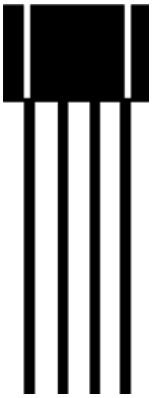
# Self-Adjusting Hall Effect Gear Tooth Sensor IC CYGTS9803 with Dual-Channel Outputs

The CYGTS9803 is a dual-channel gear tooth sensor, with two Hall sensing elements, each providing a separate digital output, for speed and direction signal processing capability. The sensor does not have a chopper delay and uses two Hall plates which are immune to rotary alignment problems. The bias magnet can be from 1000GS to 4000Gs. As the signal is sampled, the logic recognizes an increasing or decreasing flux density. The dual-channel outputs (OUTA and OUTB) are provided in the sensor. The OUTA will turn on (BOP) after the flux has reached its peak and decreased by an amount equal to the hysteresis. Similarly the OUTA will turn off (BRP) after the flux has reached its minimum value and increased by an amount equal to the hysteresis. The OUTB have the same function as OUTA. But due to the flux phase sequencing, the OUTA and OUTB have phase shift, which can be used to determine gear rotation direction.

## Features

- High sensitivity
- Two matched Hall effect switches on a single chip
- 1.4mm Hall element spacing
- Dual-Channel output signal
- True zero speed detection
- Short circuit protection
- Insensitive to orientation
- 4.5 to 24V supply operating range
- Self-adjusting magnetic range
- High speed operation
- Output protection against electrical disturbances
- RoHS compliant



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## 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.

## Device Information

| Part number | Packing | Package | Ambient Temperature | Marking |
|---|---|---|---|---|
| CYGTS9803A | Bulk, 500pcs/bag | 4-pin SIP | -40°C ~ 150°C | 94M2D |
| CYGTS9804K | Bulk, 500pcs/bag | 4-pin SIP | -40°C ~ 125°C | 94M2D |

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## Absolute Maximum Ratings

Over operating free-air temperature range

| Parameter | Symbol | Min. value | Max. value | Units |
|---|---|---|---|---|
| Power supply voltage | $V_{DD}$ | -0.5 | 30 | V |
| Output terminal voltage | OUT | -0.5 | 30 | V |
| Output terminal current sink | $I_{SINK}$ | 0 | 30 | mA |
| Operating ambient temperature | $T_A$ | -50 | 150 | °C |
| Maximum junction temperature | $T_J$ | -55 | 165 | °C |
| Storage temperature | $T_{STG}$ | -65 | 175 | °C |

## ESD Protection

Human Body Model (HBM) tests according to: standard EIA/JESD22-A114-B HBM

| Parameter | Symbol | Min. value | Max. value | Units |
|---|---|---|---|---|
| ESD-Protection | $V_{ESD}$ | -4.0 | 4.0 | kV |

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## Magnetic Specifications

Over operating free-air temperature range ($V_{DD}$=12V, unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $B_{Back}$ | Bias magnetic field | | -30 | -- | 4000 | Gs |
| $B_{OP}$ | Turn on hysteresis | $B_{Back}$=3000Gs | 15 | 30 | 45 | Gs |
| $B_{RP}$ | Turn off hysteresis | $B_{Back}$=3000Gs | 15 | 30 | 45 | Gs |
| -- | Linear Region | $V_{DD}$=4.5V to 24 V | 500 | 0 | 4000 | Gs |

1mT=10Gs

## Electrical Specifications

Over operating free-air temperature range ($V_{DD}$=12V, unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $V_{DD}$ | Operating voltage | $T_J$<$T_J$(max) | 4.5 | -- | 24 | V |
| $I_{DD}$ | Operating supply current | $V_{DD}$=4.5V to 24 V | 2.0 | 4.0 | 7.0 | mA |
| $V_{Qsat}$ | Output saturation voltage | $I_O$=20mA, $T_A$=25°C | -- | 150 | 400 | mV |
| $I_{QL}$ | Output leakage current | $V_{DD}$ < 24V | -- | -- | 10 | µA |
| $t_{rp}$[1] | Response time | $V_{DD}$>4.5V, f=1kHz | 0 | -- | 50 | mS |
| $t_r$[2] | Output rise time | R1=1kΩ, Co=20pF | -- | -- | 0.5 | µS |
| $t_f$ | Output fall time | R1=1kΩ, Co=20pF | -- | -- | 0.5 | µS |
| $f_{cu}$ | Upper corner frequency | -3dB, single pole | 20 | -- | -- | kHz |
| $f_{cl}$ | Lower corner frequency | -3dB, single pole | -- | 0 | -- | Hz |

1: Time required to initialize device.
2: Output Rise Time will be dominated by the RC time constant.

