RENISHAW

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UCC*lite-2 and* UCC*lite*

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UCC*lite-2* and UCC*lite*

installation guide

CE

FCC (USA only)

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 UCC*lite* and UCC*lite-2* has been manufactured in conformity with the following standards:

BS EN 61326:1998 Electrical equipment for measurement, control and laboratory use – EMC
A1:1998 / A2:2001   requirements.

Immunity to Annex A - industrial locations.

Emissions to class A (non-domestic) limits.

BS EN 60204-1:1998 Safety of machinery - Electrical equipment of machines

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

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.

Trademarks

Windows XP and Windows 2000 are registered trade names of the Microsoft Corporation.

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References and associated documents

It is recommended that the following documents are referred to when installing the UCC*lite-2* or UCC*lite*.

Renishaw documents

Associated documentation is available from UCCserver.com website.

Document number	Title
H-1000-5068	SPA1 installation guide
H-1000-5107	SPA*lite* installation guide
H-1000-5234	SPA*2* installation guide
H-1000-5247	SPA*2-2* installation guide
H-1000-5067	MCU installation and user's guide
H-1000-5227	SPA1 servo tuning user's guide
H-1000-5246	Digital SPA tuning guide
H-1000-5224	UCC*assist* user's guide

External documents

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

EN ISO 12100-2:2003 (Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles).

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

Safety

⚠️ **CAUTION:** The UCC*lite-2* and UCC*lite* controllers should be bonded to other conductive parts of the installation using the earthing terminal located on the rear panel of the enclosure.

Electrical requirements

The UCC*lite-2* and UCC*lite* are powered from an external PSU with an output of 24 V dc ±5% at 2.5 A maximum or it can be powered from the SPA*lite* through the SPA connector cable.

Environmental conditions

Indoor use	IP30* (BS EN 60529:1992)
Altitude	up to 2000 m
Operating temperature	+5 °C to +50 °C
Storage temperature	-25 °C to +70 °C
Relative humidity	80% maximum (non-condensing) for temperatures up to +31 °C
	Linear decrease to 50% at +40 °C

* **NOTE:** It may be necessary to house the UCC*lite-2 or* UCC*lite* in a suitable electrical enclosure according to the installations environmental conditions.

⚠️ **WARNING:** Earthing provisions for the complete machine is the responsibility of the OEM or installer.

Isolation: UCC*lite-2* and UCC*lite* are isolated by removing the power 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 OEM or product installer to ensure an adequate level of protection for the complete machine installation.

Contents

NOTE:

This document has been updated to cover the introduction of the UCC*lite-2* controller. Unless otherwise stated all references to the UCC*lite-2* also apply to the UCC*lite*.

1. Introduction

The purpose of this chapter is to describe the UCC*lite-2* (universal CMM controller) and the available options.

1.1 Overview

The UCC*lite-2* is an addition to the Renishaw CMM controller product range. Utilising the UCC1 platform introduced in 1997, the UCC*lite-2* offers similar system performance and capability.

The complete range of Renishaw 2 wire kinematic touch-trigger probes is supported. Conventional contact and strain-gauge sensors, manual and motorised probe heads with appropriate probe or stylus changers, only with supporting hardware (i.e. PH10 head will need a PHC10-2 which will be connected to the serial comms port on the UCC*lite-2*).

The UCC*lite-2* comprise of a controller in a 19 inch rack-mountable enclosure with a processor based computer system. It is coupled to the CMM host computer by a USB 1.1 link and to the CMM by external cable interface connectors.

The UCC*lite-2* CMM controller has the capability of:

- Controlling three axes of a CMM (accepting digital readhead signals and generating three 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

- Accepting two uncommitted general purpose input signals and generating one uncommitted general purpose output signal

- Serial communication for use with a Renishaw PHC10 controller

- Directly supporting the TP1, TP2, TP6, TP20 touch-trigger probes

- Indirectly supporting the TP200 via an external PI200 interface

- Directly supporting the Renishaw SPA*lite*, SPA*2* or SPA1 servo power amplifier

- Providing a +24 V supply for use by the CMM switches

- The UCC*lite-2* supports the MCU*lite* joystick, it can also support the MCU1 and MCU5.

- The UCC*lite* supports USB DirectX joysticks.

1.2   CMM host computer

For the installation of a UCC*lite-2* controller, the CMM host computer must use Windows 2000 or Windows XP Pro as an operating system and a hard disc drive with available storage space of at least 300 Mbytes. The processor speed and RAM requirements are not excessive, if the PC supports the operating system and application software, it will almost certainly support the UCC controller operation. A minimum specification of 1 GHz processor speed and 256 Mb RAM is recommended.

For UCC*lite-2* only one free USB port is required as the MCU joystick plugs directly into the controller.

For UCC*lite* the PC must have two free USB ports available for the communication and the system joystick. It is recommended NOT to use a USB hub because of the reduction in speed of operation these devices normally produce.

1.3   Installation software

1.3.1   Renicis

The Renishaw Renicis program is a utility to assist the engineer to install, commission and maintain a CMM system based on the UCC*lite* and UCC*lite-2* controllers.

It also has features which assist in the development of a software interface between any existing CMM application program and the UCC*lite* or UCC*lite-2*.

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

1.3.2   UCC*assist*

The UCC*assist* software suite complements the Renicis software package offering the following additional capabilities of:

* Basic machine system diagnostics

* Operation 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 or XL80 laser systems

* Error mapping for manual machines

1.3.3   Licence key manager

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

1.3.4   Joystick set-up (UCC*lite* only)

This is a stand-alone software utility, which is used to check and modify the joystick operation when using the UCC*lite* system.

1.3.5   Joystick display window (UCC*lite* only)

This is a stand-alone utility, which shows the machine status, similarly to a MCU1 display screen. Please refer to chapter 10 for more details. This utility is not required for UCC*lite-2* system.

1.3.6   UCC*lite-2* system components

The part numbers of the UCC*lite-2* kits and upgrades are:

1.3.6.1   UCC*lite-2* kits

A-5331-0008   UCC*lite-2* controller kit

A-5331-0201   UCC*lite-2* kit 1 comprising of:

    A-5331-0008   UCC*lite-2* controller kit

    P-EA02-0021   24 V PSU AC-DC

A-5331-0202   UCC*lite-2* kit 2 comprising of:

    A-5331-0008   UCC*lite-2* controller kit

    A-5331-0007   MCU*lite* joystick

    A-5331-0004   UCC*lite* DCC upgrade

    A-5331-0006   UCC connector and bracket kit

    A-5331-0010   SPA*lite* sales kit

A-5331-0203   UCC*lite-2* kit 3 comprising of:

    A-5331-0008   UCC*lite-2* controller kit

    A-5331-0007   MCU*lite* joystick

    A-5331-0004   UCC*lite* DCC upgrade

    A-5331-0006   UCC connector and bracket kit

    A-5121-0010   SPA*2* 3 axis DC system

    P-EA02-0021   24 V PSU AC-DC

1.3.6.2   UCC*lite-2* upgrades

A-5331-0004   DC CMM operation functionality upgrade

1.3.6.3   **UCC*lite-2* accessories**

P-EA02-0021   UCC*lite-2* power supply unit

A-5331-0007   MCU*lite* joystick (UCC*lite-2 only)*

A-5331-0003   UCC*lite* emergency stop pendant (UCC*lite only)*

P-JS01-0004   DirectX compatible joystick (must be 3 axis joystick) (UCC*lite only)*

A-1368-0100   PHC10-2 controller

A-1207-0010   PI 200 probe interface

1.3.6.4   **UCC*lite-2* compatible servo power amplifiers**

A-5355-0100   SPA*lite* digital servo power amplifier

A-5402-8302   SPA*2-2* digital servo power amplifier

2   Description of the UCC*lite-2*

2.1 UCC*lite-2* features

The unit has the following facilities:

- Rear panel connectors for the external interface cables to and from the CMM

- Rear panel USB connection for the two-way communication link to the CMM host computer

- Rear panel connection for a Renishaw MCU joystick (UCC*lite-2* only)

- 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 UCC*lite-2* enclosure indicate the operational status of the UCC*lite-2*.

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

- USB data link to the CMM host computer

- X, Y, Z axis data input from the CMM readheads

- A communication loop (SPA-A and SPA-B) to the SPA*lite* or SPA*2* servo power amplifiers

- Connections for the TP20, TP1, TP2 and TP6 touch-trigger 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

2.1.1   TTP interface

The UCC*lite-2* unit incorporates the circuitry and software necessary to interface with the Renishaw TP20, TP1, TP2 and TP6 probes.

2.2 Power supply unit

When the UCC*lite-2* is not connected to a SPA*lite* digital servo power amplifier it requires an external 24 V DC 2.5 amp power supply.

2.3 Joystick

UCC*lite-2* has an input for a MCU*lite* (or MCU1 / MCU5) joystick and therefore does not require a joystick to be connected to a USB port on the system P.C

The UCC*lite* does not have an input for a joystick control but the system will require one. The system has been designed for use with a USB joystick connected directly to a USB port on the system P.C.

NOTE: Care should be taken to ensure that for UCC*lite* systems the joystick is always plugged into the same USB port that it was connected to when the joystick drivers were installed. If it is unplugged and subsequently plugged into a different USB port then the drivers may have to be reinstalled.

CAUTION: If a wireless joystick is used they normally go to sleep when not in use to preserve battery life. If the speed control is changed while the joystick is in sleep mode then unexpected movement could occur when the joystick is woken up.

The UCC software installation includes two utility programmes for use with UCC*lite* only:

1.   A 'joystick configurer' utility, which allows the joystick directions and function switches to be configured. The use of this utility is covered in chapter 11 of this manual.

2.   A 'joystick display' window. This is a status window, similar to the screen on the MCU1 joystick, that pops up on the P.C. screen. The use of this utility is covered in chapter 10 of this manual.

NOTE: UCC*lite-2* requires neither the 'joystick configurer' nor the 'joystick display' window utilities.

3 Installation of the UCC*lite-2* components

The purpose of this chapter is to describe the procedure for installing the CMM controller and connections.

3.1 General wiring standards

To achieve reliable operation of the UCC*lite-2* and the CMM host computer, the following should be observed:

- Scale readhead signals, reference marks and error signals should comply with EIA RS-422A. It is recommended that each readhead has 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 UCC*lite-2* controller, so that the CMM electrical system is kept isolated from the circuitry within the controller, with the exception of the 0 V reference and protective grounding.

- All signal cables **MUST** be screened and all cable screens should be connected electrically to the cable connector's metal shells. Cable screens should only be connected to the protective earth (via the connector shell) at the UCC*lite-2* and SPA end, and not directly connected to the CMM 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 UCC*lite-2* 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 signals from probes.

NOTE: The UCC*lite-2* electronics 0 V rail is connected to the overall ground plane at a star point within the UCC*lite-2*.

3.1.1 Preparations

Before beginning the installation of the UCC*lite-2* check the following items:

- Ensure that all connecting cables, test equipment and software are available.

- Ensure that the CMM 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 power has been removed from the CMM, the CMM host computer, CMM servo power amplifiers and CMM axis drive motors etc.

3.2 Connecting UCC*lite-2* cables to and from CMM

- Attach all CMM cable connectors to the mating sockets on the UCC*lite-2*.

- Secure all cable connectors with the connector jack screws to ensure physical and electrical connection.

- Secure all cables for strain relief without reducing access for servicing.

3.3 Connecting the UCC*lite-2* power supply

WARNING: There is no internal fuse on the power supply to the UCC*lite-2*. The installer must provide suitable protection.

The maximum current demand of the UCC*lite-2* is 2.5 A at 24 V.

3.3.1   Connection to the SPA*lite* power supply

3.   Remove all power from the installation.

4.   Connect the servo power amplifier interconnection cable between the SPA*lite* and the UCC*lite-2* (A-5121-0062). The SPA*lite* will power the UCC*lite-2* through the SPA connector cable, this supply is protected.

3.3.2   Connection to an external power supply

5.   Remove all power from the installation.

6.   Connect the UCC*lite-2* power supply P-EA02-0021 to the power input connector on the rear of the UCC*lite-2* respectively.

7.   Connect the mains power lead to the UCC*lite-2* power supply.

NOTE: An external power supply MUST be used for systems incorporating a SPA2 or SPA2-2 Servo Power Amplifier.

4   Connecting the UCC*lite-2* to the host PC

The following sections detail how to initially connect and configure the communication link between the UCC*lite-2* and the host PC that is running either the UCC utilities or metrology application software.

4.1   Software installation (UCC*lite-2* only)

If previous versions of UCC software (V7.x or earlier) have been installed on your PC, they must be removed (using "add or remove programs") before the new UCCserver software is installed. If a previous version of UCCserver software (V4.0 or later) has been installed you do not have to uninstall it, the new software will install but it will allow you to revert to the previous version if required.

NOTE: The installation software must be installed before the USB connection to the UCC*lite-2* controller to the host PC

These instructions detail the steps required to install the UCC software for UCC*lite-2*.

1.   Load the UCCserver software (V4.1 or later) onto your PC. This software can be obtained from Renishaw's **UCCserver.com** website or it may have been supplied on a CD ROM from your local supplier.

2.   Double click on uccserversoftware-r4.1.exe

3.   This software requires *".NET2 framework"*, so if this software is not loaded on your PC you will be prompted to update (this will take a few minutes).

4.   Follow the prompts to install the UCCserver software by clicking on the "Next or "Yes" buttons as appropriate.

5.   When you get to the "Installation successfully completed" screen you are ready to connect your UCC*lite-2*.

6.   When you first connect you UCC*lite-2* into a PC USB port the drivers will be installed automatically.

7.   You are now ready to start.

4.2   Software installation (UCC*lite* only)

NOTE: The installation software must be installed before the USB connection to the UCC*lite* controller to the host PC

These instructions detail the steps required to install the UCC software for UCC*lite*.

1.   Put the UCC software CD-ROM into PC (version 7.1 or later version 7.x).

2.   You should automatically get the installer screen. Click on start button. [*Note, the ".NET" framework and V9.0c programs may take several minutes to install.*]

3.   After the various "click next" and "read this" screens. You will get to the main set-up screen.

4.   We suggest you click on standard choice for a full install.

5.   Click on "finish" and the software is then automatically installed.

6.   Remove the CD-ROM from PC.

7.   Reboot your PC as requested. **Do not attempt to run this software until this has been done.**

8.   Please ensure that the UCC*lite*, SPA*lite* (or SPA*2*), joystick and accessories are correctly connected to the CMM and switched on, **but do not connect the USB link to the P.C. at this stage**.

9.   Install the joystick software using the CD supplied with it, the "Express" install is suitable. After the drivers have been installed the joystick needs to be plugged in, you will be prompted by the Install Wizard when this is required.

10.   Plug in USB connection between the UCC*lite* and the P.C.

11.   The "Found new hardware" wizard will offer to search for software – click "No not this time" and put UCC*software* CD back in.

12.   Click finish when drivers are installed. Remove the CD.

13.   Go to start program, UCC software / UCC*lite* joystick configurer and run this program.

14.   You do not have to change the button settings but you do have to complete the procedure to load a default file (save at end). You will find it useful to take a print out of the button allocation table.

15.   Ensure unit is licensed for DCC operation by going to: start program / UCC software / UCC Licence key manager and checking that the DCC box is checked. (not necessary if you require manual operation only)

16.   Start Renicis. If it is a first time install on the PC then you will have to create a new configuration file, follow the wizard's instructions. If the P.C. has previously had a UCC controller installed then you will have to open the Master Configuration dialog box and ensure that :- a) The correct .ini file is applied for your CMM) and b) The correct downloadable is selected(.ucl for the UCC*lite*).

17.   You are now ready to start.

4.3 **UCC***lite-2* **USB connection**

The host PC is recommended to have a dedicated USB connection to the UCC*lite-2*. Connection to the UCC*lite-2* through a USB hub causes a reduction in communication speed.

The UCC*lite-2* uses the USB1.1 specification communication link. A 5 m USB cable is provided for this link as part of the UCC*lite-2* kit. Other lengths may be used; the maximum being 5m is governed by the generic specification for USB connections.

When the UCC*lite-2* is connected to the PC and power applied to the unit, Windows will automatically detect the new hardware and start the Windows hardware installation wizard.

The Windows hardware installation wizard will automatically identify the correct driver for the UCC*lite-2*. This driver is located on the UCC software installation CD in the drivers' directory.

4.4 **DCC upgrade**

When the UCC*lite-2* is supplied it will be configured for manual CMM operation. If the system is to be installed on a DCC CMM then it is necessary to upgrade the UCC*lite-2* accordingly.

To upgrade the UCC*lite-2* it is necessary to purchase a software activation code from Renishaw and then apply this to the controller using the licence key manager.

If you have the software activation code then start the licence key manager located in 'start \ program files \ UCC software'. This will open the licence key manager; input the software activation code will change the function of the unit.

4.5 Downloading

The name of the downloadable file is contrler.ucb for UCC*lite-2* (contrler.ucl for UCC*lite)*. Other Renishaw controller downloadables will not work on a UCC*lite-2*. Remember to change the name in any configuration settings appropriate for your application software.

Your UCC*lite-2* system is now ready for commissioning.

5 Connecting the UCC*lite-2* to a CMM

The purpose of this chapter is to describe the various connections available within the UCC*lite-2* design to enable connection to a CMM.

