



FACTORY AUTOMATION

OVERVIEW

ROTARY ENCODERS

Edition 2002



ACCESSORIES

Mounting aids

- Eccentric clamping elements
- Mounting brackets
- Mounting bell



Coupling

- Spring steel coupling
- Spring disc coupling
- Bellows coupling
- Precision coupling
- Helical coupling



Measuring wheels

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- Circumference 500 mm
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- Knurled plastic



Mating connectors

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- Binder



Cable lines

- Measuring range 2,000 mm
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- Measuring range 15,000 mm



Evaluation

- Counters



ENCODERS

A detailed view of an industrial robotic arm, likely a KUKA model, showing its orange and grey joints and various mechanical components. The background is a blurred industrial setting with other machinery and safety railings.

Encoders are used in automation technology as sensors for the detection of angles, position, speed and acceleration. Even linear movements can be detected with the aid of spindles, racks or measurement wheels. They convert the actual value of a mechanical quantity for counters, tachometers, programmable controls and industrial PCs into a calculable electronic signal.

Incremental Encoders

Incremental encoders deliver a specific number of signals per shaft rotation. The measurement of the cycle duration or counting the pulses per a specific time interval indicates the speed of a motion. If the pulses are added according to a reference point, then the count represents a measure for the marked angle or the distance covered. Dual-channel encoders – with output signals phased 90° apart – give coupling electronics the ability to detect the direction of the shaft rotation and thereby enable bi-directional positioning. In addition, three-channel incremental encoders produce a so called zero pulse once per rotation.

Incremental Encoders






	Series 10	Series 20	Series 21
Number of pulses	≤ 5,000	≤ 2,500	≤ 1,500
Design [mm]	ø58	55 x 55	ø40
Flange type	Clamping flange, Servo flange, Square flange	Square flange	Threaded flange
Spigot	ø36, ø50	–	–
Solid shaft [mm]	ø6 x 10, ø10 x 20	ø6 x 20	ø6 x 10
Hollow shaft [mm]	–	–	–
Recessed hollow shaft [mm]	–	–	–
Max. rotational speed [min ⁻¹]	10,000	3,000	12,000
Max. shaft load, axial [N]	60	10	10
Max. shaft load, radial [N]	80	10	16
Operating voltage [V DC]	5 or 10 ... 30	5 or 10 ... 30	4.75 ... 5.5 10 ... 30
Output type	push-pull, RS 422	push-pull, RS 422	push-pull, RS 422
Output frequency [kHz]	100	160	200
Signal output	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$	A, B, 0	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$
Protection class	IP65	IP40	IP65

Incremental Encoders






	Series 30	Series 60	Series 81
Number of pulses	≤ 5,000	≤ 1,250	≤ 500
Design [mm]	ø90	74 x 74	40 x 50
Flange type	Servo flange	Square flange	Rectangular flange
Spigot	ø40	–	–
Solid shaft [mm]	ø12 x 25	ø12 x 25	–
Hollow Shaft [mm]	–	–	ø6
Recessed hollow shaft [mm]	–	–	–
Max. rotational speed [min ⁻¹]	6,000	6,000	3,000
Max. shaft load, axial [N]	60	40	–
Max. shaft load, radial [N]	80	60	–
Operating voltage [V DC]	5 or 10 ... 30	10 ... 30	10 ... 30
Output type	push-pull, RS 422	push-pull	push-pull
Output frequency [kHz]	100	50	20
Signal output	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$	A, B, 0	A, B, 0
Protection class	IP65	IP50	IP52

Incremental Encoders

			
	RHI 58	RSI 58	RVI 58
Number of pulses	≤ 5,000	≤ 5,000	≤ 10,000
Design [mm]	ø58	ø58	ø58
Flange type	–	–	Clamping flange, Servo flange
Spigot	–	–	ø36, ø50
Solid shaft [mm]	–	–	ø6 x 10, ø10 x 20
Hollow shaft [mm]	ø10, ø12	–	–
Recessed hollow shaft [mm]	–	ø10 x 20, ø12 x 20	–
Max. rotational speed [min ⁻¹]	6,000	12,000	12,000
Max. shaft load, axial [N]	–	–	40
Max. shaft load, radial [N]	–	–	60
Operating voltage [V DC]	5 or 10 ... 30	5 or 10 ... 30	5 or 10 ... 30
Output type	push-pull, RS 422	push-pull, RS 422	push-pull, RS 422
Output frequency [kHz]	200	200	200
Signal output	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$
Protection class	IP54	IP54	IP65

