MCS - Modular Control System

User Manual

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Document Version 2.4
2018-09-21

1 Manufacturer Declarations

1.1 Declaration of Conformity

Declaration of Conformity

according to DIN EN ISO/IEC 17050-1:2010

Manufacturer: SmarAct GmbH
Manufacturer's Address: Schuette-Lanz-Strasse 9
26135 Oldenburg, Germany

CE

The manufacturer hereby declares that the product

Product name: MCS
Model Numbers: MCS-xxx
Product Options: all

complies – if installed in a compatible chassis from SmarAct – with the following European directives:

2014/35/EU Low Voltage Directive
2014/30/EU EMC Directive
2011/65/EU RoHS Directive

The applied standards certifying the conformity are listed below:

Electromagnetic Emission: EN61000-6-3:2011, EN55011:2011
Electromagnetic Immunity: EN61000-6-1:2007
Safety (Low Voltage Directive): EN61010-1:2001

July 14, 2017
Oldenburg, Germany

Axel Kortschack
Managing Director

1.2 Information, Warnings and Safety Instructions

Please read the following information, warnings and safety instructions carefully before using the product.

1.2.1 Information – Intended Use

The SmarAct MCS controllers are designed to drive the SmarAct positioners only. Please do never connect any other equipment than SmarAct positioners to the MCS controller outputs.

The MCS controllers are laboratory equipment designed according to the safety requirements for electrical equipment for measurement, control and laboratory use. The MCS controller should be operated under the following environmental conditions:

- Indoor use only
- Altitude up to 2000 m
- Temperature range from 5 °C up to 40 °C
- Maximum relative humidity 80 % up to 31 °C, decreasing linearly to 50 % relative humidity at 40 °C
- Degree of pollution: 2

Please use the provided power supply only. This is required to meet all design specifications.

1.2.2 Danger – Hazardous Voltage

The MCS controller described in this manual is capable of generating high output currents at high voltages. They may cause serious or even lethal injury if used improperly. Therefore, the equipment should only be operated by personnel, which is adequately trained and educated to prevent any improper use. Please follow general accident prevention rules.

- Do never touch any part that might be connected to an output with a high voltage.
- Do not connect products from other manufacturers to the output connectors.
- Do never use equipment that is damaged in any way.
- The MCS controller contains no user serviceable parts. Never open the case. Procedures which require opening the case must only be carried out by authorized, qualified and trained personnel.

Output connectors with dangerous signals are labelled with the following symbol:

Note: The Sensor Modules connected to these connectors have pins with high voltage, too.

1.2.3 Caution – Unpacking

Please be careful when unpacking the MCS controller. Inspect the MCS controller for signs of damage and only use equipment which shows no signs of damage. In case of any damage, contact SmarAct for replacement. Please keep all packing materials in case you would like to transport or ship the product again.

1.2.4 Caution – Installation Instructions

The MCS controller must be installed horizontally with 3cm air circulation area behind the ventilator. Insufficient air flow can cause overheating which can result in a limited functionality of the controller.

If you are using an OEM version of a MCS controller, the controller board must be installed in such a way, that free air convection can be achieved. Insufficient ventilation will cause overheating and premature failure. Therefore forced air cooling, for example in a rack with a fan, is recommended. Make sure that no part of the MCS OEM controller board other than the required connectors can be touched after final installation. Please make sure to meet all applicable requirements concerning electrical equipment in your regulatory domain.

Please avoid touching any circuit components, pins or PCB traces, as these components are ESD-sensitive devices. Touch the OEM boards on their edges only during handling and installation. Discharge any static charge on your body by touching a grounded object prior to handling the MCS controller board. If not installed, place the MCS controller boards only on conductive surfaces, such as ESD-safe transport containers (envelopes or foam).

Only apply power to the MCS OEM controller board if it is installed in the intended housing. Never apply power to a MCS OEM controller board if any other part than the required connectors can be touched.

1.2.5 Caution – Connecting Instructions

Do never use any other connecting cables than the connecting gear, that you received from SmarAct. Never use any third party adapters or cables. This can cause failure or malfunction.

The system is NOT hot-pluggable. Always make sure to power down the device before connecting or disconnecting any plugs! The only exception to this are the USB or Ethernet cables which may be removed or attached during operation.

Note: When removing the USB cable, all positioners will be stopped immediately as a safety precaution.

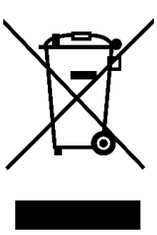
1.2.6 Caution – Disposal of Old Equipment

According to the EU directive 2012/19/EU, as of August, 13, 2012, in the member states of the European Union electrical and electronic equipment may not be disposed of with other wastes.

SmarAct respects the manufacturer's product responsibility and will take care of environmentally correct disposal of old SmarAct products free of charge.

To dispose of old SmarAct equipment, you can return it to SmarAct to the following address postage-free:

SmarAct GmbH
Schuette-Lanz-Strasse 9
26135 Oldenburg, Germany



WEEE-Reg.-Nr.: DE 47992153

1.2.7 Warranty and Liability

The General Terms and Conditions of Sale and Delivery from SmarAct GmbH always apply. These conditions are available to the operator upon signing the contract, placing an order or at http://www.smaract.com/site-notice/. No warranty or liability claims may be made in the event of injury to persons or damage to property if this has arisen from one or more of the following:

- Improper use of the unit,
- incorrect assembly, startup and operation,
- operation with defective and/or non-functional safety and protective devices,
- failure to comply with the information in the operating instructions regarding safety, transport, storage, mounting/installation, commissioning, operation and maintenance of the unit,
- incorrectly or unauthorized repairs,
- unauthorized modifications to the device,
- inadequate monitoring of parts which are subject to wear,
- damage caused by exposure to water, e.g. condensation water formation, where this is outside the responsibility of SmarAct GmbH,
- the effect of foreign bodies or mechanical damage,
- disastrous occurrences,
- force majeure.

Please refer to section 1.2.6 for the contact address for claims under warranty, repair and replacement service.

1.2.8 Life Support Policy

SmarAct GmbH does not authorize or warrant any of its products for use in life support systems, without the specific written consent of SmarAct GmbH.

Life support systems are equipment intended to support or sustain life, and whose failure to perform, when properly used in accordance with instructions provided, can be reasonably expected to result in personal injury or death.

2 Introduction

This document is a user manual for the SmarAct Modular Control System (MCS). The MCS is designed to drive piezo based stepping actuators from SmarAct GmbH.

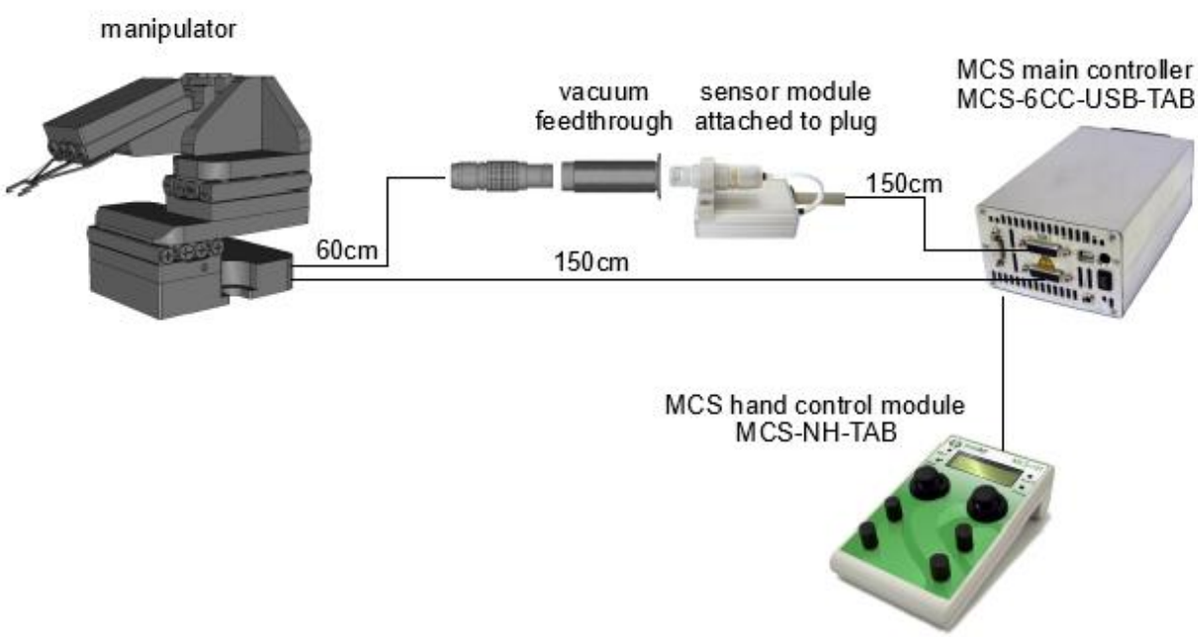
Each MCS control system consists of a main controller, an optional sensor module and an optional hand control module.

- **MCS main controller**

  The main controller has the following tasks:

  - process commands from the hand control module or from the PC
  - read in the sensor data from the integrated position sensors (via sensor module)
  - perform closed-loop position control
  - drive the positioners
- **Sensor Module:** The positioners may be equipped with integrated sensors to perform closed-loop positioning control. For this, a sensor module preprocesses the sensor data and delivers the data digitized to the main controller. The sensor module may already be integrated in the main controller when it is a single-channel controller.
- **MCS Sensor Reader (Optional):** The MCS Sensor Reader allows to read out the position of SmarAct positioners with a frequency of up to 8 kHz.
- **Hand Control Module:** The MCS offers easy and ready-to-go control by joysticks and control knobs - without the need of complex installation procedures. Please refer to the user manual of the three-channel MCS-3H-TAB hand control module or the N-channel MCS-NH-TAB hand control module.

