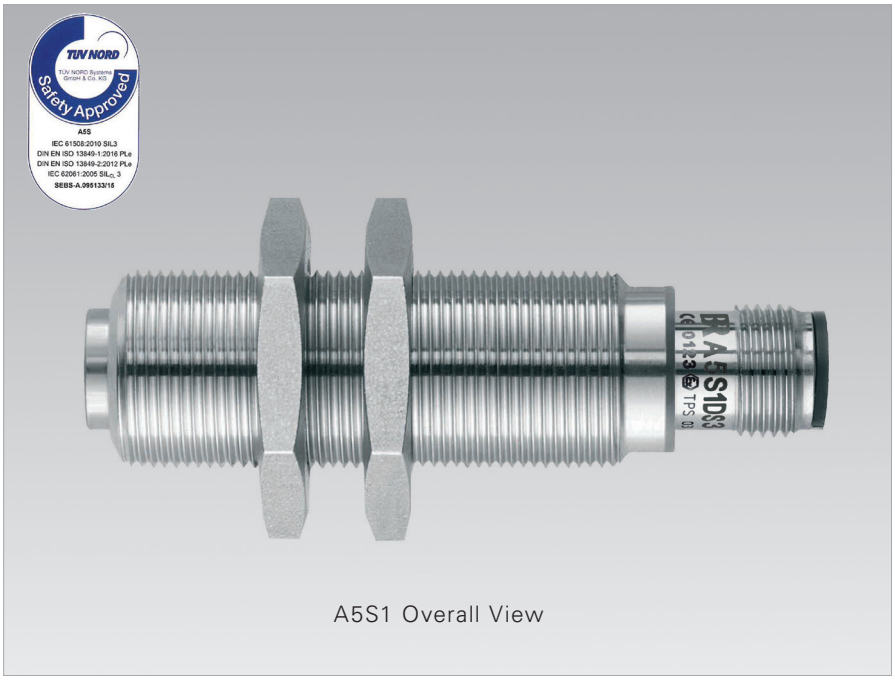
Differential-Hall-Effect based Sensors Ex nA for Detection of Speed in Hazardous Areas Zone 2

Series A5S1DD0...-n / A5S1DS0...-n



A5S1 Overall View

KEY FEATURES

- SIL3/IEC 61508:2010 certified by TÜV
- Detection of rotational speed in hazardous areas zone 2
- Speed range from 0 Hz to 25 kHz
- Air gap to the gear/pole wheel up to 2.5 mm (depending on the profile size)
- Temperature range -40…+125 °C (-40…+255 °F)
- Differential principle diminishes the influence of external magnetic stray fields and of machine vibration
- Sealed stainless steel enclosure > 200 bar pressure to the sensor tip
- Available for connection via tight plug, or with firmly attached Teflon® cable
- Powerful square wave output signal equally high over the entire speed range
- Sensor short circuit proof and protected versus polarity error
- Accepting fine and coarse profiles, as gear wheels, slots, cams, holes in any ferrous material

BENEFITS

- Contact-free with a large air gap, so the potential for damage is eliminated
- Wear-free due to its unique design principle
- Maintenance-free during lifetime, therefore minimized TCO
- Unsusceptible versus external magnetic stray fields and machine vibration
- Operates down to zero speed
- Can not be damaged by faulty wiring
- Almost every wheel profile can be used
- A5S1-n Sensors do not influence each other, no mounting distance in between is required

A5S1-n sensors – the best choice for demanding applications

The BRAUN Speed Sensors Series A5S are TÜV certified for SIL3 acc. IEC 61508:2010 and therefore meet the high SIL3 standards.

The correct choice of sensor is always a prerequisite to achieving a successful solution. Therefore BRAUN A5S1-n sensors base on the proven Differential-Hall-Effect principle. Their low end of 0 Hz allows monitoring the machine down to zero speed. In addition, they are contact-free, wear-free, maintenance-free, and unsusceptible versus external magnetic stray fields and machine vibration. These characteristics make the series of A5S1-n sensors especially suited for all applications where high accuracy and reliability are at a premium. In contrast, other sensors like magnet-inductive or static Hall sensors do not meet these demands.

