

SPA2-2 servo power amplifier

© 2007 Renishaw plc. All rights reserved.

This document may not be copied or reproduced in whole or in part, or transferred to any other media or language, by any means, without the prior written permission of Renishaw.

The publication of material within this document does not imply freedom from the patent rights of Renishaw plc.

Disclaimer

Considerable effort has been made to ensure that the contents of this document are free from inaccuracies and omissions. However, Renishaw makes no warranties with respect to the contents of this document and specifically disclaims any implied warranties. Renishaw reserves the right to make changes to this document and to the product described herein without obligation to notify any person of such changes.

Trademarks

RENISHAW® and the probe emblem used in the RENISHAW logo are registered trademarks of Renishaw plc in the UK and other countries.

apply innovation is a trademark of Renishaw plc.

All brand names and product names used in this document are trade names, service marks, trademarks, or registered trademarks of their respective owners.

SPA2-2

Installation guide

CE

FCC

Information to user (FCC section 15.105)

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

Information to user (FCC section 15.21)

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

EC declaration of conformity

Renishaw plc declare that the product: -

Name	Description
SPA2-2	Servo power amplifier

has been manufactured in conformity with the following standards: -

BS EN 61326:1998/ inc. amendments A1:1998/A2:2001/ A3:2003	Electrical equipment for measurement, control and laboratory use - EMC requirements. Immunity to annex A - industrial locations. Emissions to class A (non-domestic) limits.
BS EN 61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use. Part 1: General requirements.
BS EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

and that it complies with the requirements of directives (as amended): -

89/336/EEC	- Electromagnetic compatibility (EMC)
98/37/EC	- Machinery
73/23/EEC	- Low voltage

The above information is summarised from the full EC declaration of conformity. A copy is available from Renishaw on request.

Care of equipment

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

Remove dust from the external surfaces with a clean, dry cloth as the unit is not sealed against fluids / water.

Changes to Renishaw products

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

Warranty

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

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

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

Machine safety



WARNING: Switching off or isolating the **SPA2-2** may NOT prevent unexpected machine movement. The user is advised to isolate the machine from the electricity supply, compressed air or other energy sources in accordance with the machine manufacturer's instructions before entering the danger zone or performing any maintenance operations.

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

References and associated documents

It is recommended that the following documentation is referred to when installing the **SPA2-2**.

Renishaw documents

Documentation supplied on Renishaw UCC software CD.

Document number	Title
H-1000-5223	UCC2 controller installation guide
H-1000-5057	UCC controller programmer's guide
H-1000-5058	RENICIS user's guide
H-1000-5067	MCU installation and user's guide
H-1000-5109	UCC/ite installation guide
H-1000-5246	Digital SPA tuning guide

External documents

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

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

BS EN (IEC) 60204-1:2006 (Safety of machinery - Electrical equipment of machines - Part 1: General requirements).

This page intentionally left blank

Contents

1	System description	9
1.1	Electrical requirements.....	9
1.2	Environmental requirements	10
1.3	Output specification.....	11
1.4	SPA2-2 system components.....	11
1.4.1	SPA2-2 DC motor kits.....	11
1.4.2	SPA2-2 DC motor connector kit.....	12
1.4.3	SPA2-2 4 th axis interface card kit.....	12
1.4.4	Dual SPA2-2 integration kit.....	12
1.4.5	SPA2-2 DC connector kit.....	12
1.4.6	SPA2-2 and UCC2 system layout.....	13
1.4.7	SPA2-2 and UCC <i>lite</i>	13
2	Front panel description	14
2.1	Axes status LEDs.....	14
2.1.1	LED positions and axis link 3 axis / 6 axis	14
2.2	ESTOP LED	14
2.3	Air cooling fan inlet.....	14
3	Rear panel description.....	15
3.1	Rear panel – 3 axis system.....	15
3.2	Rear panel – 6 axis system.....	16
3.3	Connections	16
3.3.1	Encoder connectors	16
3.3.2	Motor connector	17
3.3.3	UCC2 emergency stop connection	17
3.3.4	SPA, -A, -B, -C, -D connections.....	17
3.3.5	External emergency stop connection.....	18
3.4	Motor connectors	19
3.4.1	DC motor connection card termination	19
3.4.2	Additional axis interface card termination	20
3.5	Encoder interface	21
4	Hardware configuration of the SPA2-2.....	22
4.1	Fitting a motor connection card.....	22
4.1.1	Recommended procedure to install the motor connection cards.....	22
4.2	Fitting the 4 th axis option card	23
4.2.1	Recommended procedure to install the 4 th axis interface card	23
4.3	Fitting the REVO™ connector card.....	24
4.4	Mounting the SPA2-2	25

4.4.1	Stand alone mounting	25
4.4.2	Mounting in a 19" rack.....	26
5	System installation.....	27
5.1	General.....	27
5.2	Testing and verification	27
5.3	Cable preparation	27
5.3.1	ESTOP / Reset	28
5.3.2	Axis motors	28
5.4	Replacing an SPA2-2 unit	29
6	Interconnection schemes.....	31
6.1	UCC2 DC motor and tacho connection	31
6.2	UCCLite DC motor and tacho connection	32
6.3	Dual SPA2-2 DC motor and tacho configuration.....	33
6.4	Preparation of integration kits.....	34
6.4.1	Motor connectors	34
6.4.2	Emergency stop and reset switch	35
7	Revision history	36

1 System description

The **SPA2-2** is a digital servo power amplifier solution designed specifically for use with the Renishaw **UCC2** or **UCClite** controller.

The **SPA2-2** is capable of controlling up to seven axes of movement but is customer configurable to the requirements of the installation.

The features offered by the **SPA2-2** are:

- **Two base units**
 - **SPA2-2 3-axis:** This is the basic 3-axis configuration suitable for conventional CMMs fitted with brushed dc motors. It can accommodate tacho, tacholess and encoder velocity feedback systems. An additional card can be fitted to extend this unit to a 4-axis system.
 - **SPA2-2 6-axis:** This configuration is suitable for installations requiring between 5 or 6 axis amplifiers. Like the 3-axis version it can accommodate tacho, tacholess and encoder velocity feedback systems. An additional axis card can be fitted to extend this unit to a 7-axis system.
 - Two **SPA2-2** units can be combined in a single system permitting a servo power amplifier solution with an overall power rating of 1100 W.
- **Configurable motor voltage**
 - The **SPA2-2** motor voltage can be configured by software to support a wide range of motor voltages within the range of 12 V and 60 V. The current limit can also be configured up to a maximum of 5 A continuous, 10 A peak.
 - The voltage setting of each axis is independent and therefore it is possible to have each machine motor driven by a different voltage.
- **DC analogue tacho, tacholess or encoder compatibility**
 - The **UCC2** or **UCClite** and **SPA2-2** control solution has the ability to support different types of velocity control loop based on the feedback to the controller.
 - Three control loop feedback methods are integrated into the standard design of the system, these are analogue tacho based feedback system from the motor, obtaining the feedback from the scales of the CMM or from a motor mounted encoder system.

NOTE: The **UCClite** product only permits 3-axis of machine control.

1.1 Electrical requirements

The **SPA2-2** is powered from the a.c. mains supply via a connector to IEC 60320/C14. The electrical ratings of the unit are as follows:

100 – 240 V ac +10%, -15%

47 – 63 Hz

750 W maximum

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



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

NOTE: An earth stud (M5 thread) is provided to allow bonding of the CMM metal parts to the protective earth. When the **SPA2-2** is used with the **UCC2** or **UCClite** controller the CMM frame should be bonded to both the UCC and the **SPA2-2** earth studs.

The **SPA2-2** is isolated from AC power by disconnecting the IEC mains connector on the rear panel. This should be sited within easy reach of the CMM operator. If any additional means of isolation is required, it must be specified and fitted by the machine manufacturer or the installer of the product. The disconnection device must meet the requirements of IEC 61010-1 and any national wiring regulations applicable in the country of installation.

