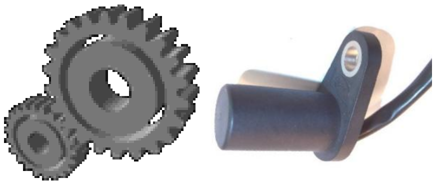
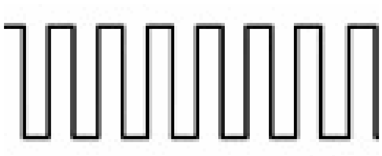
Hall Effect Differential Gear Tooth Sensors CYGTS101DC-S

CYGTS101DC-S Hall Effect Differential Gear Tooth Sensor uses a magnetically biased Hall Effect integrated circuit to accurately sense movement of ferrous metal targets. This specially designed gear tooth sensor IC with bias magnet and discrete capacitor is sealed in plastic for physical protection and cost effective installation. The GTS IC works according to differential magnetic field detection.
This unit functions under power supply from 4.5 to 24VDC. Output is digital, current sinking (open collector, NPN). Reverse polarity protection is standard. The sensor will not be damaged if power is inadvertently wired backwards.

Features

- Sensing ferrous metal targets
- Digital current sinking output NPN (open collector)
- Good signal-to-noise ratio
- Excellent low speed performance
- Output amplitude not dependent on RPM
- Fast operating speed, over 20kHz
- EMI resistant
- Reverse polarity protection and transient protection
- Wide operating temperature -40°C ~ +135°C/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.

Absolute Maximum Ratings

Supply Voltage	-35V~+30V
Output Voltage	-0.7V~+30V
Output Current	Sinking 50mA
Operating Temperature Range	-40°C~+135°C (custom made -40°C~ +150°C)

Order Guide

Part number	CYGTS101DC-S
Supply Voltage	4.5V ~ 24V
Output Saturation Voltage	<0.6V, typ. 0.25V (under sinking current 40mA)
Sense Distance (gap)	0.2mm ~ 4.0mm (using reference target wheels)
RPM	10-8000
Switching time	Rise time: 10µsec. max, fall time: 2µsec. max.
Cross Reference	1GT101DC, 1GT103DC, 1GT105DC

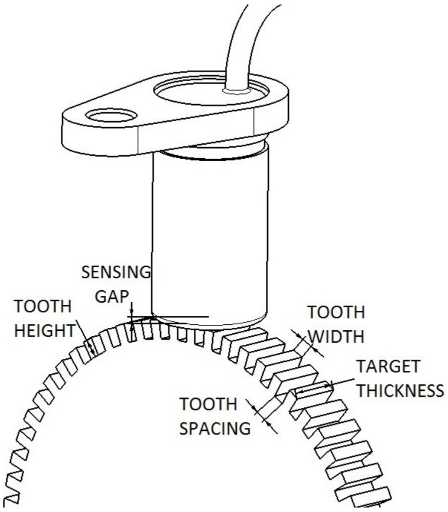
Reference Target Wheels and Sensing Gap (unit: mm)

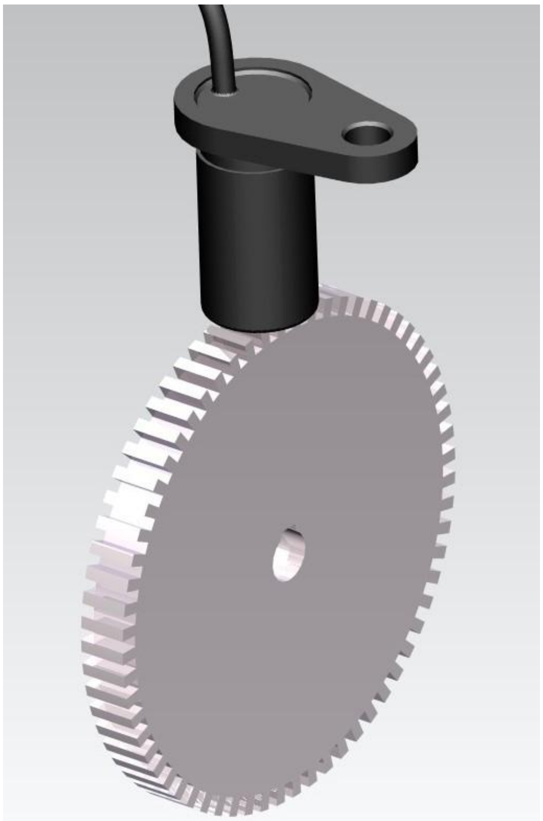
Target wheel	Outer diameter	Tooth Height	Tooth Width	Tooth Spacing	Target Thickness	Teeth Number	Sensing Gap/distance
Target wheel 1	28	5.0	7.34	7.34	8.0	6	0.2-5.0
Target wheel 2	28	5.0	3.66	3.67	8.0	12	0.2-4.0
Target wheel 3	28	3.0	2.0	2.0	8.0	22	0.2-2.4
Target wheel 4	81.5	3.0	2.0	2.0	8.0	64	0.2-2.0




Characteristics will vary due to target size, geometry, location, and material. Optimum sensor performance is dependent on the following variables which must be considered in combination:

- Target material, geometry, and speed
- Gap between sensor and target
- Ambient temperature
- Magnetic material in close proximity.

