

CHONGYUAN ENCODER CY 2444

Rotational speed and position sensor

Technical information

Version 2022-06



CHONGYUAN ENCODER with
axial cable outlet

General

- ▶ The measuring system comprises a CHONGYUAN ENCODER and a precision target wheel for attachment to shafts
- ▶ The CHONGYUAN ENCODER contactlessly scans the precision target wheel using magnetoresistive sensors and acquires the direction of rotation, rotational speed and position

Features

- ▶ Output signal level
1 V_{pp} Differential signal (sin/cos) or TTL / RS422
- ▶ Analogue or digital reference pulse
- ▶ Selection of interpolation factors to increase the number of pulses per revolution possible
- ▶ Recording of temperature and rotational speed histogram and automatic calibration possible
- ▶ Frequency range from 0 to 200 kHz ⁽¹⁾
- ▶ Temperature range -40 °C to +120 °C
- ▶ Protection class IP 68
- ▶ **Safety integrated** certificate (signal pattern K)

Advantages

- ▶ Maintenance and wear-free
- ▶ Low temperature drift and high signal quality
- ▶ Highest immunity to interference due to fully screened metal housing
- ▶ High design flexibility due to custom manufacture of precision target wheels

Field of application

- ▶ Machine tool engineering
 - Position and rotational speed acquisition in HSC spindles (High Speed Cutting)
 - Electronic synchronisation of screw spindles in vacuum pumps
 - Position and rotational speed measurement in lathes, grinding and milling machines
- ▶ Rotational speed and position measurement in test stands and motors (hybrid drives, torque motors)

Description

Construction

The CHONGYUAN ENCODERS are intended to be used for the contactless measurement of rotary and linear movements predominantly in machines, gears, motors or high-speed spindles. They are manufactured using the latest micro system technology and are fully encapsulated, as such they are particularly resistant to shocks and vibration.

Measuring system

The measuring system comprises a CHONGYUAN ENCODER and a precision target wheel. The system does not need dedicated bearings for this task, as the precision target wheel is mounted directly on the shaft. The measuring system operates contactlessly and is maintenance and wear-free. It acquires the direction of rotation, rotational speed and position of the rotating shaft. The precision target wheel is made of ferromagnetic material and is to be ordered separately.

The CHONGYUAN ENCODER has a magnetic field that is changed by the rotating precision target wheel. The sensor acquires the change in the magnetic field and the integrated electronics convert this information into appropriate output signals.

External electronics can read the output signals and determine the direction of rotation, rotational speed and position of the shaft.

A defined air gap between the precision target wheel and CHONGYUAN ENCODER is required for the contactless measurement. To make assembly easier, a corresponding distance gauge is included with the CHONGYUAN ENCODER.

Reference mark

The CHONGYUAN ENCODER can determine the position of a shaft by acquiring a reference mark.

The position is output as an analogue or digital differential pulse (track N).

The CHONGYUAN ENCODER evaluates the following reference marks: Slot (**M**), lug (**N**), tooth (**Z**), gap (**G**)
Single tooth (**V**).

Module

Possible modules: 0.3 / 0.4 / 0.5 .

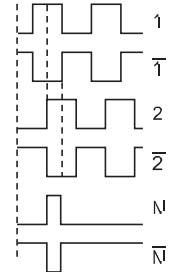
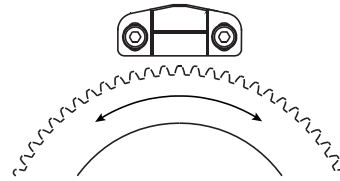


The CHONGYUAN ENCODER must be ordered to suit the design of the reference mark and to suit the module of the target wheel.

Signal pattern

Signal pattern D, T

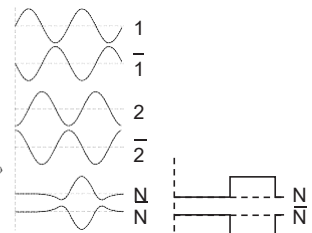
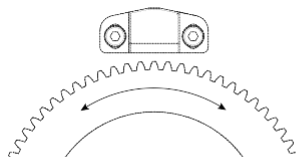
The output signals are two square-wave signals offset by 90° for the detection of direction (tracks 1 and 2) and their inverse signals.



N* Reference pulse (track N)

Signal pattern K

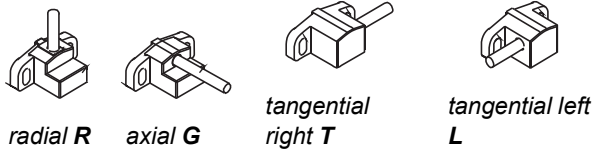
The output signals are two sinusoidal signals offset by 90° for the detection of direction (tracks 1 and 2) and their inverse signals.



