

# UCC2 universal CMM controller



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**UCC2**

**Installation guide**



## FCC

### Information to user (FCC section 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 installation 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 expense.

### Information to user (FCC section 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.

## EC declaration of conformity

The **UCC2** has been manufactured in conformity with the following standards:

BS EN 61326:1998	Electrical equipment for measurement, control and laboratory use – EMC requirements.  Immunity to Annex A - industrial locations.  Emissions to class A (non-domestic) limits.
BS EN 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use.  Part 1: General requirements.

and that it complies with the requirements of the following EC Directives (as amended):

- 89/336/EEC - Electromagnetic compatibility (EMC)
- 73/23/EEC - Low voltage

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## Care of equipment

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

## Changes to Renishaw products

Renishaw reserves the right to improve, change or modify its hardware or software without incurring any obligations to make changes to Renishaw equipment previously sold.

## Warranty

Renishaw plc warrants its equipment for a limited period (as set out in our Standard Terms and Conditions of Sale) provided that it is installed exactly as defined in associated Renishaw documentation.

Prior consent must be obtained from Renishaw if non-Renishaw equipment (e.g. interfaces and/or cabling) is to be used or substituted. Failure to comply with this will invalidate the Renishaw warranty.

Claims under warranty must be made from authorised service centres only, which may be advised by the supplier or distributor.

## Machine safety



**WARNING:** Switching off or isolating the **UCC2** 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.

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

## Trademarks

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## References and associated documents

It is recommended that the following documentation is referenced when installing the **UCC2**.

### Renishaw documents

A full set of documents are supplied on Renishaw UCC software CD. Reference to the following documents may be needed when installing a **UCC2** system:

<b>Document number</b>	<b>Title</b>
H-1000-5057	UCC controller programmer's guide
H-1000-5058	UCC Renicis user's guide
H-1000-5067	MCU1 installation guide
H-1000-5068	SPA1 installation guide
H-1000-5220	UCC daughtercard installation guide
H-1000-5222	UCC command set
H-1000-5227	SPA1 tuning guide
H-1000-5234	<b>SPA2</b> installation guide
H-1000-5107	<b>SPA</b> <i>lite</i> user's guide

### External documents

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

EN 292-2:1991 (Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications).

EN (IEC) 60204-1:1997 (Safety of machinery - Electrical equipment of machines - Part 1: General requirements).

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## Safety

### Electrical requirements

The UCC1 is powered from the a.c. mains supply via an IEC 320 connector. The operating voltages of the unit are as follows:

100 - 120 V ac and 220 - 240 V ac –15%, +10%      50/60 Hz ±5%      120 W maximum

This equipment must be connected to a protective earth conductor via a three core mains (line) cable. The mains plug shall be inserted only into a socket outlet provided with a protective earth contact. Do not use an extension cable without a protective conductor.

An earth stud is provided to allow bonding of the CMM's metal parts to the protective earth.



**CAUTION:** Any interruption of the protective conductor may make the equipment dangerous. Make sure that the grounding requirements are strictly observed.

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### Environmental requirements

The following environmental conditions comply with (or exceed) BS EN 61010-1:1993

<b>Indoor use</b>	IP30 (no protection against water)*
<b>Altitude</b>	up to 2000 m
<b>Operating temperature</b>	0 °C to +50 °C
<b>Storage temperature</b>	-10 °C to +70 °C
<b>Relative humidity</b>	80% maximum (non-condensing) for temperatures up to +31 °C Linear decrease to 50% at +40 °C
<b>Transient overvoltages</b>	Installation category II
<b>Pollution degree</b>	2

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**NOTE:** If a higher IP rating is required, an additional external enclosure will be required to house the **UCC2**. This enclosure must facilitate an airflow to allow the internal temperature to maintain the ambient within the operating temperature range.

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## Contents

1	Introduction.....	12
1.1	Overview .....	12
1.2	Literature .....	13
1.3	CMM host computer .....	13
1.4	Installation software .....	14
1.4.1	Renicis .....	14
1.4.2	UCCassist™ .....	14
1.4.3	IP configurer .....	14
1.4.4	Licence manager .....	14
1.5	Items supplied .....	15
1.5.1	UCC2 kits.....	15
1.5.2	UCC2 upgrade.....	15
1.5.3	UCC2 system accessories.....	15
2	Description of the UCC2.....	17
2.1	Motherboard.....	17
2.2	TP200 interface .....	18
2.2.1	Differences between the PI 200 and the UCC2 interface.....	18
2.2.2	Connectors .....	18
2.3	SP25M and SP600 interface.....	18
2.3.1	Connectors .....	18
2.4	Power supply unit.....	19
2.4.1	Input.....	19
2.4.2	Output .....	19
3	Connecting the UCC2 to the host PC.....	20
3.1	Hardware connection .....	20
3.2	Software installation .....	20
3.3	Configuration of IP addresses.....	21
3.3.1	IP addressing.....	21
3.3.2	Setting the IP address of the PC .....	22
3.3.3	Setting the IP address of the UCC2.....	24
3.3.4	Changing the IP address of the UCC2 .....	27
3.3.5	Establishing a new UCC2-PC pairing.....	27
3.4	Downloading .....	27

4	Connecting the UCC2 to a CMM .....	28
4.1	The controller's 24 V supply .....	30
4.2	Motor engagement via SPA connector.....	30
4.2.1	Amplifier enabling .....	31
4.2.2	Contacting energising.....	31
4.3	Motor command signals .....	32
4.4	Motor command polarity.....	32
4.5	Brakes .....	32
4.6	Air solenoid.....	33
4.7	Switched outputs .....	33
4.8	Switched inputs .....	33
4.8.1	Limit switches.....	33
4.8.2	Amplifier OK and contactor feedback .....	33
4.8.3	Fatal fault .....	34
4.8.4	Declutched mode .....	34
4.8.5	Uncommitted inputs .....	34
5	Connectors and signals .....	35
5.1	Overview .....	35
5.2	Ethernet connection .....	35
5.3	CMM readhead input connections.....	35
5.3.1	CMM readhead interface circuit.....	37
5.3.2	Adjusting readhead supply voltage.....	38
5.4	SPA2 connector A and B.....	38
5.5	Aux comms.....	38
5.6	MCU connector .....	39
5.7	SCR200 connector .....	39
5.8	PICS connector .....	40
5.9	Scanning probe connector .....	40
5.10	Servo power amplifier connector.....	41

---

5.10.1	+24 V dc.....	42
5.10.2	Contactor .....	42
5.10.3	ESTOP_C .....	42
5.10.4	Enable amps.....	42
5.10.5	ESTOP_A and ESTOP_B.....	42
5.10.6	Axis command signals .....	42
5.10.7	Command common .....	42
5.10.8	Reserved .....	42
5.10.9	Contactor feedback.....	43
5.10.10	AMPs OK .....	43
5.10.11	ESTOP tripped.....	43
5.10.12	0 V (24 V return) .....	43
5.11	Machine I/O connector .....	44
5.11.1	+24 V DC .....	45
5.11.2	UCC2 general purpose outputs .....	46
5.11.3	UCC2 general purpose inputs .....	46
5.11.4	Amplifier OK input.....	47
5.11.5	CMM declutch .....	47
5.11.6	ESTOP tripped.....	47
5.11.7	Air pressure switch .....	47
5.11.8	Crash switch .....	47
5.11.9	Contactor feedback.....	48
5.11.10	Limit switches .....	48
5.11.11	24 V return .....	48
5.12	Reset button.....	48
5.13	Daughtercard slots .....	49
5.14	PCI interface slot.....	49
6	Installation of the UCC2 components.....	50
6.1	General wiring standards .....	50
6.1.1	Preparations .....	51
6.2	Installation of daughtercards .....	51
6.3	Connecting UCC2 cables to and from CMM .....	51
6.4	Connecting the UCC2 mains supply .....	52
7	Mounting the UCC2.....	53
7.1	Stand alone mounting .....	53
7.2	Mounting in a 19" rack.....	53

8	Renishaw license key manager system .....	54
8.1	Using the Renishaw license key manager .....	54
8.2	Ordering extra functionality/upgrading .....	55
8.3	Obtaining the key .....	55
8.4	Applying the key .....	55
8.5	Demonstration mode .....	55
8.6	Repairing upgraded systems.....	56
8.7	Available functionality.....	56
8.7.1	Triggering.....	56
8.7.2	Scan 3.....	56
8.7.3	I++DME.....	57
8.7.4	Error reporting.....	57
9	UCC2 troubleshooting .....	58
9.1	Front panel LED displays .....	58
9.1.1	UCC2 power not switched ON .....	58
9.1.2	UCC2 power switched ON .....	58
9.1.3	Initialisation/test .....	59
9.1.4	System file downloading .....	59
9.1.5	Servo active LED .....	59
9.1.6	Probe seated LED.....	59
9.2	Probe head LED configuration .....	60
9.3	Fault finding.....	60
9.3.1	Fatal faults .....	60
9.3.2	Motors will not engage/re-engage.....	61
9.3.3	Poor positioning accuracy.....	62
9.3.4	Controller will not respond to host PC.....	63
9.3.5	Motor stalling.....	66
9.3.6	Machine overspeed report .....	66
9.3.7	Scale reading ('grating') failures .....	67
9.3.8	Timing out during moves or scans .....	69
9.3.9	Cannot start a move.....	69
9.3.10	Cannot start a scan.....	70

---

10	Specifications .....	71
10.1	Physical specification .....	71
10.2	Cable lengths .....	71
10.2.1	UCC2 to CMM measuring scale readhead .....	71
10.2.2	UCC2 to CMM servo power amplifier input .....	71
10.2.3	Ethernet cable link to PC .....	71
10.3	Scale readhead signal speed .....	72
10.4	Electrical power requirements .....	72
10.4.1	Controller output supplies .....	72
11	System interconnections .....	73
11.1	Probing system interconnection .....	73
11.1.1	2 wire touch-trigger probe system .....	73
11.1.2	PH10 probe head and 2 wire touch-trigger probe system .....	73
11.1.3	PH10 probe head and 'multiwire' probe system .....	74
11.1.4	PH10 probe head, 'multiwire' probe system and ACR1 .....	74
11.1.5	PH10 probe head and 'multiwire' probe system using external PHC10-2 .....	75
11.2	Servo amplifier interconnection .....	75
11.2.1	UCC2 and SPA1 .....	75
11.2.2	UCC2 and SPA <i>lite</i> .....	76
11.2.3	UCC2 and SPA2 .....	77
12	Fitting a UCC2 into a UCC1 installation .....	78
12.1	Machine I/O connection .....	78
12.2	Servo power amplifier connection .....	78
12.3	Software compatibility .....	79
12.3.1	UCC software release .....	79
12.4	Machine ini file .....	79
12.5	Installed PC .....	79
13	Maintenance .....	80
14	Testing and verification .....	81
15	Revision history .....	82

# 1 Introduction

The purpose of this chapter is to describe the **UCC2** (universal CMM controller) and the available options.

## 1.1 Overview

The **UCC2** is a further development in Renishaw's CMM controller product range. Building on the UCC1 platform introduced over five years ago, the **UCC2** offers additional capability and system performance.

The **UCC2** further optimises measurement performance through closer probe integration and is suitable for original equipment and retrofit installations.

With ever tighter tolerances, more complex components and increasing pressures on lead times, the ability to acquire large volumes of measurement data, both accurately and rapidly, is key to manufacturing competitiveness. The new **UCC2** controller offers advanced adaptive scanning, allowing accurate known part scanning at velocities limited only by the dynamic performance of the CMM. Speeds of over 500 mm/sec (20 in/sec) can be achieved.

**UCC2** offers true multi-sensor integration, giving benefits for original equipment manufacturers (OEMs), retrofit/re-builders and end-users requiring system upgrades. The controller is supplied configured for touch-trigger operation and **UCCserver™(I++DME)** as standard. It can be upgraded to conventional 3-axis scanning, **Renscan3™**, or 5-axis scanning, **Renscan5™**, by keying in a 16 digit code.

The complete range of Renishaw probe systems is supported; conventional contact, strain-gauge and analogue scanning sensors, manual and motorised probe heads, probe and stylus changers, and the latest developments in servo positioning systems. Other optical and video sensors can also be supported.

A key benefit of **UCC2** is the simple integration of complex probe systems, for existing systems and future developments, and is central to Renishaw's future plans for sensor innovation. Future products will be easily integrated via plug-in daughtercards, and because the UCC control software is downloaded from the PC each time the system is switched on, software upgrades for new products are easily integrated.

The **UCC2** comprises of a mains-powered controller in a rack-mountable enclosure with a micro-processor based computer system. It is coupled to the CMM's host computer by a network link, and to the CMM by external cable interface connectors.

The **UCC2** CMM controller has the capability of:

- Controlling four axes of a CMM (accepting digital readhead signals and generating four axes drive motor control signals)
- Accepting input signals from emergency stop, air pressure, crash detector, contactor feedback, amplifier faults and all axis inner and outer travel limit switches
- Generating seven uncommitted general purpose output signals
- Accepting six uncommitted general purpose input signals
- Providing a +24 V supply for use by the CMM switches
- Directly supporting the TP2, TP6, TP20, TP200 touch-trigger probes, also the SP25M and SP600 analogue scanning probes
- Other Renishaw probes can be integrated into the **UCC2** system using plug-in daughtercards
- Directly supporting the Renishaw MCU1 joystick
- Directly supporting the Renishaw **SPA2**, **SPA***lite* or SPA1 servo power amplifiers

## 1.2 Literature

A number of other manuals are available to assist with the installation of the **UCC2** system and are included on the UCC software CD ROM. Some of the more relevant ones are listed below:

Part number	Title	Description
H-1000-5068	SPA1 installation guide	System connection details
H-1000-5234	<b>SPA2</b> installation guide	System connection details
H-1000-5058	Renicis installation guide	System set-up and testing
H-1000-5057	UCC1 programmers guide	Programming
H-1000-5222	Command set	Programming
H-1000-5107	<b>SPA</b> <i>lite</i> user's guide	Operation

## 1.3 CMM host computer

For the installation of a **UCC2** controller, the CMM's host computer must use Windows NT (service pack 6 or later), Windows 2000 or Windows XP Pro as an operating system; a CD-ROM drive, and a hard disc drive. The storage requirements of the UCC system are less than 500 Mbytes. The processor speed and RAM requirements are not excessive, if the PC is supporting the operating system and application software, it will almost certainly support the UCC controller operation.

The PC must have one free dedicated network (Ethernet) connection port available for the **UCC2** communication. It is recommended that this NOT a USB plug-in adapter because of the reduction in speed of operation these devices normally produce.

## 1.4 Installation software

### 1.4.1 Renicis

The Renishaw Renicis program is a utility to assist the engineer to install, commission and maintain a CMM system based on the **UCC2** controller.

It also has features which assist in the development of a software interface between any existing CMM application program and the **UCC2**.

Please refer to the Renicis user's guide (Renishaw part number H-1000-5058) for more information on this product.

### 1.4.2 UCCassist™

The UCCassist software suite complements the Renicis software package offering the following additional capabilities of:

- Basic machine system diagnostics
- Compatibility with Renishaw's machine checking gauge, enabling the user to complete frequent volumetric accuracy tests to ensure the CMM is running within the specified operational tolerances
- Automated CMM error mapping routines, when used in conjunction with the Renishaw ML10 laser system

### 1.4.3 IP configurer

The IP configurer software utility is a stand-alone tool for checking and setting the IP address compatibility of the **UCC2** controller and application PC.

### 1.4.4 Licence manager

This is a stand-alone software utility which is used to check and update the licence for controller functionality.



## 1.5 Items supplied

The part numbers of the **UCC2** kits and upgrades are:

### 1.5.1 UCC2 kits

A-5121-0001 **UCC2** (touch-trigger enabled)

Comprising:

- **UCC2** controller
- 5 metre Ethernet (cross-over) cable
- CD ROM containing:-
  - System literature
  - UCC operating software
  - COM dlls
  - Renicis installation and diagnostic program
  - IP configurer software
  - Link logger

### 1.5.2 UCC2 upgrade

A-5121-0005 **Reniscan3™** scanning functionality upgrade

A-5121-0007 **Reniscan5™** scanning functionality upgrade

### 1.5.3 UCC2 system accessories

#### 1.5.3.1 SPA2

The **SPA2** servo power amplifier is designed specifically for use with the **UCC2** product and offers a comprehensive solution for most CMM installations.

#### 1.5.3.2 SPA*lite*

The **SPA*lite*** servo power amplifier is designed specifically for use with the **UCC2** product and offers a solution for CMMs typically <1 m<sup>3</sup>.

#### 1.5.3.3 MCU1

The MCU1 is a comprehensive joystick solution designed for use with the UCC range of controllers.

#### 1.5.3.4 Daughtercards

Various daughtercards are available for integration with the **UCC2** as listed below. The daughtercards, which plug into sockets on the motherboard, are available as required by the CMM application.

The UCC daughtercard installation guide (Renishaw part number H-1000-5220) details all of these cards, please refer to it for installation details.

- Joystick interface daughtercard; for use with OEM's own analogue joysticks
- PH10 probe head (PHC1050) daughtercard
- PHS1 probe head daughtercard
- Additional axis daughtercard; configurable for use as, a rotary table interface, an additional (twin) scale input, or a dual axis drive interface
- PICS/RS232 daughtercard; required to interface older (not integrated) product interfaces
- Temperature sensor daughtercard
- SP80 daughtercard

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## 2 Description of the UCC2

### 2.1 Motherboard

The motherboard comprises:

- Central processor unit (CPU)
- System memory, I/O and interconnection logic
- On-board connectors for optional plug-in daughter-boards
- Rear panel connectors for the external interface cables to and from the CMM
- Rear panel network connection for the two-way communication link to the CMM host computer
- Readhead circuitry for CMM digital measuring scales
- Axis servo control circuits
- Status indicating LEDs
- Control electronics for probes and peripheral devices attached to the CMM

LEDs visible through the front panel of the **UCC2** enclosure indicate the operational status of the **UCC2**.

Sub-circuits on the motherboard control the following interfaces through connectors on the rear panel of the enclosure:

- Ethernet data link to the CMM host computer
- X, Y, Z and additional axis data input from the CMM readheads
- A communication loop (SPA-A and SPA-B) to the **SPA2** servo power amplifier
- A communications port (CH1), reserved for use on future products
- An MCU1 joystick interface
- Supplies and control signals for an SCR200 stylus changer rack
- Connections for the TP200 and TP20 range of touch-trigger probes
- Power to and input signals from the Renishaw SP25M or SP600 analogue probes
- Signal outputs to the axis drive motors servo amplifiers of the CMM
- I/O connections to limit switches, air pressure and other digital inputs and outputs
- A reset switch

## 2.2 TP200 interface

The **UCC2** motherboard incorporates the circuitry and software necessary to interface with a Renishaw TP200 probe, and operate the associated SCR200 stylus changer rack. The **UCC2** implementation of the TP200 interface has the same automatic recognition of, and support for, conventional touch-trigger probes such as TP20, TP1, TP2 and TP6.