Incremental Encoders

			
	Series 85	TRD-GK	TRD-J
Number of pulses	≤ 1,500	≤ 5,000	≤ 2,500
Design [mm]	ø75	ø78	ø50
Flange type	–	Servo flange	Clamping flange
Spigot	–	ø42	ø30
Solid shaft [mm]	–	ø10 x 23	ø8 x 15
Hollow shaft [mm]	ø6, ø8, ø10, ø12	–	–
Recessed hollow shaft [mm]	–	–	–
Max. rotational speed [min ⁻¹]	6,000	6,000	10,000
Max. shaft load, axial [N]	–	50	30
Max. shaft load, radial [N]	–	100	50
Operating voltage [V DC]	5 or 10 ... 30	10 ... 30	5 or 4.75 ... 30
Output type	push-pull, RS 422	push-pull	push-pull, RS 422
Output frequency [kHz]	35	100	160
Signal output	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$	A, B, 0	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$
Protection class	IP54	IP65	IP50

Absolute Encoders

Absolute encoders produce a specifically coded value for each shaft position.

Absolute encoders take over the task of counting from coupling devices, especially with regard to positioning functions, so that extensive and costly input modules can be eliminated. In addition, the need to reference the encoder is eliminated when activating the machine or after the loss of supply voltage, since the current position information is immediately available. Parallel absolute encoders transfer position data across multiple leads to control interfaces in parallel.

With serial absolute encoders, the output data is transferred instead, across standard interfaces in accordance with standardized protocols. Today, an increasing number of field bus systems are used where previously only point to point connections with serial interfaces were used.

Function

Singleturn

In the singleturn encoder, one turn of the encoder (360°) is divided into a maximum of 8192 (13 bit) measurements. After each full turn, the encoding returns to its start value. The encoder controller does not recognize how many turns have been made.

Multiturn

In addition to the coded disc, found also in singleturn encoders, multiturn encoders have an integrated gear. This gear is subordinated and encoded in such a way that up to 4,096 turns (12 bit) can be detected. The total resolution therefore, is 25 bit consisting of 13 bit (singleturn resolution) and 12 bit (turns). Based on the resulting high number of measurements (33,554,432) this type of encoder can be used for very lengthy applications

Interfaces

The Pepperl+Fuchs encoder portfolio includes the most varied range of current interfaces for absolute encoders to be found on the market:

SSI-Interface

The Synchronous Serial Interface (SSI) has been specially developed for the transfer of the output data from an absolute encoder to a control device. The control device sends a bundle of timer pulses and the absolute encoder responds with the position value

Parallel interface

The key to this interface is in the rapid transfer of data. The position data is read out directly from the Gray-coded physical measurement.

AS-Interface

In modern machines and systems, binary sensors are more and more connected via the AS-Interface. In order to satisfy real time requirements, a multi-slave solution is implemented into the AS-Interface encoder.

CAN

Pepperl+Fuchs offers two encoders in accordance with the CAN standard:

- CAN encoder to CAN 2.0
- CAN open encoder to DSP406 (Class 1 and Class 2)

DeviceNet

The product range also includes DeviceNet encoders. The integrated interface supports all DeviceNet functions.

InterBus

This absolute encoder satisfies all the requirements of the InterBus profile as specified by Encom, the encoder user organisation. The profile satisfies the European InterBus standard EN 50254. The encoder can be connected by means of either copper cable or fibre optics.

PROFIBUS

The absolute encoders of this series satisfy the PROFIBUS profile for encoders, order No. 3.062. Operation is supported in accordance with Class 1 and Class 2.

