



## AG Series of Linear Encoders

### QU INDUSTRIAL CO.

📍 517 N VIRGINIA AVE., AZUSA CA91702, USA

☎ 800-289-5771

📠 626-921-2990

✉ [order@eztechdro.com](mailto:order@eztechdro.com)

🌐 [www.eztechdro.com](http://www.eztechdro.com)

# AG Series of Linear Encoders

## Mounting guidelines

### MAGNETIC SCALES WITH LARGE CROSS SECTION

-AG6333A/AG6333AC

#### Mounting direction

Magnetic scales with large cross section should be fastened to a machined surface over their entire length. This gives them a high vibration rating. The linear encoder is mounted with the sealing lips directed downward or away from splashing water.

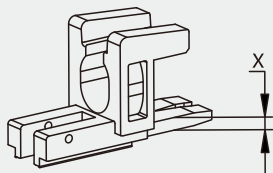
#### Mounting read header

The read header of linear encoder is mounted on a processed or unprocessed machine guideway with the help of two read header locating seats. The read header locating seats should be removed when the mounting is completed.

Generally, the cable import points to the direction in which when the read header moves, the scale outputs these signals described in the Section Interface (also shown in the following pictures in the model details). If limited by the mounting space, the cable import could point to the other direction. The read header could be also mounted by a set of T-shape brackets (optional).

#### Accessories:

Read header locating seats



Model	x (mm)
AG6333A	3.90
AG6333AC	3.90

#### Protection

Linear encoders fulfill the requirements for **IP54** protection according to **EN 60 529** or **IEC 60 529** provided that they are mounted with the sealing lips facing away from splash water.

#### Direct mounting

It is very simple to mount the **EZ TECH**'s linear encoders with slimline scale housing or standard scale housing: You need only to align the scale unit at two points along the machine guideway. Stop surfaces or stop pins can also be used for this.

The locating seats already set the proper gap between the scale unit and the scanning unit (read header), as well as the lateral tolerance.

If the locating seats need to be removed before mounting due to a lack of space, the gauge is used to set the gap easily and exactly between the scale and the read header, according to the x value of the locating seat. Lateral tolerances must also be maintained.

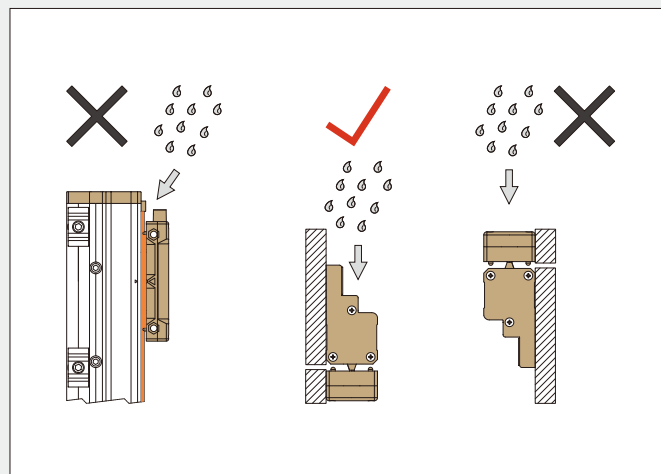
#### Mounting the multi-section

The AG6333A and AG6333AC with measuring length over 4400 mm are mounted on the machine in individual sections:

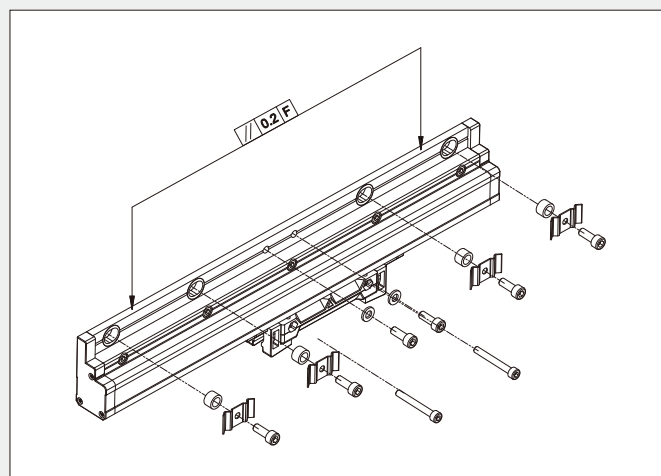
1. Mount and align the individual housing sections;
2. Pull in the magnetic tape over the entire length;
3. Lubricate the sealing lips and pull them in and fix it;
4. Insert the read header with the help of read header locating seats.