This section reviews each UCC*lite-2* connection and gives comments on the preferred methods and available alternatives.
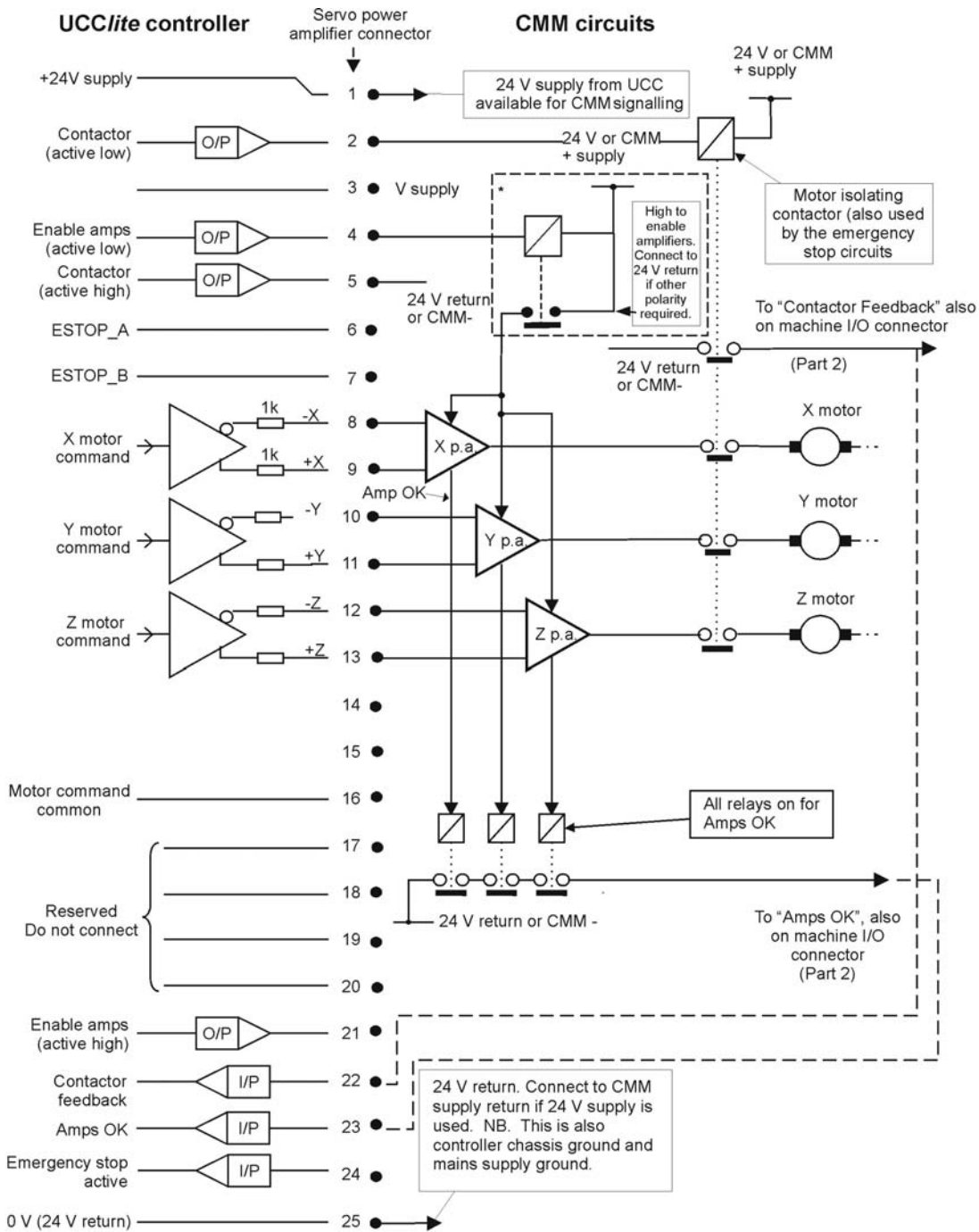
Suggested wiring to the servo power amplifier connection (part 1)

Figure 1
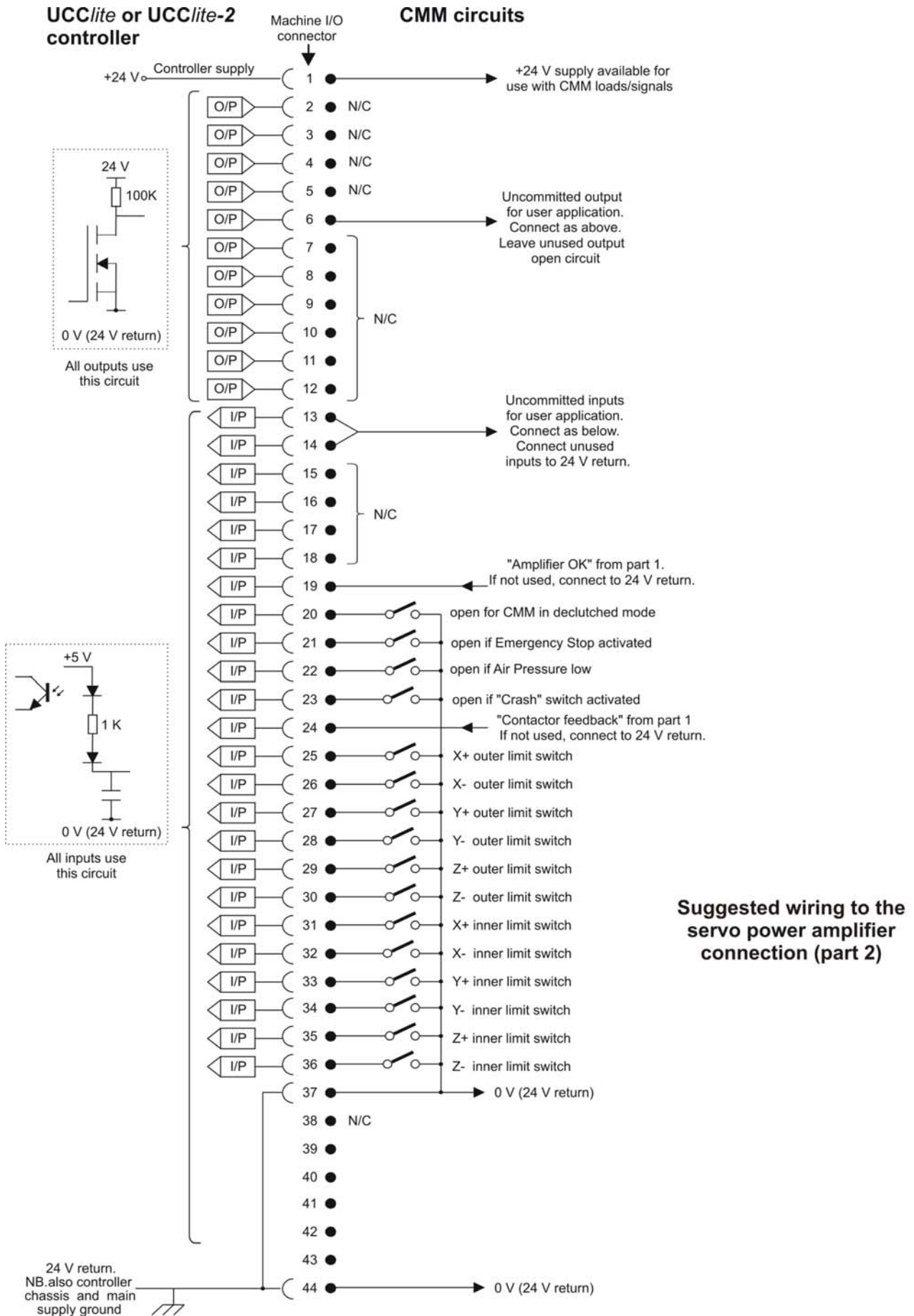
Figure 2

5.1   The controller is 24 V supply

This supply is available at both the servo power amplifier connector and the machine I/O connector for use by the CMM signalling circuits. It has an absolute maximum current rating of 1 A.

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

All inputs and outputs (except 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 chassis and to supply 0 V at a star point within the controller.

If there are any interconnections between this supply and any of the CMM 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 24 V supply but its negative rail must be connected to the controller 24 V return line.

5.2   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:

- A fatal fault has been detected (refer to H-1000-5224 UCC*assist* user's guide)

- The emergency stop system has been activated

- The probe system is triggered (touch-trigger signal open)

- A PICS 'stop' signal is detected within the system

- The amplifier OK signal not asserted

- An open limit switch

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

5.2.1   Amplifier enabling

The 'amps OK' signal produced by the amplifier control circuits is an indication to the UCC*lite-2* 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.

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 abort 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 (chapter 5, page 21) 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 amplifier 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, chapter 5, page 23) are used for this purpose.

5.2.2   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 3 seconds 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 3 second window, the controller keeps all motor commands at zero for another 0.2 second before allowing the servo system to begin operating. This is intended to give further protection against sudden machine movements when engaging the motors.

5.3 Motor command signals

The UCC*lite-2* 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 on the servo power amplifier connector).

Each motor velocity signal is capable of a swing of +/-10 V centred on a zero velocity command of 0 V. A motor 'command common' connection is provided to define this 0 V level (servo power amplifier 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 setting up process used in the UCC*assist* set up utility will help the user to set his power amplifier gains such that the maximum command signal (+/- 10 V) will produce 120% 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 output, 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 UCC*assist* set up utility will compensate for this automatically.

5.4 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.

5.5 Switched outputs

The UCC*lite-2* has the following uncommitted switched output, please refer to section 6.8.2 for details:

Pin 6 is the uncommitted output available on the UCClite-2 I/O connector. The UCC does not directly control the operation of this output, as it is controlled from the application software package via 'command 318, Write to controller port'.

The output is 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. This output is suitable for driving inputs in the range 5 to 24 V.

If the output is not connected to the installation then it should be left open circuit.

5.6 Switched inputs

The UCC*lite-2* has the following controller switch inputs, please refer to section 6.8.3 for details:

Pins 13 and 14 are the two uncommitted inputs available on the UCC*lite-2* I/O connector, all other inputs have dedicated functions. The UCC*ite-2* does not directly read these inputs, they can be read by the application software package via command 279 'Read from controller ports'.

The controller provides 20 inputs of this type. See chapter 6 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.

These inputs can accept signal levels in the range +5 V to +48 V. The inputs should be pulled below 1 V to signify a zero state.

5.6.1 Limit switches

Twelve inputs are allocated to limit switch signals, 6 inner and 6 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).

The polarity of the limit switches can be inverted by the UCCassist set up utility, the default condition of all limit switches is a normally closed circuit, opening on the event.

5.6.2   Amplifier OK and contactor feedback

The 'amplifier OK' and the 'contactor feedback' inputs have been discussed in sections 5.2.1 and 5.2.2.

5.6.3   Air pressure and crash switch (Fatal faults)

The controller monitors these two inputs and will remove power from the motors if either of them goes open circuit or high. If not required these inputs should be connected to the 24 V return line.

NOTE: The polarity of these inputs can be inverted by the UCCassist set up utility, the default condition is a normally closed circuit, opening on the event.

The crash switch is intended for use with a sensing mechanism which detects an unintended contact between the moving and fixed components of the machine, the air pressure is intended for use with a sensing mechanism which monitors the input air pressure to the CMM axis.

5.6.4   Emergency stop (Fatal fault)

The emergency stop status input is intended for the system to monitor an external stop device for the UCC controller.

NOTE: This '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 UCC*lite-2*.

6   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 UCC*lite-2* controller and to show examples of relevant circuit diagrams for the input and output circuits.

6.1   Overview

The connectors on the rear panel of the UCC*lite* controller enclosure are shown below:
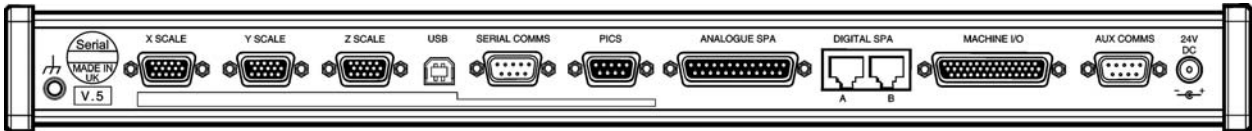
The connectors on the rear panel of the UCC*lite-2* controller enclosure are shown below:
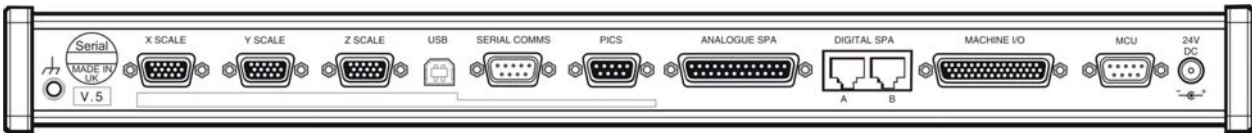
The pin-out of each connector, and its purpose, is described in the following sections.

6.2   CMM readhead input connections

The X, Y and Z 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 UCC*lite-2* enclosure.

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

The three 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 UCC*lite-2* supplies the 5.25 V dc power supply for the readheads. If standard Renishaw readhead cables are used, the recommended cable sizes are 3 m of head cable and 15 m of extension cable, or an equivalent combination. 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.

CAUTION: The connection of the cabling should be such that the CMM movements, as reported by the UCC*lite-2*, 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 UCC*lite-2* controller. Adjust this, if required, by reversing the inputs of the scale readhead signal (change over +A with +B and –A with -B).
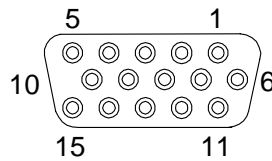
Figure 3 - Readhead connector, view on face of sockets (rear of plugs)

Pin number	Function
1	External N/C
2	0 V supply
3	- Error
4	- Reference mark
5	- B signal
6	- A signal
7	+5 V supply
8	Reserved
9	Reserved
10	+ Error / limit switch Q*
11	Limit switch P
12	+ Reference mark
13	+ B signal
14	+ A signal
15	Inner screen
Shell	Screen

* The UCC*lite* and UCC*lite-2* are 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.

6.2.1   CMM readhead interface circuit

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

Figure 4 - UCC*lite-2* input circuits for CMM readhead – scale and reference mark inputs

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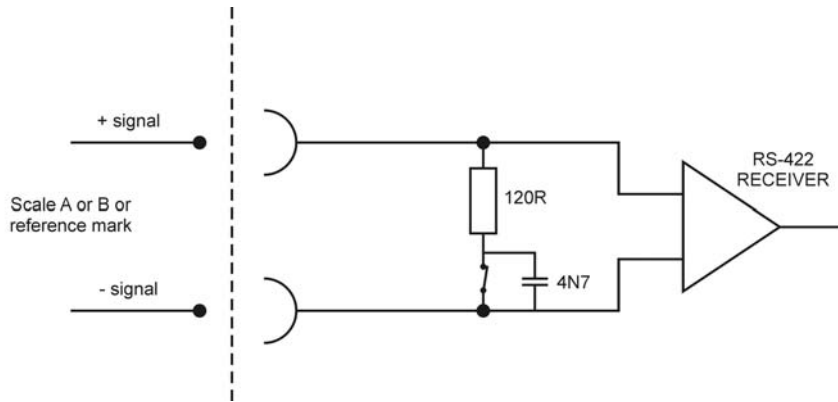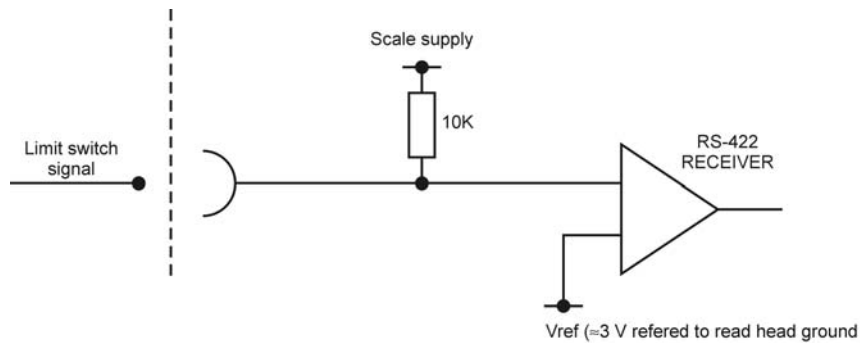

Figure 5 - UCC*lite-2* input circuit for CMM readhead – limit switch inputs
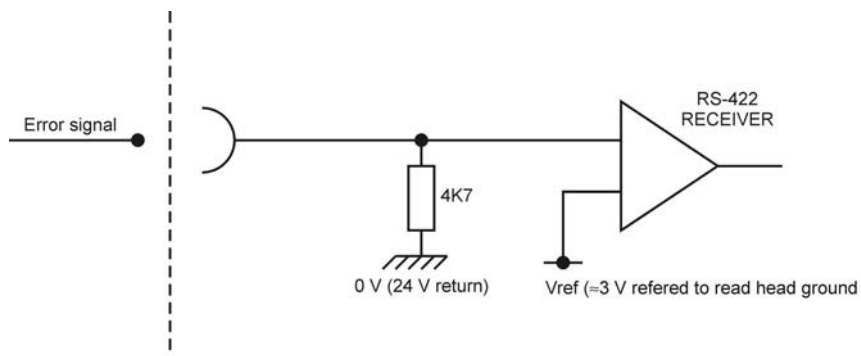
Figure 6 - UCC*lite-2* input circuit for CMM readhead – error input

6.3 USB connection

This is a standard USB type B connector providing the communication connection between the UCC*lite-2* and the PC hosting the application software.

6.4 Serial Comms

This port is designed to communicate to other Renishaw interfaces/controllers such as the PHC10-2, the properties of the port are listed below:

Baud rate: 9600   Data: 7 bits   Parity: even   Stop: 1 bit

Pin number	Function
1	N/C
2	Rx
3	Tx
4	DTR (high)
5	0 V GND
6	N/C
7	RTS
8	CTS
9	N/C
Shell	Screen
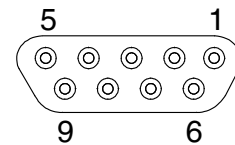
Figure 7 – Serial comms. View on face of socket (rear of plug)

6.5 PICS connector

This socket is intended for use with the TP1,TP2,TP6 or TP20 touch-trigger probes. The connector is a 9 pin 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
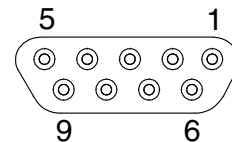
Figure 8 - PICS connector. View on face of socket (rear of plug)

6.6 Analogue SPA connector

The UCC*lite-2* has the ability to connect to a SPA1 or 3rd 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 UCC*lite-2* through this connector to energise the CMM status switch.