Absolute Encoders











	ASS 58	ASM 58	ASM 58 param.	AVS 58	AVM 58	AVM 58 param.
Resolution Singleturn	4,096	8,192		4,096	8,192	
Resolution Multiturn	1	4,096		1	4,096	
Design [mm]	ø58			ø58		
Flange type	-			Clamping flange, Servo flange		
Spigot [mm]	-			ø36, ø50		
Solid shaft [mm]	-			ø6 x 10, ø10 x 20		
Hollow shaft [mm]	-			-		
Recessed hollow shaft [mm]	ø10 x 20, ø12 x 20			-		
Max. rotational speed [min ⁻¹]	6,000			6,000		
Max. shaft load, axial [N]	-			40		
Max. shaft load, radial [N]	-			60		
Operating voltage [V DC]	18 ... 30			18 ... 30		
Interface	SSI		SSI, Param. interface	SSI		SSI, Param. interface
Output stage	RS 422		RS 422, RS 232	RS 422		RS 422, RS 232
Counting direction	yes		assignable	yes		assignable
Latch	-		assignable	-		assignable
TRISTATE	-		assignable	-		assignable
PRESET 1	yes		assignable	yes		assignable
PRESET 2	-		assignable	-		assignable
Protection class	IP65			IP65		

Absolute Encoders









	BSS 58	BSM 58	BVS 58	BVM 58	CVE 10	CVM 10	CVS 58	CVM 58
Resolution Singleturn	8,192	8,192	8,192	8,192	8,192	8,192	8,192	8,192
Resolution Multiturn	1	4,096	1	4,096	1	4,096	1	4,096
Design [mm]	ø58		ø58		ø58		ø58	
Flange type	-		Clamping flange, Servo flange		Clamping flange, Servo flange		Clamping flange, Servo flange	
Spigot [mm]	-		ø36, ø50		ø36, ø50		ø36, ø50	
Solid shaft [mm]	-		ø6 x 10, ø10 x 20		ø6 x 10, ø10 x 20		ø6 x 10, ø10 x 20	
Hollow shaft [mm]	-		-		-		-	
Recessed hollow shaft [mm]	ø10 x 20, ø12 x 20		-		-		-	
Max. rotational speed [min ⁻¹]	10,000	6,000	12,000	6,000	6,000		6,000	
Max. shaft load, axial [N]	-		40		40		10	
Max. shaft load, radial [N]	-		60		60		20	
Operating voltage [V DC]	29.5 ... 31.6		29.5 ... 31.6		18 ... 30		10 ... 30	
Interface	AS-Interface		AS-Interface		CAN		CANopen	
Output stage	-		-		CAN 2.0 Part B, SAE81C91		DSP 406, Class 1 and 2	
Counting direction	yes		yes		-		yes	
Latch	yes		yes		-		-	
TRISTATE	-		-		-		-	
PRESET 1	yes		yes		-		yes	
PRESET 2	yes		yes		-		yes	
Protection class	IP65		IP65		IP65		IP65	

Absolute Encoders

								
	DVS 58	DVM 58	FHS 58	FSS 58	FVS 58	IVE 10	IVM 10	IVM 10 SUP1
Resolution Singleturn	8,192	8,192		8,192		8,192		8,192
Resolution Multiturn	1	4,096		1		1		4,096
Design [mm]	ø58		ø58			ø58		ø100
Flange type	Clamping flange, Servo flange		–		Clamping fl. Servo fl..	Clamping flange, Servo flange		Clamping flange
Spigot [mm]	ø36, ø50		–		ø36, ø50	ø36, ø50		ø36
Solid shaft [mm]	ø6 x 10, ø10 x 20		–		ø6 x 10, ø10 x 20	ø6 x 10, ø10 x 20		ø10 x 20
Hollow shaft [mm]	–		ø12	–	–	–		–
Recessed hollow shaft [mm]	–		–	ø12 x 20	–	–		–
Max. rotational speed [min ⁻¹]	6,000		6,000	10,000	12,000	6,000		
Max. shaft load, axial [N]	10		–		40	10		
Max. shaft load, radial [N]	20		–		60	20		
Operating voltage [V DC]	10 ... 30			10 ... 30		10 ... 30		
Interface	DeviceNet		parallel			InterBus		
Output stage	–		push-pull			RS 485		
Counting direction	yes		yes			yes		
Latch	–		yes			–		
TRISTATE	–		yes			–		
PRESET 1	yes		–			yes		
PRESET 2	yes		–			–		
Protection class	IP65		IP65			IP65		

