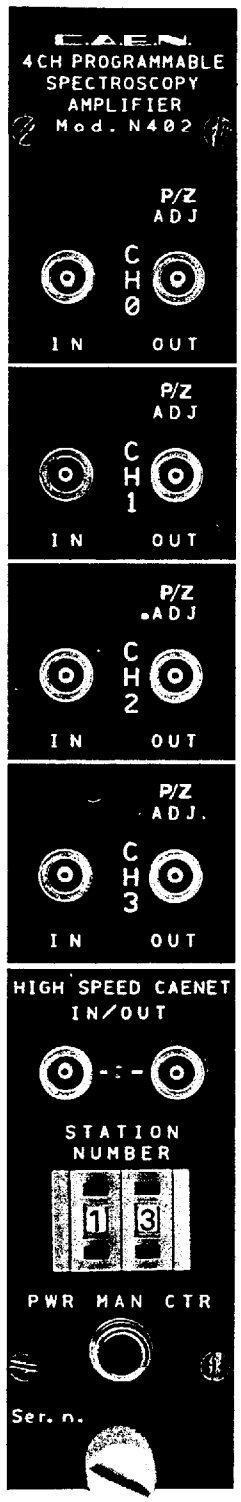
Technical Information Manual

MOD. N 402

4 CH PROGRAMMABLE SPECTROSCOPY AMPLIFIER

9th July 1992


CAEN
4CH PROGRAMMABLE
SPECTROSCOPY
AMPLIFIER
Mod. N402
P/Z
ADJ
CH 0
IN
OUT
P/Z
ADJ
CH 1
IN
OUT
P/Z
ADJ
CH 2
IN
OUT
P/Z
ADJ.
CH 3
IN
OUT
HIGH SPEED CAENET
IN/OUT
STATION
NUMBER
1
3
PWR MAN CTR
Ser. n.

WARNING

It has been discovered that when a module, which has a crate number equal to 0, is present in a CAENET network controlled by the Mod. C 117B, Mod. V 288 or Mod. A 303, H.S. CAENET Controllers, the communications may not work correctly.

This could happen in particular cases so **it is advisable not to use the crate number 0** in the network.

1. DESCRIPTION

The Model N 402 "4 CHANNEL PROGRAMMABLE SPECTROSCOPY AMPLIFIER" houses in a single width NIM unit four identical amplification sections programmable through the HIGH SPEED CAENET serial line.

Each section can accept a single-ended input signal of up to ± 8 V. The unit has been designed to accept input pulses generated from nuclear particle detectors connected with preamplifiers having an output signal pulse characterised by a fast rise time and a slow fall time.

On each unit the user can program, via the High Speed Caenet line, the symbolic names of the unit and of each one of the channels and the value of the amplification for each channel independently . The wide fine gain and coarse gain ranges allow a continuously adjustable selection from 0.6 to 200 .

Locally the unit can be preset to select, via internal dip-switches, the input pulse polarity, the shaping time of each channel and the pole-zero cancellation through the relevant front panel multi-turn screw-driver trimmer.

The address number (STATION) is obtained by the thumb-wheel switches housed on the front panel (valid numbers from 0 to 99). Two LEMO 00 type connectors are foreseen by the HIGH SPEED CAENET network; when the front panel LED lights on indicates that the module has been addressed.
The programmed parameter values of the four sections are stored in a non-volatile memory and are re-loaded automatically at the power on of the module.

2. SPECIFICATIONS

2.1 EXTERNAL COMPONENTS

Input connectors: 1, "IN" LEMO 00-type for each section.

Output connectors: 1, "OUT" LEMO 00-type for each section.

Trimmers: 1, "PZ/ADJ" multi-turn potentiometer pole-zero cancellation for each section.

H.S. CAENET Connectors: 2, "SERIAL IN/OUT" LEMO 00-type, for the communication line.
1, "POWER MANUAL CTR." coaxial female plug (RCA type), to power the H.S. CAENET Manual Controller.

LEDs: 1, signalling that the module has been addressed by a H.S. CAENET Controller.

