

The mesytec MHV-4 is a modern 4-channel high precision bias supply unit for detector bias voltages up to 400 V. It is designed to supply highly stable bias voltage for all types of silicon detectors. The output current is limited to 20 uA.

Several features are added to allow an easy survey of experiments with a large number of high voltage channels. The standard problem with silicon detectors is the rising current which occurs in beamtime with increasing damage in the crystal lattice. The MHV provides adjustable current warning thresholds for the individual channels. When the current goes beyond this threshold the voltage is not shut down (this would interrupt the experiment) but an acoustical and optical warning is emitted. The device can be remotely controlled by RS232, by analog voltages and by mesytec event bus.

### Features:

- 4 large and bright LED displays allow simultaneous survey of all currents or voltages
- Full 4 digit display
- Output connectors: SHV or BNC
- Current display resolution 1 nA
- Adjustable current warning threshold for each channel. Acoustical and optical current warning.
- Individual polarity select for each channel at the rear panel.
- Remote control: by external voltage and RS-232 serial interface or via mesytec event bus (using an MRC-1 / MRCC master module).
- Noise on high voltage < 1 mV at 200 V
- Only  $\pm 6$  V power supply needed



## Technical Data:

### Power consumption

- +6V +700 mA
- -6V -70 mA
- due to low power consumption cooling fans are not necessary

### Voltage Output

- Voltage range: 0 ... +/-100 V or 0 ... +/-400 V (selectable with front switch)
- High quality five turn potentiometer for voltage adjust
- Typical noise  $N < 1$  mV (200 V, 5 Hz to 100 MHz)
- Voltage stability: typ 0.015 %/°C
- Calibration precision  $\pm 0.25$  %
- Output current max. 20  $\mu$ A per channel, limited
- Slow voltage ramp up and down of 5 s to protect preamplifiers.
- Slow ramp up after power failure

### Display

- Full 4 digit display
- Current display with 1 nA resolution up to 20.00  $\mu$ A
- Voltage display:  
400 V range 0.0 to 400.0 V (0.2 V steps)  
100 V range 0.0 to 100.0 V (0.1 V steps)

### Current warning

- Individual warning thresholds adjustable from 10 nA to 20  $\mu$ A
- thresholds are displayed when pressing the display switch
- when a current exceeds the current warning threshold, an acoustical warning is emitted and the power on LED of the respective channel starts blinking

### Connector pinout for remote control: (external voltages and RS-232)

SubD-9 connector, female:

RS-232, standard straight modem cable can be used:

TXD (Module Data output)	pin 2
RXD (module data output)	pin 3
ground	pin 5

Analog voltage control:

ext1, ext2, ext3, ext4 (channel 1 to 4):  
pin 6..9

Pins 1 and 4 not connected.

### Remote control with external voltage:

- Remote mode is set when one of the input voltages (ext1... ext4) gets positive.
- Input voltage range: 0 to 4.0 V
- Input resistance: 1 kOhm
- 4 V corresponds to the maximum voltage which is selected by the range switch (100 or 400 V)

**Remote control with RS-232:**

- MHV-4 can be remote controlled via standard ASCII terminal program.
- Baud rate: 9.600 Bd
- Data Format: 8N1 (8 bit, no parity, 1 stopbit), input characters are echoed
- Command set: (in logical groups)

n = channel number (1...4, a = all),  
<cr> = carriage return

**Read commands:**

- St<cr>: Display MHV-4 status information (all Voltages, currents, limits, polarities, ...)
- Pr<cr>: Display MHV-4 preset information (all Voltages, currents, limits, which will take effect when RC is switched on.)
- Un<cr>: read voltage of channel n  
e.g.: U1<cr> returns:  
0831<cr>, which means:  
channel 1 voltage is 83.1 V.
- Rn<cr>: read rc voltage preset register for channel n.
- In<cr>: read current of channel n
- Ln<cr>: read current limit of channel n

