10MICRON
astro•technology
by COMEC-TECHNOLOGY

GM4000

HPS

10MICRON: NO COMPROMISES

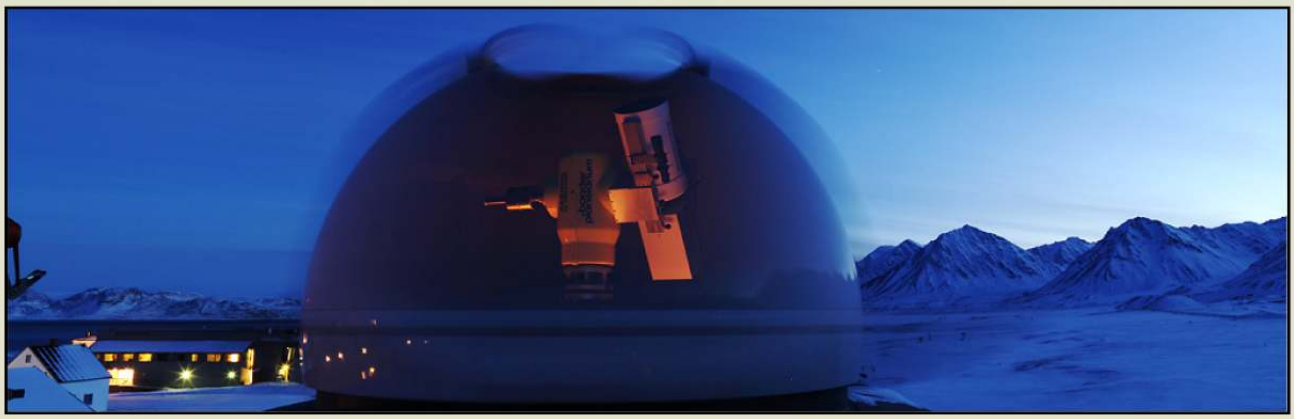
The developement of 10micron products is aimed to provide both the best performances and the maximum ease of use.

The availability on the market of more and more advanced and flexible astronomical imaging systems opens new windows on the sky: today, ultra-high definition and ultra-high speed imaging is within the amateur's reach, way more than what was predictable ten years ago. 10micron's products evolved at the same pace, in terms of tracking and pointing accuracy and speed. The HPS series mounts are now at the peak of this process.

Every observer knows that when you are under the sky you have little time and each set up operation comes with the risk of compromising the night. Having excellent performance on paper means nothing if you need many complex set up operations before reaching it.

This is the reason 10micron mounts are designed around the user's needs, and not to enforce the mount's way of operation on them.

