A1422

Low Noise Fast Rise Time Charge Sensitive Preamplifier

Data Sheet

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 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 ±3.5 V range on 50 Ω termination (±8 V on 1kΩ). Moreover, a test input accepts positive and negative signals for calibration purposes.

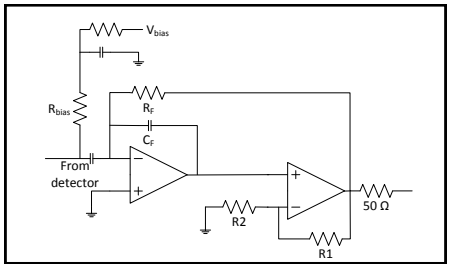
The hybrid preamplifiers are realized using a Cold Discharge Mechanism: this allows to have a low decay time value maintaining a very high feed resistance value. This technique provides good performances minimizing the pile-up in presence of moderate high counting rates.

The A1422 are implemented into alloy boxes and feature **SHV** connectors for the IN/DETECTOR and HV BIAS signals, **LEMO** connectors for the TEST IN and ENERGY OUT 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 gain values:**
  - **5 mV/MeV (Si)**
  - **45 mV/MeV (Si)**
  - **90 mV/MeV (Si)**
  - **400 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**

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

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



Specification

Charge Sensitivity

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

Recommended Range Of Input Capacitance

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

Noise FWHM keV (Si) (1)

	Detector capacitance	
Model	**0 pF**	**200 pF**
F2 - 5 mV/MeV	< 6.6	< 9.7
F2 - 45 mV/MeV	< 1.9	< 4.3
F2 - 90 mV/MeV	< 1.8	< 4.3
F2 - 400 mV/MeV	< 2.0	< 3.6
Model	**390 pF**	**1000 pF**
F3 - 5 mV/MeV	< 10.6	< 15.2
F3 - 45 mV/MeV	< 6.5	< 11.5
F3 - 90 mV/MeV	< 5.9	< 11.3

Rise Time (2)

	Detector capacitance	
Model	**0 pF**	**200 pF**
F2 - 5 mV/MeV	< 10 ns	< 20 ns
F2 - 45 mV/MeV	< 10 ns	< 35 ns
F2 - 90 mV/MeV	< 10 ns	< 75 ns
F2 - 400 mV/MeV	< 35 ns	< 110 ns
Model	**390 pF**	**1000 pF**
F3 - 5 mV/MeV	< 20 ns	< 35 ns
F3 - 45 mV/MeV	< 45 ns	< 90 ns
F3 - 90 mV/MeV	< 100 ns	< 220 ns

Output Linear Range

±8 V 1 kΩ termination
±3.5 V 50 Ω termination

Integral non Linearity

<± 0.05% (0 ÷ ±8 V 1 kΩ termination)

Temperature Instability

< ±100 ppm/°C (0 to 50°C)

Open Loop Gain

F2 (except 400 mV/MeV)	$> 2\ 10^5$
F2 - 400 mV/MeV	$> 1\ 10^6$
F3	$> 4\ 10^5$

E^2CPR Maximum energy-squared count-rate product

Sensitivity	**E^2CPR**
5 mV/MeV (Si)	$3.02\ 10^8$ MeV^2/s
45 mV/MeV (Si)	$1.11\ 10^8$ MeV^2/s
90 mV/MeV (Si)	$1.68\ 10^7$ MeV^2/s
400 mV/MeV (Si)	$3.41\ 10^6$ MeV^2/s

Decay Time

5 mV/MeV (Si)	270 µs
45 mV/MeV (Si)	110 µs
90 mV/MeV (Si)	150 µs
400 mV/MeV (Si)	14 µs

Detector Bias Voltage

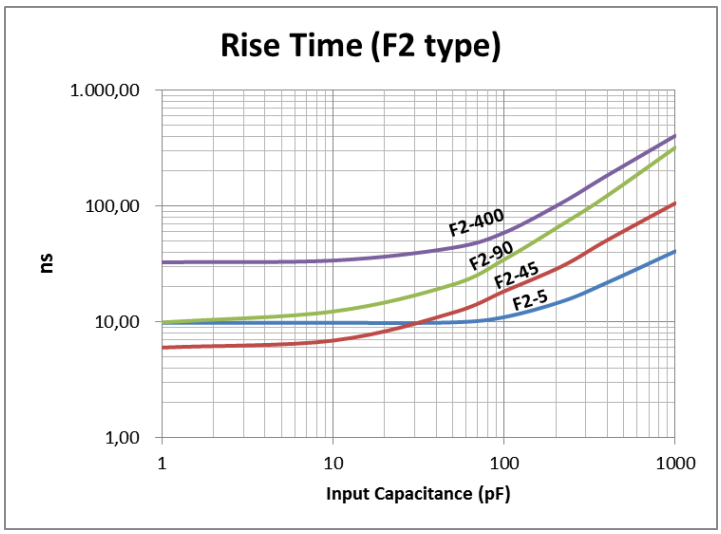
±2000 V max

Packaging

Alloy Box

Dimensions (WxHxD connector included):

