User manual

RDxx-P8-xx-xx-E1-xx

Profibus DP, CANopen, RS232/RS485

Description

This manual describes the ROTADRIVE series with Profibus DP, CANopen and RS232/RS485 interfaces. ROTADRIVE is a complete positioning unit which integrates a DC gear-motor, a drive, an encoder and a controller.

Chapters

1 - Safety summary

We strongly recommend carefully reading this user manual and following the installation guidelines below:

- High current, voltage, and rotating parts can cause serious or fatal injury.
- The use of electric machinery, like all other uses of concentrated power and rotating equipment, may be hazardous.
- Installing, operating, and maintaining electric machinery should be performed by qualified personnel only.
- 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 instrument.
- Lika assumes no liability for the customer's failure to comply with these requirements.

Connect according to the chapter 3: "Electrical connection".

1.1 Safety button

A safety button for emergency switch-off has to be installed to interrupt motor power supply.

2 - Identification

The device can be identified by the label's data (ordering code, serial number). This information is listed in the delivery document. For technical features of the product to make reference at the technical catalogue.

3 - Installation & electrical connections

3.1 Mounting instructions

Rotadrive can be mounted directly on a spindle with Ø14mm and fixed by means of the collar and the anti-rotation pin.
The unit can be mounted in any position.
In order to guarantee the maximum life of mechanical parts of the RD11, we recommend to use a flexible coupling between Rotadrive and spindle.

3.2 Electrical connections

ATTENTION !
The transmission of a Start command moves the unit and the axis. Make sure no personal injury and mechanical damage can be caused.
Each Start routine has to be taken out with care!

- Layout electrical connections according to local norms and laws.
- Avoid running the signal cables near high voltage power cables (e.g. motor power supply, drive cables).
- Always use shielded and twisted cables if possible.

3.2.1 CON1 DSub 5+2 pin (Power supply)

Pin	Function
A1	+24Vdc (motor)
A2	GND
1	Output (5Vdc - active LOW) *
2	+24Vdc ±10% (controller)
3	Input 3
4	Input 2
5	Input 1

*: on RD12 and RD22 output is not connected.

3.2.2 CON2 DSub 9 pin (Interfaces)

Pin	Profibus DP		CANopen	RS485
	RD1	RD2	RD1/RD2	RD1/RD2
1	n.c.	n.c.	n.c.	n.c.
2	n.c.	n.c.	CAN-Low	n.c.
3	B (Profi.)	B (Profi.)	n.c.	B (RS485)
4	B (RS485)	RD(RS232)	B (RS485)	B (RS485)
5	GND	GND	GND	GND
6	+5Vdc	n.c.	+5Vdc	+5Vdc
7	n.c.	n.c.	CAN-High	n.c.
8	A (Profi.)	A (Profi.)	n.c.	A (RS485)
9	A (RS485)	TD(RS232)	A (RS485)	A (RS485)

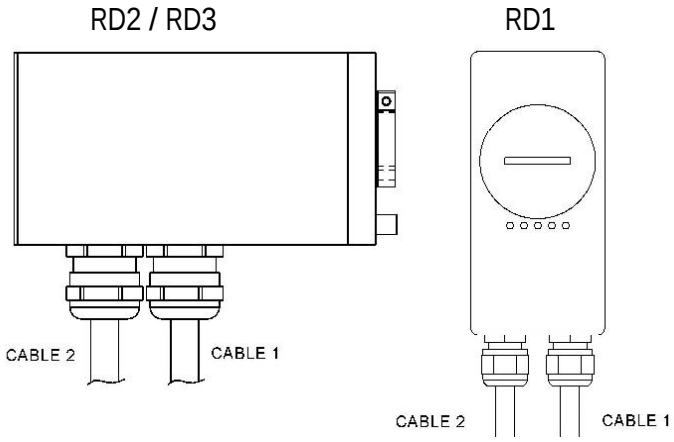
3.2.3 Cable 1

Colour	Function
Brown (1mm^2)	+24Vdc (motor)
White	GND
Grey	Output (5Vdc - active LOW) *
Brown (0.25mm^2)	+24Vdc (controller)
Green	Input 3
Red	Input 2
Blue	Input 1

3.2.4 Cable 2

Color	Profibus DP		CANopen	RS485
	RD1	RD2	RD1/RD2	RD1/RD2
Blue	n.c.	n.c.	CAN-Low	n.c.
Brown	n.c.	n.c.	CAN-High	n.c.
Pink	B (Profi.)	B (Profi.)	n.c.	B (RS485)
Violet	B (RS485)	RxD (RS232)	B (RS485)	B (RS485)
Black	GND	GND	GND	GND
Red	+5Vdc	n.c.	+5Vdc	+5Vdc
Grey	A (Profi.)	A (Profi.)	n.c.	A (RS485)
Green	A (RS485)	TxD (RS232)	A (RS485)	A (RS485)

ATTENTION !
CON2, pin 6 and Cable2, color Red (+5Vdc):
output signal used for power supply of external RS485 converter. Do not connect if not used.

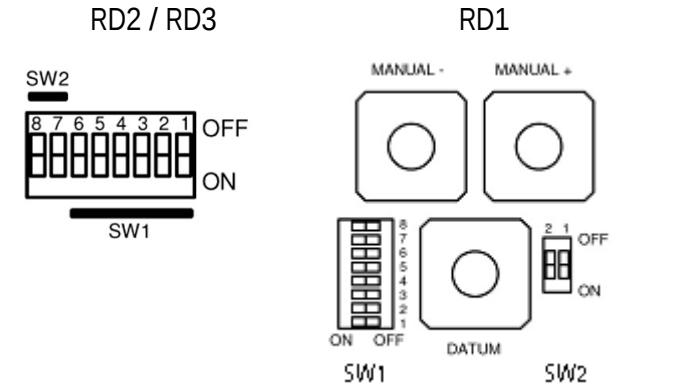


3.3 Dip-Switches

Rotadrive has DIP-Switches to set the **device address** (SW1) and **Bus termination** (SW2) if Rotadrive is an end device:

- SW1= binary switch to set device address
- SW2 = ON if RDx is end device/bus termination
  OFF if RDx is not end device

To access DIP-Switches remove the PG-closure on the back of the device.



SW1 Device address:

bit	6	5	4	3	2	1
weight	2^5	2^4	2^3	2^2	2^1	2^0

ATTENTION !
Using Drive-tool software device address must be set to "11" for RS232/RS485 interface.

4 - Parameters

ATTENTION !

Some parameters have a profound effect on the operation of the drive. They must not be altered without careful consideration of the impact on the controlled system. Measures must be taken to prevent unwanted changes due to error or tampering.

