

user manual

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SHR

Switchable High Precision AC/DC Desktop High Voltage Power Supply

- 2 / 4 channel, 2 kV / 6kV versions
- electronically switchable polarity
- versatile 6kV-channel with switchable HV-generation modes: up to 6kV/2mA, 4kV/3mA or 2kV/4mA
- high precision / ultra low ripple and noise
- Ethernet / USB interfaces, integrated iCS2 on ARM Linux server hardware
- 4.3" TFT capacitive touch display
- comprehensive features including logging, diagrammatic display and script control



Document history

Version	Date	Major changes
1.0	19.03.2018	Initial release
1.1	20.09.2018	Minor fixes

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The information in this manual is subject to change without notice. We take no responsibility for any mistake in the document. We reserve the right to make changes in the product design without reservation and without notification to the users. We decline all responsibility for damages and injuries caused by an improper use of the device.

Important security informations

It is strongly recommended to read the operator´s manual before operation. To avoid injury of users it is not allowed to open the unit. There are no parts which can be maintained by users inside of the unit. Opening the unit will void the warranty.

We decline all responsibility for damages and injuries caused by an improper use of the module. It is strongly recommended to read the operators manual before operation.

WARNING!



WARNING!

The non-observance of the advices marked as "Warning!" could lead to possible injury or death.

ATTENTION!



ATTENTION!

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

INFORMATION



INFORMATION

Advices marked as "Information" give important information.

Warranty information

This product is shipped with a warranty of 36 months, starting with issue of invoice. Within this period iseg will repair or replace in case of defective under proper use.

Safety notes

CAUTION!



CAUTION

To avoid injury of users it is not allowed to open the unit. Before any operations on the HV output or the application, the unit has to be switched off and discharge of residual voltage has to be finished. Depending on application residual voltages can be present for long time periods. These residual voltages can lead to severe injuries.

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1 General information

WARNING!



WARNING!

The devices induce output voltages and currents which conformable to **EN61010-1** are not dangerous to life. But it is possible that they effect health damages to sensitive persons.

The iseg SHR modules are standalone High Precision HV laboratory SMU – Source Measuring Unit – equipped with the finest iseg HV generation technology and iCS control system.

The SHR provides up to 4 channels, each with an independent voltage and current control and electronically reversible polarity. The 6kV channel provides a maximum versatility: with three electronically switchable HV-output modes it can supply 4mA up to voltages of 2kV, 3mA up to 4kV and 2mA up to 6kV. Alternatively the SHR can be equipped with cost efficient 2kV/6mA channels.

A high quality 4.3" TFT display shows detailed information and can be controlled by capacitive touch. All comprehensive features like logging, graphical display and customer specific plugins are also available by the precise jog-wheel and buttons.

2 Technical data

SPECIFICATIONS	SHR Standard	SHR High Precision
Polarity	Electronically switchable	
Ripple and noise (f > 10 Hz)	< 10 mV _{p-p}	< 2-3 mV _{p-p}
Ripple and noise (f > 1 kHz)	< 3 mV _{p-p}	< 2 mV _{p-p}
Ripple and noise (10 Hz – 0.1Hz)		< 5-10 mV _{p-p}
Stability [ΔVout / ΔVin]	$2 \cdot 10^{-4} \cdot V_{mode}$	$1 \cdot 10^{-4} \cdot V_{mode}$
Stability - [ΔVout / ΔRload]	$2 \cdot 10^{-4} \cdot V_{mode}$	$1 \cdot 10^{-4} \cdot V_{mode}$
Temperature coefficient	50 ppm/K	30 ppm/K 10 ppm/K (option TC)
Resolution voltage setting	$2 \cdot 10^{-6} \cdot V_{nom}$	
Resolution current setting	$2 \cdot 10^{-6} \cdot I_{nom}$	
Resolution voltage measurement	$2 \cdot 10^{-6} \cdot V_{nom}$	$1 \cdot 10^{-6} \cdot V_{nom}$
Resolution current measurement - full range	$2 \cdot 10^{-6} \cdot I_{nom}$	$1 \cdot 10^{-6} \cdot I_{nom}$
Resolution current measurement - 2 nd range	n/a	50 pA [$I_{out} < 20 \mu A$]
Accuracy voltage measurement	$\pm (0.01 \% \cdot V_{out} + 0.02 \% \cdot V_{nom})$	$\pm (0.01 \% \cdot V_{out} + 0.01 \% \cdot V_{nom})$
Accuracy current measurement - full range	$\pm (0.01 \% \cdot I_{out} + 0.02 \% \cdot I_{nom})$	$\pm (0.01 \% \cdot I_{out} + 0.01 \% \cdot I_{nom})$
Accuracy current measurement - 2 nd range	n/a	$\pm (0.01 \% \cdot I_{out} + 4 \text{ nA})$
Measurement accuracy - The measurement accuracy is guaranteed in the range $1\% \cdot V_{mode} < V_{out} < V_{mode}$ and for 1 year		
Sample rates (SPS)	5, 10, 25, 50, 60, 100, 500	
Digital filter averages	1, 16, 64, 256, 512, 1024	
Hardware limits	Potentiometer per module [V_{max} / I_{max}]; relative to V_{nom} / I_{nom}	
Voltage ramp	$1 \cdot 10^{-6} \cdot V_{mode} / s$ up to $0.2 \cdot V_{mode} / s$	
Rated AC mains input	100 – 240 VAC / 1-0.5 A max / 50-60 Hz	
Fuse	T 1.6A L 250V / microfuse 5mm x 20mm, 250V / 1.6AT	
AC power connector	socket according IEC 60320 C13 (125V/10A or 250V/16A)	
HV connector	SHV	

Safety Loop connector	Lemo 2pole: FFA.0S.302.CLAC
Safety Loop socket	Lemo 2pole: ERA.0S.302.CLL
Interfaces	Ethernet, USB(A) 2.0 (Host: Wifi, Logging, Webcam), USB(B) (remote control)
Protection	INHIBIT, Safety loop, short circuit, overload, hardware V/I limits
Case	desktop case
Dimensions (L/W/H)	331/257/103 mm
Operating temperature	0 – 40 °C
Storage temperature	-20 – 60 °C
Further environmental conditions	equipment is for use in closed environment only, relative humidity 20% to 90% (no condensation), maximum Pollution degree level 2

Table 1: Technical data: Specifications

CONFIGURATIONS SHR									
Type	Ch	Precision	V _{nom}	I _{nom}	Ripple (mV _{p-p}) >1kHz 10Hz-1kHz		HV output mode (V _{mode} / I _{mode})	Item Code	Options
SHR 20 20	2	Standard	2000 V	6 mA	3	10	2 kV / 6 mA	SR020020r605	VCT,IHB,IHD
SHR 20 60	2	Standard	6000 V	4 mA	3	10	6 kV / 2mA 4kV / 3mA 2kV / 4mA	SR020060r405	VCT,IHB,IHD
SHR 40 20	4	Standard	2000 V	6 mA	3	10	2 kV / 6 mA	SR040020r605	VCT,IHB,IHD
SHR 40 60	4	Standard	6000 V	4 mA	3	10	6 kV / 2mA 4kV / 3mA 2kV / 4mA	SR040060r405	VCT,IHB,IHD
SHR 22 20	2	High	2000 V	6 mA	2	2	2 kV / 6 mA	SR022020r605	VCT,IHB,IHD,TC,L
SHR 22 60	2	High	6000 V	4 mA	2	3	6 kV / 2mA 4kV / 3mA 2kV / 4mA	SR022060r405	VCT,IHB,IHD,TC,L
SHR 42 20	4	High	2000 V	6 mA	2	2	2 kV / 6 mA	SR042020r605	VCT,IHB,IHD,TC,L
SHR 42 60	4	High	6000 V	4 mA	2	3	6 kV / 2mA 4kV / 3mA 2kV / 4mA	SR042060r405	VCT,IHB,IHD,TC,L

Table 2: Technical data: Configurations

OPTIONS / ORDER INFO	INFO	EXAMPLE	ITEM CODE HEX CODE
SINGLE CHANNEL INHIBIT – BNC connectors	IHB	SHR 4260 IHB	400
DETECTOR INHIBIT (ORTEC/CANBERRA)	IHD	SHR 4260 IHD	800
VOLTAGE CORRECTION by TEMPERATURE	VCT	SHR 4260 VCT	008
LOWER TEMPERATURE COEFFICIENT	TC	SHR 4260 T10	004
LOWER OUTPUT CURRENT	L (I _{nom} = 100 µA)	SHR 4260 L	-

Table 3: Technical data: Options and order information

3 Handling

CAUTION!

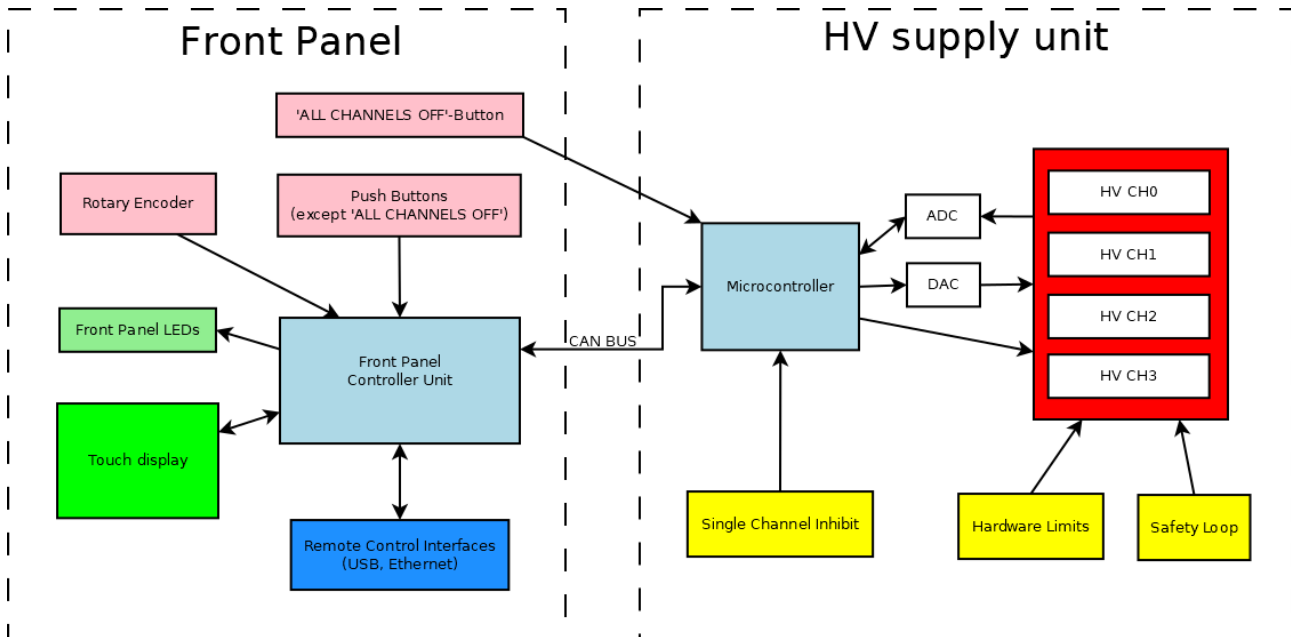


CAUTION!

The device is not designed to operate as a current sink.
Never apply external voltages of opposite polarity to the selected one or with values greater than the maximum value of the selected output mode. This can damage the module.

3.1 Functional principle

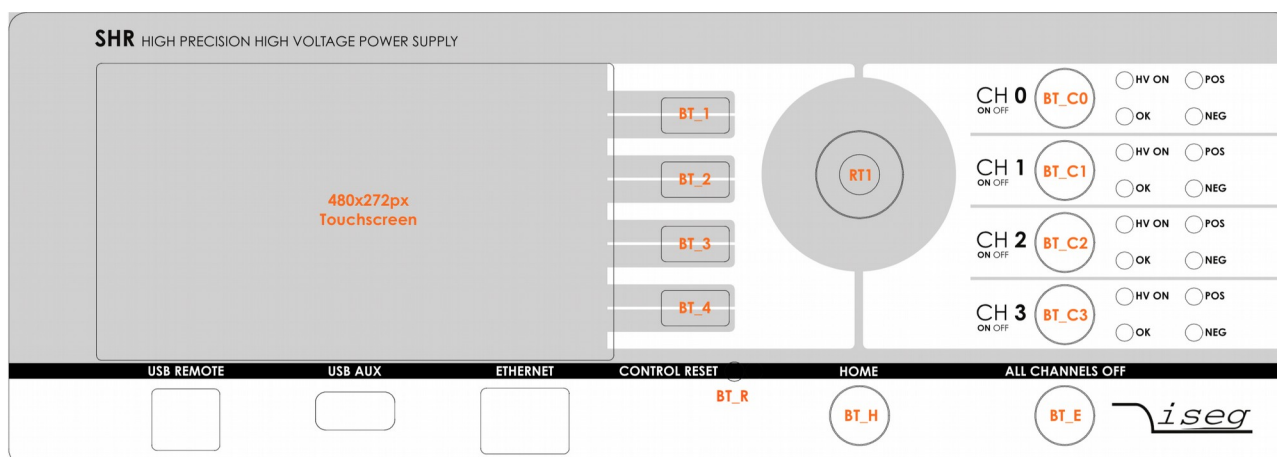
The SHR module combines a very precise and powerful high voltage supply unit and an intelligent front panel controller.



