

HIGH PRECISION GEARED  
**SERVO MOTORS**  
RDrive 85

# USER MANUAL



## INTRODUCTION

RDrive servo motors are geared actuators designed to enable precision motion control in industrial and commercial applications.

This manual is intended for technicians and engineers who design, build, and operate systems and machinery that use RDrive servo motors for actuation. In this document, you will find the following information:

- components of RDrive servo motors
- specifications of the RDrive 85 servo motor, as well as its allowable radial and axial loads
- requirements and instructions on mechanical and electrical integration of the RDrive 85 servo motor
- instructions and recommendations on enabling motion control of RDrive servos
- maintenance, transportation, and storage recommendations

## WARNING SIGNS AND THEIR MEANINGS

Below, you can see the warning symbols used throughout the manual and their meaning.



*The sign denotes important information that is not directly related to safety, but that the user should be aware of.*



*The sign indicates important safety precautions the user should follow.*

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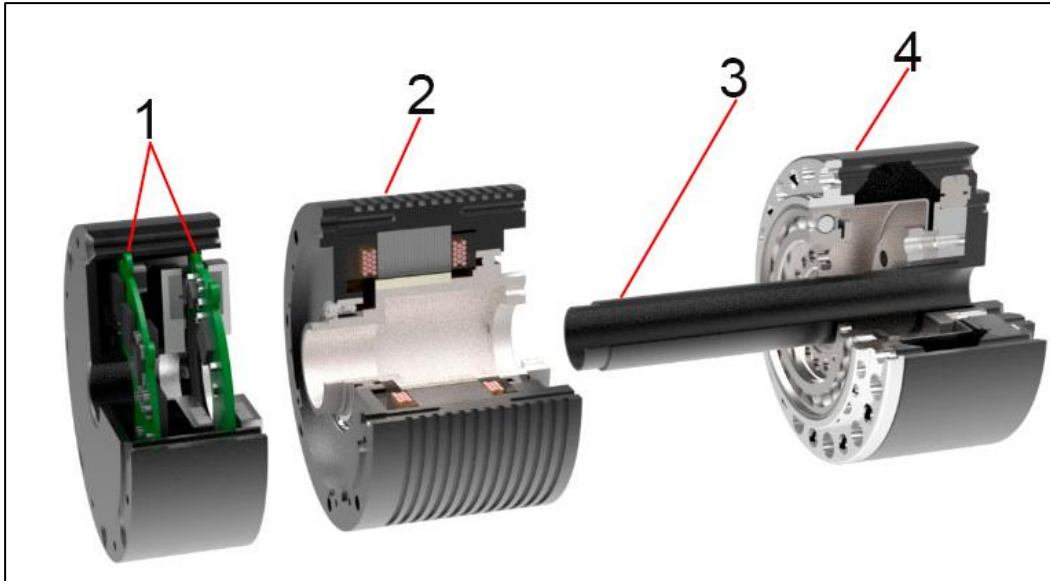
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# 1 PRODUCT OVERVIEW

## 1.1 Components

RDrive servo motors are intended for commercial and industrial use to ensure high-precision rotary motion. **Figure 1-1** is an exploded view of an RDrive servomotor in a housing.



**Figure 1-1: The components of an RDrive servo motor**

(1)	Two printed circuit boards (PCBs) connected with each other by means of the BiSS interface. One of the PCBs incorporates a controller and the other—two encoders.
(2)	A frameless brushless alternating current (AC) motor comprising a rotor and a stator, as well as a negative temperature coefficient (NTC) thermistor fitted into the stator winding.
(3)	A hollow shaft, which you can use for laying the cables to connect the servo to a machine.
(4)	A strain-wave gearhead that reduces rotation speed (RPM) and increases motor torque.

By design, the RDrive servo motor also comprises a **cable gland** located on its input flange. The gland includes four wires:

- two wires for connecting the servo to a power supply
- two wires for enabling CAN communication

## 1.2 Supply package

The basic supply package for an RDrive servo motor comprises the following:

- one or more RDrive servos
- one CAN-USB dongle (see **Section 1.2.2**)



*Each supply package includes one USB-CAN dongle only, irrespective of the total quantity of servos in it. However, users can order more dongles for an extra charge.*

### 1.2.1 Options

Apart from the basic supply package, Rozum Robotics offers the following options:

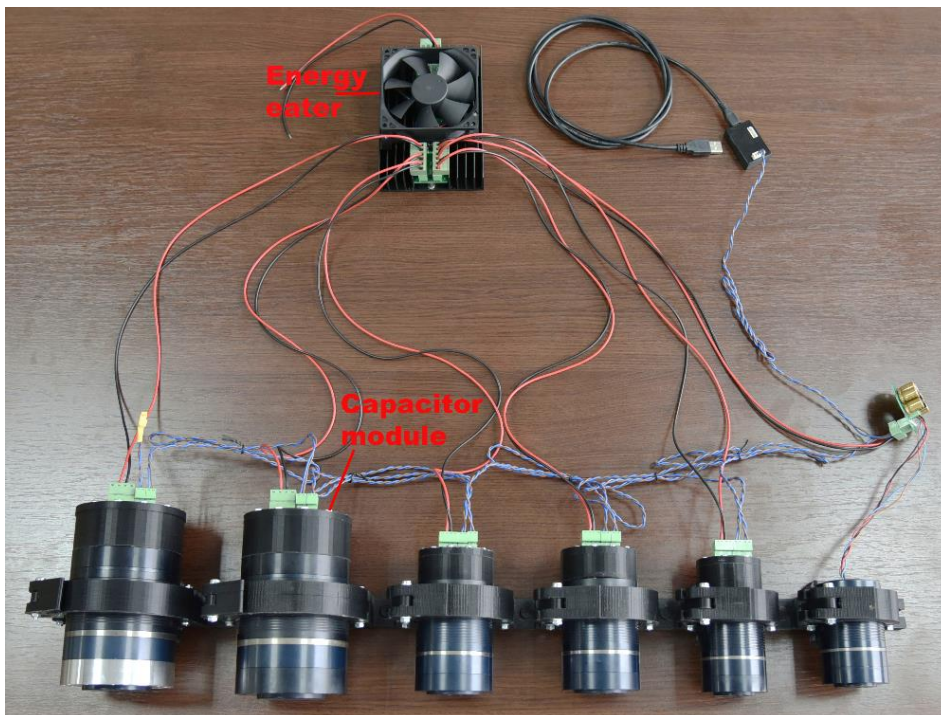
- Servobox
- Quick-start motor mounts

A **servobox** is a set of components intended to ensure safe and correct operation of RDrive servomotors at design loads. The set is customizable and can include the following (see **Figure 1-2**):

- an energy eater complete with a power supply cable
- a capacitor module comprising one or more capacitors (attached to the input flange)
- a USB-CAN adapter
- a USB-A Micro USB cable (1 m long)
- a terminating resistor 120 Ohm
- a quick-start cable set comprising a power supply cable 1 m long and a CAN cable 1 m long (one cable of each type per servo motor)



*For detailed information about the servobox solution, see [the Servobox manual](#). The document also contains instructions how to assemble a similar solution on your own.*



**Figure 1-2: A sample servobox with servo motors and motor mounts**

A **motor mount** is an optional quick-start accessory. The mounts are available in a number of sizes to match those of RDrive motors. STL models to print the mounts and assembly instructions are available for downloading at the web page: <https://rozum.com/servobox/>.

### 1.2.2 USB-CAN dongle

A USB-CAN dongle is a special adapter coupled to a USB port of a personal computer (PC) to provide CAN connectivity between one or more RDrive servos and a PC.



*If your PC runs Windows 8 or earlier versions of the operating system, you will need to download and install a driver to be able to work with the CAN-USB dongle. For the downloading link and installation instructions, go to the webpage:*

*<https://www.st.com/en/development-tools/stsw-stm32102.html>*

The dongle has two connectors (**Figure 1-3**):

- (1) for connecting the device to a CAN bus (Molex 0022035045 Connector)
- (2) for connecting a Micro USB-USB A cable