Admissible value range for each parameter is listed as follows: [unit/ min. value, max. value]
Default parameter values are written in **BOLD** characters.
All parameters with decimals are transmitted without decimal point:
x.x = xx
x.xxx = xxxx
Parameters with unit P05 are related to the engineering unit set in parameter P05.

4.1 Parameter description

P00 Actual position [P05/ ---, ---]
Contains the actual position. The measurement unit is related to parameter P05.
P00 equals P01 if the unit is positioned within the tolerance window (P09).

P01 Target position
[P05/ -2147483648, 2147483648]
Contains the target position to reach after the start command.
Default value: **0**

P02 Datum value (Preset)
[P05/ -2147483648, 2147483648]
Contains the datum (or preset) value. The actual position will be set to this value after a "Go-to-Datum" or "Set-Datum" command.
Offset value (P33) will be added if set.
Default value: **0**

P03 Software limit -
[P05/ -2147483648, 2147483648]
Lowest target value to be accepted in P01.
Default value: **-100000**

P04 Software limit +
[P05/ -2147483648, 2147483648]
Highest target value to be accepted in P01.
Default value: **100000**

P05 Distance for scaling factor
[any measuring unit/ 1, 100.00]
Position value after 1 turn of the shaft. Enter value without decimals.
Default value: **2.00**

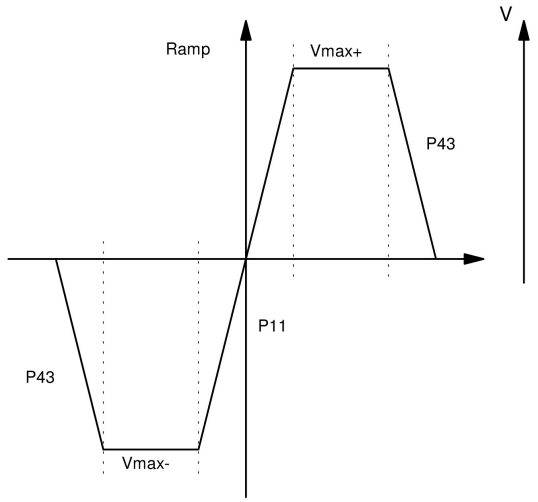
Example 1:
The spindle has a pitch of 2 mm. You want to display a resolution of 0,01 mm.
P05 would be 200 (2.00 without decimal point)

P08 Nr. of automatic restarts [nr./ 0, 255]
The unit restarts automatically if after positioning, the (new) actual position (P00) is not within Target position (P01) ± tolerance window (P09).
Default value: **0**

P09 Tolerance window [P05/ 0, 255]
Tolerance window around the target position. The controller as a proper target position accepts any position inside this window.
Default value: **0**

P10 "In-Position" time [x.xx sec/ 0.00, 2.00]
Sets the time for which a holding current is provided to keep the motor in position after reaching the target position. After this time the driver wont energize the motor in order to avoid over-heating.
Over-running of target position due to short standstill time and big inertia could be caused if P10 is too small.
Default value: **0.10**

P11 Acceleration ramp [P05/ 255, 16000]
Sets the length of positive and negative acceleration ramp expressed in increments (e.g. 2000 = +1000 / -1000).
High values mean low acceleration (longer ramp).
Too low values could cause unacceptable current peaks.
Default value: **2000**



P13 Fast speed [%/ 1, 100]
1%...100%: Percentage of max. fast speed in manual and automatic positioning mode.
Default value: **100**

P14 Manual slow speed [%/ 1, 100]
1%...100%: Percentage of max. slow speed in manual positioning mode.
Default value: **100**

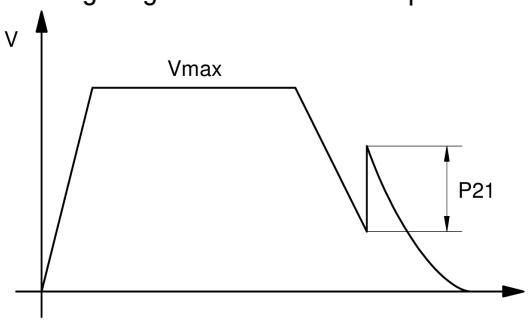
P15 Stop-ramp (activated by Stop command)
[xxxx msec/ 1, 2000]
Sets the time to decelerate and stop the motor in after a STOP command.
Default value: **100**

P16 Step length in manual mode [P05/ 0, 10000]
Sets the length in increments of each Step for the Step+ and Step- commands.
Default value: **1**

P17 Backlash compensation dwell time
[x.xx sec/ 0, 20.00]
Sets the dwell time before starting the backlash compensation. If set to 0 the parameter is disabled.
Default value: **0.00**

P18 Backlash compensation distance [P05/ 0, 250]
Sets the backlash compensation distance. The unit will overrun the target position for this distance before backlash compensation.
Default value: **0**

P21 Differential gain [increments/ 0, 10000]
Sets the differential gain that is active only in the deceleration ramp.
This parameter is useful if the motor stops before) reaching the target position (or slows down too early).
The differential gain gives the motor a short acceleration before target position by means of a ramp increment.
0 = D-gain disable
...
10000 = D-gain generates 10000 Ramp increments.



P26 Counting direction [---/ 0, 1]
Sets the counting direction of the controller.
0 = standard direction
1 = inverted direction

P26=0 and P42=0 is standard (cw counting and rotation from shaft side). It is necessary to change both P26 and P42 to invert the counting direction.

P27 Go-To-Datum direction [---/ 0, 1]
0 = in (+) direction
1 = in (-) direction

P28 Home position after Go-To-Datum routine
[P05/ -2147483648, 2147483648]
Sets the home position to go to after Go-To-datum routine.
Default value: **0**

P29 Reference switch for Go-To-Datum routine
[---/ 0, 1]
0 = Reference switch active low
1 = Reference switch active high

P33 Go-To-Datum offset
[P05 / -2147483648, 2147483648]
Sets the offset value to assign after Go-To-Datum routine. Go-To-Datum routine is completed when

reaching the first index pulse after leaving the reference switch.
New actual position P00 = Reference value P02 + Offset P33
Default value: **0**

P36 Closed loop control [---/ 0, 1]
Enables the closed loop control.
0 = disabled (OFF)
1 = enabled (ON)
P08 should be set to 0

P37 Closed loop response time [Nr. of cycles/ 1, 250]
Sets the response time (expressed in 0.5 ms cycles) of closed loop function at any change of the target position. Suggested value is 2
Default value: **1** (0.5 ms)

P38 Closed loop tolerance window [P05/ 0, 50000]
Sets a tolerance window expressed in increments. After positioning the actual value should be target value ± tolerance window. If not the closed loop control will be enabled and move the axes to correct position. Inside the tolerance window the closed loop control is not enabled.
Default value: **1** (means ±1 increments)

P39 Closed loop mode [---/ 0, 1]
Sets the closed loop operating mode.
0 = only active after each positioning (active on target value).
1 = also active after pressing Stop button or when switching power on.