Below please find a typical configuration with a six-channel controller, a three-channel sensor module, as well as a hand control module.



Each MCS controller is equipped with one of the following three interfaces:

- **USB Interface Module and Network Interface Module:** The MCS may be controlled by software running on a PC. Therefore, we deliver the system with a graphical control program (PrecisionToolCommander), a flexible and well documented Dynamic Link Library and a Linux library.We also provide ready-to-use LabVIEW VIs based on the DLL.
- **RS-232 Interface Module:** The MCS may be controlled by software running on a PC or controller via an RS-232 interface.

For more information on the available software please refer to the ***MCS Software Installation*** documentation that is in the main directory of the CD.

2.1 MCS Main Controller

2.1.1 Model and Connector Overview

There are many different types of controllers available. They differ by the type and number of driver boards, the integration of a hand control module as well as the computer interface and the housing. Each option has its own set of connectors.

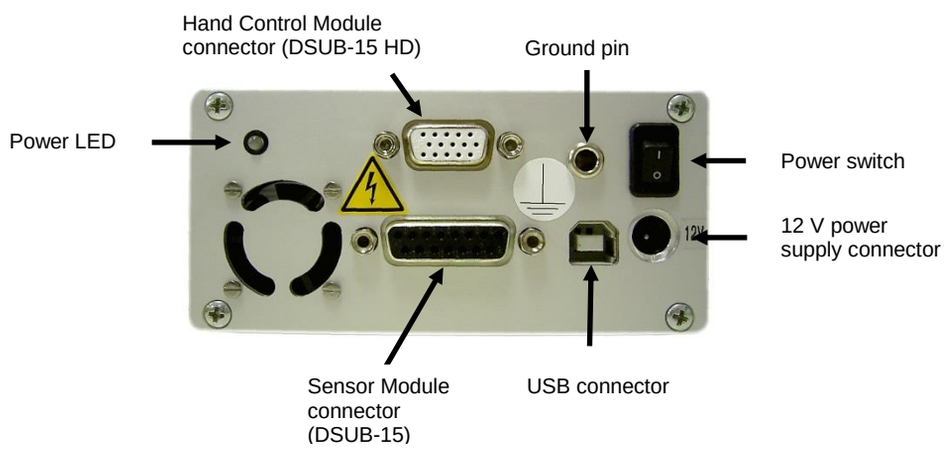
Order Code	Description	connectors
Controller Type (required)		
MCS	MCS controller	
Drivers (required, combinations possible)		
-1CS, 1CM	1 stick-slip channel, integrated sensor module	1x D-SUB-15 female
-1CCS, 1CCM	1 stick-slip channel, high current, integrated sensor module	1x D-SUB-15 female
-1C	1 stick-slip channel	1x D-SUB-15 female
-3C, -6C, -9C, …	3 / 6 / 9 / ... stick-slip channels	1x, 2x, 3, … D-SUB-15 female
-3CC, -6CC, -9CC, …	3 / 6 / 9 / ... stick-slip channels, high current	1x, 2x, 3, … D-SUB-15 female
-3F, -6F, -9F, ...	3 / 6 / 9 / … Endeffector channels	3x, 6x, 9x, … LEMO ECA.0B.306 sockets
Hand Control Module (optional)		
-3H	Internal Hand Control Module	--
Interface (optional)		
-USB	USB interface	USB socket, type B
-IUSB	internal USB interface (only at DIN connector)	---
-RS232	RS-232 interface	D-SUB-9 male
-ETH	Ethernet interface	RJ45 socket
-3/6/9...DU	direct voltage input	D-SUB-25 female
Housing (required)		
-OEM	OEM board	DIN C/3 connector
-MOD	19" rack module, 3U high	DIN C/3 connector
-TAB	Table-top housing	
Order Code	**Description**	**connectors**
MCS-xxx-xxx-TAB MCS-xxx-xxx-OEM	MCS controller in table-top housing MCS OEM controller without housing	power supply connector

Order Code	Description	connectors
MCS-xxx-xxx-TAB	MCS controller in table-top housing	ground pin: banana jack
MCS-xxx-xxx-TAB MCS-xxx-xxx-MOD without 3H	MCS controllers with housing and without integrated hand control module	hand control module interface: 1x D-SUB-15-HD female

2.1.2 Typical Connector Arrangement

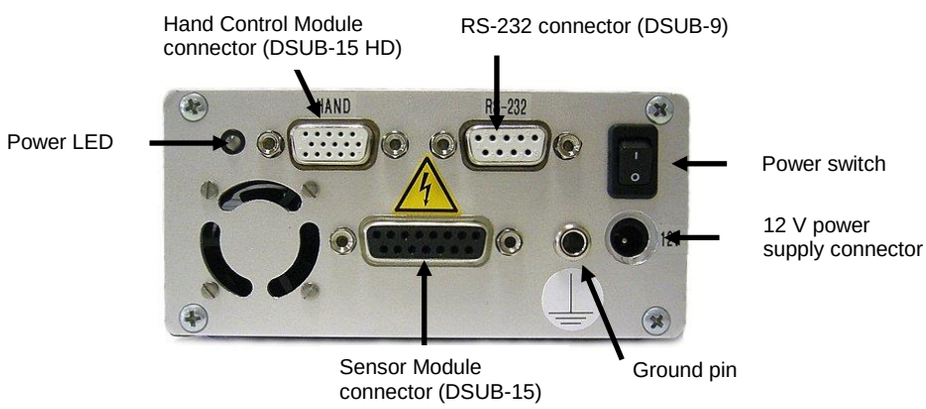
Below are some connector arrangement examples:

The single-channel and three-channel controllers in table-top housings show all main connectors. Depending on the driver board and the computer interface the arrangement is a bit different.



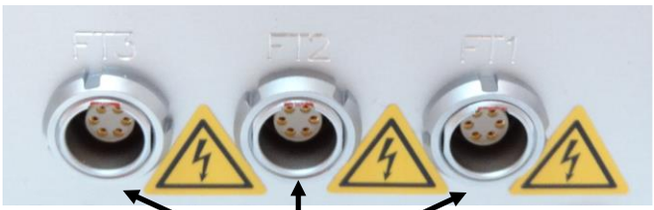
Back view

MCS-1CCS-USB-TAB and MCS-3CC-USB-TAB



Back view

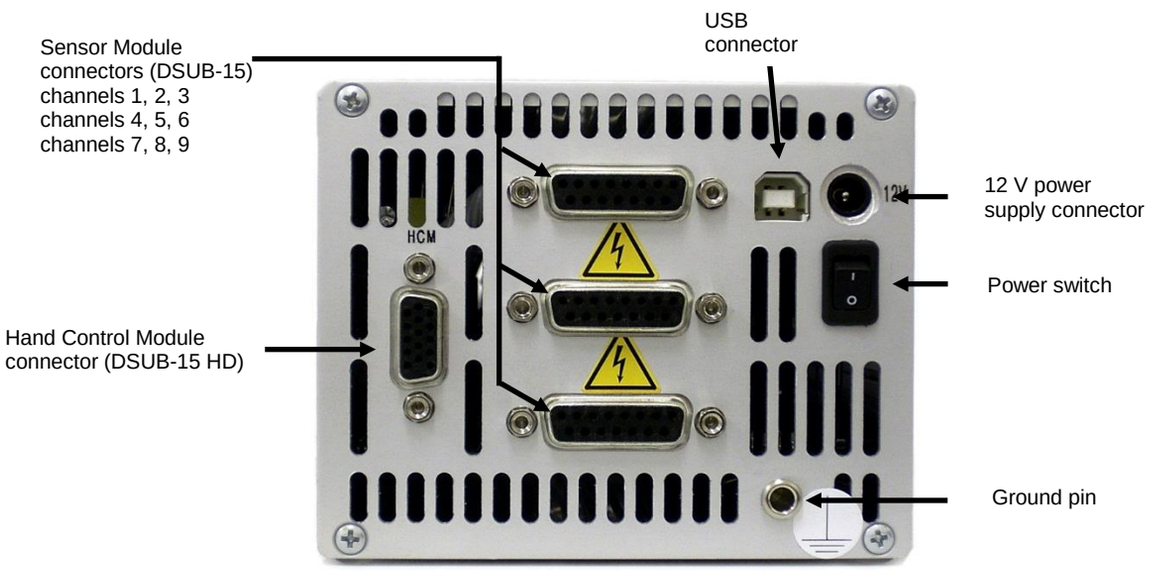
MCS-3CC-RS232-TAB



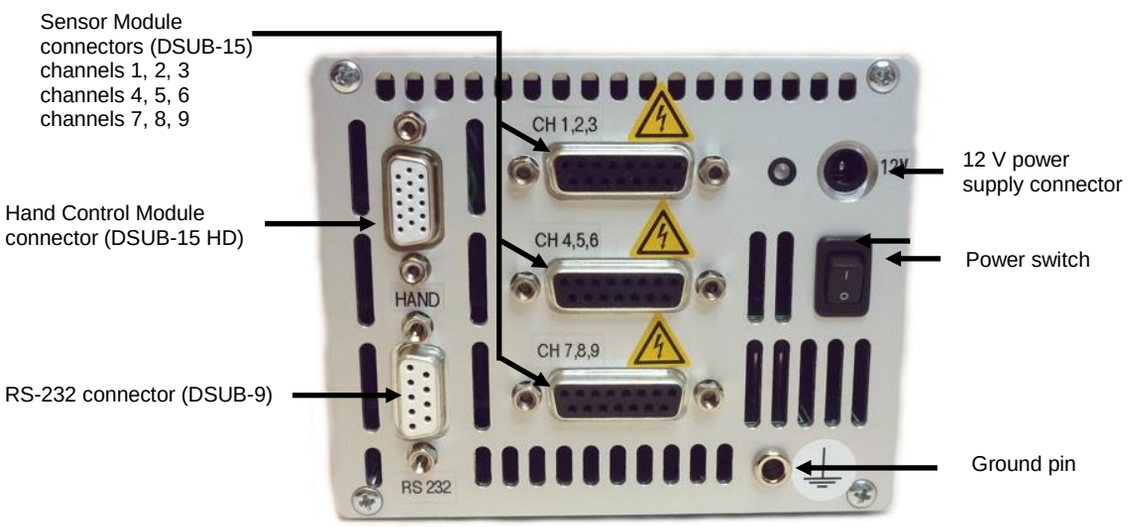
3x LEMO ECA.0B.306 sockets
for FemtoTools Endeffectors

Back view (partial)
MCS-[…]-3F-[…]-TAB

Controllers with 6, 9, 12, 15, etc. channels that are delivered in a table-top housing have the same connectors as the controllers above but are equipped with additional D-SUB-15 connectors for the sensor modules.

