

The **A1422** series are charge sensitive preamplifiers, available with either **1, 4 or 8** channels. Various sensitivity values are available and various detectors capacitances are supported:

- **F2 type:** up to 200 pF sensitivity: **5, 45, 90, 400, 450 mV/MeV (Si)**
- **F3 type:** up to 1000 pF sensitivity: **5, 45, 90 mV/MeV (Si)**

All of them can be used in nuclear and subnuclear physics experiments, where very low noise, fast response and high counting rates are required. The modules accept both positive and negative input charge pulses and provide an energy output of  $\pm 4.5$  V range on 50  $\Omega$  termination ( $\pm 10$  V on 1k $\Omega$ ). Moreover, a test input accepts positive and negative signals for calibration purposes.

The A1422 are implemented into alloy boxes and feature **SHV** connectors for the DET/IN and HV/IN signals, **LEMO** connectors for the TEST IN and EOUT and a cable with a **D-type** 9 pin male connector for the power supply.

- **Alloy box**
- **Fast, low noise inverting preamplifier**
- **Positive or negative input signals**
- **Four available sensitivities:**
  - 5 mV/MeV (Si)
  - 45 mV/MeV (Si)
  - 90 mV/MeV (Si)
  - 400 mV/MeV (Si)
  - 450 mV/MeV (Si)
- **Up to 1000 pF detector capacitance supported**
- **1, 4 and 8 channel model available**
- **Up to 2000 V (positive or negative) detector bias voltage**
- **Low noise input stage composed JFETs diode protected**



## Specification

### Packaging

Alloy Box

### Dimensions (WxHxD connector included):

A1422Axxxx (1 ch): 40.0 x 30.0 x 124 mm<sup>3</sup>  
A1422Bxxxx (4 ch): 100.0 x 50.0 x 162 mm<sup>3</sup>  
A1422Cxxxx (8 ch): 100.0 x 50.0 x 162 mm<sup>3</sup>

### Charge Sensitivity

5 mV/MeV (Si)  
45 mV/MeV (Si)  
90 mV/MeV (Si)  
400 mV/MeV (Si) (only F2)  
450 mV/MeV (Si) (only F2)

### Recommended Range of Input Capacitance

F2: up to 200 pF F3: up to 1000 pF

### Output Linear Range

$\pm 10$  V 1 k $\Omega$  termination  
 $\pm 4.5$  V 50  $\Omega$  termination

### Open Loop Gain

5 mV/MeV (F2 / F3)  $> 1 \cdot 10^5$   
45, 90 mV/MeV (F2 / F3)  $> 1 \cdot 10^6$   
400, 450 mV/MeV (F2)  $> 1 \cdot 10^6$

### E<sup>2</sup>CRP Maximum energy-squared count-rate product

| Sensitivity          | E <sup>2</sup> CRP                       |
|----------------------|------------------------------------------|
| 5 mV/MeV (Si)        | $1.57 \cdot 10^{10}$ MeV <sup>2</sup> /s |
| 45 mV/MeV (Si)       | $1.57 \cdot 10^8$ MeV <sup>2</sup> /s    |
| 90 mV/MeV (Si)       | $7.86 \cdot 10^7$ MeV <sup>2</sup> /s    |
| 400, 450 mV/MeV (Si) | $7.00 \cdot 10^6$ MeV <sup>2</sup> /s    |

### Decay Time

|                      |             |
|----------------------|-------------|
| 5 mV/MeV (Si)        | 100 $\mu$ s |
| 45 mV/MeV (Si)       | 100 $\mu$ s |
| 90 mV/MeV (Si)       | 50 $\mu$ s  |
| 400, 450 mV/MeV (Si) | 27 $\mu$ s  |

### Integral non Linearity

$\pm 0.05\%$  (0  $\pm 10$  V 1 k $\Omega$  termination)

### Temperature Instability

$< \pm 100$  ppm/ $^{\circ}$ C (0 to 50 $^{\circ}$ C)

