Enabling the Electronics Revolution

PIHER sensing systems
an Amphenol® company

Automotive and EV Sensors

Contactless Sensors - Product Range Guide

Automotive Sensors

For transmission, engine and battery systems

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PIHER sensing systems

Amphenol Sensors

Piher Sensing Systems is an expert in advanced position sensing technologies that enable our clients to accurately measure and control rotational and linear movements. We develop, manufacture and market custom and standard position sensors and controls that provide valuable real-time data needed to efficiently drive today's vehicles and machinery.

CUSTOMIZATION

Our ability to develop and customize our product line to meet exacting requirements gives our customers a technological and competitive advantage over competitors. Our value-added services range from prototyping and custom development to supply chain facilitation through the mounting of sub-assemblies.

With more than 70 years' experience, Piher Sensing Systems has the capability to move seamlessly from prototyping to true high-volume production. This makes us a trusted partner for customers in automotive, off-road, industrial, appliance, medical and marine markets throughout the world.

ENTREPRENEURIAL SPIRIT AND STABILITY OF GLOBAL AMPHENOL CORPORATION

As part of Amphenol, we benefit from the growth and development opportunities of a global corporation. We can rely on stability and financial strength that further support our continued investment in research and development. At the same time, Piher Sensing Systems retains the agility, creativity and entrepreneurial spirit of a medium-sized company that can quickly adapt to customer needs.

The Amphenol Sensors business unit (ASTG) offers the most diverse sensor portfolio for demanding regulatory and industry-driven applications. Close collaboration with our sister companies enables us to offer our clients a full spectrum of dedicated sensing solutions.

Inductive eMotor Position Sensor

Motor position sensing for electric and hybrid vehicles

Accurate feedback on the angular position, direction, and speed of the rotor shaft is essential to optimize control of the motor inverter and drive the electric engine with the best possible efficiency. With lower weight, smaller dimensions, immunity to stray fields and comparably lower cost, Piher Sensing System's inductive position sensing technology offers a true alternative to traditional resolvers. The possibility to perfectly customize the sensor to the motor dimensions enables more flexibility in the development of the electric / hybrid powertrain of the future.

INDUCTIVE HIGH-SPEED ROTARY POSITION SENSOR

	End-of-Shaft	Through-Shaft	Arc
			
Signal output	Analog: differential sine/cosine Digital*: ABI, SPI, SENT, AB, PWM		
Max. speed	Up to 600.000 rpm (el)		
Resolution	Analog: infinite Digital*: 14 bit		
Propagation delay	‹ 4.2 µsec		
Accuracy	±0.3°el		
Operating temperature	-40°C to +160°C		
Power consumption	‹ 20mA		
Sealing	IP69K		

* Check availability

PSCI - END-OF-SHAFT SENSOR

3-/4-/6-pole pair version available for testing

PSCI - TECHNICAL SPECIFICATIONS	
Signal output	Analog: differential sine/cosine (1.0V to 4.0V)
Max. speed	200.000 rpm (3-pole pair version) 150.000 rpm (4-pole pair version) 100.000 rpm (6-pole pair version)
Accuracy	±1°el
Operating temperature	-40°C to +125°C (coil temperature can be › 150°C)
Supply voltage	5V ±10%
Current	Max 15 mA; ±18V over/reverse voltage protection
Mounting torque	Max 2.2 N m

For more information contact info@piher.net or visit: PSCI

Why inductive motor control?

Advantages of inductive motor position sensors vs traditional resolvers

WORKING PRINCIPLE

Piher Sensing Systems' inductive motor position sensors are based on the physical principles of induction in wire loops and eddy currents. The sensor consists of a set of coils printed on a PCB that detect the position of a metallic target moving above the coils and provides a direct demodulated sin-cosine output. As the sensor is not based on magnetic components it is fully immune to magnetic stray fields.

