

UCC BI installation guide

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UCC BI installation guide

Documentation part number: H-1000-7602-03-D



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UCC BI general information

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 ORIGINAL LANGUAGE VERSION

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Renishaw probes and associated systems are precision tools used for obtaining precise measurements and must therefore be treated with care.

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Packaging

To aid end user recycling and disposal the materials used in the different components of the packaging are stated here:

Packaging component	Material	94/62/EC code	94/62/EC number
Outer box	Cardboard - 70% recycled content	PAP	20
Packing foam	Polyurethane	PU	7
Packing foam	Cross-linked polyethylene	LDPE	4
Plastic bags	Low density polyethylene bag	LDPE	4

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UCC BI product compliance

EU declaration of conformity

Contact Renishaw plc or visit www.renishaw.com/EUCMM for the full EU declaration.

UK declaration of conformity

Contact Renishaw plc or visit www.renishaw.com/UKCMM for the full UK declaration.

EMC conformity

This equipment must be installed and used in accordance with this installation guide. This product is intended for industrial use only and should not be used in a residential area or connected to a low voltage power supply network which supplies buildings used for residential purposes.

FCC (USA only)

Information to user (47 CFR 15.105)

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

Information to user (47 CFR 15.21)

The user is cautioned that any changes or modifications not expressly approved by Renishaw plc or authorised representative could void the user's authority to operate the equipment.

Equipment label (47 CFR 15.19)

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
 2. This device must accept any interference received, including interference that may cause undesired operation.
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ICES-001 (Canada only)

This ISM device complies with Canadian ICES-001(A) / NMB-001(A).

Cet appareil ISM est conforme à la norme ICES-001(A) / NMB-001(A) du Canada.

REACH regulation

Information required by Article 33(1) of Regulation (EC) No. 1907/2006 ("REACH") relating to products containing substances of very high concern (SVHCs) is available at:

www.renishaw.com/REACH

China RoHS

Contact Renishaw plc or visit www.renishaw.com/ChinaRoHSCMM for the full China RoHS tabulation.



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UCC BI safety

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

There are no user serviceable parts inside the equipment.

The UCC BI controller is only warranted and approved for use with the provided PSU.

The UCC BI is isolated from ac power by disconnection of the IEC mains connector from the supplied PSU. If any additional means of isolation is required, it must be specified and fitted by the machine manufacturer or installer of the product. The isolator / disconnection device must be sited within easy reach of the operator and comply with IEC61010 and any applicable national wiring regulations for the country of installation.



WARNING: Earthing of the UCC BI is required. It is the responsibility of the OEM or installer to apply the earth bonding scheme provided by Renishaw in this installation guide.



WARNING: The system can accelerate quickly during operation. The user must not enter the working volume of the CMM until all power is removed. When within the working volume of the CMM, the user should wear eye protection.



WARNING: UCC BI is isolated from ac power by disconnection of the IEC mains connector from the supplied PSU.



WARNING: Switching off or isolating the UCC BI may NOT prevent unexpected machine movement. The user is advised to isolate the machine from the electricity supply, compressed air or other energy sources in accordance with the machine manufacturer's instructions before entering the danger zone or performing any maintenance operations.



CAUTION: It is strongly recommended that the CMM manufacturer or retrofitter includes in their maintenance instructions a periodic test of the emergency stop and, if fitted, the associated reset switch.

Installation requirements

Prior to installation the installer must ensure that the requirements of the machinery directive are achieved by risk assessment and use of the appropriate harmonised standards (see External Documents for reference).

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UCC BI environmental conditions

Indoor use	IP30 (BS EN60529:1992)
Altitude	Up to 2000 m
Operating temperature	+5 °C to +50 °C
Storage temperature	-25 °C to +70 °C
Relative humidity for storage	90% maximum (non-condensing) for temperatures up to +42 °C
Pollution degree	2



NOTE: If the UCC BI is to be used in an environment where a higher IP rating is required, then the UCC BI will need to be housed in a suitable enclosure.



NOTE: The electrical input requirements to the provided PSU can be found on the PSU label.

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UCC BI references and associated documents

It is recommended that the following documentation is referenced when installing the UCC BI:

Renishaw documents

- Installation guide: UCC S5 REVO-2 CMM controller (H-1000-7598)
- Installation guide: SPA3-2 (H-1000-5364)
- Installation & user's guide: MCUIlite-2, MCU5-2 and MCU W-2 (H-1000-5280)
- Installation guide: UCC T3 PLUS and UCC S3 CMM controller (H-1000-2118)
- Installation guide: UCC T3-2 (H-1000-5254)
- Installation guide: UCC T5 (H-1000-7573)
- Installation guide: SPA2-2 (H-1000-5247)
- Installation & user's guide: MCU (H-1000-5182)
- User guide: Product interconnection system (PICS) (H-1000-5000)

UCCassist-2 help	Found within UCCassist-2
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External documents

National and international standards including the following may be applicable to the finished machine or installation:

- EN 60204-1:2006/A1:2009 (Safety of machinery - Electrical equipment of machines - Part 1: General requirements)
- BS EN 61010-1:2010 (Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements)
- BS EN ISO 13849-1:2015 and BS EN ISO 13849-2:2008 (Safety of machinery. Safety-related parts of control systems)
- BS EN ISO 12100:2010 (Safety of machinery - General principles for design - Risk assessment and risk reduction)

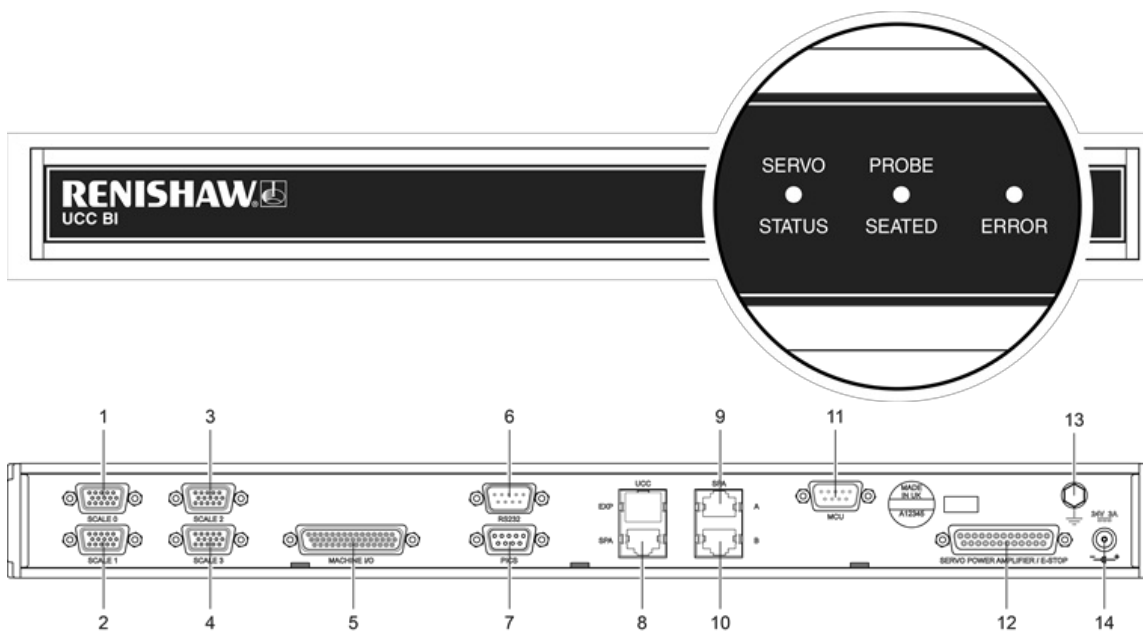
It is the responsibility of the OEM or installer to ensure that the finished installation complies with applicable national regulations for the country of installation.

