



Technical brochure

“LINEAR” EQUATORIAL MOUNT (Made in Italy)

ABOUT COMPANY

AVALON INSTRUMENTS is a branch of the Dal Sasso Srl Italian company and brings high quality and innovative instruments to the astronomical community. With more than 30 years of experience, Dal Sasso Srl is located in Aprilia (central Italy, about 30 km south-west of Rome): with a staff of more than 60 individuals, it hosts the most advanced technologies (CAD-CAM, CNC machines), making it a national reference in the field. AVALON INSTRUMENTS comes from the personal passion for astronomy of Luciano Dal Sasso, founder of Dal Sasso Srl, who has spent most of his free time over the last 15 years doing astrophotography and binocular observations.

About the mount

The LineAR Fast Reverse mount is a universal equatorial mount designed for astronomical imaging: it is one of the most innovative products ever conceived for these applications and it can host a payload up to 20 kg, both for photographic and visual applications.

The LineAR Fast Reverse project is the natural outcome from a strong passion in both astronomy and mechanics, with the benefit of more than 15 years of experience on the field, attending star parties and spending countless hours under the stars. While observing or taking pictures with many different instruments, it was clear that the mount was the main source of troubles, so the idea was to project a new one fixing as much of them as possible.

Goal: total reliability

The main goal of the project was to make available a perfect mount for **astroimaging**, with no plays and vibrations, assuring the highest precision and total reliability on the field. Every astroimager dreams a very solid, silent mount working flawlessly, with a good portability and easy to align with the pole, of course providing well tracked images. After months of hard tests, the Avalon team knows that the LineAR mount matches all these needs.



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A revolutionary technology: *Tooth belt transmission*

Designers at Avalon Instruments wanted to completely fix any play or backlash issues, eliminating the excessive costs of the traditional mechanical devices used on equatorial mounts (worms and gears) and making a new transmission system, based on pulleys and **tooth belts**. A four-stages reducer is used.

Those devices are used with great success for industrial mechanical applications, as they provide a perfect transmission of movements in a very linear way, eliminating any play and noise, at the same time assuring a very high precision.

Benefits of the *tooth belt*

A tooth belt, which has no play for itself, is better than other mechanical devices because of its working principle. In the gear-worm systems, there is just one, tangent contact point between the working parts. Under these conditions, the lever arms and the efforts produced by the telescope-mount system introduce some small non-linearities in the transmission of the motion; they are visible as small shifts, evident in the images obtained with those traditional devices. Those small effects are proportional to the focal length, so they are particularly visible with telescopes having a long focal length.

The tooth belt transmission does not introduce these troubles, as there is no contact among pulleys and motion is transmitted by the belt with no play at all. The belt has an extended contact with the pulley, so the motion is transmitted by the tooth belt in a very gradual and smooth way, without "peaks" and accelerations/decelerations, typical of traditional gear-worm systems and giving troubles while taking images, even with modern autoguiding devices. Autoguiders, indeed, often are not fast enough to compensate for those sudden anomalies coming from the gear-worm coupling.



As every experienced astroimager knows, well calibrated autoguiders are unable to provide perfectly tracked pictures with traditional mounts, even when they employ gear-worm systems with small tracking errors. These anomalies are not recorded by the guiding telescope, as they originate between the guiding device and the mechanics of the instrument.

Thermal variations, flexures and torsions, especially close to the meridian, transfer plays and mass to the gear (which is in equilibrium) and the resulting effects introduce several oscillations, creating unwanted shifts and sudden movements.

Images always perfectly tracked

Since the very first tests, the manufacturer noticed how easy it was to capture very well tracked, long exposure images, matching the primary goal of the project.

While *visual observing* with high magnifications, the absence of any noise and a very fast damping time are clearly evident, as well as the lack of any play or backlash and the immediate, smooth response to the electronic commands: no play or unpredictable behaviours are seen, even with high payloads.

