ORBIS SOLARIS

Cover picture:

ORBIS SOLARIS U for New York City
with EDT/EST dial and birthday line

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ORBIS SOLARIS Manual

The solar event horizon

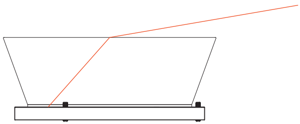
Exactly half the world with your own location at the center - that is the world circle (lat. orbis) shown on the ORBIS SOLARIS sundial.

This world circle is the solar event horizon in which the sun moves during the year from sunrise to sunset, from the winter solstice to the summer solstice. When the sun is shining, you can continuously follow on the ORBIS SOLARIS world map where the sun is currently located above the world. This is the so-called subsolar point, the geographical location where the sun is currently at its zenith in the world.

The secret behind this extraordinary function of the sundial is the refraction of sunlight in the truncated cone made of high-purity acrylic glass sitting on the dial.

The sketch shows the principle: the sun's rays, which fall through the pinhole on the surface, are deflected towards the center by the refraction and project a bright point of light onto the dial.

The refraction ensures that the projection of the sun's rays is brought from infinity into a finite horizon circle.



This is illustrated by the following comparison:

In Figure 1 above, the vertical gnomon casts a shadow on the dial of a conventional horizontal sundial. The world map is a gnomonic map projection with the gnomon on the geographical location of the sundial. The time, date and subsolar point are displayed at the end of the shadow. It is easy to see that the distortions of the world map and the dial increase dramatically with increasing distance from the gnomon. The solar event horizon, the circle of the world where the sun rises and sets, lies at infinity on this map projection.

The situation is completely different if the gnomon is replaced by an acrylic glass block with a pinhole aperture (Fig. 1 below). The pinhole sits 47 mm vertically above the location, which corresponds exactly to the gnomon height of the conventional sundial (Fig. 1 above). Taking into account the refraction of light, the solar event horizon of the gnomonic map projection shrinks from infinity to a diameter of 85 mm. The world map and the clock face are now almost undistorted. Shortly after sunrise, you can follow the point of light projected by the pinhole until almost sunset all year round and read the time, date and subsolar point.

Solar time and zone time are displayed on the ORBIS SOLARIS.

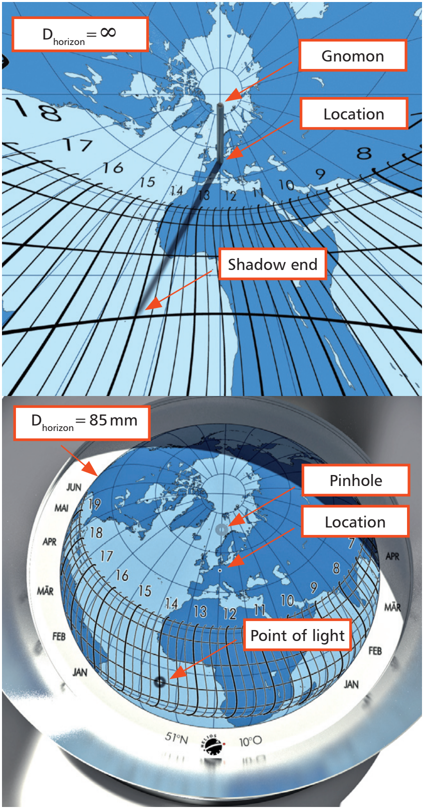


Figure 1: The solar event horizon is brought from infinity to a diameter of 85 mm.

Solar time and zone time

The dark blue lines on the two sundials in Figure 1, which intersect at the geographic North Pole of the world map, are the hour lines of solar time, officially known as Local Apparent Time (LAT). One of these passes through the location, the noon line. When this is passed by the shadow or the point of light, the sun reaches its highest point of the day exactly in the south. This is true noon, the middle of the light day, defined as 12 noon LAT.

The curved lines marked with the respective time indicate Central European Time (CET). It is an averaged time invented by man for his purposes, which refers to the time zone meridian 15° east of Greenwich, which passes through Görlitz/Germany.

If you read the Central European Time at noon every day, it will vary from day to day. Over the course of the year, there is a difference of more than half an hour from the earliest to the latest true noon.