COST EFFICIENCY

Compared to conventional resolvers material costs can be significantly reduced as neither magnets, nor extensive copper windings or external components are needed. Furthermore. the high robustness to misalignments and tilt enable further cost savings at the assembly line compared to conventional resolvers.

DESIGN FLEXIBILITY

Completely adapted designs in through-shaft, on-shaft or arc configuration can be provided by Piher Sensing Systems and are together with low weight and compact dimensions a further argument that speaks in favor of inductive technology. Support for safety-critical applications up to ASIL-D level can be reached by adding an additional chip to the given sensor design.

	INDUCTIVE HIGH-SPEED POSITION SENSOR	SINGLE COIL RESOLVER
Mechanical specifications	++	+
Max. speed	150.000 rpm*	20.000 rpm
Pair poles	Up to 32	Up to 18
Working temperature	-40°C to +160°C	-55°C to 150°C
Robustness to misalignment/tilt	high	low
Electrical specifications	++	-
Accuracy	high	high
Power consumption	low	average
Stray field immunity	yes	no
Design / integration flexibility	++	- -
Sensor configuration	End-of-shaft Through-shaft Arc/off-axis	Through-shaft
Typical weight	‹30g	›200g
Typical height	‹10mm	›25mm
Sealing	IP69K, IP67	IP5X
Time to market	low	high
Direct angle output	yes (analog or digital)	no (external converter needed)
ASIL support	yes (ASIL-D on sensor level)	no (only on system level)
Cost competitiveness	++	-
Magnet	no	no
Copper stator windings	no	yes
Raw material	low impact	high impact
External converter/component	no	yes
Assembly cost	low	high

*Based on a 4-pole pairs, electical max speed: 600.000rpm

Inductive Position Sensors

Strayfield immune, rotary and linear sensors for harsh environments

With their high tolerance to mechanical misalignment, vibrations and tilt variations, Piher Sensing System's inductive position sensors are a perfect fit for absolute rotary or linear motion sensing in automotive applications. These magnet-free sensors detect the position of a solid metallic target that is sliding or rotating above a printed circuit board. Given the underlying technology, inductive sensors are immune to stray-fields and do not need additional shielding.

INDUSTRIAL POSITION SENSORS

	Rotary	Linear
		
Output	Analog (ratiometric), PWM, SENT	
Max. speed	1.000 rpm	n/a
Configuration	Through-shaft; End-of-shaft; Arc	n/a
Resolution	Analog (up to 12 bit) PWM (up to 14 bit) SENT (up to 14 bit)	
Linearity[1]	up to ±0,5%	
Supply voltage	5V ±10%	
Supply current	Typ. 14mA (single output)	
Voltage protection	+18V over voltage, -18V reverse voltage	
Life	Virtually unlimited	
Measurement range*	40° to 360° (no dead band)	Up to 800mm
Redundancy	Yes	
Sealing	IP67, IP69K	

* Others to be studied upon request.

Hall-Effect Position Sensors

Long-life and highly accurate 360° magnetic sensing

CONTACTLESS THROUGH-SHAFT AND END-OF-SHAFT SENSORS

With truly non-contacting sensing (no gears inside subject to wear), high repeatability, low power consumption and integrated connector options, Piher Sensing System's hall-effect sensors provide an all-in-one integrated and maintenance-free position sensing solution for safety and high-reliability applications. Our sensors can be adapted to multi-turn applications, different shaft diameters or complete custom developments. Miniature versions give more flexibility for designs of space constraint applications.

TOUCHLESS AND VARIABLE AIR GAP SENSORS

Our touchless variable air gap sensor creates immunity to radial and axial play on mobile shafts where significant misalignment results in poor operational performance and labor intensive maintenance programs. It complements our PS2P-LIN and PS2P-CON series of 2-piece touchless linear and angular position sensors and will deliver the same level of precision and stability throughout its life as on the first day. Despite extremes of vibration, shock, temperature and contamination. All our hall-effect sensors are easy to assemble thereby delivering additional cost reduction on the production line.

