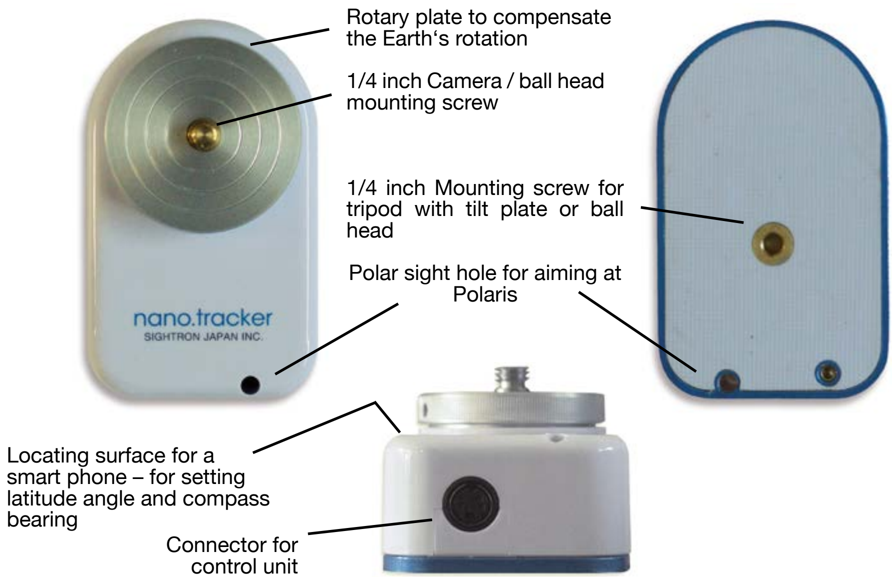
nano.tracker 2.0

Celestial Tracking Unit

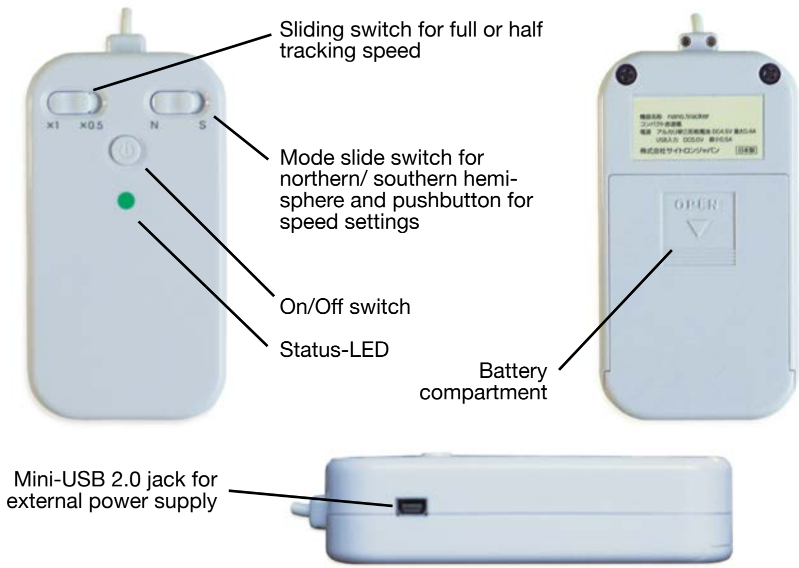
Tracking Unit nano.tracker 2.0

Front Side **Back Side**



Control Unit for the nano.tracker 2.0

Front Side **Back Side**



Introduction

Thank you for purchasing your TS nano.tracker 2.0 – a multi function de- vice for photographers who like to create long exposure images of the night sky or time-lapse pictures of the moon, the sun or any landscape in a quick and easy way. Due to its compact size this light-weight device fits in every photo bag or backpack. With the nano.tracker you can quickly and easily cre- ate perfect astro images even without any background knowledge of astro- photography. Please take some time to read this manual before using the nano.tracker.

Long exposure images of star fields

This is what the nano.tracker excels at. To capture the night sky even with its very faint stars long exposure times become necessary. However, the Earth rotates under the static starry sky with a remarkable speed. Even at exposure times of just a few seconds this results in elongated stars in the image (egg shaped stars). The nano.tracker compensates for the Earth‘s rotation, allowing longer exposure times with perfect, round shaped stars in the picture.