Each sensor in the series is available in various lengths and diameters and comes with a choice of connections. However, functionally all sensors have the same characteristics. The stainless steel sensor housing is sealed at the front and pressure-resistant (> 200 bars). A flat shaft is available or with a screw-in thread M12x1, M14x1, M14x1,5, M16x1, M16x1,5, M18x1, M18x1,5, M22x1, 5/8-18UNF-2A. Customized dimensions and thread specifications are possible.

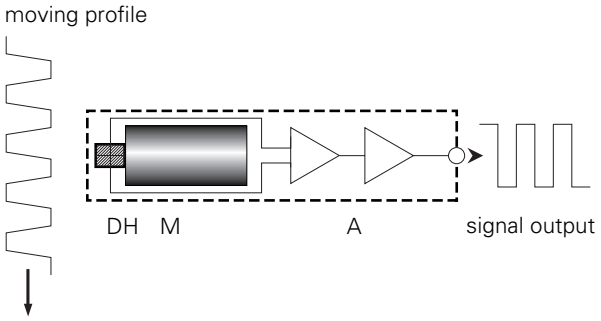
To meet the specific requirements of hazardous areas (zone 2) we provide a non-sparking (non-incendive) variation of specialized types certified for ATEX, UKEX, IECEx, and other international standards such as UL/CSA and EAC (the Eurasian Customs Union with Russia, Kazakhstan, and Belarus).

Sensors for Detection of Speed (one speed signal output)

Ex nA for Hazardous Areas (Zone 2 location)
Detection of Speed within hazardous areas zone 2.
These sensors are non-incendive (non-sparking).

Corresponding cables **L3A...** (PVC)
L3T... (Teflon®)

Principle of Operation



The Differential-Hall-Effect Principle

The Hall effect (named after its discoverer) utilizes a magnetic field that generates a voltage within a hall element.
Its level is independent of its rate of change (i.e. the speed of motion) – unlike the induction effect of magnetic pick-up sensors, which rely on the rate and therefore are weak at low speed. The A5S… sensors include the necessary magnet (M) and the dual hall element (DH). With the profile passing by, the magnetic field varies, thereby creating the signal voltage within the hall element. Here it is essential to keep in mind that the signal does not fade at low speed.

The principle engages a dual hall element and the signal amplifier (A) uses only the difference between both.
It is then amplified to provide the power square wave output.

Its Advantages
By its nature, this differential principle compensates wheel vibrations, and it diminishes the influence of external magnetic stray field. Both are essential aspects for a reliable signal. And it operates down to zero speed.

Hazardous Area (Ex)	Signal Frequency	Signal Output
0 = No 1 = Yes	DD = 0 Hz...25 kHz DS = 0 Hz...12 kHz	0 = 1x Frequency 3 = 1x Frequency / 1x Direction 4 = 2x Frequency, phase-shifted
A5S 0...	A5S0 DD...	A5S0DD 0...
		A5S0DD 3...
		A5S0DD 4...
	A5S0 DS...	A5S0DS 0...
		A5S0DS 3...
		A5S0DS 4...
Ex ia (intrinsically safe)		
requires Isolating Barrier D461 A5S 1...	A5S1 DD...	A5S1DD 0...
		A5S1DD 3...
		A5S1DD 4...
	A5S1 DS...	A5S1DS 0...
		A5S1DS 3...
		A5S1DS 4...
Ex nA (non-incendive)		
A5S 1...-n	**A5S1** DD...-n	**A5S1DD 0...-n**
		A5S1DD 3...-n
		A5S1DD 4...-n
	A5S1 DS...-n	**A5S1DS 0...-n**
		A5S1DS 3...-n
		A5S1DS 4...-n

