CAEN n
Tools for Discovery

PRELIMINARY

DS11929

A1436A

1 Channel Differential Input Low Noise Transimpedance Amplifier Data Sheet

- 6 Transimpedance range: 10^8, 10^7, 10^6, 10^5, 10^4, 10^3
- 4 Programmable Gain: 1X, 2X, 5X, 10X
- 3nV Eq. Input Noise
- Bandwidth from 10 kHz to 1 MHz
- Differential input configuration with a CMRR > of 60 dB
- Programmable 1 kHz low pass filter.
- Adjustable output offset
- 10 Volts Max. Input Bias Voltage
- Electric Discharges input protection.
- 1 Single Ended Output 50 Ohm back termination 10 V max output
- Multiplexed current output, 50 mA Max.
- Test input: 10pC /V AC coupled
- +12 / -12V Power Supply

Vout/I-in	10^8	10^7	10^6	10^5	10^4	10^3
BW	10 kHz	50 kHz	150 kHz	250 kHz	500 kHz	1 MHz
[1]Noise RMS	2 (pA)	20 (pA)	50 (pA)	200 (pA)	4 (nA)	30 (nA)
Max Input Current	100 nA	1 μA	10 μA	100 μA	1 mA	10 mA
Vbias	Max. 10 V differential 12-bit resolution					

1) Measured with maximum bandwidth of the relative range.

General Description:

The A1436A is single channel transimpedance amplifier based on a differential input configuration.
It generates an output voltage proportional to the difference of the incoming currents on its input pairs. This Solution minimizes Induced Noise in applications where intense sources of interference are present. This preamplifier is suitable, for example, to read the current of Diamond detector, and other types of Semiconductor detectors e.g. Silicon Detector, Photodiode used in both Photovoltaic mode and photoconductive mode. In this case, a Bias voltage can be supplied to the differential inputs.
This voltage is generated internally and can be programmed up to a maximum value of 10 V.
Due to the differential structure of the inputs, the bias voltage is also generated differentially, so the side of the differential input pair identified as Cathode will receive a Positive bias while the other side Anode will be Negative so that the junction is biased inversely. For this reason each input pair consists of one pole indicated by Cathode (K) and one indicated by Anode (A) and the detector junction should be connected in accordance with this of the nomenclature input.
The Preamplifier selectable parameters are:
- 6 different transimpedance values, (10^8 to 10^3);
- a low pass filter with a cut-off frequency of 1kHz,
- a 4 value gain stage: 1X, 2X, 5X, 10X,
- a disabling current mode output, usable either as a Mux Out or for multichannel current sum
- a +/- 50mV output offset adjustable with 12 bit resolution
- a differential 10V max Bias Voltage adjustable with 12 bit resolution
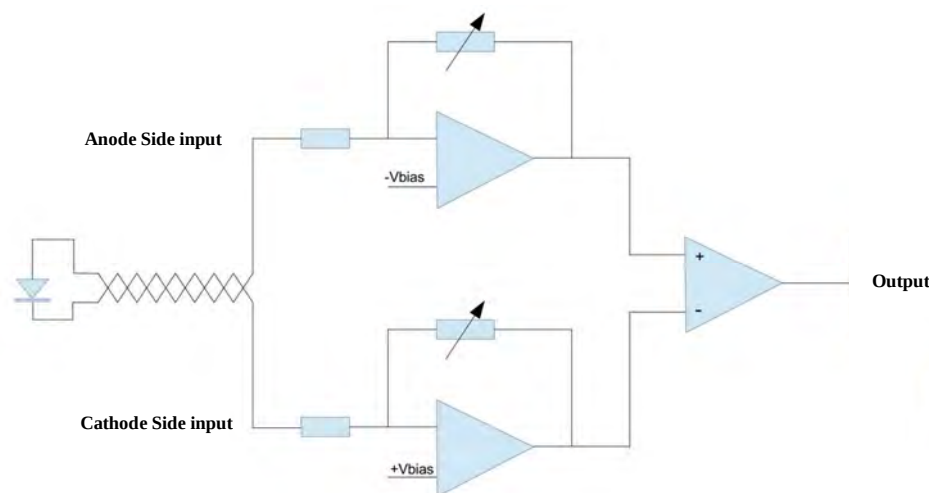All these parameters are individually remotely programmable via an RS485 connection.

