CAEN
Tools for Discovery

Electronic Instrumentation

N1068 16 Ch Spectroscopy Amplifier and CFD

Rev. 6 - 10 February 2025

Purpose of this Manual

This document is the N1068 User's Manual; it contains information about the installation, the configuration and the use of the board.

N.B. the present manual is not compliant with earlier production N1068's (channel PCB revision no.2); such units' serial numbers are: 20, 21, 32, 37, 39, 40, 41, 44, 53. If You own one of the listed modules and need any kind of support, please contact support.nuclear@caen.it

Change Document Record

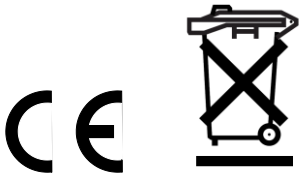
Date	Revision	Changes
23 May 2016	0	PRELIMINARY Release
25 July 2016	1	Updated Ethernet and DHCP configuration
3 October 2016	2	Updated Operating Modes
28 March 2017	3	Updated Technical Specifications, Operating Modes
25 January 2018	4	Updated Technical Specifications, Operating Modes
16 March 2022	5	Updated with N1068DB specification
10 February 2025	6	Updated Module settings

Symbols, abbreviated terms and notation

CFD: Constant Fraction Discriminator
MUX: Multiplexed

Reference Documents

T.B.D.



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1. N1068 Functional description

Fig. 1: CAEN Mod. N1068

The N1068 is a 16 channel Programmable Spectroscopy Amplifier with Time Filter, 30% Constant Fraction Discriminator (CFD) and pile-up rejection, implemented in a single width NIM module. This module is designed to be used with Silicon, Germanium, and many other detectors types connected to charge sensitive preamplifiers. Also adapted for fast input signal like PMT and all fast charge detectors. Available dedicated version for germanium detectors: N1068GE.

The first stage of the Amplifier circuits is the polarity selector circuit which select the positive or negative input polarity (N1068 is available with either single ended or differential inputs). Follow two different sections which provide the Energy and Timing information.

The Energy section is composed by a Spectroscopy amplifier with CR-RC^5 shaping type and 4 different time constants (0.5, 1, 2, 4 µs, extended up to 16 µs for N1068GE), pole-zero compensation, an 8-step coarse gain (2, 4, 8, 16, 32, 64, 128, 256), a 7-bit fine gain (from 1 to 2) and a DC restorer circuit. The Timing section is composed by a Timing filter with a differential stage followed by an integration stage both with two time constants. An amplifier stage provides 4 gain values. This timing signal is sent to a Constant Fraction Discriminator section (Constant Fraction = 30%). The CFD has an auto walk compensation and the delay time is selectable individually for each channel by 5 step jumpers. The width and delay of CFD OUT is individually programmable; the delay can be enabled or disabled.

The trigger stage foresees a Programmable Multiplicity Trigger and Multiplicity signal, an analog sum output of every channel CFD out; Multiplicity signal can be daisy chained with those provided by other modules.

Chaining with a Sum Output available as well. Pile-up rejection is configurable individually for each channel. When enabled each time a pile-up event occurs, the Energy output is set to the saturation value.The USB 2.0, Ethernet and RS485 interfaces allow to handle all functional parameters.

Spectroscopy Amplifier Control Software, a software tool that allows an easy management of all the functional parameters of the CAEN Spectroscopy Amplifiers is available too; supported operating systems are Windows and Linux.

Available versions are:

N1068S - 16 Ch Programmable Spectroscopy Amplifier & CFD Single Ended Input (50 Ohm)
N1068DB - 16 Ch Programmable Spectroscopy Amplifier & CFD Differential Input (110 Ohm)
N1068GE - 16 Ch Programmable Spectroscopy Amplifier & CFD for Germanium Detector

