Harmonic Drive AG

Specification
AC Servo Controller YukonDrive®
Option 2 - Technology
2nd SinCos Encoder

QUICKLINK
www.harmonicdrive.de/1100

...just move it!

Content

Note:
This document does not replace the YukonDrive® Operating Manual. Please be sure to observe the information contained in the „For your safety", „Intended use" and „Responsibility" sections of the Operating Manual (ID no.: 1003370). For information on installation, setup and commissioning, and details of the warranted technical characteristics of the YukonDrive®, refer to the additional documentation (Operating Manual, User Manual, etc.).

We reserve the right to make technical changes.

The content of our specification was compiled with the greatest care and attention, and based on the latest information available to us. We should nevertheless point out that this document cannot always be updated in line with ongoing technical developments in our products. Information and specifications may be subject to change at any time. Please visit www.harmonicdrive.de for details of the latest versions.

1.1 Operating modes

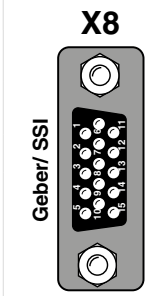
Sine / Cosine encoders are designed as optical encoders, and meet the highest accuracy demands. They emit two sinusoidal, 90° offset signals, A and B, which are scanned by analog/digital converters. The signal periods are counted and the phase angles of signals A and B are used to calculate the rotation and count direction.

Digital Interface:
The digital time-discrete interface is based on a transfer protocol. The current positional information is transmitted from the encoder to the receiver. This may be done either serially or in parallel. As the transfer only takes place at certain times, it is a time-discrete interface.

Encoders are specified in terms of their rated voltage and current consumption, and the pin assignment. Maximum permissible cable lengths are additionally specified.

Encoder interface X8 enables the evaluation of the following encoder types. For the technical specifications of the various encoder types refer to the documentation from the encoder manufacturers.

Table 4.1 Suitable encoder types on X8

Illustration	Function
	Sin/Cos-encoder with zero pulse: e.g. Heidenhain ERN1381, ROD486
	Heidenhain SinCos encoder with EnDat interface: e. g. 13 bit single-turn encoder (ECN1313) and 25 bit multi-turn encoder (EQN1325)
	Heidenhain encoder with purely digital EnDat interface: e. g. 25 bit single- turn encoder and 12 bit multi-turn encoder (EQN 1337)
	SinCos encoder with SSI interface: z. B. 13 Bit Singleturn- und 25 Bit Multiturn-Geber (ECN413-SSI, EQN425-SSI)
	Encoder with purely digital SSI interface: e. g. Kübler encoder 12 bit single-turn and 12 bit multi-turn (F3663.xx1x. B222)

Only one encoder with a purely digital EnDat or SSI interface can be used on connector X8 or X7 (see Operation Manual).

1.2 Technical Data

1.2.1 SinCos-/ TTL signal evaluation

Table 5.1 SinCos- / TTL encoder input on X8

	Specification		
Interface	• Differential voltage input. RS422-compatible; Pay attention to voltage range! • Max. cable length: 10 m • Connector: 15-pin D-SUB. High-Density. female • Surge terminating impedance built-in to device: 120 Ω		
	min.	max.	
Input frequency	0 Hz	500 kHz	
Input voltage			
Differential switching level „High"	+ 0.1 V		
Differential switching level „Low"		- 0.1 V	
Signal level reffered to ground	0 V	+5 V	

1.2.2 Absolute value encoder

Table 5.2 Absolute value encoder input on X8

	Specification		
Interface	• RS485-complian • Connector: 15-pin D-SUB. High-Density. female • Surge terminating impedance built-in to device: 120 Ω		
Pulse frequency	min.	max.	
EnDat		2 MHz	
SSI		1 MHz	
Output voltage	min.	max.	
Signal level reffered to ground	0 V	+ 3.3 V	
Differential output voltage IUI	1.5 V	3.3 V	Surge impedance ≥ 57 Ω
Input voltage	min.	max.	
Differential switching level „High"	+ 0.2 V		
Differential switching level „Low"		- 0.2 V	
Signal level referred to ground	-7 V	+ 12 V	

