Crate Controller 2x Series

Controller module for use with MMS compatible ECH crate series and MMS compatible modules

- Ethernet and WiFi (opt.) connectivity
- Master (CC24) / Slave (CC23) versions available
- Embedded Linux-Server with iCS control system (Master version)
- Two independent CAN extension ports (for Slave connection)
- Controls crate and module functions
- Digital I/O: Free configurable INHIBIT, INTERLOCK
- Preconfigured services: EPICS, SNMP, HTTP, SOAP, Websocket
- Webbrowser based control and configuration system
- Easy configuration and firmware updates of connected hardware

Document history

Version	Date	Major changes
2.4	24.06.2020	Scope of delivery
2.3	26.05.2020	improved description ICS Server
2.2	14.04.2020	Added CAN connector description; ICS Server image
2.1	06.02.2020	ICS Server, new image
2.0	25.11.2019	Safety information, Glossary, improved description
1.5	11.09.2019	Compatibility for ECH 5x, MPOD, Some fixes, Legacy mode
1.4	07.04.2017	ICS2.1 update
1.3	03.08.2016	Add Appendix
1.2	19.04.2016	Text and format revisions, Safety-Loop text changes
1.1	29.01.2016	Corrected item codes
1.0	29.01.2016	Initial release

Disclaimer / Copyright

Safety

This section contains important security information for the installation and operation of the device. Failure to follow safety instructions and warnings can result in serious injury or death and property damage.

Safety and operating instructuions must be read carefully before starting any operation.

We decline all responsibility for damages and injuries caused which may arise from improper use of our equipment.

Depiction of the safety instructions

DANGER!	
DANGER!	"Danger!" indicates a severe injury hazard. The non-observance of safety instructions marked as "Danger!" will lead to possible injury or death.

WARNING!	
WARNING!	"Warning!" indicates an injury hazard. The non-observance of safety instructions marked as "Warning!" could lead to possible injury or death.

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

INFORMATION	
INFORMATION	Advices marked as "Information" give important information.

 Read the manual.

 Attention high voltage!

 Important information.

Intended Use

The device may only be operated within the limits specified in the data sheet. The permissible ambient conditions (temperature, humidity) must be observed. The device is designed exclusively to control high voltage systems as specified in the data sheet. It must only be used specified in 3 Compatibility. Any other use not specified by the manufacturer is not intended. The manufacturer is not liable for any damage resulting from improper use.

Qualification of personnel

A qualified person is someone who is able to assess the work assigned to him, recognize possible dangers and take suitable safety measures on the basis of his technical training, his knowledge and experience as well as his knowledge of the relevant regulations.

General safety instructions

- Observe the valid regulations for accident prevention and environmental protection.
- Observe the safety regulations of the country in which the product is used.
- Observe the technical data and environmental conditions specified in the product documentation.
- You may only put the product into operation after it has been established that the high-voltage device complies with the country-specific regulations, safety regulations and standards of the application.
- The high-voltage power supply unit may only be installed by qualified personnel.

Important safety instructions

DANGER!	

⚠ DANGER!	This device is part of a high voltage supplying systems.
	High voltages are dangerous and may be fatal.
	
	USE CAUTION WHILE WORKING WITH THIS EQUIPMENT.
	BE AWARE OF ELECTRICAL HAZARDS.
	
	Always follow at the minimum these provisions:
	    • High voltages must always be grounded
	    • Do not touch wiring or connectors without securing
	    • Never remove covers or equipment
	    • Always observe humidity conditions
	    • Service must be done by qualified personnel only

WARNING	
⚠ WARNING!	RAMP DOWN VOLTAGES ! Before insertion or removal of crate controller, please make sure, that all voltages are ramped down, crates are switched off and power cord is disconnected.

WARNING!	
⚠ WARNING!	Do not operate the unit if you suspect the unit or the connected equipment to be damaged.

CAUTION!	
⚠ CAUTION!	When installing the units, make sure that an air flow through the corresponding air inlet and outlet openings is possible.

CAUTION!	
⚠ CAUTION!	When controlling, with software, the high voltage systems, make sure that nobody is near the high voltage or can be injured.

INFORMATION	
ⓘ INFORMATION	Please check the compatibility with the devices used.

Table of Contents

1. General information

The iseg CC 24/23 series is an intelligent embedded Linux-Server system with preinstalled iseg Communication Server (iCS).
The iCS comes with a large set of preconfigured services as EPICS, Web-Control, SNMP[1], SOAP, Websocket, OPC/UA[2], isegHAL and HTTP-API. The iCS also delivers two main web based user applications. iCS**control** provides a quick and smart control interface of the connected hardware by using web-browser without software installation. iCS**config** is used for hardware and service configuration and firmware upgrades. Both can also be run on mobile devices like tablets or smartphones.
For native application control several software solutions are available:

- iseg SNMP Control

- iseg**Control** (Linux, Windows, Mac)[3]

- isegHalRemote-Library

2. Package contents / Accessories

Hardware	included	optional
CC24 Master controller	CC24 controller (item code: CC24) Bitrate 125 kBit/s Dongle (item code: Z516581)	USB surveillance cam (item code: Z520158)
CC23 Slave controller	CC23 controller (item code: CC23) Bitrate 125 kBit/s Dongle (item code: Z516581)	

3. Compatibility

The CC2x crate controller series is compatible to the following MMS crates:

Crate	Slots	CC24	CC23	Required controller firmware	Notes
ECH 54A	10	X	–	ECH4XA_420	For HV-Modules
ECH 55A	10	X	–	ECH4XA_420 CC24 serial number > 5230200	For LV-Modules (only in Master crate)
ECH 56A	10	X	–	ECH4XA_420 CC24 serial number > 5230200	For HV- and LV-Modules (only in Master crate)
ECH 4xA (starting mid 2015)	10	X	X	ECH4XA_420	
ECH 4xA-LV	10	X	–	ECH4XA_420 CC24 serial number > 5230200	Low voltage crate option is only available in Master crate
ECH 242	2	X	X	ECH4XA_420	
ECH 244	4	X	X	ECH4XA_420	
ECH 224	4	–	–		As legacy slave client (CAN)
ECH 238	8	–	–	ECH238_212 ECH238_310	As legacy slave client (CAN)
ECH 44A (2013 – mid 2015)	10	X	X		Controller must be changed, i**CS**intern must be removed
ECH 43A (end 2013)	10	X	X	ECH4XA_409	CC43 and CC23 are compatible
wiener MPOD	1-10	x	x	ECH4XA_420	Starting March 2013

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1   Expected available middle of 2016
2   Expected available middle of 2016
3   Update to Version 2 is expected available middle of 2016

The CC2x crate series is compatible to the following MMS modules:

Module	Firmware	Required firmware release	Serialnumber
EBS 8/16 channel, Bipolar	E08B0 1.xx	1.11 (or higher)	Serialnumber (6 digits) 77xxx0/1
EBS 12/16/24 channel, Bipolar	E12B0_2.xx	2.11 (or higher)	Serialnumber (7 digits) 77xxxxx
EDS 16/32 channel, Distributor	E16D0 4.xx	4.43 (or higher)	Serialnumber (6 digits) 71xxx0/1
EDS 16/32 channel, Distributor	E16D1 4.xx	4.43 (or higher)	Serialnumber (6 digits) 71xxx0/1
EDS 16/32/48 channel, Distributor	E24D1 5.xx	5.52 (or higher)	Serialnumber (6 digits) 715xx0/1
EDS 16/32/48 channel, Distributor	E24D1 6.xx	6.12 (or higher)	Serialnumber (7 digits) 71xxxxx
EHS 4/6/16 channel, Common Ground	E08C0 2.xx	2.42 (or higher)	Serialnumber (6 digits) 73xxx0/1
EHS 8/16 channel, Common Floating Ground, High Precision	E08C2 1.xx	1.25 (or higher)	Serialnumber (6 digits) 78xxx0/1
EHS 2/4/8/16 channel, Common Floating Ground, Standard or High Precision	E08C2 4.xx	4.51 (or higher)	Serialnumber (7 digits) 73xxxxx and 78xxxxx
EHS 4/8/16 channel, Floating Ground	E08F0 2.xx	2.52 (or higher)	Serialnumber (6 digits) 74xxx0/1
EHS 4/8/16 channel, Floating Ground, High Precision	E08F2 4.xx	4.34 (or higher)	Serialnumber (6 digits) 72xxx0/1
EHS 2/4/8/16 channel, Floating Ground, Standard or High Precision	E08F2 6.xx	6.51 (or higher)	Serialnumber (7 digits) 74xxxxx and 72xxxxx
EHS 8/16 channel, STACK, Floating Ground	E08F7 1.xx	1.00 (or higher)	Serialnumber (7 digits) 810xxxx
EHS 8/16 channel, STACK, Floating Ground, Standard or High Presicion	E08F7 2.xx	2.26 (or higher)	Serialnumber (7 digits) 815xxxx
EHS 16/32 channel, Common Ground, Low Cost	E16C1 1.xx	1.23 (or higher)	Serialnumber (6 digits) 79xxx0/1
EHS 16/32 channel, Common Ground, Low Cost	E16C1 2.xx	2.13 (or higher)	Serialnumber (7 digits) 79xxxxx
EHS 24/48 channel, Common Ground, Low Cost, FLEX	E24C1_1.xx	1.11 (or higher)	Serialnumber (7 digits) 79xxxxx
ESS 1 channel, Bipolar	ESS01C 1.xx	1.20 (or higher)	Serialnumber (7 digits) 77xxxxx

Table 1: crate series compatible modules

The current firmware releases is able for download from our WEB site. Please refer appendix for more information.

