

EHQ 102M / 103M / 104M / 105M

Precision High Voltage Power Supplies in 3U Eurocard Format with USB and RS232-Interface

Operators Manual

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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 whatsoever 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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1. General information

The EHQ's are one channel high voltage supplies in a 3U Eurocard Chassis, 8TE wide. The units offers manual control via the front panel and operation via USB and RS232 interface (optional: CAN Bus interface). The interface control supports more functionality then the manual control.

The high voltage supplies features high precision output voltage and very low ripple, even under full load. Separate hardware switches allow to put voltage and current limits in 10%-steps. The INHIBIT input protects sensitive devices. Additionally, a maximum output current 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

Type (with USB and RS 232)		EHQ 102M	EHQ 103M	EHQ 104M	EHQ 105M
Output voltage $V_{O \text{ nom}}$		0 ... 2 kV	0 ... 3 kV	0 ... 4 kV	0 ... 5 kV
Output current $I_{O \text{ nom}}$		6 mA	4 mA	3 mA	2 mA
	Option N12	3 mA	2 mA	1 mA	1 mA
	Option 104	100 μ A	100 μ A	100 μ A	100 μ A
Ripple and noise		< 2 mV _{p-p}			< 5 mV _{p-p}
Resolution of current measurement		1 μ A; option 104: $I_{O \text{ nom}} = 100 \mu\text{A} \Rightarrow 100 \text{ nA}$			
Resolution of voltage measurement		1 V			
Accuracy	current measurement	$\pm (0,05\% I_O + 0,02\% I_{O \text{ nom}} + 1 \text{ digit})$ for one year			
	voltage measurement	$\pm (0,05\% V_O + 0,02\% V_{O \text{ nom}} + 1 \text{ digit})$ for one year			
LCD display		4 digits with sign, switch controlled voltage display in [V] current display in [A], with option 104 in [mA]			
Stability	ΔV_O (no load / load)	< $5 * 10^{-5}$			
	$\Delta V_O/V_{\text{INPUT}}$	< $5 * 10^{-5}$			
Temperature coefficient		< $5 * 10^{-5}/\text{K}$			
Voltage control		CONTROL switch in position -manual: 10-turn potentiometer, -DAC: control via serial interface			
Rate of change of	HV -ON/OFF	500 V/s (hardware ramp)			
output voltage	remote control	2 ... 255 V/s (software ramp)			
Protection		-separate current and voltage limit (hardware, rotary switch in10%-steps) -INHIBIT (external signal, TTL level, Low=active) -programmable current limit (software)			
Power requirement V_{IN}		$\pm 24 \text{ V}$ (< 500 mA), option: $\pm 12 \text{ V}$ (< 500 mA)			
Operating temperature		0 . . . 50 °C			
Storage temperature		-20 . . . +60 °C			
Packing		3U Euro cassette / 160 mm depth / 40,8 mm wide			
Connectors		96-pin connector according to DIN 41612 on the rear, USB mini B on the front panel			
HV connector		SHV-Connector at the front panel			
Inhibit connector		1-pin Lemo-hub			

3. EHQ 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

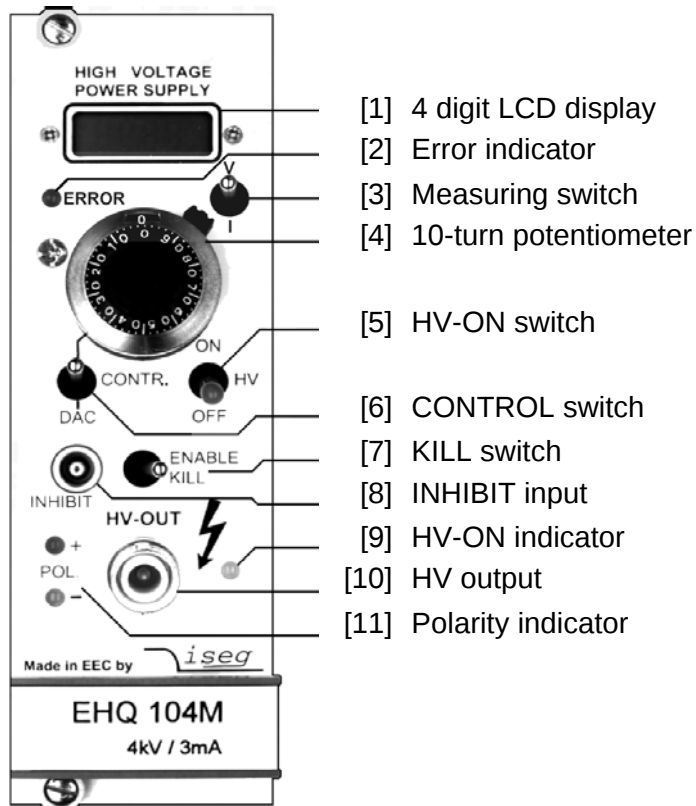
A micro controller handles all internal control, evaluation and calibration functions. The actual voltages and currents are read cyclically by an ADC with a connected multiplexer. The readings are processed and displayed on the 4 digit LCD. The current and voltage hardware limits are retrieved cyclically 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.

