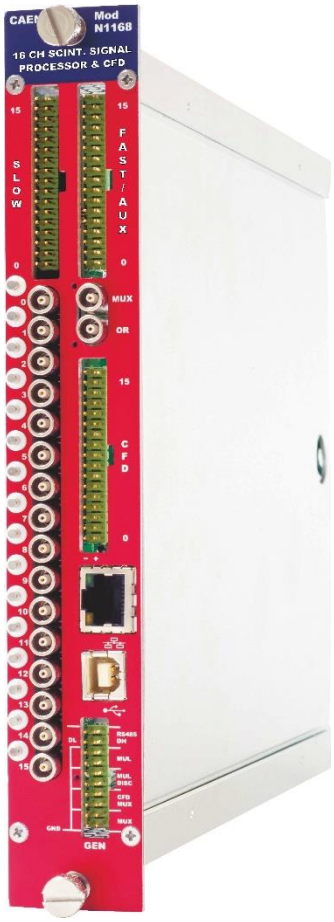
CAEN
Tools for Discovery

Electronic Instrumentation

PRELIMINARY



N1168 16 Channel Fast Scintillator Programmable Signal Processor and CFD

Rev. 5 - 10 February 2025

Purpose of this Manual

This document is the N1168 User's Manual; it contains information about the installation, the configuration, and the use of the board.

Change Document Record

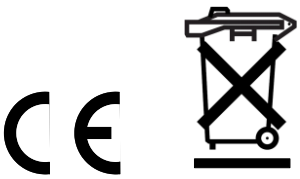
Date	Revision	Changes
2 December 2019	0	PRELIMINARY Release
11 May 2020	1	Major document update
18 February 2021	2	Technical features and ratings
16 December 2021	3	Technical features (gain)
28 February 2021	4	Input polarity setting
10 February 2025	5	Updated Module settings

Symbols, abbreviated terms and notation

CFD: Constant Fraction Discriminator
MUX: Multiplexed

Reference Documents

T.B.D.



Index

List of Figures

List of Tables

1. N1168 Functional description

Fig. 1: CAEN N1168

The N1168 is suitable for several type of scintillator detectors, particularly where different decay time of the scintillation light are present. This module allows to obtain the full handling of the detector signal, giving the total energy, amplitude of the fast component and the time information.

The analysis of the two dimensional spectrum (fast versus total) allows an excellent gamma-neutron separation for liquid scintillators or CLYC detectors, gamma-charged particle separation for BaF2 detectors, and to disentangle the gamma interaction in the different parts of a Phoswich detector.

The module is very simple to use and overcomes the inconveniences of the standard approach with two gates and QDC setup.

The board has two outputs for each input channel, where the first output is proportional to the integration charge (called SLOW output), and the second is proportional to the signal amplitude (called FAST output). The latter gives information of the shape of the input pulse, thus giving information to perform pulse shape discrimination with detectors that have a different response to particles, like gamma-neutrons.

For scintillator detectors with a single light component, the AUX output, that is a second slow output, can be used as a second total energy signal, meeting the requirements of dual energy range experimental setups, avoiding the split of the signal on two shaping amplifiers.

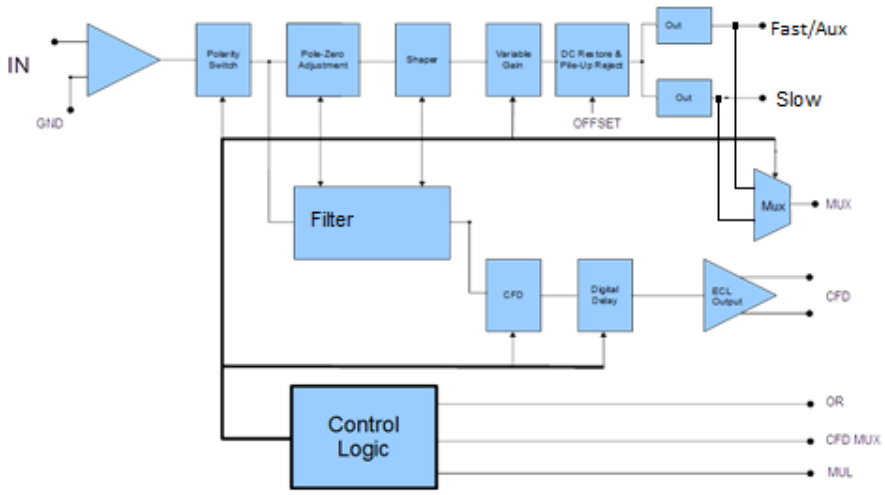
A gate-free fast stretcher circuit captures the leading-edge peak value of the signal, that is subsequently Gaussian shaped to allow simple acquisition by a peak-sensing ADC.

