

Technical  
Information  
Manual

**MOD. N 408**

*24 CHANNEL MAJORITY  
LOGIC UNIT*

**CAEN**  
24 CHANNEL  
MAJORITY LOGIC  
UNIT  
Mod. N408

I  
N  
P  
U  
T  
S

AUX  
IN

THR

WDT

NIM  
OUT

OUT

LINEAR  
OUT

Ser. n.

CAEN will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

**CAEN declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly the CAEN User's Manual before any kind of operation.**



*CAEN reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.*

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# 1. DESCRIPTION

## 1.1 FUNCTIONAL DESCRIPTION

The CAEN Model N 408 24-CHANNEL MAJORITY LOGIC UNIT is a single width NIM module that provides the functions of majority logic and analog adder.

The twenty-four inputs marked "INPUTS" on the module's front panel are DC coupled and each of them accepts standard NIM logic signals.

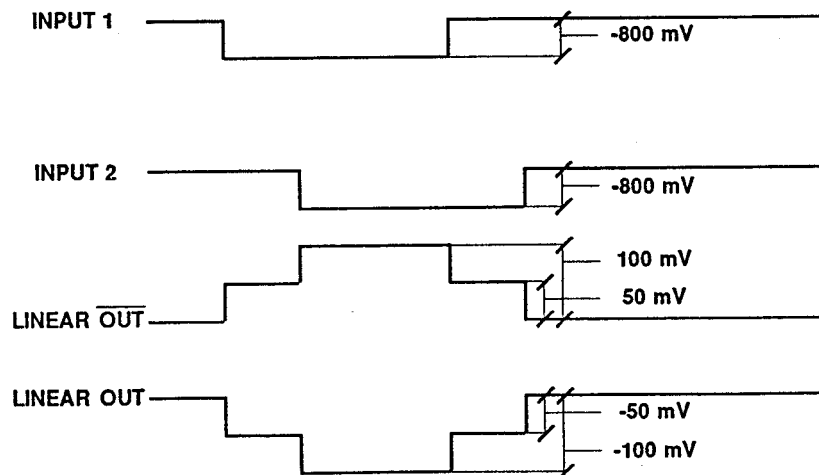
The majority level can be set by acting on the "THR" trimmer and by measuring the corresponding set voltage at the correlated test point: the set threshold voltage value determines the required majority level according to the following formula

$$V_{thr} = \{25 + [50 \times (n - 1)]\} \text{ mV}$$

where:  $V_{thr}$  = threshold voltage;  $n$  = majority level,  $1 \leq n \leq 24$ .

Two logic outputs (OUT and  $\overline{\text{OUT}}$  connectors, labelled "NIM" on the module's front panel), whose width is settable by the "WDT" front panel trimmer, are triggered when the set majority level is reached. The above mentioned outputs can be retriggerable or non retriggerable, according to the position of an internal jumper.

Two linear outputs (OUT and  $\overline{\text{OUT}}$  connectors, labelled "LINEAR" on the module's front panel) generate 50 mV (absolute value) for each true input: in this way, a signal with an amplitude proportional to the analog sum of the inputs is present at each linear output (see figure below).



The "AUX IN" input can accept positive or negative linear signals (-50 mV to -1200 mV or +50 mV to +1200 mV). The algebraic sum (see Figure 1) of the voltage level present at this input and the voltage level generated by the internal VOLTAGE GENERATOR (50 mV per true input) is sent to the MAJORITY COMPARATOR which causes the NIM outputs to be generated. This allows the user to increase or decrease the amount of true inputs by supplying the "AUX IN" input with 50 mV per true input to be added or with -50 mV per true input to be subtracted. For example, if a majority level = 8 has been set and the "AUX IN" input is supplied with a -150 mV signal, then the NIM outputs become true only in case of an occurrence of at least eleven true inputs.