1.2.3 Voltage supply for external encoder

Table 6.1 Voltage supply for external encoders on X8

	Specification		
	min.	max.	typ.
Output voltage with SinCos, TTL, EnDat, SSI encoders	+ 4.75 V	+ 5.25 V	+ 5 V
Output current with SinCos, TTL, EnDat, SSI encoders		250 mA	

Note:
The encoder supply at X8/3 is short-circuit proof in 5 V operation. The controller remains in operation, enabling the generation of a corresponding error message when evaluating the encoder signals.

Encoders with a power supply of 5 V ± 5 % must have a separate sensor cable connection. The encoder cable detects the actual supply voltage at the encoder, thereby compensating for the voltage drop on the cable. Only use of the sensor cable ensures that the encoder is supplied with the correct voltage. The sensor cable must always be connected. If a SinCos encoder is not delivering sense signals, connect pins 12 and 13 (+ / -Sense) to pins 3 and 8 (+ 5 V/ GND) on the encoder cable end.

1.2.4 Cable type and layout

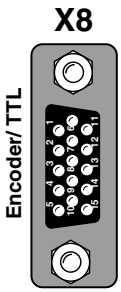
The cable type should be chosen as specified by the motor/encoder manufacturer.

The following conditions must be met:
- Use only shielded cables.
- Shield on both sides.
- Interconnect the differential track signals A, B, R or DATA and CLK by twisted-pair cables.
- Do not separate the encoder cable, for example to route the signals via terminals in the switch cabinet.

1.3 Pin assignment

The assignment of the 15-pin D-Sub female connector on slot X8 is set out in the following table:

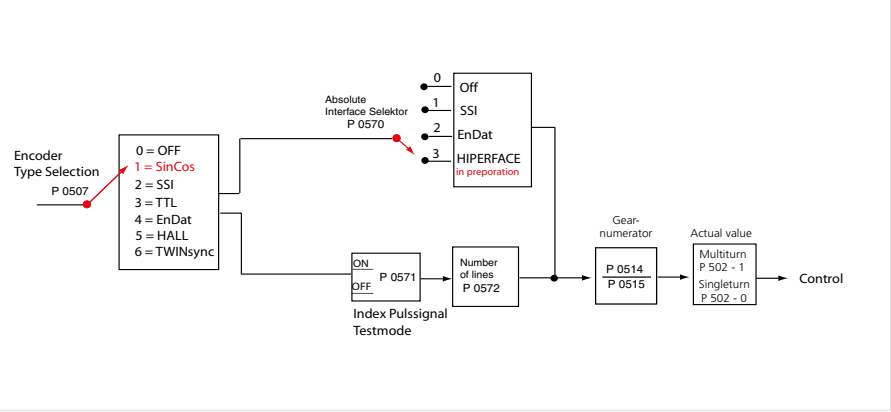
Table 7.1 Pin assignment of the SinCos module on X8

Connection	Pin	SinCos-/TTL encoder Signal	Absolute value encoder SSI, EnDat Signal
	1	Track A -	
	2	Track A +	
	3	+ 5 V Encoder supply	
	4		DATA +
	5		DATA -
	6	Track B -	
	7	-	
	8	GND	
	9	R -	
	10	R +	
	11	Track B+	
	12	Sense +	
	13	Sense -	
	14		CLK +
	15		CLK -

1.4 Configuration

1.4.1 Configuration of the encoder channel X8

Illustration 8.1 Configuration encoder channel X8



Note:
When using an encoder with incremental tracks (SinCos signal), P 0507 must be set to (1). Selector P 0570 is set to the desired encoder interface.