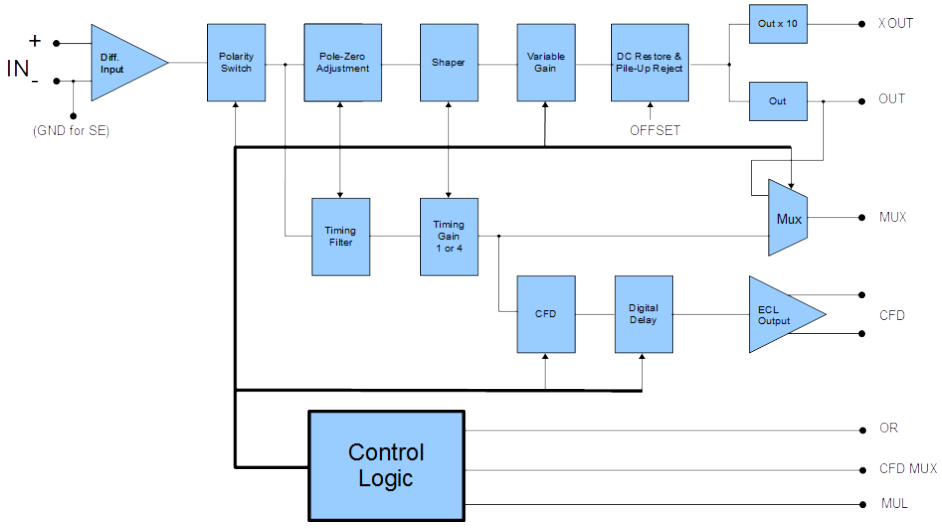


Fig. 2: Channel Block Diagram

2. Technical Specifications

Table 1: Technical features and ratings

Version	N1068S, N1068DB	N1068GE
Packaging	One unit wide NIM unit	
Power requirements	+6V 2.9 A; -6V 1.8 A; +12V 250 mA; -12V 250 mA	
Input	Positive or negative pulses, max. amplitude of ±4V, 50 Ohm impedance (Single End), 110 Ohm (Diff.); Input polarity set via terminal	Positive or negative pulses, max. amplitude of ±4V, 50 Ohm impedance (Single End) Input polarity set via terminal
OUT	Unipolar/gaussian signal with a dynamic range of 0 ÷ +8 V max (on 1 MOhm), 50Ohm output impedance; common offset adjust (-200 ÷ +200 mV) 8-bit resolution	
XOUT	Unipolar/gaussian signal, further 10x fixed amplification of the OUT value, with a dynamic range of 0 ÷ +8 V max (on 1 MOhm),50 Ohm output impedance; common offset adjustment (-200 ÷ +200 mV) 8-bit resolution	
CFD OUT	Diff. ECL output, width 75÷1730 ns ±10%, 5 bit adjustable	
MUX	Output, on LEMO connector and on double row connector; options: energy, timing, disabled; 0÷+8V max (on 1MOhm); 50Ohm output impedance; high impedance when disabled	
OR	Logical OR of the CFD Output, on LEMO connector, standard NIM output, width 157÷1825 ns ±10%, 5 bit adjustable. Individually Enable	
MUX CFD	CFD out of channel with MUX enabled. Std. NIM output on double row connector	
MUL	Multiplicity out: analog sum of CFD OUT, -1.6mA output per hit; -80mV on 50 Ohm	
MUL DISC	Standard NIM output on double row connector; Multiplicity Trigger Discriminator (Time over threshold) with Programmable Threshold.	
Integral non linearity in 10%÷90% of the full scale	≤± 0.03% Gain=150, 4µs shaping time ≤± 0.05% Gain=150, 0.5/1/2µs shaping time ≤± 0.2% Gain=50, 0.5F shaping time	≤± 0.05% Gain=150, 1 µs shaping time ≤± 0.2% Gain=150, 4/8/16µs shaping time ≤± 0.2% Gain=50, 1F shaping time
Temperature stability [0÷50°C]	Gain: < 70 ppm/°C. DC level Output: < 10 µV/°C	
Equivalent Input Noise	< 15 µV RMS (Gain=100, 4 µs shaping time)	< 11 µV RMS (Gain=100, 4 µs shaping time)
Interchannel Crosstalk	<-55 dB at max Gain, 4µs shaping time and 4 V input on adjacent channel	
Coarse Gain Range	Adjustable 8-step, nominal: 2,4,8,16,32,64,128,256; measured: 2.8 to 355 circa	
Shaping Time	(0.5, 1, 2, 4) µs; 0.5µs with fast input select (0.5F). GE version: (1, 4, 8, 16) µs; 1µs with fast input select (1F)	
Fine Gain Range	From 1 to 2 , 7-bit adjustable	
Pole- zero Adjustment	Done via software on 256 steps to match preamp tails in the 20 to 2000 µs range	
Timing Filter time constant	Diff. (100, 500ns), Int. (20, 80ns)	
Timing Gain	Adjustable 1, 4	
Timing Offset	Adjustable 12-bit; ~120mV range	
CFD Threshold	0 ÷ 4095 mV (12-bit resolution)	
CFD Delay Time	Selectable by jumper (5 steps): 8ns, 16ns, 24ns, 32ns, 40ns	
CFD WALK	<±500 ps on 60 mV ÷ 2V input with 10 ns rise time, 50 µs duration	
Delay on CFD ECL Output	20÷1700 ns ±10%, 5 bit adjustable. Individually Enabled	
Pile-up rejection	Individually selectable; when a pile-up event occurs, an output saturation is forced	
Interfaces	USB: USB B type female connector; USB 2.0 compliant ETH: 10/100 Base-T female connector; TTL signals (TCP/IP) RS485 on 10+10 pin header General I/O	

Front Panel

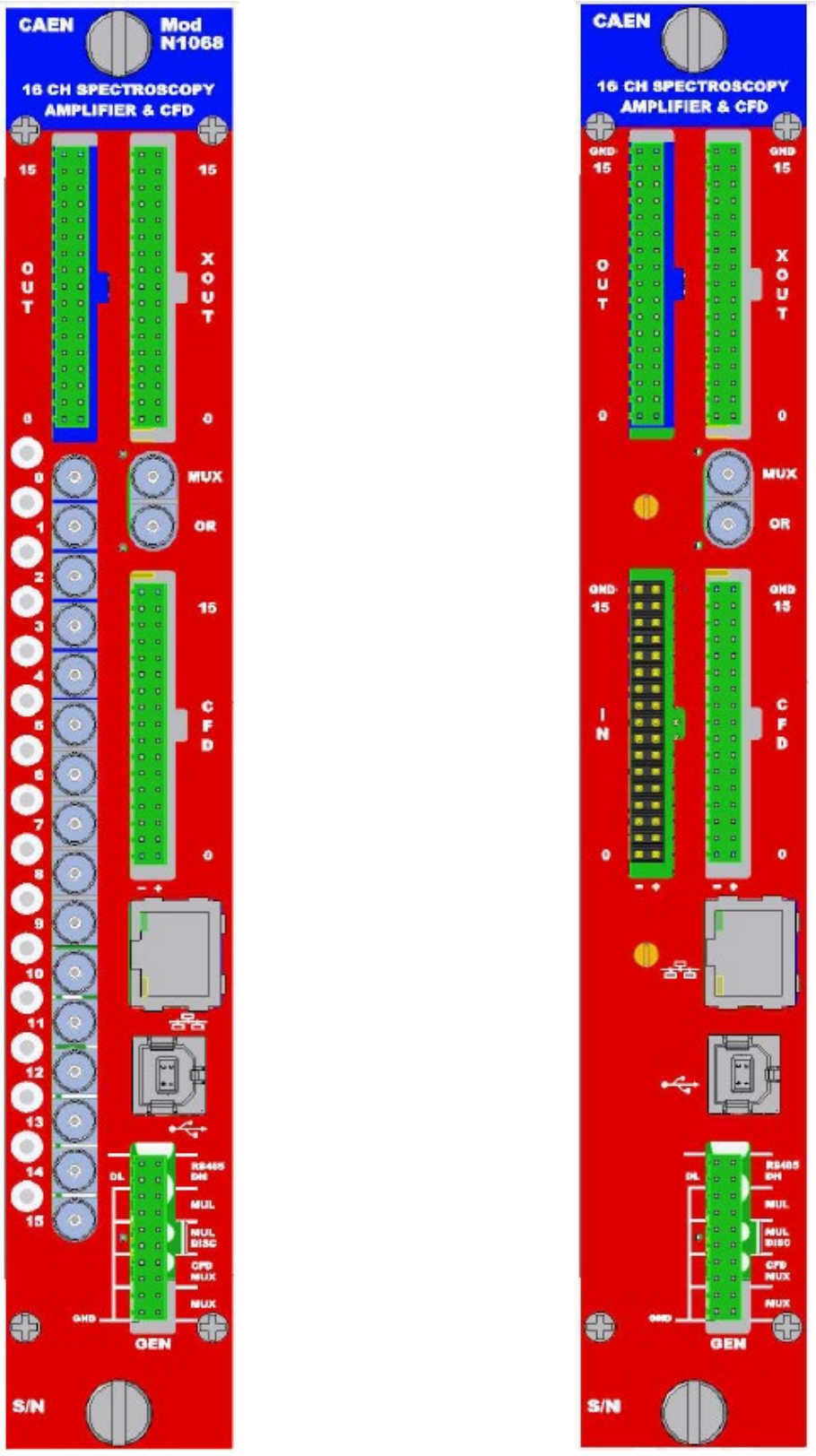


Fig. 3: Front panel layout (single ended and differential)

