

User's guide

RD5

RD53

CANopen



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General contents

User's guide.....	1
General contents.....	3
Subject Index.....	7
Typographic and iconographic conventions.....	9
Preliminary information.....	10
1 Safety summary.....	11
1.1 Safety.....	11
1.2 Electrical safety.....	11
1.3 Mechanical safety.....	12
2 Identification.....	13
3 Mounting instructions.....	14
4 Electrical connections.....	17
4.1 Ground connection (Figure 2).....	17
4.2 M12 connectors.....	18
4.3 Dip-Switches and diagnostic LEDs (Figure 3).....	20
4.3.1 Diagnostic LEDs (Figure 3).....	21
4.3.2 Setting the address node: Node ID (Figure 3).....	22
4.3.3 Setting the data transmission rate: Baud rate (Figure 3).....	23
4.3.4 RT bus termination (Figure 3).....	24
5 Quick reference.....	25
6 Functions.....	26
6.1 Working principle.....	26
6.2 Movements: jog and positioning.....	27
6.3 Objects 3120-00 Distance per revolution, 3300-00 Preset and 310F Position Range Limits.....	28
7 CANopen® interface.....	30
7.1 EDS files.....	30
7.2 Operation states.....	31
7.2.1 Initialization.....	31
7.2.2 Pre-operational state.....	32
7.2.3 Operational state.....	32
7.2.4 Stopped state.....	32
7.3 Communication messages.....	33
7.3.1 Generic pre-defined connection set.....	34
7.4 NMT messages.....	34
7.5 Boot-up messages.....	35
7.6 PDO messages.....	35
7.6.1 "RECEIVE PDO1" messages sent by the Master to the Slave.....	36
Control Word.....	36
Jog +.....	36
Jog -.....	36
Stop.....	36
Alarm reset.....	37
Start.....	37
Emergency.....	37
Brake deactivated.....	37
Motor power supply.....	37

Following error.....	38
Trajectory reset.....	38
Axis torque.....	38
Target position.....	38
7.6.2 "TRANSMIT PDO1" messages sent by the Slave to the Master.....	39
Status Word.....	39
Axis in position.....	39
Brake released.....	39
Axis enabled.....	39
SW limit switch +.....	39
SW limit switch -.....	39
Alarm.....	40
Axis running.....	40
Operational state.....	40
Undervoltage.....	40
Following error.....	40
Executing a command.....	40
Target position reached.....	40
Current speed.....	40
Current position.....	41
7.7 SDO messages.....	43
7.7.1 Command.....	43
8 Programming parameters.....	44
8.1 Objects dictionary.....	44
8.1.1 Standard objects (DS 301).....	44
1000-00 Device type.....	44
1001-00 Error register.....	44
1003 Pre-defined Error Field.....	45
1005-00 COB-ID SYNC messages.....	45
1008-00 Device name.....	45
1009-00 Hardware Version.....	45
100A-00 Software Version.....	45
100C-00 Guard Time.....	45
100D-00 Life Time Factor.....	46
1010-01 Save Parameters.....	46
1011-01 Restore Default Parameters.....	46
1014-00 COB-ID EMCY.....	47
1015-00 Inhibit Time Emergency.....	47
1018 Identity Object.....	47
1400 Receive PDO Communication Parameter 1.....	48
1600 Receive PDO Mapping Parameter 1.....	49
1800 Transmit PDO Communication Parameter 1.....	49
1A00 TPDO Mapping Parameter 1.....	51
8.1.2 Manufacturer's specific objects.....	53
3000-00 Baud rate.....	53
3001-00 Node ID.....	53
3108-00 Acceleration.....	54
3109-00 Deceleration.....	54
310C-00 Max Following Error.....	54
310D-00 Position Window.....	54
310E-00 Position Window Time.....	54

310F Position Range Limits.....	55
3111-00 Kp position loop.....	55
3112-00 Ki position loop.....	55
3114-00 Jog Speed.....	55
3115-00 Work Speed.....	56
3116-00 Max Speed.....	56
3118-00 Start torque current time.....	56
3120-00 Distance per revolution.....	56
3300-00 Preset.....	57
3301-00 Offset.....	57
3302-00 Code sequence.....	57
3330-00 Kp current loop.....	58
3331-00 Ki current loop.....	58
3340-00 Max current.....	58
3341-00 Starting torque current.....	58
3410-00 Start Waiting Time.....	58
3005-00 Current value [mA].....	60
3006-00 Temperature value.....	60
3100-00 Control Word.....	60
3101-00 Status word.....	60
3102-00 Demanded position value.....	60
3103-00 Current position value.....	60
3105-00 Current velocity value.....	61
3106-00 Target position.....	61
3107-00 Target speed.....	61
310B-00 Position following error.....	61
3110-00 Cyclic Time.....	61
3200-00 Alarms.....	62
Machine data not valid.....	62
Flash memory error.....	62
Motor power supply bit low.....	62
Following error.....	62
Axis not synchronized.....	62
Target not valid.....	62
Emergency.....	62
Overcurrent.....	63
Overtemperature.....	63
Undervoltage.....	63
CAN Life guard error.....	63
8.2 Warning messages.....	64
8.3 Emergency messages.....	64
No errors.....	64
Generic error.....	64
Power surge.....	64
Overvoltage.....	64
Undervoltage.....	64
Overtemperature.....	64
Flash memory.....	64
Life Guard.....	64
Following error.....	64
8.4 Node guarding protocol.....	65

9	Programming examples.....	66
10	Default parameters list.....	67

Subject Index

1

1000-00 Device type.....	44
1001-00 Error register.....	44
1003 Pre-defined Error Field.....	45
1005-00 COB-ID SYNC messages.....	45
1008-00 Device name.....	45
1009-00 Hardware Version.....	45
100A-00 Software Version.....	45
100C-00 Guard Time.....	45
100D-00 Life Time Factor.....	46
1010-01 Save Parameters.....	46
1011-01 Restore Default Parameters.....	46
1014-00 COB-ID EMCY.....	47
1015-00 Inhibit Time Emergency.....	47
1018 Identity Object.....	47
1400 Receive PDO Communication Parameter 1	48
1600 Receive PDO Mapping Parameter 1.....	49
1800 Transmit PDO Communication Parameter 1	49

1A00 TPDO Mapping Parameter 1.....	51
------------------------------------	----

3

3000-00 Baud rate.....	53
3001-00 Node ID.....	53
3005-00 Current value [mA].....	60
3006-00 Temperature value.....	60
3100-00 Control Word.....	60
3101-00 Status word.....	60
3102-00 Demanded position value.....	60
3103-00 Current position value.....	60
3105-00 Current velocity value.....	61
3106-00 Target position.....	61
3107-00 Target speed.....	61
3108-00 Acceleration.....	54
3109-00 Deceleration.....	54
310B-00 Position following error.....	61
310C-00 Max Following Error.....	54
310D-00 Position Window.....	54
310E-00 Position Window Time.....	54
310F Position Range Limits.....	55
3110-00 Cyclic Time.....	61
3111-00 Kp position loop.....	55
3112-00 Ki position loop.....	55
3114-00 Jog Speed.....	55
3115-00 Work Speed.....	56
3116-00 Max Speed.....	56

3118-00 Start torque current time.....	56
3120-00 Distance per revolution.....	56
3200-00 Alarms.....	62
3300-00 Preset.....	57
3301-00 Offset.....	57
3302-00 Code sequence.....	57
3330-00 Kp current loop.....	58
3331-00 Ki current loop.....	58
3340-00 Max current.....	58
3341-00 Starting torque current.....	58
3410-00 Start Waiting Time.....	58

A

Alarm.....	40
Alarm reset.....	37
Axis enabled.....	39
Axis in position.....	39
Axis not synchronized.....	62
Axis running.....	40
Axis torque.....	38

B

Brake deactivated.....	37
Brake released.....	39

C

CAN Life guard error.....	63
Control Word.....	36
Current position.....	41
Current speed.....	40

E

Emergency.....	37, 62
Executing a command.....	40

F

Flash memory.....	64
Flash memory error.....	62
Following error.....	38, 40, 62, 64

G

Generic error.....	64
--------------------	----

J

Jog -.....	36
Jog +.....	36

L

Life Guard.....	64
-----------------	----

M

Machine data not valid.....	62
Motor power supply.....	37
Motor power supply bit low.....	62

N

No errors.....	64
O	
Operational state.....	40
Overcurrent.....	63
Overtemperature.....	63 e seg.
Overvoltage.....	64
P	
Power surge.....	64
S	
Start.....	37




Status Word.....	39
Stop.....	36
SW limit switch -.....	39
SW limit switch +.....	39
T	
Target not valid.....	62
Target position.....	38
Target position reached.....	40
Trajectory reset.....	38
U	
Undervoltage.....	40, 63 e seg.

Typographic and iconographic conventions

In this guide, to make it easier to understand and read the text the following typographic and iconographic conventions are used:

- parameters and objects both of Lika device and interface are coloured in **ORANGE**;
- alarms are coloured in **RED**;
- states are coloured in **FUCSIA**.

When scrolling through the text some icons can be found on the side of the page: they are expressly designed to highlight the parts of the text which are of great interest and significance for the user. Sometimes they are used to warn against dangers or potential sources of danger arising from the use of the device. You are advised to follow strictly the instructions given in this guide in order to guarantee the safety of the user and ensure the performance of the device. In this guide the following symbols are used:

	This icon, followed by the word WARNING , is meant to highlight the parts of the text where information of great significance for the user can be found: user must pay the greatest attention to them! Instructions must be followed strictly in order to guarantee the safety of the user and a correct use of the device. Failure to heed a warning or comply with instructions could lead to personal injury and/or damage to the unit or other equipment.
	This icon, followed by the word NOTE , is meant to highlight the parts of the text where important notes needful for a correct and reliable use of the device can be found. User must pay attention to them! Failure to comply with instructions could cause the equipment to be set wrongly: hence a faulty and improper working of the device could be the consequence.
	This icon is meant to highlight the parts of the text where suggestions useful for making it easier to set the device and optimize performance and reliability can be found. Sometimes this symbol is followed by the word EXAMPLE when instructions for setting parameters are accompanied by examples to clarify the explanation.

Preliminary information

This guide is designed to provide the most complete information the operator needs to correctly and safely install and operate the **ROTADrive rotary actuators RD5 and RD53 models**.

RD5 and RD53 positioning units are positioning devices which integrate into a single package a brushless motor fitted with gearbox, a drive, a multiturn absolute encoder and a position controller. They can be used in a variety of applications in any industrial sector and are suitable to drive secondary axes such as in mold changers, mobile stops, tools changers, suction cups motion units, conveyor and spindle positioning devices on packaging & woodworking machineries, among others.

An integrated brake differentiates RD53 model from RD5 model. The brake is designed to activate as soon as the motor comes to a stop in order to prevent it from moving even slightly.

The available interfaces for fieldbus communication are: **Modbus RTU, Profibus-DP and CANopen DS 301**.

To make it easier to read the text, this guide can be divided into two main sections.

In the first section general information concerning the safety, the mechanical installation and the electrical connection as well as tips for setting up and running properly and efficiently the unit are provided.

While in the second section, entitled **CANopen Interface**, both general and specific information is given on the CANopen interface. In this section the interface features and the parameters implemented in the unit are fully described.

1 Safety summary



1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- warning ! Do not use in explosive or flammable areas;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic s.r.l. assumes no liability for the customer's failure to comply with these requirements.



