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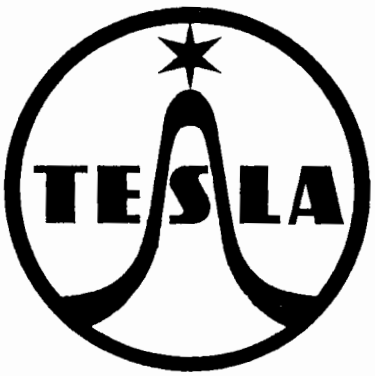


Division of Measuring Technology
Enterprise of Transmitting Technology

High Voltage Power Supply HVS 1

Operation Manual

Service Manual

TESLA a.s. (Joint Stock Company)
Praha 9 - Hloubětín, Poděbradská 186
CZ 180 66 Czech Republic

President of Company	Ing. Vilém Roleček
Director of Enterprise	Ing. František Hála
Director of Division	Ing. Jiří Najman

www.tesla.cz , tel. +420 - 2 - 66107 - 677 , tel. / fax. +420 - 2 – 66107665, e-mail: dmt-obch@tesla.cz

High Voltage Power Supply HVS 1 Operation Manual

Contents

Description of Operation

The firmware version number and the set address of the HVS1 power supply appear on the device display after it is switched on. The power supply HVS1, finishing its initialization, displays the measured values of voltages and currents, whereas all the outputs are switched off. The restoration of the last states of the outputs (that are equal to the states before switching the device off) is executed on command *Restore last State* from the main menu.

The operation of the power supply HVS1 is realized by means of menu and pushbuttons on the control unit. After depressing the ESC pushbutton the main menu appears in the lower part of the display. Using the cursor pushbuttons the required function is selected. This function is confirmed using the pushbutton ENTER. It holds generally that the cursor pushbuttons (up, down) serve to the selection of the item of the menu and that the ENTER pushbutton confirms the selection and that the ESC pushbutton evokes the return into the main menu without executing any command.

The pre-selected level of the output voltage and the switched – off state of the individual high-voltage (HV) channels are indicated by means of corresponding LEDs on the individual channel units. The blinking of the green LED (that is destined to show the pre-selection of the voltage) indicates the lock-out of the corresponding undercurrent protection. The blinking of the red LED (that is destined to show switching-off of the HV channel) indicates the state when the output voltage of this channel is greater than 60V. The switching – off of the HV channel due to the over- or under-current is indicated by means of the arrow behind the displayed value of measured current on the display of the HVS1 device. This information is available via the serial interface line in the state word. The response time t_R for switching-off of the HV channel due to over- or under-current is in the range $10ms < t_R < 12ms$.

Setting the Output Voltage

Select the item *Select channel* and confirm it by the ENTER pushbutton. Using the cursor pushbuttons select the number of the channel whose setting is to be changed and confirm it using the ENTER pushbutton. Carry out the change of this channel's setting, i.e. select its output voltage or switch its output off or eventually switch its output in, and than once again confirm this selection using the ENTER pushbutton.

Switching All the Channels OFF / SHUTDOWN

Depressing the pushbutton HV OFF all the channels are switched-off.

Restoration of the Last State of the Outputs

Using the cursor pushbuttons select the item *Restore last State* from the main menu and confirm it using the ENTER pushbutton. This command switches all the channels that were before switched-off using the HV OFF pushbutton or due to the Interlock or due to the over- or under-current protection. This command will not switch-in those HV channels that were before switched-off using the command *High Voltage OFF* from the menu.

Setting the Address of the Device

Select the item *Bus Setup* and confirm it using the ENTER pushbutton. Select the function *BUS Address* and confirm it by the ENTER pushbutton. Using the cursor pushbuttons set the address of the device in the range from 0 to 15 and confirm it by the ENTER pushbutton.

Setting the CR,LF Combination

Select the item *Bus Setup* and confirm it by the ENTER pushbutton. Select the *CR / LF setup* function and confirm it by the ENTER pushbutton. Using the cursor pushbuttons select the required combination and confirm it by the ENTER pushbutton.