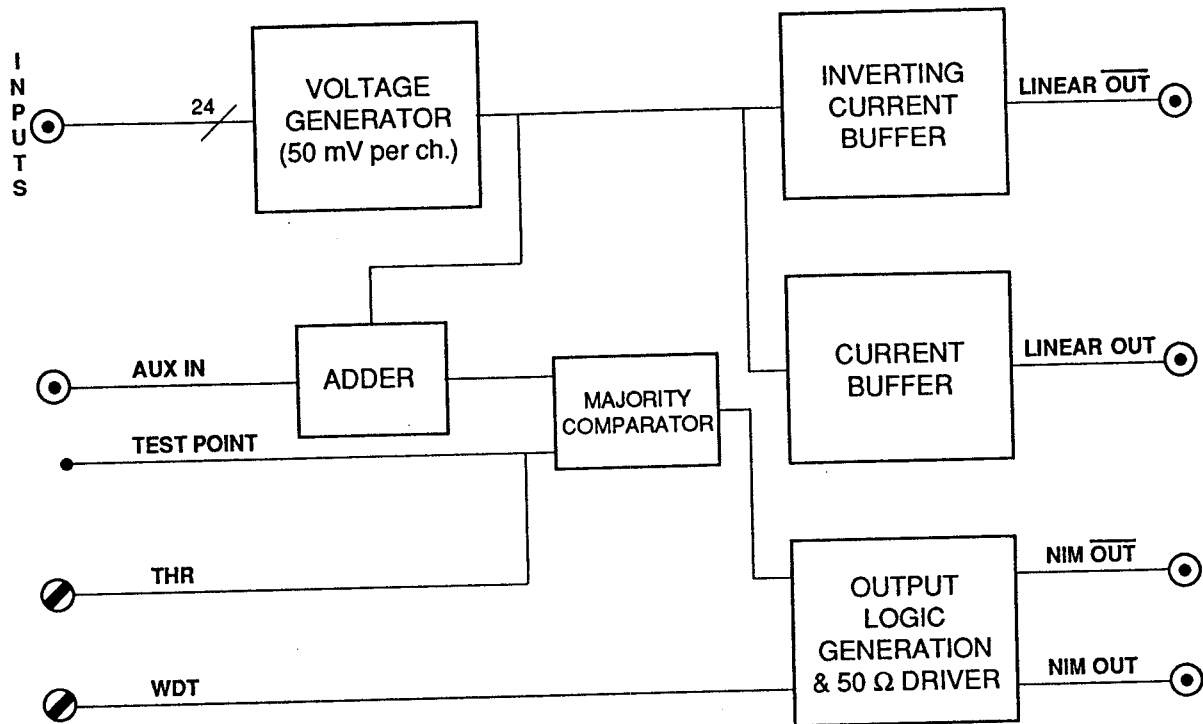


Figure 1 - Functional Block Diagram of the N 408 Module

## **2. SPECIFICATIONS**

### **2.1 PACKAGING**

1-unit wide NIM module.

### **2.2 EXTERNAL COMPONENTS**

#### **CONNECTORS:**

- No. 24 LEMO 00 type "INPUTS". Input signal connectors.
- No. 1 LEMO 00 type "AUX IN". Auxiliary input connector.
- No. 1 LEMO 00 type "NIM OUT". Normal logic output signal connector.
- No. 1 LEMO 00 type "NIM OUT". Complementary logic output signal connector.
- No. 1 LEMO 00 type "LINEAR OUT". Normal linear output signal connector.
- No. 1 LEMO 00 type "LINEAR  $\overline{\text{OUT}}$ ". Complementary linear output signal connector.

#### **TRIMMERS:**

- No. 1 screwdriver trimmer "WDT". Width adjustment of normal and complementary logic outputs.
- No. 1 screwdriver trimmer "THR" with test point. This trimmer allows the user to set the voltage value corresponding to the majority level to be set.

### **2.3 INTERNAL COMPONENTS**

- No. 1 two-position jumper. By setting this jumper to "NR" position, the logic outputs are non retriggerable. By setting this jumper to "R" position, the logic outputs are retriggerable.

### **2.4 CHARACTERISTICS OF THE SIGNALS**

#### **INPUTS:**

##### Inputs ("INPUTS" connectors):

- DC-coupled. 50  $\Omega$  impedance.
- Logical 1 = -800 mV  $\pm$ 50 mV. Logical 0 = 0 mV  $\pm$ 50 mV.

- Minimum width: 10 ns FWHM.
- Maximum frequency: 50 MHz.
- Reflection coefficient:  $\leq 20\%$  for inputs of 2 ns risetime.

#### AUXILIARY input ("AUX IN" connector):

- DC-coupled, 50  $\Omega$  impedance.
- Linear analog signal within  $\pm 1.2$  V.
- Minimum width: 15 ns FWHM.
- Maximum frequency: 50 MHz.
- Reflection coefficient:  $\leq 20\%$  for inputs of 2 ns risetime.
- Internal delay between the Leading Edge of any input signal and the Leading Edge of the Auxiliary Input Signals: 20 ns FWHM.