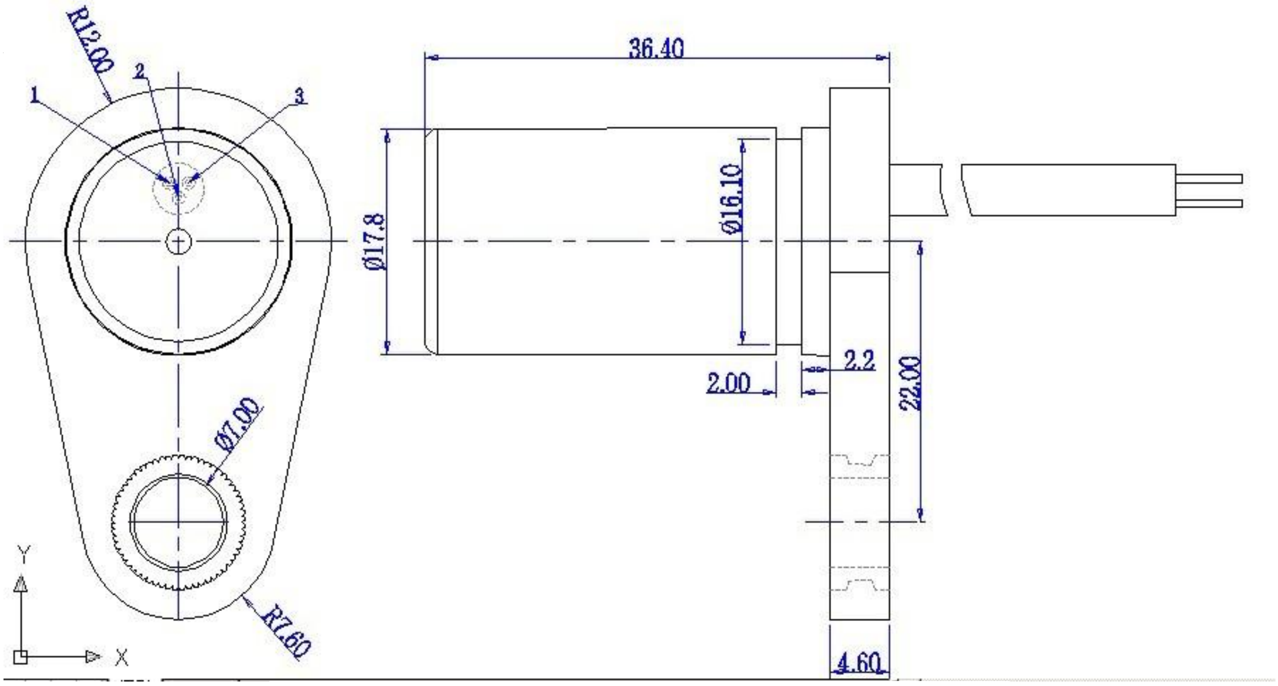


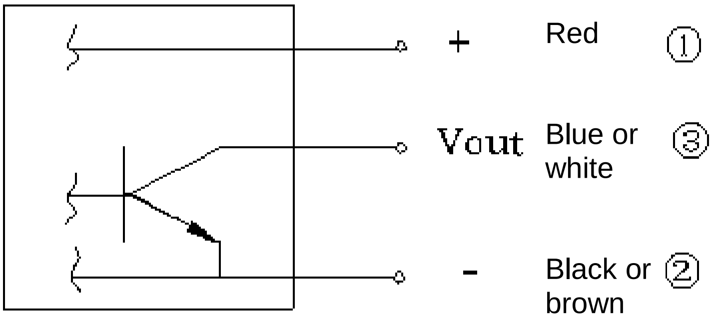


Mounting Dimensions (for reference only)