**Set commands:**

- A1<cr>: set maximum range to 400 V.
- A0<cr>: set maximum range to 100 V.  
If presets are higher than 400 V,  
they will be scaled down by a factor  
of 4 (e.g. 300 V → 75 V)
- Sn xxxx<cr>:  
set remote control voltage register  
for channel n  
e.g.: S1 0800<cr> is:  
"set channel 1 remote control  
voltage to 80.0 V"
- Tn xxxx<cr>:  
set rc current limit register for  
channel n

ONn<cr>: switch channel n on

OFFn<cr>: switch channel n off

**RC commands:**

- C1<cr>: switch remote control on  
voltages are set according to the re  
mote control voltage registers
- C0<cr>: switch remote control off  
voltages are set according to front  
panel potentiometers or to external  
voltages, if applied.

**Auxiliary commands:**

- H<cr>: Help /
- ?<cr>: lists all available commands
- V<cr>: Display hardware and firmware  
version

- Command set: (alphabetical)

A1<cr>: set maximum range to 400 V

A0<cr>: set maximum range to 100 V

C1<cr>: switch remote control on

C0<cr>: switch remote control off

H<cr>: Help /

?<cr>: lists all available commands

In<cr>: read current of channel n

Ln<cr>: read limit of channel n

ONn<cr>: switch channel n on

OFFn<cr>: switch channel n off

Pr<cr>: display presets

Rn<cr>: read rc voltage preset register

Sn xxxx<cr>: set voltage preset

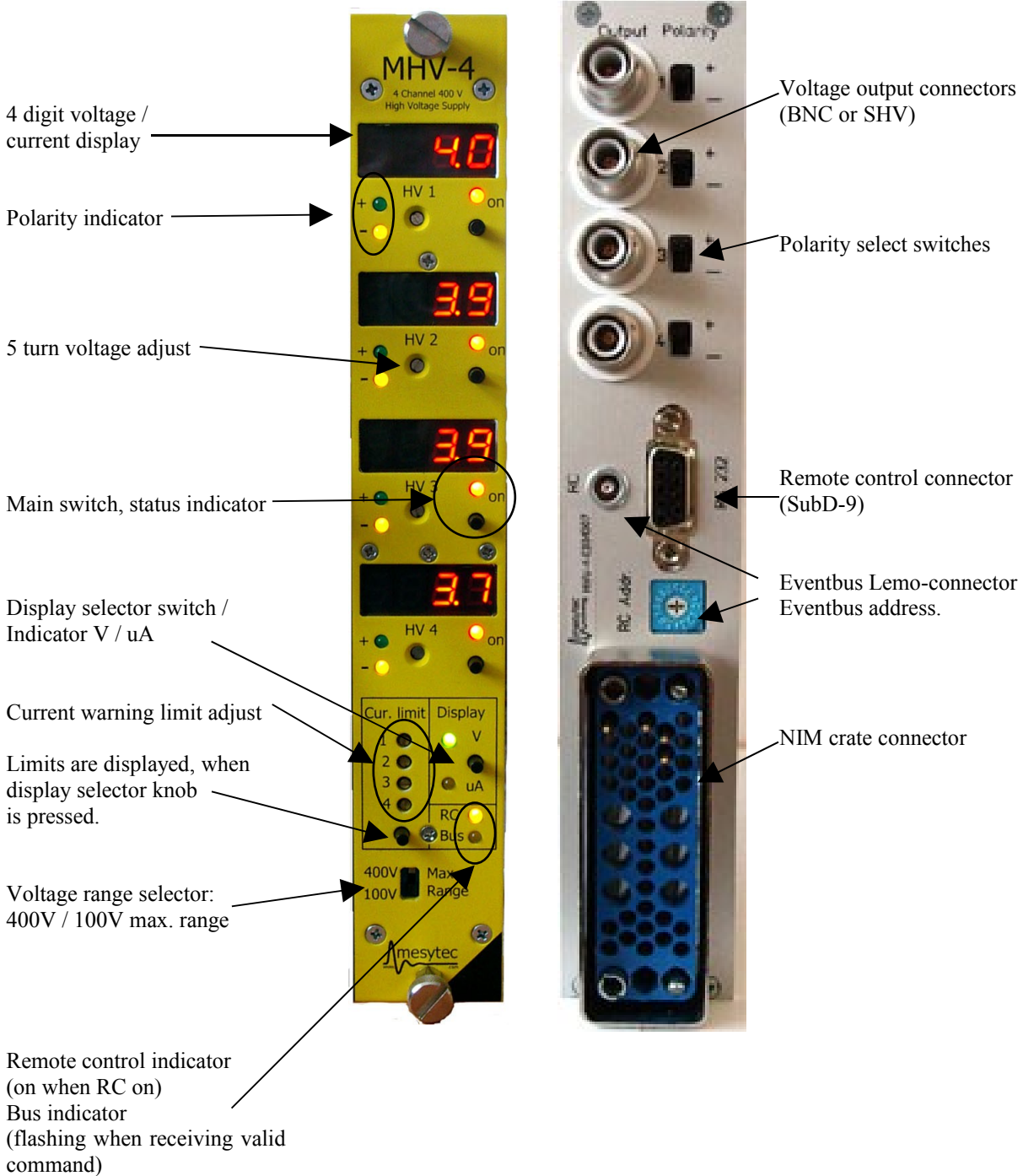
St<cr>: Display MHV-4 status

Tn xxxx<cr>: set current limit

Un<cr>: read voltage of channel n

V<cr>: Display versions

## MHV-4: Front and rear panels



## Remote Control via mesytec serial event bus (MRC-1 / MRCC master controller needed)

As an option, MHV-4 can also be remote controlled via mesytec serial event bus using the rc master modules MRC-1 or MRCC.

This enables setting up larger systems, also combining different modules (such as MHV-4 and the 16 channel shapers STM-16 / MSCF-16 or the 4 channel neutron/gamma discriminator MPD-4), all being accessed from one command interface. The data for all connected modules can be stored in the MRC-1 / MRCC. After pow-