The high voltage supply unit runs independently and controls and monitors all parameters and conditions for high voltage generation. This includes set values, ramping, voltage and current measurements, hardware control and status information, etc.. Also the protection feature safety loop, hardware limits and single channel inhibit act directly on the HV supply unit.

The front panel controller, a computer module with an embedded Linux-Server system, serves the front panel operating elements (touch display, status LEDs, push buttons except 'ALL CHANNELS OFF' and the rotary encoder) and provides remote control interfaces. It also provides the iseg Communication Server (ICS), which comes with an extensive preconfigured set of software services (see chapter „ICS2 – iseg Communication Server 2“). The front panel controller is connected to the HV supply unit via an internal CAN bus to obtain the operation data and send control commands.

3.2 Front panel



The front panel of the SHR owns the following control elements:

Touchscreen	480x272px 4" capacitive touch screen interface
RT1	Rotary button
BT_1 to BT_4	4 context sensitive pushbuttons, display shows corresponding action (see "context button bar")
BT_H	Home action push button - opens Home menu
BT_C0 to BT_C3 ¹	Channel ON/OFF push buttons
BT_E	ALL CHANNELS OFF push button - immediately shuts down all channels
BT_R	Reset for the front panel controller

Note: The **CONTROL RESET (BT_R)** button causes a reboot of the front panel controller. The high voltage generation is not affected by this. If pushed, all HV-channels will remain active with their previously specified polarity, set values, running and ramping states, trip parameters etc.. During the following reboot (approx. 10-12s) there will be no information on the display and the channel LEDs do not show the current running status, i.e. toggling of **OK**, **HV ON** or **polarity** LEDs do not indicate a change in HV generation. Also front panel and remote control is interrupted. Once reboot is finished the display/LED information is recovered and remote control services are restarted.

To shut down high voltage during the reboot process the **ALL CHANNELS OFF** button can be used. This button acts directly on the HV-channels, independently of the front panel controller.

ATTENTION!



ATTENTION!

If **CONTROL RESET (BT_R)** is pushed during operation with high voltage generation all channels will keep their running status. During reboot time of the controller the display and channel LEDs do not show the current running status (i.e. HV generation might be active although the corresponding HV ON LED is not illuminated). Front panel and remote control is not available during this time.

If high voltage must be shut down during this process this can be done pushing the **ALL CHANNELS OFF** button (**BT_E**).

3.3 Channel Switches and LEDs

The front panel of the SHR device is equipped for each channel with a "On/Off" switch (BT_C0 to BT_C3) to turn the channel on and off, two status LEDs ("OK" and "HV ON") and two LEDs ("POS" and "NEG") to indicate the selected polarity.

The green LED "OK" signals the general condition of the channel and the yellow LED "HV ON" signals measured output voltage at the corresponding channel or is flashing shortly every time the user presses the corresponding "On/Off" switch.

Following behaviors are possible:

¹ 2 channel SHR version has only BT_C0 and BT_C1

LED "OK"	LED "HV ON"	Meaning
not illuminated	not illuminated	An error event occurred, the channel cannot be switched on.
not illuminated	illuminated	An error occurred but there is still a measured voltage at the channel.
illuminated	not illuminated	The channel is switched off and can be turned on.
illuminated	illuminated	The channel is turned on and there is output voltage at the channel.
	flashing	The channel is ramping up or down

Table 4: LED Status information

ATTENTION!



During the boot-up time of the SHR device the channel LEDs may not represent the status of module. Please wait until boot-up is finished (max. 10-12s) to get current information.

ATTENTION!

3.4 Remote Control

The SHR devices offer two remote control interfaces: USBremote and Ethernet.

With the USB remote connector, one SHR can be controlled with the iseg SCPI instruction set. Available control applications are isegControl2, iseg Terminal and iseg SCPI Control. Please consider the SCPI Documentation (see appendix) for further details.

The SHR Ethernet interface is supplied by an iseg iCS2 onboard Linux based single board computer. Using Ethernet a various set of services is offered, like webbrowser based configuration, monitoring and control, by isegControl2 or to be integrated into systems by EPICS, SNMP, OPC-UA and more. The remote configuration and usage of the iCS system is described in the chapter „iCS2 – iseg Communication Server 2“.

3.5 Polarity and Output-Mode selection

Configuration change (permanent):

For all channels of NHR devices the polarity can be electronically switched. This can be done as permanent configuration of the device via front panel SHRcontrol (*HOME → SETTINGS → HARDWARE SETUP → CHANNEL SETUP → CHANNEL x → POLARITY, see chapter SHRcontrol*) or by iCSconfig (see chapter iCS2).

Modules with $V_{nom}=6kV$ (except option **L**) also provide switchable HV-output modes which allow to switch the nominal values of a channel between 2kV/4mA, 4kV/3mA and 6kV/2mA. This can be done via the front panel (*HOME → SETTINGS → HARDWARE SETUP → CHANNEL SETUP → CHANNEL x → POLARITY, see chapter SHRcontrol*) or by iCSconfig (see chapter iCS2).

Switching the polarity or output mode is only allowed if the corresponding channel is switched off and discharged below $0.002 \cdot V_{nom}$. The module blocks all switching attempts if these conditions are not satisfied.

Change during operation:

CAUTION!



The device is not designed to operate as a current sink.
Never apply external voltages of opposite polarity to the selected one or with values greater than the maximum value of the selected output mode. This can damage the module.

CAUTION!

The second way to change the polarity and output mode is during operation by use of any API (using iCSservice, isegHALservice, SNMP, EPICS, OPC-UA). Therefore the corresponding channel data objects can addressed for change (e.g. Setup.Polarity, Setup.OutputMode on iCSservice → see items.xml definition (iCS2 → iCSconfig → iCSservice))

3.6 Protection Features

3.6.1 Hardware Limit

The maximum output voltage for all channels (hardware voltage limit) is defined through the position of the corresponding potentiometer V_{max} . The maximum output current for all channels (hardware current limit) is defined through the position of the corresponding potentiometer I_{max} . Both potentiometers are located on the rear panel. The greatest possible set value for voltage and current is given by $V_{max} - 2\%$ and $I_{max} - 2\%$, respectively. The percental values always refer to the nominal values of the channel, V_{nom} and I_{nom} . E.g. for a 6kV/4mA module the reference values are 6kV and 4mA, independent of the selected output mode.

The output voltage and current are limited to the specified value. If the maximum voltage or current of the selected output mode (V_{mode} or I_{mode}) is below this limit, this will further limit the output.

If a limit is reached or exceeded in any channel the corresponding green LED on the front panel turns off.

3.6.2 Safety Loop

A safety loop can be implemented via the safety loop socket (SL) on the rear panel.

An internal current source drives approx. 5 mA with a maximum voltage drop of 18V between the connector pins. High voltage can only be generated if the safety loop is closed.

If the safety loop is opened during the operation, the output voltages are shut off without ramp. Furthermore, the corresponding bits in the „ModuleStatus“ and „ModuleEventStatus“ registers are set (see EDCP-CAN-Dokumentation in appendix). After closing the loop again, the „ModuleEventStatus“ register must be reset to turn the channels on again.

The safety loop can be deactivated by placing the provided jumper on the connector.

3.6.3 Single channel Inhibit

INFORMATION



INFORMATION

INHIBIT is an external signal, that switches off the high voltage for the device or a specific channel

Note: This section only describes the standard single channel Inhibit (**no Inhibit option** or option **IHB**). For option **IHD** see the corresponding subsection in chapter Options. For modules with option **VCT** single channel Inhibit is not available. Modules with none of the options IHB, IHD or VCT are equipped with a Sub-D connector on the backplane of the module with the following pin assignment:

SUB-D9 connector pin	Signal
1	Inhibit Channel 0
2	Inhibit Channel 1
3	Inhibit Channel 2
4	Inhibit Channel 3
5-9	GND

Modules with option IHB are equipped with a BNC-connector for each channel. The signal GND is identical with the module GND (HV-return).

The INHIBIT signals are TTL-level, the signal logic and default states can be configured. The following settings are possible:

Case 1 – IU

INHIBIT signal logic: LOW-active (LOW → HV-generation stopped)
default state: HIGH (internal pull-up resistor applied)

open INHIBIT signal input: HV enabled

Case 2 – ID

INHIBIT signal logic: LOW-active (LOW → HV-generation stopped)
default state: LOW (internal pull-down resistor applied)
open INHIBIT signal input: HV disabled

Case 3 – NIU

INHIBIT signal logic: HIGH-active (HIGH → HV-generation stopped)
default state: HIGH (internal pull-up resistor applied)
open INHIBIT signal input: HV disabled

Case 4 – NID

INHIBIT signal logic: HIGH-active (HIGH → HV-generation stopped)
default state: LOW (internal pull-down resistor applied)
open INHIBIT signal input: HV enabled

The INHIBIT signal must be applied for at least 100 ms to guarantee a detection. If an Inhibit signal is detected, the channel status bit isExternalInhibit and the channel event status bit EExternalInhibit are set. One of the following reactions to this signal can be programmed:

- No Action (default)
- Turn off the channel with ramp
- Shut down the channel without ramp
- Shut down all channels without ramp

When the INHIBIT is no longer active, the Inhibit flag must be reset before the voltage can be switched on again.

3.7 Floating GND configuration

The SHR module is a module with Common Floating Ground (CFG). All HV-channels have a common return potential (module GND), which is galvanically isolated from PE. The module housing is connected to PE. A protection circuit prevents differences between the module GND and PE potentials of more than 39V.

3.8 The function "Delayed Trip"

3.8.1 Operating principle

The function "*Delayed Trip*" provides a user-configurable, time-delayed response to an increased output current (I_{out}) higher than the set current (I_{set}). The response to this kind of event can be, for example, to ramp down the channel with the programmed ramp. A detailed description for the configuration can be found in the EDCP-CAN-Dokumentation in appendix.

By a programmable timeout with one millisecond resolution, the trip can be delayed up to four seconds. During this time, the output current is limited to the value of I_{set} (constant current mode).

The hardware regulation signals, constant voltage (CV) or constant current (CC), are sampled every millisecond by the microprocessor. Once the constant current mode is active, the programmed timeout counter is decremented. If the HV channel returns to constant voltage mode before timeout (i.e. $I_{out} < I_{set}$), the counter will be reset. So this process can be restarted if the current rises again.

To guarantee a sufficient resolution for the current set values, a nominal current adequate to the application should be selected. iseg offers HV modules with nominal currents reduced to 100 μA in all voltage classes. These are designated e.g. for semiconductor detectors, which only require a few microampere operating current.

3.8.2 Device with two current measurement ranges

High Precision SHR modules with two current ranges are a particular case. In these HV modules the high current output is combined with a picoampere resolution in the low current measurement range. The range switching is done by the microprocessor depending on I_{meas} :

High measuring range: $I_{\text{nom-low}} < I_{\text{meas}} < I_{\text{nom}}$

Low measuring range: $0 < I_{\text{meas}} < I_{\text{nom-low}}$

The typical value for $I_{\text{nom-low}}$ is 20 μA .

As long as a set current in the high measuring range is used, everything is working as described above. If a set current in low measuring range is nomified, the current limitation is set to 120 % of the low measuring range.

Example: $I_{\text{nom-low}} = 20 \mu\text{A} \rightarrow$ current limitation is set to 24 μA if $I_{\text{set}} = 10 \mu\text{A}$

Now the channel operates in the low measuring range only. A software comparison of set current I_{set} and measured current I_{meas} is performed in addition to the described hardware CC and CV signals sampling.

With this principle, two requirements are met:

- the output current will not exceed 24 μA even during fast changes and
- the delayed trip function is extended into the region of very small currents (picoampere) for these HV modules.

For the software comparison, a delay between 80 milliseconds and 1 second must be expected. This depends on the modules ADC (Analog-to-digital-converter) configuration.

This time can be adjusted by changing the ADC sample rate to meet the requirements of the application. Higher ADC sample rates lead to shorter delays but also reduce the resolution.

If the *Delayed Trip* function is activated the voltage ramp should be limited to 1 % of V_{nom} before. Higher values could trigger a trip by internal charge balancing during a ramp, even though the output current does not exceed the set value I_{set} . If the connected load contains capacities or if I_{set} is very small, it might be necessary to further reduce the ramp speed. Alternatively, the *Delayed Trip* can be activated only after the completion of the ramp.

INFORMATION



An activated KillEnable feature disables the Delayed Trip function.

INFORMATION

An active *KillEnable* function disables the *Delayed Trip* function. If *KillEnable* is active and a trip occurs, the channel is shut down without ramp at the fastest hardware response time (smaller than 1 ms). However, the actual discharge time strongly depends on the connected load.

3.9 SHRcontrol: Touchscreen and Remote User Interface

3.9.1 General UI-elements

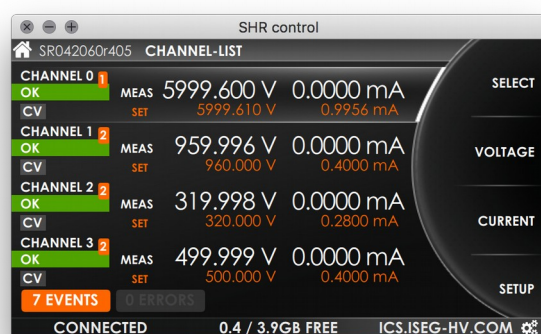


Figure 1 - SHRcontrol channel list view

The SHRcontrol user interface is available directly as HMI on the front panel of the SHR High Voltage Power supply. It is controllable by the hardware buttons and the rotary button. SHRcontrol is also available as desktop applications for Windows, Linux and Mac, where additional features are available.