Time-lapse photography with tracking of the moon or sun

The moon and the sun each have their distinctive speed in relation to the stars and the Earth‘s rotation. You can create time-lapse images with tracking of the moon or the sun from sunrise to sunset. Please do remember that it is crucial to mount a special solar filter in front of your lens. Otherwise, pointing your camera directly towards the sun may result in serious and permanent damage to your camera and/or your eyes!

Time-lapse images with camera panning

The nano.tracker helps you to create clockwise or counter clockwise time-lap- se camera panning at different speeds.

Box Contents

In the box of your nano.tracker you will find the tracking unit, the control unit with the connection cable and this manual. To put the device into action you need some batteries or an external power supply (please see „Necessary Ac- cessories“ on the next page).

Necessary Accessories

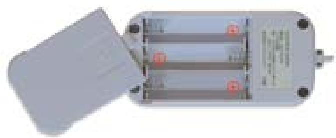
The nano.tracker is mounted between a tripod and a camera. Before you start using the device, please make sure you have the following accessories:

- 3x AA batteries or alternatively an external power supply (3.6~4.5 Volts DC) with a Mini-USB 2.0 plug (e.g. an external battery pack or a PC with USB port).
- A sturdy tripod with a ball or tilt head (we recommend a two-way tilt head with spirit level and scale) and a 1/4“ mounting screw (JIS standard).
- A light and sturdy ball head with a mounting base of approximately ø 50mm and a 1/4" thread (JIS standard), which will be attached to the rotary plate of the nano.tracker.
- A photo camera with a lens of max. 50mm focal lens (35mm when using a full-frame DSLR or analog 35mm film camera).
- We recommend using a programmable remote control for your camera.
- When using the naono.tracker in the southern hemisphere a compass and a clinometer are needed (both available as smart phone app).

Please note that the weight of your camera, with lens and ball head attached, should not exceed 2 kilograms.

Installation and start-up – step by step

1. Inserting the batteries



i) Carefully open the battery compartment on the back side of the control unit.
ii) Insert 3x AA batteries into the battery compartment. Please pay attention to the correct polarity.
c) Close the battery compartment carefully.

Using an external power supply in alternative to batteries:

Connect the external power supply (e.g. an external battery pack or a PC with USB port) with the nano.tracker‘s mini-USB 2.0 port using a USB cable.

2. Setting up the system

i) Place the tripod with the attached ball or tilt head on an even and solid surface. If possible do not extend the legs of the tripod, thus it is more stable in windy conditions.
ii) Level the tripod by adjusting its legs to make it horizontal.
c) Mount the nano.tracker on the ball or tilt head and make sure the polar sight hole (aiming aid for Polaris) is not obscured.
d) Attach the small ball head to the rotary plate of the nano.tracker.
v) Attach the ready-to-use camera onto the small ball head.
vi) Connect the control box with the nano.tracker.

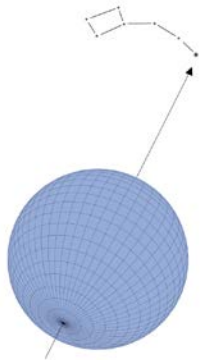
Make sure that all screw joints are tight and secure. Any loose and wobbling connection will adversely affect the quality of your image!

3. Polar alignment of the nano.tracker

This is the most complex part when setting up your nano.tracker. If you are inexperienced with astrophotography we would like to explain the meaning and the method of polar alignment to you in the following. Experienced amateur astronomers who have mastered the process can skip this part.

Once every 24 hours the Earth rotates about 360° around its own axis. This means it is turning at the speed of 1/4 degree per minute. If you would take an image with an exposure time of one minute the circular stars will be distorted on your picture meaning they will be elongated by a quarter of a degree. You would get so-called „egg shaped stars“ in your picture.
The rotary plate of nano.tracker also rotates at the speed of 1/4 degree per minute, however in the opposite direction, thus compensating for the Earth‘s rotation. To ensure that this compensation works it is essential that the axis of the rotary plate is aligned parallel to the Earth‘s axis as precise as possible. The more accurate the alignment, the longer is the potential exposure time.

Polar alignment in the northern hemisphere



In the northern hemisphere, we are very fortunate that a bright star – the North Star „Polaris” – is almost exactly in line with the Earth‘s axis at the celestial north pole. It is very easy to find since being located precisely north and being part of the constellation of Ursa Minor (or Little Dipper). For instance, if you are located in Central Europe and look up, facing north, to a height of about 50 degrees you will find it without difficulty as it is the brightest star in this region.