er up or when the reset pushbutton is pressed, it automatically reinitializes all devices with the stored values.

All MHV-4 parameters that are accessible for remote control are represented in a memory range that can be read and/or written by MRC-1 / MRCC commands. Write registers contain setup/preset values and can be written/read. The corresponding read (only) registers represent the measured values. They may differ from the preset values (e.g. when a channel voltage is preset, but the channel is switched off).

### Memory List MHV-4:

Value	Address		Comment
	Write	Read	
Voltage 1	0	32	unsigned integer value, leading '-' if neg. 0...1000 = 0V...100.0 V or 0...4000 = 0V...400.0 V
Voltage 2	1	33	
Voltage 3	2	34	
Voltage 4	3	35	
On/Off 1	4	36	Switch channel on/off or read status. 1 = on, 0 = off
On/Off 2	5	37	
On/Off 3	6	38	
On/Off 4	7	39	
CurLim 1	8	40	Current warning limits for channels (in multiple of 10 nA) e.g.: 1000 = 10µA If set to 0: panel poti value is used
CurLim 2	9	41	
CurLim 3	10	42	
CurLim 4	11	43	
RC on/off	-	44	RC on/off (set with ON/OFF cmd)
Range	13	45	Max. Voltage range: 1 = 400 V, 0 = 100 V
Polarity 1	-	46	Polarities for channels 0 = neg., 1 = pos.  (can only be set by backpanels switches!)
Polarity 2	-	47	
Polarity 3	-	48	
Polarity 4	-	49	
Current 1	-	50	Currents for channels (in nA) leading '-' if neg. e.g.: 1000 = 1000 nA = 1 µA
Current 2	-	51	
Current 3	-	52	
Current 4	-	53	

Memory positions are written with the SE (=set) command and read with the RE (=read) command. (please see command listing below for detailed cmd information)

For very safe operation a mirror page is available. It is a second write memory page that can be written without triggering changes in the current MHV-4 setup.

Write and read commands are SM (=set mirror value) and RM (= read mirror value). When everything is written and

confirmed, values can be all together copied to the active page with CP (= copy mirror page), where they take effect immediately.