External Components

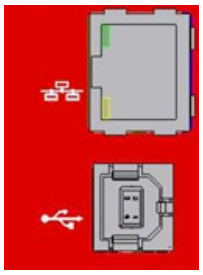
Connectors

INPUTS 0..15	16	LEMO 00 type (single ended) 17+17 pin, double row strip header (differential)	input signal connectors
OUT 0..15	1	17+17 pin, double row strip header (left ground, right signal)	output connector
XOUT 0..15	1	17+17 pin, double row strip header (left ground, right signal)	output connector
CFD OUT 0..15	1	17+17 pin, double row strip header (left ground, right signal)	output connector
MUX	1	LEMO 00 type	single selected channel output connector
OR	1	LEMO 00 type	single selected channel output connector
USB	1	USB B type female connector	USB 2.0 compliant
ETH	1	10/100 Base-T female connector	TTL signals (TCP/IP)
GEN	1	10+10 pin, double row strip header	General I/O connector

Test Points

N. 16, "INPUTS 0..15", IN signal test points; single ended version only; provides input signal across 10kOhm

Communication ports



NAME:	TYPE:	FUNCTION:
IN	AMP 280371-2	*RS485 Input[1];*
OUT	AMP 280371-2	*RS485 Output*
USB	B TYPE USB	*USB2.0 compliant*
ETH	10Base-T female	Ethernet port, TTL signals (TCP/IP)

Fig. 4: Communication links

GEN Connector

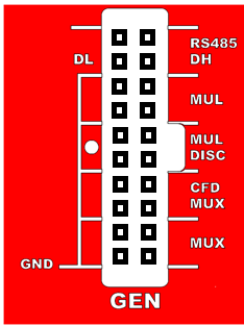


Fig. 5: GEN Connector

Signal Left	Signal Right	Function
RS485 DATA L	RS485 DATA H	RS 485 Serial Port Interface allows to control up to 32 modules connected by a twisted pair cable; the first and last modules must be terminated (see Daisy chain network)
RS485 DATA L	RS485 DATA H	
GND	MULTIPLICTY	Output Pulse proportional to Sum out of CFD out signals (1 channel ~ 80mV). To be terminated on 50Ohm
GND	MULTIPLICTY	
GND	DISCRIMINATED MULTIPLICITY	Produces NIM out if Multiplicity signal exceeds a programmable threshold (see p. 10)
GND	DISCRIMINATED MULTIPLICITY	
GND	CFD MUX	CFD out of channel with MUX enabled. Standard NIM output
GND	CFD MUX	
GND	MUX OUT	Out of ch. With MUX enabled; Options: energy, timing, disabled 0 ÷ +8V max (on 1 MOhm); 50 Ohm output impedance; high impedance when disabled
GND	MUX OUT	

[1] RS 485 Serial Port Interface allows to control up to 32 modules connected by a twisted pair cable; the first and last modules must be terminated.

3. Operating Modes

General Information

The Model N1068 16 channel Programmable Spectroscopy Amplifier and 16Ch 30 % Constant Fraction Discriminator (CFD) is implemented in a single width NIM module. Thanks to its high channel density, this unit allows the optimization of cost and size in multi-detector systems.

Initial inspection

Prior to shipment this unit was inspected and found free of mechanical or electrical defects. Upon unpacking of the unit, inspect for any damage, which may have occurred in transport. The inspection should confirm that there is no exterior damage to the unit, such as broken knobs or connectors, and that the panels are not scratched or cracked. Keep all packing material until the inspection has been completed. If damage is detected, file a claim with carrier immediately and notify CAEN. Before installing the unit, make sure you have read thoroughly the safety rules and installation requirements, then place the package content onto your bench; you shall find the following parts:
N1068 module;
USB cable
10BASE-T Ethernet cable
Moreover, in order to operate the N1068, a ventilated NIM crate and a Personal Computer are required.

Installation

USB installation

Insert the N1068 into the ventilated NIM crate and power it
Connect the N1068 to the PC via the USB cable
Download and install the USB driver for your OS, available at the N1068 page on the www.caen.it site
Now the N1068 is ready for operation, either via Terminal emulator (see p.10) or upon installation of one of the available software tools.

Ethernet installation

Insert the N1068 into the ventilated NIM crate and power it
Connect the Ethernet port of the unit to the relevant port of the PC, using the 10BASE-T Ethernet cable
Now the N1068 is ready for operation, either via Terminal emulator (see p.10) or upon installation of one of the available software tools.

Software tools

Spectroscopy Amplifier Control Software

Spectroscopy Amplifier Control Software is a software tool that allows an easy management of all the functional parameters of the CAEN Spectroscopy Amplifiers N568E and N1068. Module control can take place via either USB or TCP/IP; features include a user friendly graphical user interface. Supported OS's are Windows and Linux. For more info please visit www.caen.it (products>firmware/software section).

CAEN HV Wrapper

CAEN HV Wrapper is a library, available either as a set of ANSI C functions or LabVIEW™ VI's. Such set provides the software developer a unified software interface for the control of CAEN Amplifiers and Power Supplies. This is a low level application in which the writing of the Control SW is assigned to the user. It contains a generic software interface independent by the CAEN models and by the communication path used to exchange data with them. CAEN HV Wrapper is logically located between a higher level application, such as Spectroscopy Amplifier Control Software, and the lower layer software libraries. For more info please visit www.caen.it (products>firmware/software section).

Module Operation via Terminal Emulator

USB

Connect the unit to the host PC with the USB cable, launch the terminal emulator (we suggest using Tera Term), select the serial communication link and set the virtual communication port associated to the module. Select USB connection and the used port number; set port as follows

- baud rate 9600
- Data bits: 8
- Parity: none
- stop bit: 1
- Flow control: none
- Launch communication
- Type caen then <enter>;

Ethernet

When accessing via Ethernet (using Terminal Emulator, such as TeraTerm) select port number **23**

Please note that line editing must be disabled prior to Ethernet access.

