

# Displacement Transducers

## Displacement Transducers



**GEFRAN**

Our Know how,  
Your Solution.

# Gefran displacement transducers: reliability, precision, simple and quick installation

Gefran has designed and produced displacement sensors for over 15 years. Over a million installed transducers and in-depth knowledge of processes to be measured guarantee top performance and an excellent quality/price ratio.

**Gefran produces the sensitive element of its transducers in-house, and is therefore able to guarantee reliability and precision of measurement.**

Gefran displacement transducers are based on two different technologies: potentiometric, which guarantees the flexibility of a wide range developed over the years, and magnetostrictive, an advanced solution that provides higher performance thanks to its contactless measurement system.

The following are some of the main features of Gefran displacement transducers:

- Measurement of absolute position: when the system is switched on, the transducer immediately gives the real position without having to run mechanical repositioning.
- Life: from 100 million strokes of potentiometric transducers to practically unlimited for magnetostrictive transducers, thanks to the lack of contact between the transducer and the cursor.
- High resolution of output signal: from practically infinite for potentiometers to 2 $\mu$  for magnetostrictive transducers.
- Easy installation and simple connection to most commercially available instruments and PLCs.
- Ability to simultaneously control multiple cursors with the same transducer and provide shift speed (MK4/IK4-C in CANopen from 1 to 4 cursors).



## **NEW PRODUCT**

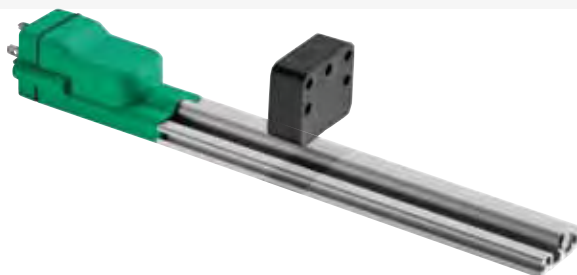
The result of constant research and innovation, this new technological solution uses a new sensitive element to read the magnetic cursors.

The structure of the sensitive element has been simplified and optimized thanks to innovative technological solutions developed and patented by Gefran.

In its simple structure, **ONDA** contains all of the performance features needed to satisfy application requirements:

- a simplified sensitive element makes the transducer even more compact
- a simple, modular structure ensures greater reliability and simpler maintenance
- the uniqueness of the solutions adopted guarantees maximum performance

To launch this new technology, Gefran introduces a magnetostrictive displacement transducer with a completely new profile: **ONP1-A**, available with analog output in voltage or in current.



# GUIDE TO CHOOSING THE BEST TRANSDUCER

## STROKE LENGTH

GEFRAN potentiometric and magnetostrictive transducers measure linear displacement on strokes from a minimum of 10 mm to a maximum of 4000 mm. It is important to remember that two strokes are usually specified:

- Mechanical stroke: the actual shift of the transducer cursor;
- Useful electrical stroke: the part of the mechanical stroke on which transducer linearity is guaranteed.

This means that when studying the application, you have to choose a transducer with a useful electrical stroke greater than or equal to the maximum shift of the moving part.

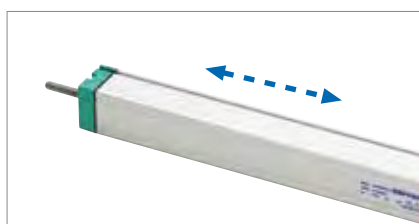
## TYPES OF ACTUATORS

To detect the shift of an object, the transducer has a mobile part that is normally attached to the object itself. This mobile part is usually one of two types:

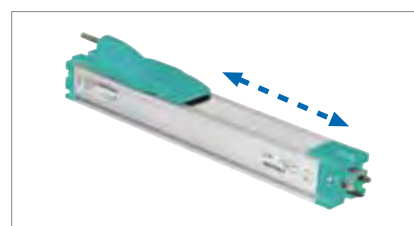
- rod: this is the traditional system used by potentiometers, and consists of a rod inserted in the transducer body and transmits the shift to the interior of the sensor;
- cursor: this system permits more compact solutions thanks to the use of a cursor attached to the moving part to be measured.