4. Technical data

SPECIFICATIONS	CC 24	Description
Connectivity		
USB – front	1x USB-A	
USB – board	1x USB-A	For manufacturer specific WiFi adapter
Ethernet (10/100/1000 MBit)	1x RJ-45	
CAN	2x RJ-45	Two seperate lines (green and yellow indication)
Control connector	1x D-SUB-9 female	Custom specific configurable, see 7.3 Control connector
Server hardware		
CPU	Freescale iMX6 Quad-Core 996 MHz	
RAM	1 GB DDR3 onboard	
Flash Memory	4 GB onboard	
Operating system		
ICS2	Manufacturer specific Linux distribution	
Services	iCSservice (Websocket, HTTP, SOAP), SNMP, EPICS, HALservice	
Native control software	isegControl (Win 7/8/10 – 32/64bit, Linux, OS X 10.9 and higher)	
Web browser based control / config software	iCSconfig / iCScontrol: All plattforms Mozilla Firefox (version > 41), Google Chrome (version > 45), iOS (Safari ,version > 7)	
System		
System connector	96-pin connector according to DIN 41612	
Dimensions (L/W/H)	MMS – Eurocassette 6U	
Weight	650 g	
Environmental conditions		
Operating temperature range	10 – 40 °C	
Storage temperature range	-20 – 85 °C	
Humidity	30 – 70 %, non condensating	
Compliance		
	RoHS, CE, UL-94, Conflict Mineral, REACH	
Notes: The CC23 Slave Controller can only be used in conjunction with the CC24 Master.		

Table 2: Technical data

5. Hardware setup and topology

An ECH crate equipped with a CC24 Host Controller can be extended with up to 2 x 4 CC23 slave controllers using the green and the yellow daisy chain CAN lines. Legacy CAN controlled crates can be connected at the end of each of these lines.

All CC2x controllers provide two independent CAN lines, that are separated by color coding, indicated by the LED of the CAN connector. The upper CAN connector connects the YELLOW CAN LINE, the lower to the GREEN CAN LINE.

The address IDs of the connected crates are configured automatically, depending on the position in the chain following this pattern:

	LINE-ID	DEVICE-ADDRESS
Yellow line IDs	1 – 5	
Green line IDs	8 – 12	
Controller CC2x series		1000
Controller legacy crate series		2000 ...
Modules		0 - 999
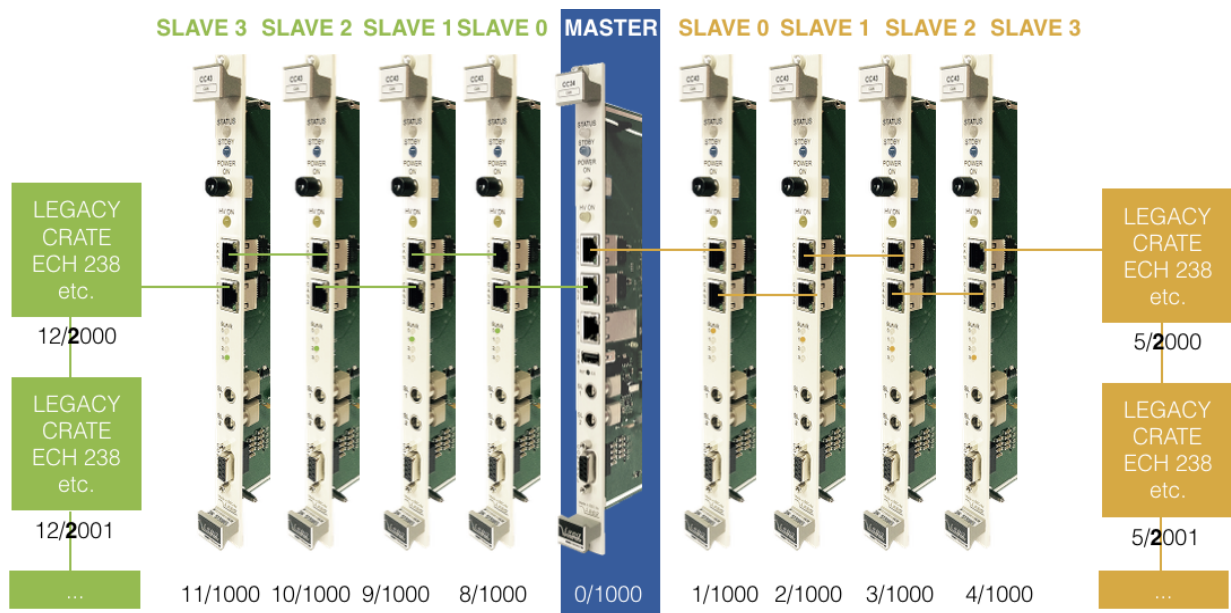
Figure 1: Topology of CC24/23 series

CAUTION!	
⚠️ CAUTION!	Before insertion or removal of crate controller, please make sure, all voltages are ramped down, crates are switched off and power cord is disconnected.

5.1. CAN connector LEDs

CC24 (Master)	CC23 (Slave)	
CAN connector indicates line (yellow or green LED at the connector)	Slave is not connected to master or previous slave	All LEDs are off
	Slave is connected to master or previous slave	CAN LED indicates the color of the master line, the slave is connected to The number LEDs indicate the slaves order number (note: not the address – see topology)

5.2. Connection and Termination

Both CAN connectors are internally terminated by a 120 Ohm resistor. If two CC2x controllers are directly connected by a direct assigned (no crossover) FTP Cat. 6 patch cable, no further termination is needed.

CAUTION!	
⚠️ CAUTION!	Do not connect both CAN connectors of a CC2x controller in any way, neither direct nor by building CAN ring bus topology.

5.3. Connecting legacy crates (ECH238, ECH224, etc.)

CC2x controllers are able to connect legacy CAN-only driven iseg crates. So it is possible to extend existing hardware setups with a new MMS series crate (ECH5xA, ECH4xA, ECH242, ECH244) and CC2x crate controller to access complete hardware by Ethernet or WiFi with all major advantages of the integrated server hardware.

Legacy crates don't automatically configure their address. The address of the backplane (bank address) must be selected by a rotary selector switch of the legacy's crate controller. Please note:

- Pay attention that every legacy crate is configured to a unique address within a CAN line.
- Modules labeled with a six digit serial number allocate one or two addresses depending on the serial number.

  If there is at least one module in a legacy crate that's six digit serial number has a one at the last digit, only equal bank addresses are allowed.

- All modules and crate controllers in legacy crates must be configured to a CAN bitrate of 250 kBit/s

Each of the Masters CAN lines (yellow and green) can address up to 64 modules in legacy crates, which is 128 modules in total.
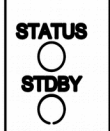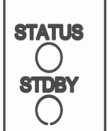
6. Front panel
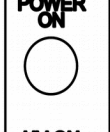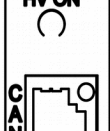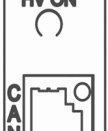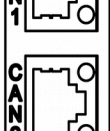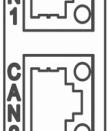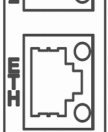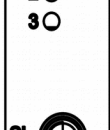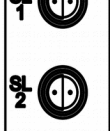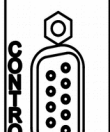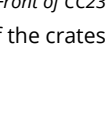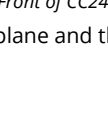
LED STATUS		System state: • LED off: Crate is switched off / Standby mode • LED green: Crate is running without error • LED red: Error occurred (Crate Status bit Sum Error is set)
LED STDBY		Standby mode: • LED blue: Crate is connected to mains, remote controllable, WiFi and Ethernet connections are active
Pushbutton POWER ON		Switches the crate on or off by pressing the button for one second ON: All modules will be supplied with power by crate and can be controlled The fan speed is regulated according to the maximum temperature within the crate OFF: All modules will be switched off. The fans run at minimal speed.
LED HV ON		HIGH VOLTAGE is active LED yellow: At least one channel in crate generates high voltage or is measuring an output voltage of more than 60 Volt
CAN1		RJ-45 CAN – connector for slave controller connection
CAN2		RJ-45 CAN – connector for slave controller connection
ETH (CC24 only)		RJ-45 Ethernet network connector (10/100/1000MBit)
LED SLAVE 0-3 (CC23 only)		Indicate the slave position in the yellow or green CAN line
USB (CC24 only)		USB 2.0 connector, for external WiFi, camera, firmware upgrade, flash memory
SL 1		Safety-Loop-Connector 1
SL 2		Safety-Loop-Connector 2
CONTROL		D-SUB-9 connector with configurable digital I/O

Figure 2:
Front of CC23

Figure 3:
Front of CC24

The voltage supply of the crates backplane and the crate connected modules is switched on by the POWER ON pushbutton or by remote control.

Normal front panel operation

Hold the POWER ON pushbutton for one second. The power supply will be switched on. LED STATUS turns to GREEN. By holding the POWER ON pushbutton again for one second, the power supply will be switched off. The LED STATUS goes OFF.

