LA12 Absolute Magnetic Encoder System with Mitsubishi, Yaskawa and Fanuc Serial Communications

TRUE ABSOLUTE SYSTEM

ROBUST DESIGN

LOW LATENCY

LA12 is a true absolute magnetic encoder system designed for motion control applications as a position and velocity control loop feedback element. The encoder readhead is sealed to IP67 providing reliable and robust operation with high resolution.

Features and benefits

- True absolute system
- Fanuc, Mitsubishi and Yaskawa serial communication protocols (Half-Duplex, RS-485)
- Suitable for highly dynamic control loops
- Robust design and great EMC compatibility
- IP67 sealing
- Speeds up to 7 m/s
- Axis lengths up to 16.3 m
- Resolutions up to ~0.244 µm

MACHINE TOOL | LINEAR MOTOR | ASSEMBLY LINES | INDUSTRIAL AUTOMATION | IN SMALL SIZE

General information

The LA12 encoder system provides true-absolute position information immediately after power-up over the two-wire communication protocol. The LA12 is extremely reliable due to the non-contact, wear-free measuring principle and the built-in safety algorithm.

The measuring standard is a magnetic scale that is magnetised with two tracks. The incremental track is magnetised with north/south 2 mm poles and the absolute track with a pseudo-random binary sequence.

The readhead consists of a Hall sensor array that reads the absolute track and an AMR sensor that reads the incremental track. The raw data is merged by the interpolator and the microcontroller unit. The position information is additionally processed in the FPGA, which enables low latency and short response time. Diagnostic information is available via the selected communication protocol and the multicolor status LED.

The readhead is connected to the outside world via a robust, highly flexible cable with various connection options. Due to the robust design of the readhead and the cable, the system ensures great electromagnetic compatibility (EMC).

Choose your LA12 system

The LA12 readhead is compatible with the RLS absolute scale AS10 and solid absolute scale SAS10. You can select the length of the AS10 scale up to 16.3 m and SAS10 up to 1.35 m. To ensure safety and reliability, the AS10 scale can be optionally covered with a protective stainless steel foil or installed using TRS track system. The completely welded version of SAS10 magnetic scale is intended for harsh environments where contamination with industrial compounds is possible. The SAS10 scale also yields better accuracy compared to AS10 type of scale.

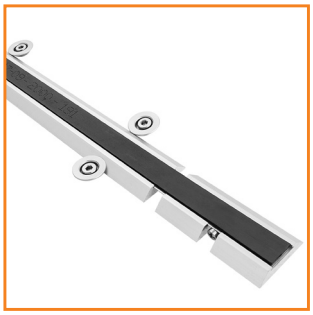
LA12 readhead

More about the LA12 readhead can be found in the LA12 at **RLS Media center.**

AS10 magnetic scale

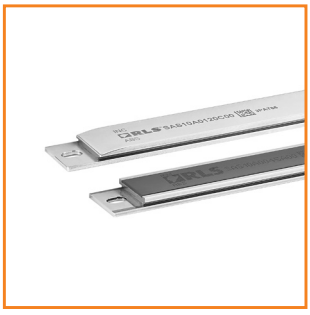
More about the AS10 magnetic scales can be found in the ASD01 at **RLS Media center.**

TRS track system (AS10)



More about the TRS track system can be found in the ASD01 at **RLS Media center.**

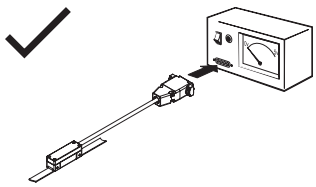
SAS10 fully welded or exposed

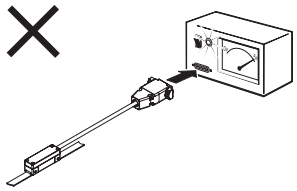


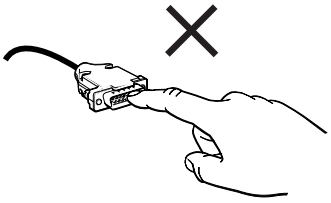
More about the SAS10 fully welded scale can be found in the ASD01 at **RLS Media center.**