It is available on some potentiometers (series PK, PME and PMI) and on most magnetostrictives.

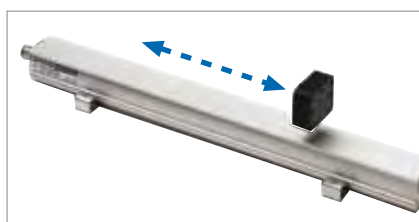
Note that the cursor can be guided (slide or ring) or completely free from the transducer (floating cursor).



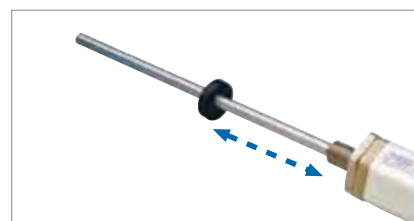
LT . . . . .



PK . . . . .



MK . . . . .

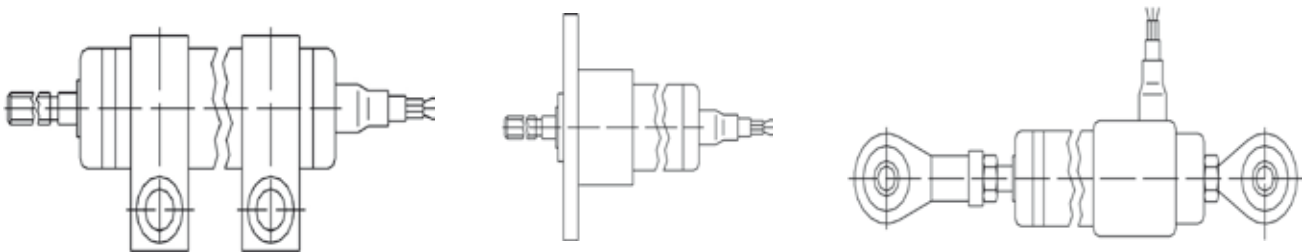


IK . . . . .

## INSTALLATION

The transducer can be installed on three types of supports:

- brackets: the traditional method; requires a free surface for installation and uses two or more brackets based on the length of the transducer;
- flanges: ideal in applications in which the rod has to pass through a hole and the transducer has to be attached to the walls of the hole; in this case, you have to pay careful attention to conditions of use, especially in case of long strokes;
- self-aligning joints: these are used to attach the ends of the transducer directly to the moving parts; it eliminates other attachment points and allows measurement of unaligned movements; this system is unsuitable for very long strokes.



PZ34-S: bracket

PZ34-F: flange

PZ34-A: joint

## PROTECTION LEVEL

Depending on their structure and technology, GEFRAN linear displacement transducers guarantee different levels of protection against dust and liquids. You can choose within a range of IP40 to IP68, as shown on the following table:

IP40	IP60	IP65	IP67	IP68
PK	LT	LT	RK2 - RK4	IC
PA1	PZ12	PC	MK4	
PY1	PZ34	PR65	IK4	
PY2		ONP1	PME	
PY3			PMA	
PS			LT67	
			PC67	
			PZ67	
			PMI / PMISL / PMISLE	

## COMMUNICATION INTERFACE

Potentiometers supply a ratiometric output in voltage. This means that the output voltage range depends on the voltage used to feed the transducer.

ATTENTION! The potentiometer must NOT be used as a variable resistance.

If you want a 0..10 VDC or 4..20 mA conditioned signal as a potentiometer output, you can connect a PCIR conditioner to the device output.

Magnetostrictive transducers let you choose the most appropriate output interface for the application:

- analog output in voltage: 0..5 VDC/5..0 VDC, 0..10 VDC/10..0 VDC,  $\pm 5$  VDC,  $\pm 10$  VDC
- analog output in current: 0..20 mA, 4..20 mA
- SSI output: 16, 21, 24, 25 bit in binary or Gray code
- CANopen output: CiA DP 3.01 rel.4.0 and DS406

**PLASTIC AND RUBBER INJECTION PRESSES:** measures displacement of 4 main movements: load, injection, die opening/closing, extraction.