Ban on the Remote Control

Depress the MENU pushbutton. Select the *Bus Setup* item and confirm it by the ENTER pushbutton. Select the *Remote Disable* function and confirm it by the ENTER pushbutton. The ban on the remote control is indicated by the light of the red LED on the front panel of the control unit. It is not possible to operate the device via remote control in this mode of operation now, only the possibility of reading the data is maintained. In the state word there is the information about the ban on the remote control at disposal.

Permission of the Remote Control

Depress the MENU pushbutton. Select the *Bus Setup* item and confirm it by the ENTER pushbutton. Select the *Remote Enable* function and confirm it by the ENTER pushbutton. The permission of the remote control is indicated by the turning off of the light of the red LED on the front panel of the control unit.

Switching the Under-Current Protection ON / OFF

Using the cursor pushbuttons select the *Global settings* item and confirm it by the ENTER pushbutton. Select the *Undercurrent* function and confirm it by the ENTER pushbutton. Select the *Enabled* or the *Disabled* setting for switching the under-current protection ON or OFF. The actual state is displayed by the position of the cursor. The OFF state of the under-current protection of a channel is indicated by the blinking of the LED that is destined to indicate the voltage level of this channel.

Setting the Limits of Tolerance

Depress the Menu pushbutton. Select the *Global settings* item and confirm it by the ENTER pushbutton. Select the *Lower/Upper limits* function and confirm it by the ENTER pushbutton. Using the cursor pushbuttons set the required voltage limit and confirm it by the ENTER pushbutton. After this setting, the setting of other following voltage limit is possible. The limit values can be set in the range from 700 V to 999 V. The limits of tolerance are valid for all the channels of the power supply that are set to this level. The violation of the limits of tolerance is indicated on the HVS1 display by the arrow behind the value of the measured voltage. This information is available as well via the interface bus in the state word.

The Survey of the Individual Menus

1. The MAIN MENU

MAIN MENU	Select Channel	- The choice of channel
----------	Restore last State	- The restoration of last states of outputs
Select	Bus Setup	- The setting of the interface bus RS422
Command:	Global settings	- The global settings of the power supply

1.1 The Selection of the Channel

Select Channel number :	Channel number : 1	

1.1.1 The Setting of the Output Voltage of the Channel

CHANNEL: 1	High Voltage OFF	- To switch the output off
----------	High Voltage ON	- To switch the output on
Set Output Voltage	Output 830V	- To switch the output over to –830V
	Output 950V	- To switch the output over to –950V

1.2 The Restoration of the Last State of the Output

MAIN MENU	Select Channel	- The choice of the channel
----------	Restore last State	- The restoration of the last state of outputs
Select Comand:	Bus Setup	- The setting of the interface RS422
	Global settings	- The global settings of the power supply

1.3 The Setting of the Interface RS422 for Remote Control

BUS SETUP	BUS Address	- Setting the address of the power supply
----------	CR / LF setup	- The setting of the CR,LF combination
Set Remote Control:	Remote Disable	- The ban of the remote control
	Remote Enable	- The permission of the remote control

1.3.1 The Setting of the Address

Seting adress for RS422	BUS Address: 1	

1.3.2 The Setting of the CR,LF Combination

CR / LF SETUP	CR LF CR / LF LF / CR	

1.4 The Global Settings of the Power supply

GLOBAL SETTINGS Select Command:	Under-current Lower/Upper limits	- Setting under-current protection ON/OFF - The setting of the limits of tolerance

1.4.1 The Switching of the Under-Current Protection ON/OFF

UNDER CURRENT Protection ON / OFF	ENABLED DISABLED	- Switching the under-current protection ON - Switching the under-current protection OFF

1.4.2 Setting of the Limits of Tolerance

Settings Output Voltage Range	Low limit 830V: 825 High limit 830V: 835 Low limit 950V: 945 High limit 950V: 955	- Lower limit for the -830V voltage level - Upper limit for the -830V voltage level - Lower limit for the -950V voltage level - Upper limit for the -950V voltage level

The List of Error Notices

NO CHANNEL CARDS !