N* Reference pulse (track N) optional

Cable outlet CHONGYUAN ENCODER

The CHONGYUAN ENCODER is available with the following cable outlets:



Optional extra signal pattern D, T

Interpolation factor (1 / 2 / 4 / 8 / A / B / C / D / G)

The interpolation is undertaken directly in the ENCODER. On the usage of a target wheel with 250 teeth and an interpolation factor of 20, the ENCODER provides 5000 square-wave signals.

Optional extra signal pattern K

Internal regulation (R)

The ENCODER regulates fluctuations in the sin/cos amplitudes on changes in the air gap and temperature. This feature significantly reduces the installation effort. It is not necessary to re-adjust the ENCODER to optimise the signals.

Configurable (P)

Configuration of the CHONGYUAN ENCODER via the connector

- ▶ Setting the sin/cos amplitudes without mechanical re-adjustment of the air gap
- ▶ Elimination of the offset and amplitude error for compensating mounting tolerances
- ▶ Definition of 7 rotational speed ranges for the activation of the rotational speed histogram in the ENCODER
- ▶ Entry of a spindle serial number (allocation of the drive)

In addition, various data is saved in the CHONGYUAN ENCODER and can be read :

- ▶ Rotational speed histogram for the analysis of the drive's operating conditions
- ▶ Number of startups
- ▶ Min. / max. temperature in the ENCODER
- ▶ Item number and serial number of the ENCODER
- ▶ Total operating time and time since the last configuration



The ENCODER can be adjusted, analysed and configured using the testing and programming .

Technical data

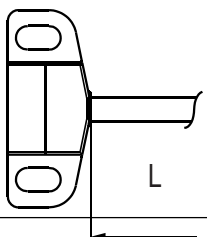
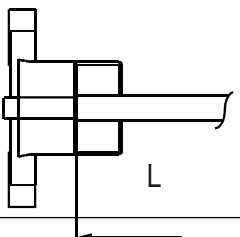
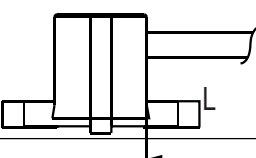
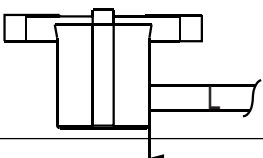
	CY 2444...3	CY 2444...4	CY 2444...5
Target wheel			
Module ⁽¹⁾	0.3	0.4	0.5
Width of the signal track	≥ 4.0 mm		
Material	Ferromagnetic steel		
Reference mark	Slot (M), lug (N), tooth to tooth (Z),gap(G) tooth(V)		
Geometric data			
Centre distance between sensor elements (1/2 and N) c ₂	6 mm		
Distance mounting surface to sensor element (1/2) c ₁	9.5 mm		
Air gap permitted	0.15 mm ± 0.02 mm	0.15 mm ± 0.03 mm	0.20 mm ± 0.03
Electrical data			
Supply voltage U _B	5 V DC ± 5%, polarity reversal protected, overvoltage protected		
Output level (1) GEL 2444K (2) GEL 2444T	1 V _{pp} Differential signal TTL / RS422		
Output signal • GEL 2444K • GEL 2444T	Two sinusoidal signals offset by 90° and their inverse signals, short-circuit-proof; option: reference pulse Two square-wave signals offset by 90° and their inverse signals, short-circuit-proof; option: reference pulse		
Output frequency	0 to 500 kHz ⁽²⁾		
Power consumption without load	≤ 0.3 W		
Electromagnetic compatibility Electromagnetic	DIN EN 61000-6-4:2011-09; DIN EN 61000-6-3:2011-09 DIN EN 61000-6-2:2006-03; DIN EN 61000-6-1:2007-10		
Dielectric strength	500 V, in accordance with DIN EN 60439–1		
Mechanical data			
Weight	30 g		
Housing material	Die cast zinc		
Assured operating temperature range	-30 °C to +85 °C		
Operating and storage temperature range	-40 °C to +120 °C		
Protection class	IP 68		
Vibration resistance	200 m/s ² , in accordance with DIN EN 60068–2–6		
Shock resistance	2000 m/s ² , in accordance with DIN EN 60068–2-27		
MT TF	5,000,000 h at 55 °C 204 10 ⁻⁹ h ⁻¹ at 55 °C		
Electrical connection			
Number of cores x core cross-section	8 x 0.15 mm ²		
Max. permitted cable length	100 m ⁽³⁾		
Cable diameter	5 mm		
Min. bending radius	25 mm		

(1) Further modules upon request

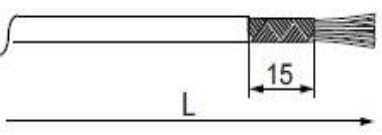
(2) Higher frequencies upon request

(3) Pay attention to voltage drop on the supply cable

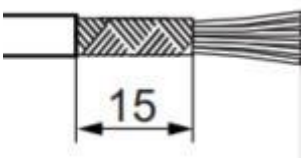
Connection

Cable outlet CHONGYUAN ENCODER			
R (radial)	G (axial)	L (tangential left)	T (tangential right)
			