The use of a suitable RCD (residual current device), for automatic disconnection in the event of an insulation failure, is recommended. The protection device must meet the requirements of IEC 61010-1 and any national wiring regulations applicable in the country of installation.

The installer must ensure that adequate mains over-current protection is provided for the controller equipment (UCC and SPA). See the electrical requirements sections of the appropriate installation guides. This must be in accordance with any national wiring regulations applicable in the country of installation.

1.2 Environmental requirements

Indoor use	IP20 (no protection against water)*
Altitude	up to 2000 m
Operating temperature	0 °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
Transient overvoltages	Installation category II
Pollution degree	2
Maximum weight	9.48Kg (20.9 lb) (7-axis system)

***NOTE:** If a higher IP rating is required an additional external enclosure will be required to house the **SPA2-2**. This enclosure must enable the internal ambient temperature to remain within the **SPA2-2** operating temperature range.

1.3 Output specification

The **SPA2-2** has the following electrical output specification:

Motor output voltage range	12 V to 60 V
Maximum peak current output per channel (peak current for ≤50 s at a duty cycle of ≤20%)	10 A
Maximum continuous current output per channel (operating)	5 A
Maximum output wattage of whole SPA2-2	550 W
Emergency stop system specification	Category 2 to EN 954-1:1996 (ISO 13849-1:1999) (refer to section 6.4.2)

1.4 SPA2-2 system components

The **SPA2-2** range of products is capable of being configured to enable support of a wide range of motor and tacho feedback giving compatibility with most machine constructions.

Part number	Description	Number of axis supported	Refer to
A-5402-8302	SPA2-2 3-axis DC motor kit	3	1.4.1
A-5402-8622	SPA2-2 6-axis DC motor kit	6	1.4.1
A-5402-8612	SPA2-2 REVO™ kit	3 + REVO™	1.4.1
A-5402-3580	SPA2-2 DC motor connector kit	3	1.4.2
A-5402-8103	SPA2-2 4 th axis interface card kit	1	1.4.3
A-5121-0011	Dual SPA2-2 integration kit	6	1.4.4
A-5121-0028	SPA DC connector kit	3	1.4.5

1.4.1 SPA2-2 DC motor kits

These kits contain all the necessary components to connect the **SPA2-2** to either the Renishaw **UCC2** or **UCClite** controller and to a CMM fitted with brushed DC motors with a tacho or tacholess velocity feedback system.

These kits contain the following components:

	SPA2-2 3-axis DC	SPA2-2 6-axis DC	SPA2-2 3-axis REVO™
3-axis SPA2-2	1	-	-
6-axis SPA2-2	-	1	1
DC motor connector I/F	3	6	3
REVO™ connector I/F	-	-	1
UCC2 or UCClite to SPA2-2 comms cable	2	3	4
Emergency stop cable	1	1	1

1.4.2 SPA2-2 DC motor connector kit

This kit contains the motor output connection cards to permit three DC motors to be connected to the **SPA2-2** unit. Normally these would be supplied with the SPA unit and do not need to be ordered separately, unless you are converting an existing system.

1.4.3 SPA2-2 4th axis interface card kit

This kit contains the optional 4th axis interface card for the **SPA2-2** system. This permits connection of an additional machine axis to the **SPA2-2** when using the **UCC2** controller.

NOTE: Each **SPA2-2** unit can only support one 4th axis interface card.

This kit contains the following components:

- 1 off 4th axis interface card
- 1 off internal connection signal loom
- 1 off internal connection power loom
- 4th axis hardware mounting kit
- 1 off mating motor connector for machine wiring

1.4.4 Dual SPA2-2 integration kit

This cable kit is designed to permit a high power solution for CMM installations where the power capacity of a single **SPA2-2** will not address the requirements for the machine.

This system enables two **SPA2-2** units to be combined as a single system and configured to drive the CMM installation. For example; if required, a single **SPA2-2** can power a single axis, or if in a dual drive configuration the two dual axis motors can be supplied from separate **SPA2-2** units and the other two axes to be integrated such that each **SPA2-2** drives two motors.

This kit contains the following component:

- 1 off **UCC2** to dual **SPA2-2** emergency stop connection cable

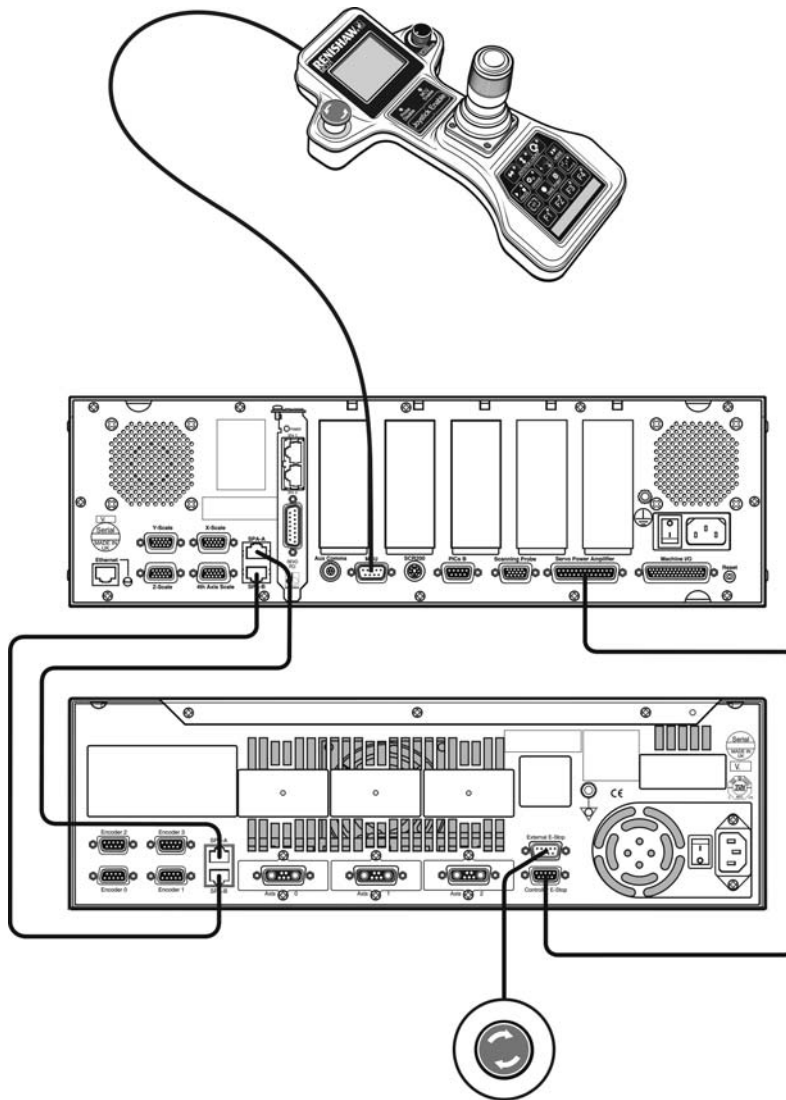
1.4.5 SPA2-2 DC connector kit

This kit has been designed to assist in the connection of either a **UCC2** or **UCClite** and **SPA2-2** to a machine installation.

