User's guide

RD4

PROFI® PROCESS FIELD BUS BUS

lika

Position measurement & control

General contents

Subject Index

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 positioning units RD4 model**.
RD4 units are positioning devices which integrate into one system 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.

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

WARNING
When you install **Lika RD4-T32** or **Lika RD4-T48** modules, the value of each parameter is uploaded at power on from the GSD file which has been loaded in the PLC. Thus any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message will be temporary: when you turn off the power supply, the set value is lost (except the preset value which is the only variable not included in the GSD file; or unless you set the preset value previously which causes all parameters values to be saved automatically, see on page 67) and the value saved in the PLC will be uploaded at next power on (thus all values, even if previously saved because of a preset setting, will be overwritten anyway).

This unit also allows to install the **Lika RD4-no param** module (it is available starting from H2S4 version, V4 GSD file). Using this module, the unit does not read the parameters from the PLC when the power is switched on (they are read from the flash memory) and allows the operator to save any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message on the non-volatile memory (by means of the bit 9 **Save parameters** in the **Control Word (Bytes 0 and 1)**). When the **Lika RD4-no param** module is installed, it is NOT possible to read and change the values of the **configuration data** parameters in the **Parameter Assignment** page of the STEP 7 **Properties - DP slave** window (see "Setting "configuration data" parameters" section on page 25). Thus you are allowed to enter new parameter values only through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message. The **Lika RD4-no param** module has no relevance to the reduction gear ratio and can be used for whatever unit and independently from its

reduction gear. Anyway it is obvious that the parameters you set must be compatible with the mechanical and electrical characteristics of the unit you are going to configure.

On the other hand using Siemens STEP7 it is possible to alter any value and then save it permanently in the PLC (except in the -no param module). To save values permanently the operator has to enter the **Properties - DP slave** window of STEP7 and then alter the desired item (see section "Setting "configuration data" parameters" on page 25). Values altered in the variables table of STEP7 (see section "5.3 Setting and reading parameter values" on page 29) are temporary only.

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 shield 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 figured 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 solid shaft: in order to guarantee maximum reliability over time of mechanical parts, we recommend a flexible coupling to be installed to connect ROTADRIVE and user's shaft; respect the misalignment tolerances required by the flexible coupling;
- unit with hollow shaft: ROTADRIVE can be mounted directly on 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 has 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 Mechanical installation

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.

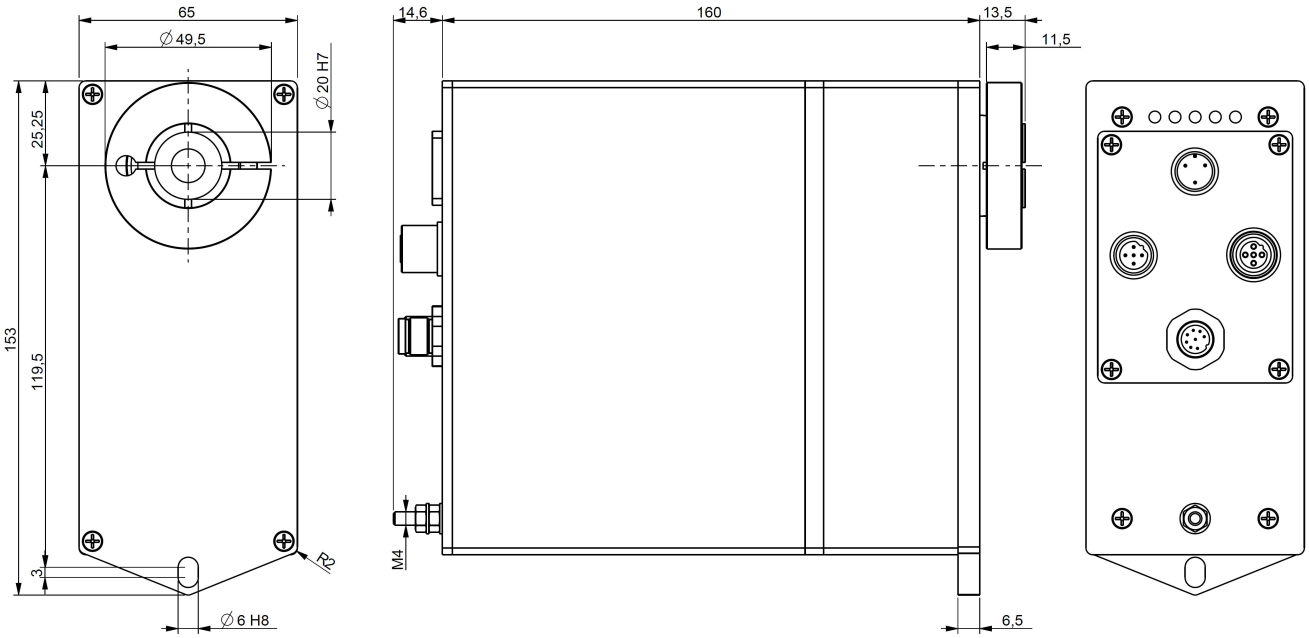


Figure 1 - RD4 unit – Overall dimensions

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 (TE M5 screw); the anti-rotation pin 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 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!

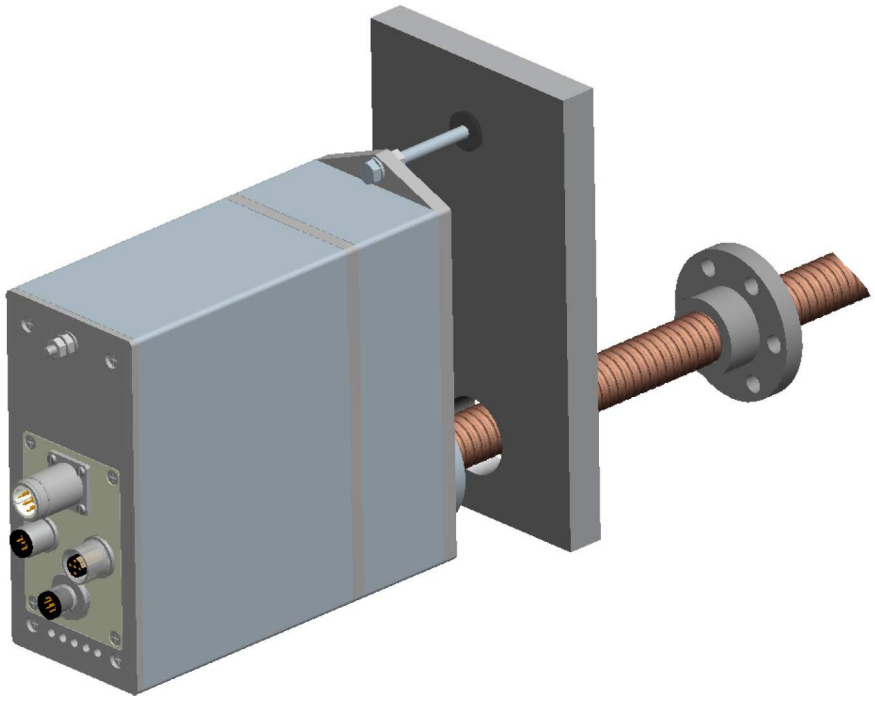
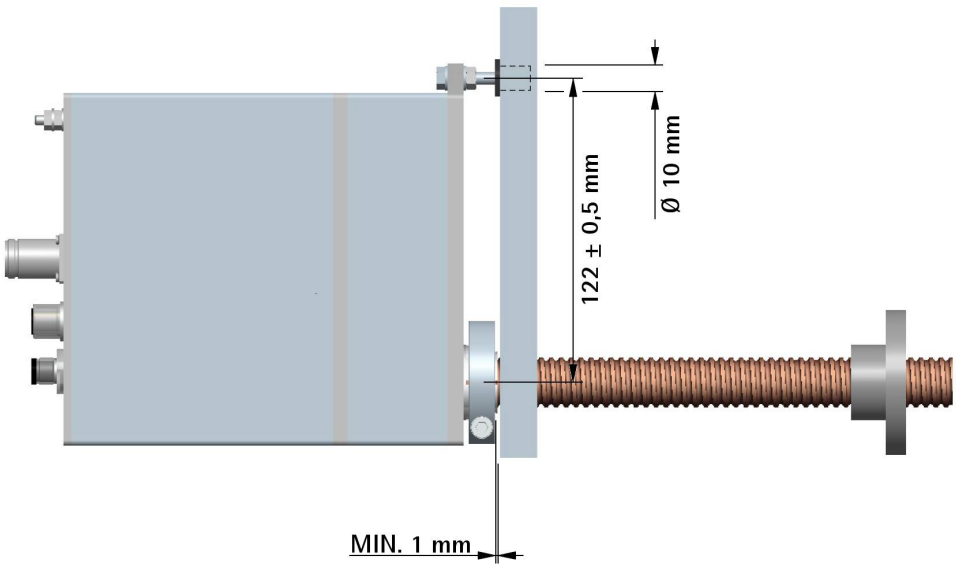


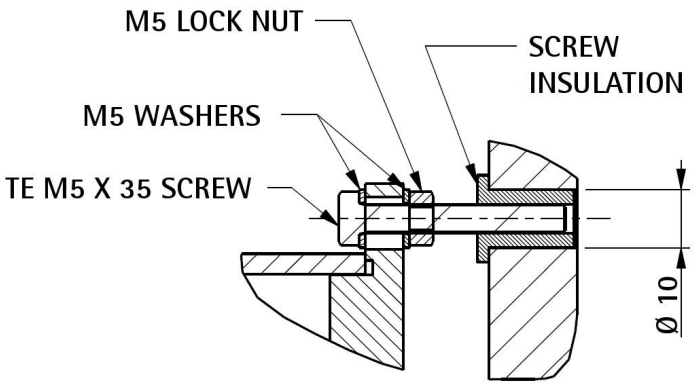
Figure 2 - Typical installation example of RD4 unit on worm screw

To install properly the ROTADRIVE 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.

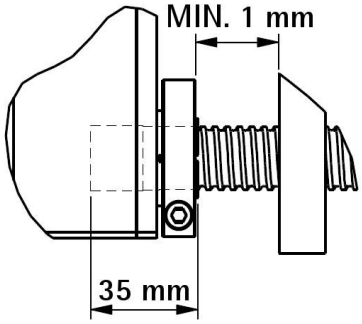
- Drill a 10 mm diameter hole in the flange or in the fixed support on user's side in order to insert the screw insulation and the anti-rotation pin. The



distance between the axis of the shaft and the axis of the hole must be 122 ± 0,5 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 M5 x 35 UNI5739 screw and the two M5 washers in the hole designed in the flange of the ROTADRIVE unit; partially screw the M5 lock nut;
- insert the user's shaft in the hollow shaft of the ROTADRIVE unit; the maximum depth of the ROTADRIVE shaft is 35 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 M5 lock nut in order to secure the anti-rotation pin to the flange of the ROTADRIVE unit.

ATTENTION

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
Power supply must be turned off before performing any operation!

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!