Top Bar

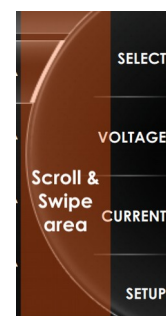


The Topbar indicates the following entries:

- the model number of the current device (or remotely the currently connected device). The home icon indicates that this area can also be used to reach the Home Screen when in remote operation
- the navigation information indicates the current view or menu page path that is displayed

Wheel

- on the right side of the user interface the half of a wheel is displayed. It indicates rotation of the rotary wheel. When using the touch interface it can be swiped to change values or select items in lists. Remotely the area over the wheel activates the mouse scroll wheel. So when the mouse pointer is over the wheel area, the scroll wheel simulates rotation of the hardware rotary.



Context Button Bar

On top of the wheel 4 context buttons are available for view specific actions. They can be clicked using the corresponding hardware buttons on the SHR or remotely by clicking directly. A context button can also be set as a toggable switch. In this case it is highlighted by a background color.

Bottom Bar



The bar on the bottom of the user interface shows hardware related information of the SHR device.

The color of each panel represents a status:

GREEN	Status of hardware or connection is OK
YELLOW	User ATTENTION is needed for hardware or connection
RED	ERROR occurred, may cause incorrect operation
GREY	Hardware or connection is INACTIVE or DISABLED

The left panel indicates the state of the remote USB connection. The middle panel shows information about the currently connected USB aux device, such as information of a USB flash memory or the connected lab surveillance camera. The right panel shows the current IP address of the SHR to easily find connection to iCS using a web browser or to be entered in a SHRcontrol remote desktop application.

When used remotely, the currently configured IP address of the SHR that is connected in this panel. In remote mode, SHRcontrol can be clicked to open the connection menu directly. This is indicated also by the menu icon (cogwheels).

3.9.2 Home view



Figure 2 - SHRcontrol HOME VIEW

The HOME VIEW shows all available APPS of SHRcontrol. Use rotary or touchscreen to select and entry and start by clicking SELECT using BT_1.

The following VIEWS / PLUGINS are available

CONTROL	Control and monitor device and channels Views: CHANNEL-LIST, CHANNEL-DETAILS
GRAPH	Graphical monitoring of channels with various functions
SETTINGS	Hard- and software configuration

3.9.3 Control / Channel list view

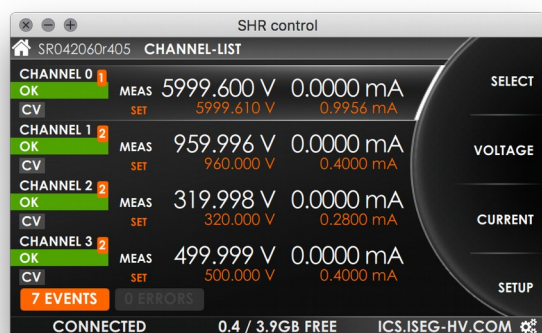


Figure 3 - SHRcontrol CHANNELLIST VIEW

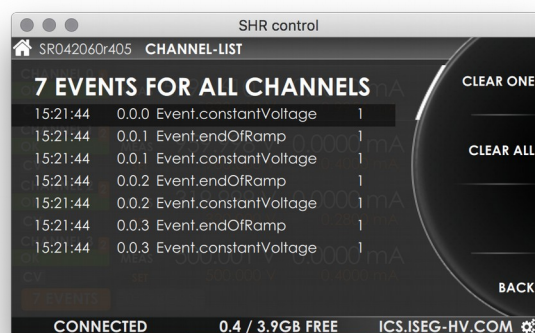


Figure 4 - SHRcontrol CHANNELLIST VIEW with EVENT LIST enabled

The channel list displays important information of all four SHR high voltage channels at a glance. By turning the rotary or using the touch interface it is possible to select a channel which is then highlighted. Now the following actions are available:

Press button **"SELECT"** to change to the channel detail view

Press **"VOLTAGE"** to change to voltage related settings of the selected channel

Press **"CURRENT"** to change to current related settings of the selected channel

Press **"SETUP"** to change directly to the channel settings page in the menu of the selected channel

Additional touchscreen / remote functions

Display Events and Errors

One Channel:

Click on an error or event badge on the upper right of a channel entry of the channel list

All Channels and device:

Click on the event / error badge on the bottom of the screen (here „7 EVENTS“)

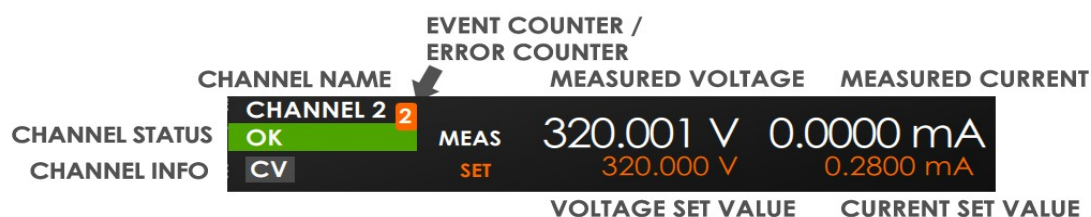


Figure 5: CHANNEL-LIST ENTRY

Each channel is represented as list element. This list element contains of the following elements

ELEMENT	DESCRIPTION
CHANNEL NAME	Channel number
CHANNEL STATUS	GREEN: OK YELLOW: Channel is RAMPING RED: ERROR occurred GRAY: channel is OFF Remote usage: CLICK on CHANNEL STATUS to switch channel ON or OFF
CHANNEL INFO	Displays indicators of Channel properties: CV: constant voltage mode CC: constant current mode TRIP: current trip is active VLIM: voltage limit is exceeded ILIM: current limit is exceeded INH: external INHIBIT is active EMERGENCY: emergency mode active
EVENT COUNTER / ERROR COUNTER	Indicates the number of errors (RED) or events (ORANGE) occurred Remote and touch usage: CLICK on badge to open ERROR or EVENT LIST overlay
MEASURED VOLTAGE	Measured voltage of this channel using the configured unit and precision (see MENU / HARDWARE / DISPLAY for configuration)
MEASURED CURRENT	Measured current of this channel using the configured unit and precision (see MENU / HARDWARE / DISPLAY for configuration)
VOLTAGE SET VALUE	Voltage Set value in configured unit
CURRENT SET VALUE	Current Set value in configured unit

3.9.4 Channel detail view

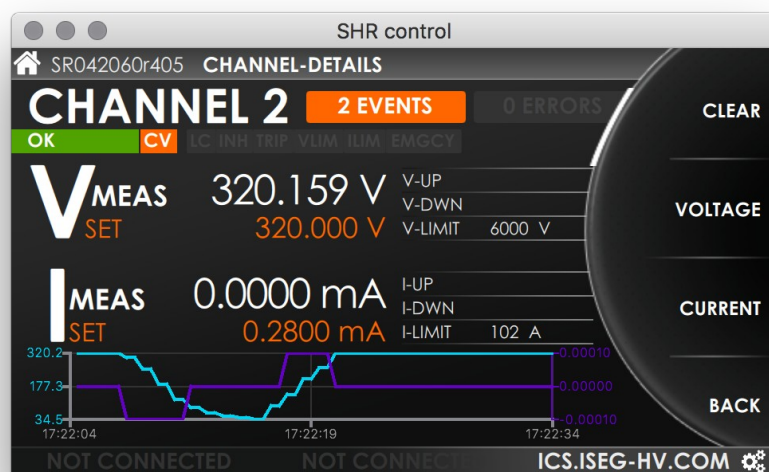


Figure 6 - SHRcontrol CHANNEL-DETAIL VIEW

The CHANNEL DETAIL VIEW shows information of the selected channel. In this context the following actions are available:

- Press **"SETUP"** to get directly to CHANNEL-SETUP menu in SETTINGS
- Press **"VOLTAGE"** to change to voltage related settings of the selected channel
- Press **"CURRENT"** to change to current related settings of the selected channel
- Press button **"BACK"** to change back to CHANNEL-LIST view

CHANNEL DETAIL VIEW user interface elements:

VOLTAGE SECTION		CURRENT SECTION	
VMEAS	Shows measured voltage shown in the configured precision and unit (see SETTINGS)	IMEAS	Shows measured current shown in the configured precision and unit (see SETTINGS)
VSET	Shows set voltage of shown channel in the configured precision and unit (see SETTINGS)	ISSET	Shows set current of shown channel in the configured precision and unit (see SETTINGS)
V-UP	Voltage Up-Ramp: configured speed of voltage changes to more voltage (absolute value) in Voltage Control (VC) mode	I-UP	Current Up-Ramp: configured speed of current changes to more current, in Current Control (CC) mode
V-DOWN	Voltage Down-Ramp: configured speed of voltage changes to less voltage (absolute value) in Voltage Control (VC) mode	I-DOWN	Voltage Down-Ramp: configured speed of voltage changes to less voltage (absolute value) in Current Control (CC) mode
V-LIMIT	Voltage limit: Depends on the configured Output mode (see SETTINGS) or the modules hardware limit (see section Hardware limits). The smaller value will be effective.	I-LIMIT	Current limit: Depends on the configured Output mode (see SETTINGS) or the modules hardware limit (see section Hardware limits). The smaller value will be effective.

The graph shows the voltage (cyan) and current (purple) flows of the last 30 seconds. The value axes automatically adjust their upper and lower limits to the min and max values in this time range. This confers the possibility to read the min/max from the axe's captions.

Events / Errors: The number of EVENTS or ERRORS registered on this channel is displayed on the corresponding badge. Click or touch directly on the EVENTS or ERRORS badge to open ERRORS LIST / EVENT LIST overlay.



Figure 7 - SHRcontrol CHANNEL DETAILS with EVENT OVERLAY

Here you can select an EVENT or ERROR by scrolling the list using the rotary (RT1), or remotely by mousewheel or keyboard cursor keys. Then you can press the context action CLEAR ONE to reset the select event or click CLEAR ALL to reset the complete list.

Channel info bar



CHANNEL DETAIL elements overview

ELEMENT	DESCRIPTION
CHANNEL NAME	Channel number
CHANNEL STATUS	GREEN: OK YELLOW: Channel is RAMPING RED: ERROR occurred GRAY: channel is OFF Remote usage: CLICK on CHANNEL STATUS to switch channel ON or OFF
CHANNEL INFO	Displays indicators of channel properties: CV: constant voltage mode CC: constant current mode LC: Low Current Mode INH: INHIBIT is ACTIVE TRIP: current trip is active VLIM: Voltage Limit is exceeded ILIM: Current Limit is exceeded EMGCY: emergency mode active
EVENT COUNTER / ERROR COUNTER	Indicates the number of errors (RED) or events (ORANGE) occurred Remote and touch usage: CLICK on badge to open ERROR or EVENT LIST overlay
MEASURED VOLTAGE	Measured voltage of this channel using the configured unit and precision (see MENU / HARDWARE / DISPLAY for configuration)
MEASURED CURRENT	Measured current of this channel using the configured unit and precision (see MENU / HARDWARE / DISPLAY for configuration)
VOLTAGE SET VALUE	Voltage Set value in configured unit
CURRENT SET VALUE	Current Set value in configured unit

3.9.5 Voltage / Current settings screens

The VOLTAGE SETTINGS and the CURRENT SETTINGS are accessible directly from the CHANNEL LIST and from the CHANNEL DETAILS by clicking the corresponding context buttons BT_2 and BT_3.