1.2 Electrical safety

- Turn OFF power supply before connecting the device;
- connect according to explanation in section "Electrical connections";
- a safety push-button for emergency power off has to be installed to shut off motor power supply in case of emergency situations;
- in compliance with 2004/108/EC norm on electromagnetic compatibility, following precautions must be taken:
 - before handling and installing the equipment, discharge electrical charge from your body and tools which may come in touch with the device;
 - power supply must be stabilized without noise; install EMC filters on device power supply if needed;
 - always use shielded cables (twisted pair cables whenever possible);
 - avoid cables runs longer than necessary;
 - avoid running the signal cable near high voltage power cables;
 - mount the device as far as possible from any capacitive or inductive noise source; shield the device from noise source if needed;
 - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit



- minimize noise by connecting the shield and/or the connector housing and/or the frame to ground. Make sure that ground is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.



1.3 Mechanical safety

- Install the device following strictly the information in the section "Mounting instructions";
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the unit;
- do not tool the unit or its shaft;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics of the product;
- unit with hollow shaft: ROTADrive can be mounted directly onto a shaft whose diameter has to respect the technical characteristics specified in the purchase order and clamped by means of the collar and the hole into which an anti-rotation pin has to be inserted.



WARNING

The unit has been adjusted by performing a no-load mechanical running test; thence default values which have been set refer to an idle device, i.e. running disengaged from the load. Furthermore they are intended to ensure a standard and safe operation which not necessarily results in smooth running and optimum performance. Thus to suit the specific application requirements it may be advisable and even necessary to enter new parameters instead of the factory default settings; in particular it may be necessary to change velocity, acceleration, deceleration and gain values.



WARNING

The counter-electromotive force (back EMF) generated by the motor in case the shaft is forced to rotate due to a manual external force can cause irreparable damages to the internal circuitry.

2 Identification

Device can be identified through the **order code** and the **serial number** printed on the label applied to its body. Information is listed in the delivery document too. Please always quote the order code and the serial number when reaching Lika Electronic s.r.l. for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product [refer to the technical catalogue](#).

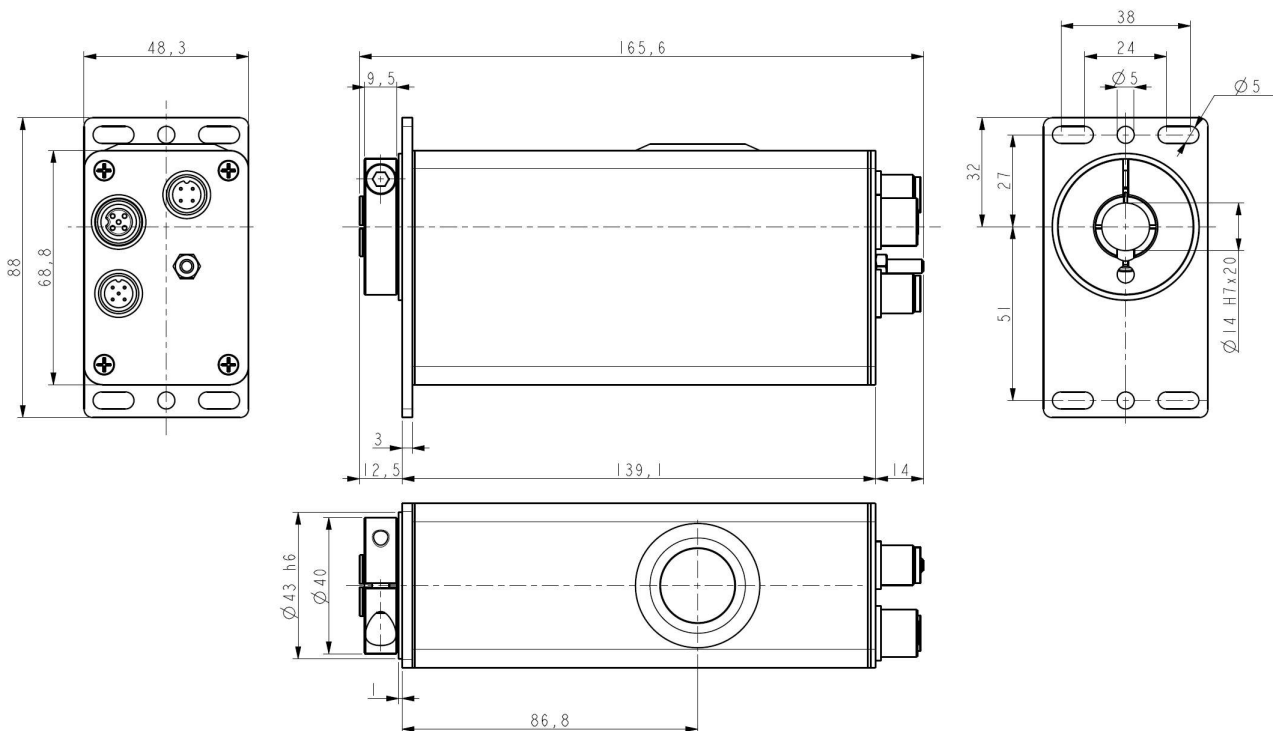


3 Mounting instructions



WARNING

Installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected. Motor and shaft must be in stop.



ROTADrive unit must be secured firmly only to the user's shaft using the provided collar. ROTADrive unit is supplied with a screw insulation and an anti-rotation pin; the anti-rotation pin (TE M4 screw) has to be inserted into the screw insulation. This will provide to the unit both stability and the mobility needed to absorb the mechanical tensions produced during operation. Do not fasten firmly the anti-rotation pin to the motor flange or the fixed support on user's side without using the screw insulation! If this occurs, the mechanical tensions would be transmitted completely to the motor shaft and this would lead to bearings damages and mechanical breakdowns!

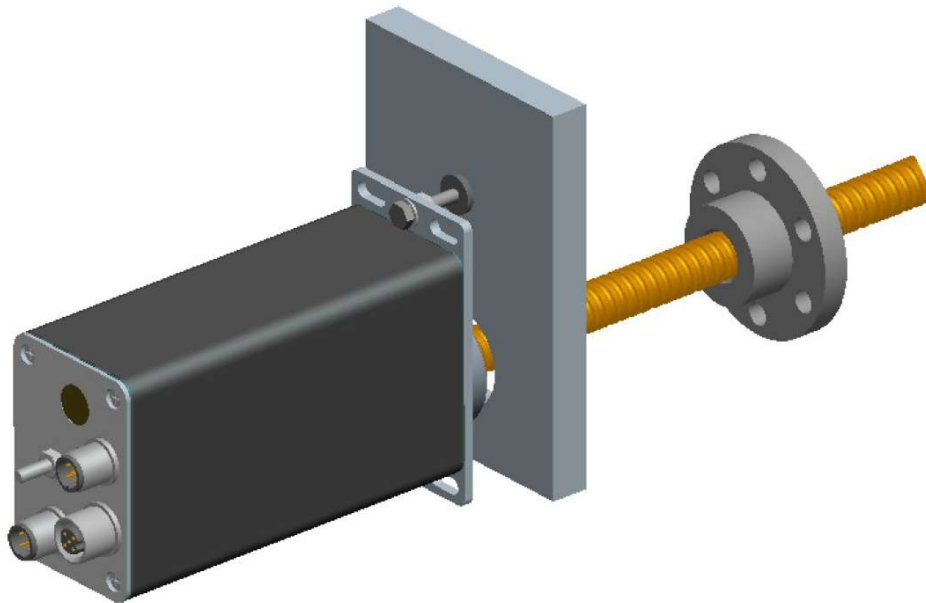
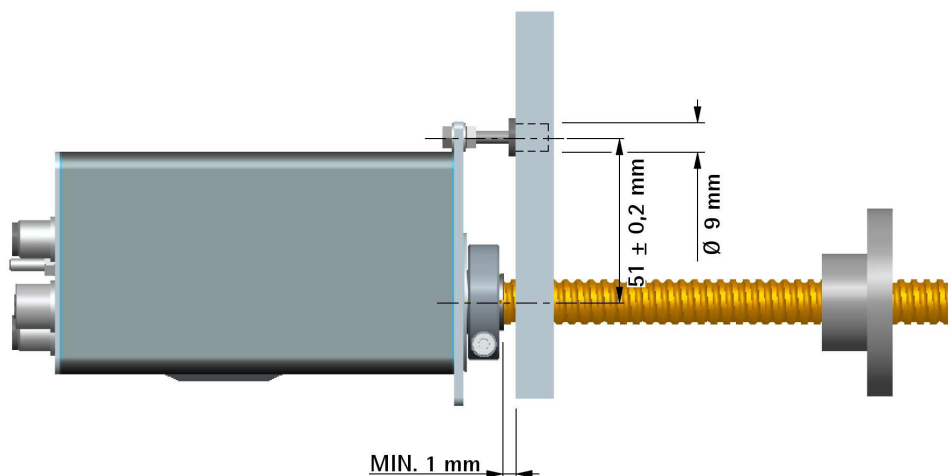


Figure 1 - Typical installation example of RD5-53 unit on worm screw

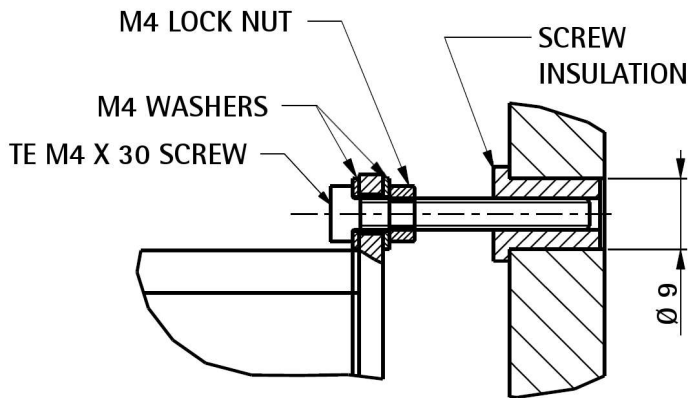
To install properly the ROTADRIIVE unit please read carefully and follow these instructions; anyway note that the unit can be installed in several manners and according to the specific user's application.

- Drill a 9 mm diameter hole in the motor flange or in the fixed support on user's side in order to insert the screw insulation and the anti-rotation pin. The distance between the axis of the shaft and the axis of the hole must be $51 \pm 0,2$ mm.





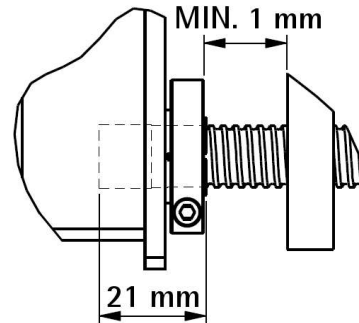
Make sure that the hole and the shaft are perfectly aligned on the vertical axis. If installation is not carried out properly, mechanical tensions would be produced on the motor shaft and this would lead to bearings damages and mechanical breakdowns!



- insert the screw insulation in the hole;
- insert the TE M4 x 30 screw and the two M4 washers in the middle hole designed in the flange of the ROTADrive unit; partially screw the M4

lock nut;

- insert the user's shaft in the hollow shaft of the ROTADrive unit; the maximum depth of the ROTADrive shaft is 21 mm; ascertain that the anti-rotation pin is inserted properly in the screw insulation; secure the user's shaft through the collar and the relevant fixing screw; the minimum distance between the collar and the fixed support on user's side must be not less than 1 mm in order to prevent the fixed parts from coming into contact;
- tighten the anti-rotation pin on the screw insulation;
- tighten the M4 lock nut in order to secure the anti-rotation pin to the flange of the ROTADrive unit.