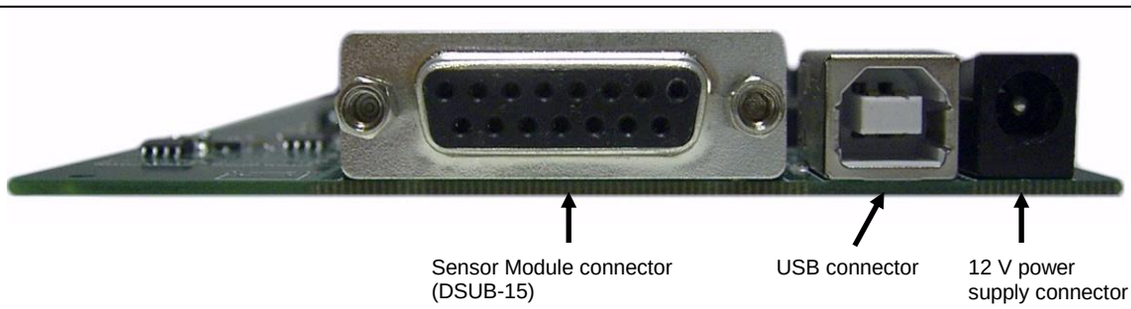


Back view
MCS-9CC-USB-TAB

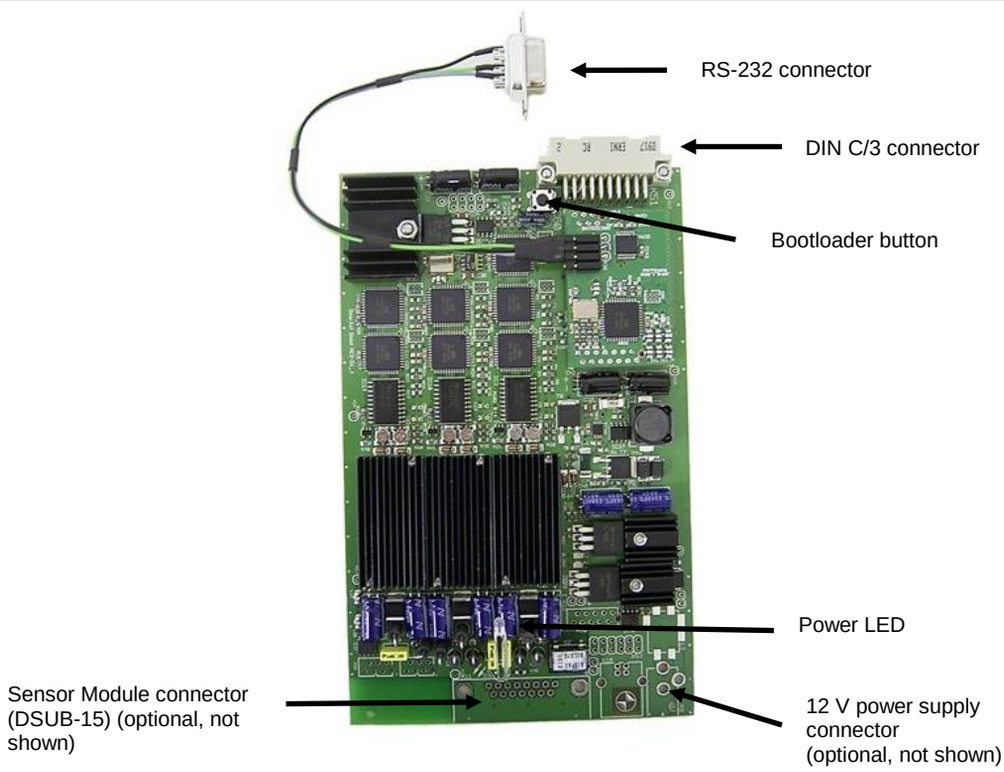


Back view
MCS-9CC-RS232-TAB

OEM controllers are delivered without housing and with a customer-specific assembly of the connectors.

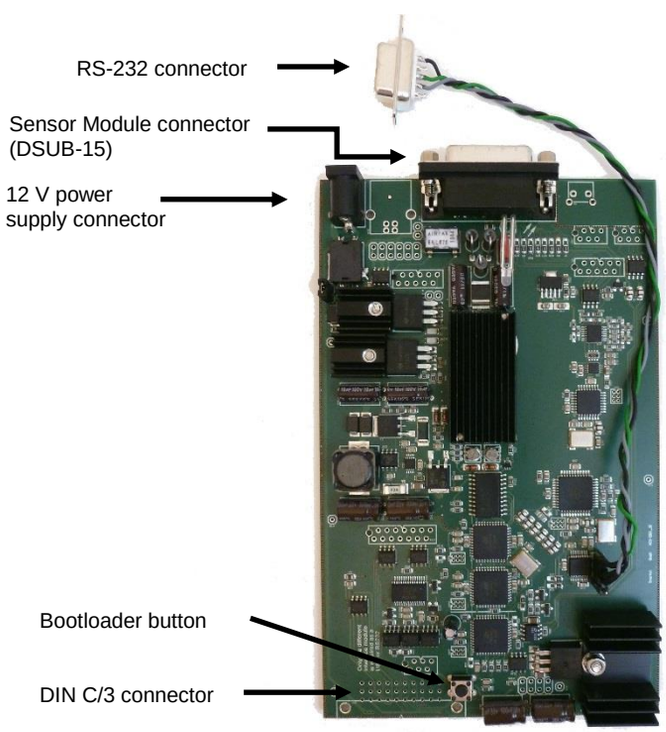


Front view
MCS-1CCS-USB-OEM and MCS-3CC-USB-OEM



Top view

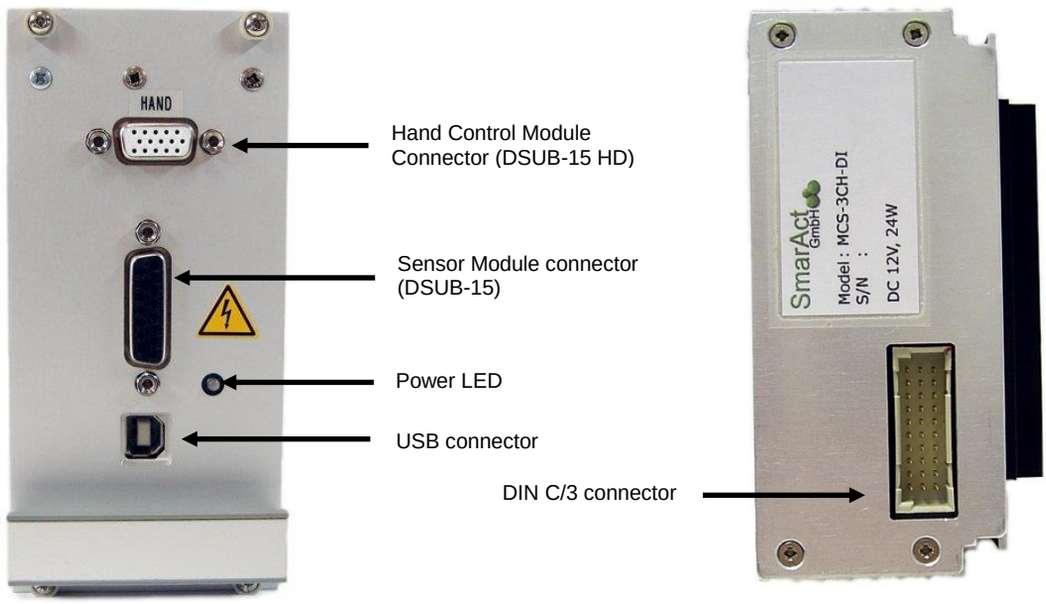
MCS-3CC-RS232-OEM



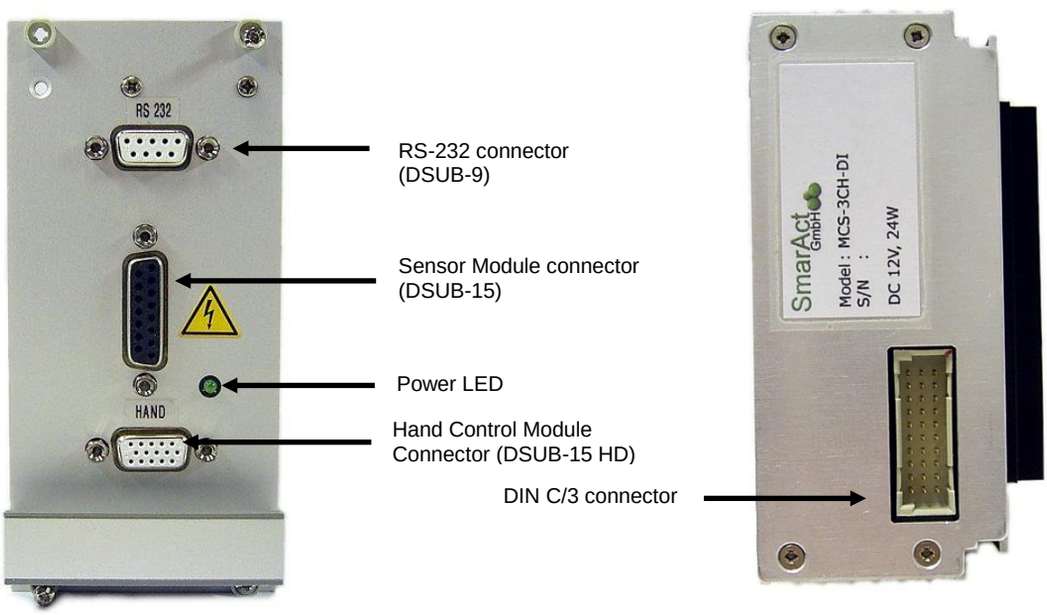
Top view

MCS-1CCS-RS232-OEM

Rack Modules are designed for the integration into a SmarAct MCS-RACK-19 chassis. They are connected to the backplane of the chassis via a DIN C/3 connector. The connectors at the front side differ depending on the driver board and the interface.