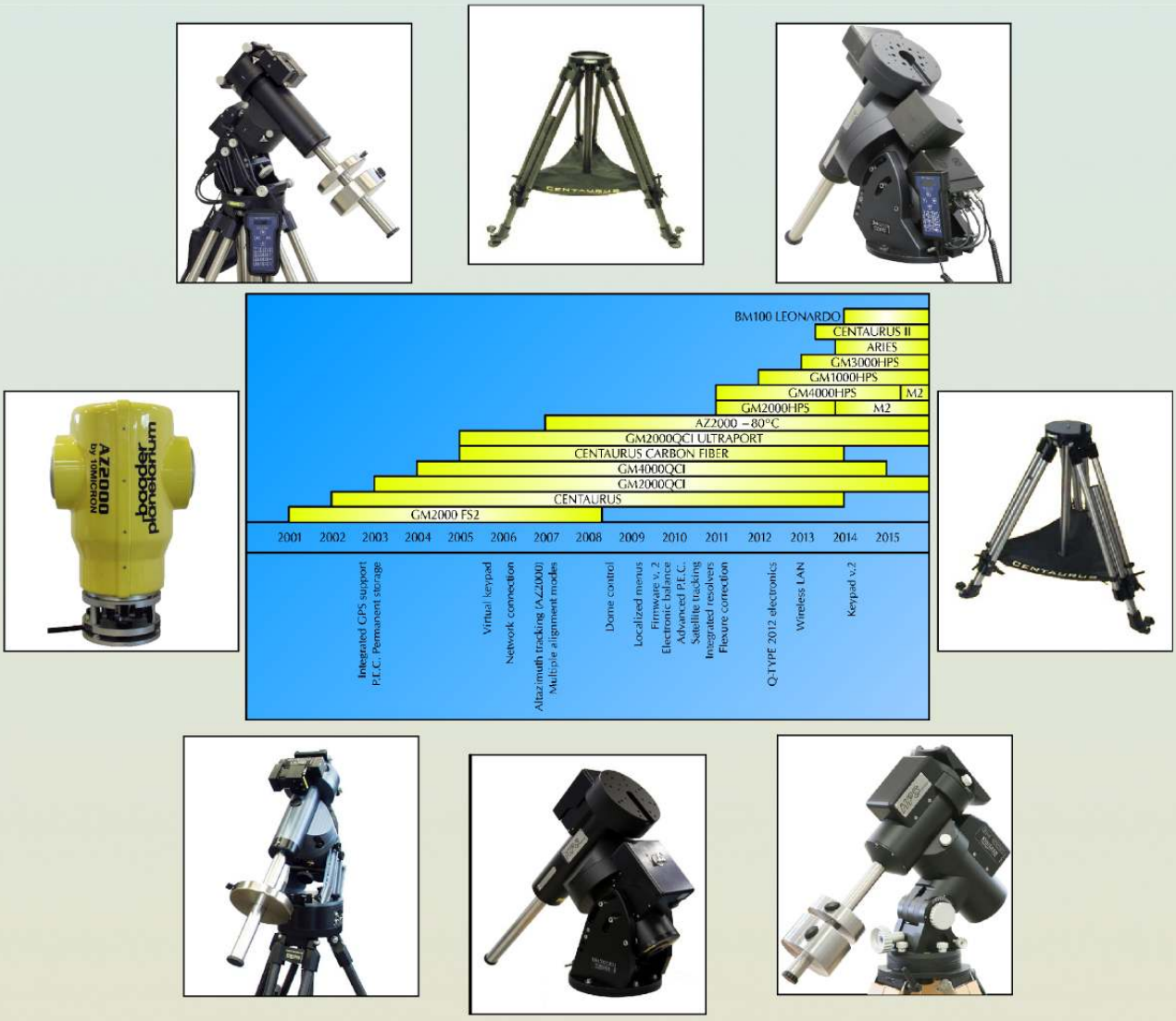
Now 10micron mounts are used in the open field as well as in remotized sites, in educational observatories as well in the extreme climates of northern Canada and Atacama desert.



TEN YEARS OF HISTORY

The experience of ten years in astronomical manufacturing.

The 10micron mount line was born in 2000 with the aim of providing high standard quality products: Equatorial mounts, altazimuth mounts and tripods always with the best performance.



The 10micron product range.

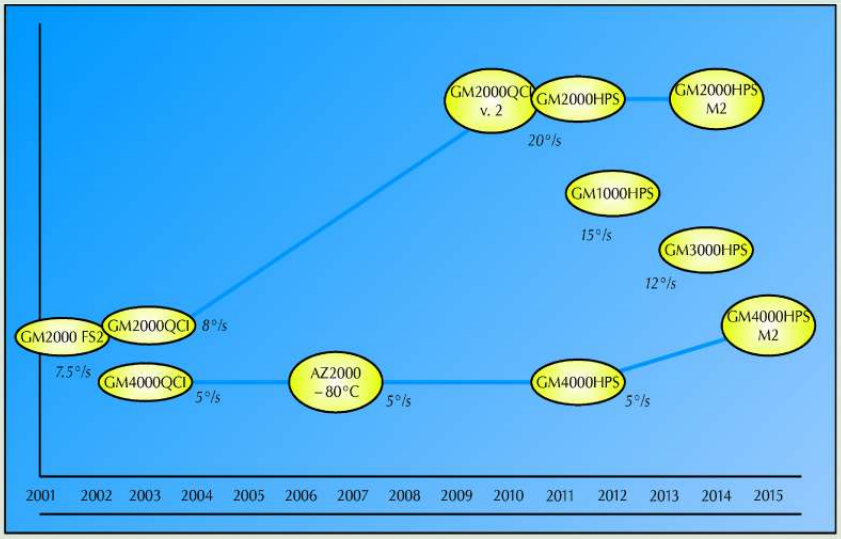
From the traditional german equatorial mounts GM2000 and GM4000, now also in the HPS version, to the special application AZ2000 altazimuth mount, and the new GM1000HPS and GM3000HPS mounts, the 10micron product range is dedicated to the most demanding observer.

