

Astro-Physics Absolute Encoders for the 1100GTO and 1600GTO Mounts

What are Absolute Encoders and What Can They Do?

In order to meet the needs of the most demanding astro-imagers and researchers, we have integrated the optional Renishaw RESOLUTE Absolute Encoders into our 1600GTO and 1100GTO mounts. These encoders and readheads comprise a true absolute non-contact optical encoder system, which offers the latest in technological advances to ensure accurate and reliable performance in the field. What will this mean for you? Near perfect periodic error correction, virtually zero Dec. backlash and your mount will never be lost, which will result in greater productivity and hassle-free imaging sessions. Your mount will be invisible, as it should be.

- Consider these features when the absolute encoders are installed in both axes:
- Absolute encoder knows the exact position of the gear angle of the mount when the power is applied.
- No separate homing sensor is needed. Current software sets a home position with the CW down and the scope pointing at the pole - equivalent to the Astro-Physics Park 3 position.
- Adjustable software slewing limits based on the position of the gear angle allow you to safely image several hours past the meridian.
- The R.A. encoder is used to set the exact sidereal rate to eliminate periodic error of the worm gear. When used in conjunction with our Astro-Physics Command Center (APCC) Pro version software (purchased separately), the sidereal rate can be adjusted in small increments and set to any custom rate that is necessary to counter R.A. and Dec. drift due to flexure, atmospheric refraction, polar misalignment, etc.
- Virtual elimination of Dec. backlash symptoms when auto-guiding. Absolute encoders will close the loop in both RA and Dec axes for very accurate guiding. The response, especially in Dec, will be instant and will eliminate all backlash delays during reversal of the motors. This is important when using a long focal length scope.
- Immediate correction of wind gusts. The encoders restore the pre-gust position so quickly that the gusts will not ruin your images.
- High immunity to dirt, scratches and light oils to withstand real-world observatory conditions.
- Sealed readhead for high reliability in harsh environments.
- Integral set-up LED on readhead for quick set-up and instant "health check" any time.
- Built-in position-checking algorithm constantly monitors calculations for ultimate safety and reliability.
- Extended temperature version available.

RESOLUTE uses a unique single optical absolute track (a world first) combined with sophisticated optics. The readhead acts like an ultra-fast miniature digital camera, taking photos of the coded scale of the encoder ring. Photos are analyzed by a high-speed DSP to determine absolute position. The built-in position check algorithm actively checks every reading. Advanced optics and position determination algorithms are designed to provide low noise and low sub-divisional error. The result is unparalleled performance.

The images below were taken using a 1600GTO mount with the Absolute Encoders installed. As mentioned earlier, the 1100GTO will use the identical encoders, readheads and software. Your results should be similar using either the 1600GTO or 1100GTO.

We feel that even longer (over 10 minutes) exposures with refractors are feasible since, typically, they only have a tiny amount of flexure compared to mirror scopes. This is particularly true if the object is straight up. However, since many optical systems have inherent flex issues and possible mirror movements and tracking rates vary from one part of the sky to another, Astro-Physics Command Center (APCC) Pro version software (purchased separately) will provide additional corrections to make unguided imaging a reality for a wide variety of optical systems, assuming that the error is repeatable and can be modeled.

Who Most Benefits from Absolute Encoders

- Imagers who strive for the best possible results
- Imagers operating remote setups either in backyards or hundreds of miles away
- Advanced amateurs and researchers who are doing photometry and spectrometry
- Supernova search requiring precise, unguided imaging
- Astronomers sharing their imaging setups
- Automated remote observatories
- Astronomers doing survey work that requires precise pointing The encoder-based pointing correction will compare the actual end-of-slew axis position with the commanded coordinates and make any subtle corrections necessary to point the axis where it needs to be pointed. Basically, this will correct for any errors that exist in the drive train.
- If you want to do precise pointing using plate solve techniques, then the encoder can position the axis exactly. Without the encoder the positioning is likely only accurate to ± 2 to 4 arc sec. The absolute encoders also compensate for wind loading on the scope tube. True closed loop control means that the axes will maintain their precise positions against outside forces.

Specifications

- One-piece 4" diameter stainless steel ring with a single track, true absolute scale marked directly onto the periphery. High accuracy graduations ensure outstanding metrology and reliability.
- Resolution: 67 million pulses per rotation, 0.019 arc second per pulse.
- Accuracy is ± 3 arc seconds over the entire 24 hour, 360 degree rotation. ± 0.2 arc sec per hour typical accuracy.
- RESOLUTE Absolute Encoder:
Operating: 0 degrees C to +80 degrees C (32 F to +176 F)
Storage: -20 degrees C to +80 degrees C (-4 F to +176 F)
- RESOLUTE ETR (Extended Temperature Range) Encoder:
Operating: -40 degrees C to +80 degrees C (-40 F to +176 F)
Storage: -40 degrees C to +80 degrees C (-40 F to +176 F)
- Operation down to -40 degrees C (-40 degrees F) in non-condensing environments is guaranteed by Renishaw. However, we have not tested the extreme ends of the range ourselves. The encoder is also tough enough to survive the physical punishment of harsh environments with solid steel ring scales. NOTE: If you plan to operate the mount in severe cold temperature environments, please contact Astro-Physics regarding special lubrication requirements that may be needed.

Software Controls for the Absolute Encoders

In early 2019, we introduced a version of APCC that includes a tab with controls for the Absolute Encoders. Note that the tab only appears for mounts with absolute encoders. All mounts with Absolute Encoders can utilize this feature.

Order Options

Requirement: The GTOCP4 control box and associated power cable are required for all installations.

Installed by Astro-Physics: You may order your 1600GTO or 1100GTO with the R.A. and Dec. Absolute Encoders installed, adjusted and tested on your mount prior to shipment. This is the least expensive option since we test the encoders at the same time that we are testing your mount.

Installed by customer after mount has shipped: This upgrade kit can be retrofit onto your 1600GTO or 1100GTO when you are ready to take advantage of its capabilities. The system will be tested as a whole prior to shipment to ensure that all components are functioning properly. In order to complete the assembly, a little manual dexterity is required to position the screws in a restrictive space. We will provide detailed instructions to guide you through this process. Please call for further information.

IMPORTANT NOTE: Since the kit must be installed onto a 1600GTO or 1100GTO mount for alignment and testing at AP, it will only be available when we have a mount on hand that we can use. Typically, this will be limited to times that we are assembling that particular mount.