Electronic Gear Ratio and Pulse Frequency

Radonix controllers generate pulse signals and transmit them to the servo drive. The servo drive receives these pulse signals and moves the motor according to its internal pulse command settings.

Each axis of a Radonix controller can generate up to **500,000 pulses per second (500 kHz)**. However, every servo drive and motor system has its own pulse command settings, encoder resolution, and electronic gear ratio parameters. These parameters determine how many input pulses are required for the motor to complete one full revolution.

For example, a **Delta B2 servo system** may have an encoder resolution of **160,000 pulses per revolution (pulse/rev)**. If the system is configured to require **160,000 command pulses for one motor revolution**, the pulse frequency required to achieve high motor speeds can be calculated.

For example, if the target motor speed is **2,000 RPM**:

160,000 pulse/rev × 2,000 rev/min = 320,000,000 pulse/min

Converting this value to pulses per second:

320,000,000 ÷ 60 = 5,333,333 pulse/s

This means that, **without using an electronic gear ratio**, the servo drive would require approximately **5.33 million pulses per second** to reach a speed of **2,000 RPM**.

However, the Radonix controller can output a maximum of **500,000 pulses per second**. Therefore, an **electronic gear ratio** must be configured in the servo drive.

The required gear ratio can be estimated as follows:

5,333,333 ÷ 500,000 ≈ 10.66

In practice, this ratio is configured using the servo drive's **Numerator** and **Denominator** parameters. A gear ratio close to the calculated value should be selected according to the machine's required speed and positioning accuracy.

For **Delta servo drives**, the electronic gear ratio is typically configured using parameters such as **P1-44** and **P1-45**.

Important Notes

- Parameter numbers may vary depending on the servo drive manufacturer and model.

- Always refer to the servo drive's user manual before modifying the electronic gear ratio.
- An incorrect electronic gear ratio may result in inaccurate travel distances, incorrect axis speeds, or reduced machine accuracy.
- After configuring the electronic gear ratio, the axis should be calibrated within the CNC software to ensure that the commanded movement matches the actual mechanical movement.
- During the final adjustment, the following factors should all be considered:
    - Controller pulse output capacity
    - Servo command resolution
    - Encoder resolution
    - Target motor speed (RPM)
    - Gearbox reduction ratio
    - Ball screw lead
    - Rack-and-pinion ratio
    - Any other mechanical transmission ratios

Summary

To achieve the correct motor speed and precise machine movement, the electronic gear ratio must be calculated and configured by considering the controller's pulse output capacity, the servo drive's pulse command settings, the motor encoder resolution, the target motor speed (RPM), and the mechanical transmission system. Proper configuration and calibration ensure both accurate positioning and optimal machine performance.

Machine Axis Calibration Procedure

To ensure that the machine's actual movement matches the movement value displayed in the software, the machine axes must be calibrated. The calibration process allows the software to correct the movement value of each axis according to its actual mechanical movement.

This procedure must be performed separately for each axis. For example, the **X**, **Y**, and **Z** axes should each be calibrated individually.

General Calibration Procedure

- First, make sure the controller is **online** and that the axis to be calibrated is ready for movement.
- Check the axis movement direction. Before calibration, the positive and negative movement directions must be configured correctly.

- Select a fixed reference point or surface on the machine. This reference point must remain unchanged throughout the test and should allow for reliable measurements.
- Measure the initial distance between the axis and the reference point.
- Enter the measured value into the **Location 1** field.
- Press the **Start** button to begin the calibration process.
- Move the axis over a certain distance. It is recommended to use the longest practical travel distance. The longer the travel distance, the smaller the measurement error and the higher the calibration accuracy.
- After the axis stops, measure the new distance from the same reference point.
- Enter the measured value into the **Location 2** field.
- The software calculates the actual travel difference between the **Location 1** and **Location 2** values and automatically corrects the movement coefficient of the selected axis.
- After the calibration is complete, perform another movement test on the same axis and compare the actual travel distance with the distance displayed in the software.

Example

Suppose we want to calibrate the **X-axis**.

First, measure the initial distance from a fixed reference point. Assume the initial measurement is **73 mm**. Enter this value into the **Location 1** field.

Next, press the **Start** button and move the X-axis over a long distance.

After the axis stops, measure the new distance from the same reference point. Assume the new measurement is **1722 mm**. Enter this value into the **Location 2** field.