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Fig. 1 Preamplifier Block Diadram of Differential Input

Fig. 2: Input Connector ERA.0S.302.CLL

Specifications:

Input:
Connector : 1x LEMO ERA.0S.302.CLL matching with LEMO FFA.0S.302.CLAC22
Max sustainable current on differential inputs: 100mA DC
Bias voltage max: 10 V differential (+5V on Cathode pin and -5V on Anode pin referred to GND)

Test input:
Connector: Lemo 00
Back termination: 50 Ohm
*Max input Voltage: 5*V
Test charge injection: 10pC*V

Channel Output:
Connector: Lemo 00
Max out Voltage: 10 V (No termination on output)
Max Out current: 100 mA
Back termination: 50 Ohm

Mux Out:
*Connector: 2*X Lemo 00
Max Out current: 50 mA
Max out Voltage: +5V, - 0,7V
Back termination: NO

RS 485 Input:
Connector: 4X1 pin Header 2,54mm pitch

Power Input:
Connector: 1X DB9 Male
Voltage Input: +12V; -12V;
Current consumption: +12=300mA; -12V=250m

Fig. 3 A1436A Preamplifier output side pannel

Fig. 4 A1436A Preamplifier input side pannel

Instructions for Operation

All parameters for A1436A are managed through a command-line communication protocol via an RS485 connection. All parameters are stored in non-volatil memory internally in the microcontroller and restored at power on. Up to 254 modules can be connected in a chain. Communication takes place in half duplex. Each module connected in the chain has an individual address **ID (1 to 254)**
A module with ID 1 must always be present in the chain.
The ID module address can be set through a specific command. It is recommended to connect each module individually so as to set a unique identifier before proceeding to connect different modules in the chain.
All the commands set, must be written in uppercase characters.
The A1436A use a Command Line Interface once the module is connected to a Terminal emulator.
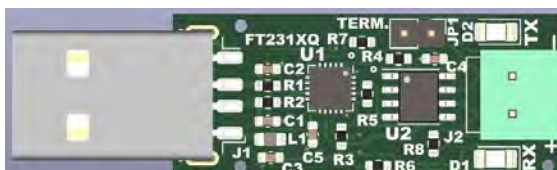The Module must be connected via a USB-RS485 adapter like the one in figure.

Fig. 5 USB-RS485 adapter

By connecting the adapter to the PC, it should be recognized as a Virtual COM port, if this is not the case try downloading the right Virtual COM Port Drivers for example the one for the FTDI's FT231XQ Chip in:
https://ftdichip.com/drivers/vcp-drivers/
Once recognized check on which COM number it is associated (e.g. with Device Management of windows 11).
Connect the RS485 line output of the adapter with a twisted cable to one of the two positions on the RS485 connector of the A1436A Preamplifier, as in the detail of fig. 6 in accordance with the polarities + and -

Fig. 6 RS485 connector detail.
The two positions are in parallel

Now open a terminal emulator (for example Putty is an open source Terminal Emulator downloadable at: https://www.putty.org/)
Set the **Connection** to **Serial** and COM number of the USB-485 adapter as **Serial Line to connect**
Set the following parameters :
Speed (baud) = 115200
Data Bit = 8
Stop Bit = 1
Parity = None
Flow control = XON/ XOFF

At this point we can power on the Preamplifier A 1436A through the power cable provided.
The following screen should appear on the Terminal:

*1: A1436 started, waiting for initialization
*A1436 started, waiting for initialization
*1: A1436 initialized successfully
*A1436 initialized successfully
*1: FW_Version: 1.04_sc_3
*FW_Version: 1.04_sc_3
*1: Type 'M1H' for display the help message
*Type 'M1H' for display the help message

Afterwards if no action is taken, after 20 seconds the module goes into sleep mode and the following message is sent:

*Modules going into Sleep Mode, press any characters to wake up

To wake up the module, after this warning, send any two characters followed by the Enter key.
The following message will appear

*Modules UP

HELP COMMAND:

We can begin by invoking the Help command

Type: **M1H** (**Enter**):

* **Command Line Interface Help**
***Overview**
**This interface controls and configures modules. Each module has a unique ID.
***Command Structure**
**```
**M<moduleID><command>[options]
**```
** `M<moduleID>`: Target module (1-254). `M255` is for broadcast commands.
** `<command>`: Action to perform (e.g., `D`, `S`, `H`, `I`, `X`).
** `[value]`: Parameters to be set (optional).

