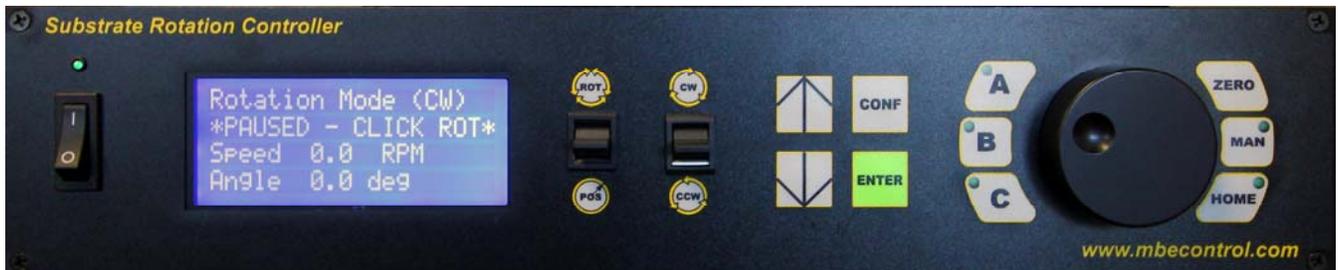


User Operation Manual: Substrate Rotation Controller



RIBER

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BEFORE YOU BEGIN

Safety Precautions

As with all industrial electronic equipment, safety depends on proper installation, use and maintenance of the instrument. Riber USA has designed the Substrate Rotation Controller (SRC) with operator safety in mind.

Please read in full this operation manual before attempting to install or operate the SRC. Refer to your respective facility guidelines on the installation of electronic equipment.

Under no circumstances should the SRC be used for a purpose other than intended nor in a manner that may create a potentially hazardous condition should a failure occur in the operation of the system.

To avoid possible shock, power down the Substrate Rotation Controller (SRC) before connecting/disconnecting cables.

To avoid possible shock, do not open the enclosure of the Substrate Rotation Controller (SRC). Contact Riber USA for servicing.

Product Concerns

CAUTION: The servo motor and cables are NOT bakeable, to avoid damage to the system please remove the servo motor assembly and cables from the manipulator prior to baking. The servo motor assembly is NOT bakeable.

CAUTION: It is imperative the Substrate Rotation Controller (SRC) be properly configured to the manipulator to which it will be installed. Failure to properly configure the SRC could result in damage to the unit as well as damage to the manipulator mechanics. Please refer to the [System Configuration](#) section for details on how to configure the SRC to your manipulator. If further information is necessary please contact Riber USA.

CAUTION: To avoid damage to the servo motor driver in the Substrate Rotation Controller, please power off the unit before disconnecting either cable to the servo motor assembly.

Specifications

Operating Temperature	0 to 55°C	
Operating Humidity	0-85%; non-condensing	
Operating Altitude	5000 ft. (1520 m)	
AC Input Voltage	1φ: 200~255V @ 50/60Hz ±5%	
AC Input Frequency	50 or 60Hz ±5%	
Servo Motor Max Torque (Large)	3.82 NM (400W motor)	
Servo Motor Max Torque (Small) <i>optional</i>	0.95 NM (100W motor)	
Rack Size	2U (full rack)	
Physical Dimensions	Controller (2U full rack) Weight: 18.3 lbs (8.32 kg) Height: 3.5 in (8.9 cm) Width: 19 in (48.2 cm) Depth: 20 in (50.8 cm)	Servo Motor Assembly Weight: 5.7 lbs (2.6 kg) Height: 2.4 in (6.0 cm) Width: 2.4 in (6.0 cm) Length: 7.75in (19.65 cm)

Support

For product related questions or assistance, please use the contact information below:

Riber USA
 137 Aero Camino, Suite B
 Goleta, CA 93117
 USA
 tel: (805) 683-3152
 fax: (805) 456-2166
 email: service@riberusa.com

INTRODUCTION

Product Description

The Substrate Rotation Controller (SRC) allows the precise control of the rotation of the substrate in an MBE system. The SRC has been designed for reliable continuous operation in a production environment as well as being simple and intuitive to use.

The SRC incorporates high precision motion control hardware which allows highly accurate, reproducible substrate rotation speed and positioning. By utilizing a precision AC servo motor with an integrated 10,000 count/revolution optical encoder, the SRC is able to precisely adjust substrate angle or rotation speed.