Depending on your latitude in the northern hemisphere, Polaris is at a specific height above the horizon. Hamburg, for instance, is located at 53° northern latitude – accordingly Polaris is 53 degrees above the horizon of Hamburg. In Frankfurt the height of Polaris is 50 degrees, in Vienna 48 degrees and at the south coast of Spain just about 36 degrees. By knowing the latitude you are located at (displayed for example in Google Earth on the bottom right of the window) you can conclude the height of Polaris above the horizon.

There is a small hole in your nano.tracker that helps you with the polar alignment. Loosen the clamping screws of the lower ball or tilt head and move the nano.tracker so that Polaris is aligned in the middle of the polar sight hole. You can now lock the clamping screws of the ball or tilt head again – your tracking unit is polar aligned and ready to go.

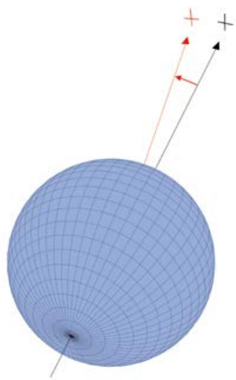
Polar alignment in the southern hemisphere or without Polaris being visible

The same procedure is a little bit more difficult in the southern hemisphere. There is no prominent star near the celestial south pole thus auxiliary means are needed to find the celestial southern pole. The method described below can also be used in the northern hemisphere when the visibility of Polaris is obscured.

A) Finding the geographical south or north with a compass

We recommend using a digital compass app for your smart phone. The advantage of a compass app is that it automatical- ly offsets the local (magnetic) declination and hence shows the geographical (and not the magnetic) pole.

Align the nano.tracker exactly in the direction of the geographical pole.



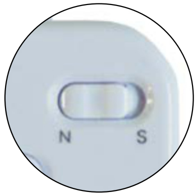
Using a magnetic compass is not quite as simple since the compass needle is directed parallel to the Earth's magnetic field and this magnetic field is inhomogeneous- ly distributed over the Earth's surface. Depending on your location the compass needle does not point at the geographi- cal but at the magnetic pole. The devia- tion between the geographical and the magnetic pole, shown by the compass, is called declination. It is measured and published each year for the shipping and aviation industry. In the appendix of this manual you will find a world map with the main field declination for 2015.

Pick the place where you intend to use the nano.tracker and correct the compass with the value shown on the map. If you are located in Namibia's capital Windhoek, for instance, the declination is -10 degrees. Accordingly, the geographic south is where your compass shows 170 degrees (180° - 10°). Align the nano.tracker exactly at 170 degrees by precisely turning the ball or tilt head in this direction. If you are located in Zurich the declination is +2 degrees. The geographic north is located in the direction of 002 degrees on your compass scale. Align the nano.tracker so that the axis of its rotary plate is pointing exactly at the right direction.

B) Finding the height of the celestial pole above the horizon

Just like in the northern hemisphere the height of the celestial south pole correlates with the latitude of your location. The Namibian capital Windhoek, for example, is located at 22° southern latitude, so the celestial south pole is at a height of 22 degree above the horizon. Setting the height is quite easy with a scaled tilt head. When there is no scale on the head, or when using a ball head, an inclinome- ter is needed. You can either buy an inexpensive tool at your local hardware store or use a digital inclinometer app for your smart phone.

4) Adjusting the tracking direction



Use the mode slide switch to select whether you are in the northern or southern hemisphere and in which direction the rotary plate of the nano.tracker turns. Is the nano.tracker polar aligned towards north it needs to compensate for the Earth‘s rotation by turning to the right – in the southern hemisphere the rotary plate needs to turn to the left.

- For the northern hemisphere, set the mode slide switch to „N“.
- For the southern hemisphere, set the mode slide switch to „S“.

5) Setting the tracking speed

Depending on the scene you like to capture and the object that is targeted, the nano.tracker needs to compensate the apparent speed of this object. After turning the device on it is always pre-set to sidereal speed. By pressing the mode switch you can toggle between the available speed settings:

- Default: sidereal speed – status LED flashes once
- Press once: lunar speed – status LED flashes twice
- Press twice (within two seconds): solar speed – status LED flashes three times
- Press three times (within two seconds): 50x sidereal speed for time-lapse photography – status LED is permanently on

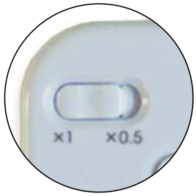
By switching the nano.tracker off and on again the tracking mode is reset to sidereal speed.