The LineAR mount must be perfectly balanced – which is very easy to do, as the LineAR axes have no friction – because it has not the play troubles originating during the mass transfer while crossing the meridian.

The LineAR transmission, based on four stages of reduction, introduces tracking errors which can be larger than those shown by traditional mounts in the same price range, but the absence of peaks and sudden accelerations makes possible perfectly tracked – autoguided – long exposures, even with more than 20kg of payload, competing with more expensive, higher class mounts.

It must be stressed that the LineAR mount requires an autoguider (but it can be easily guided by hand, thanks to its smooth, gradual errors and the quick response of the commands, even at the lower - 0.125X - rates). Furthermore, it should be underlined how the PEC is useless with the LineAR, as well as the software commonly used to handle the periodic errors.

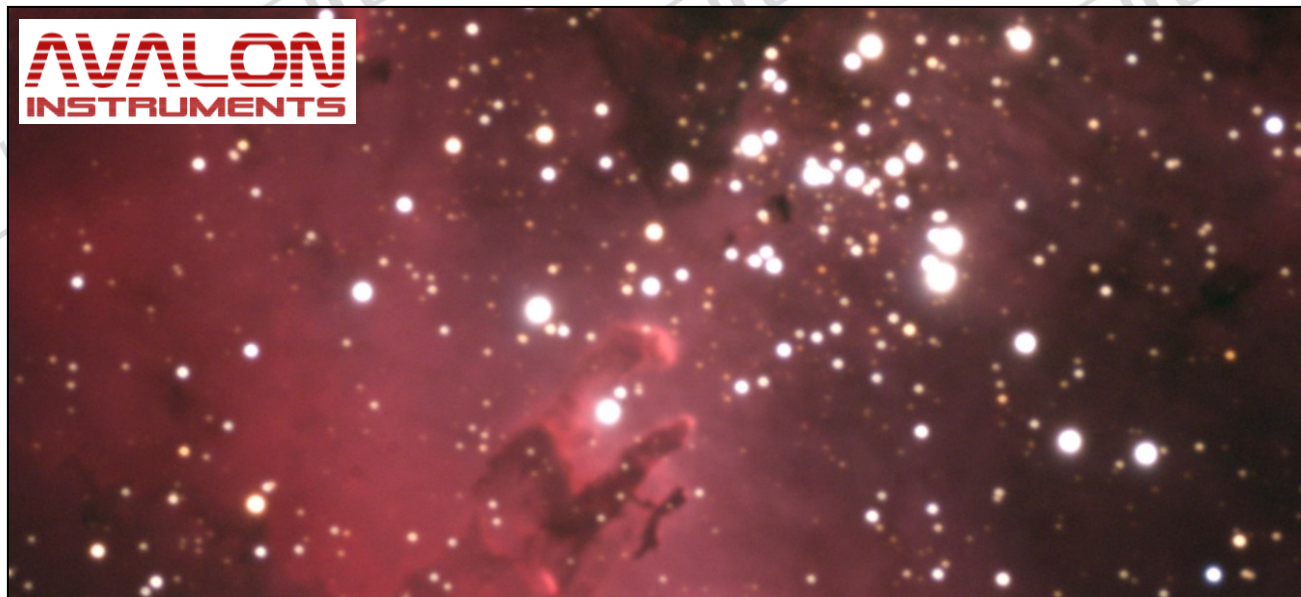


IMAGE ACQUIRED WITH LINEAR MOUNT AND EDGE HD925, AVERAGE OF THREE 20 MIN. EXPOSURES

The LineAR mount redefines the Periodic Error concept

While the tracking error generated by the transmission devices inside the LineAR is large in absolute terms (typical, mean values are of ± 5 , ± 7 arc-seconds), this is no reason of concern: the mount, which uses a four-stages reducer with tooth belts, has a very slow and smooth error, well spread over the time, so that it is very easy to handle with any autoguider, even while doing images with long focal length (2-3 meters) telescopes.