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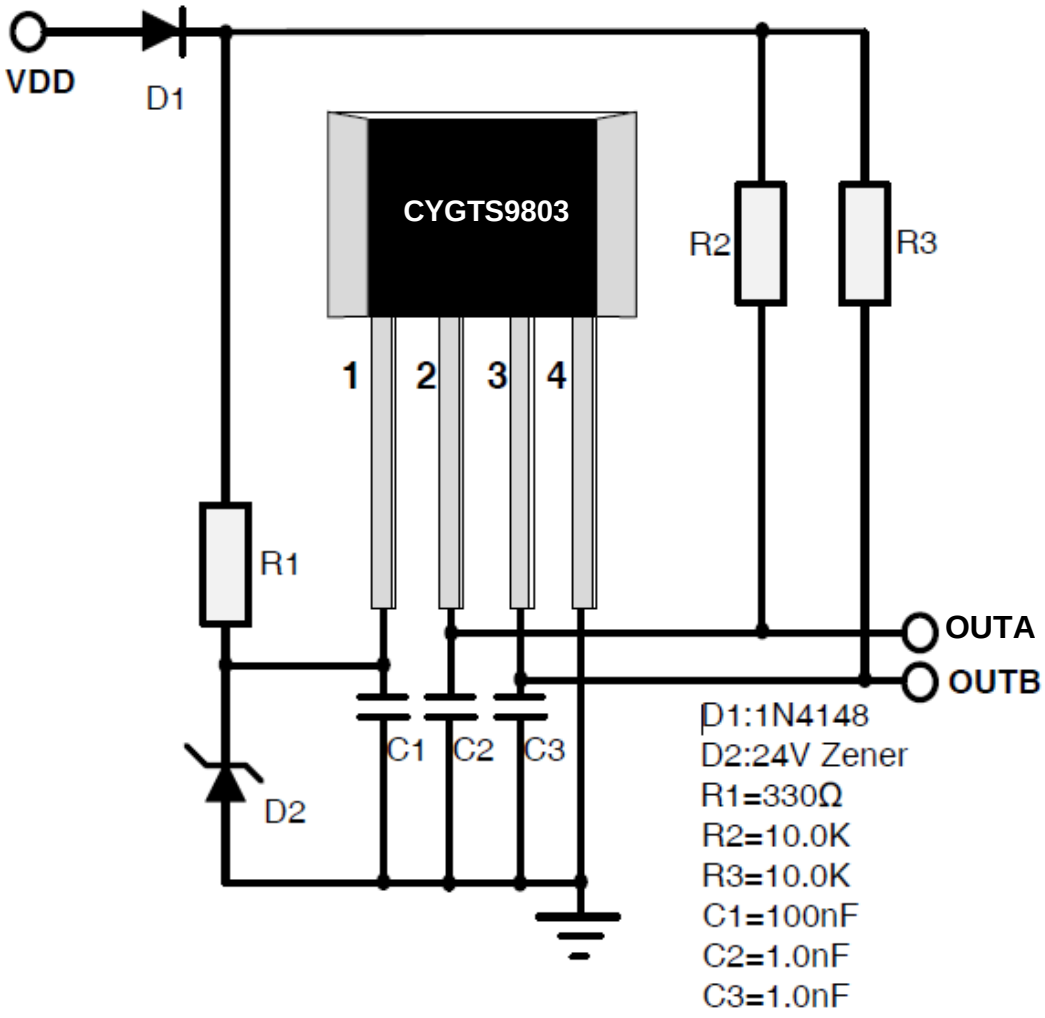
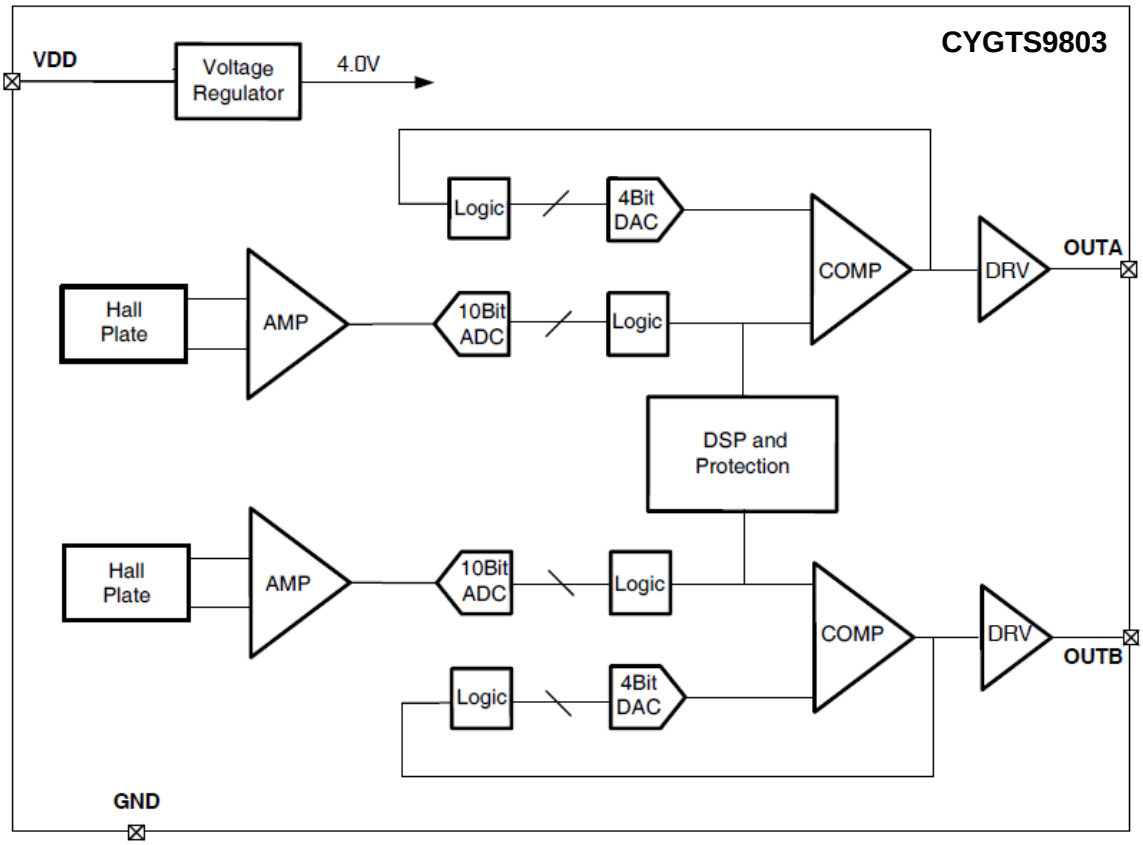
## Application Circuit and Pin Configuration