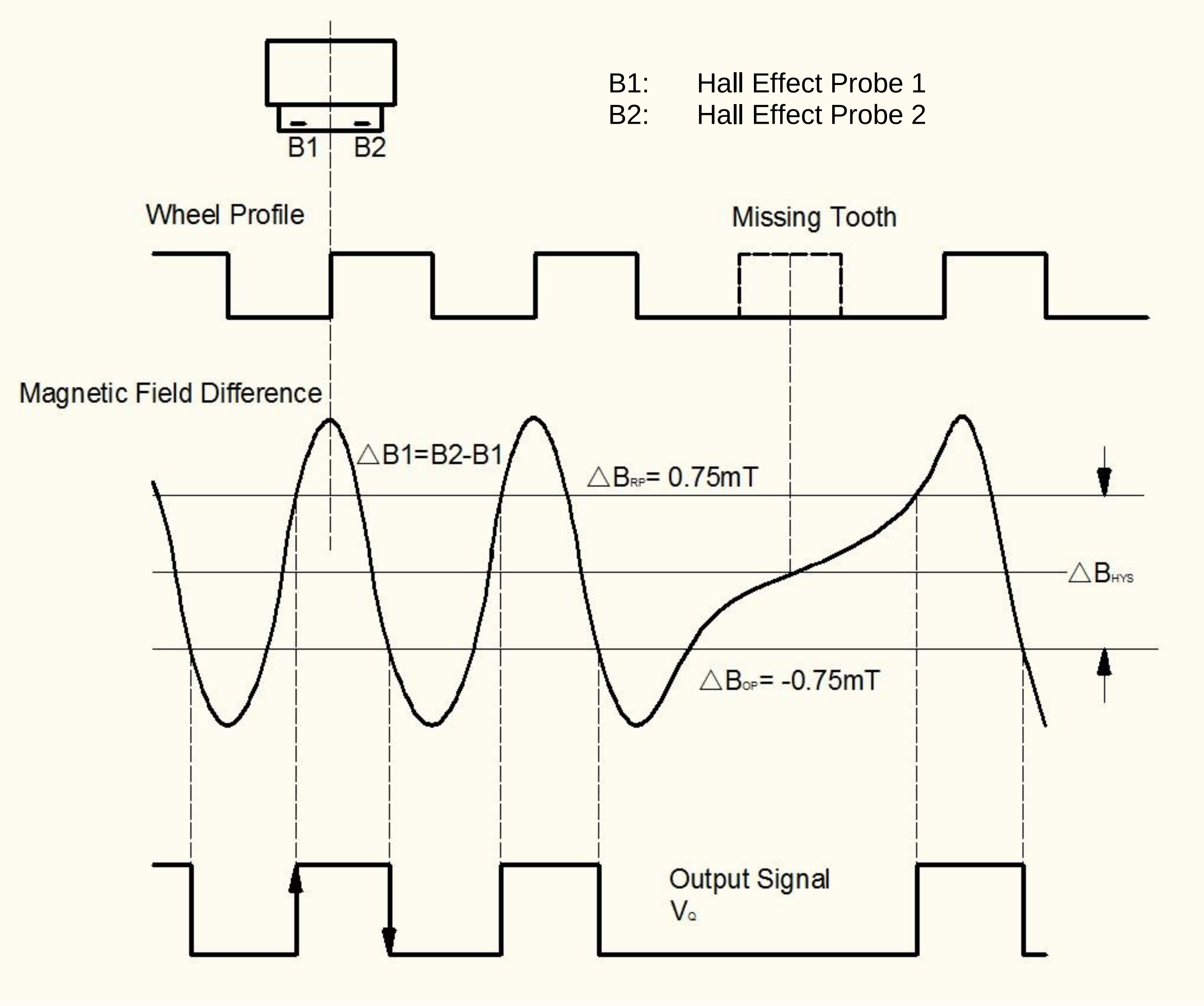
Red:	Power supply
White:	Output
Black:	Ground

The standard length of the leads is 500mm





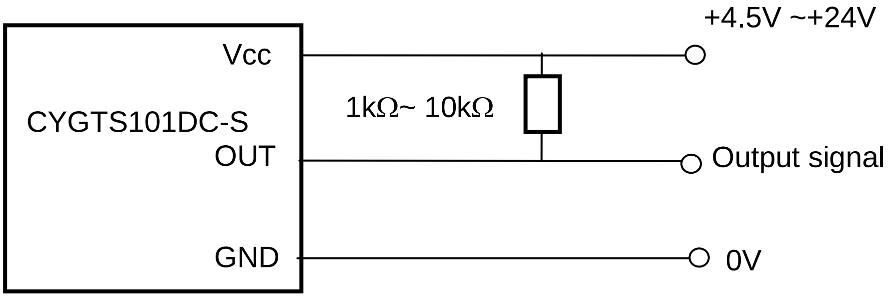
Differential Magnetic Field Detection



Operating point: $B2-B1 < \Delta B_{OP}$ switches the output ON (V_Q = LOW)
Release point: $B2-B1 > \Delta B_{RP}$ switches the output OFF (V_Q = HIGH)
$\Delta B_{RP} = \Delta B_{OP} + \Delta B_{HYS}$