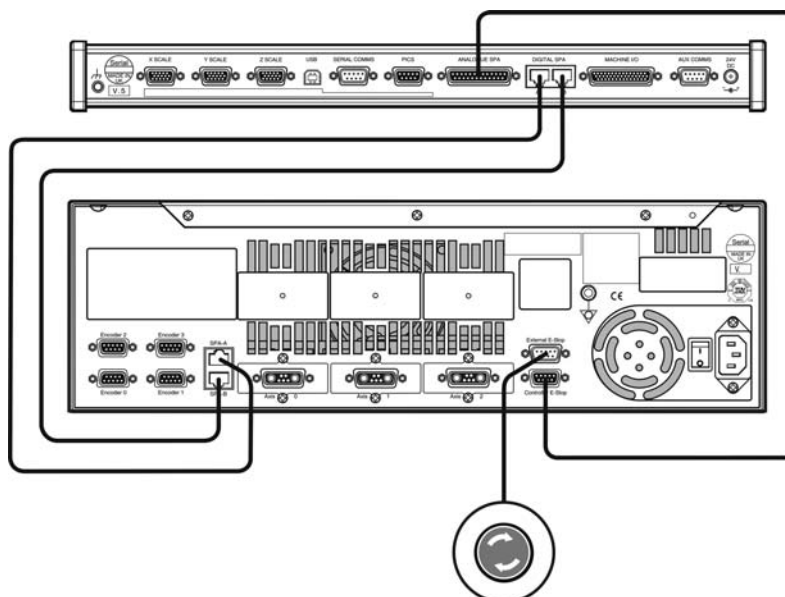
This kit contains the following components:

- 3 off 7W2 motor connectors including backshells to permit connection of the motor and analogue tacho signals to the **SPA2-2**
- 1 off 9-way D connector including backshell to permit the connection of an external emergency stop device to the Renishaw emergency stop chain

1.4.6 SPA2-2 and UCC2 system layout

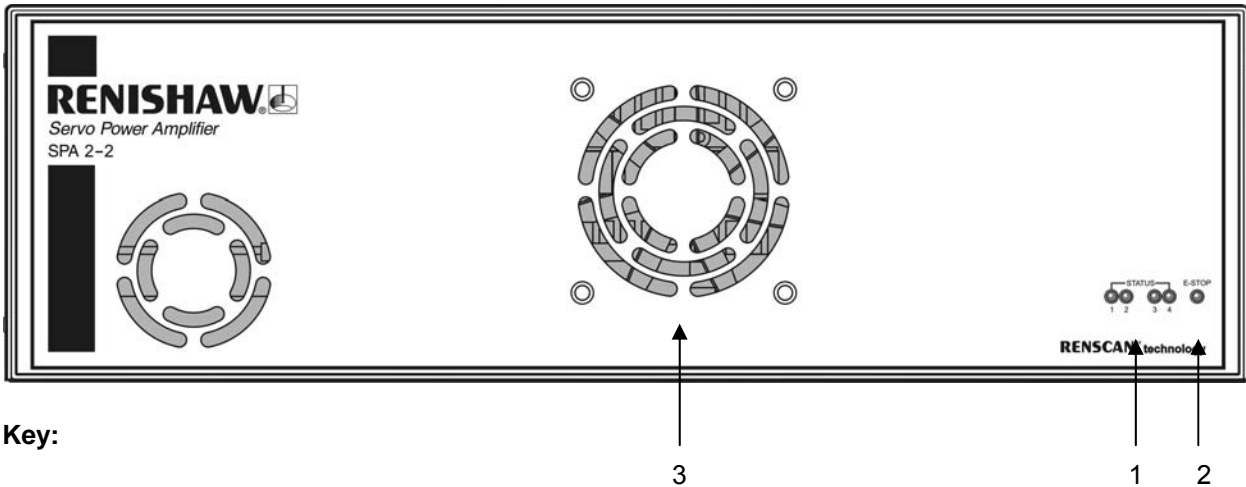


1.4.7 SPA2-2 and UCC*lite*



2 Front panel description

The diagram below shows the front panel of the **SPA2-2**:



Key:

1. Axes status LEDs
2. ESTOP LED
3. Air cooling fan inlet

2.1 Axes status LEDs

2.1.1 LED positions and axis link 3 axis / 6 axis

These LEDs indicate the status of the servo engagement within the **SPA2-2** unit as shown in the table below:

Axis status LED colour	System status
Off	The SPA2-2 has no power being applied to the system or these axes are not fitted
Orange	The servo system is active but not engaged for this axis
Green	The servo system is engaged for this axis
Red	There is a fault on this axis of the system

Status 1 indicates the status of axis 0 and 1, status 2 indicates the status of axis 2 and 3 (if fitted), status 3 indicates the status of axis 4 and 5 of a 6 axis system and status 4 indicates the status of axis 6.

2.2 ESTOP LED

This red LED indicates if the emergency stop system has been activated.

2.3 Air cooling fan inlet

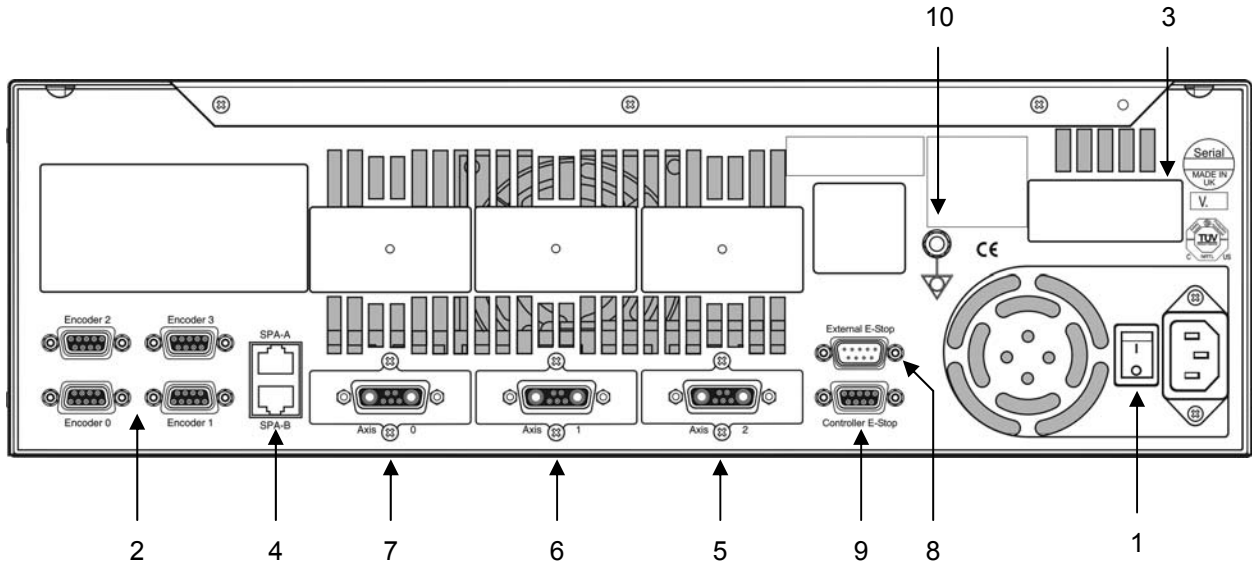
The **SPA2-2** requires air cooling, the inlet being through this fan.

The airflow to the fan must not be obstructed. A minimum of 50 mm clearance in front of the fan is required.

3 Rear panel description

When the **SPA2-2** is delivered it will be in a configurable format and it will be necessary for the motor connection cards to be fitted by the installer prior to applying power.