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UCC BI introduction

The UCC BI is required for a CMM system which uses brushless motors. The UCC BI provides the interface between the CMM controller and the SPA2-2 (which provides power to the brushless motors).



Key	Description	Key	Description
1	Scale 0 interface (15W HDD socket)	8	UCC - SPA (RJ45 socket)
2	Scale 1 interface (15W HDD socket)	9	SPA - A (RJ45 socket)
3	Scale 2 interface (15W HDD socket)	10	SPA - B (RJ45 socket)
4	Scale 3 interface (15W HDD socket)	11	MCU (9W D plug)
5	Machine I/O (44W HDD socket)	12	Servo power amplifier / E-STOP (25W D socket)
6	RS232 (9W D plug)	13	Earth terminal
7	PICS (9W D socket)	14	UCC BI power jack (6.3 mm socket)



NOTE: Please see 'Troubleshooting' section for assistance in diagnosing system faults.



WARNING: The capability to connect the UCC BI to a third party analogue amplifier requires UCCsuite v5.3 or newer.

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Features

- Up to four CMM axes can be handled by the UCC BI
- Up to five CMM axes can be handled by a dual UCC BI system.
- The UCC BI can automatically adjust the supply voltage to encoder readheads (to compensate for long scale cables)
- Some 3rd party temperature compensation boxes can be interfaced to the UCC BI using the RS232 interface
- Probe interface (PICS)
- MCU interface
- Supporting incremental and absolute encoders
- CMM machine input / output, including:
 - Air solenoid
 - Brakes (for each axis)
 - Z-axis crash status
 - Travel limit warnings (both inner and outer limits for each axis)
 - Air status
 - 13 un-committed I/O (6 input and 7 output) that can be customised by the user

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System components

The part numbers of the UCC BI brushless kits and upgrades are:

Kit	Part number
PH10 PLUS 3-axis brushless motor controller kit	A-5518-1300
PH10 PLUS 3-axis brushless motor scanning controller kit	A-5518-1305
REVO-2 brushless motor controller kit	A-5518-1320
PH20 brushless motor controller kit	A-5518-1310

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UCC BI general wiring standards

To achieve reliable operation of the UCC BI the following should be observed:

- All signal cables **MUST** be screened and all cable screens should be connected electrically to the cable connector's metal shells.
- It is recommended that cable screens should only be connected to the functional earth (via the connector shell) of the UCC BI and SPA2-2. To avoid earth loops, cable screens should not be directly attached to the CMM's functional earth.
- The grounding must be continuous between all equipment in the installation.
- All cable connectors should be secured to the UCC BI and SPA2-2 by the connector jack screws (where present).



NOTE: The UCC BI and SPA2-2 electronic zero volt rails are connected to their respective ground planes at star points within the UCC BI, the SPA2-2, and also to the protective ground of the SPA2-2 ac supply.

Naming convention

Function	Description
signal	active high
/signal/	(active low)
reserved	Do not use. For Renishaw purposes only.
signal +	Positive differential pair
signal -	Negative differential pair

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UCC BI installation

Dimensions



i **NOTE:** Dimensions in mm (in).

Weight: 2.1 kg (4 lb 10 oz)

UCC BI can either be free standing or used in a 19 inch rack system.

! **WARNING:** Ensure the UCC BI is disconnected from the mains supply during installation.



Free-standing installation

The UCC BI unit draws air from the right hand side when viewed from the front and expels air out of the left hand side. A minimum clearance gap of 10 mm is necessary between the sides of the unit and any obstruction. The dimensions shown on the above drawing are in mm (in).

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Mounting in a 19 inch rack (optional)

i NOTE: The screws supplied with this kit are M5 × 6 mm countersink type.

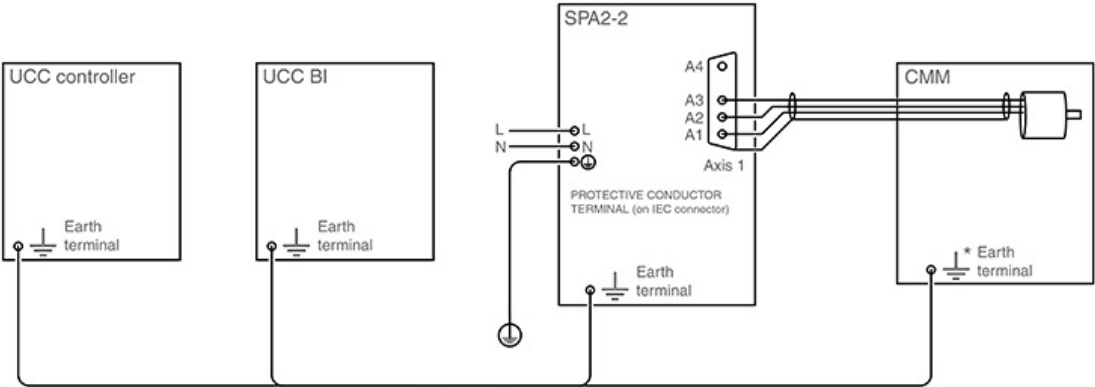


The rack mounting kit (Renishaw part number A-5518-0005) contains two brackets and four M5 × 6 mm screws. Assemble the brackets to the UCC BI as shown below:

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Earth bonding scheme

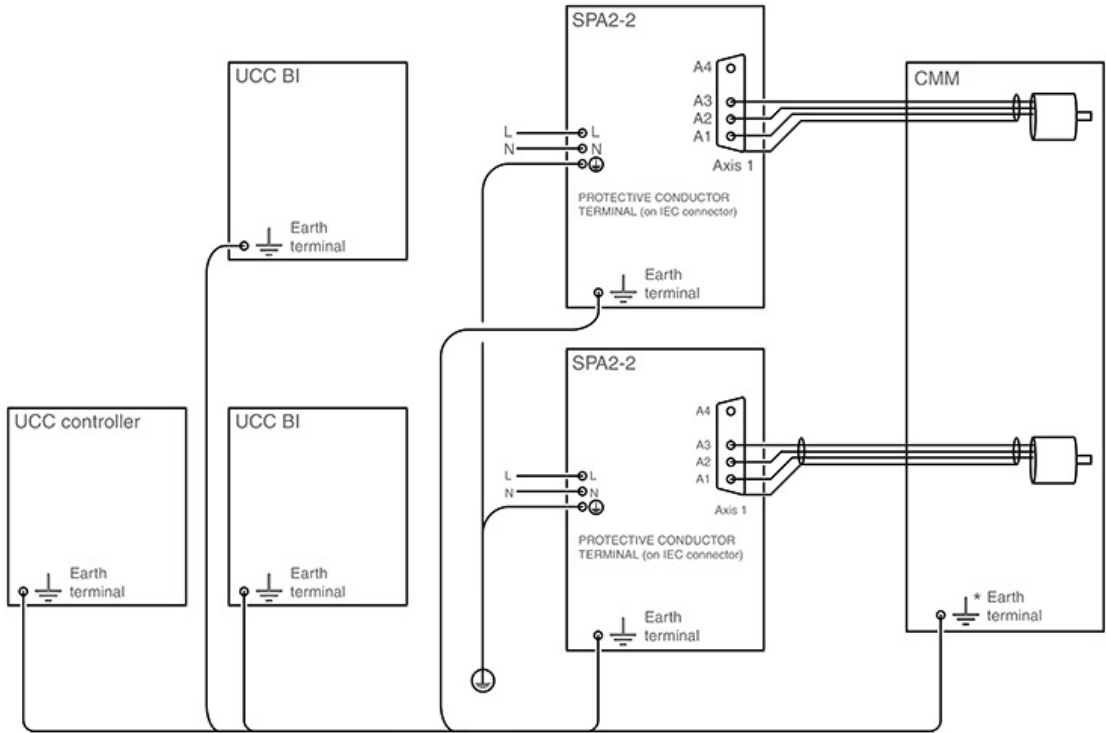



 * NOTE: May be protective earth  where appropriate for electrical safety.