### 2.2.1 Differences between the PI 200 and the UCC2 interface

- Most of the PI 200 configuration options (dip switches) have been replaced by UCC command number 426, PIB200 configure interface
- Internal connections have been implemented to permit connection of the required PICS signals to the PHC1050 daughtercard or an external probe head controller (via a PICS/RS232 daughtercard)
- The probe reset function is now activated by command number 427, PIB200 reset probe
- The interface status LEDs on the front of the PI 200, are replaced by the command number 428, PIB200 read status. This provides interface status information from the **UCC2**
- No audio 'beep' signal is generated within the **UCC2**. If fitted, the joystick unit beeper can be used for this function

### 2.2.2 Connectors

The 9-pin D-socket labelled 'trigger probe' will accept TP200 or conventional probe signals and direct them to the PI 200 interface on the **UCC2** motherboard.

A 6-pin miniature DIN socket labelled 'SCR200' is used for connection of a SCR200 rack.

## 2.3 SP25M and SP600 interface

The **UCC2** motherboard incorporates the circuitry necessary to interface with the Renishaw SP25M and SP600 probes.

The **UCC2s** implementation of the SP25M and SP600 interface has automatic recognition of, and support for, Renishaw touch-trigger probes TP200 and TP20.

### 2.3.1 Connectors

The 15-pin D-socket labelled 'analogue probe' will accept probe signals from Renishaw's SP25, SP600, TP200 and standard Renishaw touch-trigger probes, and direct them to the appropriate interface on the **UCC2** motherboard.

## 2.4 Power supply unit

The **UCC2** controller has a shielded switched-mode power supply unit (PSU) which is mounted inside the **UCC2** enclosure.

The PSU supplies the **UCC2** controller and can also supply power to the specified probes and readheads, and the status switches of the CMM.

### 2.4.1 Input

The power supply has a universal a.c. input circuit. See safety statement at the start of this document.

### 2.4.2 Output

The **UCC2** PSU provides protected low voltage d.c. supplies of +15 V, +5 V and –15 V for external devices such as scale readheads, the SP600 probe etc.

These supplies share a common 0 V return which is connected at a star point within the **UCC2** to the protective ground of the AC supply and the **UCC2** case.

The **UCC2** also provides a +24 Vdc supply available for use by the CMM to power the status switches etc. The return line of this 24 Vdc supply (which should be wired separately from the returns of the +15 V, +5 V and –15 V supplies) is also connected to the a.c. supply protective ground at a star point within the **UCC2**.

## 3 Connecting the UCC2 to the host PC

The following sections detail how to connect and configure the communication link between the **UCC2** and the host PC that is running either the UCC utilities or metrology application software.

### 3.1 Hardware connection

The host PC must have a dedicated Ethernet connection to the **UCC2**. It is recommended that this NOT a USB plug-in adapter because of the reduction in speed of operation these devices normally produce.

If the host PC is also to be connected to a network, it is necessary to install additional hardware within the host PC to permit a dedicated connection to be available for **UCC2** communication. For details on how to install additional hardware into the host PC, please refer to the PC's installation / users guide.

The **UCC2** is capable of using both 10 and 100 Mbps Ethernet, the selection being determined by the capability of the network adapter to which it is connected. We recommend that you use a 100 Mbps network adaptor.

A 5 m Ethernet cable is provided for this link as part of the **UCC2** kit and is a Cat 5e, cross-over type. Other lengths may be used, the maximum being is governed by the generic specification for Ethernet connections (i.e. a hundred metres), which is sufficient for any CMM installation. It must be a cross-over type for a single installation.

If you are concerned about EMC disruption due to your environment, or the routing of the cable, then the use a shielded cross-over cable is recommended.

We suggest that you label your cross-over cable as a cross-over cable as it looks identical to a normal, not-crossed-over, cable.

### 3.2 Software installation

The UCC software must be installed on the host PC, prior to connection of the **UCC2**.

The UCC software disc (A-1333-0080), version 6.0 and later, supports **UCC2** installations.

After the software has been installed, one of the utility programs available is "IP Configurer"; which is used to give the **UCC2** an IP address, and establishes the pairing of the PC and the **UCC2**.

Another software utility that is installed is "Renicis". It is important that for **UCC2** installations you use Renicis version 6.0, provided on the UCC software version 6.0 CD-ROM, or later versions.

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## 3.3 Configuration of IP addresses

This section describes the steps needed to connect your **UCC2** to the host PC and configure the Ethernet communication link.

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**NOTE:** The examples used in this section are for Windows XP Professional and will vary for other operating systems.

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### 3.3.1 IP addressing

You have to decide what IP address to give to the **UCC2**. The key to this is to choose an IP address for the **UCC2** and an IP address for the PC's network adaptor that are of the **same** network. What does this mean? Well, firstly we must introduce sets of networks called network classes which are defined by their IP address ranges:

class A 1.0.0.1 – 126.255.255.254

class B 128.0.0.1 – 191.255.255.254

class C 192.0.0.1 – 223.255.255.254

For class A networks, a network is defined by the first number.

For class B networks, a network is defined by the first two numbers.

For class C networks, a network is defined by the first three numbers.

If you choose to use IP addresses that belong to the class A network class, then you must be sure that the first numbers are identical, e.g. 10.0.0.1 and 10.123.4.17. If you choose to use IP addresses that belong to the class B network class, then you must be sure that the first two numbers are identical, e.g. 155.23.0.1 and 155.23.86.207. If you choose to use IP addresses that belong to the class C network class, then you must be sure that the first three numbers are identical, e.g. 192.168.32.1 and 192.168.32.2.

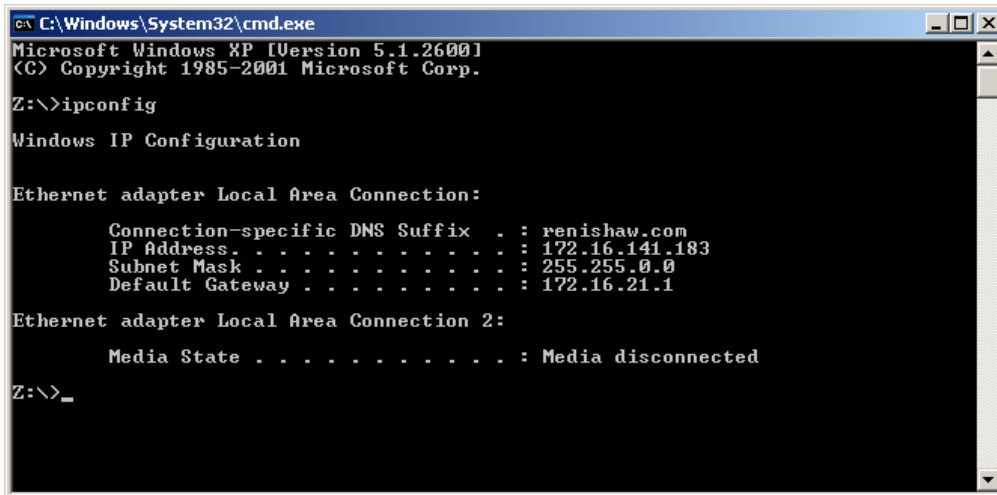
A rule that always works is to choose 'adjacent' IP addresses from the ranges given above (by adjacent we mean that the last numbers differ only by 1, e.g. 172.16.40.1 and 172.16.40.2).

---

**NOTE:** The last number must not be 0 or 255.

---

If there is more than one network connection in your PC, choose a network class for the UCC2-PC connection that is not currently in use to keep the connections clearly separate. To find out which IP address, and hence which network class your other network interfaces use, type “ipconfig” at a command prompt. Its output will look similar to this:



```

C:\Windows\System32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

Z:\>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : renishaw.com
    IP Address. . . . .               : 172.16.141.183
    Subnet Mask . . . . .            : 255.255.0.0
    Default Gateway . . . . .        : 172.16.21.1

Ethernet adapter Local Area Connection 2:

    Media State . . . . .            : Media disconnected

Z:\>_

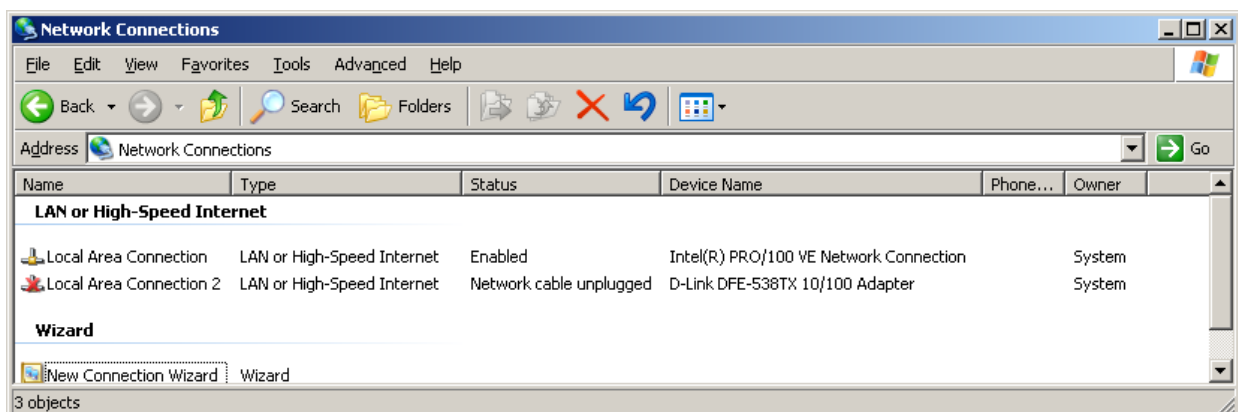
```

Here the UCC2-PC network interface had its cable removed, so shows up as “Media disconnected”. The other connection was the corporate one, and is seen to be a class B network. Hence the UCC2-PC network is best chosen to be a class A or a class C one.

### 3.3.2 Setting the IP address of the PC

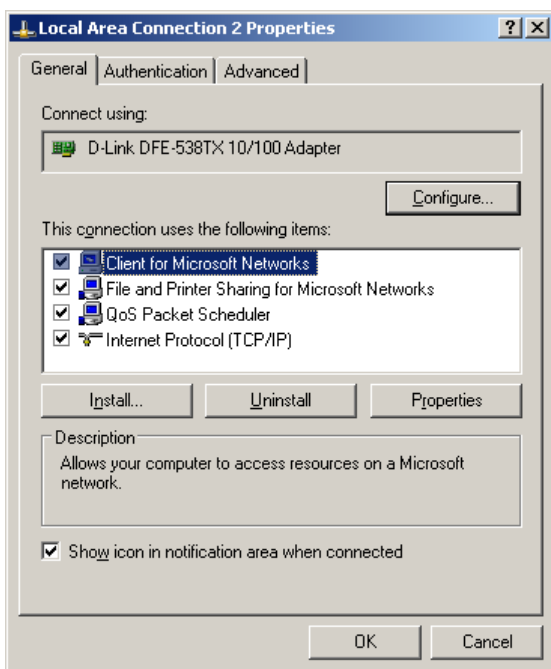
The network adapter in the PC to which the **UCC2** is connected needs an IP address. See section 3.3.1, “IP addressing” for a discussion of the choice. How to set the address in the PC varies with each version of Windows, but the basic idea is the same. Here is the process using Windows XP Professional. You need administrator rights in order to perform this operation.

a) Select Start → Settings → Control Panel → Network Connections to give:

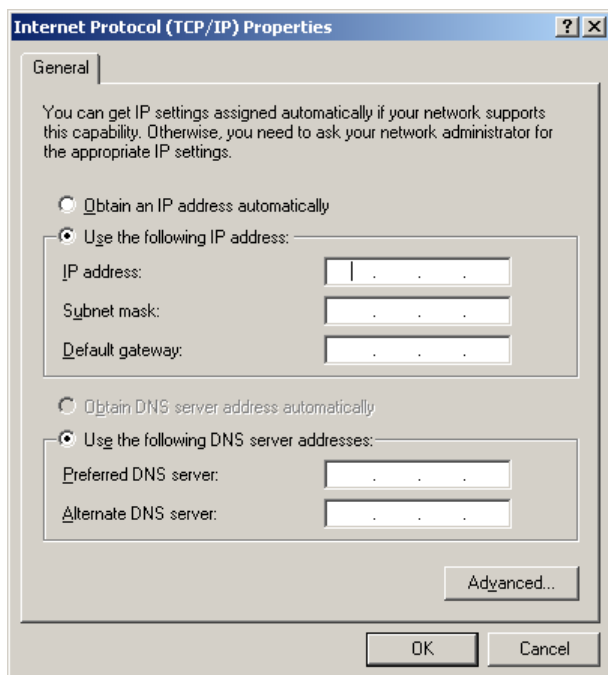




- b) Right-click the appropriate Local Area Connection and select Properties from the resultant popup menu box to give:



- c) Select 'Internet Protocol (TCP/IP)' and click Properties to give:

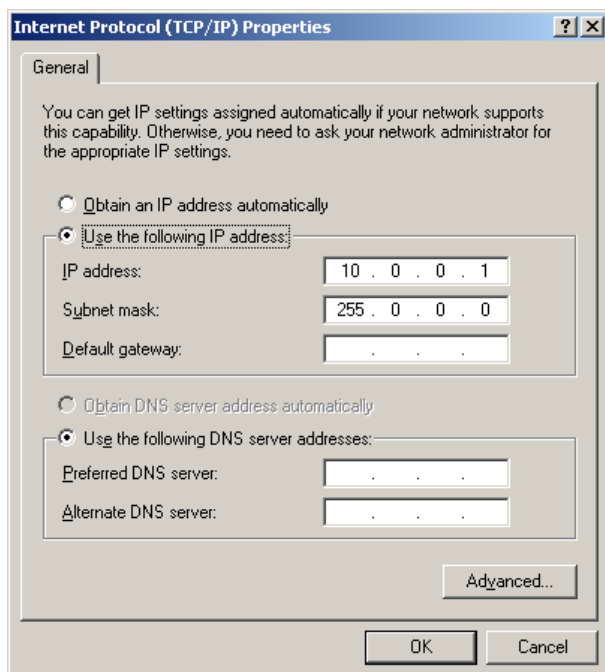


- d) If not already selected select 'Use the following IP address' and type in the IP address that you want to use for the PC end of the comms link. Now click in the Subnet mask field. On Windows XP the Subnet mask will be filled in for you. If you have to fill it in for yourself, here are the values:

Class of network IP address belongs to	Subnet mask to use
A	255.0.0.0
B	255.255.0.0
C	255.255.255.0

Leave the Default gateway field blank.

Example:



- e) Click OK and then OK again. Whether or not this setting has taken effect depends on the version of Windows that you are running. On earlier versions you will need to reboot the PC. To be absolutely sure, reboot your PC anyway.

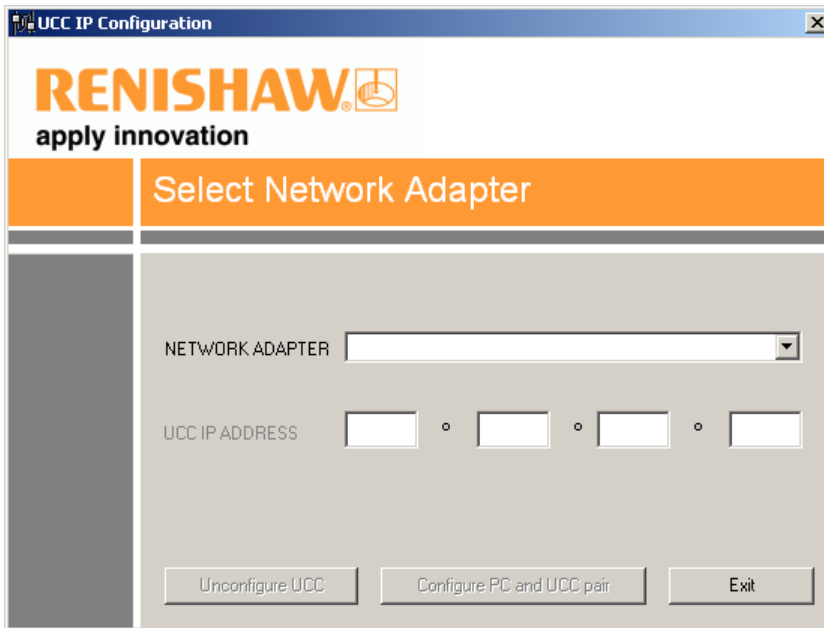
### 3.3.3 Setting the IP address of the UCC2

The **UCC2** is not intended to be used on a corporate network. It is extremely important that this setting of the IP address of the **UCC2** is on a dedicated connection. It is also important that the connection is not "firewalled" at the PC end. You need administrator rights in order to perform this operation.

When it is first installed the **UCC2** does not have any IP address. Turn the **UCC2** on and wait for it to boot up. It will enter its IP configuration state, shown by the Error LED flashing rapidly. (Please be patient; this will take about 15 seconds.)

Now start the UCC IP configuration software on the PC.

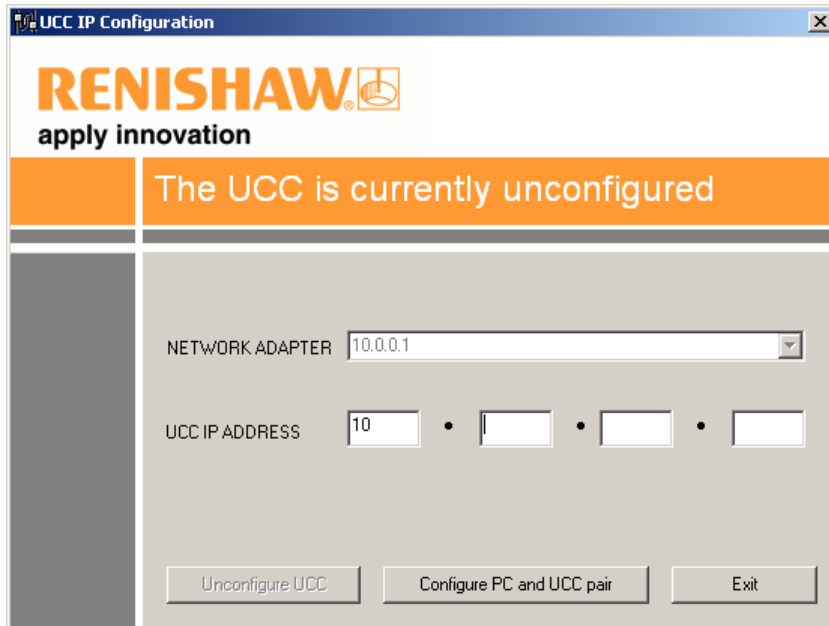
a) Start → UCC Software → IP Configurer



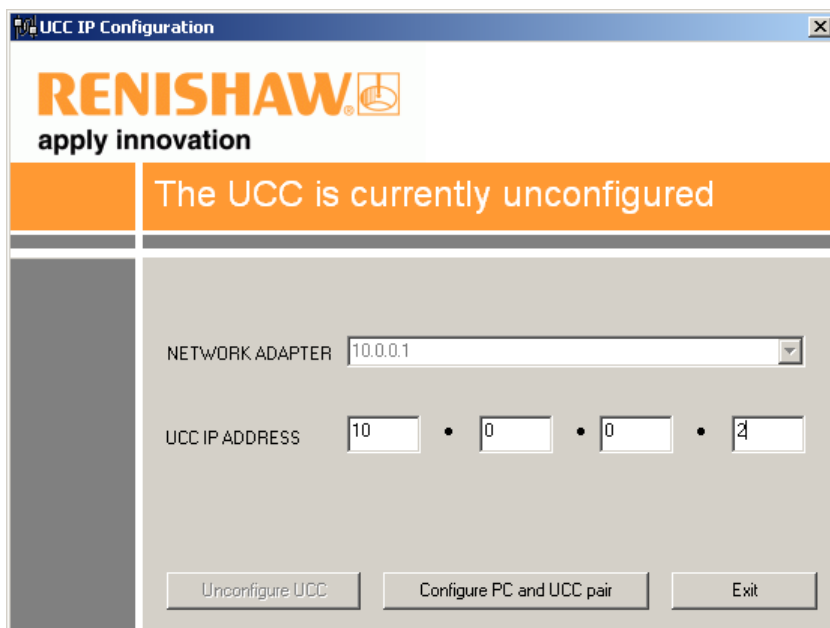
b) Click on the drop-down icon and select the IP address of the network adapter into which the **UCC2** is plugged. (This should be the one on which you set the IP address of in section 3.3.2.)



