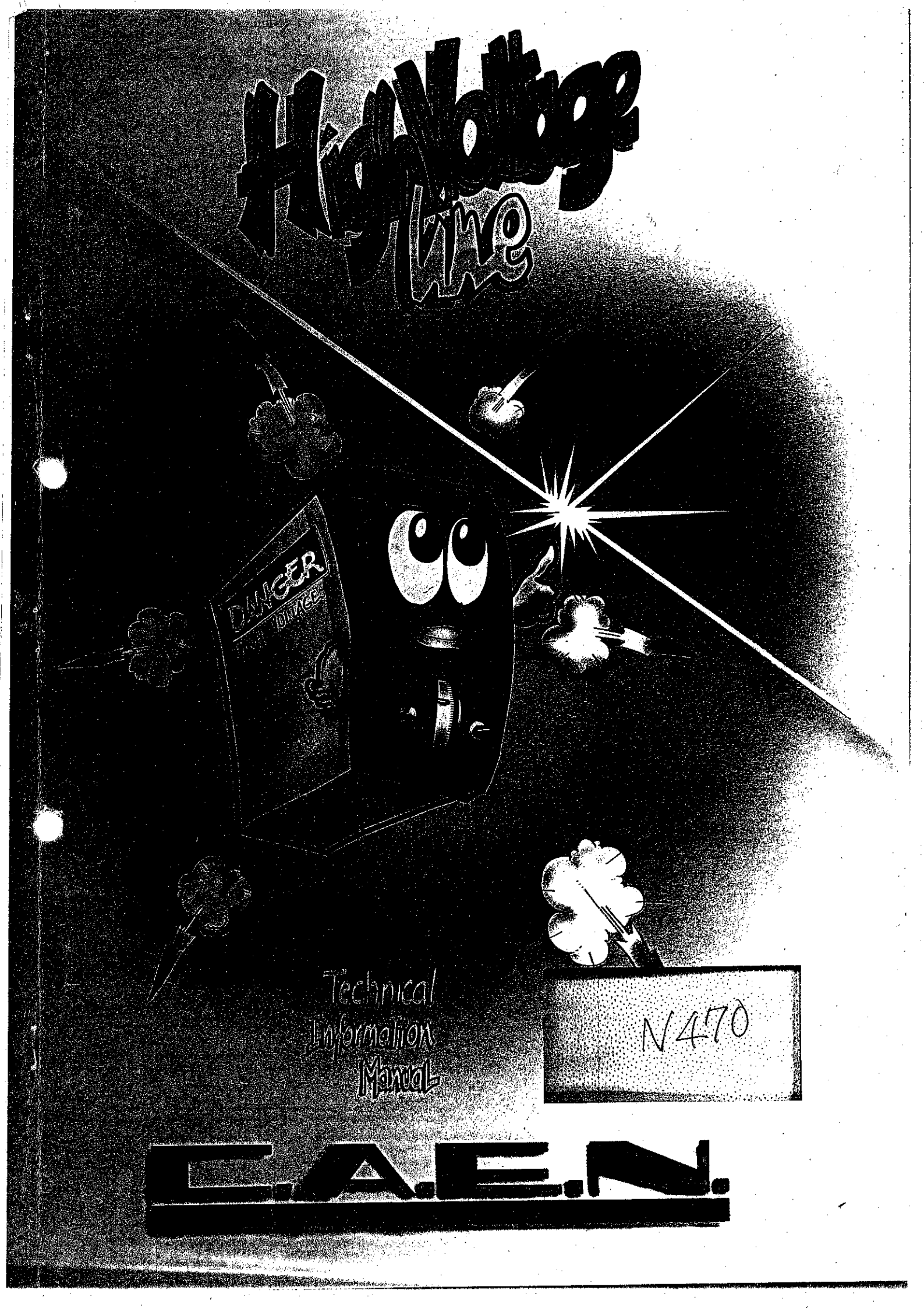
High Voltage Line



Technical Information Manual

N470

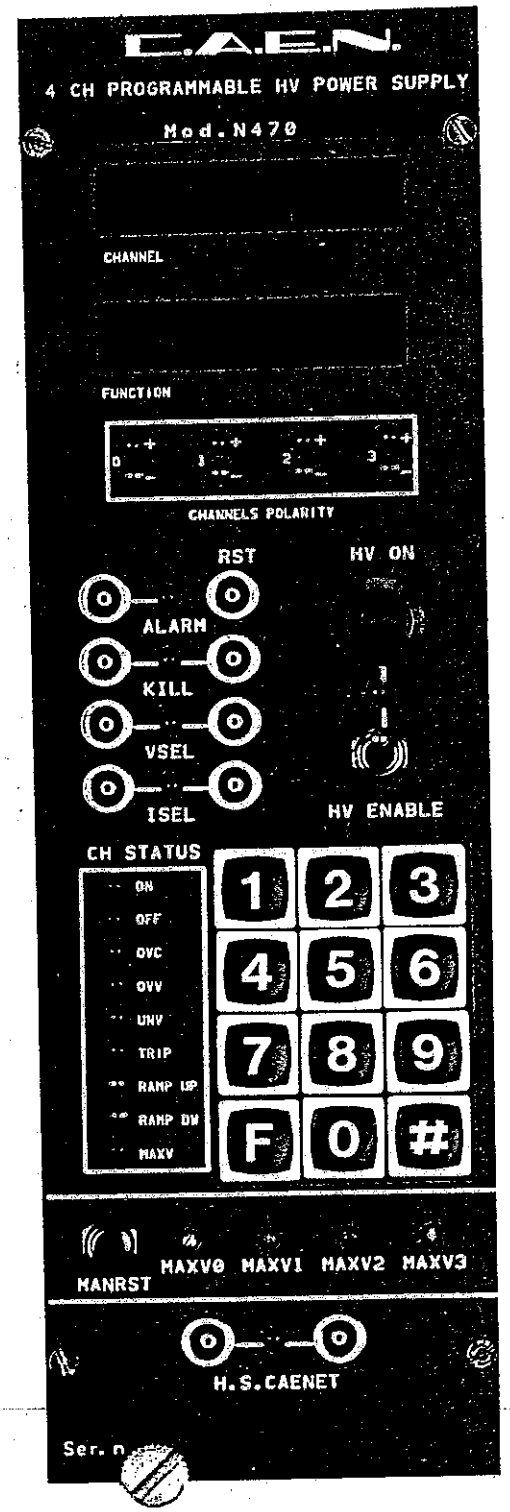
C.A.E.N.

Technical Information Manual

MOD. N 470

4 CHANNEL
PROGRAMMABLE
H.V. POWER SUPPLY

25th September 1992


C.A.E.N.
4 CH PROGRAMMABLE HV POWER SUPPLY
Mod.N470
CHANNEL
FUNCTION
CHANNELS POLARITY
RST
HV ON
ALARM
KILL
VSEL
ISEL
HV ENABLE
CH STATUS
ON
OFF
OVC
OVV
UNV
TRIP
RAMP UP
RAMP DN
MAXV
1 2 3
4 5 6
7 8 9
F 0 #
MANRST
MAXV0 MAXV1 MAXV2 MAXV3
H.S.CAENET
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.

TABLE OF CONTENTS

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. MODEL OVERVIEW

The C.A.E.N. Mod. N 470 is a FOUR CHANNEL PROGRAMMABLE HIGH VOLTAGE POWER SUPPLY housed in a two-unit wide NIM module; the unit has 4 independent H.V. channels able to supply four output voltages from 0 up to ±8 kV.

Its wide range of current and voltage along with a versatile protection scheme, monitoring and control functions make it ideal for powering the full spectrum of detectors used in the modern Physical research, such as photomultipliers (PMs), wire chambers, streamer tubes, silicon detectors and so on. The module is flexible enough to be adequate for both experiments where several channels are to be monitored by an on-line computer, and for the test labs, where simple manual operation of a limited number of channels is often required.

All the operational parameters can be programmed and monitored either locally, via the front panel keyboard and displays through specifically designed functions, or remotely via the High Speed CAENET network and relevant controllers.

Via the front panel keyboard can also be selected the standard, TTL or NIM, of the signals used as hardware controls and through a very small set-up the user can calibrate each channel of the unit and store the resulting data in an internal EEPROM (see Section 5).

Among its most relevant features there are:

- Wide Voltage-Current Capability.
  can operate in three ranges: 0 to ±3 kV / 3 mA ,
  ±3 kV to ±4 kV / 2 mA,
  ±4 kV to ±8 kV/ 1 mA.
  Therefore, the units can cover all available commercial PM tubes and any types of used detectors.

- Selection of polarity. The user can select positive or negative polarity for each channel by reversing the relevant diode bridge inside the unit (see Section 4). The selected channel polarity is shown by the relevant LED on the front panel.

- Displays. All operational parameters can be set and monitored on two alphanumeric 8–character LED display.

- A set of 9 LEDs on the front panel shows the status of the selected channel.

Flexibility in Functions and Controls which include for each channel :

- Two voltage setting levels (V_0 and V_1 respectively);

- Two preset current limits levels (I_0 and I_1 respectively);

- Variable RAMP-UP and RAMP-DOWN;

- Preset of a desired hardware HV limit that cannot be overridden by any software setting;

- Sophisticated Safety Feature.

Common to all channels :

- Local or Remote KILL;

- H.V. enable switch;

- Local or Remote RESET;

- Selection via an external VSEL signal between the V_0 and V_1 preset values;

ISelect VSEL = Vselect

- Selection via an external ISEL signal between the I_0 and I_1 preset values;

- Generation of an external ALARM signal when a danger condition occurs (OVer Voltage - OVV, UNder Voltage - UNV, TRIP, MAXV or when not calibrated module).

Handling safety is obtained through careful design. All HV components are incapsulated in silicon rubber and no HV is on the printed circuit board so that the maintenance personnel cannot accidentally be exposed to it.

The front and rear panels of the model N 470 are shown in Figure 1, on the two fold-out pages at the end of this Manual. For your convenience, keep the photograph of the unit folded out to easily associate descriptions and explanations with the model layout.

The High-Voltage output connectors, which are on the back panel, are SHV female connectors. All other connectors are LEMO 00 type.

2. SPECIFICATIONS

2.1 HIGH VOLTAGE OUTPUTS

High Voltage ranges :	±4 kV to ±8 kV 1 mA maximum output current; ±3 kV to ± 4 kV 2 mA maximum output current; 0 to ±3 kV 3 mA maximum output current; The three High-Voltage ranges are automatically selected and controlled by the control software. Any attempt to set a current/voltage value incoherent with the relevant voltage/current generates a flashing of the displays. The system in this case is waiting for a correct value; the user can only press the "F" key to abort the operation or give the rigth parameter value (see note on pag. 8)
Polarity :	positive or negative selectable by the user as described in section 4
HV Set resolution:	± 1 V
HV Mon resolution:	± 1 V
I Set resolution:	± 1 µA
I Monitor resolution:	± 1 µA
Vmon, HVout accuracy:	1% ± 5V
Imon accuracy:	2% ± 10 µA
Vmax accuracy:	1% ± 5V
RST min. width:	100 µs
KILL min. width:	15 µs
Max Delivered Power:	36 Watt in the ranges 3 kV/ 3 mA, 4 kV/2 mA; 30 Watt in the range 8 kV/1 mA
Humidity range:	0 to 80%
Operating temperature:	0 to 45 °C
H.V. out temp. coeff. :	max 0.005% °C
Ripple:	300 mV_{pp} at full load.

2.2 PROGRAMMABLE PARAMETERS

For each channel the following parameters can be programmed and monitored either locally or remotely

V_0	First High Voltage programmed value - Expressed in Volt
I_0	First Current Limit programmed value - Expressed in microamp

RAMP-UP Maximum High Voltage increase rate - Expressed in V/s

RAMP-DOWN Maximum High Voltage decrease rate - Expressed in V/s

TRIP Maximum time an "overcurrent" is allowed to last expressed in hundreds of a second. When a channel is in "overcurrent" condition it works as a current generator; the output voltage is enabled to vary in order to keep the output current less than the active programmed value (I_0 or I_1). If an "overcurrent" lasts more than the programmed value (from 1 to 9998) it will cause the channel to "trip". The output voltage will drop to zero at the programmed rate (Ramp-down) and the channel will be put in the off state.
If this parameter is set to 9999, the "overcurrent" may last indefinitely. If it is set to 0, the channel will be switched off as soon as an overcurrent is detected, irrespective of the programmed ramp down value.

VMAX Absolute maximum High Voltage level which the channel is allowed to reach, independently from the preset values V_0 or V_1. **The MAXV can be set in the range from 0 V to 8 kV. Setting a value less than 300 V on the parameter can generate a unit malfunction.** The output voltage cannot however exceed the preset value VMAX set with the relevant screwdriver adjusted potentiometer, labelled from MAXV0 to MAXV3 on the front panel. The accuracy is 1 % ± 5 V. VMAX is a hard limit which cannot be overridden.

VMON High Voltage Monitored value - Expressed in Volt

IMON Current Monitored value - Expressed in microamp

2.3 EXTERNAL COMPONENTS

All the external components are located in the front panel of the unit except the SHV output connectors and the relevant Channel On/Off LEDs which are housed in the rear one.

CONNECTORS:

All the input signals except the RST and the ALARM are provided with two bridge connectors for daisy chaining. TTL or NIM standard selectable for the input output signals. When the NIM standard is selected the last daisy chained module on the RST, KILL, VSEL and ISEL lines must be terminated with a 50 Ω impedance load.