P42 Motor rotation direction [---/ 0, 1]
Sets the motor rotation direction.
0 = standard
1 = inverted

P26=0 and P42=0 is standard (cw counting and rotation from shaft side). It is necessary to change both P26 and P42 to invert the counting direction.

P43 Deceleration ramp [P05/ 255, 16000]
Sets the length of deceleration ramp expressed in increments.
Great values stand for long deceleration ramps. Low values (short deceleration distance) may cause overrunning.
Default value: **2000**

P45 Go-To-Datum speed [%/ 1, 100]
Sets the Go-To-Datum speed expressed in percentage of max. speed.
Default value: **50**

P46 Function input 1 [---/ 0, 4] (option)
Sets the function of digital Input 1.
0 = Start *
1 = Stop *
2 = Reference switch *
3 = no function
4 = BCD coded input (only for Drive-Tool)

P47 Function input 2 [---/ 0, 4] (option)
Sets the function of digital input 2.
0 = Start *
1 = Stop *
2 = limit switch negative direction *
3 = no function
4 = BCD coded input (only for Drive-Tool)

P48 Function input 3 [---/ 0, 4] (option)
Sets the function of digital input 3.
0 = Start *
1 = Stop *
2 = limit switch positive direction *
3 = no function
4 = BCD coded input (only for Drive-Tool)

* **Start** function is active high (rising edge)
* **Stop** function is active low (falling edge)
* **Limit switch** functions are active low. When input is high, movement is possible, when input is low movement is blocked.

P49 Function output [---/ 0, 3]
Sets the function of digital output 1.
0 = in position
1 = brake active
2 = device moving
3 = no function

P50 Brake active time [sec./ 0, 1000]
Only for RD11 and RD22.
Determines how long the brake has to be active.
Default value: **0**

4.2 Read-only parameter

P52 Command word [---/ 128, 139]
Shows the command in use.

P80 Controller status [---/ 0, 255]
Shows controller status.

Hex	Dec	Description
00	0	axis not ready
01	1	axis ready
02	2	axis is moving
04	4	axis in target position
08	8	searching zero position
10	16	over current
20	32	shortcut
40	64	system error
80	128	target position value out of range
F0	240	Power supply error. Power off time too short for parameter storage operation.

P81 Reference switch/Encoder index distance [P05/ 0, 255]
Shows the distance between reference switch and encoder zero index.

P82 Actual motor current [x.xx Ampere/ 0.00, 10.00]
Shows the motor current.

P83 Actual ramp value [Ramp increments/ 0, 255]
Shows the actual ramp value of PWM controller.

P84 Controller correction value
[Ramp increments/ 0, 32000]
Shows the actual correction value of the controller.

P85 Go-To-Datum status [Status/ 0, 3]
Shows the status of Go-To-Datum routine.
0 = Go-To-datum routine initialized
1 = Axis reached reference switch
3 = Axis reached reference switch and then encoder index.

4.3 List of Rotadrive parameters

Please write down the values of all parameters on this list for assistance and service.

Nr.	Parameter	Value
P00	Actual position	
P01	Target position	
P02	Datum value	
P03	Software limit -	
P04	Software limit +	
P05	Distance for scaling factor	
P08	Nr. of automatic restarts	
P09	Tolerance window	
P10	"in position" time	
P11	Acceleration ramp	
P13	Fast speed	
P14	Manual slow speed	
P15	Stop-ramp (Stop command)	
P16	Step length in manual mode	
P17	Backlash compensation dwell time	
P18	Backlash compensation distance	
P21	Differential gain	
P26	Counting direction	
P27	Go-To-Datum direction	
P28	Home position after Go-To-Datum routine	
P29	Reference switch for Go-To-Datum routine	
P33	Go-To-Datum offset	
P36	Closed loop control	
P37	Closed loop response time	
P38	Closed loop tolerance window	
P39	Closed loop mode	
P42	Motor rotation direction	
P43	Deceleration ramp	
P45	Go-To-Datum speed	
P46	Function Input 1	
P47	Function Input 2	
P48	Function Input 3	
P49	Function output	
P50	Brake active time	
P52	Command word	
P80	Controller status	
P81	Reference-Index distance	
P82	Actual motor current	
P83	Actual ramp value	
P84	Controller correction value	
P85	Go-To-Datum status	

4.4 List of Info parameters

Nr.	Parameter	Value
P00	Identification (nr. of axes)	
P01	Identification (Device address)	
P02	Identification (Version)	
P03	Identification (Customer)	
P10	Profibus address	
P11	Profibus status	
P25	Nr. power downs	
P26	Max. current of axis	
P29	Working time	
P30	Nr. of power on/off	
P31	Nr. start routines	
P34	Nr. of Go-To-Datum routines	
P37	Nr. of over current errors	
P40	Nr. of limit switch errors	
P43	Nr. of shortcuts	
P46	Nr. feedback errors	

NOTE:
List of Info parameters is not available with Profibus interface, to access it use Serial or CANopen interface.
Parameters P10 and P11 are referred only to Profibus interface

4.5 Factory parameters (don't change)

Nr.	Parameter	Default value
P06	Encoder resolution [Pulses/1,65000]	2000
P07	Max. permanent current [x.xx Ampere/ 0.01, 10.00]	2.50
P19	Integral gain 1 [Nr. of cycles/1, 999]	10
P20	Integral gain 2 [Nr. of cycles/1, 999]	10
P22	Feedback monitoring interval [Nr.of cycles: x.x*0.5 ms/0,1000]	10
P23	Feedback-control on acceleration ramp [Pulses/ 1, 255]	1
P24	Feedback-control on deceleration ramp [Pulses/ 1, 255]	1
P25	Edge counting mode [Edges/ 0, 4]	4
P30	Index pulse edge trigger [---/ 0, 1]	1
P31	Standstill-control sampling time [x.xxx sec/ 0.000, 32.000]	0.100
P32	Max. peak current [x.xx Ampere/ 0.01, 10.00]	3.50
P34	Over current time interval [x..xx sec/ 0.01, 4.00]	0.10
P35	Ramp threshold to activate encoder -monitoring interval [%/0,100]	50
P40	Max. feedback counting frequency [Hz/ 1, 300000]	0
P41	Feedback frequency sampling interval [ms/ 0, 1000]	0
P44	Proportional gain [---/ 0, 8]	8
P51	I-limit	0
P55	Integral gain 3 [---/ 100, 1000]	800

5 - Functions

5.1.1 Start routine

The Start command moves the positioning unit to the target position accordingly to the ramp parameters set (see also chapter 10 Controller set up).
When it has reached the position inside the tolerance window, the controller gives an in-position signal.
It's possible to change the target position and the motor speed while positioning. A new Start command will change the positioning routine to the new values. If the new target position is in opposite (negative) direction the controller will change the motor direction after doing a Stop ramp.
Settings of speed will be enabled after "**Activate parameters**" command.