6) Half tracking speed for scenes with horizon

If you like to capture a scene with the horizon it will be distorted and blurred during a long exposure with your tracking unit set to sidereal speed. However, by reducing the tracking speed to 0.5x sidereal speed and adjusting the exposure time it is possible to capture round shaped stars and an (almost) prefect horizon. The exposure times and aperture settings resulting in the best images need to be determined individually for each setup by taking some test shots.

You can halve the preset tracking speed with the slide switch.

- Set the slide switch to „x1“ for 100% of the preset speed.
- Set the slide switch to „x0.5“ for 50% of the preset speed.



7) Choosing the subject and adjusting the camera

Your nano.tracker is now ready for use and you can point your camera at the desired section of the sky. Please keep in mind that your nano.tracker is now precisely aligned and when bumping the tripod even slightly you might render your polar alignment void. Also, you should never touch the system during recording as even minimal vibrations can ruin your picture. We therefore recommend to always using a programmable remote control for the camera.

- Loosen the clamping screw of the small ball head, point your camera at the desired subject and tighten the clamping screw again.
- Turn on your camera, program and connect the remote control (if used).
- Set the shutter speed to „infinity“ (Bulb) and choose the aperture.
- Before you start recording, please leave the nano.tracker running for about five minutes to eliminate any gear backlash.
- Start the exposure.

Hints and Tips

- If you turn the nano.tracker off or realign your camera the rotary plate might take a few seconds before it starts moving again. This is because of gear backlash. Please leave the nano.tracker running for about five minutes to eliminate the backlash.
- The use of long zoom lenses (even if they are set to 50mm focal length) can deteriorate image quality due to adverse leverage effects.
- When additional weight (e.g. a sandbag) is attached to the low end of the tripod‘s central pole, the whole system becomes more stable and less prone to wind. However, the weight should not be able to move freely.
- Install the system during twilight and coarsely polar align the mount. It is more difficult to set up the system in the dark.
- If you get distorted stars at the borders of the picture try stopping down the lens.

Sample picture captured with the nano.tracker 2.0

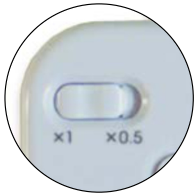
Constellation:	Orion (Belt and Sword)
Objects:	Barnard's Loop (Sh 2-276), Orion Nebula (M42), DeMairan's Nebula (M43), reflection nebula (M78), Horsehead Nebula (IC 434), Flame Nebula (IC 2024) a.s.f.
Camera:	Canon 1000D astro modified, with JJC programmable remote control
Lens:	Mamiya 45mm f/2.8 Secor C with Kiwi adapter for Canon
Aperture:	f/4
Exposure time:	15x 180 seconds, 45 minutes in total
Image processing:	Fitswork (stacking of single shots), Photoshop CS 5

Time-lapse pictures with camera panning

Time-lapse photography is a technique whereby multiple frames are captured and thereafter compiled into a film by internal camera software or PC software. This creates an interesting effect where time appears to be moving faster and thus lapsing (time-lapse). Nowadays this is a built-in feature of many camera models. With the nano.tracker you have the ability to integrate camera panning in your time lapse recording. Set up the nano.tracker so that the rotary plate is mounted horizontally on the tripod. Point the camera at the first scene of your exposure series, choose the speed of the nano.tracker and start the exposure.

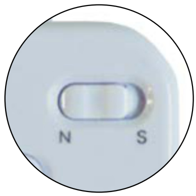
Depending on the selected speed settings the following panning speeds are available (see also page 7: 5. Setting the tracking speed):

- 0.13°/min:
  sidereal speed mode and slide switch at „x0.5“
- 0.25°/min:
  sidereal speed mode and slide switch at „x1“
- 6.25°/min:
  50x sidereal speed mode and slide switch at „x0.5“
- 12.50°/min:
  50x sidereal speed mode and slide switch at „x1“



The direction of rotation is set with the N/S slide switch:

- Camera panning to the left:
  set the mode slide switch to „N“
- Camera panning to the right:
  set the mode slide switch to „S“

