Steering Sensors

for

Electric Power Steering

and

Stability Control Systems

Selection and Application Guide

BI technologies

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TT electronics

Technology
for
Steering Position, Speed, and Torque Sensing

BI technologies is the world leader in steering system torque and position sensors. Our sensors are in use in over **7 million** vehicles world wide. Our engineering team understands this critical application and is ready to assist you in developing your specific sensor requirements.

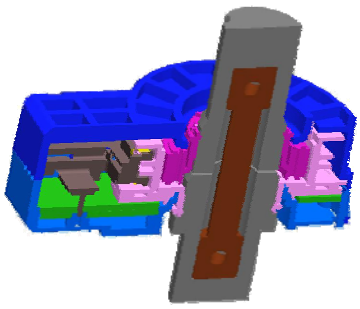
BI offers both contacting and non-contacting sensing technology to meet the most demanding requirements. Our proprietary ***Composite Polymer Resistor*** technology has been developed by our in-house material experts for the demanding needs of automotive position sensing. Polymer resistor technology is easily adapted to a wide variety of sensing configurations. Multiple outputs can be added without excessive costs.

Our non-contacting technology uses both hall effect and our proprietary ***Broad-Band Energy Transfer*** technology. ***Broad-Band Energy Transfer*** technology provides absolute position information over 360 of continuous rotation. Absolute capability can be extended to ±1440º of rotation.

Technology Features

- Continuous rotation position sensing
- Dual outputs for easy and reliable diagnostic
- Absolute position sensing over ±1440º of rotation available
- Patented Low Hysteresis coupling allows 0.3mm of customer shaft runout
- Position and torque signals are aboslute and accurate at power-on.
- Non-contacting technologies provide customer programing of offset and gain that can be used at time of customer assembly to eliminate mechanical tolerances in customer systems
- Analog, PWM and CAN Buss outputs are available
- Position and torque sensing can be combined in one compact and cost effective package

Section view of DAPS position/speed sensor and Magnetorque torque sensor in combined package. Sensor is shown positioned on typical split steering shaft. Both shafts are connected by a calibrated torque bar. The DAPS sensor provides position and speed information for the lower shaft and the Magnetorqe sensor provides relative shaft position of the two shafts while both shafts are rotating continuously.



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Technology Descriptions

Potentiometric Torque Sensor

Potentiometric torque sensors for compliant steering systems offer cost effect and flexible design solutions. A wide rage of compliances angles are available. Dual phased outputs for diagnostic evaluations are cost effective. Durability exceeds 1 million operating cycles and 12 million dither cycles. Potentiometric sensors are immune to EMI/RFI interference.

Magnetorque Torque Sensor

Magnetorque technology is a non-contacting technology designed around hall effect sensors. It features customer programmable outputs which allow the customer to program the sensor on their production line at time of assembly. This feature can be used to eliminate mechanical tolerances in the customers mechanism. Magnetorque sensors include dual phased outputs to allow mating controllers to make reliable diagnostic calculations.

Potentiometric Position Sensor

Potentiometric position sensors offer high precision and cost effective design solutions. They are the most cost effect technology when dual outputs are needed. They offer continuous rotation relative position information. They can also be supplied with a absolute turns counting function that provides absolute position information over ±900º of rotation. Potentiometric position sensors always provide accurate position information at key-on and never lose track of position information even if power is lost. Durability exceeds 1 million full cycles and 20 million dither cycles.

DAPS Position Sensor

Our DAPS (Digital Angular Position Sensor) uses a proprietary ***Broad Band Energy Transfer*** non-contacting technology to provide very accurate position and speed information. Typical steering applications can achieve 0.40% linearity with a resolution of 0.1º. Output formats include analog, PWM, and CAN Bus. Other output options are available. The DAPS output provides absolute position information over 360º of rotation with no gaps in the signal. An optional turns counter function extends the measurement range to cover up to ±1440º of rotation. DAPS sensors can be programmed by the customer at time of installation to zero offset tolerances in the customer's mechanical system.

Combination Sensors

Any of the above technologies can be combined together to provide torque and position sensing in one compact cost effective package. Contact our design team with your requirements.

Contacting Torque Sensor

BI's contacting torque sensors are designed for compliant electric power steering systems that need precision torque sensing and cost effective technology