### Noise FWHM keV (Si)<sup>(1)</sup>

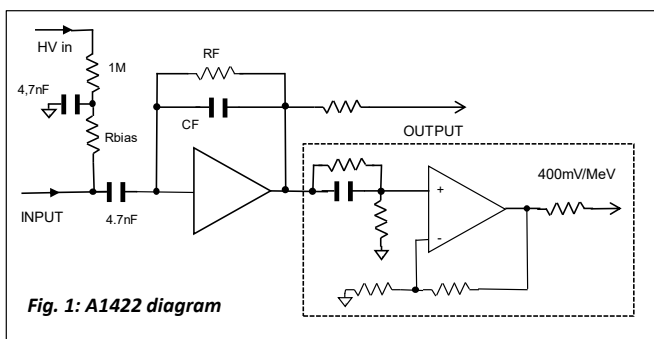
| Model                | Detector capacitance |          |
|----------------------|----------------------|----------|
|                      | 0 pF                 | 200 pF   |
| F2 - 5 mV/MeV        | $< 4.7$              | $< 7.6$  |
| F2 - 45 mV/MeV       | $< 2.2$              | $< 4.3$  |
| F2 - 90 mV/MeV       | $< 2.2$              | $< 4.2$  |
| F2 - 400, 450 mV/MeV | $< 2.2$              | $< 4.1$  |
| Model                | 390 pF 1000 pF       |          |
|                      |                      |          |
| F3 - 5 mV/MeV        | $< 10.5$             | $< 21.5$ |
| F3 - 45 mV/MeV       | $< 5.8$              | $< 13.2$ |
| F3 - 90 mV/MeV       | $< 5.5$              | $< 13.2$ |

### Rise Time<sup>(2)</sup>

| Model                | Detector capacitance |            |
|----------------------|----------------------|------------|
|                      | 0 pF                 | 200 pF     |
| F2 - 5 mV/MeV        | $< 5$ ns             | $< 15$ ns  |
| F2 - 45 mV/MeV       | $< 5$ ns             | $< 15$ ns  |
| F2 - 90 mV/MeV       | $< 10$ ns            | $< 25$ ns  |
| F2 - 400, 450 mV/MeV | $< 70$ ns            | $< 110$ ns |
| Model                | 390 pF 1000 pF       |            |
|                      |                      |            |
| F3 - 5 mV/MeV        | $< 20$ ns            | $< 40$ ns  |
| F3 - 45 mV/MeV       | $< 25$ ns            | $< 50$ ns  |
| F3 - 90 mV/MeV       | $< 45$ ns            | $< 100$ ns |

### Detector Bias Voltage

$\pm 2000$  V max



(1) Measured with a CAEN N968 Spectroscopy Amplifier and N957 Peak Sensing ADC shaping time: 3  $\mu$ s.

(2) Test input rise time: 1.6 ns, amplitude: 200 mV 50  $\Omega$  termination.

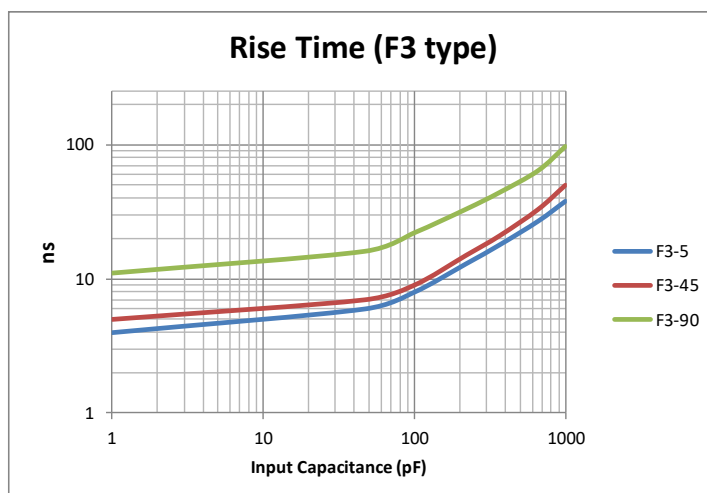
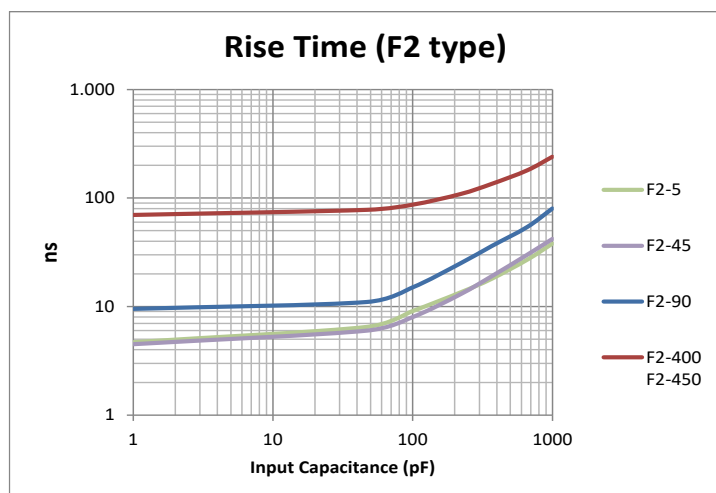