1,"ALARM" Lemo 00 type; output. TRUE when a danger condition occurs in a channel (OVV, UNV, TRIP, MAXV or non calibrated module).

1, "RST" Lemo 00 type; remote reset input. All the channels are switched OFF and the H.V. is not present at the outputs.

2, "KILL" Lemo 00 type; input. When it becomes TRUE all the channels are switched off irrespective of the Ramp-Down value programmed.

2, "VSEL" Lemo 00 type; input. Selects the active programmed value between V_0, FALSE, and V_1, TRUE, for all the channels. The H.V. outputs vary between the two values with the programmed Ramp Up and Ramp Down.

2, "ISEL" Lemo 00 type; input. Selects the active programmed value between I_0, FALSE, and I_1, TRUE, for all the channels.

2, "H.S. CAENET" Lemo 00 type; High Speed CAENET line.

1, SHV type for each channel distributing the H.V. output.

DISPLAYS:

2, 8-character alphanumeric LED displays showing all the operational parameters and functions

LEDs:

Channel Polarity

1, "+" GREEN for each channel; when it lights up the relevant channel has been preset as positive.

1, "-" YELLOW for each channel; when it lights up the relevant channel has been preset as negative.

Channel Status

The meaning of the following LEDs refers to the channel number shown in the left hand side of the upper display

1, "ON" RED, when it lights up the channel is switched ON.

1, "OFF" GREEN, when it lights up the channel is switched OFF.

1, "OVC" RED, when it lights up the channel is draining a current equal to the preset active current limit (I_0 or I_1).

1, "OVV" RED, when it lights up the channel is supplying a voltage at least 100 V greater than the preset active value (V_0 or V_1).

1, "UNV" RED, when it lights up the channel is supplying a voltage at least 100 V smaller than the preset active value (V_0 or V_1).

1, "TRIP" RED, when it lights up the channel is switched OFF at the end of the programmed TRIP time.

1, "RAMP UP" YELLOW, when it lights up the channel is ramping up to reach the preset active value.

1, "RAMP DW" YELLOW, when it lights up the channel is ramping down to reach the preset active value or to be switched off.

1, "MAXV" RED, when it lights up the channel has reached the relevant preset VMAX limit.

H.S. CAENET	1, RED, when it lights up the relevant module is the actual addressed unit on the line.
H.V. Enable	1, RED signalling when the unit is enabled to supply the High Voltage on the outputs.
Alarm	1, RED it lights up on when the "ALARM" output becomes TRUE.
Channel On/Off	4, "CH0, CH1, CH2, CH3", when it lights up the relevant channel is switched on.
LAMPS:	1,"HV ON" RED, when it lights up at least one of the channels is in the ON status. When the H.V. is disabled through the relevant front panel switch or the channels are switched off the lamp is alighted until one of the HV outputs is greater than 100 V.
SWITCHES:	1, "HV ENABLE", to enable/disable all the unit channels to reach the preset active HV level; when in the ON position the relevant LED is switched ON.
PUSH-BUTTONS:	1, "MAN RST", manual unit RESET.
TRIMMERS:	4, "MAXV0, MAXV1, MAXV2, MAXV3", multi-turn potentiometers to set the allowed absolute maximum HV outputs in the range from 0 V to 8 kV.
KEYBOARDS:	1, 12 key front panel keyboard to program and monitor all the operational parameters of the unit.

2.4 POWER REQUIREMENTS

The following power comsuptions are referred to the unit with all the channels supplying 3 kV and 3 mA to the loads (maximum deliverable power).

+24 V 1.7 A	-24 V 0.9 A
+12 V 0.2 A	-12 V 0.2 A
+6 V 1 A	-6 V 50 mA

3. MONITORING and DISPLAYS

3.1 MANUAL OPERATIONS

The unit can be operated manually through a 12-key keyboard and two 8-character LED displays located on the front panel.
All the relevant parameters of each channel may be displayed and modified by calling the appropriate "functions". A function is called by pressing the "F" key followed by a number and by the "#" key. The numbers and their associated functions are shown in the following table:

TABLE. 1 FUNCTIONS and MESSAGES

NUMBER	MNEMONIC	MESSAGE	RANGE	MEANING
0	CH	Channel	0 to 3	Selects the channel
1	V_0	V0-Set	0 V to 8000 V	Programs the first High Voltage value
2	I_0	I0-Set	0 to 3000 µA	Programs the first Current Limit value
3	I_1	I1-Set	0 to 3000 µA	Programs the second Current Limit value
4	TR	Trip	0 to 9999	Programs the Trip Time
5	V_1	V1-Set	0 V to 8000 V	Programs the second High Voltage value
6	VM	V mon		Reads the H.V. Monitor
7	IM	I mon		Reads the Current Monitor value
8	RU	Ramp up	1 to 500 V/s	Programs the H.V. Increase rate
9	RD	Ramp down	1 to 500 V/s	Programs the H.V. Decrease rate
10	ON	On		Turns the channel ON
11	OFF	Off		Turns the channel OFF
12	KILL	Kill		All H.V. channels are switched off
13	MAXV	V-Max		Reads the VMAX value
14	CL ALARM	Cl Alarm		Resets the status of the ALARM output signal
15	LEV	Lev ()		Selects the standard TTL or NIM of the hardware monitor signals.
89	Lumin.	Sel Lum	1 to 7	Adjusts the luminosity of the 2 displays (1 to 7)
90	V Calib	V Calib		Performs the calibration of the output voltage
91	I Calib	I Calib		Performs the calibration of the output current
92	MaxV Calib	MaxV Cal		Performs the calibration of the MAXV
99	Cr.	Cr. Num.	0 to 99	Sets the CAENET address

NOTE:	The channel number to which all the commands and information on the displays and LEDs are referred is always shown on the left hand side of the upper display .

The digitised data becomes active only after the "#" key has been hit. So, for example, to select the channel 1, the "CHANNEL" function is first called by typing "F0#" (see table 1) followed by the desired channel number 1 and confirmed pressing the "#" key.
Then, for example, to set the V_0 value (High Voltage), type "F1#" followed by the desired value in Volt.

As soon as the "F" key has been hit, the word "FUNCTION" will appear on the lower display to indicate that a function is expected. After typing "1", the message "V0 SET" will replace the "FUNCTION" message, an "F" appears on the right hand side of the upper display and the "1 " is shown on the most right character of the upper display. Once the "#" key has been pressed to confirm the selection of this function, the message will disappear and only a two character mnemonic code (V_0) will be shown on the left-hand side of the lower display, while the right-hand side will show the current value of the selected parameter. The new value typed, if any, will appear on the upper display (right-hand side) .
The current value of the parameter will be actually changed only if the key "#" will be pressed again.
To cancel the operation before actually affecting the current value of the parameter, just type "F" and select another function.

If an unknown function code is digitised the system gives an "INVALID" message. If the invalid function is confirmed the function number itself, on the upper row, start to flash untill the "F" key is hit again or another legal function number is digitised and confirmed.

3.2 REMOTE OPERATIONS

The model N 470 is provided with a HIGH SPEED CAENET interface. The H.S. CAENET line uses a simple 50 Ω coaxial cable as physical medium through which the unit can be controlled by the following CAEN modules:

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 selected by the F99 function) 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.

The control from an A 250 HS CAENET MANUAL CONTROLLER has not been implemented due to the complexity of the unit and the relative high number of parameters that must be controlled and monitored. Any attempt to control the unit from an A 250 gives the following message on the controller display:

Crxx	No Control
N470	by A 250

The only parameter that can be modified is the Crate number to select a different module on line. Controlling the unit from remote a 16 bit STATUS word is available to monitor the status of the selected channel or of the unit globally. The following table reports the meaning of each bit of the STATUS word

TABLE 2 N 470 STATUS WORD			
BIT No	CODE	IF	MEANING
0	ON/OFF	0	The channel is OFF
1	OVC	1	The channel is in OVC condition
2	OVV	1	The channel is in OVV condition
3	UNV	1	The channel is in UNV condition
4	TRIP	1	The channel has been switched OFF for TRIP condition
5	RUP	1	The channel is ramping up
6	RDW	1	The channel is ramping down
7	MAXV	1	The channel has reached the preset MAXV
8	POL	0 1	Positive channel Negative channel
9	VSEL	0 1	Vset = V_1 Vset = V_0
10	ISEL	0 1	Iset = I_1 Iset = I_0
11	KILL	1	Module KILLed by external pulse still active
12	HVEN	1	Module enabled to supply HV by the front panel switch
13	NIM/TTL	0 1	NIM standard selected TTL standard selected
14	OUTCAL	1	Non calibrated module
15	ALARM	1	Module in alarm condition

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

The model N 470 can be controlled via CAMAC through the Mod. C 117 B H.S. CAENET CAMAC Controller.
The standard CAMAC functions listed in table 3 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 3 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 470 (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 4 MASTER -to-SLAVE DATA COMPOSITION			
WORD 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 5).
4	F(16) N	xxxxxxxxxxxxxxxx	EVENTUAL SET VALUE

In the following table 5 the CH reported as high byte in some of the allowed operation codes is a binary number from 0 to 3 selecting the channel number to which the operation is referred to.

TABLE 5 BINARY CODE OF THE OPERATION TO BE PERFORMED TO CONTROL THE MOD. N 470

OPERATION CODE	HIGH BYTE	LOW BYTE	RESULT
0	00000000	00000000	READS THE IDENTIFICATION MODULE'S NAME AND THE SOFTWARE VERSION'S NUMBER
1	00000000	00000001	READS Vmon,Imon,MaxV and STATUS FOR ALL THE CHANNELS
2	CH	00000010	READS ALL THE OPERATIONAL PARAMETERS OF THE SELECTED CHANNEL
3	CH	00000011	SETS THE V_0 VALUE OF THE SELECTED CHANNEL
4	CH	00000100	SETS THE I_0 VALUE OF THE SELECTED CHANNEL
5	CH	00000101	SETS THE V_1 VALUE OF THE SELECTED CHANNEL
6	CH	00000110	SETS THE I_1 VALUE OF THE SELECTED CHANNEL
7	CH	00000111	SETS THE TRIP OF THE SELECTED CHANNEL
8	CH	00001000	SETS THE RAMP UP OF THE SELECTED CHANNEL
9	CH	00001001	SETS THE RAMP DOWN OF THE SELECTED CHANNEL
10	CH	00001010	SETS THE SELECTED CHANNEL ON
11	CH	00001011	SETS THE SELECTED CHANNEL OFF
12	00000000	00001100	KILLS ALL THE CHANNELS
13	00000000	00001101	CLEARS THE ALARM OUTPUT SIGNAL
14	00000000	00001110	ENABLES THE FRONT PANEL KEYBOARD
15	00000000	00001111	DISABLES THE FRONT PANEL KEYBOARD
16	00000000	00010000	SELECTS THE TTL LEVEL
17	00000000	00010001	SELECTS THE NIM LEVEL

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.
The answer data coming from the Mod. N 470 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.

IMPORTANT NOTE: For each operation to be performed (see TABLE 5) on the Mod. N 470 it is necessary, each time, to carry out the functions indicated in TABLE 4, in that order, and afterwards an F(17) N.

The first word of the answer data is shown in TABLE 6.

TABLE 6 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.

3.2.1.1 PARAMETER SETTING and READING

SINGLE PARAMETER SETTING

Operation codes 3 to 9 : Word 4 must contain the new 16 bit binary value of the various parameters.
The ranges of the allowed values are reported in the following table 7

TABLE 7 ALLOWED VALUES RANGES			
V_0/V_1 (V)	I_0/I_1 (μA)	TRIP (s/100)	RAMP UP/DOWN (V/s)
4000 to 8000	0 to 1000	0 to 9999	1 to 500
3000 to 4000	0 to 2000	"	"
0 to 3000	0 to 3000	"	"

Operation codes from 10 to 17: they not require the word 4 in the data pack. When the codes 10 and 11 are requested the N 470 gives back in the answer data pack the "Successful operation" code in the first word and the system Status in the second one.

MULTIPLE PARAMETER READING

Operation code 0	: Word 2 to Word 17	contains on the low byte the ASCII code of the string of characters identified by the name of the module and the software version "N 470 version n.m".
Operation code 1	: Word 2 to Word 17	contains the values of Vmon,Imon,MaxV and STATUS for the channels 0,1,2,3 in the order.
Operation code 2	: Word 2 to Word 12	contains the values of STATUS, Vmon, Imon, V_0 set, I_0 set, V_1 set, I_1 set, TRIP, ramp up, ramp down, and MaxV in that order of the channel selected by the code from 0 to 3 held in the high byte of the operation code.

3.2.1.2 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 470, using a 50 Ω coaxial cable .
3. Turn on CAMAC crate and Mod. N 470.
4. By performing the appropriate CAMAC functions, configure the Mod. N 470 as required.

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

The Mod. N 470 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 470 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 8 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 REGISTER	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	INTERRUPT 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 470 (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 9 MASTER-to-SLAVE DATA COMPOSITION

ORDER	OPERATION	ADDRESS	DATUM	MEANING
1	WRITE	Base address + 00	0000000000000001	HOST COMPUTER CONTROLLER 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 5 par. 3.2.1)
4	WRITE	Base address + 00	xxxxxxxxxxxxxxx	EVENTUAL SET VALUE (see table 6 par. 3.2.1.1)

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 5 par. 3.2.1) on the Mod. N 470 it is necessary, each time, to carry out the WRITE cycles indicated in TABLE 8 in the same order and afterwards a WRITE operation on the TRANSMISSION register.

The answer data coming from the Mod. N 470 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 6 par. 3.2.1.