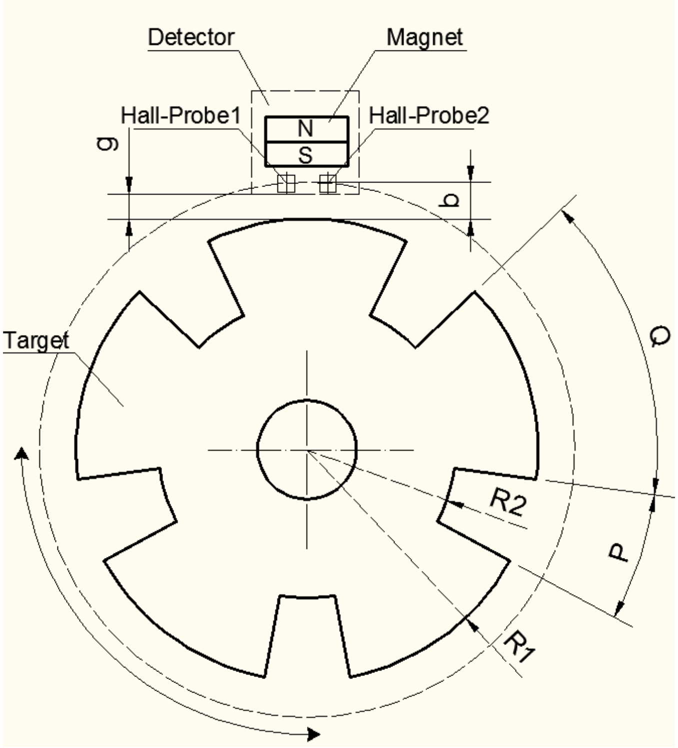
Application Notes

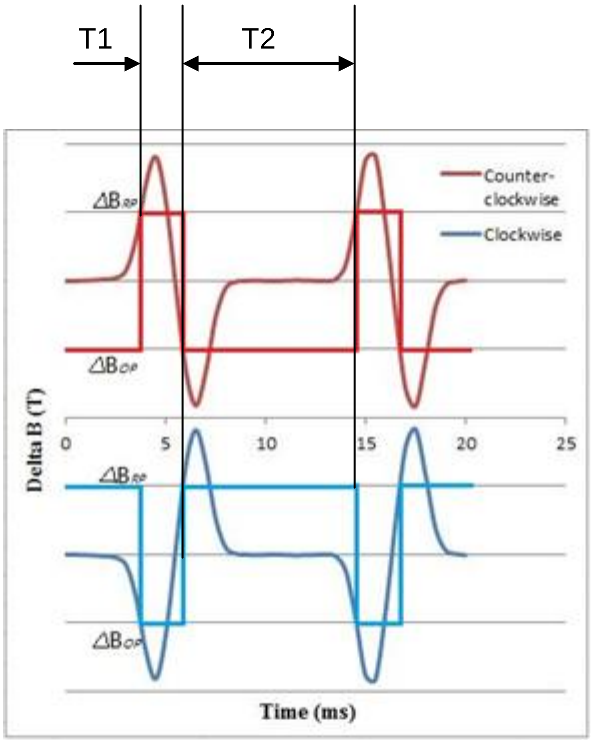
The output of the sensor is sinking current NPN (open collector). A pull-up resistor (1kΩ ~ 10kΩ) should be connected to the sensor output circuit (between power supply and output).



Duty Cycle

The magnetic field difference between the Hall probe 1 and 2, i.e., ΔB=B1-B2, changes the polarisation when the target wheel changes its rotational direction, see the right graphic below. Therefore the output pulses of the sensor will reverse its high and low level. The output impulses of clockwise and counter-clockwise is complementary.





