



Scalable PLC AC500

CD522

Technical guideline for Encoder

Contents

1. Relative encoder

- General description
- Cabling information
- Configuration
- Encoder management

2. Absolute encoder

- General description
- Cabling information
- Configuration
- Encoder Management

3. Advanced operation

- X2, X4 encoder
- Set operation
- Reset operation
- Touch operation
- RPI (Homing)
- End value reached



1. Relative encoder

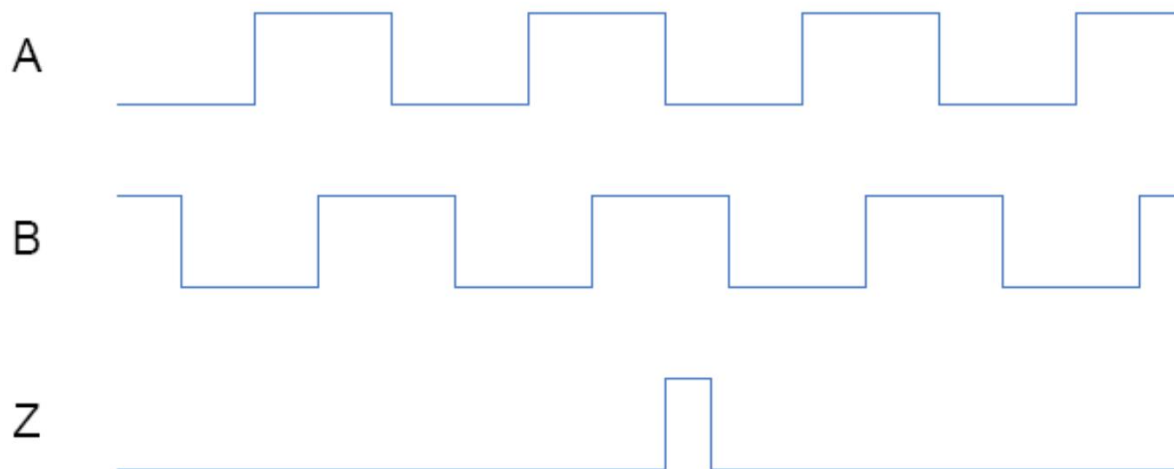
CD522 – Relative encoder

- General description.
- Cabling information.
- Configuration.
- Encoder management.

CD522 – Relative encoder

General description - 1

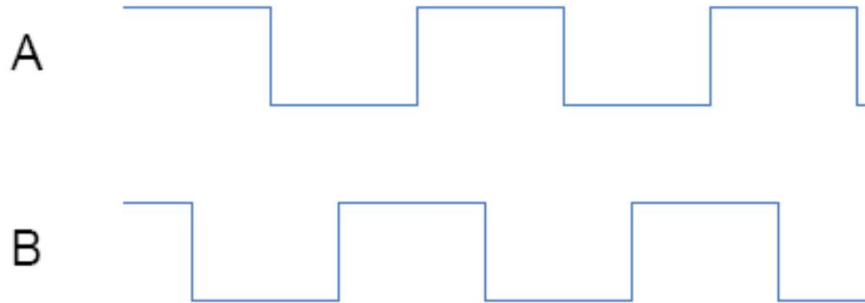
- General description
 - An incremental rotary encoder, also known as a quadrature encoder or a relative rotary encoder, has two outputs called quadrature outputs (A & B).
 - There can be an optional third output: reference (Z), which happens once every turn.
 - Typical encoder output signal :



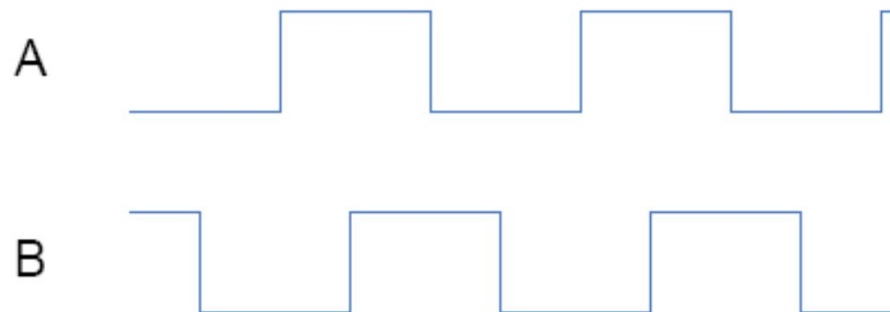
CD522 – Relative encoder

General description - 2

- Direction determination
 - Clockwise rotation, B is before A, the counter value is incremented



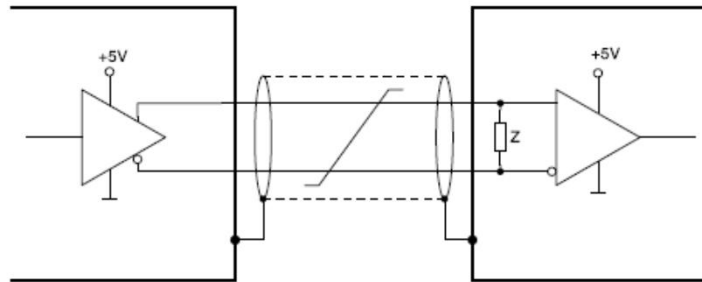
- Counterclockwise, A is before B, the counter value is decremented



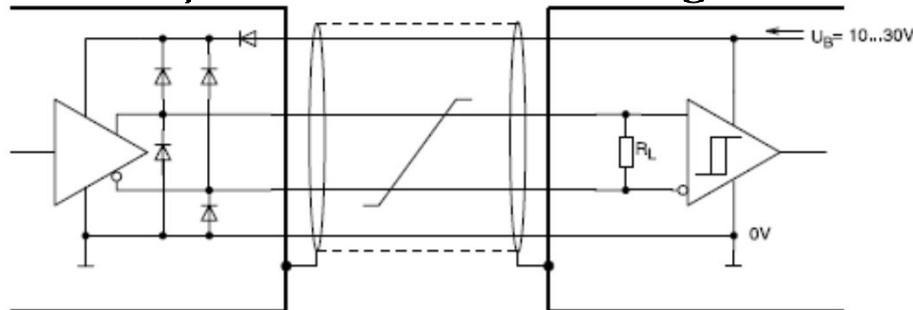
CD522 – Relative encoder

Cabling information - 1

- Usual output signal for relative encoder
 - RS422 (5 V differential) output type



- Push-pull driver +24VDC signal level



- .../...

Configuration:

CD522 Configuration	CD522 I/O Mapping	Information
Input level FCO	Enum...	0-24 VDC
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential
SSI 0...	Enum...	Sine 1 Vpp

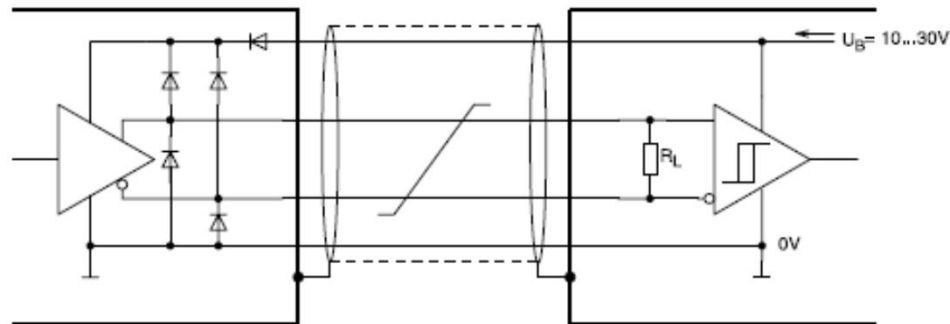
CD522 Configuration	CD522 I/O Mapping	Information
Input level FCO	Enum...	Differential
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential
SSI 0...	Enum...	Sine 1 Vpp

CD522 – Relative encoder

Cabling information - 2

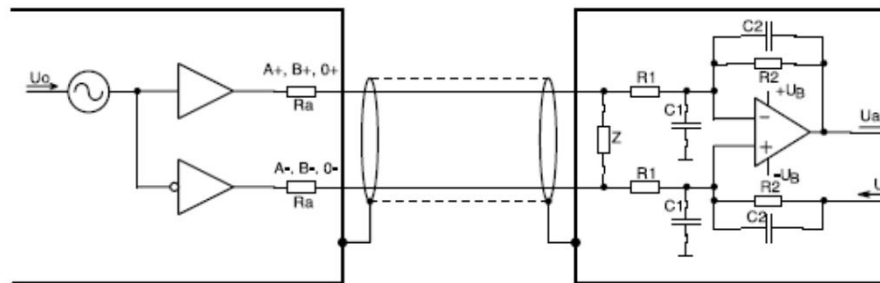
- Usual output signal for relative encoder
 - Push-pull or TTL driver +5VDC signal level

Configuration:



CD522 Configuration	CD522 I/O Mapping	Information
Input level FC0	Enum...	0-24 VDC
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential
SSI 0 code type	Enum...	Sine 1 Vpp

- Sinusoidal voltage (1Vpp signal level)



CD522 Configuration	CD522 I/O Mapping	Information
Input level FC0	Enum...	0-5 VDC
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential
SSI 0 code type	Enum...	Sine 1 Vpp

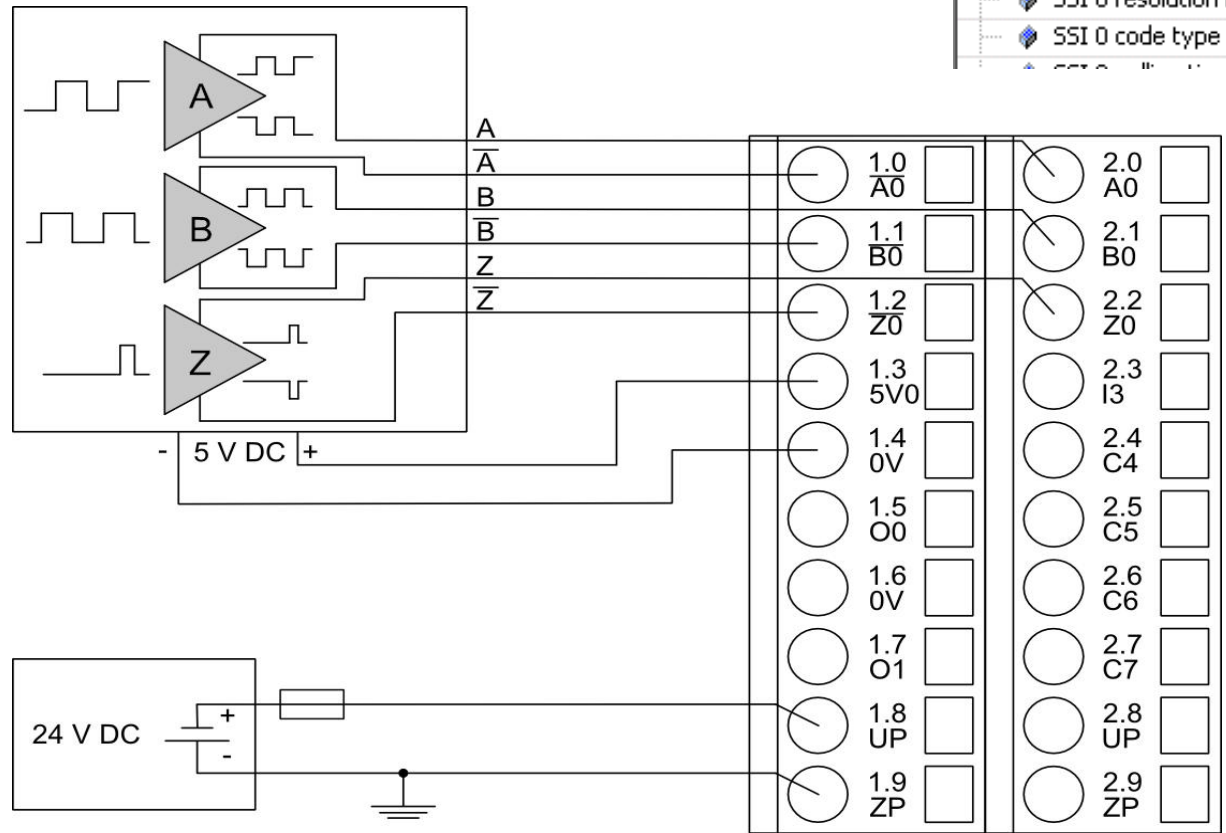
CD522 – Relative encoder

Cabling information - 3

- Cabling information
 - RS422 (5 V differential) output type

Configuration:

CD522 Configuration	CD522 I/O Mapping	Information
Input level FCO	Enum...	0-24 VDC
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential
SSI 0	Enum...	Sine 1 Vpp



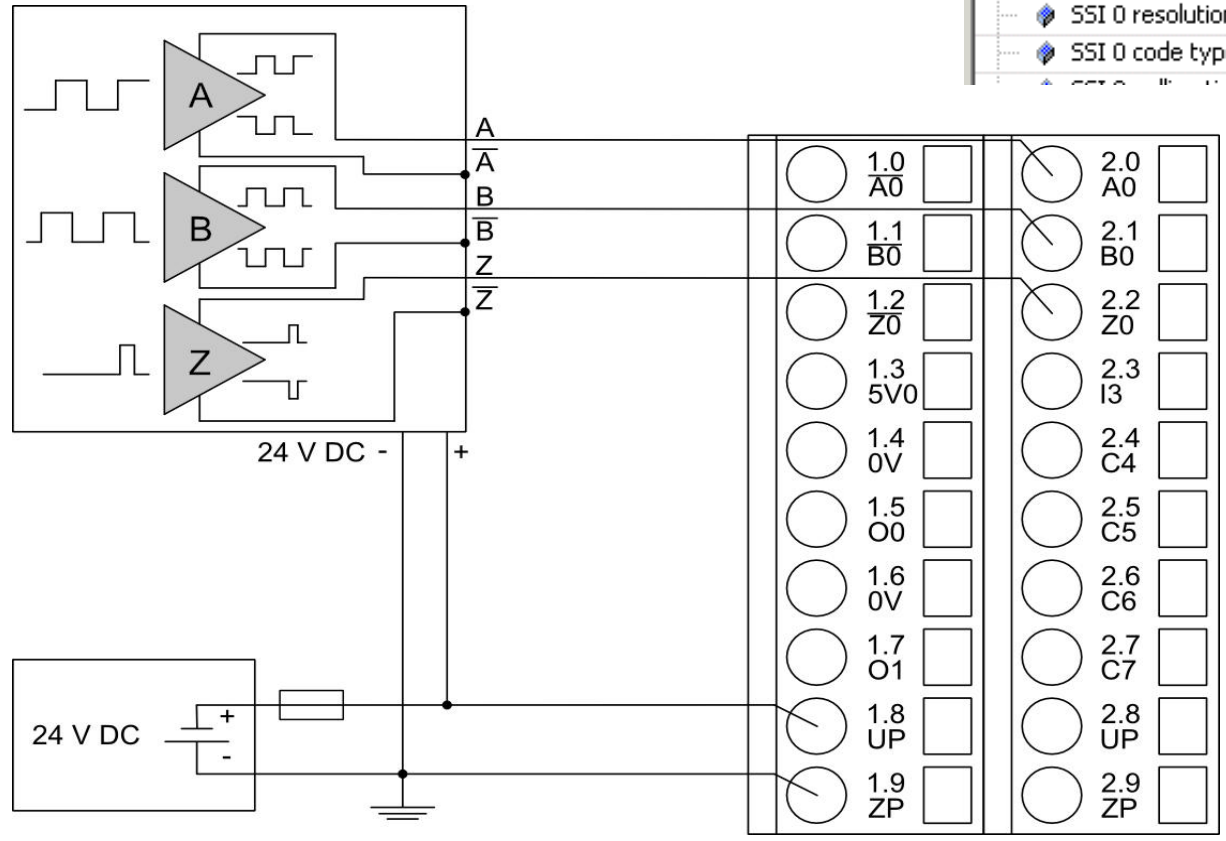
CD522 – Relative encoder

Cabling information - 4

- Cabling information
 - Push-pull driver +24VDC signal level

Configuration:

CD522 Configuration		CD522 I/O Mapping		Information	
Input level FCO	Enum...			Differential	
SSI 0 frequency	Enum...			0-24 VDC	
SSI 0 resolution in bit	BYTE(...)			0-5 VDC	
SSI 0 code type	Enum...			Differential	
				Sine 1 Vpp	



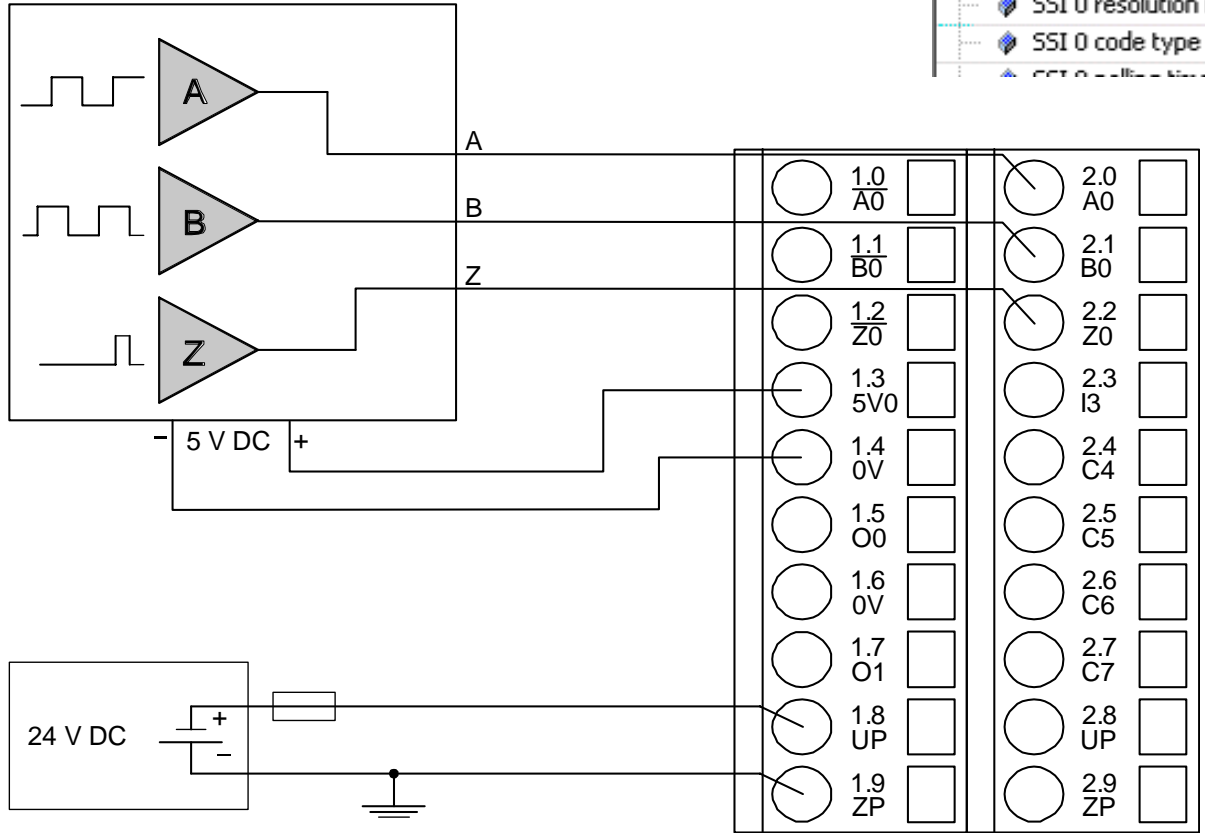
CD522 – Relative encoder

Cabling information - 5

- Cabling information
 - Push-pull or TTL driver +5VDC signal level

Configuration:

CD522 Configuration	CD522 I/O Mapping	Information
Input level FC0	Enum...	0-24 VDC
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential Sine 1 Vpp



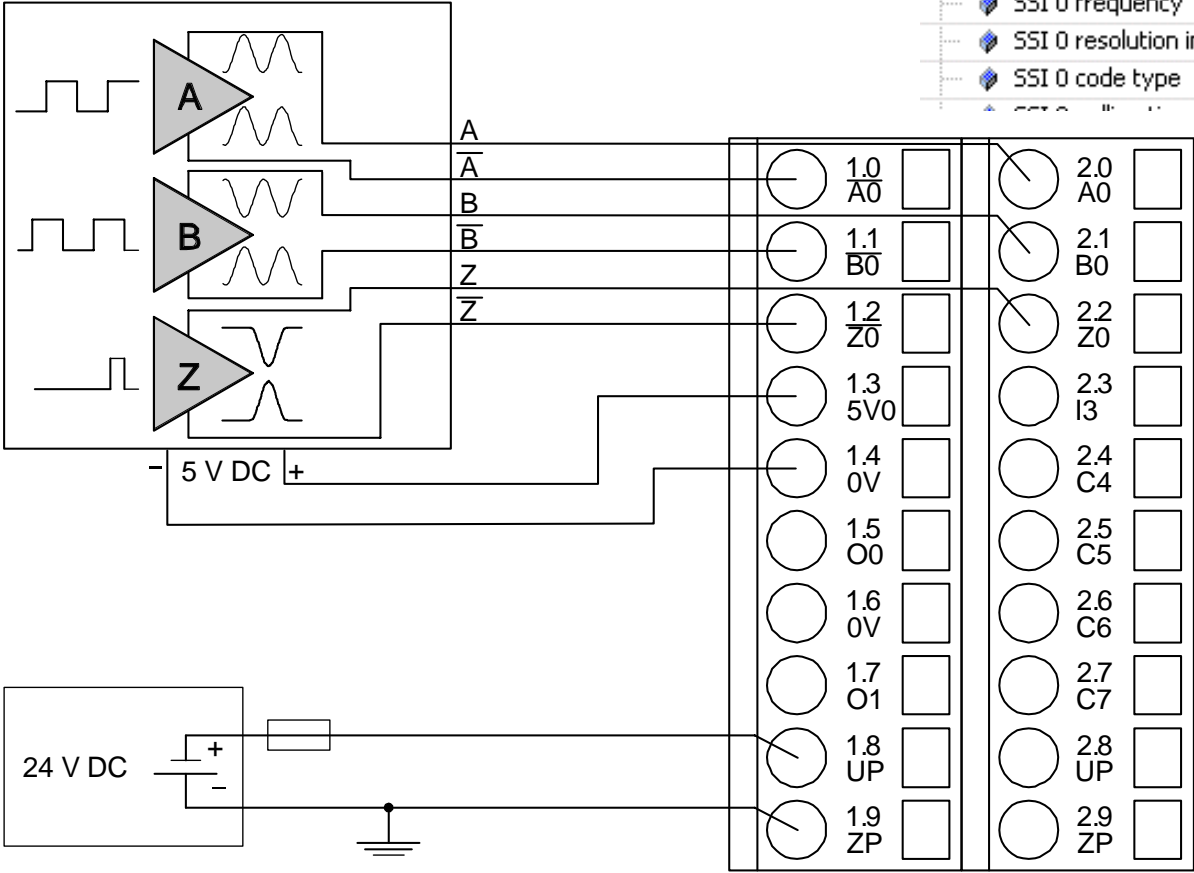
CD522 – Relative encoder

Cabling information - 6

- Cabling information
 - Sinusoidal voltage (1Vpp signal level)