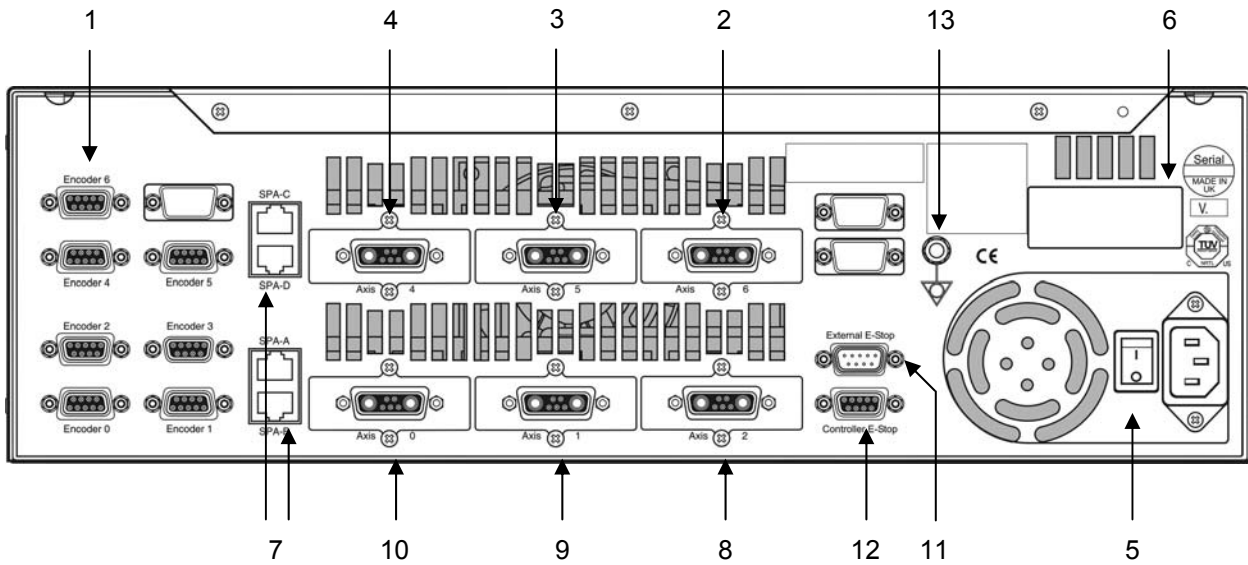
3.1 Rear panel – 3 axis system



Key	Description	Refer to section
1	Power input and ON/OFF switch	-
2	Axis 0-3 encoder tachometer input connectors	3.3.1
4	UCC2 and UCClite communication link connectors	3.3.4
5	Axis 2 motor input connector	3.3.2

Key	Description	Refer to section
6	Axis 1 motor input connector	3.3.2
7	Axis 0 motor input connector	3.3.2
8	External emergency stop and reset connector	3.3.5
9	UCC2 and UCClite emergency stop connector	3.3.3
10	Earth stud	1.1

3.2 Rear panel – 6 axis system



Key	Description	Refer to section
1	Axis 4 - 6 encoder tacho input connector	3.3.1
2	Axis 6 motor input connector	3.3.2
3	Axis 5 motor input connector	3.3.2
4	Axis 4 motor input connector	3.3.2
5	Power input and ON / OFF switch	-
6	Axis 3 motor input connector (optional)	3.3.2
7	UCC2 communication link connector	3.3.4

Key	Description	Refer to section
8	Axis 2 motor input connector	3.3.2
9	Axis 1 motor input connector	3.3.2
10	Axis 0 motor input connector	3.3.2
11	External emergency stop and reset connector	3.3.5
12	UCC2 emergency stop connector	3.3.3
13	Earth stud	1.1

3.3 Connections

3.3.1 Encoder connectors

The encoder interfaces are a machine installer configurable option, they permit the connection of digital encoders to the **SPA2-2** and **UCC2** or **UCClite** system to provide motor feedback for inclusion into the machines control loop.

For further details on these connections please refer to section 3.5.

3.3.2 Motor connector

These connections are used for the DC motor connector kit placement.

Axis position 3 is for the additional axis interface card that can be fitted by the machine installer to the **SPA2-2** unit.

For further details on these connections please refer to section 3.4.

3.3.3 UCC2 emergency stop connection

This 9-way D-connector links the emergency stop system between either the **SPA2-2** and the **UCClite** or the **SPA2-2** and the MCU1 joystick via the **UCC2** controller, the necessary cable for this connection is supplied within the **SPA2-2** kit.

3.3.4 SPA, -A, -B, -C, -D connections

These RJ45 connections permit the dedicated servo system communication link between the **SPA2-2** and the **UCC2** or **UCClite** controller for an effective control system.

NOTE: Connections A and B are used for a three or four axis **SPA2-2** system, connections C and D are only used when a six or seven axis system is contained within a single box. Refer to section 6 for further details.

3.3.5 External emergency stop connection

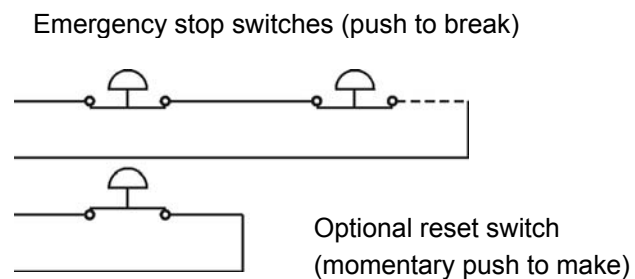
This 9-pin D-type connection is designed to permit connection of external emergency stop devices to the Renishaw controller emergency stop system.

Emergency stop devices must meet the requirements of IEC 60947-5-1 (low-voltage switchgear and controlgear – part 5-1: control circuit devices and switching elements – electromechanical control circuit devices) or UL1054 (standard for special-use switches).

The machine manufacturer or product installer must perform a risk assessment to determine the requirements for emergency stopping and emergency switching off. The **SPA2-2** emergency stop safety system is designed to achieve category 2 to standard EN954-1:1996 (ISO 13849-1). The risk assessment should therefore have determined that a category 2 safety function is satisfactory.

There are three connection pins available on this connector. Please refer to the table below for their functions:

Pin number	Function
6	ESTOP A
7	ESTOP B
5	RESET A
9	RESET B



Any additional emergency stop component that is fitted to this connector must have the following electrical characteristics:

Emergency stop system voltage : 24 V

Emergency stop system current : 1 A

NOTE: If the emergency stop reset function is not required then it will be necessary to connect pins 5 and 9 so that when an emergency stop is removed from the system, it will automatically reset.

If there are no additional emergency stop devices to be added to a **UCC2** controller system, connect pins 6 and 7 to permit the MCU1 emergency stop switch to function. An external ESTOP must be fitted for **UCClite**.

It is strongly recommended that all connections be fitted by a competent technician or engineer and that all wires should be sleeved. See also 6.4.2.

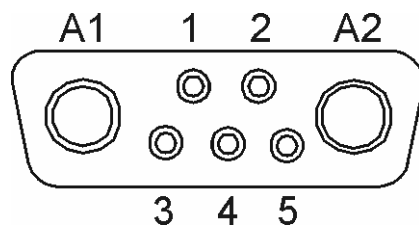
It should not be necessary to switch off the **SPA2-2** in an emergency but if a requirement is indicated by the user's risk assessment, emergency switching off for the complete machine must be implemented externally to the **SPA2-2**.

If indicated by the user's risk assessment, a 'manual reset' button (refer to EN 954-1:1996 para. 5.4) should be included in the emergency stop system. A reset switch is required when there is limited visibility of the danger zone from the control position. The reset switch must be positioned outside the danger zone and in a safe position from which it may be determined that no person is within the danger zone before resetting the safety system.

3.4 Motor connectors

3.4.1 DC motor connection card termination

Each DC motor connection card presents a 7W2 connector for connection of a CMM motor to the **SPA2-2**, as shown below:



Viewed on face of plug,
or rear of socket

There are seven connections available on this connector. Please refer to the table below:

Connector pin	Function
A1	+ve motor connection (default)
A2	-ve motor connection (default)
1	+ve tacho input (default)
2	-ve tacho input (default)
3	ground reference
4	-ve tacho input (linked to pin 2)
5	ground reference
Shell	Screen

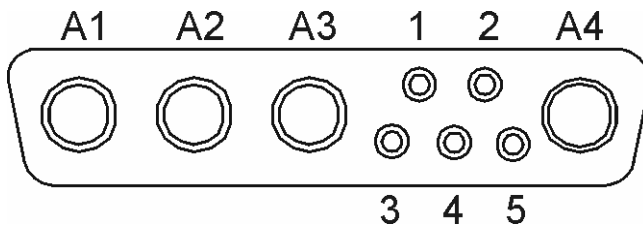
The table shows the default polarity configurations for all pins

NOTE: The motor and tacho polarities on this connector are software configured during the **SPA2-2** installation process. Please refer to the Renicis user's guide (Renishaw part number H-1000-5058) for details.



WARNING: If the **SPA2-2** is being integrated on a dual axes DCC driven machine it is essential that the motor polarities on the dual axes are the same.