#### OUTPUTS:

##### Normal and complementary logic outputs ("NIM OUT/NIM OUT" connectors):

- Retriggerable or non retriggerable mode selectable via internal jumper.
- Normal output: Logical 1 = -16 mA  $\pm$  1 mA, into 50  $\Omega$ . Logical 0 = 0 mA  $\pm$  1 mA, into 50 $\Omega$ .
- Complementary output: Logical 0 = -16 mA  $\pm$  1 mA, into 50  $\Omega$ . Logical 1 = 0 mA  $\pm$  1 mA, into 50 $\Omega$ .
- Width: adjustable in the range from 4 ns to 350 ns FWHM via front panel trimmer.
- Width jitter: better than  $\pm 1\%$ .
- Falltime: better than 1.5 ns.
- Risetime: better than 1.5 ns.
- Input-Output delay (between the leading edge of the occurred majority and the leading edge of the corresponding output signal): 35 ns.
- Overshoot: better than 15%.

##### Normal and complementary linear outputs ("LINEAR OUT/LINEAR OUT" connectors):

- DC-coupled, 50  $\Omega$  impedance.
- Signal amplitude: 50 mV (absolute value) for each true majority input.
- Risetime: better than 2.5 ns with linear output at 50mV.
- Falltime: better than 2.5 ns with linear output at 50mV.



- Overshoot: better than 25%.

**GENERAL:**

- Double pulse resolution: 15 ns when measured between two Leading Edges of the input signal.
- Minimum majority overlap: 8.5 ns.

**2.5 POWER REQUIREMENTS**

+12 V	150 mA
-12 V	120 mA
+6 V	400 mA
-6 V	200 mA

### 3. OPERATING MODES

#### 3.1 GENERAL INFORMATION

The Model N 408 24-CHANNEL MAJORITY LOGIC UNIT is provided with twenty-four input channels that can be used with any majority level up to 24. The required majority level must be set through the "THR" front panel trimmer and the correlated test point by performing the following operations:

1. Insert the N 408 to be used into a NIM crate.
2. Turn the crate ON.
3. Connect a voltmeter to the front panel test point (located above the "THR" trimmer) and to ground.
4. With a screwdriver, turn the "THR" trimmer until the voltmeter shows the voltage value corresponding to the majority level to be set, according to the table below.

VOLTAGE (mV)	MAJORITY LEVEL
25	1
75	2
125	3
175	4
.	.
.	.
1175	24

A normal and a complementary logic output ("NIM OUT" and "NIM  $\overline{\text{OUT}}$ " connectors) generate a signal, with a width adjustable via front panel trimmer ("WDT") in the range from 4 ns to 400 ns, whenever the time overlap of the connected input signals satisfies the set majority level. These outputs can be retriggerable or non retriggerable, according to the position of an internal jumper:

- if the internal jumper is set to "R" position, the Retriggerable mode is selected;
- if the internal jumper is set to "NR" position, the Non Retriggerable mode is selected.

A normal and a complementary linear output ("LINEAR OUT" and "LINEAR  $\overline{\text{OUT}}$ " connectors) generate a 50 mV (absolute value) signal during the time in which an input signal is TRUE. In this way, normal and complementary signals with an amplitude proportional to the sum of the input signals are available.

An auxiliary input ("AUX IN" connector) can accept a positive or negative linear signal with an amplitude within  $\pm 1200$  mV. By connecting this input to the "LINEAR  $\overline{\text{OUT}}$ " output of another N 408, it is possible to achieve a 24-fold majority, any 24 of 48.

Several N 408 can be connected to obtain a particular majority requirement: an example of 96-fold majority is shown in Figure 2.