There are two reasons for this phenomenon: firstly, the earth moves in an ellipse around the sun and is faster near the sun than far from it. Secondly, the sun appears to move along an orbit (ecliptic) that is inclined to the celestial equator by 23.44°. Only the part of the sun's movement in the direction of the celestial equator is included in the time measurement.

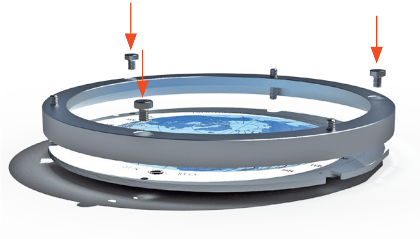


Figure 2: Dial exchange

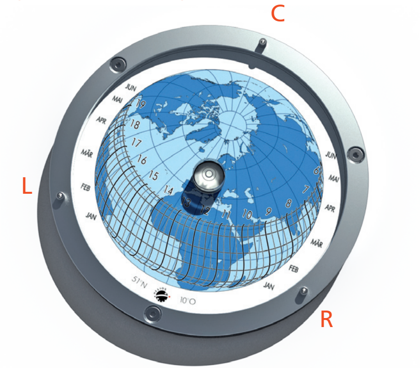


Figure 3: Leveling the dial ring

Both proportions change constantly over the course of the year and result in the apparent time sometimes moving ahead of and sometimes behind the mean time. The difference is called the equation of time.

On the ORBIS SOLARIS it is possible to read the zone time (e. g. CET/CEST) directly. In addition to the equation of time, the local time difference between the local time of the location and that of the time zone meridian is therefore also taken into account.

As the sun ascends and descends annually between the winter and summer solstices and therefore follows the same path twice a year with different equations of time, you need two dials to read the time clearly.

The illustrations show the dial for winter and spring. A second dial for summer and fall is included with the sundial for exchanging.

Exchanging the dials

The dials are exchanged at the solstices on June 20/21 and December 21/22. To do this, the three screws are loosened using the Allen key provided (Fig. 2), the dial that is no longer current is removed and the dial that matches the time of year (indicated by the month) is fitted.

Setting up the sundial

Choose a sunny spot for your sundial ORBIS SOLARIS. This could be a sunny desk in front of the window or a stone pedestal outdoors.

Place the dial ring in the intended location. Then place the supplied bubble level on it and align it horizontally using the three leveling screws (Fig. 3).

Remove the bubble level and place the acrylic glass truncated cone on the dial. When the sun is shining, the sun's rays cast a point of light onto the dial.

If you have an ORBIS SOLARIS U calculated for the location, you can skip the following chapter.

Alignment of the ORBIS SOLARIS D

The ORBIS SOLARIS D is calculated for the center of Germany (51°N 10°E) and achieves its highest accuracy there.

If you live further away, you can use the table on pages 10 and 11 to adjust the sundial for your location within Germany. After you have leveled the dial as described above, turn the left (L), center (C) and right (R) screws marked in Fig. 3 clockwise by the number of turns indicated in the table.

For example, if you live in Augsburg, turn the L screw clockwise by 3 turns and the C screw clockwise by 9.1 turns according to the table. The dial is now aligned as if it were in the horizon plane of the center of Germany (51°N 10°E).

Setting the time

To set the sundial, you need the sun and an accurate clock.

A time line is drawn on the dial every 15 minutes. Take the next time that is divisible by 15, for example 9:45 a.m. Now wait for the time and then turn the sundial until the point of light falls on this hour line (Figure 4).

The sundial is now automatically aligned in a north-south direction. Due to the point reflection in the sundial, north on the world map points in the geographic south direction.

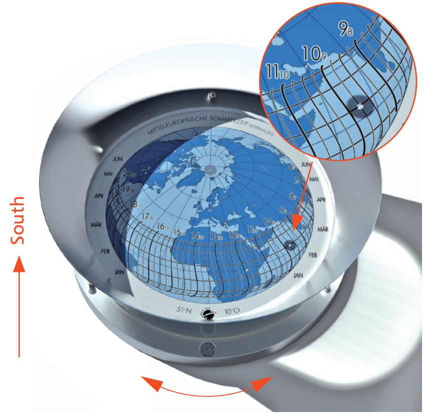


Figure 4: Setting the time on April 1 at 9:45 CEST

The functions of the ORBIS SOLARIS

Once set up, the sundial offers a wide range of reading options.