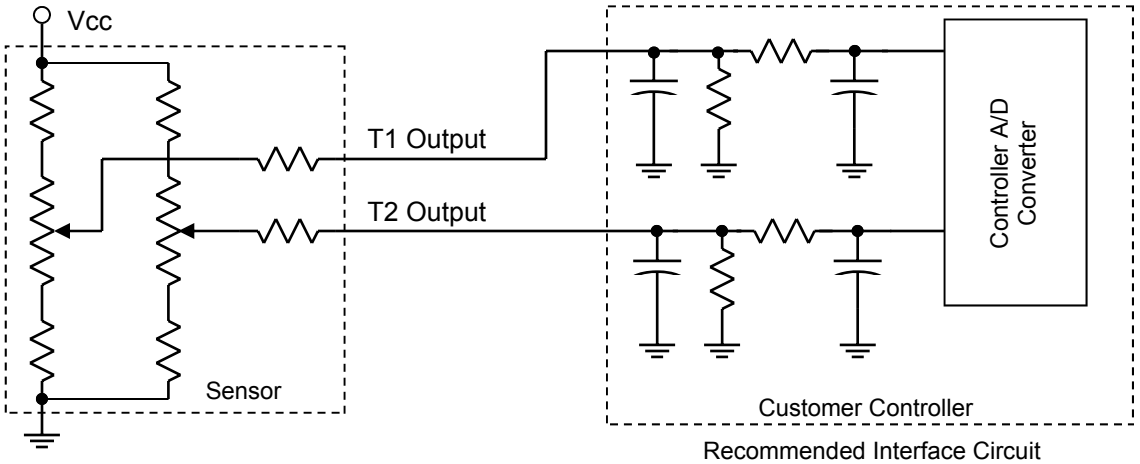
Features

- Proprietary BI Composite Polymer printed resistor technology
- Dual outputs for diagnostic evaluation
- Continuous rotation
- Integrated connector or lead wire options
- Custom package sizes available
- Customer selectable compliance angles from ±5º to ±10º
- Not affected by RFI/ESD interference
- Most cost effective technology

Specifications

- Accuracy: ± 3% (±1.5% available)
- Micro-Gradient: ± 0.6% over 0.2º
- Hysteresis: 1% max
- Operating Voltage: 8 volts max.
- Operating temperature: -40ºC to 85ºC
- Rotational Life: 1 million rotations
- Dither life: 10 million cycles
- Mechanical Shock: 10 g's max
- Vibration: 10 to 55 Hz 1 mm p-p
- Humidity: 120 hrs @ 95% non-condensing

Request BI Technologies Specification HES 32054 for more details



Recommended Interface Circuit
See application notes for component values

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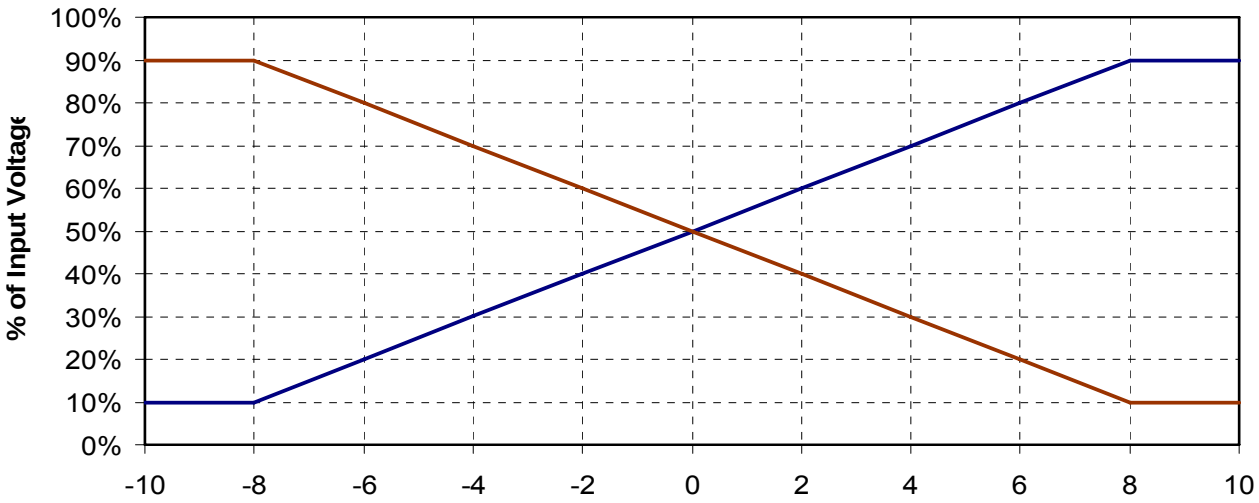
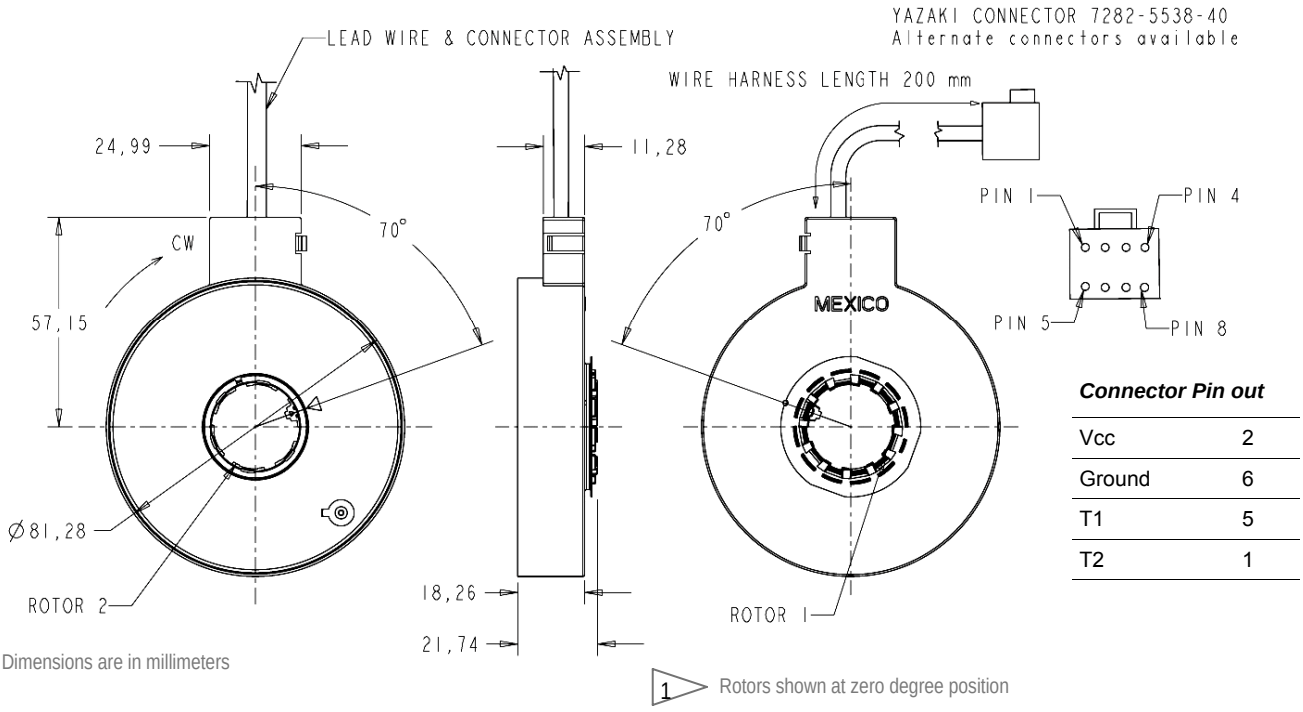
Sensor Output