**BLOWING MACHINES:** measures displacement of die opening/closing, die translation, Parison check.



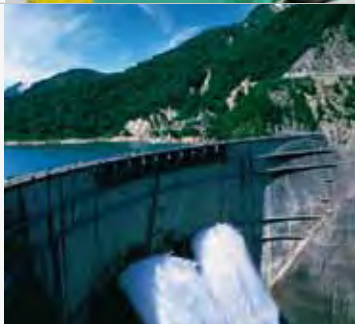
**MATERIALS WORKING:** measures displacement of tools such as brushes, wheels or rolls used in working metal, wood, marble, ceramics.



**HYDRAULIC AND PNEUMATIC CYLINDERS:** piston displacement check - the transducer is internal and a magnetic ring cursor is attached to the piston to track its movement.



**GEOTECHNICS:** use of transducers for subsidence meters and strain gauges for structural monitoring - cylindrical models are preferred.



**AUTOMATIVE TEST MACHINES:** tuning of suspensions on prototypes and competition models. Test benches. Racing cars. Crash tests.



**FARM AND EARTH MOVEMENT MACHINES:** check position of mechanical arms, bucket angle, plough height off ground, crushers, sizing of asphaltting machines.



**FOOD INDUSTRY:** check quantity of substance distributed by filling syringes or other injector machines.



**RENEWABLE ENERGIES:** check position of solar trackers, check pitch of wind generators, check valves and bulkheads in hydroelectric plants.



**LEVEL CHECKS:** measure level of liquids in tanks via selection of float.



## SHORT STROKES



### MODEL

**LT** .....

**PC** .....

**PK** .....

### USEFUL ELECTRICAL STROKE RANGE

50..900 mm

50..750 mm

100..2000 mm

### INDEPENDENT LINEARITY

± 0,05%

± 0,05%

± 0,05%

### RESOLUTION

Infinite

Infinite

Infinite

### WORK TEMPERATURE RANGE

-30..+100°C

-30..+100°C

-30..+100°C

### MAXIMUM DISPLACEMENT SPEED

10 m/sec

5 m/sec

10 m/sec

### PROTECTION LEVEL

IP60 (model -S)  
IP65 (model -P)

IP65

IP40

### ACTUATOR

Rod

Rod

Sliding cursor

### INSTALLATION

Brackets  
(variable distances between centers)

Self-aligning joints

Brackets  
(variable distances between centers)

### APPLICATIONS

Reliability in measurement and control applications, even under harsh conditions. Brackets allow installation in most appropriate position.

The best solution for mechanical applications and vehicle development, automation and robotics, thanks to its sturdiness and accuracy.

The absence of a rod lets the cursor be used along the axis for longer strokes.

INJECTION PRESSES  
HYDRAULIC PRESSES  
SANDERS

BENDERS  
SANDERS  
EARTH MOVING

INJECTION PRESSES  
WOODWORKING



PA1

PZ12

PZ34

25..150 mm

25..250 mm

25..300 mm

± 0,2% on 25  
± 0,1% from 50 to 100  
± 0,05% from 125 to 150

± 0,2% on 25  
± 0,1% from 50 to 100  
± 0,05% from 125 to 250

± 0,2% on 25  
± 0,1% from 50 to 100  
± 0,05% from 125 to 300

Infinite

Infinite

Infinite

-30..+100°C

-30..+100°C

-30..+100°C

5 m/sec

10 m/sec

10 m/sec

IP40

IP60  
(on request: IP65)

IP60  
(on request: IP65)

Rod

Rod

Rod

Brackets  
(variable distances between  
centers)

Brackets (model -S)  
Joints (model -A)  
Flange (model -F)

Brackets (model -S)  
Joints (model -A)  
Flange (model -F)

Compact. A joint provides greater tolerance in movement. Reliable even at high speeds or if subject to impact and vibration.

Problems traditionally associated with rotative potentiometers (especially reliability, life, accuracy and speed) are eliminated. The ability to attach joints provides error-free operation even in case of misalignment between transducer axis and direction of movements.