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. 3.2.1.1 for Parameter Setting and Reading.

3.2.2.1 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 470, with a 50 Ω coaxial cable.

3. Turn ON VME crate and Mod. N 470.

4. By performing the appropriate VME WRITE/READ cycles, configure each Mod. N 470 as required.

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

The Mod. N 470 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 10).

TABLE 10 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 470 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 470 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 11 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 CONTROLLER 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 Oper. Code	CODE OF THE OPERATION TO BE PERFORMED (see TABLE 5 par. 3.2.1)
4	WRITE WRITE	Base address + 00 Base address + 00	Low Byte: XXXXXXXX High Byte: 00000000	EVENTUAL SET VALUE (see par. 3.2.1.1)

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 5 par. 3.2.1) on the Mod. N 470 it is necessary carry out the WRITE operations indicated in TABLE 11 in the same order and afterwards a WRITE operation on the STATUS TX register.

The answer data coming from the Mod. N 470 is automatically collected in the RX DATA buffer. As soon as the data pack is stored in this buffer, the controller unit gives an interrupt (if enabled) to the CPU in the computer and then the data can be read.

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 12.

TABLE 12 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 table 12, 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. 3.2.1.1 for the Parameter Setting and Reading.

The STATUS REGISTER of the controller unit gives the current communication status as shown in TABLE 13.

TABLE 13 - 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.

3.2.3.1 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 470 with a 50 Ω coaxial cable.

3. Turn ON the computer and the Mod. N 470.

4. By performing the appropriate WRITE/READ operations, configure each Mod. N 470 as required.

4. OPERATING MODES

The model N 470 lets the user select the High-Voltage polarity with simple operations which are detailed in this Section. Note that the polarity is indicated by two LEDs for each channel on the front panel.

1. In order to change polarity the user must switch off the unit and wait for the complete discharge of the capacitors then remove the side covers thereby accessing the Printed Circuit Boards.

2. Lay down the unit, NIM crate connector on the left and the front panel on the right, components side up and refer to Figure 3.

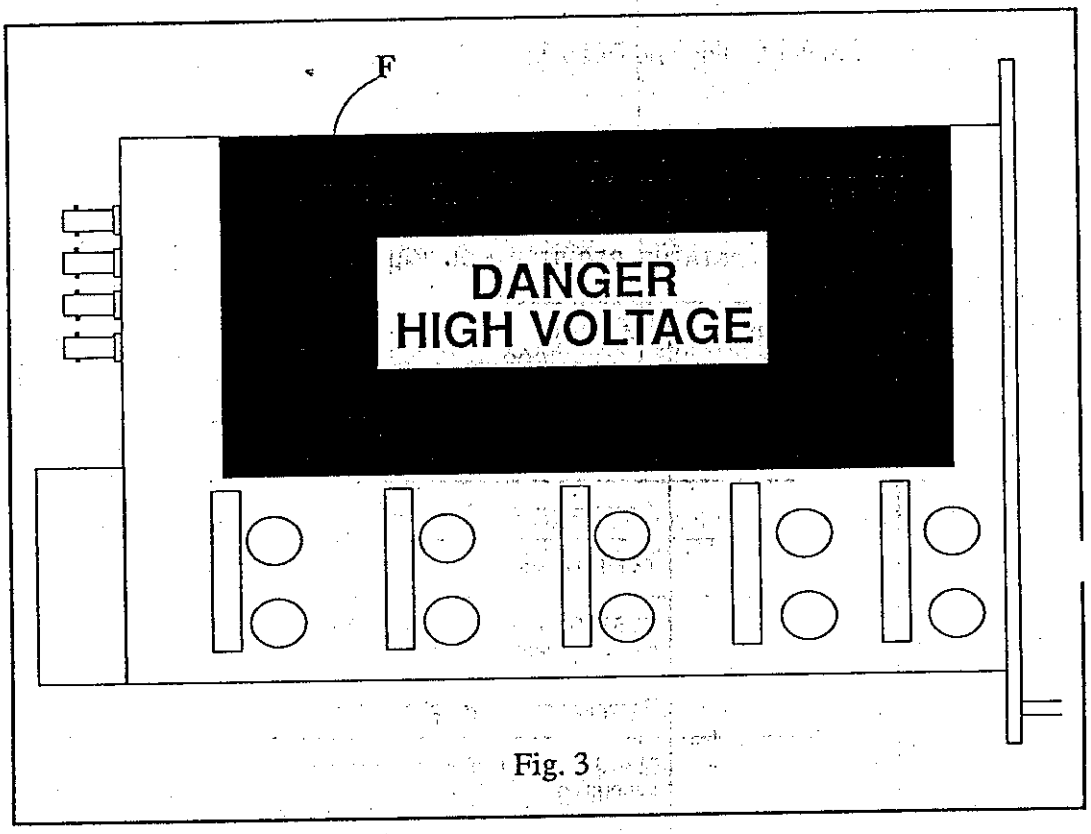


Fig. 3

A large module (labelled F in the figure) is conspicuous on the Board. This is the High-Voltage block housing the four multipliers of the channels and bears a "High-Voltage Danger" sign. The cover if fixed to the base through several screws; remove them and the cover.
The four multipliers will appear as shown in figure 4 with the channel 0 multiplier on the right. All the HV components are encapsulated in a silicon black rubber and only the DIODE BRIDGE labelled BDG in figure 4 is accessible to the user.

The diode bridge itself is encapsulated in silicon rubber with a round hole located at one side. If the diode bridge is inserted inside the multiplier block with the round hole towards the transformer the relevant channel is selected as a POSITIVE channel, otherwise the channel is selected as a NEGATIVE one.

3. Configure the unit to satisfy to your requirements eventually mixing positive and negative channels in the same unit.

4. If the polarity of one or more channels must be changed, extract the module Bdg from its contacts and insert it in the opposite position according to the figure 4.

5. Reassemble the unit.

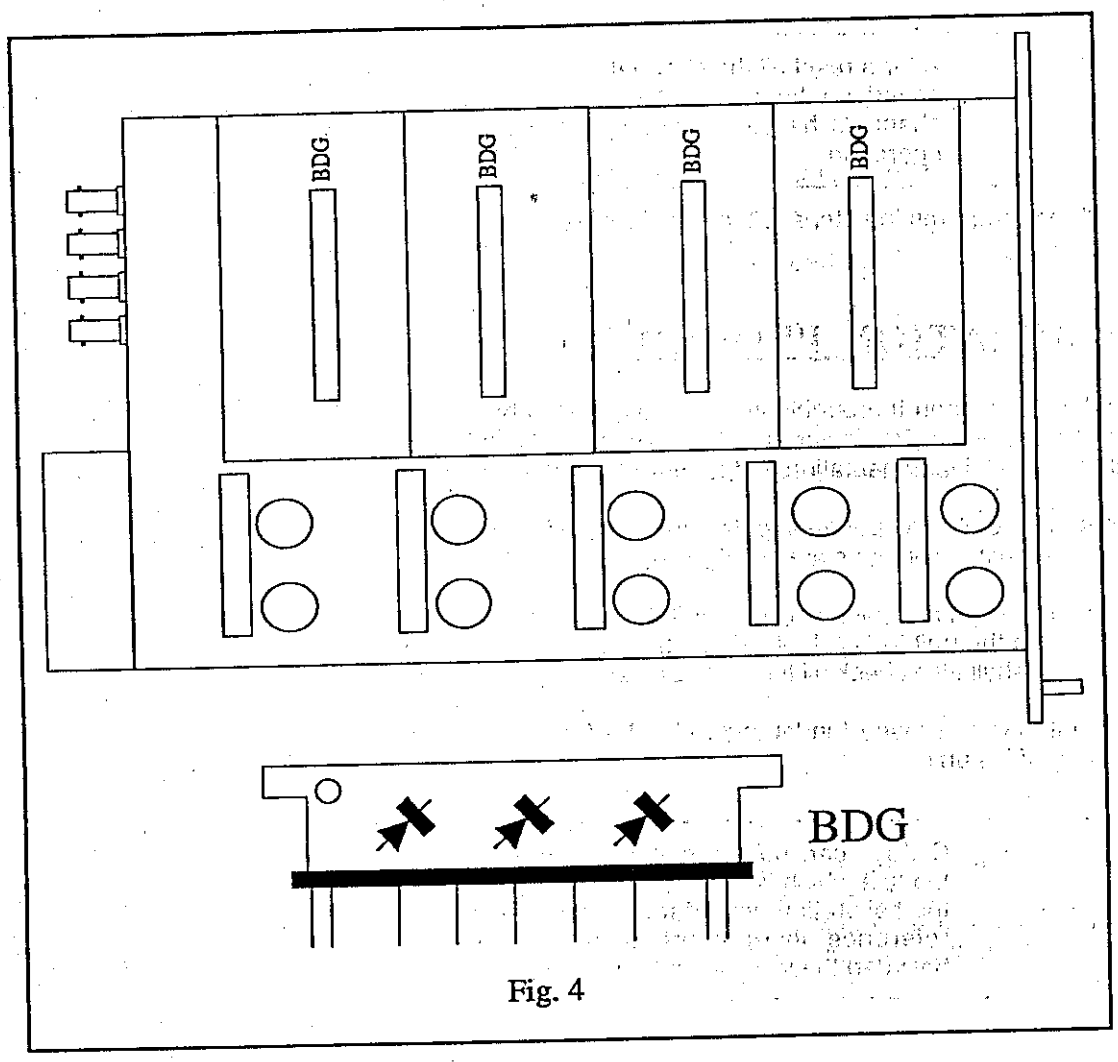


Fig. 4

Insert the unit inside a NIM crate, and switch it ON.

At the power the two displays show for a few seconds the following messages

C.A.E.N.

Mod. N 470

and after that the two displays will show

Ch 0

Vm xxxx

Verify the channels polarity checking that the polarity LEDs are switched on according to the programmed configuration; connect the H.V. cable linking the outputs to the relevant loads to be supplied and enable the H.V. outputs switching the HV ENABLE front panel switch in the position in which the relevant LED lights up.

NOTE:	After a reset all the channel are in OFF condition irrespective of the last saved configuration. In this way the user must switch on all the channels he needs either by the specific function or by the remote operation .

Perform all the programming steps, either locally or remotely, you need to obtain the wished configuration.

5. CALIBRATION PROCEDURE

The modules have been thoroughly and carefully tested before delivery to insure maximum reliability and precision. Particular care is given to the High-Voltage calibrations, which are made with C.A.E.N. instrumentation and a reference HV voltmeter standard.

If the unit (or one of its components) gets damaged and/or parts need replacements, the user must remember that calibrations are usually lost.

Consequential, if such a situation occurs, or if the calibration is anyhow suspected, the user is advised to return the unit to C.A.E.N. labs. Our Technical Service shall take care of repairing the Module and shall also check all the calibrations.

If the user intends to proceed independently, the following guidelines are provided to test the calibration of his unit.

NOTE :	CAEN can not be considered responsible of an user recalibrated module which is out of the declared specifications. The user who made the calibration procedure has to be sure concerning the quality of the reference instruments used and the effective correspondence between the values read on the H.V. voltmeter and the true values.

5.1 EQUIPMENT REQUIREMENT

- One High-Voltage Voltmeter,
- One reference resistive load in the range from 1 MΩ to 8 MΩ ± 1% .

NOTE:	The following steps must be performed only in the given sequential order. **Remember:** all the data must be confirmed by pressing the "#" key.

1. Following the procedure described in section 4 to set all the channels of the module as positive channels.
2. Insert the unit inside a NIM crate and switch it ON.
3. Adjust the MaxV of all the channels at the maximum clockwise turning the front panel screw driver trimmers.
4. Enable the H.V. output.

5.2 VOLTAGE CALIBRATION

5. Perform the F0 function to select the desired channel and connect the H.V. voltmeter to the relevant output connector.

6. Perform the F90 function to execute the Vmon calibration procedure. The unit shows on the displays the following message

Chx	F90
V	Calib.

Press the "#" key on the front panel keyboard to confirm the function selection and the unit will show

Press	#
to	Conf.

Press the "#" key to confirm and the unit will ask once again

Press	#
to	Start

Once the "#" key has been pressed the system start the calibration of the selected channel supplying same H.V. output at the relevant connector. The ON LED lights up and the user can read the value of the H.V. on the voltmeter connected to the output. The system asks the user to write the exact value read on the H.V. voltmeter with the following message

Chx	****
Mem	Val1

The same procedure is repeated 5 times, from Val1 till Val5. Once the user has confirmed the digitised value the system increases the H.V. output and asks to repeat the previous step till the end of the procedure. After the Val5 value has been introduced the system start to calculate its internal parameters and the unit displays will show the following message.

Wait	for
end	Calib.

It will take a few seconds after that the channel is switched off and the relevant LED on the front panel lights up.

Repeat the steps 5 and 6 to calibrate the voltage of all the desired channels.

5.3 CURRENT CALIBRATION

7. Perform the F0 function to select the desired channel and connect the reference load to the relevant output connector.

8. Perform the F91 function to execute the Current calibration procedure. The unit shows on the displays the following message

Chx	F91
I	Calib.

Press the "#" key on the front panel keyboard to confirm the function selection and the unit will show

Press	#
to	Conf.

Press the "#" key to confirm and the unit will ask once again

Press	#
to	Start

Once the "#" key has been pressed the system start the calibration and ask the user the value expressed in kΩ of the reference load connected to the output.