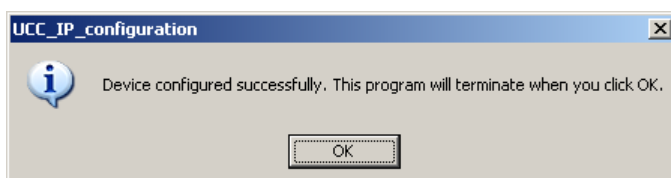
c) You are now told that the **UCC2** does not have an IP address:



d) Fill in the desired IP address – the IP Configuration software has given you a head start by filling in the network part of the address appropriate for the network adapter you have selected. (See section 3.3.1, “IP addressing” for a discussion of the choice and of IP addresses in general.)



e) Click on ‘Configure PC and UCC pair’. If all is well this will result in a confirmatory dialogue box:



---

The **UCC2** will now have moved into its 'waiting for download' state – shown by the error LED flashing slowly.

You have established the UCC2-PC system using the IP addresses of section 3.3.2 and this section.

---

**NOTE:** Whenever you change one of the items in this pairing, e.g. by connecting a different **UCC2** to the PC, you must re-run the **UCC2** IP configuration software to establish the new UCC2-PC system.

---

### 3.3.4 Changing the IP address of the UCC2

If the **UCC2** has an IP address, after booting up it skips its IP configuration state and proceeds into waiting for a download, shown by the error LED flashing slowly. There are two ways to force the **UCC2** into its IP configuration state:-

- a) During the 15 second power up phase, before the error LED comes on, press and release the Reset button on the rear of the **UCC2**. At the end of the power up phase the error LED will flash rapidly indicating it is in the IP configuration state.
- b) If the **UCC2** has already powered up with the error light flashing slowly, i.e. about once per second, or even if the control software has been downloaded, the reset switch will need to be pressed twice. The first time to reset the controller then a second time, within 15 seconds, to force the IP configuration state.

The **UCC2** is now in its IP configuration state, and the **UCC2** IP configuration software can be run on the PC, selecting the appropriate network adapter required. The current IP address of the **UCC2** will be displayed. Type in the new one and click on 'Configure PC and UCC pair'.

### 3.3.5 Establishing a new UCC2-PC pairing

If you connect a different **UCC2** to your PC, or a different PC to your **UCC2**, or even if you modify the network settings on the PC, you must ensure that they are a matched pair. To do this, go through the procedure in section 3.3.2, **even if you do not wish to change the IP address of the UCC2**. (If the IP address is already suitable, then you do not need to re-type it.) Clicking on 'Configure PC and UCC pair' will establish the new pairing.

## 3.4 Downloading

The name of the downloadable file is contrler.uca. UCC1 and other controller downloadables will not work on a **UCC2**. Remember to change the name in any configuration settings appropriate for your front-end.

Your **UCC2** system is now established.

## 4 Connecting the UCC2 to a CMM

The purpose of this chapter is to describe the various connections available within the **UCC2** design to enable connection to a CMM.

This section reviews each **UCC2** connection and gives comments on the preferred methods and available alternatives.

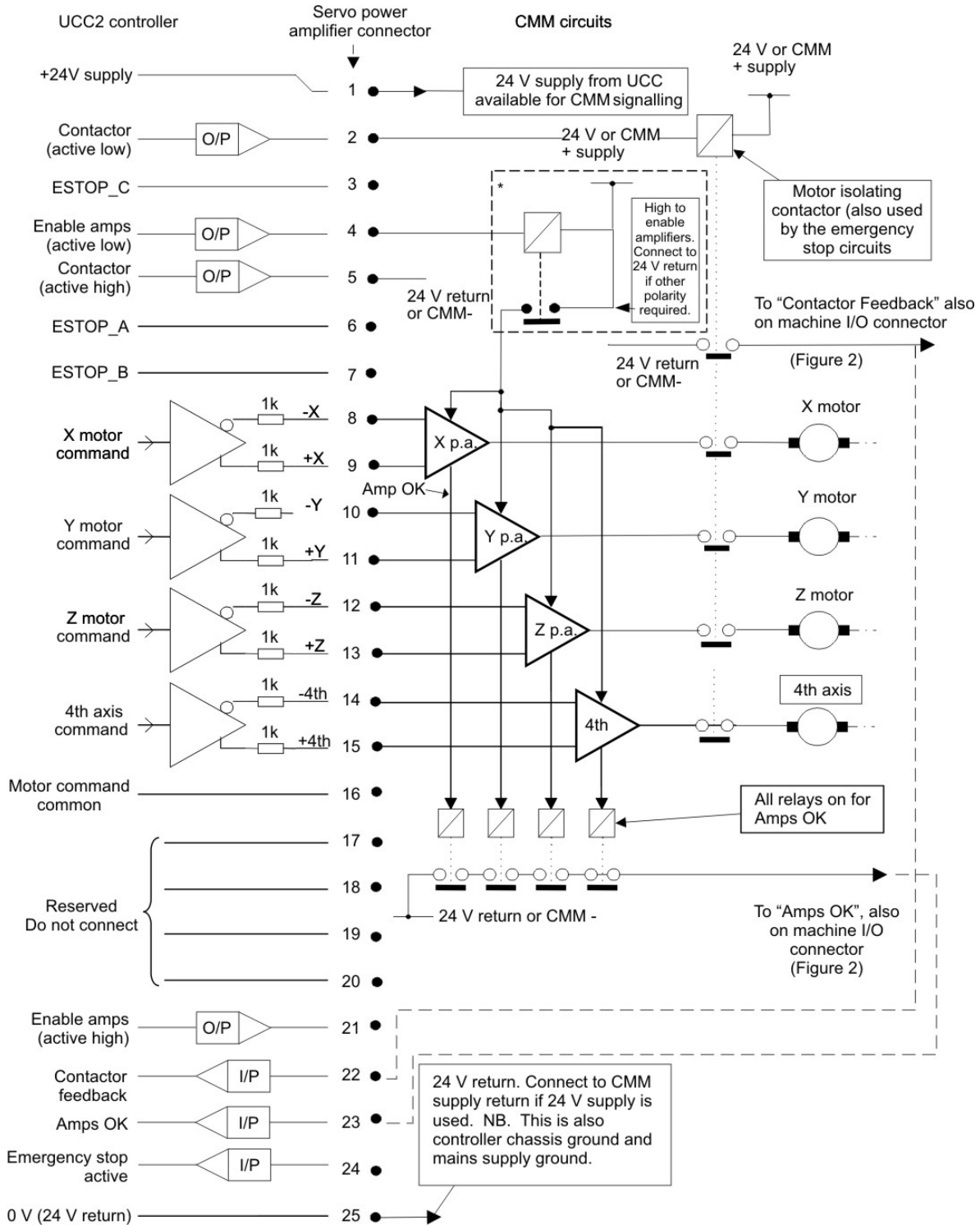


Figure 1 - Suggested wiring to the servo power amplifier connection

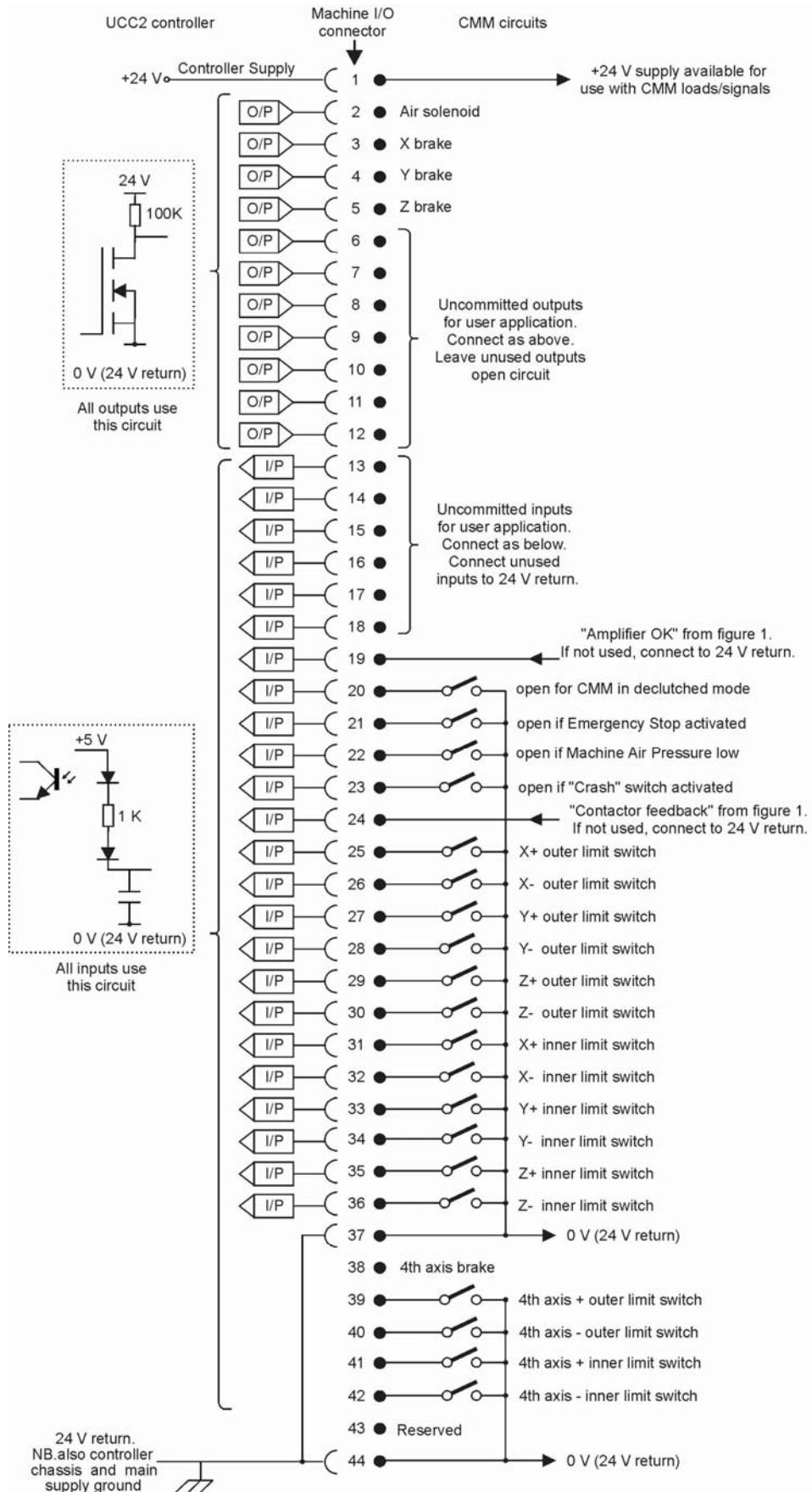


Figure 2 - Suggested wiring to the servo power amplifier connection

## 4.1 The controller's 24 V supply

This supply is available at both the servo power amplifier connector and the machine's I/O connector for use by the CMM signalling circuits. It has a relatively low current rating, see section 5.11, and is thus not suitable for heavy loads.

Please use semiconductors or relays to interface with high power loads or to those which need electrical isolation.

All inputs and outputs (excepting the optically isolated amp control signals) are referenced to this supply.

It is not a floating supply, the 24 V return line is connected to the controller's chassis and to the mains supply protective ground at a star point within the controller.

If there are any interconnections between this supply and any of the CMM's supplies, there is a possibility that an additional path to ground may be created.

A separate supply of similar voltage may be used for signalling purposes in place of the controller's 24 V supply but its negative rail must be connected to the controller's 24 V return line.

## 4.2 Motor engagement via SPA connector

The controller will begin to engage the servo motors when instructed to do so by the host computer, if all the operating functions are in a safe or 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 (refer to Renicis users guide, Renishaw part number H-1000-5058)
- The emergency stop system has been activated
- A PICS 'stop' signal is detected within the system
- The amplifier OK signal not asserted
- An open 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.



---

### 4.2.1 Amplifier enabling

The 'amps OK' signal produced by the amplifier control circuits is an indication to the **UCC2** controller that the servo power amplifiers are not faulty.

The controller 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 connector pin 4 or 5, figure 1). See chapter 6 for its electrical ratings.

This "enable amps", signal will be held on for 0.1 second to allow the 'amps OK' signal, from the servo power amplifier, to become valid. If this signal does not become valid (i.e. pin 19 of the machine I/O connector is not pulled low) the controller will abandon the engagement process. If no error is detected then the controller will wait for a further period of 1 second before beginning the next stage, to allow the amplifiers to settle after any initial transients.

Figure 1 (section 4) 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 shown. The circuits that are used in the installation will vary depending on the amplifiers' requirements but must pull the 'amps OK' input (pin 19) 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 connector, figure 2) are used for this purpose.

If the installer of the CMM makes the decision that the amplifier enabling function is not needed, the 'Enable amps (active low)' signal could be connected directly to the 'amps OK' input signal. This will provide immediate feedback to the controller during the amplifier enabling process and permit the next stage to begin.

---

**NOTE:** This method is not recommended.

---

### 4.2.2 Contactor energising

After establishing that the amplifiers are working correctly, the controller will take the "contactor" signal (pin 2 of the servo power amplifier connector) low, this should be used to signal the servo power amplifier to apply power to the motors. The controller will keep this output signal low for 0.2 of a second during which it expects the 'contactor feedback' input (machine I/O connector pin 24) 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 the amp control signals (pins 4+5) are turned off and the motor engagement process is stopped.

If the 'contactor feedback' signal is received within this 0.2 second window, the controller keeps all motor commands at zero for another 1.0 second before allowing the servo system to begin operating. This is intended to give further protection against sudden machine movements when engaging the motors.

If the installer of the CMM makes the decision that the contactor energising function is not needed, the 'contactor' signal (pin 2) can be joined to the 'contactor feedback' input signal (pin 22). This will provide immediate feedback to the controller during the contactor energising process and permit the next stage to begin.

---

**NOTE:** This method is not recommended.

---

### 4.3 Motor command signals

The **UCC2** controller generates complementary motor velocity command signals for each axis (X axis = pins 8+9, Y axis = pins 10+11, Z axis = pins 12+13, 4th axis = pins 14+15).

Each motor velocity signal is capable of a swing of +/-10 Vs centred on a zero velocity command of 0 Vs. A motor "command common" connection is provided to define this 0 V level (servo power amplifier connector, pin 16, figure 1).

The motor command common signal is also connected to the 24 V supply return, the controller chassis and the mains supply protective ground at a star point within the controller. Care may be required in its application.

The controller's setting up process (detailed in the Renicis users guide H-1000-5058) will help the user to set his power amplifier gains such that the maximum command signal (+/- 10 V) will produce 125% of the required maximum machine 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 1k ohm to protect the controller from inadvertent damage and this will reduce the drive signal to the power amplifiers if their inputs are of low impedance. The 'RENICIS' setting up program provided with the controller will compensate for this automatically.

### 4.4 Motor command polarity

For each axis, the motor command +ve pin will go negative with respect to the command common line to produce a positive change of position.

The motor command -ve pin will go positive at the same time.

### 4.5 Brakes

These outputs have not yet been activated. Do not make connections to these outputs.

---

## 4.6 Air solenoid

This output has not yet been activated. Do not make connections to this output.

## 4.7 Switched outputs

The **UCC2** has the following uncommitted switched outputs, please refer to section 5.11.2 for details :

There are 7 uncommitted outputs available on the **UCC2** I/O connector, pins 6 to 12 are allocated to be outputs 0 to 6 consecutively. The UCC does not directly control these outputs, it merely acts as a post-box. These outputs are controlled from the application software package via command 318 "Write to controller port".

These switched outputs are pulled up to the 24 V rail by a 20 k ohm resistor when inactive, and will be pulled down to the 24 V return line via an NPN transistor when activated. There is an excess voltage protective diode fitted internally to the controller.

The outputs can be activated by a command from the main computer to the controller. If not being used they should be left open circuit.

## 4.8 Switched inputs

The **UCC2** has the following controller switch inputs, please refer to section 5.11.3 for details:

There are 6 uncommitted inputs available on the **UCC2** I/O connector, pins 13 to 18 are allocated to be inputs 0 to 5 consecutively. The UCC does not directly read these inputs, it merely acts as a post-box. These inputs are read by the application software package via command 279 "Read from controller ports".

The controller provides 29 inputs of this type. See chapter 5 for their electrical ratings.

Each input is connected to an LED fed from the +24 V rail, and is activated by being pulled down to the 24 V return line. The LED is part of an opto-coupler which is used to give the controller some isolation from unwanted electrical signals on the input wiring.

### 4.8.1 Limit switches

Sixteen inputs are allocated to limit switch signals, 8 inner and 8 outer. When a limit switch is not activated (i.e. the machine is within its working range) these inputs should be connected to the 24 V return line by the limit switch contacts. If the machine installation does not require the connection of the limit switches the signals must be connected to the 24 V return line.

---

**NOTE:** Limit switches should be installed such that they will not be damaged in the event of overtravel. Where necessary for safety related functions, they should be of the direct (or positive) operating type to IEC 60947-5-1).

---

### 4.8.2 Amplifier OK and contactor feedback

The 'amplifier OK' and the 'contactor feedback' inputs have been discussed in sections 4.2.1 and 4.2.2.

### 4.8.3 Fatal fault

Three 'Fatal Fault' inputs are provided: emergency stop, machine air pressure low and a 'Crash Switch' input. This last is intended for use with a sensing mechanism which detects an unintended contact between the machine's moving and fixed components. The controller monitors these inputs and will stop the motors if one or more input goes open circuit or high. If not required these inputs should be connected to the 24 V return line.

---

**NOTE:** The 'emergency stop' input is not a primary safety device, although the controller will stop the motors as far as it can. Its main use is to allow the controller to inform the main computer, and hence the operator, of the 'emergency stop' switch actuation. In addition it will prevent motor re-engagement if the 'emergency stop' switch is still activated. Where an electromechanical controlled emergency stop is required, to IEC/ EN60204-1 category 0, it must be separately provided and external to the **UCC2**.