Compliance shown above is (±8º). Sensor can be order with any compliance angle between ±5º and ±10.º

Alternate connectors available

SX-4355A



Connector Pin out

Vcc	2
Ground	6
T1	5
T2	1

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DAPS Non-Contacting Speed & Position Sensor

BI's DAPS non-contacting position sensors are designed for steering column position sensing. Our unique DAPS technology offers precision and high resolution with a choice of output formats.

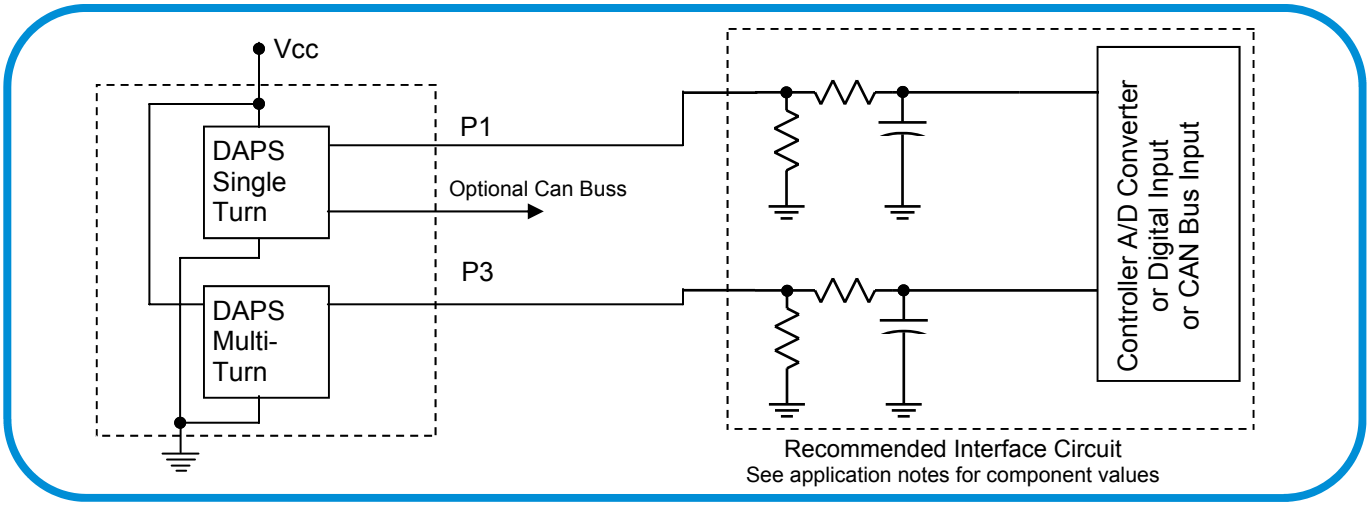
Features

- 12 bit resolution over 360º of rotation
- Absolute position output over 360º of rotation
- Optional absolute position output with up to ± 1440º of rotation available
- Continuous rotation
- Zero degree position programmable by customer
- Custom package sizes available
- CAN Bus output available
- Can be integrated with Magnetorque torque sensing technology

Specifications

- Accuracy: ± 0.40%
- Resolution: 0.2º
- Hysteresis: 0.4% max
- Operating Voltage: 5.0 V ± 0.25 V
- Operating temperature: -40ºC to 125ºC
- Rotational Life: 25 million rotations
- Dither life: 500 million cycles
- Mechanical Shock: 10 g's max
- Vibration: 10-55 Hz 1 mm p-p
- Humidity: 95% non-condensing