The total energy circuit basically consists of an integrator, followed by a Gaussian shaper amplifier.

The time information is given by a Constant Fraction Discriminator, with selectable delay line and an automatically walk compensation circuit.

The very low noise level of the module matches the requirements of the new class of high energy resolution scintillators (LaBr3), over a large energy dynamics applications range, and also in a very low discrimination level.

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.



2. Technical Specifications

Table 1: Technical features and ratings

Packaging	One-unit wide NIM unit
Power requirements	1.7 A @ +6V; 2.5 A @ -6V; 400 mA @ +12V; 220 mA @ -12V
Input	Positive or negative pulses, max. amplitude of ±3V, 50 ohm impedance Input polarity jumper selectable
SLOW OUT	Unipolar gaussian; dynamic range 0 ÷ +8V max (on 1Mohm), 50 ohm back termination; offset adjust: -400 ÷ +400 mV; 8-bit resolution; common to all channels
FAST/AUX OUT	Unipolar gaussian; dynamic range 0 ÷ +8V max (on 1Mohm), 50 ohm back termination; offset adjust: -400 ÷ +400 mV; 8-bit resolution; common to all channels
CFD OUT	Diff. ECL output; width 50÷1150 ns, 5 bit adjustable
MUX	Output, on LEMO connector and on double row connector; options: Slow, Fast/Aux selectable, disabled; 0÷+8V max (on 1MOhm); 50Ohm output impedance; high impedance when disabled. N.B. MUX out are attenuated by ~0.5 factor versus SLOW & FAST/AUX OUT; when used, they must be terminated on HIGH impedance
OR	Logical OR of the CFD Output, on LEMO connector, standard NIM output, width 145÷1250 ns, 5 bit adjustable. Individually Enabled
MUX CFD	CFD out of channel with MUX enabled. Std. NIM output on double row connector
MUL	Multiplicity out: analog sum of CFD OUT, -800µA output per hit; -40mV on 50 Ohm
MUL DISC	Standard NIM output on double row connector; Multiplicity Trigger Discriminator (Time over threshold) with Programmable Threshold.
Gain	Product of coarse and fine gain setting. Coarse: 4-step adjustable (nominal: 1x, 4x, 16x, 64x); Fine: 0 ÷ 191 steps adjustable. Total range: 2.3÷312 for Negative inputs. With positive inputs, all values are halved; see also p.14
Shaping time	Slow Out-AUX: 0.2, 0.4, 0.8 µs; Fast Out: 0.2, 0.4 µs
Slow Integral non linearity	T.B.D.
Fast Integral non linearity	T.B.D.
FAST-SLOW Crosstalk	<-50 dB (measured on FAST OUT, induced by SLOW OUT on same channel)
Slow equivalent Input Noise	< 92 µV (Gain=100x; 0.2 µs shaping time)
Fast equivalent Input Noise	< 135 µV (Gain=100x; 0.2 µs shaping time)
FAST-SLOW rejection	< 30 dB
CFD Threshold	0 ÷ 4095mV; 1mV step
CFD Zero Crossing Delay	Selectable by jumper (5 steps): 1.5ns, 3ns, 4.5ns, 6ns, 7.5ns
Delay on CFD ECL Output	Range: 20ns - 1100 ns, 5-bit resolution (from 1 to 31); individually programmable and disabled (see p.16)
Pile-up rejection	Individually selectable; when a pile-up event occurs within 3 T output saturation is forced
Interfaces	USB 2.0, Ethernet and RS485 accessible from the front panel