The ON / OFF commands make the remote control active or inactive. The power up default is inactive. While inactive, the front panel values are set.

Identification code for MHV-4 (detected when running the scan bus command "SC") is IDC = 17

**MRC-1 / MRCC command Summary:**

cmd format:

*cmd bus [dev] [adr] [val]*

*bus* = bus number [0...1]  
*dev* = device number [0...15]  
*adr* = parameter number [0...31]  
*val* = See memory list page 4

*SC bus*

Scans given bus (0, 1) and returns id code (IDC) for each device number that responds. MHV-4 will return IDC=17.

*ON bus dev*

Activates remote control for given device @ bus. Will invoke rc settings instead of panel settings. (Be sure to have parameters set correctly or in a sure range before activating rc.)

*OFF bus dev*

Switches off remote control for given device @ bus. Returns settings to panel values.

*RST bus dev*

Resets all parameters for device @ bus to zero. (->leads to a safe configuration in a MHV-4, as all voltage presets are set to 0 V and all channels will be switched off.)

*SE bus dev adr val*

Set direct memory address adr in device @ bus to value val. Changes will take effect immediately if rc is switched on. For a special safe setup and common application of all set values, please use the mirror memory and copy command.

*RE bus dev adr*

Read value from direct memory address adr in device @ bus.

Please notice: for all parameters that can be set, there are two addresses to read from. Reading at the write addresses in the memory map above returns the preset values. Reading at the read addresses returns measured values. These may differ in some cases, e.g. if a voltage is preset but the according channel is switched off.

*SM bus dev adr val*

Same as SE command, but writes to the mirror memory page. Values are copied to direct memory using the CP copy command. Presets can be changed safely and will only take effect if copied to direct memory.

*RM bus dev adr*

Read mirror memory – returns the preset value out of mirror memory.

*CP bus dev*

Copy mirror memory to active memory.

Presets will take effect immediately if rc is switched on.

**Example:**

Assume an MHV-4 configured as device id 2 on bus 0.  
Please check that polarities are set correctly using the backpanel switches.

For a basic safe operation, the following steps are a possible suggestion:

- Check for appropriate device code on bus:  
SC 0  
should (among others) return a line like:  
2: 17, off  
indicating an MHV-4 (IDC 17) with rc switched off  
(if on: switch off with Off 0 2)
- Set voltage range to desired value (here: 400 V):  
SE 0 2 13 1  
Notice: default value is 0 = 100 V, regardless the panel switch position!
- Set channel voltages to desired values (here: 310 V):  
SE 0 2 0 3100  
(Same at addresses 1, 2, 3 for channel # 2, 3, 4)
- Set current limits to desired values (here: 8.0 uA):  
SE 0 2 8 800  
(Same at addresses 9, 10, 11 for channel # 2, 3, 4)
- Switch on required channels (here: channel 1):  
SE 0 2 4 1  
(Same at addresses 9, 10, 11 for channel # 2, 3, 4)
- Switch rc on:  
ON 0 2  
(Frontpanel displays should indicate currents / voltages according to the preset values.)
- Check voltages:  
RE 0 2 32  
should return something like:  
RE 0 2 32 3100  
(Same at addresses 33, 34, 35 for channel # 2, 3, 4)
- Check currents:  
RE 0 2 50  
should return something like:  
RE 0 2 50 iiii  
(With iiii being a low leakage current you expect for your detector...)  
(Same at addresses 51, 52, 53 for channel # 2, 3, 4)

Adjusting parameters is just done by writing the appropriate values into the memory cells.

For a super safe operation, especially to avoid possible problems with typographic errors, or while working with rc for a first time, it is recommended to use the mirror memory when rc is switched on.

There you can set parameters just like in direct memory but read back the presets for confirmation. They will take effect when the copy command `CP bus dev` is executed, which will copy the mirror memory values into the according direct memory locations. This also allows to have all parameters set up and let them take effect at the same time instead of setting them sequentially.