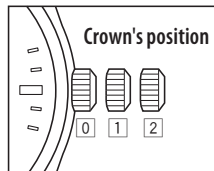


- To see details of specifications and operations, refer to the instruction manual:  4398 instruction manual

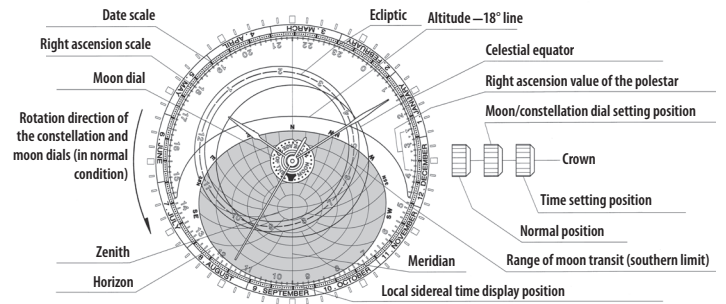
Component identification



- Actual appearance may differ from the illustration.
- The crown has two positions when pulling it out.



Constellation dial (displaying the entire sky at 35°N)



- Distortion is minimal in the northern hemisphere and approximately 94.9% of the celestial sphere visible at 35°N is displayed. (The display range of the constellation dial: declination from -55.57° to +65.20°)
- The celestial sphere near the turning center of the constellation dial is not displayed because it is hidden under the moon dial.

Setting the time

- 1. Pull the crown out to position 2 when the second hand points 0 second.**

The second hand stops.

- 2. Rotate the crown to set the time.**

- Move the hands 4 or 5 minutes forward and move them back to the right time to set the time more precisely.

- 3. Push the crown in to position 0 in accordance with a reliable time source.**

The second hand starts moving.



Setting the constellation dial and the moon dial

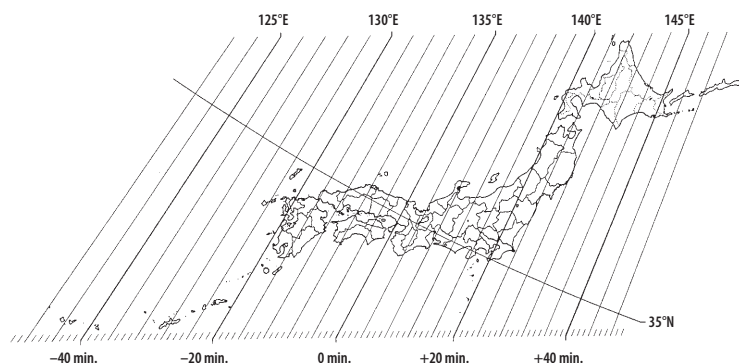
1. Find the lunar age.

- Find it referring to newspapers, the Internet or other sources.
- The lunar age (lunar age at noon) gets older by 1 per 1 day until the next new moon. It means that the age gets older by about 0.042 per 1 hour. For example, when the lunar age of the next day is 5.6 at noon, the age at 21:00 of the day is found by subtracting the product of 1-hour advancement of the lunar age, 0.042 and the hour from 21:00 to the next 12:00, 15 from 5.6 and it is about 5 ($5.6 - (0.042 \times 15)$).

2. Find the time difference in local sidereal time from the difference between the longitude of Japan Standard Time and that of your observation place.

- $+1^\circ$ of longitude difference results in about +4-minute time difference.
- You can find the time difference in local sidereal time at your observation place through the difference between the longitude of Japan Standard Time (135°E) and your place using the figure below. For example, in places near Tokyo (the longitude of Japan Standard Time $+5^\circ$), the time difference becomes 20 minutes ($= 5 \text{ (degree)} \times 4 \text{ (minute)}$).

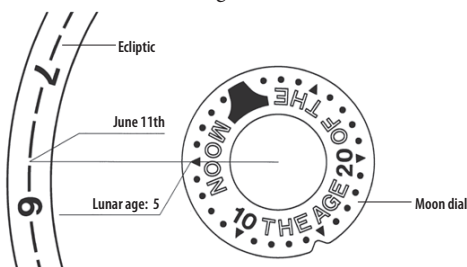
Difference from the longitude of Japan Standard Time and time difference



3. Pull the crown out to position 1.

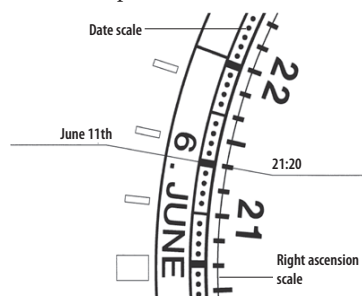
4. Rotate the crown to set the moon dial.