Default settings are:

IP address 192.168.0.1

Subnet mask 255.255.255.0

Gateway 255.255.255.0

- Launch communication
- Type caen then <enter>;

as the communication is established, the Main Menu will be displayed:

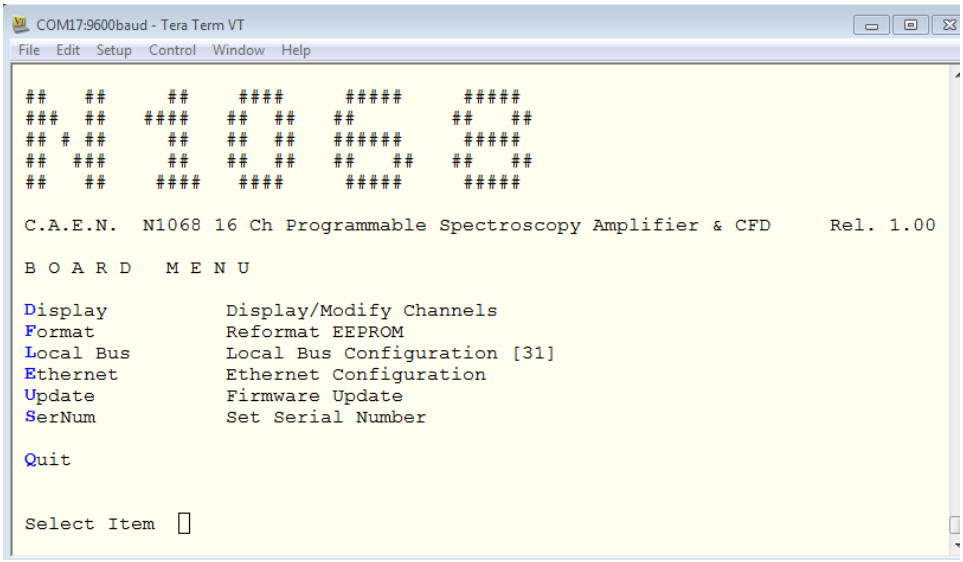
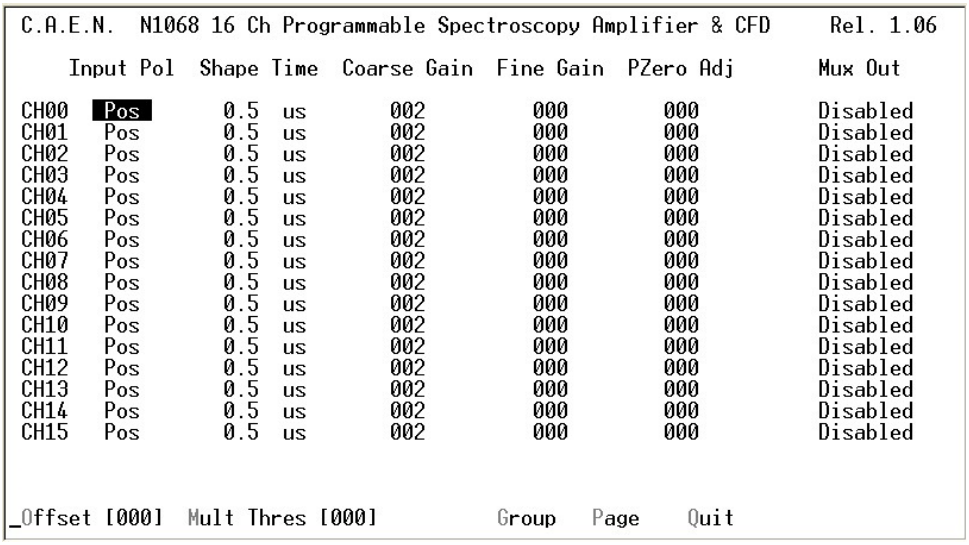


Fig. 6: Main Menu

Channel Settings

By typing **D** it is possible to monitor and set all the channels parameters; the items range and function is explained at page 14:



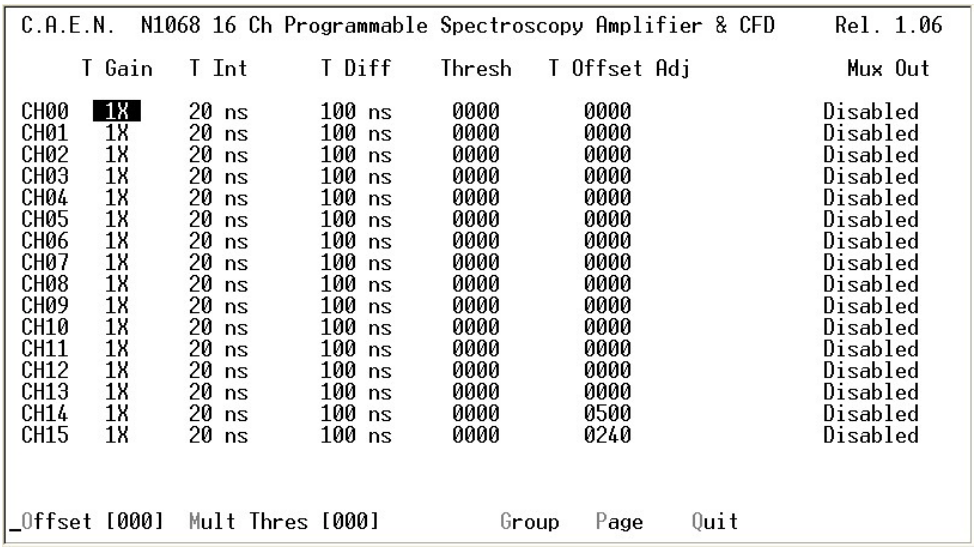
```
C.A.E.N.  N1068 16 Ch Programmable Spectroscopy Amplifier & CFD     Rel. 1.06

     Input Pol  Shape Time  Coarse Gain  Fine Gain  PZero Adj       Mux Out

CH00   Pos       0.5  us       002          000        000          Disabled
CH01   Pos       0.5  us       002          000        000          Disabled
CH02   Pos       0.5  us       002          000        000          Disabled
CH03   Pos       0.5  us       002          000        000          Disabled
CH04   Pos       0.5  us       002          000        000          Disabled
CH05   Pos       0.5  us       002          000        000          Disabled
CH06   Pos       0.5  us       002          000        000          Disabled
CH07   Pos       0.5  us       002          000        000          Disabled
CH08   Pos       0.5  us       002          000        000          Disabled
CH09   Pos       0.5  us       002          000        000          Disabled
CH10   Pos       0.5  us       002          000        000          Disabled
CH11   Pos       0.5  us       002          000        000          Disabled
CH12   Pos       0.5  us       002          000        000          Disabled
CH13   Pos       0.5  us       002          000        000          Disabled
CH14   Pos       0.5  us       002          000        000          Disabled
CH15   Pos       0.5  us       002          000        000          Disabled


_Offset [000]  Mult Thres [000]          Group   Page    Quit
```