Request BI Technologies Specification HEP-32053 for more details



Recommended Interface Circuit
See application notes for component values

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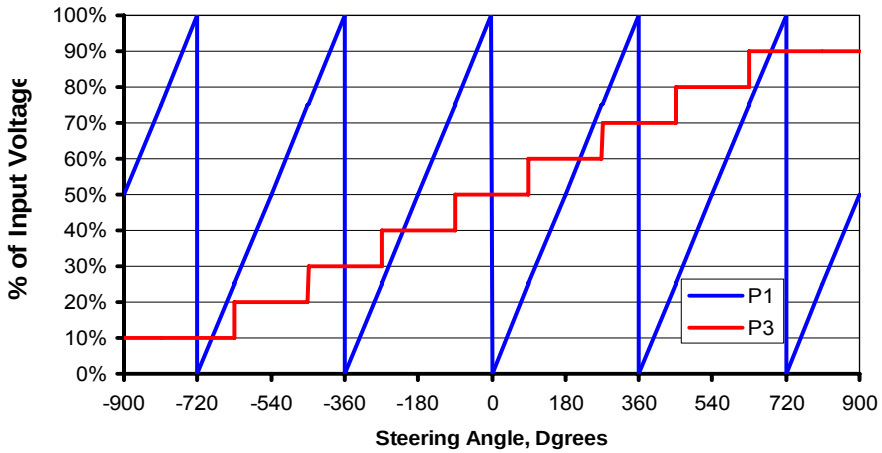
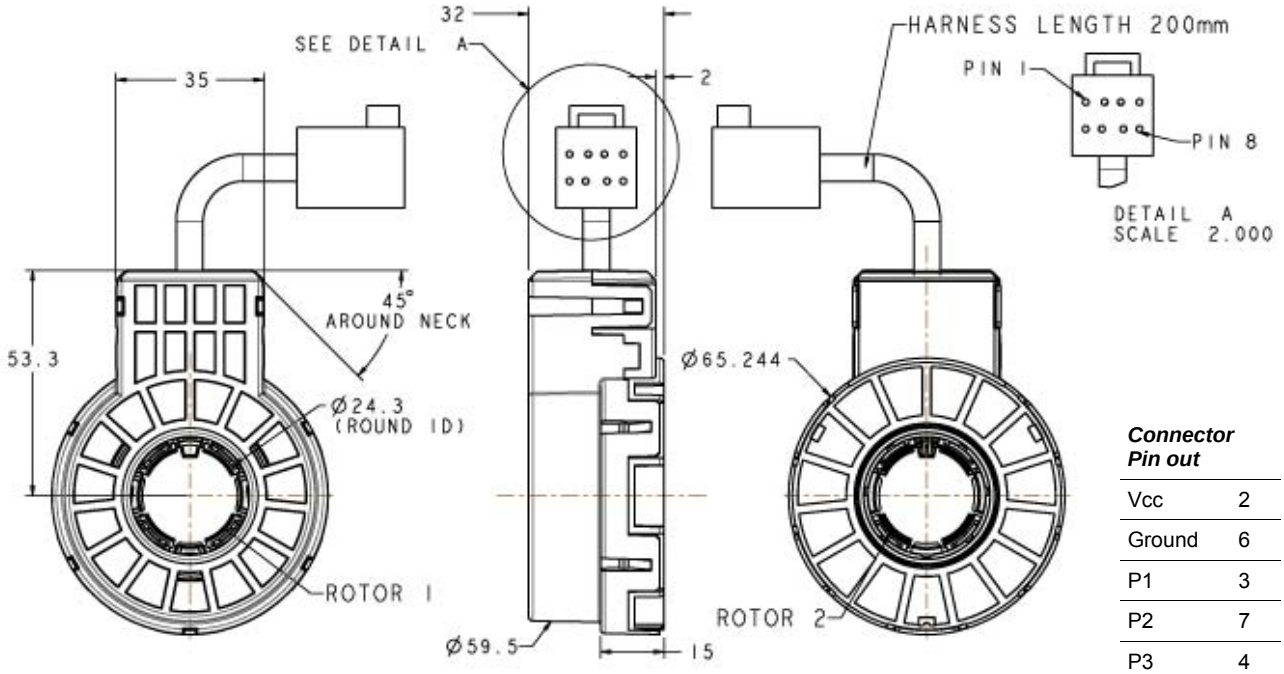
Position Signal Outputs

Analog Format
Alternate output formats available



P3 output shown as configured for ±2 turns. Sensor can be programmed for up to ±1440º of rotation.
Speed information is available on sensors with CAN Bus output.

Yazaki Connector 7282-5538-40
Alternate connectors available



Connector Pin out	
Vcc	2
Ground	6
P1	3
P2	7
P3	4

Dimension are in millimeters

Rotors are shown in the zero degree position

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Contacting Steering Torque &Position Sensor

BI's LH3 steering sensor combines torque and position sensing capability in one cost effective package. The relative position signals can be enhanced with an optional turns counting function for absolute position information over ±900º

Features

- Dual outputs for diagnostic evaluation
- Continuous rotation
- Integrated connector or lead wire options
- Custom package sizes available
- Optional absolute position output over ±900º available
- Not affected by RFI/EMI interference
- Most cost effective technology
- -40ºC to 100ºC operating temperature