Application Notes and Connection Types

Application Notes
BRAUN A5S1-n speed sensors base on the proven Differential-Hall-Effect principle and are the best choice for demanding applications. Their low end of 0 Hz allows monitoring the machine down to zero speed. In addition, they are contact-free, wear-free, maintenance-free, and unsusceptible versus external magnetic stray fields and machine vibration. These characteristics make the series of A5S1-n sensors especially suited to all applications where high accuracy and reliability are at a premium.
Each series includes various dimensions and connection types, but all with the same functional characteristics.
For details and ordering codes see the last page.

Connection Types
All A5S1-n sensors are available with a hardwired Teflon® cable attached, alternatively with a socket accepting plug-in connectors with PVC or Teflon® cable. A plug-in connector is the easier way to handle a long cable. Cables in PVC (up to 85 °C) with plastic connectors or in high temperature (up to 125 °C) Teflon® quality with metal connectors can be provided. With a straight or angular plug in a metallic enclosure, all tight to IP 67. Alternatively, the connectors only.
For duty under liquids, however, or for narrow space applications, the firm Teflon® cable is the better choice.

Wheel Requirements and Air Gap

Installation, profile size, and air gap to the wheel
Flush mounting in any material possible. The allowed air gap (clearance) to the wheel depends on its length: see table below. No mounting distance between A5S sensors is required.

Wheel Material
Any standard steel will be accepted, excluding stainless steel or any other non-magnetic material.

Wheel Profile
A standard gear wheel is frequently used, as it is easy to get and to place on the shaft. A split gear wheel must have its division at the bottom between the teeth.
Slots milled into a steel shaft or other rotor also result in a solid and well-defined signal. However, care should be taken to have a smooth surface and edges. Edges may be sharp but must be deburred. The sensor with its sharp resolution might otherwise respond to scratches or other irregularities.
Care, however, must be given to a regular position of slots, holes, or bolts at the rotor. Irregular distances result in fluctuating speed measurements. Hexagonal screw heads may result in an irregular pulse division. A slot or such like in the screw head may cause multiple pulses.

Repeatability of the profile marks
It is an essential factor, specifically with high accuracy and high-reliability applications. Though covered up by the averaging automatics in our evaluating units, an irregularity may cause a fluctuation in the measurement.

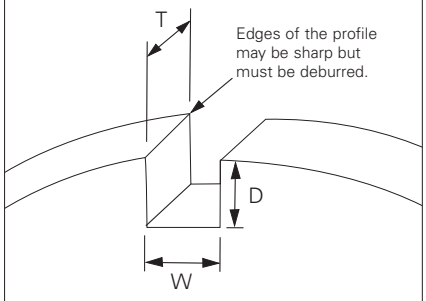
Profile Size of a Pole Wheel
It determines the allowable air gap (clearance) between the sensor tip and the wheel. Defined by the slot or cam width (whichever is the shorter).

A larger profile is accepted but does not increase the allowable gap any further. Minimum thickness (T) of wheel = 6 mm (plus a possible lateral shift). Speed does not limit the size values.

Number of poles or teeth
Any number of poles is possible. More than 60 poles do not improve the response time to a speed variation.

Details of a Pole Wheel

D = minimum 3 mm
T = minimum 6 mm
W = minimum 3 mm



Gear Wheel* Module	Diametral Pitch approx.	Pole Wheel* Width of slot or cam	A5S1DS0-n A5S1DD0-n Allowable air gap	A5S1DS3-n / DS4-n A5S1DD3-n / DD4-n Allowable air gap
Module 1	25.4 inch	--	0.5 - 0.8 mm	--
Module 1.5	16.9 inch	--	0.5 - 1.0 mm	--
Module 2	12.7 inch	--	0.8 - 1.5 mm	0.3 - 0.8 mm
Module 3	8.5 inch	3 mm	0.8 - 2.0 mm	0.3 - 1.2 mm
Module 4	6.4 inch	4 mm	1.0 - 2.5 mm	0.5 - 1.5 mm