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Dual



i * **NOTE:** May be protective earth  where appropriate for electrical safety.

! **CAUTION:** The capability to use the UCC BI in a dual SPA system or a system using absolute scales is not yet available, please contact CMM support for further information.

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Software installation

Support for the UCC BI is included in UCCsuite version 5.3 and onwards. All recommended updates for any of the system components must be installed for correct operation.

The UCCassist-2 application included in this software release will allow the user to correctly configure the system to use the UCC Controller to interface to the UCC BI.

The software can be obtained online at www.renishaw.com/cmmsupport or from your local Renishaw supplier. Follow the prompts to install the UCCsuite software.

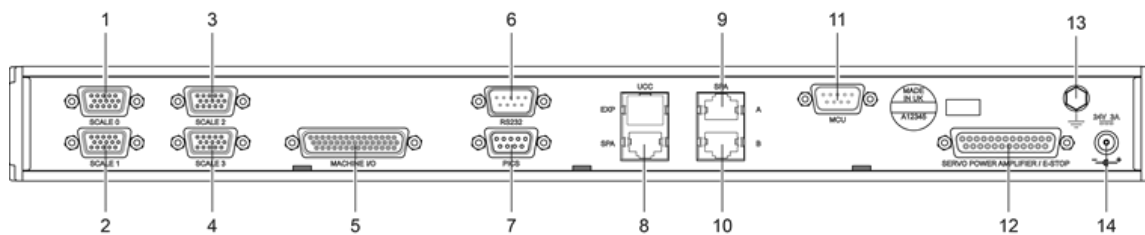
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Connectors and signals

This section describes, in turn, the use of each port on the UCC BI:

- Scale interface (15W HDD socket)
- Machine I/O (44W HDD socket)
- RS232 (9W D plug)
- PICS (9W D socket)
- UCC - SPA (RJ45 socket)
- SPA - A and B (RJ45 socket)
- MCU (9W plug)
- Servo power amplifier / E-STOP (25W D socket)
- UCC BI power (6.3 mm socket)



Key	Description	Key	Description
1	Scale 0 interface (15W HDD socket)	8	UCC - SPA (RJ45 socket)
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Scale interface (4 × 15W HDD sockets)

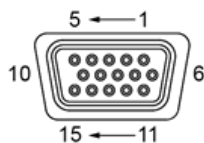
UCC BI provides a digital interface for Renishaw digital incremental and absolute encoders (BiSS protocol only), as well as dual signal interface for dual TONiC or Signum systems.

UCC BI can also be used with compatible 3rd party encoders.

Connector details

The port uses a 15-way high-density D-socket, the connections are shown in the table below.

NOTE: If the machine scale is of a different format (e.g. analogue, single-ended) then this will require an external adaptor.



Pin no.	Function	Function
	Incremental	Absolute
1	Reserved	Reserved
2	0 V scale supply	0 V scale supply
3	Error -	Reserved
4	Reference mark -	Reserved
5	B signal -	MA -
6	A signal -	SLO -
7	+V scale supply	+V scale supply
8	+V scale supply sense	+V scale supply sense
9	0 V scale supply sense	0 V scale supply sense
10	/Limit switch Q/ (active low)	Reserved
11	Error + or /limit switch P/ (active low)	Reserved
12	Reference mark +	Reserved
13	B signal +	MA +
14	A signal +	SLO +
15	0 V scale supply (inner screen)	0 V scale supply (inner screen)
Shell	Screen	Screen

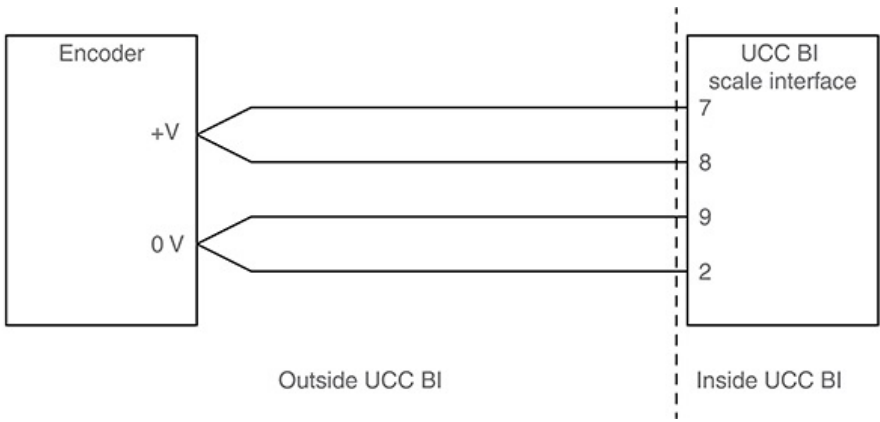
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+V scale can be adjusted independently for each scale interface port.

If the scale power sense wires are connected to the respective scale power supply signals at the readhead, the voltage will automatically adjust to maintain +5 V at the readhead.

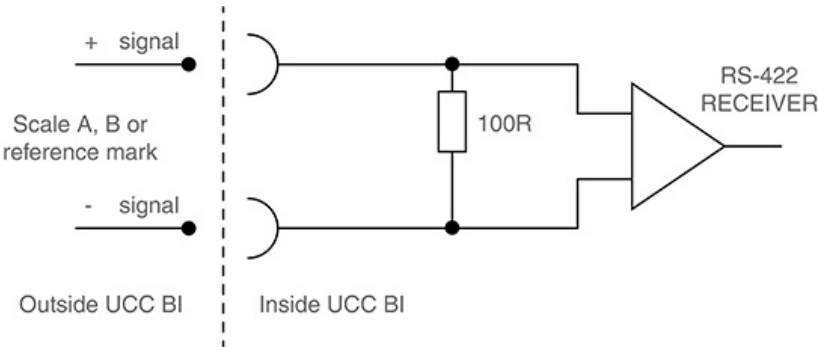
If the sense wires are open circuit then the voltage can be adjusted through the UCCsuite software. In both cases the scale supply voltage is nominally +5 V and can be adjusted to a maximum of +7 V. The sense and supply signals should be connected as close to the encoder as possible (see diagram below):



The scale inputs support a quadrature waveform with a minimum edge separation of 50 ns, which equates to 20 million counts per second with an ideal waveform.

Encoder resolution	Maximum move speed
1 μm	20 m/s
0.1 μm	2 m/s
50 nm	1 m/s
1 nm	0.02 m/s

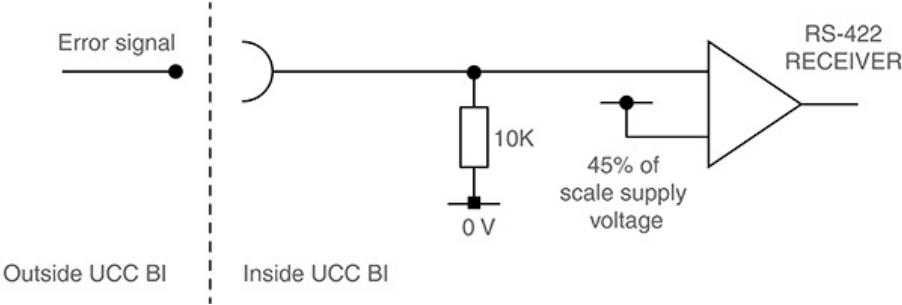
UCC BI scale signal interface circuit



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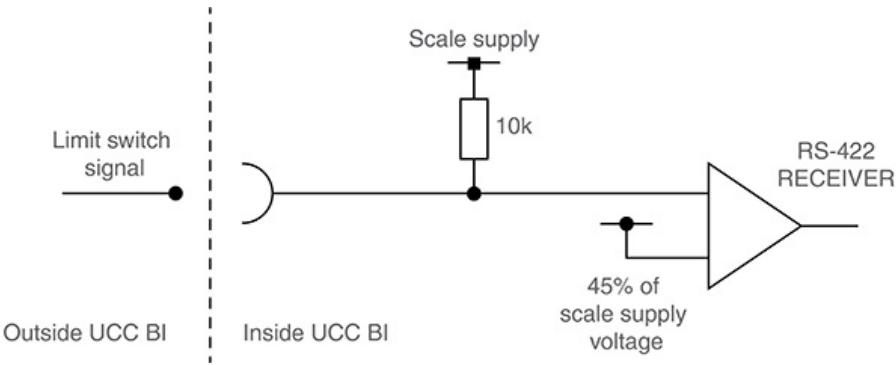
UCC BI scale error interface circuit