The notice warning that no card responds to commands coming from the control unit.
No control is possible.

WARNING !!!

At Least one channel without response

The notice warning that at least one channel card does not respond to commands coming from the control unit (at the reset only).

ERROR !!! --- HV Power supply Failure

Notice warning that there is failure on the HV part of the high power power supply. No further control is possible.

INTERLOCK OFF ! --- Check interlock loop or turn on Bypass switch

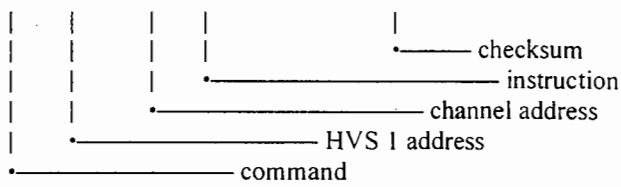
Discontinuity of the interlock loop.

The Communication Via the RS422 Interface - Baud rate 9600bd.

Commands for Operation:

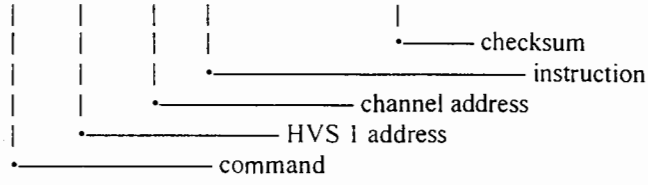
Set 830V:

| @ | adr1 | adr2 | L | V | L | 1 | csum | CR | LF |



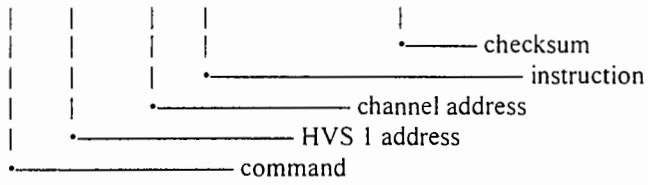
Set 950V:

| @ | adr1 | adr2 | L | V | L | 2 | csum | CR | LF |



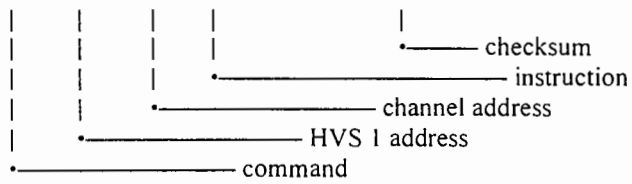
Channel OFF:

| @ | adr1 | adr2 | O | F | F | | csum | CR | LF |



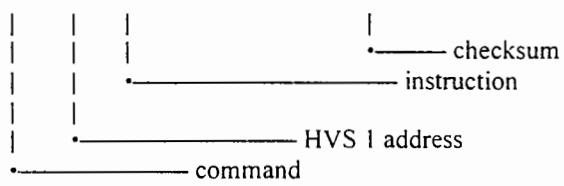
Channel ON:

| @ | adr1 | adr2 | O | N | | | csum | CR | LF |



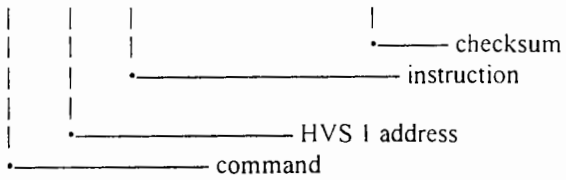
Local: switches the HVS 1 over into the local mode of control

| @ | adr1 | L | O | C | A | L | csum | CR | LF |



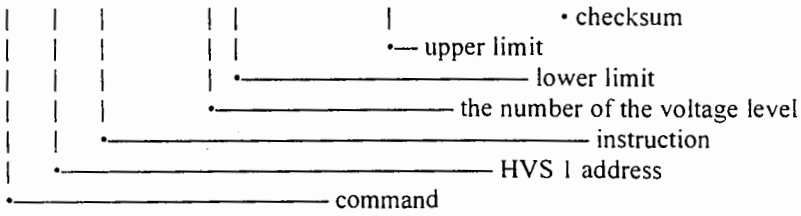
Remote: switches the HVS 1 over into the remote mode of operation

