HEIDENHAIN

Product Information

LIDA 497M

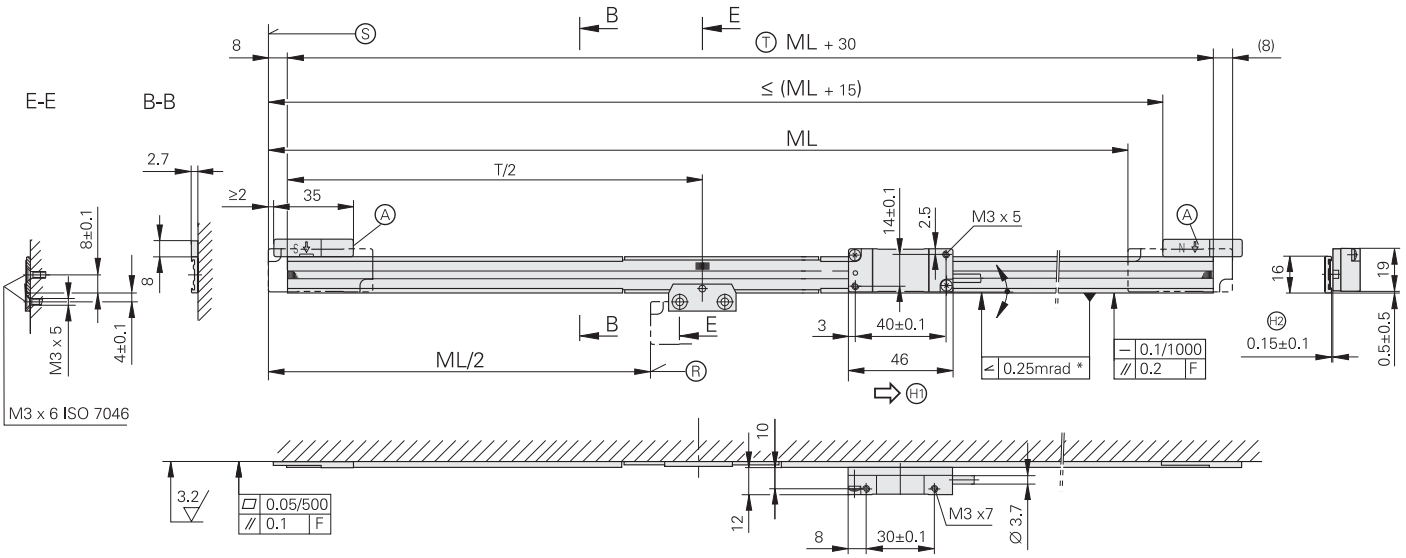
Incremental Linear Encoder

April 2012

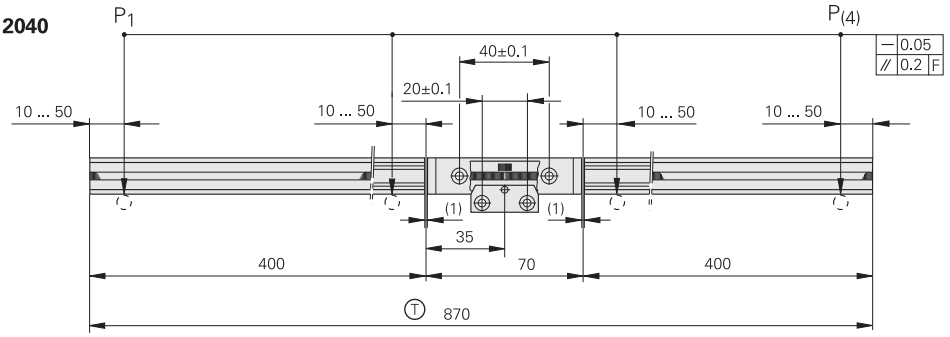
LIDA 497 M

Incremental linear encoder for measuring ranges up to 6 m

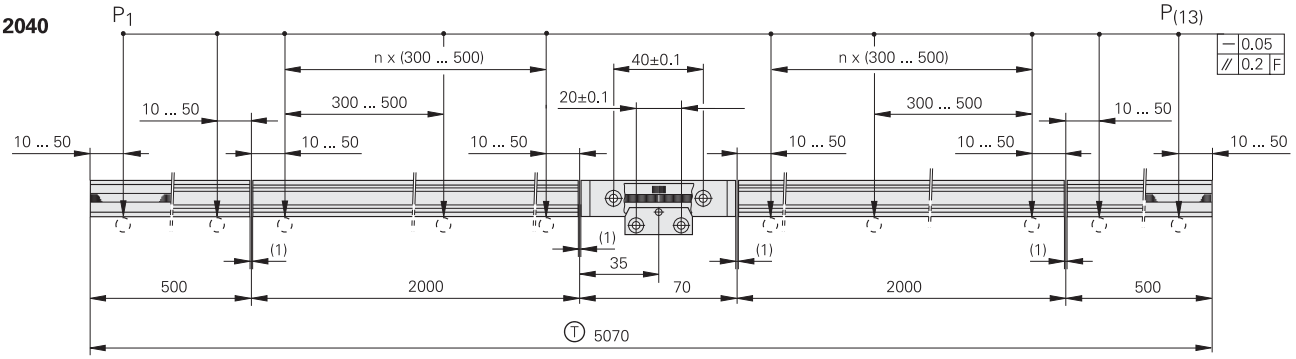
- **For measuring steps to 0.005 µm**
- **Large mounting tolerances**
- **Integrated interface electronics converts the incremental scanning signals into absolute position values**
- **Mitsubishi High Speed Serial Interface**



