

Technical information

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RS-232 Interface Programmers Guide

for NHQ High Precision and Standard Modules

Document history

Version	Date	Major changes
2.1	2023-01-17	Fixed minimum wait time (command W) and High Precision set voltage format (command D)
2.0	2016-04-20	Relayouted documentation
1.0	2012-03-06	Initial release

Disclaimer / Copyright

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Safety

This section contains important security information for the installation and operation of the device. Failure to follow safety instructions and warnings can result in serious injury or death and property damage.

Safety and operating instructions must be read carefully before starting any operation.

We decline all responsibility for damages and injuries caused which may arise from improper use of our equipment.

Depiction of the safety instructions

DANGER!



DANGER!

"Danger!" indicates a severe injury hazard. The non-observance of safety instructions marked as "Danger!" will lead to possible injury or death.

WARNING!



WARNING!

"Warning!" indicates an injury hazard. The non-observance of safety instructions marked as "Warning!" could lead to possible injury or death.

CAUTION!



CAUTION!

Advices marked as "Caution!" describe actions to avoid possible damages to property.

INFORMATION



INFORMATION

Advices marked as "Information" give important information.



Read the manual.



Important information.



HIGH VOLTAGE

Attention high voltage!

Intended Use

The device may only be operated within the limits specified in the data sheet. The permissible ambient conditions (temperature, humidity) must be observed. The device is designed exclusively to control high voltage systems as specified in the data sheet. Any other use not specified by the manufacturer is not intended. The manufacturer is not liable for any damage resulting from improper use.

Qualification of personnel

A qualified person is someone who is able to assess the work assigned to him, recognize possible dangers and take suitable safety measures on the basis of his technical training, his knowledge and experience as well as his knowledge of the relevant regulations.

General safety instructions

- Observe the valid regulations for accident prevention and environmental protection.
- Observe the safety regulations of the country in which the product is used.
- Observe the technical data and environmental conditions specified in the product documentation.
- You may only put the product into operation after it has been established that the high-voltage device complies with the country-specific regulations, safety regulations and standards of the application.
- The high-voltage power supply unit may only be installed by qualified personnel.

Important security information

DANGER!



DANGER!

This device generates high voltages or is part of or attached to high voltage supplying systems. High voltages are dangerous and may be fatal.

USE CAUTION WHILE WORKING WITH THIS EQUIPMENT.
BE AWARE OF ELECTRICAL HAZARDS.

Always follow at the minimum these provisions:

- High voltages must always be grounded
- Do not touch wiring or connectors without securing
- Never remove covers or equipment
- Always observe humidity conditions
- Service must be done by qualified personnel only

WARNING!



WARNING!

RAMP DOWN VOLTAGES!

Before insertion or removal of crate controller, please make sure, that all voltages are ramped down, modules are switched off and power cord is disconnected.

CAUTION!



CAUTION!

When remote controlling the high voltage systems, make sure that nobody is near the high voltage or can be injured.

INFORMATION



INFORMATION

CHECK COMPATIBILITY!

Please check compatibility list first.

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1. RS-232 Interface NHQ High Precision

The RS-232 interface provides the following functionality for the operation of the high voltage units.

1.1. RS-232 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 voltage and current; status

Front panel switches have priority over software control.

1.2. Manual Control Mode

While the unit is operated in manual control mode, only RS-232 read cycles are interpreted. Commands are accepted, but do not result in an output voltage change.

1.3. RS-232 Interface Specification

The RS-232 interface is located at a D-SUB-9 connector on the back panel.

The electric transfer is performed via RxD and TxD, related to floating GND of the interface. The D-SUB-9 pin assignment is given in the following table.

The cable connection to the computer is 1:1 (no null modem-cable!). If no 9-pin cable is available, connections must be set up as shown in the table.

	Signal	HV-supply		PC		Connection
	RS-232	D-SUB-9	Internal	D-SUB-9	D-SUB-25	3-lead cable
Signal pin assignment	RxD	2		2	3	
	TxD	3		3	2	
	GND	5		5	7	
		4	⌋ (bridged)	4	20	⌋ (bridged)
		6	⌋ (bridged)	6	6	⌋ (bridged)
		8	⌋ (bridged)	8	5	⌋ (bridged)

Table 1 RS-232 interface pin assignment

1.4. Interface Programming

The serial interface is set to 9600 Bit/s, 8 Bit/character, no parity, 1 Stop-Bit.