Interface type (currently only K type is provided, the rest need to be customized)

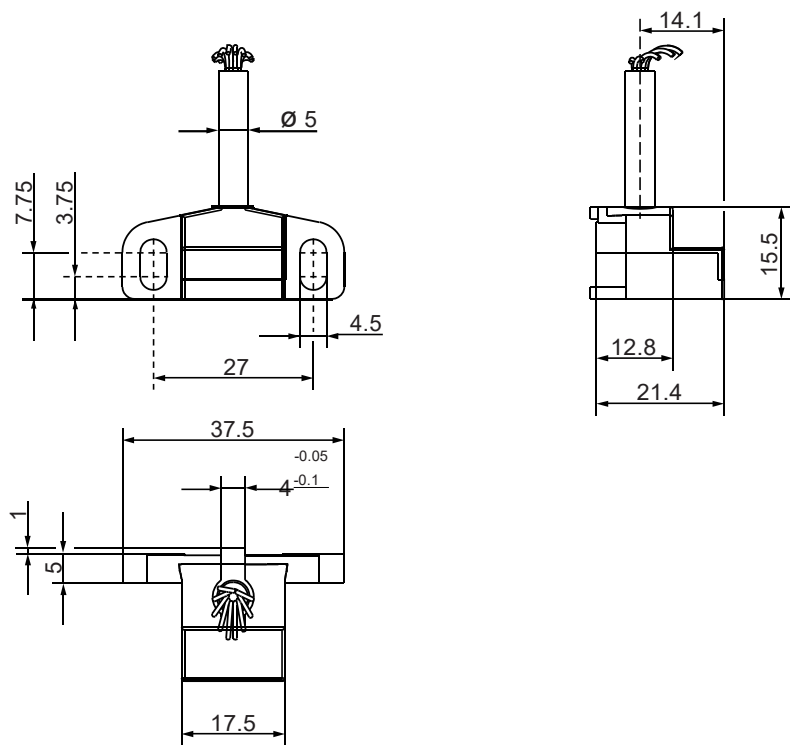
K (flying lead)		Cable lengths available: 030 / 050 / 150 / 250 / 600
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Connection type K

Flying lead	Core colour	Signal / function	
	Green	U_{1+}	Signal track 1
	Yellow	U_{1-}	Inverse signal track 1
	Brey	U_{N+}	Signal reference track N
	White	0 V	GND
	Brown	U_B	+ 5 V supply voltage
	Blue	U_{2+}	Signal track 2
	Red	U_{2-}	Inverse signal track 2
	Pink	U_{N-}	Inverse signal reference track N