| @ | adr1 | R | E | M | O | T | csum | CR | LF |



Set Limit: sets the tolerance zone for the given level

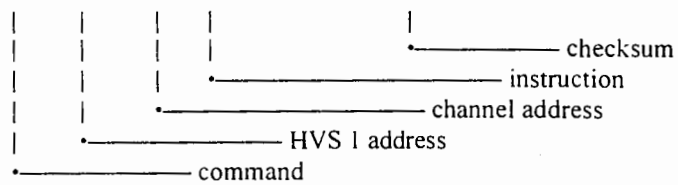
| @ |adr1|L|I|M|I|T|n|A1|A2|A3|A4|B1|B2|B3|B4|csum|CR|LF|



n – the number of the voltage level for which is the set tolerance zone valid
1 - 830V
2 - 950V
lower limit - 4 digits determining the minimum voltage for the given voltage level
(the insignificant zeroes have to be written, e.g. 0825)
upper limit - 4 digits determining the maximum voltage for the given voltage level
(the insignificant zeroes have to be written, e.g. 0835)

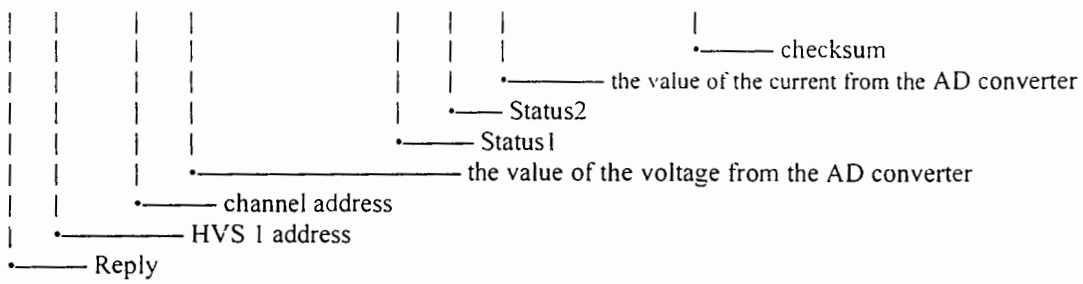
Read: reads the voltage on the output of the channel

| @ | adr1 | adr2 | R | E | A | D | csum | CR | LF |



Reply: acknowledgement of the correctness of the command (READ, Set 830V, Set 950V, Channel ON, Channel OFF)

| # | adr1 | adr2 |V1|V2|V3|V4|V5| S1 | S2 | C1 | C2 | C3 | csum | CR | LF |



V1 - bit0 - the most significant bit of the measured voltage corresponding to thousand Volt.
bit1 - X
bit2 - overflow of the AD converter
bit3 - polarity of the measured voltage
V2 - value corresponding to the hundreds of Volt.
V3 - value corresponding to the tens of Volt.
V4 - value corresponding to the units of Volt.
V5 - value corresponding to the tenths of Volt.

Status1:

bit 0 - L = HV On / H = HV Off
bit 1 - output voltage L = 830V, H = 950V
bit 2 - L = HV On / H = HV Off – pre-selected value that does not relate to actual state
bit 3 - H = failure of the channel

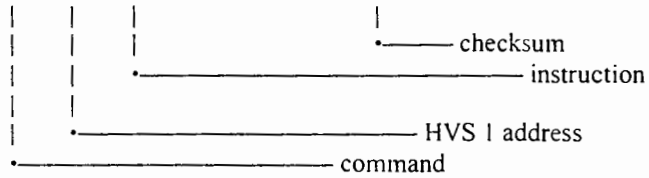
Status2:

bit 0 - Under the Tolerance limit
bit 1 - Over the Tolerance limit
bit 2 - Under-current
bit 3 - Over-current

C1 - value corresponding to the tens of mA.
C2 - value corresponding to the units of mA.
C3 - value corresponding to the tenths of mA.