***Available Commands**

** `M<moduleID>D`: Ping modules in the chain. Use `M255D` to discover all the modules in the chain.
** `M<moduleID>S`: Display module settings.
** `M255Z`:Makes all the nodes going to sleep.
** `M<moduleID>H`: Print this help.
** `M<moduleID>I<new_module_id>`: Set a new module ID (1-254).
** `M<moduleID>X[0-1]`: Enable (1) or disable (0) the MUX.

***Module-Specific Commands**
** Options after `M<moduleID>`:
* * `T<transimpedance_val>`: Set transimpedance (10^x, 3-9)
* * `B<v_bias_val>`: Set V Bias (0-4095)
* * `O<offset_val>`: Set Offset (-2048 to 2047)
* * `L<low_pass_fileter_enabled>`: Enable (1) or Disable (0)
* * `G<gain_Set>`: Set the gain value 1X, 2X, 5X, 10X
* * `X`: Switch MUX to the selected channel.

***Important Notes**
** `M255` affects ALL modules.
** Only ONE module should have ID 1 if using multiple.
** Channel options can be executed one at a time.

***Examples**
** `M5S`: Show settings for module 5.
** `M255D`: Discover all modules.
** `M3T5`: Module 3 Transimpedance set to 10^5

*1: <OK>
*<OK>

As we can see, there are two types of commands:
Module Commands and **Module Specific Commands.**
The **Module Commands** concern command utility of the module itself as module ID setting, Help, etc.
Module Specific Commands are about setting the specifications of the amplifier parameters
The structure of these commands is as follows:
The first Letter is always:
"**M**" followed by the ID number (**1** to **255** where ID 255 is the broadcasting address) and a letter identifying the command, followed by any option, and with **ENTER** we send to execution
For example: **M1S (Enter):**
We get the status of the parameters of the indexed module (1 in this case)

*Status Report for Module 1
*Mux Enable: OFF
*+----------------------------+-----------------------+---------+------------+-----------+
*| Trans Impedenza | Low Pass Filter| Gain | V Bias | Offset |
*+----------------------------+-----------------------+---------+------------+-----------+
*| 10^5 | ON | 10x | 0 | 10 |
*+----------------------------+-----------------------+---------+------------+-----------+
*1: <OK>
*<OK>

Module Commands

The list of Module Commands are:
D; S; Z; H; I; X;

D: Display Module; Auto Identification of the addressed Module, the addressed module responds by sending its number ID with a delay proportional to it. This command help to identify the modules in the chain.
If ID 255 is used all modules will send their identifier in sequence.

Ex: **M255D Enter**
*1:
*2:
It means that we have two modules in the chain with IDs 1 and 2.
The time taken by the module to response to this command is proportional to the module ID number, this allows in the case of the broadcasting command to have the sequential list of modules present avoiding a simultaneous response conflict

S: Set-Up; This command gets as a response a table summarizing the parameter values of the module Addressed as in the previous examples;

Z: Sleep Mode; forces the addressed module in Sleep Mode if ID 255 is used it puts all nodes in the chains in sleep at the same time .
NOTE: The Sleep Mode greatly reduces the noise that the microcontroller induces on the Preamplifier outputs
 For example:
  M255Z (Enter):
In response we will receive the message:
*Modules going into Sleep Mode, press any characters to wake up.

H: Help Message; The addressed Module sends a summary description of the operation of the Command Line Interface. It is recommended to use ID 1 because it is always present
Example: **M1H (Enter):**

I: ID setting; Command to set a new module ID.
Example: **M1I2** changes the ID of module 1 to the new value of ID 2.

