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HV - Series

Multichannel high voltage sources

HV_Series_Data-Sheet_2013.doc
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Data Sheet

2013, Rev. 2.2

- very low noise outputs
- highly stable and low temperature drifts
- true bipolar outputs (4-quadrant)
- includes easy and intuitive LabVIEW control software, both ready-to-run, and open source code

devices: HV 200-xx, HV 400-xx, HV 500-xx
(xx denominates the number of channels)

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General Information and Overview

Purpose of the HV series devices is the supply of stable, low-noise DC voltages up to +/- 500V (true bipolar, 4-quadrant outputs) for electrostatic lenses, beam deflectors or ion traps. Unlike DC *power* supplies, the outputs currents are limited to small values, and the outputs are optimized for very high short and long term stability, low ripple, low noise and low temperature drift. The HV Series devices are housed in standard 19-inch rack-mount cases. User control of the device can be accomplished by PC control programs, utilizing a standard USB connection (USB 2.0 compatible) as hardware link. A LabVIEW™ control program is provided by the manufacturer for this purpose with open source code.

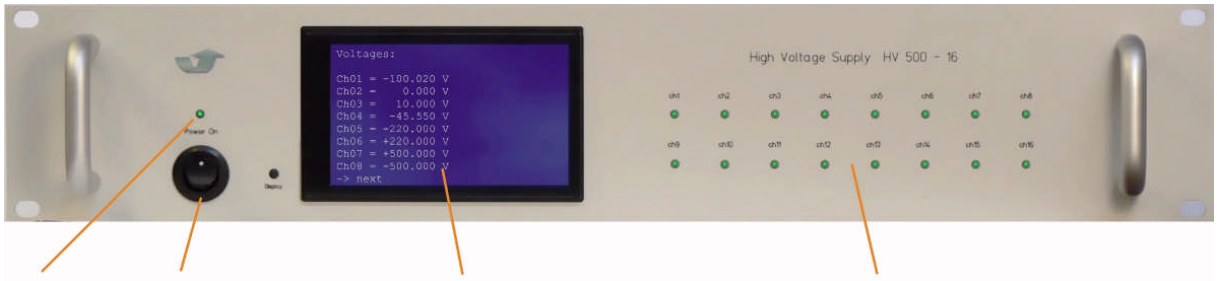

Figure 1: Picture of front plate

The front plate contains several control elements for the device.
The **LCD display** on the front side shows information about received commands or the latest voltage settings for the output channels. The actual output voltages, being read from every individual channel, are also displayed, correspondingly right besides the programmed values.

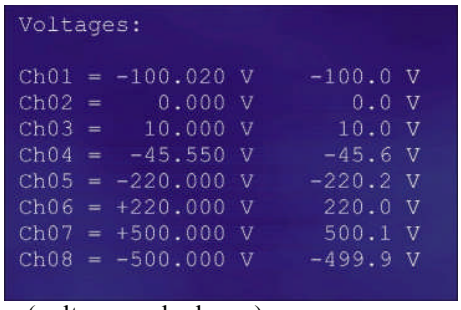

Figure 2: Multifunction LCD display (voltage mode shown)

Additionally, **LED indicators** on the right hand side of the device show the overload status of the individual output channels and lighten up green normally.

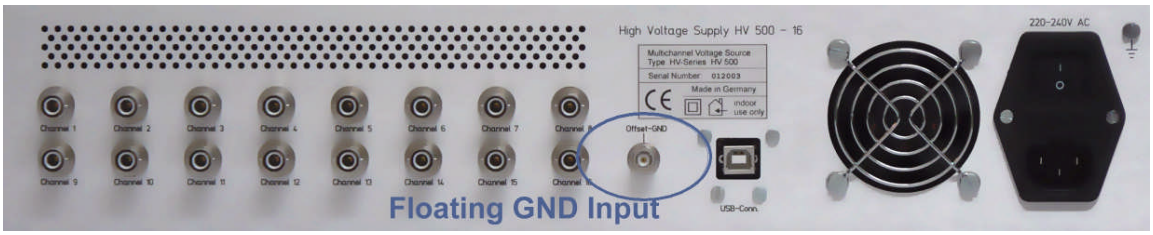

Figure 3: Picture of device rear side

The rear side picture shows the output channel sockets (BNC or SHV), the reference floating ground input (in case the option is installed), and the galvanically isolated USB interface connection to a control PC.