END-OF-SHAFT SENSORS

Series	MSC-360	PSC-360	PSE-360 / PSE-290
End-of-Shaft Sensing	 Miniature size		
Output	Analog (ratiometric), PWM	Analog (ratiometric), PWM, SPI	Analog (ratiometric), PWM
Resolution	Analog, PWM: 12bit SPI: 14bit		
Linearity	±1.5% absolute	±1% absolute (±0.5% upon request)	
Supply voltage	5V ±10%	5V; 7V to 15V (25V)	5V ±10%
Supply current	Typ 12,6mA	Typ 8.5 mA (single) Typ 17 mA (redundant)	Typ 8.5 mA
Voltage protection	+10V over voltage, -10V reverse voltage		±18V over / reverse voltage
Rotational life	Up to 7M cycles	Up to 50M cycles	
Switch output	no	Yes, programmable	no
Angular range*	90° to 360°	40° to 360°	50° to 360° 270° with end-stop
Redundancy	yes		no
Shaft diameter	1.9mm	6mm	6.25mm
Mounting	Flange, Fly lead harness		Panel mount
Sealing	IP67	IP67	not tested

* Others available on request

THROUGH-SHAFT SENSORS

Series	MTS-360	MTS-360PCB	PST-360
Through-Shaft Sensing	 Miniature size	 Miniature size	 PATENTED
Output	Analog (ratiometric), PWM, SPI		
Resolution	Analog, PWM: 12bit; SPI: 14bit		
Linearity	±1% absolute (±0.5% upon request)		
Supply voltage	5V ±10%		5V; 7V to 15V (25V)
Supply current	Single version Typ 8.5 mA Redundant version Typ 17 mA		
Voltage protection	+20V over voltage, -10V reverse voltage		+10V over voltage, -10V reverse voltage
Rotational life	Up to 50M cycles		
Switch output	Yes, programmable		
Angular range*	40° to 360° (no dead band)		
Redundancy	Yes		
Rotor diameter	4mm		14mm or 17mm
Mounting	SMD	Flange, Molex connector	Flange, Fly lead harness
Sealing	IP50		IP67; IP69K

* Others available on request

2-PIECE TOUCHLESS SENSORS

Series	PS2P-LIN	PS2P-CON	PS2P-ARC
Touchless Sensor			 Custom solution
Type	Linear	Rotary concentric	Rotary variable air gap
Output	Analog (ratiometric), PWM, SPI		
Resolution	Analog, PWM: 12bit SPI: 14bit		
Linearity	±1% absolute (±0.5% upon request)		
Supply voltage	5V; 7V to 15V (25V)		
Supply current	Single version Typ 8.5 mA Redundant version Typ 17 mA		
Voltage protection	+10V over voltage, -10V reverse voltage		
Life	Virtually unlimited		
Switch output	Yes, programmable		
Measurement range	25mm (higher on request)	Up to 360°	Up to 180°
Redundancy	Yes		
Nominal air gap	3mm		custom
Maximum air gap	5mm		custom
Sealing	IP67, IP69K		

Gear-Tooth Speed Sensors

Solid state hall-effect wheel speed and direction sensors

The flange mount gear tooth speed and direction sensors of Piher Sensing Systems are designed to precisely calculate speed and direction of ferrous gears in demanding environments such as vehicle transmissions. The hall-effect sensor measures the variation in flux found in the airgap between the magnet and the passing teeth. Based on its touchless technology and rugged design our speed sensors provide true long-term reliability.

