

INSTRUCTION MANUAL

Orion HDX110 EQ-G Equatorial GoTo Mount

#10011 HDX110 Mount with Tripod Pier

#10044 HDX110 Mount only



Figure 1. The HDX110 EQ-G mount with Tripod Pier

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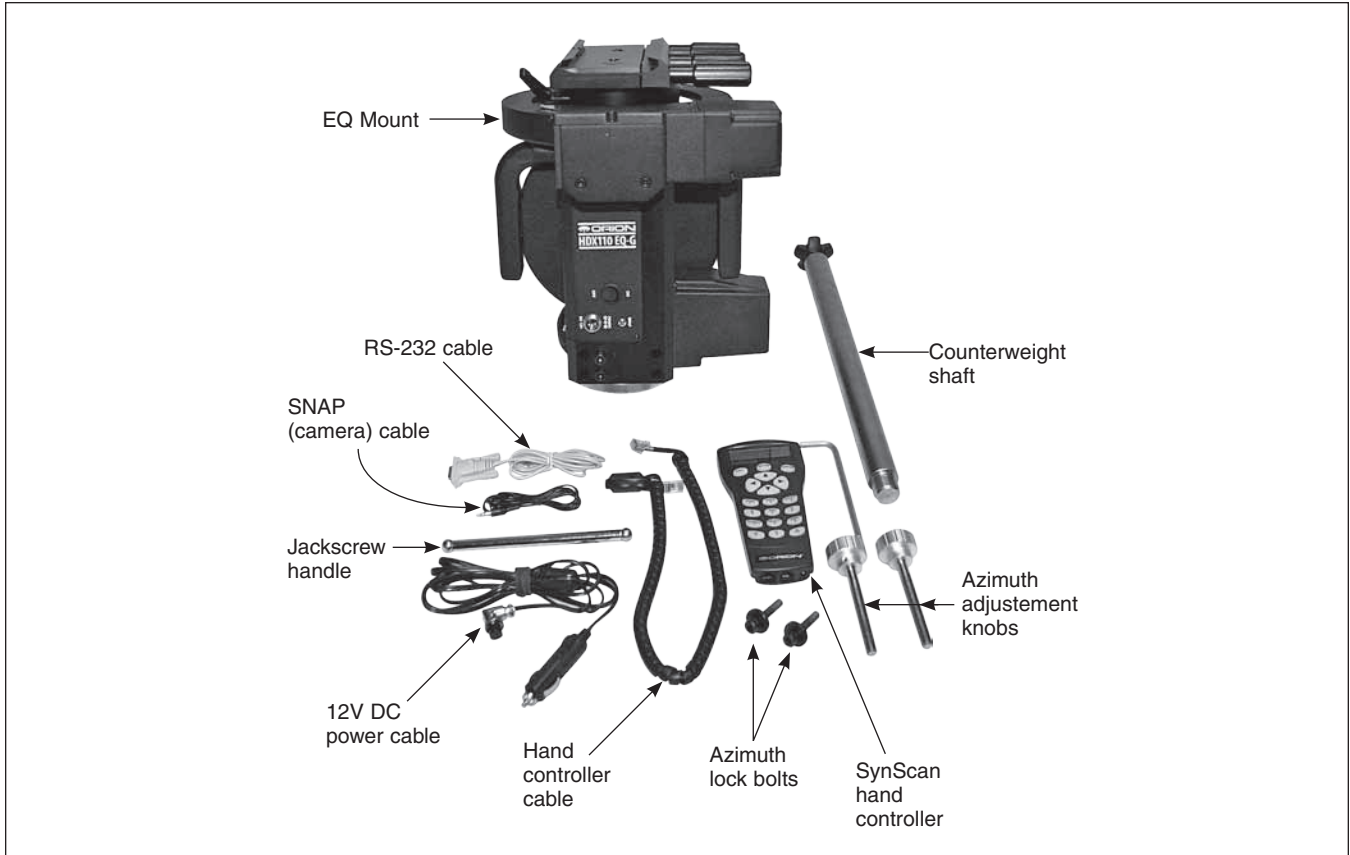


Figure 2. Contents of the Equatorial Mount box

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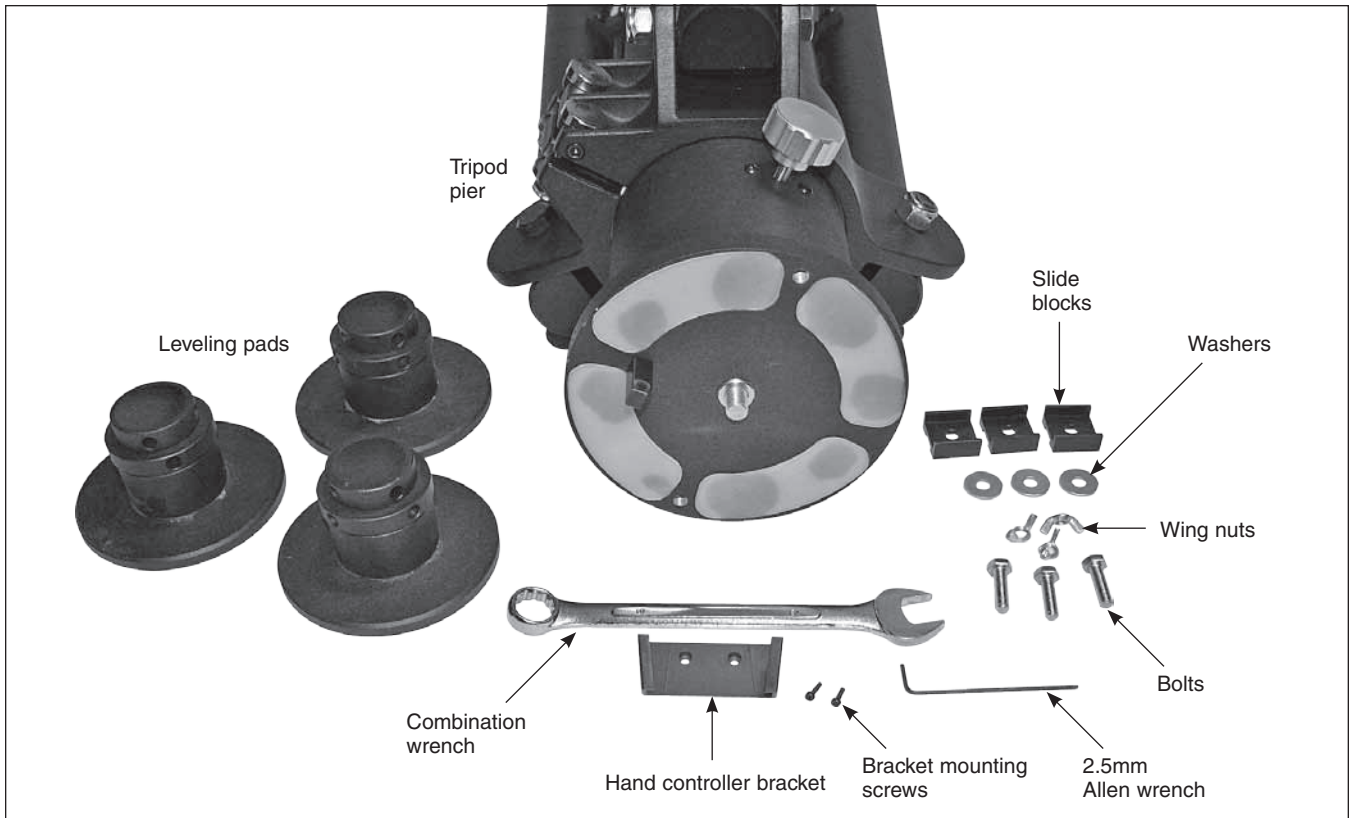


Figure 3. Contents of the Tripod Pier box (included with #10011)

Congratulations on your purchase of the Orion HDX110 EQ-G GoTo Mount! This high-performance equatorial mount with an instrument payload capacity of 110 lbs. and typically +/- 3 arc-second tracking accuracy delivers the stability and precision needed for serious visual and imaging work with medium-size to large telescopes. These instructions will help you set up and properly use your new mount. Please read them over thoroughly before getting started.