- Set the lunar age found to the imaginary line from the center of watch to the date of the day on the ecliptic. Ex.: June 11th, 21:00, lunar age 5



5. Rotate the crown to set the constellation dial.

- Set the time of the day on the right ascension scale to the corresponding date on the date scale compensating the time difference found in step 2. Ex.: In a place of 140°E on June 11th 21:00 (compensated time: 21:20)



- Finally rotate the constellation dial clockwise to finish the setting.

6. Push the crown in to position 0.

- Each mark of the date scale on the dial is inscribed with setting each day's noon of universal time of the mean year (21:00 Japan Standard Time) as the center of the mark. The 1st, 11th and 21st of each month are indicated with a thick line, and the 6th, 16th and 26th are indicated with a thin line.
- In the period when the right ascension scale on the constellation dial is hidden, set the +2 hours of the current time on the right ascension scale to the target date of the previous month.
- Refer to the instruction manual for usage of the moon and constellation dials and further methods of compensation.

Main features

- The constellation display shows 1,027 fixed stars of visual magnitude 4.8 or brighter (maximum magnitude values for variable stars) in increments of 0.1 and in four colors by spectral type. In addition, 166 major nebulae, star clusters and galaxies, the delimitations of constellations, the ecliptic, and the celestial equator are shown based on their positions as of the year 2000.0.
- The constellation dial not only displays the current positions of constellations but also functions as a planisphere in which the constellation dial is independently rotated.
- The solar position display shows, in the form of spaces along a broken line, the position of the sun along the ecliptic (the sun's apparent path on the celestial sphere during the year) on the 1st, 11th, and 21st of each month (for 12 noon Universal Time over the mean year). You can see the times for sunrise and sunset by looking at the horizon line on the transparent dial.
- The azimuth and altitude display feature shows the azimuths and altitudes of the major fixed stars, nebulae, star clusters and galaxies on the celestial sphere. The altitude line, with intervals of 15° on the transparent dial, compensates for refractions.
- The local sidereal time display is convenient for finding the positions of constellations. Reading the right ascension scale that overlays the meridian on the transparent dial allows you to find the local sidereal time.
- The astronomical twilight indicator lets you identify the hours of increasing darkness, a function especially useful for astronomical observations. Using the sun's position on the ecliptic and the -18° altitude line on the transparent dial (with reference to 35°N), you can find the beginning and end of astronomical twilight.
- The polar star hour display lets you align an astronomical telescope to the polar axis. The right ascension values of the polar star for every 10 years between the year 2000.0 and 2050.0 is displayed with marks on the constellation dial. The angle that is measured counterclockwise from the meridian direction of the transparent dial to the position equivalent to the current right ascension value of the polar star is the polar star hour angle.
- The celestial sphere near the turning center of the constellation dial is not displayed because it is hidden under the moon dial.

Indication of the constellation dial

- In principle, the fixed stars are displayed by color in the categories below, based on the spectral types.

Spectrum type of fixed stars	Displaying color	No. of stars
O type and B type	Bluish silver	269
A type and F type	Silver	343
G type and K type	Yellowish silver	343
M type	Reddish silver	72
- The fixed star magnitude is displayed near the right ascension scale of 0h on the constellation dial.
- Nearby stars (including multiple stars) that are difficult to separate on the constellation dial are displayed with a combined magnitude. The color and position are displayed according to the spectral type and position of the main star (the star that appears brightest).
- Variable stars are displayed on the constellation dial at their maximum magnitude. Note that variable stars are not separately identified on the constellation dial.
- The main nebulae, star clusters and galaxies are displayed in light green or turquoise.
- The star clusters of Pleiades and Hyades are shown together in the fixed star group.