---

### 4.8.4 Declutched mode

The 'CMM in declutched mode' input is intended to tell the controller that the driving motors are mechanically disconnected from the machine, and that the machine may be moved by some other means, e.g. by hand. In this state, the motor commands will be kept at zero velocity until the machine clutches are re-engaged, at which time the controller will resume servo control at the new machine position. For normal servo operation, this input should be pulled down to the 24 V return line. If this function is not required, the input should be connected to the 24 V return line.

### 4.8.5 Uncommitted inputs

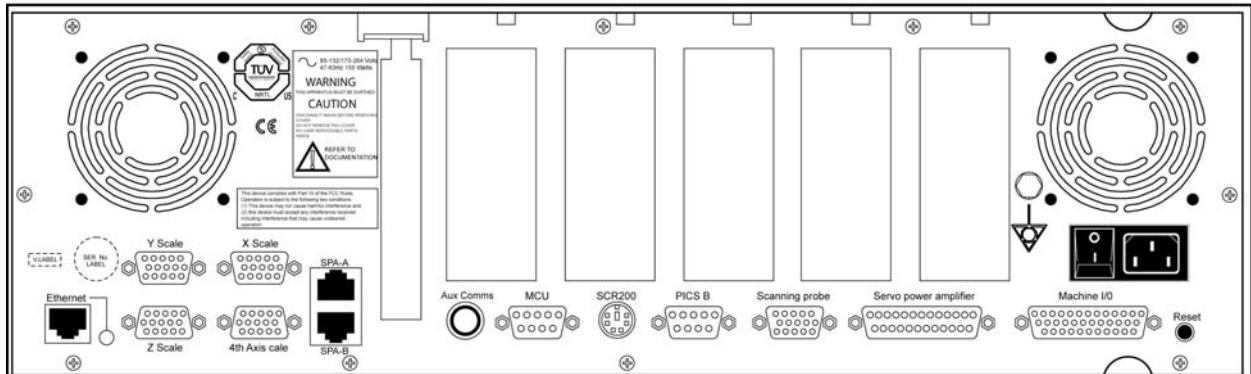
The remaining six inputs are uncommitted and may be used as required. These signals are not used by the controller and are simply passed to the main computer, on request. If not required these inputs should be connected to the 24 V return line.

## 5 Connectors and signals

The purpose of this chapter is to describe in detail the pin-outs of the connectors mounted at the rear of the **UCC2** controller and to show examples of relevant circuit diagrams for the input and output circuits.

### 5.1 Overview

The connectors on the rear panel of the **UCC2** controller enclosure are shown below:



The pin-out of each connector, and its purpose, is described in the following sections.

### 5.2 Ethernet connection

This is a standard RJ45 connector providing the Ethernet connection between the **UCC2** and the PC hosting the application software. Connection between these two units must be made using a standard, Cat 5e, cross-over type Ethernet cable.

### 5.3 CMM readhead input connections

The X, Y, Z and “4<sup>th</sup> Axis” measuring scale readhead input connectors are high density 15-way ‘D’ sockets.

The X, Y and Z axis scale readheads of the CMM must be connected to the relevant socket on the rear panel of the **UCC2** enclosure.

Similarly the 4th axis scale readhead (dual axis or rotary table capability), if required, must be connected to the socket (marked 4<sup>th</sup> axis) on the rear panel of the **UCC2** enclosure.

**Suggestion:** Label all readhead connectors to avoid cross connection, if removed and replaced in the future.

The four CMM readhead sockets are wired to the same pin-out, suitable for direct connection to Renishaw RGH22 and RGH24 scale readhead wiring.

**NOTE:** Other manufacturers’ readheads and interpolators may require an external adapter to enable them to use the Renishaw standard readhead connector wiring. They may also not produce an error signal to the RS-422 specification.

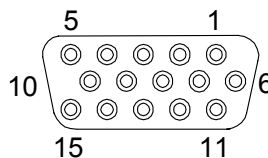
The **UCC2** supplies a servoed 5 V dc power supply for the readheads. See chapters 5.3 and 10.4 for details.

If standard Renishaw cables are used, the recommended cable sizes are 3 m of head cable and 15 m of extension cable, or an equivalent combination. That the head cable is 5 times the resistance of the extension cable, e.g. 4 m of head cable and 10 m of extension cable.

Even with the servoed 5 V supply it is still important that the cable resistance is kept to less than 2 ohms.



**CAUTION:** The connection of the cabling should be such that the CMM's movements, as reported by the **UCC2**, are of the correct polarity i.e. machine movement in a positive direction along any axis should give positive change of position as reported to the host computer by the **UCC2** controller. Adjust this, if required, by reversing the inputs of the scale readhead signal (change over +A with +B and -A with -B).



**Figure 3** - Readhead connector, view on face of sockets (rear of plugs)

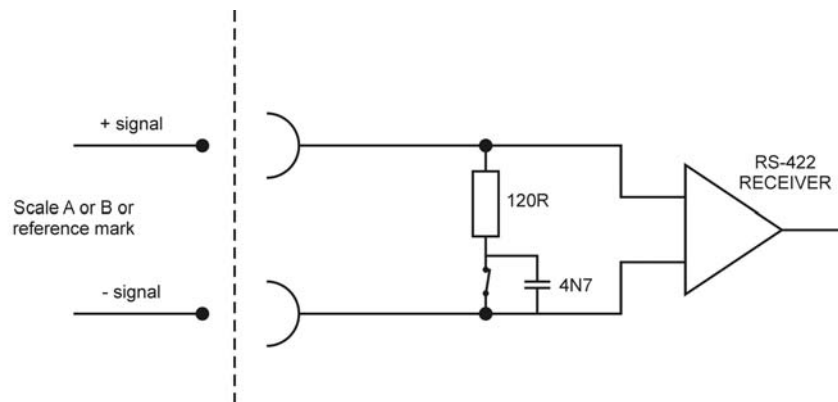
Pin number	Function
1	External set up
2	0 V supply from <b>UCC2</b>
3	- Error
4	- Reference mark
5	- B signal
6	- A signal
7	+5 V supply from <b>UCC2</b>
8	+5 V sensing
9	0 V sensing
10	Limit switch P
11	+ Error / limit switch Q*
12	+ Reference mark
13	+ B signal
14	+ A signal
15	Inner screen
Shell	Screen

\* The UCC2 is capable of supporting both single and dual limit-switch RG22 readheads. The electronic circuits can interface either type without any intervention but the correct type must be set in the machine "ini" file. If dual limit types are fitted pin 11 functions as the second limit switch. If single types are fitted then pin 11 becomes the +Error signal.

**NOTE:** The 0 V supply and the 0 V sensing leads are connected together at the readhead. The +5 V supply and +5 V sensing leads are similarly connected at the readhead. It is important that all the cable cores are connected to ensure the voltage drop is compensated for.

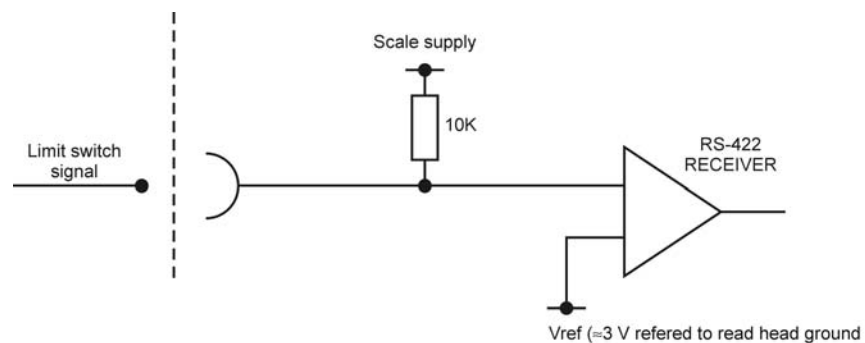
### 5.3.1 CMM readhead interface circuit

The signals from a readhead or interpolator should be to EIA specification RS-422.

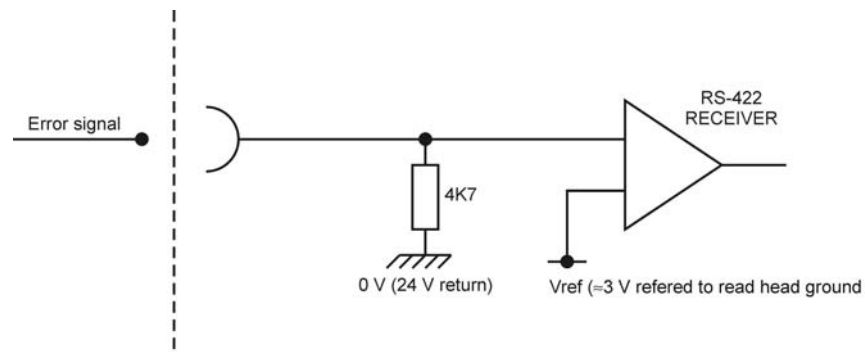


**Figure 4 - UCC2 input circuit for CMM readhead – scale and reference mark inputs**

**NOTE:** If error inputs are not used or the readhead type is RGH24, tie the +error input to 0 V and the – error input to +5 V.



**Figure 5 - UCC2 input circuit for CMM readhead – limit switch inputs**



**Figure 6 - UCC2 input circuit for CMM readhead – error input**

### 5.3.2 Adjusting readhead supply voltage

It is strongly recommended that the sense lines are connected to the readhead so that the adjustment of the supply voltage, to compensate for cable drop, is automatic. However, there are some circumstances where this is not practical and we have provided a manual method of boosting the supply voltage.

In the .ini file there is a section called ReadHeadPSU which contains three parameters per axis. These parameters are termination type, enable and voltage.

**Termination type** – controls the controller readhead circuits to provide either AC termination (0) or DC termination (1) [recommended].

**Enable** – This is set to 0 as a default which allows the normal automatic voltage servo to operate. If it is set to 1, then the readhead supply voltage can be manually set.

**Voltage** – This is the manual readhead voltage setting. It is only read when the enable is set to 1 and the allowable range is 5.0 V to 7.5 V.

---

**NOTE:** You must ensure that the voltage at the readhead is within the range  $5\text{ V} \pm 5\%$  (i.e. must not exceed 5.25 V).

---

## 5.4 SPA2 connector A and B

This a pair of standard RJ45 connectors that support the high speed communication links to and from the **SPA2** servo power amplifier. See **SPA2** installation guide (Renishaw part number H-1000-5234) for details.

## 5.5 Aux comms

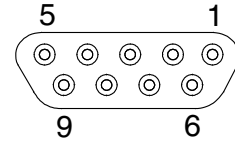
This connector is reserved for future use, no connections should be made to it.



## 5.6 MCU connector

This is a 9 pin D plug suitable for direct connection to the MCU1 joystick unit.

Pin number	Function
1	Ground
2	RX_B
3	RX_A
4	TX_A
5	Reserved
6	+15 V
7	TX_B
8	ESTOP_B
9	ESTOP_A
Shell	Screen

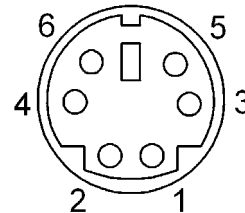


**Figure 8** – MCU connector. View on face of socket (rear of plug)

## 5.7 SCR200 connector

This is a 6 pin miniature DIN socket suitable for direct connection to the SCR200 stylus change rack.

Pin number	Function
1	Remote reset
2	Error
3	Inhibit
4	Rack power
5	0 V
6	Not connected
Shell	Screen

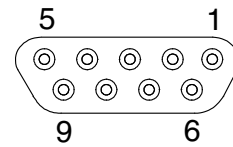


**Figure 9** - SCR connector. View on face of socket (rear of plug)

## 5.8 PICS connector

This socket is intended for use with any of the range of Renishaw touch-trigger probes, including the TP200. The connector is a 9 pin miniature D socket, pinout as follows:

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



**Figure 10** - PICS connector. View on face of socket (rear of plug)

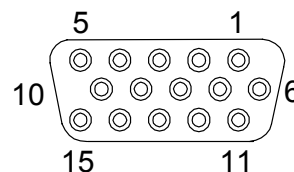
## 5.9 Scanning probe connector

The plug on the cable from the analogue probe connects to the 15-way high-density 'D' socket on the rear panel of the **UCC2**.

This socket is intended for use with the Renishaw TP2, TP6, TP20 and TP200 touch-trigger probes and the SP25 and SP600 series of analogue scanning probes.

The pin-out of the socket is as follows:

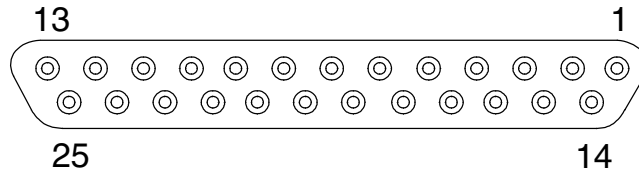
Pin number	Function
1	+5 V supply
2	Not connected
3	Probe common
4	B signal
5	C signal
6	+12 V supply
7	-12 V supply
8	Probe identification
9	Not connected
10	Overtravel
11	A signal
12	0 V reference
13	Touch-trigger probe signal
14	Fixed probe head LED cathode
15	Fixed probe head LED anode
Shell	Screen



**Figure 11** - Scanning probe connector. View on face of socket (rear of plug)

## 5.10 Servo power amplifier connector

The **UCC2** has the ability to connect to either a SPA1 or 3<sup>rd</sup> party servo power amplifier system through this 25-way D-type socket on its rear panel. A 24 V dc supply is also provided by the **UCC2** through this connector to energise the CMM status switch.



**Figure 12** - Servo power amplifier connector. View on face of socket (rear of plug)

Pin number	Function	Description	Refer to section
1	+24 V dc	Supply provided for use with CMM status switches	5.10.1
2	Contactor (active low)	Output signal to control motor contactor (active low)	5.10.2
3	ESTOP_C	ESTOP system - reset signal	5.10.3
4	Enable Amps (active low)	Command to SPA to enable amplifiers (active low)	5.10.4
5	Contactor (active high)	Output signal to control motor contactor (active high)	5.10.2
6	ESTOP_A	ESTOP signal from MCU1 / Joystick	5.10.5
7	ESTOP_B	ESTOP signal from MCU1 / Joystick	5.10.5
8	-X command	Differential output to CMM X drive motor	5.10.6
9	X command	Differential output to CMM X drive motor	5.10.6
10	-Y command	Differential output to CMM Y drive motor	5.10.6
11	Y command	Differential output to CMM Y drive motor	5.10.6
12	-Z command	Differential output to CMM Z drive motor	5.10.6
13	Z command	Differential output to CMM Z drive motor	5.10.6
14	-4 <sup>th</sup> axis command	Differential output to CMM 4 <sup>th</sup> axis drive motor	5.10.6
15	4 <sup>th</sup> axis command	Differential output to CMM 4 <sup>th</sup> axis drive motor	5.10.6
16	Command common	Reference line for power amplifiers	5.10.7
17	Reserved		5.10.8
18	Reserved		5.10.8
19	Reserved		5.10.8
20	Reserved		5.10.8
21	Enable Amps (active high)	Command to SPA to enable amplifiers (active high)	5.10.4
22	Contactor feedback	Confirmation of contactor operation	5.10.9
23	Amps OK	Confirmation from the servo amplifiers that they are ready	5.10.10
24	ESTOP tripped	Indication from the SPA that the ESTOP signal is asserted	5.10.11
25	24 V return	Common reference line for supply and contactor signals	5.10.12
Shell	Screen		

### 5.10.1 +24 V dc

+24 V dc supply provided for the use of contactors, relays and other motor control circuits. Current limit 1.0 Amps

### 5.10.2 Contactor

This command is issued by the **UCC2**, to the SPA, 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.

### 5.10.3 ESTOP\_C

This is the ESTOP reset line from the servo power amplifier. It is made available to the **UCC2** plug in daughter-card slots for incorporation by products that need to be aware or pass on this signal's status. It is part of the "category 2" ESTOP system supported by the **UCC2** and **SPA2** controller system.

### 5.10.4 Enable amps

This is a command from the **UCC2** to the SPA 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.

### 5.10.5 ESTOP\_A and ESTOP\_B

These are the connections from the SPA ESTOP system to the joystick / MCU mounted emergency stop switch. ESTOP\_A is the high end and ESTOP\_B is the return. The ESTOP\_B signal is also made available to the **UCC2** plug in daughter-card slots for incorporation by products that need to be aware or pass on this signal's status. A rotary table is a good example of where it needs to be incorporated as part of the ESTOP system.

### 5.10.6 Axis command signals

These outputs (pins 8 to 15) are the velocity demand signals for each axis from the **UCC2** to the servo power amplifiers. They vary over the range +10 V to -10 V.

### 5.10.7 Command common

An analogue reference zero is available to the servo power amplifiers but this signal is not used by our SPA1 and **SPA2** amplifiers although some third party units do require this reference. It is important that this is not used as a 0 V return for digital signals because this will inject noise into the velocity demands. This pin (16) should be left open circuit if not required.

### 5.10.8 Reserved

These pins (17 to 20) have high-speed serial communication driver / receivers connected to them, they are intended for future development. It is important that these pins should be left open circuit.

---

### 5.10.9 Contactor feedback

This is a confirmation signal from the motor contactor to the **UCC2** that it has successfully operated and the motors are now engaged. This signal was on the I/O connector (pin 24) for the UCC1 and is still available on that connector on the **UCC2** for backwards compatibility reasons.

### 5.10.10 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. This signal was on the I/O connector (pin 19) for the UCC1 and is still available on that connector on the **UCC2** for backwards compatibility reasons.

### 5.10.11 ESTOP tripped

This input (pin 24) is used to inform the **UCC2** of the CMM 'Emergency Stop' condition (ESTOP). If the input pin is pulled down to 0 V (24 V return) the **UCC2** will assume that there is no emergency stop active and allow the servo motors to be energised. This input is also on the I/O connector pin 21.

If the input pin is open-circuit or near +24 V the **UCC2** will assume that the emergency stop is active and will disable all motors and inform the host computer of the event.

---

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

---

### 5.10.12 0 V (24 V return)

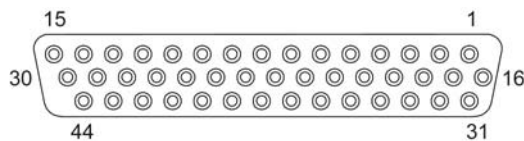
This is the 0 V reference connection for all the digital and switching signals, unless otherwise stated the 0 V connections from all external devices should be connected to this line. This signal line is available on pin 25 on the SPA connector and pins 37 and 44 of the I/O connector. It is taken to a star point within the **UCC2** 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 0V and ground connections are made.

## 5.11 Machine I/O connector

The plug on the cable from the CMM connects to the 44 way miniature (high density) socket on the rear of the panel of the **UCC2**.