1. Unpacking

1.1. Unpacking

The entire mount including tripod pier (#10011) is packaged in four boxes, one containing the equatorial head, hand controller, and cables (**Figure 2**); one containing the pier tripod and leveling pads (**Figure 3**); and two boxes containing one 22-lb. counterweight each (**Figure 4**). Use care in opening the boxes.

If you purchased the #10044 HDX110 equatorial head only, it comes in one box (**Figure 2**).

We recommend keeping all of the original packaging after the mount is unpacked. In the event that the mount has to be

WARNING: Do NOT look at the Sun without a professionally made solar filter on the telescope; serious eye damage may result if you look at the Sun with any unfiltered optical instrument. Do not leave the telescope unsupervised around children. Always cover the lenses when leaving the telescope in direct sunlight.

returned to Orion for warranty repair, having the proper packaging will ensure that the mount will survive the journey intact.

Make sure all the parts in the Parts List are present. Be sure to check the boxes thoroughly, as some parts are small. If anything appears to be missing or damaged, immediately call Orion Customer Support (800-676-1343) or email support@telescope.com for assistance.

1.2 Parts List

Equatorial Mount Box (**Figure 2**)

Qty	Item
1	HDX110 equatorial head
1	Counterweight shaft
1	DC power cable
1	SynScan hand controller
1	Hand controller coil cable
1	RS-232 serial cable
1	Shutter release cable (select Canon EOS)
1	Jackscrew handle



Figure 4. Two 22-lb. counterweights (included with #10011)

- 1 6mm Allen wrench
- 1 Cable clamp (not shown)
- 1 Instruction manual – HDX110 EQ-G
- 1 Instruction manual – SynScan

Tripod Pier Box (Figure 3)

- 1 Tripod pier
- 3 Leveling pads
- 1 Bracket for SynScan controller
- 2 M3 Allen screws (for SynScan bracket)
- 1 2.5mm Allen wrench
- 3 Slide blocks
- 3 Hex head bolts
- 3 Washers
- 3 Wing nuts
- 1 Combination wrench (19mm)

Counterweight box (Figure 4)

- 1 Counterweight (22 lbs.), with lock knob

Counterweight box

- 1 Counterweight (22 lbs.), with lock knob

CAUTION: *Never set the equatorial head down such that the motor covers or encoder/gear housings bear the weight of the mount, as this could damage those components and the hardware inside them. If you need to set the mount down on the ground or other flat surface, always orient the mount in the “upright” position in which only the bottom plate contacts the surface.*

2. Setting Up the HDX110 EQ-G Mount

2.1 Setting Up the Tripod Pier

The HDX110’s tripod pier is heavy and thus should be handled with due caution.

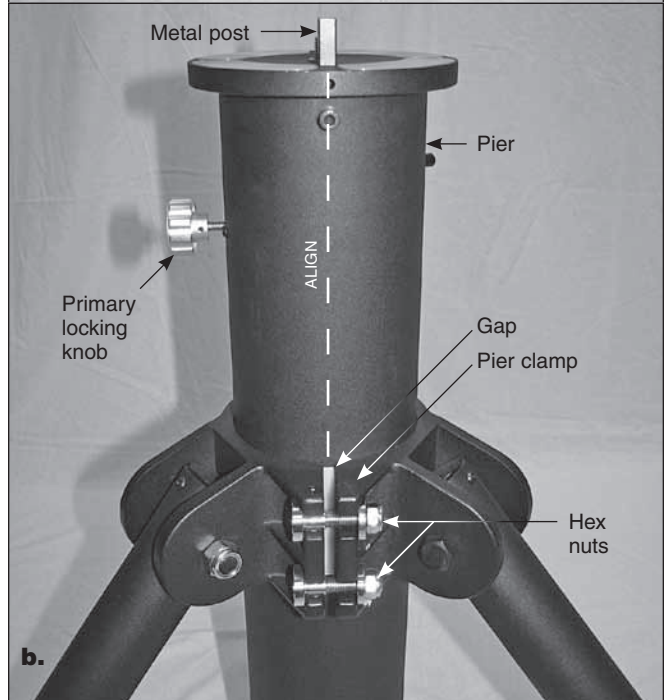


Figure 5. (a) Once the tripod legs are spread all the way outward, **(b)** the pier height can be adjusted by loosening the two hex nuts on the pier clamp.

1. Spread the tripod legs outward as far as they will go (**Figure 5a**).
2. Loosen the two hex nuts on the pier clamp with the included combination wrench (**Figure 5b**). Loosen them alternately, a little at a time. Be aware that the pier could drop suddenly if the clamp becomes loose enough. To prevent this, we recommend keeping some positive, upward pressure on the pier with one hand while loosening the nuts with the other.

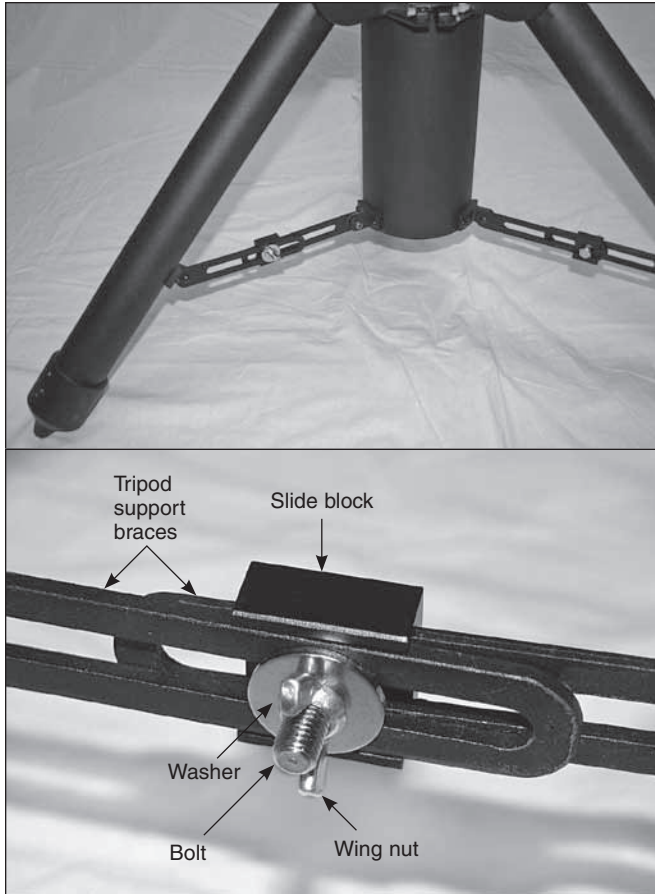


Figure 6. Clamp the tripod support braces with the included hardware as shown.

3. Once the clamp is loosened, rotate the pier in the clamp until the post on the top plate is roughly aligned with the gap in the clamp (**Figure 5b**).
4. Slide the pier up or down in the clamp to the desired height, then tighten the two hex nuts on the clamp. Tighten them in an alternate manner a little bit at a time to avoid damage to the clamp. Do not overtighten the two nuts!
5. Clamp the three tripod support braces with the slide blocks and associated hardware as shown in **Figure 6**. Tighten the wing nuts.
6. If your surface is not level, use the leveling pads underneath the tripod legs. Place a leveling pad under each tripod foot by lifting each leg one at a time and sliding a leveler pad under it. Place the tip of the foot in the center depression of the pad (**Figure 7**).
7. While the HDX110's equatorial head has a built-in circular bubble level, if you wish to level the tripod before adding the weight of the head on top of it, you will need to purchase a circular bubble level from a hardware store.