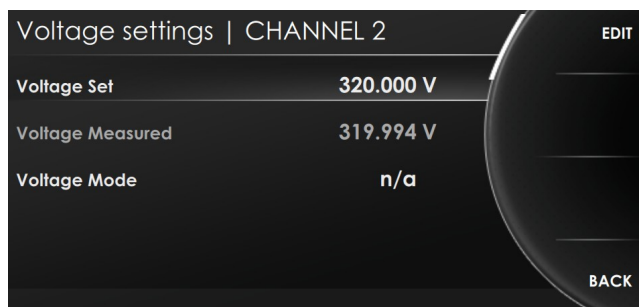


Figure 8 - SHRcontrol CHANNEL-DETAIL VIEW

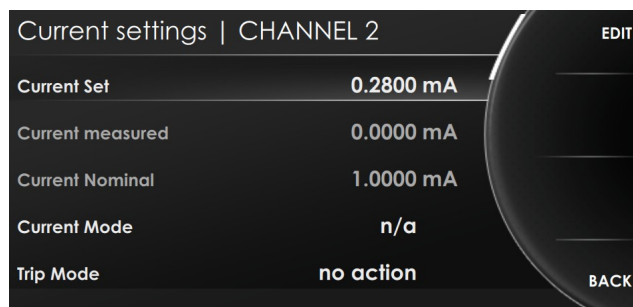


Figure 9 - SHRcontrol CHANNEL-DETAIL VIEW

Select a list entry by rotation of the rotary knob (RT1) or remotely using the mouse wheel or cursor keys on the keyboard. Then use to following context options will be available:

Press **"BACK"** to reenter the parent menu
Press **"EDIT"** to change a value

After choosing EDIT the EDIT MODE will be active (wheel element turns to orange) and you can change entries depending on the value type by using the rotary, the mouse wheel or the cursor keys. The following context options will be available:

Press **"APPLY"** to commit the value change and save it to configuration
Press **"AUTO-APPLY"** to commit the value changes done with rotary automatically, if AUTO-APPLY is ON it is highlighted
Press **"DIGIT"** to move the digit marker. The marked digit will be increased or decreased by rotary (RT1)
Press **"CANCEL"** to cancel the change and return to the previous value
Press **"DEFAULT"** to reset the value to the factory default value

If wrong values were entered or reached Min/Max borders (e.g. Set voltage limits by nominal, mode or hardware limit) the wheel color indicates an error (wheel turns yellow). After applying a value the success will be displayed by turning the wheel to green for a 1 second. *Note: The refresh of the displayed value using the SHRcontrol remotely can take up to 2 seconds.*

VOLTAGE SECTION		CURRENT SECTION	
Voltage Set	Set voltage in the configured preferred unit and resolution	Current Set	Set current in the configured preferred unit and resolution
Voltage Measured	Measured voltage in the configured preferred unit and resolution	Current Measured	Measured current in the configured preferred unit and resolution
Voltage Mode	Displays the actually selected voltage of the output mode, which can be configured in Channel Setup	Current Mode	Displays the actually selected current of output mode, which can be configured in Channel Setup
		Trip Mode	Select the possible trip behaviour (see section Current trip)
		Delayed Trip time	Select the desired delay time for the Trip Mode selected action after a current trip occurred

3.9.6 Settings menu

The SETTINGS MENU can be started directly from the HOME SCREEN. Depending on the select list entry the context buttons BT_1 to BT_4 show the following actions:

Press **"SELECT"** to enter a submenu of the selected list entry
Press **"BACK"** to reenter the parent menu
Press **"EDIT"** to change a value
Press **"APPLY"** to commit the value change and save it to configuration
Press **"CANCEL"** to cancel the change and return to the previous value
Press **"DEFAULT"** to reset the value to the factory default value
Press **"OK"** to run an action, for example CLEAR ALL events and errors

Note: Readonly entries will be shown in grey text color and can not be edited, so no action will be available
Note: n/a is displayed, when the current device does not support this configuration item or value could currently not be received from the device

Select box values can be changed by using the rotary or remotely clicking the arrows.

Numeric values can be changed by using the rotary for increasing or decreasing value or can be entered directly using the screen keyboard or the device keyboard (remotely).

Alpha numeric values can be entered directly using the screen keyboard or the device keyboard (remotely). Note: Values will be cleared by starting typing. To add or change existing text, move cursor first.

The settings menu has the following structure:

Level 1	Level 2	Level 3	Level 4	Type / Options	Default	Notes / Description
HARDWARE SETUP	DEVICE SETUP	MEASUREMENT	ADC-Samplerate	5,10,25,50,60,100,500	50	How many samples are measured per second
			Digital Filter Averages	1,16,64,256,512,1024	64	How many samples are averaged to on
		CONTROL	Global KILL ENABLE			
		HARDWARE LIMITS	Hardware Voltage Limit	0-102% (readonly)	100%	Device specific hardware limit relative to nominal voltage. Adjustable with hardware limit potentiometer.
			Hardware Current Limit	0-102% (readonly)	100%	
		DISPLAY	Display Brightness	10 - 100%	60%	Display brightness
			Display Standby	0/2/5/10/30/60/120 min	10min	Display will standby after x minutes
			Voltage unit	V / kV	V	Preferred unit for displaying voltage values
			Voltage resolution	1,2,3,4,5	4	Number of digits displayed after separator
			Current unit	µA, mA, A	mA	Preferred unit for displaying current values
			Current resolution	1,2,3,4,5	4	Number of digits displayed after separator
			Current unit LCR	µA, mA, A	mA	Preferred unit for displaying current values for Low Current Range (see hardware specs)
			Current resolution LCR	1,2,3,4,5	4	Number of digits displayed after separator for Low Current Range (see hardware specs)
		DATE & TIME	System date	YYYY-MM-DD	2018-05-20	System year
			System tim	HH:mm:ss	13:00:00	System time in 24 hour format
	CHANNEL SETUP	ALL CHANNELS CH 0-4	Polarity	Positive / Negative		Select polarity of selected channel
			Output Mode	6 kV / 2 mA 4 kV / 3 mA 2 kV / 4 mA		Device dependent channel output mode of selected channel, see section "technical data"
			Voltage Ramp Up		V / s	Voltage increase speed for selected channel(s), limited by output mode, hardware limits
			Voltage Ramp Down		V / s	Voltage decrease speed for selected channel(s), limited by output mode, hardware limits
			Current Ramp Up		mA / s	Current increase speed for selected channel(s), limited by output mode, hardware limits
			Current Ramp Down		mA / s	Current decrease speed for selected channel(s) limited by output mode, hardware limits
	INTERFACES	Ethernet	DHCP	Enabled / Disabled	Enabled	Ethernet interface obtains IP by DHCP server
			IP-Address	IP address	192.168.0.1	Fixed IP address (used when DHCP is off)
			IP-Mask	IP mask	255.255.255.0	IP Mask when fixed IP address
			DNS	IP address	192.168.0.254	Nameserver when fixed IP address
			Gateway	IP address	192.168.0.254	Standard Gateway when fixed IP address
			NTP Time server	IP or host name	0.pool.ntp.org	Host address or IP of a NTP timeserver
		Wireless	Enable Wifi	Enabled / Disabled	Disabled	Enable/disable wireless feature (needs iseg certified USB WiFi adapter at USB-AUX port)
			IP-Adress	192.168.1.1 (fixed)		Factory fixed IP address of the WiFi network created by the device
			SSID	Text	iseq-ICS	Enter the desired SSID (wifi network name)

			WiFi Channel	1,2,3,4,5,6,7,8,9,10,11	1	WiFi channel
			WiFi Password	Text	password	WiFi password
SOFTWARE	HTTP interface	HTTP interface		Enabled / Disabled	Enabled	Enable / Disable HTTP interface
	HAL interface	HAL interface		Enabled / Disabled	Enabled	Enable / Disable HAL interface
	EPICS IOC	EPICS IOC		Enabled / Disabled	Enabled	Enable / Disable EPICS IOC server
	SNMP	SNMP		Enabled / Disabled	Enabled	Enable / Disable SNMP server
CLEAR / RESET	Clear events and errors			SET		All caught events and errors will be reset. This allows reenabling of voltage generation when suppressed. Press OK Button to commit action.
	Set values reset			SET		Resets all set values (V=0, I=max) Press OK Button to commit action.
	Factory reset			SET		Sets all values and configuration to factory default (HV unit flash memory values and iCS configuration reset (similar to RESET_ICS by USB) Press OK Button to commit action.
DEVICE INFO	Device temperature			xx.x °C	Readonly	Current temperature of the device.
	Device model number			SR042060r405xxxxx	Readonly	Full item code number of SHR model
	Device serial number			23000x	Readonly	Serial number of SHR device
	Firmware name			N004C2	Readonly	Firmware name of HV hardware
	Firmware release			01.37	Readonly	Firmware release number
	iCS version			2.2 2018xxxx_yyyy	Readonly	ICS system version number
	Connected clients			2	Readonly	Number of currently connected clients to SHR
	CAN bus state			OK	Readonly	CAN bus diagnostic information
	CAN bus information			OK	Readonly	CAN bus diagnostic information
REMOTE ²	Remote host			IP or host name	ics.iseg-hv.com	IP or host name of the SHR the SHRcontrol should connect to
	Remote port			Port	8080	The websocket port of the SHR device that should remotely connect
	User			Username	demo	Enter the username of a valid user at the SHR ³
	Password			Password	demo	Enter the password of a valid user at the SHR ⁴

3.9.7 Graph plugin

² Available for SHRcontrol in remote mode (e.g. as Desktop application)

³ The default user of an iCS installation is "admin" - it can be changed using the iCSconfig web tool - see iCS configuration chapter

⁴ The default password of an iCS installation is "password" - it can be changed using the iCSconfig web tool - see iCS configuration chapter

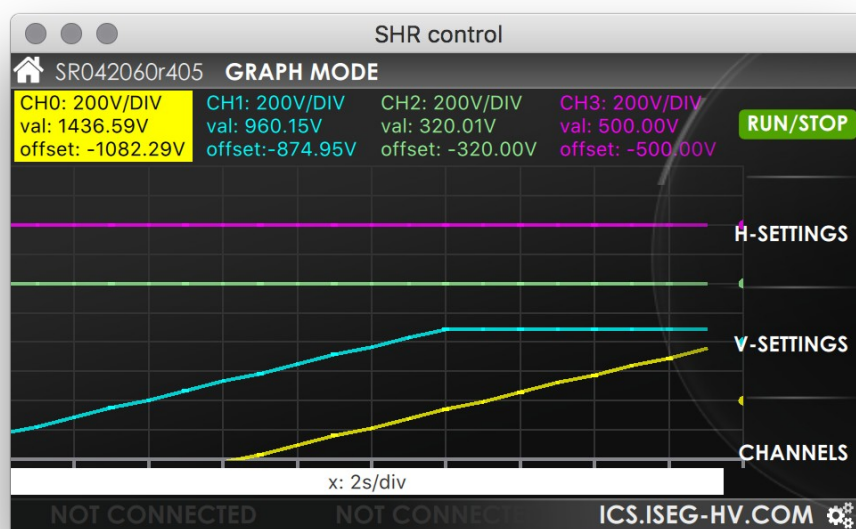


Figure 10 - SHRcontrol GRAPH MODE

The graph plugin visualizes voltage and / or current flows of up to 4 SHR channels in one plot. On the top of the plugin the SET VALUE, the MEASURED VALUE and the OFFSET POINT of voltage or current are visible. To change the CHANNEL GRAPH SETTINGS you can directly click or touch on the respective area. Then it will be highlighted and the context buttons change to the channel's settings page.

On the bottom a white handle bar indicates the currently set X-axis resolution and can be dragged by touch or mouse to scroll the graph back.

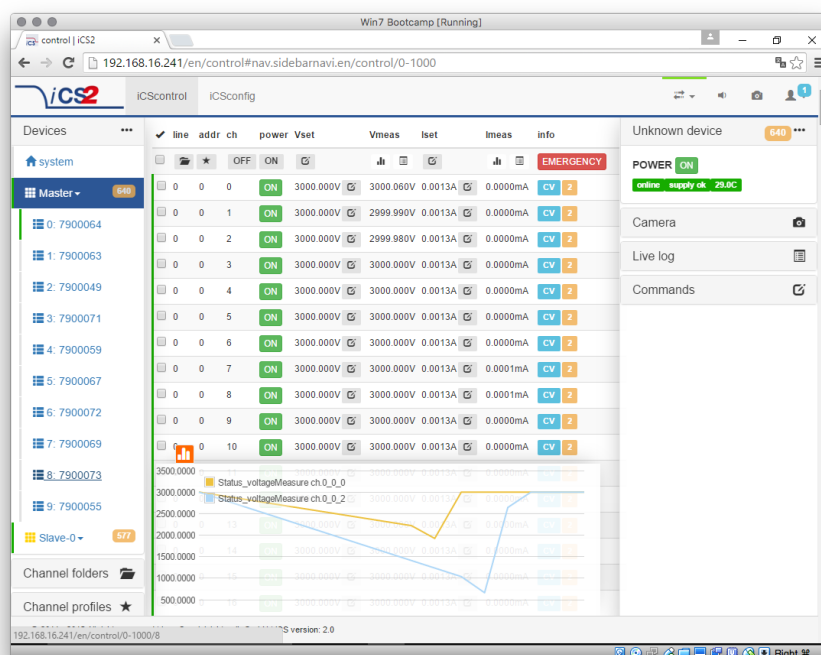
The following context menu structure is available in the GRAPH MODE plugin:

MENU	BT_1	BT_2	BT_3	BT_4
GRAPH HOME	RUN / STOP Toggles run or stop of data acquisition and scope updating	H-SETTINGS Enter H-SETTINGS menu for horizontal setup	V-SETTINGS Enter H-SETTINGS menu for horizontal setup	CHANNELS Enter GRAPH CHANNELS - SETTINGS
H-SETTINGS	SCALE Increases or decreases the horizontal resolution of the scope	SHIFT Moves the scope left or right by using the rotary RT1 or the mousewheel	LATEST DATA Shifts scope to latest data received	BACK Returns to GRAPH HOME menu
V-SETTINGS	AUTO ALL Sets vertical mode to AUTO ALL: Using this mode all channels will be scaled to a common scale factor. The offset will be set individually.	AUTO SINGLE Sets vertical mode to AUTO SINGLE: Using this mode all channels will be scaled to individual scale factors. The offset will be set individually.	MANUAL ALL Enter MANUAL ALL menu	BACK Returns to GRAPH HOME menu
MANUAL ALL	SCALE ALL If selected the rotary or mouse wheel can be used to select a vertical scale factor applied to all channels.	OFFSET ALL If selected the rotary or mouse wheel can be used to select a vertical offset applied to all channels.	V/I If clicked the channel settings of all channels will toggle between Voltage and Current	BACK Returns to GRAPH HOME menu
CHANNELS	CH0	CH1	CH2	CH3
	Enters GRAPH CHANNELS-SETTINGS for the selected channel			
GRAPH CHANNEL SETTINGS	SCALE If selected the rotary or mouse wheel can be used to select a vertical scale factor applied to the selected channel.	OFFSET If selected the rotary or mouse wheel can be used to select a vertical offset applied to the selected channel.	V / I / OFF If clicked the channel settings of the selected channel will toggle between Voltage, Current or been hidden.	BACK Returns to GRAPH HOME menu

3.9.8 More plugins / customization

Isseg permanently develops and improves SHRcontrol. If you need custom specific apps or plugins

4 iCS2 – iseg Communication Server 2.2



4.1 System description

The iseg Communication Server iCS is a software solution to control iseg high voltage hardware from multiple devices over wired or wireless network. iCS is a manufacturer specific Linux OS, which runs on iseg hardware, like iCSmini2, CC24 crate controller series or SHR Desktop High Voltage Power Supply.

