

## Programming AksIM-2 encoders with EncoLink communication protocol

**Abstract:** EncoLink is a communication protocol that can be implemented on different physical channels, UART and SPI. It is a multilayer communication protocol that provides position, CRC and error/warning bits in the first channel, control position and detailed status in the second channel and register access in the third channel. The user can read all data simultaneously, the first channel with the highest bandwidth and the third channel with the lowest bandwidth.

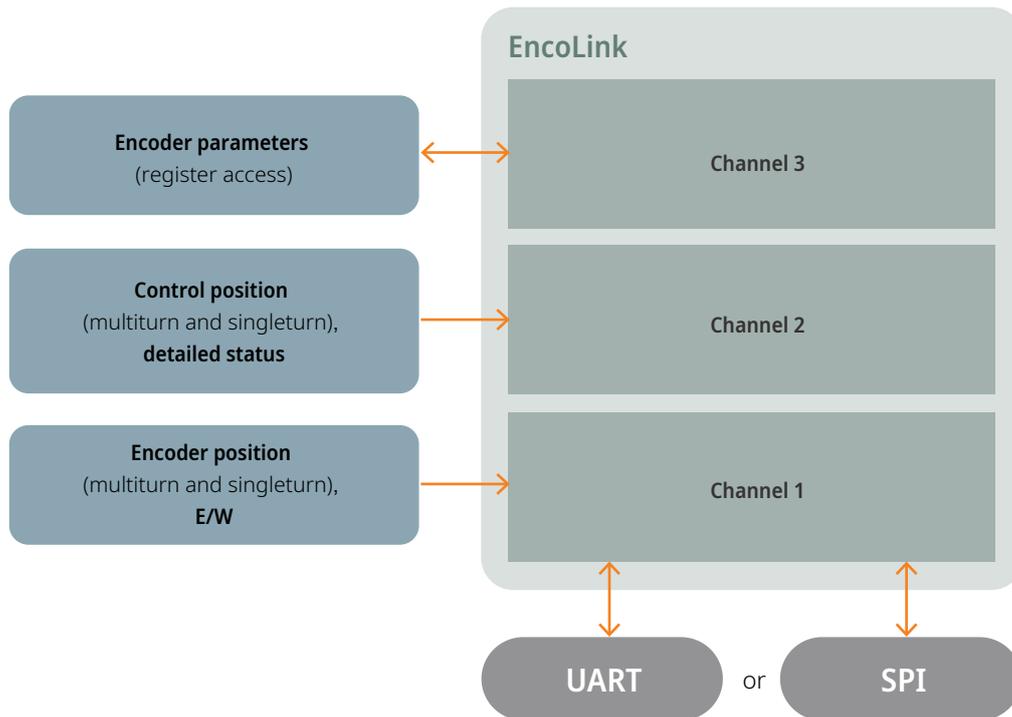
**User implementation:** The user can choose one of two options:

- ▶ Channel 1 only. Functionality is the same as on AksIM-1. Only the encoder position is available, with general Error and Warning bits. For SPI, the MOSI line can be tied to GND (unused) and for UART, an empty request (0x00, 0x00) is sent.
- ▶ Full 3-channel access. RLS provides precompiled libraries (without NDA) or source code of EncoLink master libraries (with NDA). The end user does not need to write custom code to implement full encoder functionality.

### Related product



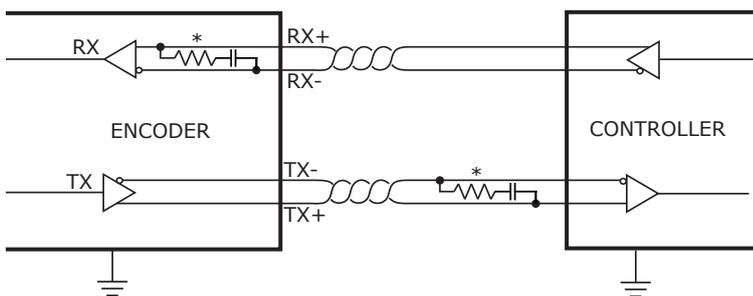
**AksIM-2** off-axis absolute magnetic encoder



## Asynchronous serial communication interface (UART)

Asynchronous serial communication is supported by a universal asynchronous receiver/transmitter commonly known as UART. It comprises two unidirectional communication channels that form a full-duplex bidirectional data link. Each channel consists of a two-wire differential twisted-pair connection conforming to the RS422 signalling standard.

### Electrical connection



\* The RX and TX signals are 5 V RS422 compatible differential pairs. RX signal is terminated with RC (100  $\Omega$ , 1 nF) inside the encoder.

### Line signals

<b>RX+</b>	RX data in +
<b>RX-</b>	RX data in -
<b>TX+</b>	TX data out +
<b>TX-</b>	TX data out -

### Communication parameters

<b>Character length</b>	8 bits
<b>Parity</b>	None
<b>Stop bits</b>	1
<b>Flow control</b>	None
<b>Bit order</b>	LSB first (standard)

Communication interface variant in the part number:

<b>Communication interface variant</b>	L
<b>Baud rate [kbps]</b>	1000

## Encoder position data structure (Channel 1)

Transmitted data (2 bytes): Command 0x00, Data 0x00

Received data: see the following table

### For multeturn

<b>b55 : b40</b>	Multiturn counter (if specified in part number) – Left aligned, MSB first.
<b>b39 : b18</b>	Encoder position + zero padding bits – Left aligned, MSB first.
<b>b17</b>	Error – If low, the position data is not valid.
<b>b16</b>	Warning – If low, the position data is valid, but some operating conditions are close to limits.
<b>b15 : b8</b>	Inverted CRC, 0x97 polynom
<b>b7 : b0</b>	Data for channel 2, not used

### For singleturn

<b>b39 : b18</b>	Encoder position + zero padding bits – Left aligned, MSB first.
<b>b17</b>	Error – If low, the position data is not valid.
<b>b16</b>	Warning – If low, the position data is valid, but some operating conditions are close to limits.
<b>b15 : b8</b>	Inverted CRC, 0x97 polynom
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CRC calculation example is in application note document CRCD01, available for download from [AksIM-2 website](#).