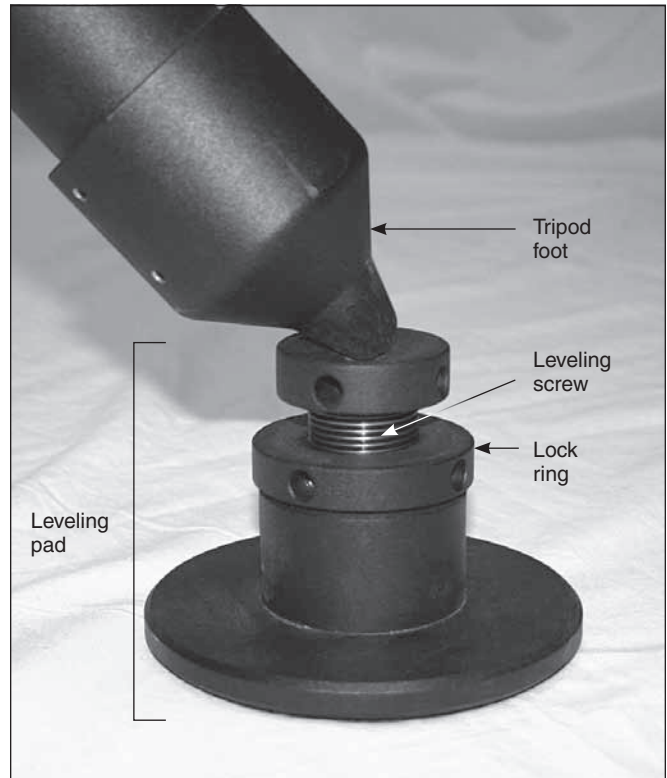


Figure 7. Leveling pads placed under the tripod feet help level the mount.

8. To extend the leveling screw, turn it counterclockwise. Tighten the lock rings on all three leveling pads once the tripod is level (**Figure 7**).



Figure 8. The hand controller bracket installed.

9. Attach the hand controller bracket to the two posts with the included screws (**Figure 8**).

2.2 Attaching the Mount to the Tripod Pier

1. Lift the mount out of the case with both hands, using the handles attached to the mount.
2. Before attaching the mount, if the azimuth adjustment knobs are installed, make sure there is a wide gap between the bolts (**Figure 9**).
3. Then place the mount on the tripod pier, aligning the metal post on the top of the pier with the gap between the two azimuth adjustment knobs (**Figure 10**).
4. Once the mount is seated on the pier, turn the primary locking knob clockwise. That turns the threaded center post on the pier, which threads into the hole on the bottom center of the mount. Turn the knob until tight.
5. Install the two azimuth locking bolts with washers; do not tighten them completely yet (**Figure 11**).
6. Install the two azimuth adjustment knobs if they are not already installed. Thread them in as far as they will go. Refer to **Figure 12**.
7. Install the two altitude locking bolts if they are not already installed. Do not tighten them completely.
8. Unthread and remove one of the two ball-head screws from the end of the jackscrew handle and slide the jackscrew handle into the hole in the altitude jackscrew. Then replace the ball-head screw.

2.3 Leveling the Mount

The HDX110 mount has a built-in bubble level, shown in **Figure 12**, making it easy to level the mount using the three leveling pads that you placed under the tripod legs. It will be easier to do this now, before attaching the counterweights and telescope.

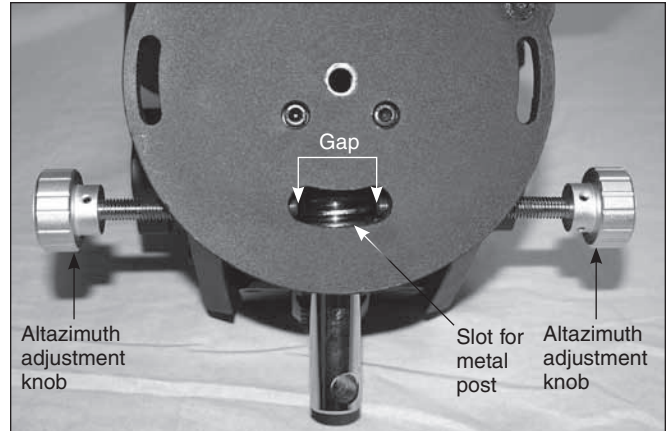


Figure 9. If the azimuth adjustment bolts are already installed, make sure there is a wide gap between them in the slot.

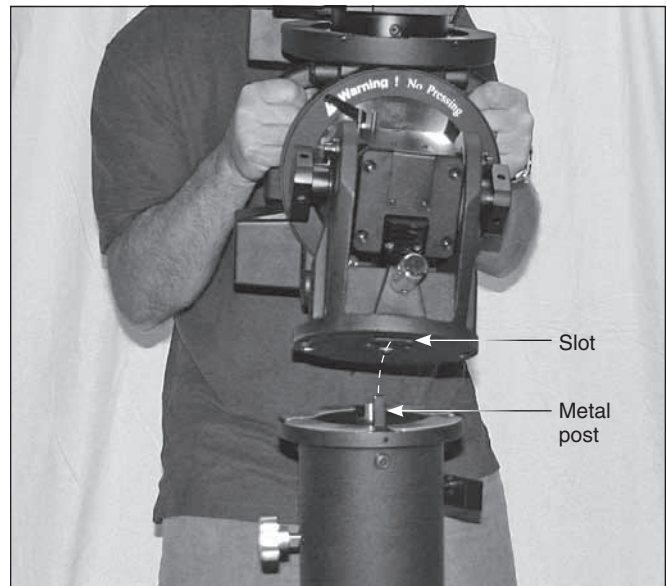


Figure 10. When installing the mount on the tripod pier, align the metal post on the pier with the slot on the mount's baseplate.

1. Adjusting the leveling screw on the leveling pad will raise or lower the tripod leg. Adjust one or more of the leveling screws until the bubble is centered in the circle of the bubble level. The small holes on the side of the leveling screw and locking ring can accept a small "tool," such as a Phillips screwdriver shaft or an Allen wrench, to aid in turning them, if needed (**Figure 7**).

We found it helpful to lift the corresponding tripod leg with one hand (yes, it's heavy!) while turning the leveling screw with the other hand.

2. Lightly tighten the lock rings on all three pads after the mount is leveled.

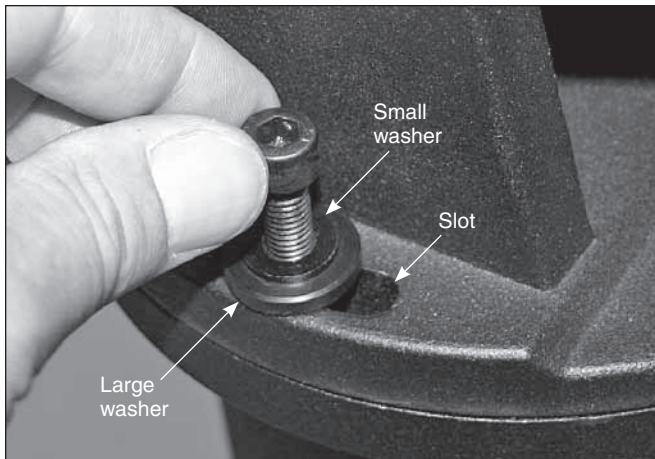


Figure 11. Install the two azimuth locking bolts.

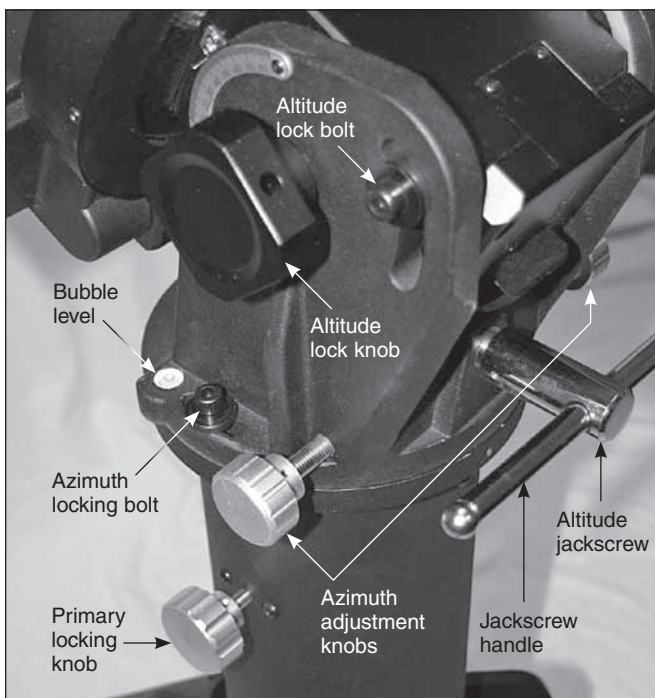


Figure 12. Install the azimuth adjustment knobs and thread them in all the way.