Fig. 7: Channels Menu page 1/3



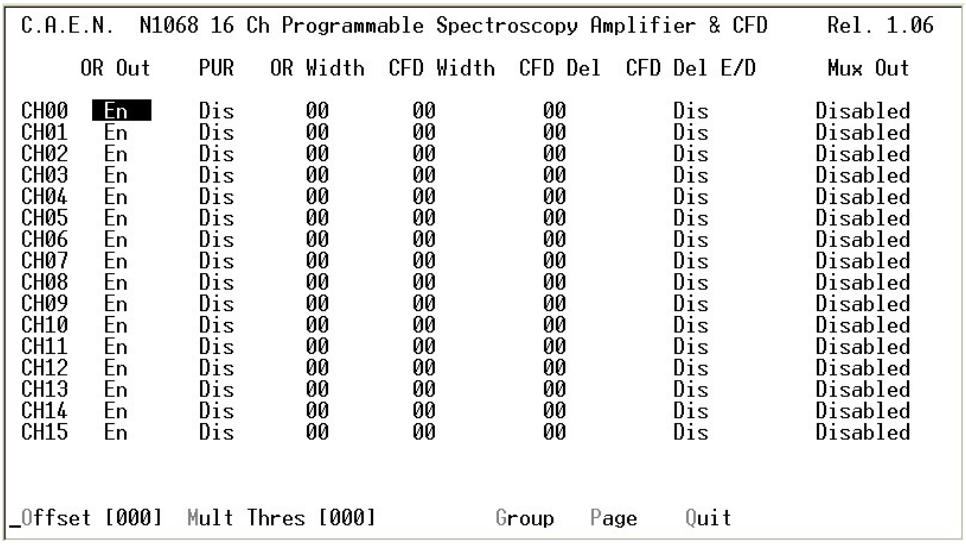
```
C.A.E.N.  N1068 16 Ch Programmable Spectroscopy Amplifier & CFD     Rel. 1.06

      T Gain   T Int      T Diff     Thresh   T Offset Adj             Mux Out

CH00   1X      20 ns      100 ns      0000       0000                Disabled
CH01   1X      20 ns      100 ns      0000       0000                Disabled
CH02   1X      20 ns      100 ns      0000       0000                Disabled
CH03   1X      20 ns      100 ns      0000       0000                Disabled
CH04   1X      20 ns      100 ns      0000       0000                Disabled
CH05   1X      20 ns      100 ns      0000       0000                Disabled
CH06   1X      20 ns      100 ns      0000       0000                Disabled
CH07   1X      20 ns      100 ns      0000       0000                Disabled
CH08   1X      20 ns      100 ns      0000       0000                Disabled
CH09   1X      20 ns      100 ns      0000       0000                Disabled
CH10   1X      20 ns      100 ns      0000       0000                Disabled
CH11   1X      20 ns      100 ns      0000       0000                Disabled
CH12   1X      20 ns      100 ns      0000       0000                Disabled
CH13   1X      20 ns      100 ns      0000       0000                Disabled
CH14   1X      20 ns      100 ns      0000       0500                Disabled
CH15   1X      20 ns      100 ns      0000       0240                Disabled


_Offset [000]  Mult Thres [000]          Group   Page    Quit
```

Fig. 8: Channels Menu page 2/3



```
C.A.E.N.  N1068 16 Ch Programmable Spectroscopy Amplifier & CFD     Rel. 1.06

      OR Out    PUR   OR Width  CFD Width  CFD Del  CFD Del E/D      Mux Out

CH00   En       Dis      00         00         00         Dis        Disabled
CH01   En       Dis      00         00         00         Dis        Disabled
CH02   En       Dis      00         00         00         Dis        Disabled
CH03   En       Dis      00         00         00         Dis        Disabled
CH04   En       Dis      00         00         00         Dis        Disabled
CH05   En       Dis      00         00         00         Dis        Disabled
CH06   En       Dis      00         00         00         Dis        Disabled
CH07   En       Dis      00         00         00         Dis        Disabled
CH08   En       Dis      00         00         00         Dis        Disabled
CH09   En       Dis      00         00         00         Dis        Disabled
CH10   En       Dis      00         00         00         Dis        Disabled
CH11   En       Dis      00         00         00         Dis        Disabled
CH12   En       Dis      00         00         00         Dis        Disabled
CH13   En       Dis      00         00         00         Dis        Disabled
CH14   En       Dis      00         00         00         Dis        Disabled
CH15   En       Dis      00         00         00         Dis        Disabled


_Offset [000]  Mult Thres [000]          Group   Page    Quit
```

Fig. 9: Channels Menu page 3/3

To change one parameter: point the parameter with the arrow keys, and Type or Toggle the desired value.

Fine Gain, Pzero Adj, Thresh, T_offset, CFD Del, OR Width, CFD Width → type the desired value and confirm by typing <Enter>
The desired value of the other channel parameters can be toggled using the <Space> bar.
To set board Offset, press 'O', then type the desired value and confirm by typing <Enter>
To set board Multiplicity Threshold press 'M', then type the desired value and confirm by typing <Enter>
Type “P” to move to the next page
Type “G” for group mode (performed settings are extended to all channels);
Type “Q” to go back to Main Menu

Local Bus settings

To set board local bus configuration, from Main Menu, type L:

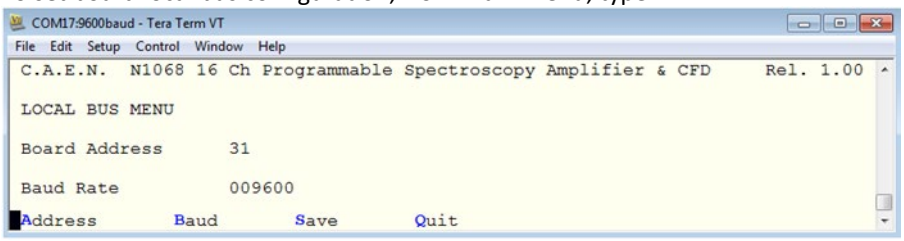


Fig. 10: Address Menu

Type “A” to select address; to update it, type the new address and press <Enter>.
Type “B” to toggle Baud rates.
Type “S” to save Local Bus configuration in device EEPROM and return to main menu.
Type “Q” to go back to Main Menu.
Default settings are:
baud rate: 9600
board address: 0

Format EEPROM

In order to format the Board EEPROM, from Main Menu, type F:

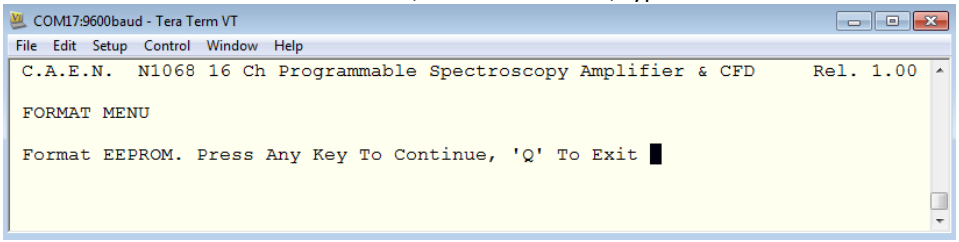


Fig. 11: Format Menu

Type “Q”to go back to Main Menu, type any other key to proceed with format operation.