Short Term Fluctuation,
Typical characteristics

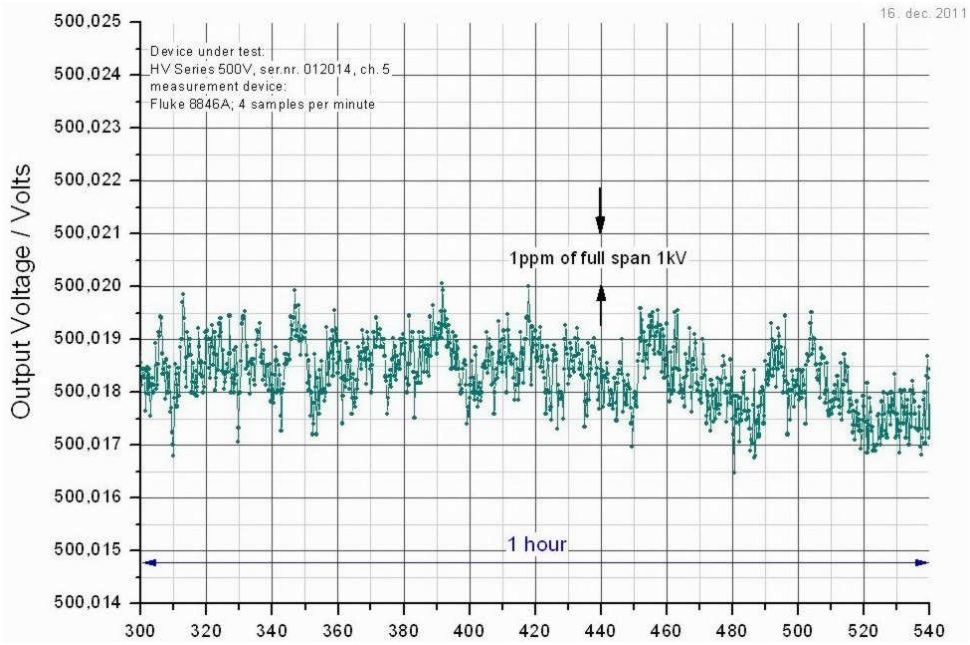

Figure 4:
Typical 1-hour fluctuation data; device: HV 500-16 at +500V_{DC}.
Measurement device: Fluke 8846A multimeter, 4 samples per minute

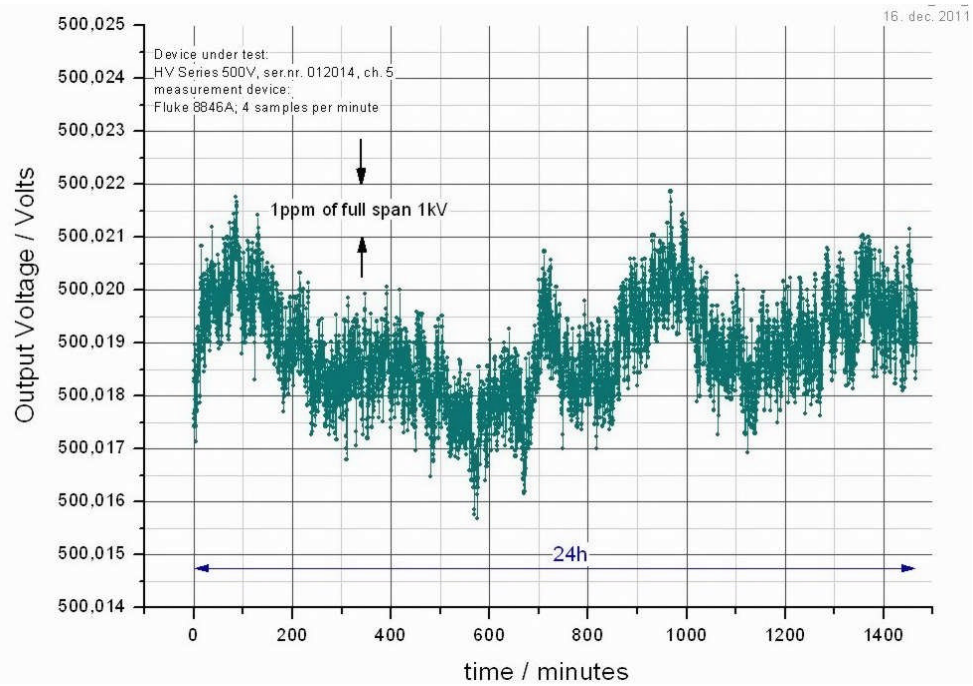

Figure 5:
Typical 24-hour fluctuation data; device: HV 500-16 at +500V_{DC}
Measurement device: Fluke 8846A multimeter, 4 samples per minute