4. Front panel



5. Handling

The unit is set into operating state by connecting at the 96-pin connector according to DIN 41612 on the backside. This also attaches the RS232 interface. The USB interface is connected via the USB mini B connector on the frontpanel (below the polarity indicator).

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!

An undefined switch setting (not at one of the end positions) will cause no output voltage.

High voltage output is switched on with HV-ON switch [5] at the front panel. The viability is signalled by the yellow LED [9].

Attention! If the CONTROL switch [6] is in upper position (manual control), high voltage is generated at the HV-output [10], started with a ramp speed from 500 V/s (hardware ramp) to the set voltage given by the 10-turn potentiometer [4]. This is also the case, if DAC control is switched over to manual control while operating.

If the CONTROL switch [6] is in lower position (DAC), high voltage will be activated only after receiving corresponding serial interface (DAC) commands.

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

The LCD [1] displays the output voltage in [V] or the output current in [μ A], depending on the position of the Measuring switch [3].

In the manual control mode the output voltage can be set via 10-turn potentiometer [4] in a range from 0 to the maximum voltage.

If the CONTROL switch [6] is switched over to serial interface control (DAC), 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 $V_{\max}$ and $I_{\max}$ (switch dialled to 10 corresponds to 100%) on the cover side (see appendix B) independently of programmable current trip. The red error LED on the front panel [2] signals if the output voltage or current approaches the limits.

The KILL switch [7] specifies the response on exceeding limits or on the external protection signal at the INHIBIT input [8] 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 [5] or KILL [7] 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 resp. USB interface

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

Serial interface 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.

Pin assignment 96-pin connector on the flip side

A3 B3 C3	+24V	
A5 B5 C5	GND, connected to chassis and HV-GND	
A7 B7 C7	-24V	
A9	@GND	} potential free
B9	@RXD	
C9	@TXD	

Specification of the 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 pin assignment at the PC side is given in table 1. The bridging on the PC side if a three-lead cable is used, is also given in table 1.

Table 1:

Signal pin assignment

Signal RS 232	PC DSUB9	PC DSUB25	Connection 3-lead cable
RxD	2	3	
TxD	3	2	
GND	5	7	
	4	20	└┐
	6	6	└┐
	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.

Command set

Command	Computer	HV-supply
Read module identifier	# *	# * nnnnnn ; n.nn ; U ; I * (unit number ; softwarerel. ; V_{out} [V] ; I_{out} [μ A])
Read break time	W *	W * nnn * (break time 2 ... 255 ms)
Write break time	W=nnn *	W=nnn * * (break time = 2 - 255 ms)
Read actual voltage channel 1	U1 *	U1 * {polarity / voltage} * (in V)
Read actual current channel 1	I1 *	I1 * {mantisse / 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 , $\Rightarrow$ Status information)
Write current trip channel 1	L1=nnnn *	L1=nnnn * * (corresponding resolution current > 0)
Read current trip channel 1	L1 *	L1 * nnnn * (s.a., for nnnn=0 $\Rightarrow$ no current trip)
Read status word channel 1	S1 *	S1 * xxx * (S1 , $\Rightarrow$ Status information)
Read module status channel 1	T1 *	T1 * nnn * (code 0...255, $\Rightarrow$ Module status)
Write auto start channel 1	A1=nn *	A1=nn * * (conditions $\Rightarrow$ Auto start)
Read auto start channel 1	A1 *	A1 * n * (8 $\Rightarrow$ auto start is active; 0 $\Rightarrow$ inactive)