Storage and handling

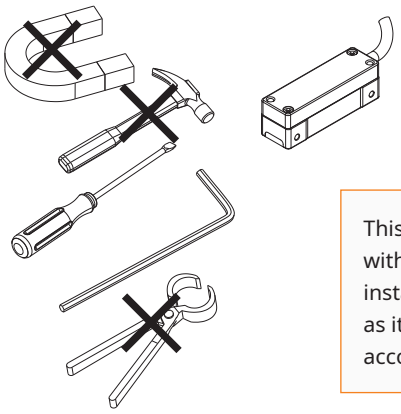
Storage temperature	Operating temperature	Humidity
–20 °C to +85 °C	0 °C to +55 °C	100 % condensing







Readhead is ESD sensitive - handle with care.
Do not touch electronic circuit, wires or sensor area without proper ESD protection or outside of ESD controlled environment.



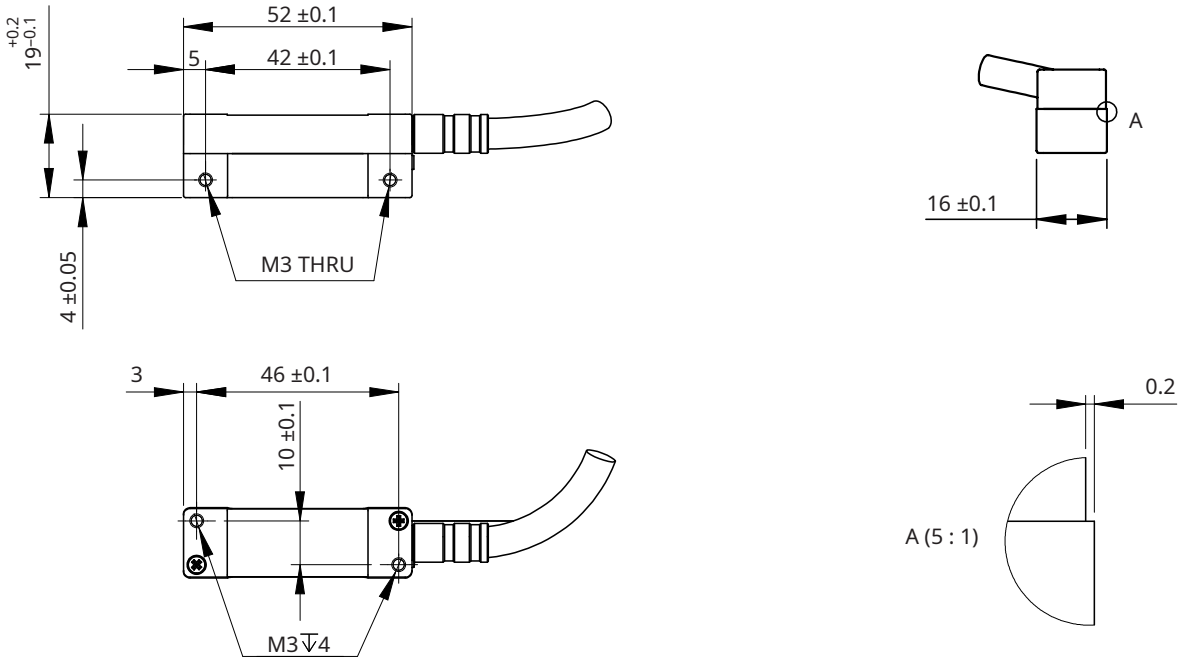
This encoder system is a high performance metrology product and should be handled with the same care as any other precision instrument. The use of industrial tools during installation or exposure to strong magnets such as a magnetic base is not recommended as it carries the risk of damaging parts of the system which as a result might not perform in accordance with specifications.

Packaging

Each readhead is packed individually in an antistatic bag, according to ESD protection measures.

Dimensions drawing

Dimensions and tolerances are in mm. Dimensions without tolerance values are in accordance with ISO 2768-m.