NOTE: The UCC*lite-2* analogue SPA connector does not have the same capability as offered by the UCC*2* product. The active high enable amps and contactor are not implemented.

Figure 8 - Servo power amplifier connector. View on face of socket (rear of plug)

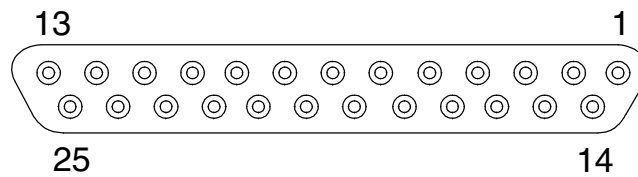| Pin number	Function	Description	Refer to section
1	+24 V dc	Supply provided for use with CMM status switches	5.10.1
2	Contactor (active low)	Output signal to control motor contactor (active low)	5.10.2
3	Power 24 V IN	VDD power from SPA*lite*	5.10.3
4	Enable Amps (active low)	Command to SPA to enable amplifiers (active low)	5.10.4
5	Reserved		
6	Reserved		
7	Reserved		
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	Reserved		
15	Reserved		
16	Command common	Reference line for power amplifiers	5.10.7
17	Reserved		
18	Reserved		
19	Reserved		
20	Reserved		
21	Reserved		
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		

6.6.1   +24 V dc

+24 V dc supply provided for the use of contactors, relays and other motor control circuits. Maximum total current output 1.0 Amps.

6.6.2   Contactor

This command is issued by the UCC*lite-2*, 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 form on pin 2 and an active high form on pin 5.

6.6.3   Enable amps

This is a command from the UCC*lite-2* to the SPA requesting it to enable its amplifiers. This output signal is provided as both an active low signal on pin 4 and an active high form on pin 21.

6.6.4   Axis command signals

These outputs (pins 8 to 13) are the velocity demand signals for each axis from the UCC*lite-2* to the servo power amplifiers. They vary over the range +10 to –10 Vs.

6.6.5   Command common

An analogue reference zero is available to the servo power amplifiers but this signal is not used by the Renishaw range of servo power 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.

6.6.6   Reserved

These pins (3,5,14,15,17 to 21) have communication driver / receivers connected to them, they are intended for future development. It is important that these pins should be left open circuit.

6.6.7   Contactor feedback

This is a confirmation signal from the motor contactor to the UCC*lite-2* that it has successfully operated and the motors are now engaged. For UCC1 systems this signal is also on the I/O connector (pin 24) and is still available on pin 24 of the UCC*lite-2* machine I/O connector for backwards compatibility reasons.

6.6.8   AMPs OK

This is a confirmation signal (pin 23) from the servo amplifiers that they on and ready. It is produced as a response to the 'Enable Amps' command. For UCC1 systems this signal is also on the I/O connector (pin 19) and is still available on pin 19 of the UCC*lite-2* machine I/O connector for backwards compatibility reasons.

6.6.9   ESTOP tripped

This input (pin 24) is used to inform the UCC*lite-2* of the CMM 'emergency stop' condition (E_STOP). If the input pin is pulled down to 0 V (24 V return) the UCC*lite-2* 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 UCC*lite-2* 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.

6.6.10   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 UCC*lite-2* 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.

6.7 Digital SPA connector A and B

This a pair of standard RJ45 connectors that support the high speed communication links to and from the SPA*lite* or the SPA*2* servo power amplifier. Refer to the appropriate servo power amplifier installation guide for details.

6.8 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 UCC*lite-2*.

The input/output (I/O) signals to/from the UCC*lite-2* controller are:

- Emergency stop switch

- Air pressure switch

- Crash switch

- Contactor feedback

- X+ and X-, Y+ and Y-, Z+ and Z- inner and outer limit switches of the CMM

- General purpose outputs and inputs
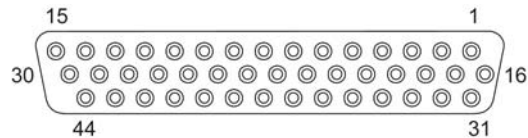
- 24 V dc supply and return

Figure 9

NOTE: The majority of the connections on the machine I/O connector can be configured such that they are either active high or active low signals but settings available within the machine configuration file. The default setting for all signals is active high.

Pin number	Function	Description	Refer to section
1	+24 V DC	Supply provided for use on CMM switches	6.8.1
2 to 5	Reserved		
6	Output 0	General purpose output signal	6.8.2
7 to 12	Reserved		
13	Input 0	General purpose input signal	6.8.3
14	Input 1	General purpose input signal	6.8.3
15 to 18	Reserved		
19	Amplifier OK		6.8.4
20	CMM declutch		6.8.5
21	ESTOP tripped		6.8.6
22	Air pressure	Air pressure switch input	6.8.7
23	Crash	Crash detector switch input	6.8.8
24	Contactor feedback	Contactor input signal	6.8.9
25	X axis outer limit	CMM X axis limit switch input	6.8.10
26	-X axis outer limit	CMM X axis limit switch input	6.8.10
27	Y axis outer limit	CMM Y axis limit switch input	6.8.10
28	-Y axis outer limit	CMM Y axis limit switch input	6.8.10
29	Z axis outer limit	CMM Z axis limit switch input	6.8.10
30	-Z axis outer limit	CMM Z axis limit switch input	6.8.10
31	X axis inner limit	CMM X axis limit switch input	6.8.10
32	-X axis inner limit	CMM X axis limit switch input	6.8.10
33	Y axis inner limit	CMM Y axis limit switch input	6.8.10
34	-Y axis inner limit	CMM Y axis limit switch input	6.8.10
35	Z axis inner limit	CMM Z axis limit switch input	6.8.10
36	-Z axis inner limit	CMM Z axis limit switch input	6.8.10
37	24 V return	Common reference line for input and output signals	
38 to 43	Reserved		
44	24 V return	Common reference line for input and output signals	6.8.11
Shell	Screen		

6.8.1 +24 V DC

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

6.8.2   **UCC*lite-2* general purpose output**

This transistor output signal (pin 6) is switched on and off by commands from the host computer (See the UCC programmers guide, command number 318). The outputs are active low.

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.

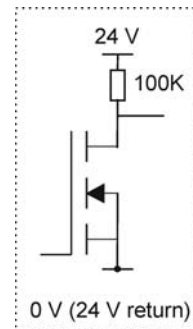Suitable for driving inputs in the range of +5 V to +24 V.

Figure 10

6.8.3   **UCC*lite-2* general purpose inputs**

These 2 opto-isolated LED inputs (pins 13 and 14) to the UCC*lite-2* can be used to send signals from the CMM to the CMM host computer via the UCC*lite-2*. 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.

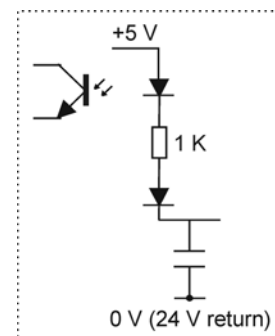This circuit can be driven by inputs in the range +5 V to +48 V.

Figure 11

6.8.4   **Amplifier OK input**

This signal (pin 19) is produced by the servo power amplifier to inform the connected UCC*lite-2* 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.

6.8.5   **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 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 position when the signal again goes low.

6.8.6   ESTOP tripped

This input (pin 21) is used to inform the UCC*lite-2* 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 UCC*lite-2* 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 UCC*lite-2* 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.

6.8.7   Air pressure switch

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

If the input is not pulled down, the UCC*lite-2* will disable all motors and will inform the CMM host computer of the low air pressure.

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

6.8.8   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 UCC*lite-2* will disable all motors, and inform the CMM host computer of this state.

6.8.9   Contactor feedback

This input signal (pin 24) is used by the UCC*lite-2* 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 UCC*lite-2* 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 UCC*lite-2* will disable the drive motors and inform the CMM host computer of this fault.

6.8.10 Limit switches

The **UCC***lite-2* will use these input signals (pins 25 to 36) to stop the CMM as programmed by the host computer (See the UCC programmer's guide, command number 311).

All outer limit switches have to be closed before the CMM drives can be engaged. Operation of these switches is interpreted as a fatal fault. If any of them is operated, all the CMM 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 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.

The limit switch polarity can be configured for normally high or normally low inputs.

6.8.11 24 V return

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

6.9 MCU connector

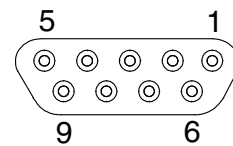| Pin number	Function
1	GND
2	RX_B
3	RX_A
4	TX_A
5	RESERVED
6	+ 15 V
7	TX_B
8	ESTOP_B
9	ESTOP_A
Shell	Screen

Figure 12 - MCU connector. View on face of socket (rear of plug)

On UCC*lite-2* controllers this connector is marked as MCU and used as the connection for MCU*lite* or MCU1 / MCU5 joysticks. On the UCC*lite* this connector is called AUX COMMS and is unused.

7   **UCC***lite-2* **troubleshooting**

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

7.1   **Front panel LED displays**

To aid troubleshooting of the UCC*lite-2* system, six status LEDs are visible through the front panel of the unit, these are detailed below.

USB Comms active	Power On	System Ready	Servos Active	Probe Seated	Error		Refer to section
○	●	○	○	○	○	Power applied to UCC*lite-2*	7.1.2
●	●				✳	USB comms link established, waiting for download	7.1.3
✳	●					USB data being passed	
	●			○		Probe triggered	7.1.6
	●			●		Probe seated	7.1.6
	●	○				Motors disengaged	7.1.5
	●	●				Motors engaged	7.1.5
	●				●	Error, reboot and try again	
	●	✳			✳	Error, return to Renishaw	
	●	✳		✳	●	Scale error, reboot required	
	●	✳				Download failed, reboot	7.1.4

○ = off	● = on	✳ = Flashing

7.1.1   **UCC***lite-2* **power not switched ON**

All LEDs OFF.

7.1.2   **UCC***lite-2* **power switched ON**

Power on LED is on.

If switch-on is successful the UCC*lite-2* proceeds to the initialisation/test sequence.

7.1.3   **Initialisation/test**

If the initialisation tests fail, then after about 15 seconds several of the above error LED configurations will indicate the reason for the failure:

NOTE: The state of all LEDs 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 the initialisation tests are successful then the power on LED will remain lit and the error LED will start flashing. The controller is now ready for the system file to be downloaded.

7.1.4   System file downloading

During system file downloading, the power on LED is on 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 on. In this condition, the UCC*lite-2* 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 on.

7.1.5   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.

7.1.6   Probe seated LED

When the probe is not deflected the probe seated LED is on.

When the probe is deflected the probe seated LED is off.

7.2   Fault finding

7.2.1   Fatal faults

Under certain conditions 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 too low, if relevant.

• Crash switch operated, if fitted.

• A scale reading failure.

• An indicated overspeed (calculated from the rate of change of position).

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

7.2.2   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)

Any of the 'fatal faults' will cause this problem, 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.

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.

7.2.3   Motors disengage / relays chatter during move

Symptoms

When the system is engaged, either in moving or in the hold state, the SPA relays chatter and the motors and momentarily disengaged.

Possible causes (UCC*lite* only)

On the UCC*lite* the servo update loop is controlled within the P. C. The typical update interval is 10 ms but there is a safety mechanism that disengages the motors if the delay between updates reaches 100 ms.

The UCC*lite* software has been written to ensure it has a very high priority within the PC task list, however is has been found that certain parallel port program dongles can delay the PC processor for longer than 100 ms.

Test / cures

Remove the dongle and check that this problem does not occur when using UCCassist or Renicis to generate moves. If the parallel port dongle is the cause of this problem, contact your software supplier. They may have a USB alternative available or have modified their program so the parallel port dongle is not accessed during motion.

7.2.4 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 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 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.

Large 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 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 sufficiently accurate.

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).

7.2.5   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' section below.

Possible causes, tests, cures

If only some commands are ignored:

- Identify which commands are not working.

- 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 data from a peripheral when none is available.

UCCassist-2 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:

- Reboot the controller. 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 USB 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. Chapter 4 describes the USB configuration in detail.

7.2.6   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 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 (other then 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 creep 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 UCCassist-2 and request more detailed error reporting from the application software.

7.2.7   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 setting 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 max 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 next section.

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.

Possible causes

On a new machine, the readhead cables may introduce too large a voltage drop. Check specification for heads and cable, see chapter 6.2.

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 LED's 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 6.2 and 8.4, Description of connector signals, CMM readhead input connections, for the electrical details of the cables and heads.

7.2.8   Timing out during moves

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 setting a '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 CMM servo capabilities, it will cause time-out failures during moves. Adjust it using the positional tolerance parameter in UCCassist-2.

7.2.9   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.

- 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.

- All inner limit switches must be closed and the machine must be inside all soft limits, if these are enabled.

8   Specifications

This chapter defines the power requirements and the environmental conditions required by the UCC*lite-2* controller and list the available supplies.

8.1 Physical specification

The UCC*lite-2* controller is housed inside a 1U 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: 43 mm

- Depth: 130 mm

- Width: 435 mm

- Weight: 1.2 kg (without cables)

8.2 Cable lengths

8.2.1   UCC*lite-2* 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 mm². For further details please refer to chapter 6.2, CMM readhead input connections.

8.2.2   UCC*lite-2* to CMM servo power amplifier input

Dependent on the servo power amplifier, SPA1 or SPA*2*/ SPA*lite*, 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.

8.2.3   USB cable link to PC

This is a standard USB cable and a 5 metres cable is supplied as part of the UCC*lite-2* kit.

Other lengths can be fitted up to a maximum of 5 metres.

8.3 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

8.4 Electrical power requirements

8.4.1   Controller output supplies

The UCC*lite-2* 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 UCC*lite-2* also provides protected supplies for other external devices such as scale read-heads, the probe, etc.

The supply to the scale readheads is a nominal 5.25 Vdc to it compensates for any cable volt drop.

9   System interconnections

The UCC*lite-2* 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.