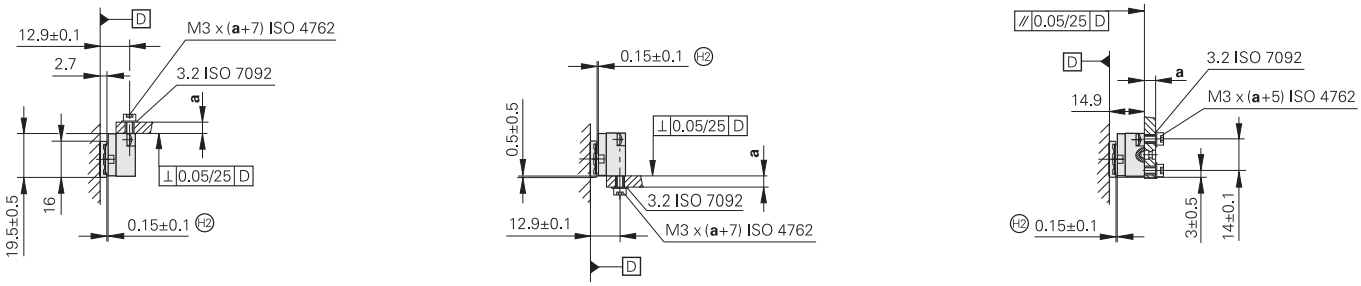
ML ≤ 2040



ML > 2040



Possibilities for mounting the scanning head



mm

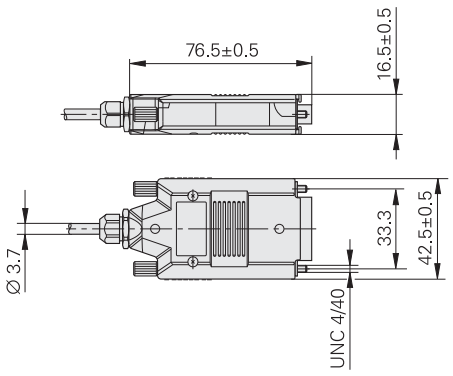
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

* = Max. change during operation
F = Machine guideway
P = Gauging points for alignment
Ⓡ = Reference mark position
Ⓢ = Beginning of measuring length (ML)
Ⓐ = Selector magnet for limit switch
Ⓣ = Carrier length

Ⓗ1 = Direction of scanning unit motion for output signals in accordance with interface description
Ⓗ2 = Adjust or set