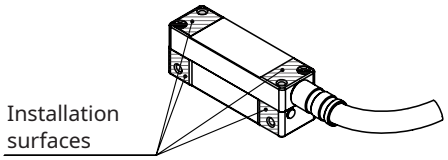
3D model available for download at **RLS Media center.**

Installation instructions

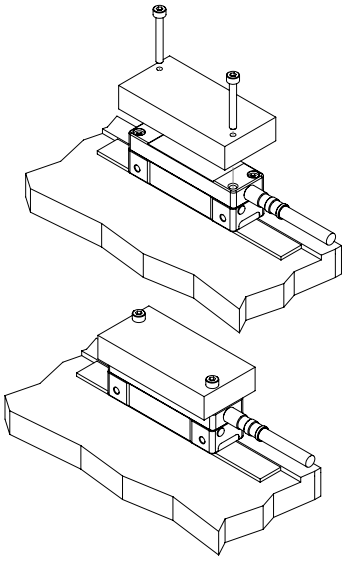
The readhead LED must be green at all measuring length positions. Otherwise, the installation will not be performed correctly. The 0.1 mm to 0.6 mm thick plastic spacer (shim) can be used to facilitate installation. For optimal installation, the recommended thickness of the shim is 0.2 mm.

After mounting the magnetic scale, place the plastic shim and the readhead on the magnetic scale. Make sure that the readhead, shim and magnetic scale are in full contact with each other. Ensure that the orientation and alignment of the readhead relative to the magnetic scale is as shown in the ASD01 at **RLS Media center**. The print on the scale can be used to determine the orientation.

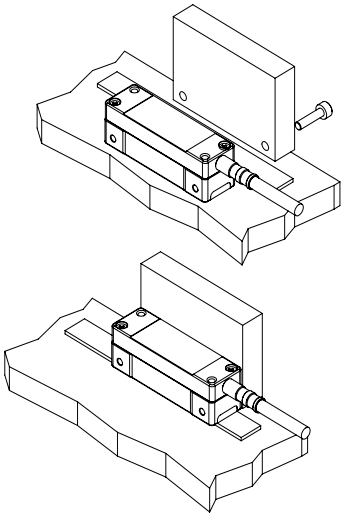
Improper mounting of the magnetic scale and readhead can impair the function of the magnetic encoder system and lead to total failure.



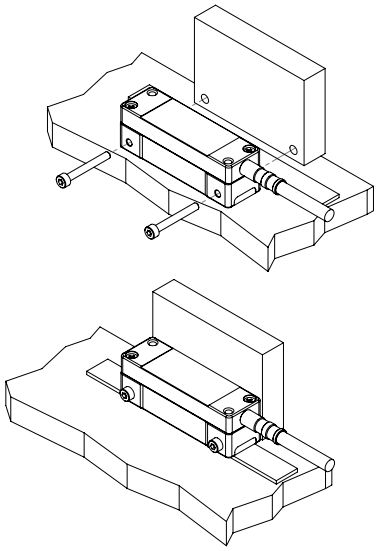
Variant A



Variant B



Variant C



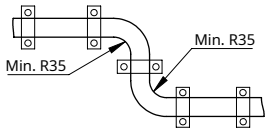
- The magnetic encoder system must be installed and mounted in strict compliance with the installation dimensions and tolerances given on **page 4** and in the ASD01 at **RLS Media center**. Contact between the readhead and magnetic scale must be avoided over the entire measuring range.

- The magnetic encoder system must be used in accordance with the specified degree of protection. The following factors must be taken into account: IP protection class, operating temperature, external magnetic field, mechanical load and EMC compatibility.

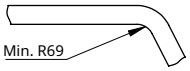
- The magnetic encoder system is sensitive to the external magnetic fields. The magnitude of the influence on the magnetic encoder system depends on the magnitude and direction of the external magnetic field. In particular, the rapidly changing stray magnetic fields affect the system and can alter its function. Magnetic field strength within 1 mT reduces the accuracy of the system. Field strengths greater than 1 mT will cause the system to malfunction and as a result the readhead will report an incorrect absolute position with the error status active. Magnetic field strengths greater than 25 mT will cause irreversible damage to the magnetic scale and will have to be replaced.

