NHQ x0xx

Precision NIM High Voltage Supply NHQ STANDARD series

RS232 Interface

Operators Manual

Contents:

Attention!

-It is not allowed to use the unit if the covers have been removed.

-We decline all responsibility for damages and injuries caused by an improper use of the module. It is highly recommended to read the operators manual before any kind of operation.

Note

The information in this manual is subject to change without notice. We take no responsibility for any error in the document. We reserve the right to make changes in the product design without reservation and without notification to the users.

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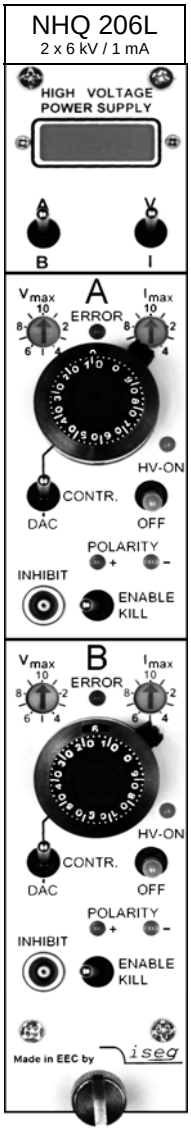
iseg Spezialelektronik GmbH
Bautzner Landstr. 23
D - 01454 Radeberg / Rossendorf
Email: sales@iseg-hv.de
http://www.iseg-hv.com
Germany
Phone ++ 49 351 / 26 996 - 0
Fax ++ 49 351 / 26 996 - 21

1. General information

The NHQ x**0**xx is a single- or dual-channel high voltage supply in a NIM chassis. The unit is 1 slot wide and offers manual control and remote operation via RS232 Interface. As an option also a CAN-Bus interface according to the CAN specification 2.0 B is available. The use of remote control supports extended functionality compared to manual control.
The high voltage supplies provide a high precision output voltage together with very low ripple an noise, even under full load. Separate hardware switches allow to put voltage and current limits in 10%-steps. An INHIBIT input protects sensitive devices. Additionally, a maximum output current per channel can be specified via the interface. The high voltage source is protected against overload and short circuit. The output polarity can be switched over. The HV-GND is connected to the chassis and the powering GND.

2. Technical Data

NHQ - one channel **- two channel**		**102M** **202M**	**103M** **203M**	**104M** **204M**	**105M** **205M**	**106L** **206L**
Output voltage V_{out}		0 .. 2 kV	0 ... 3 kV	0 ... 4 kV	0 ... 5 kV	0 ... 6 kV
Output current I_{out}		0 ... 6 mA	0 ... 4 mA	0 ... 3 mA	0 ... 2 mA	0 ... 1 mA
		with option 104 (**M** ⇒ **L**): max 100 µA				
Ripple and noise	typ.	< 1 mV_{pp}	< 1 mV_{pp}	< 1 mV_{pp}	< 2 mV_{pp}	< 2 mV_{pp}
	max.	2 mV_{pp}	2 mV_{pp}	2 mV_{pp}	5 mV_{pp}	5 mV_{pp}
LCD Display		4 digits with sign, switch controlled -voltage display in [V], -current display in [µA]				
Resolution of voltage measurement		1 V				
current measurement		1 µA, with option 104: 100 nA at $I_{out\ max} \leq$ 100 µA				
Accuracy	voltage	± (0,05% V_{out} + 0,02% $V_{out\ max}$ + 1 digit) for one year				
	current	± (0,05% I_{out} + 0,05% $I_{out\ max}$ + 1 digit) for one year				
Stability	$\Delta V_{out} / V_{INPUT}$	< 5 ∗ 10^{-5}				
	ΔV_{out}	< 5 ∗ 10^{-5} (idle to max. load)				
Temperature coefficient		< 5 ∗ 10^{-5}/K				
Voltage control		CONTROL switch in: upper position - manual: 10-turn potentiometer, lower position - DAC: control via interface				
Rate of change of Output voltage		- HV -ON/OFF (hardware ramp): 500 V/s - control via interface (software ramp): 2 - 255 V/s				
Protection		- separate current and voltage limit (hardware, rotary switch in 10%-steps), - INHIBIT (external signal, TTL-level, Low active), - programmable current limit (software)				
Power requirements V_{INPUT}		± 24 V (< 800 mA, one channel < 400 mA), ± 6 V (< 100 mA), with option N24: only ± 24 V				
Operating temperature		0 . . . 50 °C				
Storage temperature		-20 . . . +60 °C				
Packing		NIM Standard chassis: NIM 1/12				
Connector		NIM: 5-pin; Interface: 9-pin female D-Sub				
HV connector		SHV-Connector on rear side				
INHIBIT connector		1-pin Lemo-hub				



3. NHQ Description

The functional principle is described in the block diagram, Appendix A.