Table 9.1

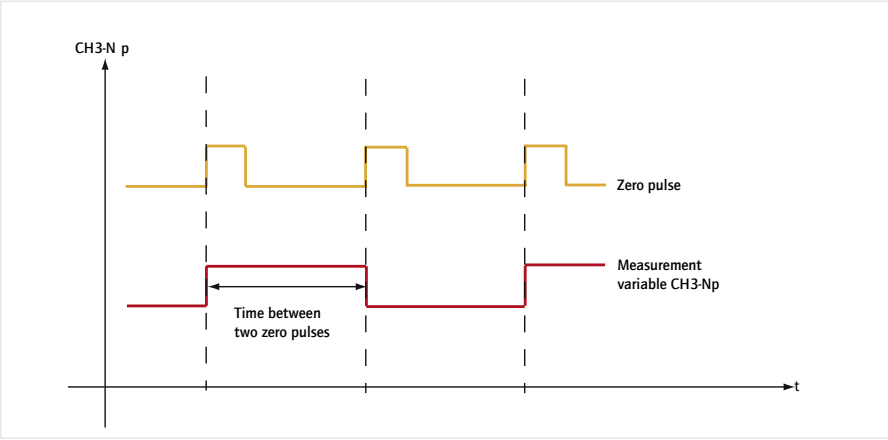
Basic setting of encoder channel

Parameter no.	Setting	Designation in DMS	Function
P 0502		ENC_CH3_ActVal	Actual value parameter: Raw data of single-turn and multi-turn information to test encoder evaluation.
(0)	00...00hex	Singleturn	The raw data are displayed after the electronic gearing and before the scaling (see illustration 8.1).
(1)	00...00hex	Multiturn	
P 0507		ENC-CH3-Sel	Selection of encoder
(0)	OFF	No function	No function
(1)	SinCos-encoder	SinCos	SinCos selection
(2)	SSI-encoder	SSI	SSI-selection
(3)	TTL-encoder	TTL	TTL-selection
(4)	EnDat 2.1/2.2	EnDat	EnDat-selection
(5)	TTL- encoder with commutation tracks	TTL_COM	Function not supported
(6)	TWINsync	TWINsync	Function not supported
P 0514	$-(2^{15})...+(2^{15}-1)$	ENC_CH3_Num	Numerator of encoder gearing
P 0515	$1...(2^{31}-1)$	ENC_CH3_Denom	Denominator of encoder gearing
P 0570		Absolute Position Interface select	Absolute interface selector
(0)	OFF		No evaluation
(1)	SSI		SSI-Interface
(2)	EnDat		EnDat-Interface
(3)	-		Not implemented
P 0571		ENC_CH3_NpTest	Zero pulse wiring test (more details following)
(0)	OFF	No function	No function
(1)	ON	ENABLE_ISR	Zero pulse test mode active
P 0572		ENC_CH3_Lines	Setting of number of lines (max. 65536) of encoder per motor revolution
P 0573		Number of Multi Turn Bits	Number of bits of multi-turn information
P 0574		Number of SingleTurn Bits	Number of bits of single-turn information
P 0575		Code Select (SSI Absolut Position Interface)	Selection of code with which the SSI encoder is to be evaluated
(0)		Binary coded data	Evaluation of the binary code
(1)		Gray coded data	Evaluation of the gray code
P 0577		Encoder Observation Minimum sqrt (a2+b2)	Sensitivity for encoder monitoring
P 0630		Nominal increment A of reference marks	Setting of the increment-coded reference marks. These values are given on the encoder data sheet.
P 0631		Nominal increment B of reference marks	

1.4.2 Zero pulse wiring test

To enable evaluation for the wiring test parameter P 0571 = ON (1) is set. On the oscilloscope it can then be depicted with the measurement variables CH3-Np. To make the zero pulse clearly visible, the measurement variable remains at High level until the next zero pulse appears. Conversely, the measurement variable remains at Low level until another zero pulse appears.

Illustration 10.1 Zero pulse recording via measurement variable CH3-NP



Note: In zero pulse test mode zero pulse evaluation of homing runs is disabled.