If the duty cycle of the output pulses for the counter-clockwise rotation is determined by

$$DC_{ccw} = \frac{T1}{T1+T2} \times 100\% \qquad (1)$$

the duty cycle of the output pulses for the clockwise rotation can be then calculated by

$$DC_{cw} = 100\% - DC_{ccw} = \frac{T2}{T1+T2} \times 100\% \qquad (2)$$

This property of the duty cycle can be used for detect the rotational direction. By using an optimized geometric duty cycle of the target wheel:

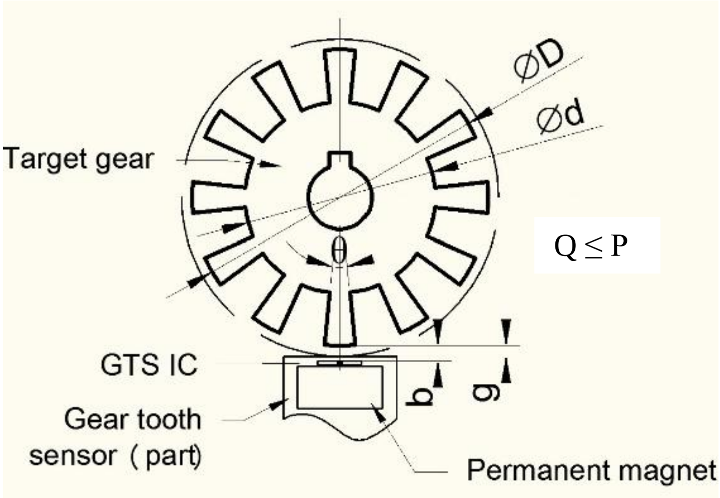
$$\eta_g = \frac{Q}{Q+P} \times 100\% \qquad (3),$$

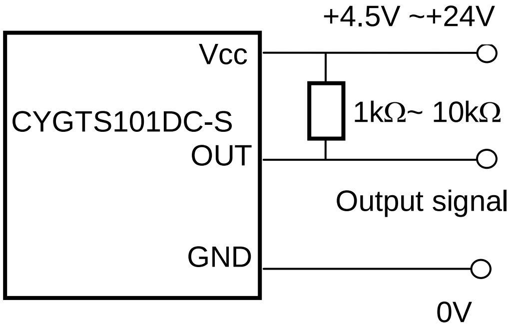
one can obtain different duty cycle DC_{ccw} and DC_{cw} for detecting the rotational direction.

Application Examples

1) Rotational Speed Measurement without Direction Detection

For rotational speed measurement without direction detection, the duty cycle DC_{ccw} should be equal to the duty cycle DC_{cw}, i.e., $DC_{ccw}=DC_{cw}=50\%$. The geometric duty cycle η_g should be designed in range 40~50% (Q≤ P) in this case, see the following target wheel.





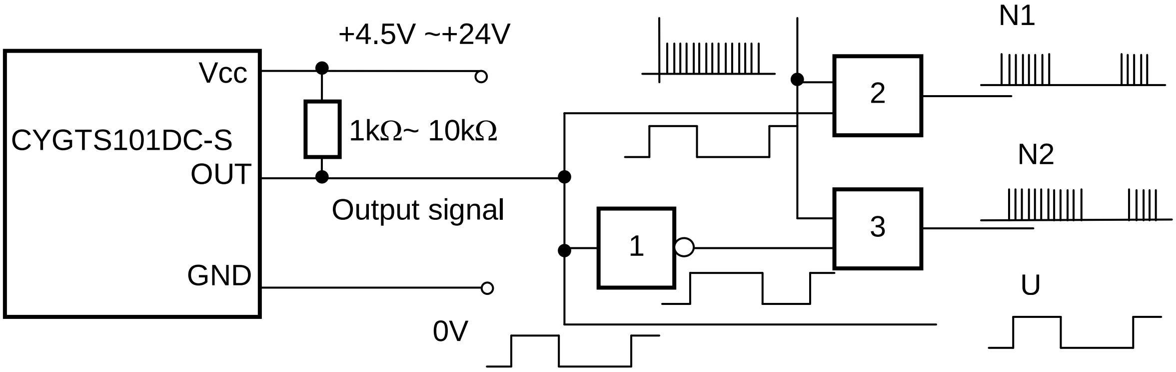
Rotational speed:

$$\omega = \frac{60N}{mT} \qquad \text{(rpm)} \qquad (4)$$

m: the number of teeth, N: quantity of pulses, T: measuring time

2) Rotational Speed Measurement with Direction Detection

For detecting the rotational direction of the target wheel, the duty cycle of the output signal must be determined in the following way. A negation should be connected to the output of the sensor, in order get an additional complementary signal. An additional pulse signal with a high frequency is used for the interpolation, see the following diagram. The impulse quantity is presented with N1 and N2.



The target wheel rotates in the counter-clockwise direction if N1 < N2. Otherwise the target wheel rotates in the clockwise direction (N1>N2). The rotational speed can be determined by (4) under using the pulse signal U. In order to guarantee the detection of the rotational direction, the condition Q>2P should be fulfilled.