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



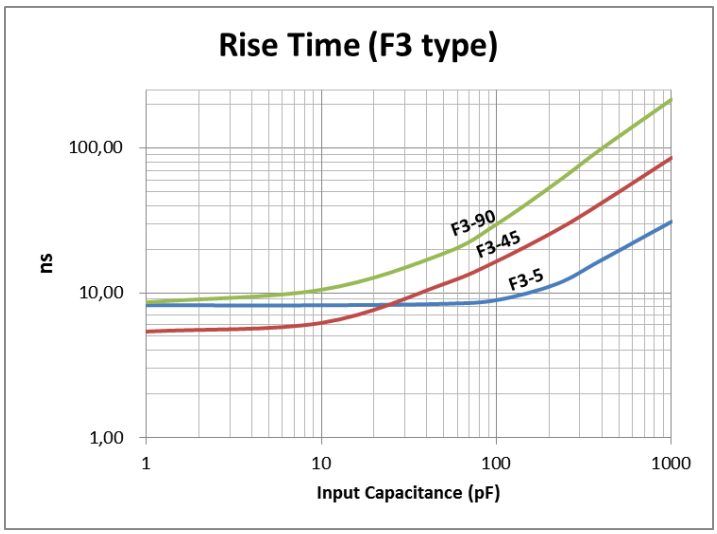
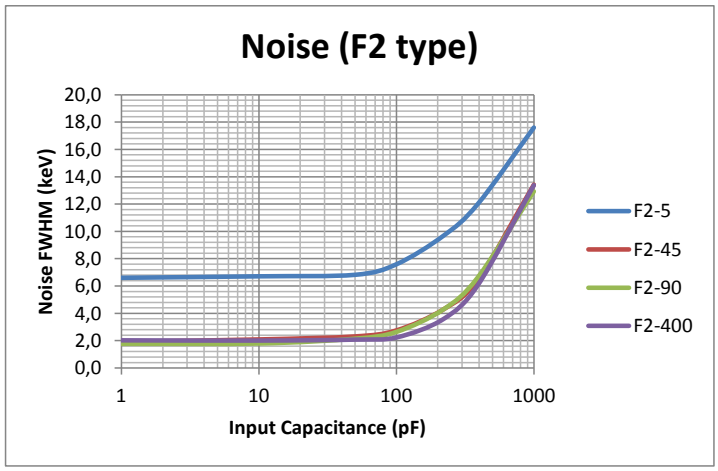


Fig. 1 : Typical Rise Time vs input Capacitance (test input rise time = 1.6 ns, amplitude: 200 mV, 50 Ω termination)



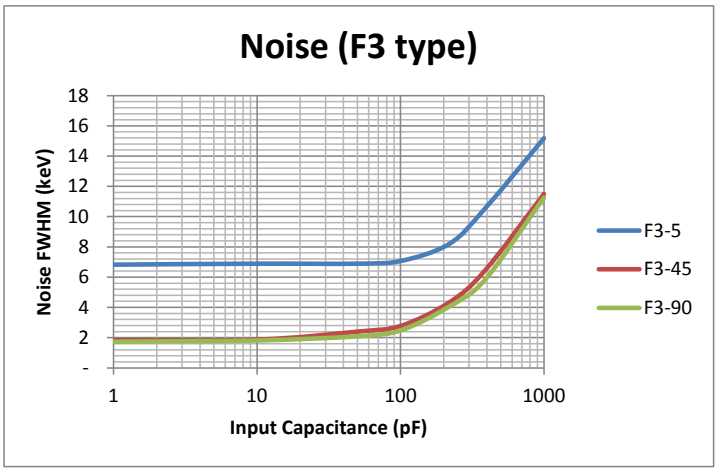


Fig. 2: Maximum Noise vs input Capacitance

Inputs

Input/Detector

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

High Voltage Bias

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

Test

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 9 pin** male connector.

Power Requirements

Models		+12 V	-12 V
A1422AxxxF2	(1 ch):	14 mA	6 mA
A1422BxxxF2	(4 ch):	55 mA	25 mA
A1422CxxxF2	(8 ch):	105 mA	50 mA
A1422AxxxF3	(1 ch):	24 mA	6 mA
A1422BxxxF3	(4 ch):	80 mA	25 mA
A1422CxxxF3	(8 ch):	160 mA	50 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.