X: MUX enable; Enables or disables the **MUX** output of the selected Module, options are: 1 to Enable, 0 to Disable.
When Disabled the Mux current output is forced to zero, while setting 1 is enabled a current output with a proportion of 5mA per Volt of the output signal. A Green LED on, indicates the enabled state of the MUX.
Example: **M1X1 Enter**
Enables the MUX output of Module 1

Module-Specific Commands

This commands allow to act on the amplifier parameters of the addressed module.
The list of Module-Specific Commands are:
T: Transimpedance;
B: Bias Voltage:
O: Offset Adjust:
L: Low pass Filter:
G: Gain Set:

In detail:

T: Transimpedance, set one of 6 transimpedance values expressed by its exponent, the permitted values are:
 3, 4, 5, 6, 7, 8 which correspond to Transimpedance values: 10^3, 10^4, 10^5, 10^6, 10^7, 10^8
Example: **M1T8**
sets the transimpedance value of module 1 to the value of 10^8.

B: Bias Voltage sets the value of the Bias voltage, the permitted values are "0 to 4095" which correspond to a Bias value from 0 to 10 V respectively
Example **M1B1024**
Set a Bias value of approximately 2.5V volts on module 1.

O: Offset Adjust, set a +/- 50 mV of output offset, the permitted values are "- 2048 to + 2047"
the value of the output offset in mV corresponding to the set value "N "* 0.025
Example **M1O-1000**
Set the output offset value at -25mV.

L: Low pass filter:

set a low pass filter with 1 kHz cut-off frequency the parameters are: **1** to enable the filter; **0** to disable
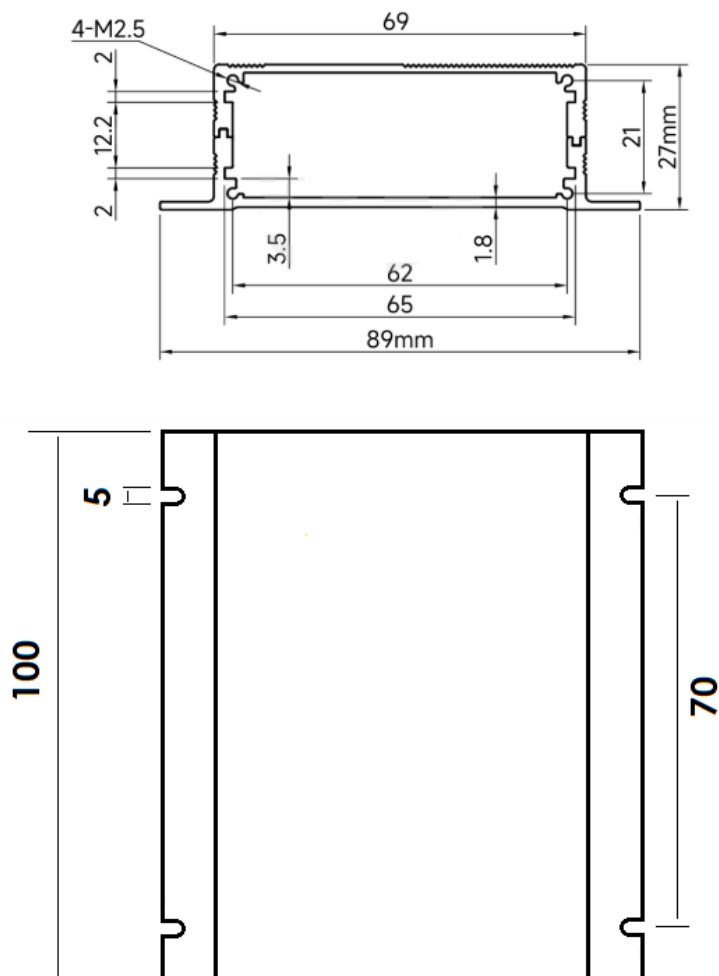Example **M1L1**
enables the 1khz filter on module 1.

G: Gain Set: set the value of the gain stage, the options are: **1, 2, 5, 10** corresponding to gains 1X, 2X, 5X, 10X
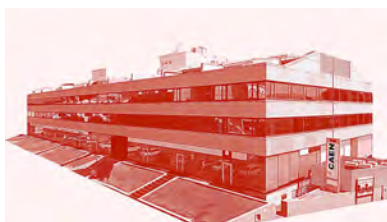Example **M1G10**

Dimension:

Ordering Option

Ordering code	Description
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