The iCS front end is based on browser technology to keep installation and maintenance effort low, to enable a quick start for configuration independently from the user's software platform, even on mobile devices.

iCS is equipped with an integrated role and user management, and delivers important software services right out of the box, like EPICS IOC, OPC server, SNMP interface, HTTP, SOAP and webservice to give a quick access to iseg hardware.

iCS also delivers configuration utilities and straight forwarded tools for firmware upgrading process.

iCS software components	Description	Port / Protocol
iCSconfig	Configuration section for iCS software services, restorable hardware configurations, and firmware updates, documentation access and more...	TCP 80 / HTTP
iCScontrol	Multi-user browser based device control, surveillance cam support	TCP 80 / HTTP
iCSservice	Internal websocket based server, JSON objects, with clients Push (websocket) or pull (HTTP polling) technology	TCP 8080 / Websocket TCP 80 / HTTP API
iseqHALservice	iseq hardware abstraction layer service, simple hardware access	TCP 1454 / iseqHAL Socket
EPICS IOC	EPICS Input / Output controller, autoconfiguring to hardware setup, customizable by file upload	EPICS Base R3.14.12.4 TCP/UDP 5064,5065
OPC/UAservice	OPC / UA server – <i>coming soon</i>	coming soon
SNMPservice	Simple Network Management Protocol	UDP 161

4.1.1 Software architecture

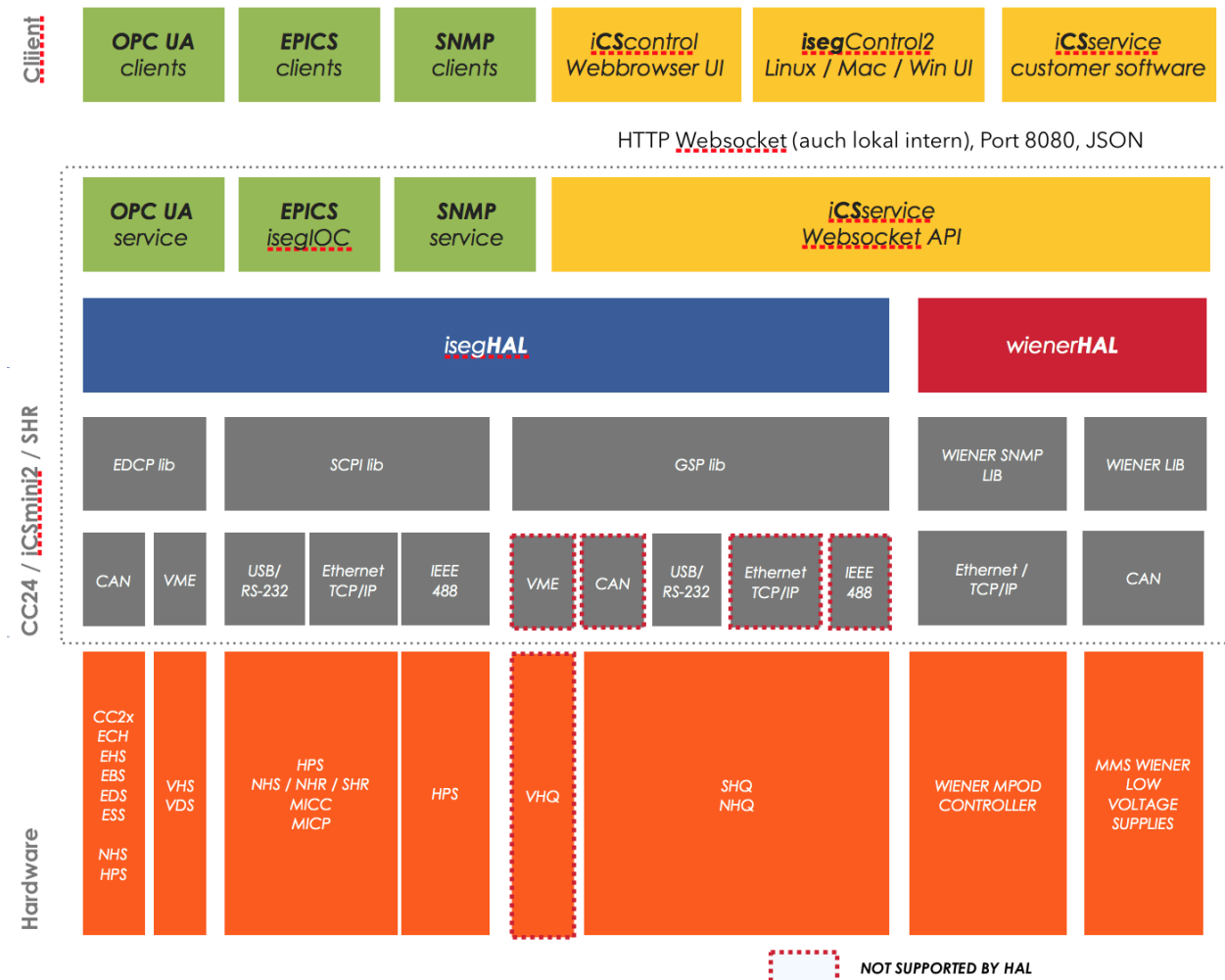


Figure: iCS2 software architecture / supported hardware

4.2 How to connect via WiFi

1. Make sure to have the WiFi adapter onboard or external installed, all modules are plugged in and CAN connections if used attached. Start the crate or device.
2. Use your mobile device or computer to search for existing WiFi networks and select „iseq-ICS_XXXX“ (serial). Enter the factory default password (**password**) .
3. Open a recommended web-browser and enter the factory default IP address (**192.168.1.1**)
4. Enter the factory default username (**admin**) and password (**password**)

4.3 How to connect via Ethernet

For Ethernet connections with the use of factory defaults, it is necessary to know the IP address of the iCS server first.

By default the iCS is configured to obtain the IP automatically by DHCP. To discover the IP address of the iCS, a small software application **iCSfinder** can be used. It scans the local network for running iCS services.

iCS also provides UPnP and Zeroconf/Bonjour messages, which can be discovered, e.g. in Windows using „Network“ environment.

INFORMATION



NOTE

To discover iCS installations on the local network, a small utility **iCSfinder** can be used

It can be downloaded here:

http://download.iseg-hv.com/SOFTWARE/iCS/iCSfinder/iCSfinder-1.0_win.zip

<http://download.iseg-hv.com/SOFTWARE/iCS/iCSfinder/iCSfinder2.dmg>

http://download.iseg-hv.com/SOFTWARE/iCS/iCSfinder/iCSfinder-1.0_linux.zip

Note: If you wish to set a fixed address without preconnecting via DHCP, please use a (temporarily) WiFi connection to setup OR follow the instructions of (re)setting the ethernet settings (see chapter ethernet configuration)

Hint: If you experience problems using iCSfinder, please try using free software tools like "IP SCANNER" / MAC or "ADVANCED IP SCANNER" (Windows)

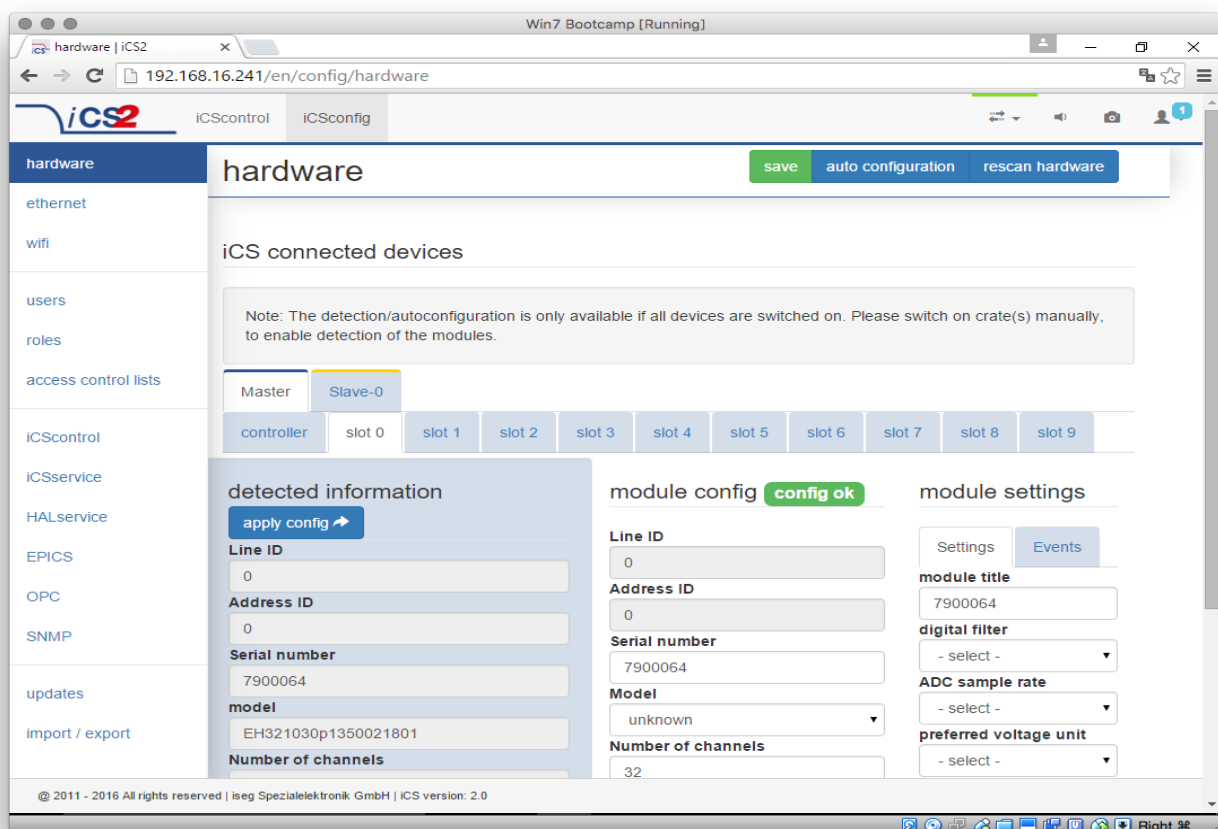
1. Make sure to have the network cable, all modules plugged in and all CAN connections if used attached. Start the crate.
2. Open a recommended web-browser and enter the current IP address (see preparations before)
3. Enter the factory default username (**admin**) and password (**password**)

4.4 iCSconfig: manage hardware, service and preferences

iCS has a comprehensive set of configurable properties. All of them are stored in a XML file, to keep configuration flexible. This enables the possibility to have multiple configuration setups stored and restored using the import / export utility.

iCS config sections	
Hardware	Manage connected hardware, set configurations, auto configure, start firmware updates
Ethernet	Manage Ethernet port settings of the iCS
Wifi	Manage wireless access point of the iCS
Users	Create / edit / delete iCS users
Roles	Create / edit / delete iCS roles
Access lists	Grant / deny rights on user / group / channel / item base
iCScontrol	Manage preferences of iCS web control application
iCSService	Configure iCSService API / HTTP API
EPICService	Configure the embedded EPICS Input/Output controller (IOC)
OPC U/A service	Configure the embedded OPC U/A server
SNMP	Configure the embedded SNMP server
Updates	Download updates (System, Product database, firmware) from internet
Import / Export	Save and restore complete iCS configuration to backup hardware setup

4.4.1 Hardware



In the hardware section, all iCS connected devices like connected crates, controllers and modules are listed and configurable. Each device is represented by a tab, modules and controllers are nested into their responding crates. The CAN lines of the crates are presented with a yellow or green upper tab border (corresponding to yellow or green CAN line), master crates and modules in legacy crates with a blue upper tab border.

The configuration is stored independently from the current hardware setup or connected states. This gives the opportunity to detect misconfigurations and recent hardware setups can easily be restored.

To apply the complete detected hardware state into the configuration use the „**AUTO CONFIGURATION**“ button after triggering a rescan using the „**RESCAN HARDWARE**“ button.

To apply the detected config of just one device (controller or module) use the „**APPLY CONFIG**“ button under each single tab.

The devices information is stored with the information of „module/device config“ column. Here the line and address ID are shown and a serial number can be entered (or applied by using auto configuration / apply). If the model of the hardware device could be detected automatically, a model is selected in the dropdown list, otherwise it should be selected manually. Here a „**FIND**“ buttons checks the list and helps prefiltering the list.

HARDWARE TYPES	
Device	Standalone High Voltage Power Supply
Crate	Case / Bin for a modular HV-supply (module), which supplies power
Controller	Special controller card used in a crate to control, monitors and manages nested modules and Crate functions, like switch ON/OFF of Crate power supply, monitor temperatures, fans, UPS and more
Module	Modular High Voltage Power Supply, plugged in a slot of a crate, supplied by a CRATE, communication and management by CRATE CONTROLLER, no own POWER ON feature

Information in the row „module settings /device settings“ are module / device specific settings and are stored into the XML configuration file. These settings will get lost when using **AUTO-CONFIGURATION** or **APPLY CONFIG** functionality.