Specifications

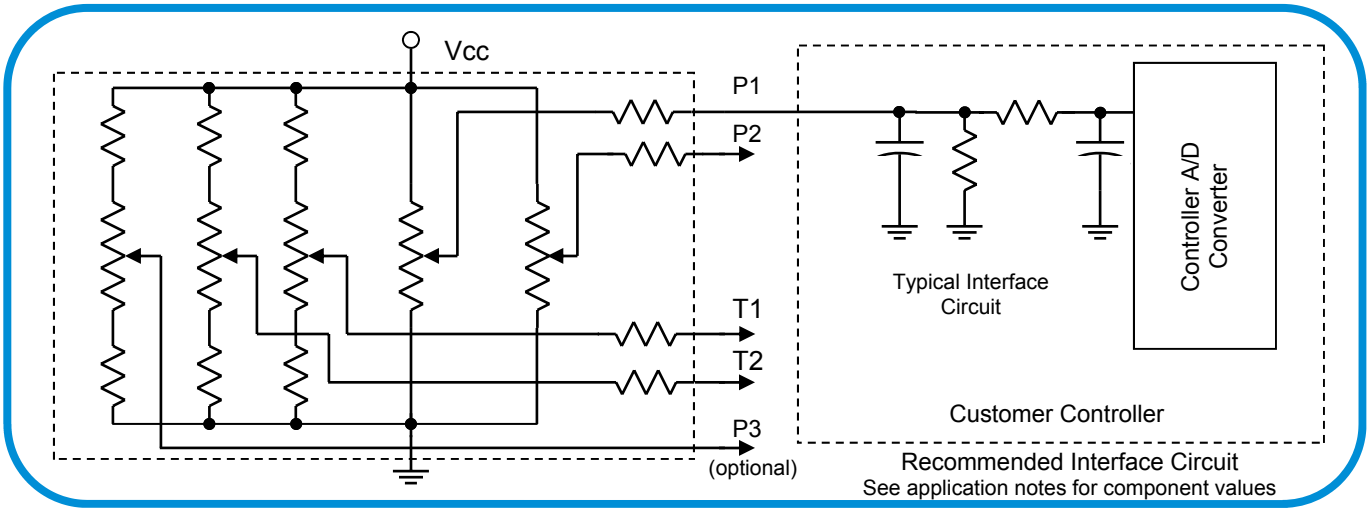
Torque

- Accuracy: ± 3% (±1.5% available)
- Micro-Gradient: ± 0.6% over 0.2 degrees
- Rotational Life: 1 million cycles
- Dither life: 10 million cycles
- Hysteresis: 1% max.

Position

- Accuracy: ± 2%
- Micro Gradient: ± 0.4% over 2 degrees
- Rotational Life: 1 million rotations
- Dither life: 12 million cycles
- Hysteresis: 0.4% max.

Request BI Technologies Specification HEP 32054 for more details



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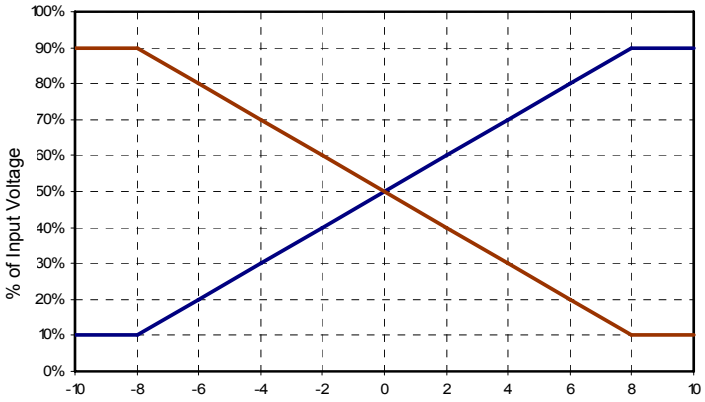
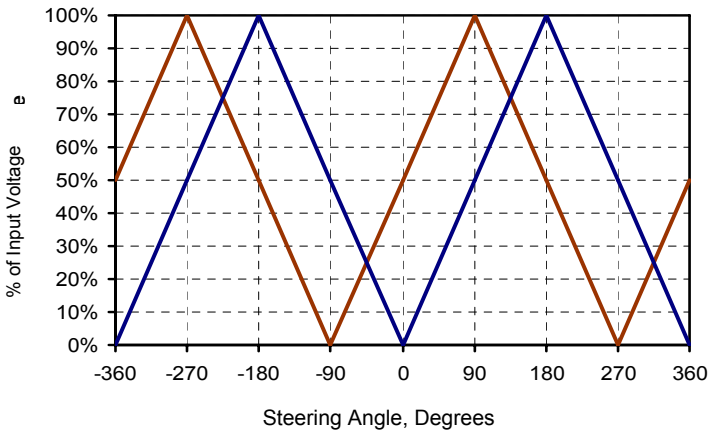
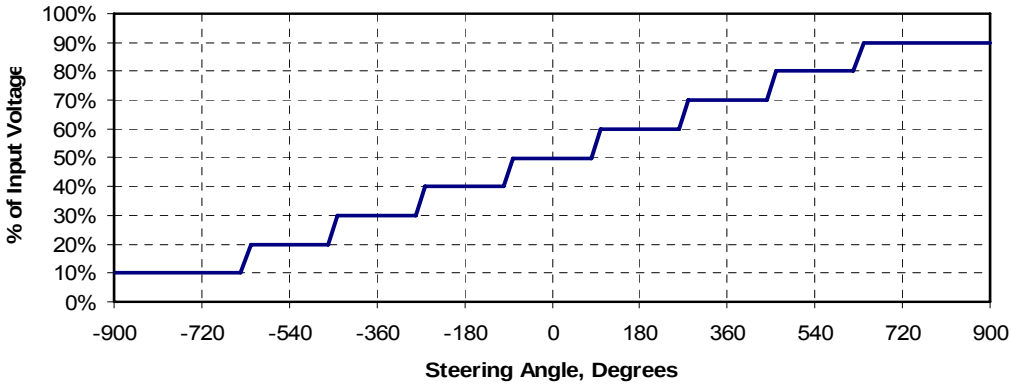
Torque Signal