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User Control Software

After starting the main control program (implemented in LabVIEW™) the following user surface appears, which can be operated in an intuitive style. Up/down buttons with variable step size are available and direct user entry of voltages is possible. In case several devices are connected, the user may choose the device to control in a window at the left hand side. Additionally, the complete source code, grouped in VI-blocks is openly accessible, for easy implementation into own programs.

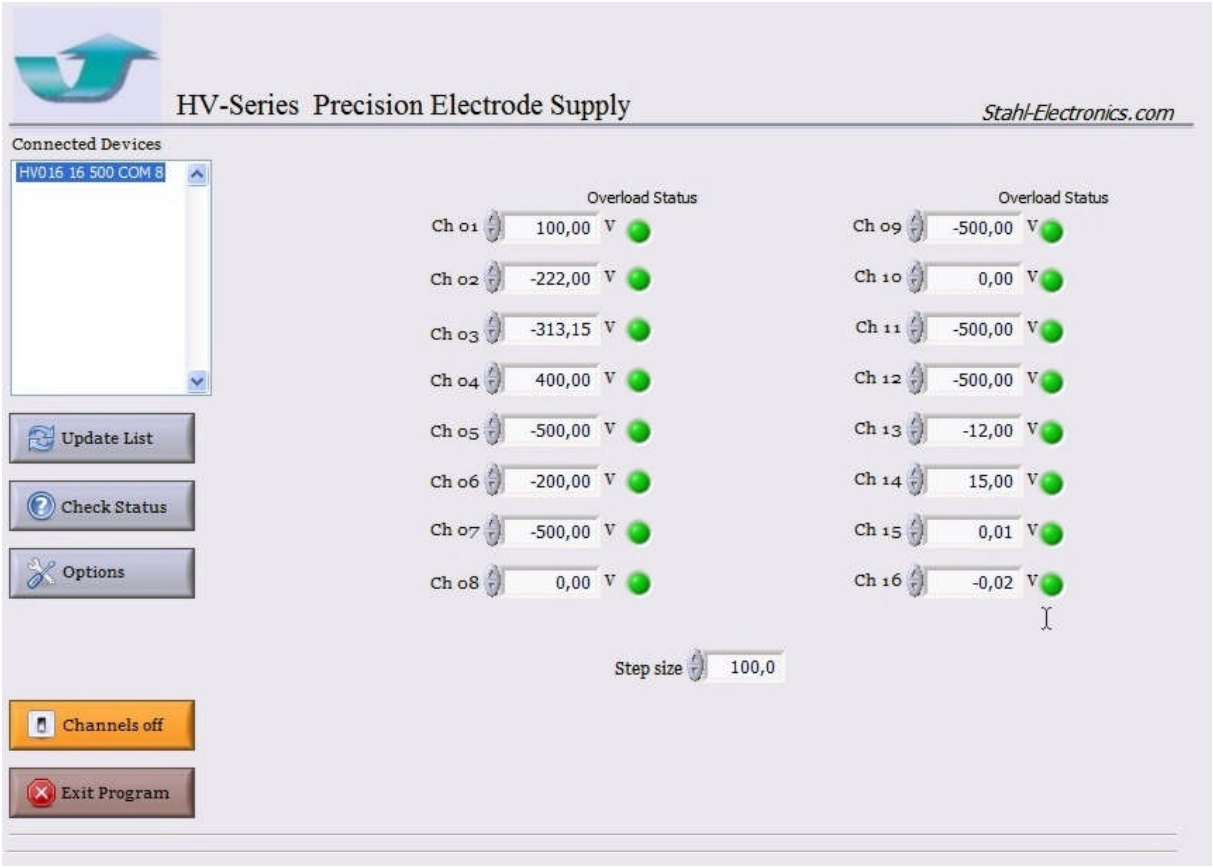

Figure 6: Screenshot of user surface. Program is available for instant use (.exe-file) and additionally supplied with free source text for own implementations.