4.4.2 Ethernet configuration

The ethernet settings of the iCS server hardware (CC2x Crate Controller, iCSmini) can be changed under the **ETHERNET** tab. By turning DHCP Client to enabled the iCS will try to obtain an IP address from the local networks DHCP server. Otherwise the IP can be set fixed. Therefore DHCP client must be disabled and IP v4.0 settings can be entered manually.

ETHERNET FACTORY DEFAULTS	
IP	DHCP
GATEWAY	empty
NAMESERVER	empty
DNS	empty
TIMESERVER	empty

4.4.3 (Re)set / ethernet configuration

You can reset the ethernet configuration and also set to fixed IP adress e.g. cause of problems with DHCP IP relay using the following procedure:

1. Shut down all modules/devices and turn off the iCS System by unplugging mains.
2. Create an empty file called „RESET_NET.txt“ on a USB flash drive (FAT32 format)
3. Now edit the file. It should contain the following entries, separated by new lines.

CONTENT OF RESET_NET.txt			
LINE	PARAMETER	EXAMPLE	DEFAULT-VALUE
0	IP address / DHCP	192.168.0.10	DHCP
1	NET MASK	255.255.255.0	255.255.255.0
2	GATEWAY	192.168.0.1	192.168.0.1
3	NAMESERVER	192.168.0.1	192.168.0.1

4. Plug USB flash drive into the USB slot at the front panel of the device (CC24, iCSmini2, SHR)
5. Plug in mains

6. Please wait about 20 seconds until iCS has started completely
7. optional: Plug off the USB flash drive and check on a computer if the file created on point 2 is still there.
Check if RESET_NET.txt was renamed into RESET_NET.txt.done on success.

4.4.4 WiFi configuration

The WiFi configuration sets the wireless network properties provided by the iCS hardware access point (optional). Generally the WiFi function can be disabled using the WiFi support switch. The IP address of the WiFi is fixed, so once connected with a iCS WiFi the IP stays always the same.

WIFI FACTORY DEFAULTS	
IP (fixed)	192.168.1.1
SSID	iseg-iCS2_[HARDWARE SERIAL-NUMBER]
Channel	5
Password	password

4.4.5 Users / roles configuration

Users of iCScontrol can be added, edited and removed in the users section. Users of iCScontrol can be added, edited and removed in the users section. Users can be assigned roles, such like admin, user etc. One or more users can be selected by editing a role.

USER DEFAULTS	
User	admin
Password	password
Role	admin

4.4.6 Access control lists (ACL)

With the access control list rights to grant or forbid control on special objects for principals (roles or users) is managed. This gives a powerful tool for very detailed right mechanism.

INFORMATION	
 NOTE	Note: Users, roles and ACL are only applied for user authentication for applications and services, which are based on iCSservice. These are iCScontrol, iCSconfig, isegControl, SOAP and HTTP API. isegHAL based services should implement own security mechanisms .

4.4.7 SSH access

The ICS2 Linux host system can be fully accessed as root user using a encrypted SSH shell access over port 22.

This enables user to install own services or freely configure, e.g.EPICS plugins etc.

INFORMATION	
 NOTE	The local filesystem is divided into a system and a user data partition. To make changes on the readonly mounted system part use the following command: mount / -o remount,rw

4.4.8 (Re)set SSH access

INFORMATION



NOTE

To protect your iCS system we strongly advice to change the standard factory password into a new userdefined one. Keep this password secret!

For security reasons this is only possible with direct hardware access using the following procedure:

1. Create a file RESET_SSH.txt with your new Root Passwort as content in the first line and save it to an USB flash memory (FAT32 format). Note: if the file is empty, the iCS root password will be reset to factory default
2. Plug the stick into iCS hardware and resboot iCS.
3. The iCS changes the password during the boot process. In case of success the file will be renamed into RESET_SSH.txt.done.

4.4.9 iCS Factory Reset Invocation

In case the user has forgotten his password or simply wants to get back to factory default configuration, it is possible to invoke a factory reset. For factory reset a USB flash drive (USB stick) with a FAT32/FAT16 partition is needed.

ATTENTION



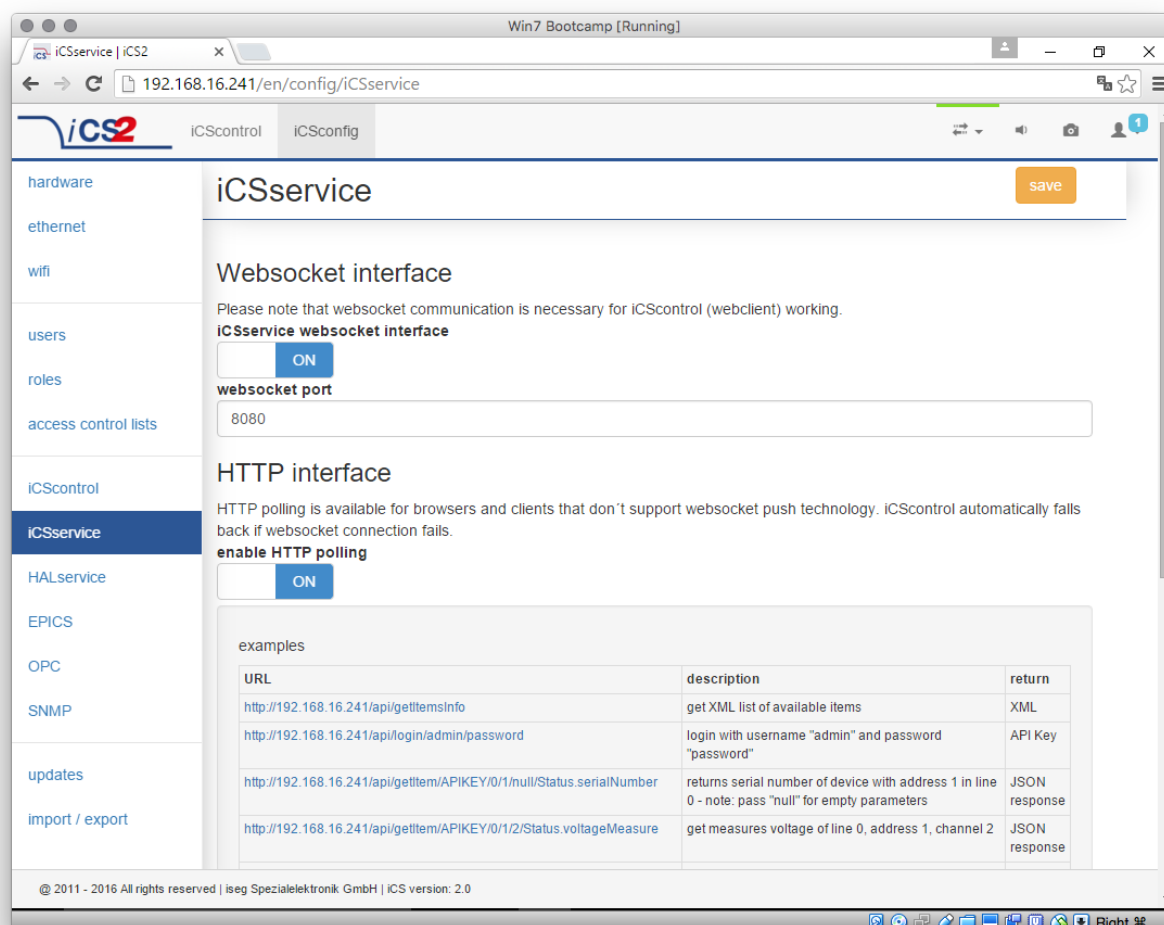
CAUTION

After factory reset all hardware configurations will get lost!

4.4.10 Instructions

1. Shut down all modules / devices and turn off the iCS System by unplugging mains.
2. On the USB flash drive create an empty file called "RESET_ICs.txt"
3. Plug USB flash drive into the USB slot at the front panel of the Crate-Controller
4. Plug in mains
5. Please wait about 20 seconds until iCS has started completely
6. optional: Plug off the USB flash drive and check on a computer if the file created on point 2 is still there.
If not, the factory reset was succesful.

4.4.11 iCService configuration



The iCService running on iCS hardware provides two interfaces, a websocket interface with push technology and a HTTP polling interface, which is fallback for browsers and clients, that do not support websocket technology. Both of them can be disabled, whereas at least one of them is necessary for the correct operation of iCService.

iCService DEFAULTS

Websocket Port	8080
HTTP port	80
HTTP URL BASE	<IP-of-iCSmini>/api/

4.4.12

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NOTE

The documentation of iCService API, step by step connection guide to use Websocket / HTTP interface and an example Javascript is available on iCS directly (iCService / iCService) or online on:

<https://iseq-hv.com/download/?dir=SOFTWARE/iCS/doc/iCService/>

4.4.13 HTTP interface

This interface gives quick access to iCService by simple HTTP queries.

iCService HTTP functions		
URL, Parameters with leading \$, params not mandatory [\$param]	Response	Description
http://<IP-of-iCSmini>/api/getItemsInfo	XML	XML with item object information
http://<IP-of-iCSmini>/api/login/\$username/\$password	API Key	Returns API Key to be identified for session
http://<IP-of-iCSmini>/api/logout/\$session-ID	TRUE / FALSE	
http://<IP-of-iCSmini>/api/getItem/\$apikey/\$line/\$address/\$channel/\$item	JSON Object	Returns state of a specific item of a hardware path \$line, \$address, \$channel and \$item can be set by wildcard '*'
http://<IP-of-iCSmini>/api/setItem/\$apikey/\$line/\$address/\$channel/\$item/\$value/[\$unit]	TRUE / FALSE	Sets state of a specific item of a hardware path \$line, \$address, \$channel can be set by wildcard '*'
http://<IP-of-iCSmini>/api/getUpdate/\$apikey/	JSON Object	returns all changes collected by iCService since last getUpdate call for this client session
Use "*" as wildcard, e.g. to set or get items on multiple channels at once. Use "null" as empty set identifier, e.g. to obtain module specific objects without channel declaration.		
EXAMPLES		
http://192.168.1.1/api/getItem/123456-321/0/1/0/Status.voltageMeasure	Returns voltage value, unit and timestamp of channel 0 of module with address 1 of line 0	
http://192.168.1.1/api/setItem/123456-321/0/1/*Control.voltageSet/1/kV	Set set voltages of all channels of module 1 in line 0 to 1,000 Volt	
http://192.168.1.1/api/setItem/123456-321/0/null/null/Control.power/1	Switch controller of line 0 (master) on	

4.4.14 EPICS

For the use of iseg hardware with Experimental Physics and Industrial Control System (EPICS) the iCS comes with a preinstalled integrated Input-Output-Controller (IOC). This service can be enabled or disabled using the switch „**enable EPICS input / output controller**“. To keep things straight-forward the iCS can generate IOC configuration files (.db and .sub), using the current hardware configuration. Both files can be downloaded to the local computer, be edited manually, e.g. with a text editor and be uploaded again. This gives a quick start to run an IOC out of the box. To get an overview on all available process variables (PV), which are generated at the start of IOC, the PV list can be downloaded using the respective button. The IOC script combines a process variable definition file (.db) with a substitution file (.sub), which contains hardware setup information and placeholders to create all accessible process-variables at runtime.

File	Description	Sample content (extraction)
iseg_epics.db	Database file with definitions of PV	<pre>##### # ### Crate item values ### # ##### record(mbbiDirect, "ISEG:\${CONTROLLER_SN}:\${CAN_LINE}:\${ {DEVICE_ID}:StatusLow") { field(DESC, "Lower 16 bit of module status register") field(DTYP, "isegHAL") field(INP, "@\${CAN_LINE}.\${DEVICE_ID}.Status") field(NOBT, "16") field(SHFT, "0") field(TSE, "-2")</pre>

		} ...
iseq_epics.sub	Substitution file contains a pattern that will be substituted by the following lines for each corresponding channel	{CONTROLLER_SN,CAN_LINE,DEVICE_ID,MODULE_ID,CHANNEL_ID} {5230003,0,1000,0,0} {5230003,0,1000,0,1} {5230003,0,1000,0,2} ...
iseq_epics.pv	Text file with list of process variables generated	ISEG:5230003:0:0:0:CurrentMeasure ISEG:5230003:0:0:0:CurrentNominal ISEG:5230003:0:0:0:VoltageMeasure ISEG:5230003:0:0:0:VoltageNominal ...

For more detailed information on EPICS, please visit: <http://www.aps.anl.gov/epics/>, for sample libraries and test scripts, please contact support@iseq-hv.de.

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NOTE

The documentation of iseq EPICS IOC and a sample script is available on iCS directly (iCSconfig / EPICS) or online on:

<https://iseq-hv.com/download/?dir=SOFTWARE/iCS/doc/iseqIOC/>

4.4.15 iseqHALService

The iseqHALService provides a secure sockets encrypted end-to-endpoint access to iseq Hardware layer running on crate Controller / iCSmini hardware. The iseqHALService API is similar to iseqHALapi with some specific extension. Please refer Appendix “iseqHAL” for details. For an easy start a simple example program *iseqHalRemoteExample* demonstrates the remote access. There are virtual instruments (VIs) which are based on the library “iseqHAL-remote” in order to control iseq hardware via LabVIEW⁵.