WARNING

Never force manually the rotation of the shaft not to cause permanent damages! The counter-electromotive force (back EMF) generated by the motor in case the shaft is forced to rotate due to a manual external force can cause irreparable damages to the internal circuitry.

4 Electrical connections



WARNING

When you send **Start**, **Jog +** or **Jog -** commands, the unit and the shaft start moving! Make sure there are no risks of personal injury and mechanical damages.

Each **Start** routine has to be checked carefully in advance!

Never force manually the rotation of the shaft not to cause permanent damages!

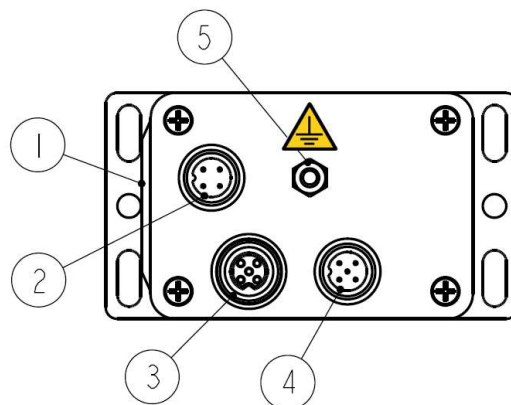


Figure 2: Electrical connections

Legend

1	Internal housing for dip-switches and diagnostic LEDs
2	M12 4-pin male connector for power supply
3	M12 5-pin female connector for BUS OUT
4	M12 5-pin male connector for BUS IN
5	Connection to earthing

4.1 Ground connection (Figure 2)

To minimize noise connect properly the frame to ground; we suggest using the ground screw provided in the frame (see Figure above). Connect properly the cable shield to ground on user's side. Lika's EC- pre-assembled cables are fitted with shield connection to the connector ring nut in order to allow grounding through the body of the device. Lika's E- connectors have a plastic gland, thus grounding is not possible. If metal connectors are used, connect the cable shield properly as recommended by the manufacturer. See also note in the next paragraph. Anyway make sure that ground is not affected by noise. It is recommended to provide the ground connection as close as possible to the device.

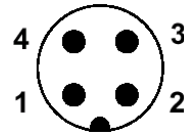
4.2 M12 connectors

Power supply

M12 4-pin male connector

A coding

(frontal side)



Pin	Description
1	+24VDC \pm 10% Motor power supply
2	+24VDC \pm 10% Controller power supply
3	0VDC Power supply
4	n.c.

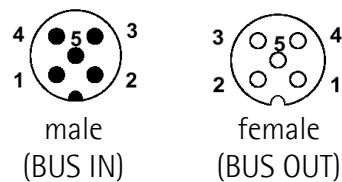
n.c. = not connected

Interface

M12 5-pin connector

A coding

(frontal side)



Pin	Description
1	n.c.
2	n.c.
3	CAN GND ¹
4	CAN High
5	CAN Low
Case	Shielding ²

¹ CAN GND is the 0V reference of CAN signals, it is not connected to 0VDC supply voltage.

² Lika's EC- pre-assembled cables only.

n.c. = not connected

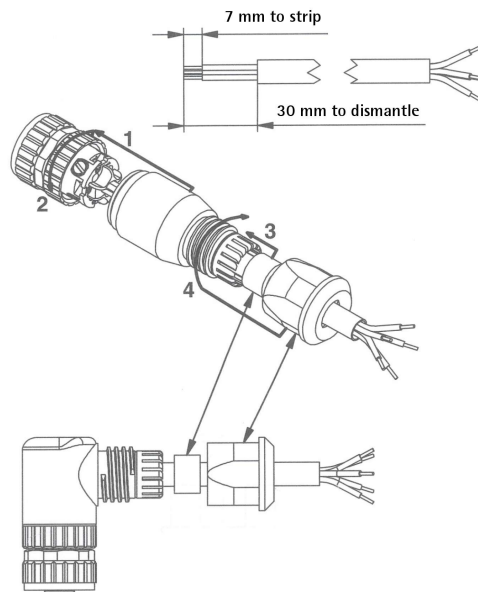
We recommend CANopen certified cables to be used.



NOTE

We suggest always connecting the cable shield to ground on user's side.

Lika's EC- pre-assembled cables are fitted with shield connection to the connector ring nut in order to allow grounding through the body of the device. Lika's E- connectors have a plastic gland, thus grounding is not possible (see Figure below). If metal connectors are used, connect the cable shield properly as recommended by the manufacturer.



4.3 Dip-Switches and diagnostic LEDs (Figure 3)



WARNING

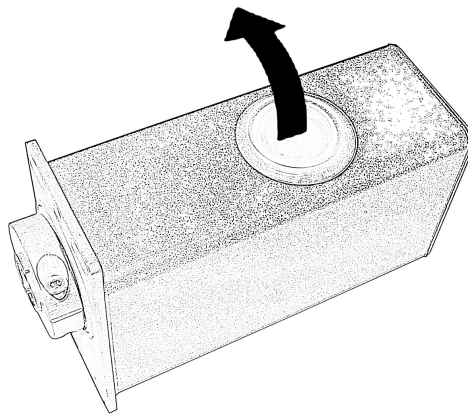
Power supply must be turned off before performing this operation!



NOTE

When performing this operation be careful not to damage the connection wires.

To access the DIP-Switches and the diagnostic LEDs remove the plastic cover fitted on one side of the device.



The DIP-switches and the diagnostic LEDs are located just beneath.

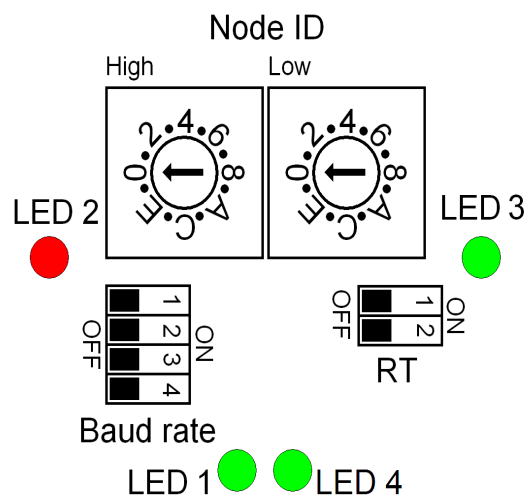


Figure 3: Dip-Switches and diagnostic LEDs

4.3.1 Diagnostic LEDs (Figure 3)

Four LEDs located in the inside of the device next to the provided switches and accessible by removing the plastic cover fitted on one side of the housing (see the previous page) are designed to show visually the operating or fault status of the CANopen interface and the unit as well. The meaning of each led is explained in the following table:

LED 1 GREEN	Description
ON	Indicates the power supply of the controller is turned on
OFF	Indicates the power supply of the controller is turned off
LED 2 RED ERR	Description
ON	Bus off
Double flash	Node guarding error (see on page 65)
Single flash	Maximum number of warning errors/faults
Blinking led	Generic error/fault or Flash memory error
OFF	No error
LED 3 GREEN RUN	Description
ON	Device in Operational state
Single flash	Device in Stopped state
Blinking led	Device in Pre-Operational state
LED 4 GREEN	Description
ON	Indicates the motor is enabled (control loop activated)
OFF	Indicates the motor is disabled (control loop deactivated)

During initialisation, system checks the diagnostic LEDs for proper operation; therefore they blink for a while.

4.3.2 Setting the address node: Node ID (Figure 3)



WARNING

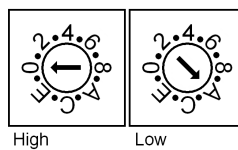
Power supply must be turned off before performing this operation!

Set the node address expressed in hexadecimal notation.
The range of node addresses is between 1 and 127 (127 = 7F hex).

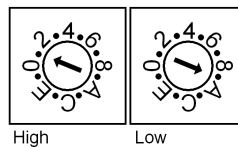


Example

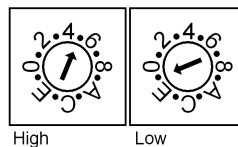
Address 10 = 0A hex:



Address 25 = 19 hex:



Address 95 = 5F hex:



NOTE

The default address is 1.

If you set an address higher than 127, device will be set to 127 automatically.



WARNING

If you set the node address to 0, at power up:

- the brake is disengaged automatically (RD53 model only);
- the program stops before starting the initialization process (the boot-up message is not sent, thus the CAN network cannot be managed).

4.3.3 Setting the data transmission rate: Baud rate (Figure 3)



WARNING

Power supply must be turned off before performing this operation!

Set the binary value of the transmission rate according to the following table considering that: ON = 1, OFF = 0.

Available baud rate values:

Switches 1... 4	Baud rate
0000	20 Kbit/s
1000	50 Kbit/s
0100	100 Kbit/s
1100	125 Kbit/s
0010	250 Kbit/s
1010 (default)	500 Kbit/s
0110	800 Kbit/s
1110	1000 Kbit/s



Example

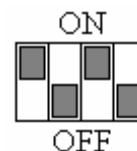
Set the baud rate to 250 Kbit/s:

Switches	1	2	3	4
Position	OFF	OFF	ON	OFF
Value	0	0	1	0



Set the baud rate to 500 Kbit/s:

Switches	1	2	3	4
Position	ON	OFF	ON	OFF
Value	1	0	1	0



4.3.4 RT bus termination (Figure 3)

A bus termination resistor is provided and has to be activated as line termination in the last device of the transmission line.

Use RT Switch to activate or deactivate the bus termination.

RT	Description
1 = 2 = ON	Activated: when the device is at the end of the transmission line
1 = 2 = OFF	Deactivated: when the device is not at the end of the transmission line

5 Quick reference

Following instructions are given to allow the operator to set up the device for standard operation in a quick and safe mode.

- Mechanically install the device;
- execute electrical connections;
- if required, set data transmission rate (baud rate; see on page 23);
- if required, set the node address (see on page 22);
- switch +24VDC power supply on (both motor and controller);
- set a proper value in **3120-00 Distance per revolution** (object 3120h; see on page 56);
- set a proper value in **3300-00 Preset** (object 3300h; see on page 57);
- set proper values in **310F Position Range Limits** (objects **310F Position Range Limits** sub 1 **Limit switch Pos** and **310F Position Range Limits** sub 2 **Limit switch Neg**; see page 28);
- save the new setting values (object **1010-01 Save Parameters** 1010h sub 1; see on page 46).