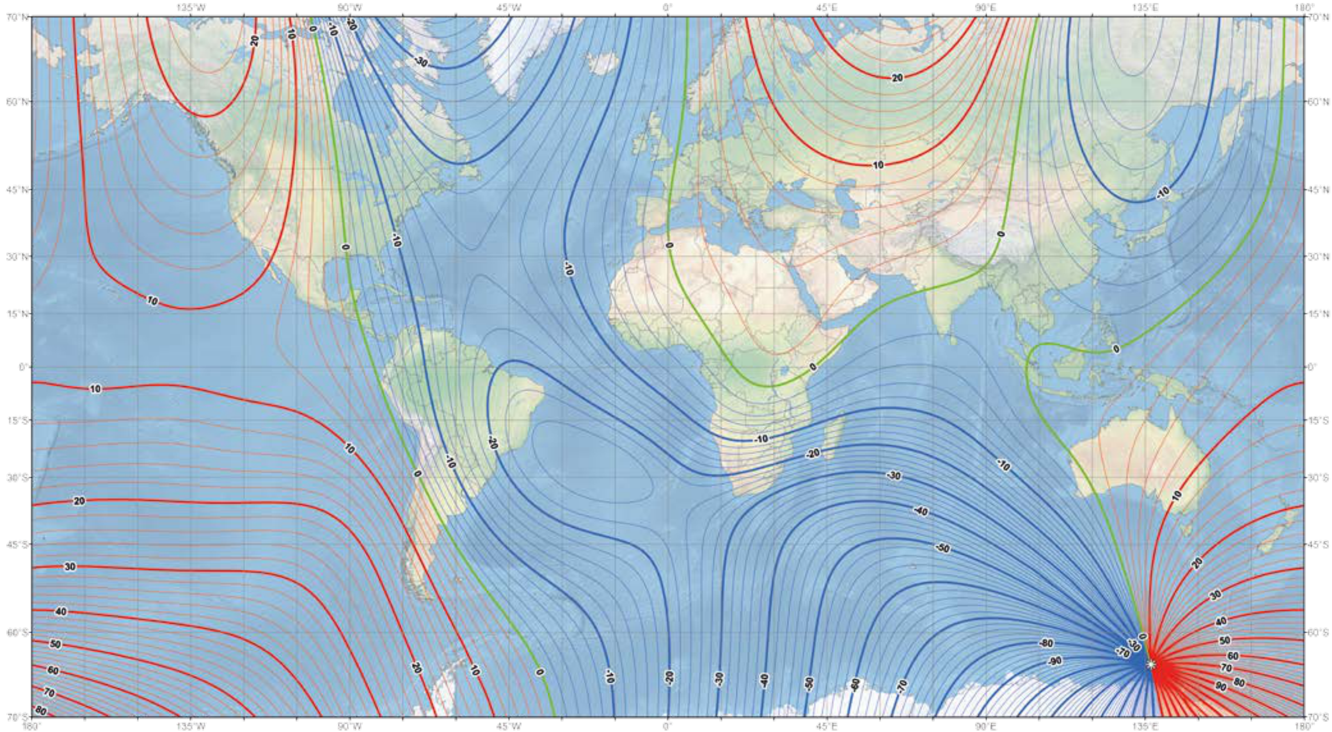


Specifications

Tracking modes:	sidereal, solar and lunar speed, fast mode (50x), half speed (x0.5), northern/southern hemisphere
Motor:	stepper motor
Gear Wheel:	50 teeth
Bearing:	two pieces
Max. Payload:	2 kg
Polar sight hole:	8.9° field of view
Power Supply:	3x AA batteries
Voltage:	3.6~4.5 Volts DC
Duration of Operation:	approx. 5 hours (alkaline batteries at 20°C)
Dimensions:	Tracking Unit: 60 x 98 x 44 cm Control Unit: 50 x 105 x 22 cm
Weight:	Tracking Unit: approx. 400g Control Unit: approx. 80g (without batt.)

Specifications and equipment are subject to change without any formal notice or obligation on the part of the manufacturer.

US/UK World Magnetic Model - Epoch 2015.0
Main Field Declination (D)



Main field declination (D)
Contour interval: 2 degrees, red contours positive (east); blue negative (west); green (agonic) zero line.
Mercator Projection.
Position of dip poles

Map developed by NOAA/NGDC & CIRES
http://ngdc.noaa.gov/geomag/WMM
Map reviewed by NGA and BGS
Published December 2014

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