PUSHING THE PERFORMANCE ENVELOPE

Always striving for the best performance.

Two are the main numbers defining the performance of an astronomical mount: the tracking accuracy and the maximum slew speed. The constant tecnhological evolution allows for improving these numbers continuously. From the first GM2000 mounts with stepper motors up to the new GM3000HPS, the tracking accuracy has been improved by an order of magnitude and the pointing speed has been improved by a factor of three.

An high pointing speed is required for many astronomical applications. Searching for supernovae, asteroids or exoplanets, where images of a large number of different objects are required in the minimum time, as well as tracking artificial satellites.



Pointing speed of 10micron mounts.

An excellent tracking accuracy is required instead for high-resolution deep-sky imaging, in order to simplify or completely get rid of complex autoguiding systems, which can be source of errors or breakdowns.

Tracking accuracy of 10micron mounts.

THE HPS TECHNOLOGY

HPS stands for High Precision and Speed, representing the essence of the new 10micron mounts. High precision, thanks to an innovative and exclusive absolute encoder paired with the 10micron manufacturing. High speed, thanks to high performance electronics and AC servo motors.

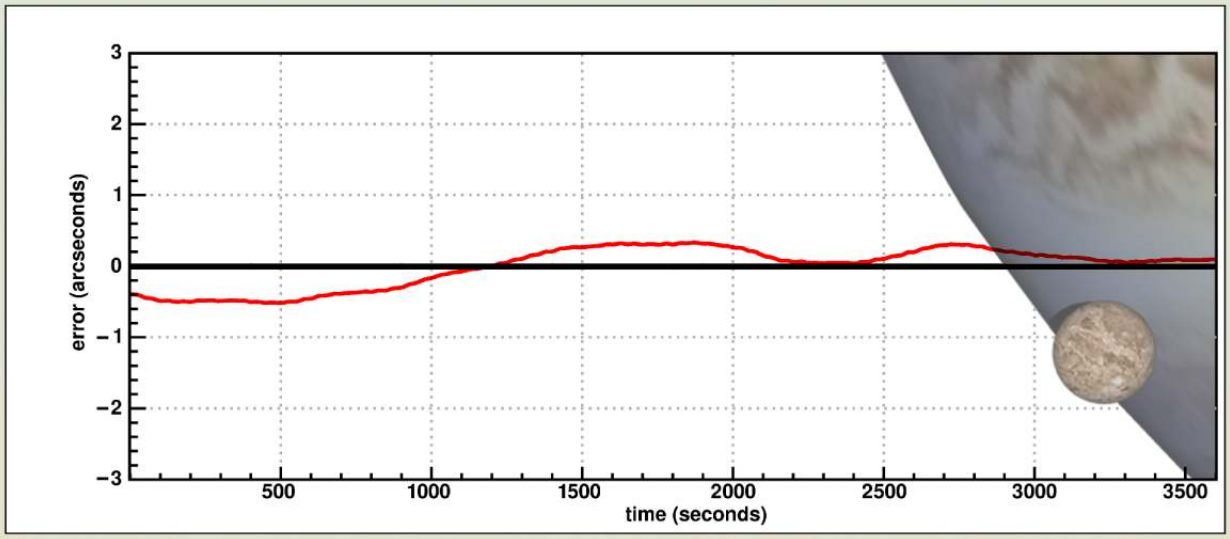
The HPS series mounts are equipped with a pair of absolute encoder with ultra-high resolution, directly mounted on the right ascension and declination axes.

This technology has been used already in the professional observatories, where the high cost and complexity are not an issue. Measuring directly the rotation angles of the axes allows to compensate the large part of the mechanical errors, such as periodic errors and transmission backlash. However, this requires systems with very high resolution.

In the past few years this technology is being found also in amateur astronomers' instruments, often paired with the use of *direct drive* technology, where motors are mounted directly on the mount's axes, without any mechanical reduction gearing.

While having some advantages, using a *direct drive* system implies also some drawbacks such as having axes less robust to external stresses like wind and greater power needs. For this reason, 10micron mounts continue to feature the traditional worm – wormwheel transmission.