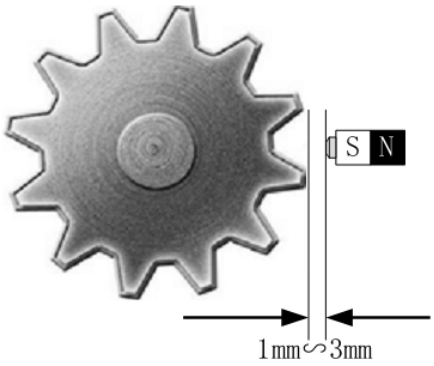


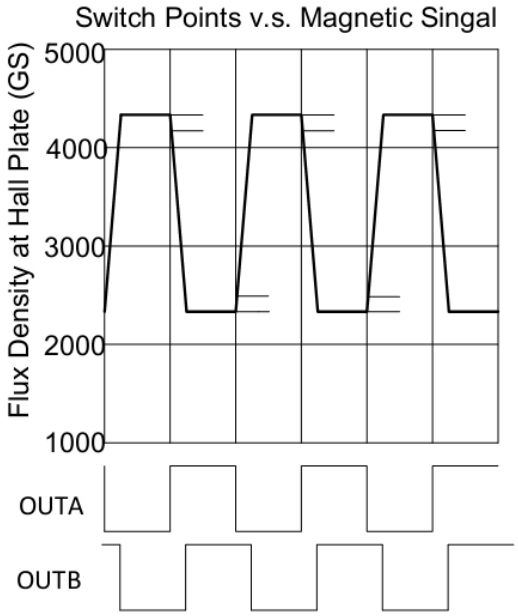

| Terminal name | Terminal number | type | Description |
|---|---|---|---|
| VDD | 1 | PWR | 4.5V to 24 V power supply |
| OUTA | 2 | Output | Open-drain output required a pull-up resistor |
| OUTB | 3 | Output | Open-drain output required a pull-up resistor |
| GND | 4 | Ground | Ground |