Front / Back view
MCS-3CC-USB-MOD



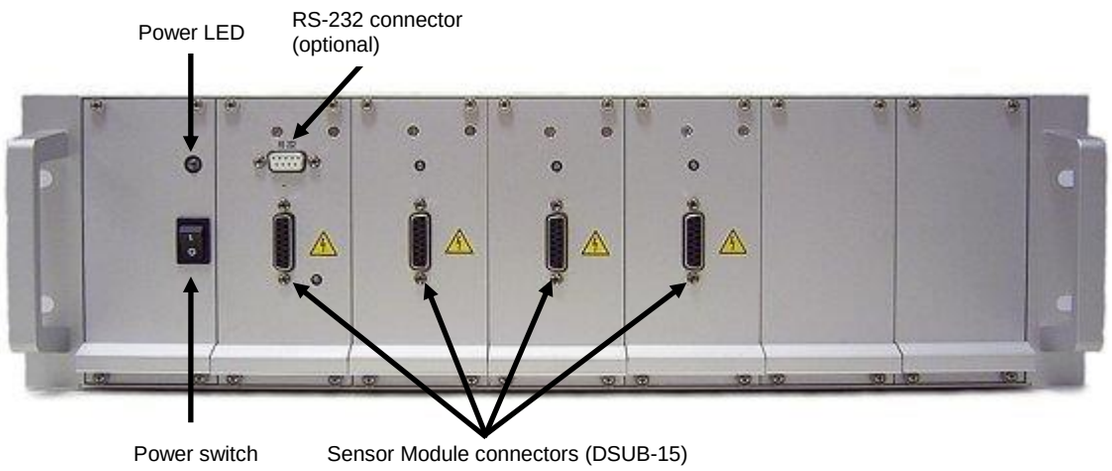
Front / Back view
MCS-3CC-RS232-MOD

2.2 SmarAct Chassis (optional)

MCS controller modules can be inserted in a 19'' chassis.

Order Code	Description
MCS-RACK-19	19 inch wide housing

The figure below shows the main components of the SmarAct MCS 19'' rack chassis equipped with four MCS controller modules.



Front view

MCS 19” rack chassis (example)

The 19'' SmarAct chassis includes a **power module** with power LED and power switch. The power module comprises of an AC adapter for 230V / 50Hz input and outputs 12V. The power LED indicates that the power supply is switched on.

One **MCS control module** is equipped with either a **USB interface**, an **RS-232 interface** or with an **Ethernet interface**. All MCS control modules are connected internally via a backplane and share the common communication interface.

2.2.1 Insertion and Removal of Modules

Please follow the following instructions for inserting or removing MCS modules to and from the MCS controller:

1. Make sure that the **power switch** is in the “**off**” position (0).
2. **Remove the line cord**.
3. **Wait one minute** to be sure that all electric circuits are discharged completely.
4. **Unscrew the four screws** at the corner of the module or front cover to be removed.
5. **Remove** the module or front cover.
6. **Insert** the desired module or front cover.
7. **Tighten the four screws** at the corner of the module or front cover.
8. **Plug in the line cord.**

2.2.2 Fuses

The chassis is equipped with a slow-blow fuse (see value at housing) in the connector for the line cord. Please follow the following instructions for exchanging the fuse:

9. Make sure that the **power switch** is in the "**off**" position (0).
10. **Remove the line cord**.
11. **Wait one minute** to be sure that all electric circuits are discharged completely.
12. **Take out the fuse carrier** and **replace the fuse**.
13. **Insert the fuse carrier** again.
14. Plug in the **line cord.**

2.2.3 Proprietary Chassis

Alternatively to using a SmarAct chassis, the MCS modules may also be inserted in a proprietary chassis.

MCS modules should never be used without a suitable chassis. The chassis must ensure free air convection and protection of the user.

For operation MCS control modules must be connected to a suitable power supply:

- Voltage: 12V DC - The power supply must be voltage-regulated.
- Current: the current / power as specified on the label must be provided. This is typically 2A or 4A for each MCS control module. For safety reasons the current must be limited.

2.3 MCS Sensor Module

For positioners with integrated sensors a sensor module is required which digitizes the sensor data. The sensor module type depends on the sensor type, the driver type as well as the connector to the positioner.

Order Code	Description	Connectors
Controller Type		
MCS	MCS controller	
Sensor Type		
-1S, -2S, -3S	Nanosensor with 1 / 2 / 3 channels	1, 2, 3 connectors
-1L, -2L, -3L	Improved Microsensor with 1 / 2 / 3 channels	1, 2, 3 connectors
-1M, -2M, -3M	Microsensor with 1 / 2 / 3 channels	1, 2, 3 connectors
Driver Type		
-EP	for stick-slip positioners	D-SUB-15 plug on cable
-ES	for stick-slip positioners	D-SUB-15 socket
Connector Type		
-SDS15	for stick-slip positioners	DSUB 15 sockets
-BLE1B10G	for stick-slip positioners	LEMO 1B board sockets, 10 pins, EPG
-BLE1B14G	for stick-slip positioners	LEMO 1B board sockets, 14 pins, EPG
-LEMO1B	for stick-slip positioners	LEMO 1B plug, 14 pins, FGJ
-LEMO2B	for stick-slip positioners	LEMO 2B plug, 32 pins, FGJ
-LEMO2K	for stick-slip positioners	LEMO 2K plug, 32 pins, FGJ
-3ADC	ADC input	Additional Coaxial SMB connectors
-3DMS	Strain gauge input	Additional Lemo 00 sockets, 4 pins, EZG. Supports half bridge strain gauge configurations. For use with 350 Ohm metal foil strain gauges.
Housing Type		
-OEM	OEM board	
-TAB	Table-top housing	
-TABM	Table-top housing with mounting holes	
---	mounted to Lemo plug	

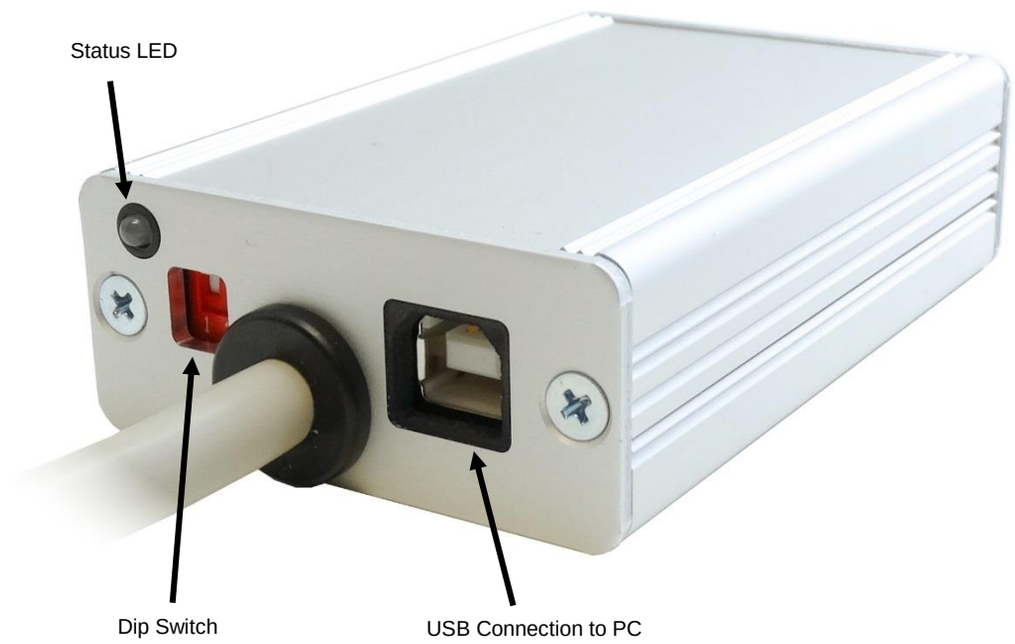
The most common sensor modules are shown below:

Order Code	Description	
MCS-3S-EP-SDS15-TAB MCS-3L-EP-SDS15-TAB MCS-3M-EP-SDS15-TAB	- 3 channels - D-SUB-15 plugs	
MCS-3S-EP- LEMO2B MCS-3S-EP- LEMO2K	- 3 channels - directly mounted to one Lemo plug (size 2B, 32 pins)	
MCS-3S-EP- LEMO1B	- 3 channels - directly mounted to three Lemo plugs (size 1B, 14 pins)	
MCS-3S-EP-BLE1B10G-TABM	- 3 channels - Lemo plugs (size 1B, 10 pins)	
MCS-3S-3ADC-EP-SDS15-TAB	- 3 channels - D-SUB 15 plugs - 3 ADC inputs	

Order Code	Description	
MCS-3S-3DMS-EP-SDS15-TAB	- 3 channels - D-SUB 15 plugs - 3 strain gauge inputs	

2.4 MCS Sensor Reader

The MCS Sensor Reader extracts the raw data stream of the sensor module and provides position data with a bandwidth up to 8 kHz. Using the USB interface of the Sensor Reader the data are accessible.