2.4 Attaching the Counterweight Shaft and Counterweights

CAUTION: Always install the counterweight(s) before installing your telescope on the mount! (And when packing up, always remove the telescope from the mount before removing the counterweights.)

1. Thread the counterweight shaft into the mount (**Figure 13a**).
2. Remove the safety stop knob from the end of the counterweight shaft.
3. Loosen the lock knob on the counterweight(s), then slide one or more counterweights (depending on your instrument payload) onto the shaft. Tighten the lock knob.



Figure 13. (a) The counterweight shaft threads into the mount. **(b)** Install the counterweight(s) and replace the safety stop knob.

4. Replace the safety stop knob on the counterweight shaft (**Figure 13b**).

2.5 Setting the Latitude

1. Make sure the two large altitude lock knobs and the two altitude lock bolts are all loosened slightly.
2. Use the jackscrew handle to set the mount angle to your latitude, referring to the latitude scale and pointer on the left side of the mount (**Figure 14**). (If you don't know your latitude, consult a geographical atlas or look it up on the internet.) For example, if your latitude is 36° North, set the pointer to 36.
3. Tighten the two large altitude lock knobs and the two altitude lock bolts. Note that when you perform a polar alignment, you will need to loosen these knobs and bolts a very slight amount to permit adjustment. Then you should lightly tighten them once polar alignment has been established.

2.6 Adjusting the Azimuth

1. Make sure the azimuth locking bolts are slightly loosened.
2. Use the azimuth adjustment knobs to move the mount in either direction. To do this, loosen one knob by turning it counterclockwise, then turn the opposite knob clockwise.
3. When you've rotated the mount to the desired position, carefully tighten the two azimuth adjustment knobs. Then lightly tighten the two azimuth locking bolts.

Note that when you perform a polar alignment, you will need to loosen the azimuth locking bolts a very slight amount to permit adjustment. Then you should lightly tighten them once polar alignment has been established.

3. Installing a Telescope on the Mount

The HDX110 EQ-G mount is designed to hold a maximum instrument payload of up to 110 lbs. This will vary with the length of the telescope: for longer telescopes, which have a longer moment arm, the maximum weight will be less.

3.1 Installing the Telescope

1. Before installing a telescope, be sure that:
 - The counterweight shaft is pointing toward the ground.
 - The counterweights are installed on the counterweight shaft and have been moved to the bottom end of the shaft.
 - The R.A. axis is secured by tightening the R.A. clutch lever.
2. Release the Dec. clutch lever and rotate the saddle until the arrow on it points either forward or to the right, depending on your preference. It's shown pointing forward in **Figure 15**. Then retighten the Dec. clutch lever.
3. Loosen the three saddle clamp knobs alternately until the width of the groove is slightly wider than the width of the dovetail bar on your telescope or telescope tube rings.
4. While holding the telescope securely, seat or slide the dovetail bar of the telescope into the dovetail groove of

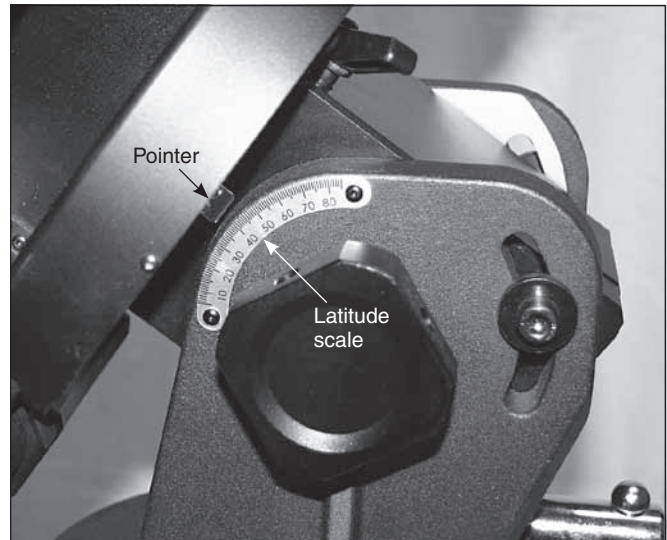


Figure 14. Refer to the latitude scale to set the mount to the latitude of your observing or imaging site.

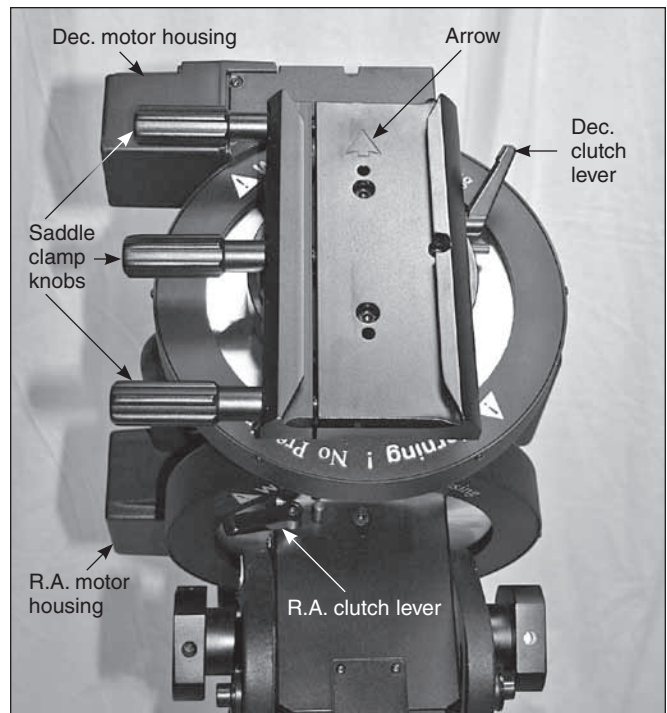


Figure 15. When installing the telescope, the arrow on the saddle should be pointing forward or to the right.

the saddle. Then, while still supporting the telescope with one arm, tighten the three saddle lock knobs alternately to secure the dovetail bar in the saddle.

3.2 Balancing the Telescope

To minimize stress on the motor drive system and ensure smooth, accurate movement of a telescope on both axes of the mount, it is imperative that the optical tube be properly balanced. Proper balancing is critical for accurate tracking. We will first balance the telescope with respect to the right ascension (R.A.) axis, then the declination (Dec.) axis.



Figure 16. Optional polar-axis scope installed on the HDX110.

1. Keeping one hand on the telescope optical tube, loosen the R.A. clutch lever (**Figure 15**). Make sure the Dec. clutch lever is tightened, for now. The telescope should now be able to rotate freely about the R.A. axis. Rotate it until the counterweight shaft is parallel to the ground (i.e., horizontal).
2. Now loosen the counterweight lock knob and slide the weight(s) along the shaft until it exactly counterbalances the telescope. That's the point at which the shaft remains horizontal even when you let go of it. Once balance is achieved, retighten the counterweight lock knob.
3. To balance the telescope on the Dec. axis, first tighten the R.A. clutch lever, with the counterweight shaft still in the horizontal position. Then with one hand on the telescope optical tube, release the Dec. clutch lever and check for any rotation. If there is some, you'll need to adjust the telescope forward or back in the saddle or in its tube rings until it remains horizontal when you carefully let go of it. (You will likely have to swing the R.A. axis so the telescope is back on top of the mount before making this adjustment.)