Ethernet and DHCP configuration

To access Ethernet settings, type E:

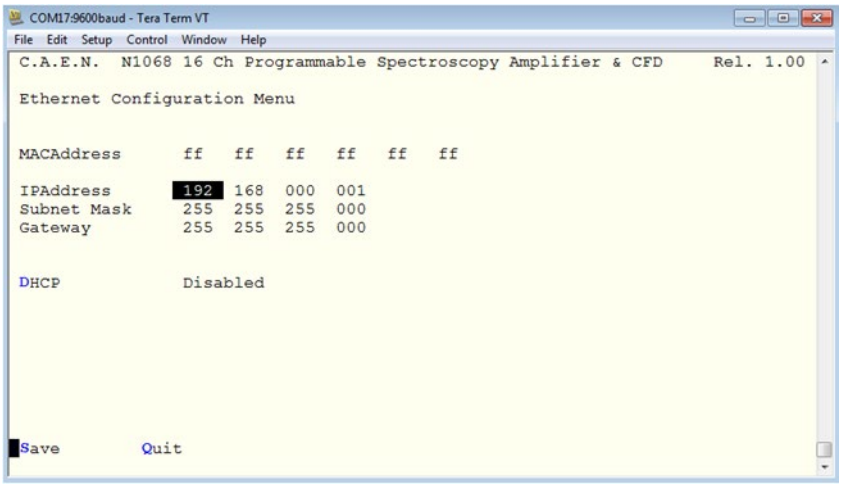


Fig. 12: Terminal Ethernet settings

At first Power On the module is configured with default static IP (factory setting); such IP can be updated using the “arrows” to select the fields, typing the new values and confirming with <Enter>.

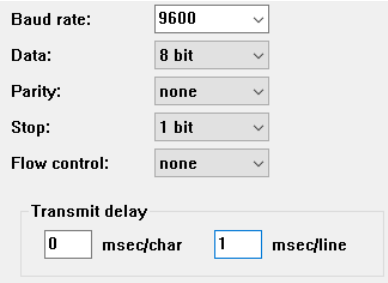
Type S to save the new setting in the EEPROM and go back to Main Menu.

The new setting will become active at next Power On; if a DHCP Server is available, then the module can be enabled or disabled as DHCP client; type S to save the new setting in the EEPROM and go back to Main Menu: the DHCP server will automatically assign a new IP to the module at next Power On.

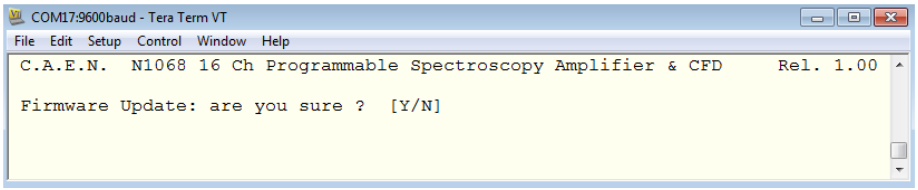
Firmware upgrade

To upgrade the firmware:

- download from www.caen.it N1068 page the most recent firmware revision for your module
- connect to the module via USB using Tera Term VT Emulator
- in the Tera Term options, select “set up” > “serial port” and in the Transmit Delay menu set 1 msec/line delay as shown below

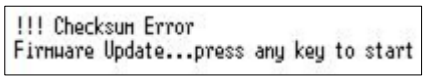


- click OK to confirm
- go to Terminal Board Menu
- type U in order to upgrade the firmware:

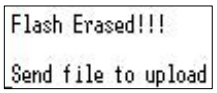


- Type y
- Disconnect the terminal emulator serial port connection, then disconnect the USB cable
- Reconnect the USB cable, then reconnect to the module via the terminal emulator

- the following message will be shown:



- Press any key;
- Wait until the following message is shown:



- Select “File” > send file
- Browse the image file
- Select “open”
- Wait the upload to complete
- turn OFF and then ON the module

now the unit is ready to operate running the upgraded firmware

Module settings

At Power-ON, the module contains the last performed settings before Power-Off, except for MUX, which is always disabled. The status of these settings can be read out via Software.
The settings on each channel of the module can be performed in any order. Due to the logical dependence of certain settings from others, it is anyhow suggested to perform the first time User' settings on each channel of the module in the following order:

- set the input polarity (positive or negative);
- set the shape;
- set the coarse gain;
- set the fine gain;
- set the pole-zero adjustment;
- set the offset;
- enable to energy/timing or disable the multiplexed output
- set the Timing section gain;
- set the Timing integral
- set the Timing differential
- set the CFD threshold;
- set the CFD delay;
- enable/disable CFD delay;
- set the CFD output width;
- enable/disable OR output;
- set the OR output width;
- enable/disable the Pile-up rejection;

Once performed either first-time or ordinary settings, it is suggested, for best noise performances, NOT to access the module frequently via Software (e.g. for monitoring) while the module is operating on the final experimental setup.
The following paragraphs describe in more detail the single settings. Offset, Fine Gain and Pole-zero settings must be seen not as absolute settings, but as "digital trimmers" with which the User sets the desired parameters and controls the outputs obtained with well-known pulse shapes.

Shape adjusting

The shaping time can be selected in 5 steps among the following: 0.5 µs, 1 µs, 2 µs, 4 µs, 0,5 µs with fast input select (0.5F). When setting is 0.5F, the Differential parameter of Timing section is forced to 500 ns, TInt, TDiff, and Pole-Zero Adjustment settings are reserved. N1068GE provides 1 µs, 4 µs, 8 µs, 16 µs constants; 1 µs with fast input select (1F).