BENDERS  
SANDERS  
TRANSFER MACHINES

GLASS WORKING AND CUTTING  
GEOTECHNICAL TEST AND INSPECTION MACHINES



MODEL	PME12	PMI12	PMISL
USEFUL ELECTRICAL STROKE RANGE	50..1000 mm	50..1000 mm	50..1000 mm
INDEPENDENT LINEARITY	± 0,1% from 50 to 100 ± 0,05% from 150 to 1000	± 0,1% from 50 to 100 ± 0,05% from 150 to 1000	± 0,35%
RESOLUTIONE	Infinite	Infinite	Infinite
WORK TEMPERATURE RANGE	-30..+100°C	-30..+100°C	-30..+100°C
MAXIMUM DISPLACEMENT SPEED	5 m/sec	5 m/sec	5 m/sec
PROTECTION LEVEL	IP67	IP67	IP67
ACTUATOR	Ring cursor	Ring cursor	Ring cursor
INSTALLATION	Brackets (variable distances between centers)	Flange	Flange
APPLICATIONS	<p>For pneumatic cylinders. Pre-wired models or models with connector. High protection level and sturdiness guarantee long life.</p> <p>INJECTION PRESSES PNEUM. CYLINDERS GEOTECHNICS SANDERS GLASS MACHINES</p>	<p>For hydraulic cylinders. Model with threaded flange lets you install transducer without removing cylinder.</p> <p>GEOTECHNICS UTILITY VEHICLES HYDRAULIC CYLINDERS BOTTLING</p>	<p>For hydraulic cylinders, where smaller rods are necessary dimensions. As in the PMI12, the model with threaded flange lets you install the transducer without removing the cylinder.</p> <p>GEOTECHNICS UTILITY VEHICLES HYDRAULIC CYLINDERS BOTTLING</p>





PMISLE



PMA12



IC

50..1000 mm

50..1000 mm

100..550 mm

± 0,35%

± 0,1% from 50 to 100  
± 0,05% from 150 to 1000

± 0,1%

Infinite

Infinite

Infinite

-30..+80°C

-30..+100°C

-30..+100°C

5 m/sec

5 m/sec

1,5 m/sec

IP67

IP67

IP68

Ring cursor

Rod

Ring cursor

Flange

Self-aligning joints

Flange

For in-cylinder applications that require an economic solution with integrated analog signal.

Coaxial rod for installation with self-aligning joints. Low friction, self-cleaning rod completely in anodized aluminum.

The best solution for installation in small spaces. Used especially inside hydraulic cylinders.

GEOTECHNICS  
UTILITY VEHICLES  
HYDRAULIC CYLINDERS  
BOTTLING

INJECTION PRESSES  
EARTH MOVING  
ELEVATORS  
SANDERS  
LEATHERWORKING

HYDRAULIC CYLINDERS

## COMPARATORS



Potentiometric displacement transducers

### MODEL

**PY1** .....

**PY2** .....

**PY3** .....

### USEFUL ELECTRICAL STROKE RANGE

25..150 mm

10..100 mm

10..50 mm

### INDEPENDENT LINEARITY

± 0,2% on 25  
± 0,1% from 50 to 100  
± 0,05% on 150

± 0,3% on 10  
± 0,2% on 25  
± 0,1% from 50 to 100

± 0,3% on 10  
± 0,2% on 25  
± 0,1% on 50

### RESOLUTION

Infinite

Infinite

Infinite

### WORK TEMPERATURE RANGE

-30..+100°C

-30..+100°C

-30..+100°C

### MAXIMUM DISPLACEMENT SPEED

10 m/sec

10 m/sec

10 m/sec

### PROTECTION LEVEL

IP40

IP40

IP40

### ACTUATOR

Rod

Rod with return spring

Rod with return spring

### INSTALLATION

Brackets  
(variable distances  
between centers)

Brackets  
(variable distances  
between centers)

Brackets  
(variable distances  
between centers)

### APPLICATIONS

Compact.  
Double support for measurement rod.  
Side connection permits through-rod structure, guaranteeing greater overall sturdiness of the sensor.  
Model PY1 has a joint for greater tolerance in movement.  
PY2 and PY3 automatically position the head thanks to the return spring, making them the best solution for precise checks on cams or products leaving an automatic production line.