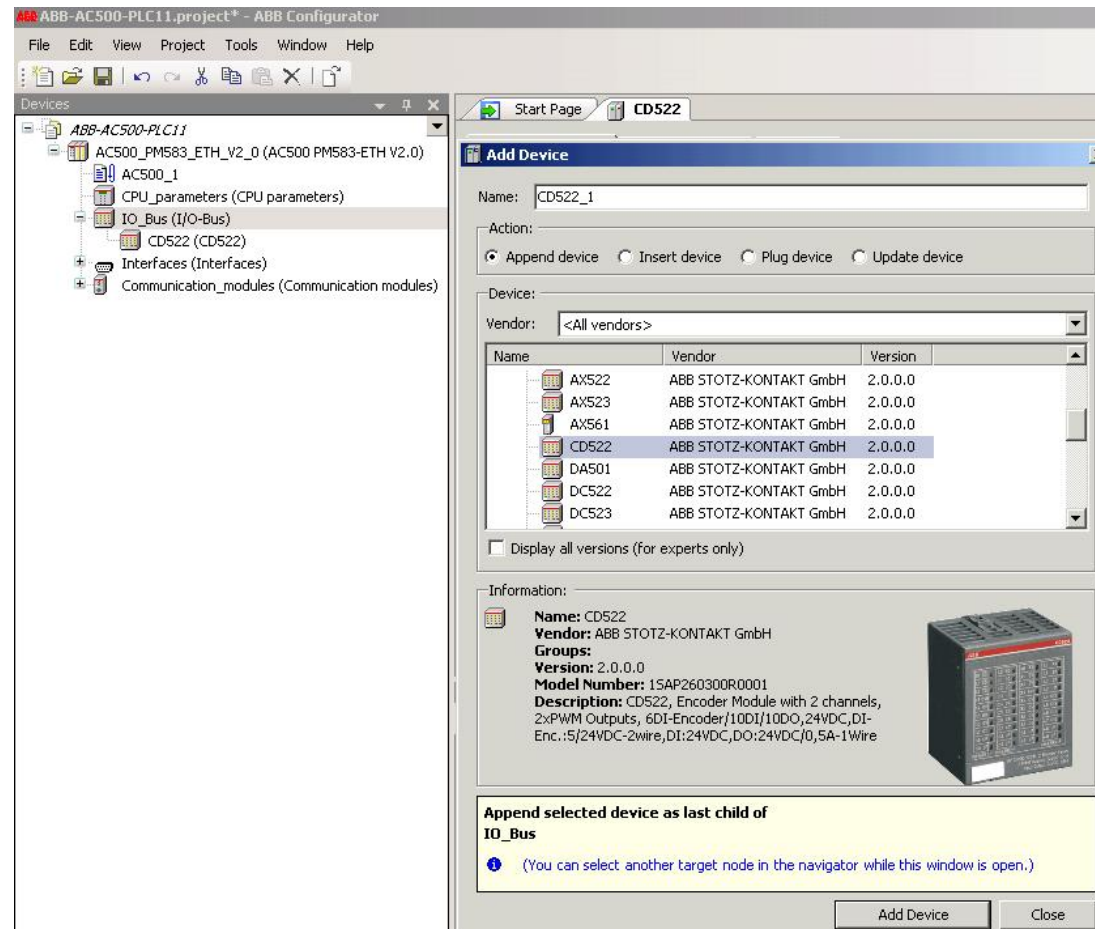
Configuration:

CD522 Configuration	CD522 I/O Mapping	Information
Input level FCO	Enum...	0-5 VDC
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential
SSI 0 signal level	Enum...	Sine 1 Vpp



CD522 – Relative encoder Configuration – Include CD522 module

- In ABB Configurator, right click on the place where to add the device, and select CD522 in the list of modules available.



CD522 – Relative encoder Configuration – Select encoder mode

- Select incremental encoder (mode 11)

The screenshot shows the 'CD522 Configuration' window with the 'Information' tab selected. A table lists various parameters, and the 'Mode counter 0' parameter is expanded to show a list of encoder modes. The '11-1 Incremental encoder' option is highlighted in blue.

Parameter	Type	Value
Ignore module	Enum...	No
Check supply	Enum...	On
Input delay	Enum...	8 ms
Mode counter 0	Enum...	No counter
Freq limit FC0	Enum...	5-1 UpDown dynamic set (B)/rising edge
Input level FC0	Enum...	6-1 UpDown dynamic set (B)/falling edge
SSI 0 frequency	Enum...	8-1 UpDown with release (B), 0 cross detection
SSI 0 resolution in bit	BYTE(...)	11-1 Incremental encoder
SSI 0 code type	Enum...	12-1 Incremental encoder X2
SSI 0 polling time	BYTE(...)	13-1 Incremental encoder X4
Encoder 0 supply	Enum...	14-1 SSI, absolute encoder
		15-1 Time frequency meter (Z)



CD522 – Relative encoder Configuration – Select encoder electric signal

- Select encoder electric signal
 - (check previous slides for cabling info)

Parameter	Type	Value
Ignore module	Enum...	No
Check supply	Enum...	On
Input delay	Enum...	8 ms
Mode counter 0	Enum...	11-1 Incremental encoder
Freq limit FC0	Enum...	No filter
Input level FC0	Enum...	0-24 VDC
SSI 0 frequency	Enum...	0-24 VDC
SSI 0 resolution in bit	BYTE(...)	0-5 VDC
SSI 0 code type	Enum...	Differential
SSI 0 polling time	BYTE(...)	Sine 1 Vpp



CD522 – Relative encoder Configuration – Valid power supply

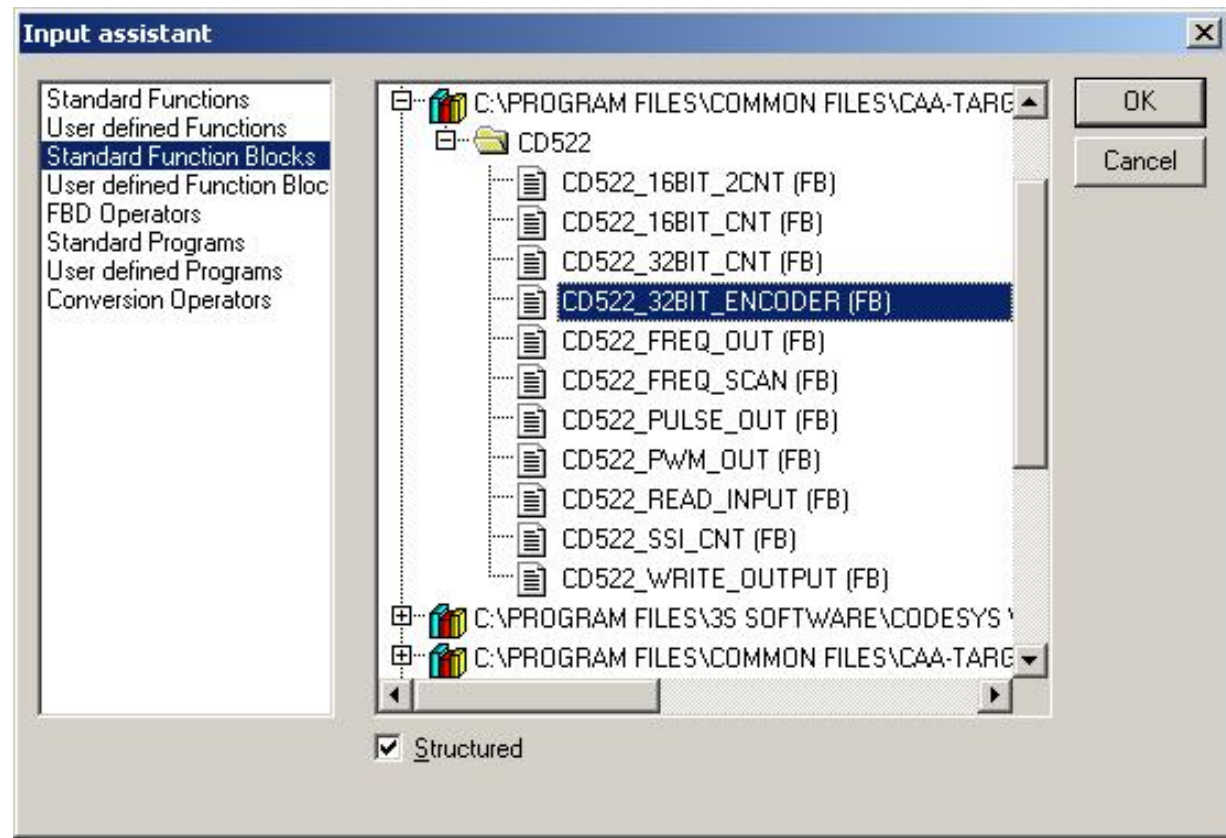
- If encoder is powered with +5VDC power supply provided by CD522 module, configure it as described , if not skip this step

Parameter	Type	Value
Ignore module	Enum...	No
Check supply	Enum...	On
Input delay	Enum...	8 ms
Mode counter 0	Enum...	11-1 Incremental encoder
Freq limit FC0	Enum...	No filter
Input level FC0	Enum...	Differential
SSI 0 frequency	Enum...	200 kHz
SSI 0 resolution in bit	BYTE(...)	16
SSI 0 code type	Enum...	Binary
SSI 0 polling time	BYTE(...)	10
5V sensor 0 supply	Enum...	Off
Mode counter 1	Enum...	Off
Freq limit FC1	Enum...	On

CD522 – Relative encoder

Encoder management – include function block

- In PS501 Control Builder, insert the function block, press F2, then select the CD522_32BIT_ENCODER function block in input assistant :