The input/output (I/O) signals to/from the **UCC2** controller are:

- Emergency stop switch
- Machine air pressure switch
- Crash switch
- Contactor feedback
- X+ and X-, Y+ and Y-, 4th axis- and 4th axis+, Z+ and Z- inner and outer limit switches of the CMM
- General purpose outputs and inputs
- 24 V dc supply and return



**Figure 13** - Machine I/O connector, view on face of socket (rear of plug)

Pin number	Function	Description	Refer to section
1	+24 V DC	Supply provided for use on CMM switches	5.11.1
2	Air solenoid	Reserved for future use	
3	X brake	Reserved for future use	
4	Y brake	Reserved for future use	
5	Z brake	Reserved for future use	
6	Output 0	General purpose output signal	5.11.2
7	Output 1	General purpose output signal	5.11.2
8	Output 2	General purpose output signal	5.11.2
9	Output 3	General purpose output signal	5.11.2
10	Output 4	General purpose output signal	5.11.2
11	Output 5	General purpose output signal	5.11.2
12	Output 6	General purpose output signal	5.11.2
13	Input 0	General purpose input signal	5.11.3
14	Input 1	General purpose input signal	5.11.3
15	Input 2	General purpose input signal	5.11.3
16	Input 3	General purpose input signal	5.11.3
17	Input 4	General purpose input signal	5.11.3
18	Input 5	General purpose input signal	5.11.3
19	Amplifier OK		5.11.4

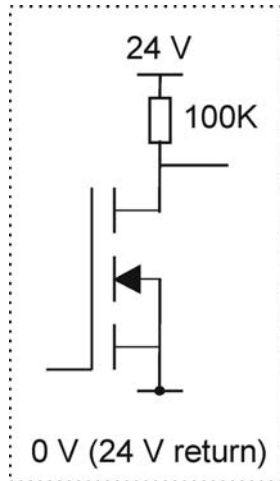
20	CMM declutch		5.11.5
21	ESTOP tripped		5.11.6
22	Air pressure	Machine air pressure switch input	5.11.7
23	Crash	Crash detector switch input	5.11.8
24	Contactator feedback	Contactator input signal	5.11.9
25	X axis outer limit	CMM X axis limit switch input	5.11.10
26	-X axis outer limit	CMM X axis limit switch input	5.11.10
27	Y axis outer limit	CMM Y axis limit switch input	5.11.10
28	-Y axis outer limit	CMM Y axis limit switch input	5.11.10
29	Z axis outer limit	CMM Z axis limit switch input	5.11.10
30	-Z axis outer limit	CMM Z axis limit switch input	5.11.10
31	X axis inner limit	CMM X axis limit switch input	5.11.10
32	-X axis inner limit	CMM X axis limit switch input	5.11.10
33	Y axis inner limit	CMM Y axis limit switch input	5.11.10
34	-Y axis inner limit	CMM Y axis limit switch input	5.11.10
35	Z axis inner limit	CMM Z axis limit switch input	5.11.10
36	-Z axis inner limit	CMM Z axis limit switch input	5.11.10
37	24 V return	Common reference line for input and output signals	
38	4 <sup>th</sup> Axis brake	Reserved for future use	
39	+4 <sup>th</sup> Axis outer limit	CMM 4 <sup>th</sup> Axis limit switch input	5.11.10
40	-4 <sup>th</sup> Axis outer limit	CMM 4 <sup>th</sup> Axis limit switch input	5.11.10
41	+4 <sup>th</sup> Axis inner limit	CMM 4 <sup>th</sup> Axis limit switch input	5.11.10
42	-4 <sup>th</sup> Axis inner limit	CMM 4 <sup>th</sup> Axis limit switch input	5.11.10
43	Reserved	Reserved for future use	5.11.7
44	24 V return	Common reference line for input and output signals	5.11.11
Shell	Screen		

### 5.11.1 +24 V DC

+24 V dc supply provided for the use of contactors, relays and other motor control circuits. Current limit 1.0 Amps.

### 5.11.2 UCC2 general purpose outputs

These 7 transistor output signals (pins 6 to 12) are switched on and off by commands from the host computer (See the UCC programmers guide, command number 318). The outputs are active low.



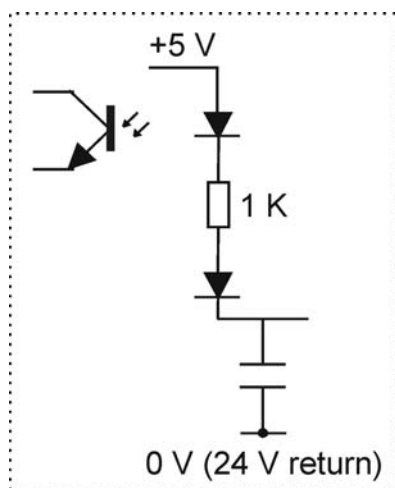
- Absolute maximum voltage rating 55 V dc
- Recommended maximum voltage 48 V dc
- Recommended maximum current 1.0 A
- The output is protected against higher currents but the output state may change due to thermal shutdown.

Figure 14

When the output is not activated the transistor is not switched on and the output pin is loosely pulled high (+24 V) via a 100K resistor. When the output is activated, by sending a '1' to the relevant control bit the transistor will turn on, pulling the output pin down to the 24 V return line.

### 5.11.3 UCC2 general purpose inputs

These 6 opto-isolated LED inputs (pins 13 to 18) to the **UCC2** can be used to send signals from the CMM to the CMM host computer via the **UCC2** (see the UCC programmers guide, command number 279). Pulling an input pin low, towards the 0 V (24 V return line) will cause the controller to return a '0' in reply to the read command.



- Absolute maximum voltage rating 55 V dc
- Recommended maximum voltage 48 V dc

Figure 15



#### 5.11.4 Amplifier OK input

This signal (pin 19) is produced by the servo power amplifier to inform the connected **UCC2** controller that ALL the servo power amplifiers have been successfully enabled, it is an active low signal i.e. pulled to 0 V (+24 return) to indicate success. This signal is a response to an active 'amp control' signal from the controller. This signal is also available on the SPA connector pin 23.

#### 5.11.5 CMM declutch

This input on pin 20 should normally be pulled down to the 24 V return 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 a CMM has been temporarily 'de-clutched' from its 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 position when the signal again goes low.

#### 5.11.6 ESTOP tripped

This input (pin 21) is used to inform the **UCC2** of the CMM 'emergency stop' condition (ESTOP). This signal is also available on the SPA connector pin 24.

If the input pin is pulled down to the 24 V return line, the **UCC2** will assume that there is no emergency stop active and will allow the servo motors to be energised.

If the input pin is open-circuit or near +24 V the **UCC2** will assume that the emergency stop is active and will disable all motors, and inform the host computer of the event.

---

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

---

#### 5.11.7 Air pressure switch

The machine air pressure input signal (pin 22) should be generated by a CMM air-pressure monitoring transducer which should pull the input down to 0 V (24 V return line) if an adequate air supply pressure is available.

This input is not pulled down, the **UCC2** will disable all motors and will inform the CMM's host computer of the low air pressure.

This feature is not required, the input should be permanently connected to the 24 V return line.

#### 5.11.8 Crash switch

This input signal (pin 23) is used to stop the CMM movement if there is a collision involving parts of the CMM and probe system, as detected by a switching mechanism.

The crash switch should pull the input down to the 24 V return line. If the input is not pulled down, the **UCC2** will disable all motors, and inform the CMM's host computer of this state.

### 5.11.9 Contactor feedback

This input signal (pin 24) is used by the **UCC2** to monitor the operation of the axes drive motors control contactor. This signal is also available on the SPA connector pin 5.

When the contactor is energised (drive motors enabled), this signal should be pulled down to the 24 V return line to indicate that motor power is available.

If the **UCC2** has turned on the 'contactor' output (servo power amplifier socket, pin 2) and the signal on pin 24 indicates that the contactor has not operated, after a short delay the **UCC2** will disable the drive motors and inform the CMM host computer of this fault.

### 5.11.10 Limit switches

The **UCC2** will use these input signals (pins 25 to 36 and 39 to 42) to stop the CMM as programmed by the host computer (See the UCC programmers guide, command number 311).

All outer limit switches have to be closed before the CMM's drives can be engaged. Operation of these switches is interpreted as a fatal fault. If any of them is operated, all the CMM's axes servo drive motors are automatically disengaged. These signals cannot be overridden by a software command. Recovery from an outer limit operation is either by manually pushing the machine "off" the limit switch or by a separate override switch provided by the CMM's manufacturer / retrofitter.

When a CMM actuates an inner limit switch on any of its axes, all CMM axes are decelerated, stopped and backed off in the opposite direction as if it were a touch-trigger event. The inner limit switches can be overridden by a software command for error mapping or collision recovery purposes, see command number 311, control limit switch override, in the programmer's guide.

### 5.11.11 24 V return

This is the 0 V reference for all of the I / O signals and is available on pins 37 and 44.

## 5.12 Reset button

The rear panel reset button has two different functions. Its function depends on what operational state the controller is in.

- a) If the unit has just been switched on and is in the stage before it is ready for download i.e. approximately a 15 second window from switch-on, pressing and releasing this button will force the controller into the IP configuration state. See section 3.3.3 for details.
- b) If the controller is ready for download, or if the control software has been downloaded (in the operational state), operation of this button will force a reset, i.e. the software will restart as if the unit had been switched "off" then "on" again.

If you wish to enter the IP configuration state when the controller is ready for download, or is running the control software, then two presses of this button, with a momentary pause between them, will achieve this state.

### 5.13 Daughtercard slots

Inside the **UCC2** controller is a Renishaw proprietary bus system for connecting additional interfaces in the form of daughter-cards. There is a wide range of additional interfaces available such as a PH10 controller, a SP80 interface, an additional axis (rotary table or dual drive), a temperature interface, etc. This allows the **UCC2** to be correctly configured for the application for which it is being used, and also allows for the integration future products.

### 5.14 PCI interface slot

This is an industry standard PCI interface slot. It is intended for future Renishaw advanced product interfaces.

## 6 Installation of the UCC2 components

The purpose of this chapter is to describe the procedure for installing the CMM's controller, its daughtercards and connections.

### 6.1 General wiring standards

To achieve reliable operation of the **UCC2** and the CMM's host computer, the following should be observed:



**WARNING:** It is essential that the **UCC2** controller is connected to a mains supply earth. The recommended method of ensuring that the controller is earthed is to use the protective earth wiring in the AC supply cable and connector:

Earthing provisions for the complete machine are the responsibility of the manufacturer or installer.

Isolation: **UCC2** is isolated by removing the mains connector. It is the responsibility of the installer or user to fit additional means of isolation if indicated by risk assessment.

Earth fault/residual current protection: It is the responsibility of the machine manufacturer or product installer to ensure an adequate level of protection for the complete machine installation.

---

- Scale readhead signals, reference marks and error signals should comply with EIA RS-422A. It is recommended that each readhead had its own screened cable and that these cables are kept well away from electrically noisy wiring such as motor supplies, etc.
- All opto-isolated inputs and outputs should be separate from other connections to the **UCC2** controller, so that the CMM's electrical system is kept isolated from the circuitry within the controller, with the exception of the 0 V reference and protective grounding.
- The analogue ground ( if daughtercard fitted) for a 3<sup>rd</sup> party joystick compatibility should be dedicated only to that function.
- The analogue ground for the analogue probe connections should be dedicated only to that function.
- 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 protective earth (via the connector shell) at the **UCC2** and SPA end, and not directly connected to the CMM's protective earth. This is to avoid earth loops. However, the protective grounding must be continuous between the controller and all other equipment in the installation.
- All cable connectors should be secured to the **UCC2** by the connector jack screws.

- See also the installation instructions supplied with other Renishaw components in the system, i.e. probes or probe heads etc. Particular attention should be paid to the screening and earthing methods of the cables carrying low level signals from either analogue or touch-trigger probes.

---

**NOTE:** The **UCC2** electronics 0 V rail is connected to the overall ground plane at a star point within the **UCC2** and also to the protective ground of the AC supply.

---

### 6.1.1 Preparations

Before beginning the installation of the **UCC2** check the following items:

- Ensure that all connecting cables, Ethernet link, daughtercards, test equipment and software are available.
- Ensure that the CMM's measuring scales/readheads are correctly installed and are functioning.
- Ensure that all the CMM status and limit switches etc. are correctly installed and have been function checked.
- Ensure that all mains power has been removed from the CMM, CMM's host computer, CMM servo power amplifiers and CMM's axis drive motors etc.
- Ensure that the CMM and the **UCC2** are in their final positions and that all connecting cables are of the required length.

## 6.2 Installation of daughtercards



**WARNING:** It is essential that full anti-static precautions are taken before working within the **UCC2** controller enclosure.

---

To install a daughtercard please refer to the daughtercard installation guide, H-1000-5220

### 6.3 Connecting UCC2 cables to and from CMM

- Attach all CMM cable connectors to the mating sockets on the **UCC2**.
- Secure all cable connectors with the connector jacking screws to ensure physical and electrical connection.
- Secure all cables for strain relief without reducing access for servicing.

## 6.4 Connecting the UCC2 mains supply

- This installation must be undertaken by suitably experienced and / or qualified personnel.
- The **UCC2** contains no user serviceable fuses. It is protected internally from inadvertent current overload by self resetting fuses.
- There is no internal fuse on the mains supply of the **UCC2**. The installer must provide suitable protection. The recommended fuse is a 5 Amp type T (anti-surge) to IEC60127/UL248-14, rated to at least 250 V with a high breaking capacity. Its installation must meet the requirements of IEC61010 and any applicable national wiring regulations for the country of installation.
- The **UCC2** is isolated from AC power by disconnection of the IEC mains connector on the rear panel. If any additional means of isolation is required, it must be specified and fitted by the machine manufacturer or the installer of the product. The isolator must comply with IEC61010 and any applicable national wiring regulations for the country of installation.
- The use of suitable RCD (residual current device), for automatic disconnection in the event of insulation failure is recommended. This should be sited within easy reach of the CMM operator and must meet the requirements of IEC61010 and any applicable national wiring regulations for the country of installation.

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## 7 Mounting the UCC2

The **UCC2** can be installed into either a 19" rack mount system or as a stand alone unit.

The location and mounting arrangement must take account of the environmental requirements for the equipment and accessibility for cabling to the rear panel.

The dimensions of the units are:

Width: 440 mm

Height: 127 mm (3U)

Depth: 330 mm

### 7.1 Stand alone mounting

Four self adhesive rubber feet are supplied with the unit for stand-alone use.

### 7.2 Mounting in a 19" rack

To permit the **UCC2** to be fitted into a 19" enclosure a rack mounting kit is required.

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**NOTE:** The screws supplied with this kit are M5 × 6 mm countersink type. DO NOT replace with longer screws as damage could occur.

---

The following procedure is recommended to fit the rack mounting brackets to the **UCC2**:

1. Position the **UCC2** on a firm flat surface, with either the left or right hand side of the unit placed on the surface and the front of the unit facing towards you.
2. Remove the blanking plugs from the side of the unit, there are two of these located about 15 mm from the front lip on the enclosure and about 15 mm from the top and bottom of the enclosure.
3. Remove the rack mounting kit from its packaging and place one of the countersunk screws supplied in the kit through one of the rack mounting brackets supplied.
4. Align this screw and mounting bracket assembly to the fixing holes in the side of the **UCC2** enclosure, so that the rack mounting flange is flush with the front of the unit, and engage the screw into the mating thread. Do not tighten at this point
5. Align the other fixing location in the rack mounting bracket with the fixing hole in the side of the **UCC2**, and engage the other countersunk screw into the mating thread.
6. Tighten both countersunk screws to ensure a secure fixing.
7. Rotate the **UCC2** such that the other side of the enclosure can be accessed and then repeat steps 2 to 6.

## 8 Renishaw license key manager system

The purpose of this chapter is to describe the Renishaw licence key manager system and the procedure for enabling software upgrades.

The license key system has been designed to allow the OEM and retrofitters to easily upgrade **UCC2** systems by simply entering in a licence key into the controller via the host PC. The upgrades can be done in the OEM factory, or in the field, without the need for hardware dongles or additional extra inventory (extra units configured for different functionality),

The license key system is based on a controller ID that is embedded into the **UCC2** hardware. For each **UCC2** system there is a unique 'key' that is required to unlock the required functionality.

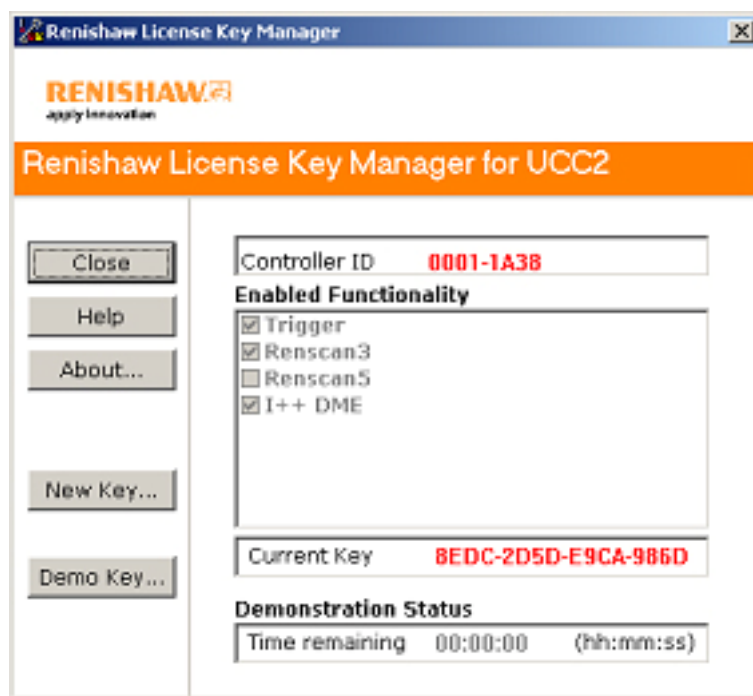


Figure 16- Renishaw licence key manager screen

This 'key' is provided by Renishaw, the process being explained below. Once this 'Key' is entered into the **UCC2**, using the Renishaw license key manager software, it is stored in non-volatile memory. The **UCC2** will remember the 'key' and so once a function is enabled it will remain enabled until a new function is applied.

### 8.1 Using the Renishaw license key manager

When the **UCC2** is received from Renishaw, it will be configured in the touch-trigger state and have the I++DME active.

If only the touch-trigger system was purchased then no further action is required.

However, if additional functionality was purchased (or has been purchased since), the process of upgrading the system must be conducted.



## 8.2 Ordering extra functionality/upgrading

Additional functionality can be enabled by the application of a new 'key'. Before the 'key' can be issued by Renishaw, an order for the upgrade must be placed.

Two pieces of information are required in this process.

1. The controller's ID.
2. A valid order number for the required upgrade.

To read the enabled functions on a controller the connection must be made between the **UCC2** and the PC via the Ethernet link. No other connection to the **UCC2**, other than power, is required at this stage.

Using the Renishaw license key manager software, the controller ID number will be read from the system. The format of the ID is an 8 digit number, hyphenated (e.g. xxxx-xxxx).

This number will be needed to request a new 'key' which will then enable the required function upgrade.

## 8.3 Obtaining the key

To obtain the 'key', the above information needs to be supplied to Renishaw. This can be done by e-mail, fax or even by telephone. See [www.renishaw.com](http://www.renishaw.com).

They will have the capability to generate the unique key required for the unit in question, which will be supplied in a 16 digit hexadecimal number of the form xxxx-xxxx-xxxx-xxxx.

## 8.4 Applying the key

Using the Renishaw license key manager software, the 'new key' button is clicked. The software then prompts the user to enter the 16 digit key. Once entered, the 'key' is stored in the unit and will enable the purchased upgrade. This can be checked by looking at the 'enabled functionality' table. The unit will remember these settings even after it has been powered down.