Cable bending radius

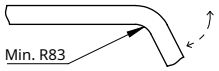
Fixed laying application



Flexible application



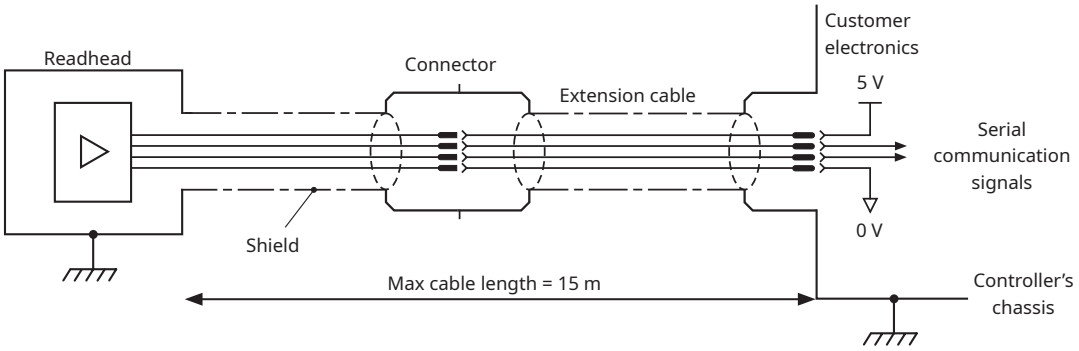
Continuously flexible application



The cable requires adequate strain relief to ensure integrity and avoid side forces that could damage the cable entry. The cable bending radius also applies to the connector side.

Shield connection

Figure below shows a recommended shield termination in order to ensure electromagnetic compatibility.

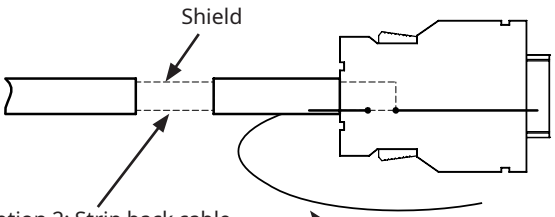


Housing of the encoder is galvanically connected with the housing of the connector. The encoder system must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

Connecting the cable screen

The following arrangement should be applied to FANUC versions only.

The cable is supplied with the shield connected to pin 16 inside the connector, making the required connection to the FANUC equipment. The shield must also be connected to machine Earth, either by using the external Earth wire provided, or by cutting back the cable insulation to expose the shield and clamping that to machine Earth.



Option 2: Strip back cable insulation to expose the braided shield and clamp to machine Earth.

Option 1: Connect external Earth wire to machine Earth.

Technical specifications

System data

Pole length	2 mm		
Maximum measuring length	AS10: 16.3 m SAS10: 1.288 m		
System accuracy	±20 µm/m to ±40 µm/m For more information about accuracy of AS10 or SAS10 magnetic scale please refer to ASD01 available at **RLS Media center.**		
Hysteresis	< 2 µm at 0.2 mm ride height		
Unidirectional repeatability	< 1 µm		
Resolutions	**Part number**	**Resolution**	**Max. speed**
Fanuc interface	**8D0**	0.25 µm	2 m/s
Mitsubishi interface	**1D0**	2 µm	7 m/s
	2D0	1 µm	7 m/s
	11B	0.9765625 µm	7 m/s
	12B	0.48828125 µm	4 m/s
	13B	0.244140625 µm	2 m/s
Yaskawa interface	**11B**	0.9765625 µm	7 m/s
	12B	0.48828125 µm	4 m/s
	13B	0.244140625 µm	2 m/s

Electrical data

Power supply	From 4.75 V to 5.5 V (on the connector), reverse polarity protection
Current consumption	< 250 mA (at 5 V power supply and 15 m cable length, without load)
Set-up time after power-on	< 1 s (the encoder will start responding according to the communication protocol after set-up time has passed)
Position latency *	< 1 µs

* Delay caused by the sensor, interpolator and data processing.