2.3 INTERNAL COMPONENTS (for each section)

JUMPERS: 2, three position jumper per section located on the printed circuit board to select the input pulse polarity (see fig. 1).
9, to select the output shaping time amongst the allowed values: 0.5 µs, 1.5 µs, 3 µs (see fig.1).

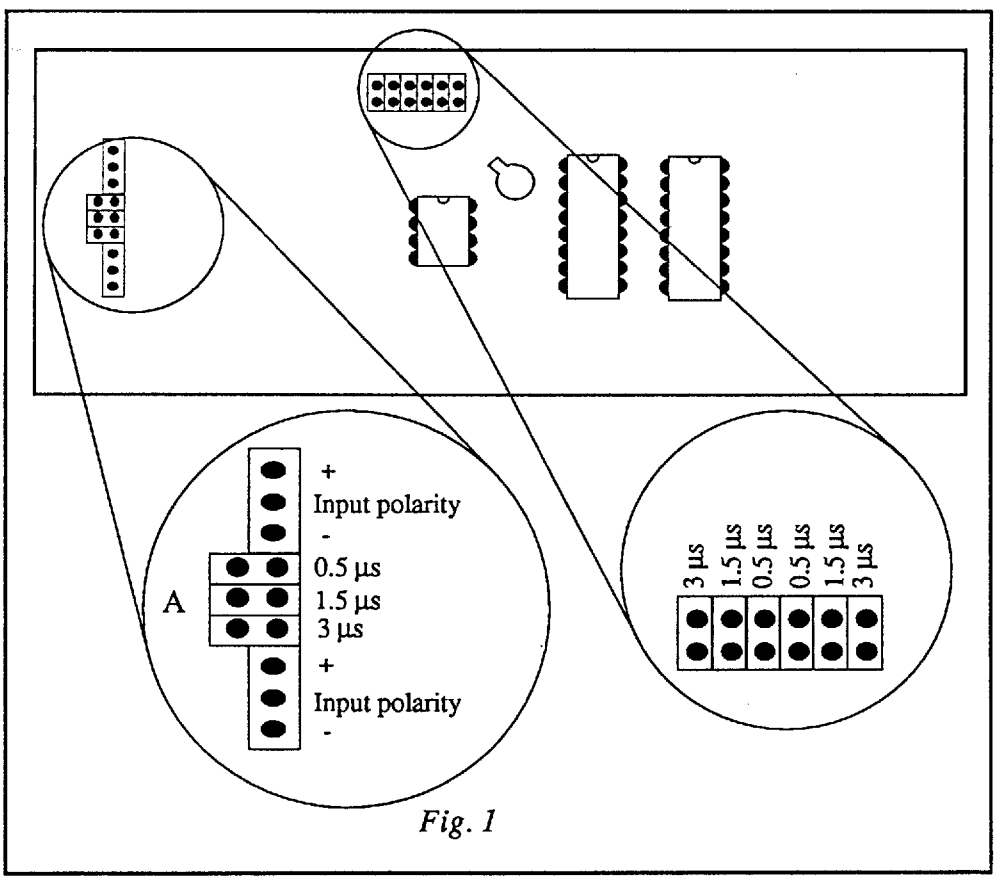


Fig. 1

2.3 CHARACTERISTICS OF THE SIGNAL

INPUTS:	maximum voltage value ± 8 V;
Minimum Rise Time	18 ns;
Polarity	positive or negative selectable via internal jumpers;
OUTPUTS:	maximum unipolar voltage value 8 V;
Gain	continuously adjustable from 0.6 to 200 (255 * 8 possible combinations of Coarse and Fine settings);
Integral non Linearity	≤ ± 0.45 % (≤ 0.1 % for 1.5 μs shaping time) in 90% of the full scale;
Shaping time	three position jumpers on board select time constant of 0.5 μs, 1.5 μs, 3 μs (other values available on request) see fig. 1;

2.4 POWER REQUIREMENTS

+24 V 150 mA
-24 V 300 mA
+6 V 900 m A (1.2 A with Manual Controller connected).

3. REMOTE OPERATING MODES

The Mod. N 402 is provided with a HIGH SPEED CAENET interface through which it can be controlled by the following H.S. CAENET CAEN modules:

Mod. A 250 - H.S. CAENET Manual Controller;
Mod. C 117 B - H.S. CAENET CAMAC Controller
Mod. V 288 - H.S. CAENET VME Controller
Mod. A 303 - H.S. CAENET PC Controller.