Specifications		LIDA 497M
Measuring standard Grating period Thermal expansion coefficient		Steel scale-tape with METALLUR graduation 20 µm $\alpha_{therm} \approx 10 \cdot 10^{-6}\ K^{-1}$
Accuracy grade		± 15 µm ± 5 µm after linear length-error compensation in the evaluation electronics
Measuring length ML in mm		240, 440, 640, 840, 1040, 1240, 1440, 1640, 1840, 2040, 2240, 2440, 2640, 2840, 3040, 3240, 3440, 3640, 3840, 4040, 4240, 4440, 4640, 4840, 5040, 5240, 5440, 5640, 5840, 6040
Reference marks		One at midpoint of measuring length
Max. traversing speed		Max. 480 m/min
Vibration 55 Hz to 2000 Hz **Shock** 11 ms		≤ 200 m/s² (EN 60068-2-6) ≤ 500 m/s² (EN 60068-2-27)
Operating temperature		0 °C to 50 °C
Storage temperature		–20 to 70 °C
Protection EN 60529		*Scanning head:* IP 40 *Scale:* IP 00
Relative humidity without condensation		Max. 75 % Temporarily 90 %
Weight	Scanning head Scale Encoder cable D-sub connector	15 g (without cable) Approx. 25 g + 0.1 g/mm ML 22 g/m 140 g (interface electronics integrated)
Supply voltage Current consumption		5 V DC ± 5% < 270 mA (without load)
Absolute position values		Mitsubishi High Speed Serial Interface
Measuring step		Approx. 0.005 µm (4096-fold interpolation integrated)
Electrical connection Cable length		Cable 3 m (Ø 3.7 mm) with D-sub connector (15-pin) Interface electronics are integrated in the connector ≤ 15 m

D-sub connector
with integrated interface electronics



General Mechanical Information

Mounting
To simplify cable routing, the scanning head is usually screwed onto a stationary machine part, and the scale onto the moving machine part.

The **mounting location** for the linear encoders should be carefully considered in order to ensure both optimum accuracy and the longest possible service life.
- The encoder should be mounted as closely as possible to the working plane to keep the Abbé error small.
- To function properly, linear encoders must not be continuously subjected to strong vibration; the more solid parts of the machine tool provide the best mounting surface in this respect. Encoders should not be mounted on hollow parts or with adapter blocks.
- The linear encoders should be mounted away from sources of heat to avoid temperature influences.

Protection (EN 60529)
The scanning heads of the exposed linear encoders feature a degree of protection given in the specifications. The scales have no special protection. Protective measures must be taken if the possibility of contamination exists.

Acceleration
Linear encoders are subjected to various types of acceleration during operation and mounting.
- The indicated maximum values for **vibration** apply for frequencies of 55 to 2000 Hz **(EN 60068-2-6).** Any acceleration exceeding permissible values, for example due to resonance depending on the application and mounting, might damage the encoder. **Comprehensive tests of the entire system are required.**
- The maximum permissible acceleration values (semi-sinusoidal shock) for **shock and impact** are valid for 11 ms **(EN 60068-2-27).** Under no circumstances should a hammer or similar implement be used to adjust or position the encoder.

Expendable parts
In particular the following parts in encoders from HEIDENHAIN are subject to wear:
- LED light source
- Cables

System tests
Encoders from HEIDENHAIN are usually integrated as components in larger systems. Such applications require ***comprehensive tests of the entire system*** *regardless of the specifications of the encoder.*

The specifications given in this brochure apply to the specific encoder, not to the complete system. Any operation of the encoder outside of the specified range or for any other than the intended applications is at the user's own risk.

In safety-related systems, the higher-level system must verify the position value of the encoder after switch-on.

General electrical information

Supply voltage

The encoders require a **stabilized DC voltage U_P** as power supply. The respective *Specifications* state the required power supply and the current consumption. The permissible ripple content of the DC voltage is:

- High frequency interference
  U_{PP} < 250 mV with dU/dt > 5 V/µs
- Low frequency fundamental ripple
  U_{PP} < 100 mV

The values apply as measured at the encoder, i.e., without cable influences. The voltage can be monitored and adjusted with the encoder's **sensor lines.** If a controllable power supply is not available, the voltage drop can be halved by switching the sensor lines parallel to the corresponding power lines.

Calculation of the **voltage drop**:

$$\Delta U = 2 \cdot 10^{-3} \cdot \frac{L_C \cdot I}{56 \cdot A_P}$$

where

ΔU: Voltage drop in V
L_C: Cable length in m
I: Current consumption in mA
A_P: Cross section of power lines in mm²

Switch-on/off behavior of the encoders
The output signals are valid no sooner than after the switch-on time t_{SOT} = 1.3 s (2 s for PROFIBUS-DP) (see diagram). During the time t_{SOT} they can have any levels up to 5.5 V (with HTL encoders up to U_{Pmax}). If an interpolation electronics unit is inserted between the encoder and the power supply, this unit's switch-on/off characteristics must also be considered. If the power supply is switched off, or when the supply voltage falls below U_{min}, the output signals are also invalid. These data apply to the encoders listed in the catalog—customer-specific interfaces are not included.