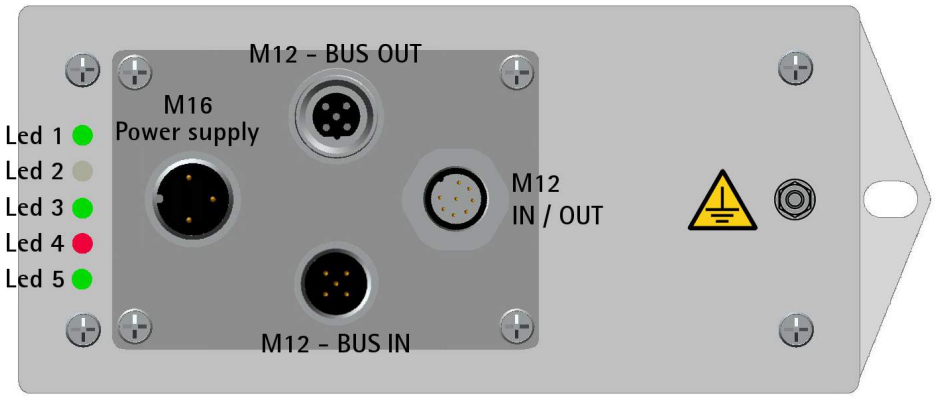


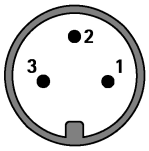
Figure 3: Electrical connections and diagnostic LEDs

4.1 Ground connection (Figure 3)

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. Connect the cable shield to the connector metal housing; 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 Connectors (Figure 3)

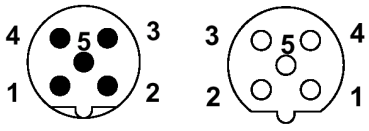
Power supply
M16 3-pin male connector



(frontal side)

Pin	Description
1	+24VDC ±10% motor power supply
2	+24VDC ±10% controller power supply
3	motor and controller 0 VDC supply voltage

Profibus signals
M12 5-pin connectors
B coding
(frontal side)



male (BUS IN) female (BUS OUT)

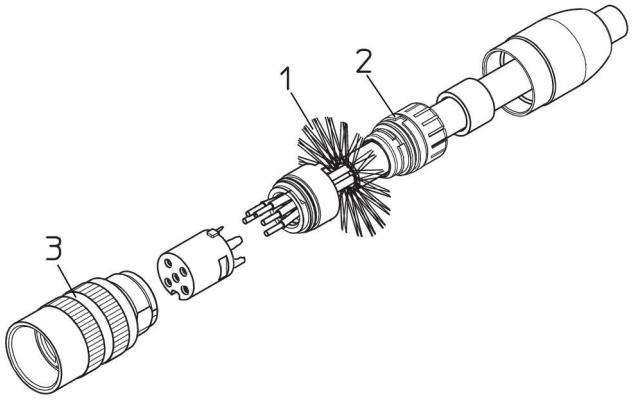
Pin	Description
1	n.c.
2	Profibus A (Green)
3	n.c.
4	Profibus B (Red)
5	n.c.
Case	Shielding[1]

n.c. = not connected
1 Connect the cable shield to the cable gland of the metal connector

We recommend Profibus-DP certified connectors and cables to be used.

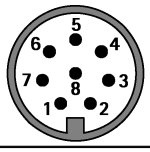
NOTE

It is of great importance that shielded cables are used for transmitting signals in the Profibus network; furthermore, shielding must be connected to the metal ring nut of the connector for a safe grounding through the body of the device. So always disentangle and shorten the shielding 1 and then bend it over the part 2; finally place the ring nut 3 of the connector. Be sure that the shielding 1 is in tight contact with the ring nut 3.



Inputs/ outputs (optional)

M12 8-pin male connector
(frontal side)



Pin	Description
1	0 VDC
2	Input 1
3	Input 2
4	Input 3
5	Output 1
6	Output 2
7	Output 3
8	n.c.

n.c.: not connected

4.3 Diagnostic LEDs (Figure 3)

Five LEDs located next to the M16 power supply connector (see Figure 3) are meant to show visually the operating or fault status of the Profibus interface and the device 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	Not used

LED 3 GREEN	LED 4 RED	Description
STATUS	FAULT	Profibus network diagnostic LEDs
OFF	OFF	Power supply is turned off or hardware breakdown not recognized
ON	OFF	Normal operation in Data_Exchange mode
Blinking	ON	Indicates that an alarm is active (for the complete list of alarm messages refer to page 55); or configuration parameters are not valid
ON	Blinking	Bus communication is cut off
Blinking	Blinking	Flash memory error, it cannot be restored

LED 5 GREEN	Description
ON	Indicates the motor is enabled (control loop activated)
OFF	Indicates the motor is disabled (control loop deactivated)

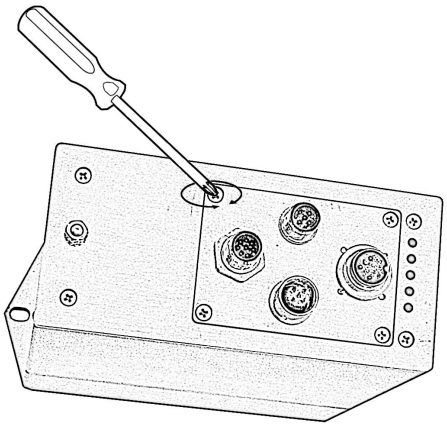
During initialisation, system checks the diagnostic LEDs for proper operation; therefore they blink for a while.

4.4 Dip-Switches (Figure 4)

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 DIP-Switches loosen the four screws and remove the connectors metal cover. Handle the cover with care not to stretch or pull out the connection wires. Be careful to replace the metal cover at the end of the operation.



The DIP-switches are just beneath.

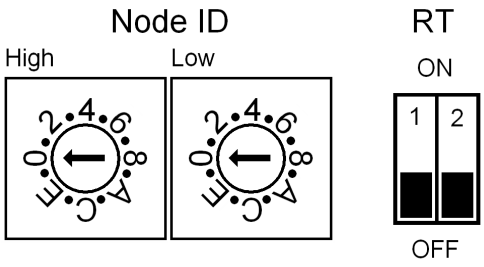


Figure 4: Dip-Switches

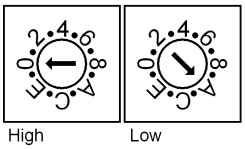
4.4.1 Setting the node address: Node ID (Figure 4)

WARNING
Power supply must be turned off before performing this operation!

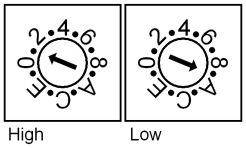
Set the node address expressed in hexadecimal notation.
The range of node addresses is between 0 and 125 (125 = 7D hex).

Example

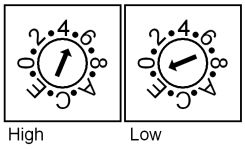
Address 10 = 0A hex:



Address 25 = 19 hex:



Address 95 = 5F hex:



NOTE
The default address is 1.
If you set the address to 0, device will be set to 1 automatically (address 0 is reserved for Master).
If you set an address higher than 125, device will be set automatically to 125.

4.4.2 RT bus termination (Figure 4)

A bus termination resistance 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

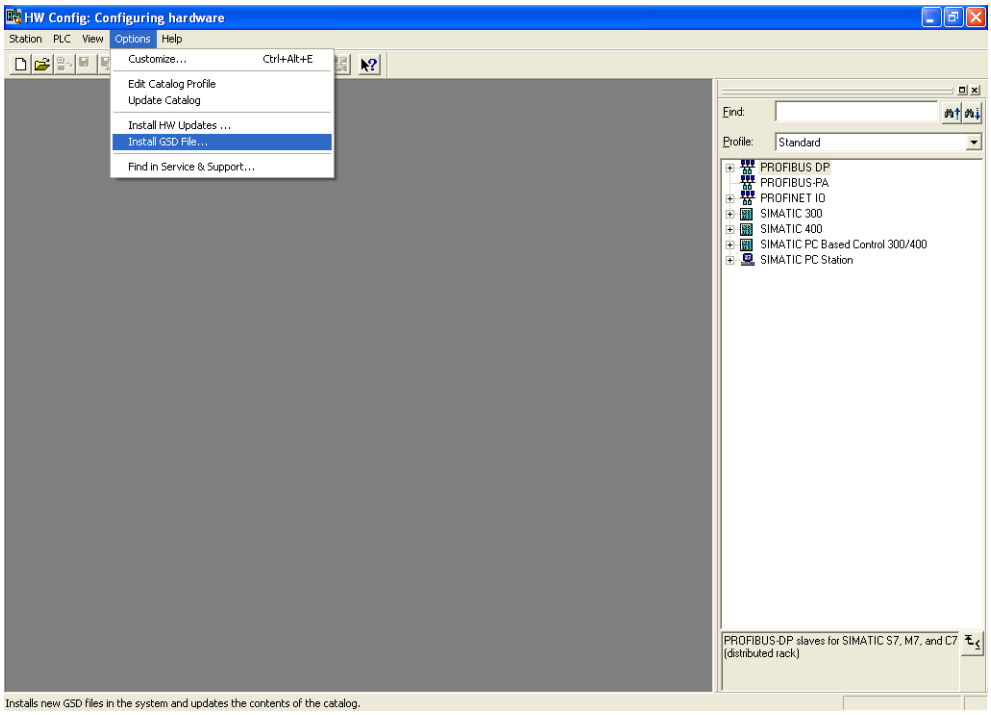
5.1 Configuring the unit using Siemens STEP7

Installing the GSD file

RD4 positioning units fitted with Profibus interface are supplied with their own GSD file **RD4Vx.GSD** (see enclosed documentation or click **www.lika.biz > PRODUCTS > DRIVECOD > RD4**).
GSD file is available in both English version (**RD4Vx.GSE**) and Italian version (**RD4Vx.GSI**).

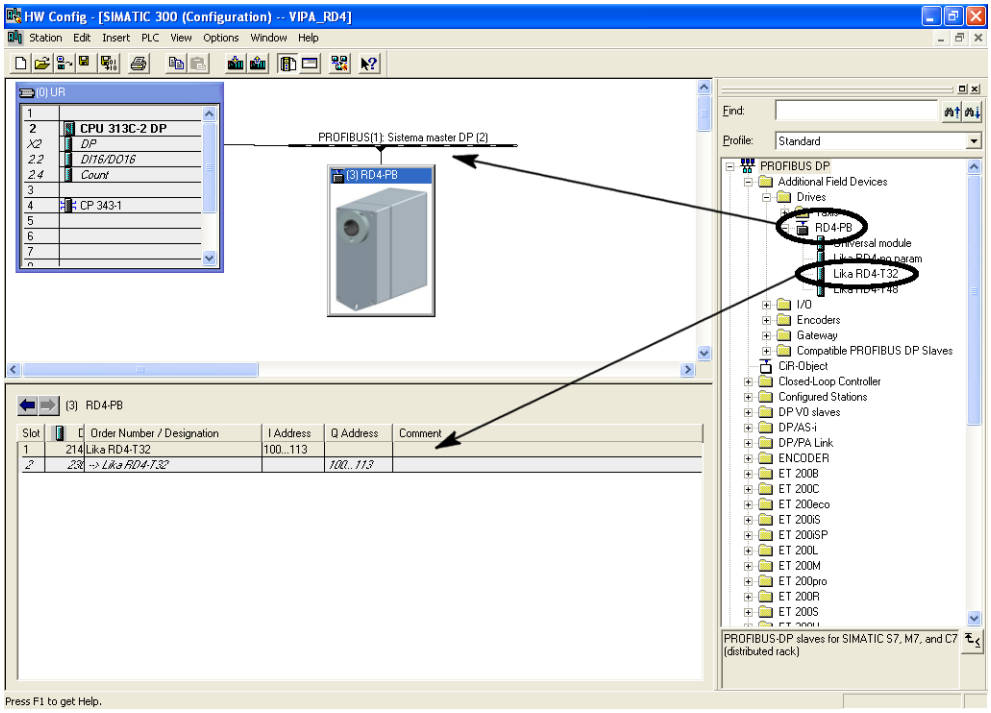
WARNING
HW2 SW4 version of the unit RD4-Profibus introduces the new module -no param. Using this module, the unit does not read the parameters from the PLC when the power is switched on (they are read from the flash memory) and allows the operator to save any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message on the non-volatile memory (by means of the bit 9 **Save parameters** in the **Control Word (Bytes 0 and 1)**). It has to be used with the GSD file version V4 or later. You can install also the previous version V3, of course this is intended only for models having -T32 and -T48 reduction gear, as parametrization for -no param module is not available before H2S4 firmware version.

To install RD4 unit on Siemens STEP7 proceed as follows.
In the main window **HW Config** of STEP7 select **Install GSD File...** command from **Options** menu bar.
In the window that appears you can select the GSD file specific to the unit you need to install in your Siemens control system.



Adding a node to the project

To add a node to the project, extend the directory tree in the right pane of the STEP7 **HW Config** main window and select the **RD4-PB** module available in **Catalog > PROFIBUS-DP > Additional Field Devices > Drives**; drag the module to the pane on the left and drop it on the "BUS".
Then drag the **Lika RD4-T32** or **Lika RD4-T48** or **Lika RD4-no param** module (according to the model you need to install) to the variables table in the bottom left; for instance, install the **Lika RD4-T32** module.