The UCC BI supports the error signal provided by Renishaw's digital incremental encoders. The UCC BI can also detect tri-state conditions on the A and B signals. If the error signal is not integrated into the connected encoder, then the user should connect pin 3 (Error -) to pin 7 (+V scale).

UCC BI scale limit switch interface circuit

If scale limit switch signals are integrated into the encoder being used then the following diagram should be referenced to ensure compatibility with the UCC BI.

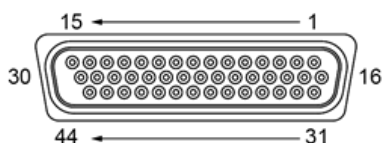


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Machine I/O (44W HDD socket)

The machine I/O socket is used to provide connections for the CMM input / output. The cable needs to be created by the CMM installer using the pin out guide below. The connector for the machine I/O socket is provided within the UCC BI kit.



Pin	Function	Pin	Function
1	External I/O +24 V	23	Crash
2	/Enable air solenoid/ (active low)	24	Reserved
3	/Axis 0 brake/ (active low)	25	Axis 0 positive outer limit
4	/Axis 1 brake/ (active low)	26	Axis 0 negative outer limit
5	/Axis 2 brake/ (active low)	27	Axis 1 positive outer limit
6	Uncommitted output 0	28	Axis 1 negative outer limit
7	Uncommitted output 1	29	Axis 2 positive outer limit
8	Uncommitted output 2	30	Axis 2 negative outer limit
9	Uncommitted output 3	31	Axis 0 positive inner limit
10	Uncommitted output 4	32	Axis 0 negative inner limit
11	Uncommitted output 5	33	Axis 1 positive inner limit
12	Uncommitted output 6	34	Axis 1 negative inner limit
13	Uncommitted input 0	35	Axis 2 positive inner limit
14	Uncommitted input 1	36	Axis 2 negative inner limit
15	Uncommitted input 2	37	0 V
16	Uncommitted input 3	38	/Axis 3 brake/ (active low)
17	Uncommitted input 4	39	Axis 3 positive outer limit
18	Uncommitted input 5	40	Axis 3 negative outer limit
19	Reserved	41	Axis 3 positive inner limit
20	De-clutch	42	Axis 3 negative inner limit
21	Reserved	43	Reserved
22	Low air pressure	44	0 V
		Shell	Screen

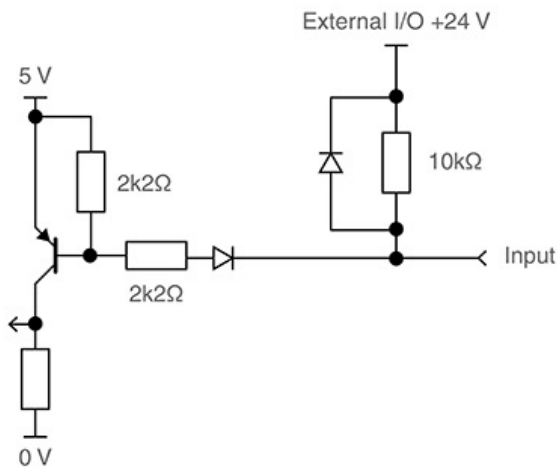
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All input pins

The inputs are activated by being pulled down to 0 V. They are not opto isolated and are pulled up to +24 V by a 10 kΩ resistor within the UCC BI. These inputs can accept signal levels in the range of +5 V to +24 V, and need to be pulled below 1.5 V to signify the active state. The input pin must be driven above 4.2 V, or left open circuit, to signify the inactive state.

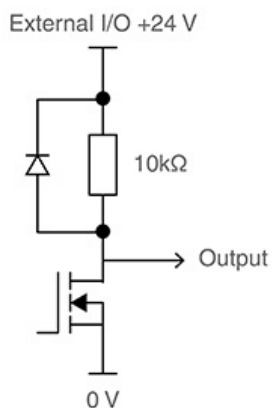
WARNING: The input pins must not be driven above 24 V.



All output pins

The open drain output with a 10 kΩ pull-up resistor to external I/O +24 V is suitable for driving devices in the range +5 V to +24 V and can sink a maximum current of 200 mA. If this output is not required, then it should be left as an open circuit.

WARNING: The output pins must not be driven above 24 V.



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External I/O +24 V

External I/O +24 Vdc supply is provided for use with the I/O equipment. Maximum current 1 A (1000 mA).



NOTE: All I/O peripherals should be supplied from the +24 V I/O pin.

Enable air solenoid

An active low signal to engage an air solenoid.

Brake

These outputs (pins 3, 4, 5 and 38) are used to disengage the CMM axis brakes if fitted. These outputs become active as soon as the CMM servos are engaged. During the commissioning process it is possible to invert the output from the brake connections from an active low signal to an active high signal.

Uncommitted inputs

These input pins can be configured to the customer's requirements via the UCCsuite software.

Uncommitted outputs

These output pins can be configured to the customer's requirements via the UCCsuite software.

De-clutch

This input on pin 20 should be pulled down to the 0 V line, to signal to the controller that the CMM's drives are mechanically connected to the moving elements of the machine (i.e. in their normal condition). The input should be open circuit, or held high, when the CMM has been temporarily 'de-clutched' from the drive motors to allow manual positioning. The servo system will not drive the motors in this condition and will resume control at the machine's current position when the signal goes low. The de-clutch signal can be inverted using the UCCsuite software.

Low air pressure

The low air pressure signal should be connected to a suitable air pressure switch. This input is monitored by the controller and when activated will remove power from the motors by causing a system fatal fault. During the commissioning process it is possible to invert this signal from an active low signal to an active high signal. If this capability is not required for integration to the system then the signal should be connected to the 0 V or inverted during commissioning.

Crash

The crash signal is used to inform the UCC BI of a collision of the mechanical structure of the machine. Typically this is a sensor that is fitted to the end of the CMM quill and if activated will remove power from the motors by causing a system fatal fault.

During the commissioning process it is possible to invert this signal from an active low signal to an active high signal. If this capability is not required for integration to the system then the signal should be connected to the 0 V or inverted during commissioning.

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Limit switches

The UCC BI controller supports both inner and outer limit switches for each of the machine axes. During the commissioning process it is possible to invert these signals from an active low signal to an active high. If this capability is not required for integration to the system then they should be connected to the 0 V or inverted during commissioning.

Inner limit switches

If an inner limit is activated the UCC system will perform a maximum movement de-acceleration in all axes to a stop and then perform a controlled axis back-off in the opposite direction, as if a trigger event occurred.

Outer limit switches

If an outer limit is activated the UCC system will immediately disengage all servo power to the machine drives. Recovery of this error is only possible by removing the outer limit switch activation (i.e. by moving the machine off of the switch).

0 V

This is the 0 V reference for all of the I/O signals.