The telescope is now balanced on both axes. When you loosen the clutch lever on one or both axes and manually point the telescope, it should move without resistance and should not drift from where you point it.

NOTE: For imaging, it is recommended that the mount be slightly *IMBALANCED* – weighting the R.A. axis to the EAST and the Dec. axis in either direction. The imbalance should be very slight and should be implemented after you have found the correct balance point using the above procedure. This weight offset keeps a minimal load on the gears at all times, which improves guiding behavior.

So for the R.A. axis, if the telescope is on the west side of the mount, slide the counterweight down the counterweight shaft (which is on the east side of the mount) a bit – 3 centimeters or so should be enough. If the telescope is on the east side of the mount, slide the counterweight up the shaft by the same distance.

4. Polar Alignment

The HDX110 EQ-G mount can be polar aligned either with aid of the optional, externally mounted polar-axis scope (available from Orion) or by the iterative polar alignment routine in the SynScan hand controller. The iterative method does not require the polar scope, and it can be done even without direct visual access to Polaris (in Northern hemisphere) or Octans (in Southern hemisphere). The iterative method is the more accurate of the two methods.

4.1 Preparing the Mount for Polar Alignment

1. Set up the mount as directed in Part 2. We recommend performing the polar alignment with the telescope and other equipment installed.
2. Referring to **Figure 12**, slightly loosen the primary locking knob and the two azimuth locking bolts, then use the azimuth adjustment knobs to rotate the mount until the azimuth locking screws are centered in the slots (**Figure 11**). Lightly tighten the azimuth locking screws.
3. Loosen the altitude lock knobs and altitude lock bolts, then lightly tighten them.
4. Tighten the primary locking knob and then loosen it 1/4 turn.
5. Move the tripod to roughly align the R.A. axis to true north (or south for use in Southern hemisphere).
6. Install the handle on the altitude jackscrew and use it to set the latitude scale to your local latitude (**Figure 14**).

4.2 Polar Alignment Using the SynScan Hand Controller

1. Select 2-Star or 3-Star alignment to align the mount for GoTo operation, then perform the polar-alignment routine detailed in the SynScan Hand Controller manual. Repeat these operations several times until the SynScan hand controller reports a small polar alignment error after the 2-Star alignment or 3-Star alignment.
2. At the end of the polar-alignment routine, tighten the primary locking knob, and then tighten the azimuth locking screws, the altitude lock knobs, and the altitude lock bolts. You should observe the final alignment star in the eyepiece while alternately tightening these symmetric knobs and screws, to try to minimize the movement of the alignment star in the eyepiece while locking things down.
3. It is recommended to remove the jackscrew handle after the polar-alignment is completed, to avoid inadvertently hitting it or having a cable catch on it, either of which could disturb the polar-alignment.

4.3 Polar Alignment Using the Optional Polar-Axis Scope

Instructions for using the polar-axis scope are included with that accessory and are available for viewing or download on our website. **Figure 16** shows the polar-axis scope installed on the mount.

5. Drive Panel Interface

5.1 Drive Panel

The drive panel of the HDX110 EQ-G is shown at right (Figure 17).

5.2 Panel Interface Components

POWER: This is a threaded 12V DC power input jack that provides a secure connection to the power source. Align the index on both the connector of the cable and the input jack on the drive panel, then insert the connector into the jack and thread it on (Figure 18). The “cigarette lighter” plug on the other end of the cable connects to your 12V DC field battery or AC-to-DC adapter.

AUTO GUIDE: A 6-pin RJ-12 jack is for connecting an autoguider. It is compatible with any autoguider with an ST-4 type interface.

HAND CONTROLLER: This RJ-45 8-pin jack is for connecting the coil cable of the SynScan hand controller.

SNAP: This stereo jack allows connection to a camera’s shutter control port. The SynScan hand controller can control a camera to take pictures automatically via this interface. The camera control cable included with the HDX110 mount is compatible with select Canon EOS series DSLR cameras. It has a right angle 2.5mm stereo plug on one end for connection to the drive panel and a straight 2.5mm plug on the other end for connection to the camera. Cables for other cameras can be sourced optionally or custom made.

ON/OFF Switch: Turns on and off the power to the mount and hand controller. The power LED serves as a power-on indicator and provides other status information:

1. **Steady on:** Power voltage is normal.
2. **Slow flashing:** Power voltage is low; continuing to operate the mount may damage the battery (if a 12V lead-acid battery is in use).
3. **Fast flashing:** Power voltage is extremely low; continuing to operate the mount may damage the battery and the motor controller in the mount.
4. **Intermittent single flash:** The PPEC training routine has been triggered, but the controller board in the mount has not received the worm index signal and the PE correction recording has not started yet.
5. **Intermittent double flash:** The PPEC training routine has been started and the controller board in the mount has received the worm index signal and started to record the PE correction. When the intermittent double flash stops, it means the PPEC training has finished.
6. **Intermittent triple flash:** Sidereal tracking with PEC is now enabled.

5.3 Pinout of the Interfaces (Figure 19)

Note:

- The SNAP port provides two trigger signals to the stereo plug. The signal to the head of the plug is issued slightly later than the signal to the ring of the plug.

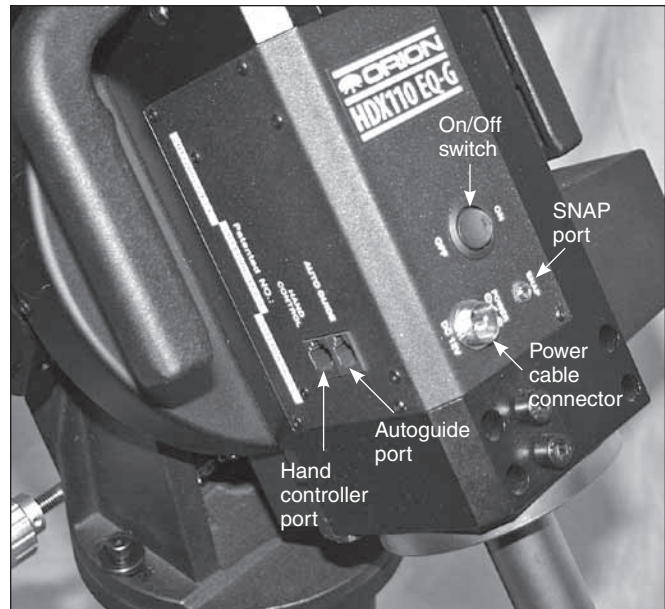


Figure 17. The drive panel of the HDX110.



Figure 18. The right angle connector of the included 12V DC power cable threads onto the power connector on the mount.

- For a camera that needs only a shutter-release signal, either trigger signal will work. For a camera that requires a “Focus” signal ahead of the shutter-release signal, both signals will be utilized.

5.4 Connecting the SynScan GoTo Hand Controller

The coil cable for the SynScan hand controller has RJ-45 connectors on each end. Plug one connector into the Hand Control port of the drive panel and the other connector into the RJ-45 port on the bottom of the SynScan controller. Push the connector into the port until it clicks into place.