The absolute encoders used in the HPS mounts have been specifically designed for this application. Beyond a resolution of the order of a tenth of an arcsecond, in this way we have also removed any need for homing or position-saving procedures.



Tracking error profile measured with an encoder coupled to the r.a. axis.
Jupiter and Ganymede are shown as they appear from Earth, at the same scale.

GM4000HPS

Evolving perfection.

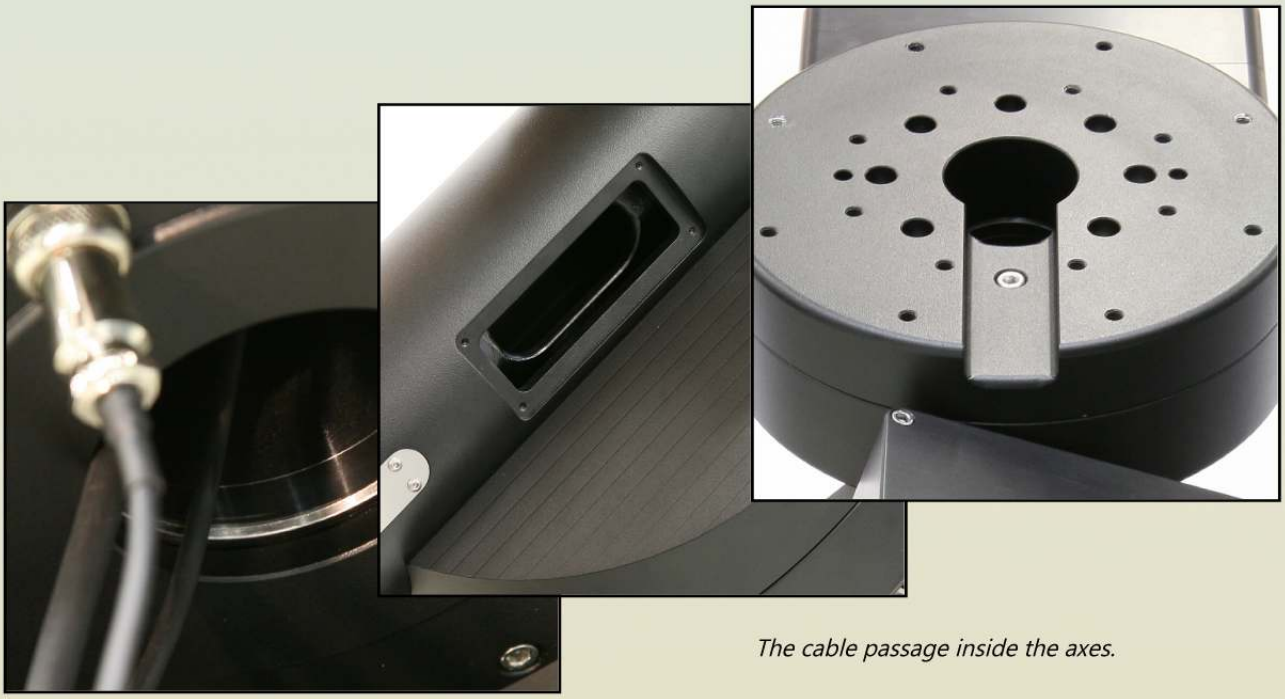
The GM4000HPS mount, now in the new M2 version, is built for observatories with an instrumentation up to a weight of 150 kg – 330 lbs (excluding counterweights). It is ideal for remotized observation sites, and its loading capacity allows for mounting instruments like 300 mm diameter refractors, 400 mm diameter Newton reflectors, 600 mm diameter Cassegrains and so on.

Movements are driven by two AC servo motors, with timing belt reduction having zero-backlash. Both axes feature a classic worm – wormwheel pairing. The wormwheels are made of bronze (B14), with a diameter of 330 mm and 430 teeth in right ascension, and a diameter of 244 mm and 315 teeth in declination. The worms are made of alloy tempered steel with a diameter of 32 mm. The axes themselves are made of alloy steel, with a diameter of 85 mm (right ascension) and 80 mm (declination), for the maximum rigidity.

The control box on the GM4000HPS.

The electronics is housed in an easily detachable housing (control box), mounted above the right ascension axis, in order to obtain the best accessibility of all connections. The connections of the mount and keypad secutiry lock screws. Only one cable runs from the control box to the mount.