Fig. 2: Typical Rise Time vs input Capacitance (test input rise time = 1.6 ns, amplitude: 200 mV, 50  $\Omega$  termination)

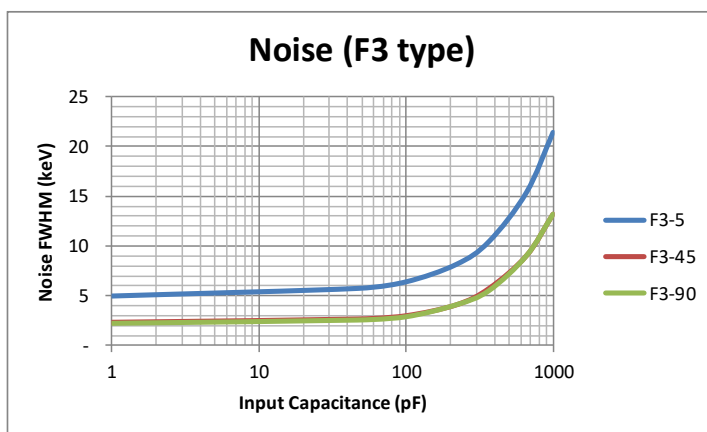
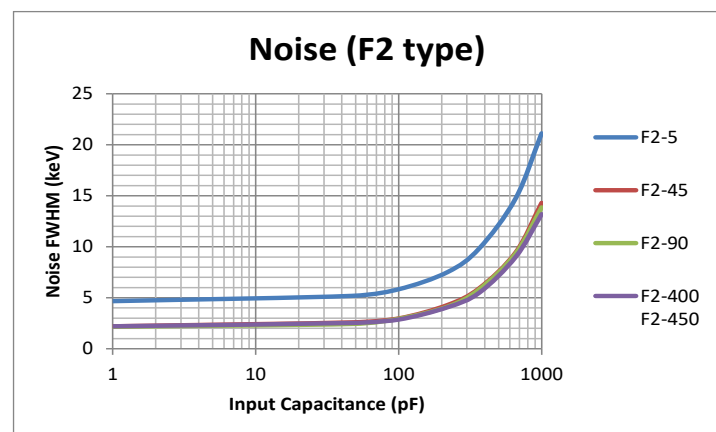


Fig. 3: Maximum Noise vs input Capacitance

## Inputs

### DET/IN

Accepts positive and negative input charge pulses from semiconductor detectors and supplies the HV bias to the detector itself; **SHV** connector.

### HV/IN

Up to 2000 V (positive or negative) for the detector bias. 100 M $\Omega$  resistance in series (other on request); **SHV** connector (**BNC** on request).

### TEST IN

Positive or negative input for the energy calibration via Ctest = 1 pF or 10 pF (on 5 mV/MeV versions); **LEMO-00** connector.

### Power

Input Power through a 2.1 m cable with a **D-type type 9 pin** male connector.

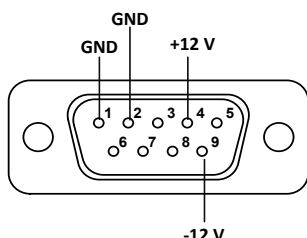


Fig. 4: Power Supply Connector pin out

## Outputs

### E OUT

$\pm 10$  V max. (open circuit), 50  $\Omega$  back termination. The output voltage is proportional to the amount of input charge.