INFORMATION
⚠ INFORMATION — If the POWER ON pushbutton will be hold for five seconds, the crate enters the bitrate configuration mode (see 9 Module Bitrate Configuration)!

Front panel operation with errors

If an error occurs while trying to switch the Crate on, the LED STATUS lights RED for 5 seconds. After that the crate controller shuts down the operation and the LED STATUS goes OFF. If an error occurs during operation, the crate remains powered on and the LED STATUS is permanent RED.

All possible errors are described in the Crate Controller Status register description (see 16 Appendix, CAN EDCP programmers guide).

7. Connectors

7.1. CAN connector

Both CC24 (master) and CC23 (slave) are equipped with CAN connectors to connect further CC23 or legacy slave crates (section 5 Hardware setup and topology).

The CC24 also provides the Legacy Mode (section 12 Legacy Mode) through the front panel CAN connectors.

The CAN connections on the RJ-45 connector are as follows:

RJ-45 pin	Signal
1	CAN_H
2	CAN_L
3	CAN_GND
4	Reserved
5	Reserved
6	Reserved
7	CAN_GND
8	Reserved

Table 3: CAN connector

7.2. Safety-Loop connector

The SL1 and SL2 connectors serve as current source for the safety loop. The current flow through a safety loop enables the high voltage generation within the modules. When the safety loop is interrupted, the high voltage generation stops immediately.

INFORMATION	
⚠ℹ INFORMATION	The safety loop feature has to be activated by removing a jumper on the backside of the high-voltage modules also. See the specific module manual for more information. Check the compatibility with the devices used.

SL1

Potential-free current source (8 to 10 mA) to supply a safety loop for up to 10 modules. The safety loop is routed through the modules SL connectors by a series connection. Start- and end point of the safety loop is SL1. For modules with a Redel connector, the associated SL pins have to be bridged. Additional potential-free contacts to open the safety loop through external signals can also be inserted.
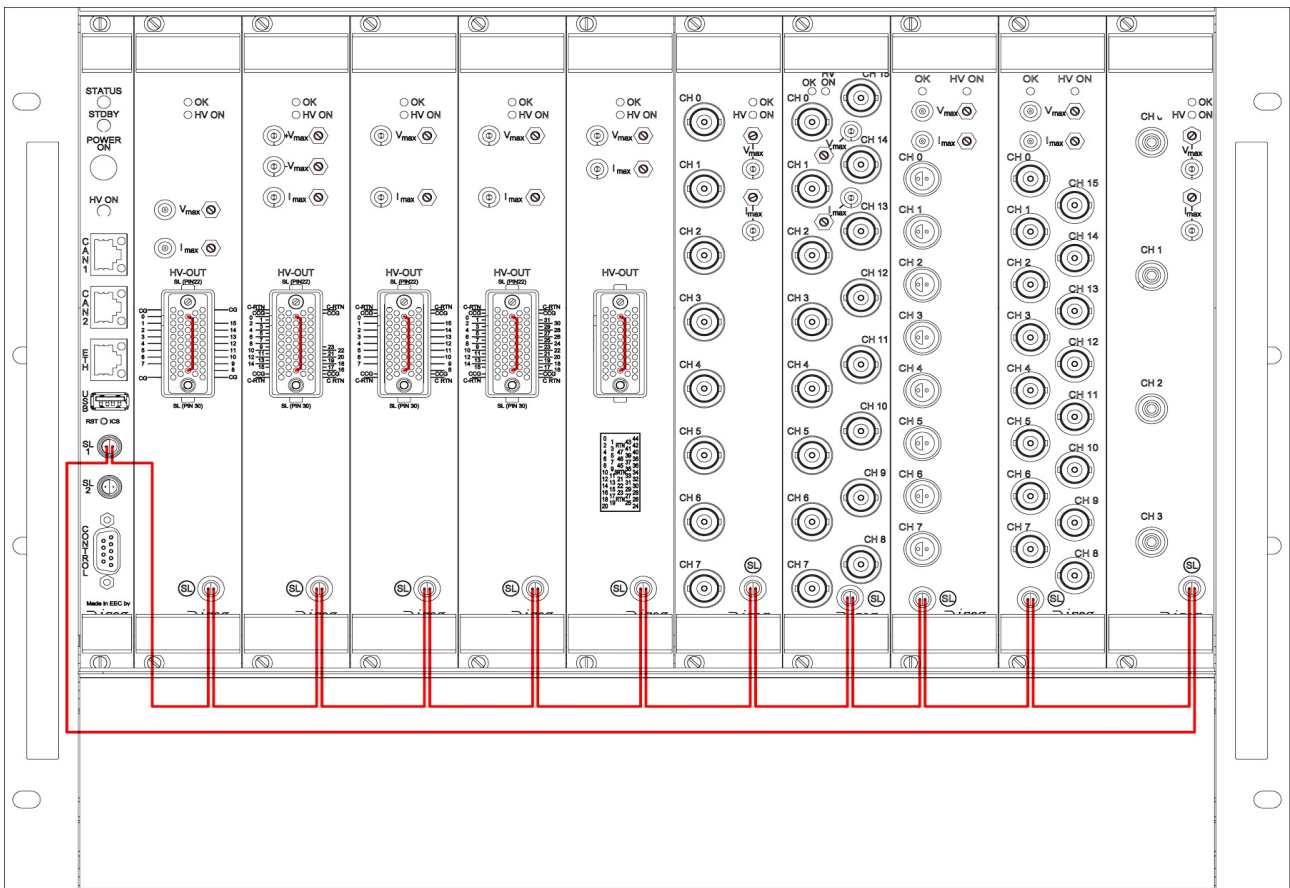
Figure 4: Safety loop 1 - wiring example

SL2

A current source on crate GND potential for modules with option SLP (internal supplied safety loop). The SL2 connector pins can be bridged by a short-circuit plug or an external potential-free switch. In this case the modules are supplied with the loop current via the crate's backplane.

To enable a module its SL connector (and, if applicable, the SL pins on the Redel connector) must be bridged. All modules are supplied with the loop current in parallel, i.e. opening the SL connector on a module will only deactivate this one module.

7.3. Control connector

The CONTROL D-SUB-9 female connector provides digital input and output functions.

To use all control connector functions, it may be necessary to perform firmware updates for all modules in the crate first (see 3 Compatibility).

The high level is +5 Volt, low level is ground potential.
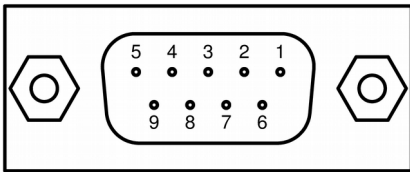
Figure 5: Pin assignment of CONTROL connector

Pin	Direction	Name	Description
1	Input	Crate Enable	This function must be activated by setting the Crate Enable Active bit in the Control register to one. This setting is permanent and restored after Power On. • When pulled high, the Crate Status bit Crate Enabled is set and high voltage can be turned on. • When open or pulled low, the Crate Status bit Crate Enabled is cleared and no high voltage can be turned on. If the pin is opened or pulled low during operation, all high voltages will be turned off with the programmed ramp.
2	Input	Crate Fast Off	When pulled high, the Crate Status bit Crate Fast Off is set to one and all high voltages will be shut down without ramp.
3	Input	Reserved	
4	Input	Reserved	
5	–	Ground	Always low, can be used to pull down input pins
6	Output	High Voltage On	High when the Crate Status bit High Voltage On is set
7	Output	Reserved	
8	Output	Reserved	
9	Output	Logic High	Always high, can be used to pull up input pins

Table 4: Pin assignment

8. WiFi

The CC24 Master crate controller is optionally equipped with a removable WiFi access point.

In case this feature is unwanted, you can switch it off by software configuration (see 11.2.3 iCSconfig: manage hardware, service and preferences) or remove the USB-hardware part from the controller board or front panel USB port.

For more information of WiFi configuration and use, refer to the iCS section (see 11.2.1 How to connect via WiFi).

9. Module Bitrate Configuration

INFORMATION
INFORMATION	All modules must be configured to a CAN bitrate of 250 kBit/s for operation with CC2x controller series. If modules are configured to a CAN bitrate of 125 kBit/s, they can be re-configured by the crate controller in a bitrate configuration mode.

Carefully follow these steps to prepare modules for use with the CC2x crate controller series:

1. The crate is connected to mains power, the backplane is turned off, no module is plugged in
2. No connector is plugged into the CONTROL socket of CC 2x crate controller
3. Press and hold the pushbutton POWER-ON for about five seconds
4. The LED STATUS blinks slowly GREEN
5. If a module is recognized now, the controller switches into normal operation mode
   ◦ If no module is recognized, the controller enters CONFIGURATION MODE
6. The LED STATUS blinks quickly, the controller scans for a module at both bitrates
7. Insert exactly one module which bitrate should be adapted (by hot plugging).
   ◦ If the module is recognized on the wrong bitrate (i.e. 125 kBit/s), it will programmed to the correct bitrate (250 kBit/s) and restarted afterwards
8. If the module is (now) recognized at the correct bitrate, the LED STATUS blinks slowly
9. The module can be plugged out now and another module can be plugged in to repeat the configuration process from step 5
10. Press the button POWER-ON for about one second to turn off the crate and exit the CONFIGURATION MODE

INFORMATION
INFORMATION	In case of the need of reconfiguration to 125 kBit/s, the provided Bitrate Configuration dongle (shortens Pin 2 and Pin 9) must be connected to the CONTROL connector before starting the configuration. The LED STATUS blinks red instead of green in this case. You can contact iseg customer support for purchase accessory parts.