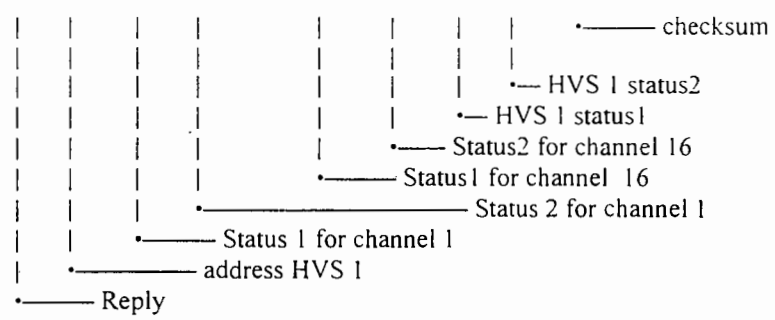
State: reads the state of the whole HVS 1

| @ | adr1 | S | T | A | T | E | csum | CR | LF |



Reply: acknowledgement of correctness of the command (State, Set Limit, Local, Remote)

| # | adr1 |S1-1|S2-1|.....|S1-16|S2-16|CS1|CS2|csum|CR|LF|



Status1 and Status2 are described above and relate to each channel.

HVS 1 status1:

bit 0 - H = Interlock OnLine
bit 1 - H = Interlock bypass connected
bit 2 -
bit 3 - H = Ban of the remote control

HVS 1 status2:

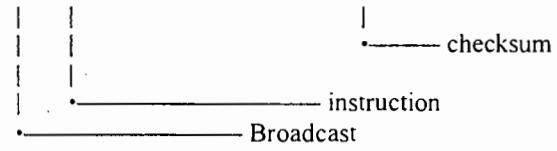
bit 0 - H = System shutdown
bit 1 - H = Under-current protection switched OFF
bit 2 - H = Failure of the high power part of the power supply

Broadcast commands :

The commands of this group do not send acknowledgement to the control computer. These commands hold for all the connected HVS 1 power supplys.

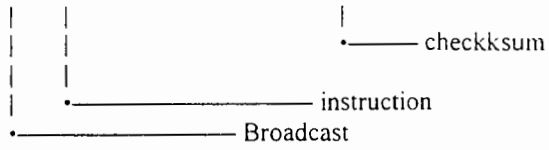
Shutdown: Switches off voltages on all the outputs of all the HVS 1 power supplys.

| * | S | D | O | W | N | * | csum | CR | LF |



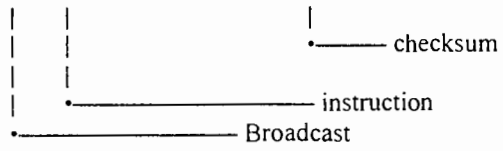
Start: Restore voltages on all the pre-selected outputs of all the HVS1 power supplys

| * | S | T | A | R | T | * | csum | CR | LF |



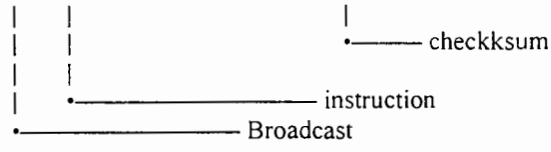
Undercurrent On: Switches the under-current protection for all the HVS 1 power supplys ON