The smaller modular port next to the RJ-45 port on the hand controller enables serial communication between the HDX110 mount and a computer running astronomy software such as Starry Night Pro. For that you will need the RS-232 computer interface cable that was included with the mount. If your computer does not have an RS-232 port, you will also need a

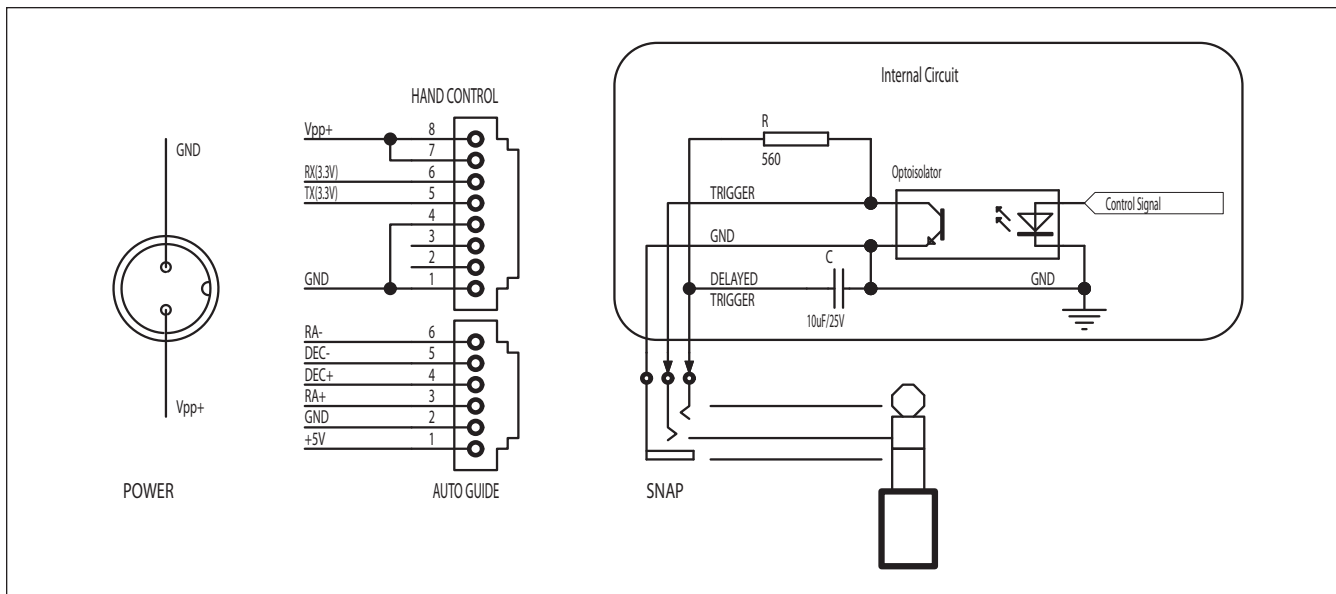


Figure 19. Schematic diagrams of the drive panel's electronic interfaces.

USB-to-serial adapter. Check telescope.com for an available adapter.

The 12V DC power jack on the hand controller is used only for updating the firmware in the hand controller or for browsing the object database without connecting to the telescope mount. Do not connect the hand controller to a power source when using the mount for normal operation!

5.5 Power Supply Requirements

The HDX110 EQ-G requires power from a 12V DC marine battery or an AC-to-DC power supply with a 3-amp or higher output current rating.

- Output Voltage: DC 11V (minimum) to DC 16V (maximum). Voltage not in this range could cause permanent damage to the motor controller board or the hand controller.
- Output Current: 4A for power supply with 11V output voltage, 2.5A for power supply with 16V output voltage.
- Do not use an unregulated AC-to-DC adapter. When choosing an AC adapter, it is recommended to use a switching power supply with 15V output voltage and at least 3A output current.
- If the power voltage is too low, the motor controller will stop the motors automatically.

6. Other HDX110 EQ-G Features

6.1 Auto-Home Function

The HDX110 EQ-G mount has two integrated home position sensors. With the SynScan hand controller the mount can be placed to the same home position after turning on the power. For detailed information, refer to the SynScan Hand Controller instruction manual.

6.2 Auxiliary Encoder Function

Auxiliary encoders on both the R.A. and Dec. axes of the HDX110 EQ-G mount enable it to continue tracking even when the user unlocks the clutches and manually rotates the mount in R.A. and Dec. With this feature, you can manually operate the mount any time without worrying about losing the mount's GoTo star alignment status. When you want to operate the mount with the SynScan hand controller again, no re-alignment is required; all that is needed is to re-lock the clutch levers. This feature can be enabled or disabled in the SynScan Hand Controller.

6.3 Permanent Periodic Error Correction

The HDX110 EQ-G mount is equipped with an index on its R.A. worm, thus the motor controller can keep tracking the current position of the worm. After a proper PEC training routine, in which the training data is stored in the motor controller permanently, a user can start the periodic error correction (PEC) at any time to improve the tracking performance for astrophotography. A training process is not required in the next observing session (assuming that the polar alignment is always accurate), thus this is a Permanent Period Error Correction (PPEC). A user can train the mount by guiding either manually or electronically with auto-guiding. For detailed instructions, please refer to the relevant section in the SynScan Hand Controller instruction manual.

6.4 Batch Exposure Function

The HDX110 EQ-G mount has a SNAP port that can control the shutter of a DSLR camera (see **Figure 17**). Working with the SynScan hand controller's "Camera Control" function, you can set the number of exposures, exposure duration, and exposure interval for up to eight different sets of exposures. For detailed information, refer to the SynScan Hand Controller instruction manual.

7. Care of Your HDX110 EQ-G Mount

To protect the equatorial mount, we recommend transporting and storing it in its original shipping box or in an optional hard case.

CAUTION: *Never set the equatorial head down such that the motor covers or encoder/gear housings bear the weight of the mount, as this could damage those components and the hardware inside them. If you need to set the mount down on the ground or other flat surface, always orient the mount in the “upright” position in which only the bottom plate contacts the surface.*

Addendum: Adjusting the Declination Axis Backlash

If you believe that the declination axis (DEC) of your HDX110 EQ-G mount has unwanted backlash, or on the contrary that the DEC worm and ring gear are binding due to being too tightly meshed, follow this procedure for adjusting the gear mesh.

You will need a Philips screwdriver and a set of metric Allen keys to perform this adjustment.

1. Rotate the saddle of the mount head to its default position and then lock the DEC clutch lock lever as shown in **Figure 20**. Rotate the saddle back and forth to feel how much “play” there is (**Figure 21**, see Note below). This is an indication of how tightly the worm is meshed to the ring gear. It is normal to feel a tiny bit of play. If you don’t feel any movement, not even the slightest jog, the DEC gear mesh may be too tight. If you feel a lot of play, the gears may be too loosely meshed.

NOTE: *It may help to install a long dovetail plate in the saddle, as shown in **Figure 21**, to give you a longer moment arm for rotating the saddle back and forth. In our tests it was easier to feel the amount of backlash when we rotated the DEC axis via an installed dovetail plate.*

2. Now connect the hand controller to the mount and turn on the power. Use the hand controller to slew the saddle several degrees left (**Figure 22**). Rotate the saddle back and forth by hand again to feel the amount of play, as you did in Step 1. Can you feel even the slightest jog?
3. Slew a few more degrees in the same direction as in Step 2, and again rotate the saddle back and forth to feel the amount of DEC play.
4. Repeat the previous step, going a few degrees at a time, until the DEC axis has completed a 360° rotation, to find the position of the saddle where you feel the smallest amount of play. That’s where the gap between the worm and ring gear is smallest. Slew several degrees left and right of this position to pinpoint the exact position where the smallest gap of gear mesh is found. In the following steps, you will carefully adjust the gear mesh to the proper setting.

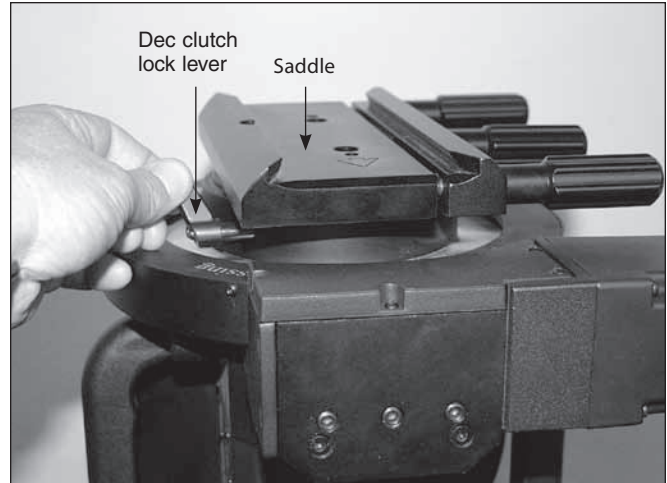


Figure 20: Start with the dovetail saddle in the “default” position, pointing straight ahead.