## Block Diagram




## Gear Tooth Sensing




In the case of Ferromagnetic toothed wheel application the IC has to be biased by the south pole of a permanent magnet (Maximum 4000Gs). When assembling the sensor system, suggest to

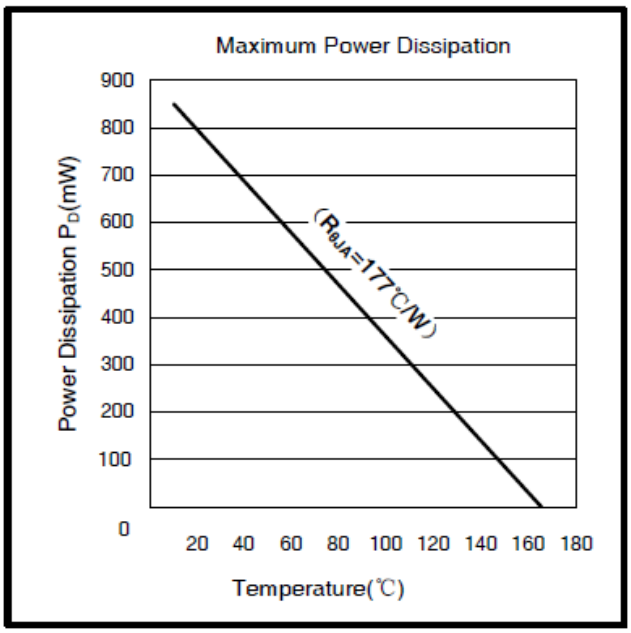
choose a magnet as back bias flux from 1000Gs to 4000Gs. Normally the South pole of magnet faces the unbranded side of the IC. The magnet should be glued to the back surface (non branded side) of the IC using an adhesive or suitable epoxy. The sensor SC9003 is “Self adjusting” over a wide range of back bias flux eliminating the need for any trimming in the application. At the chip power on state, the output is reset to the high state whatever the field is. The output only changes after the first min is detected. The reset state holds no information about the field. If the supply of the chip is raised slowly, the reset state is not stable; the output maybe can’t set to the high state. The maximum air gap depends on

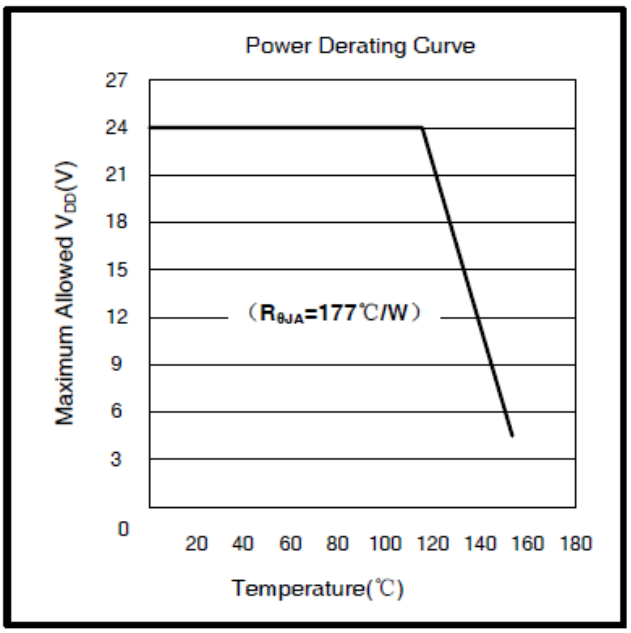
- the magnetic field strength (magnet used; pre-induction) and
- the toothed wheel that is used (dimensions, material, etc.)

It is strongly recommended that an external ceramic bypass capacitor in the range 10nF to 1uF be connected between the supply and ground of the device to reduce external noise. The series resistor in combination with the bypass capacitor creates a filter for EMC pulse. The pull-up resistor should be chosen to limit the current through the output transistor; do not exceed the maximum continuous output current of the device.