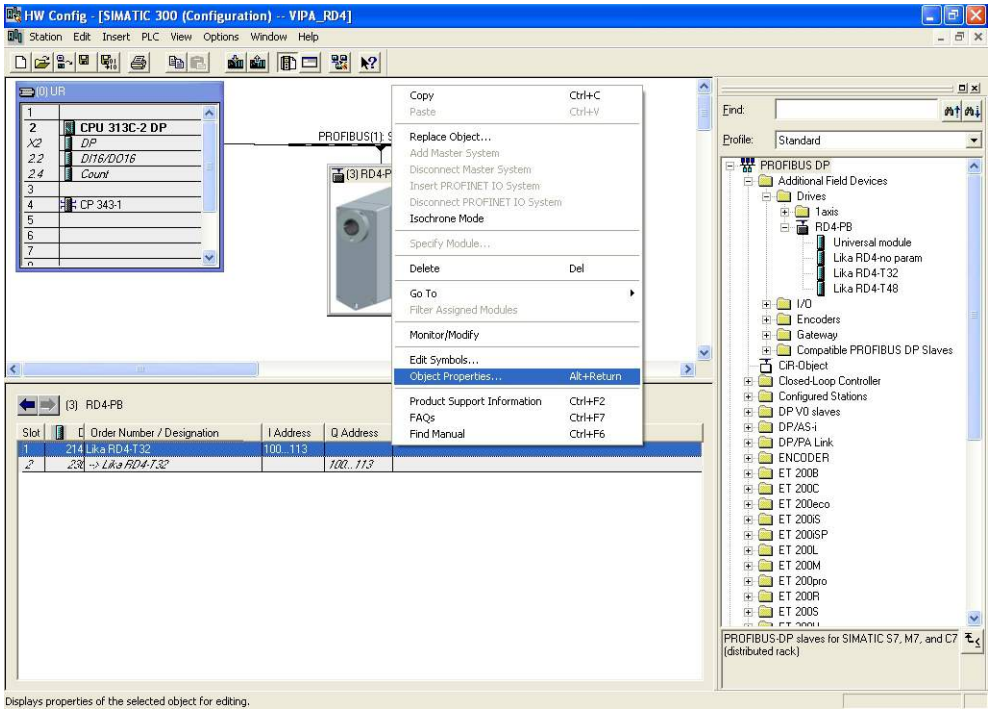


Setting "configuration data" parameters

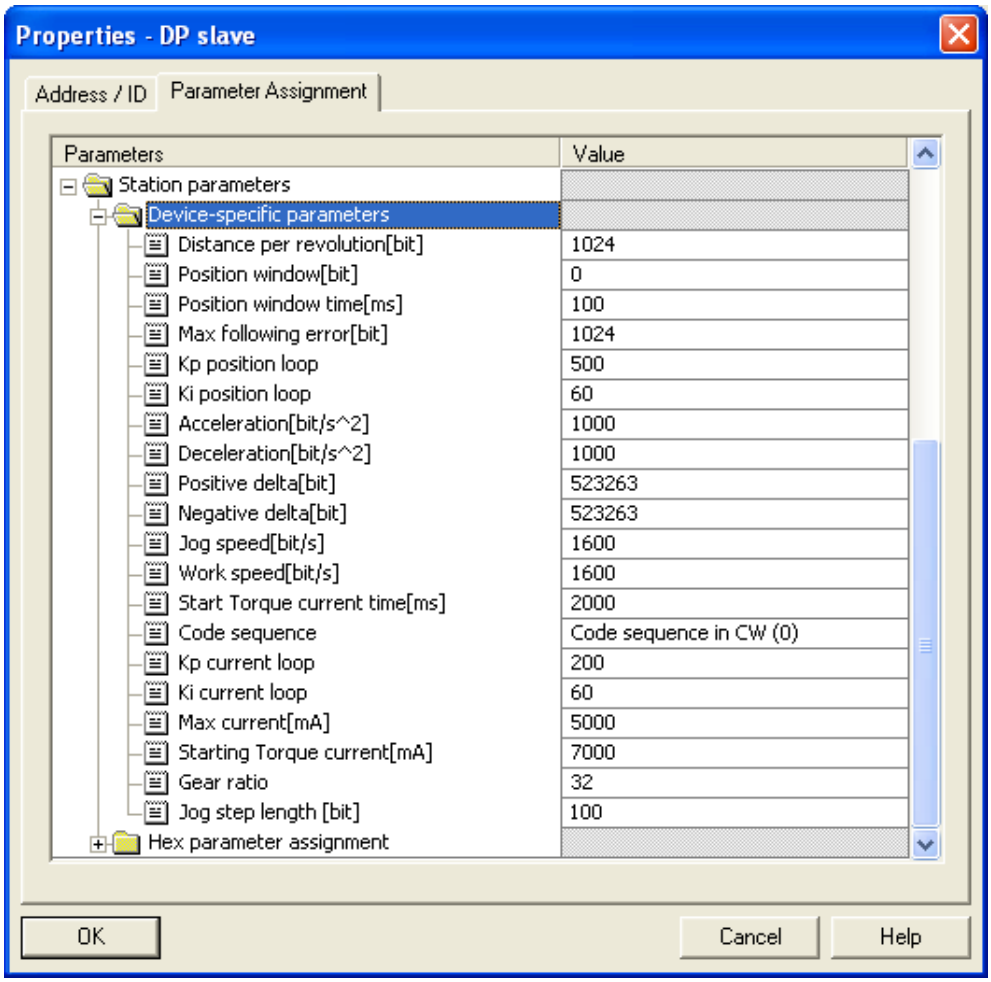
NOTE

The "configuration data" parameters setting page (**Parameter Assignment** page in the **Properties - DP slave** window) is hidden and thus not available when you install the **Lika RD4-no param** module. Using this module, the unit does not read the parameters from the PLC when the power is switched on (they are read from the flash memory) and allows the operator to save any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message on the non-volatile memory (by means of the bit 9 **Save parameters** in the **Control Word (Bytes 0 and 1)**). When the **Lika RD4-no param** module is installed, parameters can be saved only through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message.

To access the parameters configuration window, first enter the STEP7 **HW Config** main window and select the **Lika RD4** item just installed (**Lika RD4-T32** model in the example) available in the variables table in the bottom left; then right-click the item and press the **Object Properties...** command in the shortcut menu.



The **Properties - DP slave** window will appear. In the **Parameter Assignment** page all **configuration data** parameters available for the device are listed.
For a comprehensive description of the parameters and how to set them properly refer to the specific explanation in section "Programming parameters".

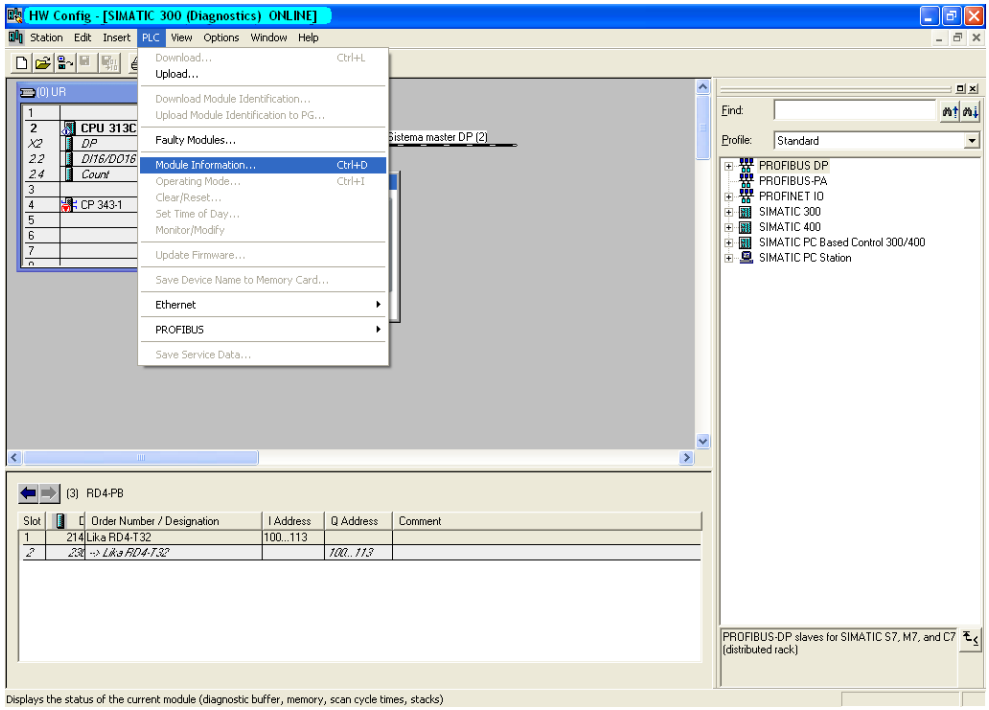


After having set parameter values, press the **OK** button to close the **Properties - DP slave** window and then press the **Download to module** button (see icon on the left) in the toolbar of the **HW Config** main window to download the set values.

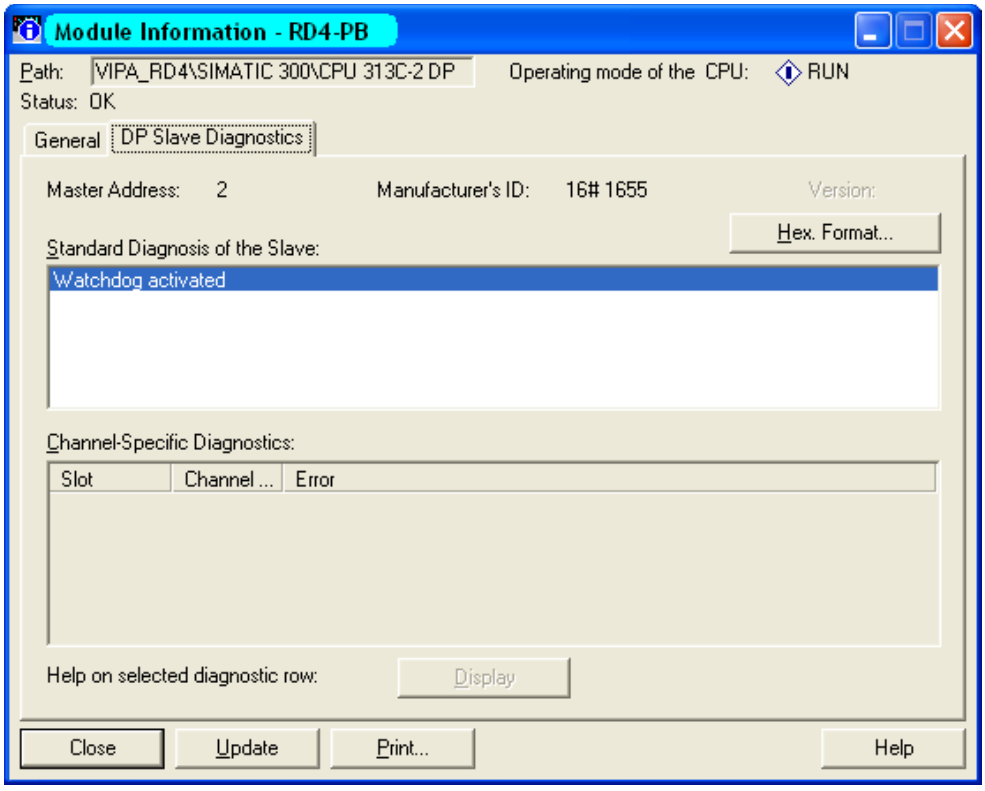
5.2 Reading diagnostic information

Before entering the diagnostic page, it is necessary to connect to the unit and go online. To do this, enter the **HW Config** main window and press the **Go online** command in the **Station** menu bar; or press the **Online / Offline** button in the toolbar of the same window (see icon on the left).

Now select the RD4-PB module linked to the BUS and then the **Module Information...** command in the **PLC** menu bar to enter the **Module Information** window.

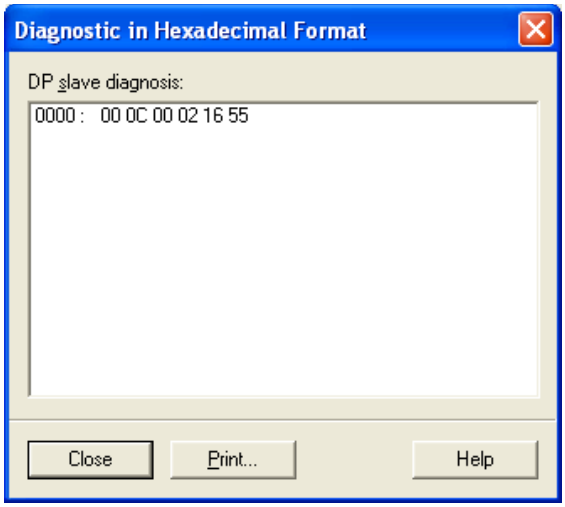


Finally open the **DP Slave Diagnostics** page in the **Module Information** window.