Chx	xxxx
Load	(kΩ)

Once digitized and confirmed the exact value of the load the system proceeds to the current calibration for the Imon first and the Iset after . The user can evaluate the procedure evolution from the front panel displays that will show the following message where the calibration steps range from 1 to 5.

Chx	stepx
I	Calib.

After the last step has been performed the system start to calculate its internal parameters and the unit displays will show the following message.

Wait	for
end	Calib.

It will take a few seconds after that the channel is switched off and the relevant LED on the front panel lights up.

Repeat the steps from 7 to 8 for all the channels you want to calibrate.

5.4 MAXV CALIBRATION

9. Perform the F0 function to select the desired channel and connect the H.V. voltmeter to the relevant output connector.

10. Perform the F92 function to execute the MaxV calibration procedure. The unit shows on the displays the following message

Chx	F92
MaxV	Calib.

Press the "#" key on the front panel keyboard to confirm the function selection and the unit will show

Press	#
to	Conf.

Press the "#" key to confirm and the unit will ask once again

Press	#
to	Start

Once the "#" key has been pressed the system start the calibration and adjust the H.V. output at about 6000 V. The unit displays will show the following message

Chx	step1
MaxV.	Cal.

Adjust the trimmer corresponding to the selected channel in order to vary the value displayed by the H.V. voltmeter. Stop the adjustment when you read a value near to the one reported in the following table

Step No	Reference Value
1	350 V
2	1500 V
3	3000 V
4	4500 V
5	5800 V

Verify that the system modify the output voltage according to the trimmer adjustment and the front panel MaxV LED on the front panel lights up; confirm the value pressing the "#" key. The system will repeat 5 times the same procedure, from step1 to step5. After the last step has been performed the system start to calculate its internal parameters and the unit displays will show the following message.

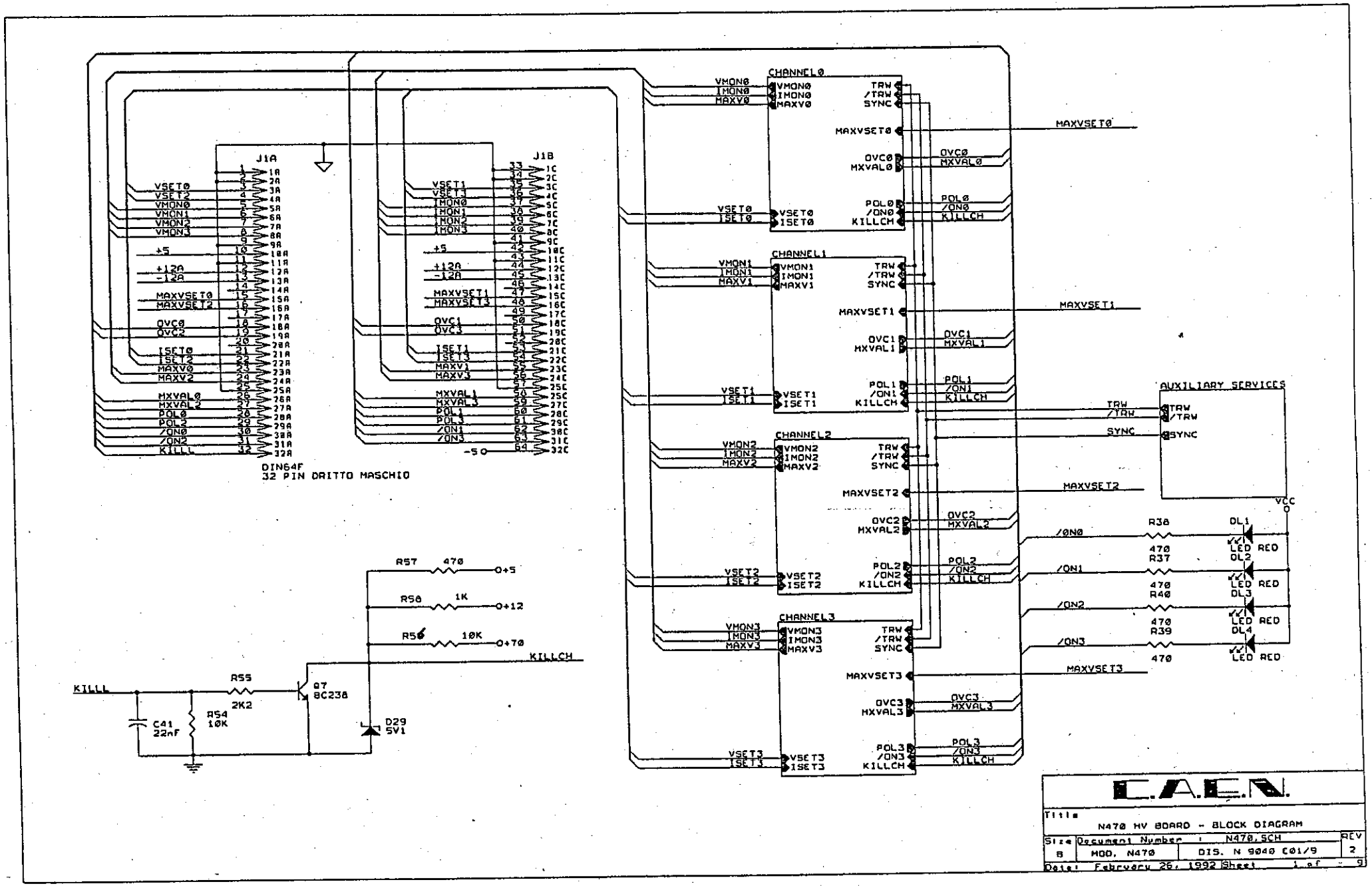
Wait	for
end	Calib.

It will take a few seconds after that the channel is switched off and the relevant LED on the front panel lights up.

Repeat the steps from 9 to 10 for all the channels you want to calibrate.

11. Switch off the module and wait for a few seconds in order to be sure that all the H.V. capacitors are discharged. Following the procedure described in section 4 to reverse the polarity of the channels you are calibrating. Repeat all the steps from 2 to 10

ELECTRICAL DIAGRAMS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CHANNEL2
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R56 10K +70
KILLCH
KILLL
R55 2K2
Q7 BC238
R54 10K
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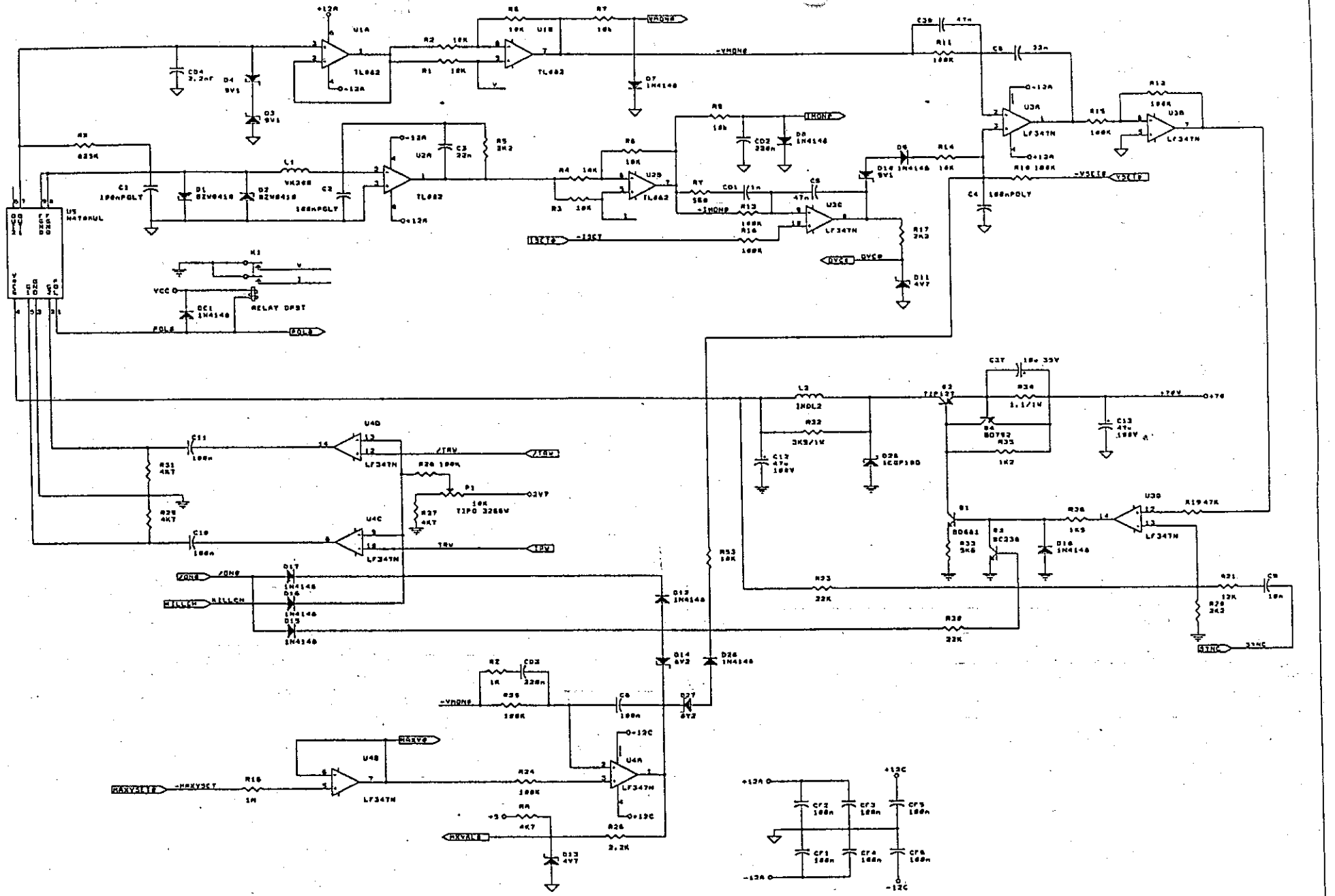
Size B
Document Number : N470.SCH
REV 2
MOD. N470
DIS. N 9040 C01/9
Date: February 26, 1992 Sheet 1 of 9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C04 2.2nF
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D3 9V1
R9 10k
CD2 220n
D8 1N4148
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R6 10K
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C6 47n
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R16 100K
U3C
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D10 1N4148
9V1
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LF347N
R10 100K
R12 100K
U3B
LF347N
R15 100K
-VSETP
VSETP
C4 100nPOLY
R8 825K
C1 100nPOLY
D1 BZW04P18
D2 BZW04P18
L1 VK200
C2 100nPOLY
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TL082
C3 22n
R5 3K2
U5 NATIONAL
K1
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-ISET
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DVCP
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R17 2K2
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L2 INDL2
D3 TIP137
R34 1.1/1W
BD792
R35 1K2
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C12 47n 100V
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+76V
+76
U4D
LF347N
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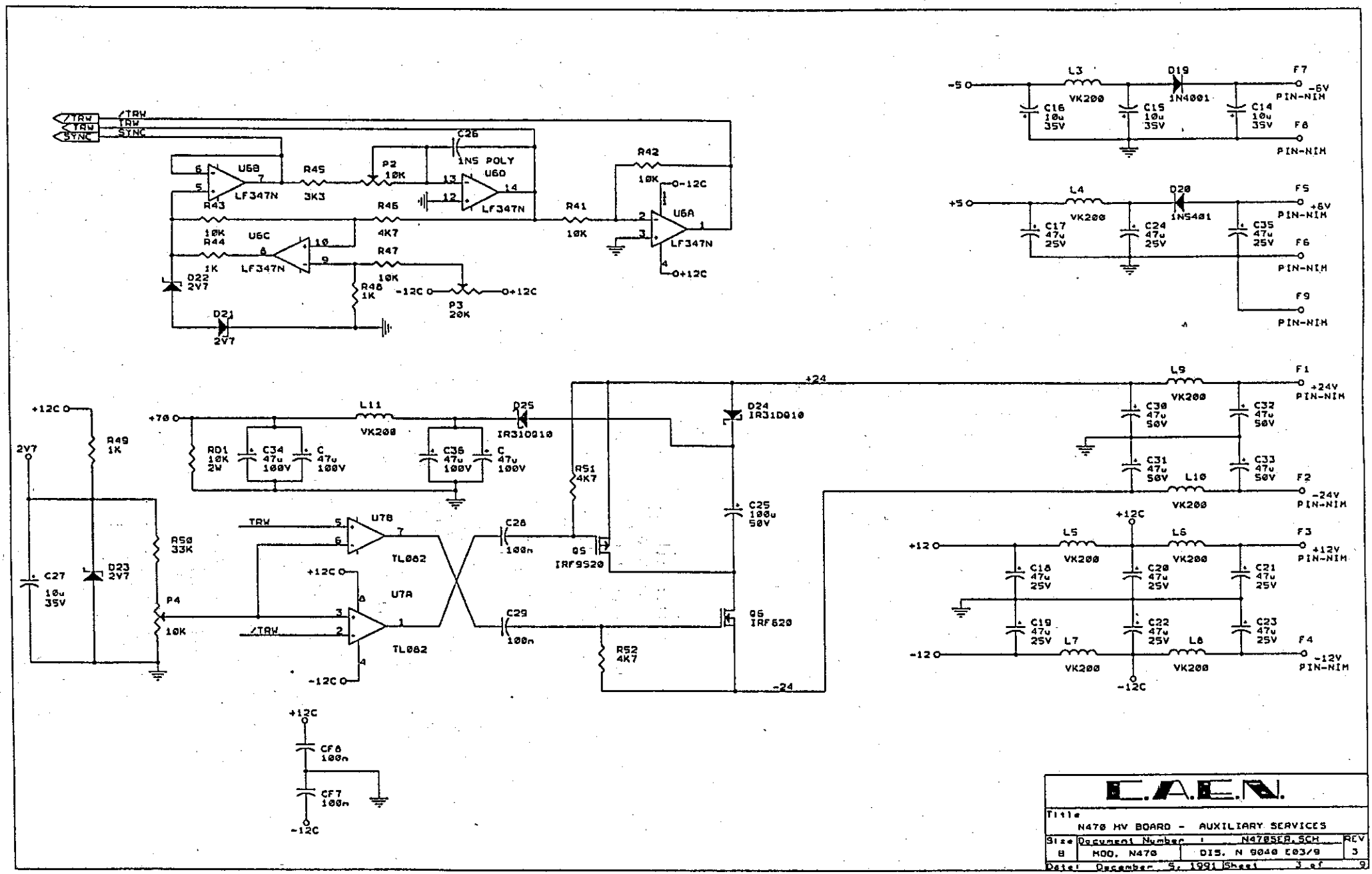