The data transfer is character based, with echos as handshake between the compu and the HV power supply unit (Input direction). The transfer direction "HV power supply to computer" (Output direction) is free running.

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 command transfer uses ASCII characters. Commands are terminated by <CR><LF> (\$0D \$0A or 13 10). Leading zeros can be omitted on input, output is in fixed format.

In order to assure synchronization between the computer and the supply, <CR><LF> has to be sent as first command.

1.5. Command Set

Command	Computer	HV-supply	Description
Read module identifier	# *	# * nnnnnn;m.mm;Vmax;lmax *	Serial number; software release; $V_{out\ max}$; $I_{out\ max}$
Read answer delay time	W *	W * nnn *	Answer delay time $1 \leq W \leq 255\ ms$
Write answer delay time	W=nnn *	W=nnn * *	Answer delay time $1 \leq W \leq 255\ ms$
Read measured voltage channel A	U1 *	U1 * { polarity / mantissa / signed exp. } *	(in V)
Read measured current channel A	I1 *	I1 * { mantissa / signed exp. } *	(in A)
Read voltage limit channel A	M1 *	M1 * nnn *	(in % of $V_{out\ max}$)
Read current limit channel A	N1 *	N1 * nnn *	(in % of $I_{out\ max}$)
Read set voltage channel A	D1 *	D1 * { mantissa / signed exp. } *	(in V)
Write set voltage channel A	D1=nnnn.n *	D1=nnnn.nn * *	(voltage corresponding resolution in V; $0 \leq D1 \leq M1$)
Read ramp speed channel A	V1 *	V1 * nnn *	(in V/s)
Write ramp speed channel A	V1=nnn *	V1=nnn * *	(in V/s; $2 \leq V1 \leq 255$)
Start voltage ramp channel A	G1 *	G1 * S1=xxx *	see Status Information
Write current trip channel A	L1=nnnn *	L1=nnnn * *	Trip corresponding resolution range $I_{OUTmax} > 0$ Current trip disabled for nnnn = 0
Read current trip channel A	L1 *	L1 * { mantissa / signed exp. } *	(see above, current trip in A)
Read status word channel A	S1 *	S1 * xxx *	see Status Information
Read module status channel A	T1 *	T1 * nnn *	Code 0...255, see Module Status
Write auto start channel A	A1=nn *	A1=nn * *	Conditions, see Auto Start
Read auto start channel A	A1 *	A1 * nnn *	8 = Auto start is active; 0 = inactive
Notes: * = <CR><LF> The channel B of the supply is addressed by replacing 1 with 2.			

Table 2 NHQ High Precision command set

1.6. Status Information

The answer for the command S1 is one of the following:

Description	
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 or was exceeded
INH	Inhibit signal is or was active
QUA	Quality of output voltage not given at present
L2H	Output voltage increasing
H2L	Output voltage decreasing
LAS	Look at Status (only after G-command)
TRP	Current trip was active
Notes: <SP> = 0x30 = Space	

Table 3 NHQ High Precision status information

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

1.7. Error Codes

Description	
????	Syntax error
?WCN	Wrong channel number
?TOT	Timeout error (with following reinitialization)
?<SP>UMAX=nnnn	Set voltage exceeds voltage limit, max. possible value is nnnn

Table 4 NHQ High Precision error codes

1.8. Module Status

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
QUA	ERR	INH	KILL_ENA	OFF	POL	MAN	U/I resp. A/B

Status-Bit	Description	Bit is 0	Bit is 1
QUA	Quality of output voltage	guaranteed	not guaranteed
ERR	V_{\max} or I_{\max}	is not exceeded	is or was exceeded
INH	External INHIBIT signal	is inactive	is or was active
KILL_ENA	KILL-ENABLE is	off	on
OFF	Front panel HV-ON switch is	in ON position	in OFF position
POL	Polarity is set to	negative	positive
MAN	Control	via RS-232 interface	manual
U/I (command T1)	Display dialled to	current measurement	voltage measurement
A/B (command T2)	Channel dialled to	channel B	channel A

Table 5 NHQ High Precision module status

Reading the Module Status ("Tx") does not reset the flags "ERR" and "INH". This can be done by reading the corresponding channels status word ("Sx").