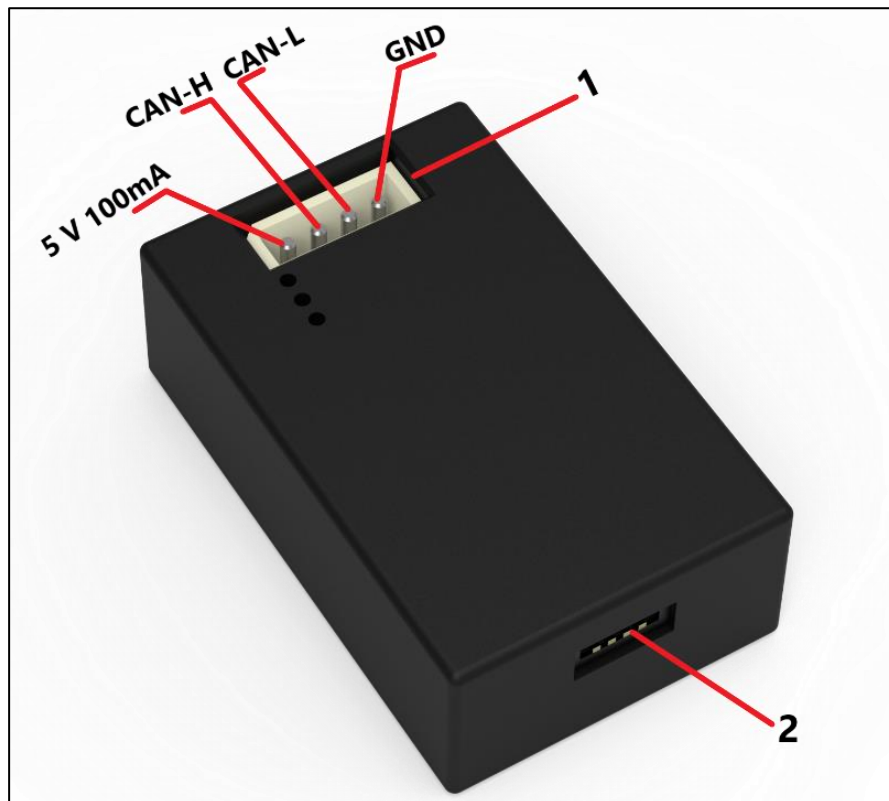


Figure 1-3: The CAN-USB dongle in the RDrive supply package

The CAN-USB dongle is supplied complete with the following:

- a Micro USB-USB A cable
- a Molex 0050375043 connector housing and Molex 08-70-1039 pins for providing CAN bus connection

## 1.3 Intended use and operating conditions

RDrive motors are designed for industrial and commercial use. **Inadmissible applications** include explosive or otherwise hazardous areas, as well as locations with highly corrosive atmospheres.

Table 1-1: Operating conditions of RDrive servos

Parameter	Value
Altitude	Not higher than 1,000 m above the sea
Operating temperature	0°C to +35°C
Operating humidity	80% max at 25°C (90% at 20°C)
IP protection	IP20



*Avoid exposing servo motors to any operating conditions outside of the above specifications. This can damage their components and/or reduce their service life.*

## 2 WORKING PRINCIPLE

### 2.1 Motion control system

The RDrive motion control system is of the closed-loop type. RDrive servo motors not only receive motion control commands from a control device (e.g., a PC or a CAN master), but also provide feedback on their execution.

The system consists of a self-designed controller and two encoders (see **Section 2.2**). During servo operation, the components of the system interact as described below:

- The controller receives a control command from a control device and applies current to a frameless AC motor to produce motion with required parameters.
- Two encoders monitor the absolute positions of the rotor and output shaft and send feedback to the controller.
- The controller processes the feedback, compares the resulting values with the control command, and sends a signal to adjust the motor position, if needed.
- The controller transmits the command execution results to the control device. Communication between the servo motor and the control device is either based on the CANOpen protocol stack (see **Section 5.1**) or the Application Programming Interface (API) (see **Section 5.2**).

### 2.2 Motion and other feedback

RDrive servo motors comprise two integrated feedback devices—absolute magnetic encoders. The two encoders are mounted on a separate PCB connected with the controller PCB by means of a flat cable (a BiSS line). One of the encoders delivers information about the absolute position of the output shaft and the other—about that of the rotor.

Table 3-1: Encoder data

<b>Type</b>	rotary magnetic single-turn
<b>Output</b>	absolute position
<b>Resolution</b>	19-bit



In addition, the controller receives and processes feedback signals from the NTC thermistor in the motor winding. When the value based on the thermistor reading exceeds the maximum temperature limit, the controller cuts the servo off.

### 3 PRODUCT SPECIFICATIONS

#### 3.1 Specifications of the RDrive 85 servo motor

**Table 3-1** contains performance, electrical, and mechanical specifications, as well as dimensions of the RDrive 85 servo motor.

**Table 3-1: Specifications of the RDrive 85 servo motor**

<b>PERFORMANCE DATA</b>		
Rated rotation speed	40	RPM
RMS current	8.8	A
Rated torque	108	N·m
Peak torque	157	N·m
Torque constant (Kt) at 20°C	112	mN·m/A
Service life	35,000	hours
<b>ELECTRICAL DATA</b>		
Rated power	450	W
Supply voltage	48	V
<b>MECHANICAL DATA</b>		
Motor inertia	0.32	kg·cm <sup>2</sup>
Weight	2.1	kg
IP rating	IP21*	
<b>DIMENSIONS</b>		
Length (L):	112.5	mm
Diameter (D):	88	mm
Hollow shaft diameter (d):	13	mm

\*Upon request, RDrive 85 servos can be supplied with a higher IP rating.

In **Table 3-2**, you will find basic specifications of the gearhead integrated into the RDrive servo.