3.4.2 Additional axis interface card termination



Viewed on face of plug,
or rear of socket

The additional axis interface card presents 1 off 9W4 connector for connection of a CMM motor to the **SPA2-2**, as shown below:

There are seven connections available on this connector. Please refer to the table below:

Connector pin	Function
A1	+ve motor connection (default)
A2	Reserved for future expansion
A3	-ve motor connection (default)
A4	Reserved for future expansion
1	+ve tacho input (default)
2	-ve tacho input (default)
3	ground reference
4	-ve tacho input (linked to pin 2)
5	ground reference
Shell	Screen

The table shows the default polarity configurations for all pins

NOTE: The motor and tacho polarities on this connector are software configured during the **SPA2-2** installation process. Please refer to the Renicis user's guide (Renishaw part number H-1000-5058) for details.



WARNING: Pins with the function reserved for future expansion must not be connected to any other system component



WARNING: If the **SPA2-2** is being integrated on a dual axes DCC driven machine it is essential that the motor polarities on the dual axes are the same.

3.5 Encoder interface

The encoder interface offers four axes of encoder input to the **SPA2-2** system, each being a 15-way high-density D-type connector, designed for digital tachometer (encoder) input.

The encoder interface is designed to accept signals from an RS422 compliant encoder (maximum input frequency 20 MHz).

NOTE: Connection to single ended encoders is not recommended.

The 5 V supply from the encoder interface has the ability to supply a maximum of 1 A per axis pair.

For connection details please refer to the table below:

Connector pin	Function
1	Not connected
2	0 V (from SPA2-2)
3	Not connected
4	-Ref mark
5	-B signal
6	-A signal
7	+5 V supply from SPA2-2
8	+5 V supply from SPA2-2
9	0 V (from SPA2-2)
10	Not connected
11	Not connected
12	+Ref mark
13	+B signal
14	+A signal
15	0 V (from SPA2-2)
Shell	Screen

4 Hardware configuration of the SPA2-2



CAUTION: Connection to the protective bonding circuit: Provision for connecting the complete machine to the protective ground (earthing) is the responsibility of the manufacturer or equipment installer.

Isolation: The **SPA2-2** is isolated by removing the mains connector. It is the responsibility of the equipment installer or user to fit additional means of isolation if indicated by risk assessment.

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

4.1 Fitting a motor connection card

When the **SPA2-2** kit is ordered, the appropriate quantity and type of motor connector cards for that kit will be supplied with the **SPA2-2**. The following section details the installation procedure for these cards.

4.1.1 Recommended procedure to install the motor connection cards

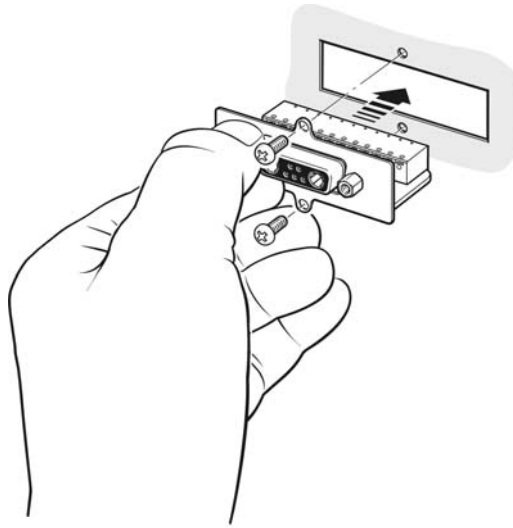
NOTE: It is assumed that this is the first installation process and that no mains supply is connected to the unit.

1. Remove the **SPA2-2** from its transit packaging.
 2. Place the **SPA2-2** on a firm flat surface, with the front of the unit placed on the surface and the rear of the unit in the upward direction.
 3. Remove only the necessary connector protection covers from the rear of the **SPA2-2**. These are retained by spring clips and can be simply pulled out using the hole in the centre.
 4. Remove a motor connection card from its packaging.
 5. Align the motor connection card with the necessary axis connection position on the rear of the **SPA2-2** and press the connector firmly into position (see following diagram).
-



CAUTION: It is essential that each axis connector location should have either a connector blanking plate or a motor connector in place before the **SPA2-2** is powered up.

NOTE: The motor connection card must be inserted into the **SPA2-2** until its mounting plate is in contact with the rear panel of the **SPA2-2**.



6. Using the screws provided with the kit, fix the motor connection card to the **SPA2-2** rear panel.
7. Repeat steps 3 through 6 until all required motor connections are fitted to the **SPA2-2**.
8. If a 4th axis interface card is to be fitted please proceed to section 4.2, or if a **REVO™** interface card is to be fitted then proceed to section 4.3. Otherwise the unit can now be installed.

4.2 Fitting the 4th axis option card

If the 4th axis interface card has been purchased with the **SPA2-2** the recommended procedure for installation of this card follows.

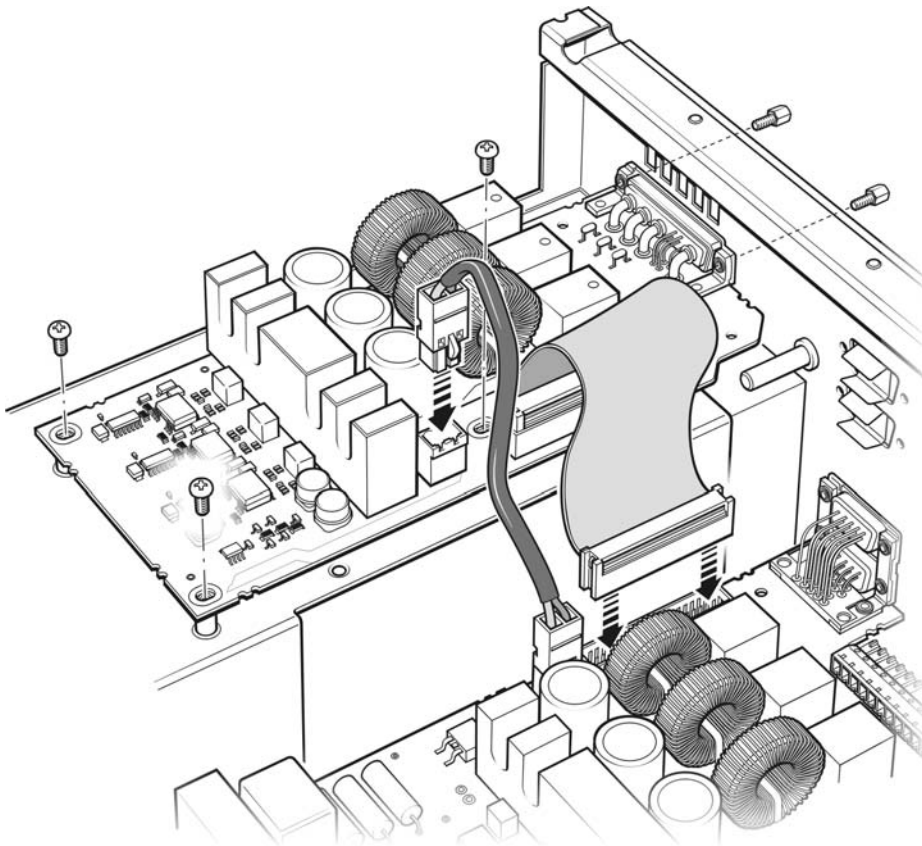
4.2.1 Recommended procedure to install the 4th axis interface card

1. Place the **SPA2-2** on a firm flat surface, with the base of the unit placed on the surface and the rear of the unit facing towards you.
2. Remove the four plastic bungs from the front of the side panels.
3. Remove the top panel of the **SPA2-2** enclosure by removing the three lid screws at the top of the rear panel and then lever the rear of the top panel upwards by inserting a screwdriver into the semi-circular cut out in the top of the rear panel. When the top panel is clear of the rear panel pull the top panel towards you to release the front clips. The top panel can now be lifted off. Retain the fixings.
4. Remove the necessary connector protection cover from the rear of the **SPA2-2**, this is retained by a spring and can simply be pushed out.
5. Remove the 4th axis option card from its packaging.
6. Attach the communication and power cables that are supplied with the 4th axis option card to the motherboard, see diagram below.