Encoders with new features and increased performance range may take longer to switch on (longer time t_{SOT}). If you are responsible for developing subsequent electronics, please contact HEIDENHAIN in good time.

Insulation
The encoder housings are isolated against internal circuits.
Rated surge voltage: 500 V
(preferred value as per VDE 0110 Part 1, overvoltage category II, contamination level 2)

Cables

HEIDENHAIN cables are mandatory for **safety-related applications**. The **cable lengths** listed in the *Specifications* apply only for HEIDENHAIN cables and the recommended input circuitry of subsequent electronics.

Durability
All encoders have polyurethane (PUR) cables. PUR cables are resistant to oil, hydrolysis and microbes in accordance with **VDE 0472.** They are free of PVC and silicone and comply with UL safety directives. The **UL certification** "AWM STYLE 20963 80 °C 30 V E63216" is documented on the cable.

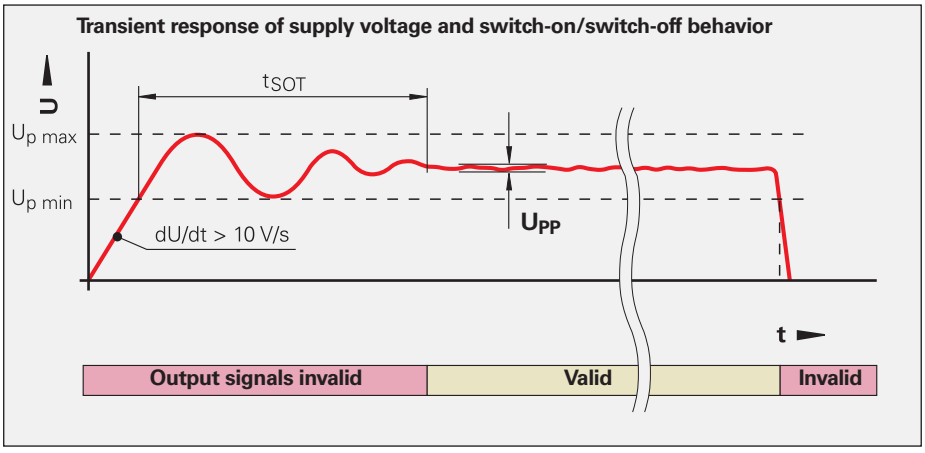
Temperature range
HEIDENHAIN cables can be used for

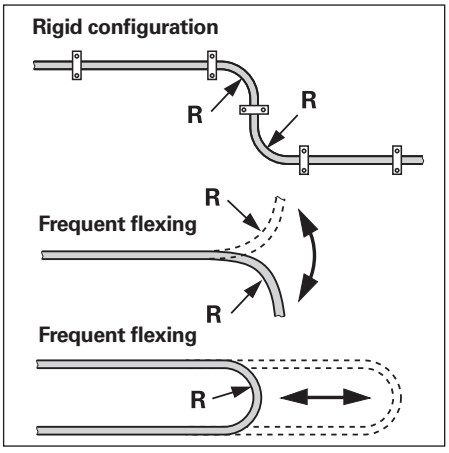
- rigid configuration –40 °C to 80 °C
- frequent flexing –10 °C to 80 °C

Cables with limited resistance to hydrolysis and media are rated for up to +100 °C. If needed, please ask for assistance from HEIDENHAIN Traunreut.

Bend radius
The permissible bend radius R depends on the cable diameter and the configuration:

Transient response of supply voltage and switch-on/switch-off behavior





Connect HEIDENHAIN encoders only to subsequent electronics whose power supply is generated from PELV systems **(EN 50178).** In addition, overcurrent protection and sometimes overvoltage protection are required in safety-related applications.