Table 3-2: The RDrive gearhead data

GEARHEAD DATA		
Gearhead type	Strain-wave	
Gearhead ratio	1:100	
Gearhead backlash	0.3	arcmin

## 3.2 Allowable axial and radial loads

The gearhead in the RDrive servo motor incorporates a high-rigidity crossed roller bearing to support output loads. The bearing can withstand high axial and radial forces, as well as high tilting moments. It keeps the gearhead protected from external loads, which guarantees long life and consistent performance of the gearhead.

**Table 3-3** lists allowable axial and radial loads for RDrive 85 servo motors.

Table 3-3: RDrive 50 allowable axial and radial loads

Allowable axial load, $F_a$ [N] <sup>1)2)</sup>	2,000
Allowable radial load, $F_r$ [N] <sup>1)2)</sup>	1,330

<sup>1)</sup> These data are valid for  $n = 15$  RPM and  $L_{10} = 25,000$  h, where  $L_{10}$  is the operating life of the output bearing.

<sup>2)</sup> These data are valid, only provided the following conditions are met:

For:

- **Fa**:  $M = 0$ ;  $F_r = 0$ ;

- **Fr**:  $M = 0$ ;  $F_a = 0$ ,

where **M** is the tilting moment.

## 4 INTEGRATION INTO AN APPLICATION

### 4.1 Installation requirements



*Magnetic-sensitive objects, such as banking cards, pacemakers, or other magnetic information carriers, should be kept away at a distance of 1 m from the motor.*

RDrive servo motors are intended for installation as part of a motion system or a machine. You can mount the actuators in any required position — vertical, horizontal, or at an angle. The installation site should meet the following requirements:

- Well-ventilated and free from dust, moisture, and vibration
- Ambient temperature, altitude, and other environmental conditions as specified in **Table 1-1**
- Easy access for inspection and dismantling

## 4.2 Installation procedure

The procedure for installing an RDrive servo motor includes the following steps:

1. Preparing for installation (**Section 4.2.1**)
2. Mechanical integration (**Section 4.2.2**)
3. Connecting to a CAN bus (**Section 4.2.3**)
4. Electrical connection (**Section 4.2.4**)
5. Pre-commissioning checks (**Section 4.2.5**)

### 4.2.1 Preparing for servo installation

The preparation sequence is as follows:

1. Unpack the servo motor.



*Never lift or pull servo motors by cables!*



*Make sure to avoid shocks as this can damage high-precision encoders inside servos.*

2. Check the fitting surfaces of both the servo and the machine for visible damages.



*Using damaged servos is forbidden because it can result in unintended operation of the machine and endanger the operator.*

3. Clean the fitting surfaces with a lint-free cloth and a suitable cleaning agent, if needed, and degrease them.

### 4.2.2 Mechanical integration



*For mating dimensions and surfaces, see the confirmation drawings available for downloading at <https://rozum.com/servomotors-documentation/>.*

For mechanical integration, proceed as below:

1. Fasten the servo to a mounting surface. To do this, you can proceed in either of the two ways:
  - A. Insert twelve M4 screws into the holes on the input flange and tighten them to the torque of 4 N·m max.
  - B. Screw the servo down on its output flange with twelve M4 screws. The tightening torque should be 4 N·m max.



*Allow for sufficient clearance around the servo for proper heat dissipation.*

- Attach a load to the output shaft. To do this, use the twelve M4 holes on the shaft, applying the tightening torque of 4.5(\*) N·m max.



(\*) The tightening torque value is indicated for 12.9 class screws.



*Make sure not to apply excessive impact or force to the output flange.*

## 4.2.3 CAN connection

### 4.2.3.1 General requirements

To provide a CAN connection, use the brown and blue wires on the input flange of the RDrive servo motor. The brown is for CAN<sub>HIGH</sub>, and the blue one—for CAN<sub>LOW</sub>.

Two connection types are possible, depending on the preferred servo control method:

- In case servo control is based on the CANOpen protocol stack, provide a CAN bus connection of the configuration as shown in **Figure 4-1**.
- In case servo control is via API, provide a CAN-to-PC connection as shown in **Figure 4-2**.

Irrespective of the connection type, make sure to comply with the following requirements:

- Terminate CAN bus lines of less than 40 m long with 120 Ohm resistors at both ends. For bus lines of over 40 m long, use 150-300 Ohm resistors.



*In a CAN-to-PC connection, you have to provide only one resistor because one is already integrated into the USB-CAN dongle included in the RDrive supply package.*

- The bus line cable must be a twisted pair cable with the lay length of 2 to 4 cm.
- For the cross section of the bus line, see **Table 4-1**.
- To ensure the baud rate required for your application, LΣ should meet the specific values as indicated in **Table 4-1**.