9.1   Probing system interconnection

9.1.1   2 wire touch-trigger probe system for UCC*lite*
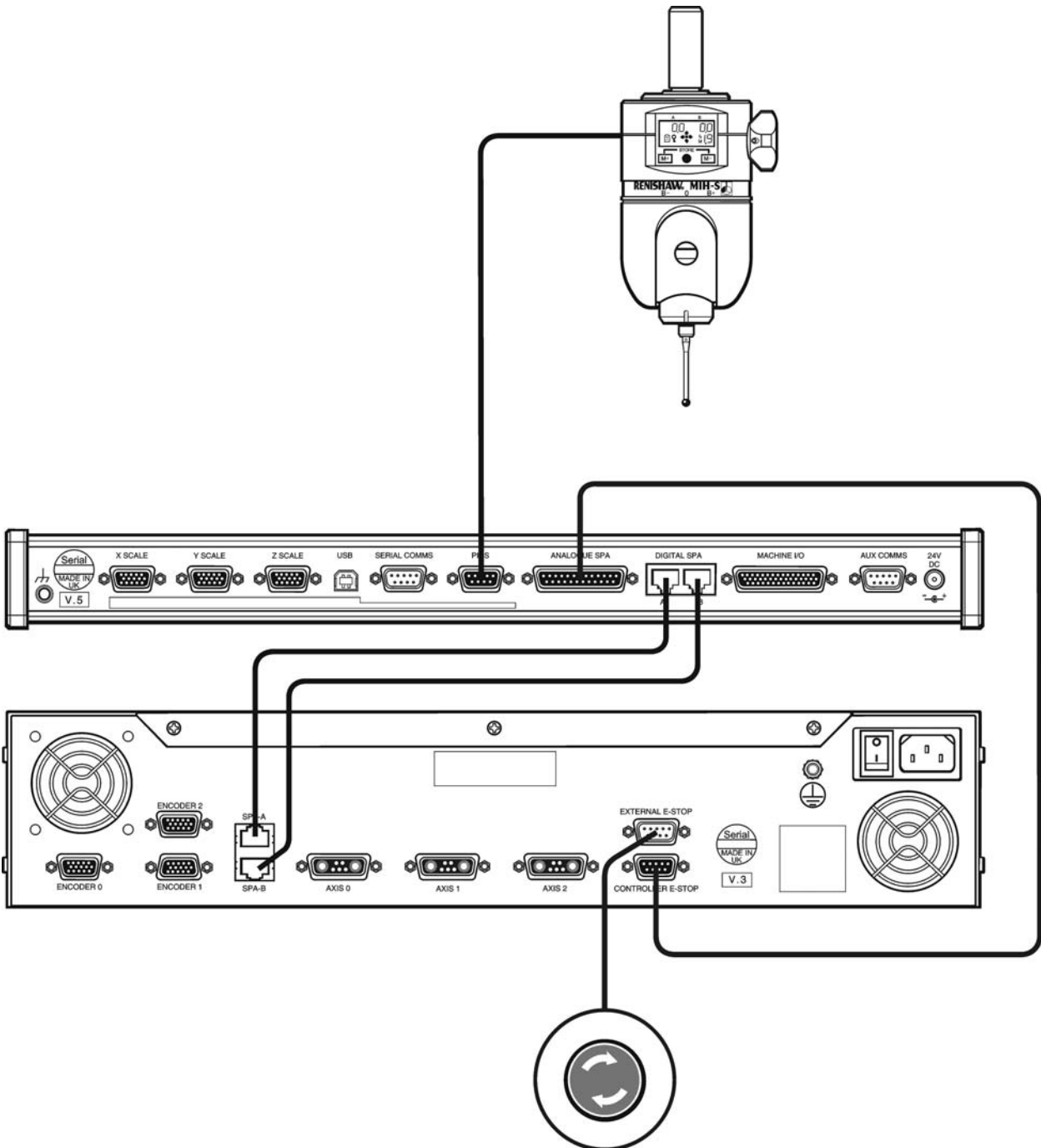
9.1.2 2 wire touch-trigger probe system for UCC*lite-2*
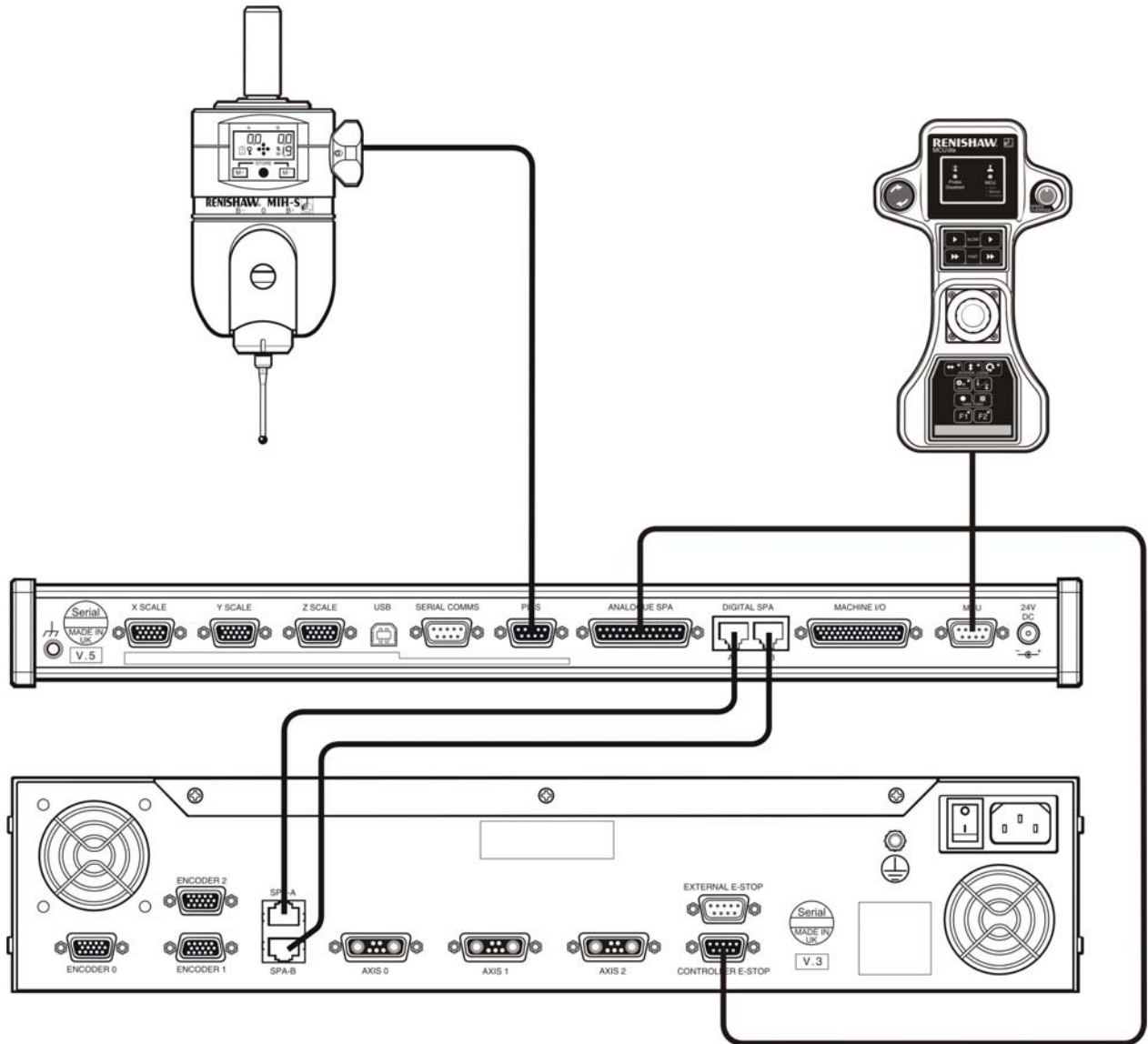
9.1.3 TP200 touch-trigger probe system for UCC*lite*
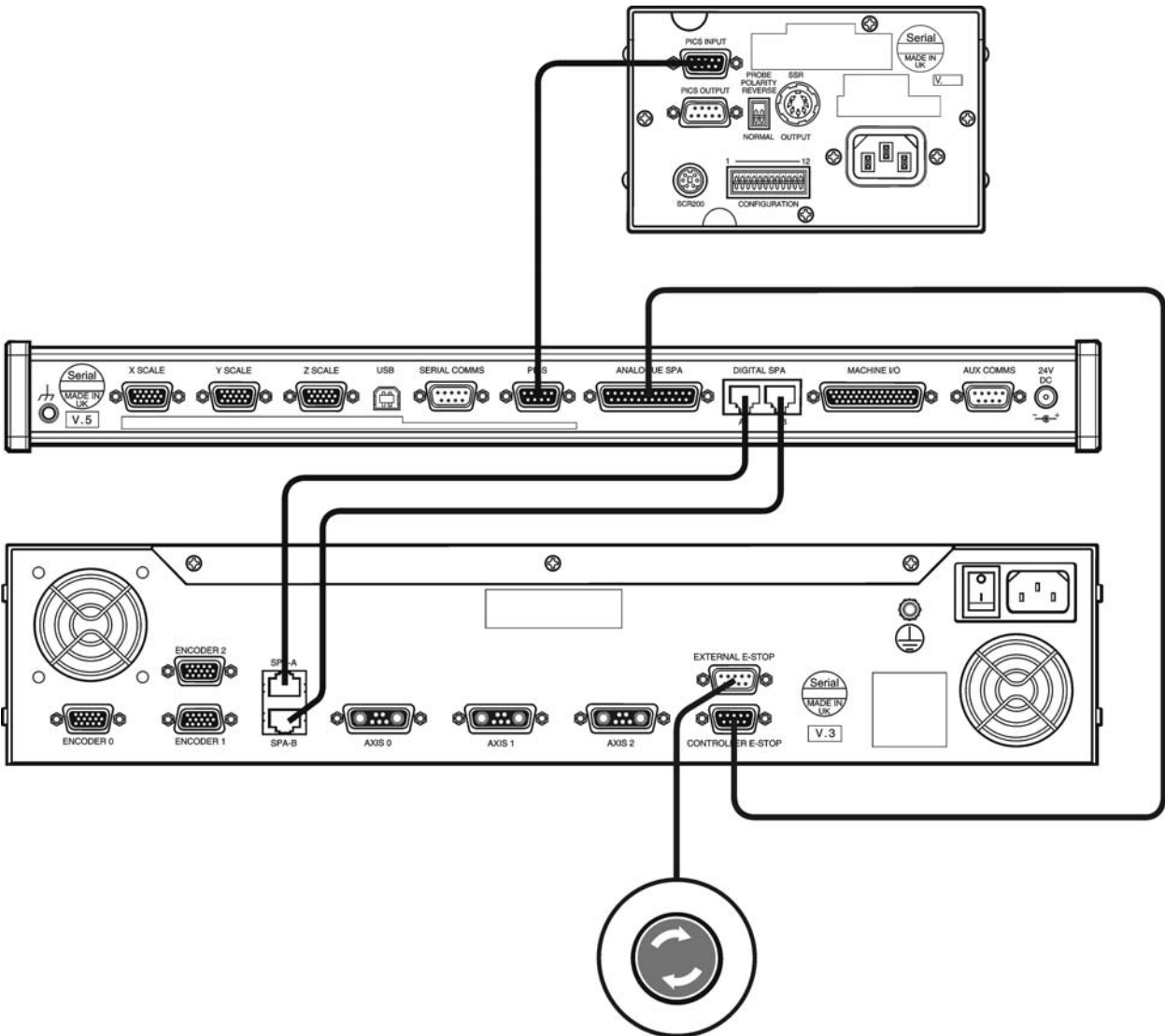
9.1.4 TP200 touch-trigger probe system for UCC*lite-2*
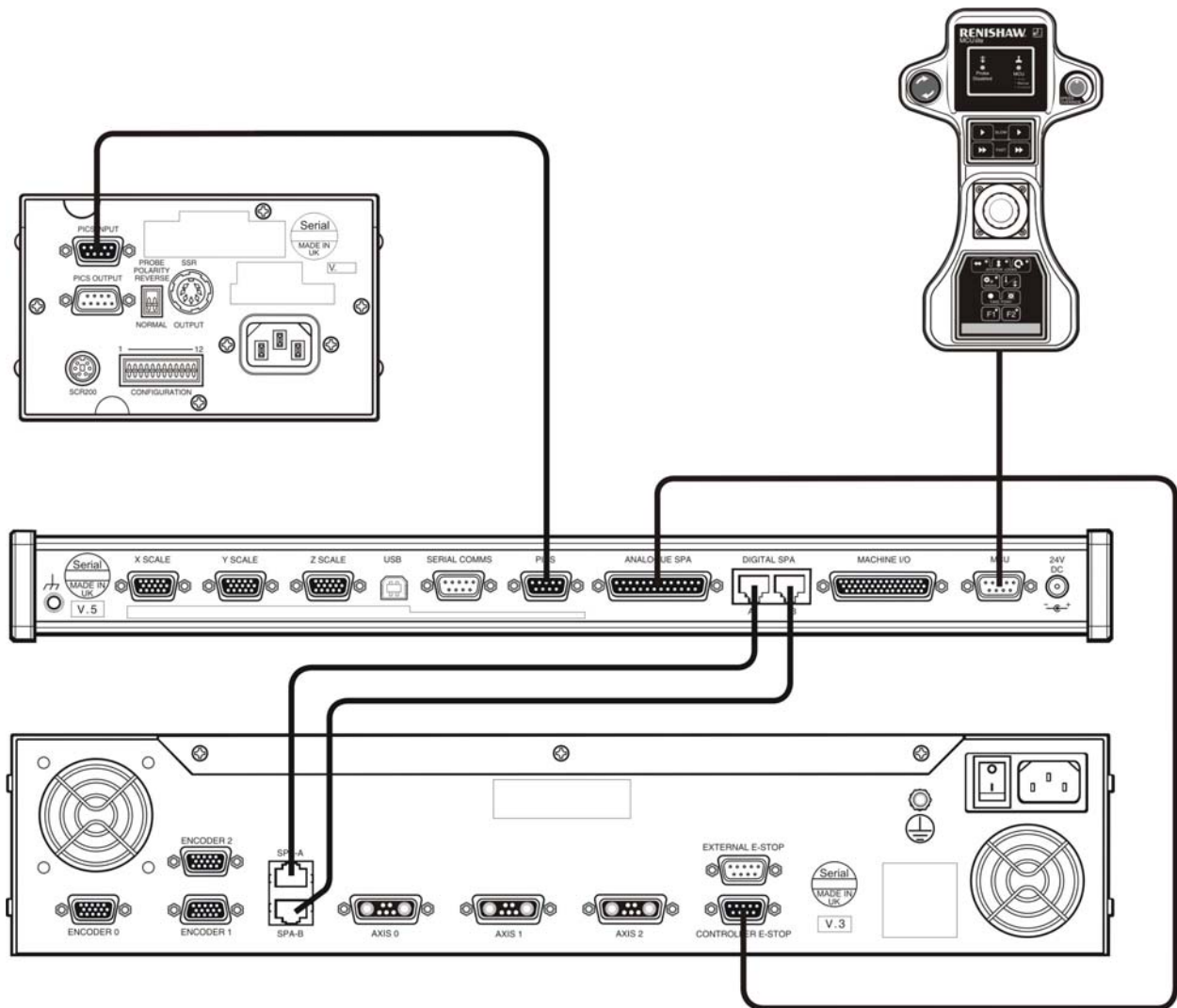