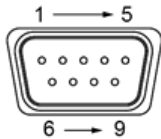
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RS232 (9W D plug)

RS232 (9-pin D-plug)

A 9-way D-type plug provides RS232 communications to third party devices, this is typically a temperature sensing interface. It provides one transmit and receive signal as well as CTS and RTS lines for handshaking. DTR indicates to the other device that this device is powered.



Pin	Function
1	Reserved
2	RX_IN
3	TX_OUT
4	DTR_OUT
5	0 V
6	Reserved
7	RTS_OUT
8	CTS_IN
9	Reserved
Shell	Screen

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PICS (9W D socket)

If the CMM system is using a UCC T5 or UCC S5 and a PICS port is required, then the PICS port on the UCC BI should be used. The PICS cable will be provided in other Renishaw kits. The PICS port on the UCC controller should be used in all other circumstances.

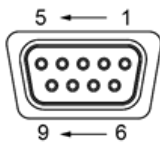
Configuration of the PICS (product interconnection system) is via UCCassist-2.

Please refer to the PICS installation guide (Renishaw part number H-1000-5000) for further information when interfaces are fitted.

i **NOTE:** TP7 and TP200 are not supported with this product.

Connector details

This socket is intended for use with XM-600, DMT and any of the range of Renishaw touch-trigger probes (except TP7 and TP200). The connector is a 9-pin D socket, pinout as follows:



Pin number	Function
1	/PICS STOP/ (active low)
2	/PICS PPOFF/ (active low) probe power off
3	0 V
4	PICS LED anode
5	Probe signal
6	Reserved
7	/PICS PDAMP/ (active low) probe damping
8	/PICS LEDOFF/ (active low) LED off
9	0 V
Shell	Screen

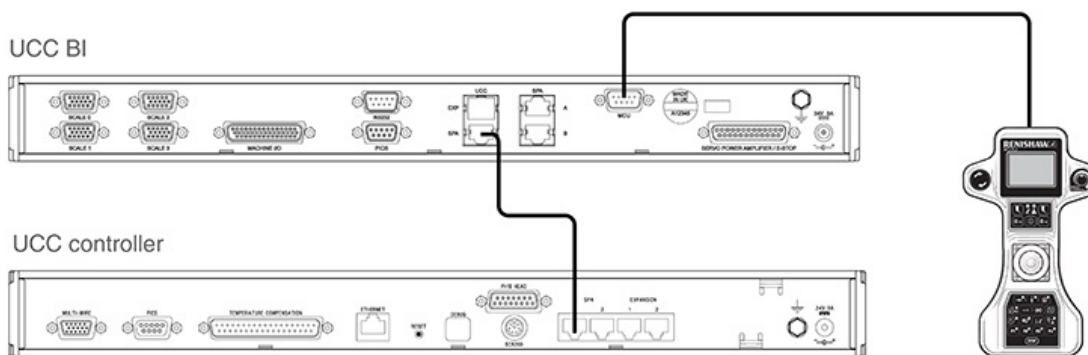
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UCC - SPA (RJ45 socket)

The UCC BI should be connected from the UCC - SPA port to the UCC controller (SPA port) using the RJ45 cable (P-CA40-0040) provided in the UCC BI kit.

If the provided RJ45 cable is not used then the cable should be no longer than 300 mm in length, CAT 5E and shielded.



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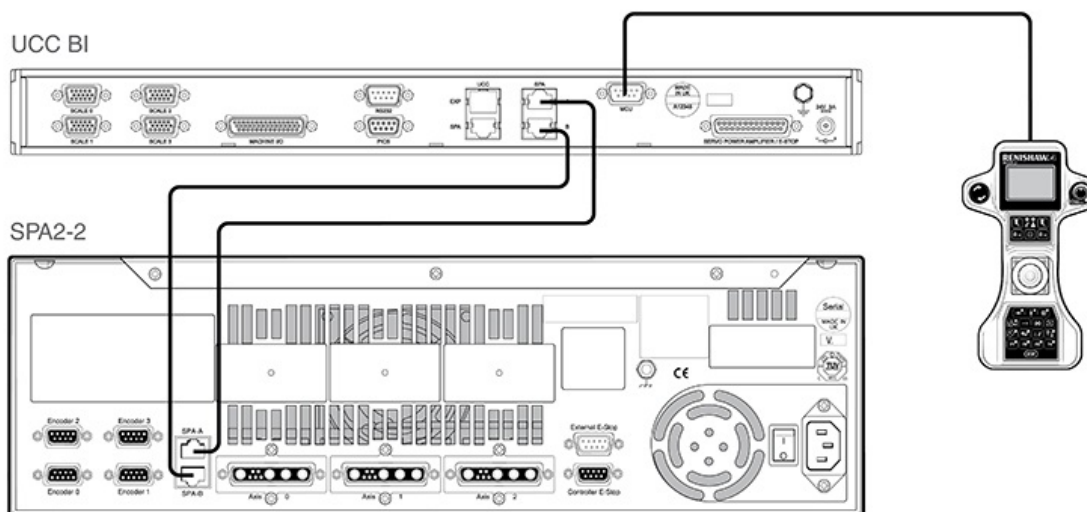
SPA - A and B (RJ45 socket)

SPA2-2 comms connection

The comms link between the UCC BI and the SPA2-2 is made using two RJ45 cables (P-CA82-0017) provided in the SPA2-2 kit.

- The UCC BI port SPA-A should be connected to the SPA2-2 port SPA-A
- The UCC BI port SPA-B should be connected to the SPA2-2 port SPA-B

If the provided RJ45 cables are not used then the cables should be no longer than 1000 mm in length, CAT 5E and shielded.



NOTE: If 4th axis is required, the SPA2-2 will require the daughtercard interface kit: A-5402-8103.

Dual UCC BI interconnection

Dual UCC BI installations require a special E-STOP cable (Renishaw part number A-5208-0011). This cable has three tails, all marked with their function, and must be installed as per the diagram below.

MCU, RS232, PICS, servo power amplifier / E-STOP cable and machine I/O should be connected to UCC BI 1.