**Table 4-1: CAN line parameters**

Baud Rate	50 kbit/s	100 kbit/s	250 kbit/s	500 kbit/s	1 Mbit/s
Total line length, LΣ, m	< 1000	< 500	< 200	< 100	< 40
Cross-section, mm <sup>2</sup>	0.75 to 0.8	0.5 to 0.6	0.34 to 0.6	0.34 to 0.6	0.25 to 0.34

### 4.2.3.2 Connection diagrams

#### Connection for control based on CANOpen

The connection is in accordance with the diagram as shown in **Figure 4-1**. Connect the CAN cables on the RDrive input flange to the corresponding twisted pair wires: the brown one to CAN<sub>HIGH</sub>, and the blue one — to CAN<sub>LOW</sub>.

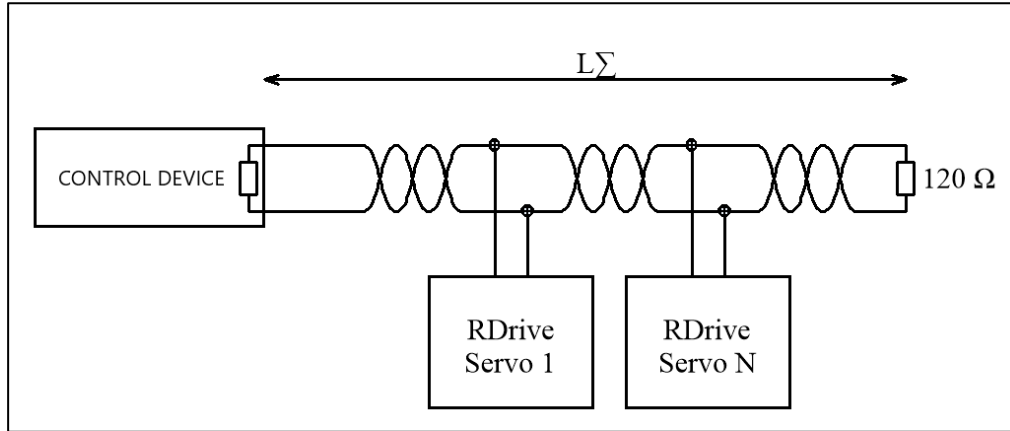


Figure 4-1: CAN connection to control servos based on CANOpen

**Connection for control via API**

The connection is in accordance with the diagram as shown in **Figure 4-2**, taking into consideration the arrangement of connectors on the USB-CAN dongle (see **Figure 4-3**). To provide the connection, use the cable on the input flange of the servo motor: the brown one corresponds to CAN<sub>HIGH</sub>, and the blue one — to CAN<sub>LOW</sub>.

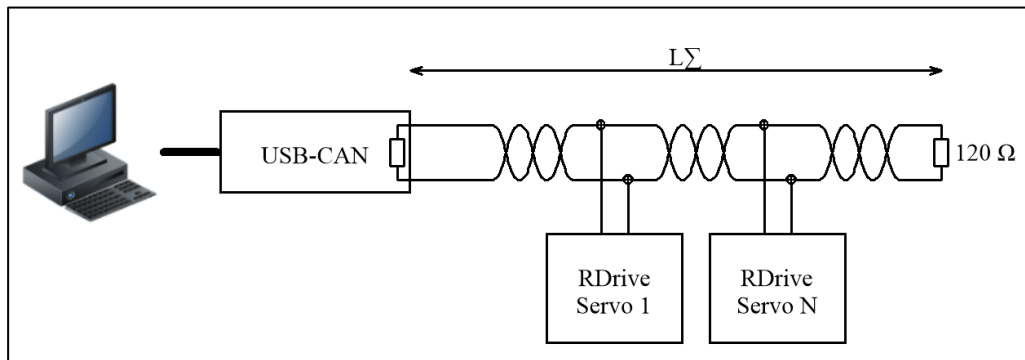


Figure 4-2: CAN-to-PC connection to control servos via API

Before connecting, make sure to solder the CAN cable leads into the Molex 0050375043 housing (included in the USB-CAN dongle supply package), using the Molex 08-70-1039 pins (also included in the supply package).