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NOTE

The documentation of iseq HAL (service) is available on iCS directly (iCSconfig / HALService) or online on:

<https://iseq-hv.com/download/?dir=SOFTWARE/iCS/doc/iseqhal/index.html>

4.4.16 SNMPService

For backward compatibility of the iCS2 to SNMP controlled systems like WIENER mPOD iCS2 is able to communicate using the SNMP service.

The service can be enabled or disabled using the switch „**enable SNMP interface**“.

Using the current iCS2 hardware configuration a SNMP configuration can be automatically generated. To create a new SNMP configuration, which is compatible to WIENER Configuration file (.mib) please use button “generate configuration” under the SNMP tab in iCSconfig.

For user specific changes of configuration, the .mib (vendor specific definition of datapoints) and .sub (substitution information with list of hardware channels) files can be downloaded, locally modified and reuploaded.

Please note: local modifications will overwritten every time the “generate configuration” function will be used.

4.4.17 Updates

The following types of updates can be managed with iCS:

Type	Description
base	product database with information about iseg hardware specifications
system	update image of the iCS server operating system (CC, iCSmini)
firmware	firmware update files for iseg devices (like HV modules, crate controllers etc.)

All update files can be downloaded from iseg web repository using the **CHECK ONLINE FOR UPDATES** or using the update **UPLOAD** function to send a file from local computer to iCS server.

Once an update file is available on the iCS it can be installed using **INSTALL** or removed by using **DELETE** Buttons. After using install, follow the instructions shown on the screen.

Firmware files can be unzipped using **EXTRACT**. After extraction the available firmware files are shown in a list. By clicking **INSTALL** the iCS tries to apply the selected firmware to all connected devices, that are qualified for (matching item code, online, lower firmware version installed).

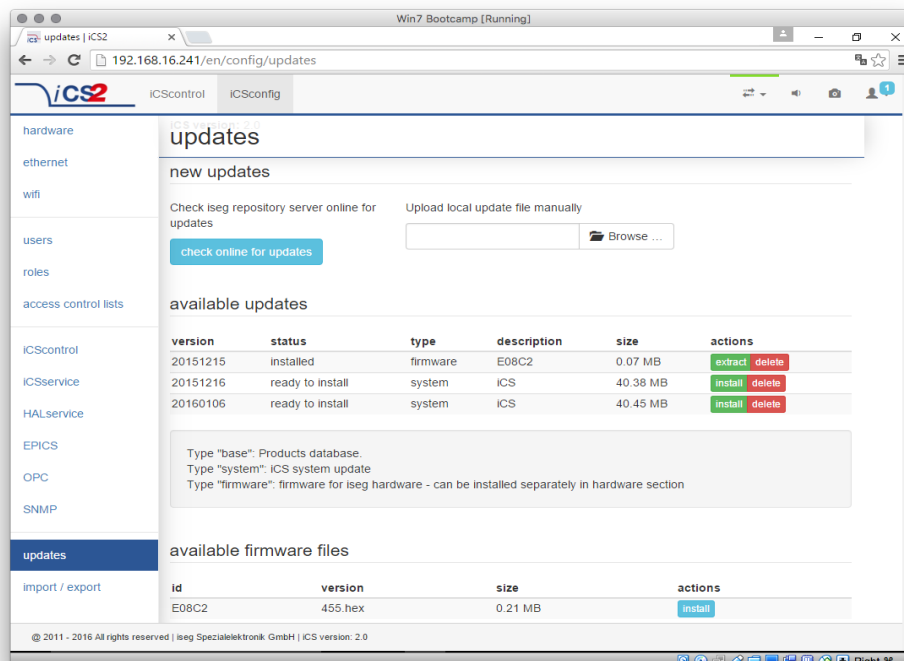
To update specific hardware devices please extract the firmware package first and then navigate in the **hardware** section to the corresponding device and use firmware update functionality individually.

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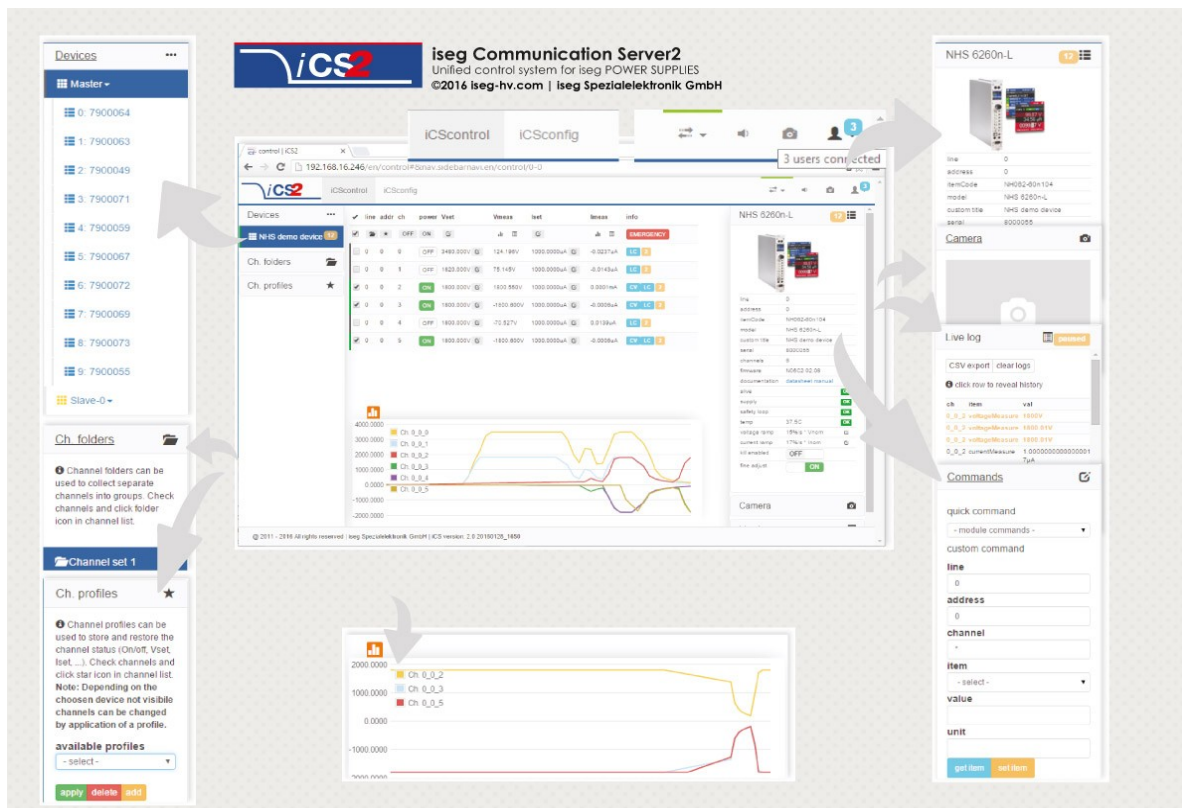
NOTE

Using the "Check online for updates" feature the iCS directly connects to iseg online software repository. All update files can also be downloaded from iseg website (<http://iseg-hv.com/en/support/downloads>) or directly on <http://download.iseg-hv.com/>



4.5 iCScontrol – control and monitor web application

The user interface of iCScontrol software is divided into three bars.



4.5.1 Left bar: Hardware Explorer

The left column shows the configured hardware.

If connected with iseg CAN line management (starting with CC23) slaves are shown in yellow or green background, corresponding to the CAN line they are connected with. Every device has a colored left border showing the running state.

Crate/Device running states	
grey	one of the nested modules is ramping to the desired voltage
yellow	one channel of one of the nested channels is ramping to the desired voltage
red	the crate / device (or one of the nested modules/channels) has one or more errors (refer to the error/event badges)
green	the crate / device (and all of the nested modules) are in a good condition, at least one channel of a nested module is running high voltage

Module running states	
grey	not present, not connected or switched off
yellow	one channel of the module is ramping to the desired voltage
red	the module has one or more errors (refer to the error/event badges)
green	the device/module is in a good condition, at least one channel is running high voltage

Channel running states	
blurred / faded out	Module is not detected (probably switched off)
grey	not present (configured module to current module mismatch), or switched off

yellow	channel is ramping to the desired set voltage
red	channel has at least one error (please inspect error counter badge)
green	channel is in good condition and switched on

4.5.2 Left bar: Channel folders

Channel folders are shown in the section “channel folders” below the hardware section in the left application bar. Channel folders can be created and extended by selecting a set of channels and clicking the folders icon on top of the channel list.

Existing folders can be selected or removed in the folders section of the left bar.

4.5.3 Left bar: Channel profiles

Channel profiles store information about set values, On/off states, and Kill-Properties of channels. They can be created by selecting the channels that should be restored in the channel list and clicking the star-icon. Existing profiles can be selected, applied and removed in the channel profiles section of the left bar. A new option with the custom given title appears in the Select Box. By selecting a Channel profile and clicking the **APPLY** button the stored state of the channel will be adjusted.

4.5.4 Center bar: Channel list

Once a device or channel folder has been selected, the channel list will update and show only the corresponding channels, with

- The topological location (line, address, channel),
- The running state,
- Set and measured values,
- Channel infos, events and errors (displayed as clickable badges)

The list header has an **ACTION ROW**, where all channels can be selected with one click for more actions.

Each action in this row is located in top of its respective column.

Some examples:

- To create a new channel folder of specific channels, select these channels and click the folder-icon.
- To store the current setup of the specific channels (running state, set-values, kill enable etc.), select them and click on the star-icon. To enable or disable all selected channels, click the ON / OFF icons.
- Change the set voltages of all selected channels, click the edit-icon which is located in the Vset column.
- To display a graph of measured voltages of all selected channels, click on the graph-icon located in the Vmeas column.
- To show a live log of measured voltages of all selected channels, click on the logtable-icon located in the Vmeas column.

4.5.5 Center bar: Chart

At the bottom of the center bar a floating chart window can be shown over the channel list by clicking the toggle button with the chart icon on the upper left of the chart bar. To show only specific channel information, please select the channels to display and select the Chart-Icon on top of the respective column of the action row, e.g. to display the voltages of the selected channels, select them and click on the Chart-Icon on top of Vmeas column. To show plots of all channels select or deselect all channels, and disable/re-enable the chart by clicking the chart icon twice.

4.5.6 Right bar: Device information

The device section gives information on the currently selected hardware device of the device explorer. Depending on the device type, hardware status information are given (temperature, error, safety loop states), the device can be enabled / disabled. Device specific parameters can be set (ramps, kill parameters ...). To get a quick help, hardware documentation can be downloaded directly.

4.5.7 Right bar: Camera

The camera tab shows the captured image of the configured camera. It can be directly connected with the iCS hardware or an IP-Cam URL, configured in **hardware / iCScontrol** section.

4.5.8 Right bar: Live log

The live log collects information of the current session. The log data is only available until a reload of the iCScontrol webpage occurs. The live log can be filtered to specific channels or value types, by selecting channels and clicking the corresponding log icon in the action row on top of the channel list. The log list shows the last value of an item. By clicking on it, previous log items are displayed.

All session log data can be exported as **CSV** file for ongoing work with spreadsheet applications, eg. Microsoft® Excel.

4.5.9 Right bar: Commands

Commands can be send directly to connected devices. Quick commands are mass operations that can be sent to more devices at one time. The commands tab prefills the input fields according to the selected hardware device (device explorer).

5 Options

5.1 VCT – voltage correction by temperature

This option allows a temperature dependent correction of the output voltage. The temperatures are measured with a distinct sensor for each channel. The temperature sensors are connected via BNC connectors on the backplane of the module. An user-adjustable VCT-coefficient allows to specify a linear relationship between the measured temperature and the output voltage. As an option one sensor per module can be ordered.

5.1.1 Technical data

Sensor type	EPCOS B57867S0502F140
Temperature range	-40 ... 80°C
Accuracy of temperature measurement	±0.5 K (0 ... 60°C)
Resolution of temperature measurement	1 mK (0 ... 60°C)
Temperature update rate	15 updates/min

Table 5: Technical data VCT sensor

5.1.2 Operation

The connector of the temperature sensor must be plugged in the slot of the corresponding channel on the VCT-connector at the rear panel of the HV-module.

A programmable VCT-coefficient for each channel defines the rate and the direction of the voltage correction. The temperatures, measured at the sensors can be read out from the module.

At the time a HV-channel is switched on or the output voltage is set by the user, the module registers the temperature of the corresponding sensor and the set voltage as reference values.

If the temperature at the sensor changes, the output voltage is automatically adjusted according to the formula:

$$V = V_{ref} + a \cdot (T - T_{ref}) \quad (a \dots \text{VCT-coefficient})$$

Example:

A channel is set to 60V. At the time it is switched on a temperature of 25°C is measured. The VCT-coefficient is set to +1V/K. If the temperature now increases to 26°C the output voltage will increase to 61V. (For channels with a negative output voltage the voltage changes from -60V to -61V).

A VCT-coefficient of -1V/K would decrease the voltage to 59V.

Notes:

During operation the values for V_{set} are adjusted. If a channel is switched off the adjusted set value will be kept, not the original value set by the user.

If the VCT-coefficient is modified during operation, V_{ref} and T_{ref} are reset to the present values to prevent a sudden voltage change.

If the temperature sensor is dis- and reconnected during operation, V_{ref} and T_{ref} are reset to the present values to prevent a sudden voltage change.