The LineAR must be used with an autoguider and a slow correction rate, as 0.125X, but it still makes possible to take unguided images with 500-600mm focal length telescopes. Furthermore, because of the technology used, having four different, very slow tracking curves, the PEC function is not useful (as well as the software generally used to optimize the PEC performances, which do not contemplate such a complex case).

The final result: perfectly tracked images, with ROUND stars. The positive effects of the reducers, using tooth belts, were clearly obvious since the very first imaging sessions: many tests were performed, with focal lengths between 1 and 3 meters and single exposures up to 30 minutes, without even a single wrong image. Some images taken using the LineAR mount are available here: <http://www.avalon-instruments.com/prodotti.asp?cod=AR> (click on the images there).

Zero Maintenance, zero adjustments

A side benefit from the tooth belts is that they don't need of any lubrication, so the LineAR mount has no grease inside. Also, thanks to a belt puller, the transmission system does not show any play, no matter the payload, the wear and the thermal variations. The LineAR mount does not use materials subject to wear or corrosion.

Once perfectly balanced, the LineAR mount does not need any further counterweight adjustment while in use, while the traditional mounts, with gears and worms, need it before and after the passage at the meridian to reduce the "pendulum" effect. Once properly adjusted, the counterweights work for every position, a property making the LineAR mount a great choice for permanent installations and remote observatories.

Lightness, sturdiness and high precision

The components of the LineAR "head" are directly made from a single block of aluminium, thanks to extremely high precision CNC machines with 5 axes. The whole process is done in a single session, never removing the part under construction. So, the resulting orthogonality of the axes is highly accurate, within a few thousandths of degree.

The belts used in the LineAR are made of puliuretan, with steel inside. Puliuretan is a highly non-deformable technopolymer, with a high elastic module, so it keeps its structure unchanged over the time, even under strong efforts and large thermal variations. In addition a puller is used on each axis, to remove any play.

The pulleys, made by Avalon Instruments in its own factory, are made with a technopolymer using a glass fiber, providing an amazing dimensional stability. The Avalon designers created special, smoothed teeth, removing or minimizing every unwanted small variation in the tracking speed (a source of tracking error), which would otherwise originate because of the interaction between the belt and the pulley.

Solutions making life easier

The Avalon LineAR is a mount integrating solutions making life of amateur astronomers easier, eliminating many technical problems. For example:

- Very sturdy and lightweight for easy transportation.
- A handle installed on the body of the mount, to easily move and transport the LineAR around.
- No cables around: all the cables connecting the motors to the electronics are inside the mount, so they do not interfere with the hand control unit cables.
- GoTo system: the LineAR mount uses the well known and tested GoTo Synscan system, based on the reliable microstep technology. It is a solid, reliable device, with one autoguider port and a RS-232 port; the firmware is easy to update via the Internet. It is fully compatible with the ASCOM platform, so it supports many advanced functions, like pointing models with T-Point, remote control and so on.
- The surface offers the best anodization process available, providing an excellent protection against scratches; it is also insensitive to the atmospheric agents and it is very stable over the time.
- A clear, easy to read latitude scale and indexes marking the "home" position are impressed on the body and on the AR stand of the mount.