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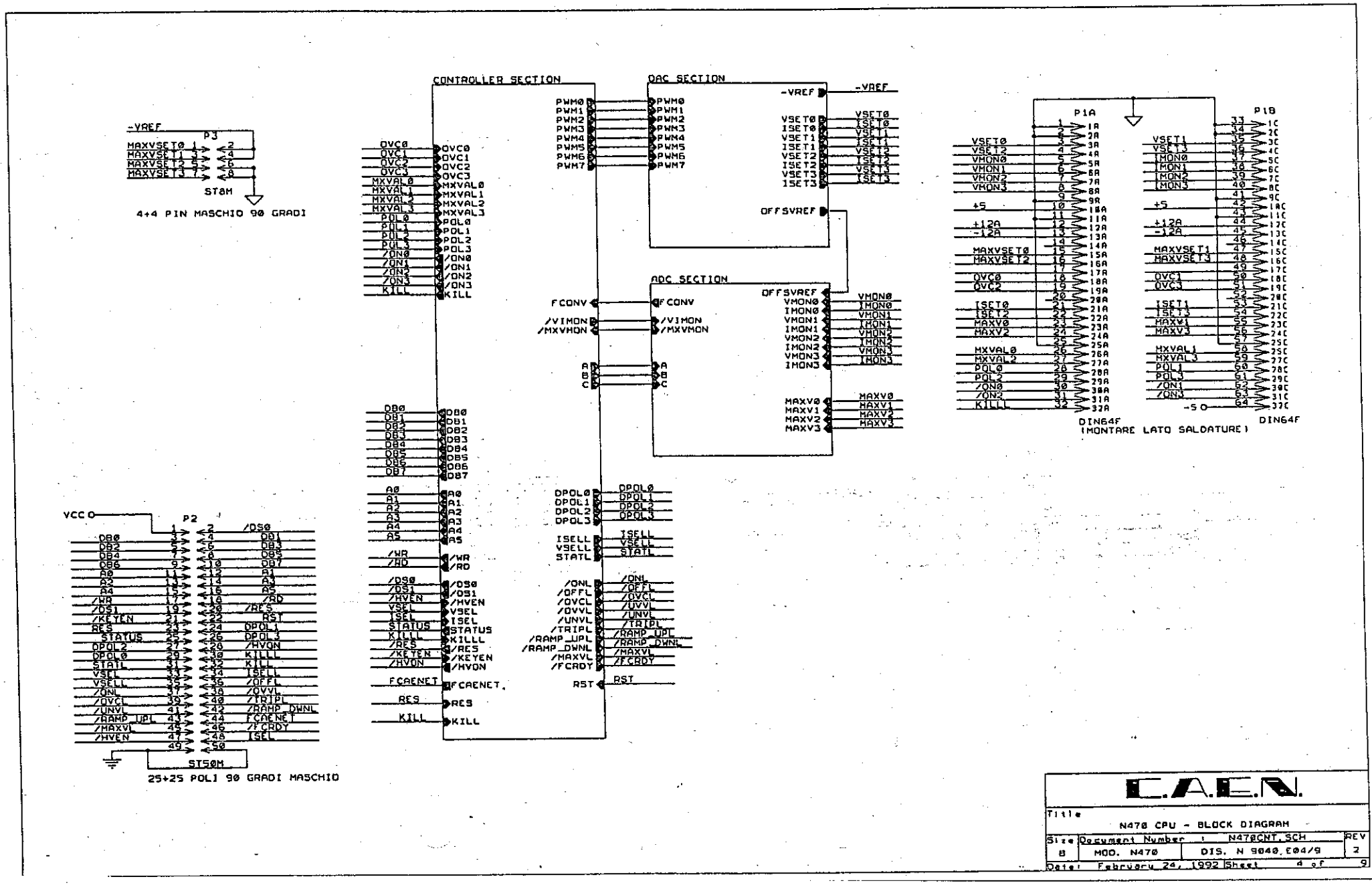
MOD. N470	DIS. N 9040 E03/9	
Date: December 5, 1991	Sheet: 3 of 9	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MOD. N470
DIS. N 9040.E04/9
Date: February 24, 1992
Sheet
4 of
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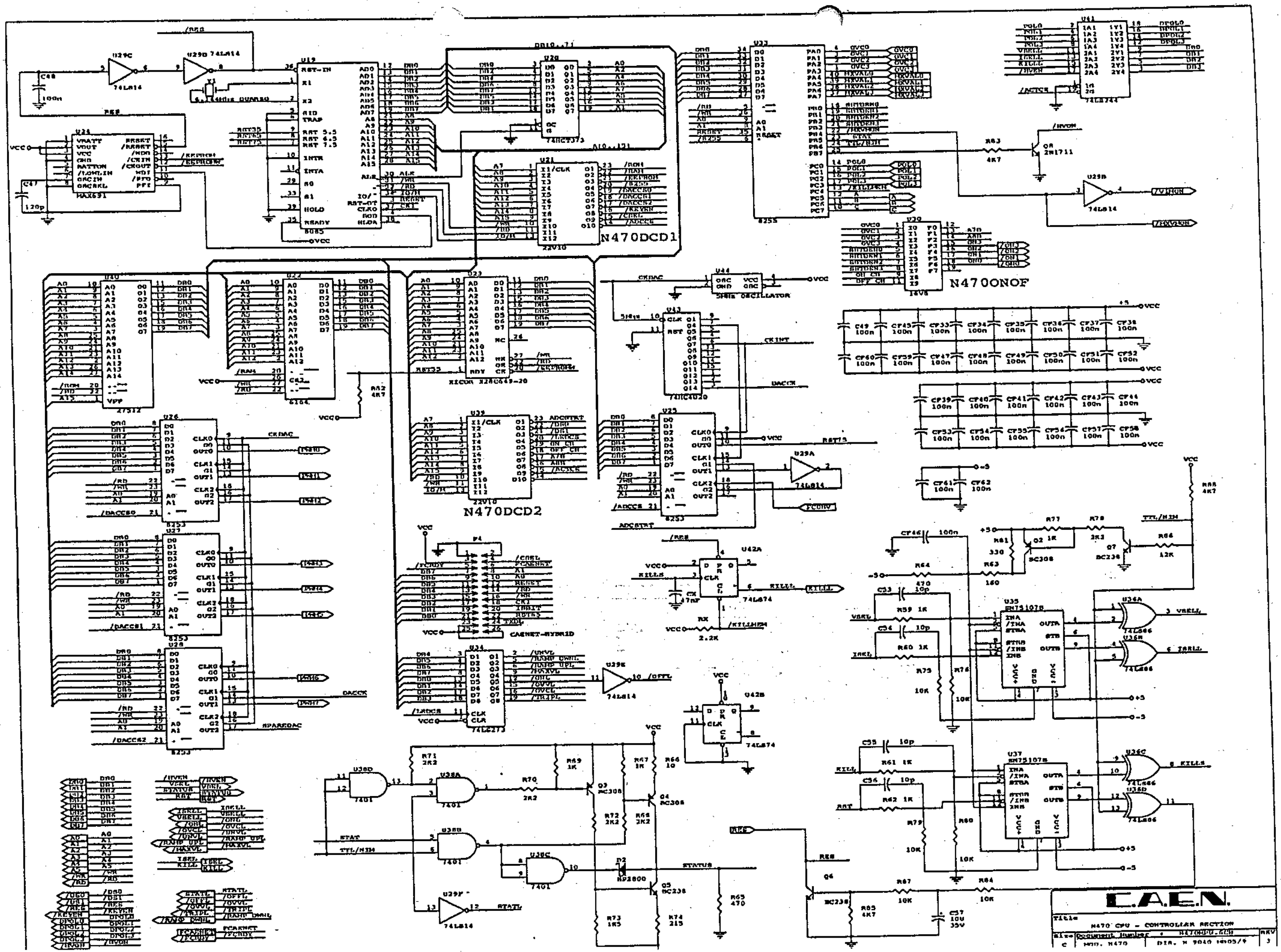
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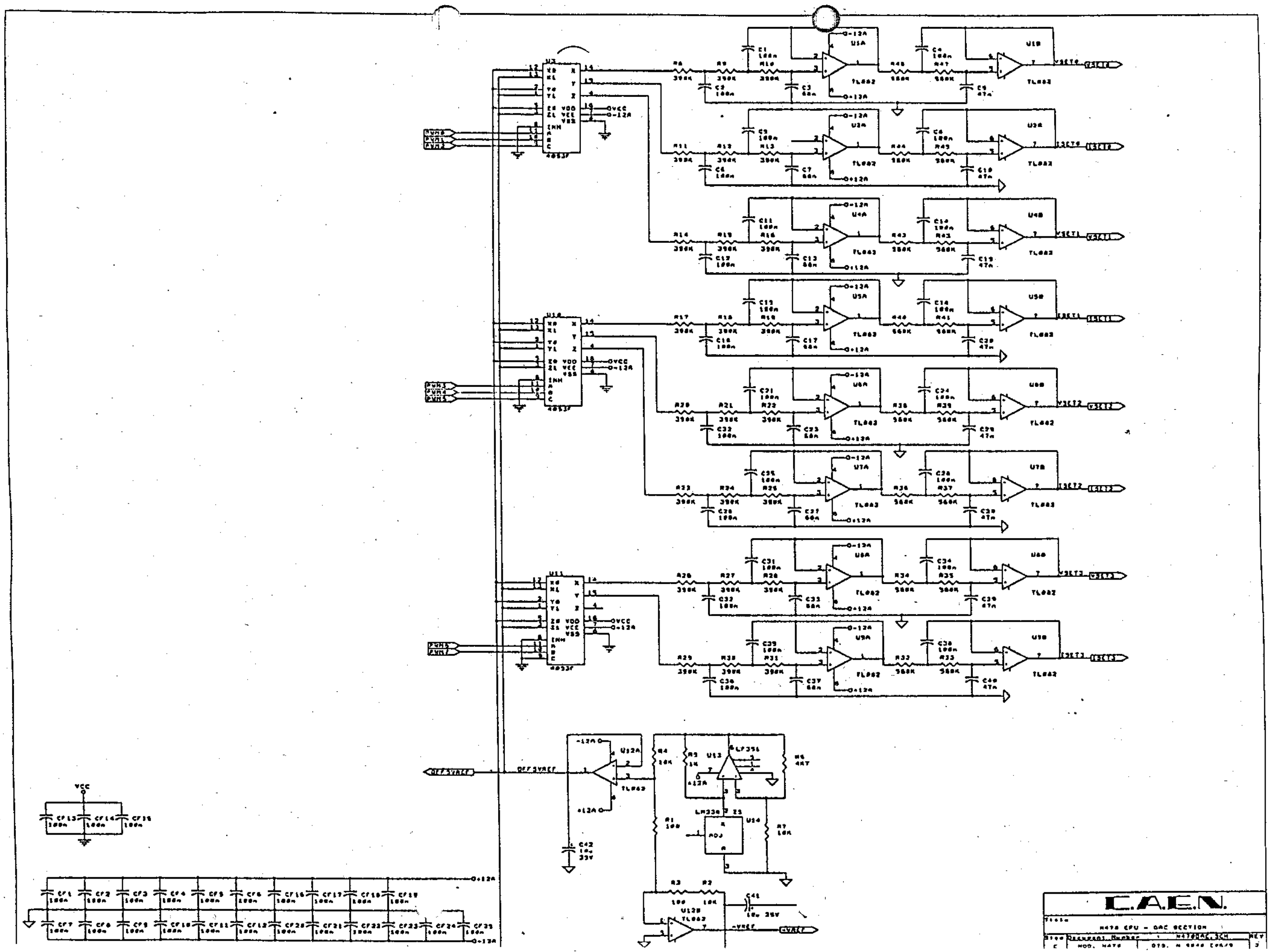
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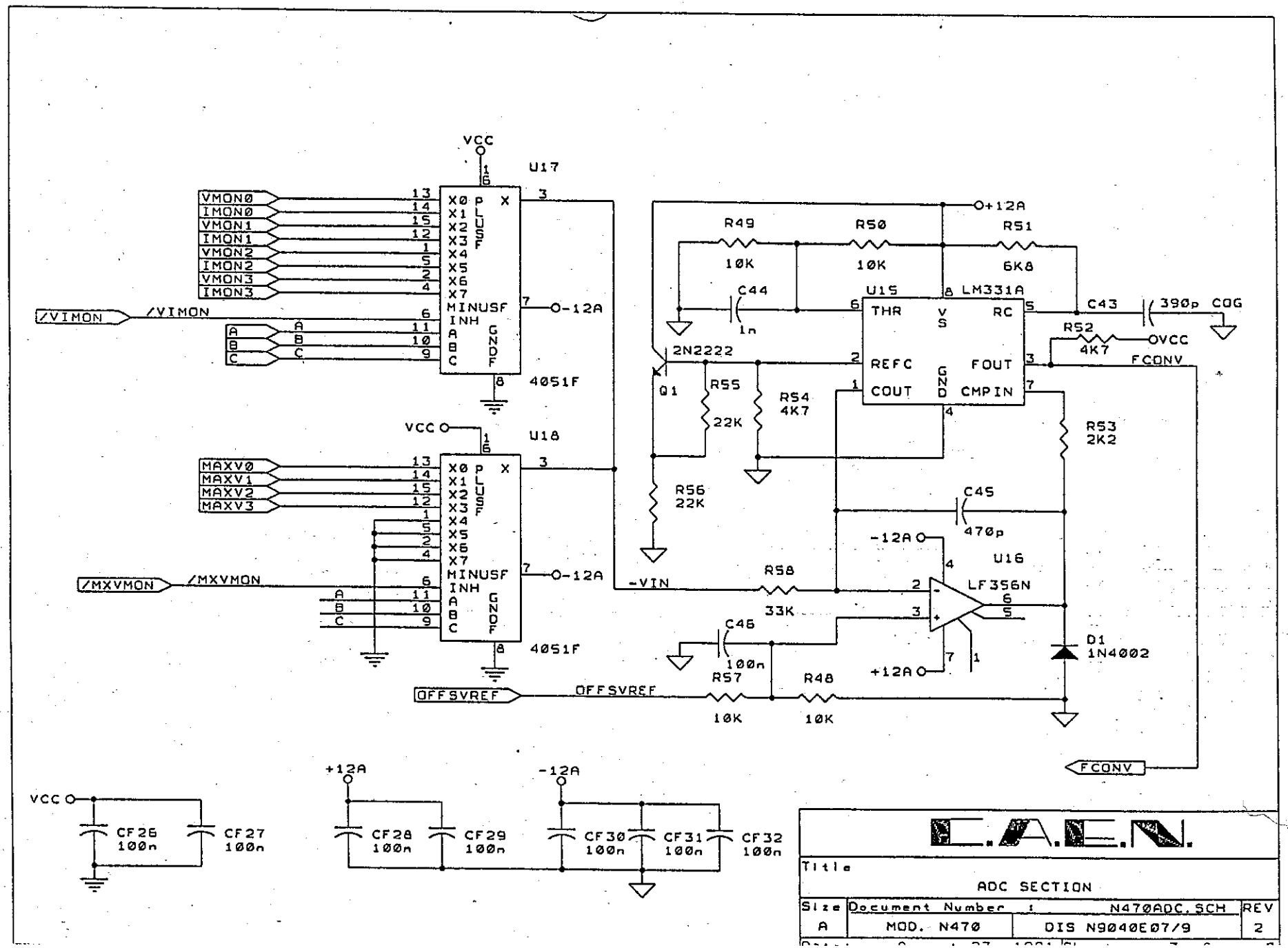
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R50
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COUT
RC
FOUT
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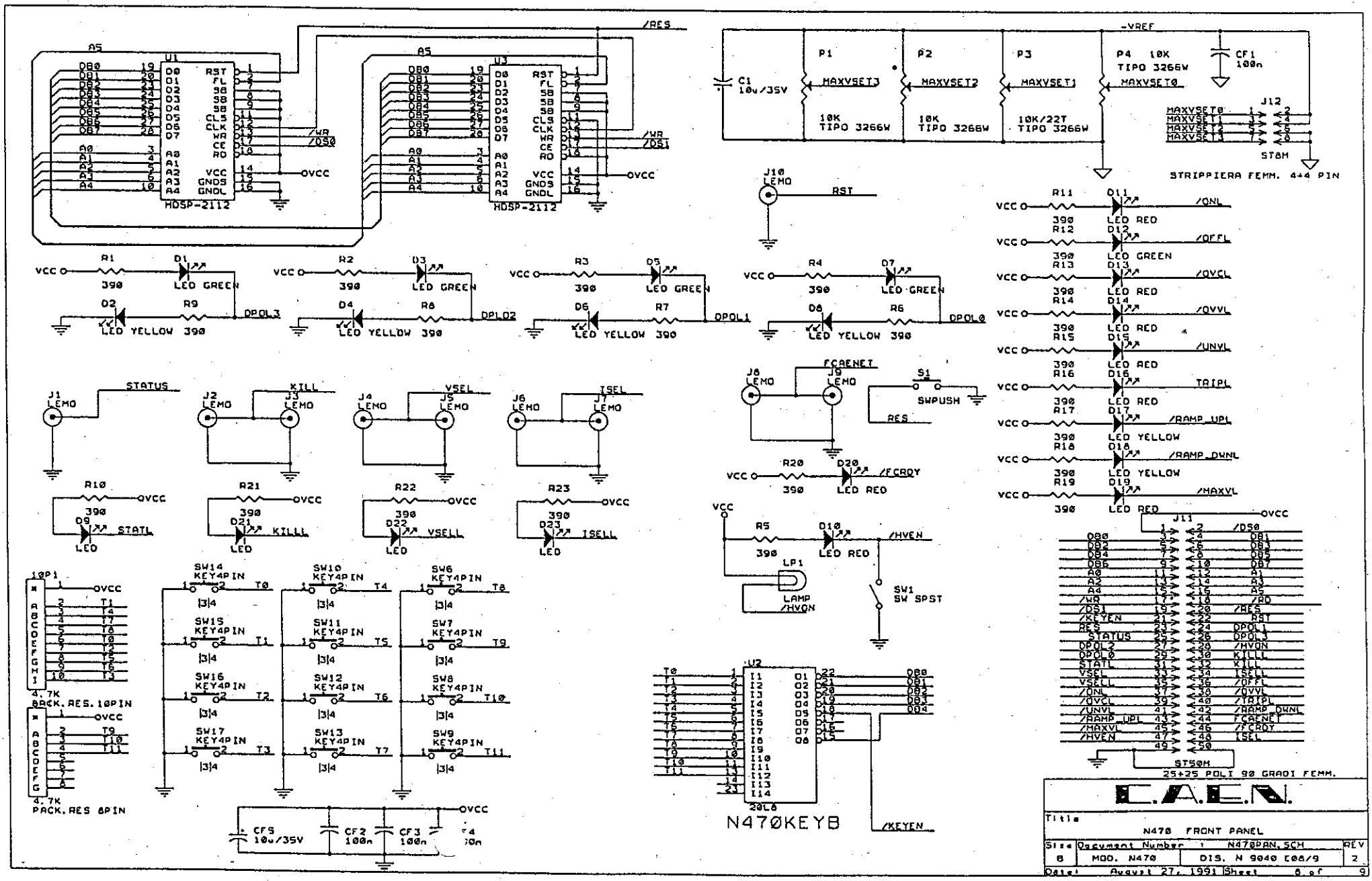