GEOTECHNICS  
SANDERS  
CERAMIC MACHINES (thickness and planarity check)  
WOODWORKING MACHINES (thickness and planarity check)



LT67



PC67



PZ67A



PZ67S

50..900 mm

50..750 mm

25..300 mm

25..300 mm

 $\pm 0,05\%$   
 $\pm 0,075\% \times \text{stroke} \leq 150\text{mm}$ 
 $\pm 0,05\%$   
 $\pm 0,075\% \times \text{stroke} \leq 150\text{mm}$ 
 $\pm 0,2\%$  on 25  
 $\pm 0,1\%$  from 50 to 100  
 $\pm 0,05\%$  from 125 to 300

 $\pm 0,2\%$  on 25  
 $\pm 0,1\%$  from 50 to 100  
 $\pm 0,05\%$  from 125 to 300

Infinite

Infinite

Infinite

Infinite

-30..+100°C

-30..+100°C

-30..+100°C

-30..+100°C

Standard: 3 msec  
(max: 5 msec)Standard: 3 msec  
(max: 5 msec)Standard: 3 msec  
(max: 5 msec)Standard: 3 msec  
(max: 5 msec)

IP67

IP67

IP67

IP67

Rod

Rod

Rod

Rod

Brackets  
(variable distances  
between centers)

Self-aligning joints

Self-aligning joints

Brackets  
(variable distances  
between centers)

is designed to guarantee a high protection level (IP67) in applications under harsh conditions and outdoors, where it may be necessary to work in the direct presence of dust, dirt, or liquids (not in prolonged immersion).

INJECTION PRESSES

MOBILE HYDRAULICS  
AGRICULTURAL MACHINES  
EARTH MOVING

TEST BENCH EQUIPMENT

GLASS WORKS





MK4-S



MK4-C

50..4000 mm

50..4000 mm

± 0,02%

± 0,02%

max 2 µm

max 2 µm

-30..+75°C

-30..+75°C

10 m/sec

10 m/sec

SSI

CANopen

1 cursor

from 1 to 4 cursors

IP67

IP67

Brackets  
(variable distances between  
centers)

Brackets  
(variable distances between  
centers)

SSI digital interface allows  
high-precision absolute  
displacements.

CANopen interface  
allows connection via  
fieldbus.

SERVO-DRIVES  
ROBOTICS

PRESSES  
ROBOTICS  
MACHINE TOOLS



MODEL

IK4-A . . . . .

IK4-S

. . . . .

IK4-C

. . . . .

USEFUL ELECTRICAL STROKE RANGE

50..4000 mm

50..4000 mm

50..4000 mm

INDEPENDENT LINEARITY

± 0,02%

± 0,02%

± 0,02%

RESOLUTION

infinite

max 2 µm

max 2 µm

WORK TEMPERATURE RANGE

-30..+75°C

-30..+75°C

-30..+75°C

MAXIMUM DISPLACEMENT SPEED

10 m/sec

10 m/sec

10 m/sec

INTERFACE

Analog

SSI

CANopen

MEASUREMENT TAKEN

1 cursor  
(normal+reverse)

1 cursor

From 1 to 4 cursors  
(displacement+speed)

PROTECTION LEVEL

IP67

IP67

IP67

INSTALLATION

Flange

Flange

Flange

APPLICATIONS

The IK4 line's new mechanical structure offers improved features for in-cylinder use, including a series of new models, free rotation of the connector head, and replacement of internal electronics without removal of the transducer.

The digital SSI interface ensures high-precision absolute displacements.

Precision of digital signal plus practical CANopen interface allows adaptation in existing plants using standard communication systems..