CD522 – Relative encoder

Encoder management – Name instance

- Name instance of the function block

Declare Variable

Class	Name	Type
VAR	Encoder_0	CD522_32BIT_ENCODEF

Symbol list	Initial Value	Address
CD522_Module_Map		

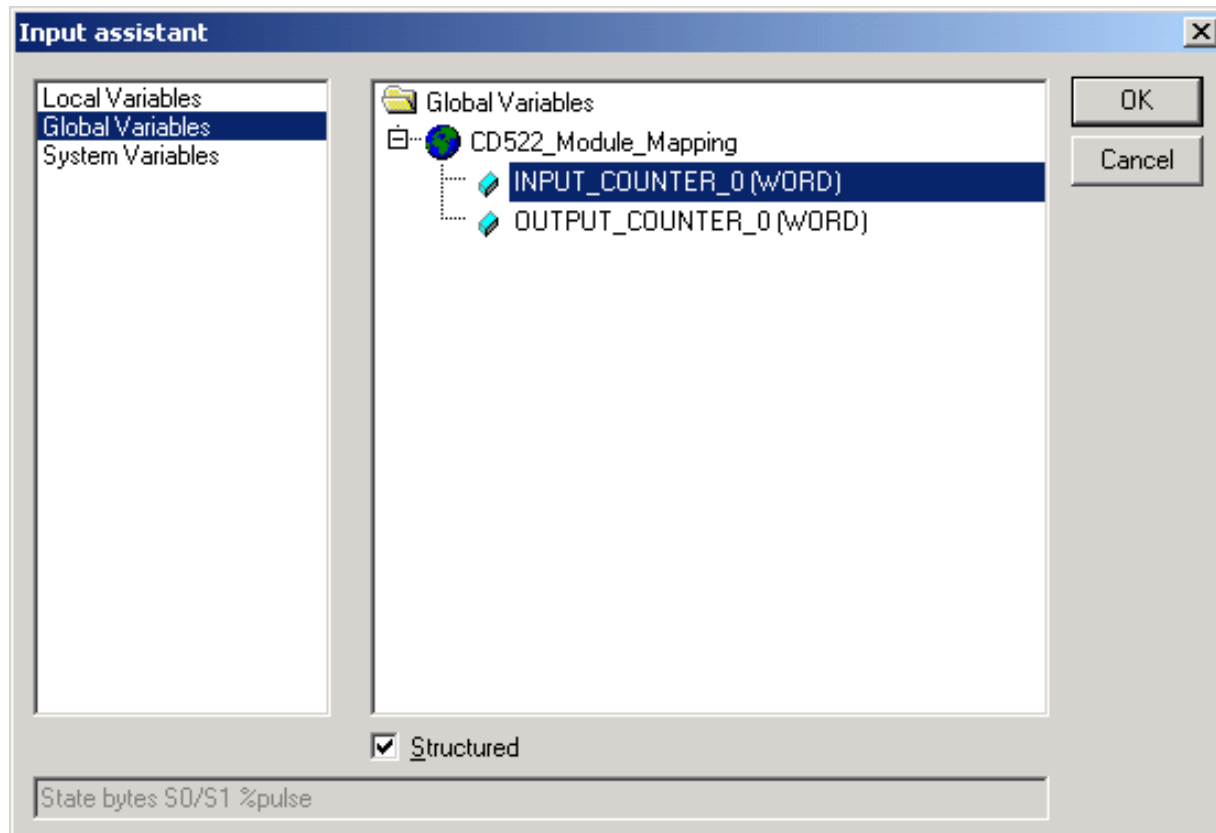
Comment:

CONSTANT
 RETAIN
 PERSISTENT

CD522 – Relative encoder

Encoder management – Input/output pointer

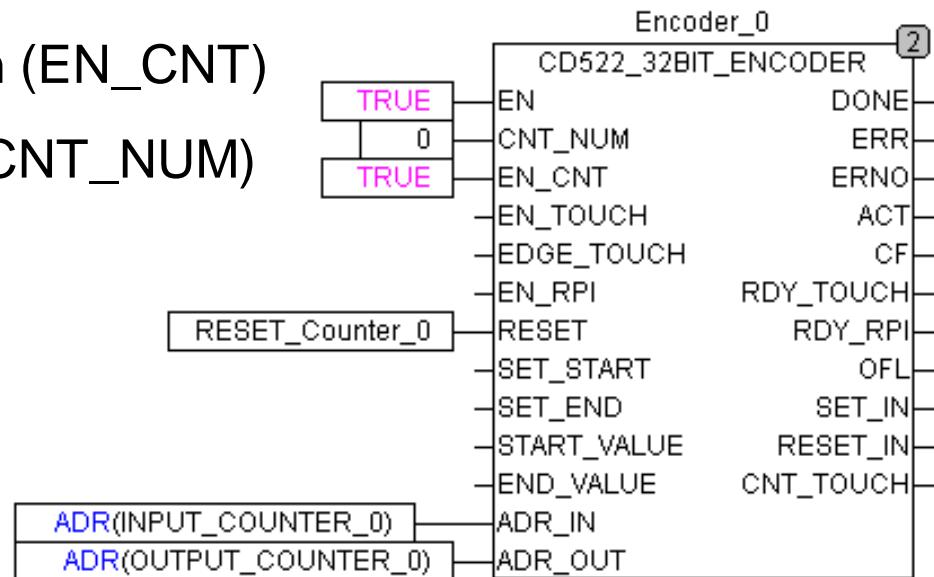
- Add input and output address pointer on ADR_IN and ADR_OUT of parameter inputs of function block.
(use address conversion box ADR)



CD522 – Relative encoder

Encoder management – Enable block and counter

- Enable block operation (EN)
- Enable counter operation (EN_CNT)
- Select counter number (CNT_NUM)

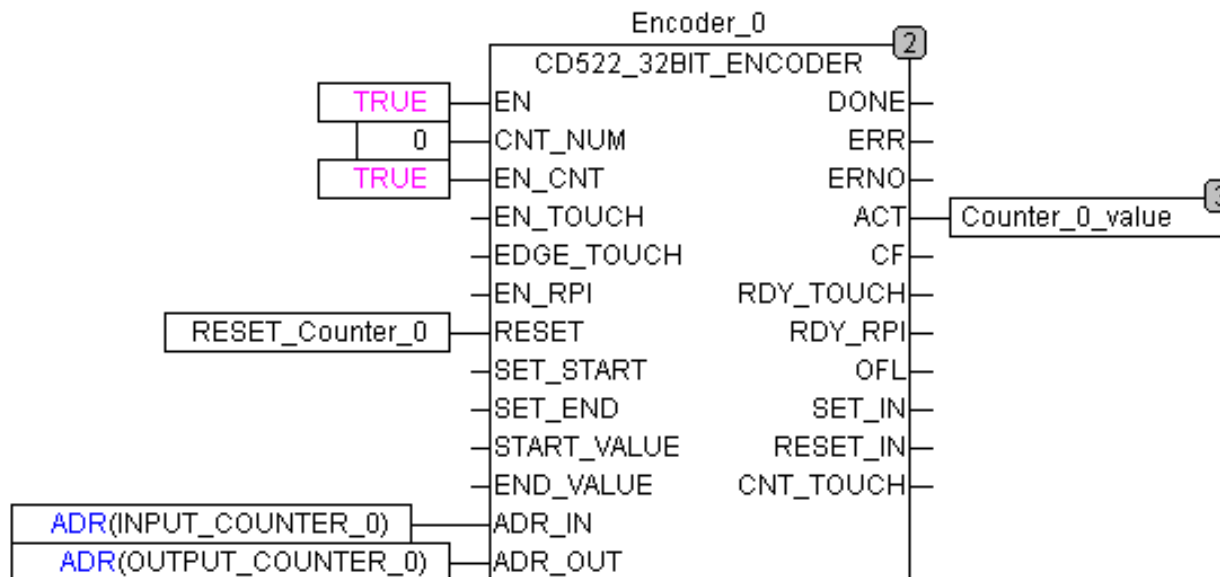


- Addresses of Pointers
(ADR_IN, ADR_OUT)

CD522 – Relative encoder

Encoder management – Connect output value

- Add counter variable on output parameter (ACT)



- The relative Encoder is ready to run



2. Absolute encoder

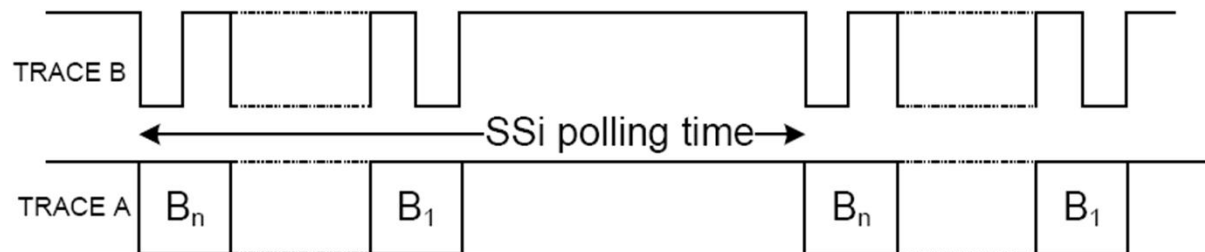
CD522 – Absolute encoder

- General description.
- Cabling information.
- Configuration.
- Encoder management.

CD522 – Absolute encoder

General description - 1

- General description
 - The absolute digital encoder produces an unique digital code for each distinct angle of the shaft .
 - For absolute encoders interface there are several formats for transmission of absolute encoder data, most often used is SSi (Synchronous Serial Interface)
 - Typical encoder output signal (RS422) :

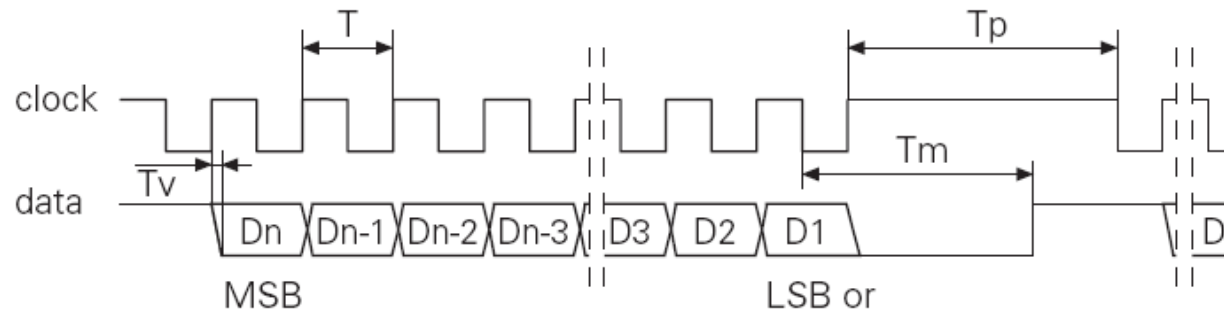


- CD522 provides the clock (B trace), the encoder returns the data to Trace A

CD522 – Absolute encoder

General description - 2

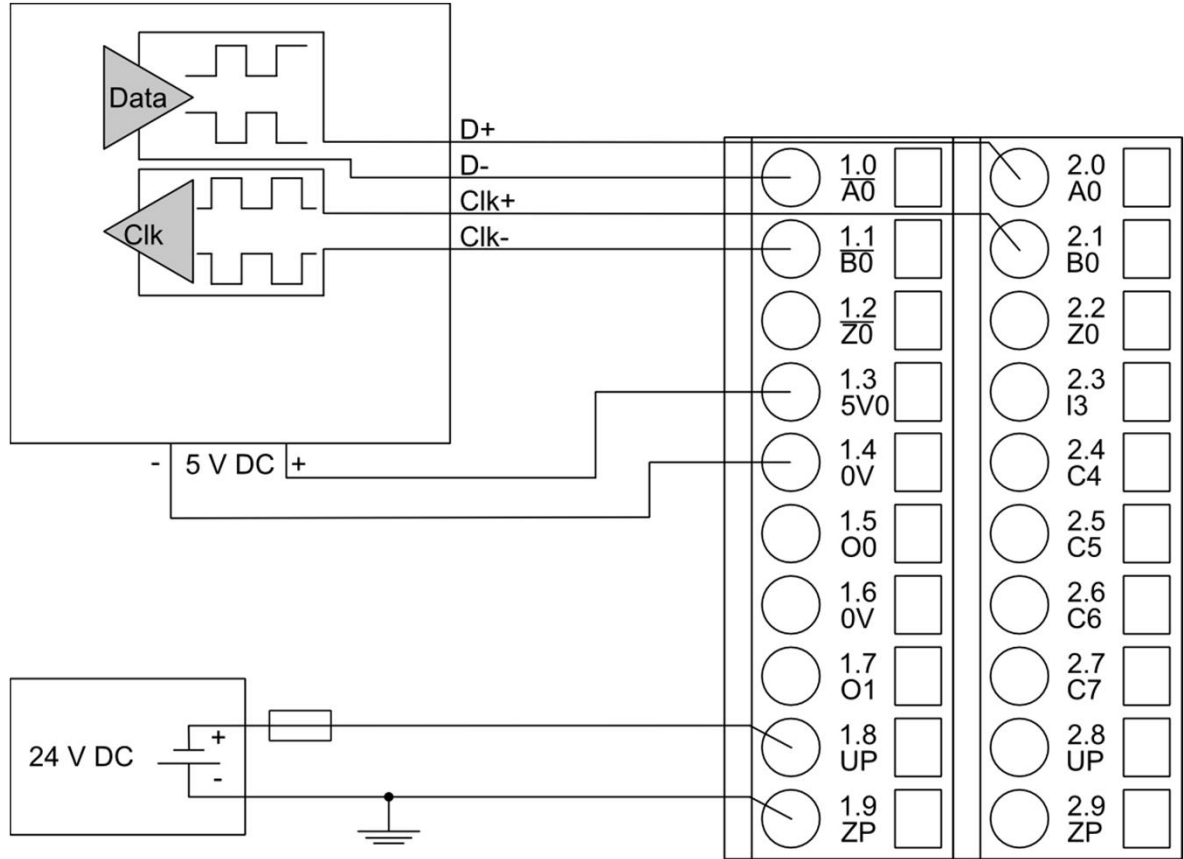
- General description
 - In SSI communication the serial data received are limited to the counter value, it doesn't include any CRC or addition check on data.
 - To synchronize with a new data value there must be a silent time (T_p) on the clock during a time specified in the data of encoder.