* minimum thickness (T) of wheel = 6 mm

Figure includes special versions

Sensor Positioning and Signal Features

Sensor Positioning
We recommend a radial orientation of the sensor to the wheel circumference. Its position in parallel to the rotational axis, though possible, may involve problems caused by a lateral shift of the wheel. All specifications refer to the recommended radial position.
The differential principle of the A5S1-n sensors, which diminishes the influence of other magnetic stray fields and machine vibrations, necessitates a correct positioning in reference to the profile of the wheel. Marking planes at the sensor rear end assist with this, as explained in its manual. A deviation of up to ±20 degrees will be tolerated.

Sensors, detecting the sense of rotation, reverse their forward/reverse signal by a 180° turn of the sensor. A marking at the sensor end indicates the required position for a given sense of the direction signal.

The allowable air gap (clearance) between sensor tip and profile depends on the profile size (see table on the left).

Signal Output
A5S1-n sensors provide a square wave pulse train as their speed signal. The incorporated output amplifier is strong enough to pull up or sink a load as heavy as 25 mA (push-pull characteristics). With any higher load, specifically if short-circuited (to zero or to supply lead), the incorporated limiter responds and cuts off before the sensor can sustain damage.
Thus, every A5S1-n sensor can transmit over a distance up to 500 m (1500 ft) up to its high-frequency end. For details, see Signal Transmission.

If more is required, a unit D461 may be installed after 500 m transmission or in front of an even heavier load to feed it adequately.

Signal Frequency
With a regularly divided wheel profile (and a correspondingly regular output pulse train), the signal frequency regarding Hz equals the wheel speed (regarding RPM) multiplied by the number of poles or teeth divided by 60.

Signal Transmission
The characteristic of the transmission line is a significant factor. The data given previously refer to a 3 lead screened cable with a lead cross-section of 0.5 mm^2 with R < 36Ω / km and C < 150 pF/m. The transmission cables supplied by BRAUN are in conformity with this.

Important: Each sensor connection must be individually screened.

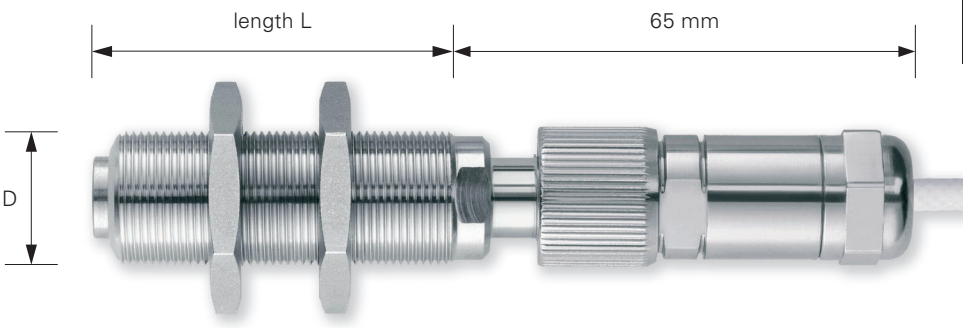
Keep the signal cable clear of interfering sources and do not run it parallel to power supply cables.

Shielding and grounding
Always use an uninterrupted shield against interferences between the sensor and signal evaluation. Connect the shield to a screen bar at the receiving end. At transmission distance exceeding 25 m, grounding at both ends may be helpful but may lead to equalizing current due to different ground potentials.