#### Accessories:

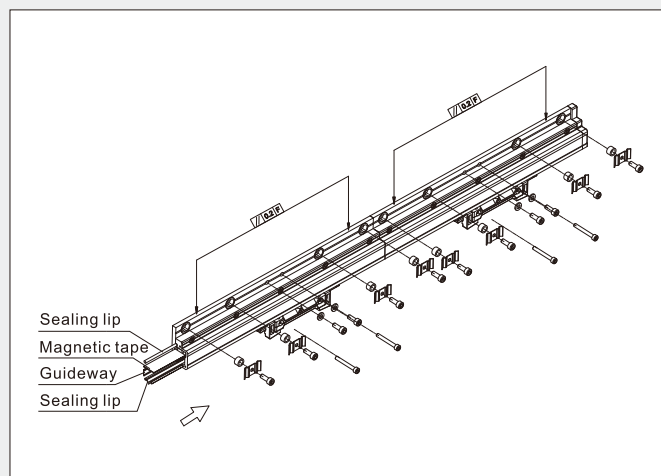
Read header locating seats  
Sealing lips



Mounting direction of scale with large cross section



Mounting scale with large cross section directly



Mounting the multi-section

# AG Series of Linear Encoders

## Interfaces

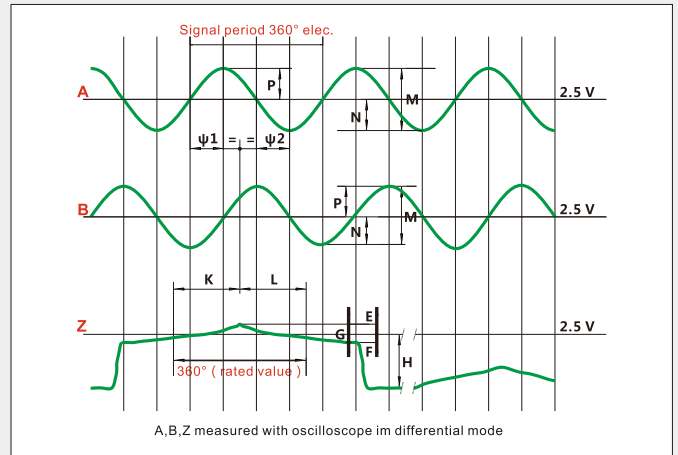
### INCREMENTAL SINUSOIDAL SIGNALS~ 1 Vpp

**EZ TECH's** linear encoders with ~1 Vpp output signals provide highly interpolable voltage signals.

The sinusoidal incremental signals A and B are phaseshifted by 90° elec. and have amplitudes of typically 1 Vpp.

The illustrated sequence of output signals - with B lagging A - applies for the direction of motion where the cable points in the front view of all scale series for numerically controlled machine tools .

The reference mark signal Z has an unambiguous assignment to the incremental signals. The output signal might be somewhat lower next to



Sinusoidal signals ~ 1 Vpp

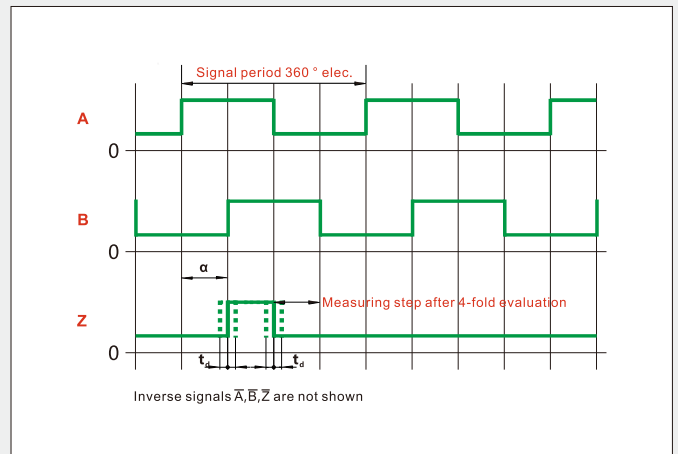
### INCREMENTAL EIA-422A SIGNALS

**EZ TECH's** linear encoders with EIA-422A signals incorporate electronics that digitize sinusoidal scanning signals with or without interpolation.

