A1422

Low-Noise Fast-Rise-Time Charge-Sensitive Preamplifiers

Data Sheet

The **A1422** series is a family of charge-sensitive preamplifiers, available in 1-, 4-, and 8-channel versions. Various sensitivity values are available, and a wide range of detector capacitances is supported:

- **F2 type:** up to 200 pF sensitivities: **5, 45, 90, 400, 450 mV/MeV (Si)**
- **F3 type:** up to 1000 pF sensitivities: **1, 5, 45, 90 mV/MeV (Si)**

All models can be used in nuclear and sub-nuclear 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 with a ±4.5 V range into a 50 Ω termination (±10 V into 1 kΩ). A test input is also provided, accepting positive and negative signals for calibration.

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

- **Alloy box**
- **Fast, low-noise inverting preamplifier**
- **Positive or negative input signals**
- **Six available sensitivities:**
  - **1 mV/MeV (Si)**
  - **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 with diode-protected JFETs**

Specification

Packaging

Alloy Box

Dimensions (WxHxD connector included):

A1422Axxxx (1 ch): 40.0 × 30.0 × 124 mm^3
A1422Bxxxx (4 ch): 100.0 × 50.0 × 162 mm^3
A1422Cxxxx (8 ch): 100.0 × 50.0 × 162 mm^3

Charge Sensitivity (on HiZ)

1 mV/MeV (Si) (only F3)
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

±10V 1 kΩ termination
±4.5V 50 Ω termination

Open-loop Gain

1 mV/MeV (F3)	$> 4 \cdot 10^4$
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^2CRP Maximum energy-squared count-rate product

Sensitivity	E^2CRP
1 mV/MeV (Si)	$7.5 \cdot 10^{11}$ MeV^2/s
5 mV/MeV (Si)	$1.57 \cdot 10^{10}$ MeV^2/s
45 mV/MeV (Si)	$1.57 \cdot 10^{8}$ MeV^2/s
90 mV/MeV (Si)	$7.86 \cdot 10^{7}$ MeV^2/s
400,450 mV/MeV (Si)	$7.00 \cdot 10^{6}$ MeV^2/s

Decay Time

1 mV/MeV (Si)	47 µs
5 mV/MeV (Si)	100 µs
45 mV/MeV (Si)	100 µs
90 mV/MeV (Si)	50 µs
400,450 mV/MeV (Si)	27 µs

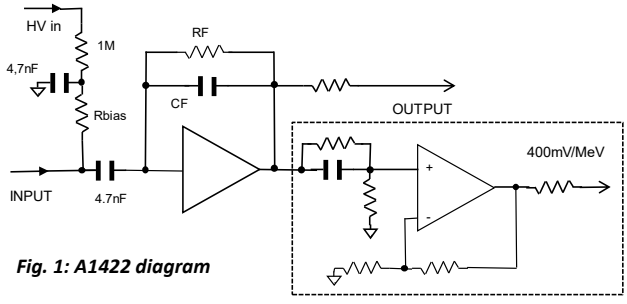


Fig. 1: A1422 diagram

Integral Non-Linearity

< ±0.05 % (0 to ±10 V, 1 kΩ termination)

Temperature Instability

< ±100 ppm/°C (0 to 50 °C)

Noise FWHM keV (Si)(1)

	Detector capacitance	
Model	**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 - 1 mV/MeV	< 36.0	< 46.6
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(2)

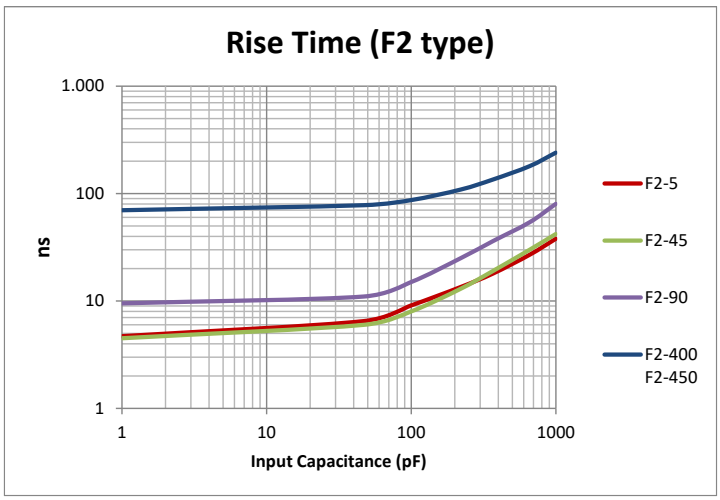
	Detector capacitance	
Model	**0 pF**	**200 pF**
F2 - 5 mV/MeV	< 5 ns	< 15 ns
F2 - 45 mV/MeV	< 5 ns	< 15 ns
F2 - 90 mV/MeV	< 10 ns	< 25 ns
F2 - 400, 450 mV/MeV	< 70 ns	< 110 ns
Model	**390 pF**	**1000 pF**
F3 - 1 mV/MeV	< 10 ns	< 20 ns
F3 - 5 mV/MeV	< 20 ns	< 40 ns
F3 - 45 mV/MeV	< 25 ns	< 50 ns
F3- 90 mV/MeV	< 45 ns	< 100 ns