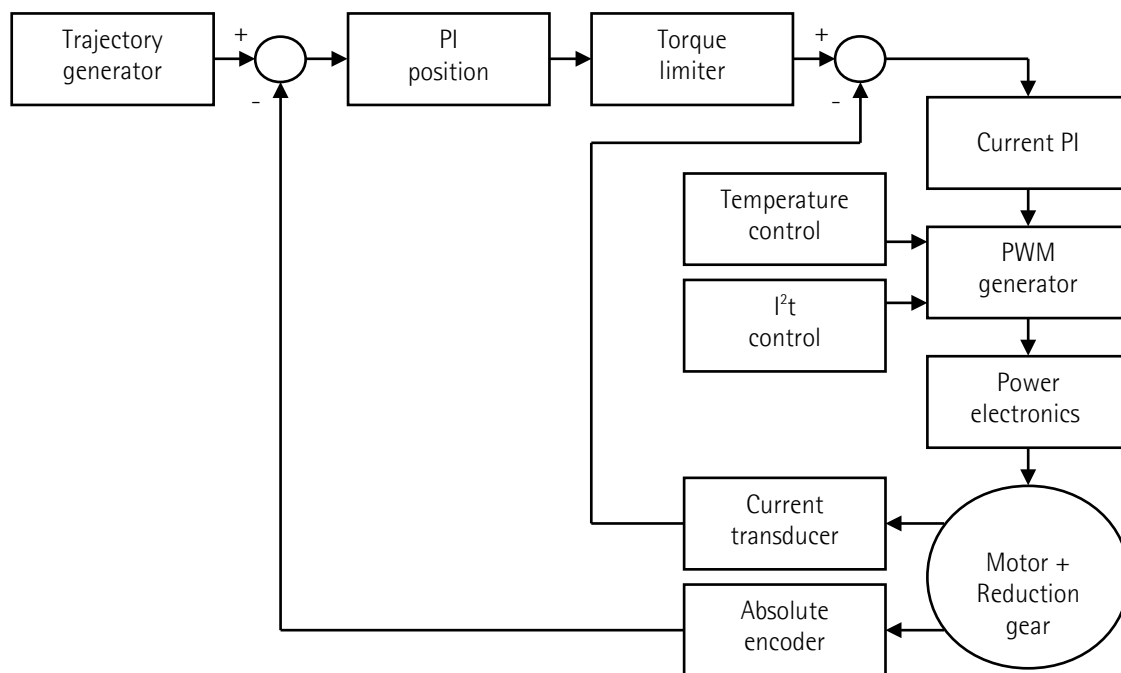
NOTE

Parameters **3120-00 Distance per revolution**, **3300-00 Preset**, **310F Position Range Limits** sub 1 **Limit switch Pos** and **310F Position Range Limits** sub 2 **Limit switch Neg** are closely related, hence you have to be very attentive when you need to change the value in one of them. For any further information please refer to page 28.

6 Functions

6.1 Working principle

The following scheme is intended to show schematically the working principle of system control logic.



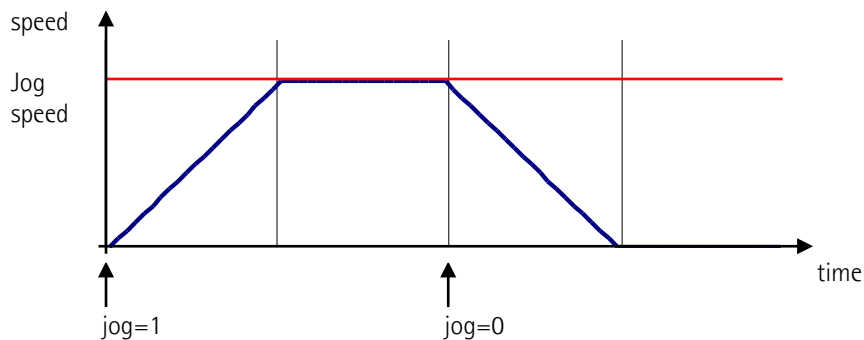
6.2 Movements: jog and positioning

Two kinds of movement are available in the ROTADRIVE positioning unit, they are:

- Jog: speed control;
- Positioning: position and speed control.

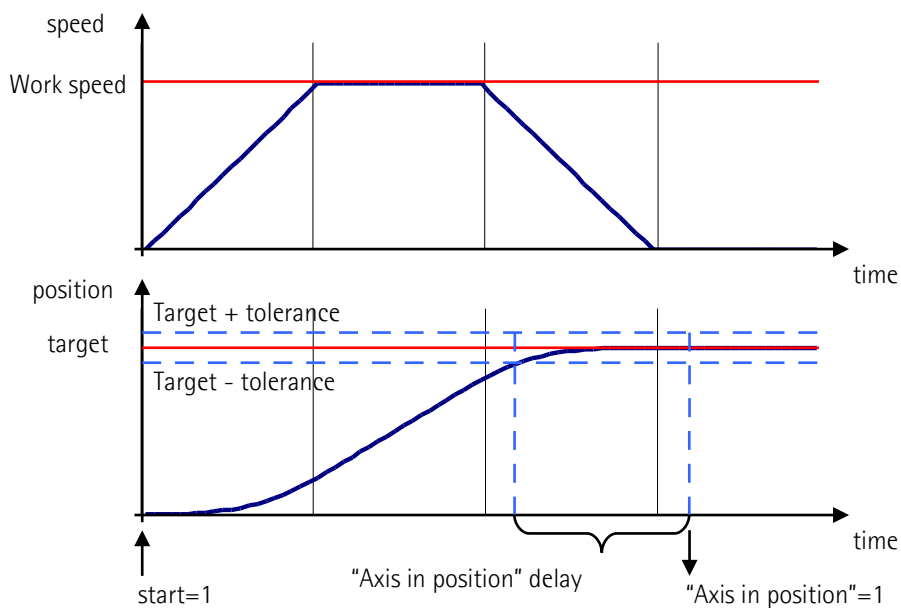
Jog: speed control

This kind of control is intended to generate a speed trajectory which is able to make the maximum rotation speed of the ROTADRIVE unit shaft to be equal to the value set in **3114-00 Jog Speed**.



Positioning: position and speed control

This kind of control is a point-to-point movement and the maximum reachable speed is equal to the value set in **3115-00 Work Speed**; set speed can be reached only if space is long enough.



6.3 Objects **3120-00 Distance per revolution**, **3300-00 Preset** and **310F Position Range Limits**

Objects **3120-00 Distance per revolution**, **3300-00 Preset** and **310F Position Range Limits** are closely related, hence you have to be very attentive every time you need to change the value in any of them.

Should that be necessary, you have to operate in compliance with the following procedure:

- set a proper value next to the **3120-00 Distance per revolution** item (object 3120h, see on page 56);
- set a proper value next to the **3300-00 Preset** item (object 3300h, see on page 57);
- set proper values next to the **310F Position Range Limits** items (objects 310Fh sub 1 and sub 2, see on page 55);
- save new values (object **1010-01 Save Parameters** 1010h sub 1, see on page 46).



WARNING

Each time you change the value in **3120-00 Distance per revolution** you must then set a new value also in **3300-00 Preset** in order to define the zero of the shaft as the system reference has now changed.

After having changed the parameter in **3300-00 Preset** it is then compulsory to set new values also in **310F Position Range Limits** as maximum and minimum limits have now changed; in this way you can ensure that the maximum stroke on the right of Preset value is exactly the same as the maximum stroke on the left of Preset value: so you have always the maximum number of revolutions considering the buffer centred in **3300-00 Preset** value. The number of revolutions managed by the system is 127 in negative direction and 127 in positive direction assuming **3300-00 Preset** as reference.



Example 1

Default values:

3120-00 Distance per revolution = 1024 steps per revolution

3300-00 Preset = 0

Limit switch Pos max. value = 130047 (1024 steps per revolution x 127 revolutions when **3300-00 Preset** value = 0)

Limit switch Neg min. value = -130047 (1024 steps per revolution x 127 revolutions when **3300-00 Preset** value = 0)



Example 2

ROTADrive positioning unit is joined to a worm screw having a 5 mm pitch and you need to have a hundredth of a millimetre resolution.

3120-00 Distance per revolution = 500 steps per revolution

3300-00 Preset = 0

Limit switch Pos max. value = $500 \times 127 = 63499$

Limit switch Neg min. value = $-(500 \times 127) = -63499$



Example 3

ROTADrive positioning unit is joined to a worm screw having a 1 mm pitch and you need to have a hundredth of a millimetre resolution.

3120-00 Distance per revolution = 100 steps per revolution

3300-00 Preset = -500 (ex. thickness of the tool)

310F Position Range Limits Limit switch Pos max. value = $(100 \times 127) - 500 = 12199$

310F Position Range Limits Limit switch Neg min. value = $-(100 \times 127) - 500 = -13199$

7 CANopen® interface

Lika ROTADRIIVE positioning units are Slave devices and are designed in compliance with the "Application Layer and Communication Profile DS301". For any further information or omitted specifications please refer to "CiA Draft Standard 301" document available at www.can-cia.org.

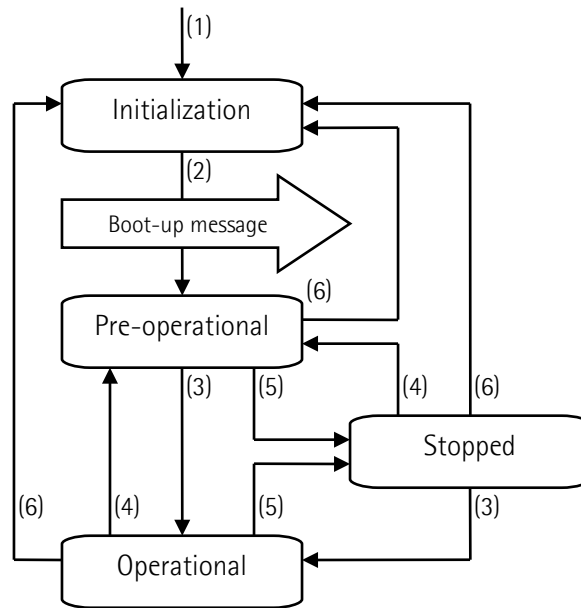
7.1 EDS files

CANopen® devices are supplied with their own EDS file **RDx_E14.EDS**, it can be downloaded from **www.lika.biz > PRODUCTS > ROTARY ACTUATORS > POSITIONING UNITS**). EDS file has to be installed on CANopen® Master device. Install **RD5_CB_Vx.eds** file for RD5 devices (Vx is the EDS file version). Install **RD53_CB_Vx.eds** file for RD53 devices (Vx is the EDS file version).

EDS files are available in both English version (_en) and Italian version (_it).

7.2 Operation states

CANopen® devices are designed to operate using different states. Transition from one state to another is achieved by sending specific NMT messages (see Figure below).



(1)	Power turned on
(2)	Initialization carried out, boot-up message is sent automatically
(3)	NMT message: Start remote node
(4)	NMT message: Enter pre-operational
(5)	NMT message: Stop remote node
(6)	NMT message: Reset node or Reset communication

7.2.1 Initialization

This is the first state the CANopen® device enters after power is turned on or after performing a hardware reset by means of a **Reset node** command. During initialization, device reads and loads the parameters saved on EPROM. As soon as the basic CANopen® device initialization is carried out, device sends a boot-up message and then switches automatically to **Pre-operational** state.

7.2.2 Pre-operational state

In this state communication between Master and Slave is possible using SDO messages. They allow working parameters to be set. Slave cannot send PDO messages.

To switch Slave device to **Operational** state Master must send a **Start remote node** command using a NMT message.

7.2.3 Operational state

In this state Slave device is active and all communication objects are available. Slave device can use the parameters available in the "Object dictionary" and is allowed to send process data using PDO messages. "Object dictionary" can be accessed using SDO messages. To switch Slave device to **Pre-operational** state Master must send an **Enter pre-operational** command using a NMT message.



WARNING

For safety reasons, in **Operational** state Master must check Slave device continuously and in a proper way. For a description of the correct procedure see section "7.6 PDO messages".

7.2.4 Stopped state

In this state the Slave device is forced to interrupt communication with the Master altogether (except node guarding, if active).

Communication using PDO and SDO messages is not allowed.