The Substrate Rotation Controller consists of two main components: 1) a rack mounted controller that powers and reads out the servo motor position. 2) the servo motor assembly that mounts onto the rotary feedthrough of the substrate manipulator.

The servo motor can be controlled one of three ways:

- **Jog Wheel-** In position mode, the user can control substrate azimuthal position via rotation of the jog wheel on the front of the controller. In rotation mode, the jog wheel sets the rotation speed in rotations per minute (RPM).
- **Predefined Position-** Three pre-defined positions can be programmed to the A/B/C buttons located on the front panel of the controller. The user is able to set the predefined position and “jump” quickly to the programmed set points. This can be useful for RHEED investigations.
- **Remote Operation-** The Substrate Rotation Controller can be connected to the process control PC via a standard RS-232 serial interface. The SRC is compatible with most major equipment vendor process software and emulates the eurotherm EI-Bisynch protocol.

INSTALLATION

This section will explain how to setup the Substrate Rotation Controller (SRC), for use on your substrate manipulator.

WARNING: Before making any cable connections check to make sure the power switches (front and rear) are in the off position. Failing to do so may cause injury or damage to the equipment. Never install/remove the motor cabling with the power on to the unit as damage can occur.

Install the Controller in the Electronics Rack

The following procedure is used to install the controller into the electronics rack.

1. Make sure the power switches are in the off position; there is one switch on the front and rear of the unit.
2. Mount the controller in your electronics rack.
3. At the rear of the controller, connect the AC power cord to the controller. Do not attempt to run the controller using the incorrect voltage or damage will occur. **The input voltage must be between 200 and 255 VAC.**
4. Connect the other end to a proper AC outlet, you may need to contact your facility support personal for this operation.
5. Connect the Motor Power Cable to the rear of the controller.
6. Connect the Motor Encoder Cable to the rear of the controller.