10. AC line power fail

Crate without Option UPS (Uninterruptible Power Supply)

If a power fail is detected by the crate controller, which is connected to a crate without option UPS, the controller shuts down all high voltages with a very fast ramp (1,000 percent = tenfold of nominal voltage per second), to avoid uncontrolled floating high voltages.

If the AC line goes bad, the crate status bit Power Fail and it's corresponding Crate Event Status bit is set and the crate controllers STATUS LED lights red.

Crate with Option UPS (Uninterruptible Power Supply)

The function UPS offers protection against AC line power fails. This protection is provided by a power supply with integrated batteries. The battery backup time is long enough to safely ramp down all high voltages before power loss.

CAUTION!
⚠️ CAUTION! Please make sure that the extra fuse for UPS use is applied to the crates power supply. Open the fuse when transporting the crate.

The high voltage modules and the crate controller are supplied from the internal battery while the AC line is bad.

After ten seconds of line power fail, all modules begin to ramp down the high voltage with a ramp speed of two percent of nominal voltage per second, which takes approx. 50 seconds when starting at maximum voltage.

Additional status and measurement values with UPS:

- The Crate Status bits Low +24 Battery and High +24 Battery are set when the measured battery voltage exceeds the limits.
- The measured battery voltage can be read out by Crate Supply Measurement channel 8.
- The Crate Status bit High +24 Battery is also a hint for an open battery fuse.

11. iCS2 – iseg Communication Server 2.5
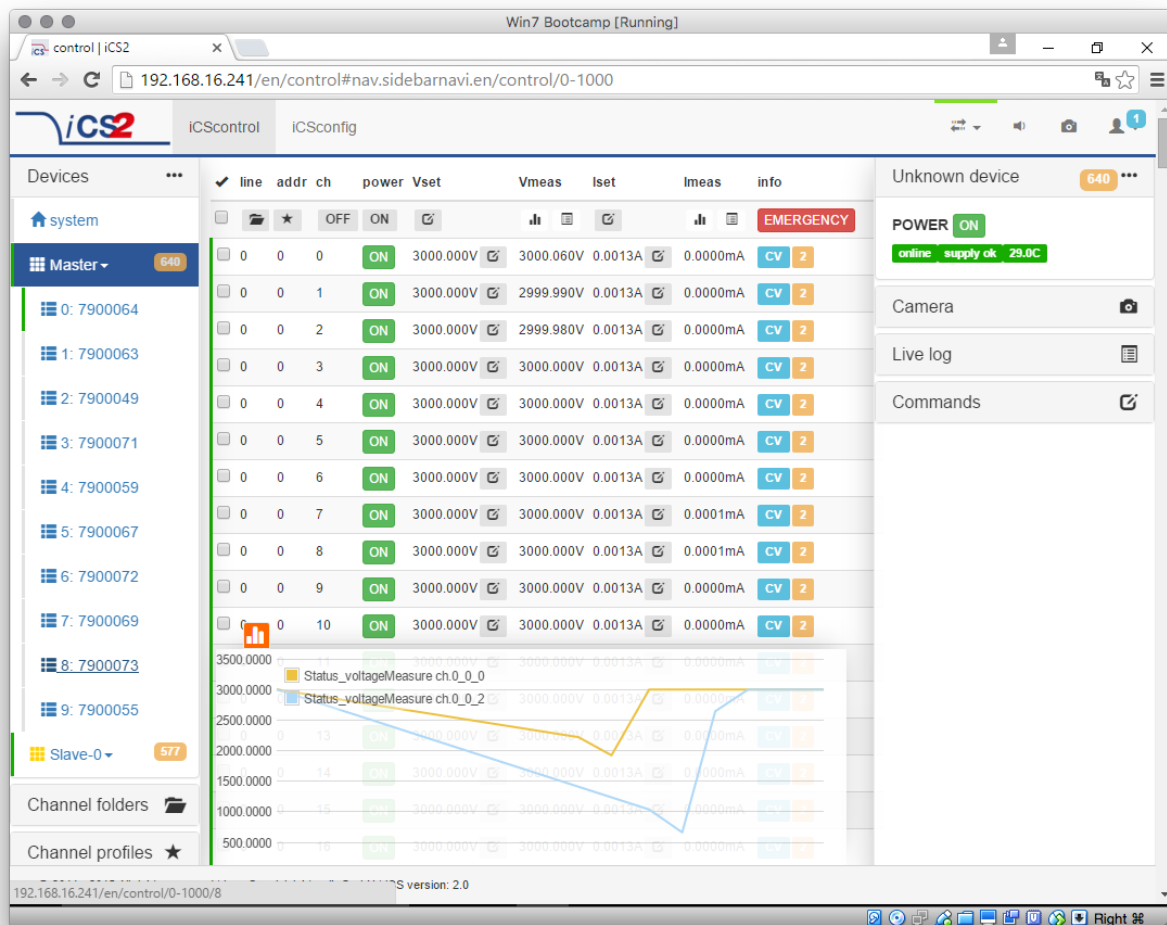
Figure 6: iseg Communication Server

11.1. 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 webservices to give a quick access to iseg hardware.

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

The installed iCS2 libraries and services licenses files are located on the system under:

/usr/share/common-licences/[library or service module]

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 8081 / HTTP API
isegHALservice	iseg hardware abstraction layer service, simple hardware access	TCP 1454 / isegHAL Socket
EPICS IOC	EPICS Input / Output controller, autoconfiguring to hardware setup, customizable by file upload#	EPICS Base R3.15.7 TCP/UDP 5064, 5065
OPC/UA	OPC / UA server	
SNMP	Simple Network Management Protocol	UDP 161

Table 5

11.2. Software architecture

Figure 7: Software architecture

11.2.1. 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) are attached. Start the crate or device.

2) Use your mobile device or computer to search for existing WiFi networks and select „iseg-iCS_XXXX" (XXXX is the iCS serial number).
Enter the factory default WiFi password (**password**).

3) Open a recommended web-browser like Google Chrome and enter the factory default IP address (**192.168.1.1**)

4) Enter the factory default username (**admin**) and password (**password**)

INFORMATION	
INFORMATION	WiFi support can be turned off in iCSconfig → WiFi. The default WiFi password can be changed there also.

11.2.2. 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. More details are in the INFORMATION box below.

iCS also provides UPnP messages, which can be discovered, e.g. in Windows using „Network" environment. For Linux and MAC, Zeroconf/Bonjour can be used to find the iCS.

INFORMATION	
INFORMATION	To discover iCS installations on the local network, a small utility **iCSfinder** can be used.
	It can be downloaded here: https://iseg-hv.com/download/?dir=SOFTWARE/iCS/iCSfinder/
	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**).

11.2.3. iCSconfig: manage hardware, service and preferences

iCS has a comprehensive set of configurable properties. All of them are stored in an 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	
iCScontrol Setup	Manage preferences of iCS web control application
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 Control Lists	Grant / deny rights on user / group / channel / item base
iCSservice	Configure iCSservice API / HTTP API
HAL/HALservice	Configure HAL logging and HALservice credentials
EPICS	Configure the embedded EPICS Input/Output controller (IOC)
OPC	Configure the embedded OPC/UA server
SNMP	Configure the embedded SNMP server
Updates	Download updates (System, Product database, firmware) from internet
Custom Scripts	Configure the custom Python3 scripts
Import / Export	Save and restore complete iCS configuration to backup hardware setup