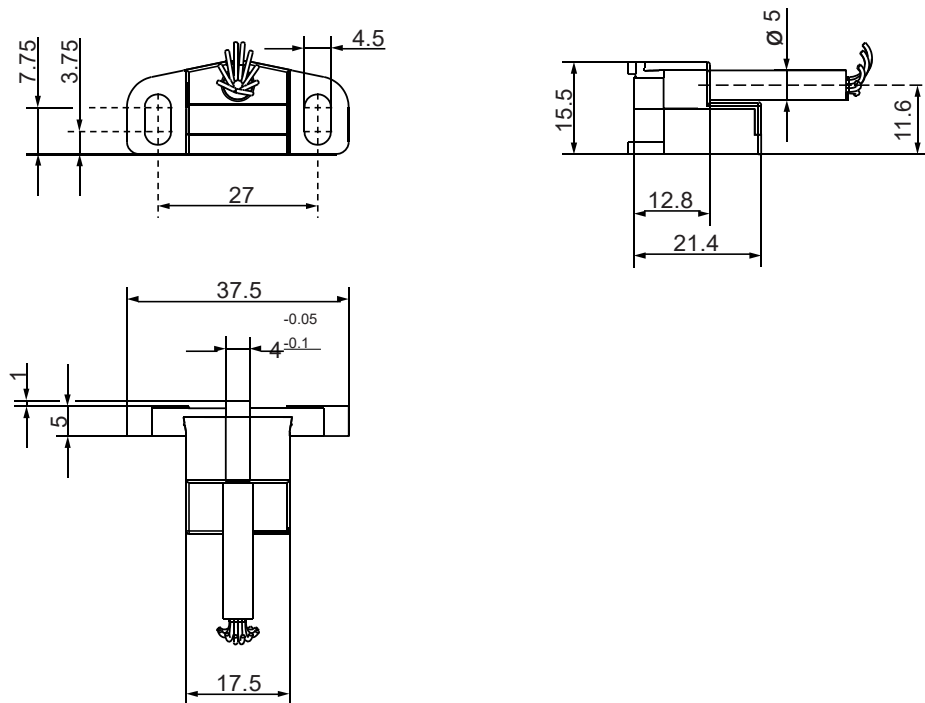
Dimensional drawings

Dimensional drawing CY 2444 with radial cable outlet



All dimensions stated in mm
General tolerance ISO 2768-m

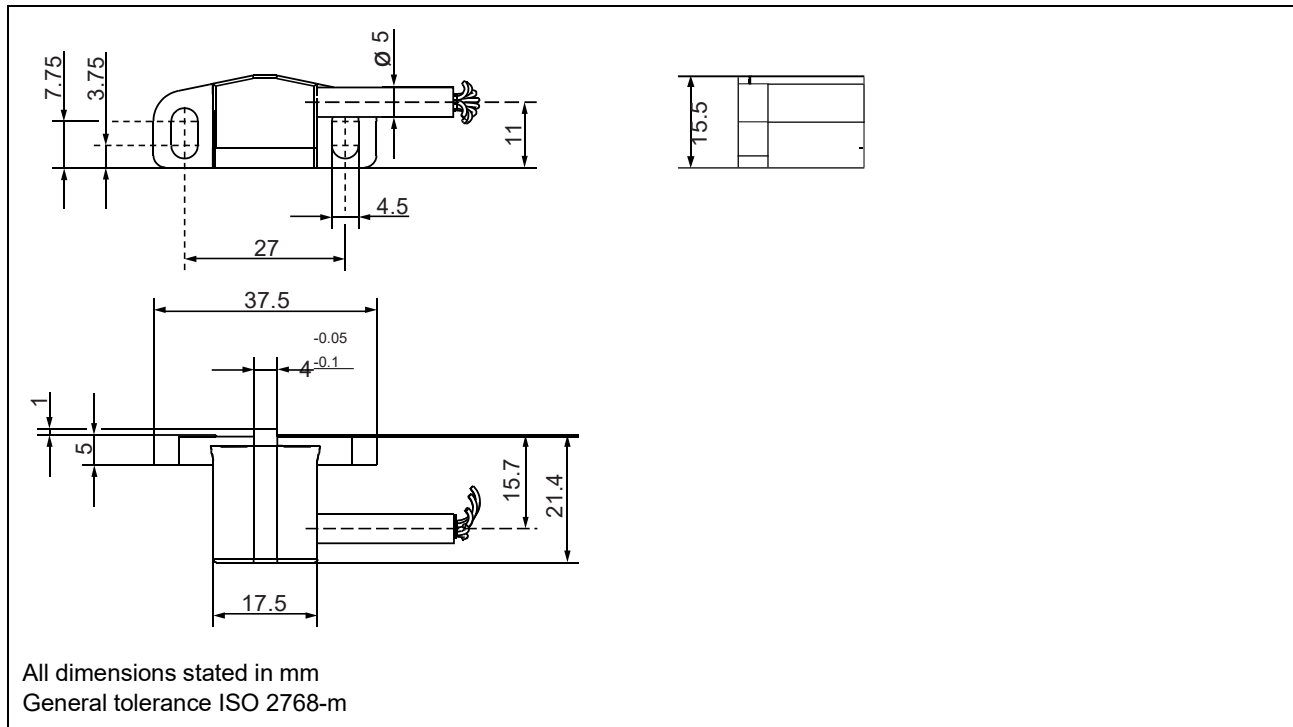
Dimensional drawing CY 2444 with axial cable outlet