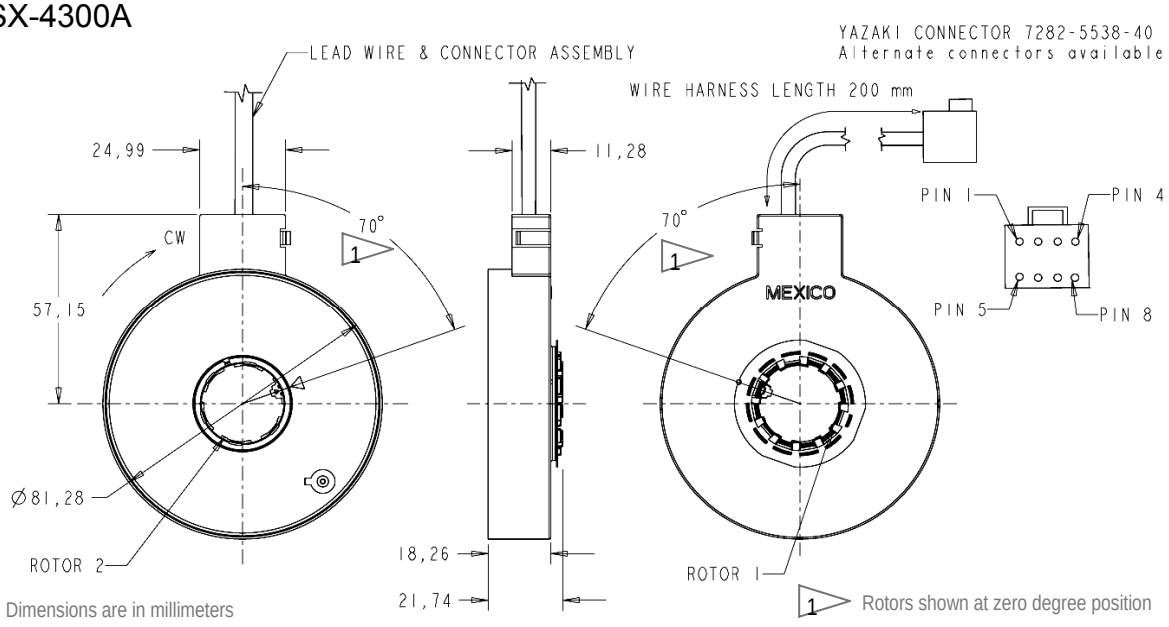
Position Signal



Turns Counter Output P3



SX-4300A



Connector Pin out	
Vcc	2
Ground	6
T1	5
T2	1
P1	3
P2	7
P3	4

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Non-Contacting Steering Torque, Position, & Speed Sensor

BI's combination DAPS and Magnetorque sensor combines all of the advantages of our DAPS and Magnetorque technologies into one cost effective package. All of the features and benefits of both technologies are available in this combination package.

Features

- 12 bit resolution over 360º of rotation (DAPS)
- Absolute position output over 360º of rotation (DAPS)
- Optional absolute position output over ± 900º of rotation available (DAPS)
- Continuous rotation
- Zero degree position programmable by customer
- Custom package sizes available
- CAN Bus output available (DAPS)
- Operating temperature: -40ºC to 125ºC