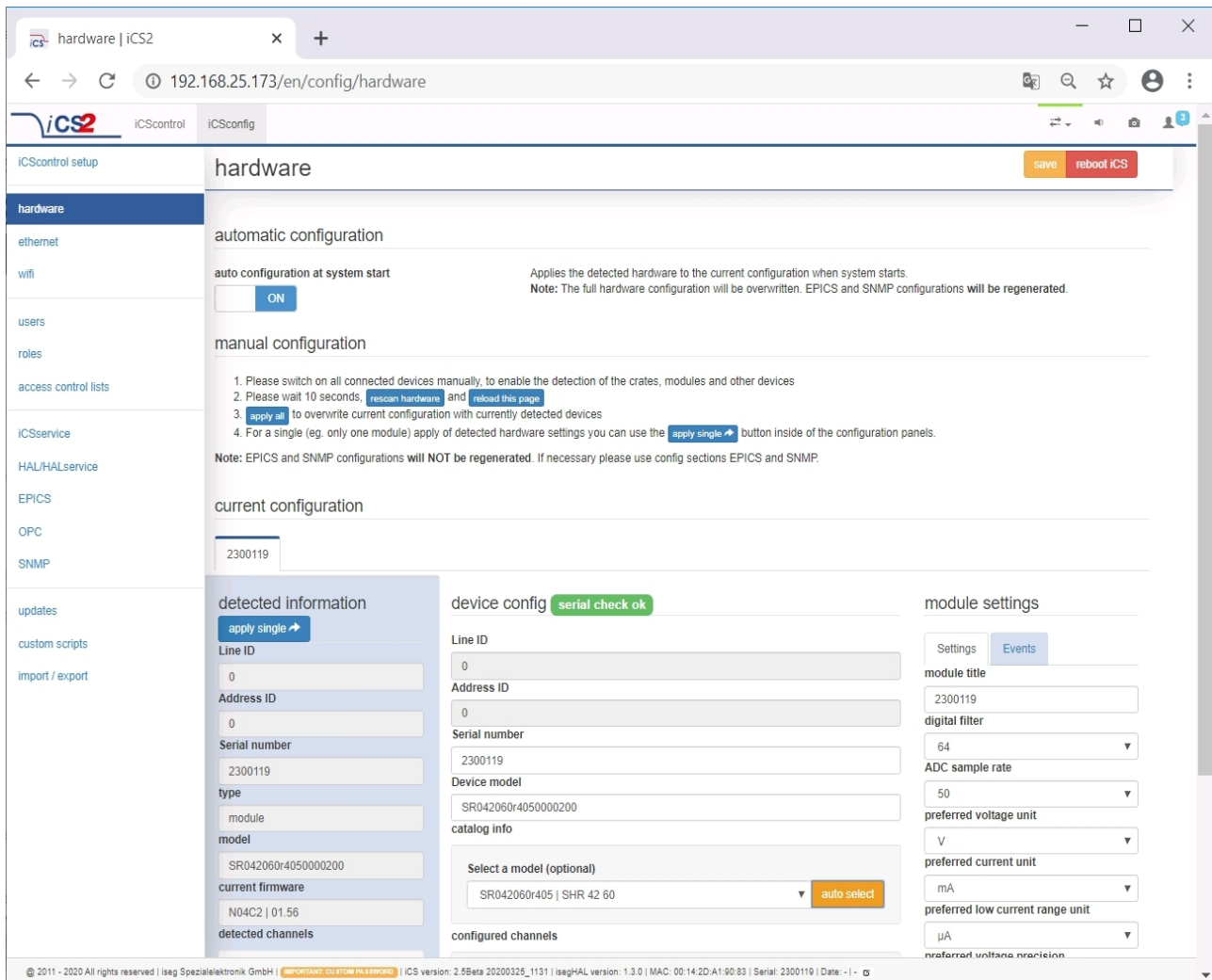*Table 6*

11.3. Hardware

Figure 8: 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.

The feature **auto configuration at system start** supports automatically take over of the detected to the configured hardware, generation of EPICS and SNMP configuration. Auto configuration will be executed one time after iCS system start when master crate backplane is on or when iCS is running on a iCSmini.

To apply the complete detected hardware state into the configuration use the apply all 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 single 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 and provides slots for the modules
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

Table 7: Hardware Types

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 at system start**, **apply all** or **apply single** functionality.

11.3.1. 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 IPv4 settings can be entered manually.

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

Table 8:Ethernet Defaults

The ethernet settings will be stored automatically to the USB flash memory, directory iseg-iCS as file ip-config.txt whenever an USB flash memory is plugged in. This allows retrieving the current IP configuration from an iCS system.

11.3.2.   (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 memory drive (FAT32 format)

3) Now edit the file. It should contain the following entries, separated by new lines.

4) Plug USB flash memory 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 memory drive and check on a computer if the file created on step 2 was renamed to RESET_NET.txt.done. If it was not renamed, then something went wrong.

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

Table 9

INFORMATION
⚠️ i **INFORMATION**   Use quality USB flash memory drives, otherwise the drive might not be detected by the iCS. Also make shure, the flash memory has no file system problems.

11.3.3.   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 address always stays the same.

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

Table 10

11.4. Users / roles configuration

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

11.4.1. 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 rights mechanism.

INFORMATION	
⚠ INFORMATION	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, and HTTP API. isegHAL based services should implement their own security mechanisms.

11.4.2. SSH access

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

This enables user to install own services or freely configure e.g. EPICS plugins etc. The setup of a custom password will be described in the next chapter (Re)set SSH access.

INFORMATION	
⚠ INFORMATION	The local file system is divided into a system and a user data partition. To make changes on the read-only mounted system part use the following command: **mount-rw /** and **mount-ro /** switches the root file system back to read-only.

11.4.3. (Re)set SSH access

INFORMATION
To protect your iCS system we strongly advice to change the standard factory password into a new user defined 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 drive (FAT32 format). Note: if the file is empty, the iCS root password will be reset to factory default.

2) Plug the USB flash into iCS hardware and reboot 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.

11.4.4. 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 an USB flash drive (USB stick) with a FAT32/FAT16 partition is needed.
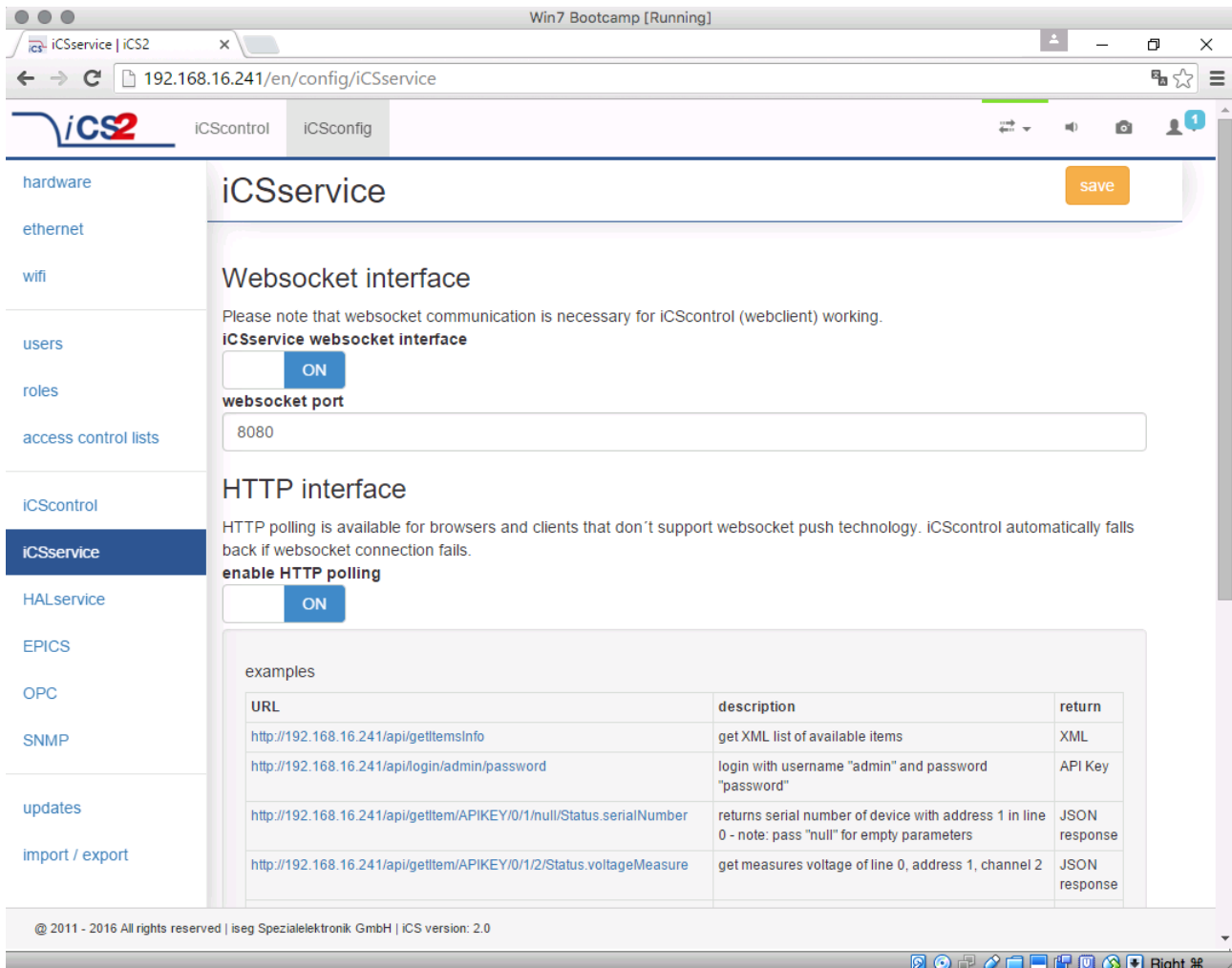
CAUTION!
After factory reset all hardware configurations will get lost!

11.4.5. 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 the USB flash memory 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) In case of success the file will be renamed to RESET_ICS.txt.done.

11.5. iCSservice configuration

Figure 9: iCSservice configuration

The iCSservice 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 iCScontrol.

iCSservice DEFAULTS	
Websocket Port	8080
HTTP port	8081
HTTP URL BASE	<IP-of-iCS>:8081/api/

INFORMATION	
INFORMATION	The documentation of iCSservice API, step by step connection guide to use Websocket / HTTP interface and an example Javascript is available on iCS directly (iCSconfig / iCSservice) or online on: https://iseg-hv.com/download/?dir=SOFTWARE/iCS/doc/iCSservice/

11.5.1. HTTP interface

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

iCSservice HTTP functions		
URL, Parameters with leading $, params not mandatory [$param]	Response	Description
http://<IP-of-ICS>:8081/api/login/$username/$password	API Key	Returns API Key to be identified for session
http://<IP-of-ICS>:8081/api/logout/$session-ID	TRUE / FALSE	
http://<IP-of-ICS>:8081/api/getItem/$apikey/$line/$address/$channel/$item	JSON Object	Returns state of a specific item of a hardware path $line, $address, $channel and $item can be set by wildcard '*'
http://<IP-of-ICS>:8081/api/setItem/$apikey/$line/$address/$channel/$item/$value/[$unit]	TRUE / FALSE	Sets state of a specific item of a hardware path $line, $address, $channel can be set by wildcard '*'
http://<IP-of-ICS>:8081/api/getUpdate/$apikey/	JSON Object	returns all changes collected by iCSservice since last getUpdate call for this client session
Notes: 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.		