KEY FEATURES

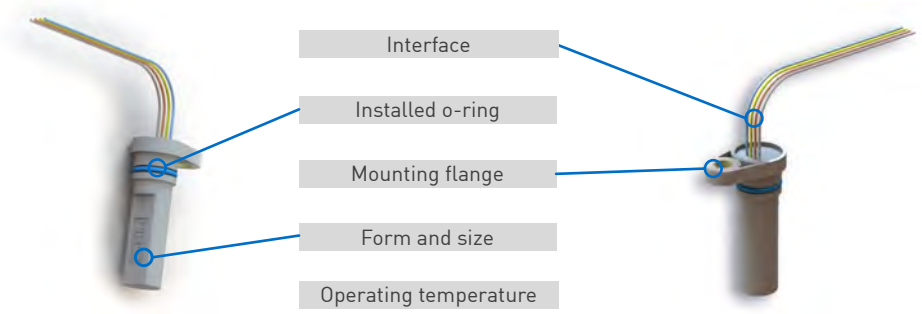
- Speed and direction feedback
- Operating temperature of 125ºC (higher on demand)
- Fast and near zero speed sensing capable
- Compact and rugged for automotive & industrial areas
- Sealed for harsh environments: IP67
- Resistant to moist and high vibration environments such as engines, transmissions, brakes and chassis systems
- ESD protection
- Easily customizeable cable or connector interface

TECHNICAL SPECIFICATIONS

	Two Wire Current Source	A/B Signal
Air gap	1.5mm	
Maximum speed	12 kHz (forward) / 7 kHz (reverse)	40 kHz
Operating temperature	-40°C to +125°C (higher ranges possible)	
Sealing	IP67	
Operating voltage range	4VDC to 24 VDC	
Reverse supply voltage	-18 VDC	
Supply current	Low state: 5.9 to 8 mA High state: 12 to 16 mA	Typ. 10 mA
Power-on time	1 ms	
Output risetime	10 µs	5 µs
Output falltime	10 µs	5 µs

CUSTOMIZATION POSSIBILITIES

Custom product design can easily be provided to meet any form, fit and function including the choice of wire harness and interface connector.



Current Sensors

Automotive Open Loop Current Sensor

Open loop current sensor that generates a ratiometric analog output voltage signal proportional to the current flowing through the conductor. Based on Hall effect technology the sensor has been designed for accurate measurement of currents in automotive battery management and motor control applications.

KEY FEATURES

- Open loop current transducer based on Hall effect
- Measured current values from ±200 A to ±1,500 A
- Simple or redundant analog ratiometric output
- Non-intrusive technology
- Galvanic separation between power and control

TECHNICAL SPECIFICATIONS

Parameter	
Current measurement range	±200 A, ±300 A, ±400 A, ±500 A, ±700 A, ±800 A, ±1000 A, ±1200 A, ±1500 A
Current type	AC, DC
Output protocol	Analog (ratiometric)
Output voltage	0.5 V to 4.5 V ±10%
Supply current	9 mA to 14 mA
Supply voltage	5 V ±10%
Voltage protection	10 V
Accuracy at 25°C*	‹ 2%
Response time	‹ 3µsec
Frequency bandwidth	DC to 200kHz
Operating temperature	-40°C to +125°C
Mounting type	Busbar

* Depending on measurement range

APPLICATIONS

- Battery management
- Motor control
- EV motor inverters
- DC/DC converters

Hall-Effect and Reed Switches

Reliable position feedback for seat belt buckles

Seat belt buckle sensors detect whether the buckle tongue is currently latched and feedback this information to alert the driver, adjust airbag deployment or block vehicle ignition. Piher Sensing Systems can provide custom solutions based on hall-effect or reed switch technology for accurate performance under harsh and challenging environmental conditions. Based on fully sealed, contactless technology without moving parts or external magnets these sensors save space, cost and set-up operating.

Custom packaging including the choice of wire harness, connector options and electronical values can be provided.

Alternative applications include hood latch, liquid level or HVAC compressor status control.