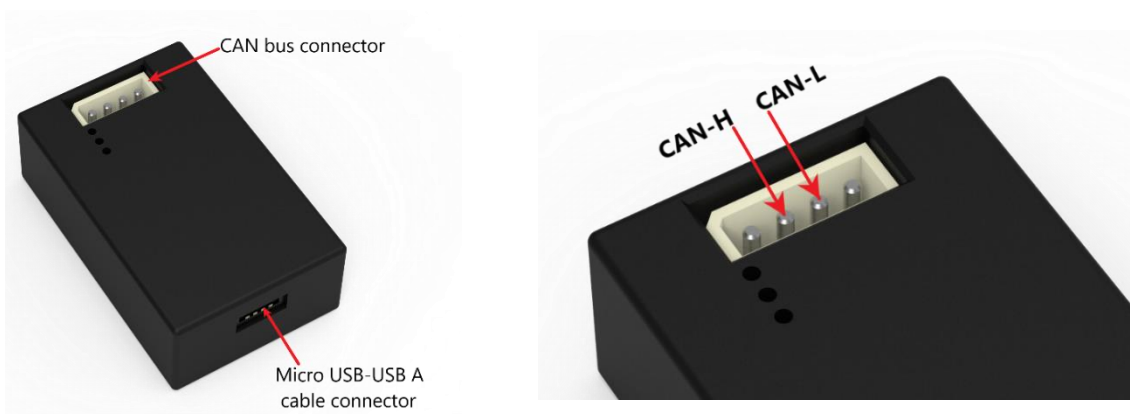


Figure 4-3: Connectors on the USB-CAN dongle

#### 4.2.4 Connecting to a power supply



*Before starting any wiring works, make sure that no power is supplied to the circuit you are assembling.*

##### 4.2.4.1 Electrical connection requirements

To connect RDrive servo motors to a power supply unit, use the red and black wires on its input flange:

- red for +
- black for –



*For cable arrangement and protective earthing requirements, refer to the installation drawing available at: <https://rozum.com/servomotors-documentation/>.*

However, connecting a servo directly to a power supply is **ONLY POSSIBLE FOR UNLOADED OPERATION** (e.g., for a test run).

*To ensure correct and safe operation of RDrive servo motors **CONNECTED TO A LOAD**, a power supply circuit for an RDrive servo **must** include:*

- at least one **energy eater** to dissipate dynamic braking energy that can cause servos to generate voltages in excess of the power supply voltage
- one or more **capacitor** to accumulate electric energy and supply to the servo, compensating for short-term consumption peaks due to inductive resistance



*Total capacitance requirement for a power supply circuit is  $\geq 5 \mu\text{F}$  per 1 W of connected servo power*

To meet the safe and correct operation requirement, you have *two ways* to proceed:

- to [order a servobox](#) offered by Rozum Robotics as an option (see **Section 1.2.1**), customized to your specific supply circuit requirements

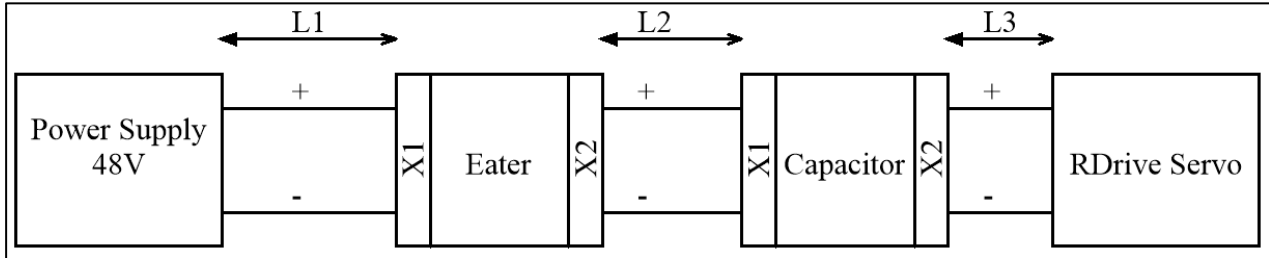
*or*

- to provide an energy eater(s) and a capacitor(s) on your own, following the instructions and requirements in [the Servobox manual](#).