ATTENTION !
The positioning speed can be changed "on the fly". This doesn't change the parameter and doesn't need "**Activate parameters**" command.

5.1.2 Stop routine

The Stop command interrupts the positioning routine and stops the motor according to the stop ramp settings.

5.2.1 Manual mode Step +

P14	Manual slow speed
P16	Step length in manual mode

The Manual mode Step + command will move the unit for one Step according to the value of P16 at the speed P14.
This command sets:
Target position P01 = actual position P00 + P16.
Note that another Start command will move the unit again to the same position.

5.2.2 Manual mode Step -

P14	Manual slow speed
P16	Step length in manual mode

The Manual mode Step - command will move the unit for one Step according to the value of P16 at the speed P14.
This command sets:
Target position P01 = actual position P00 - P16.
Note that another Start command will move the unit again to the same position.

5.3.1 Manual mode Slow +

P14	Manual slow speed
P04	Software limit +

The "Manual mode slow +" command slows down the motor to the speed set in P14, sets the target value to P04 (Software limit +).
The unit moves until reaching position P04.
Use Stop command to interrupt the positioning.
Make sure the Software limits are inside the mechanical limits of machine or application to avoid damage and injury.
Note that another Start command will move the unit again to the same position.
To move to another position a new target value has to be set.

5.3.2 Manual mode Slow -

P14	Manual slow speed
P03	Software limit -

The "Manual mode Slow -" command slows down the motor to the speed set in P14 and sets the target value to P03 (Software limit -).
The unit will move until reaching position P03.
Use Stop command to interrupt the positioning.
Make sure the Software limits are inside the mechanical limits of machine or application to avoid damage and injury.
Note that another Start command will move the unit again to the same position.
To move to another position a new target value must be set.

5.4.1 Manual mode Fast +

P13	Fast Speed
P04	Software Limit +

The "Manual mode Fast +" command slows down the motor to the speed set in P13 and sets the target value to P04 (Software limit +).
The unit will move until reaching position P04.
Use Stop command to interrupt the positioning.
Make sure the Software limits are inside the mechanical limits of machine or application to avoid damage and injury.
Note that another Start command will move the unit again to the same position. Target value now coincides with "Manual mode Fast+" position.

5.4.2 Manual mode Fast -

P13	Fast Speed
P03	Software limit -

The "Manual mode Fast -" command slows down the motor to the speed set in P13 and sets the target value to P03 (Software limit -).
The unit will move until reaching position P03.
Use Stop command to interrupt the positioning.
Make sure the Software limits are inside the mechanical limits of machine or application to avoid damage injury.
Note that another Start command will move the unit again to the same position.
Target value now coincides with "Manual mode Fast-" position.

5.5.1 Set-To-Datum

P02	Datum value

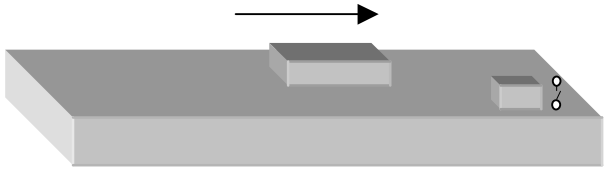
This command sets the actual position to Datum value (parameter P02).

5.5.2 Go-To-Datum routine

Starts a Go-To-Datum routine.

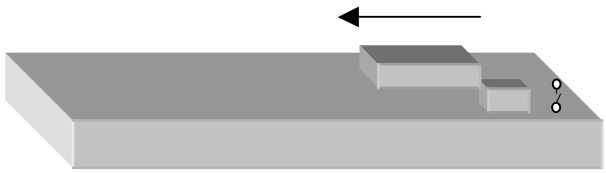
P02	Datum value
P45	Go-To-Datum speed
P27	Go-To-Datum direction
P28	Home position after Go-To-Datum routine
P29	Reference switch for Go-To-Datum routine

Routine:
The motor moves the axis at the speed P45 in the direction set in P27.



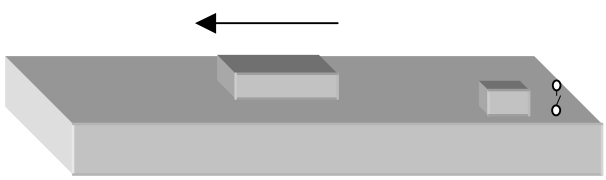
The axis actuates the Reference switch, the motor stops the axis as set in P15 (Stop-ramp).

The axis restarts in opposite direction at the speed P14 and leaves the Reference switch. The first Index pulse after leaving the limit switch sets the Datum value.



The Actual value is set to Datum (P2 and P33) immediately when reaching the Index pulse of the feedback.

Now the unit moves to Home position set in parameter P28.



5.6 Limit switches

Limit switches set the extreme limits of your application's mechanical stroke.
Limit switch inputs are safe to cable break (if a cable breaks motor will stop immediately).

The unit will stop when:

- activating the Limit switch + by moving in positive direction
- activating the Limit switch - by moving in negative direction

5.7 Backlash compensation

P17	Backlash compensation dwell time
P18	Backlash compensation distance
P08	Nr. of automatic restarts

Backlash errors of the spindle or gearbox can be avoid moving to target positions always in the same direction.
The unit will overrun the target position of the distance set in P18 and hold for the time set in P17.
Positive values of P18 overrun the target position in positive direction whereas negative values overrun in negative direction.
P08 sets the max. number of automatic restarts to reach the target position (within the tolerance window) during the backlash compensation routine.
If P08 is set to zero (0) backlash compensation function is not active.