Specifications

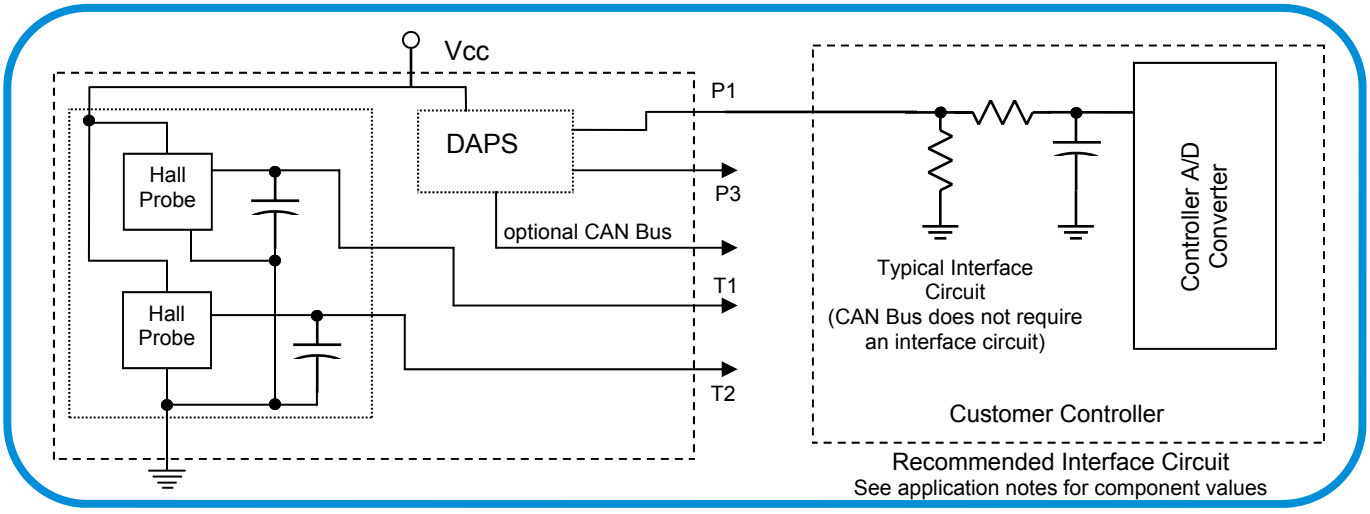
Torque

- Accuracy: ± 3% (±1.5% available)
- Rotational Life: 25 million cycles
- Dither life: 500 million cycles
- Hysteresis: 1.0 %
- Resolution: 0.6%

Position

- Accuracy: ±0.4%
- Rotational Life: 25 million rotations
- Dither life: 500 million cycles
- Hysteresis: 0.4%
- Resolution: 0.2º

Request BI Technologies specification HEP 32052 for torque specifications and HEP 32053 for position details



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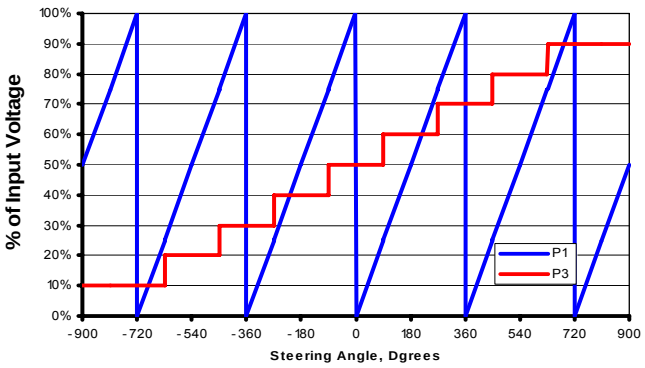
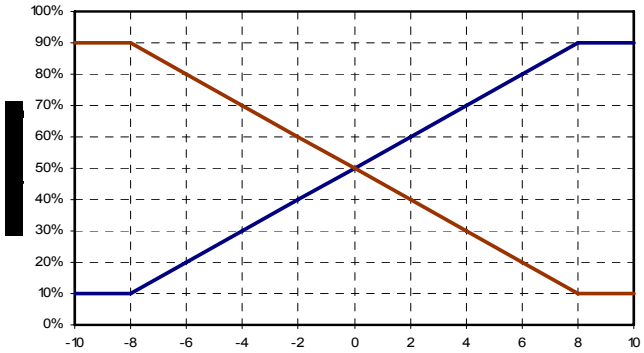
Position Signal Outputs
Analog Format

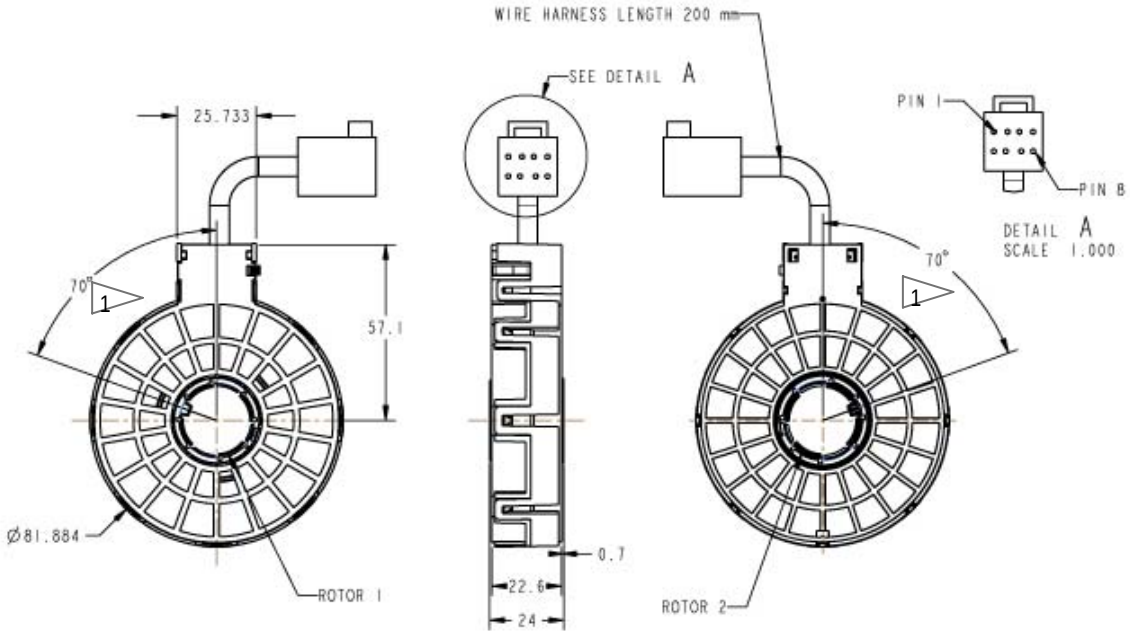


Torque Sensor Output



Differential Steering Angle, Degrees Between Rotors 1 & 2

P3 output shown as configured for ±2 turns. Sensor can be programmed for up to ±1440º of rotation.
Speed information is available on sensors with CAN Bus output.