Mechanical data

Material	Readhead: Aluminium (Eloxal - anodised)
Mass	86 g (readhead with 1 m cable, no connector)

Environmental data

Temperature	Operating	0 °C to +55 °C
	Storage	–20 °C to +85 °C
Vibrations (55 Hz to 2000 Hz)		300 m/s² (IEC 60068-2-6:2007)
Shocks (11 ms)		300 m/s² (IEC 60068-2-6:2007)
Humidity		100 % (condensation permitted)
EMC Immunity		EN IEC 61000-6-2:2019
EMC Emission		EN IEC 61000-6-4:2019
Environmental sealing		IP67 (according to IEC 60529:1992+A2:2013)
External magnetic field during operation		<0.5 mT

Cable

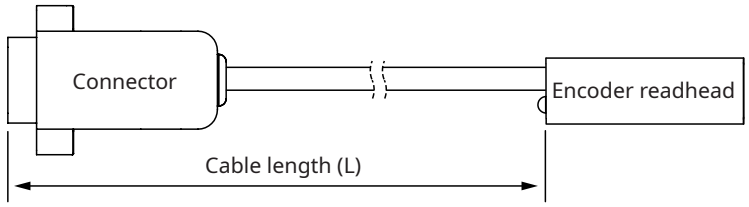
Cable type	Green colour, PUR high flex cable, UL AWM recognised, drag-chain compatible, tinned braided shield. RoHS approved.
Number of wires	6
Outer diameter	6.9 ±0.3 mm
Wires AWG	Green/Yellow/Blue/Pink 2 × 2 × 0.2 mm² + Red/Black 2 × 0.38 mm²
Cable bending radius *	Fixed installation: 35 mm, free movement: 69 mm, for continuous flexing: 83 mm
Mass	61 g/m
Torsion	Continuous torsion not allowed

* Please see the chapter **Cable bending radius**.

Cable tolerances

LA12 with cable

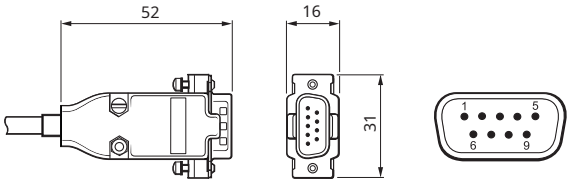
Cable length L [m]	Tolerance [mm]
≤ 2	+30/–0
2 < L ≤ 7	+40/–0
10 < L ≤ 15	+50/–0



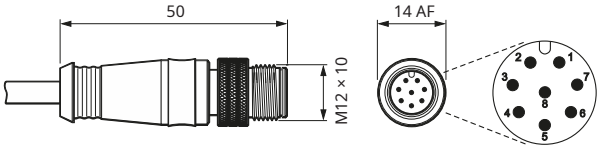
Electrical connections

Function	Signal	Wire colour	9 pin D type plug (option A)	10-way Mitsubishi (option C)	20-way Fanuc (option V)	M12 8-way (option W)	6-way Yaskawa (option Y)
Power	Vdd	Red	5	1	9, 20	2	1
	GND	Black	9	2	12, 14	5, 8	2
Serial communication	MR	Green	2	3	5	3	5
	MRR	Yellow	3	4	6	4	6
Reserved	-	Blue	6	-	-	7	-
	-	Pink	7	-	-	6	-
Shield	Shield	Shield	Case	Case	External shield, pin 16	Case	Case

9-way D-type connector

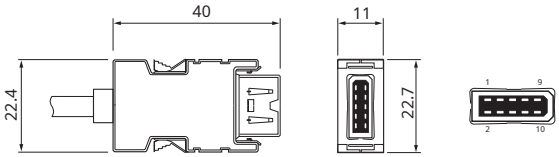


M12 8-way sealed connector (male type) *

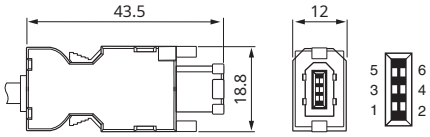


* Depending on availability. Available with overmoulded or metal housing connector version.