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10u/35V
CF1
100n
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ST8M
STRIPPIERA FEMM. 4+4 PIN
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LEMO
RST
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VSEL
ISEL
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DPOL2
DPOL1
DPOL0
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/HVEN
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SW SPST
J11
ST50M
25+25 POLI 90 GRADI FEMM.
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PACK. RES. 10PIN
4.7K
PACK. RES 8PIN
KEY4PIN
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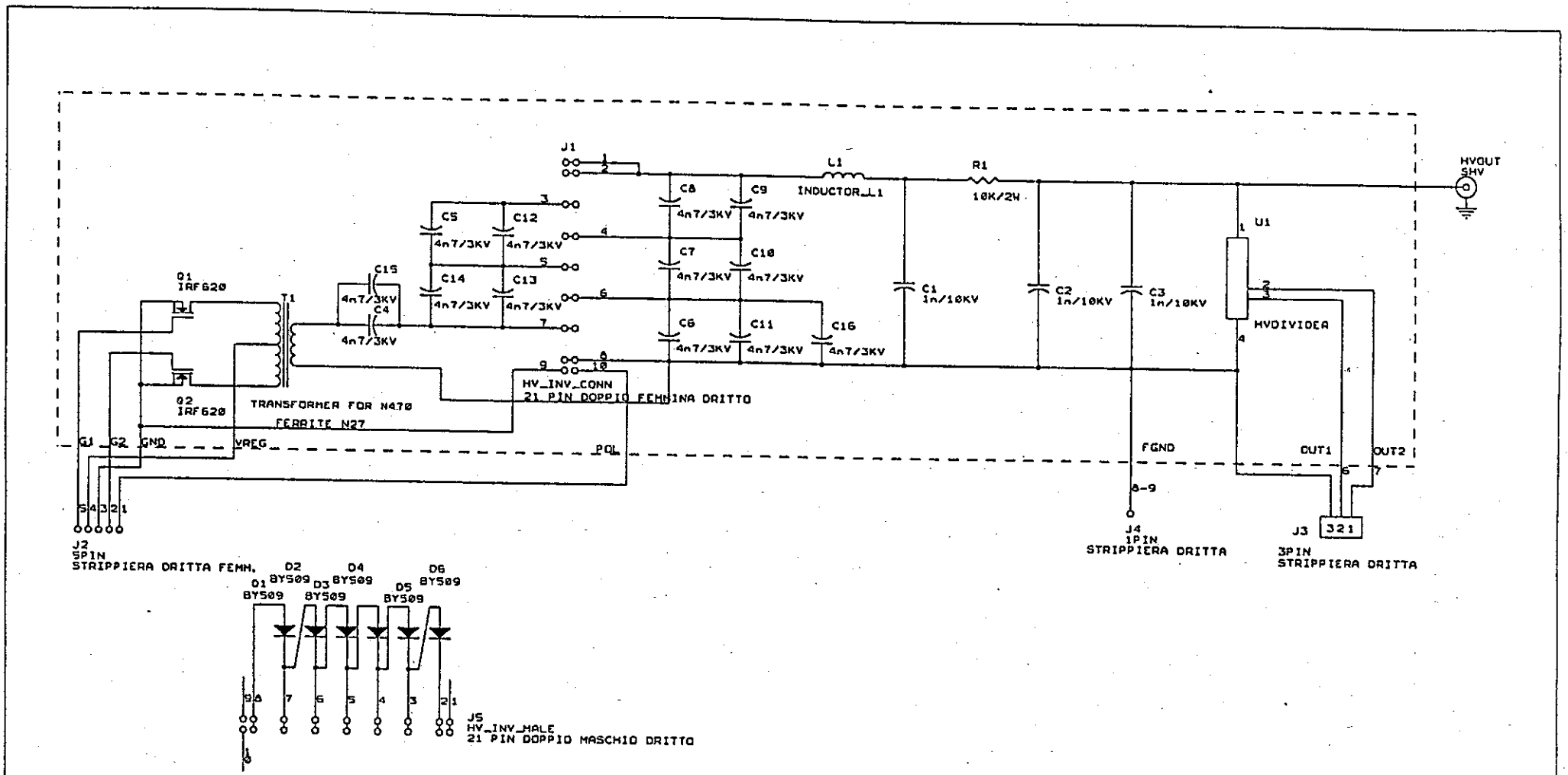
DIS. N 9040 [00/9
Date: August 27, 1991 Sheet 6 of 9