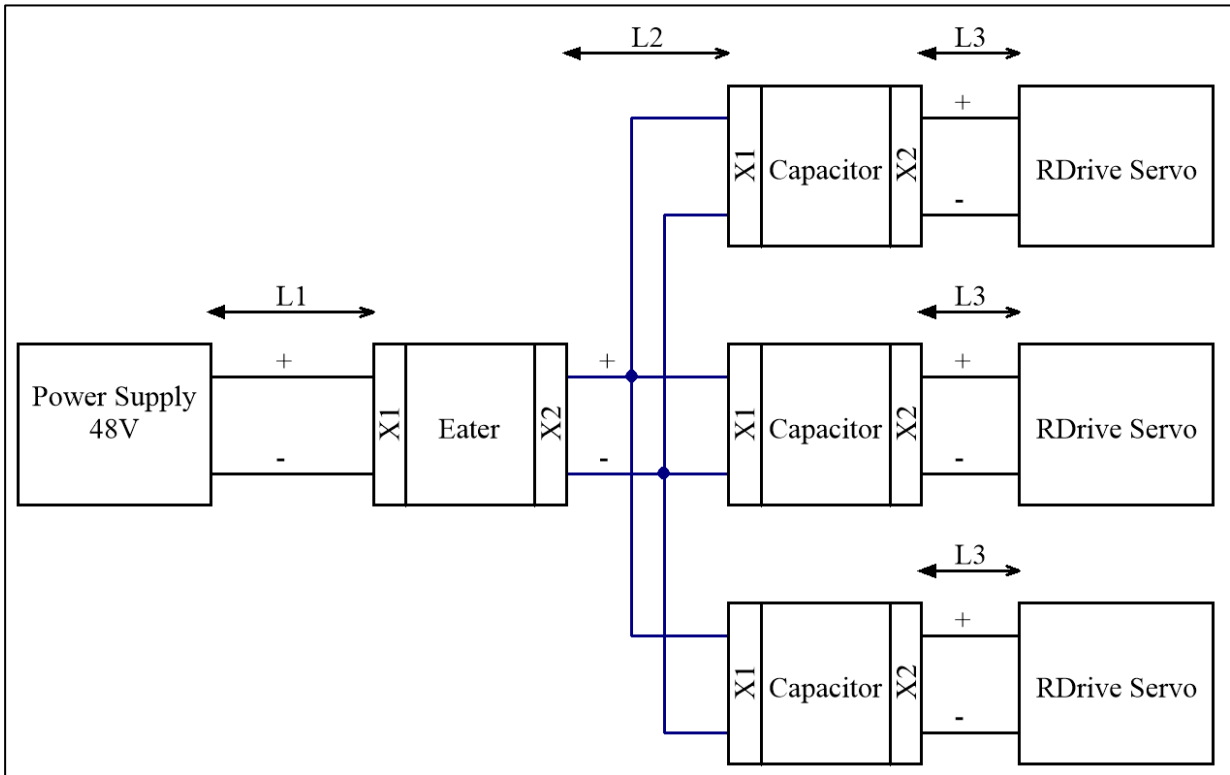
##### 4.2.4.2 Connection diagrams

The connection diagram with an eater and a capacitor included must have either of the following configurations:

- to connect a **single servo**



- to connect **multiple servos**



**Legend:**

X1	Input connector (power source)
X2	Output connector (from the power consumer to the servo)
L1	Wiring segment from the power supply to the eater
L2	Wiring segment from the eater to the capacitor
L3	Wiring segment from the capacitor to any servo

Whichever of the configurations you are using, make sure to meet the following electrical connection requirements:

- The total circuit length from the power supply unit to any servo motor must not exceed 10 meters.
- The L1 length must not be longer than 10 meters.

- When the total connected motor power is **less than 250 W**, the cable cross-section within the segment must be at least 1.00 mm<sup>2</sup>.
- When the total connected motor power is **less than 500 W**, the cable cross-section within the segment must be at least 2.00 mm<sup>2</sup>.
- The L2 length must not exceed the values from **Table 4-2**.
- The L3 length must not exceed the values from **Table 4-2**.

**Table 4-2: Lengths vs. cross-sections of wiring segments for RD 50**

L2						L3							
0.75 mm <sup>2</sup>	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>	4.0 mm <sup>2</sup>	6.0 mm <sup>2</sup>	0.25 mm <sup>2</sup>	0.5 mm <sup>2</sup>	0.75 mm <sup>2</sup>	1.0 mm <sup>2</sup>	1.5 mm <sup>2</sup>	2.5 mm <sup>2</sup>	4.0 mm <sup>2</sup>	6.0 mm <sup>2</sup>
0.8 m	1 m	1 m	2 m	4 m	6 m	-	-	-	-	0.08 m	0.13 m	0.21 m	0.32 m

#### 4.2.5 Pre-commissioning checks

Before commissioning a servo, it is advisable to check whether the following is up to requirements:

- Operating conditions (refer to **Table 1-1** and **Section 1.3**)
- Mechanical integration (refer to **Section 4.2.2**)
- Electrical integration (see **Section 4.2.4**):
  - protective earthing
  - tight connection and integrity of power supply cables
  - at least one energy eater and one capacitor integrated into the supply circuit of the servo (see **Section 1.2.1** and the [Servobox Manual](#))
- CAN connection, tight connection and integrity of communication cables (see **Section 4.2.3**)

As soon as the connections are provided and the checks are completed as appropriate, you can supply power to servo motors and enable motion control.



*Before you proceed to enable motion control and operate a servo connected to a load, it is advisable to perform its test run in accordance with instructions in Section 5. For a testing circuit, you do not have to use capacitors or eaters.*

## 5 ENABLING MOTION CONTROL

You can implement motion control of RDrive servo motors in either of the two ways:

- based on CANOpen communication
- via the Application Programming Interface (API)

### 5.1 Enabling CANOpen-based communication

CANOpen communication implemented for RDrive servos relies on the Controller Area Network (CAN) for its physical infrastructure. CAN is a two-wire bus line that transmits differential signals—CAN<sub>HIGH</sub> and CAN<sub>LOW</sub>.