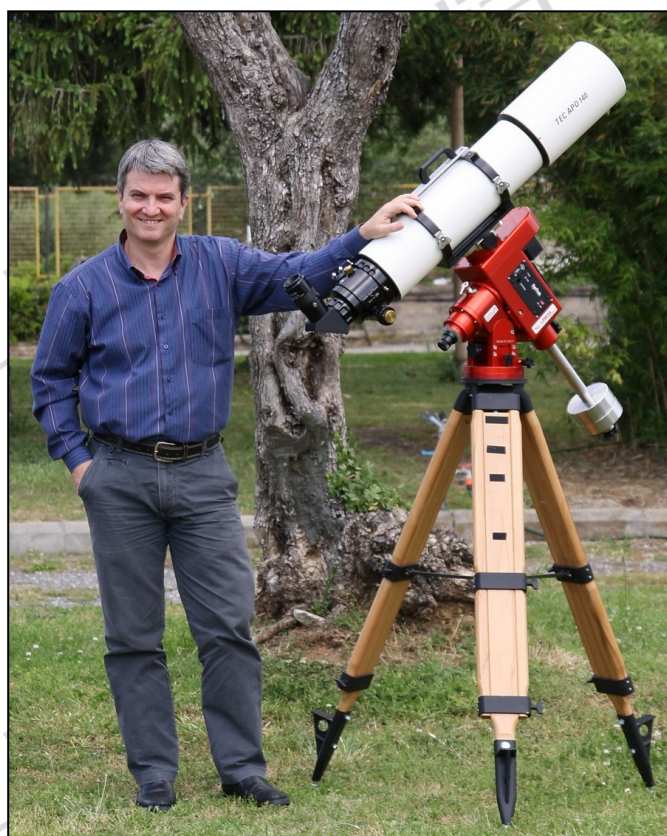
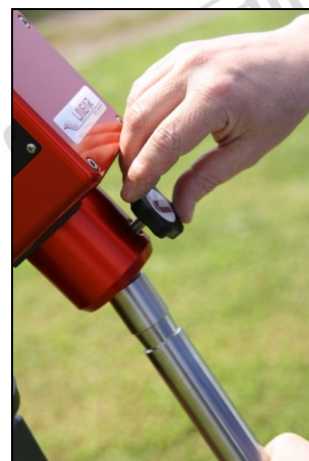
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Solutions making life easier

- Blocks on both axes are easy to use even with gloves.
- Ergonomic Knobs for fine tuning both the altitude and the azimuth of the polar axis. The altitude worm is not under the weight of the mount – in contrast with many competing mounts – so it is smooth and very accurate.
- Plate L=3" (75 mm) Losmandy dovetail compatible, with a single blocking knob using two tightening points. A larger clamp handles better heavy payloads, as the weight is distributed over a larger surface.
- Universal tripod/column plate (ready to accept Baader AHT, Skywatcher tripods and more).
- Quick and robust counterweight shaft clamping, making easy the mount assembly.
- Polar finder included, for an easier polar alignment.
- Both axes use high quality bearings, for a very fluid motion, with no friction even with heavy payloads, allowing a perfect balance of the mount. Very short damping time.
- Quick to assemble: the LineAR mount requires just a few minutes to be ready and properly polar aligned, thanks to a special reticle and to the support of the Synscan device; long exposure images can be started within minutes.
- Mount easy to balance. Thanks to the very small friction on both RA and DEC. axes, reaching a perfect, very accurate balance is amazingly easy.
- Light and very sturdy: the head of the mount weights 12.5 kg (without counterweights and their shaft) and it can hosts a 200-280mm catadioptric, a 250mm-f/4, f/5 Newtonian and a 130-150mm, short focal length refractor.

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Included Accessories

- 3", Losmandy type plate
- Polar scope
- 6 Kg, stainless steel counterweight
- Synscan system
- Cardboard box with customized foam