Cables	**Cross section** of power supply lines A_P				**Bend radius R**	
	1 V_{PP}/TTL/HTL	**11 µA_{PP}**	**EnDat/SSI** 17-pin	**EnDat**[5] 8-pin	**Rigid configuration**	**Frequent flexing**
Ø 3.7 mm	0.05 mm²	–	–	–	≥ 8 mm	≥ 40 mm
Ø 4.3 mm	0.24 mm²	–	–	–	≥ 10 mm	≥ 50 mm
Ø 4.5 mm **Ø 5.1 mm**	0.14/0.09[2] mm² 0.05[3] mm²	0.05 mm²	0.05 mm²	0.14 mm²	≥ 10 mm	≥ 50 mm
Ø 6 mm **Ø 10 mm**[1]	0.19/0.14[4] mm²	–	0.08 mm²	0.34 mm²	≥ 20 mm ≥ 35 mm	≥ 75 mm ≥ 75 mm
Ø 8 mm **Ø 14 mm**[1]	0.5 mm²	1 mm²	0.5 mm²	1 mm²	≥ 40 mm ≥ 100 mm	≥ 100 mm ≥ 100 mm

[1] Metal armor [2] Rotary encoders [3] Length gauges [4] LIDA 400
[5] Also Fanuc, Mitsubishi

Electrically permissible speed/ traversing speed

The maximum permissible shaft speed or traversing velocity of an encoder is derived from

- the **mechanically** permissible shaft speed/traversing velocity (if listed in the *Specifications*)
  and
- the **electrically** permissible shaft speed/ traversing velocity. For encoders with **sinusoidal output signals**, the electrically permissible shaft speed/traversing velocity is limited by the –3 dB/ –6 dB cutoff frequency or the permissible input frequency of the subsequent electronics.

  For encoders with **square-wave signals,** the electrically permissible shaft speed/ traversing velocity is limited by
  – the maximum permissible scanning/ output frequency f_{max} of the encoder, and
  – the minimum permissible edge separation a for the subsequent electronics.

For angle or rotary encoders

$$n_{max} = \frac{f_{max}}{z} \cdot 60 \cdot 10^3$$

For linear encoders

$$v_{max} = f_{max} \cdot SP \cdot 60 \cdot 10^{-3}$$

Where:

n_{max}: Elec. permissible speed in min^{-1}
v_{max}: Elec. permissible traversing velocity in m/min
f_{max}: Max. scanning/output frequency of encoder or input frequency of subsequent electronics in kHz
z: Line count of the angle or rotary encoder per 360°
SP: Signal period of the linear encoder in µm

Noise-free signal transmission

Electromagnetic compatibility/ CE-compliance
When properly installed, and when HEIDENHAIN connecting cables and cable assemblies are used, HEIDENHAIN encoders fulfill the requirements for electromagnetic compatibility according to 2004/108/EC with respect to the generic standards for:

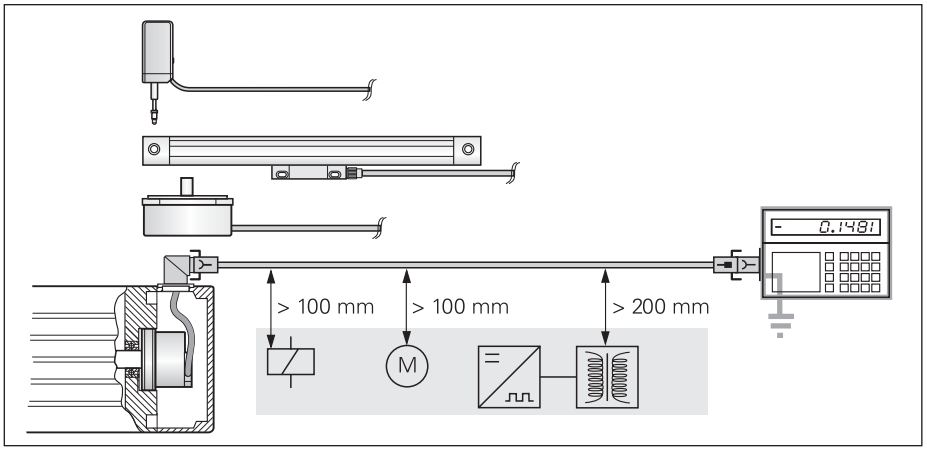
- **Noise immunity EN 61000-6-2:**
  Specifically:
  – ESD EN 61000-4-2
  – Electromagnetic fields EN 61000-4-3
  – Burst EN 61000-4-4
  – Surge EN 61000-4-5
  – Conducted disturbances EN 61000-4-6
  – Power frequency magnetic fields EN 61000-4-8
  – Pulse magnetic fields EN 61000-4-9
- **Interference EN 61000-6-4:**
  Specifically:
  – For industrial, scientific and medical equipment (ISM) EN 55011
  – For information technology equipment EN 55022