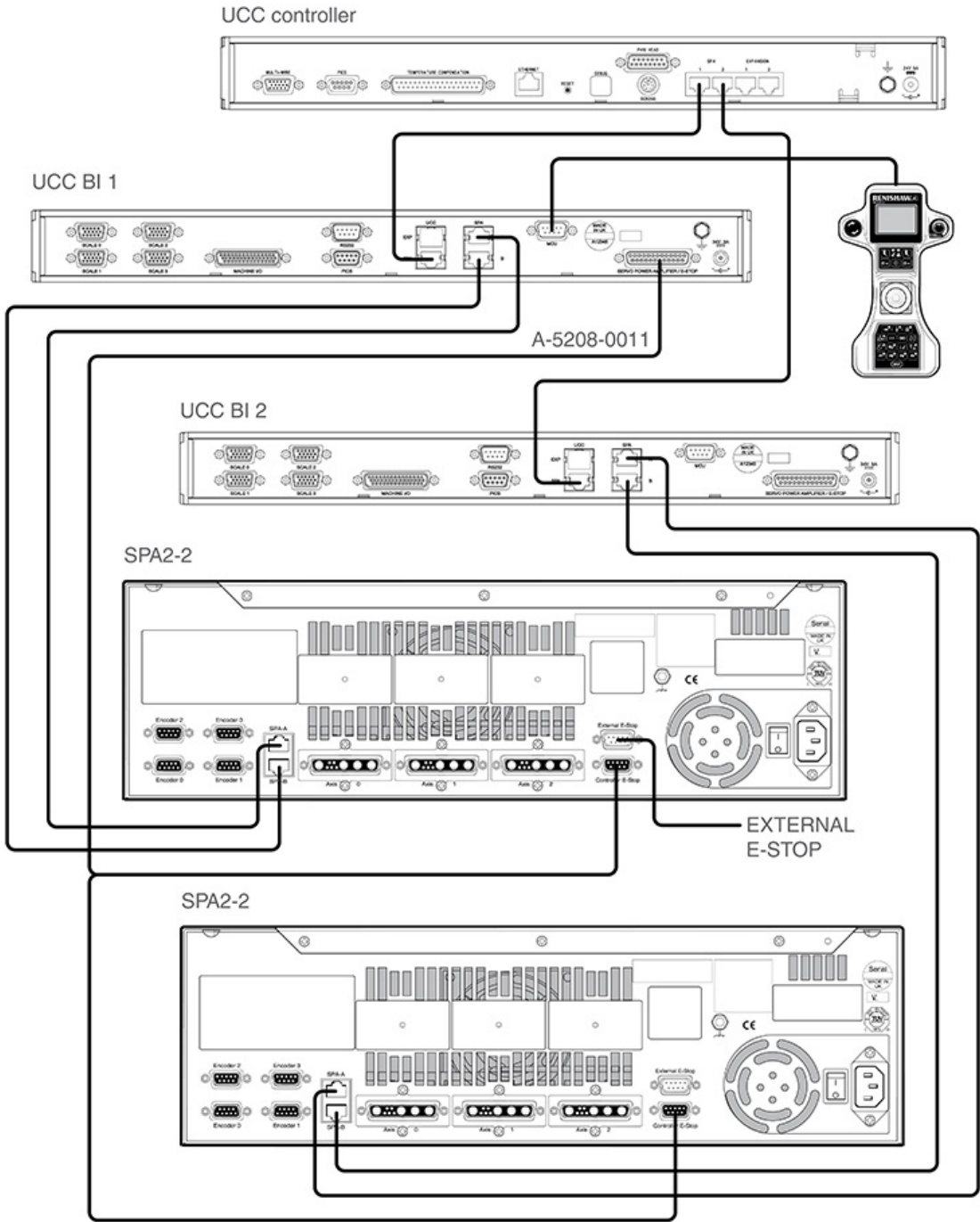
NOTE: E-STOP cable (Renishaw part number A-5208-0011) is supplied only with the SPA2-2 dual, dc, and linear kits.



CAUTION: The capability to use the UCC BI in a dual SPA system or a system using absolute scales is not yet available, please contact CMM support for further information.

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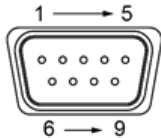
MCU (9W D plug)

It is highly recommended that the UCC BI is connected to the MCU using the cable provided with the MCU kit.

Connector details

The following is provided for information only:

This is a 9-pin 'D' plug suitable for connection to the MCU5, MCU5-2, MCU W, MCU W-2 or MCULite-2 joystick.

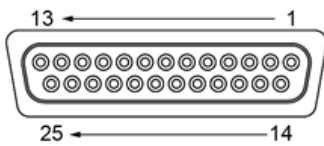


Pin no.	Function	Description
1	0 V	Ground
2	RX -	RS422 recieve
3	RX +	RS422 recieve
4	TX +	RS422 transmit
5	Reserved	Reserved
6	+15 V	MCU supply
7	TX -	RS422 transmit
8	E-STOP_B	E-STOP chain
9	E-STOP_A	E-STOP chain
Shell	Screen	Screen

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Servo power amplifier / E-STOP (25W D socket)



The connection on the UCC BI is a 25W D socket with the following connections:

Pin	Function	Pin	Function
1	Reserved	14	Reserved
2	Reserved	15	Reserved
3	Reserved	16	Reserved
4	/Enable amps/ (active low)	17	Reserved
5	Reserved	18	Reserved
6	E-STOP A	19	Reserved
7	E-STOP B	20	Reserved
8	Reserved	21	Reserved
9	Reserved	22	Reserved
10	Reserved	23	Reserved
11	Reserved	24	Reserved
12	Reserved	25	0 V
13	Reserved	Shell	Screen

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E-STOP electrical characteristics

- The UCC BI passes the E-STOP signal chain through the MCU E-STOP button and back to the attached SPA
- Maximum current is 1 A (1000 mA)
- For details see the documentation for the MCU and SPA used in the installation

Any emergency stop components fitted to this connector must have the following electrical characteristics:

Emergency stop signal chain voltage	24 V
Emergency stop signal chain current	1 A max.

All connections to this connector should be fitted by a competent technician or engineer and all wires should be sleeved.



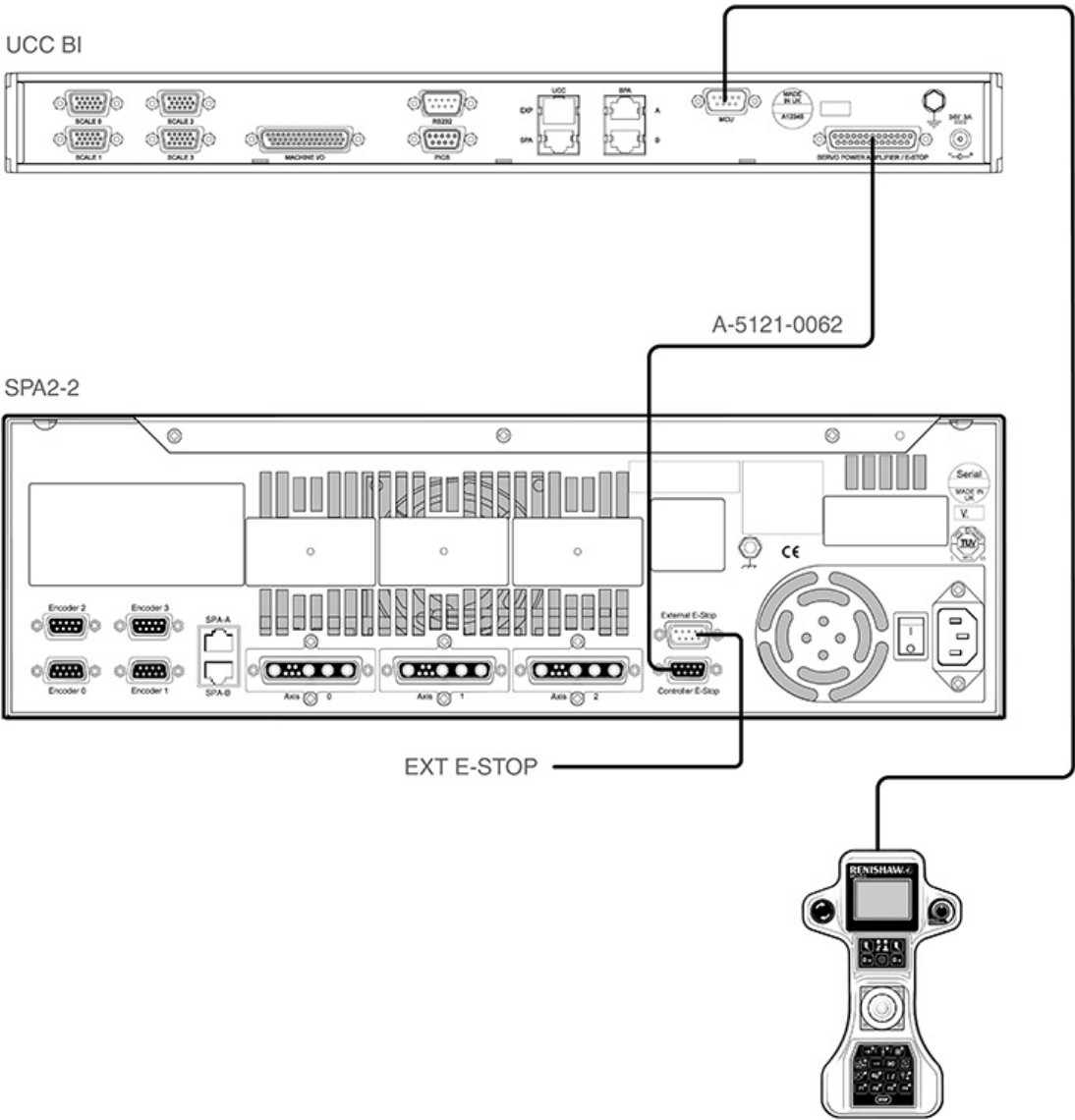
CAUTION: It is strongly recommended that the CMM manufacturer or retrofitter includes a periodic test of the emergency stop and, if fitted, the associated reset switch in their maintenance instructions.