First of all, you can read the Daylight (Summer) Time (large digits) or Standard Time (small digits). In Figure 5, it is currently 3 o'clock p.m. CEST.

The longitude that passes through the location is the so-called noon line. When the point of light passes this, it is true noon, i.e. 12 noon Local Apparent Time (LAT). The next longitude in a westerly direction on the world map is then 1 o'clock p.m, the next but one is 2 o'clock p.m. LAT and so on. In an easterly direction you will find 11 o'clock a.m., 10 o'clock a.m. LAT etc. in descending order. The Local Apparent Time refers to the longitude for which the sundial was calculated. For the ORBIS SOLARIS D this is the longitude 10°E, for the ORBIS SOLARIS U the longitude of the location.

The date lines run parallel to the circles of latitude. These indicate the first day of the month. In Figure 5 it is May 1st. On this day, the point of light moves along this line from morning to evening.

The place and time of sunrise and sunset can theoretically be read from the intersection of the date line with the horizon circle. However, only a rough estimate is possible as the horizon circle is viewed tangentially to the globe in the plane projection and the resolution of the hour lines is correspondingly low.

Also, the point of light is not immediately visible at sunrise because the flat sunbeams are first reflected on the acrylic glass surface before the refraction of light directs them onto the dial. The same applies in reverse order at sunset.

An unusual function of the ORBIS SOLARIS is the display of the subsolar point. This is the point on the earth where the sun is vertical, i.e. at its zenith. A person standing upright does not cast a shadow there. In Figure 5, the sun is just above Senegal.

Instructions for use

The sundial can be used outdoors all year round. The acrylic glass body protects the dial from sunlight. The acrylic glass should only be cleaned with water or alcohol-free cleaning agents and a soft cloth.

Contact us

If you have any questions about the sundial, please contact us:

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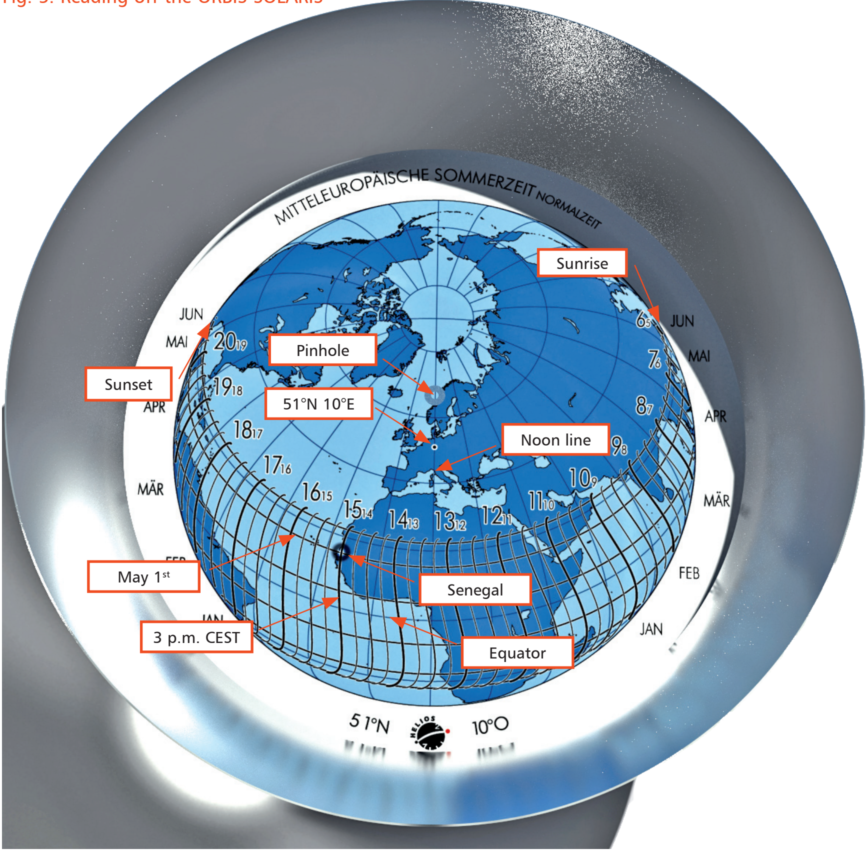
Fig. 5: Reading off the ORBIS SOLARIS