NOTE:	the address number (station number on the thumb-wheel switch) must be the only one in the line in which you wish to insert the module. Due to high transmission speed of the data in line it is necessary to terminate this line on a 50 Ω impedance at the end to avoid reflections.

From an A 250 the user can program for each channel the amplification of the channel itself.

From a remote controller, either a Mod. C 117B or a V 288 or an A 303, the user can programme a symbolic name for each unit and for each of the channels the amplification and a symbolic name of the channel itself.

3.1 USING THE H.S. CAENET MANUAL CONTROLLER (Mod. A 250)

Connect the Manual Controller to the Mod. N 402 using a 50 Ω coaxial cable to insert into one of the connectors present on the front panel of the module and called SERIAL IN/OUT,

connecting the other connector to the existing network or terminating it on a load of 50 Ω; the supply of the H.S. CAENET Manual Controller can be effected through the suitable connector still present on the front panel and called PWR MAN CTR.
Once supplied the Manual Controller will show:

```
CAEN  A 250  1.0
Select Cr              **
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the indication 1.0 refers to the software release installed in the controller itself.

Digitise the address number of the module previously set through the thumb-wheel switch on the front panel of the module itself, and confirm the module choice with the key "#".

The display will show:

ADDRESS FIELD	CHANNEL FIELD	PARAMETER FIELD	VALUE FIELD
MM	Ch0	Fine	AV1
N 402		Coarse	V

where MM is the selected module's address number, AV1 and V are the amplification values, Fine and Coarse respectively, programmed on channel 0.
By pressing repeatedly the key "#" you can move the flashing cursor onto the various display fields on which it is permitted to operate.

To modify the value of a programmed value on one of the channels:

- position the cursor by pressing the key "#" on the VALUE field that you wish to modify;
- press the "ENTER" key until the field shows some asterisks, three on the Fine amplification value field and one in the Coarse one, instead of the old values;
- digitise the desired value;
- confirm the data by pressing the key "#".

To modify the number of the module with which you wish to communicate:

- position the cursor on the ADDRESS field pressing the key "#";
- press the "ENTER" key; the ADDRESS field modifies itself showing 2 asterisks.
- digitise the number of the new module with which you wish to communicate;
- confirm this choice by pressing the key "#".

To modify the number of the channel with which you wish to communicate:

- position the cursor on the CHANNEL field pressing the key "#";
- press the "ROLL" key to select the desired channel number;
- confirm this choice by pressing the key "#".

3.2 USING THE H.S. CAENET CAMAC CONTROLLER (Mod. C 117 B)

The Mod. N 402 can be controlled via CAMAC through the Mod. C 117 B H.S. CAENET CAMAC Controller.

The standard CAMAC functions listed in table 1 allow the user to perform the required control and setting operations according to the typical MASTER/SLAVE communication protocol, where the CAMAC controller assumes the MASTER function.

TABLE 1 Mod. C 117 B CAMAC FUNCTIONS	
F(0) N	Reads the data stored in the Mod. C 117 B DATA buffer. Q response until the buffer contains data.
F(8) N	Tests the LAM line. Q response if LAM is true.
F(9) N	Resets the Mod. C 117 B (clears buffer and LAM; disables the LAM line).
F(16) N	Stores the data into the Mod. C 117 B DATA buffer. Q response until the buffer is full (256 16-bit words).
F(17) N	Transfers data to the serial line.
F(24) N	Disables the LAM line.
F(26) N	Enables the LAM line.
C, Z	Same as F(9) N.