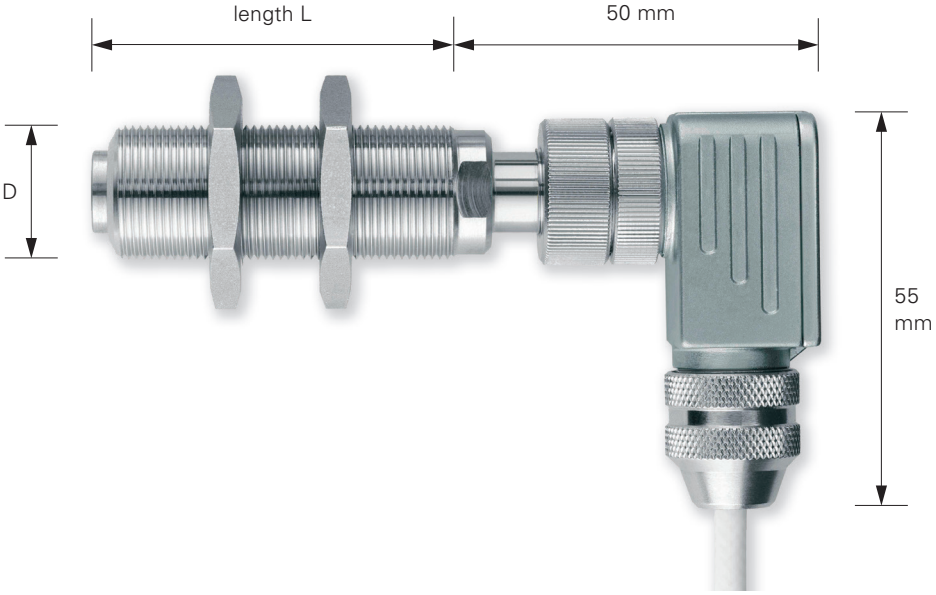
Note: The sensor body and the sensor screen are isolated from each other. Do not connect the screen to the connector housing.

Standard Design Versions

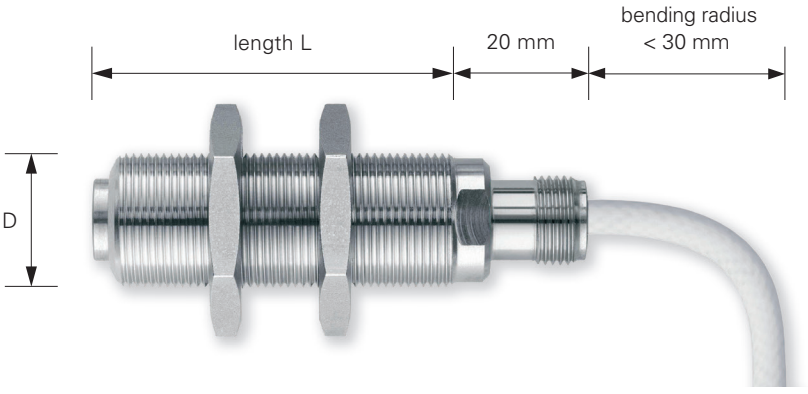
Plug-in version shown with straight metal connector



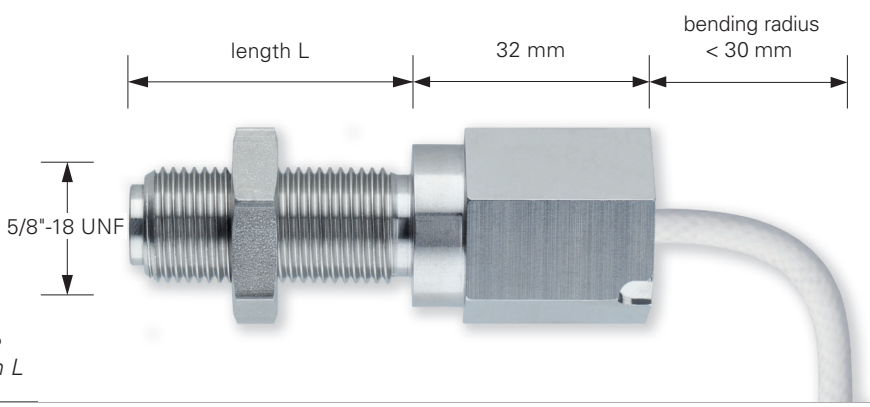
Plug-in version shown with angled metal connector