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UCC BI to SPA2-2

NOTE: The connection between the UCC BI's servo power amplifier socket and the SPA2-2's controller E-STOP plug is made by cable A-5121-0062. This cable is provided with the SPA2-2 (A-5402-8300).



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UCC BI power (6.3 mm socket)

It is highly recommended that the UCC BI is powered by the ac - dc power supply unit (PSU) supplied with the UCC BI. The UCC BI controller is only warranted and approved for use with the provided PSU.

The PSU provides the UCC BI with 72 W at +24 Vdc. The UCC BI power socket interfaces with a dc jack plug, 2.5 mm inner diameter, 5.5 mm outer diameter, centre positive.



CAUTION: The user must comply with the PSU electrical input information provided on the PSU label.

24V 3A



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Testing and verification

The machine manufacturer or the installer of the UCC BI is responsible for ensuring that the following testing and verification is performed to the appropriate standard:

- Verification that the electrical equipment is in compliance with the technical documentation
- Continuity testing of the protective bonding circuit
- Insulation resistance tests
- Functional tests, particularly those related to safety and safeguarding



NOTE: It is strongly recommended that any measuring equipment is regularly checked for accuracy. An initial 'pass off' test should be performed prior to normal use.



NOTE: It is recommended that metrology tests should be performed after any update.



WARNING: The system installer should intentionally cause a scale fault (for example: by placing a piece of paper between the readhead and the scale) to check that a scale error is reported during initial set-up and all service and maintenance operations.

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UCC BI maintenance

 **NOTE:** There are no user serviceable parts inside this unit.

Periodically check that all mounting screws and electrical connectors are securely tightened. Electrical safety checks should include inspecting the mains cable for damage and the safety of the connections. Periodic safety checks should also include the function of the emergency stop system, including operation of all switches integrated into the system. After operating the emergency stop system, the servo amplifier system should be checked to ensure servo power can be engaged.

Remove dust from the external surfaces with a clean dry cloth as the unit is not sealed against liquid.

 **WARNING:** Maintenance should only be carried out after the machine has been isolated from the electrical supply, compressed air supply or other energy sources in accordance with the machine manufacturer's instructions.

Filter replacement

The UCC BI has a positive air flow within its enclosure for cooling purposes. This system has a replaceable filter to protect it from the ingress of dust. The machine operator should check the condition of this filter on a regular basis. It is recommended that this filter is removed and checked / replaced as necessary during the machine installer or retrofitter's regular maintenance routine.

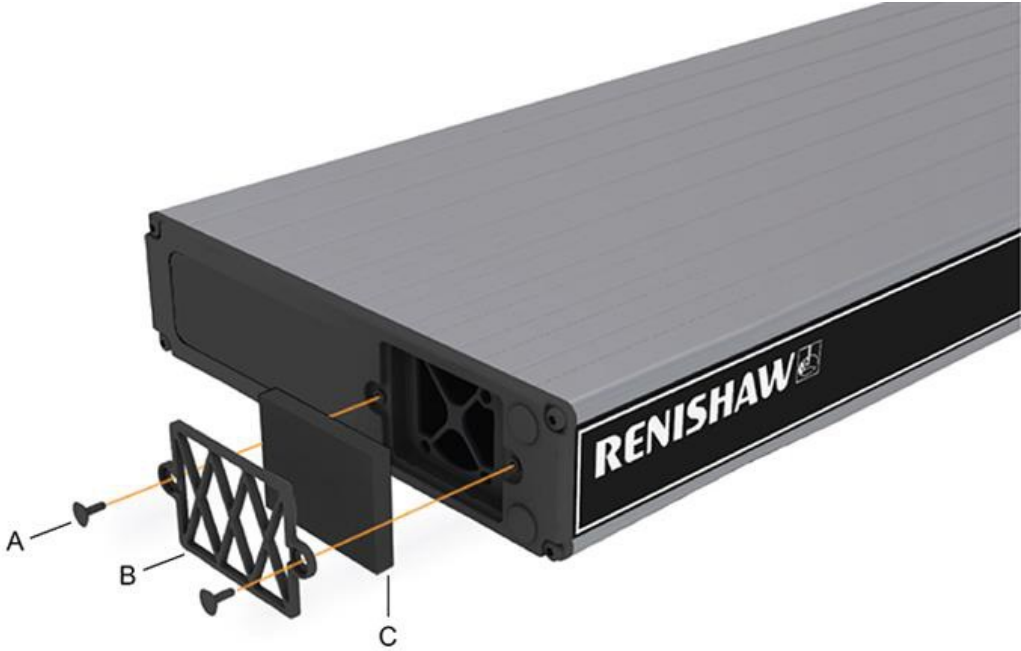
Exchanging / removing the air filter

The following procedure is recommended when exchanging / removing the air filter:

- Remove power from the controller
- Remove the 19 inch rack mounting brackets (if fitted) by removing the two fixing screws
- Pull both the filter retaining clips away from the unit, this should permit the external filter cover to be pulled away
- Remove the filter material from the filter recess (replacement part number of filter is A-5518-0011)
- Replace the filter using the reverse of the method given above

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UCC BI troubleshooting

UCC BI visual diagnostics



A visual indication of the system status is provided by three LEDs on the front panel, providing assistance in diagnosing and rectifying system faults.

LED status key

	Description
	LED on, displaying green, amber or red
	Red flash
	Green flash
	LED off

i **NOTE:** The following light patterns apply when using UCCsuite version 5.3 and onwards.

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Servo status	Probe seated	Error	Description
⊖	⊖	⊖	No power Amplifier not engaged
⊖	⊖	●	Hardware failure
⊖	●	●	Security failure (fast green flash)
⊖	●	●	Firmware error (intermittent fast green flash)
⊖	●	●	** Controller not connected, waiting for download, download failed, device not recognised by UCC firmware or device not recognised by UCC downloadable software
●	⊖ ●	⊖	Amplifier not engaged: E-STOP active or amplifier fault
●	⊖ ●	⊖	Amplifier not engaged: E-STOP not pressed and amplifier has no fault
●	⊖ ●	⊖	Amplifier engaged
● ● ●	●	⊖	Probe seated
● ● ●	⊖	⊖	Probe not seated



NOTE: ** A slow flash synchronised with the controller's slow flashing status LED indicates that the UCC BI is correctly connected to the controller and that the controller is waiting for a software download.

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Fatal faults

Situations can occur that make it inadvisable or dangerous to continue using the CMM servo system. These are known in UCCsuite as fatal faults.

A list of the main UCC BI related fatal faults is shown below and will be indicated through the user's software (for example MODUS):

- A report of the emergency stop switch being active
- Air pressure is too low
- Crash switch operated, if fitted
- A scale reading failure
- An indicated overspeed (calculated from the rate of change of position)
- Outer limit switch active
- Digital SPA engage relay fault (when a safety relay in the SPA2-2 is detected to be stuck)
- Amp fault (when the SPA2-2 has a fault, which includes emergency stop active)
- PICS_STOP



NOTE: Other faults not classed as fatal can prevent the CMM's operation.