Gain adjusting

The Coarse Gain can be set in 8 steps: nominal range is from 2 to 256 (measured: 2.8 to 355 circa), each step approximately doubles the Gain of the previous one.
The Fine Gain can be set in 128 steps in the range 0÷127, corresponding to a gain value from 1 to 2.
The fine gain and coarse gain ranges allow a choice accuracy from 2 to 512 (nominal); measured 2.8 to 710 circa.

Pole Zero Adjustment

This setting can be done on 8 bit to match preamp tails in the range 20 µs ÷ 2000 µs.

Offset Adjustment

This setting can be done on 8 bit to add an offset value to shift the baseline of the Gaussian output (OUT and XOUT). Allowed values are from -200 mV to +200 mV.

Multiplicity Threshold

If Multiplicity signal exceeds this threshold, a NIM signal is produced on the relevant pin of the GEN connector. This setting can be done on 8 bit in the 0 ÷ +3.3V range.

Mux Operation

When MUX is enabled, the CFD MUX out is enabled too (GEN connector); the MUX output provides the Gaussian or timing signal (Energy/Timing; selectable via software) of the enabled channel.

MUX and CFD MUX output shall be used for debug purposes and are better kept disabled during normal operation.

Timing section settings

Differential constant:	100ns or 500ns;
Integral constant:	20ns or 80ns;
Gain:	1 or 4.
Timing Offset:	12bit, ~120mV range; factory calibrated according to Differential constant and Gain setting (see above). The User can anyway modify the Timing Offset value to his needs. Factory calibrated values can be recovered performing a Format cycle (see p.12). N.B. Timing Offset is not factory calibrated when *fast input* is selected (see Shape Adjusting p.14).

CFD Section

N.B.: it is important that the CFD Section is correctly configured to allow the N1068 to properly produce output signals; the delay must be set according to the formula described below and the threshold must be set to the lowest level of interest.

The Constant Fraction Discrimination technique is based on summing a delayed, full height input signal to an inverted and attenuated signal. The resulting signal is fed into a zero-crossing comparator, thus obtaining a precise timing information that eliminates any walk errors induced by constant rise time and varying amplitude signals.

For correct operation, the maximum of the attenuated pulse must cross the delayed pulse at the selected fraction. This condition leads to the following relation:

Tdelay = Trise * (1 - F)

where:

Tdelay = selected delay on the Constant Fraction Discriminator

Trise = rise time of the CFD input signals

F = Constant Fraction value (30%)

Remember that CFD input signal is the processed signal coming out from the Timing section; this is valid also for the threshold setting.

CFD Delay Configuration

The CFD delay can be selected in 5 steps (8, 16, 24, 32, 40 ns) by jumper inserted on J1 socket placed on each channel board. The channel boards are indexed from 0 to 15, starting from the rear panel.

Position no.1 (leftmost) leads to 8ns delay, pos. no.2 to 16ns and so on; refer to figure below for the components location.

Jumper must be inserted in one of the foreseen positions, otherwise the CFD will not work.

N.B. CFD Delay must be set according to Tdelay = Trise * (1 - F), otherwise the N1068 will not properly produce output signals.

Fig. 13: CFD Delay setting jumpers

CFD threshold

This setting can be done on 12 bit in the range 0÷4095 mV. The CFD threshold is referred to the processed signal coming out from the Timing section.
N.B.: CFD threshold must be set to the lowest level of interest, otherwise the N1068 will not properly produce output signals.

CFD output width

This setting can be done on 5 bit in the range 75÷1730 ns ±5%.

CFD output delay

This setting can be done on 5 bit in the range 20÷1700 ns ±5%.

OR width

This setting can be done on 5 bit in the range 157÷1825 ns ±5%.

Daisy chain network

It is also possible to build a daisy chain of up to 32 N1068's, with the first module connected to the either PC USB or Ethernet port and the subsequent ones daisy chained through the COMM IN/OUT (see p.8); in this case, communication with the chained modules is achieved through the Communication Protocol, see § 4. All modules must be assigned a LOCAL BUS ADDRESS different from one another and the last one must be terminated (below SW1, SW2 set to "dot not visible):

Fig. 14: Termination switches

4. Communication Protocol

The protocol is based on sequences of commands, consist of ASCII characters and is common for the two types of interfaces (USB, which uses a Virtual Communication Port, and ETHERNET, which uses TCP/IP); it allows to communicate with up to 32 daisy chained modules.

In this way, the user can write a single management program for all types of interface, that differs only in a low level part, related to communications.

The format of a command consists of the following string:

$BD:**,CMD:***,CH**,PAR:***,VAL:***<CR>

The fields of the string have the following meaning:

BD: 0 .. 31 module address to send the command.

CMD: MON, SET

CH: 0 .. 16 (16 for controls on all channels)

PAR: (see parameter table)

VAL: (numerical value must be in a format compatible with the resolution and range)

The format string response is as follows:

Response strings in case of error

#BD:**CMD:ERR<Cr> invalid command or command not recognized

#BD:**CH:ERR<Cr> field channel is not present or wrong channel value

#BD:**PAR:ERR<Cr> field parameter is not present or unrecognized parameter

#BD:**VAL:ERR<Cr> value set incorrectly (<Min or > Max)

Response strings in the case of correct command

#BD:**,CMD:OK Command Ok

#BD:**,CMD:OK,VAL:*** Command Ok *** = value if the command is for one channel

#BD:**,CMD:OK,VAL:*;*. .*;* Command Ok *;*. .*;* Values for Ch0, .. CH15, if the command is for all channels

Set Controls for the channel 'X'