To switch Slave device to **Pre-Operational** or **Operational** state Master must send the specific commands **Enter pre-operational** or **Start remote node** using a NMT message.

7.3 Communication messages

Four different kinds of communication messages are used in a CANopen® network:

- **Network management NMT** service: through node control services, the NMT Master controls the NMT state of the NMT Slaves; see "7.4 NMT messages" section on page 34.
- **Process Data Object PDO** service: the real-time data transfer is performed by means of "Process Data Objects (PDO)". The PDOs correspond to entries in the "Object Dictionary" and provide the interface to the application objects; see "7.6 PDO messages" section on page 35.
- **Service Data Object SDO** service: SDOs used to provide direct access to entries of a CANopen® device "Object dictionary" (page 44); they allow to read and set parameters; see "7.7 SDO messages" section on page 43.
- **Special Function Object** services:
 - SYNC: synchronization object provides the basic network synchronization mechanism and is used by the Master to enable the Slave devices to transmit process data (position and velocity; see on page 45);
 - Emergency EMCY: emergency objects are triggered by the occurrence of a CANopen® device internal error situation, see on page 64;
 - Node guarding protocol: it is used to detect remote errors in the network, see page 65.

Relation between device states and communication objects:

	Initialization	Pre-operat.	Operational	Stopped
NMT		X	X	X
PDO			X	
SDO		X	X	
SYNC			X	
EMCY		X	X	
Boot-up	X			
Nodeguard		X	X	X

7.3.1 Generic pre-defined connection set

Broadcast objects of the generic pre-defined connection set		
Type of COB (Object)	Function code (binary)	COB-ID (hex)
NMT	0000	000
SYNC	0001	080

Peer-to-peer objects of the generic pre-defined connection set		
EMERGENCY	0001	081 - 0FF
PDO 1 (tx)	0011	181 - 1FF
PDO 1 (rx)	0100	200 - 27F
SDO (tx)	1011	581 - 5FF
SDO (rx)	1100	601 - 67F
Nodeguard	1110	701 - 77F
Boot-up	1110	701 - 77F

The type of COB (tx means COB-ID sent; rx means COB-ID received) is viewed from Slave device.

7.4 NMT messages

Structure of NMT messages:

COB-ID (11 bit)		2 CAN Data Bytes	
Func.code	Node ID	Command	Slave ID
0000	0	NMT function	Slave ID

If Slave ID = 00h, the NMT message is issued to all network nodes.

Command	NMT service	Node state
01 hex	Start remote node	Operational
02 hex	Stop remote node	Stopped
80 hex	Enter pre-operational	Pre-operational
81 hex	Reset node	Pre-operational
82 hex	Reset communication	Pre-operational

7.5 Boot-up messages

Structure of Boot-up messages:

COB-ID(hex)	1 CAN Data Byte
700+Node ID	00

7.6 PDO messages



WARNING

For safety reasons, when ROTADrive unit is on a continuous data exchange between the Master and the Slave has to be planned in order to be sure that the communication is always active; this is intended to prevent danger situations from arising in case of failures in the communication network.

For monitoring the communication state in the network, among the possible methods the Node guarding protocol can be implemented (complying with DS301 specifications, see on page 65).

ROTADrive positioning unit sends PDO messages to Master according to the set cyclic or synchronous work mode (see object 1800h: **1800 Transmit PDO Communication Parameter 1**).



PDO messages are always made up of 8 CAN Data Bytes. Please note that the structure of sent messages and received messages is different anyway.

Structure of **RECEIVE PDO1** messages received by the Slave device (sent by the Master):

IDENTIFIER		8 CAN data byte							
COB-ID(hex)		0	1	2	3	4	5	6	7
F.C.	Node-ID	Control Word				Target position			
200+ Node ID		Low	...	...	High	Low	...	...	High

Structure of **TRANSMIT PDO1** messages sent by the Slave device (received by the Master):

IDENTIFIER		8 CAN data byte							
COB-ID(hex)		0	1	2	3	4	5	6	7
F.C.	Node-ID	Status Word		Current speed		Current position			
180+ Node ID		Low	High	Low	High	Low	...	...	High

Structure of bytes:

bit	7	6	5	4	3	2	1	0
	M.S.bit							L.S.bit

7.6.1 "RECEIVE PDO1" messages sent by the Master to the Slave

Control Word

Index 0x3100-00. 32 bits. It contains the commands to be sent in real time to the Slave in order to manage it. See also **3100-00 Control Word** on page 60.

Byte 0

Jog +

bit 0:

As long as **Jog +** = 1 the Slave moves toward positive direction; velocity, acceleration and deceleration are set in objects **3114-00 Jog Speed**, **3108-00 Acceleration** and **3109-00 Deceleration** respectively. For a detailed description of jog control see on page 27.

Jog -

bit 1:

As long as **Jog -** = 1 the Slave moves toward negative direction; velocity, acceleration and deceleration are set in objects **3114-00 Jog Speed**, **3108-00 Acceleration** and **3109-00 Deceleration** respectively. For a detailed description of jog control see on page 27.

Stop

bit 2:

If set to "1" the Slave is allowed to execute the movements as commanded. If, while the unit is running, this bit switches to "0" then Slave must stop executing the deceleration procedure set in **3109-00 Deceleration**. For an immediate halt in the movement, use bit 7 **Emergency**.

Alarm reset

bit 3:

Setting this bit to "1" causes the normal work status of the device to be restored. This command is used to reset an alarm condition of the Slave but only if the faulty condition has ceased. Using SDO messages you can read further information about the alarm in the index **1003 Pre-defined Error Field**.

Please note that should the alarm be caused by wrong object values (**Machine data not valid**) normal work status can be restored only after having set proper values. **Flash memory error** alarm cannot be reset.



bits 4 and 5:

Not used.

Start

bit 6:

If set to "1" device moves in order to reach the set target position. For a complete description of the position control see on page 26. For any information on target position see **Target position** on page 38.

Emergency

bit 7:

This bit has to be normally high ("=1"), otherwise it will cause the device to stop immediately. For a normal halt (not immediate) which respects the set deceleration see above bit 2 **Stop**.

Byte 1

Brake deactivated

bit 8:

This function is available only for RD53 version (model fitted with brake); in the RD5 version (model without brake) bit 8 is not used. RD53 model is fitted with a brake designed to activate as soon as the motor comes to a stop in order to prevent it from moving even slightly. Setting this bit to "1" causes the brake to be disabled; setting this bit to "0" causes the brake to be enabled and managed automatically by the system.

Motor power supply

bit 9:

If set to "0" the supply voltage of the motor is not monitored and the use of **Jog +**, **Jog -**, **Start** and **Brake deactivated** commands causes the **Motor power supply bit low** alarm to be triggered (bit 2 object **3200-00 Alarms**).

If set to "1" the supply voltage of the motor is monitored and **Jog +**, **Jog -**, **Start** and **Brake deactivated** commands are allowed.

Following error

bit 10: If set to "0" **Following error** alarm is disabled.
If set to "1" **Following error** alarm is enabled; threshold is set in the object **310C-00 Max Following Error**.

Trajectory reset

bit 11: Do not use this bit in standard applications. This command is meant to re-initialize the trajectory generator. Commanded position keeps the value of the real position. Reset is done by setting this bit to "1" first and then to "0".

Axis torque

bit 12: When the axis has reached the commanded position, it keeps the torque. This function not available for jogs. This function is available only for RD5 version (model without brake); in the RD53 version (model fitted with brake) bit 12 is not used.
If set to "0", when axis is in position, PWM is deactivated.
If set to "1", when axis is in position, PWM is kept active.

bits 13 ... 15: Not used

Bytes 2 and 3 Not used

Bytes 4 ... 7

Target position

Position to be reached, otherwise referred to as commanded position. When the **Start** command is sent while **Stop** and **Emergency** bits are "1" and the alarm condition is off, device moves in order to reach the target position.



Override function

It is possible to change the target position while the device is reaching it; to do this, send a **Start** command and the new target value in **Target position**.



NOTE

Jog +, **Jog -** and **Start** functions cannot be enabled simultaneously. For instance: if a **Jog +** command is sent to Slave while it is moving to target position, jog command will be ignored; if **Jog +** and **Jog -** commands are sent simultaneously, device does not move or, if already moving, stops its movement.

7.6.2 "TRANSMIT PDO1" messages sent by the Slave to the Master

Status Word

Index 0x3101-00. 16 bits. In these bytes the status of the PI controller in **Operational** work mode is shown. See also **3101-00 Status word** on page 60.

Byte 0

Axis in position

bit 0:

If value is "=1" device has reached the set position for the time set in **310E-00 Position Window Time**. It is kept active until the position error is lower than **310D-00 Position Window**.

Brake released

bit 1:

This function is available only for RD53 version (model fitted with brake); in the RD5 version (model without brake) bit 1 is not used. RD53 model is fitted with a brake designed to activate as soon as the motor comes to a stop in order to prevent it from moving even slightly. This is intended to give information about the state of the brake.

If value is "=0" brake is active.

If value is "=1" brake is not active.

For any further information see command **Brake deactivated** on page 37.

Axis enabled

bit 2:

It shows the enabling status of the motor. This bit is "=1" when the motor is enabled, that is: PWM is active and the axis is under closed-loop control (while reaching a target position or using a jog, for instance). It is "=0" when the motor is disabled, that is when the controller is off after a positioning or jog movement or because of an alarm condition.

SW limit switch +

bit 3:

If value is "=1" device has reached the maximum positive limit (positive limit switch). See object **310F Position Range Limits** sub 1 **Limit switch Pos**.

SW limit switch -

bit 4:

If value is "=1" device has reached the maximum negative limit (negative limit switch). See object **310F Position Range Limits** sub 2 **Limit switch Neg**.

Alarm

bit 5: If value is "1" an alarm has occurred, see details at indexes **1003 Pre-defined Error Field** and **3200-00 Alarms**.

Axis running

bit 6: If value is "0" device is not moving.
If value is "1" device is moving.

Operational state

bit 7: If value is "0" current state is **Stop** or **Pre-operational**.
If value is "1" current state is **Operational**.

Byte 1

Undervoltage

bit 8: If value is "0" motor is supplied properly.
If value is "1" motor is not supplied or voltage is too low.

Following error

bit 9: If value is "0" error is not active.
If value is "1" difference between theoretical position and real position is greater than the value set in parameter **310C-00 Max Following Error**. We suggest reducing the speed.

Executing a command

bit 10: If value is "0" controller is not executing any command.
If value is "1" controller is executing a command.

Target position reached

bit 11: If value is "1" device has reached the target position (see **Target position**). Bit is kept active until new **Target position** or **Alarm reset** commands are sent.

bits 12 ... 15: Not used.

Bytes 2 and 3

Current speed

Speed of the device expressed in pulses per second [PPS], updated at every second.