#### Connector:

- A1422A (1 ch): **BNC**
- A1422B/C (4/8 ch): **LEMO-00**

The typical rise time is

**Detector capacitance = 0 pF**

- < 5 ns F2 - 5/45 mV/MeV
- < 10 ns F2 - 90 mV/MeV
- < 70 ns F2 - 400, 450 mV/MeV

**Detector capacitance = 390 pF**

- < 20 ns F3 - 5 mV/MeV
- < 25 ns F3 - 45 mV/MeV
- < 45 ns F3 - 90 mV/MeV

**Adjacent Channel Crosstalk (4/8 ch) = -40 dB** with reverse polarity

## Power Requirements

| Models               | +12 V  | -12 V |
|----------------------|--------|-------|
| A1422Axxx F2 (1 ch): | 12 mA  | 4 mA  |
| A1422Bxxx F2 (4 ch): | 48 mA  | 16 mA |
| A1422Cxxx F2 (8 ch): | 96 mA  | 32 mA |
| A1422Axxx F3 (1 ch): | 20 mA  | 4 mA  |
| A1422Bxxx F3 (4 ch): | 80 mA  | 16 mA |
| A1422Cxxx F3 (8 ch): | 160 mA | 32 mA |

The power supply can be provided by CAEN Spectroscopy Amplifier **N968** (via a D-type female connector on the rear-panel) or **DT5423** Desktop Linear Power Supply.

**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

A customization is available to improve amplifier protection from transients generated in the DET/HV network (up to  $\pm 2200$  V). Anyway care must be taken in the use of A1422 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

## Panel Layout

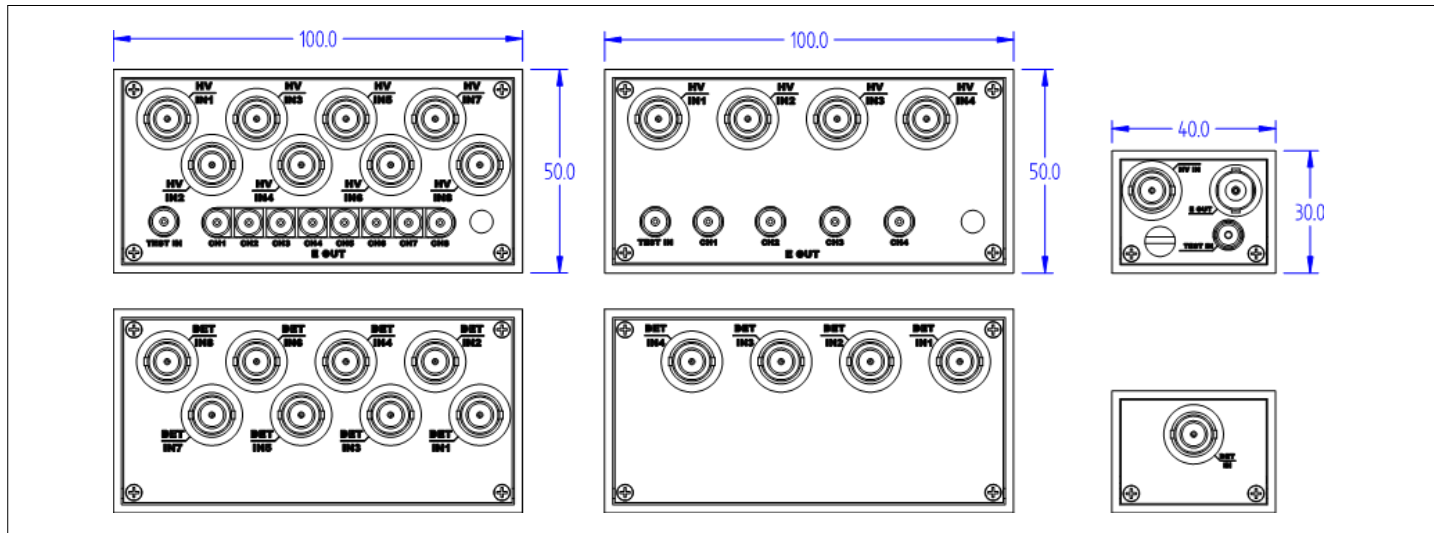


Fig. 5: A1422 series Front and Rear panel 8ch, 4ch, 1ch (dimension: mm)