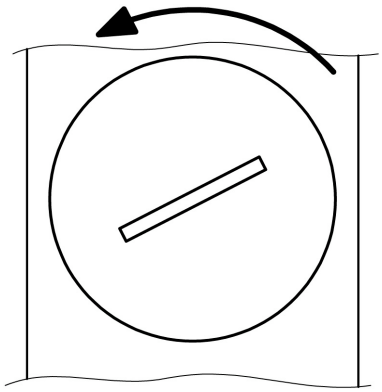
5.8 Closed loop

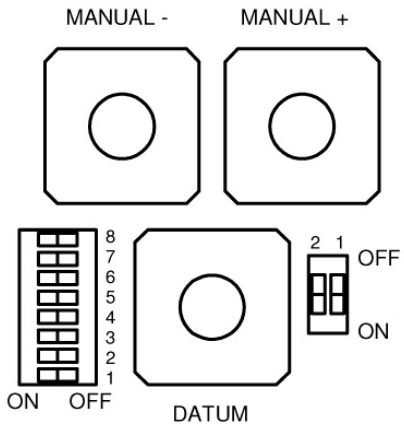
P36	Closed loop control
P37	Closed loop response time
P38	Closed loop tolerance window
P39	Closed loop mode

The Closed loop function allows to keep the unit in position (within the tolerance window P38). The closed loop function gets active when any external force tries to move the axis away from the target position. Closed loop is done by an intelligent PI-controller.

IMPORTANT (only RD1) !
Manual mode slow + and - can be done directly on the unit by means of push-buttons **MANUAL+** and **MANUAL–**.
The **DATUM** push-button is equivalent to "Set-To-Datum" (see parameter P02 and chapter 5.5.1)

Unscrew the PG cover on the back-side of RD1 to access the push-buttons.





6 - Profibus DP interface

6.1.1 Introduction

The following chapters describe the cyclic data transfer. The layout of data transfer has been optimized for drives, to be fast and at constant time intervals.

6.1.2 GSD File

Rotadrive is supplied with it's GSD file **RDxxx.gsd** (see enclosed support or **www.lika.biz > products > actuators**). The GSD file has to be installed in your Profibus-DP master device.

6.1.3 Telegram structure

Byte	Field	Function
1	AK*	Acknowledgement
2	PNU	Parameter nr.
3	IND	axis nr.
4	SUBIND	reserved
5	PWE	Value of parameter
6		
7		
8		
9	I/O 1	Input/Output 1
10	I/O 2	Input/Output 2
11	ZSW/STW	Status word / Command word
12		
13	HIW/HSW	Target position / Actual position
14		
15		
16		

* structure of AK

Bit	7	6	5	4	3	2	1	0
	SISB	AK			SPM	ERR		

6.2 AK Acknowledgement Master → Slave

Bits 0, 1, 3 (ERR), 3 (SPM) and 7 (SISB) are not used and therefore set to 0 (zero).
The status of bits 4, 5, 6 (AK) indicates if the data transmission has been performed successfully or not.

Example:

You send a parameter and Rotadrive replies AK=01(Hex) parameter is ok.

6.2.1 Parameter request

When the master requests a parameter from the unit,

- PWE contains the assigned parameter value
- IND contains the axis nr.
- PNU the parameter nr.

6.2.2 Parameter change

After changing a parameter must be activated by "**activate parameter**" command (value 3).
To store the parameter (into EEProm) it must be saved by the "**save parameter**" command (value 4).

ATTENTION !

If not saved the parameter will be cancelled after power off.
The "save parameter" routine lasts approx. 500 ms. During this time no Parameter- or Save commands can be send to the device.

6.2.3 Master → Slave functions

AK value	Description
0	no command
1	request parameter value
2	change parameter value
3	activate parameter
4	save parameter (on EEProm)

6.3 AK Acknowledgement Slave → Master

The device issues an error message against incorrect parameter requests.

6.3.1 Parameter OK

The parameter has been accepted.

6.3.2 Parameter error

Error value	Description
2	Parameter nr. not valid (range of parameters is from 0 to 80)
3	Parameter value not valid (see value range of each parameter in parameter list)

6.3.3 Axis error

Axis number not valid (see IND).

6.3.4 Slave → Master functions

AK value	Description
0	not valid
1	parameter OK
2	parameter nr. not valid
3	parameter value not valid
4	axis nr. not valid

6.3.5 SISB
Not used.

6.3.6 SPM
Not used.

6.4 PNU (byte 2)
Parameter number (see parameter list)

6.5 IND (byte 3)
Rotadrive is a single axis unit. Set IND always 0 (zero).
0 = axis nr. 1

6.6 SUBIND (byte 4)
Reserved bits, set always to 0 (zero)

6.7 PWE (byte 5-8)
Contains the parameter value. Byte 8 is LSB (least significant byte).
At power-on PWE contains the service time of RD.

6.8 I/O 1, Digital input (byte 9)
Contains input signal status.
01(Hex) : High Input 1
02(Hex) : High Input 2
04(Hex) : High Input 3

6.9 I/O 2 (byte 10)
Not used.

6.10 ZSW/STW (byte 11-12)
Only byte 11 is used. Byte 12 is always zero.
ZSW shows the status of the unit after a command from the Master.

Communications Slave → Master		
hex	dec	Description
00	0	axis not ready
01	1	axis ready
02	2	axis moving
04	4	axis in position
08	8	Go-To-Datum routing active
10	16	over current
20	32	shortcut
40	64	encoder error/malfunction
80	128	target position out of range
F0	240	power supply error

The unit can respond with a combination of the above information.

Example:
03(Hex) means Rotadrive is ready and moving.
05(Hex) means Rotadrive is within the tolerance window.

STW contains the command to send.
Following commands are available.

Commands Master → Slave		
hex	dec	Description
80	128	Start axis
81	129	Stop axis
82	130	Manual mode Step +
83	131	Manual mode Step -
84	132	Manual mode Slow +
85	133	Manual mode Slow -
86	134	Manual mode Fast +
87	135	Manual mode Fast -
88	136	Start Go-To-Datum routine
89	137	Activate parameters
8A	138	Save data (EEProm)
8B	139	Go-To-Datum
8C	140	Feedback frequency

6.11 HIW/HSW (byte 13-16)
Contains the actual position and target position.

7 - CANopen interface

7.1 Introduction

CANopen profile define the "Arbitration field" (COB-ID) and the 8 bytes "Data field" (CAN data bytes) of CAN frame. The following chapters describe asynchronous data transfer.
Rotadrive is always a slave device.

IMPORTANT:
For every omitted specify make reference to the document "CiA Draft Standard 301" available on www.can-cia.org.

7.2 Bit rate

Rotadrive support only one kind of bit rate, with the follow characteristics:

Baud rate	Max bus length	Nominal bit time
125 Kbit/s	500m	8µs

7.3 EDS File

RDx is supplied with its EDS file **RDxxx.eds** (see enclosed support or **www.lika.biz > products > actuators**). The EDS file has to be installed in your CANopen master device.

