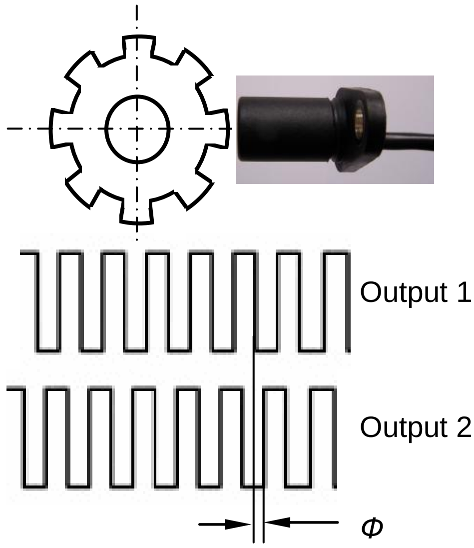
ChenYang
Technologies GmbH & Co. KG

Hall Effect Gear Tooth Sensors CYGTS104

Hall Effect Gear Tooth Sensor CYGTS104 uses two magnetically biased Hall Effect integrated circuits (ICs) to accurately sense movement of ferrous metal target (measuring) wheel. These specially designed integrated circuits, with bias magnet and discrete capacitor, are sealed in plastic package for physical protection and cost effective installation.
This sensor functions under power supply from 4.5 to 24VDC. Two output signals are impulse, current sinking (open collector, NPN), which can be used for rotary speed measurement with direction detection. It has the advantage of reverse polarity protection. The sensor will not be damaged if power is inadvertently wired backwards.

Features

- Sensing ferrous metal target wheels
- Two impulse current sinking outputs NPN (OC) for speed measurement with direction detection
- Good signal-to-noise ratio
- Excellent low speed performance (1Hz)
- Output amplitude not dependent on RPM
- Fast operating speed, over 10kHz
- EMI resistant
- Reverse polarity protection and transient protection
- Wide operating temperature -40°~+150°C



Applications

Automotive and Heavy Duty Vehicles:

- Camshaft and crankshaft speed and position
- Transmission speed
- Tachometers
- Anti-skid/traction control

Industrial Areas:

- Sprocket speed
- Chain link conveyor speed/distance
- Stop motion detector
- High speed low cost proximity
- Tachometers, counters.

Recommended Operating Conditions

Parameter	Conditions	Min	Typ	Max	Unit
Operating Temperature		L: -25; H:-40		L: +125; H:+150	°C
Supply Voltage Vcc		4.5		24.0	V DC
Supply Current Icc		1	2.0	3.0	mA
Output Saturation Voltage Vsat	Low Output	≤0.50			V DC
High Output Voltage (Voh)		Voh ≥Vcc-0.5V			V
Frequency range		0.001		10	kHz
Output Current	Low Output			20	mA
Output Leakage Current	High Output			10	µA
Rise Time (at load resistanc 2kΩ)				≤10.0	µs
Fall Time (at load resistanc 2kΩ)				≤10.0	µs
Duty Cycle for $t_1=t_2$		0.4	0.5	0.6	

Markt Schwabener Str. 8
D-85464 Finsing
Germany

Tel.: +49 (0)8121 – 2574100
Fax: +49 (0)8121– 2574101
Email: info@cy-sensors.com
http://www.cy-sensors.com

Definition of Part Numbers:

CYGTS 104	d	-	v	t
(1)	(2)		(3)	(4)