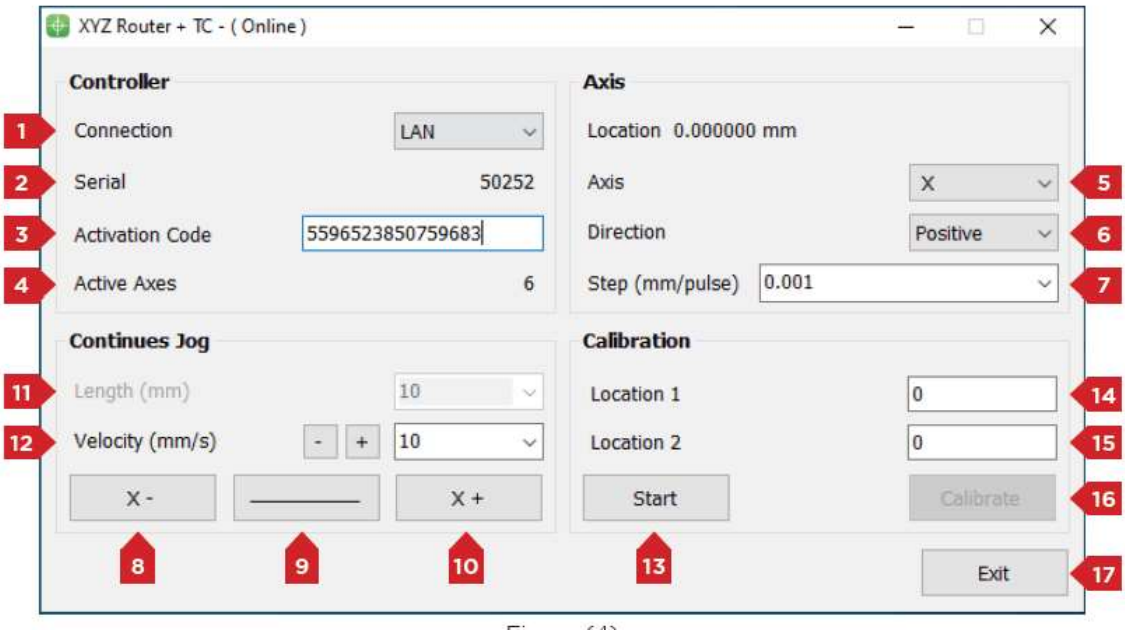
After these two values have been entered, the software calculates the actual travel difference and corrects the calibration settings for the X-axis.

The same procedure should be repeated for the **Y** and **Z** axes.

Important Notes

- The initial measurement must always be entered into the **Location 1** field.
- The final measurement, taken after the axis has moved, must be entered into the **Location 2** field.
- Both measurements must be taken from the same fixed reference point.
- All values should be entered in **millimeters (mm)**.
- Before calibration, ensure that the axis movement direction is correct.
- Using a longer travel distance reduces measurement error.

- During calibration, the movement speed should be kept at a safe level.
- Before moving the axis, ensure that the travel path is clear and that there is no risk of mechanical collision.
- After each axis has been calibrated, perform a test movement to verify the calibration accuracy.
- If a significant error is observed, the calibration procedure should be repeated.



Calibration Software and Axis Calibration

This section is used to ensure that the machine's actual travel distance matches the travel distance defined in the software. The calibration procedure must be performed separately for each axis.

The calibration interface allows the operator to verify the controller connection, select the axis to be calibrated, configure the axis direction, control the manual movement speed, and enter the required measurement values.

Calibration Interface Description

No.	Section	Description
1	**Connection**	Displays the connection type between the controller and the computer. It should display **LAN** when using ProLAN controllers and **USB** when using ProUSB controllers.
2	**Serial**	Displays the controller's serial number.
3	**Activation Code**	The 16-digit activation code used to enable the machine axes.
4	**Active Axes**	Displays the number of axes activated by the activation code.
5	**Axis**	Used to select the axis to be calibrated, such as the **X**, **Y**, or **Z** axis.
6	**Direction**	Used to ensure that the axis movement direction matches the standard coordinate system. Negative movement should correspond to the negative direction, and positive movement should correspond to the positive direction.
7	**Step**	Displays the step value (calibration coefficient) automatically calculated by the software after the calibration process is completed.
8	**Negative Jog**	Moves the selected axis manually in the negative direction.

No.	Section	Description
9	**Jog Mode**	Used to select the manual movement mode. Either **Continuous Movement** or **Incremental Movement** can be selected.
10	**Positive Jog**	Moves the selected axis manually in the positive direction.
11	**Length**	Specifies the distance the axis moves for each command when **Incremental Movement** mode is selected.
12	**Velocity**	Sets the manual movement speed. The adjacent + and − buttons are used to increase or decrease the speed.
13	**Start**	Starts the calibration procedure.
14	**Location 1**	The field used to enter the initial measurement value for calibration. This value must be measured from a fixed reference point.
15	**Location 2**	The field used to enter the final measurement value after the axis has moved. This value must also be measured from the same fixed reference point.
16	**Calibrate**	Completes the calibration process and instructs the software to calculate the new step value (calibration coefficient).
17	**Exit**	Closes the calibration program.