Detector Bias Voltage

±2000 V max

(1) Measured with a CAEN N968 Spectroscopy Amplifier and an N957 Peak-Sensing ADC; shaping time: 3 µs.

(2) Test input rise time: 1.6 ns; amplitude: 200 mV into 50 Ω termination.



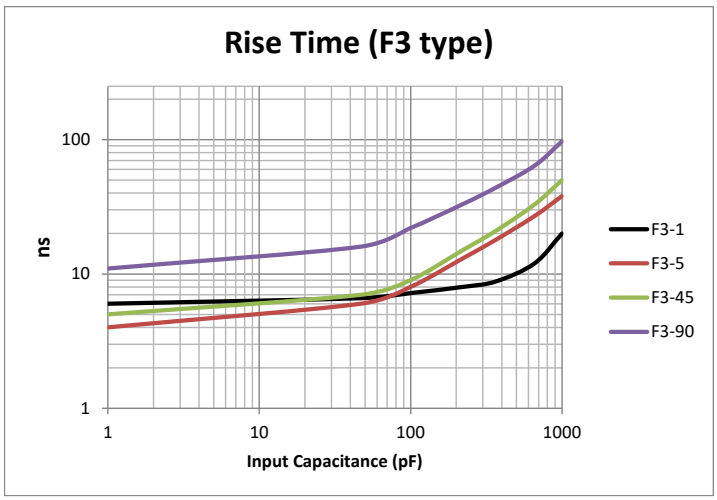
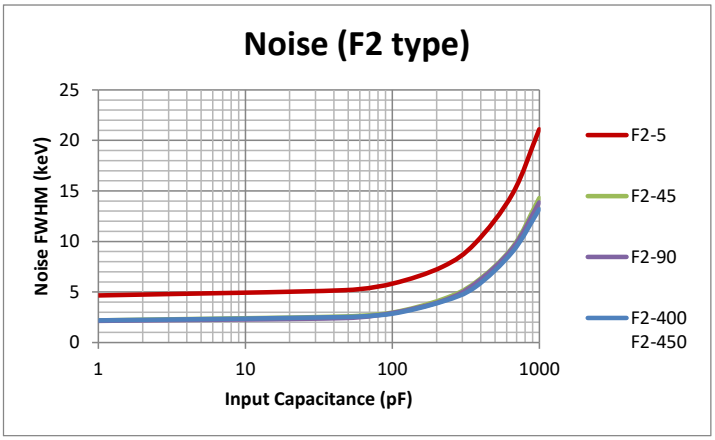


Fig. 2: Typical rise time vs. input capacitance (test input rise time = 1.6 ns; amplitude: 200 mV into 50 Ω).



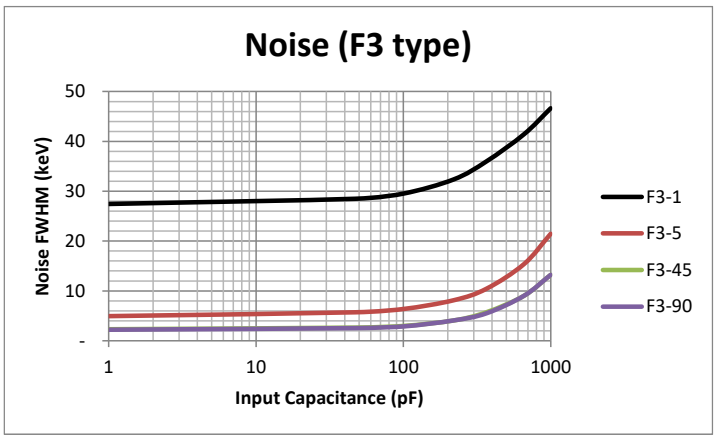


Fig. 3: Maximum noise vs. input capacitance.

Inputs

DET/IN

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

HV/IN

Up to 2000 V (positive or negative) for the detector bias. 100 MΩ series resistance (other values available on request); **SHV** connector (**BNC** on request).