MCS-3SR-USB-TAB

The Status of the LED and the Dip Switch settings are as follows:

LED off	Sensor Reader disabled
LED blinking	Connection linking
LED on	Connection established

Dip Switch 0	On: ADC Signal / Reference Signal
Dip Switch 1	reserved

Both D-Sub 15 Connectors of the Sensor Reader have the same pinout as described in Chapter 3.2.1.

2.5 MCS Hand Control Module

An external hand control module can be connected to the main controller with the cable that is delivered with the system. Please refer to one of the separate documents for the operation description.

Order Code	Description	
MCS-3H-TAB	Hand Control Module for three channels	
MCS-NH-TAB	Hand Control Module for N channels	

2.6 Connecting Cables

Please follow the following instructions for connecting all cables to the MCS controller:

1. Make sure that the **power switch** is in the "**off**" position (0) or that the MCS control module is not supplied with power, respectively.
2. Connect the **Sensor Modules**, which may be integrated into the manipulator base plate, to the D-SUB 15 pin female connector(s) of the **MCS controller**. If the connectors are labeled, their labels must match.
3. If the cables from the positioners or Sensor Modules are delivered with feedthroughs, **install the feedthroughs** at a flange of the vacuum chamber and connect the matching connectors to both sides of the feedthrough. If the connectors are labeled, their labels must match.
4. If the Sensor Modules are delivered in a **separate housing**, connect the positioners to the D-SUB 15 pin female connectors of the Sensor Modules. If the connectors are labeled, their labels must match.
5. If the Hand Control Module is delivered in a separate housing, connect the **Hand Control Module** to the D-SUB 15 pin high-density female connector of the **MCS controller** by using the enclosed cable.
6. Connect the **power supply**, which has been delivered with the controller, to the power supply connector of the **MCS controller**.
7. If desired, connect the **ground potential of the mechanical system setup** to the ground pin of the **MCS controller**. This is recommended for applications in scanning electron

microscopes where the ground potential of the system setup should be equivalent to the ground potential of the controllers.

8. Connect the **MCS controller** with one of the following cables:
   - **RS-232** cable to the PC or controller, from which the MCS controller will receive commands.
   - **USB** cable to the PC, on which the software will be installed.
   - **Ethernet** cable to the Ethernet switch or PC, on which the software is installed.
9. Power up the controller by switching the **power switch** to the "**on**" position (1).

3 Technical Data

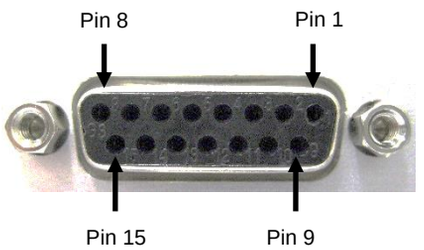
3.1 Power Supply

The MCS controller is supplied by a 12V power supply. Please use the power supply that has been shipped with the MCS controller and that matches the current and power rating which is specified on the label of the controller (typically on underside or back side).

3.2 MCS Main Controller Connectors

3.2.1 D-SUB-15 Connector at Single-Channel Controller MCS-1C...

The MCS controller provides a female DSUB15 connector to connect stick-slip positioners - either directly or via an MCS sensor module.



Connector at Controller

The pin assignment of each DSUB connector is as follows:

Pin	Signal	Function
1	HV-OUT	Positioner driving signal
2	d.n.c.	DO NOT CONNECT
3	d.n.c.	DO NOT CONNECT
4	S-GND	Ground for sensor
5	S-SIN+	U1/sin+ signal from sensor
6	S-COS+	U2/cos+ signal from sensor
7	S-REF+	U0/reference+ signal from sensor
8	d.n.c.	DO NOT CONNECT
9	HV-GND	Ground for positioner driving signal
10	S-SCL	SCL for I²C bus, sensor programming
11	S-SDA	SDA for I²C bus, sensor programming
12	S-SIN-	U1/sin- signal from sensor
13	S-COS-	U2/cos- signal from sensor
14	S-REF-	U0/reference- signal from sensor
15	S-VCC	Power supply for sensor (up to 5 V DC)

The positioner driving signals are specified as follows:

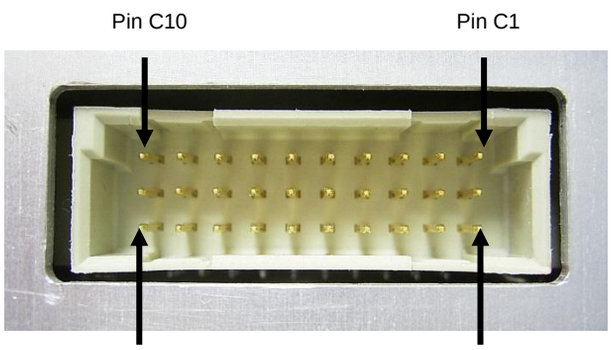
Driving Signal (HV-OUT-x)	Value	Unit
Output voltage range	0 to 100	V
Average current per channel	340	mA
Peak current per channel, < 10 µs, max. speed	20	A
Signal	sawtooth (step mode), constant (scan mode)	

3.2.2 DIN Connector at Single-Channel Stick-Slip Controller MCS-1xx-...-MOD/TAB

Most signals to and from an MCS OEM controller board or an MCS rack controller module can be transmitted with the male DIN plug type C/3. This includes

- the power supply,
- the positioner driving signals,
- the USB connection,

- an emergency stop signal.



DIN C/3 Connector

The pin assignment is as follows:

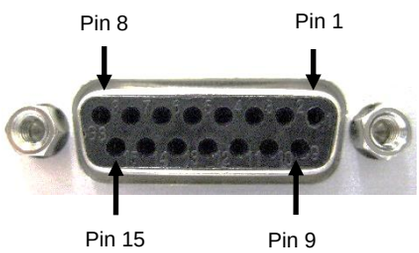
Pin	Signal	Function
A1	d.n.c.	DO NOT CONNECT
A2	d.n.c.	DO NOT CONNECT
A3	SM-D+	RS-485 D- signal from an external Sensor Module
A4	HCM-MOSI	Hand Control Module: SPI communication: master out - slave in
A5	HCM-HS2	Hand Control Module: SPI communication: hand shake
A6	HCM-HS1	Hand Control Module: SPI communication: hand shake
A7	USB-DAT-	USB data -
A8	d.n.c.	DO NOT CONNECT
A9	MCS-12V	Power supply for MCS controller, 12V DC
A10	MCS-GND	Ground for MCS controller
B1	d.n.c.	DO NOT CONNECT
B2	SM-D-	RS-485 D- signal from Sensor Module
B3	MCS-GND	Ground for MCS controller
B4	HCM-SCLK	Hand Control Module: SPI communication: serial clock
B5	HCM-5V	Power supply for Hand Control Module, 5V DC
B6	EMERG-STP	Emergency stop (stop all movements when pulled low)
B7	USB-DAT+	USB data +
B8	d.n.c.	DO NOT CONNECT
B9	MCS-12V	Power supply for MCS controller, 12V DC
B10	MCS-GND	Ground for MCS controller
C1	HV-OUT	Positioner driving signal
C2	HV-GND	Ground for positioner driving signals
C3	SM-5V	Power supply for Sensor Module, 5V DC
C4	HCM-SS	Hand Control Module: SPI communication: slave select
C5	HCM-MISO	Hand Control Module: SPI communication: master in - slave out
C6	d.n.c.	DO NOT CONNECT
C7	USB-GND	Ground for USB
C8	USB-5V	Power supply for USB, 5V DC
C9	MCS-12V	Power supply for MCS controller, 12V DC
C10	MCS-GND	Ground for MCS controller

The positioner driving signals are specified as follows:

Driving Signal (HV-OUT-x)	Value	Unit
Output voltage range	0 to 100	V
Average current per channel	340	mA
Peak current per channel, < 10 µs, max. speed	20	A
Signal	sawtooth (step mode), constant (scan mode)	

3.2.3 D-SUB-15 Connector at Three-Channel Stick-Slip Controller MCS-3C...

The MCS controller provides a female DSUB15 connector to connect stick-slip positioners - either directly or via an MCS sensor module.