Optional Accessories

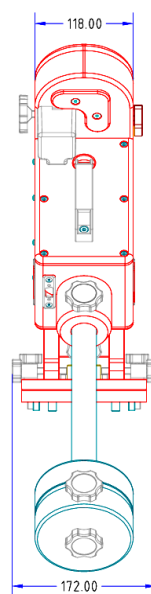
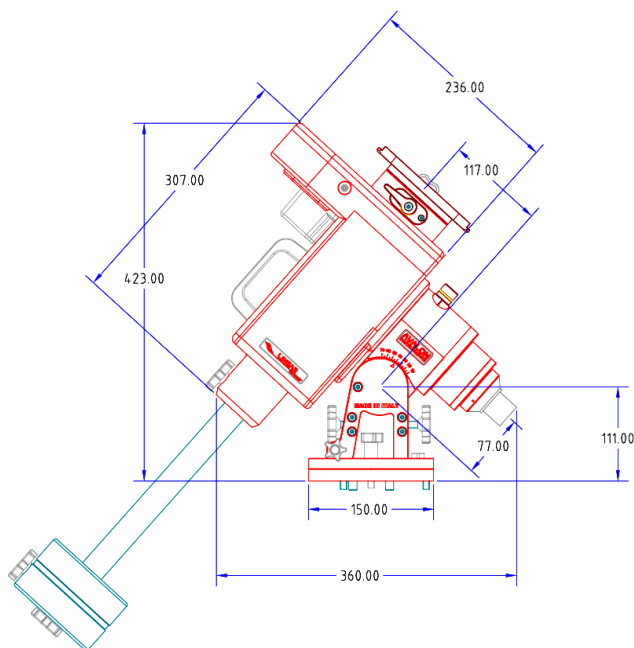
- Synscan **GPS** Kit.
- Baader AHT tripod.
- SkyWatcher EQ6 tripod.
- Original Losmandy polar finder.
- Additional 2 - 3 - 4 & 6 Kg counterweights.
- Avalon metallic piers (diam. 150 - 180 - 200 mm, various heights).
- Custom plates upon request for other tripods/piers.
- Soft transport case: a soft case is available upon request with custom foam, for a safe and easy transportation of the mount (av. 12/11).
- Rigid transport case: an hard case is available upon request with custom foam, for a safe and easy transportation of the mount.
- Available colours: the LineAR mount is available only in red.
- EQ-Mod software for advanced, remote control of the mount.
- Synscan standalone Autoguide or LVI SG/SG2.
- Portable Celestron Power Tank 17Ah power supply.
- TheSky 6 and T-Point software packages for a very advanced remote control and pointing error correction.
- Celestron EdgeHD 800/925/1100 telescopes with Astro-Physics CCD67 focal reducers or Optec Lepus 0.62x.
- SharpStar AL106 refractor with field flattener.



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Technical specifications

Type:	German equatorial mount
Construction material:	Aluminium, steel, brass, technopolymer
Transmission	Four-stages reducer, with pulleys and tooth belts mounted on bearings, with zero play on both axes
Transmission system	Pulleys made with special technopolymer loaded with glass fiber and high precision tooth belts
R.A. axis	Heavy duty steel, diam. 35 mm.; 2 roller, conical bearings, diam 62 mm. + 1 roller bearing diam. 72mm + 2 roller bearings diam. 45mm – on bearings clutch
DEC. axis	Heavy duty steel, diam. 35 mm.; 2 roller, conical bearings, diam 62 mm. + 1 roller bearing diam. 72mm + 1 roller bearing diam. 45 mm - on bearings clutch
Tracking error	Average: +/-5-7 arc-seconds
Altitude/Azimuth motions	Contrast worms with ergonomic knobs
Tripod plate	With multiple holes, ready for Baader AHT and SkyWatcher EQ6 tripods
OTA plate	Losmandy 3" (75 mm) standard dovetail with single knob clamp, with two tightening points.
Payload capacity	25 Kg Max, 20 Kg for imaging
Suggested tripod	Baader AHT (optional). It is possible to order the SkyWatcher steel tripod with 2" legs (EQ6) or the Avalon metallic pier (diam. 150 mm, height 1000 mm)
GoTo system	SkyWatcher Synscan (for technical details, please see the technical data for the Skywatcher Synscan Upgrade Kit or NEQ6 Synscan)
Motors	Stepper, microstep motors.
Communication Ports	RS-232, Autoguider (ST-4)
Counterweight bar	Quick release, stainless steel, diam. 30 mm.
Counterweights	One adjustable, 6-kg stainless steel counterweight (included)
Polar Finder	SkyWatcher EQ5 (included) – Upon request, the Losmandy polar finder is available
Power	12 V 3 A stabilized power supply (included)
Weight	13,00 Kg (without counterweights and counterweight bars)



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