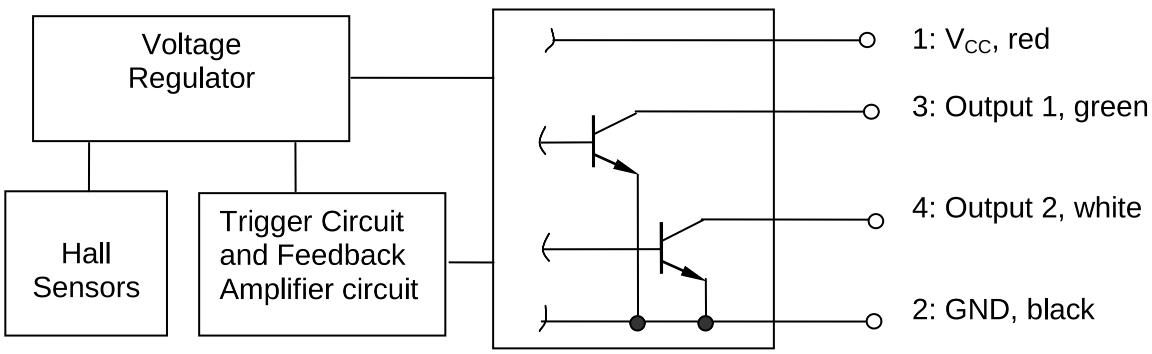
(1) Series Name	(2) Distance (*a*) between the sensing centers	(3) Output impulse when sensitive surface facing tooth addendum	(4) Operating Temperature
CYGTS104	**d=U:** 5.4mm **d=X:** 3.0mm	**v=H:** High level **v=L:** Low Level	**t=L:** -25°C ~ +125°C **t=H:** -40°C ~ +150°C

Example: CYGTS104U-HL for sensor with distance between sensing centers: 5.4mm, output impulse: high level and operating temperature: -25° ~ + 125°C.

Absolute Maximum Ratings

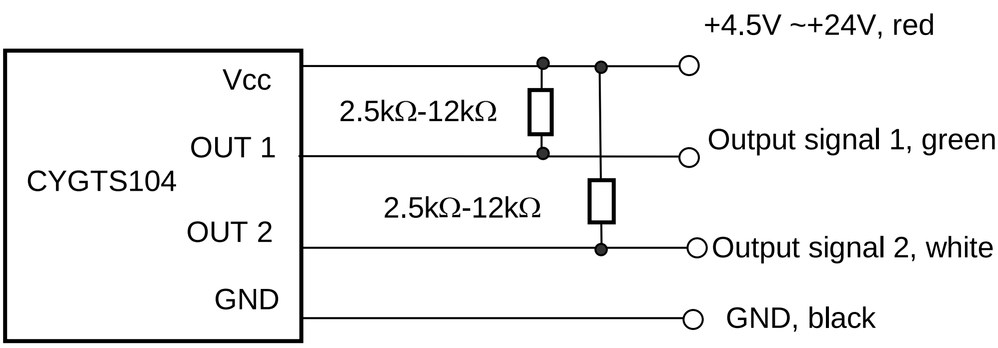
Supply Voltage	+28V
Voltage Externally Applied to Output	-0.3V～+28V (Output high)
Output Current	Sinking 30mA

Block Diagram

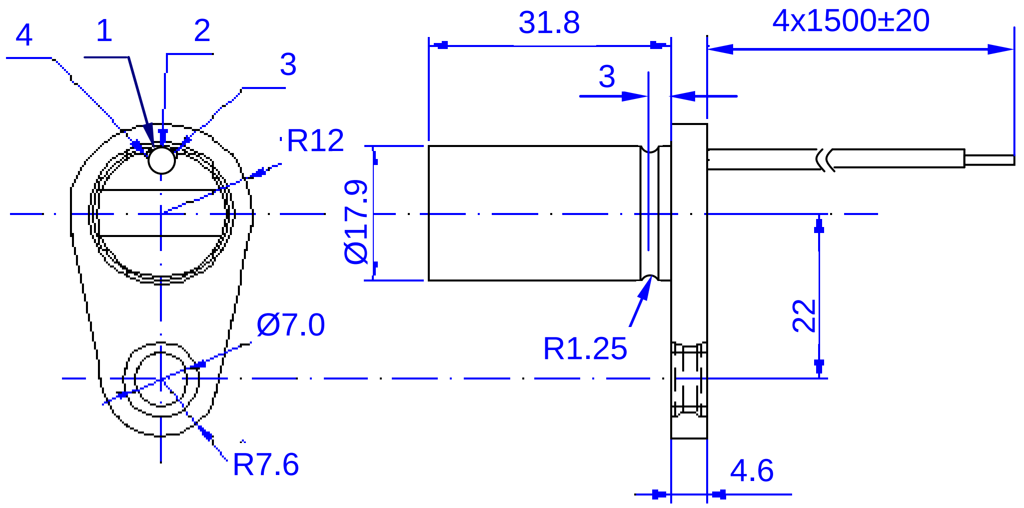


Connection

The output of the sensors is sinking current NPN (open collector). A pull-up resistor (2.5kΩ-12kΩ) should be connected to the sensor output circuit (between power supply Vcc and output).