## 8.5 Demonstration mode

A demonstration mode can be enabled giving 40 run time hours of all available functions.

The purpose of this is for sales demonstrations and short term evaluation. The 'demo key' is obtained from Renishaw using the controller ID number. The key is generated in much the same way as the main key, but is only 8 digits.

The 'demo key' is applied by clicking the 'demo key' button and entering the code.

Once the 40 hours have been used up, this 'demo key' becomes invalid. To use this function again a new 'demo key' must be obtained. It is intended that the 'demo key' is only used a limited number of times. After this number Renishaw will be unable to issue further 'demo keys'.

## 8.6 Repairing upgraded systems

If a unit is returned for repair and it is necessary to send a replacement / exchange unit back, then it will arrive in the touch-trigger functionality state.

At this point, a new 'key' must be obtained. In this case the controller ID will be required and instead of an order number, the repair number, GRA number or the serial number of the original unit returned is required.

## 8.7 Available functionality

### 8.7.1 Triggering

Touch-trigger function supports touch-trigger operation with conventional trigger probes (e.g. TP2, TP6, TP20, etc), electronic trigger probes (TP200, TP7, etc) and trigger operation of analogue probes (SP600, SP25 and SP80).

### 8.7.2 Scan 3

Scanning mode supports all the functions offered by the triggering functionality (as specified above) as well as surface measurement and part measurement modes using dedicated scanning routines.

Specifically these are: -

- Cylinder scan
- Gasket scan
- Grid scan
- Find centre
- RenscanDC™
- 2D scan
- 3D scan
- 2½D scan

### 8.7.3 I++DME

I++DME is an international standard for the command protocol used between an application software package and a CMM controller. The application software uses an I++DME client and the controller uses an I++DME server. Renishaw has produced an I++DME server for the UCC controller family (**UCC*lite***, UCC1 and **UCC2**).

All controllers supplied after January 2006 have this capability activated.

### 8.7.4 Error reporting

If a command is sent to the **UCC2** requiring functionality that is not enabled, the **UCC2** will inform the application software that the command has failed. It will give the 'illegal command' response and this will then be handled by the application software.

## 9 UCC2 troubleshooting

The purpose of this chapter is to provide assistance in diagnosing and rectifying system faults.

### 9.1 Front panel LED displays

To aid troubleshooting of the **UCC2** system, five status LEDs are visible through the front panel of the **UCC2**.

LED					System status	Refer to section
○ = off		● = on				
Power on	System ready	Servo active	Probe seated	Error		
○	○	○	○	○	Power off	9.1.1
●	○	○	○	○	Default start up condition.	9.1.2

#### 9.1.1 UCC2 power not switched ON

All LEDs OFF.

#### 9.1.2 UCC2 power switched ON

Power on LED is lit.

If switch-on is successful the **UCC2** proceeds to the initialisation/test sequence.

### 9.1.3 Initialisation/test

If the initialisation tests fail, then after about 15 seconds three LED configurations are possible, each indicating a different form of failure:

Power on	System ready	Servo active	Probe seated	Error
on	off	off	flashing slowly	flashing fast
on	off	off	off	on
on	off	off	off	off

**NOTE:** These failures are not fixable at the customer's site - if any of these forms of failure are indicated the unit must be returned to your local Renishaw office.

**NOTE:** The state of all LEDs being off except 'power on' is the normal switch-on state (as per section 8.1.1); it only indicates failure if it remains like this beyond about 15 seconds.

Try switching the controller off, waiting about 10 seconds, then turning it on again. If the problem persists, the unit needs attention.

If initialisation tests are successful, the power on LED will remain lit and the error LED will start flashing. A slow flash (approximately 0.5 second period) indicates the system is ready for a download. A fast flash (approximately 0.2 second period) indicates the **UCC2** is in its IP configured state (see chapter 3.3).

### 9.1.4 System file downloading

During system file downloading, the power on LED is lit and the error LED is slowly flashing.

If the system file download fails then the power on, error and system ready (flashing) LEDs will be lit. In this condition, the **UCC2** waits for a system restart. Switch the controller off and after approximately 10 seconds switch it on again.

After a successful download the system is ready for use the power on and system ready LEDs will be lit.

### 9.1.5 Servo active LED

When the servo drives are not active, the servo LED is off.

When the servo drives are active, the servo LED is on.

### 9.1.6 Probe seated LED

When the probe is not deflected (in the case of analogue contact probes, not deflected beyond the trigger threshold zone): probe seated LED is on.

When the probe is deflected: probe seated LED is off

## 9.2 Probe head LED configuration

If a fixed 'multiwire' probe head such as a PH6M is connected to the **UCC2**, its trigger status LED is controlled via the probe (multiwire) connection. When a motorised 'multiwire' probe head such as a PH10M is in use the trigger status LED is controlled via the head (machine cable) connection.

The **UCC2** automatically recognises which type of head is fitted and switches the connections accordingly. Unlike the UCC1 no configuration switches are required.

## 9.3 Fault finding

### 9.3.1 Fatal faults

Some conditions can arise which mean that it is inadvisable or even dangerous to continue using the CMM servo system. These are known in this document, and in the Renicis program, as 'fatal' faults, and are as follows.

- 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

---

**NOTE:** That other faults (not classed as fatal) can prevent the CMMs operation. Refer to following sections.

---

### 9.3.2 Motors will not engage/re-engage

#### Symptoms

Either the servo drives will not engage when the controller has been sent the 'engage' command, or the drives have disengaged automatically and will not re-engage.

#### Possible causes (or reported causes)

After switch on, before the system is allowed to engage, it must be configured for motion (i.e. the machine, servo and move parameters must be sent to the controller).

Any of the "fatal faults" will prevent the system from engaging, in addition the following will disengage the servo motors.

- A reported failure from a servo power amplifier (amplifier feedback signal).
- The absence of the feedback signal from the motor contactor.
- The following list can also inhibit drive engagement or re-engagement.
- The probe being deflected
- Any outer limit switch being operated, or a soft limit exceeded.
- An active PICS STOP signal.
- Specifying the wrong probe type in the machine configuration, since open-circuit analogue probe inputs may eventually drift to an apparently 'deflected' value.

#### Tests/cures

Check each of the above signals using the status flags returned to the host PC, and/or by confirming the values of the actual signals reaching the controller.

Renicis can be used for further help with this by displaying the system status, the status bytes and the PICS signals.

The amplifier and motor contactor feedback signals can also be examined using the 'input signals' window.

A PICS STOP signal may originate from an external accessory such as a probe head controller. If the external device is a Renishaw interface it will indicate it is asserting the PICS STOP by illuminating its own stop led but it may be necessary to remove the PICS connections to peripherals one by one to establish which one is responsible.

Remember, a PICS accessory may produce a STOP signal. Renicis can be used to find the condition causing this, which should then be removed.

### 9.3.3 Poor positioning accuracy

#### Symptoms

The CMM will not finish a move at the correct position. This may occur even if it had reported having reached the target position near the end of the move.

#### Possible causes, tests and cures

Power amplifier offset:

Check this by engaging the servo drives with the position loop open and a zero speed demand (using Renicis), and check that the machine does drift slowly. Use the power amplifier's offset adjustment to reduce the drift to a minimum. See the following paragraph on forces applied by the machine since it may be difficult to distinguish between these effects.

Forces applied by the machine:

Forces such as those caused by elastic deformation of a cable chain attached to an axis, or by gravity if the machine is imperfectly levelled or counter-balanced, will produce a position error which may vary with the machine's position. Correct the mechanical problem as necessary. Do not compensate by introducing a power amplifier offset to cancel the error.

High axis bearing friction:

Move the machine (manually) with the servo drives not energised to search for general or localised high friction. Alternatively, use Renicis to show the following error as the CMM is moved slowly. High friction will cause a larger following error. Adjust or repair the machine as necessary.

Too large a positioning tolerance:

This parameter, set by the 'enter positional tolerance' command, defines the maximum allowed position error at the end of a move. Adjust if necessary, but note that if this is made too small for the CMM's servo capabilities, it will cause time-out failures during moves. See below!

Insufficient position loop gain:

If the machine has previously performed adequately this is unlikely to be the cause but during the tuning process, this problem could occur. If the position loop gain (defined as the axis proportional gain in the 'servo configuration' command) is set too low, the machine may not be able to hold position accurately enough.

Insufficient position loop integration term:

The integration term in the servo position loop is set when the machine is commissioned to give the best compromise between long-term positioning accuracy and machine stability. If the machine has previously performed adequately, the cause is more probably due to some mechanical degradation.

General servo system tuning:

If the CMM has never been set up for optimum servo performance, or has been modified or repaired since this was originally done, this process should be carried out. See the 'UCC servo tuning guide' (H-1000-5227) and also the section on servo filters in the 'UCC Programmer's guide' (H-1000-5057).



### 9.3.4 Controller will not respond to host PC

#### Symptoms

All or some commands from the user's PC are not executed by the controller. See also the 'Cannot start a move/scan' sections below.

#### Possible causes, tests, cures

If only some commands are ignored:

- Check that the **UCC2** is enabled for the type of commands you are sending. If you are sending scanning commands and the controller has not been licensed for scanning, then the commands will not be accepted.
- Some commands are not executed by the controller if it is preoccupied with a previous command. See the programmer's guide for information on individual commands and their handling. The controller state number (from the status bytes in the reply to the 'position and status' command) will indicate whether it is able to execute that command at that time.
- Other commands are ignored if inappropriate for the current circumstances, e.g. asking for a peripheral's data when none is available.

Renicis may make it simpler to carry out these tests if the user front-end software does not give access to such information.

If all commands are ignored:

- Send the 'resync controller' command (#351). If this restores normal operation, the controller was in a locked state due to some internal malfunction. A possible cause is an incorrectly constructed command from the host PC to the controller. If the system is fully commissioned and is being controlled by proven user front-end software, consult the Renishaw support services. If the front-end software is not fully proven in service, the faulty command must be found. Renicis may assist by logging all communications in both directions while the fault conditions are reconstructed. Refer to the **UCC2** programmer's guide.
- Send the reboot controller command (#335). If the front panel LEDs are now extinguished, except the 'power on' and flashing error, download the controller program and reinitialise the controller.
- Power down the controller, wait at least 10 seconds and then power up again. Download the controller program and re-initialise the controller. If this restores normal operation the controller was in a locked state due to some internal malfunction. Proceed as described above.
- Check that the Ethernet cable between the host PC and the controller is in place and undamaged. Reconnect or replace as necessary.

If none of the above tests succeed in solving the problem then it is possible that there is a problem with the communication link between the host PC and the controller. Section 3 describes the IP configuration in detail but in the following sections there some additional checks outlined that you can make.

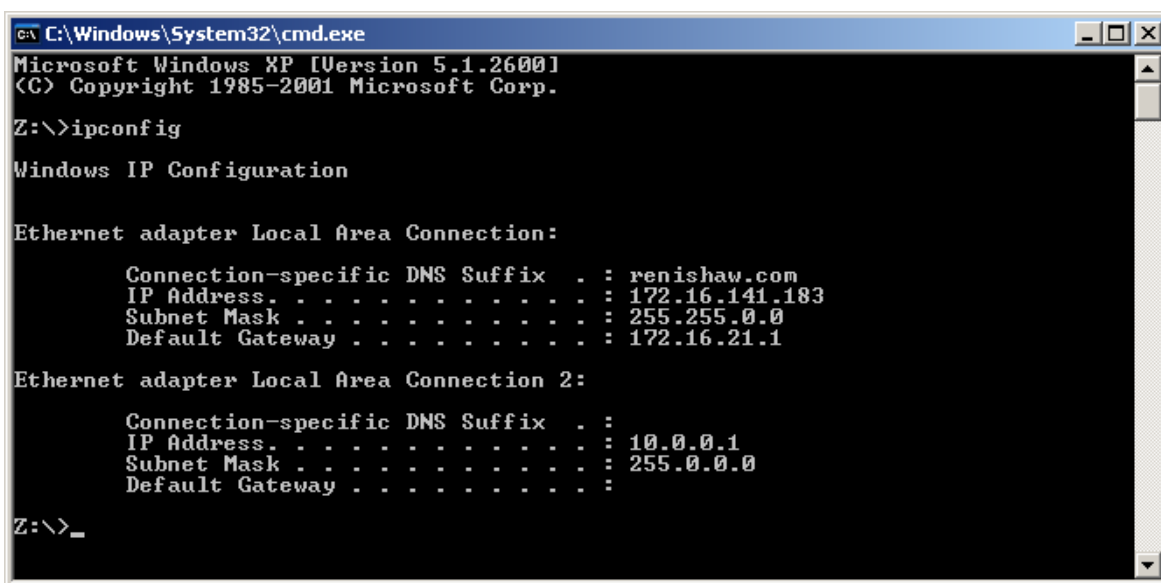
#### 9.3.4.1 Seeing the IP address of a UCC2

Follow the procedure in section 3.3.4, but once you have seen the IP address of the device click on the 'Exit' button.

#### 9.3.4.2 Checking the IP address of the UCC2 with ping

You can check the IP address of a **UCC2** either by running the IP configuration software, as described in section 3.3.3 and 3.3.4, or you can use the command-line utility ping. Ping tests connectivity, so as long as your **UCC2** has an IP address and is either waiting for a download or the downloadable is running, you can check that you have a connection to it by pinging it. This is done as follows:

1. Use ipconfig to ensure that your network adapter is not in the "Media disconnected" state:



```
C:\Windows\System32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

Z:\>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : renishaw.com
    IP Address. . . . .                : 172.16.141.183
    Subnet Mask . . . . .              : 255.255.0.0
    Default Gateway . . . . .          : 172.16.21.1

Ethernet adapter Local Area Connection 2:

    Connection-specific DNS Suffix  . :
    IP Address. . . . .                : 10.0.0.1
    Subnet Mask . . . . .              : 255.0.0.0
    Default Gateway . . . . .          :

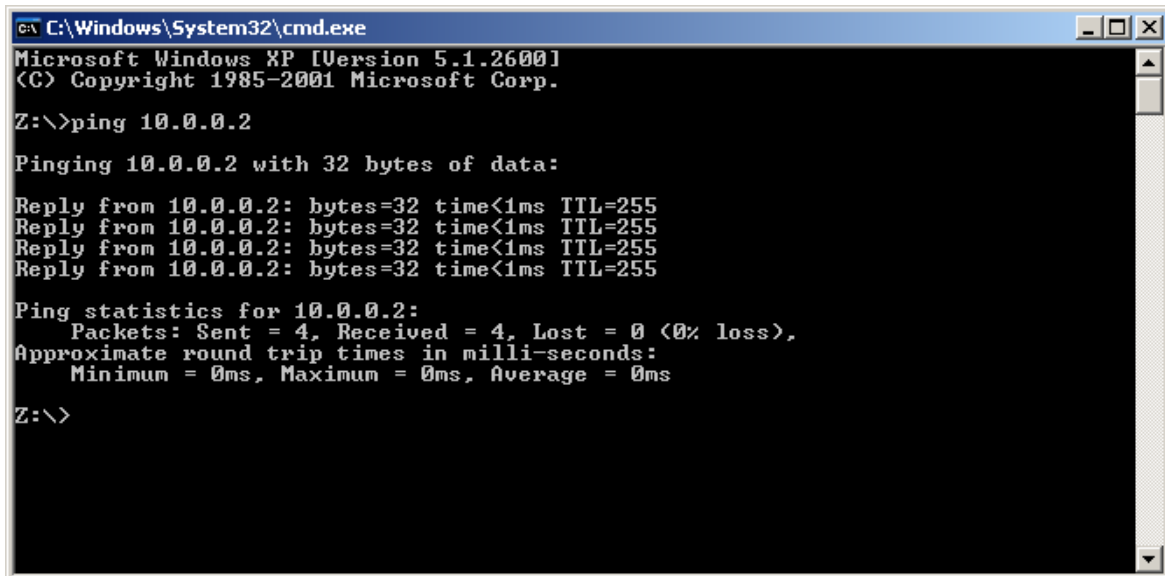
Z:\>_
```

---

**NOTE:** The IP addresses displayed here are those on the PC.

---

- Now ping the **UCC2** using its IP address, e.g. if you think that the **UCC2s** IP address is 10.0.0.2, then a successful ping of it would look like this:



```
C:\Windows\System32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

Z:\>ping 10.0.0.2

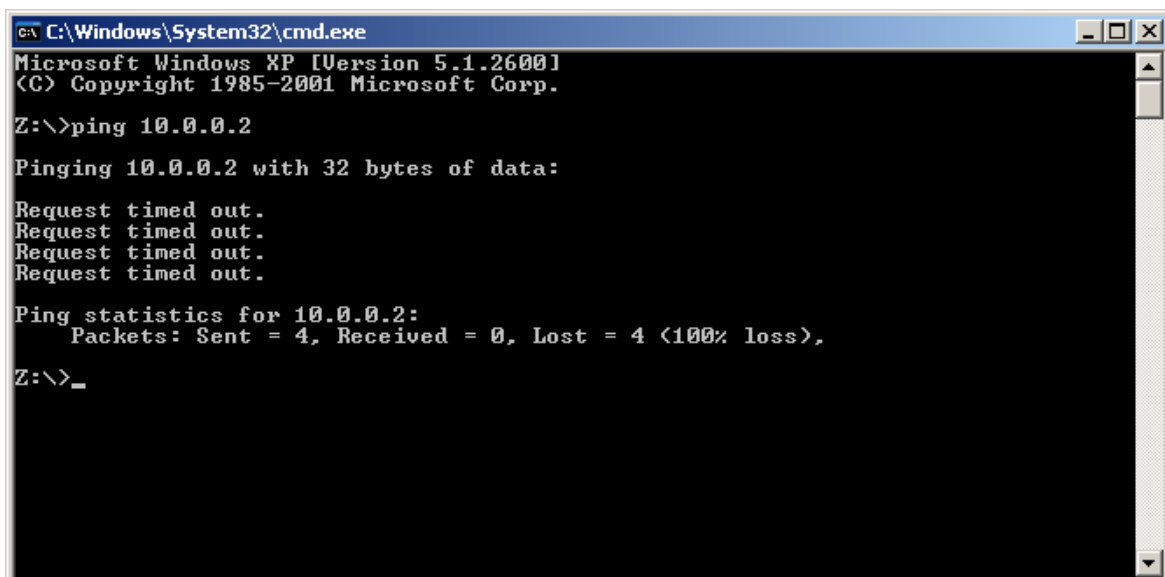
Pinging 10.0.0.2 with 32 bytes of data:

Reply from 10.0.0.2: bytes=32 time<1ms TTL=255
Reply from 10.0.0.2: bytes=32 time<1ms TTL=255
Reply from 10.0.0.2: bytes=32 time<1ms TTL=255
Reply from 10.0.0.2: bytes=32 time<1ms TTL=255

Ping statistics for 10.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

Z:\>
```

The parts which matter in the output are the replies and “0% loss”. If the **UCC2** had a different address then the ping would have looked like the following:



```
C:\Windows\System32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

Z:\>ping 10.0.0.2

Pinging 10.0.0.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 10.0.0.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

Z:\>_
```

Notice the lack of replies and the “100% loss”.