### 3.2 OPERATIONS TO BE PERFORMED

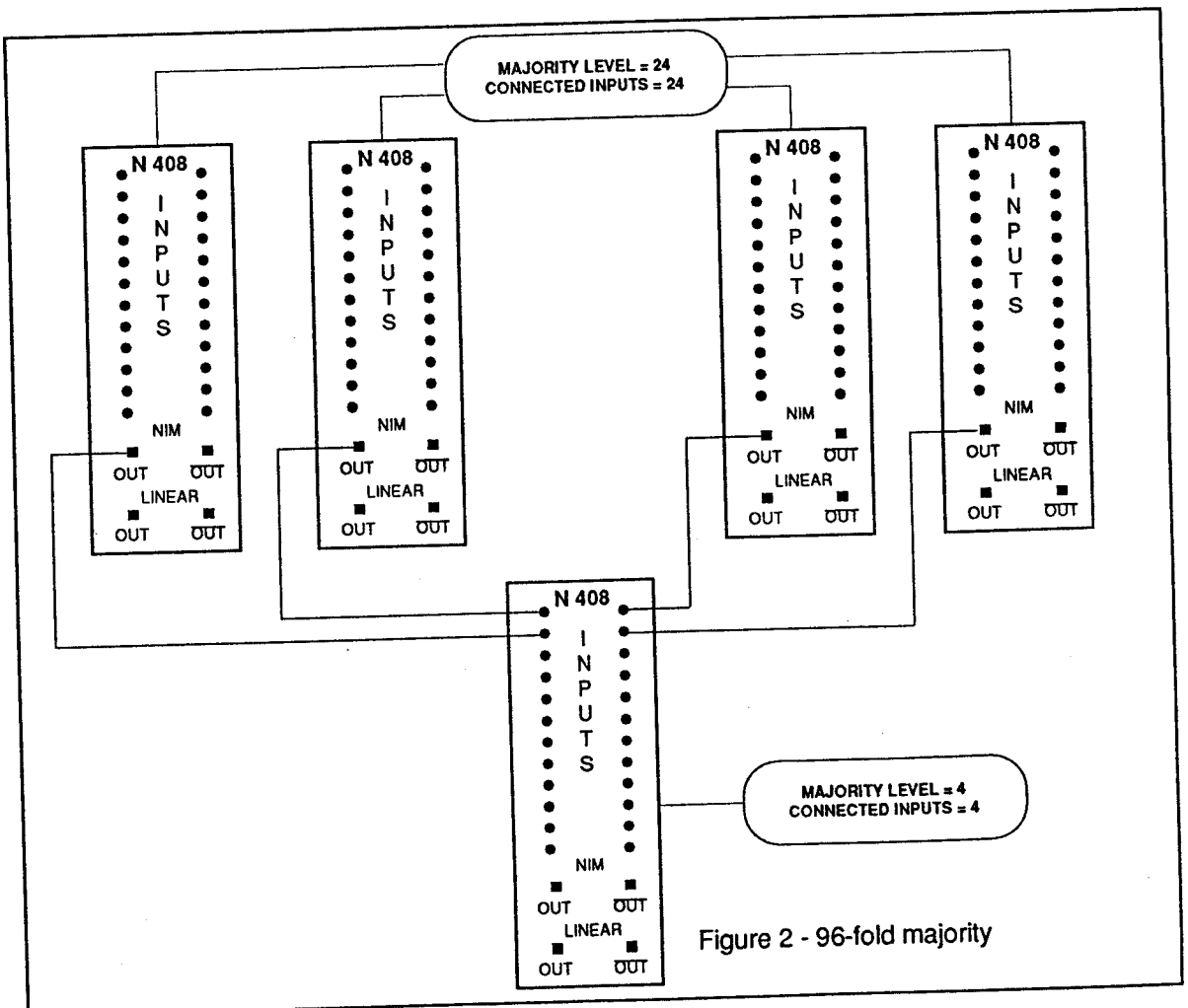
**CAUTION:** turn the NIM crate OFF before inserting or removing the module.

1. Set the two-position internal jumper of the N 408 as required ("NR" position = NON RETRIGGERABLE logic outputs; "R" position = RETRIGGERABLE logic outputs).
2. Insert the N 405 into the NIM crate.
3. Turn the crate ON.
4. By performing the operations listed in the preceding paragraph 3.1 GENERAL INFORMATION, set the required majority level.
5. Connect the output connectors of the module to the detection devices to be used.

*The unused output connectors must be terminated in 50Ω.*

6. Connect the signal sources to the "INPUTS" connectors of the module.

*The width of the two logic outputs ("NIM OUT" and "NIM OUT" connectors) can be adjusted in the range from 4 ns to 400 ns by acting on the "WDT" front panel trimmer.*



## 4. TEST PROCEDURE

### 4.1 INTRODUCTION

The operations to be performed to test the N 408 module are listed in the procedure below and have to be carried out according to their numerical sequence. None of the procedural step can be omitted. Each procedural step contains the operation to be performed and the corresponding effect or the verification to be accomplished.

### 4.2 SUGGESTED INSTRUMENTS

- No. 1 Oscilloscope (100 MHz minimum bandwidth).
- No. 1 CAEN model N 105 Dual Fan-Out 1x16.
- No. 1 Voltmeter.
- No. 1 Signal Generator capable of producing Std. NIM level signals and signals as described in steps 11 and 12.
- 1 NIM crate.

