UCC AI installation guide

Documentation part number: H-1000-7611-03-C

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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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EU declaration of conformity

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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.

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.

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 AI controller is only warranted and approved for use with the provided PSU.

The UCC AI 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 AI is required. It is the responsibility of the OEM or installer to apply the earth bonding scheme provided by Renishaw in this installation guide.
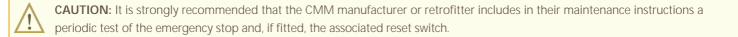
⚠ **WARNING:** The system can accelerate quickly during operation. The user must not enter the working volume of the CMM until all power is removed. When within the working volume of the CMM, the user should wear eye protection.

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

⚠ **WARNING:** Switching off or isolating the UCC AI 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).

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 AI is to be used in an environment where a higher IP rating is required, then the UCC AI 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.

References and associated documents

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

Renishaw documents

Title	Document number
Installation guide: UCC T3 PLUS and UCC S3	H-1000-2118
Installation guide: UCC T3-2	H-1000-5254
Installation guide: UCC T5	H-1000-7573
Installation guide: UCC S5	H-1000-7598
Installation and user's guide: MCU	H-1000-5182
Installation and user's guide: MCU5-2 and MCU W-2	H-1000-5280
Guide: Product interconnection system (PICS)	H-1000-5000
UCCassist-2 help	Found within UCCassist-2

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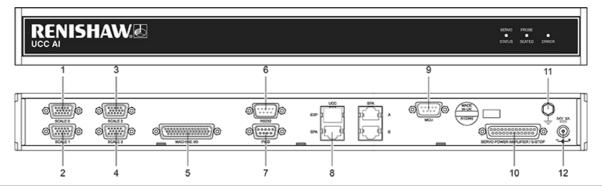
It is the responsibility of the OEM or installer to ensure that the finished installation complies with applicable national regulations for the country of installation.

Introduction

The UCC AI is required for large higher voltage CMM systems which may require motor voltages in excess of 80 V or motor currents in excess of 10 A. These voltages and currents are not supported by current Renishaw SPA products. The UCC AI provides the interface between the CMM controller and a third party servo power analogue amplifier (which provides power to the CMM motors).

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

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

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

Features

- Supports third party servo power analogue interface amplifiers
- ± 10 V differential analogue SPA command
- SPA control I/O
- The UCC AI can automatically adjust the supply voltage to encoder readheads (to compensate for long scale cables)
- Up to four CMM axes can be handled by the UCC AI
- Up to five CMM axes can be handled by a dual UCC AI setup
- Some 3rd party temperature compensation boxes can be interfaced to the UCC AI 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

System components

The part numbers of the UCC AI kits and upgrades are:

Kit	Part number
Analogue amplifier PH10 kit (UCC T3 PLUS, UCC AI, connector kit)	A-5518-1324
REVO-2 analogue amplifier kit (UCC S5, UCC AI, connector kit)	A-5518-1325

General wiring standards

To achieve reliable operation of the UCC AI 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 AI and the amplifier. 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 AI and the amplifier by the connector jack screws (where present).

> **NOTE:** The UCC AI electronic zero-volt rail is connected to chassis at a star point within the UCC AI.

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

Installation

Dimensions

Width	Depth	Height	Weight
440 mm (17.3 in)	180 mm (7.1 in)	44 mm (1.7 in)	2.1 kg (4 lb 10 oz)

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

⚠️ **WARNING:** Ensure the UCC AI is disconnected from the mains supply during installation.

Free-standing installation

The UCC AI 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).