You have to be slightly careful with ping because you can successfully ping yourself! The output of ipconfig (step 1) tells you which IP addresses are associated with your network adapters. Use this information to make sure that you are not pinging yourself and thinking that you have just confirmed your connection with a **UCC2**.

#### 9.3.4.3 “IP configure” software fails to run

If the PC is using a VPN (virtual private network) software such as “check point”, it will be necessary to disable the use of this software for the network card dedicated for UCC use. This is carried out in ‘control panel’ / ‘network connections set-up page’.

---

**NOTE:** A reboot of the PC will be required before this change is implemented.

---

### 9.3.5 Motor stalling

#### Symptoms

The machine stops unexpectedly. The event should be reported as a fault by the user’s program and may be identified as a stall on a specified axis. (The condition is reported to the application software by the controller’s setting of one of the three ‘axis overdriven’ flags in a status report).

#### Possible causes, tests, cures

- The problem may be due to unintentional contact between a moving part of the machine (not the probe’s stylus) and some object. Correct as required, checking for correct CMM calibration if a serious impact occurred.
- Contact between cables or cable-chains and the machine structure may also be the cause, similarly lock-up may be due to cable creepage through clamps and limiting travel.
- Excessive friction can cause the problem due to a mechanical problem (low air pressure, contaminated bearings/ways, etc.). Drive the machine slowly past the suspect region to localise the problem area. Correct as required.
- Other factors may stop the machine such as the operation of limit switches, crash switches, air pressure switches, etc. These should be reported as such by the application software. If not, confirm the effect using Renicis and request more detailed error reporting from the application software.

### 9.3.6 Machine overspeed report

#### Symptoms

The event should be reported by the application software as an ‘overspeed’ or similar wording.

(The condition is reported to the application software by the controller’s setting of the ‘overspeed’ flag in a status report.) The servo drives, if engaged, will be disengaged automatically by the controller.

#### Possible causes, tests, cures

- Machine movement by hand (with motors disengaged) at speeds higher than the limit set by ‘max move speed’ times the ‘overspeed factor’. See the ‘move configuration’ command. Avoid moving the machine too quickly by hand, or ensure that the application software suppresses this warning if the motors are disengaged, provided that it is unlikely that the machine can be moved so quickly that the controller counter circuit bandwidth limit is exceeded, see the ‘Specification’ chapter of this manual.

- Very high apparent speed due to initialisation with improper values of maximum speed or scale increment, or incorrect velocity or position feedback signal polarities causing instability (normally only occurring if a machine configuration parameter is altered). See the sections in this manual on read-head connections and motor command signals. Correct the values/polarities as required.
- A scale reading failure can cause an apparent large change of position. This fault may also be reported as a 'scale reading' failure, or an 'overdriven' failure. Correct the scale reading problem, see below.

### 9.3.7 Scale reading ('grating') failures

#### Symptoms

The machine will stop and disengage the servo drives. The event should be reported by the application software as a 'scale reading fault' or similar wording. (The condition is reported to the application software by the controller's setting of the 'scale reading failure' flag in a status report.) The readhead hardware may have reported an error condition, or the fault may be elsewhere.

Any errors detected on the readheads by the UCC are treated as fatal faults which cause the system to disengage. If this happens after the system has been homed it is possible that the scale error will have affected metrology. For this reason if the UCC detects a readhead error on any axis that has its absolute datum set (i.e. after the CMM has been homed), the UCC will enter "permanent scale error" mode.

When the UCC enters a "permanent scale error" mode the following will happen:

- Any measuring datums will be lost, the UCC will revert to machine coordinates.
- On the front of the UCC the error LED will be on and the "system ready" LED will flash.
- If an MCU joystick is fitted the screen display will be locked to the following message:

```
SCALE ERROR(S)  
Axis: X Y Z W Y2 *  
UCC reboot required
```

\* Actual readout will denote the axis / axes on which the scale error was detected.

- The system will be put into the disengaged state.
- It will not be possible to engage the system until the UCC has rebooted and no scale error is detected.

If a scale error occurs prior to absolute datum being set the system will still disengage with a fatal fault, but, it will be possible to recover by moving the axis so it is not in error and the reengaging. This allows the CMM system to be commissioned or fault found without the need to continually reboot.

#### Possible causes

On a new machine, the readhead cables may introduce too large a voltage drop. Check specification for heads and cable, see chapter 5.3.

On a machine which has previously been operating correctly, the fault may be due to:

- Connector displacement or cable damage. Visually examine and then check by temporarily exchanging readheads with drives disabled, since the machine will be violently unstable if drives are engaged in that condition.

- Mechanical disturbance of the readhead; use the readhead LEDs to diagnose. Realign the head if necessary or replace the head if damaged.
- Damage or contamination of the scale. Clean or replace scale as required.
- Machine bearing damage causing head misalignment. Repair or adjust as needed.
- The supply voltage to the readheads may be below specification. Check applied voltage and calculate the voltage at the heads, comparing with manufacturers specification. See chapter 5.3 and 10.4, Description of connector signals, CMM readhead input connections, for the electrical details of the cables and heads.
- The readhead could have detected an overspeed. Check the readheads are capable of supporting the maximum move speed setting.

---

**NOTE:** A scale error will cause the UCC2 to enter an error state. This is not recoverable within a metrology application environment. If a scale error occurs, it is now necessary to re-initialise the installation. This is because of the possibility of lost scale counts and therefore metrology being effected.

---

### 9.3.8 Timing out during moves or scans

#### Symptom

The CMM takes a long time to complete a commanded move. The event should be reported by the application software as a 'move timeout fault' or similar wording. (The condition is reported to the application software by the controller's setting of the 'time-out during move or scan' flag in a status report).

#### Possible causes, tests, cures

This is similar to the 'poor positioning accuracy' fault described earlier in this chapter. In particular, the drive friction level and the positional tolerance setting are important factors.

Check that the friction levels have not deteriorated since the machine was commissioned.

The positioning tolerance defines the maximum allowed position error at the end of a move. If this is made too small for the CMMs servo capabilities, it will cause time-out failures during moves. Adjust it using the 'Enter positional tolerance' command 308.

### 9.3.9 Cannot start a move

#### Symptom

The machine does not respond when given a move command. The controller returns either the 'cannot start move' or the 'illegal parameter' status flag with the normal 'action complete' flag.

#### Possible causes, tests, cures

- The 'illegal parameter' flag indicates that the move command may contain a parameter which is outside its acceptable range or is not logical. See the definition of the move command.
- The servo motors are not engaged, engage the motors, see above.
- Physical restraint of the CMM causing an immediate stall condition (e.g. unreported failure of the air supply to air bearings). Check CMM mobility, rectify as required.
- If a joystick unit is attached, the controller must be in DCC mode, not the manual joystick mode.
- The controller is not in 'HOLD' state, e.g. it may be completing a previous command, or it may be in joystick mode and responding to a joystick deflection. Wait for the action complete flag from the previous command, or send an Abort command to ensure termination.
- The probe is open/deflected. Use the joystick "probe disable" switch or the 'probe open override' (command number 310) to escape from the deflecting surface - remember to turn the override off afterwards.
- The probe is reported as 'deflected' even when not in contact with a surface. test/cure: check probe calibration – has the configuration changed since last qualification, if so correct and null the scanning probe with command number 288.
- All inner limit switches must be closed and the machine must be inside all soft limits, if these are enabled. limit switch operation can be over-ridden by use of command number 311.
- The analogue probe signal converter within the **UCC2** reports an error. To resolve this problem the system must be rebooted.

### 9.3.10 Cannot start a scan

#### Symptom

When a scan command is sent to the controller, it does not begin the search for the part surface. If this process does not start it returns either the 'cannot start move' or the 'illegal parameter' status flag with the normal 'action complete' flag.

#### Possible causes, tests, cures

- The 'illegal parameter' flag indicates that the scan command may contain a parameter which is outside its acceptable range or is not logical. See the definition of the scan command.
- Check that none of the faults which would stop a move are present, see above, except that a scan CAN be started with the probe deflected.
- The absolute datum and master datum have not been set.
- The analogue probe has not been qualified
- In the case of 2D or 3D scans, the actual position at the point that the scan command is issued, is different from the specified position by more than the "positional tolerance" (see command 308). To resolve this problem, either ensure that the parameters are the same, or move to the correct start position.
- If the search for a surface starts but then stops the search distance is smaller than the gap between the starting point and the surface. To resolve this set a larger search distance for the scan.
- The UCC2 licence has not been upgraded to permit scanning.



---

## 10 Specifications

This chapter defines the power requirements and the environmental conditions required by the **UCC2** controller and list the available supplies.

### 10.1 Physical specification

#### UCC2

The **UCC2** controller is housed inside a 3U high enclosure which can be mounted in a 19 inch rack. Alternatively, it can be used as a desktop unit.

A rack mounting kit is available as an optional extra.

- Height: 127 mm
- Depth: 330 mm
- Width: 435 mm
- Weight: 8 kg (without cables and daughtercards)

### 10.2 Cable lengths

#### 10.2.1 UCC2 to CMM measuring scale readhead

The maximum specified cable length is 18 metres assuming that individual cable wire cross-sectional area is a minimum of 0.055 mm<sup>2</sup>. For further details please refer to chapter 5.3, CMM readhead input connections.

#### 10.2.2 UCC2 to CMM servo power amplifier input

Dependent on the servo power amplifier, **SPA<sub>lite</sub>**, SPA1 or **SPA2**, this link is either a dedicated 25-way D-type cable or a pair of Ethernet cables. One metre cables are supplied as standard with the SPA kits. Other lengths can be fitted but it is recommended that the cable is kept as short as possible with a maximum cable length of 2 metres.

#### 10.2.3 Ethernet cable link to PC

This is a standard Ethernet cat 5 cross-over cable and a 5 metres cable is supplied as part of the **UCC2** kit.

Other lengths can be fitted up to a maximum of 100 metres.

### 10.3 Scale readhead signal speed

The maximum frequency of any one of the scale readhead quadrature signals, with ideal waveforms and phase displacement, is 12.5 MHz. However, it is recommended that the maximum frequency of any one of the scale readheads should be 10 MHz

### 10.4 Electrical power requirements

#### 10.4.1 Controller output supplies

The **UCC2** produces a +24 V current limited supply with a maximum output current of 1 A.

This supply is available for use by the CMM system to supply status switches, etc.

The **UCC2** also provides protected supplies for other external devices such as scale read-heads, the probe, joystick, etc.

These supplies are:

**+ 5 Vdc\* at 1.0 A max**

**+15 Vdc at 1.0 A max**

**- 15 Vdc at 1.0 A max**

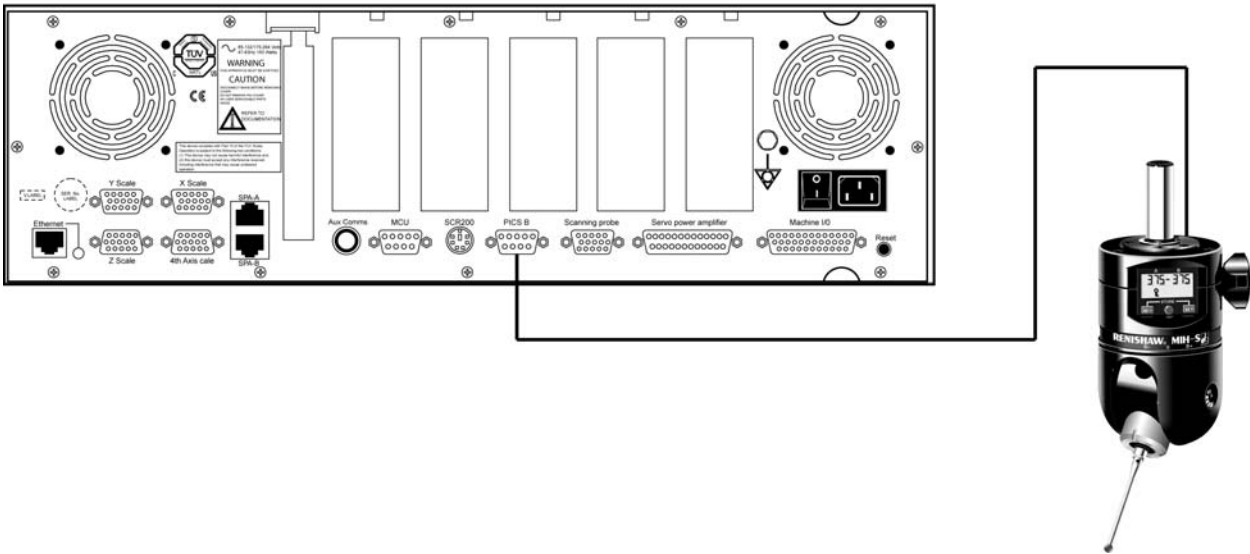
\* The supply to the scale readheads is a nominal 5.2 Vdc but, providing the sensor lines are connected through to the readhead, this voltage servoed within the range 5 to 7 Vs to ensure the supply is 5.2 V at the readhead. I.e. it compensates for the cable volt drop. If the sense lines are not connected the supply defaults to 5.2 Vdc.

# 11 System interconnections

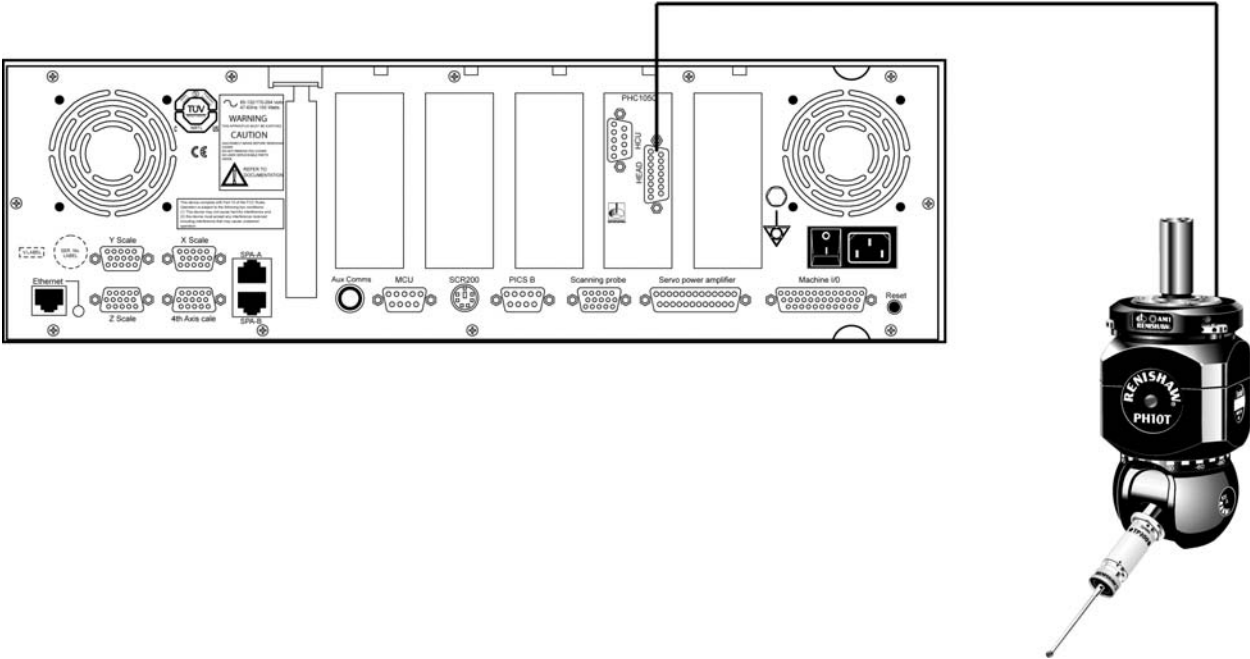
The **UCC2** provides a simpler means of interconnecting many of the sub-systems (e.g. a probe head) in a measuring system. The purpose of this chapter is to illustrate some system configurations.

## 11.1 Probing system interconnection

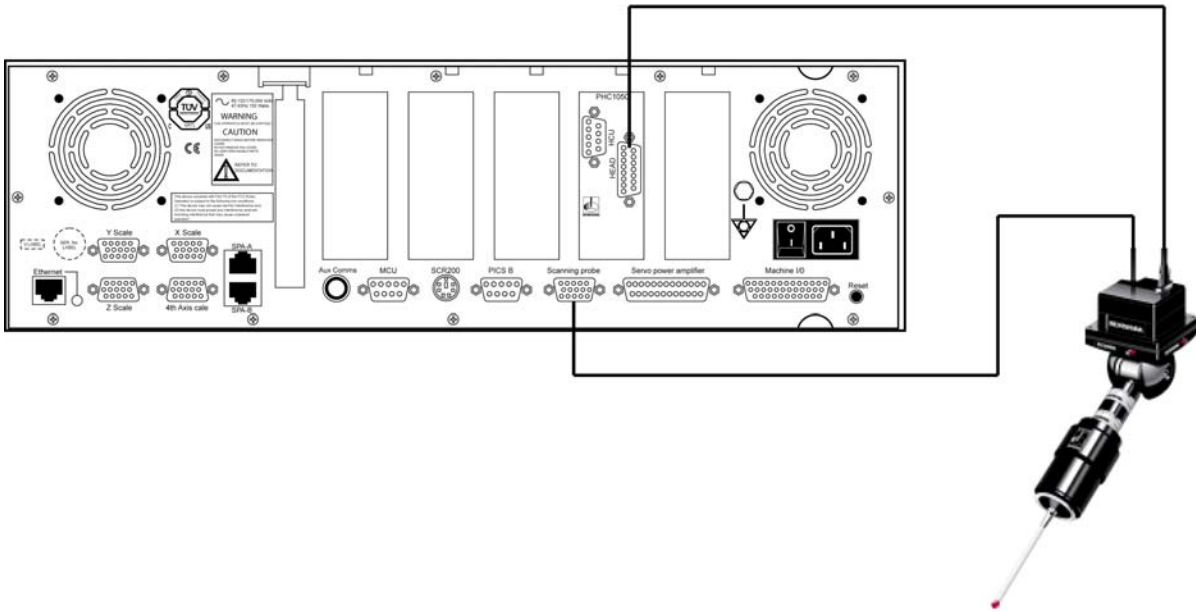
### 11.1.1 2 wire touch-trigger probe system