The incremental signals are transmitted as the square-wave pulse trains A and B, phase-shifted by 90° elec. The reference mark signal consists of one or more reference pulses Z, which are triggered by the incremental signals. In addition, the integrated electronics produce their inverted signals  $\bar{A}$ ,  $\bar{B}$  and  $\bar{Z}$  for noise-proof transmission.

The illustrated sequence of output signals - with B lagging A - applies for the direction of motion where the cable points in the front view of all scale series for manually controlled machine tools .

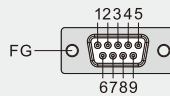
The distance between two successive edges of the incremental signals A and B through 1-fold, 2-fold or 4-fold evaluation is one measuring step.



Incremental EIA-422A signals

Pin	1	2	3	4	5	6	7	8	9
Signal	$\bar{A}$	0V	$\bar{B}$	Vacant	$\bar{Z}$	A	+5V	B	Z
Color	Greenblack	Black	Orangeblack	FG	Whiteblack	Green	Red	Orange	White

Sinusoidal signals output with 9-pin D-sub connector  
EIA-422A signals output with 9-pin D-sub connector



FG: Cable shield connected to housing  
Sensor: The sensor line is connected in the encoder with the corresponding power line  
Vacant pins or wires must not be used!

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# AG Series of Linear Encoders

**QU INDUSTRIAL CO. (EZ TECH, for short)** has two series of linear encoders, magnetic scales and glass grating scales. Both series have models for **numerically controlled** and **manually controlled machine tools**.

Linear encoders can be used nearly everywhere. They are ideal for machines and other equipment whose feed axes are in a servo loop, such as milling machines, machining centers, boring machines, lathes, grinding machines, presses machines, bending machines, automation and production equipments.

Linear encoders predestine themselves for use on highly-dynamic conventional axes as well as on direct drives with the beneficial dynamic behavior, the high permissible traversing speed and the acceleration in the direction of measurement.

## ADVANTAGES OF LINEAR ENCODERS

Linear encoders measure the position of linear axes without additional mechanical transfer elements. The position control loop with a linear encoder includes the entire feed mechanics.

Transfer errors from the mechanics can be detected by the read header of linear encoder, and corrected by the control electronics. Therefore, this makes it possible to eliminate several potential error sources:

1. **Positioning error due to thermal behavior of the recirculating ball screw**
2. **Backlash error**
3. **Kinematics error through ball-screw pitch error**

Therefore, linear encoders are indispensable for machine tools with high positioning accuracy and a high machining rate.

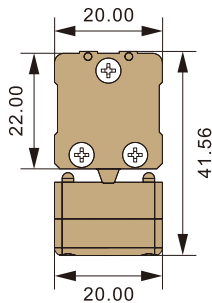
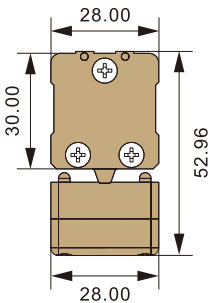
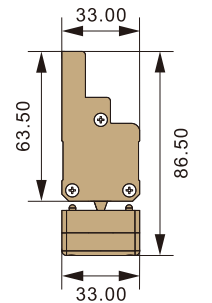
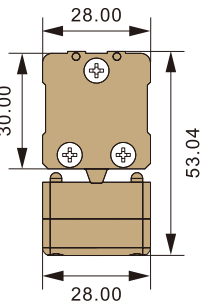
## MECHANICAL STRUCTURE

**EZ TECH's** linear encoders are sealed scales: An aluminum housing protects the magnetic tape or glass grating, read header and its guideways from chips, dust, and fluids. Downward-oriented elastic lips seal the housing.

The read header travels along the scale on a low-friction guide. The main part of read header is fixed to the machine guideways. The connecting structure between the main part and slide car of the read header compensates the misalignment between the scale and the machine guideways.

Depending on the encoder model, lateral and axial offsets of  $\pm 0.2$  mm to  $\pm 0.3$  mm between the scale and mounting block are permissible.