TEST IN

Positive or negative input for energy calibration through a Ctest capacitor: **1 pF** (standard), **10 pF** on 5 mV/MeV versions, and **47 pF** on 1 mV/MeV versions; **LEMO-00** connector.

Power

Power is supplied through a 2.1 m cable terminated with a 9-pin D-sub male connector.

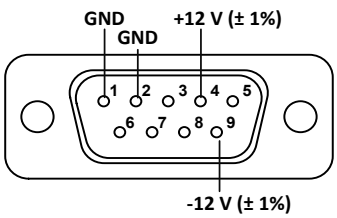


Fig. 4: Power Supply Connector pinout.

Outputs

E OUT

±10V max. (open circuit), 50 Ω back-termination. The output voltage is proportional to the 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
< 10 ns F3 - 1 mV/MeV
< 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
A1422AxxxF2	(1 ch):	12 mA	4 mA
A1422BxxxF2	(4 ch):	48 mA	16 mA
A1422CxxxF2	(8 ch):	96 mA	32 mA
A1422AxxxF3	(1 ch):	20 mA	4 mA
A1422BxxxF3	(4 ch):	80 mA	16 mA
A1422CxxxF3	(8 ch):	160 mA	32 mA

The power supply can be provided by the CAEN **N968** Spectroscopy Amplifier (through a D-sub female connector on its rear panel) or by the **DT5423**, **N5424**, or **V5425** (Desktop, NIM, and VME) Linear Power Supplies.

WARNING During normal operation, a potentially hazardous high-voltage bias is applied to a detector through 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; therefore, this circuitry can remain at high voltage for an extended period. If the user does not exercise adequate caution, this voltage can cause personal injury through 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 (**DET/IN**).
- If you are using a variable power supply, bring the voltage to zero and wait 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 only to a detector/power supply that is properly grounded to safety earth.

Operation

A customization is available to improve amplifier protection from transients generated in the DET/HV network (up to ±2200 V). However, care must be taken when using the A1422 with high-voltage detectors.

Please remember to:

- Gradually decrease the bias voltage before connecting or disconnecting the preamplifier input.
- Avoid rapid changes in the bias voltage.
- Avoid detector breakdown or discharge.

Panel Layout

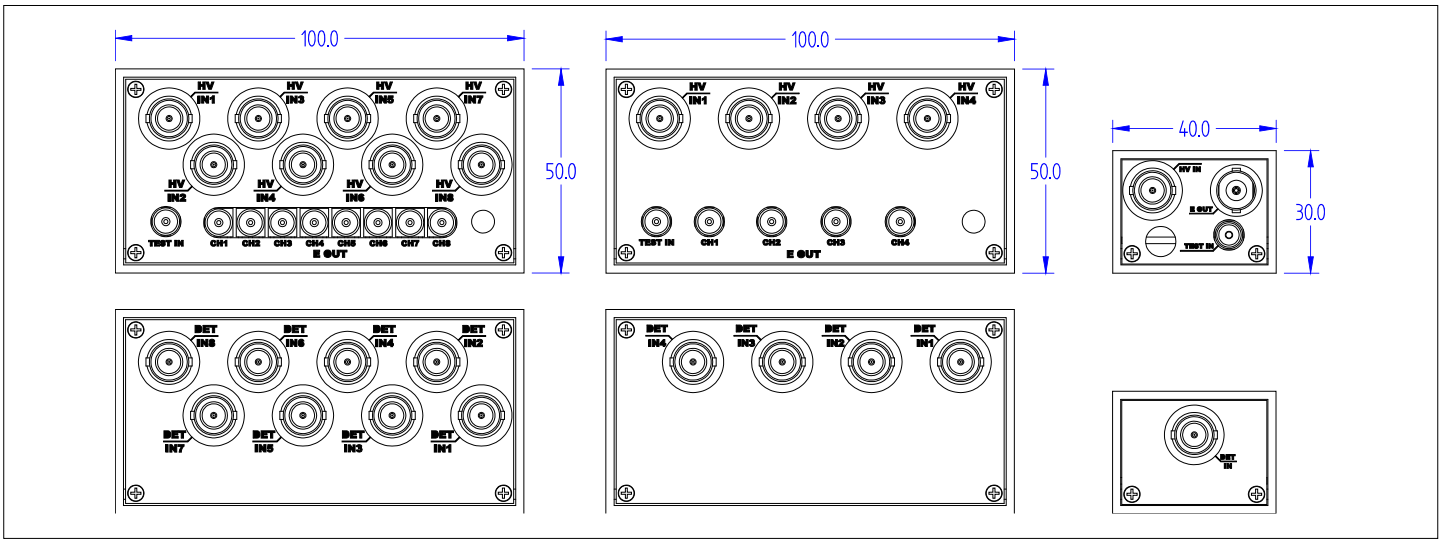


Fig. 5: A1422 series, front and rear panels (8-ch, 4-ch, and 1-ch models; dimensions in mm).