CD522 – Absolute encoder

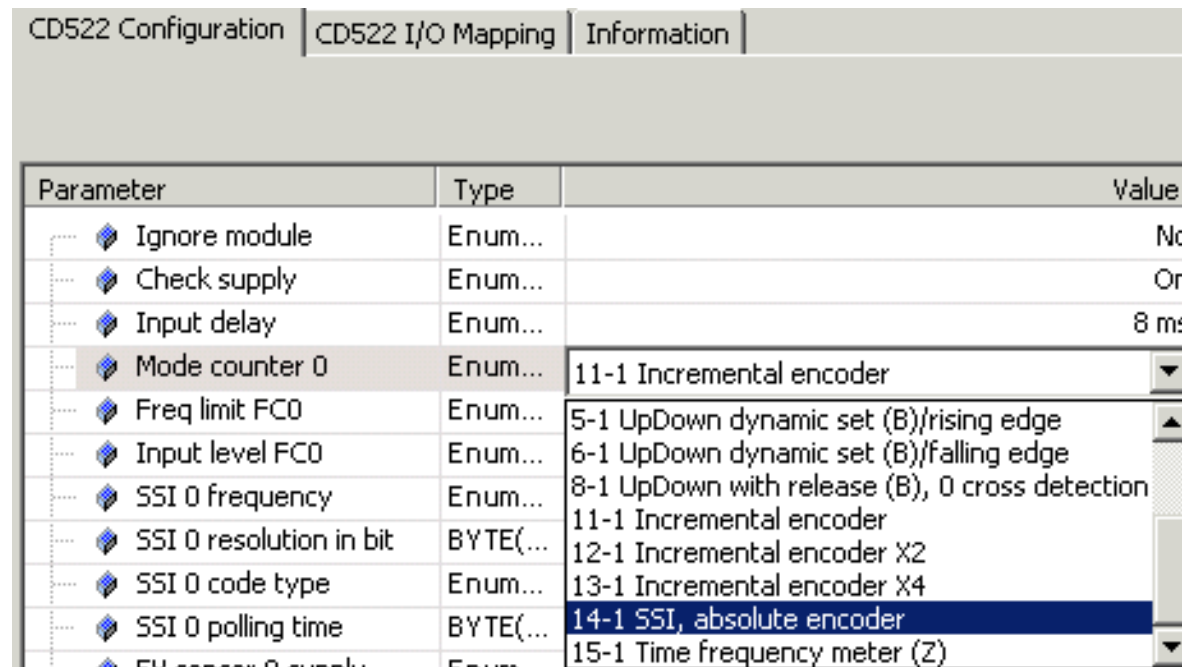
Cabling information

- Typical cabling information



CD522 – Absolute encoder Configuration - 1

- Configuration: with ABB Configurator
 - Insert CD522 module
(check in relative encoder description)
 - Set counting mode in Absolute encoder (Mode 14)

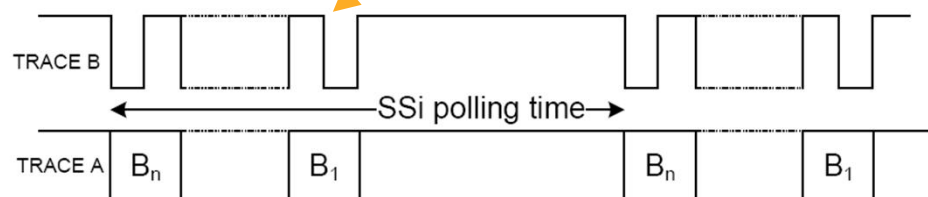


Parameter	Type	Value
Ignore module	Enum...	No
Check supply	Enum...	On
Input delay	Enum...	8 ms
Mode counter 0	Enum...	11-1 Incremental encoder
Freq limit FCO	Enum...	5-1 UpDown dynamic set (B)/rising edge
Input level FCO	Enum...	6-1 UpDown dynamic set (B)/falling edge
SSI 0 frequency	Enum...	8-1 UpDown with release (B), 0 cross detection
SSI 0 resolution in bit	BYTE(...)	11-1 Incremental encoder
SSI 0 code type	Enum...	12-1 Incremental encoder X2
SSI 0 polling time	BYTE(...)	13-1 Incremental encoder X4
EM context 0 supply	Enum...	14-1 SSI, absolute encoder
		15-1 Time frequency meter (Z)

CD522 – Absolute encoder Configuration - 2

- Configuration: with ABB Configurator
 - Set frequency of clock output

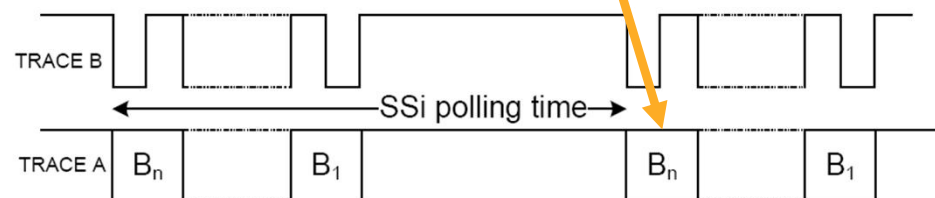
Parameter	Type	Value
Ignore module	Enum...	No
Check supply	Enum...	On
Input delay	Enum...	8 ms
Mode counter 0	Enum...	14-1 SSI, absolute encoder
Freq limit FCO	Enum...	No filter
Input level FCO	Enum...	Differential
SSI 0 frequency	Enum...	200 kHz
SSI 0 resolution in bit	BYTE(...)	200 kHz
SSI 0 code type	Enum...	500 kHz
SSI 0 pollina time	BYTE(...)	1 MHz



CD522 – Absolute encoder Configuration - 3

- Configuration: with ABB Configurator
 - Resolution: Set size of data: number of bit

Parameter	Type	Value	Default Value
Ignore module	Enum...	No	No
Check supply	Enum...	On	On
Input delay	Enum...	8 ms	8 ms
Mode counter 0	Enum...	14-1 SSI, absolute encoder	No counter
Freq limit FC0	Enum...	No filter	No filter
Input level FC0	Enum...	Differential	0-24 VDC
SSI 0 frequency	Enum...	200 kHz	200 kHz
SSI 0 resolution in bit	BYTE(...)	25	16
SSI 0 code type	Enum...	Binary	Binary

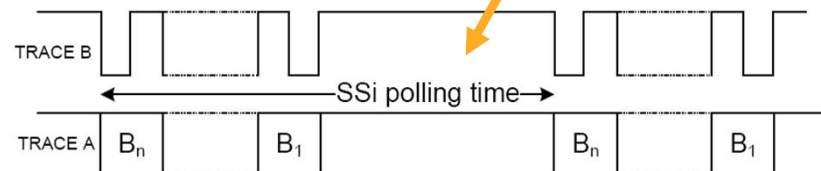


- The code type is always “Binary”, the conversion such as BCD, or Gray is done with function block

CD522 – Absolute encoder Configuration - 4

- Configuration: with ABB Configurator
 - Check for time required between measurement (T_p)
 - Set polling time (time between each measurement in ms)

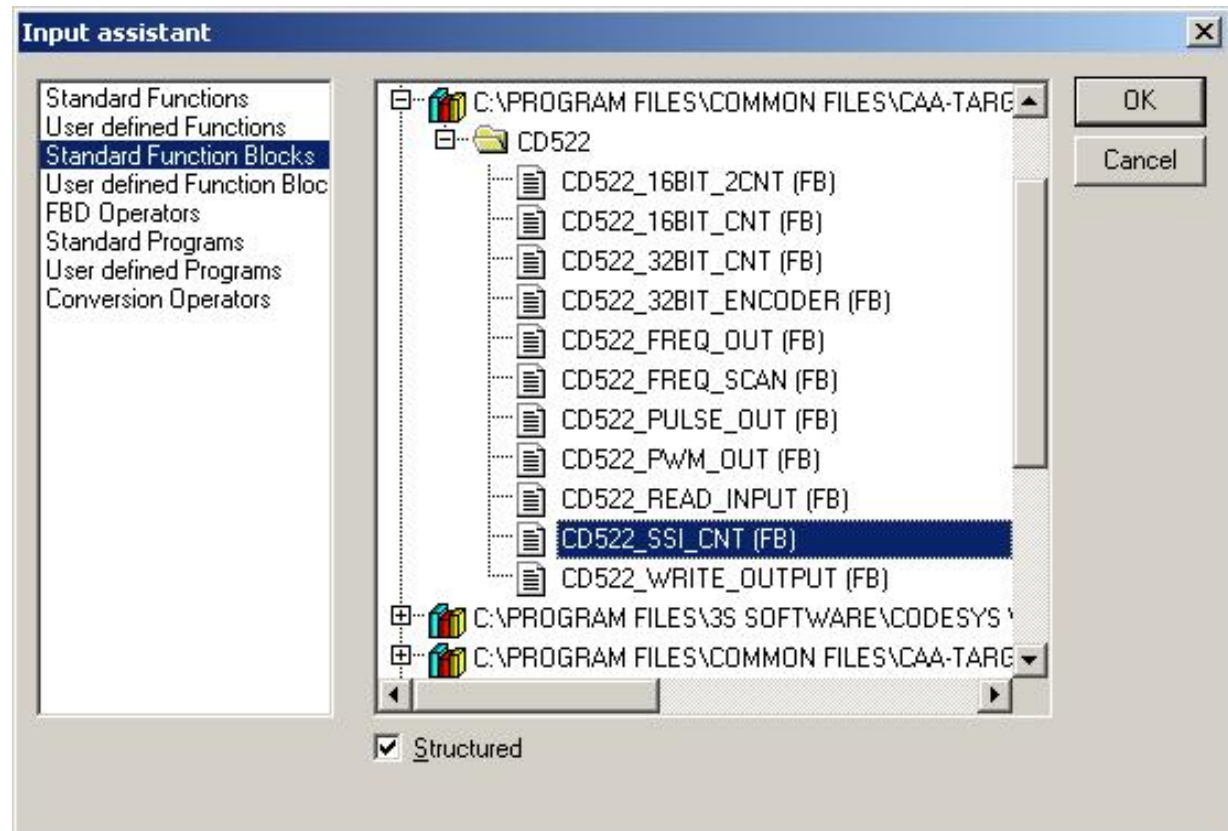
Parameter	Type	Value	Default Value	Unit
Ignore module	Enum...	No	No	
Check supply	Enum...	On	On	
Input delay	Enum...	8 ms	8 ms	
Mode counter 0	Enum...	14-1 SSI, absolute encoder	No counter	
Freq limit FCO	Enum...	No filter	No filter	
Input level FCO	Enum...	Differential	0-24 VDC	
SSI 0 frequency	Enum...	200 kHz	200 kHz	
SSI 0 resolution in bit	BYTE(...)	25	16	
SSI 0 code type	Enum...	Binary	Binary	
SSI 0 polling time	BYTE(...)	10	10 ms	
SV sensor 0 supply	Enum...	On	Off	