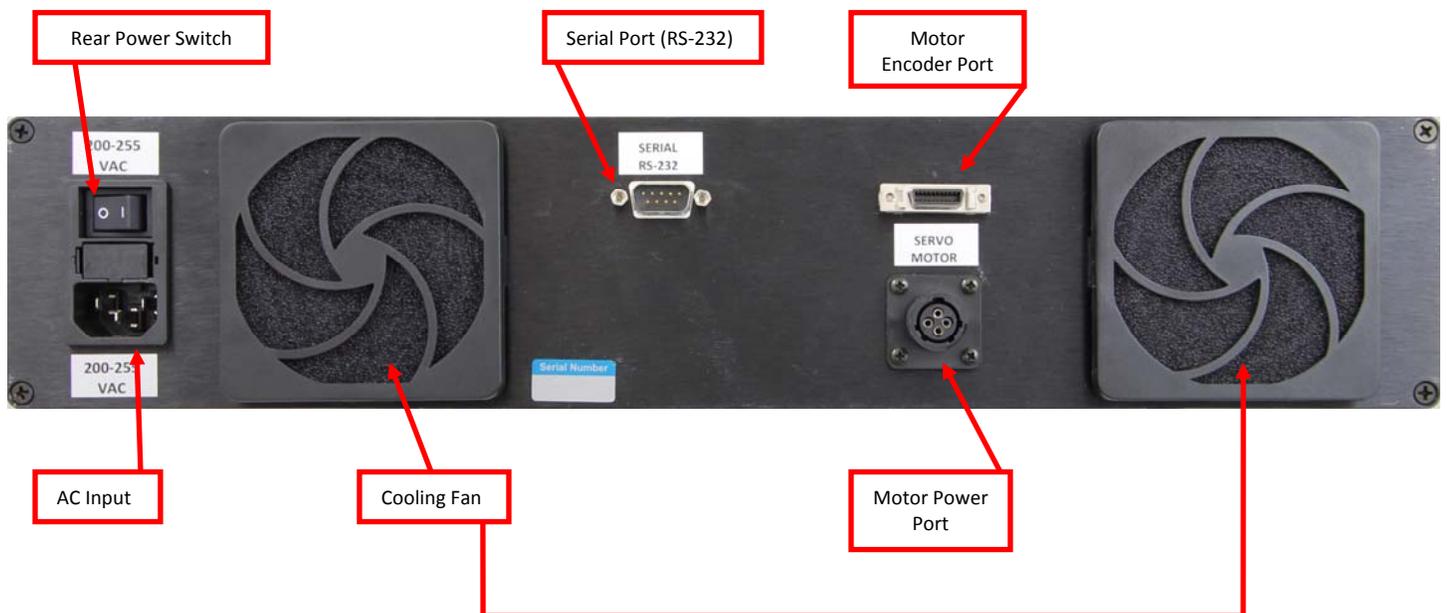


Figure 1: Substrate Rotation Controller – Rear Panel

Install the Servo Motor Assembly on the Manipulator

Figure 2 shows the servo assembly installed on the manipulator on a Gen 2 system. These steps can be done either before or after connecting the motor power and encoder cables.

1. Install large helical coupler, $\frac{1}{4}$ " shaft and small flexible coupler on motor shaft.
2. Install motor on motor mount so that small flexible coupler mates with magnetic rotary feedthrough.
3. Using a 2.5mm Allen key, tighten the helical coupling set screw to clamp the coupler to the lead screw stem.