7.4 Pre-defined function code

Object	Function code (binary)	COB-ID (hex)	Used
NMT	0000	000	yes
SYNC	0001	080	no
EMERGENCY	0001	081 - 0FF	yes
PDO 1 (tx)	0011	181 - 1FF	yes
PDO 1 (rx)	0100	201 - 27F	yes
PDO 2 (tx)	0101	281 - 2FF	no
PDO 2 (rx)	0110	301 - 37F	no
SDO (tx)	1011	581 - 5FF	yes
SDO (rx)	1100	601 - 67F	yes
Nodeguard	1110	701 - 77F	yes

"COB-ID" is define as transmit (tx) or receive (rx) regarding the Slave device.

7.5 Initialisation

The rotadrive accesses the CAN network 4s after power on, it sends a Boot-up message (Nodeguarding) to Master:

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

The encoder is now in "pre-operational" state.

- **PRE-Operational**

In this state, node can communicate to master throw SDO message. SDOs are used to set or read slave parameters. In pre-operational mode, slave can't send PDO or Emergency messages.
To put node in "Operational state", master must sent a "Start remote node" with NMT message.

- **Operational**

This is the operative state, node can send PDO (process value) and Emergency message..
To put slave in "Pre-operational state", master must sent a "Enter pre-operational" with NMT message.

7.6 NMT Message

NMT structure:

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 directed to all network node.

NMT function:

Code	NMT function	Status node
01 hex	Start remote node	Operational
02 hex	Stop remote node	Prepared
80 hex	Enter pre-operational	Pre-operational
81 hex	Reset node	Pre-operational
82 hex	Reset communication	Pre-operational

7.7 PDO1 Message

Receive PDO1 and Transmit PDO1 are composed by 8 data bytes but the structures are different.

7.7.1 Receive PDO1 (Master → Slave)

COB-ID (hex)	8 CAN Data Bytes							
200+Node ID	0	1	2	3	4	5	6	7
	CW	IND	DSP	res	TPosition			

IND Selected axis [0]
The index (IND) is planned for devices with more than an axis. It is in the RDx always zero: IND = 0.

res Reserved

CW Command word [1, 144]
Command that Master send to Slave.

Commands Master → Slave		
hex	**dec**	**Description**
01	1	PDO released
80	128	Start axis
81	129	Stop axis
82	130	Manual mode Step +
83	131	Manual mode Step -
84	132	Manual mode Slow +
85	133	Manual mode Slow -
86	134	Manual mode Fast +
87	135	Manual mode Fast -
88	136	Start Go-To-Datum routine
8B	139	Go-To-Datum
90	144	Start axis with speed set

DSP Demand speed [0, 100]
Value in percent of the maximum speed in automatic positioning. By Control word 144 "start axes with speed set" is activated with the "Demand Speed activated" value.
Only a "start axis" 128, in object 2100h with Sub index 0Eh is taken as a speed.

TPosition Target position
It contains the target position (P01) of the regulator in the unit, which was determined by the parameter P05.

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

7.7.2 Transmit PDO1 (Slave → Master)

COB-ID(hex)
180+Node-ID

8 CAN Data Bytes							
0	1	2	3	4	5	6	7
STATE	IND	ASP	res	APosition			

Transmit PDO 1 is sent always when a Receive PDO1 was received with the valid node number and a valid order (CW).

IND Selected axis [0]
The index is planned for devices with more than an axis. It is in the RDx always zero: IND = 0.

ASP Actual speed

res Reserved

STATE Status message
In the status message, the condition of the device is reproduced. The device answers with a data byte. Following status messages are implemented:

bit	7	6	5	4	3	2	1	0

bit 0 = 1: axis ready
bit 1 = 1: axis moving
bit 2 = 1: axis in position
bit 3 = 1: Go-To-Datum routine active
bit 4 = 1: over current
bit 5 = 1: shortcut
bit 6 = 1: encoder error / malfunction
bit 7 = 1: target position out of range

Also combinations of the above-mentioned messages can appear, i.e. a 03h means that the regulator is ready and goes in position, a 05h that the axis is in the tolerance window.

APosition Actual position
It contains the actual position (P00) of the regulator in the unit, that was determined by the parameter P05.

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

7.8 SDO Message

SDOs messages are used to know or modified rotadrive parameters, these parameters are enclosed in the "Object dictionary". Max 4 bytes are used for CAN data, other 4 bytes are used for Command, Index and Sub-index fields. SDOs are always follow by confirmation: when Master send a SDO to Slave, it always reply (with warning in case of problem).

SDO structure:

IDENTIFIER	
COB-ID(hex)	
F.C.	Node-ID

4 CAN Data Bytes			
0	1	2	3
Command	Index		Sub index
1 byte	LSB	MSB	1 byte

From 1 to 4 CAN Data Bytes			
4	5	6	7
Process data			
LSByte	...	...	MSByte

7.8.1 Command

The command byte contents the kind of telegram which is sent across the CAN network.
There are three kinds of telegrams:

- Set: to send to the encoder configuration parameters;
- Req: used by Master to read data from an encoder;
- Warnings: used by encoder to send to Master error messages (es. index does not exist, illegal parameter, ...).

Command (hex)	COB	COB type	Data length
22h	Set	M → S request	not spec.
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	
40h	Req	M → S request	0 byte
42h	Req	S → M reply	not spec.
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

7.8.2 Object dictionary

Index (hex)	Sub	Name	Ac
1000	00	Device type	ro
1001	00	Error register (see chap.7.8.3)	ro
1008	00	Manufacturer device name	ro
1009	00	Manufacturer hardware version	ro
100A	00	Manufacturer software version	ro
100C	00	Guard time	rw
100D	00	Life time factor	rw
100E	00	COB-ID guarding protocol	rw
1010	04	Save all parameters (chap.7.8.4)	rw
1011	01	Restore all default parameters (chap.7.8.5)	rw
1011	02	Restore communication param.	rw
1011	04	Restore axis parameters	rw
1011	05	Restore device parameters	rw
1014	00	COB-ID Emergency	rw
1017	00	Producer heartbeat time	rw
1018	01	Vendor-ID	ro
1400		Receive PDO1 parameter	
1400	01	COB-ID used by PDO1	rw
1400	02	Transmission type	rw
1600		Receive PDO1 mapping param.	
1600	01	Mapped object_1	rw
1800		Transmit PDO 1 parameter	
1800	01	COB-ID used by PDO	rw
1800	02	Transmission type	rw
1A00	00	1st transmit PDO mapping	rw
2000		Info parameters	ro
2000	01	P25 Nr. power downs	ro
2000	02	P26 Max. current of axis	ro
2000	03	P29 Working time	ro
2000	04	P30 Nr. of power on/off	ro
2000	05	P31 Nr. start routines	ro
2000	06	P34 Nr. of Go-To-Datum routines	ro
2000	07	P37 Nr. of over current errors	ro
2000	08	P40 Nr. of limit switch errors	ro
2000	09	P43 Nr. of shortcuts	ro
2000	0A	P46 Nr. feedback errors	ro
2100		Rotadrive parameters	
2100	01	P00 Actual position	rw
2100	02	P01 Target position	rw
2100	03	P02 Datum value	rw
2100	04	P03 Software limit -	rw
2100	05	P04 Software limit +	rw
2100	06	P05 Distance for scaling factor	rw
2100	09	P08 Nr. of automatic restarts	rw
2100	0A	P09 Tolerance window	rw
2100	0B	P10 "in position" time	rw
2100	0C	P11 Acceleration ramp	rw
2100	0E	P13 Fast speed	rw
2100	0F	P14 Manual slow speed	rw
2100	10	P15 Stop-ramp(Stop command)	rw
2100	11	P16 Step length in manual mode	rw
2100	12	P17 Backlash compensation dwell time	rw
2100	13	P18 Backlash compensation distance	rw
2100	16	P21 Differential gain	rw
2100	1B	P26 Counting direction	rw
2100	1C	P27 Go-To-Datum direction	rw
2100	1D	P28 Home position after Go-To-Datum routine	rw