Click the **Hex. Format...** button to display diagnostic information.

6-byte diagnostic:

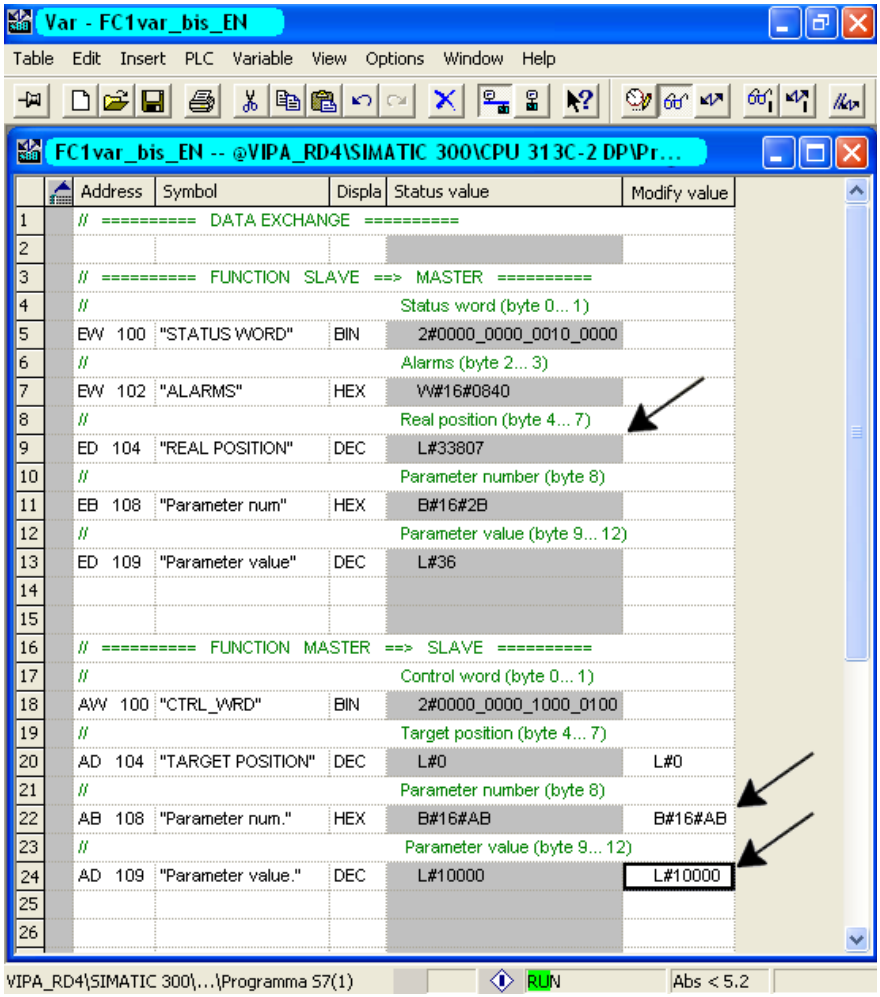


5.3 Setting and reading parameter values

When the device is in Data_Exchange mode, setting and reading of both **configuration data** and **operating parameters** are allowed; the meaning of the messages transmitted between the Master and the Slave is explained in the section "7.6 DDLM_Data_Exchange" on page 45.
To set a new parameter value please refer to the example described in the section "**Setting parameter 28 Preset**" just below.
To read a parameter value please refer to the example described in the section "**Reading parameter 29 Current velocity value**" further below.

Setting parameter 28 Preset

In the following example device having node address 3 transmits its position to the Master through variable at address ED 104...107 -**Position (Bytes 4 ... 7)**- and receives the preset value through variables AB 108 (**Parameter number (Byte 8)**) and AD 109...112 (**Parameter value (Bytes 9 ... 12)**).



Parameter number = A8hex — index of parameter **28 Preset** is 28h (see on page 67); then command 80h for writing values must be added (28h + 80h = A8h).

Parameter value = 10000 — (Preset value, by way of example).

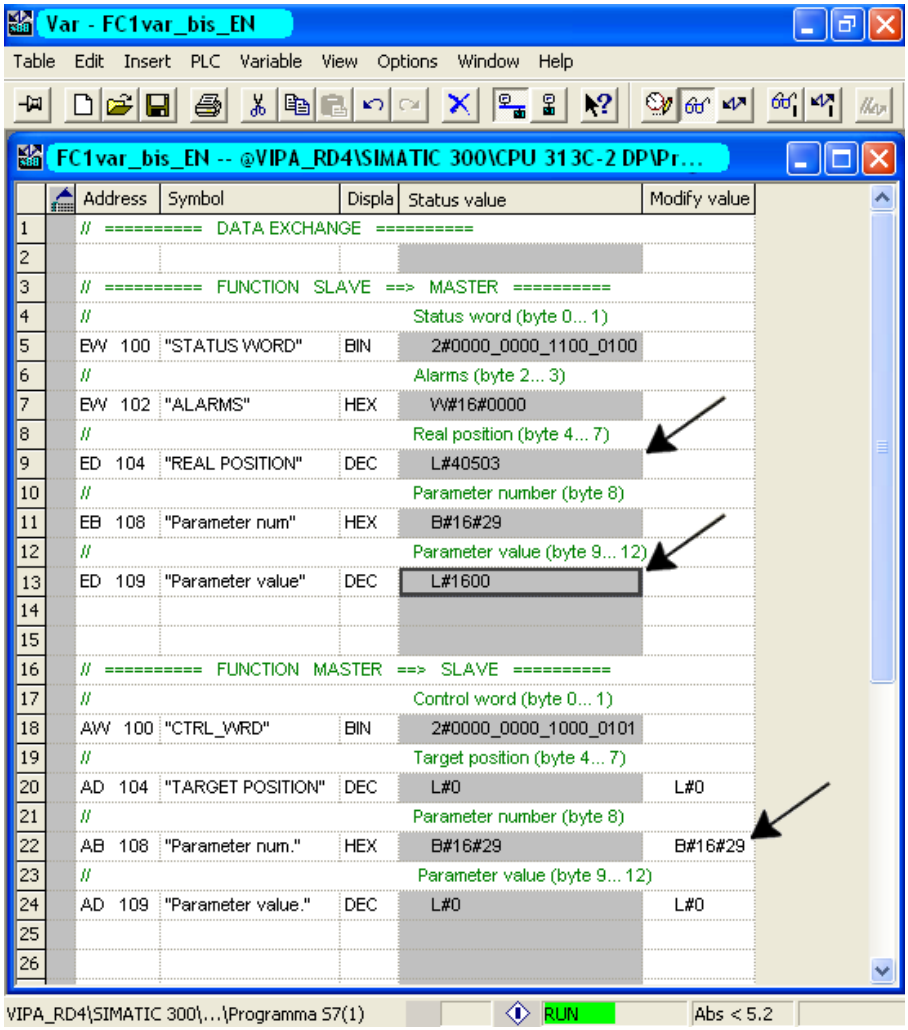
To download the preset value press the **Modify variable** button in the toolbar (see icon on the left, on the right of the **Monitor Variable** button symbolized by the glasses).

Now device can send the preset value "10000".

To carry out the preset procedure, switch bit 7 of the same variable to 0 and then press again the **Modify variable** button (**Parameter number** 28h).

Reading parameter 29 Current velocity value

In the following example device having node address 3 transmits to the Master its position through the variable at address ED 104...107 -Position (Bytes 4 ... 7)- and its speed through the variable at address ED 109...112 (Parameter value (Bytes 9 ... 12)).



Parameter index = 29hex — index of parameter 29 Current velocity value (see on page 68).

Parameter value = 1600 — speed = 1600 pulses per second.

To read the speed value, press the **Modify variable** button in the toolbar (see icon on the left, on the right of the **Monitor Variable** button symbolized by the glasses).

Now device transmits the speed value: "1600" pulses per second.

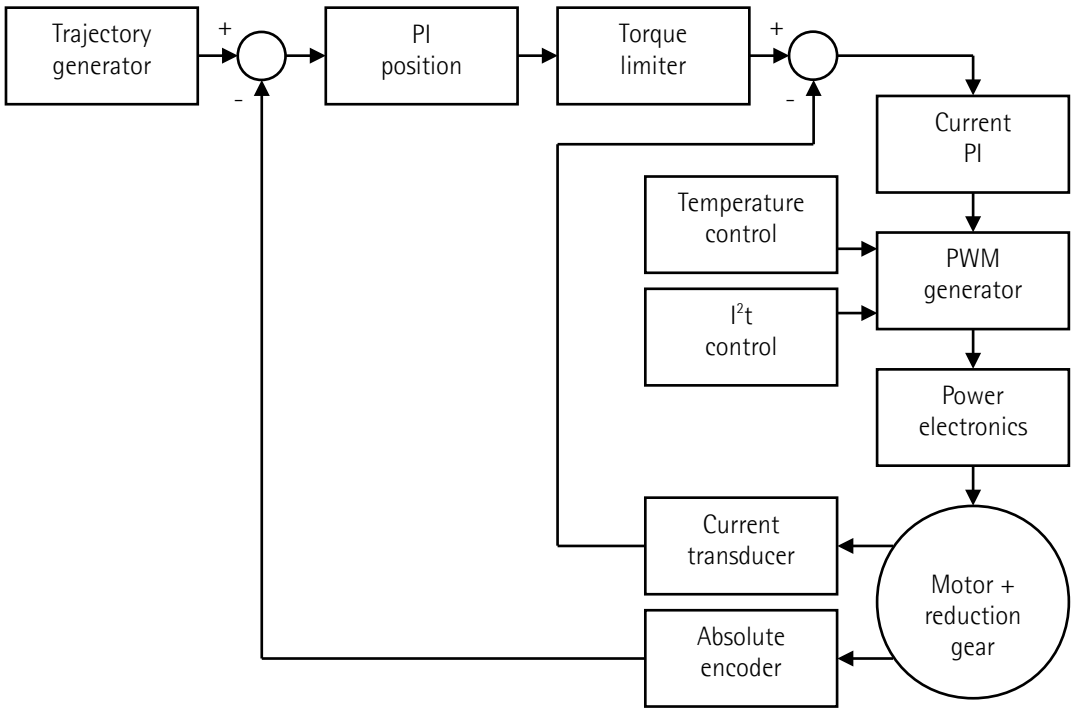
NOTE

It may occur that data variables having index higher than 127 or data greater than 4 bytes are not treated properly in STEP7 software. Should this happen, we recommend the "MD" reference operators (pointers) for managing variables transmitted between Master and Slave to be used.

6 Functions

6.1 Working principle

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



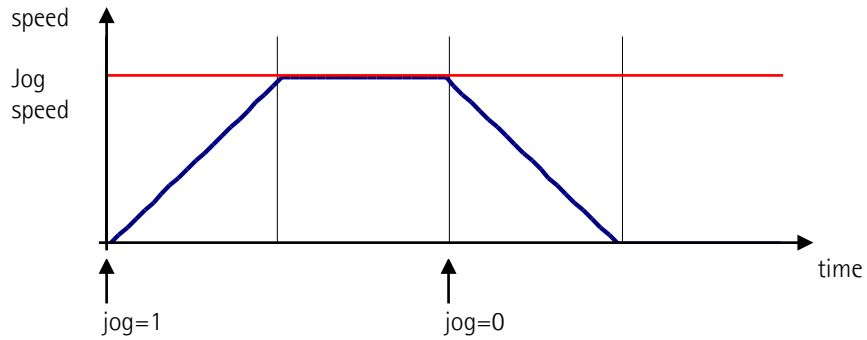
6.2 Movements: jog and positioning

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

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

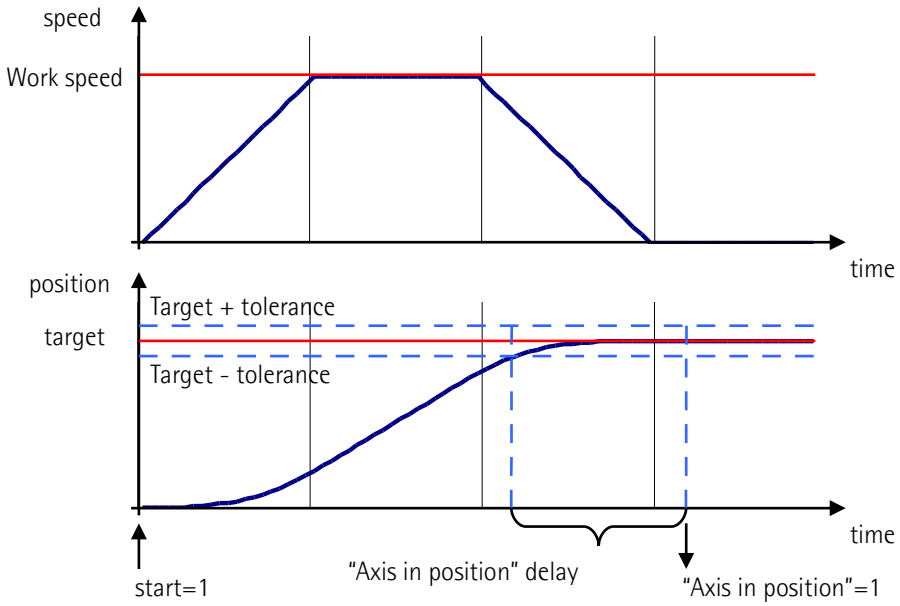
Jog: speed control

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 **0B 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 **0C Work speed**; set speed can be reached only if the available space is long enough.