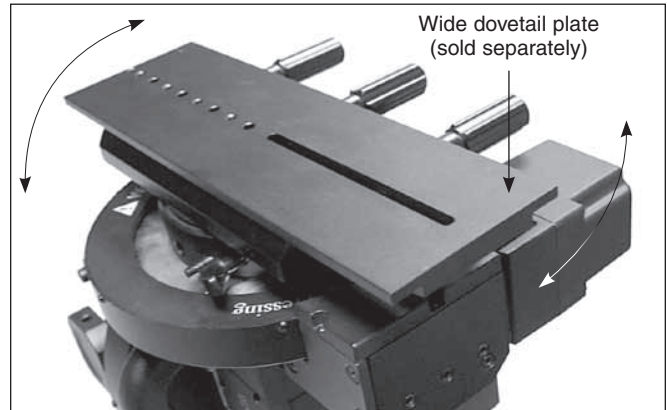


Figure 21: It’s best to install a wide dovetail plate in the saddle to test for DEC backlash, as it provides a longer lever arm. With the DEC clutch lock lever tightened, grasp the plate firmly with both hands – one hand on each end – and jog it rotationally back and forth and feel for “play” (backlash).

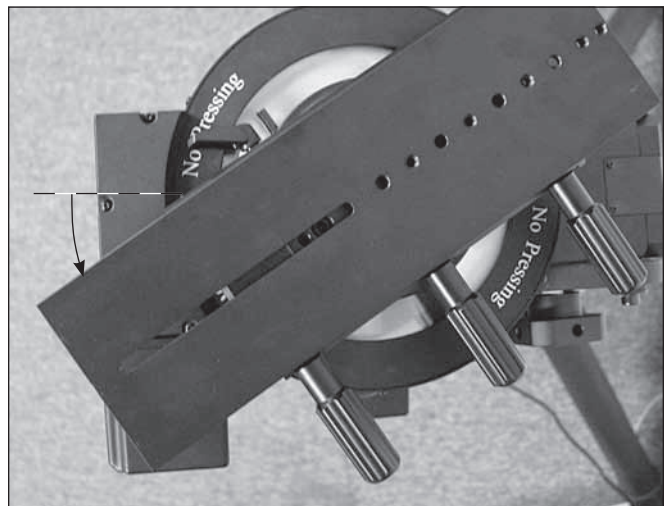


Figure 22: Slew the saddle using the hand controller a few degrees, then jog it again as in step 2 and note the amount of backlash. Repeat this step several times until the saddle has rotated 360 degrees.

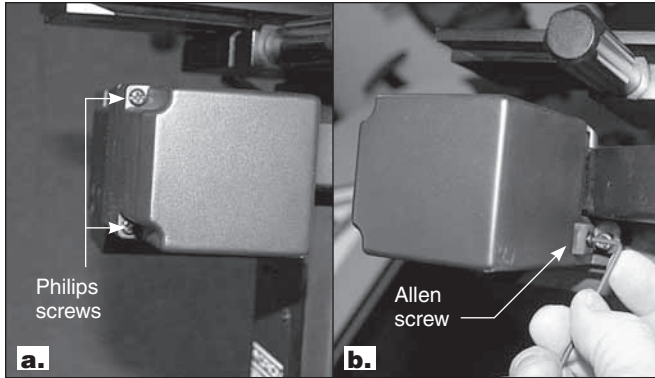


Figure 23: Removing the Dec motor housing is done by unthreading two Philips screws (a) and one Allen screw (b).

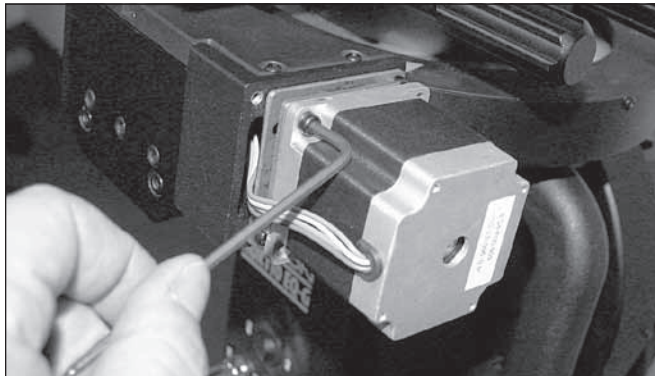


Figure 24: Loosen by a quarter turn the two diagonally opposed screws that fasten the motor to the seat plate.

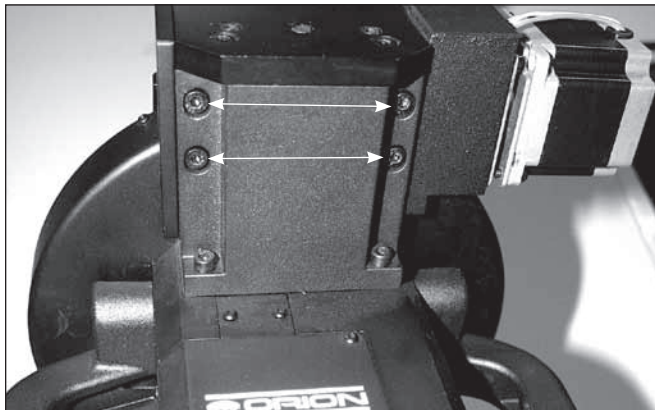


Figure 25: Loosen the four Allen screws underneath the DEC worm gear housing by no more than ½ turn, to allow the worm block to move during the adjustment process.

NOTE: When locating the position of the least amount of play, or tightest gear mesh, the smaller the angle the saddle is rotated, the more precise the position can be pinpointed.

5. Remove the plastic DEC motor housing by unscrewing the three screws shown in **Figure 23**, using a Philips screwdriver and a 2mm Allen key.
6. Now with a 3mm Allen key loosen by a quarter turn only the two screws that connect the DEC motor to the seat plate as shown in **Figure 24**. These two screws are

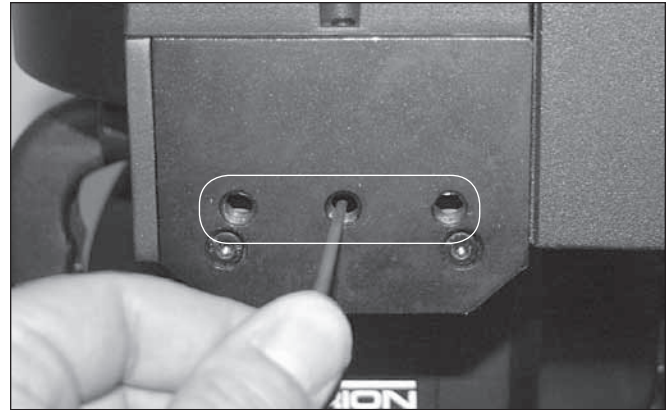


Figure 26: Completely remove the three cosmetic cover screws on the front plate and set them aside.

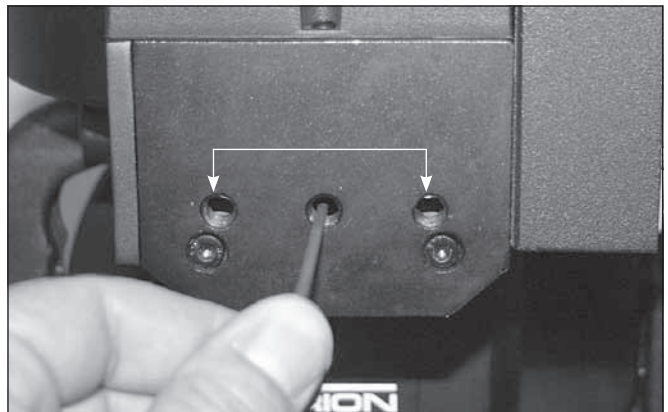


Figure 27: The three backlash adjustment screws are set deep inside the housing. The outer two are adjusted with a 4mm Allen key while the center screw requires a 2.5mm key. Be sure to follow the proper procedure in the text! Do not over-tighten any of the screws or you could damage the gears!