9.1.5 PH10 probe head and 2 wire touch-trigger probe system for UCC*lite*
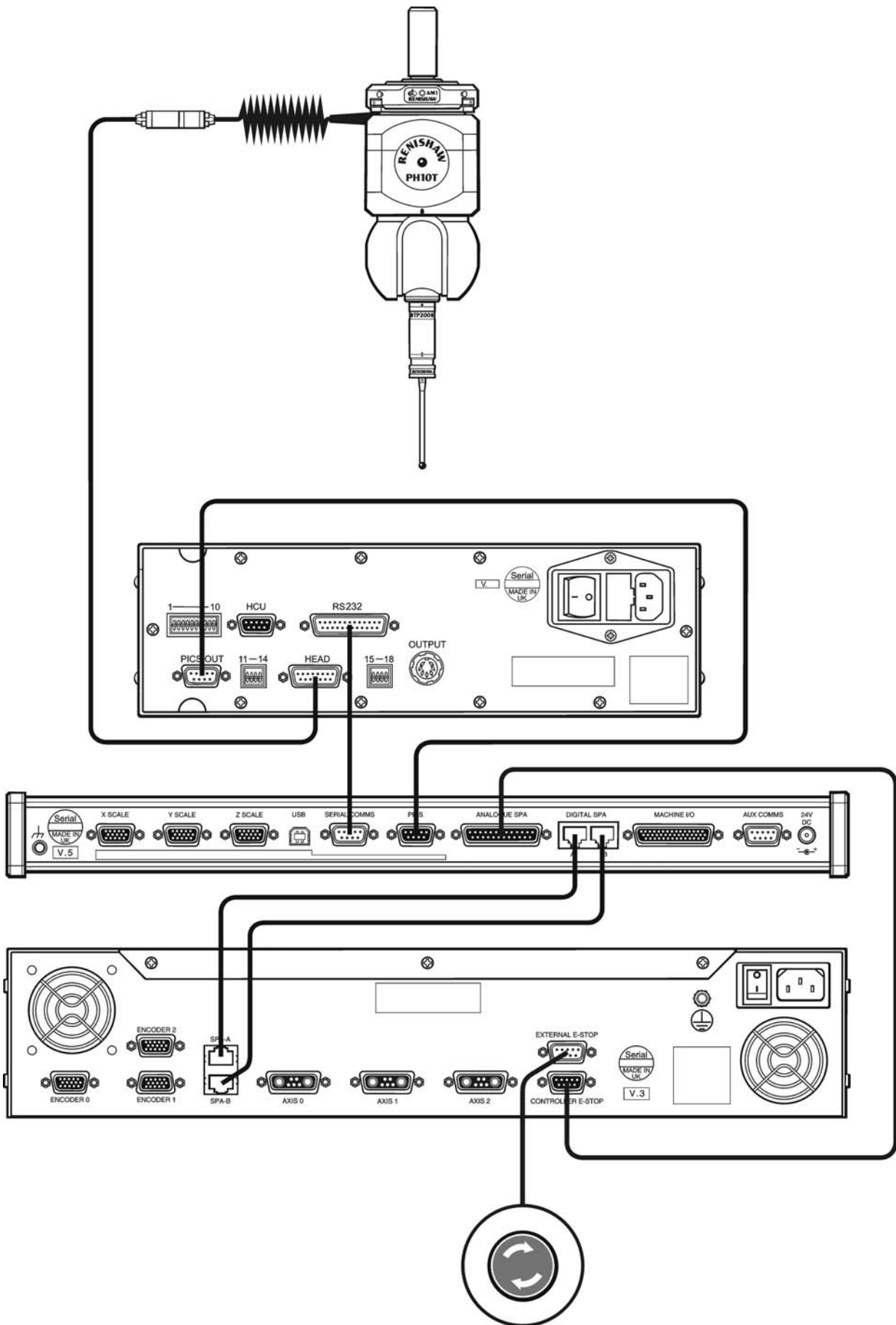
9.1.6   PH10 probe head and 2 wire touch-trigger probe system for UCC*lite-2*
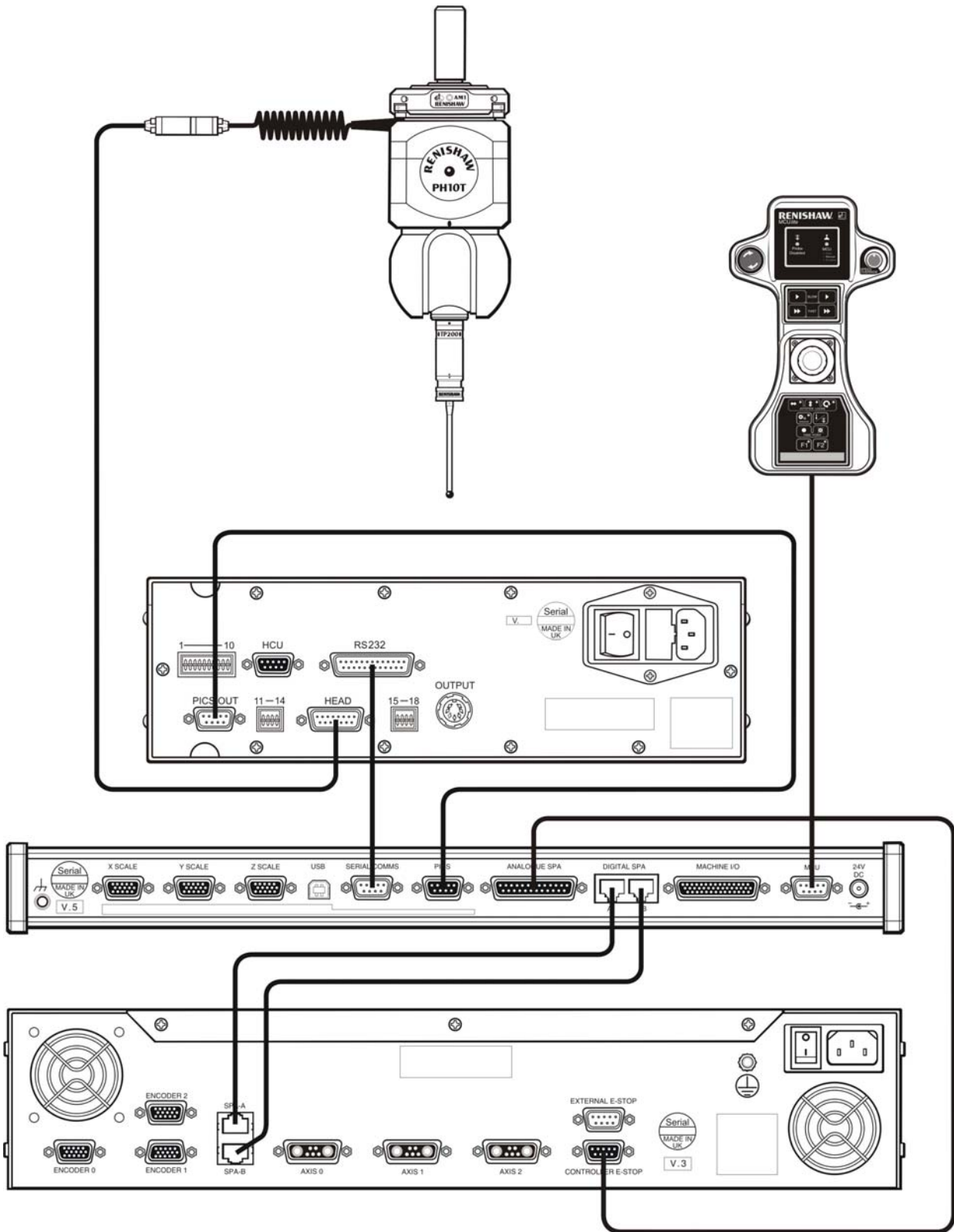
9.1.7   PH10 probe head and TP200 trigger probe system for UCC*lite*
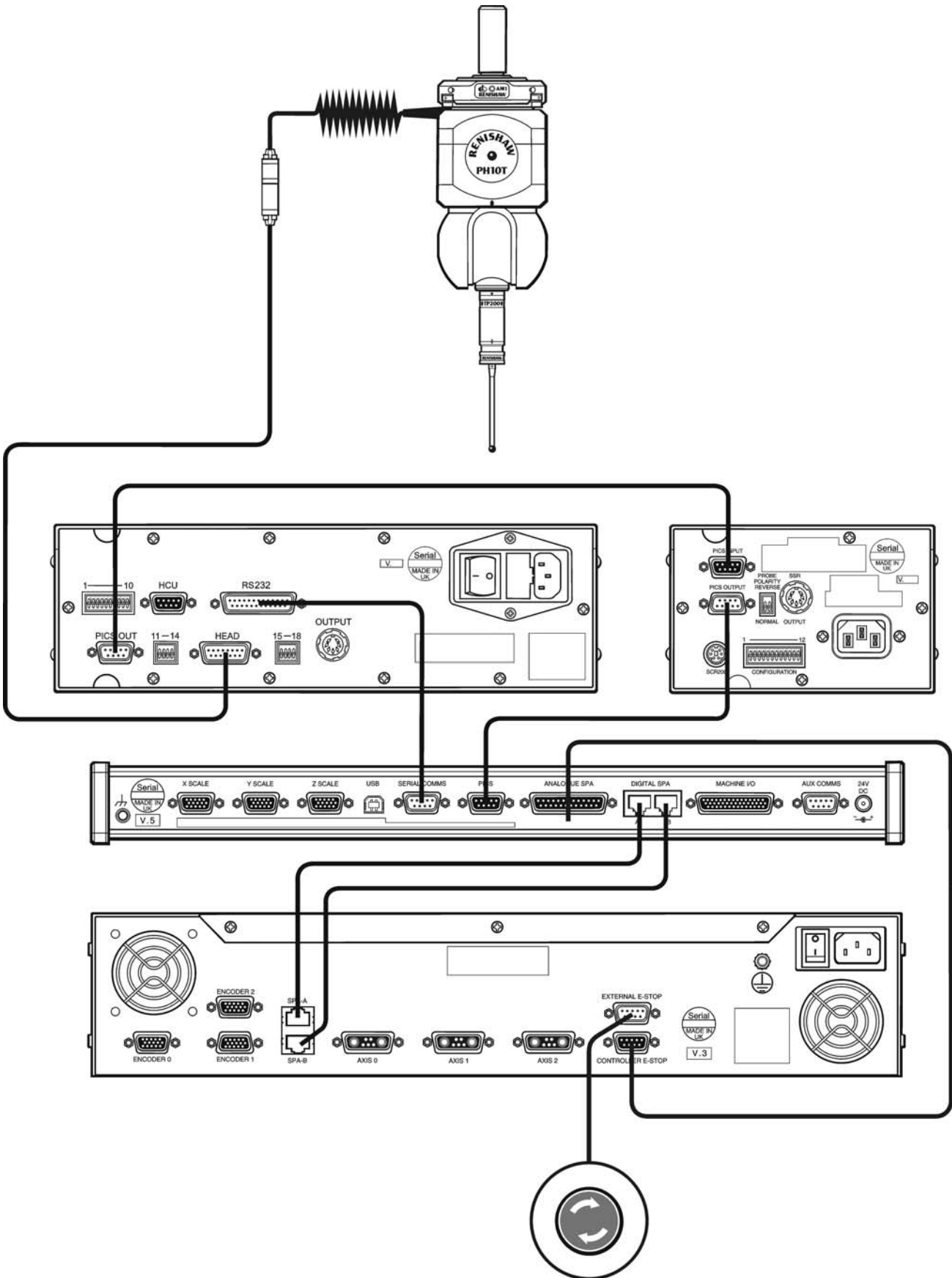
9.1.8 PH10 probe head and TP200 trigger probe system for UCC*lite-2*
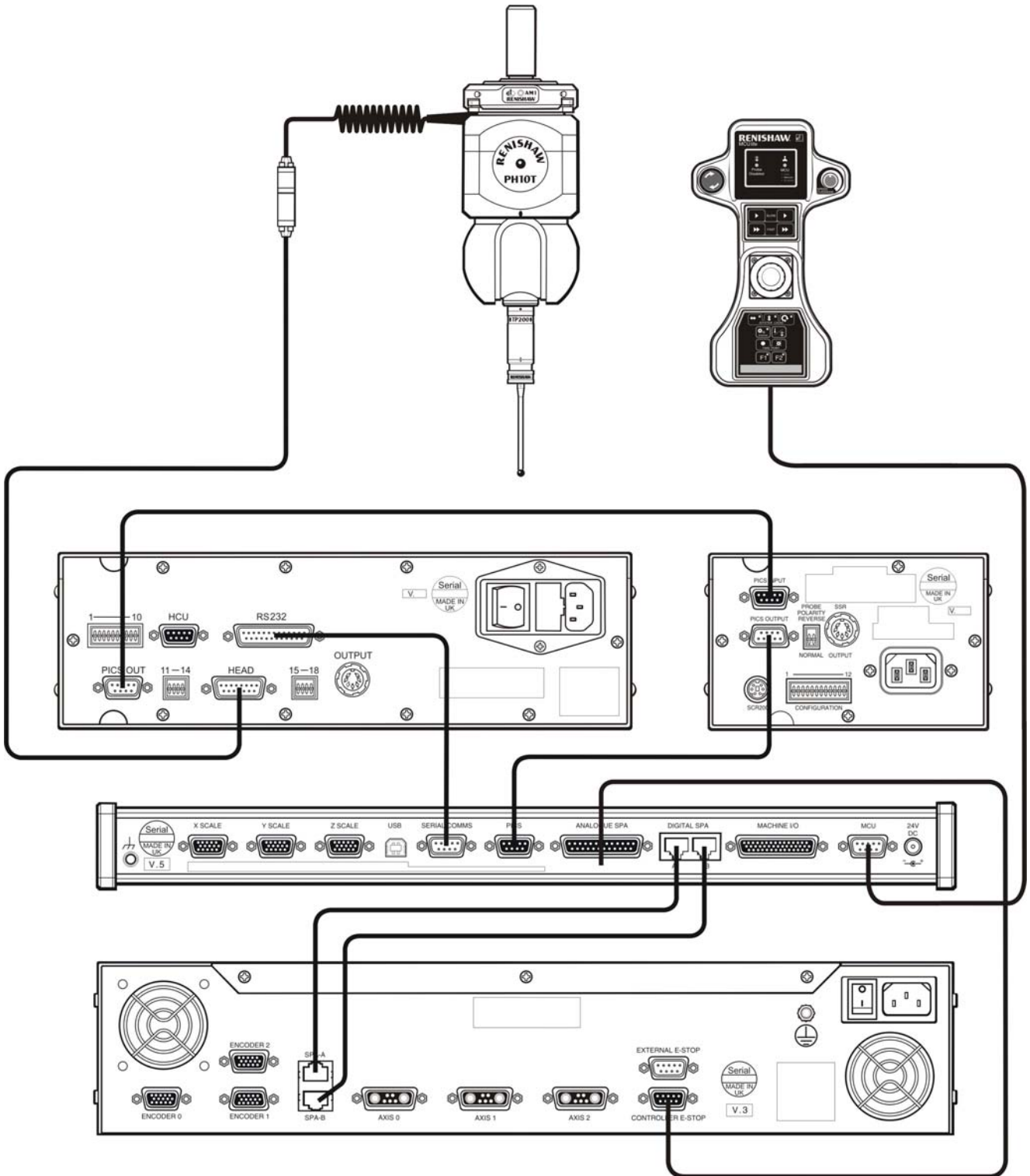
9.2 Servo amplifier connection