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 AI as shown below:
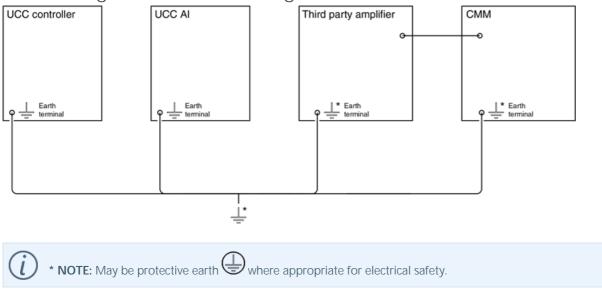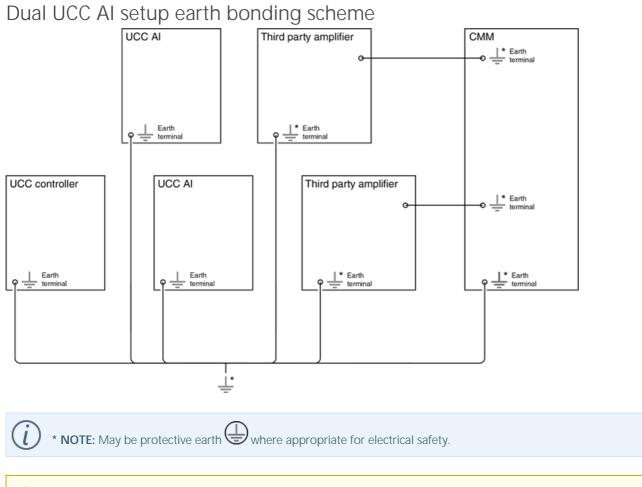
Earth bonding scheme

UCC AI single unit earth bonding scheme

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

Dual UCC AI setup earth bonding scheme

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

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

Software installation

Support for the UCC AI 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 AI.

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.
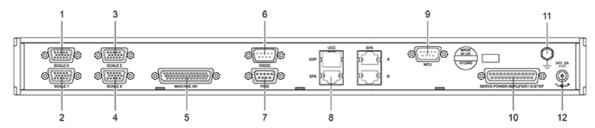
Connectors and signals

This section contains information on the following UCC AI ports:

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

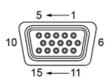| Key	Description	Key	Description
1	Scale 0 interface (15W HDD socket)	7	PICS (9W D socket)
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4	Scale 3 interface (15W HDD socket)	10	Servo power amplifier / E-STOP (25W D socket)
5	Machine I/O (44W HDD socket)	11	Earth terminal
6	RS232 (9W D plug)	12	UCC AI power jack (6.3 mm socket)

Scale interface (15W HDD socket)

UCC AI 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 AI can also be used with compatible 3rd party incremental 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.

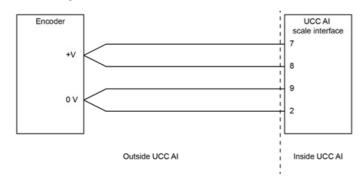| Pin no.	Function	Function
	Incremental	**Absolute**
1	Reserved	Reserved
2	0 V scale supply	0 V scale supply
3	Error -	Reserved
4	Reference mark -	Reserved
5	B signal -	MA -
6	A signal -	SLO -
7	+V scale supply	+V scale supply
8	+V scale supply sense	+V scale supply sense
9	0 V scale supply sense	0 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

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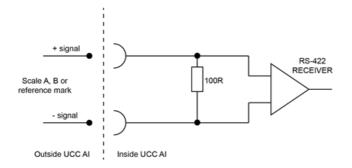
If the sense wires are open circuit then the voltage can be adjusted through the UCCsuite software. In both cases the scale supply voltage is nominally +5 V and can be adjusted to a maximum of +7 V. The sense and supply signals should be connected as close to the encoder as possible (see diagram below):

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

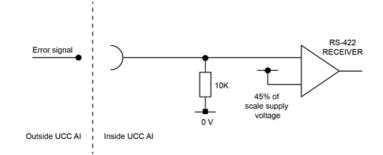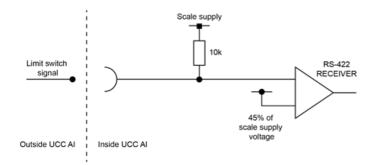## UCC AI scale signal interface circuit