NOTE: If this interface card is being fitted to a 6-axis **SPA2-2** then the communication and power cables will have already been installed on the lower motherboard. In this instance the cables supplied with the kit can be discarded.

7. Position the 4th axis interface card into the location, as shown in diagram below.

8. Locate the 4th axis interface card onto the pillar mounts using the M3 screws supplied with the kit. Do not tighten these screws yet.
9. Using the jackscrews supplied in the kit, locate the 4th axis interface connector through the location hole in the rear panel of the **SPA2-2**. Tighten these jackscrews (taking care not to overtighten) and then tighten the screws inserted in step 7.
10. Fit the communication cable attached to the **SPA2-2** motherboard control electronics to the 4th axis interface card.
11. Fit the voltage supply cable loom from the **SPA2-2** control electronics to the 4th axis option card, as shown in diagram below.
12. Refit the top panel by reversing the procedure given in step 3 and replacing the plastic bungs.



4.3 Fitting the REVO™ connector card

To fit the **REVO™** connector card into the **SPA2-2** the procedure is the same as for the motor connector card (see section 4.1) with the following exception:

The **REVO™** connection is via a single connector but this takes the output of three axis channels. To avoid any misconnection the **REVO™** connector card is mounted on a bracket which is fitted across all three output ports, so all three blanking plates have to be removed and the **REVO™** connector card secured with the six screws provided.

4.4 Mounting the SPA2-2

The **SPA2-2** can be installed into either a 19" rack mount system or as a stand alone unit.

The dimensions of the units are:

Width: 440 mm

Height: 135 mm

Depth: 330 mm

4.4.1 Stand alone mounting

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

4.4.2 Mounting in a 19" rack

To permit the **SPA2-2** to be fitted into a 19" enclosure, a 3U rack mounting kit (A-1333-0029) is required.

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

The following procedure is recommended to fit the rack mounting brackets to the **SPA2-2**:

1. Position the **SPA2-2** on a firm flat surface, with either the left or right hand side of the unit placed on the surface and the front of the unit facing towards you.
2. Remove the blanking plugs from the side of the unit, there are two of these located about 15mm from the front lip on the enclosure and about 15 mm from the top and bottom of the enclosure.
3. Remove the 3U rack mounting kit from its packaging and place one of the countersunk screws supplied in the kit through one of the rack mounting brackets supplied.
4. Align this screw and mounting bracket assembly to the fixing holes in the side of the **SPA2-2** enclosure and engage the screw into the mating thread. Do not tighten at this point
5. Align the other fixing location in the rack mounting bracket with the fixing hole in the side of the **SPA2-2**, and engage the other countersunk screw into the mating thread.
6. Tighten both countersunk screws to ensure a secure fixing.
7. Rotate the **SPA2-2** such that the other side of the enclosure can be accessed and then repeat steps 2 to 6.

5 System installation

5.1 General

The **SPA2-2** system is configured by software settings stored within the unit and on the host PC. The setting of these configuration parameters is performed by the Renicis commissioning software via the **UCC2** or **UCC*lite*** communication protocol.

The Renicis software contains a structured installation process to assist in the commissioning of the **SPA2-2**, please refer to the Renicis installation guide (Renishaw part number H-1000-5058) for further information.

5.2 Testing and verification

The manufacturer of the finished machine, or the installer of the **SPA2-2**, is responsible for ensuring that the following test and verification procedures are performed to the appropriate standards 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

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

5.3 Cable preparation

The cables for connecting the UCC controller to the host PC and to a Renishaw SPA are provided with the controller and SPA kits. The OEM or retrofitter is responsible for the provision of the following cables:

- ESTOP / Reset
- Axis motors
- Motor encoder (if appropriate)

NOTE: We strongly recommend that all cables are screened with a braided screen with a minimum of 70% coverage and that the screen is connected to the connector body. Connector backshells should be metal and connected to the screen.

The following sections cover Renishaw's recommendations.

5.3.1 ESTOP / Reset

The external ESTOP connector is provided to allow connection of external ESTOP switches and a reset switch (see section 3.3.5 for connection details). For the circuit the maximum voltage is 24 V dc and the maximum current is 1 Amp. The cable size will depend on its length (see the table below for our recommendations).

The current taken by the ESTOP can be up to 1A.

Maximum current (Amps)	Maximum permitted Volt drop	Maximum length (metre)	Minimum CSA (mm ²)	Minimum diameter (mm)	Nearest AWG size
1	2	10	0.09	0.33	27
1	2	20	0.17	0.47	24
1	2	40	0.34	0.66	21

5.3.2 Axis motors

The axis motor connectors provide the power to the axis motors and, if appropriate, the motor tacho connections. For the **SPA2-2** the maximum voltage is 60Vdc and the peak current is 10 amps. The actual peak current will be dependant on the size of motor fitted and how hard it needs to be driven, so cable sizes for 2 A, 5 A and 10 A are given in the table below.

The 3 motor connections can provide 5A continuous and 10A peak.

Maximum motor current (Amps)	Maximum permitted Volt drop *	Max length (metre)	Minimum CSA (mm ²)	Minimum diameter (mm)	Nearest AWG size
2	2	10	0.17	0.47	24
2	2	20	0.34	0.66	21
2	2	40	0.69	0.94	18
5	2	10	0.43	0.74	20
5	2	20	0.86	1.05	17
5	2	40	1.72	1.48	14
10	2	10	0.86	1.05	17
10	2	20	1.72	1.48	14
10	2	40	3.44	2.09	11

* This is just a suggested value. The machine design will determine the actual value.

- Motor encoders

If the axis drive motors are fitted with rotary encoders as a method of speed control then these encoders will need to be connected to the SPA2-2 Motor encoder connectors. The encoders are sensitive to supply voltage so the recommended maximum volt drop is only 0.25V.

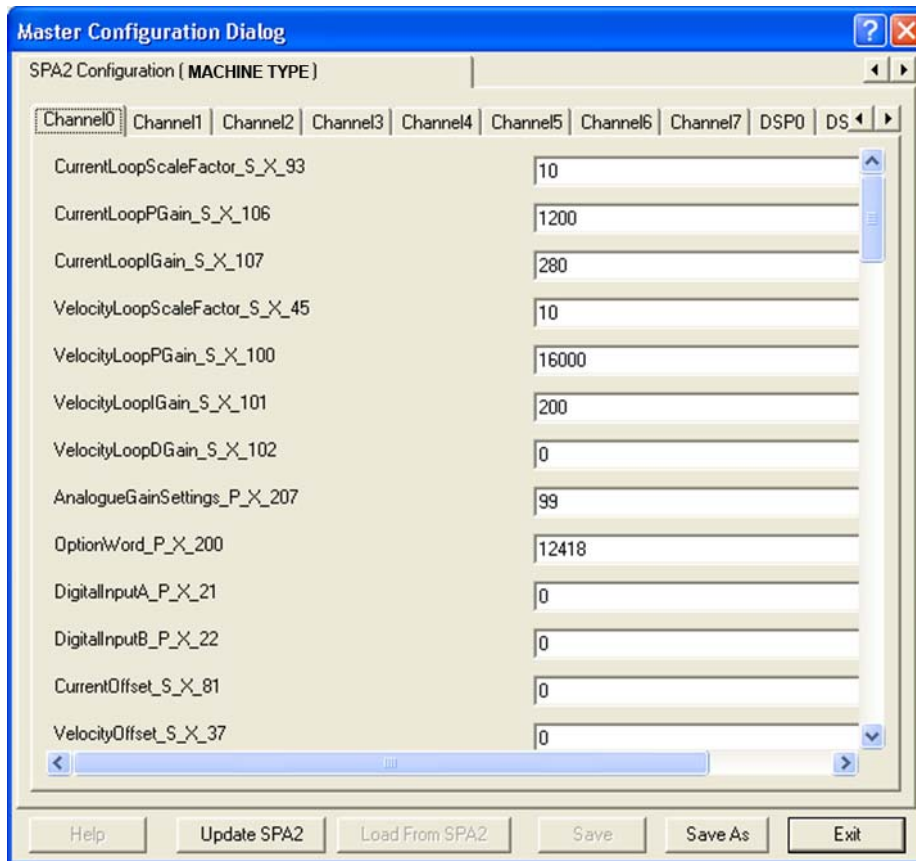
The encoder can typically take up to 500mA.