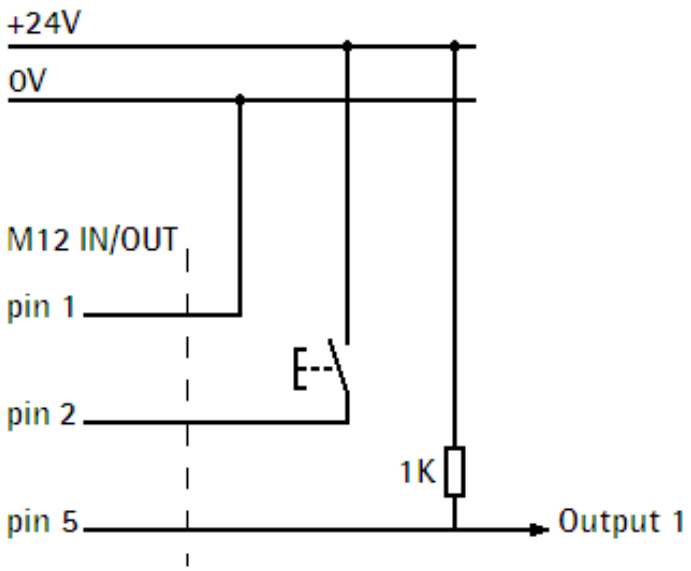
6.3 Digital inputs and outputs

RD4 unit is fitted with **three digital inputs** and **three digital outputs**.

Inputs are read by the Slave device and transmitted to the Master through **Status word (Byte 0 and 1)** (bits 13-15; see on page 54) when the device is running in **Data_Exchange** mode.
"High" logic value is read when voltage is equal to +24VDC ±10%.

Slave outputs are operated by the Master through **Control Word (Bytes 0 and 1)** (bits 13-15; see on page 48) when the device is running in **Data_Exchange** mode.
Outputs are "open collector" type having Imax = 150mA.

Example of connection scheme:



6.4 01 Distance per revolution, 0B Jog speed, 0C Work speed, 28 Preset, 09 Positive delta and 0A Negative delta

Parameters **01 Distance per revolution**, **0B Jog speed**, **0C Work speed**, **28 Preset**, **09 Positive delta** e **0A Negative delta** 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 value in **01 Distance per revolution** (parameter 01h, see on page 61);
- set value in **0B Jog speed** (parameters 0Bh, see on page 64);
- set value in **0C Work speed** (parameters 0Ch, see on page 64);
- set value in **28 Preset** (parameter 28h, see on page 67);
- check that value in **09 Positive delta** is set properly (parameter 09h, see on page 63);
- check that value in **0A Negative delta** is set properly (parameter 0Ah, see on page 63).

WARNING
Each time you change the value in **01 Distance per revolution** you must then set new values also in **0B Jog speed** and **0C Work speed** as speed values are expressed in pulses per second (PPS). To calculate the speed values you have always to adhere to the following ratio:

$$\frac{\text{Min. speed} * \text{Distance per revolution}}{1024} \leqslant \text{Speed} \leqslant \frac{\text{Max. speed} * \text{Distance per revolution}}{1024}$$

where:

- **Distance per revolution**: this is the new value you want to set in **01 Distance per revolution**, expressed in pulses
- **Min. speed**: minimum speed 1 [PPS] for all RD4 units
- **Max. speed**: maximum speed 1600 [PPS] for RD4-...-T32-... model
  1066 [PPS] for RD4-...-T48-... model
- **1024**: this is the maximum value you can set in **01 Distance per revolution** (expressed in pulses).

After having changed the parameter in **01 Distance per revolution** it is then compulsory to set also the value in **28 Preset** in order to define the zero of the shaft as the system reference has now changed.
On the other hand, after having entered a new value in **28 Preset** it is not necessary to set new values for travel limits as the Preset function then

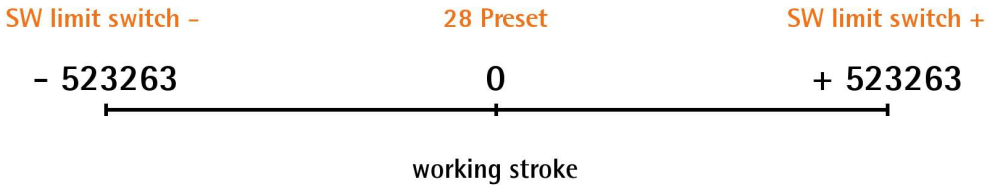
calculates them automatically and initializes again the positive and negative limits according to the values set in **09 Positive delta** and **0A Negative delta**.

The number of revolutions the device is able to reach is 511 in negative direction and 511 in positive direction by taking reference of **28 Preset**.
Value set in parameter **09 Positive delta** plus value set in parameter **28 Preset** is the maximum forward travel (positive travel) starting from the preset (value is expressed in pulses).
Value set in parameter **0A Negative delta** subtracted from value set in parameter **28 Preset** is the maximum backward travel (negative travel) starting from the preset (value is expressed in pulses).

WARNING
Please note that the parameters listed hereafter are closely related to the **01 Distance per revolution** parameter; hence when you change the value in **01 Distance per revolution** also the value expressed by each one is necessarily redefined. They are: **02 Position window**, **04 Max following error**, **07 Acceleration**, **08 Deceleration**, **09 Positive delta**, **0A Negative delta**, **29 Current velocity value**, **30 Positive absolute limit switch**, **31 Negative absolute limit switch**, **Target position (Bytes 4 ... 7)** and **Position (Bytes 4 ... 7)**. See for instance the relationship between **01 Distance per revolution** and the speed values, explained in the previous page.

Example 1
Default values:
01 Distance per revolution = 1024 pulses per revolution
Max. **0C Work speed**:
= 1600 pulses per second for RD4-...T32-... model (1600*1024/1024 = 1600)
= 1066 pulses per second for RD4-...T48-... model (1066*1024/1024 = 1066)
28 Preset = 0

09 Positive delta and **0A Negative delta** maximum values = 523263 = (1024 pulses per revolution x 511 revolutions) - 1 when **28 Preset** = 0
SW limit switch + maximum value = 0 + 523263 = 523263 pulses (forward stroke)
SW limit switch - maximum value = 0 - 523263 = 523263 pulses (backward stroke)
Therefore, when **28 Preset** = 0, the working stroke of the axis will span the maximum positive and negative limits range, that is **SW limit switch +** = 523263 and **SW limit switch -** = - 523263.



Example 2

RD4-...T32-... positioning unit is joined to a worm screw having a 1 mm pitch and you need to have a hundredth of a millimetre resolution.

01 Distance per revolution = 100 pulses per revolution

Max. **0C Work speed** = 156 pulses per second (1600*100/1024 = 156, rounded off to the nearest integer)

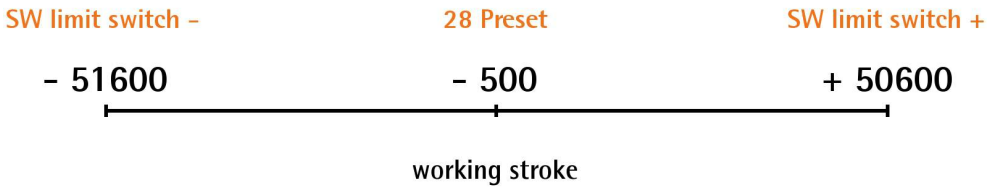
28 Preset = -500 (ex. thickness of the tool)

09 Positive delta / **0A Negative delta** maximum values = 100 pulses per revolution x 511 revolutions = 51100 pulses

SW limit switch + maximum value = (-500) + 51100 = 50600 pulses (forward stroke)

SW limit switch - maximum value = (-500) - 51100 = - 51600 pulses (backward stroke)

Therefore, when **28 Preset** = - 500, the working stroke of the axis will span the maximum positive and negative limits range, that is **SW limit switch +** = + 50600 and **SW limit switch -** = - 51600.



7 Profibus® interface

Lika ROTADRIVE positioning units with Profibus interface are Slave devices and are designed in compliance with "PROFIBUS-DP Profile".
For any further information or omitted specifications please refer to documentation issued by Profibus International and available at www.profibus.com.

7.1 GSD file

RD4 devices fitted with Profibus interface are supplied with their own GSD file **RD4Vx.GSD** (see enclosed documentation or click **www.lika.biz > PRODUCTS > DRIVECOD > RD4**). GSD file has to be installed on Profibus Master device.
GSD file is available in both English version (**RD4Vx.GSE**) and Italian version (**RD4Vx.GSI**).

WARNING
HW2 SW4 version of the unit RD4-Profibus introduces the new module -no param. Using this module, the unit does not read the parameters from the PLC when the power is switched on (they are read from the flash memory) and allows the operator to save any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message on the non-volatile memory (by means of the bit 9 **Save parameters** in the **Control Word (Bytes 0 and 1)**). It has to be used with the GSD file version V4 or later. You can install also the previous version V3, of course this is intended only for models having -T32 and -T48 reduction gear, as parametrization for -no param module is not available before H2S4 firmware version.

WARNING
When you install **Lika RD4-T32** or **Lika RD4-T48** modules, the value of each parameter is uploaded at power on from the GSD file which has been loaded in the PLC. Thus any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message will be temporary: when you turn off the power supply, the set value is lost (except the preset value which is the only variable not included in the GSD file; or unless you set the preset value previously which causes all parameters values to be saved automatically, see on page 67) and the value saved in the PLC will be uploaded at next power on (thus all values, even if previously saved because of a preset setting, will be overwritten anyway).

This unit also allows to install the **Lika RD4-no param** module (it is available starting from H2S4 version, V4 GSD file). Using this module, the unit does not read the parameters from the PLC when the power is switched on (they are read from the flash memory) and allows the operator to save any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message on the non-volatile memory (by means of the bit 9 **Save parameters** in the **Control Word (Bytes 0 and 1)**). When the **Lika RD4-no param** module is installed, it is NOT possible to read and change the values of the **configuration data** parameters in the **Parameter Assignment** page of the STEP 7 **Properties - DP slave** window (see "Setting "configuration data" parameters" section on page 25). Thus you are allowed to enter new parameter values only through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message. The **Lika RD4-no param** module has no relevance to the reduction gear ratio and can be used for whatever unit and independently from its reduction gear. Anyway it is obvious that the parameters you set must be compatible with the mechanical and electrical characteristics of the unit you are going to configure.

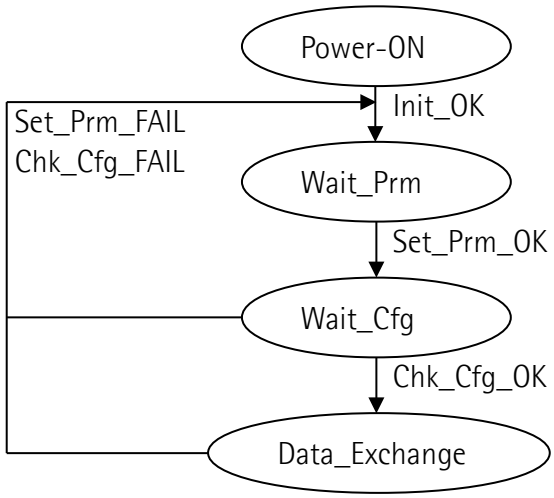
On the other hand using Siemens STEP7 it is possible to alter any value and then save it permanently in the PLC (except in the -no param module). To save values permanently the operator has to enter the **Properties - DP slave** window of STEP7 and then alter the desired item (see section "Setting "configuration data" parameters" on page 25). Values altered in the variables table of STEP7 (see section "5.3 Setting and reading parameter values" on page 29) are temporary only.