| * | U | C | O | N | * | csum | CR | LF |

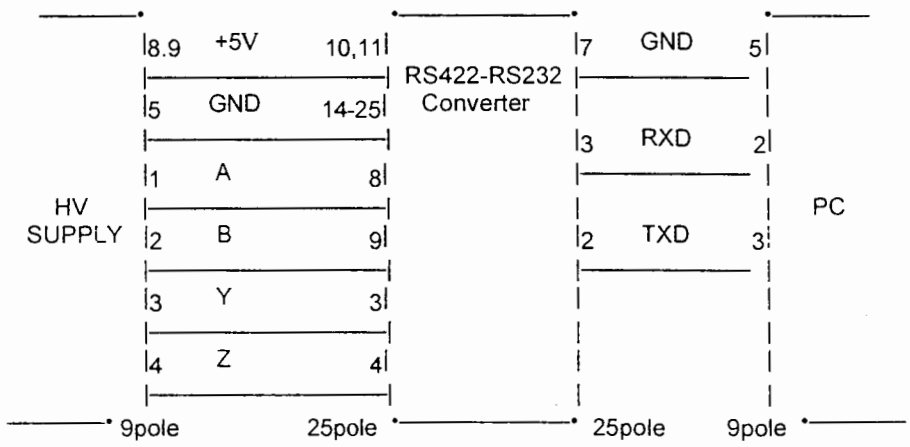


Under-Current OFF: Switches the under-current protection for all the HVS 1 power supplys OFF

| * | U | C | O | F | F | * | csum | CR | LF |



Interconnection of the HVS 1 Power supply Via Interface RS422 with the Controlling Computer:



Type: **HVS 1** Name: **HIGH VOLTAGE POWER SUPPLY** **049 200 010**

High Voltage Power Supply HVS 1 - SPECIFICATION

Electrical Parameters

Each HV output channel provides two output voltage levels -830V and -950V. Each output channel is individually set to the proper voltage level by means of the communication and control unit, and its status is indicated by LEDs. Each channel has over-current and under-current protection. The voltage and current of each output channel are measured and available to remote and manual control.

The input power of the whole system will be less than **5.8kW** for all 16 crates. A summary of the electronics specifications of the **HVS 1** is presented in the following table.

Parameter	Value
Input line voltage range	230V ± 10%
Input line frequency	50Hz
Output DC nominal voltage (changeable)	-830V
	-950V
Channel outputs with common floating ground	
Max. voltage between the floating ground and the frame of the device	± 50V
Output voltage accuracy (nominal load current: 11mA)	± 0.25%
Line regulation at input line voltage 220V ± 10%	± 0.01%
(nominal load current: 11mA)	
Load regulation of the channel voltage	± 0.02%
(load current change: 11mA ± 7mA)	
Long-term stability	± 0.1%
Temperature coefficient	± 50ppm
Ripple and noise (20MHz bandwidth)	≤ 20mV pk-pk
Over-current protection	
Protection initiating current	20mA ± 1mA
Time of drop of the output voltage to 5% (resistive load)	< 1.5ms
(resistive + capacitive load ~ 1uF)	< 150ms
Undercurrent protection	
Protection initiating current	2mA ± 0.5mA
Time of drop of the output voltage to 5% (resistive load)	< 15ms
(resistive + capacitive load ~ 1uF)	< 1.5sec
Response time of the current protection	11ms ± 1ms
Disconnecting of the load - undercurrent protection in action	
Time of drop of the output voltage to 5%	< 100ms
Safety	IEC 61010-1
Inrush current	15A peak max
Efficiency (P_{outmax}/P_{in})	> 76%
Power factor (P_{outmax})	0.99
Turn-on time	cca 2sec
Operating temperature range	5 to 40 °C
Weight	15kg

Technical Glossary:

Output Voltage Accuracy:

For a nominal output load current, the tolerance in percent of the output voltage with respect to its nominal value, when other parameters are within allowed ranges.

Line Regulation:

The change of output voltage from its nominal value when the input line voltage is varied between its specified limits, at nominal load current and constant temperature.

Load Regulation:

The change of output voltage from its nominal value when the load current is varied between its specified limits, at nominal input line voltage and constant temperature.

Long-term Stability:

The change of output voltage, in percent, due to time only, with all other factors held constant. Long-term stability is a function of component aging.

High Voltage Power Supply HVS 1
Service Manual

1.
HIGH VOLTAGE POWER SUPPLY
R1-R8, M1, Z1-Z3

2.
TWO CONTROLLED HV REGULATORS
R1-R9, M1,Z1-Z4

3.
CONTROL UNIT
R1-R7, M1, Z1-Z3

4.
KEYBOARD
R1, M1, Z1

5.
INTERFACE
R1, M1, Z1

6.
MOTHERBOARD
R1-R4, M1-M2, Z1-Z5