If the fatal fault cannot be resolved, please contact your local CMM support centre who can advise.

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Appendix

Installing / commissioning brushless motors

Compatibility / restrictions

- Brushless motor functionality is only available in UCCsuite 5.3 or later
- Brushless motor functionality is only available when using a UCC BI and SPA2-2
- The software does not support Hall Effect sensors for commutation. However, it is likely that these systems can still be retrofitted by using the scale feedback or a motor encoder.
- If a brake is fitted to an axis driven by a brushless motor the brake must have a small amount of compliance to allow the commutation search procedure to move the motor by a small amount (between 0.1 mm and 0.5 mm but is dependent on motor specification).
- Rotary brushless motors must have an encoder on the motor, otherwise commutation angle errors will occur after a few revolutions. The resolution of the rotary encoder must be given exactly as the original motor specification, otherwise commutation angle errors will occur after a few revolutions.

Encoder cable connection

For linear brushless motors the axis scale cables must be connected to the UCC BI scale connector. The UCC BI will transmit the scale feedback information to the SPA2-2 over the SPA2-2 comms connection.

For rotary brushless motors the motor encoder cables must be connected to the encoder connectors on the SPA2-2.

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Commissioning sequence

Most of the commissioning sequence is the same as conventional brushed motors, the differences are detailed in the following section.

SPA configuration

The SPA configuration screen has additional parameters that are only configurable when 'motor type' is set to 'brushless'.

For linear brushless motor drives

- Select "Encoder (via UCC BI scale connector)" as the velocity feedback source
- Select "Brushless" for motor type
- Peak current / voltage follows the motor specification
- See below for an explanation of encoder count per revolution and pole pairs per revolution

For rotary brushless motor drives

- Select "Encoder (via SPA encoder connector)" as the velocity feedback source
- Select "Brushless" for motor type
- Peak current / voltage follows the motor specification
- See below for an explanation of encoder count per revolution and pole pairs per revolution



NOTE: the term 'revolution' is applicable to both rotary and linear motors as a linear motor can be envisaged as a rotary motor that has been rolled out flat.

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Encoder counts per revolution:

This is the number of encoder counts seen when the motor travels past the number of pole pairs specified by 'Pole pairs per revolution'.

Pole pairs per revolution:

This parameter sets the number of pole pairs in one revolution of the motor.

A linear brushless motor has north and south poles laid out alternately:



Number of pole pairs = total number of poles / 2.

The above image contains 5 pole pairs.

It is unlikely that the number of pole pairs in a rotary brushless motor can be determined without opening the motor casing, therefore the motor manufacturer's specification must be used.

Unless the polarity of "pole pairs per revolution" is known from an identical machine it can only be determined by using the 'configure motor, scale and feedback polarity' action in the machine commissioning sequence.

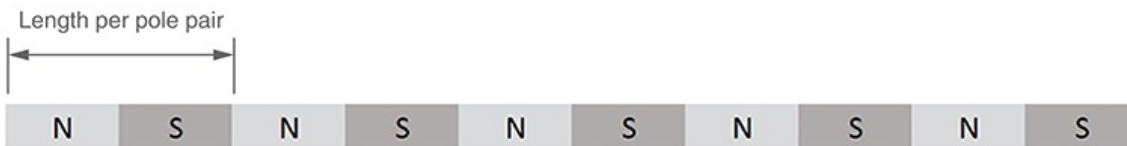
Determining "encoder counts per revolution" for rotary motors:

For rotary brushless motors the accuracy of this value is critical so it must come from the motor manufacturer's specification. It would very difficult to count the exact number of counts per revolution and any error would be compounded over multiple revolutions.

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Determining “encoder counts per revolution” for linear motors:



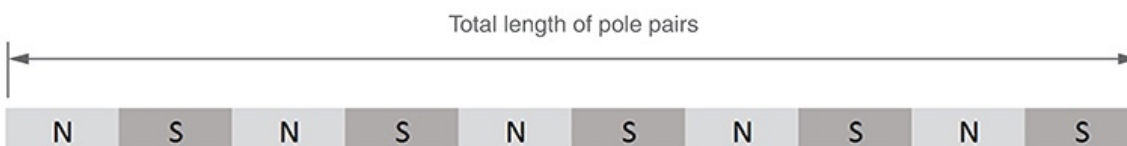
If 'length per pole pair' is known from the motor specification it can be used to calculate encoder counts per revolution.

Counts per pole pair = length per pole pair / scale resolution

Encoder counts per revolution = number of pole pairs X counts per pole pair

For example, if the manufacturer's motor specification states that the length per pole pair is 30 mm and the resolution of the scale is 0.0001 mm then counts per pole pair is $30 / 0.0001 = 300000$. As the number of pole pairs for this length is 1, encoder counts per revolution will also be 300000.

If the motor specification for “length per pole pair” cannot be obtained it can be calculated for linear motors by measuring the length of as many pole pairs as possible, ideally the distance from the start of the first pole to the end of the last pole. A small amount of measurement error (i.e. 1 mm or 2 mm) is acceptable if the measurement is over many pole pairs.



Encoder counts per revolution = total length of pole pairs / scale resolution

For example, if the total length of pole pairs is 965 mm and the resolution of the scale is 0.0001 mm then encoder counts per revolution = $965 / 0.0001 = 9650000$. This value is proportional to 'pole pairs per revolution', which in this example is 5.

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Configure motor, scale and feedback polarity (battery box test)

The battery box test for a brushed motor finds:

- Motor polarity
- Scale polarity
- Scale increment
- Motor feedback polarity

The battery box test for brushless motor will also find:

- The polarity of “pole pairs per revolution”. The polarity of “pole pairs per revolution” is effectively the polarity of the commutation angle, if the polarity is incorrect the commutation angle will be updated incorrectly as the axis moves - this means that the axis will not move smoothly or might not move at all.



NOTE: The battery box test will release the axis brakes. Typically, linear motors have low static friction, so when the brakes are released the axes could move if the CMM is not level or if some force is being exerted by the energy chains. So that this movement is not confused with battery box motion it is recommended to manually release the brakes and let the axes settle before re-applying the brakes and starting the battery box test.

Running the battery box test is very similar to commissioning conventional brushed motor machines. The difference is that the dialog box that is displayed to the user after each run completes now has a checkbox called “Flip poles per rev polarity each time the test is run”. If this box is checked, the polarity of “number of pole pairs” will be inverted on the next run.

Battery Box

Please specify whether the machine moved in a positive or negative direction (the coordinate system should be right handed). Please enter the estimated distance travelled.

Moved positive greater than 30 mm

Moved negative greater than 30 mm

Increase amplitude and retest

Cancel

Flip poles per rev polarity each time test is run

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The basic technique is to look for smooth machine motion. Even if the distance moved is small (it needs to be longer than the length of one pole pair), smooth machine motion means the sign of the commutation angle is correct.

- Move to the middle of the machine volume
- Release brakes (if fitted) to allow the axis to settle then re-apply
- Keep your hand on the E-STOP whilst running
- The tests start with "Flip poles per rev polarity each time test is run" checked
- Perform the battery box test
- The test will take longer than the brushed motor battery box test because the commutation angles need to be found first
- If the axis "jerks" a small distance this is not smooth machine motion, click on "increase amplitude and retest"
- When the axis moves over a small distance smoothly, it means the sign of commutation angle is correct. Uncheck "flip poles per rev polarity each time test is run" and carry on until the axis moves more than 30 mm.

Storing commutation offset angles

If there is concern that the commutation angle finding routine performed during "configure for motion" is giving inconsistent results it is possible to configure the system to apply a known (i.e. previously found) commutation angle after the axes have been homed. UCCassist-2 does not provide a commissioning interface for this functionality so the user must contact CMM support for further information.

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