Via CAMAC functions, the C 117 B module (MASTER) transmits or receives data packs composed of subsequent 16-bit words to/from the addressed Mod. N 402 (SLAVE). Up to 256 words can be stored into the Mod. C 117 B DATA buffer.

The MASTER-to-SLAVE data have to be written into the DATA buffer by performing subsequent F(16) N functions as follows:

TABLE 2 MASTER -to-SLAVE DATA COMPOSITION			
ORDER	CAMAC FUNCTION	W16 TO W1	MEANING
1	F(16) N	0000000000000001	HOST COMPUTER CONTROLLER IDENTIFIER CODE
2	F(16) N	xxxxxxxxxxxxxxxx	ADDRESS NUMBER OF THE MODULE TO BE ADDRESSED
3	F(16) N	xxxxxxxxxxxxxxxx	CODE OF THE OPERATION TO BE PERFORMED (see TABLE 3).
4	F(16) N	xxxxxxxxxxxxxxxx	EVENTUAL SET VALUE

The answer data coming from the Mod. N 402 or Mod. C 117 B itself are automatically stored into the Mod. C 117 B DATA buffer and are read-out in Q STOP mode through the functions F(0) N.

TABLE 3 BINARY CODE OF THE OPERATION TO BE PERFORMED TO CONTROL THE MOD. N 402			
OPERATION CODE	HIGH BYTE	LOW BYTE	RESULT
0	00000000	00000000	READS THE IDENTIFICATION MODULE'S NAME
1	00000000	00000001	READS ALL OPERATIONAL PARAMETERS
2	00000000	00000010	READS THE SYMBOLIC NAME ASSIGNED TO THE MODULE BY THE USER
3	00000000	00000011	READS THE SYMBOLIC NAME OF THE CHANNEL 0
4	00000000	00000100	READS THE SYMBOLIC NAME OF THE CHANNEL 1
5	00000000	00000101	READS THE SYMBOLIC NAME OF THE CHANNEL 2
6	00000000	00000110	READS THE SYMBOLIC NAME OF THE CHANNEL 3
7	00000000	00000111	SET THE CHANNEL 0 AMPLIFICATION
8	00000000	00001000	SET THE CHANNEL 1 AMPLIFICATION
9	00000000	00001001	SET THE CHANNEL 2 AMPLIFICATION
10	00000000	00001010	SET THE CHANNEL 3 AMPLIFICATION
11	00000000	00001011	WRITE THE MODULE'S SYMBOLIC NAME
12	00000000	00001100	WRITES THE SYMBOLIC NAME OF THE CHANNEL 0
13	00000000	00001101	WRITES THE SYMBOLIC NAME OF THE CHANNEL 1
14	00000000	00001110	WRITES THE SYMBOLIC NAME OF THE CHANNEL 2
15	00000000	00001111	WRITES THE SYMBOLIC NAME OF THE CHANNEL 3

After the required F(16)N functions have been performed, it is necessary to carry out an F(17) N function in order to transfer the stored data to the addressed module.

IMPORTANT NOTE: For each operation to be performed (see TABLE 3) on the Mod. N 402 it is necessary, each time, to carry out the functions indicated in TABLE 2, in that order, and afterwards an F(17) N.

The first word of the answer data is shown in TABLE 4.

TABLE 4 WORD 1 CONTENT		
HIGH BYTE	LOW BYTE	MEANING
00000000	00000000	Successful operation
11111111	00000000	BUSY module (it has tried to effect an operation while the module is still busy registering previous data inside the EEPROM)
11111111	00000001	Code not recognised or message incorrect.
11111111	00000010	Incorrect set value.
11111111	11111101	No data to be transmitted.
11111111	11111110	The H.C. Controller identifier is incorrect.
11111111	11111111	The addressed module does not exist. This message is generated after a period of 500 ms.

In the case of a successful operation, the contents of the subsequent words are the functions of the command that has been sent.

3.2.1 PARAMETER SETTING and READING

SINGLE PARAMETER SETTING

Operation codes 7 to 10 : Word 4 must contain the value of the new amplification to be programmed according to the following table:

High Byte	Low Byte
COARSE Gain	FINE Gain

if the GAIN value is greater than 7FFH the programmed value is forced to 7FFH.

MULTIPLE PARAMETER SETTING

Operation codes 11 to 15	: Word 4 to Word 11	must contain on the low byte the ASCII code of the string of characters (8 characters max) identifying the symbolic name of the module or the symbolic name of the channel according to the table 3.

MULTIPLE PARAMETER READING

Operation code 0	: Word 2 to Word 5	contains on the low byte the ASCII code of the string of characters identified by the name of the module "N402".