Connector to Sensor Module

The pin assignment is as follows:

Pin	Signal	Function
1	HV-OUT-1	Positioner driving signal, channel 1, 4, 7, ...
2	HV-OUT-2	Positioner driving signal, channel 2, 5, 8, ...
3	HV-OUT-3	Positioner driving signal, channel 3, 6, 9, ...
4	SM-GND	Ground for Sensor Module and sensor
5	SM-D-	RS-485 D- signal from Sensor Module
6	SM-SW2	Switch for sensor, channel 2
7	d.n.c.	DO NOT CONNECT
8	d.n.c.	DO NOT CONNECT
9	HV-GND-1	Ground for positioner driving signal, channel 1, 4, 7, ...
10	HV-GND-2	Ground for positioner driving signal, channel 2, 5, 8, ...
11	HV-GND-3	Ground for positioner driving signal, channel 3, 6, 9, ...
12	SM-D+	RS-485 D+ signal from Sensor Module
13	SM-SW1	Switch for sensor, channel 1
14	SM-SW3	Switch for sensor, channel 3
15	SM-5V	Power supply for Sensor Module, 5V DC
Shielding	SM-GND	Ground for Sensor Module and sensor

The positioner driving signals are specified as follows:

Driving Signal (HV-OUT-x)	Value	Unit
Output voltage range	0 to 100	V
Average current per channel	340	mA
Peak current per channel, < 10 µs, max. speed	20	A
Signal	sawtooth (step mode), constant (scan mode)	

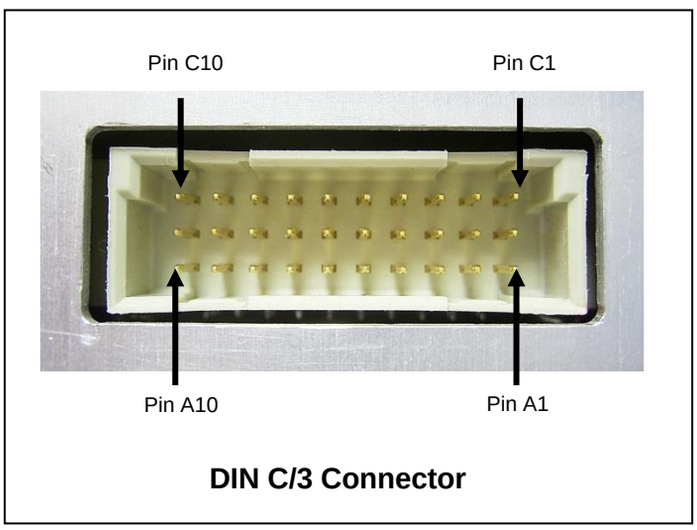
The signals from the sensor module are specified as follows:

Signal from Sensor Module (D+, D-)	Value	Unit
Voltage range	0 to 5	V
Signal	digital, RS-422 protocol	

3.2.4 DIN Connector at Three-Channel Controller MCS-3xx-...-MOD/TAB

Most signals to and from an MCS OEM controller board or an MCS rack controller module can be transmitted with the male DIN plug type C/3. This includes

- the power supply,
- the positioner driving signals,
- the USB connection,
- an emergency stop signal.



DIN C/3 Connector

The pin assignment is as follows:

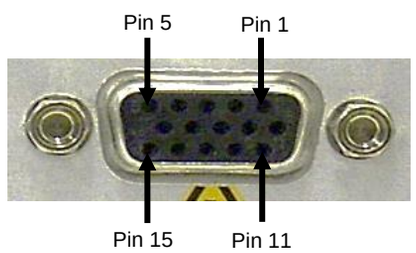
Pin	Signal	Function
A1	HV-OUT-3	Positioner driving signal, channel 3
A2	d.n.c.	DO NOT CONNECT
A3	SM-D+	RS-485 D- signal from Sensor Module
A4	HCM-MOSI	Hand Control Module: SPI communication: master out - slave in
A5	HCM-HS2	Hand Control Module: SPI communication: hand shake
A6	HCM-HS1	Hand Control Module: SPI communication: hand shake
A7	USB-DAT-	USB data -
A8	d.n.c.	DO NOT CONNECT
A9	MCS-12V	Power supply for MCS controller, 12V DC
A10	MCS-GND	Ground for MCS controller
B1	HV-OUT-2	Positioner driving signal, channel 2
B2	SM-D-	RS-485 D- signal from Sensor Module
B3	MCS-GND	Ground for MCS controller
B4	HCM-SCLK	Hand Control Module: SPI communication: serial clock
B5	HCM-5V	Power supply for Hand Control Module, 5V DC
B6	EMERG-STP	Emergency stop (stop all movements when pulled low)
B7	USB-DAT+	USB data +
B8	d.n.c.	DO NOT CONNECT
B9	MCS-12V	Power supply for MCS controller, 12V DC
B10	MCS-GND	Ground for MCS controller
C1	HV-OUT-1	Positioner driving signal, channel 1
C2	HV-GND	Ground for positioner driving signals
C3	SM-5V	Power supply for Sensor Module, 5V DC
C4	HCM-SS	Hand Control Module: SPI communication: slave select
C5	HCM-MISO	Hand Control Module: SPI communication: master in - slave out
C6	d.n.c.	DO NOT CONNECT
C7	USB-GND	Ground for USB
C8	USB-5V	Power supply for USB, 5V DC
C9	MCS-12V	Power supply for MCS controller, 12V DC
C10	MCS-GND	Ground for MCS controller

The positioner driving signals are specified as follows:

Driving Signal (HV-OUT-x)	Value	Unit
Output voltage range	0 to 100	V
Average current per channel	340	mA
Peak current per channel, < 10 µs, max. speed	20	A
Signal	sawtooth (step mode), constant (scan mode)	

3.2.5 D-SUB-15-HD Connector to Hand Control Module

For the Hand Control Module the MCS controller provides a female D-SUB 15 pin high-density female connector.



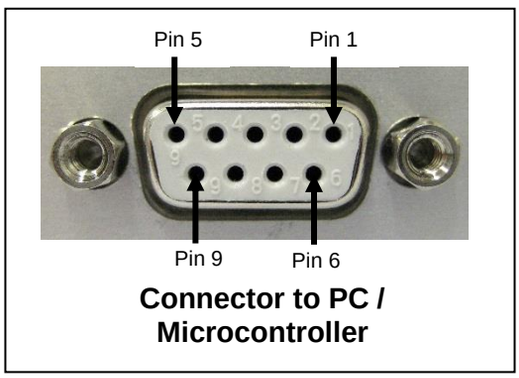
D-SUB-15-HD connector

The pin assignment is as follows:

Pin	Signal	Function
1	GND	Ground for Hand Control Module
2	SCLK	SPI communication: serial clock
3	MISO	SPI communication: master in - slave out
4	MOSI	SPI communication: master out - slave in
5	SS	SPI communication: slave select
6	HS1	SPI communication: hand shake
7	HS2	SPI communication: hand shake
8	GND	Ground for electronics
9	5V	power supply for Hand Control Module, 5V DC
10	d.n.c.	DO NOT CONNECT
11	d.n.c.	DO NOT CONNECT
12	d.n.c.	DO NOT CONNECT
13	d.n.c.	DO NOT CONNECT
14	d.n.c.	DO NOT CONNECT
15	d.n.c.	DO NOT CONNECT
Shielding	GND	Ground for Hand Control Module

3.2.6 D-SUB-9 Connector for RS-232 Communication

The D-SUB 9 pin female connector at the MCS controller provides a standard RS232 interface to a PC or microcontroller.



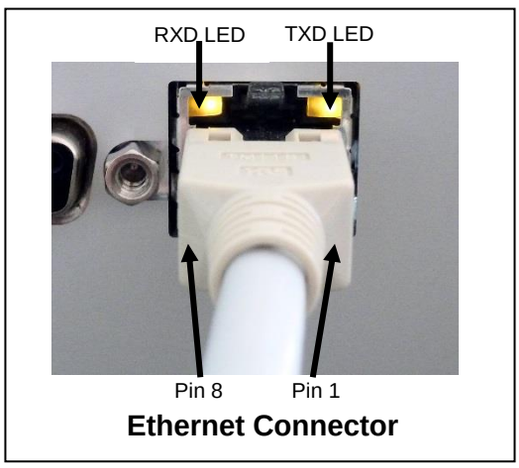
Connector to PC / Microcontroller

The pin assignment is as follows:

Pin	Signal	Function
1	d.n.c.	DO NOT CONNECT
2	RS-RX	RS-232 communication: MCS to PC
3	RS-TX	RS-232 communication: PC to MCS
4	d.n.c.	DO NOT CONNECT
5	RS-GND	RS-232 communication: ground
6	d.n.c.	DO NOT CONNECT
7	d.n.c.	DO NOT CONNECT
8	d.n.c.	DO NOT CONNECT
9	d.n.c.	DO NOT CONNECT
Shielding	MCS-GND	Ground for MCS controller

3.2.7 RJ45 8P8C Connector for Ethernet Communication

The RJ45 8P8C-modular jack connector at the MCS controller provides a standard 10BaseT / 100BaseTX Ethernet interface.



Ethernet Connector

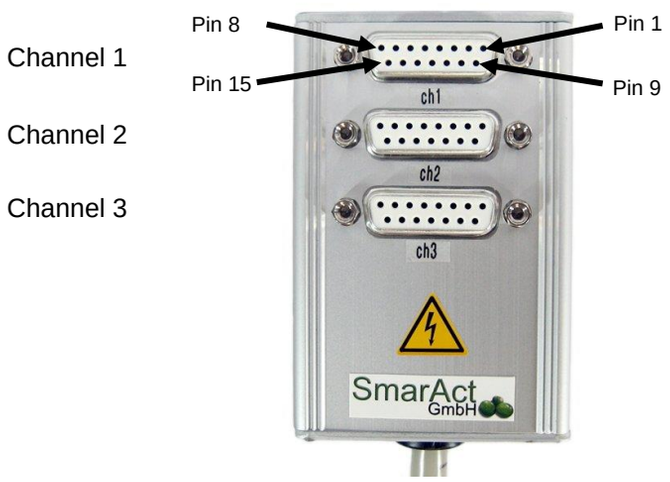
The pin assignment is as follows:

Pin	Signal	Function
1	Tx+	Signal Pair, the differential data is transmitted to the media on the Tx-/Tx+ signal pair
2	Tx-	
3	Rx+	Signal Pair, the differential data from the media is received on the Rx-/Rx+ Signal pair
4	d.n.c.	DO NOT CONNECT
5	d.n.c.	DO NOT CONNECT
6	Rx-	Signal Pair, the differential data from the media is received on the Rx-/Rx+ Signal pair
7	d.n.c.	DO NOT CONNECT
8	d.n.c.	DO NOT CONNECT
Shielding	MCS-GND	Ground for MCS controller