C.A.E.N.

Title	N470 - MULTIPLIER & DIODES	
Size: B	Document Number: N470MUL.SCH	REV: 3
	MOD. N470	DIS. N 9040 E09/9

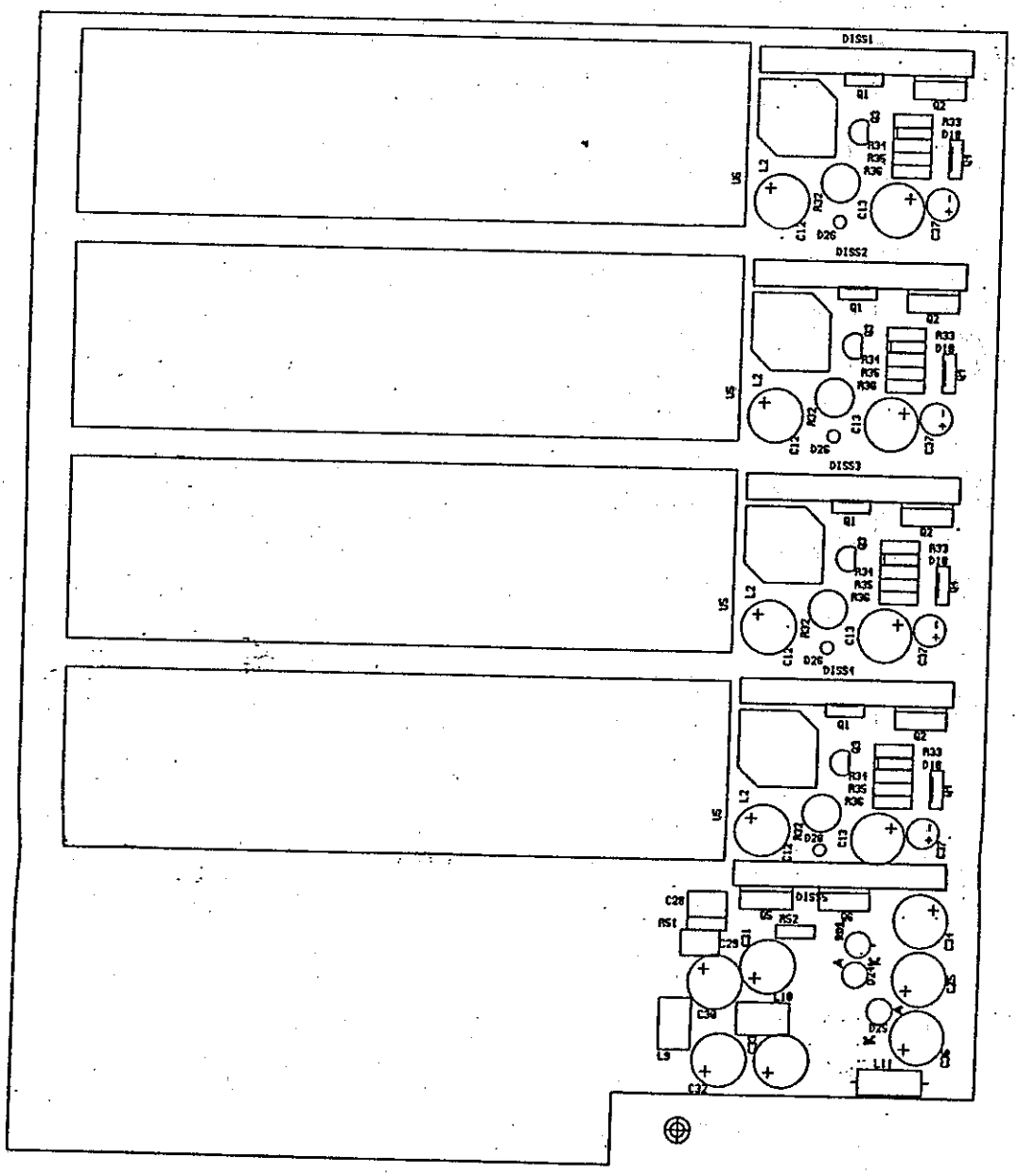
COMPONENTS LIST AND LOCATION

4 CH PROGR.H.V. PWR SUPPLY - MOD. N470 Component List rev. :Dec.06,1991

Item	Quantity	Reference	Part
		FRONT PANEL BOARD	
1	4	CF1,CF2,CF3,CF4	100NF
2	2	C1,CF5	10UF/35V
3	5	D1,D3,D5,D7,D12	GREEN LED
4	6	D2,D4,D6,D8,D17,D18	YELLOW LED
5	12	D9,D10,D11,D13,D14,D15, D16,D19,D20,D21,D22,D23,	RED LED
6	10	J1,J2,J3,J4,J5,J6,J7,J8, J9,J10	LEMO
7	1	J11	FEMALE 17+17 PIN HEADER
8	1	J12	FEMALE 4+4 PIN HEADER
9	1	LP1	LAMP
10	4	P1,P2,P3,P4	10K 3266W
11	23	R1,R2,R3,R4,R5,R6,R7,R8, R9,R10,R11,R12,R13,R14, R15,R16,R17,R18,R19,R20, R21,R22,R23	390
12	1	SW1	SWITCH TWO POSITION
13	12	SW6,SW7,SW8,SW9,SW10, SW11,SW12,SW13,SW14,SW15, SW16,SW17	KEY4PIN (1cm)
14	1	S1	SW-PUSHBUTTON
15	2	U1,U3	HDSP-2112
16	1	U2	GAL20V8
17	1	8P1	4.7K PACKAGE 8PIN
18	1	10P1	4.7K PACKAGE 10PIN
19	4	ON REAR PANEL	SHV

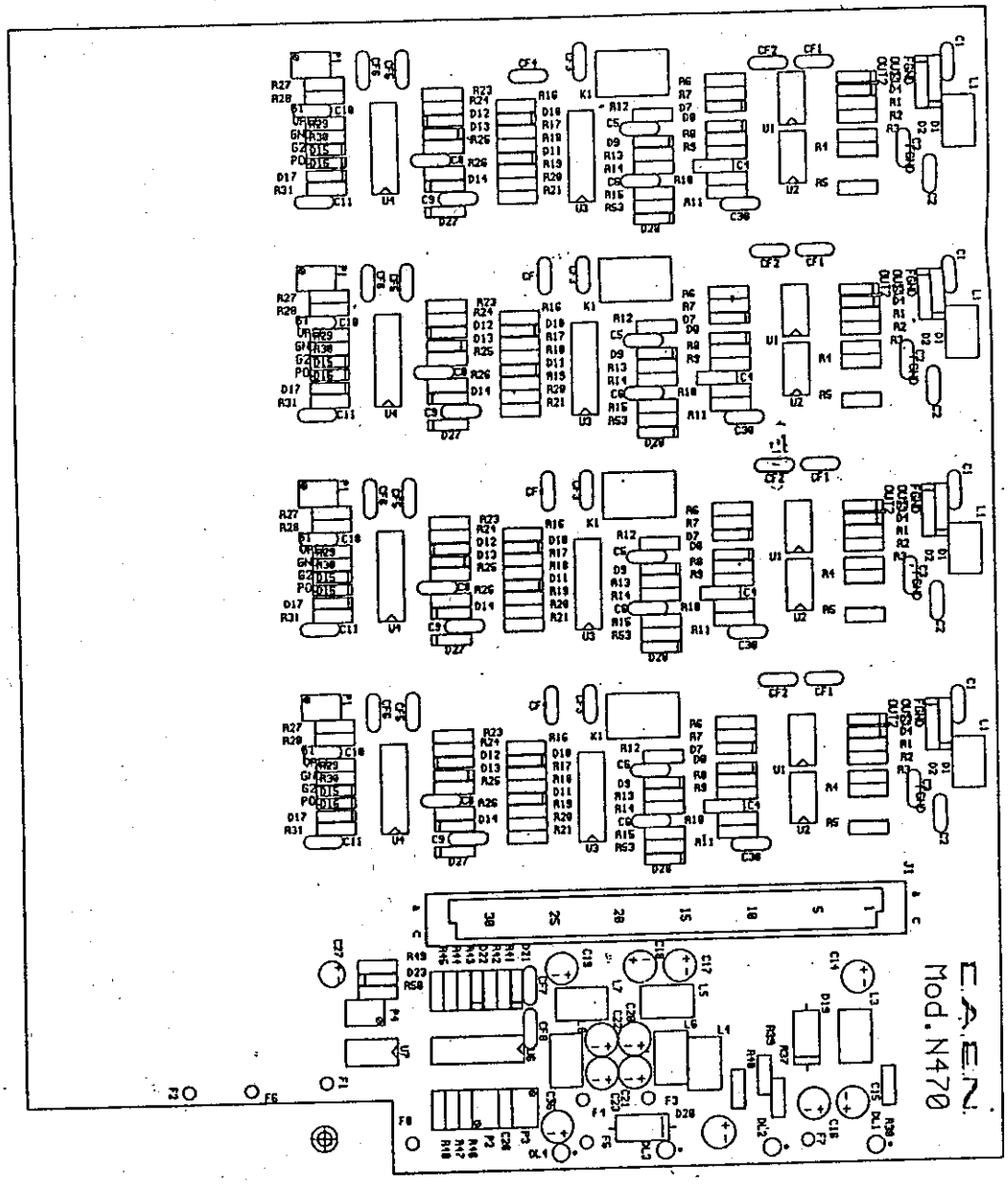
4 CH PROGR.H.V. PWR SUPPLY - MOD. N470 Component List rev. :Dec.06,1991

Item	Quantity	Reference	Part
		MULTIPLIER BOARD	
1	3	C1,C2,C3	1NF/10KV
2	13	C4,C5,C6,C7,C8,C9,C10, C11,C12,C13,C14,C15,C16	4N7F/3KV
3	6	D1,D2,D3,D4,D5,D6	BY509
4	1	J1	STRAIGHT FEM.DOUBLE 21 PIN HEADER
5	1	J2	STRAIGHT FEMALE 5 PIN HEADER
6	1	J3	STRAIGHT FEMALE 3 PIN HEADER
7	1	J4	STRAIGHT FEMALE 21 PIN HEADER
8	1	J5	STRAIGHT MALE DOUBLE 21 PIN HEADE
9	1	L1	INDUCTOR_L1
10	2	Q1,Q2	IRF620
11	1	R1	10K/2W
12	1	T1	TRANSFORMER FOR N470
13	1	U1	HVDIVIDER