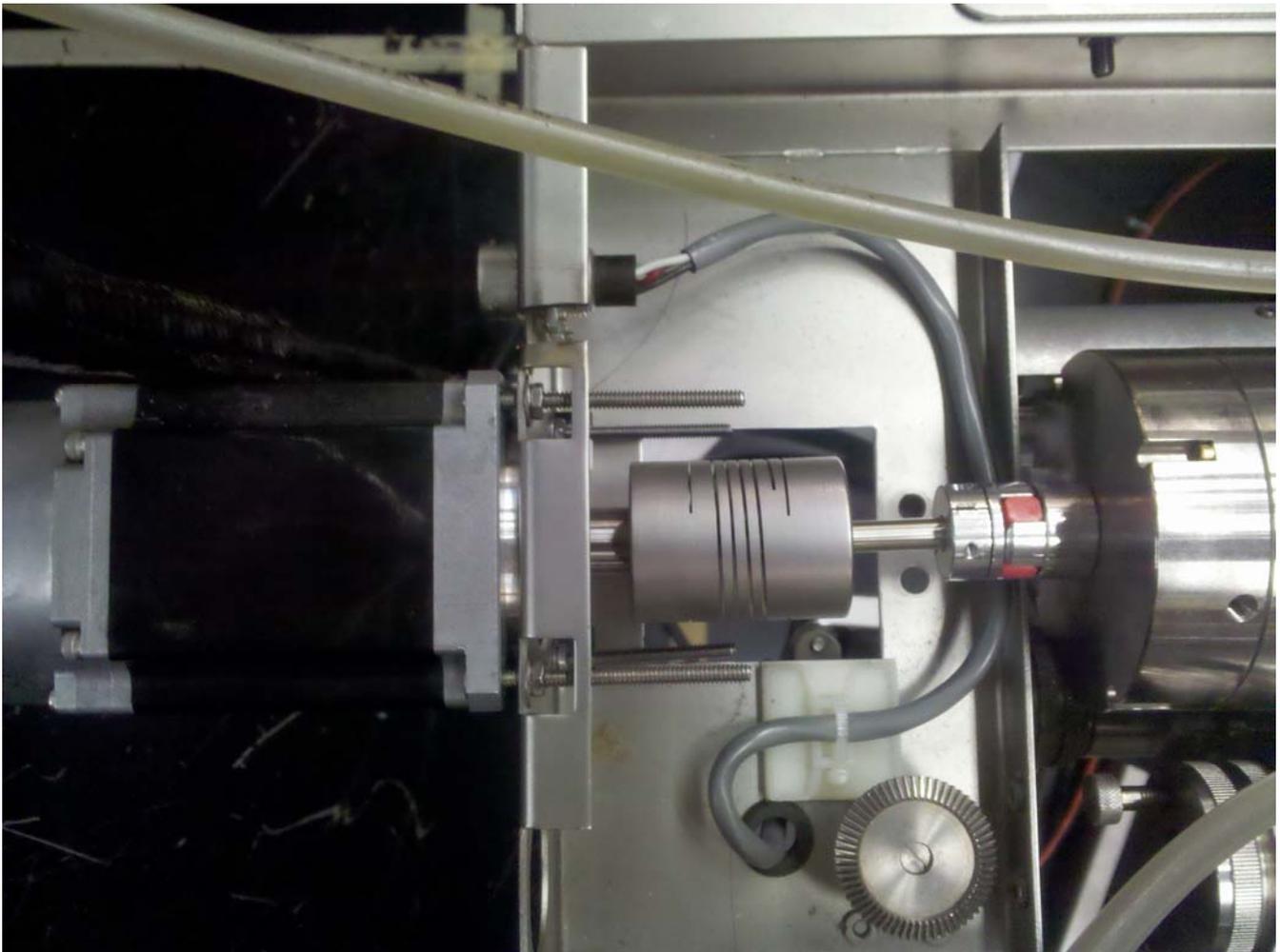


Figure 2: Motor installed on manipulator rotation feedthrough

OPERATION

This section will familiarize you with the operation of the Substrate Rotation Controller (SRC) rack mounted controller.

Features – FRONT PANEL

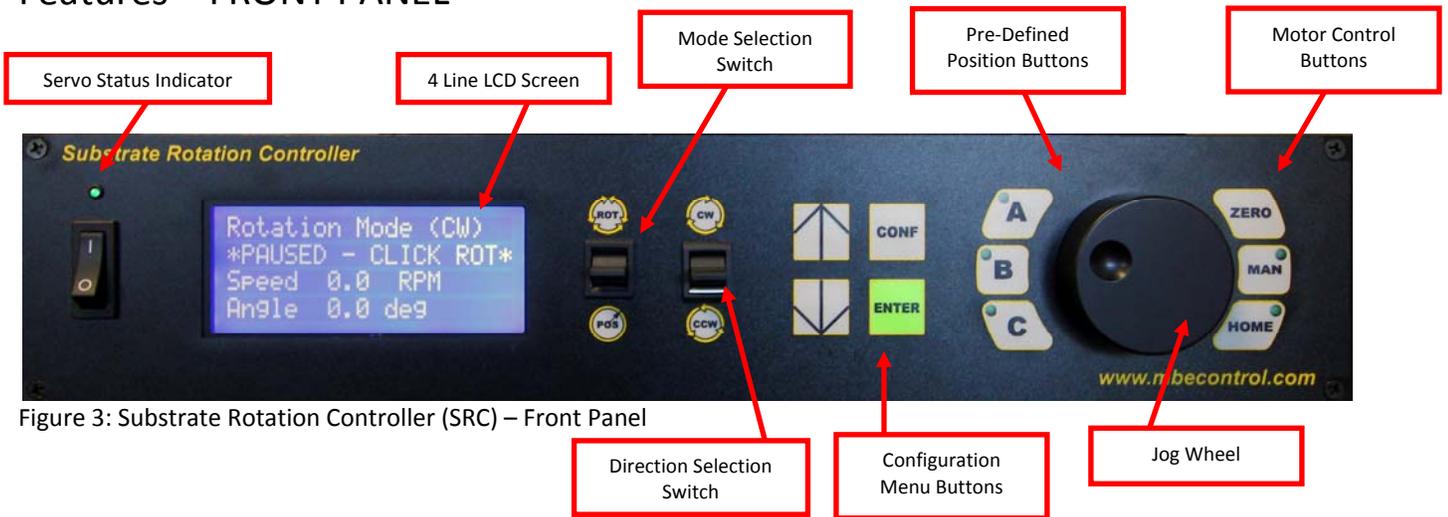


Figure 3: Substrate Rotation Controller (SRC) – Front Panel

Startup

To power on the controller, both the rear power switch and the front power switch must be turned on. These 2 switches are wired in series. Once both power switches have been set to the “on” position, startup of the controller takes approximately 60 seconds to complete. During startup the Servo Status Indicator and the LCD should turn-on; If the Servo Status Indicator does not illuminate, check the following:

1. Power/Encoder cables are connected to the rear of the MVC.
2. Power/Encoder cables are connected to the Servo Motor Assembly.

Once the controller has completed the boot process, the substrate rotation controller will be in position mode and will set the current rotation angle to zero. The controller will then maintain this position. Rotation of the jog wheel will cause the substrate to rotate. To set the current position to zero, simply press **ZERO** on the controller front panel.