Transmission of measuring signals— electrical noise immunity
Noise voltages arise mainly through capacitive or inductive transfer. Electrical noise can be introduced into the system over signal lines and input or output terminals.
Possible sources of noise include:

- Strong magnetic fields from transformers, brakes and electric motors
- Relays, contactors and solenoid valves
- High-frequency equipment, pulse devices, and stray magnetic fields from switch-mode power supplies
- AC power lines and supply lines to the above devices

Protection against electrical noise
The following measures must be taken to ensure disturbance-free operation:

- Use only original HEIDENHAIN cables. Consider the voltage drop on supply lines.
- Use connecting elements (such as connectors or terminal boxes) with metal housings. Only the signals and power supply of the connected encoder may be routed through these elements. Applications in which additional signals are sent through the connecting element require specific measures regarding electrical safety and EMC.
- Connect the housings of the encoder, connecting elements and subsequent electronics through the shield of the cable. Ensure that the shield has complete contact over the entire surface (360°). For encoders with more than one electrical connection, refer to the documentation for the respective product.
- For cables with multiple shields, the inner shields must be routed separately from the outer shield. Connect the inner shield to 0 V of the subsequent electronics. Do not connect the inner shields with the outer shield, neither in the encoder nor in the cable.
- Connect the shield to protective ground as per the mounting instructions.
- Prevent contact of the shield (e.g. connector housing) with other metal surfaces. Pay attention to this when installing cables.
- Do not install signal cables in the direct vicinity of interference sources (inductive consumers such as contactors, motors, frequency inverters, solenoids, etc.).
  – Sufficient decoupling from interference-signal-conducting cables can usually be achieved by an air clearance of 100 mm or, when cables are in metal ducts, by a grounded partition.
  – A minimum spacing of 200 mm to inductors in switch-mode power supplies is required.
- If compensating currents are to be expected within the overall system, a separate equipotential bonding conductor must be provided. The shield does not have the function of an equipotential bonding conductor.
- Provide power only from PELV systems **(EN 50178)** to position encoders. Provide high-frequency grounding with low impedance **(EN 60204-1 Chap. EMC).**
- For encoders with 11 μA_{PP} interface: For extension cables, use only HEIDENHAIN cable ID 244955-01. Overall length: max. 30 m.

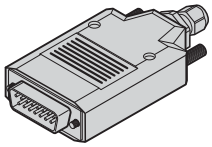


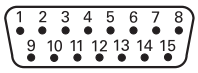
Minimum distance from sources of interference

Electrical connection

Pin layout

15-pin
D-sub connector

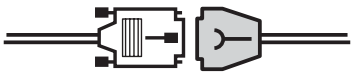
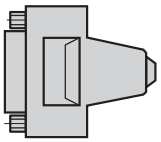




	Supply voltage				Incremental signals[1]						Absolute position values			
	4	**12**	**2**	**10**	**1**	**9**	**3**	**11**	**14**	**7**	**5**	**13**	**8**	**15**
	U_P	**Sensor** U_P	**0 V**	**Sensor** 0 V	**A+**	**A–**	**B+**	**B–**	**R+**	**R–**	**Serial Data**	**$\overline{\text{Serial Data}}$**	**Request Frame**	**$\overline{\text{Request Frame}}$**
	Brown/ Green	Blue	White/ Green	White	/	/	/	/	/	/	Gray	Pink	Violet	Yellow

[1] Only for adjusting; do not use in normal operation
Color assignment applies only to extension cable
Shield on housing; **U_P** = power supply voltage
Sensor: The sensor line is connected internally with the corresponding power line.
Vacant pins or wires must not be used!

Connecting elements and cables

Mating connector for encoder connector 	**D-sub coupling (female), 15-pin** ID 315650-14	
Connecting cable	**Cable only** PUR Ø 6 mm [2(2 x 0.14 mm^2) + (4 x 0.5 mm^2)] ID 333063-01	
	Cable complete with connectors PUR Ø 6 mm [2(2 x 0.14 mm^2) + (4 x 0.5 mm^2)] with D-sub coupling (female) 15-pin and Mitsubishi connector ID 366419-xx	

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More Information
- Brochure: *Exposed Linear Encoders*
- *General Electrical Information* see www.heidenhain.de