Table 11

EXAMPLES	
http://192.168.1.1:8081/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://192.168.1.1:8081/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://192.168.1.1:8081/api/setItem/123456-321/0/null/null/Control.power/1	Switch controller of line 0 (master) on

Table 12: Examples

11.5.2. 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, edited manually, e.g. with a text editor and 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	```############################## # ### 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 can0") field(NOBT, "16") field(SHFT, "0") field(TSE, "-2") } ...```
iseg_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,"AUTO"} {5230003,0,1000,0,1,"AUTO"} {5230003,0,1000,0,2,"AUTO"} ...```
iseg_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 ...

Table 13

For more detailed information on EPICS, please visit: https://epics.anl.gov/, for sample libraries and test scripts, please contact support@iseg-hv.de.

INFORMATION

The documentation of iseg EPICS IOC and a sample scripts are available on iCS directly (iCSconfig / EPICS) or online on: https://iseg-hv.com/download/?dir=SOFTWARE/iCS/doc/isegIOC/

INFORMATION

11.5.3.   HALservice

The isegHALservice provides a secure sockets encrypted end-to-endpoint access to the iseg hardware layer running on iCS hardware. The isegHALservice API is similar to isegHAL API, with some specific extension. Please refer Appendix "isegHAL" for details. For an easy start a simple example program isegHalTerminal demonstrates the remote access. There are virtual instruments (VIs) which are based on the library **isegHAL-remote** in order to control iseg hardware via LabVIEW [4].

INFORMATION
⚠\i\ **INFORMATION**   The documentation of iseg HAL (service) is available on iCS directly (iCSconfig / HALservice) or online on: https://iseg-hv.com/download/SOFTWARE/iCS/doc/isegHAL/index.html

11.5.4.   SNMP

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 (substition information with list of hardware channels) files can be downloaded, locally modified and uploaded again.

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

INFORMATION
⚠\i\ **INFORMATION**   The documentation of iseg SNMPservice and sample scripts are available on iCS directly (iCSconfig / SNMP) or online on: https://iseg-hv.com/download/SOFTWARE/SNMPguide/SNMP_Programmers-Guide_en.pdf

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4   © National Instruments Corporation. All rights reserved.

11.5.5. 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 the local computer to the 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.

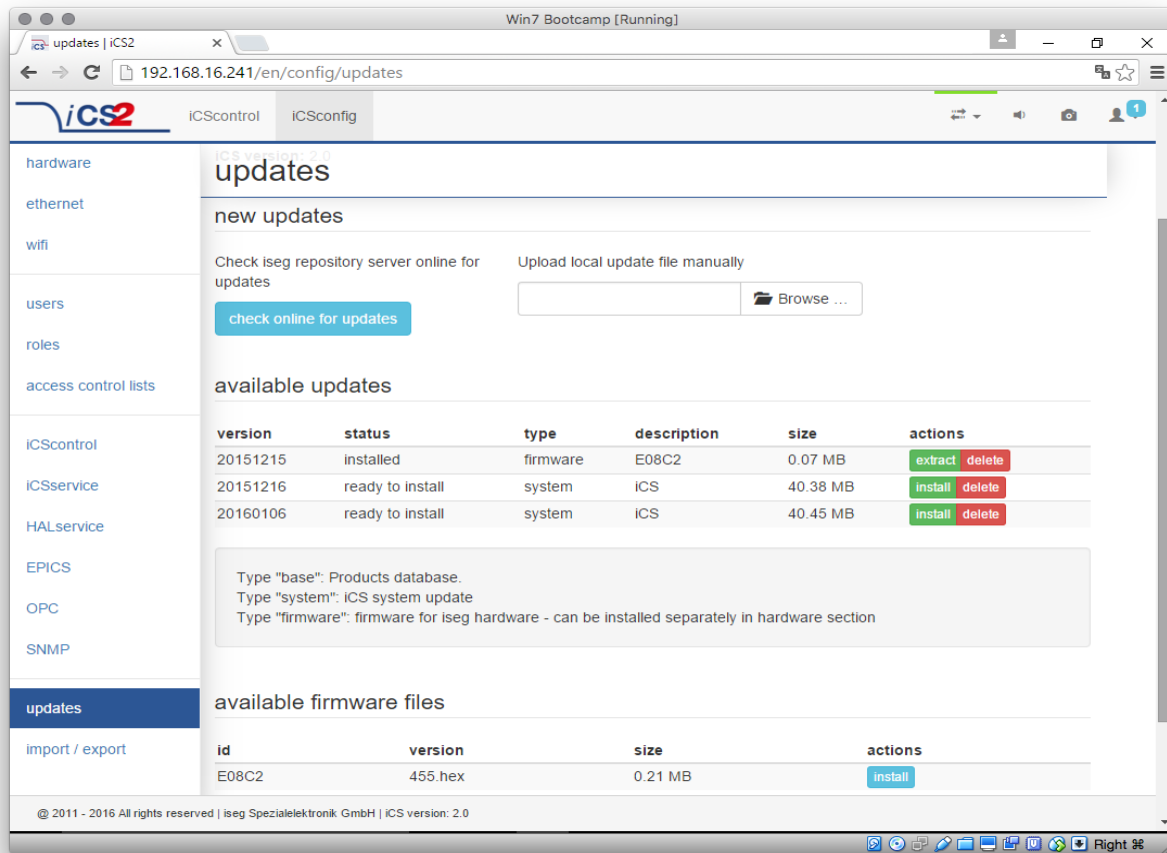| INFORMATION	
⚠ i INFORMATION	Using the Check online for updates feature the iCS directly connects to iseg online software repository. All update files can also be downloaded directly on http://download.iseg-hv.com/?dir=SOFTWARE/iCS