Town	*L*	*C*	*R*	*Town*	*L*	*C*	*R*
Aachen	0.0	7.1	13.0	Essen	1.5	0.0	8.4
Augsburg	3.0	9.1	0.0	Esslingen am Neckar	0.0	7.6	2.3
Bergisch Gladbach	0.0	4.8	9.5	Frankfurt am Main	0.0	4.7	4.4
Berlin	11.0	1.1	0.0	Freiburg im Breisgau	0.0	12.2	7.1
Bielefeld	0.5	0.0	5.4	Fürth	3.3	6.0	0.0
Bochum	0.0	3.2	9.3	Gelsenkirchen	0.0	3.2	9.6
Bonn	0.0	5.6	9.6	Gera	6.9	3.8	0.0
Bottrop	0.0	3.6	10.2	Göttingen	1.4	0.0	1.6
Brandenburg	8.5	0.2	0.0	Hagen	0.1	0.0	6.8
Braunschweig	4.5	0.0	2.8	Halle/Saale	6.5	1.9	0.0
Bremen	4.0	0.0	8.0	Hamburg	7.4	0.0	7.3
Bremerhaven	5.0	0.0	9.7	Hamm	0.0	1.7	7.3
Chemnitz	9.7	5.3	0.0	Hannover	3.5	0.0	4.4
Cottbus	14.4	5.0	0.0	Heidelberg	0.0	6.7	4.3
Darmstadt	0.0	5.5	4.5	Heilbronn	0.0	6.7	2.6
Dessau	7.5	1.3	0.0	Herne	0.0	3.0	9.3
Dortmund	0.0	2.7	8.4	Hildesheim	3.2	0.0	3.4
Dresden	12.4	6.1	0.0	Ingolstadt	4.8	8.8	0.0
Duisburg	0.0	4.1	10.7	Iserlohn	0.0	2.7	7.6
Düsseldorf	0.0	4.7	10.7	Jena	5.3	2.8	0.0
Erfurt	3.4	1.7	0.0	Kaiserslautern	0.0	8.2	7.4
Erlangen	3.3	5.7	0.0	Karlsruhe	0.0	8.4	5.3

Table: ORBIS SOLARIS D setting data

Town	*L*	*C*	*R*	*Town*	*L*	*C*	*R*
Kassel	0.1	0.0	1.7	Paderborn	0.0	0.0	4.2
Kiel	9.8	0.0	9.4	Pforzheim	0.0	8.3	4.3
Koblenz	0.0	5.9	8.0	Potsdam	10.1	1.0	0.0
Köln	0.0	5.2	10.1	Recklinghausen	0.0	2.9	9.3
Krefeld	0.0	4.7	11.4	Regensburg	7.0	9.2	0.0
Leipzig	7.9	3.0	0.0	Remscheid	0.0	4.2	9.4
Leverkusen	0.0	4.9	10.0	Reutlingen	0.0	8.5	2.6
Lübeck	9.4	0.0	7.1	Rostock	12.4	0.0	5.4
Ludwigshafen am Rhein	0.0	7.0	5.2	Saarbrücken	0.0	10.1	10.0
Magdeburg	5.9	0.0	0.5	Salzgitter	3.9	0.0	2.5
Mainz	0.0	5.8	5.8	Schwerin	9.9	0.0	5.3
Mannheim	0.0	6.9	5.1	Siegen	0.0	3.6	6.5
Moers	0.0	4.3	11.2	Solingen	0.0	4.4	9.7
Mönchengladbach	0.0	5.4	11.9	Stuttgart	0.0	7.7	2.7
Mülheim an der Ruhr	0.0	3.9	10.4	Trier	0.0	9.2	11.1
München	5.2	10.9	0.0	Ulm	0.0	7.4	0.0
Münster	0.0	1.2	7.9	Wiesbaden	0.0	5.5	5.9
Neuss	0.0	4.9	11.0	Wilhelmshaven	4.1	0.0	10.4
Nürnberg	3.6	6.3	0.0	Witten	0.0	3.2	8.9
Oberhausen	0.0	3.9	10.5	Wolfsburg	5.4	0.0	2.8
Offenbach am Main	0.0	4.6	4.1	Wuppertal	0.0	3.9	9.3
Oldenburg in Niedersachsen	3.2	0.0	9.2	Würzburg	0.0	3.6	0.2
Osnabrück	0.5	0.0	6.9	Zwickau	8.3	5.0	0.0