Maximum current (Amps)	Maximum permitted Volt drop	Maximum length (metre)	Minimum CSA (mm ²)	Minimum diameter (mm)	Nearest AWG size
0.5	0.25	10	0.34	0.66	21
0.5	0.25	20	0.69	0.94	18
0.5	0.25	40	1.38	1.32	15

5.4 Replacing an SPA2-2 unit

All the digital SPA units (SPA2-2, SPA2 and SPAlite) have their section of the machine .ini set up file, stored in internal memory. When changing a SPA unit on a CMM that has already been set up and tuned, it is important that the SPA configuration is uploaded to the new SPA unit using the following procedure.

- Start the Renicis utility program.
- Boot the UCC controller.
- Click on the “edit configuration files” icon.
- In the Master Configuration Dialog window, click on the “SPA Configuration” tab.
- At the bottom of the screen (see below) click on the “update SPA2” button.
- Click on the Exit button.
- Close Renicis.
- After exiting Renicis the controller should be reset.

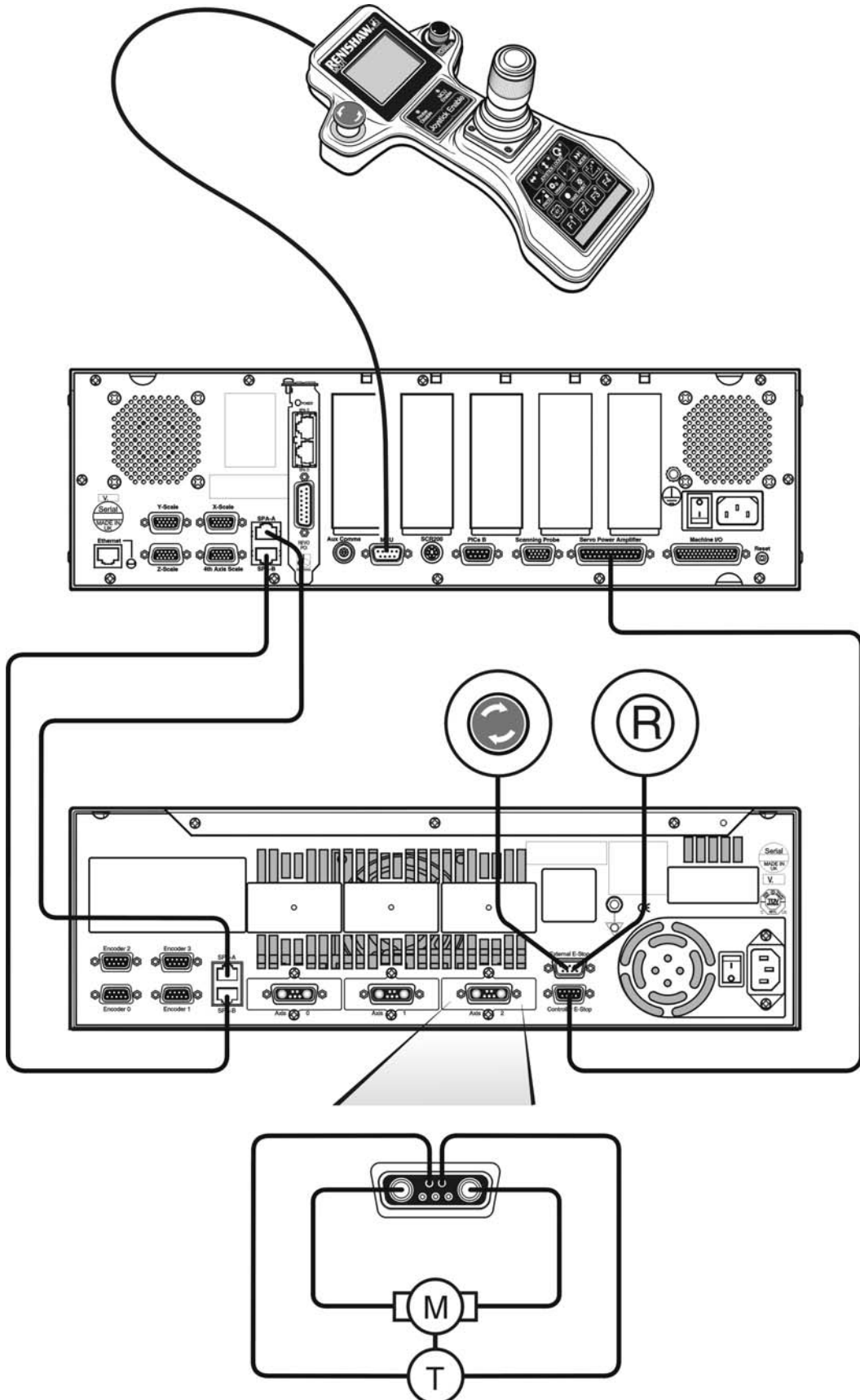


Other differences to be aware of when changing between SPA types are:-

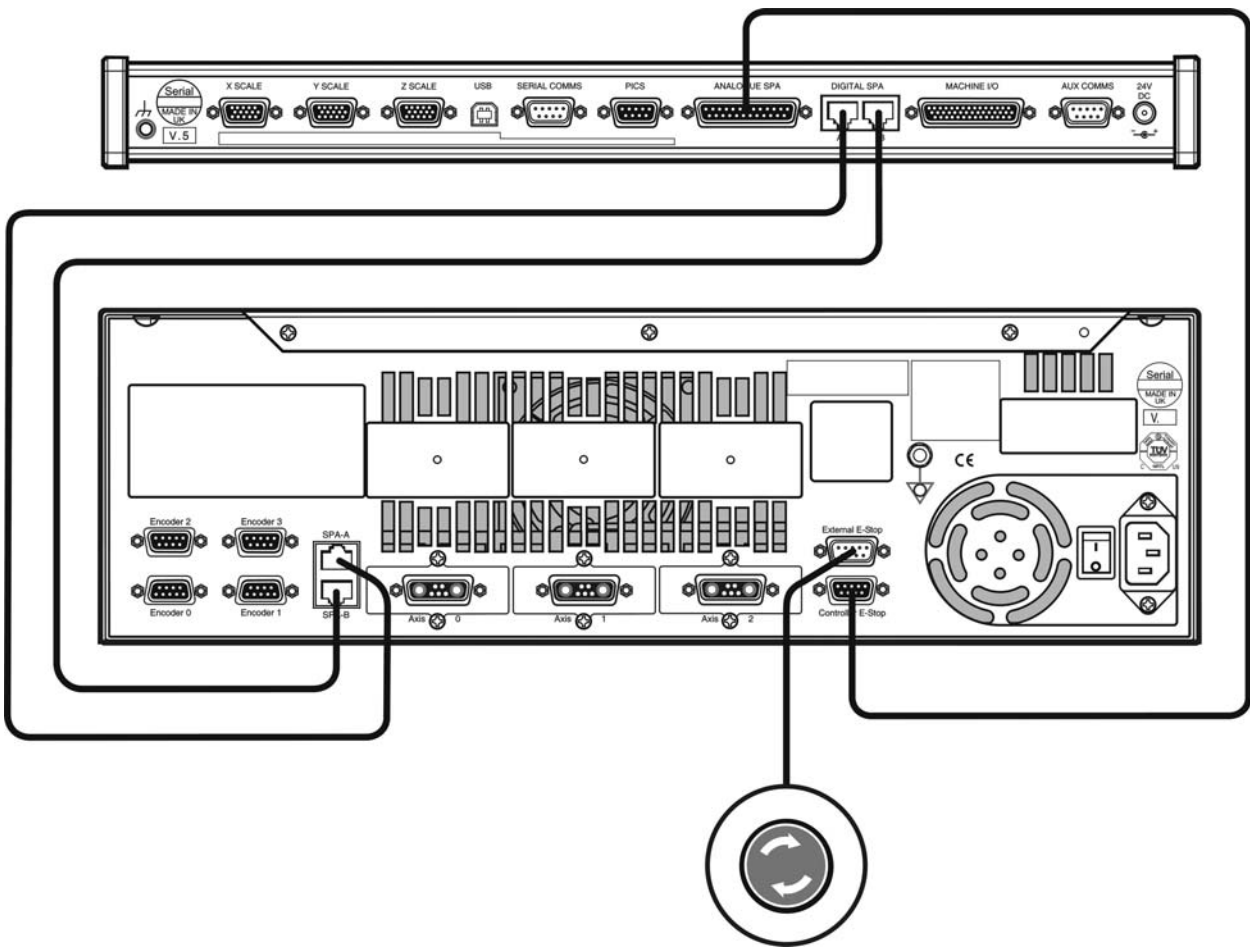
- The 4th axis card for the **SPA2-2** is different from the one for the **SPA2** and cannot be interchanged, i.e. the 4th axis card must be correct one for the SPA type (the motor connections are the same on both so there is no problems on changing between **SPA2** and **SPA2-2** on an installation).
- The axis motor connectors are in a different order on the **SPA2** than they are on the **SPA2-2** and **SPA^{lite}**. Looking on the back panel and reading from left to right, the axes are 0, 1, 2 on the **SPA2-2** and **SPA^{lite}** units, but 2, 1, 0 on the **SPA2**.