- located diagonally across the motor; only one is visible in the figure. (For a very small DEC adjustment, you can skip this step.)
7. With a 4mm Allen key, unscrew the four screws at the bottom of the worm gear housing a quarter or half turn only, as shown in **Figure 25**. Do not over-loosen these screws!
 8. Now with the same Allen key completely remove the three cover screws on the front of the DEC housing (**Figure 26**). These screws are cosmetic only. Once they are removed you will be able to get to the Allen screws inside the housing, which are the ones used to actually adjust the gear mesh.
 9. Adjust the three screws as shown in **Figure 27** to change the gear mesh of the DEC worm and ring gear:

To TIGHTEN the mesh (REDUCE the backlash), first loosen the center screw just a little bit by turning it counterclockwise. Then tighten the outer two screws evenly by turning them clockwise.

To LOOSEN the mesh (INCREASE the backlash), first loosen the outer two screws a little bit by turning them counterclockwise the same amount, then tighten the center screw by turning it clockwise.

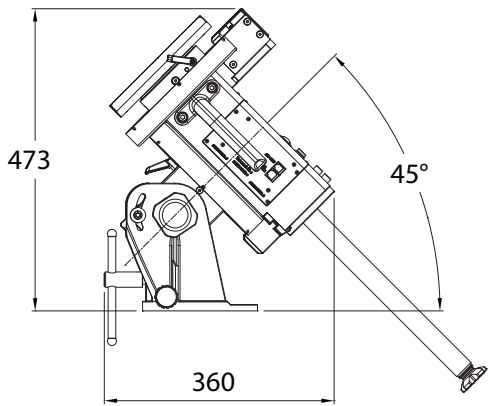
Loosen/Tighten the three screws only in small increments to avoid over-adjustment or possible damage to the worm or ring gear!

10. Now, with the DEC clutch lock lever tightened, jog the saddle rotationally back and forth again by hand and see if the backlash has decreased to a more desirable level.
11. After the gear mesh has been adjusted to your satisfaction, re-install the three cover screws removed in Step 8, and then re-tighten the four screws on the bottom of the worm gear housing loosened in Step 7.
12. Before retightening the two screws loosened in Step 6, use the hand controller's up or down directional button to drive the DEC motor and the worm gear for a few seconds. This will allow the motor to auto-center and align the drive shaft with the worm rod. After this is done, the two screws can be fully tightened.
13. Now use the hand controller to slew the DEC axis at least 2 complete cycles (720 degrees) to check if there is any stalling or binding as a result of your mesh adjustment. If there is, be sure to repeat this procedure from the top and make the necessary adjustments. If there isn't, re-attach the DEC motor housing with the three screws removed in Step 5.

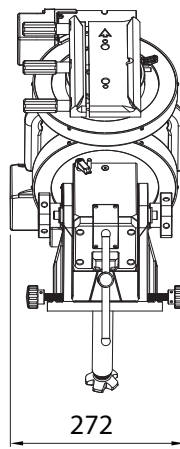
Specifications

Product name	HDX110 EQ-G
Mount type	German equatorial GoTo
Payload (counterwts. excl.)	110 lbs. (50kg), depending on telescope length
Saddle type	Wide (Losmandy style)
R.A. worm wheel	Dia. 219.5mm, 435 teeth, aluminum
Dec. worm wheel	Dia. 219.5mm, 435 teeth, aluminum
RA shaft	Dia. 55mm, aluminum
Dec. shaft	Dia. 55mm, aluminum
Motors	0.9° hybrid stepper motors
Transmission	435:1 worm drive + 64 microstep/0.9° stepper motor drive

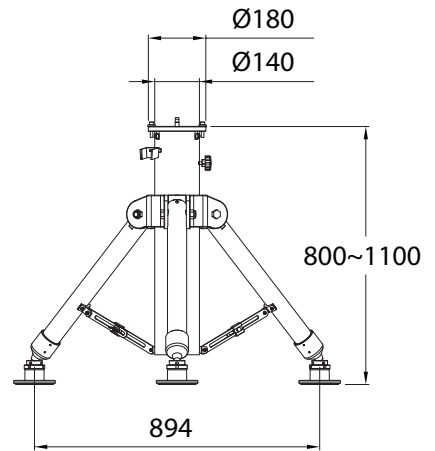
Resolution	11136000 counts/rev; approx 0.12 arc-second
Tracking accuracy	typically ±3 arc-seconds (native)
Maximum slewing speed	3.3° /s
Tracking rates	Sidereal, solar, lunar
Autoguiding speeds	0.125x, 0.25x, 0.5x, 0.75x, 1x
PEC	100 segments permanent PEC
Latitude adjustment range	10° – 65°
Azimuth adjustment range	±10°
Counterweight shaft	Dia. 31.5mm, length 15.9" (403mm), weight 5.7 lbs. (2.6kg)
Counterweight	22 lbs. (10kg) each (x2)
Tripod pier	Height range 31.1"-43.3" (790-1100mm)
Tripod leg diameter	2.4" (60.5mm)
Tripod min. folded length	32.5" (82.6cm)
Tripod leveler pads	Qty 3, all metal, height range 2.7"-3.7" (69-94mm)
Polar alignment	Software assisted (iterative) or optional polar scope
Polar axis scope	Optional, external mounting
Hand controller	SynScan, illuminated keypad
Database	42,000+ objects
Celestial object catalogs	Messier, NGC, IC, SAO, Caldwell, Double Star, Variable star, Named stars, Planets
Pointing accuracy	Up to 5 arc-min (RMS)
GoTo alignment	1-star, 2-star, 3-star
Resolution of aux. encoders	17,624 Counts/rev., approx. 1.2 arc-minutes
Weight of EQ head (excl. Counterweight shaft)	55 lbs. (25kg)
Weight of Tripod Pier	63 lbs. (28.6kg)
Case for EQ head	Dimensions: 19.5"x23.5"x25.5", incl. casters
Power requirement	11-16V DC, 4A
Power cable	12V DC cigarette lighter style with threaded connector to mount
RS-232 cable	Included



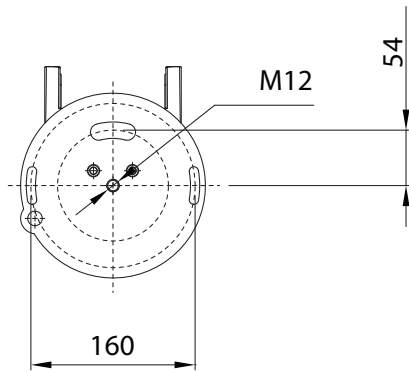
Mount



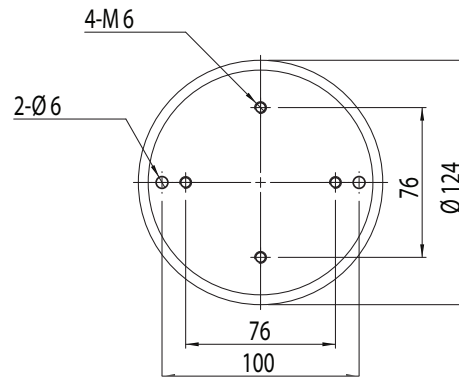
Mount



Tripod



Mount Bottom Plate



Saddle Head

One-Year Limited Warranty

This Orion product is warranted against defects in materials or workmanship for a period of one year from the date of purchase. This warranty is for the benefit of the original retail purchaser only. During this warranty period Orion Telescopes & Binoculars will repair or replace, at Orion's option, any warranted instrument that proves to be defective, provided it is returned postage paid. Proof of purchase (such as a copy of the original receipt) is required. This warranty is only valid in the country of purchase.

This warranty does not apply if, in Orion's judgment, the instrument has been abused, mishandled, or modified, nor does it apply to normal wear and tear. This warranty gives you specific legal rights. It is not intended to remove or restrict your other legal rights under applicable local consumer law; your state or national statutory consumer rights governing the sale of consumer goods remain fully applicable.

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