LED Colors	RXD LED	TXD LED
Off	Ethernet connector is not connected	Ethernet connector is not connected
Yellow	Ethernet is connected and no data received	Ethernet is connected and no data transmitted
Green	Data received	Data transmitted

3.3 MCS Sensor Module Connectors

3.3.1 D-SUB-15 Connector at Sensor Module MCS-3M-EP-SDS15-TAB



Connectors to Positioners

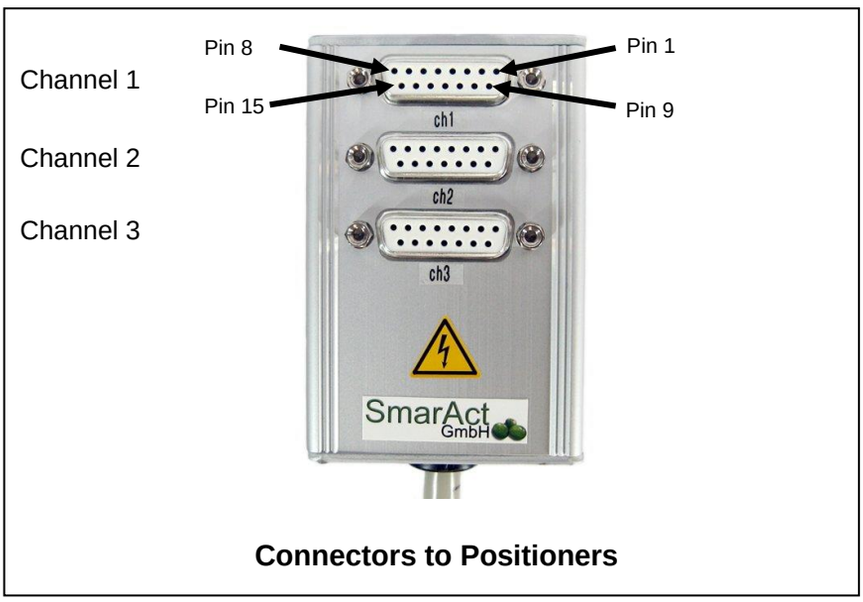
The pin assignment of each D-SUB connector is as follows:

Pin	Signal	Function
1	HV-OUT-x	Positioner driving signal, channel x
2	d.n.c.	DO NOT CONNECT
3	d.n.c.	DO NOT CONNECT
4	S-GND	Ground for sensor
5	S-SIN+	sin signal from sensor
6	S-COS+	cos signal from sensor
7	d.n.c.	DO NOT CONNECT
8	d.n.c.	DO NOT CONNECT
9	HV-GND-x	Ground for positioner driving signal, channel x
10	d.n.c.	DO NOT CONNECT
11	d.n.c.	DO NOT CONNECT
12	d.n.c.	DO NOT CONNECT
13	d.n.c.	DO NOT CONNECT
14	d.n.c.	DO NOT CONNECT
15	S-VCC	Power supply for sensor (up to 5 V DC)

The HV-OUT-x signals are identical to the HV-OUT-x signals from the MCS controller.

3.3.2 D-SUB-15 Connector at Sensor Module MCS-3S-EP-SDS15-TAB

The pin assignment of each D-SUB connector is as follows:



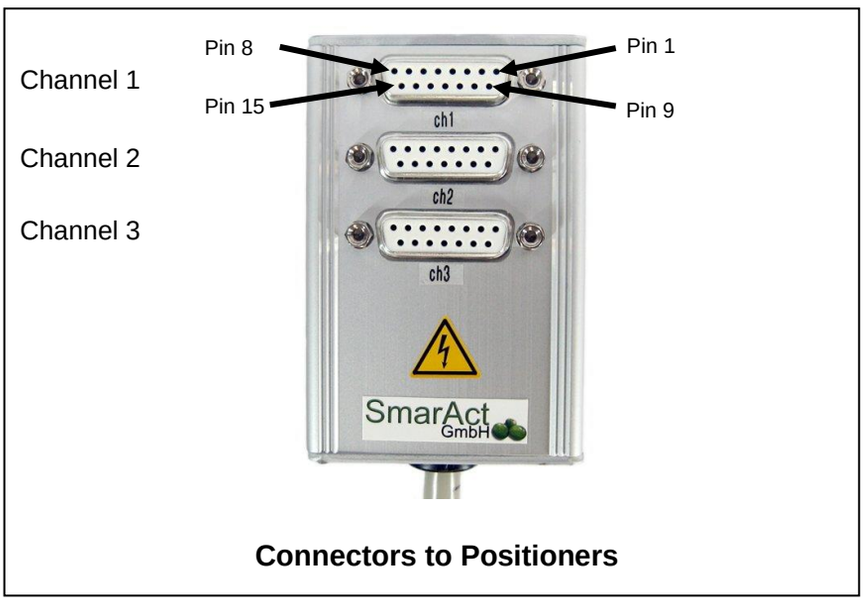
Connectors to Positioners

Pin	Signal	Function
1	HV-OUT-x	Positioner driving signal, channel x
2	d.n.c.	DO NOT CONNECT
3	d.n.c.	DO NOT CONNECT
4	S-GND	Ground for sensor
5	S-SIN+	U1/sin+ signal from sensor
6	S-COS+	U2/cos+ signal from sensor
7	S-REF+	U0/reference+ signal from sensor
8	d.n.c.	DO NOT CONNECT
9	HV-GND-x	Ground for positioner driving signal, channel x
10	S-SCL	SCL for I²C bus, sensor programming
11	S-SDA	SDA for I²C bus, sensor programming
12	S-SIN-	U1/sin- signal from sensor
13	S-COS-	U2/cos- signal from sensor
14	S-REF-	U0/reference- signal from sensor
15	S-VCC	Power supply for sensor (up to 5 V DC)

The HV-OUT-x signals are identical to the HV-OUT-x signals from the MCS controller.

3.3.3 D-SUB-15 Connector at Sensor Module MCS-3L-EP-SDS15-TAB

The pin assignment of each D-SUB connector is as follows:



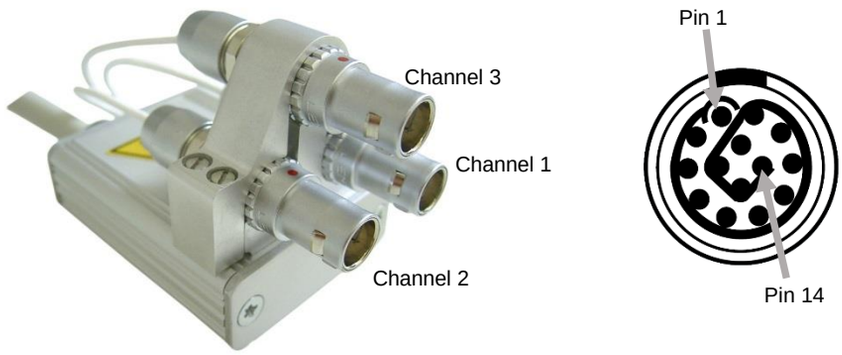
Connectors to Positioners

Pin	Signal	Function
1	HV-OUT-x	Positioner driving signal, channel x
2	d.n.c.	DO NOT CONNECT
3	d.n.c.	DO NOT CONNECT
4	S-GND	Ground for sensor
5	S-SIN+	U1/sin+ signal from sensor
6	S-COS+	U2/cos+ signal from sensor
7	S-REF	U0/reference signal from sensor
8	d.n.c.	DO NOT CONNECT
9	HV-GND-x	Ground for positioner driving signal, channel x
10	S-SCL	SCL for I²C bus, sensor programming
11	S-SDA	SDA for I²C bus, sensor programming
12	S-SIN-	U1/sin- signal from sensor
13	S-COS-	U2/cos- signal from sensor
14	d.n.c.	DO NOT CONNECT
15	S-VCC	Power supply for sensor (up to 5 V DC)

The HV-OUT-x signals are identical to the HV-OUT-x signals from the MCS controller.

3.3.4 14 Pin Lemo-1B Connector at Sensor Module MCS-3S-EP-LEMO1B

The MCS3S-EP-LEMO1B sensor module is directly attached to LEMO 1B plugs and can be directly connected to the feedthroughs.



Connector to Positioners

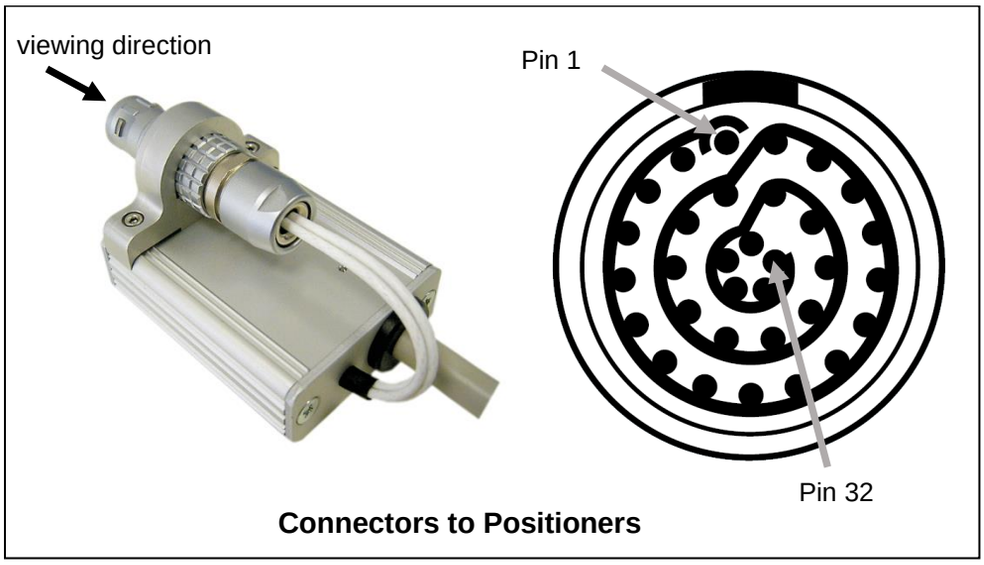
The pin assignment of each Lemo 1B connector is as follows:

Pin	Signal	Function
1	S-SDA	SDA for I²C bus, sensor programming
2	S-SCL	SCL for I²C bus, sensor programming
3	d.n.c	DO NOT CONNECT
4	d.n.c.	DO NOT CONNECT
5	S-VCC	Power supply for sensor (up to 5 V DC)
6	S-REF-	U0/reference- signal from sensor
7	S-REF+	U0/reference+ signal from sensor
8	S-COS-	U2/cos- signal from sensor
9	S-COS+	U2/cos+ signal from sensor
10	S-SIN-	U1/sin- signal from sensor
11	S-SIN+	U1/sin+ signal from sensor
12	S-GND	Ground for sensor
13	HV-GND-x	Ground for positioner driving signal, channel x
14	HV-OUT-x	Positioner driving signal, channel x

The HV-OUT-x signals are identical to the HV-OUT-x signals from the MCS controller.