* = <CR><LF>

Status information:

xxx:	ON<SP>	Output voltage according to set voltage
	OFF	Channel is switched off via the front panel switch
	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 given at present
	L2H	Output voltage increasing
	H2L	Output voltage falling
	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 reinitialization)
?<SP>UMAX=nnnn	Set voltage exceeds voltage limit

Module status:

Status	Description		Bit	Valency
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

Auto start:

Description		Bit	Valency
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 $\Rightarrow$ 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 a minimum of 1 million saving cycles)

Software

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

7. Program example

```

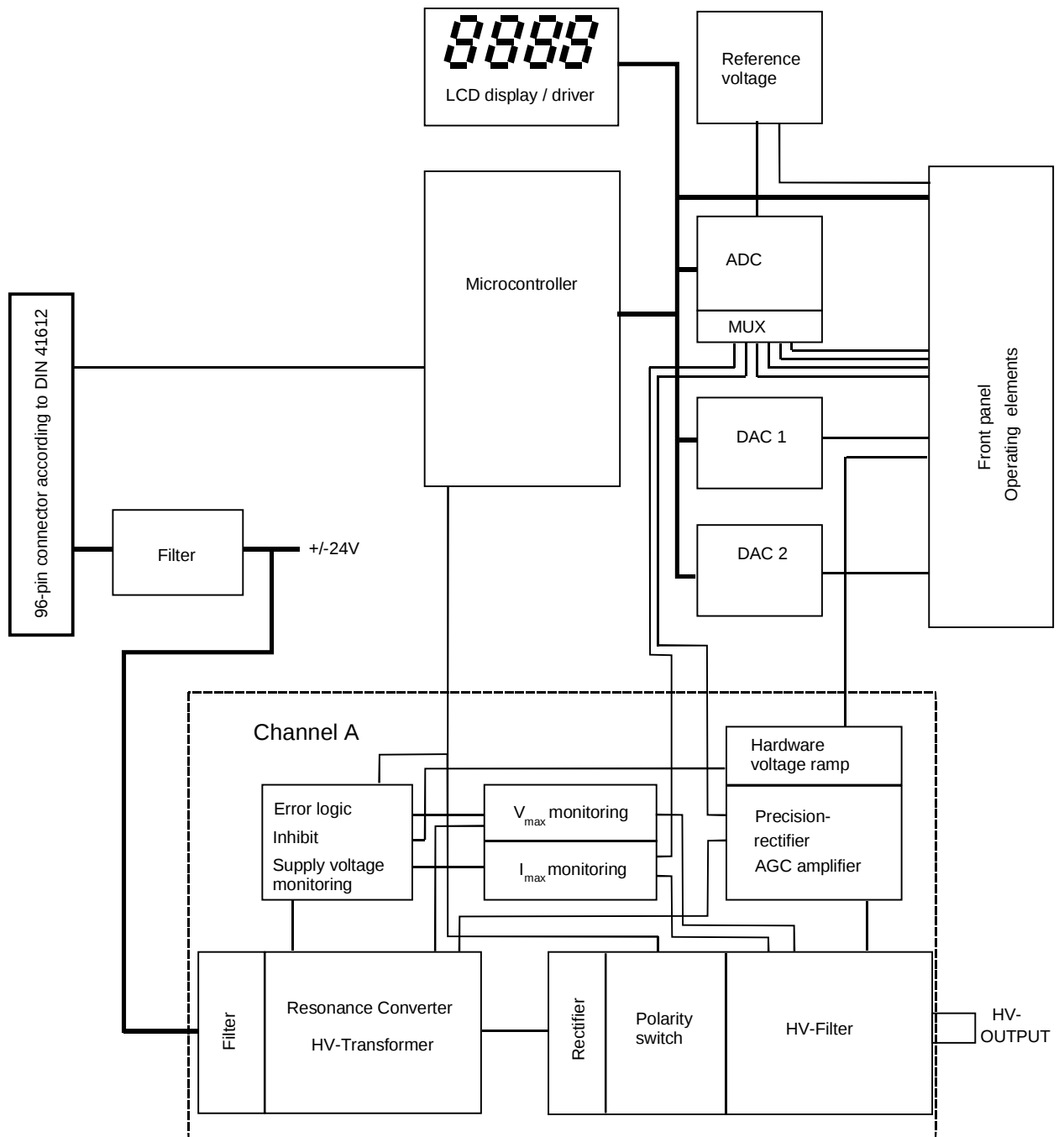