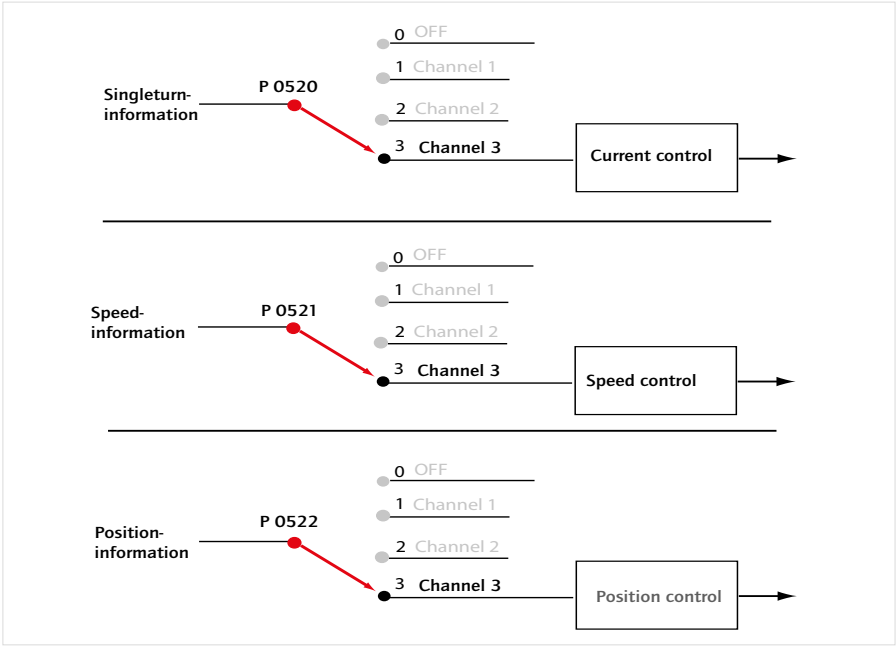
1.4.3 Interface configuration of encoder for closed loop control

By way of P 0520, P0521, P0522 the physical encoder interface is adapted to the current, speed or position controller.

Table 10.2 Encoder configuration

Parameter no.	Setting	Designation in DMS	Function
P 0520		ENC_MCon: Encoder: Channel Select for Motor Commutation and Current control	Selection of encoder channel for commutation angle and current control. Feedback signal for field-oriented regulation.
P 0521		ENC_SCon: Encoder: Channel select for Speed Control	Selection of encoder channel for speed configuration. Feedback signal for speed controller.
P 0522		ENC_PCon: Encoder: Channel select for Position Control	Selection of encoder channel for position information. Feedback signal for position controller.
Parameter settings apply to P 0520, P 0521, P 0522			
(0)	OFF		No encoder selected
(1)	CH1		Channel 1: SinCos on X7
(2)	CH2		Channel 2: Resolver on X6
(3)	CH3		Channel 3: Option on X8

Illustration 11.1 Display of encoder configuration for encoder channel X8



A parameter can only be written or read with the appropriate access rights (e.g. „Local administrator“).
A changed parameter must always be saved on the device.

When editable online, a parameter executes a reaction on the device immediately, so inputs must always be carefully checked.

1.5 Increment-coded reference marks

In the case of relative encoders with increment-coded reference marks, multiple reference marks are distributed evenly across the entire travel distance. The absolute position information, relative to a specific zero point of the measurement system, is determined by counting the individual measuring increments between two reference marks. The absolute position of the scale defined by the reference mark is assigned to precisely one measuring increment. So before an absolute reference can be created or the last selected reference point found, the reference mark must be passed over.

In the worst-case scenario this requires a rotation of up to 360°. To determine the reference positon over the shortest possible distance, encoders with increment-coded reference marks are supported (HEIDENHAIN ROD 280C). The reference mark track contains multiple reference marks with defined increment differences. The tracking electronics determines the absolute reference when two adjacent reference marks are passed over - that is to say, after just a few degrees of rotation.