Operation code 1	: Word 2 to Word 5	contains the programmed GAIN value for CH0..CH3 in that order according to the previous table.
Operation codes 2 to 6	: Word 2 to Word 9	contains on the low byte the ASCII code of the string of characters identifying the symbolic module name or the symbolic name of the channel according to the table 3.

3.2.2 OPERATIONS TO BE PERFORMED

1. Insert a Mod. C 117 B H.S. CAENET CAMAC Controller into a CAMAC slot.
2. Connect the C 117 B "SERIAL LINE" connector to the "SERIAL IN-OUT" input connector, located on the front panel of the Mod. N 402, using a 50 Ω coaxial cable .
3. Turn on CAMAC crate and Mod. N 402.
4. By performing the appropriate CAMAC functions, configure the Mod. N 402 as required.

3.3 USING THE H.S. CAENET VME CONTROLLER (Mod. V 288)

The Mod. N 402 can be controlled remotely via VME through the Mod. V 288 H.S. CAENET VME controller.

Standard VME cycles allow the user to perform the required control and setting operations on each Mod. N 402 in the network, according to the typical MASTER/SLAVE communication protocol, where the VME controller assumes the MASTER function.

The Mod. V 288 VME interface is provided with the following registers:

TABLE 5 Mod. V 288 REGISTERS			
NAME	TYPE	ADDRESS	FUNCTION
DATA BUFFER	READ/WRITE register	Base Address +00	DATA STORAGE
STATUS REGISTER	READ only register	Base Address +02	AFTER A H.S. CAENET OPERATION HAS BEEN PERFORMED, THIS REGISTER INDICATES WHETHER THE OPERATION IS VALID OR NOT (FFFE = VALID OPERATION; FFFF = NO VALID OPERATION)
TRANSMISSION REG.	WRITE only register	Base Address +04	BY WRITING INTO THIS REGISTER, THE DATA BUFFER CONTENT IS TRANSFERRED TO THE ADDRESSED SLAVE
RESET REGISTER	WRITE only register	Base Address +06	MODULE'S RESET
INTERRUPT VECTOR REGISTER	WRITE only register	Base Address +08	INTERUPT VECTOR PROGRAMMING

By WRITE/READ cycles, the Mod. V 288 (MASTER) transmits or receives data packs composed of subsequent 16-bit words to/from the addressed N 402 (SLAVE). Up to 256 words can be stored into the Mod. V 288 DATA buffer.

The MASTER-to-SLAVE data have to be written into the DATA buffer by performing subsequent WRITE cycles as follows:

TABLE 6 MASTER-to-SLAVE DATA COMPOSITION				
ORDER	OPERATION	ADDRESS	DATUM	MEANING
1	WRITE	Base address + 00	0000000000000001	HOST COMPUTER CONT-ROLLER IDENTIFIER CODE.
2	WRITE	Base address + 00	xxxxxxxxxxxxxxx	THE ADDRESS NUMBER OF THE MODULE TO BE ADDRESSED.
3	WRITE	Base address + 00	xxxxxxxxxxxxxxx	CODE OF THE OPERATION TO BE PERFORMED (see TABLE 3 par. 4.2)
4	WRITE	Base address + 00	xxxxxxxxxxxxxxx	EVENTUAL SET VALUE (see par. 4.2.1)

As soon as the data pack has been stored in the DATA buffer, it can be transferred to the addressed module by performing a WRITE operation on the TRANSMISSION register.

IMPORTANT NOTE: For each operation to be performed (see codes in TABLE 3 par. 3.2) on the Mod. N 402 it is necessary, each time, to carry out the WRITE cycles indicated in the TABLE 6 in the same order and afterwards a WRITE operation on the TRANSMISSION register.

The answer data coming from the Mod. N 402 or Mod. V 288 itself are automatically stored into the Mod. V 288 DATA buffer. As soon as the data pack is stored in this buffer, a VME interrupt (if enabled) is generated and then the data can be read.

The first word of the answer data is shown in TABLE 4 par. 3.2.

In the case of a successful operation, the contents of the subsequent words are the functions of the command that has been sent.

See par. 3.2.1 for Parameter Setting and Reading.

3.3.1. OPERATIONS TO BE PERFORMED

1. Insert a Mod. V 288 H.S. CAENET VME Controller into a VME slot. Make sure that the V 288 base address is set as required.