X = 0..16 X = 16 → set parameter for all channels

$BD:**,CMD:SET,CH:X,PAR:POL,VAL:x<Cr> Set Input Polarity

$BD:**,CMD:SET,CH:X,PAR:PZADJ,VAL:xxx<Cr> Set Pole/Zero Compensation

$BD:**,CMD:SET,CH:X,PAR:SHAPE,VAL:x<Cr> Set Shaping Time

$BD:**,CMD:MON,CH:X,PAR:FGAIN,VAL:xxx<Cr> Set Fine Gain

$BD:**CMD:SET,CH:X,PAR:CGAIN,VAL:x<Cr> Set Coarse Gain

$BD:**,CMD:SET,CH:X,PAR:PUR,VAL:x<Cr> Pile-Up Rejection Enable/Disable

$BD:**CMD:SET,CH:X,PAR:TINT,VAL:x<Cr> Set Timing Integration

$BD:**CMD:SET,CH:X,PAR:TDIFF,VAL:x<Cr> Set Timing Differential

$BD:**CMD:SET,CH:X,PAR:TGAIN,VAL:x<Cr> Set Timing Gain

$BD:**CMD:SET,CH:X,PAR:TOFF,VAL:xxxx<Cr> Set Timing Offset

$BD:**,CMD:SET,CH:X,PAR:MUX,VAL:x<Cr> Set Channel Multiplexer configuration

$BD:**CMD:SET,CH:X,PAR:THR,VAL:xxxx<Cr> Set Threshold

$BD:**,CMD:SET,CH:X,PAR:CFDED,VAL:x<Cr> Set CFD Delay Enable/Disable

$BD:**CMD:SET,CH:X,PAR:CFDDEL,VAL:xx<Cr> Set CFD Delay

$BD:**CMD:SET,CH:X,PAR:CFDWDT,VAL:xx<Cr> Set CFD width

$BD:**CMD:SET,CH:X,PAR:ORWDT,VAL:xx<Cr> Set CFD OR width

$BD:**,CMD:SET,CH:X,PAR:OR,VAL:x<Cr> Set OR out Enable/Disable

The set values possible for each field are the following:

POL 0 → +, 1 → -

PZADJ 0..255

SHAPE 0, 1, 2, 3, 4

0, 1, 2, 3 → 0.5us, 1us, 2us, 4us

4 → 0.5F mode : shaping time = 4us , with input forced in FAST mode and

timing differential = 500ns

FGAIN 0..127

CGAIN 0, 1, 2, 3, 4, 5, 6, 7 → 2x, 4x, 8x,16x, 32x, 64x, 128x, 256x

PUR 0 → PUR Disable, 1 → PUR Enable

TINT 0 → 20ns, 1 → - 80ns

TDIFF 0 → 100ns, 1 → - 500ns

TGAIN 0 → 1x, 1 → 4x

MUX 0, 1, 2

0 → Multiplexer is DISABLED

1 → ENERGY Multiplexer is ENABLED

0 → TIMING Multiplexer is ENABLED

THR 0..4095

1 bit → 1mV

CFDED 0 → CFD Delay Disable, 1 → CFD Delay Enable

CFDDEL 0..31

1 bit → 34ns

CFDWDT 0..31

1 bit → 40ns

ORWDT 0..31

1 bit → 40ns

OR 0 → OR out Enable, 1 → OR out Disable

Command Set of the module

$BD:**,CMD:SET,PAR:BDOFFSET,VAL:XXX<Cr> Set Board Offset

$BD:**,CMD:SET,PAR:BDMULTITHR,VAL:XXX<Cr> Set Multiplicity signal Threshold

$BD:**,CMD:SET,PAR:BDFORMAT,VAL:XXX<Cr> Format module EEPROM

The set values possible for each field are the following:

BDOFFSET 0..255 → -1.3V..+1.3V

BDMULTITHR 0..255 → 0..3.3V

BDFORMAT Set all parameters to 0

Monitor Commands related to the channel 'X'

X = 0 .. 16. X = 16 -> parameter reading for all channels CH0 to CH15.

$BD:**,CMD:MON,CH:X,PAR:POL<Cr> Read Input Polarity

$BD:**,CMD:SETON,CH:X,PAR:PZADJ<Cr> Read of Pole / Zero Compensation

$BD:**,CMD:MON,CH:X,PAR:SHAPE<Cr> Read 'Shaping Time'

$BD:**,CMD:MON,CH:X,PAR:FGAIN<Cr> Read Fine Gain

$BD:**CMD:MON,CH:X,PAR:CGAIN<Cr> Read Coarse Gain

$BD:**,CMD:MON,CH:X,PAR:PUR<Cr> Read PUR status

$BD:**CMD:MON,CH:X,PAR:TINT<Cr> Read Timing Integration

$BD:**CMD:MON,CH:X,PAR:TDIFF<Cr> Read Timing Differential

$BD:**CMD:MON,CH:X,PAR:TGAIN<Cr> Read Timing Gain

$BD:**CMD:MON,CH:X,PAR:TOFF<Cr> Read Timing Offset

$BD:**,CMD:MON,CH:X,PAR:MUX<Cr> Read Channel Multiplexer status

$BD:**CMD:MON,CH:X,PAR:THR<Cr> Read Threshold

$BD:**,CMD:MON,CH:X,PAR:CFDED<Cr> Read 'CFD Delay' status

$BD:**CMD:MON,CH:X,PAR:CFDDEL<Cr> Read CFD Delay value

$BD:**CMD:MON,CH:X,PAR:CFDWDT<Cr> Read CFD width

$BD:**CMD:MON,CH:X,PAR:ORWDT<Cr> Read CFD OR width

$BD:**,CMD:MON,CH:X,PAR:OR<Cr> Read OR out status

Commands related to the monitor module

$BD:**,CMD:MON,PAR:BDNAME<Cr> Read module Name(N1068)

$BD:**,CMD:MON,PAR:BDFREL<Cr> Read Firmware Release (X.XX)

$BD:**,CMD:MON,,PAR:SERNUM<Cr> Reading Serial Number (XXXXX)

$BD:**,CMD:MON,,PAR:BDOFFSET<Cr> Read Board Offset(0..255)

$BD:**,CMD:MON,PAR:BDMULTITHR<Cr> Read Multiplicity Threshold(0..255)

$BD:**,CMD:MON,PAR:BDADDR<Cr> Read module Address on Local Bus(0..31)

$BD:**,CMD:MON,PAR:BDBAUD<Cr> Read Baud Rate on Local Bus (0..4)

0 → 9600, 1 → 19200, 2 → 38400,

3 → 57600, 4 → 115200

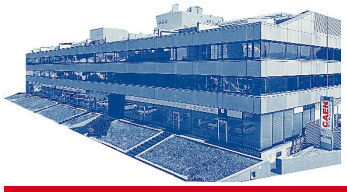
$BD:**,CMD:MON,PAR:BDMAC<Cr> Read MAC Address(xx xx xx xx xx xx)

$BD:**,CMD:MON,PAR:BDIP<Cr> Read IP Address(xxx.xxx.xxx.xxx)

$BD:**,CMD:MON,PAR:BDMASK<Cr> Read Subnet Mask(xxx.xxx.xxx.xxx)

$BD:**,CMD:MON,PAR:BDGATE<Cr> Read Gateway(xxx.xxx.xxx.xxx)

$BD:**,CMD:MON,PAR:BDDHCP<Cr> Read DHCP status (EN/DIS)



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