CD522 – Absolute encoder

Encoder management – include function block

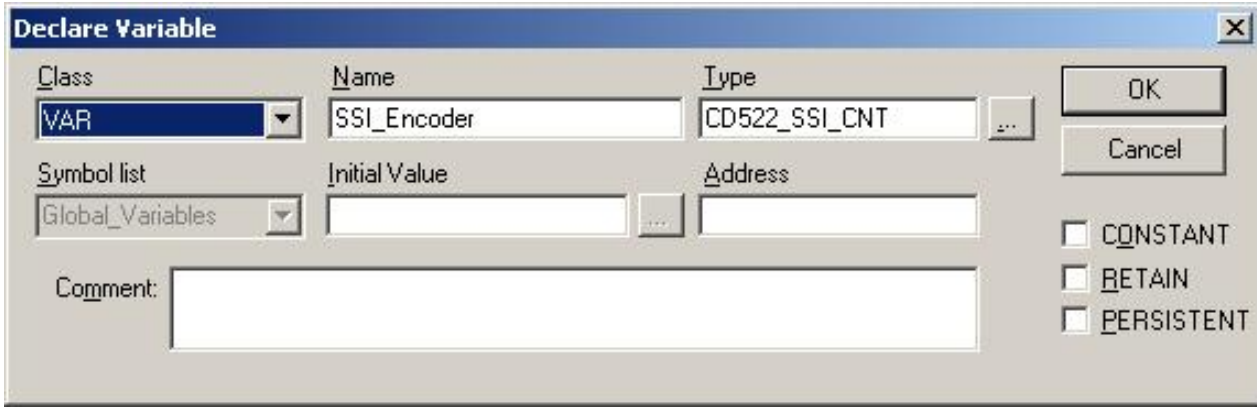
- In PS501 Control Builder, insert the function block, press F2, then select the CD522_SSI_CNT function block in input assistant :



CD522 – Absolute encoder

Encoder management – Name instance

- Name instance of the function block



The image shows a 'Declare Variable' dialog box with the following fields and options:

Class	Name	Type
VAR	SSI_Encoder	CD522_SSI_CNT

Symbol list	Initial Value	Address
Global_Variables		

Comment:

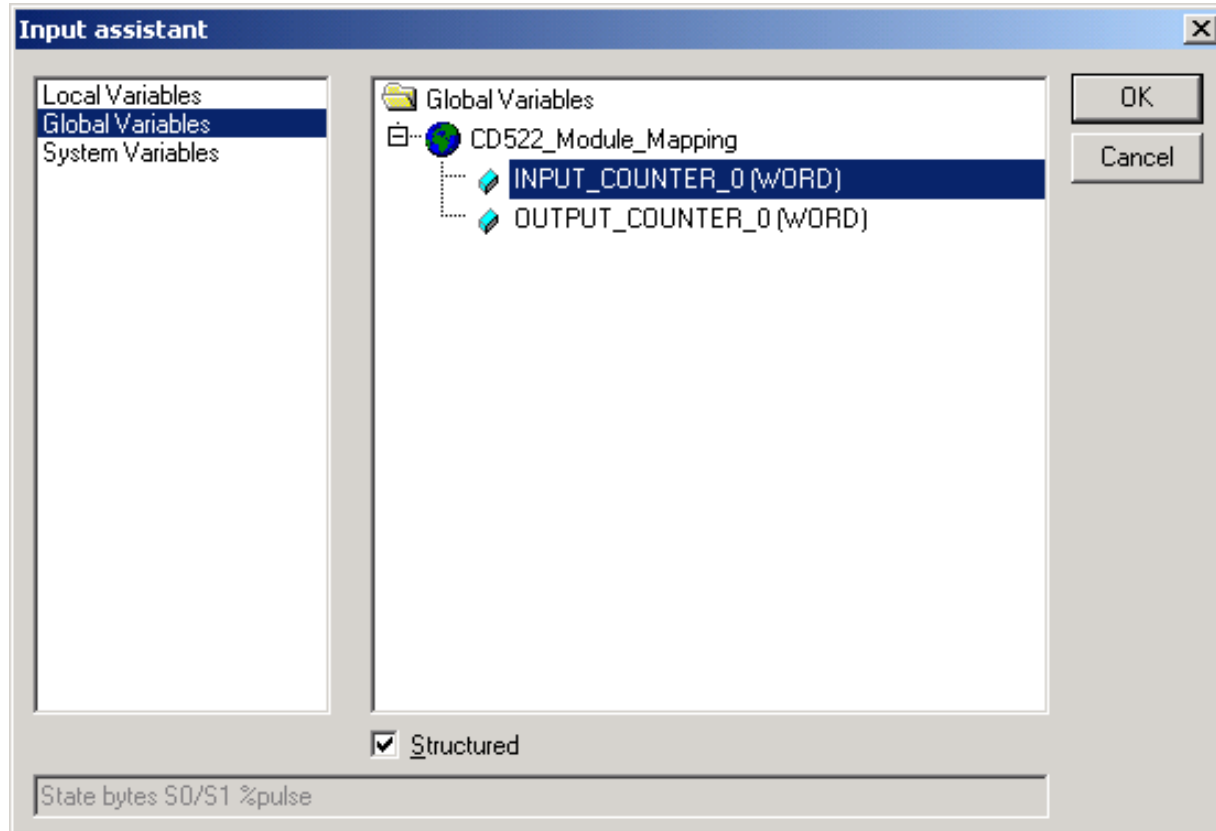
Options: CONSTANT, RETAIN, PERSISTENT

Buttons: OK, Cancel

CD522 – Absolute encoder

Encoder management – Input/output pointer

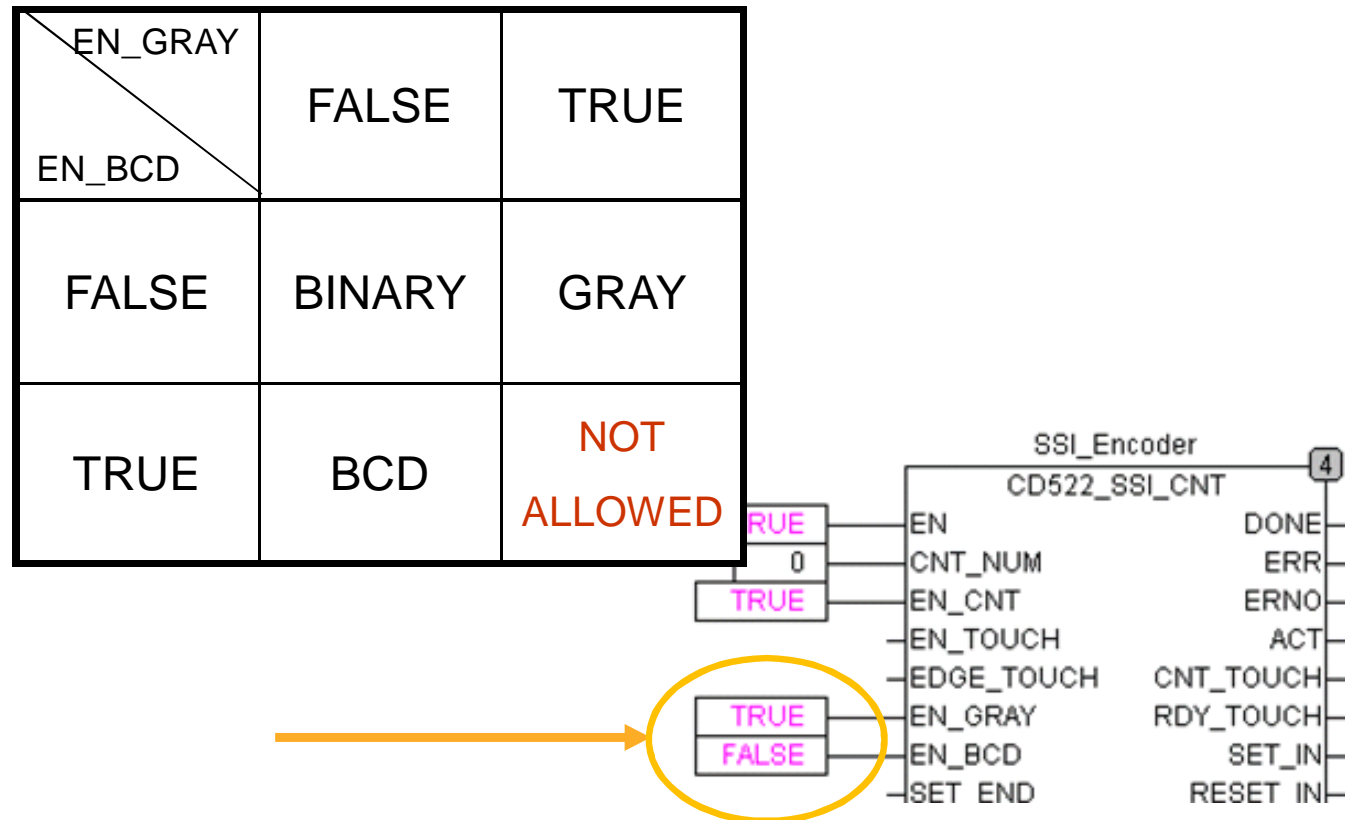
- Add input and output address pointer on ADR_IN and ADR_OUT of parameter inputs of function block.
(use address conversion box ADR)



CD522 – Absolute encoder

Encoder management – Enable coding type

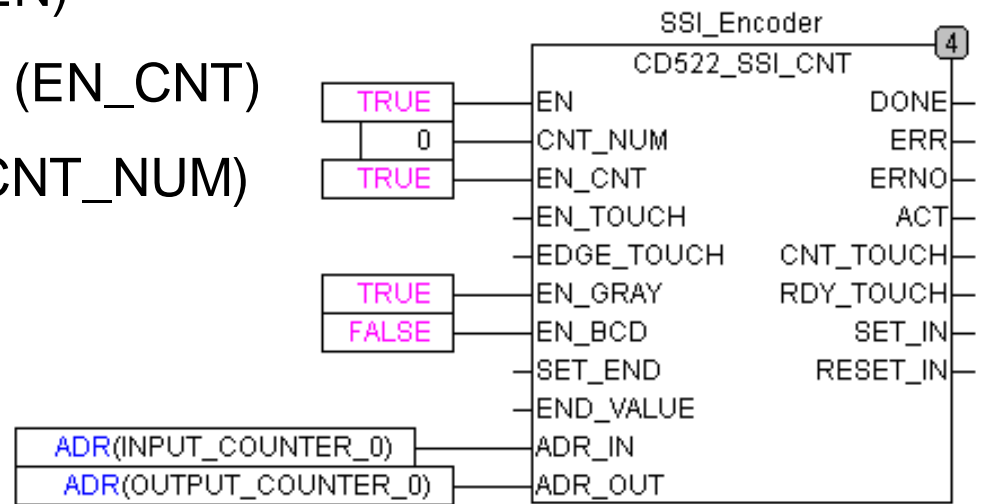
- Use input parameters (EN_GRAY) and (EN_BCD) to select Binary, Gray or BCD coding type