7.2 Baud rate

RD4 ROTADRIVE positioning units with Profibus interface are able to recognize automatically the data transmission rate of the Profibus-DP Master. The same baud rate is set by the Master for all devices in the network. The supported baud rates are as follows:
9.6Kbps – 19.2Kbps – 93.75Kbps – 187.5Kbps – 500Kbps – 1.5Mbps – 3Mbps – 6Mbps – 12Mbps.

7.3 Operating states

Profibus devices are designed to operate according to different states, see the Figure below.



NOTE
Configuration data parameters are sent when Set_Prm phase is active and device is in **Data_Exchange** mode; operational parameters are sent when the device is in **Data_Exchange** mode.

Communication messages

A basic differentiation is made between the following statuses when exchanging data between Master and Slave:

- **DDLM_Set_Prm**: configuring and parametrizing phase. This is active when the system is turned on; in this phase configuration data is sent to the Slave device. For any further information refer to section "7.4 DDLM_Set_Prm" on page 43.
- **DDLM_Chk_Cfg**: using this function the Master defines the number of bytes needed for data transmission in **Data_Exchange** mode. For any further information refer to section "7.5 DDLM_Chk_Cfg" on page 44.
- **DDLM_Data_Exchange**: "Standard operation". In this work mode the Master can send a preset value to the Slave, while the Slave can respond sending the actual position (and velocity, as well). For any further information refer to section "7.6 DDLM_Data_Exchange" on page 45.
- **DDLM_Slave_Diag**: This is used when the system is turned on and every time the Master needs to acquire diagnostic information from the Slave: in this status the Slave sends diagnostic data to the Master. For any further information refer to section "7.7 DDLM_Slave_Diag" on page 59.

7.4 DDLM_Set_Prm

When the system is turned on, configuration data set by the operator is sent to the Slave by the controller. Parameters transmission depends on the configuration chosen by the operator. Customarily data is sent automatically while data setting is carried out via the user's interface available in the controller's software (for instance, STEP7, see on page 22).
A detailed description of the available parameters can be found in section "Programming parameters" on page 60.
Data transmission is carried out respecting the structure shown in the following table.

Bytes	Parameter
0...6	Reserved for PROFIBUS network
7...9	Reserved for PROFIBUS network
10...13	01 Distance per revolution
14...17	02 Position window
18...21	03 Position window time
22...25	04 Max following error
26...29	05 Kp position loop
30...33	06 Ki position loop
34...37	07 Acceleration
38...41	08 Deceleration
42...45	09 Positive delta
46...49	0A Negative delta
50...53	0B Jog speed
54...57	0C Work speed
58...61	0D Start Torque current time
62...65	0E Code sequence
66...69	0F Kp current loop
70...73	10 Ki current loop
74...77	11 Max current
78...81	12 Starting Torque current
82...85	13 Gear ratio
86...89	14 Jog step length

7.5 DDLM_Chk_Cfg

Configuration function allows the Master to define the number of bytes used for data transmission in **Data_Exchange** mode; transmission and receipt are viewed from Master device.

Chk_Cfg message structure (1 byte):
bit 7 = Consistency (="1")
bit 6 = Word format ("0"=byte, "1"=word=2byte)
bit 5 ... 4 = In/out data ("01"=Input, "10"=output)
bit 3 ... 0 = Code length

Allowed values:

bit	7	6	5	4	3	2	1	0	
Data	1	1	0	1	0	1	1	0	D6h
	1	1	1	0	0	1	1	0	E6h

D6hex = 14 byte input E6hex = 14 byte output

7.6 DDLM_Data_Exchange

This is the normal operation status of the system.
Using **Data_Exchange messages** system manages all available parameters and operates the movements of the axis.

Data_Exchange messages structure:

Byte	Master → Slave function	Slave → Master function
0	Control Word (Bytes 0 and 1)	Status word (Byte 0 and 1)
1		
2	Not used	Alarms (Bytes 2 and 3)
3		
4	Target position (Bytes 4 ... 7)	Position (Bytes 4 ... 7)
5		
6		
7		
8	Parameter number (Byte 8)	Parameter number (Byte 8)
9	Parameter value (Bytes 9 ... 12)	Parameter value (Bytes 9...12)
10		
11		
12		
13	Not used	Not used

7.6.1 Master → Slave function

In this section Data_Exchange messages sent by the Master to the Slave are described.

Control Word (Bytes 0 and 1)

It contains the commands to be sent in real time to the Slave in order to manage it.

Byte 0

Jog +

bit 0 — If bit 4 **Incremental jog** = 0, as long as **Jog +** = 1, the Slave moves toward positive direction; otherwise if bit 4 **Incremental jog** = 1, the activation of this bit causes at rising edge the execution of a single step toward positive direction having the length, expressed in pulses, set next to

the **14 Jog step length** item; then the slave stops and waits for another issue. Velocity, acceleration and deceleration are set in parameters **0B Jog speed**, **07 Acceleration** and **08 Deceleration** respectively. For a detailed description of jog control see on page 36.

Jog -
bit 1

If bit 4 **Incremental jog** = 0, as long as **Jog -** = 1, the Slave moves toward negative direction; otherwise if bit 4 **Incremental jog** = 1, the activation of this bit causes at rising edge the execution of a single step toward negative direction having the length, expressed in pulses, set next to the **14 Jog step length** item; then the slave stops and waits for another issue. Velocity, acceleration and deceleration are set in parameters **0B Jog speed**, **07 Acceleration** and **08 Deceleration** respectively. For a detailed description of jog control see on page 36.

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 the Slave must stop and execute the deceleration procedure set in **08 Deceleration**. For an immediate stop of the movement, use bit 7 **Emergency**.

Alarm reset
bit 3

In a normal work condition this bit is set to "0". Setting this bit to "1" causes the normal work status of the device to be restored. Normal work status is resumed by switching this bit from "0" to "1". This command is used to reset an alarm condition of the Slave but only if the fault condition has ceased.
Please note that should the alarm be caused by wrong parameter values (see **Machine data not valid** and **32 Wrong parameters list**), normal work status can be restored only after having set proper values. **Flash memory error** alarm cannot be reset.

Incremental jog
bit 4

If set to "=0", the activation of bits **Jog +** and **Jog -** causes the slave to move as long as **Jog +** / **Jog -** = 1. Setting this bit to 1 the incremental jog function is enabled, that is: the activation of bits **Jog +** and **Jog -** causes at rising edge the execution of a single step toward positive or negative direction having the length, expressed in pulses, set next to

the 14 Jog step length item; then the slave stops and waits for another issue.

bit 5 Not used.

Start

bit 6 When bit value switches from "0" to "1" device moves in order to reach the set target position. For a complete description of the position control see on page 33. For any information on the target position refer to Target position (Bytes 4 ... 7) on page 49. This bit has to be switched to "0" after the device has started.

Emergency

bit 7 This bit has to be normally high ("=1") otherwise it will cause the device to stop immediately. For a normal stop (not immediate) respecting the set deceleration see above bit 2 Stop.

Byte 1

bit 8 Not used.

Save parameters

bit 9 The function of this bit is available only when you install the **Lika RD4-no param** module (see "Adding a node to the project" section on page 24). You must NOT set this bit via Profibus if you do not use the -no param module. Data are saved on non-volatile memory at each rising edge of the bit; in other words, save is performed each time this bit is switched from logic level low ("0") to logic level high ("1"). For detailed information on the **Lika RD4-no param** module please refer to the "Preliminary information" section on page 8.

Load default parameters

bit 10 The function of this bit is available only when you install the **Lika RD4-no param** module (see "Adding a node to the project" section on page 24). You must NOT set this bit via Profibus if you do not use the -no param module. Default parameters (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) are restored at each rising edge of the bit; in other words, the default parameters loading operation is performed each time this bit is switched from logic level low ("0") to logic level high ("1"). The complete list of machine data and relevant default parameters preset by Lika Electronic engineers are available

on page 72. When the default parameters loading operation is carried out, system also triggers an automatic save of all settings on the flash memory. For detailed information on the **Lika RD4-no param** module please refer to the "Preliminary information" section on page 8.

bit 11 Not used.

Axis torque

bit 12 When the axis has reached the commanded position, it keeps the torque.
If set to "=0", PWM is deactivated (if there are not jogs or positioning movements in progress).
If set to "=1", PWM becomes active: axis enters the space control condition (even if there are not jogs or positioning movements in progress).

OUT 1

bit 13 This is intended to activate / deactivate the operation of the digital output 1. The meaning of the available outputs is described in section "Programming parameters" on page 60.
OUT 1 = 0 output 1 low (not active)
OUT 1 = 1 output 1 high (active)

OUT 2

bit 14 This is intended to activate / deactivate the operation of the digital output 2. The meaning of the available outputs is described in section "Programming parameters" on page 60.
OUT 2 = 0 output 2 low (not active)
OUT 2 = 1 output 2 high (active)

OUT 3

bit 15 This is intended to activate / deactivate the operation of the digital output 3. The meaning of the available outputs is described in section "Programming parameters" on page 60.
OUT 3 = 0 output 3 low (not active)
OUT 3 = 1 output 3 high (active)

Bytes 2 and 3 Not used.

Target position (Bytes 4 ... 7)

This is the 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.

Byte 4	byte 5	byte 6	byte 7
Low	...	...	High

Position override function

It is possible to change the target position value even while the device is still reaching it; to do this, send the Start command and the new value for Target position (Bytes 4 ... 7).

NOTE

Jog +, Jog - and Start functions cannot be used simultaneously. For instance: if a Jog + command is sent to the 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, it stops its movement.

Should the device be disconnected from the Profibus network while it is moving (for instance because of a broken cable or faulty wiring), device stops moving immediately and enters the emergency status. As soon as the network communication is restored, the Profibus communication not active alarm message is invoked to appear.

Parameter number (Byte 8)

This is reserved for setting the index of the parameter whose value is set / read in the next four bytes.
For the complete list of the available parameters and their meaning please refer to section "Programming parameters" on page 60.

bit 7	bit 6	bit 5 ... 0
R/W	0	Parameter index

R/W = 0 reading the parameter
R/W = 1 writing the parameter

Example 1
You need to write a value next to the parameter **28 Preset** (index 28h), so set 0xA8 = 1010 1000:

	R/W	-	Parameter index					
bit	7	6	5	4	3	2	1	0
binary	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**

where:
bit 7 = R/W = 1, i.e. "writing the parameter"
bit 6 = bit always set to 0
bit 5 ... 0 = parameter index = 101000 binary value = 28h = **28 Preset**

Value to be set must be typed in the next four bytes 9...12.

Example 2
You need to read the value next to the parameter **2A Temperature value** (index 2Ah), so set 0x2A = 0010 1010:

	R/W	-	Parameter index					
bit	7	6	5	4	3	2	1	0
binary	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**0**

where:
bit 7 = R/W = 0, i.e. "reading the parameter"
bit 6 = bit always set to 0
bit 5 ... 0 = parameter index = 101010 binary value = 2Ah = **2A Temperature value**

The next four bytes 9...12 -**Parameter value (Bytes 9 ... 12)**- are ignored.

Parameter value (Bytes 9 ... 12)

These contain the value to be assigned to the parameter set in the previous byte. 4 data bytes are available for each parameter.
For the complete list of the available parameters and their meaning please refer to section "Programming parameters" on page 60.

byte 9	byte 10	byte 11	byte 12
Low	...	...	High

WARNING

When you install **Lika RD4-T32** or **Lika RD4-T48** modules, the value of each parameter is uploaded at power on from the GSD file which has been loaded in the PLC. Thus any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message will be temporary: when you turn off the power supply, the set value is lost (except the preset value which is the only variable not included in the GSD file; or unless you set the preset value previously which causes all parameters values to be saved automatically, see on page 67) and the value saved in the PLC will be uploaded at next power on (thus all values, even if previously saved because of a preset setting, will be overwritten anyway).