Connector Pin out	
Vcc	2
Ground	6
T1	5
T2	1
P1	3
P2	7
P3	4

Dimensions are in millimeters

1 Rotors shown at zero degree position

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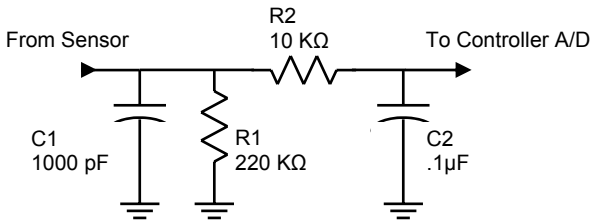
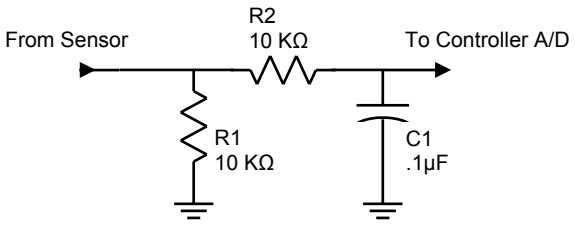
Applications Information

Sensor Interface Recommendations



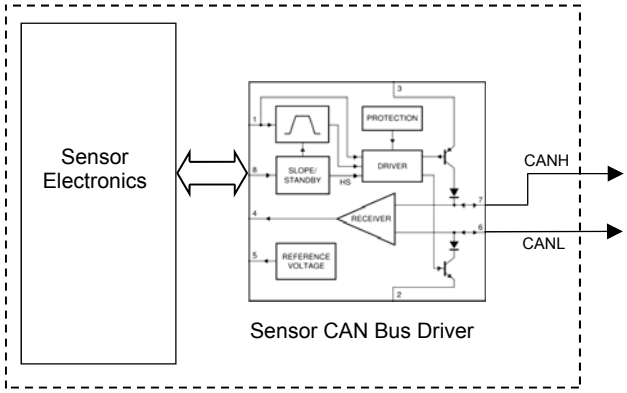
Interface Circuit for Contacting Sensors

Interface circuits for contacting sensors ensure low noise operation and maximum immunity to outside interference. C1 is selected to decouple the controller from power supply noise. R1 ensures minimum current flow through cabling between the sensor and controller which reduces the pickup of stray electrical noise. R2 and C2 work together as a low pass filter with a cutoff frequency of 159 Hz. This provides for adequate noise filtering while providing an anti-alias filter function for controllers with sampling speeds at or below 1KHz.



Interface Circuit for Non-Contacting Sensors

Interface circuits for non-contacting sensors ensure low noise operation and maximum immunity to outside interference. Power supply decoupling capacitors are incorporated into non-contacting sensors. R1 ensures minimum current flow through cabling between the sensor and controller reducing EM electrical noise. R2 and C1 work together as a low pass filter with a cutoff frequency of 159 Hz. This filter provides high frequency noise reduction and anti-aliasing for controllers with sampling rates of 1 KHz and below.



CAN Bus interface circuit

CAN Bus equipped sensors are designed for direct attachment to CAN Bus 2.0B networks. No additional interface components or filters are needed. A CAN Bus driver is incorporated into the sensor and handles connection to the physical layer of the CAN bus structure.

Non-Contacting Technology Life Cycle Specifications

The core technologies employed by BI's non-contacting sensors do not have failure modes related to rotational life. Both the DAPS technology and the Magnetorque technology will operate indefinitely as long as environmental conditions do not exceed specifications. Non-contact sensors are typically limited by the type of bearings used in the construction of the sensor. Rotational life is really dependent on bearing design and materials.

With these details in mind we approach each customer's application and bring to the design effort our extensive experience with sensor bearing design. We can use our design knowledge to specify the right combination of bearing design and materials to produce the most cost effective solution for your requirements.

Programming Non-Contacting Sensors

Magnetorque Programming Options

Magnetorque sensors can be programmed by our customers for offset, gain, rail levels, and temperature compensation. This feature is very helpful for customers that want to minimize the effect of tolerance stack-ups in their systems. Magnetorque sensors are programmed by plugging a programming system into the sensor's connector after the sensor is installed in the customers system and positioned at a known position. Typically this is the center (zero torque) position.

Programming is accomplished by using EEPROM technology to store program settings. The V_{oq} (output voltage when no field is applied), sensitivity (gain), direction of slope, the magnitude of sensitivity drift over temperature (sensitivity temperature coefficient – 1st & 2nd order), the clamping levels, the thermal V_{oq} drift and the bandwidth, are all programmable.

Request BI Technologies programming specification HEP 32052 for more details on programming methods and options.

DAPS Programming Options

DAPS sensors can be programmed by our customers for offset. Given their "encoder" like nature, there is no need to program gain. Customers can take advantage of this feature to minimize system tolerances. DAPS sensors are typically installed into the customer's system and programmed through the sensor's connector using a desktop computer or laptop with a CAN Bus interface card. Using this method, the sensor's output value can be set to any possible output value.

Request BI Technologies programming specification HEP 32053 for more details on programming methods and options.

Contact Information

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