UCC AI scale error interface circuit

The UCC AI supports the error signal provided by Renishaw's digital incremental encoders. The UCC AI 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).
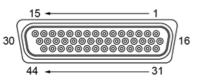
UCC AI scale limit switch interface circuit

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

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 AI kit.
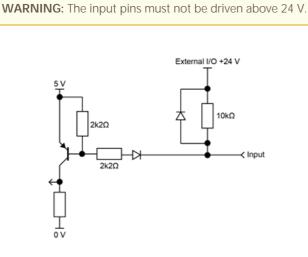

Pin	Function	Pin	Function
1	External I/O +24 V	23	Crash
2	/Enable air solenoid/ (active low)	24	Reserved
3	/Axis 0 brake/ (active low)	25	Axis 0 positive outer limit
4	/Axis 1 brake/ (active low)	26	Axis 0 negative outer limit
5	/Axis 2 brake/ (active low)	27	Axis 1 positive outer limit
6	Uncommitted 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

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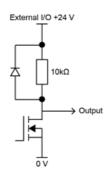
⚠ **WARNING:** The input pins must not be driven above 24 V.

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.

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:** Please be aware that the 1 A current is shared between the machine I/O and servo power amplifier connectors.

> ⓘ **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 AI 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.

Limit switches

The UCC AI 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.

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

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 AI 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.

Connector details

This socket is intended for use with 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

UCC - SPA (RJ45 socket)

3 and 4-axis UCC AI interconnection

The UCC AI should be connected from the UCC - SPA port to the UCC controller (SPA port) using the RJ45 cable (Renishaw part number P-CA40-0040) provided in the UCC AI 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.
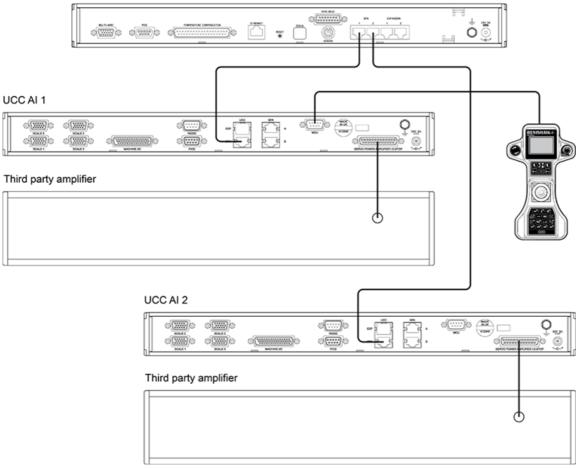
4 and 5-axis dual UCC AI interconnection

Dual UCC AI installations may require an E-STOP cable. This will depend on the E-STOP linkage between the UCC AI and third party amplifiers. However, the E-STOP tripped input on both UCC AIs is monitored.

NOTE: MCU, RS232, PICS, enable air solenoid, de-clutch, low air pressure and crash should be connected to UCC AI 1.

NOTE: The signals, 'amps OK', 'contactor', 'enable amps' and 'contactor feedback' on the UCC AI 1 should be connected to the 3rd party SPA associated with UCC AI 1, and these signals on UCC AI 2 should be connected to the 3rd party SPA associated with UCC AI 2.

MCU (9W D plug)

The UCC AI must be connected to the MCU using the cable provided with the MCU kit.
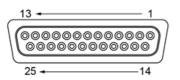
Connector details

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 joysticks.