High voltage supply

For the high voltage generation a patented highly efficient resonance converter circuit is used, which provides a sinusoidal voltage with low harmonics for the HV-transformer. For the high voltage rectification high speed HV-diodes are used. A high-voltage switch, connected to the rectifier allows the selection of the polarity. The consecutive active HV-filter damps the residual ripple and ensures low ripple and noise values as well as the stability of the output voltage. A precision voltage divider is integrated in the HV-filter to provide a feedback voltage for the output voltage control, an additional voltage divider supplies the signal for the maximum voltage monitoring. A precision control amplifier compares the feedback voltage with the set value given by the DAC (remote control) or the potentiometer (manual control). Signals for the control of the resonance converter and the stabilizer circuit are derived from the result of the comparison. The two-stage layout of the control circuit results in an output voltage, stabilized with very high precision to the set point.
Separate security circuits prevent exceeding the front-panel switch settings for the current I_{max} and voltage V_{max} limits. A monitoring circuit prevents malfunction caused by low supply voltage.
The internal error detection logic evaluates the corresponding error signals and the external INHIBIT signal and impacts the output voltage according to the setup. In addition this allows the detection of short over currents due to single flashovers.

Digital control unit

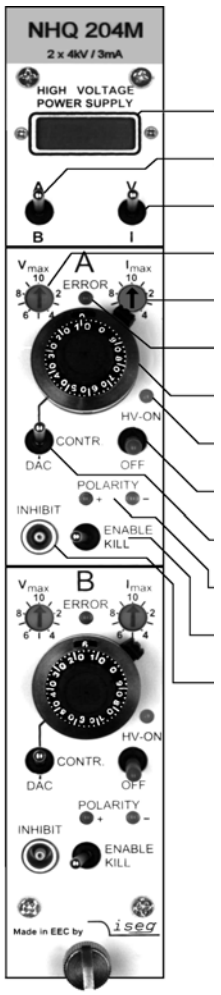
A micro controller handles the internal control, evaluation and calibration functions of both channels. The actual voltages and currents are read cyclically by an ADC with a connected multiplexer. The readings are processed and displayed on the 4 digit LCD. The current and voltage hardware limits are retrieved cyclically several times per second. A reference voltage source provides a precise voltage reference for the ADC and the control voltage for the manual operation mode of the unit.
In the computer controlled mode the set values for the corresponding channels are generated by a 16-Bit DAC.

Filter

A special feature of the unit is a tuned filtering concept, which prevents perturbation of the unit by external electromagnetic radiation, as well as the emittance of interferences by the module. A filtering network for the supply voltages is located next to their connectors, the converter circuits of the individual channels are protected by additional filters. The high-voltage filters are housed in individual metal enclosures to shield even minimal interference radiation.

iseg Spezialelektronik GmbH
Bautzner Landstr. 23
D - 01454 Radeberg / Rossendorf
Email: sales@iseg-hv.de
http://www.iseg-hv.com
Germany
Phone ++ 49 351 / 26 996 - 0
Fax ++ 49 351 / 26 996 - 21

4. Front panel



[1] 4 digit LCD display
[2] Channel switch
[3] Measuring switch
[4] Rotary switch Voltage limit
[5] Rotary switch Current limit
[6] Error indicator
[7] 10 - turn potentiometer
[8] HV-On indicator
[9] HV-On switch
[10] Control switch
[11] Polarity indicator
[12] KILL switch
[13] INHIBIT input

5. Handling

The NIM connector, the HV-outputs and the 9 pin female D-Sub connector for the RS 232 interface are located on the rear panel.

Before the unit is powered the desired output polarity must be selected by the rotary switch on the cover side (see appendix B). The chosen polarity is displayed by a LED on the front panel [11] and a sign on the LCD [1].

Attention! It is not allowed to change the polarity under power!