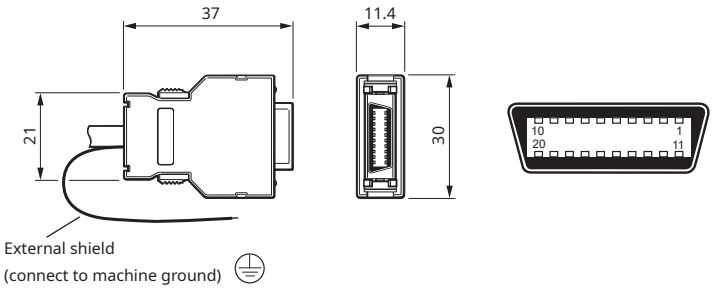
10-way Mitsubishi connector (MOLEX 54599-1019)



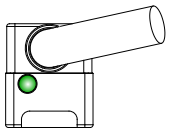
6-way Yaskawa connector



20-way Fanuc connector



Status indicator LED



After installing the AS10 magnetic scale, the readhead can be easily adjusted on the machine using the LED setup indicator. The LED indicator shows the internal status of the encoder and is used for encoder installation and diagnostics.
Slow flashing LED indicates that power is being supplied to the encoder, but communication between the encoder and the controller has not yet been established. The error status has a higher priority than the warning status in the LED signaling. The LED signaling may be different from the encoder status signaled by the controller.

LED Status		Status	Description
●	**Green**	Normal operation	Position data is valid.
●	**Orange**	Warning	Position data is valid. The internal temperature is near operational limits.
●	**Red**	Error	Position data is not valid. Possible causes: • The distance between the readhead and the magnetic scale is too large. • Signal lost. • The readhead is out of alignment with the magnetic scale or the magnetic scale is demagnetised. • Incorrect orientation of the readhead and the magnetic scale. • The internal temperature is out of the operational limits. • The encoder speed is out of operational limits.
●●●●●	**Fast red flashing**	Error	Position data is not valid. Internal system error.
●●● / ●●●	**Slow red or green flashing**	-	The communication has not been established.
○	**No light**	No power supply	/

During installation, the readhead must be moved for more than 10 mm above the magnetic scale to see the current encoder status on LED. The change from red to green color LED indicates a correctly installed encoder. After successful installation, perform a power off/on cycle.

The LED signal statuses listed in the table above do not indicate non-optimal installation of the readhead, such as accuracy outside the specified range.

If the readhead reports an error during operation as a result of incorrect decoding of absolute position on the magnetic scale, this indicates a serious issue. Serious issues are a wrong installation or damaged magnetic scale. To determine the root cause of the problem, please do the following:

- Verify the installation that is in accordance with the LA12 specification (ride-height, lateral offsets and yaw/pitch/roll tolerances)
- If possible, check the error spot on the magnetic scale with the magnet viewer for the abnormal pattern in the magnetic code

Once the root cause is determined, please perform the power OFF-ON cycle of the readhead or move it for 10 mm over the scale.

The same behavior applies when the application in which the LA12 readhead is installed forces the readhead to leave the magnetic scale (no overlapping). In this case, when the readhead starts to overlap again from either side of the magnetic scale, the error disappears once the readhead travels 10 mm of valid position.

Output type

Fanuc

Interface type	Alpha-I, Type-6, 2-wire (one pair transmission)
Supported controllers *	• 30iB, 0i-D, F from its first version • Series 15i, 16i, etc. 90B1 series/following versions from K(11) • Series 30i, etc. 90D0, 90E0 series/following versions from P(16)

Mitsubishi

Interface type	2-wire RS-485 half-duplex
Supported controllers *	MR-J4 (140J at the end of the PN)
Compatible software version of the controller/servo	From version C3 onwards

Yaskawa

Interface type	Yaskawa Sigma-LINK, (2-wire, one pair transmission)
Supported controllers *	Sigma-7 (Version 0021, 4Mbps mode only);

*** Not all controllers are listed. Please contact the controller manufacturer to confirm product compatibility.**

Part numbering

LA12 MS A 13B A A 50D C 00

Communication interface
FA - Fanuc interface
MS - Mitsubishi interface
YA - Yaskawa interface

Communication interface variant
A - Two-wire interface (half-duplex RS485)

Resolution
For **FA**:
8D0 - 0.25 µm

For **MS:**
13B - 0.244140625 µm
12B - 0.48828125 µm
11B - 0.9765625 µm
2D0 - 1 µm
1D0 - 2 µm

For **YA:**
13B - 0.244140625 µm
12B - 0.48828125 µm
11B - 0.9765625 µm

Minimum edge separation
A - N/A

Power supply
A - 5 V (regardless of cable length up to 15 m)

Cable length
10D - 1 m
20D - 2 m
30D - 3 m
40D - 4 m
50D - 5 m
70D - 7 m
10M - 10 m
12M - 12 m
15M - 15 m

Maximum cable length is 15 m. If extension cable is used, the readhead cable length + extension cable length must not exceed 15 m.