HALL-EFFECT SENSOR		
Electrical Specifications		
Sensor logic		Bi-state
Voltage		2.7V to 24V
Over-/reverse voltage protection		32 Vdc max / -30Vdc max.
Current	Switching low Switching high	5.0mA / 6.9mA 12.0mA / 17.0mA
Resistance	Circuit Isolation	100Ω max. › 20MΩ max.
Environmental Specifications		
Operating temperature		-40°C to +125°C

REED SWITCH	
Electrical Specifications	
Sensor logic	Normally open
Voltage	16Vdc max.
DC switched current output	0.35A max.
Switch power	5W max.
Environmental Specifications	
Operating temperature	-40°C to +85°C

Sensor Applications

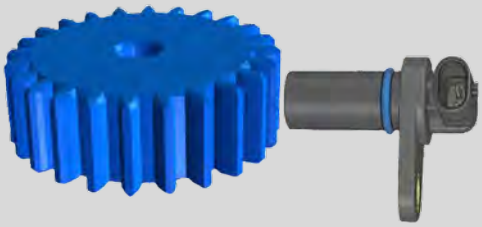
Our position sensors are made for the harsh environments and comply with safety critical requirements. Beyond the development and manufacturing of sensors we also offer connector and cable assembly. With different technologies available, we will develop the most suitable solutions for your specific requirement.

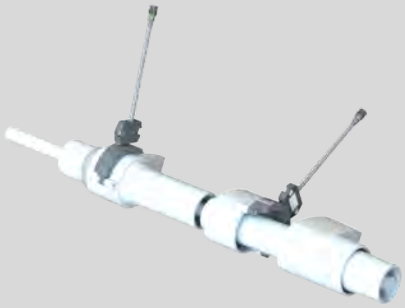
E-MOTOR CONTROL

With lower weight, smaller dimensions, immunity to strayfields and comparably lower cost, Piher Sensing System's inductive position sensing technology offers a true alternative to traditional resolvers.

TRANSMISSION SPEED

We provide linear, rotary and speed sensor solutions to measure transmission input and output speed, gear speed and gear position.





ACTIVE SUSPENSION SYSTEMS

Measuring large shafts can be a challenge especially due to changing airgaps during the product life time. Our variable airgap arc sensors bridge the gap and are in this case used to measure the torque applied to a torsion bar.

PARK LOCK SENSOR

The park lock blocks the transmission when the park position is selected to avoid any movement of the vehicle. The correct (de)activation of the park lock is monitored by a linear touchless sensor.

PEDAL-BY-WIRE

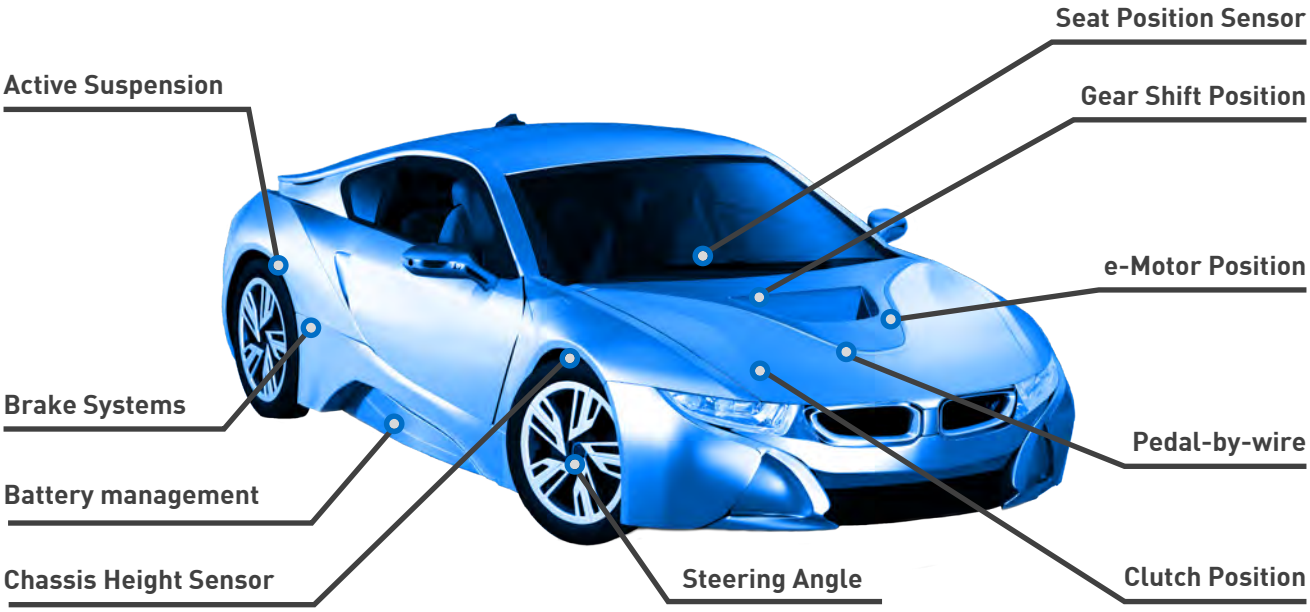
Based on inductive or hall-effect technology the contactless pedal position sensors are easily mounted and virtually maintenance free. Switch options (e.g. for break lights) are programmable.