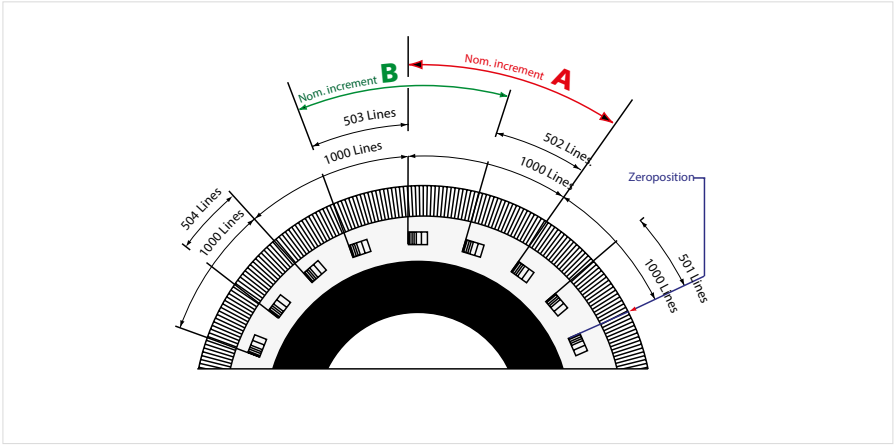
1.5.1 Rotary measurement system

Rotary encoder:
Basic increment, reference measure A: (small increment e.g. 1000)
- corresponding to parameter P 0630 ENC_CH3_Nominal Increment A

Basic increment, reference measure B: (large increment e.g. 1001)
- corresponding to parameter P 0631 ENC_CH3_Nominal Increment B

The lines per revolution are entered in parameter P 0572 ENC_CH3_Lines.
A sector increment difference of +1 and +2 is supported.
One mechanical revolution is precisely one whole multiple of the basic increment A.

Illustration 12.1 Schematic view of circular graduations with increment-coded reference marks



Example of a rotary measurement system

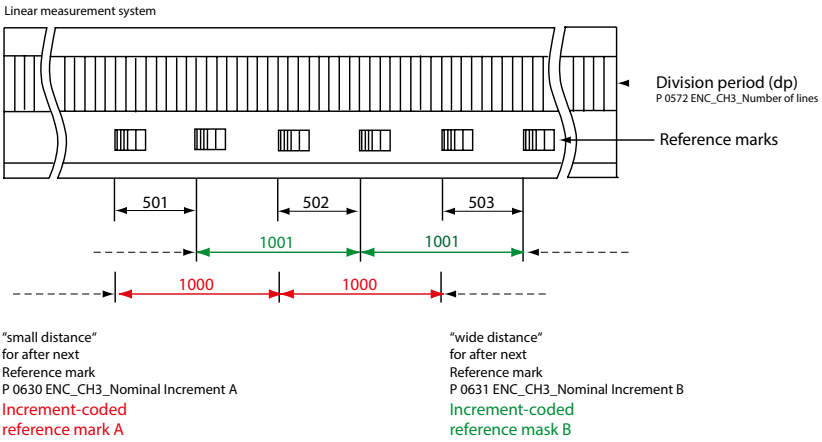
Table 12.2 Example of a rotary system

Lines per revolution P 0572	Number of reference marks	Basic Increment G Nominal Increment A P 0630	Basic Increment G Nominal Increment B P 0631
18 x 1000 lines	18 basic marks + 18 coded marks = ∑ 36	Reference measure A = 1000 lines corresponding to 20°	Reference measure B 1001 lines.

1.5.2 Linear measurement system

In preparation:

Illustration 13.1 Schematic for a linear scale



Homing method for increment-coded encoders:

Supported encoder types:
Typ -6: Increment-coded encoders with negative direction of rotation
Typ -7: Increment-coded encoders with positive direction of rotation

...just move it!

Germany
Harmonic Drive AG
Hoenbergstraße 14
65555 Limburg/Lahn

T +49 6431 5008-0
F +49 6431 5008-119

info@harmonicdrive.de
www.harmonicdrive.de

06/2015 1003371