CD522 – Absolute encoder

Encoder management – Enable block and counter

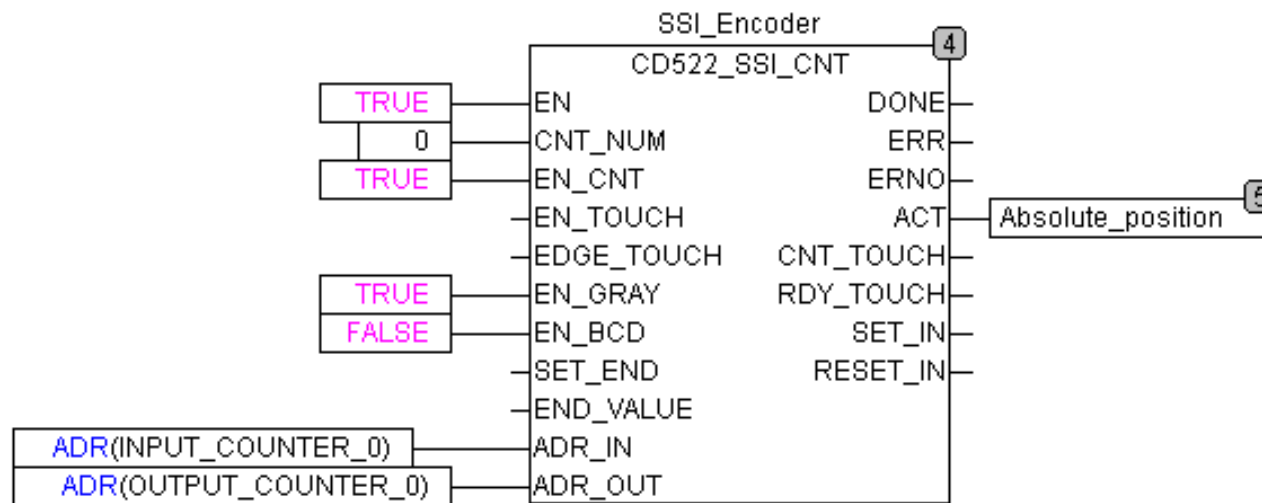
- Enable block operation (EN)
- Enable counter operation (EN_CNT)
- Select counter number (CNT_NUM)
- Type of coding (EN_GRAY, EN_BCD)
- Addresses of Pointers (ADR_IN, ADR_OUT)



CD522 – Absolute encoder

Encoder management – Input/output pointer

- Add user absolute position variable on output parameter (ACT)



- The SSI absolute encoder is ready to run



3. Advanced operation

CD522 – Advanced operation

- X2, X4 encoder.
- Set operation.
- Reset operation.
- Touch operation.
- RPI (Mechanical Homing) procedure.
- End value reached.

CD522 – Advanced operation

X2, X4 encoder - 1

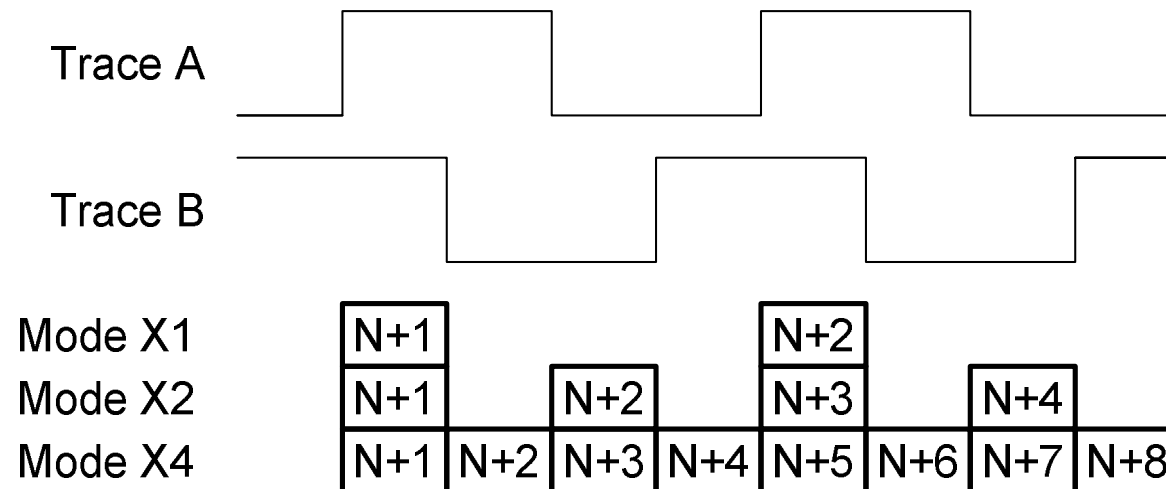
- 32 bit X2, X4 encoder – how to configure
 - Only change the mode counter parameter:

CD522 Configuration			CD522 I/O Mapping	Information
Parameter	Type	Value		
Ignore module	Enum...	No		
Check supply	Enum...	On		
Input delay	Enum...	8 ms		
Mode counter 0	Enum...	11-1 Incremental encoder		
Freq limit FC0	Enum...	5-1 UpDown dynamic set (B)/rising edge		
Input level FC0	Enum...	6-1 UpDown dynamic set (B)/falling edge		
SSI 0 frequency	Enum...	8-1 UpDown with release (B), 0 cross detection		
SSI 0 resolution in bit	BYTE(...)	11-1 Incremental encoder		
SSI 0 code type	Enum...	12-1 Incremental encoder X2		
SSI 0 polling time	BYTE(...)	13-1 Incremental encoder X4		
5V sensor 0 supply	Enum...	14-1 SSI, absolute encoder		
		15-1 Time frequency meter (Z)		

CD522 – Advanced operation

X2, X4 encoder - 2

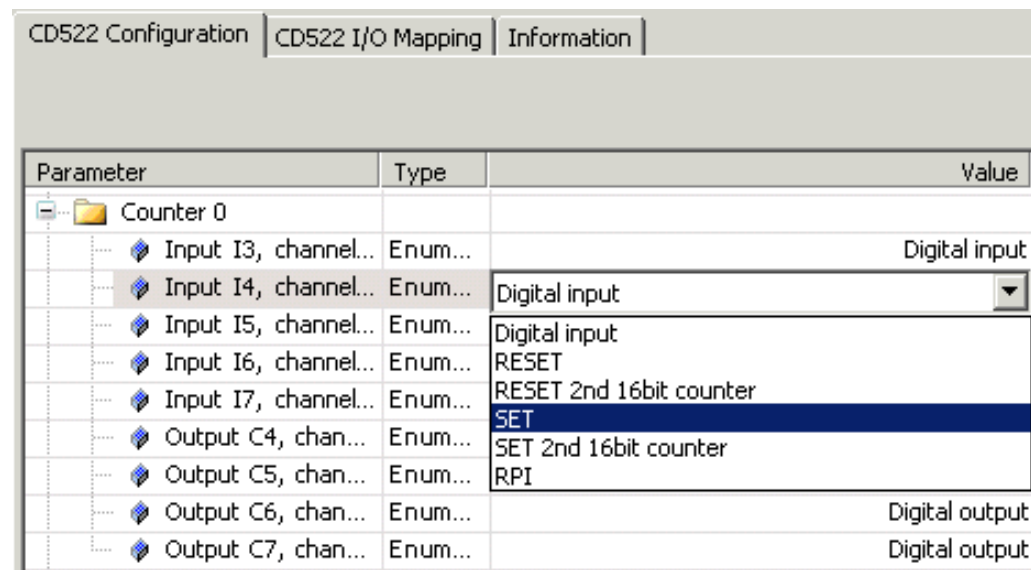
- 32 bit X2, X4 encoder
 - For the same shaft relative encoder, the CD522 provides mode which allows to increase the initial resolution.
 - X2 mode counts pulse when rising edge **AND** falling edge of the A signal is detected.
 - X4 mode counts pulses on **BOTH** edge of signal A **AND** B



CD522 – Advanced operation

SET Operation

- SET operation
 - The set operation is identical for encoder and counter
 - SET_BIT is used to set both END value and START value. It can be performed by a rising edge at input I3, I4, I5, I6 or I7 (for counter 0) or I11, I12, I13, I14 or I15 (for counter 1) or directly on input parameter of function block.
 - Counting operation is stopped until SET_BIT is true.



Parameter	Type	Value
Counter 0		
Input I3, channel...	Enum...	Digital input
Input I4, channel...	Enum...	Digital input
Input I5, channel...	Enum...	Digital input
Input I6, channel...	Enum...	RESET
Input I7, channel...	Enum...	RESET 2nd 16bit counter
Output C4, chan...	Enum...	SET
Output C5, chan...	Enum...	SET 2nd 16bit counter
Output C6, chan...	Enum...	RPI
Output C7, chan...	Enum...	Digital output
		Digital output

CD522 – Advanced operation

RESET Operation

- RESET operation
 - The reset operation is identical for encoder and counter.
 - Current counter value is immediately reset while RESET_BIT is true. It can be performed by a rising edge at input I3, I4, I5, I6 or I7 (for counter 0) or I11, I12, I13, I14 or I15 (for counter 1) or directly on input parameter of function block.
 - Counting operation is stopped until RESET_BIT is true.

CD522 Configuration			CD522 I/O Mapping	Information
Parameter	Type	Value		
Counter 0				
Input I3, channel...	Enum...	Digital input		
Input I4, channel...	Enum...	SET		
Input I5, channel...	Enum...	Digital input		
Input I6, channel...	Enum...	RESET		
Input I7, channel...	Enum...	RESET 2nd 16bit counter		
Output C4, chan...	Enum...	SET		
Output C5, chan...	Enum...	SET 2nd 16bit counter		
Output C6, chan...	Enum...			Digital output
Output C7, chan...	Enum...			Digital output

CD522 – Advanced operation

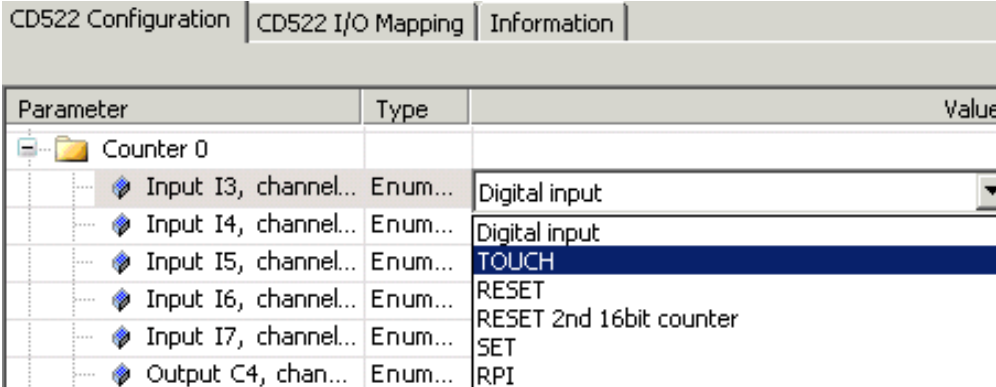
TOUCH Operation - 1

- TOUCH operation
 - TOUCH operation is a fast acquisition of actual value of the counter (or encoder position) synchronously with external hardware signal.
 - This operation is realized internally in the module, this removes the latency of I/O bus and network.
 - This operation is the way to synchronize two or more relative encoders connected to the same external signal for synchronization.