## Encoder programming

Encoder supports setting zero position, changing default baud rate, running self-calibration function, automatic transmission of selected data packet at programmable frame rate.

Additional functions are available over Channels 2 and 3 with use of EncoLink libraries.

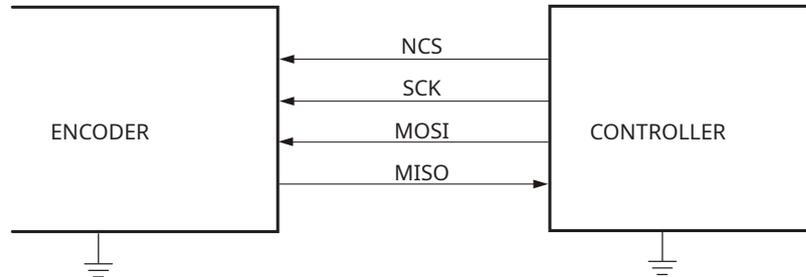
## SPI - Serial peripheral interface (slave mode)

The Serial Peripheral Interface (SPI) bus is a bidirectional, synchronous, four wire serial communication interface, typically used for short-range communications. It operates in full duplex mode, where the master (controller) selects the slave with the NCS line, generates a clock signal on the SCK line, sends commands over the MOSI line, and receives data over the MISO line.

### Electrical connection

All data signals are 3.3 V LVTTTL. Inputs are 5 V tolerant. Maximum current sourced or sunk from signal lines should not exceed 20 mA. Single-ended signals should be as short as possible, especially if high frequencies are used.

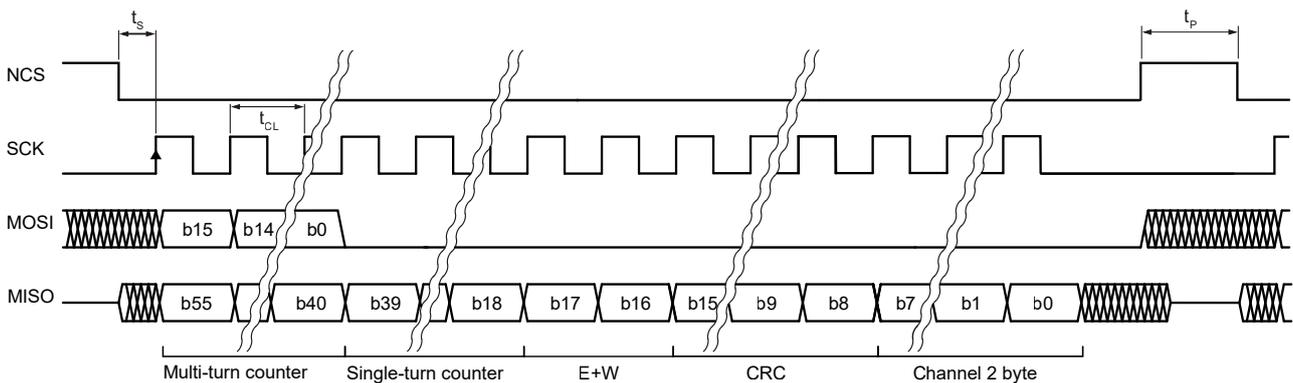
Signal termination: 100 Ω resistors are added in series with all SPI signals.



### Pinout

Signal	Description	Pin	SPI
NCS	Active low. NCS line is used for synchronisation between master and slave devices. During communication it must be held low. Idle is high. When NCS is high, MISO line is in high-Z mode. This allows connection of multiple slaves in parallel, sharing all lines except NCS.	1	+5 V
SCK	Serial clock. Shifts out the data on rising edge.	2	GND
MOSI	Master output → Slave input. Command from the controller to encoder.	3	-
MISO	Master input ← Slave output. Data is output on rising edge on SCK after NCS low. When NCS is high, MISO line is in high-Z mode.	4	-
		5	SCK
		6	NCS
		7	MISO
		8	MOSI

### SPI timing diagram



Controller starts communication by setting the NCS signal low. At the same time, the last available position data is latched. The encoder requires a delay of  $t_s$  to prepare the data, which is shifted to MISO output on rising edges of clock signal SCK. The command is received on eight consecutive rising edges of SCK. Position and General Status data (active low) are sent out regardless of the command received. The following Requested data length as well as the content depends on the command. The last eight bits contain CRC (inverted) of the complete data packet.

## Communication parameters

Parameter	Symbol	Min	Typ	Max
Clock period	$t_{CL}$	250 ns		
Clock frequency	$f_{CL}$			4 MHz
Time after NCS low to first SCK rising edge	$t_s$	5 $\mu$ s		
Pause time	$t_p$	5 $\mu$ s		

## Encoder position data structure (Channel 1)

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CRC calculation example is in application note document CRCD01, available for download from [AksIM-2 website](#).

## Encoder programming

Encoder supports setting zero position and running self-calibration function.

Additional functions are available over Channels 2 and 3 with use of EncoLink libraries ([Contact RLS](#)).

## Head office

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