Figure 10: Updates

11.5.6. Custom scripts

The custom script folder provides an access to the script setup. A list of installed scripts will be displayed here.
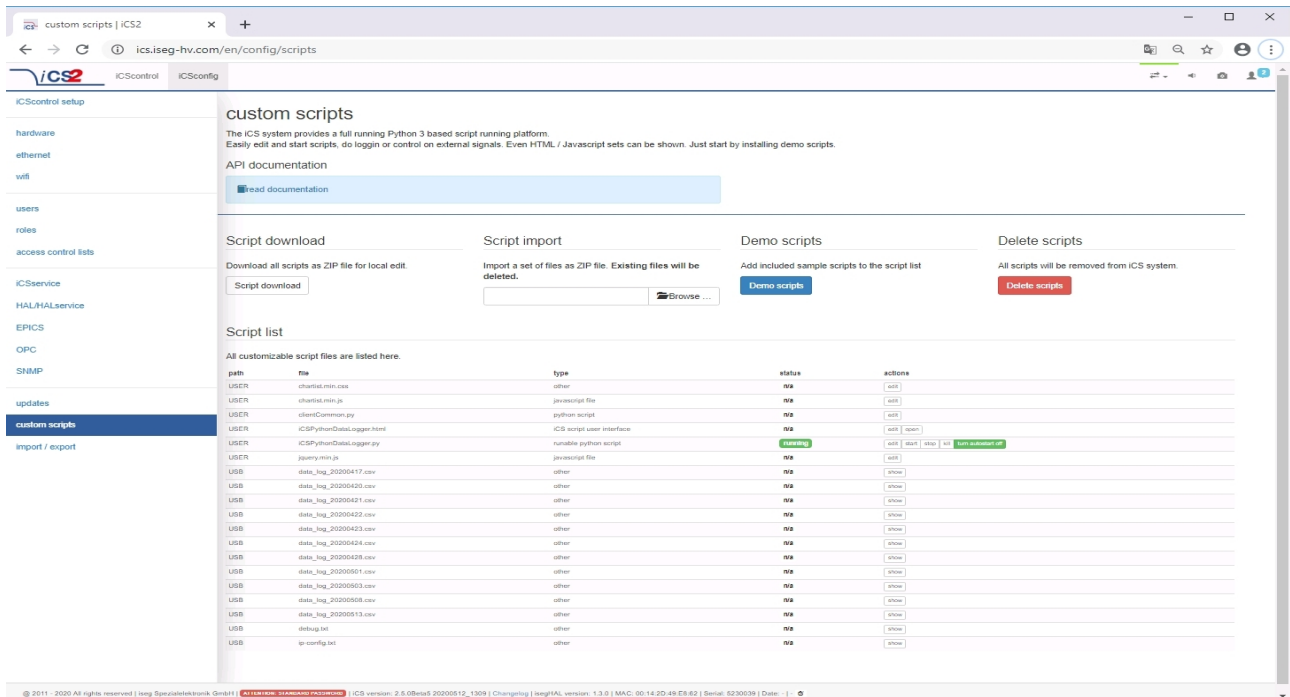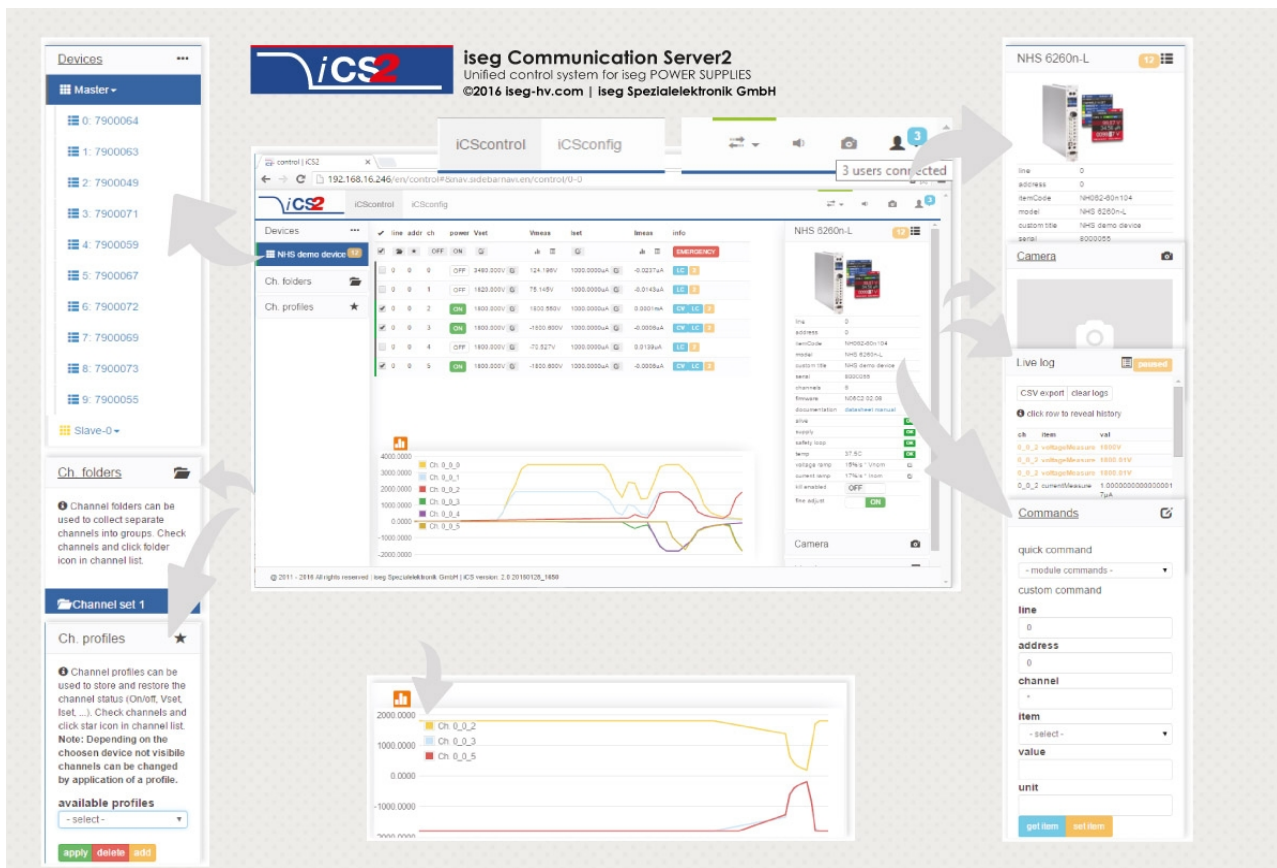

Figure 11: Custom scripts setup

Custom scripts	
Script download	Load a copy of all installed files from iseg hardware */mnt/user/data/scripts* as ZIP file to your local download directory
Script import	Import a ZIP file to iseg hardware and extract it to */mnt/user/data/scripts*. Existing files will be overwritten.
Demo scripts	Add included sample scripts to */mnt/user/data/scripts on iCS hardware*
Delete scripts	All scripts will be removed from iCS system
Edit	An editor window open the selected file to make changes or input additionally contents.
Open	Open iCSPythonDataLogger.html for graphical output of logging data.
Start	Start script execute a python3 process with the scrip
Stop	Send a stop command to the script in order to finish the execution.
Kill	Kill the script execution process
Turn on autostart on	Configure an autostart process for a script when the iCS system will be started.

Table 14: Custom script

11.6. iCScontrol software overview

The user interface of iCScontrol software is divided into three parts. The left bar contains the **Devices**, **Ch folders** channel folders and **Ch profiles** channel profiles. The center bar contains control elements, device and channel process variables with the possibility to output a graphical line plott. The right bar contains a device section, **Camera** access to an optional USB webcam, **Live log** for data logging and a field to input single **Commands** from a list.

Figure 12: iCScontrol

11.6.1. 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 to. Every device has a colored left border showing the running state.

Crate/Device running states	
gray	all channels of the module are off
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	
gray	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)
gray	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

11.6.2. 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.

11.6.3. 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.

11.6.4.　　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 V_{set} column.
- To display a graph of measured voltages of all selected channels, click on the graph-icon located in the V_{meas} column.
- To show a live log of measured voltages of all selected channels, click on the logtable icon located in the V_{meas} column.

11.6.5.　　Right bar: Device information

The device section gives information on the currently selected hardware device of the hardware 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.

11.6.6. 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.

11.6.7. 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.

11.6.8. 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 (in hardware explorer).

12. Legacy Mode

12.1. Introduction

The Legacy Mode provides a means to control an ECH5xA, ECH4xA, ECH242, or ECH244 crate directly by CAN bus, e.g. connected to a PC with a PCAN-USB adapter and running iseg or customer specific software.

This mode allows to use these modern crates as direct replacement for ECH238 and ECH224 crates.

When the Legacy Mode is activated, no further communication from the services (isegHAL, iCSservice, SNMP, EPICS) to the modules is possible. However, the crate controller itself can still be controlled by these services (e.g. monitoring or turning the backplane on or off). The Crate Status bit High Voltage On is always zero, even if high voltage is turned on

The following limitations currently apply:

- Legacy Mode is only implemented into CC24 Master controllers
- Only one crate can be connected to a CAN line
- Remote controlling and monitoring the crate controller by CAN bus is not possible
- Monitoring high voltage on and the module temperatures is no longer possible. Therefore the fans go to maximum speed
- The backplane of modern crates has non-linear addressing, so the modules have different addresses compared to ECH238. The mapping is available in the following table

Slot	Address Single Module	Address Double Module	
		A Board	B Board
0	0	0	1
1	2	4	5
2	3	6	7
3	12	8	9
4	13	10	11
5	14	14	15
6	16	16	17
7	18	20	21
8	19	22	23
9	28	24	25

12.2. Enabling or disabling Legacy Mode

- Make sure a custom ssh password has been set
- The backplane is turned off
- Log in to the CC24 Linux shell by ssh / Putty
- Run the command: cc24-set-legacy-mode 1
- The Yellow LED HV ON starts to blink periodically
- To later disable the legacy mode, run: cc24-set-legacy-mode 0