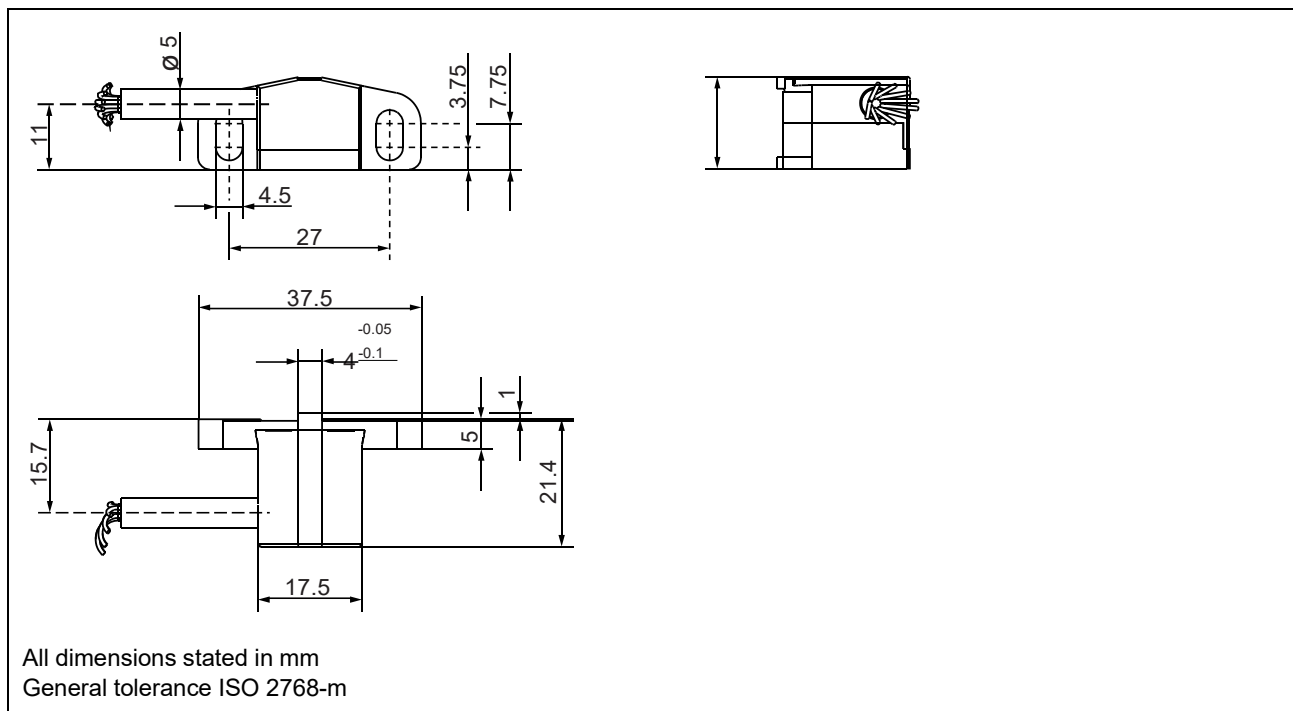
All dimensions stated in mm
General tolerance ISO 2768-m

Dimensional drawings

Dimensional drawing CY 2444 with tangential cable outlet right



Dimensional drawing CY 2444 with tangential cable outlet left



Explanations about the target wheel

Target wheels

For the measurement of rotary movements, CHONGYUAN ENCODERS form a unit together with target wheels. The target wheel size and the related diameter depend directly on the module and the number of teeth.

Standard target wheels

Standard target wheels are available on short delivery times from stock. For specifications and designs see "Technical information ZAx / ZFx".

Custom target wheels

Custom target wheels are manufactured individually to customer requirements. Please send us a design drawing of your target wheel (if possible as a dxf file) to provod40@mail.ru

Reference marks

The CHONGYUAN ENCODER can detect reference marks in the form of a slot, lug or tooth. The pulse detected can be used for referencing the position. This feature is necessary, for example, to automatically change a tool in a milling spindle or grinding spindle.

The selection of the reference mark is defined by the size and rotational speed of the target wheel used, as both parameters have an effect on the forces acting on the reference mark. In case of new designs we recommend the usage of a target wheel with reference mark variant "Z".

Reference mark N – lug

A metal lug integrated into the target wheel and that is positioned exactly between two teeth is detected. The lug must be made of ferromagnetic material and must not protrude beyond the outside diameter of the target wheel. Due to the forces acting on the reference lug, this variant is only allowed to be used in a very limited speed range.

Reference mark M – slot

The CHONGYUAN ENCODER detects a reference slot between two teeth. This target wheel is made up of two pieces for technical reasons.

Reference mark Z – tooth on tooth

These target wheels are made from one piece.

Reference mark –gap

These target wheels are made from one piece.

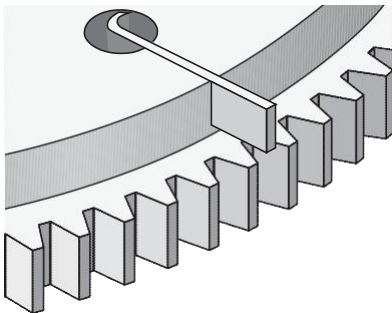
Reference mark – Single tooth

These target wheels are made from one piece.

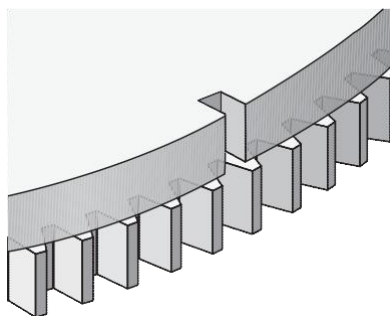
Module

The module is a tooth parameter for tooth wheels and describes the relationship between the number of teeth and the diameter of the tooth wheel. Given the same number of teeth, the smaller the module, the smaller the outside diameter.

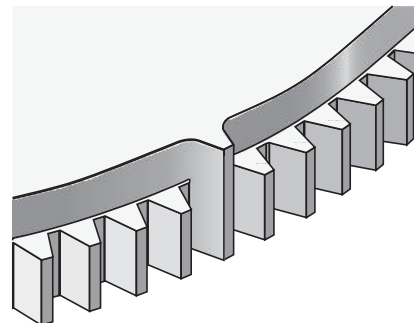
The CHONGYUAN ENCODER must be ordered to suit the design of the reference mark and to suit the module of the target wheel.