## Ordering Option

| Detector capacitance pF | Gain mV/MeV | No. of Channels | Ordering code | Description                                                        |
|-------------------------|-------------|-----------------|---------------|--------------------------------------------------------------------|
| < 200                   | 5           | 1               | WA1422A005F2  | A1422A005F2 - 1 Ch. Charge Preamplifier, 5mV/MeVgain, Cdet<200pF   |
|                         |             | 4               | WA1422B005F2  | A1422B005F2 - 4 Ch. Charge Preamplifier, 5mV/MeVgain, Cdet<200pF   |
|                         |             | 8               | WA1422C005F2  | A1422C005F2 - 8 Ch. Charge Preamplifier, 5mV/MeVgain, Cdet<200pF   |
|                         | 45          | 1               | WA1422A045F2  | A1422A045F2 - 1 Ch. Charge Preamplifier, 45mV/MeVgain, Cdet<200pF  |
|                         |             | 4               | WA1422B045F2  | A1422B045F2 - 4 Ch. Charge Preamplifier, 45mV/MeVgain, Cdet<200pF  |
|                         |             | 8               | WA1422C045F2  | A1422C045F2 - 8 Ch. Charge Preamplifier, 45mV/MeVgain, Cdet<200pF  |
|                         | 90          | 1               | WA1422A090F2  | A1422A090F2 - 1 Ch. Charge Preamplifier, 90mV/MeVgain, Cdet<200pF  |
|                         |             | 4               | WA1422B090F2  | A1422B090F2 - 4 Ch. Charge Preamplifier, 90mV/MeVgain, Cdet<200pF  |
|                         |             | 8               | WA1422C090F2  | A1422C090F2 - 8 Ch. Charge Preamplifier, 90mV/MeVgain, Cdet<200pF  |
|                         | 400         | 1               | WA1422A400F2  | A1422A400F2 - 1 Ch. Charge Preamplifier, 400mV/MeVgain, cdet<200pF |
|                         |             | 4               | WA1422B400F2  | A1422B400F2 - 4 Ch. Charge Preamplifier, 400mV/MeVgain, Cdet<200pF |
|                         |             | 8               | WA1422C400F2  | A1422C400F2 - 8 Ch. Charge Preamplifier, 400mV/MeVgain, Cdet<200pF |
| < 1000                  | 5           | 1               | WA1422A005F3  | A1422A005F3 - 1 Ch. Charge Preamplifier, 5mV/MeVgain, Cdet<1000pF  |
|                         |             | 4               | WA1422B005F3  | A1422B005F3 - 4 Ch. Charge Preamplifier, 5mV/MeVgain, Cdet<1000pF  |
|                         |             | 8               | WA1422C005F3  | A1422C005F3 - 8 Ch. Charge Preamplifier, 5mV/MeVgain, Cdet<1000pF  |
|                         | 45          | 1               | WA1422A045F3  | A1422A045F3 - 1 Ch. Charge Preamplifier, 45mV/MeVgain, Cdet<1000pF |
|                         |             | 4               | WA1422B045F3  | A1422B045F3 - 4 Ch. Charge Preamplifier, 45mV/MeVgain, Cdet<1000pF |
|                         |             | 8               | WA1422C045F3  | A1422C045F3 - 8 Ch. Charge Preamplifier, 45mV/MeVgain, Cdet<1000pF |
|                         | 90          | 1               | WA1422A090F3  | A1422A090F3 - 1 Ch. Charge Preamplifier, 90mV/MeVgain, Cdet<1000pF |
|                         |             | 4               | WA1422B090F3  | A1422B090F3 - 4 Ch. Charge Preamplifier, 90mV/MeVgain, Cdet<1000pF |
|                         |             | 8               | WA1422C090F3  | A1422C090F3 - 8 Ch. Charge Preamplifier, 90mV/MeVgain, Cdet<1000pF |

## Personalization

| Ordering code | Description                                                                 |
|---------------|-----------------------------------------------------------------------------|
| WPERS0142201  | A1422A 1 Ch. Preamplifier Personalization for Improved Input ESD Protection |
| WPERS0142204  | A1422B 4 Ch. Preamplifier Personalization for Improved Input ESD Protection |
| WPERS0142208  | A1422C 8 Ch. Preamplifier Personalization for Improved Input ESD Protection |