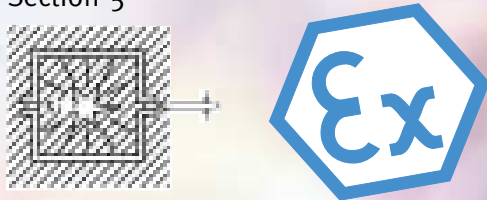
Absolute Encoders

						
	PSS 58	PSM 58	PVS 58	PVM 58	SCS 10	SCM 30
Resolution Singleturn	8,192	8,192	8,192	8,192	8,192	4,096
Resolution Multiturn	1	4,096	1	4,096	1	4,096
Design [mm]	ø58		ø58		ø58	ø90
Flange type	–		Clamping flange Servo flange		Clamping flange, Servo flange	Servo flange
Spigot [mm]	–		ø36, ø50		ø36, ø50	ø40
Solid shaft [mm]	–		ø6 x 10, ø10 x 20		ø6 x 10, ø10 x 20	ø10 x 25
Hollow shaft [mm]	–		–		–	–
Recessed hollow shaft [mm]	ø10 x 20, ø12 x 20		–		–	–
Max. rotational speed [min ⁻¹]	10,000	6,000	12,000	6,000	6,000	
Max. shaft load, axial [N]	–		40	40	40	
Max. shaft load, radial [N]	–		60	60	60	
Operating voltage [V DC]	18 ... 30		18 ... 30		18 ... 32	
Interface	PROFIBUS		PROFIBUS		parallel	
Output type	RS 485		RS 485		push-pull	
Counting direction	yes		yes		yes	
Latch	–		–		yes	
TRISTATE	–		–		–	yes
PRESET 1	yes		yes		yes	–
PRESET 2	–		–		–	
Protection class	IP65		IP65		IP 65	

Rotary Encoders for EX-Areas Intrinsically Safe or Flame Proof

Flameproof Enclosure “Ignition Protection”

(EEx d) DIN EN 50016/VDE/0170/0171
Section 5



“The ignition protection method where the components that can ignite a combustible atmosphere, are installed inside a housing which can withstand the pressure of an explosion originating within the housing and which can prevent the propagation of the explosion to the combustible atmosphere surrounding the housing”.

The housings are not constructed to be gas tight, but instead have a flameproof gap which serves to vent explosive pressure. Escaping hot gases are cooled so rapidly that they cannot ignite the combustible atmosphere surrounding the housing.

An ignition is avoided if the minimum ignition temperature and the minimum ignition energy of the surrounding explosive atmosphere is not reached. For this reason, the apparatus employing this ignition protection method are approved for explosion groups

I, IIA, IIB, IIC with varying minimum gap lengths and maximum gap widths (see table 1 and 2 of EN 50018) depending on the type of gap.

An important detail of the ignition protection method EEx d is the flameproof gap which must neither be enlarged (abrasive removal of rust) or decreased (lubricated with grease which contains resin) in size.

When using flameproof enclosure protected apparatus, the installation of the electrical leads is usually performed on the basis of the “Increased Safety” ignition protection method.

Flame Proof Enclosure “Intrinsic Safety”

(EEx i) DIN EN 50020

In using the latest technology and maintaining the standard voltage and current values, binary switching characteristics within sensors is now possible (simultaneous changes in the switch status in the sensor and amplifier). The characteristic values of the voltage and current are kept at such a low level that the NAMUR* proximity sensors can be installed in hazardous areas (“Intrinsic Safety”).

NAMUR* sensors are connected to external switch amplifiers which convert a change in voltage into a binary output signal. Pepperl+Fuchs GmbH offers a wide range of switch amplifiers for Ex and non Ex applications.

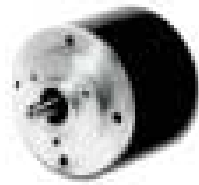
NAMUR* Proximity Sensors, Two-wire

NAMUR* Proximity sensors according to EN 50227 (VDE 0660 section 212) are two-wire sensors.