The axes feature a 60 mm diameter hole allowing for the passage of instrumentation cables. This effectively solves the problem of entangling cables and damaging instruments, especially for remote observatories.



The cable passage inside the axes.

The mount is powered with low voltage, requiring a maximum power of about 100W. This makes possible using the mount even in locations with limited power available.

The GM4000HPS can be controlled completely using the included hand pad, without requiring any external PC.

The keypad is built in order to maintain the maximum readability in all lighting conditions. Both the display and the ergonomic keys, allowing for the use of gloves, feature a red backlight. An heater keeps the display warm for usage below freezing temperatures.

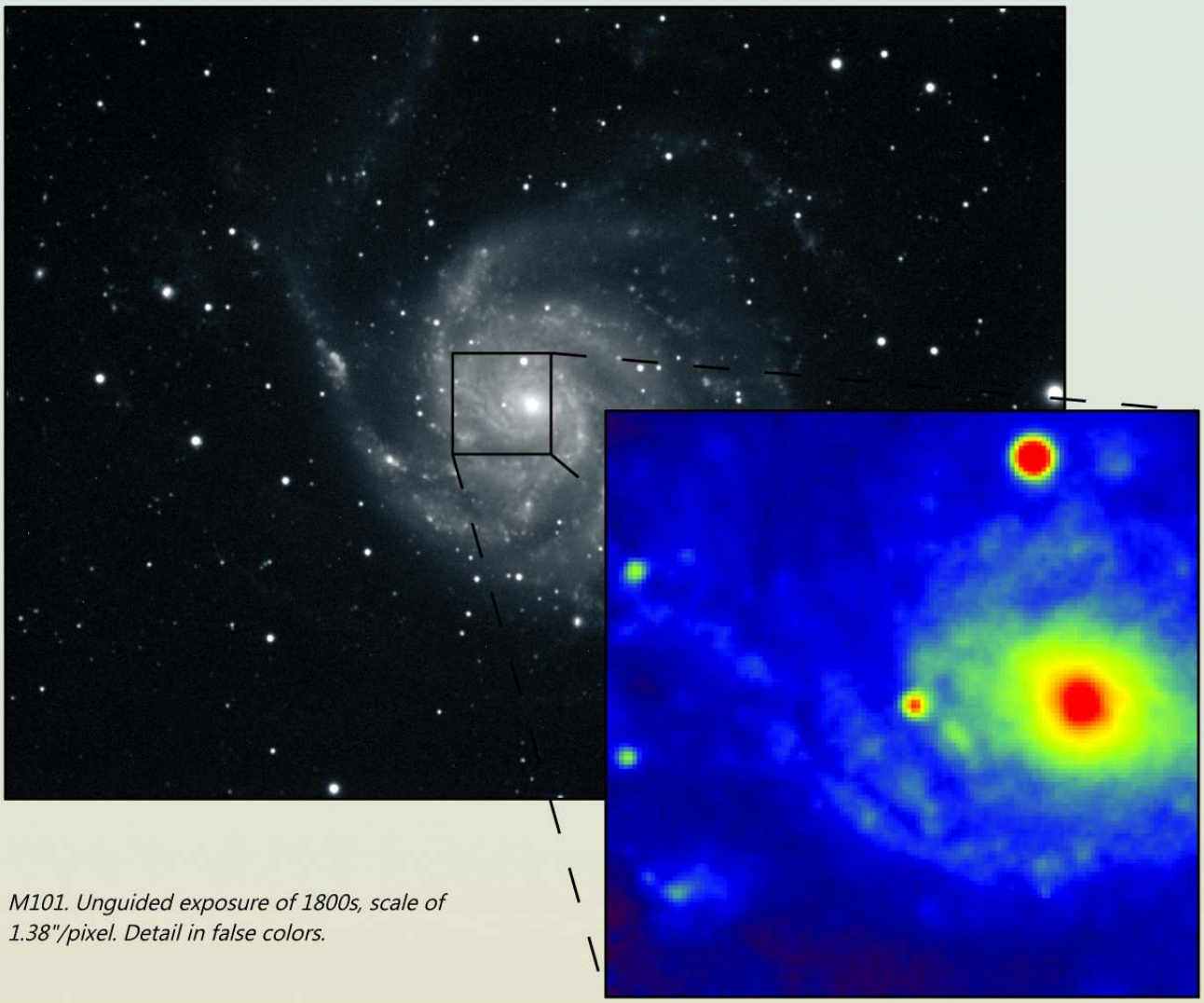
The mount can be controlled using the most common software packages by connecting it to a PC with the RS-232 serial port or the Ethernet connection, via the 10micron ASCOM driver or the Meade compatible command protocol. Furthermore, a dedicated software (also included with the mount) can be used to create a "virtual keypad" replicating exactly the functions of the physical keypad. The RS-232 port can also be used to control an external dome. This flexibility makes the GM4000HPS an ideal mount for observatories and remotized observing sites.