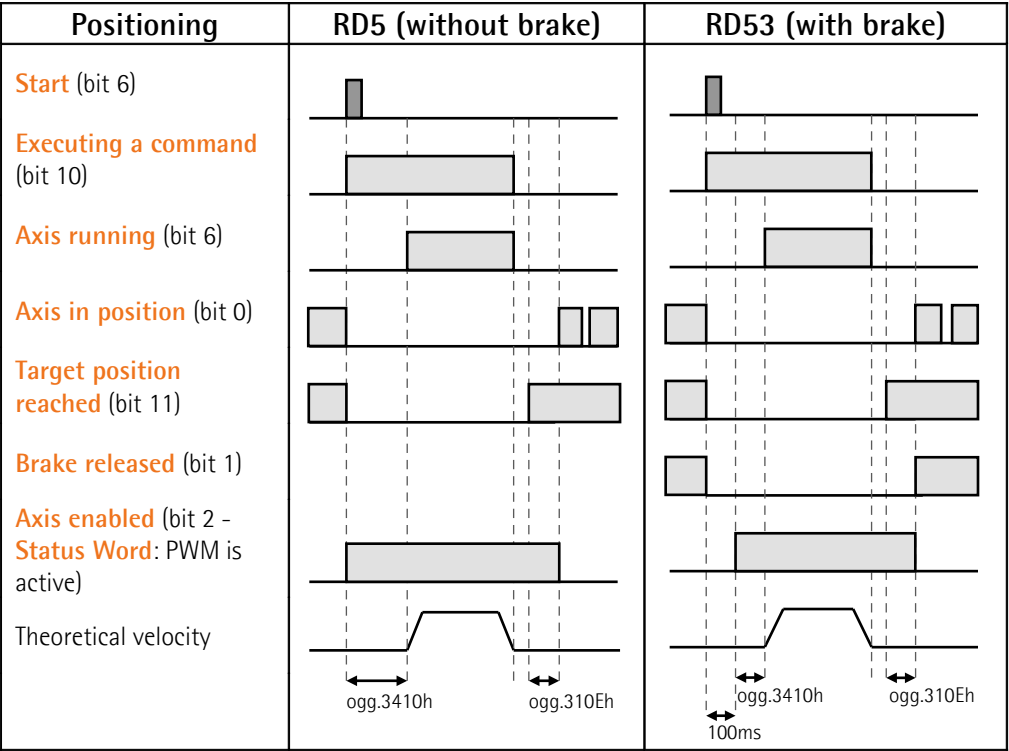
Bytes 4 ... 7

Current position

Absolute position of the device when the PDO message is sent.

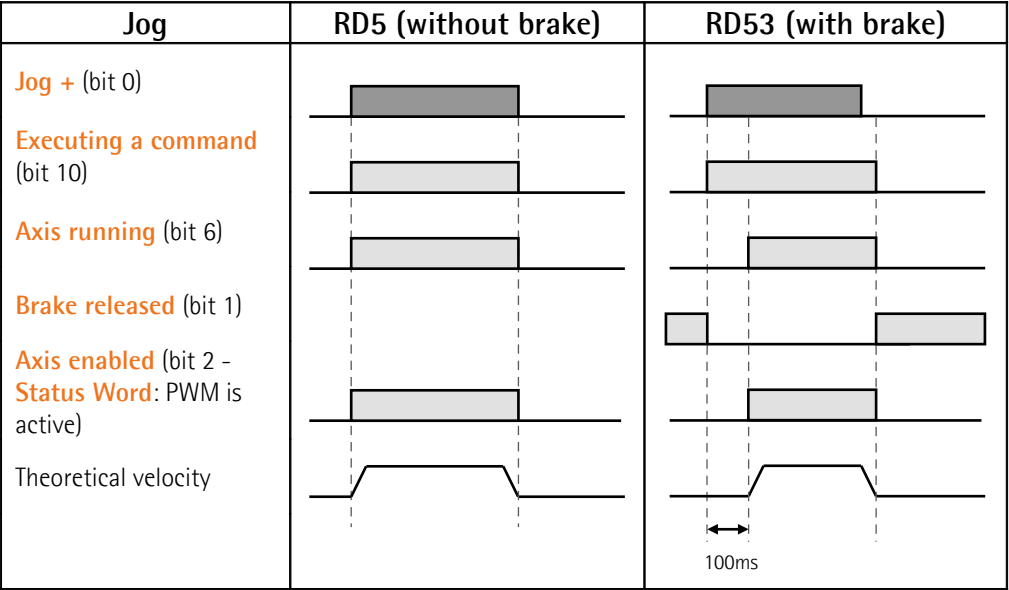


Example 1





Example 2



7.7 SDO messages

SDO messages are used to both set new values and read values from the device. These parameters are described in the "Object dictionary" (see on page 44). 4 bytes at the most are used for CAN data, other 4 bytes are used for Command, Index and Sub-index fields. SDO messages are always followed by confirmation. It follows that when the Master sends a SDO message to the Slave, the Slave always sends a reply (and a warning, should an error occur).

SDO structure:

IDENTIFIER		from 4 to 8 CAN data bytes							
COB-ID(hex)		0	1	2	3	4	5	6	7
F.C.	Node-ID	Com	Index		Sub	Data			
		1 byte	LSB	MSB	1 byte	LSB	...	...	MSB

Com command
Index parameter index
Sub parameter sub-index
Data parameter value (set or read)

7.7.1 Command

Command byte contains the type of COB telegram transmitted to the CAN network.

Three types of telegram are available:

- **Set**: used to send configuration parameters to the Slave;
- **Req**: used by the Master to read data from the Slave;
- **Warnings**: used by the Slave to send error messages to the Master (e.g. "Index does not exist", "Process data value not valid", etc.).

Command	COB	COB type	Data length
22h	Set	M → S request	not specif.
23h	Set	M → S request	4 byte
2Bh	Set	M → S request	2 byte
2Fh	Set	M → S request	1 byte
60h	Set	S → M confirmation	0 byte
40h	Req	M → S request	0 byte
42h	Req	S → M reply	non specified
43h	Req	S → M reply	4 byte
4Bh	Req	S → M reply	2 byte
4Fh	Req	S → M reply	1 byte
41h	Req	S → M reply segmented SDO	
80h	Warning	S → M reply	4 byte

8 Programming parameters

8.1 Objects dictionary

In the following pages the objects implemented are listed and described as follows:

Index-subindex Object name

[data types, attribute]

- Index and subindex are expressed in hexadecimal notation.
- Attribute:
 - ro = read only access
 - rw = read and write access
 - const = ro + constant value

Unsigned16 data type:

Data byte	
byte 4	byte 5
LSByte	MSByte

Unsigned32 data type:

Data byte			
byte 4	byte 5	byte 6	byte 7
LSByte	...	...	MSByte

8.1.1 Standard objects (DS 301)

1000-00 Device type

[Unsigned32, ro]

Default = 0000012Dh

1001-00 Error register

[Unsigned8, ro]

Should an error occur, bit 0 of this object will be set to "1".

Default = 00h

1003 Pre-defined Error Field

This object contains the list of the five previous errors which generated an EMCY emergency message.

- **00** Number of current errors [Unsigned8, rw]
Enter 00h to delete the errors list.
- **01** Last error occurred [Unsigned32, ro]
- **02...05** Previous errors occurred [Unsigned32, ro]

1005-00 COB-ID SYNC messages

[Unsigned32, rw]

Default = 0000 0080h

1008-00 Device name

[String, ro]

It shows the name of the device.

Default = "RD5" or "RD53"

1009-00 Hardware Version

[String, ro]

It shows the hardware version of the device.

100A-00 Software Version

[String, ro]

It shows the software version of the device.

100C-00 Guard Time

[Unsigned16, rw]

It contains the "guard time" value expressed in msec (milliseconds). The NMT Master polls each NMT Slave at regular time intervals issuing RTR messages. This time-interval is called the "node guard time" and may be different for each Slave. For further details see section "8.4 Node guarding protocol" on page 65.

Default = 0

100D-00 Life Time Factor

[Unsigned8, rw]

100C-00 Guard Time and **100D-00 Life Time Factor** objects are used in "Node guarding protocol" controlled by Master. For further details see section "8.4 Node guarding protocol" on page 65.

Default = 0

1010-01 Save Parameters

[Unsigned32, rw]

Use this object to save all parameters on non-volatile memory.

Write **save** (ASCII code in hexadecimal form) in the data bytes:

Master → Slave

COB-ID	Cmd	Index	Sub	Data bytes
600+ID	23	10	10	01 73 61 76 65

Slave → Master (confirmation)

COB-ID	Cmd	Index	Sub	Data bytes
580+ID	60	10	10	01 00 00 00 00

1011-01 Restore Default Parameters

[Unsigned32, rw]

This object allows you to restore all parameters to default values (they are set at the factory by Lika Electronic engineers to allow the operator to run the device for standard operation in a safe mode).

Write **load** (ASCII code in hexadecimal form) in the data bytes and then issue a **Reset node** command:

Master → Slave

COB-ID	Cmd	Index	Sub	Data bytes
600+ID	23	11	10	01 6C 6F 61 64

Slave → Master (confirmation)

COB-ID	Cmd	Index	Sub	Data bytes
580+ID	60	11	10	01 00 00 00 00

Master → Slave (reset node)

COB-ID	Cmd	Slave ID
000	81	ID

Slave → Master (Boot-up)

COB-ID	Cmd
700+ID	00



NOTE

Save default values using **1010-01 Save Parameters** function.

1014-00 COB-ID EMCY

[Unsigned32, rw]

This object defines the COB-ID used to send emergency messages (EMCY).

When the power is turned on, this object always contains the default value.

For a complete list of the emergency messages refer to section "8.3 Emergency messages" on page 64.

Default = 80h+Node ID

1015-00 Inhibit Time Emergency

[Unsigned16, rw]

Inhibit time of emergency messages (EMCY), i.e. minimum interval between subsequent emergency messages expressed in multiples of 100 µs.

Default = 1 (0,1ms)

1018 Identity Object

- **01 Vendor Id** [Unsigned32, ro]
- **02 Product code** [Unsigned32, ro]
- **03 Revision number** [Unsigned32, ro]
- **04 Serial number** [Unsigned32, ro]

1400 Receive PDO Communication Parameter 1

This object contains the communication parameters for the PDOs the device is able to receive (Receive PDOs).

- **01 COB-ID** of PDO1 [Unsigned32, rw]

Bit number	Value	Meaning
31 (MSB)	0	PDO exists / is valid
	1	PDO does not exist / is not valid
30	0	RTR allowed on this PDO (not implemented)
	1	no RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28 ... 11	0	if bit 29 = 0
	X	if bit 29 = 1: bits 28-11 of 29-bit-COB-ID
10 ... 0 (LSB)	X	bits 10-0 of COB-ID

Default = 4000 0200h+Node ID (no RTR, COB-ID)



WARNING

It is mandatory to set the bit 30 of COB-ID to 1 (value 0 is not allowed). This means that "No RTR is allowed on the PDO".

At power on, this object always contains the default value.

- **02 Transmission Type** [Unsigned8, rw]

Transmission type	PDO transmission	
00h (0)	Acyclic, synchronous	not implemented
01h ... F0h (1 ... 240)	Cyclic, synchronous	implemented
F1h ... FBh (241 ... 251)	not implemented - reserved	
FCh (252)	Synchronous, RTR only	not implemented
FDh (253)	Asynchronous, RTR only	not implemented
FEh (254)	Asynchronous, manufacturer specific	implemented
FFh (255)	Asynchronous, device profile specific	not implemented

Default = FEh (event-driven, asynchronous, manufacturer specific)



WARNING

Following an attempt to set the **Transmission Type** to 0, the PDO message is not sent; following an attempt to change the **Transmission Type** to any other value that is not supported by the device, an abort message (abort code = 0609 0030h: **Value range of parameter exceeded**) is generated.



NOTE

- Before altering the value of **COB-ID** it is compulsory to deactivate the receipt of PDO1, then enter the new COB-ID value, finally activate again the receipt of PDO1.
- PDO1 receipt can be activated (deactivated) by setting to "0" ("1") the most significant bit of the object **1400 Receive PDO Communication Parameter 1** sub 1 **COB-ID**.