## Selection guide

Type	Magnetic scale with slimline scale housing	Magnetic scale with standard scale housing	Magnetic scale with large-section scale housing		Glass grating scale with standard scale housing	
Scanning principle	MR effect scanning principle	MR effect scanning principle	MR effect scanning principle		Single-field photoelectricity scanning	
Accuracy grade	$\pm 4\mu\text{m/m}$	$\pm 4\mu\text{m/m}$	$\pm 4\mu\text{m/m}$		$\pm 5\mu\text{m/m}$	
Cross section						
Series	<b>AG2220A</b>	<b>AG3028A</b>	<b>AG6333A</b>	<b>AG6333AC</b>	<b>AG3028B</b>	<b>AG3028BC</b>
Interface	EIA-422A	EIA-422A	EIA-422A	$\sim 1\text{Vpp}$	EIA-422A	$\sim 1\text{Vpp}$
Application	manually controlled machine tools	manually controlled machine tools	manually controlled machine tools	numerically controlled machine tools	manually controlled machine tools	numerically controlled machine tools
Resolution	5/1/0.5 $\mu\text{m}$	5/1/0.5 $\mu\text{m}$	5/1/0.5 $\mu\text{m}$	—	5 $\mu\text{m}$	—
Incremental signal period	1000 $\mu\text{m}$	1000 $\mu\text{m}$	1000 $\mu\text{m}$		20 $\mu\text{m}$	
Measuring length (ML)	70-720mm	170-1920mm	1100-3000mm (Over 50m upon request)		170-1420mm	

# AG Series of Linear Encoders

## Measuring principles

### GLASS GRATING SCALE

**EZ TECH's** glass grating scale bases on the photoelectric scanning principle for the incremental measurement.

Photoelectric scanning of a measuring standard is contact-free, and as such, free of wear. This method detects even very fine lines, about 20 micrometers wide, and generates output signals with very small signal periods.

As the figure on the right shown, the imaging scanning principle bases projected light signal generation:

Two gratings with equal or similar grating periods are moved relative to each other - the scale grating and the index grating. The carrier material is transparent glass for the index grating and the scale graduation as the measuring standard.

When parallel light passes through a grating, light and dark surfaces are projected at a certain distance. When the two gratings move relative to each other, the incident light is modulated. If the gaps in the gratings are aligned, light passes through. If the lines of one grating coincide with the gaps of the other, no light passes through.

An array of photodiodes convert these variations in light intensity into electrical signals. The specially structured grating of the index grating filters the light to generate nearly sinusoidal output signals. The smaller the period of the grating structure is, the closer and more tight-tolerance the gap must be between the index grating and scale grating.

The measure standard of glass grating scale is periodic grating. With specially developed photolithographic technologies, these graduations are applied to a quartz glass substrate by hard chromium plating. The position information is obtained by counting the individual increments (measuring steps) from some point of origin. the glass grating has an additional track that bears a reference mark.

The absolute position on the scale, established by the reference mark, is gated with exactly one signal period. The reference mark must be scanned to establish an absolute reference or to find the last selected datum. In the most unfavorable case this may necessitate machine movements over large lengths of the measuring range.

To speed and simplify such "reference runs", **EZ TECH's** glass grating scales has multiple distance-coded reference marks which are individually spaced according to a mathematical algorithm.

### MAGNETIC SCALE

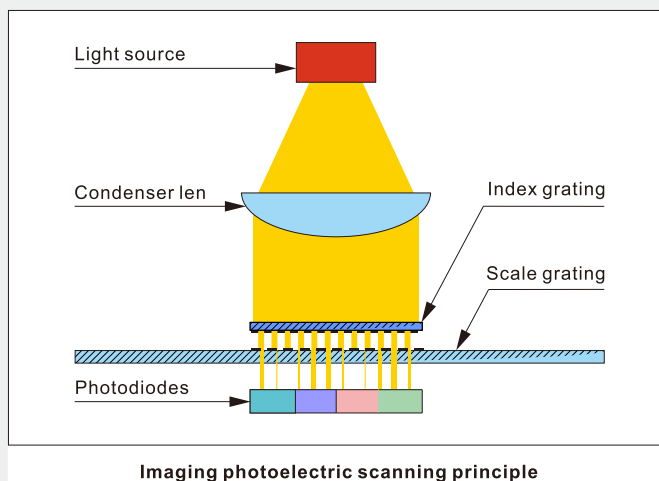
**EZ TECH's** magnetic scales base on the MR effect scanning principle for the incremental measurement. The high precision magnetic tapes and MR sensors are made in Germany. The high precision magnetic tapes act as the measuring standard, with very reliable precision positioning signal storage system made by metal magnetic powder.

The north pole and south pole of magnetic elements are arranged alternately along the magnetic tape.