If the switch setting is undefined (not at one of the end positions) high voltage cannot be switched on.

High voltage output is switched on with the HV-ON switch [9] at the front panel. The viability is signaled by the yellow LED [8].

Attention! If the CONTROL switch [10] is in upper position (manual control), high voltage is generated at the HV-output on the rear side, started with a ramp speed from 500 V/s (hardware ramp) to the set voltage chosen via the 10-turn potentiometer [7].
This is also the same, if the unit is switched from interface control to manual control.

If the CONTROL switch [10] is in lower position (DAC) the high voltage will be activated only after receiving corresponding interface commands.

Attention! If the function ″Autostart″ has been activated in the previous operating session, the high voltage generation starts immediately with the saved parameters.

Output voltage in [V] or output current in [µA] will be displayed on the LCD [1] depending on the position of the Measuring switch [3].

For two channel units the Channel switch [2] selects whether channel (A) or channel (B) is displayed.

In the manual control mode the output voltage can be set via 10-turn potentiometer [7] in a range from 0 to the maximum voltage.

If the CONTROL switch [10] is switched over to remote control, the DAC takes over the last set output voltage of the manual control. The output voltage can be changed remotely with a programmable ramp speed (software ramp) from 2 to 255 V/s in a range from 0 to the maximum voltage.

The maximum output current for each channel (current trip) can be set via the remote interface in units of the resolution of the upper measurement range. If the output current exceeds the programmable limit, the output voltage will be shut off permanently by the software. A recovery of the voltage is possible after ″Read status word″ and then ″Start voltage change″ via serial interface. If ″Auto start″ is active, ″Start voltage change″ is not necessary.

The maximum output voltage and current can be selected in 10%-steps with the rotary switches V_{max} [4] and I_{max} [5] (switch dialed to 10 corresponds to 100%) independently of programmable current trip. The red error LED on the front panel [6] signals if the output voltage or current approaches the limits.

The KILL switch [12] specifies the response on exceeding limits or on the external protection signal at the INHIBIT input [13] as follows:

Switch to the right position: (ENABLE KILL)	When exceeding V_{max}, I_{max} or in the presence of an INHIBIT signal (Low=active) the output voltage will be shut off permanently without ramp. The output voltage is only restored after switching HV-ON [9] or KILL [12] or ″Read status word″ and then ″Start voltage change″ by DAC control. If ″Auto start″ is active, ″Start voltage change″ is not necessary.
Note:	If a capacitance is effective at the HV-output or when using a high voltage ramp speed (hardware ramp) under high loads, then the KILL function may be triggered by the capacitor charging currents. In this case smaller output voltage change rates (software ramp) should be used or ENABLE KILL should only be selected once the set voltage is reached at the output.
Switch to the left position: (DISABLE KILL)	The output voltage is limited to V_{max}, the output current to I_{max} respectively; INHIBIT shuts the output voltage off without ramp, the previous voltage setting will be restored with hard- or software ramp once INHIBIT no longer being present.

6. RS232 interface

The following functionality is provided for the operation of the high voltage units via the RS232 interface.

RS232 control mode

- Write function: set voltage; ramp speed; maximal output current (current trip); auto start
- Switch function: output voltage = set voltage, output voltage = 0
- Read function: set voltage; actual output voltage; ramp speed; actual output current; current trip; auto start ; hardware limits current and voltage; status

Front panel switches have priority over software control.

Manual control mode

While the unit is operated in manual control mode, RS232 read cycles are interpreted only. Commands are accepted, but do not result in a change of the output voltage.

Specification RS232 interface

The data exchange is character based, the synchronisation for the transfer direction PC to HV-source (input) is performed using an echo. The data transfer to the PC (output) is asynchronous. Between two characters a programmable delay time is included to allow the computer to receive and evaluate the incoming data. The default delay time setting is 3 ms.

The hardware setting of the RS232 interface is 9600 bit/s, 8 bit/character, no parity, 1 stop bit.

Signal transmission is performed potential free via the RxD and TxD, relative to GND.

The HV-supply is equipped with a 9 pin female D-Sub connector, the connection can be set up using a 1:1 extension cord (no null modem cable) when a PC is used. The pin assignment is given in table 1. Control signals to be bridged on the PC side when a three lead cable is used, are also given in table 1.