Device Variety

The following devices are currently members of the HV series device family:

HV 200	HV 200-2, HV200-8, HV 200-16	Output voltage -200V … +200V 2, 8- and 16- channel device
HV 400	HV 400-8, HV 400-16	Output voltage -400V … +400V 8- and 16- channel device
HV 500	HV 500-8, HV 500-16	Output voltage -500V … +500V 8- and 16- channel device
HV 1000 (obsolete)	HV 1000-4	Output voltage -1kV… 0 or 0…+1kV 4 channels
HV QUAD	HV QUAD 275-16, HV QUAD 450-16	8 pairs of unipolar complementary outputs with opposite polarity, 0…+/- 275V, or 0…+/-450V; designed for electrostatic quadrupole lenses
HV Steerer	HV Steerer 450-16	8 pairs of bipolar complementary outputs with opposite polarity, designed for electrostatic quadrupole lenses and steerer plates

Voltages are referenced to case ground, alternatively a “Floating Ground Option“ can be ordered, which allows floating the reference GND up to a specified floating voltage (max. +/-2kV).

Output Specifications				
Output Voltage Range	HV 200-xx	-200V … +200V, 4-quadrant, continuous zero crossing		
	HV 500-xx	-500V … +500V, 4-quadrant, continuous zero crossing		
	HV 1000-xx	-1000V… 0V or 0V…+1000V		
Output Connectors (unless customized)	HV 200 - xx HV 400 - xx HV 500 - xx	BNC, SHV on request		
	HV 1000 - xx	SHV		
DC Output Current	HV 200	0 to ±100 µA guaranteed		
	HV 400, HV500 HV 1000	0 to ±70 µA guaranteed		
	Per device	max. ±350 µA (HV200), ±300 µA (HV 500, HV 1000) guaranteed		
	Per output	maximum value +180µA / -370µA		
Sink/Source Capability		full 4 quadrant-operation of all outputs		
Reference Ground	Standard	All outputs share a common GND (= case ground)		
	Floating	reference GND may float ±350V vs. GND of case, 1kV or 2kV optionally		
Accuracy assuming $T_{ambient}$ = 21°C…26°C		typical	maximum	typical drift
% of Setting, Related to full span		0.015%	0.05%	0.002% per day 0.014% per year
Offset Error		±10mV	±100mV	±3mV per day
Ripple (50Hz, 100Hz), **HV 200, HV 500** **HV 200-2** **HV 400**		 5mVpp 2mVpp 0.75mVpp	 7mVrms ‘’ 2mVrms	
Noise 1 Hz …10MHz **200V, 500V** **HV 200-2** **HV 400**		 2mVrms 1mVrms 0.4mVrms		
Channel crosstalk (DC voltage change on any channel, influenced by any other channel)		1.2ppm	2.5ppm	
Temperature Coefficient Setting Offset		 +15ppm/K 1.5mV/K	 +/-21ppm/K 4.5mV/K	
Front Plate Read-Back Digital Voltmeters on LCD Screen				
Accuracy:		typical	maximum	
Scale error		0.06%	0.1%	
Offset error		0.1V	0.3V	
Remote Control / Communication				
Remote Connection		USB 2.0 compatible connection to PCs, with galvanic isolation		
USB Isolation Rating		max. +/-350V vs. case GND		
Command Language		clear ASCII code (see below)		
Software Support		Win XP™, Windows7™ Free LabVIEW™ 8.2 based user surface and driver routines are supplied		
Environmental Conditions, Power Supply, Case Style				
Magnetic Field		max. 5 mT admissible		
Storage Temperature		-55 C° to +85 C°		
Humidity & Temperature		noncondensing relative humidity up to 95%, temperatures of +10°C and +35°C.		
AC Supply Rating		AC input voltage 230V_{AC} at 50Hz , typ. 60W		
Case dimensions		19.00” wide x 10” deep. Front-panel mounting holes M6		
Weight		approximately 4.7kg, configuration dependent		

Appendix

List of Remote-Control Commands

In order to access the device by self-written program code, or in order to change the provided LabVIEW™ VI's according to own wishes, the commands for remote-control are described below.

Several commands can be sent in order to communicate between a control device, like a standard PC and the HV Series voltage sources. The commands are sent in clear ASCII text strings over a standard USB-connection (1.0 protocol, but also 2.0 compatible), which is galvanically isolated for low external noise pickup. In case LabVIEW™ (Version 8.0 or higher) is used, the open source-text SubVI's (provided by the manufacturer) can be altered and included into own programs in case required.