### 4.3 PROCEDURE

*The N 408 module comes from CAEN fully tested and calibrated. This procedure allows the user to accomplish a functional test of the module.*

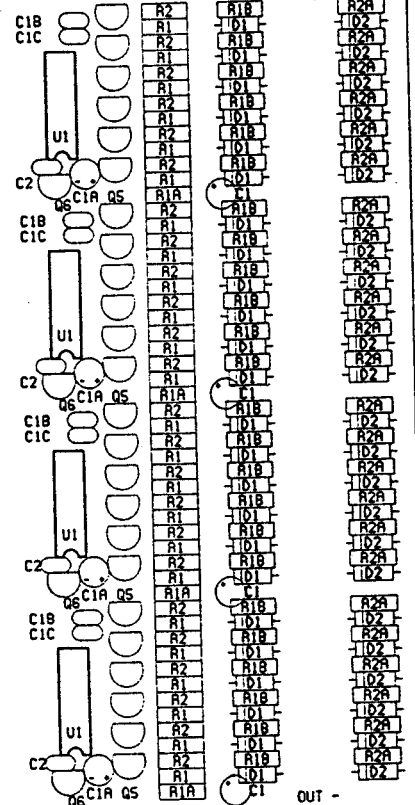
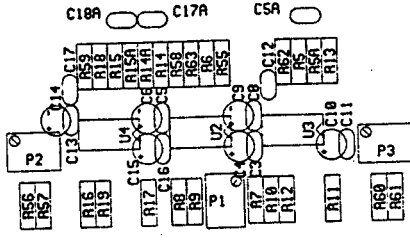
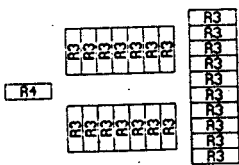
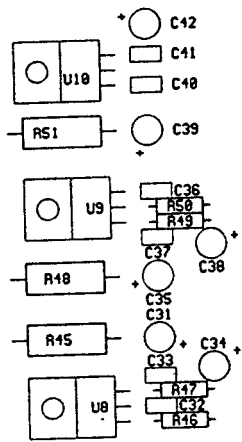
**CAUTION:** Turn OFF the crate before inserting or removing the module.

1. On the N 408 printed circuit board, verify that the jumper is set either to "NR" or to "N" position.
2. Insert the N 408 and N 105 modules into the crate.
3. Turn the crate ON.
4. Connect the voltmeter to both the front panel test point (located above the "THR" trimmer) and ground.
5. With a screwdriver, turn the "THR" front panel trimmer of the N 408 module until a -1175 mV voltage value is shown on the voltmeter: a majority level of 24 is set.
6. Connect each of the N 408 inputs to one of the N 105 outputs.
7. Via Signal Generator, supply both the N 105 inputs with a Std. NIM level signal then, on the N 408, verify that:

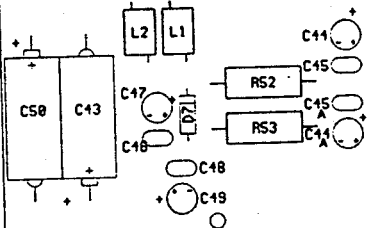
- (a) a signal with an amplitude of about -800 mV on 50  $\Omega$  is present at the "NIM OUT" connector;
  - (b) a complementary signal is present at the "NIM  $\overline{\text{OUT}}$ " connector;
  - (c) a signal with an amplitude of about 1200 mV is present at the "LINEAR OUT" connector;
  - (d) a signal with an amplitude of about -1200 mV is present at the "LINEAR  $\overline{\text{OUT}}$ " connector.
8. With a screwdriver, turn the "WDT" front panel trimmer of the N 408 module and verify that the width of both the logic outputs ("NIM OUT" and "NIM  $\overline{\text{OUT}}$ " connectors) can vary in the range from 4 ns to 400 ns.
9. Remove one of the input connectors from the N 408 then verify that:
- (a) no signal is present at the "NIM OUT" connector;
  - (b) no signal is present at the "NIM  $\overline{\text{OUT}}$ " connector;
  - (c) a signal with an amplitude of about 1150 mV is present at the "LINEAR OUT" connector;
  - (d) a signal with an amplitude of about -1150 mV is present at the "LINEAR  $\overline{\text{OUT}}$ " connector.
10. Remove the input connectors from the N 105.
11. Supply the "AUX IN" input of the N 408 with a +1200 mV signal, then repeat the verifications listed in step 7., (a), (b).
12. Supply the "AUX IN" input of the N 408 with a +1150 mV signal, then repeat the verifications listed in step 9., (a), (b).

THE MODULE IS TESTED AND OPERATES CORRECTLY

# CAEN MOD. N408



+12V -12V  
GND  
+6V -6V



IN SUM

OUT -  
OUT +

TP  
WTH  
THR  
Q NIM