9.2.1   UCC*lite* and SPA1

Power
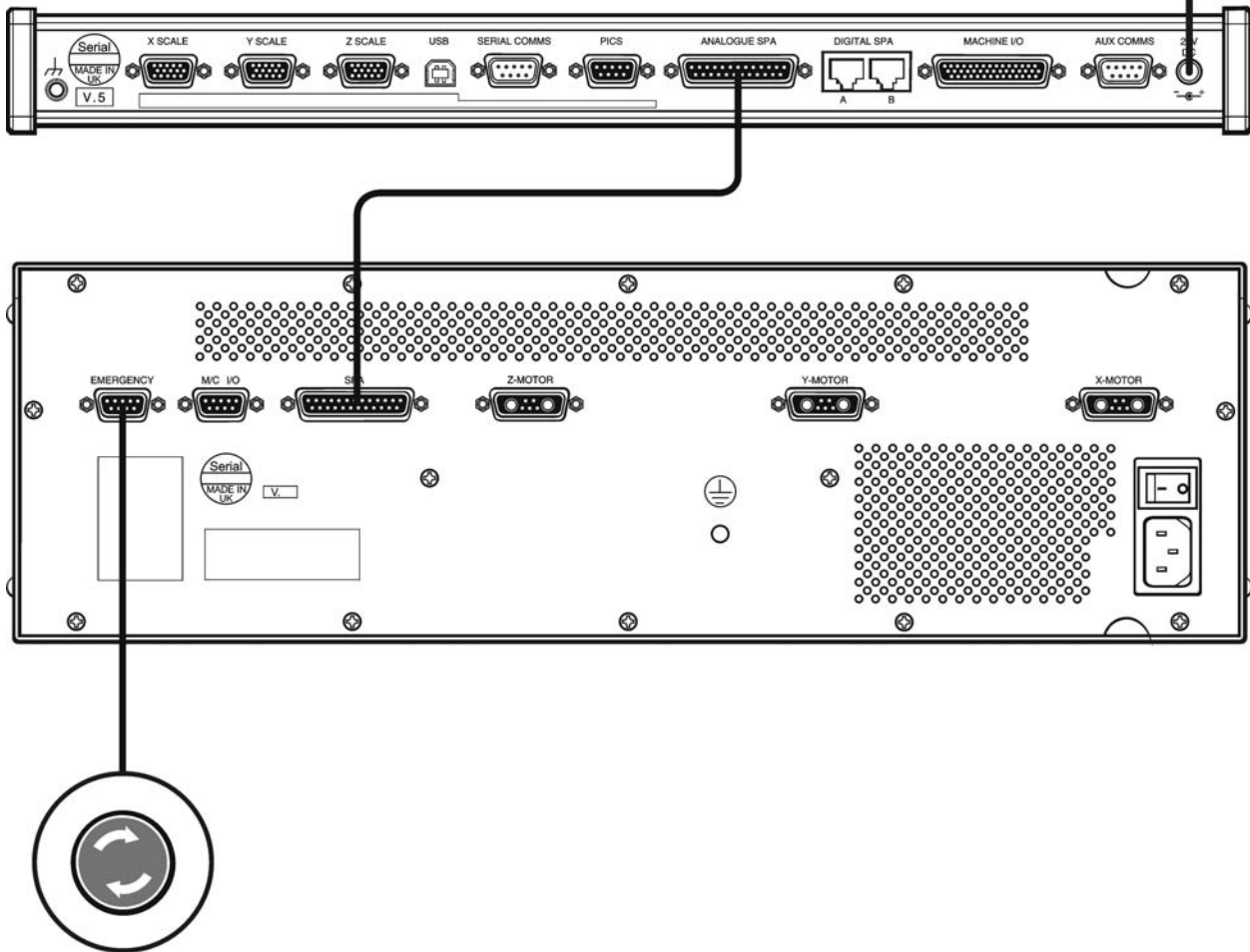
9.2.2 **UCC***lite-2* **and SPA1**
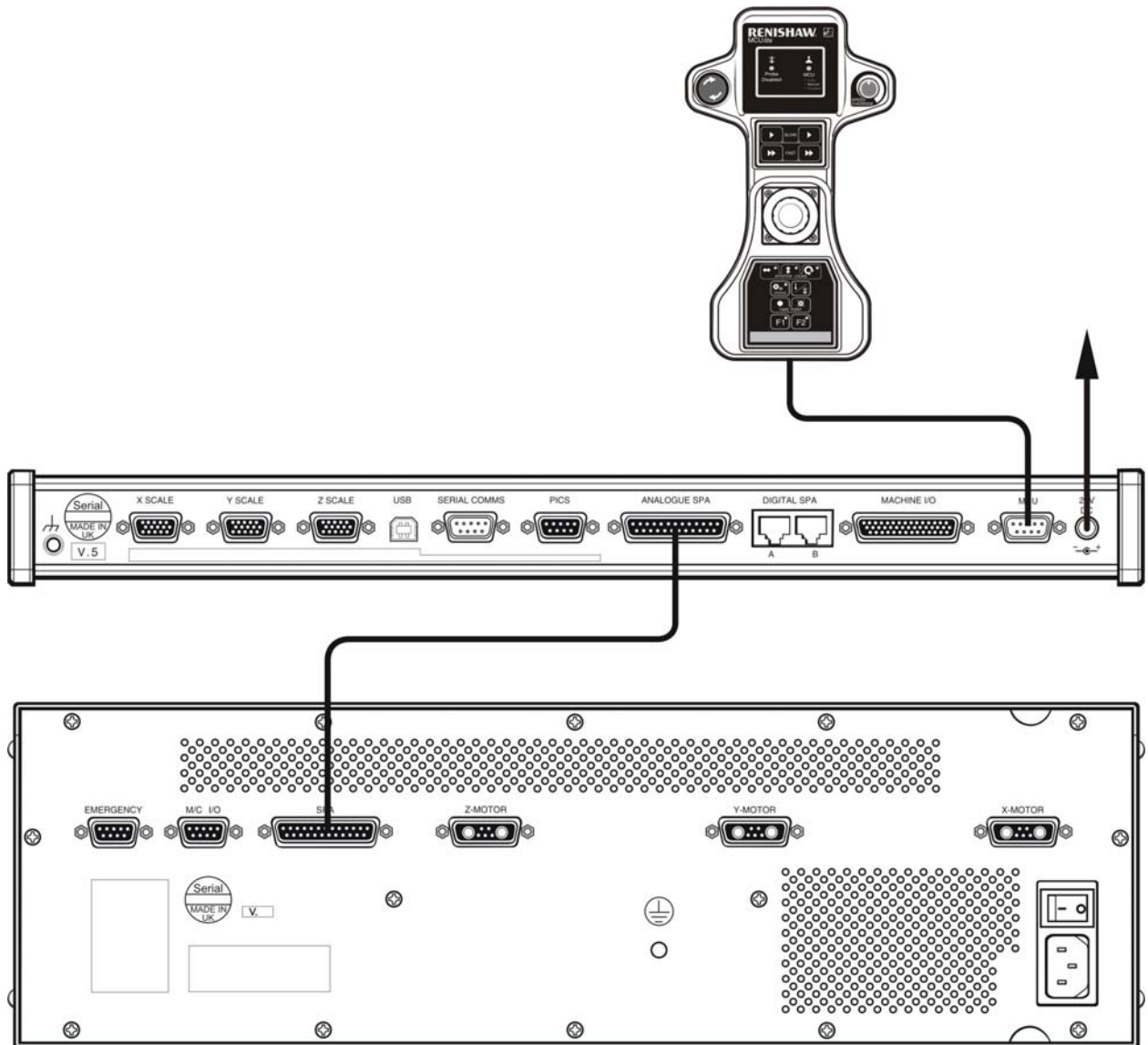
9.2.3   **UCC***lite* **and SPA***2-2*
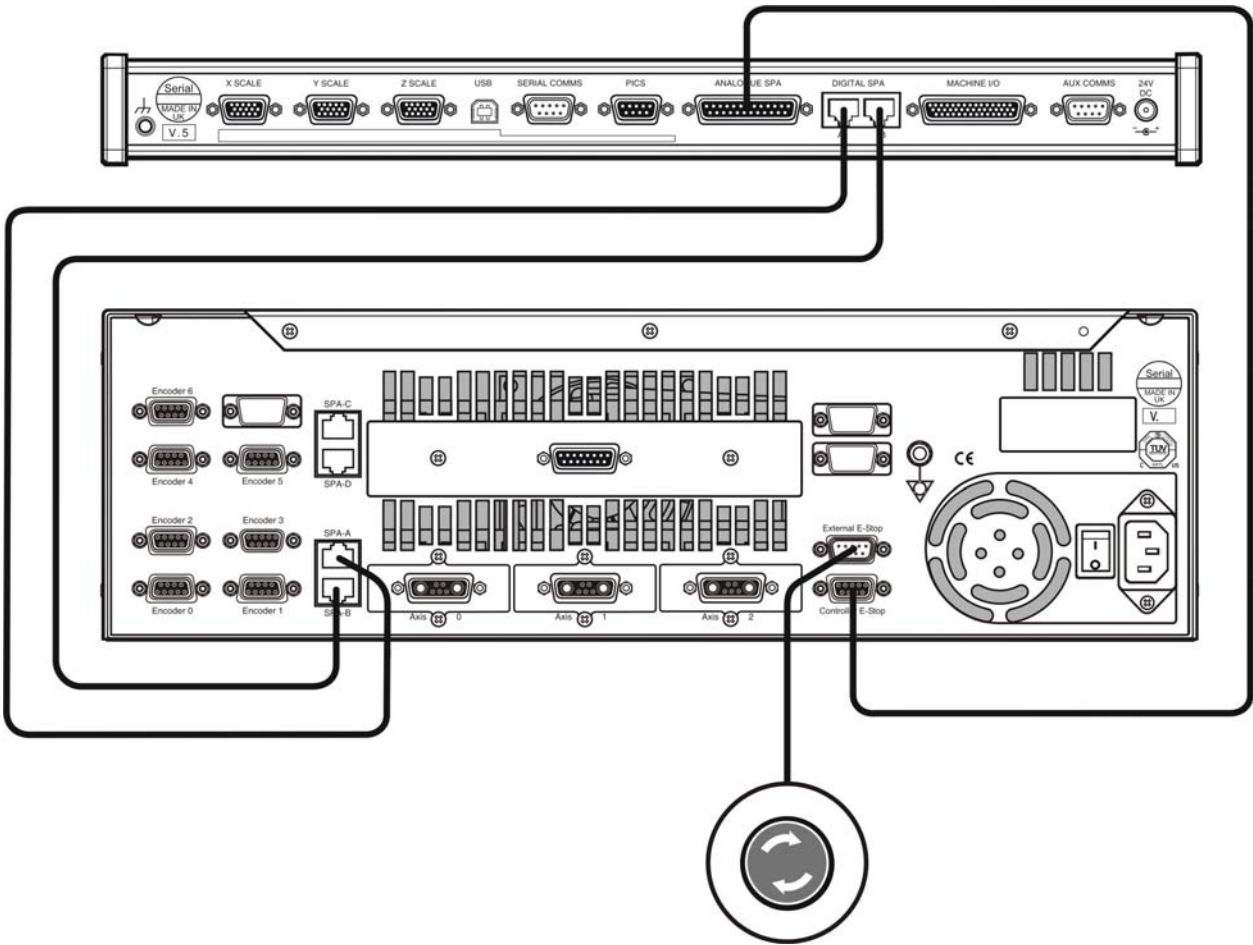
9.2.4 **UCC***lite-2* **and SPA2-2**
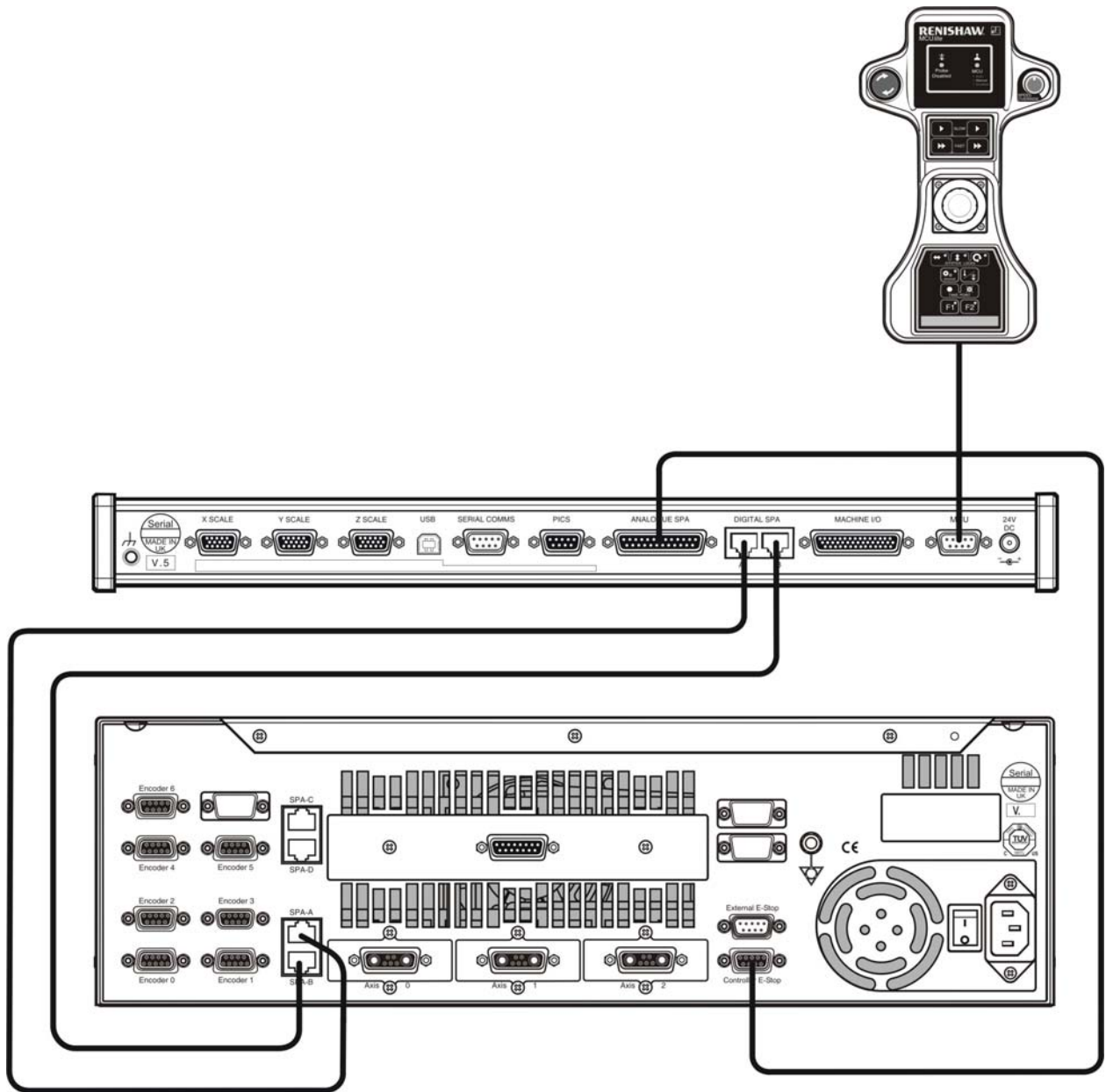
9.2.5 UCC*lite* and SPA*lite*
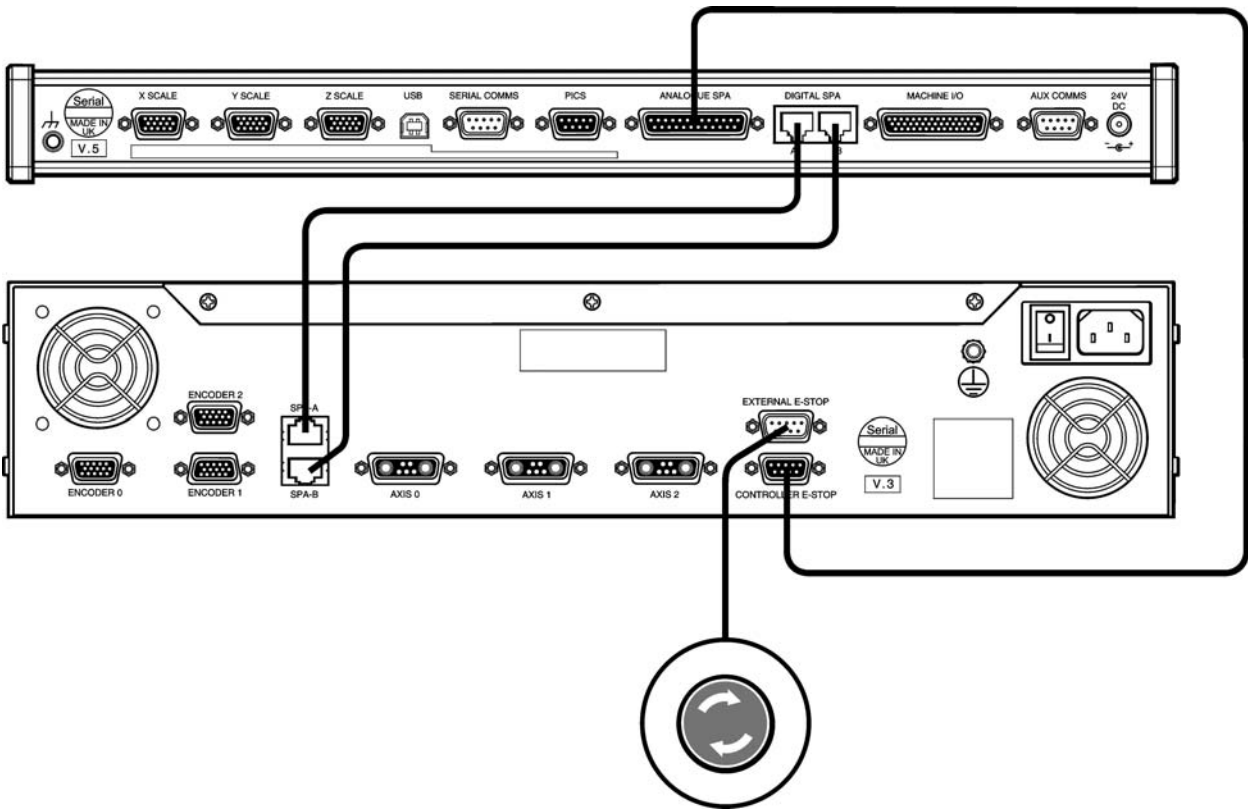
9.2.6 UCC*lite-2* and SPA*lite*
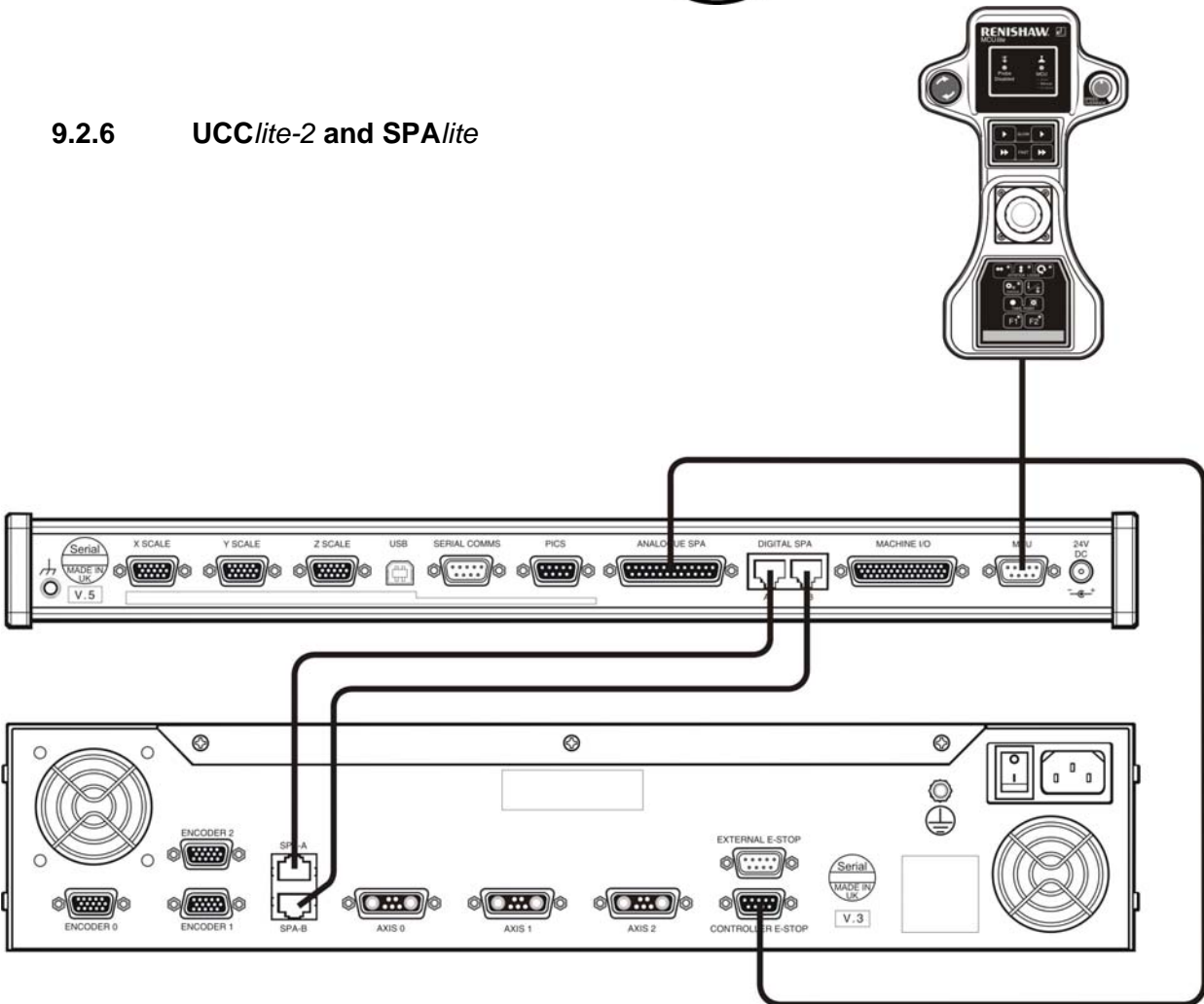
10 Joystick display window (only applicable for UCC*lite*)

10.1 The window

10.1.1 Behaviour

The joystick display window behaves like a standard window. Click the '❎' button to hide the window.
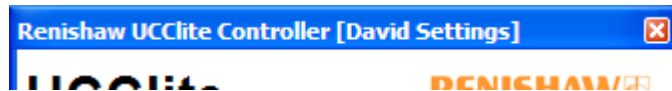
Figure 13 - The title bar

Click and drag the border to resize the window, or click and drag the title bar to move it to another position. Double-click the title bar to make the window fill the screen or restore it back to its original size and position.

10.1.2 Viewing joystick settings

To show or hide the joystick settings, press the thin button with the arrow, located on the right hand side of the window as shown in figure 14 and figure 15.
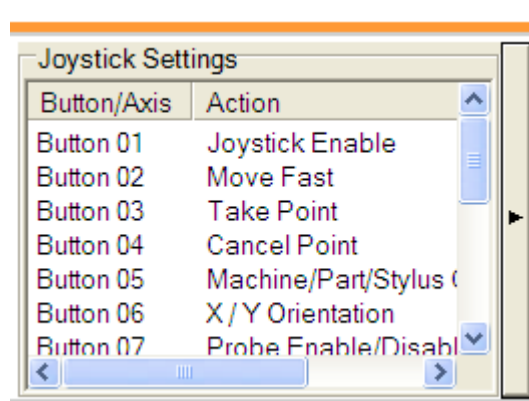
Figure 14 - Settings visible

Figure 15 - Settings hidden

10.2 Manual mode
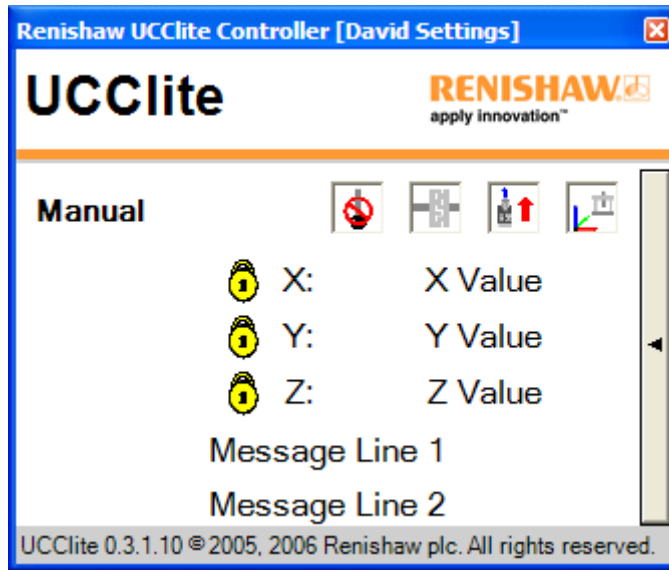
Figure 16 - Manual mode features
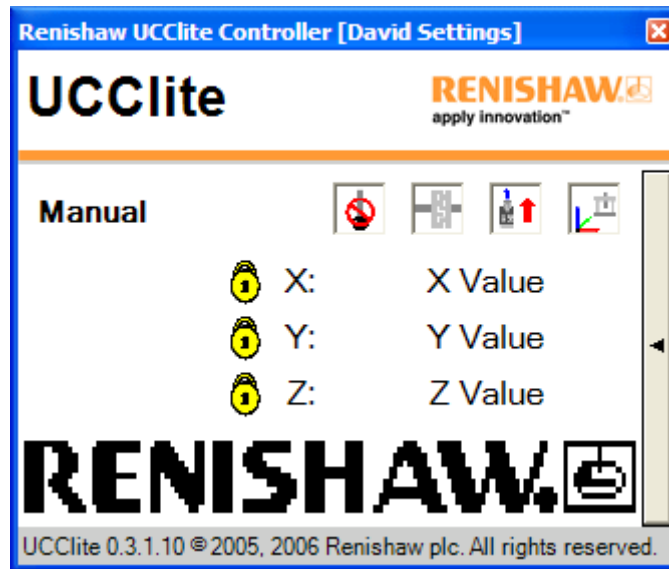
Figure 17 - Manual mode with graphics

The manual mode screen is displayed while the user has control of the joystick.

- Four icons are shown in the top right corner of the screen area.

    - The state of the probe trigger, illustrated by figures 19 and 20.

    - The state of the CMM motors, illustrated by 21 and 22.

    - The Y+ Axis Orientation, illustrated by figures 23 to 26.

    - The active co-ordinate system illustrated by 27 to 32.

- Line 1 displays the current co-ordinate system position in the X-axis.

- Line 2 displays the current co-ordinate system position in the Y-axis.

- Line 3 displays the current co-ordinate system position in the Z-axis.