3.3.5 32 Pin Lemo-2B Connector at Sensor Module MCS-3S-EP-LEMO2B / -LEMO2K

The MCS-3S-EP-LEMO2B / -LEMO2K sensor module is directly attached to a LEMO 2B plug and can be directly connected to the feedthrough.



Connectors to Positioners

The pin assignment of the LEMO 2B plug is as follows:

Pin	Signal	Function
1	S-SIN+_1	U1/sin+ signal from sensor, channel 1
2	S-SIN-_1	U1/sin- signal from sensor, channel 1
3	S-COS+_1	U2/cos+ signal from sensor, channel 1
4	S-COS-_1	U2/cos- signal from sensor, channel 1
5	S-REF+_1	U0/reference+ signal from sensor, channel 1
6	S-SIN+_2	U1/sin+ signal from sensor, channel 2
7	S-SIN-_2	U1/sin- signal from sensor, channel 2
8	S-COS+_2	U2/cos+ signal from sensor, channel 2
9	S-COS-_2	U2/cos- signal from sensor, channel 2
10	S-REF+_2	U0/reference+ signal from sensor, channel 2
11	S-REF-_2	U0/reference- signal from sensor, channel 2
12	S-SIN+_3	U1/sin+ signal from sensor, channel 3
13	S-SIN-_3	U1/sin- signal from sensor, channel 3
14	S-COS+_3	U2/cos+signal from sensor, channel 3
15	S-COS-_3	U2/cos- signal from sensor, channel 3
16	S-REF+_3	U0/reference+ signal from sensor, channel 3
17	S-REF-_3	U0/reference- signal from sensor, channel 3
18	S-VCC_1	Power supply for sensor (up to 5 V DC) channel 1
19	S-GND_1	Ground for sensor, channel 1
20	S-REF-_1	U0/reference- signal from sensor, channel 1
21	S-GND_2	Ground for sensor, channel 2
22	S-VCC_2	Power supply for sensor (up to 5 V DC) channel 2

23	d.n.c.	DO NOT CONNECT
24	d.n.c.	DO NOT CONNECT
25	S-VCC_3	Power supply for sensor (up to 5 V DC) channel 3
26	S-GND_3	Ground for sensor, channel 3
27	HV-GND_3	Ground for positioner driving signal, channel 3
28	HV-OUT_1	Positioner driving signal, channel 1
29	HV-GND_1	Ground for positioner driving signal, channel 1
30	HV-GND_2	Ground for positioner driving signal, channel 2
31	HV-OUT_2	Positioner driving signal, channel 2
32	HV-OUT_3	Positioner driving signal, channel 3

The HV-OUT-x signals are identical to the HV-OUT-x signals from the MCS controller.

3.3.6 10 Pin Lemo-1B Connector at Sensor Module MCS-3S-EP-BLE1B10G-TABM

Connectors to Positioners

The pin assignment of each D-SUB connector is as follows:

Pin	Signal	Function
1	S-VCC	Power supply for sensor (up to 5 V DC)
2	S-REF-	U0/reference- signal from sensor
3	S-REF+	U0/reference+ signal from sensor
4	S-COS-	U2/cos- signal from sensor
5	S-COS+	U2/cos+ signal from sensor
6	S-SIN-	U1/sin- signal from sensor
7	S-SIN+	U1/sin+ signal from sensor
8	S-GND	Ground for sensor
9	HV-GND-x	Ground for positioner driving signal, channel x
10	HV-OUT-x	Positioner driving signal, channel x

The HV-OUT-x signals are identical to the HV-OUT-x signals from the MCS controller.

3.3.7 SMB connector at MCS-3S-3ADC-EP-SDS15-TAB

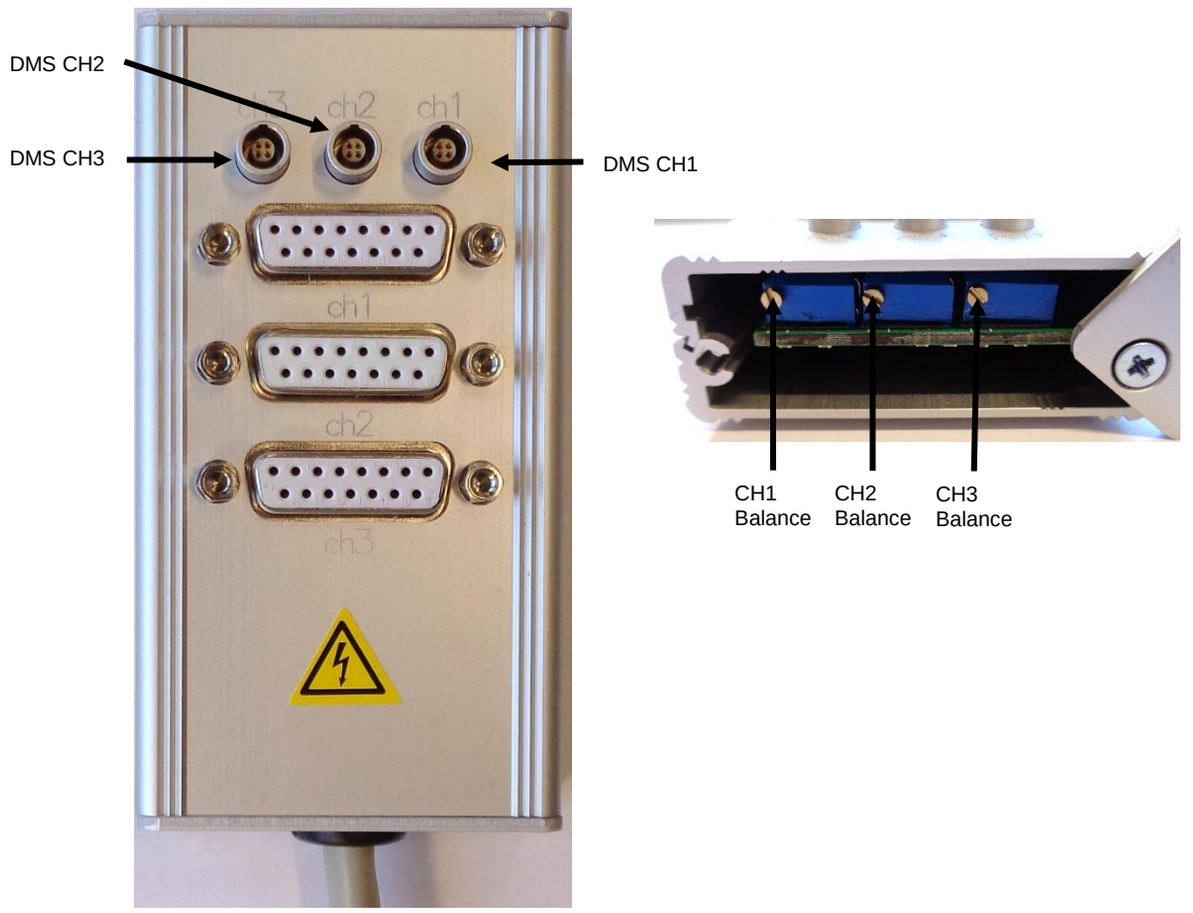
MCS-3S-3ADC-EP-SDS15-TAB

Pin Description for ADC CH1, ADC CH2, ADC CH3:

Pin	Signal	Function
Tip	ADC input	The ADC input signal 0 – 3.3V
Shield	ADC ground	Ground for ADC input

The Pin assignment of the D-SUB sockets can be found in section 3.3.2.

3.3.8 Lemo 00 connector at MCS-3S-3DMS-EP-SDS15-TAB



MCS-3S-EP-SDS15-3DMS-TAB

Pin Description for DMS CH1, DMS CH2, DMS CH3:

Pin	Signal	Function
1	Bridge supply	2,5 V power supply for half bridge
2	Bridge input	Input for half bridge signal
3	d.n.c.	DO NOT CONNECT
4	GND	GND for half bridge
Shield	Cable shield	Cable shield

The Pin assignment of the D-SUB sockets can be found in section 3.3.2.

3.4 Operating Conditions

The MCS controller must be used in normal environmental conditions:

- Indoor usage only.
- Altitude up to 2000 m
- Temperature range from 5 °C up to 40 °C
- Maximum relative humidity 80 % up to 31 °C, decreasing linearly to 50 % relative humidity at 40 °C
- Degree of pollution: 2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