Table 1:

Signal pin assignment

Signal RS 232	HV-supply DSUB9	Int.	PC DSUB9	PC DSUB25	Connection 3-lead cable
RxD	2		2	3	
TxD	3		3	2	
GND	5		5	7	
	4	┐	4	20	┐
	6	┤	6	6	┤
	8	┘	8	5	┘

Syntax

The commands are transmitted in ASCII. All commands are terminated by the sequence <CR> <LF> (0x0D 0x0A , 13 10 respectively). Leading zeroes can be omitted on input, output is in fixed format.
In order to assure synchronisation between the computer and the supply at first <CR><LF> has to be sent.

Command set

command	Computer	HV-supply
Read module identifier	# *	# * nnnnnn ; n.nn ; U ; I * (unit number ; software-rel. ; $V_{out\ max}$; $I_{out\ max}$)
Read delay time	W *	W * nnn * (delay time 1 ... 255 ms)
Write delay time	W=nnn *	W=nnn * * (delay time = 1 - 255 ms)
Read actual voltage channel 1	U1 *	U1 * {polarity / voltage} * (in V)
Read actual current channel 1	I1 *	I1 * {mantissa / exp. with sign} * (in A)
Read voltage limit channel 1	M1 *	M1 * nnn * (in % of $V_{out\ max}$)
Read current limit channel 1	N1 *	N1 * nnn * (in % of $I_{out\ max}$)
Read set voltage channel 1	D1 *	D1 * {voltage} * (in V)
Write set voltage channel 1	D1=nnnn *	D1=nnnn * * (voltage in V; <M1)
Read ramp speed channel 1	V1 *	V1 * nnn * (2 ... 255 V/s)
Write ramp speed channel 1	V1=nnn *	V1=nnn * * (ramp speed = 2 - 255 V/s)
Start voltage change channel 1	G1 *	G1 * S1=xxx * (S1 , ⇒ Status information)
Write current trip cannel 1	L1=nnnn *	L1=nnnn * * (corresponding current resolution > 0)
Read current trip channel 1	L1 *	L1 * nnnn * (s.a., for nnnn=0 ⇒ no current trip)
Read status word channel 1	S1 *	S1 * xxx * (S1 , ⇒ Status information)
Read module status channel 1	T1 *	T1 * nnn * (code 0...255, ⇒ Module status)
Write auto start channel 1	A1=nn *	A1=nn * * (conditions ⇒ Auto start)
Read auto start channel 1	A1 *	A1 * n * (8 ⇒ auto start is active; 0 ⇒ inactive)

* = <CR><LF>

The second channel of the supply is addressed by replacing 1 with 2 !

Status information:

xxx:	ON<SP>	Output voltage according to set voltage
	OFF	Channel front panel switch off
	MAN	Channel is on, set to manual mode
	ERR	V_{max} or I_{max} is / was exceeded
	INH	Inhibit signal was / is active
	QUA	Quality of output voltage not guaranteed at present
	L2H	Output voltage increasing
	H2L	Output voltage decreasing
	LAS	Look at Status (only after G-command)
	TRP	Current trip was active

If output voltage has been shut off permanently (by ERR or INH at ENABLE KILL or TRP) the command ″Read status word″ must be executed before the output voltage can be restored.

Error codes:

????	Syntax error
?WCN	Wrong channel number
?TOT	Timeout error (with following re-initialisation)
?<SP>UMAX=nnnn	Set voltage exceeds voltage limit

Module status:

Status		Description		Bit	value
QUA		Quality of output voltage not given at present		7=1	128
ERR		V_{max} or I_{max} is / was exceeded		6=1	64
INH		INHIBIT signal	was / is active	5=1	32
			inactive		0
KILL_ENA		KILL-ENABLE is	on	4=1	16
			off		0
OFF		Front panel HV-ON switch in	OFF position	3=1	8
			ON position		0
POL		Polarity set to	positive	2=1	4
			negative		0
MAN		Control	manual	1=1	2
			via RS 232 interface		0
T1:	U/I	Display dialled to	voltage measurement	0=1	1
			current measurement		0
T2:	A/B	Channel dialled to	channel A	0=1	1
			channel B		0

Auto start:

Description		Bit	value
If the precondition for Auto start (module status: OFF + ERR + INH + MAN = 0) is satisfied, the output voltage is automatically ramped to the set voltage. Thus the G-command or POWER-ON and OFF ⇒ ON are not required. If output voltage has been shut off permanently (by ERR or INH at ENABLE KILL or TRP), the previous voltage setting will be restored with software ramp after ″Read status word″.		3=1	8
Values are written to the registers only at POWER-ON!	Save Current trip to EEPROM	2=1	4
	Save Set voltage to EEPROM	1=1	2
	Save Ramp speed to EEPROM	0=1	1

(EEPROM guarantees 1 million saving cycles)

Software

Contact us for an overview on our user friendly control and data acquisition software!