## Thermal Characteristics

| Symbol | Parameter | Test Conditions | Rating | Units |
|---|---|---|---|---|
| $R_{\theta JA}$ | Package thermal resistance | Single-layer PCB, with copper limited to solder pads | 177 | °C/W |

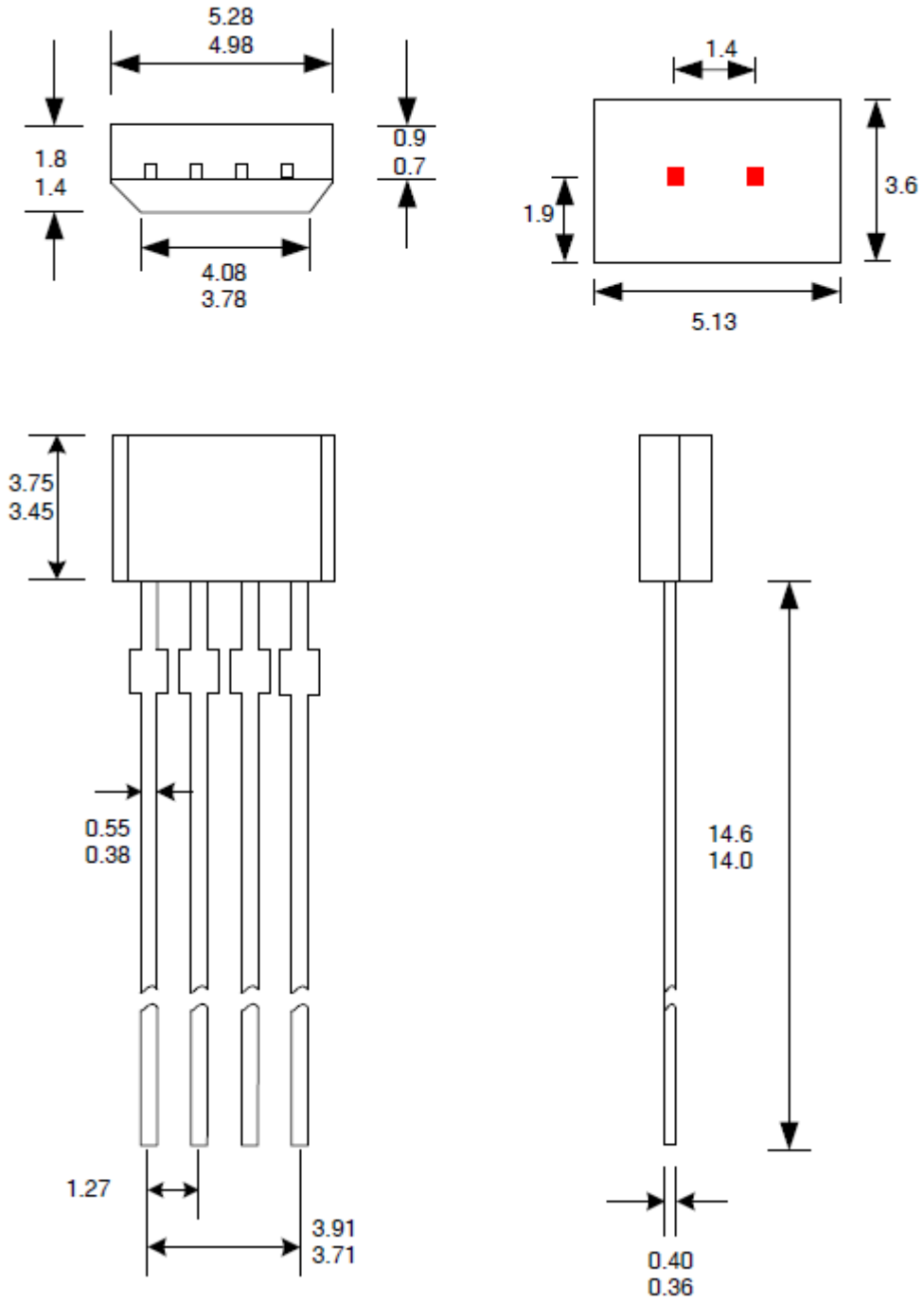


## Package Designator

4 – Terminal VB Package

Dimension: in mm




## Notes:

1. Exact body and lead configuration at vendor's option within limits shown.
2. Height does not include mold gate flash.
3. Where no tolerance is specified, dimension is nominal.

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