This unit also allows to install the **Lika RD4-no param** module (it is available starting from H2S4 version, V4 GSD file). Using this module, the unit does not read the parameters from the PLC when the power is switched on (they are read from the flash memory) and allows the operator to save any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message on the non-volatile memory (by means of the bit 9 **Save parameters** in the **Control Word (Bytes 0 and 1)**). When the **Lika RD4-no param** module is installed, it is NOT possible to read and change the values of the **configuration data** parameters in the **Parameter Assignment** page of the STEP 7 **Properties - DP slave** window (see "Setting "configuration data" parameters" section on page 25). Thus you are allowed to enter new parameter values only through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message. The **Lika RD4-no param** module has no relevance to the reduction gear ratio and can be used for whatever unit and independently from its reduction gear. Anyway it is obvious that the parameters you set must be compatible with the mechanical and electrical characteristics of the unit you are going to configure.

On the other hand using Siemens STEP7 it is possible to alter any value and then save it permanently in the PLC (except in the -no param module). To save values permanently the operator has to enter the **Properties - DP slave** window of STEP7 and then alter the desired item (see section "Setting "configuration data" parameters" on page 25). Values altered in the variables table of STEP7 (see

section "5.3 Setting and reading parameter values" on page 29) are temporary only.

Byte 13 Not used.

7.6.2 Slave → Master functions

In this section Data_Exchange messages sent by the Slave to the Master are described.

Status word (Byte 0 and 1)

In this byte the status of the PI controller in Data_Exchange mode is shown.

Byte 0

Axis in position

bit 0 — If value is "=1" device has reached the commanded position for the time set in **03 Position window time**. This is kept active until the position error is lower than **02 Position window**.

bit 1 — Not used.

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 parameter **09 Positive delta**.

SW limit switch -

bit 4 — If value is "=1" device has reached the maximum negative limit (negative limit switch). See parameter **0A Negative delta**.

Alarm

bit 5 — If value is "=1" an alarm has occurred, see details in **Alarms (Bytes 2 and 3)**.

Axis running

bit 6 — Theoretical state of the axis.
If value is "=0" device is in stop (not moving).
If value is "=1" device is currently moving.

Executing a command

bit 7 — If value is "=0" controller is not executing any command.
If value is "=1" controller is executing a command.

Byte 1

Target position reached

bit 8 — If value is "=1" device has reached the target position set in **Target position (Bytes 4 ... 7)**. Bit is kept active until new **Target position (Bytes 4 ... 7)** or **Alarm reset** commands are sent.

bits 9 ... 11 — Not used.

DAC Saturation

Bit 12 — The current supplied by power electronic for controlling the motor has reached the maximum value and cannot be increased further.

IN 1

bit 13 — This is meant to show the status of the digital input 1. The meaning of the available inputs is described in section "Programming parameters" on page 60.

IN 1 = 0 input 1 low (not active)

IN 1 = 1 input 1 high (active)

IN 2

bit 14 — This is meant to show the status of the digital input 2. The meaning of the available inputs is described in section "Programming parameters" on page 60.

IN 2 = 0 input 2 low (not active)

IN 2 = 1 input 2 high (active)

IN 3

bit 15 — This is meant to show the status of the digital input 3. The meaning of the available inputs is described in section "Programming parameters" on page 60.

IN 3 = 0 input 3 low (not active)

IN 3 = 1 input 3 high (active)

Alarms (Bytes 2 and 3)

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

Byte 2

Machine data not valid

bit 0 0001h — One or more parameters are not valid, set proper values to restore normal work condition. See the list of wrong parameters in **32 Wrong parameters list**.

Flash memory error

bit 1 0002h — Internal error, it cannot be restored.

bit 2 — Not used.

Following error

bit 3 0008h — The difference between the real position and the theoretical position calculated by the system is greater than the value set in parameter **04 Max following error**; we suggest reducing the work speed.

Axis not synchronized

bit 4 0010h — Internal error, it cannot be restored.

Target not valid

bit 5 0020h — Target position is over maximum travel limits.

Emergency

bit 6 0040h — Bit 7 **Emergency** in **Control Word (Bytes 0 and 1)** has been forced to low value (0); or alarms are active in the unit.

Overcurrent

bit 7 0080h — The power supply current is exceeding maximum ratings.

Byte 3

Overtemperature

bit 8 0100h — The internal temperature of the device as sensed by a probe is exceeding maximum ratings (see parameter **2A Temperature value**).

Address not valid

bit 9 0200h — Parameter number (address) not valid.

Undervoltage

bit 10 0400h — The power supply voltage is under minimum ratings.

bit 11 Not used.

Read-only

bit 12 1000h This is a read-only parameter and cannot be written to.

Profibus communication not active

bit 13 2000h This bit is intended to warn (value 1) that the communication in the Profibus network has broken (cable disconnected? Voltage drop? ...). Alarm is invoked to appear immediately after the communication has been restored.

bits 14 and 15 Not used.

To reset an alarm condition of the Slave use **Alarm reset** command, **Control Word (Bytes 0 and 1)** bit 3. In a normal work condition the **Alarm reset** bit is set to "0". Setting the bit to "1" causes the normal work status of the device to be restored. Normal work status is resumed by switching this bit from "0" to "1". This command resets the alarm but only if the fault condition has ceased.

Please note that should the alarm be caused by wrong parameter values (see **Machine data not valid** and **32 Wrong parameters list**), normal work status can be restored only after having set proper values. **Flash memory error** alarm cannot be reset.

Position (Bytes 4 ... 7)

Absolute position of the device in the moment in which the message is sent.

Parameter number (Byte 8)

This contains the index of the parameter whose value is shown in the four following bytes.
Indexes are listed in section "Programming parameters" on page 60.

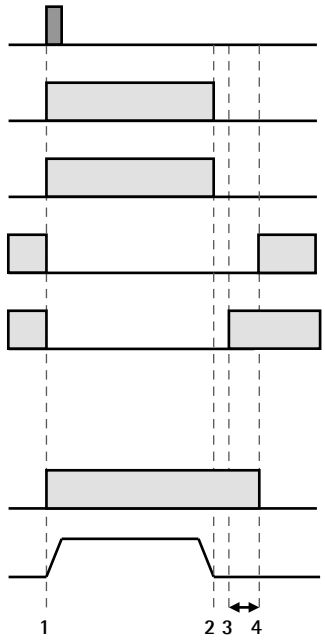
Parameter value (Bytes 9...12)

These contain the value assigned to the parameter whose number is shown in the previous byte. 4 data bytes are available for each parameter.
For the complete list of the available parameters and their meaning please refer to section "Programming parameters" on page 60.

byte 9	byte 10	byte 11	byte 12
Low	...	...	High

Byte 13 Not used

Example 1

Positioning	RD4
Start (bit 6 - Control Word (Bytes 0 and 1)) Executing a command (bit 7 - Status word (Byte 0 and 1)) Axis running theoretically (bit 6 - Status word (Byte 0 and 1)) Axis in position (bit 0 - Status word (Byte 0 and 1)) Target position reached (bit 8 - Status word (Byte 0 and 1)) Axis enabled (bit 2 - Status word (Byte 0 and 1): PWM is active) Theoretical velocity	

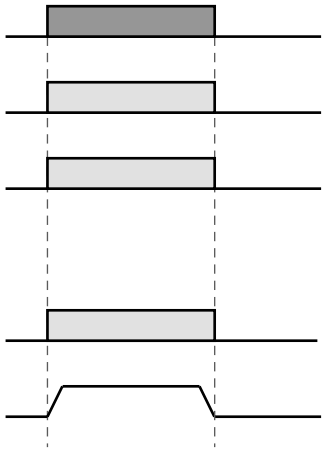
Point 1: Start command is issued to device; controller activates the internal PWM and generates the velocity profile; Executing a command and Axis running bits have value "1".

Point 2: controller has theoretically reached the target position.

Point 3: axis has actually reached the position within the tolerance window limits set in parameter 02 Position window.

Point 4: time set in parameter 03 Position window time has expired and therefore the Axis in position bit is set to "=1".

Example 2

Jog +	RD4
Jog + (bit 0 - Control Word (Bytes 0 and 1))	
Executing a command (bit 7 - Status word (Byte 0 and 1))	
Axis running theoretically (bit 6 - Status word (Byte 0 and 1))	
Axis enabled (bit 2 - Status word (Byte 0 and 1): PWM is active)	
Theoretical velocity	

7.7 DDLM_Slave_Diag

Master device can send a request for diagnostic information to the Slave device at any time.
RD4 devices provide the 6-byte reduced diagnostic.

6-byte diagnostic:

Byte	Description
0	Status 1
1	Status 2
2	Status 3
3	Master ID
4	Manufacturer ID
5	

8 Programming parameters

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

Index Parameter name
[data types, attribute]

- Index is expressed in hexadecimal notation.
- Attribute:
  ro = read only access
  rw = read and write access

Unsigned32 data type:

Data byte			
byte 9	byte 10	byte 11	byte 12
2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}
MSByte	...	...	LSByte

WARNING
When you install **Lika RD4-T32** or **Lika RD4-T48** modules, the value of each parameter is uploaded at power on from the GSD file which has been loaded in the PLC. Thus any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message will be temporary: when you turn off the power supply, the set value is lost (except the preset value which is the only variable not included in the GSD file; or unless you set the preset value previously which causes all parameters values to be saved automatically, see on page 67) and the value saved in the PLC will be uploaded at next power on (thus all values, even if previously saved because of a preset setting, will be overwritten anyway).

This unit also allows to install the **Lika RD4-no param** module (it is available starting from H2S4 version, V4 GSD file). Using this module, the unit does not read the parameters from the PLC when the power is switched on (they are read from the flash memory) and allows the operator to save any new setting made locally through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message on the non-volatile memory (by means of the bit 9 **Save parameters** in the **Control Word (Bytes 0 and 1)**). When the **Lika RD4-no param** module is installed, it is NOT possible to read and change the values of the **configuration data** parameters in the **Parameter Assignment** page of the STEP 7 **Properties - DP slave** window (see "Setting "configuration data" parameters" section on page 25). Thus you are allowed to

enter new parameter values only through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)** items of the Data Exchange message. The **Lika RD4-no param** module has no relevance to the reduction gear ratio and can be used for whatever unit and independently from its reduction gear. Anyway it is obvious that the parameters you set must be compatible with the mechanical and electrical characteristics of the unit you are going to configure.

On the other hand using Siemens STEP7 it is possible to alter any value and then save it permanently in the PLC (except in the -no param module). To save values permanently the operator has to enter the **Properties - DP slave** window of STEP7 and then alter the desired item (see section "Setting "configuration data" parameters" on page 25). Values altered in the variables table of STEP7 (see section "5.3 Setting and reading parameter values" on page 29) are temporary only.

Configuration data parameters

01 Distance per revolution

[Unsigned32, rw]

01 Distance per revolution 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 warm screw having a 5 mm pitch; by setting **01 Distance per revolution** = 500, at each shaft revolution system performs a 5 mm pitch with one-hundredth of a millimetre resolution.

Default = 1024 (min. = 1, max. = 1024).

WARNING

After having changed this parameter you must then set new values also in parameters **0B Jog speed**, **0C Work speed** and **28 Preset**. For a detailed explanation see on page 36 and relevant parameters.

Please note that the parameters listed hereafter are closely related to the **01 Distance per revolution** parameter; hence when you change the value in **01 Distance per revolution** also the value expressed by each one is necessarily redefined. They are: **02 Position window**, **04 Max following error**, **07 Acceleration**, **08 Deceleration**, **09 Positive delta**, **0A Negative delta**, **29 Current velocity value**, **30 Positive absolute limit switch**, **31 Negative absolute limit switch**, **Target position (Bytes 4 ... 7)** and **Position (Bytes 4 ... 7)**. See for instance the relationship between **01 Distance per revolution** and the speed values, explained on page 64.

NOTE

If **01 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.

02 Position window

[Unsigned32, rw]

This parameter defines the tolerance window for the **Target position (Bytes 4 ... 7)** value. When the axis is within the tolerance window limits for the time set in parameter **03 Position window time**, then the state is signalled through the **Axis in position** status bit. Parameter is expressed in pulses.

Default = 0 (min. = 0, max. = 100000).

03 Position window time

[Unsigned32, rw]

It represents the time for which the axis has to be within the tolerance window limits set in the previous parameter **02 Position window** before the state is signalled through the **Axis in position** status bit. Parameter is expressed in milliseconds.

Default = 100 (min. = 0, max. = 10000).