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

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

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

Pin	Function	Pin	Function
1	External I/O +24 V	14	Axis 3 command -
2	/Contactor/ (active low)	15	Axis 3 command +
3	Reserved	16	Command common
4	/Enable amps/ (active low)	17	Reserved
5	Contactor	18	Reserved
6	E-STOP A	19	Reserved
7	E-STOP B	20	Reserved
8	Axis 0 command -	21	Enable amps
9	Axis 0 command +	22	Contactor feedback (active low)
10	Axis 1 command -	23	/Amps OK/ (active low)
11	Axis 1 command +	24	E-STOP tripped
12	Axis 2 command -	25	0 V
13	Axis 2 command +	Shell	Screen

NOTE: The following servo power amplifier / E-STOP I/O pin structures can be referred to machine I/O diagrams and thresholds (see section 'Machine I/O (44W HDD socket)').

External I/O +24 V

+24 V dc supply provided for the use of contactors, relays and other motor control circuits. Current limit 1 A.

> (i) **NOTE:** Please be aware that the 1 A current is shared between the machine I/O and servo power amplifier connectors.

Contactor

This command is issued by the UCC AI, to the amplifier, to engage the motor contactor. This output signal can drive the contactor directly providing its current consumption is within the output specification. This output signal is available in both an active low on pin 2 and an active high on pin 5.

Enable amps

This is a command from the UCC AI to the amplifier requesting it to enable its amplifiers. This output signal is provided as both an active low signal on pin 4 and as an active high signal on pin 21.

E-STOP A and E-STOP B

These are the connections from the amplifier E-STOP system to the MCU mounted emergency stop switch. E-STOP A is the high end and E-STOP B is the return.

> ⚠ **CAUTION:** If the UCC AI's MCU and RS232 devices are accidentally swapped, the RS232 CTS pin will be connected to the E-STOP B signal. The system installer must ensure that any power provided by a connected RS232 device's CTS signal will not allow the SPA E-STOP system to be enabled.

Axis command signals

These outputs (pins 8 to 15) are the velocity demand signals for each axis from the UCC AI to the servo power amplifiers. They vary over the range +10 V to −10 V.

Command common

An analogue zero reference is available, some third party units do require this reference. It is important that this is not used as a 0 V for digital signals because this will inject noise into the velocity demands. This pin (16) should be left open circuit if not required.

Contactor feedback

This is a confirmation signal (pin 22) from the motor contactor to the UCC AI that is has successfully operated and the motors are now engaged.

Amps OK

This is a confirmation signal (pin 23) from the servo amplifiers that they are on and ready. It is produced as a response to the 'enable amps' command.

E-STOP tripped

This input (pin 24) is used to inform the UCC AI of the CMM 'emergency stop' condition (E-STOP). If the input pin is pulled down to 0 V the UCC AI will assume that there is no emergency stop active and allow the servo motors to be energised.

If the input pin is open-circuit or above 4.2 V the UCC AI will assume that the emergency stop is active and will remove the motor demand signals, as well as the 'enable amps' and contactor commands.

> (i) **NOTE:** No motor can be enabled while this input is high or open-circuit.

0 V

This is the 0 V reference connection for all the digital and switching signals, unless otherwise stated the 0 V connections from all external devices should be connected to this line. This signal line is available on pin 25 on the SPA connector and pins 37 and 44 of the machine I/O connector. It is taken to a star point within the UCC AI controller where it is connected to protective ground, cable screens and all the internal supply 0 V lines. The star point must be the only point that these different 0 V and ground connections are made.

E-STOP electrical characteristics

- The UCC AI passes the E-STOP signal chain through the MCU E-STOP button and back to the attached amplifier
- Maximum current is 1 A (1000 mA)
- For details see the documentation for the MCU and amplifier 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 maximum

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

The machine manufacturer or product installer must perform a risk assessment to determine the requirements for emergency stopping and emergency switching off. The UCC AI emergency stop signal paths have been designed to be compatible with the category 2 architecture in standard ISO 13849-1:2015. The risk assessment should therefore have determined that a category 2 safety function is satisfactory.

> ⚠ **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.

> ⚠ **CAUTION:** If an RS232 device is to be connected to UCC AI then the E-STOP risk assessment should specifically assess the consequences of accidentally connecting it to the MCU port.