The object database contains many star catalogs and deep-sky objects up to the 16th magnitude. Solar system objects can be tracked so that their motion is compensated with respect to the stars. You may load orbital elements of comets, asteroids and artificial satellites into the mount, so that these objects can be tracked directly.

Pointing is made accurate through the usage of a model containing up to 100 stars, which allows for the correction of the classical polar alignment and conic errors, and also of the most important flexure terms of the optical tube. In this way it is possible to obtain pointing accuracies of the order of 15 arcseconds RMS. The same model can be used in order to obtain the maximum tracking accuracy, compensating also for the atmospheric refraction (depending on the local atmospheric pressure and temperature). A series of auxiliary functions is provided to help the user for quick aligning the mount to the celestial pole. You may also save and recover the alignment data of different observing sessions. This function is very useful if you have many instruments in different setups, each one requiring different flexure corrections.

Tracking through the meridian, a typical problem with german mounts, is solved allowing for tracking for up to 30° past the meridian (configurable), in both directions. In this way any object can be tracked for at least four hours.

The tracking accuracy makes autoguiding not necessary for many uses. The absolute encoders on both axes allows to obtain a typical tracking error below 1 arcsecond. It is possible to autoguide anyway, using the ST4-compatible port or through the serial/Ethernet connection, with a guide rate configurable from 0.1x to 1x. The guide rate can be automatically corrected for the declination of the target, so that there is no need of recalibrating the autoguide when observing at different declinations.