04 Max following error

[Unsigned32, rw]

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

Default = 1024 (min. = 0, max. = 100000).

05 Kp position loop

[Unsigned32, rw]

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

Default = 500 (min. = 0, max. = 1000).

06 Ki position loop

[Unsigned32, rw]
This parameter contains the integral gain used by the PI controller for the position loop. Value has been optimized by Lika Electronic according to the technical characteristics of the device.
Default = 60 (min. = 0, max. = 1000).

07 Acceleration

[Unsigned32, rw]
This parameter defines the acceleration value that has to be used by the device. Parameter is expressed in pulses per second^2 [PPS^2].
Default = 1000 (min. = 100, max. = 10000).

08 Deceleration

[Unsigned32, rw]
This parameter defines the deceleration value that has to be used by the device. Parameter is expressed in pulses per second^2 [PPS^2].
Default = 1000 (min. = 100, max. = 10000).

09 Positive delta

[Unsigned32, rw]
This value is used to calculate the maximum forward (positive) limit the device is allowed to reach starting from the preset value. When the maximum forward limit is reached, a signalling is activated through the **SW limit switch +** status bit. Parameter is expressed in encoder pulses.
SW limit switch + = **28 Preset** + **09 Positive delta**.
Default = 523263 (min. = 0, max. = 523263).

0A Negative delta

[Unsigned32, rw]
This value is used to calculate the maximum backward (negative) limit the device is allowed to reach starting from the preset value. When the maximum backward limit is reached, a signalling is activated through the **SW limit switch -** status bit. Parameter is expressed in encoder pulses.
SW limit switch - = **28 Preset** - **0A Negative delta**.
Default = 523263 (min. = 0, max. = 523263).

0B Jog speed

[Unsigned32, rw]
This parameter allows to set the maximum speed of the unit when using **Jog +** and **Jog -** functions. Parameter is expressed in pulses per second.
Default = 1600 (min. = 1, max. = 1600) for RD4-...-T32-... model
Default = 1066 (min. = 1, max. = 1066) for RD4-...-T48-... model

0C Work speed

[Unsigned32, rw]
This parameter is meant to set the maximum speed the unit can reach in automatic work mode (movements are controlled using **Start** and **Target position (Bytes 4 ... 7)** commands). Parameter is expressed in pulses per second.
Default = 1600 (min. = 1, max. = 1600) for RD4-...-T32-... model
Default = 1066 (min. = 1, max. = 1066) for RD4-...-T48-... model

WARNING
Each time you change the value in **01 Distance per revolution** you must then set new values also in **0B Jog speed** and **0C Work speed** as speed values are expressed in pulses per second. To calculate the speed values you have always to adhere to the following ratio:

$$\frac{\text{Min. speed} * \text{Distance per revolution}}{1024} \leqslant \text{Speed} \leqslant \frac{\text{Max. speed} * \text{Distance per revolution}}{1024}$$

For detailed information please refer to page 36.

0D Start Torque current time

[Unsigned32, rw]
This parameter defines the maximum time for which the motor is supplied with starting torque current when it starts its movement (see parameter **12 Starting Torque current**). Parameter is expressed in milliseconds.
Default = 2000 (min. = 0, max. = 3000).

0E Code sequence

[Boolean, rw]

It sets the rotation direction of the encoder shaft and consequently defines 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 necessarily affected. Therefore it is compulsory to set a new value in parameter **28 Preset** and then check parameters **09 Positive delta** and **0A Negative delta**.

0F Kp current loop

[Unsigned32, rw]

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

Default = 200 (min. = 0, max. = 1000).

10 Ki current loop

[Unsigned32, rw]

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

Default = 60 (min. = 0, max. = 1000).

11 Max current

[Unsigned32, rw]

This parameter defines the maximum current supplied by the power electronic for controlling the motor. Parameter is expressed in mA (milliamperes). This value cannot be greater than the one in parameter **12 Starting Torque current**.

Default = 5000 (min. = 10, max. = 5000).

12 Starting Torque current

[Unsigned32, rw]

This parameter defines the maximum current supplied to the motor only when it starts its movement and for the maximum time set in parameter **0D Start Torque current time**. Parameter is expressed in mA (milliamperes).

Default = 7000 (min. = 10, max. = 7000).

13 Gear ratio

[Unsigned32, ro]

It displays the gear ratio of the reduction gear installed between the motor and the encoder shaft of the unit. This is a read-only parameter.

Default = 32 for RD4-...-T32-... model

Default = 48 for RD4-...-T48-... model

14 Jog step length

[Unsigned32, rw]

If the incremental jog function is enabled (bit 4 **Incremental jog** in **Control Word (Bytes 0 and 1)** = 1), the activation of bits **Jog +** and **Jog -** causes at rising edge the execution of a single step toward positive or negative direction having the length, expressed in pulses, set next to this item; then the slave stops and waits for another issue.

Default = 100 (min. = 1, max. = 10000).

Operational data parameters

28 Preset

[Integer32, rw]
Use this parameter to set the Preset value. Preset function is meant to assign a certain value to a desired physical position of the encoder shaft. Value is expressed in pulses. 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 preset value is activated. The preset value is activated at the rising edge of the bit 7 in the byte 8 **Parameter number (Byte 8)** of the Data_Exchange message sent by the Master to the Slave; in other words, the preset value is entered and activated when the bit 7 in the byte 8 **Parameter number (Byte 8)** is switched from logic level low ("0") to logic level high ("1"). The value to be set must be typed in the next four bytes 9...12 -**Parameter value (Bytes 9 ... 12)** of the Data_Exchange message. When the preset setting operation is carried out, system also triggers an automatic save of all settings on the flash memory.
Default = 0 (min. = -1048576, max. = +1048576).

Example
You need to write a value next to the **28 Preset** parameter (index 28h), so set 0xA8 = 1010 1000 in the byte 8 **Parameter number (Byte 8)** of the Data_Exchange message sent by the Master to the Slave:

	R/W	-	Parameter index					
bit	7	6	5	4	3	2	1	0
binary	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**

where:
bit 7 = R/W = 1, i.e. "writing the parameter"
bit 6 = bit always set to 0
bit 5 ... 0 = parameter index = 101000 binary value = 28h = **28 Preset**

WARNING
A new value has to be set in **28 Preset** every time **01 Distance per revolution** value is changed. After having entered a new value in **28 Preset** it is not necessary to set new values for travel limits as the Preset function then calculates them automatically and initializes again the positive and negative limits according to the values set in **09 Positive delta** and **0A Negative delta**. For a detailed explanation see on page 36.

29 Current velocity value

[Integer32, ro]
This parameter shows the value of the current speed calculated every second. Parameter is expressed in pulses per second.

2A Temperature value

[Integer32, ro]
This parameter shows the value of the internal temperature of the device as sensed by a probe. Parameter is expressed in °C (Celsius degrees). The minimum detectable temperature is -20°C.

2B Current value [mA]

[Integer32, ro]
This parameter shows the value of the current absorbed by the motor (rated current). Parameter is expressed in mA (milliamperes).

2C 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 parameter **04 Max following error**, then the alarm **Following error** is triggered and the unit stops.

2D Software version

[Integer32, ro]
It contains the software version of the device.
The meaning of the 16 bits in the index is as follows:

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Ms bit								Ls bit							
Major number								Minor number							

Value 258 in decimal notation corresponds to the binary representation 00000001 00000010 and has to be interpreted as: 01 02 hex, i.e. version 1.2.

2E Hardware version

[Integer32, ro]
It contains the hardware version of the device.
The meaning of the 16 bits in the index is as follows:

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
ROTADRIVE model				Interface				Brake	-			Hardware version			

where:

00 ... 03	= hardware version
04 ... 06	= bits not used
07	= brake (0 = without brake; 1 = with brake)
08 .. 11	= interface (00 = Modbus; 01 = Profibus; 02 = CANopen; 03 ... 0F = bits not used)
12 ... 15	= ROTADRIVE model (00 = RD4; 01 = RD1xA; 02 = RD5; 03 ... 0F = bits not used)

Value 257 in decimal notation corresponds to the binary representation 00000001 00000001 and has to be interpreted as follows: hardware version 1 (bit 0 = 1); device without brake (bit 7 = 0); Profibus interface (bit 8 = 1); RD4 model (bit 12 = 0).

2F Offset

[Integer32, ro]
This parameter defines the difference between the position value transmitted by the device and the real position: real position – preset. Value is expressed in pulses.

30 Positive absolute limit switch

[Unsigned32, ro]
This is the **SW limit switch +** value (maximum positive limit) calculated according to values set in parameters **28 Preset** and **09 Positive delta**. When the maximum forward limit is reached, a signalling is activated through the **SW limit switch +** status bit.
SW limit switch + = **28 Preset** + **09 Positive delta**.
Value is expressed in encoder pulses.

31 Negative absolute limit switch

[Unsigned32, ro]

This is the **SW limit switch -** value (maximum negative limit) calculated according to values set in parameters **28 Preset** and **0A Negative delta**. When the maximum backward limit is reached, a signalling is activated through the **SW limit switch -** status bit.

SW limit switch - = **28 Preset** – **0A Negative delta**.

Value is expressed in encoder pulses.

32 Wrong parameters list

[Unsigned32, ro]

The operator has set invalid data and the **Machine data not valid** alarm has been triggered. This variable is meant to show the list of the wrong parameters, respecting the structure shown in the following table.

Please note that normal work status can be restored only after having set proper values.

NOTE

Variable **32 Wrong parameters list** can be read by the PLC only if the RD unit goes online properly. On the other hand ROTADRIVE unit can go online only if the PLC sends correct parameters. If, for instance, you alter the value of index **01 Distance per revolution** directly in the GSD file without entering suitable values also next to the speed items, RD unit is not able to go online and thus it is not possible to enter this index and have information. Index **32 Wrong parameters list** can be read by the PLC only if you make changes, for instance, in the variables table. When you alter a parameter through **Parameter number (Byte 8)** and **Parameter value (Bytes 9 ... 12)**, ROTADRIVE unit is necessarily in **Data_Exchange** mode; so data exchange between Master and Slave is active and therefore it is possible to read this index. At power on, ROTADRIVE unit enters the **Data_Exchange** mode only after finalizing the SET_PRM phase: this means that configuration data has been sent properly to the Slave device.

Bit	Parameter
1	01 Distance per revolution
7	07 Acceleration
8	08 Deceleration
9	09 Positive delta
10	0A Negative delta

11	0B Jog speed
12	0C Work speed
13	0D Start Torque current time
14	0E Code sequence
17	11 Max current
18	12 Starting Torque current
19	13 Gear ratio
20	14 Jog step length
26	28 Preset

9 Default parameters list

Parameters list	Default values		
01 Distance per revolution PPR	1024		
02 Position window P	0		
03 Position window time ms	100		
04 Max following error P	1024		
05 Kp position loop	500		
06 Ki position loop	60		
07 Acceleration PPS^2	1000		
08 Deceleration PPS^2	1000		
09 Positive delta P	523263		
0A Negative delta P	523263		
0B Jog speed PPS	1600 (RD4-...T32-...) 1066 (RD4-...T48-...)		
0C Work speed PPS	1600 (RD4-...T32-...) 1066 (RD4-...T48-...)		
0D Start Torque current time ms	2000		
0E Code sequence	0		
0F Kp current loop	200		
10 Ki current loop	60		
11 Max current mA	5000		
12 Starting Torque current mA	7000		
28 Preset P	0		
13 Gear ratio	32 (RD4-...T32-...) 48 (RD4-...T48-...)		
14 Jog step length P	100		

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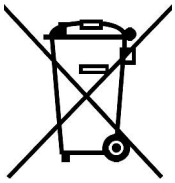
HW-SW release	Document release	Description
1-1	1.0	First issue
2-2	1.1	Updating explanation of limit switches, added parameters 30 Positive absolute limit switch and 31 Negative absolute limit switch
2-2	1.2	Revised edition
2-2	1.3	Revised edition
2-3	1.4	Added Incremental jog function in Control Word (Bytes 0 and 1) and 14 Jog step length parameter. Updated jog entries. Updated Axis enabled entry. Added Subject Index. Updated GSD file (V3).
2-3	1.5	Updated section "Electrical connections".
2-4	1.6	"-No param" module version, parameters save and default parameters load commands available to the Profibus interface. Updated GSD file (V4). Updated Preset entries.
2-4	1.7	Warning against back EMF



Dispose separately

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