

## Orbis™

### Using advanced functions over SPI



Programming the Orbis encoder via the SPI interface allows you to:

- ▶ Set the position offset (zero position),
- ▶ set multiturn counter value (if available),
- ▶ perform the self-calibration function,
- ▶ store the current Orbis configuration parameters in a non-volatile memory,
- ▶ reset the Orbis configuration parameters to the factory settings.

## Related products



**Orbis** true absolute rotary encoder

Programming is done by sending separate bytes to the encoder.

Each byte represents the first MOSI byte in the SPI frame. Each byte must be in a separate data frame (an NCS signal cycle transmits only one byte via MOSI). The command sequences for each command.

Each of the programming options must be started with specific unlocking sequence. This prevents unintended changes to the encoder configuration parameters. The sequences of the individual programming options are described below.

The delay between the individual bytes sent during programming must be at least 1 ms.

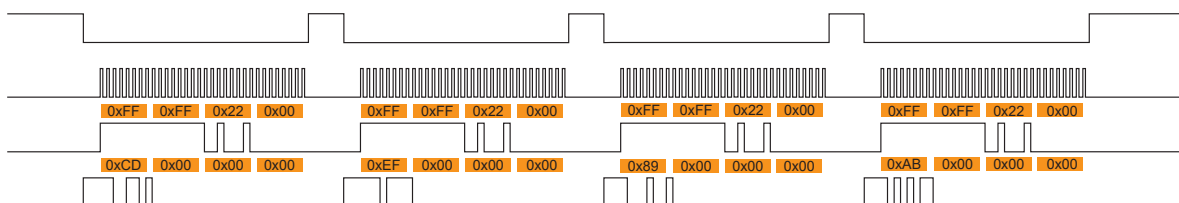
## Unlocking sequence

To unlock the encoder and enable programming, four exact bytes must be sent in the specified sequence. They are listed in the following table:

Byte in sequence	Programming command byte	
	HEX	ASCII
B1	0xCD	/
B2	0xEF	/
B3	0x89	/
B4	0xAB	/

Whenever the sequence is interrupted by a wrong byte, the unlock stage is reset and must be started from the beginning.

Image below shows the unlocking sequence captured by the logic analyzer.



In an SPI transaction, only one byte (command) must be sent to the encoder. In the above example, 3 additional bytes are transmitted because the application reads the encoder's position data at the same time as it programmes the encoder. The SPI transaction can be terminated at any time with the NCS signal high. If the encoder has been successfully unlocked, the fifth byte in a complete sequence must be one of the valid programming command bytes described below. If the fifth byte is not one of these, the encoder is "locked" again.

## Programming command bytes

The programming command bytes vary depending on the desired programming function. The valid programming bytes are listed in the following table. Some of them perform the desired task immediately (e.g., resetting factory defaults), while others require additional data bytes (e.g., setting the position offset). Each task is described in the following sections. When programming is complete, the programming option returns to the 'locked' phase.

Programming feature	Programming command byte		Additional data bytes required
	HEX	ASCII	
Setting zero offset	0x5A	'Z'	4
Multiturn counter setting	0x4D	'M'	4
Configuration parameters save	0x63	'c'	0
Reset to factory defaults	0x72	'r'	0
Triggering self-calibration	0x41	'A'	0

## Setting zero offset

First transfer zero position offset into RAM. Second, send the command to store this value into non-volatile memory. Pos\_offset parameter has max value of 16383.

Byte in sequence	Programming command byte		Purpose
	HEX	ASCII	
B1	0xCD	/	Unlock sequence
B2	0xEF	/	
B3	0x89	/	
B4	0xAB	/	
B5	0x5A	'Z'	Setting zero offset command
B6	0x00	/	Pos_offset
B7	0x00	/	
B8	HH (High byte)		
B9	LL (Low byte)		

## Programming example: Encoder position offset setting to 5144 (0x1418) counts

Bytes listed in the following table should be sent to the encoder in exact order with at least 1 ms of delay between bytes.

Byte in sequence	Programming command byte		Purpose
	HEX	ASCII	
B1	0xCD	/	Unlock sequence
B2	0xEF	/	
B3	0x89	/	
B4	0xAB	/	
B5	0x5A	'Z'	Setting zero offset command
B6	0x00	/	Encoder position shifted for 5144 counts
B7	0x00	/	
B8	0x14	/	
B9	0x18	/	

To save the offset position to non-volatile memory, the encoder configuration parameters must be saved according to the section **Saving configuration parameters to non-volatile memory**.

## Multiturn counter

Multiturn counter value can be between 0 and 65535.  
Saving to non-volatile memory is performed on power-off.

Byte in sequence	Programming command byte		Purpose
	HEX	ASCII	
B1	0xCD	/	Unlock sequence
B2	0xEF	/	
B3	0x89	/	
B4	0xAB	/	
B5	0x4D	'M'	Multiturn counter setting command
B6	0x00	/	New multiturn counter value
B7	0x00	/	
B8	HH (High byte)		
B9	LL (Low byte)		

## Saving configuration parameters to non-volatile memory

The bytes listed in the following table must be sent to the encoder in exact sequence.  
After this sequence has been completed, the encoder is non-responsive for a few milliseconds.