- When an axis is locked, the symbol illustrated in figure 18 is displayed on the left side of the axis letter.

- Lines 4 and 5 display up to 21 characters of messages from the user front end, as shown in figure 16, or a 256 byte pixel-based graphic as shown in figure 17.

10.2.1   Axis lock

Figure 18 - On

10.2.2   Probe trigger status

Figure 19 - Disabled

Figure 20 - Enabled

10.2.3   CMM motors status

Figure 21 - Motors not engaged

Figure 22 - Motors engaged

10.2.4   Y+ Axis Orientation
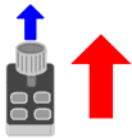
Figure 23 - Up
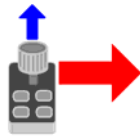
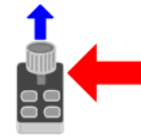

Figure 24 - Right
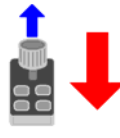
Figure 25 - Down

Figure 26 - Left

10.2.5   Active co-ordinate system

Machine co-ordinates

Figure 27 - Active
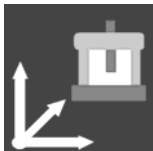
Part co-ordinates

Figure 28 - Active
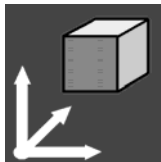
Stylus co-ordinates
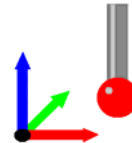
Figure 29 - Active

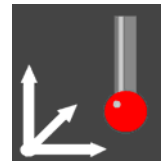**Figure 30 -** Selected

Figure 31 - Selected

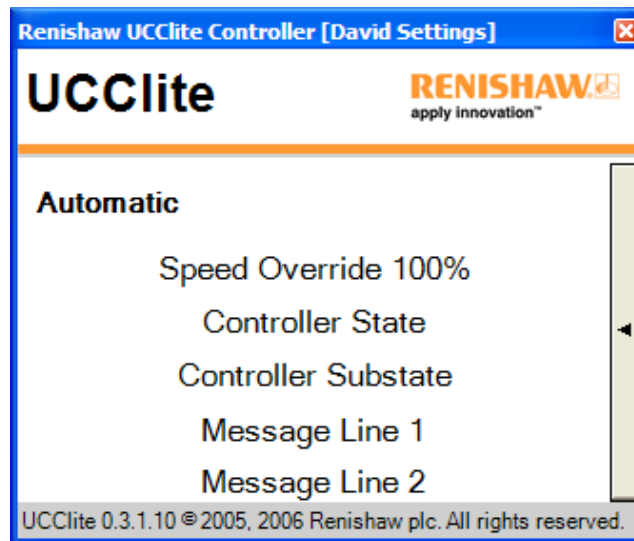**Figure 32 -** Selected

10.3 Automatic mode

Figure 33 - Automatic mode features

The automatic mode screen is displayed while the CMM is under the control of an automatic routine, also known as 'dcc' or 'direct CMM control' mode.

- The first line displays the current value of Speed Override as a percentage of the current speed. It will flash if it falls below a set threshold.

- The second line displays the controller state.

- If applicable, the third line shows the controller substate.

- As in manual mode, the fourth and fifth lines can display two lines of text or 256 bytes of graphics.
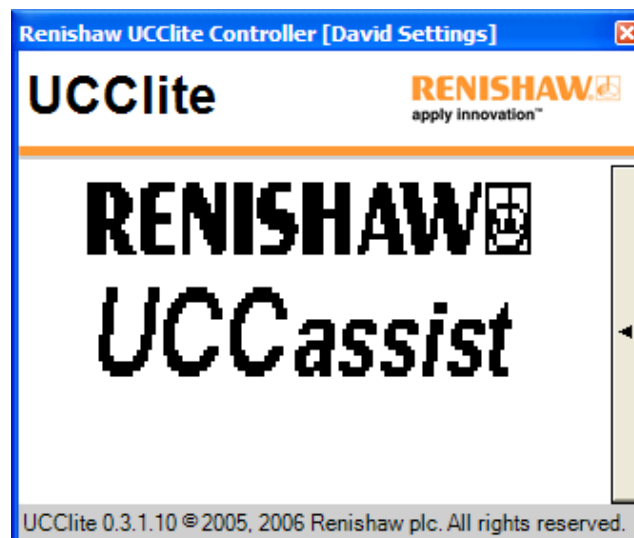
10.4 User mode

Figure 34 - User mode features

The User Mode screen is displayed when requested by the front end. The available space is filled with a pixel-based message. The message lines are not visible in this mode.

11   Joystick configurer (UCC*lite* only)

11.1 Joystick USB connection (only required for UCC*lite*)

The host PC is recommended to have a dedicated USB connection to the joystick, connection to the joystick through a USB hub causes a reduction in communication speed that these devices normally produce.

The UCC*lite* system requires a DirectX compatible joystick that is either USB1.1 or 2.0 specification. During the UCC*lite* software installation process DirectX 9.0c is installed on the system.

When the joystick is connected to the PC Windows will automatically detect the new hardware, start the Windows hardware installation wizard and identify the correct driver for the joystick.

11.2 What is a configuration?

A configuration tells the UCC*lite* system how to interpret button press and axis movement information from the joystick. Any number of configurations can be defined to suit different user requirements, but only one is used the UCC*lite* system

11.3 What is the default configuration?

When the UCC*lite* system it is shut down, it will reset the active configuration back to the default configuration.

NOTE: The following sections have been written assuming that only one joystick type is used on the installation. If a CMM has been configured to work with a certain joystick and then a different joystick is fitted, the "joystick configurer" utility must be used to set up the new joystick before the CMM can be used.

11.4 Joystick configuration (UCC*lite* only)

When the UCC*lite* is supplied a default joystick configuration file is installed during the UCC*lite* software installation, these settings are as detailed below:

Joystick function	Machine function
X axis movement	Move in X axis, to ISO841 convention
Y axis movement	Move in Y axis, to ISO841 convention
Z axis rotation	Move in Z axis, clockwise twist is positive movement
Hat Switch	Manual control
Slider	Speed override
DirectX button 0	Joystick enable
DirectX button 1	Joystick fast move
DirectX button 2	Record point
DirectX button 3	Cancel point
DirectX button 4	Machine / part co-ordinate system selection
DirectX button 5	X / Y orientation selection
DirectX button 6	Probe inhibit
DirectX button 7	X axis lock
DirectX button 8	Not configured
DirectX button 9	Y axis lock
DirectX button 10	F1 – function button
DirectX button 11	Z axis lock

To modify the configuration of the joystick and for the explanation of the machine functions please refer to the chapter 9.2.5.

11.5 Setting up a configuration

11.5.1   Choosing a default

The following dialog box will only be displayed when the application loads, if the default configuration is missing or invalid.
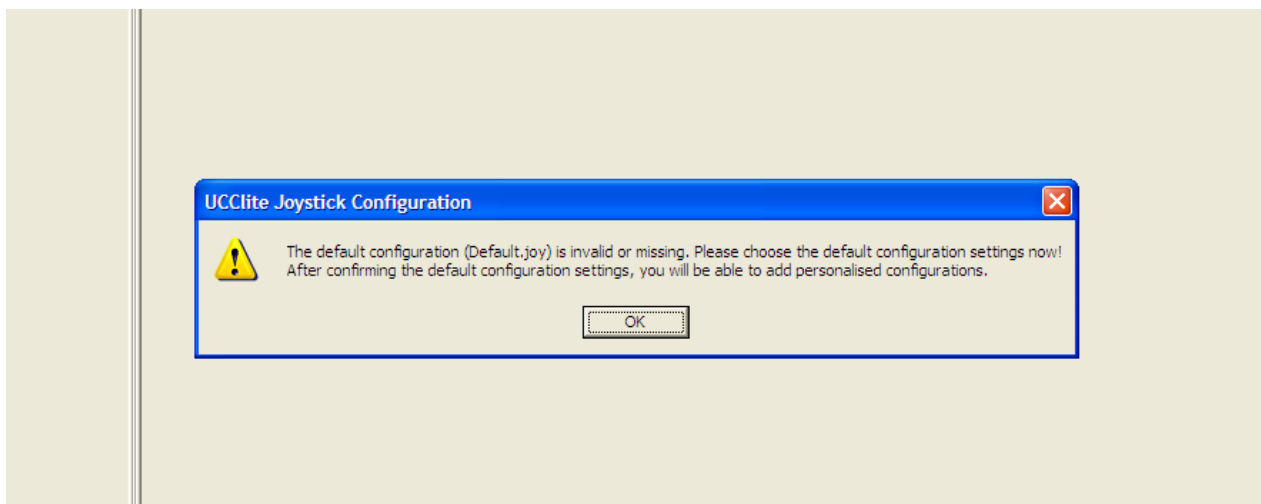

Figure 35 - Warning about missing default configuration

11.5.2   Choose controls

Use the mouse, arrow keys or joystick to assign actions to joystick controls.

- **Using the joystick**
  Press a button or move an axis on the joystick to select the corresponding item in the list. Deflect and hold the joystick in the x-axis until the focus switches to the Actions list, then deflect in the Y-axis until the desired action is highlighted. Press Button 1, usually the 'fire' button, to assign the highlighted action to the joystick control.

- **Using the mouse**
  Double click on an item in the Controls list to select it and switch the focus to the Actions list. Double-click on an action to assign it to the selected control.

- **Using the keyboard**
  Press the Up and Down arrow keys to highlight an item in the Controls list. Press the 'Enter' key to select the item and switch the focus to the Actions list. Use the Up and Down arrow keys to highlight an action and press Enter again to assign it to the selected control.
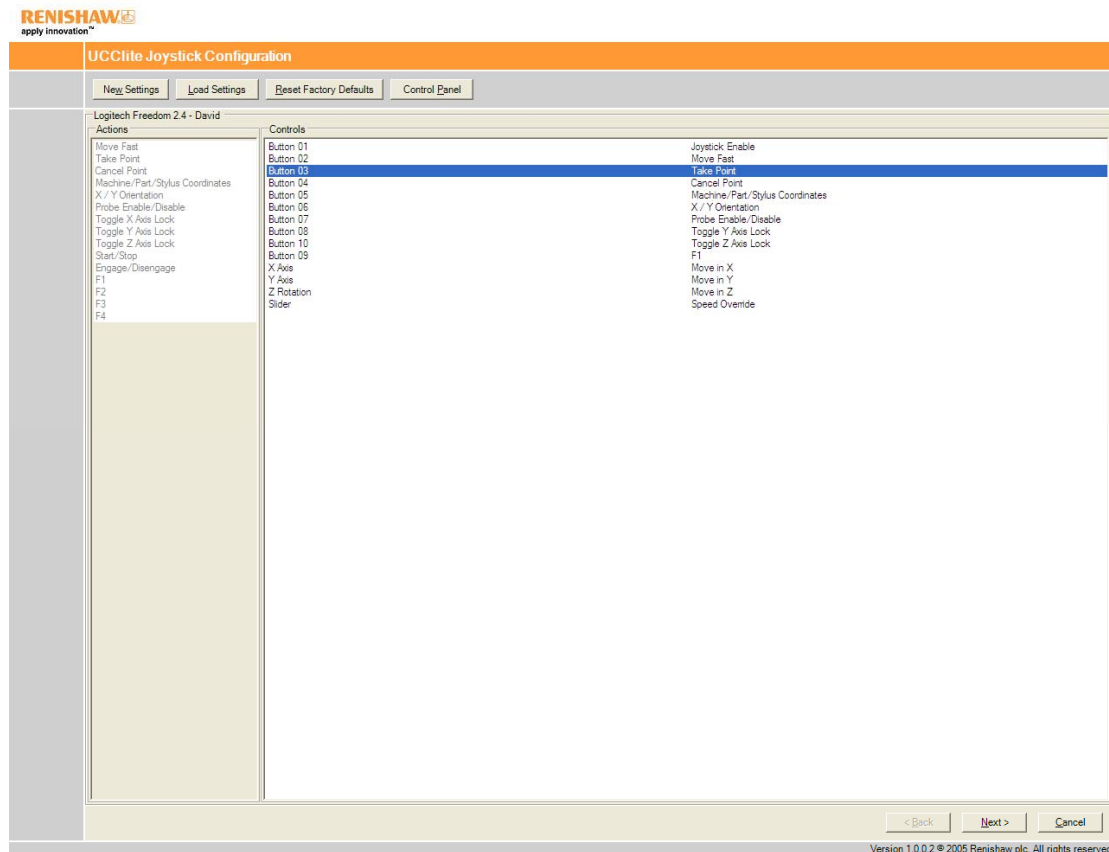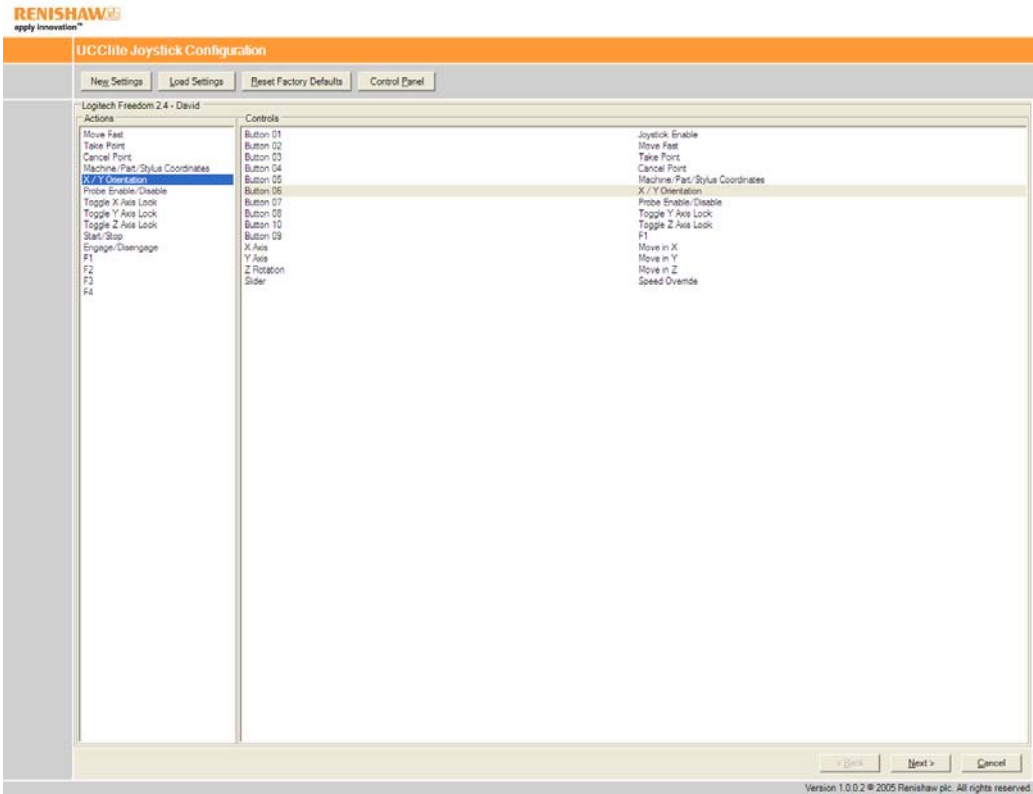

Figure 36 - Button 03 highlighted in controls list

Figure 37 - Button 06 selected. X/Y orientation item highlighted in actions list

11.5.3 View game controller control panel

If necessary, additional joystick settings can be changed via the Game Controller Control Panel provided by the operating system. Press the Control Panel button to view it.
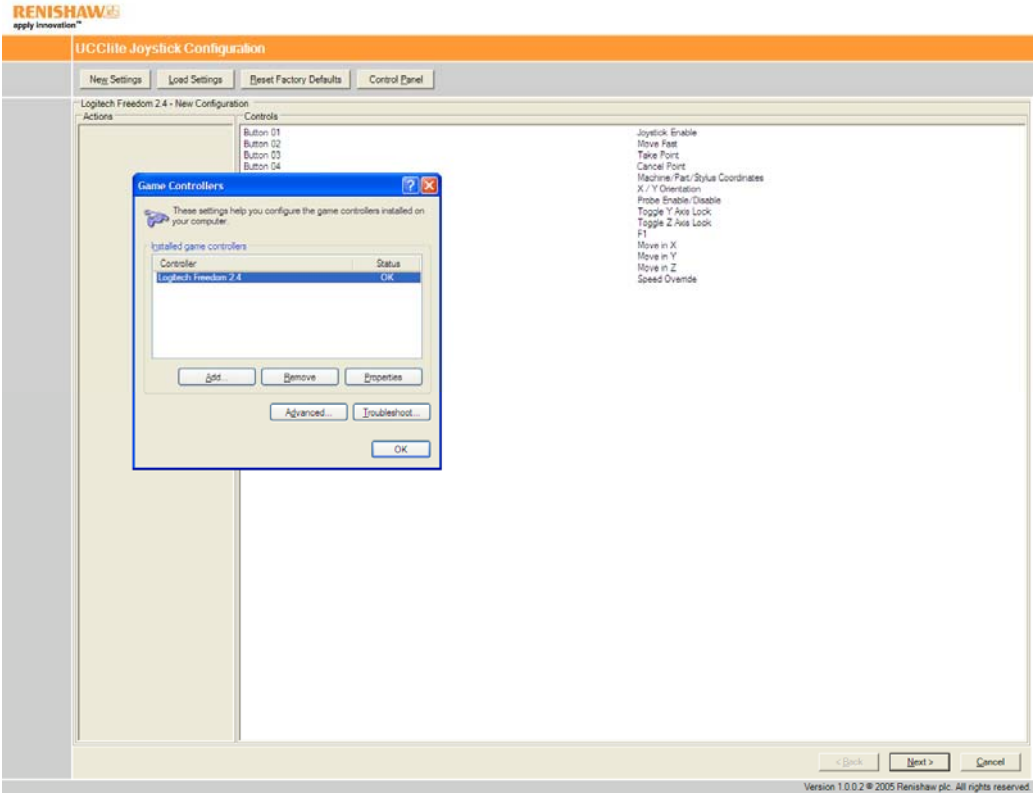