Version with fixed Teflon® cable attached



NPT-version with fixed Teflon® cable, only for 5/8"-18 (inch) thread



See Ordering Key for available thread diameters D and length L

Specifications of A5S1DD0...-n / A5S1DS0...-n

Conformity to Standards

EU-Directive(s)		Standard(s)
2014/30/EU	(EMC Directive)	EN 61326-1, EN IEC 61326-3-2
2014/35/EU	(Low Voltage Directive)	EN 61010-1
2011/65/EU	(RoHS Directive)	EN IEC 63000
2014/34/EU	(ATEX Product Directive)	EN 60079-0, EN 60079-15

UKEX Standards: BS EN 60079-0, BS EN 60079-15
US Standards: National Electrical Code (NEC) dated 2014
UL 60079-0, UL 60079-15, UL 913 - 8th edition, UL 61010-1, edition 3
Canadian Standards: Canadian Electrical Code (CEC) dated 2012
CSA C22.2 Nos. 60079-0, 60079-15, 157-92, 213-1987, 61010-1-12, edition 3
SIL3 acc. IEC 61508:2010, EN ISO 13849:2008

Power Supply

For Zone 2 supply voltage +6 V…+30 V DC / min. 40 mA*, max. 120 mA*,
*depending on temperature class and connection type (see manual for details).
The sensor is protected versus polarity error.

Signal Output

Square wave with constant high and low level over the entire speed range.
Push-pull amplifier output. Max. load 20 mA.
Output is short circuit proof and protected versus polarity error.

Signal Frequency

0 Hz…12 kHz (A5S1DS0...-n), resp.
0 Hz…25 kHz (A5S1DD0...-n)
Its low end of 0 Hz allows to monitor the machine down to zero speed.

Response Time

< 20 microseconds

Signal Transmission

Screened cable with a lead cross section of 0.5 mm^2 with R < 36Ω / km and C < 150 pF/m.
Connect sensors A5S1… to the high level input of BRAUN units (response level of >7 / <4 V).

Protection Class for Hazardous Area

ATEX, UKEX, IECEx, EAC certified for Ex nA IIC T4/T6 Gc (non-incendive)
QPS / QPSus certified for Class I, Div 2, groups A, B, C, D according to UL and CSA standards, temperature code T4/T6 (non-incendive)

Protection Grade

IP 67, sealed stainless steel enclosure (1.4305)

Connection Type

Plug-in connection (straight or angular) or fixed Teflon® cable with open ends

Ambient Temperature for Temperature Class T4 resp. T6

Class	Connection Type	Temperature Range
T4	with plug-in socket	-40…+85 °C (-40…+185 °F), 125 °C at the sensor tip
T4	with fixed Teflon® cable	-40..+125 °C (-40…+255 °F), 125 °C at the sensor tip
T6	for all types	-5…+60 °C (23…+140 °F), 80 °C at the sensor tip

Dimensions

Depends on length and shaft diameter of the sensor

Weight

Depends on length and shaft diameter of the sensor (plus fixed cable)

Optional Accessories (cable with connector)

L3A22BO-xm: PVC sensor connecting cable (3 leads) with straight plastic connector
L3A23BO-xm: PVC sensor connecting cable (3 leads) with angular plastic connector
L3T24MO-xm: Teflon® sensor connecting cable (3 leads) with straight metal connector
L3T25MO-xm: Teflon® sensor connecting cable (3 leads) with angular metal connector
x = cable length in m (Standard x = 5, 10, 15 or 20)

Optional Accessories (connector only)

Bi4F/01: Straight connector (plastic housing)
Bi4F/02: Angular connector (plastic housing)
Bi4F/05: Straight connector (metal housing)
Bi4F/04: Angular connector (metal housing)