Byte in sequence	Programming command byte		Purpose
	HEX	ASCII	
B1	0xCD	/	Unlock sequence
B2	0xEF	/	
B3	0x89	/	
B4	0xAB	/	
B5	0x63	'c'	Save configuration parameters command

## Reset to factory defaults

The command resets the zero position offset to 0 and the self-calibration parameters to factory defaults.  
The bytes listed in the following table must be sent to the encoder in exact sequence.  
After this sequence is completed, the encoder is non-responsive for a few milliseconds.

Byte in sequence	Programming command byte		Purpose
	HEX	ASCII	
B1	0xCD	/	Unlock sequence
B2	0xEF	/	
B3	0x89	/	
B4	0xAB	/	
B5	0x72	'r'	Reset to factory defaults command

## Triggering self-calibration

The self-calibration function eliminates the error caused by eccentricity, which accounts for much of the accuracy of the encoder and is caused by the eccentric mounting of the ring. This function eliminates the error of one sine wave per revolution. If the multiturn counter is used in the encoder and the speed is higher than  $\pm 300$  RPM, it may have an incorrect value after self-calibration. In this case the multiturn error flag is set.

Requirements:

- Free mechanical rotation for one full revolution ( $360^\circ$ )
- Good signal over the entire calibration angle
- Maximum time available is 10 seconds
- Direction is not important
- Maximum speed during self-calibration is 600 RPM
- Self-calibration must be started when there is no error present (green LED)
- LED must be visible to check self-calibration status

Byte in sequence	Programming command byte		Purpose
	HEX	ASCII	
B1	0xCD	/	Unlock sequence
B2	0xEF	/	
B3	0x89	/	
B4	0xAB	/	
B5	0x41	'A'	Triggering self-calibration command

Saving to non-volatile memory occurs automatically when calibration is successful and LED flashes green rapidly. LED must be visible to check the status of self-calibration, otherwise the status of self-calibration cannot be checked.

Rotation speed and direction during self-calibration may be inconsistent. The only requirement is that the shaft makes at least one complete revolution within 10 seconds of sending the command.

Currently, there is no command to query the status whether the self-calibration has been completed successfully or not. Refer to the LED. Fast flashing green means that the process has been completed successfully.

## Head office

---

### RLS Merilna tehnika d.o.o.

Poslovna cona Žeje pri Komendi  
Pod vrbami 2  
SI-1218 Komenda  
Slovenia

**T** +386 1 5272100

**F** +386 1 5272129

**E** [mail@rls.si](mailto:mail@rls.si)

[www.rls.si](http://www.rls.si)

## Global support

---

Visit our [website](#) to contact your nearest sales representative.

## Document issues

Date	Issue	Page	Description
3. 1. 2022	2	-	New design

This product is not designed or intended for use outside the environmental limitations and operating parameters expressly stated on the product's datasheet. Products are not designed or intended for use in medical, military, aerospace, automotive or oil & gas applications or any safety-critical applications where a failure of the product could cause severe environmental or property damage, personal injury or death. Any use in such applications must be specifically agreed to by seller in writing, and is subject to such additional terms as the seller may impose in its sole discretion. Use of products in such applications is at buyer's own risk, and buyer will indemnify and hold harmless seller and its affiliates against any liability, loss, damage or expense arising from such use. Information contained in this datasheet was derived from product testing under controlled laboratory conditions and data reported thereon is subject to the stated tolerances and variations, or if none are stated, then to tolerances and variations consistent with usual trade practices and testing methods. The product's performance outside of laboratory conditions, including when one or more operating parameters is at its maximum range, may not conform to the product's datasheet. Further, information in the product's datasheet does not reflect the performance of the product in any application, end-use or operating environment buyer or its customer may put the product to. Seller and its affiliates make no recommendation, warranty or representation as to the suitability of the product for buyer's application, use, end-product, process or combination with any other product or as to any results buyer or its customer might obtain in their use of the product. Buyer should use its own knowledge, judgment, expertise and testing in selecting the product for buyer's application, end-use and/or operating environment, and should not rely on any oral or written statement, representation, or samples made by seller or its affiliates for any purpose. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH IN THE SELLER'S TERMS AND CONDITIONS OF SALE, SELLER MAKES NO WARRANTY EXPRESS OR IMPLIED WITH RESPECT TO THE PRODUCT, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, WHICH ARE DISCLAIMED AND EXCLUDED. All sales are subject to seller's exclusive terms and conditions of sale which, where the seller is (a) RLS Merilna tehnika d.o.o., are available at <https://www.rls.si/eng/salesterms>, (b) Renishaw, Inc., are available at <https://www.renishaw.com/legal/en/-42186>, or (c) another person, are available on request, and in each case, are incorporated herein by reference, and are the exclusive terms of sale. No other terms and conditions apply. Buyer is not authorized to make any statements or representations that expand upon or extend the environmental limitations and operating parameters of the products, or which imply permitted usage outside of that expressly stated on the datasheet or agreed to in writing by seller.

RLS Merilna tehnika d.o.o. has made considerable effort to ensure the content of this document is correct at the date of publication but makes no warranties or representations regarding the content. RLS Merilna tehnika d.o.o. excludes liability, howsoever arising, for any inaccuracies in this document. © 2022 RLS d.o.o.