6 Interconnection schemes

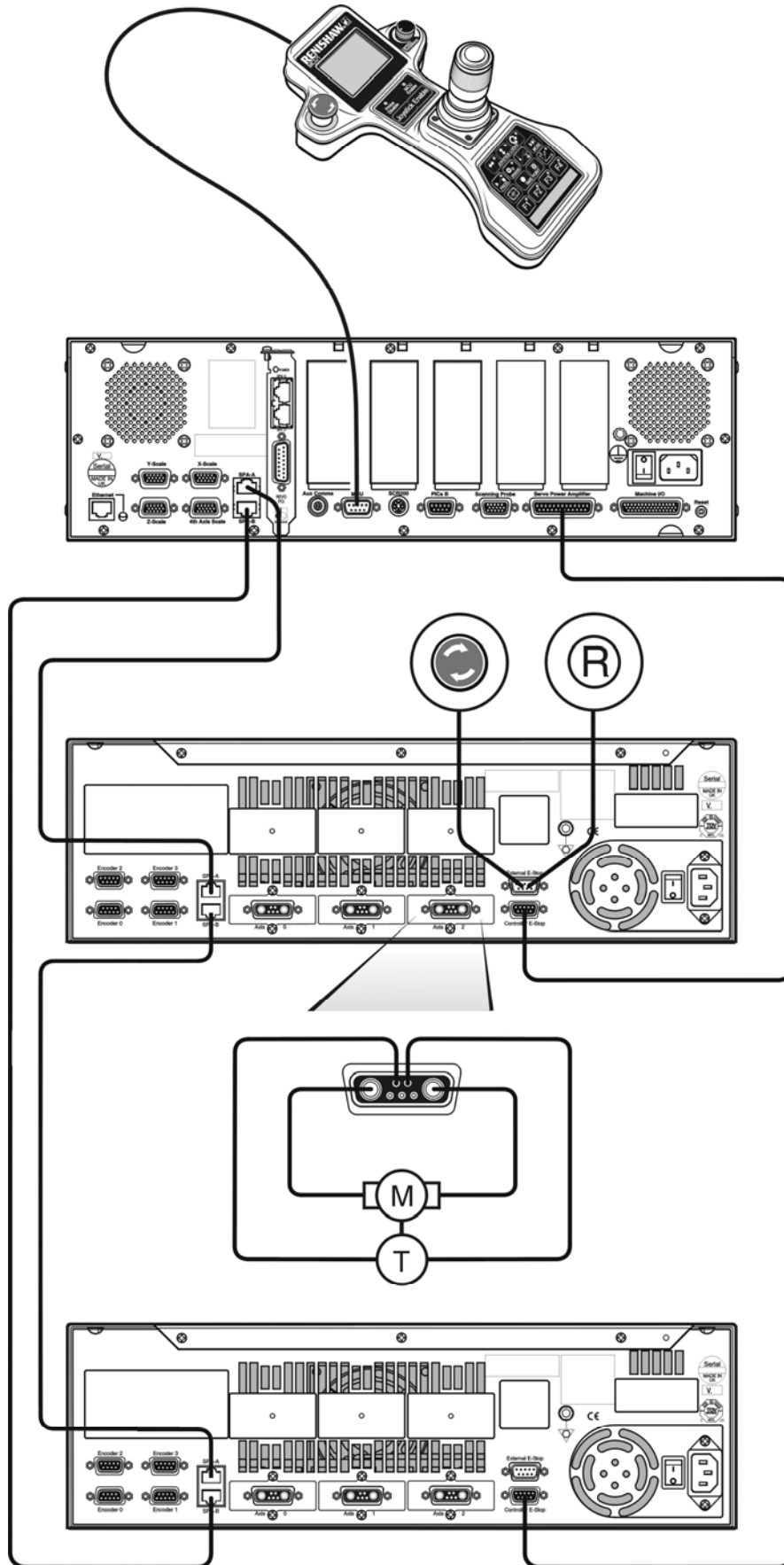
6.1 UCC2 DC motor and tacho connection



6.2 UCCLite DC motor and tacho connection



6.3 Dual SPA2-2 DC motor and tacho configuration



6.4 Preparation of integration kits

The **SPA2-2** integration kit will contain the necessary components required connect the **SPA2-2** and either the **UCC2** or **UCC*lite*** controller system to a CMM installation.

NOTE: All connectors used in the integration of the **SPA2-2** to a CMM installation are widely commercially available, the connector kits are designed to ease the system integration by permitting the connectors to be purchased at the same time as the **SPA2-2**.

6.4.1 Motor connectors

Each connector kit will contain three motor connectors which are appropriate for DC motor output from the **SPA2-2**.

NOTE: This connector is of the solder bucket variety, it is recommended that they are fitted to the CMM wiring by a competent technician or engineer, and that sleeving is used for all connections to reduce the possibility of short circuits.

Each of the three connector assemblies consist of the following:

- 1 off metal backshell
- 1 off 7W2 power and signal D-type connector
- 2 off power pins

6.4.2 Emergency stop and reset switch

The **SPA2-2** and **UCC2** control system is capable of providing category 2 * emergency stop system safety level. The **SPA2-2** and **UCClite** is capable of providing a category B emergency stop. However, this is subject to the machine manufacturers / installers method of integration and their risk assessment.

Each machine integration kit contains one 9-way D-type connector that permits the installer to add additional emergency stop devices to the emergency stop system integrated within the **SPA2-2**.

NOTE: Emergency stop switches (where required by the manufacturer or installer's risk assessment) must comply with the requirements of standards UL1054/EN60947.

This connector is of the solder bucket variety. It is recommended that they are fitted to the CMM wiring by a competent technician or engineer, and that sleeving is used for all connections to reduce the possibility of short circuits.

* Category 2 to EN954-1:1996 (ISO13849-1:1999).

7 Revision history

Issue 01-A

First issue.

Renishaw plc
New Mills, Wotton-under-Edge,
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com
www.renishaw.com

RENISHAW 
apply innovation™

**For worldwide contact details,
please visit our main website at
www.renishaw.com/contact**



H - 1000 - 5247 - 01