/*****
/*
/*      ehq.cpp
/*
/*      example program for iseg ehq hv boards, written by Jens Römer, 27.2.97
/*
/*      this code was compiled under BC, please contact iseg for the source file
/*
*****/

#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;

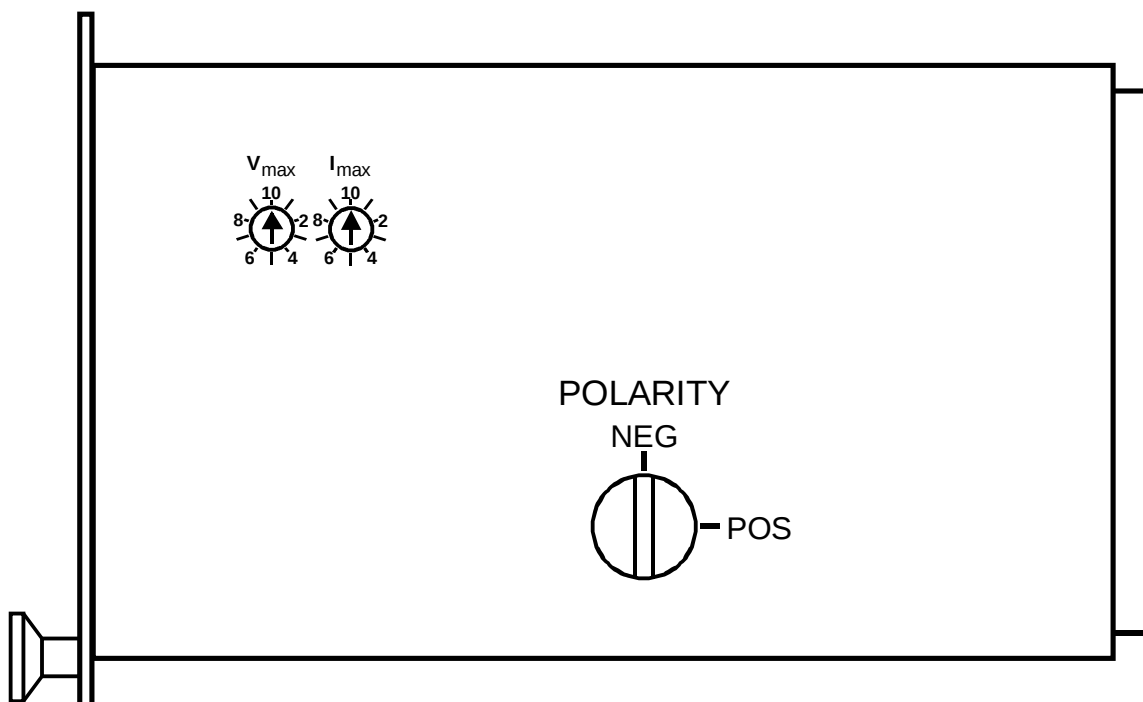
void main(void)
{
    clrscr();
    COM2_init();
    COM2_set(9600);                                // COM2: 9600 baud, 8 databits, no parity, 1 stopbit
    ok=True_;
    ptr=readU;
    for (;;)
    {
        if (*ptr==etx) break;
        COM2_send(*ptr);                            //send one byte
        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);
}

```



Appendix A:

Block diagram EHQ



Appendix B: EHQ side cover

Polarity rotary switch (e.g.: polarity negative)
Rotary switches for $V_{\max}$ and $I_{\max}$