To continuously rotate the substrate, you must enter rotation mode. Click upwards on the Mode Selection Switch towards **ROT** to enter rotation mode. After a single click, the rotation speed will be displayed and the rotation will be paused. At this point, the rotation speed can be set using the jog wheel. Clicking up on the Mode Selection Switch a second time will initiate the rotation. To pause the rotation and stay in rotation mode, click the Mode Selection Switch again. Upward clicking of this switch toggles between paused and rotating. To return to position mode, click downward towards **POS**. This will halt rotation and maintain the current position.

To change rotation direction while in rotation mode, click the Direction Selection Switch towards either **CW** or **CCW**.

Configuration

Several configuration parameters can be set within the substrate rotation controller. To enter the configuration mode, press the **CONF** button on the front panel. Navigation through the configuration menu is done via the up/down arrow buttons, a parameter value can be changed using the jog wheel. Once the desired value is set, press the **ENTER** button to register the change. To cancel the new value, select a different parameter using the up or down arrows without pressing **ENTER**. To exit configuration mode, press the **CONF** button again and the new values will be saved to memory. The first 2 parameters require a power cycle after changing the values. A message will appear if a power cycle is required. The list of parameters follows.

- **Motor Rotation Direction:** The direction that the motor will turn to rotate the substrate as viewed from the back of the motor. Select CW for clockwise and CCW for counterclockwise.
- **Positioning RPM:** The speed in rotations per minute (RPM) that the motor will turn when changing substrate position in position mode.
- **Acceleration Time:** The time in milliseconds over which the motor will accelerate from zero velocity to the positioning or rotation velocity. Limiting the acceleration provides for smoother motion of the substrate and produces less strain on the mechanical components.
- **Torque (%):** The maximum torque the motor will apply while moving to a new position and in maintaining the current position. The torque value is expressed as a percentage of the maximum rated continuous torque of the motor.
- **Max Speed:** The maximum speed that can be used in rotation mode.
- **Position A:** The position value associated with preset A
- **Position B:** The position value associated with preset B
- **Position C:** The position value associated with preset C
- **Position Gain (r/s):** This is one of two tuning parameters for the control loop that maintains position and speed of the motor.
- **Velocity Gain (r/s):** This is one of two tuning parameters for the control loop that maintains position and speed of the motor.

After changing parameters and exiting configuration mode, do not power off for any reason until waiting 5 seconds to give the controller enough time to save the new parameters. This delay is not necessary for settings that require a power cycling.

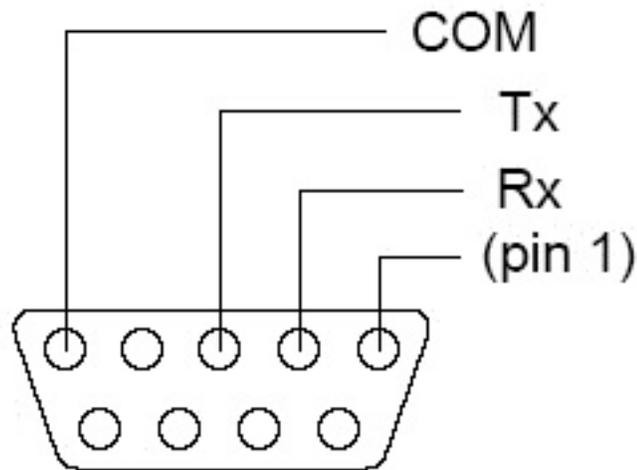
To reinitialize all the settings to the default values, hold down the **CONF** key while the unit powers up. This will reset the stored settings to the default value.

Remote Serial Operation

A DB9 connector on the back of the unit allows for remote operation using the eurotherm compatible EI-Bisynch communications protocol. For additional information on using the EI-Bisynch protocol please contact Riber USA.

The serial port settings are fixed at: 9600 baud rate, 7 data bits, even parity, and 1 stop bit

The pin-out of the male DB9 connector is shown below:



If your controller has a female DB9 connector, it is configured for RS-485 4 wire communications. Please contact Riber USA for more information.

To send a position setpoint remotely, use the SL parameter in your control software. This corresponds to the temperature setpoint of a normal eurotherm loop. To set a rotation velocity, send a RR (ramp rate) command from your control software. Sending an RR command will automatically put the controller into rotation mode and start the rotation. Sending an SL parameter will put the controller into position mode, stop rotation, and move to the desired setpoint.