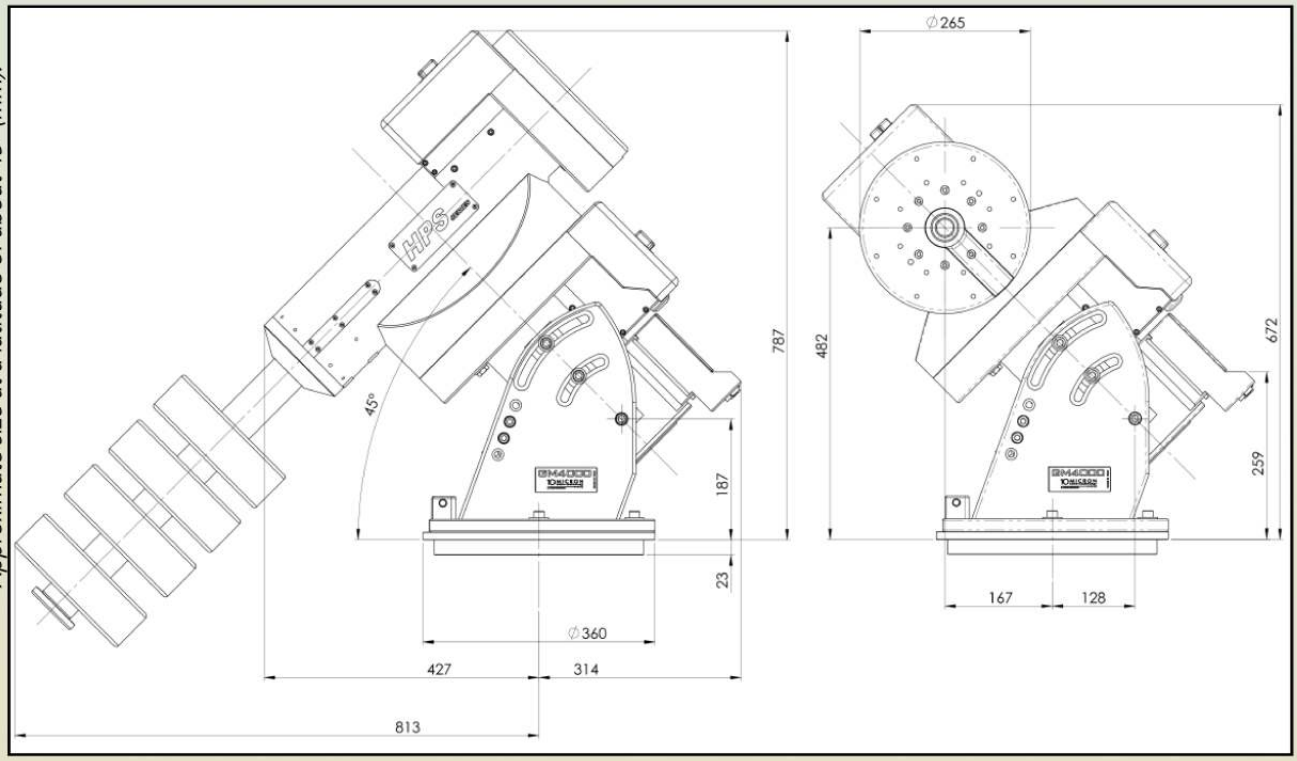


M101. Unguided exposure of 1800s, scale of 1.38"/pixel. Detail in false colors.

The mount has also dedicated function for easy use in the observatory. A dedicated connector on the control box panel is used for remotized switching on and off. The instrument can be electronically balanced, without disengaging the worm from the wormwheel. The mount can be parked in different user-defined positions.

The serial RS-232 port can be used to control directly an external dome, avoiding the need of using a dedicated external PC. Once configured with your instrument parameters, the firmware is able to make all the calculations required for positioning the dome slit in front of your optical tube, for almost all instrument configurations.

Approximate size at a latitude of about 45° (mm).



TECHNICAL DATA SHEET

Type	German Equatorial Mount
Weight (mount)	125 kg – 276 lbs without accessories
Instrument payload capacity	150 kg – 330 lbs
Latitude range	20° – 70°
Azimuth fine adjustment range	+/– 10°
Counterweight shaft	60 mm diameter, stainless steel, weight 13 kg – 29 lbs
Axes	r. a. 85 mm diameter, alloy steel dec. 80 mm diameter, alloy steel
Bearings	Pre-loaded tapered roller bearings
Worm wheels	a.r. 430 teeth, 330 mm diameter, B14 bronze dec. 315 teeth, 244 mm diameter, B14 bronze
Worm gears	diameter 32mm, tempered alloy steel, grinded and lapped
Transmission system	Backlash-free system with timing belt and automatic backlash recovery
Motors	2 axes AC servo brushless
Power supply	24 V DC
Power consumption	~ 1,5 A at sidereal speed ~ 5 A at maximum speed ~ 6 A peak
Go-to speed	Adjustable from 2°/s to 8°/s (6°/s in a.r.)
Pointing accuracy	< 20" with internal multiple-stars software mapping
Average tracking accuracy	< +/– 1" typical for 15 minutes (< 0.7" RMS) with internal multiple-stars software mapping and compensation of flexure and polar alignment errors

Security stop	+/– 30° past meridian in r.a. (software) +/– 35° past meridian in r.a. (mechanical) +/– 170° interval in dec. (software) +/– 172,5° interval in dec. (mechanical)
Communication ports	RS–232 port; GPS port; autoguide ST-4 protocol port; Ethernet port.
Database	Stars: by name, Bayer designation, Flamsteed designation, Bright Star Catalogue, SAO, HIP, HD, PPM, ADS, GCVS. Deep-sky: M, NGC, IC, PGC ,UGC limited up to m_V = 16. Solar system: Sun, Moon, planets, asteroids, comets, artificial satellites. Equatorial and altazimuth coordinates. User defined objects, fast slewing positions.
Firmware features	User defined mount parking position, 2-stars and 3-stars alignment function, up to 100 alignment stars for modeling, correction of polar alignment and orthogonality errors, estimate of average pointing error, storage of multiple pointing models, sidereal, solar and lunar tracking speed adjustable on both axes, declination-based autoguide speed correction, adjustable horizon height limit, pointing and tracking past meridian, assisted balance adjustment, manual or GPS based time and coordinates setting, automatic synchronization to PC clock with ClockSync proprietary software, leap second support and full accounting for the UT1 – UTC timescales, direct dome control via RS-232, configurable atmospheric refraction, network settings, comets and asteroids filter, multi-language interface. Remote Assist via Internet connection.
Keypad control	Rugged keypad with metal housing and reliable micro switches, large graphic display with up to five text lines and status icons, heating for low temperature operation, dimmable display and backlit keys; all the functionality of the mount is available through the keypad without requiring an external PC.
PC control	Remote control via RS-232 or Ethernet; proprietary ASCOM driver or LX200 compatible protocol; update of firmware and orbital elements of comets, asteroids and artificial satellites via RS-232 or Ethernet; virtual keypad control panel via RS-232 or Ethernet; integrated Wi-Fi module for connection with smartphones, tablets and any wireless network.