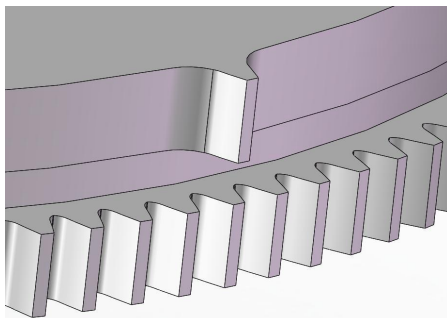
N = Reference mark – lug



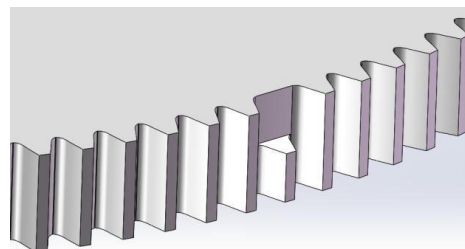
M = Reference mark – slot



Z = Reference mark – tooth



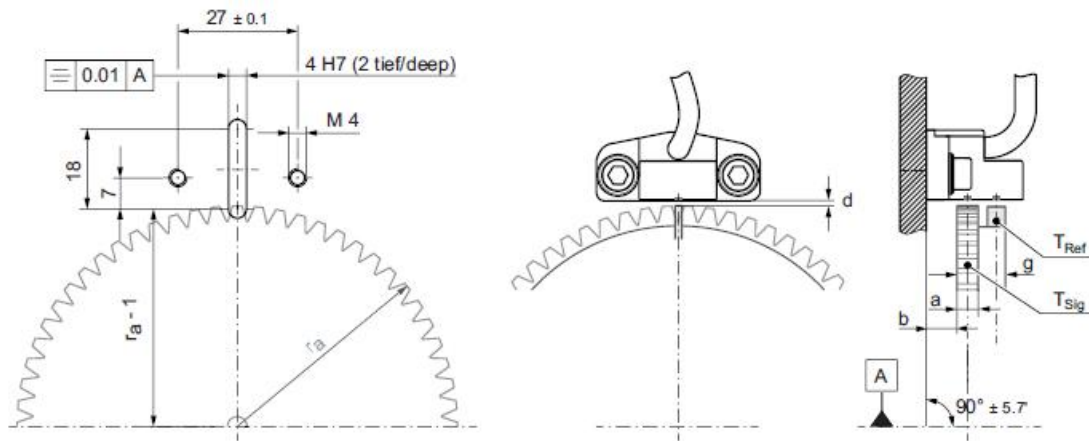
V=Reference mark – Single tooth



G=Reference mark –gap

Hole pattern and installation dimensions, air gap table

Hole pattern and installation dimensions



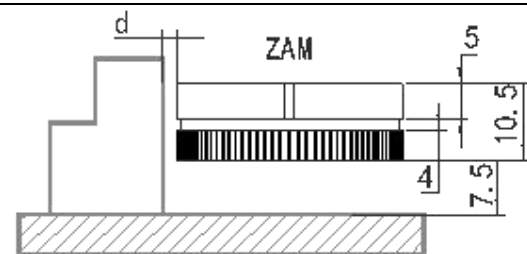
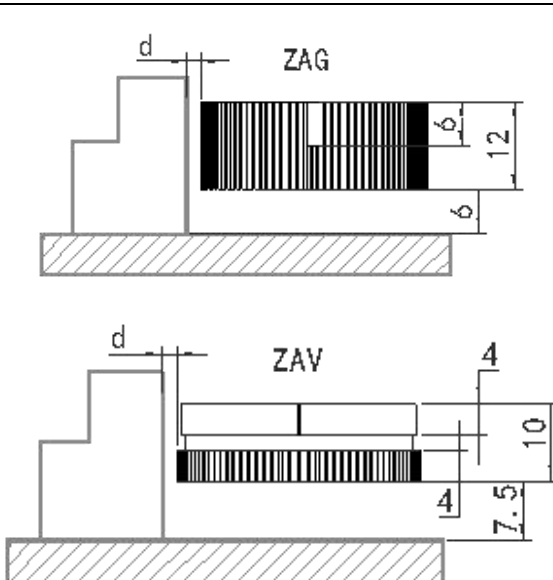
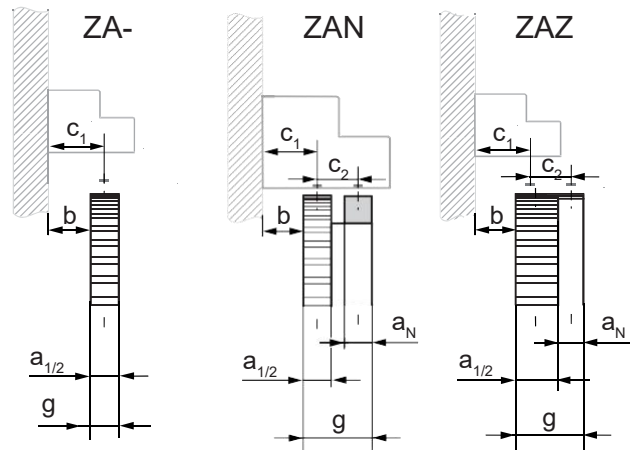
All dimensions stated in mm