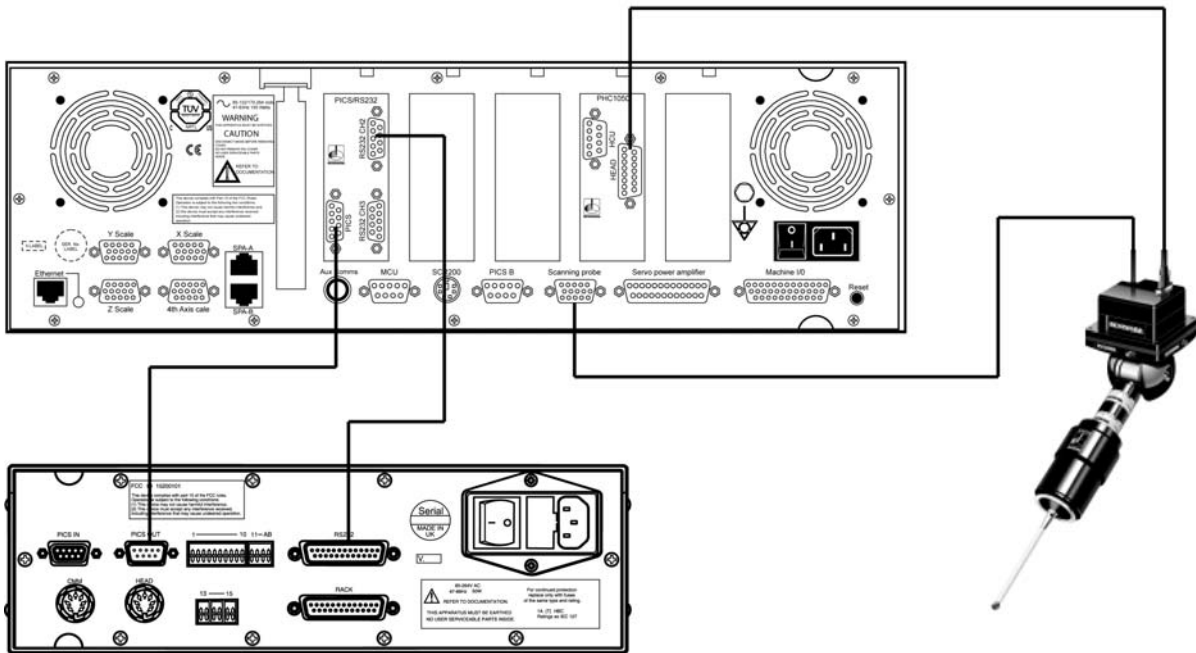
### 11.1.2 PH10 probe head and 2 wire touch-trigger probe system



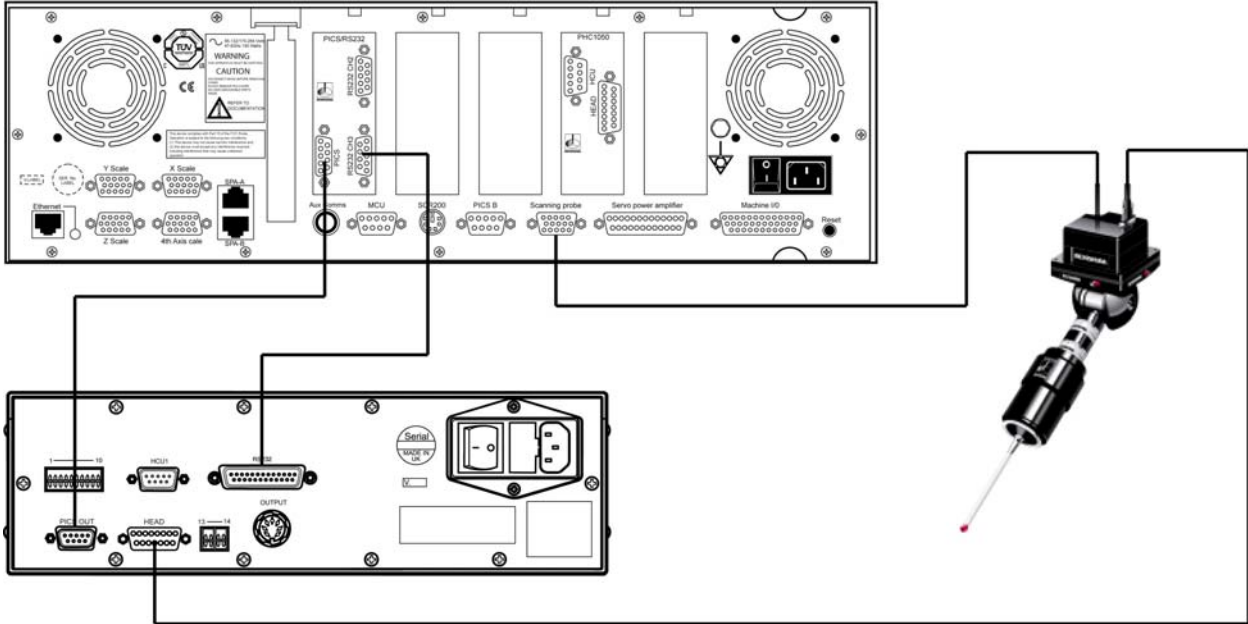
### 11.1.3 PH10 probe head and 'multiwire' probe system



### 11.1.4 PH10 probe head, 'multiwire' probe system and ACR1

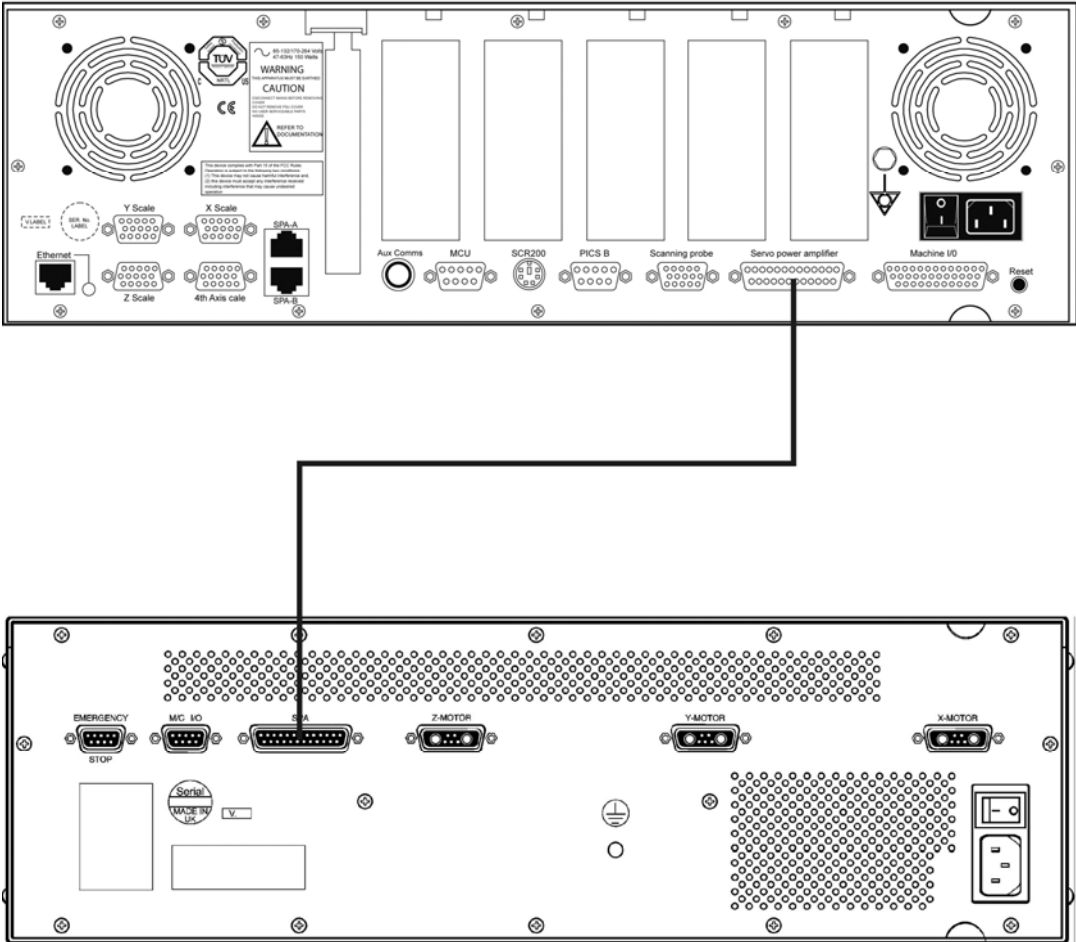


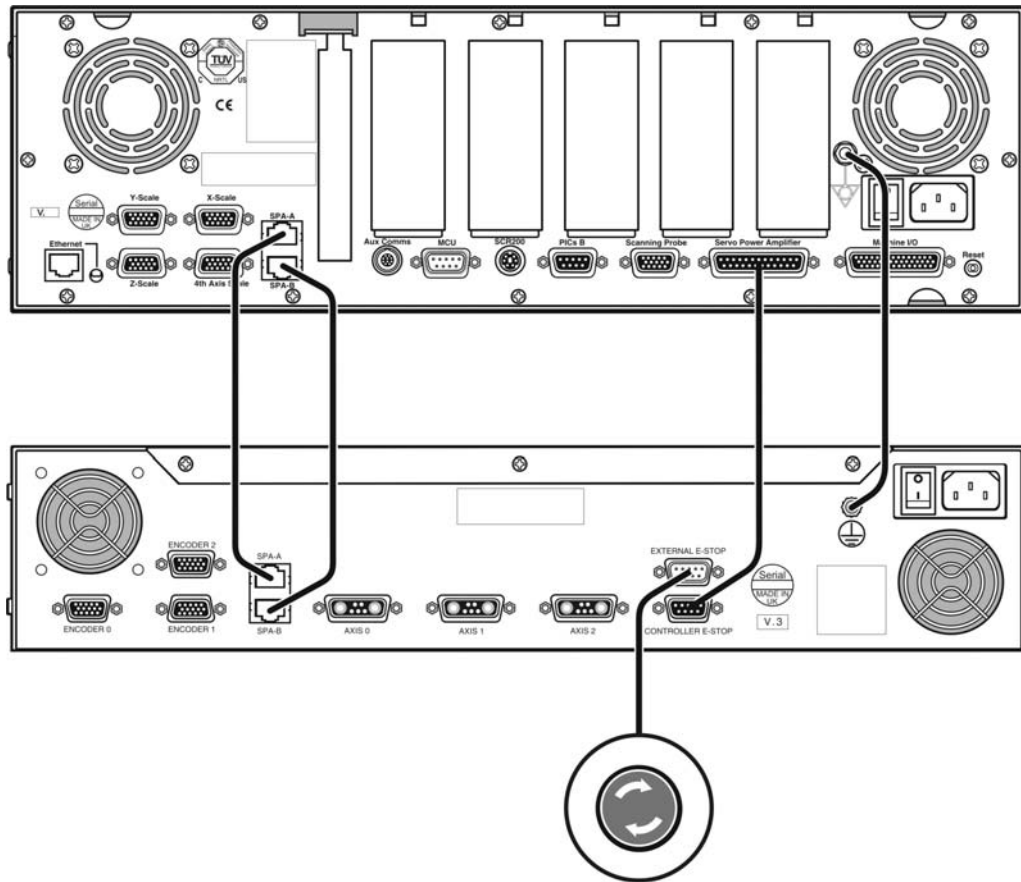
### 11.1.5 PH10 probe head and 'multiwire' probe system using external PHC10-2



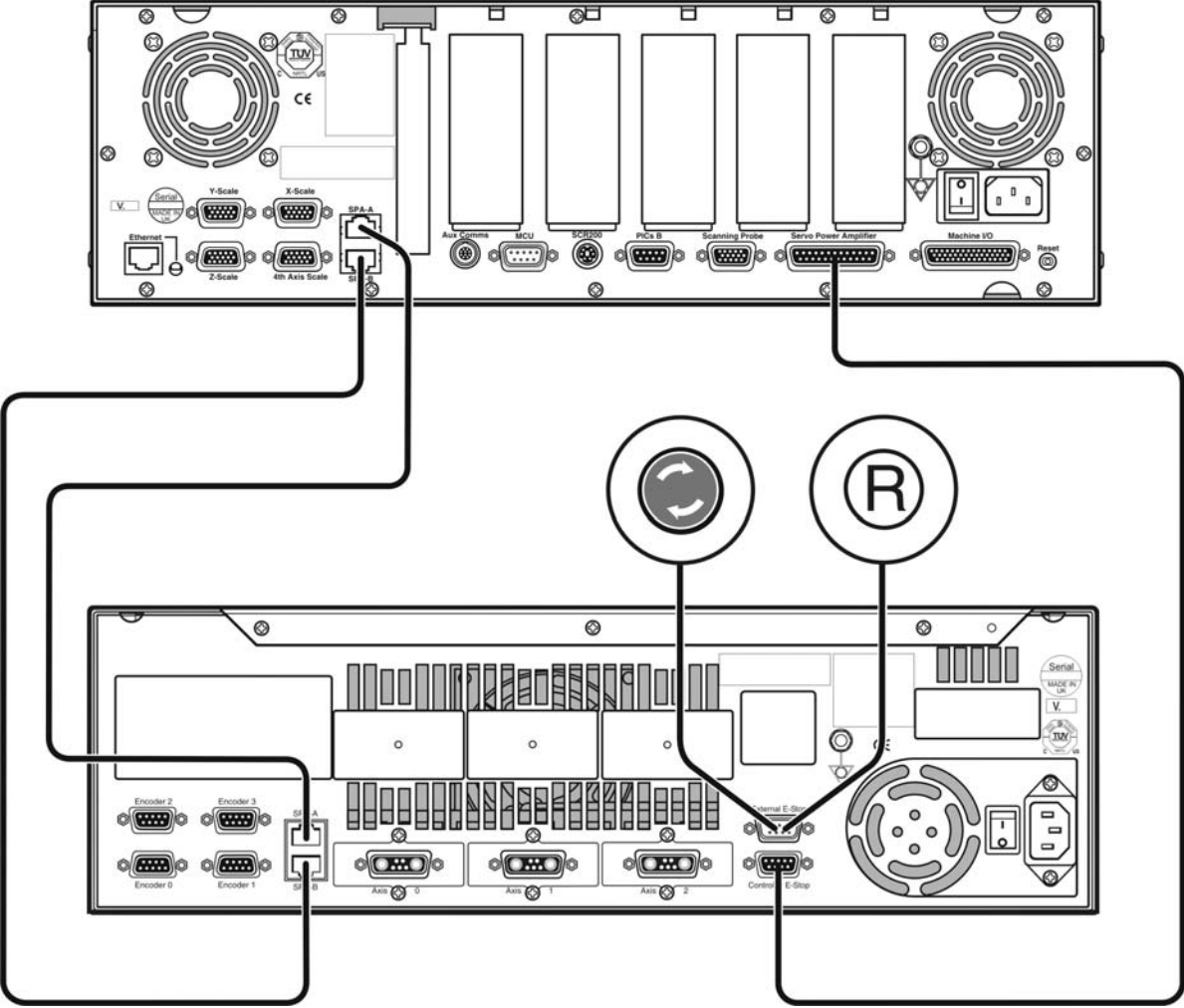
## 11.2 Servo amplifier interconnection

### 11.2.1 UCC2 and SPA1



11.2.2 UCC2 and SPA<sup>lite</sup>

11.2.3 UCC2 and SPA2



## 12 Fitting a UCC2 into a UCC1 installation

The **UCC2** system has the same electrical connections as that available within the UCC1. It offers more capability and, if it should be necessary to exchange an installed UCC1 for that of a **UCC2**, the following points are to be noted.

### 12.1 Machine I/O connection

The **UCC2** uses a 44-way D-type machine I/O connector. This is different to the UCC1 which has a 37-way D-type machine I/O connector and is due to the additional axis capability offered by the **UCC2** controller.

To enable the **UCC2** to be connected to a UCC1 installation, it is recommended that an adapter cable, available from Renishaw, is installed (part number A-5121-0060).

The connections are “one to one” for pins 1 through to pin 37. The functions on pins 38 through to pin 44 are all for the **UCC2** fourth axis and have no relevance to a UCC1.

### 12.2 Servo power amplifier connection

The connections between the servo power amplifier and UCC controller are subtly different for the UCC1 and **UCC2**. The **UCC2** uses some of the previously redundant pins to connect through the ESTOP tripped, Amplifiers OK and Contactor Feedback signals. However the connectors used are identical.

To fit a **UCC2** into an UCC1 installation, it is necessary to replace the servo power amplifier cable with a different version (A-5121-0063) available from Renishaw. With this new cable fitted, there is no need for the 3 ended I/O adapter cable because the I/O to SPA connections are all included in this new SPA cable.

Listed below is the wiring scheme used by this cable :-

25 way End “A”	25 way End “B”
1	1
2	2
3	N/C
4	N/C
5	N/C
6	6
7	7
8	12
9	13
10	10
11	11
12	8
13	9
22	22
23	23
24	24
25	25



## 12.3 Software compatibility

### 12.3.1 UCC software release

The UCC software release for **UCC2** product compatibility must be version 6.0 or later.

If you are unsure of the software version installed, it is recommended that you locate the file "UCC\_Software\_Release\_Notes.htm" typically located within the UCC software installation directory (default path = C:\Program Files\Renishaw\Ucc).

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**NOTE:** If an earlier version of the UCC software has been previously installed then it is strongly recommended that the metrology application software supplier is contacted prior to updating the UCC software, as updating this software may cause the metrology application software to fail.

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## 12.4 Machine ini file

With the introduction of **UCC2** and the additional functionality in release v7.0 of the UCC software, there are several new parameters and options in the machine "ini" file. The default settings in these new parameters ensure that, providing no hardware changes have been made to a CMM, an "ini" file created for a UCC1 controller will work on for a **UCC2**, subject to changing the downloadable to the appropriate type (contrler.ucc for **UCC2**).

If new hardware has been introduced e.g. dual limit readheads, then the "ini" file will have to be modified to accommodate these changes.

## 12.5 Installed PC

For **UCC2** use Windows NT4, Windows 2000 and Windows XP-Professional are supported.

Windows 95, Windows 98, Windows ME and Windows XP-Home are not supported.

## 13 Maintenance

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**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.

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Periodically, check the security of mounting screws and electrical connectors.

Periodical electrical safety checks should include inspecting the mains cable for damage and safe connections. An earth continuity (ground bonding) test may be applied between the protective earth pin of the mains connector and the metal case at a test current of no greater than 25 A.

Periodical 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 fluids/water.

## 14 Testing and verification

The manufacturer of the finished machine, or the installer of the **UCC2**, is responsible for ensuring that the following testing and verification, to the appropriate standards, is performed as a minimum on the complete installation.

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

## 15 Revision history

### Issue 01-A

- First issue

### Issue 02-A

- Text changes to:
  - 3.3.1
  - 3.3.4
  - 3.3.5
  - 8.1.3
  - 8.1.4
  - 8.3.4.2
- Table changes in:
  - 5.6
  - 8.1

### Issue 03-A

- Inclusion of **SPA***lite* information
- Change to software licence keys
  - Renamed
  - Introduction of Scan 5
  - Removal of I++ as an option
- Enhancement to error LEDs in troubleshooting section
- Changes to presentation of electrical specification to conform to TUV requirements
- Chapter 6.4 'Connecting the UCC2 mains supply' and fuse recommendations rewritten to conform to TUV recommendations
- Back panel illustrations updated
- 5.11.2 and 5.11.3 maximum ratings added

### Issue 03-B

- Documentation of the secondary air pressure switch input.
- Changes to section 4 figure 2, section 4.8.3, section 5.11 figure 13, section 5.11.7 and section 9.3.1

**Issue 04-A**

- Removal of the secondary air pressure switch input. Sections 4, 4.8.3, 5.11, 5.11.3
- Update of system interconnection diagram to show **SPA2-2**. Section 11.2.3
- New scale error function in section 9.3.7

**Issue 04-B**

- Section 4.2 p. 30. - The 4<sup>th</sup> bullet ("The probe system...") removed from the list
- The new exclusion of liability statement added
- The information about the extended warranty added on the front cover
- The picture added on the front cover.

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