2100	1E	P29	Reference switch for Go-To-Datum routine	rw
2100	22	P33	Go-To-Datum offset	rw
2100	25	P36	Closed loop control	rw
2100	26	P37	Closed loop response time	rw
2100	27	P38	Closed loop tolerance window	rw
2100	28	P39	Closed loop mode	rw
2100	2B	P42	Motor rotation direction	rw
2100	2C	P43	Deceleration ramp	rw
2100	2E	P45	Go-To-Datum speed	rw
2100	51	P80	Controller status	rw
2100	52	P81	Reference-Index distance	rw
2100	53	P82	Actual motor current	rw

7.8.3 Error register (index 1001 h)

Error register has the follow meaning:

bit	7	6	5	4	3	2	1	0

bit 0 = 1: No error
bit 4 = 1: CAN bus error
bit 7 = 1: Device error

7.8.4 Save all parameters

Writing to this object stores manufacturer defined parameters to EEProm.
Process data bytes to send:

	Process Data Bytes			
byte	4	5	6	7
ASCII	e	v	a	s
hex	65	76	61	73

7.8.5 Restore all parameters

Writing to this object restores the default values (factory settings).
Process data bytes to send:

	Process Data Bytes			
byte	4	5	6	7
ASCII	d	a	o	l
hex	64	61	6F	6C

7.8.6 Error codes on SDO

Error codes are specified in Process data bytes:

Process Data Bytes			
4	5	6	7
Error register		Error code	
LSB	MSB	LSB	MSB

E.R.	E.C.	Description
0002	0601h	Attempt to write a read only object
0000	0602h	Object does not exist
0011	0609h	Sub-index does not exist
0031	0609h	Value of parameter written too high
0032	0609h	Value of parameter written too low

7.9 Emergency error codes

Error	Meaning
0000	Error Reset or no Error
2300	Motor over current
8130	Life Guard Error
FF20	Motor short
FF40	Encoder Error

8 - RS232/RS485 interface

8.1 Connection

8.1.1 RS232 connection

Use 9 pin DSub connector and connect with CON2 according to wiring diagram on chapter 3.2.

CON2	Cable 2	Name	Function
4	Violet	RxD	Receive Data
5	Black	GND	Ground
9	Green	TxD	Transmit Data

Make sure that RxD on PC side is connected with TxD on Rotadrive side and TxD on PC is connected with RxD on Rotadrive.

8.1.2 RS485 connection

Use 9 pin DSub connector and connect with CON2 according to wiring diagram on chapter 3.2.

CON2	Cable 2	Name	Function
4	Violet	B	Channel B
9	Green	A	Channel A

8.2 Technical data

Function	Data
Baud rate	9600
Bit of data	8
Parity bit	No
Stop bit	1
Flow control	No

8.3 Introduction

The RS232 and RS485 protocol is according to DIN 66019, ISO 1765, ANSI X3.28.
The PC is master and Rotadrive is the slave with individual serial address. Slaves cannot send information without master request.
There are 3 ways of communication:

- Send
- Receive
- Broadcast

8.4 Communication frame

Field	Value	Function
EOT	04 h	End Of Transmit
AD1	ASCII	unit address, MSByte
AD2	ASCII	unit address, LSByte
STX	02	Start of Text
C1, C2	ASCII	axis command = 20: Info parameters 21: Rotadrive parameters
C3, C4	ASCII	parameter number = 00...99
DATA	n byte ASCII	process data
ETX	03 h	End of TeXt
BCC	xx h	Block Check Character
ENQ	05 h	ENQuiry
NAK	15 h	Not AcKnowledge
ACK	06 h	ACKnowledge

NOTE:

- **BCC** (block-check-character) is a character used for check the correct transmission. It is generated by XOR-ing characters C1, C2, C3, C4, DATA and ETX (including). If BCC < 20 Hex, BCC must be added up with 20 Hex, this avoids BCC to have values in the range of control character values.
- **DATA** field can contain any number of numerical characters, a sign and can be filled up with zeroes. All DATA are sent in ASCII Code.

8.5 Send data from Master to Slave

The complete set of parameters can be sent to the unit. The parameter values must be inside the allowed range (see chap. 4.1 Parameter description).
PC → Rotadrive

EOT	AD1	AD2	STX	C1	C2	C3	C4

DATA	ETX	BCC

When transmission is correct slave replies with ACK in any other cases with NAK.
Rotadrive → PC

ACK	or	NAK

All parameters sent to the slave are stored in a data buffer. Parameters have to be activated by the "activate parameter" command (ex. on chap. 8.8).

8.7 Receive data from slave

PC → Rotadrive

EOT	AD1	AD2	STX	C1	C2	C3	C4	ENQ

The correct reception of the string is acknowledged with the following message:

Rotadrive → PC

STX	C1	C2	C3	C4	DATA	ETX	BCC

The reception of a incorrect string is followed by a negative acknowledgement like:

Rotadrive → PC

STX	C1	C2	C3	C4	EOT

in any other cases with "**NAK**":

Rotadrive → PC

NAK

8.8 Serial commands

All commands are sent with parameter P52 (C1, C2, C3, C4 fields = 2152).

The following commands are available.

Commands Master → Slave	
DATA	**Description**
80 h	Start axis
81 h	Stop axis
82 h	Manual mode Step +
83 h	Manual mode Step -
84 h	Manual mode Slow +
85 h	Manual mode Slow -
86 h	Manual mode Fast +
87 h	Manual mode Fast -
88 h	Start Go-To-Datum routine
89 h	Activate Parameters
8A h	Save data (EEProm)
8B h	Go-To-Datum
8C h	Feedback frequency

The transmission of correct commands is acknowledged with **ACK**.