- a Width of the signal track: ≥ 4.0 mm
- b Mounting surface to tooth wheel distance: dependent on the geometry of the target wheel (e.g. width of the signal track)
- d Air gap: dependent on the module (see air gap table)
- g Width of the target wheel
- $r_a = d_a/2$ (with d_a = Outside diameter of the tooth wheel)
- T_{Ref} Reference track
- T_{Sig} Signal track

Installation dimensions for standard target wheels

Dimension	ZA-	ZAN	ZAZ
g	4	10	10
$a_{1/2}$	4	4	6
a_N	-	4	4
b	7.5 ± 0.5	7.5 ± 0.5	7.5 ± 0.5
Position of the sensor elements: $c_1 = 9.5$ mm; $c_2 = 6$ mm			

All dimensions stated in mm
General tolerance ISO 2768-m

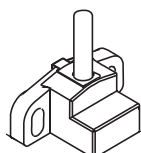


Module	Air gap d, preset measure $\pm$ distance tolerance
0.3	0.15 mm $\pm$ 0.02 mm
0.4	0.15 mm $\pm$ 0.03 mm
0.5	0.20 mm $\pm$ 0.03 mm

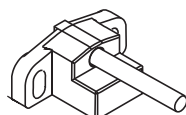
Type code CY 2444

	Signal pattern							
	K	Sin/cos signals 1 V _{pp}						
	T	Square-wave signals TTL / RS422 (digital reference signal)						
	Reference mark							
	-	None						
	M	Slot						
	N	Lug						
	Z	Tooth to tooth						
	G	Gap						
	V	Single tooth (not connected to the tooth of the signal trajectory)						
	Optional extras							
	1	Interpolation factor 1 / without internal regulation (analogue reference signal)						
	2	Interpolation factor 2						
	4	Interpolation factor 4						
	8	Interpolation factor 8						
	A	Interpolation factor 10						
	B	Interpolation factor 12						
	C	Interpolation factor 16						
	D	Interpolation factor 20						
	G	Interpolation factor 32						
	P	Configurable (with digital reference signal)						
	R	With internal amplitude regulation (analogue reference signal)						
	Cable outlet							
	R	Radial						
	G	Axial						
	T	Tangential, cable outlet right						
	L	Tangential, cable outlet left						
	Module ⁽¹⁾							
	3	0.3						
	4	0.4						
	5	0.5						
	Connection type							
	K	Flying lead (only cable length 030 / 050 / 150 / 250 / 600 available)						
	Cable length L							
	030	0.3 m						
	050	0.5 m						
	120	1.2 m						
	150	1.5 m						
	200	2.0 m						
	250	2.5 m						
	600	6.0 m						
2444	-	-	-	-	-	-	-	-

Cable outlet



radial **R**



axial **G**



tangential right **T**



tangential left **L**

⁽¹⁾ Further modules upon request

Restrictions in the type code

Signal pattern, optional extras and reference mark

Signal pattern	Optional extras	Reference mark		Note
		Waveform	Reference mark	
K	1	Analogue	— / M / N / Z	
	R	Analogue	— / M / N / Z	With amplitude regulation
	P	Digital	— / M / N / Z	Configurable
T	1 / 2 / 4 / 8 / A / B / C / D / G	Digital	— / M / N / Z	Interpolation factor

Use in safety applications

Fault detection has a major influence on the availability of safety functions. This task must be realised by the control system, as fault detection is not integrated into the sensor.



Safety of the overall system

The assessment of the safety of the drive train and the machine can only be undertaken by the machine manufacturer taking account the relevant directives, standards and safety regulations.

MTTF_d⁽¹⁾

For simplicity it is assumed that only 50 % of the hardware failures on electronic components are hazardous failures.

For MTTF_d figures it is therefore typically possible to assume twice the MTTF figure⁽²⁾

(sources: EN ISO 13849-1:2008 (D); Annex C, section 5.2 Semiconductors; EN 61800-5-2:2007, Annex B, section 3.1.3 Anteil sicherer Ausfälle (Portion of safe failures)).

The expected operating temperature must be taken into account in this assumption.

PFH_d⁽³⁾

The performance level and SIL level do not relate to the reliability of sub-components but to the availability

of safety functions. The MTTF_d figures for the sensors are used in these calculations.

Safety Integrated

CHONGYUAN ENCODERS with sin/cos signals (signal pattern **K**) have been checked according to Safety Integrated by the IFA in conjunction with Siemens Sinumerik control systems.