HYDRAULIC SYSTEMS FOR PLANT AUTOMATION  
INDUSTRIAL HYDRAULICS  
LEVEL CHECKS

HYDRAULIC SYSTEMS FOR METALWORKING

HYDRAULIC SYSTEMS FOR METALWORKING



RK-2



RK-4

50..4000 mm

50..4000 mm

± 0,02%

± 0,02%

infinite

infinite

-30..+90°C

-30..+90°C

10 m/sec

10 m/sec

Analog  
Digital  
CANopen (option  
remote electronic)

Analog

1 cursor

1 cursor

IP67

IP67

Internal flange

Threaded external flange

The overall dimensions of the sensor are among the smallest on the market.  
The optional and remotable (maximum of 50 meters) electronics allows the use of advanced interfaces without affecting sensor size, for in-cylinder installation.

EARTH MOVING  
AGRICULTURAL MACHINES  
UTILITY VEHICLES  
INDUSTRIAL HYDRAULICS



Rotative displacement transducers

MODEL	PS09	PS11	PS20	PR65
USEFUL ELECTRICAL STROKE RANGE	340° ± 4°	345° ± 4°	350° ± 4°	345° ± 4°
INDEPENDENT LINEARITY	± 1 .. ± 0,05% [on request]	± 1 .. ± 0,05% [on request]	± 1 .. ± 0,05% [on request]	± 1 .. ± 0,05% [on request]
RESOLUTION	Infinite	Infinite	Infinite	Infinite
WORK TEMPERATURE RANGE	-55..+100°C	-55..+100°C	-55..+100°C	-55..+100°C
MAXIMUM ROTATION SPEED	600 U/min	600 U/min	600 U/min	600 U/min
MAXIMUM TORQUE	0,20 Ncm	0,20 Ncm	0,20 Ncm	1,8 Ncm
PROTECTION LEVEL	IP40	IP40	IP40	IP65
INSTALLATION	Servo (flange)	Servo (flange)	Servo (flange)	Servo (flange)
OUTSIDE DIAMETER	22,25 mm	27,05 mm	50,80 mm	55 mm
SHAFT DIAMETER	3,175 mm	3,175 mm	6,35 mm	6 mm
APPLICATIONS	For measurement, control, and instrumentation applications. A high-precision angular displacement transducer that satisfies the requirements of most analog applications. Stainless steel shaft, gold-welded terminals; all metal parts protected against corrosion.			High protection level, all-metal housing.



SIGNAL CONDITIONERS FOR POTENTIOMETRIC TRANSDUCERS

PCIR-101: Output 0...10Vdc  
PCIR-102: Output 4...20mA



PCIR-A: Output 0...10Vdc



Interface module integrated in female connector  
(directly connectable to series LT and PK)  
Standard output 0..10Vcc (PCIR 101)  
Standard output 4..20mA (PCIR 102)  
High linearity (0.01% FSO)  
Lower Zero and Span thermal drift  
Settable Zero and Span

High input impedance (>100 MOhm)  
Standard output 0..10Vcc  
Linearity error: 0.02% FSO  
Thermal drift: 0.01% FSO/°C  
Simultaneous control of two transducers  
Preset for DIN EN50035 and EN50022 mounting  
MOR031 female connector

JOINTS FOR POTENTIOMETRIC TRANSDUCERS PKIT015: for pot. series LT



CURSORS FOR MAGNETOSTRICTIVE TRANSDUCERS

SERIES MK4 / ONP1

PCUR034



PCUR035



PCUR036



PCUR037



PCUR135



PCUR136



PCUR137



SERIES IK

PCUR026



PCUR027



PCUR022



PCUR023



PCUR024



Ø int. 12,5 mm  
Ø ext. 54 mm  
length 70 mm

Ø int. 15 mm  
Ø ext. 54 mm  
length 70 mm

Ø int. 13,5 mm  
Ø ext. 32,8 mm  
length 7,9 mm

Ø int. 13,5 mm  
Ø ext. 32,8 mm  
length 7,9 mm

Ø int. 13,5 mm  
Ø ext. 32,8 mm  
length 7,9 mm

FEMALE CONNECTOR FOR POTENTIOMETRIC TRANSDUCERS

Models:

