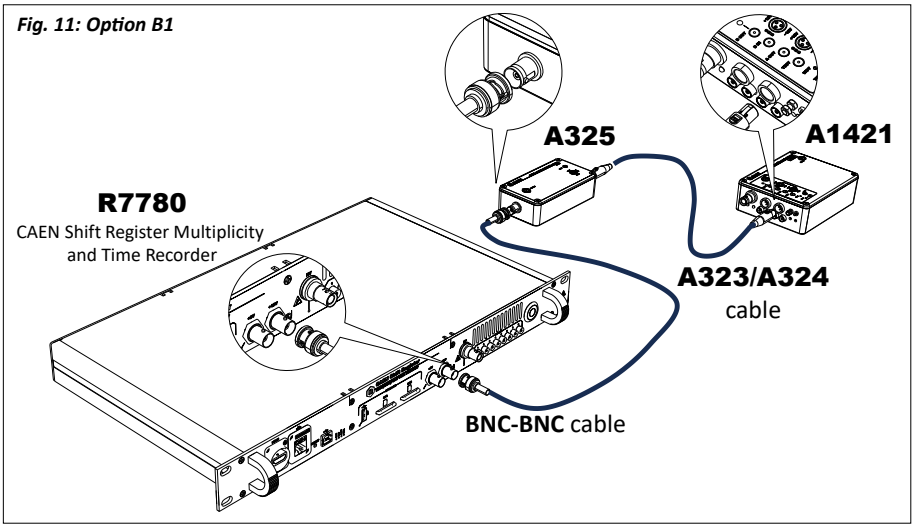


Fig. 11: Option B1



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

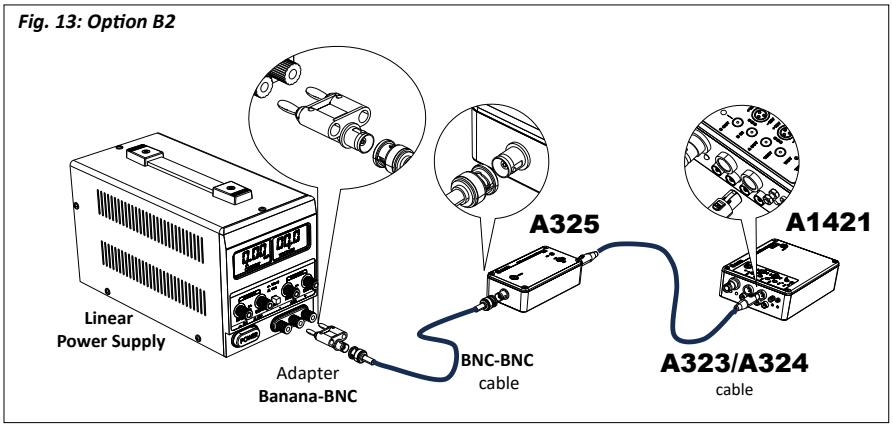
The A1421 can also be powered by providing a single power line of +12V. In this case you need a power adapter, the CAEN DC-DC converter module A325, which converts +12V input (via BNC connector) into ±12V output.

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 connect to the A1421.
2. **Linear Power Supply**: Opt for a standard linear benchtop power supply that delivers +12V DC.

As shown in Figures 11 and 12, 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.

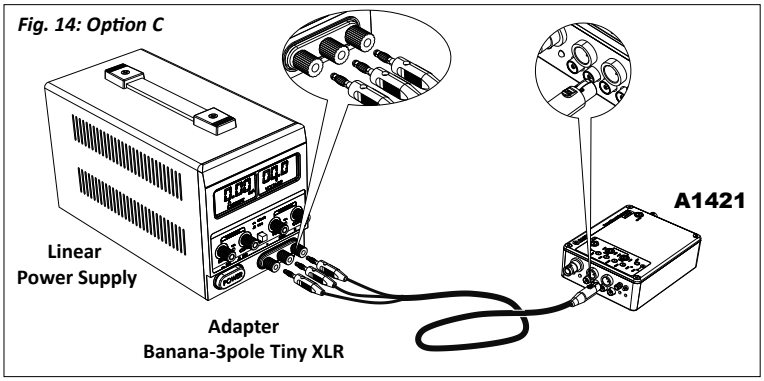
Fig. 13: Option B2



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 14, 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. 14: 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.

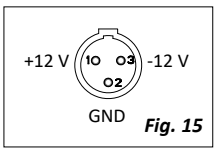


Fig. 15

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