On a higher level, CANOpen communication for RDrive servos is implemented as a stack of CANOpen protocols. The protocols monitor the network states and transmit and/or read CAN data frames containing various types of data (e.g., commands, parameters, servo telemetry) in the binary format.

To enable control based on CANOpen, connect RDrive servo motors in accordance with **Figure 4-1**. For a detailed description of the CANOpen communication interface implemented for RDrive servos and related application cases (including servo initialization), refer to “[CANOpen Communication Guide](#).”

## 5.2 Enabling control via the API

### 5.2.1 Hardware prerequisites

For enabling motion control of RDrive servos via API, you need the following hardware:

- an electrical connection in accordance with **Section 4.2.4**.
- a CAN-PC connection in accordance with **Section 4.2.3.2**



*Since RDrive servos are supplied with default CAN IDs from 32 to 37, there’s a risk of collision when you connect more than one motor to the same CAN bus. Accordingly, before you proceed to enable control via API, make sure to change the default CAN IDs of connected servos as described in **Section 5.2.3**.*

### 5.2.2 Software prerequisites

Software prerequisites depend on the preferred coding technology and operating system:

#### C

##### Linux OS

- gcc MinGW compiler
- libpthread library
- make package

##### Windows OS

- Cygwin
- gcc MinGW compiler
- libpthread library
- make package

Additionally, for *Windows 8 and earlier versions*, you need a driver to be able to work with the USB-CAN dongle (download [here](#)).

#### Python

##### Linux OS

- Python (latest version, but not older than 3.4)
- PyCharm IDE
- gcc MinGW compiler
- make package

##### Windows OS

- Python (latest version, but not older than 3.4)
  - PyCharm IDE
- Additionally, for *Windows 8 and earlier versions*, you need a driver to be able to work with the USB-CAN dongle (download [here](#)).

Enabling access to servo motors via API is in accordance with the following [GitHub repository](#) instructions.

### 5.2.3 Setting new CAN IDs when connecting multiple servos

Since all RDrive servos are supplied with default CAN IDs ranging from 32 to 37, there is a risk of collision in case you connect more than one servo to the same CAN bus. To avoid collisions, you need to set a unique CAN ID to replace the default one for each of the servos. To do this, follow the instructions below:

1. Take servo 1 and connect it **unloaded** to the CAN bus and the power supply as described in **Section 4.2.3** and **Section 4.2.4** accordingly.
2. Enable API control by completing all the steps from the instructions in the [GitHub repository](#).
3. Run the special tutorials to change the CAN ID
  - **C** — [change\\_servo\\_id.c](#)
  - **Python** — [change\\_servo\\_id.py](#)
4. Remember or write down the new CAN ID and disconnect the servo.
5. Repeat steps 1-4 to change the IDs of the other servos.

## 6 MAINTENANCE

RDrive servo motors contain no parts that users need to service. Therefore, the maintenance scope is limited to the following:

- Visual inspection of electrical connections for damages
- Checking screw connections and tightening the loosened ones
- Monitoring vibration and noise levels, as well as heating during daily operation



*The above-listed maintenance procedures are not mandatory. It is up to the user to decide to follow the recommendations or not, depending on the application-specific conditions (e.g., whether a servo is accessible for visual inspection).*

## 7 TROUBLESHOOTING

**Table 7-1** describes the most common problems that can occur during operation of RDrive servomotors, their possible causes, and recommended user actions.

**Table 7-1: Possible servo problems, their causes, and recommended actions**

Problem	Possible cause	Recommended action
The motor will not start.	Improper connection.	Check the motor connections.
	Incorrect motor control settings.	Check the motor control settings or contact our service department.
The motor is overheating.	Excessive accumulation of dirt.	Clean the outside of the motor.
	Ambient temperature is too high.	Provide adequate cooling.

	Air pressure is too low because of the altitude.	Provide adequate cooling.
	The motor is too hot.	Check the power supply is up to the specifications ( <b>Table 3-1</b> ) or contact our service department.
Increased noise during operation.	Damaged bearing.	Contact our service department.
Sporadic failure.	Damaged cable.	Contact our service department.



*Only qualified service personnel can perform repair works.*

## 8 TRANSPORTATION AND STORAGE

For transporting the RDrive servo motor, always use the original packaging. In case you have no plans to put the servos into operation immediately upon delivery, make sure to meet the following storage requirements:

- Store servo motors in a dry, dust- and vibration-free location.
- The admissible storage temperature range—from + 5°C to + 40°C.
- The storage humidity should be 80% max at 25°C (90% at 20°C).