Figure 38 - Viewing the game controllers control panel
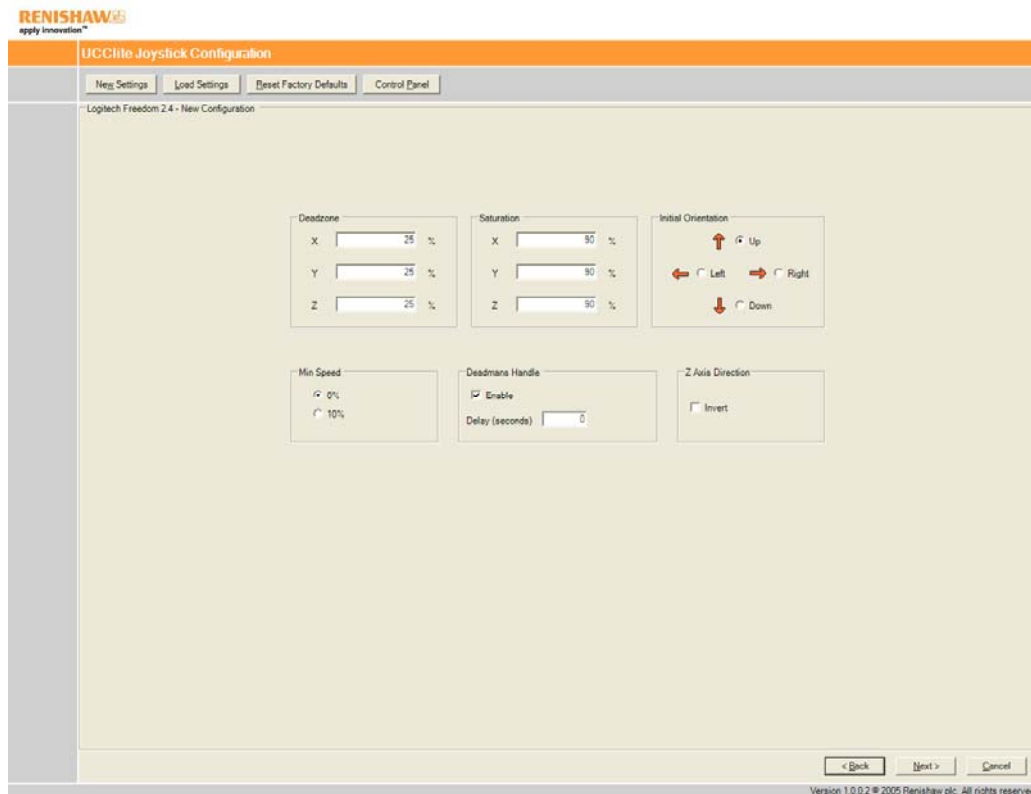
11.5.4   Choose settings

Figure 39 - The settings screen

- Deadzone defines the threshold of axis deflection that is treated as zero deflection.

- Saturation defines the threshold of axis deflection that is treated as full deflection.

- Initial orientation defines the starting position of the operator relative to the CMM machine.

- Min Speed sets the lowest possible value for the speed override.

- Deadmans handle sets the delay before the joystick enable takes effect.

- Z axis direction allows the Z-axis (the rotational axis) to be inverted.
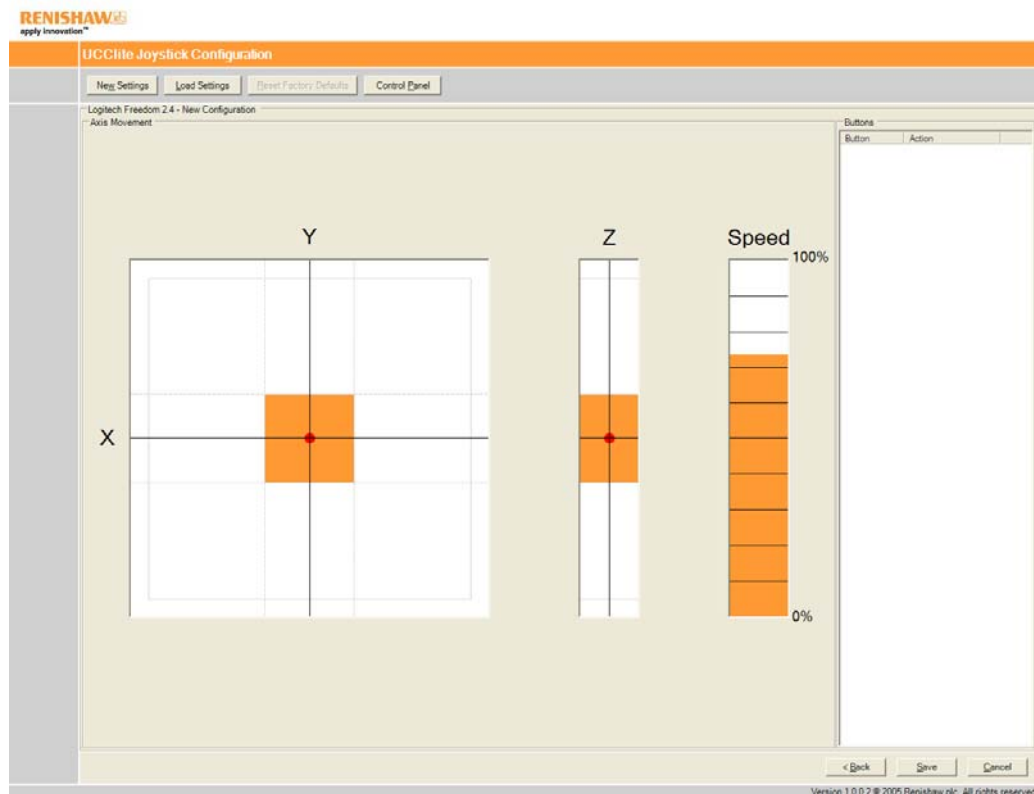
11.5.5   Test settings

Figure 40 - The test screen

The test screen allows the user to get some feedback on the behaviour of the configuration. Move the joystick along its axes to move the red dots around the graphs. If the axis enters a dead zone or saturation, the area around the dot will be coloured in orange. The Speed meter indicates the change in speed override as the slider is moved. When a button is pressed, the Buttons list shows the action assigned to it.

NOTE: If you have changed the initial orientation from the 'up' setting in the previous screen, this will not be reflected in the XY display of motion in this screen. If you have inverted the Z axis direction in the previous screen this will change the direction of the Z display bar.

11.5.6   Saving the configuration

The following dialog box will only be displayed when 'Save' is pressed, if the default configuration is missing or invalid. The current settings will be set as the default settings when 'Yes' is pressed.
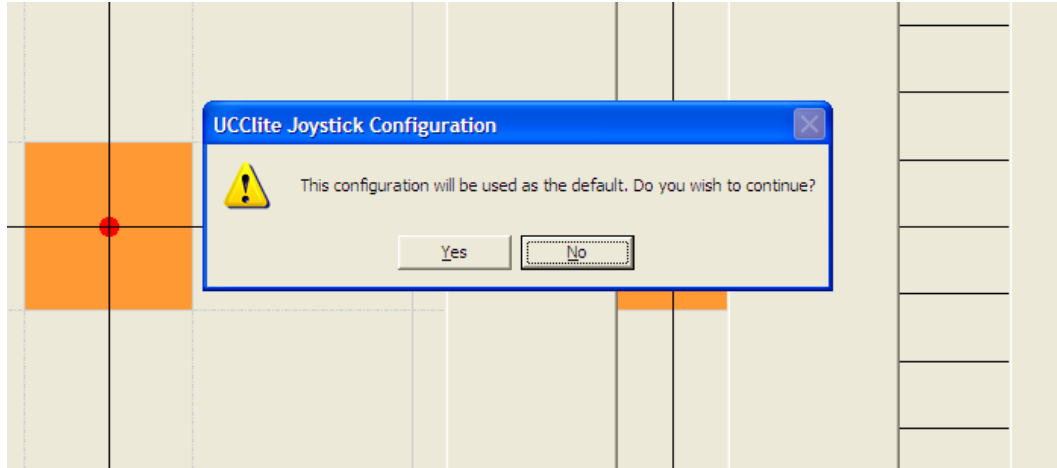

Figure 41 - Warning about saving the default configuration

If the default configuration is valid, the following dialog box will be displayed, to allow the current settings to be saved under a new name, or to replace an existing configuration.
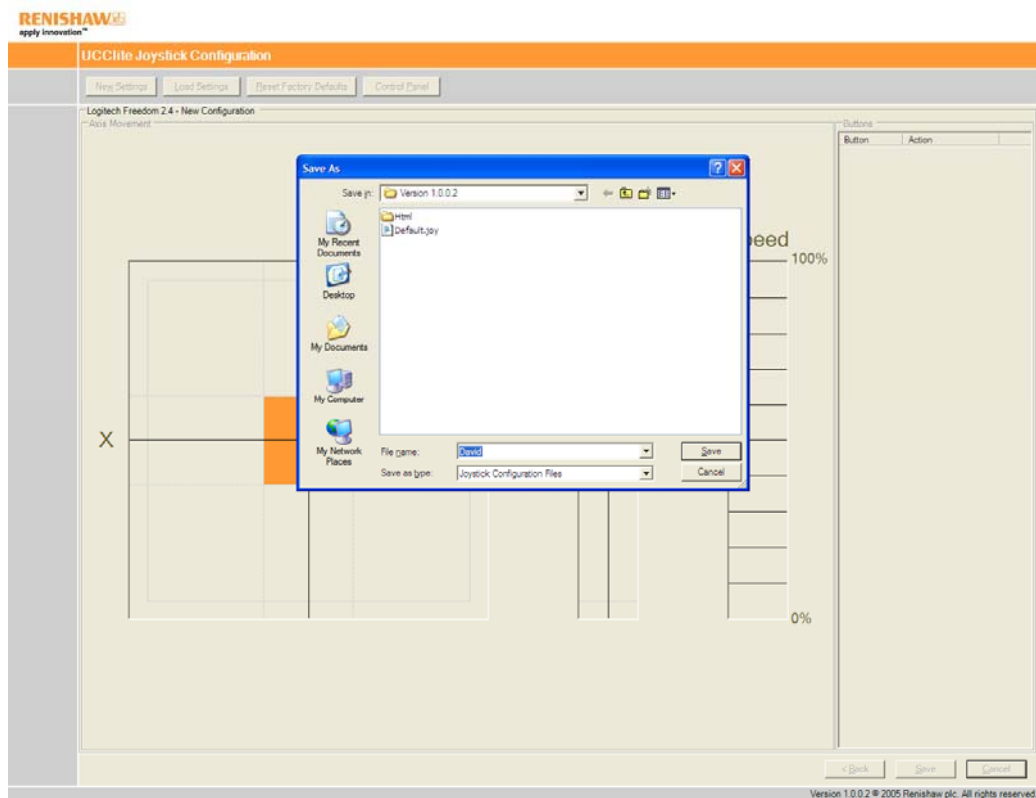
Figure 42 - Choosing the configuration name

Select the configuration to be replaced, or type the new name in the 'File name' box, and press 'Save'.
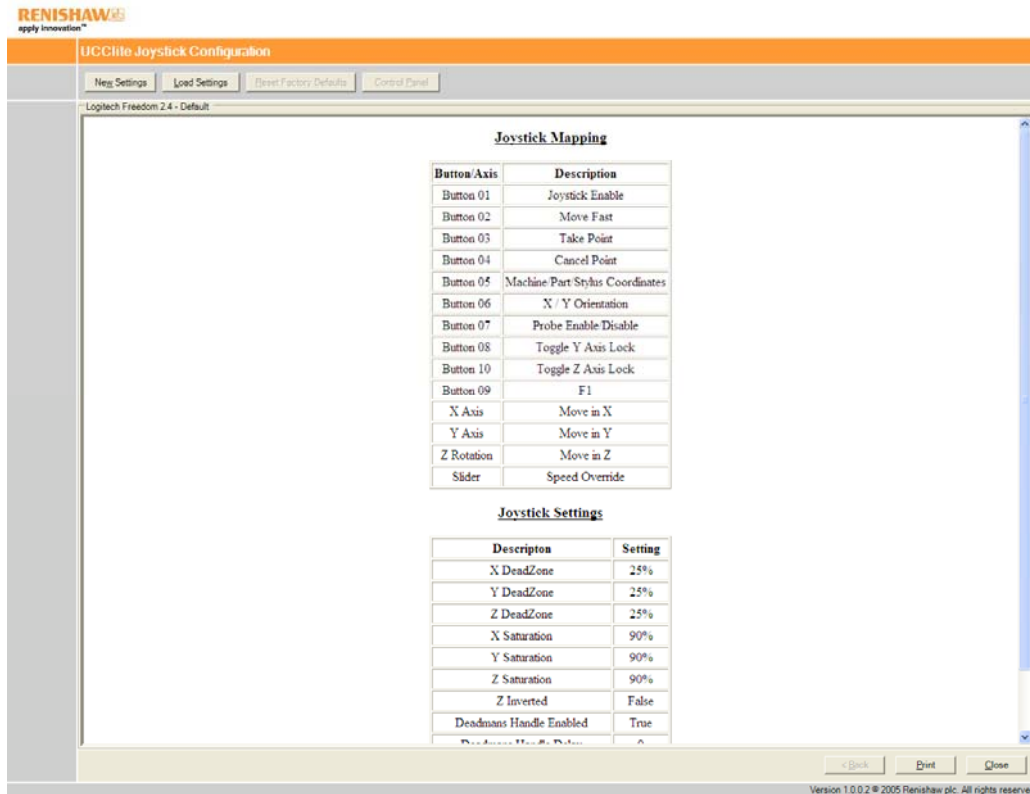
11.5.7   Print configuration

Figure 43 - Reviewing the completed configuration

The final configuration step will display a summary of the joystick configuration. Press 'Print' to make a hard copy.

11.6 Adding a new configuration

Press the 'New Settings' button, then follow the 'setting up a configuration' process to create a new configuration.

11.7 Changing configuration details

11.7.1   Changing an existing configuration

Press the 'Load Settings' button and use the Open dialog box to locate the configuration to be changed. Press the 'Open' button to load the configuration. Follow the 'setting up a configuration' process and make changes to the actions and settings as required.
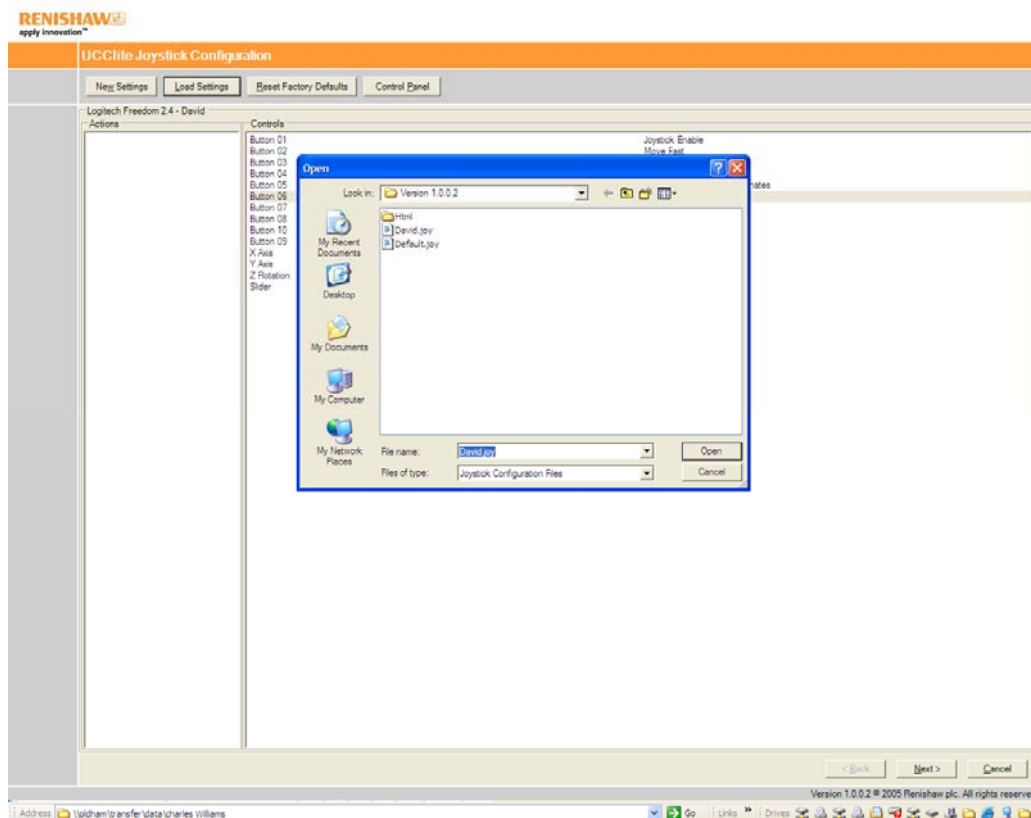

Figure 44 - Loading an existing configuration

11.7.2   Changing the default configuration

Press the 'New Settings' button to start a new configuration or press the 'Load Settings' to load an existing configuration on which to base the new defaults. Follow the 'setting up a configuration' process until prompted to save the configuration. Select the 'Default' configuration in the save dialog box and press 'Save' to overwrite the old defaults.

11.8 Activating a configuration

The Joystick Configurer always activates a configuration when it is saved, meaning that the last saved configuration will be used by the UCC*lite* system when the configurer is closed. To activate a specific configuration, follow the 'changing configuration details' process, but do not change any of the settings, then close the application.

12 Maintenance

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.

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.

13 Testing and verification

The manufacturer of the finished machine, or the installer of the UCC*lite-2*, 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.

Following replacement, modification, software update or any other changes to the UCC*lite-2*, the tests and verification procedures specified in the technical documentation must be performed.

These tests and checks should also be performed prior to machine calibration or at other intervals according to the user's risk assessment.

14 Revision history

Issue 01-A

- First issue.

Issue 02-A

- Addition of UCC*lite-2*

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