Connector options
A - 9 pin D type plug
C - 10-way Mitsubishi (Molex 54599-1019)
F - Flying leads (no connector)
V - 20-way Fanuc connector
W - Overmould/metal-housed M12 male *
Y - 6-way Yaskawa

* Depending on availability. Available with overmoulded or metal housing connector version. Overmoulded M12 connectors with cable lengths 2m, 5 m and 10 m are available from stock. Longer delivery times apply for other lengths with the overmoulded connector.

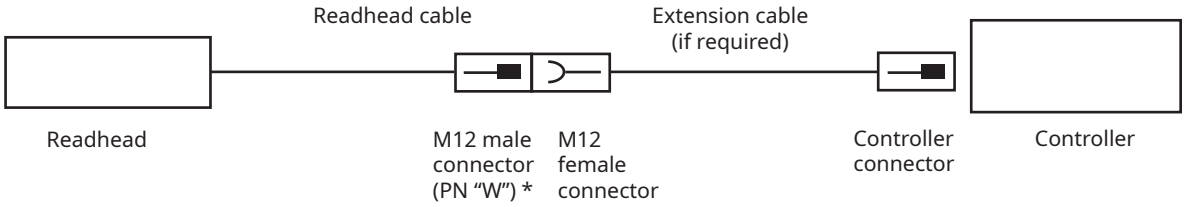
Special requirements
00 - No special requirements (standard)

For the extension cable (Female M12 to dedicated connector), please **see page 14.**

Table of available combinations

Series	Communication interface	Comm interface variant	Resolution	Minimum edge separation	Power supply	Cable length	Connector option	Special requirements
LA12	FA	A	8D0	A	A	10D / 20D / 30D / 40D / 50D / 70D / 10M / 12M / 15M	A / F / V / W	00
	MS		13B / 12B / 11B / 2D0 / 1D0				A / C / F / W	
	YA		13B / 12B / 11B				A / F / W / Y	

Part numbering for extension cable



* Input of the extension cable is M12 female overmould connector. When using an extension cable the LA12 readhead must be ordered with M12 (PN “W”) connector.

EC 12000 A V 00

Extension cable

EC - Extension cable

Cable length *

04000 - 4 m
05000 - 5 m
07000 - 7 m
10000 - 10 m
12000 - 12 m
15000 - 15 m
DDDDD - Cable length in mm

* Cable length 2 m, 5 m and 10 m available from stock. Longer delivery times apply for other lengths.

Readhead compatibility

A - LA12

Output connector type

V - FANUC connector
Y - Yaskawa connector
C - Mitsubishi connector
F - Flying leads
A - 9-pin D-type plug
W - Overmould/metal-housed M12 male **

** Depending on availability. Available with overmoulded or metal housing connector version.

Special requirements

00 - No special requirements (standard)

Accessories

End clamp kit
LM10ECL00

(2 clamps + 2 fasteners)

Magnet viewer
MM0001

Track section, 1.00 m
TRS100A00

(1x fastener M3x10 included)

Track section, 2.00 m
TRS200A00

(1x fastener M3x10 included)

Fastener and washer
TRC00

Scale clamp with fasteners, 0.04 m
TRE004A00

(2x fastener M3x10 and 1x fastener M2x4 included)

Extension cable

See **page 14** for more information.

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Document issues

Issue	Date	Page	Description
3	1. 4. 2022	11	Mitsubishi supported controllers amended
4	31. 1. 2023	4	Dimensions drawings amended
		8	Cable tolerances added
5	17. 5. 2023	8	Cable tolerances amended
		14	Accessories added
6	12. 2. 2024	11	Yaskawa output amended
		12	Readhead part numbering amended
		14	Part numbering for cable added