1.9. Auto Start

When writing to this register, the corresponding values are permanently stored (a minimum of one million write cycles is guaranteed). The stored values are read back into the registers after POWER-ON.

Bit 7...4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	Enable Auto Start ^{*)}	Save Current Trip	Save Set Voltage	Save Ramp Speed

Notes:

^{*)} 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 KILL-ENABLE or TRP), the previous voltage setting will be restored with software ramp after "Read status word".

2. RS-232 Interface NHQ Standard

The RS-232 interface provides the following functionality for the operation of the high voltage units.

2.1. RS-232 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 voltage and current; status

Front panel switches have priority over software control.

2.2. Manual Control Mode

While the unit is operated in manual control mode, only RS-232 read cycles are interpreted. Commands are accepted, but do not result in an output voltage change.

2.3. RS-232 Interface Specification

The RS-232 interface is located at a D-SUB-9 connector on the back panel.

The electric transfer is performed via RxD and TxD, related to floating GND of the interface. The D-SUB-9 pin assignment is given in the following following table.

The cable connection to the computer is 1:1 (no null modem-cable!). If no 9-pin cable is available, connections must be set up as shown in the table.

	Signal	HV-supply		PC	PC	Connection
	RS 232	DSUB9	Int.	DSUB9	DSUB25	3-lead cable
Signal pin assignment	RxD	2		2	3	
	TxD	3		3	2	
	GND	5		5	7	
		4	⌋ (bridged)	4	20	⌋ (bridged)
		6	⌋ (bridged)	6	6	⌋ (bridged)
		8	⌋ (bridged)	8	5	⌋ (bridged)

Table 6 NHQ Standard RS-232 interface pin assignment

2.4. Programming

The serial interface is set to 9600 Bit/s, 8 Bit/character, no parity, 1 Stop-Bit.

The data transfer is character based, with echos as handshake between the computer and the HV power supply unit (Input direction). The transfer direction "HV power supply to computer" (Output direction) is free running.

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 command transfer uses ASCII characters. Commands are terminated by <CR><LF> (\$0D \$0A or 13 10). Leading zeros can be omitted on input, output is in fixed format.

In order to assure synchronisation between the computer and the supply, <CR><LF> has to be sent as first command.

2.5. Command Set

Command	Computer	HV-supply	Description
Read module identifier	# *	# * nnnnnn;m.mm;Vmax;Imax *	Serial number; software release; V _{out max} ; I _{out max}
Read answer delay time	W *	W * nnn *	Answer delay time 1 ≤ W ≤ 255 ms
Write answer delay time	W=nnn *	W=nnn * *	Answer delay time 1 ≤ W ≤ 255 ms
Read measured voltage channel A	U1 *	U1 * { polarity / voltage } *	(in V)
Read measured current channel A	I1 *	I1 * { mantissa / signed exp. } *	(in A)
Read voltage limit channel A	M1 *	M1 * nnn *	(in % of V _{out max})
Read current limit channel A	N1 *	N1 * nnn *	(in % of I _{out max})
Read set voltage channel A	D1 *	D1 * { voltage } *	(in V)
Write set voltage channel A	D1=nnnn *	D1=nnnn * *	(in V; 0 ≤ D1 ≤ M1)
Read ramp speed channel A	V1 *	V1 * nnn *	(in V/s)
Write ramp speed channel A	V1=nnn *	V1=nnn * *	(in V/s; 2 ≤ V1 ≤ 255)
Start voltage ramp channel A	G1 *	G1 * S1=xxx *	see Status information
Write current trip channel A	L1=nnnn *	L1=nnnn * *	Trip corresponding current resolution > 0 Current trip disabled for nnnn = 0
Read current trip channel A	L1 *	L1 * nnnn *	(see above, current trip in A)
Read status word channel A	S1 *	S1 * xxx *	see Status Information
Read module status channel A	T1 *	T1 * nnn *	Code 0...255, see Module Status
Write auto start channel A	A1=nn *	A1=nn * *	Conditions, see Auto Start
Read auto start channel A	A1 *	A1 * nnn *	8 = Auto start is active; 0 = inactive
Notes: * = <CR><LF> The channel B of the supply is addressed by replacing 1 with 2.			