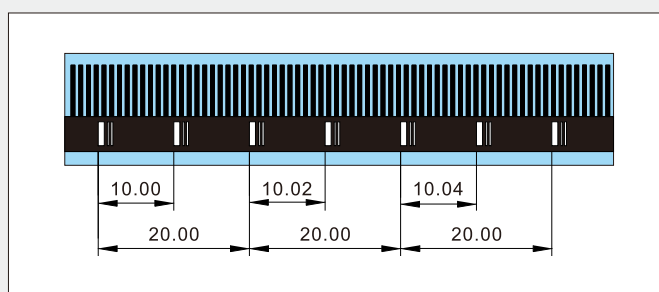
The resistance value of the MR sensor changes when the magnetic field acting on the sensor changes during its scanning process along the magnetic tape. This change in resistance value is read by scale electronics.

For AG6333AC applied in numerically controlled machine tools, the absolute reference marks are coded in the method shown in the picture on the right.

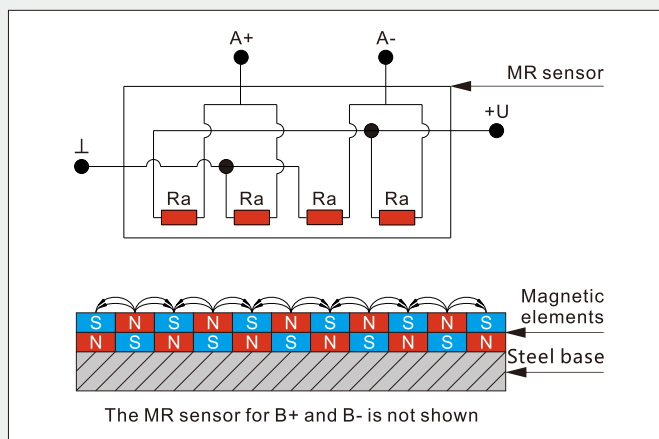
For magnetic scales applied in manually controlled machine tools, AG2220A has one absolute reference mark in the scale center; AG3028A has two absolute reference marks located near two scale ends respectively; AG6333A has three absolute reference marks located in the scale center and near two scale ends respectively.



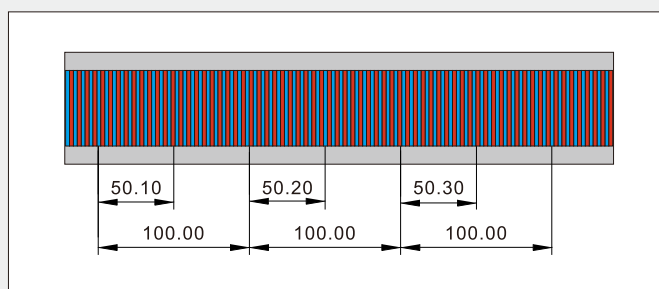
Imaging photoelectric scanning principle



Schematic representation of an incremental graduation with distance-coded reference marks



MR effect scanning principle



Schematic representation of a magnetic tape with distance-coded reference marks

# AG Series of Linear Encoders

## Mounting guidelines

### LINEAR ENCODERS WITH SLIMLINE SCALE HOUSING OR STANDARD SCALE HOUSING

-AG2220A/AG3028A/AG3028B/AG3028BC

#### Mounting direction

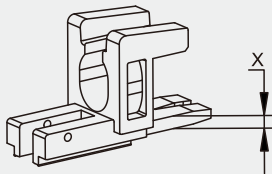
Linear encoders with slimline scale housing or standard scale housing should be mounted with the sealing lips directed downward or away from splashing water.

#### Mounting read header

The read header of linear encoder is mounted on a processed or unprocessed machine guideway with the help of two read header locating seats. The read header locating seats should be removed when the mounting is completed. Generally, the cable import points to the direction in which when the read header moves, the scale outputs these signals described in the Section Interface (also shown in the following pictures in the model details). If limited by the mounting space, the cable import could point to the other direction. The read header could be also mounted by a set of T-shape brackets (optional).

#### Accessories:

Read header locating seats



Model	x(mm)
AG2220A	3.86
AG3028A	3.46
AG3028B	4.00
AG3028BC	4.00

#### Protection

Linear encoders fulfill the requirements for **IP54** protection according to **EN 60 529** or **IEC 60 529** provided that they are mounted with the sealing lips facing away from splash water.