Front Panel

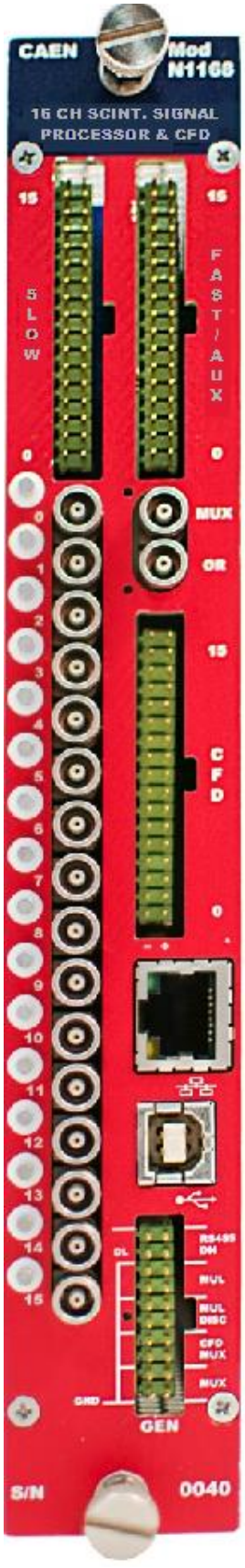


Fig. 2: Front panel layout

External Components

Connectors

INPUTS 0..15	16	LEMO 00 type	input signal connectors
SLOW OUT 0..15	1	17+17 pin, double row strip header (left GND, right signal)	output connector
FAST/AUX OUT 0..15	1	17+17 pin, double row strip header (left GND, right signal)	output connector
CFD OUT 0..15	1	17+17 pin, double row strip header (left ECL-, right ECL+)	output connector
MUX	1	LEMO 00 type (see table p. 6)	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; provides input signal across 10kOhm

Communication ports

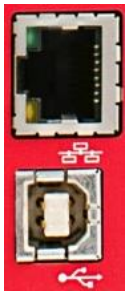


Fig. 3: Communication links

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)

GEN Connector

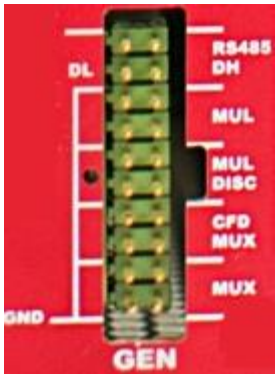


Fig. 4: GEN Connector

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 ~ 40mV). 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 (see table p. 6)	Out of ch. With MUX enabled; Options: Slow, Fast/Aux selectable, disabled; 0 ÷ +8V max (on 1 MOhm); 50 Ohm output impedance; high impedance when disabled
GND	MUX OUT (see table p. 6)	

[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 N1168 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:
N1168 module;
USB cable
10BASE-T Ethernet cable
Moreover, in order to operate the N1168, a ventilated NIM crate and a Personal Computer are required.

Installation

USB installation

Insert the N1168 into the ventilated NIM crate and power it
Connect the N1168 to the PC via the USB cable
Download and install the USB driver for your OS, available at the N1168 page on the www.caen.it site
Now the N1168 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 N1168 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 N1168 is ready for operation, either via Terminal emulator (see p.10) or upon installation of one of the available software tools.

Software tools (coming soon)

N1168 Control Software

N1168 Control Software is a software tool that allows an easy management of all the functional parameters of the CAEN N1168. 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:

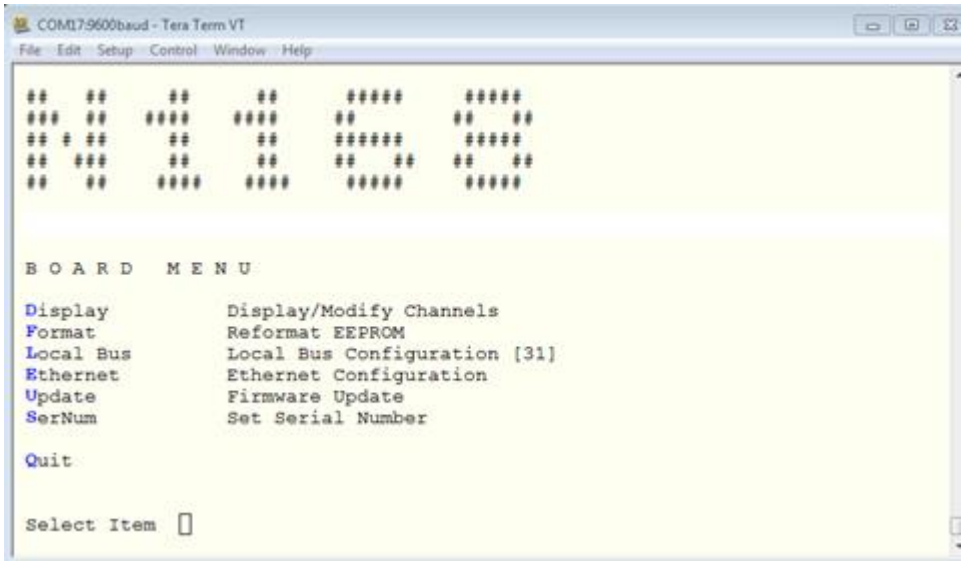
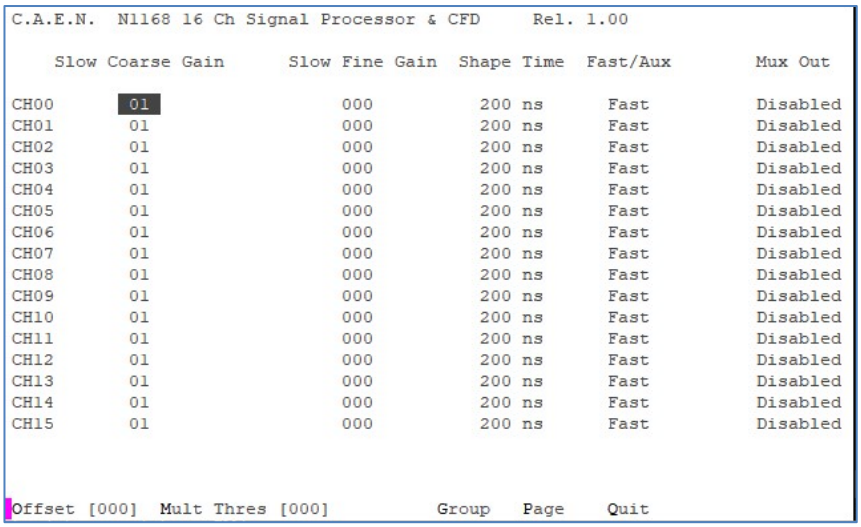


Fig. 5: Main Menu

Channel Settings

By typing **D** it is possible to monitor and set all the channels parameters;