*NAMUR:
Normenarbeitsgemeinschaft für
Mess- und Regeltechnik der
chemischen Industrie

Ex-Encoders

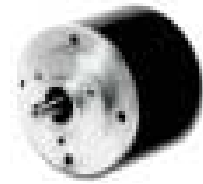
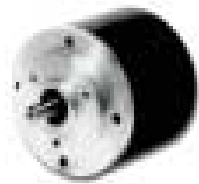
Incremental encoders



		Series 14	RHI 74	TRD-G
Protection class		EEx d IIC T6	EEx d IIC T6	EEx ia IIC T6, EEx ib IIC T6
Number of pulses	[mm]	≤ 5,000	≤ 5,000	≤ 100
Design	[mm]	ø116	ø70	ø78
Flange type		Clamping flange	Servo flange	Servo flange
Spigot	[mm]	ø40	ø60	ø56
Solid shaft	[mm]	ø12 x 25	–	ø10 x 23
Hollow shaft	[mm]	–	ø12	–
Recessed hollow shaft	[mm]	–	–	–
Max. rotational speed	[min ⁻¹]	6,000	6,000	3,000
Max. shaft load, axial	[N]	60	–	50
Max. shaft load, radial	[N]	80	–	100
Operating voltage	[V DC]	5 or 10 ... 30	5 or 10 ... 30	8
Output stage		push-pull, RS 422	push-pull, RS 422	NAMUR
Output frequency	[kHz]	100	200	5
Signal output		A, \bar{A} , B, \bar{B} , 0, $\bar{0}$	A, \bar{A} , B, \bar{B} , 0, $\bar{0}$	A, B
Protection class		IP65	IP64	IP65

Ex-Encoders

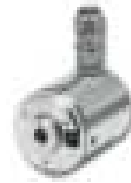
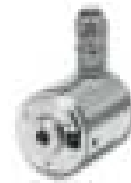
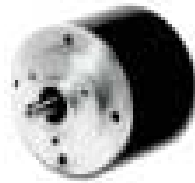
Absolute Encoders