Motor engagement

Motor engagement via SPA connector

The UCC AI will begin to engage the servo motors when instructed to do so by the host computer or via the engage button on the MCU, if all the operating functions are in a safe and acceptable condition.

Listed below are possible causes for the motor engagement to fail:

- The system has not yet been configured for motion (i.e. the machine, servo and move parameters have not been sent to the controller)
- A fatal fault has been detected
- The emergency stop system has been activated
- A PICS 'stop' signal is detected within the system
- An open outer limit switch
- A present or previously present scale reading fault

The process is in two stages, amplifier enabling and contactor energising, with protective delays between each stage.

Analogue amplifier enabling

The UCC AI will first ensure that all its motor demand signals are zero and will then try to enable the power amplifiers by asserting the 'enable amps' signal (servo power amplifier / E-STOP socket, pin 4 or 21).

This 'enable amps' signal will be held on for 100 ms to allow the 'amps OK' signal, from the servo power amplifier, to become valid (the 'amps OK' signal produced by the amplifier control circuits is an indication to the UCC AI that the servo power amplifiers are not faulty). If this signal does not become valid (i.e. pin 23 of the Servo power amplifier / E-STOP socket, is not pulled low) the controller will abandon the engagement process. The 'amps OK' is invertible, therefore pin 23 of the Servo power amplifier / E-STOP socket, would need to be pulled active.
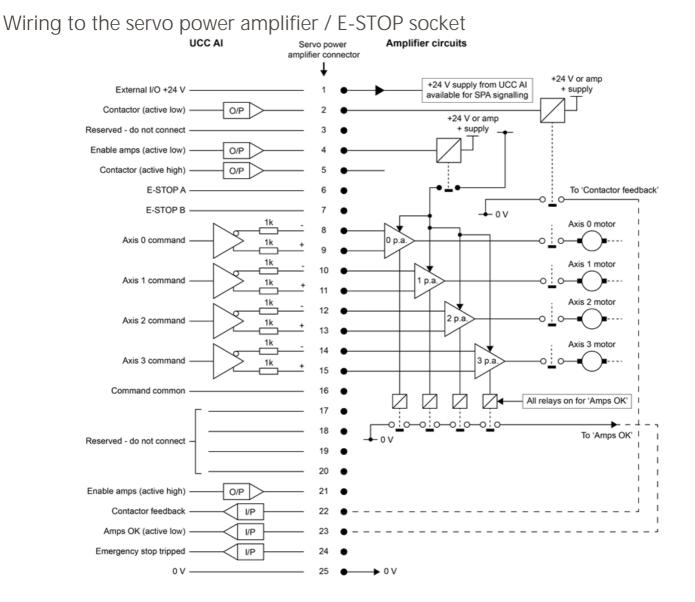
If no error is detected then the UCC AI will wait for a further period of 1 second before beginning the next stage, to allow the amplifiers to settle after any initial transients.

The diagram below is an example of the recommended circuits that can be used to drive the power amplifier enable inputs and to generate the 'amps OK' signal. The circuits that are used in the installation will vary depending on the amplifiers requirements but must pull the 'amps OK' input (pin 23) down if all amplifiers are operating correctly.

If the user wishes to signal amplifier failures individually to the main computer, it is recommended that the uncommitted user inputs (machine I/O socket) are used for this purpose.

UCC AI installation guide

Wiring to the servo power amplifier / E-STOP socket

Contactor energising

After establishing that the amplifiers are working correctly, the UCC AI will assert the 'contactor' signal (pins 2 and 5 of the servo power amplifier / E-STOP socket), this should be used to signal the servo power amplifier to apply power to the motors. The UCC AI will keep this output signal asserted for 3 seconds during which it expects the 'contactor feedback' input (servo power amplifier / E-STOP socket, pin 22) to be pulled low to indicate that the motors are now powered.