The temperature dependent voltage correction can be deactivated by setting the VCT-coefficient to 0 or by disconnecting the temperature sensor. If this is done during operation, the channel will keep the actual voltage set.

If the temperature sensor is disconnected a temperature of -273.15°C is shown for that channel.

The VCT data points are described in the manual "iseg Hardware Abstraction Layer" (see appendix).

5.2 IHB – BNC connectors for Single channel INHIBIT

Single channel INHIBIT via BNC connectors (one per channel), located on the backplane of the module.

5.3 IHD - Detector INHIBIT

The option IHD is a special version of a single channel INHIBIT to be connected to the HV INHIBIT outputs of detectors/preamplifiers from Ortec and Canberra. In order to enable the HV generation either a positive voltage signal (Canberra) or a negative signal (ORTEC) must be applied. The INHIBIT signals are connected via BNC connector (one for each channel) located on the backplane of the module.

5.4 L – Lower output current (HP only)

The output current is limited to a lower value, e.g. 100 μ A.

5.5 T10 – Lower temperature coefficient (HP only)

Improved temperature coefficient of 10ppm/K

6 Dimensional drawings

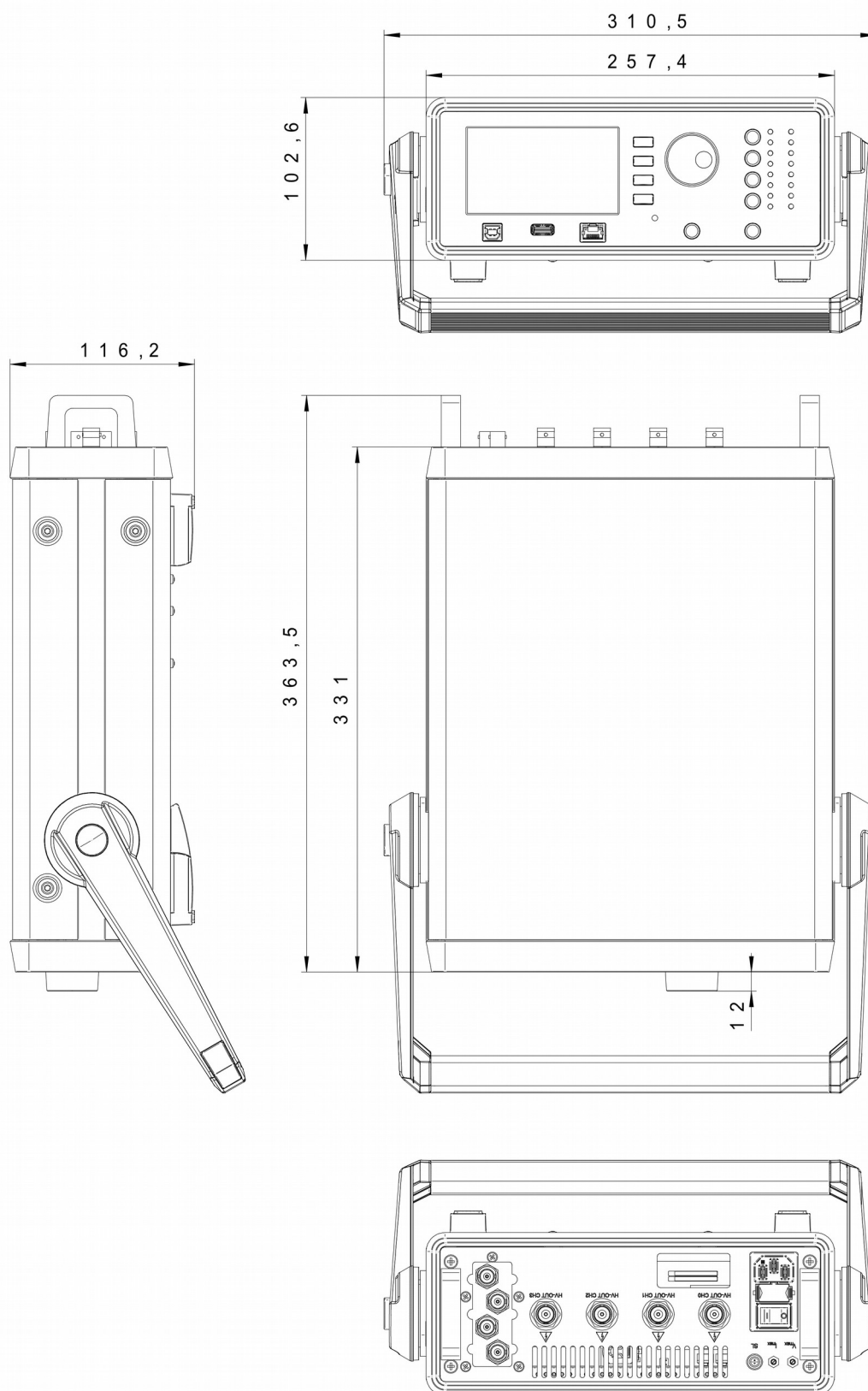


Figure 11: Dimensional drawing – SHR 4 channel version

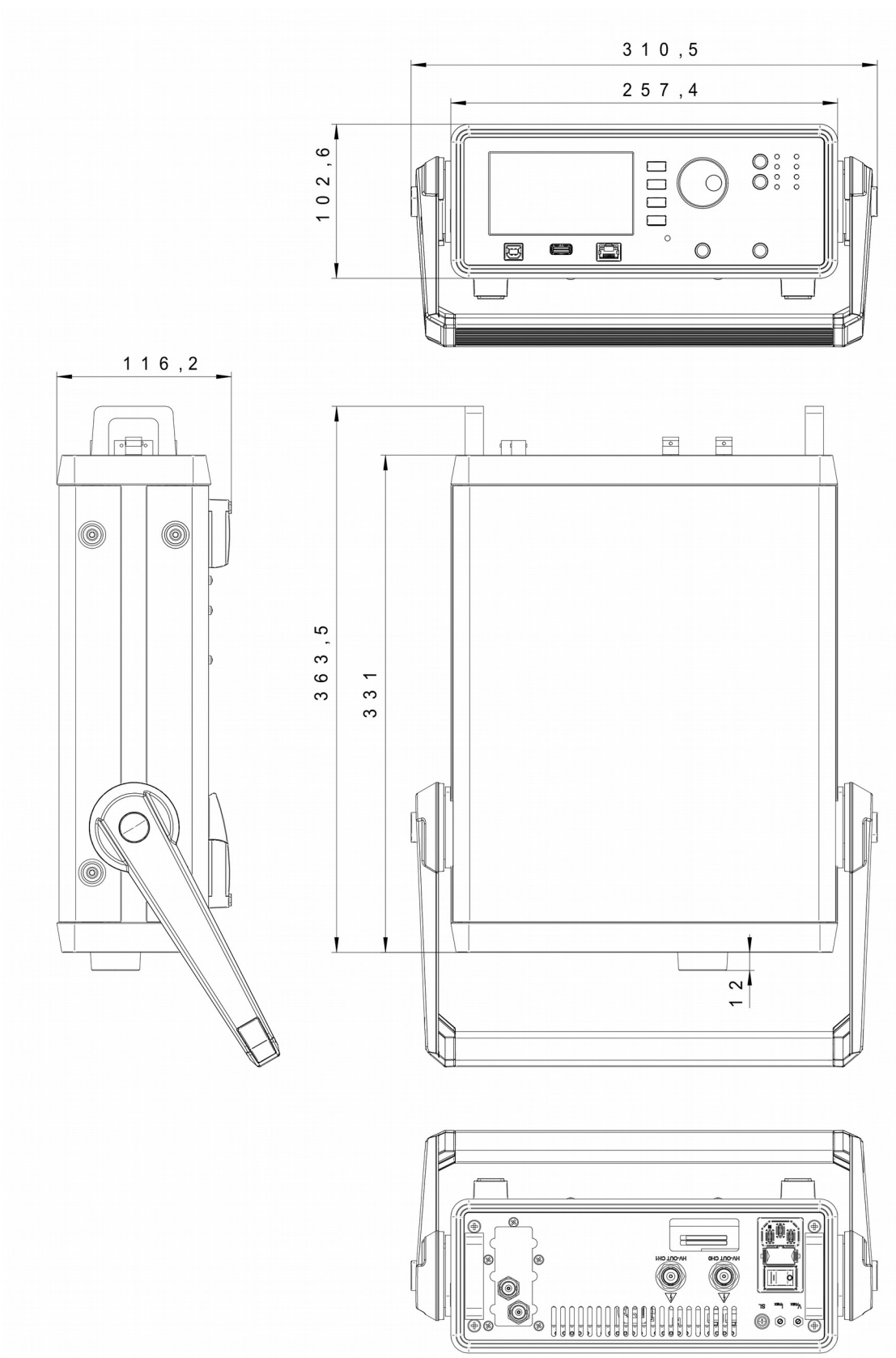


Figure 12: Dimensional drawing – SHR 2 channel version

7 Connectors and PIN assignments

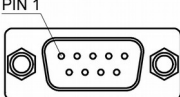
HV CONNECTOR ASSIGNMENTS																																		
Name	SHV																																	
Figure																																		
INHIBIT																																		
Name	INHIBIT connector- DSUB9		INHIBIT connector- DSUB9																															
Figure	<table><tr><th>PIN</th><th>INHIBIT 1</th><th></th></tr><tr><td>1</td><td>CHANNEL 0</td><td></td></tr><tr><td>2</td><td>CHANNEL 1</td><td></td></tr><tr><td>3</td><td>CHANNEL 2</td><td></td></tr><tr><td>4</td><td>CHANNEL 3</td><td></td></tr><tr><td>5</td><td>GND</td><td></td></tr><tr><td>6</td><td>GND</td><td></td></tr><tr><td>7</td><td>GND</td><td></td></tr><tr><td>8</td><td>GND</td><td></td></tr><tr><td>9</td><td>GND</td><td></td></tr></table>		PIN	INHIBIT 1		1	CHANNEL 0		2	CHANNEL 1		3	CHANNEL 2		4	CHANNEL 3		5	GND		6	GND		7	GND		8	GND		9	GND		PIN 1 	
PIN	INHIBIT 1																																	
1	CHANNEL 0																																	
2	CHANNEL 1																																	
3	CHANNEL 2																																	
4	CHANNEL 3																																	
5	GND																																	
6	GND																																	
7	GND																																	
8	GND																																	
9	GND																																	

Table 7: Connector and pin assignments

CONNECTORS PART NUMBERS (manufacturer code / iseg accessory parts item code)			
POWER SUPPLY SIDE		CABLE SIDE	
SHV (ROSENBERGER)			
Socket		Connector	57K101-006N3 / Z590162

Table 8: Connectors part number information

8 Order guides

CABLE ORDER GUIDE				
POWER SUPPLY SIDE CONNECTOR	CABLE CODE	CABLE DESCRIPTION	LOAD SIDE CONNECTOR	ORDER CODE <i>LLL = length in m</i> (*)
SHV	04	HV cable shielded 30kV (HTV-30S-22-2)	open	SHV_1C04-LLL

*) Length building examples: 10cm => 0.1, 2.5m => 2.5, 12m => 012, 999m => 999

Table 9: Guideline for cable ordering

CONFIGURATION ORDER GUIDE (item code parts)								
SR	04	0	020	r	605	000	02	00
High Voltage, Distinct Source	Numbers of channels	Class	V _{nom}	Polarity	I _{nom} (nA)	Option (hex)	HV-Connector	Customized Version
	02 = 2ch 04 = 4ch	0 = Standard 4 = High Precision	three significant digits *100V For Examble: 020 = 2000V	r = reversible	two significant digits + number of zeros For Examble: 605 = 6mA	Sum of the hex codes (s. table 3) For Example: IU + TC = 804	02 = SHV	00 = none

Table 10: Item code parts for different configurations

ACCESSORY / SPARE PARTS ORDER GUIDE	
ITEM	ORDER CODE
WiFi USB adapter	Z520175
USB surveillance camera	Z520158
VCT probe	

Table 6: Guidelines and item codes for accessories

9 Appendix

For more information please use the following download links:

This document
https://iseq-hv.com/download/AC_DC/SHR/iseq_manual_SHR_en_1.1.pdf
SHRcontrol desktop application
https://iseq-hv.com/download/?dir=SOFTWARE/iseqSHRcontrol/
iCS (iseq Communication Server)
https://iseq-hv.com/download/?dir=SOFTWARE/iCS
SCPI Programmers-Guide
https://iseq-hv.com/download/SOFTWARE/iseqSCPI/SCPI_Programmers-Guide.pdf
CAN EDCP Programmers-Guide
https://iseq-hv.com/download/SOFTWARE/iseqEDCP/CAN_EDCP_Programmers-Guide.pdf
iseqHAL (Hardware Abstraction Layer)
https://iseq-hv.com/download/SOFTWARE/iCS/doc/iseqHAL/index.html
iCSservice-API
https://iseq-hv.com/download/SOFTWARE/iCS/doc/iCSservice/iCSapiWebsocket_Docu.html
https://iseq-hv.com/download/SOFTWARE/iCS/doc/iCSservice/iCSapiWebsocket_Example.html
iseqIOC (EPICS Input / Output Controller)
https://iseq-hv.com/download/SOFTWARE/iCS/doc/iseqIOC/iseqIOC_doc.pdf
https://iseq-hv.com/download/SOFTWARE/iCS/doc/iseqIOC/iseqIOC_sampleScript.zip

10 Manufacturer's contact

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