Table 7 NHQ Standard command set

2.6. Status Information

The answer for the command S1 or S2 is one of the following:

Description	
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 or was exceeded
INH	Inhibit signal is or was active
QUA	Quality of output voltage not given at present
L2H	Output voltage increasing
H2L	Output voltage decreasing
LAS	Look at Status (only after G-command)
TRP	Current trip was active
Notes: <SP> = 0x30 = Space	

Table 8 NHQ Standard status information

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

2.7. Error Codes

Description	
????	Syntax error
?WCN	Wrong channel number
?TOT	Timeout error (with following reinitialization)
?<SP>UMAX=nnnn	Set voltage exceeds voltage limit, max. possible value is nnnn
Notes: <SP> = 0x30 = Space	

Table 9 NHQ Standard error codes

2.8. Module Status

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
QUA	ERR	INH	KILL_ENA	OFF	POL	MAN	U/I resp. A/B

Status-Bit	Description	Bit is 0	Bit is 1
QUA	Quality of output voltage	guaranteed	not guaranteed
ERR	V_{\max} or I_{\max}	is not exceeded	is or was exceeded
INH	External INHIBIT signal	is inactive	is or was active
KILL_ENA	KILL-ENABLE is	off	on
OFF	Front panel HV-ON switch is	in ON position	in OFF position
POL	Polarity is set to	negative	positive
MAN	Control	via RS-232 interface	manual
U/I (command T1)	Display dialled to	current measurement	voltage measurement
A/B (command T2)	Channel dialled to	channel B	channel A

Table 10 NHQ Standard module status

2.9. Auto Start

When writing to this register, the corresponding values are permanently stored (a minimum of one million write cycles is guaranteed). The stored values are read back into the registers after POWER-ON.

Bit 7...4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	Enable Auto Start ^{*)}	Save Current Trip	Save Set Voltage	Save Ramp Speed

^{*)} 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 KILL-ENABLE or TRP), the previous voltage setting will be restored with software ramp after "Read status word".

3. Glossary

SHORTCUT	MEANING
0V	Supply ground
V_{nom}	nominal output voltage
V_{out}	output voltage
V_{set}	set value of output voltage
V_{mon}	monitor voltage of output voltage
V_{meas}	digital measured value of output voltage
V_{p-p}	peak to peak ripple voltage
V_{in}	input / supply voltage
V_{type}	type of output voltage (AC, DC)
V_{ref}	internal reference voltage
V_{max}	limit (max.) value of output voltage
V_{limit}	voltage limit
$\Delta V_{out} - [\Delta V_{in}]$	deviation of V_{out} depending on variation of supply voltage
$\Delta V_{out} - [\Delta R_{load}]$	deviation of V_{out} depending on variation of output load
V_{bounds}	voltage bounds, a tolerance tube $V_{set} \pm V_{bounds}$ around V_{set}
I_{nom}	nominal output current
I_{out}	output current
I_{set}	set value of output current
I_{mon}	monitor voltage of output current
I_{meas}	digital measured value of current
I_{trip}	current limit to shut down the output voltage
I_{in}	input / supply current
I_{max}	limit (max.) value of output current
I_{limit}	current limit
I_{bounds}	current bounds, a tolerance tube $I_{set} \pm I_{bounds}$ around I_{set}
P_{nom}	nominal output power
P_{in}	input power
P_{in_nom}	nominal input power
T	temperature
T_{REF}	reference temperature

SHORTCUT	MEANING
ON	HV ON
OFF	HV OFF
CH	channel(s)
HV	high voltage
LV	low voltage
GND	signal ground
INH	Inhibit
POL	Polarity
KILL	KillEnable

Table 11 Glossary and shortcuts

4. Manufacturer contact

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