The transmission of incorrect commands is acknowledged with **NAK**.

Example:

Sending of the command "activate parameter" to the unit with device address 11.

PC → Rotadrive

	EOT	AD1	AD2	STX	C1	C2	C3	C4
ASCII		1	1		2	1	5	2
Hex	04	31	31	02	32	31	35	32

	DATA			ETX	BCC
ASCII	1	3	7		
Hex	31	33	37	03	32

Rotadrive → PC

	ACK
Hex	06

Example:

Sending of target position 135,12 to unit 15 and start command for positioning.

Sending target position:

PC → Rotadrive

	EOT	AD1	AD2	STX	C1	C2	C3	C4
ASCII		1	1		2	1	0	1
Hex	04	31	31	02	32	31	30	31

	DATA					ETX	BCC
ASCII	1	3	5	1	2		
Hex	31	33	35	31	32	03	35

Rotadrive → PC

	ACK
Hex	06

Start axis:

PC → Rotadrive

	EOT	AD1	AD2	STX	C1	C2	C3	C4
ASCII		1	1		2	1	5	2
Hex	04	31	31	02	32	31	35	32

	DATA			ETX	BCC
ASCII	1	2	8		
Hex	31	32	38	03	3C

Rotadrive → PC

	ACK
Hex	06

8.9 Status request P80

The status of Rotadrive can be requested at any time. It reports the status of the device and I/O's.

PC → Rotadrive (unit 11)

	EOT	AD1	AD2	STX	C1	C2	C3	C4	ENQ
ASCII		1	1		2	1	8	0	
Hex	04	31	31	02	32	31	38	30	05

In responding to a status request the unit replies with some DATA bytes (2 hex bytes: 1st I/O-status, 2nd device-status).

Rotadrive → PC

	STX	C1	C2	C3	C4	DATA			
ASCII		2	1	8	0	x	x	x	x
Hex	02	32	31	38	30	3x	3x	3x	3x

	ETX	BCC
ASCII		
Hex	03	xx

Status information

I/O Status:

bit	7	6	5	4	3	2	1	0

bit 0 = 1: High Input 1
bit 1 = 1: High Input 2
bit 2 = 1: High Input 3
bit 3 = 1: High Output 1

Device Status:

bit	7	6	5	4	3	2	1	0

bit 0 = 0: axis not ready
bit 0 = 1: axis ready
bit 1 = 1: axis moving
bit 2 = 1: axis in position
bit 3 = 1: Go-To-Datum routing active
bit 4 = 1: over current
bit 5 = 1: shortcut
bit 6 = 1: encoder error/malfunction
bit 7 = 1: target position out of range
bit 4...7 = 1: power supply error

The status information can be combined together.

Example:

03Hex means Rotadrive is ready and moving.
05Hex means Rotadrive is within the tolerance window.

9 - Diagnostics

9.1 Power down

The recommended power supply of Rotadrive is 24Vdc. The integrated power-failure-controller senses voltage levels below 18Vdc and saves all actual values. In power-down-mode the unit is not enabled to run. Return of correct power supply will restart the unit.

Situation 1:

Power supply falls down and remains under 18Vdc.
- the unit switches to power-down-mode.
- the controller is not enabled to run the device.

Situation 2:

During a positioning routine power supply falls down under 18Vdc and subsequently increases again over 18Vdc.

- the unit switches to power-down-mode (<18Vdc)
- lost of correct actual position
- controller restarts working (>18Vdc)
- power failure error will be stored in diagnostic-memory
- run Go-To-Datum routine or reset actual position to right value

IMPORTANT !

In this condition the power supply is not dimensioned appropriately.

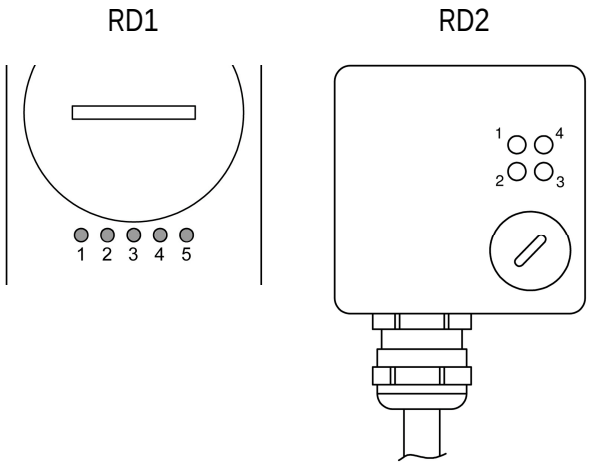
9.2 Diagnostics memory

Rotadrive has a diagnostics memory that can be checked by means of Lika Drive-tool.
The following information is stored permanently:

- Nr. of power on/off events
- Nr. of power-down events (see Situation 2)
- Nr. of positioning routines (Start with 0x80)
- Nr. of Go-To-Datum routines (Start with 0x88)
- Nr. of over current events
- Nr. of encoder errors/malfunctions
- Nr. of shortcut events
- Nr. of limit switch errors
- max. motor current during operation
- service time (power supply switched on)

9.3 LED Diagnostics

RD1 has 5 LED's on it's cover and RD2 has 4 LED's on it's cover (see figure) which optically represent the status of the device.



Nr.	LED	Description
1	Green	Axis in position (see 0x04)
2	Green	Bus communication OK
3	Red	Error (see 0x10, 0x20, 0x40, 0x80)
4	Green	Power supply Controller OK
5	Green	Power supply Motor OK

10 - Controller set up

Before switching on the unit make sure all connections are according to the wiring diagrams.

Follow these steps for a correct setup of the unit.

- Set parameters P03, P04 and P05 according to the mechanical characteristics of the application.
- Switch off parameters like P08 (nr. automatic restarts), P09 (tolerance window) and P17 (backlash compensation dwell time).
- Move the unit using manual mode + and -.
- Change P26 and P42 (controller and motor rotation direction) if necessary.
- Now enter a target position value and start moving. During this operation the motor should reach maximum rotational speed.
- The stroke should exceed the value entered in P11 (acceleration ramp).
- If Rotadrive overruns the target position increase the value of P11.
- Decrease P11 if the positioning time is too high.
- If the unit stops before reaching the target position increase value of P21 (differential gain). The setup of this parameter depends on the ramp length.
- Switch on P08 (nr. of automatic restarts) if the unit is unable to reach the target properly.
- If the application allows some tolerances regarding the positioning accuracy set parameter P09 (tolerance window) to this value. The controller reports "in position" when the unit is inside the tolerance window.

Rev.	Man.Vers.	Description
0	1.0	1^ issue Unification of in Rotadrive manuals

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