#### Direct mounting

It is very simple to mount the **EZ TECH**'s linear encoders with slimline scale housing or standard scale housing: You need only to align the scale unit at two points along the machine guideway. Stop surfaces or stop pins can also be used for this. The locating seats already set the proper gap between the scale unit and the scanning unit (read header), as well as the lateral tolerance.

If the locating seats need to be removed before mounting due to a lack of space, the gauge is used to set the gap easily and exactly between the scale and the read header, according to the x value of the locating seat. Lateral tolerances must also be maintained.

Along with the standard procedure of using two screws to mount the scale unit on a plane surface, there is another mounting method:

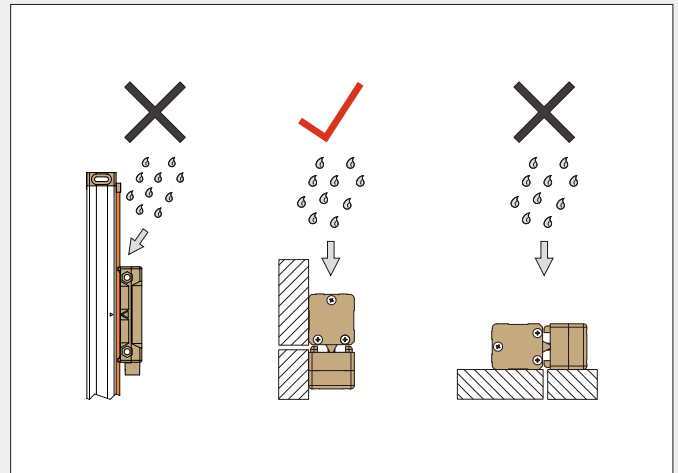
#### Installation with mounting spar

Mounting the scale with a mounting spar can be especially beneficial. It can be fastened as part of the machine assembly process. The scale is then simply clamped on during final mounting. Easy exchange also facilitates servicing. A mounting spar is recommended by **EZ TECH** for highly dynamic applications with measuring length greater than 620 mm. It is always necessary for measuring length starting from 1020 mm.

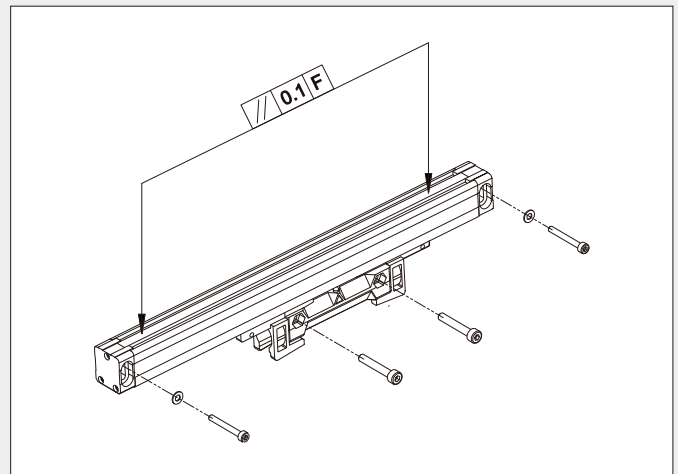
#### Accessories:

AG2220A or AG3028A mounting spar

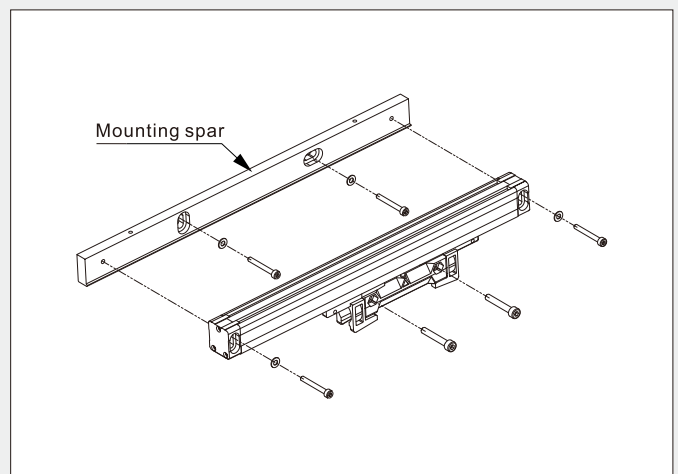
Read header locating seats



Mounting direction of scale with slimline scale housing or standard scale housing



Mounting scale with slimline scale housing or standard scale housing directly



Mounting scale with a mounting spar