Nebulae, star clusters and galaxies on the constellation dial

M31(And) NGC752(And) M72(Aqr) NGC7009(Aqr) M2(Aqr) NGC7293(Aqr) NGC6167(Ara) I.4651(Ara) NGC6397(Ara) M38(Aur) M36(Aur) M37(Aur) M30(Cap) NGC281(Cas) NGC457(Cas) NGC559(Cas) M103(Cas) I.1805(Cas) I.1848(Cas) NGC7635(Cas) M52(Cas) NGC7789(Cas) NGC4945(Cen) NGC5128(Cen) NGC5139(Cen) NGC5460(Cen) NGC6946(Cep) NGC246(Cet) NGC247(Cet) M77(Cet) M41(CMa) M44(Cnc) M67(Cnc) NGC1851(Col) M98(Com) M99(Com) M100(Com) M85(Com) M88(Com) NGC4548(Com) NGC4565(Com) M64(Com) M53(Com) NGC6541(CrA) NGC4258(CVn) NGC4449(CVn) NGC4631(CVn) M94(CVn) M63(CVn) M51(CVn) M3(CVn) NGC6871(Cyg) I.1318(Cyg) M29(Cyg) NGC6992-5(Cyg) NGC7000(Cyg) M39(Cyg) NGC5866(Dra) NGC1291(Eri) NGC1316(For) M35(Gem) NGC2392(Gem) M13(Her) M92(Her) M48(Hya) NGC3242(Hya) M68(Hya) M83(Hya) NGC2903(Leo) M95(Leo) M96(Leo) NGC3379(Leo) NGC3521(Leo) M65(Leo) M66(Leo) M79(Lep) NGC5897(Lib) NGC5822(Lup) NGC5986(Lup) M57(Lyr) M56(Lyr) NGC2237-9(Mon) NGC2301(Mon) M50(Mon) NGC6067(Nor) NGC6171(Oph) M12(Oph) M10(Oph) M62(Oph) M19(Oph) M9(Oph) M14(Oph) NGC6633(Oph) M42(Ori) M78(Ori) NGC2174-5(Ori) M15(Peg) M76(Per) NGC869(Per) NGC884(Per) M34(Per) NGC1245(Per) NGC1499(Per) NGC1528(Per) M74(Psc) M47(Pup) M46(Pup) M93(Pup) NGC2546(Pup) NGC55(Scl) NGC253(Scl) NGC300(Scl) M80(Sco) M4(Sco) NGC6124(Sco) H12(Sco) M6(Sco) M7(Sco) M26(Sct) M11(Sct) M5(Ser) M16(Ser) I.4756(Ser) M71(Sge) M23(Sgr) M20(Sgr) M8(Sgr) M21(Sgr) M24(Sgr) M18(Sgr) M17(Sgr) M28(Sgr) M69(Sgr) M25(Sgr) M22(Sgr) M70(Sgr) M54(Sgr) NGC6723(Sgr) M55(Sgr) NGC6822(Sgr) M75(Sgr) NGC1647(Tau) NGC1746(Tau) M1(Tau) M33(Tri) NGC3556(UMa) M97(UMa) M101(UMa) NGC2547(Vel) I.2395(Vel) H3(Vel) NGC3132(Vel) NGC3201(Vel) M61(Vir) M84(Vir) M86(Vir) M49(Vir) M87(Vir) M89(Vir) M90(Vir) M58(Vir) M104(Vir) M59(Vir) M60(Vir) M27(Vul) NGC6940(Vul)

- The nebulae, star clusters and galaxies are arranged in the alphabetic order of the constellation to which they belong, and those within constellations are ordered according to the right ascension sequence (moving to the right around the constellation dial).

Abbreviations of constellations and their full name

Abbreviation	Full name	Abbreviation	Full name
And	Andromeda	Leo	Leo
Ant	Antlia	Lep	Lepus
Aps	Apus	Lib	Libra
Aql	Aquila	LMi	Leo Minor
Aqr	Aquarius	Lup	Lupus
Ara	Ara	Lyn	Lynx
Ari	Aries	Lyr	Lyra
Aur	Aurgia	Men	Mensa
Boo	Bootes	Mic	Microscopium
Cae	Caelum	Mon	Monoceros
Cam	Camelopardalis	Mus	Musca
Cap	Capricornus	Nor	Norma
Car	Carina	Oct	Octans
Cas	Cassiopeia	Oph	Ophiuchus
Cen	Centaurus	Ori	Orion
Cep	Cepheus	Pav	Pavo
Cet	Cetus	Peg	Pegasus
Cha	Chamaeleon	Per	Perseus
Cir	Circinus	Phe	Phoenix
CMa	Canis Major	Pic	Pictor
CMi	Canis Minor	PsA	Piscis Austrinus
Cnc	Cancer	Psc	Pisces
Col	Columba	Pup	Puppis
Com	Coma	Pyx	Pyxis
CrA	Corona Australis	Ret	Reticulum
CrB	Corona Borealis	Scl	Sculptor
Crt	Crater	Sco	Scorpius
Cru	Crux	Sct	Scutum
Crv	Corvus		Serpens
CVn	Canes Venatici	Ser	Serpens Caput
Cyg	Cygnus		Serpens Cauda
Del	Delphinus	Sex	Sextans
Dor	Dorado	Sge	Sagitta
Dra	Draco	Sgr	Sagittarius
Equ	Equuleus	Tau	Taurus
Eri	Eridanus	Tel	Telescopium
For	Fornax	TrA	Triangulum Australe
Gem	Gemini	Tri	Triangulum
Gru	Grus	Tuc	Tucana
Her	Hercules	UMa	Ursa Major
Hor	Horologium	UMi	Ursa Minor
Hya	Hydra	Vel	Vela
Hyi	Hydrus	Vir	Virgo
Ind	Indus	Vol	Volans
Lac	Lacerta	Vul	Vulpecula

- Abbreviations are not shown for the Aps, Cha, Cir, Cru, Hyi, Men, Mus, Oct, Pav, TrA, Tuc, UMi and Vol constellations because they are in a range that is hidden by the moon dial or are completely or almost completely in a celestial sphere range that cannot be seen from 35°N.