7. Program example

```
/*****************************************************************************************************/
/*                                                                                                   */
/*      nhq.cpp                                                                                      */
/*                                                                                                   */
/*      example program for iseg nhq hv boards, written by Jens Römer, 27.2.97                       */
/*                                                                                                   */
/*      this code was compiled under BC, please contact iseg for the source file                     */
/*                                                                                                   */
/*****************************************************************************************************/

#include <dos.h>
#include <stdio.h>
#include <conio.h>
#include <stdlib.h>
#include "int14.h"                                          // COM2 handling

const       etx= 0x03;
const       f = 0x0a;
const       cr = 0x0d;
unsigned    char readU[]={'U','1',cr,lf,etx};               //read voltage
unsigned    char sendU[]={'D','1','=','1','0',cr,lf,etx};   //set voltage to 10V
unsigned    char *ptr;
unsigned    char rby;
int         i, cnt;
boolean     ok;

void main(void)
{
        clrscr();
        COM2_init();
        COM2_set(9600);                                     // COM2:        9600 baud, 8 databits, no parity, 1 stopbit
        ok=True_;
        ptr=readU;
        for (;;)
        {
                if (*ptr==etx) break;
                COM2_send(*ptr);                            //send one byte
                rby=COM2_read();                            //read one byte
                if (rby!=*(ptr++)) ok=False_;               //compare sent with read data
                else switch (rby)
                {
                        case lf : printf("%c",lf); break;
                        case cr : printf("%c",cr); break;
                        default : printf("%c",rby); break;
                }
                if (ok==False_)
                {
                        printf("No coincident read data found!");
                        exit(1);
                }
        }
        cnt=8;
        do
        {
                rby=COM2_read();                                    //read voltage data
                switch (rby)
                {
                        case lf : printf("%c",lf); break;
                        case cr : printf("%c",cr); break;
                        default : printf("%c",rby); break;
                }
                cnt--;
        } while (cnt>=1);
}
```

8. CE Certificate

CE – Certificate (Copy)

This is to certify that the manufacturer

iseg Spezialelektronik GmbH
Bautzner Landstr. 23
D - 01454 Radeberg / Rossendorf
Germany

guaranties the compliance to the following:

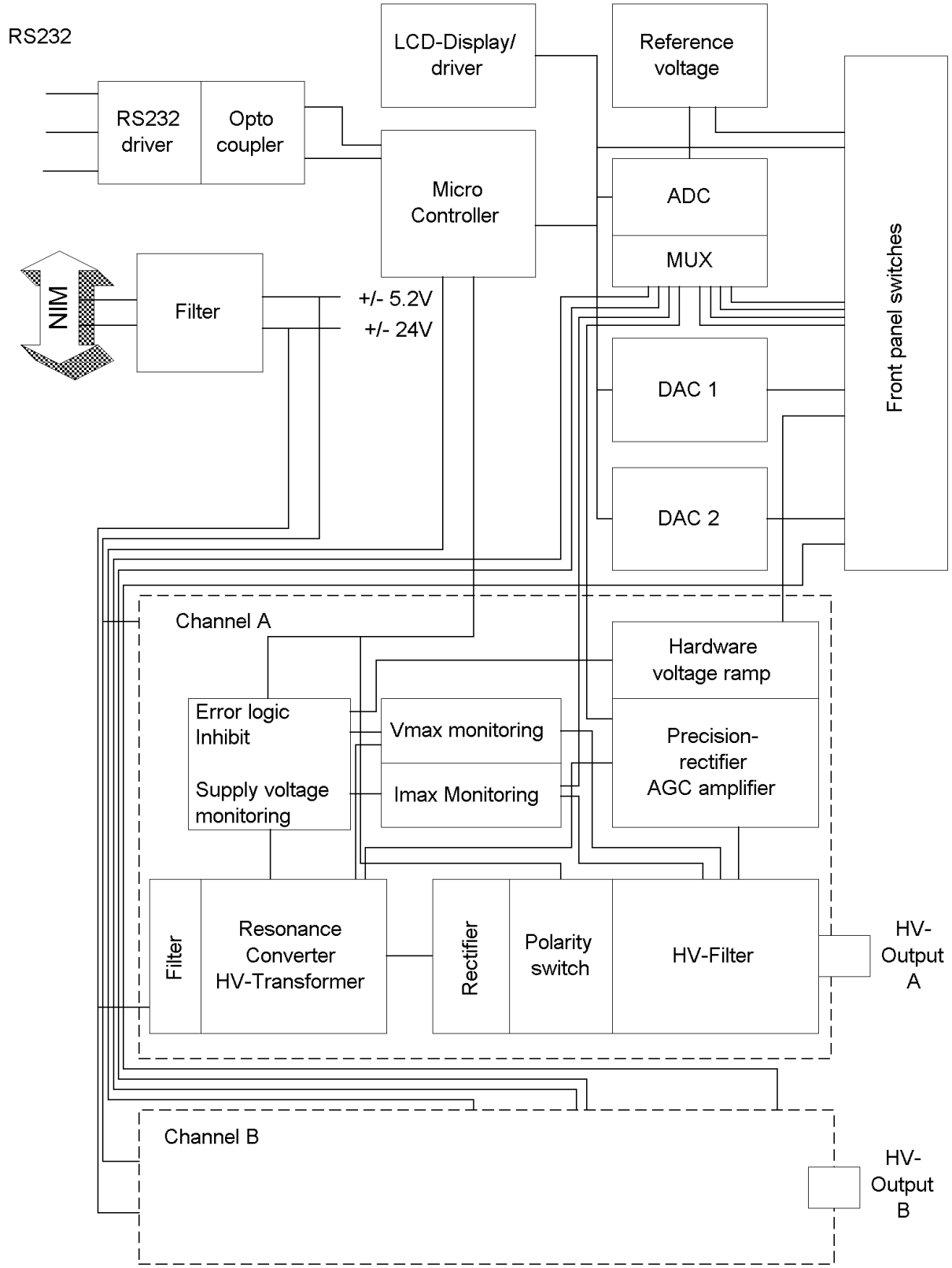
VDE 0843 Part 3 / 02.88
VDE 0875 Part 11 / 07.92
VDE 0877 Part 1 / 03.89
EN 50082-2 / 02.96
ENV 50140 / 02.95
EN 61000 Part 4-2 / 03.96
EN 61000 Part 4-4 / 03.96
EN 61000 Part 4-6 / 04.97
EN 61000 Part 4-8 / 05.94

for the precision high voltage power supplies

of the NHQ STANDARD – Series.