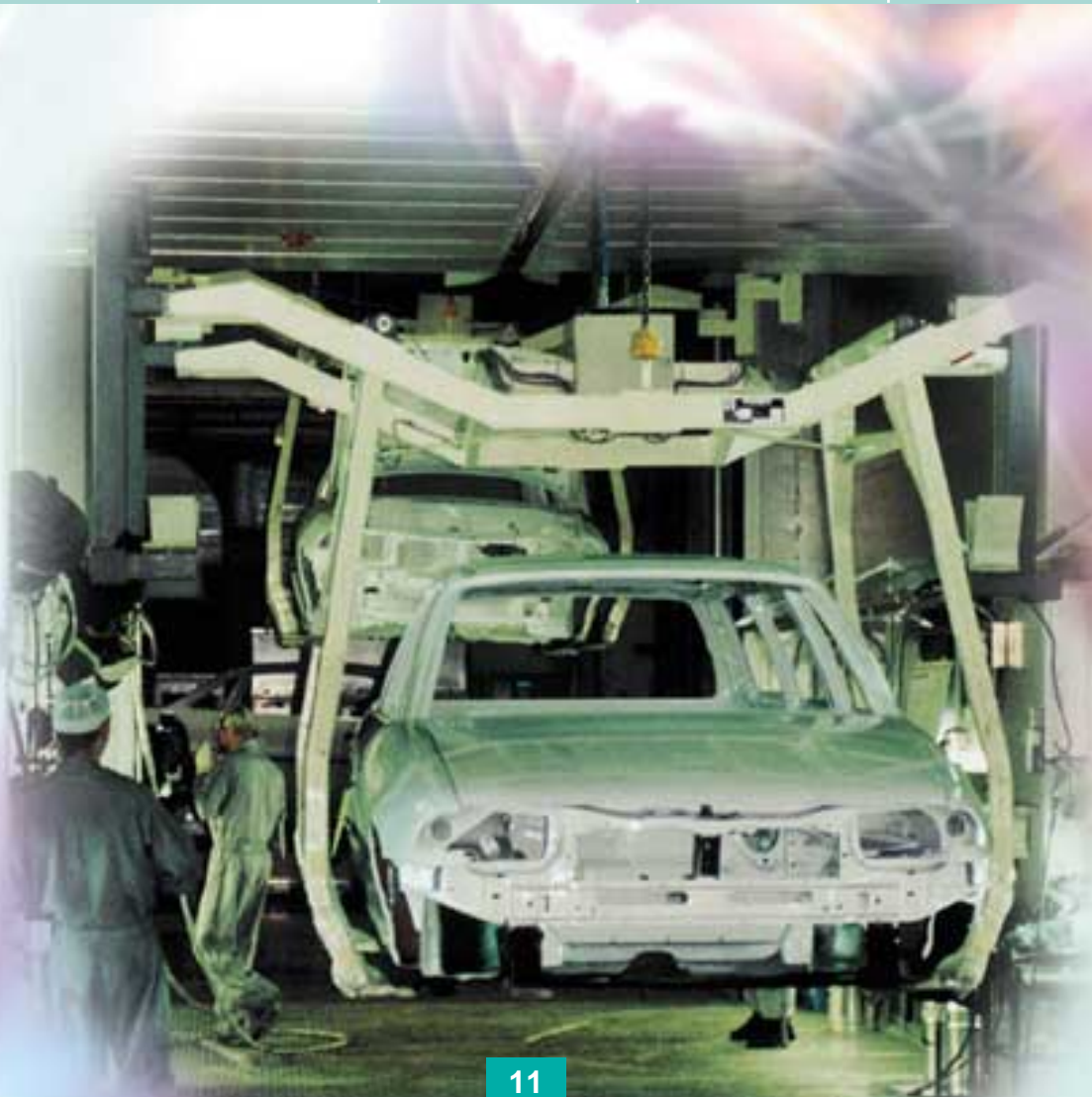
		AVE 14	AVM 14	BVE 14	BVM 14	CVE 14	CVM 14
Protection class		EEx d II C T6		EEx d II C T6		EEx d II C T6	
Resolution Singleturn		4,096	4,096	8,192	8,192	8,192	8,192
Resolution Multiturn		1	4,096	1	4,096	1	4,096
Design	[mm]	ø116		ø116		ø116	
Flange type		Clamping flange		Clamping flange		Clamping flange	
Spigot	[mm]	ø40		ø40		ø40	
Solid shaft	[mm]	ø12 x 25		ø12 x 25		ø12 x 25	
Hollow shaft	[mm]	–		–		–	
Recessed hollow shaft	[mm]	–		–		–	
Max. rotational speed	[min ⁻¹]	6,000		6,000		6,000	
Max. shaft load, axial	[N]	40		40		40	
Max. shaft load, radial	[N]	60		60		60	
Operating voltage	[V DC]	18 ... 30		29.5 ... 31.6		18 ... 30	
Interface		SSI		AS-Interface		CAN	
Output stage		RS 422		–		CAN 2.0 Part B SAE81C91	
Counting direction		yes		yes		–	
TISTATE		–		–		–	
PRESET 1		–		yes		–	
PRESET 2		–		yes		–	
Protection class		IP65		IP65		IP65	

Ex Encoders

Absolute Encoders



	SCS 14	AHS 74	SHS 74
Protection class	EEx d II C T6	EEx d II C T6	EEx d II C T6
Resolution Singleturn	8,192	8,192	8,192
Resolution Multiturn	1	1	1
Design [mm]	ø116	ø70	ø70
Flange type	Clamping flange	Servo flange	Servo flange
Spigot [mm]	ø40	ø60	ø60
Solid shaft [mm]	ø12 x 25	–	–
Hollow shaft [mm]	–	ø12	ø12
Recessed hollow shaft [mm]	–	–	–
Max. rotational speed [min ⁻¹]	6,000	6,000	6,000
Max. shaft load, axial [N]	40	–	–
Max. shaft load, radial [N]	60	–	–
Operating voltage [V DC]	18 ... 30	10 ... 30	10 ... 30
Interface	parallel	SSI	parallel
Output stage	push-pull	RS 422	push-pull
Counting direction	yes	–	yes
Latch	–	–	–
TRISTATE	–	–	–
PRESET 1	–	–	yes
PRESET 2	–	–	–
Protection class	IP65	IP64	IP64



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