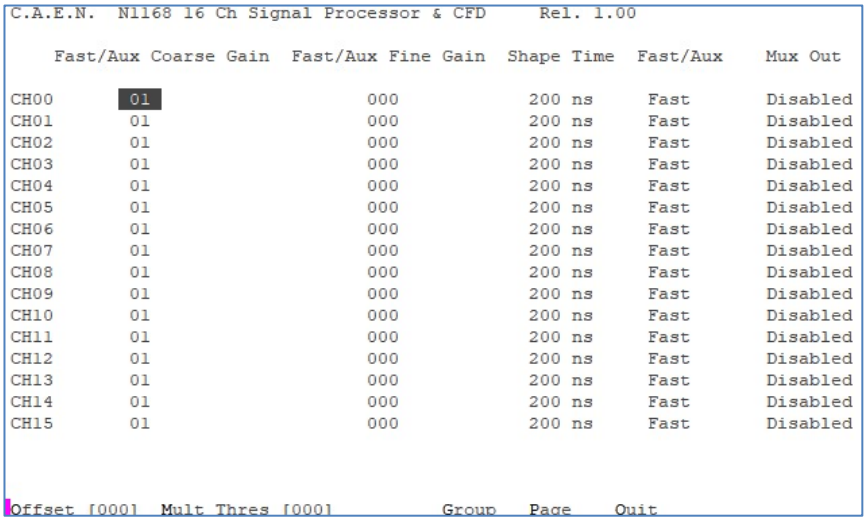
```
C.A.E.N.  N1168 16 Ch Signal Processor & CFD     Rel. 1.00

    Slow Coarse Gain      Slow Fine Gain  Shape Time  Fast/Aux        Mux Out

CH00        01                 000          200 ns      Fast          Disabled
CH01        01                 000          200 ns      Fast          Disabled
CH02        01                 000          200 ns      Fast          Disabled
CH03        01                 000          200 ns      Fast          Disabled
CH04        01                 000          200 ns      Fast          Disabled
CH05        01                 000          200 ns      Fast          Disabled
CH06        01                 000          200 ns      Fast          Disabled
CH07        01                 000          200 ns      Fast          Disabled
CH08        01                 000          200 ns      Fast          Disabled
CH09        01                 000          200 ns      Fast          Disabled
CH10        01                 000          200 ns      Fast          Disabled
CH11        01                 000          200 ns      Fast          Disabled
CH12        01                 000          200 ns      Fast          Disabled
CH13        01                 000          200 ns      Fast          Disabled
CH14        01                 000          200 ns      Fast          Disabled
CH15        01                 000          200 ns      Fast          Disabled


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

Fig. 6: Channels Menu /1



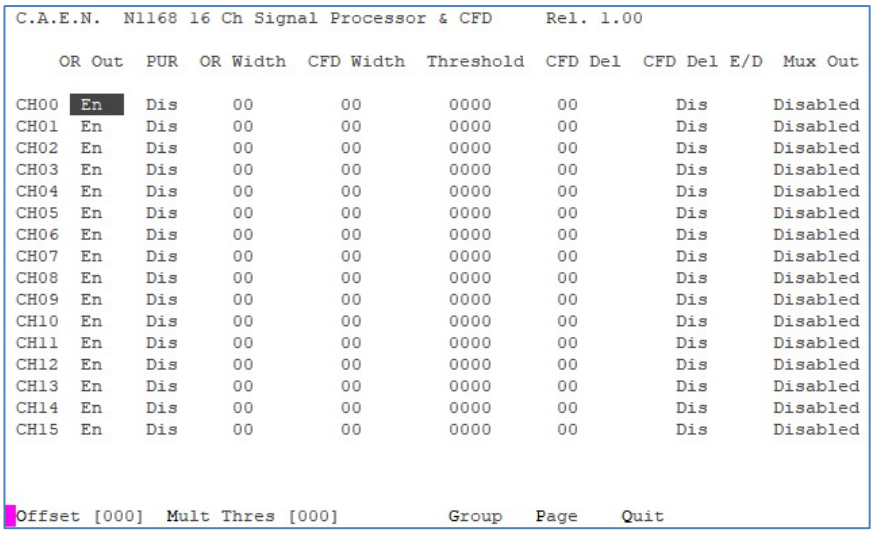
```
C.A.E.N.  N1168 16 Ch Signal Processor & CFD     Rel. 1.00

    Fast/Aux Coarse Gain  Fast/Aux Fine Gain  Shape Time  Fast/Aux    Mux Out

CH00        01                 000          200 ns      Fast        Disabled
CH01        01                 000          200 ns      Fast        Disabled
CH02        01                 000          200 ns      Fast        Disabled
CH03        01                 000          200 ns      Fast        Disabled
CH04        01                 000          200 ns      Fast        Disabled
CH05        01                 000          200 ns      Fast        Disabled
CH06        01                 000          200 ns      Fast        Disabled
CH07        01                 000          200 ns      Fast        Disabled
CH08        01                 000          200 ns      Fast        Disabled
CH09        01                 000          200 ns      Fast        Disabled
CH10        01                 000          200 ns      Fast        Disabled
CH11        01                 000          200 ns      Fast        Disabled
CH12        01                 000          200 ns      Fast        Disabled
CH13        01                 000          200 ns      Fast        Disabled
CH14        01                 000          200 ns      Fast        Disabled
CH15        01                 000          200 ns      Fast        Disabled