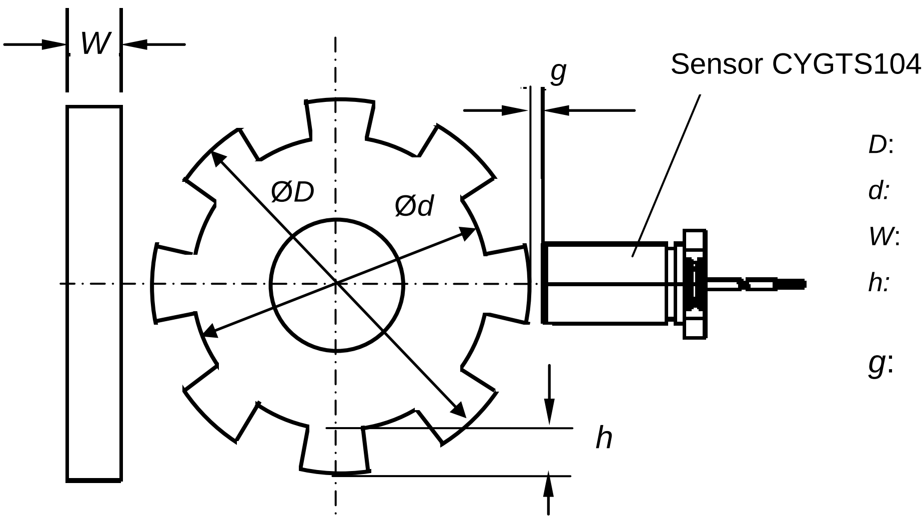


Mounting Dimensions (for reference only)



The standard length of the leads is 1.50m; diameter Ø4.0mm

Sensor Position to Target (Measuring) Wheel



D:	Outside Diameter
d:	Root Diameter
W:	Face width ≥5mm
h:	Addendum height ≥3mm
	h=(*D*-*d*)/2
g:	Sensing Gap ≥0.5mm

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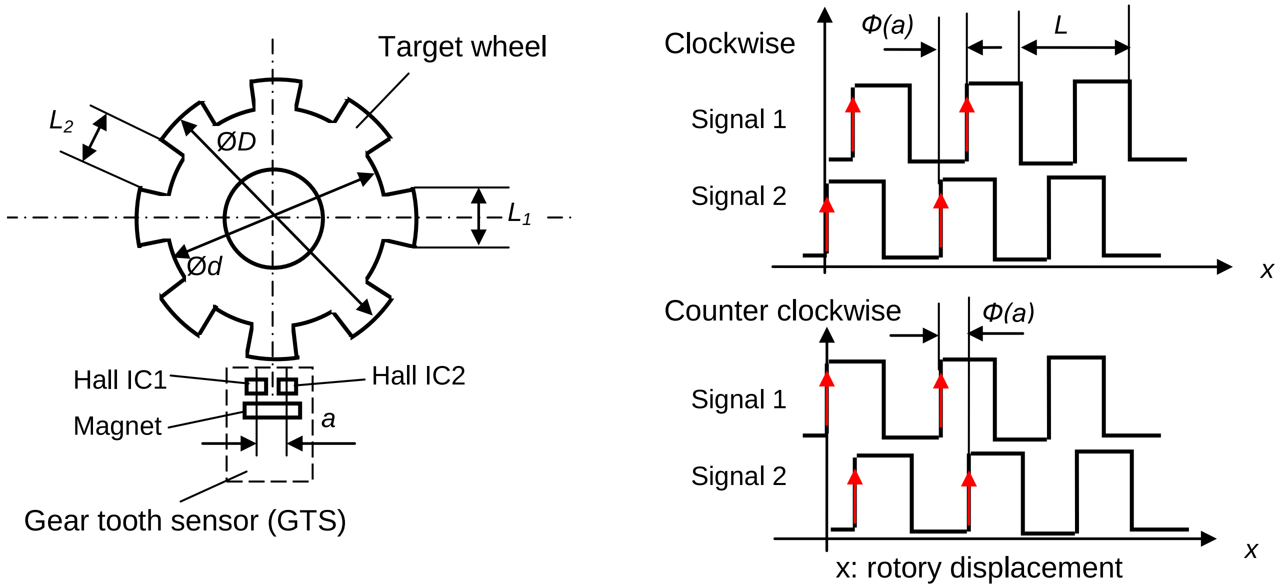
Measuring Principle