2. Connect the Mod. V 288 "SERIAL LINE" connector to the "SERIAL IN-OUT" input connector, located on the front panel of the Mod. N 402, with a 50 Ω coaxial cable.

3. Turn ON VME crate and Mod. N 402.

4. By performing the appropriate VME WRITE/READ cycles, configure each Mod. N 402 as required.

3.4 USING THE H.S. CAENET PC CONTROLLER (Mod. A 303)

The Mod. N 402 can be controlled via an IBM PC (XT, AT or 80386) or compatible through the Mod. A 303 H.S. CAENET PC controller.

This is an interface board directly insertable into a std. I/O PC slot and is mapped in the MS-DOS I/O or memory address space. Thereby it is controllable by all the languages (high level or assembly) through the proper instructions, independently from the computer type (XT, AT or 80386 family).

Dip-switches located on the printed circuit board allow the user to set the unit according to the computer to be used.

The controller is composed of a collection of registers, managing the commands acknowledged by the unit, and two memory buffers arranged in FIFO logic 512 bytes deep (see TABLE 7).

TABLE 7 Mod. A 303 REGISTERS			
REGISTER/BUFFER	**ADDRESS**	**OPERATION**	**DESCRIPTION**
TX DATA BUFFER	Base address + 0	WRITE	FIFO Logic (512 byte max. depth)
START TX	Base address + 1	WRITE	Starts the transmission of the TX BUFFER data.
RESET CAENET INTERFACE	Base address + 3	WRITE	Clears TX and RX buffers and reset all the interrupt signals
RX DATA BUFFER	Base address + 0	READ	FIFO logic (512 byte max. depth)
STATUS REGISTER	Base address + 1	READ	8-bit register (see the STATUS REGISTER CONFIGURATION table 10)
STATUS REGISTER	Base address + 2	READ	Reads the STATUS REGISTER and resets a present interrupt.
CLEAR RX DATA	Base address + 3	READ	Reads and clears the RX buffer.

The two buffers are the TRANSMITTER (TX) data buffer and the RECEIVER (RX) one.

WRITE and READ operations allow the user to perform the required controls and settings on each Mod. N 402 in the network, according to the typical MASTER/SLAVE communication protocol, where the PC controller assumes the MASTER function.

By WRITE/READ operations, the Mod. A 303 (MASTER) transmits or receives data packs composed of subsequent 16-bit words to/from the addressed N 402 module (SLAVE). Up to 256 words can be stored into the Mod. A 303 DATA buffers.

The MASTER-to-SLAVE data have to be written into the TX data buffer by performing subsequent WRITE operations as described in the table below:

TABLE 8 MASTER-to-SLAVE DATA COMPOSITION				
ORDER	**OPERATION**	**ADDRESS**	**DATUM**	**MEANING**
1	WRITE WRITE	Base address + 00 Base address + 00	Low Byte: 00000001 High Byte: 00000000	HOST COMPUTER CONTROL-LER IDENTIFIER CODE.
2	WRITE WRITE	Base address + 00 Base address + 00	Low Byte: XXXXXXXX High Byte: 00000000	THE ADDRESS NUMBER OF THE MODULE TO BE ADDRESSED.
3	WRITE WRITE	Base address + 00 Base address + 00	Low Byte Oper. Code High Byte 00000000	CODE OF THE OPERATION TO BE PERFORMED (see TABLE 3 par. 3.2)
4	WRITE WRITE	Base address + 00 Base address + 00	Low Byte: XXXXXXXX High Byte: XXXXXXXX	EVENTUAL SET VALUE (see par. 3.2.1)

As soon as the data pack has been stored in the TX DATA buffer, it can be transferred to the addressed module by performing a WRITE operation on the START TX register (base address + 1).

IMPORTANT NOTE:	For each operation to be performed (see codes in TABLE 3 par. 3.2) on the Mod. N 402 it is necessary carry out the WRITE operations indicated in the TABLE 8 in the same order and afterwards a WRITE operation on the STATUS TX register.

The answer data coming from the Mod. N 402 is automatically collected into the RX DATA buffer and therefore are available to the user. At the same time the controller unit gives an interrupt (if enabled) to the CPU in the computer.