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

Fig. 7: Channels Menu /2



```
C.A.E.N.  N1168 16 Ch Signal Processor & CFD     Rel. 1.00

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

CH00  En    Dis     00         00         0000       00          Dis     Disabled
CH01  En    Dis     00         00         0000       00          Dis     Disabled
CH02  En    Dis     00         00         0000       00          Dis     Disabled
CH03  En    Dis     00         00         0000       00          Dis     Disabled
CH04  En    Dis     00         00         0000       00          Dis     Disabled
CH05  En    Dis     00         00         0000       00          Dis     Disabled
CH06  En    Dis     00         00         0000       00          Dis     Disabled
CH07  En    Dis     00         00         0000       00          Dis     Disabled
CH08  En    Dis     00         00         0000       00          Dis     Disabled
CH09  En    Dis     00         00         0000       00          Dis     Disabled
CH10  En    Dis     00         00         0000       00          Dis     Disabled
CH11  En    Dis     00         00         0000       00          Dis     Disabled
CH12  En    Dis     00         00         0000       00          Dis     Disabled
CH13  En    Dis     00         00         0000       00          Dis     Disabled
CH14  En    Dis     00         00         0000       00          Dis     Disabled
CH15  En    Dis     00         00         0000       00          Dis     Disabled


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

Fig. 8: Channels Menu /3

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

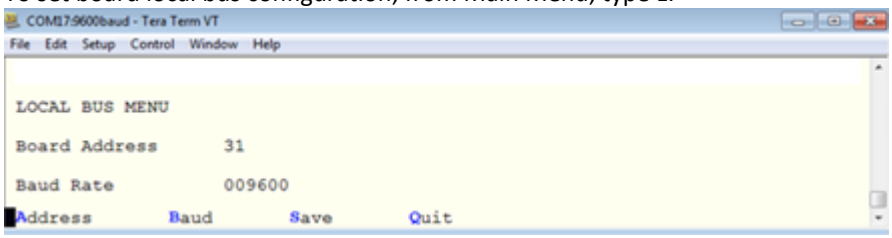


Fig. 9: Address Menu

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:

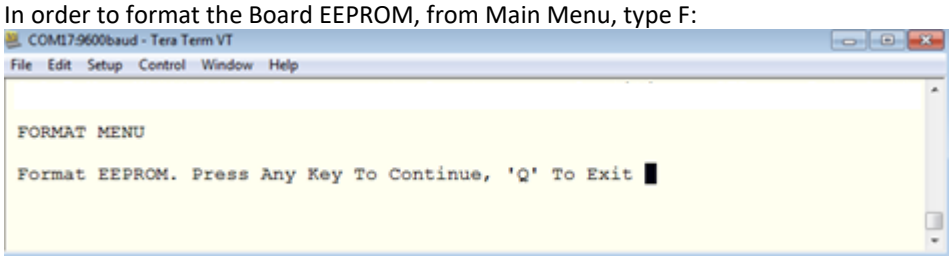


Fig. 10: Format Menu

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:

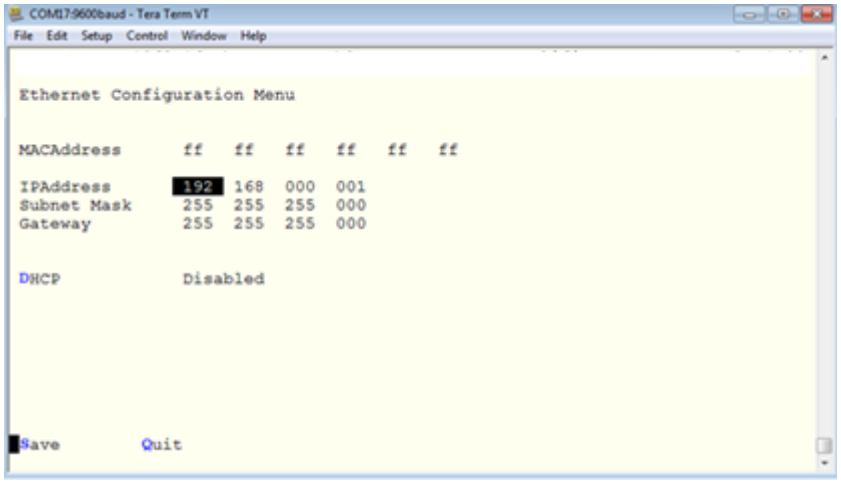


Fig. 11: Terminal Ethernet settings

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>.

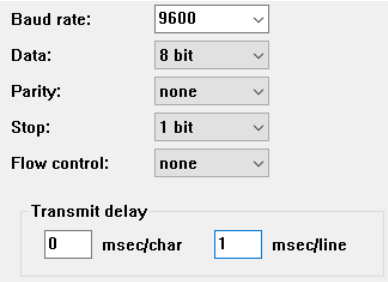
Type S to save the new setting in the EEPROM and go back to Main Menu.

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.

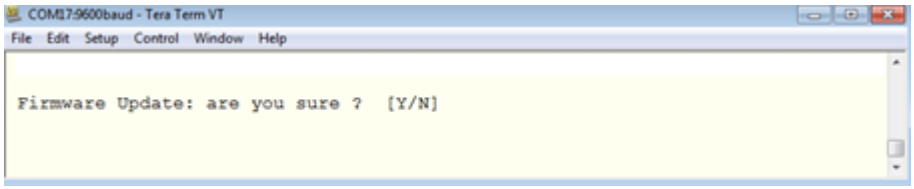
Firmware upgrade

To upgrade the firmware:

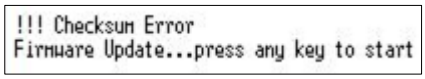
- download from www.caen.it N1168 page the most recent firmware revision for your module
- connect to the module via USB using Tera Term VT Emulator
- in the Tera Term options, select “set up” > “serial port” and in the Transmit Delay menu set 1 msec/line delay as shown below



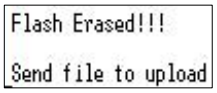
- click OK to confirm
- go to Terminal Board Menu
- type U in order to upgrade the firmware:



- 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

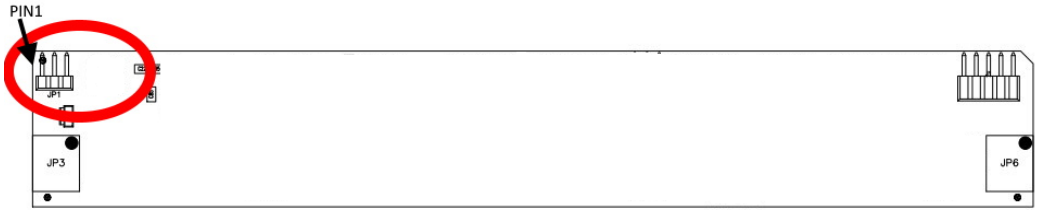
At Power-ON, the module contains the last performed settings before Power-Off, except for MUX, which is always disabled. The status of these settings can be read out via Software.