CD522 – Advanced operation

TOUCH Operation - 2

- TOUCH operation: with ABB Configurator
 - Only input I3 (for counter/encoder 0) and input I11 (for counter/encoder 1) could be configured as TOUCH input (24VDC signal level)

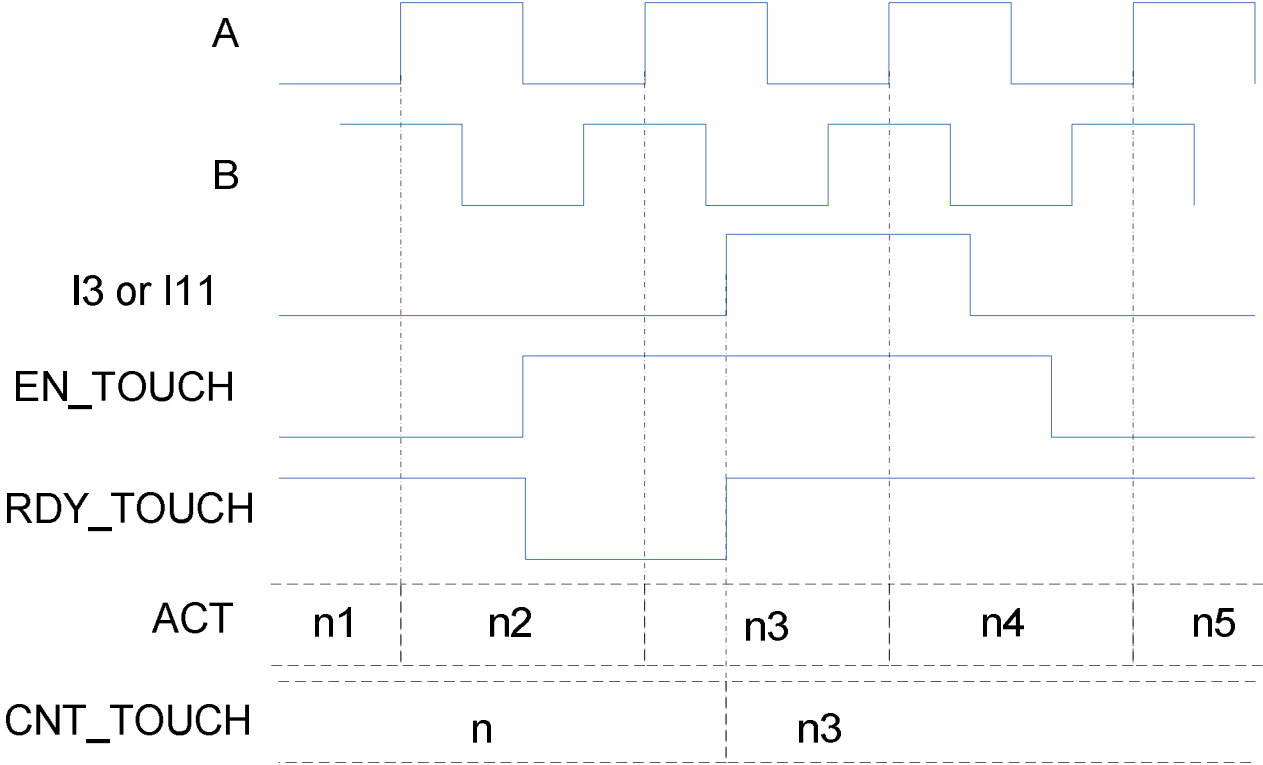


Parameter	Type	Value
Counter 0		
Input I3, channel...	Enum...	Digital input
Input I4, channel...	Enum...	Digital input
Input I5, channel...	Enum...	TOUCH
Input I6, channel...	Enum...	RESET
Input I7, channel...	Enum...	RESET 2nd 16bit counter
Output C4, chan...	Enum...	SET
		RPI

CD522 – Advanced operation

TOUCH Operation - 3

- TOUCH operation – the timing diagram



- Example timing diagram with encoder in X1 mode

CD522 – Advanced operation

RPI (Reference Point Initialization) - 1

- RPI – Mechanical homing procedure
 - The goal RPI mechanism is to synchronize the encoder with its own “zero” (or N) signal.
 - When the procedure is activated:
A rising edge at the inputs I3, I4, I5, I6 or I7 (for counter 0) or I11, I12, I13 (for counter 1) , and the next rising edge of the Z signal detected will copy the SET value to the actual counter value (ACT) and an internal signal is provided to indicate that RPI procedure is done

Parameter	Type	Value
Counter 0		
Input I3, channel...	Enum...	TOUCH
Input I4, channel...	Enum...	RESET
Input I5, channel...	Enum...	Digital input
Input I6, channel...	Enum...	RESET
Input I7, channel...	Enum...	RESET 2nd 16bit counter
Output C4, chan...	Enum...	SET
Output C5, chan...	Enum...	SET 2nd 16bit counter
		RPI

CD522 – Advanced operation

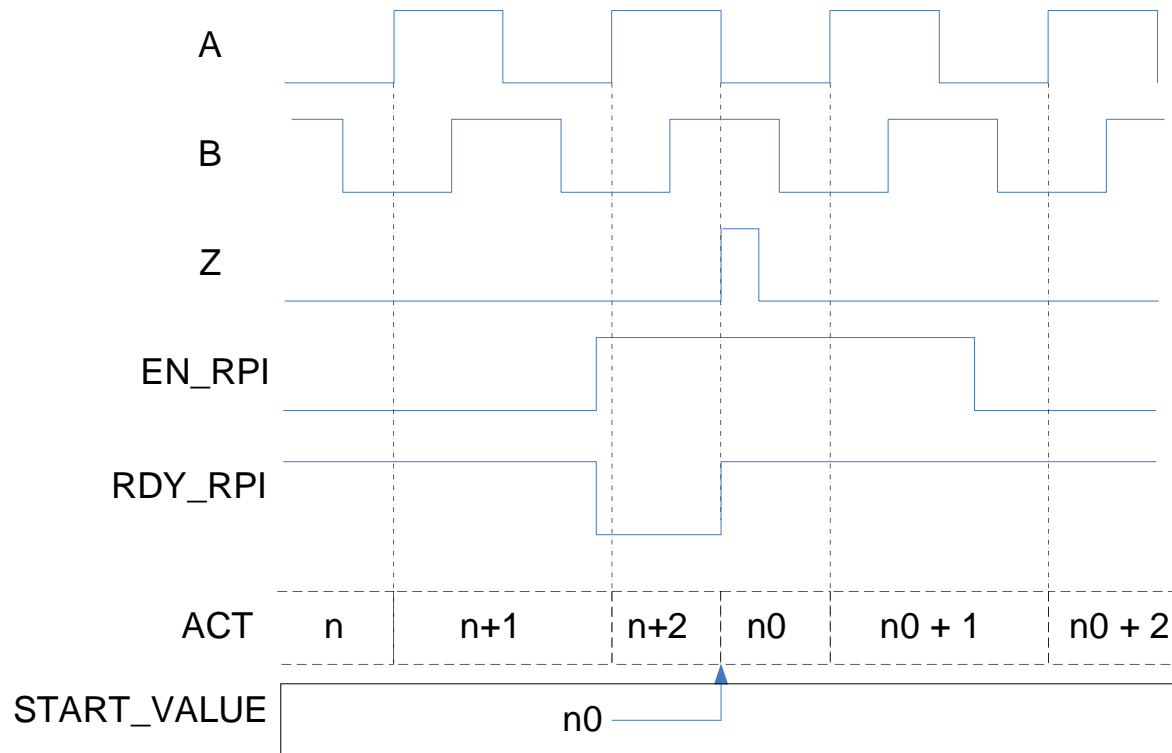
RPI (Reference Point Initialization) - 2

- RPI – Mechanical homing procedure
 - This operation mode could be used as a “TOUCH” operation mode when the goal is to set a new reference value for encoder with external signal synchronization.
 - If both functions are enabled simultaneously or if the execution of one function is not yet completed when enabling the other function, the RPI function will have a higher priority than the TOUCH function.
 - The electrical signal level (Z) is the same than the encoder signal itself (+5VDC, 24VDC, RS422)

CD522 – Advanced operation

RPI (Reference Point Initialization) - 3

- RPI – Mechanical homing procedure – Timing diagram



- In the previous example; value n0 is set into the ACT value when edge of Z signal is detected

CD522 – Advanced operation

END Value Reached - 1

- ENDV – End value reached
 - The goal of ENDV mechanism is to detect, and keep information, that the counter value goes cross a predetermined value.
 - An external output could be configured as “ENDV”

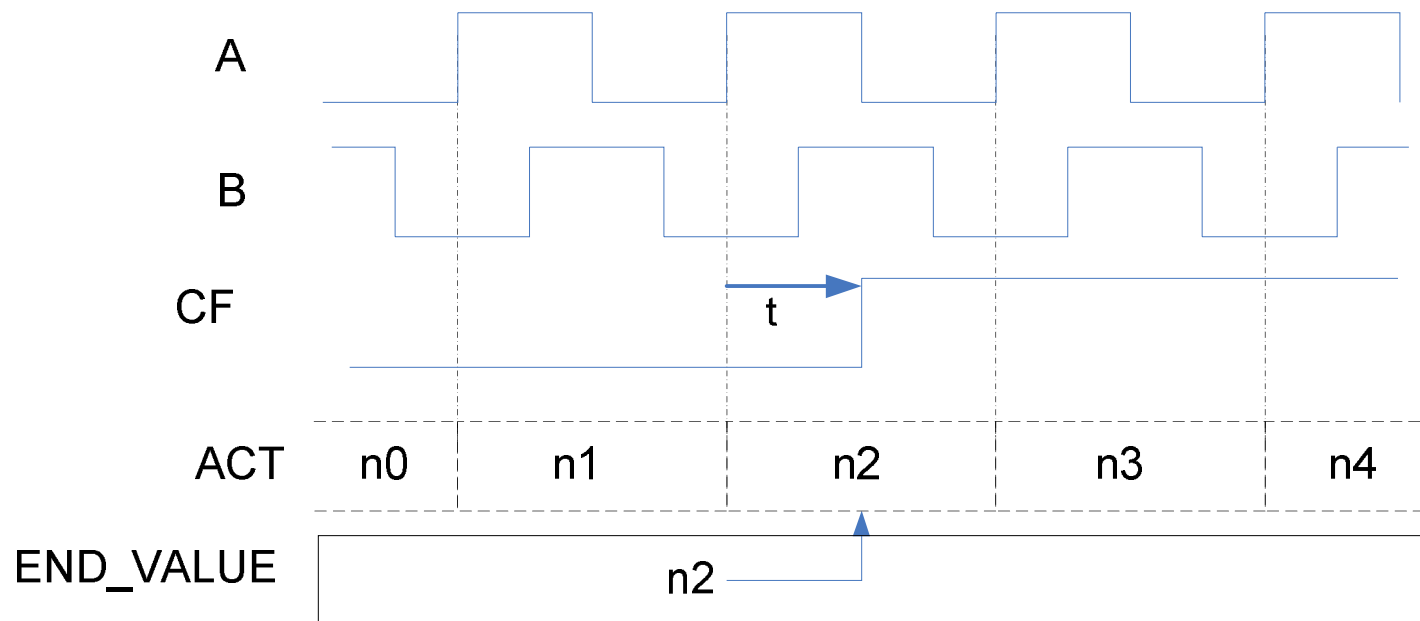
Parameter	Type	Value
Counter 0		
Input I3, channel...	Enum...	TOUCH
Input I4, channel...	Enum...	RPI
Input I5, channel...	Enum...	Digital input
Input I6, channel...	Enum...	Digital input
Input I7, channel...	Enum...	Digital input
Output C4, chan...	Enum...	Digital output
Output C5, chan...	Enum...	Digital output
Output C6, chan...	Enum...	ENDV

- Internal bit indicates also End value reached.
- The End value information is reset only if counter is RESET, SET or DISABLE.

CD522 – Advanced operation

END Value Reached - 2

- Timing graphics; Counter is counting up



- Reaction t is based on module cycle time, min. 250 μ s
- The ENDEV signal is set when the predetermined value is crossed over, whatever is the counting direction

Power and productivity
for a better world™