The first word in the answer data pack is always the Host Computer Controller Identifier Code resent back to the master by the addressed unit.
The second word of the answer data is shown in TABLE 9.

TABLE 9 WORD 2 CONTENT

HIGH BYTE	LOW BYTE	MEANING
00000000	00000000	Successful operation
11111111	00000000	BUSY module (it has tried to effect an operation while the module is still busy registering previous data inside the EEPROM).
11111111	00000001	Code not recognised or message incorrect.
11111111	00000010	Incorrect set value.

NOTE:	Any other error condition, which is not mentioned in the above table, must be controlled by the user.

In the case of a successful operation, the contents of the subsequent words are the functions of the command that has been sent.

See par. 3.2.1. for the Parameter Setting and Reading.

The STATUS REGISTER of the controller unit gives the current communication status as shown in TABLE 10.

TABLE 10 - STATUS REGISTER CONFIGURATION		
BIT	BIT STATUS	MEANING
7	0	Transmission in progress
6	0	Reception in progress.
5	0	Transmission end. Interrupt generation.
4	0	TX FIFO empty.
3	0	RESTART in progress. In this status the module cannot accept commands.
2	0	Reception end. Interrupt generation.
1	0	The RX FIFO has been unloaded. Interrupt generation.
0	0	RX FIFO empty.

3.4.1 OPERATIONS TO BE PERFORMED

1. Set the H.S. CAENET PC Controller according to the computer type to be used, then insert it into an I/O slot.

2. Connect the Mod. A 303 output connector to the "SERIAL IN/OUT" input connector located in the front panel of the Mod. N 402 with a 50 Ω coaxial cable.

3. Turn ON the computer and the Mod. N 402.

4. By performing the appropriate WRITE/READ operations, configure each Mod. N 402 as required.

4. TEST PROCEDURE

4.1 INTRODUCTION

The following Test Procedure is intended to be a guide for the user. We do not claim it to be exhaustive and therefore the module may be tested in various other ways.

Each procedural step contains the operation to be performed and the corresponding effect or the verification to be performed.

4.2 SUGGESTED INSTRUMENTS

- No. 1 NIM crate.

- No. 1 Mod. A 250, H.S. CAENET Manual Controller.

- No. 1 Oscilloscope (100 MHz).

- No. 1 Pulse Generator able to perform Tail Pulses with a 0.2 μs leading edge and 200 μs decay time.

4.3 PROCEDURE

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

NOTE: In the following instructions we refer to the Jumpers in Fig. 1.

1. Position the Jumpers for the selection of the input polarity for negative pulses.

2. Set the Jumpers for the selection of the output shaping form to a rise time of 0.5 μs

3. Connect the Mod. A 250 power supply cable to the "POWER MANUAL CTR" coaxial female plug (RCA type) housed on the front panel.

4. Connect the Mod. A 250 H.S. CAENET cable to one of the two "SERIAL IN/OUT" LEMO 00 type connectors and insert a 50 Ω termination on the other.

5. Turn ON the NIM crate.

6. Connect the Manual Crate, Mod. A 250 to the Mod. N 402 (see chapter 3 of this manual).

7. Insert negative Tail Pulse with an amplitude of 25 mV into channel 0.

8. Set the channel's amplification equal to:

FINE	255
COARSE	7

9. After having connected the channel's output to the oscilloscope, verify that a positive signal is present and that this signal maintains a 0.5 μs rise time.

10. Adjust the Fine Gain by setting the following values: 128, 64, 32, 16, 8, 4, 2, 1, 0 and verify that the amplification is correct.

11. Adjust the Coarse Gain by setting all the values and verify that the amplification is correct.

12. Repeat steps 7 to 11 after having set the other two different rise times.

13. Repeat steps 7 to 12 after having set the input jumpers in order to accept positive input signals.

14. πRepeat steps 7 to 13 for the the remaining three channels.

THE MODULE IS TESTED AND OPERATES CORRECTLY.