IFA assessment

(IFA test report no. 2013 23874):

"The sensor is suitable for providing two independent items of speed information. Due to the fault detection in the Sinumerik control systems, it is only necessary to use one sensor for safety applications."

Control systems from other manufacturers

For control systems from other manufacturers with a safety function, fault detection must be undertaken in the control system as in the Sinumerik:

- ▶ Faults in the sensor function are detected in the downstream control system by monitoring the differential sin/cos signals. For this purpose the amplitudes, the frequency, the offset or the phase on the sin/cos signals should be checked for plausibility.
- ▶ Mechanical slip or detachment of the target wheel from the shaft in operation or at standstill should, e.g., be excluded by a connection with a shaped fit.

Characteristics as a function of the temperature

Operating temperature [°C]	FIT [10 ⁻⁹ h ⁻¹] (4)	MTTF [h] (2)
85	1611	620732
75	805	1242236
65	402	2487562
55	204	5000000
45	105	9523810

(1) Mean time to failure "dangerous"

(2) Mean time to failure

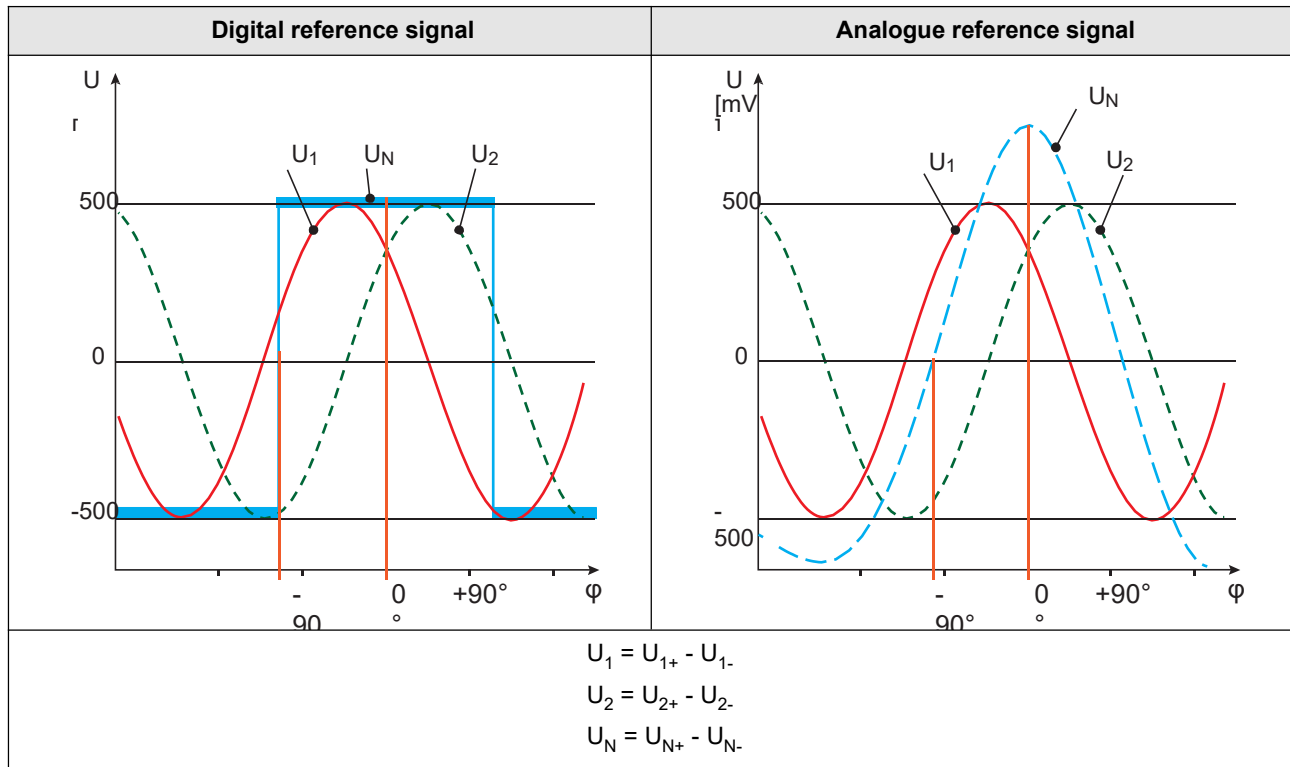
(3) Probability of dangerous failure per hour

(4) Failure in time; i.e. failures per 10⁹ hours

Evaluation aid for reference signals

Advantages of the digital reference signal

Wave forms



The following applies for the digital reference signal:

The amplitude of the reference signal is independent of the air gap and in the ideal case set to +500 mV.

The offset level in relation to the quiescent voltage is fixed at -500 mV to provide a large signal to noise ratio.

Summary

Both waveforms correspond to the common specifications for reference signals on the usage of 1 V_{pp} interface.

【END】