The settings on each channel of the module can be performed in any order. Due to the logical dependence of certain settings 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 (common to Slow and Fast/Aux Out);
- set the Slow out coarse gain;
- set the Slow out fine gain;
- set the Fast/Aux Out coarse gain;
- set the Fast/Aux Out fine gain;
- set the Fast/Aux Out selection (Fast or Aux)
- set the offset;
- enable multiplexed output (options Slow, Fast/Aux) or disable
- set the CFD threshold;
- set the CFD zero crossing delay;
- set or 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.

Input polarity setting

To select negative input polarity, short circuit pin 1 and 2 of JP1 on channel circuit; to select positive input polarity, short circuit pin 2 and 3 of JP1. Default setting is negative. The channel boards are indexed from 0 to 15, starting from the rear panel.



Shape adjusting

The shaping time can be selected in the following steps: SLOW: 0.2 µs, 0.4 µs, 0.8 µs; FAST: 0.2 µs, 0.4 µs

Gain adjusting

The Coarse Gain can be set in 4 steps (1x, 4x, 16x and 64x nominal).
The Fine Gain can be set in 192 steps in the range 0÷191 (nonlinear relationship for intermediate values); this leads to a total gain value (indicative):

Coarse gain		**1**		**4**		**16**		**64**	
Input polarity		**-**	**+**	**-**	**+**	**-**	**+**	**-**	**+**
Fine gain	**0**	2.3	1.15	7	3.5	24.5	12.25	78	39
	191	9.2	4.6	28	14	98	49	312	156

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 -400 mV to +400 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 either the Slow or the FAST/AUX signal (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.

CFD Section

N.B.: it is important that the CFD Section is correctly configured to allow the N1168 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 CFD delay must be set as close as possible to the input pulse rise time. The constant fraction value is 40%.

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 (1.5, 3, 4.5, 6, 7.5 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 1.5ns delay, pos. no.2 to 3ns and so on; refer to figure below for the component's location.

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

CFD Delay must be set as close as possible to the input rise time, otherwise the N1168 will not properly produce output signals.

Fig. 12: 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 N1168 will not properly produce output signals.

CFD output width

This setting can be done on 5 bit in the range 50÷1150 ns ±5% if CFD output delay is enabled (set from 1 to 31; 0 is not valid value)

CFD output delay

This setting can be done on 5 bit in the range 20÷1100 ns ±5%; N.B: CFD delay must be enabled via software as well.

OR width

This setting can be done on 5 bit in the range 145÷1250 ns ±5%.

Daisy chain network

It is also possible to build a daisy chain of up to 32 N1168'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):