The Sensor CYGTS104 consists of two Hall Effect Switsch ICs and one permanent magnet. The Hall ICs are faced to the target wheel. The distance (*a*) between the sensing centers of the Hall ICs is defined, for instance, 5.4mm for CYGTS104U and 3mm for CYGTS104X.



The magnetic fluxdensity passed through the Hall ICs is higher than the operating point of the Hall ICs during the sensor faces to the addendum of the target wheel. In this case, taking the sensor CYGTS-104U-vt as example, the sensor CYGTS104U-Ht has a high voltage output while the sensor CYGTS104U-Lt has a lower voltage. The magntic fluxdensity through the sensor is lower than the release point of the Hall ICs when the sensor comes to tooth valley. The sensors get then their opposite voltage level.

The phase difference *Φ* between the two output signals (signal 1 and signal 2) depends on the sensing distance (*a)* of the two Hall ICs and the tooth arc period (*L*) of the target wheel. The phase difference *Φ* is calculated proximately as follows:

$$\phi = \phi_2(signal\ \ 2) - \phi_1(signal\ \ 1) = \frac{2\pi}{L}a \qquad (1)$$

The tooth arc period *L* is the sum (L_1+L_2) of the addendum arc width L_1 and the outside arc width L_2 of the tooth valley. Under the condition *a*=*L*/4 the phase difference is *Φ=π/2.*

The Duty Cycle (factor) *η* of the output signals is determined by

$$\eta = \frac{L_1}{L} \qquad (2)$$

For target wheel with L_1 = L_2 =*L*/2 the duty factor is *η*=0.5.

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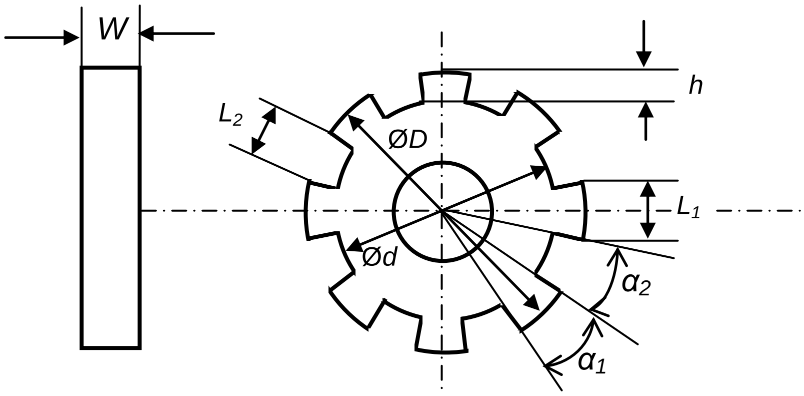
Parameter Recommendation of Target (Measuring) Wheel



Here are the recommended paramters for the design of a target (measuring) wheel:

Material	Magnetic material with high permeability (Low-carbon steel)
Addendum Surface	Smooth surface
Addendum height h	$h \geq 3$mm
Sensing gap g	$g \geq 0.5$mm, $g_{max}=3.0$mm
Addendum arc width L_1	$L_1 = 2a$ (2 times of the distance between sensing centers of Hall ICs)
Outside arc width of the tooth valley L_2	$L_2 = L - L_1$
Tooth arc period L	$L = L_1 + L_2 = 4a$ (4 times of the distance between sensing centers of Hall ICs)
Tooth number N	Dependent on the solution of speed measurement
Outside Diameter D	$D = NL/\pi$
Diameter d	$d = D - 2h$,
Face width W	$W \geq 5$mm
Tooth angle	$\alpha_1 = \alpha_2 = \pi/N$ or $\alpha_1 \geq \alpha_2$

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