Ordering Key A5S1...-n

A5S1 b c d e f g -xm -n

Hazardous Area (Ex)
1 = Ex version (Ex nA)

Signal Frequency
b = **DD** : 0 Hz...25 kHz
b = **DS** : 0 Hz...12 kHz

Signal Output
c = **0** : 1x Frequency
c = **3** : 1x Frequency / 1x Direction*
c = **4** : 2x Frequency, phase-shifted*
***minimum nominal thread length 74 mm**

Unit of Shaft Diameter
d = **M** : Metric
d = **N** : Inch and 1/2"-NPT at rear end of sensor (only in conjunction with thread 5/8"-18 (inch) and fixed Teflon® cable)
d = **U** : Inch

Thread of Shaft Diameter
Standard thread:
e = **1210** : M12x1 (metric)
e = **1410** : M14x1 (metric)
e = **1415** : M14x1,5 (metric)
e = **1610** : M16x1 (metric)
e = **1615** : M16x1,5 (metric)
e = **1810** : M18x1 (metric)
e = **1815** : M18x1,5 (metric)
e = **2210** : M22x1 (metric)
e = **3416** : 3/4"-16 (inch)
e = **3420** : 3/4"-20 (inch)
e = **5818** : 5/8"-18 (inch)
other threads or flat shafts on request

Protection Type Ex nA
Amendment **-n** only for version Ex nA

Length of fixed Teflon® cable in m*
Standard lengths for cable:
x = **2**, **5**, **8**, **10**, **15**, **20**
*(omit for versions with screw-plug-in connection)

Nominal Thread Length in mm
Standard lengths for thread:
g = **50**, **80**, **120** : M12x1 (1210)
g = **50**, **90**, **154** : M14x1 (1410)
g = **50**, **90**, **154** : M14x1,5 (1415)
g = **48** : M16x1 (1610)
g = **80**, **154** : M16x1,5 (1615)
g = **48**, **94** : M18x1 (1810)
g = **50**, **74**, **94** : M18x1,5 (1815)
g = **48**, **94** : M22x1 (2210)
g = **90** : 3/4"-16 (3416)
g = **90** : 3/4"-20 (3420)
g = **48**, **100**, **165** : 5/8"-18 (5818)
other lengths on request

Connection Type
f = **B** : screw-plug-in connection
f = **T** : fixed Teflon® cable

Examples:
A5S1DD0M1415B90-n : Ex nA version, max. 25 kHz, 1x Frequency, metric shaft with thread M14x1,5 and 90mm nominal thread length, screw-plug-in connection

A5S1DS0U5818T100-5m-n: Ex nA version, max. 12 kHz, 1x Frequency, inch shaft with thread 5/8"-18 and 100mm nominal thread length, fixed Teflon® cable with 5m length

BRAUN – Speed Monitoring and Protection Systems for Rotating Equipment

BRAUN Industrial Electronics develops, produces, and supplies "Rotating Equipment" protection systems for industrial applications worldwide, focusing on overspeed protection. These systems comply with the highest standards of safety and availability.

As a globally leading technology provider with over 60 years of experience, BRAUN has been continually meeting and mastering the challenges associated with protecting the facilities of companies within the power generation, oil, gas, and chemical industries. Our protection systems are installed in more than 100 countries worldwide, and our customers use them in safety-critical applications with "Rotating Equipment".

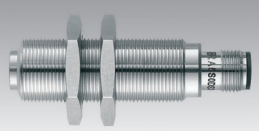
For our OEM customers, BRAUN is both a solution-oriented systems provider and a reliable system partner.

Our solutions comprise a variety of products for the detection and monitoring of speed and related parameters.

Always matching the requirement. Always the perfect solution for safety and availability.

Protection Systems Triple Channel

Protection Systems Single Channel



Speed Sensors

Tachometers

BRAUN
Protecting Your Rotating Equipment

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