1600 Receive PDO Mapping Parameter 1

This object indicates the kind of parameter contained in the Receive PDO message.

- **01 3100-00 Control Word** [Unsigned32, ro] Default = 3100 0020h.
- **02 3106-00 Target position** [Unsigned32, ro] Default = 3106 0020h.

1800 Transmit PDO Communication Parameter 1

These objects contain the communication parameters of Transmit PDO.

- **01 COB-ID** of PDO1 [Unsigned32, rw]

Bit number	Value	Meaning
31 (MSB)	0	PDO exists / is valid
	1	PDO does not exist / is not valid
30	0	RTR allowed on this PDO (not implemented)
	1	no RTR allowed on this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28 ... 11	0	if bit 29 = 0
	X	if bit 29 = 1: bits 28-11 of 29-bit-COB-ID
10 ... 0 (LSB)	X	bits 10-0 of COB-ID

Default = 4000 0180h+Node ID (no RTR, COB-ID)



WARNING

It is mandatory to set the bit 30 of COB-ID to 1 (value 0 is not allowed). This means that "No RTR is allowed on the PDO".

At power on, this object always contains the default value.

- 02 **Transmission Type** [Unsigned8, rw]

Transmission type	PDO transmission	
00h (0)	Acyclic, synchronous	not implemented
01h ... F0h (1 ... 240)	Cyclic, synchronous	implemented
F1h ... FBh (241 ... 251)	not implemented - reserved	
FCh (252)	Synchronous, RTR only	not implemented
FDh (253)	Asynchronous, RTR only	not implemented
FEh (254)	Asynchronous, manufacturer specific	implemented
FFh (255)	Asynchronous, device profile specific	not implemented

Default = FEh ("status, position, velocity exchange" transmission or cyclic transmission, see hereafter and object **3110-00 Cyclic Time**)



WARNING

Following an attempt to set the **Transmission Type** to 0, the PDO message is not sent; following an attempt to change the **Transmission Type** to any other value that is not supported by the device, an abort message (abort code = 0609 0030h: **Value range of parameter exceeded**) is generated.

If the value next to the object **3110-00 Cyclic Time** $\neq 0$, the PDO message is sent cyclically and the interval between two messages is the time set next to the object **3110-00 Cyclic Time**; otherwise, if the value next to the object **3110-00 Cyclic Time** = 0, the PDO message is sent only at each status exchange (see object **3101-00 Status word**) and/or position exchange (see object **3103-00 Current position value**) and/or velocity exchange (see object **3105-00 Current velocity value**); in this case the minimum interval between two PDO transmissions is set next to the following parameter **Inhibit Time** object 1800h sub 3.

- **03 Inhibit Time** [Unsigned16, rw]
Minimum interval between two PDO transmissions when "status, position, velocity exchange" transmission is set (see the parameter **Transmission Type** object 1800h sub 2 and the NOTE just below); value is expressed in multiples of 100 µs.
Default = 0190h (40ms)



NOTE

- Before altering the value of **COB-ID** it is compulsory to deactivate the transmission of PDO1, then enter the new COB-ID value, finally activate again the transmission of PDO1.
- PDO1 transmission can be activated (deactivated) by setting to "0" ("1") the most significant bit of the object **1800 Transmit PDO Communication Parameter 1** sub 1 **COB-ID**.
- Cyclic transmission or synchronous transmission can be modified by setting a suitable value in the object **1800 Transmit PDO Communication Parameter 1**, sub 2 **Transmission Type**. To have a PDO1 transmission every "n" SYNC commands, set "n" value in the object 1800h, sub 2.
01h = synchronous transmission at every SYNC command
02h = synchronous transmission every two SYNC commands
...
FEh = "cyclic transmission" or "status, position, velocity exchange transmission":
if **3110-00 Cyclic Time** ≠ 0 → cyclic transmission: cycle time is set in object 3110h;
if **3110-00 Cyclic Time** = 0 → "status, position, velocity exchange" transmission: device issues a PDO message each time parameters mapped in PDO change (see object **1A00 TPDO Mapping Parameter 1**) with a minimum interval not lower than **1800 Transmit PDO Communication Parameter 1** sub 3 **Inhibit time**.

1A00 TPDO Mapping Parameter 1

This object indicates the kind of parameter contained in the Transmit PDO message.

- **01 3101-00 Status word** [Unsigned32, ro] Default = 3101 0010h.
- **02 3105-00 Current velocity value** [Unsigned32, ro] Default = 3105 0010h.
- **03 3103-00 Current position value** [Unsigned32, ro] Default = 3103 0020h.



NOTE

Save default values using **1010-01 Save Parameters** function.
Should the power be turned off or **Reset node** or **Reset communication** commands be sent all data not saved will be lost!

8.1.2 Manufacturer's specific objects

Communication parameters

3000-00 Baud rate

[Unsigned8, ro]

This object is meant to show the baud rate (transmission rate) set by means of the dedicated switch, according to the following table; for any information on setting the baud rate see section "4.3.3 Setting the data transmission rate: Baud rate (Figure 3)" on page 23.

Data byte	Baud rate
00h	20 Kbit/s
01h	50 Kbit/s
02h	100 Kbit/s
03h	125 Kbit/s
04h	250 Kbit/s
05h (default)	500 Kbit/s
06h	800 Kbit/s
07h	1000 Kbit/s

3001-00 Node ID

[Unsigned8, ro]

This object is meant to show the node identifier (address) of the device set by means of the dedicated switch; for any information on setting the node-ID see section "4.3.2 Setting the address node: Node ID (Figure 3)" on page 22. The default address is 1.

Device profile objects

3108-00 Acceleration

[Unsigned32, rw]

This object defines the acceleration value that has to be used by the device. Parameter is expressed in pulses per second² [PPS²].

Default = 1000

3109-00 Deceleration

[Unsigned32, rw]

This object defines the deceleration value that has to be used by the device. Parameter is expressed in pulses per second² [PPS²].

Default = 1000

310C-00 Max Following Error

[Unsigned32, rw]

This object defines the maximum allowable difference between the real position and the theoretical position of the device. If device detects a value higher than the one set in this object, the alarm **Following error** is triggered and the unit stops. Parameter is expressed in pulses.

Default = 1024

310D-00 Position Window

[Unsigned16, rw]

This object defines the tolerance window for the **3106-00 Target position** value. When the axis is within the tolerance window limits for the time set in the object **310E-00 Position Window Time**, then the state is signalled through the **Axis in position** status bit. Parameter is expressed in pulses.

Default = 0

310E-00 Position Window Time

[Unsigned16, rw]

It represents the time for which the axis has to be within the tolerance window limits set in the object **310D-00 Position Window** before the state is signalled through the **Axis in position** status bit. Parameter is expressed in milliseconds.

Default = 0

310F Position Range Limits

- **01 Limit switch Pos** [Integer32, rw]
Maximum positive limit the device is allowed to reach. When this limit is reached, a signalling is activated through the **SW limit switch +** status bit. Parameter is expressed in encoder pulses.
Default = 130047
- **02 Limit switch Neg** [Integer32, rw]
Minimum negative limit the device is allowed to reach. When this limit is reached, a signalling is activated through the **SW limit switch -** status bit. Parameter is expressed in encoder pulses.
Default = -130047



WARNING

Every time **3120-00 Distance per revolution** and **3300-00 Preset** parameters are changed, also **310F Position Range Limits** has to be set again. For a detailed explanation see on page 28.

3111-00 Kp position loop

[Unsigned32, rw]

This object contains the proportional gain used by PI controller for the position loop. Value has been optimized by Lika Electronic according to the technical characteristics of the device.

Default = 480

3112-00 Ki position loop

[Unsigned32, rw]

This object contains the integral gain used by PI controller for the position loop. Value has been optimized by Lika Electronic according to the technical characteristics of the device.

Default = 1

3114-00 Jog Speed

[Unsigned32, rw]

This object contains the maximum speed of the device when using **Jog +** and **Jog -** functions. Parameter is expressed in pulses per second.

Default = 800

3115-00 Work Speed

[Unsigned32, rw]

This object contains the maximum speed of the device in automatic work mode (movements are controlled using **Start** command and are performed in order to reach the position set in **Target position**). Parameter is expressed in pulses per second.

Default = 800

3116-00 Max Speed

[Unsigned32, ro]

This object defines the maximum speed you can set in the objects **3114-00 Jog Speed** and **3115-00 Work Speed**. Parameter is expressed in pulses per second.

Default = 1024

3118-00 Start torque current time

[Unsigned32, rw]

This object defines the time for which the motor is supplied with starting torque current when it starts its movement (see object **3341-00 Starting torque current**). Parameter is expressed in milliseconds. Maximum value allowed is 5 seconds.

Default = 2000

3120-00 Distance per revolution

[Unsigned32, rw]

This object sets the number of pulses per each complete revolution of the shaft. This parameter is useful to relate the revolution of the shaft and a linear measurement. For example: unit is joined to a worm screw having a 5 mm pitch; by setting **3120-00 Distance per revolution** = 500, at each shaft revolution system performs a 5 mm pitch with one-hundredth of a millimetre resolution. Maximum value is 1024.

Default = 1024



WARNING

After having changed this parameter you must set new values also in objects **3300-00 Preset** and **310F Position Range Limits**. For a detailed explanation see on page 28.



NOTE

If **3120-00 Distance per revolution** is not a power of 2 (2, ..., 512, 1024), at position control a positioning error could occur having a value equal to one pulse.

3300-00 Preset

[Integer32, rw]

Use this object to set the Preset value. Preset function is meant to assign a certain value to a desired physical position of the axis. The chosen physical position will get the value set next to this item and all the previous and following positions will get a value according to it. The preset value will be set for the position of the axis in the moment when the value is entered.

Default = 0



WARNING

A new value has to be set in **3300-00 Preset** whenever **3120-00 Distance per revolution** value is changed. After having changed this parameter you must set new value also in object **310F Position Range Limits**. For a detailed explanation see on page 28.

3301-00 Offset

[Integer32, ro]

This object defines the difference between the position value transmitted by the device and the real position: real position – preset. Value is expressed in pulses.

Default = 0

3302-00 Code sequence

[boolean, rw]

It sets whether the position value output by the encoder increases when the encoder shaft rotates clockwise (0) or counter-clockwise (1). Clockwise and counter-clockwise rotations are viewed from shaft.

0 = clockwise rotation (default)

1 = counter-clockwise rotation



WARNING

Changing this value causes also the position calculated by the controller to be different. Therefore it is compulsory to set new values in objects **3300-00 Preset** and **310F Position Range Limits**.

3330-00 Kp current loop

[Unsigned32, rw]

This object contains the proportional gain used by PI controller for the current loop. Value has been optimized by Lika Electronic according to the technical characteristics of the device.

Default = 160

3331-00 Ki current loop

[Unsigned32, rw]

This object contains the integral gain used by PI controller for the current loop. Value has been optimized by Lika Electronic according to the technical characteristics of the device.

Default = 60

3340-00 Max current

[Unsigned32, rw]

This object defines the maximum current supplied by the power electronic to control the motor. Parameter is expressed in mA (milliamperes). This value cannot be greater than the one in object **3341-00 Starting torque current**. Maximum value is 1600.