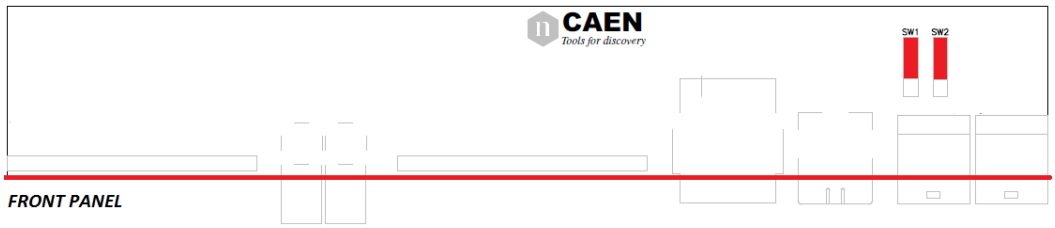


Fig. 13: Termination switches

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:SHAPE,VAL:x<Cr> Set Shaping Time

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

$BD:**,CMD:MON,CH:X,PAR:FAUXFGAIN,VAL:xxx<Cr> Set Fast/Aux Fine Gain

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

$BD:**CMD:SET,CH:X,PAR:FAUXCGAIN,VAL:x<Cr> Set Fast/Aux Coarse Gain

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

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

$BD:**,CMD:SET,CH:X,PAR:OUTSEL,VAL:x<Cr> Set Channel Fast/Aux 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:

SHAPE 0, 1, 2

0, 1, 2 → 200µs, 400µs, 800µs

FGAIN 0..191

CGAIN 0, 1, 2, 3 → 1x, 4x, 16x, 64x

PUR 0 → PUR Disable, 1 → PUR Enable

MUX 0, 1, 2

0 → Multiplexer is DISABLED

1 → SLOW Multiplexer is ENABLED

0 → FAST/AUX Multiplexer is ENABLED

OUTSEL 0, 1

0 → FAST Multiplexer is ENABLED

1 → AUX MultIplexer is ENABLED

THR 0..4000

1 bit → 1mV

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

CFDDEL 0..31 (20ns → 1100ns)

CFDWDT 0..31(50ns → 1150ns) N.B.: allowed values are 1..31; setting is valid only if CFDED=1

ORWDT 0..31(70ns → 1150ns)

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

Set Commands for 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 → -400mV..+400mV

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:SHAPE<Cr> Read 'Shaping Time'

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

$BD:**,CMD:MON,CH:X,PAR:FAUXFGAIN<Cr> Read Fast/Aux Fine Gain

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

$BD:**CMD:MON,CH:X,PAR:FASTAUXCGAIN<Cr> Read Fast/Aux Coarse Gain

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

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

$BD:**,CMD:MON,CH:X,PAR:OUTSEL<Cr> Read Fast/Aux 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

Monitor Commands related to the module

$BD:**,CMD:MON,PAR:BDNAME<Cr> Read module Name(N1168)

$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)

$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 (N1168)

$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)

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

CAEN SpA is acknowledged as the only company in the world providing a complete range of High/Low Voltage Power Supply systems and Front-End/Data Acquisition modules which meet IEEE Standards for Nuclear and Particle Physics. Extensive Research and Development capabilities have allowed CAEN SpA to play an important, long term role in this field. Our activities have always been at the forefront of technology, thanks to years of intensive collaborations with the most important Research Centres of the world. Our products appeal to a wide range of customers including engineers, scientists and technical professionals who all trust them to help achieve their goals faster and more effectively.

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