Establishing USB connection and sending commands:

Before sending any command, the USB connection to the device has to be established. This is basically done by physically connecting the device by an appropriate cable (standard USB A- and B-plug) and installing an appropriate USB driver. Drivers for Windows (2000, ME, XP, Vista), Mac OS and Linux are provided by the manufacturer. You might also consult the USB-manufacturers homepage (www.ftdichip.com) for latest updates. The readily available "virtual COM port" (VCP) drivers allow simple access on the USB connection in the fashion of "classical" serial port (RS232) communication. This means, once the connection is opened, the user can send clear-text ASCII-strings over USB line to the connected device.

The following table lists the available commands, their functions and text strings which are returned from an HV-device as answer. For simplicity several abbreviations are used: "DDDDD" stands for the name of the device including its serial number. This serial number can be found on the rear side of the device (last 3 digits) or (on newer devices) be read on the front screen in the "protocol mode" of the front LCD-panel. For instance "DDDDD" = "HV009" means HV device with serial number "009". Generally all commands must be terminated with an ENTER (13 in ASCII code). After establishing the USB link to the HV device and turning it on, an "IDN identifier request" can be sent in order to retrieve the serial number, which will be used to address the device. Please see also examples and more details after the table.

Command to HV-device	String to be sent to device	Received from device	Observations
Identify	IDN	HV001…	The device replies with its name and serial number
Set voltage	DDDDD CHXX Y.YYYYY	CHXX Y.YYYYY	XX is the channel number (01 up to 16) Y.YYYYY is a decimal number between 0 and 1 which represents the scaled voltage. "0" represents the minimum voltage (e.g. -500V), "1" the maximum value (e.g. +500V). 5 digits after the comma have to be provided.
Read temperature	DDDDD TEMP	XX.X°C	XX.X is the temperature in °C
Check lock status of all	DDDDD LOCK	$B_3B_2B_1B_0$	Probes all channels to see if any is unlocked. The response is coded into 4 bytes (B_3 to B_0), see also

channels			appendix 3. If a Bit is zero, then locking is ok, if = 1 then a problem occurred in the respective channel
Turn On/Off individual outputs	DDDDD SWITCH	$B_3B_2B_1B_0$	Turns certain channels on or to zero. Coding see below, "1" means *on*, "0" means *off* *Note, that this command is not available in all device versions.* *Sending the command in that case will have no effect.*
Send string to LCD-display	DDDDD DIS "string"		Sends a "string" (arbitrary chain of characters, max. 16 characters long) to be displayed on the front LCD display. The string will be visible in the protocol mode. For format see appendix 2
Set correction parameters	DDDDD CORR ……..		Change of correction parameter, in a dedicated LabVIEW control, or coded as shown below. For adjustment during manufacturing process or later re-adjustment only.

Definition of device identifiers,
received from a device upon request by the "IDN" command:

After sending "IDN" from a PC to the device, the returned identifier string consists of several parts, devivering information about the device. Every part is separated from the next by a normal "space"-character:
Example:
"HV023 500 16 b" = "HV" + "003" + " 500" + " 16" + " b"
That means: a HV-series device answers, serial number is 023, voltage range 500V, 16 channels, and having **b**ipolar outputs. The last character represents the device type:
b - bipolar device
u - unipolar device
q - quadrupole device (for electrostatic quadrupole lenses)
s - steerer device (for electrostatic steerer lenses)

This identifier string is programmed into the FlashRom of every HV-series device by factory.
The different string options are:

first string part:	always "HV"
2nd part:	serial number between "001" and "999"
3rd part:	voltage range of device in volts, can be any (integer) number between 1 and 100000
4th part:	number of channels, presently either "4" or "8" or "16"
5th part:	"b" like bipolar or "u" like unipolar "q" like quadrupole lens supply, "s" like steerer supply

Several Command Examples for setting a voltage:

The command "HV014 CH02 0.00000" puts channel number 2 on minimum voltage, i.e. -500V for a HV500 device (assuming the devices serial number is 014).

The command "HV014 CH02 1.00000" puts channel number 2 on maximum voltage, i.e. +500V for a HV500 device.

The command "HV014 CH02 0.50000" puts channel number 2 on half span between minimum and maximum, which is zero voltage.

Note, that all other voltages between "0.00000" and "1.00000" are scaled linearly, e.g. "0.75000" represents 75% of full span above minimum voltage, which is +250V for a HV500 device.