Default = 1600

3341-00 Starting torque current

[Unsigned32, rw]

This object defines the maximum current supplied to the motor only when it starts its movement and for the maximum time set in the object **3118-00 Start torque current time**. Parameter is expressed in mA (milliamperes). Maximum value is 3000.

Default = 3000

3410-00 Start Waiting Time

[Unsigned16, rw]

This object sets the time gap between the activation of PWM controller and the beginning of the movement. This is used only for positioning command, not for jog commands. This parameter is useful when operating RD53 units (version fitted with brake): it allows to control the vertical axis in order to keep it in position as the brake is disengaged. Parameter is expressed in milliseconds. Maximum value allowed is 1 second.

Default = 0



NOTE

Save default values using **1010-01 Save Parameters** function.
Should the power be turned off or **Reset node** or **Reset communication** commands be sent all data not saved will be lost!

Operating parameters

3005-00 Current value [mA]

[Integer16, ro]

This object shows the value of the current absorbed by the motor (rated current). Parameter is expressed in mA (milliamperes).

3006-00 Temperature value

[Integer16, ro]

This object shows the value of the internal temperature of the device as sensed by a probe. **3006-00 Temperature value** is expressed in °C (Celsius degrees).

3100-00 Control Word

[Unsigned32, rw]

This object contains the commands to be sent in real time to the Slave in order to manage it. **3100-00 Control Word** parameter is used to edit PDO messages received by the Slave (see further details in the section "7.6 PDO messages" on page 35).

3101-00 Status word

[Unsigned16, ro]

This object shows information about the device state. **3101-00 Status word** object is contained in the PDO messages sent by the Slave (see further details in the section "7.6 PDO messages" on page 35).

3102-00 Demanded position value

[Integer32, ro]

This object shows the value of the theoretical position calculated by the device while moving. This value is used by PI controller to control the motor.

3103-00 Current position value

[Integer32, ro]

This object shows the value of the current position. **3103-00 Current position value** object is contained in the PDO messages sent by Slave (see further details in the section "7.6 PDO messages" on page 35).

3105-00 Current velocity value

[Integer16, ro]

This object shows the value of the current speed. **3105-00 Current velocity value** object is contained in the PDO messages sent by the Slave (see further details in the section "7.6 PDO messages" on page 35). Parameter is expressed in pulses per second.

3106-00 Target position

[Integer32, rw]

This object defines the target position, otherwise referred to as commanded position. **3106-00 Target position** parameter is used to edit PDO messages received by the Slave (see further details in the section "7.6 PDO messages" on page 35).

3107-00 Target speed

[Integer32, ro]

This object shows the value of the theoretical speed used by the device for generating the position trajectory. Parameter is expressed in pulses per second.

310B-00 Position following error

[Integer32, ro]

This object contains the difference between the target position and the current position step by step. If this value is greater than the one set in the object **310C-00 Max Following Error**, then the alarm **Following error** is triggered and the unit stops.

3110-00 Cyclic Time

[Unsigned16, rw]

3110-00 Cyclic Time is used in asynchronous work mode and sets the interval between two PDO transmissions.

If the value next to this object **3110-00 Cyclic Time** $\neq 0$, the PDO message is sent cyclically and the interval between two messages is the time set here; otherwise, if the value next to this object **3110-00 Cyclic Time** = 0, the PDO message is sent only at each status exchange (see object **3101-00 Status word**) and/or position exchange (see object **3103-00 Current position value**) and/or velocity exchange (see object **3105-00 Current velocity value**); in this case the minimum interval between two PDO transmissions is set next to the parameter **Inhibit Time** object 1800h sub 3.

This parameter only concerns the PDO messages issued by the Slave, not by the Master. Parameter is expressed in milliseconds. For further information see object **1800 Transmit PDO Communication Parameter 1** on page 49.

Default = 0

3200-00 Alarms

[Unsigned16, ro]

This object is meant to show the alarms currently active in the device.

Structure of the alarms byte:

byte	Data byte 4			Data byte 5		
bit	7	...	0	15	...	8
			L.S.bit	M.S.bit		

Alarm codes available:

bit 0 : 0001h	Machine data not valid	One or more parameters are not valid, set proper values to restore normal work condition.
bit 1: 0002h	Flash memory error	Internal error, it cannot be restored.
bit 2: 0004h	Motor power supply bit low	Bit 9 Motor power supply in the Control Word is set to "0" and the power voltage is not monitored, thus the use of Jog + , Jog - , Start and Brake deactivated commands causes this alarm to be triggered. See on page 37
bit 3: 0008h	Following error	The difference between the real position and the theoretical position is greater than the value set in parameter 310C-00 Max Following Error . We suggest reducing the speed. See on pages 38, 40 and 54.
bit 4: 0010h	Axis not synchronized	Internal error, it cannot be restored.
bit 5: 0020h	Target not valid	Target position is over maximum travel limits.
bit 6: 0040h	Emergency	Bit 7 Emergency in the Control Word has been forced to low value (0); or alarms are active in the unit.

bit 7: 0080h	Overcurrent	The power supply current is exceeding maximum ratings.
bit 8: 0100h	Overtemperature	The internal temperature of the device as sensed by a probe is exceeding maximum ratings (see 3006-00 Temperature value).
bit 9: 0200h	Not used	
bit 10: 0400h	Undervoltage	The power supply voltage is under minimum ratings.
bit 11: 0800h	CAN Life guard error	Error in the "Node guarding protocol". For further information see section "8.4 Node guarding protocol" on page 65.
bits 12 ... 15	Not used	

To reset a faulty condition use **Alarm reset** bit. Setting this bit to "1" causes the normal work status of the device to be restored. This command is used to reset an alarm condition of the Slave but only if the faulty condition has ceased. Using SDO messages you can read further information about the alarm in the index **1003 Pre-defined Error Field**.



Please note that should the alarm be caused by wrong object values (see **Machine data not valid**), normal work status can be restored only after having set proper values. **Flash memory error** alarm cannot be reset.



NOTE

Save default values using **1010-01 Save Parameters** function. Should the power be turned off or **Reset node** or **Reset communication** commands be sent all data not saved will be lost!

8.2 Warning messages

For the complete list and the meaning of the warning messages please refer to "SDO abort codes" section in "CiA Draft Standard 301" document available at www.can-cia.org.

8.3 Emergency messages

Emergency (EMCY) objects are issued by the device when an internal error occurs.

Structure of EMCY object:

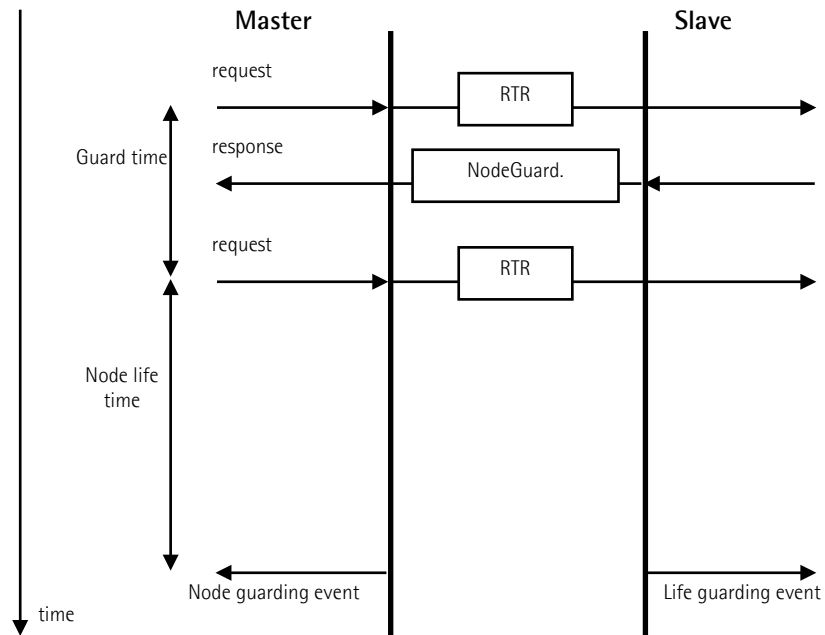
IDENTIFIER	CAN Data Byte			
COB-ID(hex)	0	1	2	3...7
See object 1014h	Error code		Errors sub-register	Specific codes
	LSB	MSB	01	00...00

Emergency codes available:

0000h	No errors
1000h	Generic error
2220h	Power surge
3110h	Overvoltage
3120h	Undervoltage
4310h	Overtemperature
5530h	Flash memory
8130h	Life Guard
8611h	Following error

8.4 Node guarding protocol

At system boot the "Node guarding protocol" is not active; this protocol is activated automatically as soon as Master device sends a RTR (remote transmission request) message the first time.



100C-00 Guard Time: interval between two RTR messages (see page 45).

Node life time: maximum time by which the Slave device must receive the following RTR message issued by the Master device.

"Node life time" = "100C-00 Guard Time" * "100D-00 Life Time Factor".

"Node guarding" is enabled only if "Node life time" ≠ 0.

If the Slave device does not receive a RTR message before the "Node life time" has expired, it warns activating a "Life Guarding Event". Furthermore the red LED located inside the device starts flashing so indicating the "Node guarding error" (see on page 20), objects **1001-00 Error register** and **1003 Pre-defined Error Field** are updated and an error message is sent.

To reset the error send a **Reset node** command.

9 Programming examples

Hereafter are some examples of transmission between Master and Slave devices. A generic "ID" value is used to indicate the encoder address; Master address is always 0.

All values are expressed in hexadecimal notation.

Setting the Operational / Pre-operational state

NMT message Master → Slave

	COB-ID	Cmd	Nodo
Operational:	000	01	ID
Pre-operational:	000	80	ID

Setting object 3300-00 Preset (preset = 1000 = 3E8h)

Master → Encoder (Set request)

COB-ID	Cmd	Index		Sub	Process data			
600+ID	23	00	33	00	E8	03	00	00

Encoder → Master (Set confirmation)

COB-ID	Cmd	Index		Sub	Process data			
580+ID	60	00	33	00	00	00	00	00



NOTE

Save default values using **1010-01 Save Parameters** function.
Should the power be turned off or **Reset node** or **Reset communication** commands be sent all data not saved will be lost!

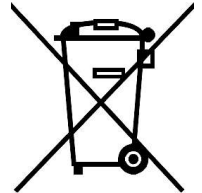
10 Default parameters list

Parameters list	Default value		
3120-00 Distance per revolution PPR	1024		
310D-00 Position Window P	0		
310E-00 Position Window Time ms	0		
310C-00 Max Following Error P	1024		
3111-00 Kp position loop	480		
3112-00 Ki position loop	1		
3108-00 Acceleration PPS ²	1000		
3109-00 Deceleration PPS ²	1000		
310F Position Range Limits Limit switch Pos P	130047		
310F Position Range Limits Limit switch Neg P	-130047		
3114-00 Jog Speed PPS	800		
3115-00 Work Speed PPS	800		
3118-00 Start torque current time ms	2000		
3302-00 Code sequence	0		
3330-00 Kp current loop	160		
3331-00 Ki current loop	60		
3340-00 Max current mA	1600		
3341-00 Starting torque current mA	3000		
3300-00 Preset P	0		
3410-00 Start Waiting Time ms	0		
3110-00 Cyclic Time ms	0		



HW-SW release	Document release	Description
RD5: H2.0 S7.1 RD53: H1.0 S1.1	1.0	First issue
RD5: H2.0 S7.1 RD53: H1.0 S1.1	1.1	Address 0 setting warning information, warning against back EMF

Dispose separately



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