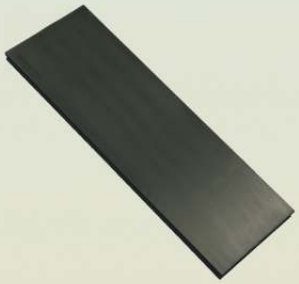
ACCESSORIES FOR GM4000HPS

#10M4550
5" dovetail plate.
Extended 5" dovetail plate, 3 locking points.
For the #10M4560 bar.

#10M4560
5" dovetail bar.
Lenght 500 mm, mathes the #10M4550 plate.

#10M4555
Giant 8" dovetail plate.
Special plate, design by Baader Planetarium.
For the #10M4540 bar or PlaneWave telescopes model CDK 17, CDK 20, CDK 24.

#10M4540
Giant 8" dovetail bar.
Length 500 mm, matches the #10M4555 plate.



#10M4545
Adapter flange for 3" Losmandy dovetail plate. To assemble the #10M2135, #10M2085 or #10M2185 plates with the GM4000.

#10M2135
4" MAXI plate. To mount the MAXI dovetail bar (#10M2199). Dovetail with dual locking knobs and safety lock. Length 250 mm. Requires the #10M4545 adapter flange.

#10M2199
4" MAXI dovetail bar
Matches the MAXI plate (#10M2135).
Lenght 400 mm.

#10M2085 – #10M2185
Losmandy 3" dovetail plate.
To mount the Losmandy universal dovetail bars #10M2125 / #10M2130, with dual locking knobs (#10M2085) or three locking knobs (#10M2185). To be mounted on adapter flange #10M4545.

#10M2125 – #10M2130
Losmandy dovetail bar.
Matches the Losmandy plates (#10M2085, #10M2185). Length 300 mm (#10M2125), 400 mm (#10M2130).

#10M4083
20 kg – 44 lbs counterweight.
Stainless steel. Minimum quantity 5 pieces.

#10M4090
Pier adapter.
For assembly on new or pre-existing column. Electroplated steel.

#10M4230
GM4000 standard pillar.
Circular section 33 cm diameter. Fixed circular base plate. Not leveling. Height 120 cm.

#10M4185
Heavy steel leveling flange.
By Baader Planetarium. To be assembled on pillar #10M4220.

#10M4220
Octagonal steel pillar.
By Baader Planetarium. Dual wall design, Zeiss FI-analysis. Weight 200 kg – 440 lbs.

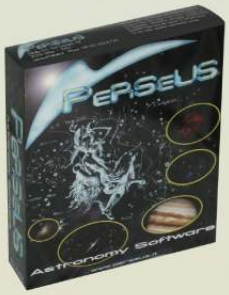
#10M4206
Stabilized power supply.
Input 110 V AC, output 24 V DC 6/8A 200 W.

#10M4105
GPS receiver module.
Directly connected to the mount, provides the exact time and coordinates of the observation site.

#10M4100
Wooden case on pallet, for shipping.
Sturdy wood case meeting the international treatment standards for transport.

#10M4199
Mandatory shipping kit for GM4000.
Wooden case (#10M4100) and pier adapter (#10M4090), both necessary for shipping the mount . The robust steel flange is mandatory not only to securely attach the mount to the delivery pallet, but also afterward to transmit all the mount loading capacity to the pillar.

#10M5010
PERSEUS LEVEL III software.
By Filippo Riccio. Astronomy simulation software and mount control via PC.



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