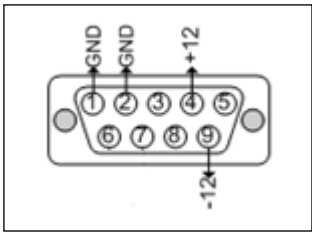


Fig. 3: Power Supply Connector pin out

Outputs

Output/Energy

± 8V max. (open circuit), 50 Ω 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
< 10 ns F2 - 5/45/90 mV/MeV
< 35 ns F2 - 400 mV/MeV

Detector capacitance = 390 pF
< 20 ns F3 - 5 mV/MeV
< 45 ns F3 - 45 mV/MeV
< 100 ns F3 - 90 mV/MeV

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

Panel Layout

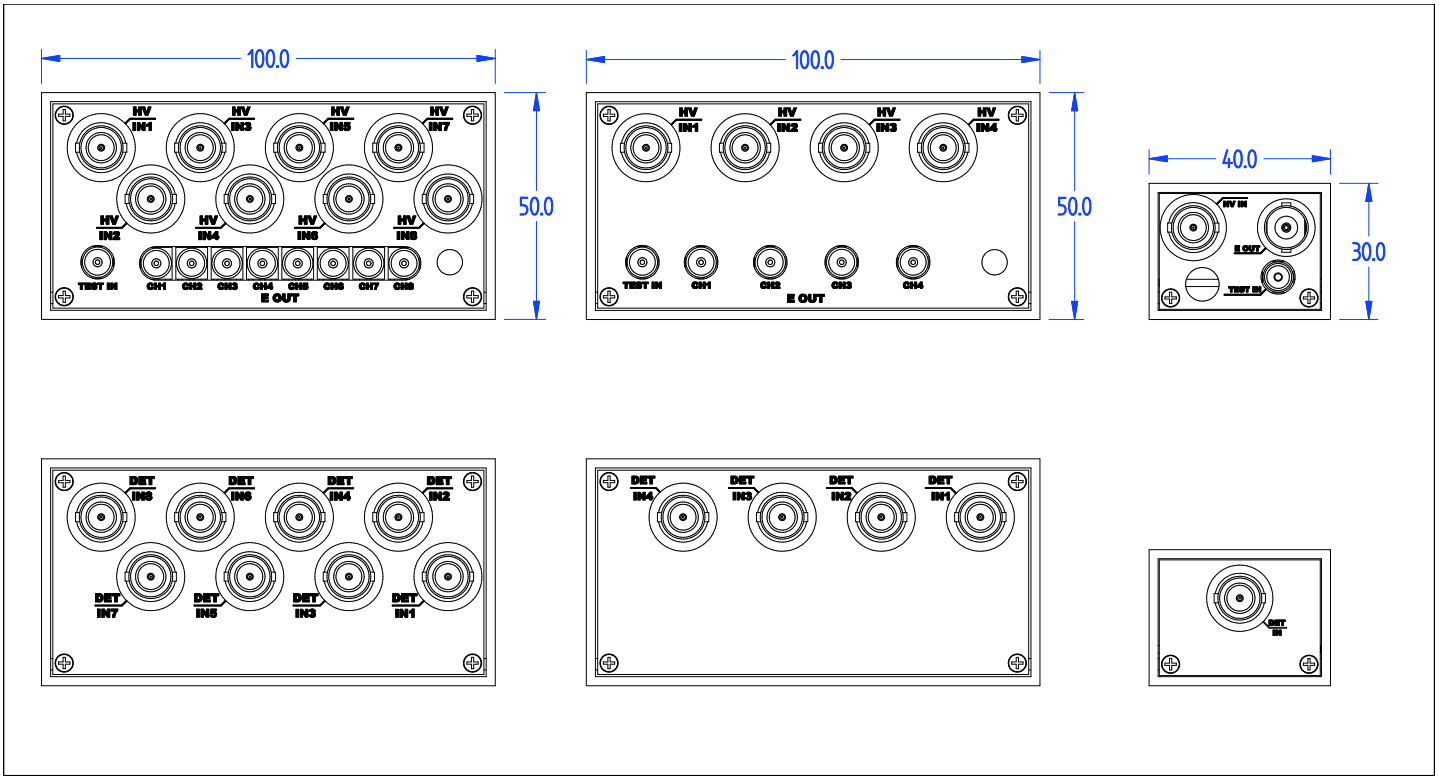


Fig. 4: A1422 series Front and Rear panel 8ch, 4ch, 1ch (dimension: mm)

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
< 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

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