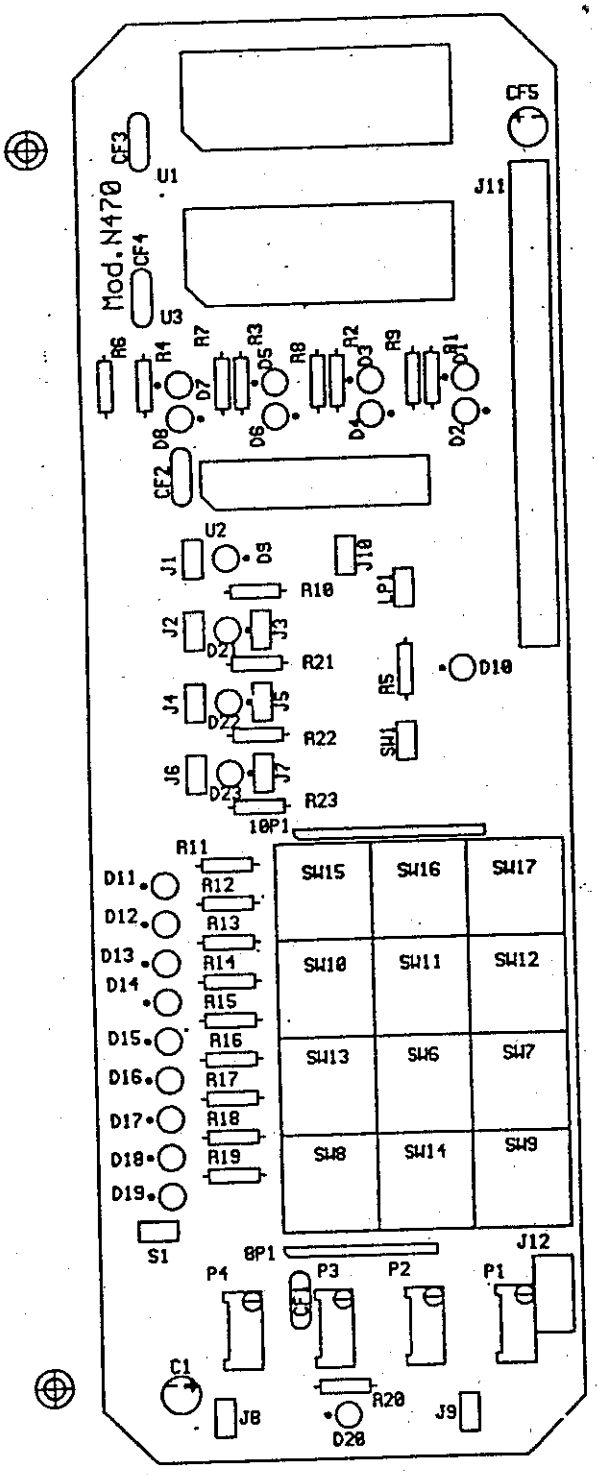


Mod.N470

SOLDER SIDE



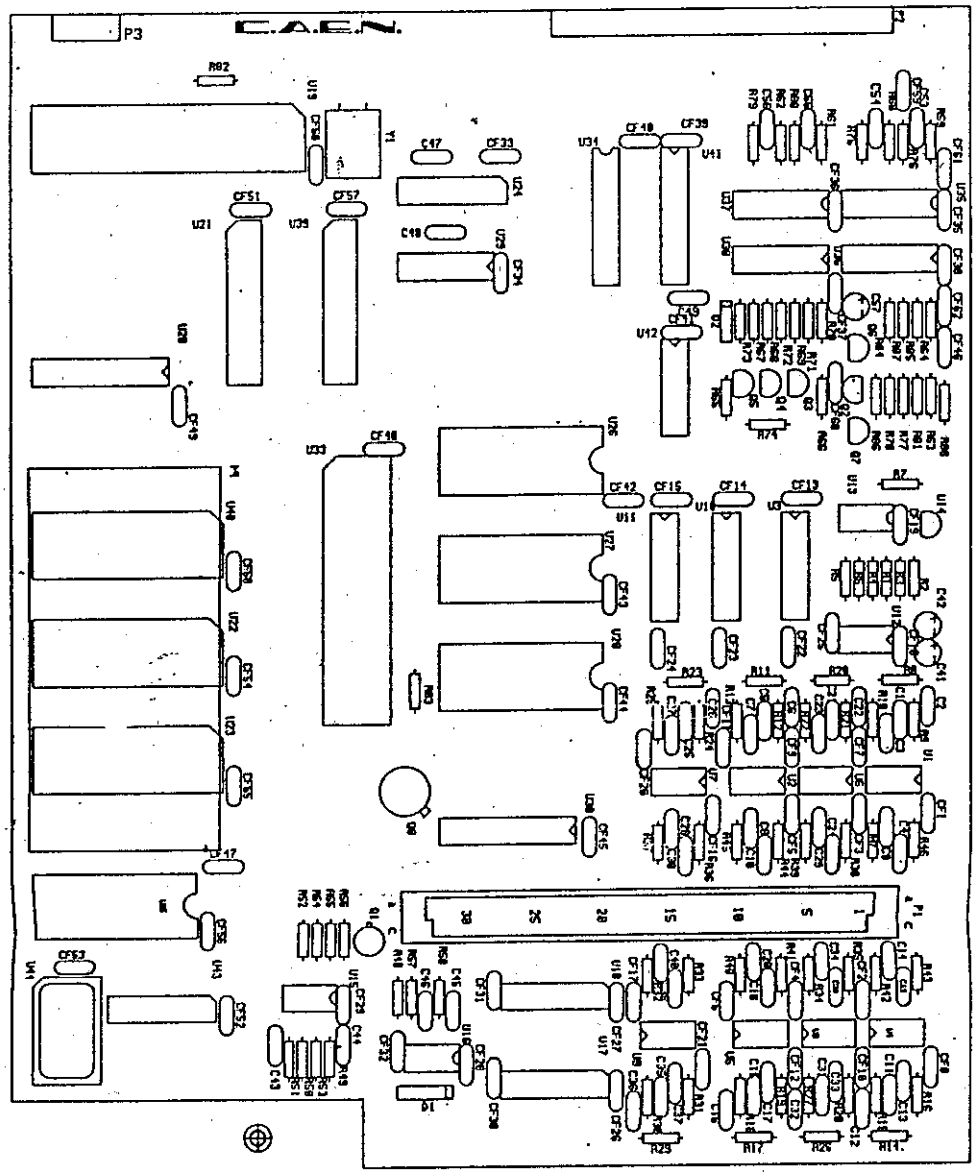
COMPONENTS SIDE



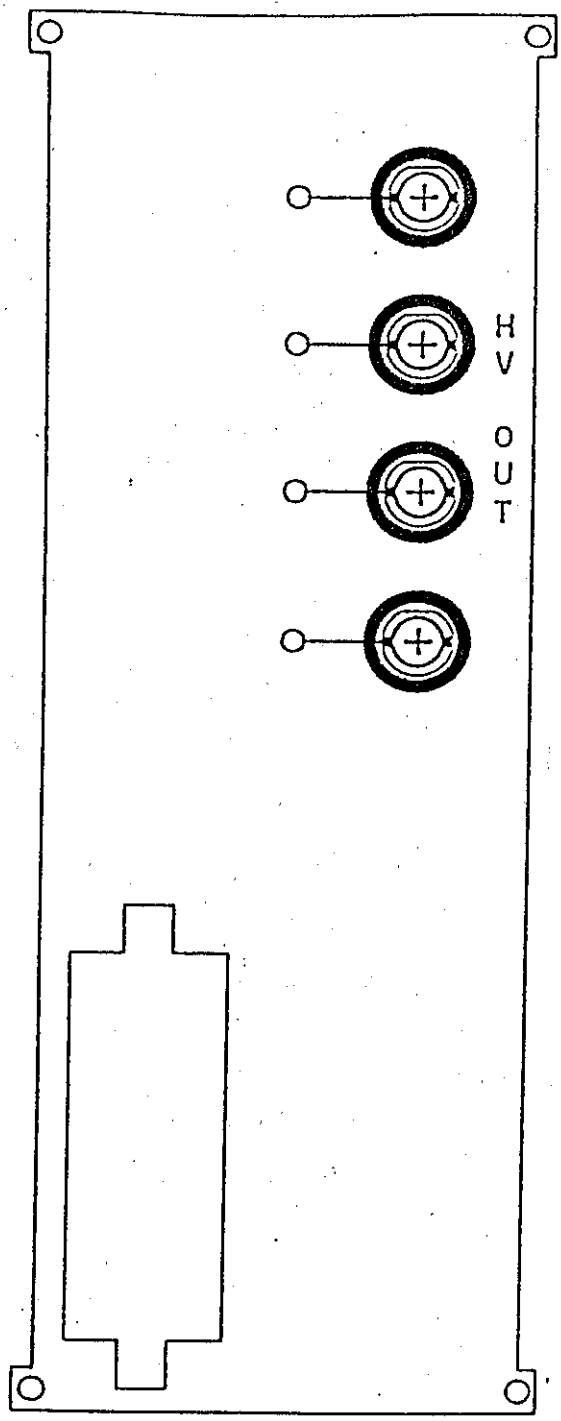
Mod. N470

COMPONENTS SIDE

Mod. N470



COMPONENTS SIDE


HV OUT

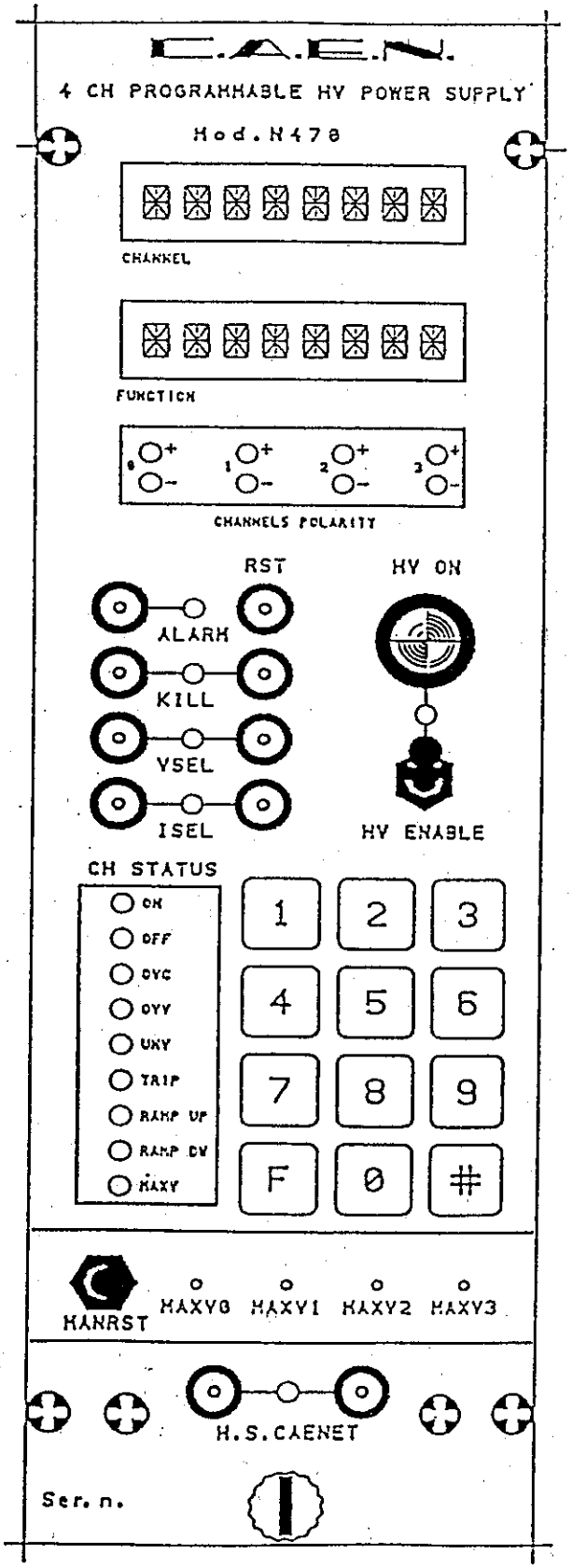

C.A.E.N.
4 CH PROGRAMMABLE HV POWER SUPPLY
Mod.N478
CHANNEL
FUNCTION
CHANNELS POLARITY
RST
HV ON
ALARM
KILL
VSEL
ISEL
HV ENABLE
CH STATUS
ON
OFF
OVC
OVV
UNV
TRIP
RAMP UP
RAMP DW
MAXV
1
2
3
4
5
6
7
8
9
F
0
#
MANRST
MAXV0
MAXV1
MAXV2
MAXV3
H.S.CAENET
Ser.n.

fig. 1

DESCRIPTION

The model N 209 A "TRIPLE PROGRAMMABLE GATED COINCIDENCE" is a single NIM unit which measures the time interval between a START and a STOP signal.

The measure is performed verifying the coincidence between the STOP signal and a GATE signal which is delayed in respect to the START signal. Both the delay and the width of the GATE are programmable. The coincidences are available with three independent GATE signals.

The signals START and STOP are amplified and discriminated according to the technique of the "constant fraction"; the threshold voltages are programmable manually with the trimmer and relative test point situated on the front panel; also the fine adjustment of the zero crossing is foreseen on the front panel through the trimmer and test point.

The output signals from the amplifiers and discriminators are available as well as the three GATE signals and the three coincidence signals; these last signals are also available on the rear panel.

The GATE delay and width are programmable through the CAENET serial line and can be controlled both manually (A 250 Caenet Manual Controller) and by CAMAC (C 117 B Caenet Camac Controller).

All the programmed parameters are memorised in a non-volatile memory and are automatically reloaded at the power-on.

PROGRAMMING

The programming of the N 209 A module parameters can be carried out through the High Speed CAENET serial line controllable by the Mod. A 250 CAENET Manual Controller, and from CAMAC, Mod. C 117 B CAENET CAMAC Controller. For this purpose the N 209 A module has two thumb-wheel switches on the front panel with which it is possible to set the address number (station) which one wants to attribute.

NOTE: this address number must be the only one in line in which you want to insert the module. Due to high transmition speed of the data in line it is necessary to terminate such a line on an impedance of 50Ω at the end to avoid reflections.

For each module N 209 A three channels are at your disposal. Each channel has two programmable parameters called"Delay" and "Gate" respectively.

Using the CAENET Manual Controller A 250

Connect the manual controller to the N 209 A module using a 50Ω coaxial cable by inserting one of the connectors present on the front panel of the module called SERIAL IN/OUT, connecting the other connector to the already existing network or by terminating it on a load of 50Ω. The CAENET manual controller supply can be effected through the dedicated connector still present on the front panel and called POWER MANUAL CTR.

Once supplied the manual controller display will show

CAEN A 250 1.0

Select Cr * *

the indication 1.0 refers to the software release of the controller itself.

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

The display will show

MM Ch1 Del ddd

N 209 Gate gg

where MM is the selected address number, ddd and gg are the delay and gate values actually set on channel 1.

Pressing repeatedly key "#" you can move the flashing cursor, at this moment under the MM field, onto the various display fields on which it is permitted to operate (MM, Ch1, ddd, gg).

Position the cursor on the channel's selection field by pressing the "ROLL" key; the field shows the various channels available for selection in sequence. To confirm the channel choice with which one wishes to operate press the key "#". The display is modified showing in the data fields the programmed values on the selected channel.

To modify the value of a programmed value on a channel:

- select the desired channel;
- position the cursor onto the data field of the parameter you wish to modify;
- press the key "ENTER".

The display modifies itself in the following way

MM Ch2 Del ***

N209 A Gate gg

-digitise the new value for the delay confirming the data pressing the key "#".

The accepted values of the manual controller are 0 ÷ 400 nS in steps of 2 nS for the delay, and 5 ÷ 33 nS in steps of 2 nS for the gate.

NOTE: In trying to programme a value outside the allowed limits the manual controller reacts by inserting the maximum limit nearest to the digitated value.

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

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

Using the CAENET CAMAC controller C 117 B

COMMUNICATION PROTOCOL

The colloquy between the modules Mod. C 117 B CAENET CAMAC Controller and the Mod. N 209 A occurs with an interchange of 16 bit (word) data packets of variable lengths acting as the particular operation requested or of the data to be passed back to the controller.

The data packets from the controller to the N 209 A module must always be contained in the first two words respectively:

word 1	1	code identifier of the controller C 117 B;
word 2	xx	binary code identifier of the module's crate number to which the subsequent message is addressed.

The third word contains the binary code of the command that is to be performed. The N 209 A recognises the following command codes:

0	reading the addressed module's name. The name is passed with 4 ASCII codes that occupies the less significant bytes of 4 words in the answer packet;
1	reading the delay set on channel 1;
2	reading the delay set on channel 2;
3	reading the delay set on channel 3;
4	reading the gate set on channel 1;

5	reading the gate set on channel 2;
6	reading the gate set on channel 3;
7	reading the module parameters identified by codes from 1 to 6 in order;
8	programming the delay of channel 1;
9	programming the delay of channel 2;
10	programming the delay of channel 3;
11	programming the gate of channel 1;
12	programming the gate of channel 2;
13	programming the gate of channel 3;

NOTE. when one uses codes from 8 to 13 the subsequent word must contain the binary data corresponding to the new delay (400 max) or gate (from 5 to 33) value expressed in nSec.

The data packet caused by the N 209 Mod. contains on the first word the answer code of the module with the following meaning:

word 1	0	successful operation
	FF00	BUSY module (if an operation has been tried while the module is still busy registering previous data inside the EEPROM);
	FF01	code not recognised or message incorrect;
	FFFF	the addressed module does not exist. This message is generated after a time limit of 500 mSec;
	FFFE	the master identifier is not correct;
	FFFD	there is no data to transmit.

In the absence of errors the content of the subsequent word is function of the command that is to be sent.

SINGLE PARAMETER READING

Word 2 contains the requested parameter value.

MULTIPLE READING

When the command code to be performed corresponds to the codes 0 or 7 the structure of the data answer packet sent from N 209 A to the controller C 117 B assumes the form

word 2...word 5	contains on the low byte the ASCII code of the string characters identified by the name of the module "N 209";
word 2...word 7	contains the data relative to the corresponding parameters in order of the command codes from 1 to 6. The values are present in the receiving buffer in the same order.

OPERATING MODES

The data packet to be sent to the slave module is loaded in the transmission buffer performing a succession of F(16). The data must be inserted into the buffer in order: from word 1 to word 3 or word 4. Once loaded the packet to be sent to the transmission buffer performs an F (17) to send the packet into line.

The receiving buffer is read in Q stop through the functions F(0).

For more information consult the Technical Information Manual relative to the C 117 B module.