12.3. iseg Software compatibility list

- iseg CAN HV Control (Windows)
- iseg OPC Server (Windows)
- iseg CAN Flash (Windows)
- iseg CAN Config (Windows)
- isegHAL (Windows, Linux)
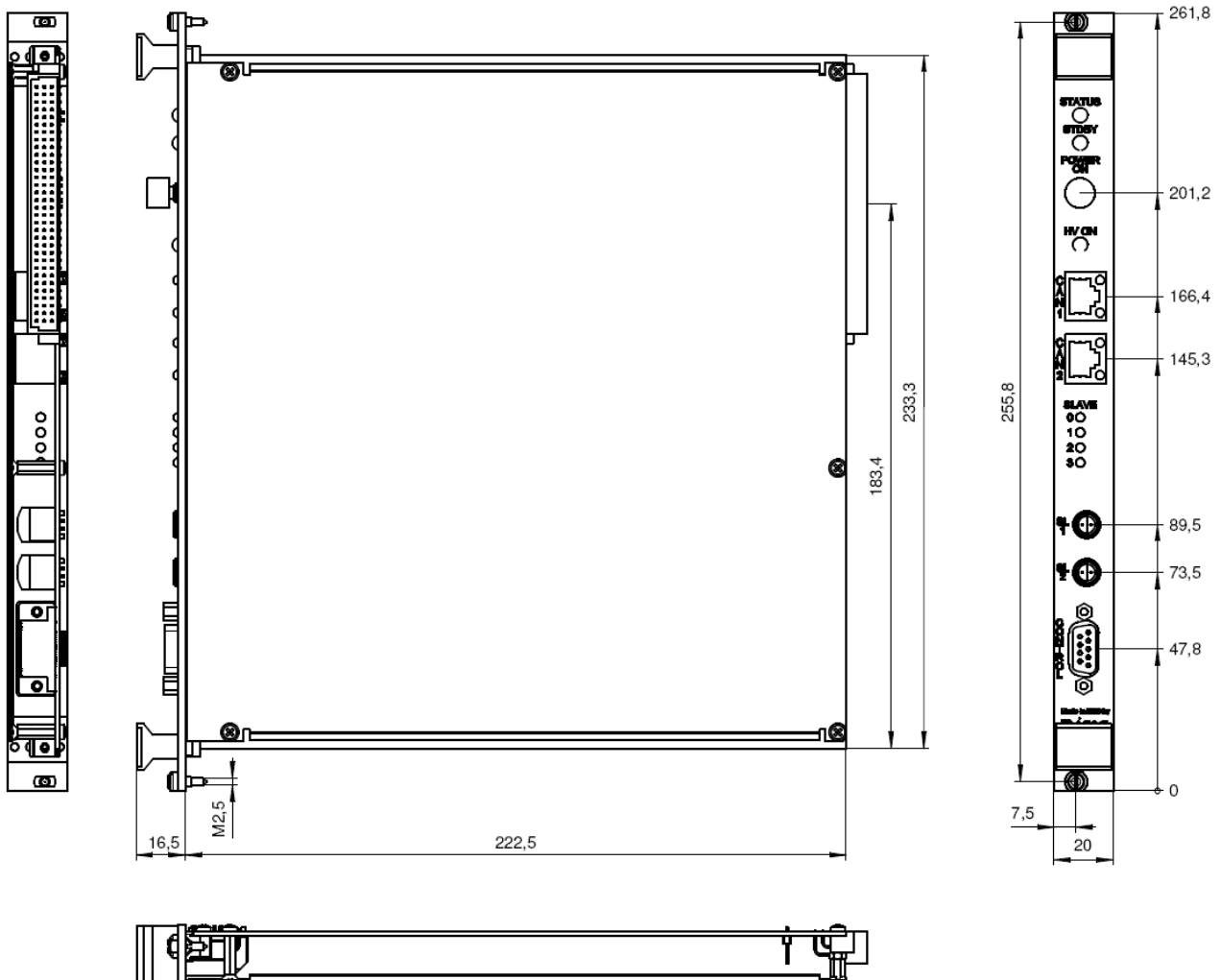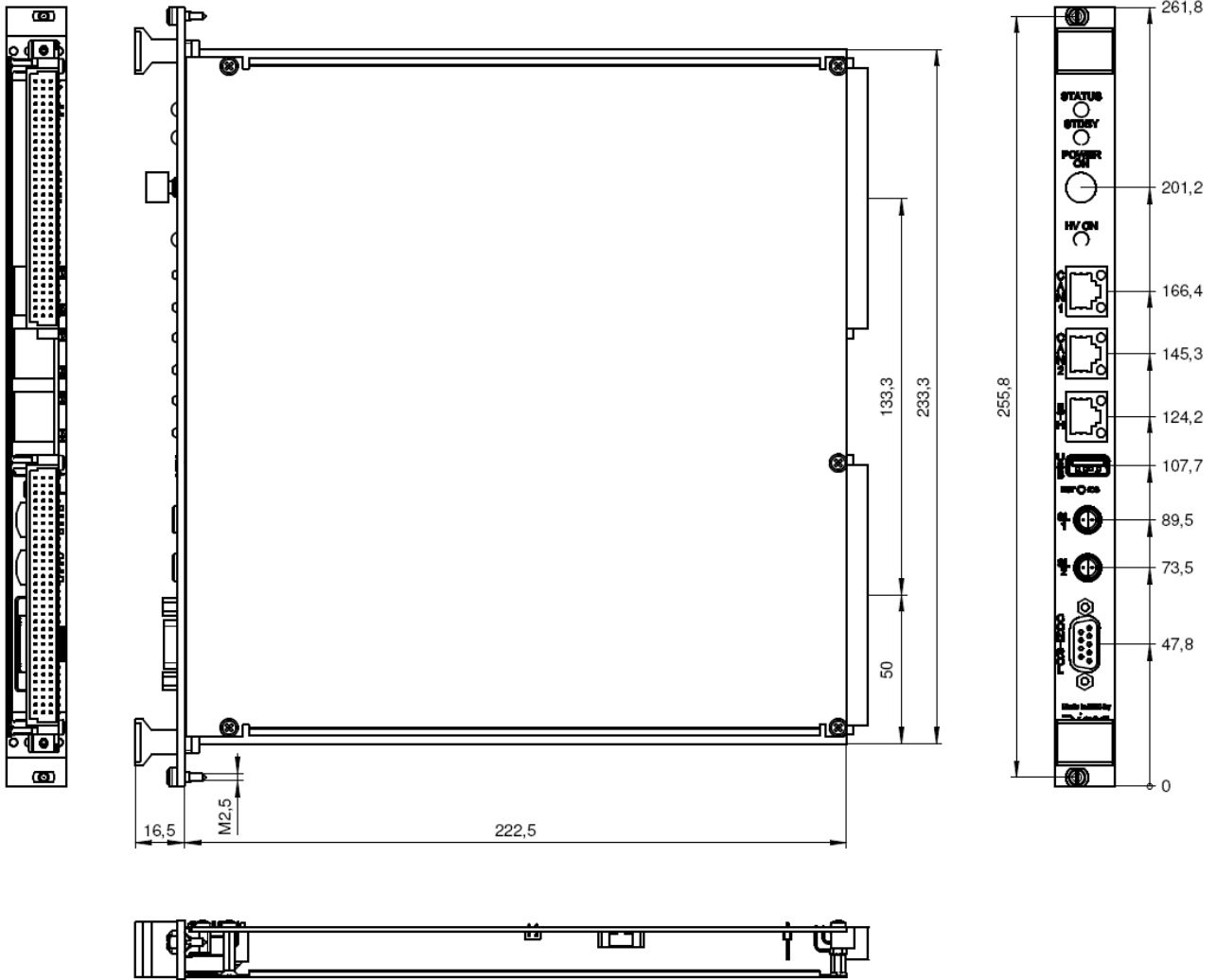- isegFlash (Linux)

13. Dimensional drawings

Figure 13: Dimensional drawing CC23, SLAVE

Figure 14: Dimensional drawing CC24, MASTER

14. Connectors and PIN assignments

SAFETY LOOP				
Name	Safety Loop socket			
Figure				

CONNECTORS PART NUMBERS (manufacturer code / iseg accessory parts item code)			
Safety Loop (LEMO)			
Socket	ERA.0S.302.CLL	Connector	FFA.0S.302.CLAC / Z592312

15. Accessories

CAUTION!
⚠ CAUTION! Only use genuine iseg parts like power cables, CAN cables and terminators for stable and safe operation.

ACCESSORY ITEM	ORDER ITEM CODE
WiFi USB adapter	Z520175
Bitrate 125 kBit/s Dongle	Z516581
USB surveillance camera	Z520158
Lemo plug 2-pole without collet chuck (SL)	Z592312

16. Appendix

For more information please use the following download links:

This document
https://iseg-hv.com/files/media/iseg_manual_CC2x_en.pdf
CAN EDCP Programmers-Guide
http://download.iseg-hv.com/documentation/SYSTEMS/Manuals/English/MMS/CAN_EDCP_Programmers-Guide.pdf
CAN EDCP Programmers-Guide
http://download.iseg-hv.com/SYSTEMS/MMS/CAN_EDCP_Programmers-Guide.pdf
isegHAL / isegHALservice
https://iseg-hv.com/download/?dir=SOFTWARE/isegHAL/isegHalDoc
ICS2 Server
https://iseg-hv.com/download/?dir=SOFTWARE/iCS/

17. Glossary

SHORTCUT	MEANING
V_{nom}	nominal output voltage
V_{out}	output voltage
V_{set}	set value of output voltage
V_{mon}	monitor voltage
V_{meas}	digital measured value of voltage
V_{p-p}	peak to peak ripple voltage
V_{in}	input / supply voltage
V_{type}	type of output voltage (AC, DC)
V_{ref}	internal reference voltage
V_{max}	limit (max.) value of output voltage
$\Delta V_{out} - [\Delta V_{in}]$	deviation of V_{out} dep. on variation of supply voltage
$\Delta V_{out} - [\Delta R_{load}]$	deviation of V_{out} dep. on variation of output load
V_{bounds}	Voltage bounds, a tolerance tube $V_{set} \pm V_{bounds}$ around V_{set}.
I_{nom}	nominal output current
I_{out}	output current
I_{set}	set value of output current
I_{mon}	monitor voltage of output current
I_{meas}	digital measured value of current
I_{trip}	current limit to shut down the output voltage
I_{in}	input / supply current
I_{max}	limit (max.) value of output current
I_{limit}	Current Limit.
I_{bounds}	Current bounds, a tolerance tube $I_{set} \pm I_{bounds}$ around I_{set}.
P_{nom}	nominal output power
P_{in}	input power
P_{in_nom}	nominal input power
T	temperature
T_{REF}	Reference temperature
ON	HV ON/OFF
/ON	HV OFF/ON
CH	channel(s)
HV	high voltage
LV	low voltage
GND	signal ground
INH	Inhibit
POL	Polarity
KILL	KillEnable

18. Warranty & Service

This device is made with high care and quality assurance methods. The factory warranty is Standard 36 months. Please contact the iseg sales department if you wish to extend the warranty.

CAUTION!	
⚠️ CAUTION!	Repair and maintenance may only be performed by trained and authorized personnel. For repair please follow the RMA instructions on our website: www.iseg-hv.com/en/support/rma

19. Disposal

INFORMATION	
INFORMATION	All high-voltage equipment and integrated components are largely made of recyclable materials. Do not dispose the device with regular residual waste. Please use the recycling and disposal facilities for electrical and electronic equipment available in your country.

20. Manufacturer contact

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