CODE	DESCRIPTION	LT	PC	PK	PA1	PME12	IC	PY1 PY2 PY3
CON002	3-pin female mating connector; IP40 protection	LT-H	PC-H					
CON006	4-pin female mating connector (DIN43650A)	LT-M		PK-M				
CON008	4-pin female mating connector (DIN43650C)		PC-M					
CON011	5-pin female mating connector; IP40 protection	LT-B	PC-B	PK-B	PA1-C			PY-C
CON012	5-pin female mating connector; IP67 protection	LT-B	PC-B	PK-B	PA1-C			PY-C
CON013	Angled 5-pin female mating connector IP40 protection	LT-B	PC-B	PK-B	PA1-C			PY-C
CON050	Angled 4-pin M12 female mating connector; IP67 protection							
CON293	4-pin M12 female mating connector; IP67 protection							
CON300	6-pin female mating connector						IC-C	
CAV010	Female connector + 2mt of wired cable PVC (for PME model)					PME12-C		
CON021	6-pin female mating connector; IP40; DIN45322							
CON022	6-pin female mating connector; IP67; DIN45322							
CON023	Angled 6-pin female mating connector; IP67; DIN45322							
CON026	8-pin female mating connector; IP40; DIN45326							
CON027	8-pin female mating connector; IP67; DIN45326							
CON028	Angled 8-pin female mating connector; IP67; DIN45326							
CON031	5-pin M12 female mating connector; IP67							
CON035	8-pin M12 female mating connector; IP67							
CON041	Angled 5-pin M12 female mating connector; IP67							
CON042	Angled 8-pin M12 female mating connector; IP67							
CON460	8-pin M12 male mating connector; IP67 (for RK-EK connection)							
CAV002	Female connector with 2 meter cable length; IP67 protection							
CAV003	Female connector with 5 meter cable length; IP67 protection							
CAV004	Female connector with 10 meter cable length; IP67 protection							
CAV009	Female connector with 15 meter cable length; IP67 protection							
CAV005	90° angled female connector with 2 meter cable length; IP67 protection							
CAV006	90° angled female connector with 5 meter cable length; IP67 protection							
CAV007	90° angled female connector with 10 meter cable length; IP67 protection							
CAV008	90° angled female connector with 15 meter cable length; IP67 protection							
CAV011	Female connector with 2 meter cable length IP67 protection							
CAV012	Female connector with 5 meter cable length IP67 protection							
CAV013	Female connector with 10 meter cable length IP67 protection							
CAV015	Female connector with 15 meter cable length IP67 protection							
CAV021	90° angled female connector with 2 meter cable length IP67 protection							
CAV022	90° angled female connector with 5 meter cable length IP67 protection							
CAV023	90° angled female connector with 10 meter cable length IP67 protection							
CAV024	90° angled female connector with 15 meter cable length IP67 protection							

LT67 PC67 PZ67	ONP1-A	MK4-A	MK4-S	MK4-C	IK4-A	IK4-S	IK4-C	RK2	RK4
	ONP1-A-M								
LT67/PC67/PZ67-S									
LT67/PC67/PZ67-S									
PZ67-A									
		MK4-A-B	MK4-S-B	MK4-C-B	IK4-A-B	IK4-S-B	IK4-C-B/C-X	RK2+EK_ _-B	
		MK4-A-B	MK4-S-B	MK4-C-B	IK4-A-B	IK4-S-B	IK4-C-B/C-X	RK2+EK_ _-B	
		MK4-A-B	MK4-S-B	MK4-C-B	IK4-A-B	IK4-S-B	IK4-C-B/C-X	RK2+EK_ _-B	
		MK4-A-C	MK4-S-C						
		MK4-A-C	MK4-S-C						
		MK4-A-C	MK4-S-C						
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	
		MK4-A-H	MK4-S-H						
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	
		MK4-A-H	MK4-S-H						
								RK2+EK_	
		MK4-A-H							
		MK4-A-H							
		MK4-A-H							
		MK4-A-H	MK4-S-H						
		MK4-A-H	MK4-S-H						
		MK4-A-H	MK4-S-H						
		MK4-A-H	MK4-S-H						
		MK4-A-A	MK4-S-H	MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A	MK4-S-H	MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A	MK4-S-H	MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4
		MK4-A-A		MK4-C-A	IK4-A-A		IK4-C-A/C-Y	RK2+EK_ _-M	RK4

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