STEERING ANGLE POSITION

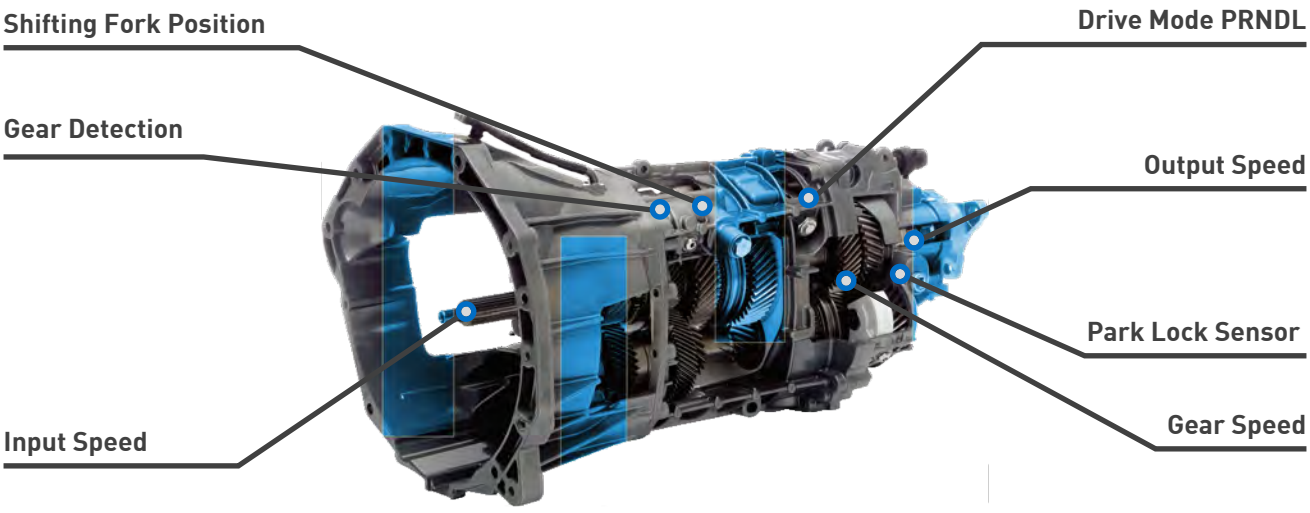
Steer-by-wire systems replace the mechanical connection between steering wheel and chassis. Our multi-turn position sensors enable precise steering, are robust to the environmental conditions and measure the movement of the steering shaft directly at the source.