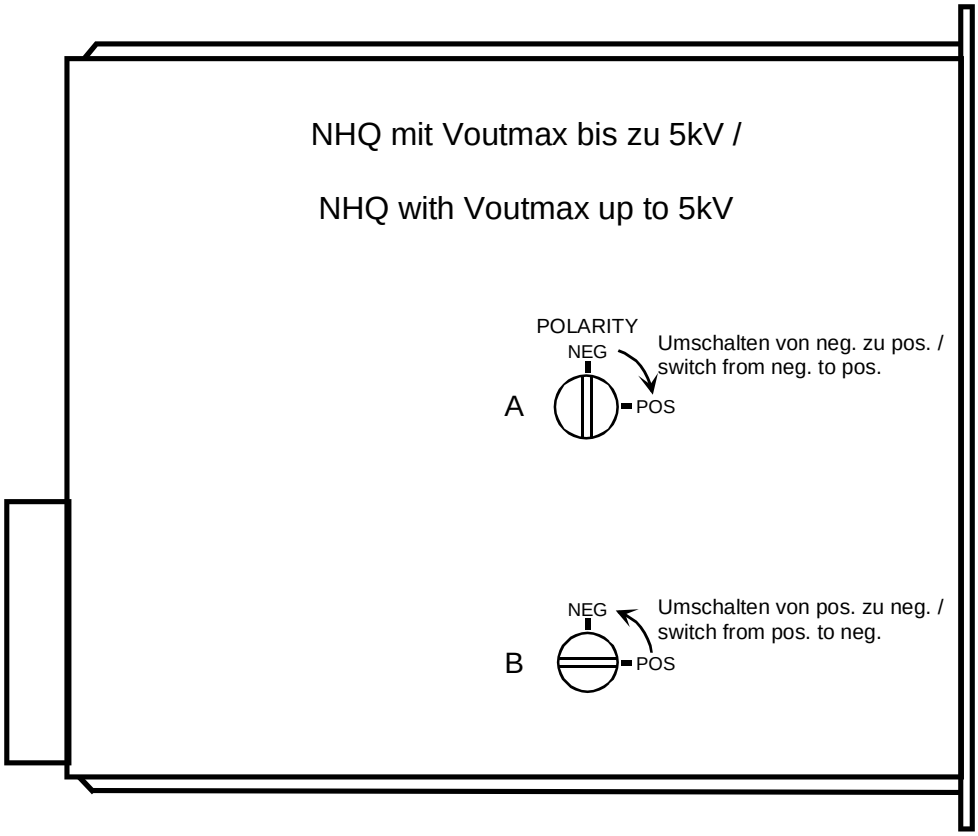
Rossendorf, dated 30.09.98

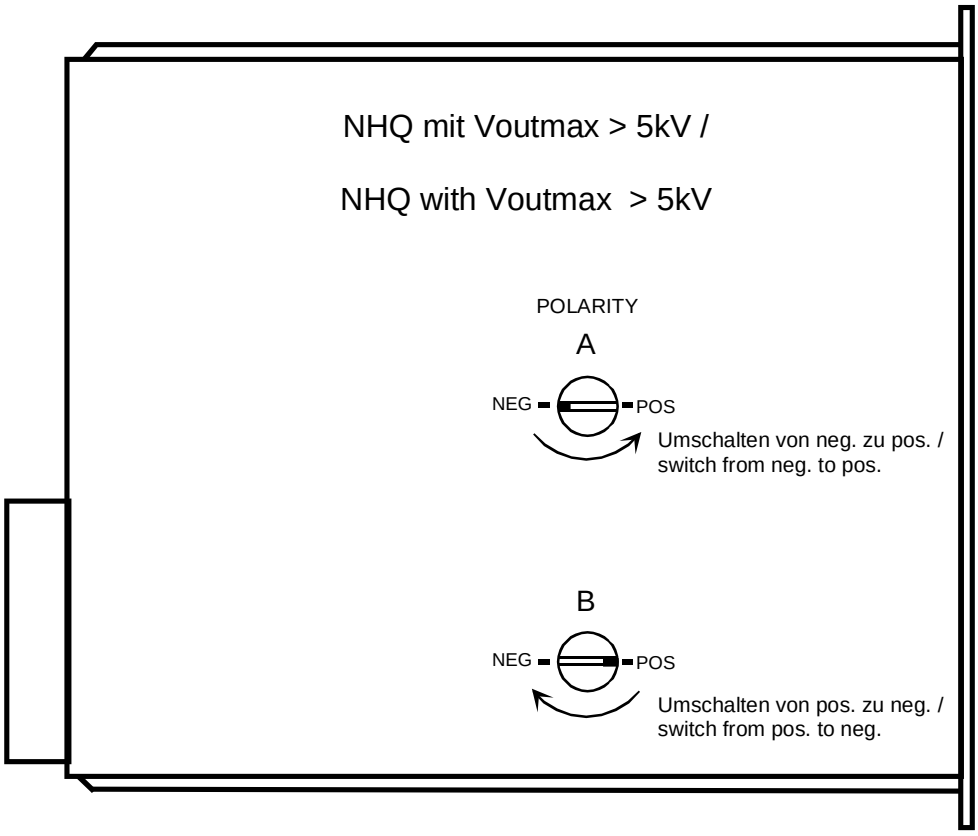
Signed for Dr. Frank Gleisberg
Managing director



Appendix A: Block diagram NHQ

iseg Spezialelektronik GmbH
Bautzner Landstr. 23
D - 01454 Radeberg / Rossendorf
Email: sales@iseg-hv.de
http://www.iseg-hv.com
Germany
Phone ++ 49 351 / 26 996 - 0
Fax ++ 49 351 / 26 996 - 21





Appendix B: NHQ side cover, Polarity rotary switch

e.g.: channel A, polarity negative
channel B, polarity positive