If the 'contactor feedback' signal is not received in time, the contactor (pin 2 and 5) and the enable amps signals (pins 4 and 21) are de-asserted and the motor engagement process is stopped.

If the 'contactor feedback' signal is received within this 3 second window, the controller keeps all motor commands at zero for another 0.2 seconds before allowing the servo system to begin operating. This is intended to give further protection against sudden machine movements when engaging the motors.

Motor command signals

The UCC AI generates complementary motor velocity command signals for each axis (axis 0 = pins 8 + 9, axis 1 = pins 10 + 11, axis 2 = pins 12 + 13, axis 3 = pins 14 + 15).

Each motor velocity signal is capable of a swing of ±10 V centred on a zero-velocity command of 0 V. A motor command common connection is provided to define this 0 V level (servo power amplifier / E-STOP socket, pin 16, diagram above).

The motor command common signal is also connected to the 0 V and the UCC AI chassis at four star points within the UCC AI.

The UCCassist-2 setting up process will help the user to set the power amplifier gains such that the maximum command signal (± 10 V) will produce 120% of the required maximum axis speed.

If complementary signals are not required, either of the motor command signals may be used as a single ended input, referred to the motor command common line.

Each motor command signal has a series resistor of 1 kohm to protect the UCC AI from inadvertent damage. This will reduce the drive signal to the power amplifiers if their inputs are of low impedance.

Safety

The UCC AI can stop CMM movement using any one of three methods; 'Contactor' output pin, 'Enable amps' output pin, the analogue 'command' outputs. It is strongly recommended that the amplifier is configured to use all three methods of control so that back-ups exist should a fault occur with one method. A recommended configuration is shown in the diagram 'Wiring to the servo power amplifier / E-STOP socket'.

UCC AI power socket (6.3 mm socket)

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

The PSU provides the UCC AI with 72 W at +24 Vdc. The UCC AI 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.

Testing and verification

The machine manufacturer or the installer of the UCC AI 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 all service and maintenance operations.

Maintenance

> ℹ️ **NOTE:** There are no user serviceable parts inside this unit, except the filter.

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 AI 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.
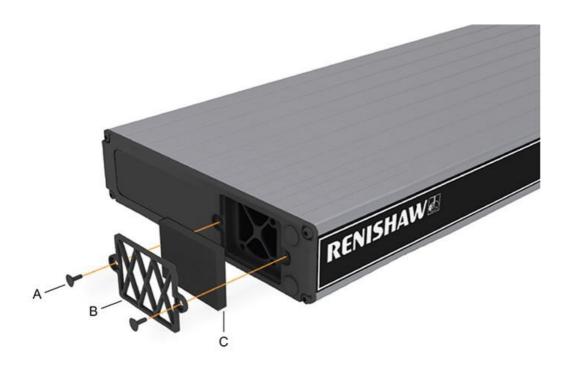
Exchanging / removing the air filter

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

Troubleshooting

UCC AI 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

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

Servo status	Probe seated	Error	Description
⊖ (off)	⊖ (off)	⊖ (off)	No power (note that this pattern is also possible when working normally and the probe is not seated). Amplifier not engaged.
⊖ (off)	⊖ (off)	● (red)	Hardware failure
⊖ (off)	☀ (green flash)	● (red)	Security failure (fast green flash)
⊖ (off)	☀ (green flash)	● (red)	Firmware error (intermittent fast green flash)
⊖ (off)	☀ (green flash)	☀ (red flash)	** Controller not connected, waiting for download, download failed, device not recognised by UCC firmware or device not recognised by UCC downloadable software
⊖ (off)	⊖ ● (off, green)	⊖ (off)	Amplifier not engaged
● (green)	⊖ ● (off, green)	⊖ (off)	Amplifier engaged
⊖ ● (off, green)	● (green)	⊖ (off)	Probe seated
⊖ ● (off, green)	⊖ (off)	⊖ (off)	Probe not seated

> ℹ **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.

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 UCC AI 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

> ℹ **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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