Sensor Applications

Vehicle Systems



Transmission Systems



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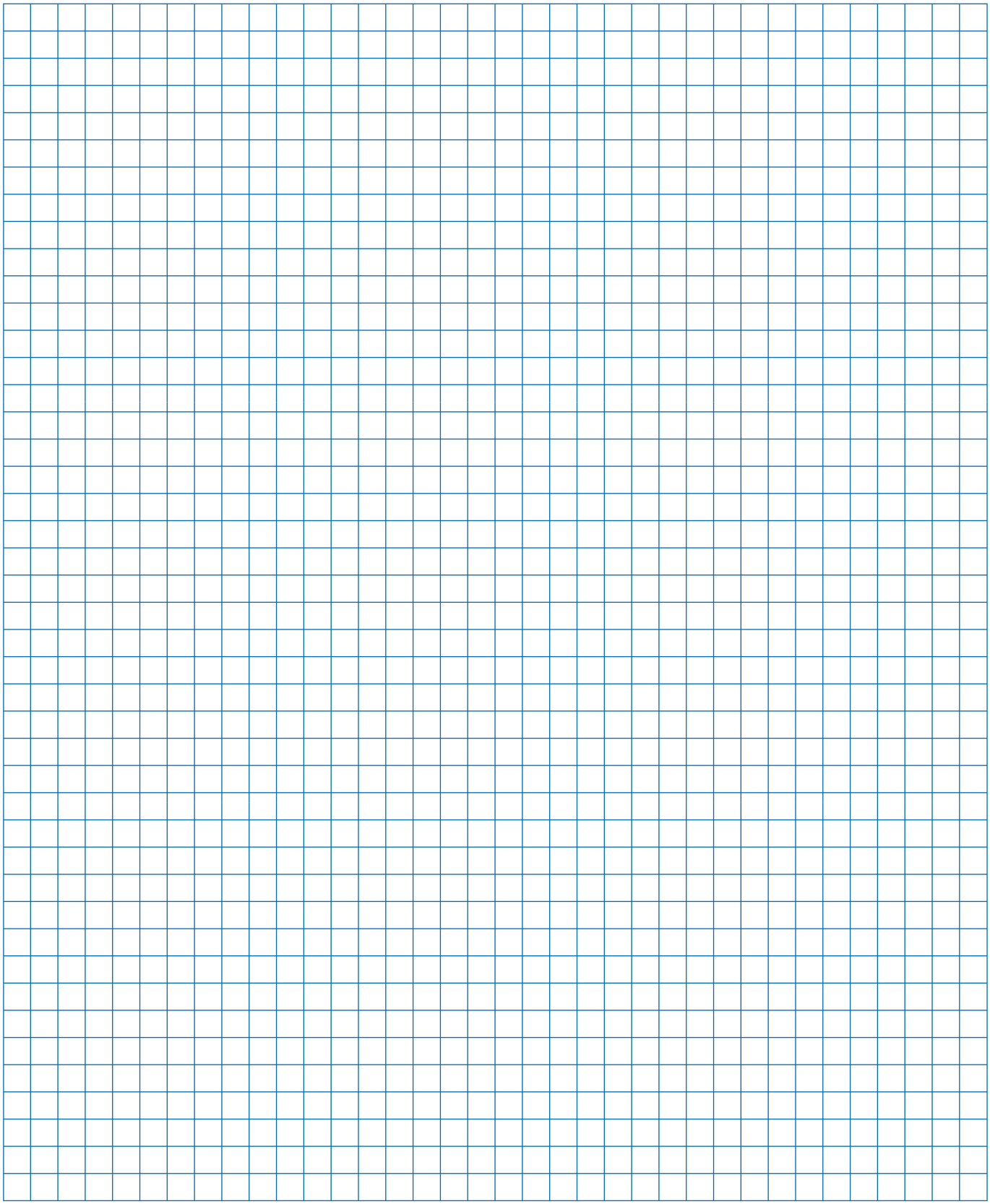

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