Ordering Options

Detector capacitance pF	Gain mV/MeV	No. of Channels	Ordering code	Description
< 200	5	1	WA1422A005F2	A1422A005F2 - 1 Ch. Charge Preamplifier, 5mV/MeV gain, Cdet<200pF
		4	WA1422B005F2	A1422B005F2 - 4 Ch. Charge Preamplifier, 5mV/MeV gain, Cdet<200pF
		8	WA1422C005F2	A1422C005F2 - 8 Ch. Charge Preamplifier, 5mV/MeV gain, Cdet<200pF
	45	1	WA1422A045F2	A1422A045F2 - 1 Ch. Charge Preamplifier, 45mV/MeV gain, Cdet<200pF
		4	WA1422B045F2	A1422B045F2 - 4 Ch. Charge Preamplifier, 45mV/MeV gain, Cdet<200pF
		8	WA1422C045F2	A1422C045F2 - 8 Ch. Charge Preamplifier, 45mV/MeV gain, Cdet<200pF
	90	1	WA1422A090F2	A1422A090F2 - 1 Ch. Charge Preamplifier, 90mV/MeV gain, Cdet<200pF
		4	WA1422B090F2	A1422B090F2 - 4 Ch. Charge Preamplifier, 90mV/MeV gain, Cdet<200pF
		8	WA1422C090F2	A1422C090F2 - 8 Ch. Charge Preamplifier, 90mV/MeV gain, Cdet<200pF
	400	1	WA1422A400F2	A1422A400F2 - 1 Ch. Charge Preamplifier, 400mV/MeV gain, Cdet<200pF
		4	WA1422B400F2	A1422B400F2 - 4 Ch. Charge Preamplifier, 400mV/MeV gain, Cdet<200pF
		8	WA1422C400F2	A1422C400F2 - 8 Ch. Charge Preamplifier, 400mV/MeV gain, Cdet<200pF
	450	1	WA1422A450F2	A1422A450F2 - 1 Ch. Charge Preamplifier, 450mV/MeV gain, Cdet<200pF
		4	WA1422B450F2	A1422B450F2 - 4 Ch. Charge Preamplifier, 450mV/MeV gain, Cdet<200pF
		8	WA1422C450F2	A1422C450F2 - 8 Ch. Charge Preamplifier, 450mV/MeV gain, Cdet<200pF
< 1000	1	1	WA1422A001F3	A1422A001F3 - 1 Ch. Charge Preamplifier, 1mV/MeV gain, Cdet<1000pF
		4	WA1422B001F3	A1422B001F3 - 4 Ch. Charge Preamplifier, 1mV/MeV gain, Cdet<1000pF
		8	WA1422C001F3	A1422C001F3 - 8 Ch. Charge Preamplifier, 1mV/MeV gain, Cdet<1000pF
	5	1	WA1422A005F3	A1422A005F3 - 1 Ch. Charge Preamplifier, 5mV/MeV gain, Cdet<1000pF
		4	WA1422B005F3	A1422B005F3 - 4 Ch. Charge Preamplifier, 5mV/MeV gain, Cdet<1000pF
		8	WA1422C005F3	A1422C005F3 - 8 Ch. Charge Preamplifier, 5mV/MeV gain, Cdet<1000pF
	45	1	WA1422A045F3	A1422A045F3 - 1 Ch. Charge Preamplifier, 45mV/MeV gain, Cdet<1000pF
		4	WA1422B045F3	A1422B045F3 - 4 Ch. Charge Preamplifier, 45mV/MeV gain, Cdet<1000pF
		8	WA1422C045F3	A1422C045F3 - 8 Ch. Charge Preamplifier, 45mV/MeV gain, Cdet<1000pF
	90	1	WA1422A090F3	A1422A090F3 - 1 Ch. Charge Preamplifier, 90mV/MeV gain, Cdet<1000pF
		4	WA1422B090F3	A1422B090F3 - 4 Ch. Charge Preamplifier, 90mV/MeV gain, Cdet<1000pF
		8	WA1422C090F3	A1422C090F3 - 8 Ch. Charge Preamplifier, 90mV/MeV gain, 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

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